V_{DRM}	=	4500 V
I_{TGQM}	=	4000 A
I_{TSM}	=	32 kA
V_{T0}	=	1.40 V
r_T	=	0.325 mΩ
V_{DClink}	=	2800 V

Asymmetric Integrated Gate-Commutated Thyristor

5SHY 35L4510

PRELIMINARY

Doc. No. 5SYA1232-00 Mai 01

- **Highest snubberless turn off rating**
- **Optimized for medium frequency (<1kHz) and wide temperature range**
- **Suitable for series connection**
- **High reliability**
- **Very high EMI immunity**
- **Simple control interface with status feedback**
- **AC supply voltage**

Blocking

V_{DRM}	Repetitive peak off-state voltage	4500 V	$V_{GR} \geq 2V$
I_{DRM}	Repetitive peak off-state current	≤ 50 mA	$V_D = V_{DRM}$ $V_{GR} \geq 2V$
V_{DClink}	Permanent DC voltage for 100 FIT failure rate	2800 V	Ambient cosmic radiation at sea level in open air.

Mechanical data (see Fig. 6)

F_m	Mounting force	min.	36 kN	
		max.	44 kN	
D_p	Pole-piece diameter		85 mm	±0.1 mm
H	Housing thickness		26 mm	±0.5 mm
m	Weight IGCT		2.90 kg	
D_s	Surface creepage distance		≥ 33 mm	Anode to Gate
D_a	Air strike distance		≥ 10 mm	Anode to Gate
l	Length IGCT		439 mm	±1.0 mm
h	Height IGCT		40 mm	±1.0 mm
w	Width IGCT		172.5 mm	±1.0 mm

GCT Data

On-state (see Fig. 2)

I_{TAVM}	Max. average on-state current	1700 A	Half sine wave, T_C = 85 °C		
I_{TRMS}	Max. RMS on-state current	2700 A			
I_{TSM}	Max. peak non-repetitive surge current	32 kA	t_p =	10 ms	T_j = 125 °C After surge: $V_D = V_R$ = 0V
		12 kA	t_p =	100 ms	
I^2t	Limiting load integral	$5.1 \cdot 10^6$ A^2s	t_p =	10 ms	
		$7.2 \cdot 10^6$ A^2s	t_p =	100 ms	
V_T	On-state voltage	≤ 2.70 V	I_T =	4000 A	T_j = 125 °C
V_{T0}	Threshold voltage	1.40 V	I_T =	1000 - 4000 A	
r_T	Slope resistance	0.325 mΩ			

Turn-on switching (see Fig. 8, 9)

di/dt_{crit}	Max. rate of rise of on-state current	1000 A/µs	f =	0..500 Hz	T_j =	125	°C
			I_T =	4000 A	V_D =	2800	V
t_{don}	Turn-on delay time	≤ 3 µs	V_D =	2800 V	T_j =	125 °C	
t_r	Rise time	≤ 1 µs	I_T =	3300 A			
$t_{on\ (min)}$	Min. on-time	10 µs	R_s =	0.65 Ω	L_i =	5.0 µH	
E_{on}	Turn-on energy per pulse	≤ 1.5 J	C_{CL} =	10.0 µF	L_{CL} =	0.3 µH	

Turn-off switching (see Fig. 3, 4, 8, 9)

I_{TGQM}	Max. controllable turn-off current	4000 A	V_{DM} ≤	V_{DRM}	T_j =	125 °C	
			V_D =	2800 V	L_{CL} =	0.3 µH	
t_{doff}	Turn-off delay time	≤ 7.0 µs	V_D =	2800 V	V_{DM} ≤	V_{DRM}	
t_f	Fall time	≤ 1.0 µs	T_j =	125 °C	R_s =	0.65 Ω	
$t_{off\ (min)}$	Min. off-time	10 µs	I_{TGQ} =	3300 A	L_i =	5.0 µH	
E_{off}	Turn-off energy per pulse	≤ 18 J	C_{CL} =	10.0 µF	L_{CL} =	0.3 µH	

Gate Unit

Power supply (see Fig. 5, 6, 7)			
V_{GAC}	Gate supply voltage	24..40 V_{AC}	AC square wave. Without galvanic isolation to power circuit.
P_{Gin}	Gate Unit power consumption	≤ 100 W	f_S = 500 Hz, I_{TGQ} = 1500 A, δ = 0.5
X1	Gate Unit power connector	WAGO, Part Number 231-533/001-000 Note 1	
Optical control input/output (see Fig. 8)			
$P_{on\ CS}$	Optical input power	> -21 dBm	Valid for 1mm plastic optical fibre (POF)
$P_{off\ CS}$	Optical noise power	< -40 dBm	
$P_{on\ SF}$	Optical output power	> -19 dBm	
$P_{off\ SF}$	Optical noise power	< -50 dBm	
t_{GLITCH}	Pulse width threshold	≤ 400 ns	Max. pulse width without response
CS	Receiver for command signal	Agilent, Type HFBR-2528 Note 2	
SF	Transmitter for status feedback	Agilent, Type HFBR-1528 Note 2	
Visual feedback (see Fig. 8, 9)			
LED1 (green)	Gate OFF	"Light" when GCT is off	
LED2 (yellow)	Gate ON	"Light" when gate-current is flowing	
LED3 (red)	Fault	"Light" when not ready / Failure	
LED4 (green)	Power supply voltage OK	"Light" when power supply is within specified range	

Note 1: WAGO, www.wago.com
Note 2: Agilent Technologies, www.semiconductor.agilent.com

Thermal

T_j	Operating junction temperature range	-40…125	°C	
T_{stg}	Storage temperature range	-40…60	°C	
T_{amb}	Ambient operational temperature range	-40…60	°C	
T_{amb}	Ambient operational and storage temperature range	-40…70	°C	IGCT operation with lifetime reduction
R_{thJC}	Thermal resistance junction to case	≤ 8.5	K/kW	Double side cooled
R_{thCH}	Thermal resistance case to heatsink	≤ 3	K/kW	Double side cooled

Analytical function for transient thermal impedance.

$$Z_{thJC}(t) = \sum_{i=1}^{n} R_i(1 - e^{-t/\tau_i})$$

i	1	2	3	4
R_i(K/kW)	5.625	1.486	0.849	0.527
τ_i(s)	0.52748	0.08969	0.00905	0.00244
F_M = 36… 44 kN Double side cooled				

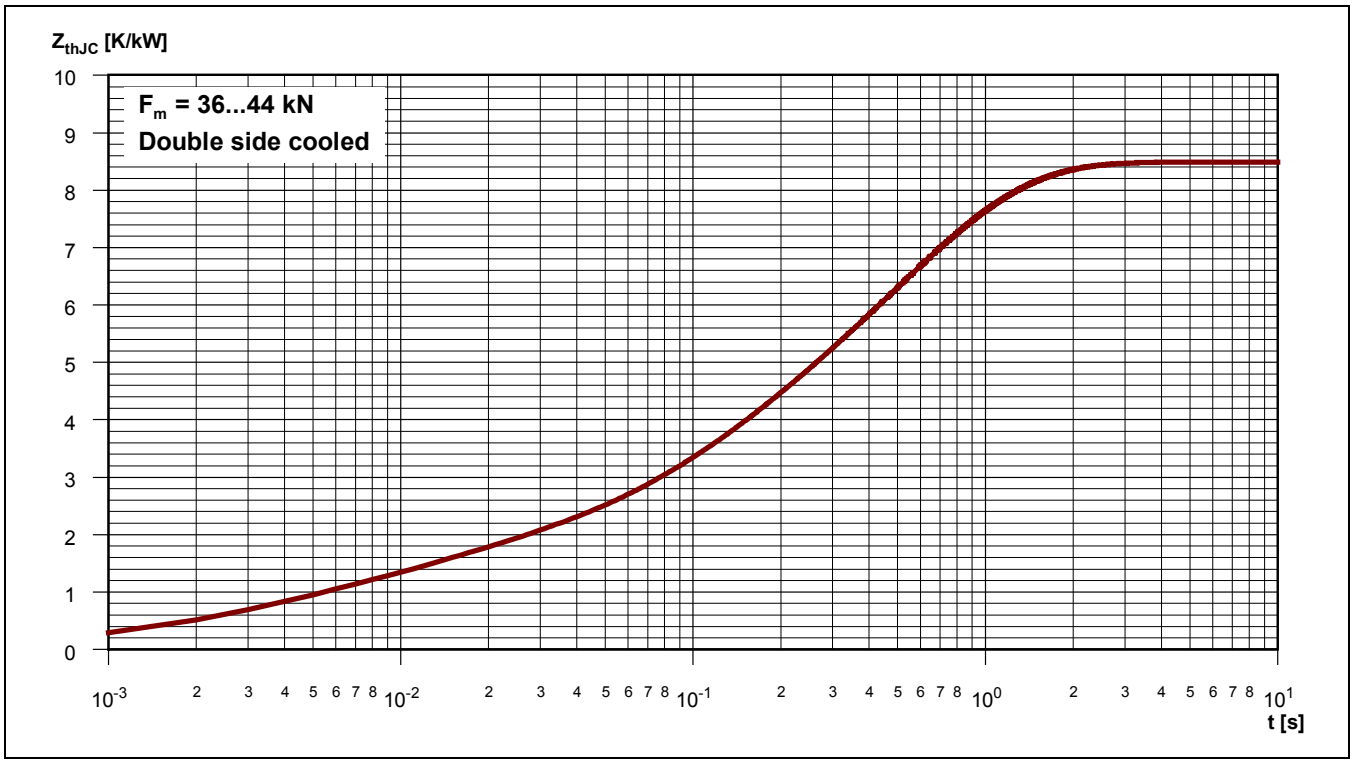

Fig. 1 Transient thermal impedance (junction-to-case) vs. time (max. values).

GCT Part

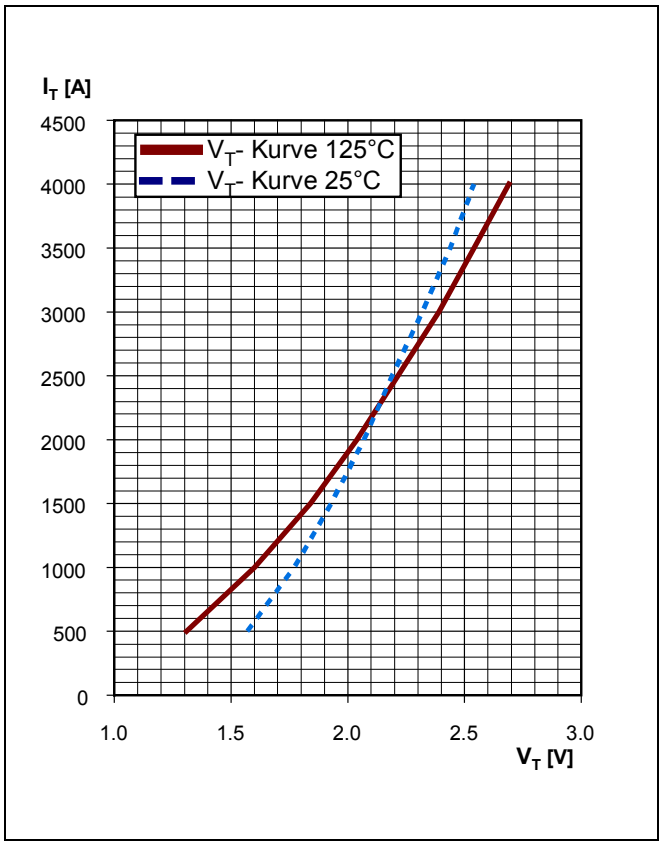

Fig. 2 GCT on-state characteristics.

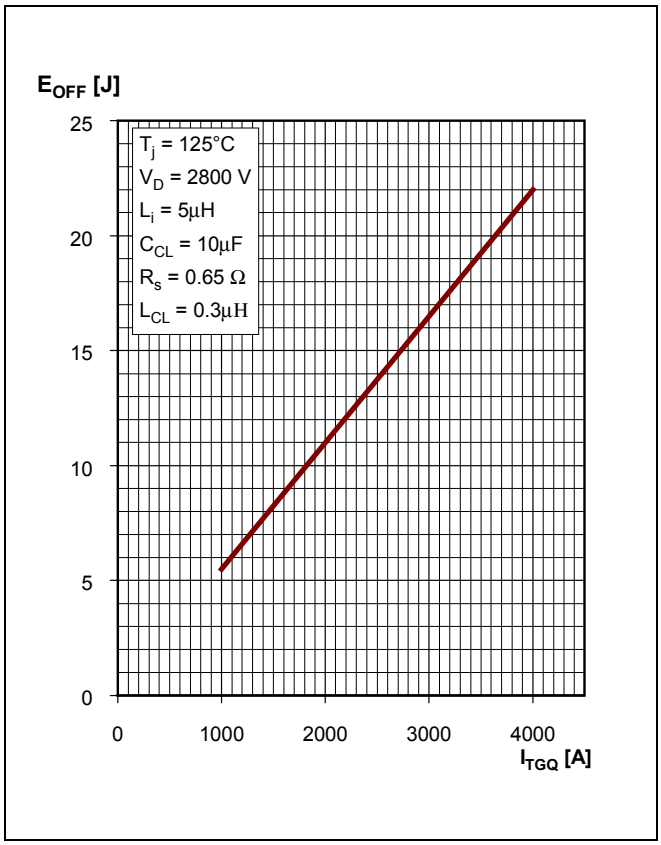

Fig. 3 GCT turn-off energy per pulse vs. turn-off current.

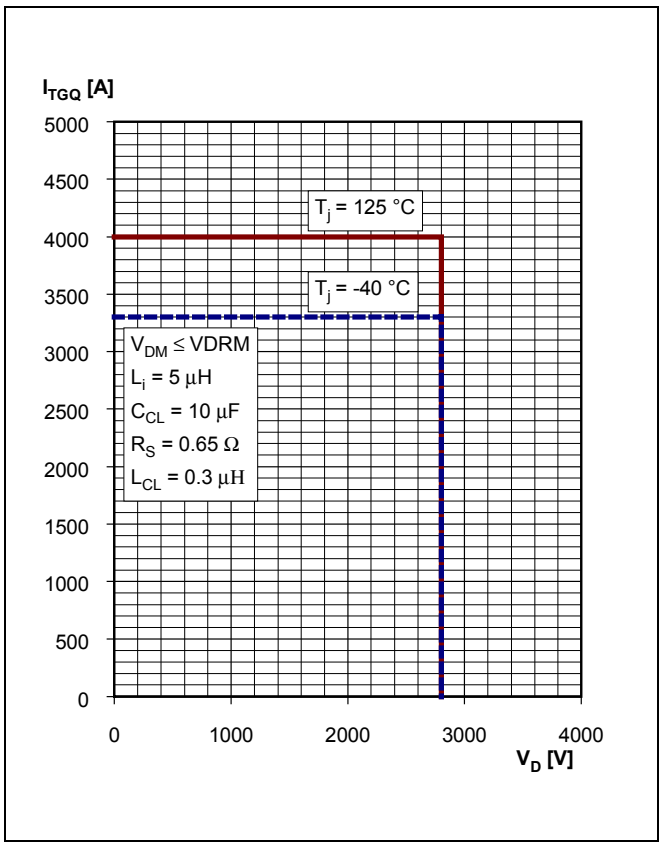

Fig. 4 Safe Operation Area

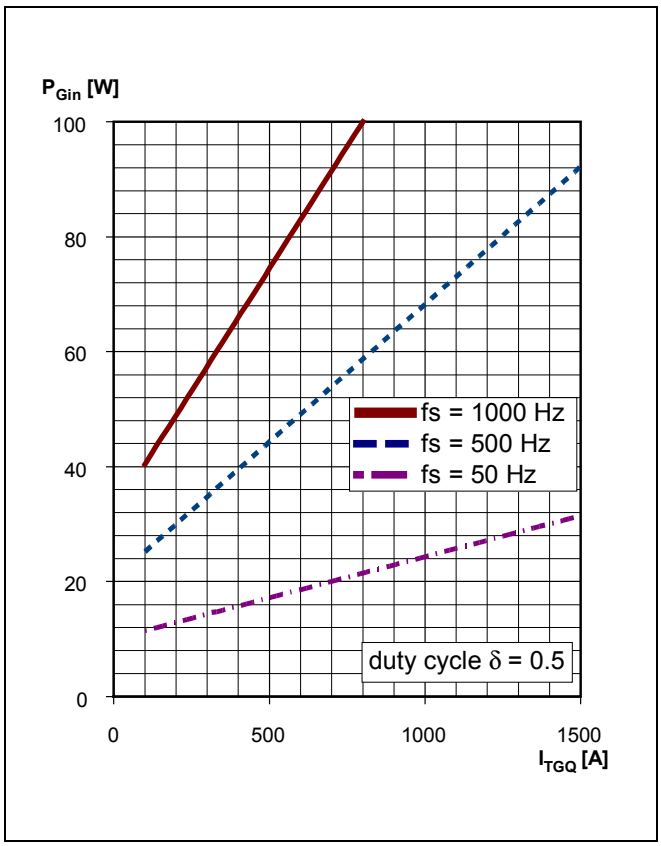

Fig. 5 Max. Gate Unit input power

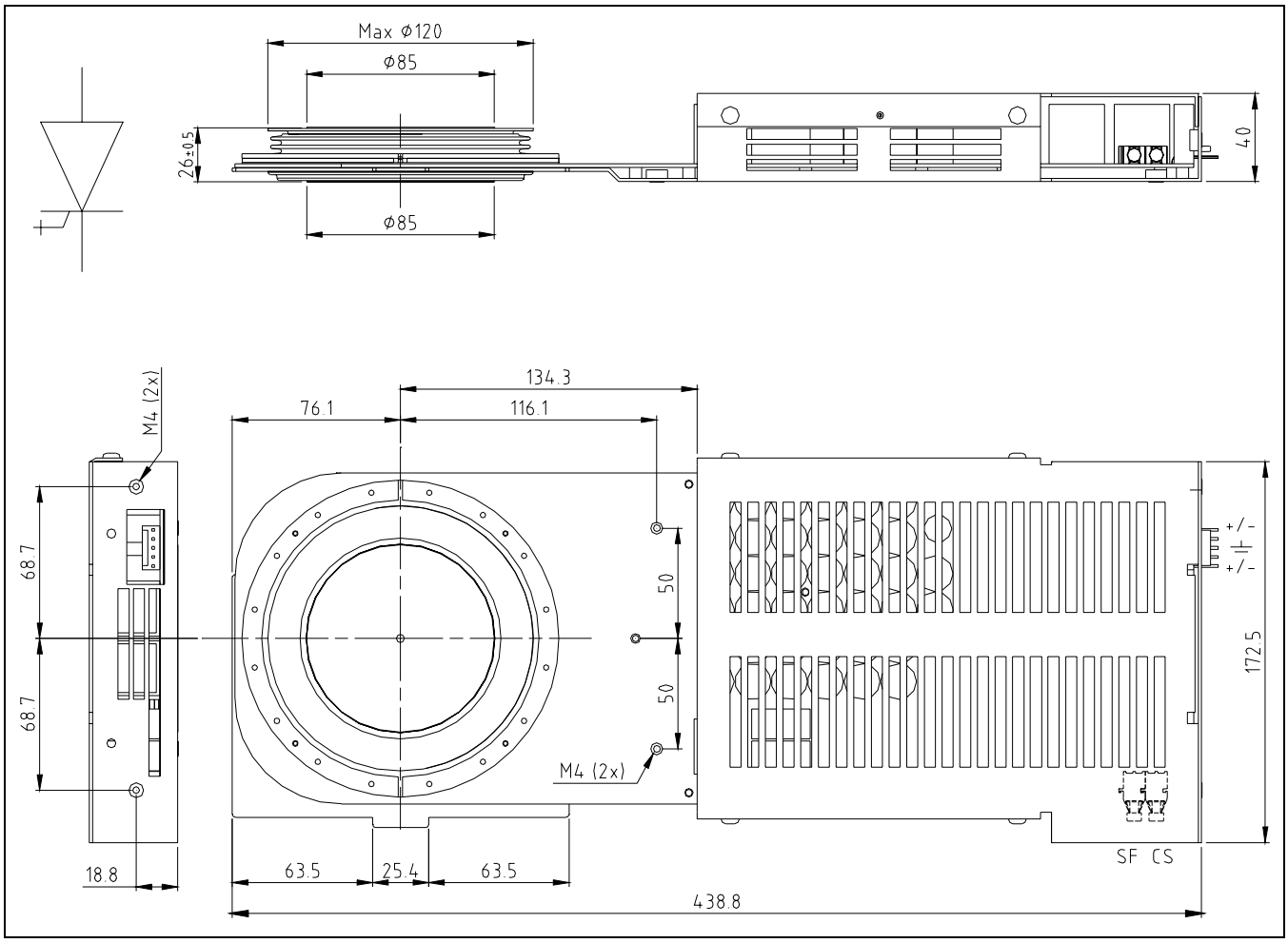

Fig. 6 Outline drawing. All dimensions are in millimeters and represent nominal values unless stated otherwise.

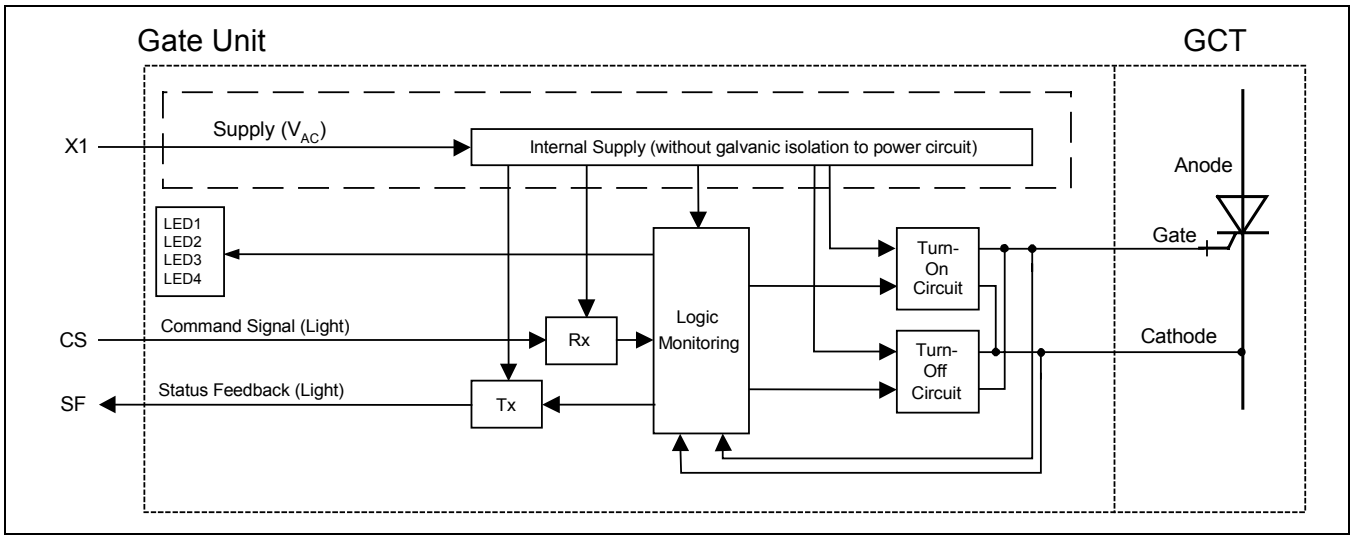

Fig. 7 Block diagram.

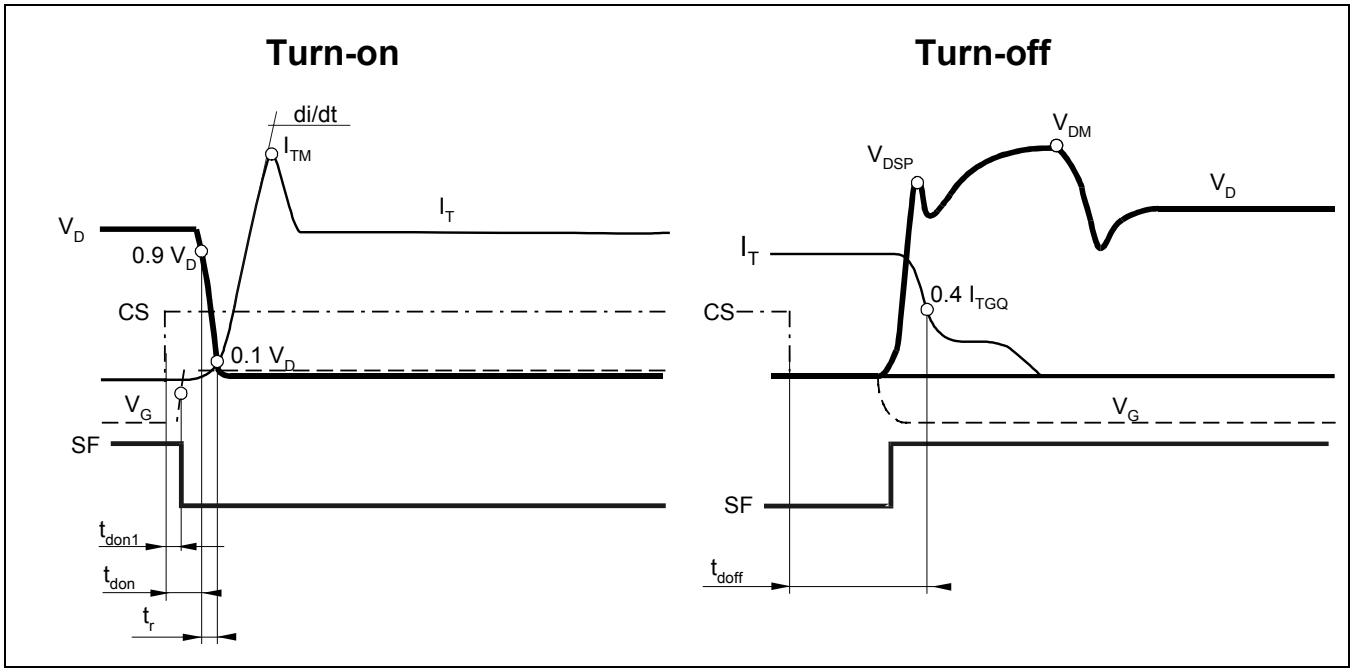

Fig. 8 General current and voltage waveforms with IGCT - specific symbols.

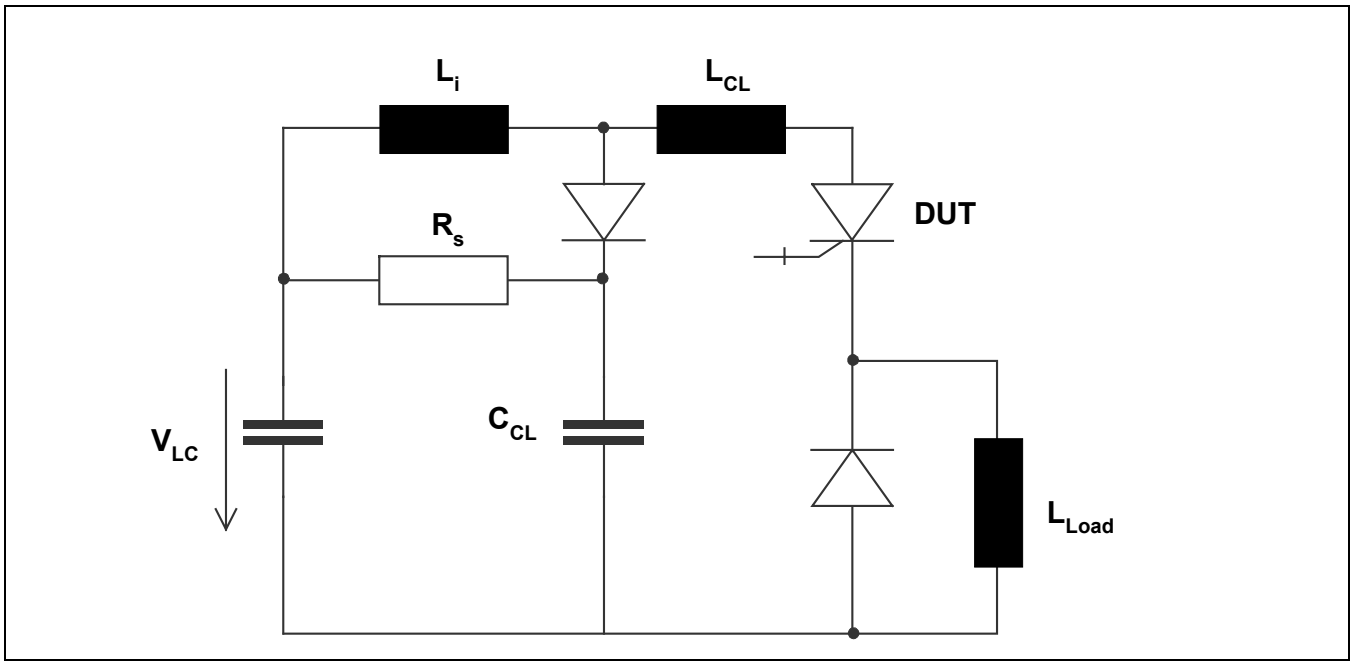

Fig. 9 Test circuit.

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