V_{DRM}	=	4500 V
I_{TGQM}	=	340 A
I_{TSM}	=	2.1 kA
V_{T0}	=	1.8 V
r_T	=	4.7 mΩ
V_{DClink}	=	2800 V

Reverse Conducting Integrated Gate-Commutated Thyristor

5SHX 04D4502

Doc. No. 5SYA1224-03 Jan. 02

- **Direct fiber optic control**
- **Fast response (t_{don} < 3 µs, t_{doff} < 6 µs)**
- **Precise timing (Δt_{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	4500 V	$V_{GR} \geq 2V$
I_{DRM}	Repetitive peak off-state current	≤ 20 mA	$V_D = V_{DRM}$ $V_{GR} \geq 2V$
V_{DClink}	Permanent DC voltage for 100 FIT failure rate	2800 V	$0 \leq T_j \leq 115$ °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	±0.1 mm
H	Housing thickness		26 mm	±0.5 mm
m	Weight IGCT		0.55 kg	
D_s	Surface creepage distance	≥	33 mm	
D_a	Air strike distance	≥	13 mm	
l	Length IGCT		202.5 mm	+0/-0.5 mm
h	Height IGCT		46.5 mm	±1.0 mm
w	Width IGCT		200 mm	+0/-0.5 mm

GCT Data

On-state (see Fig. 1)

I_{TAVM}	Max. average on-state current	130 A	Half sine wave, T_C = 85 °C				
I_{TRMS}	Max. RMS on-state current	205 A					
I_{TSM}	Max. peak non-repetitive surge current	2.1 kA	t_p	=	10 ms	T_j = 115 °C After surge: $V_D = V_R$ = 0V	
		3.8 kA	t_p	=	1 ms		
I^2t	Limiting load integral	$23x10^3$ A^2s	t_p	=	10 ms		
		$7.3x10^3$ A^2s	t_p	=	1 ms		
V_T	On-state voltage	≤ 3.4 V	I_T	=	340 A	T_j = 115 °C	
V_{T0}	Threshold voltage	1.8 V	I_T	=	100 - 500 A		
r_T	Slope resistance	4.7 mΩ					

Turn-on switching

di/dt_{crit}	Max. rate of rise of on-state current	130 A/µs	f	=	500 Hz	T_j	=	115	°C
			I_T	=	340 A	V_D	=	3200	V
t_{don}	Turn-on delay time	≤ 3 µs	V_D	=	2700 V	T_j	=	115 °C	
t_r	Rise time	≤ 1 µs	I_T	=	340 A	di/dt	=	110 A/µs	
$t_{on\ (min)}$	Min, on-time	10 µs	R_S	=	4.2 Ω	L_i	=	25 µH	
E_{on}	Turn-on energy per pulse	≤ 0.13 J	C_{CL}	=	0.5 µF	L_{CL}	=	1 µH	

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

I_{TGQM}	Max. controllable turn-off current	340 A	V_{DM}	≤	V_{DRM}	T_j	=	115 °C	
			V_D	=	2700 V	L_{CL}	≤	1 µH	
t_{doff}	Turn-off delay time	≤ 6 µs	V_D	=	2700 V	V_{DM}	≤	V_{DRM}	
t_f	Fall time	≤ 1 µs	T_j	=	115 °C	R_s	=	4.2 Ω	
$t_{off\ (min)}$	Min. off-time	10 µs	I_{TGQ}	=	I_{TGQM}	L_i	=	25 µH	
E_{off}	Turn-off energy per pulse	≤ 1.35 J	C_{CL}	=	0.5 µF	L_{CL}	≤	1 µH	

Diode Data

On-state (see Fig. 4)

I_{FAVM}	Max. average on-state current	85 A	Half sine wave, T_C = 85 °C		
I_{FRMS}	Max. RMS on-state current	135 A			
I_{FSM}	Max. peak non-repetitive surge current	2.3 kA	t_p = 10 ms	T_j = 115 °C	
		6 kA	t_p = 1 ms	After surge:	
I^2t	Limiting load integral	28×10^3 A^2s	t_p = 10 ms	$V_F = V_R$ = 0V	
		17.9×10^3 A^2s	t_p = 1 ms		
V_F	On-state voltage	≤ 4.8 V	I_F = 340 A	T_j = 115 °C	
V_{F0}	Threshold voltage	2.4 V	I_F = 100 - 500 A		
r_F	Slope resistance	6.9 mΩ			

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

di/dt_{crit}	Max. rate of rise of on-state current	130 A/µs	I_F = 340 A	T_j = 115 °C		
			V_{CL} = 3200 V			
I_{rr}	Reverse recovery current	≤ 190 A	V_{CL} = 2700 V	I_F = 340 A		
E_{rr}	Turn-off energy	≤ 0.6 J	di/dt = 110 A/µs	T_j = 115 °C		
			R_s = 4.2 Ω	L_i = 25 µH		
			C_{CL} = 0.5 µF	L_{CL} = 1 µH		

Gate Unit

Power supply (see Fig. 9 to 11)			
V_{GDC}	Gate Unit voltage	20 ±0.5 V_{DC}	Without galvanic isolation to power circuit.
P_{Gin}	Gate Unit power consumption	≤ 11 W	f_S = 500 Hz, $I_{TGQ\ AV}$ = 140 A, δ = 0.9
X1	Gate Unit power connector	WAGO, Part Number 231-532/001-000 Note 1	
Optical control input/output Note 3 (see Fig. 9 to 11)			
$P_{on\ CS}$	Optical input power	> -20 dBm	Valid for 1mm plastic optical fibre (POF)
$P_{off\ CS}$	Optical noise power	< -45 dBm	
t_{GLITCH}	Pulse width threshold	≤ 500 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
Note 3: Do not disconnect or connect fiber optic cables while light is on.

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

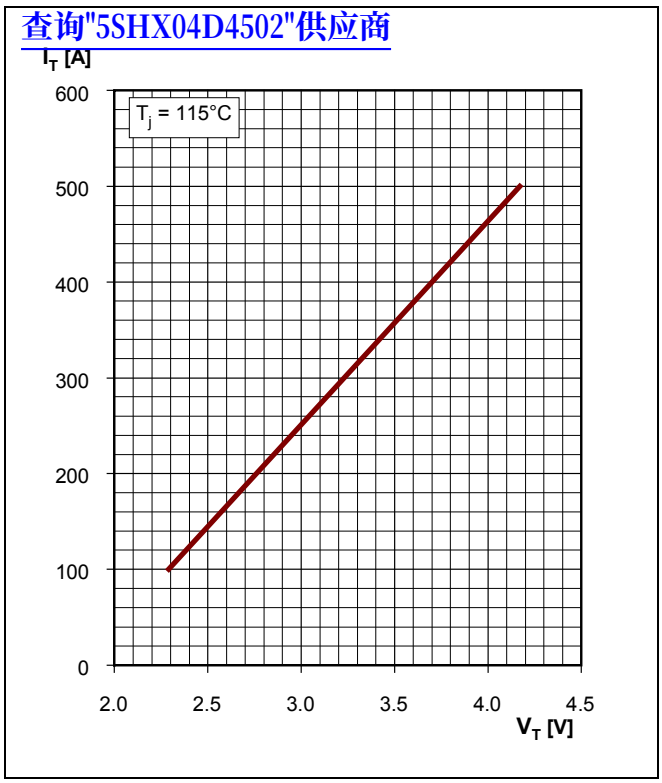

Fig. 1 GCT on-state characteristics.

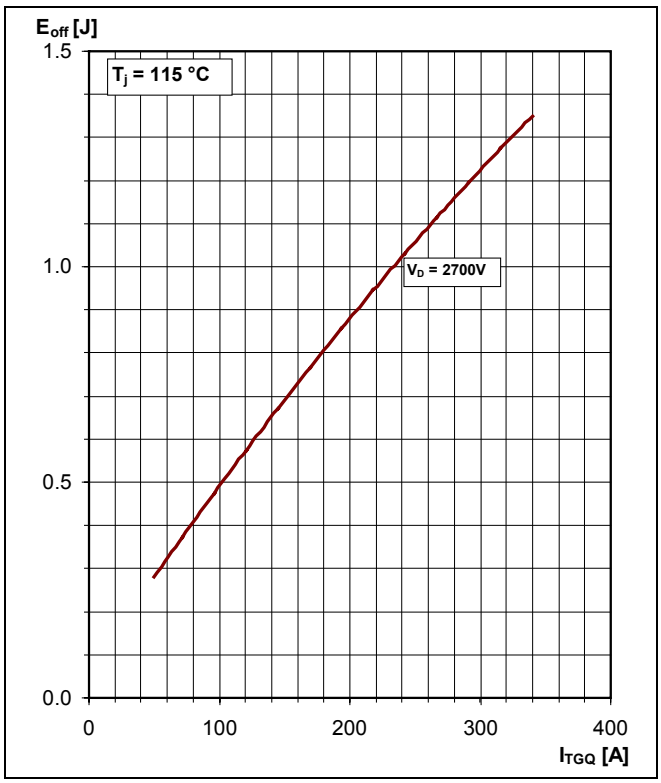

Fig. 2 GCT turn-off energy per pulse vs. turn-off current.

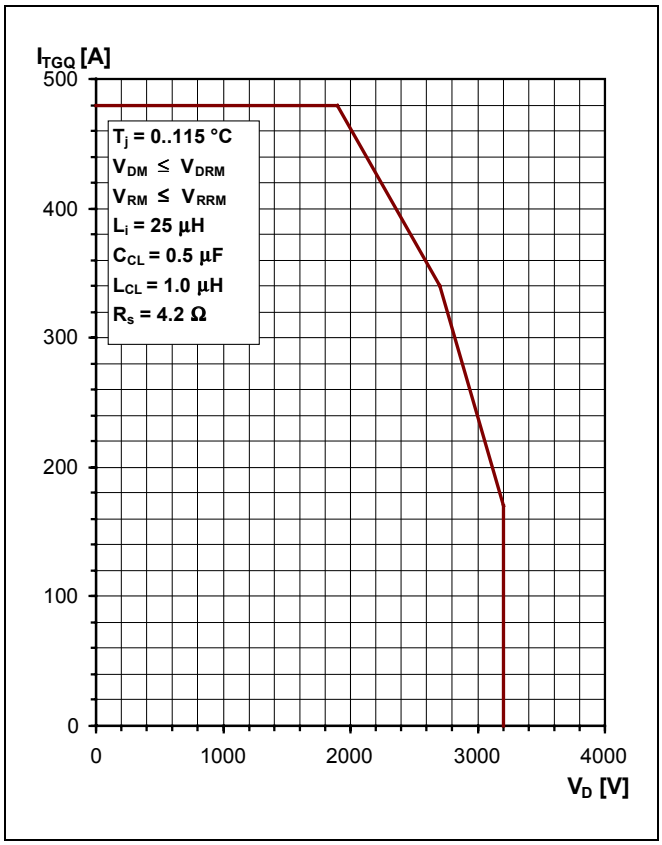

Fig. 3 Max. repetitive GCT turn-off current.

Diode Part

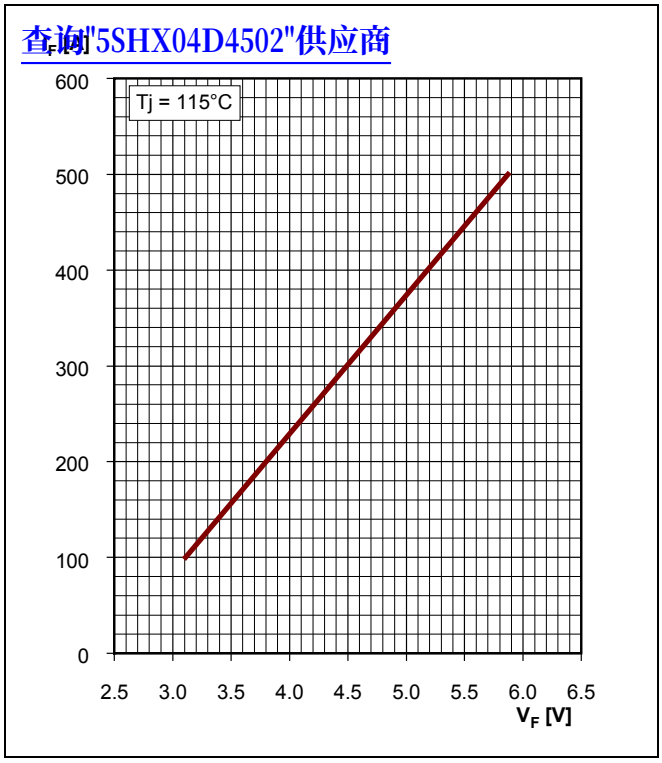

Fig. 4 Diode on-state characteristics.

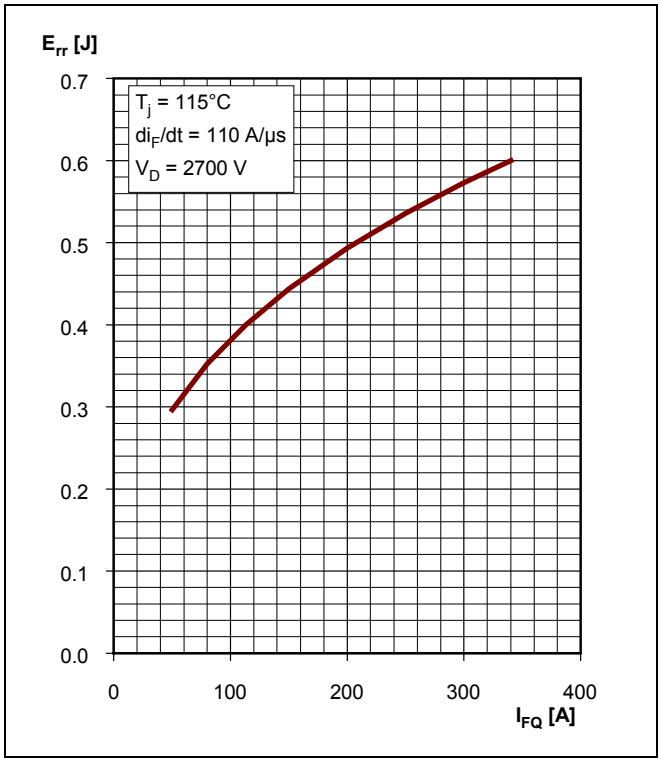

Fig. 5 Diode turn-off energy per pulse vs. turn-off current.

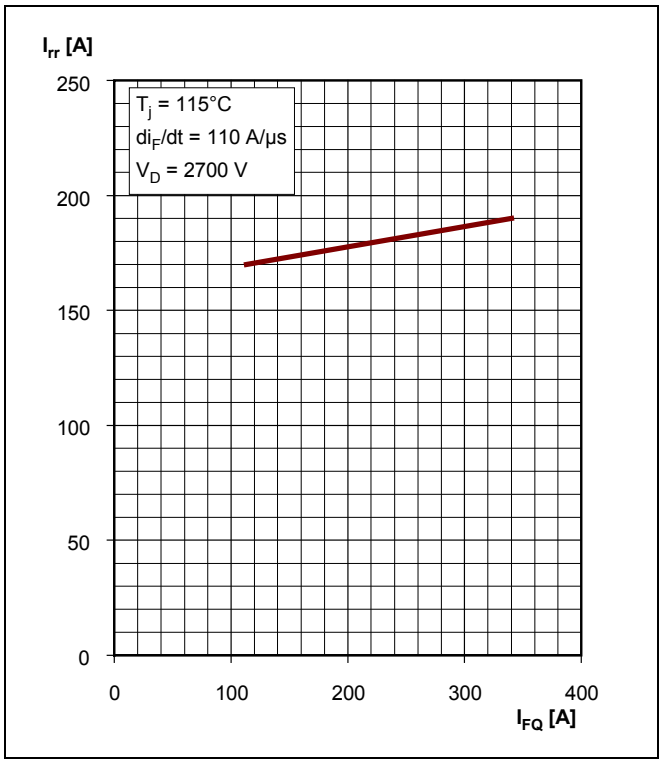

Fig. 6 Diode reverse recovery current vs. turn-off current.

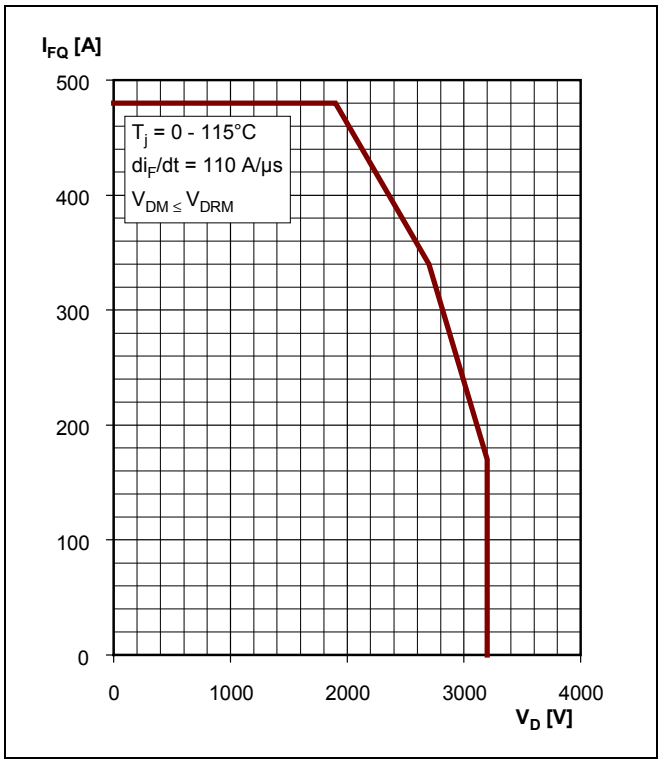

Fig. 7 Max. repetitive diode forward current.

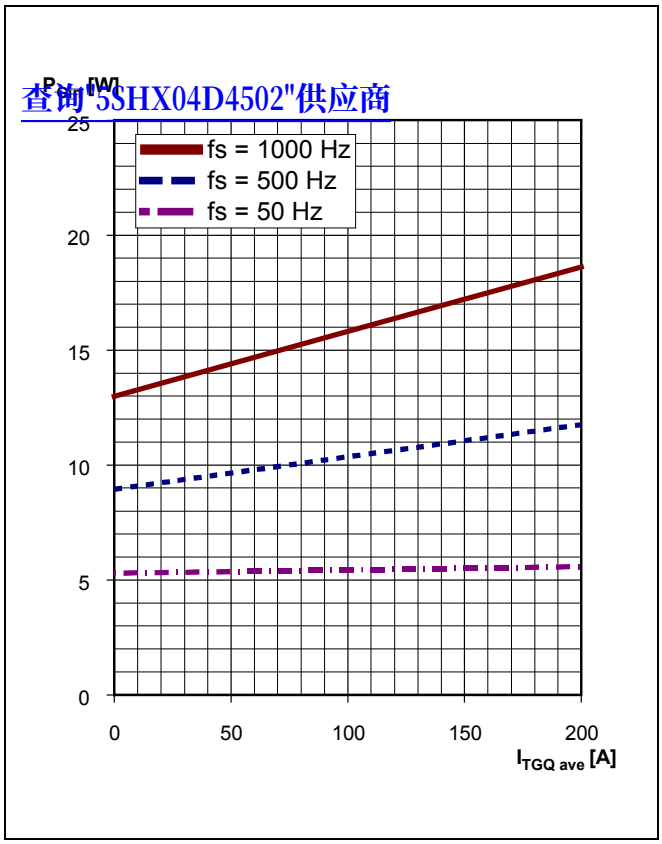

Fig. 8 Gate Unit power consumption.

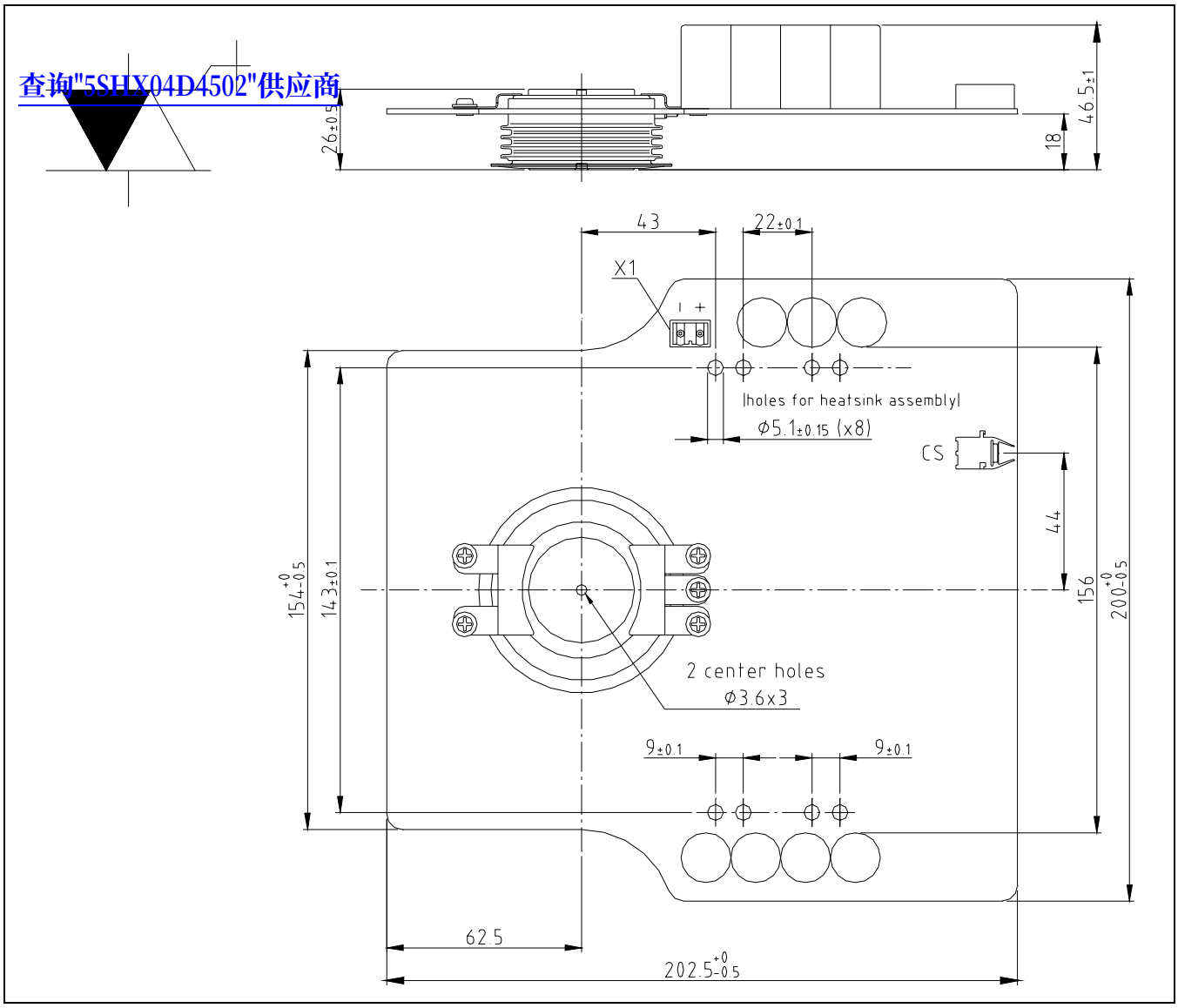

Fig. 9 Device Outline Drawing.

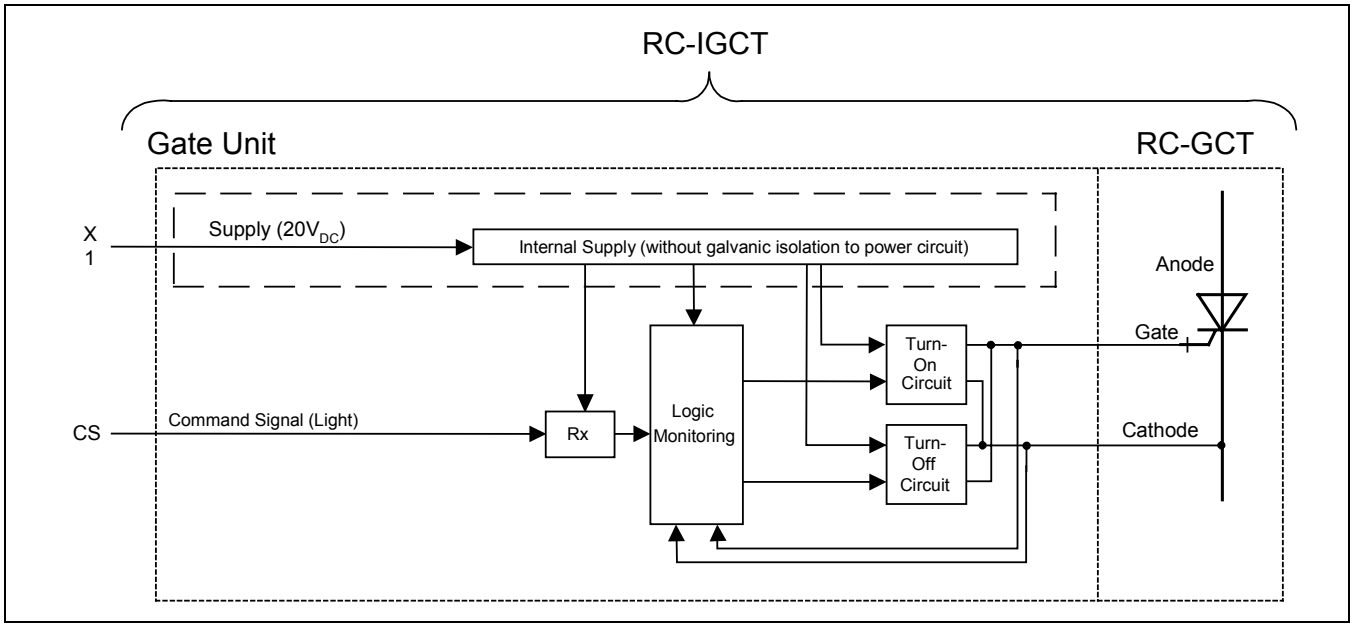

Fig. 10 Block diagram.

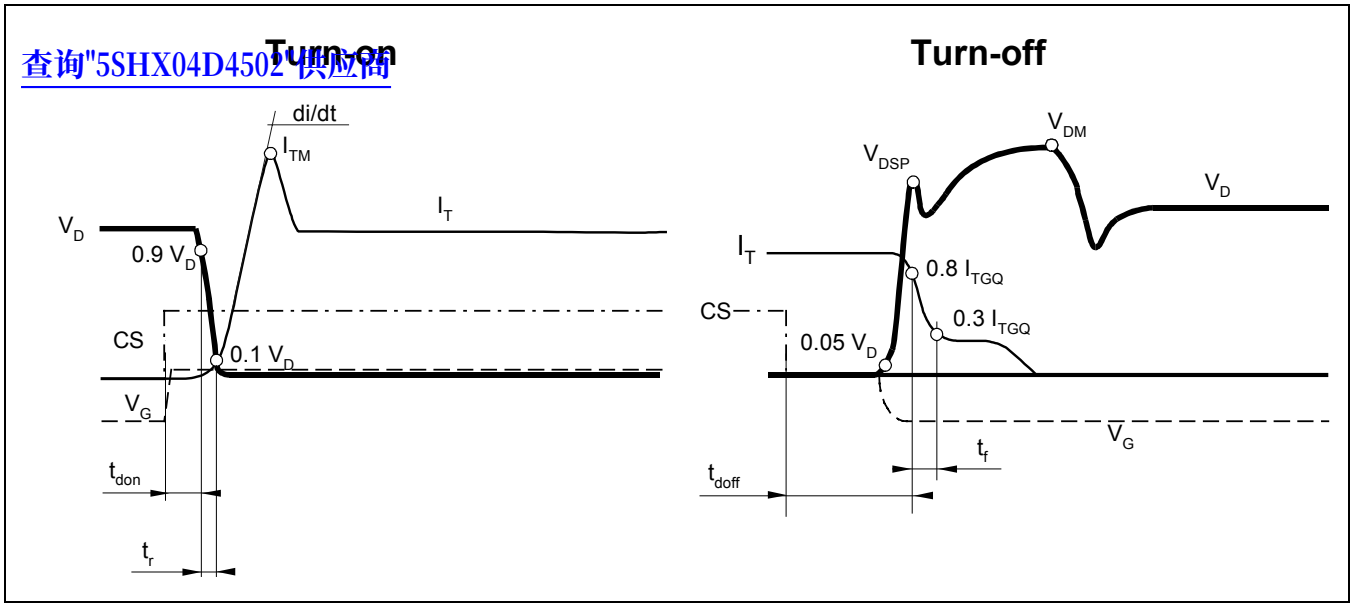

Fig. 11 General current and voltage waveforms with IGCT-specific symbols.

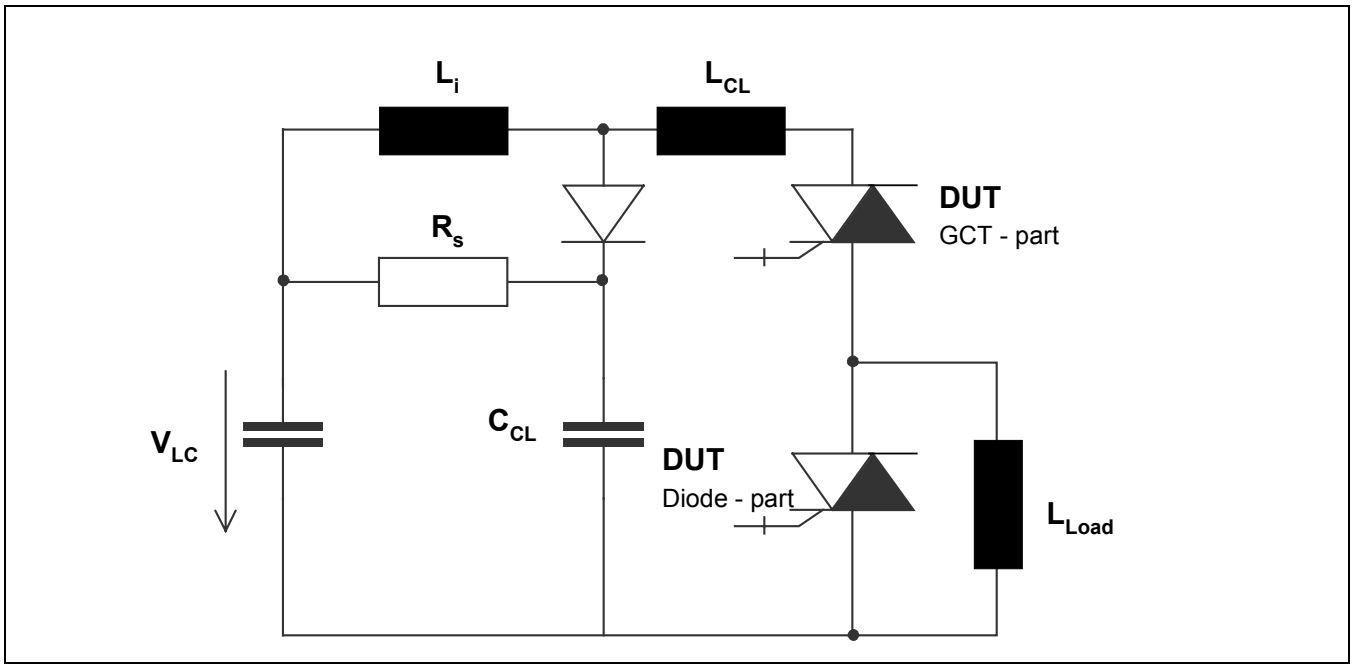

Fig. 12 Test circuit.

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