SIEMENS

SIMATIC

PCS 7
QUADLOG DP/IO Bus Link Module

Installation and Operating Manual

11/2007
A5E00781246-01

Safety Guidelines

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

⚠WARNING
This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.

Trademarks

All names identified by ® are registered trademarks of the Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

이 기기는 업무용(A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정 외의 지역에서 사용하는 것을 목적으로 합니다.

Siemens AG
Automation and Drives
Postfach 48 48
90327 NÜRNBERG
GERMANY

A5E00781246-01
Ⓟ 11/2007

Preface

Purpose of the Manual

This manual provides information necessary to use DP/IOBus Link module DP/IO Bus Link module .

Required Basic Knowledge

Readers are presumed to be knowledgeable in the use of PCS 7 and APACS+ and QUADLOG systems.

Where is this Manual valid?

This manual is valid for the DP/IO Bus Link module and the software that accompanies it.

Training Centers

Siemens Technical Training Center provides extensive training for all levels of plant personnel to ensure optimal performance from PCS 7 control systems. Classes include extensive hands-on activities using appropriate equipment, making the training directly and immediately applicable.

On-line information is available: http://www.sea.siemens.com/sitrain

Siemens also offers a number of training courses to familiarize you with the SIMATIC S7 automation system. Please contact your regional training center or our central training center in D 90327 Nuremberg, Germany for details:

Telephone: +49 (911) 895-3200.

Internet: http://www.sitrain.com

A&D Technical Support

Worldwide, available 24 hours a day:

<table>
<tr><th>United States: Johnson City, TN</th><th>Worldwide: Nürnberg</th><th>Asia / Australia: Beijing</th></tr>
<tr><td rowspan="2">Technical Support and Authorization
Local time: Monday to Friday
8:00 AM to 5:00 PM
Telephone:+1 (423) 262 2522
or +1 (800) 333-7421 (USA only)
Fax:+1 (423) 262 2289
Mail to: techsupport.sea@siemens.com
GMT: -5:00</td><td>Technical Support
24 hours a day, 365 days a year
Phone:+49 (180) 5050-222
Fax:+49 (180) 5050-223
E-Mail: ad.support@siemens.com
GMT:+1:00</td><td rowspan="2">Technical Support and Authorization
Local time: Monday to Friday
8:00 AM to 5:00 PM
Phone:+86 10 64 75 75 75
Fax:+86 10 64 74 74 74
Mail to:ad.support.asia@siemens.com
GMT:+8:00</td></tr>
<tr><td>Authorization
Local time: Monday to Friday
8:00 AM to 5:00 PM
Phone: +49 (180) 5050-222
Fax: +49 (180) 5050-223
Mail to: ad.support@siemens.com
GMT: +1:00</td></tr>
<tr><td colspan="3">Automation and Drives Service and Support International
http://www.siemens.com/automation/service&support</td></tr>
<tr><td colspan="3">The languages of the SIMATIC Hotlines and the authorization hotline are generally German and English.</td></tr>
</table>

Contents

1 Safety Notes

Warning

Safety Note - I/O Modules must have at least one configured channel

Each I/O module must be configured with at least one channel. The system may fail to operate properly if an I/O module is added without at least one configured channel.

Warning

Safety Note - Read Programmable Controllers S7 F/FH Systems

Read and understand the manual *SIMATIC S7 F/FH Systems Configuring and Programming* and read the Safety Notes.

Warning

Safety Note - Automatic Reintegration may not always be possible

The parameterization of the input ACK_NEC=0 is only permitted if automatic reintegration is permissible for the process from a safety point of view.

The acceptance authority must agree that automatic reintegration is permissible for the process. See the manual titled *SIMATIC S7 F/FH Systems Configuring and Programming*.

Warning

Safety Note - Startup Protection to handle short power failures in the F-I/O

Following a power failure in the F-I/O that is shorter than the watchdog time set for the F-I/O in HW Config (See *Safety Engineering in SIMATIC S7* system description), automatic reintegration can occur, as is the case when ACK NEC = 0, regardless of your setting for ACK NEC. If automatic reintegration for the affected process is not permitted for this case, you must program startup protection by evaluating the variables QBAD or PASS_OUT (see Programming Startup Protection).
When a power failure occurs in the F-I/O and lasts longer than the watchdog time set for the F-I/O in HW Config, the F-system detects a communication error (see *Passivation and Reintegration of the F-I/O after Communication Errors*).

Warning

Safety Note - Automatic Reintegration through F_QUITES

The non-safety-related input IN of F_QUITES must not be interconnected with a signal or defined by a signal that automatically produces the above mentioned condition (change from 6 to 9 within a minute) for a fail-safe acknowledgment. The fail-safe acknowledgment can only be produced by means of **conscious, manual input on the ES/OS**, not automatically in the program.

Warning

Safety Note - Maintenance Overrides

There are occasions during the life of a Safety Instrumented System (SIS) when inputs must be overridden for maintenance purposes (see Safety Note - TÜV Maintenance Override Criteria). The SIS design must account for these situations and provide for safe operation of the process during maintenance.

Warning

Safety Note - TÜV Maintenance Override Criteria

The TÜV document *Maintenance Override* requires the following override criteria for all programmable safety systems:

- Only inputs may be overridden.
- All inputs that can be overridden must be predefined during the design process. A list of these inputs must be maintained on the system.
- Only one input may be overridden for each defined process unit.
- Logic must be configured to allow a single command to disable all maintenance overrides at once.
- Maintenance overrides may not last longer than one shift.

Warning

Safety Note - Automatic shutdown not always desirable

Having an automatic shutdown occur in response to a system failure may not be desired in all applications. To disable the default automatic shutdown function, configure the Auto Shutdown (**DISAUTSD**) input of the F_Q_CTRL block to be TRUE. System failure is still annunciated, but shutdown does not automatically take place.

Automatic shutdown may be disabled in applications where the operator has sufficient means to monitor and shut down the process, independent of the system, and the process safety time is sufficiently long to ensure a safe, manual reaction to the shutdown.

Furthermore, the user may choose to incorporate the system failure flag into the application-specific process shutdown logic to automatically trip the appropriate process equipment on system failure. This is a form of automatic shutdown using the application shutdown logic, rather than the default configuration, to set the outputs to their fail safe states.

Warning

Safety Note - Leave DISAUTSW in its default state (FALSE)

The **DISAUTSW** input should remain at its default value (FALSE) unless a maintenance override is required. When the **DISAUTSW** input is TRUE, it disables periodic switchovers of redundant DP/IO partners. This periodic switchover is intended to uncover faults in the system that could keep outputs enabled. The duration when periodic switchover is disabled should be strictly limited.

Warning

Safety Note - HW Config does not always intercept or prevent impermissible S7 F/H system configurations

In systems with CDO-DC outputs, energize-to-trip (ETT) and de-energize-to-trip (DTT) hardware cannot coexist on the same rack.

- In S7 F/FH systems, energize-to-trip (ETT) outputs are neither permitted nor supported.
- Customers using ETT, which is permitted in QUADLOG, must ensure that hardware (DP/IOBus Link module, I/O modules, power supply) and the logic that provide ETT are confined to racks separate from racks associated with S7 F/FH hardware and logic.

DTT is incompatible with ETT because ETT outputs require that auto-shutdown be disabled by setting the DISAUTSD input of the F_Q_CTRL block to TRUE. This setting applies to all the hardware and logic associated with that rack. Conversely, DTT requires that auto-shutdown be enabled for the entire rack.

Warning

Safety Note - Response Time

The safety instrumentation system (SIS) response time must be less than the process safety time. The SIS response time must include the response times of sensors, logic solver, and final elements in the safety function. The logic solver time includes I/O processing and the controller scan rate. Since I/O processing occurs asynchronously to the controller on independent modules, the input and output modules contribute a separate portion to the logic solver response time. The control module's scan rate must be set to the appropriate time.

Warning

Safety Note - Functional Requirements for all applications

- Operation and maintenance procedures must be followed (see the section titled Operation and Maintenance).
- Certified configuration language components must be used to process safety-critical signals and functions. Only F-Blocks that have been certified for use in process-safety systems should be used.

Warning

Safety Note - EN 54 Part 2

With specific reference to clauses from EN 54 Part 2, the following unambiguous measures have to be taken:

- 5.1.2
  For multiple sensors in one fire zone, independent input channels on at least two different input modules are necessary. Complementary outputs, such as general visual and audible alarm versus zone alarm, shall be on at least two different output modules.
- 7.1.5
  The application has to be built such that no multiple fire signals can result from the simultaneous operation of two points. This can be achieved e.g. by means of “m out of n”-voting.
- 8.2.4
  Line faults and system faults, the latter represented by the REPAIR -output of the F_Q_CTRL function block (common alarm), are processed by the application. The REPAIR output value of the block shall be continuously monitored for the presence of a fault. This can be easily implemented using an alarm function in the HMI.
- 8.4
  The system shall monitor the standby power and an alarm shall be sent to the operator.
- 8.5
  The degradation and system shutdown must be indicated by visible and audible alarm via a safety-rated output board and inverter relays.
- 8.8
  Use of de-energize-to-trip (DTT) output boards with inverter relays when needed.
- 8.9
  The contact side of the inverter relay needs to be loop monitored.
- 12.3.1
  The cabinet shall meet at least IP30.
- 13.5.3d
  Only systems with redundant logic solvers (minimum 1oo1D with redundant DP/IO Bus Link modules) shall be used. Use of redundant I/O is optional.
- 13.7
  The size of a sub system (redundant DP/IO Bus Link module pair) shall remain less than 512 total fire detectors and/or manual call points.

Warning

Safety Note - Guidelines for use in fire and gas applications

For conformance to the EN 54 standard, it is recommended that the following QUADLOG modules (all certified as "safety-rated") be used for a fire detection and alarm system:

- DP/IO Bus Link module
- CAI (Critical Analog Input module)
- CAM (Critical Analog module)
- CDM (Critical Discrete module)
- CDO (Critical Discrete Output module)

Refer to the individual module Installation and Service Instruction manuals. See www.siemens.com/automation/service&support.

Different field instrument configurations may be used for each detection zone. It is the responsibility of the system designer to verify that field instrumentation is acceptable for each zone, points, addressable points and/or fire alarm devices.

Inputs

Many fire detection and alarm applications utilize the ability to connect multiple detectors or manual call points to a single input channel. The QUADLOG i/o system supports this connectivity, but limits the maximum quantity to less than thirty-two detectors per input channel. Since variations exist in the length and type of wiring and manufactured detector differences, calculations are to be performed by the system designer to determine the maximum quantity of devices allowed per channel. These calculations should be compared to the specified operating parameters for the Critical Discrete Supervised Input (CDSI) channel type and F_CDSI function block.

The F_CDSI function block and the CDSI channel type should be used for energize-to-trip (ETT)inputs. The F_CDSI function block is a chart-in-chart block built from F-function blocks. It is designed to monitor and detect fault conditions accurately. The channel is designed to be used with the contactor elements of fire detection devices.

Outputs

Critical output channels for fire detection and alarming applications are typically configured as normally de-energized. To meet output channel requirements, configure each output channel of a CDM or CDO module so its pulse testing function is *enabled*. This function checks the channel for specific types of line faults. The protected output and shutdown softlist parameters for each configured output channel should be *disabled* to prevent potentially dangerous false trips. For additional information about configuring CDM or CDO output channels, refer to the module Installation and service Instructions see the sections titled QUADLOG Critical Discrete Module (CDM) and QUADLOG Critical Discrete DC Output (CDO_DC) Modules.

Auto-Shutdown

For fire alarming and detection applications, disable the auto shutdown (DISAUTSD) input of the F_Q_CTRL function block by changing its default value from FALSE to TRUE. This change prevents the automatic system shutdown (all outputs turned off) resulting from the emergence of any shutdown-level (class 4) error on the DP/IO Bus Link module or any of its scanned I/O modules. This change is imperative due to the nature of fire detection and alarming applications operating in the normally de-energized (energize-to-trip) mode.

Warning

Safety Note - PES Components must be fully operational

All programmable electronic system (PES) components must be fully operational before process start-up. All error codes and faults must be cleared. If the PES detects faults in field wiring or in other areas, they must be repaired before start-up.

Warning

Safety Note - Program separation

The safety-related portion of the configuration should be separated from the non-safety-related portion of the configuration.

PCS 7 supports the development of hierarchical or object-oriented configurations for S7 F Systems. Runtime groups can be configured within the CPU. The non-safety-related (grey or standard blocks) and safety-related (yellow or F-Blocks) portion of the configuration must be configured in different runtime groups. However, the non-safety-related and safety-related blocks may be contained in the same chart within CFC. The charts within CFC are created and placed to define the major sections of the project. The charts can be arranged in a way to provide a clear distinction between the safety-related and nonsafety-related sections of the application program. The CFCs can also be arranged according to the purposes, i.e. the plant, unit, or function. The Plant Hierarchy has been provided within SIMATIC Manager. This is also where the associations or separation will be visibly made. In summary, one runtime group may contain only safety-related (yellow F-Blocks) or only non-safety-related (grey or standard blocks) and may not contain a combination of the two. User runtime groups may be placed in any order within an OB. CFC makes no distinction regarding safety-related or non-safety-related blocks. Please refer the document *SIMATIC S7 F/FH Systems Configuring and Programming* for information about Partial Shutdown Groups.

Warning

Safety Note - Communications Separation

The communication between DP/IO Bus Link control modules and I/O modules takes place over the redundant IOBUS. IOBUS communications is safety-related since control and I/O modules use it to exchange safety-critical input and output information. The IOBUS can be extended locally or remotely from its corresponding control module using standard IOBUS cables. It can connect multiple I/O racks including UNIRACs, Remote I/O Racks, SIXRACs or MODULRACs. Inter-processor communications, which transfers configuration and status information between redundant DP/IO Bus Link modules, is also safety related.

Warning

Safety Note - Determining safety classes of the process

Every safety-instrumented function (safety protection loop) has to be classified with regard to safety integrity. Classification can be determined by applying corporate standards, industry standards or international standards. If multiple safety-instrumented functions are within one Safety Instrumented System (SIS), the common elements of the SIS, such as *logic solver*, should meet the highest loop safety class.

SIL	DP/IO Bus Link Architecture
1-3	1oo2D
1-2	1oo1D

Standard IEC61508 refers to Safety Integrity Levels (SIL) and provides quantitative targets for PFDavg values for each level and application. This target refers to the entire safety instrumented function (safety loop) including sensors, logic solver, and valve/actuator. To achieve the required SIL, the entire safety loop from end to end should be considered in a quantitative calculation. The configuration of field instruments. Field Instrumentation) will have an impact on the quantitative results. Those attempting to comply with IEC61508 should contact Siemens for failure rate information and assistance.

Warning

Safety Note - Power systems

Each QUADLOG rack can accept power from up to three independent power supplies. For SIL 3 rated installations, the system must have at least two power supplies - one for each side of a 1oo2D system. Additional power supplies can be added for higher availability.

Some I/O modules require power for field I/O. This power must be supplied from a power source separate from the power supplying the rack.

Warning

Safety Note - Safety PLC power

Power for the QUADLOG safety PLC must be supplied using a safety-critical rated power supply such as the model 39PSR4A or alternative that operates within its specifications and meets all necessary agency approvals for a particular application.

Warning

Safety Note - Power-up/power-down response

The safety PLC is designed to de-energize when power fails for a sufficient period of time (that is, a cold start has occurred). When power is restored after a cold start, outputs will not re-energize the outputs until the shutdown logic has been reset (see the section titled Shutdown Logic). For power interruptions of shorter duration, the system designer can decide how to respond within certain constraints. Cold start is the default setting.

For more information, see the manual *SIMATIC Process Control System PCS 7 Engineering System*.

Warning

Safety Note - Field I/O power

Power for field I/O must be supplied using a Safety Extra Low Voltage (SELV) power supply or an alternative power supply that operates within specified tolerances and meets all necessary agency approvals (IEC 1010). Power for field I/O must be independent of the power for the QUADLOG module rack.

Warning

Safety Note - Selecting configurable parameters for TÜV-approved systems

- If a QUADLOG safety-related discrete input detects a fault in its input hardware, the input can be set to TRUE or FALSE, depending upon the setting of the InputFaultState parameter. For TÜV-certified requirements, the InputFaultState must be set to a safe value. For normally energized discrete inputs, this is FALSE, the default setting.
- Discrete input channel parameters for safety-related discrete inputs using the Critical Discrete Module (CDM) must be set as follows: InputFaultState set to the safe value, PulseDiagTest set to enabled, ShutdownChannel may be enabled (see the section titled Shutdown Logic).
- For QUADLOG input channels, customers must configure and use the channel driver's substitute value to ensure that the input value is at a safe value. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.
- Discrete output channel parameters for safety-related discrete outputs using the CDM and CDO-DC must be set as follows: ProtectedOutput set to enabled, Readback set to enabled, PulseDiagTest set to enabled, and ShutdownChannel may be enabled.
- All CAM versions are allowed in non-redundant operation.

Warning

Safety Note - Module error status outputs

Module error status variables on the module driver function blocks are provided to indicate module status. These outputs are coded with error status for use with seems that do not include OS faceplates.

For more information see the document *readme.wri* at the root level of the distribution CD for information about a help file with a table of contents based on error codes and instructions for using a related utility program that decodes errors.

Warning

Safety Note - Outputs should not be driven by system error status

Physical outputs should not be driven by a system error status variable (such as the output of a System Information or Module Information function block) in a 1oo2D architecture. These outputs may be logically different between the master and standby units because errors may not be identical, causing a process outputs mismatch error. This will shut down the system if automatic shutdown is configured.

Warning

Safety Note - Critical Analog Input, Programmable Limits (CAIP) channel type

The CAIP channel type is an optional analog input channel type available on release 3.03 of the CAM and CAI analog I/O modules. (Refer to I/O module help files or the document titled *ProcessSuite® 4-mation Configuration QUADLOG® I/O Module Configuration Version 3.32 or Higher* for more information.) Open circuit and short circuit diagnostics provide coverage for some fault modes in wiring and I/O devices that are not covered by other diagnostics. These are conditions that may be a result of a failed component on the I/O module, masking the actual sensor data. If these diagnostics are disabled for safety critical channels, another way to detect the fault modes may be required. This can be accomplished with configuration logic within the controller. If handled by the control logic, this logic must be configured to drive the process into a safe state upon failure. Alternatively, there may be ways to monitor the I/O devices and I/O signals independently.

If the channel is a non-redundant shutdown channel (that is, it is safety critical and not 1oo2 or 2oo3), the open-circuit and short-circuit detection must be enabled at some reasonable thresholds where they will be detected.

Warning

Safety Note - Additional Program Logic Guidelines for Safety Critical Channels

Open-circuit and short-circuit diagnostics must cover any failure modes on the I/O module that are not covered by other diagnostics. These are conditions that may be a result of a failed component on the I/O module, masking the actual sensor data. These fault modes are the following:

- CAM, open MTA cable, one channel (looks like open circuit)
- CAI, short across single channel in MTA cable (looks like open circuit)

If the open circuit diagnostics are totally disabled, function blocks such as the Less Than (LT) block can be used to detect specific limits (or ranges) on the input values. The compare limits for these blocks should detect input values near 0 mA (e.g. between 0 - 0.5 mA). These block outputs can be combined with maintenance logic or timing logic to determine if a true fault needs annunciation.

Warning

Safety Note - Input Timing Considerations

Inputs to any sampling system must not change more frequently than the sample period, or input signals will not be accurately received. While the Critical Discrete Module (CDM) does provide transient capture of an input signal that transitions within its scan rate of 25 ms., this operates only once per control module scan. Frequency signals that change more frequently than the control module scan rate will not be accurately received. It is recommended that Boolean inputs be stable for a period longer than three CDM scans. If Boolean signals change at a more rapid rate, frequency inputs of the Enhanced Analog Module (EAM) should be used. (EAM is not a safety-rated module.)The Standard Analog Module (SAM) has a scan rate of 75 ms. It has a digital filter time constant that is configurable for each channel.

Warning

Safety Note - Diagnostic Timing Considerations

Some diagnostics within QUADLOG I/O are hardware controlled. Other diagnostics are executed on a periodic basis by system software with different diagnostics running at different rates. For reference, the maximum diagnostic execution times for one example of each class are listed in the table below. Listing all diagnostics is beyond the scope of this document.

The system responds to detected faults depending on architecture and user configuration. A 1oo2D architecture will degrade to 1oo1D when a fault is detected in one unit. A 1oo1D architecture may be configured to display the error condition or automatically shutdown when a fault is detected (see the section titled Shutdown Logic) Automatic shutdown response time includes fault detection time plus one DP/IO Bus Link module scan unless the safety instrumented function has all I/O within one CDM module, in which case the CDM module responds within 25 ms of fault detection time.

DIAGNOSTIC	DETECTION MECHANISM	FAULT DETECTION TIME
DP/IO RAM Failure	Hardware	< 1 millisecond

DIAGNOSTIC	DETECTION MECHANISM	FAULT DETECTION TIME
DP/IO ROM Failure	CRC Test	< 2 seconds
DP/IO Memory Test Circuit Fail	Dynamic Stimulation - CCM	1 DP/IO Scan
DP/IO CPU Failure	Self Test	5 DP/IO Scans
DP/IO CPU Failure	I/O Processor Data Compare	1 DP/IO Scan
DP/IO Clock Failure	Independent I/O Watchdog	< 3 Seconds
DP/IO I/O Bus Failure	CCM Error Counter	< 5 DP/IO Scans
DP/IO I/O Bus Failure	I/O Readback Test	1 DP/IO Scan
DP/IO I/O Bus Failure	CRC Test	1 DP/IO Scan
CDM RAM Memory Failure	Data Comparison Test	25 milliseconds
CDM ROM Memory Failure	CRC Test	< 3.2 seconds
CDM RAM Memory Failure	CRC Test	< 2 seconds
CDM Clock Failure	Independent I/O Watchdog	< 3 seconds
CDM Open Circuit Output	Hardware	< 3 milliseconds
CDM Short Circuit Output	Pulse Test	< 3.2 seconds
CDM Short Circuit Output	Readback Hardware	75 milliseconds
CDM Input Circuit s0	Pulse Test	< 3.2 seconds
CDM Input Circuit s1	Pulse Test	< 3.2 seconds
CDM Input Circuit Failure	Dynamic D/A signal	25 milliseconds
CDM I/O Power Failure	Hardware	< 5 milliseconds
CDM I/O Bus Failure	CRC Test	75 milliseconds
CDM I/O Bus Failure	Lost Messages	< 3 seconds
CDO-DC RAM Memory Failure	Data Comparison Test (Dual CPU)	500 milliseconds
CDO-DC ROM Memory Failure	CRC Test	1 second
CDO-DC RAM Memory Failure	CRC Test (Static Data)	1 second
CDO-DC Clock Failure	Independent I/O Watchdog	< 2 seconds
CDO-DC Open Circuit	Pulse Test	1.2 seconds
CDO-DC Open Circuit	Readback Hardware	75 milliseconds
CDO-DC I/O Bus Failure	CRC Test	75 milliseconds

DIAGNOSTIC	DETECTION MECHANISM	FAULT DETECTION TIME
CDO-DC I/O Bus Failure	Lost Messages	75 milliseconds
CAM RAM Memory Failure	Data Comparison Test (dual CPU)	1 second
CAM ROM Memory Failure	CRC Test	1 second
CAM RAM Memory Failure	CRC Test (Static data)	1 second
CAM Clock Failure	Independent I/O Watchdog	< 2 seconds
CAM Open Circuit Output	Hardware	< 150 milliseconds
CAM Short Circuit Input	Hardware	150 milliseconds
CAM Input/Output Circuit Failure	D/A Endpoints	150 milliseconds
CAM I/O Power Failure	Hardware	< 150 milliseconds
CAM I/O Bus Failure	CRC Test	150 milliseconds
CAM I/O Bus Failure	Lost Messages	< 3 seconds
CAI RAM Memory Failure	Data Comparison Test (dual CPU)	1 second
CAI ROM Memory Failure	CRC Test	1 second
CAI RAM Memory Failure	CRC Test (Static data)	1 second
CAI Clock Failure	Independent I/O Watchdog	< 2 seconds
CAI Short Circuit Input	Hardware	150 milliseconds
CAI Input Circuit Failure	D/A Endpoints	150 milliseconds
CAI Input Open Circuit Failure	Pulse test	1.2 seconds
CAI I/O Power Failure	Hardware	< 150 milliseconds
CAI I/O Bus Failure	CRC Test	150 milliseconds
CAI I/O Bus Failure	Lost Messages	< 3 seconds
Power Low	Hardware	3 I/O scans
Power High	Hardware	3 I/O scans

Warning

Safety Note - I/O Loop OK Functionality Test for CDO in a 1oo2D System

The following test should be performed at startup and any regular maintenance or proof test interval at the site when a CDO has critical channels configured in a 1oo2D system.

- Select a critical CDO channel.
- Disconnect the channel's wire from the I/O termination panel.
- Verify that a "I/O Loop Broken" error (error code SSC 36 EC 03) is posted for the CDO that has the disconnected wire. Other open circuit errors may be generated (for example: SSC 51 EC 04, SSC 51 EC 06).
- Reconnect the channel's wire to the I/O termination panel.
- Clear the generated errors from this test.

If the SSC 36 EC 03 error does not occur, the CDO module should be replaced.

Warning

Safety Note - Custom HMI Diagnostic Displays

All system diagnostics are available for communication to any human machine interface (HMI). This capability provides the ability to create customized system diagnostic displays for maintenance and troubleshooting.

Warning

Safety Note - Management of Change

If it ever becomes necessary to change the operation of an Safety Instrumented System (SIS), each change should follow the appropriate steps in the safety life-cycle. A complete analysis of the impact of the change must be made. All changes should be documented and properly reviewed. Validation tests are recommended for all changes. Validation testing should verify that only the intended change is made and that the rest of the system is unaffected. The use of a validation checklist is recommended.

It is recommended that previous versions of configurations be archived.

Warning

Safety Note - Security

QUADLOG I/O must be operated with its security features activated in TÜV-approved applications. The security feature prevents unauthorized changes that can affect safety. If changes in the configuration are needed, follow all relevant steps in the safety life-cycle. De-activating security is not allowed while an SIS is protecting a process.

To active system security:

Access the CPU **Safety Mode** switch in CFC or HMI. See the section titled Safety Mode for detailed information and instructions on how to enable **Safety Mode**.

To disable system security:

Access the CPU **Safety Mode** switch in CFC or HMI. See the section titled Safety Mode for detailed information and instructions on how to disable **Safety Mode**.

Warning

Safety Note - Security, Validating Softlist Parameters

It is necessary to perform validation of the DP/IO Bus Link module and QUADLOG I/O modules. See Validating the Softlist Parameter of the Safety Program. After the entire configuration has been delivered to the CPU, the following must be completed:

- Perform a printout of the HW Config with the options selected.
- Compare this printout with the expected values for each parameter for each I/O module.
- Print the F-Tool address list .
- Perform a comparison of all addresses to ensure accuracy.

There are also other checks that must be performed.

Warning

Safety Note - Verifying scan rate setting changes

- Use the procedure in the section titled Standard Faceplate Pane to change the scan rate of a system employing Safety Mode.
- Add this procedure to a checklist of procedures followed every time the Safety Mode is deactivated and reactivated.

Warning

Safety Note - F_Q_CTRL outputs when QERR is TRUE

Whenever QERR is TRUE, all other outputs of the F_Q_CTRL block (except DIAG and those related to OS actions) are not updating; they hold their last value.

Warning

Safety Note - DP/IO Bus Link Module only supports the equivalent of a QUADLOG Total I/O Shutdown

For those familiar with QUADLOG, the shutdown logic within the DP/IO Bus Link module is similar to that created within QUADLOG. The shutdown logic within QUADLOG was managed by either a TOTIOSD (Total IO Shutdown) or PARTIOSD (Partial IO Shutdown) function block. The DP/IO Bus Link module only supports the equivalent of the Total IO Shutdown. It is not possible to configure the DP/IO Bus Link module in a way that is similar to the Partial IO Shutdown within QUADLOG.

QUADLOG supported full shutdown and partial shutdown. DP/IO Bus Link module only supports full shutdown, which is the equivalent of configuring a QUADLOG project with only the TOTIOSD block.

Warning

Safety Note - Scan Rate can only be changed within the OS if the F-Program's Safety Mode is disabled

An initial value for scan rate can also be set within HW Config. To change the scan rate from HW Config requires the following:

- A CPU Stop to download because H-CiR is not supported in DP/IO Bus Link V1.0.
- A recompile of CFC with the *Generate Module Drivers* option selected. Selecting this option obtains a cyclical redundancy check (CRC) value from the HW Config program. This CRC is necessary to ensure the integrity of the DP/IO Bus Link module's configuration

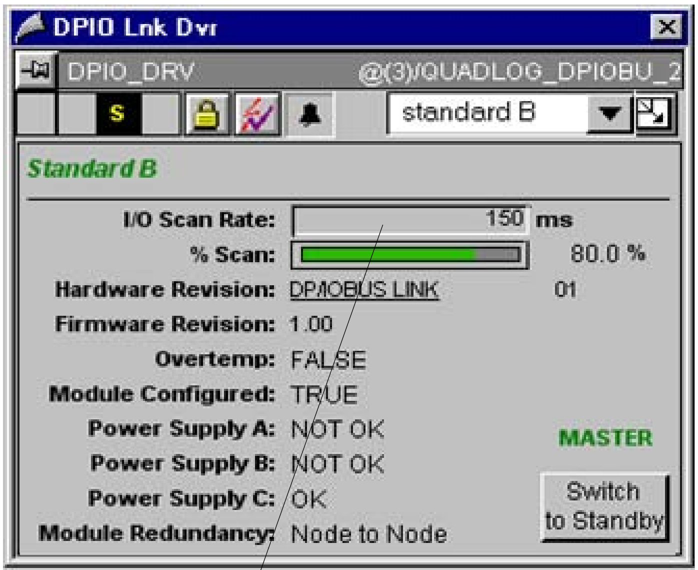
If a scan rate change is made from within the OS faceplate, the initial value established in HW Config is not automatically changed. To change the initial value, it is necessary to make the change in HW Config, compile and download HW Config and compile and download the CRC. The change in initial value takes effect at the next CPU Stop/Restart.

Warning

Safety Note - Verifying scan rate setting changes

Add the following procedure to a checklist followed every time the Safety Mode is deactivated and reactivated.

1. From Simatic manager, open the project and select the automation system (AS) to which the DP/IO Bus Link Module is connected.
2. Click the **Edit Safety Program** icon on the toolbar.
3. In the Edit Safety Program dialog box, click the **Safety Mode** button to disable Safety Mode.
4. Disable Safety Mode for the automation system (AS) to which the DP/IO Bus Link Module is connected.
5. From the OS, use the faceplate for the DPIO_DRV to determine and modify the scan rate. A change made through the faceplate is accepted and echoed



Scan rate indicator
and control

6. Return to SIMATIC Manager and re-activate Safety Mode.
7. Return to the OS and observe the scan rate on the faceplate. Confirm that the changed scan rate is reflected in the faceplate.

Warning

Safety Note - Avoid Changing Scan Rate Online in a Commissioned System

Changing the scan rate while online may result in a unpredictable shutdown of critical I/O modules with shutdown channels configured. Siemens recommends that the scan rate be changed only during a scheduled shutdown or before or during commissioning of the system."

Warning

Safety Note - Follow Published Rules and Guidelines

Follow the rules and guidelines published in the *SIMATIC S7 F/FH Systems Configuring and Programming Manual* and this document.

Warning

Safety Note - Do Not Disable Runtime Groups Containing Safety Function Blocks

Using a feature to disable runtime groups which contain safety related function blocks is not permitted and is prevented by the compiler. Every yellow or safety function block must run every scan; otherwise, a flow control failure occurs and the F-Program shuts down.

Warning

Safety Note - Follow Instructions When Creating Charts-in-Charts

When creating chart-in-charts or compiled chart-in-charts in a Failsafe program, failure to follow published instructions can result in an F-Program that shuts down unpredictably.

Warning

Safety Note - Do Not Change Softlist Parameters in a Running System

It is not possible to change the softlist parameters of I/O modules in a running DP/IO Bus Link module. Do not use the PARAM_RW function block in an online running system to access the QUADLOG I/O module’s softlist parameters.

2 Hardware Installation

This section serves as a reference document and a procedural guide for installation and configuration tasks.

This section describes the installation of the DP/IO Bus Link and its associated transition board. Read this entire section before starting an installation. It also describes the configuration process for integrating a DP/IO Bus Link and its associated field I/O into a PCS 7 environment.

Warning
DP/IO Bus Link installation should be performed in accordance with the National Electrical Code (NEC) and other applicable construction and electrical codes.

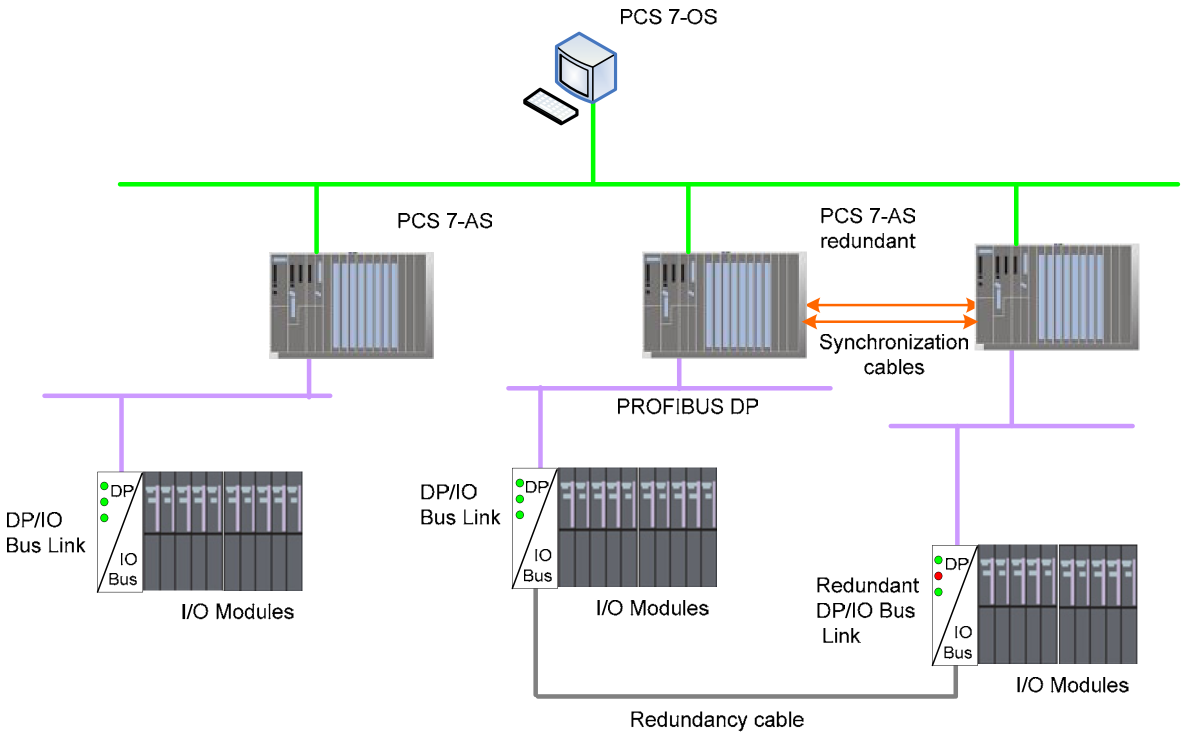
2.1 Hardware Installation Quick Start

1. Removing QUADLOG Components
2. Installing the DP/IO Bus Link Transition Board
3. Keying the DP/IO Link Bus Module and MODULRAC
4. Installing the DP/IO Bus Link Module into the MODULRAC
5. Cabling Transition Boards to PROFIBUS-DP
6. Connecting Redundant DP/IO Bus Link Transition Boards
7. Locating and Setting the Address Switches
8. Setting Transition Board Node Switch (S1))

2.2 System Architectures

The illustration that follows shows a block diagram of a typical redundant and non-redundant system based on the DP/IO Bus Link.

Illustration of System Components in Typical Configurations



2.3 Capabilities and Restrictions Overview

The DP/IO Bus Link module is a hardware and software interface between QUADLOG I/O modules and Siemens S7 400 CPU controllers. The DP/IO Bus Link module is a drop-in replacement for QUADLOG controllers, enabling customers to retain the value of existing I/O and field wiring while migrating proven hardware and control strategies to state-of-the-art controllers and HMI (human-machine interface).

For part numbers see DP/IO Bus Link Hardware Identification.

Systems that include the DP/IO Bus Link module include the following limitations:

- A maximum of 14 I/O modules per DP/IO Bus Link module
- A maximum of two DP/IO Bus Link modules per S7-400H CPU (MLFB 6ES7 417-4HL04-0AB0, in this documentation the *S7400H CPU* refers specifically to the product ordered with this MLFB; this is the only CPU supported for use with the DP/IO Bus Link module) An S7 400H CPU includes a PROFIBUS interface, To support a second DP/IO Bus Link module, the rack containing the CPU must have a CP443-5 card, which provides a second PROFIBUS interface. As a result, a single CPU can be connected to two DP/IO Bus Link modules, and the CPU can thus support a maximum of 28 I/O modules. For redundancy, the hardware requirements double: two CPUs, two CP443-5 cards, four DP/IO Bus Link modules
- The PROFIBUS between a CPU and a DP/IO Bus Link module must operate at 12 Mbps.

- Maximum cables distances for PROFIBUS cables are 100 m with copper conductors and 10 Km with fiber-optic links. S7-400 CPU racks and their associated DP/IO Bus Link modules must be located within these limits.
- DP/IO Bus Link module redundant cables, which connect a redundant DP/IO Bus Link module pair, are available in the following lengths: lengths:
  - 1 m: 6EQ2013-0CE10-0XA0 (Siemens part number A5E00681058)
  - 2 m: 6EQ2013-0CE20-0XA0 (Siemens part number A5E00681059)
  - 6 m: 6EQ2013-0CE60-0XA0 (Siemens part number A5E00681060)
- The following table lists the QUADLOG I/O Module Rev/Firmware levels compatible with the DP/IO Bus Link module:

Component	Rev/Firmware Level
QUADLOG DP/IOBus Link	1.00
QLCDM	3.03 3.04
QLSAM	3.00
QLVIM	3.04
QLODM	3.00 3.01
QLIDM	3.00
QLEAM	3.01
QLRTM	3.00 3.01
QLSDM+	3.03
QLCAM	3.04
QLCDODC	3.00 3.01
QLCAI	3.04

- The scan rate of the DP/IO Bus Link module must be tuned to ensure that the PCTSCAN is less than 90%. See Adding a DP/IO Bus Link Module and Standard Faceplate Pane.
- Peer-to-peer redundancy is not supported.

2.4 Limitations and Considerations

2.4.1 Medium Systems

A maximum of 14 I/O modules

- S7 400 H capable CPU for redundancy
- PCS 7 ES and a PC
- PCS 7 OS and correct licenses for the number of process tag types
- DP/IO Bus Link module (two for redundancy)

- DP/IOBUS Link Term Board Assy (known as the "transition board" (two for redundant systems
- Redundancy cable (order the correct length for the distance between the redundant systems)

2.4.2 Large Systems

Greater than 14 I/O modules

- If not otherwise used, MBX cards can be removed from MODULRACS
- May require purchase of additional MODULRAC to accommodate DP/IO Bus Link modules
- Requires rearranging of I/O modules to ensure that a maximum of 14 I/O modules is connected to a single PROFIBUS controller. With the second DP/IO Bus Link module there is a requirement of two (if redundant) CP443-5 PROFIBUS communication processor boards to be connected to the S7-400 CPU Racks.
- The APACS and QUADLOG controllers that existed in the plants almost certainly had sharing of data using the communications blocks. The same must be done for the S7-400 CPUs and care must be taken not to overload the CPUs.
- I/O modules beyond 28 modules must be placed into another system with another set of S7-400 CPUs. This is a system that will typically not be encountered for QUADLOG users but may be encountered for APACS users.
- The DP/IO Bus Link module may only be configured with 14 I/O modules. If you need more than 14 I/O modules then a second set of DP/IO Bus Link modules must be installed.
- The non-critical channel driver function blocks (A_CH_DI, A_CH_DO, A_CH_RI, A_CH_RO) need to be in the same OB as the safety critical channel driver function blocks (F_Q_CHDI, F_Q_CHDO, F_Q_CHRI, F_Q_CHRO) for the same DP/IO Bus Link module.

Note

Large systems are not yet supported.

2.4.3 Compatibility with S7 F Systems Partial Shutdown Groups

Partial Shutdown Groups contain one or more F-runtime groups. F-runtime group to F-runtime group communication blocks are not necessary to connect between F-Blocks in different F-runtime groups within the same Partial Shutdown Group. If a failure is detected within a Partial Shutdown Group, the respective Partial Shutdown Group will be shutdown, and others may also be shutdown depending upon the configuration of the F_SHUTDN function block.

The Shutdown logic responds to an internal diagnostic that has detected a failure by disabling either the entire Safety Program (Full Shutdown) or the isolated Partial Shutdown Group (Partial Shutdown). The shutdown logic response depends on how you configured the shutdown logic, either Partial Shutdown or Full Shutdown.

The F-Program may contain several Partial Shutdown Groups. The DP/IO Bus Link module is only compatible with one Partial Shutdown Group. The channel drivers used to communicate with the DP/IO Bus Link module may span multiple runtime groups within one Partial Shutdown Group. These channel drivers cannot be placed in different Partial Shutdown Groups. If the project contains multiple Partial Shutdown Groups then a choice must be made as to which Partial Shutdown Group will be host to the DP/IO Bus Link module. If data must be shared with other Partial Shutdown Groups then it will be necessary to use runtime group to runtime Group communication blocks F_R_BO, F_R_R, F_S_BO and F_S_R from the S7 F Systems Failsafe Library.

See the document titled SIMATIC Programmable Controllers S7 F/FH Systems for more information. for more information.

2.4.4 Probability of Failure

Redundant Operation

The following table lists the probability values of QUADLOG I/O modules when used with the DP/IO Bus Link module **in redundant operation**. All values are based on a proof test interval of one year and a repair time of 72 hours. Module calculations meet the limits for use in SIL3 applications.

	Low Demand Mode Operation (Average probability of failure to perform the safety function on demand)	**High Demand Mode Operation (Probability of dangerous failure per hour)**
CAI - Input (1oo2D)	7.79E-05	1.66E-08
CAM - Input (1oo2D)	5.70E-05	1.30E-08
CAM - Output (1oo2D)	5.72E-05	1.30E-08
CDM - Input (1oo2)	5.87E-05	1.33E-08
CDM - Output (1oo2)	5.85E-05	1.33E-08
CDO (1oo2D)	6.60E-05	1.46E-08
CAI - Input (1oo2D)	7.79E-05	1.66E-08

Non-Redundant Operation

The information is included in the file *readme.wri* located at the root directory of the distribution CD containing DP/IO Bus Link module software.

Calculating Probability of Failure

These PFD/PFH values should be combined with PFD/PFH values of sensor and final control elements to determine the total PFD/PFH value of the safety loop.

Example:

A safety function is implemented with an S7 FH System using the F-capable CPU, DP/IO Bus Link, and QUADLOG I/O modules. All modules are used in a redundant configuration. Operation is in low demand mode:

Equipment	Equipment	Redundancy	PFD
F-capable CPU	2*	yes	18.8E-05
CAI - Input	2*	yes	7.79E-05
CDM - Output	2	yes	5.85E-05
Total			**32.44E-05**

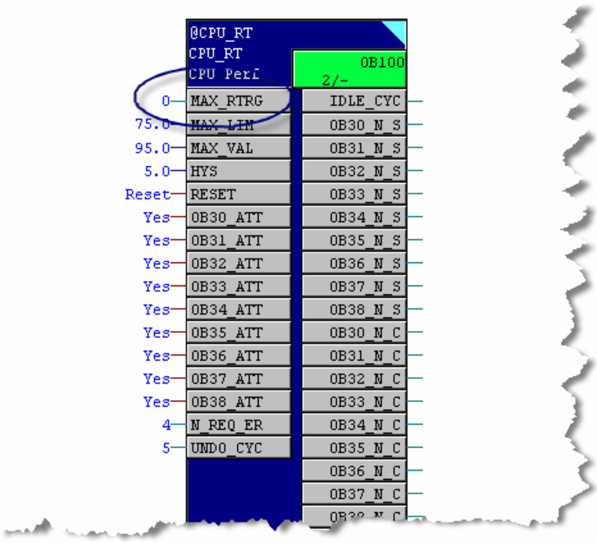
*Only 1 module is active in the safety loop

2.4.5 Cautions about Using the @CPU_RT Function Block

PCS 7 V7.0 introduces the @CPU_RT function block, with manages CPU stop avoidance functions. It is inserted automatically into an OB and slows down the OB by skipping execution of the OB if a program is taking to long to execute, thus avoiding scan overruns.

The block must be configured properly in CFCs to ensure that it does not cause the DP/IO Bus Link module to shutdown.

To avoid this, ensure that the **MAX_RTRG** input to 0:



2.4.6 Features and Functions Not Supported in DP/IO V1.0

- Configuration in Run (CIR)
- Asset Management
- Sequence of Events (SOE)
- Peer-to-peer redundancy

2.4.7 Typical Response Time of AS Function Blocks

Function blocks take a measurable amount of time (base time) to execute in an automation station's (AS) CPU. Added to this time is the execution time of configured blocks that are required or subordinate to the block being measured.

The information in the following tables is included in a spreadsheet in the file *readme.wri* located at the root directory of the distribution CD containing DP/IO Bus Link module software. For systems capable of running Excel spreadsheets, double-clicking on this spreadsheet opens it in Excel, and you can modify the values in the **Number Config'd** column to calculate execution time for your system. For system that cannot open Excel spreadsheets, execution time can calculated manually by changing the **Number Conf'd** multiplier (**Number** in the following tables).

Execution times in these tables were measured on a CPU 417-4H (6ES7 417-4HL04-0AB0), H/W version 1, F/W version 4.0.7. These times may vary according to the CPU model and its firmware revision.

The time to execute a DPIO_DRV block consists of its base time plus the time required to execute its subordinate blocks, in this case the F_Q_MOD driver and the MOD_DRV driver. This time is listed in the column labeled **Totals**. Execution times are in microseconds.

Block Type	Subordinate and Required Blocks	Number		Execution Time		Subtotals	Totals
DPIO_DRV (FB492)		1	x	958	=	958	
	F_Q_MOD driver	1	x	17	=	17	
	MOD_DRV driver	1	x	17	=	17	
							992

To this total it is necessary to add the execution time of the F_Q_CTR block, which is required to run any safety block, but whose execution time is unaffected by subordinate blocks.

Block Type	Subordinate and Required Blocks	Number		Execution Time		Subtotals	Totals
F_Q_CTR (FB150)		1	x	958	=	958	
							658

The F_Q_MOD block has blocks subordinate to it that have execution times:

Block Type	Subordinate and Required Blocks	Number		Execution Time		Subtotals	Totals
F_Q_MOD (FB151)		1	x	1510	=	1510	
	F_Q_CHDI	1	x	43	=	43	
	F_Q_CHDO	1	x	43	=	43	
	F_Q_CHRI	1	x	43		43	
	F_Q_CHRO	1	x	43	=	43	
							1682

MOD_DRV block, too, has subordinate blocks:

Block Type	Subordinate and Required Blocks	Number		Execution Time		Subtotals	Totals
MOD_DRV (FB494)		1	x	797	=	1510	
	A_CH_DI	1	x	10	=	10	
	A_CH_DO	1	x	10	=	10	
	A_CH_RI	1	x	10		10	
	A_CH_RO	1	x	10	=	10	
							837

Finally, individual channel driver blocks have base execution times. These times are multiplied by the number of configured channels to produce the execution time for the driver block.

Channel Driver	Number		Execution Time		Subtotals	Totals
F_Q_CHDI (FB152)	1	x	49	=	49	
F_Q_CHDO (FB153)	1	x	46	=	46	
F_Q_CHRO (FB155)	1	x	51	=	51	
F_CDSI	1	x	625		625	
	1					**827**

Channel Driver	Number		Execution Time		Subtotals	Totals
A_CH_DI (FB495)	1	x	21	=	21	
A_CH_DO (FB496)	1	x	19	=	19	
A_CH_RI FB497)	1	x	27	=	27	
A_CH_RO (FB498)	1	x	21		21	
	1					**88**

The total time to execute the function blocks in the above configuration is

992 + 658 + 1682 + 837 + 827 + 88 = 5084 microseconds.

2.4.8 Calculating Failsafe Response Times

This information is included in the file *readme.wri* located at the root directory of the distribution CD containing DP/IO Bus Link module software.

2.5 Predicting and Determining System Data Block (SDB) Use

Review the material in this section if any PROFIBUS master manages more than 13 I/O modules. In this context, Each PROFIBUS connection from the S7-400 CPU, such as the X1 or X2 connectors, or a PROFIBUS connection from an expansion card such as the CP443-5 PROFIBUS Communications Processor, is controlled by a master, and all the devices attached to it make up a subnet.

Each PROFIBUS subnet attached to a CPU is assigned a 64 KB memory space known as a system data block (SDB). In a system based upon the DP/IO Bus Link modules, a subnet consists of a DP/IO Bus Link module and its associated I/O modules and configured channels. QUADLOG modules and channels consume varying amounts of SDB, depending upon the complexity of the data they generate or require.

The amount of SDB consumed is by a subnet is the sum of the memory required by DP/IO Bus Link module, its I/O modules, and their configured I/O channels.

It is possible both to predict SDB use by an envisioned PROFIBUS subnet and to determine the SDB use of a configured system.

Note

CP443-5 PROFIBUS Communications Processor is not supported in DP/IO Bus Link Release V1.0.

2.5.1 Predicting the SBD Capacity for Modules and Channels

Use the table below to approximate the memory required by the modules to be attached to a CPU. Multiply the quantity of each module type by its size and record the results in the column labeled **Total Module Requirements**. Add the numbers in the column to determine the **Bytes Used for Modules**.

Modules

Note

The following table is available as an Excel spreadsheet object in the file *readme.wri* located at the root level of the distribution CD.

Module Type	Number of Modules		Module Size		Total Module Requirements
CAI		x	623	=	
CAM		x	731	=	
CDM		x	731	=	
CDO		x	731	=	
EAM		x	623	=	
IDM		x	623	=	
ODM		x	623	=	
RTD		x	632	=	
SAM		x	623	=	
SDM+		x	731	=	
VIM		x	635	=	
DP/IO Bus Link	1	x	400	=	400
				Bytes Used for Modules (sum of Total Module Requirements)	

Channels

To determine the memory required by channels, multiple the number of channels of each type by the **Channel Size** for that channel, recording the product in the column labeled **Total Channel Requirements**. Add the numbers in the column to determine the **Bytes Used for Channels.**

Channel Type	Number of Channels		Channel Size		Total Channel Requirements
ACDI		x	61	=	
ACDO		x	70	=	
ADIC		x	58	=	
AVDI		x	61	=	
CAAI		x	102	=	
CAIC		x	90	=	
CAIP		x	106	=	
CAOC		x	106	=	
CDDO		x	125	=	
CDOC		x	82	=	
CDSI		x	58	=	
CEDO		x	125	=	
CPIF		x	94	=	
CPIT		x	58	=	
DPOC		x	70	=	
EACI		x	82	=	
EADO		x	61	=	
EAOC		x	94	=	
EAVI		x	82	=	
IDMI		x	50	=	
RIC		x	106	=	
RTD		x	114	=	
SADI		x	61	=	
SAIC		x	85	=	
SAOC		x	106	=	
SDOC		x	70	=	
SOEI		x	98	=	
SOEO		x	122	=	
TIC		x	102	=	
VIC		x	98	=	
VPIF		x	94	=	
VPIT		x	58	=	
Bytes Used for Channels (sum of Total Channel Requirements)					

The sum of the **Bytes Used for Modules** and **Bytes Used for Channels** is an approximation of the requirements of the envisioned system.

2.5.2 Determining SDB Memory Consumed by I/O Modules and Channels

The system data block (SDB) to which a DP/IO Bus Link module is assigned is determined by the PROFIBUS interface to which it is attached.

Identifying SDBs

The table below assumes a non-redundant systems or Side A of redundant pair. In redundant systems, it is only necessary to determine the SDB consumption on one side, as that of the redundant partner on the other side is by definition identical.

DP Interface on the CPU	SDB
X1 (the combination DP/MPI connector)	123
X2 (the DP only port)	122
First CP443-5 module	126
Subsequent CP443-5 modules	127-129

Note

CP443-5 PROFIBUS Communications Processor is not supported in DP/IO Bus Link Release V1.0.

Procedure

After you have identified the interface and its corresponding SDB, determine the SDB use as follows:

1. Open SIMATIC manager.
2. Select Component View.
3. From within the S7 program, open the **Blocks** folder.
4. Double-click the **System data** folder.
   A list of SDB blocks appears with information including the memory usage.

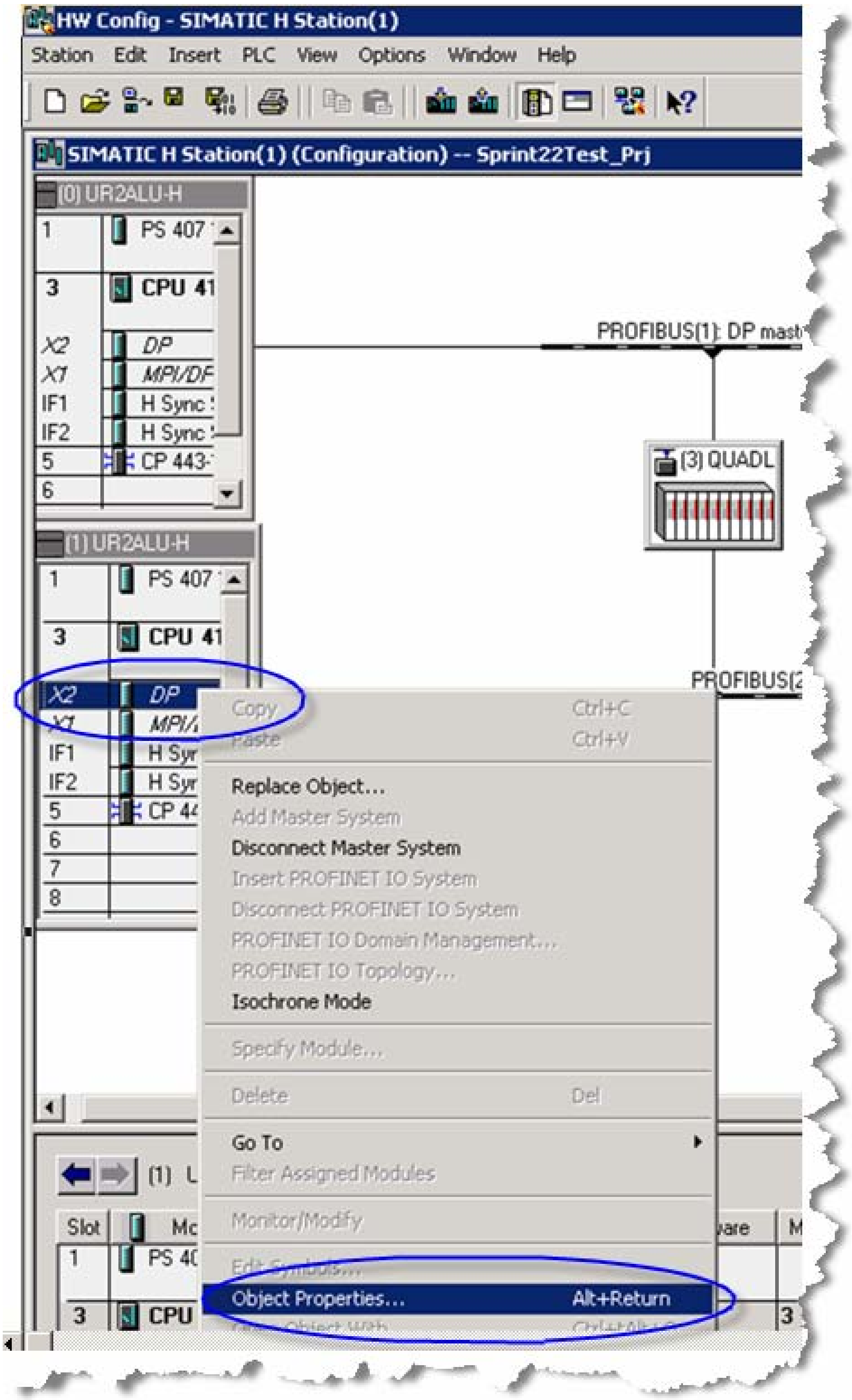
The SDB memory consumed by DP/IO Link Module and its associated I/O modules and configured channels cannot exceed 64 KB.

2.6 Exporting a PCS 7 Project from within HW Config

When exporting a project ensure that the DP operation mode is set to **DPV1** and not **S7-compatible**. Not doing so results in a number of parameters not being included in the archive. In redundant systems, both sides must be set to **DPV1** before exporting.

To determine and change the operating mode

1. From HW Config, select the DP slot and right click.
   A context menu appears:



2. Select **Object Properties**.
   A properties window opens.
3. Select the **Operating Mode** tab.
4. Confirm that the **DP mode:** setting is **DPV1** or use the drop-down list box to change it to **DPV1**.

5. In redundant system, perform this procedure for each side of the redundant pair.
6. Perform the archive.
7. If necessary, change the **DP mode** back to **S7-compatible**.

2.7 Installation Preparations

Read the sections titled EMC Directive Installation Considerations and Environmental Considerations before continuing with installation. The section EMC Directive Installation Considerations describes considerations required to ensure that QUADLOG modules are compliant with the European Union's Electromagnetic Compatibility (EMC) Directive, which can be found at the following web site:

http://www.newapproach.org/Directives/DirectiveList.asp

2.7.1 EMC Directive Installation Considerations

Some installations of QUADLOG modules may require adherence to the European Union's Electromagnetic Compatibility (EMC) Directive. EMC compliance requires the following:

- System components must be housed in enclosures having sufficient RF attenuation.
- MODULBUS cables that enter or exit the enclosure must be filtered. If the DP/IO Bus Link module is replacing CCM controllers, MODULBUS cables can be removed. MBX modules can be removed as well if another CCM or ACM does not reside in the same rack.

Consult your Siemens representative for additional information concerning EMC Directive installation and the availability of enclosures and needed hardware.

2.7.2 FM Enclosure Considerations

To meet FM requirements, the equipment must be installed in suitable equipment enclosures in accordance with ANSI/ISA S82.01 and S82.03.

2.7.3 Environmental Considerations

Many industrial environments create severe operating conditions. The conditions at each DP/IO Bus Link location must be within the specifications stated in the section titled Environmental Specifications.

Caution

Exceeding specified operating temperature limits could adversely affect performance and cause damage. Air temperature should be periodically checked to ensure that these specifications are not exceeded.

To ensure reliable data communications, locate QUADLOG module enclosures as far as possible from sources of interference such as high current electrical equipment, which emit strong electromagnetic fields and switching transients.

Industrial environments often contain particulate, liquid, and gaseous contaminants. Particulate matter, usually dust and dirt, is abrasive and can cause intermittent contact in connectors associated with circuit assemblies. A layer of dust on circuit boards will interfere with semiconductor heat dissipation. Liquid and gaseous contaminants can have a corrosive effect on metal, rubber, plastic and circuit board components. Extended exposure to this environment may result in equipment malfunction.

To reduce contaminant related equipment malfunctions:

- Identify contaminants and implement methods to reduce their presence.
- When cleaning equipment and surrounding area, especially the floor, either vacuum away all dust and dirt or use a dampened rag or mop.
- Clean or replace all air conditioning filters, room air filters, and equipment filters regularly.
- Inform personnel with access to QUADLOG modules of the need for site cleanliness.

2.7.4 Mechanical and Electrical Specifications

Specifications	Data
Module Weight	3.9 lbs/1.77 kg
Supply Voltage	24 VDC +/- 10% (from MODULRAC/SIXRAC backplane)
Supply input Current	0.21 A typical 0.27 A max
Power Dissipation	5.1 W +/- 10%
CPU	MPC860 PBGA
Clock Speed	75 MHz (bus operation
Memory	Redundant 16 MB SDRAM

Communications Buses Transition board I/O Serial Port	 Redundancy cable, PROFIBUS cable (12 Mbps) Redundant IOBUS interface Diagnostic port

2.7.5 Environmental Specifications

Specification	Data	Reference Standard
Ambient Temperature Range Operating Storage	 0 to 70°, 0.5°C/min -40 to 85 °C, 10°C/min	 IEC 60068-2-2 IEC 60068-2-1
Relative Humidity Operating Storage	 5 to 99%, non-condensing 0 to 100%, condensing	 IEC 60068-2-30
Vibration	2-150 Hz, 1 g peak	IEC 60068-2-6
Mechanical Shock Acceleration Duration	 15 g 11 ms	 IEC 60068-2-27
Corrosives	Class G3, 10+ years	ANSI/ISA S71.04
Radiated Emission, E-Field	30-230 MHz 40 dB (µV/m) Q at 10 m 230-1000 MHz 47 dB (µV/m) Q at 10 m	EN 55011
	0.15-30 MHz 80-50 dB (µV/m) at 3 m 30-100 MHz 60-54 dB (µV/m) at 3 m 100-2000 MHz 54 dB (µV/m) at 3 m, except for 156-165 MHz 24 dB(µV/m) at 3 m	CISPR 16-1, 16-
Conducted Emission Power Lines	10-150 KHz 120-69 dB (µV) 0.15 Mhz-0.5 MHz 79 db (µV) quasi-peak, 66 dB (µV) avg. 0.5-30 MHz 73 dB (µV) quasi-peak, 60 dB (µV) avg.	EN 55011 CISPR 16-1, 16- EN 55011, Class A Group 1
Immunity, Conducted Electromagnetic Field	150 kHz-80 MHz, 10 V	EN 61000-4-6
Immunity, Power and Signal Lines Surge	+/- 1 kV line to line +/- 1 kV line to earth +/- 1 kV communications (signal)	EN 61000-4-5
Immunity, Electrical Fast Transients	+/- 2 kV communications lines (signal) +/- 4 kVA to Power	EN 61000-4-4
Immunity, Radiated E-Field	3 V/m 80 Mhz-2000Mhz 3V/m 2000 MHz-2700 MHz	EN 61000-4-3
Immunity Electrostatic Discharge	6 kV contact, 8 kV aire	EN6100-4-2

2.7.6 Equipment Delivery and Handling

The following subsections provide information of interest to shipping, receiving, and warehouse personnel.

Predelivery Test

A DP/IO Bus Link supplied for customer installation is fully tested and inspected to ensure proper operation.

Factory Shipment

DP/IO Bus Link Modules supplied for customer installation are delivered in static shielding bags and packaged for shipment. Accessories are packaged separately.

Receipt of Shipment

All cartons should be inspected at the time of their delivery for possible external damage. Any visible damage should be immediately recorded on the carrier's copy of the delivery slip. Each carton should be carefully unpacked and its contents checked against the enclosed packing list. At the same time, each item should be inspected for hidden damage that may or may not have been accompanied by exterior carton damage.

If it is found that some items have been damaged or are missing, notify Siemens immediately and provide full details. In addition, damages must be reported to the carrier with a request for their on-site inspection of the damaged item and its shipping carton.

Equipment Handling

The DP/IO Bus Link is completely enclosed and may be safely handled without undertaking special ESD (electrostatic discharge) handling procedures provided the battery compartment door is closed and secured. DO NOT touch the connector pins on the back of the module. Handle the module carefully and do not subject it to excessive shock or vibration.

Equipment Storage

The storage temperature and humidity parameters listed in the section titled Environmental Specifications must be met to properly store a DP/IO Bus Link module.

Return of Equipment within North America

See the section titled A&D Technical Support

2.8 DP/IO Bus Link Hardware Identification

Part Numbers

Description	MLFB
DP/IOBUS Link Module Assy	6EQ2013-0CE00-0XA0
DP/IOBUS Link Term Board Assy (known as the "transition board")	6EQ2013-1CE00-0XA0
Redundancy Cables	1 m: 6EQ2013-0CE10-0XA0 is a 1 meter cable (Siemens part number A5E00681058) 2 m: 6EQ2013-0CE20-0XA0 is a 2 meter cable (Siemens part number A5E00681059) 6m: 6EQ2013-0CE60-0XA0 is a 6 meter cable (Siemens part number A5E00681060)
CD	6EQ2000-1AX06-2BC0

DP/IO Bus Link Identification

The DP/IO Bus Link is identified by name on the front bezel and by a nameplate labels.

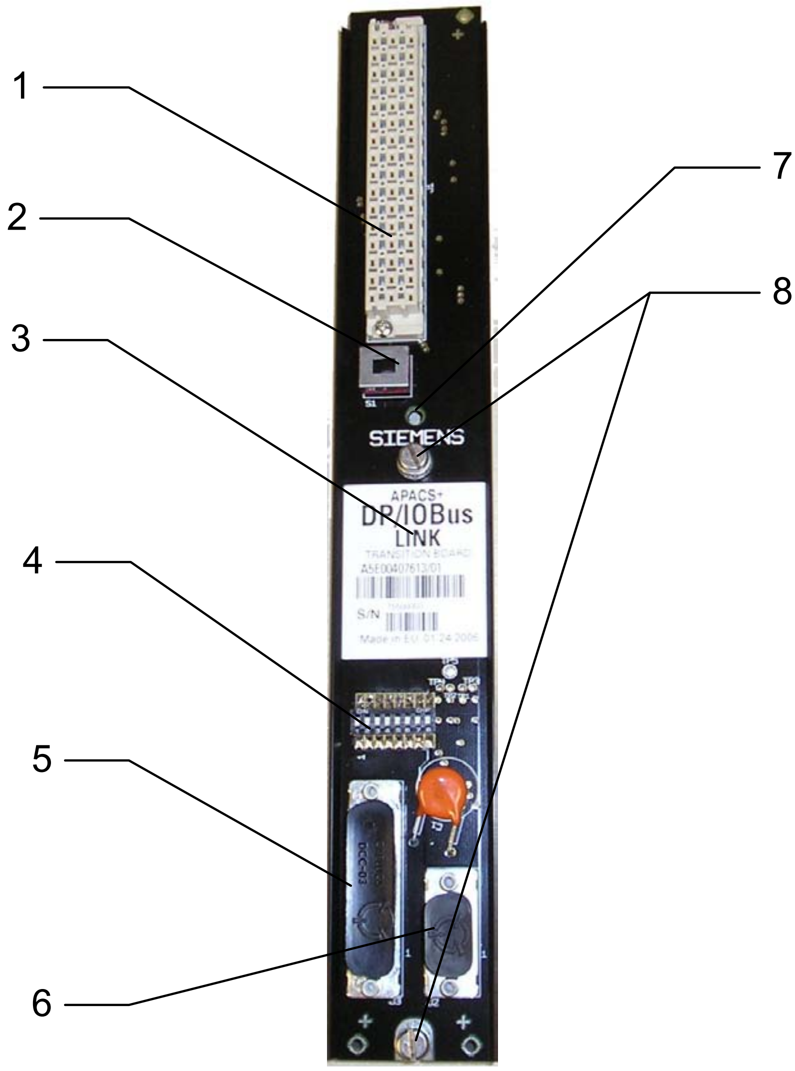
Key	Feature
1	Pivoting top handle
2	Diagnostic LEDs
3	Pivoting bottom handle.

The nameplate label, located on the tracking plate (left side of the DP/IO Bus Link), is depicted in the illustration that follows. The label includes the module's model designation, part number, and serial number. The label also lists the module's current and voltage requirements.


SIEMENS
Siemens Energy & Automation, Inc.
DP/IOBUS LINK
APACS+™
ADVANCED CONTROL MODULE
MADE IN EU
07.06.2006
MODEL
6EQ20130CE000XA
POWER: 24 VDC
0.32 A MAX
A5E00407555/01
COMM. SIGNAL: +/-15 VDC
S/N
75700021
READ ALL INSTRUCTIONS BEFORE INSTALLING TO PREVENT PERSONAL INJURY OR DAMAGE TO EQUIPMENT.
CLASS I, DIV. 2, GROUPS A, B, C & D
DO NOT DISCONNECT EQUIPMENT UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS. CERTIFIED COMPONENTS FOR USE IN A SUITABLE ENCLOSURE. SUBSTITUTION OF COMPONENTS OR OTHER EQUIPMENT MODIFICATION MAY IMPAIR SUITABILITY FOR CL. I, DIV. 2.
TEMP. CODE: T4A @ 70°C
MAX. AMB. TEMP.: 70°C

DP/IO Bus Link Transition Board

The transition board is labeled on the component side of the board:



Key	Feature
1	Module connector (J1)
2	Node switch (S1)
3	Component label
4	PROFIBUS-DP address selector switch
5	Redundancy cable connector (J3)
6	PROFIBUS-DP cable connector (J2)
7	Hole for MODULRAC alignment pin
8	Captive screws (2)

Note

If one rack of a redundant pair is located above the other, it may be necessary to purchase cable with right-angle or 45º PROFIBUS DP connectors. See the PCS 7 catalog for more information.

Below is detailed illustration of a typical component label for a DP/IO Bus Link Transition Board:

2.9 Removing QUADLOG Components

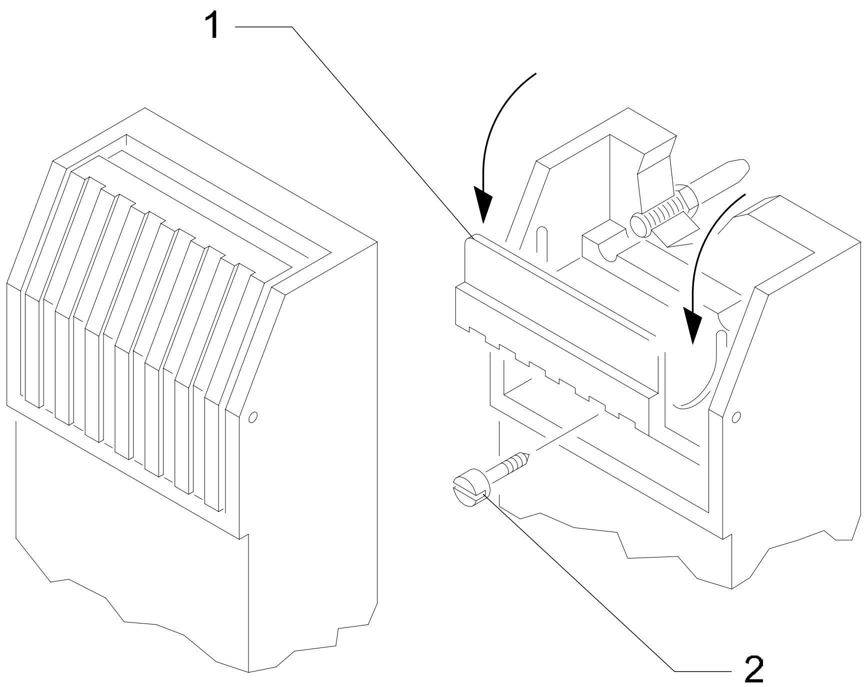
The DP/IO Bus Link module and related hardware are always installed to the left of I/O modules in a MODULRAC. In most installations, the DP/IO Bus Link module is installed in MODLURAC slot 1. In instances where a power supply module occupies slot 1, the DP/IO Bus Link module is installed in slot 2 to the right of the power-supply module.

QUADLOG Controller Removal

Take appropriate steps to shutdown the processes monitored or controlled by the field devices controlled by the controller.

Remove the controller as follows:

1. As shown in the drawing below, pull open the bezel’s pivoted top and bottom handles to expose the module’s slotted captive module-mounting screws. Loosen the screws.



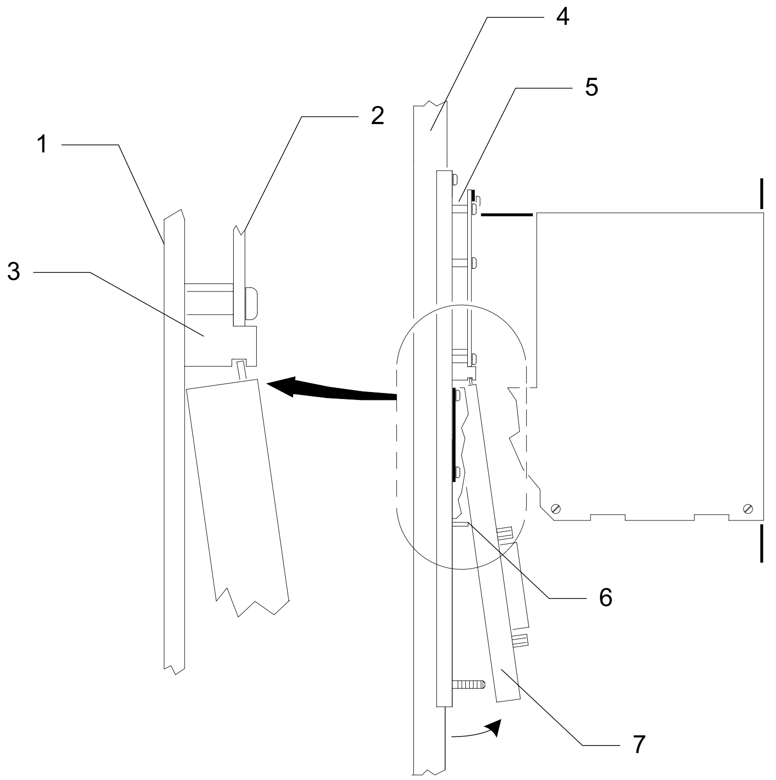
Key	Feature
1	Pivoting handles, top and bottom (top shown)
2	Captive module-securing screw, top and bottom (top shown)

2. Grasp the top and bottom handles and pull the module from the card cage.
3. Disconnect the battery for long-term storage. Place the module in a static shielding bag

Transition Board Removal

All cables should be labeled for correct reconnection.

The drawing below shows a side view of a MODULRAC cage and a detailed drawing showing how a transition board fits into a slot in an extruded space. Refer to the drawing below and to the following removal procedure:



Key	Feature
1	MODULRAC panel
2	Backplane
3	Extruded spacer
4	Mounting rail
5	Top spacer
6	Alignment pin
7	Transition board

1. Remove redundancy and serial port cables from the transition board.
2. Loosen the transition board’s captive mounting screws. Gently lift the bottom of the board in an arc until the board is free of its alignment pin located immediately above the Siemens logo. Pull the top of the transition board from the grooved back plane spacer and lift it from the module rack.
3. Place the transition board in a static-shielding bag

2.10 Installing the DP/IO Bus Link Components

Installing the DP/IO Bus Link Transition Board

Caution

The DP/IO Bus Link transition board includes static-sensitive components that are not readily visible. Follow procedures that reduce the likelihood of electrostatic discharge: keep the board in static-shielding packaging until it is ready for installation, ensure that personnel handling the board are grounded through an antic-static wrist strap, and avoid touching connectors.

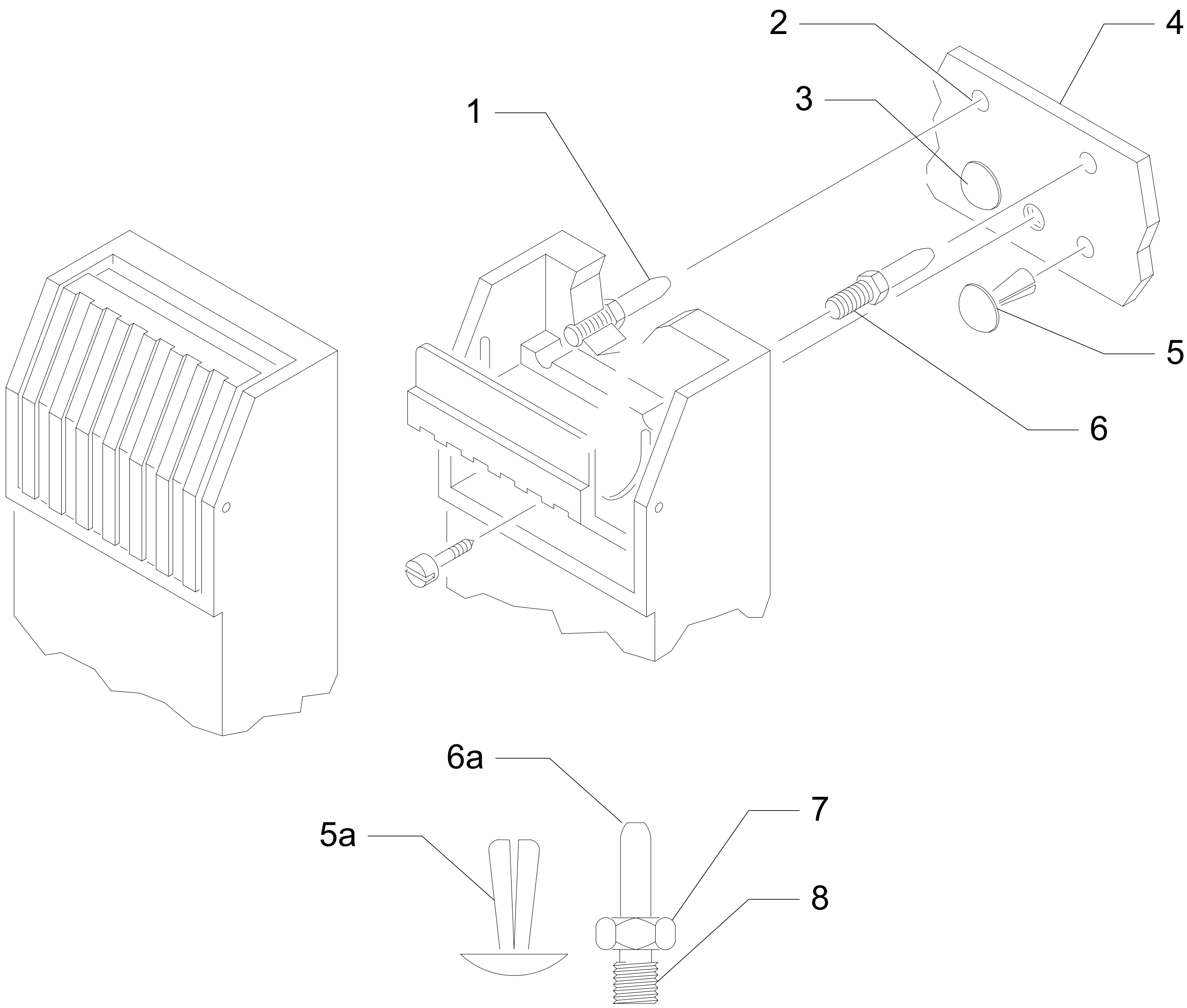
Installing a transition board is the reverse of removing one. See the illustration in the section titled Removing QUADLOG Components.

1. Identify the slot location where the QUADLOG controller was installed.
2. Tilt the transition board slightly with the top toward the MODULRAC chassis.
3. Slide the transition board under the MODULRAC cage so that the board’s upper edge fits into the groove in the backplane.
4. Pivot the transition board in an arc toward the MODULRAC chassis, locating the board on the alignment pin.
5. Secure the transition board to the MODULRAC chassis using the two captive screws attached to the board.

Keying the DP/IO Link Bus Module and MODULRAC

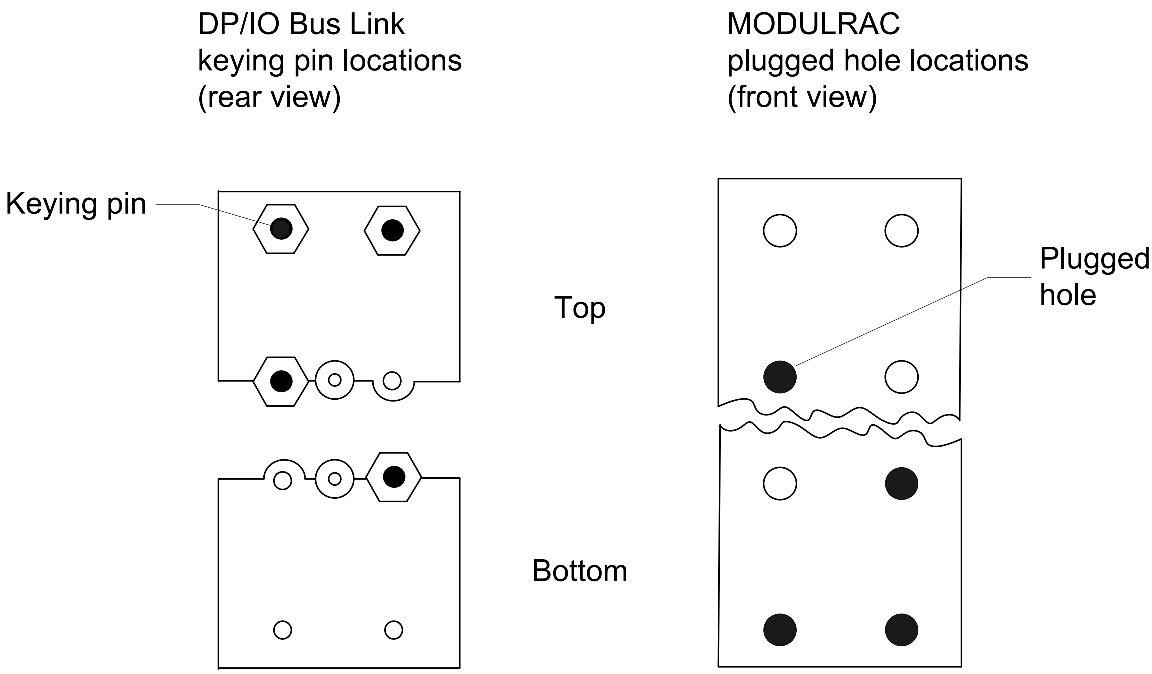
Siemens recommends that modules and racks be keyed to ensure that modules cannot be inadvertently plugged into the wrong slots. Modules are supplied with a set of keys and plugs.

The illustration below shows how keys and plugs are installed. This section also includes an illustration of the recommended key-and-plug pattern for DP/IO Bus Link modules and their corresponding MODULRAC slots.



Key	Feature
1	Keying pin (installed)
2	Module Key holes
3	E Stop plug (installed)
4	Portion of MODULRAC's top rail
5	Key plug (see 5a)
5a	Key plug detail
6	Keying pin (see 6a)
6a	Keying pin detail
7	Tighten with 3/16-inch wrench
8	Threaded into rear bezel of DP/IOBus Link Module

The illustration below shows the recommended pattern of keying pins and plugs for DP/IOBus Link Modules.



Installing the DP/IO Bus Link Module into the MODULRAC

Caution
Forcing a DP/IO Bus Link module into a MODULRAC slot with a transition board not designed for a DP/IO Bus Link module can destroy the MODULRAC power supply. Use the key-and-pin system described previously in this section to prevent a mismatch between modules and transition boards.

See the illustrations in the topic titled Keying the DP/IO Link Bus Module and MODULRAC.

1. Slide the DP/IO Bus Link Module into the MODULRAC controller slots that as been keyed and plugged correctly.
2. Secure the module to the rack using the captive screws that are exposed when the top and bottom handles have been pivoted open.

Cabling Transition Boards to PROFIBUS-DP

PROFIBUS-DP cables and related tools are available from Siemens. A downloadable (PDF) catalog is available from the web site http://www.pcs7.com/. Use the search function to find the string *catalog.* Select **Print- & Multimedia (English)**, which leads to a page listing all available catalogs (segregated by PCS 7 version and language). The downloaded document has a search feature of its own, so your can readily find tools and supplies.

Note

If one rack of a redundant pair is located above the other, it may be necessary to purchase cable with right-angle or 45º PROFIBUS DP connectors. See the PCS 7 catalog for more information.

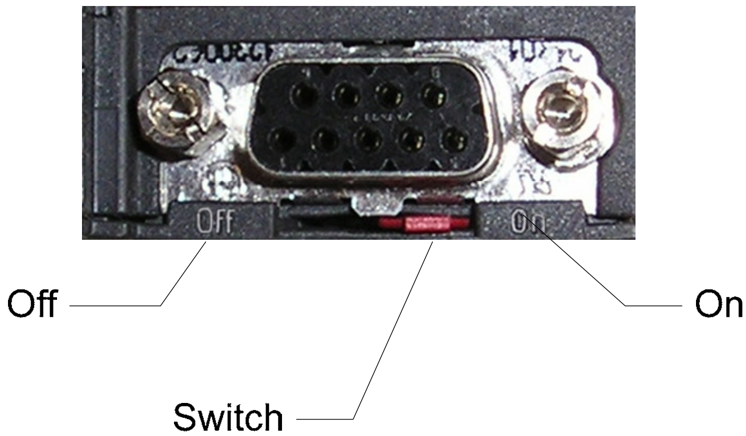
A PROFIBUS-DP cable connects the DP/IO Bus Link module, a DP slave, through its transition board to a PROFIBUS-DP connector on an S7-400 controller, the DP master. In a typical installation the transition board is on one end of the cable and the controller is on the other, with no intermediate devices.

PROFIBUS-DP cable connectors include a 15-pin male D connector and a 15-pin female D connector. In a typical system that includes the DP/IO Bus link, the female cable connectors are not used.

PROFIBUS-DP cable connectors are equipped with terminating resistors that can be switched on or off as necessary to terminate the physical ends of the PROFIBUS-DP bus. In a typical installation, where the only devices connected to the bus are the S7-400 controller and the DP/IO Bus Link module, the terminating resistors included in the cable-connector assembly must be switched to the ON position. The picture below shows a PROFIBUS-DP cable connector with the terminating-resistor switch in the ON position.

Siemens recommends that active terminators be purchased and used for PROFIBUS lines so that field maintenance can be performed without breaking the PROFIBUS link. See the PCS 7 V7.0 catalog for the part number of the active PROFIBUS terminator.

Use an optical link module (OLM) or other equivalent extender to extend PROFIBUS running at 12 Mbps (the only supported rate for the DP/IOBus Link module) beyond the length limitations imposed by copper cables.



The procedure that follows makes reference to the transition board connector J2, shown in an illustration included in the section titled DP/IO Bus Link Hardware Identification.

1. Connect one of the PROFIBUS-DP cable's male connector to the female connector labeled J2 on the transition board. Secure the cable with the captive screws provided.
2. Connect the other PROFIBUS-DP cable's male connector to the corresponding female connector on the S7 400 controller. Secure the cable with the captive

screws provided. There are two connectors, labeled **X1** and **X2**. The PROFIBUS-DP cable can connect to either. The only restriction is that in a redundant system, the connections must be identical for both partners. Ensure that the system configured in the HW Config program reflects the physical connections selected.

3. Ensure that the terminating-resistor switches are in the ON position at the physical ends of the PROFIBUS-DP. Typically, the ends are at the transition board and the controller.

Connecting Redundant DP/IO Bus Link Transition Boards

Caution

Ensure that the DP/IO Bus Link module on the standby side is powered off or removed from the rack before connecting the redundancy cable to a transition board. This caution applies regardless whether the redundancy cable has been removed completely (both sides) or has been removed from either of the transition boards (one side). See Redundancy Cable, Transition Board, and IO Module Maintenance Considerations.

Siemens recommends that power may be off when DP/IO Bus Link Transition boards are connected to one another.

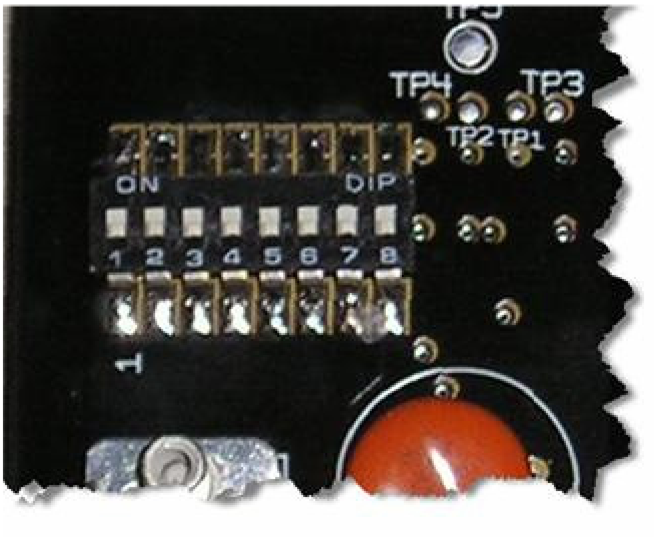
Connect DP/IO Bus Link modules together with redundancy cable (6EQ2013-0CE10-0XA0/001). The cable has identical 25-pin male D connectors on each end that plug into mating connectors J3 on the transition boards. An illustration in the section titled DP/IO Bus Link Hardware Identification shows the location of the redundancy connector (J3).

It is not possible to use the QUADLOG redundancy cable with the DP/IO Bus Link Transitions board. The QUADLOG cable has 37-pin connectors. The DP/IO Bus Link redundancy cable has 25-pin connectors.

2.11 Setting the PROFIBUS Address

The PROFIBUS-DP address selector switch is a dual in-line package (DIP) switch array located on the DP/IO Bus Link Transition Board (see the illustration in the topic DP/IO Bus Link Hardware Identification for the location of this switch).

The picture below shows a close-up of the switch:



Tool Required

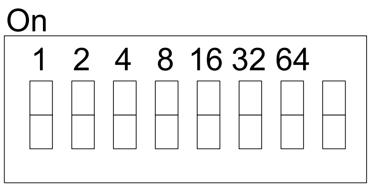
Set the PROFIBUS-DP address with a 3 mm screwdriver.

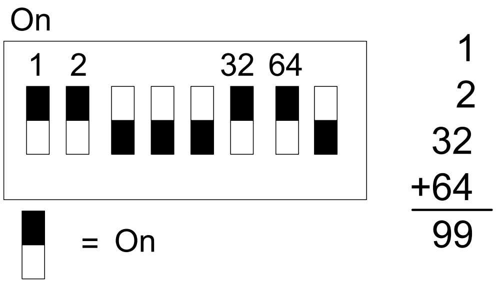
Locating and Setting the Address Switches

Each PROFIBUS-DP node must be set to a unique, valid address. In redundant architectures, however, the master/standby pair of DP/IO Bus Link modules shares the same address. Because only one element of the of the pair is active at a time, there is no addressing conflict.

- The permitted PROFIBUS-DP addresses are 1 to 125.
- Each device on PROFIBUS must have a unique address number. For each element of a redundant pair, the same PROFIBUS address must be used on the A-side and B-side. A redundant pair of CPUs uses one address, a redundant pair of DP/IO Bus Link modules uses another, and so forth.
- To change the PROFIBUS-DP address of the DP/IO Bus Link module, remove the module, change its address, and plug it back in.

Switches have numerical value based on their positions in the array, as shown in the illustration below. The sum of the ON switches is the DP address specified by the array. The bottom half of the illustration shows the switch settings that provide a DP address of 99.





The unlabeled switch is not connected internally, so its position is of no consequence in determining the PROFIBUS-DP address of the DP/IO Bus link.

Note

If the address is invalid, the DP LED blinks rapidly at power-up.

See the section titled Interpreting Front-Panel LEDs.

2.12 Configuring Redundant Architectures

- Node-to-node
- IOBUS
- PROFIBUS DP

Setting the Transition Board Node Switch (S1)

The Node Switch (S1) is a slide switch located on the DP/IO Bus Link Transition Board (see the illustration in the topic DP/IO Bus Link Hardware Identification).

In redundant architectures, the switch position determines the preferred master partner for PROFBUS DP communications between DP/IO Bus Link modules and PCS 7 controllers. The switch position also determines the A- and B-sides of the redundant architecture. In redundant architectures, the S1 switch positions must differ; otherwise, an error message is returned.

- Left = A = DP preferred master
- Right = B = DP standby

Caution

Set Transition Board Node switches properly before starting the system. Changing these switches in a running system could result in a class 1 error. See Error 17:10 Node (A/B) Switch Setting.

2.13 CP 1613 Network Adapter Card Installation

A CP 1613 Industrial Ethernet interface is recommended for H-Communication between the engineering station (ES) PC and an S7 417H-CPU. An IE General (a generic Industrial Ethernet interface) may be used during a design phase.

Follow the instructions supplied with the device to install it and its drivers in the engineering station (ES) PC

3 System and Software Configuration

Prerequisites

- PCS 7 V7.0 + SP1 or higher.
- PCS 7 V7.0 OS only needed if configuring an OS station.
- S7 F Systems V6.0.
- CP1613 card is required for S7-400H CPUs.
- Read and understand the *Best Practices* document.

Note

Before installing software, read in its entirety the file *readme.wri* on the root directory of the distribution CD.

Warning

Safety Note - Read *SIMATIC S7 F/FH Systems Configuring and Programming*

Read and understand the manual *SIMATIC S7 F/FH Systems Configuring and Programming* and read the Safety Notes.

3.1 Install PCS 7 DP/IO Bus Link V1.0 Software

This section outlines the procedure for installing the PCS 7 DP/IO Bus Link module software and provides a table listing the software installed on each node type.

3.1.1 Installing DP/IO Bus Link Software

Note

Before installing this software

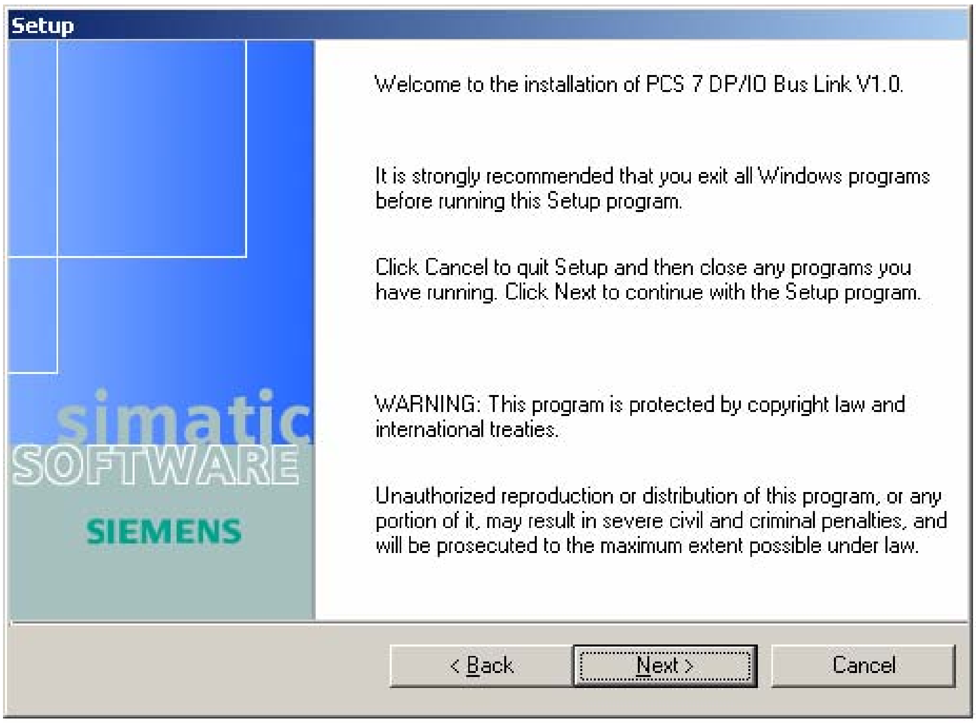
- Install all other PCS 7 software.
- Log on to Windows with Administrator rights.
- Disable any virus protection software that is currently running

Refer to the file *ReadMe_DPIO_Library.wri* in the root directory of the installation CD for more information.

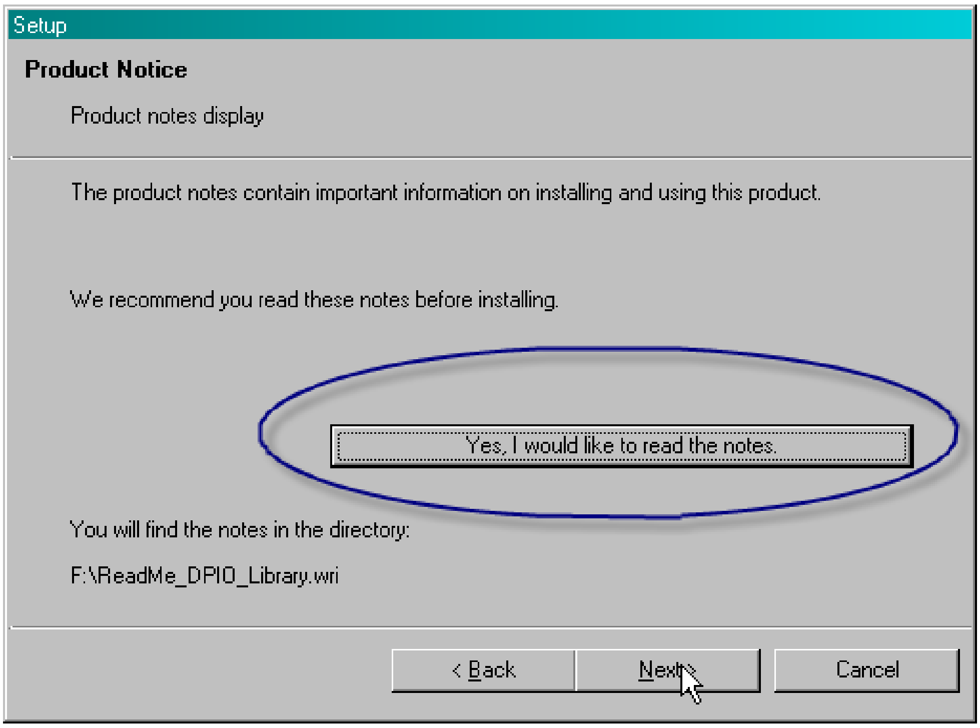
---

1. Insert the PCS 7 DP/IO Bus Link V1.0 CD into the CD-ROM drive. The setup program autoruns if your system permits autorun. Otherwise, run **Setup.exe**

from the root directory of the distribution CD.
The **Welcome** dialog box opens.



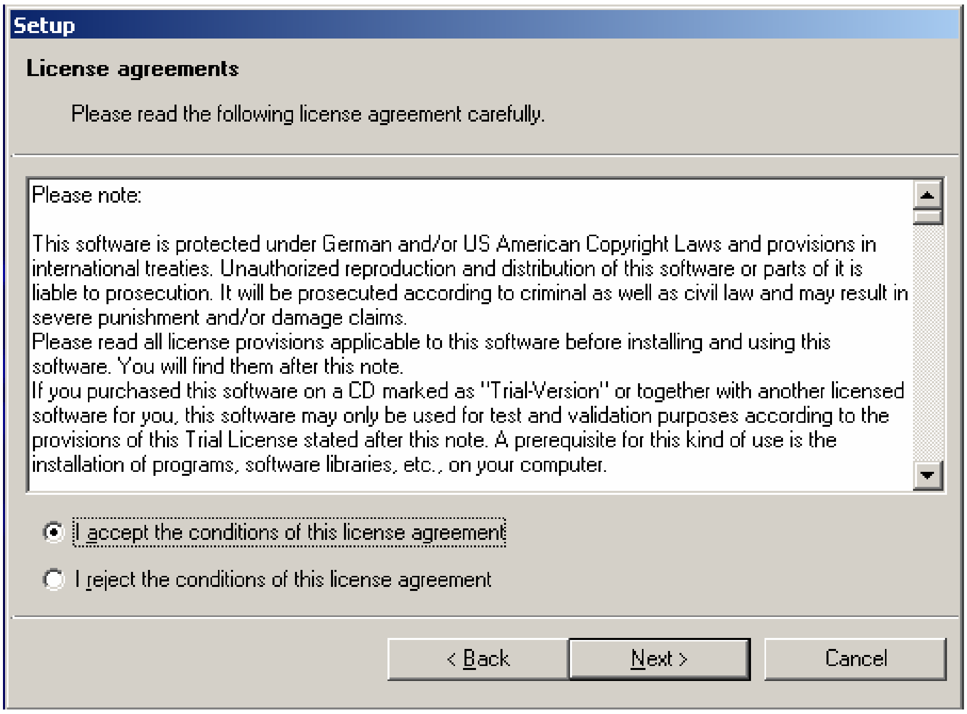
2. Click the Next button to continue.
   The **Product Notice** window opens.



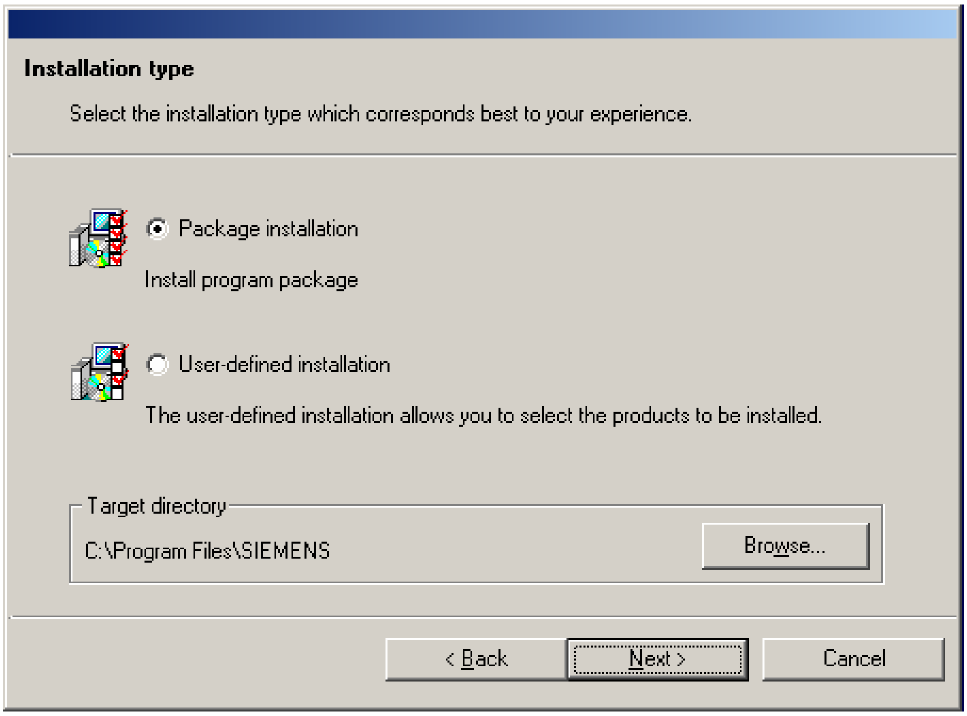
3. Click the button labeled **Yes, I would like to read the notes** to display the readme file supplied with the CD.

   Siemens strongly recommends that you read the notes carefully and print them for further reference. The notes contain the most up-to-date information available as the CD is produced and supersede other documentation, including this manual. The notes are stored on the root directory of the distribution CD in the file *ReadMe_DPIO_Library.wri* and can be opened with the Windows WordPad program.

4. Click the **Next** button to continue. The **License agreements** dialog box opens.

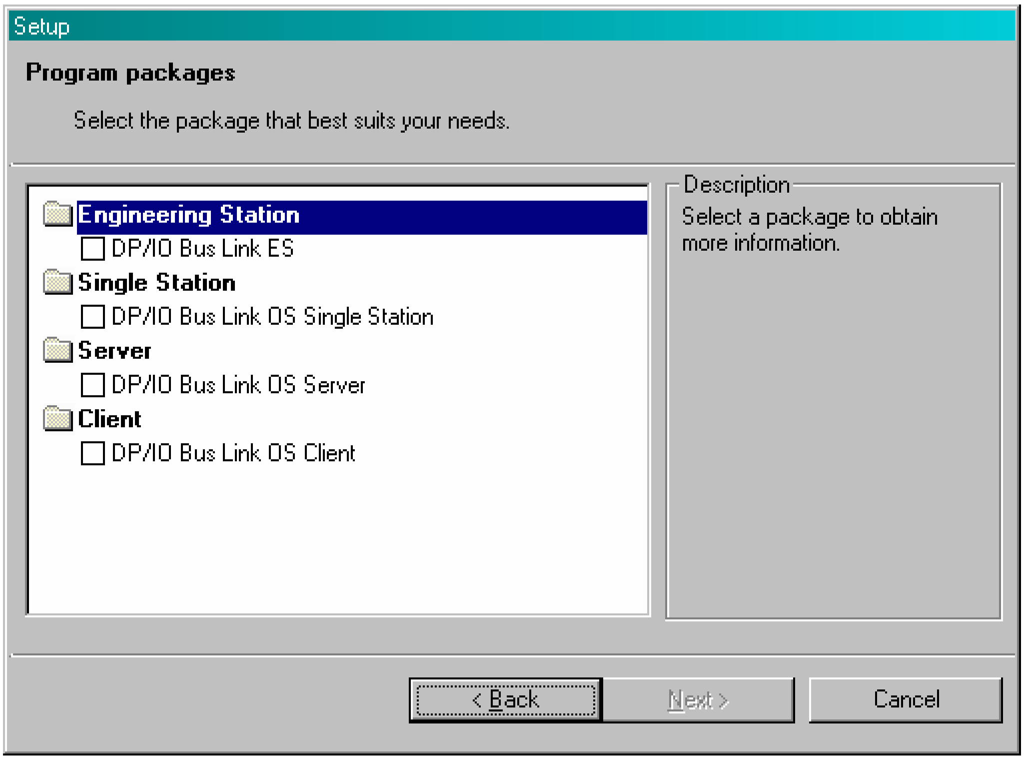


5. Read the license agreement. Select the **I accept the conditions of this license agreement** radio button. Click the **Next** button to continue.
   The **Installation type** window opens.



The window displayed above asks you to select **Package Installation** or **User-defined installation.** If you select **Package Installation** the choices available are either the ES or OS installation. If you select **User-defined installation** you will be able to select the type of stations that the software will be used in. The installation program decides what packages to install.

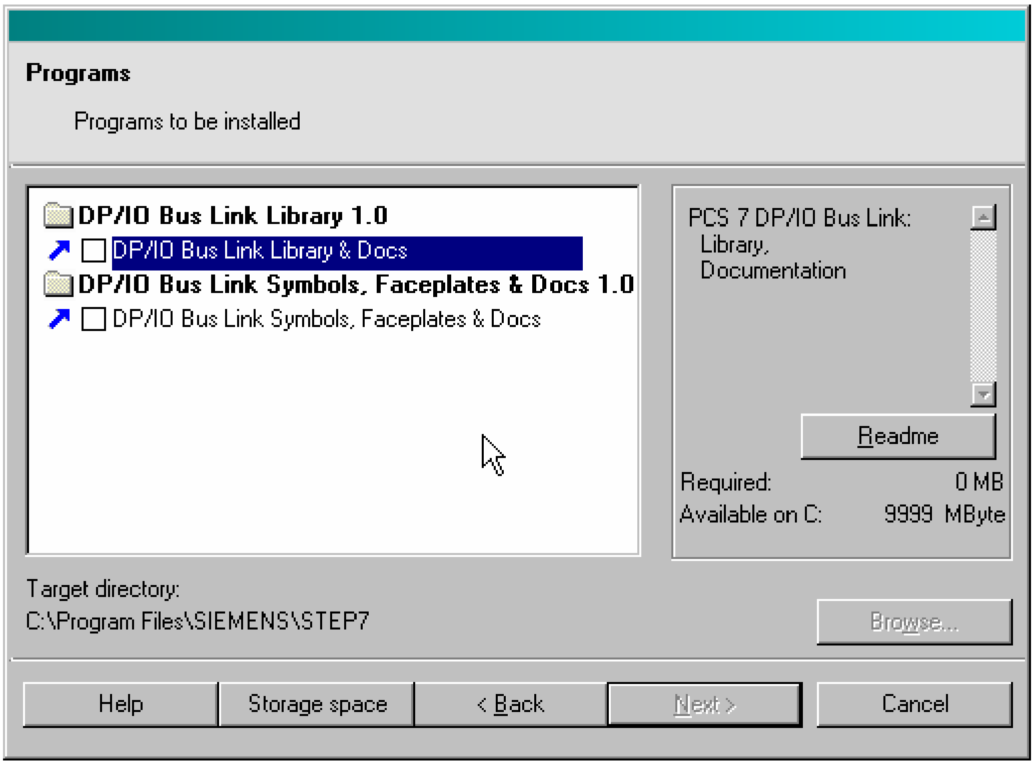
6. Select the **Package installation** or **User-defined installation** button. Click the **Next** button to continue.
   Assuming you have selected **Package installation,** the **Program packages** window opens:



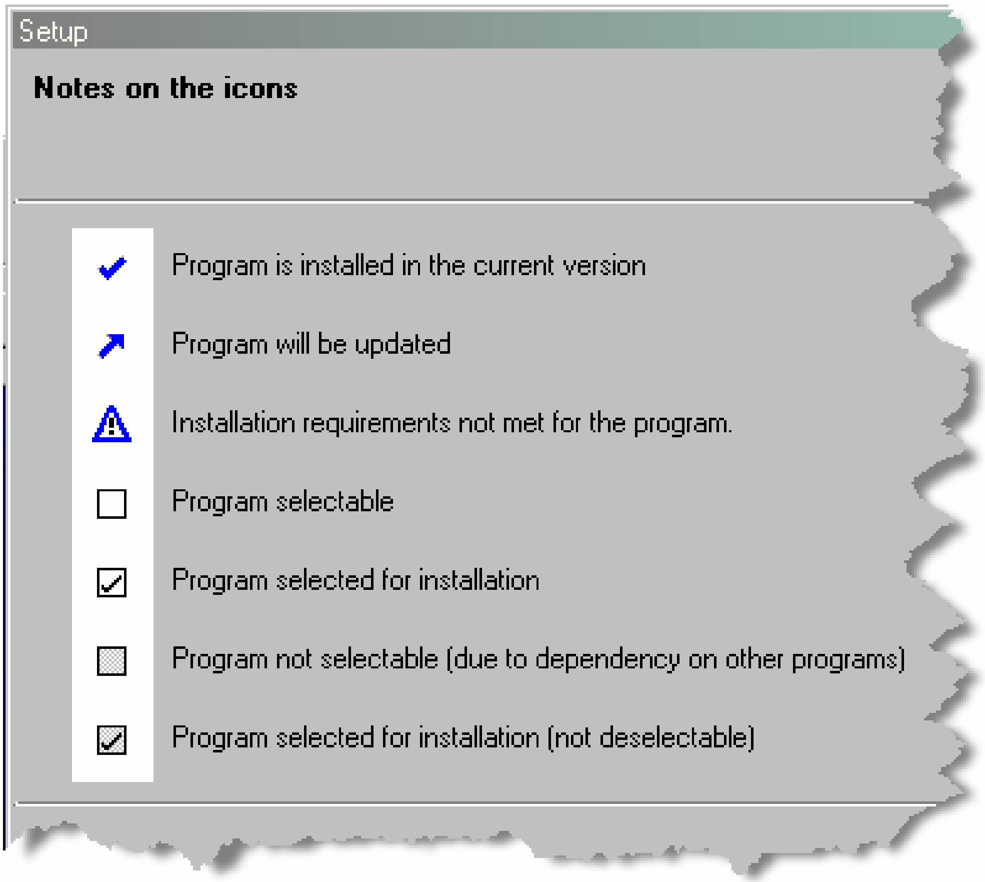
7. Select the appropriate packages.
   Select the **Next** button to continue.
8. The **Programs** window opens.

   In the instance of a new install (or an install after the program has been removed using the Windows function **Start > Control Panel > Add or Remove Programs)**, skip this step and go to the next numbered step.

   In the instance of an upgrade, you must explicitly indicate an intention to overwrite existing software by selecting checkboxes where an upgrade is possible:

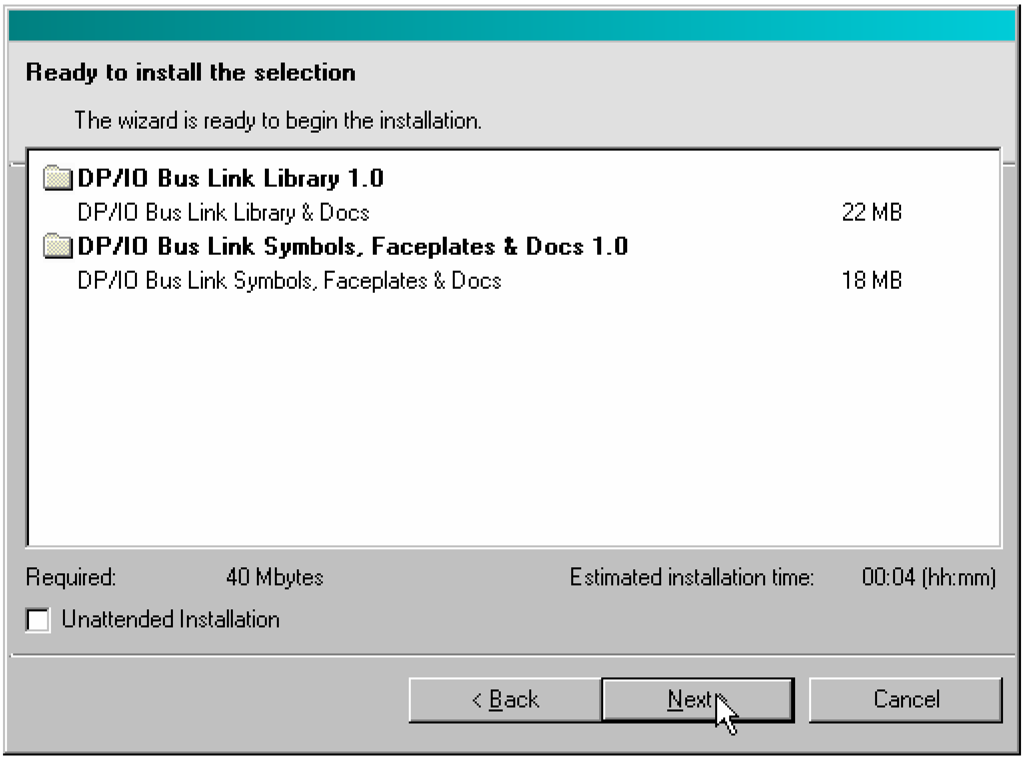


The **Help** button displays a key to the symbols used to specify available options:



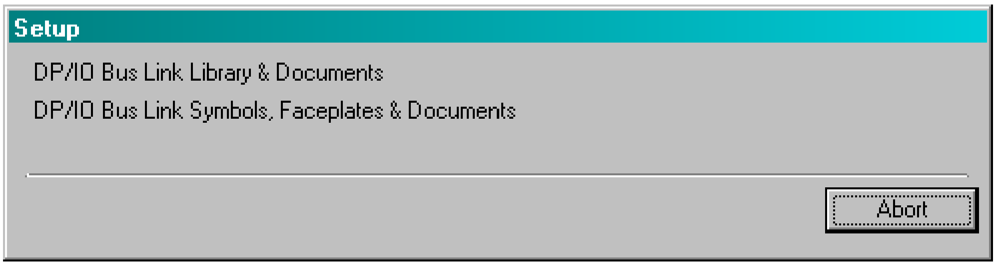
When you have made your selections, the **Next** button becomes available. Click the **Next** button.

9. The **Ready to install the selection** window opens, listing the selected components.

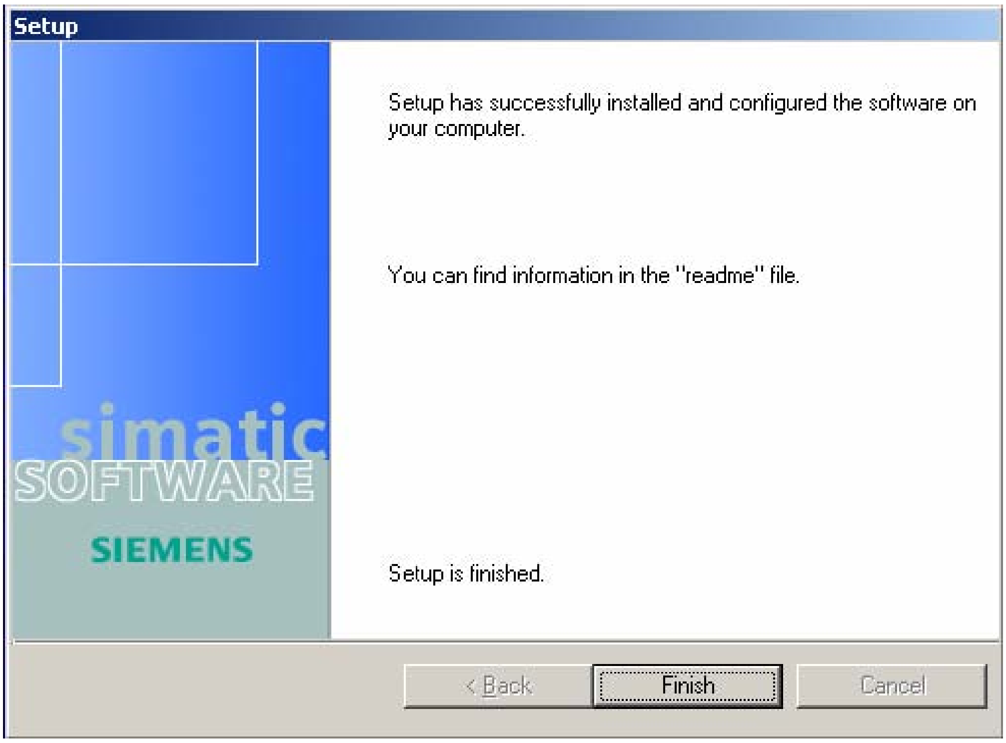


Click the **Next** button.

10. A window opens to indicate that the install is underway:



A notice appears after the software has installed successfully:



11. Click the **Finish** button.
    The installation program closes and the Windows desktop returns.

3.1.2 Software Installed on Each PC Node Type

Packages	Engineering Station	OS Server	OS Client	OS Single Station
DP/IO Bus Link ES	Yes			
DP/IO Bus Link OS Server		Yes		
DP/IO Bus Link OS Client			Yes	
DP/IO Bus Link OS Single Station				Yes
Components				
DP/IO Bus Link Library 1.0	Yes			
DP/IO Bus Link Symbols, Faceplates & Docs 1.0	Yes	Yes	Yes	Yes

3.2 Customizing SIMATIC Settings

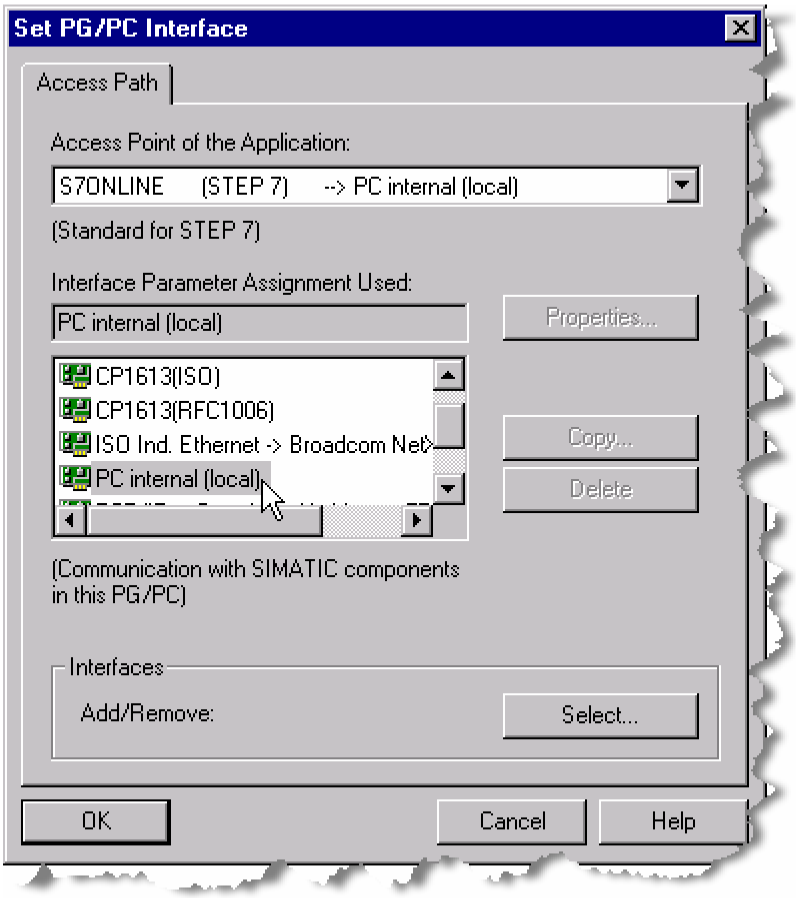
Instruction for setting up PCs for use with a DP/IO Bus Link module are found in the document *Process Control System PCS 7 V7.0 PC Configuration and Authorization*.

One customization worth noting: the PKZIP for Windows program is used for archiving in a DP/IO Bus Link module environment. The setup program for PKZIP for Windows is on the PCS 7 Toolset DVD. PKZIP for Windows is automatically installed during the system setup of PCS 7. You can open PKZIP for Windows from the SIMATIC Manager.

3.3 Setting the PG/PC Interface to PC Internal

PG/PC is a Siemens SIMATIC term describing a PC with a hardware interface that permits it to connect to a program other SIMATIC devices.

1. Select **Start > Control Panel > Setting PG/PC Interface**.
   The **Set PG/PC Interface** window opens.
2. Select **PC internal (local)** and click the **OK** button:



3.4 Running the SIMATIC New Project Wizard

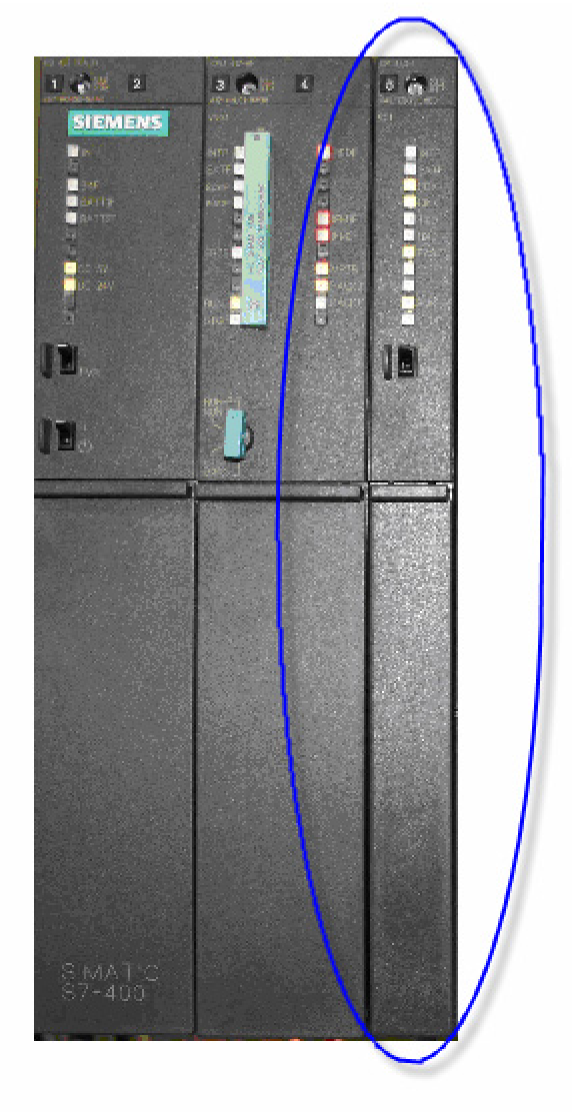
This procedure creates a new multiproject containing an automation system (AS) and an operator station (OS).

Prerequisite information

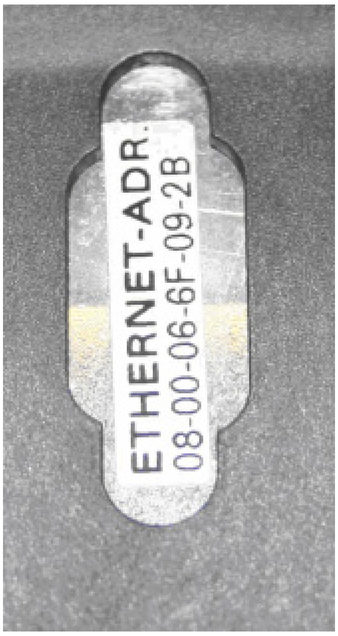
- Bundle MLFB (part number). If possible, get this from documents that accompany the purchase and delivery of the system. Otherwise, se
- CPU model number (such as AS417-4-2H)

- Number of communications modules (typically 1)
- Read and understand the Best Practices document.
- Read and understand the document *SIMATIC Process Control Systems PCS 7 Engineering Systems*
- MAC address of CP 433-1 Communications Processor .

Determining the MAC address of the communications processor



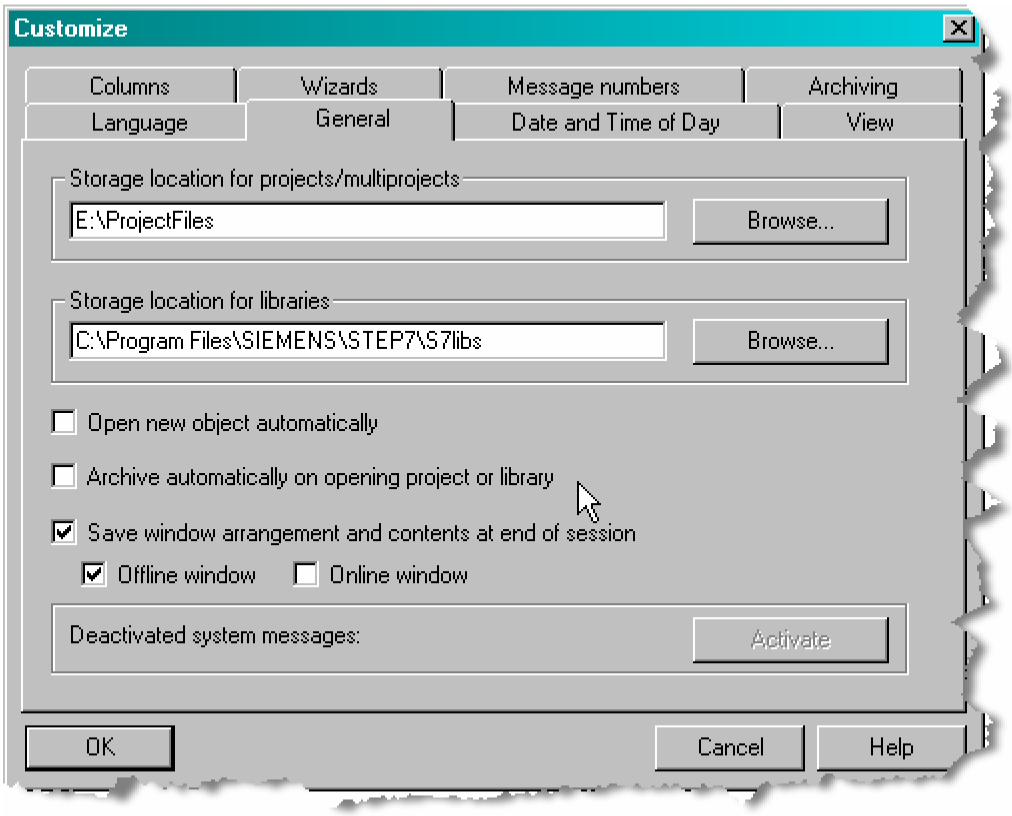
Open the module door and read the MAC address from the label inside.



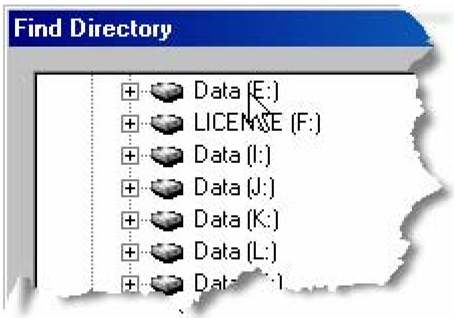
Procedure

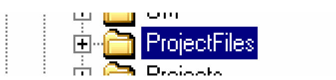
Selections made on page 4 of the new project wizard determine where the project's files reside. For DP/IO Bus Link applications, Siemens recommends that you not accept the default locations, but instead store files on a disk partition dedicated to project files. In the description of steps that follow, it is assumed that this partition is the *E:* drive, which contains a folder labeled *ProjectFiles.* The location must be created (by partitioning and formatting) before completing page 4 of the **'New Project'** wizard.

1. From the **Start** menu, select **SIMATIC > SIMATIC Manger**.
   The **Simatic Manager** program opens.
2. From the menu bars of the SIMATIC Manager program, select **Options > Customize..** and select the **General** tab.
   The **General** window opens:



3. Next to the edit box labeled **Storage location for projects/multiprojects**, click the **Browse…** button to identify the desired location of the project.
   A **Find Directory** window opens:





4. Select the drive and directory and click the **OK** button.
   Consult the *Best Practices* document for recommendations on selecting directories.

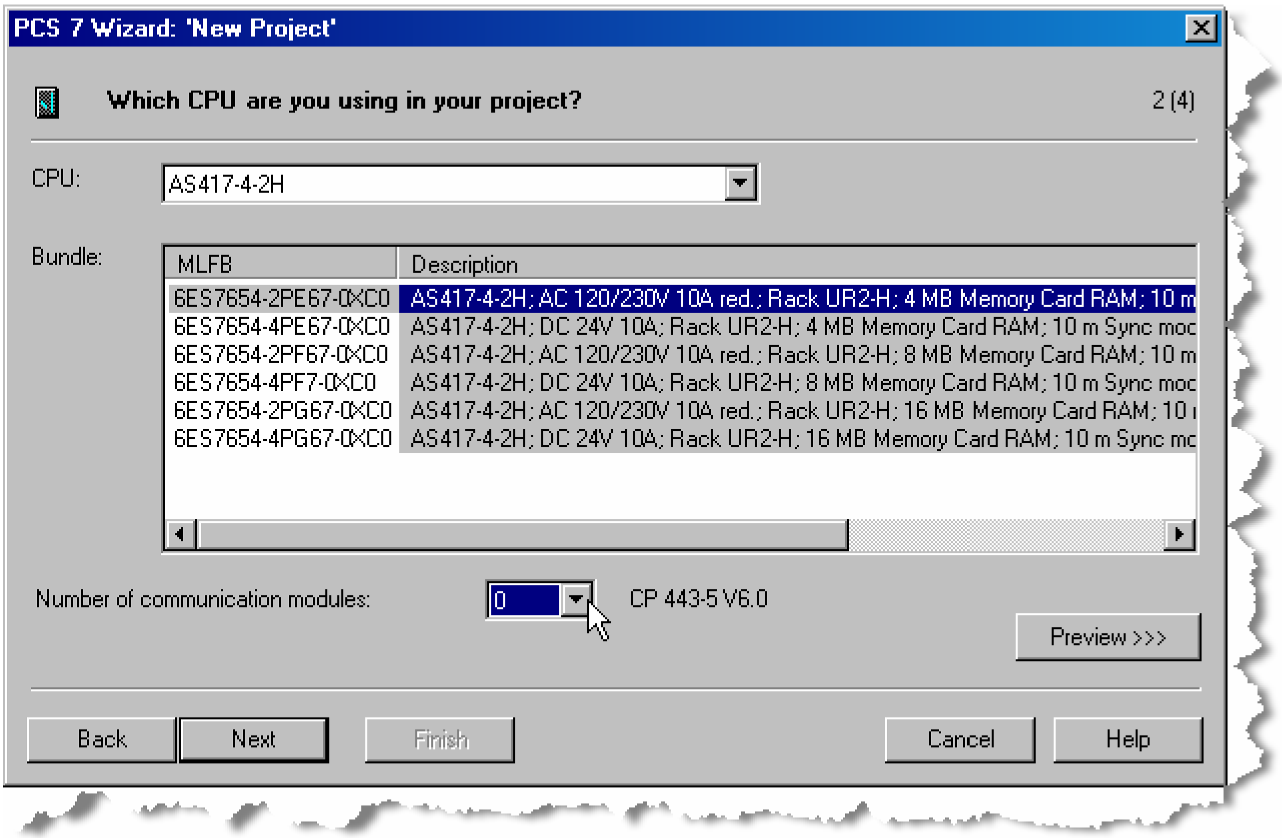
5. Select **File > 'New Project' Wizard**
   The **PCS 7 Wizard: 'New Project' Introduction** window opens.

6. Click the **Next** button
   The PCS 7 Wizard page 2 of 4 opens.

7. Select the following:

   - CPU

- Bundle MLFB (see below)
- Number of communications modules:

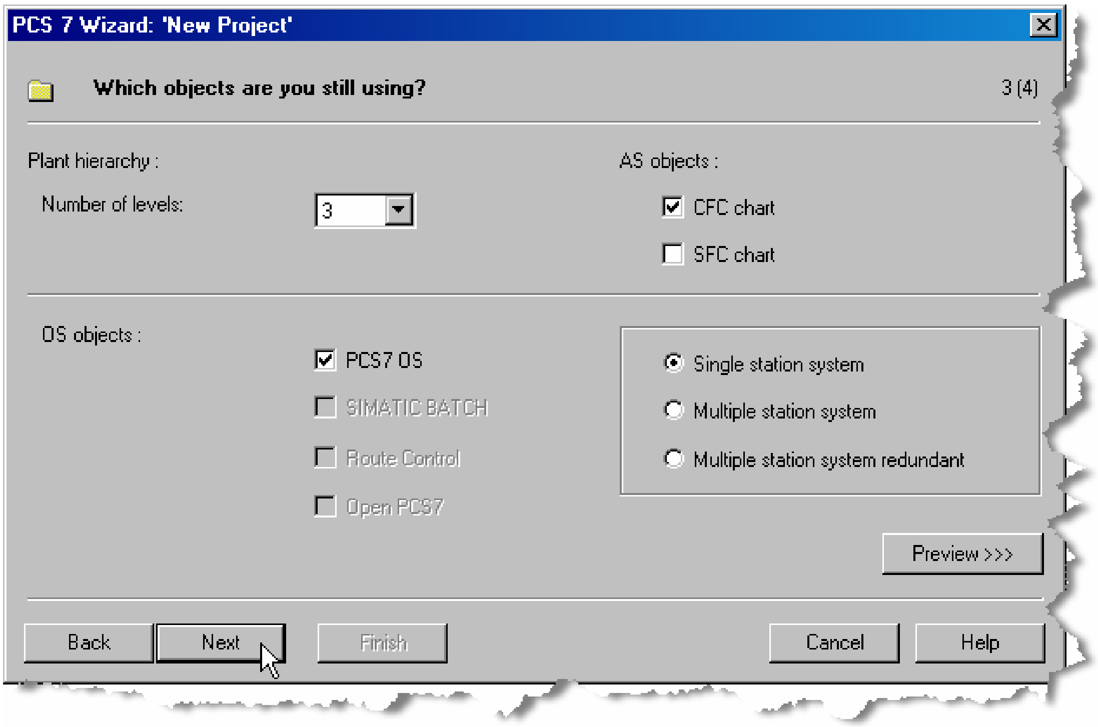


If you don't know the MLFB of your system, you can determine it by carefully examining system components. Be aware, however, that if your MLFB bundle includes redundant CPUs, There is no indication of this on the label inscribed on each CPU chassis. For example, if your MLFB bundle includes a redundant pair of AS 417-4H CPUs, select as CPU the model AS417-4-2H, where *2H* indicates redundant, high-availability CPUs. These CPUs include a synchronization module and cable, which are not immediately visible in the **Description** field. Note that the default value for CP 443-5V6.0 communications processors is not 0, but must be typically set to 0.

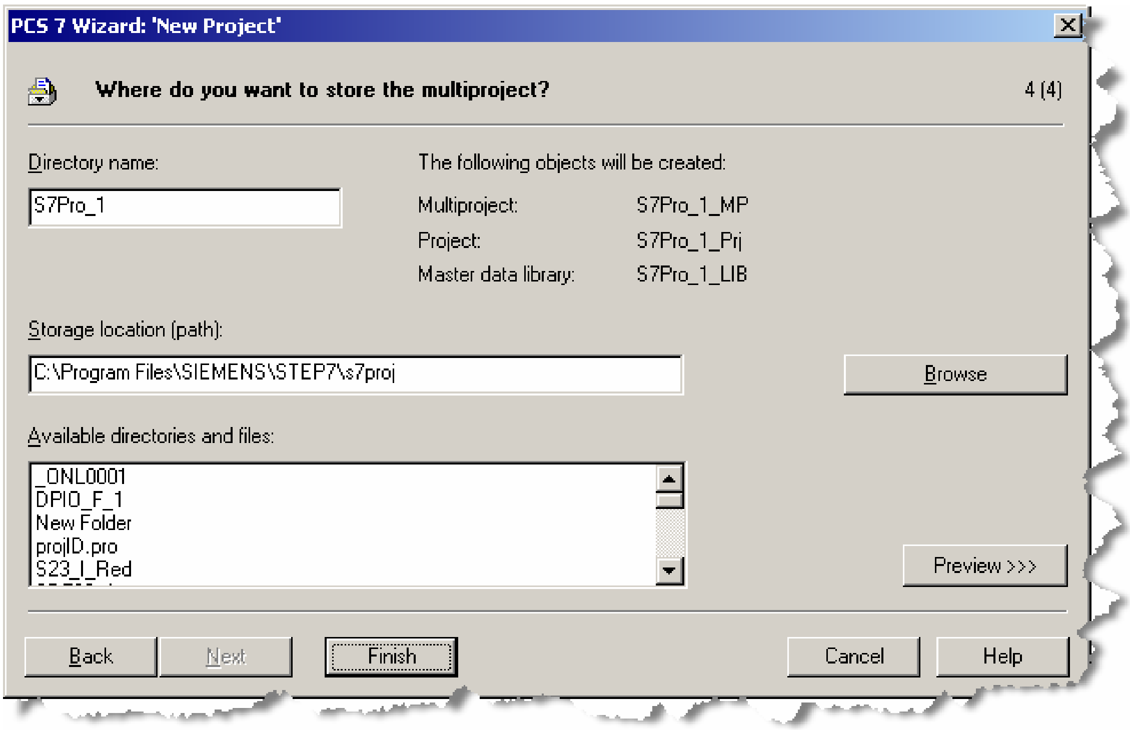
The illustration below shows how to decode the entries in the description.

6ES7654-2PG67-0XC0	Bundle MFLB
AS417-4-2H;	CPU
AC 120/230V 10A red.;	Power supply
Rack UR2-H;	Mounting rack
16 MB Memory Card RAM;	CPU Memory card
10 m Sync module;	CPU synchronization module
1m FO-Sync cable;	Synchronization cable
CP 443-1 EX11	Communication processor

8. Click the **Next** button.
   PCS 7 Wizard page 3 of 4 opens.
9. Select the following (click the **Help** button for information about the implications of these selection):
   Plant hierarchy levels
   AS objects
   OS objects
   Single/multiple/redundancy

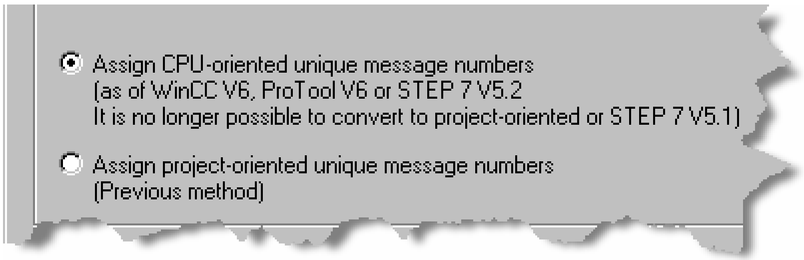


10. Click the **Next** button.
    PCS 7 Wizard page 4 of 4 opens:

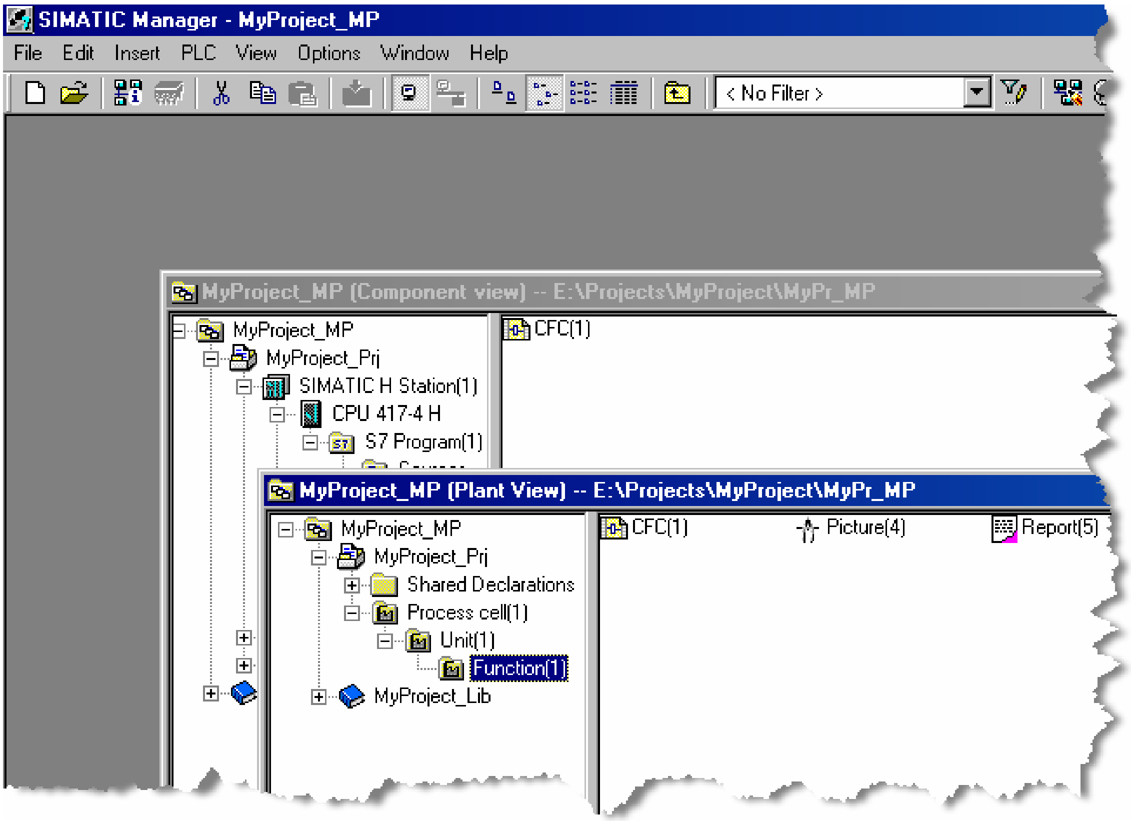


11. Fill in the **Directory name** and **Storage location (path)** edit boxes using the information just entered in the Simatic Manager program.
12. Click the **Finish** button.
    The ***project_Prj*** **- Message Number Assignment Selection** window opens.

13. Select the checkbox labeled **Assign CPU-oriented unique messages numbers…** and click the **OK** button



Messages appear, indicating that project-creation is underway. Eventually the project's component and plant views appear:



3.5 Configuring the AS Station (CPU and CP 443-1)

3.5.1 Opening HW Config

Note

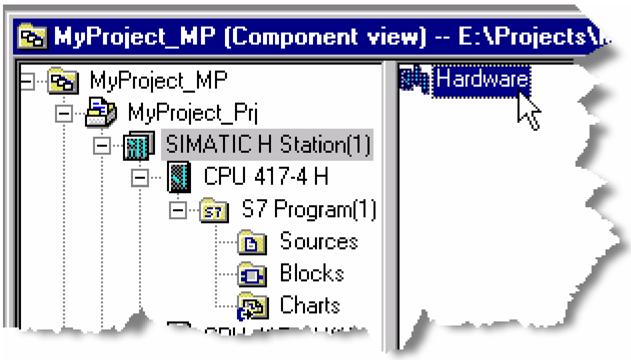
Changes made through the HW Config program must be explicitly saved by clicking the **Save** button.

To abandon ill-considered modifications, it is possible simply to close the program before saving.

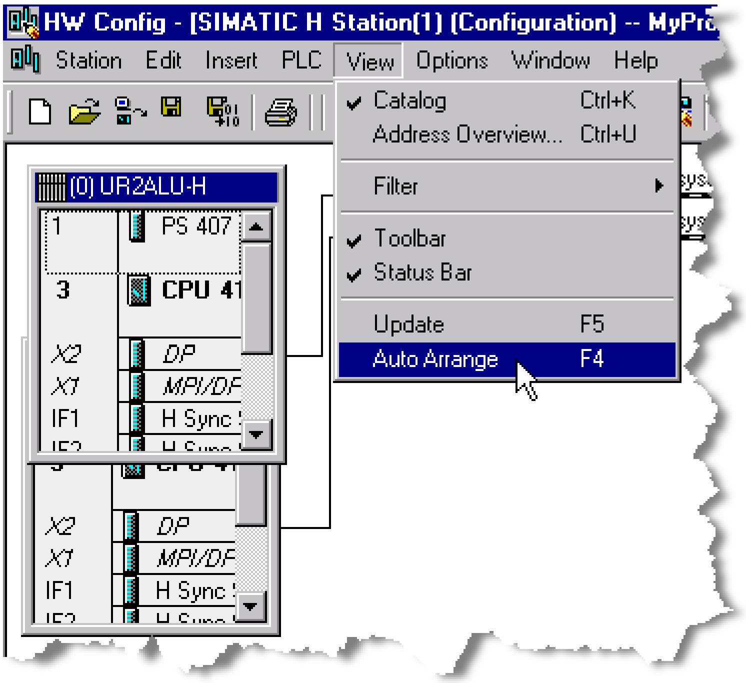
If you open HW Config and at any time click an **OK** button while HW Config remains open, the configuration may be left in an indeterminate state and may have unpredictable effects on other program. This is true even if you make a change and then later restore an original value.

To ensure predicable results, save or close without saving.

1. In SIMATIC Manager, select **View > Component View.** Select **SIMATIC H Station (1)**.

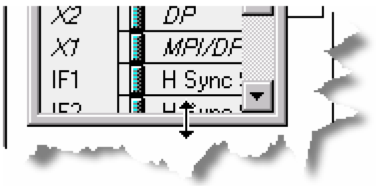


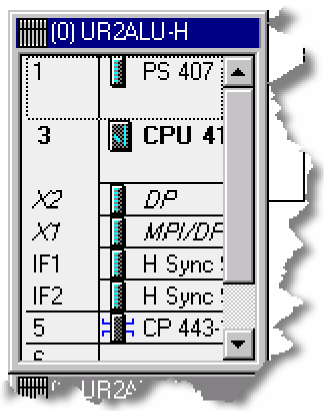
2. In the right plane double-click the **Hardware** icon:
   The HW Config program opens for the project.
3. In the HW Config program, select **View > Auto Arrange**.



4. A message asks you to confirm your instruction to re-arrange the view. Click the **Yes** button.
   Objects in the HW Config window are positioned so they can be easily viewed.

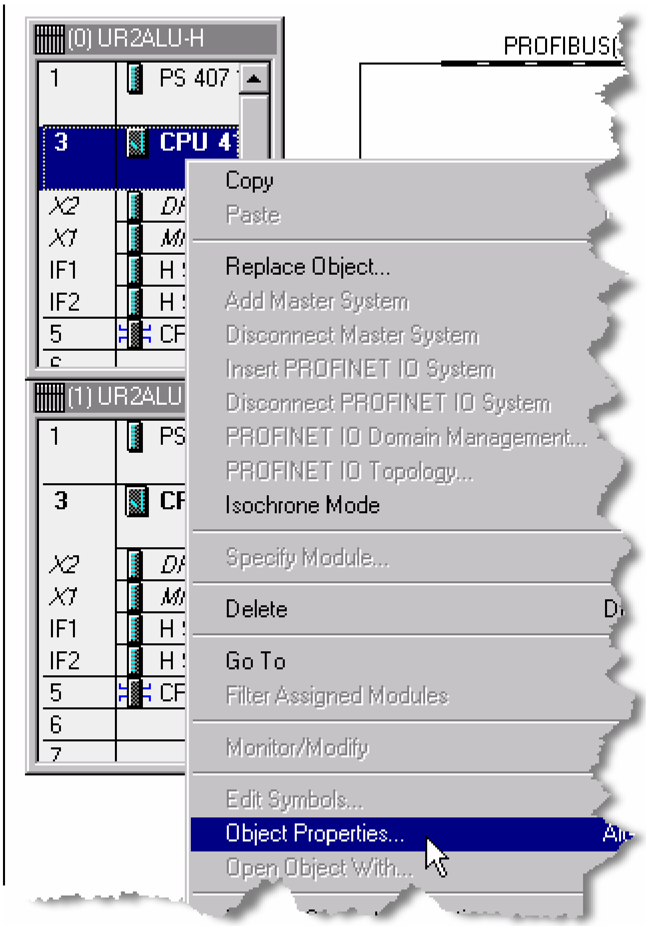
5. Extend the height of the objects containing the hardware listings so that all components are visible. Click and hold the bottom border of the object and pull it down to extend it. Do this for both sets of redundant hardware:





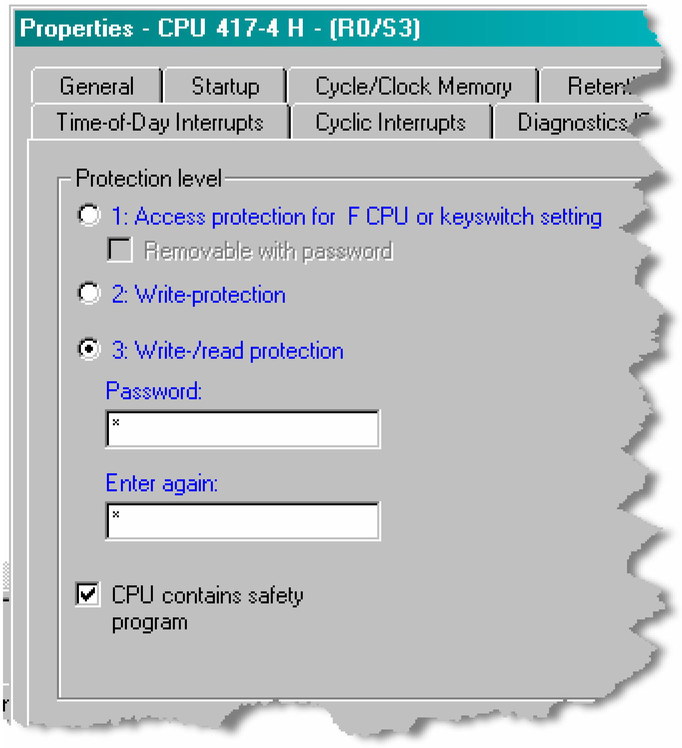
3.5.2 Setting the CPU Properties

1. Right-click the CPU entry in the and select **Object Properties…** from the context menu.



The **General** tab opens, providing a description of the CPU.

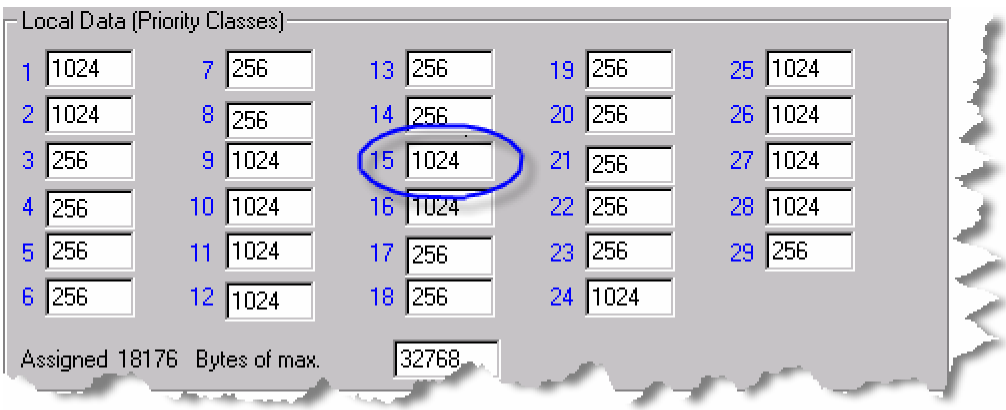
2. Select the **Protection** tab.
   The available properties are displayed.



3. Select the **Write-/read** protection checkbox.
4. In the **Password** field, enter a suitable password.
   Re-enter the password in the **Enter again** field.
   Select the checkbox labeled **CPU contains safety program**.

The next step adjusts the local data for priority 15 is because organizational block 38 (OB38) is where the DPIO_DRV function block is placed. The DPIO_DRV function block requires more stack space every time the function block executes. Failure to make this adjustment results in an error during download to the CPU.

5. Click the **Memory** tab. Change the **Local Data (Priority Classes)** to conform to the following:



Click the **OK** button.

Failing to set the priority classes to an appropriate size could result in the following warning during compilation of the CFC pages:

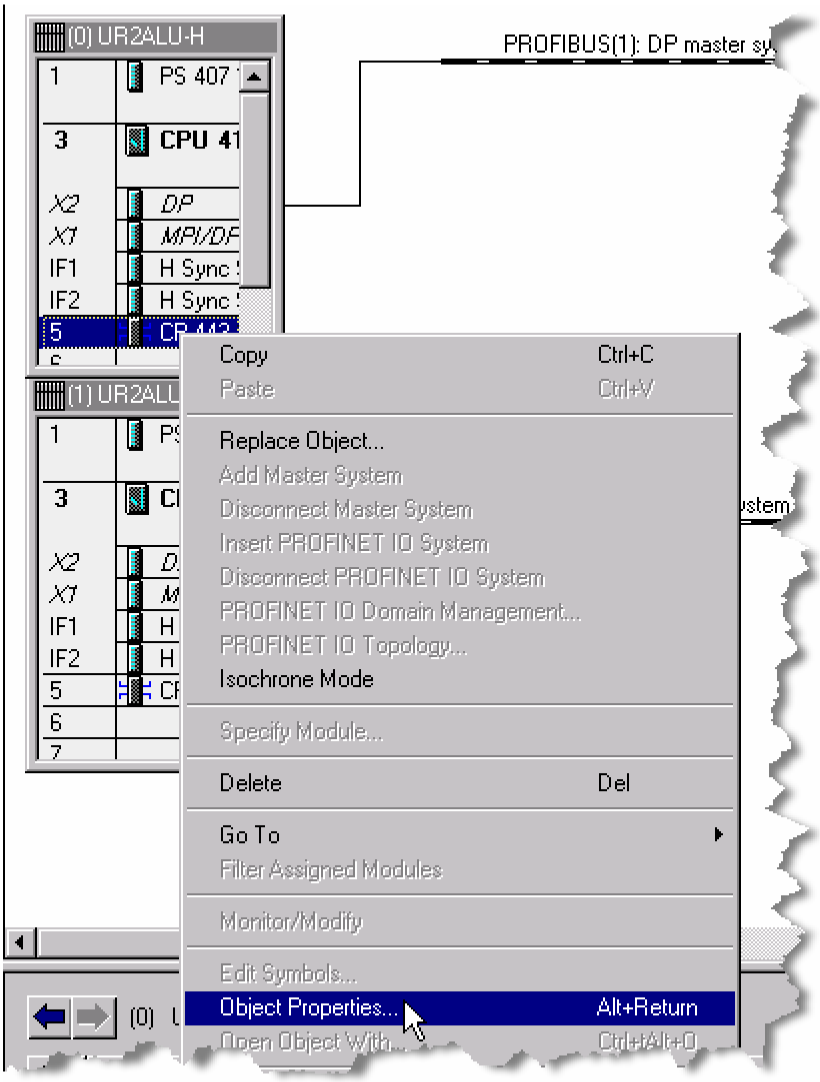
```
W: Local data requirements for the priority class 15:

   The local data requirements (668 bytes, including OB121
   and OB122) of organization block OB38 exceed the
   configured local data stack of the corresponding priority
   class on the connected offline CPU.
```

See troubleshooting information in the topic titled [Warning: Local data requirements for the priority class XX:].

6. If the CPU needs to be configured for time synchronization, see the topic "Configuring the CPU for Time Synchronization" in the section [Engineering Station or Single-Station Time Stamping Configuration].

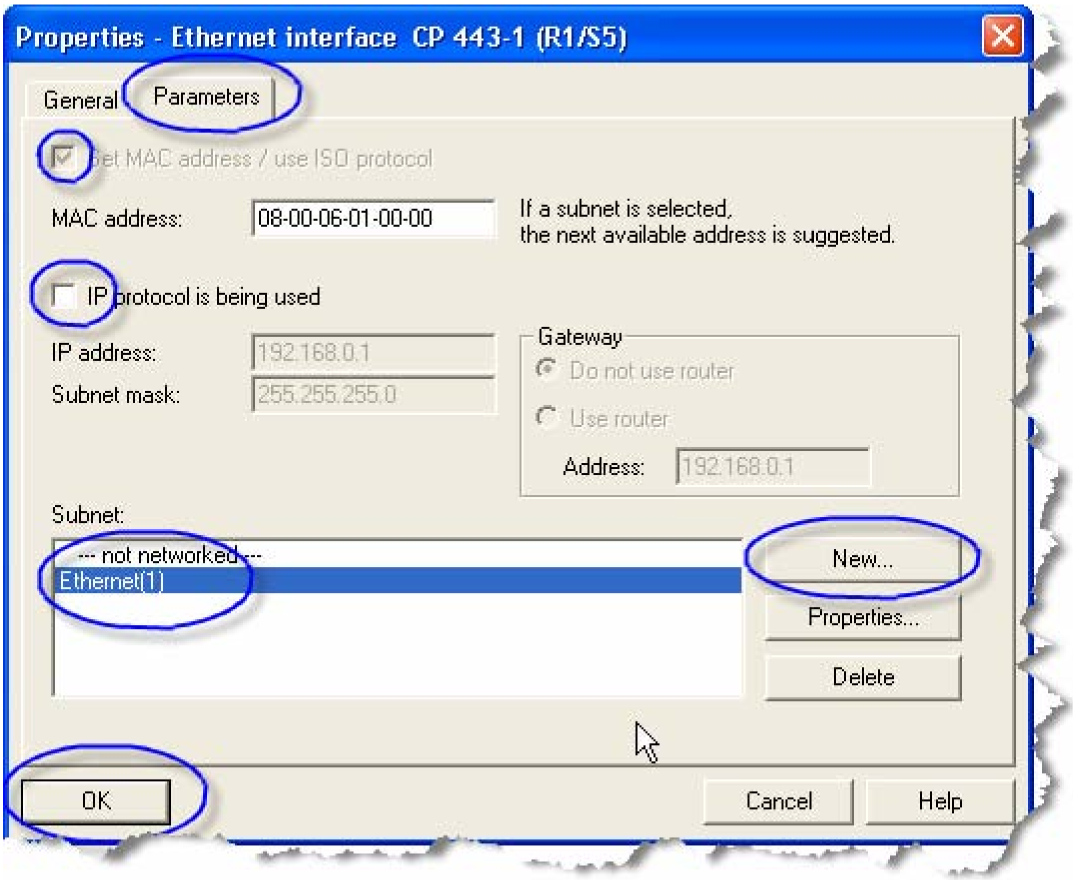
3.5.3 Setting the Communications Processor Parameters

1. In HW Config right-click the communication processor of the uppermost redundant partner, one whose label begins with (0). Select **Object Properties…** from the context menu:



The properties window opens to its **General** tab.

2. Click the **Properties…** button.
   A window labeled **Properties - Ethernet interface CP 443-1** opens. The instructions that follow require attention to the circled areas on the following illustration:



3. Ensure that the **Parameters** page is active. Select the check box labeled **Set MAC address / use ISO protocol**.
   The **MAC address** edit box becomes active and contains the default MAC address.
4. Replace the existing MAC address with the one provided by your network administrator or with the one found on the communications processor.
5. Clear the check box labeled **IP protocol is being used** and click the **New…** button.
   A window opens labeled **Properties - New subnet Industrial Ethernet** with **Ethernet(1)** inserted in the **Name** field.
6. Ensure that the Industrial Ethernet **Ethernet(1)** is named. Click the **OK** button.
   - The window labeled **Properties - Ethernet interface CP 443-1** is in focus again. In the **Subnet** field,
   - **Ethernet(1)** is present, reflecting the action completed in the previous step.
7. Ensure that **Ethernet (1)** is selected by clicking it.
8. Click the **OK** button.
   The **Properties - Ethernet interface CP 443-1** window closes.

The next two steps apply to redundant systems.

9. In HW Config right-click the communication processor of the lower redundant partner (rack 1), labeled in the illustration below as **(1)*xxxxxxx-x***. Select **Object Properties…** from the context menu.
10. Repeat step 2 through 9, ensuring that the MAC addressed for the redundant partners differ.
11. Follow the instructions in the section titled Configuring the Time Stamping Functions for the CP 443-1 interface for the communications processor in the rack 0, the uppermost in the component view of HW Config. Repeat for a redundant partner.

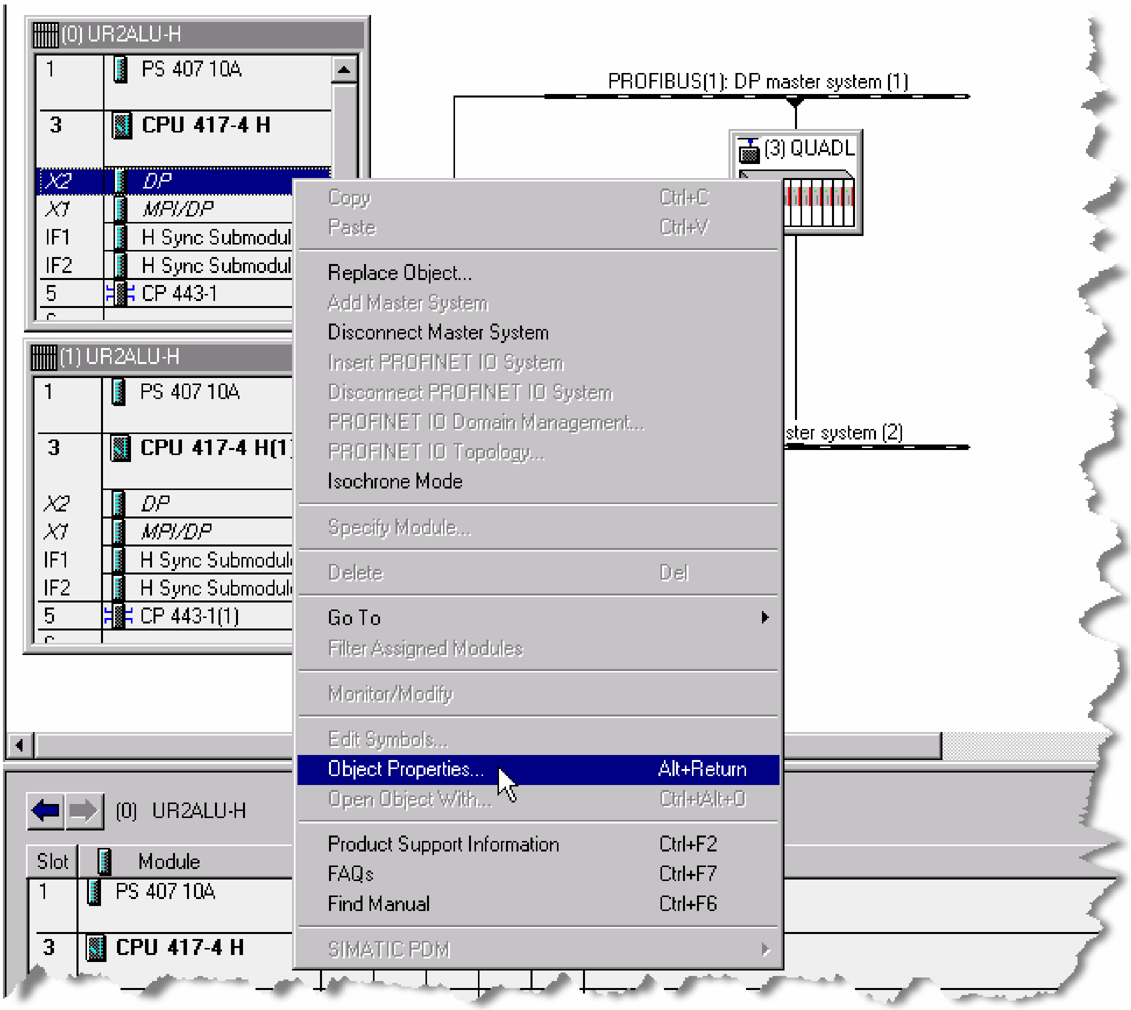
3.5.4 Configuring the Process Image Partition (PIP)

The DP/IO Bus Link module V1.0 does not support process image partitions.

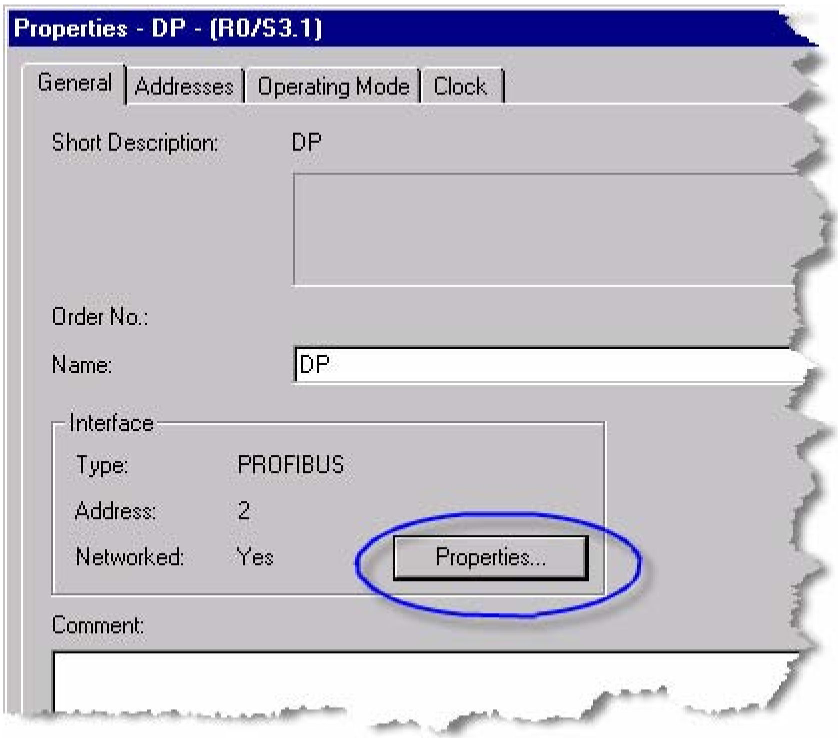
3.5.5 Setting the PROFIBUS Data Communications Rate and Configuring TimeSynch

In redundant systems, complete the following procedure for both partners of a redundant pair

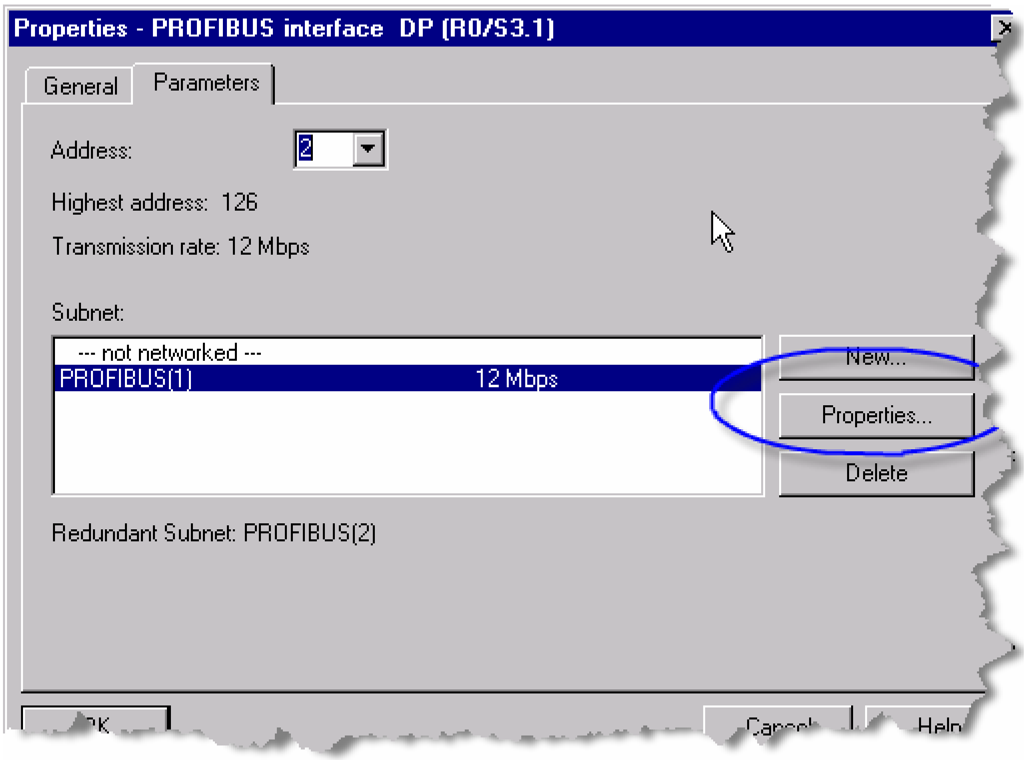
1. In HW Config, right-click the DP component.
   A context menu appears.
2. Select **Object Properties**.



The **Properties - DP window** opens to the **General** tab:



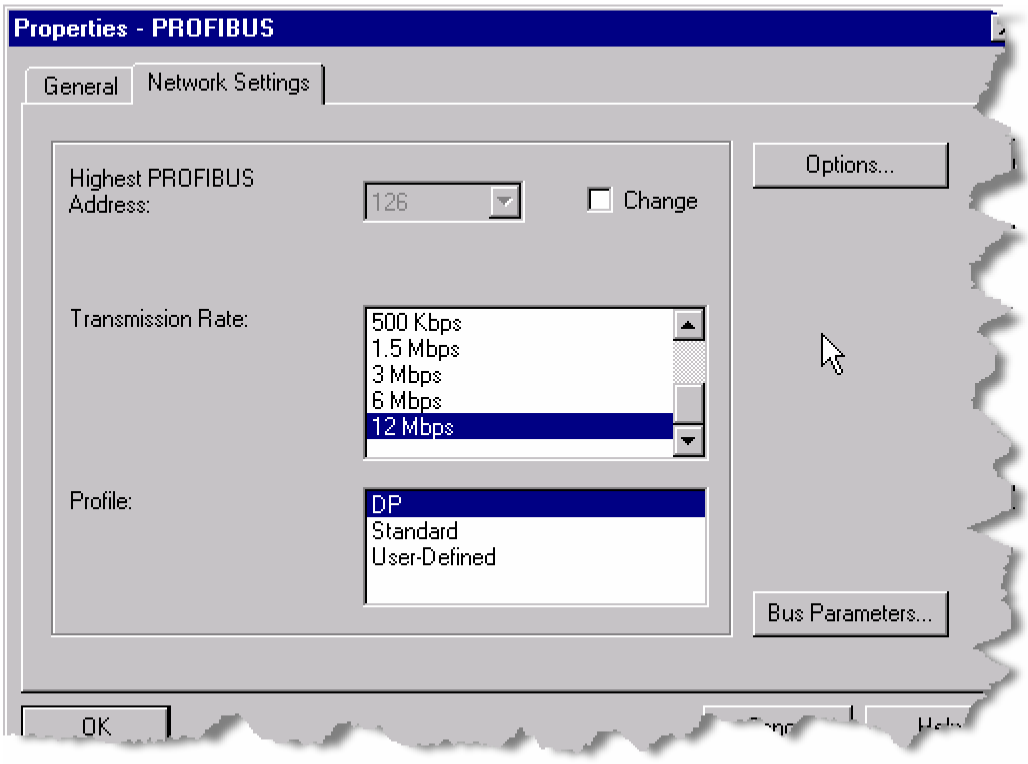
3. Click the **Properties** button.
   The **Properties - PROFIBUS interface DP** window opens:



4. Click the **Parameters** tab and the **Properties** button.
5. Click the **Network Settings** tab.
6. From the list box, select **12 Mbps**:

Note

12 Mbps is the only supported PROFIBUS speed for the CPU connected to the DP/IO Bus Link module.



7. To configure time synchronization, follow the instructions in the topic "Configuring the DP Master for Time Synchronization" in the section titled Engineering Station or Single-Station Time Stamping Configuration. Otherwise, click the **OK** button.

Repeat this procedure for each partner in a redundant pair.

At this point in system configuration, it is easy to set the PROFIBUS Highest Scanned Address (HSA) for each PROFIBUS network in the system, using the procedure detailed in the following section, titled Setting the PROFIBUS Highest Scanned Address (HSA).

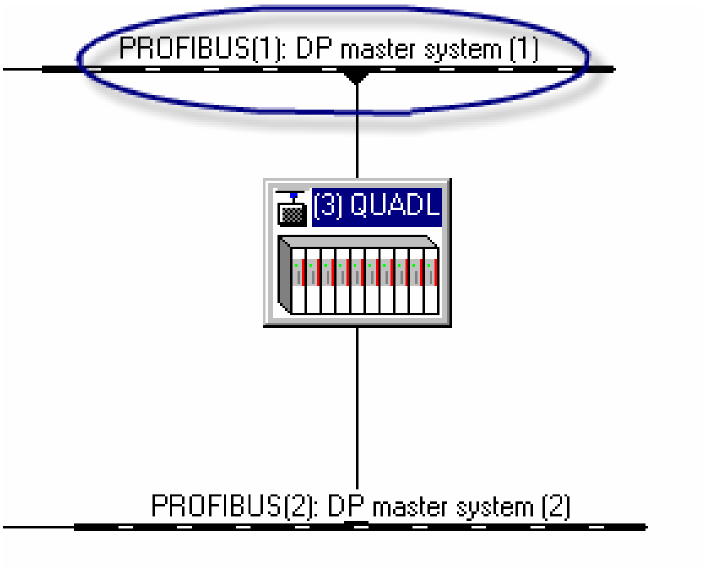
3.5.6 Setting the PROFIBUS Highest Scanned Address (HSA)

Siemens recommends that you adjust the HSA for each PROFIBUS network to ensure efficient use of system resources. The HSA can be set at any time and takes effect the next time a configuration is compiled and downloaded.

Between the cyclic scans used to distribute data to its slaves, the DP master performs bus maintenance, which includes polling the bus to determine if any new devices have been added. This polling can take significant time if the starting point (the lowest slave address known to be available) is low and the ending point, (the HSA) is high. To reduce this time, you can adjust the HAS to reduce the span of addresses to be automatically checked by the Master, particularly if it is unlikely that you will be adding devices after the initial configuration.

For example, if a network is configured with a master at address 2 and a slave at address 3, which is typical for a DP/IO Bus Link network, you can improve performance by setting the HSA to 3 , thereby preventing the master from performing periodic checks and waits for the other 123 addresses (the default for HSA is 126)

1. In HW Config, right-click on a DP network line:

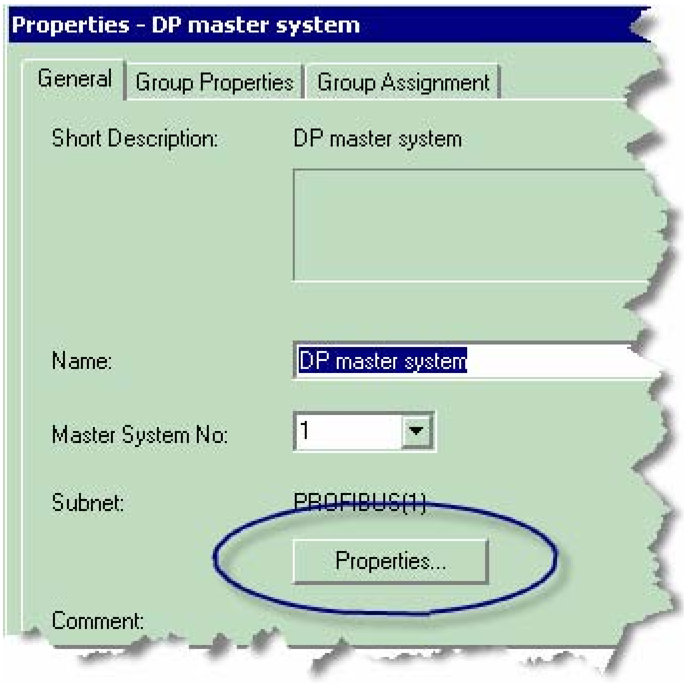


A context menu appears.

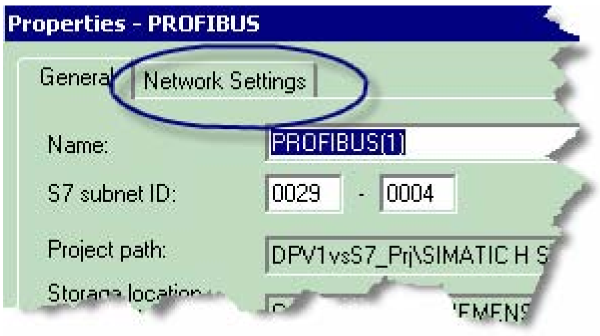
2. Select **Object Properties**:

A **Properties - DP master system** window appears.

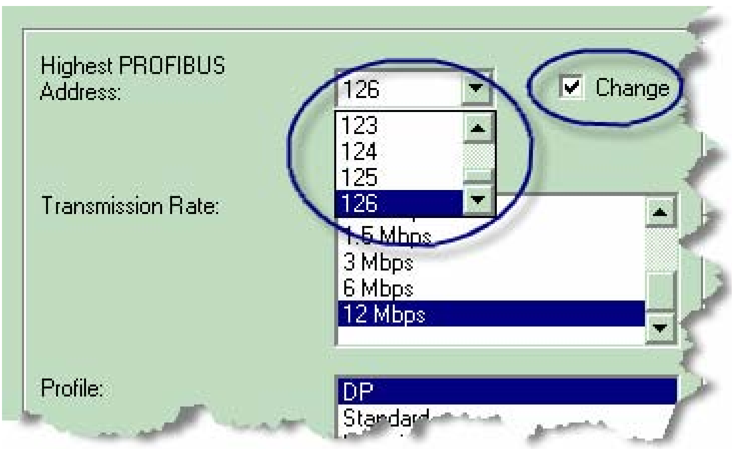
3. Click the **Properties** button



The **Properties - PROFIBUS** window opens:



4. Click the tab labeled **Network Settings**.
   A window with settings labeled **Highest PROFIBUS Address:** opens:



5. Select the **Change** checkbox.
   PROFIBUS addresses become available in a drop-down list box.

6. Select an appropriate HSA address, typically 3 on buses that include DP/IO Bus Link modules.

Repeat for the redundant partner.

Repeat for each communications processor in instances where the system includes one or more CP443-5 PROFBUS communication processor board.

You can leave the HW Config program open.

3.6 Configuring the PC Station

3.6.1 Changing the Name of the PC Station within SIMATIC Manager

Prerequisite Information

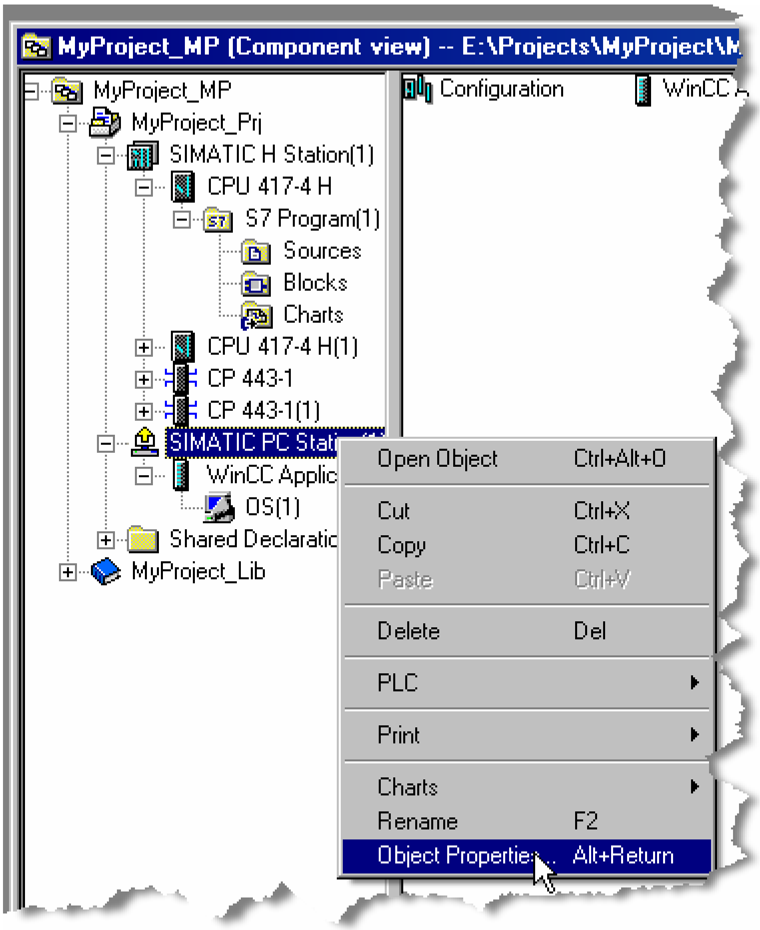
The computer name of the SIMATIC PC Station:

1. Open the PC desktop.
2. Right-click the icon representing your PC.

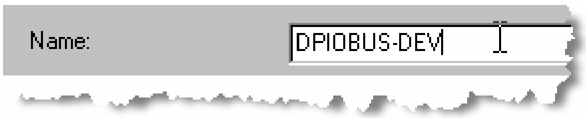
3. Select the **Properties** from the context menu.
4. Select the **Computer Name** tab.
   If the full computer name is not correct, click the **Change** button. To register the full name, click the **OK** button in the current window and the one that replaces it.
5. Make a note of the entry in **computer name** field.

Procedure

1. In the In the **SIMATIC Manager Component view**, right-click the **SIMATIC PC Station (1)** and select **Object Properties** from the context menu:



2. In the **Properties - SIMATIC PC Station General** tab, edit the **Name** field as necessary to match your computer name.



3. Select the checkbox labeled **Computer name identical to PC station name.** The computer name field reflects this choice:

Click the **OK** button.

3.6.2 Adding the PC's Ethernet Interface with HW Config

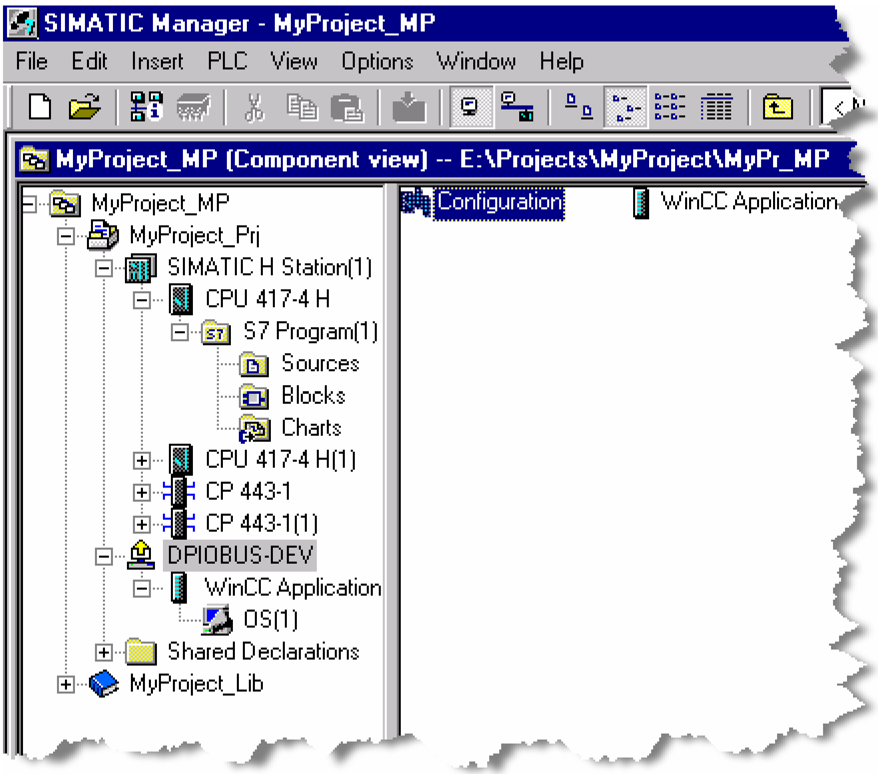
Prerequisite Information

If your Industrial Ethernet interface is a Siemens CP-1613 Industrial Ethernet interface, you may use the MAC address provided by your network administrator. If you are using an IE General interface, you must use the MAC address hard-coded in the card. You can determine this as follows:

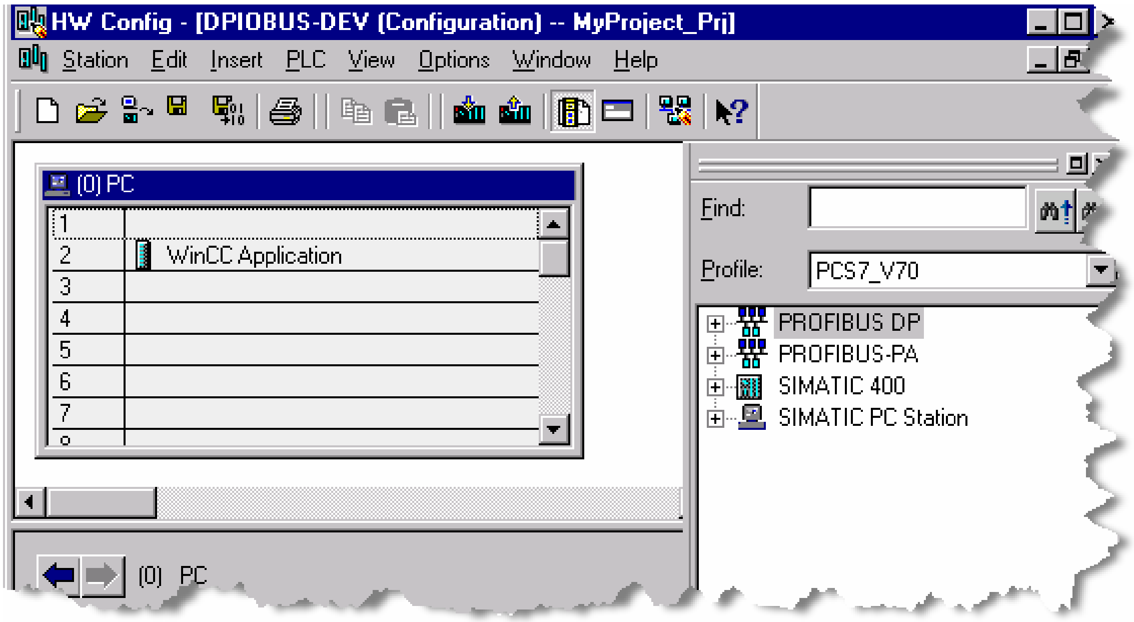
1. Click the **Start** button and select **RUN**.
2. Enter **CMD** and click the **OK** button.
   A DOS window opens.
3. Enter the command **IPCONFIG /ALL** and press the **Enter** key.
   The command executes and display information including the MAC address of the interface. Record this address and use it in the **Properties - Ethernet Interface** window:

Procedure

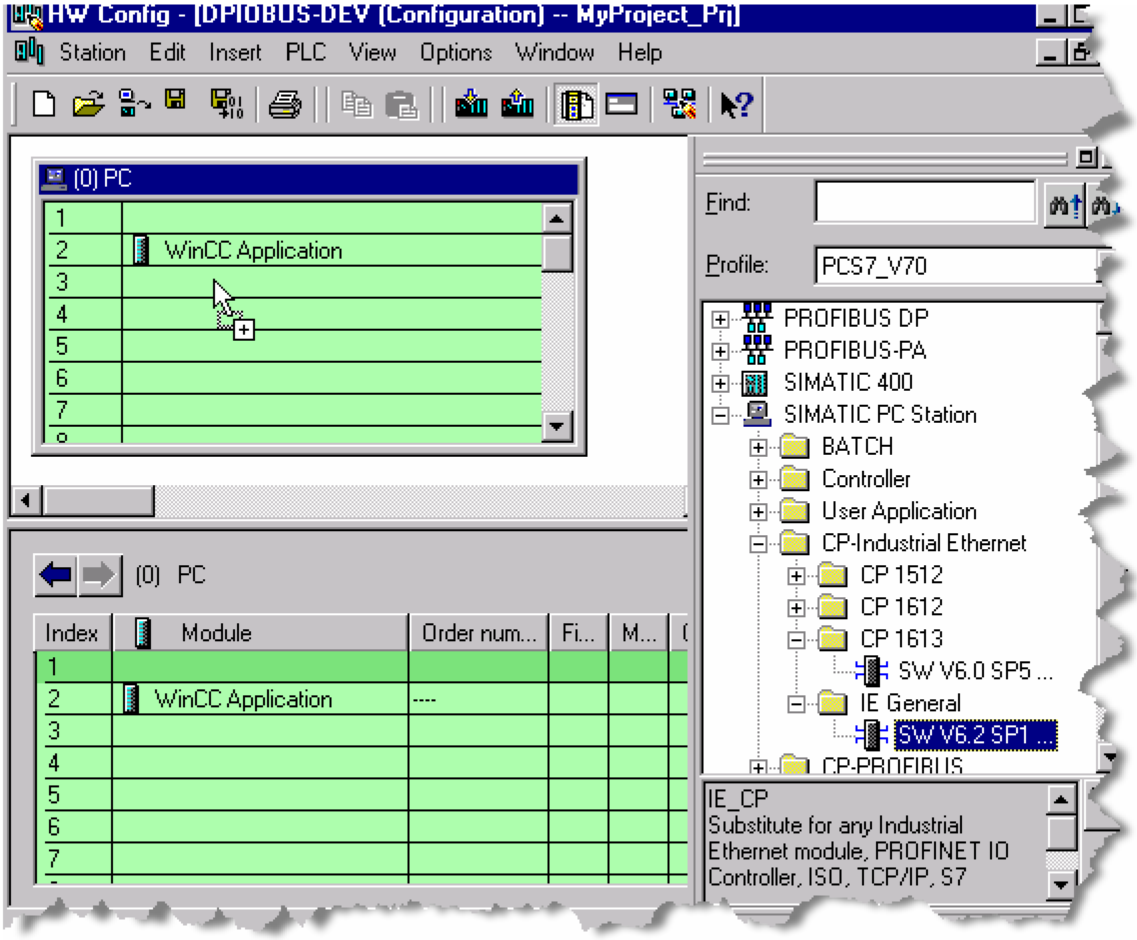
1. From **SIMATIC Manager Component view**, select the PC Station in the left pane and double-click the **Configuration** icon in the right pane.



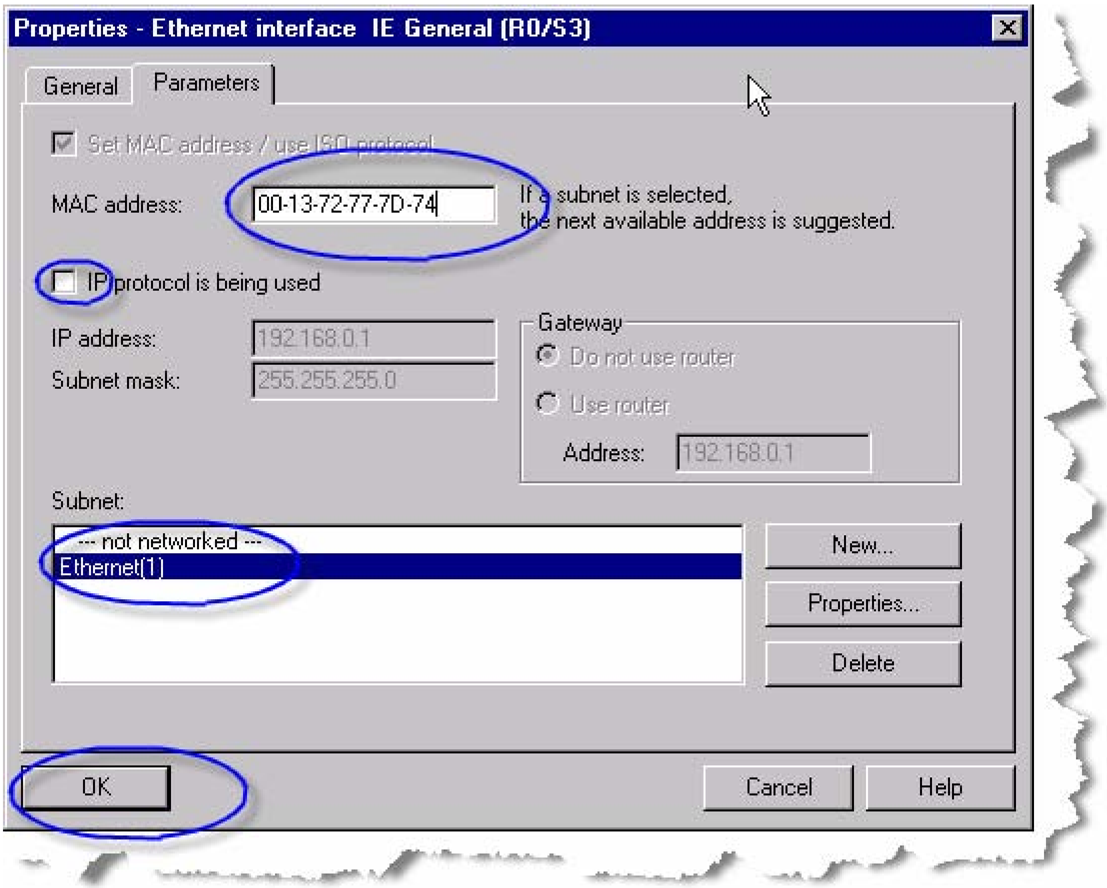
HW Config opens for the PC station:



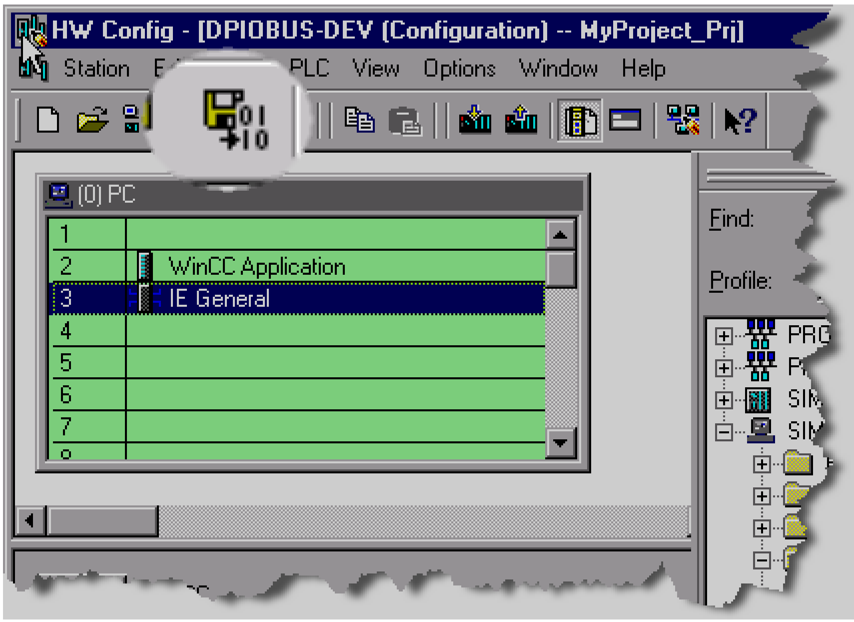
2. In the drop-down list box labeled **Profile:** select **PCS_V70** and expand the **SIMATIC PC Station** as shown in the following illustration.



3. Drag the installed Industrial Ethernet interface to the SIMATIC PC Station as shown above, where the destination slot is typically slot 3.
   A message appears, asking whether you intend to edit the configuration.
4. Click the **OK** button.
   The **Properties - Ethernet interface** window opens. The title varies according to the interface installed.
5. In this window you set the MAC address of the interface, turn off IP protocol and select its subnet, Ethernet(1) in this example. Ethernet (1) was created for the CP443-1 module in the HW Config for the AS.
   If your Industrial Ethernet interface is a Siemens CP-1613 Industrial Ethernet interface, you may use the MAC address provided by your network administrator. If you are using an IE General interface, you must use the MAC address hard-coded for the card. Instructions for finding this address are included above in the discussion titled **Prerequisite Information.**



6. Click the **OK** button.
   The **HW Config** window returns.
7. Save and compile your changes by clicking the **Save and Compile** icon:



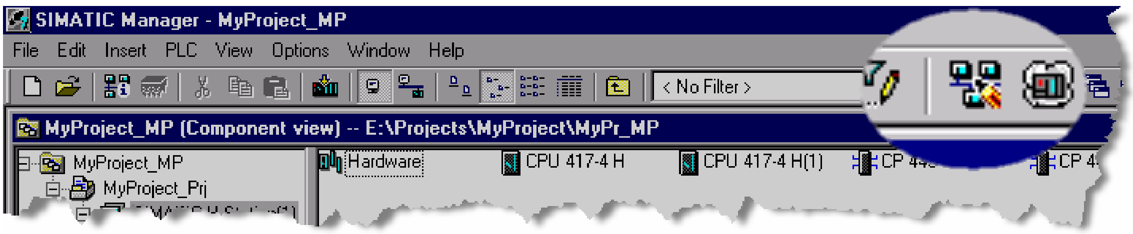
3.6.3 Configuring Connections between the OS and CPUs

Prerequisite information

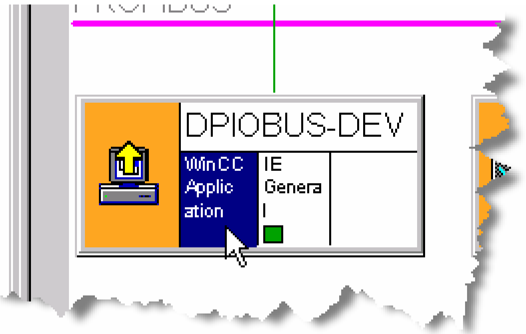
You must know whether your ES PC has a CP 1613 Industrial Ethernet interface or an IE General (a generic Industrial Ethernet interface).

Procedure

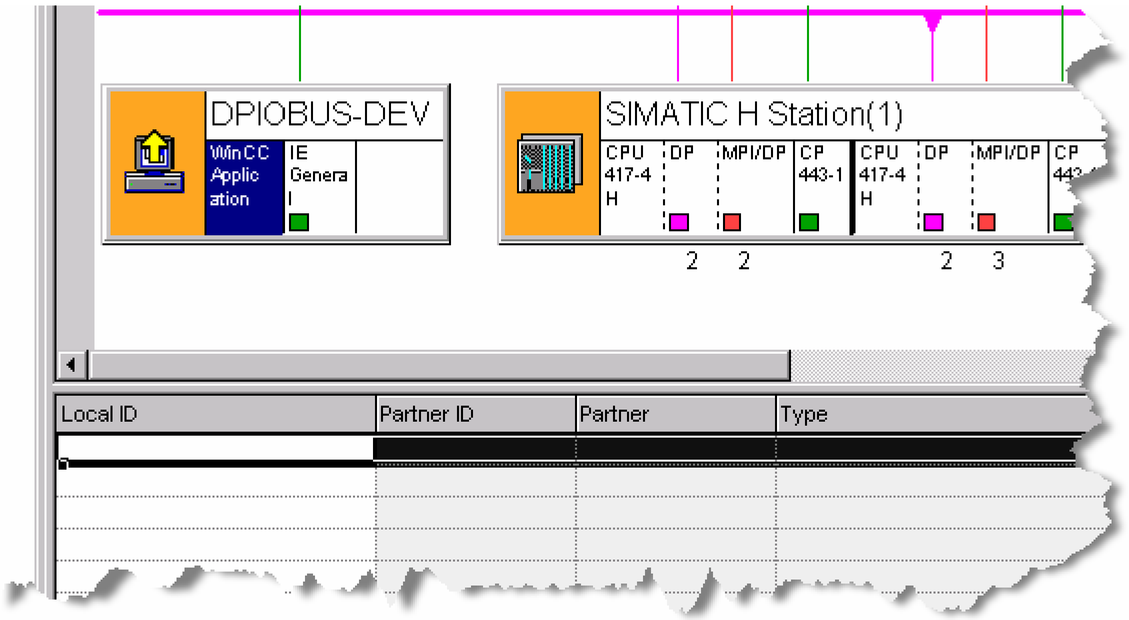
1. From within SIMATIC Manager open NetPro by pressing the Configure Network button in the toolbar.



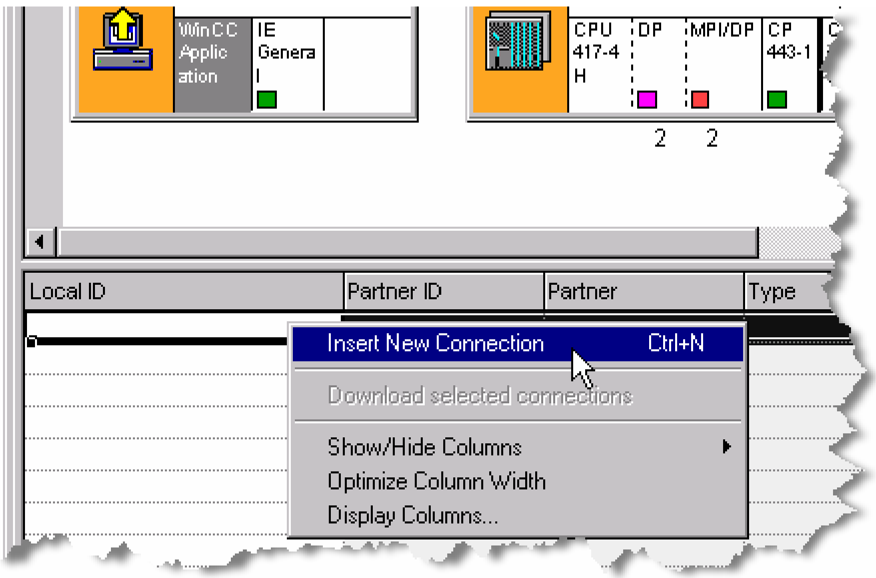
NetPro opens. The PC Station is visible, labeled with the name previously applied. (An orange background indicates that a change has been made and it is necessary to compile.)



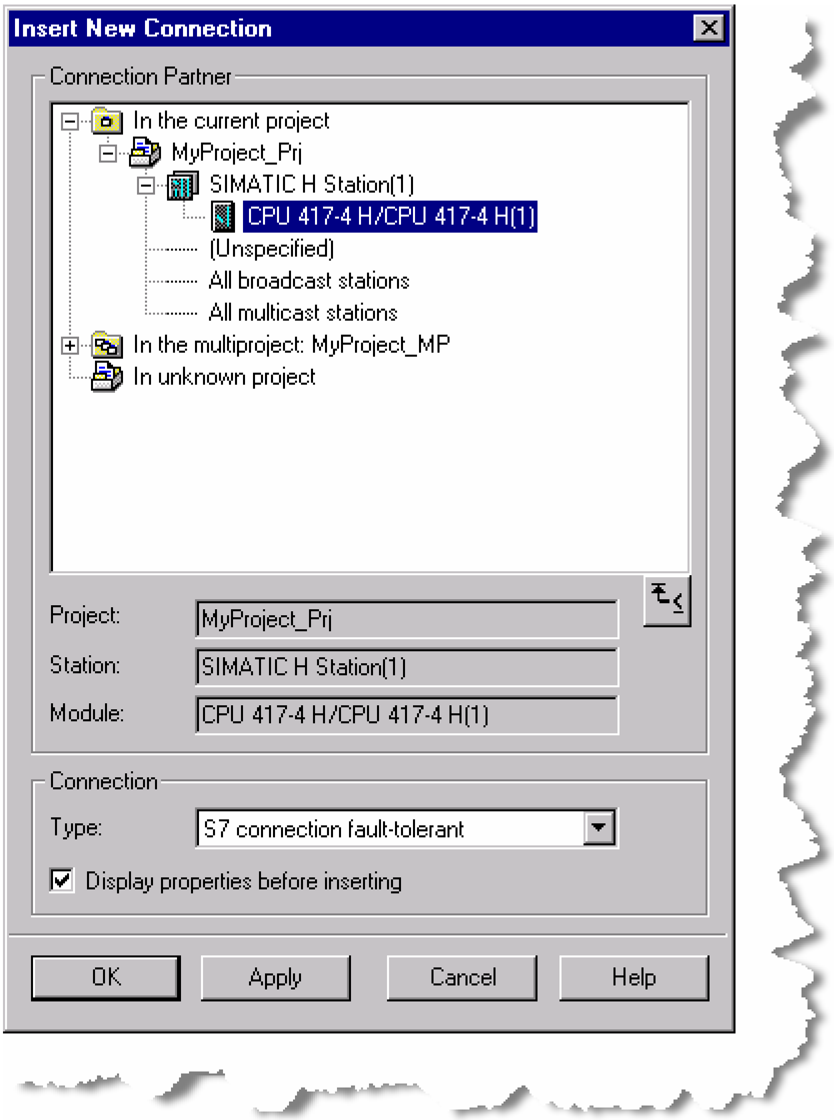
2. Select **WinCC Application**.
   A table of connections (initially empty) opens



3. Right click the first entry in this table and from the context menu select **Insert New Connection.**

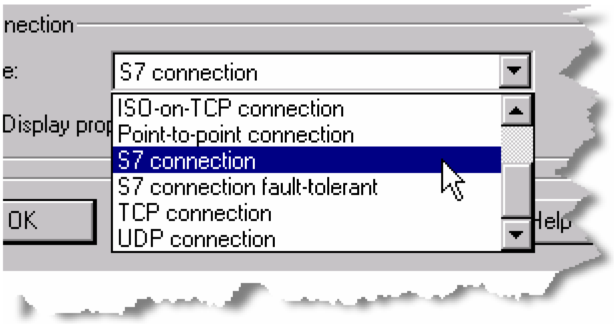


An **Insert New Connection** window opens

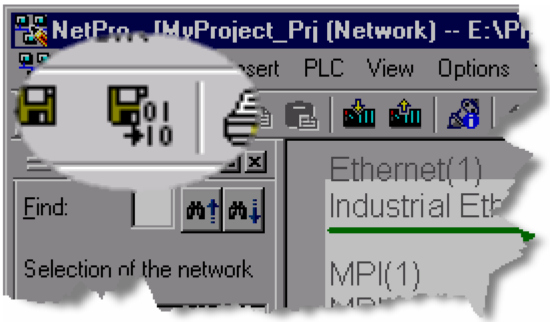


4. If your system includes a CP 1613 Industrial Ethernet interface, from the drop-down **Type** list, select **S7 connection fault-tolerant**.

If your system includes an IE General interface, from the drop-down **Type** list, select **S7 connection**

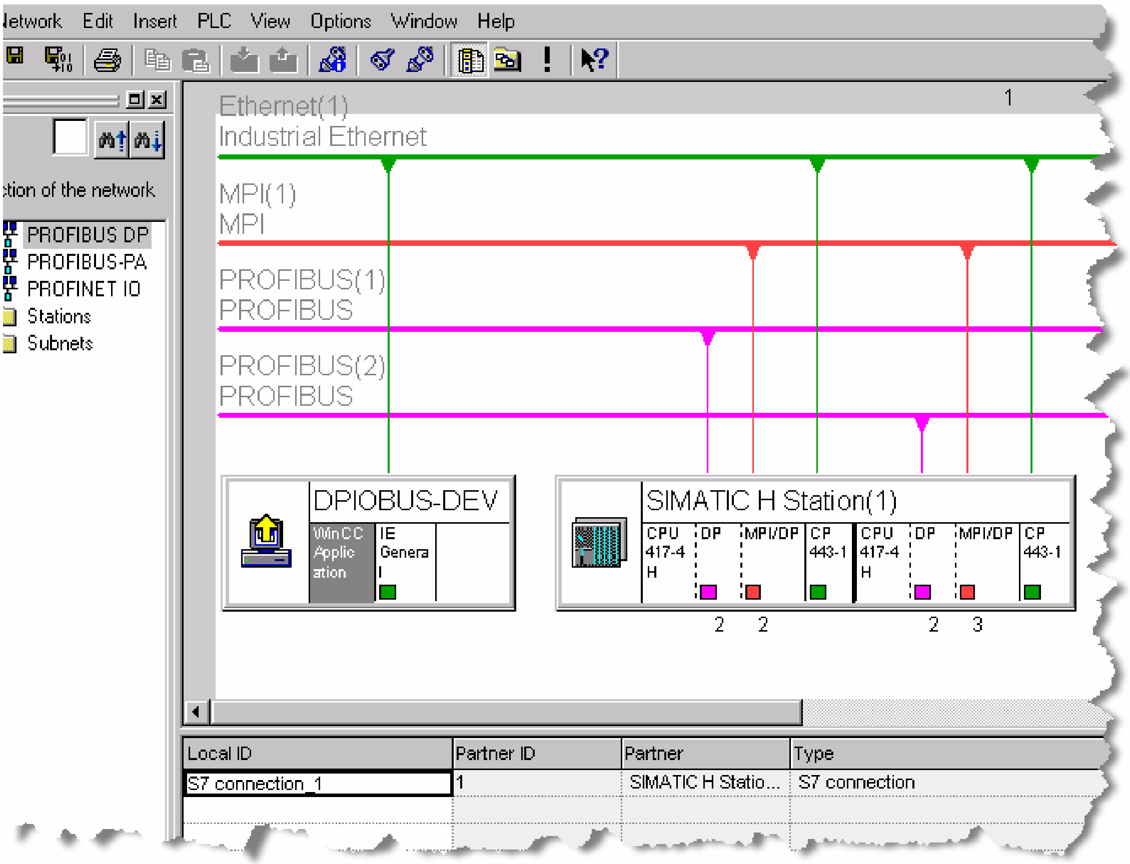


5. Press the **OK** button.
   The **Properties - S7 Connection** appears.
6. Press the **OK** button.
   An updated table of connections appears.
7. Click NetPro's save-and-compile button:



   The **Save and Compile** window opens:

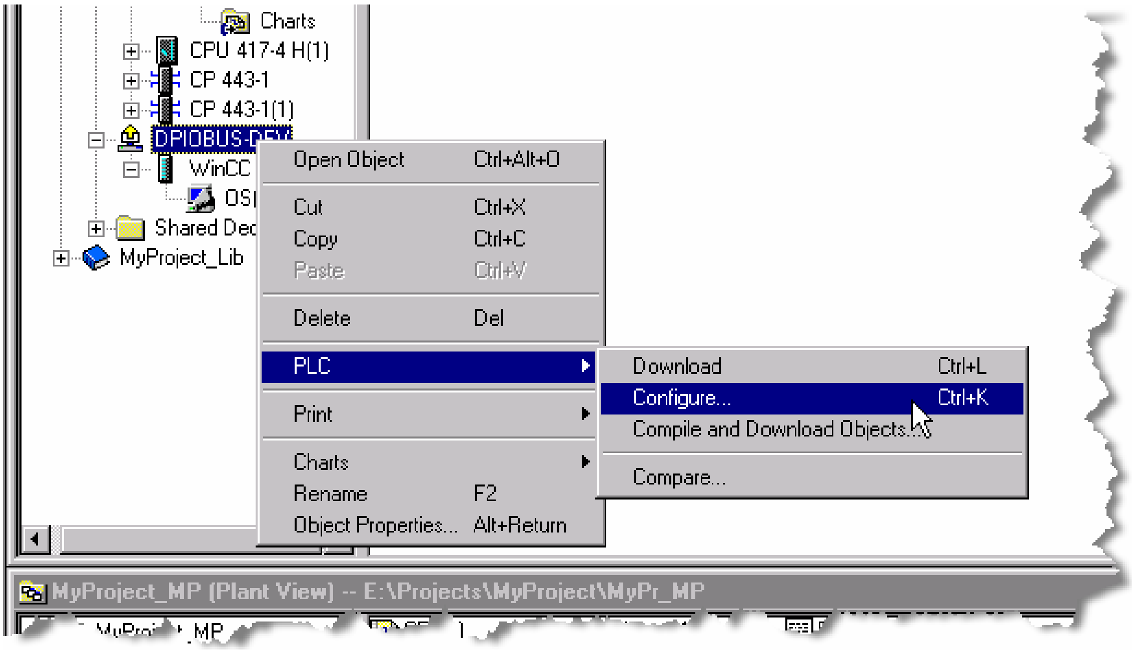
8. Ensure that **Compile changes only** is selected, and Press the **OK** button
   Orange highlights change to white, indicating that connections have been updated properly.



9. Close NetPro.

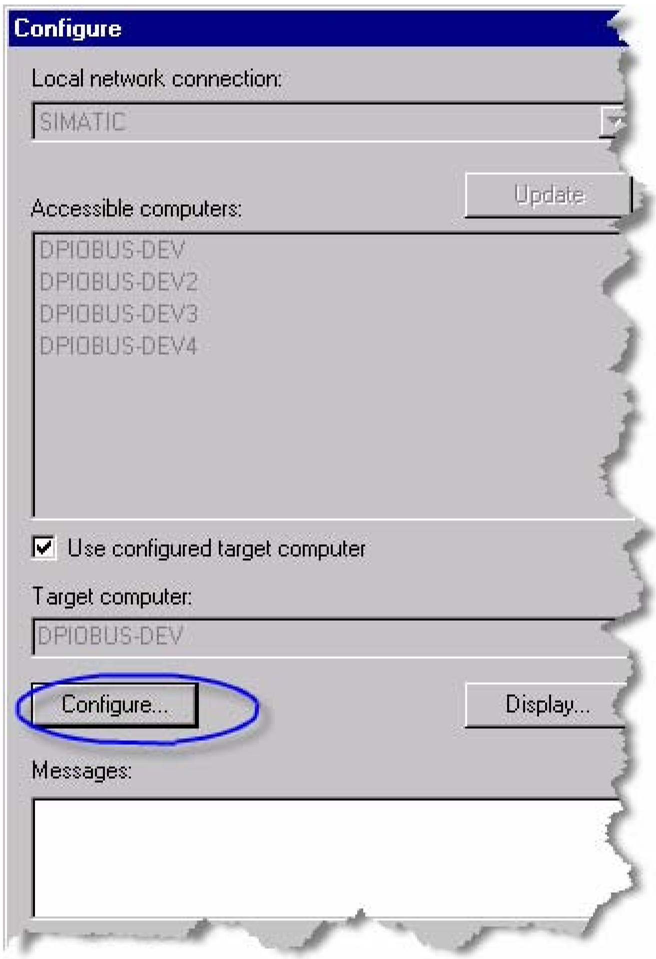
3.6.4 Compiling NetPro and Downloading the PC Station

1. From SIMATIC Manager, right-click the PC Station and from the context menu select **PLC > Configure....**

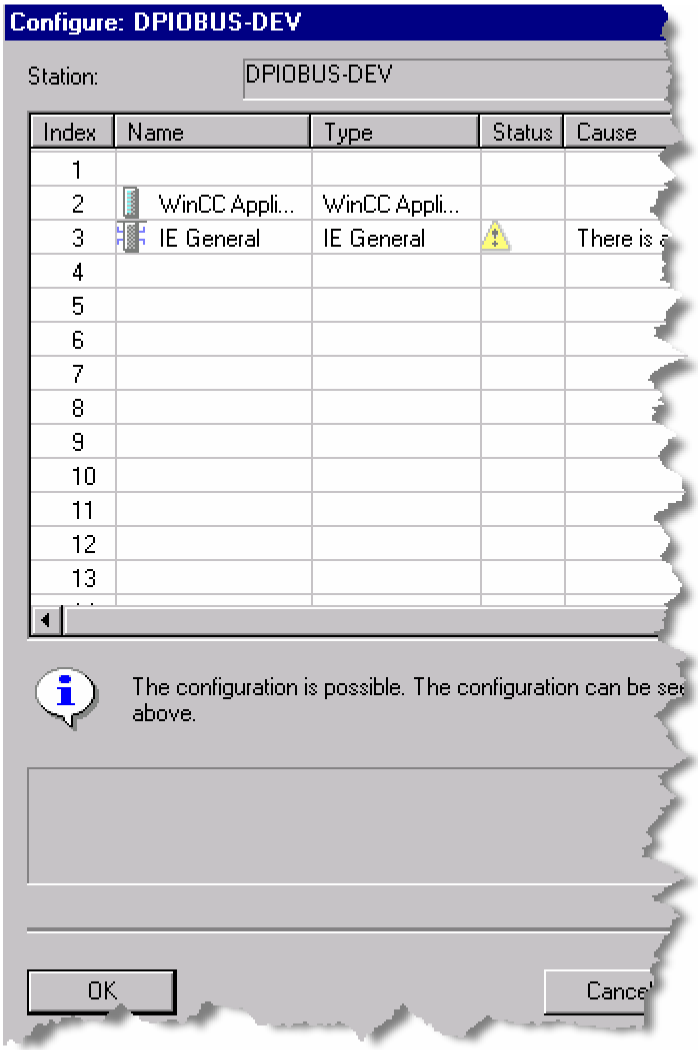


The **Configure** window opens.

2. Click the **Configure** button.

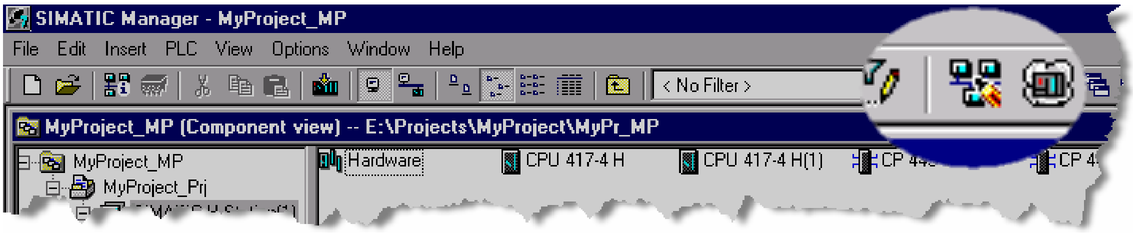


A window labeled **Configure: *pcname*** opens, displaying the current status:

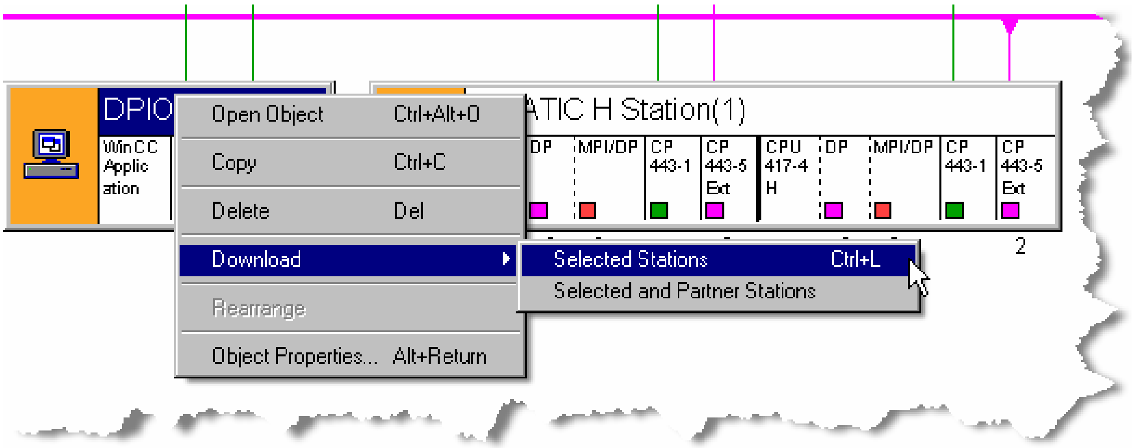


3. Click the **OK** button.
   A **Information** window opens, explaining that the PC Station will be reconfigured if you continue.
4. Click the **OK** button, acknowledging that continuing will reconfigure the PC station.

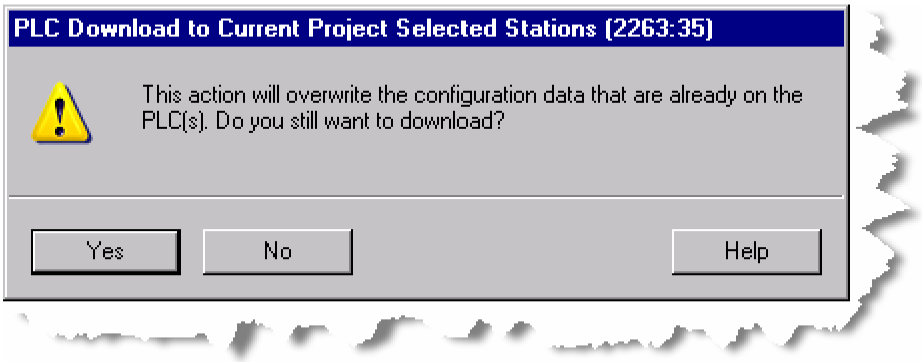
5. Click the **Close** button in the **Configure** window.
6. From within SIMATIC Manager open NetPro by pressing the **Configure Network** button in the toolbar.



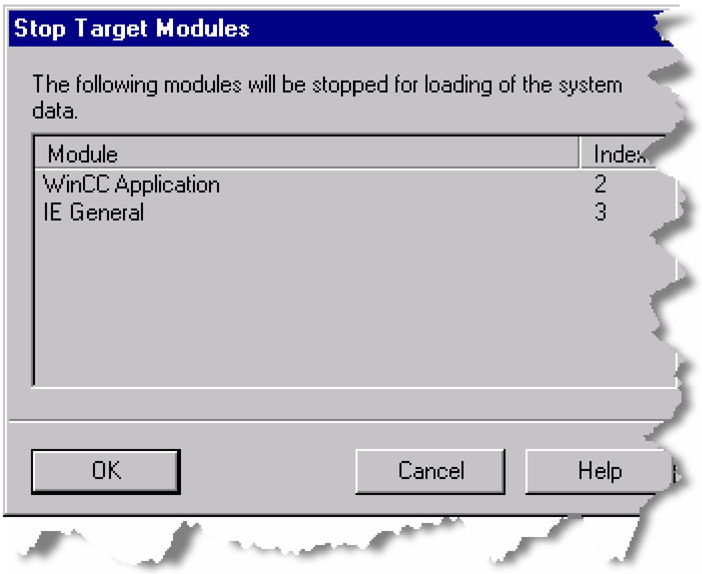
7. Right click the PC station and from the context menu, select **Download > Selected Stations**:



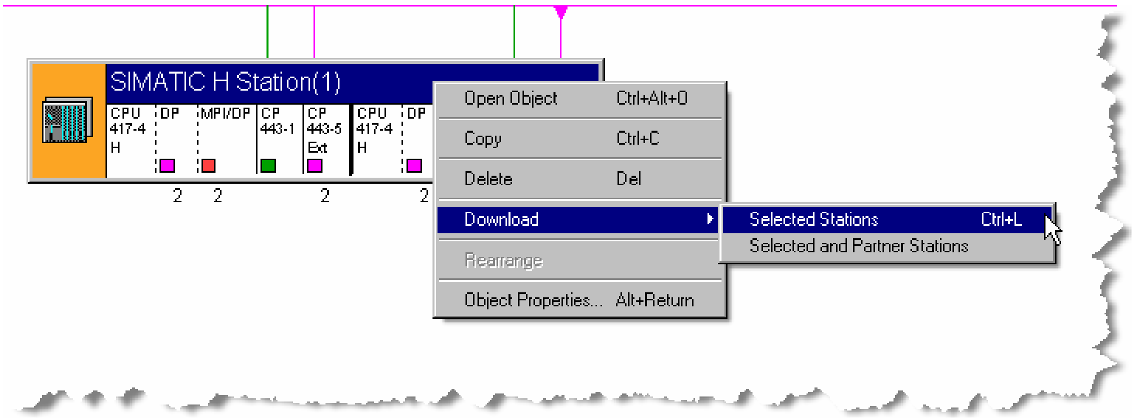
A window opens cautioning that the proposed download will overwrite an existing configuration:



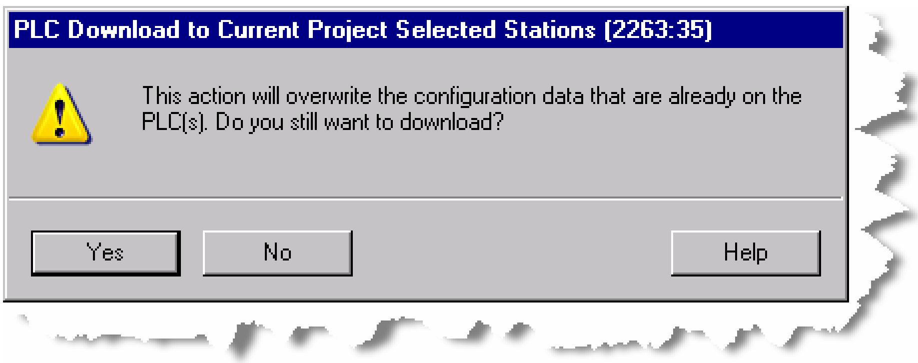
8. Click the **Yes** button to continue.
A window labeled **Stop Target Modules** opens.



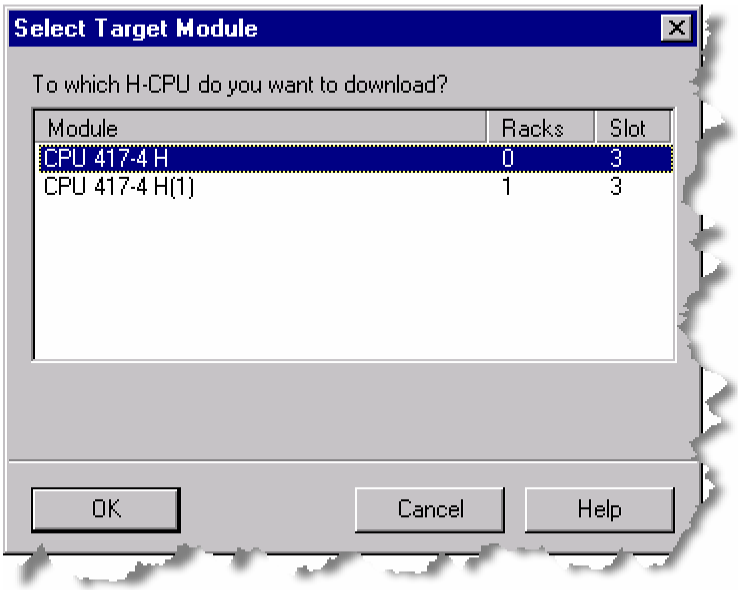
9. Click the **OK** button.
10. Right Click the AS Station **SIMATIC H Station(1)** and from the context menu select **Download > Selected Stations**.



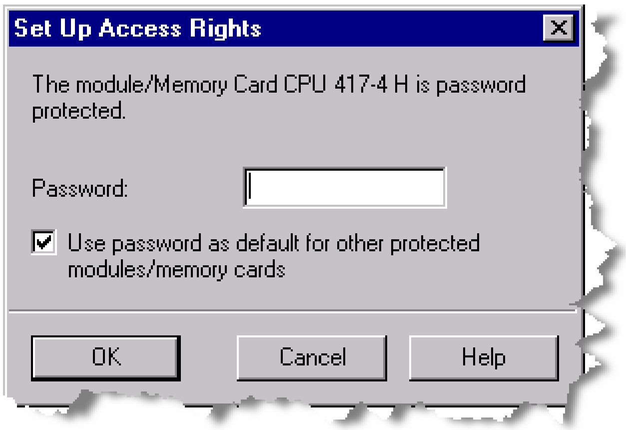
A window opens cautioning that the proposed download will overwrite an existing configuration:



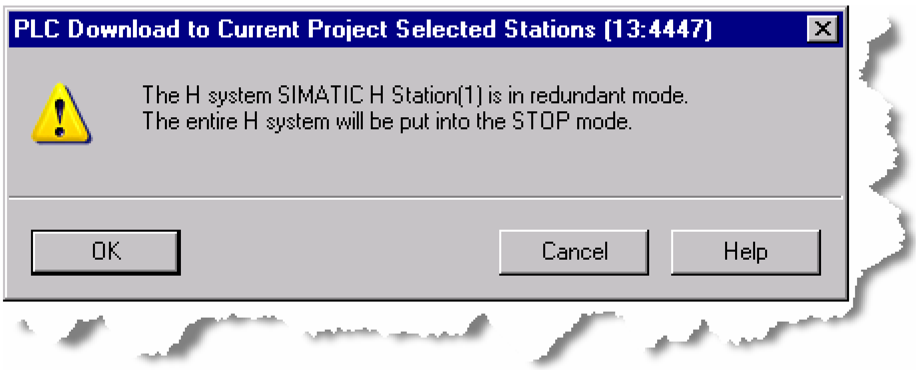
11. Click the **Yes** button to continue.
    A window labeled **Select Target Modules** opens.



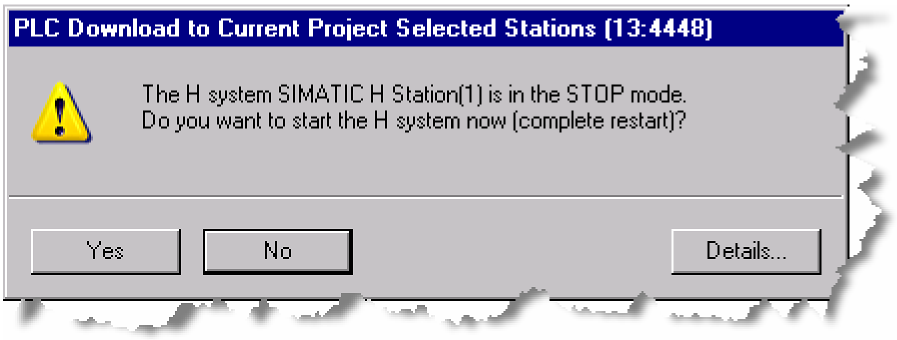
12. Click the **OK** button.
    The **Set UP Access Rights** window opens (it may not appear in a non-redundant system):



13. Enter the CPU password selected when the CPU parameters were entered and click the **OK** button:
    A window opens cautioning you that the entire system will halt if you proceed:



14. Click the **OK** button.
    When the download is complete, the message changes:



15. Click the **Yes** button to restart the system.
16. Close NetPro.

3.6.5 Configuring the PC Station for Time Synchronization

Follow the instructions in the section titled PC Time and Date Settings.

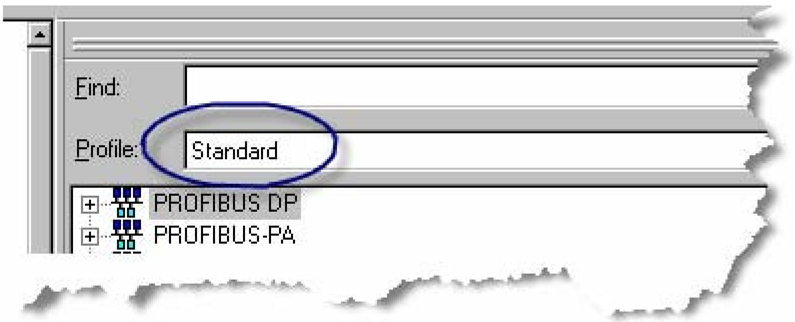
3.7 Adding QUADLOG Components with HW Config

Note

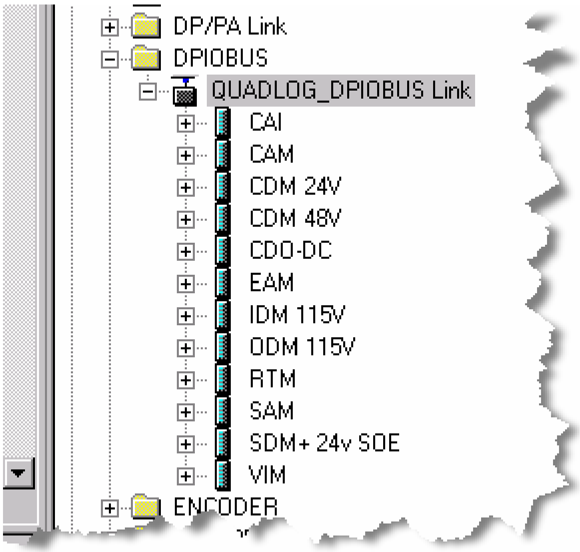
When I/O modules are added to or deleted from a configuration, it is necessary to shutdown and restart the system before the configuration can be added to the CPU. Channels can be added to or deleted from existing modules without a shutdown.

3.7.1 Adding a DP/IO Bus Link Module

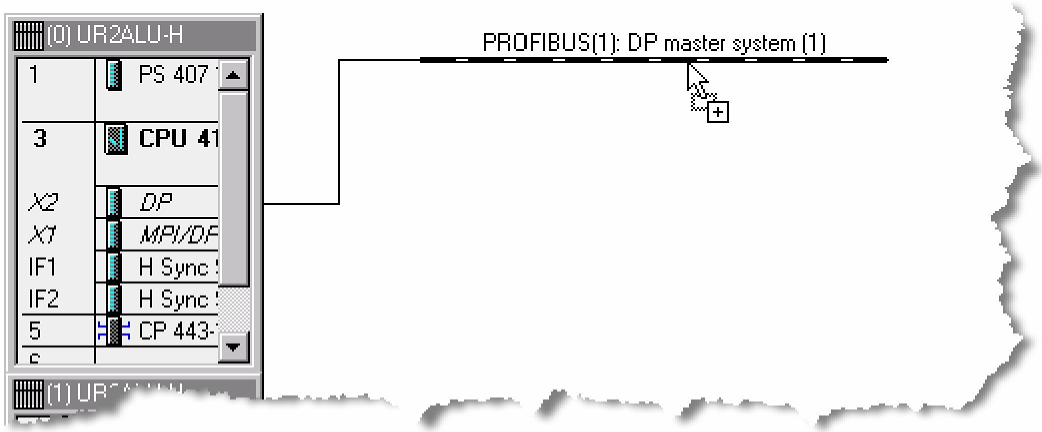
1. In the right pane of the HW Config program, ensure that the displayed value in the **Profile** field is **Standard**:



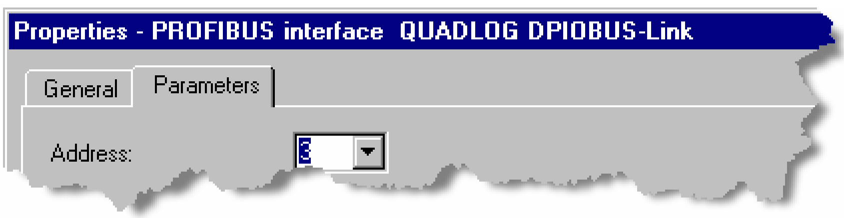
1. From the right pane of the HW Config program, Select **PROFIBUS DP** > **DPIOBUS > QUADLOG_DPIOBUS Link**.
   Available QUADLOG I/O modules appear in a list.



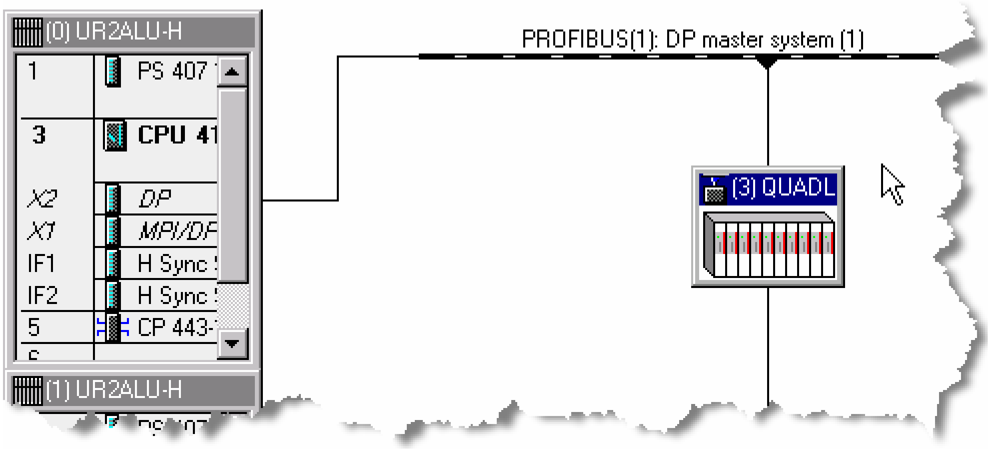
2. Drag the **QUADLOG_DPIOBUS Link** from the list to the left-pane to a position under the bus labeled **PROFIBUS(1): DP** master system (1). The cursor is augmented with a plus sign (+) to indicate that it is capable of a drop-and-drag operation.



3. Release the mouse button.
   A window labeled **Properties - PROFIBUS interface QUADLOG DPIOBUS-Link** opens to the **Parameters** tab:



4. From the drop-down selection list labeled **Address**, select an appropriate PROFIBUS address for this device, typically 3. This address must match the PROFIBUS address selected on the DP/IO Bus Link Transition Board. See Setting the PROFIBUS Address. Click the **OK** button.
   The selected address appears on the graphic representing the link:



5. Right-click the graphic representing the link and select **Object Properties** from the context menu.
   A window labeled **DP slave properties** opens to the **General** tab.
6. Click the **Operating Parameters** tab. Ensure that the parameters selected are as follows:
   - **Redundancy Mode**: Only **NODE TO NODE** and **Non-Redundant** are supported.
   - **Switch Rate**: The parameter can be set between 4 and 12 hours so that a transition occurs at least once per day (12 hrs) or optionally once per normal shift (4 hrs).
   - **Scan Rate**: The rate should match or be faster than the OB cycle time. Tuning the scan rate is an incremental process. An acceptable value is from 80 to 1000 ms. This value is an initial value, which can be tuned in real time in a CFC with the DPIO_DRV function block by adjusting the SCANRATE input and monitoring the PCT_SCAN output, ensuring that its value stays below 90%. An initial value for the scan rate is set with the HW Config program..
     You can manually adjust the **SCANRATE** input to the CFC **DPIO_DRV** function block and observe the result on the PCT_SCAN output. See DPIO_DRV.
     From an OS, you can use the standard faceplate to control the scan rate and to monitor the **PCT_SCAN** output. See Standard Faceplate Pane.

Note

The scan-rate control silently rejects values that it cannot accept. When an entered value is rejected, the last value is retained.

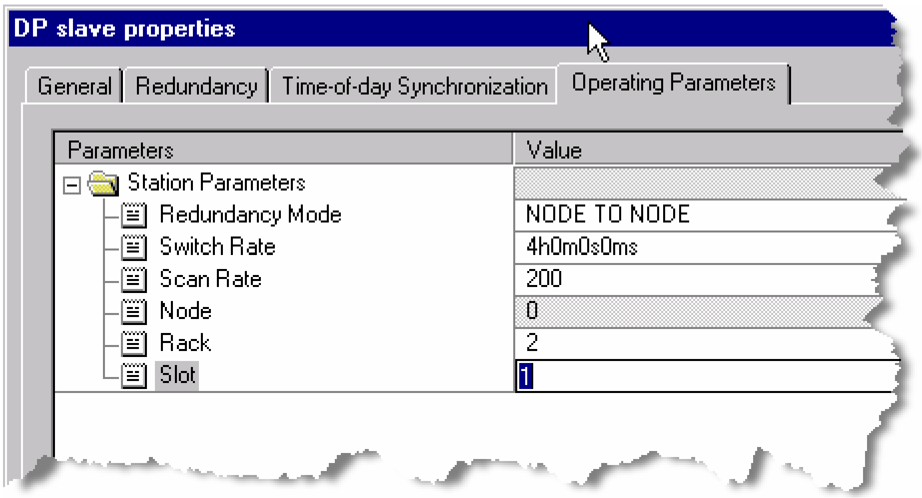
Valid entries have the following characteristics:

- They are within the range of 80 ms to 1 sec
- They reflect 10 ms resolution.

Entries that fall within 80 ms to 1 sec are rounded off and then divided by 10. Results that are evenly divisible by 10 are accepted. For example, 149.4 is rejected; 149.5 is rounded to 150, which is evenly divisible by 10, and accepted as 150.

The actual scan rate is reported as an output on the AS function block DPIO-DRV and on the OS faceplate for the DP/IO Bus Link module.

- **Node**, **Rack**, and **Slot**: These parameters describe the DP/IO Bus Link module within the QUADLOG system.



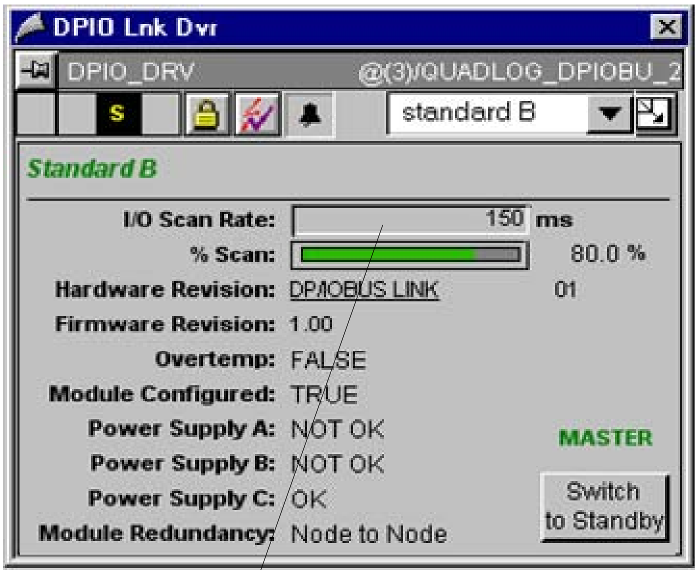
7. Click the **OK** button.
   The window closes.

Warning

Safety Note - Verifying scan rate setting changes

Add the following procedure to a checklist followed every time the Safety Mode is deactivated and reactivated.

1. From Simatic manager, open the project and select the automation system (AS) to which the DP/IO Bus Link Module is connected.
2. Click the **Edit Safety Program** icon on the toolbar.
3. In the Edit Safety Program dialog box, click the **Safety Mode** button to disable Safety Mode.
4. Disable Safety Mode for the automation system (AS) to which the DP/IO Bus Link Module is connected.
5. From the OS, use the faceplate for the DPIO_DRV to determine and modify the scan rate. A change made through the faceplate is accepted and echoed



Scan rate indicator and control

6. Return to SIMATIC Manager and re-activate Safety Mode.
7. Return to the OS and observe the scan rate on the faceplate. Confirm that the changed scan rate is reflected in the faceplate.

Warning

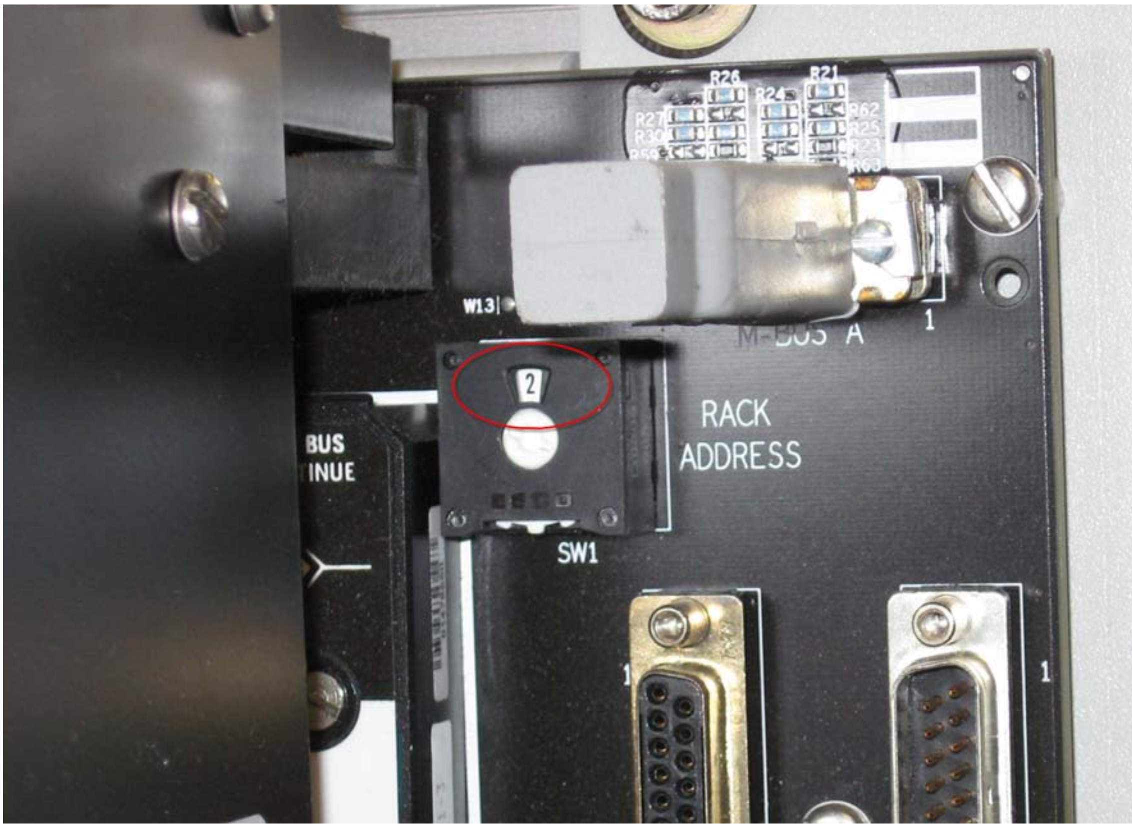
Safety Note - Avoid Changing Scan Rate Online in a Commissioned System

Changing the scan rate while online may result in a unpredictable shutdown of critical I/O modules with shutdown channels configured. Siemens recommends that the scan rate be changed only during a scheduled shutdown or before or during commissioning of the system."

3.7.2 Adding QUADLOG Modules and Channels

Prerequisite information

- MODLURAC Rack Address.
  This address is determined by a switch position (SW1) on the right side of the printed circuit board that serves as the MODLURAC backplane: in the following illustration, the switch position is 2 (in a node-to-node redundant system, the rack addresses of the redundant partners must be identical) The following illustrations shows the location of the switch:



- MODLURAC slot address of each slot into which an I/O module is installed.
  Slots are clearly numbered, as shown in the following illustration:

Procedure

Note

All channels power up in the OFF state.

Warning

Safety Note - I/O Modules must have at least one configured channel

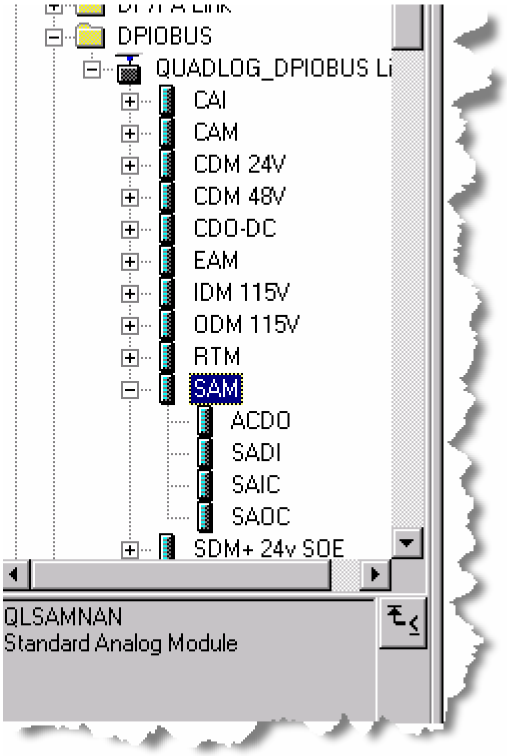
Each I/O module must be configured with at least one channel. The system may fail to operate properly if an I/O module is added without at least one configured channel.

Notes

- When I/O modules are added to or deleted from a configuration, it is necessary to shutdown and restart the system before the configuration can be added to the CPU. Channels can be added to or deleted from existing modules without a shutdown.
- If an I/O module is physically removed from its MODLURAC and the MODLURAC as a result improperly contains gaps between modules or is otherwise improperly terminated, the on-line HW Config program may report errors related to the missing module, even if the module is re-inserted. It is necessary to download the configuration again after the MODULRAC is properly populated and terminated. For an extensive discussion of MODLURAC termination, see the section titled The LoopOK Signal.

1. In the right pane of the HW Config program, called the **Hardware Catalog**, select the desired module type from the expanded list beneath the DP/IO Bus

Link module. In this case, select **PROFIBUS DP > DPIOBUS > QUADLOG_DPIOBUS Link > SAM**

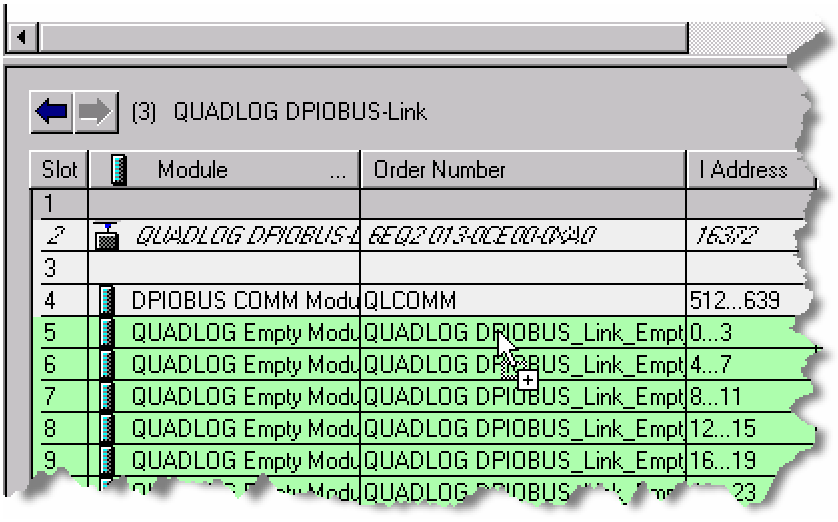


The **SAM** module is highlighted.

2. Click and hold the SAM module. As you start to drag it, the cursor is augmented with a plus sign (+) to indicate that it is carrying an object. Drag the SAM module to the lower plane of the HW Config display, placing it on the first empty module slot, slot 5 (this "slot" is not to be confused with the MODULRAC slot, discussed later). The green background signifies rows where object placement is permitted.

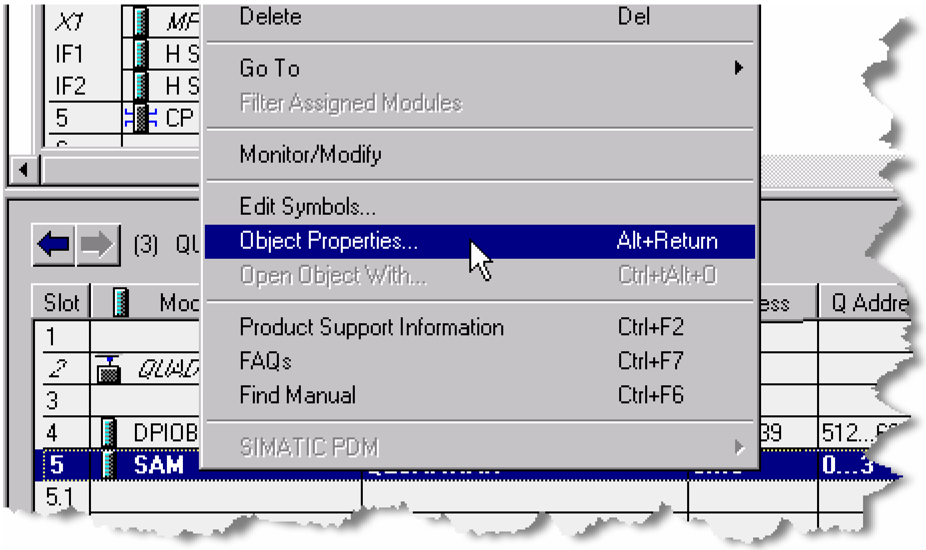
   A window opens asking you to confirm your intention.

3. Click the **YES** button.



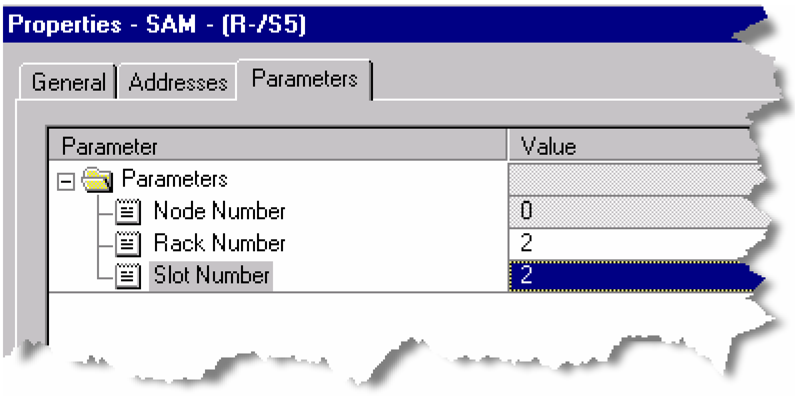
A window opens asking you to confirm your intention.

4. Click the **YES** button. The SAM module is inserted in the selected slot
5. Right-click the SAM module and from the context menu select **Object Properties**:



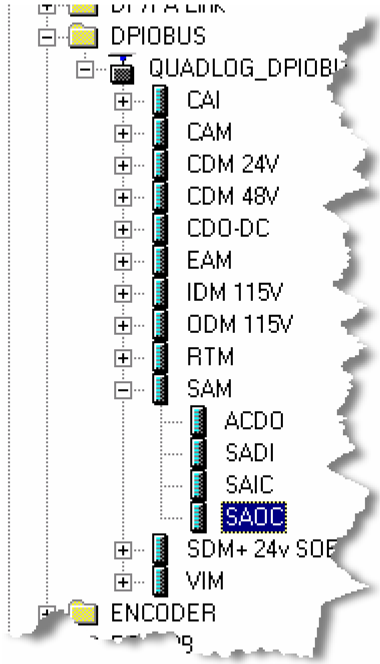
A **Properties - SAM** window opens to the General tab.

6. Select the **Parameters** tab insert the appropriate node, rack, and slot address, as shown in the following illustration:

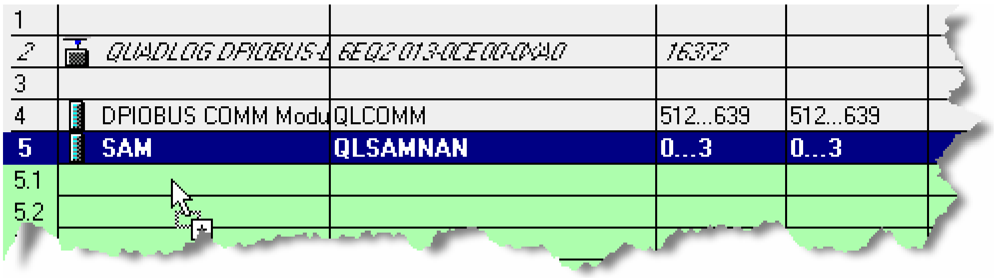


Click the **OK** button.
The window closes.

7. In the right pane of the HW Config program, called the **Hardware Catalog,** select the desired channel type from the expanded list beneath the SAM module. In this case, select **PROFIBUS DP > DPIOBUS > QUADLOG_DPIOBUS Link > SAM >SAOC**.



8. Drag and drop the channel into the first vacant slot within the **SAM** module. As you drag the cursor, the plus sign (+) appended to it indicates that it is carrying an object. The slots numbered 5.1, 5.2, … correspond to the actual channel number within the SAM module. Slot 5.1 corresponds to channel 1, slot 5.2 corresponds to channel 2, and so forth.



After the channel is dropped into place, it appears within the module:

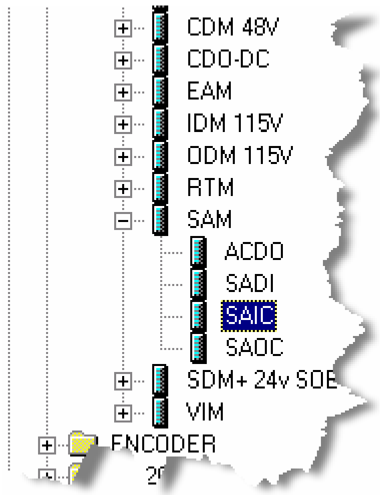
Notice

It is possible to place a channel in one slot and then later move it to another, but only by using the following procedure, which ensures that channel attributes are properly reset:

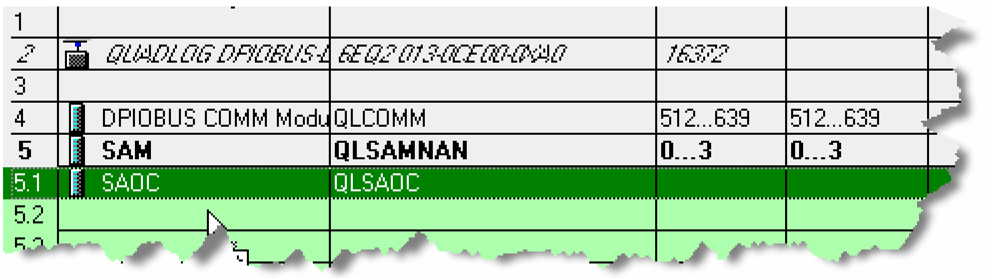
1. Left click the existing channel, holding the left mouse button down while dragging the channel to the desired slot.
2. Drag another channel from the hardware catalog and place it the original slot.
3. Delete this channel from the original slot.

---

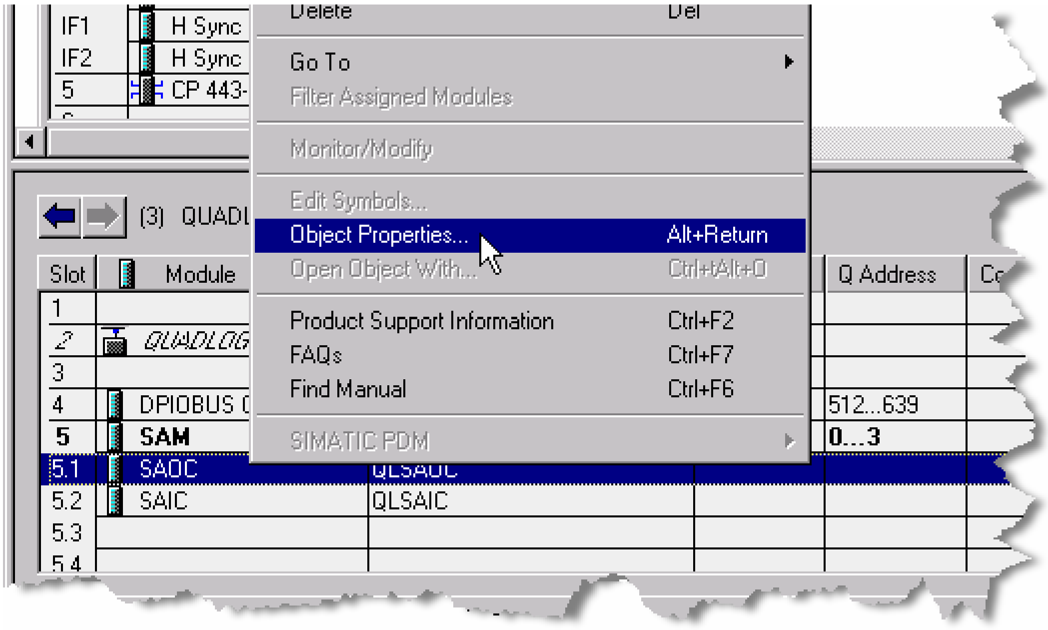
9. Select the SAIC channel type within the SAM module hierarchy:



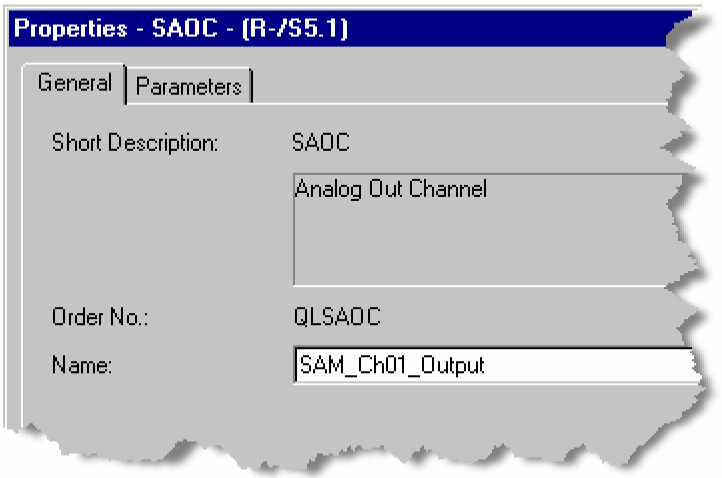
10. Drag the SAIC channel to slot 5.2:



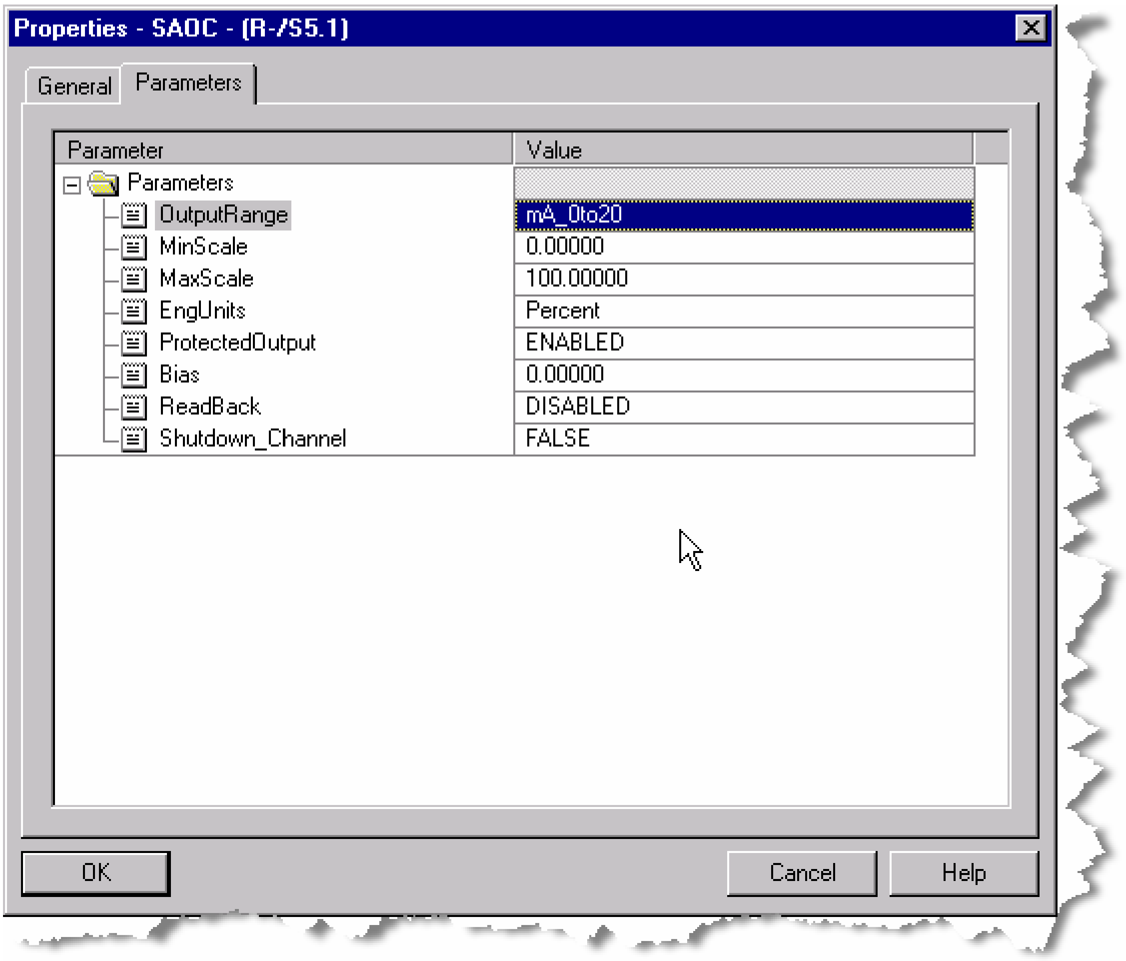
11. Double-click or right-click on channel 5.1 and chose **Object Properties** from the resulting context menu:



12. The **General Properties** window opens:

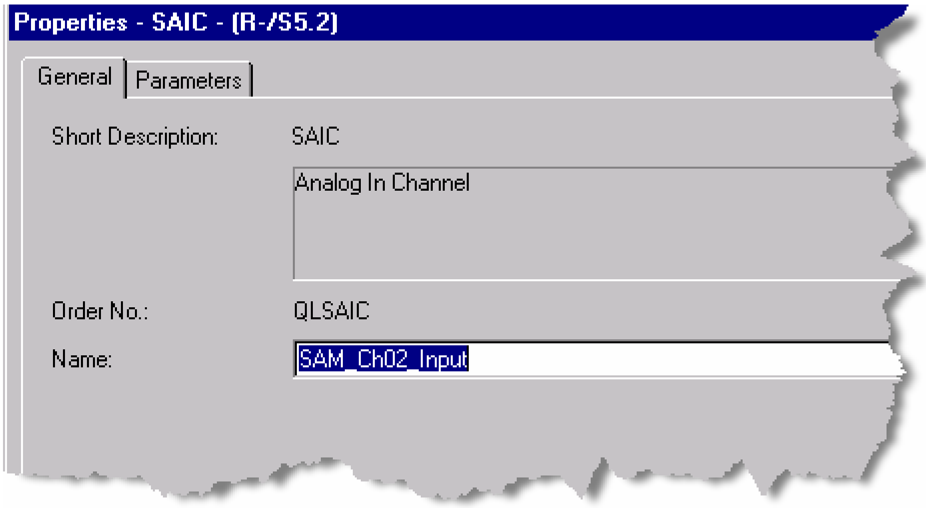


13. Change the channel's name to **SAM_Ch01_Output**. Click the **Parameters** tab.
The **Parameters** window opens:

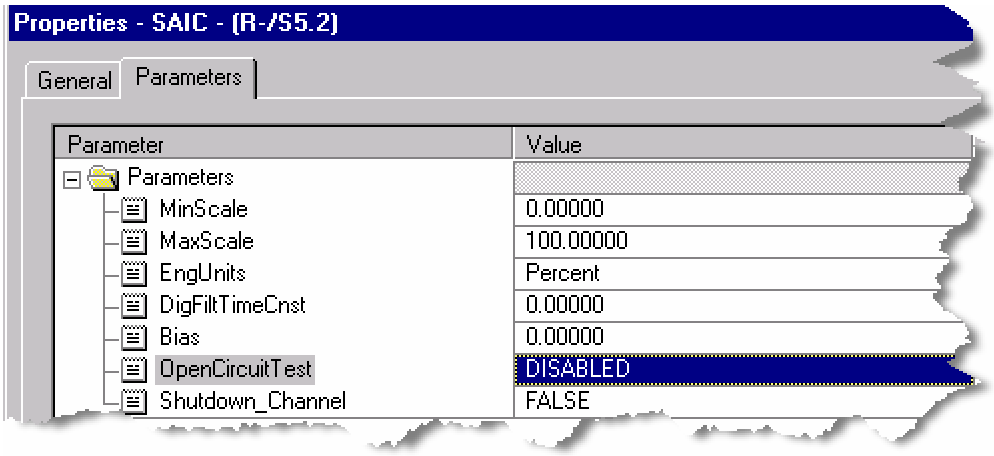


These parameters are known as *softlist* parameters. The **Help** button launches channel-specific help that provides information about the channel type and its associated parameters.
Set the parameters as desired.
Click the **OK** button when you are finished.

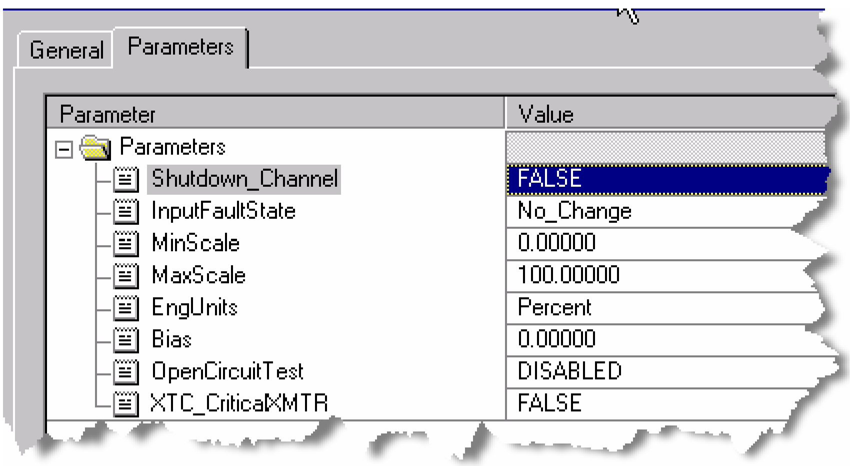
14. Double-click the SAIC in slot 5.2 to open the properties window. From the **General** window, change the name as desired. In the example the name SAM_Ch02_Input is entered:



15. Click the **Parameters** tab and change the softlist parameters as necessary. Click the **OK** button when you are finished.



16. Right-click the row listing the channel and select **Object Properties** from the context menu.
    A window labeled **Properties - SAIC (R-/S5.2)** opens to the **General** tab.
17. Click the **Parameters** tab and edit the channel properties as necessary. Typical parameters for a CAIC channel are shown in the following illustration:



Click the **OK** button.
The window closes.

3.7.3 Editing Symbols

The following procedure focuses on adding symbol names to I/O channels. The process is illustrated by following the HW Config workflow necessary to configure and edit the symbol table for four channels. This entails configuring the following:

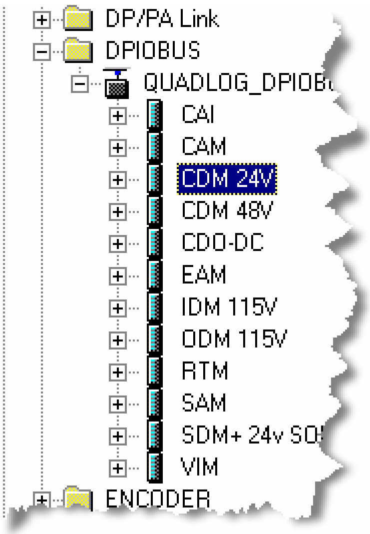
- Two modules
  - SAM
  - CDM 24V
- Four channels
  - SAOC (Standard Analog Output Channel)
  - SAIC (Standard Analog Input Channel)
  - CDOC (Critical Discrete Output Channel)
  - ADIC (QUADLOG Discrete Input Channel)
- Four symbol table entries, properly accounting for channel offsets and input/output characteristics

Module and Channel Setup

1. Follow the procedures describe in the section titled Adding QUADLOG Modules and Channels, using HW Config to add a SAM module and two channels, an SAOC and an SAIC.

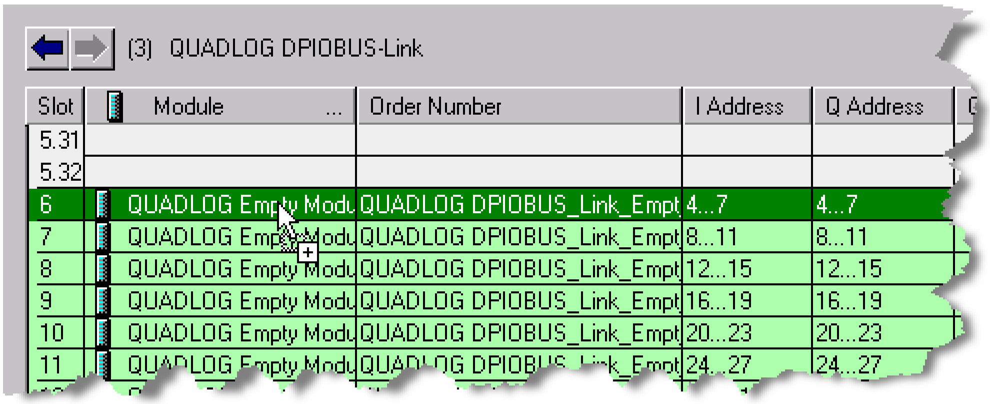
Using the same general procedure, add a CDM 24V module with a CDOC channel and an ADIC channel:

2. In the right pane of the HW Config program, called the **Hardware Catalog,** select the desired module type from the expanded list beneath the DP/IO Bus Link module. In this case, select **PROFIBUS DP > DPIOBUS > QUADLOG_DPIOBUS Link > CDM 24V**

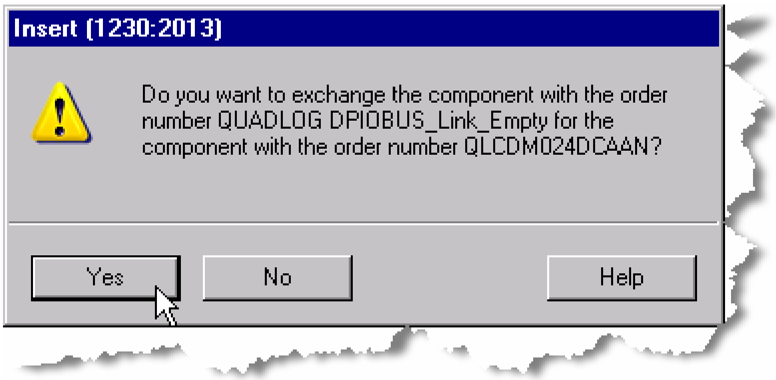


The **CDM 24V** module is highlighted.

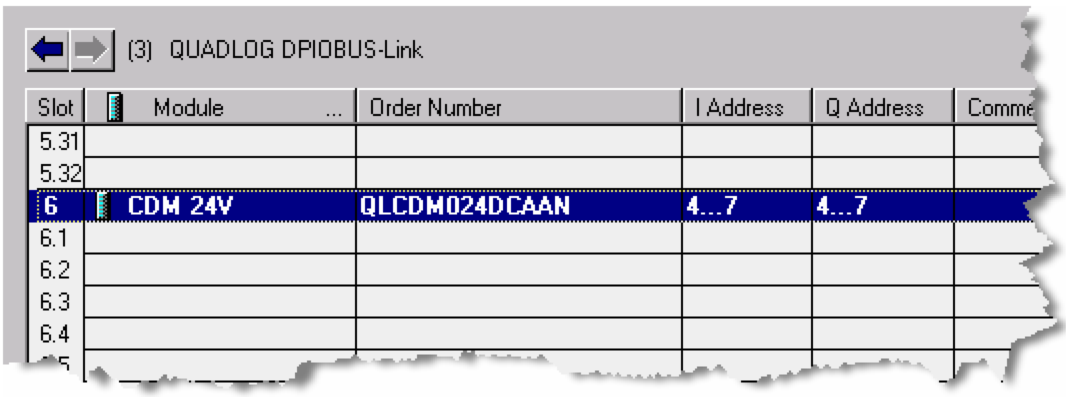
3. Click and hold the CDM 24V module. As you start to drag it, the cursor is augmented with a plus sign (+) to indicate that it is carrying an object. Drag the SAM module to the lower plane of the HW Config display, placing it on the first empty module slot, slot 6 The green background signifies rows where object placement is permitted.



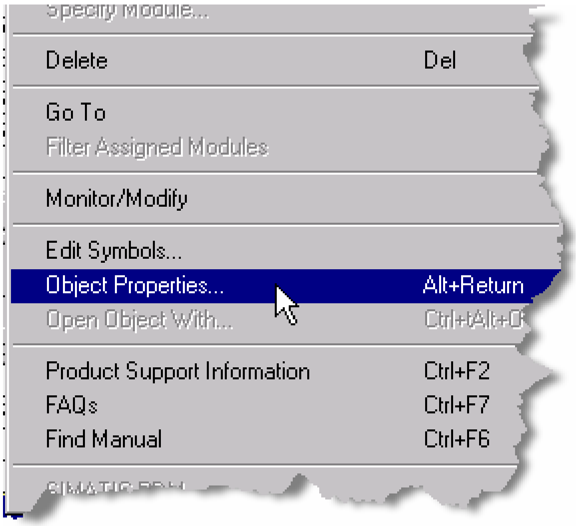
A window opens asking you to confirm your intention.



4. Click the **YES** button. The CDM 24V module is inserted in the selected slot:

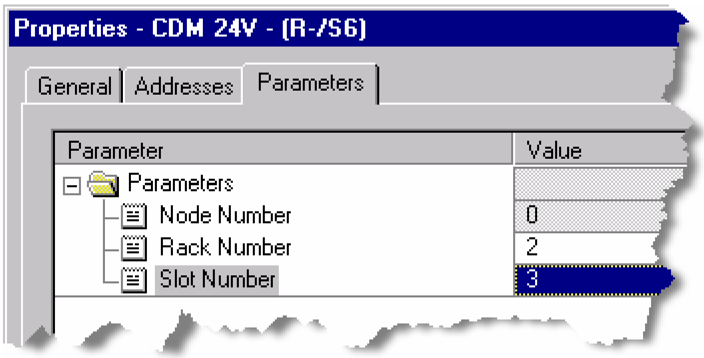


5. Right-click the CDM 24 V module and from the context menu select **Object Properties**:



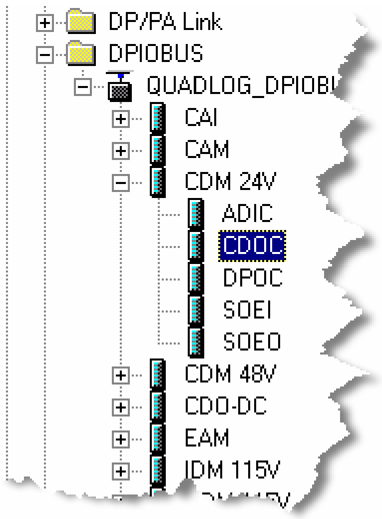
A **Properties - CDM 24V** window opens to the General tab.

6. Select the **Parameters** tab insert the appropriate node, rack, and slot address, as shown in the following illustration. The **Node number, Rack Number** and **Slot Number** refer to the physical location of the CDM 24V module in the MODULRAC:

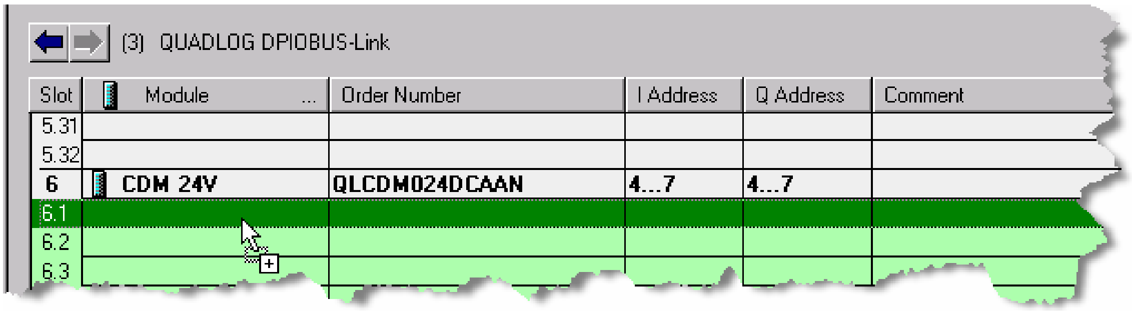


Click the **OK** button.
The window closes.

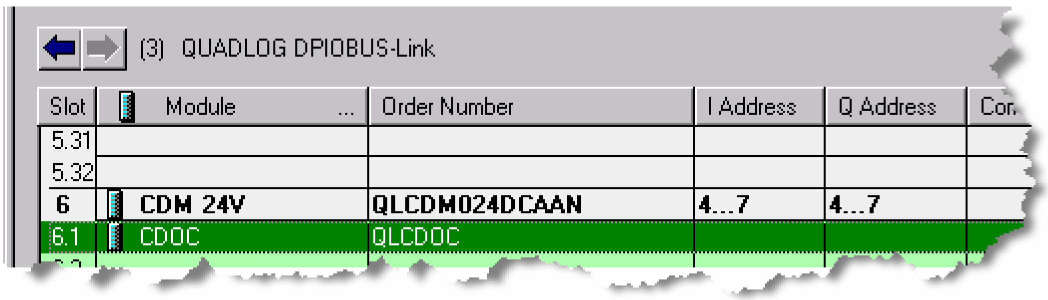
7. In the right pane of the HW Config program, select the desired channel type from the expanded list beneath the SAM module. In this case, select **PROFIBUS DP > DPIOBUS > QUADLOG_DPIOBUS Link > CDM 24 V > CDOC**.



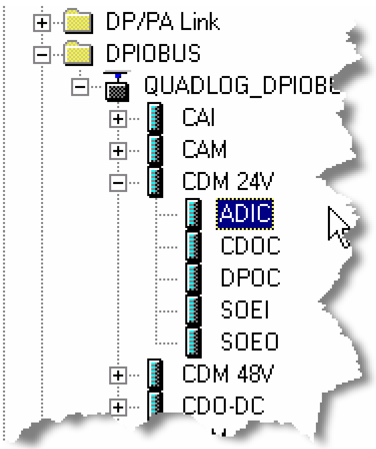
8. Drag and drop the channel into the first vacant slot within the **CDM 24V** module. As you drag the cursor, the plus sign (+) appended to it indicates that is carrying an object. The slots numbered 6.1, 6.2, … correspond to the actual channel number within the SAM module. Slot 6.1 corresponds to channel 1, slot 6.2 corresponds to channel 2, and so forth.



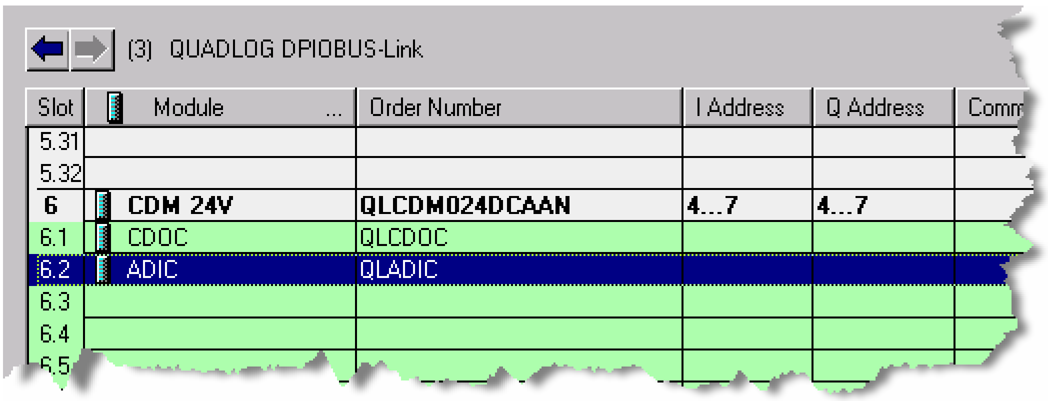
After the channel is dropped into place it appears within the module:



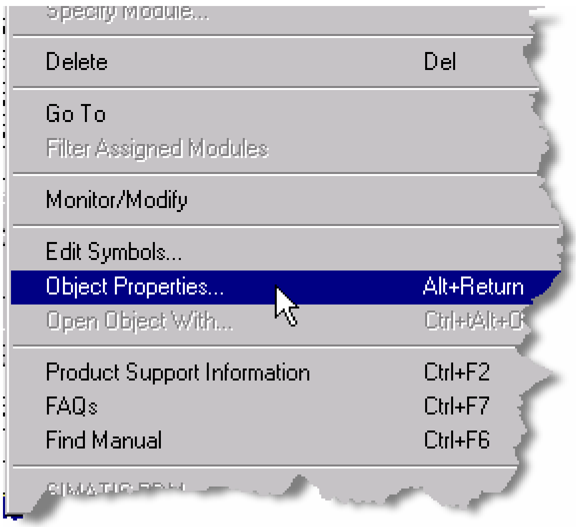
9. Select the ADIC channel type within the CDM 24V module hierarchy:



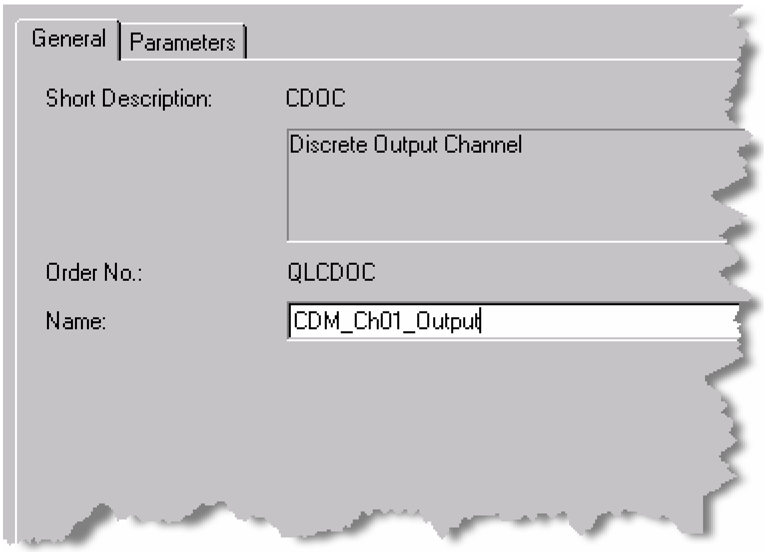
10. Drag the ADIC channel to slot 6.2:



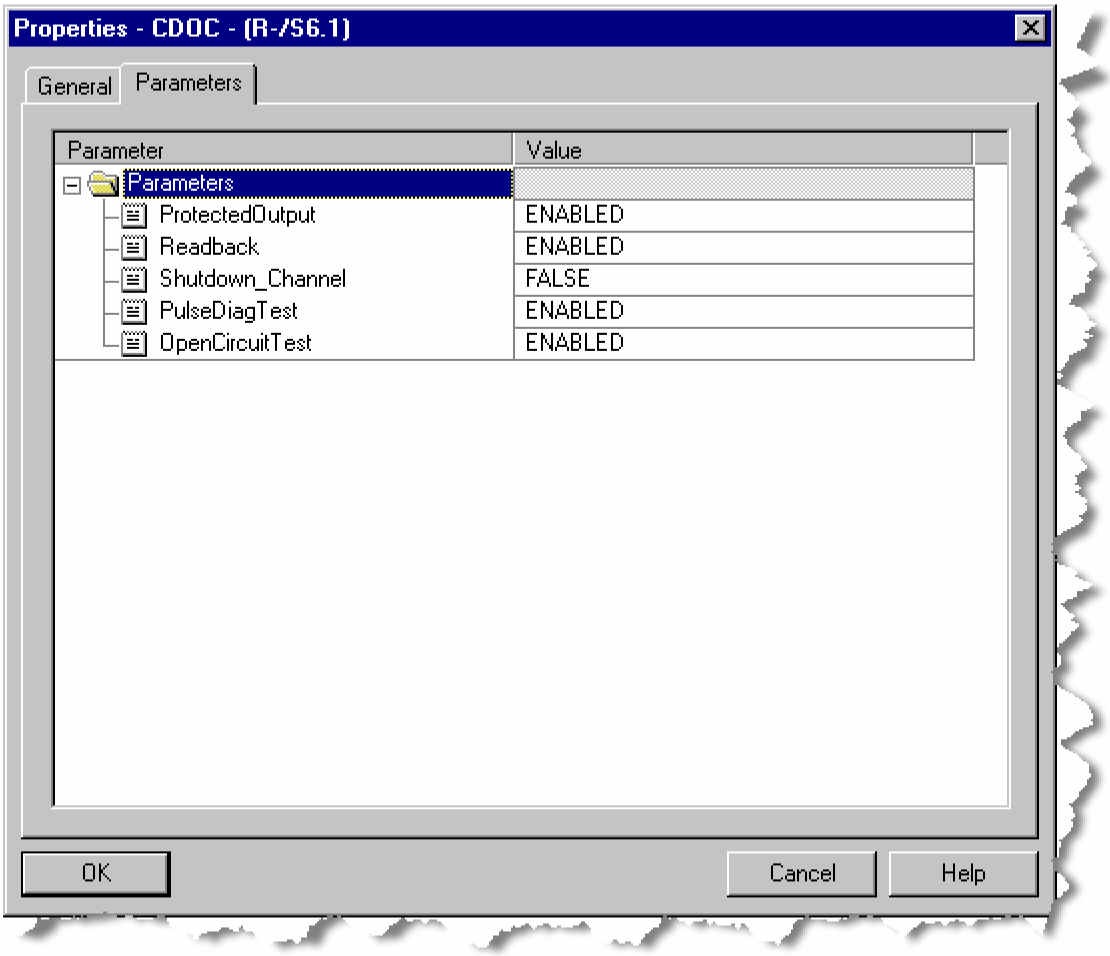
11. Double-click or right-click on channel 6.1 and chose **Object Properties** from the resulting context menu:



12. The **General Properties** window opens:



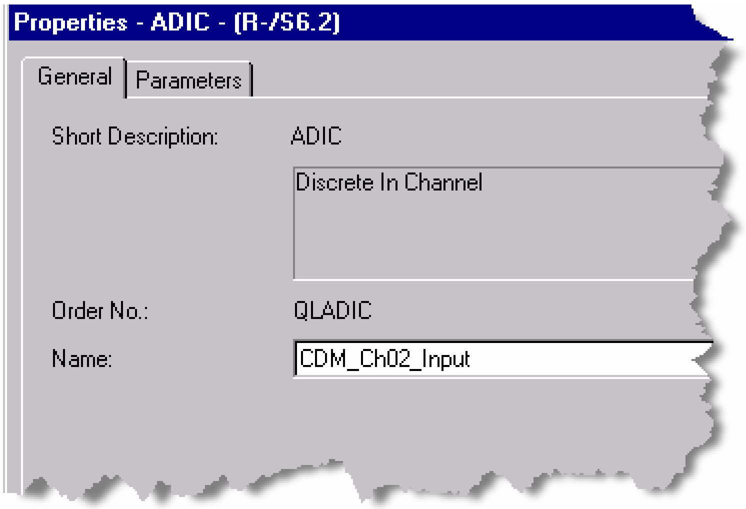
13. Change the channel's name to **CDM_Ch01_Output**. Click the **Parameters** tab.
    The **Parameters** window opens:



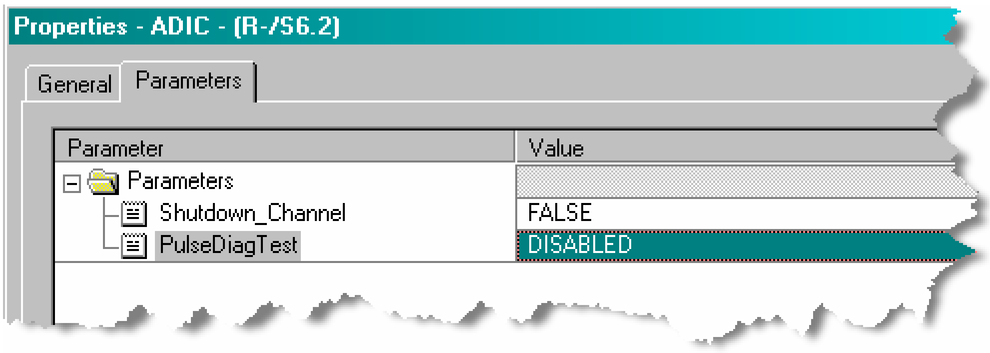
These parameters are known as *softlist* parameters. The **Help** button launches channel-specific help that provides information about the channel type and its associated parameters.

Set the parameters as desired.
Click the **OK** button when you are finished.

14. Double-click the ADIC in slot 6.2 to open the properties window. From the **General** window, change the name as desired. In the example the name CDM_Ch02_Input is entered:



15. Click the **Parameters** tab and change the softlist parameters as necessary.



16. Click the **OK** button when you are finished.
The window closes.

Adding Symbols

This discussion presupposes a system configured according to the procedure in the previous topic, *Module and Channel Setup*

HW Config assigns an address range to each configured module during compilation. To do this it must know the physical location and characteristics of the module's channels, including whether they are inputs or outputs. This is done in an interface called the *Symbol Table*

There are two parts to configuring symbols. The first part is identifying the location of channels and identifying them as either inputs or outputs The second part is assigning names (presumably human-readable) to make a connection between channel drivers and the I/O channels. The names entered typically describe the purposes of the channels. Channel drivers are described in the next section, Configuring Channel Drivers.

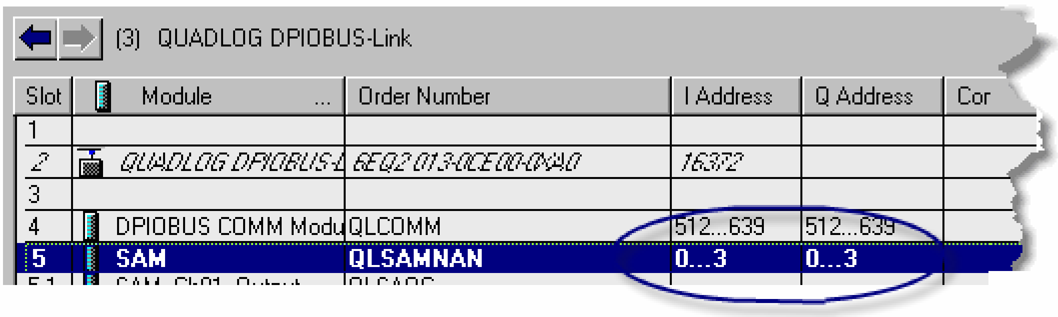
First, it is useful to see how I/O modules are assigned bit addresses by HW Config. In this limited context, an *address* is the location in a data structure of a single bit whose state indicates whether an I/O channel is present or not. The location of bits indicating channel presence also determine whether a channel is an input or an output. With respect to the symbol tables, *address* has nothing to do with the location of I/O data.

Configuration must be done deliberately and carefully to ensure that you do not configure the same channel as both an input and an output. The key to avoiding this error is carefully accounting for the byte and bit offsets for each module and channel. HW Config does not intercept such errors, and a compile of a CFC page that includes a channel configured as both an input and output channel produces error messages that are difficult to interpret. See No hardware found for symbol <Symbol Name> with address I<XXX.YY>and Error Message: Interconnection / Value of the parameter 'xxxxx' cannot be checked automatically..

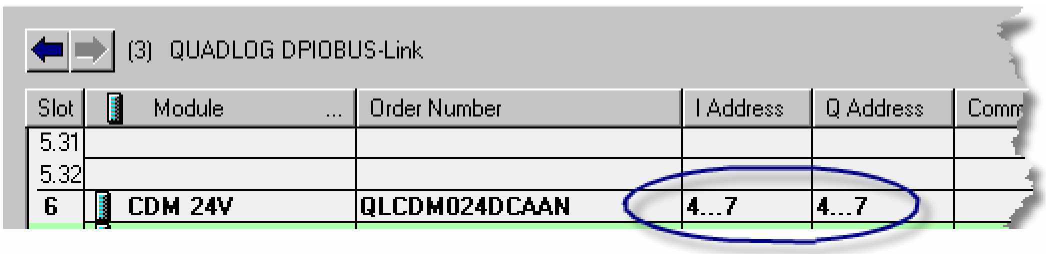
A SAM module supports a maximum of 32 channels. Since each channel is represented by one bit, a SAM 4 bytes of bit address:

$$4\,bytes = \frac{1\,bit}{channel} \times \frac{1\,byte}{8\,bits} \times 32\ channels$$

When a SAM module is configured in HW Config as the first module (in slot 5, the first available slot), the **I Address** (input) and **Q Address** (output) columns report that the SAM has been allocated 4 bytes, identified as **0...3 (**which means 0, 1, 2, 3), sufficient for 32 channels:



The **I Address** (input) and **Q Address** (output) for the CDM 24V modules in slot 6 also account for 32 channels and also requires 4 bytes. The bytes reserved for the CDM 24V channels are **4...7,** beginning with an offset of four bytes from the start of the I/O addresses for the SAM module:



Modules in subsequent slots would have even greater offsets from the beginning of the I/O addresses.

When you edit symbols for the SAM and CDM 24 V channels, two module-specific symbol tables open, each containing 2 x 32 = 64 rows. The first 32 rows (1 through 32) are for input channels and the next 32 (33 through 64) are for output channels.

For the SAM module, the table below shows the correspondence between row, byte and bit, and module channel. The first byte is byte 0 and the first bit, corresponding the channel 1, is bit 0.

Row	**Address I/O Byte.Bit**	**Corresponding Module Channel**
1	`I 0.0`	1
2	`I 0.1`	2
3	`I 0.2`	3
...		
8	`I 0.7`	8
9	`I 1.0`	9
10	`I 1.1`	10
11	`I 1.2`	11
...	...	...
32	`I 3.7`	32
33	`Q 0.0`	1
34	`Q 0.1`	2
...	...	...
64	`Q 3.7`	32

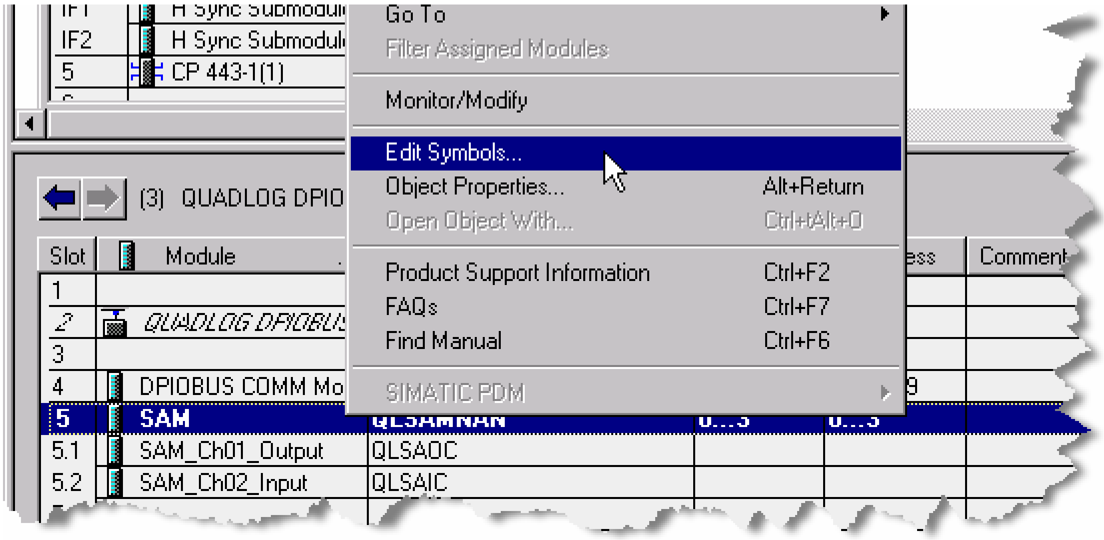
For the CDM 24 V module, whose I/O address spaces begins at byte 4, the table below shows the correspondence between row, byte and bit, and module channel:

Row	**Address I/O Byte.Bit**	**Corresponding Module Channel**
1	`I 4.0`	1
2	`I 4.1`	2
3	`I. 4.2`	3
...	...	...
8	`I 4.7`	8
9	`I 5.0`	9
10	`I 5.1`	10
11	`I 5.2`	11
...	...	...
32	`I 7.7`	32
33	`Q 4.0`	1
34	`Q 4.1`	2
...	...	...
64	`Q 7.7`	32

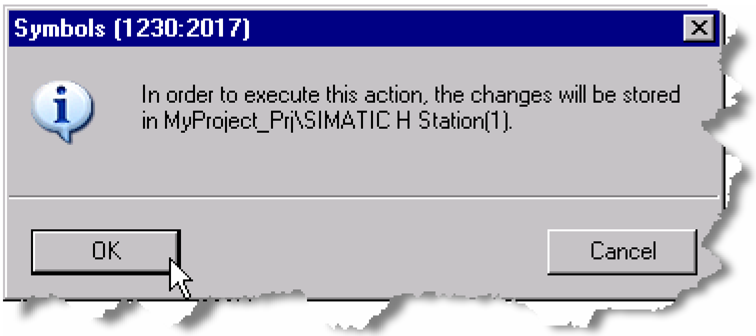
Symbols can be edited in any order. In the following example, symbols are entered in the following order:

- SAM input channel,
- SAM output channel
- CDM 24 V input channel
- CDM 24 V output channel.

1. In the lower pane of HW Config, right-click select the SAM module in slot 5 and select **Edit Symbols** from the context menu.



A message window appears, notifying you that changes to symbols will be stored in a project folder:

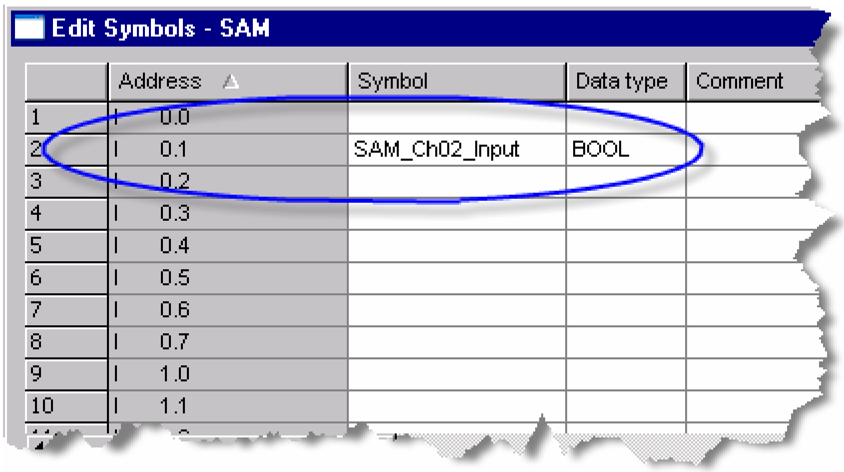


2. Click the **OK** button.
   The window closes and is replaced with an **Edit Symbols** window, containing the Symbol Table. The table is exclusive to the selected SAM module and thus contains 64 rows, 32 input rows and 32 output rows.
3. To place the SAM Input channel, located in HW Config in slot 5.2, into the table, find the row in the symbol table that corresponds to channel 2 configured as an input.

   Keep in mind that byte are numbered starting with 0: 0, 1, 2, etc.
   Bits are numbered starting with 0: 0, 1, 2, etc.

In this case it is row 2. Note the address column, **I 0.1**, where

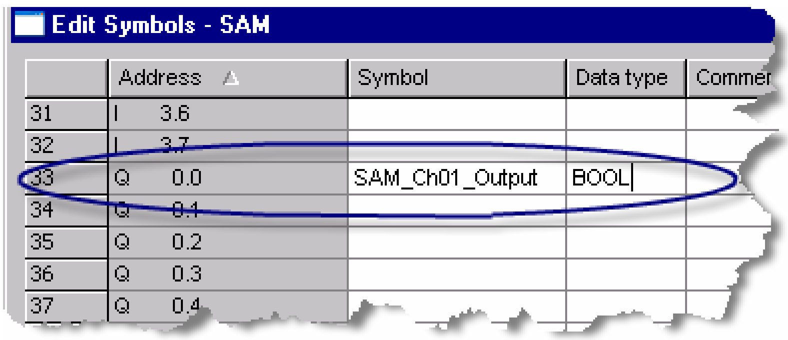
I = input
0 = byte 1
.1 = bit 2 for channel 2:



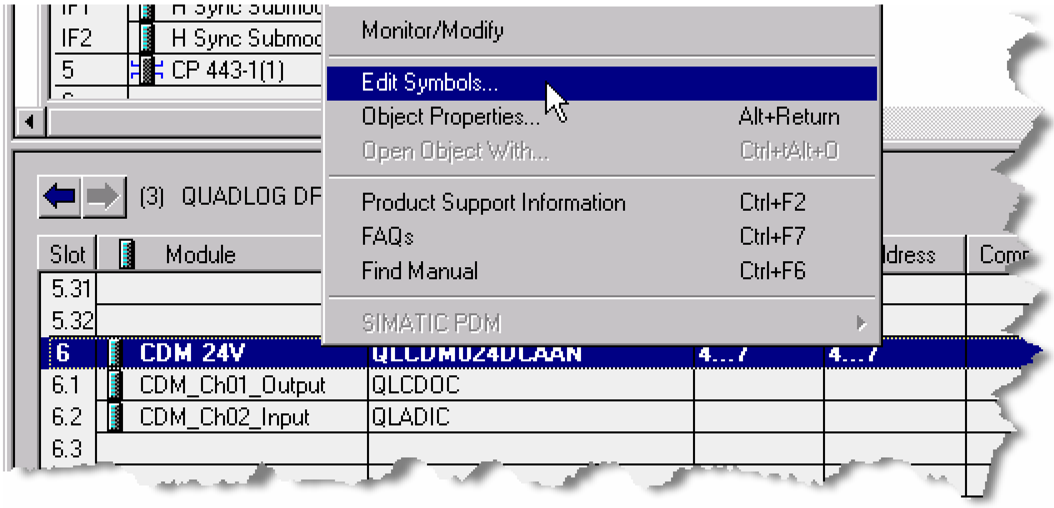
4. In the **Symbol** column, enter an appropriate name, *SAM_Ch02_Input* in this instance, a reasonable name indicating that the channel is channel 2 on the SAM module and it is an input. Note that the **Data Type** column is filled in automatically, always with **BOOL** (this data type has nothing to do with the channel data, which may require many bytes). Enter a free-form comment in the **Comment** column if you wish.
5. As before, keep in mind that byte are numbered starting with 0: 0, 1, 2, etc. Bits are numbered starting with 0: 0, 1, 2, etc.

   To place the SAM output channel, located in HW Config in slot 5.1, scroll down in the **Edit Symbols** table and select row 33, whose address in **Q 0.0**, where

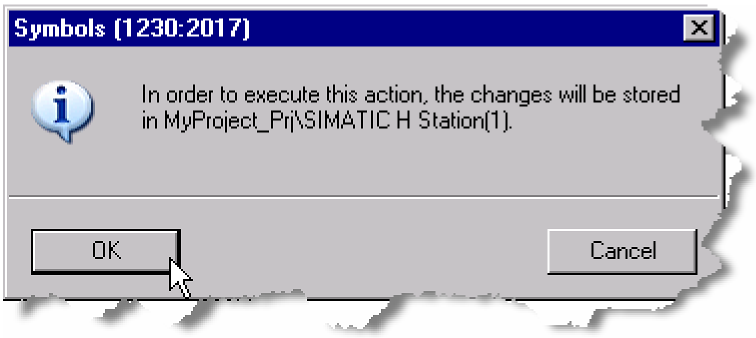
   Q = output
   0 = byte 1
   .0 = bit 1 for channel 1
6. In the **Symbol** column enter an appropriate name, *SAM_Ch01_Output* in this instance. Enter a free-form comment in the **Comment** column if you wish:



7. Click the **OK** button to confirm module and channel configuration. The HW Config display returns.
8. Right click the CDM 24V in slot 6. Choose **Edit Symbols**.



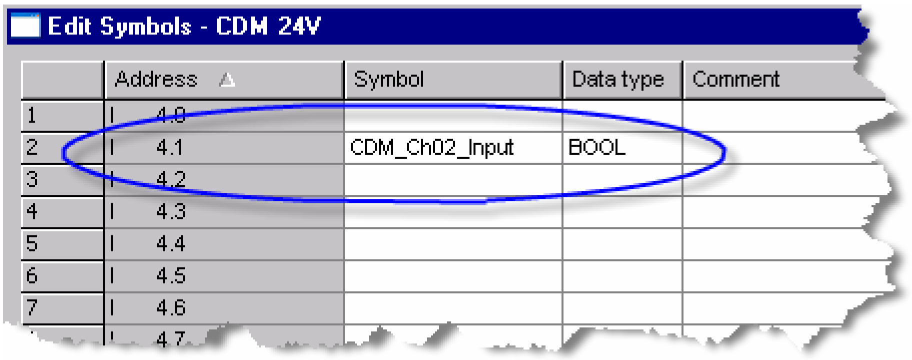
A message window appears, notifying you that changes to symbols will be stored in a project folder:



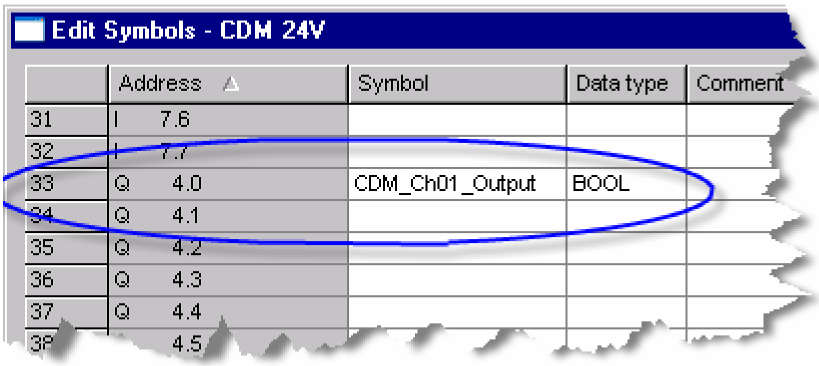
9. Click the **OK** button.
   The window closes and is replaced with an **Edit Symbols** window. The table is exclusive to the selected CDM 24V module and thus contains 64 rows, 32 input rows and 32 output rows.

10. To place the CAM 24V input channel, located in HW Config in slot 6.1, find the row in the symbol table that corresponds to channel 2 configured as an input. In this case it is row 2. Note the address column, **I 4.1**, where
    I = input
    4 = byte 5
    .1 = bit 2 for channel 2

11. In the **Symbol** column enter an appropriate name, *CDM_Ch02_Input* in this instance Enter a free-form comment in the **Comment** column if you wish:



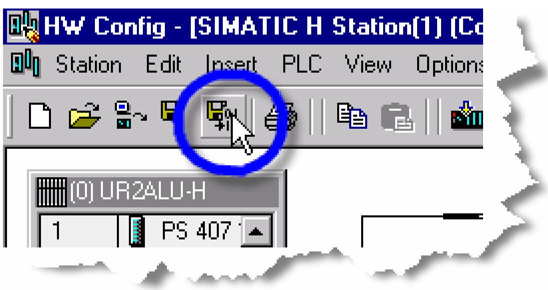
12. To place the CDM 24V output channel, located in HW Config in slot 6.2, Find the row in the symbol table that corresponds to channel 2 configured as an output. In this case it is row 33. Note the address column, **Q 4.0**, where
    Q = output
    4 = byte 5
    .0 = bit 1 for channel 1
13. In the **Symbol** column enter an appropriate name, *CDM_Ch01_Onput* in this instance. Enter a free-form comment in the **Comment** column if you wish:



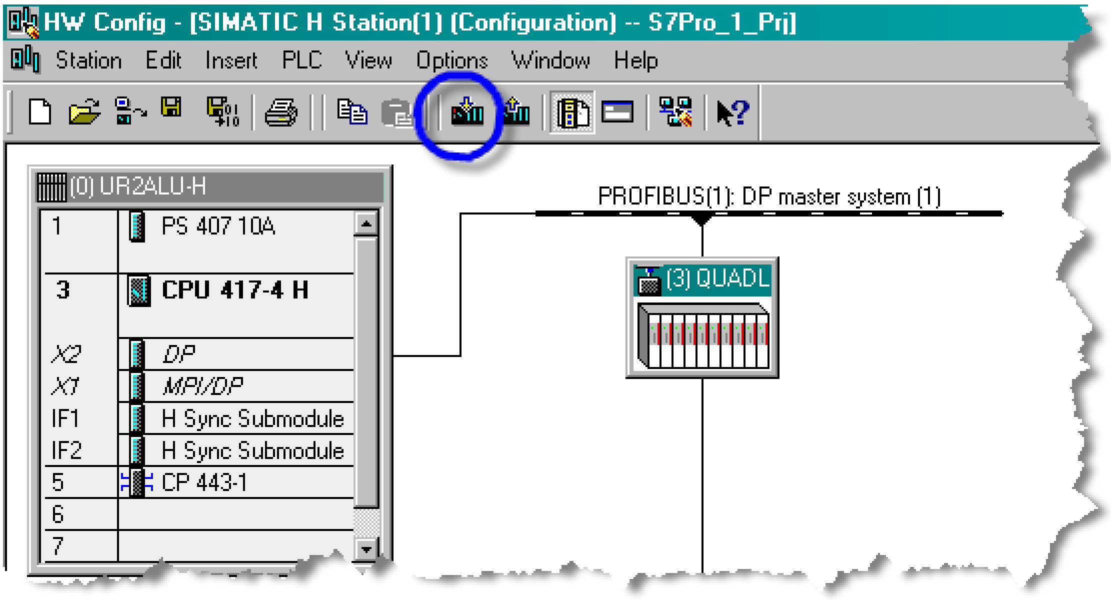
14. Click the **OK** button to confirm your changes.
    The HW Config display returns.

3.8 Compiling and Downloading a Configuration.

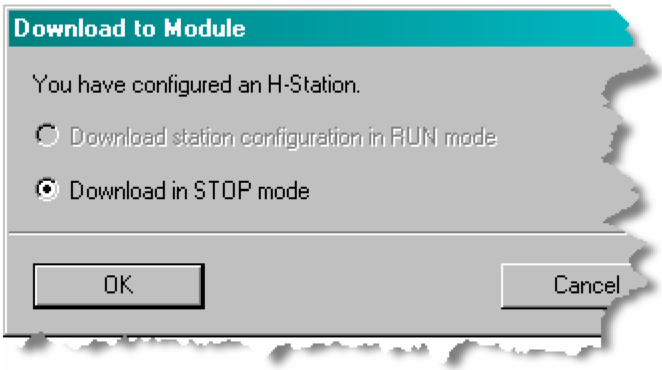
1. Click the **Save and Compile** button:



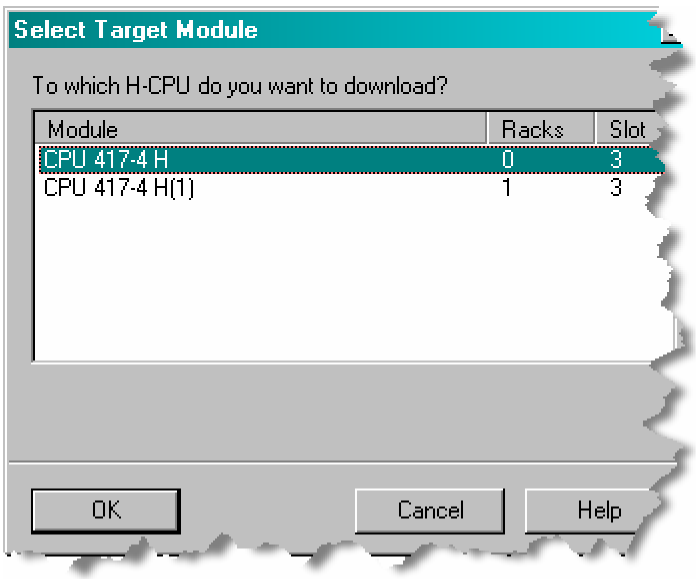
2. To download the compiled configuration, in HW Config, select the DP/IO Bus Link Module and click the **Download to Module** button:



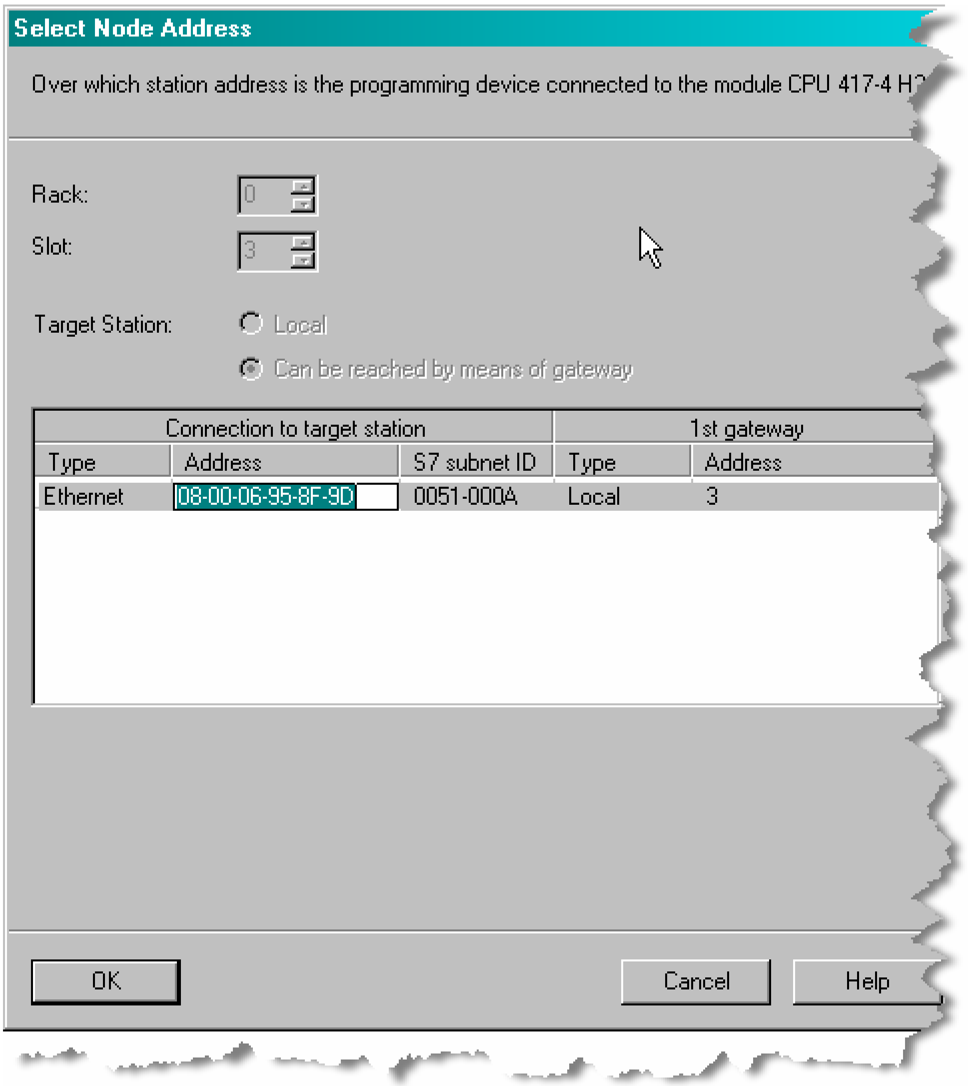
The system responds by notifying you that it is in the STOP mode



3. Click the **OK** button.
   The system responds by asking you to select the target module.



4. In a redundant system, you ordinarily select the module in rack 0. The configuration gets cross loaded to the redundant partner automatically. Click the **OK** button.
   The system responds by asking you to select the communications processor, identified by MAC address, to which the CPU is connected:

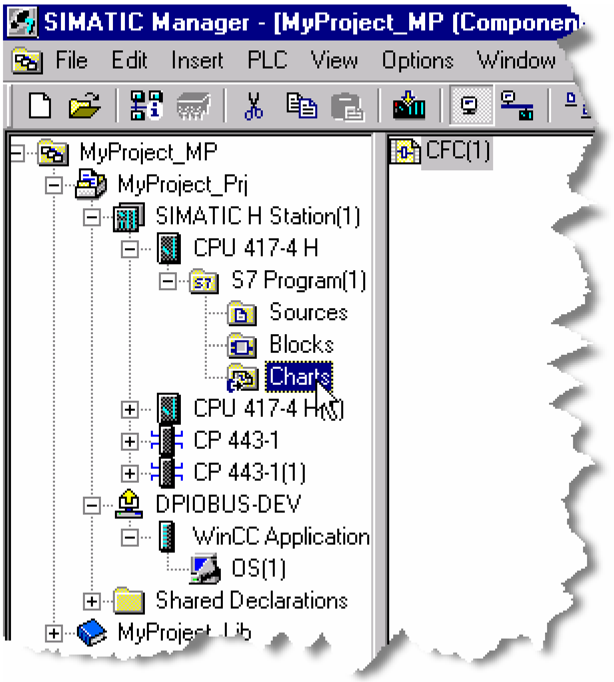


5. The suggested MAC address should belong to the communications processor in a rack with the master CPU. If it is not, you can change the address inserted into the **Address** field to correspond with the address of the proper communications processor. Click the **OK** button.
   The configuration downloads.

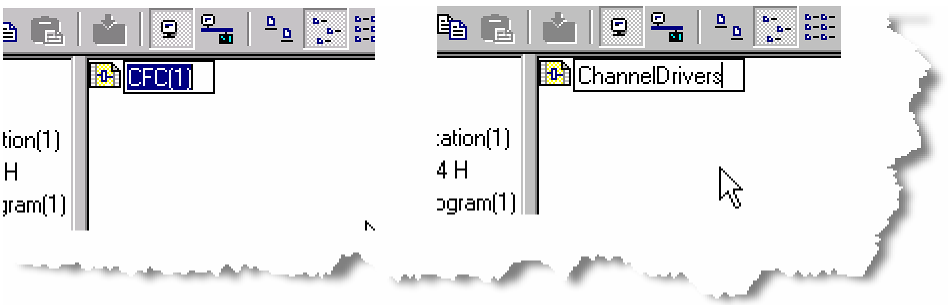
3.9 Configuring with CFC (Continuous Function Chart)

After the hardware configuration has been downloaded, it is possible to configure the channel drivers within CFC and associate them with the symbols that were created within HW Config. The CFC charts contains the user's program logic. The inputs and outputs for that logic are read or driven by channel drivers.

1. From the SIMATIC Manager component display, expand the project listing in the left pane as necessary and select **Charts**:

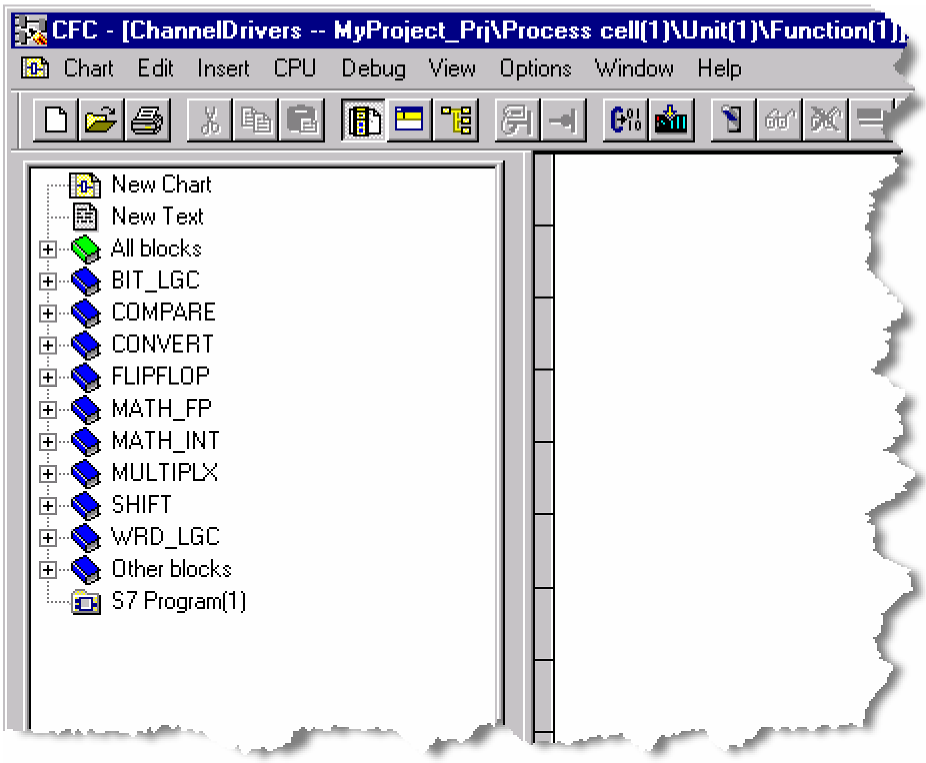


2. Rename **CFC(1)** in the right pane to **ChannelDrivers**:

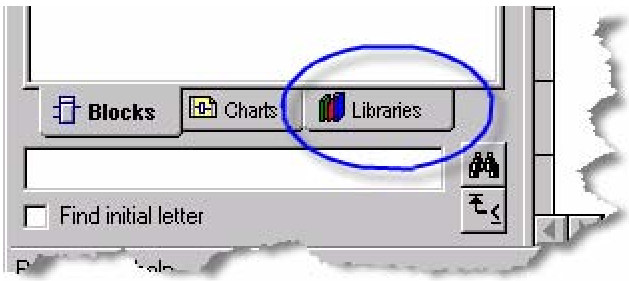


3. Double-click the chart labeled **ChannelDrivers**.
   The CFC editor opens.

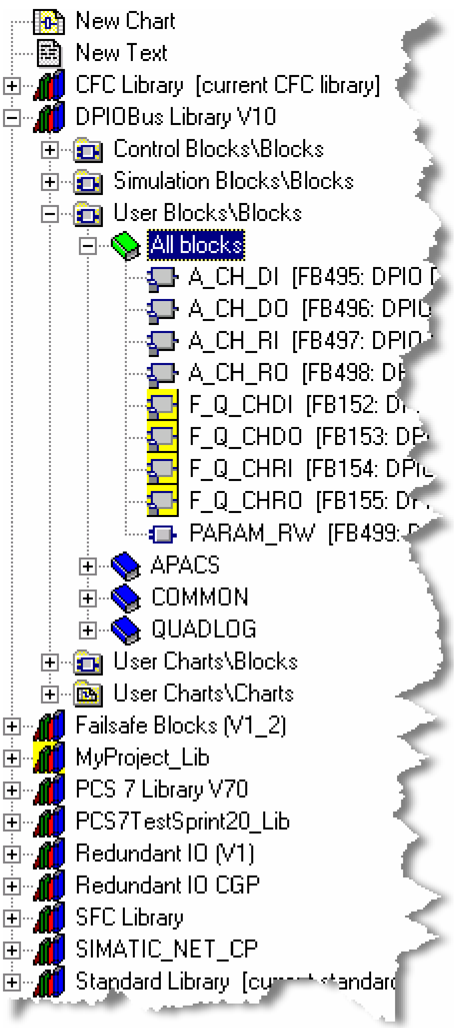
4. The catalog should be visible within the CFC editor. If it is not, press the Ctrl + K keys to toggle catalog view:



5. Click the **Library** tab and expand the **DPIOBus Library V10**:



Yellow blocks are safely blocks and grey blocks are standard or non-safety blocks:



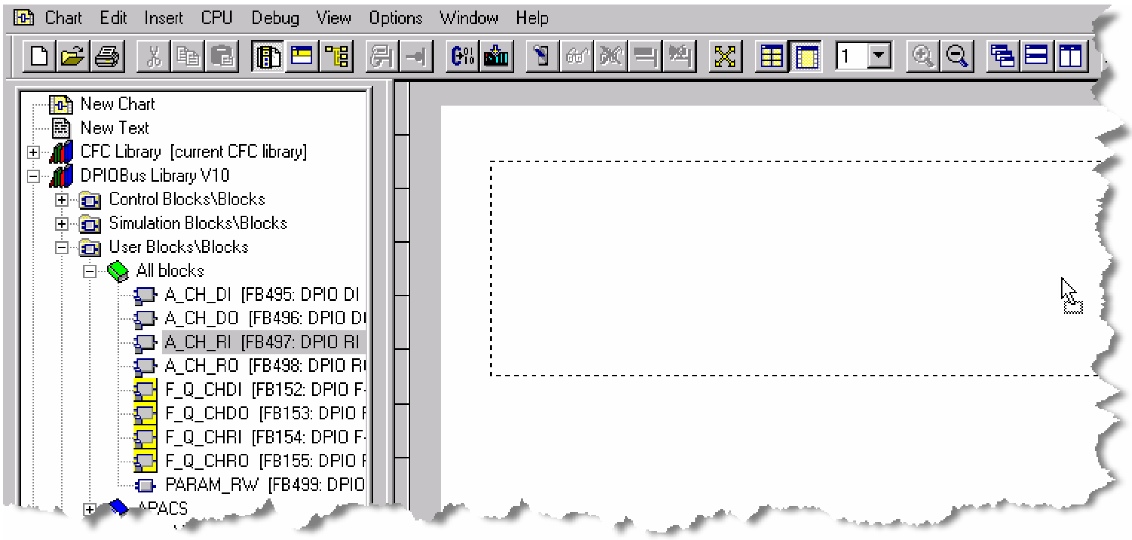
The steps that follow assume that four channels were configured within HW Config: two from a SAM and two from a CDM 24 V. From the SAM the channels are an SAIC (Analog/Real Input) and a SAOC (Analog/Real Output). From the CDM 24 V module are an SDIC (Discrete/Bool Input) and a CDOC (Discrete/Bool Output)

Because the SAM is a non-critical module, its channels are connected to grey channel driver blocks:
SAIC --> A_CH_RI
SAOC --> A_CH_RO

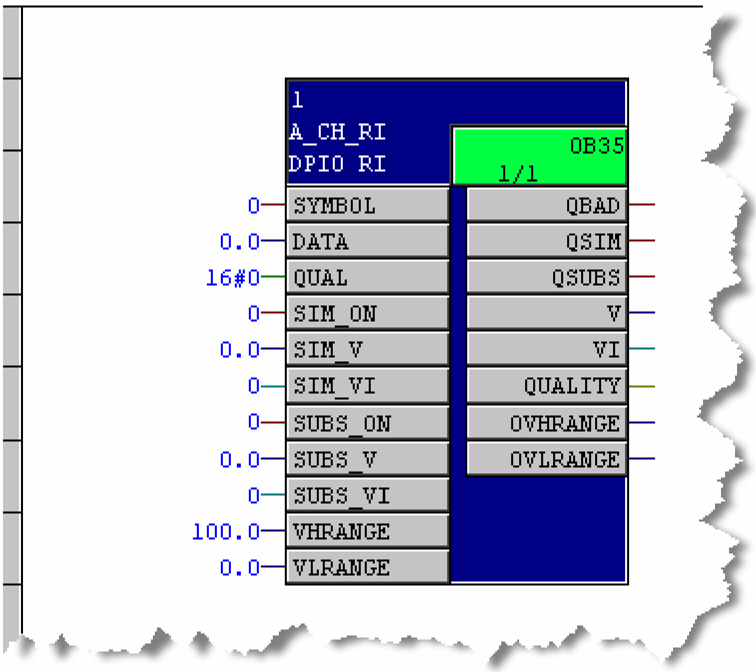
Because the CDM 24V is a critical module, its channels are connected to yellow or safety-related channel driver blocks:
ADIC --> F_Q_CHDI
CDOC --> F_Q_CHDO

3.9.1 Configuring Standard Channel Drivers

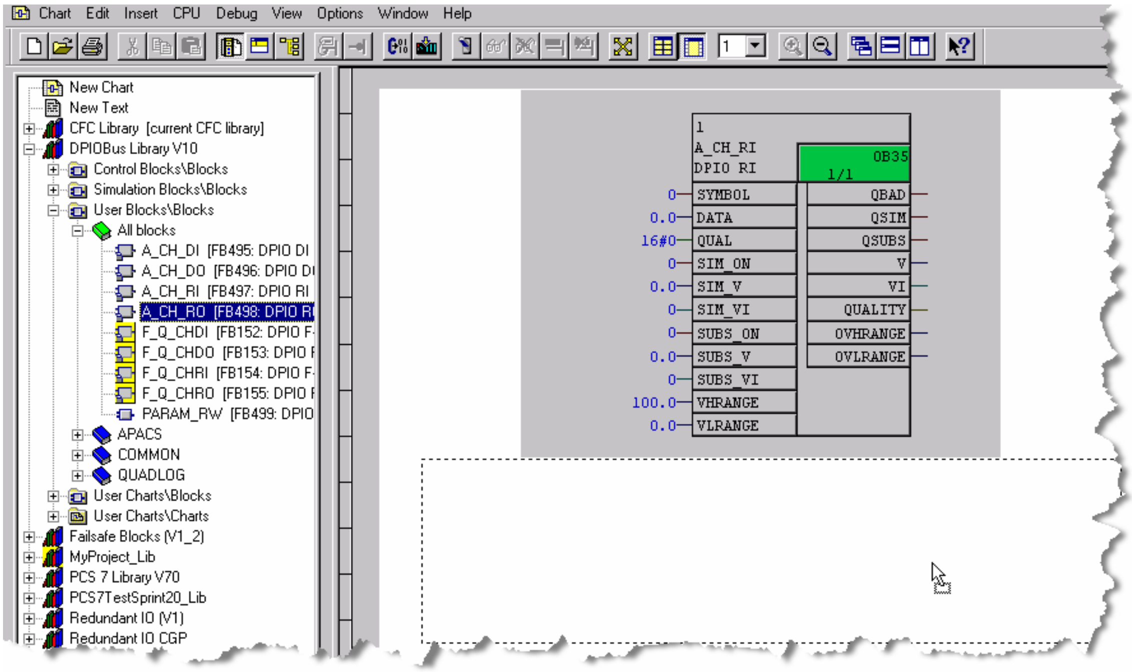
1. Click the **A_CH_RI** block in the left pane and drag it to the chart:



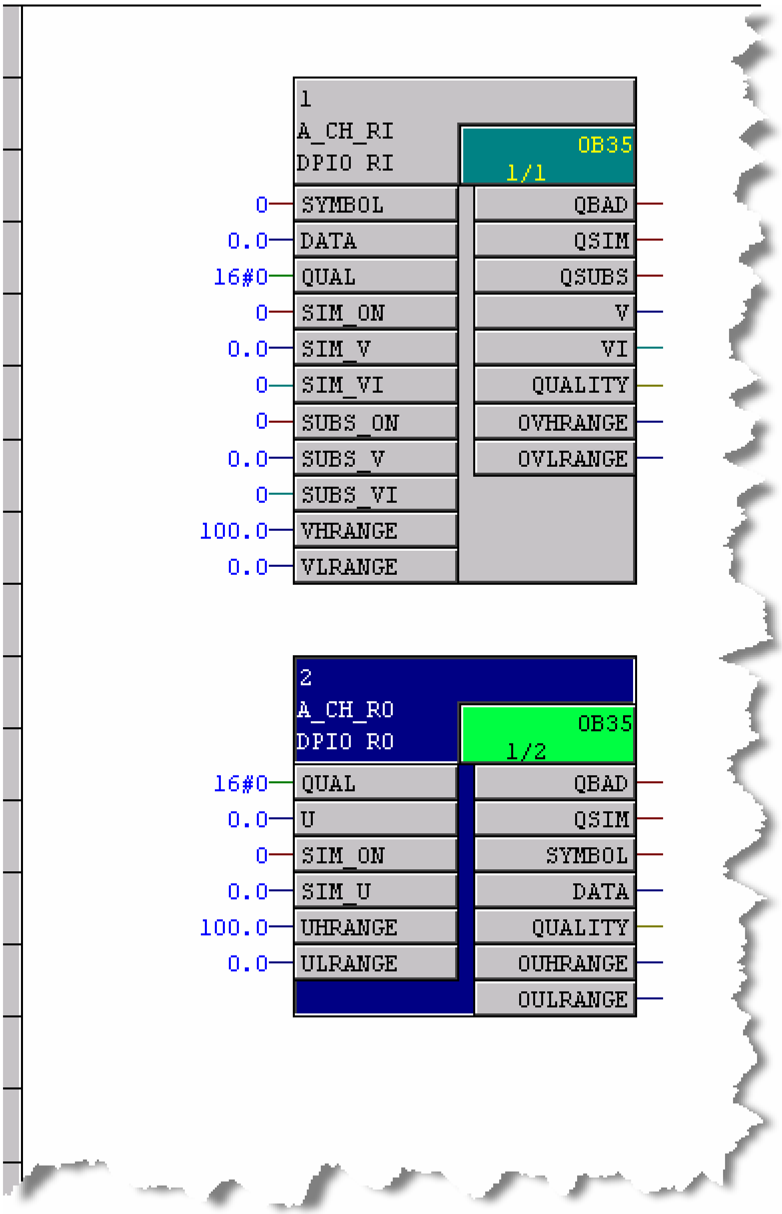
The block appears on the chart where it was dropped. Move it to a desired position:



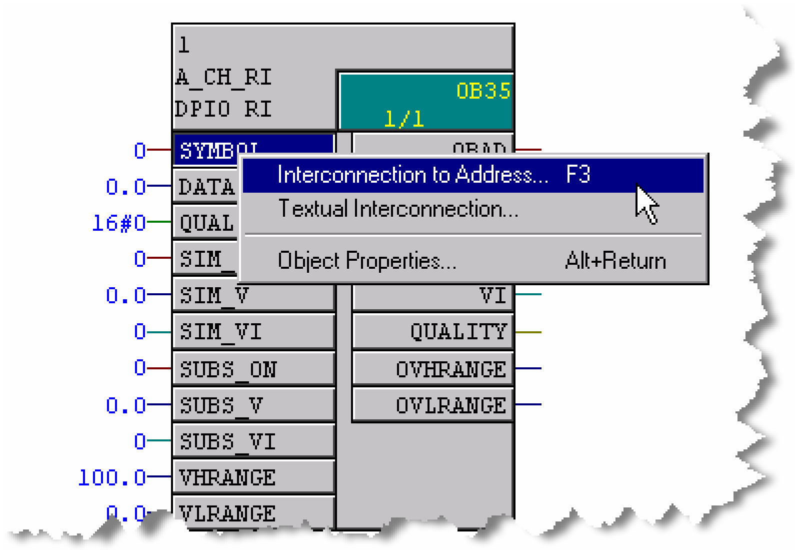
2. Click the **A_CH_RO** block in the left pane and drag it to the chart:



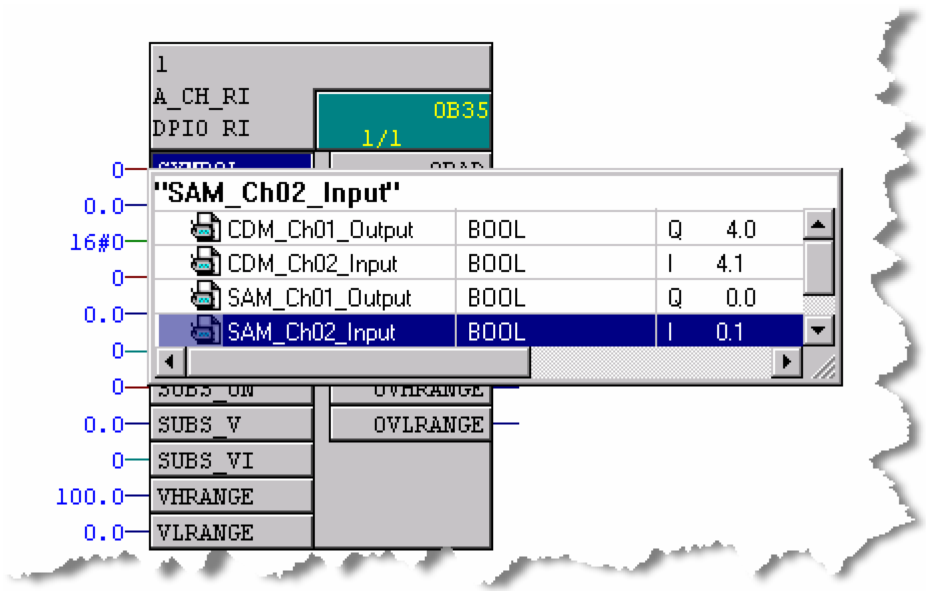
The block appears where placed on the chart:



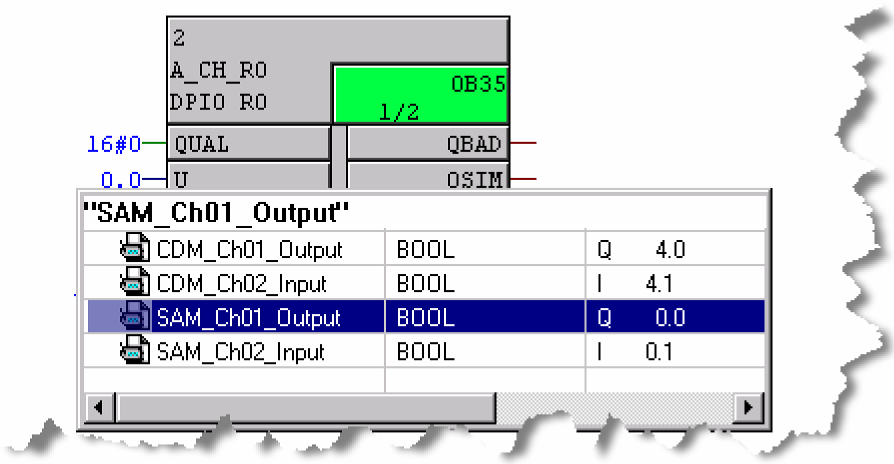
3. Right click on the **SYMBOL** input of the A_CH_RI block.
   A context menu opens:



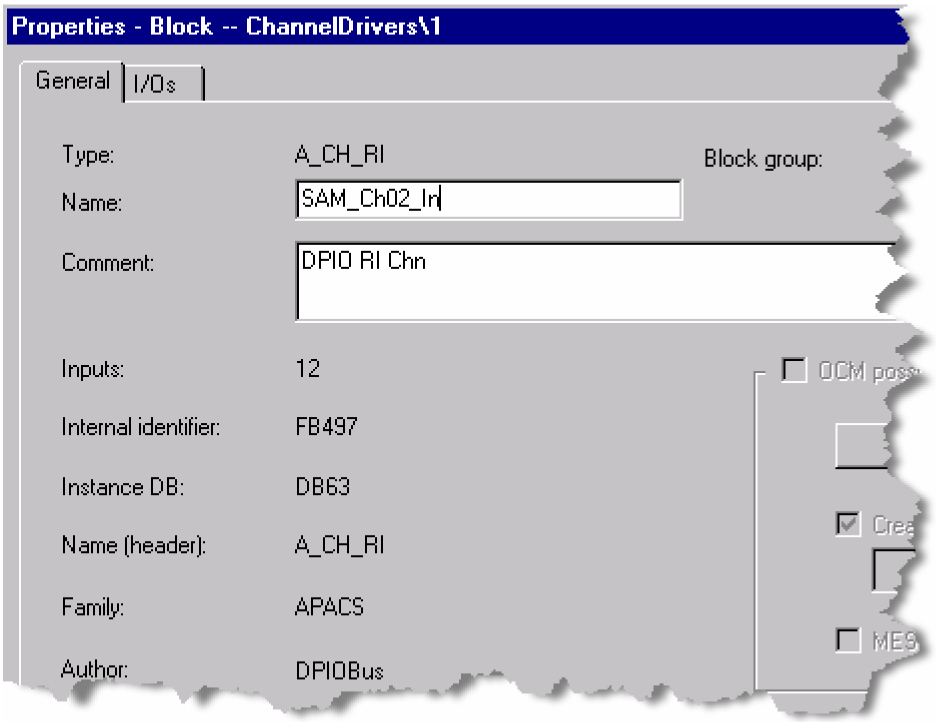
4. Select **Interconnection to Address…**
   A list of available connections appears:



5. Choose **SAM_Ch02_Input**. Double-click the entry to confirm.
6. Right click the **A_CH_RO SYMBOL** output and choose **Interconnection to Address…**
7. Select the **SAM_Ch01_Output** symbol name. Double-click this entry to confirm:



8. Select the **A_CH_RI** block and right-click. Select **Object Properties** from the context menu.
   A **Properties - Block** window appears.

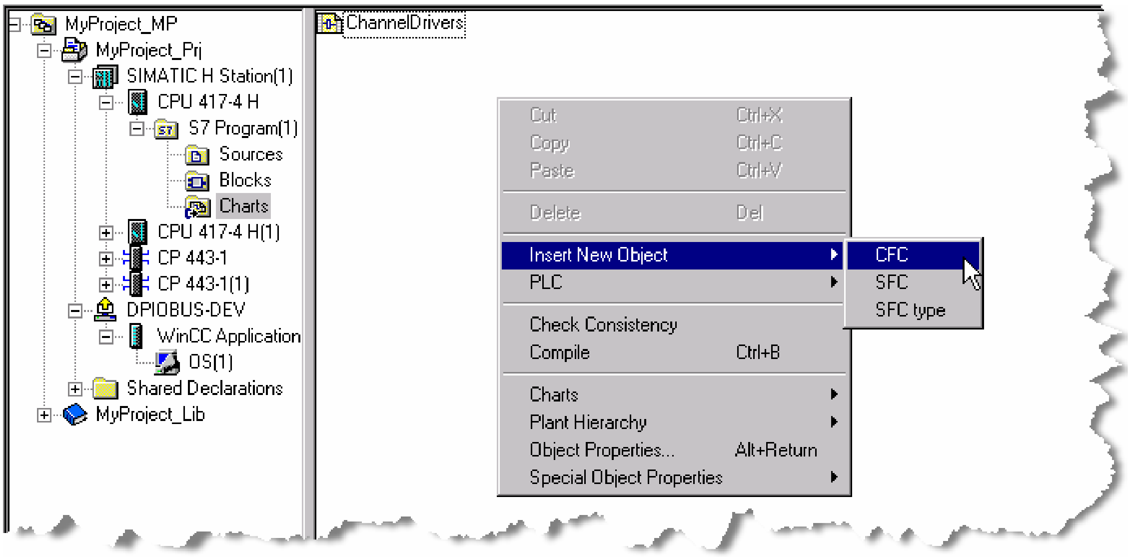


9. Provide an appropriate name and comment. Click the **OK** button to accept the change.
10. Repeat steps 8 and 9 for the **A_CH_RO** block.

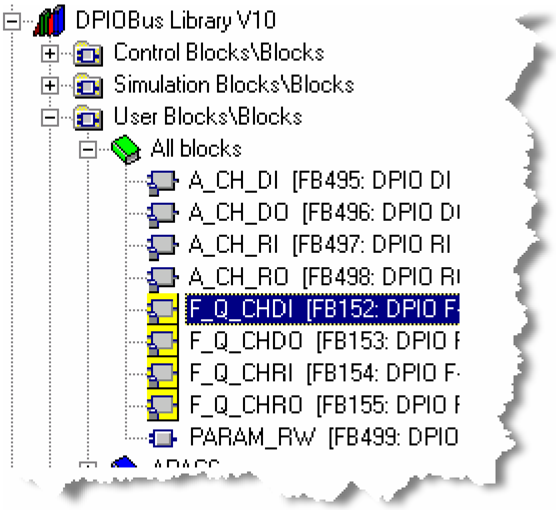
3.9.2 Configuring Safety Channel Drivers

The steps for creating safety channel drivers are similar to the steps for creating standard channel drivers and are thus less fully illustrated. Refer to the previous topic for more detail.

1. From SIMATIC Manager, select the **Charts** folder. Right-click and select **Insert New Object > CFC:**

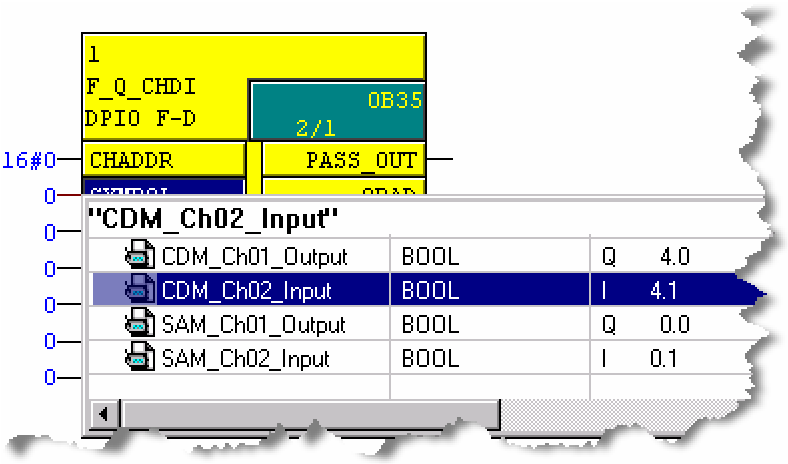


2. Rename the chart **SafetyDrivers**.
3. Double-click the chart in the right pane labeled **SafetyDrivers** to open it in the CFC editor.
4. Select the **F_Q_CHDI** function block and drop it on the chart:

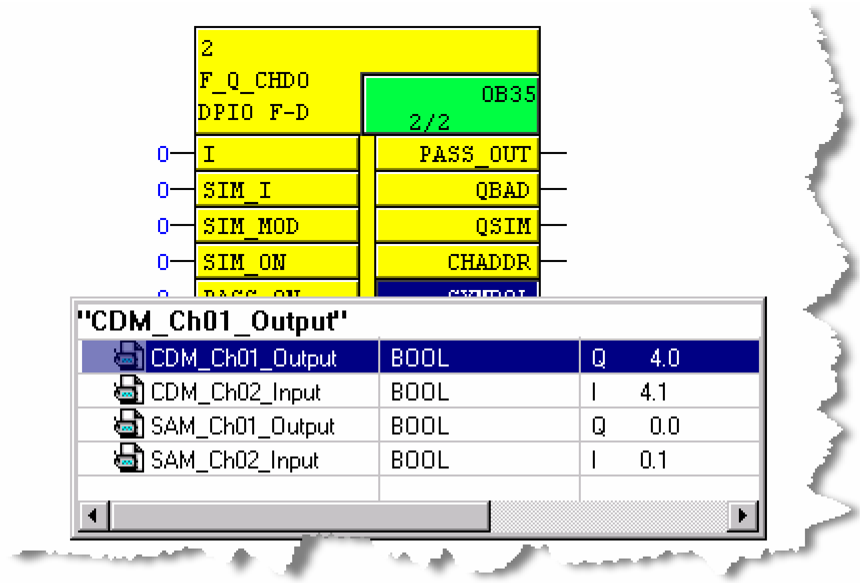


5. Select the **F_Q_CHDO** block and drag and drop it below the **F_Q_CHDI** block.
6. Right click the **F_Q_CHDI SYMBOL** input and choose **Interconnection to Address…**

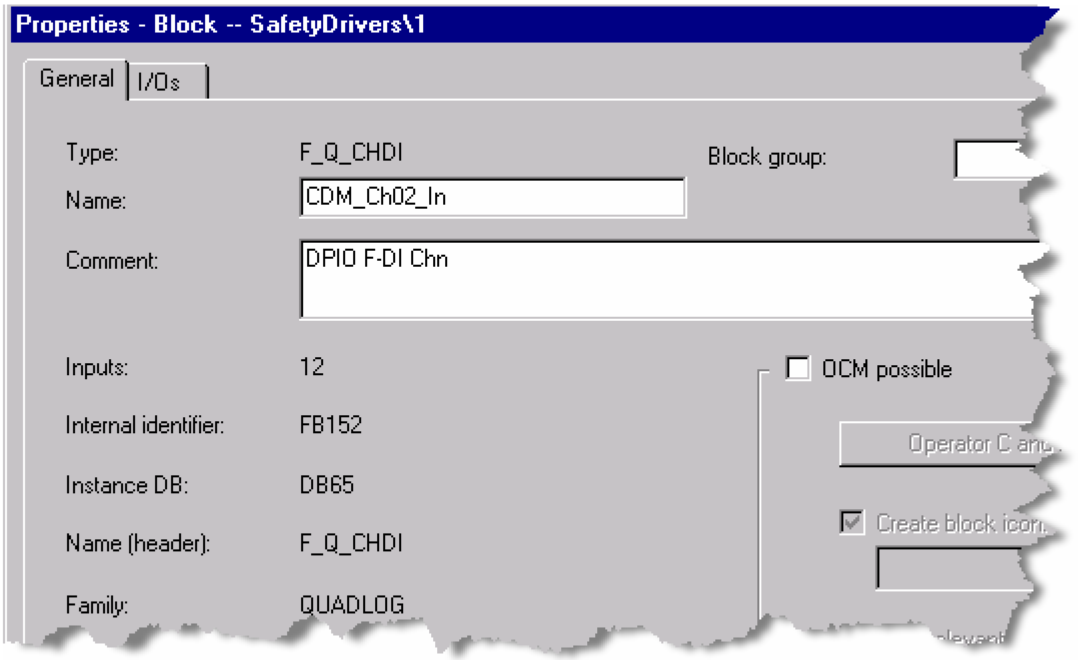
7 From the available choices select the **CDM_Ch02_Input.** Double-click to confirm:



8. Right click on the SYMBOL output on the F_Q_CHDO and choose **Interconnection to Address…**
9. From the available choices select the **CDM_Ch01_Output.** Double-click to confirm:



10. Select the **F_Q_CHDI** block and right-click. Select **Object Properties** from the context menu.
    A **Properties - Block** window appears.



11. Provide an appropriate name and comment. Click the **OK** button to accept the change.
12. Repeat steps 10 and 11 for the **F_Q_CHDO** block.

3.9.3 Configuring Additional Safety Channel Block Driver I/O

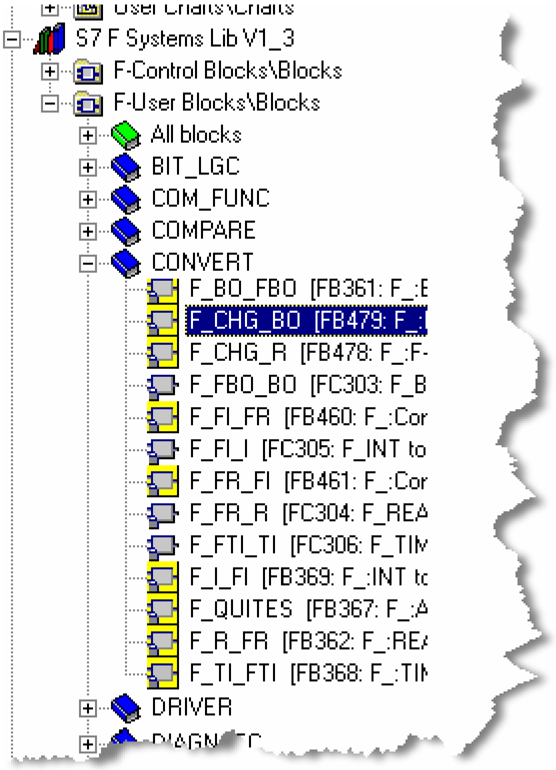
Safety Control Block Driver Channel

The F_Q_CTRL block behaves like a module driver and requires an associated F_Q_CHDI channel driver block. You can control the execution order of the F_Q_CTRL block by placing its channel driver in the appropriate organizational block (OB) or runtime group (RTG). See the section titled Notes on Using the Driver Blocks.

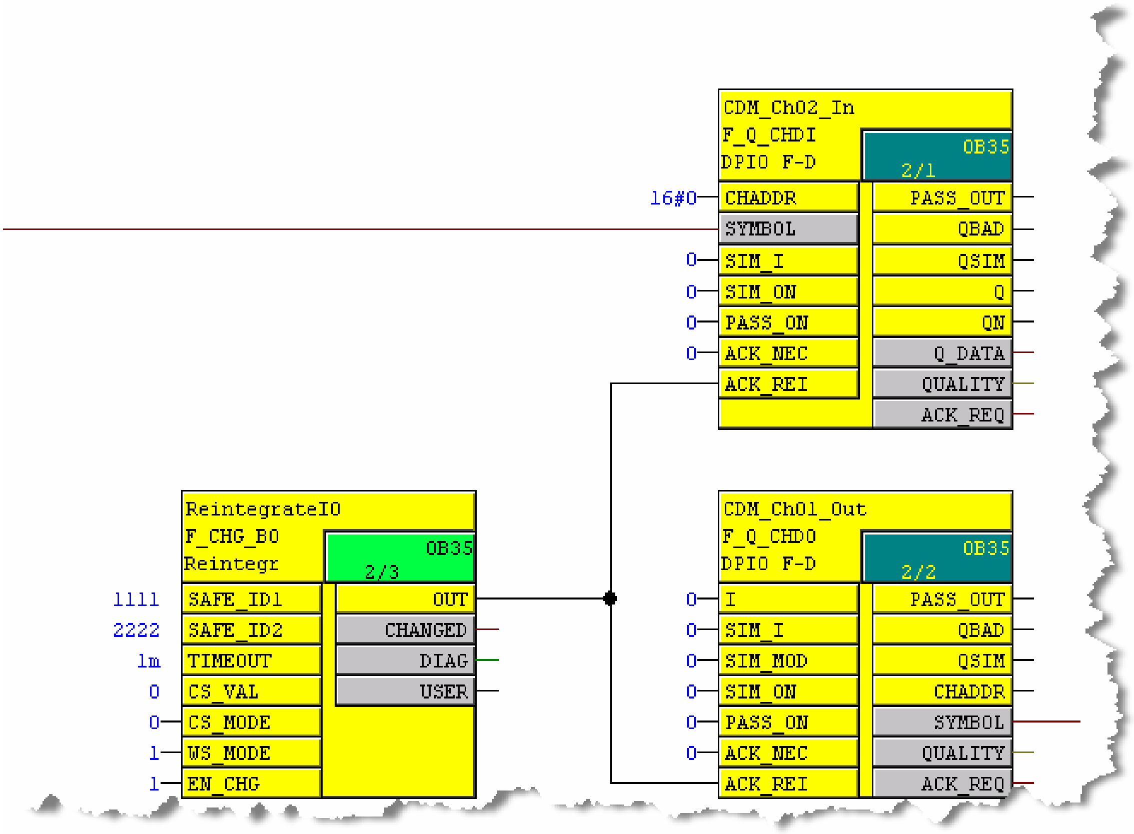
Safety Channel Block Driver Reintegration

The safety channel driver blocks have some additional inputs and outputs for use with safety systems. Among these is the input the **ACK_REI**, required to reintegrate the I/O, and the **F_CHG_BO** function block. For more information on reintegration within F-Systems please refer to the document *SIMATIC S7 F/FH Systems Configuring and Programming*.

1. Within the same SafetyDrivers chart expand the Failsafe Blocks library. Expand the F-User Blocks folder to reveal the CONVERT folder:

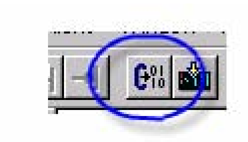


2. Place the **F_FHG_BO** on the chart and rename the block to **Reintegrate IO**.
3. Change the value of **SAFE_ID1** and **SAFE_ID2** to unique values.
   Change the **EN_CHG** value to 1 to enable the block.
   Connect its **OUT** output to the **ACK_REI** inputs of both the **F_Q_CHDI** and **F_Q_CHDO** blocks:

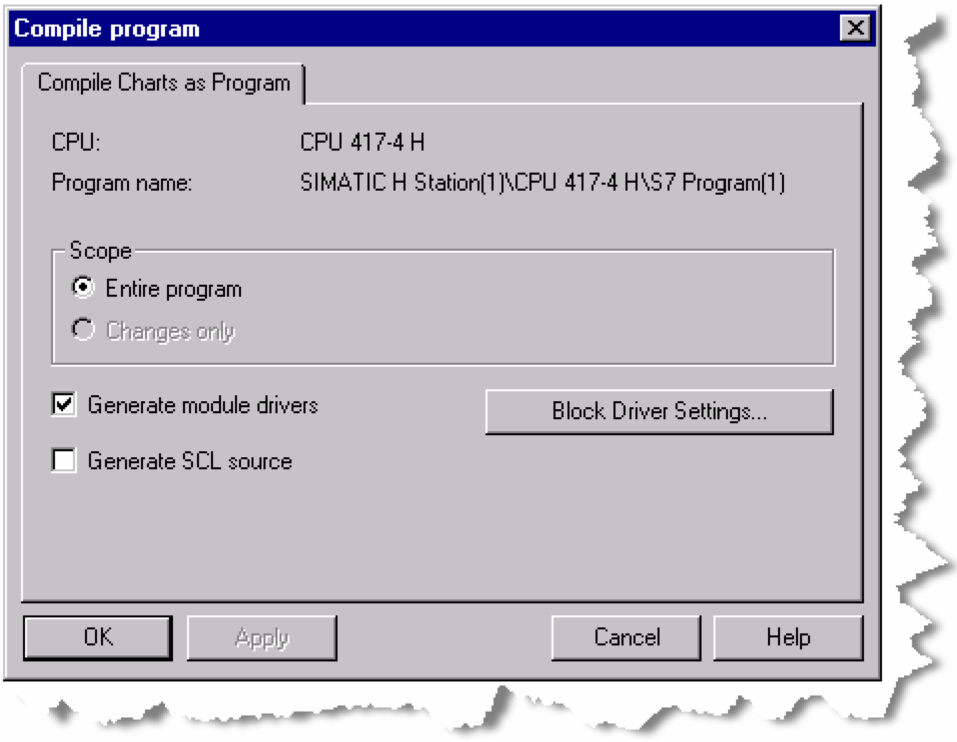


3.9.4 Compiling the CFC

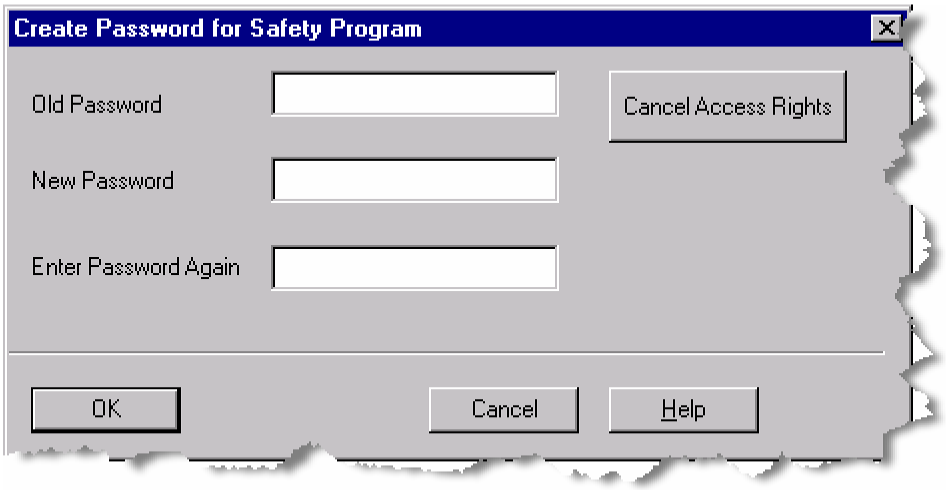
1. Click the **Compile** icon:



The **Compile program** window opens:



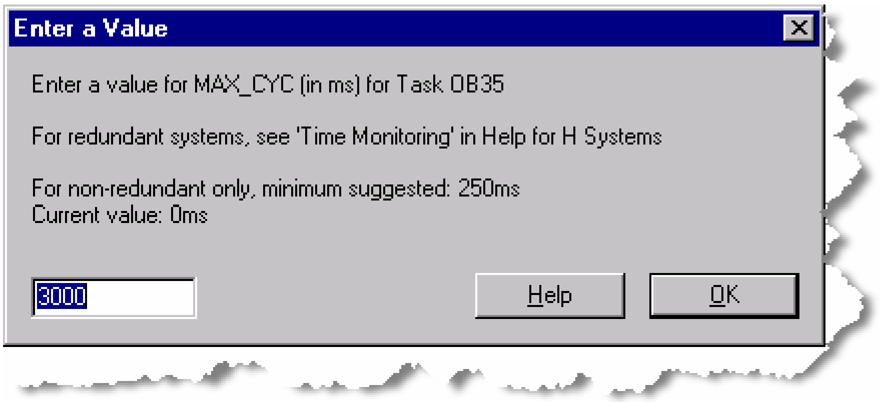
2. Ensure that the **Generate module drivers** checkbox is selected.
   Press the **OK** button to begin the compile.
   A **Generate module drivers** window shows the progress of the compile.
   When the compile completes, a **Create Password for the Safety Program** window appears:



The password for sample projects provided with the DP/IO Bus Link module is a single press of the spacebar. Although this is sufficient for sample projects, for an operational system you should choose a password that adheres to your organization's security standards.

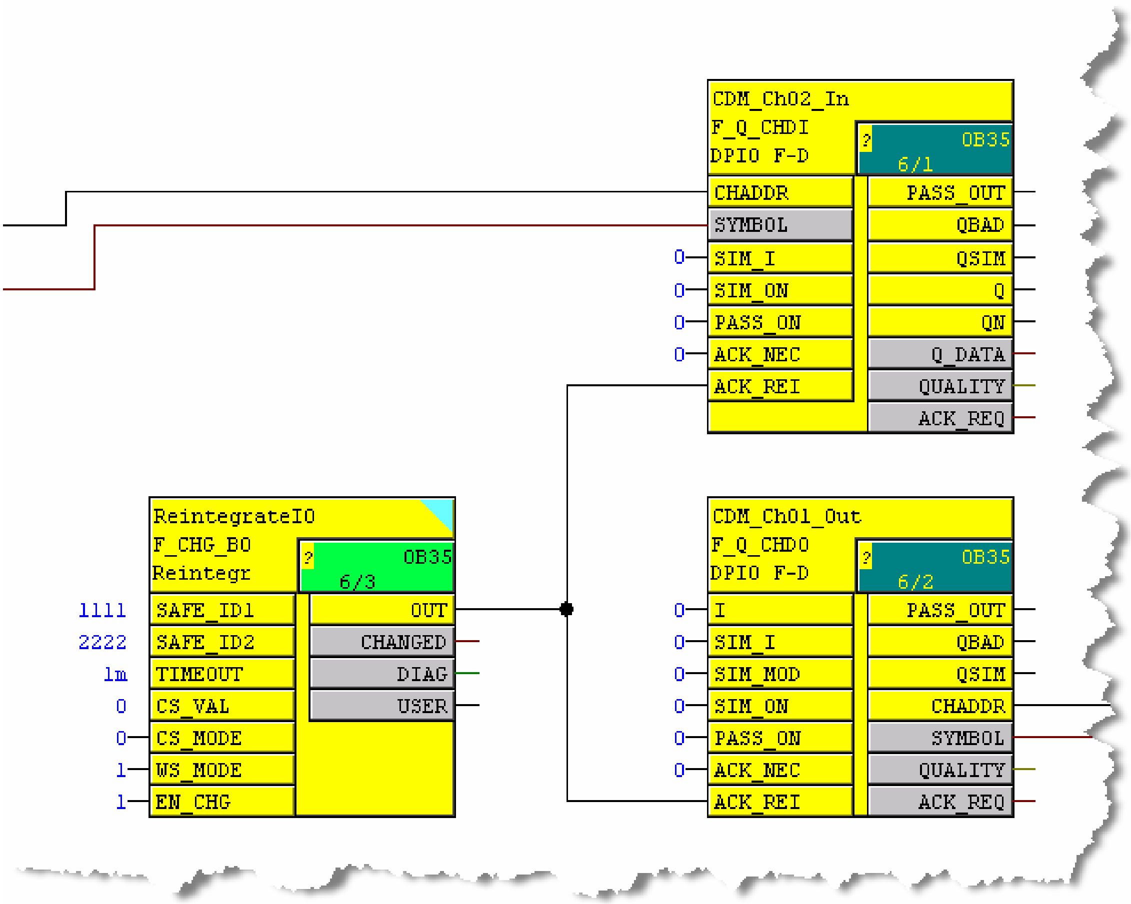
The first time you enter a password for a safety program, the cursor will not rest in the **Old Password** field. Instead it advances to the **New Password** field.

3. Enter and re-enter it. Click the **OK** button.
   The **Enter a Value** window opens:



4. In an operational project the value assigned to **MAX_CYC** must be changed. Please refer to the document *SIMATIC S7 F/FH Systems Configuring and Programming*.

The results of the compile are evident by the **CHADDR** input and output connections to the module driver blocks in other charts created automatically by the module driver wizard:



Note

For optimal performance, After compiling your CFC project, check the Archive setting for each **OCM possible** I/O on each driver block (DPIO_DRV, MOD_DRV, F_Q_MOD) and each F_Q_CTRL block. Ensure that the setting is correct for your project so that the OS only writes important values to the archive.

If you change the Archive settings for an I/O you will need to recompile CFC and the OS.

3.10 Configuring the Simatic Project for OS Operation

Overview

An operator station (OS) provides displays that allow an operator to view and oversee plant data.

To make DP/IO Bus block icons available in the OS, the associated charts (CFC) must be placed in the appropriate location within the hierarchy of the project's Plant View. Placing the chart at the proper level adds the block icons to the picture at that hierarchy level.

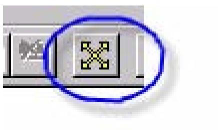
The associated charts are those containing the following block types:

- **DPIO_DRV** block
- **F_Q_MOD** blocks (one for each safety critical module)
- **MOD_DRV** blocks (one for each non-safety critical module)
- **F_Q_CTRL** block

Determining Which Charts Contain DP/IO Blocks

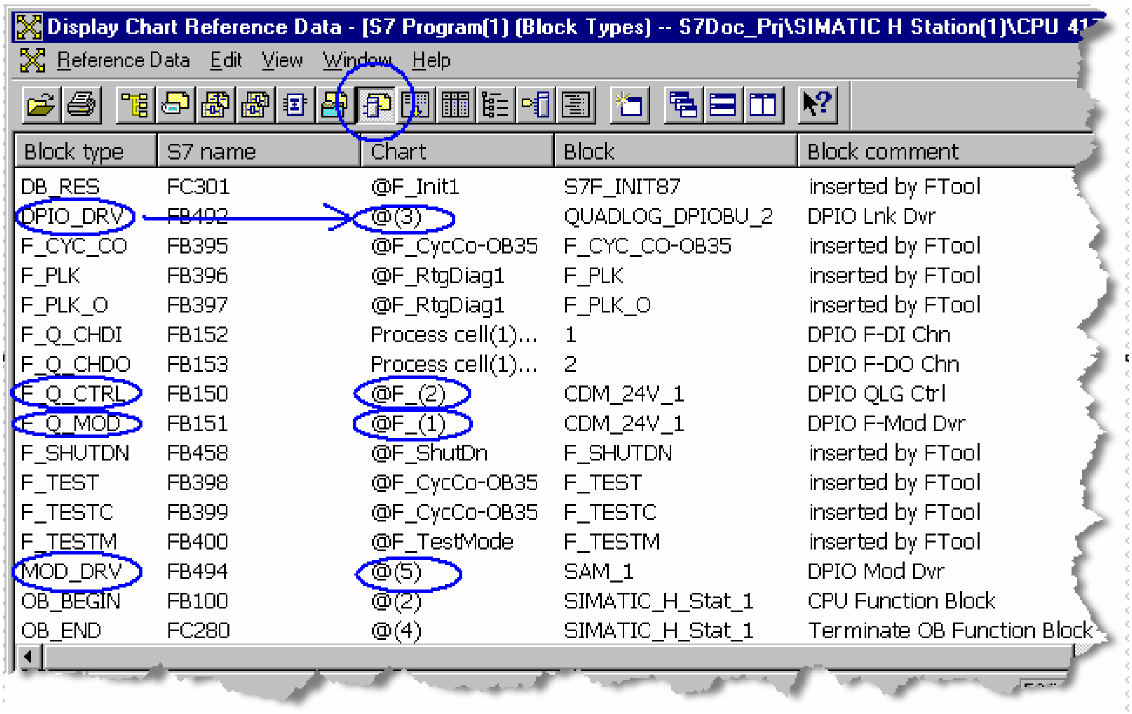
To determine which charts contain these blocks, perform the following:

1. From within CFC, click the **Chart Reference Data** toolbar button.



   The **Display Chart Reference Data** window opens.
   A message appears indicating that no list has been selected.

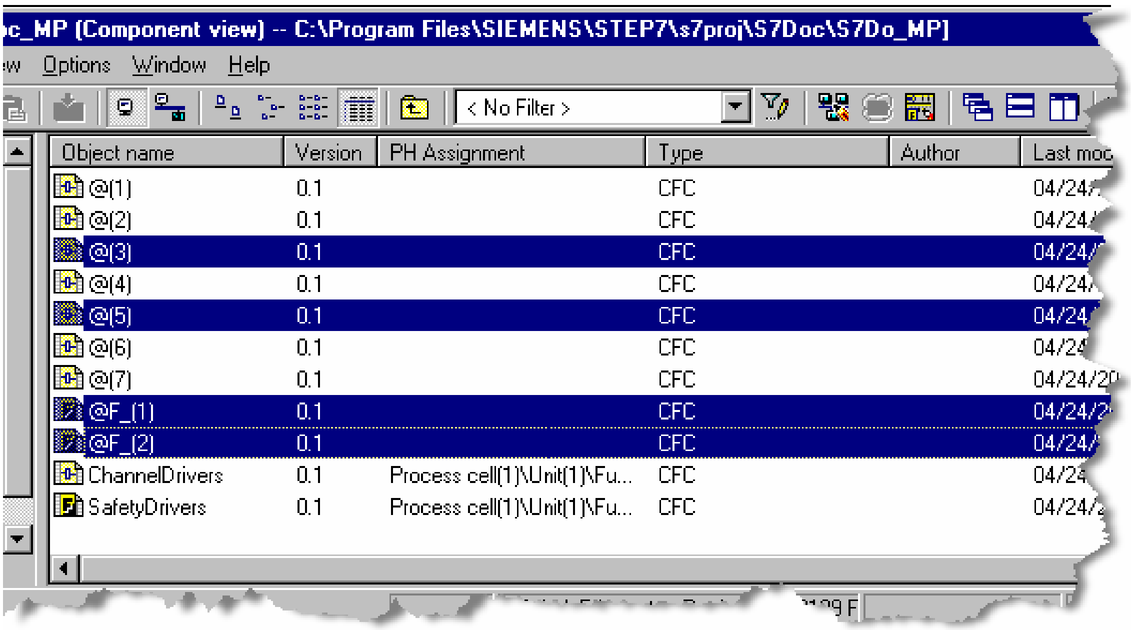
2. Select the **Block Types** icon on the toolbar.
   Charts containing these blocks are displayed as shown below:



Record the name of the charts that contain these block. The illustration above is representative, but may not apply in all instances.

Placing Charts in the Plant View

1. Use SIMATIC Manager to open the charts folder in your project's hierarchy in the component view.
2. On a chart-by-chart basis, for each chart containing one of the block types listed above, select, right-click, and cut the chart.

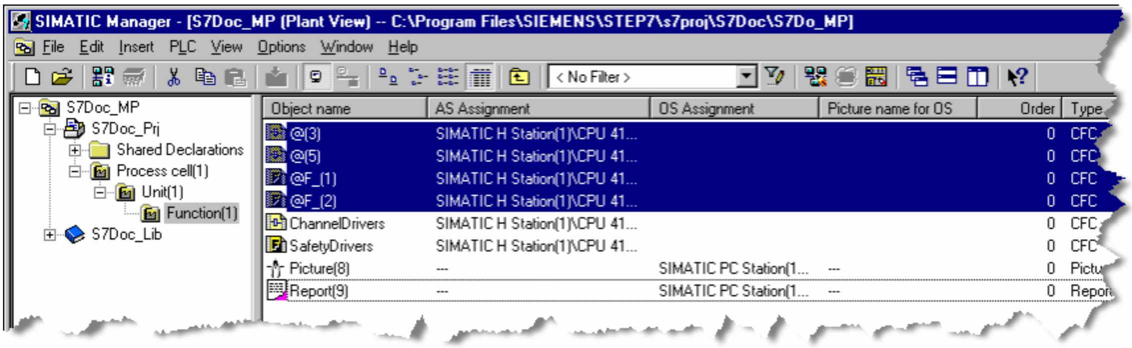


Note

In the next step, you paste a chart into a destination folder. Before doing so, ensure that the chart for the DPIO_DRV block and its associated F_Q_CTRL block are in the same hierarchy area. Otherwise, the safety pane in the link module's faceplate may not function correctly.

---

3. In the Plant View tree, right-click the destination folder where you want the block icons associated with that chart to be displayed. Select **Paste**.



When you subsequently compile the OS, block icons are added to pictures associated with this hierarchy folder.

Ensure that this has been done for each chart containing a DP/IO Bus Link module block so that you have at least one picture with a block icon for each module.

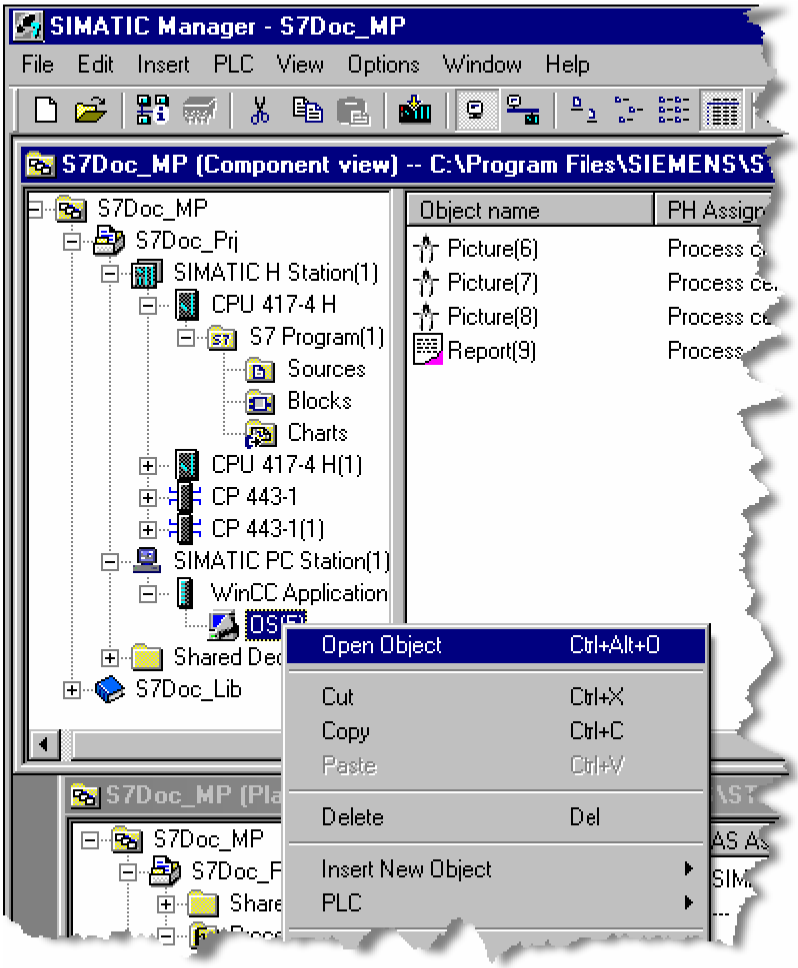
Editing the OS project

Note

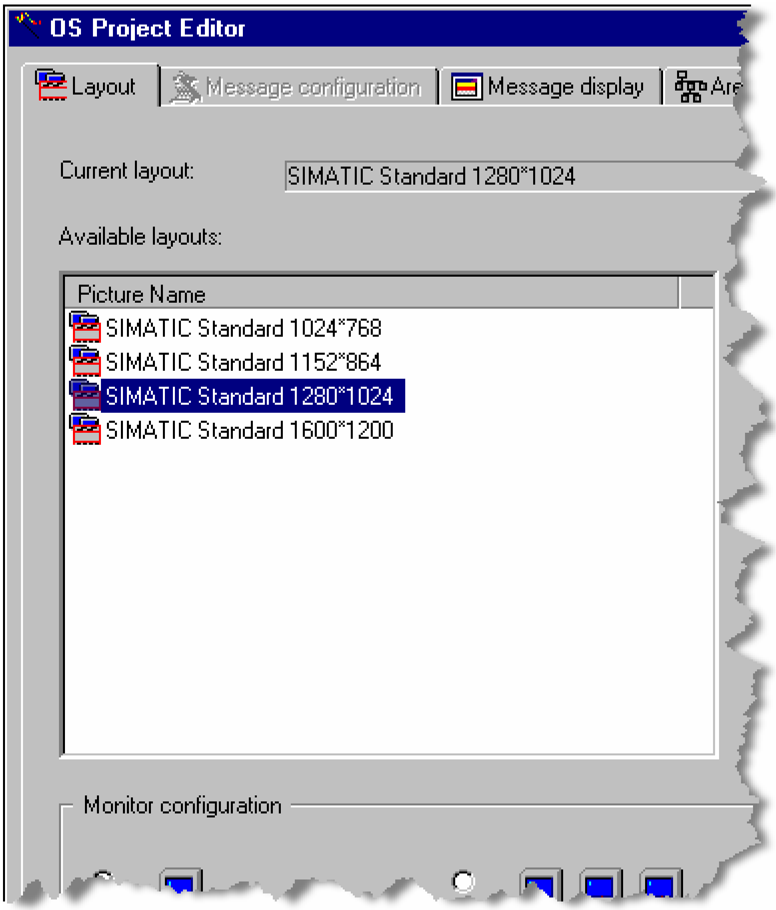
Before compiling your OS project, ensure that the **OCM possible** I/Os on each driver block (DPIO_DRV, MOD_DRV, F_Q_MOD) and each F_Q_CTRL block are correctly set for your project. If not, set them as needed and recompile CFC. Otherwise, when your OS goes to runtime, it may start writing values of no importance to an archive, thus affecting performance of the OS.

---

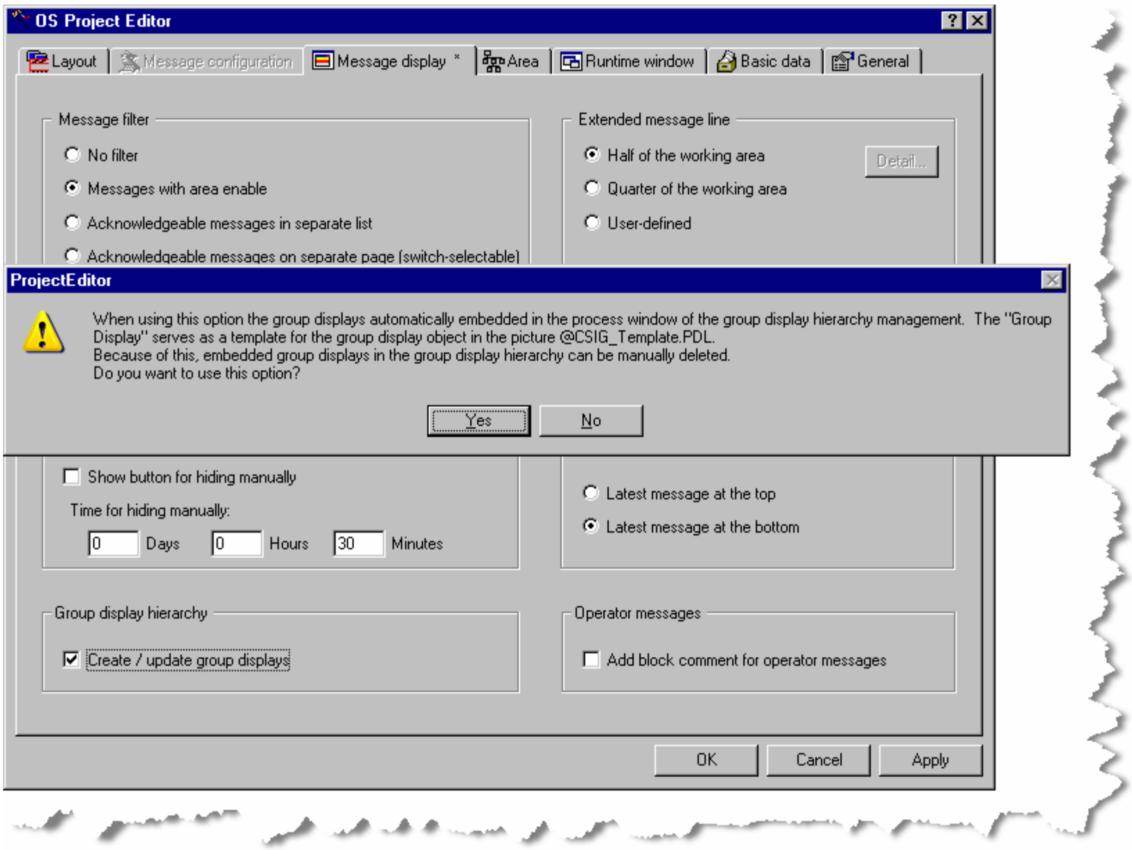
1. From the Component View, open the OS by clicking the OS object name and selecting **Open Object** from the context menu:



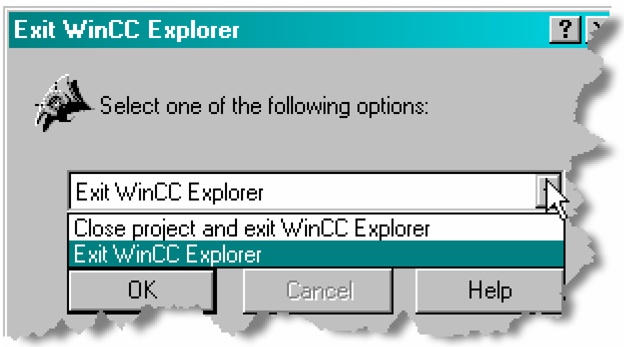
2. From WinCCExplorer, open the **OS Project Editor**. Select the **Layout** tab. Set the screen resolution to 1280 x 1024 or higher (in accord with your monitor's resolution setting). A lower resolution results in faceplate cropping



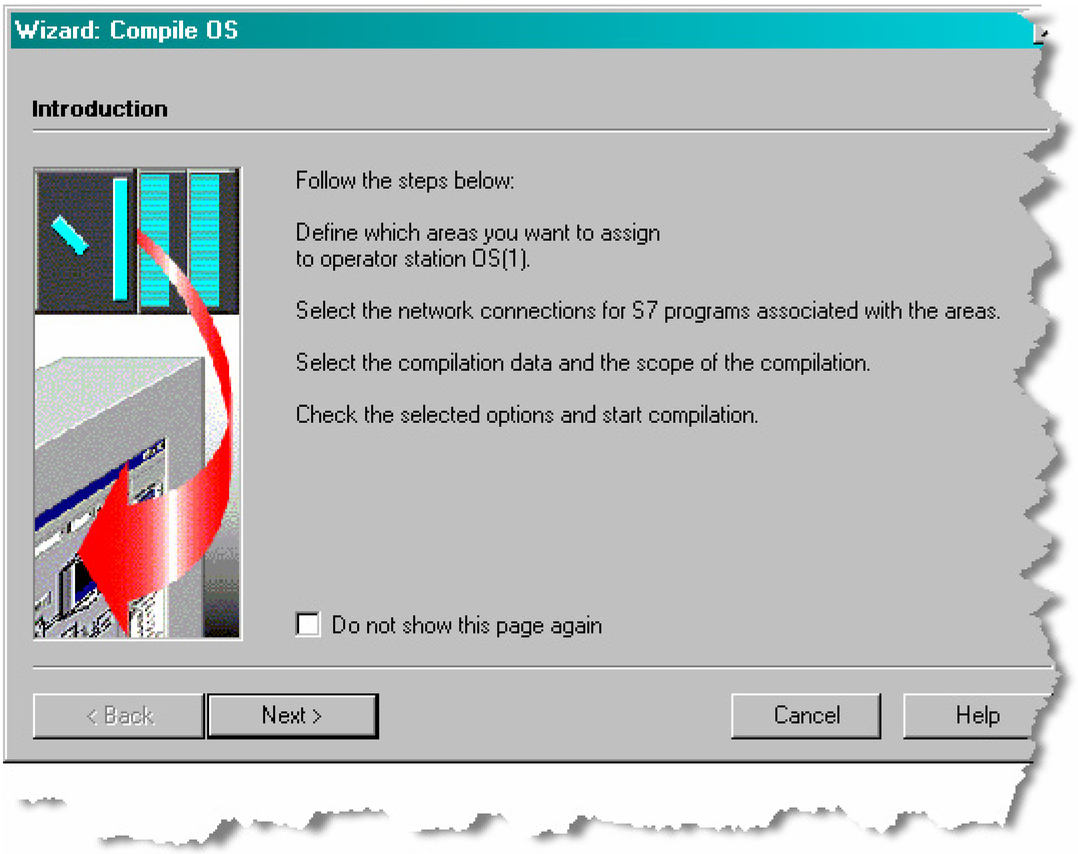
3. Click the **Message Display** tab. Select the checkbox labeled **Create/update group displays**. This selection ensures that alarm information is aggregated up the runtime hierarchy. Selecting this checkbox produces the following warning:



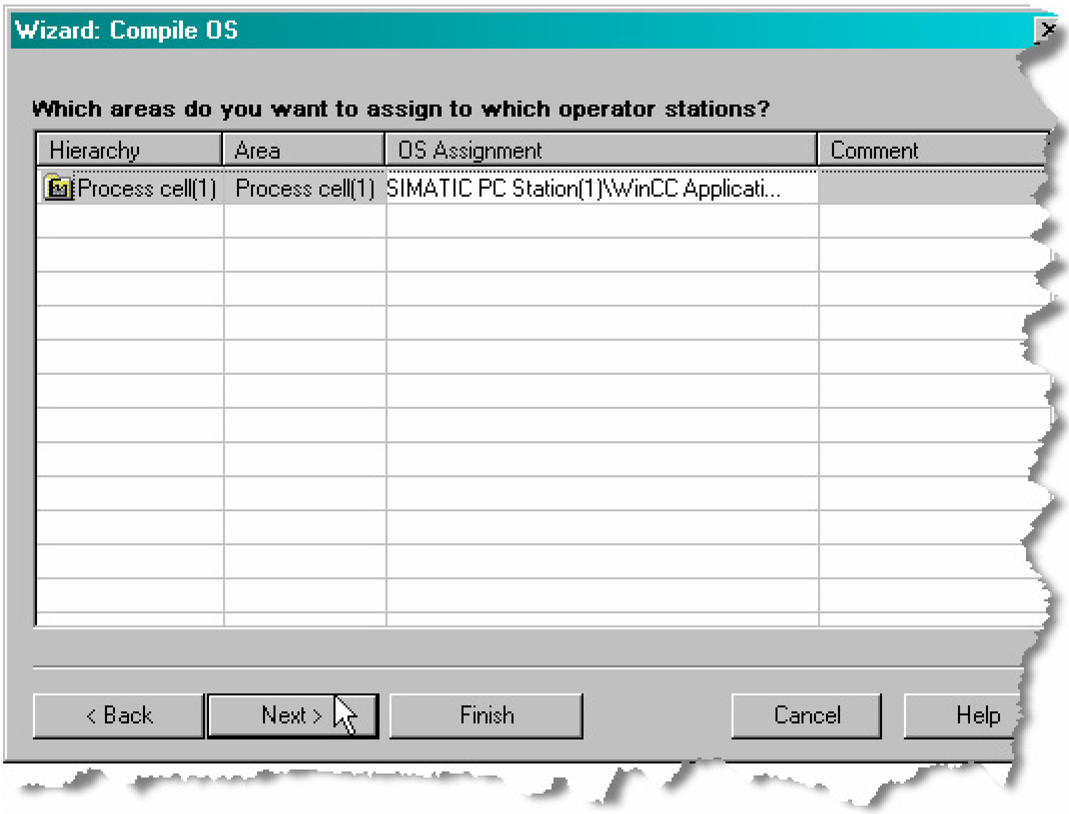
4. Click the **Yes** button to acknowledge the warning.
5. Click the **OK** button to configure the OS project and close the editor.
   A window opens asking whether to close the project and exit or to exit:



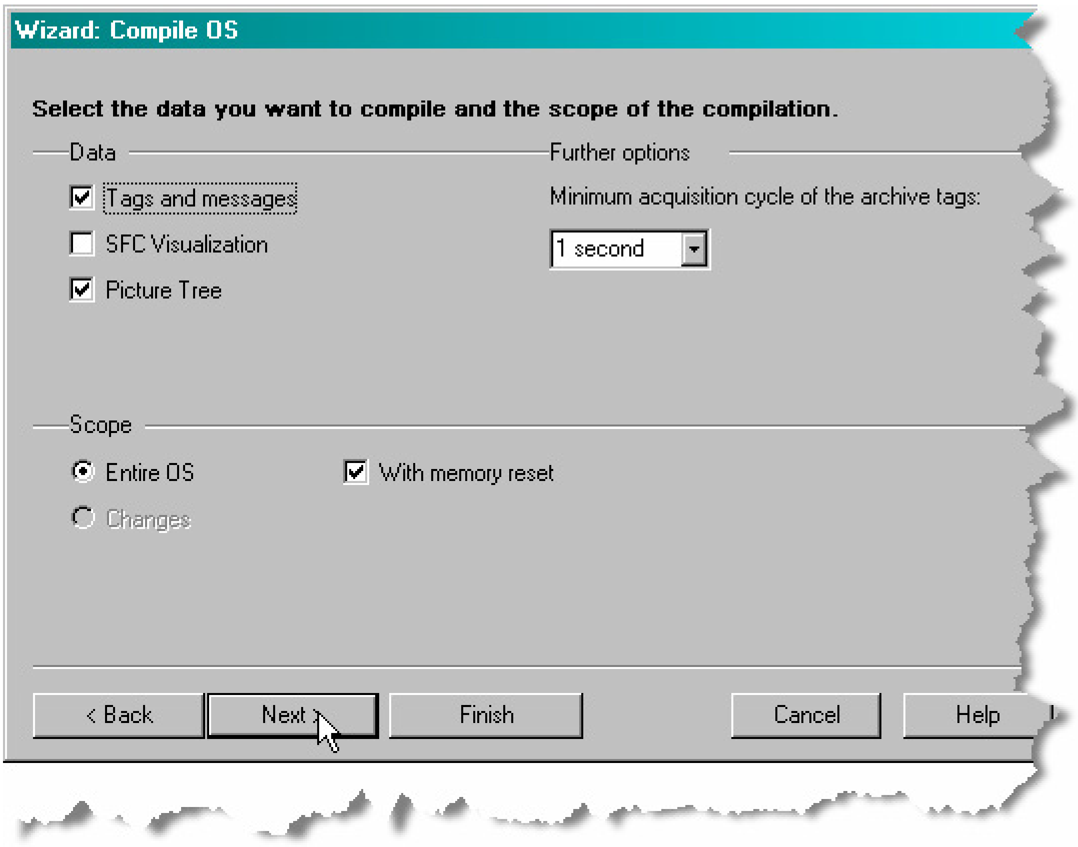
6. Select **Close project and exit WinCC Explorer** and click the **OK** button.
7. Within SIMATIC Manager,
   - Select the OS
   - Right-click
   - From the context menu, select **Compile** the OS.
     The **Wizard: Compile OS** opens



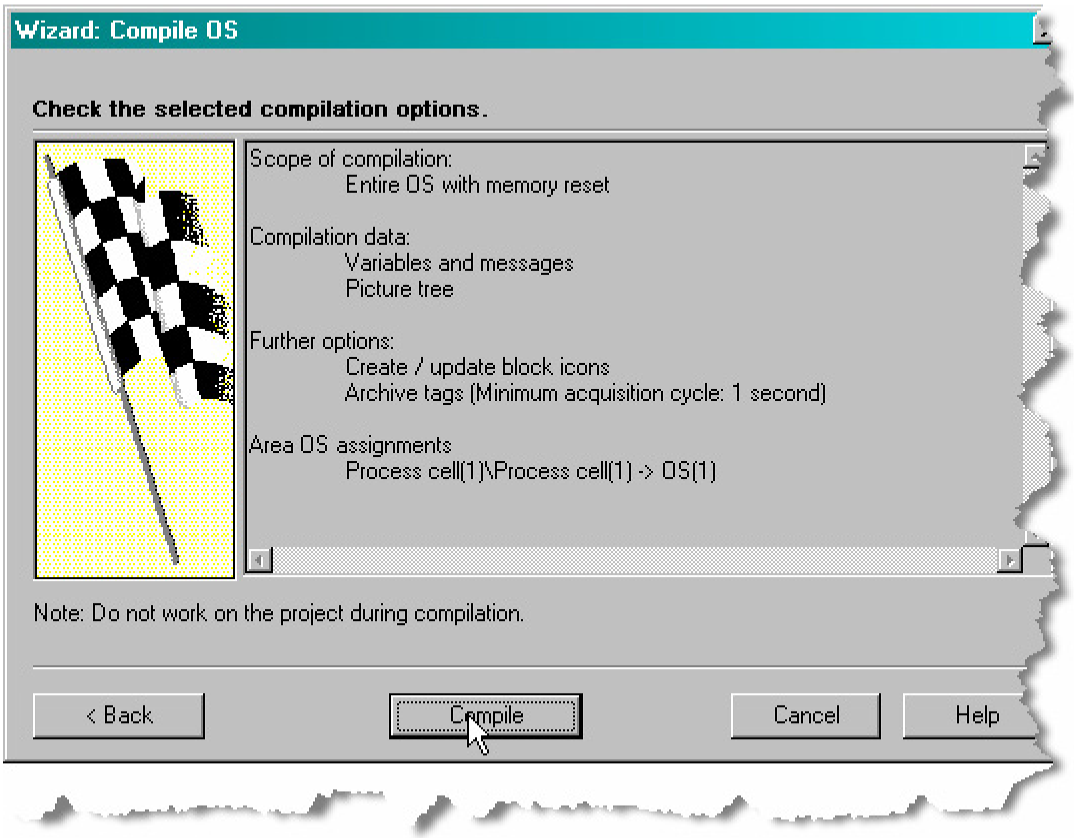
8. Click the **Next** button.
   The wizard list the areas that can be assigned to an OS:



9. Click the **Next** button. A wizard asks you to select network components.
10. Click the **Next** button.
    The wizard asks you to indicate the scope of the compile:



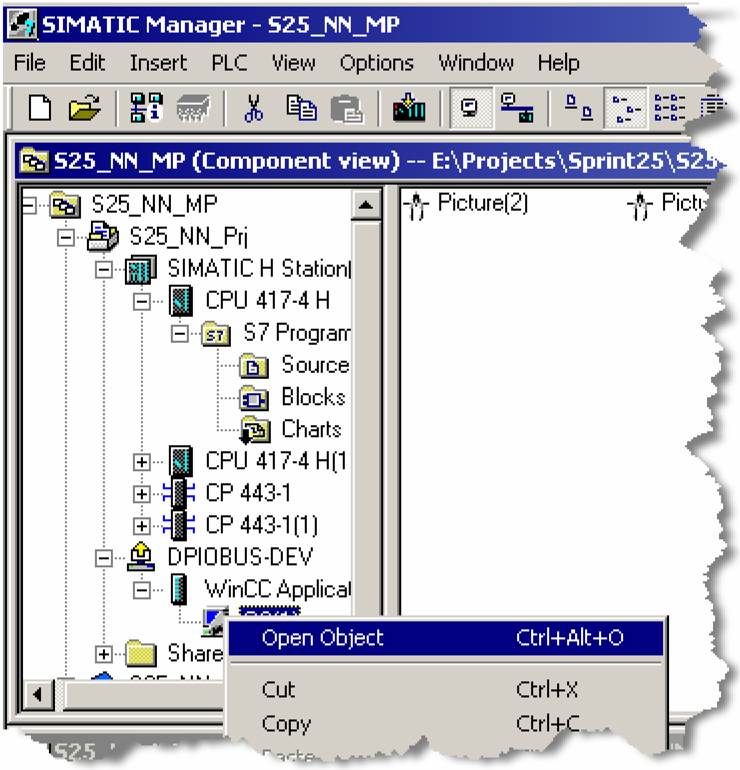
11. Click the **Next** button.
    The wizard lists the option and gives you a chance to cancel:



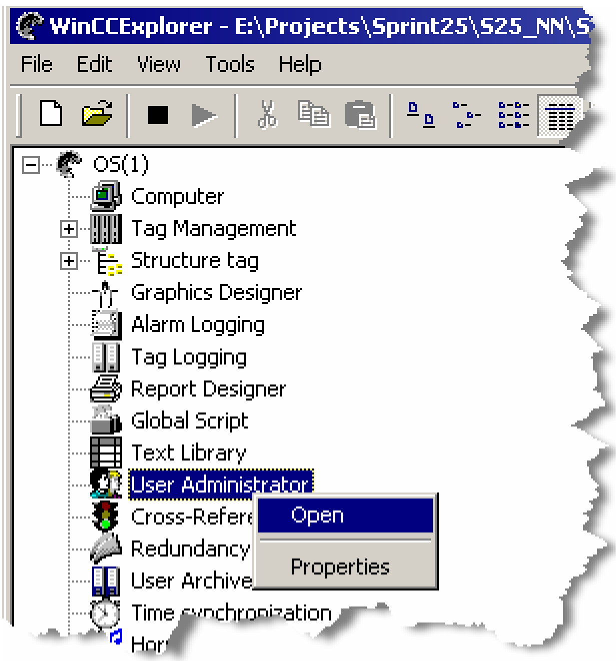
12. Click the **Compile** button.

Adding User to an OS Project

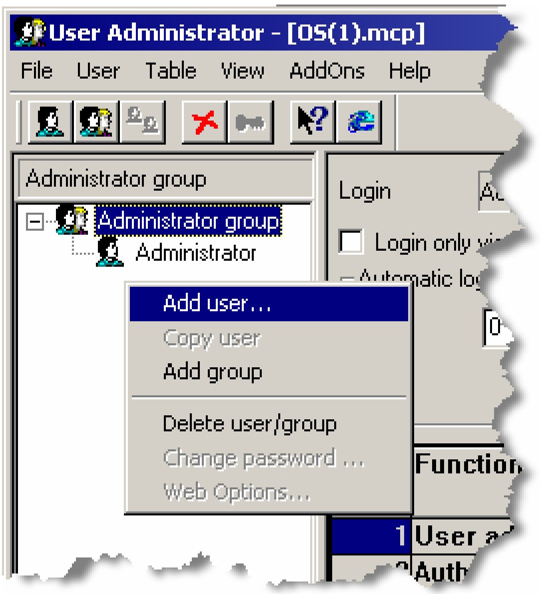
1. In SIMATIC Manager, start WinCC Explorer by clicking the OS and selecting **open Object:**



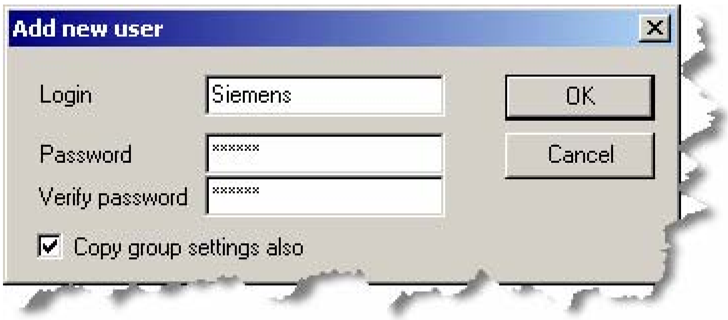
2. Open the **User Administrator** utility by clicking it and selecting **Open**:



3. Right-click in the left pane and select **Add User**:



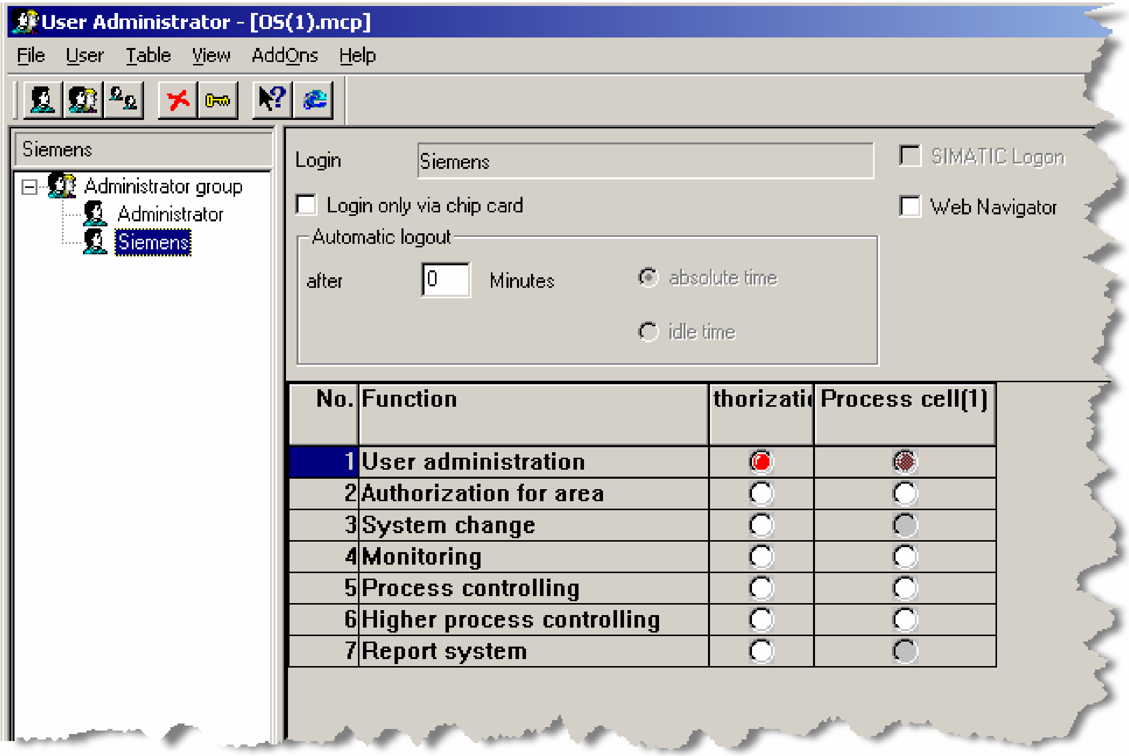
4. In the **Login** field enter `Siemens`. In the **Password** and **Verify password** fields, enter `123456` or any user account name and password: If the checkbox is selected, the person logging in has all the privileges of his or her user group.



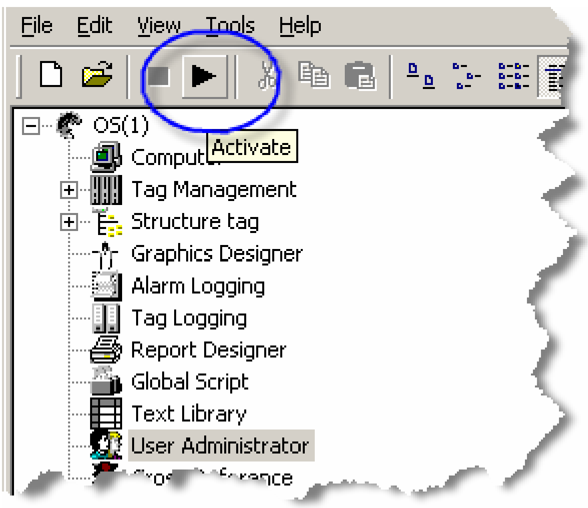
5. Click the **OK** button.
6. Double click the buttons in **Authorization** column as necessary to assign permissions. The **Level** column in the table that follows corresponds to the **No.** rows in the user-administration window. The **Permission** column refers to tasks that pertain to the operation of a system that includes a DP/IO Bus Link module. Level 6 permission is required to make changes from an OS faceplate:

Level	Permission
1-4	View all Panes
5	Acknowledge alarms Change scan rate Request switchover Purge error history
6	Safety Pane: • Reset I/O shutdown • Change checkbox states

In the following illustration, to assign level 2 permissions, for example, it is necessary to select the **Authorization** column in rows 1 and 2. To provide level 6 authorization, it is necessary to select columns 1 through 6. Select columns by double-clicking; simply clicking has no effect:



7. Activate WinCC runtime mode by click the **Activate** button on the toolbar:

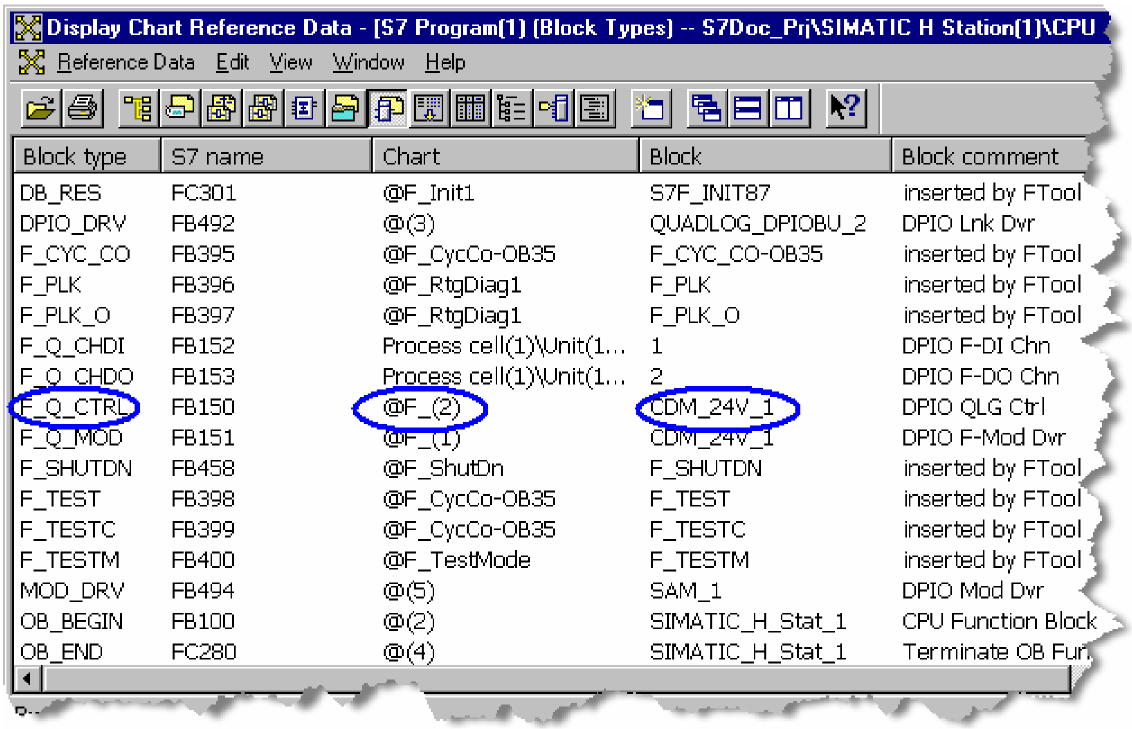


The WinCC runtime screen appears.

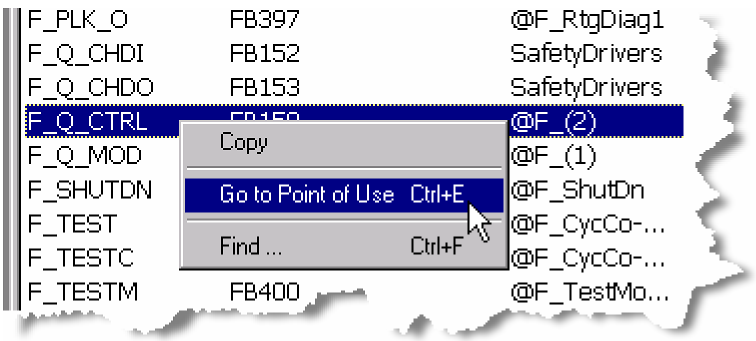
8. Click the **System Login** box, enter the user name and password, and click the **OK** button

Naming the Safety ID Input of the F_Q_CTRL Block

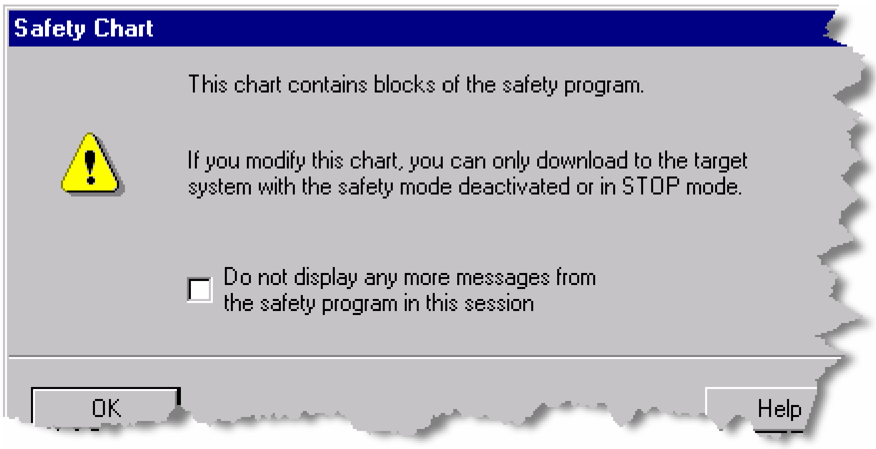
1. Return to the **Chart Reference Data**. Find the chart that contains the **F_Q_CTRL** block. Record the name of the chart and block for use later:



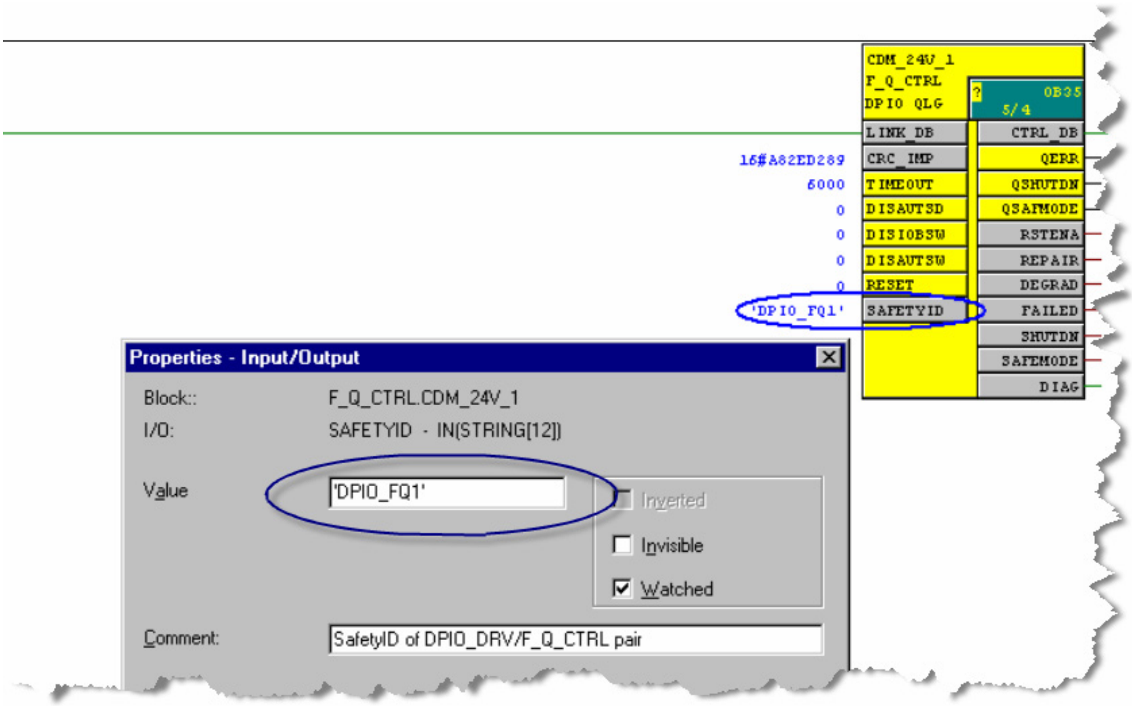
2. Right-click the **F_Q_CTRL** block.
   A context menu appears:



3. Select **Go to Point of Use**
   A window labeled **Safety Chart** appears and cautions you about the implications of downloading to the target system:



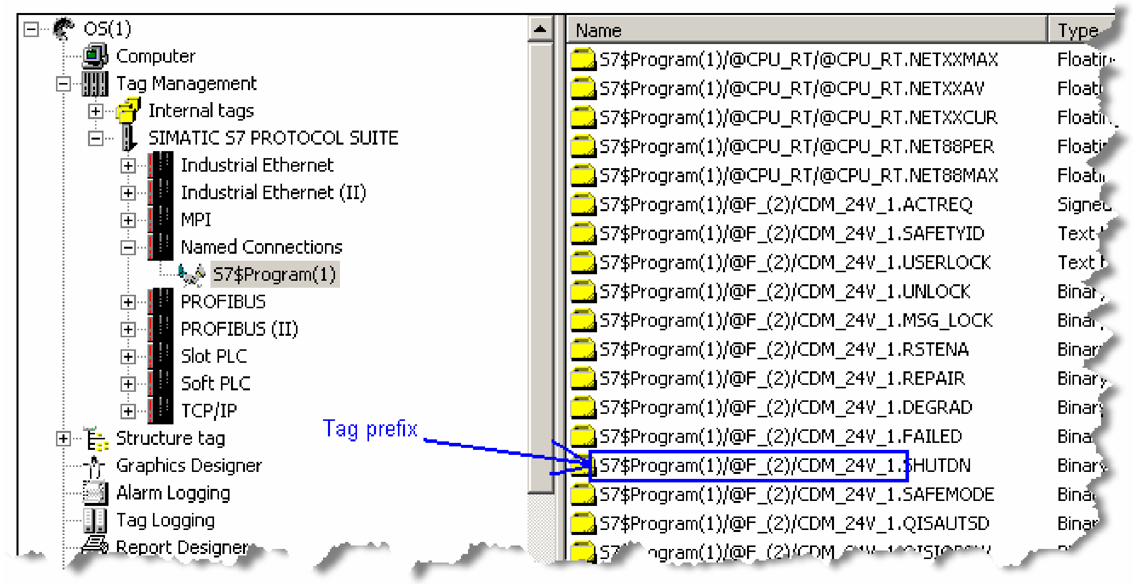
4. Click the **OK** button.
   The chart containing the **F_Q_CTRL** block opens.
5. Chose an appropriate identifier for the **F_Q_CTRL** block associated with your **DPIO_DRV** block. This identifier ensures that safety related changes are made to the proper **DPIO_DRV/F_Q_CTRL** block combination. The Safety ID may only contain printable characters (excluding spaces and tabs).
6. While offline, enter this identifier into the **SAFETYID** parameter of the **F_Q_CTRL** block:



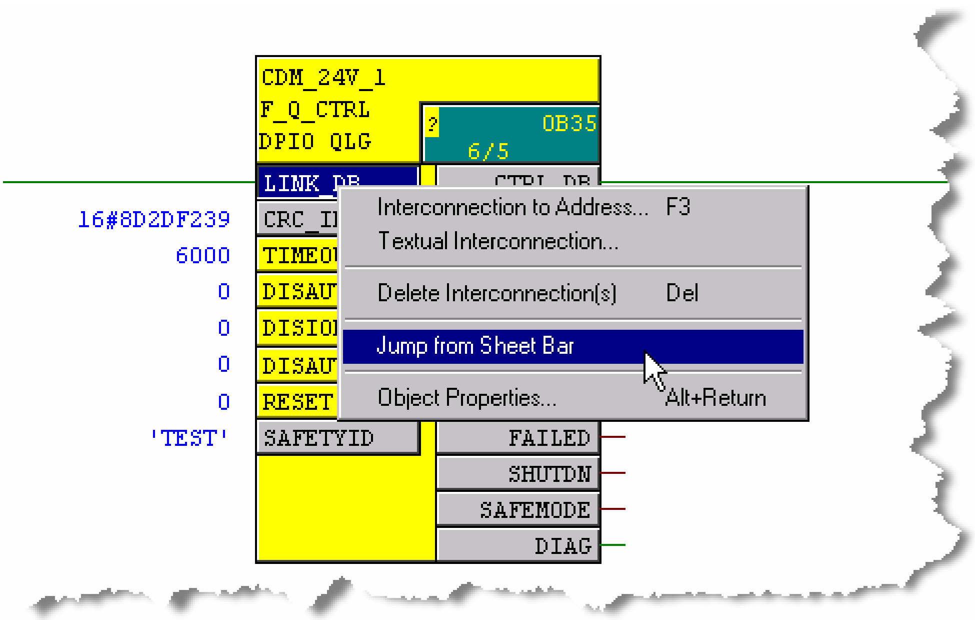
Setting the Path for the INAME Input of the DPIO_DRV Block

1. In WinCCExplorer, locate your S7 program by expanding **Tag Management > SIMATIC S7 PROTOCOL SUITE > Named Connection.**
2. Click your program name to display the tag list. Find any tag in the **F_Q_CTRL** block identified by both chart and block name (previously recorded), and note

the prefix of the tag. As the illustration below shows, the prefix is the set of characters to the left of the period ("."), such as
`@F_(@)/CDM_24V_1`
or
`S7$Program/@F_(2)/CDM_24V_1`

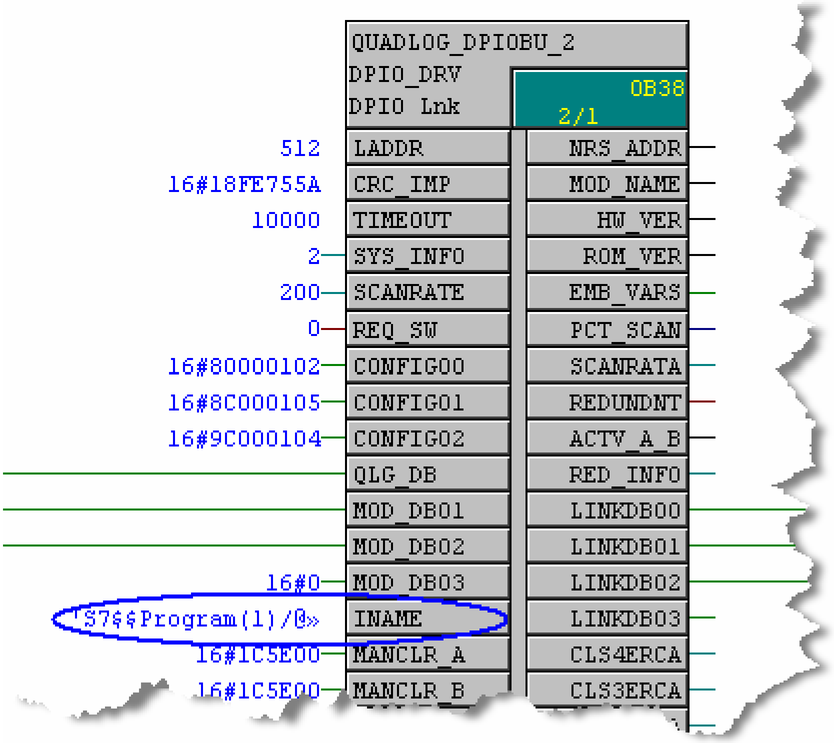


3. In the CFC editor, right-click the input labeled **LINK_DB** and from the resulting context menu choose **Jump from Sheet Bar** to jump to the **DPIO_DRV** block instance:



4. While offline in the CFC editor, enter the prefix into the **INAME** parameter of the **DPIO_DRV** block. If the prefix includes a dollar sign ($), as in the previous example, enter it as **`$$`** in the **INAME** parameter. Text in the **INAME** parameter

must adhere to standard WinCC restrictions (note that the entire name may not be visible on the block input).



Note

Each time you recompile your OS, you should check to make sure that the tag prefix you typed into the INAME nub on the DPIO_DRV block in your CFC still matches the WinCC tag prefix for the F_Q_CTRL block. Recompiling the OS may have changed the prefix in WinCC. If it does not match, you must correct it in CFC, recompile your CFC and re-download it to your CPU. Otherwise, the Safety features of your DPIO_DRV OS symbol and faceplate will not function properly.

Compilation

1. Recompile the CFC with the **Generate Module Drivers** checkbox cleared. Download the compiled CFC to the CPU.
2. From SIMATIC Manager, re-compile the OS.

To verify that block icons were correctly added to the pictures chosen in the Plant View hierarchy, open each picture in the WinCC Graphics Designer.

If the blocks were not added as expected to the pictures, the cause is typically one of the following:

- The **OCM Possible** property of a block was cleared (it is selected by default).
- The **Create Block Icons** property of a picture was cleared (it is selected by default.

3.11 Configuring the Time Synchronization Settings

Preparing the system for time stamping requires three sets of operations:

- Setting the time and date in each PC operating system
- Configuring engineering stations or single stations for time stamping
- Configuring time stamping in WinCC

3.11.1 PC Time and Date Settings

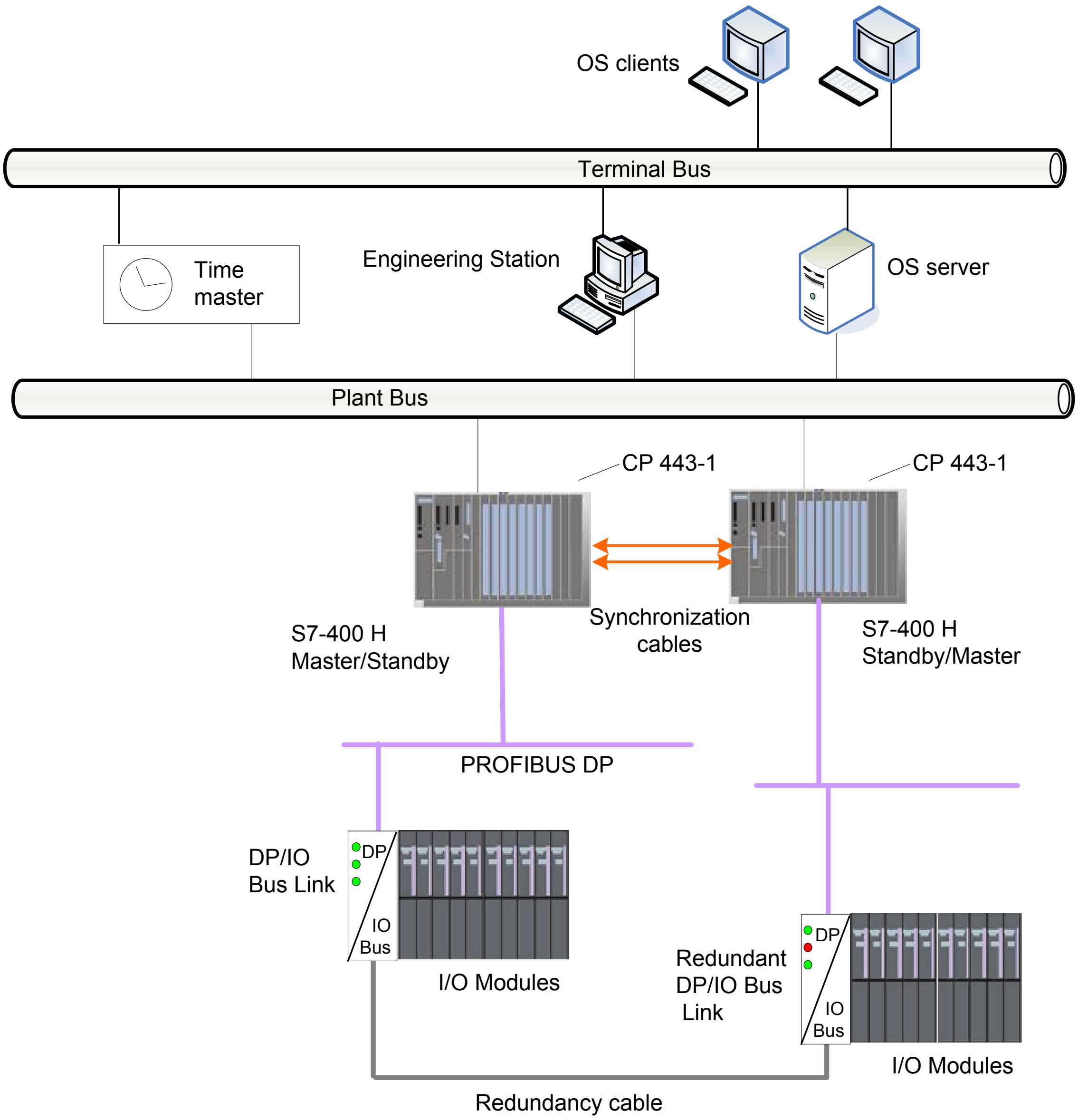
All PCs used in conjunction with the DP/IO Bus Link must use the same Windows settings for time zone and daylight savings adjustment. This applies to the following:

- Engineering stations
- Operator stations
- Single stations
- Servers
- Clients

1. From the Windows **Start** menu, select **Settings > Control Panel > Date and Time** to open the **Date and Time Properties** window:

2. Click the **Time Zone** tab and select the **GMT**.
3. Clear the checkbox labeled **Automatically adjust clock for daylight saving change**.
4. Repeat for each PC in the system.
5. Click the **OK** or **Apply** button.

The following illustration shows an example of a redundant system that supports time stamping:



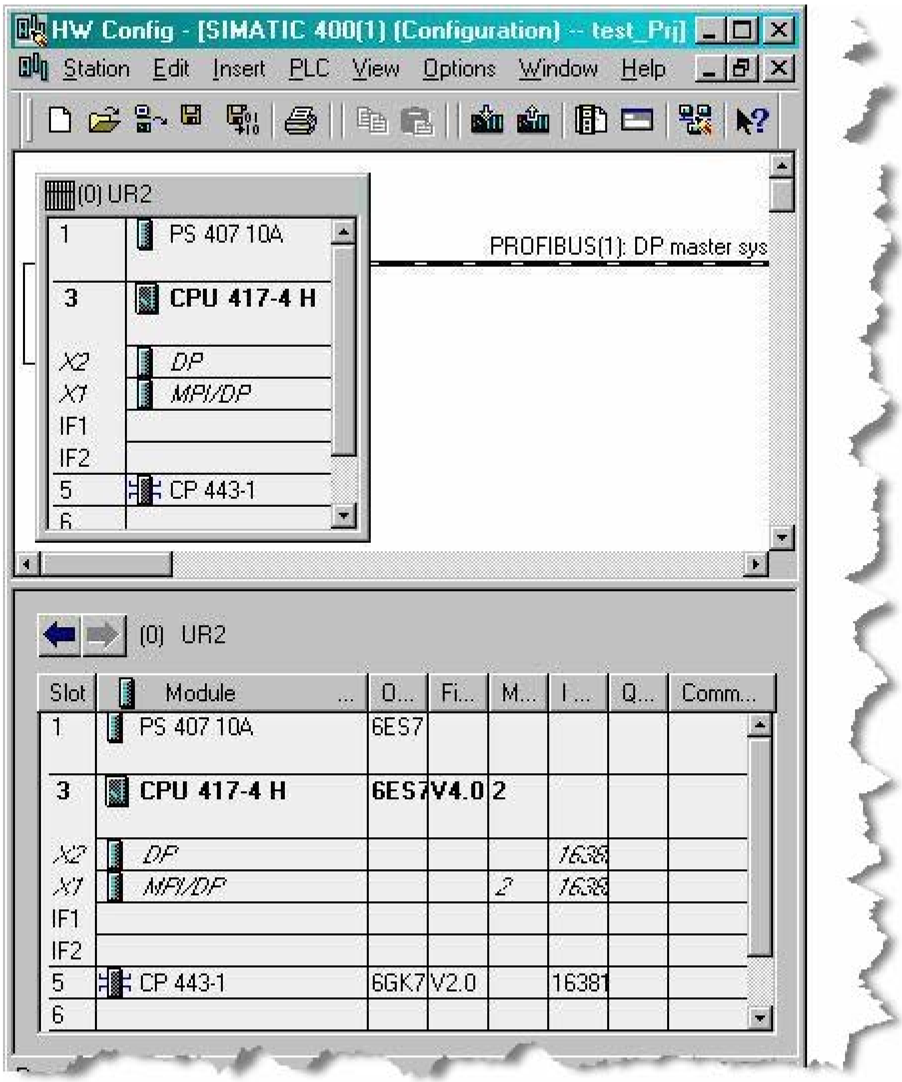
3.11.2 Engineering Station or Single-Station Time Stamping Configuration

Configuring the CPU for Time Synchronization

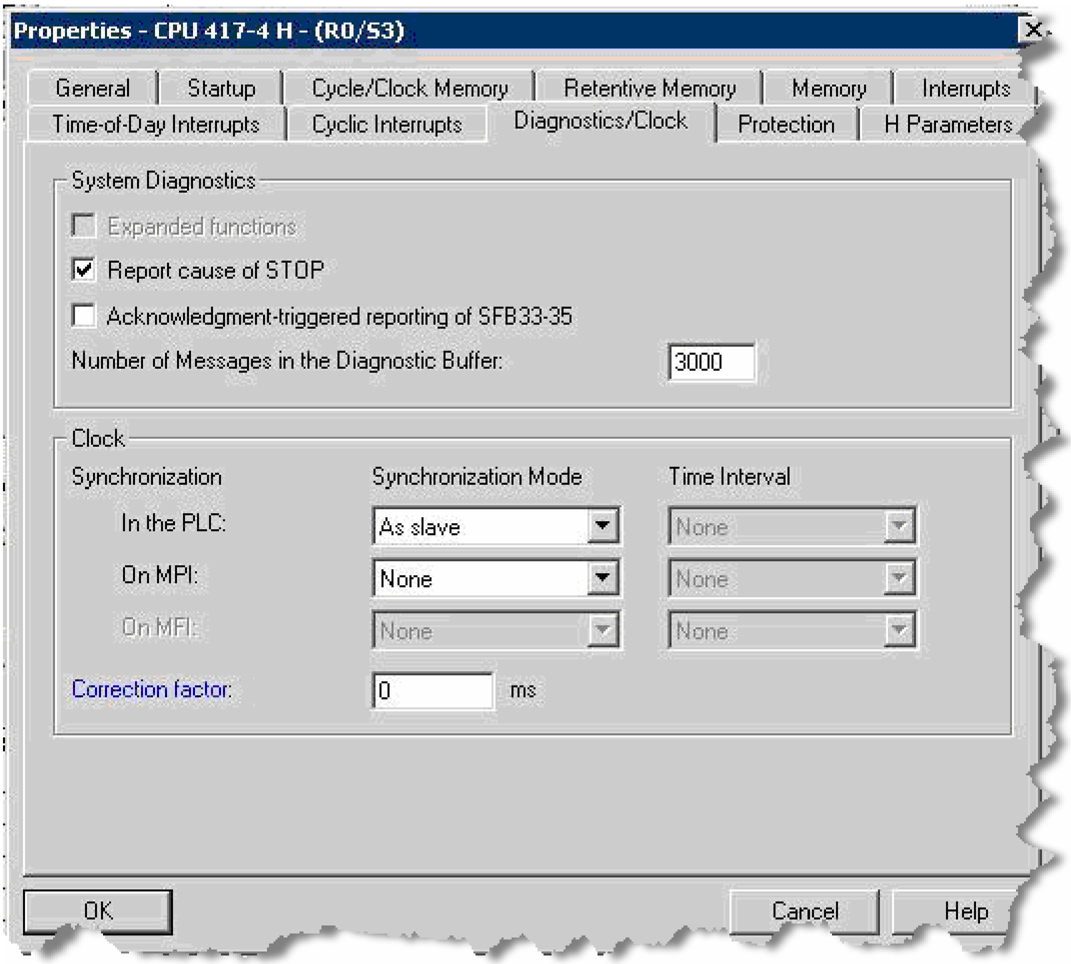
Notice

In redundant systems, CPU configuration is done only for the CPU on the A-side (rack 0).

1. Open Hardware-Configuration
   The **HW Config** window opens:



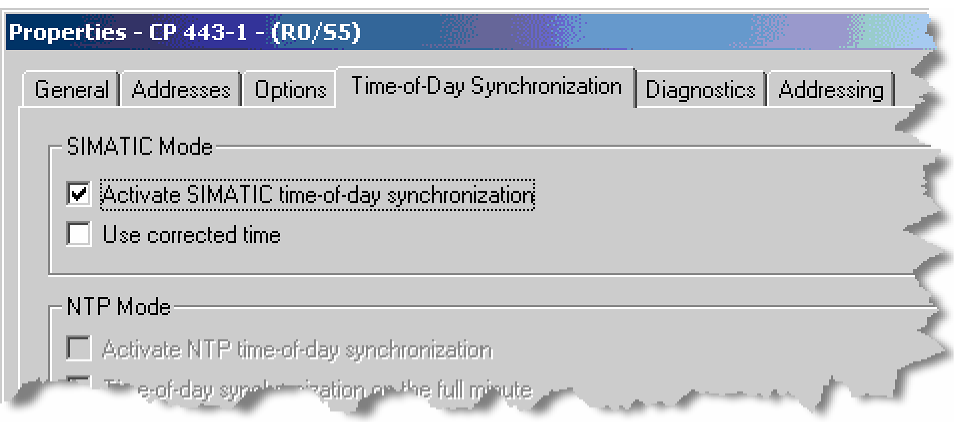
2. Double click the CPU 417-4 listing (top or bottom) to open the **Properties** window.
   The **Properties - CPU** window opens:
3. Click the **Diagnostics/Clock** tab
   The **System Diagnostics** and **Clock** properties are displayed:



4. In the **Synchronization Mode** list, select the **As slave** option**.**
5. Click the **OK** button to confirm changes and exit.

Configuring the CP 443-1 for Time Synchronization

1. In HW Config, double click the CP 443-1 listing to open the Properties window
   The **Properties - CP** window open.
2. Click the **Time-of-Day Synchronization** tab.
   The **SIMATIC Mode** properties appear:

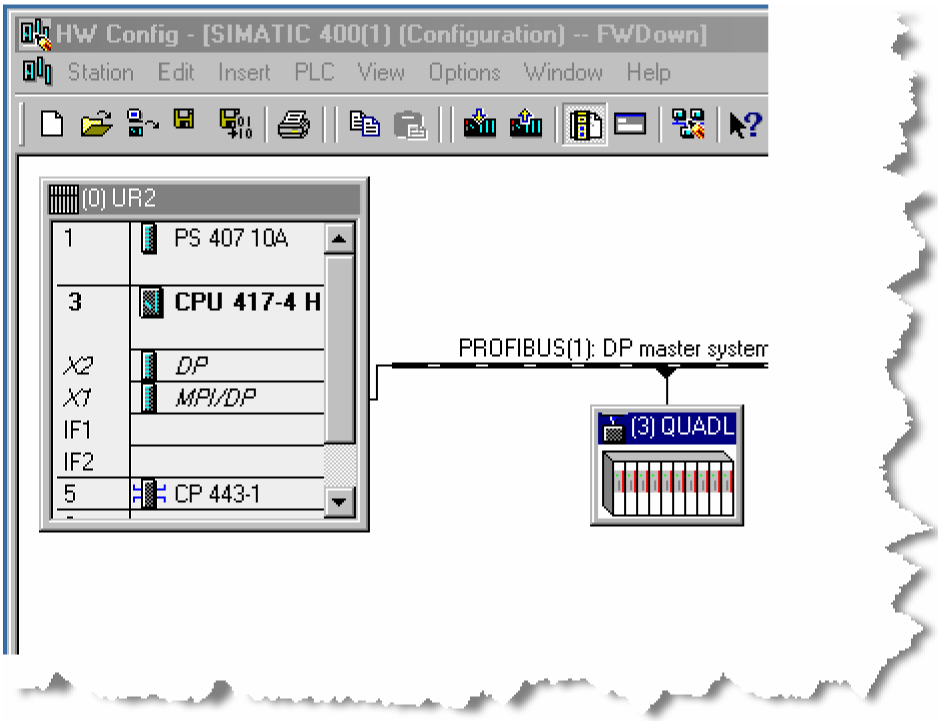


3. Select **Activate SIMATIC time-of-day-synchronization.**
4. Click the **OK** button to confirm changes and exit.

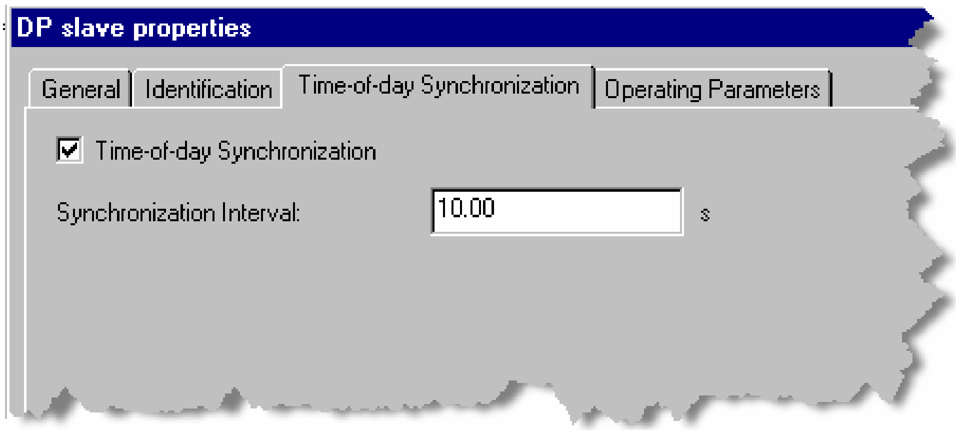
In redundant systems, repeat for each CP.

Configuring the DP/IO Bus Link Module (DP Slave)

1. From HW Config, double-click the symbol representing the DP/IO Bus Link module.



The **DP Slave Properties** window opens:



2. Select the **Time-of-day Synchronization** checkbox.
3. Click the **OK** button.
4. Repeat for redundant partner.

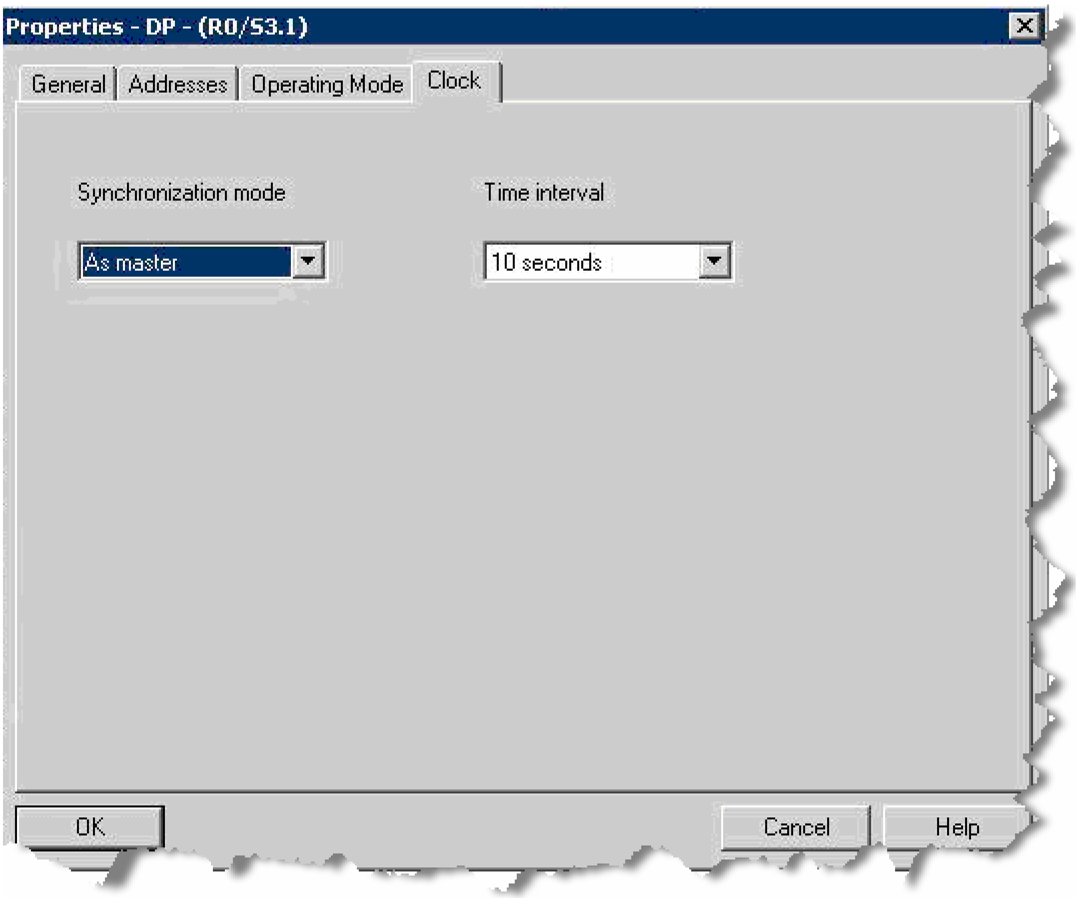
Caution

A configuration created with HW Config exists in volatile PC memory until it is downloaded to an automation station (AS) or exported (saved) to a file stored on a hard disk drive or other mass storage. A downloaded configuration can be uploaded to HW Config, and an exported configuration can be imported.

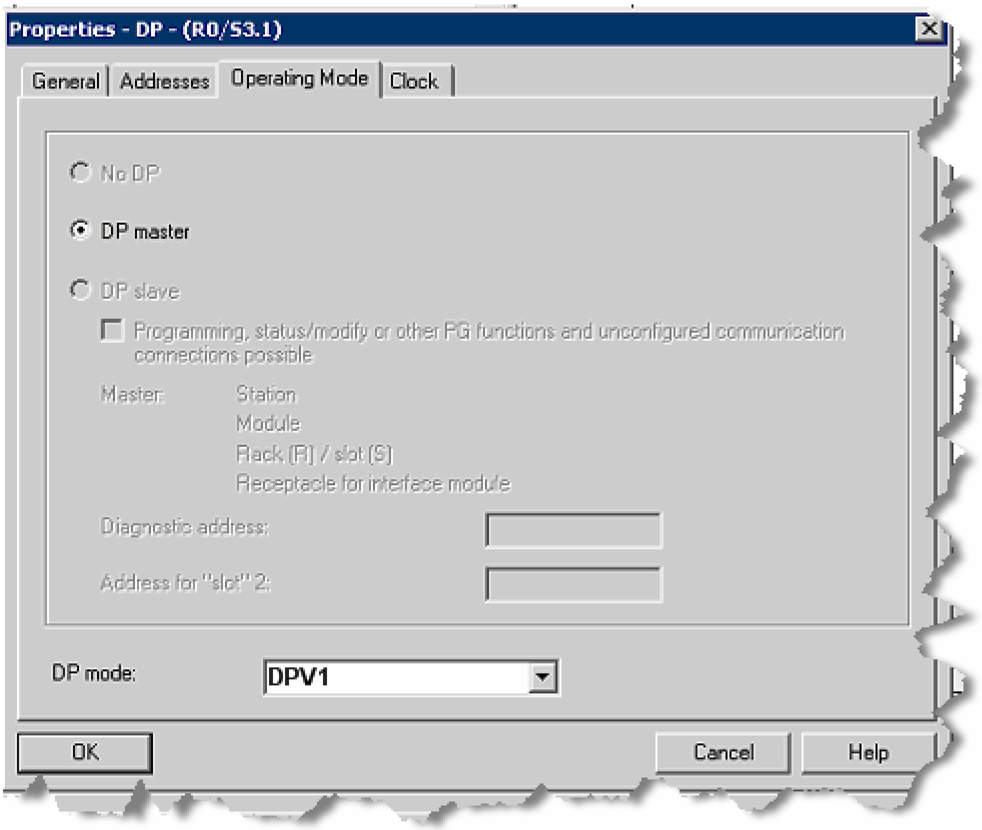
A downloaded or imported configuration may have its Time-of-day Synchronization checkbox selected and its Synchronization Interval set to the default value (10.00 seconds), regardless of the settings when the configuration was downloaded or exported.

Configuring the DP Master for Time Synchronization

1. In HW Config, double-click the DP listing.
   The **Properties - DP** window opens.
2. Select the **Clock** tab.
   The clock properties appear.
3. From the **Synchronization Mode** list, select **AS Master**.
4. From the **Time interval** list, select **10 second**



5. Click the **Operating Mode** tab.
   The operating mode options appear:



6. Select the **DP Master** option
7. From the **DP Mode** list, select **DPV1**
8. Click the **OK** button

For redundant systems, repeat for each DP master.

Setting CPU Time of Day

Note

The OS Server is ordinarily the time master and the CPU time settings are derived from the time master. Set the CPU time of day only if the CPU is the time master.

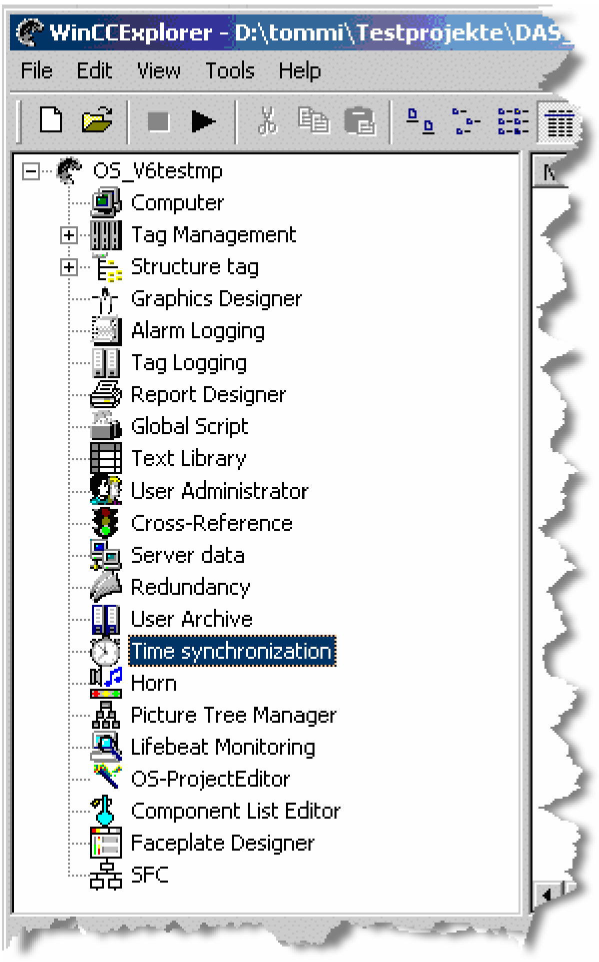
1. In HW Config, from the **PLC** drop-down menu, select **Time of Day**.
2. Set the **Module time** as necessary
3. Click the **Apply** button
4. Click the **Close** button

Repeat for each CPU.

3.11.3 Configuring Time Synchronization in WinCC

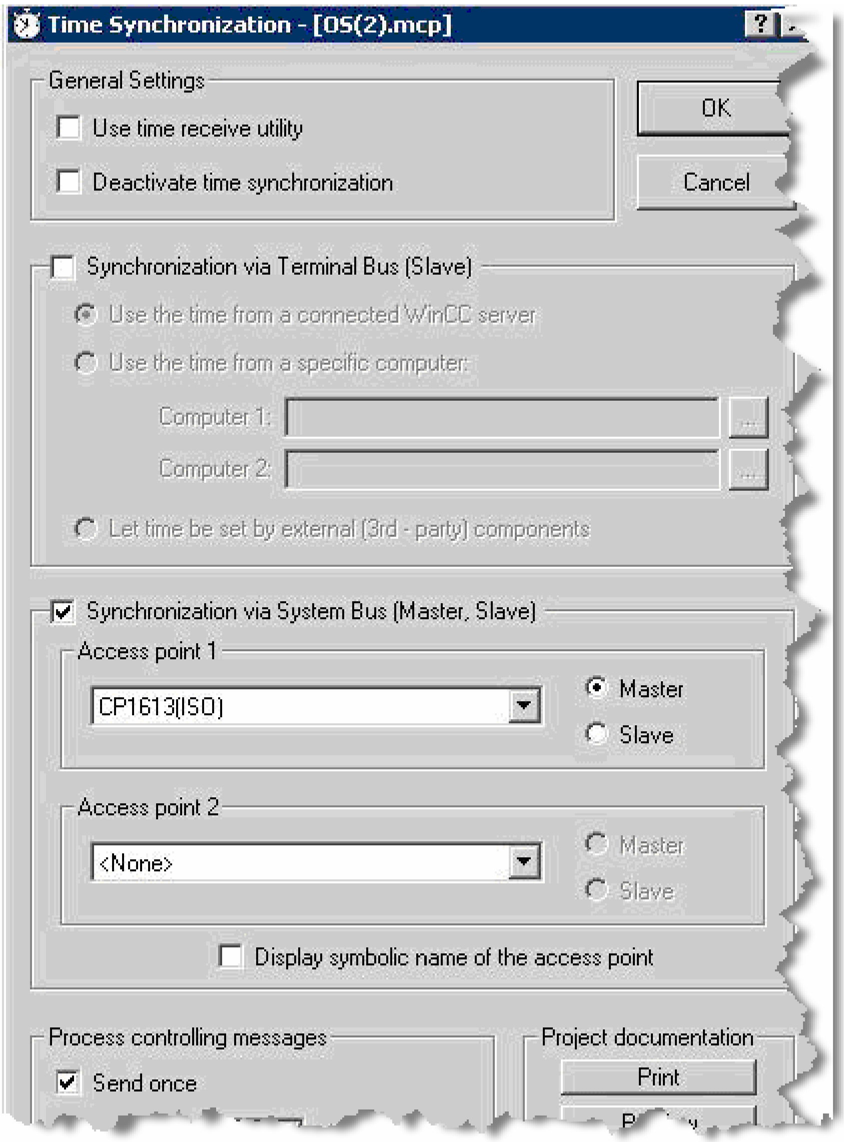
Use the WinCC Explorer to configure every PC in the system for time synchronization.

Right-Click the **Time synchronization** icon in WinCC Explorer for access to the **Time Synchronization** configuration window:



Configuring the PCS7 OS Single Station

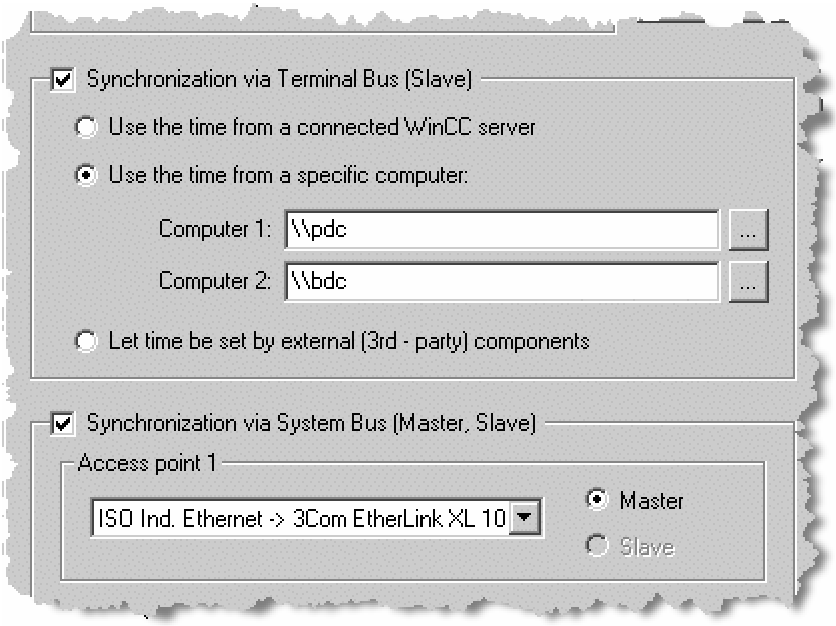
1. From the WinCC Explorer, select **Time synchronization**.
   The **Time synchronization** window opens:



2. Select **Synchronization via System Bus.**
3. For **Access point 1**, select the correct interface device.
4. For **Access point 1,** select the Master checkbox.
5. Click the **OK** button to confirm changes and exit.

Configuring the PCS 7 OS Server

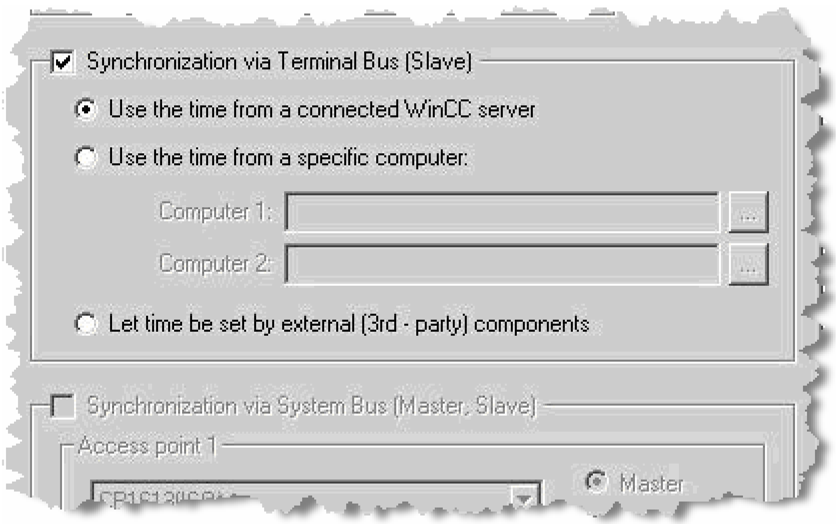
1. From the WinCC Explorer, select **Time synchronization**.
   The **Time synchronization** window opens:



2. Select **Synchronization via Terminal Bus (Slave).**
3. Select **Use the time from a specific computer**.
4. For **Computer 1** and **Computer 2**, select the master computer (domain).
5. Select **Synchronization via System Bus (Master, Slave)**.
6. For **Access point 1**, select the correct interface device.
7. For **Access point 1,** select the Master checkbox.
8. Click the **OK** button to confirm changes and exit.

Configuring the PCS7 OS Client

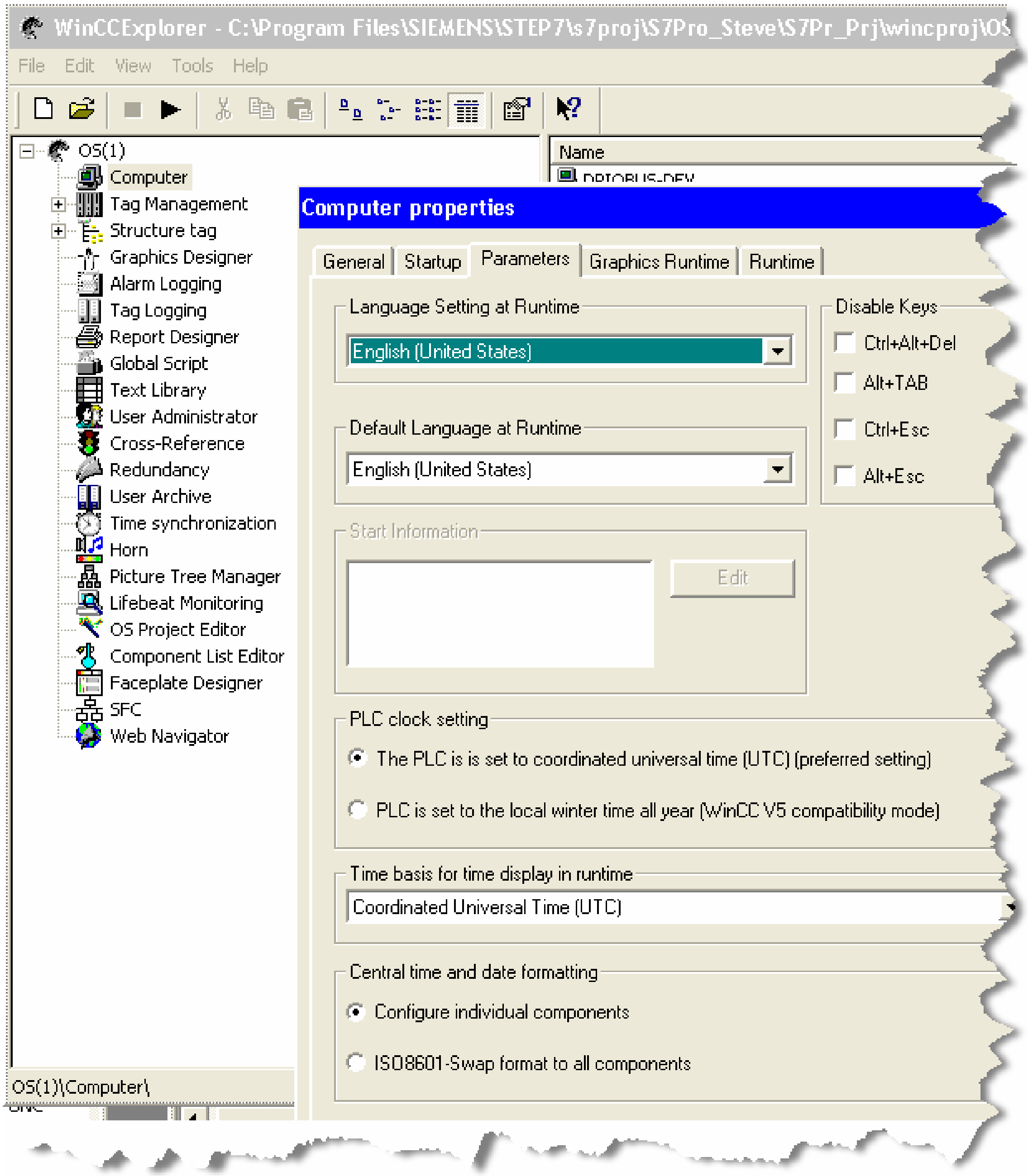
1. From the WinCC Explorer, select **Time synchronization**.
2. Double-click or right-click and select **Open.**
   The **Time synchronization** window opens:



3. Select **Synchronization via Terminal Bus (Slave).**
4. Select the checkbox labeled **Use the time from a connected WinCC server**
5. Click the **OK** button to confirm changes and exit.

3.11.4 Configuring OS Server Projects for Time Synchronization

1. From WinCC Explorer, right-click the **Computer** icon.
2. Double-click or right-click and select **Open**.
   The **Computer Properties** window opens.
3. Select the **Parameters** tab.
   The **Parameters** window opens, as shown below:



4. Ensure that the following are selected:
   - **The PLC is set to coordinated world time (UTC) (preferred setting)**. This sets the Error Log timestamps to use UTC.
   - The **Time basis for time display in runtime** is set to **coordinated world time (UTC)**. This sets the Alarm Message Timestamps to also use UTC
   - The **Central time and date formatting** is set to **Configure individual components**. The alternative is also acceptable: **ISO8601-Swap format to all components**
5. Click the **OK** button to confirm changes and exit.

3.12 Validating the Softlist Parameter of the Safety Program

Warning

Safety Note - Security, Validating Softlist Parameters

It is necessary to perform validation of the DP/IO Bus Link module and QUADLOG I/O modules. After the entire configuration has been delivered to the CPU, the following must be completed:

- Perform a printout of the HW Config with the options selected.
- Compare this printout with the expected values for each parameter for each I/O module.
- Print the F-Tool address list.
- Perform a comparison of all addresses to ensure accuracy.

There are also other checks that must be performed.

This section shows how to verify that the softlist parameters configured in HWConfig are the same as the softlist parameters that you want loaded into the controller. Verifying the parameters is required before going live.

Prerequisites

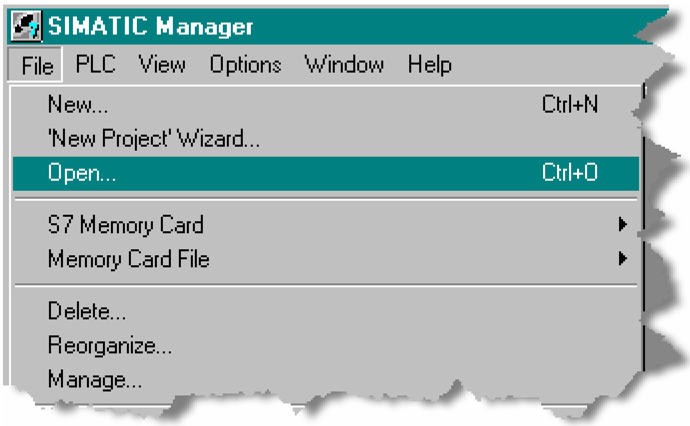
- A text-comparison tool (such as Microsoft Word)
- The capacity to print to a file in lieu of a printer:

1. From your engineering station PC, select **Start > Control panel > Printers and Faxes > Add Printer**
   The **Add a Printer Wizard** opens.
2. Select a **local** printer.
3. Clear the checkbox labeled **automatically detect and install my plug and play printer**.
4. Select **use the following port: LPT1**.
5. Select **Generic** as the manufacturer and **Generic/text only** for the printer.
6. Name the printer or accept the default name.
7. When asked whether to use the printer as the default printer, select **No**
8. Select **Do not share this printer**.

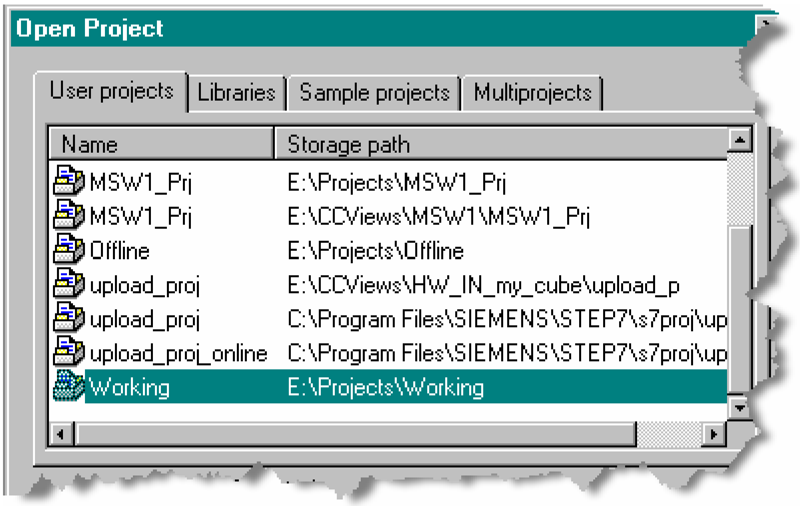
9. Select **No** when asked whether to print a test page.

3.12.1 Exporting Softlist Parameters in the Offline Configuration

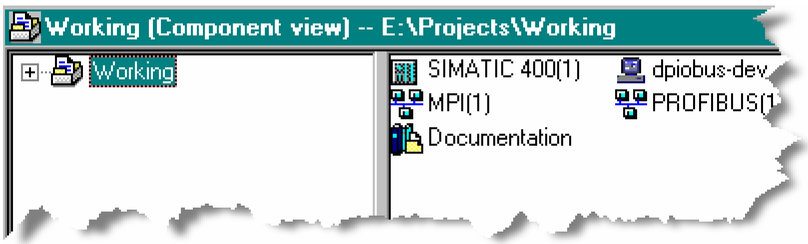
1. Open Simatic Manager.
2. Select **File > Open**.



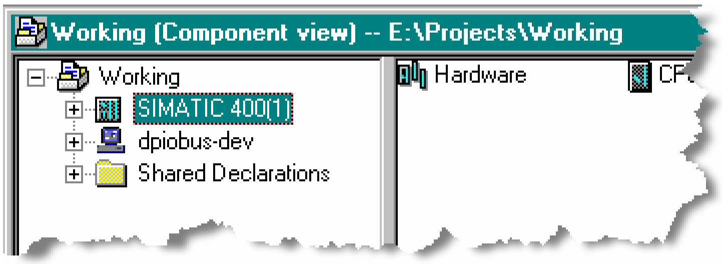
The **Open Project** window appears.



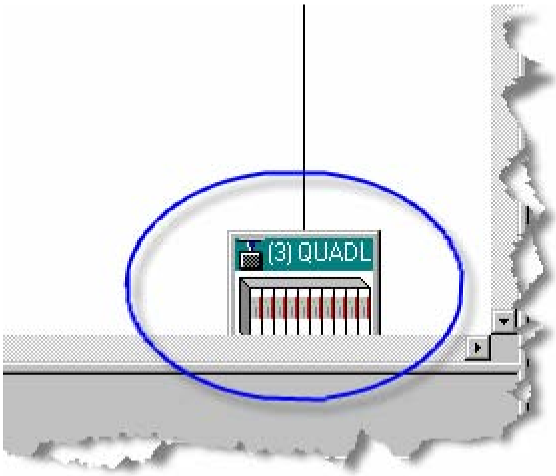
3. Select the project you wish to verify and click the **OK** button.
   The component view of your project appears (in the illustration below, the name of the project is *Working*).



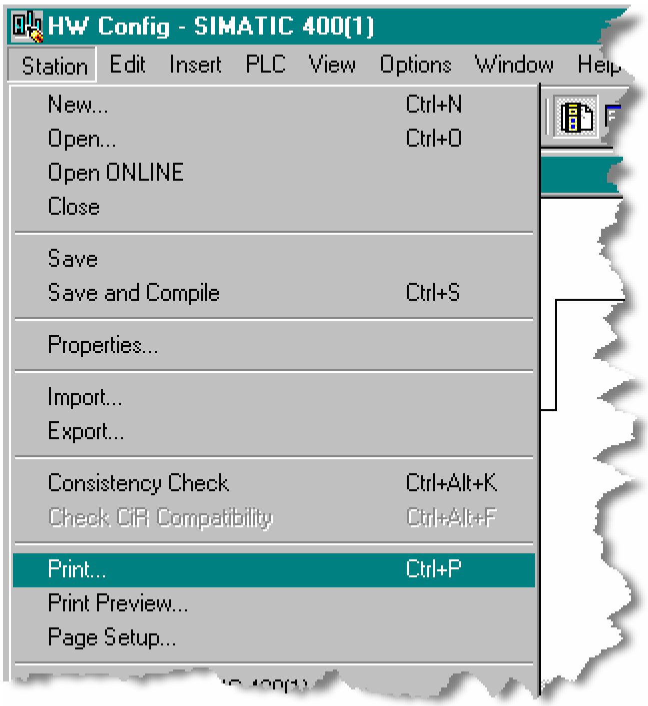
4. Double-click **Simatic 400(1)** to expand its contents:



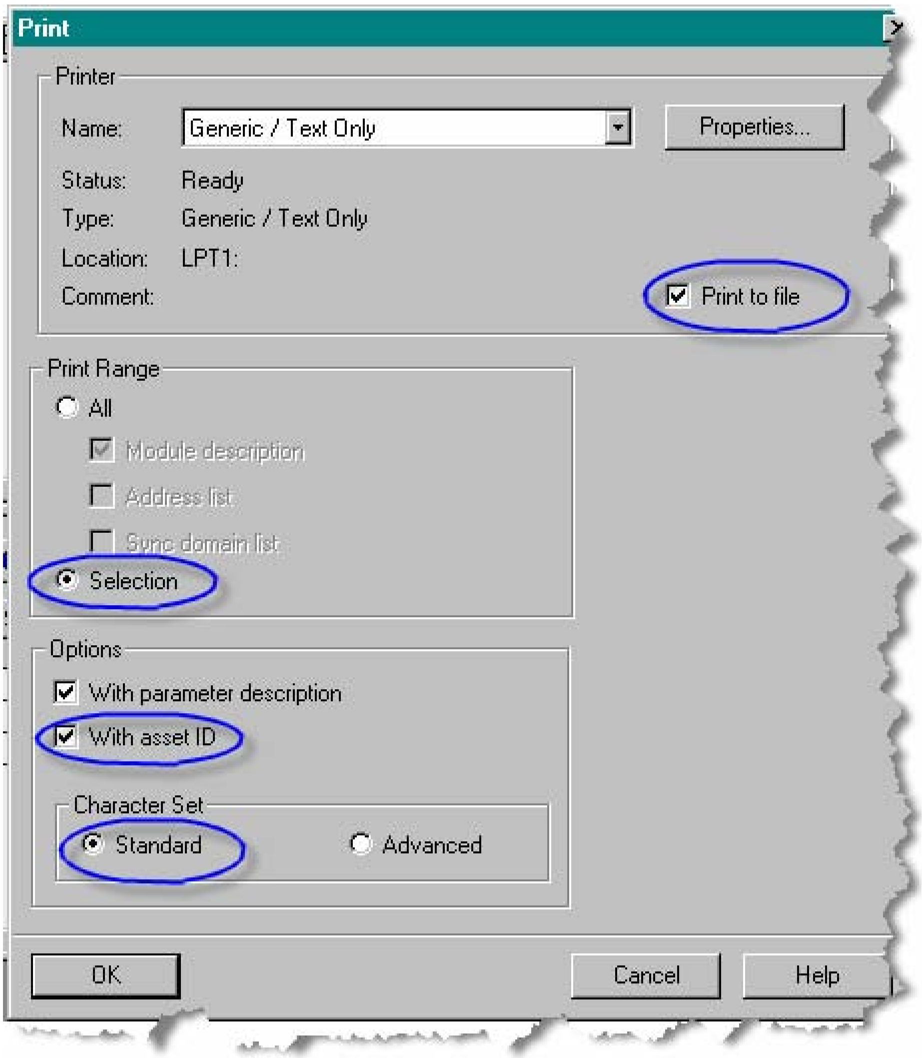
5. Double-click the **Hardware** icon to open HW Config
6. In HW Config, select the picture of the QUADLOG rack:



7. From the menu bar in HW Config, select **Station > Print**:

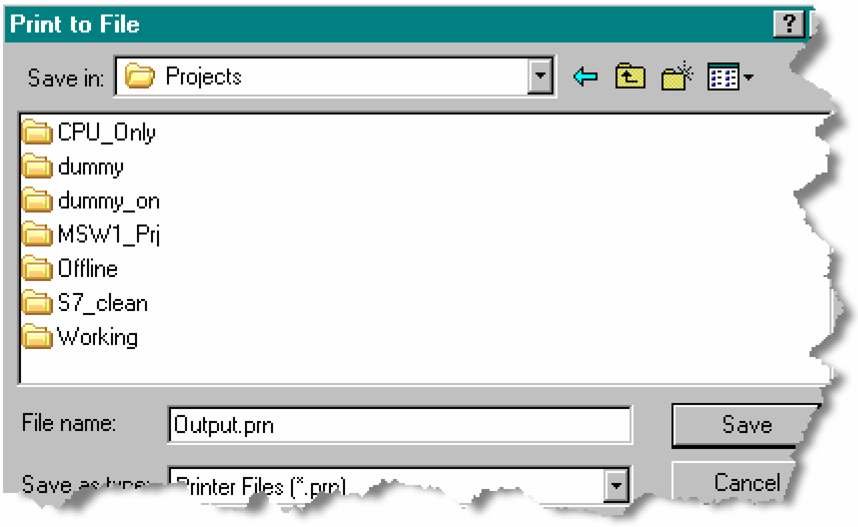


The **Print** window appears:



8. Select the following checkboxes:
   - **Print to file**
   - Print Range: **Section**
   - Options: **With asset ID**
   - Character Set: **Standard**
9. Click the **OK** button.
   The **Print to File** window opens:

   The **Print to File** window appears.



10. Accept the default name **Output.prn** or change it to something more meaningful.

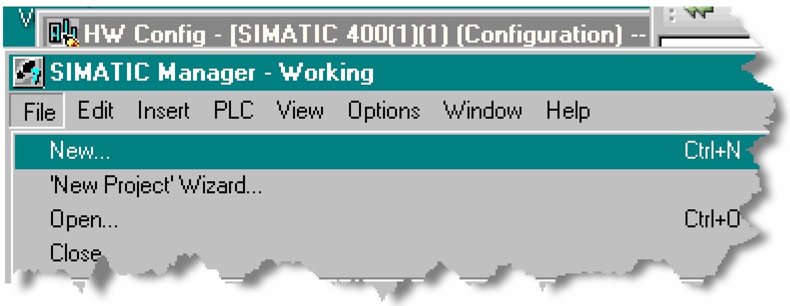
You can inspect this file with a text editor and compare the softlist parameters to those in your records to ensure that the values were correctly stored and implemented.

3.12.2 Exporting Softlist Parameters in the Online Configuration:

This is an optional procedure used to ensure that the data in the DP/IO Bus Link module is correct. This procedure follows the steps necessary to create a fictitious, blank project as a target for a configuration upload.

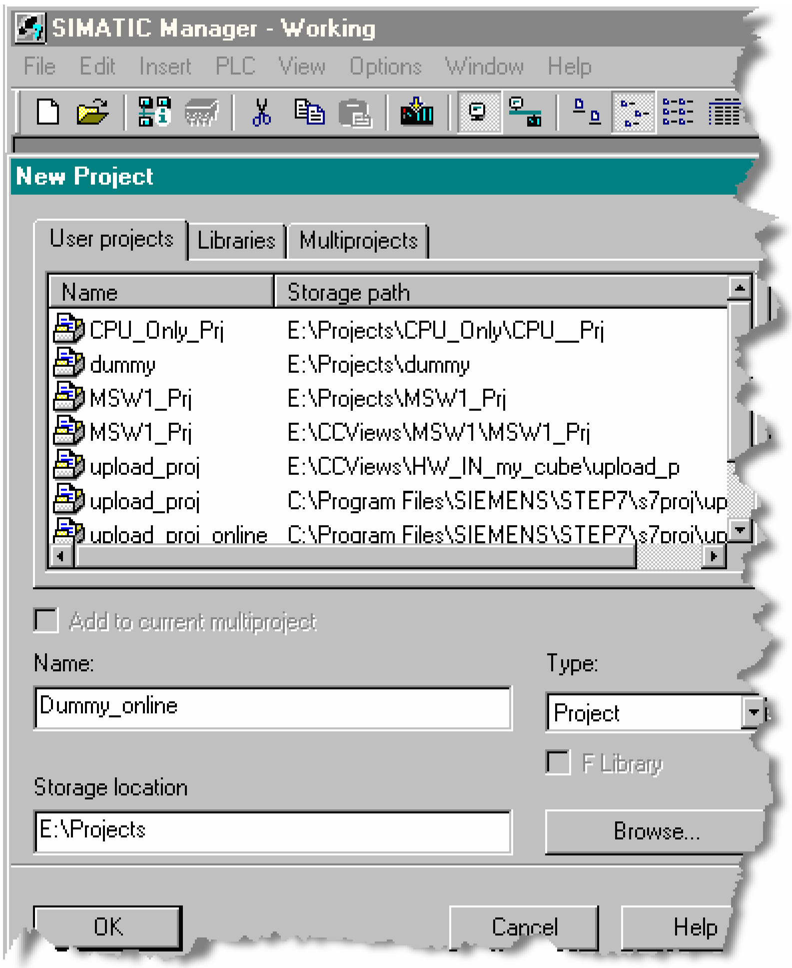
After the configuration is uploaded to the blank project, the configuration export is repeated, and the resulting online and offline printout are compared to identify any differences.

1. Create a dummy project in SIMATIC Manager (do not use the New Project Wizard), by selecting **File > New:**

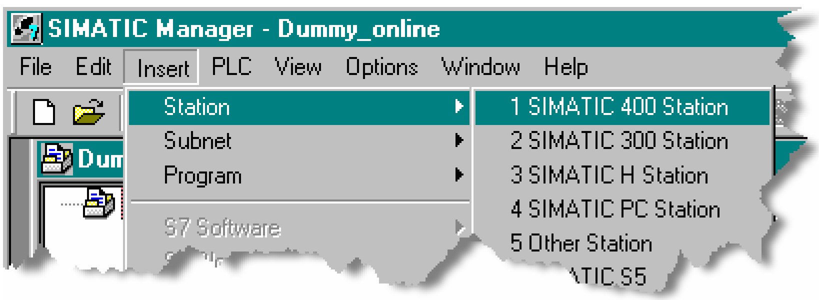


The **New Project** window opens.

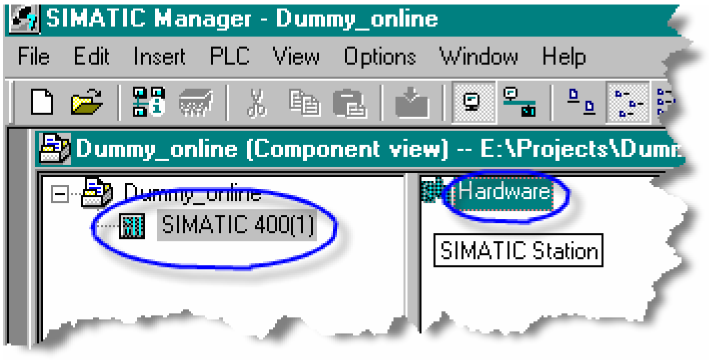
2. In the **Name:** field, provide a name for the file (tip: use *online* in the name).



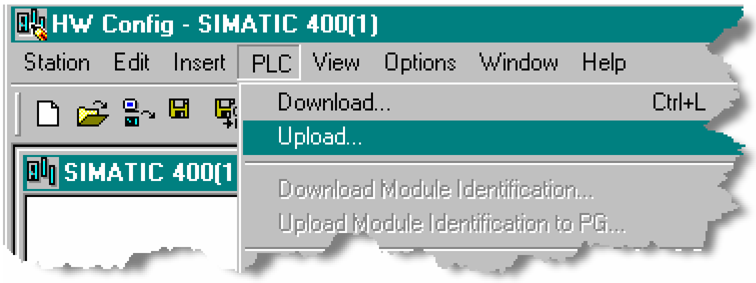
3. Click the **OK** button.
   A project is created, but it has no components and no program data.
4. From Simatic Manager, select **Insert > Station > Simatic 400 Station**.



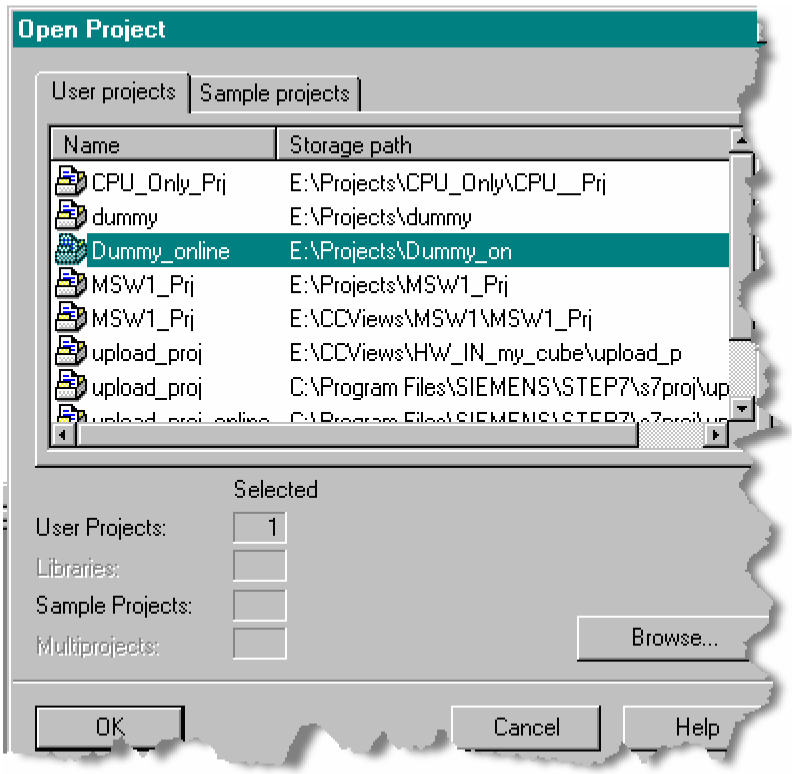
The Simatic 400 Station appears:



5. Double-click the station (SIMATIC 400(1)).
6. Double-click the object labeled **Hardware**.
   The HW Config program opens.
7. From the menu bar, select **PLC > Upload**.

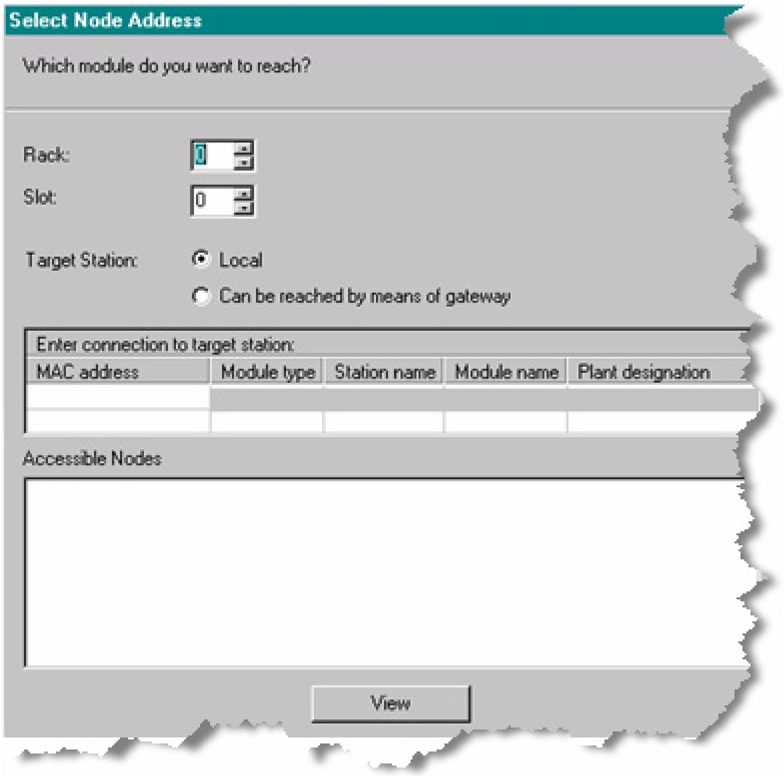


The **Open Project** window appears:

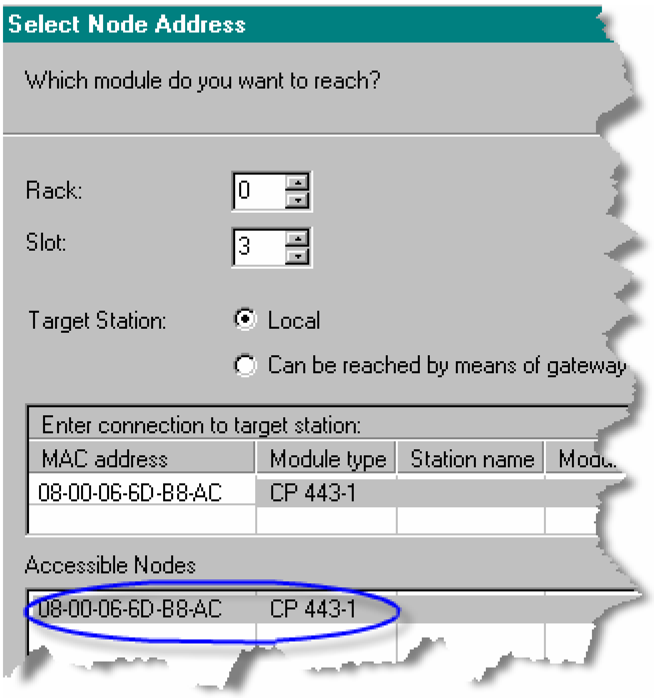


8. Select the dummy project created previously.

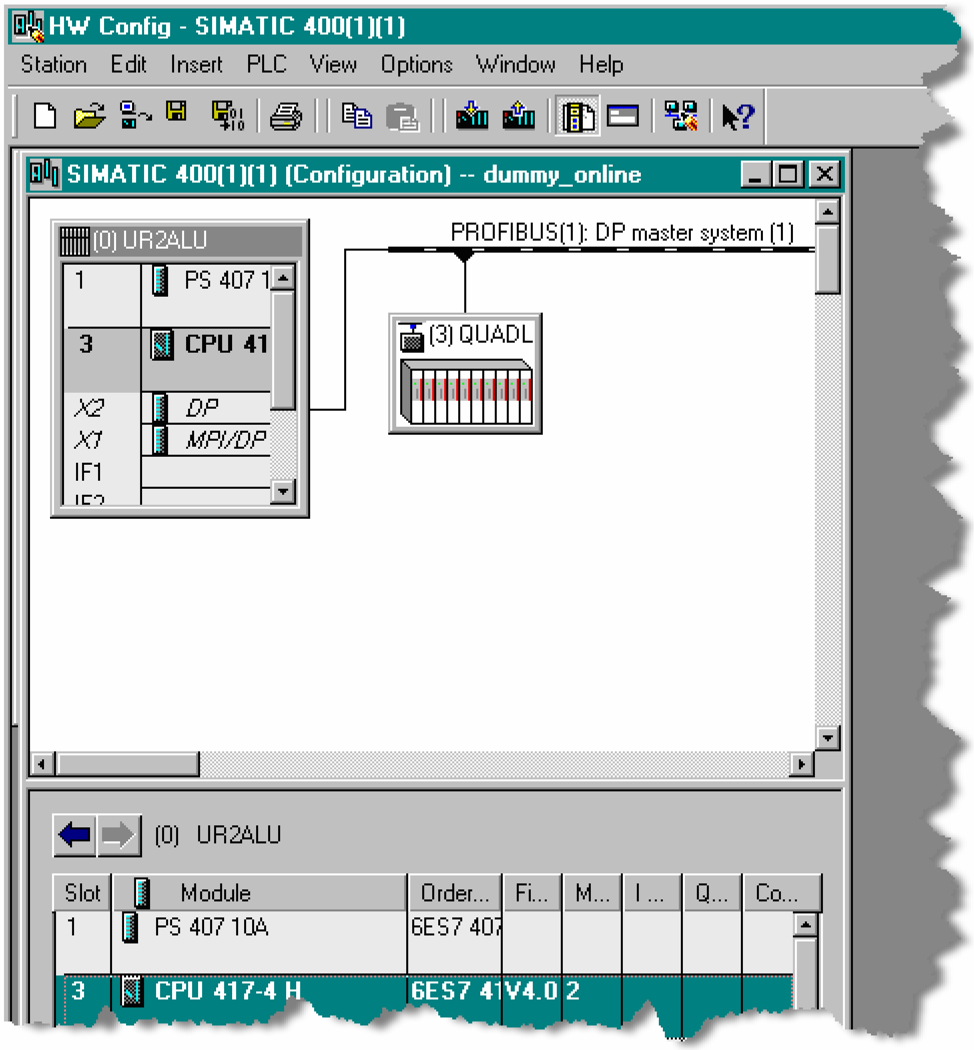
9. Click the **OK** button.
   The **Select Node Address** window appears.



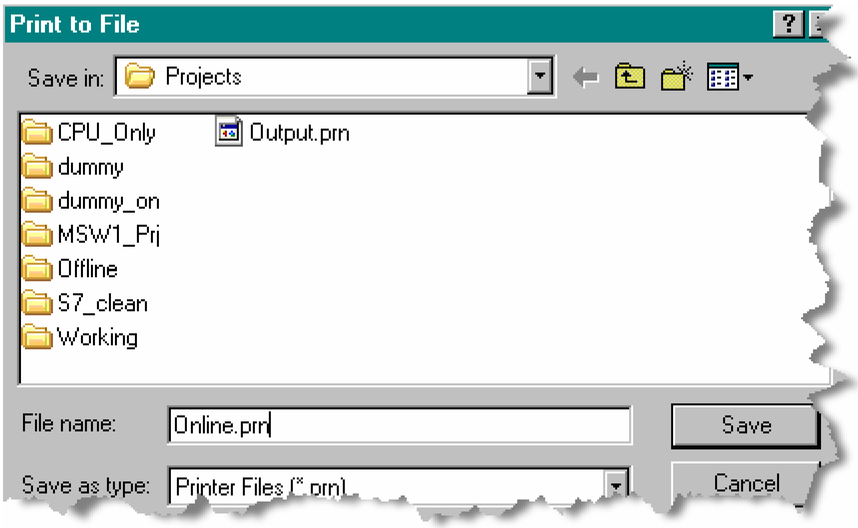
10. You may need to enter the **Rack:** and **Slot**: addresses. The *rack address* can be read from the front of the S7 417-4 H CPU (either the **RACK0** or **RACK1** light will be on). The *slot* refers to the slot of the PCS7 controller (the power supply usually occupies slots 1 and 2, and the controller is in slots 3 and 4. Enter 3).
11. Click the **View** button.
    A node is added to the **Accessible Nodes** list:



12. Click the **OK** button.
    When the upload process is complete, HW Config contains the controller's configuration:



13. Export the online configuration to a text file that is human readable. The procedure for doing this is to repeat steps 1 through 9 in the section titled Exporting Softlist Parameters in the Offline Configuration. After completing these steps, print the configuration to a file with a name different from the one used previously in step 10 (tip: use a name that contains *online,* as in *present online in this controller*):



3.12.3 File comparison Offline vs. Online

The result of the previous procedures is two text file: one with the online parameters and one with the offline parameters. Use a file-comparison tool to compare them to ensure that there are no unanticipated differences. Any program that supports file comparison is suitable, including most word-processing programs

The comparison of two files, Output.prn and Online.prn, understandably reveals that they are not identical. The differences between the two files consist of the names of the project (such as *working* vs. *dummy_online*) and the names of the channels (for example, *CDM_Ch01_Output* would from an online configuration be labeled simply with the channel type *CDOC*). The different file names and the difference between a given channel name (*CDM_Ch01_Output*) and the reported channel type (*CDOC*) are expected.

3.13 Updating DP/IO Bus Link Firmware

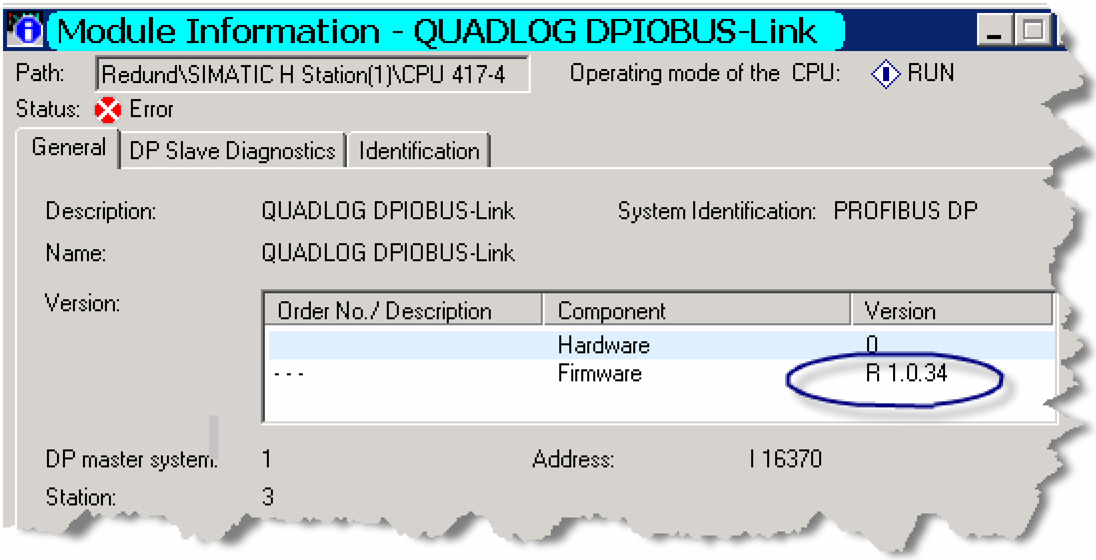
Updating DP/IO Bus Link firmware is a maintenance task that should only be performed on a system that is out of service. The procedure to follow updates the firmware on the DP/IO Bus Link module that is currently the DP slave master, denoted by a front-panel LED labeled DP displaying steady green.

Prerequisite

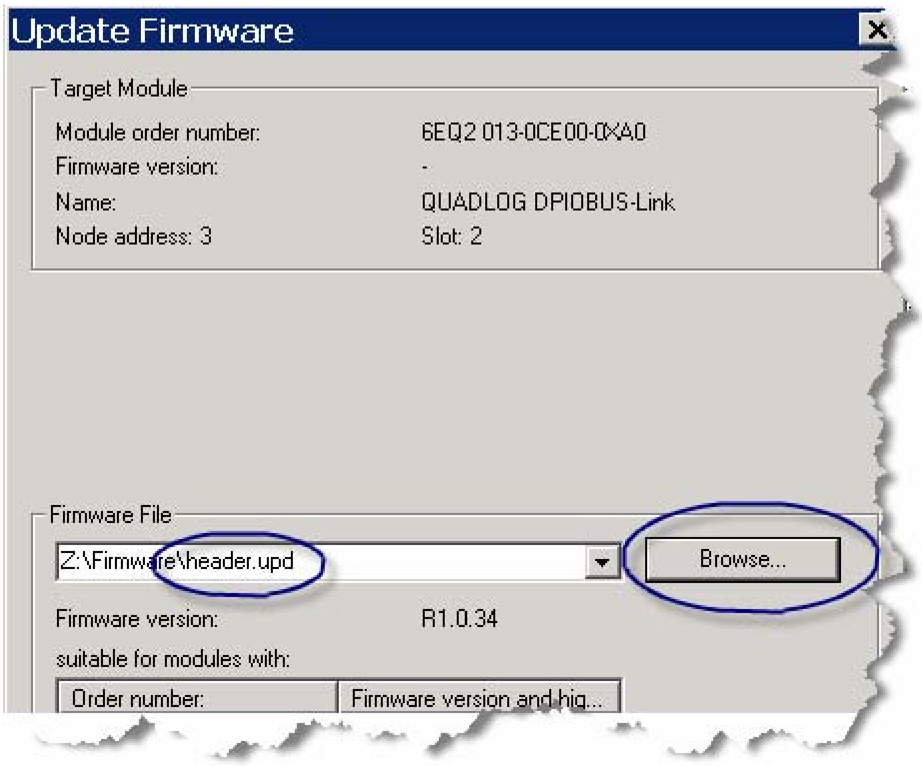
- A set of upgraded firmware files, typically distributed on CD. On a software distribution CD, these are in a folder labeled **Firmware**
- A working, but out-of-service, system containing a DP/IO Bus Link module or redundant pair.
- An ES (engineering station) PC with the HW Config program running.
- Decide whether to reset the module immediately after updating the firmware. The procedure for updating firmware load new firmware into flash memory where it remains until the module is reset. When the module is reset, the firmware is transferred from flash memory to working RAM memory. The module does not actually run the new firmware until it is in RAM.

Procedure

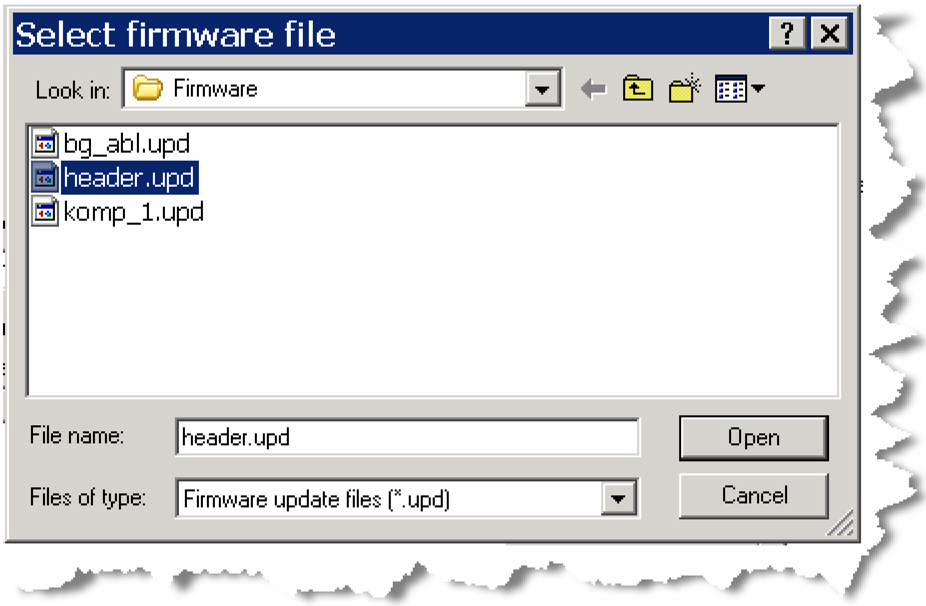
1. Identify the DP slave master. In redundant systems, disconnect its partner, the DP slave standby DP/IO Bus Link module, from the MODULRAC backplane by loosening its securing fasteners and pulling it an inch or two out of the MODULRAC. See the section titled Removing QUADLOG Components for illustrations and details.
2. To determine the current firmware level of the remaining module, in the HW Config Configuration view, right-click the DP/IO Bus Link module.
3. Select **Module Information** from the context menu.
4. Note the current firmware version:



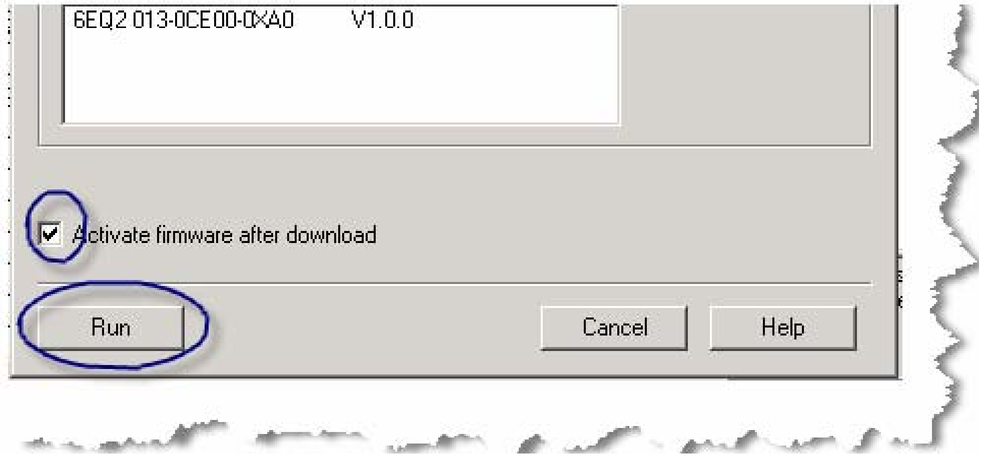
5. In HW Config component view, select the DP/IO Bus Link module
6. From the menu bar, select **PLC > Update** firmware.
   The **Update Firmware** window opens:



7. Select the **Browse** button to locate the file labeled *header.upd* in the firmware set:



8. If you want the module to reset automatically and immediately load and run the firmware upgrade, select the checkbox labeled **Activate firmware after download**. If you want to module to reset and load the firmware at some time of your choosing, clear the checkbox:



9. Click the **Run** button.
   A progress message appears.
10. After the module has been reset—whether automatically or by a manual method—confirm that the firmware level has changed from the version noted earlier in this procedure.
11. For redundant systems, reinstall the disconnected module and remove the operational module. Wait for the system to stabilize and repeat this procedure. Confirm that both modules are running the same version of firmware.

4 Operation and Maintenance

This section discusses the following:

- QUADLOG to DP/IO Bus Link module migration
- Differences between using a QUADLOG CCM and a system based on a DP/IO Bus Link module
- Operation and maintenance of systems based on the DP/IO Bus Link module.

The focus is on tools and techniques available from the operators station (OS), but includes some discussion of operation and maintenance related to CFCs, the HW Config program, and SIMATIC Manager.

The OS provides block icons, faceplates, and loop-display views of the DP/IO Bus Link module and its associated I/O modules. These graphic elements provide various levels of status overview. The OS also conveys messages that are an initial indication that the status of the system has changed.

4.1 Migrating QUADLOG to PCS 7

This section compares the QUADLOG distributed control system (DCS) and PCS 7 system based on a DP/IO Bus Link QUADLOG module.

The chief difference between a QUADLOG system and a PCS 7 system with a DP/IO Bus Link module is that control logic in a PCS 7 system executes not in an ACM or CCM, but in an S7 CPU. The DP/IO Bus Link module physically replaces and ACM or CCM, but does not replace its controlling functions, serving instead as a conduit for I/O data between field I/O and a Siemens S7-417H CPU.

To become better acquainted with SIMATIC PCS 7, please refer to the PCS 7 Getting Started manuals. These walk you through the process of creating a new project using the New Project Wizard.

Since the QUADLOG DP/IO Bus Link product requires the use of S7 F Systems V6.0, you must read and understand manual titled *SIMATIC S7 F/FH Systems Configuring and Programming*.

For customers familiar with QUADLOG, this section helps identify corresponding features. The list below provides links to the topics that may be of interest.

- Controller/Automation Station
- Engineering Tools
- Function Blocks
  - Function Block Libraries
  - Control Function Blocks
  - Safety Data Format (SDF)
  - Channel Drivers
  - Reintegration of I/O

  - No Equivalent to QUADLOG Actions
  - Sequential Function Charts (SFCs)
  - User Defined Function Blocks versus Chart in Chart
  - Function Block Order of Execution
- Scanning of QUADLOG I/O Modules
  - Scanning Outputs
  - Scanning Inputs
- Shutdown Logic Differences
  - Partial Shutdown Groups (PSGs)
  - Details of F_SHUTDN Function Block
- Data Display
- Accessing Variables
- Communicating Variables to Another Resource
- Communicating F-Parameters to Partial Shutdown Group
- Viewing Softlist Data
- Viewing Error Information
  - HW Config Diagnostics
- Percent of Scan Considerations
- Configuring Multiple DP/IO Bus Links

4.1.1 Controller/Automation Station

The controller is the device that communicates with other controllers and with the QUADLOG I/O modules. An example of the controller in a QUADLOG environment is the QUADLOG CCM.

In a PCS 7 environment, the controller, its power supply, and its interface modules are collectively known as the Automation Station (AS). The AS may be redundant or non-redundant. The AS may have additional interface modules. The AS S7-417H redundant CPU bundle can come in an 18 slot rack and have a pair of power supplies, two S7-417H CPUs, and two CP443-1 ethernet communications processor modules. An optional CP443-5 PROFIBUS DP Communications processor may be purchased for each CPU to provide an additional PROFIBUS DP communications port. Also an S7-417H CPU bundle may be purchased with these modules included.

Information in the section titled Limitation and Considerations provides guidance in determining which S7-417H CPU to purchase.

4.1.2 Engineering Tools

In a QUADLOG distributed control system (DCS), *4-mation* is the engineering tool used to configure the following:

- QUADLOG resources

- I/O modules' node, rack and slot numbers
- Softlist parameters
- User logic

A separate QUADLOG control library adds the capability of programming the QUADLOG controller resources. This library includes a QUADLOG function block library and a set of configurable I/O modules.

In a PCS 7 environment, engineering tools are installed on a dedicated PC called the engineering station (ES). It runs SIMATIC Manager, which manages projects and launches other applications, including these:

- HW Config (Hardware Configuration)
- NetPro (a network manager)
- CFC (Continuous Function Charts), similar to *4-mation* in that it edits sheets containing function blocks and their interconnections
- SFC (Sequential Function Charts)
- PCS 7 OS, the human-machine interface (HMI) operator station (OS), started through WinCC Explorer.

Creating PCS 7 failsafe functions requires separate purchase of S7 F Systems V6.0 for installation on the ES. This is analogous to the QUADLOG in the environment for a QUADLOG control library installed on the *4-mation* engineering station to program QUADLOG controllers.

4.1.3 Function Blocks

Function blocks available for QUADLOG controllers through *4-mation* include logic, arithmetic, array, and string blocks. There are comparable function-blocks available within PCS 7, where they are divided into two categories: standard function blocks (denoted by gray coloring) and failsafe function blocks (depicted in yellow).

Standard and safety function blocks can coexist in a S7-417H CPU, where the standard function blocks make up the standard program and the failsafe function blocks make up the failsafe or F-Program. There are, however, constraints governing using standard and failsafe block together. For example, it recommended that data from standard function blocks not be fed into the failsafe user logic. Moreover, the compiler prevents combining standard and failsafe function blocks in the same runtime group (see the section titled Function Block order of Execution).

Ensure that you follow the rules and guidelines listed in the *SIMATIC S7 F/FH Systems Configuring and Programming* manual and in this document.

Function Block Libraries

QUADLOG function blocks available within *4-Mation* vary according to the products installed and the licenses purchased. MODBUS capability, for example, requires one or more QUADLOG MODBUS library licenses, and the library must be installed on the *4-mation* engineering station before the system can be programmed to use MODBUS communications

Function block libraries exist for PCS 7 as well. Libraries available for SIMATIC Manager and the CFC Editor are found by browsing the catalog and clicking on the

Library tab. Systems using the QUADLOG DP/IO Bus link module require that the S7 F Systems V6.0 license and software be installed on the ES.

Many function blocks available in *4-mation* do not exist as Failsafe function blocks within S7 F Systems and are not available within the Failsafe Library. These include blocks for modifying strings or communicating over MODBUS, which are not considered Failsafe functions in PCS 7. In PCS 7, if it is necessary to have data from a standard program interface to the failsafe function blocks within the F-Program, function blocks that convert data are available. Interfacing data from a standard program to an F-Program requires careful planning approved by your safety engineer.

Warning

Safety Note - Follow Published Rules and Guidelines

Follow the rules and guidelines published in the *SIMATIC S7 F/FH Systems Configuring and Programming* manual and this document.

There are some notable differences between QUADLOG function blocks and the Failsafe function blocks. For example, in QUADLOG, an AND block could be extended within *4-mation* to have multiple inputs. The Failsafe function block F_AND has four inputs. If you additional, inputs, you must cascade the function blocks to increase the number of inputs and outputs.

Control Function Blocks

In PCS 7, there are two types of function blocks: User Function Blocks and Control Function Blocks. User function blocks are used for the user logic, such as Boolean logic (NOT, AND, OR, etc) or other function blocks. A channel driver is also a user block. The function block libraries installed on your PC typically contain a folders named *Control Blocks* and *User Blocks* or variations of these names.

Control function blocks are function blocks placed by the compiler. These include function blocks that maintain safety integrity through diagnostic tests and function blocks that provide information or communicate with other devices, such as module drivers.

Control function blocks are discussed in detail in the *SIMATIC S7 F/FH Systems Configuring and Programming* manual and are described briefly here. The compiler automatically places control function blocks for the S7 F Systems, including these:

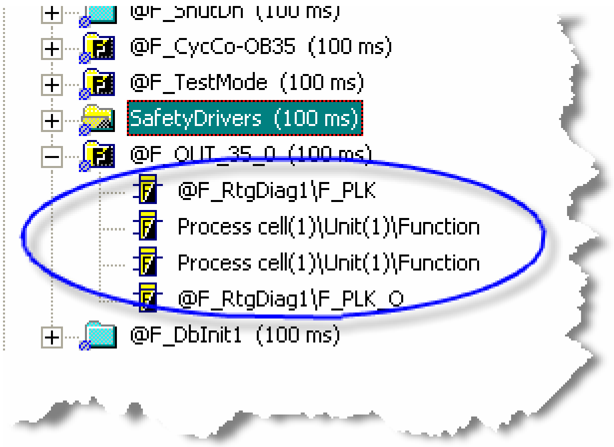
- @F_TESTM
- @F_TESTC
- @F_TEST
- @F_CYC_CO
- @F_ShutDn
- @F_PLK
- @F_PLKO

These blocks are placed in charts that begin with an '@' symbol, which readily identifies them as system level charts and thus differentiates them from control charts and user charts.

- @F_TESTx blocks manage the Safety Mode of the F-Program and verify the integrity of the CPU through CPU instruction tests.
- F_CYC_CO monitors the F-Program execution time. If the allocated time is exceeded, the F_CYC_CO halts the F-Program.
- F_SHUTDN manages the F-Program and resets it.

The F_PLK monitors program flow control. Every failsafe input has a PAR_ID (discussed in the next section) to determine if the proper output was routed to the proper input. If this output is not fed to an input determined at compile time or an output is connected to an incorrect input, then the F_PLK shuts down the F-Program because of a program-flow control failure. The F_PLK function block monitors program flow of function block execution. At the end of every failsafe function block execution, a special sequence is executed to handshake with the F_PLK. If this sequence is not executed because the function block exited prematurely or the sequence is executed out of order with a different function block, then the F_PLK function block shuts down the F-Program. The compiler places user logic between the @F_CycCo and the instance of the F_PLK function block in a runtime group named SafetyDrivers. The user logic is protected by the F_CYC_CO and the F_PLK function blocks.

Any output or input/output module drivers that are created by the compiler are placed between the F_PLK and the F_PLK_O. The F_PLK_O function block is monitors data flow for the module drivers and shuts down the F-Program when it detects improper data flow, data interruption, and data corruption.



Safety Data Format (SDF)

The PCS 7 Safety Data Format concept is discussed in the *SIMATIC S7 F/FH Systems Configuring and Programming* manual. Data protected by the safety program is called SDF data and is contained of the following structure:

DATA : Data_type

PAR_ID

COMPLEMENT : Data_type_complement

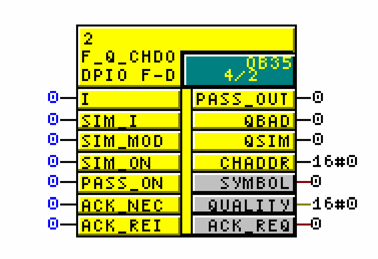
Data and its complement are processed and stored in the safety function blocks. To ensure data integrity, the data is calculated in a different way by an alternate programming technique and complemented. A diagnostic test verifies the integrity of the data by comparing the DATA to the inverse of the COMPLEMENT. The

PAR_ID is used to monitor the flow of data to ensure that data is routed correctly. If a fault is detected, a failure is reported and the F-Program shuts down. This process is discussed in section titled Shutdown Logic.

Channel Drivers

Within *4-mation* the input and output data of a resource is made available to the user logic through a %TAGNAME structure assigned to the associated channel.

PCS 7 system based on a DP/IO Bus Link QUADLOG module use channel drivers to access input and output data. The PCS 7 channel driver is the equivalent of the QUADLOG %TAGNAME structure. The channel driver manages channel data. The following is an CFC illustration of a channel driver:



If the channel experiences an open circuit or other failure, the channel data quality goes bad, and the channel driver displays this summary information on the QBAD output. If the quality goes bad, it is possible to program the channel driver to produce substitute data provided on channel driver function blocks inputs labeled SUBS. A channel driver can also shut down an output or input if quality goes bad or a communications failure occurs. There are two sets of channel drivers. Both sets are available within the DPIOBus Link Library. One set is standard channel drivers (grey function blocks) for use with non-critical QUADLOG I/O modules, such as the QUADLOG IDM, QUADLOG ODM, QUADLOG VIM, QUADLOG SAM, QUADLOG SDM+, and QUADLOG EAM. The other set is the failsafe function blocks (yellow function blocks) for use with the critical QUADLOG I/O modules such as the QUADLOG CDM, QUADLOG CDO, QUADLOG CAM, and QUADLOG CAI.

Detailed information is available in the descriptions of the failsafe channel drivers:

- F_Q_CHDI
- F_Q_CHDO
- F_Q_CHRI
- F_Q_CHRO

and the standard channel drivers:

- A_CH_DI
- A_CH_DO
- A_CH_RI
- A_CH_RO

The section titled Adding QUADLOG Components with HW Config illustrates how to configure the QUADLOG DP/IO Bus Link module for a sample system consisting of a SAM and a CDM.

Reintegration of I/O

In QUADLOG, outputs could be configured to shutdown if a class 4 error were detected. This is true of PCS 7 as well.

In PCS 7, a process called *reintegration* is required to make the system operational again after a shutdown stemming from a class 4 error:

- After any reset of the DP/IO Bus Link shutdown logic
- To re-enable the inputs or outputs if a communications failure or bad or unavailable quality is detected and the fault condition is removed

Reintegration of outputs and inputs a new concept to QUADLOG users. It can be regarded as a second level of shutdown logic at the channel level. Although each channel driver can require reintegration, it is not necessary to manage each channel individually. In a project with 1000 channel drivers, for example, each channel drivers' ACK_REI could be connected to a single function block and be reintegrated at once.

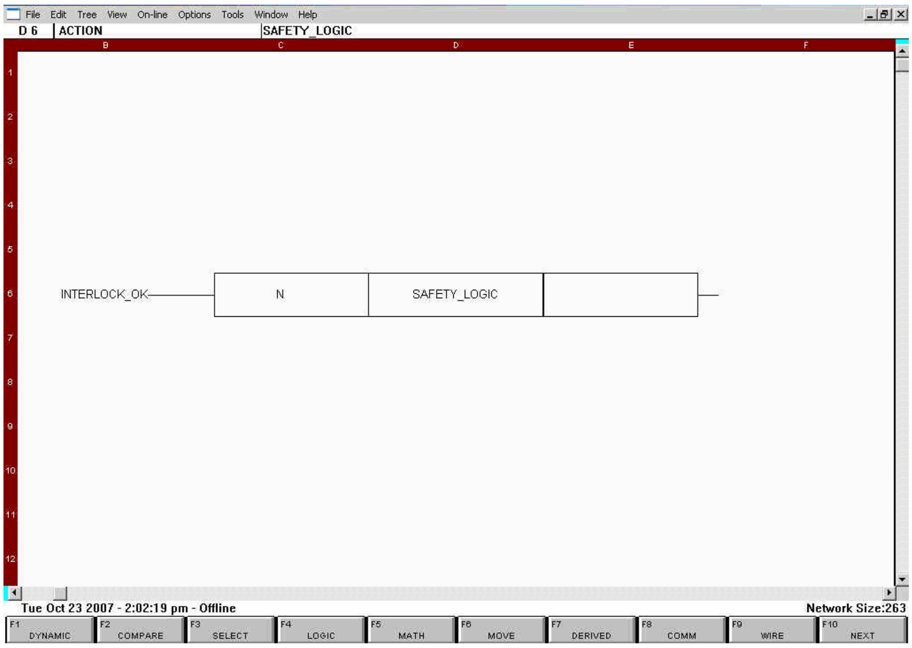
It is also possible to segregate groups of channel drivers based on the functional area in the plant or unit and connect the ACK_REI of those drivers for reintegration.

For more information, see the section titled Passivation and Reintegration of the Input and Output Channels. The process of reintegration is also discussed in the *SIMATIC S7 F/FH Systems Configuring and Programming* manual.

To this end, PCS 7 includes the F_QUITES function block for reintegrating or starting channel drivers. This function block is discussed in the *SIMATIC S7 F/FH Systems Configuring and Programming* manual. You may choose to use the F_CHG_B function block, which allows the PCS 7 OS to write to these ACK_REI parameters.

No Equivalent to QUADLOG Actions

QUADLOG *4-mation* supports a block known as an *action*. An action may be enabled or disabled through a Boolean input and used for custom batch programming or when similar function is necessary for an application.



Within PCS7, it is possible to create a function similar to a QUADLOG action, but only for standard function blocks. This equivalent is created in PCS 7 at the runtime group level by attaching the EN input of the runtime group to a Boolean output that enables or disables the runtime group.

This action-equivalent cannot be created for safety-related or yellow function blocks because they must run during every scan. Otherwise, a flow control failure occurs and the F-Program shuts down.

It is important to understand that if the runtime group is disabled by a signal from within the runtime group itself, it will not be able to be re-enabled except by recompiling and re-downloading the CFC after correcting the disabling signal. If the values within a runtime group that can be disabled are used in another part of the standard program, when the runtime group is disabled the values will hold their last value.

Warning

Safety Note - Do Not Disable Runtime Groups Containing Safety Function Blocks

Using a feature to disable runtime groups which contain safety related function blocks is not permitted and is prevented by the compiler. Every yellow or safety function block must run every scan; otherwise, a flow control failure occurs and the F-Program shuts down.

Sequential Function Charts (SFCs)

For more information about SFCs, see the document titled *SIMATIC Process Control System PCS 7 Engineering System*.

There is also the SFC Visualization optional package that requires a separate license to manage the SFCs from within the PCS 7 OS.

User Defined Function Blocks versus Chart in Chart

QUADLOG supports structures called *User Defined Blocks* (UDBs). In PCS 7. it is possible create your own standard function blocks using sequential control language (SCL), which is similar to structured text or BASIC. You cannot, however, create custom failsafe function blocks from within SCL.

Within PCS 7 you may create your own custom function blocks by creating chart-in-charts in your project. However, if you are creating a Failsafe custom function blocks as chart-in-charts or compiled chart-in-charts, follow the directions in the *SIMATIC S7 F/FH Systems Configuring and Programming* manual.

Warning

Safety Note - Follow Instructions When Creating Charts-in-Charts

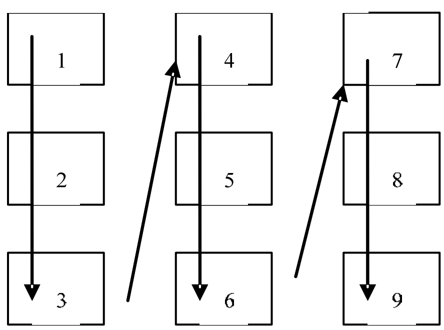
When creating chart-in-charts or compiled chart-in-charts in a Failsafe program, failure to follow published instructions can result in an F-Program that shuts down unpredictably.

Function Block Order of Execution

In QUADLOG the order of execution of function blocks is determined by their position on a structure called a *sheet*. Execution of the sheets within the QUADLOG controller is based on the order of the Resource Sheet, as observed within *4-mation* from the resource tree. Typically the Resource Sheet is the top level sheet and the first sheet to execute. User logic is created on sheets below the Resource Sheet.

As the figure below illustrates, within a sheet, the top left-most function block is executed first, and then execution continues down the left column until the bottom block is executed. Execution resumes at the top of the second column from the left, and so forth until the page is complete.

QUADLOG function block order of execution



A PCS 7 environment provides a control scheme with more flexibility than that of QUADLOG. In a S7-417H CPU, it is possible for programs to run concurrently, but with varying scan rates and priorities. A higher level priority scan can interrupt a lower level priority scan. The structures for regulating execution are known as Organizational Blocks or OBs. The OBs for user programs range from OB30 through OB38, where OB30 is the slowest OB and OB38 the fastest OB, which by default runs at 10 ms. The execution time of an OB may be changed within HW Config.

Note

OB38 is used by DP/IO Bus Link module for data transmission. Its default scan rate of 10 ms should not be changed.

Within an OB, function blocks are placed within a chart in a runtime group. PCS 7 helps minimize this effort by placing function blocks automatically, creating runtime groups based on the chart name.

These runtime groups must be validated and reorganized as necessary. The **Set Insert Point as Predecessor** function (discussed below) simplifies the process of organizing function blocks within the runtime group to produce desired program flow. You may, for example, wish to acquire data from inputs channel drivers before executing control logic, which then sends values to the outputs.

Time management is critical when organizing runtime groups within an OB. For example, if program placed within OB35 takes 100 ms to execute, it is using all the CPU's resources because OB35's default scan rate is 100 ms. Moving this 100 ms program to OB34 changes the utilization to 50% of the CPU's resources because OB34 runs at 200 ms.

The standard program is the combination of all standard runtime groups. The F-Program is the combination of all of the failsafe runtime groups.

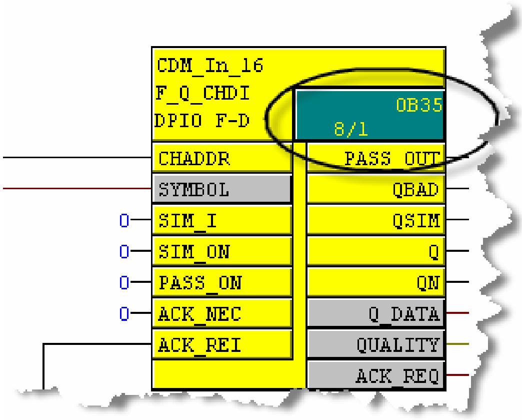
Note

For every DP/IO Bus Link module that is used within the S7-417H CPU, one module driver is placed within the 10 ms OB38 (a maximum of two pairs of redundant DP/IO Bus Link modules can be connected to a S7-417H CPU). A module driver requires approximately 1.5 ms of execution time to communicate data over Profibus DP, so the DP/IO Bus Link module takes approximately 15% of the CPU time. Two pairs of DP/IO Bus Link on an S7-417H CPU consume 30% of the CPU time.

There are two ways readily to determine the run sequence of function blocks in PCS 7:

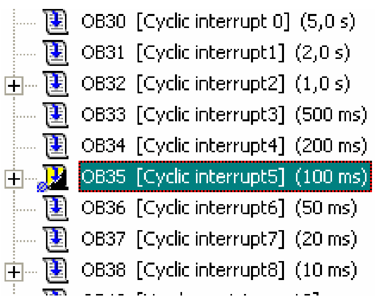
- From the CFC editor, open the run sequence by clicking on the icon shown below, which is found in the toolbar.

- From a displayed function block, double-click the green order-of-execution box in the upper right corner of the block (Tip: to locate a function block within a runtime group, right-click the block within the CFC Editor and from the context menu, choose **Go to insert point**):

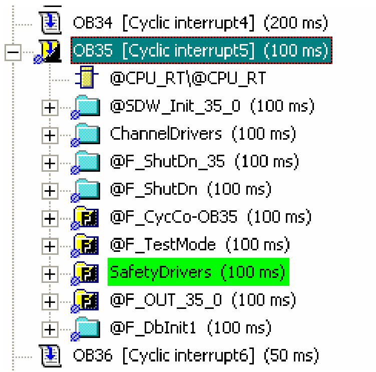


The Runtime Editor displays the frequency of OB execution.

The number following the OB description is related to the frequency at which the OB executes. In the highlighted example, OB35 executes every 100 ms. This is a default value and can be changed within HW Config.

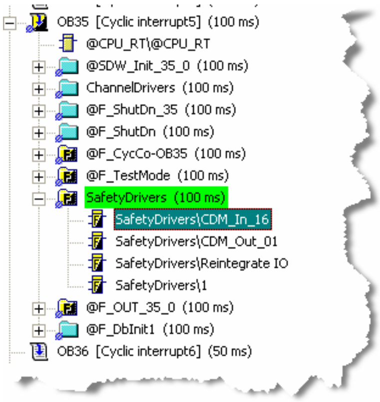


Runtime Groups exist within OBs and are depicted as blue or yellow folders. In the illustration below, the OB35 folder is highlighted because it was selected when the Runtime Editor was invoked.

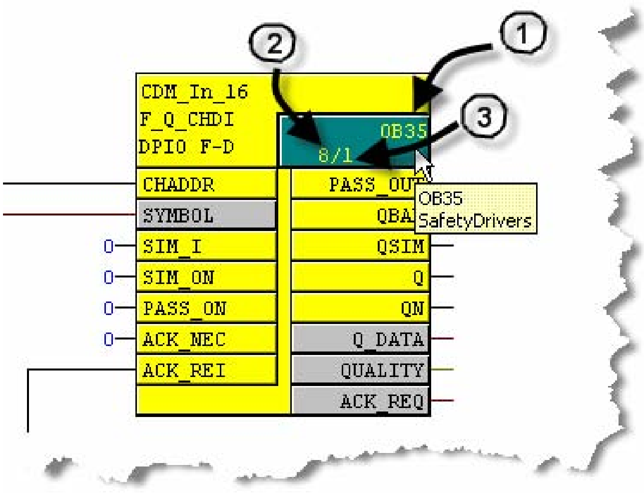


Order of execution is the order of individual folders with the OB, from top to bottom. This is known as the Runtime Order. To change the order of execution select the runtime group that you want immediately below inserted objects, right-click and select **Set Insert Point as Predecessor** from the context menu.

A folder typically includes a number of constituent elements. Double-clicking the icon labeled SafetyDrivers, for example, displays the contents of the SafetyDrivers Runtime Group, which are in turn listed in their run order. In the illustration below, execution begins with CDM_IN_16, followed by CDM_Out_01, and so forth:



In addition to using the Runtime Editor to determine sequence of execution, from an CFC chart, you can determine by inspection the run sequence of any function block by examining the green runtime-sequence block in its upper-right corner. The function block highlighted above, for example, is shown below. Its labeling indicates that it is in (1) OB35, (2) in the eighth Runtime group, and (3) the first element in the run order of that Runtime group:



4.1.4 Scanning of QUADLOG I/O Modules

In the QUADLOG controller, the Resource Sheet contains the function block TOTIOSD (Total IO Shutdown) function block. This function block scans QUADLOG I/O modules and manages the shutdown logic of the QUADLOG controller. In a QUADLOG environment, the Resource Sheet is typically the first sheet to execute.

QUADLOG I/O scanning is performed asynchronously, the CCM module polling the IO Modules for their Input Data at a rate equal to the Scan Rate. The IO Modules run asynchronously to the CCM and gather their input data and respond with that data when scanned by the CCM.

In the DP/IO Bus Link module, the IO Data is passed between the DP/IO Bus Link module and the CPU asynchronously with respect to the execution of the control logic. The data is gathered within the S7-417H CPU by the DPIO_DRV function block that runs within OB38. The OB38 scan rate of 10 ms should not be changed.

Scanning Outputs

The process of scanning outputs begins at the S7-417H CPU within the user program. The user program is placed in an OB with a scan rate that matches its requirements, such as OB34 at 200 ms, or a slower OB. The user logic within the standard program or the F-Program prepares the output data. This data is then fed to downstream function blocks called output channel drivers. The output channel drivers such as the F_Q_CHRO or F_Q_CHDO for safety critical I/O modules and A_CH_RO or A_CH_DO for non-critical I/O modules (such as the QUADLOG SAM, and QUADLOG SDM+) take the data that is linked to it from the user program logic and make it available to a module driver.

A module driver is a function block that gathers the data and assembles it into a buffer of data that can be transmitted to the I/O signal device. The module driver is either the F_Q_MOD or the MOD_DRV function block. The compiler automatically inserts the module drivers for you when you compile the project. The module driver function blocks gather the data from all of the assembled output channel driver data, and make it available to another module driver, the DPIO_DRV function block. The DPIO_DRV function block is placed by the compiler in OB38, which executes at the fastest possible rate (10 ms) to ensure that the data is transmitted and received as quickly as possible. For this reason, it is important not to change the scan rate of OB38.

The DPIO_DRV module driver function block grabs the entire output buffer from each of the F_Q_MOD or MOD_DRV module driver function blocks and splits it into manageable pieces for transmission over DP to the DP/IO Bus Link module. This is where a distinct difference exists between the I/O scanning methods of the DP/IO Bus Link module and the QUADLOG controller.

The QUADLOG controller is able to send an entire scan message of output data directly to the I/O module. The DP/IO Bus Link module it is not able to do this directly. The DPIO_DRV module driver must split this message into smaller PROFIBUS DP messages. These smaller DP messages are sent over PROFIBUS DP to the DP/IO Bus Link module. The DP/IO Bus Link module collects these messages. When a complete set of messages is received it assembles them back into the original buffer and marks this set of data as ready to be used by the IOBus scanner.

The DP/IO Bus Link module contains several buffers so it can decide which message to use. The algorithm uses two ready-to-use buffers while other data is stored and assembled in other buffers. This approach accommodates missed or incomplete messages resulting from lost packets. One of the ready buffers is used to write the output message to the I/O Bus modules. In a redundant Node to Node DP/IO Bus Link module system, this data is also synchronized to and exchanged with the partner DP/IO Bus Link module to ensure that it, too, has the latest data. This method of comparing output data also checks data integrity to ensure that it is valid in exactly in the same way that it is checked in the QUADLOG controller.

Scanning Inputs

The process of scanning inputs begins at the I/O module. The I/O module scans a rate more rapidly than 100 ms/scan, typically around 25 or 50 ms. The I/O module reads the scanned inputs and latches the data into a buffer. When the DP/IO Bus Link module requests it, the prepared buffer is sent to it as an I/O Bus message.

The DP/IO Bus Link module contains a set of buffers to store the latest I/O Bus input message from the I/O module. The latest set of data is always transferred to the S7-417H CPU. The data in this input buffer is typically too long for a single PROFIBUS DP message and must be split among multiple messages, much like the splitting of output messages, before it can be sent to the S7-417H CPU.

Within the S7-417H CPU, the DPIO_DRV module driver function block, running in OB38 at 10 ms, receives the PROFIBUS DP messages and assembles them into a complete message. Several 10 ms scans may be required to obtain and assemble an entire message. After the message is assembled, it is then prepared to be delivered to the I/O module drivers, which is either the F_Q_MOD or the MOD_DRV module driver function blocks.

The module driver function blocks run in the same OB3x as the input channel drivers. The module drivers take the input data and deliver it to the input channel drivers such as the F_Q_CHDI, F_Q_CHRI, A_CH_DI or A_CH_RI.

After this process, the input channel drivers now have the data available to the user program for function blocks downstream.

4.1.5 Shutdown Logic Differences

In the QUADLOG controller the TOTIOSD and the PARTIOSD function blocks manage the shutdown logic. If a failure or a shutdown level error is detected, the function block shuts down outputs if the shutdown mode governed by AUTOSD (auto shutdown) is configured as TRUE.

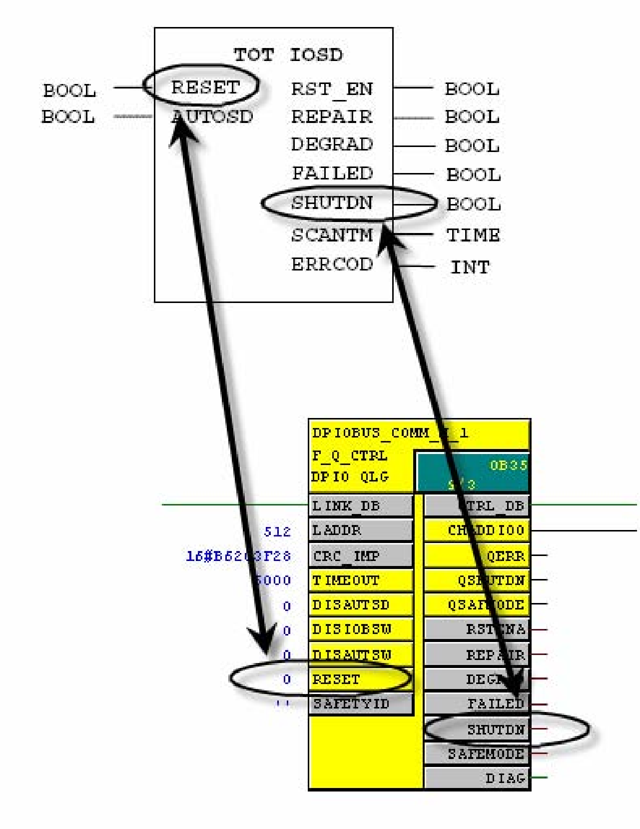
Note

In QUADLOG disabling Auto_SD (Auto shutdown) also disables redundancy if a class 4 error is reported.

In DPIOBus Link, however, redundancy is still active after disabling Auto_SD, and a class 4 error is reported.

There are two levels of shutdown logic used in the DP/IO Bus Link module. The first is identical to the shutdown logic within the QUADLOG controller. The illustration below shows the similarity between the QUADLOG TOTIOSD function block and the comparable PCS_7 F_Q_CTRL block. The F_Q_CTRL function block is similar to the module drivers F_Q_MOD and MOD_DRV, but is always paired with the DP/IO Bus Link module, which which it communicates. The information exchanged includes data on the shutdown inputs and outputs such as RESET, QSAFMODE, DEGRAD, SHUTDN, SCANRATE. The F_Q_CTRL function block is also responsible for transmitting the safety mode status to the DP/IO Bus Link module.

The PCS 7 safety mode status is analogous with the the QUADLOG security switch. When the PCS 7 Safety Mode is enabled, the S7 F system performs integrity checks equivalent to those performed in the QUADLOG controller when security mode is enabled.



These inputs may be observed from within CFC while in Testmode (which displays live data from the CPU). The preferred method is to manage the shutdown logic from the PCS 7 OS DP/IO Bus Link faceplate, See the section titled Safety Pane to learn more about this feature.

Note

In QUADLOG it is possible to use the TOTIOSD and the PARTIOSD function blocks to permit partial IO Scanning. Only the equivalent of the TOTIOSD is supported within the DP/IO Bus Link module. With PCS 7, there is no partial shutdown mechanism.

The second level of shutdown logic in S7 F Systems is created automatically by the compiler when you create a project containing any failsafe function blocks.

The F_SHUTDN function block is placed in a chart named @F_ShutDn. This chart can be opened from SIMATIC Manager or from CFC by selecting the **Charts** tab, right-clicking the chart, and selecting **Open**. The F_SHUTDN block is described in Appendix A.3.9 of the *SIMATIC S7 F/FH Systems Configuring and Programming* manual. The F_SHUTDN block manages the shutdown conditions that could arise within the F-Program as a result of a diagnostic trip such as an SDF failure.

Failsafe blocks are configured within Runtime Groups, and the Runtime Groups can be placed within Shutdown Groups. With PCS7, the User can configure multiple sections of the configuration to shutdown individually; these are called Partial Shutdown Groups and are discussed in detail in the next section.

Partial Shutdown Groups (PSGs)

The is no QUADLOG equivalent to S7 F Systems Partial Shutdown Groups. They are inherent to S7 F Systems and not exclusively a feature of the DP/IO Bus Link module.

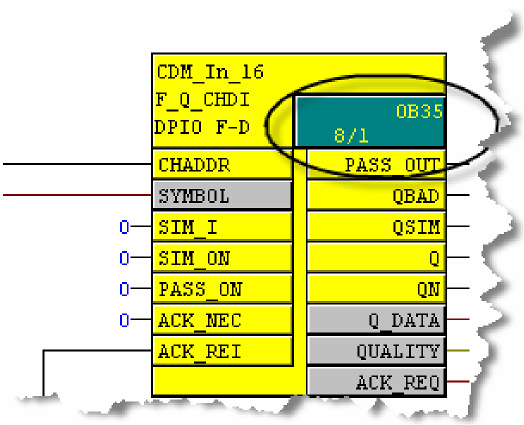
S7 F Systems Partial shutdown groups are not like the QUADLOG PARTIOSD (Partial IO Shutdown Blocks) in spite of the similar name. A Partial Shutdown Group is a collection of Failsafe Runtime groups. The Partial Shutdown Group allow multiple contiguous failsafe runtime groups to be protected and considered as one large failsafe runtime group.

The advantage of this is evident when making connections from one failsafe runtime group to another failsafe runtime group. You may do so directly without function blocks that communicate from one runtime group to another. Such communications do, however, require function blocks as described in the section titled Communicating F-Parameters to a Partial Shutdown Group.

The PSGs are managed by the Partial Shutdown Group Marker block, discussed later. The only practical way to determine visually the physical boundaries of a Partial Shutdown Group is to search for the Partial Shutdown Group Mark block. If you did not place any Partial Shutdown Group Mark blocks in your project, all the failsafe runtime groups for a particular OB are placed within one large PSG. This is the default and most common configuration.

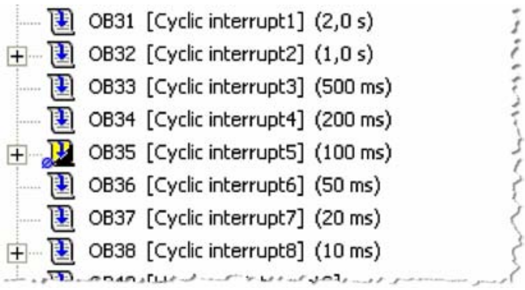
The runtime groups (grey or cyan) and failsafe runtime groups (yellow) can be observed through the runtime sequence editor. This can be opened by clicking the **Run Sequence** icon in the toolbar within the CFC editor.

The runtime sequence editor can also be opened by double-click the green runtime sequence box within a function block:

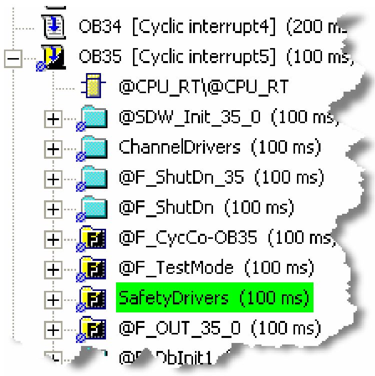


The following list is from of a project that contains a Partial Shtudown Group. The list shows how the Failsafe blocks fit within the configuration and ultimately how a Partial Shutdown Group fits into the Simatic Configuration.

The portion of the Runtime editor display is shown in the following illustration:



The illustration below shows an expansion of OB35, the default location for any logic created by the user when configuring.



Notice in the runtime groups within this Organization Block, OB35:

- Blue icons indicate standard Runtime groups

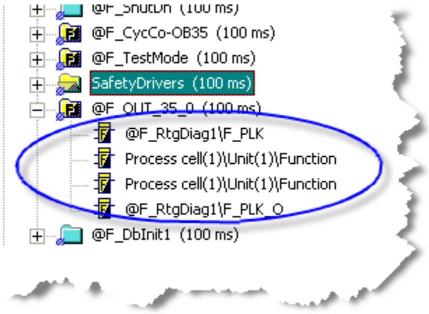
- Yellow/black with F icons are for Failsafe Runtime groups.

As the illustration indicates, Failsafe RTGs are contiguous, since timing in Failsafe logic often won't allow the time delays allowed in standard runtime groups.

The run sequence of the RTGs within an OB is from top to bottom. To keep the RTGs in a Failsafe Shutdown group separate from Standard RTGs, the following requirements are enforced:

- The last standard RTG prior to the Failsafe RTGs contains the standard Function Block F_SHUTDN. In the illustration below, it in the Standard Runtime Group labeled @F_ShutDn:

- The end of the Shutdown group, within the last Failsafe RTG, contains an F_PLK block. As show below, the last Failsafe RTG is named @F_OUT_35_0, and the F_PLK block is on the @RtgDiag1 page within CFC:



If you were to intersperse STD RTGs within the Failsafe RTGs, the delays allowed in STD RTGs would very likely cause a timeout failure in the Failsafe logic. You may allow for this by increasing the cycle time on the F_CYC_CO function block.

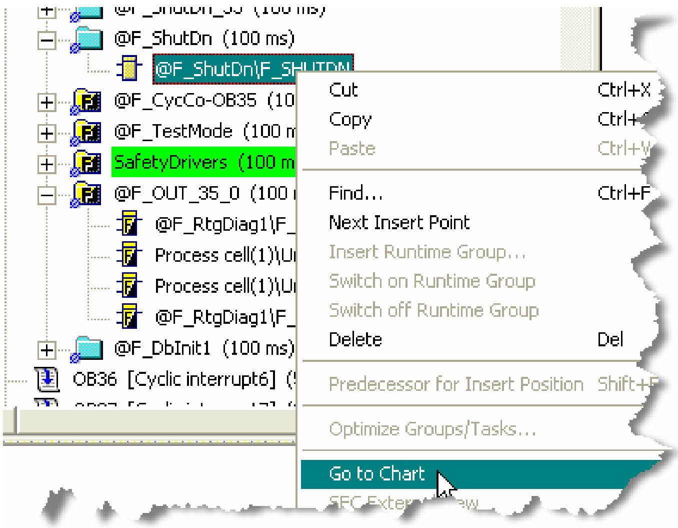
For that reason, do not intersperse standard RTGs within Failsafe RTGs without taking into account the cycle time of the F-Program. As is shown here:

There is, however, a way to execute logic contained in standard RTGs, located between Failsafe RTGs. This is accomplished by introducing an F_PSG_M block (Partial Shutdown Group Marker Block). Upon detecting this block, the compiler automatically adds the extra close (F_PLK) and open (F_SHUTDN) blocks in the run sequence.

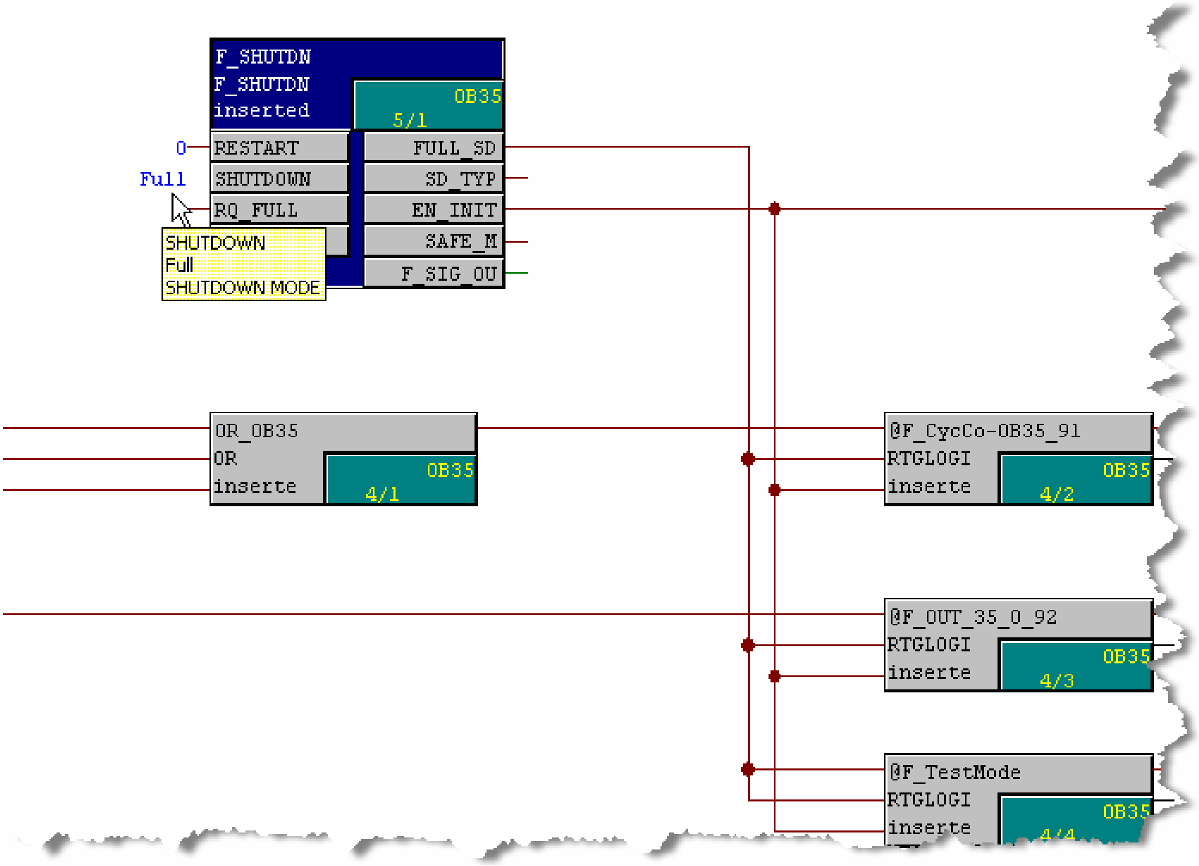
Details of F_SHUTDN Function Block

An example illustrates the features of the F_SHUTDN block.

Right-click the block and choose **Go to Chart** from the context menu:

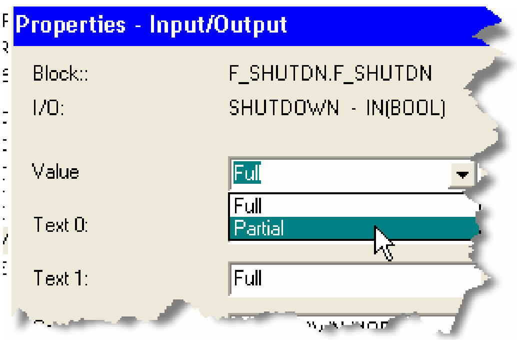


The chart containing the function block appears:



Hovering your cursor over the **SHUTDOWN** input reveals that the input is configured to to operate in Full Shutdown mode.

Double-clicking the input opens a **Properties** window with a **Value** field for changing the shutdown setting:



By using multiple shutdown blocks and associating each with a separate section of logic (the logic within a individual pair of @F_SHUTDN/@F_PLK Function Blocks), the shutdown can be customized to limit the effects of a failure to a section of the plant or logic.

If a failure, such as an such as an SDF failure, is detected on a failsafe function block within a PSG, the PSG and all the failsafe function blocks running within the PSG shut down. If the @F_ShutDn function block is configured as a Partial shutdown, the shutdown is limited to this affected PSG. However, if the @F_ShutDn is configured as a Full shutdown, the shutdown will involve all failsafe blocks in every PSG in the entire F-Program.

Note

If the F-Program is shutdown or the PSG is shutdown that contains the channel drivers and module drivers of the DP/IO Bus Link module then the outputs associated with that DP/IO Bus Link module will be shutdown after the 3 second I/O module timeout.

4.1.6 Data Display

With QUADLOG you can view online data on the function blocks inputs and outputs.

Within PCS 7 there are two ways to view online data:

- CFC test mode, for observing selected inputs and outputs
- PCS 7 OS, where you can examine any of the PCS 7 function blocks to observe data values, such as MEAS_MON to monitor real values or DIG_MON to monitor discrete values.

4.1.7 Accessing Variables

In QUADLOG, any variable can be passed to any variable by directly wiring it or using inline structured text.

In QUADLOG any value can be written to using a Set_Val function block, including softlist parameters of I/O modules.

The writing of a variable can be restricted using the security function, so unless security was disabled, a variable is not changeable.

Warning

Safety Note - Do Not Change Softlist Parameters in a Running System

It is not possible to change the softlist parameters of I/O modules in a running DP/IO Bus Link module. Do not use the PARAM_RW function block in an online running system to access the QUADLOG I/O module's softlist parameters.

4.1.8 Communicating Variables to Another Resource

In QUADLOG variables can be transferred between CPUs (CCMs) using the READ/WRITE function blocks.

Within PCS 7 you may transfer failsafe outputs from one S7-417H CPU to another using the send and receive function blocks:

Sending station	Receiving station
F_SENDBO for sending Boolean data	F_RCVBO for receiving Boolean data
F_SENDR for sending Real data	F_RCVR for receiving Real data

For more information, see section 7.1.2 of the document titled S7 F/FH Systems Configuring and Programming, which contains additional information about these blocks.

4.1.9 Communicating F-Parameters to a Partial Shutdown Group

In QUADLOG any variable can be connected to any other variable..

In PCS 7 it is possible to make direct connections from standard function blocks to standard function blocks in any location in the S7-417H CPU. However, this is not necessarily possible within S7 F Systems, and special communications blocks may be required. The rules are simple:

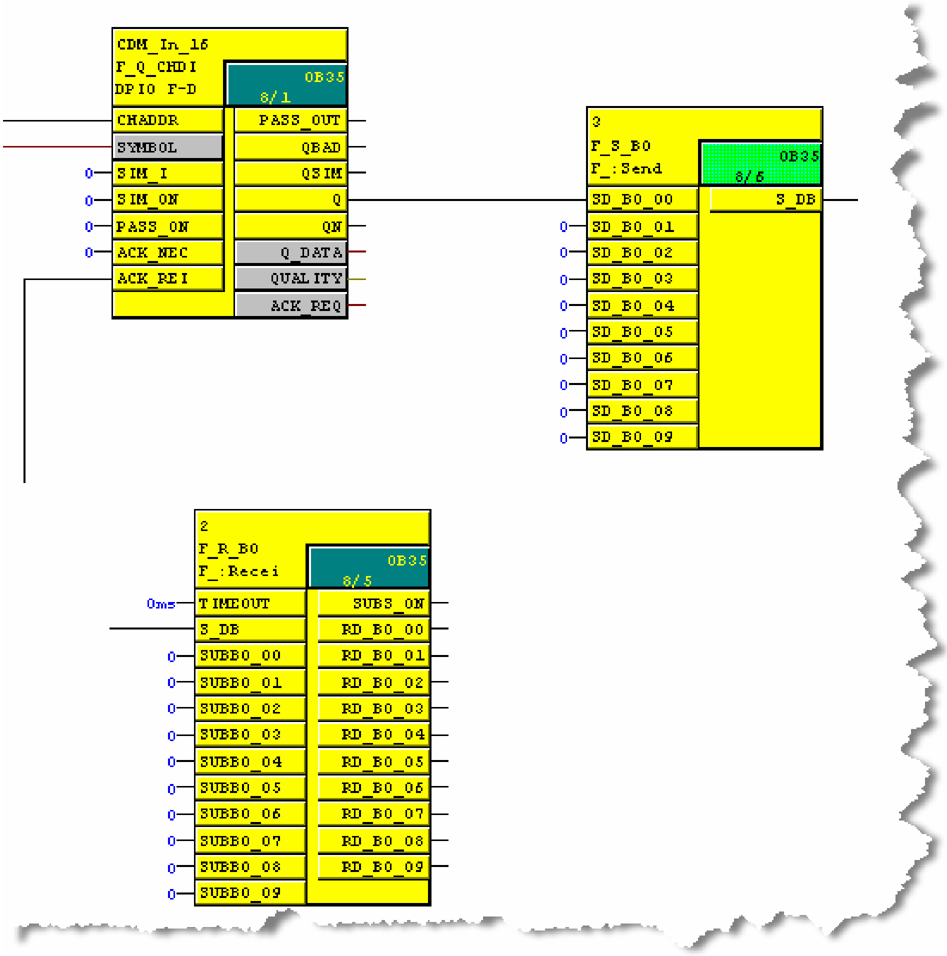
- You may directly wire a connection to communicate a failsafe parameter to another function block within the same failsafe runtime group.
- Since A Partial Shutdown Group is a collection of Failsafe Runtime Groups, any failsafe parameter may be connected to any failsafe parameter within the same Partial Shutdown Group (Partial Shutdown Groups are discussed in the F-Systems manual, Programmable Controllers S7 F/FH Systems).
- To communicate a failsafe parameter to another Partial Shutdown Group, you must use one of the runtime-group to runtime group-communications function blocks.

The following function blocks ensure the integrity and completeness of the failsafe data if the logic is spanning Partial Shutdown Groups (see section 5.8 of the document titled S7 F/FH Systems Configuring and Programming for more information):

- F_R_BO receives 10 elements of f_bool
- F_S_BO sends 10 elements of f_bool
- F_R_R receives 10 elements of F_Real
- F_S_R sends 10 elements of F_Real

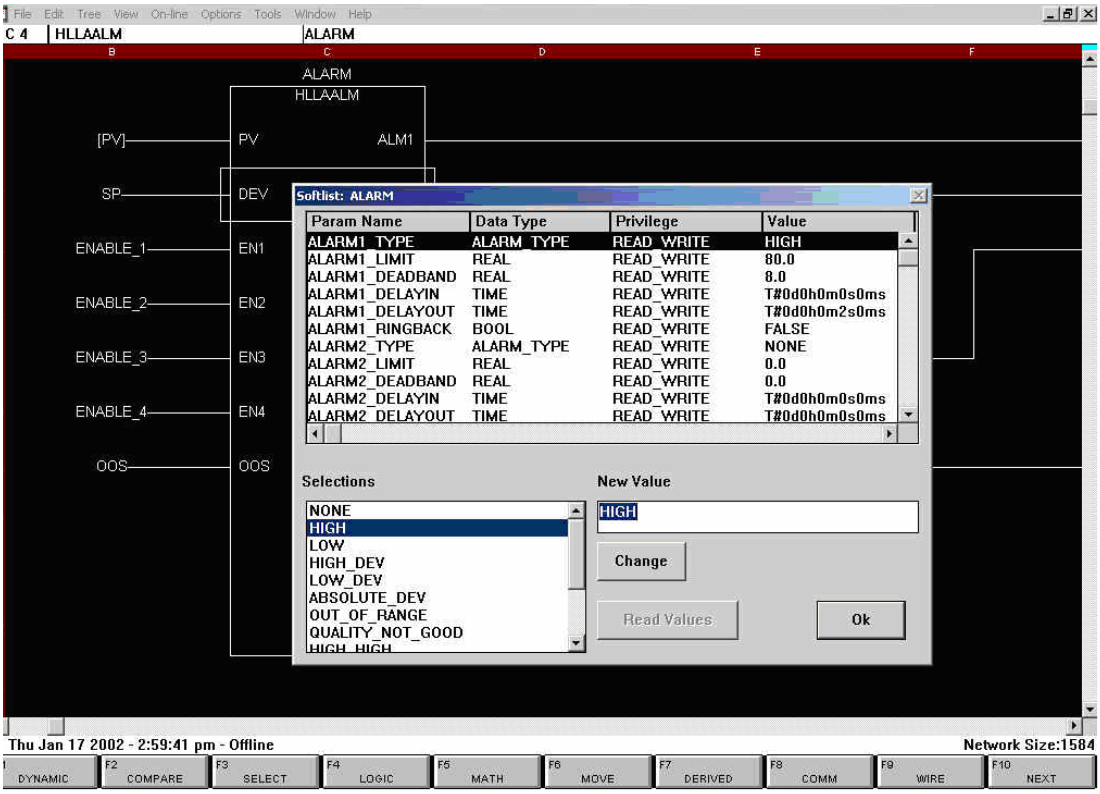
These blocks manage timeouts and other aspect of data communication.

Below is an example of the Send Block connecting to a Receive block, allowing connections to span across Partial Shutdown Groups.



4.1.10 Viewing Softlist Data

In QUADLOG, parameters are read and changed by means of an I/O Dialog box and through the SET_VAL block:



In QUADLOG any value can be written to a variable using a Set_Val function blocks This capability is subject to restrictions eforced by the security function, so unless security is disabled, a variable is not changeable. In a redundant PCS7 system, direct transfers would result in data corruption.

In QUADLOG variables can be transferred between CPUs(CCMs)

See the section titled Communicating F-Parameters to Partial Shutdown Group.

4.1.11 Viewing Error Information

In QUADLOG, the Diagnostic Logger displays all errors from all resources connected to the *4-mation* engineering station. In addition, the IOM_ERR function block can be used to read individual errors.

The equivalent of Diagnostic Logger is not available for DP/IO Bus Link module. However, asset-management information built into the faceplates displays the five most current errors (sorted in descending order starting with the highest class error) on the A-Side and B-Side. Faceplates also provides a circular buffer of the most recent 100 errors and events. A faceplate control is available to write the current history buffer to a list.

See the sections titled Current Errors and Error History for a description of how the error system works.

In QUADLOG, through *4-mation*, the resource tree displays the health of all resources through green, red, yellow, or white module. The PCS 7 OS provides the same information with faceplates dedicated to the DP/IO Bus Link module and I/O modules.

In PCS 7, the OS obtains this error information from the individual module drivers from the F_Q_MOD blocks (for Failsafe modules) or MOD_DRV blocks (for

Standard modules) and the DPIO_DRV function block for the DP/IO Bus Link module itself.

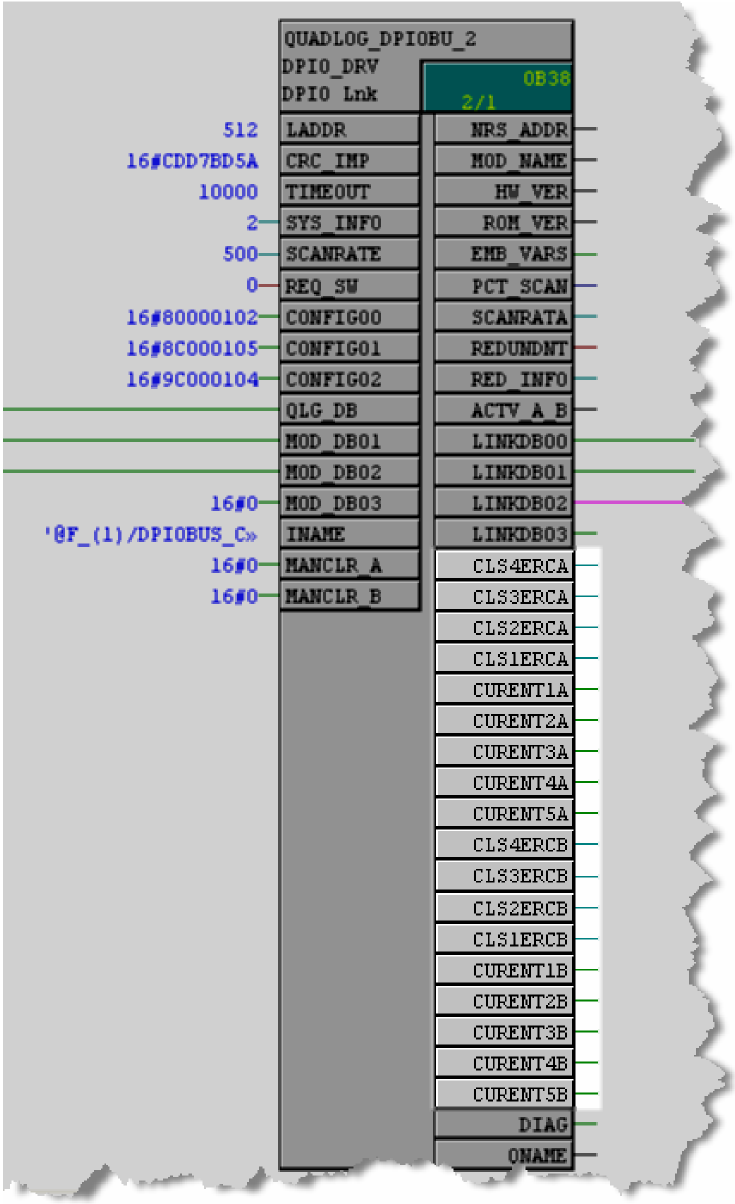
Outputs of these modules convey error information:

- CLSxERCx provides number of class 1, 2, 3, or 4 errors on the A-Side or B-Side.
- CURENTxy is the five most current errors on A side or B-Side. These errors are encoded in a hexadecimal format

The faceplates within the PCS 7 OS translates this data into an error code and system service code. A utility program, DecodeError.exe, available in the *_Tools* directory on the software distribution CD, decodes the hexadecimal error codes from these function blocks into error codes and system service codes

For an engineer in a design phase without access to PCS 7 OS faceplates, there is error-decoding tool on the software distribution CD the **_Tools** folder This utility decodes the hexadecimal error format into the error code and system service code. The table of contents of the help file DPIOERRORS_toc.chm, located at the root directory of the CD, is organized by error code and system service code.

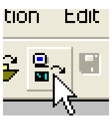
The following illustration highlights function blocks outputs that convey error information:



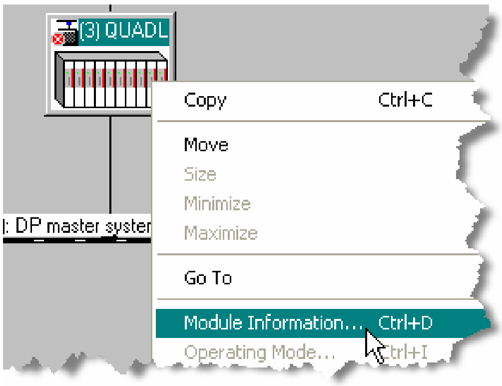
HW Config Diagnostics

The chief purpose of the HW Config program to configure hardware and parameters for PCS 7 system. HW Config also provides important, if limited, diagnostic information regarding standard and failsafe signal modules and other hardware, including the DP/IO Bus Link module. OS faceplate are the chief source of this asset management information, but it is important not to overlook the HW Config diagnostics.

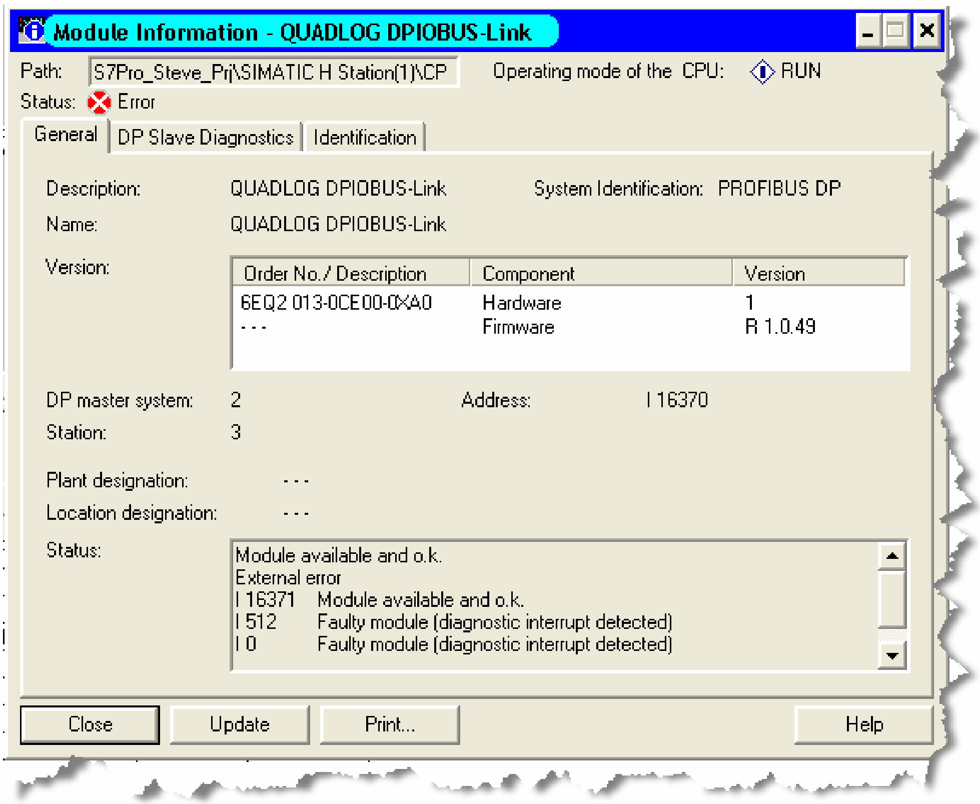
1. From HW Config, click the OFFLINE/ONLINE toggle icon from the menu bar to put the system online so that errors can be monitored:



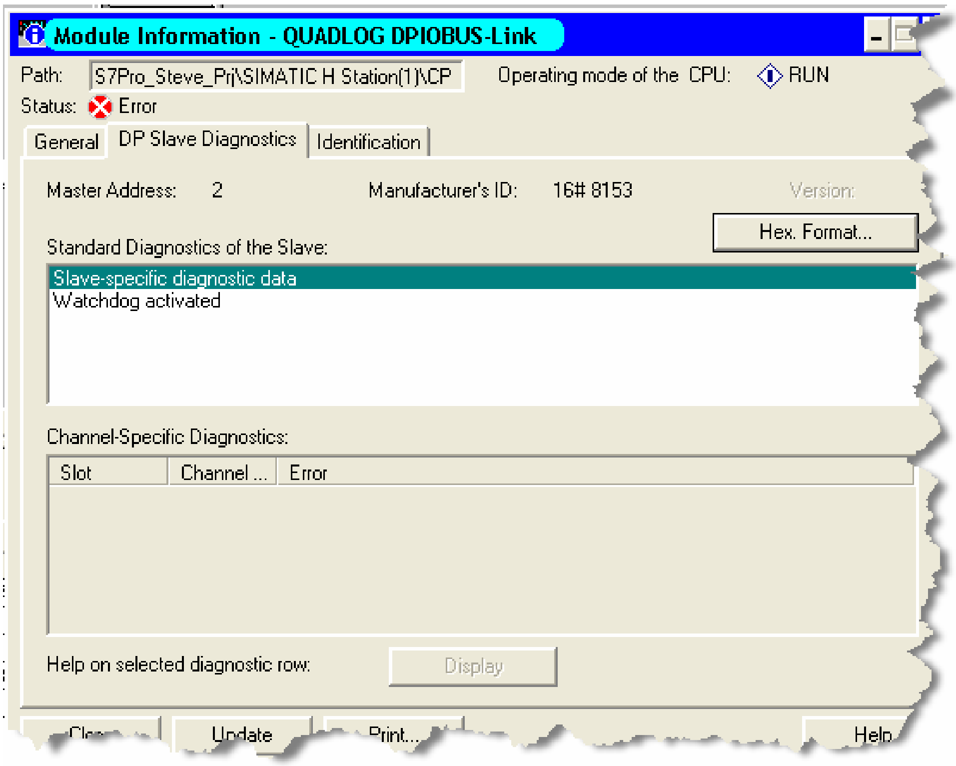
2. To view errors associated with the DPIO-Bus Link, right click on that icon and choose **Module Information…:**



The **Module Information** window opens:

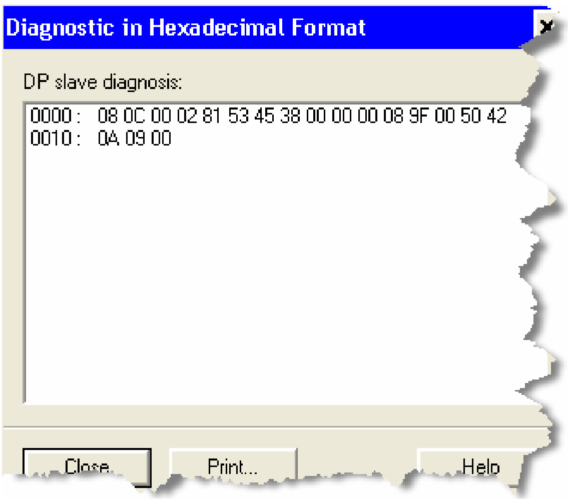


3. Select the **DP Slave Diagnostics** tab to displays errors associated with the DPIO-Bus Link Module:



More specific errors are displayed.

4. If the error is specific to the slave, click the **Hex Format…** button to see the reported detail:



Although this information is not always useful in the case of the DP/IO Bus Link module and its I/O modules, in conjunction with information from faceplate status LEDs on the DP/IO Bus Link module, it can help diagnose a failure. This information might be useful, for example, to help technical support staff identify a module communications failure.

4.1.12 Percent of Scan Considerations

In QUADLOG, the scan rate is monitored by the operator, with the goal of keeping the PCT_SCAN (percent scan) below 70% to allow for enough background time to handle diagnostics and communications. Failure to keep this percentage below 70% could result in lost communications. Typically MBus communications would be the first to encounter a failure.

With the DP/IO Bus Link module, there is a similar need to provide the CPU with enough time to perform background tasks, including Profibus DP communications and diagnostic monitoring.

See the section titled Scan Rate regarding setting the scan rate, and read the safety notes regarding the scan rate. The scan rate cannot be changed in an online, running system because the change could cause some I/O modules to experience a shutdown-channel failure, resulting in a DP/IO Bus Link shutdown of outputs.

4.1.13 Configuring Multiple DP/IO Bus Links

Naming conflicts are possible when configuring multiple DP/IO Bus Link modules across different S7-417H CPUs within the same project. Some simple, manual name changes can be made in advance to avoid problems compiling the OS.

You may need to change the name of the runtime groups that are created by the compiler to avoid having discrepancies when compiling the OS. Tag naming conflicts are detected during an OS compile if two or more CPUs, each with DP/IO Bus Link modules, are present in a single-station OS configuration. This problem could also affect the OS server.

The compiler generates charts used by the DP/IO Bus Link module. These charts sometimes have the same name and could potentially have the same function block names, especially if the projects are identical. For instance, the F_Q_CTRL function block is usually placed within a chart @F_(1). There is no algorithm that dictates that it will always be placed in @F_(1), but this is usually where it is placed. The DPIO_DRV function block is typically placed in @(3). The non-safety critical module drivers are placed in @(2) and the safety critical module drivers are placed in @F_(2). If these identical names exist across multiple S7-417H CPUs in the same project on a single station or OS, the OS compile may fail because of a tag naming conflict. If this occurs, simply change the name of one of the S7-417H CPUs charts. For example, you may change the name of @F_(1), @F_(2), @(3), and @(2) to @F_(1CPU1), @F_(2 CPU1), @(3 CPU1), and @(2 CPU1) respectively to help differentiate between the two CPUs. Recompile CFC and recompile the OS to correct the issue.

4.2 Differences Between QUADLOG CCM and DP/IO Bus Link Module Operation

Warning

Safety Note - DP/IO Bus Link Module only supports the equivalent of a QUADLOG Total I/O Shutdown

For those familiar with QUADLOG, the shutdown logic within the DP/IO Bus Link module is similar to that created within QUADLOG. The shutdown logic within QUADLOG was managed by either a TOTIOSD (Total IO Shutdown) or PARTIOSD (Partial IO Shutdown) function block. The DP/IO Bus Link module only supports the equivalent of the Total IO Shutdown. It is not possible to configure the DP/IO Bus Link module in a way that is similar to the Partial IO Shutdown within QUADLOG.

4.3 Prerequisites

The material in this section assumes that system configuration through the HW Config program and CFCs have been compiled and downloaded to the automation station (AS) as prescribed by the previous section. The material in this section further assumes that OS has been compiled and is activated. If the OS is not communicating with the AS, see the troubleshooting tips in the section titled Connection between PCS 7 OS and AS Station Not Operational.

4.4 Safety ID and INAME

The Link module faceplate **Safety** pane and symbol will not function correctly until the following are configured properly:

- At least one user identify, created and logged on when entering runtime.
- A **Safety ID** text string entered on the **SafetyID** nub of the Link module's F_Q_CTRL block in CFC (this ensures that the **Safety** pane corresponds to the proper F_Q_CTRL block). See the section titled Configuring CFC.
- A tag prefix for the Link module's F_Q_CTRL block on the **INAME** nub of the Link module's DPIO_DRV block CFC (the faceplate and symbol use this to determine which F_Q_CTRL block is tied to the Link module's DPIO_DRV block). See the section titled Configuring the Simatic Project for OS Operation.

Notes

- If the tag prefix you specify for INAME contains a dollar sign ($) , then you should type in two dollar signs ($$) as required by WinCC text syntax rules.
- If after an OS compile the **Safety Mode Not Configured** message appears in the safety pane, it could be the result of a change to the name associated with the F_Q_CTRL function block. See section titled Configuring the Simatic Project for OS Operation, which explains how to obtain the path for the F_Q_CTRL function block for setting up the OS.

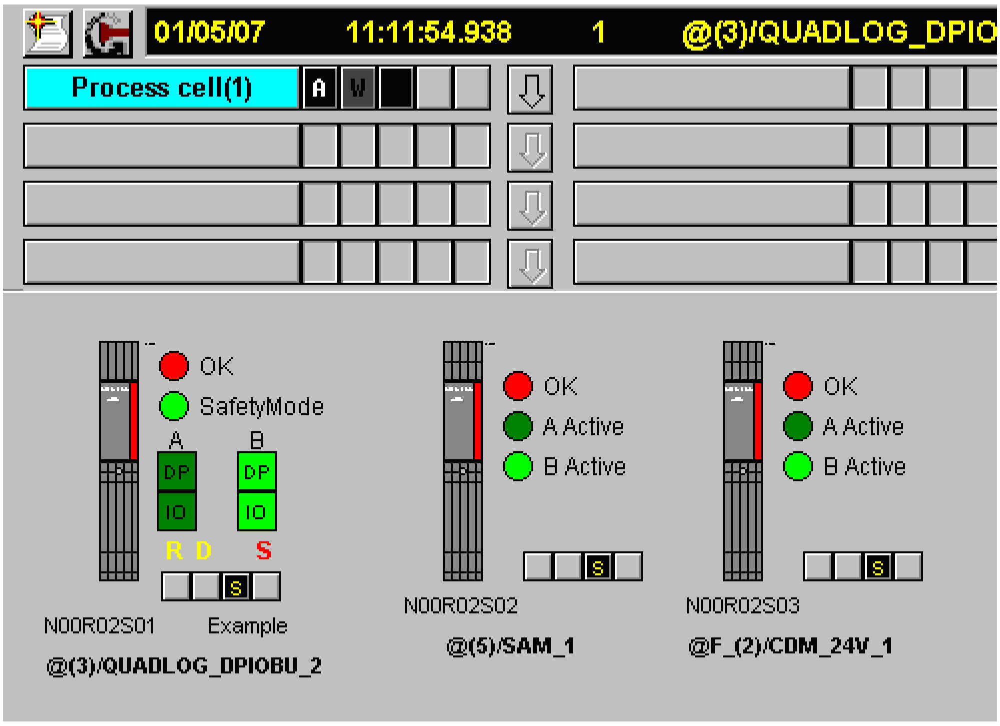
Symptoms indicating configuration problems include the following:

- The faceplate **Safety** pane is covered by an error panel.
- The faceplate **Safety** pane shows **NoSafetyID** for the **Safety ID**.

For more information, see the section titled Safety Pane.

4.5 DP/IO Bus Link Module Symbols (Block Icons)

Compiling the OS automatically generates block icons (unless the option to generate them is automatically disabled within CFC). The block icons, or symbols, provide a high-level overview of the DP/IO Bus Link module and the associated I/O modules. Block icons make it possible to determine by inspection the operational mode of the DP/IO Bus Link module and any of the I/O modules. The illustration that follows shows block icons for a DP/IO Bus Link module, as well as I/O modules consisting of a SAM and a CDM:



Assume for the moment that the **OK** LEDs on the DP/IO Bus Link module and the I/O modules are blinking red, a clear indication of a class 3 error.

The section that follow are a guide to determining the cause of errors like this and other that occur when the system is in runtime mode.

4.6 Status of Hardware

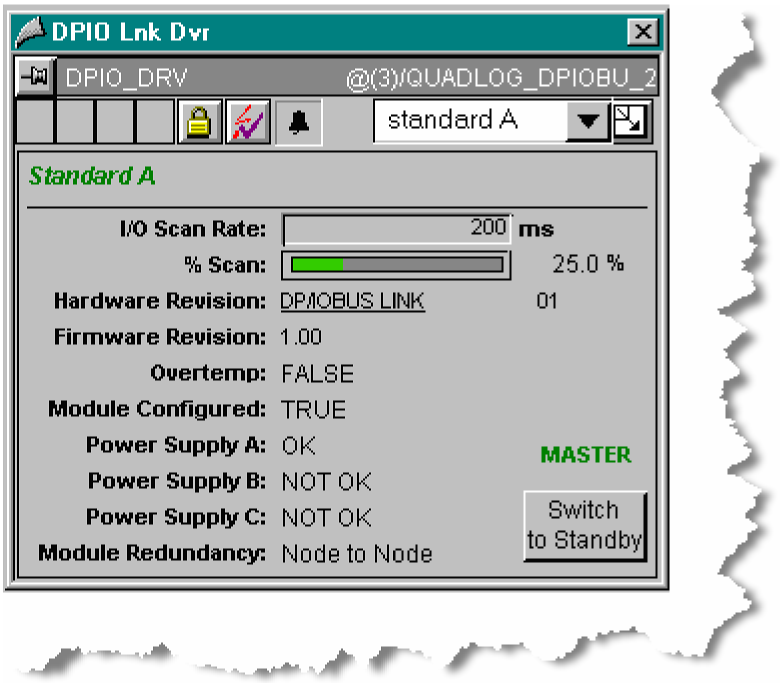
The **Standard** panes within the DP/IO Bus Link faceplates displays the status of the hardware:

- Three backplane power supplies
- Module over-temperature
- Hardware version and firmware revision level

- Status of redundant partner
- IOBus master or standby status
- IOBus **Switch to Standby** button (visible on IOBus master)

Note

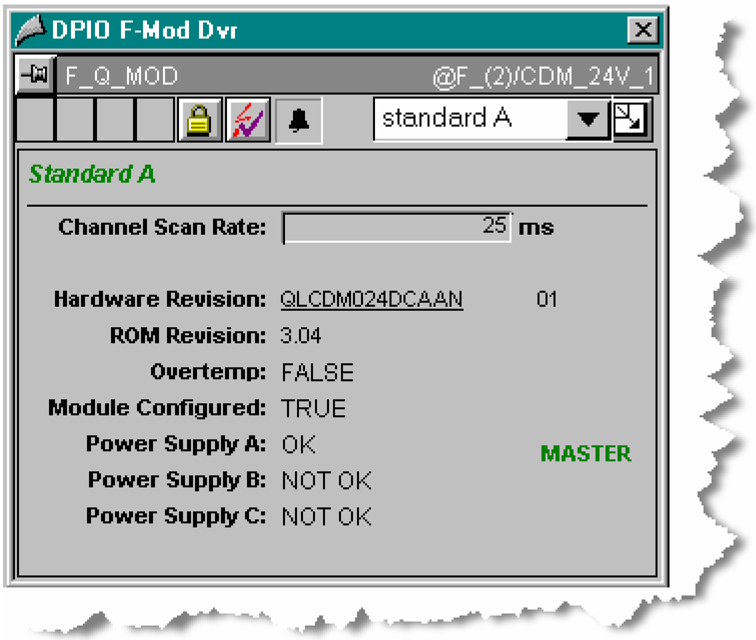
IOBus master and standby status is visible on block icons. See DP/IO Bus Link Module Symbols (Block Icons).



Note

In a redundant configuration, if either the A-side or B-side DP/IO Bus Link module is unavailable, then the default values are displayed.

The Standard pane may also be opened within the group display of an I/O module to determine the status of its hardware.

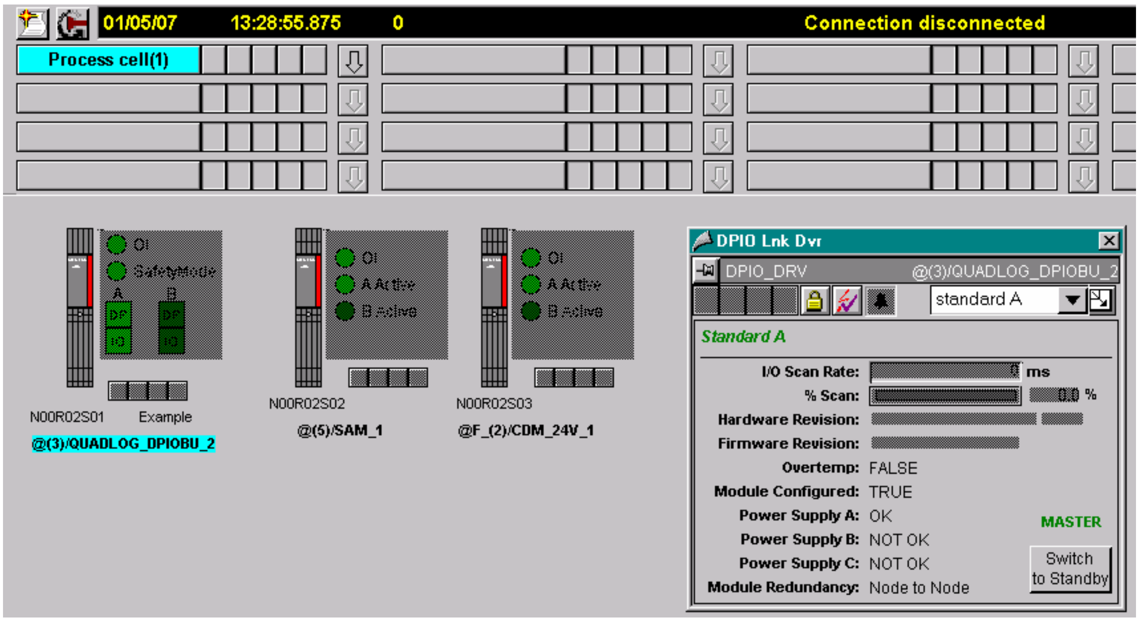


4.7 Communication

The status of communications between the OS and the AS can be readily determined from the block icons (or symbols).

4.7.1 OS to CPU

Failed communication between the OS and the S7 417 CPU is indicated low resolution gray For symbols, the background of the symbol is gray. For faceplates, tag fields are gray.



Gray indicates a general communication problem between the OS and the CPU, possibly because of a physical break in the communication link, such as a cable disconnection.

Note

If the problem has been persistent since initial startup of the project, it could be the result of a missed step during the configuration of the PC Station, AS Station, or CPU. Please retrace the steps in the section titled System and Software Configuration. to ensure no step was missed. See also the section titled Connection between PCS 7 OS and AS Station Not Operational for hints regarding communications problems.

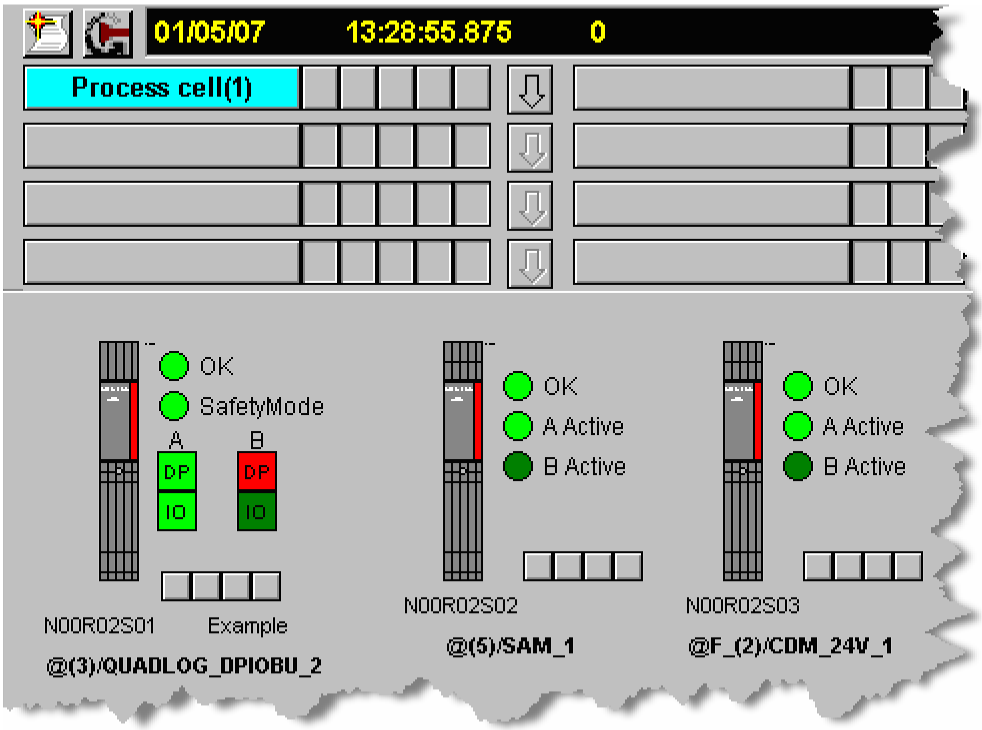
If only some symbols and faceplates are gray, then the problem is a software miss-configuration for those modules.

Note

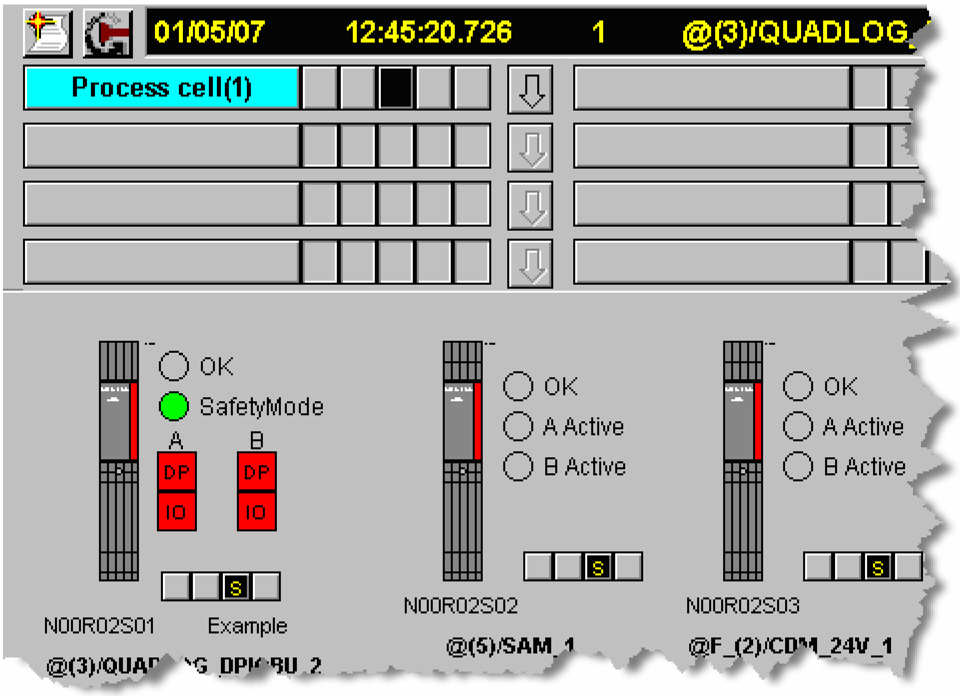
If '@' charts were deleted intentionally or accidentally then the CFC must be recompiled with the *Generate Module Drivers* option selected. Recompiling creates new data blocks and breaks any connection between the OS and the AS. Consequently, the OS must be recompiled to regenerate the block icons.

4.7.2 CPU to Link Module

The link module's symbol shows the status of communications between the S7 417 CPUs and the DDP/IO Bus Link module. Red DP indicators indicated failed communication between the S7 417 CPU and a DP/IO Bus Link module. DP is the only connection interface between the S7 417 CPU and the DP/IO Bus Link module. In the illustration below, the DP connection on DP/IO Bus Link module B is faulty. If this faulty connection is corrected then the DP indicator will change to green.



If both DP connections are lost, the result is much more drastic. Communications between the S7 417 CPU and the DP/IO Bus Links are completely lost, and this results in a total shutdown of the DP/IO Bus Link modules. Since communications is completely lost, the I/O modules symbols reflect this by showing **OK**, **A Active** and **B Active** LEDs in grey. The outputs on the I/O modules associated with the DP/IO Bus Link modules will shutdown. Until the DP connection is re-established between the S7 417 CPUs and at least one of the DP/IO Bus Link modules, the outputs will remain shutdown.



Once communication is reestablished, it is possible to reset the shutdown logic by using the Safety Pane of the DP/IO Bus Link module's group display. This is discussed within the section titled Shutdown Logic.

Notes

If the physical DP connection is broken, then communications will cease between the DP/IO Bus Link module and the associated S7 417 CPU.

If the physical DP connection is intact and appears to be operational, yet a communications problem remains, there could be several causes:

- The DP address switches on the DP/IO Bus Link module may not match the settings established in HW Config.
- A terminator could be improperly set on the DP connectors.
- An I/O module may be configured improperly or incompletely. Ensure the following:
  - All modules are properly configured
  - At least one channel is configured for each I/O module
  - Each channel has a channel drives
  - Each channel is connected to a channel symbol
- The DP/IO Bus Link module is not operational. See the section titled Interpreting Front-Panel LEDs

---

4.7.3 Link Module to I/O Module

The **A Active** and **B Active** indicators within the DP/IO Bus Link module symbol show the status of communications over IOBus between the DP/IO Bus Link module and the I/O modules:

- Green indicates a good status
- Light green indicator on either the **A Active** or **B Active** LEDs indicates that communications are good and that side is the Master IOBus side.
- A dark green **A Active** or **B Active** LED indicates that communications are good and this side is the Standby IO Bus side.
- Red I/O indicators on the Link module symbol indicates a communications failure between the Link module and its I/O modules
- Gray I/O **OK** and **Active** LEDs indicate a communications failure between a Link module and one or more I/O modules.

The illustration below shows the result of a CDM module in rack 2 slot 2 being removed from the B-Side. The **OK** LED of the DP/IO Bus Link module and the SAM module blink red, an indication of a class 3 error. The reported error indicates that a shutdown condition exists and that outputs are disabled. The CDM module's **OK** LED is solid red, which indicates that a class 4 error exists.

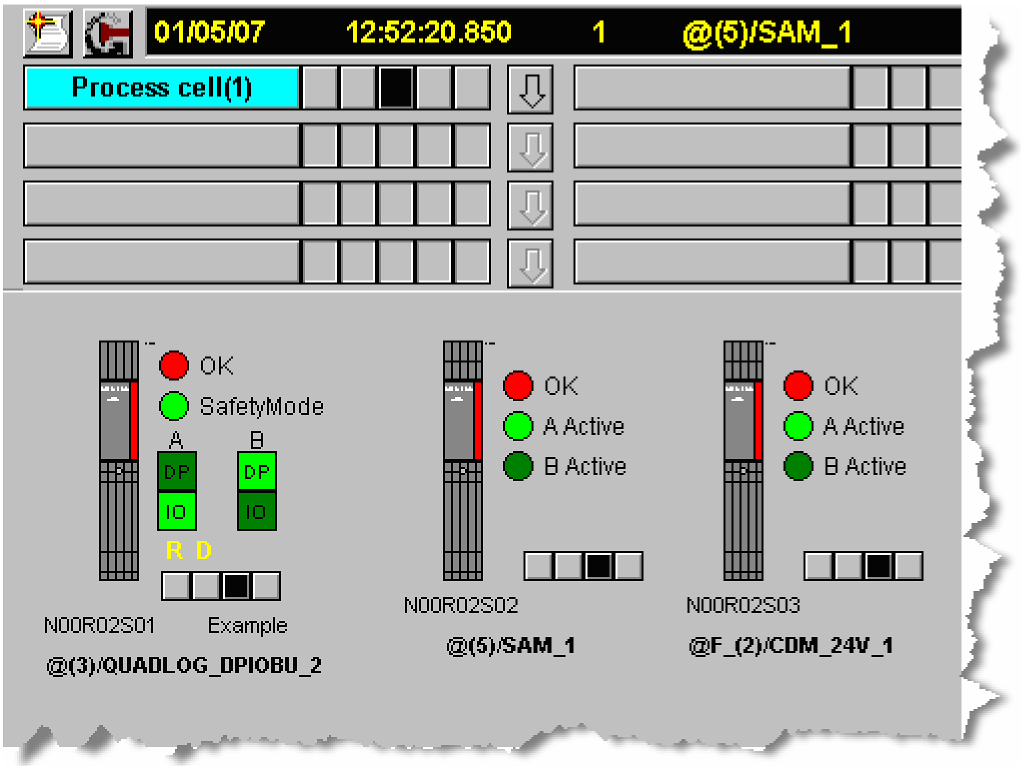
Note

An SSC 29 EC 10 (29:10) “A-Side I/O Bus not working” or SSC 29 EC 11 (29:11) “B-Side I/O Bus not working” error means that the IOBus is not operating properly on one side. The IOBus is a redundant set of two communications paths, by convention labeled A-Side and B-Side,

This description of IOBus A- and B-side should not be confused with the larger A- and B-side redundancy in which A-side and the B-side are fully functional mirror images of one another, where each side includes a CPU, a DP/IO Bus Link module, and an IOBus subsystem.

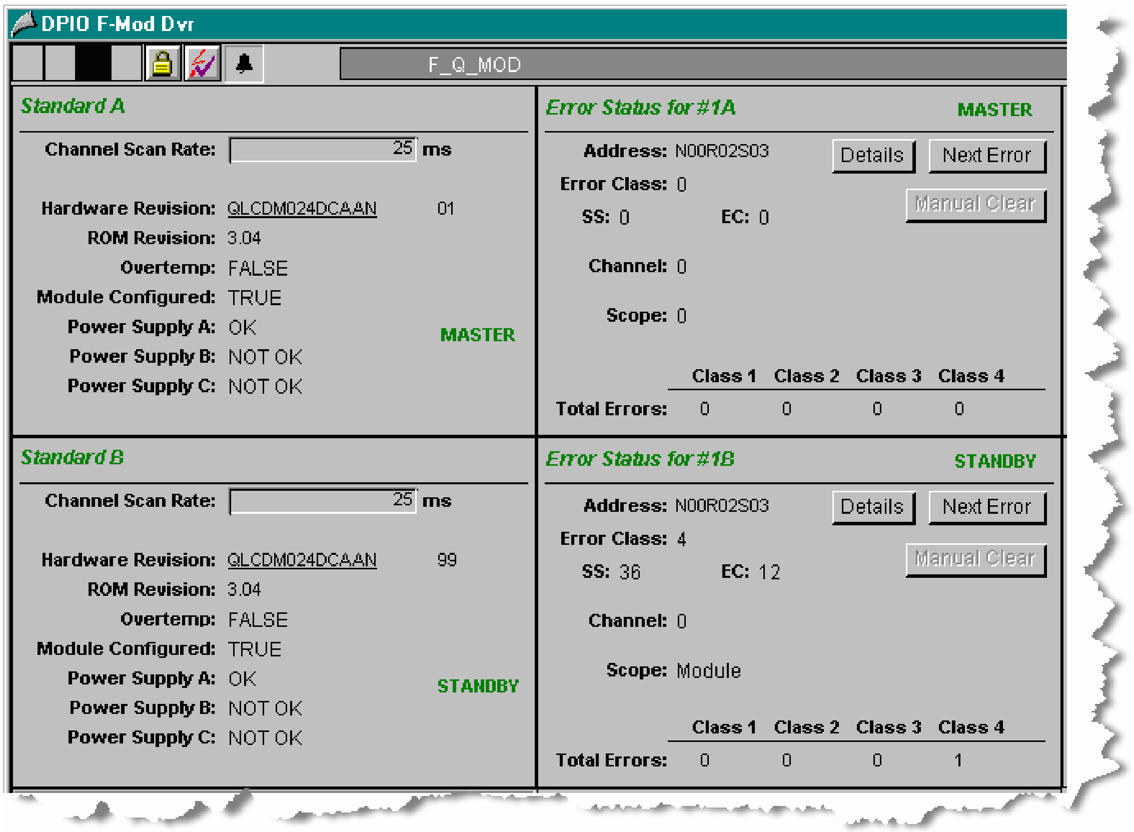
See the section titled Current Errors.

For information about MODULRACs and IOBus configuration and considerations, see the section titled The LoopOK Signal.



Diagnosing and Repairing a Typical I/O Module Failure

1. Click the CDM_24V_1 symbol to open the loop display:



2. Observe the errors associated with the CDM. Notice that there are no errors on the A-Side. There is an SSC 36 EC 12 error reported on the B-Side, which indicates that the I/O module is not present. The DP/IO Bus Link A side and its I/O modules continues to operate.
3. Replace the failed I/O module to clear the error. The shutdown logic at this moment is in a degraded state because one side is shutdown and the other side (the A-Side) is operational.

Note

An improperly terminated I/O Bus backplane could result in failed communications with an I/O module. Verify the position of MODLURAC terminators to ensure that only the last terminator at the last I/O module is switched to terminate. See the section titled The LoopOK Signal.

As see the document APACS+™/QUADLOG® MODULRAC and Local Termination Panel Installation and Service Instruction.

After the faulty I/O module is replaced or reinstalled then the shutdown logic can be reset within the DP/IO Bus Link safety pane.

4.8 Compiling and Downloading Parameter Changes

Parameter changes to modules and channels must be compiled and downloaded properly. They take effect in F-Systems after a cold restart.

Changes in the DP/IO Bus Link module parameters are discussed in the section titled DP/IO Bus Link Module Parameters.

Changes made to I/O module and channel parameters require a prescribed procedure. The discussion below discusses channel parameters, but the procedure for I/O modules is essentially the same.

1. In the HW Config program, select the DP/IO Bus Link module.
2. Select the I/O module associated with the channel parameter you wish to change.
3. Right-click the channel with the parameter you wish to change.
4. Select the **Parameters** tab.
5. Edit the target parameter and click the **OK** button.
6. Select the **Save and Compile** button from the toolbar.
7. Open the CFC.
8. Select the **Compile** button from the tool bar.
9. Select the **Download** button from the tool bar.
10. When the window containing restarting options appears, select **Cold Start**.

Note

If you open HW Config and at any time click an **OK** button, while it remains open it may be left in an indeterminate state and may have unpredictable effects on other program. This is true even if you make a change and then later restore an original value.

To ensure predicable results, save or close without saving.

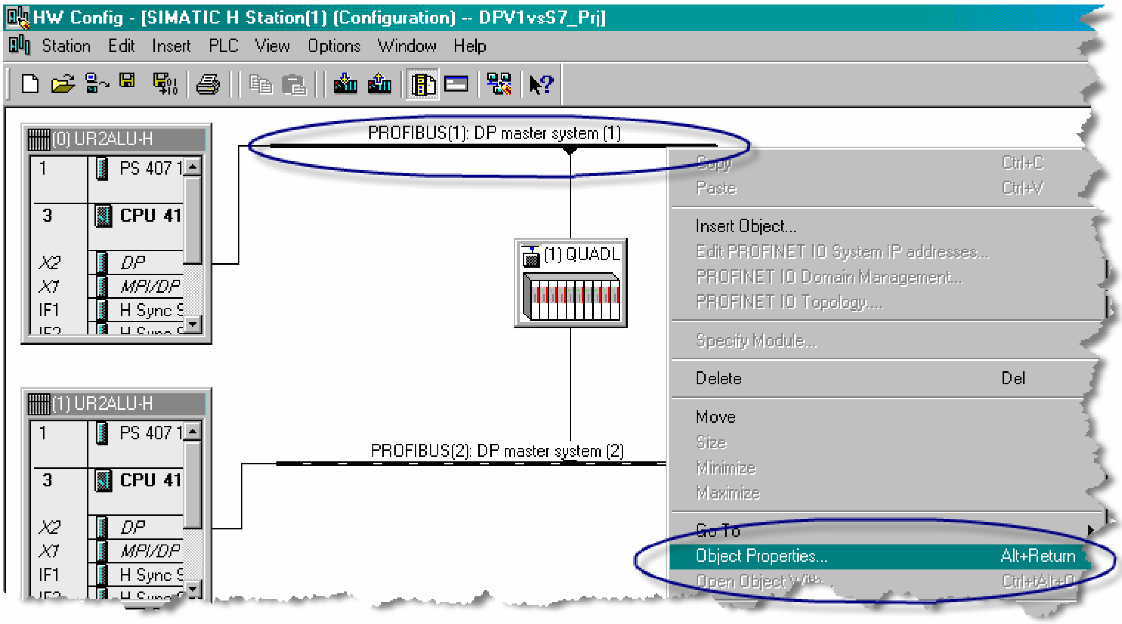
4.9 Simulating a QUADLOG application in a PCS 7 Environment

See the document titled *readme.wri* located on the root directory of the DP/IO Bus Link module software distribution CD for information about support for simulation.

4.10 Adjusting DP Fault Tolerance

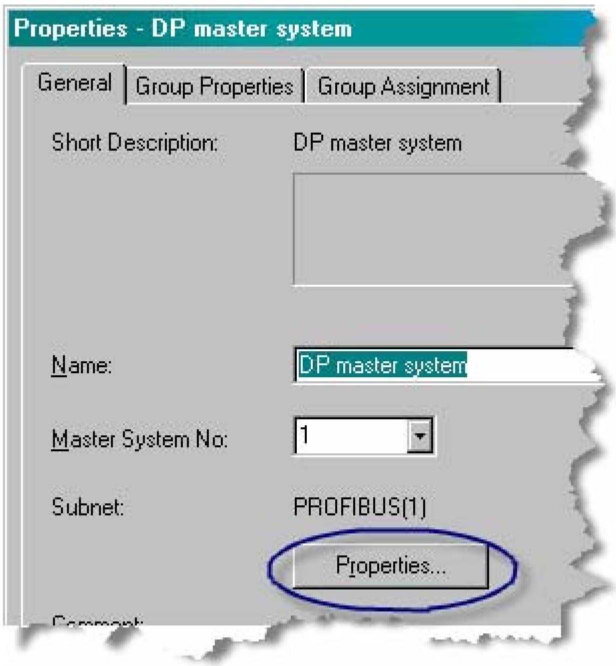
It many be necessary to tune the DP bus retry setting to adjust the fault tolerance of the DP bus. The tuning ordinarily occurs after a period of empirical testing of the default value provided by the HW Config program.

1. Open HW Config, right-click he PROFIBUS line, and select **Object Properties** from the resulting context menu:

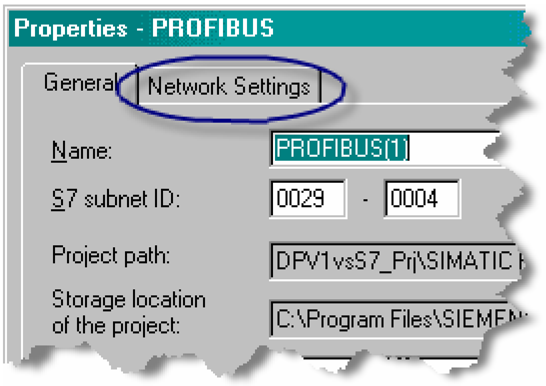


A window labeled **Properties DP master system** opens.

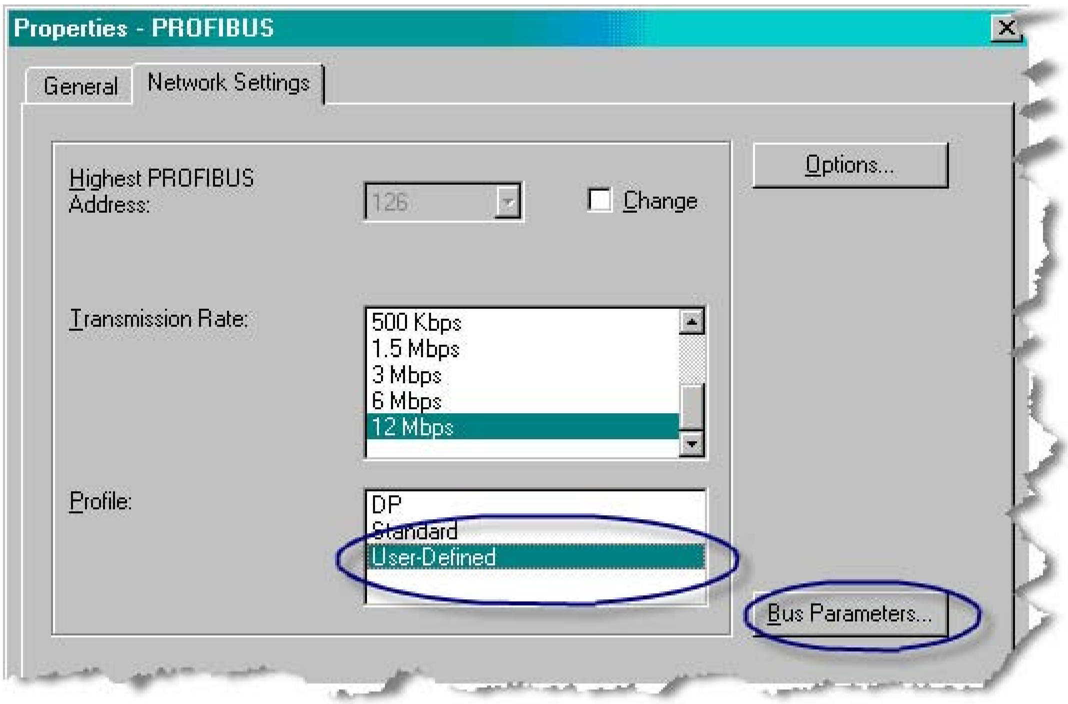
2. Select the **Properties** button:



3. From the **Properties - PROFIBUS** window, select the **Network Settings** tab:

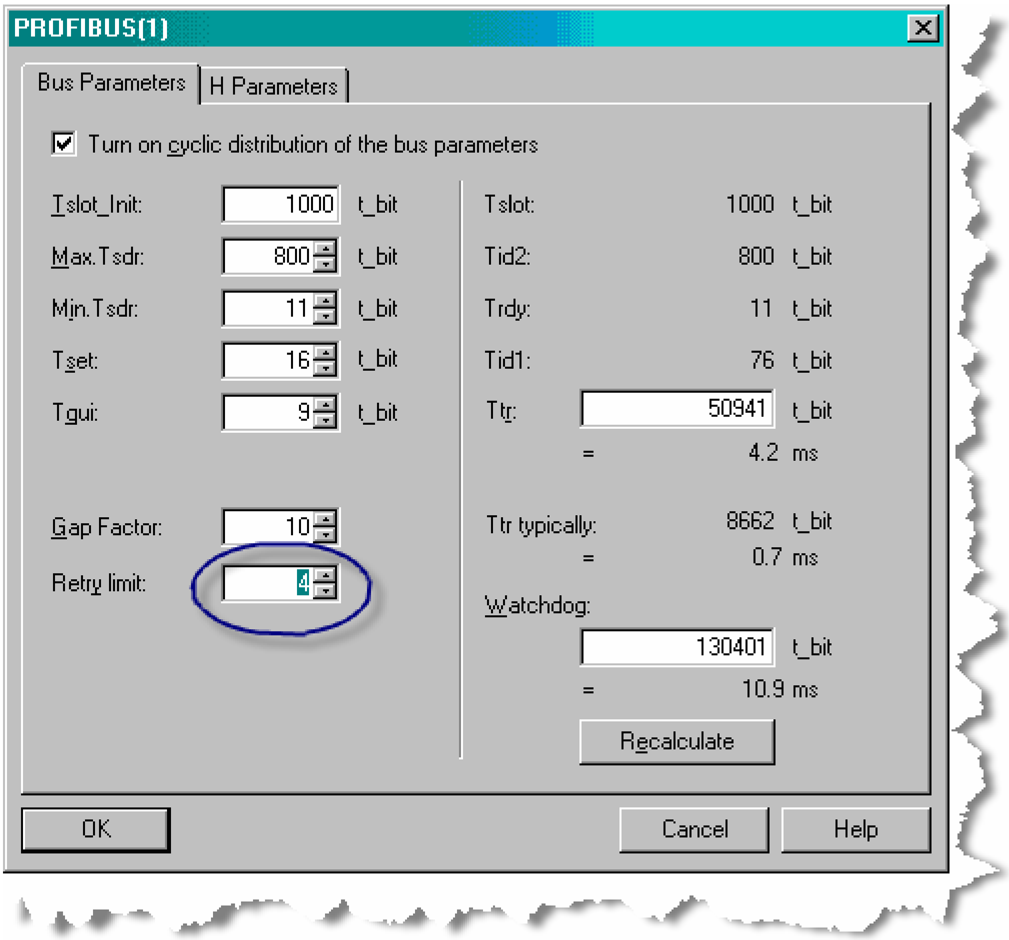


4. In the **Properties** window, change the **Profile** setting from **DP** to **User-Defined** and then select **Bus Parameters**:.



The **Bus Parameters** window opens.

5. Select the **Retry limit** field and change it, increasing it to increase the default or current limit.



The transmission time (**T tr**) and the **Watchdog** time change accordingly.

6. Click the **OK** button. You can exit HW Config.
7. After examining the result of changing the retry limit, you can return to HW Config and repeat this procedure.

5 Runtime Operation

5.1 Master/Standby

In a redundant system, a symbol or a faceplate provides information about the DP/IO Bus Link module, one module in a non-redundant configuration or a pair of modules in a redundant configuration.

The link module's symbol shows which set of I/O modules are master and which are standby.

Link Module DP LED:

Light green = Master

Dark green = Standby

I/O Module Active A Active B LEDs:

Light green = Master

Dark green = Standby

Faceplate indications of Master/Standby Status

In the **Standard** panes. the master side has a green **Master** label, and the standby side a green **Standby** label.

Switching IOBus Master and Standby

On the Link module faceplate, a button allows you to switch DP/IO Bus Link Master and Standby Links.

5.2 Scan Rate

Recommended Percent Scan Setting

From an operational perspective, setting the DP/IO Bus Link module's adjustable scan rate, called the *I/O Scan Rate configured scan rate* (SCANRATE), is essential to optimizing system performance. The optimal scan rate varies according system size and configuration and must be tuned for each installation.

The system provides a monitoring value called *percent scan* (PCT_SCAN) to help you determine the optimal scan rate. Percent scan is the percentage of the configured scan that used. This value is available on the ES from the PCT_SCAN output nub of the DPIO_DRV block. It is also available on the OS in the standard pane of the DPIO_DRV block as an annotated bar graph labeled *% Scan.*

It is recommended that the system not exceed a percent scan of 90%.

If the percent scan is too low, the system has the capacity to do more processing with each scan. If the percent scan rate is too high, some processing may be skipped.

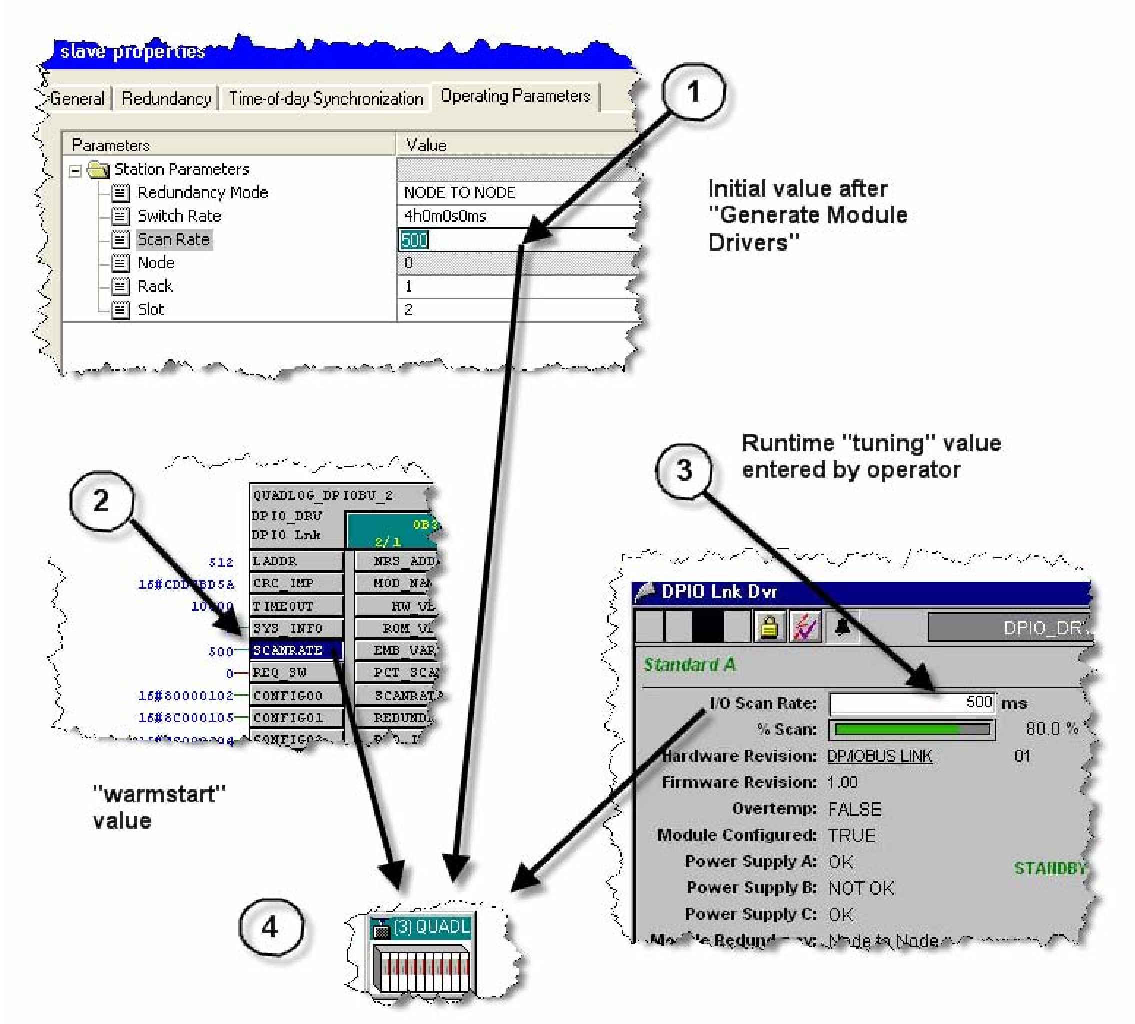
During a scan, the DP/IO Bus Link module performs the following essential tasks:

- Synchronizes itself with its redundant partner (in redundant systems)
- Reads from each configured field input channel
- Writes to each field output channel
- Compares I/O data with its redundant partner (in redundant systems)
- Communicates I/O data to the CPU
- Performs miscellaneous overhead tasks

There are three ways the adjust the scan rate to ensure that the percent scan value stays below a maximum of 90%:

- From the HW Config program, you can set the initial value.
- From CFC running on an engineering station, you can adjust the current value with the DPIO_DRV AS function block. When the CFC is downloaded, the value input to the function bock becomes the current value and the initial value following a warmstart.
- From an OS station, an authorized operator can tune the scan rate value from the DPIO_DRV faceplate and observe the effects on the percent scan. This scan rate value does is not retained after a reset or power cycle.

The topics below refer to the following illustration:



Setting the Initial Scan Rate Value from the HW Config Program

An initial value for the scan rate is set with the HW Config program **(1)**. This parameter, together with the other parameters for the DP/IO Bus Lin k module and the AS 417 CPU, is compiled and downloaded to the AS 417 CPU. See Adding a DP/IO Bus Link Module.

Adjusting the Scan Rate Value from CFC

When the program logic is built within CFC and is compiled with the option *Generate Module Drivers* enabled, and then and downloaded to the CPU, the value from HW Config **(1)** is copied into the SCANRATE input nub of the DPIO_DRV function block **(2)** and sent to the DP/IO Bus Link module **(4)**.

It is important to understand here that there exists CFC online (residing within the CPU) and CFC offline (residing within the project on the Engineering Workstation). If a change is made to CFC offline and never downloaded, it is never implemented. When you are in online mode within CFC you can observe the online values See DPIO_DRV.

If a change, including a manual scan rate change, is made to online CFC through the test mode feature within CFC Editor, then this value **(2)** is written to the CPU and becomes the initial value sent to the DP/IO Bus Link module **(4)** after a warmstart following a power failure or resulting from choosing warmstart from within the Operating Mode dialog of SIMATIC Manager or CFC Editor. If CFC is compiled again with *Generate Module Drivers,* the value in HW Config **(1)** overwrites the CFC value **(2)** and is ultimately sent to the DP/IO Bus Link module **(4)**.

Adjusting the Scan Rate Value from the OS DPIO_DRV Faceplate

Warning

Safety Note - Avoid Changing Scan Rate Online in a Commissioned System

Changing the scan rate while online may result in a unpredictable shutdown of critical I/O modules with shutdown channels configured. Siemens recommends that the scan rate be changed only during a scheduled shutdown or before or during commissioning of the system."

From an OS, you can use the standard faceplate to tune and control the scan rate, displayed as *I/O Scan Rate,* and to monitor the percent scan (*% scan*) output **(3)**. See Standard Faceplate Pane.

During runtime it may be desirable to change the scan rate of the DP/IO Bus Link module to tune it to match the configured I/O's scanning requirements. This can be done from within online CFC **(2)** However, it is recommended to make all changes online from the OS faceplate **(3)**. The faceplate percent-scan indicator only shows percentages up to 100%. If you want to see how much the percent scan has exceeded 100% open the loop view and look at the percent scan trend pane, which shows the true values.

Synchronizing Scan Rate Value

The CPU transfers the latest scan rate value from the online DPIO_DRV function block **(2)** to the DP/IO Bus Link module **(4)**. This latest value is determined by the most recent user action or the most recent power-cycle event.

During operation and maintenance phase of the DP/IO Bus Link module, it is prudent to synchronize the scan rate values among HW Config, offline CFC, and the OS DPIO_DRV faceplate.

After an optimal final value is determined, you should do the following:

1. Enter the final, optimal value at the online DPIO_DRV block's SCANRATE input nub **(2)**. This stores the scan rate in case a warmstart occurs. During recovery from a power cycle or a operator-initiated warmstart, the initial value of the scan rate within the online DPIO_DRV block is transferred to the (4) DP/IO Bus Link module.
2. Enter the optimal value determined by tuning **(3)** into HW Config **(1)** and save.
3. From HW Config, compile and download the configuration.
4. From CFC, compile and download the configuration.

Warning

Safety Note - Scan Rate can only be changed within the OS if the F-Program's Safety Mode is disabled

An initial value for scan rate can also be set within HW Config. To change the scan rate from HW Config requires the following:

- A CPU Stop to download because H-CiR is not supported in DP/IO Bus Link V1.0.
- A recompile of CFC with the *Generate Module Drivers* option selected. Selecting this option obtains a cyclical redundancy check (CRC) value from the HW Config program. This CRC is necessary to ensure the integrity of the DP/IO Bus Link module's configuration

If a scan rate change is made from within the OS faceplate, the initial value established in HW Config is not automatically changed. To change the initial value, it is necessary to make the change in HW Config, compile and download HW Config and compile and download the CRC. The change in initial value takes effect at the next CPU Stop/Restart.

5.3 Alarms

Alarms are generated by the DP/IO Bus Link module driver and the I/O module drivers. These alarms are indicated in the appropriate alarm group display. There is a group display in the hierarchy, in each symbol and on the faceplate.

The alarm pane can be used to view the alarms of a module. Alarms can be acknowledged from the faceplate or from within the PCS 7 alarm summary.

5.4 Current Errors

Module errors are divided into four classes of severity. Class 1 errors are the least severe and are considered informational. Class 4 errors are the most severe. Class 4 errors generally cause a shutdown of the DP/IO Bus Link module and its associated I/O if full shutdown is enabled Refer to the section titled Shutdown Logic.

You determine whether a module has a current error by looking at the **OK** LED of its symbol:

Highest Class of any Current Error	OK LED Behavior
4	Steady Red
3	Blinking Red/Black
2	Blinking Red/Green
1 or no error	Steady Green

You can look at the current errors for a module in more detail from the **Error Status** panes of its faceplate. There are separate panes for each side in a redundant configuration.

The **Error Status** pane shows one of the five current errors. You can navigate through these by pressing the **Next** button four times. The most recent error is the first. If you press **Next** when viewing the fifth error, the display will change to the first error.

You can get additional information about an error by pressing the **Details** button. This will open a help file with additional information and list a description of the error.

Note

If you click anywhere outside the help window invoked by the **Details** button, the help window falls behind the PCS 7 runtime environment, becomes unavailable, and cannot be closed. As a result, there could be one or more help windows open during runtime that are not visible but nonetheless require system resources. These only become visible when you deactivate the PCS 7 runtime environment. Close the help window before clicking outside of it.

The **Error Status** pane also shows a summary of how many errors of each class are current.

Note

There is not always a one-to-one relationship between error indications on link and I/O module LEDs and errors reported on the OS faceplates. Errors can be reported on the PCS 7 OS faceplate LED and not on the physical modules. If the system experienced a class 4 error and autoshutdown were enabled, all I/O modules would be shutdown, but not all module faceplates would report module errors.

DP/IOBus Link module software is distributed on a CD that includes a help file with a table of contents for looking up errors by error code. See the document *readme.wri* at the root level of the CD for information about this file and instructions for using a related utility program that decodes errors.

5.5 Error History

The history buffer for each module stores the 99 most recent errors . There is a separate buffer for each side of a module pair in a redundant configuration. You can look at the entries in these buffers by viewing the **Error Log** panes for a module. See the section titled Error Log Pane.

In a system based on the DP/IO Bus Link module, it is not possible to use the DLOGGER functions to obtain error codes. Although the I/O modules have an error code buffers for 255 entries, the Error Log faceplate pane can only display the most recent 99 errors in a buffer.

When you open a pane the most recent error in the buffer is displayed. To navigate back through the buffer use the **Next** button. To navigate forward in the file, use the **Previous** button. This buffer is circular, so when you reach the end or the beginning the buttons will take you to the beginning or the end. You can also jump to a specific position in the buffer.

If you want to see all the errors in the buffer at once, you can press the **Save to File** button to dump the buffer to a file. The file is named <Module Name><Time Date> and is placed in the top level project folder. For example: for a module named CDM_1 whose A side log is saved at 3:41:07pm on April 12, 2007, the file would be named CDM_1154107041207.txt.

Note

If power to an I/O module or the DP/IO Bus Link module is lost or if either are is reset, the Error History is erased and lost from the faceplates.

5.6 Safety Operation

Please read and understand the section on titled Shutdown Logic.

5.6.1 Safety Mode

There is a Safety Mode indicator on the Link module symbol and on the Link module's faceplate **Safety** pane. This indicator is light green when Safety Mode is on and gray when not. Safety Mode within the DP/IO Bus Link module is equivalent to the QUADLOG CCM/CCM+/CCMx security mode. Safety Mode is controlled by the user and is an attribute of the F-Program, which is part of the SIMATIC S7 F Systems component. See the document *SIMATIC S7 F/FH Systems Configuring and Programming* look for the keyword Safety Mode.

Safety Mode is controlled within the Edit Safety Program dialog box, which is available from within SIMATIC Manager by first selecting the appropriate S7 417 CPU in the project and selecting **Options > Edit Safety Program**.

Note

Within CFC, the Safety Mode of the system can be observed by inspecting the **F_ShutDn** function block within the @F_ShutDn chart, or by inspecting the **F_Q_CTRL** function block's **SAFEMODE** output.

5.6.2 Repair, Degraded, Failed

If any module in the system has its **Repair**, **Degrade** or **Failed** flag set to true, then the appropriate indicator on the Link module symbol (just above the alarm group display) and on the Link module's faceplate **Safety** pane is displayed.

5.6.3 Shutdown

If a shutdown within the DP/IO Bus Link module has occurred, then the **Shutdown** indicator is displayed on the Link module symbol and in the Link module faceplate **Safety** pane.

Note

When the DP/IO Bus Link module is shutdown, the DP/IO Bus Link will also report an SSC 36 EC 03 (36:03) diagnostic (IO Bus Master Software. I/O Loop Broken) and an SSC 30 EC 06 (30:06) diagnostic (IO Bus Master Software. Channel Not Configured)

When the condition that caused the shutdown is eliminated, the **Reset Enable** flag goes true and is so indicated on the **Safety** pane. At that time, the **Reset I/O** button is enabled and you will be able to reset the shutdown I/O modules.

5.6.4 Periodic Switchover

Periodic Switchover is a configurable feature which switches the IOBus master to the standby partner in a redundant system. This switchover is requested every four to twelve hours. The purpose of this periodic switchover is to determine if there are any faults that are only detected when a side is the IOBus master. If a fault is detected when the switchover occurs, then the associated diagnostic is reported and the IOBus master will switch back to the good side.

This is an important feature to improve availability. It helps detect failures so they may be repaired within the mean time to repair and help ensure sustained operability.

From the Link module faceplate **Safety** pane you can view the state of the **Periodic Switchover** and the **IOBus Switchover**. You can also enable or disable **Periodic Switchover**.

6 DP/IO Bus Link and I/O Module Properties

6.1 DP/IO Bus Link Module Parameters

DP/IO Bus Link module parameters are set in the HW Config program as follows:

1. Right-click the graphic representing the link and select **Object Properties** from the context menu.
   A window labeled **DP slave properties** opens to the **General** tab.
2. Click the Operating Parameters tab. Ensure that the parameters selected are as follows:
   - **Redundancy Mode**: Only **NODE TO NODE** is supported.
   - **Switch Rate**: The parameter can be set between 4 and 12 hours so that a transition occurs at least once per day (12 hrs) or optionally once per normal shift (4 hrs).
   - **Scan Rate**: The rate should match or be faster than the OB cycle time. Tuning the scan rate is an incremental process. An acceptable value is from 80 to 1000 ms. Siemens recommends that the scan rate be set so that the percent scan is 90% or lower. See the section titled Scan Rate.

Note

The scan-rate control silently rejects values that it cannot accept. When an entered value is rejected, the last value is retrained.

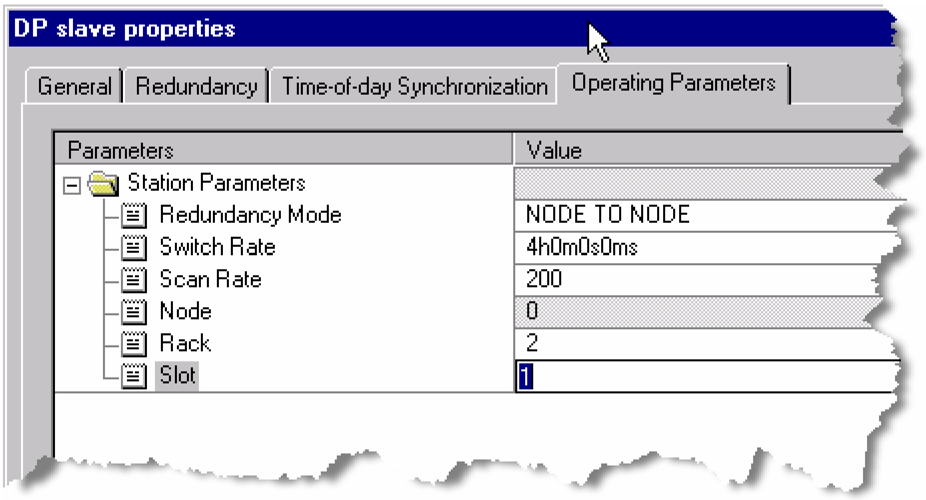
Valid entries have the following characteristics:

- They are within the range of 80 ms to 1 sec
- They reflect 10 ms resolution.

Entries that fall within 80 ms to 1 sec are rounded off and then divided by 10. Results that are evenly divisible by 10 are accepted. For example, 149.4 is rejected; 149.5 is rounded to 150, which is evenly divisible by 10, and accepted as 150.

The actual scan rate is reported as an output on the AS function block DPIO-DRV and on the OS faceplate for the DP/IO Bus Link module.

   - **Node**, **Rack**, and **Slot**: These parameters follow the conventions of the QUADLOG system. The **Node** number is read only and always 0.



3. Click the **OK** button.
   The window closes.

6.2 General Tab

In HW Config, the object properties of an I/O Module include a **General** tab, which provides information on the type and location of the module.

Short Description, Order number, Name

The short description, the information below it, and the order number are identical to the details in the **Hardware Catalog** window.

The **Name** field provides a short description of the module, which you can change to meet your requirements. If you change the description, the new description appears in the configuration table.

Comment

In this field, you enter information about the module (such as the purpose).

6.3 Addresses Tab

In HW Config, the object-properties addresses tab enables you to enter input/output addresses for a module.

1. Assign a start address to the module.
2. If the address range is to be assigned to a process image partition, in the dropdown list **Process Image Partition**, select the desired process image partition.

Process Image

A process image has the advantage that it can access a consistent image of the process signals during cyclic program processing. The dropdown menu offers you the selection between "OB1-PI" and "PIP 1" up to max. "PIP 15".

- "OB1-PI" represents the cyclic process image that does not have to be initialized.

- "PIP 1" to max. "PIP 15" are part process images that need to be explicitly initialized in the user program. This offers you the option to update the process image event controlled in the user program per SFC call, while(cyclic) process image updating is switched off.

You can update each part process image in the user program with SFCs (SFC 26 UPDAT_PI for the part process image of inputs and SFC 27 UPDAT_PO for the part process image for outputs)

Note

This option can only be activated in modules equipped with I/Os. The CPU must also support part process images. The number of available part process images is also dependent on the CPU.

If the entry "---" is visible in the "Process Image" field, no process image is available for the specified address area:

- Select a low start address for digital I/O modules.
- You must also select a low start address for an analog module that is to be addressed via process image. However, shifting of a start address to the address area for process images must be supported by the CPU.
- If the CPU has a parameter that sets the size of process image, then you can increase the size of the process image so that the selected address once again lies in the process image. To do this, open the CPU properties sheet and select the "Cycle/Clock Memory" tab. The parameter there is called "Size of the Process Image ...".

Hardware Interrupt Triggers

If the module can trigger a hardware interrupt, and you enabled the hardware interrupt in the "Inputs" tab, you can select under "Hardware Interrupts Triggers …OB…" the hardware interrupt OB that the CPU is supposed to process when a hardware interrupt occurs.

6.4 Parameter Tab

In HW Config, I/O module parameters are entered through the **Parameters tab**. The discussion of these parameters proceed lists of channel type parameters in the section titled I/O Module and Channel Parameters.

7 I/O Module and Channel Parameters

7.1 QUADLOG Critical Analog Input (CAI)

The CAI module interfaces up to 32 channels of analog input signals from field devices to a control module's IOBUS.

QUADLOG CAI Channel Types

The CAI supports the following channel types:

- CAI Analog Input (CAAI)
- Critical Analog Input, Programmable Limits (CAIP)
- Critical Discrete (Disc) Supervised Input (CDSI)

7.1.1 QUADLOG CAI Analog Input (CAAI)

The CAI Analog Input channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
Shutdown_Channel	TRUE, FALSE	FALSE
InputFaultState	No_Change, MinRange, MaxRange (hidden in HW Config)	No_Change
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
Bias	Any REAL Number	0.0
OpenCircuitTest	Enabled, Disabled	Enabled
XTC_CriticalXMTR	TRUE, FALSE	FALSE

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CAI reports a shutdown error. The configuration can be changed to only shut down the affected inputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur.

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"When the input channel is faulted (BAD, QUESTIONABLE, or UNAVAILABLE data quality), the channel reports the value configured in this softlist parameter. No_Change returns the actual value. MinRange returns the smallest value (MinScale). MaxRange returns the largest value (MaxScale). "

MinScale: The module will linearly scale raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters set by the user. For example, given a MinScale of 0.0 and a MaxScale of 100.0. If the input to the channel is 12 mA, the scaled value will be 50.0. MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38)

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Bias: The user can enter a bias in engineering units on a per channel basis to compensate for known offsets. The bias value is added to the scaled input.

OpenCircuitTest: The user can enable or disable open circuit testing. An open circuit condition exists if the reading is <= 3.6 mA.

XTC_CriticalXMTR: When this parameter is TRUE, the Model 345 XTC Critical Transmitter limits will be used for over/under range, open/short circuit, and transducer failure indications, as defined in the table below. When this parameter is FALSE, the over/under range is extended to include the transmitter failure range, so transmitter failure is not reported. This parameter should be set to FALSE for non-critical transmitters.

Current Range (mA)	XTC_CriticalXMTR = TRUE	XTC_CriticalXMTR = FALSE
>= 21.0	Short circuit (or transducer failed high)	Short circuit
> 20.5 to < 21.0	Transducer failed high	Over range
>20.0 to <= 20.5	Over range	Over range
20.0	MaxScale	MaxScale
4.0	MinScale	MinScale
>= 3.8 to < 4.0	Under range	Under range
> 3.6 to < 3.8	Transducer failed (safe) low	Under range
<= 3.6	Open circuit	Open circuit

7.1.2 QUADLOG Critical Analog Input, Programmable Limits (CAIP)

The Critical Analog Input, Programmable Limits (CAIP) channel type returns a REAL variable. This channel type allows the diagnostic ranges to be configured by the user. These diagnostic ranges are configured in milliamps (mA).

The table below lists the CAIP channel softlist parameters.

Softlist Parameter	Settings	Default
Shutdown_Channel	TRUE/FALSE	FALSE
InputFaultState	Min/Max/NoChange (hidden in HW Config)	NoChange
Min Scale	Any REAL Value	0.0
Max Scale	Any REAL Value	100.0
EngUnits	Pick from list	Percent
Bias	Any REAL Number	0.0
OpenCircuitLimit	0.0 mA-4.0 mA	3.6 mA
UnderRangeLimit	0.0 mA-4.0 mA	3.6 mA
OverRangeLimit	20.0 mA-22.0 mA	21.0 mA
ShortCirLimit	20.0 mA-22.0 mA	21.0 mA

Warning

Safety Note - Critical Analog Input, Programmable Limits (CAIP) channel type

The CAIP channel type is an optional analog input channel type available on release 3.03 of the CAM and CAI analog I/O modules. (Refer to I/O module help files or the document titled *ProcessSuite® 4-mation Configuration QUADLOG® I/O Module Configuration Version 3.32 or Higher* for more information.) Open circuit and short circuit diagnostics provide coverage for some fault modes in wiring and I/O devices that are not covered by other diagnostics. These are conditions that may be a result of a failed component on the I/O module, masking the actual sensor data. If these diagnostics are disabled for safety critical channels, another way to detect the fault modes may be required. This can be accomplished with configuration logic within the controller. If handled by the control logic, this logic must be configured to drive the process into a safe state upon failure. Alternatively, there may be ways to monitor the I/O devices and I/O signals independently.

If the channel is a non-redundant shutdown channel (that is, it is safety critical and not 1oo2 or 2oo3), the open-circuit and short-circuit detection must be enabled at some reasonable thresholds where they will be detected.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CAI reports a shutdown error. The configuration can be changed to only shut down the affected inputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur.

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"When the input channel is faulted (BAD, QUESTIONABLE, or UNAVAILABLE data quality), the channel reports the value configured in this softlist parameter. No_Change returns the actual value. MinRange returns the smallest value (MinScale). MaxRange returns the largest value (MaxScale)."

MinScale: The module will linearly scale raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters set by the user. For example, given a MinScale of 0.0 and a MaxScale of 100.0. If the input to the channel is 12 mA, the scaled value will be 50.0. MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38)

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Bias: The user can enter a bias, in engineering units, on a per channel basis to compensate for known offsets. The bias value is added to the scaled input.

OpenCircuitLimit: This parameter is a REAL value that establishes the upper boundary, in milliamps, for the open circuit diagnostic. The adjustment range is 0.0 mA to 4.0 mA and the default value is set to 3.6 mA to comply with the NAMUR NE-43 standard. Setting the open circuit value to 0.0 mA disables the open circuit diagnostic. If you disable the diagnostic for a safety critical channel, you will have to configure logic in the controller to detect and respond to an open circuit fault condition.

UnderRangeLimit: This parameter a REAL value that establishes the upper boundary for the under-range diagnostic, in milliamps. The adjustment range is 0.0 mA to 4.0 mA. Setting this value equal to, or beyond, the open circuit limit disables this diagnostic. The lower boundary of this diagnostic is equal to the open circuit limit value. By default, this value limit is set to the open circuit limit default value (3.6 mA) so this diagnostic is disabled.

OverRangeLimit: This parameter a REAL value that establishes the lower boundary of the over-range diagnostic, in milliamps. The adjustment range is from 20.0 mA to 22.0 mA. Setting this value equal to, or beyond, the short circuit limit disables this diagnostic. The upper boundary of this diagnostic is equal to the short circuit limit value. By default, this value is set to the short circuit limit default value (21 mA), so this diagnostic is disabled.

ShortCirLimit: This parameter a REAL value that establishes the lower boundary, in milliamps, for the short circuit diagnostic. The adjustment range is 20.0 mA to 22.0 mA and the default value is set to 21.0 mA to comply with the NAMUR NE-43 standard. The default value prevents most over-range values from reporting an error while still allowing true short circuits to be detected. The default value permits a defective (open) sense resistor on the CAI Marshalled Termination Assembly (MTA) to be detected.

Open circuit and short circuit diagnostics provide coverage for some fault modes in wiring and I/O devices that are not covered by other diagnostics. These are conditions that may be a result of a failed component on the I/O module, masking the actual sensor data. If these diagnostics are disabled for safety critical channels, another way to detect the fault modes may be required. This can be accomplished with configuration logic within the controller. If handled by the control logic, this logic must be configured to drive the process into a safe state upon failure. Alternatively, there may be ways to monitor the I/O devices and I/O signals independently.

If the channel is a non-redundant shutdown_channel (i.e., it is safety critical and not 1oo2 or 2oo3), the open circuit and short circuit detection must be enabled at some reasonable thresholds where they will be detected.

When programming the diagnostics for this channel type, note the following considerations listed in the table below.

Input Value (mA)	**Diagnostic Result**
>ShortCirLimit	Short Circuit Error
<= ShortCirLimit and >OverRangeLimit	Over Range Error
<=OverRangeLimit and >=UnderRangeLimit	None
<UnderRangeLimit and >=OpenCircuitLimit	Under Range Error
<OpenCiruitLimit	Open Circuit Error

7.1.3 QUADLOG Critical Discrete (Disc) Supervised Input (CDSI)

The CDSI (Critical Discrete Supervised Input) channel type returns an analog variable, automatically ranged and scaled to 0-20 mA, which may be converted to discrete values by the Critical Discrete Supervised Input (CDSI) function block.

Note

Ensure that in the HW Config program, the CDSI, an analog channel type, is connected to a F_Q_CHRI AS function block and not a discrete function block (F_Q_CHDI). HW Config will not prevent an inappropriate connection, and a CFC that includes an incorrect configuration of this type will compile without error. If a CFC with this incorrect configuration is downloaded as part of a project and run, the system is subject to a runtime group shutdown.

For more information, see the section titled CDSI Channel Type Should Be Configured with the F_Q_CHRI Channel Driver Block

When this channel type is selected, it should be connected to the F_CDSI function block in the controller logic. This function block contains the fixed thresholds that convert the analog signal from a CAM or CAI to a Boolean value. For detailed information, refer the section titled F_CDSI and the manual *QUADLOG® Critical*

Analog Input Module (CAI) (SDQLCAI-1), which contains wiring details for CDSI channel types.

Note

Ensure that in the HW Config program, the CDSI, an analog channel type, is connected to a F_Q_CHRI AS function block and not a discrete function block (F_Q_CHDI). HW Config will not prevent an inappropriate connection, and a CFC that includes an incorrect configuration of this type will compile without error. If a CFC with this incorrect configuration is downloaded as part of a project and run, the system is subject to a runtime group shutdown.

For more information, see the section titled CDSI Channel Type Should Be Configured with the F_Q_CHRI Channel Driver Block

When this channel type is selected, it should be connected to the F_CDSI function block in the controller logic. This function block contains the fixed thresholds that convert the analog signal from a CAM or CAI to a Boolean value. For detailed information, refer the section titled F_CDSI and the manual *QUADLOG® Critical Analog Input Module (CAI)* (SDQLCAI-1), which contains wiring details for CDSI channel types.

The table below lists Critical Discrete Supervised Input softlist parameter.

PARAMETER	SELECTION	DEFAULT
Shutdown_Channel	TRUE, FALSE	FALSE

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CAM or CAI reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.2 QUADLOG Critical Analog Module (CAM)

The CAM can interface 32 channels of analog I/O and discrete input signals to a control module's IOBUS. To isolate field faults, all channels are electrically isolated from the module's CPU, IOBUS, and ground. Also, each channel uses an isolated 28 V power source, and all channels are current-limited to protect against short-circuits.

CAM Channel Types

The channel types supported for the CAM are listed as follows:

- CAM Analog Input (CAIC)
- Critical Analog Input, Programmable Limits (CAIP)
- CAM Analog Output (CAOC)
- Critical Discrete (Disc) Supervised Input (CDSI)

In a DP/IO Bus Link environment, configuration information in this document supersedes information in the section titled "Configuring I/O Channels" in the document *Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher* (CG39-20).

7.2.1 QUADLOG Analog Input (CAIC)

The CAM Analog Input Channel returns a REAL variable.

The table below lists the CAM Analog Input Channel softlist parameters.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
Shutdown_Channel	TRUE, FALSE	FALSE
InputFaultState	No_Change, MinRange, MaxRange (hidden in HW Config)	No_Change
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
Bias	Any REAL Number	0.0
OpenCircuitTest	Enabled, Disabled	Enabled
XTC_CriticalXMTR	TRUE, FALSE	TRUE

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CAM reports a shutdown error (Class 4, SSC 37, EC 31). Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"When the input channel is faulted (BAD, QUESTIONABLE, or UNAVAILABLE data quality), the channel reports the value configured in this softlist parameter. No_Change returns the actual value. MinRange returns the smallest value (MinScale). MaxRange returns the largest value (MaxScale)."

MinScale: The module linearly scales raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters that you set. For example, given a MinScale of 0.0 and a MaxScale of 100.0, if the input to the channel is 12 mA, the scaled value is 50.0. MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38)

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Bias: The user can enter a bias (in engineering units) on a per channel basis to compensate for known offsets. The bias value is added to the scaled input.

OpenCircuitTest: The user can enable or disable open circuit testing. An open circuit condition exists if the reading is < 3.6 mA. If this diagnostic is disabled, an under range error is reported.

XTC_CriticalXMTR: When this parameter is TRUE, the Model 345 XTC Critical Transmitter limits are used for over/under range, open/short circuit, and transducer failure indications, as defined in the following table. When this parameter is FALSE, the over/under range is extended to include the transmitter failure range, so transmitter failure is not reported. This parameter should be set to FALSE for non-critical transmitters.

The table below lists XTC_CriticalXMTR Analog Input current range definitions

CURRENT RANGE (ma)	XTC_CriticalXMTR = TRUE	XTC_criticalXMTR = FALSE
>= 21.0	Short circuit (or transducer failed high)	Short circuit
> 20.5 to < 21.0	Transducer failed high	Over range
>20.0 to <= 20.5	Over range	Over range
20.0	MaxScale	MaxScale
4.0	MinScale	MinScale
>= 3.8 to < 4.0	Under range	Under range
> 3.6 to < 3.8	Transducer failed (safe) low	Under range
<= 3.6	Open circuit	Open circuit

7.2.2 QUADLOG Critical Analog Input, Programmable Limits (CAIP)

The Critical Analog Input, Programmable Limits (CAIP) channel type returns a REAL variable. This channel type allows the diagnostic ranges to be configured by the user. These diagnostic ranges are configured in milliamps (mA).

The table below lists the CAIP channel softlist parameters.

Softlist Parameter	Settings	Default
Shutdown_Channel	TRUE/FALSE	FALSE
InputFaultState	Min/Max/NoChange (hidden in HW Config)	NoChange
Min Scale	Any REAL Value	0.0
Max Scale	Any REAL Value	100.0
EngUnits	Pick from list	Percent
Bias	Any REAL Number	0.0
OpenCircuitLimit	0.0 mA-4.0 mA	3.6 mA
UnderRangeLimit	0.0 mA-4.0 mA	3.6 mA
OverRangeLimit	20.0 mA-22.0 mA	21.0 mA
ShortCirLimit	20.0 mA-22.0 mA	21.0 mA

Warning

Safety Note - Critical Analog Input, Programmable Limits (CAIP) channel type

The CAIP channel type is an optional analog input channel type available on release 3.03 of the CAM and CAI analog I/O modules. (Refer to I/O module help files or the document titled *ProcessSuite® 4-mation Configuration QUADLOG® I/O Module Configuration Version 3.32 or Higher* for more information.) Open circuit and short circuit diagnostics provide coverage for some fault modes in wiring and I/O devices that are not covered by other diagnostics. These are conditions that may be a result of a failed component on the I/O module, masking the actual sensor data. If these diagnostics are disabled for safety critical channels, another way to detect the fault modes may be required. This can be accomplished with configuration logic within the controller. If handled by the control logic, this logic must be configured to drive the process into a safe state upon failure. Alternatively, there may be ways to monitor the I/O devices and I/O signals independently.

If the channel is a non-redundant shutdown channel (that is, it is safety critical and not 1oo2 or 2oo3), the open-circuit and short-circuit detection must be enabled at some reasonable thresholds where they will be detected.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CAM reports a shutdown error. The configuration can be changed to only shut down the affected inputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur.

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"When the input channel is faulted (BAD, QUESTIONABLE, or UNAVAILABLE data quality), the channel reports the value configured in this softlist parameter. No_Change returns the actual value. MinRange returns the smallest value (MinScale). MaxRange returns the largest value (MaxScale)."

MinScale: The module will linearly scale raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters set by the user. For example, given a MinScale of 0.0 and a MaxScale of 100.0. If the input to the channel is 12 mA, the scaled value will be 50.0. MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38)

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Bias: The user can enter a bias, in engineering units, on a per channel basis to compensate for known offsets. The bias value is added to the scaled input.

OpenCircuitLimit: This parameter is a REAL value that establishes the upper boundary, in milliamps, for the open circuit diagnostic. The adjustment range is 0.0 mA to 4.0 mA and the default value is set to 3.6 mA to comply with the NAMUR NE-43 standard. Setting the open circuit value to 0.0 mA disables the open circuit diagnostic. If you disable the diagnostic for a safety critical channel, you will have to configure logic in the controller to detect and respond to an open circuit fault condition.

UnderRangeLimit: This parameter a REAL value that establishes the upper boundary for the under-range diagnostic, in milliamps. The adjustment range is 0.0 mA to 4.0 mA. Setting this value equal to, or beyond, the open circuit limit disables this diagnostic. The lower boundary of this diagnostic is equal to the open circuit limit value. By default, this value limit is set to the open circuit limit default value (3.6 mA) so this diagnostic is disabled.

OverRangeLimit: This parameter a REAL value that establishes the lower boundary of the over-range diagnostic, in milliamps. The adjustment range is from 20.0 mA to 22.0 mA. Setting this value equal to, or beyond, the short circuit limit disables this diagnostic. The upper boundary of this diagnostic is equal to the short circuit limit value. By default, this value is set to the short circuit limit default value (21 mA), so this diagnostic is disabled.

ShortCirLimit: This parameter a REAL value that establishes the lower boundary, in milliamps, for the short circuit diagnostic. The adjustment range is 20.0 mA to 22.0 mA and the default value is set to 21.0 mA to comply with the NAMUR NE-43 standard. The default value prevents most over-range values from reporting an error while still allowing true short circuits to be detected. The default value permits a defective (open) sense resistor on the CAI Marshalled Termination Assembly (MTA) to be detected.

Open circuit and short circuit diagnostics provide coverage for some fault modes in wiring and I/O devices that are not covered by other diagnostics. These are conditions that may be a result of a failed component on the I/O module, masking the actual sensor data. If these diagnostics are disabled for safety critical channels, another way to detect the fault modes may be required. This can be accomplished with configuration logic within the controller. If handled by the control logic, this logic must be configured to drive the process into a safe state upon failure. Alternatively, there may be ways to monitor the I/O devices and I/O signals independently.

If the channel is a non-redundant shutdown_channel (i.e., it is safety critical and not 1oo2 or 2oo3), the open circuit and short circuit detection must be enabled at some reasonable thresholds where they will be detected.

If the open circuit diagnostics are totally disabled, function blocks such as the Less Than (LT) block or the Analog Voter (ANVOTER) block can be used to detect specific limits (or ranges) on the input values. The compare limits for these blocks should detect input values near 0 mA (e.g. between 0 - 0.5 mA). These block outputs can be combined with maintenance logic or timing logic to determine if a true fault needs annunciation.

When programming the diagnostics for this channel type, note the following considerations listed in the table below.

Input Value (mA)	**Diagnostic Result**
>ShortCirLimit	Short Circuit Error
<= ShortCirLimit and >OverRangeLimit	Over Range Error
<=OverRangeLimit and >=UnderRangeLimit	None
<UnderRangeLimit and >=OpenCircuitLimit	Under Range Error
<OpenCiruitLimit	Open Circuit Error

7.2.3 QUADLOG CAM Analog Output (CAOC)

The CAM Analog Output Channel accepts a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	**SELECTION**	**DEFAULT**
Shutdown_Channel	TRUE, FALSE	FALSE
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
OutputRange	MA_4to20, mA_0to20	mA_4to20

PARAMETER	SELECTION	DEFAULT
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
ProtectedOutput	Enabled, Disabled	Enabled
Bias	Any REAL Number	0.0
ReadBack	Enabled, Disabled	Enabled

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CAM reports a shutdown error (Class 4, SSC 37, EC 31). Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

Enabling this parameter also enables the controller readback diagnostic. This diagnostic compares the output value sent by the controller to the value "read back" by the CAM.

MinScale: The module performs a linear conversion from engineering units to the selected OuputRange for each channel. The scaling algorithm uses the MinScale/MaxScale and OutputRange parameters that you set. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an OutputRange of 4-20 mA, if the value written to the CAM Analog Out channel is 50, the module will output 12 mA. MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

OutputRange: CAM Analog Output channels are configurable to operate with two current ranges: 4-20 mA and 0-20 mA

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

ProtectedOutput: Each output can be configured to turn off (0 mA = -25%) all CAM I/Os in the event that diagnostics determine that the output current is greater than it is intended to be by 2% or more. You may want to configure an output as a ProtectedOutput if it is critical to the process, or if it presents a possible hazard to personnel or equipment.

Bias: The user can enter a bias (in engineering units) on a per channel basis to compensate for known offsets. The bias value is added to the scaled output.

ReadBack: The state of an output channel is automatically "read back" by input circuitry on the same channel. ReadBack is used to diagnose and report faults. You can disable ReadBack, which, in turn, disables reporting of readback-related faults (i.e. Master Readback Data Mismatch, Standby & Master Readback Mismatch, Standby Readback Data Mismatch, Partner Readback Data Mismatch).

Note

Disabling ReadBack does not disable the controller readback diagnostic. ReadBack should be enabled if Shutdown_Channel = TRUE.

7.2.4 QUADLOG Critical Discrete (Disc) Supervised Input (CDSI)

The CDSI (Critical Discrete Supervised Input) channel type returns an analog variable, automatically ranged and scaled to 0-20 mA, which may be converted to discrete values by the Critical Discrete Supervised Input (CDSI) function block.

Note

Ensure that in the HW Config program, the CDSI, an analog channel type, is connected to a F_Q_CHRI AS function block and not a discrete function block (F_Q_CHDI). HW Config will not prevent an inappropriate connection, and a CFC that includes an incorrect configuration of this type will compile without error. If a CFC with this incorrect configuration is downloaded as part of a project and run, the system is subject to a runtime group shutdown. For more information, see the section titled CDSI Channel Type Should Be Configured with the F_Q_CHRI Channel Driver Block

When this channel type is selected, it should be connected to the F_CDSI function block in the controller logic. This function block contains the fixed thresholds that convert the analog signal from a CAM or CAI to a Boolean value. For detailed information, refer the section titled F_CDSI and the manual *QUADLOG® Critical Analog Input Module (CAI)* (SDQLCAI-1), which contains wiring details for CDSI channel types.

The table below lists Critical Discrete Supervised Input softlist parameter.

PARAMETER	SELECTION	DEFAULT
Shutdown_Channel	TRUE, FALSE	FALSE

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CAM or CAI reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.3 QUADLOG Critical Discrete Module (CDM)

The Critical Discrete Module (CDM) interfaces discrete DC sensors and actuators with a control module's IOBUS. It provides 32 channels. Each channel can be configured as any of the five discrete channel types: an input, an output, an event recording input, an event recording output, or a pulse output.

The CDM's inputs are current sinking (i.e. the input device is wired between the power supply positive and the I/O terminal). Outputs are current sourced (i.e. the output device is wired between the output terminal and power supply common). In addition, a soft-fuse circuit protects each output channel from a short-circuit in the field wiring and prevents a short from affecting other CDM channels. Note that a soft-fuse can be reset locally or remotely.

All channel types, except pulse output, can be configured to run pulse test diagnostics to ensure the channel is in working order. The diagnostics require inputs to have an external device called a Safety-Related Switch Adapter (SRSA). The diagnostics detect shorts in the field, channel-to-channel shorts, and channel-to-power shorts.

Caution

To avoid signal interference, do not externally wire an output channel to other QUADLOG or APACS input channels if it is configured to use pulse test diagnostics. The short pulses emitted by the diagnostics are not intended to be connected directly to these input types.

Starting with version 3.1 of the CDM software (firmware), each output channel can be configured so the diagnostics can also detect an open load condition (i.e. when there is no load attached to that channel's I/O termination). When an open load condition is detected, the module reports a module error (SSC 07, EC 37). The following table lists the criteria necessary to determine if the load connected to an output channel is compatible with the open load diagnostics. It applies to both redundant and non-redundant CDM configurations.

The table below lists the limits for open load diagnostics

CDM MODEL	OPEN LOAD DETECTION THRESHOLD	CONNECTED LOAD DETECTION THRESHOLD
QLCDM024DCxAN (24 V)	A load resistance greater than 4,050 ohms is considered open.	A load resistance less than 496 ohms is considered connected.
QLCDM048DCxAN (48 V)	A load resistance greater than 4,271 ohms is considered open.	A load resistance less than 1,030 ohms is considered connected.

Notes

1. A load resistance value in the range between the open and connected thresholds can be detected as either open or connected.
2. If an output channel is connected to a load, but the module still reports an error (SSC 07, EC37) , you can disable the open load diagnostics by setting the channel's PulseDiagTest softlist value to disable. **However, this parameter must be enabled for a safety critical output channel**. Starting with firmware 3.02, the OpenCircuitTest softlist parameter disables open load diagnostics.

A discrete pulse output channel type is configurable so it is on for a time duration that you define (within a range of 25 to 2000 ms and a resolution of 25 ms).

Every input and output circuit is electrically isolated from the CDM's CPU, IOBUS, and ground. In addition, a soft-fuse circuit protects each output channel from a short circuit in the field wiring and prevents a short from affecting other CDM channels. Note that a soft-fuse can be reset locally or remotely.

ScanRate (hidden in HW Config)**:** This is a read-only parameter that displays the current scan rate of the module. Generally, the scan rate will be the same as the scan rate of the control module, but can be a multiple of the control module's scan rate.

QUADLOG CDM Channel Types

The following channel types are supported for the CDM. In a DP/IO Bus Link environment, configuration information in this document supersedes information in the section titled "Configuring I/O Channels" in the document *Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher* (CG39-20).

- Discrete Input (ADIC)
- CDM Discrete Output (CDOC)
- Discrete Pulse Output (DPOC)

7.3.1 QUADLOG Discrete Input (ADIC)

The Discrete Input channel type returns a BOOL variable. The table below lists the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
InputFaultState	TRUE, FALSE (hidden in HW Config)	FALSE
Shutdown_Channel	TRUE, FALSE	FALSE
PulseDiagTest	Enabled, Disabled	Enabled

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"When an input channel has a hardware failure that makes the channel value impossible to discern, the channel reports the BOOL value configured in this softlist parameter."

Shutdown_Channel: When the Shutdown_Channel parameter is set to TRUE, a shutdown error (class 4, SSC 37, EC 31) is reported in addition to a class 2 or class 3 channel error that affects channel quality (when BAD or QUESTIONABLE quality is set). When this parameter is FALSE, the shutdown error is not reported. Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

PulseDiagTest: This parameter is used to enable or disable pulse diagnostic testing. It is used to detect channel anomalies such as shorts in the field, channel-to-channel shorts, and channel-to-power shorts. It is an added protection measure for safety critical channels. **Channels that perform safety critical I/O functions must have this parameter enabled**. An input channel that uses this parameter must be wired to an external Safety-Related Switch Adapter.

7.3.2 QUADLOG Discrete Output (CDOC)

The Discrete Output channel type accepts a BOOL variable. The table below lists the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
ProtectedOutput	Enabled, Disabled	Enabled
Readback	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE
PulseDiagTest	Enabled, Disabled	Enabled
OpenCircuitTest	Enabled, Disabled	Enabled

ProtectedOutput: Each output can be configured to turn off all CDM outputs in the event that a channel is intended to be off, but diagnostics have determined that it is on. You may want to configure an output as ProtectedOutput if it is critical to the process or if it presents a possible hazard to personnel or equipment.

Readback: The state of an output channel is automatically “readback” by input circuitry on the same channel. The Readback is used to diagnose and report the following five types of faults. Disabling Readback disables reporting of the first four types.

1. Diagnostic Read Error
2. Output Failed ON (energized)
3. Protected Output Failed ON (energized)
4. Output Failed OFF (de-energized, blown hard fuse)
5. Output Failed OFF (de-energized, tripped soft-fuse)

Notes

Disabling ReadBack does not disable the controller readback diagnostic. ReadBack should be enabled if Shutdown_Channel = TRUE.

As listed above, there are two possibilities for an output channel to fail OFF. One way is when the hard fuse blows (it is not field-replaceable); the other is when the soft-fuse trips (it is locally or remotely resettable). The soft-fuse trip error cannot be disabled by the Readback softlist.

Shutdown_Channel: When the Shutdown_Channel parameter is set to TRUE, a shutdown error (class 4, SSC 37, EC 31) is reported in addition to a class 2 or class 3 channel error that affects channel quality (when BAD or QUESTIONABLE quality is set). When this parameter is FALSE, the shutdown error is not reported. Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

Enabling this parameter also enables the controller readback diagnostic. This diagnostic compares the output value sent by the controller to the value “read back” by the CDM.

PulseDiagTest: This parameter is used to enable or disable pulse diagnostic testing. It is used to detect channel anomalies such as shorts in the field, channel-to-channel shorts, and channel-to-power shorts. It is an added protection measure for safety critical channels.

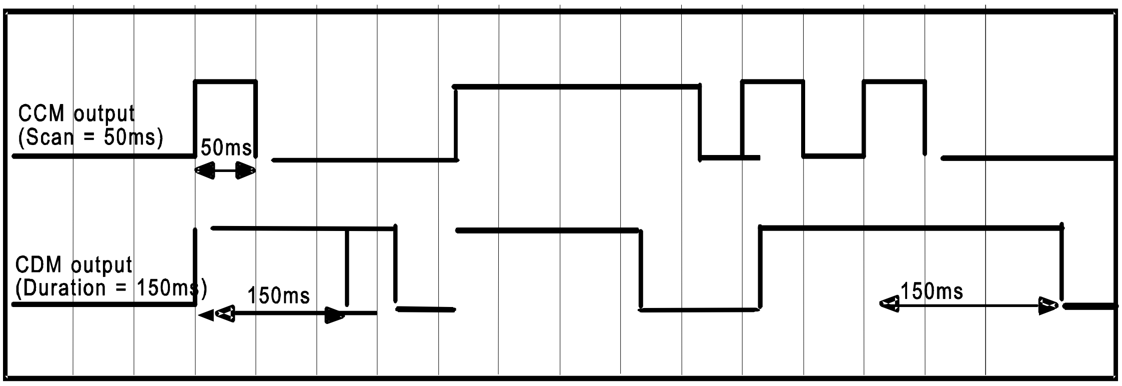
OpenCircuitTest: This parameter is used to enable or disable open load (circuit) testing. Starting with version 3.01 of the CDM software (firmware), each output channel can be configured so the diagnostics can also detect an open condition (i.e. when there is no load attached to that channel's I/O termination). When an open load condition is detected, the module reports a module error (SSC 07, EC 37) .

7.3.3 QUADLOG Discrete Pulse Output (DPOC)

The Discrete Pulse Output channel type accepts a BOOL variable. This channel type turns on its assigned output for a pre-determined time period (the resolution of the pulse output is ±25 ms, accurate to within ±2 ms). The time period is established by the Duration softlist parameter value. It can be set between 25 ms and 2000 ms.

When the BOOL output value, sent from the control module to the CDM, transitions from FALSE to TRUE, the corresponding output will turn on for the specified duration. However, if another FALSE to TRUE transition occurs before the end of the pulse, the pulse output is retriggered. Therefore, to keep a pulse output channel constantly on, you must write a FALSE to TRUE transition to the channel at a faster rate than the pulse duration.

The following timing diagram shows the output value being sent from a CONTROLLER to the CDM. In this example, the CONTROLLER scan rate is set to 50 ms; therefore, the CONTROLLER can only change the state of the output every 50ms. The CDM output is configured as a Discrete Pulse Output channel with a duration of 150 ms. The figure below shows how a FALSE to TRUE transition of the CONTROLLER output triggers a pulse output. It also illustrates that once a pulse output has been triggered, it can be retriggered before the end of the pulse duration.



The table below lists the softlist parameters for the CDM Discrete Output Pulse channel type.

PARAMETER	SELECTION	DEFAULT
Duration	25 to 2000 ms	25 ms
Readback	Enabled, Disabled	Enabled
ProtectedOutput	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

Duration: The duration of a pulse output channel can be specified between 25 ms and 2000 ms in 25 ms increments. Any value not in 25 ms increments is rounded up to the next 25 ms increment, however, there is a 5 ms deadband before rounding occurs. For example, if the duration specified is 28 ms, the actual pulse will be 25ms because of the deadband. Likewise, if the duration specified is 31 ms, the actual pulse will be rounded up to 50 ms. Use the examples in tables below as guidelines.

EXAMPLE DURATION VALUE	ACTUAL PULSE DURATION
25 ms	25 ms

EXAMPLE DURATION VALUE	ACTUAL PULSE DURATION
26 to 30 ms	25 ms (because of 5 ms deadband)
31 to 50 ms	50 ms (rounded up)

Readback: The state of an output channel is automatically "readback" by input circuitry on the same channel. The Readback is used to diagnose and report the following five types of faults. Disabling Readback disables reporting of the first four types.

1. Diagnostic Read Error
2. Output Failed ON (energized)
3. Protected Output Failed ON (energized)
4. Output Failed OFF (de-energized, blown hard fuse)
5. Output Failed OFF (de-energized, tripped soft-fuse)

Notes

Disabling ReadBack does not disable the controller readback diagnostic. ReadBack should be enabled if Shutdown_Channel = TRUE.

As listed above, there are two possibilities for an output channel to fail off. One way is when the hard fuse blows (it is not field replaceable); the other is when the soft-fuse trips (it is locally or remotely resettable). The soft-fuse trip error cannot be disabled by the softlist.

ProtectedOutput: Each output can be configured to turn off all CDM outputs in the event that a channel is intended to be off but diagnostics have determined that it is on. You may want to configure an output as ProtectedOutput if it is critical to the process, or if it presents a possible hazard to personnel or equipment.

Shutdown_Channel: When the Shutdown_Channel parameter is set to TRUE, a shutdown error (class 4, SSC 37, EC 31) is reported in addition to a class 2 or class 3 channel error that affects channel quality (when BAD or QUESTIONABLE quality is set). When this parameter is FALSE, the shutdown error is not reported. Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

Enabling this parameter also enables the controller readback diagnostic. This diagnostic compares the output value sent by the controller to the value "read back" by the CDM.

7.4 QUADLOG Critical Discrete DC Output (CDO_DC) Modules

The DP/IO Bus Link supports the DC Critical Discrete Output (CDO-DC) module.

The CDO-DC module interfaces discrete 24 to 125 Vdc output devices with a control module's IOBUS, supporting 16 isolated outputs. This enables outputs requiring different power sources to be connected to the same module. Furthermore, each channel is electrically isolated from the module's CPU, IOBUS, and ground.

QUADLOG CDO-DC Channel Types

The following channel types are supported for the CDO-DC. In a DP/IO Bus Link environment, configuration information in this document supersedes information in the section titled "Configuring I/O Channels" in the document *Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher* (CG39-20).:

- CDO-DC De-energize-To-Trip DC Output (CDDO)
- CDO-DC Energize-To-Trip DC Output (CEDO)

7.4.1 QUADLOG CDO-DC De-energize-To-Trip DC Output (CDDO)

The CDO-DC De-Energize-To-Trip DC Output channel type accepts a BOOL variable. The table below shows the softlist parameters for this channel type. This channel type should be selected for applications when the failsafe state of the output is FALSE (de-energized).

The table below lists the softlist parameters for the CDO-DC De-Energize-To-Trip DC Output.

PARAMETER	SELECTION	DEFAULT
Shutdown_Channel	TRUE, FALSE	FALSE
Protected Output	YES, NO	YES
FieldWiringDiag	ENABLE, DISABLE	ENABLE
Readback	ENABLE, DISABLE	ENABLE
PulseTestDiag	ENABLE, DISABLE	ENABLE
Description	Any 28 char.	‘’
Event Priority	1-4	1
Alarm State	Not applicable (read-only in HW Config)	TRUE

7.4.2 QUADLOG CDO-DC Energize-To-Trip DC Output (CEDO)

The CDO-DC Energize-To-Trip DC Output channel type accepts a BOOL variable. This channel type should be selected for applications when the failsafe state of the output is TRUE (energized).

Warning

Safety Note - HW Config does not always intercept or prevent impermissible S7 F/H system configurations

In systems with CDO-DC outputs, energize-to-trip (ETT) and de-energize-to-trip (DTT) hardware cannot coexist on the same rack.

- In S7 F/FH systems, energize-to-trip (ETT) outputs are neither permitted nor supported.
- Customers using ETT, which is permitted in QUADLOG, must ensure that hardware (DP/IOBus Link module, I/O modules, power supply) and the logic that provide ETT are confined to racks separate from racks associated with S7 F/FH hardware and logic.

DTT is incompatible with ETT because ETT outputs require that auto-shutdown be disabled by setting the DISAUTSD input of the F_Q_CTRL block to TRUE. This setting applies to all the hardware and logic associated with that rack. Conversely, DTT requires that auto-shutdown be enabled for the entire rack.

PARAMETER	SELECTION	DEFAULT
Shutdown_Channel	TRUE, FALSE	FALSE
IOBUS Fault	OFF, ON, HOLD	ON
FieldWiringDiag	ENABLE, DISABLE	ENABLE
Readback	ENABLE, DISABLE	ENABLE
PulseTestDiag	ENABLE, DISABLE	ENABLE
Description	Any 28 char.	‘’
Event Priority	1-4	1
Alarm State	Not applicable (read-only in HW Config)	TRUE

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the CDI reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all system outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

IOBUS Fault: If the CDO module is unable to communicate with the controller (loss of IOBUS), the output is set to the IOBUS Fault state. Once set to the IOBUS Fault, the diagnostic must be acknowledged for normal output updates to occur again.

Note

The default setting for the CDO ETT IOBUS fault parameter is ON; this setting should be carefully considered and adjusted if a trip is not desired for IOBUS fault conditions.

Protected Output: When Protected Output is set to Enable, the module will de-energize the output via the diagnostic cutoff switch if diagnostics detect that the output is ON when it is supposed to be OFF.

Open Circuit Test: This enables a diagnostic that determines whether a load is present. Note that loads of less than 50 mA may not be reported correctly by this diagnostic.

Readback: The CDO contains circuitry on every output to “read back” the actual output current. Readback is used to diagnose the following faults (see APS for list of Readback diagnostics). Disabling Readback inhibits reporting of Readback-related diagnostics.

PulseTestDiag: Enables pulse diagnostic testing for this channel.

Alarm State (read-only in HW Config)**:** This read-only parameter is used to establish the alarm and/or trip state of the channel. If the channel type is De-Energize-to-Trip, the alarm state is by definition FALSE. If the channel type is Energize-to-Trip, the alarm state is TRUE. This parameter is not configurable.

7.5 QUADLOG Enhanced Analog Module (EAM)

The Enhanced Analog Module (EAM) interfaces both analog and discrete I/O signals to a control module's IOBUS. Each of its 16 configurable channels can be configured as an analog input, analog output, frequency input, totalizer input, discrete input, or discrete output. Related signals, such as the I/O for a particular loop, can be grouped together to permit isolation and ease in responding to faults. Each channel is electrically isolated from the module's CPU, IOBUS, and ground, as well as from every other channel.

QUADLOG EAM Channel Types

The channel types supported for the EAM are listed here. In a DP/IO Bus Link environment, configuration information in this document supersedes information in the section titled “Configuring I/O Channels” in the document *Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher* (CG39-20)..

- EAM Analog In Current (EACI)
- EAM Analog Out Current (EAOC)
- EAM Analog In Voltage (EAVI)
- EAM Voltage Pulse In-Freq (VPIF)
- EAM Current Pulse In-Freq (CPIF)
- EAM Voltage Pulse In-Total (VPIT)
- EAM Current Pulse In-Total (CPIT)
- EAM Disc In Voltage (AVDI)

- EAM Disc In Current (ACDI)
- EAM Disc Out (EADO)

7.5.1 QUADLOG EAM Analog In Current (EACI)

The EAM Analog In Current channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
InputRange	4-20 mA, 0-20Ma	4-20 mA
Resolution	13 bits, 14 bits, 15 bits, 16 bits	13 bits
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
Shutdown_Channel	TRUE, FALSE	FALSE

InputRange: EAM analog input channels are configurable to operate with two current ranges: 4-20 mA or 0-20 mA.

Resolution: The EAM employs the sigma-delta method of analog to digital conversion. Both the resolution of a sigma-delta converter and normal mode rejection are improved by increasing the filtering amount. The degree of filtering appropriate for the selected resolution is applied to the signal within the EAM, before the control module scans the signal.

MinScale: The module will linearly scale raw data (mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and InputRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an InputRange of 4-20 mA, if the input to the channel is 12 mA, the scaled value will be 50.0.
MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.2 QUADLOG EAM Analog Out Current (EAOC)

The EAM Analog Out Current channel type accepts a REAL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
OutputRange	4-20 mA, 0-20 mA	4-20 Ma
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	In, ft, mm, cm, m, in3, ft3, bbl, ml, liter, m3, lb, ton, mol, g, kg, ft/sec, m/sec,ft/sec2, msec2, DegF, DegR, DegC, DegK, psi, psia, psig, InH2O, InHg, ATM, kPa, kPaa, kPag, mmHg, kg/cm2, mbar, bar, lb/ft3, g/cm3, kg/m3, mol/m3, ft3/lb, m3/kg, ppm, pH, PPH, KPPH, t/day, kg/hr, kg/day, gal/min, GPM, GPH, GPD, ACFM, ACFH, SCCM, SCFH, SCFM, MCFH, yd3/hr, yd3/day, BPD, gal/hr, gal/day, m3/hr, m3/day, l/min, l/hr, l/day, mV, Volts, mA, AMPS, Ohms, mhos, W, kW, MW, Btu, Btu/SCF, Btu/lbm, Btu/hr, hp, bhp, vars, VA, kVA, joules, Percent, pulses, Hz, rpm, deg, rad, cal, cal/SCF, cal/hr, cal/lbm, kcal, kcal/SCF, kcal/hr, kcal/lbm, tonne, tonne/day	Percent
ProtectedOutput	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

OutputRange: EAM Analog Output Current channels are configurable to operate with two current ranges: 4-20 mA or 0-20 mA.

MinScale: The module performs a linear conversion from engineering units to the selected OuputRange for each channel. The scaling algorithm uses the MinScale/MaxScale and OutputRange parameters that you set. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an OutputRange of 4-20 mA, if the value written to the EAM Analog Output Channel is 50, the module outputs 12 mA.
MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

ProtectedOutput: If ProtectedOutput is enabled and an error condition exists for which the channel cannot be turned off individually, then all channels of the module are turned off.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.3 QUADLOG EAM Analog In Voltage (EAVI)

The EAM Analog In Voltage channel type returns a REAL variable. The table below shows the softlist parameters this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
InputRange	1-5 V, 0-5 V	1-5 V
Resolution	13 bits, 14 bits, 15 bits, 16 bits	13 bits
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
Shutdown_Channel	TRUE, FALSE	FALSE

InputRange: EAM Analog In Voltage channels are configurable to operate with two voltage ranges: 1-5 V or 0-5 V.

Resolution: The EAM employs the sigma-delta method of analog to digital conversion. The resolution of a sigma-delta converter and normal mode rejection are improved by increasing the amount of filtering. The degree of filtering, appropriate for the selected resolution, is applied to the signal within the EAM, before the control module scans the signal.

MinScale: The module will linearly scale raw data (volts) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and InputRange parameters set by the user. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an InputRange of 1-5 Volts. If the input to the channel is 3 Volts, the scaled value will be 50.0.

MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.4 QUADLOG EAM Voltage Pulse In-Freq (VPIF)

The Voltage Pulse In-Freq channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
Threshold	Regular, TTL	Regular
MinRange	0.0 to 45,000 Hz	0.0
MaxRange	0.0 to 45,000 Hz	45,000.0
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	45,000.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Hz
Resolution	10, 12, 14, 16-bit	12-bit
Shutdown_Channel	TRUE, FALSE	FALSE

Threshold: You can select the threshold for voltage input pulses. The Regular threshold is 2.5 V with 130 mV of hysteresis. The TTL threshold is 1.4 V with 130 mV of hysteresis.

MinRange: The MinRange parameter allows you to specify a minimum operating value in Hz. If the reading drops below this value, an underrange error is reported.

MaxRange: The MaxRange parameter allows you to specify a maximum operating value in Hz. If the reading goes above this value, an overrange error is reported.

MinScale: The module will linearly scale raw data (Hz) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and MinRange/MaxRange parameters values that you set. For example, given a MinScale of 0.0, a MaxScale of 100.0, a MinRange of 0, and a MaxRange of 10,000. If the input to the channel is 5000 Hz, the scaled value will be 50.0.

MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Resolution: The EAM counts the number of pulses occurring in a measured length of time. The frequency of the waveform is calculated by dividing the number of pulses by the corresponding length of time. Increasing the resolution increases the length of time in which pulses are accumulated.

To meet certain application requirements, the selection of 10-bit resolution actually yields 11-bit resolution. This provides better than 0.06% accuracy with a minimal delay.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.5 QUADLOG EAM Current Pulse In-Freq (CPIF)

The Current Pulse In-Freq channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
InputRange	4-20 mA, 0-20 mA	0-20Ma
MinRange	0.0 to 45,000 Hz	0.0
MaxRange	0.0 to 45,000 Hz	45,000.0
MinScale	Any REAL Number	0.0

PARAMETER	SELECTION	DEFAULT
MaxScale	Any REAL Number	45,000.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Hz
Resolution	10, 12, 14, 16-bit	12-bit
Shutdown_Channel	TRUE, FALSE	FALSE

InputRange: Current Pulse In-Freq channels are configurable to operate with two current ranges: 4-20 mA or 0-20 mA. The threshold for both ranges is fixed at 10 mA with a hysteresis of 0.5 mA.

MinRange: The MinRange parameter allows you to specify a minimum operating value in Hz. If the reading drops below this value, an underrange error is reported.

MaxRange: The MaxRange parameter allows you to specify a maximum operating value in Hz. If the reading goes above this value, an overrange error is reported.

MinScale: The module will linearly scale raw data (Hz) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and MinRange/MaxRange parameter values that you set. For example, given a MinScale of 0.0, a MaxScale of 100.0, a MinRange of 0, and a MaxRange of 10,000. If the input to the channel is 5000 Hz, the scaled value will be 50.0.

MinScale can be any REAL number (REAL numbers are valid between -3.4028E38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Resolution: The EAM counts the number of pulses occurring in a measured length of time. The frequency of the waveform is calculated by dividing the number of pulses by the corresponding of time. Increasing the resolution increases the length of time in which pulses are accumulated.

To meet certain application requirements, the selection of 10-bit resolution actually yields 11-bit resolution. This provides better than 0.06% accuracy with a minimal delay.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.6 QUADLOG EAM Voltage Pulse In-Total (VPIT)

The EAM Voltage Pulse In-Total channel type returns a UDINT variable. This channel type must be used with the EAM_TOT (Enhanced Analog Module Totalizer) function block. For more information on this function block, refer to *ProcessSuite® 4-mation™ Configuration* QUADLOG® ACM+/CCM Version 3.30 or Higher (CGQL-3). The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
Threshold	Regular, TTL	Regular
Shutdown_Channel	TRUE, FALSE	FALSE

Threshold: You can select the threshold for voltage input pulses. The Regular threshold is 2.5 V with 130 mV of hysteresis. The TTL threshold is 1.4 V with 130 mV of hysteresis.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.7 QUADLOG EAM Current Pulse In-Total (CPIT)

The Current Pulse In-Total channel type returns a UDINT variable. The Current Pulse In-Total channel type must be used with the EAM-TOT (Enhanced Analog Module Totalizer) function block. The table below shows the softlist parameter for the EAM Current Pulse In-Total channel type.

PARAMETER	SELECTIONS	DEFAULT
InputRange	4-20 mA, 0-20 mA	0-20 mA
Shutdown_Channel	TRUE, FALSE	FALSE

InputRange: Current Pulse In-Total channels are configurable to operate with two current ranges: 4-20 mA or 0-20 mA. The threshold for both ranges is fixed at 10 mA with a hysteresis of 0.5 mA.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31). Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

Note

Selecting 0-20 mA disables "open-input" diagnostic errors.

7.5.8 QUADLOG EAM Disc In Voltage (AVDI)

The EAM Disc In Voltage channel type returns a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
MinOnStatePct	0.0 to 100	80.0
MaxOffStatePct	0.0 to 100	20.0
Shutdown_Channel	TRUE, FALSE	FALSE

MinOnStatePct: The reading is automatically scaled from 0-5 V to 0-100%. A scaled reading greater than or equal to MinOnStatePct returns a TRUE to the control module.

MaxOffStatePct: The reading is automatically scaled from 0-5 V to 0-100%. A reading less than or equal to MaxOffStatePct returns a FALSE to the control module.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.9 QUADLOG EAM Disc In Current (ACDI)

The EAM Disc In Current channel type returns a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
MinOnStatePct	0.0 to 100	80.0
MaxOffStatePct	0.0 to 100	20.0
Shutdown_Channel	TRUE, FALSE	FALSE

MinOnStatePct: The reading is automatically scaled from 0-20 mA to 0-100%. A scaled reading greater than or equal to MinOnStatePct returns a TRUE to the control module.

MaxOffStatePct: The reading is automatically scaled from 0-20 mA to 0-100%. A reading less than or equal to MaxOffStatePct returns a FALSE to the control module.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, this module reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes **all** outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.5.10 QUADLOG EAM Disc Out (EADO)

The EAM Disc Out channel type accepts a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
ProtectedOutput	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

ProtectedOutput: If ProtectedOutput is enabled and an error condition exists for which the channel cannot be turned off individually, then all channels of the module are turned off. You may want to configure an output as a ProtectedOutput if it is critical to the process, or if it presents a possible hazard to personnel or equipment.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the EAM disables (0V or 0 mA) all of its output channels and reports a shutdown error (class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.6 QUADLOG Input Discrete Module (IDM)

The Input Discrete Module (IDM) interfaces discrete 115 or 230 Vac input devices with a control module's IOBUS. It supports 32 AC inputs in eight isolated groups of four channels each. This allows AC inputs from different power sources to be connected to the same module. To isolate field faults, each channel is electrically isolated from the module s CPU, IOBUS, and ground.

QUADLOG IDM Channel Types

The IDM supports the QUADLOG IDM Disc In (IDMI) channel type. For information on configuring I/O channels, see the section titled QUADLOG IDM Disc In (IDMI). In a DP/IO Bus Link environment, this information supersedes the information in the “Configuring I/O Channels” section of *Using the 4-mation Configuration Software* (document number CG39-20).

7.6.1 QUADLOG IDM Disc In (IDMI)

The IDM Disc In channel type returns a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
	TRUE, FALSE (hidden in HW Config)	TRUE
Shutdown_Channel	TRUE, FALSE	FALSE

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"When an input channel has a hardware failure that makes the channel value impossible to discern, the channel will report the value configured in this softlist parameter."

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, this module reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.7 QUADLOG Output Discrete Module (ODM)

The ODM interfaces discrete 115 Vac devices with a control module's IOBUS. It supports 32 AC outputs in eight isolated groups of four channels each. This allows each group to use a separate power supply. Each group is individually fused with a 5.0 amp fuse to protect the group from a short-circuit in the field wiring and prevents a short-circuit from affecting other channel groups in the module. To isolate field faults, every output circuit is electrically isolated from the module's CPU, IOBUS, and ground.

QUADLOG ODM Channel Type

The ODM supports the QUADLOG Disc Out (SDOC) channel type. For information on configuring this channel type, see the section titled QUADLOG Disc Out (SDOC). In a DP/IO Bus Link environment, this information supersedes the information in the "Configuring I/O Channels" section of *Using the 4-mation Configuration Software* (document number CG39-20).

7.7.1 QUADLOG Disc Out (SDOC)

The Discrete Output channel type accepts a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
ProtectedOutput	Enabled, Disabled	Enabled
Readback	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

ProtectedOutput: Each output can be configured to turn off all outputs in the event that a channel is intended to be off but diagnostics have determined that it is on. You may want to configure an output as ProtectedOutput if it is critical to the process or if it presents a possible a hazard to personnel or equipment.

Readback: The state of an output channel is automatically "readback" by input circuitry on the same channel. The readback is used to diagnose and report faults. There are five types of faults as listed here. You can disable readback, which, in turn, disables reporting of the first four types.

1. Diagnostic Read Error
2. Output Failed ON (energized)
3. Protected Output Failed ON (energized)
4. Output Failed OFF (de-energized, blown hard-fuse)
5. Output Failed OFF (de-energized, tripped soft-fuse)

Note

As listed above, there are two possibilities for an output channel to fail off. One way is when the hard fuse blows (it is not field replaceable); the other is when the soft-fuse trips (it is locally or remotely resettable). The soft-fuse trip error cannot be disabled by the softlist.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the SDM+ module disables (0 mA) all of its output channels and reports a shutdown error (Class 4, SSC 37, EC 31). Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.8 QUADLOG Resistance Temperature Module (RTM)

The RTM interfaces RTDs (resistance temperature devices) and other resistance input signals to a control module's IOBUS. It provides 16 configurable channels isolated into eight groups of two channels each. Each input circuit is isolated from the module's CPU, IOBUS, and ground. In addition, each two-channel group is electrically isolated from the other groups.

QUADLOG RTM CHANNEL TYPES

The channel types supported for the RTM are listed here. For information on configuring this channel type, see the sections titled QUADLOG RTM RTD Input (RTD) and QUADLOG RTM Resistance Input (RIC). In a DP/IO Bus Link environment, this information in these section supersedes the information in the "Configuring I/O Channels" section of *Using the 4-mation Configuration Software* (document number CG39-20).

- RTM RTD Input (RTD)
- RTM Resistance Input (RIC)

7.8.1 QUADLOG RTM RTD Input (RTD)

The RTD Input channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT

PARAMETER	SELECTION	DEFAULT
RTD_Type	Pt_100_IEC/DIN Pt_100_JIC/SAMA Pt_200_IEC/DIN Pt_200_JIC/SAMA Ni_100 _DIN Linear	Pt_100_IEC/DIN
Alpha	Any REAL Number	0.00385
Resistance	10.0 to 200.0 Ohms	100.0
Bias	Any REAL Number	0.0
EngUnits	DegF, DegC, DegK, Deg R	Deg C
MinRange	Any REAL Number >= MinRange of selected RTD	Min Range of selected RTD Type (on-line) -200.0 (off-line)
MaxRange	Any REAL Number <= MaxRange of selected RTD	Max Range of selected RTD Type (on-line) +850.0 (off-line)
Scale_To_Percent	Yes_No Enforced by RTM board	No
InputFaultState	No_Change, MinRange, MaxRange	MinRange
DigFiltTimeCnst	0.0 to 159.0 sec.	0.016
StepResponseTime	0.100 to 40.000 sec.	1.0

RTD_Type: Select from the list of supported RTD types. If Linear is selected, the measured input, R, is linearized using a straight line approximation as detailed in *ProcessSuite® 4-mation Configuration QUADLOG® I/O Module Configuration Version 3.32 or Higher* (CGQL-4).

Alpha: Alpha is the average percent change, in resistance per degree, of a pure metal resistance device between 0 and 100 C. The most commonly used element material is the standard platinum with a resistance of 100 ohms at 0 degC and a temperature coefficient resistance of 0.00385 ohms/ohm/ C (IEC 751 and DIN 43760).

This parameter need only be specified when the RTD_Type specified is Linear.

Resistance: The resistance, in ohms, of the RTD at 0°C. This parameter need be specified only when the RTD Type specified is Linear.

Bias: You can enter a bias, in engineering units, on a per channel basis to compensate for known offsets. The bias value is added to the linearized input.

EngUnits: You can select from the following engineering units: DegF, DegC, DegK, DegR.

MinRange: MinRange is an optional parameter that allows you to specify a minimum operating value in EngUnits. If the reading drops 5% below this value, an underrange error is reported.

MaxRange: MaxRange is an optional parameter that allows you to specify a maximum operating value in EngUnits. If the reading goes 5% above this value, an overrange error is reported.

Scale_To_Percent: If Scale_To_Percent is TRUE, the linearized temperature reading, T, is scaled to a percent.

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"If a channel is faulted (quality is set to bad or questionable), you can select to have the module return the actual reading (No_Change), the largest value for the channel (MaxRange), or the smallest value (MinRange). The default is to return the MinRange. **"**

DigFiltTimeCnst: Digital filtering can be applied to RTD input signals to reduce the effects of electrical noise. The digital filter is a first order lag, adjustable for time constants of 0.0159 to 159.0 seconds. Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

StepResponseTime: This is parameter determines the time for the channel to fully respond to a step input. A longer StepResponseTime will provide more accurate readings. The valid range is between 0.100 and 40.00 seconds.

7.8.2 QUADLOG RTM Resistance Input (RIC)

The Resistance Input channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
MinRange	15 to 1015 Ohms	15.0
MaxRange	15 to 1015 Ohms	1015
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
Bias	Any REAL Number	0.0
InputFaultState	No_Change, MinRange, MaxRange	MinRange
DigFiltTimeCnst	0.0 to 159.0 sec.	0.016
StepResponseTime	0.100 to 40.000 sec.	1.0

MinRange: MinRange is an optional parameter that allows you to specify a minimum operating value in EngUnits. If the reading drops below this value, an underrange error is reported.

MaxRange: MaxRange is an optional parameter that allows you to specify a maximum operating value in EngUnits. If the reading goes above this value, an overrange error is reported.

MinScale: The module will linearly scale raw data (ohms) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale and MinRange/MaxRange parameters that you set. For example, given a MinScale of 0.0, a MaxScale of 100.0, a MinRange of 0.0, and a MaxRange of 1000, if the input to the channel is 500 ohms, the scaled value will be 50.0.

MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

Bias: You can enter a bias in engineering units, on a per channel basis, to compensate for known offsets. The bias value is added to the linearized input.

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"If channel quality is bad or questionable, you can select to have the module return the actual reading (No_Change), the largest value for the channel (MaxRange), or the smallest value (MinRange). The default is to return the MinRange."

DigFiltTimeCnst: Digital filtering can be applied to resistance input channel signals to reduce the effects of electrical noise. The digital filter is a first order lag, adjustable for time constants of 0.0159 to 159.0 seconds. Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

StepResponseTime: This parameter determines the time for the channel to fully respond to a step input. A longer StepResponseTime provides more accurate readings. The valid range is between 0.1 and 40.00 seconds.

7.9 QUADLOG Standard Analog Module (SAM)

The Standard Analog Module (SAM) can interface both analog and discrete I/O signals to a control module’s IOBUS. It provides 32 channels, each of which can be configured for standard I/O types. Related signals, such as the I/O for a particular loop, can be grouped together. To isolate field faults, each channel is electrically isolated from the module’s CPU, IOBUS, and ground. Also, each channel uses an isolated 24 V power source, and all channels are current-limited to protect against short circuits.

QUADLOG SAM Channel Types

The channel types supported for the SAM are listed here. In a DP/IO Bus Link environment, configuration information in this document supersedes information in the section titled "Configuring I/O Channels" in the document *Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher* (CG39-20)..

- SAM Analog In (SAIC)
- SAM Analog Out (SAOC)
- SAM Disc In (SADI)
- SAM Disc Out (ACDO)

7.9.1 QUADLOG SAM Analog In (SAIC)

The SAM Analog In channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
DigFiltTimeCnst	0.0 to 159.0 sec	0.0
Bias	Any REAL Number	0.0
OpenCircuitTest	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

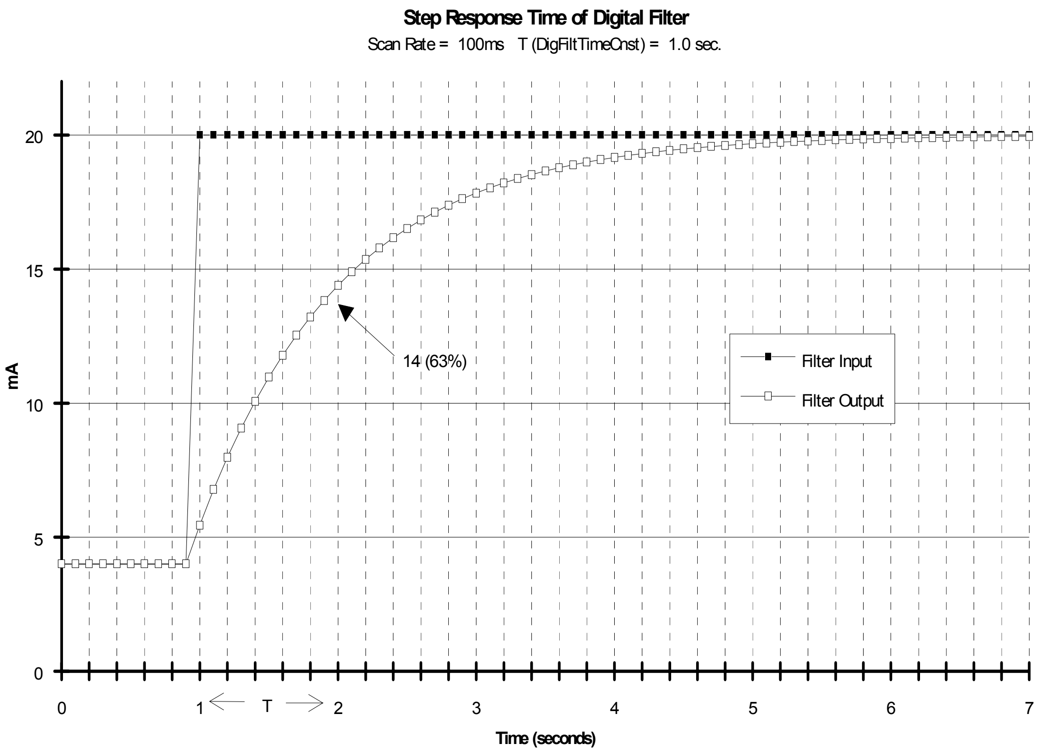
MinScale: The module linearly scales raw data (4-20 mA) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameters that you set. For example, given a MinScale of 0.0 and a MaxScale of 100.0, if the input to the channel is 12 mA, the scaled value will be 50.0.
MinScale can be any REAL number (REAL numbers are valid between-3.4028e38 and +3.4028e38)

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

DigFiltTimeCnst: Digital filtering can be applied to analog input signals to reduce the effects of electrical noise. The digital filter is a first order lag, adjustable for time constants of 0.0159 to 159.0 seconds (0.0 disables the filter). Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

The figure below shows the step release time of the digital filter.



Bias: You can enter a bias, in engineering units, on a per channel basis to compensate for known offsets. The bias value is added to the scaled input.

OpenCircuitTest: You can enable or disable open circuit testing. An open circuit condition exists if the reading is < 0.02 mA.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the SAM module disables (0 mA) all of its I/O and reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.9.2 QUADLOG SAM Analog Out (SAOC)

The SAM Analog Out channel type accepts a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
OutputRange	mA_4to20, mA_0to20	mA_4to20
MinScale	Any REAL Number	0.0
MaxScale	Any REAL Number	100.0
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
ProtectedOutput	Enabled, Disabled	Enabled
Bias	Any REAL Number	0.0
ReadBack	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

OutputRange: SAM Analog Output channels are configurable to operate with two current ranges: 4-20 mA and 0-20 mA

MinScale: The module performs a linear conversion from engineering units to the selected OuputRange for each channel. The scaling algorithm uses the MinScale/MaxScale and OutputRange parameter values that you set. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an OutputRange of 4-20 mA, if the value written to the SAM Analog Output Channel is 50, the module will output 12 mA.
MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

ProtectedOutput: Each output can be configured to turn off (0 mA) all SAM outputs in the event that diagnostics determine that the output current is greater than it is intended to be by 9% or more. You may want to configure an output as a ProtectedOutput if it is critical to the process or if it may present a hazard to personnel or equipment.

Bias: You can enter a bias in engineering units, on a per channel basis, to compensate for known offsets. The bias value is added to the scaled output.

ReadBack: The state of an output channel is automatically “read back” by input circuitry on the same channel. The readback is used to diagnose and report faults. You can disable readback, which, in turn, disables reporting of readback-related faults (i.e. Open Circuit, Readback Lower than Output, Readback > Output, Readback > Output on Critical Channel).

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the SAM module disables (0 mA) all of its I/O and reports a shutdown error (Class 4, SSC 37, EC 31). Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.9.3 QUADLOG SAM Disc In (SADI)

The SAM Disc In channel type returns a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
MinOnStatePct	0.0 to 100.0	80.0
MaxOffStatePct	0.0 to 100.0	20.0
Shutdown_Channel	TRUE, FALSE	FALSE

MinOnStatePct: The reading is automatically scaled from 0-10 mA to 0-100%. A scaled reading greater than or equal to MinOnStatePct will report a Boolean TRUE to the control module.

MaxOffStatePct: The reading is automatically scaled from 0-10 mA to 0-100%. A reading less than or equal to MaxOffStatePct will report a Boolean FALSE to the control module.

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the SAM module disables (0 mA) all of its I/O and reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.9.4 QUADLOG SAM Disc Out (ACDO)

The SAM Disc Out channel type accepts a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
ProtectedOutput	Enabled, Disabled	Enabled
ReadBack	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

ProtectedOutput: Each output can be configured to turn off (0 mA) all SAM outputs in the event that diagnostics determine that the output current is greater than it is intended to be by 9% or more. You may want to configure an output as a ProtectedOutput if it is critical to the process, or if it presents a possible hazard to personnel or equipment.

ReadBack: The state of an output channel is automatically "read back" by input circuitry on the same channel. The readback is used to diagnose and report faults. You can disable readback which, in turn, disables reporting of readback related faults (i.e. Readback Lower than Output, Readback > Output, Readback > Output on Critical Channel).

Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the SAM module disables (0 mA) and reports a shutdown error (Class 4, SSC 37, EC 31) . Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.10 QUADLOG Standard Discrete Module Plus (SDM+)

The Standard Discrete Module Plus (SDM+) interfaces discrete DC sensors and actuators with a control module's IOBUS. It provides 32 channels. Each channel can be configured to any of five discrete channel types: an input, an output, an event recording input, an event recording output, or a pulse output.

The SDM+'s inputs are current sinking (i.e. the input device is wired between the power supply positive (+) and the I/O terminal). Outputs are current sourced (i.e. the output device is wired between the output terminal and the power supply common). A pulsed output is an output channel that is on for a user-defined duration (within the range of 25 to 2000 ms and a resolution of 25 ms).

Each input and output circuit is electrically isolated from the module's CPU, IOBUS, and ground. In addition, a soft-fuse (TM) circuit protects each output channel from a short circuit in the field wiring and prevents a short from affecting other SDM+ channels. Note that a soft-fuse can be reset locally or remotely.

QUADLOG SDM+ Channel Types

The channel types supported for the SDM+ are listed here. In a DP/IO Bus Link environment, configuration information in this document supersedes information in the section titled “Configuring I/O Channels” in the document *Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher* (CG39-20)..

- SDM+ Disc In (ADIC)
- SDM+ Disc Out (SDOC)
- SDM+ Disc Pulse Out (DPOC)

7.10.1 QUADLOG Discrete Input (ADIC)

The Discrete Input channel type returns a BOOL variable. The table below lists the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
InputFaultState	TRUE, FALSE (hidden in HW Config)	FALSE
Shutdown_Channel	TRUE, FALSE	FALSE
PulseDiagTest*	Enabled, Disabled	Enabled

*This parameter is not used in the SDM+, but is listed because its channel type is shared with other modules.

InputFaultState (hidden from HW Config, cannot be changed in HW Config)**:** For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

The original description of **InputFaultState** is as follows:

"When an input channel has a hardware failure that makes the channel value impossible to discern, the channel reports the BOOL value configured in this softlist parameter."

Shutdown_Channel: When the Shutdown_Channel parameter is set to TRUE, a shutdown error (class 4, SSC 37, EC 31) is reported in addition to a class 2 or class 3 channel error that affects channel quality (when BAD or QUESTIONABLE quality is set). When this parameter is FALSE, the shutdown error is not reported. Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

PulseDiagTest: This parameter is used to enable or disable pulse diagnostic testing. It is used to detect channel anomalies such as shorts in the field, channel-to-channel shorts, and channel-to-power shorts. It is an added protection measure for safety critical channels. **Channels that perform safety critical I/O functions must have this parameter enabled**. An input channel that uses this parameter must be wired to an external Safety-Related Switch

Adapter. This parameter is not used in the SDM+, but is listed because its channel type is shared with other modules.

7.10.2 QUADLOG Disc Out (SDOC)

The Discrete Output channel type accepts a BOOL variable. The table below shows the softlist parameters for this channel type.

PARAMETER	SELECTION	DEFAULT
ProtectedOutput	Enabled, Disabled	Enabled
Readback	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

ProtectedOutput: Each output can be configured to turn off all outputs in the event that a channel is intended to be off but diagnostics have determined that it is on. You may want to configure an output as ProtectedOutput if it is critical to the process or if it presents a possible a hazard to personnel or equipment.

Readback: The state of an output channel is automatically "readback" by input circuitry on the same channel. The readback is used to diagnose and report faults. There are five types of faults as listed here. You can disable readback, which, in turn, disables reporting of the first four types.

1. Diagnostic Read Error
2. Output Failed ON (energized)
3. Protected Output Failed ON (energized)
4. Output Failed OFF (de-energized, blown hard-fuse)
5. Output Failed OFF (de-energized, tripped soft-fuse)

Note

As listed above, there are two possibilities for an output channel to fail off. One way is when the hard fuse blows (it is not field replaceable); the other is when the soft-fuse trips (it is locally or remotely resettable). The soft-fuse trip error cannot be disabled by the softlist.

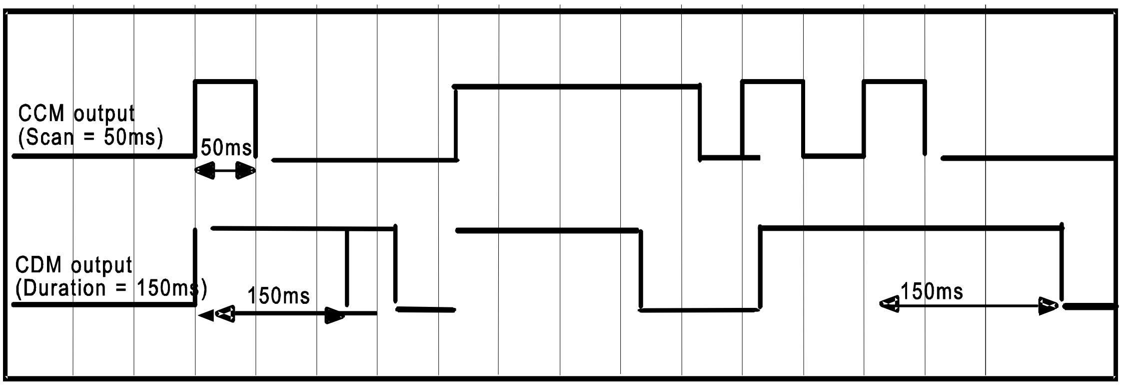
Shutdown_Channel: When TRUE and channel quality is BAD or QUESTIONABLE, the SDM+ module disables (0 mA) all of its output channels and reports a shutdown error (Class 4, SSC 37, EC 31). Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

7.10.3 QUADLOG Discrete Pulse Output (DPOC)

The Discrete Pulse Output channel type is available in the CDM and SDM+ modules. It accepts a BOOL variable. This channel type turns on its assigned output for a pre-determined time period (the resolution of the pulse output is +/-25 ms, accurate to within +/-2 ms). The time period is established by the Duration softlist parameter value. It can be set between 25 ms and 2000 ms.

When the BOOL output value, sent from the control module to the CDM or SDM+, transitions from FALSE to TRUE, the corresponding output will turn on for the specified duration. However, if another FALSE to TRUE transition occurs before the end of the pulse, the pulse output is retriggered. Therefore, to keep a pulse output channel constantly on, you must write a FALSE to TRUE transition to the channel at a faster rate than the pulse duration.

The following timing diagram shows the output value being sent from a CONTROLLER to the CDM or SDM+. In this example, the CONTROLLER scan rate is set to 50 ms; therefore, the CONTROLLER can only change the state of the output every 50 ms. The CDM or SDM+ output is configured as a Discrete Pulse Output channel with a duration of 150 ms. The figure below shows how a FALSE to TRUE transition of the CONTROLLER output triggers a pulse output. It also illustrates that once a pulse output has been triggered, it can be retriggered before the end of the pulse duration.



The table below lists the softlist parameters for the Discrete Output Pulse channel type.

PARAMETER	SELECTION	DEFAULT
Duration	25 to 2000 ms	25 ms
Readback	Enabled, Disabled	Enabled
ProtectedOutput	Enabled, Disabled	Enabled
Shutdown_Channel	TRUE, FALSE	FALSE

Duration: The duration of a pulse output channel can be specified between 25 ms and 2000 ms in 25 ms increments. Any value not in 25 ms increments is rounded up to the next 25 ms increment, however, there is a 5 ms deadband before rounding occurs. For example, if the duration specified is 28 ms, the actual pulse will be 25ms because of the deadband. Likewise, if the duration specified is 31 ms, the actual pulse will be rounded up to 50 ms. Use the examples in tables below as guidelines.

EXAMPLE DURATION VALUE	ACTUAL PULSE DURATION
25 ms	25 ms
26 to 30 ms	25 ms (because of 5 ms deadband)
31 to 50 ms	50 ms (rounded up)

Readback: The state of an output channel is automatically "readback" by input circuitry on the same channel. The Readback is used to diagnose and report the following five types of faults. Disabling Readback disables reporting of the first four types.

1. Diagnostic Read Error
2. Output Failed ON (energized)
3. Protected Output Failed ON (energized)
4. Output Failed OFF (de-energized, blown hard fuse)
5. Output Failed OFF (de-energized, tripped soft-fuse)

Note

Disabling ReadBack does not disable the controller readback diagnostic. ReadBack should be enabled if Shutdown_Channel = TRUE.

As listed above, there are two possibilities for an output channel to fail off. One way is when the hard fuse blows (it is not field replaceable); the other is when the soft-fuse trips (it is locally or remotely resettable). The soft-fuse trip error cannot be disabled by the softlist.

ProtectedOutput: Each output can be configured to turn off all CDM or SDM+ outputs in the event that a channel is intended to be off but diagnostics have determined that it is on. You may want to configure an output as ProtectedOutput if it is critical to the process, or if it presents a possible hazard to personnel or equipment.

Shutdown_Channel: When the Shutdown_Channel parameter is set to TRUE, a shutdown error (class 4, SSC 37, EC 31) is reported in addition to a class 2 or class 3 channel error that affects channel quality (when BAD or QUESTIONABLE quality is set). When this parameter is FALSE, the shutdown error is not reported. Based on the default configuration supplied with QUADLOG, a class 4 error causes all outputs to shut down to their de-energized state (i.e. 0 volts or 0 mA). The configuration can be changed to only shut down the affected outputs or not to shut down at all. Only channels that are critical to the process should be configured as shutdown_channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur. Refer to the section titled Shutdown Logic.

Enabling this parameter also enables the controller readback diagnostic. This diagnostic compares the output value sent by the controller to the value "read back" by the CDM or SDM+.

7.11 QUADLOG Voltage Input Module (VIM)

The Voltage Input Module (VIM) interfaces thermocouple and voltage input signals to a control module's IOBUS. It provides 16 channels, each of which can be configured to be a thermocouple or voltage input. The VIM can accommodate many input types with minimal configuration and high accuracy. Each input is electrically isolated from the module's CPU, IOBUS, and ground to isolate field faults. In addition, each channel is isolated from other channels.

QUADLOG VIM Module Scope Parameters

The table below lists the Module Scope softlist parameters for the VIM. To view/edit the module scope parameters, place the cursor on the desired module in the module tree and select the Edit, Object/Item menu item. The Hardware Modules dialog box opens. Choose the Softlist command button to open the Module Scope Softlist dialog box.

PARAMETER	SELECTION	DEFAULT
ScanRate	Not Applicable (hidden in HW Config)	Not Applicable
LineFreq	50 Hz, 60 Hz	60 Hz
SharedTC	Yes, No	Yes

ScanRate (hidden in HW Config)**:** This is a read-only parameter that displays the current scan rate of the module. Generally, the scan rate will be the same as the scan rate of the control module, but can be a multiple of the control module's scan rate.

LineFreq: The module software utilizes a notch filter to reduce noise from AC power sources. Specifying the line frequency of AC power will optimize the filtering algorithm.

SharedTC: This parameter only applies when using VIMs in a redundant system. Often, one thermocouple is wired to both the calculate (primary) and standby (backup) VIMs. If this is the wiring arrangement for the VIMs being configured, set SharedTC to Yes. If each VIM has its own thermocouples, set SharedTC to No. For non-redundant VIMs, set SharedTC to No (default).

QUADLOG VIM Channel Types

The channel types supported for the VIM are listed here. In a DP/IO Bus Link environment, configuration information in this document supersedes information in the section titled "Configuring I/O Channels" in the document *Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher* (CG39-20)..

- VIM TIC - Thermocouple Input (TIC)
- VIM VIC - Voltage Input Thermocouple Input (VIC)

7.11.1 QUADLOG VIM Thermocouple Input (TIC)

The Thermocouple Input channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

Note

Selecting a thermocouple type does not automatically adjust the default **MinRange** and **MaxRange** to values appropriate for that type. If your thermocouple is other than Type J, ensure that **MinRange** and **MaxRange** settings are set properly. See the description of **TCType** below for a list of supported thermocouple types.

PARAMETER	SELECTION	DEFAULT
TCType	B, E, J, K, N1, R, S, T, N2	J
EngUnits	DegF, DegC, DegK, DegR	DegC
StepResponseTime	0.100 to 2.000 Seconds	1.0
Bias	Any REAL number	0.0
MinRange	Any REAL number	Min. range of TC type selected. (on-line) -1000.0 (off-line)
MaxRange	Any REAL number	Max. range of TC type selected. (on-line) +5000.0 (off-line)
Scale_To_Percent	Boolean	FALSE
Burnout	Disable, Up, Down	Disable
DigFiltTimeCnst	0.0 to 159.0 sec.	0.016

TCType: The types of thermocouple must be specified from the list of selections. Temperatures are given in Degrees C.

J_MIN_TEMP -210.0f
J_MAX_TEMP 1200.0f

K_MIN_TEMP -270.0f
K_MAX_TEMP 1372.0f

T_MIN_TEMP -270.0f
T_MAX_TEMP 400.0f

B_MIN_TEMP 42.0f
B_MAX_TEMP 1820.0f

S_MIN_TEMP -50.0f
S_MAX_TEMP 1767.0f

N1_MIN_TEMP 0.0f
N1_MAX_TEMP 1300.0f

N2_MIN_TEMP -270.0f
N2_MAX_TEMP 400.0f

E_MIN_TEMP -270.0f

E_MAX_TEMP 1000.0f

R_MIN_TEMP -50.0f
R_MAX_TEMP 1767.0f

EngUnits: You can select from the following engineering units: DegF, DegC, DegK, DegR.

StepResponseTime: This parameter determines the time for the channel to fully respond to a step input. A longer StepResponseTime will provide higher resolution and better repeatability of the signal.

Bias: A bias value can be entered to adjust for any known offset (usually due to thermocouple aging). The bias value can be any REAL number and will be added to the scaled thermocouple reading.

MinRange: MinRange is an optional parameter that allows you to specify a minimum operating value in EngUnits. If the reading drops below this value, an underrange error is reported. The MinRange can be any REAL number.

MaxRange: MaxRange is an optional parameter that allows you to specify a maximum operating value in EngUnits. If the reading goes above this value, an overrange error is reported. The MaxRange can be any REAL number.

Scale_To_Percent: This is a Boolean softlist parameter whose default value is FALSE.

Burnout: You can specify burnout detection or open circuit detection for a thermocouple:

Disable = No burnout or open circuit detection
Up = Return max operating value for TCType selected
Down = Return min operating value for TCType selected

DigFiltTimeCnst: Digital filtering can be applied to thermocouple input signals to reduce the effects of electrical noise. The digital filter is a first order lag, adjustable for time constants of 0.0159 to 159.0 seconds. Equivalent breakpoint frequencies are 10.0 to 0.001 Hz. The default value can be increased for noisy signals.

7.11.2 QUADLOG Voltage Input (VIC)

The Voltage Input channel type returns a REAL variable. The table below shows the softlist parameters for this channel type.

EngUnits (engineering units) is an optional parameter (no engineering units is an acceptable choice)

PARAMETER	SELECTION	DEFAULT
InputRange	VDC1to5, VDC0to5, VDCNeg10to10, VDCNeg5to5, VDCNeg1to1, Custom	VDC1to5
Custom_Range_Low	-10 to 10	0
Custom_Range_High	-10 to 10	0
MinScale	Any REAL number	0.0
MaxScale	Any REAL number	100.0

PARAMETER	SELECTION	DEFAULT
EngUnits	ACFH, ACFM, AMPS, ATM, bar, BARG, bbl, bhp, BPD, bph, Btu, Btu/hr, Btu/lbm, Btu/SCF, cal, cal/hr, cal/lbm, cal/SCF, cm, cps, days, deg, degC, degF, degK, degR, ft, ft/sec, ft/sec2, ft3, ft3/lb, g, g/cm3, gal, gal/day, gal/hr, gal/min, GPD, GPH, GPM, hp, hr, Hz, in, in3, InH2O, InHg, joules, kcal, kcal/hr, kcal/lbm, kcal/SCF, kg, kg/cm2, kg/day, kg/hr, kg/m3, kPa, kPaa, kPag, KPPH, kVA, kW, 1/day, 1/hr, 1/min, lb, lb/ft3, lb/hr, liter, m, m/sec, m/sec2, m3, m3/day, m3/hr, m3/kg, mA, mbar, MBRA, MBRG, MCFH, mhos, mil, min, ml, Mlb/hr, mm, mmHg, mol, mol/m3, ms, mS/cm, mV, MW, NM3/H, Ohms, Percent, PCT_LVL, pH, PPH, ppm, psi, psia, psig, pulses, rad, rpm, S/cm, SCCM, SCFH, SCFM, sec, t/day, ton, tonne, tonne/day, VA, vars, Volts, W, yd3/day, yd3/hr	Percent
StepResponseTime	0.050 to 2.000 sec.	1.0
DigFiltTimeCnst	0.0 to 159.0 sec.	0.016

InputRange: Voltage input channels are able to read any voltage between -10 and +10. The module utilizes auto-ranging circuitry to provide high resolution even at millivolt levels. For scaling and diagnostic purposes, the range of values being measured by the channel must be specified. Several standard ranges are selectable from a list, or, a custom range can be selected by specifying Custom for the InputRange and editing Custom_Range_Low and Custom_Range_High values.

Custom_Range_Low: An optional parameter that allows you to specify a minimum input range in volts. If the reading drops below this value, an underrange error is reported. This parameter is only used when InputRange is specified as Custom.

Custom_Range_High: An optional parameter that allows you to specify a maximum input range in volts. If the reading goes above this value, an underrange error is reported. This parameter is only used when InputRange is specified as Custom.

MinScale: The module will linearly scale raw data (volts) to engineering units for each channel. The scaling algorithm uses the MinScale/MaxScale parameter values that you set. For example, given a MinScale of 0.0, a MaxScale of 100.0, and an InputRange of 1-5 Volts, if the input to the channel is 3 Volts, the scaled value will be 50.0. MinScale can be any REAL number (REAL numbers are valid between -3.4028e38 and +3.4028e38).

MaxScale: MaxScale can be any REAL number.

EngUnits: Engineering units for the scaled value can be selected from a list of common engineering units.

DigFiltTimeCnst: This parameter sets the time constant of a low-pass digital filter applied to the input data. This filter reduces non-repetitive noise from the input data and can be disabled by setting this parameter to 0.0.

StepResponseTime: This parameter sets the length of a moving-average digital filter applied to the input data. It determines the time to fully respond to an input step. Increasing this parameter reduces periodic or repetitive noise and improves repeatability and resolution. The recommended setting for this parameter is between 0.5 and 4.0 seconds.

8 Function Blocks and Module Drivers

8.1 MOD_DRV

Function

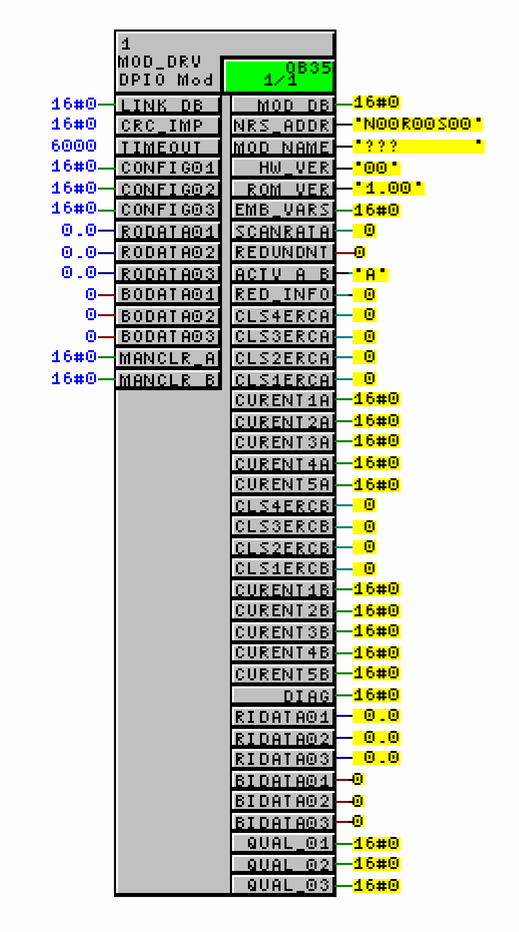
This block is used with the DP/IOBus Link module. This block processes the data for all channels of a non-Safety Critical QUADLOG I/O module connected via the DP-IOBus Link. The block provides the interface between the Link Driver block (DPIO_DRV) and channel driver blocks (A_CH_xx).

This block is a module driver and is classified as a system level function block. This means that the compiler automatically inserts this block when a DP/IO Bus Link module has been added to a system (provided that *Generate Module Drivers* is selected during CFC compiles). One MOD_DRV block is added per non-safety critical QUADLOG module pair (or single if non-redundant).

Note

The **MOD_DRV** block is a valuable tool for project engineering. There is useful information available from the MOD_DRV block for determining the current state of operation. For instance, if the output of DIAG is 0x10, there has been a timeout. This timeout could be could be a result of problems with communications between the S7-400 CPU and the DP/IO Bus Link or I/O module. Such communication problems could result from a poor connection or an improperly compiled project (perhaps HW Config does not match the CFC configuration)

CFC Block Diagram



Only the first three of CONFIGxx, RODATAxx, BODATAxx, RIDATAxx, BIDATAxx and QUAL_xx are visible by default; there are actually 32 of each group numbered 01 through 32.

Inputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
LINK_DB	DWORD	Interconnection to the link driver block's LINKDBxx output	Interconnected automatically
CRC_IMP	DWORD	Module configuration CRC	Supplied automatically
TIMEOUT	INT	Monitoring time (milliseconds) for link communications	6000 (6 seconds)
CONFIGxx	DWORD	Channel configuration info (channel type, etc.)	Supplied automatically
RODATAxx	REAL	Interconnection to Real Output channel's DATA output	Interconnected automatically
BODATAxx	BOOL	Interconnection to Discrete Output channel's DATA output	Interconnected automatically
EV_ID_A	DWORD	Event ID for Alarm_8, Side A messages	Supplied automatically
EV_ID_B	DWORD	Event ID for Alarm_8, Side B messages	Supplied automatically

Name	Data Type	Explanation	Default
EV_ID_C	DWORD	Event ID for Alarm_8p messages, communications failure	Supplied automatically
MSG_LOCK	BOOL	Enable Alarm Message Locking (1 = message locked)	False
PURGE_ER	BOOL	Purge Side A Error History Buffer	False
PURGE_EB	BOOL	Purge Side B Error History Buffer	False
MANCLRA	DWORD	Error to be cleared on side A	0
MANCLRB	DWORD	Error to be cleared on side BDWORD	0
AUX_PR05	ANY	Associated Value for Alarm_8p	0
AUX_PR06	ANY	Associated Value for Alarm_8p	0
AUX_PR07	ANY	Associated Value for Alarm_8p	0
AUX_PR08	ANY	Associated Value for Alarm_8p	0
AUX_PR09	ANY	Associated Value for Alarm_8p	0
AUX_PR10	ANY	Associated Value for Alarm_8p	0

Outputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
MOD_DB	DWORD	Interconnection to the link driver block's MOD_DBxx input	Interconnected automatically
NRS_ADDR	STRING	Address of Module (in NRS format)	'N00R00S00'
MOD_NAME	STRING	Module's Name (example: 'SAM', 'SDM', etc.)	'???'
HW_VER	STRING	Module's Hardware Revision	'00'
HW_VERB	STRING	Module's Hardware Revision (side B)	'00'
ROM_VER	STRING	Module's ROM Revision	'1.00'
ROM_VERB	STRING	Module's ROM Revision (side B)	'1.00'
EMB_VARS	WORD	Various state information (bit-significant status, see below)	0
EMB_VARB	WORD	Various state information (side B) (bit-significant status, see below)	0
PCT_SCAN	REAL	% of IOBus Scan Rate consumed	0.0
PCT_SCNB	REAL	% of IOBus Scan Rate consumed (side B)	0.0
SCANRATA	INT	Module's Effective Scan Rate (milliseconds)	0
SCANRATB	INT	Module's Effective Scan Rate, (side B) (milliseconds)	0
REDUNDANT	BOOL	True if Module is redundant (backup is available)	False
ACTV_A_B	STRING	Active IOBus side indicator (will be either 'A' or 'B')	'?'
RED_INFO	INT	System redundancy information (0=NonRedundant, 2=N:N)	0
CLS4ERCA	INT	Class 4 Error Count, side A	0
CLS3ERCA	INT	Class 3 Error Count, side A	0
CLS2ERCA	INT	Class 2 Error Count, side A	0
CLS1ERCA	INT	Class 1 Error Count, side A	0

Name	Data Type	Explanation	Default
CURENT1A	DWORD	Highest priority error, side A	0
CURENT2A	DWORD	2nd highest priority error, side A	0
CURENT3A	DWORD	3rd highest priority error, side A	0
CURENT4A	DWORD	4th highest priority error, side A	0
CURENT5A	DWORD	5th highest priority error, side A	0
CLS4ERCB	INT	Class 4 Error Count, side B	0
CLS3ERCB	INT	Class 3 Error Count, side B	0
CLS2ERCB	INT	Class 2 Error Count, side B	0
CLS1ERCB	INT	Class 1 Error Count, side B	0
CURENT1B	DWORD	Highest priority error, side B	0
CURENT2B	DWORD	2nd highest priority error, side B	0
CURENT3B	DWORD	3rd highest priority error, side B	0
CURENT4B	DWORD	4th highest priority error, side B	0
CURENT5B	DWORD	5th highest priority error, side B	0
DIAG	DWORD	Diagnostic error information (bit-significant status, see below)	0
RIDATAxx	REAL	Interconnection to Real Input channel driver's DATA input	Interconnected automatically
BIDATAxx	BOOL	Interconnection to Discrete Input channel driver's DATA input	Interconnected automatically
QUAL_xx	WORD	Interconnection to a channel driver's QUAL input	Interconnected automatically
ERHISACT	INT	Error History Buffer Entry Count, Side A	0
ERHISANX	INT	Error History Buffer Next Entry, Side A	0
ERHISAnn	STRING	Error History Buffer, Side A	''
ERHISBCT	INT	Error History Buffer Entry Count, Side B	0
ERHISBNX	INT	Error History Buffer Next Entry, Side B	0
ERHISBnn	STRING	Error History Buffer, Side B	''
AL_ERR_A	BOOL	Alarm_8 call error, Side A	False
AL_STA_A	WORD	Alarm_8 error info, Side A	0
AL_ACK_A	WORD	Alarm_8 status bits, Side A	0
AL_ERR_B	BOOL	Alarm_8 call error, Side B	False
AL_STA_B	WORD	Alarm_8 error info, Side B	0
AL_ACK_B	WORD	Alarm_8 status bits, Side B	0
AL_ERR_C	WORD	Alarm_8 call error, communications failure	False
AL_STA_C	WORD	Alarm_8 status bits, communications failure	0
AL_ACK_C	WORD	Alarm _8 status bits, communications failure	0
QMSG_SUP	BOOL	Message suppression active	False

Note

The ‘xx’ in CONFIGxx, RODATAxx, BODATAxx, RIDATAxx, BIDATAxx and QUAL_xx signifies one of a maximum of 32 channels available on a given APACS I/O Module, which are numbered 01 through 32 (the block actually provides 32 of each of these inputs/outputs). The ‘nn’ in the ERHISAnn and ERHISBnn represents one of a maximum of 100 Error History Buffer entries available on this module, which are numbered 00 through 99 (the block actually provides 100 of each of these outputs).

Addressing

The LADDR input will be assigned the starting address of the I/O Module’s memory footprint within the Process Image (PI).

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the module driver and the link driver block (DPIO_DRV). In this time, data exchanges with any connected channel driver blocks indicates bad quality.

After startup, the messages generated by this block are suppressed for the first 10 executions.

Error Handling

The function does not check the plausibility of input parameters.

Report Characteristics

The block has no reporting behavior.

Information in the EMB_VARS (side A) and EMB_VARB (side B) Outputs

Byte	Bit	Meaning
0	0	CONFIGURED: set when the module has received a valid configuration
	1	POWER SUPPLY A OK: set when module detects the presence of supply A
	2	POWER SUPPLY B OK: set when module detects the presence of supply B
	3	POWER SUPPLY C OK: set when module detects the presence of supply C
	4	IOBus REDUNDANCY: set when the IOBus is operating in redundant mode
	5	OVERTEMP: set when the module’s overtemperature sensor is active
	6	QUADLOG: set when the module is a QUADLOG module
	7	Reserved
1	Reserved	

Information in the DIAG Output

Byte	Bit	Meaning

Byte	Bit	Meaning
0	0	Reserved
	1	ISA (Input Scan Active): set during the transfer of input process values
	2	OSA (Output Scan Active): set during the transfer of output process values
	3	PLCSIM: set when running on PLCSIM instead of a CPU
	4	TIMEOUT: set when communications failure exceeds TIMEOUT parameter
	5	NotForMe: set when block has received data for an entity not in is configuration
	6	CRC Error: set when block receives data failing the CRC check
	7	SeqNumErr: set when block receives data failing the Sequence Number check
1	Reserved	
2	Reserved	
3	Reserved	

Information in the CURENTnx Outputs (n=1-5,x=A/B)

Byte 0 Scope or Channel	Bits	Meaning
Scope information	7-6	Scope Type
		00 = System Scope
		01 = Channel Type
		10 = Group Scope
		11 = Module Scope
	5-0	Group Number if Group Scope (otherwise reserved)
Channel Information	7-0	Channel number

Byte 1 Error Code and Status	Bits	Meaning
	7-2	Error Code
	1	Manual Clear
		0 = Manual Clear Allowed
		1 = Manual Clear Disallowed
	0	Scope or Channel
		0 = Scope or Channel (byte 0) contains Scope Information
		1 = Scope or Channel (byte 0) contains Channel Information

Byte 2 System Service Code	Bits	Meaning
	7-0	System Service Code

Byte 3 Class and Action	Bits	Meaning
	7-6	Class
		00 =Class 1 (lowest priority)
		01 = Class 2

Byte 3 Class and Action	Bits	Meaning
		10 = Class 3
		11 + Class 4 (highest priority)
	5-0	User Action Code

Message Response

The MOD_DRV block uses the ALARM_8 and ALARM_8P blocks to generate messages.

The following message triggers exist:

- Non-zero class 1, 2, 3, or 4 error counts
- Communications failure

Process control messages can be completely blocked with MSG_LOCK.

QMSG_SUP is set if the 10 seconds since restart have not yet elapsed or MSG_LOCK = TRUE or AL_STA_x = 21.

Assignment of Message Text and Message Class to the Block Parameters

Message Number	Block Parameter	Default Message Text	Message Class	Can Be Suppressed By
1	CLS1ERCx	Class 1 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
2	CLS2ERCx	Class 2 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
3	CLS3ERCx	Class 3 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
4	CLS4ERCx	Class 4 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
5	TimedOut OR NotForMe OR CRCerror OR SegNumErr	Communications Failure $$BlockComment$$ @1W%04x@	PLC Process Control Message - Failure	MSG_LOCK

Assignment of Associated Values to the Block Parameters

Associated Value:	Block Parameter:
1	TimedOut
2	NotForMe
3	CRCError
4	SeqNumErr
5	AUX_PR05

Associated Value:	Block Parameter:
6	AUX_PR06
7	AUX_PR07
8	AUX_PR08
9	AUX_PR09
10	AUX_PR10

See Also

Notes on Using the DP-IOBus Link

8.2 DPIO_DRV

Function

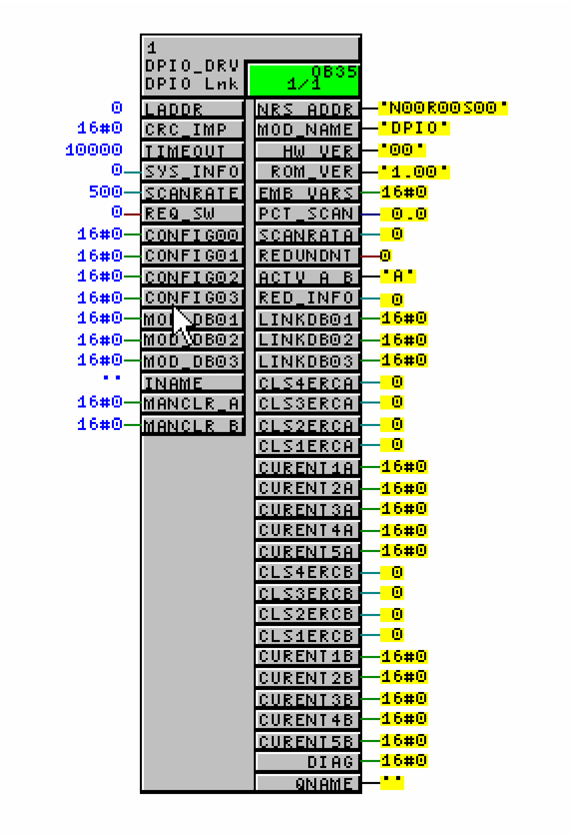
This block communicates with the DP-IOBus Link. This block implements the CPU-side communications protocol and transfers data between the DP-IOBus Link Module and the one or more module driver blocks (MOD_DRV or F_Q_MOD).

This block is a module driver and is classified as a system level function block. This means that the compiler automatically inserts this block when a DP/IO Bus Link module has been added to a system (provided that *Generate Module Drivers* is selected during CFC compiles). One DPIO_DRV block is added per DP/IO Bus Link module pair (or single if non-redundant).

Note

The **DPIO_DRV** block is a useful tool for project engineering. There is useful information available from the DPIO_DRV block for determining the current state of operation. For instance, if the output of DIAG is 0x10, there has been a timeout. This timeout could be could be a result of problems with communications between the S7-400 CPU and the DP/IO Bus Link module. Such communication problems could result from a poor connection or an improperly compiled project (perhaps HW Config does not match the CFC configuration).

CFC Block Diagram



Only the first three of CONFIGxx, MOD_DBxx and LINKDBxx are visible by default; there are actually 28 of each group numbered 01 through 28.

Inputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
LADDR	INT	Logical address of DP-IOBus Link (process image starting address)	Supplied automatically
CRC_IMP	DWORD	DP-IOBus configuration CRC	Supplied automatically
TIMEOUT	DINT	Monitoring time (milliseconds) for link communications	10000 (10 seconds)
SYS_INFO	INT	System configuration information (0=NonRedundant,2=N:N)	Supplied automatically
SCANRATE	INT	DP-IOBus Link module's IOBus Scan rate (milliseconds)	Supplied automatically
REQ_SW	BOOL	Request IOBus switchover (on False to True transition)	False
CONFIGxx	DWORD	(module type, address, etc.)	Supplied automatically
QLG_DB	DWORD	Interconnection from F_Q_CTRL block's CTRL_DB output	Interconnected automatically
MOD_DBxx	DWORD	Interconnection from MOD_DRV or F_Q_MOD block's MOD_DB output	Interconnected automatically

Name	Data Type	Explanation	Default
EV_ID_A	DWORD	Event ID for Alarm_8 messages, Side A error counts	Supplied automatically
EV_ID_B	DWORD	Event ID for Alarm_8 messages, Side B error counts	Supplied automatically
EV_ID_B	DWORD	Event ID for Alarm_8p messages, Communications failure	Supplied automatically
MSG_LOCK	BOOL	Enable Alarm Messaging Locking (1=messages locked)	False
INAME	STRING	Full path name to attached (if any) F_Q_CTRL block	‘’
PURGE_ER	BOOL	Purge Side A Error History Buffer	False
PURGE_EB	BOOL	Purge Side B Error History Buffer	False
MANCLRA	DWORD	Error to be cleared on side A	0
MANCLRB	DWORD	Error to be cleared on side B	0
AUX_PR05	ANY	Associated Value for Alarm_8p	0
AUX_PR06	ANY	Associated Value for Alarm_8p	0
AUX_PR07	ANY	Associated Value for Alarm_8p	0
AUX_PR08	ANY	Associated Value for Alarm_8p	0
AUX_PR09	ANY	Associated Value for Alarm_8p	0
AUX_PR10	ANY	Associated Value for Alarm_8p	0

Outputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
NRS_ADDR	STRING	Address of DP-IOBus Link Module (in NRS format)	‘N00R00S00’
MOD_NAME	STRING	Module’s Name	‘DPIO’
HW_VER	STRING	Module’s Hardware Revision	‘00’
HW_VERB	STRING	Module’s Hardware Revision (side B)	‘00’
ROM_VER	STRING	Module’s ROM Revision	‘1.00’
ROM_VERB	STRING	Module’s ROM Revision (side B)	‘1.00’
EMB_VARS	WORD	Various state information (bit-significant status, see below)	0
EMB_VARB	WORD	Various state information (side B) (bit-significant status, see below)	0
PCT_SCAN	REAL	% of IOBus Scan Rate consumed	0.0
PCT_SCNB	REAL	% of IOBus Scan Rate consumed (side B)	0.0
SCANRATA	INT	IOBus Scan rate (milliseconds). Actual scan rate.	0
SCANRATB	INT	IOBus Scan rate (milliseconds). Actual scan rate.	0
REDUNDANT	BOOL	True if DP-IO Link is redundant (backup is available	False
ACTV_A_B	STRING	Active IOBus side indicator (will be either ‘A’ or ‘B’)	‘?’
RED_INFO	INT	System redundancy information (copy of SYS_INFO input)	0
CRC_DISA	DWORD	CRC Checking Disabled (when equal to 16#21435243)	0

Name	Data Type	Explanation	Default
LINKDB00	DWORD	Interconnection to F_Q_CTRL block's LINK_DB input	Interconnected automatically
LINKDBxx	DWORD	Interconnection to MOD_DRV or F_Q_MOD block's LINK_DBxx input	Interconnected automatically
CLS4ERCA	INT	Class 4 Error Count, side A	0
CLS3ERCA	INT	Class 3 Error Count, side A	0
CLS2ERCA	INT	Class 2 Error Count, side A	0
CLS1ERCA	INT	Class 1 Error Count, side A	0
CURENT1A	DWORD	Highest priority error, side A	0
CURENT2A	DWORD	2^{nd} highest priority error, side A	0
CURENT3A	DWORD	3^{rd} highest priority error, side A	0
CURENT4A	DWORD	4^{th} highest priority error, side A	0
CURENT5A	DWORD	5^{th} highest priority error, side A	0
CLS4ERCB	INT	Class 4 Error Count, side B	0
CLS3ERCB	INT	Class 3 Error Count, side B	0
CLS2ERCB	INT	Class 2 Error Count, side B	0
CLS1ERCB	INT	Class 1 Error Count, side B	0
CURENT1B	DWORD	Highest priority error, side B	0
CURENT2B	DWORD	2^{nd} highest priority error, side B	0
CURENT3B	DWORD	3^{rd} highest priority error, side B	0
CURENT4B	DWORD	4^{th} highest priority error, side B	0
CURENT5B	DWORD	5^{th} highest priority error, side B	0
DIAG	DWORD	Diagnostic error information (bit-significant status, see below)	
ERHISACT	INT	Error History Buffer Entry Count, Side A	0
ERHISANX	INT	Error History Buffer Next Entry, Side A	0
ERHISAnn	STRING	Error History Buffer, Side A	‘’
ERHISBCT	INT	Error History Buffer Entry Count, Side B	0
ERHISBNX	INT	Error History Buffer Next Entry, Side B	0
ERHISBnn	STRING	Error History Buffer, Side B	‘’
AL_ERR_A	BOOL	Alarm_8 call error, Side A	False
AL_STA_A	WORD	Alarm_8 error info, Side A	0
AL_ACK_A	WORD	Alarm_8 status bits, Side A	0
AL_ERR_B	BOOL	Alarm_8 call error, Side B	False
AL_STA_B	WORD	Alarm_8 error info, Side B	0
AL_ERR_C	WORD	Alarm_8 call error, communications failure	
AL_STA_C	WORD	Alarm_8 error info, communications failure	0
AL_ACK_C	WORD	Alarm,_8 status bits, communications failure	0
QMSG_SUP	BOOL	Message Suppression Active	False
QNAME	STRING	Copy of INAME	`'

Note

The ‘xx’ in CONFIGxx, MOD_DBxx and LINKDBxx signifies one of a maximum of 28 modules available on a given DP-IOBus Link, which are numbered 01 through 28 (the block actually provides 28 of each of these inputs/outputs). The ‘nn’ in the ERHISAnn and ERHISBnn represents one of a maximum of 100 Error History Buffer entries available on this module, which are numbered 00 through 99 (the block actually provides 100 of each of these outputs)

Addressing

The LADDR input will be assigned the starting address of the DP-IOBus Link Module’s memory footprint within the Process Image (PI).

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the link driver and the DP-IOBus Link Module. In this time, data exchanges with any connected module driver blocks (MOD_DRV or F_Q_MOD) will indicate bad quality.

After startup, the messages generated by this block are suppressed for the first 100 executions.

Error Handling

The function does not check the plausibility of input parameters.

Report Characteristics

The block has no reporting behavior.

Information in the EMB_VARS (side A) and EMB_VARB (side B) Outputs

Byte	Bit	Meaning
0	0	CONFIGURED: set when the module has received a valid configuration
	1	POWER SUPPLY A OK: set when module detects the presence of supply A
	2	POWER SUPPLY B OK: set when module detects the presence of supply B
	3	POWER SUPPLY C OK: set when module detects the presence of supply C
	4	IOBus REDUNDANCY: set when the IOBus is operating in redundant mode
	5	OVERTEMP: set when the module’s overtemperature sensor is active
	6	QUADLOG: set when the module is a QUADLOG module
	7	Reserved
1	0	DP COMM OK: set when DP/IOBus Link Module declares its DP Communications as Healthy
	1	DP MASTER: set when DP/IOBus Link Module declares its DP Communications as the DP Master
	2	IOBus COMM OK: set when DP/IOBus Link Module declares its IOBus Communications as Healthy

Byte	Bit	Meaning
	3	IOBus MASTER: set when DP/IOBus Link Module declares its IOBus Communications as the IOBus Master
	4-7	Reserved

Information in the DIAG Output

Byte	Bit	Meaning
0	0	EOS (End Of Scan): set for one cycle upon completion of each total I/O scan
	1	ISA (Input Scan Active): set during the transfer of input process values
	2	OSA (Output Scan Active): set during the transfer of output process values
	3	PLCSIM: set when running on PLCSIM instead of a CPU
	4	TIMEOUT: set when communications failure exceeds TIMEOUT parameter
	5	NotForMe: set when block has received data for an entity not in is configuration
	6	CRC Error: set when block receives message with CRC not equal to CRC_IMP input
	7	Reserved
1	Reserved	
2	Reserved	
3	Reserved	

Information in the CURENTnx Outputs (n=1-5,x=A/B)

Byte 0 Scope or Channel	Bits	Meaning
Scope information	7-6	Scope Type
		00 = System Scope
		01 = Channel Type
		10 = Group Scope
		11 = Module Scope
	5-0	Group Number if Group Scope (otherwise reserved)
Channel Information	7-0	Channel number

Byte 1 Error Code and Status	Bits	Meaning
	7-2	Error Code
	1	Manual Clear
		0 = Manual Clear Allowed
		1 = Manual Clear Disallowed
	0	Scope or Channel
		0 = Scope or Channel (byte 0) contains Scope Information
		1 = Scope or Channel (byte 0) contains Channel Information

Byte 2 System Service Code	Bits	Meaning

Byte 2 System Service Code	Bits	Meaning
	7-0	System Service Code

Byte 3 Class and Action	Bits	Meaning
	7-6	Class
		00 =Class 1 (lowest priority)
		01 = Class 2
		10 = Class 3
		11 + Class 4 (highest priority)
	5-0	User Action Code

Message response

The DPIO_DRV block uses the ALARM_8 and ALARM_8P blocks to generate messages.

The following message triggers exist:

- Non-zero class 1, 2, 3, or 4 error counts
- Communications failure

Process control messages can be completely blocked with MSG_LOCK.

QMSG_SUP is set if the 10 seconds since restart have not yet elapsed or MSG_LOCK = TRUE or AL_STA_x = 21.

Assignment of Message Text and Message Class to the Block Parameters

Message Number	**Block Parameter**	**Default Message Text**	**Message Class**	**Can Be Suppressed By**
1	CLS1ERCx	Class 1 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
2	CLS2ERCx	Class 2 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
3	CLS3ERCx	Class 3 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
4	CLS4ERCx	Class 4 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
5	TimedOut OR NotForMe OR CRCerror	Communications Failure $$BlockComment$$ @1W%04X@	PLC Process Control Message - Failure	MSG_LOCK

Block Parameters

The first four of the associated values of the message block are assigned to block parameters and the remaining ones (AUX_PRx) can be freely assigned by the user.

Associated Value:	**Block Parameter:**
1	TimedOut
2	NotForMe
3	CRCError
4	0
5	AUX_PR05
6	AUX_PR06
7	AUX_PR07
8	AUX_PR08
9	AUX_PR09
10	AUX_PR10

See Also

Notes on Using the DP/IO Bus Link

8.3 PARAM_RW

Function

This block has been designed for use with the DP/IOBus Link. It can either read or write a channel's softlist parameter for a particular I/O Module. The I/O Module is selected by its logical address (LADDR) and the data transfer direction identified by the state of the R_W input. A transaction is started via false-to-true transition of the REQ input and is completed when either the DONE or ERROR outputs become true. Multiple invocations of the PARAM_RW function block may be necessary to complete a transaction, during which the BUSY output will be true (any changes of the function block's inputs while BUSY is true are ignored).

The type of data to be transferred (and the corresponding input or output containing the data) is determined by the SEL_DAT input. For example, if SEL_DAT=2 and R_W=True, the value on the O_DAT_DW input is written to the softlist parameter. Likewise, if SEL_DAT=3 and R_W=False, the softlist parameter is read and its value placed on the I_DAT_R. Refer to the I/O Module's documentation to be sure the proper data type is selected for the intended softlist parameter. See the section titled Specifying Softlist Parameters with the PARM_RW Block for lists of software parameters and their values.

Changing a Channel's Softlist Parameters with PARAM_RW

The PARAM_RW function block works only with a DP/IO Bus Link module in a non-redundant system or, in a redundant system, with the DP/IO Bus Link module that is currently in control (the DP slave master, whose **DP** LED is steady green).

Warning

Changing parameters of an online safety system is discouraged and should be avoided. While it is possible to change parameters while online, the effects on the entire system can be unpredictable.

The purpose of this block is to provide a method of changing and determining parameters of a system during the design phase through the commissioning phase. To avoid an unanticipated shutdown of the DP/IO Bus Link and its configured I/O modules, carefully record changes that are made while using the block. Following the procedures below can help reduce the likelihood that an unanticipated shutdown could occur.

The PARAM_RW block only writes to one side of a redundant system, the side with the DP slave master. This is the side with the DP/IO Bus Link module **DP** LED in steady green. The side with the DP slave standby does not receive the parameter change. It is important to avoid changing the parameters of a DP/IO Bus Link Module and its I/O modules while the DP/IO Bus Link module is active and running in a system that is out of service.

In a redundant system Siemens recommends removing the DP/IO Bus Link module serving as the IOBus standby (**ACTIVE** LED off) on its DP/IO Bus Link module. Removing the IOBus standby prevents a switchover to a redundant partner that may not have a newly written parameter and that may thus be subject to an unanticipated condition.

The following procedure should be reserved for testing parameter changes in systems that are out-of-service.

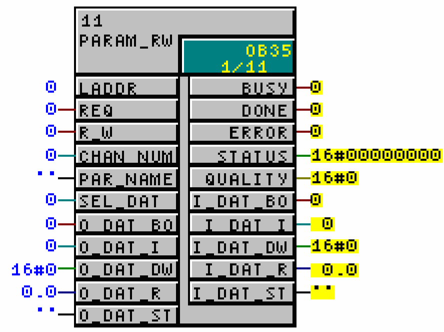
1. Turn off Safety Mode.
2. Remove the DP/IO Bus Link module that is the IOBus Standby module (**ACTIVE** LED off).
3. Use the PARAM_RW block to determine the current online value of the parameter to be changed. Record this value.
4. Use the PARAM_RW block to change the parameter while online to the new value.
5. Use the PARAM_RW block to read and confirm the value of the parameter just changed (some parameters have a limited acceptable range of values and out-of-range values may be replaced during the write operation).
6. Observe system operation and confirm intended results (repeating the previous step as necessary).
7. Use the PARAM_RW block to restore the changed parameter to its original value.
8. Install the DP/IO Bus Link Module removed in step 2, above.
9. Turn on Safety Mode.
10. Use the HW Config program to edit the desired value into the offline configuration.
11. Compile and download the changes.

Quality Codes

For a parameter successfully read and made available at the output I_DAT_x, a value status (quality code) is presented at the output QUALITY that can take on the following states:

State	Quality Code	QUADLOG Definition
Valid value	16#80	good
Simulation value	16#44	unavailable
Not Accurate	16#50	questionable
Invalid Value	16#00	bad

CFC Block Diagram



Determining LADDR

To determine the LADDR for a module:

1. Open the HW Config program.
2. Select and right-click the module of interest.
3. Select **Object Properties** > **Addresses**.
4. Determine the starting addresses for both the inputs and outputs, which are identical. The starting address is the LADDR.

Inputs

Name	Data Type	Explanation	Default
LADDR	INT	Logical address of I/O Module (starting address in HW Config)	0
REQ	BOOL	Request transaction start (on False to True transition)	False
R_W	BOOL	Transfer direction (false = read, true = write)	False
CHAN_NUM	INT	Channel Number (valid range: 1-32)	0
PAR_NAME	STRING	Parameter Name (example: 'MaxScale')	“”
SEL_DAT	INT	Select Data Type (valid range: 0-4) for transfer	0
O_DAT_BO	BOOL	Output Data, Boolean value (written when SEL_DAT=0)	False
O_DAT_I	INT	Output Data, INT value (written when SEL_DAT=1)	0

Name	Data Type	Explanation	Default
O_DAT_DW	DWORD	Output Data, DWORD value (written when SEL_DAT=2)	DW#16#0
O_DAT_R	REAL	Output Data, REAL value (written when SEL_DAT=3)	0.0
O_DAT_ST	STRING	Output Data, STRING value (written when SEL_DAT=4)	“”

Outputs

Name	Data Type	Explanation	Default
BUSY	BOOL	Transaction in process when true	False
DONE	BOOL	Transaction successful when true	False
ERROR	BOOL	Transaction failed when true	False
STATUS	DWORD	Error status (non-zero when ERROR is true)	DW#16#0
QUALITY	BYTE	Value status (quality code) of parameter upon successful read	0
I_DAT_BO	BOOL	Input Data, Boolean value (read when SEL_DAT=0)	False
I_DAT_I	INT	Input Data, INT value (read when SEL_DAT=1)	0
I_DAT_DW	DWORD	Input Data, DWORD value (read when SEL_DAT=2)	DW#16#0
I_DAT_R	REAL	Input Data, REAL value (read when SEL_DAT=3)	0.0
I_DAT_ST	STRING	Input Data, STRING value (read when SEL_DAT=4)	“”

Addressing

You must assign the starting address of the I/O Module within the Process Image to the LADDR input.

Normal Operation

A transaction is started when the REQ input transitions from False to True. The BUSY output will be set True (and the DONE, ERROR and STATUS outputs zeroed) until the transaction completes. If the transaction is successful, the DONE output is set True. If the transaction is unsuccessful, the ERROR output is set True and the STATUS output updated to indicate the failure.

Error Handling

The STATUS output is comprised of a 16-bit error code (least significant 16 bits) and several single-bit flags. The error code word is the same as that returned via RDREC (SFB52) or WRREC (SFC 53) if the failure is caused by a failure of those functions (which are used by this block).

Failure	STATUS
RDREC or WRREC failure	DW#16#0000xxxx
Transaction failure	DW#16#00010000
Invalid PAR_NAME input	DW#16#00020000
Invalid CHAN_NUM input	DW#16#00040000
Invalid SEL_DAT input	DW#16#00080000
PLCSIM detected (not necessarily a failure, just informational)	DW#16#80000000

Note that a STATUS output value of DW#16#00020000 (invalid PAR_NAME INPUT) indicates that the PAR_NAME input was invalid (or NULL) when the block's REQ input went true. A valid (non-NULL) yet unfound PAR_NAME input value results in a STATUS output value of DW#16#000080B4. This can happen when parameter names are misspelled, Names are case-sensitive (MaxScale is different from Maxscale).

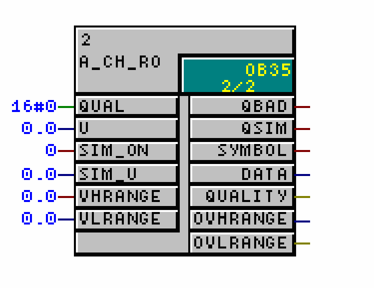
8.4 A_CH_RO

Function

This block has been designed for use with the DP-IOBus Link. This block makes the process value at the input U available for the analog output channel of a non-safety critical QUADLOG I/O module whose symbolic name is linked to the input SYMBOL from the associated module. The module driver (MOD_DRV) writes the process value (REAL) to the channel of the analog output module (or possibly a module that is redundant to this one). The connection to the associated module driver is automatically established by means of the interconnection at the output DATA and input QUAL. If the channel quality indicates an error has occurred, the substitute value 0 is made available at the output DATA instead of the process value from the input U. Alternatively, a simulation value (SIM_U) can be made available at the output DATA. For the process value being output to the module, a value status (quality code) is generated at the output QUALITY that can take on the following states:

State	Quality Code
Invalid value	16#00
Valid value	16#80
Simulation value	16#60
Not Accurate	16#50
High range limited	16#56
Low range limited	16#55

CFC Block Diagram



Inputs (names in bold are visible by default)

Name	Data Type	Explanation	Default

Name	Data Type	Explanation	Default
QUAL	WORD	Interconnection to the module driver for the channel's status	Interconnected automatically
U	REAL	Process Value	0.0
SIM_ON	BOOL	1 = activate simulation value 0 = deactivate simulation value	0
SIM_U	REAL	Simulation value	0.0
UHRANGE	REAL	High limit of process value	Interconnected automatically
ULRANGE	REAL	Low limit of process value	Interconnected automatically

Outputs (names in bold are visible by default)

Name	Data Type	Explanation	Default
QCHF_HL	F-BOOL	1 = process value high limit failure	0
QCHF_LL	F-BOOL	1 = process value low limit failure	0
QBAD	BOOL	1 = process value invalid, value substitution active	0
QSIM	BOOL	1 = simulation active	0
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	0
DATA	REAL	Interconnection to the module driver for the channel's data	Interconnected automatically
QUALITY	BYTE	Value status (quality code) of the process value	0
OUHRANGE	REAL	High limit of process value (copy)	0.0
OULRANGE	REAL	Low limit of process value (copy)	0.0

Addressing

You must assign the symbol of the corresponding analog output channel to the input SYMBOL of the channel driver.

Normal Value

The analog process value (REAL) at the input U is made available to the specified channel of the associated module and a quality code of 16#80 is made available at the output QUALITY. The channel will linearly scale the process value to the channel's output range using the ULRANGE/UHRANGE configuration parameters set by the user. For example, given a ULRANGE of 0.0, a UHRANGE of 100.0, and an output range of 4-20 mA, if the process value written is 50.0, the scaled output will be 12 mA. The value at the input U is limited between the values for the ULRANGE and UHRANGE inputs before being sent to the channel. The outputs QCHF_HL and QCHF_LL also provide information on whether output value limits have been set.. To allow the interconnection of the ULRANGE and UHRANGE settings to other block parameters, these are written to the outputs OULRANGE and OUHRANGE.

Simulation Value

A simulation value can be output to the module instead of the normal value read from the input U (e.g. for hardware testing). When the input parameter SIM_ON is true, the value of the input parameter SIM_U is made available to the module, a quality code of 16#60 is made available at the output QUALITY, the output QSIM set true and the output QBAD set false. In the event of an error, the output of the simulation value takes precedence over the output of the substitute value.

Substitute Value

A substitution value can be made available to the module if an error has occurred. The substitute value 0 is made available at the output DATA, a quality code of 16#48 is made available at the output QUALITY and the output QBAD set true.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the module driver and the discrete output module. In this time, the substitute value 0 is made available at the output DATA, a quality code of 16#48 is made available at the output QUALITY and the output QBAD set false.

Error Handling

The function does not check the plausibility of input parameters.

Report Characteristics

The block has no reporting behavior.

See Also

Notes on Using Driver Blocks

8.5 A_CH_RI

Function

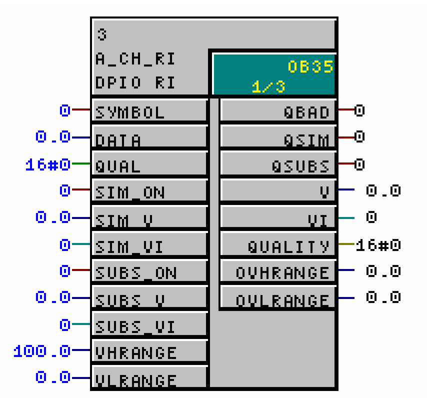
This block has been designed for use with the DP-IOBus Link. This block reads the real value of the analog input channel of a non-safety critical QUADLOG I/O module whose symbolic name is linked to the input SYMBOL from the associated module. The module driver (MOD_DRV) has read the channel value from the analog input module (or possibly a module that is redundant to this one). The connection to the associated module driver is automatically established by means of the interconnection at the inputs DATA and QUAL. If the real value is valid, it is made available at the output V. If the real value is invalid, either that last valid value or the substitute value (SUBS_V) is made available at the output V, depending on the value of the SUBS_ON input. Alternatively, a simulation value (SIM_V) can be made available at the output V if the value of the SIM_ON input is true.

For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

For the process value made available at the output V, a value status (quality code) is generated at the output QUALITY that can take on the following states:

State	Quality Code
Valid value	16#80
Last valid value	16#44
Simulation value	16#60
Substitute value	16#48
Not accurate	16#50
Invalid value	16#00

CFC Block Diagram



Inputs

Name	Data Type	Explanation	Default
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	0
DATA	REAL	Interconnection to the module driver for the channel's data	Interconnected automatically
QUAL	WORD	Interconnection to the module driver for the channel's status	Interconnected automatically
SIM_ON	BOOL	1 = activate simulation value 0 = deactivate simulation value	0
SIM_V	REAL	Simulation value	0.0
SIM_VI	DINT	Simulation value for VI output	0
SUBS_ON	BOOL	1 = enable failure substitution 0 = disable failure substitution	0
SUBS_V	REAL	Failure substitution value	0.0
SUBS_VI	DINT	Substitution value for VI output	0

Name	Data Type	Explanation	Default
VHRANGE	REAL	High limit of process value	Interconnected automatically
VLRANGE	REAL	Low limit of process value	Interconnected automatically

Outputs

Name	Data Type	Explanation	Default
QBAD	BOOL	1 = process value invalid	0
QSIM	BOOL	1 = simulation active	0
QSIM	BOOL	1 = simulation active	0
QSUBS	BOOL	1 = substitution active	0
V	REAL	Process Value	0.0
VI	DINT	Process Value, (binary copy of V)	0
QUALITY	BYTE	Value status (quality code) of the process value	0
OVHRANGE	REAL	High limit of process value (copy)	0.0
OVLRANGE	REAL	Low limit of process value(copy)	0.0

Addressing

You must assign the symbol of the corresponding analog input channel to the input SYMBOL of the channel driver.

Normal Value

The specified channel's analog process value (REAL) from the associated module is made available at the output V and a quality code of 16#80 is made available at the output QUALITY. The channel will linearly scale raw data to the process value using the VLRANGE/VHRANGE configuration parameters set by the user and the channel's input range. For example, given a VLRANGE of 0.0, a VHRANGE of 100.0, and an input range of 4-20 mA, if the input to the channel is 12mA, the scaled process value will be 50.0. To allow the interconnection of the VLRANGE and VHRANGE settings to other block parameters, these are written to the outputs OVLRANGE and OVHRANGE.

Simulation Value

A simulation value can be made available at the output V instead of the normal value read from the module (e.g. for hardware testing). When the input parameter SIM_ON is true, the value of the input parameter SIM_V is made available at the output V, a quality code of 16#60 is made available at the output QUALITY, the output QSIM set true and the output QBAD set false. In the event of an error, the output of the simulation value takes precedence over the output of the substitute value.

Substitute Value

A substitution value can be made available at the output V if an invalid value is read from the module. When the input parameter SUBS_ON is true, the value of the input parameter SUBS_V is made available at the output V, a quality code of 16#48 is made available at the output QUALITY, the output QSUBS set true and the output QBAD set true.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the module driver and the real input module. In this time, the substitute value 0 is made available at the output V, a quality code of 16#48 is made available at the output QUALITY, the output QSUBS set true and the output QBAD set false.

Error Handling

The function does not check the plausibility of input parameters.

Report Characteristics

The block has no reporting behavior.

Use with Exam's Totalizer Channels

This block is also used to read the integer (counter) value of the EAM module's totalizer channels (CPIT AND VPIT). In this case the channel value is obtained from the VI output. The SIM-VI inputs can be used to supply a simulation and substitute value for the VI outputs.

See Also

Notes on Using Driver Blocks

8.6 A_CH_DI

Function

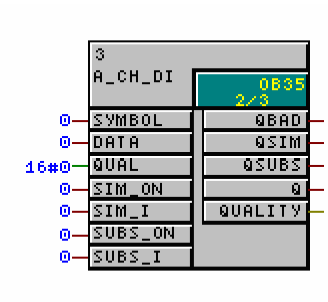
This block has been designed for use with the DP-IOBus Link. This block reads the Boolean value of the discrete input channel of a non-safety-critical QUADLOG I/O module whose symbolic name is linked to the input SYMBOL from the associated module. The module driver (MOD_DRV) has read the channel value from the discrete input module (or possibly a module that is redundant to this one). The connection to the associated module driver is automatically established by means of the interconnection at the inputs DATA and QUAL. The Boolean value is made available at the output Q. If a channel failure has occurred, either that last valid value or the substitute value (SUBS_I) is made available at the output Q, depending on the value of the SUBS_ON input.

For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

Alternatively, a simulation value (SIM_I) can be made available at the output Q if the value of the SIM_ON input is true. For the process value made available at the output Q, a value status (quality code) is generated at the output QUALITY that can take on the following states:

State	Quality Code
Valid value	16#80
Simulation value	16#60
Last valid value	16#44
Substitute value	16#48
Not Accurate	16#50
Invalid value	16#00

CFC Block Diagram



Inputs

Name	Data Type	Explanation	Default
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	0
DATA	BOOL	Interconnection to the module driver for the channel's data	Interconnected automatically
QUAL	WORD	Interconnection to the module driver for the channel's status	Interconnected automatically
SIM_ON	BOOL	1 = activate simulation value 0 = deactivate simulation value	0
SIM_I	BOOL	Simulation value	0
SUBS_ON	BOOL	1 = enable failure substitution 0 = disable failure substitution	0
SUBS_I	BOOL	Failure substitution value	0

Outputs

Name	Data Type	Explanation	Default
QBAD	BOOL	1 = process value invalid	0
QSIM	BOOL	1 = simulation active	0
QSUBS	BOOL	1 = substitution active	0

Name	Data Type	Explanation	Default
Q	Process Value	Process Value	0
QUALITY	BYTE	Value status (quality code) of the process value	0

Addressing

You must assign the symbol of the corresponding discrete (Boolean) input channel to the input SYMBOL of the channel driver.

Normal Value

The specified channel's discrete process value (BOOL) from the associated module is made available at the output V and a quality code of 16#80 is made available at the output QUALITY.

Simulation Value

A simulation value can be made available at the output Q instead of the normal value read from the module (e.g. for hardware testing). When the input parameter SIM_ON is true, the value of the input parameter SIM_I is made available at the output Q, a quality code of 16#60 is made available at the output QUALITY, the output QSIM set true and the output QBAD set false. In the event of an error, the output of the simulation value takes precedence over the output of the substitute value.

Substitute Value

A substitution value can be made available at the output Q if an error occurs on the module. When the input parameter SUBS_ON is true, the value of the input parameter SUBS_I is made available at the output Q, a quality code of 16#48 is made available at the output QUALITY, the output QSUBS set true and the output QBAD set true.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the module driver and the discrete input module. In this time, the substitute value false is made available at the output Q, a quality code of 16#48 is made available at the output QUALITY, the output QSUBS set true and the output QBAD set false.

Error Handling

The function does not check the plausibility of input parameters.

Report Characteristics

The block has no reporting behavior.

See Also

Notes on Using Driver Blocks

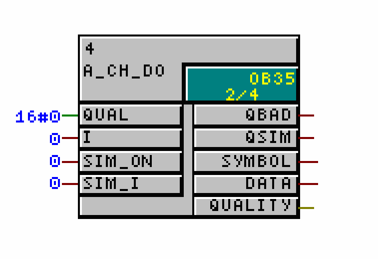
8.7 A_CH_DO

Function

This block has been designed for use with the DP-IOBus Link. This block makes the process value at the input I available for the discrete output channel of a non-safety-critical QUADLOG I/O module whose symbolic name is linked to the input SYMBOL from the associated module. The module driver (MOD_DRV) writes the process value (BOOL) to the channel of the discrete output module (or possibly a module that is redundant to this one). The connection to the associated module driver is automatically established by means of the interconnection at the output DATA and input QUAL. If the channel quality indicates an error has occurred, the substitute value false is made available at the output DATA instead of the process value from the input I. Alternatively, a simulation value (SIM_I) can be made available at the output DATA. For the process value being output to the module, a value status (quality code) is generated at the output QUALITY that can take on the following states:

State	Quality Code
Invalid value	16#00
Valid value	16#80
Simulation value	16#60
Substitute value	16#48
Not Accurate	16#50

CFC Block Diagram



Inputs

Name	Data Type	Explanation	Default
QUAL	WORD	Interconnection to the module driver for the channel's status	Interconnected automatically
I	BOOL	Process Value	0
SIM_ON	BOOL	1 = activate simulation value 0 = deactivate simulation value	0

Name	Data Type	Explanation	Default
SIM_I	BOOL	Simulation value	0

Outputs

Name	Data Type	Explanation	Default
QBAD	BOOL	1 = process value invalid	0
QSIM	BOOL	1 = simulation active	0
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	0
DATA	BOOL	Interconnection to the module driver for the channel's data	Interconnected automatically
QUALITY	BYTE	Value status (quality code) of the process value	0

Addressing

You must assign the symbol of the corresponding analog output channel to the input SYMBOL of the channel driver.

Normal Value

The Boolean process value (BOOL) at the input I is made available to the specified channel of the associated module and a quality code of 16#80 is made available at the output QUALITY.

Simulation Value

A simulation value can be output to the module instead of the normal value read from the input I (e.g. for hardware testing). When the input parameter SIM_ON is true, the value of the input parameter SIM_I is made available to the module, a quality code of 16#60 is made available at the output QUALITY, the output QSIM set true and the output QBAD set false. In the event of an error, the output of the simulation value takes precedence over the output of the substitute value.

Substitute Value

A substitution value can be made available to the module if an error has occurred. The substitute value false is made available at the output DATA, a quality code of 16#48 is made available at the output QUALITY and the output QBAD set true.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the module driver and the discrete output module. In this time, the substitute value false is made available at the output DATA, a quality code of 16#48 is made available at the output QUALITY and the output QBAD set false.

Error Handling

The function does not check the plausibility of input parameters.

Report Characteristics

The block has no reporting behavior.

See Also

Notes on Using Driver Blocks

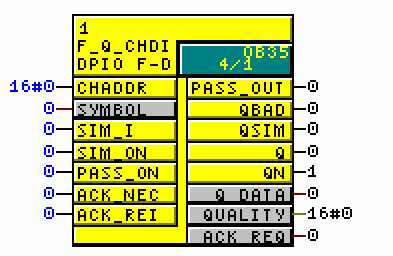
8.8 F_Q_CHDI

Function

This block has been designed for use with the DP-IOBus Link. This block reads the discrete (Boolean) value of the input channel of a safety-critical QUADLOG I/O module whose symbolic name is linked to the input SYMBOL from the associated F module driver (F_Q_MOD). The F module driver has read the discrete value via a safety frame from the discrete input module (or possibly a module that is redundant to this one). The connection to the associated F module driver is automatically established by means of the interconnection at the input CHADDR. If the discrete value is valid, it is made available at the output Q (F_BOOL) and Q_DATA (BOOL). If the discrete value is invalid, the substitute value 0 is output at the output Q and Q_DATA. For the reintegration of a process value after an error is corrected, a user acknowledgment is required depending on the parameterization and error type. Alternatively, a simulation value can be output at the output Q and Q_DATA. For the process value at the outputs Q and Q_DATA, a value status (quality code) is generated at the output QUALITY that can take on the following states:

State	Quality Code
Valid value	16#80
Simulation value	16#60
Substitute value	16#48

CFC Block Diagram



Inputs

Name	Data Type	Explanation	Default
CHADDR	F_WORD	Interconnection to the F module driver for the channel's data	Interconnected automatically
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	0
SIM_I	F_BOOL	Simulation value	0
SIM_ON	F_BOOL	1 = activate simulation value 0 = deactivate simulations value	0
PASS_ON	F_BOOL	1 = activate passivation 0 = deactivate passivation	0
ACK_NEC	F_BOOL	User acknowledgment for reintegration after error 1 = required 0 = not required	0
ACK_REI	F_BOOL	Reintegration acknowledgment	0

Outputs

Name	Data Type	Explanation	Default
PASS_OUT	F_BOOL	Passivation output	0
QBAD	F_BOOL	1 = process value invalid, value substitution active	0
QSIM	F_BOOL	1 = simulation active	0
Q	F_BOOL	Process Value	0
QN	F_BOOL	Process Value (negated)	1
Q_DATA	BOOL	Process Value	0
QUALITY	BYTE	Value status (quality code) of the process value	0
ACK_REQ	BOOL	Acknowledgment required for reintegration	0

Addressing

You must assign the symbol of the corresponding discrete (Boolean) input channel to the input SYMBOL of the F channel driver.

Normal Value

The discrete value is output at the outputs Q and Q_DATA with the quality code (QUALITY) set to 16#80.

Simulation Value

A simulation value can be output at the outputs Q and Q_DATA instead of the normal value read from the module. When the input parameter SIM_ON is true, the value of the input parameter SIM_I is output at the outputs Q and Q_DATA with the quality code (QUALITY) set to 16#60 and the output QSIM set true. In the event of an error, the output of the simulation value takes precedence over the output of the substitute value.

Substitute Value

In the case of an invalid discrete value as a result of a safety communications protocol error or channel fault (e.g. wire break), in the case of passivation and during a startup (cold or warm restart), the substitute value 0 is output at the outputs Q and Q_DATA with the quality code (QUALITY) set to 16#48 and the output QBAD set true. If the substitute value is not caused by passivation, the output PASS_OUT is set true as well to passivate other channels.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the F module driver and the discrete input module. In this time, the substitute value 0 is output with the quality code (QUALITY) set to 16#48, and the outputs QBAD and PASS_OUT are both set true as well.

Error Handling

If an event critical to safety is detected, the system function **F_CTRL** is called (this is described in the document *SIMATIC S7 F/FH Systems Configuring and Programming*). This records the event in the Diagnostic Buffer and requests a switch to the reserve CPU if the error occurred only on the master CPU. For non-redundant systems or a common-cause error occurring in both CPUs, the shutdown logic can be configured to either disable the Partial Shutdown Group with the error or the entire safety program.

Error Information in Diagnostic Buffer

Error Code (W#16#...)	**Description**
75DAH	Error in the safety data format (error due to online modification of the Safety Program or internal CPU fault)

Report Characteristics

The block has no reporting behavior.

See Also

Passivation and Reintegration of the Input and Output Channels

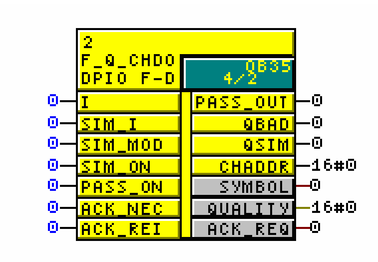
8.9 F_Q_CHDO

Function

This block has been designed for use with the DP-IOBus Link. This block makes the process value at the input I available to the associated F module driver (F_Q_MOD). The F module driver reads the value from this channel driver and writes it via a safety frame to the channel of the discrete output module of a safety-critical QUADLOG I/O module addressed via the output SYMBOL. The connection to the associated F module driver is automatically established by means of the interconnection at the output CHADDR. If the F channel driver detects at the next call that errors have occurred, the substitute value 0 is made available for the associated F module driver at the next call instead of the process value at the input I. For the reintegration of the process value after an error is corrected, a user acknowledgment is required depending on the parameterization and error type. Alternatively, a simulation value can be output at the module output if there is no error. For the discrete value I output to the module, a value status (quality code) is generated at the QUALITY output that can take on the following states:

State	Quality Code
Valid value	16#80
Simulation value	16#60
Substitute value	16#48

CFC Block Diagram



Inputs

Name	Data Type	Explanation	Default
I	F_BOOL	Process Value	0
SIM_I	F_BOOL	Simulation value	0
SIM_MOD	F_BOOL	1 = simulate I/O Module	0
SIM_ON	F_BOOL	1 = activate simulation value 0 = deactivate simulations value	0
PASS_ON	F_BOOL	1 = activate passivation 0 = deactivate passivation	0
ACK_NEC	F_BOOL	User acknowledgment for reintergration after error 1 = required 0 = not required	
ACK_REI	F_BOOL	Reintegration acknowledgment	0

Outputs

Name	Data Type	Explanation	Default
PASS_OUT	F_BOOL	Passivation output	0
QBAD	F_BOOL	1 = process value invalid, value substitution active	0
QSIM	F_BOOL	1 = simulation active	0
CHADDR	F_WORD	Interconnection to the F module driver for this channel's data	Interconnected automatically

Name	Data Type	Explanation	Default
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	0
QUALITY	BYTE	Value status (quality code) of the process value	0
ACK_REQ	BOOL	Acknowledgment required for reintegration	0

Addressing

You must assign the symbol of the corresponding discrete (Boolean) output channel to the output SYMBOL of the F channel driver.

Normal Value

The process value at the input I is made available to the associated F module driver (F_Q_MOD). 16#80 is output as the quality code (QUALITY).

Simulation Value

At the output, a simulation value can be output instead of the value at the input I (e.g. for hardware tests).

When the input parameter SIM_ON is true, the value of the input parameter SIM_I is made available to the associated F module driver. 16#80 is output as the quality code (QUALITY), and the output QSIM is true.

When SIM_MOD is false, the output of the simulation value takes precedence over the output of the normal value and passivation, but not over the substitution value 0 in the event of an error.

When SIM_MOD is true, the output of the simulation values always takes precedence over the output of the normal value and passivation, regardless of any module error (QBAD is false) This mode would be useful to simulate "error-free" operation even without the hardware DO modules.

Substitute Value

In the case of an invalid discrete value as a result of a safety communications protocol error or channel fault (e.g. wire break), in the case of passivation and during a startup (cold or warm restart), the substitute value 0 is output with the quality code (QUALITY) 16#48 and the output QBAD is true. If the substitute value is not caused by passivation, the output PASS_OUT is true as well to passivate other channels.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the F module driver and the discrete output module. In this time, the substitute value 0 is output with the quality code (QUALITY) 16#48, and the outputs QBAD and PASS_OUT are both true as well.

Error Handling

If an event critical to safety is detected, the system function **F_CTRL** is called (this is described in the document *SIMATIC S7 F/FH Systems Configuring and Programming*). This records the event in the Diagnostic Buffer and requests a switch to the reserve CPU if the error occurred only on the master CPU. For non-redundant systems or a common-cause error occurring in both CPUs, the shutdown logic can be configured to either disable the Partial Shutdown Group with the error or the entire safety program.

Error Information in Diagnostic Buffer

Error Code (W#16#...)	Description
75DAH	Error in the safety data format (error due to online modification of the Safety Program or internal CPU fault)

Report Characteristics

The block has no reporting behavior.

See Also

Passivation and Reintegration of the Input and Output Channels

8.10 F_Q_CHRI

Function

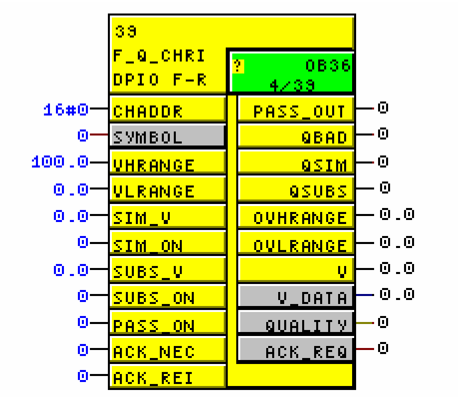
This block has been designed for use with the DP-IOBus Link. This block reads the real (analog) value of the input channel of a safety-critical QUADLOG I/O module whose symbolic name is linked to the input SYMBOL from the associated F module driver (F_Q_MOD). The F module driver has read the real value via a safety frame from the real input module (or possibly a module that is redundant to this one). The connection to the associated F module driver is automatically established by means of the interconnection at the inputs CHADDR. If the real value is valid, it is made available at the output V (F_REAL) and V_DATA (REAL). If the real value is invalid, the substitute value 0.0 is output at the output V and V_DATA.

For QUADLOG input channels, Siemens strongly recommends that customers configure and use the channel driver's substitute value to ensure that the input value is safe under fault conditions. Doing so may allow out-of-range values to be input for one or two scans, but then the channel driver stabilizes to the substitute value.

For the reintegration of a process value after an error is corrected, a user acknowledgment is required depending on the parameterization and error type. Alternatively, a simulation value can be output at the output V and V_DATA. For the process value at the outputs V and V_DATA, a value status (quality code) is generated at the output QUALITY that can take on the following states:

State	Quality Code
Valid value	16#80
Simulation value	16#60
Substitute value	16#48
Last valid value	16#44

CFC Block Diagram



Inputs

Name	Data Type	Explanation	Default
CHADDR	F_WORD	Interconnection to the F module driver for the channel's data	Interconnected automatically
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	Interconnected automatically
VHRANGE	F_REAL	High limit of process value	Interconnected automatically
VLRANGE	F_REAL	Low limit of process value	Interconnected automatically
SIM_V	F_REAL	Simulation value	0.0
SIM_ON	F_BOOL	1 = activate simulation value 0 = deactivate simulations value	0
SUBS_V	F_REAL	Substitution value	0.0
SUBS_ON	F_BOOL	1 = enable substitution value 0 = disable substitution value	0
PASS_ON	F_BOOL	1 = activate passivation 0 = deactivate passivation	0
ACK_NEC	F_BOOL	User acknowledgment for reintergration after error 1 = required 0 = not required	0
ACK_REI	F_BOOL	Reintegration acknowledgment	0

Inputs

Outputs

Name	Data Type	Explanation	Default
PASS_OUT	F_BOOL	Passivation output	0
QBAD	F_BOOL	1 = process value invalid, value substitution active	0
QSIM	F_BOOL	1 = simulation active	0
QSUBS	F_BOOL	1=substitution active	0
OVHRANGE	F_REAL	High limit of process value (copy)	0.0
OVLRANGE	F_REAL	Low limit of process value(copy)	0.0
V	F_REAL	Process Value	0.0
V_DATA	REAL	Process Value	0.0
QUALITY	BYTE	Value status (quality code) of the process value	0
ACK_REQ	BOOL	Acknowledgment required for reintegration	0

Addressing

You must assign the symbol of the corresponding real (analog) input channel to the input SYMBOL of the F channel driver.

Normal Value

The specified channel's analog process value from the associated module is made available at the output V and V_DATA and a quality code of 16#80 is made available at the output QUALITY. The channel will linearly scale raw data to the process value using the VLRANGE/VHRANGE configuration parameters set by the user and the channel's input range. For example, given a VLRANGE of 0.0, a VHRANGE of 100.0, and an input range of 4-20 mA, if the input to the channel is 12mA, the scaled process value will be 50.0. To allow the interconnection of the VLRANGE and VHRANGE settings to other block parameters, these are written to the outputs OVLRANGE and OVHRANGE.

Simulation Value

A simulation value can be output at the outputs V and V_DATA instead of the normal value read from the module. When the input parameter SIM_ON is true, the value of the input parameter SIM_I is output at the outputs V and V_DATA with the quality code (QUALITY) set to 16#60 and the output QSIM set true. In the event of an error, the output of the simulation value takes precedence over the output of the substitute value.

Substitute Value

In the case of an invalid real value as a result of a safety communications protocol error or channel fault (e.g. wire break), in the case of passivation and during a startup (cold or warm restart), the substitute value 0 is output with the quality code (QUALITY) 16#48 and the output QBAD is set true. If the substitute value is not caused by passivation, the output PASS_OUT is set true as well to passivate other channels.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the F module driver and the real input module. In this time, the substitute value 0 is output at the outputs V and V_DATA with the quality code (QUALITY) set to 16#48, and the outputs QBAD and PASS_OUT set true as well.

Error Handling

If an event critical to safety is detected, the system function **F_CTRL** is called (this is described in the document *SIMATIC S7 F/FH Systems Configuring and Programming*). This records the event in the Diagnostic Buffer and requests a switch to the reserve CPU if the error occurred only on the master CPU. For non-redundant systems or a common-cause error occurring in both CPUs, the shutdown logic can be configured to either disable the Partial Shutdown Group with the error or the entire safety program.

Error Information in Diagnostic Buffer

Error Code (W#16#...)	Description
75DAH	Error in the safety data format (error due to online modification of the Safety Program or internal CPU fault)

Report Characteristics

The block has no reporting behavior.

See Also

Passivation and Reintegration of the Input and Output Channels

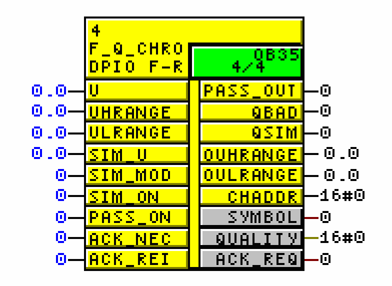
8.11 F_Q_CHRO

Function

This block has been designed for use with the DP-IOBus Link. This block makes the process value at the input U available to the associated F module driver (F_Q_MOD). The F module driver reads the value from this channel driver and writes it via a safety frame to the channel of the real safety-critical QUADLOG output module addressed via the output SYMBOL. The connection to the associated F module driver is automatically established by means of the interconnection at the output CHADDR. If the F channel driver detects at the next call that errors have occurred, the substitute value 0 is made available for the associated F module driver at the next call instead of the process value at the input U. For the reintegration of the process value after an error is corrected, a user acknowledgment is required depending on the parameterization and error type. Alternatively, a simulation value can be output at the module output if there is no error. For the real value U output to the module, a value status (quality code) is generated at the QUALITY output that can take on the following states:

State	Quality Code
Valid value	16#80
Simulation value	16#60
Substitute value	16#48
High range limited	16#56
Low range limited	16#55

CFC Block Diagram



Inputs (names in bold are visible by default)

Name	Data Type	Explanation	Default
ADR_CODE	DWORD	Address code for SYMBOL interconnection	Supplied automatically
U	F_REAL	Process Value	0.0
UHRANGE	F_REAL	High limit of process value	Interconnected automatically
ULRANGE	F_REAL	Low limit of process value	Interconnected automatically
SIM_U	F_REAL	Simulation value	0.0
SIM_MOD	F_BOOL	1 = simulate I/O Module	0
SIM_ON	F_BOOL	1 = activate simulation value 0 = deactivate simulations value	0
PASS_ON	F_BOOL	1 = activate passivation 0 = deactivate passivation	0
ACK_NEC	F_BOOL	User acknowledgment for reintergration after error 1 = required 0 = not required	
ACK_REI	F_BOOL	Reintegration acknowledgment	0

Outputs (names in bold are visible by default)

Name	Data Type	Explanation	Default
PASS_OUT	F_BOOL	Passivation output	0
QCHF_HL	F_BOOL	1 = process value high limit failure	0
QCHF_LL	F_BOOL	1 = process value low limit failure	0
QBAD	F_BOOL	1 = process value invalid, value substitution active	0
QSIM	F_BOOL	1 = simulation active	0
Q	F_BOOL	Process Value	0

Name	Data Type	Explanation	Default
OUHRANGE	F_REAL	High limit of process value (copy)	0.0
OULRANGE	F_REAL	Low limit of process value(copy)	0.0
CHADDR	F_WORD	Interconnection to the F module driver for this channel's data	Interconnected automatically
SYMBOL	BOOL	Must be interconnected with the symbolic address of the channel from HW CONFIG across the margin of the chart	0
QUALITY	BYTE	Value status (quality code) of the process value	0
ACK_REQ	BOOL	Acknowledgment required for reintegration	0

Addressing

You must assign the symbol of the corresponding real (analog) output channel to the output SYMBOL of the F channel driver.

Normal Value

The process value at the input U is made available to the associated F module driver (F_Q_MOD). 16#80 is output as the quality code (QUALITY).The channel will linearly scale the process value to the channel's output range using the ULRANGE/UHRANGE configuration parameters set by the user. For example, given a ULRANGE of 0.0, a UHRANGE of 100.0, and an output range of 4-20 mA, if the process value written is 50.0, the scaled output will be 12 mA. The value at the input U is limited between the values for the ULRANGE and UHRANGE inputs before being sent to the channel. The outputs QCHF_HL and QCHF_LL also provide information on whether output value limits have been set. To allow the interconnection of the ULRANGE and UHRANGE settings to other block parameters, these are written to the outputs OULRANGE and OUHRANGE.

Simulation Value

A simulation value can be output to the module instead of the normal value read from the input U (e.g. for hardware testing). When the input parameter SIM_ON is true, the value of the input parameter SIM_U is made available to the associated F module driver, a quality code of 16#60 is made available at the output QUALITY and the output QSIM is true.

When SIM_MOD is false, the output of the simulation value takes precedence over the output of the normal value and passivation, but not over the substitution value 0 in the event of an error.

When SIM_MOD is true, the output of the simulation values always takes precedence over the output of the normal value and passivation, regardless of any module error (QBAD is false). This mode would be useful to simulate "error-free" operation even without the hardware DO modules.

Substitute Value

In the case of an invalid real value as a result of a safety communications protocol error or channel fault (e.g. wire break), passivation (the PASS_ON input is true) and during a startup (cold or warm restart), the substitute value 0 is output with the quality code (QUALITY) 16#48 and the output QBAD is true. If the substitute value is not caused by passivation, the output PASS_OUT is true as well to allow the user to passivate other channels.

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the F module driver and the real output module. In this time, the substitute value 0 is output with the quality code (QUALITY) 16#48, and the outputs QBAD and PASS_OUT are both true as well.

Error Handling

If an event critical to safety is detected, the system function **F_CTRL** is called (this is described in the document *SIMATIC S7 F/FH Systems Configuring and Programming*). This records the event in the Diagnostic Buffer and requests a switch to the reserve CPU if the error occurred only on the master CPU. For non-redundant systems or a common-cause error occurring in both CPUs, the shutdown logic can be configured to either disable the Partial Shutdown Group with the error or the entire safety program.

If any of the U, UHRANGE, ULRANGE, or SIM_U inputs are invalid floating-point numbers (NaN) or if invalid floating-point numbers (NaN) are produced by the calculation in the block, the substitute value 0 is output with the quality code (QUALITY) 16#48 and the output QBAD, QCHF_LL and QCHF_HL are set to 1. If the invalid floating-point numbers (NaN) are the result of the calculation in the block, a diagnostic event is entered in the diagnostic buffer of the CPU.

Error Information in Diagnostic Buffer

Error Code (W#16#...)	Description
75D9H	An invalid floating-point number (NaN) has been created due to the calculation of the resultant process value.
75DAH	Error in the safety data format (error due to online modification of the Safety Program or internal CPU fault)

Report Characteristics

The block has no reporting behavior.

See Also

Passivation and Reintegration of the Input and Output Channels

8.12 F_Q_MOD

Function

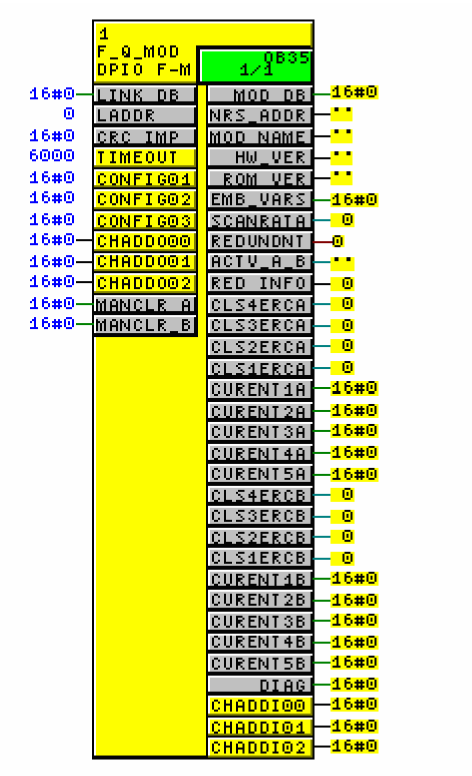
This module driver block is used with the DP/IOBus Link. This block processes the data for all channels of a Safety Critical QUADLOG I/O Module connected by the DP/IOBus Link. The block provides the interface between the link driver block (DPIO_DRV) and channel driver blocks (F_Q_CHxx). …

This block is a module driver and is classified as a system level function block. This means that the compiler automatically inserts this block when a DP/IO Bus Link module has been added to a system (provided that *Generate Module Drivers* is selected during CFC compiles). One F_Q_MOD block is added per safety critical QUADLOG module pair (single or non-redundant).

Note

The **F_Q_MOD** block is a valuable tool for project engineering. There is useful information available from the F_Q_MOD block for determining the current state of operation. For instance, if the output of DIAG is 0x10, there has been a timeout. This timeout could be could be a result of problems with communications between the S7-400 CPU and the DP/IO Bus Link or I/O module. Such communication problems could result from a poor connection or an improperly compiled project (perhaps HW Config does not match the CFC configuration).

CFC Block Diagram



Inputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
LINK_DB	DWORD	Interconnection to the link driver block's LINKDBxx output	Interconnected automatically
LADDR	INT	Logical address of DP/IOBus Link (process image starting address)	Supplied automatically
CRC_IMP	WORD	Module configuration CRC	Supplied automatically
TIMEOUT	DINT	Monitoring time (milliseconds) for link communications	6000 (6 seconds)
CONFIGxx	F_WORD	Channel configuration info (channel type, etc.)	Supplied automatically
CHADDOxx	F_WORD	Interconnection to DP/IO Bus failsafe output channel driver	Interconnected automatically
EV_ID_A	DWORD	Event ID for Alarm_8 messages, Side A error counts	Supplied automatically
EV_ID_B	DWORD	Event ID for Alarm_8 messages, Side B error counts	Supplied automatically
EV_ID_C	DWORD	Event ID for Alarm_8p messages, communications failures	Supplied automatically
MSG_LOCK	BOOL	Enable Alarm Message Locking (1=messages locked)	False
PURGE_ER	BOOL	Purge Side A Error History Buffer	False
PURGE_EB	BOOL	Purge Side B Error History Buffer	False
MANCLRA	DWORD	Error to be cleared on side A	0
MANCLRB	DWORD	Error to be cleared on side BDWORD	0

Outputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
MOD_DB	D_WORD	Interconnection to the link driver block's MOD_DBxx input	Interconnected automatically
NRS_ADDR	STRING	Module address as 'NxxRxxSxx'	N00R00S00
MOD_NAME	STRING	Module's Name/Part Number (for example, QLCAMAAN)	'???'
HW_VER	STRING	Module's Hardware Revision	'00'
HW_VERB	STRING	Module's Hardware Revision (Side B)	'00'
ROM_VER	STRING	Module's ROM Revision	'1.00'
ROM_VERB	STRING	Module's ROM Revision (Side B)	'1.00'
SCANRATE	INT	Module's IOBus Scan Rate (mS)	0
EMB_VARS	WORD	Various state information (bit-significant status, see below)	0
EMB_VARB	WORD	Various state information, Side B (bit-significant status, see below)	0
SCANRATA	INT	Module's effective scan rate (milliseconds)	0
SCANRATB	INT	Module's effective scan rate, Side B (milliseconds)	0
REDUNDANT	BOOL	True if module is redundant (backup is available)	False

Name	Data Type	Explanation	Default
ACTV_A_B	STRING	Active IOBus side indicator (‘A’ or ‘B’)	‘?’
RED_INFO	INT	System redundancy information (0=non-redundant, , 2=N:N)	
CLS4ERCA	INT	Active class 4 error count, side A	0
CLS3ERCA	INT	Active class 3 error count, side A	0
CLS2ERCA	INT	Active class 2 error count, side A	0
CLS1ERCA	INT	Active class 1 error count, side A	0
CURENT1A	DWORD	Highest priority error, side A	0
CURENT2A	DWORD	2nd highest priority error, side A	0
CURENT3A	DWORD	3rd highest priority error, side A	0
CURENT4A	DWORD	4th highest priority error, side A	0
CURENT5A	DWORD	5th highest priority error, side A	0
CLS4ERCB	INT	Active class 4 error count, side B	0
CLS3ERCB	INT	Active class 3 error count, side B	0
CLS2ERCB	INT	Active class 2 error count, side B	0
CLS1ERCB	INT	Active class 1 error count, side B	0
CURENT1B	DWORD	Highest priority error, side B	0
CURENT2B	DWORD	2nd highest priority error, side B	0
CURENT3B	DWORD	3rd highest priority error, side B	0
CURENT4B	DWORD	4th highest priority error, side B	0
CURENT5B	DWORD	5th highest priority error, side B	0
DIAG	DWORD	Diagnostic error information (bit-significant status, see below0	Interconnected automatically
CHADDIxx	F_WORD	Interconnection to DP/IO Bus failsafe input channel driver	Interconnected automatically
ERHISACT	INT	Error history buffer entry count, Side A	0
ERHISANX	INT	Error history buffer next entry, Side A	0
ERHISAnn	STRING	Error History Buffer, Side A	""
ERHISBCT	INT	Error history buffer entry count, Side B	0
ERHISBNX	INT	Error history buffer next entry, Side B	0
ERHISBnn	STRING	Error History Buffer, Side B	""
AL_ERR_A	BOOL	Alarm_8 call error, Side A error count	False
AL_STA_A	WORD	Alarm_8 error info, Side A (not visible by default)	0
AL_ACK_A	WORD	Alarm_8 status bits, Side A	0
AL_ERR_B	BOOL	Alarm_8 call error, Side B (not visible by default)	False
AL_STA_B	WORD	Alarm_8 error info, Side B (not visible by default)	0
AL_ACK_B	WORD	Alarm_8 status bits, Side B (not visible by default)	0
AL_ERR_C	BOOL	Alarm_8 call error, communications failure	False
AL_STA_C	WORD	Alarm_8 error info, communications failure	0
AL_ACK_C	WORD	Alarm_8 status bits, communications failure	0
QMSG_SUP	BOOL	Message Suppression Active	False

Note

The ‘xx’ in CONFIGxx, CHADDOxx, and CHADDIxx signifies one of a maximum of 32 channels available on a given QUADLOG I/O Module, which are numbered 00 through 31. Therefore, the block actually provides 32 of each of these inputs/outputs.

The ‘nn’ in the ERHISAnn and ERHISBnn signifies a maximum of 100 Error History Buffer entries available on this module, which are numbered 00 through 99 (the block actually provides 100 of each of these outputs).

Addressing

The LADDR input will be assigned the starting address of the I/O Module’s memory footprint within the Process Image (PI).

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the module driver and the link driver block (DPIO_DRV). In this time, data exchanges with any connected channel driver blocks will indicate bad quality.

After startup, the messages generated by this block will be suppressed for the first 10 executions.

Error Handling

The function does not check the plausibility of input parameters.

Error Information in Diagnostic Buffer

Error Code (W#16#...)	Description
75DAH	Error in the safety data format (error due to online modification of the Safety Program or internal CPU fault)

Report Characteristics

The block has no reporting behavior.

Information in the EMB_VARS Output

Byte	Bit	Meaning
0	0	CONFIGURED: set when the module has received a valid configuration
	1	POWER SUPPLY A OK: set when module detects the presence of supply A
	2	POWER SUPPLY B OK: set when module detects the presence of supply B
	3	POWER SUPPLY C OK: set when module detects the presence of supply C
	4	IOBus REDUNDANCY: set when the IOBus is operating in redundant mode
	5	OVERTEMP: set when the module’s overtemperature sensor is active
	6	QUADLOG: set when the module is a QUADLOG module

Byte	Bit	Meaning
	7	Reserved
1	Reserved	

Information in the DIAG Output

Byte	Bit	Meaning
0	0	Reserved
	1	ISA (Input Scan Active): set during the transfer of input process values
	2	OSA (Output Scan Active): set during the transfer of output process values
	3	PLCSIM: set when running on PLCSIM instead of a CPU
	4	TIMEOUT: set when communications failure exceeds TIMEOUT parameter
	5	NotForMe: set when block has received data for an entity not in is configuration
	6	CRC Error: set when block receives message with CRC not equal to CRC_IMP input
	7	SeqNumErr: set when block receives data failing the Sequence Number check
1	Reserved	
2	Reserved	
3	Reserved	

Information in the CURENTnx Outputs (n=1-5,x=A/B)

Byte 0 **Scope or Channel**	**Bits**	**Meaning**
Scope information	7-6	Scope Type
		00 = System Scope
		01 = Channel Type
		10 = Group Scope
		11 = Module Scope
	5-0	Group Number if Group Scope (otherwise reserved)
Channel Information	7-0	Channel number

Byte 1 **Error Code and Status**	**Bits**	**Meaning**
	7-2	Error Code
	1	Manual Clear
		0 = Manual Clear Allowed
		1 = Manual Clear Disallowed
	0	Scope or Channel
		0 = Scope or Channel (byte 0) contains Scope Information
		1 = Scope or Channel (byte 0) contains Channel Information

Byte 2 **System Service Code**	**Bits**	**Meaning**
	7-0	System Service Code

Byte 3 Class and Action	Bits	Meaning
	7-6	Class
		00 =Class 1 (lowest priority)
		01 = Class 2
		10 = Class 3
		11 + Class 4 (highest priority)
	5-0	User Action Code

Message response

The F_Q_MOD block uses the ALARM_8 and ALARM_8P blocks to generate messages.

The following message triggers exist:

- Non-zero class 1, 2, 3, or 4 error counts
- Communications failure

Process control messages can be completely blocked with MSG_LOCK.

QMSG_SUP is set if the 10 seconds since restart have not yet elapsed or MSG_LOCK = TRUE or AL_STA_x = 21.

Assignment of Message Text and Message Class to the Block Parameters

Message Number	Block Parameter	Default Message Text	Message Class	Can Be Suppressed By
1	CLS1ERCx	Class 1 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
2	CLS2ERCx	Class 2 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
3	CLS3ERCx	Class 3 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
4	CLS4ERCx	Class 4 Error Count non-zero, Side x: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
5	TimedOut OR NotForMe OR CRCerror OR SeqNumErr	Communications Failure $$BlockComment$$ @1W%04X@	PLC Process Control Message - Failure	MSG_LOCK

Assignment of Associated Values to the Block Parameters

Associated Value:	Block Parameter:

Associated Value:	Block Parameter:
1	TimedOut
2	NotForMe
3	CRCError
4	SeqNumErr
5	0
6	0
7	0
8	0
9	0
10	0

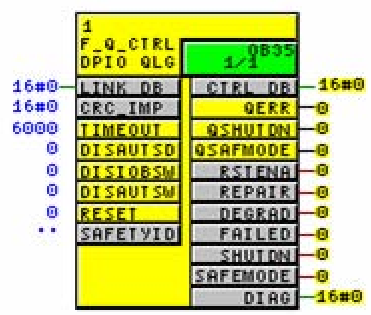
8.13 F_Q_CTRL

Function

This block has been designed for use with the DP/IOBus Link. This block controls certain safety aspects of the DP/IO Bus Link and QUADLOG I/O modules.

One discrete input channel driver block (F_Q_CHDI) must be placed and its SYMBOL input manually assigned to the first input bit address of the DPIOBUS COMM Module, which is typically found in HW Config in Slot 4 of the QUADLOG DPIOBUS-Link rack object (for example: *'I512.0'*). The runtime execution order (OB/RTG/PSG--organizational blockk, runtime group, partial shutdown group--placement) of this block is then governed by the placement of its associated F_Q_CHDI block. The process value passed to the interconnected F_Q_CHDI block is the state of this block's QERR output.

CFC Block Diagram



Inputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
LINK_DB	DWORD	Interconnection to the link driver block's LINKDB00 output	Interconnected automatically

Name	Data Type	Explanation	Default
LADDR	INT	Logical address of DP/IOBus Link (process image starting address)	Supplied automatically
CRC_IMP	WORD	Module configuration CRC	Supplied automatically
TIMEOUT	F-DINT	Monitoring time (milliseconds) for link communications	6000 (6 seconds)
DISAUTSD	F_BOOL	Disable automatic shutdown on class 4 error	False
DISIOBSW	F_BOOL	Disable redundant IOBus operation	False
DISAUTSW	F_BOOL	Disable periodic switchover	False
AUTSWTIM	F_TIME	Periodic switchover cycle (4-12 hours, in milliseconds)	(4 hours) 14400
RESET	F_BOOL	Reset after auto shutdown (reintegration acknowledgment)	0
ACTREQ	INT	ActionID of requested OS action	0
ACTCRC	DWORD	ActionCRC of requested OS action	0
SAFETYID	STRING	SafetyID unique to each DPIO_DRV/F_Q_CTRL pair	"
USERLOCK	STRING	UserID for requested OS action	"'
UNLOCK	BOOL	Cancel requested OS action	False
EV_ID_C	DWORD	Event ID for Alarm 8p messages, communications failure	Supplied automatically
MSG_LOCK	BOOL	Enable alarm Message Locking (1-message locked	False

Outputs

Names in **bold** are visible by default.

Name	Data Type	Explanation	Default
CTRL_DB	F_BOOL	Interconnection to the link driver block's QLG_DB input	Interconnected automatically
CHADDIxx	F_WORD	Interconnection to DPIOBus failsafe input channel driver	Interconnected automatically
QERR	F_BOOL	Transfer error (see DIAG output for more information)	False
QSHUTDN	F_BOOL	Outputs disabled on both sides(copy of SHUTDN)	False
QSAFMODE	F_BOOL	Outputs disabled on both sides (copy of SAFMODE)	False
QREPAIR	F_BOOL	Class 2 or 3 or 4 error exists (copy of REPAIR)	False
QDEGRAD	F_BOOL	Loss of redundancy (copy of DEGRAD)	False
QFAILED	F_BOOL	Failure exists on both sides (copy of FAILED)	False
RSTENA	BOOL	Reset enabled (acknowledgement) required for reintegration)	False
REPAIR	BOOL	Class 2 or 3 or 4 error exists	False
DEGRAD	BOOL	Loss of redundancy	False
FAILED	BOOL	Failure exists on both sides	False
SHUTDN	BOOL	Outputs disabled on both sides	False
SAFEMODE	BOOL	S7-F System in safemode	False

Name	Data Type	Explanation	Default
DIAG	DWORD	Diagnostic error information (bit-significant status, see below)	False
QISAUTSD	BOOL	Automatic shutdown on class 4 error disabled	False
QISIOBSW	BOOL	Redundant IOBus operation disabled	False
QISAUTSW	BOOL	Periodic switchover disabled	False
ACTERR	INT	ErrorID of requested OS action	0
ACTRESP	INT	Compliment of valid ActionID	0
ACTSEQ	INT	Sequence number of requested OS action	0
AL_ERR_A	BOOL	Alarm_8 call error, Side A error counts	False
AL_STA_A	WORD	Alarm_8 error info, Side A error counts	0
AL_ACK_A	WORD	Alarm_8 status bits, Side A error counts	0
QMSG_SUP	BOOL	Message Suppression Active	False

Warning

Safety Note - Leave DISAUTSW in its default state (FALSE)

The **DISAUTSW** input should remain at its default value (FALSE) unless a maintenance override is required. When the **DISAUTSW** input is TRUE, it disables periodic switchovers of redundant DP/IO partners. This periodic switchover is intended to uncover latent faults which may exist on one side of the system and may only be detectable on the master side or the standby side. This features aids in uncovering a latent fault and resolving it to avoid a loss in system availability.

DISAUTSW must not be disabled when the security mode is enabled, but it may be disabled during system staging and commissioning.

Addressing

The LADDR input will be assigned the starting address of the DP/IOBus Link Module's memory footprint within the Process Image (PI).

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the F_Q_CTRL block and the DP/IOBus Link Driver block (DPIO_DRV). In this time, the QERR output may turn true (QERR=1 indicates a communications problem and the remaining block outputs may not be valid).

After startup, the messages generated by this block will be suppressed for the first 10 executions.

Error Handling

If an event critical to safety is detected, the system function **F_CTRL** is called (this is described in the document *SIMATIC S7 F/FH Systems Configuring and*

Programming). This records the event in the Diagnostic Buffer and requests a switch to the reserve CPU if the error occurred only on the master CPU. For non-redundant systems or a common-cause error occurring in both CPUs, the shutdown logic can be configured to either disable the Partial Shutdown Group with the error or the entire safety program.

Information in the DIAG Output

The DIAG output contains internal operating state information (byte 0, bits 0-3), communications failure conditions (byte 0, bits 4-7) and non-default modes of operation (byte 1, bits 0-3). The QERR output is True whenever a communications failure condition exists between the DP/IOBus Link and the F_Q_CTRL block.

Warning

Safety Note - F_Q_CTRL outputs when QERR is TRUE

Whenever QERR is TRUE, all other outputs of the F_Q_CTRL block (except DIAG and those related to OS actions) are not updating; they hold their last value.

Byte	Bit	Meaning
0	0	**EOS** (Executing OS operation): set when the OS is resetting SHUTDN state
	1	**ISA** (Input Scan Active): set for one cycle upon transfer of input process values
	2	**OSA** (Output Scan Active): set for one cycle upon transfer of output process values
	3	**PLCSIM**: set when running on PLCSIM instead of a CPU
	4	**TIMEOUT**: set when communications failure exceeds TIMEOUT parameter
	5	**NotForMe**: set when block has received data for an entity not in is configuration
	6	**CRC Error**: set when block receives data failing the CRC check
	7	**SeqNumErr**: set when block receives data failing the Sequence Number check
1	1	**SafetyModeDiscrepancy**: set when SafetyMode in CPU and DP/IOBus Link differ
	1-7	Reserved
2	Reserved	
3	Reserved	

Message response

The F_Q_CTRL block uses the ALARM_8 block to generate messages.

Process control messages can be completely blocked with MSG_LOCK.

QMSG_SUP is set if the 10 seconds since restart have not yet elapsed or MSG_LOCK = TRUE or AL_STA_A = 21.

Assignment of Message Text and Message Class to the Block Parameters

Message Number	Block Parameter	Default Message Text	Message Class	Can Be Suppressed By
1	REPAIR	Class 2, 3 or 4 error exists: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
2	DEGRADE	Class 4 error exists (or latched): $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
3	FAILED	Critical error exists on Side A & B: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
4	SHUTDN	Outputs disabled by Auto-Shutdown: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
5	SafetyModeDiscrepancy	SafetyMode Discrepancy: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
6	AutoSwitchDisabled	Periodic Switchover Disabled: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
7	RedundIOBDisabled	IOBus Redundancy Disabled: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK
8	AutoShutdnDisabled	Auto-Shutdown Disabled: $$BlockComment$$	PLC Process Control Message - Failure	MSG_LOCK

Error Information in Diagnostic Buffer

Error Code (W#16#...)	Description
75DAH	Error in the safety data format (error due to online modification of the Safety Program or internal CPU fault)

Report Characteristics

The block has no reporting behavior.

See Also

Shutdown Logic and the F_Q_CTRL (Failsafe QUADLOG Control) Function Block

Notes on Using the Driver Blocks.

8.14 DPIO_SIM

Function

This block has been designed for use with the S7 System when running the DP-IOBus Link on PLCSIM. It simulates the unique communications protocol of the DP-IOBus Link Module. It is suggested that this block be placed in a separate CFC chart along with the additional module driver blocks (MOD_DRV) necessary to implement a “mirror image” of the original DP-IOBus Link configuration. That is, for each output channel in the user’s configuration, there must be a corresponding input channel of the same data type in the simulation configuration, at the same rack, slot and channel number. Likewise, for each input channel in the user’s configuration, there must be a corresponding output channel of the same data type in the simulation configuration, at the same rack, slot and channel number.

The simulation configuration’s output channel will provide data to the user configuration’s input channel drivers and data from the user configuration’s output channel drivers will be presented to the simulation configuration’s input channels.

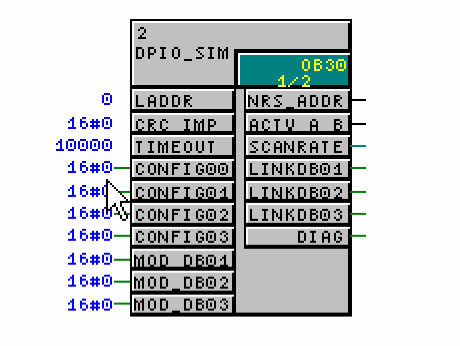
Since the MOD_DRV module driver block is used along with the DPIO_SIM block in the simulation configuration, channel drivers are not necessary as data can be read from and written to the MOD_DRV's xIDATAnn outputs and xODATAnn inputs.

For more information regarding the proper configuration of DPIO_SIM, refer to the sample project ZEn37_02_SPOPBus_FHP_prj, found on the distribution CD.

Note

Do not run the DPIO_SIM block within a F-program that is being executed in an active system.

CFC Block Diagram



Inputs

Names in **bold** are visible by default

Name	Data Type	Explanation	Default

LADDR	INT	Logical address of DP-IOBus Link (process image starting address)	0
CRC_IMP	DWORD	DP-IOBus configuration CRC	0
CRC_PRM	DWORD	DP/IOBus Link module configuration CRC	0
TIMEOUT	INT	Monitoring time (milliseconds) for link communications	10000 (10 seconds)
CONFIGxx	DWORD	Module configuration info (module type, address, etc.)	0
MOD_DBxx	DWORD	Interconnection from MOD_DRV block's MOD_DB output	0
SYS_INFO	INT	System configuration information (0=NonRedundant, 2=N:N)	0
HW_VER	INT	Module's Hardware Revision	0
ROM_VER	INT	Module's ROM Revision	100
PCT_SCAN	REAL	% of IOBus Scan Rate consumed	50.0
EMB_VARS	WORD	Various state information (bit-significant status, see below)	W#16#001F

Outputs

Names in **bold** are visible by default

Name	Data Type	Explanation	Default
NRS_ADDR	STRING	Address of DP-IOBus Link Module (in NRS format)	'N00R00S00'
ACTV_A_B	STRING	Active IOBus side indicator (will be either 'A' or 'B')	'A'
SCANRATE	INT	DP-IOBus Link module's IOBus Scan rate (milliseconds)	0
LINKDBxx	DWORD	Interconnection to MOD_DRV block's LINK_DBxx input	0
DIAG	DWORD	Diagnostic error information (bit-significant status, see below)	0

Note

The 'xx' in CONFIGxx, MOD_DBxx and LINKDBxx signifies one of a maximum of 28 modules available on a given DP-IOBus Link, which are numbered 01 through 28 (the block actually provides 28 of each of these inputs/outputs).

Addressing

The LADDR input will be assigned the starting address of the DP/IOBus Link Module's memory footprint within the Process Image (PI).

Startup Characteristics

After a startup (cold restart or warm restart), communication must first be established between the DPIO_SIM block and the DPIO_DRV block. In this time, data exchanges with any connected module driver blocks (MOD_DRV) will indicate bad quality.

Error Handling

The function does not check the plausibility of input parameters.

Information for the EMB_VARS Input

Byte	Bit	Meaning
0	0	CONFIGURED: set when the module has received a valid configuration
	1	POWER SUPPLY A OK: set when module detects the presence of supply A
	2	POWER SUPPLY B OK: set when module detects the presence of supply B
	3	POWER SUPPLY C OK: set when module detects the presence of supply C
	4	IOBus REDUNDANCY: set when the IOBus is operating in redundant mode
	5	OVERTEMP: set when the module's overtemperature sensor is active
	6	QUADLOG: set when the module is a QUADLOG module
	7	Reserved
1	Reserved	
2	Reserved	
3	Reserved	

Report Characteristics

The block has no reporting behavior.

See Also

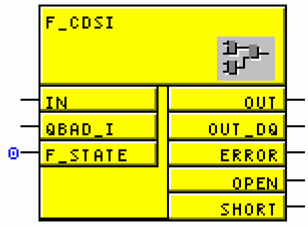
Sample project: Zen37_02_DPIOBus_FHP_prj

Notes on Using the DP/IO Bus Link

8.15 F_CDSI

F_CDSI is a Critical Discrete Supervised Input Block for use with the QUADLOG Critical Discrete Supervised Input (CDSI) channel type.

Block Diagram



The symbol for the Critical Discrete Supervised Input (F_CDSI) function block is shown above. This block converts an analog value (received from a fire detection system switch input) to a discrete value. The conversion thresholds are fixed.

The F_CDSI block converts a 0 to 20 mA analog signal to a set of discrete outputs. The input is intended to be connected to a CDSI-configured channel of a Critical Analog Module (CAM) or Critical Analog Input (CAI), the span of which is fixed. The four outputs and the data quality of the discrete output (OUT) are set based on the IN input value and its data quality (as described in the following table). The outputs are set or cleared each scan; none are latched. The F_STATE input value specifies the output state to be set when the input value is not valid.

Input Value (mA)	**Output Value**	**Output Data Quality**	**Error Output Value**	**OPEN Output Value**	**SHORT Output Value**
IN < 3.0	F_STATE	BAD	TRUE	TRUE	FALSE
.0 <= IN < 3.875	FALSE	BAD	TRUE	FALSE	FALSE
3.875 <= IN < 5.0	FALSE	GOOD	FALSE	FALSE	FALSE
5.0 <= IN < 6.0	FALSE	BAD	TRUE	FALSE	FALSE
6.0 <= IN < 8.0	F_STATE	BAD	TRUE	FALSE	FALSE
8.0 <= IN < 9.25	TRUE	GOOD	TRUE	FALSE	FALSE
9.25 <= IN < 13.5	TRUE	GOOD	FALSE	FALSE	FALSE
13.5 <= IN < 15.0	TRUE	BAD	TRUE	FALSE	FALSE
IN >= 15.0	F_STATE	BAD	TRUE	FALSE	TRUE
Data quality of IN notGOOD	F_STATE	BAD	TRUE	FALSE	FALSE

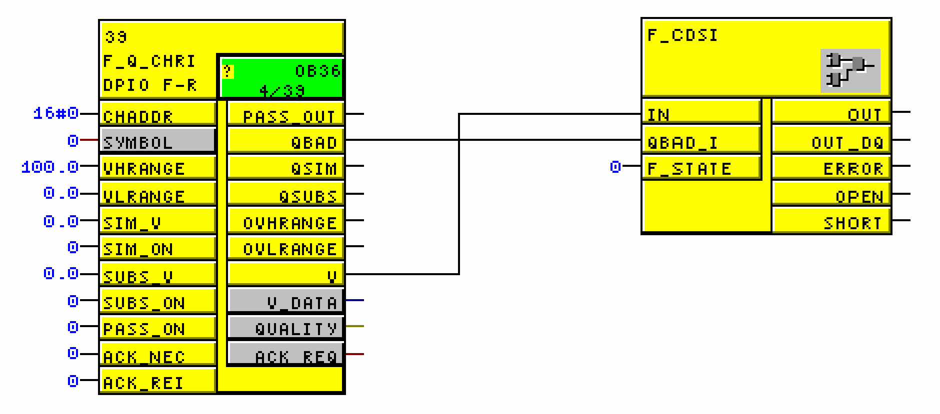
- This function block is only intended for use with the F_Q_CHRI channel driver block whose input is connected to a CDSI channel and whose quality is set by the CAM or CAI based on its diagnostics. The CAM CAI does not set the input fault state for this channel type. If no input is connected, IN data quality is assumed to be UNAVAILABLE.
- The output data quality (OUT_DQ) is either GOOD or BAD as specified; it does not simply follow the data quality of IN. The block's output can be connected to an HMI display.
- If the IN value makes a transition from a valid value to an invalid one (as indicated by the ERROR column), a delay of one scan cycle is allowed before the ERROR output is set TRUE and the OUT quality is changed to BAD (so that transient noise does not affect their settings). However, if the IN value makes a transition to a valid value, the ERROR output is set FALSE, and the OUT quality is set GOOD without any delay

The F_STATE input value specifies the block's output value if the IN value is out-of-range or its data quality is other than GOOD.

PARAMETER	**TYPE**	**DEFAULT**	**RANGE**
F_STATE	BOOL	FALSET	TRUE/FALSE

Connection to F_Q_CHRI

The diagram below shows connections between an F_Q_CHRI block and a F_CDSI blocks The value of F_STATE on the F_CDSI block is set manually.



8.16 Notes on Using the DP/IO Bus Link

Most standard PCS 7 I/O modules consume as much Process Image space as the amount of data they transfer. For example, a 24-bit Discrete Input module consumes 3 bytes in the Process Image Input area. However, every QUADLOG I/O Module consumes 4 bytes of Process Image space - both input and output area. These 4 bytes reserve the space for a maximum of 32 channels. Unlike standard PCS7 I/O Modules, where the Process Image area contains the actual channel values, the Process Image area consumed by the QUADLOG I/O Modules serves only as a placeholder for the purpose of assigning Symbols to be referenced by the associated channel driver blocks.

QUADLOG I/O Module consuming the 4-byte Process Image address range 8.0 through 11.7 (the LADDR value for this module would be 8, which the lowest address). Channel driver blocks reference five of the module’s 32 channels via the symbols. Even though a channel consumes both an input and an output Process Image address, the channel can only be configured as an input channel or an output channel. For each channel, only the appropriate input symbol or output symbol should be applied, not both for the same channel.

Output Symbol	**Process Image Output Address**	**CHANNEL NUMBER**	**Process Image Input Address**	**Input Symbol**
	Q8.0	1	I8.0	Input_A
	Q8.1	2	I8.1	Input_B
Output_C	Q8.2	3	I8.2	
	Q8.3	4	I8.3	Input_D
	Q8.4	5	I8.4	
	Q8.5	6	I8.5	
	Q8.6	7	I8.6	
	Q8.7	8	I8.7	
	Q9.0	9	I9.0	

	Q9.1	10	I9.1	
	Q9.2	11	I9.2	
	Q9.3	12	I9.3	
Output_E	Q9.4	13	I9.4	
	Q9.5	14	I9.5	
	Q9.6	15	I9.6	
	Q9.7	16	I9.7	
	Q10.0	17	I10.0	
	Q10.1	18	I10.1	
	Q10.2	19	I10.2	
	Q10.3	20	I10.3	
	Q10.4	21	I10.4	
	Q10.5	22	I10.5	
	Q10.6	23	I10.6	
	Q10.7	24	I10.7	
	Q11.0	25	I11.0	
	Q11.1	26	I11.1	
	Q11.2	27	I11.2	
	Q11.3	28	I11.3	
	Q11.4	29	I11.4	
	Q11.5	30	I11.5	
	Q11.6	31	I11.6	
	Q11.7	32	I11.7	

Note that not all QUADLOG I/O Modules have 32 channels that are configurable as inputs or outputs. Some modules have only 16 channels, some modules have only inputs, and some modules have only outputs. For these modules, only a subset of the above table applies.

8.17 Notes on Using the Driver Blocks

The DP/IO Bus Link requires several driver blocks to be properly configured for successful operation. Each DP/IO Bus Link Module (or redundant pair) requires one DPIO_DRV and F_Q_CTRL block and each QUADLOG I/O Module (or redundant pair) requires either one F_Q_MOD or one MOD_DRV block. Depending on the number of modules and channels configured, the number of interconnections could easily approach one thousand. While it is possible to place the necessary driver blocks manually in CFC and make the proper interconnections, there are several driver block inputs that must be configured with specific parameters generated by the HW Config program. Therefore, the *Generate Module Drivers* option should be used when compiling CFC so that the Module Driver Wizard automatically places the required driver blocks, makes the necessary interconnections and assigns the various parameters.

Safety Control Block Driver Channel

The F_Q_CTRL block behaves like a module driver and requires an associated F_Q_CHDI channel driver block. You can control the execution order of the

F_Q_CTRL block by placing its channel driver in the appropriate organizational block (OB) or runtime group (RTG). The following general outline of this manual process:

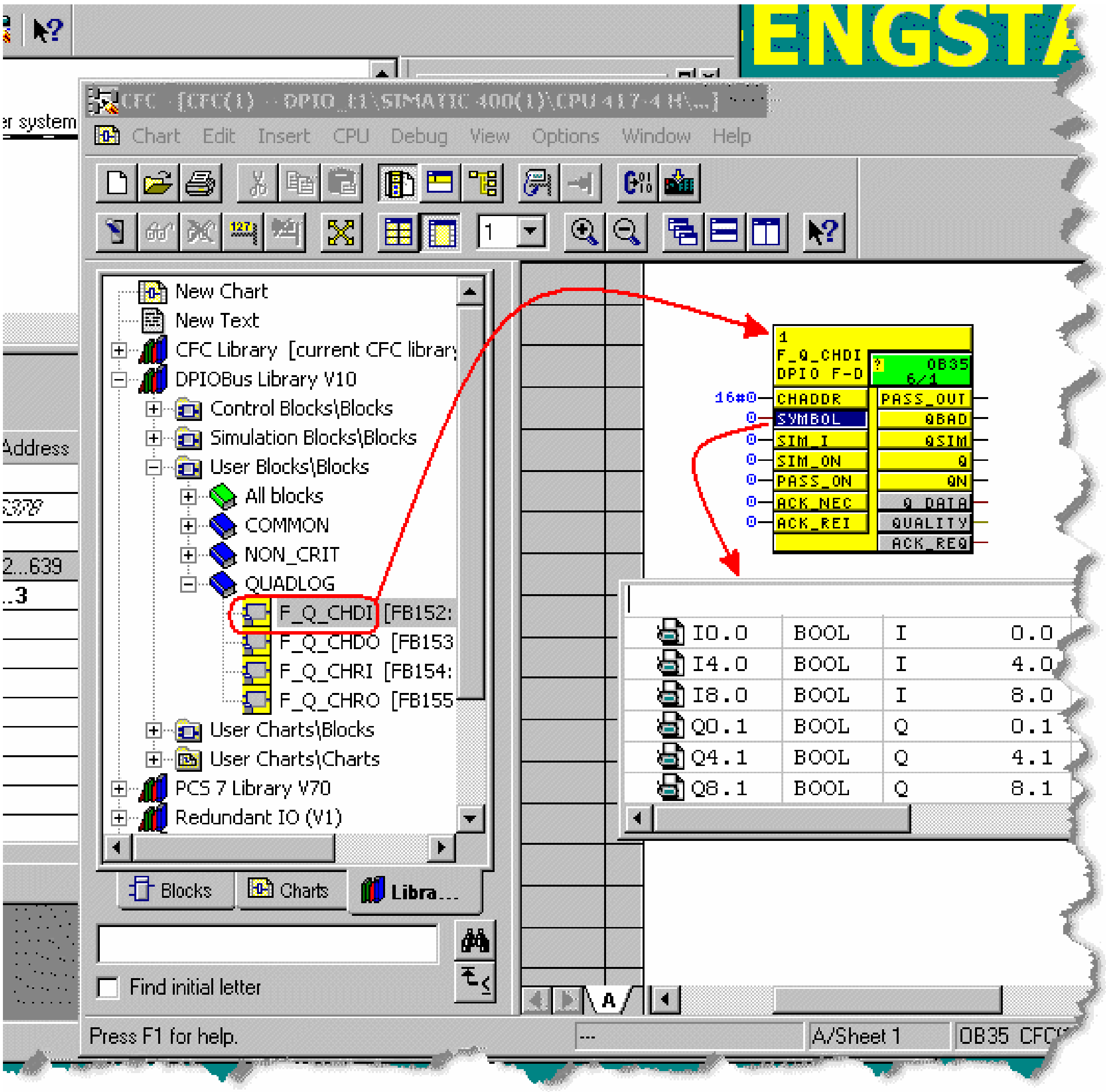
- Place the F_Q_CHDI block and assign its **SYMBOL** input to the starting process image (PI) address of the DPIOBus_COMM object (slot 4 in the DPIOBus _Rack, typically I512.0). Note that when configuring two or more DP/IOBus Links, an F_Q_CHDI block is required for each link and that they must be assigned to the appropriate addresses (I512.0, I640.0, and so forth) created by HW Config.
- The **Generate Module Drivers** function recognizes this channel address is part of the DP/IO Bus Link and places the F_Q_CTRL block in the same OB/RTG as the associated F_Q_CHDI block.
- Move the execution position of the associated F_Q_CHDI block to move the execution position of corresponding F_Q_CTRL block (after recompiling with **Generate Module Drivers** enabled).
- The process value passed to the F_Q_CHDI block is the state of QERR output of the F_Q_CTRL block.

Failing to complete the following procedure may result in an error message, "E: No insert points are defined for block DPIOBUS COMM Module (F_Q_CTRL). The block was not created." This error message can appear in either

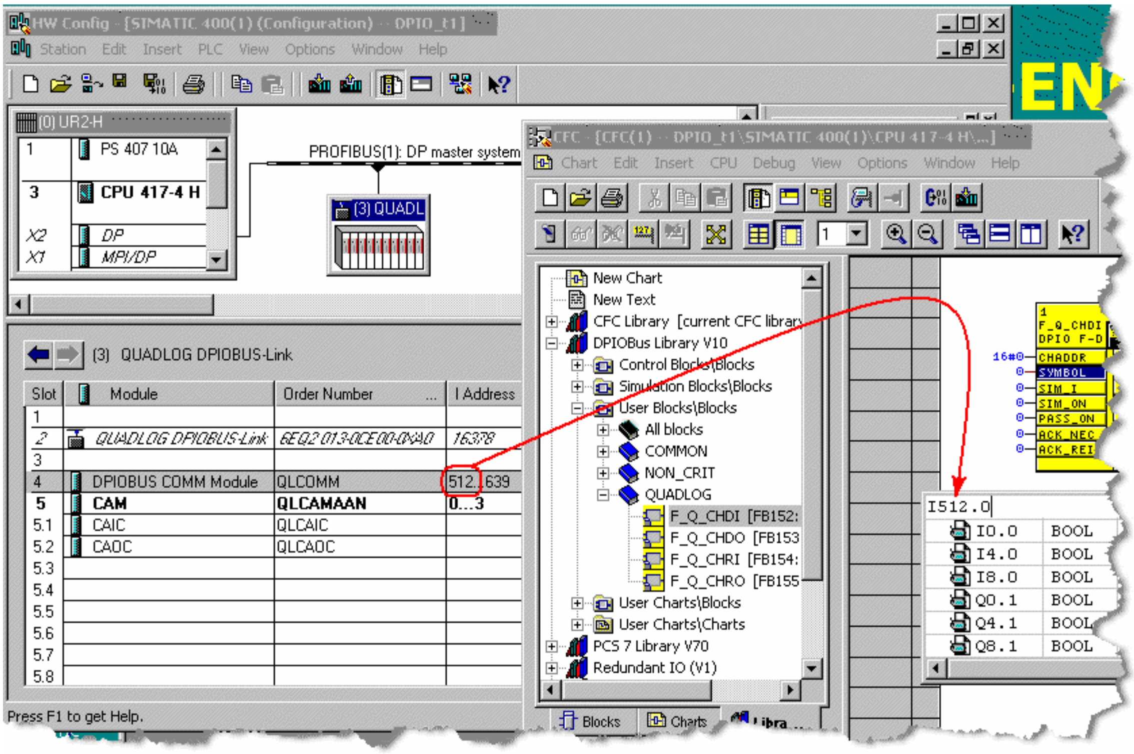
- A pop-up dialog box if *Generate Module Drivers* is invoked from Simatic Manager.
- The compile logs (when compiling within the CFC editor)

The procedure is as follows:

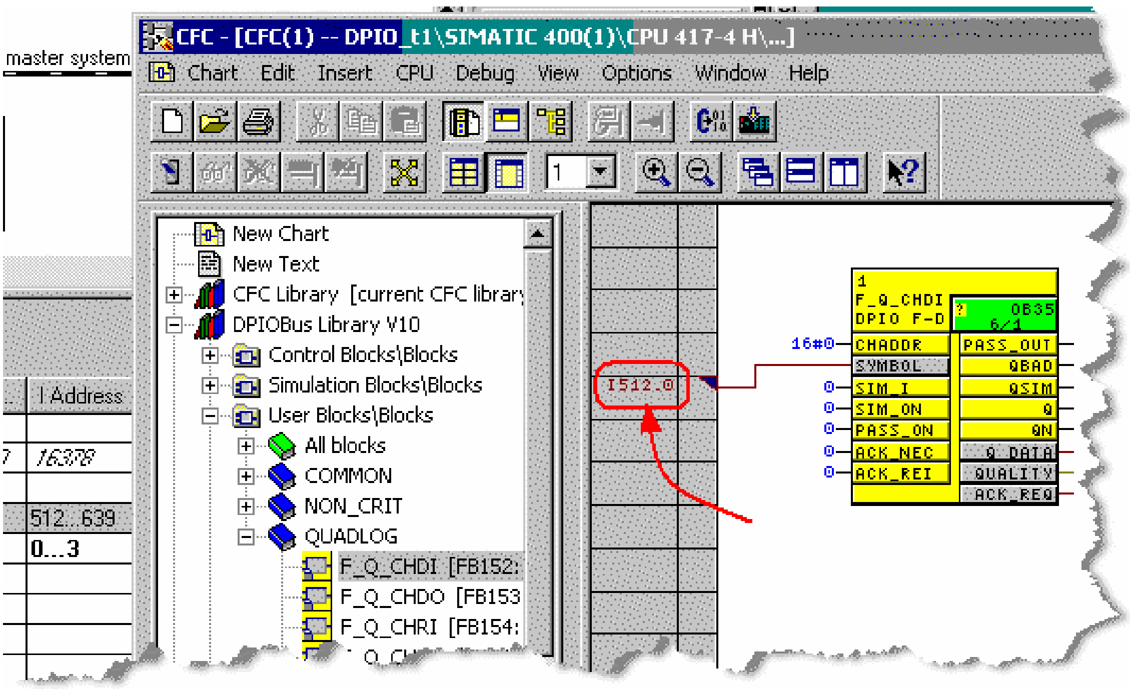
1. With HW config and the CFC editor open, drag and drop the F_Q_CHDI block from the QUADLOG function block library to CFC chart.
2. Select the **SYMBOL** input and press the **F3** key.
   The **Interconnection to Address** dialog box opens:



3. Examine the HW Config display to determine the address to enter at the cursor's position in the dialog box. As the illustration below indicates, the address in this instance is 512. The address must be preceded with *I* (uppercase I) and followed with *.0* (period zero):



The illustration below shows the successful result of assigning the address. The chart is ready for compiling with the **Generate Module Drivers** option enabled.



8.18 Specifying Channel Softlist Parameters with the PARM_RW Block

See I/O Module Parameters for information about Softlist parameters for specific channel types.

AN_INPUT_FLT_STATE

NO_CHANGE	0
MIN_RANGE	1
MAX_RANGE	2

ANALOG_FLT_STATE

OFF	0
HOLD_LAST_STATE_ ANALOG	1
PRESET_VALUE	2

BOOLSEG_TRUE_FALSE

BOOLSEG_FALSE	0
BOOLSEG_TRUE	1

BURNOUT

DISABLE	0
UP	1
DOWN	2

CURRENT_RANGE

OUTPUT4_20MA	0
OUTPUT0_20MA	1

DIG_FLT_STATE

OFF	0
ON	1
HOLD_LAST_STATE	2

ENABLE_FLAG

DISABLE	0
ENABLE	1

ENGUNITS (alphanumeric, by name)

%LVL	115
ACFH	72
ACFM	73
AMPS	18
ATM	3
bar	81
BARG	112
bbl	82
bhp	83
Blank (no unit)	20
BPD	74
bph	118
Btu	75
Btu/hr	95
Btu/lbm	96
Btu/SCF	76
cal	101
cal/hr	103
cal/lbm	104
cal/SCF	102
cm	97
cps	117
days	29
deg	69
DegC	5
DegF	6
DegK	8
DegR	7
ft	22
ft/sec	33
ft/sec2	34
ft3	24
ft3/lb	38
g	54
g/cm3	84
gal	116
gal/day	85
gal/hr	71

gal/min	4
GPD	77
GPH	78
GPM	79
Hp	86
hr	28
Hz	10
in	21
in3	23
InH2O	1
InHg	19
joules	87
kcal	105
kcal/hr	107
kcal/lbm	108
kcal/SCF	106
kg	55
kg/cm2	89
kg/day	66
kg/hr	65
kg/m3	62
kPa	58
kPaa	59
kPag	60
KPPH	40
kVA	88
kW	46
l/day	90
l/hr	98
l/min	99
lb	30
lb/ft3	37
lb/hr	119
liter	11
m	51
m/sec	56
m/sec2	57
m3	53
m3/day	68
m3/hr	67
m3/kg	64
mA	12
mbar	91
MBRA	114
MBRG	113

MCFH	42
mhos	92
mil	121
min	27
ml	52
Ml b/hr	120
mm	50
mmHg	61
mol	32
mol/m3	63
ms	25
mS/cm	123
mV	9
MW	47
NM3/H	111
Ohms	14
Percent	0
pH	93
PPH	15
Ppm	39
psi	2
psia	35
psig	36
pulses	48
rad	70
rpm	49
S/cm	122
SCCM	100
SCFH	16
SCFM	17
sec	26
t/day	41
ton	31
tonne	109
tonne/day	110
VA	80
vars	94
Volts	13
W	45
yd3/day	44
yd3/hr	43

ENGUNITS (numeric order, by integer)

Percent	0

InH2O	1
psi	2
ATM	3
gal/min	4
DegC	5
DegF	6
DegR	7
DegK	8
mV	9
Hz	10
liter	11
mA	12
Volts	13
Ohms	14
PPH	15
SCFH	16
SCFM	17
AMPS	18
InHg	19
Blank (no unit)	20
in	21
ft	22
in3	23
ft3	24
ms	25
sec	26
min	27
hr	28
days	29
lb	30
ton	31
mol	32
ft/sec	33
ft/sec2	34
psia	35
psig	36
lb/ft3	37
ft3/lb	38
Ppm	39
KPPH	40
t/day	41
MCFH	42
yd3/hr	43
yd3/day	44
W	45

kW	46
MW	47
pulses	48
rpm	49
mm	50
m	51
ml	52
m3	53
g	54
kg	55
m/sec	56
m/sec2	57
kPa	58
kPaa	59
kPag	60
mmHg	61
kg/m3	62
mol/m3	63
m3/kg	64
kg/hr	65
kg/day	66
m3/hr	67
m3/day	68
deg	69
rad	70
gal/hr	71
ACFH	72
ACFM	73
BPD	74
Btu	75
Btu/SCF	76
GPD	77
GPH	78
GPM	79
VA	80
bar	81
bbl	82
bhp	83
g/cm3	84
gal/day	85
Hp	86
joules	87
kVA	88
kg/cm2	89
l/day	90

mbar	91
mhos	92
pH	93
vars	94
Btu/hr	95
Btu/lbm	96
cm	97
l/hr	98
l/min	99
SCCM	100
cal	101
cal/SCF	102
cal/hr	103
cal/lbm	104
kcal	105
kcal/SCF	106
kcal/hr	107
kcal/lbm	108
tonne	109
tonne/day	110
NM3/H	111
BARG	112
MBRG	113
MBRA	114
%LVL	115
gal	116
cps	117
bph	118
lb/hr	119
Ml b/hr	120
mil	121
S/cm	122
mS/cm	123

FREQ_RESOLUTION

BITS_10	0
BITS_12	1
BITS_14_FR	2
BITS_16	3

INTSEG_50_60

INTSEG_50HZ	0

INTSEG_60HZ	1

INTSEG_YES_NO

INTSEG_NO	0
INTSEG_YES	1

RESOLUTION

BITS_13	0
BITS_14	1
BITS_15	2
BITS_16	3

RTD_TYPE

RTD_100_IEC	0
RTD_100_USA	1
RTD_200_IEC	2
RTD_200_USA	3
RTD_100_DIN	4
RTD_LINEAR	5

TC_TYPE

TCType_B	1
TCType_E	3
TCType_J	4
TCType_K	5
TCType_N1	6
TCType_R	7
TCType_S	8
TCType_T	9
TCType_N2	10

TC_UNITS

TC_ENGDEGF	0
TC_ENGDEGC	1
TC_ENGDEGK	2
TC_ENGDEGR	3

THRESHOLD

REGULAR	1
TTL	2

VOLTAGE_RANGE1

VDC1_TO_5	0
VDC0_TO_5	1
VDCNEG10_TO_10	2
VDCNEG5_TO_5	3
VDCNEG1_TO_1	4
VDCCUSTOM	5

VOLTAGE_RANGE2

VDC0_TO_5	0
VDC1_TO_5	1

8.19 Passivation and Reintegration of the Input and Output Channels

Passivation

Passivation means that in the event of a fault/error, one or more channels of an F-I/O are switched to the safe state.

When a channel fault occurs (e.g. sensor defective), only the **affected** channel is passivated. In the event of a module fault/error (e.g. communication error), all the channels of the F-I/O are passivated. The messages on the ES/OS indicate whether all channels or only specific channels of a fail-safe module are passivated.

Passivation can be triggered by the F-I/O, the F module driver or F channel driver or by the user in the safety program.

If an F-I/O detects a fault/error, it switches the affected channel or all its channels to the safe state. In other words, channels of this module are passivated. The F-I/O reports detected error to the F driver block.

- **Passivation of output channels** means that the outputs are de-energized. The F channel driver of a passivated digital output channel outputs a substitute value with the quality code (QUALITY) 16#48 and the output QBAD = 1 is set.
- **Passivation of input channels** means that substitute values are forwarded to the safety program regardless of the current process signal. The F channel driver of a passivated digital input channel outputs the substitute value 0 with the quality code (QUALITY) 16#48 and the output QBAD = 1 is set. Depending on the parameterization at the input SUBS_ON, the F channel driver of an analog input channel outputs a substitute value with the quality code (QUALITY) 16#48 or the last valid value with the quality code (QUALITY)

16#44 . In addition, the output QBAD = 1 is set and, if a substitute value is output, the output QSUBS = 1 is set as well.

Via the input PASS_ON, you can also switch the passivation of a channel on and off in the safety program (e.g. depending on certain conditions in the execution of the program). If PASS_ON = 1 is set, the channel is passivated as described above. If PASS_ON = 0, passivation is canceled.

Group Passivation

In the event of a fault or error, other channels (of the same or different modules) can be passivated by interconnecting the input PASS_ON with the output PASS_OUT of another channel. For a group shutdown of several channels, all the PASS_OUT outputs of the channels in this group are ORed, and the result is sent to the PASS_ON inputs of all the channels in this group.

A group shutdown by means of PASS_OUT/PASS_ON can also be used to force a simultaneous switchover to process values after a startup (cold or warm restart).

Reintegration After Error Correction

Reintegration means:

- Valid process values are output again on the output channels of the fail-safe output modules.
- The F channel drivers of the fail-safe input modules forward valid process values to the safety program again.

After an error/fault is corrected, a channel of a fail-safe module can be reintegrated automatically or after a user acknowledgment. At the input ACK_NEC of an F channel driver, you can specify whether a user acknowledgment is required:

- **Value 0**: automatic reintegration without user acknowledgment
- **Value 1**: request of user acknowledgment for reintegration after fault/error correction

If passivation is caused by setting PASS_ON = 1, no user acknowledgment is required for reintegration.

Automatic Reintegration

If the input ACK_NEC is not set, after the correction of the fault/error (with the exception of communication errors) reintegration (depassivation) of the affected channel is carried out automatically:

- In the case of input modules - immediately
- In the case of output modules - within minutes, due to the need for test signal application

After safety communications protocol errors, a user acknowledgment is always required for reintegration (output ACK_REQ set), even when ACK_NEC is not set.

Note

After safety communications protocol errors, a user acknowledgement is **always required** for reintegration (output ACK REQ set), even when ACK NEC is not set.

Note

In the event that an F-I/O module is removed, all F channel drivers for the module are passivated. To prevent the automatic reintegration of these F channel drivers when the module is reinstalled, the input ACK_NEC of the F channel drivers must be set to 1.

Warning

Safety Note - Automatic Reintegration may not always be possible

The parameterization of the input ACK_NEC=0 is only permitted if automatic reintegration is permissible for the process from a safety point of view.

The permissibility of automatic reintegration depends on the process and must be agreed with the acceptance authority.

Warning

Safety Note - Startup Protection to handle short power failures in the F-I/O

Following a power failure in the F-I/O that is shorter than the watchdog time set for the F-I/O in *HW Config* (See *Safety Engineering in SIMATIC S7* system description), automatic reintegration can occur, as is the case when ACK NEC = 0, regardless of your setting for ACK NEC. If automatic reintegration for the affected process is not permitted for this case, you must program startup protection by evaluating the variables QBAD or PASS_OUT (see Programming Startup Protection).
When a power failure occurs in the F-I/O and lasts longer than the watchdog time set for the F-I/O in HW Config, the F-system detects a communication error (see *Passivation and Reintegration of the F-I/O after Communication Errors*).

Reintegration After User Acknowledgment

If the input ACK_NEC is set, the reintegration of the input or output channel does not take place until after a user acknowledgment with a positive edge at the input ACK_REI of the F channel drivers. At the output ACK_REQ of the F channel driver, a value of 1 indicates that the error has gone and that a user acknowledgment of the reintegration is possible.

You can implement the user acknowledgment of reintegration in the Safety Program as follows:

- A manual input using OS/ES (see below) or
- A hardware switch connected to a fail-safe input module.

Note

In the event of a safety communications protocol error on the fail-safe input module with the hardware switch, manual acknowledgment of the input ACK_REI is no longer possible. This can lead to blocking, which can only be corrected by means of a startup (cold or warm restart).

We therefore recommend that the acknowledgment is also always possible via ES/OS.

User Acknowledgment by Means of OS/ES

You can use the F_QUITES block in the following way for fail-safe acknowledgment using a non-fail-safe Engineering System or Operator Station:

Insert the F_QUITES block in the runtime group of the F channel driver.

Interconnect the ACK_REI input of the F channel driver with the OUT output of F_QUITES.

Warning

Safety Note - Automatic Reintegration through F_QUITES

The non-safety-related input IN of F_QUITES must not be interconnected with a signal or defined by a signal that automatically produces the above mentioned condition (change from 6 to 9 within a minute) for a fail-safe acknowledgment. The fail-safe acknowledgment can only be produced by means of **conscious, manual input on the ES/OS**, not automatically in the program.

Behavior in the Case of Module Redundancy

In the case of module redundancy, user acknowledgment after reintegration is only required if both redundant modules have a fault at the same time.

9 Failure and Recovery in Redundant Systems

Manually Clearing errors

See the section titled Error Status Pane.

9.1 Shutdown Logic

Shutdown logic is contained within each DP/IO Bus Link module. This logic causes the DP/IO Bus Link module to shutdown output channels on its side when it detects a failure of its I/O or of its ability to process its I/O. After a shutdown, input channels are still read and may still be used in critical systems for comparison with input values for the operational side.

How the Shutdown Logic Works

The shutdown logic uses system diagnostic information to determine whether the system is sufficiently capable of performing I/O reads and writes. Diagnostics are ranked into several classes (class 1 through class 4). The most serious, a class 4 diagnostic, indicates a failure in which the component reporting the diagnostic has failed in a way that inhibits a safety demand.

The default shutdown logic gathers diagnostics from the control and I/O components of the system. A shutdown is generated if any of the following system diagnostics are active:

- A class 4 (severe) error reported on the DP/IO Bus Link module.
- A class 4 error reported by any of the I/O modules being scanned by the DP/IO Bus Link module.
- The occurrence of a system cold start.

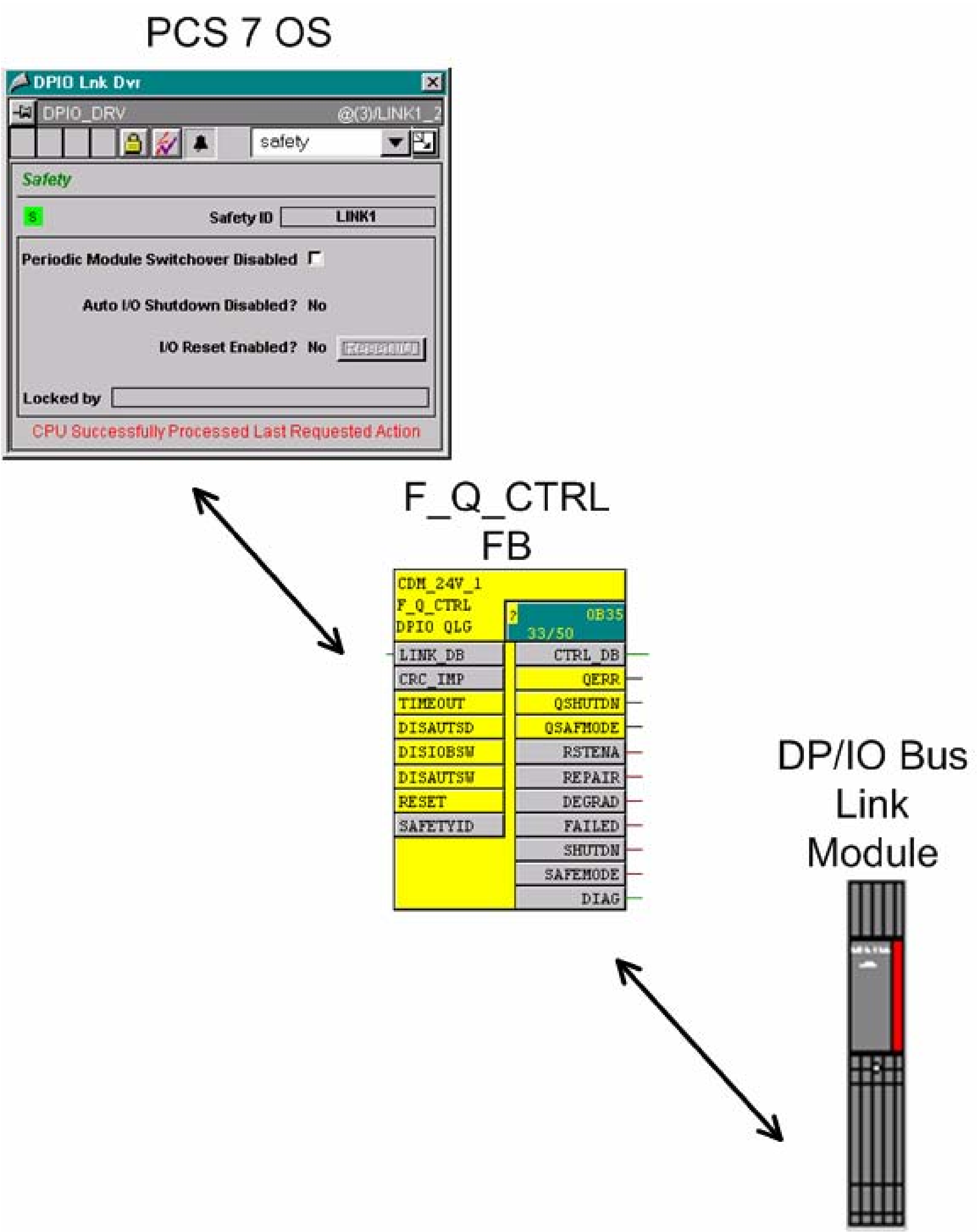
The shutdown logic only shuts down one side of a redundant system.

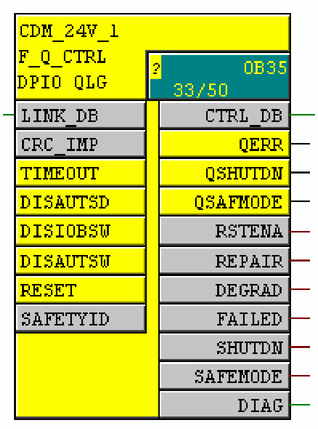
In a node-to-node redundant system (redundant pairs of CPUs, DP/IO Bus Link modules, and I/O modules), if the DP/IO Bus Link module detects a class 4 error, switchover to the failed DP/IO Bus Link module is disabled until repairs are made. If the remaining DP/IO Bus Link module detects a class 4 error, the default shutdown logic activates the System Failed flag and automatically shuts down (if Disable Auto Shutdown is FALSE).

Shutdown Logic and the F_Q_CTRL (Failsafe QUADLOG Control) Function Block

When a project is configured and compiled with the DP/IO Bus Link module, the compiler automatically configures function block logic necessary to communicate with the DP/IO Bus Link module and the associated I/O modules. These blocks are instantiated by the module driver wizard (the module driver wizard executes when a compile within CFC is performed with the **Generate Module Drivers** checkbox selected).

The F_Q_CTRL block is one of the blocks that the module driver wizard automatically creates within the project. This block contains an interface between diagnostic data and user actions to manage the shutdown logic within the DP/IO Bus Link module and the S7-400 CPU. The F_Q_CTRL block also has an interface that communicates diagnostic data and user's actions between the PCS 7 OS and the S7-400 CPU (the S7-400 CPU is where the F_Q_CTRL block resides) shown in the figure below:





The F_Q_CTRL function block is shown above. When configured for auto-shutdown, this block operates as a latching flip-flop. The shutdown logic outputs of the I/O Shutdown block can be used to trigger annunciation of the various states of the system. During normal operation, the **REPAIR**, **DEGRAD** (degraded), **FAILED**, and **SHUTDN** (shutdown) outputs should remain FALSE. A transition to TRUE on any of these outputs indicates that some level of repair is needed for the system. Any of these outputs can drive physical outputs to annunciate the level of system repair required.

There are five states of operation within the shutdown logic:

- Operational (not shutdown)
- Shutdown
- Degraded
- Failed
- Repair.

These states are observed from within the F_Q_CTRL function blocks outputs or through the DP/IO Bus Link safety pane in the OS.

The outputs of the F_Q_CTRL block which are used to display this state are **SHUTDN**, **FAILED**, **DEGRAD**, and **REPAIR**. The operational state is represented by **SHUTDN** equal to FALSE.

Caution

Connections made to function blocks within @ charts (the **@** sign indicates a chart created automatically by the module driver wizard or the compiler) may be broken under certain circumstances. Please update necessary checklists to ensure the connected user logic still remains after an update of the system.

If the outputs are connected to a form of annunciation and these devices are relied upon for important visual or audible alarm then this recommendation should be followed.

The **REPAIR** output, when TRUE, indicates that the system is in need of repair. This output is active when a class 2, 3, or 4 error exists in the system regardless of whether the system is configured for auto-shutdown. If only non-critical class 2 or 3 errors exist, this is the block's only active output. It is recommended that any system failures be repaired as soon as possible. The class 2, 3, or 4 errors that cause the system to need repair are listed in the PCS 7 OS within the faceplate displays for the DP/IO Bus Link module and the associated I/O modules. Automatic periodic switchovers are ordinarily disabled whenever the system is in need of repair, but if both sides are in the same equal state of disrepair, automatic periodic switchovers are still enable. For, example, both sides have a one class 2 error.

The **DEGRAD** output indicates that a critical class 4 error exists in the system or the auto-shutdown latch has not been cleared. Repair action should be taken in a timely manner whenever critical errors are reported. If the system is degraded, redundancy has been lost and a failure on the remaining functional side of the system will cause a system failure. Whenever the system is degraded, the following actions take place:

- The **DEGRAD** output is set to TRUE.
- A SSC 30, EC 06 diagnostic error code is reported for the DP/IO Bus Link module if DISAUTSD is set to 0 or FALSE.

The **FAILED** output indicates that critical errors exist on both sides of the redundant system. The entire system has failed. If auto-shutdown is not selected, the FAILED output indicates that the integrity of the I/O modules' output data is in question. Repairs should be made to the system immediately. When auto-shutdown is not configured, only the I/O modules disable their outputs based on their own diagnostics. These I/O errors are still reported to the DP/IO Bus Link module.

The **SHUTDN** output indicates that a system configured for auto shutdown has disabled the I/O modules' outputs. This state is latched and must be reset after the critical errors are repaired. Whenever a shutdown is requested and auto-shutdown is configured, the following actions take place:

- The outputs for the I/O modules are disabled.
- The **SHUTDN** output is set to TRUE.
- Error code SSC 30, EC 06 (QUADLOG ACM/CCM Shut Down module outputs) is reported for each DP/IO Bus Link module indicating outputs are disabled. Switchovers are disabled.

The inputs and outputs of this block are defined as follows (see the section titled F_Q_CTRL for information about other inputs and outputs for this block):

RESET (Reset input) - Accepts a BOOL value. Used for resetting the block after an auto shutdown. When RST_EN is TRUE, and the RESET input senses a FALSE to TRUE transition, the side that was shut down clears.

Notes

- Only the **SHUTDN** and **DEGRAD** outputs latch when **DISAUTSD** is FALSE. The **REPAIR** and **FAILED** outputs automatically clear when the shutdown condition is cleared. If **DISAUTSD** (disable auto shutdown) is TRUE, **DEGRAD** automatically clears when the offending shutdown-level condition is cleared.
- Make no connections to the **RESET** input. The reason for this is that the PCS 7 OS DP/IO Bus Link safety pane is intended to communicate with the **RESET** input. If a connection were able to be made to this input, the reset button within the PCS 7 OS DP/IO Bus Link safety pane would not function.
- The **RESET** input may be used within CFC. The **RESET** input is rising edge sensitive.

DISAUTSD (Disable Auto Shutdown input) - Accepts a BOOL value. When FALSE, any shutdown level (class 4) error on the controller or any of the scanned I/O modules causes an automatic shutdown (outputs are disabled) of the side of the system reporting the error. An automatic shutdown can also be caused by a cold start of the DP/IO Bus Link module (restart after a power failure lasting longer than a user-defined length of time).

RSTENA (Reset Enabled output) - Delivers a BOOL data value. When TRUE, indicates that either side of the system is shut down, and there are no active shutdown level conditions (class 4 error or cold start occurred) on that side.

REPAIR (System in need of Repair output) - Delivers a BOOL data value. When TRUE, indicates that there is a class 2, 3, or 4 error in the system. While in need of repair, the system discontinues auto-switchover (remaining on the side with less severe errors).

DEGRAD (System Degraded output) - Delivers a BOOL data value. When TRUE, indicates that the standby side of the system is shutdown, and that there is a loss of redundancy. If auto shutdown is enabled, this state is latched until the shutdown condition is cleared, and a **RESET** is issued.

FAILED (System Failed output) - Delivers a BOOL data value. When TRUE, indicates that both the master and standby sides of the system have failed due to at least one shutdown condition on each side.

SHUTDN (Auto Shutdown output) - Delivers a BOOL data value. When TRUE, indicates that both the master and standby sides of the system have failed and disabled their outputs due to at least one shutdown error on each side. **DISAUTSD** input must be FALSE for **SHUTDN** to become TRUE.

Warning

Safety Note - Maintenance Overrides

There are occasions during the life of a Safety Instrumented System (SIS) when inputs must be overridden for maintenance purposes. The SIS design must account for these situations and provide for safe operation of the process during maintenance.

Warning

Safety Note - TÜV Maintenance Override Criteria

The TÜV document Maintenance Override requires the following override criteria for all programmable safety systems:

- Only inputs may be overridden.
- All inputs that can be overridden must be predefined during the design process. A list of these inputs must be maintained on the system.
- Only one input may be overridden for each defined process unit.
- Logic must be configured to allow a single command to disable all maintenance overrides at once.
- Maintenance overrides may not last longer than one shift.

Warning

Safety Note - Automatic shutdown not always desirable

Having an automatic shutdown occur in response to a system failure may not be desired in all applications. To disable the default automatic shutdown function, configure the Auto Shutdown (**DISAUTSD**) input of the F_Q_CTRL block to be TRUE. System failure is still annunciated, but shutdown does not automatically take place.

Automatic shutdown may be disabled in applications where the operator has sufficient means to monitor and shut down the process, independent of the system, and the process safety time is sufficiently long to ensure a safe, manual reaction to the shutdown.

Furthermore, the user may choose to incorporate the system failure flag into the application-specific process shutdown logic to automatically trip the appropriate process equipment on system failure. This is a form of automatic shutdown using the application shutdown logic, rather than the default configuration, to set the outputs to their fail safe states.

Note

Although this block has inputs and outputs which can be used within CFC, some of these inputs are not permitted to be linked to external sources. Please see the details of the F_Q_CTRL block for a list of details on this block. The PCS 7 OS is intended to be used as the method which interfaces between the user and the DP/IO Bus Link module.

See the Safety Note titled DP/IO Bus Link Module only supports the equivalent of a QUADLOG Total I/O Shutdown in the section titled Differences Between QUADLOG CCM and DP/IO Bus Link Module Operation

Note

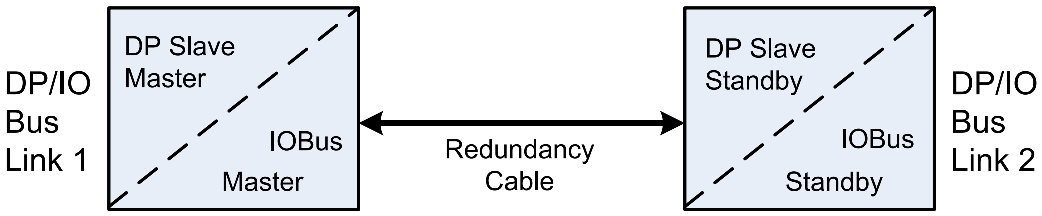
The inputs and outputs of the F_Q_CTRL function block may be used within CFC directly to determine the status of the system in the event that a PCS 7 OS is not available. This may occur during initial system design or system testing. To locate the instance of this block use the Cross Reference tool within CFC to locate it See the section Configuring Additional Safety Channel Block Driver I/O, which discusses the use of this.

9.2 Redundancy Nomenclature

Siemens typically describes an active, controlling element of a redundant system as *master,* while the reserve side is regarded as *standby.* For Siemens, the terms *master* and *standby* describe the current logical status of a component or subsystem, a status that can change as the result of a detected failure or a prescribed switchover.

In this section, descriptions of redundant systems use terms that conform to both Siemens and PROFIBUS conventions. In some cases these descriptions result in awkward, but accurate constructions. In a PROFIBUS environment, for example, an S7 400 H CPU device is by definition a PROFIBUS *master*--regardless whether it is currently active, passive, controlling or standby--while a DP/IO Bus Link module is by definition a PROFIBUS *slave*, again, regardless whether it is active or in reserve.

As a result, redundant systems include a component whose name is oxymoronic, *DP Slave Master*, mirrored by a device with a less awkward label, *DP Slave Standby.* As with other system components, in static illustrations in this section the current status of the component is listed in its label. Thus, the DP Slave Master is labeled *DP Slave Master*, while the DP Slave Standby is labeled *DP Slave Standby,* but note that master-standby status is a logical designation that can change according to system operation.



In addition, the terms *A side, B side, Link 1* and *Link 2* refer to physical entities, which at any point may be either logically *master* or *standby.*

Terms and Concepts Used to Describe Redundant Systems

Term or phrase	Description
Exception	Process core on the DP/IO Bus link module detects an invalid bus operation or instruction
Degraded status	The standby side of the system has failed, and that there is a loss of redundancy, so there can be no IOBus switchover.

Reintegrate I/O	See Passivation and Reintegration of the Input and Output Channels.
Class 1 error	See Error Detection and Error Handling.
Class 2 error	
Class 3 error	
Class 4 error	
Shutdown channel	A shutdown channel is a safety critical channel. A channel failure that normally causes only a class 2 or class 3 error, perhaps because of a detected open or short circuit error, is also reported as a class 4 error on a shutdown channel. A shutdown channel is designated in HW Config as a parameter.
Periodic switchover	A IOBus switchover from master to standby requested by the CPU every 4 hours (default).
Immediate switchover	A IOBus switchover from master to standby initiated by a break in the **LoopOK** signal. If an I/O module is pulled from a rack, for example, the **LoopOK** is broken, the IOBus master indicates that it detects this problem, and the standby IOBUS immediately takes control. Understanding **LoopOK** key to understanding IOBus redundancy. See the section titled The LoopOK Signal.
Automatic switchover	A switchover that occurs based on error-count comparisons.
F_Q_CTRL block	See F_Q_CTRL and Shutdown Logic and the F_Q_CTRL (Failsafe QUADLOG Control) Function Block.
Error clearing	See the section titled Error Log Pane.
LoopOK	A signal the DP/IO Bus Link module sends to and reads from the I/O modules. A break in the signal triggers an immediate switchover.
Loop enable	A signal sent to the I/0 indicating whether the side is master or standby.
IOBus switchover	Change in the master/slave status of the IOBus
Crossload	Transfer of configuration from one link to another.
Manual error clearing	Acknowledgement of an error to remove it from the active error list.
Self-clearing error	Certain errors can self-clear if the condition that originally caused the error is rectified.

Conventions Used in Graphics Describing Redundancy

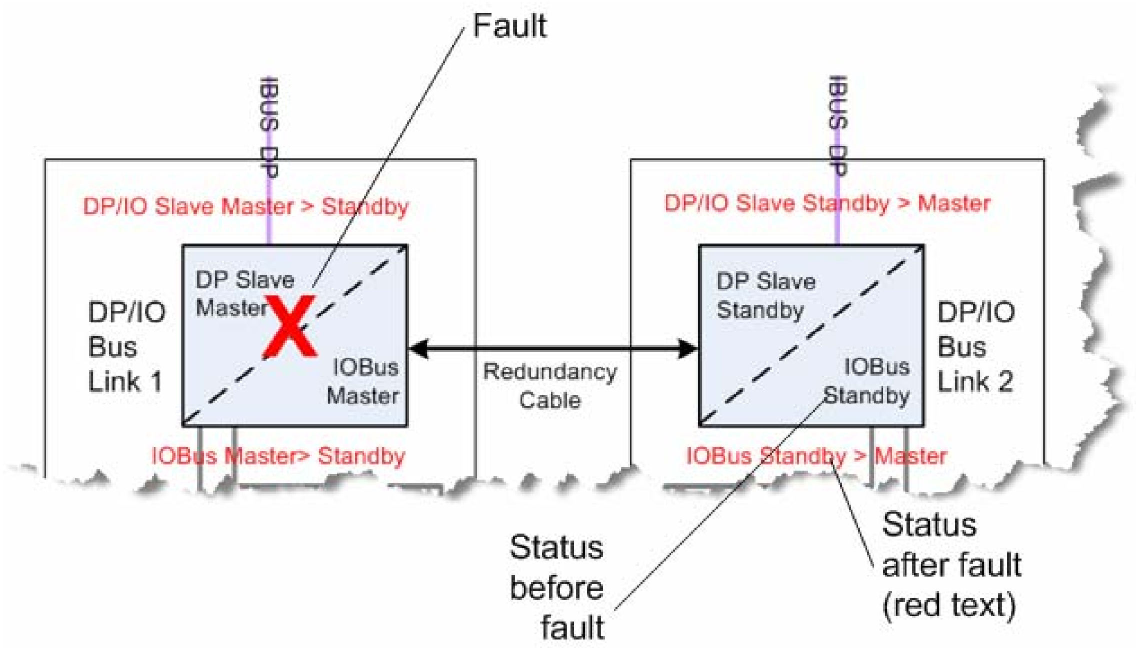
In the illustrations that describe failure and recovery of redundant systems, a large red X represents the failure or is superimposed over the component that has failed.

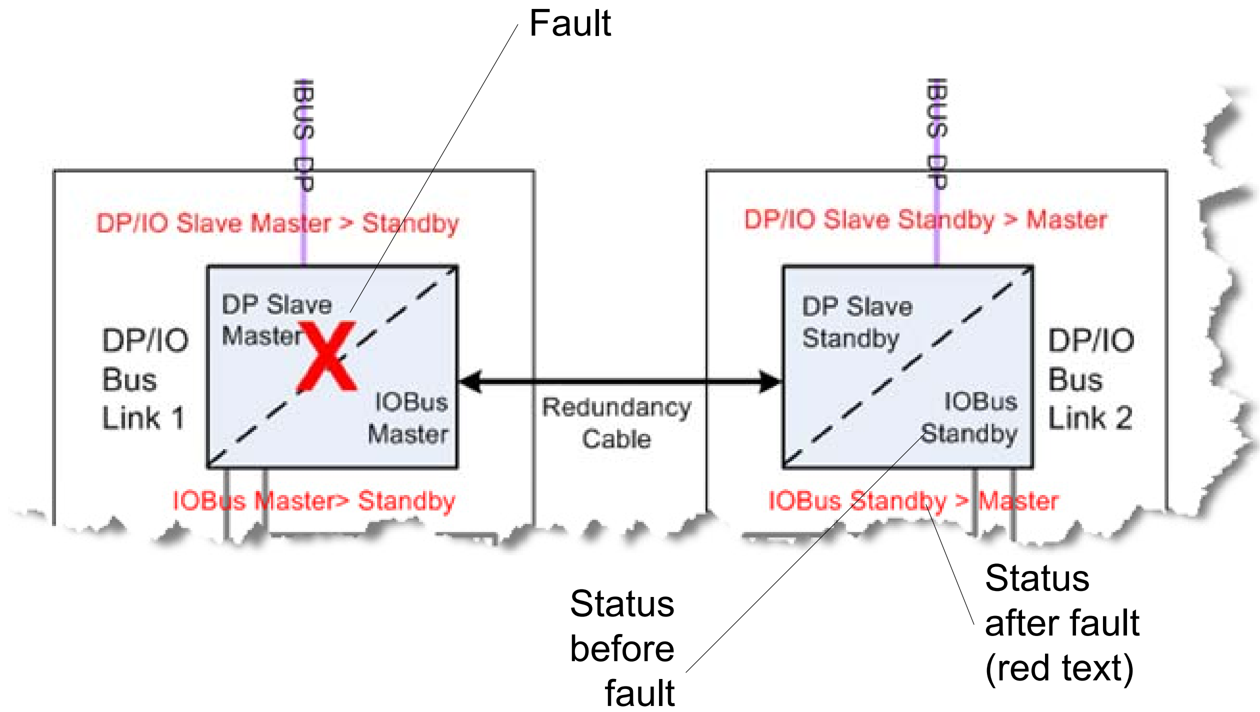
The system's reaction to failure is a dynamic process and is difficult to convey in a static diagram. To accommodate the changing status of system components, annotations in black typically indicate the pre-failure status, while annotations in red indicate changes in status resulting from failures. For example, if a failure causes a DP Slave Master to become a DP Slave Standby, this is indicated in illustrations in red text with an annotation such as the following:

DP Slave Master> Standby

A corresponding change in the status of the redundant partner is indicated with an notation like

DP Slave Standby > Master





9.3 The LoopOK Signal

LoopOK is a signal used on a node-to-node redundant system only. The system uses it to determine the health of the DP/IO Bus Link module and its associated I/O modules. The **LoopOK** signal is driven by the DP/IO Bus Link module and is sent along the MODULRAC backplane in serial fashion as follows:

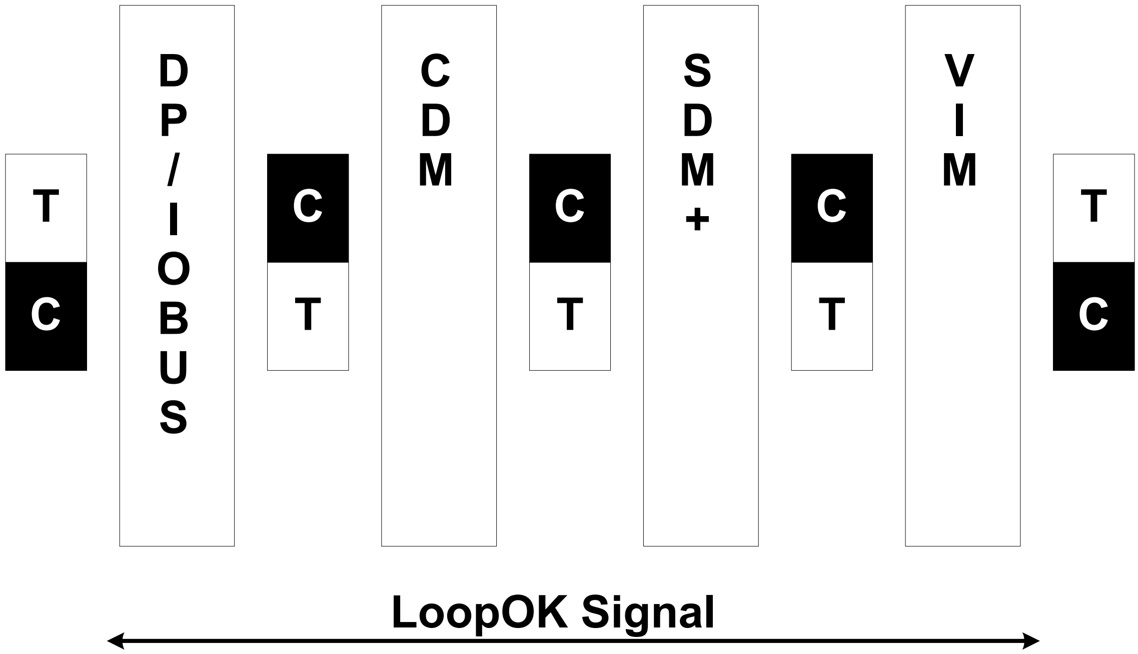
- From the DP/IOBus Link module
- To the MODULRAC backplane
- In turn, to each I/O module then back to the backplane
- To the I/IOBus Terminator Block set to the **I/O Bus Terminate** position
- Back to the DP/IOBus Link module

Removing the DP/IOBus Link module, like removing any I/O module in the MODULRAC, breaks the **LoopOK** signal. The DP/IO Bus Link module also uses the **LoopOK** signal to determine if there is a failure in its MODLURAC. Some I/O modules can themselves break the **LoopOK** signal if they detect specific system failures. The CDM 24 V module, for example, breaks the **LoopOK** signal if it determines than the 24 V power supply is missing. In this instance it also reports an SSC7 EC 18 (07:18) *I/O Power Failed Error* and an SSC 36 EC 03 (36:03) error message. The class 3 error count on the side experiencing this error is incremented accordingly, which helps prevent an I/IOBus switchover to its side. The healthy sides remains the IOBus master.

The Role of IOBus Terminator Blocks in the LoopOK Signal Path

The IOBus sub-system consists of the DP/IO Bus Link modules and a set of I/O modules that connect to terminal strips, then to a variety of terminal assemblies, and ultimately to field I/O devices. In its most basic configuration, the IOBus is located within a MODLURAC, although there are ways to extend the I/O Bus beyond a single rack. In node-to-node redundant systems, the IOBus on the A-side of the system is mirrored by an independent redundant partner on the B-side.

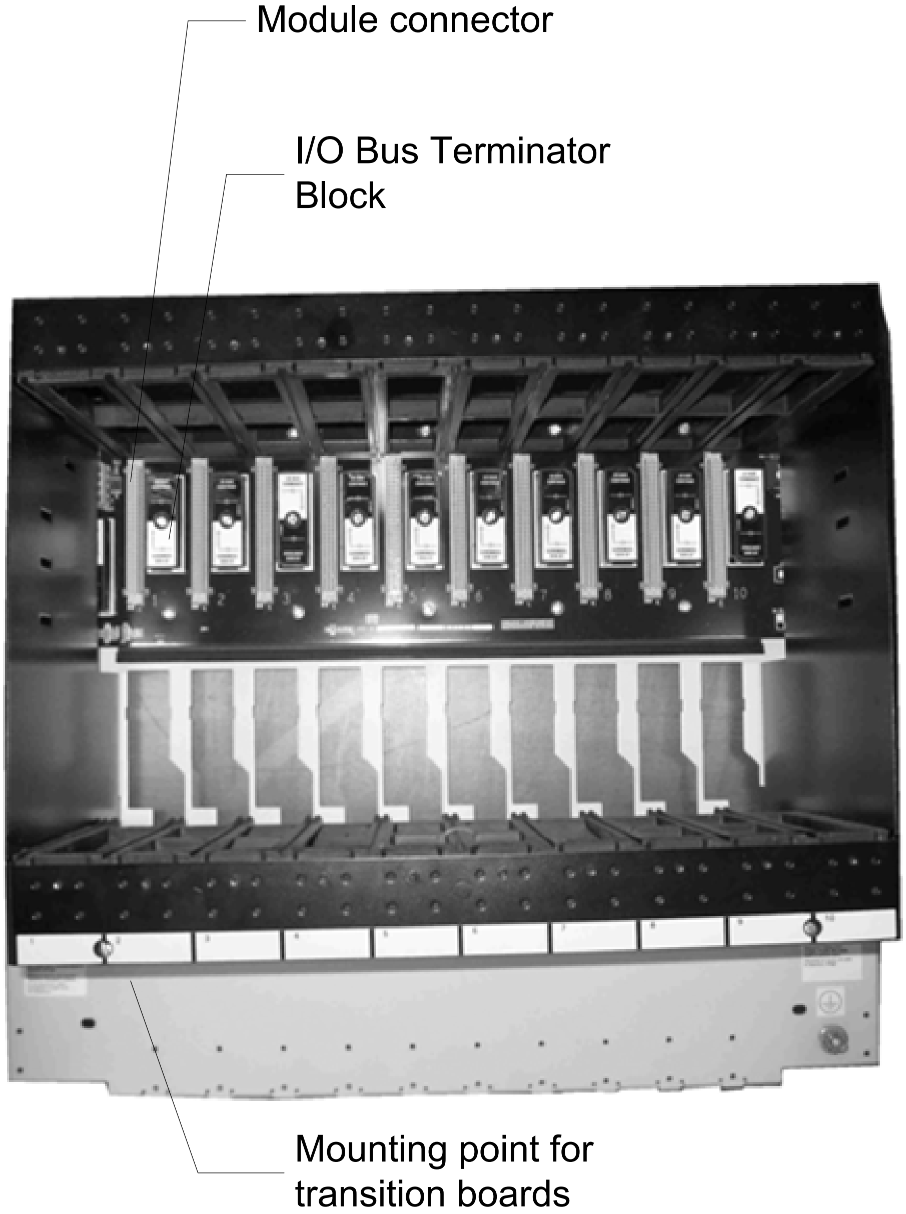
The block diagram below shows typical components of the IOBus located in between terminators. On both sides of the modules are *I/O Bus Terminator Blocks*, shown in the drawing as rectangles with **T** and **C** labels. Blocks with a **T** at the top are in the *Terminate* position, while blocks with a **C** on top are in the *Continue* position. The **LoopOK** signal extends between the two block placed in the **I/O Bus Terminate** position.



The continuity of the **LoopOK** signal requires the following:

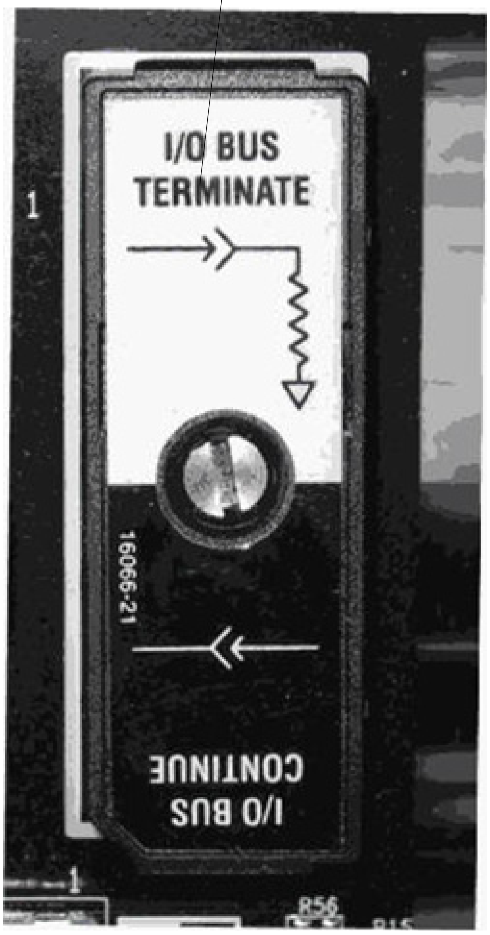
- Module slots between these **I/O Bus Terminate** blocks must contain modules, otherwise the **LoopOK** loop is interrupted,
- The I/O Bus Terminator blocks in intermediate positions must be installed in **I/O Bus Continue** position.

Below is an illustration of the inside of an empty MODULRAC, which shows I/O Bus terminators mounted directly on a printed-circuit board that serves as the MODLURAC backplane.



Bus-termination components are located in devices called *I/O Bus Terminator Blocks*, and are enabled by positioning the terminator block so that the notation *I/O Bus Terminate* is right-side up. Terminator blocks between the ends of the bus are positioned so that the notation *I/O Bus Continue* is right-side up. I/O Bus Terminator Blocks sit on both sides of module slots in the MODULRAC backplane. The illustration below shows a block in the *I/O Bus Terminate* position:

I/O Bus Terminator Block in *I/O Bus Terminate* position



In systems where the IOBus extends beyond the MODLURAC, the rack may have one or no blocks in the **I/O Bus Terminate** position. For more information about these advanced configurations, see the document titled *APACS+™/QUADLOG® MODULRAC and Local Termination Panel Installation and Service Instruction.*

Errors Reported when LoopOK is broken

In a running system, if an I/O module is removed, there is a failure like those described in the sections titled I/O Module Failure on IOBus Standby Side and I/O Module Failure on IOBus Master Side. The DP/IO Bus Link module reports an SSC 36 EC 03 (36:03) *LoopOK Broken* error. Other I/O modules on that side also report a 36:03 error. The DP/IO Bus Link module reports an SSC 36 EC 12 (36:12) *I/O Module Not Responding* error.

9.4 Error Detection and Error Handling

Extensive error-detection and error-handling capability is built into the DP/IO Bus Link module and I/O. Errors in communications, hardware failures, logic errors, and I/O module failures are detected and grouped into classes with ascending severity. Some errors are manually clearable. Manually clearable means that the error will remain persistent in an active error list until an authorized operator selects the error and manually clears it. If the error condition is still present, the same error will be reported again. Some errors self-clear when the condition that invoked them is rectified.

Class 1. These are informational or warning (has no effect on redundancy).

Class 2. This is the lowest class error and causes an IOBus switchover if the standby controller has fewer current class 2 errors and no class 3 or class 4 errors).

Class 3. A class 3 error points to a problem that is not severe enough to cause a shutdown. Class 3 errors can cause an IOBus switchover if switchover is enabled and if standby side has fewer class 3 errors and no class 4 errors. Examples:

- Class 3 error SSC 18 EC 03 (18:03) indicates that the partner is not present.
- Class 3 error SSC 30 EC 06 (30:06) indicates that outputs are shutdown. This error is usually accompanied by another , more severe class 4 error. This error is also reported at startup. Outputs for all I/O modules are shutdown if autoshutdown is enabled.

Class 4. The most severe errors are class 4. In a QUADLOG environment, they can cause a switchover and a shutdown on the side with the class 4 error. A switchover occurs if IOBus switchovers are enabled and if standby side has no class 4 errors.

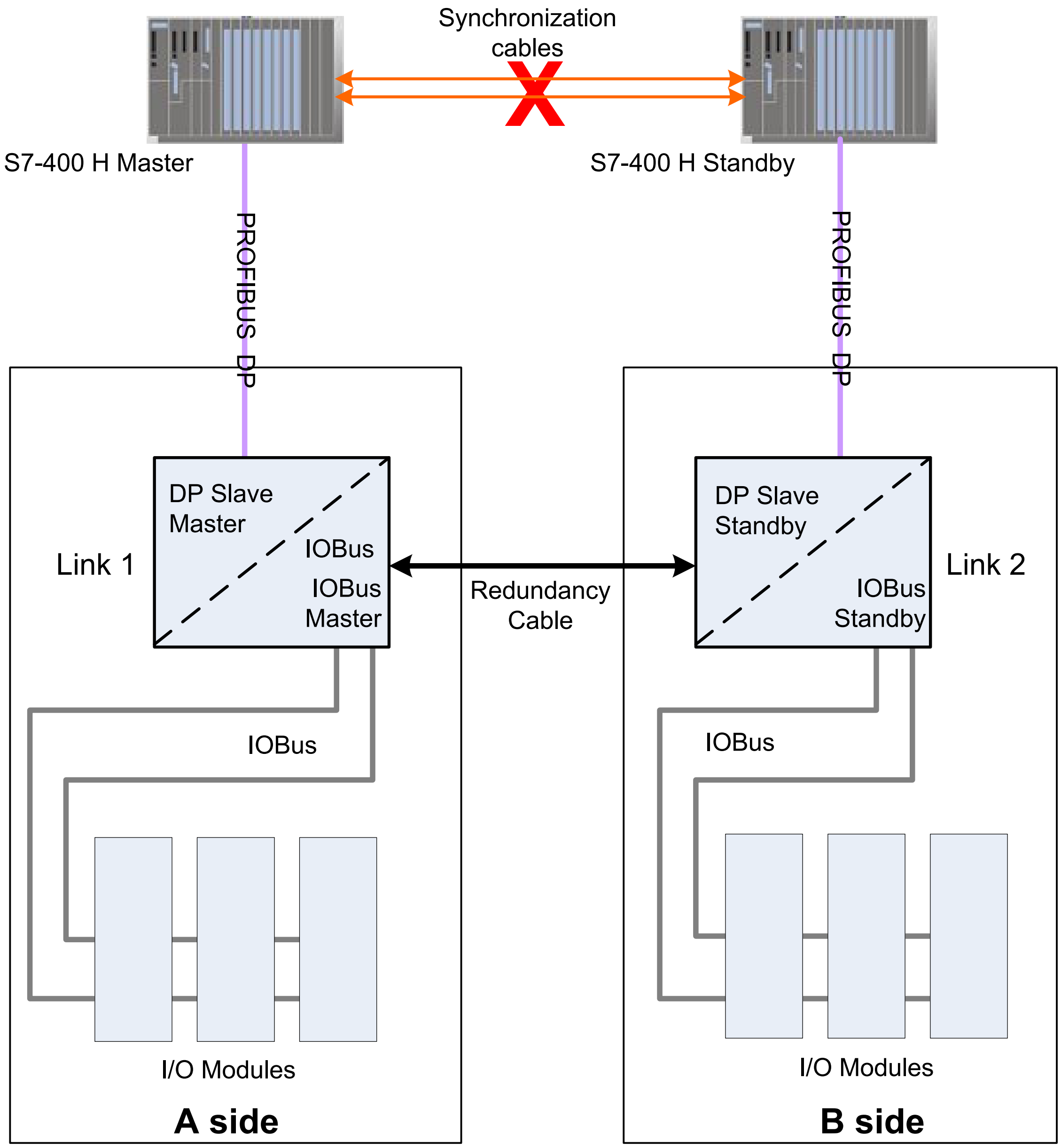
The DP/IOBus Link module may be configured in a Node to Node redundant configuration, meaning redundant pairs of CPUs, DP/IO Bus Link modules, and I/O modules.

9.5 S7-400 CPU Synchronization Link Failure

Scenario

A synchronization cable between the two S7-400 H CPUs is broken or removed.

Block Diagram



Results

Component	Status
S7-400 H CPUs	The S7-400 H CPU standby resets
DP	Unchanged
IOBus	Unchanged
I/O Modules	Unchanged

- The IOBus Master continues to process diagnostic data from IOBus modules.
- The IOBus Master continues to send outputs to I/O modules.
- The IOBus Master continues to send inputs to the CPU.

Recovery

Follow instructions in the S7-400 H CPU documentation.

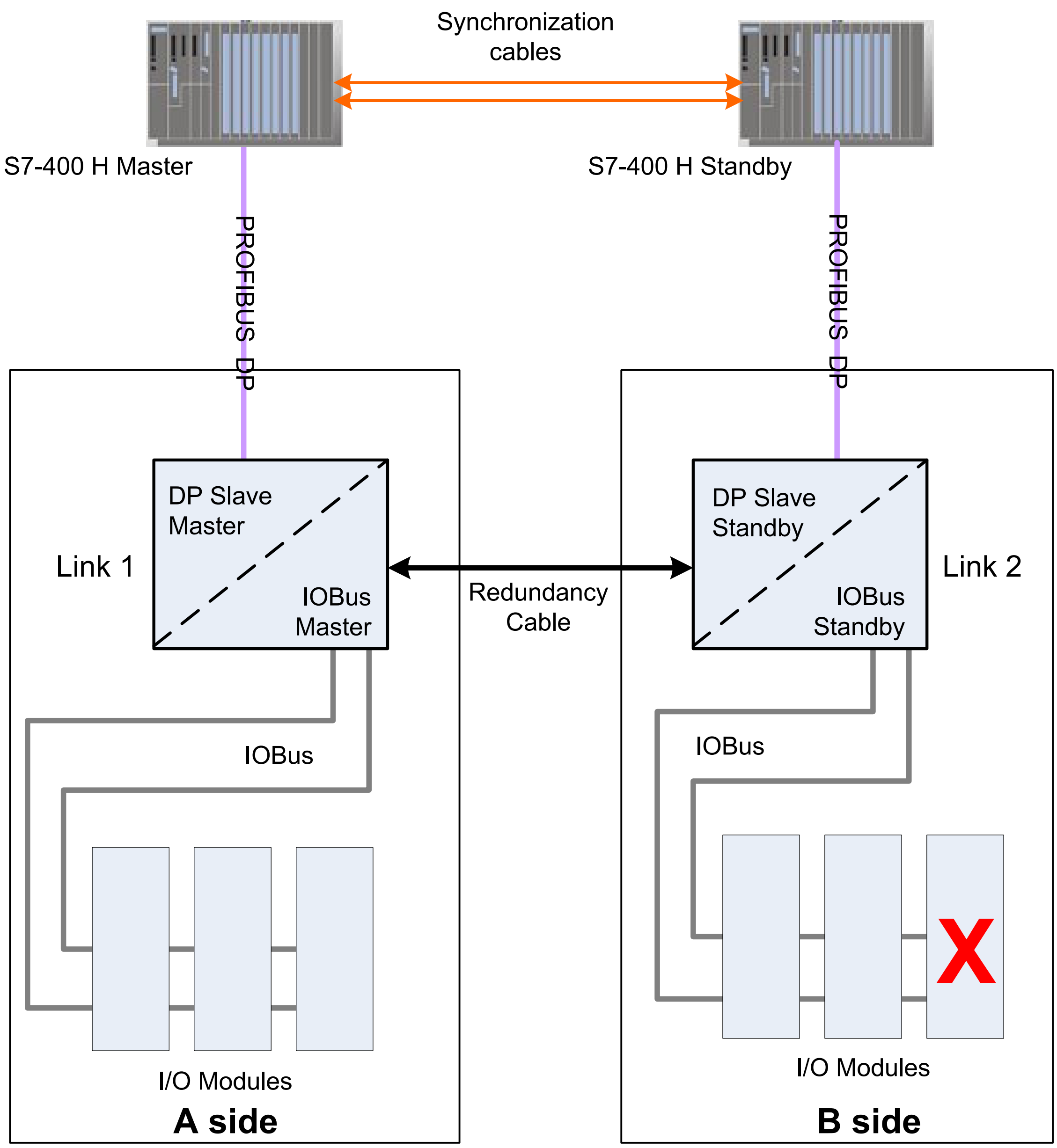
9.6 I/O Module Failure on IOBus Standby Side

Scenario

An I/O module in the IOBus Standby side encounters one of the following faults:

- The I/O module is removed, powered down, or experiences a hardware failure.
- The module encounters a class 2 or class 3 error.
- The module encounters a class 4 error.

Block Diagram



Results and Recovery

Component	Status
S7-400 H CPUs	Unchanged
DP	Unchanged
IOBus	Unchanged
I/O Modules	Link 2 side outputs disabled if automatic shutdown is enabled

Case 1: An I/O module is removed, it experiences a hardware problem, or an exception occurs.

1. The LoopOK signal on the IOBus backplane in interrupted. Since this occurs on the IOBus standby side, (Link 2), no switchover occurs.
2. Automatic switchovers are disabled because the LoopOK is broken and a class 4 error is reported on the DP/IO Bus module.
3. If Automatic Shutdown is enabled, the outputs on Link 2 side are disabled because of the class 4 error.

Case 1 Recovery: When the I/O module is reinserted or a recovery from the exception completes, the class 4 error automatically clears and the LoopOK error clears. If automatic shutdown is enabled, then the outputs of the system controlled by the DP/IO Bus Link module remain disabled until the user clears the error and resets the shutdown logic on the F_Q_CTRL function block. This is done by removing the condition that caused the error so it automatically clears. An operator can reset the DP/IO Bus Link shutdown logic by a faceplate control or, if the faceplate is not available, from within CFC by the following actions:

- Opening the chart containing the @F_Q_CTRL function block
- If the value on the RESET input is 0, entering a 1 followed by a 0 on the RESET input.

Case 2: An I/O module records a class 2 or class 3 error:

This assumes that Link 1 side is error free prior to this error being reported. When the class 2 or class 3 error is reported, automatic switchovers are disabled. As a result, the Link 1 module remains the IOBus master.

Case 2 Recovery:

When the error condition is removed and the class 2 or class 3 error is removed, the automatic and periodic switchovers are enabled again. The Link 1 module remains the IOBus Master until the periodic switchover occurs.

Case 3: The module reports a class 4 error.

When this error is reported on the IOBus Standby side the I/O module outputs will be shutdown if automatic shutdown is enabled on the F_Q_CTRL block. A switchover does not occur since the IOBus Master in Link 1 is already the IOBus Master. Automatic switchovers are disabled because of the class 4 error. The F_Q_CTRL block will report degraded status since Link 1 module is shutdown.

Recovery:
When the error condition is removed and the class 2 or class 3 error is

removed the automatic and periodic switchovers will be re-enabled. The Link 1 module will remain the IOBus Master until the periodic switchover occurs.
If automatic shutdown were set to false then the outputs would automatically be enabled if the class 4 error were cleared.

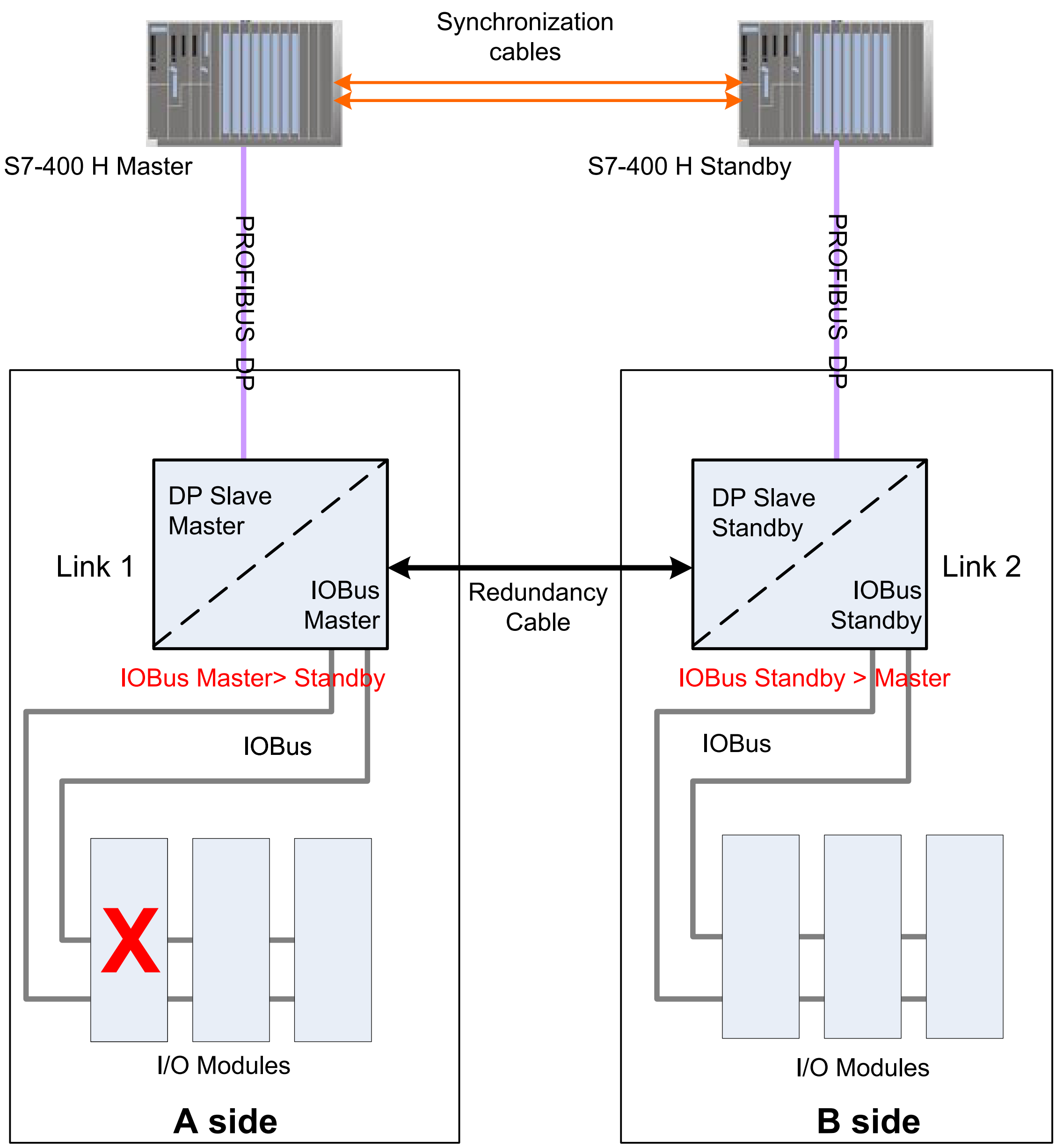
9.7 I/O Module Failure on IOBus Master Side

Scenario

An I/O module in the IOBus Master side encounters one of the following faults:

- The I/O module is removed, powered down, or experiences a hardware failure.
- The module encounters a class 2 or class 3 error.
- The module encounters a class 4 error.

Block Diagram



Results and Recovery

Component	Status
S7-400 H CPUs	Unchanged
DP	Unchanged
IOBus	Master > Standby Standby > Master
I/O Modules	Link 2 side outputs disabled if automatic shutdown is enabled. See Case 3 and 4 below.

Case 1: An I/O module is removed, it has a hardware problem, or an exception occurs.

If the fault were an exception or a power failure on the I/O module, the LoopEnable) signal is interrupted. The Link 1 master detects that the LoopOK signal is interrupted and reports a failure and a class 4 error. The Link 2 standby module determines that the master has this failure.

Case 1 Recovery: The Link 2 module requests a switchover. After the quick handshake, the Link 2 module takes control to become the IO Bus master. The Link 1 module reports that the I/O module is no longer present.

When the I/O module is functional again, the class 4 error is automatically cleared and the LoopOK signal is asserted again. If automatic shutdown is enabled, then the I/O module outputs will remain disabled until the user clears the error and resets the F_Q_CTRL function block shutdown logic.

Case 2: An I/O Module from the Link 1 side reports a class 2 or class 3 error This assumes that Link 2 side is error free.

Case 2 Recovery: When the class 2 or class 3 error is reported, an automatic switchover occurs. The Link 2 module to become the IOBus Master. Since there are no errors on the Link 2 side, subsequent automatic switchovers are inhibited because the error counts are higher on Link 1 than on Link 2

Case 2 Recovery: When the error condition is removed and the class 2 or class 3 error is cleared, automatic and periodic switchovers are re-enabled. The Link 2 module remains the IOBus Master until the periodic switchover occurs.

Case 3: I/O Module from Link 1 side reports a class 4 error.

Auto Shutdown disabled (**DISAUTSD = TRUE)** on F_Q_CTRL function block.

When this error is reported on the IOBus Master side (Link 1), I/O module outputs are shutdown. A switchover occurs, and Link 2 becomes the I/O Bus Master. After the switchover, further automatic switchovers are disabled because of the class 4 error. The F_Q_CTRL block reports redundancy degraded since Link 1 module is shutdown. This status is shown by the DEGRAD output on the faceplate and the F_Q_CTRL function block.

Case 3 Recovery When the error condition and the class 4 error are removed, automatic and periodic switchovers are re-enabled. The Link 2 module remains the I/O Bus Master until a periodic switchover occurs.

When the class 4 error is cleared, the I/O module's outputs are automatically enabled.

Case 4: I/O Module from Link 1 side reports a class 4 error. Auto Shutdown enabled (**DISAUTSD = FALSE**) on F_Q_CTRL function block.

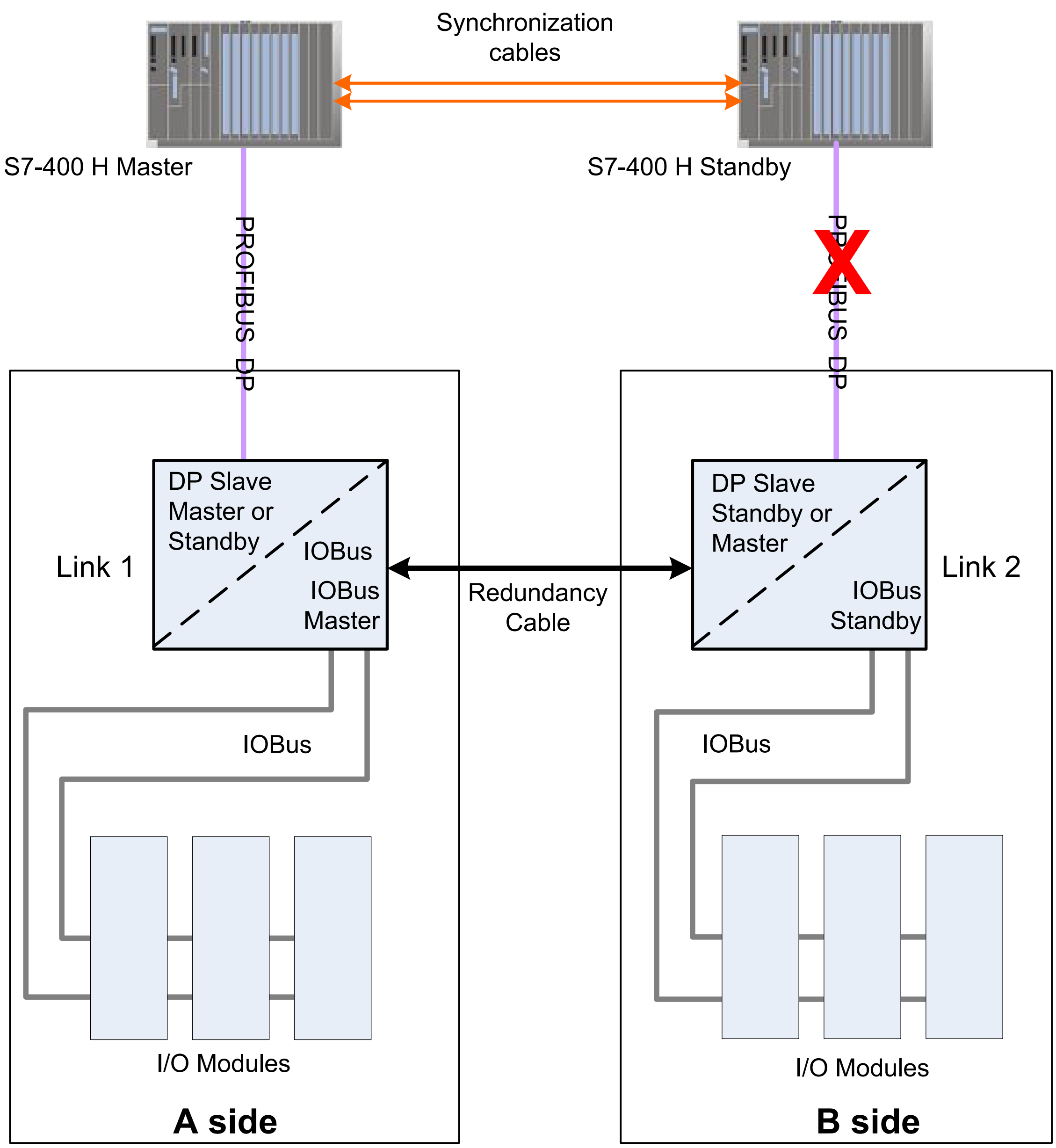
Case 4 Recovery: After the class 4 error condition is removed, and the DP/IO Bus Link module is reset from the faceplate or by a FALSE to TRUE transition on the RESET input of the F_Q_CTRL block, automatic and periodic switchovers are re-enabled. The Link 2 module will remain the I/O Bus Master until a periodic switchover occurs.

9.8 PROFIBUS DP Cable Failure

Scenario

A PROFIBUS DP cable is cut or DP communications hardware fails.

Block Diagram



Results

Component	Status
S7-400 H CPUs	The CPU posts a redundancy failure message.
DP slaves	If the DP cable/communications failure occurs on the master side, Master > Standby Standby > Master Otherwise, master/standby status is unchanged.
IOBus Gateways	Unchanged
I/O Modules	Unchanged

- The controller indicates redundancy failure.
- The IOBus switchover mechanism is still functional.
- If a Link failure occurs on the DP Slave Master while this condition exists, both sides shutdown.

Recovery

Restoring the DP communications link clears the error.

If the failure requires removal of the DP/IO Bus Link Transition Board, see Redundancy Cable, Transition Board, and IO Module Maintenance Considerations.

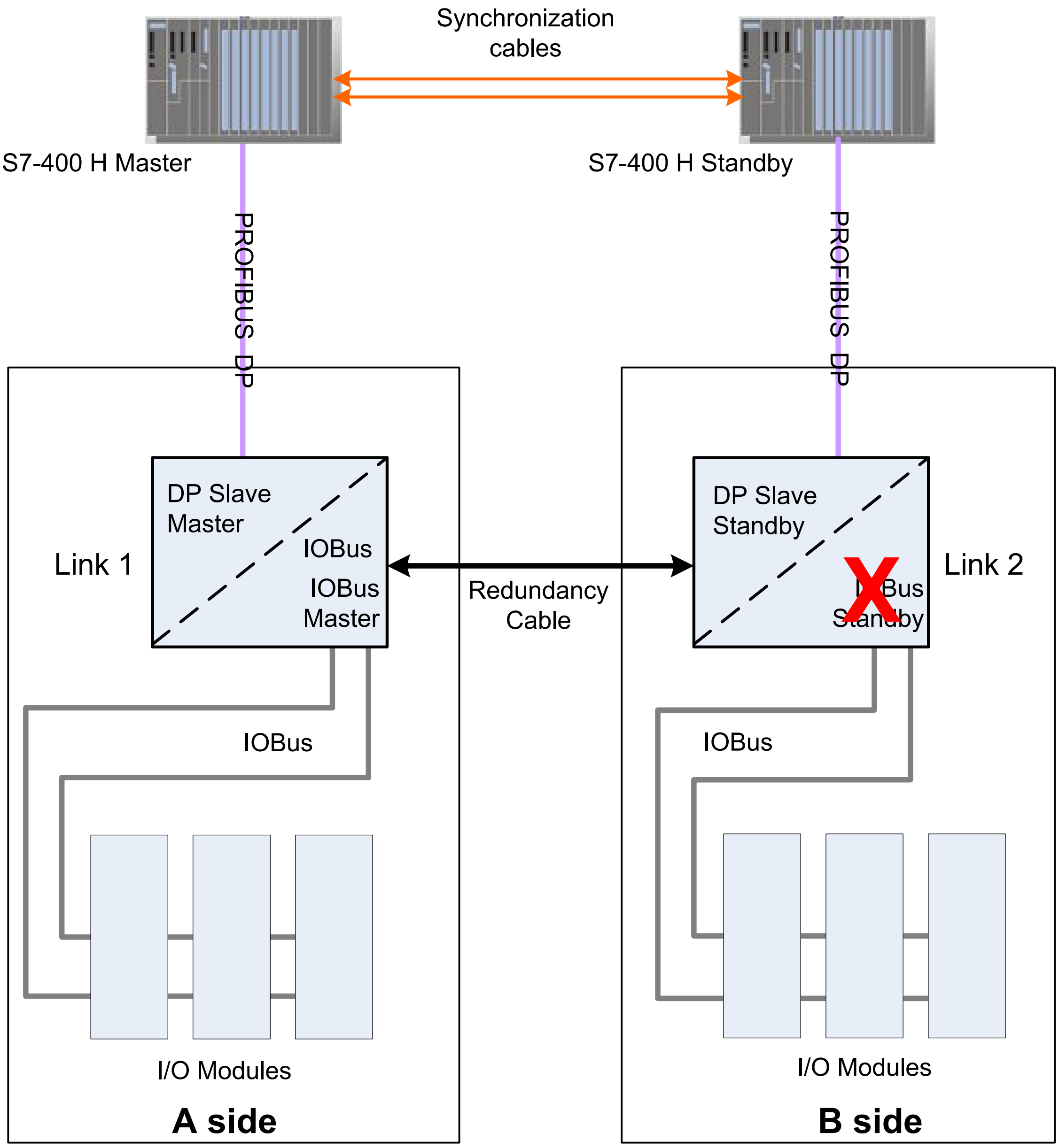
9.9 IOBus Standby Fails

Scenario

Fails here includes the following conditions or symptoms:

- Removal
- Power failure
- Hardware failure
- Class 2 or 3 error
- Class 4 error.

Block Diagram



Results and Recovery

Component	Status
S7-400 H CPUs	Unchanged
DP	Unchanged
IOBus	Unchanged

Case 1: Link 2 is removed, power fail, or exception occurs.

If the fault were an exception or a power failure, the master-standby status of system components is unchanged. Link 1 detects that the Link 2 is unavailable and reports this error. The IOBus on the Link 2 side is already disabled since it is the IOBus standby. Switchovers are disabled at this point since the partner is unavailable. The **DEGRADE** output on the F_Q_CTRL block indicates that the system in degraded mode.

Case 1 Recovery: When the Link 2 module is reinserted, has power restored, or recovers from the reset, switchovers are re-enabled. Side B I/O modules come online and work error-free as part of the IOBus Standby subsystem.

Case 2: Link 2 reports a class 2 or class 3 error

Assuming that that the Link 1 side is error free prior to this error being reported, when the class 2 or class 3 error is reported, switchover occurs unless additional errors of a higher class are reported on the Link 1 side Periodic switchovers are disabled.

Case 2 Recovery:
When the error condition is removed and the class 2 or class 3 error is cleared, periodic switchovers to the Link 2 standby are enabled. The Link 1 module will remain the IOBus Master until a periodic switchover occurs.

Case 3: Link 2 reports a class 4 error. Auto Shutdown disabled

(**DISAUTSD = TRUE**) on the F_Q_CTRL function block.

When the error condition and the class 4 error are removed, automatic and periodic switchovers are re-enabled. The Link 1 module remains the I/O Bus Master until a periodic switchover occurs.

The F_Q_CTRL block DEGRADE output reports that the system in degraded mode since the Link 2 module is shutdown.

Case 3 Recovery:
When the error condition is removed and the class 4 error is cleared, automatic and periodic switchovers are re-enabled. The Link 1 module remains the IOBus master until the periodic switchover occurs.

Case 4: I/O Module from Link 2 side reports a class 4 error.

Auto Shutdown enabled (**DISAUTSD = FALSE**) on F_Q_CTRL function block.

Case 4 Recovery: After the class 4 error condition is removed, and the DP/IO Bus Link module is reset from the faceplate or by a FALSE to TRUE transition on the RESET input of the F_Q_CTRL block, automatic and periodic switchovers are re-enabled. The Link 1 module remains the I/O Bus Master until a periodic switchover occurs.

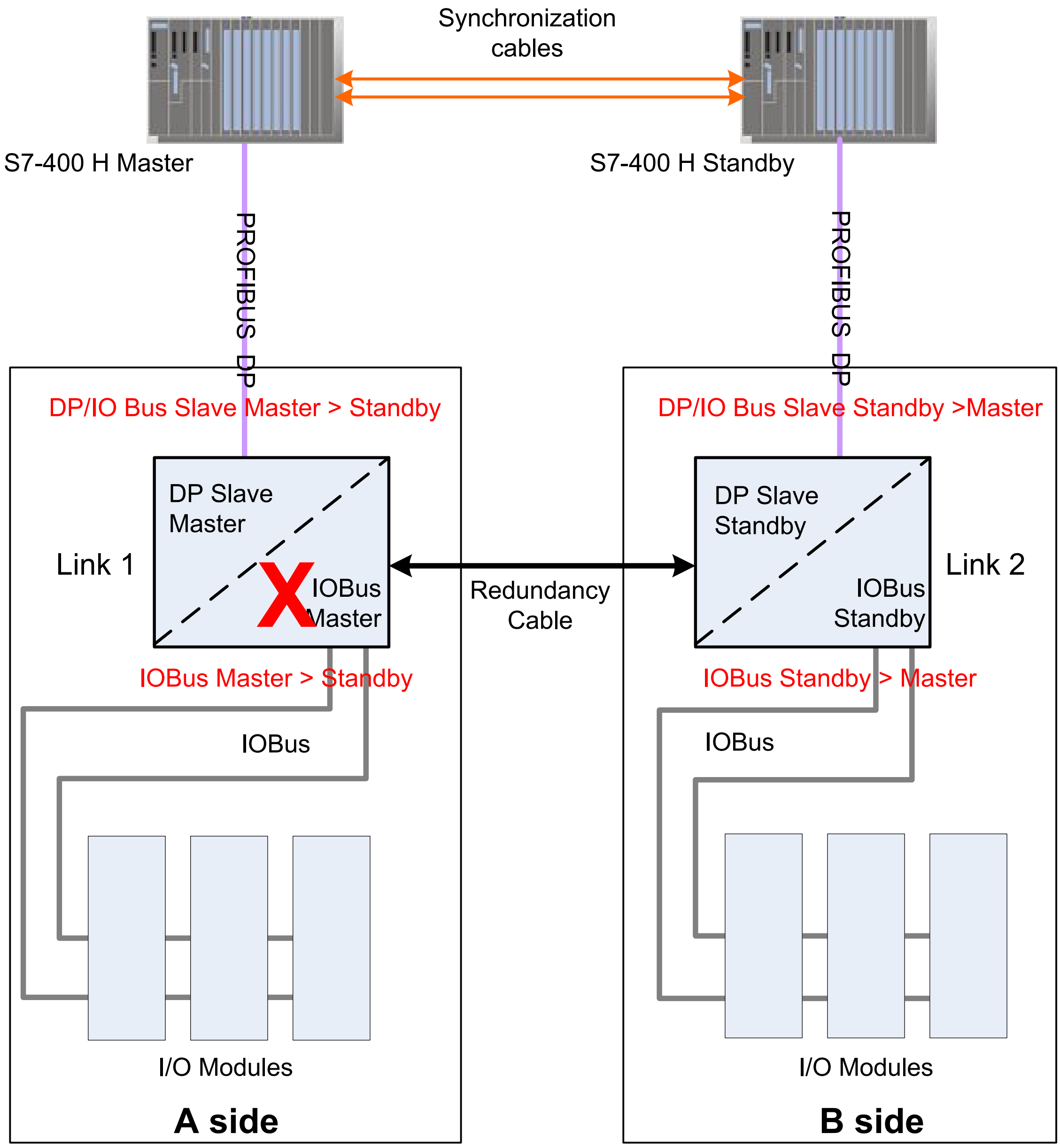
9.10 IOBus Master Fails

Scenario

Fails here includes the following conditions or symptoms:

- Removal
- A power failure
- Hardware failure
- Class 2 or 3 error
- Class 4 error

Block Diagram



Results and Recovery

Component	Status
S7-400 H CPUs	Unchanged
DP	Removal, Power failure, hardware failure: Master > Standby Standby > Master Class 2, 3, or 4 error: Unchanged
IOBus	Master > Standby Standby > Master

I/O Modules	If automatic shutdown enabled, I/O Outputs controlled by Link 1 are shutdown

Case 1: Link 1 is removed, power fails, or an exception occurs

If the fault were an exception or a power failure, the master-standby status of system components is unchanged. Link 2 detects that the module is unavailable and reports this error. The Master Enable on the Link 2 side IOBus is already disabled since it is the IOBus Standby. Link 2 requests a switchover and issues the first part of the handshake request. No response is returned, so the Link 2 module takes control and becomes the IOBus Master.

Case 1 Recovery: When the Link 1 module is reinserted, has power restored, or recovers from the reset, switchovers are re-enabled. Side A I/O modules come online and work error-free as part of the IOBus Standby subsystem.

Case 2: Link 1 reports a class 2 or class 3 error.

Assuming that that the Link 2 side is error free prior to this error being reported, when the class 2 or class 3 error is reported, automatic switchovers are inhibited. Unless additional errors of a higher class are reported on the Link 2 side, automatic switchover is re-enabled.

Case 2 Recovery: When the error condition is removed and the class 2 or class 3 error is cleared, automatic switchovers to the Link 2 standby can occur if the same class or higher class error occurs. The Link 2 module will remain the IOBus Master until a periodic switchover occurs.

Case 3: Link 1 reports a class 4 error.

Auto Shutdown disabled (**DISAUTSD = TRUE**) on F_Q_CTRL function block.

Case 3 Recovery: When this error is reported on the IOBus Master side (Link 1) and automatic shutdown is enabled on the F_Q_CTRL block, the I/O module outputs controlled by Link 1 are shutdown. A switchover occurs and Link 2 becomes and remains the IOBus master. Automatic switchovers are disabled because of the class 4 error. The F_Q_CTRL function block reports that its is **DEGRAD** mode since Link 1 module is shutdown.

Case 4: Link 1 side reports a class 4 error.

Auto Shutdown disabled (**DISAUTSD = TRUE**) on F_Q_CTRL function block.

When this error is reported on the IOBus Master side (Link 1), and automatic shutdown is enabled in the F_Q_CTRL function block, I/O module outputs are shutdown. A switchover occurs, and Link 2 becomes the I/O Bus Master. After the switchover, further automatic switchovers are disabled because of the class 4 error. The F_Q_CTRL block reports redundancy degraded since Link 1 module is shutdown. This status as shown by the DEGRAD output on the faceplate and the F_Q_CTRL function block.

Case 3 Recovery When the error condition and the class 4 error are removed, automatic and periodic switchovers are re-enabled. The Link 2 module remains the I/O Bus Master until a periodic switchover occurs.

When the class 4 error is cleared, the I/O module outputs are automatically enabled.

Case 4: Link 1 side reports a class 4 error.

Auto Shutdown enabled (**DISAUTSD = FALSE**) on F_Q_CTRL function block.

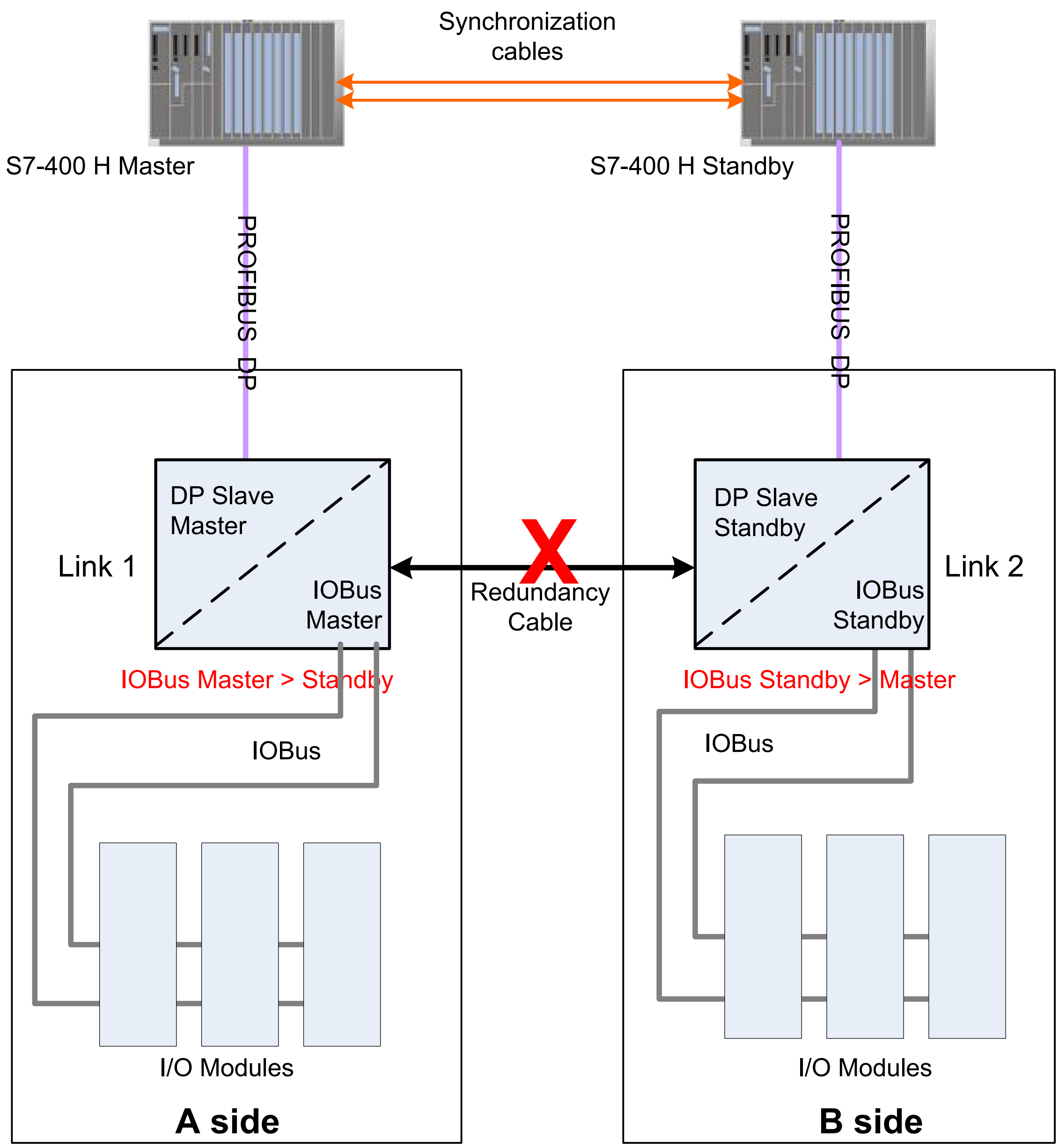
Case 4 Recovery: After the class 4 error condition is removed, and the DP/IO Bus Link module is reset from the faceplate or a FALSE to TRUE transition on the RESET input of the F_Q_CTRL block, automatic and periodic switchovers are re-enabled. The Link 2 module will remain the I/O Bus Master until a periodic switchover occurs.

9.11 Link Redundancy Cable Is Removed While DP Slave Master Is IOBus Master

Scenario

The DP Slave Master and the IOBus Master are in the same link module. The redundancy cable between the link modules is cut or the hardware drivers associated with the redundancy cable fail.

Block Diagram



Results

Component	Status
S7-400 H CPUs	Unchanged
DP	Standby resets
IOBus	Standby resets
I/O Modules	Link-2 side shuts down

- The DP Slave Master reports the following errors:
  - 17:04 (DPIO Link Redundancy. Bad Redundancy Cable)
  - 18:03 (QUADLOG Redundancy. Redundancy not in operation)
- Link 1 side I/O Continues
- Link 2 side I/O resets and is shutdown

Recovery

- Power down Link-2 side
- Repair cable

Caution

Ensure that the DP/IO Bus Link module on the standby side is powered off or removed from the rack before connecting the redundancy cable to a transition board. This caution applies regardless whether the redundancy cable has been removed completely (both sides) or has been removed from either of the transition boards (one side). See Redundancy Cable, Transition Board, and IO Module Maintenance Considerations.

- Re-apply power and reset I/O

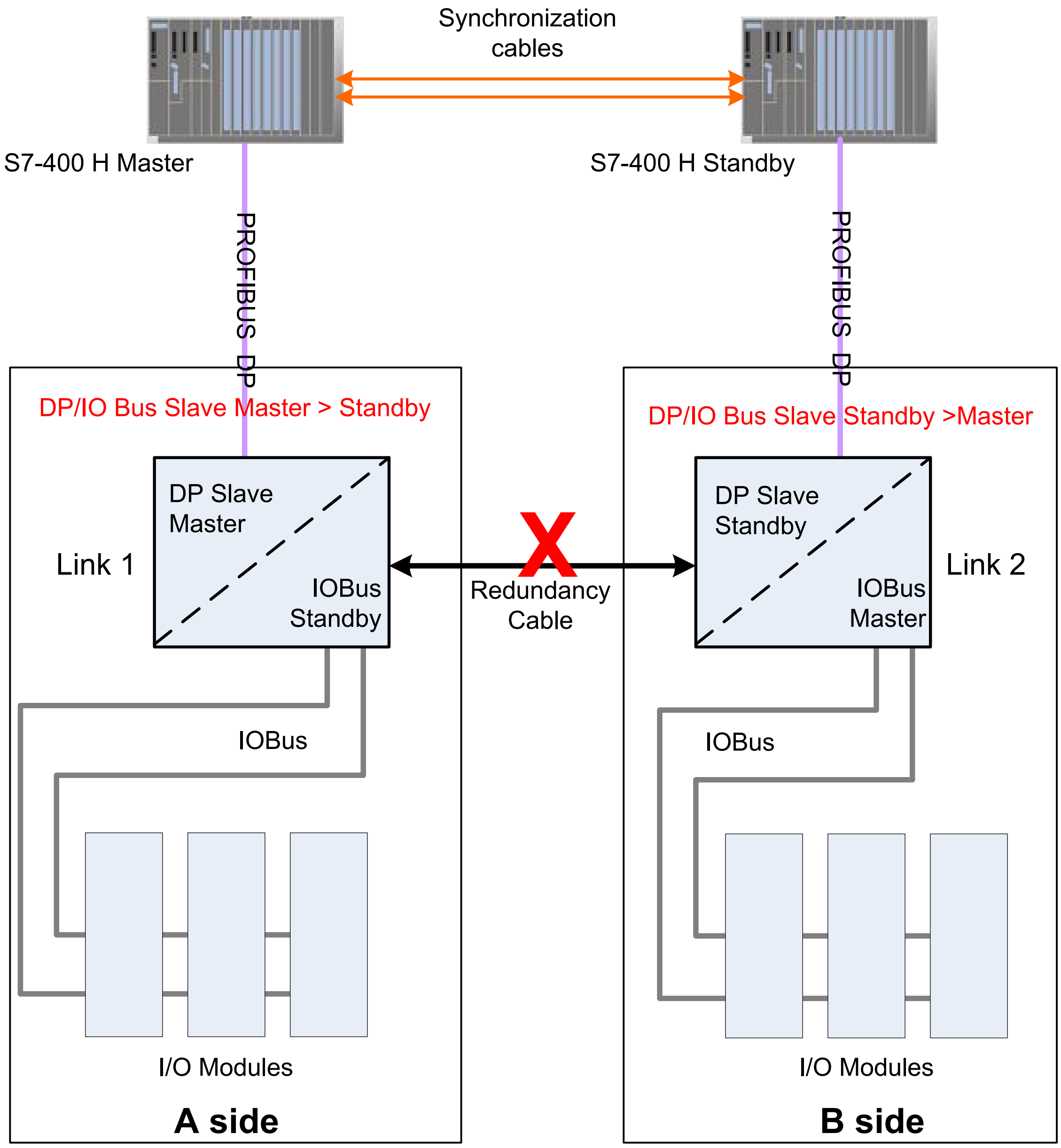
9.12 Link Redundancy Cable Is Removed While DP Slave Standby is IOBus Master

Scenario

In this scenario Link 1 is the DP Slave Master and the IOBus Standby.

Conductors in the redundancy cable are cut or hardware drivers associated with these conductors fail.

Block Diagram



Results

Component	Status
S7-400 H CPUs	Unchanged
DP/IO Bus Links	Master Reset Standby > Master
IOBus Gateways	Standby reset

Prior to the fault, Link 1 is the DP Slave Master, and Link 2 is the DP Slave Standby. When the redundancy cable break occurs, both sides immediately detect the cable break. The IOBus slave resets, which causes the DP Slave standby to become the master.

The system reports degraded mode since the DP/IO Bus Link A module is not able to communicate with the DP/IO Bus Link B side.

The DP/IO Bus Link A module reports a 17:04 error indicating that there is a cable error.

The DP/IO Bus Link A module also reports an 18:03 error indicating that the partner is not present.

Recovery

See recovery for Link Redundancy Cable Is Removed While DP Slave Master Is Also IOBus Master

9.13 PROFIBUS DP Slave Master Cable Failure, Followed by Failure of I/O Module on Link 2

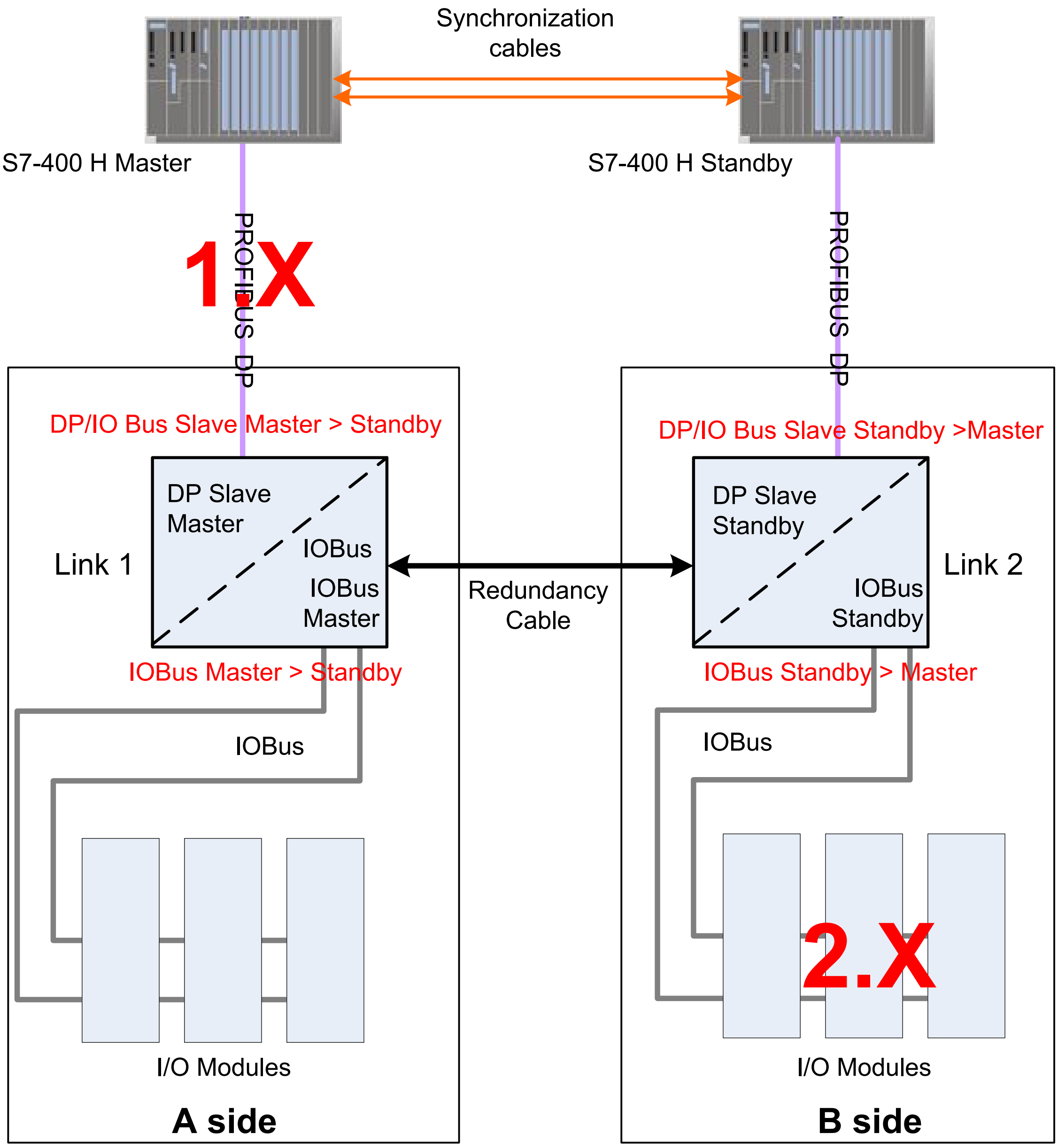
Scenario

A sequence of two failures is assumed:

1. A failure in the PROFIBUS DP Master cable or related hardware. This fault leaves the system in the state described in the section titled PROFIBUS DP Cable Failure.
2. A subsequent failure in an I/O module connected to Link 2, caused by
   - Exception
   - Module removal
   - Class 2 or 3 error raised to Class 4 error because of shutdown channel
   - Class 4 error

This second failure leaves the system in the state described in the sections titled I/O Module Failure on IOBus Standby Side or I/O Module Failure on IOBus Master Side.

Block Diagram



Recovery

The recommended procedure is to repair the system in this order:

1. Repair the I/O module failure. Follow the procedures in the sections titled I/O Module Failure on IOBus Standby Side or I/O Module Failure on IOBus Master Side.
2. Restore DP communications. Follow the procedures in the section titled PROFIBUS DP Cable Failure.

9.14 PROFIBUS DP Slave Cable Failure, Followed by a DP Slave Master Failure

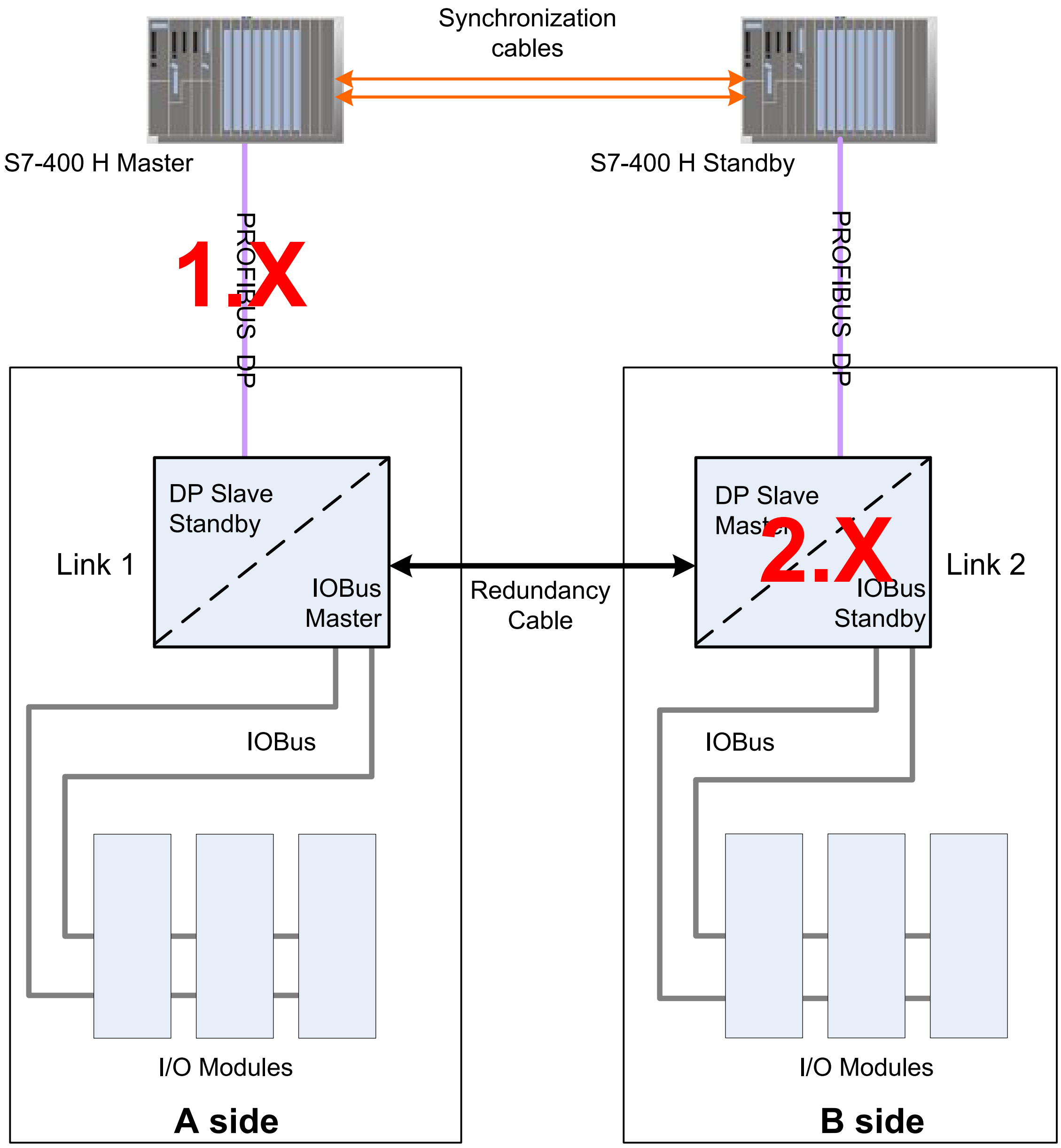
Scenario

This scenario demonstrates that the system is in danger of a shutdown if there is a secondary failure after a failure in a PROFIBUS DP master cable or related communications hardware.

This scenario assumes a sequence of two failures:

1. A failure in the PROFIBUS DP cable or communications hardware. This fault leaves the system in the state described in the section titled PROFIBUS DP Cable Failure.
2. A subsequent failure of DP Slave Master, caused by one or more of the following:
   - An exception that results in a reset of the Link 1 module
   - Power failure

Block Diagram



Results

Fault 1: See the section titled PROFIBUS DP Cable Failure.

Fault 2: DP/IO Bus Link 2 Module is removed, power fails, or exceptions occur

Component	Status
S7-400 H CPUs	Unchanged
DP	Both Reset

I/O Modules	Modules connected to Link 2 timeout after 3 seconds and shutdown

- The current DP Slave Master resets and waits in power-up state for configuration data from an S7-400 H controller.
- The system is completely shutdown.

Recovery

The recovery from the failure on the DP Slave Master varies according to the nature of the failure.

- If the fault was caused by an exception, the system automatically recovers to previous state.
- If the fault was caused by a module removal or power failure, first restore module or apply power as described in the sections titled IOBus Slave Fails and IOBus Master Fails.

Correct the PROFIBUS DP communications. See the section titled PROFIBUS DP Cable Failure.

9.15 PROFIBUS DP Slave Cable Failure, Followed by a DP Slave Standby Failure

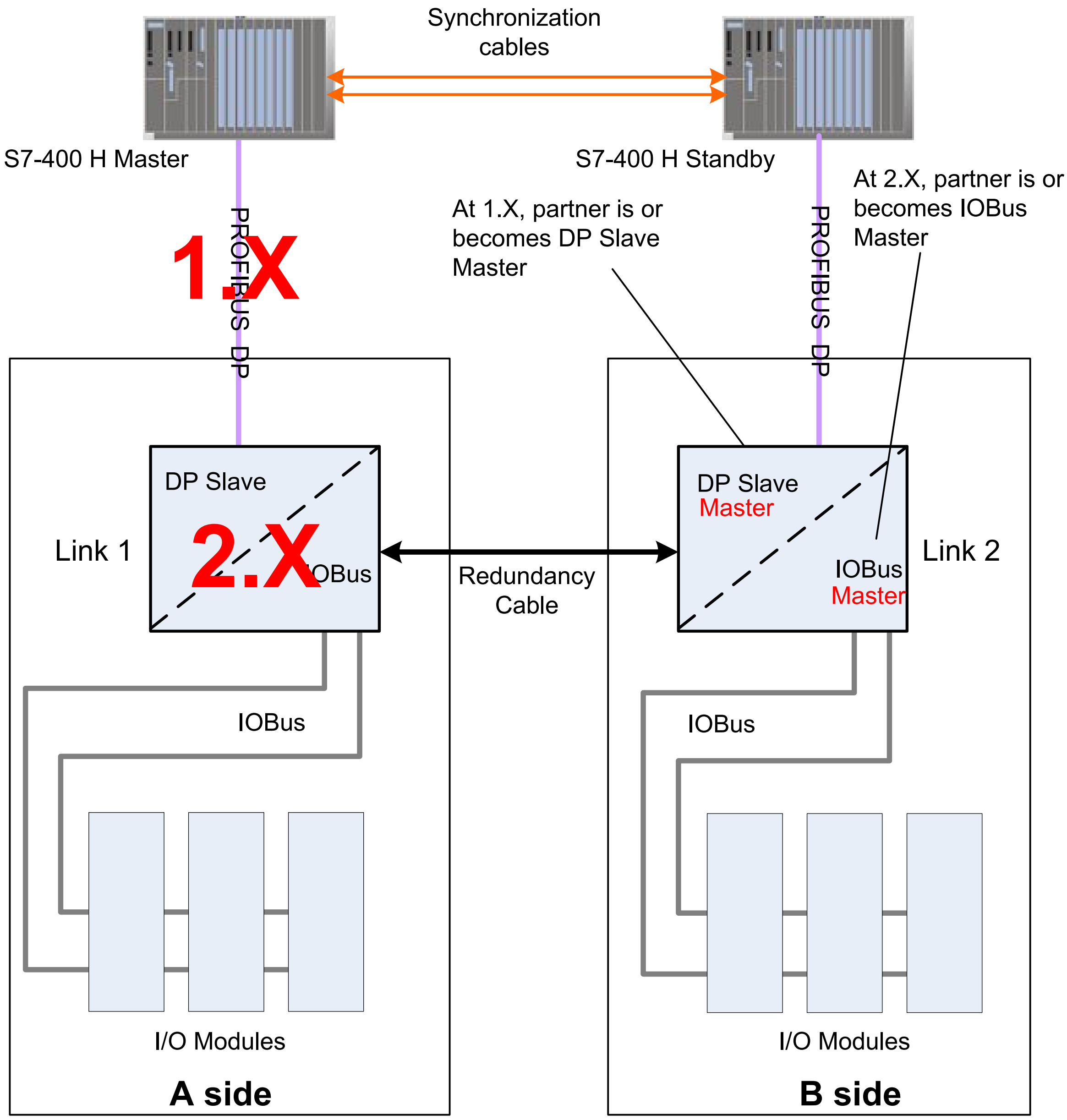
Scenario

This scenario demonstrates that the system may be operational if there is a secondary failure after a failure in a PROFIBUS DP master cable or related communications hardware.

This scenario assumes a sequence of two failures:

1. A failure in the PROFIBUS DP cable or communications hardware. This fault leaves the system in the state described in the section titled PROFIBUS DP Cable Failure.
2. A subsequent failure of DP Slave Standby, caused by one or more of the following:
   - An exception that results in a reset of the DP/IO Bus Link 1 module
   - Power failure

Block Diagram



Results

Fault 1: See the section titled PROFIBUS DP Cable Failure.

Fault 2: DP/IO Bus Link 2 Module is removed, power fails, or exceptions occur

Component	Status
S7-400 H CPUs	Unchanged

IOBus	If fault 2 occurs on IOBus master slave > master If fault 2 occurs on IOBus standby No change
I/O Modules	Modules attached to affected link shutdown due to reset. Modules attached to unaffected link remain operational.

Recovery

See the recovery described in the section titled PROFIBUS DP Slave Cable Failure, Followed by a DP Slave Master Failure.

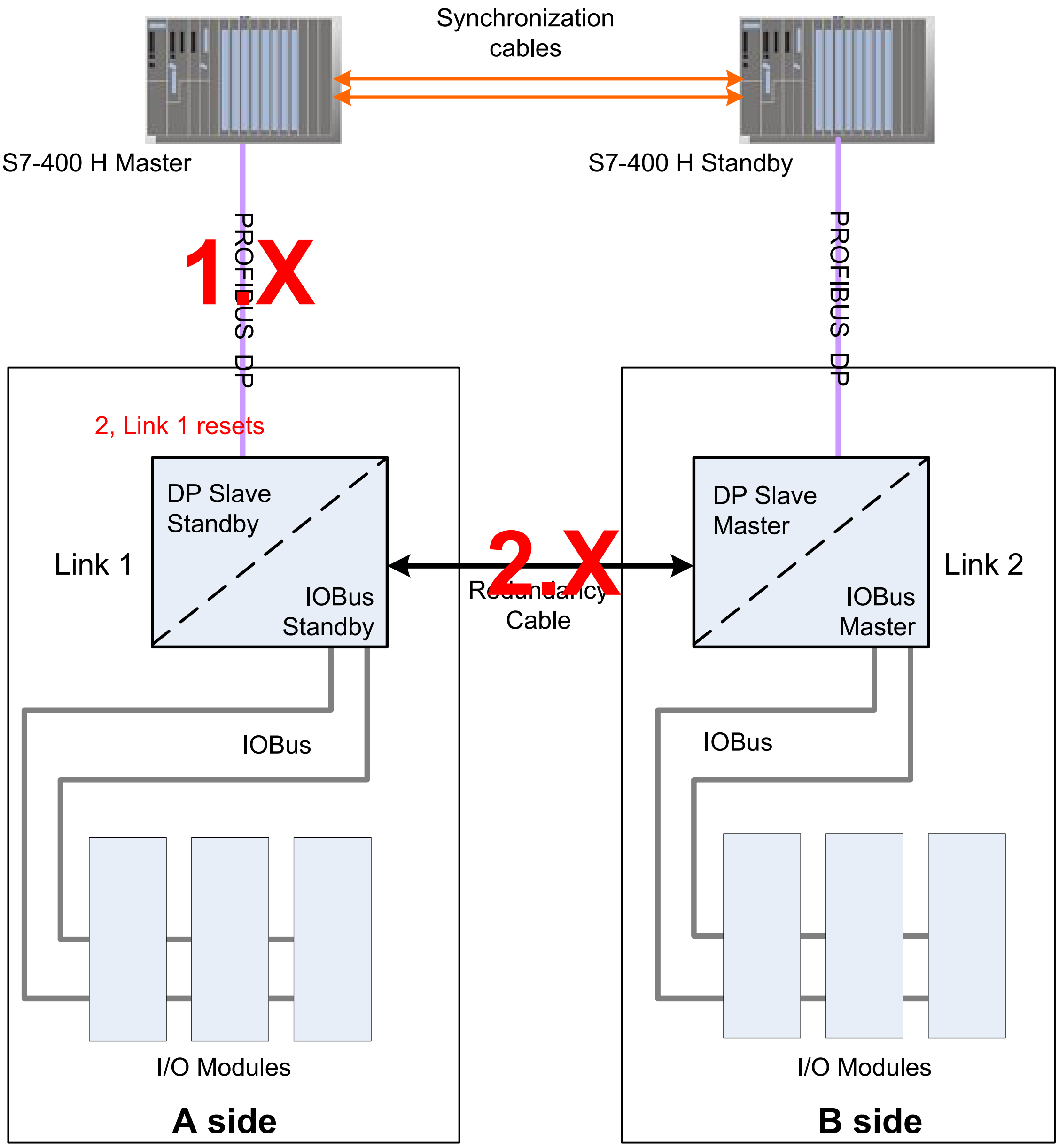
9.16 DP Slave Cable Failure, Redundancy Cable Failure, DP Slave Master and IOBus Master on Same Side

Scenario

This scenario assumes a sequence of two failures:

1. A failure in the PROFIBUS DP cable or communications hardware. This fault leaves the system in the state described in the section titled PROFIBUS DP Cable Failure.
2. A subsequent failure of the redundancy cable or related hardware.

Block Diagram



Results

Fault 1: See the section titled PROFIBUS DP Cable Failure.

Fault 2: Redundancy cable or related hardware fails:

Component	Status
S7-400 H CPUs	Unchanged
DP	Master is unaffected Standby resets

IOBus	Master unaffected Standby resets
I/O Modules	Modules attached to resetting link shutdown Modules attached to unaffected link remain operational.

Recovery

Repair redundancy cable first.

Caution

Ensure that the DP/IO Bus Link module on the standby side is powered off or removed from the rack before connecting the redundancy cable to a transition board. This caution applies regardless whether the redundancy cable has been removed completely (both sides) or has been removed from either of the transition boards (one side). See Redundancy Cable, Transition Board, and IO Module Maintenance Considerations.

See the recovery described in the section titled Redundancy Cable, Transition Board, and IO Module Maintenance Considerations.

Repair DP communications. See the section titled PROFIBUS DP Cable Failure.

9.17 DP Slave Cable Failure, Redundancy Cable Failure, DP Slave Master and IOBus Master Opposite Sides

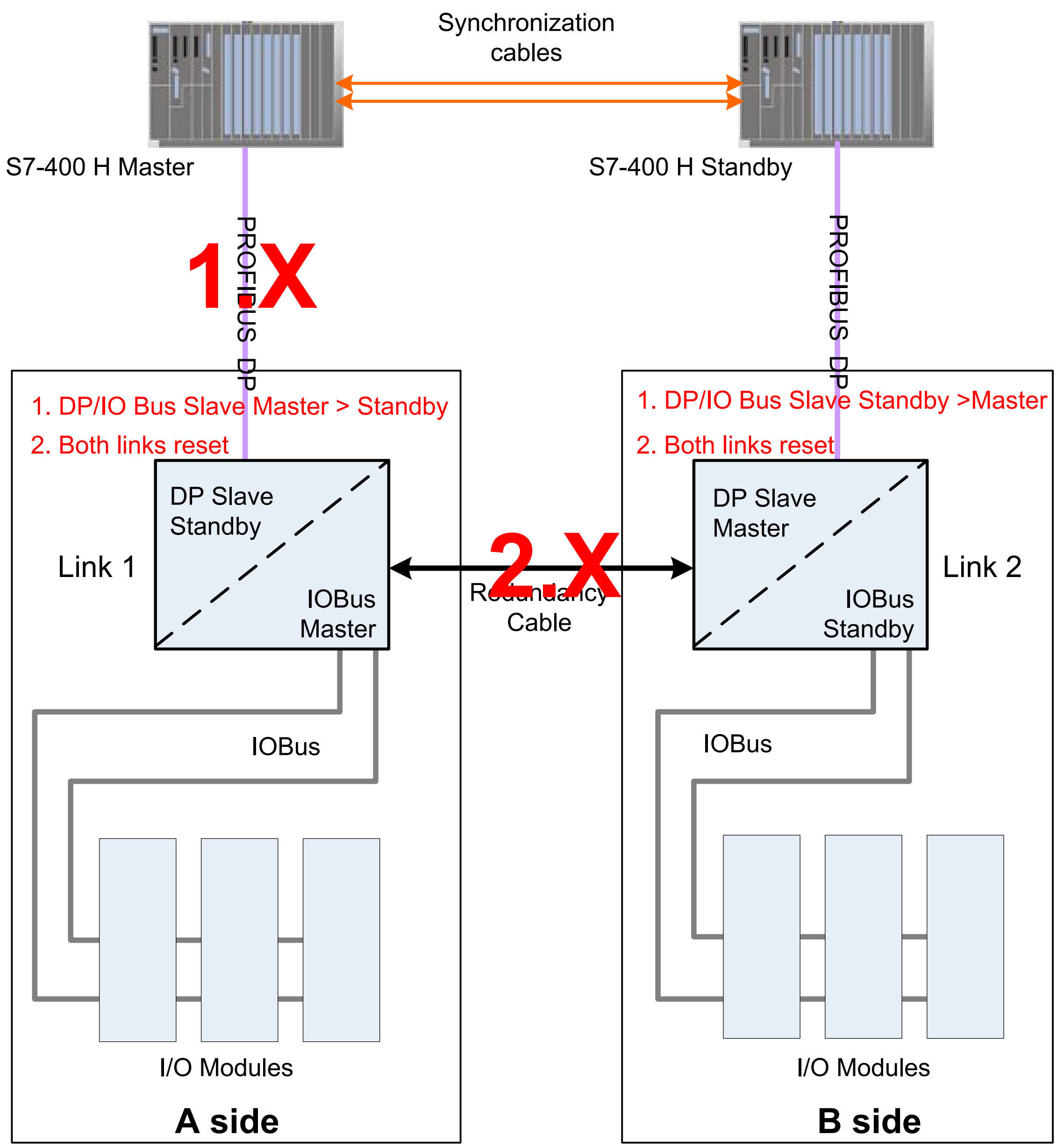
Scenario

This scenario demonstrates that the system is in danger of a shutdown if there is a secondary failure after a failure in a PROFIBUS DP master cable or related communications hardware.

This scenario assumes a sequence of two failures:

1. A failure in the PROFIBUS DP cable or communications hardware. This fault leaves the system in the state described in the section titled PROFIBUS DP Cable Failure.
2. A subsequent failure of the redundancy cable or related hardware.

Block Diagram



Results

Fault 1: See the section titled PROFIBUS DP Cable Failure.

Fault 2: Redundancy cable or related hardware fails:

Component	Status
S7-400 H CPUs	Unchanged
DP	Both sides reset
IOBus	Both sides reset
I/O Modules	All I/O Module shutdown

Recovery

Repair redundancy cable first.

Caution

Ensure that the DP/IO Bus Link module on the standby side is powered off or removed from the rack before connecting the redundancy cable to a transition board. This caution applies regardless whether the redundancy cable has been removed completely (both sides) or has been removed from either of the transition boards (one side). See Redundancy Cable, Transition Board, and I/O Module Maintenance Considerations.

See the recovery described in the section titled Redundancy Cable, Transition Board, and IO Module Maintenance Considerations.

Repair DP communications. See the section titled PROFIBUS DP Cable Failure.

9.18 Hyperswitchover/Excessive Prevention

Hyperswitchover Scenario

A noisy input signal is the most likely source of rapid switchovers between IOBus gateways, known as *hyperswitchover.* The condition occurs if I/O module errors are reported and cleared frequently. The system has a mechanism to prevent hyperswitchover.

1. A module error is reported on the IOBus master side and not on the IOBus slave side.
2. The error clears immediately after a switchover occurs and is reported on the new IOBus master side.
3. Because the I/O module on the Link 1 IOBus Slave side is error-free at this point, another switchover occurs.
4. Because the I/O Module on the Link 2 IOBus Slave is error-free, yet another switchover occurs.

Switchovers are blocked when the following are true

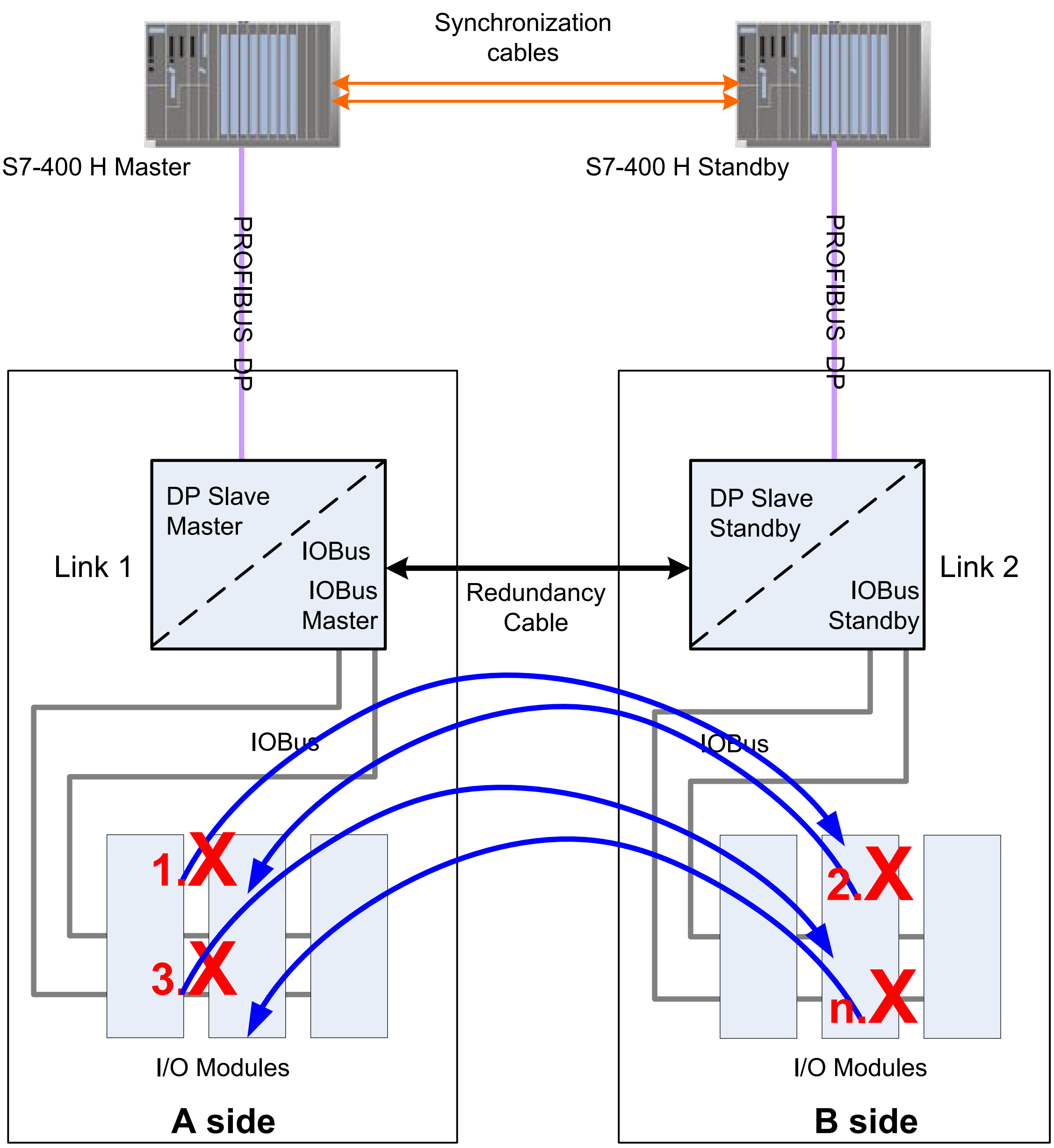
- 3 consecutive switchovers in 3 seconds plus 1 scan
- No change in error counts

At this point, switchovers initiated by the faceplate are disabled.

Excessive Switchover Scenario

If error counts are not the same, the system tests for excessive switchovers, defined as 5 switchovers in five seconds plus one scan. Switchovers are then blocked for five seconds, the hyperswitchover counter is reset, and switchovers are re-enabled.

Block Diagram



9.19 Redundancy Cable, Transition Board, and I/O Module Maintenance Considerations

9.19.1 Powering Up a Redundant System with no Redundancy Cable

Scenario

Avoid this scenario for the following reason:

If both sides of a redundant system are powered up without a redundancy cable, both Link modules take control of their IOBuses. One DP/IO Bus Link module receives a configuration from its master CPU.

If a redundancy cable is then installed, the system reaction is unpredictable. The DP/IO Bus Link module with a configuration may not crossload the configuration to its partner, but it also may not realize that it is in control. It is also possible that both DP/IO Bus Link modules may regard themselves as DP masters. The redundant DP/IO Bus Link modules may be unresponsive until they are reset simultaneously.

Scenario Avoidance

Never install a redundancy cable unless one or both of the DP/IO Bus Link modules are not powered.

9.19.2 Link 1 is IOBus Master

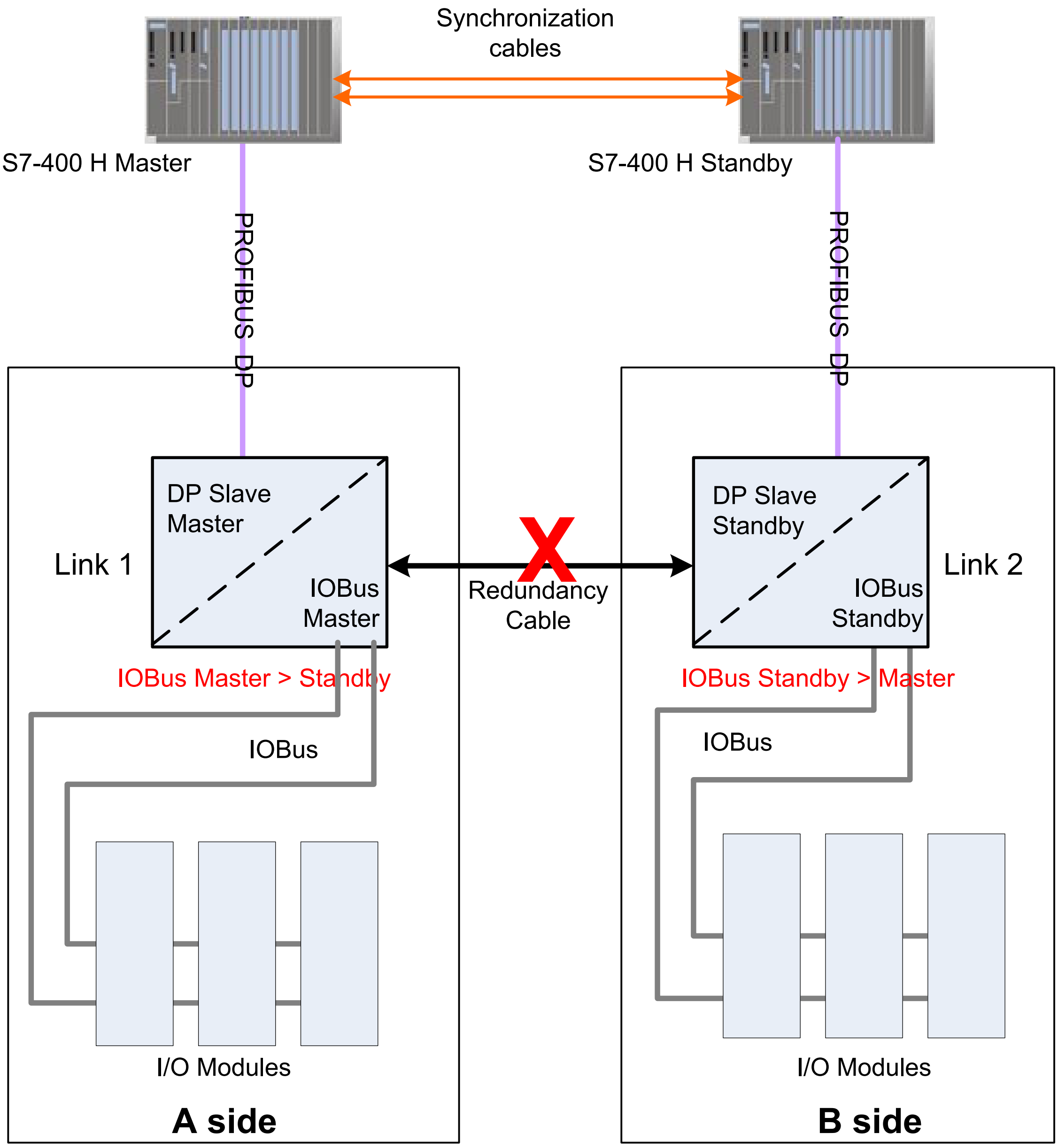
Scenario

Any of the following components require replacement in a system that cannot be shutdown:

- Redundancy cable
- Transition Board
- I/O modules

Following the prescribed procedure ensures that the replacement does not cause a shutdown.

Block Diagram



Component	Status
S7-400 H CPUs	Unchanged
DP/IO Bus Links	
IOBus Gateways	Link 1 is Master Link 2 is Standby
I/O Modules	

Procedure

The system must be error free to ensure that the removal of a DP/IO Bus Link module or redundancy cable does not cause a shutdown.

1. Halt periodic switchovers with DISAUTSW on the F_Q_CTRL function block or faceplate control.
2. Force an IOBus gateway switchover to the side that does not need to be replaced. Use the OS faceplate to initiate the switchover.
3. Disable the input (switch to TRUE) on the F_Q_CTRL block that disables periodic switchovers (**DISIOBSW**).
4. Remove the standby DP/IO Bus Link module from the system. This prevents adverse affects resulting from removing the cable. This is a safety precaution. DP Slave/Master status may change as a result of this.
5. Remove the redundancy cable from both DP/IO Bus Link Module Transition Boards.

Caution

Ensure that the DP/IO Bus Link module on the standby side is powered off or removed from the rack before connecting the redundancy cable to a transition board. This caution applies regardless whether the redundancy cable has been removed completely (both sides) or has been removed from either of the transition boards (one side).

---

6. Replace the redundancy cable.
7. Replace transition board or I/O modules.
8. Replace the DP/IO Bus Link Module.
9. Verify that a crossload of the I/O module configuration has occurred (DP LED blinks green).

Results and Recovery

Following the above procedure ensures that the system and its redundancy are restored properly. No errors are reported (unless error conditions that existed prior to this replacement still exist).

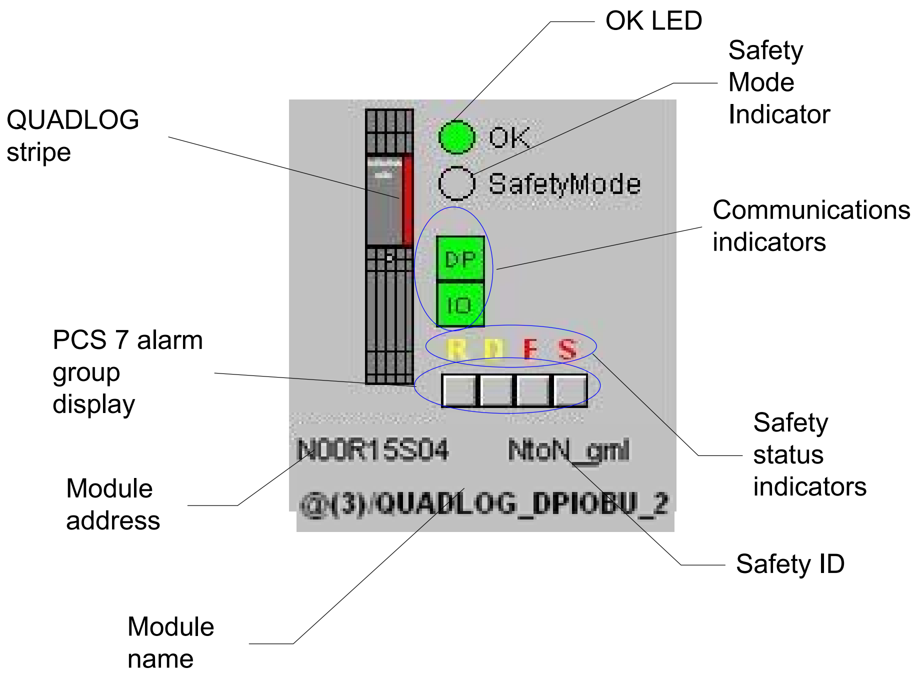
10 Block Icons and Faceplates

10.1 Block Icons

Blocks icons representing DP/IO Bus link IOBus controllers and objects appear in PCS 7 process area pictures.

These block icons differ slightly depending whether they represent controllers that exist in redundant or non-redundant configurations.

QUADLOG Non-redundant DP/IO Bus Link Block Icon



OK LED: The color of the LED is as follows:

Color	Error Status
Steady Gray	No communications with module
Steady Green	Highest error is Class 1
Blink red/Green	Highest error is Class 2
Blink Red/Black	Highest error is Class 3

Safety Mode indicator: Light green when Safety Mode is true, gray when false.

Communications indicators:

- The square labeled **DP** reflects the status of the communications between the S7 400 H CPU and the DP/IO Bus Link module.
- The square labeled **IO** indicates the diagnostic status of communications between the DP/IO Bus Link module and IO Modules. For both, green indicates operational communications, red indicates failures.

Safety Status indicators are visible for QUADLOG modules when the indicated conditions are true:

Indicator	Condition
R	Repair
D	Degraded
F	Failed
S	Total I/O Shutdown

Safety ID: customer-defined name entered into the AS function block F_Q_CTRL block tag `.SAFETYID`, a string that identifies the function block.

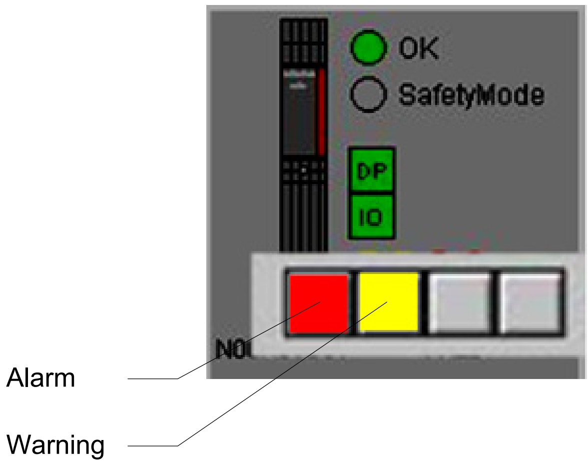
Module name: The first part of the name is the CFC chart on which the module driver is placed. The second part is the unique block instance name assigned to the driver block.

Module address: provided as Node Rack Slot (NRS)

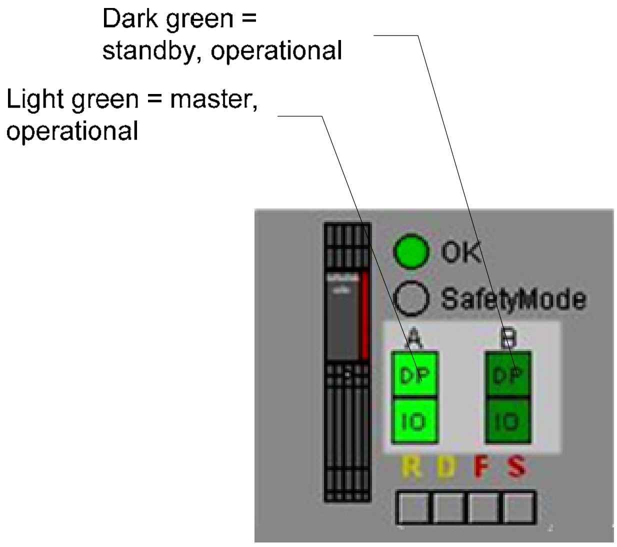
QUADLOG stripe: red indicates QUADLOG.

PCS 7 alarm group display:

- **Alarm**, leftmost square: flashes red when an alarm is active and not acknowledged and is steady red when an alarm is active and acknowledged. Otherwise it is gray.
- **Warning**, The second square from the left: flashes yellow when a warning is active and unacknowledged and is steady yellow when a warning is active and acknowledged. Otherwise it is gray.



QUADLOG Node-to-Node Redundant DP/IO Bus Link Block Icon

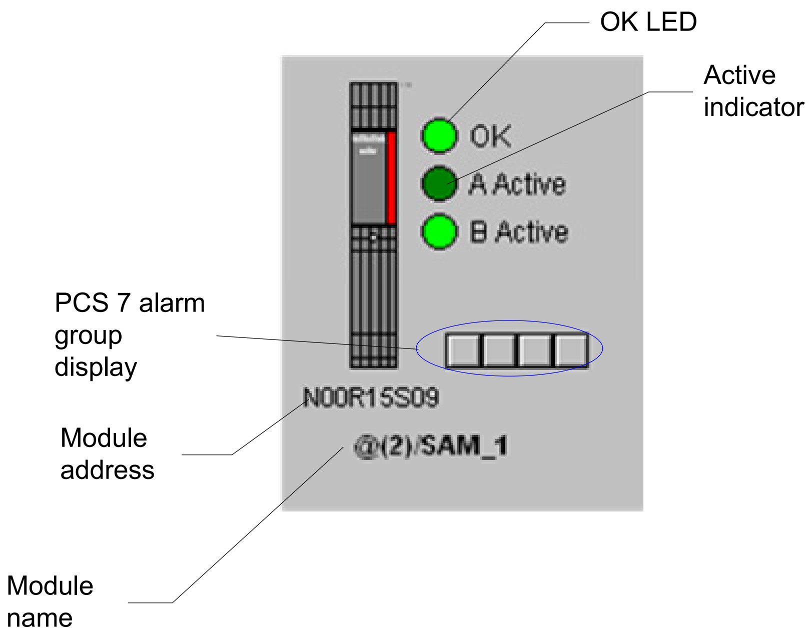


Node-to-Node Redundant DP/IO Bus Link block icons include the features of non-redundant QUADLOG DP/IO Bus Link blocks icons, plus the following:

DP and IO indicators:

- **Light green**: operational, active
- **Dark Green**: operational, standby
- **Red**: failure

Non-Redundant I/O Module Block



OK LED: Red indicates at least one error counts is non-zero in the counters `.CLS1ERCA`, `.CLS2ERCA`, `.CLS3ERCA`, and `.CLE4ERCA`.

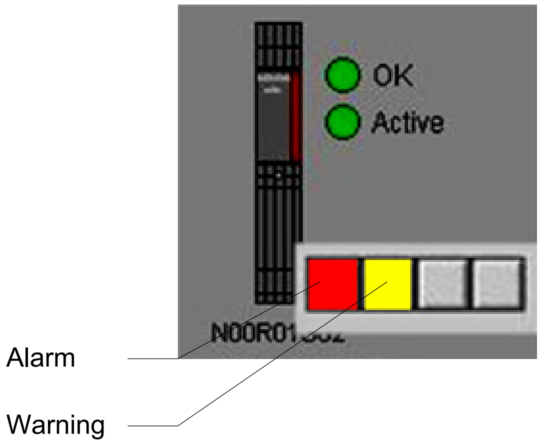
Color	**Circumstance**
Steady Gray	No communications with module
Steady Green	Highest error is Class 1
Blink red/Green	Highest error is Class 2
Blink Red/Black	Highest error is Class 3

Active LED: Green indicates that the module is active, but note that the LED remains green if the module is pulled from the rack. .

Module name: The first part of the name is the CFC chart on which the module driver is placed. The second part is the unique block instance name assigned to the driver block.

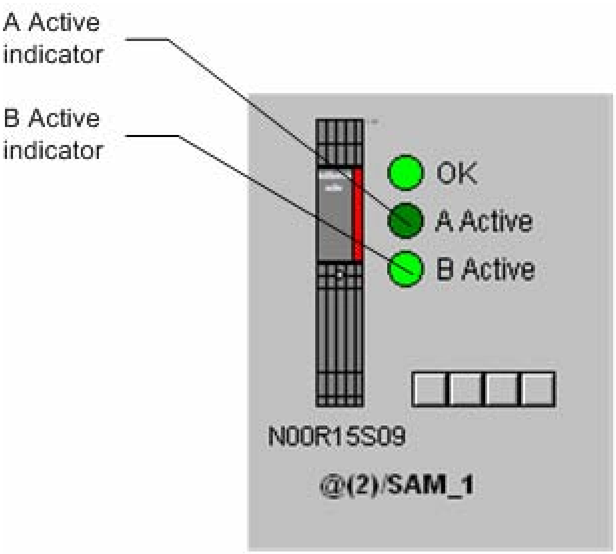
Module address: provided as Node Rack Slot (NRS)

PCS 7 alarm group display: In the alarm group display the leftmost square flashes red when an alarm is active and not acknowledged and is steady red when an alarm is active and acknowledged. Otherwise it is gray. The second square from the left flashes yellow when a warning is active and unacknowledged and is steady yellow when a warning is active and acknowledged. Otherwise it is gray.



Redundant I/O Module Block

Node-to-Node Redundant I/O module block icons include the features of non-redundant I/O module block icons, plus the following:



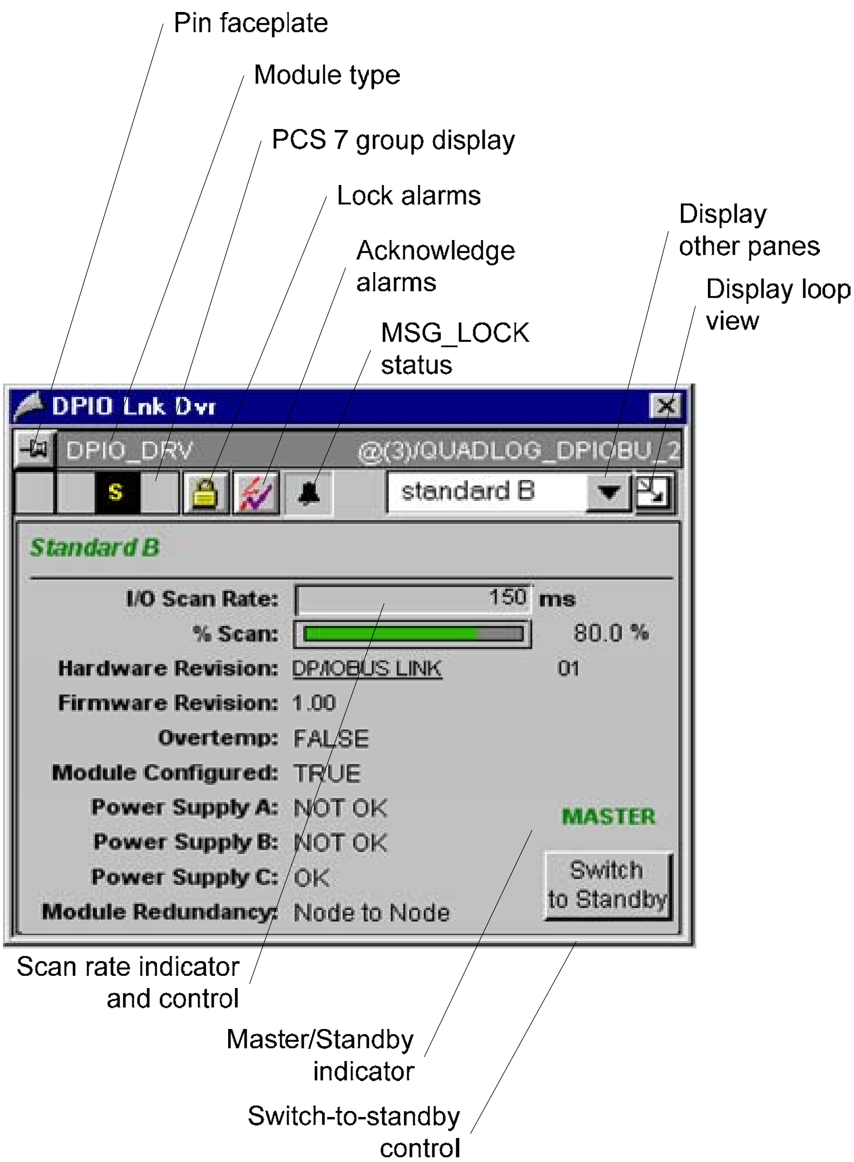
Note

In a node-to-node redundant environment, if the CPUs detect a calculate/verify error (class 3), the OS indicates this on the IOBus module faceplate by flashing its OK LED red/black.

The physical modules cannot provide this LED indication of an error because they are unable on their own to detect a difference between the calculate and verify values. In this situation, the faceplates provide enhanced or supplemental information, but do not in the strictest sense mimic the modules.

10.2 Standard Faceplate Pane

Double-clicking a block icon displays the standard pane of the corresponding faceplate. The illustration below shows a typical standard pane. In redundant systems, the pane indicates whether it is displaying A- or B-side information.



Pin faceplate: clicking this button once ensures that the faceplate remains on screen even if the underlying graphic changes. Clicking the button again disables this feature.

PCS 7 Group Display

- A **A** Alarm, white font on red background, flashing when incoming and not acknowledged

- W W: Warning, black font on yellow background, flashing when incoming and not acknowledged
- S S Process control fault, yellow font on black background, flashing when incoming and not acknowledged

Lock alarms: for operators with level 5 permission, clicking this button once halts alarm annunciation. When alarms annunciation is suppressed, the system still logs alarms and they remain active. The lock-alarm feature is not the same as alarm disable, which instructs the system not to record an alarm. If the alarm-locking feature is already in force, clicking this button unlocks alarms and the system annunciates them.

MSG_LOCK status: reports the current status of the MSG_LOCK input, found on the following AS function blocks: F_Q_MOD, F_Q_CTRL, MOD_DRV, and DPIO_DRV. The illustration shows the default state, message-locking disabled.

Alarm acknowledge: for operators with level 5 permission, clicking this button acknowledges all active alarms.

Display other panes: clicking the down arrow produces a list of available panes:

- A-side Standard pane
- B-side Standard pane
- A-side Error Status pane
- B-side Error Status pane
- A side Error Log pane
- B side Error Log pane
- Safety pane (DPIO_DRV faceplate only)
- PCS 7 Alarm pane
- Trend Pane

Display loop view: the loop view is a composite of all six panes.

Scan rate indicator and control: The indicator displays the scanning rate of the IOBus. If the faceplate is a for a DP/IO Bus Link module, the indicator becomes a control as well. The scan rate cannot be changed if any of the following are true:

- The module is QUADLOG
- Safety Mode is True
- The operator does not have level 6 permission

Warning

Safety Note - Avoid Changing Scan Rate Online in a Commissioned System

Changing the scan rate while online may result in a unpredictable shutdown of critical I/O modules with shutdown channels configured. Siemens recommends that the scan rate be changed only during a scheduled shutdown or before or during commissioning of the system."

When the scan rate can be changed, indications of the change are reflected in the **% Scan** display, which Siemens recommends be kept below 90%. Changes made through the faceplate override the initial values established in the HW Config program.

Note

The scan-rate control silently rejects values that it cannot accept. When an entered value is rejected, the last value is retrained.

Valid entries have the following characteristics:

- They are within the range of 80 ms to 1 sec
- They reflect 10 ms resolution.

Entries that fall within 80 ms to 1 sec are rounded off and then divided by 10. Results that are evenly divisible by 10 are accepted. For example, 149.4 is rejected; 149.5 is rounded to 150, which is evenly divisible by 10, and accepted as 150.

The actual scan rate is reported as an output on the AS function block DPIO-DRV and on the OS faceplate for the DP/IO Bus Link module.

Warning

Safety Note - Verifying scan rate setting changes

- Use the procedure below to change the scan rate of a system employing Safety Mode.
- Add this procedure to a checklist of procedures followed every time the Safety Mode is deactivated and reactivated.

---

1. While the operators station (OS) is running,
   - Open Simatic manager
   - Open the current project
   - Select the automation system (AS) to which the DP/IO Bus Link Module is connected.
2. In Simatic Manager, click the **Edit Safety Program** icon on the toolbar.
3. In the **Edit Safety Program** window, click the **Safety Mode** button to disable Safety Mode.
4. In the OS use the **Scan rate indicator and control** in the DP/IO Bus link Module faceplate to change the scan rate, paying attention to the restrictions and conditions described in the **Note** provided above. An annotated illustration of the faceplate and scan-rate control appears at the beginning of this section.
5. Return to Simatic Manager and click the **Safety Mode** button to reactivate Safety Mode.
6. Return to the OS and confirm that the displayed scan rate matches the entered scan rate.

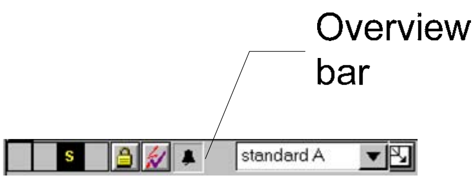
Master/standby indicator: indicates whether the current module's IOBus is in master or standby status.

Switch-to-Standby control: Not visible when redundancy disabled or if the pane is displaying information from a side that is not the master, this control provides a manual method of switching IOBus control to the standby module.

Module redundancy: reports the current status of redundancy: *None* or *Node-to-Node.*

Overview Bar

Controls on the overview bar of the standard pane shown below are on overview bars of other panes as well. These include **Alarm acknowledge**, **Display other panes**, and **Display loop view.** Note that loop views cannot be pinned

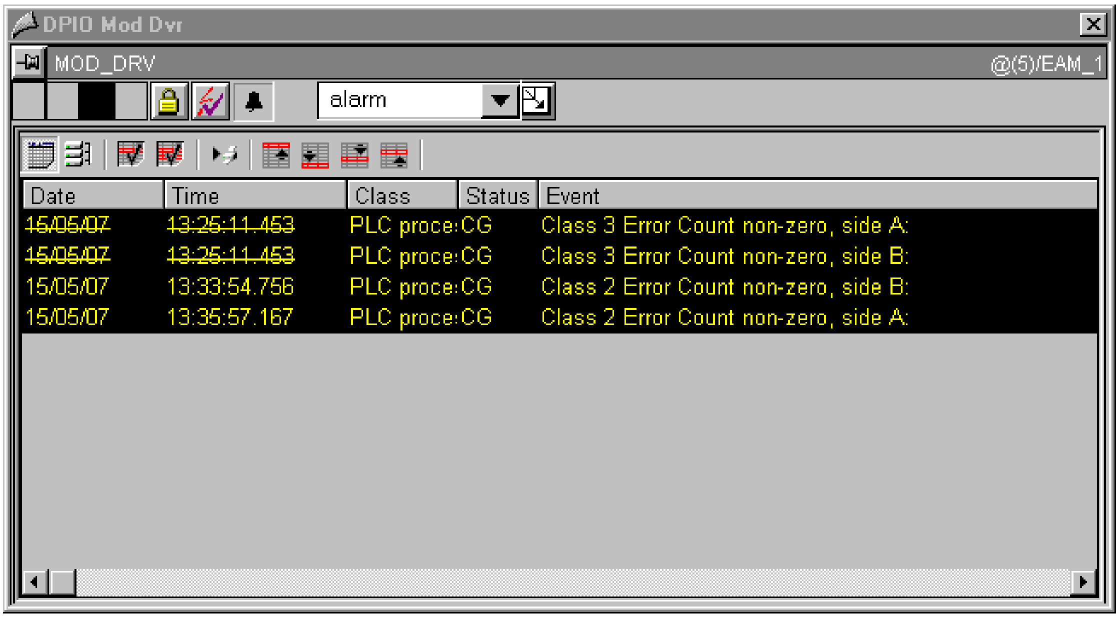


Tags Related to Standard Panes

Field	Tag
Module Type	.MOD_NAME
Scan Rate	.SCANRATE
% Scan	.PCT_SCAN
Hardware or Firmware Revision	.HW_VER
ROM Revision	.ROM_VER
Overtemp	.EMB_VARS (bit 5)
System Configured	.EMB_VARS (bit 0)
Power Supply A	.EMB_VARS (bit 1)
Power Supply B	.EMB_VARS (bit 2)
Power Supply C	.EMB_VARS (bit 3)
Module Redundancy	.RED_INFO
Master/Standby Indicator	.ACTV_A_B
Switch to Standby button	.REQ_SW

10.3 Alarm Faceplate Pane

The alarm pane is standard for the PCS 7 environment. Clicking a line containing an alarm acknowledges the alarm. Buttons on the overview bar have the same functions as buttons on the overview bar on the standard pane and supports alarm acknowledgement and navigation to the block icon picture, to other panes, and to the loop view.



10.4 Error Log Pane

The error log consists of a maximum of 99 errors per side (A or B). The error log pane displays errors for the active side, A or B, in redundant systems. In non-redundant systems the error log pane displays system errors for only side, by convention the A-side.

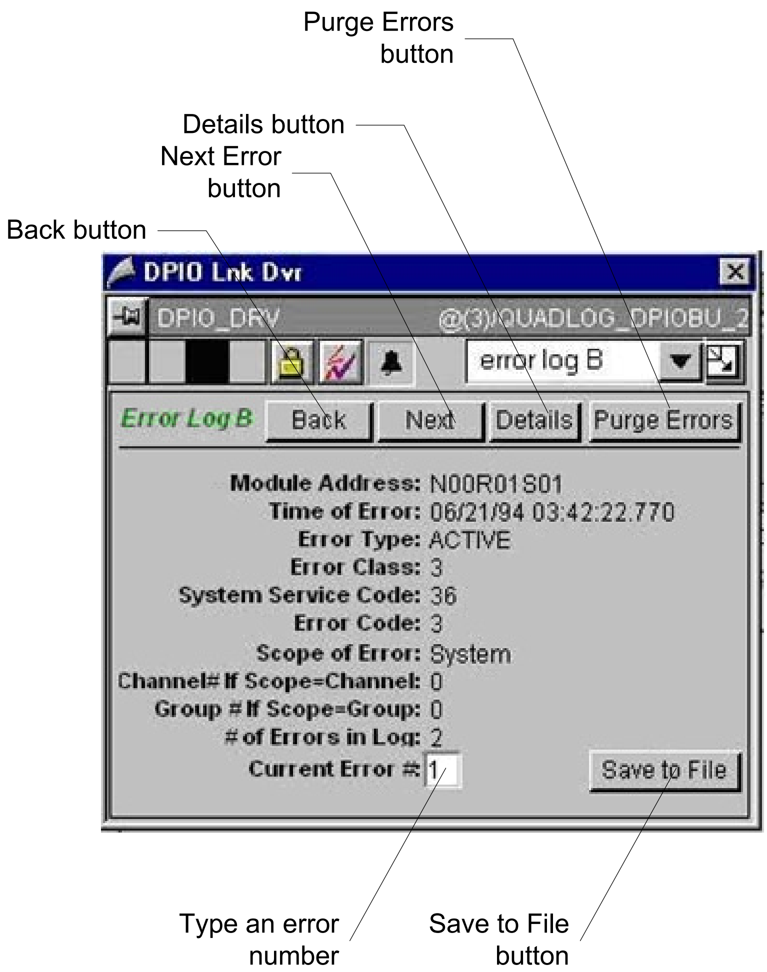
If the number of errors exceeds 99, previous errors are shifted so that error 99 becomes error 98, error 98 becomes 97, and so forth. The most recent error occupies position 99.

The Error Log Pane does not update in real-time. If the number of errors exceeds 99, to refresh the error count you must do one of the following:

- Shut and reopen the pane
- Press the **Back** or **Next** button
- Enter a specific number in the **Current Error #** field

If you are looking at error 99, for example, and wish to see the most recent error in case any new errors have been recorded, you could press the **Next** button, which refreshes the error count and displays error 1, and then the **Back** button, which displays error 99, the most recent error. If the system has detected that many errors, you may want to click the **Save to File** button so that you can examine them together in a file.

The illustration below shows a typical error log pane:



Controls

Control	Function
Next	Next error in the log is displayed (**Next Error** is disabled if the next error is number 0).
Back	The previous error is displayed.
Details	Display more detailed information from the help file for this error condition.
Current Error #	The entered error is displayed.
Purge Errors	All errors in the log are reset to 0 and the pane displays the first entry (**Purge Errors** is disabled if users does not have level 6 permission or if all the errors in log are 0).
Save to File	All non-zero entries in the log are saved to a file whose name is: <ModuleName><A or B><Time><Date>.txt Example: SAM_1A123243040407.txt Module name is SAM_1, LOG is A, Time is 123204, Date is 040407 This file is located in the top level folder of your OS project (OS(1) by default).

Buttons on the overview bar have the same functions as buttons on the overview bar on the standard pane and supports alarm acknowledgement and navigation to the block icon picture, to other panes, and to the loop view.

Note

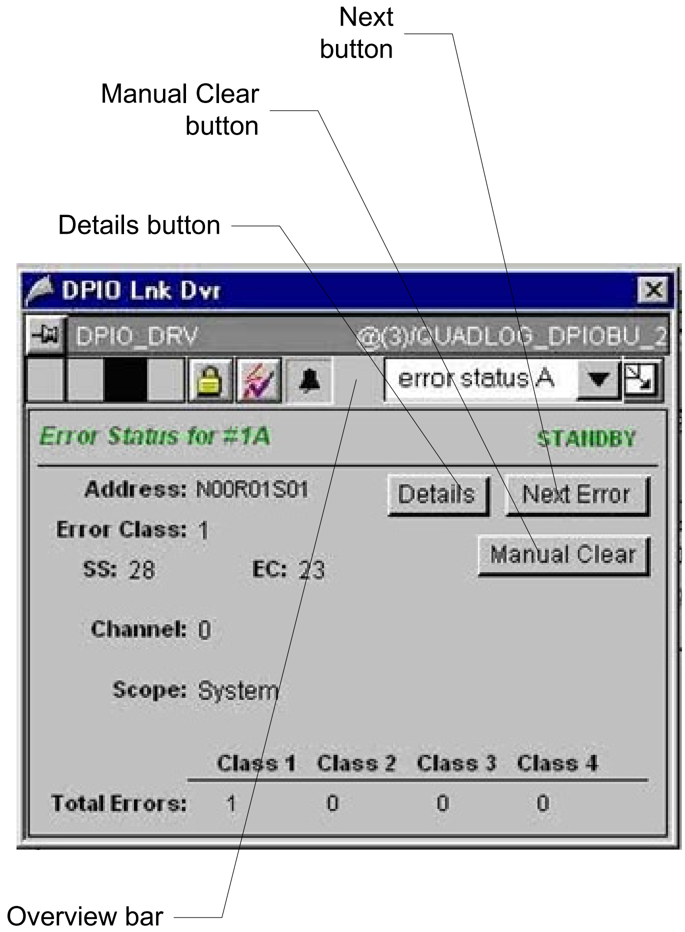
Manually clearing an error that originates in an I/O module produces two entries in the Error Log. The first entry is for the Manual Clear request, and the second is the I/O module acknowledgement of the manual clear action. Each entry has a different, but close, timestamp.

Tags Related to Error Log Panes

Field	Tag
Module Address	.NRS_ADDR
Time of Error	.ERHISXnn (first 8 bytes in S7 BCD format)
Error Type	.ERHISXnn (last four bits of the 8th byte)
Error Class	.ERHISXnn (bits 30 and 31 of the last 4 bytes)
System Service Code	.ERHISXnn (bits 16 through 23 of the last four bytes)
Error Code	.ERHISXnn (bits 10 through 15 of the last four bytes)
Scope of Error	.ERHISXnn (bits 6 and 7 of the last four bytes)
Channel# if scope=channel	• .ERHISXnn (bits 0 through 7 of the last four bytes, if bit 8 is 1) • ERHISXnn (bits 0 through 5 of the last four bytes, if bits 6, 7 and 8 are 001)
Group # if scope=group	.ERHISXnn (bits 0 through 5 of the last four bytes)

10.5 Error Status Pane

The error status panel displays the current five most critical error. The pane is updated if an error count changes. In redundant configurations, error status panes exist for both A- and B-side modules



Controls

Control	Function
Details	Displays more information from the help file for this error condition.
Next	Displays the next error; if the current error is error 5, the next error is error 1.
Manual Clear	Clears the current error (disabled if the user does not have level 6 permission and the *OK to Clear* flag is not set to *Yes).* Manually clearing an error that originates in an I/O module produces two entries in the Error Log. The first entry is for the Manual Clear request, and the second is the I/O module acknowledgement of the manual clear action. Each entry has a different, but close, timestamp.

Buttons on the overview bar have the same functions as buttons on the overview bar on the standard pane and supports alarm acknowledgement and navigation to the block icon picture, to other panes, and to the loop view.

Tags Related to the Error Status Pane

Field	Tag
Address	.NRS_ADDR
Error Class	Bits 30 and 31 of the error word

SS	Bits 16 through 23 of the error word
EC	Bits 10 through 15 of the error word
Channel	Bits 0 through 7 of the error word, if bit 8 is 1 Bits 0 through 5 of the error word, if bits 6, 7 and 8 are 001)
Scope of Error	Bits 6 and 7 of the error word
Class 1 Total Errors	.CLS1ERCX (where X is A or B)
Class 2 Total Errors	.CLS2ERCX (where X is A or B)
Class 3 Total Errors	.CLS3ERCX (where X is A or B)
Class 4 Total Errors	.CLS4ERCX (where X is A or B)
Class 1 Total Errors	.CLS1ERCX (where X is A or B)

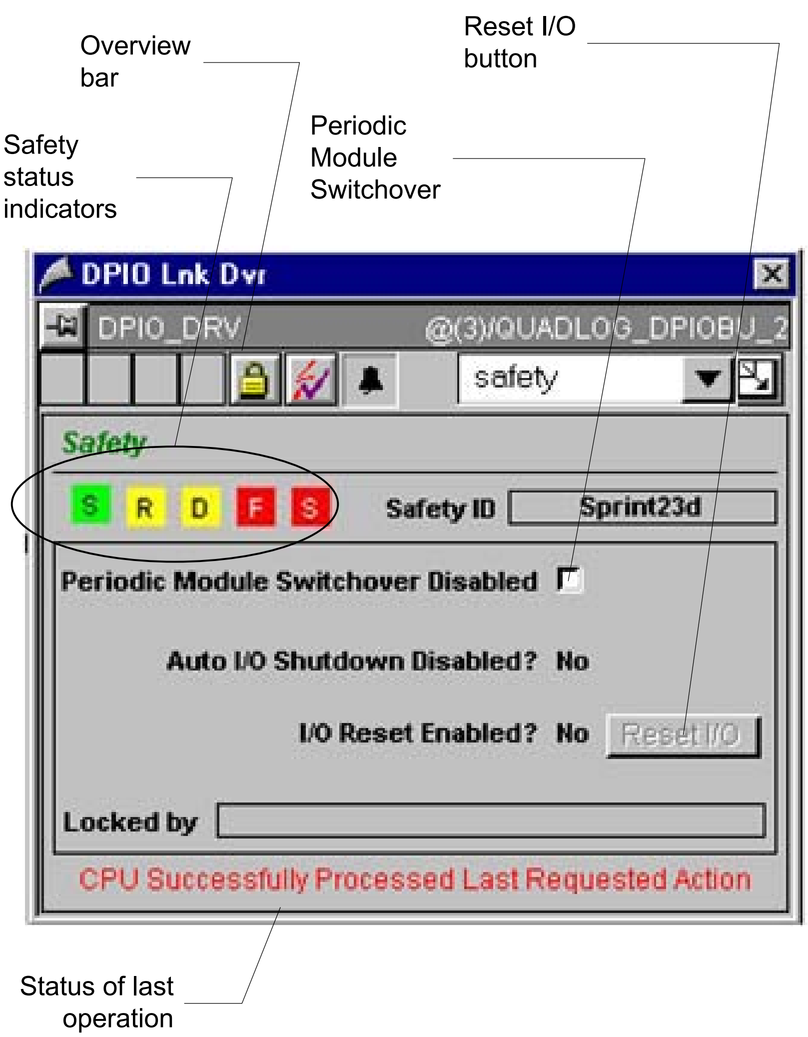
10.6 Safety Pane

The safety pane relies on information from the F_Q_CTRL block that is the companion to the DPIO_DRV block. These blocks require the following before the final compile of the CF program:

- The F_Q_CTRL block requires a unique user-supplied identifying string as its `.SAFETYID` tag.
- The DPIO _DRV block requires the WinCC pathname of the C_Q_CTRL block as its .QNAME tag

If this information has not be supplied, the safety pane is obscured with an error message explaining the deficiency.

The control are disabled for operators without level 6 authorization.



Controls

The control are disabled for operators without level 6 authorization.

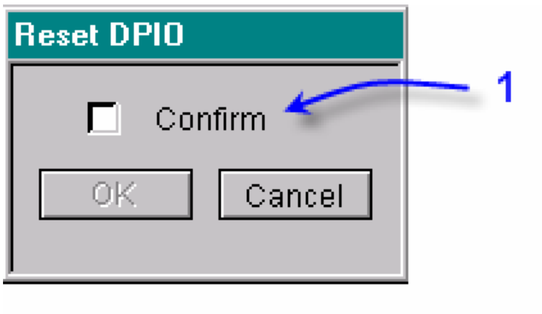
Periodic Module Switchover Disabled Selecting this checkbox disables periodic module switchover. Clearing it enables periodic switchovers. This checkbox is not displayed if redundancy is not enabled. Clearing the checkbox to enable switchovers requires confirmation:

Reset I/O: Resets I/O modules after an I/O shutdown resulting from a total I/O failure. This button is available only if I/O Reset Enabled is **Yes** and the Shutdown safety status indicator is displayed. See Tags Related to the Safety Pane.

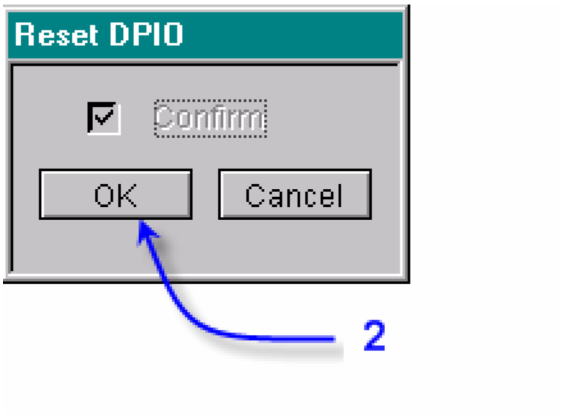
Action Confirmations

Actions require double confirmation. The mechanism for this is a window titled with the requested action, *Reset DPIO* in the following illustration, appearing on top of the faceplate. To confirm the action requires two steps:

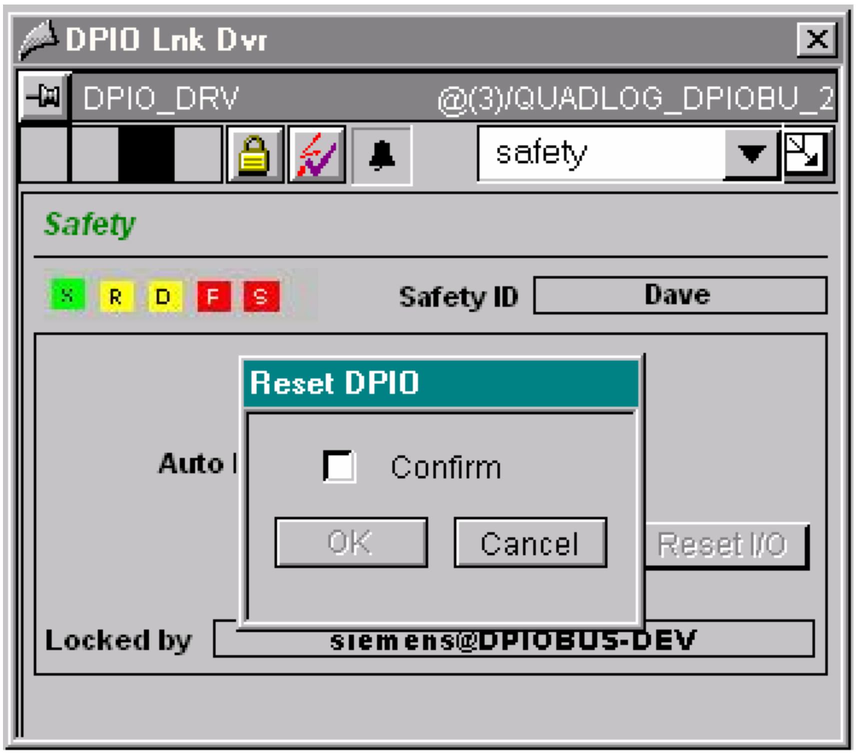
1. Select the **Confirm** checkbox.
   The **OK** button becomes active.



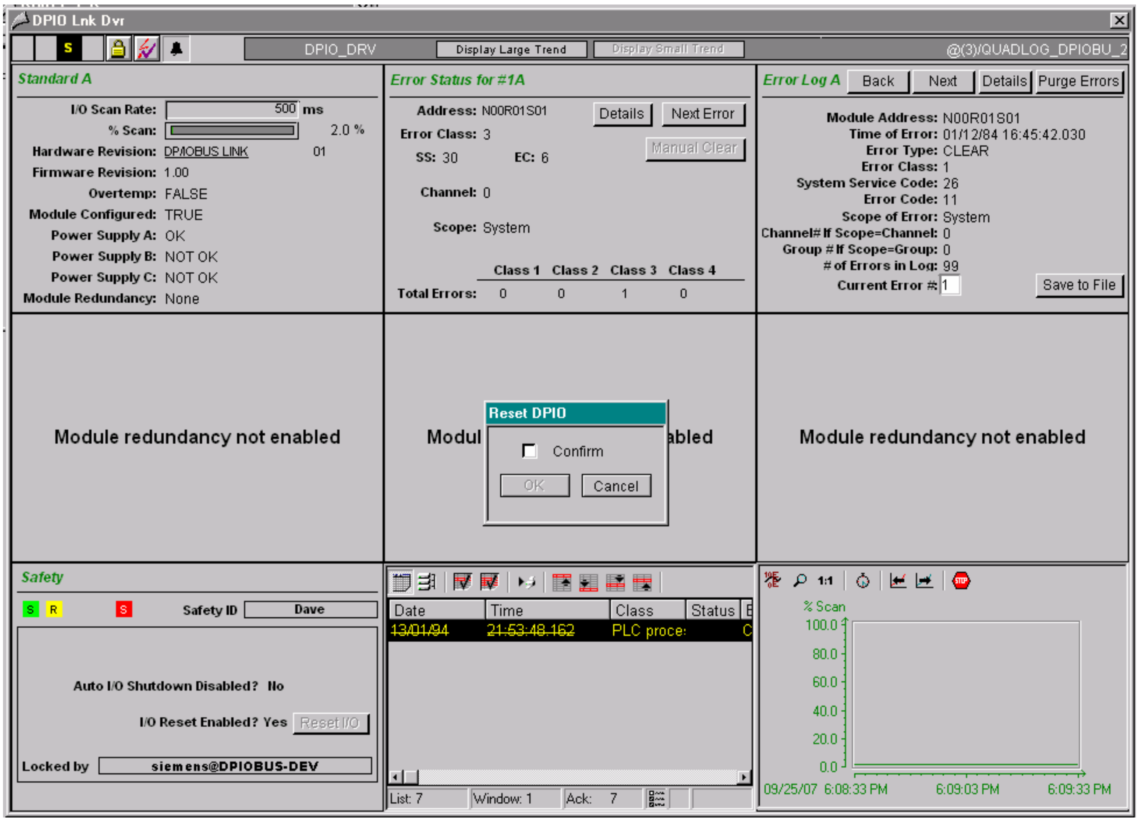
2. Click the **OK** button.
   The action is initiated.



On individual faceplates, the confirmation window appears on top of the standard window.



In loop view, the confirmation window appears in the middle of the loop display.



Processing Action Requests

After an action has been requested:

1. The faceplate locks the F_Q_CTRL functions block
2. The faceplate submits the requested action to the function block.
3. The function block records the request.
4. The faceplate asks for operator confirmation.
   - If confirmation fails to arrive in 60 seconds, after another 60 seconds the function block drops the request and returns to its initial state.
   - If the request is canceled, the faceplate returns to its initial state.
5. After confirmation, the faceplate records the confirmation and request the action.
   - If the action is successfully performed, this is reported on the faceplate.
   - If a timeout occur, the function blocks waits 60 seconds before resetting to its initial state.

Tags Related to the Safety Pane

Field	Tag (from F_Q_CTRL Function Block)
Safety Mode	.SAFEMODE
Repair Indicator	.REPAIR
Degraded Indicator	.DEGRAD
Failed Indicator	.FAILED
Shutdown Indicator	.SHUTDN
Safety ID	.SAFETYID
Periodic Module Switchover Disabled Checkbox	.DISAUTSW
Auto I/O Shutdown Disabled	.DISAUTSD
I/O Reset Enabled	.RSTENA
Locked By	.USERLOCK
Success/Failure of last request	.ACTERR

Error Messages in the Safety Pane

The safety pane can report an error message and have its controls are disabled. Error messages report one of four conditions

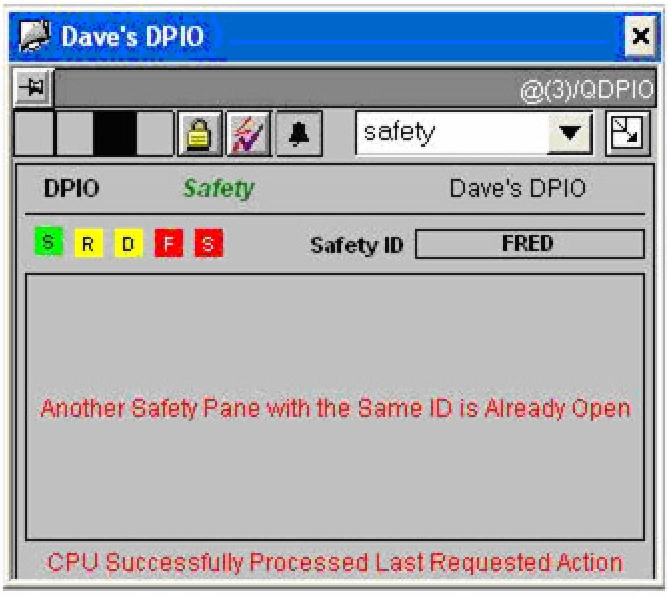
No User Logged In: an authorized operator must be logged in to take responsibility for assuming manual control of a safety system.

Another Safety Pane With the Same ID is Already Open: This condition includes a pane opened in loop view. Only one operator at a time can assume manual control of a safety system.

Safety ID Invalid or Not Configured: No string on the F_Q_CTRL block SAFETYID input nub or name with a incorrect syntax (non-printable characters such as spaces, line-feeds, and carriage-returns are not allowed)

Function Block Name Not Configured: The DPIO_DRV block associated with the faceplate must have its path entered in the **INAME** input on the **DPIO_DRV** block.

The following is an example of a safety pane with an obscuring error message:

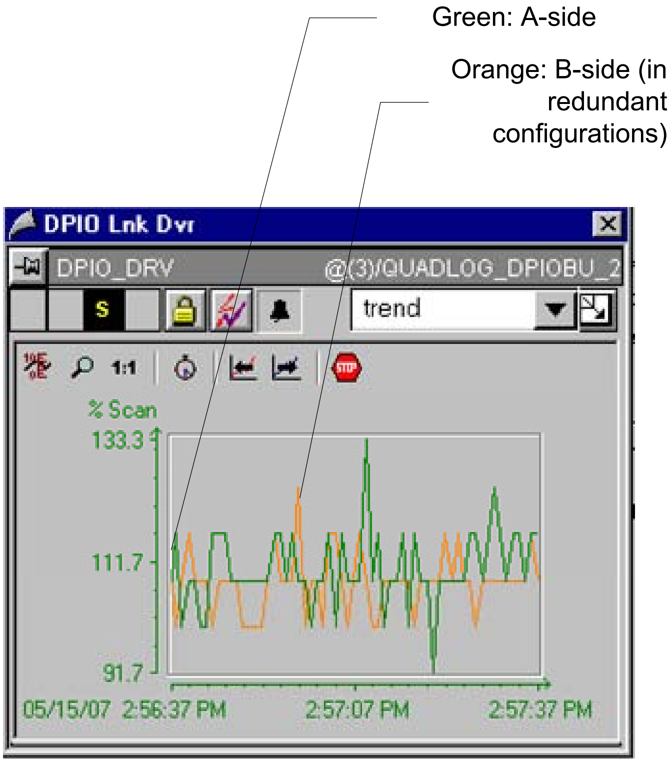


Note

If the faceplate is closed during before a required operator confirmation is registered and then re-opened, the operator will have to wait until the pertinent function block times out before being able to request another action.

10.7 Trend Pane

The Trend Pane provides plots of the percent scan of each module. The green pen reports data from the A-side module, and in redundant configurations, the orange shows the percent scan of the B-side module.

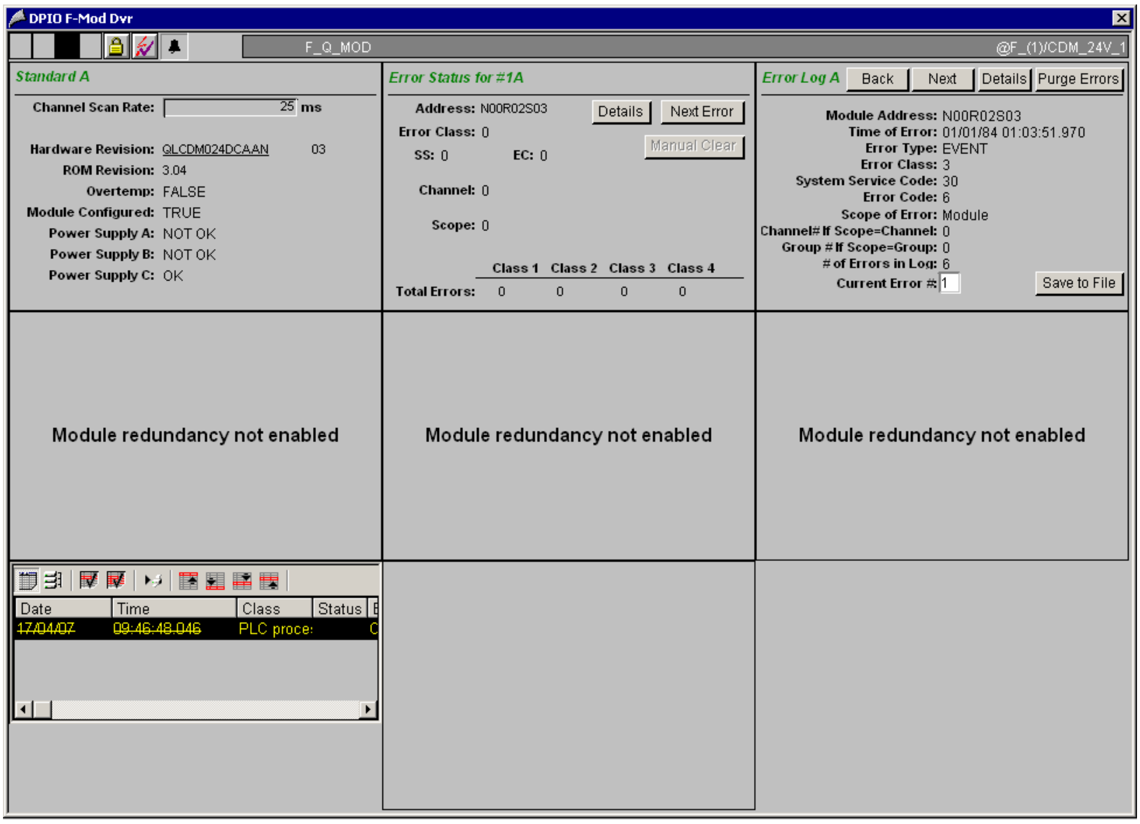


10.8 Loop View

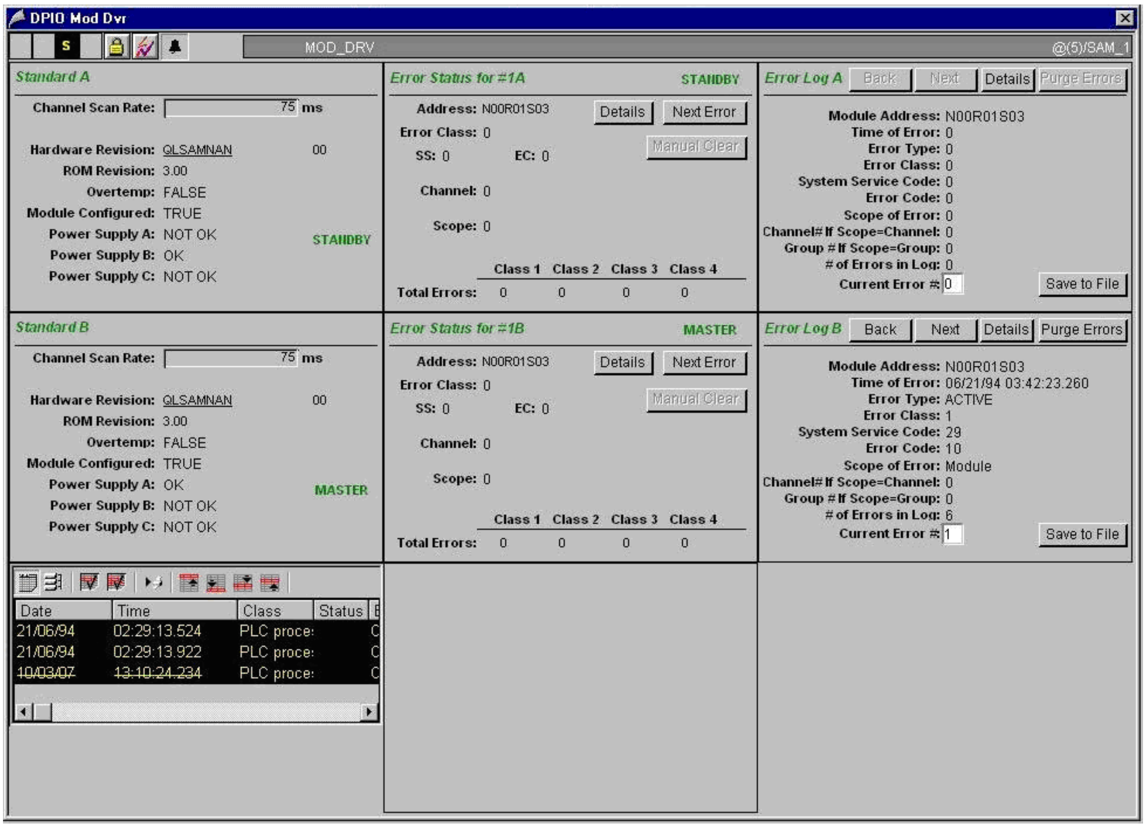
The loop view is a composite of the available panes. The loop view for a redundant configuration includes error status panes for both A- and B-sides. Note that loop views cannot be pinned.

The Loop View includes buttons labeled **Display Large Trend** and **Display Small Trend**. When **Display Large Trend** is enabled, the trend display expands to encompass four panes in the nine-pane grid, eliminating the display of B-side error status and error log displays. When **Display Small Trend**, the default, is enabled, B-side error and error log information is visible.

Redundancy not enabled

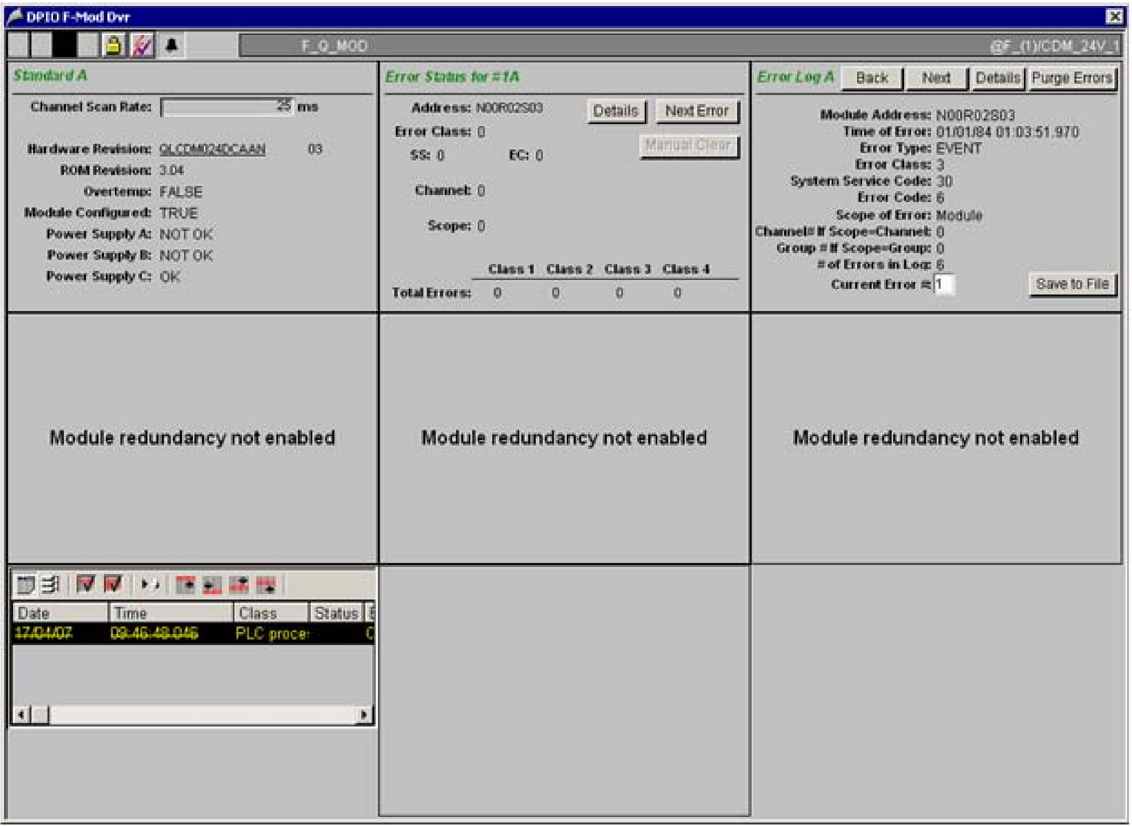


Redundancy enabled

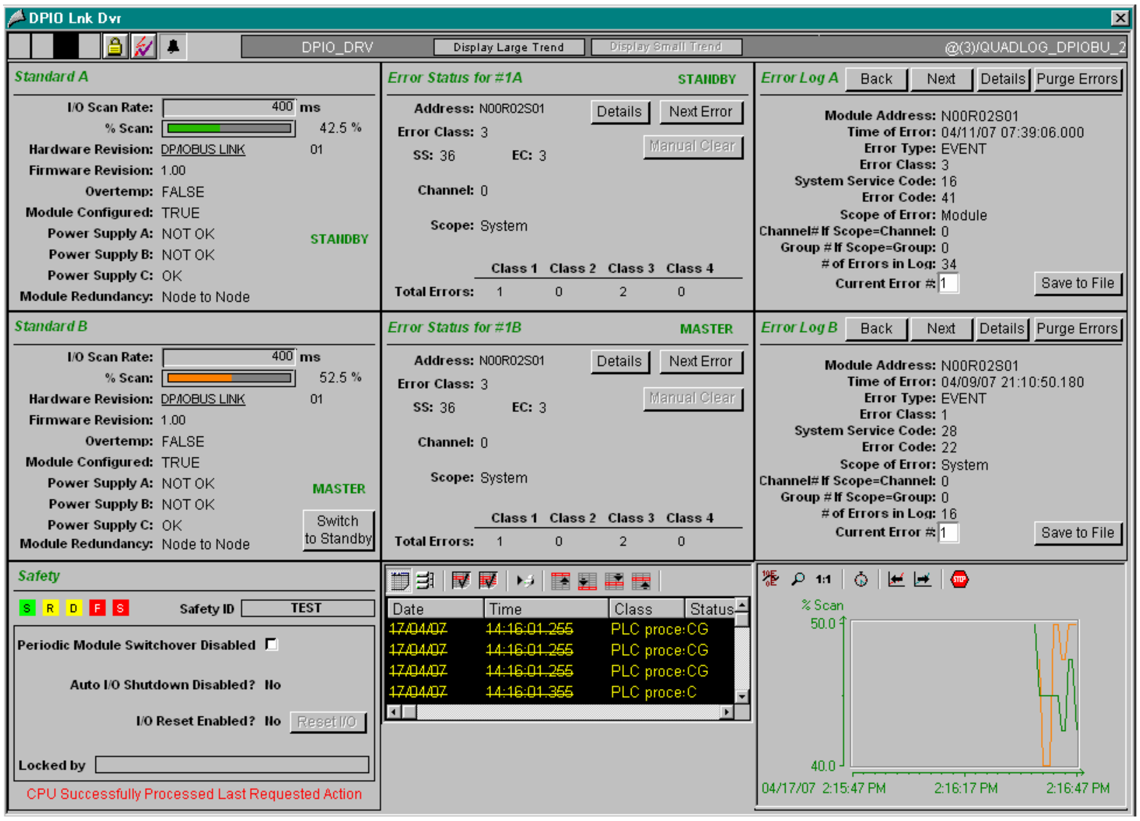


Buttons on the overview bar have the same functions as buttons on the overview bar on the standard pane and supports alarm acknowledgement and navigation to the block icon picture, to other panes, and to the loop view.

QUADLOG redundancy not enabled



QUADLOG redundancy enabled



10.9 Finding More information about Faceplates

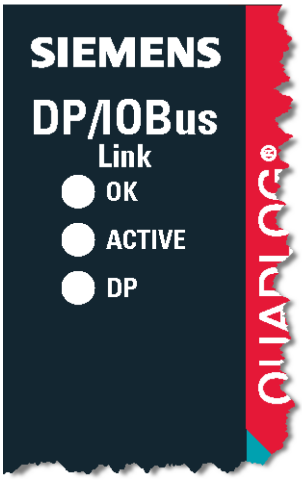
PCS 7 Faceplates are described fully in the manual titled *Process Control PCS 7 PCS 7 OS Process Control*.

11 Troubleshooting Guide

11.1 Symptoms and Procedures

11.1.1 Interpreting Front-Panel LEDs

Front-panel status LEDs can be steady red or green, flashing red or green, or off. See the table below to decode the status messages they convey.



Led Label	Indication	DP/IO Bus Link Module Status
OK	Steady GREEN	DB/IO Bus Error Free. Class 1 errors could exist.
	Flashing RED and GREEN	The highest error is a Class 2.
	Steady RED	DP/IO Bus I/O functions inoperative. The highest error is a Class 4 (default power up state)
	Flashing RED	DBIOB I/O functions partially operative. The highest error is a Class 3.
	OFF	DB/IO Bus input power fault.
ACTIVE	Steady GREEN	DP/IO Bus Link module is active; lit on active DP/ IO Bus Link module of redundant pair.
	OFF	• Module is in backup state • I/O functions inoperative if OK LED is steady RED
DP	Steady GREEN	DP slave interface is in active data exchange
	Flashing RED	• Valid DP Bus, DP/IO Bus Link not configured. (DP Configuration/Parameterization). • The DP/IO Bus Link module has rejected the DP/IO Bus Link configuration

Led Label	Indication	DP/IO Bus Link Module Status
	Flashing RED and GREEN	• DP Configuration/Parameterization received, waiting for IOBUS configuration. • DP/IO Bus Link module has rejected the DP/IO Bus Link configuration • Verify that the rack slot numbers for the DP/IO Bus Link module in HW Config match the hardware
	Flashing GREEN	DP slave interface is in standby data exchange (zero input data returned, output data ignored).
	Steady RED	DP Bus error, possible cause: default power up state. Bus error, possible causes: • Short circuit on the bus. • Differing baud rates. See Setting the PROFIBUS Data Communications Rate and Configuring TimeSynch. • HSA less than master address. See Setting the PROFIBUS Highest Scanned Address (HAS). • Faulty RS 485 circuit. (default power up state).
	Fast Flashing RED	AND OK LED is OFF • DP Address is invalid (DIP switches on transition board set to 0 or >= 126). AND OK LED is steady RED • Overvoltage detected at power up.
	OFF	Waiting for parameterization from master.

11.1.2 DP LED is flashing red/black on a redundant partner

The DP LED is flashing red/black on a redundant partner. Two possibilities:

- The DP address on the DP/IO Bus Termination Board is not correct. Verify that the DP address switches on the DP/IO Bus Termination Board are correct.
- The DP/IO Bus Link module has rejected the DP/IO Bus Link configuration

11.1.3 LEDs are all off

Check power, defective module.

11.1.4 External Fault (EXTF) LED on S7-CPU Stays on After All Errors in System Are Cleared

The faceplates in the OS always show which errors currently exist in the system. and should be the primary source of error information for the DP/IO Bus Link module and associated I/O modules. The OS provides additional error information to help you correct problems.

The diagnostic buffer of the S7-CPU indicates when the first error on the DP/IO Bus Link module or an I/O module occurs and when the last error clears. On rare occasions, the **EXTF** LED on the S7 CPU stays on after errors have cleared because he DP/IO Bus Link module and the CPU lose synchronization. When this occurs, entries are no longer made to the diagnostic buffer for the DP/IO Bus Link module or one or more I/O Modules. This would only be a concern if you have error handling routines added to OB85.

Attempting to run the CPU without a downloaded CFC downloaded can cause this error synchronization problem.

To correct this problem, the CPU must have a valid configuration and CFC in its memory, and then the DP/IO Bus Link module must be reset. If you choose not to reset the DP/IO Bus Link module, you should only use the error information in the OS.

11.1.5 Error indication in HW Config Online does not agree with error indication in OS

The faceplates in the OS always show which errors currently exist in the system. The OS should always be your primary source of error information for the DP/IO Bus Link module and associated I/O modules. The OS provides additional error information to help you correct the problem.

Rudimentary error information is also available in HW Config Online. Only the presence of an error on the DP/IO Bus Link module or an I/O Module is indicated.

If errors are indicated in HW Config Online, but not in the OS, first make sure the information you are viewing is up to date. If you are viewing the HW Config main window, select **View > Update** . If you are viewing a dialog box, select the **Update** button.

If errors are still indicated, the DP/IO Bus Link module may not have received an alarm acknowledgement when it expected one. This can happen when the S7-CPU quickly goes from Stop to Run to Stop again.

When you Clear/Reset the S7-CPU memory, you erase the configuration and CFCs. Do not attempt to restart the CPU after the Clear/Reset. Attempting to restart the CPU without any CFCs can cause the CPU to go from Stop to Run to Stop and create the alarm-acknowledgement problem.

To correct this problem, the CPU must have a valid configuration and CFC in its memory and then the DP/IO Bus Link module must be reset. If you choose not to reset the Link, you should only use the error information in the OS.

11.1.6 CDSI Channel Type Should Be Configured with the F_Q_CHRI Channel Driver Block

With a CDSI channel in HW Config linked via its symbol to an F_Q_CH**DI** channel driver block in CFC, the Module Driver Wizard generates the following.

```
Log: Module driver
Filter: Only errors and warnings
Generate module driver for DPIO_t4\SIMATIC 400(1)\CPU 417-4 H\S7
Program(1)\ of 7/23/2007 1:31:58 PM.
W: No hardware found for symbol XYZ with address I4.0.
Complete: 7/23/2007 1:32:03 PM.
0 error(s), 1 warning(s)
```

Since the Module Driver Wizard generated a warning instead of an error, a CFC compile operation continues (does not stop after the Module Driver Wizard runs, as it would had the Wizard generated an error) and eventually, the F-Tool generates the following:

```
Log: Compile
Filter: Only errors and warnings
Compiling changes to the charts as program SIMATIC 400(1)\CPU
417-4 H\S7 Program(1) on 7/23/2007 1:31:57 PM
   Generate block drivers: on
   Generating SCL sources: off
W: The "Generate Module Driver" function found 1 warnings.
Set sampling times from  7/23/2007 1:32:03 PM
Setting sampling times completed: 7/23/2007 1:32:04 PM.
E: Block '4': module not configured or parameter SYMBOL not
supplied [In HWConfig, configure a module for this driver, and
link it to the driver in SIMATIC Manager by means of "Generate
Module Drivers"]
W: Interconnection / Value of the parameter 'CFC(1)\4\CHADDR'
cannot be checked automatically. [Ensure that the
interconnection / value of this parameter agrees with the HW
Configuration for this parameter.]
  End of code generator: 7/23/2007 1:32:37 PM
  1 error(s) and 2 warning(s) found
```

CDSI channel type should be configured with the F_Q_CH**RI** channel driver block.

11.1.7 Redundancy not working

Confirm

- Redundancy cable installed properly.

Caution

Ensure that the DP/IO Bus Link module on the standby side is powered off or removed from the rack before connecting the redundancy cable to a transition board. This caution applies regardless whether the redundancy cable has been removed completely (both sides) or has been removed from either of the transition boards (one side). See Redundancy Cable, Transition Board, and IO Module Maintenance Considerations.

- Modules screwed into the MODULRAC.

11.1.8 System is shutdown

- Identify cause
- Check for class 4 errors.
- Check reset enable flag on faceplate.'

11.1.9 Connection between PCS 7 OS and AS Station Not Operational

Check your connection between the AS and the OS.

Some things to consider:

- Are the CP443-1 modules enabled (switches on the front of the module set to **RUN** or **STOP**)?
- Is every device between the OS and the AS connected and powered on:
  - Routers,
  - Network switches
  - Network hubs
- If a network router is being used, have the routing tables been properly setup?
- Are communications between the ES Station and the AS working? Check available stations within SIMATIC Manager to observe that they are working properly (Note, set PC/PG Station to ISO prior to performing Available Stations, and do not forget to switch back to PC Internal or the desired setting after using Available Stations.).
- Has the PC Station been configured properly? Check for a connection that should have been created within NetPro. See Compiling NetPro and Downloading the PC Station and Compiling NetPro and Downloading the PC Station.
- Have the proper MAC addresses been assigned to the CP443-1 expansion modules and also to the CP1613 ISO network interface card?
- Has the S7 417 CPUs? Simply perform a cold start of the CPUs to resolve this problem.
- Under certain circumstances, when a connection between the OS and the AS is lost this may require opening NetPro and downloading the PC Station from within NetPro.
- Verify the status of driver connections from within WinCC explorer.
- Verify the project has not changed significantly. The OS may require a compile and download.
- See the troubleshooting section in the manual titled *Process Control PCS 7 PCS 7 OS Process Control*.

11.1.10 Safety Faceplate Is Not Connecting to the DP/IO Bus Link module (through the F_Q_CTRL block)

- Check the name of the SAFETYID on the F_Q_CTRL block.
- Confirm the proper name on the INAME input on the DPIO_DRV function block. This name must match the path of the F_Q_CTRL block.
- Verify that the F-Program is not shutdown. Open the @F_ShutDn block within CFC and verify that the SHUTDN output on the block is 0. A value of 1 indicates that there is a shutdown of the F_Program, which require a restart of the shutdown logic.

11.1.11 Shutdown logic on the faceplate cannot be reset

The Reset Enabled bit may not be set, indicating that the system still has a shutdown level (class 4) error present.

1. Identify this error through the error faceplate and clear the condition that caused the error.
2. Manually clear the class 4 error if it did not automatically clear.
3. Switch to the safety faceplate and reset the shutdown logic.

The error (16:34) can be caused by change made to HW Config and downloaded without a corresponding compile and download of a CFC with the *Generate Module Drivers* option selected.

11.1.12 DP/IO Bus Link Faceplate Not Displayed in Graphics

If the DP/IO Bus Link faceplate is not displayed in graphics after a compile with import block types selected, two possibilities exist:

- The checkbox for create block icons is cleared.
- You neglected to cut the chart from the **Component View -> Charts** folder and paste it into the desired plant hierarchy level.

11.1.13 Caution Related to Deleting an I/O Module or Channel

If you delete a module from HW Config, you must also delete channel drivers associated with its channels. The corresponding graphic that contains the module driver faceplate must also be deleted.

Problems Resulting from Deleting a Module or Channel Improperly

A module or channel deleted under the following conditions:

- Previously configured in HW Config and CFC
- Deleted from HW Config
- Deleted associated channel drivers

can result in the following problems:

- Deleted @F_(x) chart from an Module Driver Wizard cleanup
- Deleted charts that were previously cut and pasted into plant view
- Broken faceplate connections

Recovery

1. Cut and paste a new @F_(x) chart from the component view to the plant view
2. In SIMATIC Manager, compile the PCS 7 OS.

11.1.14 Delayed Startup

Symptom

Unusually long startup times before the DPIOB Link and the Simatic Controller are ready for control.

Possible Cause

When starting up DP/IO Bus Link module from a Stop/Cold Start condition, the Siemens Controller sends to the DP/IO Bus Link configuration information for the DP/IO Bus Link module and each of its configured I/O Modules.

After the destination of this configuration information has been determined, a check is made of the Rack/Slot Address of the modules present. If any of these modules is not fully seated (and secured with the locking screws) it is possible that the code reading the Rack/Slot positions of the module may read the value inaccurately.

This would cause rejection of the configuration information being sent (the destination would not agree with any of the modules present).

During the subsequent retries, environmental factors such as vibrations and expansion could cause the correct value to eventually be read. At this point the configuration information would be accepted and the DP/IO Bus Link would then be allowed to startup.

Corrective Action

Ensure that modules are fully seated in the MODULRAC and secured with the screws provided. If the symptoms continue, try releasing and re-seating the modules, again securing them with the fasteners provided.

11.1.15 A Non-Redundant System Incorrectly Posts Error Bits

Conditions Leading to the Problem

In a non-redundant system that is running without error, the operator selects **Clear/Reset** and then elects to restart the CPU.

From HW Config and CFC, the sequence is **CPU > Reset**.

From SIMATIC Manager, the sequence is **PLC > Diagnostic/Setting > Clear/Reset**

At the end of the Clear/Reset sequence, the operator selects **Yes** to restart the CPU.

Circumvention

Select **No** when asked whether to restart the CPU.

or

Use the CPU **RUN/STOP/MRES** switch to clear the memory.

1. Switch to **STOP**
   The **STOP** LED is lit.
2. Press the spring-loaded switch to the **MRES** setting and hold it at this position.
   The **STOP** LED cycles as follows:1 sec OFF > 1sec ON > 1 sec OFF > then continuously ON.

3. Release the switch so it springs to **STOP**, then within the next 3 seconds return to **MRES**, then release the switch so it can return to **STOP**.
   The **STOP** LED flashes at least 3 seconds at 2 Hz (memory reset is being executed), then its signal is ON continuously.

11.1.16 In a Redundant System, Both DP/IO Bus Link Modules Shutdown

Both DP/IO Bus Link modules can be forced to shutdown if an error causing an IOBUS switchover occurs after any of the following conditions:

- One side a synchronization cable is removed from a CPU, which causes the standby CPU to halt. In this case the **DP** LED on the standby DP/IO Bus Link module flashes green, suggesting that the DP connection is fully operational, which is not the case. An alarm is reported: "CPU redundancy loss in rack x."
- A DP failure affects one CPU (for example, the DP cable is removed. In this case the **DP** LED of the connected DP/IO Bus Link module displays steady red. On the CPU, the **BUS1F** or **BUS2F** led flashes red. An alarm is reported: "Station x/y: Redundancy loss"
- The **Control** switch on a CPU is moved to the **STOP** position.

Under these conditions, when a error causing an IOBUS switchover s detected, the system tries to force the active DP connection to be on the same side as the IOBUS master. If the IOBus master is on the side with the CPU that has bee affected by the above conditions, the system times out and evetually shuts down.

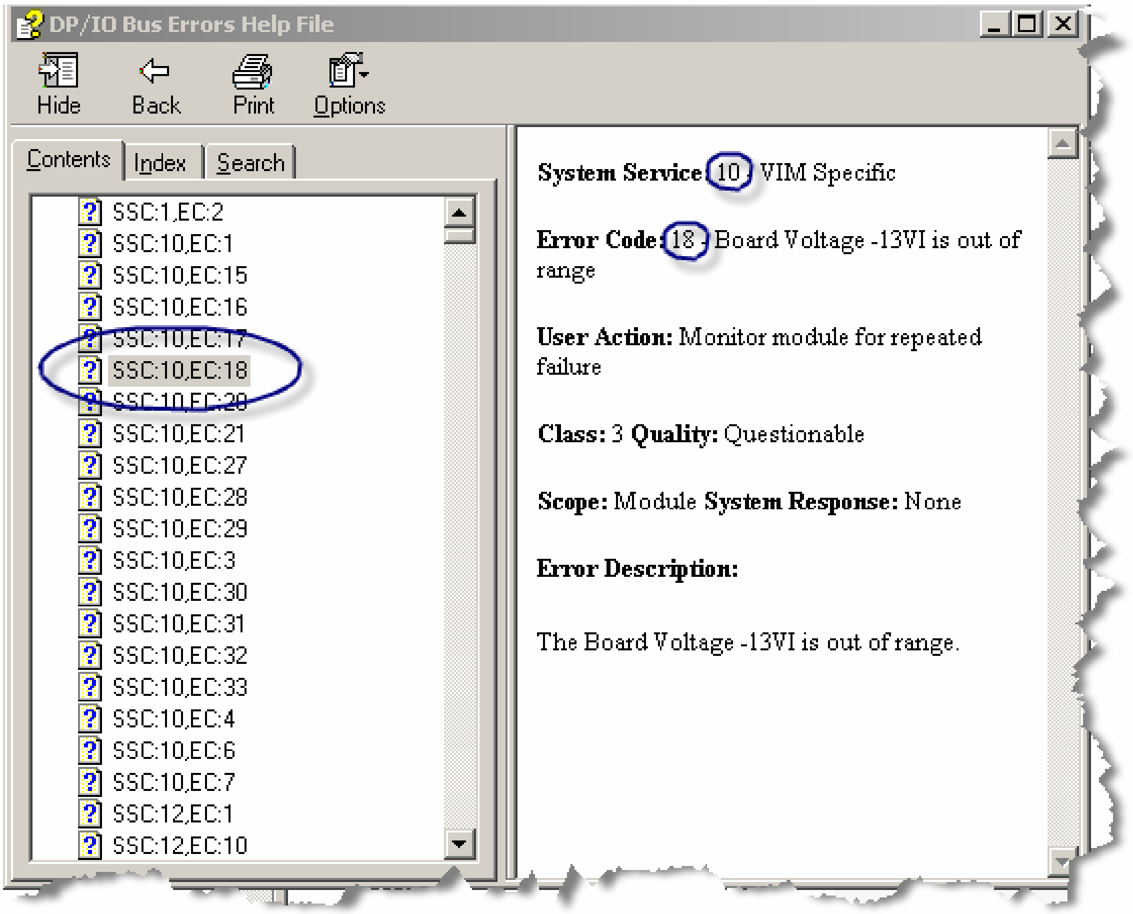
11.1.17 Trouble Compiling OS Due to Tag Name Conflict

Naming conflicts are possible when configuring multiple DP/IO Bus Link modules across different S7-417H CPUs within the same project. Some simple, manual name changes can be made in advance to avoid problems compiling the OS.

See the section titled Configuring Multiple DP/IO Bus Links.

11.2 Error Messages

Errors ordinarily reported in a form identifying a System Service Code (SSC) and an Error Code (EC), such as *SSC:10; EC:18*, are in this document described simply as *SSC:EC*. As a result, *Error SSC:10;EC:18* reduces to *Error 10:18.* If you have occasion to look up an error code in the help file *DPIOERRORS_toc.chm,* which is supplied on the software distribution CD, remember that the colon (:) separates the SSC from the EC. The window below shows a help-file entry for 10:18 error:



11.2.1 Error 16:29 DPIO Rejected Configuration

If the DPIO Bus link is powered on with an unsupported set of I/O modules in its rack, for example, an APACS module is accidentally inserted in place of a QUADLOG module, the DP/IO Bus Link module reports a 16:29 class 4 error. This error will not clear until the fault condition is rectified and the DP/IO Bus Link module is power cycled

11.2.2 Error 16:30 Timeout (or Other Sequence Number Error)

timeout error (16:30 or other sequence number error) can be the result of having an overscan. Check the PCT_SCAN output of the DPIO_DRV function block or look in the DP/IO Faceplate and ensure that the PCTSCAN is 90% or less.

There are three ways the adjust the scan rate to ensure that the PCT_SCAN value is kept below a maximum of 90%:

- An initial value for the scan rate is set with the HW Config program. See Adding a DP/IO Bus Link Module.
- You can manually adjust the **SCANRATE** input to the CFC **DPIO_DRV** function block and observe the result on the **PCT_SCAN** output. See DPIO_DRV.
- From an OS, you can use the standard faceplate to control the scan rate and to monitor the **PCT_SCAN** output. See Standard Faceplate Pane.

Warning

Safety Note - Avoid Changing Scan Rate Online in a Commissioned System

Changing the scan rate while online may result in a unpredictable shutdown of critical I/O modules with shutdown channels configured. Siemens recommends that the scan rate be changed only during a scheduled shutdown or before or during commissioning of the system."

11.2.3 Error 16:34

See Shutdown logic on the faceplate cannot be reset.

11.2.4 Error 16:37 Safety Mode Mismatch

When there is a mismatch in the Safety Mode settings between the redundant DP/IO Bus Link partners, error 16:37 is reported. The condition is reported after a Safety Mode mismatch exists for a period of 3 DP/IO Bus Link consecutive scans. If accompanied by a persistent CPU FB alarm for Safety Mode discrepancy between the CPU and DP/IO Bus Link module, then the problem is on the DP/IO Bus Link module that is the IOB master side. Otherwise, the problem is on the DP/IO module that is IOBus standby side. This occurs because the DP/IO Bus Link module that has Safety Mode set will be in control of the IOBus, and the IOBus master will not match the CPU if the CPU is not in Safety Mode.

Recovery

1. Check the Safety Mode of the CPU.
2. Check the Safety Mode feedback from the DPIO module on the F_Q_CTRL FB.
3. Manually clear the error and monitor for repeated errors.
4. If the error recurs, try to toggle the Safety Mode in the CPU, or try to power cycle the faulty DP/IO Bus Link module.

11.2.5 Error 17:10 Node (A/B) Switch Setting

In node-to-node redundant systems, the node switch (S1) on DP/IO Bus Link module transition boards selects which side of a redundant pair is the A-side and which is the B-side. The switches must be set to opposite positions before power-up and should not be toggled while the system is underway. If the switches of a redundant pair are the same, either at power-up or during operation, a 17:10 error is likely.

Online Reaction

If a switch position is changed while the system is underway, so that both switches select **A** or both select **B**, the side whose switch was changed posts a 17:10 error.

Online Recover

Clearing the error requires that the changed switch be set back to its original position.

It is also possible to switch the previously unchanged switch to the opposite position, but the next time the system is powered-up, the A and B sides may be reversed.

Improper Setting at Power-Up

If a node-to-node redundant system is powered up with the node switches in the same position (both **A** or both **B**), then one side assumes control and the other side fails to connect to the DP portal in the PCS 7 controller. The DP/IO Bus Link modules whose switch was changed posts a 17:10 error. The **REDUNDNT** output is **0** instead of **1**.

Recovery from Improper Setting at Power-Up

Change the node switch on the partner that is not in control and power cycle the DP/IO Bus Link module associated with it. Power cycling must be done twice to recover from this error.

An alternative is to put both switches in the correct position and power cycle both DP/IO Bus Link modules

It is also possible to switch the previously unchanged switch to the opposite position, but the next time the system is powered-up, the A and B sides may be reversed.

11.2.6 Error 17:04 and 18:03

There is a problem with the redundancy cable or related hardware. See Link Redundancy Cable Is Removed While DP Slave Master Is IOBus Master.

11.2.7 Errors 29:10 and 29:11 A/B Side I/O Bus not working

A 29:10 “A-Side I/O Bus not working” or29: 11 (29:11) “B-Side I/O Bus not working” error reported on a I/O module means that the IOBus, which is a redundant set of two communications paths, by conventions labeled A-Side and B-Side, is not operating properly on one side.

This description of IOBus A- and B-side should not be confused with the larger A- and B-side redundancy in which A-side and the B-side are fully functional mirror images of one another.

See the section titled Link Module to I/O Module.

11.2.8 Error 36:31 Critical Scan IORSP CRC Error

If this error is reported during DP/IO Bus Link module startup or after downloading a configuration from the CPU, manually clear it.

11.2.9 Error 37:33 I/O Configuration Corrupt

- In redundant systems, if the DP/IO Bus Link module rejects a downloaded I/O configuration and a module reports this error, ensure that the firmware revision of redundant modules is at the same revision level.
- This error can also occur at startup in redundant systems with VIM modules:
  - Clear/reset the CPUs to remove any memory-resident configurations.
  - Power off the redundant partner CPU.
  - Download the configuration to the powered CPU.
  - Restart the powered CPU.
  - After the powered CPU has finished its startup sequences and is running, turn on its redundant partner. The configuration cross loads.

11.2.10 DPIO_DRV Reports CRC Error and Timeout

Confirm that HW Config does not include an I/O Module with no channels configured.

11.2.11 Error Message: "CPU redundancy loss in rack x"

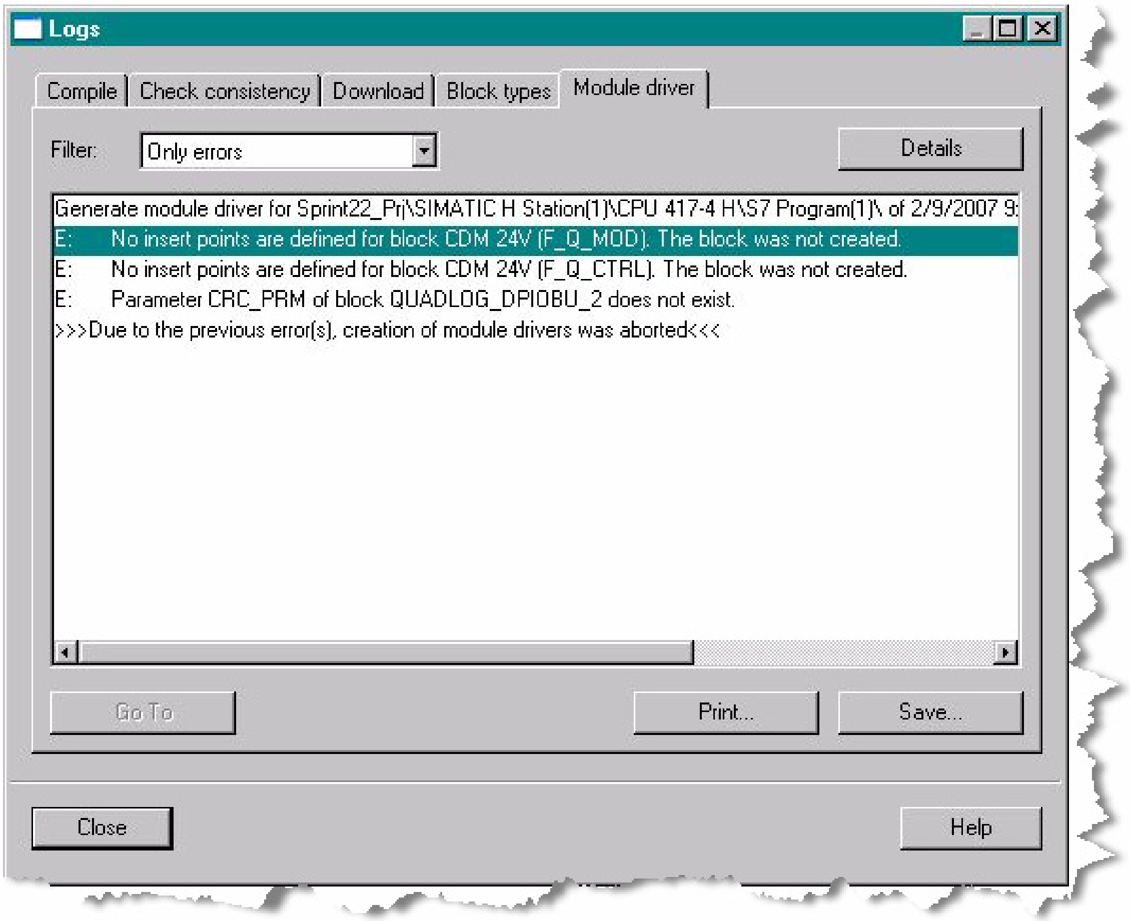
See In a Redundant System, Both DP/IO Bus Link Modules Shutdown.

11.2.12 Error message: "E: No insert points are defined for block x. The block was not created"

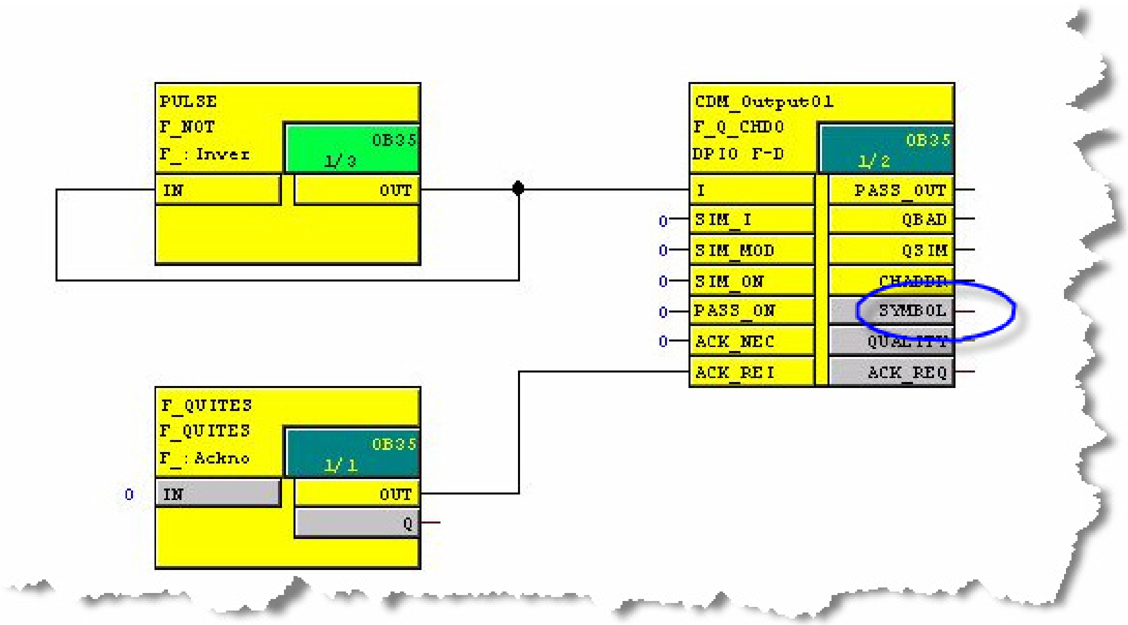
This error generally points to a failure to connect a channel driver symbol input or output to an address defined in HW Config.

Check the channel type and verify that the symbol that was configured for the channel type agrees with it (input or output) and verify that the channel type (input or output) of the channel driver matches.

The error is presented in window similar to the following:



In the following example, the symbol output is not connected:

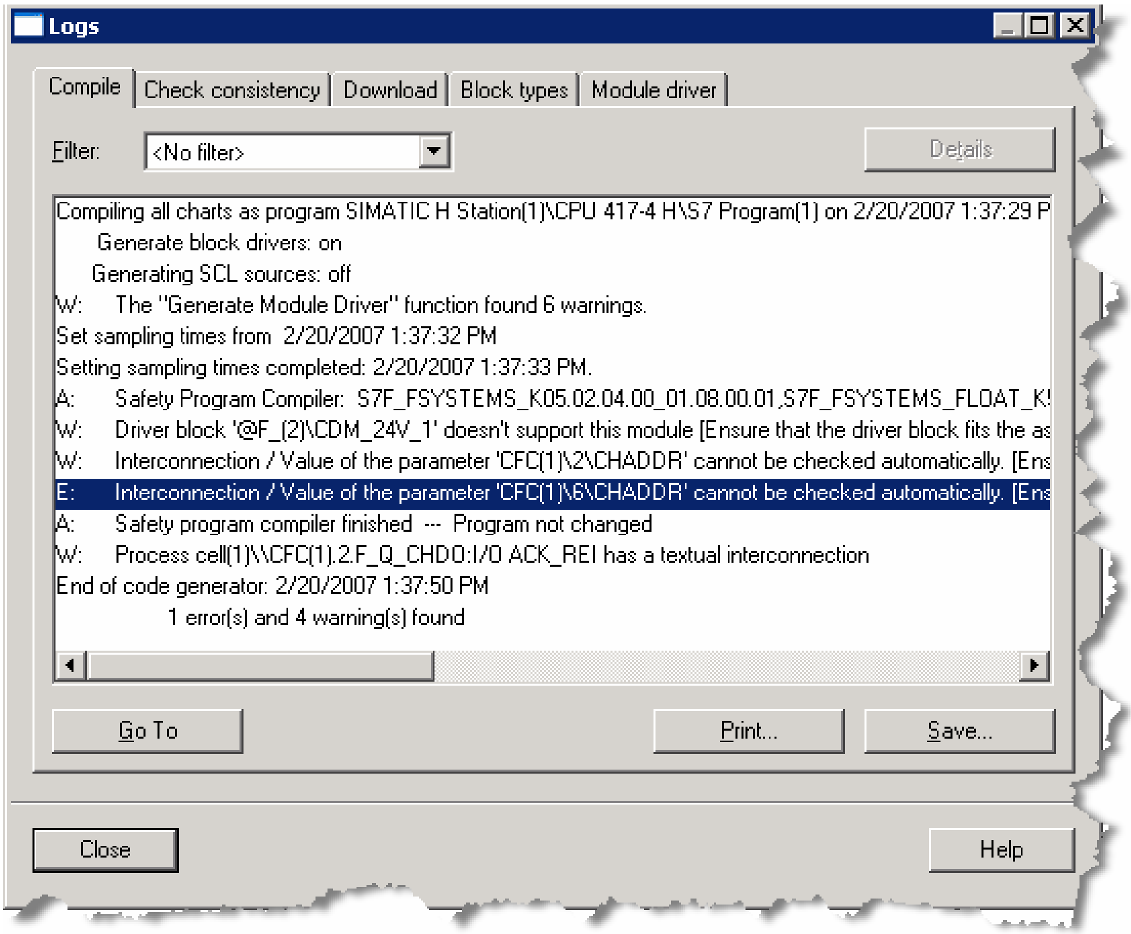


The error message can also appear if you neglect to use a standard channel driver A_CH_xx block for a non-critical QUADLOG module.

The error message can also appear if you have not followed the procedure outlined in the section titled Notes on Using the Driver Blocks, which includes manual steps that must be followed when placing an F_Q_CHDI block associated with an F_Q_CTRL block

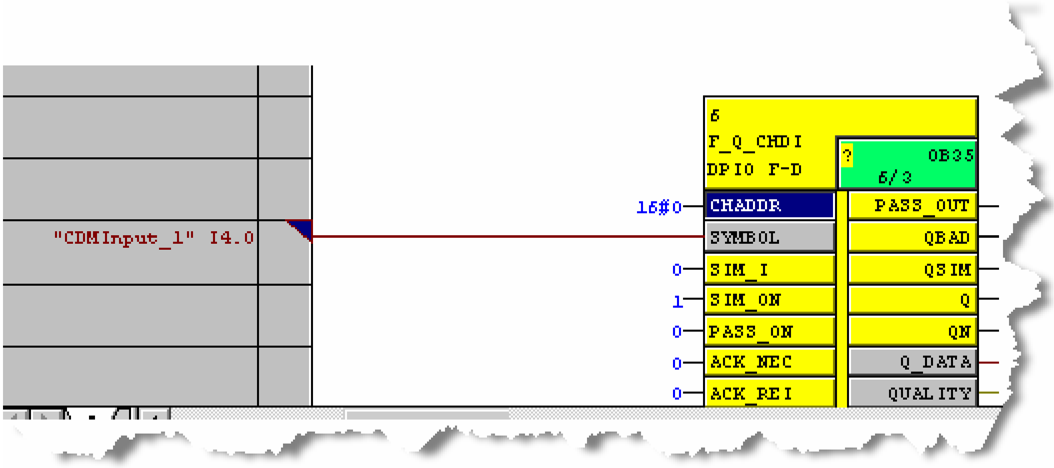
11.2.13 Error Message: "Interconnection / Value of the parameter 'xxxxx' cannot be checked automatically"

This message may appear after a CFC compile in the **Logs**.



To correct the error do the following:

1. Click the **Go To** button to open the CFC page with the error and highlight the nub in question. In this case, that is the CHADDR input.



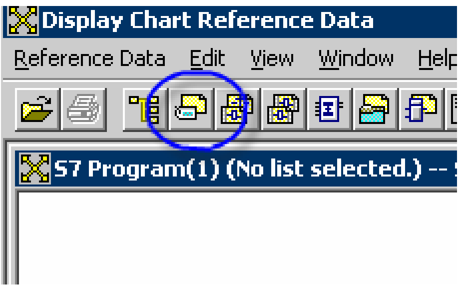
2. Determine which symbol is connected to this input and check the Symbol Table to determine whether another symbol is assigned to the channel, (in this case the Output Channel 1).
3. Ensure that connections are made properly.

Alternative method: use the Cross Reference tool.

1. In Simatic Manager, invoke the cross-reference tool by clicking the following icon:

The **Display Chart Reference Data** window opens with an indication that no list has been selected.

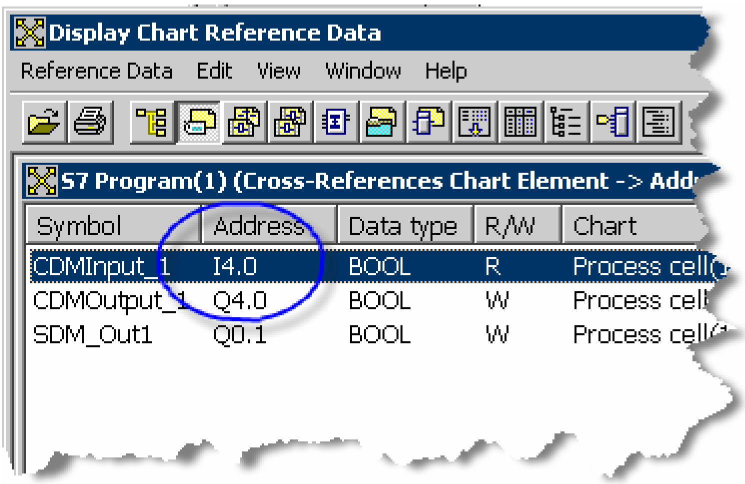
2. In toolbar of the open window, select the fourth icon:



A window labeled **S7 Program(x) Cross-References Chart Element > Address opens.**

3. In the list, look up the symbol causing the problems, in this case CDMInput_1.

TIP: Click the heading or the column labeled **Address** to sort the table according to addresses. As the following illustration shows, doing this makes it clear when two symbols are using the address, **4.0** in the illustration.



The control logic should use only one of the symbols pointing to a channel. It is not necessary to change which symbol is using the channel.

If you delete a symbol interconnection in a CFC page, the following should be noted: Whenever changing the interconnections of an existing channel driver block (SYMBOL or CHADDR for the F_Q_CHxx blocks or SYMBOL, DATA or QUAL for the A_CH_xx blocks), always delete the interconnections between the module driver and channel driver blocks that were created by the Module Driver Wizard as well. (that is, delete CHADDR for the F_Q_CHxx blocks and delete DATA and QUAL for the A_CH_xx blocks). Deleting these interconnections forces the Module Driver Wizard re-make the proper interconnections.

11.2.14 Error Message: "Error in generator environment"

See Unexpected CFC Compile Errors.

11.2.15 Error Message: "Station x/y: Redundancy loss"

See In a Redundant System, Both DP/IO Bus Link Modules Shutdown.

11.2.16 Error Message: "Unspecified Error"

See Unexpected CFC Compile Errors.

11.2.17 Unexpected CFC Compile Errors

An intermittent anomaly can produce windows announcing the following CFC compile errors:

- "Error in generator environment"
- "Unspecified Error"
- "System Errors"

These errors typically occur after you have examined I/O module parameters and, even though you have not made any changes, have clicked the **OK** button rather than the **Cancel** button. They can also occur after you have added a module, then removed the module, generating no apparent change, or after you have changed a parameter value and then changed it back.

Corrective Action

Close the HW Config program before compiling the CFC.

11.3 Warning Messages

Warning typically do not prevent the DP/IO Bus Link module and related software from running, although they may not run properly until the condition producing the warning is rectified.

11.3.1 Warning Message: "QUADLOG DPIOBUS-Link (6EQ2 013-0CE00-0XA0) is not supported"

In early versions of PCS 7 Version 7 this message may appear after compiling an CFC. It may be safely ignored.

11.3.2 Warning message: "...\CHADDR' cannot be checked automatically"

Depending upon the version of F-Systems installed, this message may appear. It can be safely ignored.

11.3.3 Warning Message: "No hardware found for symbol <Symbol Name> with address I<XXX.YY>"

You may have selected an incorrect channel driver for the module type.

Examples:

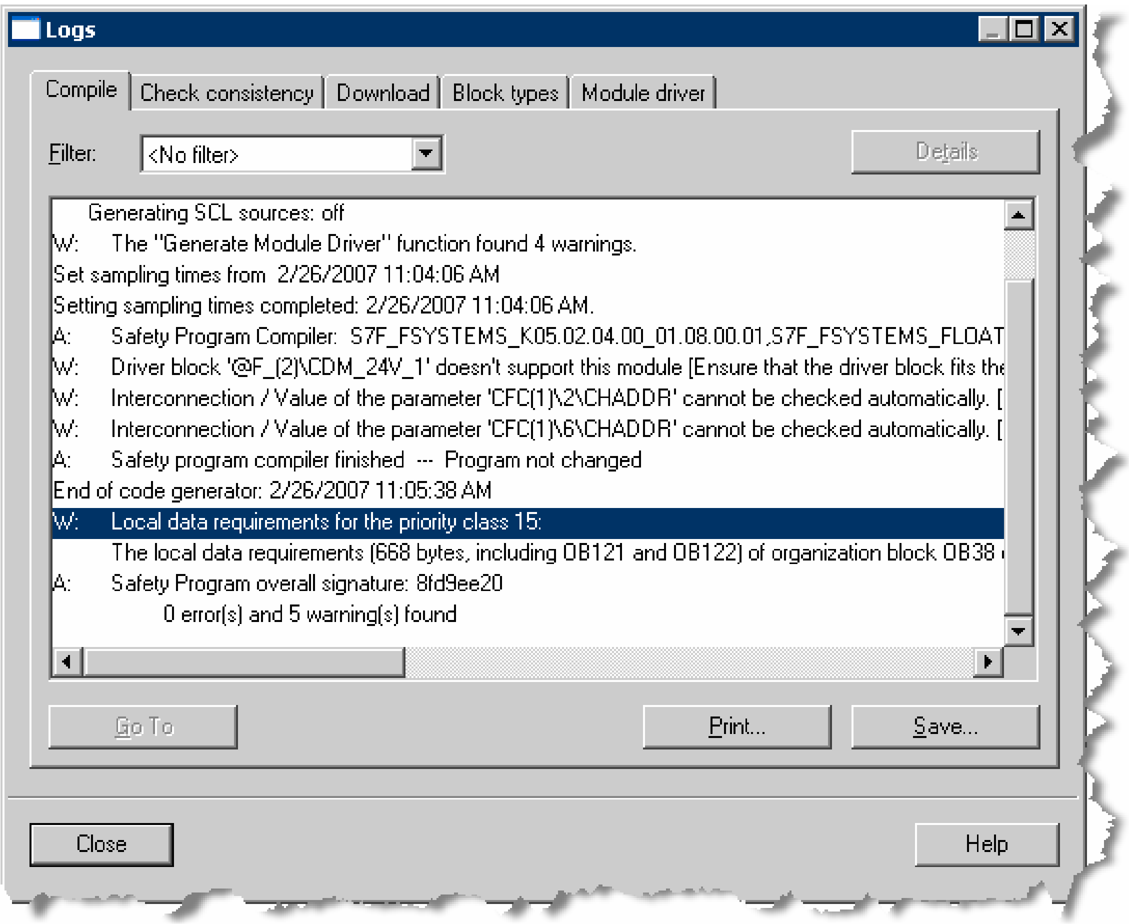
- An F_Q_CHRI block instead of an A_CH_RI block for a SAM. The A_CH_RI block is appropriate for non-critical modules.
- An A_CH_RI block instead of a an F_Q_CHRI block for a CAM. an F_Q_CHRI block is appropriate for safety critical modules.

In HW Config, you may have identified a channel as both an input and output. See Editing Symbols in HW Config and Error Message: Interconnection / Value of the parameter 'xxxxx' cannot be checked automatically.

11.3.4 Warning: "Local data requirements for the priority class XX:"

If a warning is displayed that reports local data requirements exceed the local data stack size, increase the local stack size using the following method:

Determine which priority class is in error (the XX), in this case we'll assume the warning seen below:

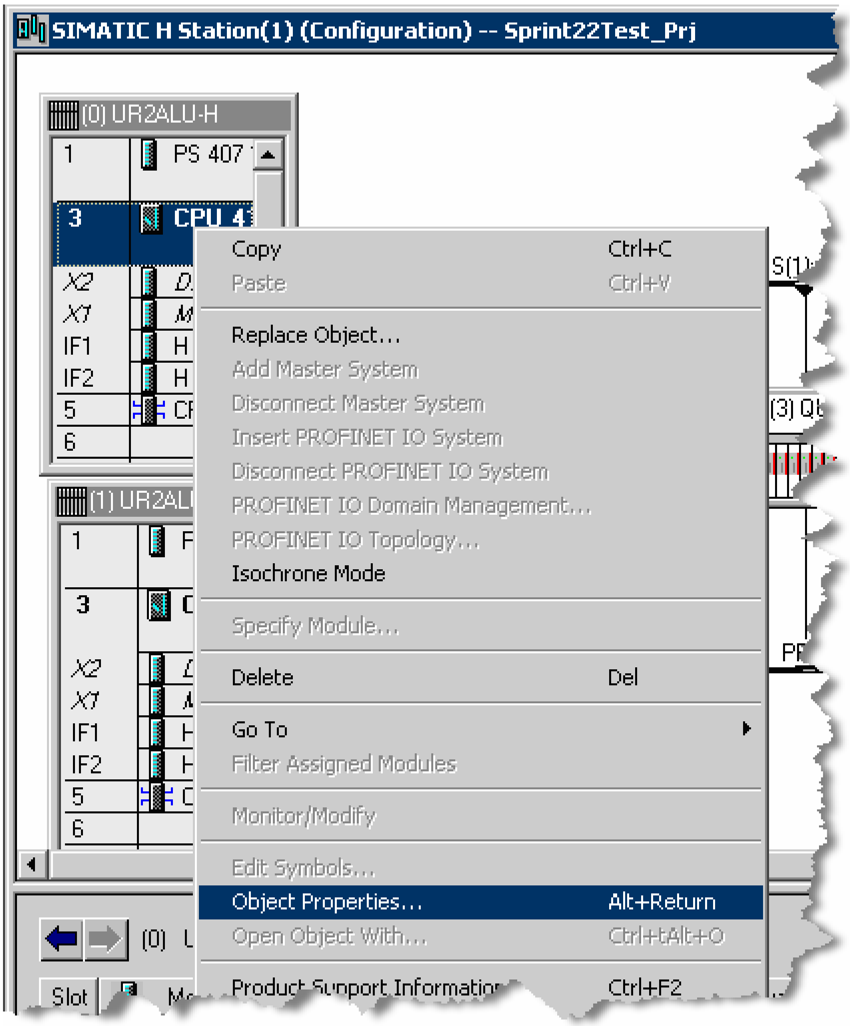


This warning indicates it is priority class 15

Therefore the user must increase the size of the priority 15 memory component:

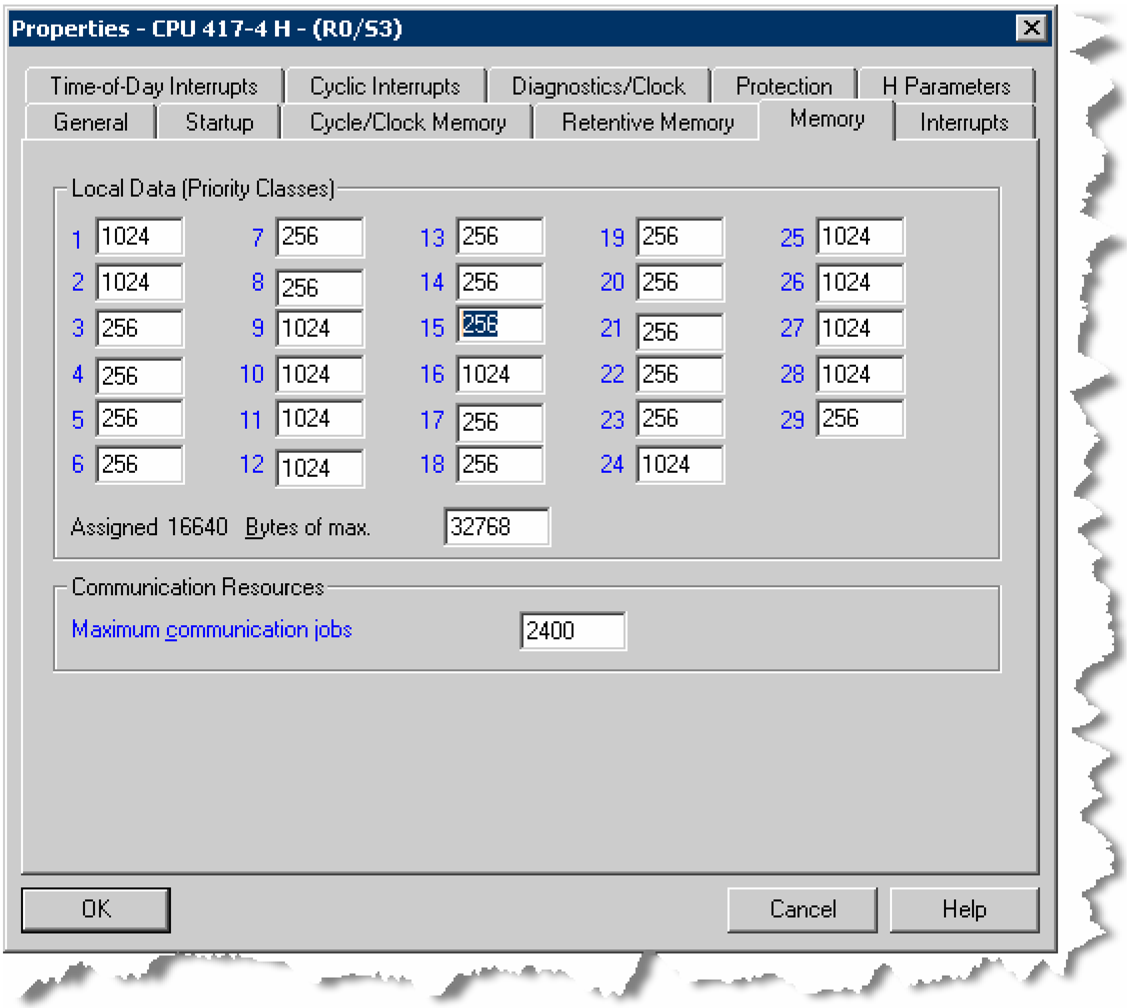
To do this,

1. Open H/W Config.
2. Select the CPU module
3. Right-click and select the Object Properties option:



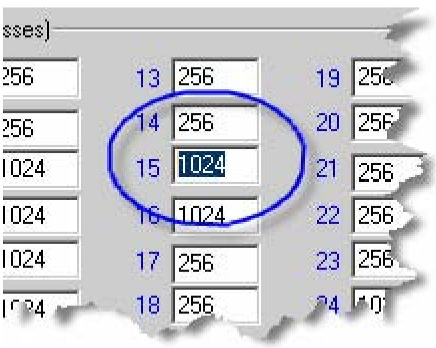
The **Properties** window opens to the **General** tab

4. Click the **Memory** tab.
   A window opens displaying the memory allocated for each priority class:



This warning was for Priority Class 15, indicating that its local data memory requirements exceeded the configured size, (256).

5. Select the entry in Priority 15 and change to a larger value. Siemens suggests changing from 256 to 1024 bytes to prevent small future changes from causing the warning to reappear:



6. Click the **OK** button.
7. Compile HW Config and the CFC pages.

12 Resources and References

12.1 Availability

- Up-to-date documentation is available for viewing and downloading from the web site www.siemens.com/automation/service&support. The site includes a panel labeled *Search Product Support Documents*, which leads to a search engine.
- Relevant documentation current at the time of product release is installed on OS and ES PCs and is available by selecting **Start > SIMATIC > Documentation > English**.
- The encyclopedic DVD titled *SIMATIC PCS7 Manual Collection* is revised and distributed periodically. The DVD includes a user interfaces and search function to help you find relevant documentation quickly.

12.2 Best Practices

Customers' engineering staffs are encouraged to familiarize themselves with the latest version of document titled *Best Practices for SIMATIC@ PCS 7 Project Engineering* (A5E00918133-nn). This document provides an overview of proven engineering methods and makes reference to specific topics in available documentation.

12.3 Finding the Most Current Documentation

Documentation is updated on the web site www.siemens.com/automation/service&support as soon as it becomes available. All referenced Siemens documents (with a drawing number A5E*xxxxxxx-xx*) are available from this site. Many of them are loaded upon a local hard disk drive when PCS 7 is installed. APAC+ documentation is also available on this site, but may not be installed locally with PCS 7.

Documentation installed on OS and ES PCs is current at the time of installation, but, like all technical documentation, may be displaced by revised materials.

Documentation available on the DVD titled *SIMATIC PCS7 Manual Collection* of necessity lags behind major product releases, but where the focus is on engineering principles rather than specific procedures, it is possible to apply principles and make minor adjustments to accommodate improvements and updates in available software. This is especially true, for example, in the case of the *Best Practices* document, which makes frequent reference to other documents. If you need specific procedures or specifications, it is prudent to determine whether the document referred to has been updated, and if so, to adjust accordingly.

12.4 Identifying Documentation

Title/topic	Desktop Link	Number	Filename
	PCS 7 - Getting Started Part 1 (online help)		ps7gs1_b.chm
	PCS 7 - Getting Started Part 2 (online help)		ps7gs2_b.chm
APACS+™ Advanced Control Module (ACM) Standard Function Blocks Version 4.40 and Higher		CG39-22 Rev: 8 August 2002	Search web site http://support.automation.siemens.com/WW/view/en/23435080
APACS+™/QUADLOG® MODULRAC and Local Termination Panel Installation and Service Instruction		SD39MODULRAC-1 Rev: 6 February 2000 (Updated January 2002	Search web site http://support.automation.siemens.com/WW/view/en/23445272
"Process-Image Input/Output Tables"	PCS 7 - Basic Documentation		ps7bas_b.chm
Best Practices for SIMATIC@ PCS 7 Project Engineering		A5E00918133-*nn*	Search web site
Process Control PCS 7 PCS 7 OS Process Control	PCS 7 - OS Process Control	A5E00324835-01	ps7osp_b.pdf http://support.automation.siemens.com/WW/view/en/21400983
ProcessSuite® 4-mation™ Configuration QUADLOG® ACM+/CCM Version 3.30 or Higher		CGQL-3 Rev: 9 March 2004	Search web site http://support.automation.siemens.com/WW/view/en/23446265
ProcessSuite® 4-mation Configuration QUADLOG® I/O Module Configuration Version 3.32 or Higher		CGQL-4 Rev: 6 June 2004	Search web site http://support.automation.siemens.com/WW/view/en/23446031
QUADLOG® Critical Analog Module		SDQLCAM-1 Rev: 4 September 2005	Search web site http://support.automation.siemens.com/WW/view/en/23445939
QUADLOG® Critical Analog Input Module (CAI)		SDQLCAI-1 Rev: 4 September 2005	Search web site http://support.automation.siemens.com/WW/view/en/23445061
Safety Manual for QUADLOG® Version 3.32 or Higher		CGQLSAFETY-1 Rev. 8 September 2004	Search web site http://support.automation.siemens.com/WW/view/en/23447258
SIMATIC Process Control System PCS 7 Getting Started-Part 1	PCS 7 - Getting Started Part 1 (PDF)	A5E00369624-02	ps7gs1_b.pdf http://support.automation.siemens.com/WW/view/en/21405992

SIMATIC S7 F/FH Systems Configuring and Programming		A5E00085588-05	Search web site http://support.automation.siemens.com/WW/view/en/2201072
SIMATIC Process Control System PCS 7 Getting Started-Part 2	PCS 7 - Getting Started Part 2 (PDF)	A5E00369629-02	ps7gs2_b.pdf http://support.automation.siemens.com/WW/view/en/21407103
SIMATIC Process Control System PCS 7 V7.0 PC Configuration and Authorization		A5E00783465-01	ps7pck_b.pdf http://support.automation.siemens.com/WW/view/en/24450438
SIMATIC Process Control System PCS 7 Engineering System	PCS 7 - Configuration Manual Engineering System	A5E00346923-02	ps7phesb.pdf http://support.automation.siemens.com/WW/view/en/24450116
SIMATIC Safety Engineering in SIMATIC S7		A5E00109529-05	S7%2DSicher_e[1].pdf http://support.automation.siemens.com/WW/view/en/12490443
Using the ProcessSuite 4-mation Configuration Software Version 4.30 or Higher		CG39-20 Rev: 5-prelim July 2001	Search web site http://support.automation.siemens.com/WW/view/en/23436388

13 Glossary

AS

1. **Automation System:** which is composed of the S7 CPUs and I/O. In the context of systems that include the DP/IO Bus Link module, the term refers primarily to software executing in the S7 CPUs.

   The automation system performs the following tasks:

   - The AS acquires and processes the process tags from the connected I/O (centralized and distributed) and outputs control information and setpoints to the process.
   - The AS supplies the operator station with data for visualization.
   - The AS recognizes operator inputs and returns them to the process.

2. **Automation Station**, distinguished from the engineering station (ES), and the operator's station (OS), consists of S7 CPUs and related hardware, such as power supplies and communications processors.

Automation Station

This term used to refers to S7-400 CPUs, which contain the DP/IO Bus Link Function Block Library. Although the Function Block Library is installed on the Engineering Station, it is categorized as an Automation Station component within the DP/IO Bus Link project because ultimately the function blocks are downloaded to the S7-400 CPU.

CFC

CFC (Continuous Function Chart) is an editor with a graphical user interface, an extension based on the STEP 7 software package. It is used to create the entire software structure of the CPU and uses pre-configured blocks. The editor lets you insert blocks into function charts, assign block parameters and interconnect blocks. Interconnecting means that values can be transferred from one output to one or more inputs during communication between the blocks or other objects.

Class *n error*

Where *n* ranges from 1 to 4, see Error Detection and Error Handling in the section labeled Failure and Recovery in Redundant Systems. Some errors are apparent from face places (see Block Icons) and from module front-panel LEDs:

Solid Green = Module OK (normal operation)

Flashing Green/Black = Module is not configured

Flashing Green/Red = Minor fault detected (class 2 error present)

Flashing Red/Black = Major fault detected (class 3 error present)

Flashing Red/Black (fast) = IOBUS communications lost (module shutdown)

Solid Red = Severe module fault detected (module shutdown, class 4 error present)

Cold start

Restart of an automation system and its user program after all dynamic data (tags of the I/O image, internal registers, timers, counters, etc. and the corresponding program elements) were set to default. A cold start may be triggered automatically (for example, due to power failure, loss of dynamic data in memory).

DP

PROFIBUS Decentralize Processing network.

DP/IOBUS Link

PROFIBUS DP to IOBUS link module, adapting IOBUS I/O modules to S7 CPUs via DP.

ES

Engineering System. The ES consists of software components such as SIMATIC Manager, STEP 7, CFC, SFC, F-Tool, These software tools are used to control, configure, program, and diagnose S7 CPUs and I/O modules. ES can also refer to Engineering Station, which the physical PC where this software runs. The engineering station is typically a dedicated PC.

The engineering station is used for centralized engineering of all PCS 7 system components: operator stations, automation systems, and I/O. You download the configuration data to the PCS 7 system components once engineering is complete. You change the configuration data only on the engineering station. Afterwards, you download it again. Engineering stations are PCs on which the PCS 7 engineering software for configuring a PCS 7 project is installed.

Fail-safe Systems

Fail-safe systems (F-systems) are systems that remain in a safe state or immediately switch to another safe state when certain failures occur.

F-system

See Fail-safe Systems.

IOBUS

The IOBus is a proprietary 1 Mbps bus connecting I./O modules in an QUADLOG process automation system to their controller. The DP/IO Bus Link module is a hardware and software interface between QUADLOG I/O modules on the IOBus and an S7 400 controller.

IOBus Switchover

An IOBus switchover is a reversal of the master/standby status of the IOBus controllers in a redundant pair of DP/IO Bus Link modules.

Switchovers occur in response to error conditions. Under normal conditions, an IOBus switchover occurs when the error count on the master side of the redundant system is higher than the count on the standby.

Switchovers can be invoked or disabled from OS Safety Pane faceplate or from the F_Q_CTRL function block of the ES. Periodic switchovers occur in operational systems at a specified frequency (selected form a range extending from four and twelve hours).

Master and Standby

Master refers to the module that is in control within a redundant pair. The other module is known as the *Standby*. Redundant S7-400 CPUs are master or standby, depending upon the status of the system. Similarly the DP/IO Bus Link module in a redundant configuration can be master or standby depending upon the status of the IOBus.

In a redundant QUADLOG system, the controller in control of the IOBus was called the *Calculate* and the other controller was called the *Verify*.

MLFB

Part number, or more precisely, order number, ordinarily visible on hardware chassis and software labels.

Node-to-Node

The name referring to the QUADLOG redundancy architecture providing 1oo2D I/O with 2oo2 control redundancy.

LoopOK

The LoopOK signal in the DP/IOBus Link module indicate the health a particular side of a redundant pair. The LoopOK signal is broken by a set of specific diagnostic failures. A LoopOK-broken condition is annunciated to the user through a class 3 SSC 36 EC 03 error code is visible on the module's faceplate. A master DP/IO Bus Link module cannot switch control to a side that whose LoopOK signal is broken.

An example of a condition that cause a LoopOK-broken condition is a defective field device that causes a open circuit on a CDM channel. When this open circuit is detected, the a LoopOK is broken. An internal I/O module diagnostic failure could also break the LoopOK signal.

OB Priority

The operating system of the S7-400 CPU differentiates between various priority classes, for example, cyclic program processing, process interrupt-controlled program processing. Each priority class is assigned organization blocks (OBs), where the S7 user can program a reaction. As a standard, the OBs have different priorities to which they are processed when they occur simultaneously or when they interrupt each other.

OB, Organizational Block

Organization blocks form the interface between the operating system of the S7-400 CPU and the user program. The sequence in which the user program should be processed is laid down in the organization blocks.

The PCS 7 OBs for programming are OB30 through OB38. These OBs are based on periodic interrupts. The frequency of these interrupts can be changed in the HW Config program. The default duration of OB35 is 100ms, which the default for OB34 is 500ms, and the default for OB38 is 10ms.

OS

PCS 7 Operator Station (HMI). In most system operator stations and the engineering station (ES) are on separate PCs.

The operator station is used to operate and monitor your PCS 7 system in process mode. You connect the operator station to the plant bus to enable the required data communication with the automation system. Operator stations are PCs on which the PCS 7 OS software is installed.

QUADLOG

The QUADLOG process safety system.

Reintegrate I/O

Reintegration means:

- Valid process values are output again on the output channels of the fail-safe output modules.
- The F channel drivers of the fail-safe input modules forward valid process values to the safety program again.

See Passivation and Reintegration of the Input and Output Channels.

RTG, Run-Time Group

An OB can consist of multiple runtime groups. Blocks in a runtime group run in the order that they are listed in the runtime group. The runtime groups run in the order that they are listed within the OB.

Safety Mode

Operating mode of the safety program. In Safety Mode, all safety mechanisms for fault detection and fault reaction are activated. In Safety Mode, the safety program cannot be modified during operation. Safety Mode can be deactivated by the operator for test purposes, commissioning, etc. Whenever Safety Mode is deactivated, the safety of the system must be ensured by other organizational measures, such as operational monitoring and manual safety shutdown.

softlist parameters

Softlist parameters refer to selectable channel characteristics that an operator can edit, such as output range, minimum scale, maximum scale, shutdown channel, and so forth. In a DP/IO Bus Link module environment, channel parameters that can be edited are exposed in the HW Config program as **Object Properties**, where they are selected from the **Parameters** tab.

shutdown channel

A shutdown channel is a safety critical channel. A channel failure that normally causes only a class 2 or class 3 error, perhaps because of a detected open or short circuit error, is also reported as a class 4 error on a shutdown channel. A shutdown channel is designated in HW Config as a parameter. Only channels that are critical to the process should be configured as shutdown channels. Note that in rack-to-rack redundant systems, a switchover to the standby side, rather than a system shutdown, occurs if an I/O failure occurs. Both sides of a redundant system would have to fail for a shutdown to occur.

switchover

warm restart

During a CPU startup and before cyclic program processing starts (OB1), either OB101 (hot restart), or OB100 (restart/warmstart), or OB102 is processed first. Prerequisite f or the execution of the "hot restart” function is a backup of all CPU data. The data of all data areas (timers, counters, flags, DBs) are retained. The process-mage input table is read in and the STEP7 user program processed starting at the last break point STOP, power failure.

Work Memory

The work memory is the RAM (Random Access Memory) in the CPU to which the STEP 7 user program is automatically reloaded from the load memory. The processor executes the program in the work memory in RUN mode.

Index

R

S

T

U

W