3. Users Guide

The most important user aspects of gate drive power supply, isolation interface, optical interface, control and diagnostic functionality during normal and faulty operation are explained. Also environmental issues like electromagnetic immunity, thermal management and pollution are briefly covered. As an appetiser an example of a functional block diagram of an IGCT gate drive is given in Fig. 1:

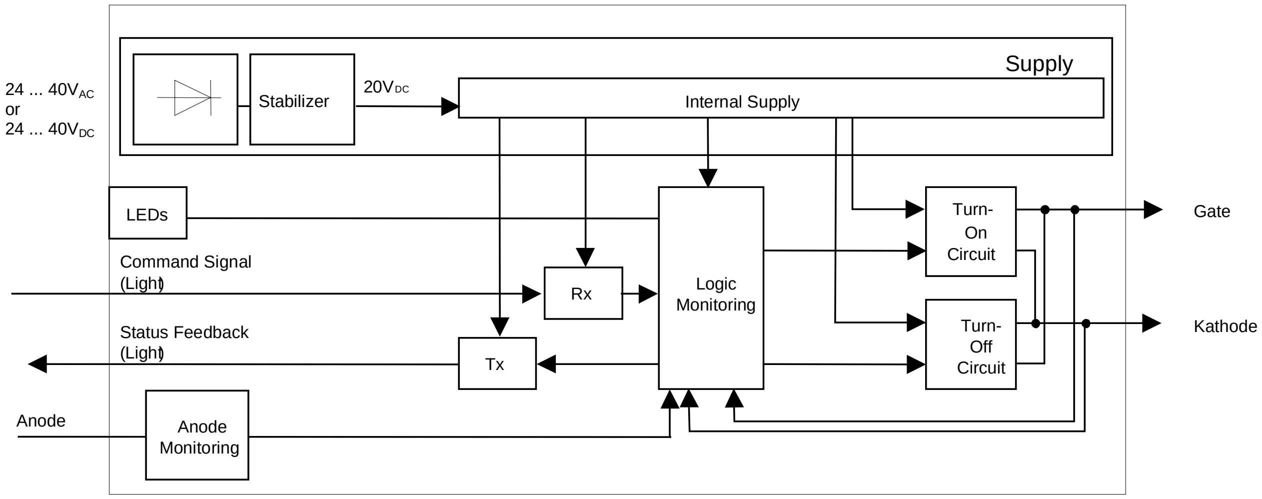


Fig. 1: Block diagram of an AC input asymmetric IGCT.

3.1 Power Supply Interface

Isolation

The isolation requirement in the IGCT environment is a function of the maximum applied nominal voltage of the converter application itself. This voltage varies from a few thousand volts to several tens of thousands of volts over the IGCT application range. Hence, the requirements on isolation strength and distances can be very different. Furthermore, the power consumption which needs to be transferred across the isolation interface is also strongly application dependent, and users are likely to require quite different isolation interfaces in terms of both power handling capability and isolation strength.

As this also applies to the costs of the interface, standardisation of the isolation interface is difficult.

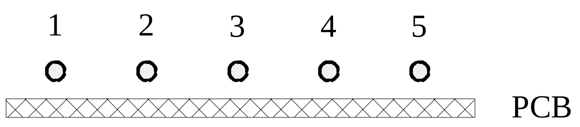
This is why the IGCT gate drive does not provide an on-board potential separation and the gate unit power supply output as well as the supply cable must withstand the high voltage potential of the power semiconductor switch against all other relevant potentials in the converter.

Gate Unit Power Connector

The connector X1 is specified in the corresponding IGCT data sheet. The information about the corresponding power cable connector can be found on the connector supplier's web site, which is also mentioned in the data sheet.

Product	Connector X1	Remark
5SHX xx**D**xx**0**x 5SHX xx**F**xx**0**x 5SHX xx**H**xx**0**x 5SHZ xx**F**xx**0**x 5SHZ xx**H**xx**0**x	2 pin DC input	Polarity shown on gate drive board Positive pin is cathode potential
5SHY xx**L**xx**1**x	5 pin AC input	Center pin is cathode potential for possible shield connection. See Fig. 2
5SHX xx**L**xx**0**x 5SHY xx**L**xx**0**x	4 pin DC input	As 5 pin connector shown in Fig. 2, but without center pin Polarity shown on gate drive board Positive pins are cathode potential

Table 1: Power connector main data by product group.



1 - $V_{IN,\ positiv}$

2 - $V_{IN,positiv}$

3 - transformer shield, cathode

4 - $V_{IN,return}$

5 - $V_{IN,return}$

Fig. 2: Pinout of power input connector of 5SHY … gate drive (looking into the connector from the outside)

Regulated DC Input Voltage

The hard drive principle of the IGCT requires a regulated internal DC supply voltage:

$$V_{GINT} = 20 \pm 0.5 \text{ V}$$

For some IGCT products (see data sheet and Table 1) this is also the requirement on the gate drive supply voltage V_{GDC}. When using IGCT products of this type, an interface board with a rectifier and a regulator has to be provided between the IGCT and the isolation transformer. This board needs to be mounted on high voltage potential.

AC Input Voltage

Other IGCT products (see data sheet and Table 1) have built-in rectifier and voltage regulator. Hence the isolation transformer output can be connected directly to the gate drive power supply input. The power supply voltage V_{GAC}, specification yields:

$$V_{GAC} = 24 \ldots 40 \text{ V}$$

square wave amplitude

or equivalently

V_{GAC} = 48 ... 80 V
square wave peak-to-peak voltage

Recommended frequency range of the ac square wave voltage is

f_{in} = 15 … 100 kHz

Inrush Current Limitation

The AC input gate drive has an internal voltage regulator and a current limitation, which also limits the inrush current at power up. See Fig. 14, page 13.

DC input gate drives do not have this feature.

Power Consumption

The power supplied to the gate unit falls into two parts:

One big part is transferred from the turn-off capacitors to the load during turn-off. A charge equal to the gate turn-off charge Q_{GQ}, is necessary to recharge the capacitors to the reference voltage, V_{GINT} after each turn-off event. Thus the transferred power can be expressed as

$$P_{transfer} = V_{GINT} * Q_{GQ}(I_{TGQ}) * f_S$$

f_S being the device switching frequency and I_{TGQ} the anode turn-off current.

The gate charge Q_{GQ}, is a function of the turn-off current I_{TGQ}, and the device design itself. Gate charge characteristics and transferred power as a function of switching frequency, turn-off current at a duty cycle of 50% of the device 5SHY 35L4510 are shown in Fig. 3 and 4.

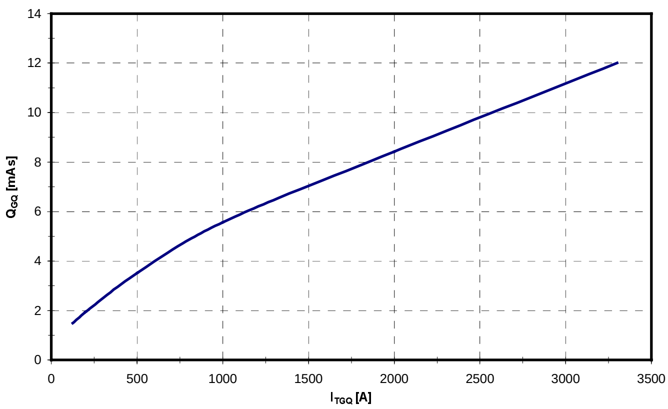


Fig. 3: Gate charge characteristics of 5SHY 35L4510

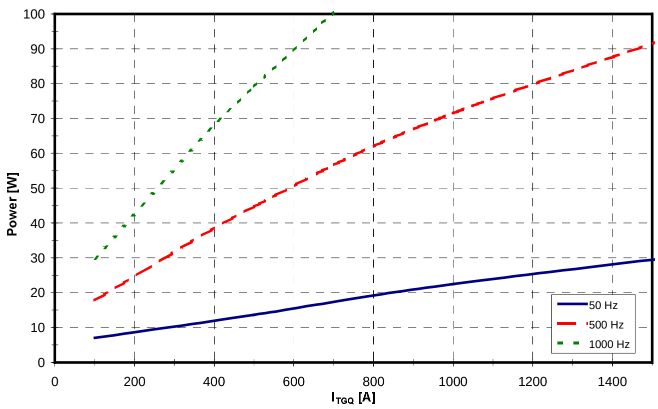


Fig. 4: Transferred power of 5SHY 35L4510

The second part of the power is dissipated in the gate circuit (including gate-cathode junction). It comprises standby power, generation of turn-on pulse and back-porch current, dissipation in the gate drive turn-off circuit and input rectifier.

Fig. 5 shows the dissipation in the gate circuit as a function of the device switching frequency at zero anode current.