

V_{DRM}	=	5500 V
I_{TGQM}	=	280 A
I_{TSM}	=	1.8 kA
V_{T0}	=	1.95 V
r_T	=	7.2 m Ω
V_{DClink}	=	3300 V

Reverse Conducting Integrated Gate-Commutated Thyristor

5SHX 03D6004

Doc. No. 5SYA1225-03 Jan. 02

- Direct fiber optic control
- Fast response ($t_{don} < 3 \mu s$, $t_{doff} < 6 \mu s$)
- Precise timing ($\Delta t_{doff} < 800 ns$)
- Patented free floating silicon technology
- Optimized low On-state and switching losses
- Very high EMI immunity
- Cosmic radiation withstand rating



Blocking

V_{DRM}	Repetitive peak off-state voltage	5500 V	$V_{GR} \geq 2V$
I_{DRM}	Repetitive peak off-state current	$\leq 20 mA$	$V_D = V_{DRM}$ $V_{GR} \geq 2V$
V_{DClink}	Permanent DC voltage for 100 FIT failure rate	3300 V	$0 \leq T_j \leq 115 \text{ }^\circ C$. Ambient cosmic radiation at sea level in open air.

Mechanical data (see Fig. 9)

F_m	Mounting force	min.	10 kN	
		max.	14 kN	
D_p	Pole-piece diameter		34 mm	$\pm 0.1 mm$
H	Housing thickness		26 mm	$\pm 0.5 mm$
m	Weight IGCT		0.55 kg	
D_s	Surface creepage distance	\geq	33 mm	
D_a	Air strike distance	\geq	13 mm	
l	Length IGCT		202.5 mm	+0/-0.5 mm
h	Height IGCT		46.5 mm	$\pm 1.0 mm$
w	Width IGCT		200 mm	+0/-0.5 mm

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GCT Data

On-state (see Fig. 1)

I_{TAVM}	Max. average on-state current	110 A	Half sine wave, $T_C = 85\text{ °C}$	
I_{TRMS}	Max. RMS on-state current	170 A		
I_{TSM}	Max. peak non-repetitive surge current	1.8 kA	$t_p = 10\text{ ms}$	$T_j = 115\text{ °C}$ After surge: $V_D = V_R = 0V$
		3.6 kA	$t_p = 1\text{ ms}$	
I^2t	Limiting load integral	$16.9 \times 10^3\text{ A}^2\text{s}$	$t_p = 10\text{ ms}$	
		$6.6 \times 10^3\text{ A}^2\text{s}$	$t_p = 1\text{ ms}$	
V_T	On-state voltage	$\leq 3.95\text{ V}$	$I_T = 280\text{ A}$	$T_j = 115\text{ °C}$
V_{T0}	Threshold voltage	1.95 V	$I_T = 100 - 500\text{ A}$	
r_T	Slope resistance	7.2 m Ω		

Turn-on switching

di/dt_{crit}	Max. rate of rise of on-state current	90 A/ μs	$f = 500\text{ Hz}$	$T_j = 115\text{ °C}$
			$I_T = 280\text{ A}$	$V_D = 3900\text{ V}$
t_{don}	Turn-on delay time	$\leq 3\text{ }\mu\text{s}$	$V_D = 3300\text{ V}$	$T_j = 115\text{ °C}$
t_r	Rise time	$\leq 1\text{ }\mu\text{s}$	$I_T = 280\text{ A}$	$di/dt = 75\text{ A}/\mu\text{s}$
$t_{on(min)}$	Min, on-time	10 μs	$R_s = 5.2\text{ }\Omega$	$L_i = 44.5\text{ }\mu\text{H}$
E_{on}	Turn-on energy per pulse	$\leq 0.15\text{ J}$	$C_{CL} = 0.5\text{ }\mu\text{F}$	$L_{CL} = 1\text{ }\mu\text{H}$

Turn-off switching (see Fig. 2, 3)

I_{TGQM}	Max. controllable turn-off current	280 A	$V_{DM} \leq V_{DRM}$	$T_j = 115\text{ °C}$
			$V_D = 3300\text{ V}$	$L_{CL} \leq 1\text{ }\mu\text{H}$
t_{doff}	Turn-off delay time	$\leq 6\text{ }\mu\text{s}$	$V_D = 3300\text{ V}$	$V_{DM} \leq V_{DRM}$
t_f	Fall time	$\leq 1\text{ }\mu\text{s}$	$T_j = 115\text{ °C}$	$R_s = 5.2\text{ }\Omega$
$t_{off(min)}$	Min. off-time	10 μs	$I_{TGQ} = I_{TGQM}$	$L_i = 44.5\text{ }\mu\text{H}$
E_{off}	Turn-off energy per pulse	$\leq 1.5\text{ J}$	$C_{CL} = 0.5\text{ }\mu\text{F}$	$L_{CL} \leq 1\text{ }\mu\text{H}$

Diode Data

On-state (see Fig. 4)

I_{FAVM}	Max. average on-state current	65 A	Half sine wave, $T_C = 85\text{ °C}$	
I_{FRMS}	Max. RMS on-state current	100 A		
I_{FSM}	Max. peak non-repetitive surge current	1.9 kA	$t_p = 10\text{ ms}$	$T_j = 115\text{ °C}$ After surge: $V_F = V_R = 0\text{ V}$
		4.4 kA	$t_p = 1\text{ ms}$	
I^2t	Limiting load integral	$18.2 \times 10^3\text{ A}^2\text{s}$	$t_p = 10\text{ ms}$	
		$9.6 \times 10^3\text{ A}^2\text{s}$	$t_p = 1\text{ ms}$	
V_F	On-state voltage	$\leq 6.5\text{ V}$	$I_F = 280\text{ A}$	$T_j = 115\text{ °C}$
V_{F0}	Threshold voltage	3.52 V	$I_F = 100 - 500\text{ A}$	
r_F	Slope resistance	10.7 m Ω		

Turn-off switching (see Fig. 5, 6)

di/dt_{crit}	Max. rate of rise of on-state current	90 A/ μs	$I_F = 280\text{ A}$	$T_j = 115\text{ °C}$
I_{rr}	Reverse recovery current	$\leq 170\text{ A}$	$V_{CL} = 3900\text{ V}$	
E_{rr}	Turn-off energy	$\leq 0.8\text{ J}$	$V_{CL} = 3300\text{ V}$	$I_F = 280\text{ A}$
			$di/dt = 75\text{ A}/\mu\text{s}$	$T_j = 115\text{ °C}$
			$R_s = 5.2\ \Omega$	$L_i = 44.5\ \mu\text{H}$
			$C_{CL} = 0.5\ \mu\text{F}$	$L_{CL} = 1\ \mu\text{H}$

Gate Unit

Power supply (see Fig. 9 to 11)

V_{GDC}	Gate Unit voltage	$20 \pm 0.5\text{ V}_{DC}$	Without galvanic isolation to power circuit.
P_{Gin}	Gate Unit power consumption	$\leq 11\text{ W}$	$f_S = 500\text{ Hz}$, $I_{TGOAV} = 115\text{ A}$, $\delta = 0.9$
X1	Gate Unit power connector	WAGO, Part Number 231-532/001-000 ^{Note 1}	

Optical control input/output (see Fig. 9 to 11)

P_{onCS}	Optical input power	$> -20\text{ dBm}$	Valid for 1mm plastic optical fibre (POF)
P_{offCS}	Optical noise power	$< -45\text{ dBm}$	
t_{GLITCH}	Pulse width threshold	$\leq 450\text{ ns}$	Max. pulse width without response
CS	Receiver for command signal	Agilent, Type HFBR-2528 ^{Note 2}	

Note 1: WAGO, www.wago.com

Note 2: Agilent Technologies, www.semiconductor.agilent.com

Thermal

T_{jop}	Operating junction temperature range	0...115 °C	
T_{stg}	Storage temperature range	-40...60 °C	
T_{amb}	Ambient operational temperature range	0...60 °C	
Thermal resistance junction to case			
R_{thJC} GCT	Diode not dissipating	≤ 70 K/kW	Double side cooled
R_{thJC} Diode	GCT not dissipating	≤ 90 K/kW	
Thermal resistance case to heatsink			
R_{thCH} GCT	Diode not dissipating	≤ 16 K/kW	Double side cooled
R_{thCH} Diode	GCT not dissipating	≤ 16 K/kW	

GCT Part

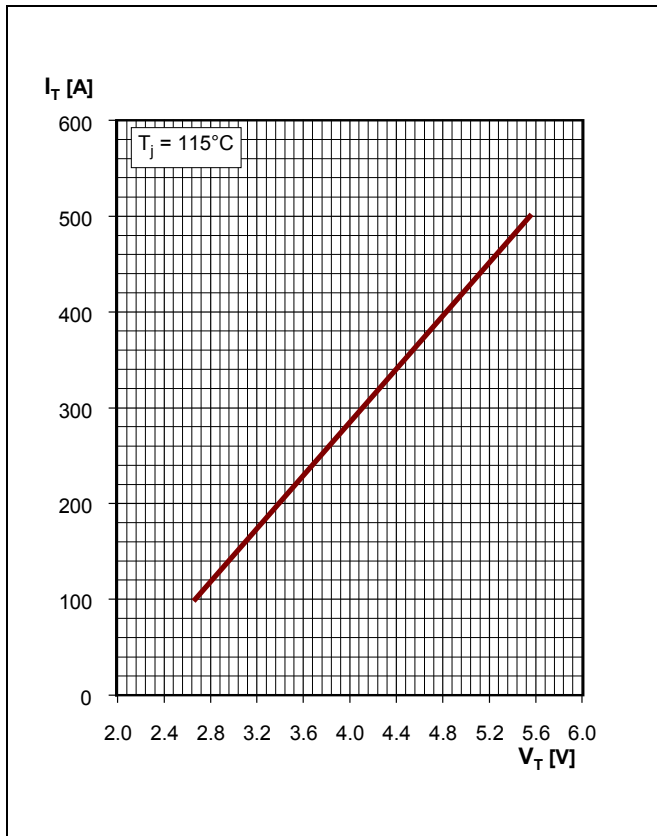


Fig. 1 GCT on-state characteristics.

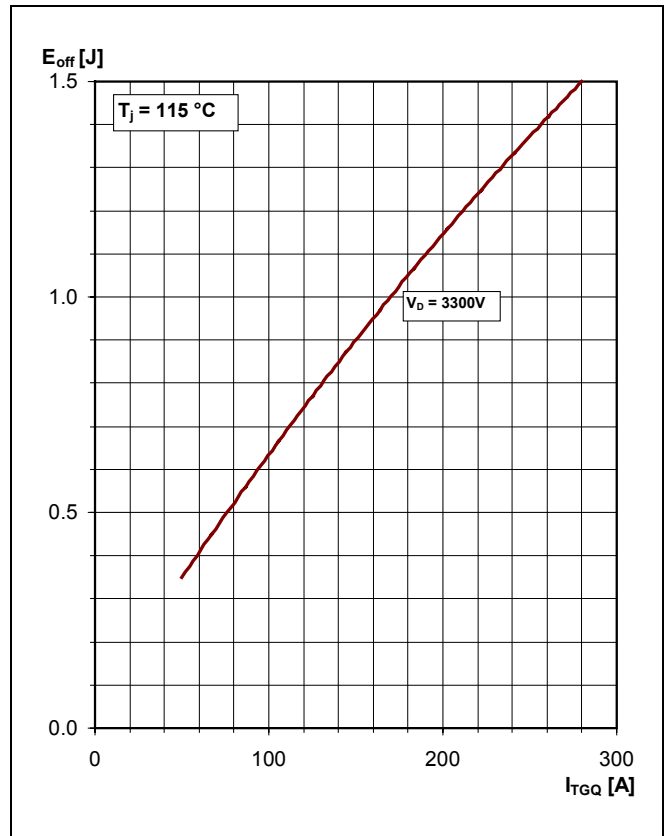


Fig. 2 GCT turn-off energy per pulse vs. turn-off current.

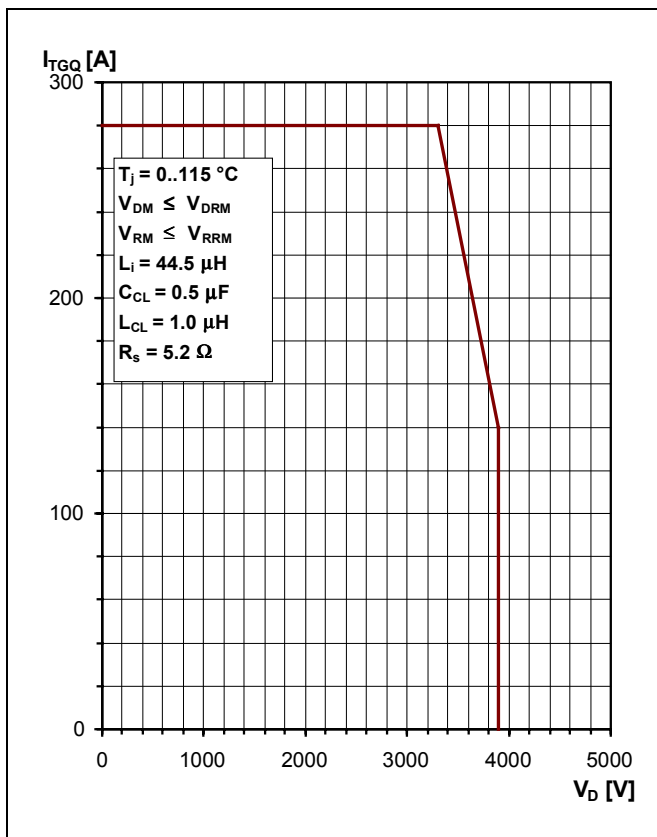


Fig. 3 Max. repetitive GCT turn-off current.

Diode Part

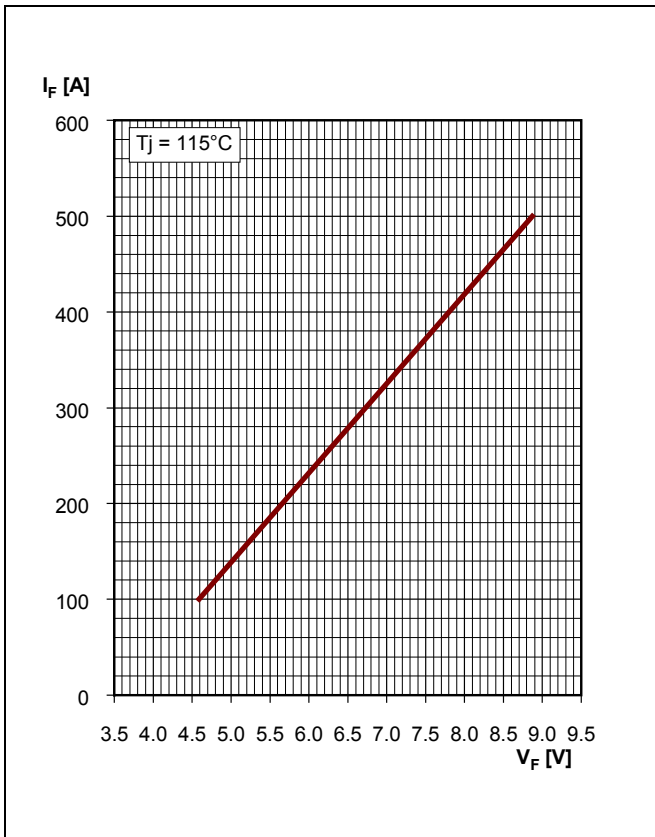


Fig. 4 Diode on-state characteristics.

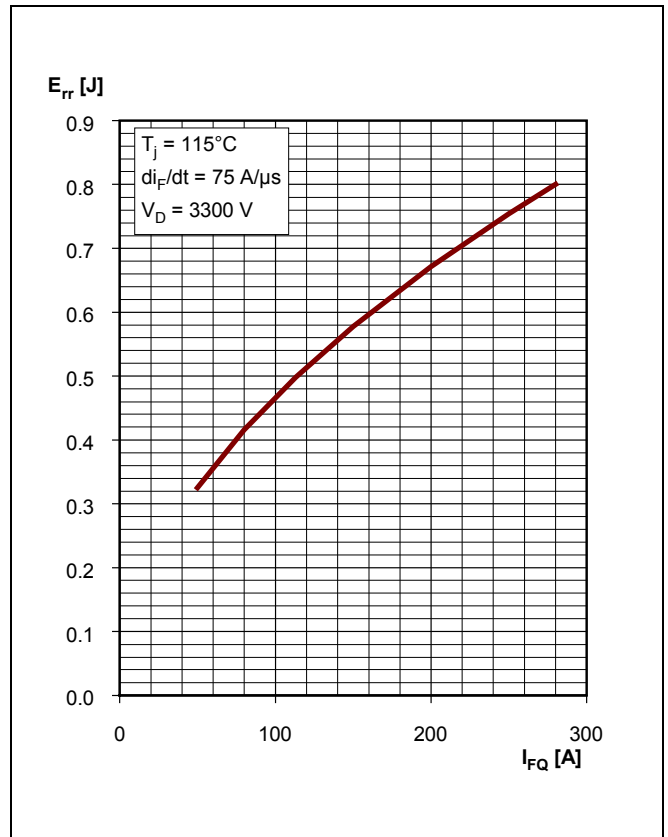


Fig. 5 Diode turn-off energy per pulse vs. turn-off current.

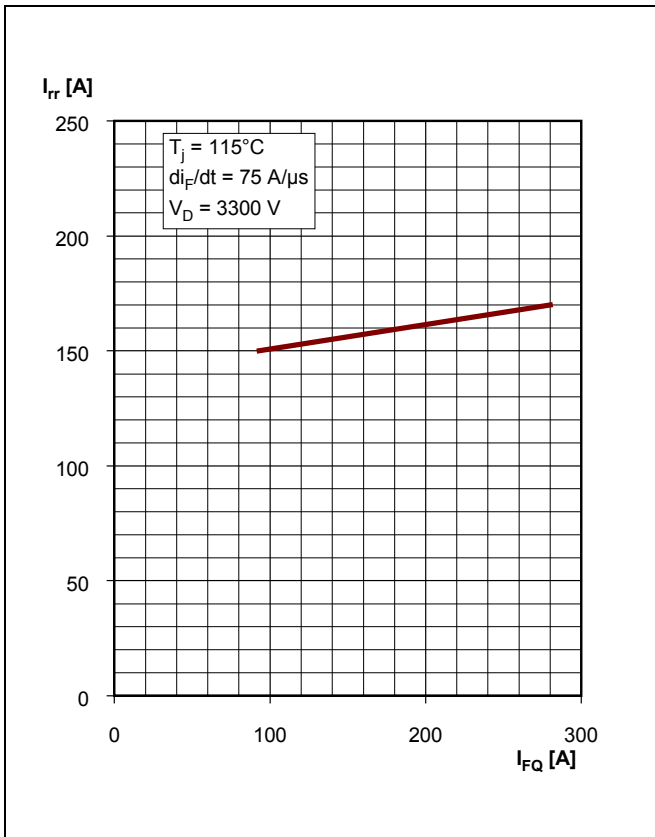


Fig. 6 Diode reverse recovery current vs. turn-off current.

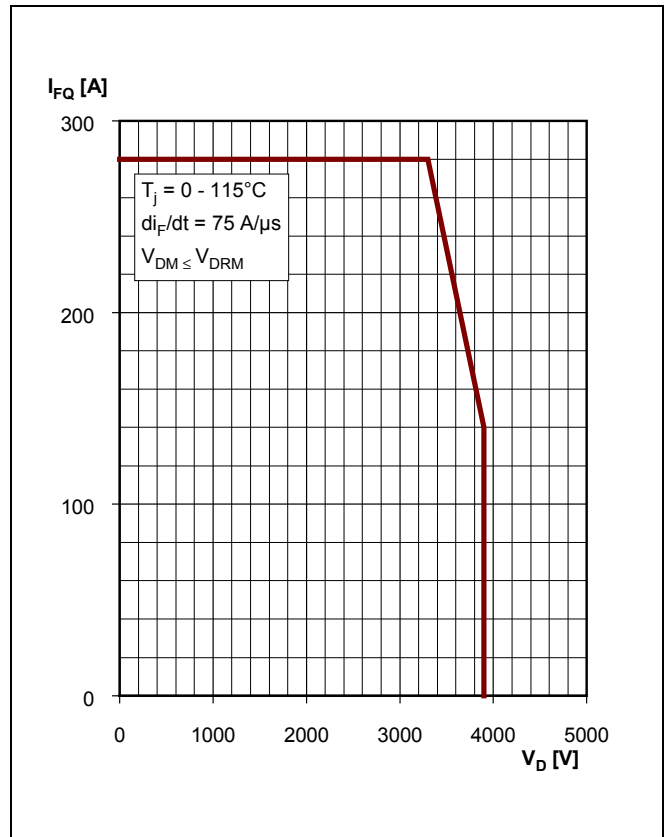


Fig. 7 Max. repetitive diode forward current.

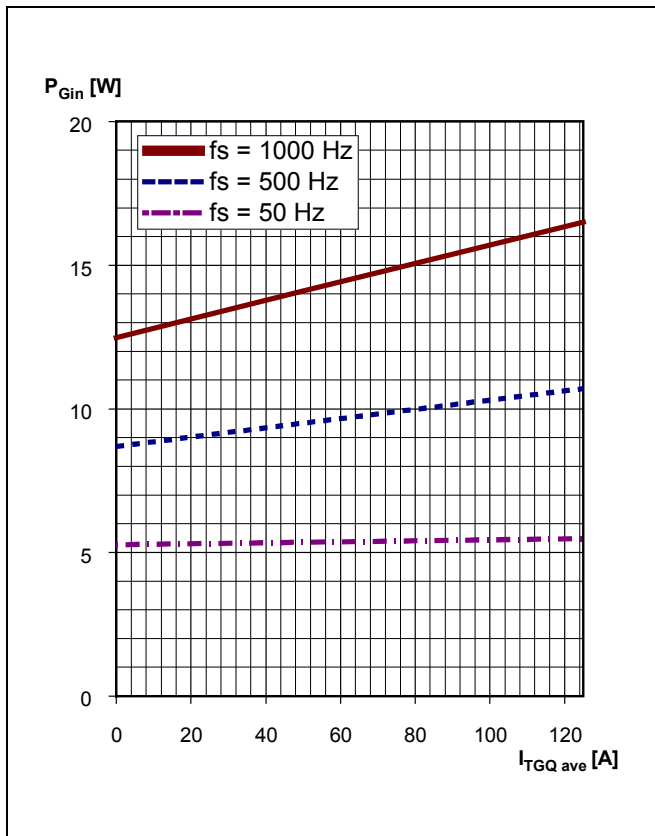


Fig. 8 Gate Unit power consumption.

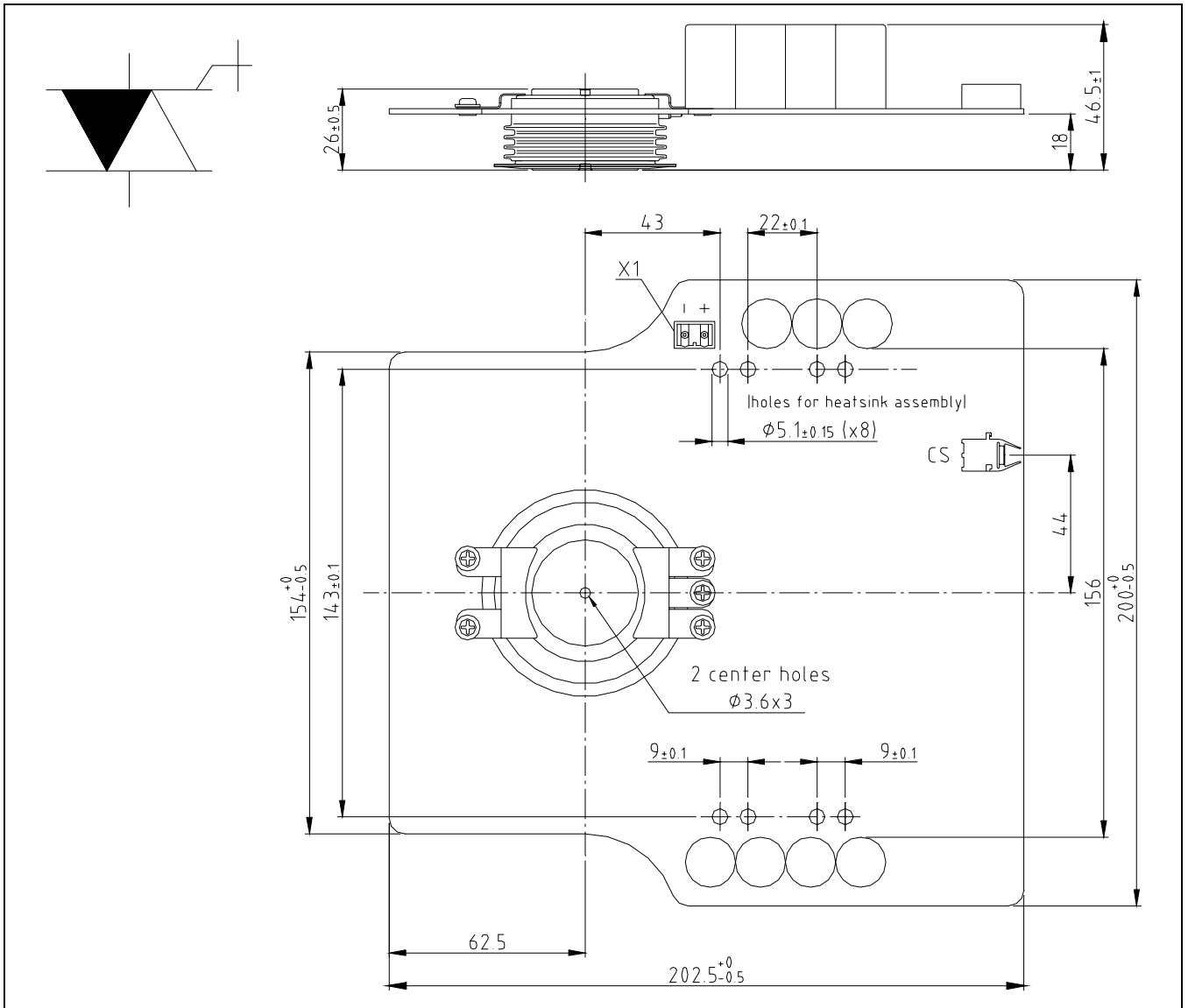


Fig. 9 Device Outline Drawing.

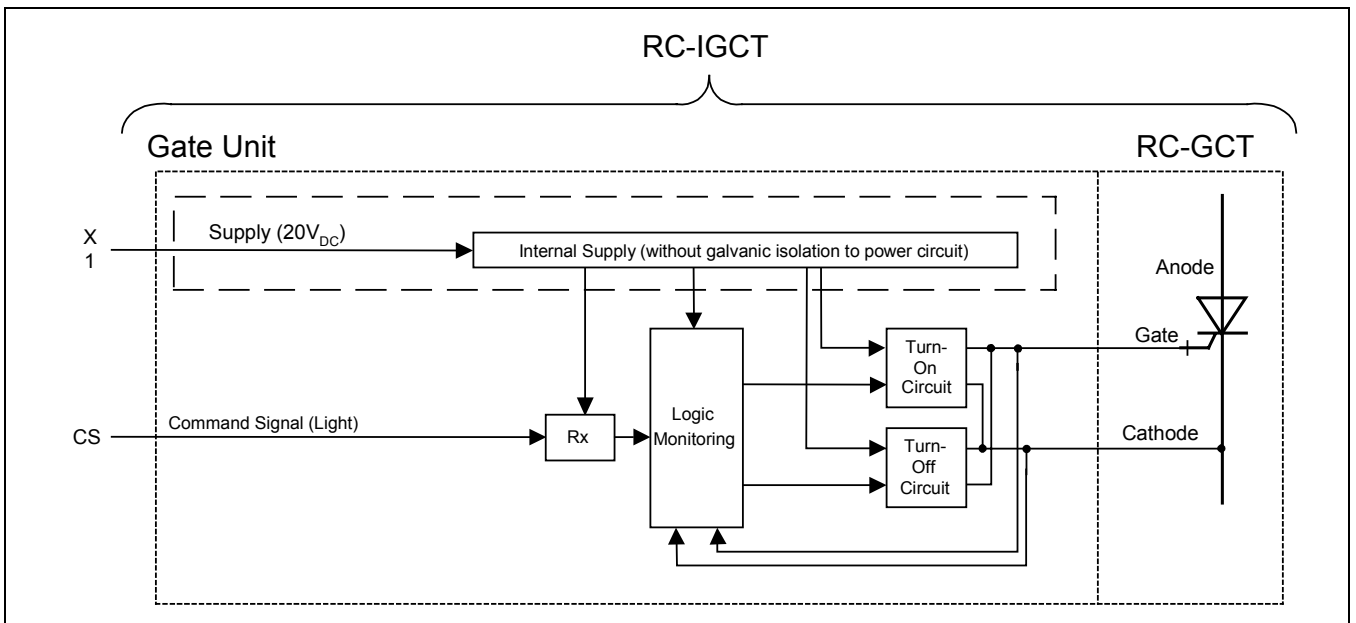


Fig. 10 Block diagram.

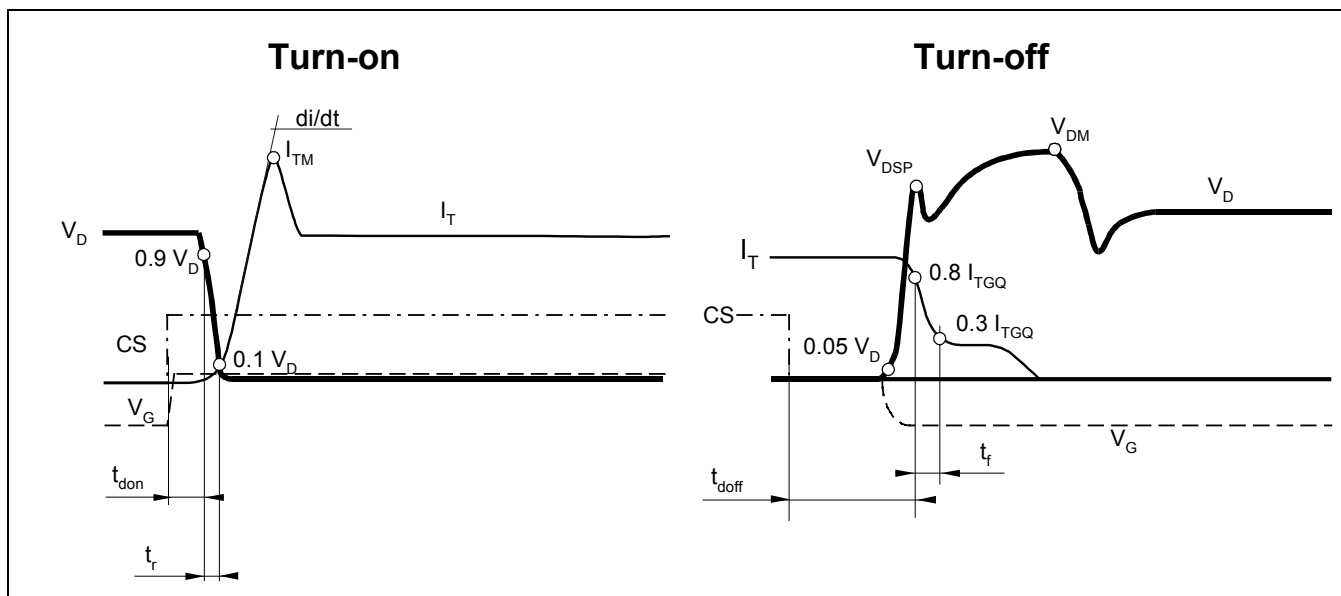


Fig. 11 General current and voltage waveforms with IGCT-specific symbols.

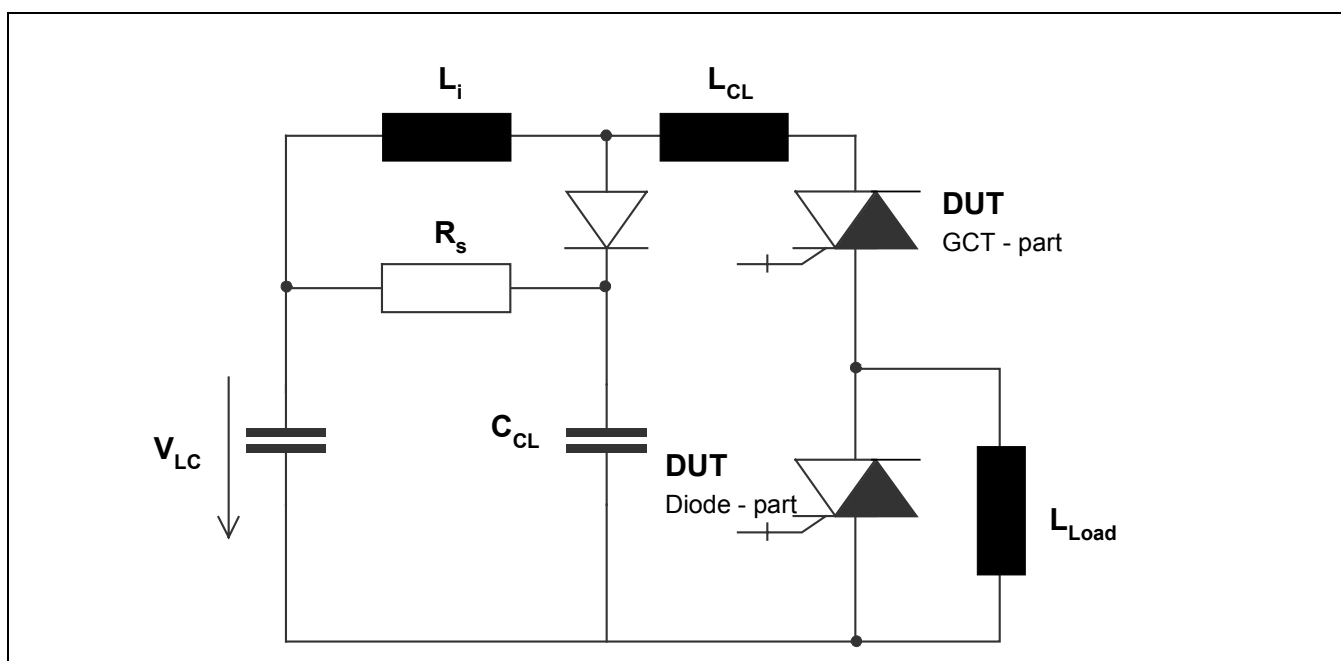


Fig. 12 Test circuit.

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