

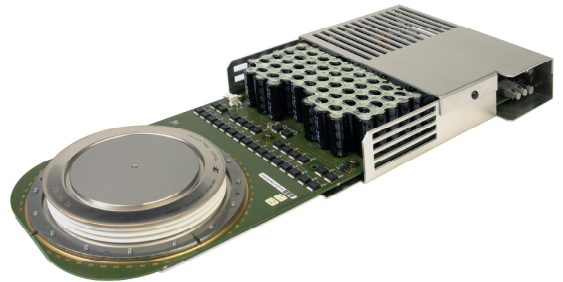
| | | |
|------------|---|--------------------|
| V_{DRM} | = | 4500 V |
| I_{TGQM} | = | 5000 A |
| I_{TSM} | = | 33×10^3 A |
| $V_{(T0)}$ | = | 1.22 V |
| r_T | = | 0.28 m Ω |
| V_{DC} | = | 2800 V |

Asymmetric Integrated Gate-Commutated Thyristor

5SHY 55L4500

Doc. No. 5SYA1243-06 April 13

- High snubberless turn-off rating
- Optimized for medium frequency
- High electromagnetic immunity
- Simple control interface with status feedback
- AC or DC supply voltage
- Option for series connection (contact factory)



Blocking

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|--|-----------|--|-----|-----|------|------|
| Rep. peak off-state voltage | V_{DRM} | Gate Unit energized | | | 4500 | V |
| Permanent DC voltage for 100 FIT failure rate of GCT | V_{DC} | Ambient cosmic radiation at sea level in open air. Gate Unit energized | | | 2800 | V |
| Reverse voltage | V_{RRM} | | | | 17 | V |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|-----------------------------|-----------|---------------------------------------|-----|-----|-----|------|
| Rep. peak off-state current | I_{DRM} | $V_D = V_{DRM}$, Gate Unit energized | | | 50 | mA |

Mechanical data (see Fig. 11, 12)

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|----------------|--------|------------|-----|-----|-----|------|
| Mounting force | F_m | | 36 | 40 | 44 | kN |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---------------------------|--------|---------------|------|-----|------|------|
| Pole-piece diameter | D_p | ± 0.1 mm | | 85 | | mm |
| Housing thickness | H | | 25.3 | | 25.8 | mm |
| Weight | m | | | | 2.9 | kg |
| Surface creepage distance | D_s | Anode to Gate | 33 | | | mm |
| Air strike distance | D_a | Anode to Gate | 10 | | | mm |
| Length | l | ± 1.0 mm | | 439 | | mm |
| Height | h | ± 1.0 mm | | 41 | | mm |
| Width IGCT | w | ± 1.0 mm | | 173 | | mm |

1) Maximum rated values indicate limits beyond which damage to the device may occur

ABB Switzerland Ltd, Semiconductors reserves the right to change specifications without notice.



GCT Data

On-state (see Fig. 3, 4, 5, 6, 14)

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|------------------|--|-----|-----|--------------------|-----------|
| Max. average on-state current | $I_{T(AV)M}$ | Half sine wave, $T_C = 85\text{ °C}$, Double side cooled | | | 1870 | A |
| Max. RMS on-state current | $I_{T(RMS)}$ | | | | 2940 | A |
| Max. peak non-repetitive surge on-state current | I_{TSM} | $t_p = 3\text{ ms}$, $T_j = 125\text{ °C}$, sine half wave, $V_D = V_R = 0\text{ V}$, after surge | | | 50×10^3 | A |
| Limiting load integral | I^2t | | | | 3.75×10^6 | A^2s |
| Max. peak non-repetitive surge on-state current | I_{TSM} | $t_p = 10\text{ ms}$, $T_j = 125\text{ °C}$, sine half wave, $V_D = V_R = 0\text{ V}$, after surge | | | 33×10^3 | A |
| Limiting load integral | I^2t | | | | 5.45×10^6 | A^2s |
| Max. peak non-repetitive surge on-state current | I_{TSM} | $t_p = 30\text{ ms}$, $T_j = 125\text{ °C}$, sine half wave, $V_D = V_R = 0\text{ V}$, after surge | | | 22×10^3 | A |
| Limiting load integral | I^2t | | | | 7.26×10^6 | A^2s |
| Stray inductance between GCT and antiparallel diode | L_D | Only relevant for applications with antiparallel diode to the IGCT | | | 300 | nH |
| Critical rate of rise of on-state current | $di_T/dt_{(cr)}$ | For higher di_T/dt and current lower than 100 A an external retrigger puls is required. | | | 200 | $A/\mu s$ |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|-------------------|------------|---|-----|------|------|-----------|
| On-state voltage | V_T | $I_T = 4000\text{ A}$, $T_j = 125\text{ °C}$ | | 2.15 | 2.35 | V |
| Threshold voltage | $V_{(T0)}$ | $T_j = 125\text{ °C}$ | | 1.12 | 1.22 | V |
| Slope resistance | r_T | $I_T = 1000 \dots 5000\text{ A}$ | | 0.24 | 0.28 | $m\Omega$ |

Turn-on switching (see Fig. 14, 15)**Maximum rated values**¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|------------------|---|-----|-----|------|------------------|
| Critical rate of rise of on-state current | $di_T/dt_{(cr)}$ | $f = 0..500 \text{ Hz}$, $T_j = 125 \text{ °C}$, $I_T = 5000 \text{ A}$ $V_D = 2800 \text{ V}$, $I_{TM} \leq 7000 \text{ A}$ | | | 1000 | A/ μs |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|------------------------------------|----------------|--|-----|-----|-----|---------------|
| Turn-on delay time | $t_{d(on)}$ | $V_D = 2800 \text{ V}$, $T_j = 125 \text{ °C}$, $I_T = 4000 \text{ A}$, $di/dt = V_D / L_i$ | | | 4 | μs |
| Turn-on delay time status feedback | $t_{d(on) SF}$ | $L_i = 3 \mu\text{H}$ | | | 7 | μs |
| Rise time | t_r | $C_{CL} = 20 \mu\text{F}$, $L_{CL} = 0.3 \mu\text{H}$ $D_{FWD} = D_{CL} = 5\text{SDF } 10\text{H}4503$ | | | 1 | μs |
| Turn-on energy per pulse | E_{on} | | | | 1.8 | J |

Turn-off switching (see Fig. 2, 7, 8, 10, 14, 15)**Maximum rated values**¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|------------------------------------|-------------|---|-----|-----|------|------|
| Max. controllable turn-off current | I_{TGQM1} | $V_{DM} \leq V_{DRM}$, $T_j = 0..125\text{ °C}$, $V_D = 2800 \text{ V}$ $t_{on} > 100\mu\text{s}$ | | | 5000 | A |
| Max. controllable turn-off current | I_{TGQM2} | $R_S = 0.35 \Omega$, $C_{CL} = 20 \mu\text{F}$, $L_{CL} \leq 0.3 \mu\text{H}$, $f = 0..300 \text{ Hz}^2)$ $D_{FWD} = D_{CL}$ $= 5\text{SDF } 10\text{H}4503$ $V_D = 2800 \text{ V}$ $40\mu\text{s} < t_{on} < 100\mu\text{s}$ | | | 4400 | A |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|-------------------------------------|-----------------|---|-----|------|------|---------------|
| Turn-off delay time | $t_{d(off)}$ | $V_D = 2800 \text{ V}$, $T_j = 125 \text{ °C}$, | | | 8 | μs |
| Turn-off delay time status feedback | $t_{d(off) SF}$ | $V_{DM} \leq V_{DRM}$, $R_S = 0.35 \Omega$ $I_{TGQ} = 4000 \text{ A}$, $L_i = 3 \mu\text{H}$ $C_{CL} = 20 \mu\text{F}$, $L_{CL} = 0.3 \mu\text{H}$ | | | 7 | μs |
| Turn-off energy per pulse | E_{off} | $D_{FWD} = D_{CL} = 5\text{SDF } 10\text{H}4503$ | | 26.5 | 31.5 | J |

2) Higher frequency is applicable with reduced max. turn-off conditions (contact factory).

Gate Unit Data

Power supply (see Fig. 2, 9, 10, 12, 13)

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---|----------------|---|-----|-----|-----|------|
| Gate Unit voltage (Connector X1) | $V_{Gin\ RMS}$ | AC square wave amplitude (15 kHz - 100kHz) or DC voltage. No galvanic isolation to power circuit. | 28 | | 40 | V |
| Min. current needed to power up the Gate Unit | $I_{Gin\ Min}$ | Rectified average current see application note 5SYA 2031 | 2 | | | A |
| Gate Unit power consumption | $P_{Gin\ Max}$ | | | | 130 | W |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|-----------------------------|----------------|--|-----|-----|-----|------|
| Internal current limitation | $I_{Gin\ Max}$ | Rectified average current limited by the Gate Unit | | | 8 | A |

Optical control input/output ³⁾

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---------------|-----------|------------|-----|-----|-----|---------|
| Min. on-time | t_{on} | | 40 | | | μs |
| Min. off-time | t_{off} | | 40 | | | μs |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|--------------------------------|---------------|---|-----|-----|------|------|
| Optical input power | $P_{on\ CS}$ | CS: Command signal SF: Status feedback | -15 | | -1 | dBm |
| Optical noise power | $P_{off\ CS}$ | | | | -45 | dBm |
| Optical output power | $P_{on\ SF}$ | Valid for 1mm plastic optical fiber (POF) | -19 | | -1 | dBm |
| Optical noise power | $P_{off\ SF}$ | | | | -50 | dBm |
| Pulse width threshold | t_{GLITCH} | Max. pulse width without response | | | 400 | ns |
| External retrigger pulse width | t_{retrig} | | 700 | | 1100 | ns |

3) Do not disconnect or connect fiber optic cables while light is on.

Connectors ³⁾ (see Fig. 11, 12, 13)

| Parameter | Symbol | Description |
|-------------------------------------|--------|--|
| Gate Unit power connector | X1 | AMP: MTA-156, Part Number 641210-5 ⁴⁾ |
| LWL receiver for command signal | CS | Avago, Type HFBR-2521Z ⁵⁾ |
| LWL transmitter for status feedback | SF | Avago, Type HFBR-1528Z ⁵⁾ |

3) Do not disconnect or connect fiber optic cables while light is on.

4) AMP, www.amp.com

5) Avago Technologies, www.avagotech.com

Visual feedback (see Fig. 13)

| Parameter | Symbol | Description | Color |
|-------------------------|--------|---|----------|
| Gate OFF | LED1 | "Light" when GCT is off | (green) |
| Gate ON | LED2 | "Light" when gate-current is flowing | (yellow) |
| Fault | LED3 | "Light" when not ready / Failure | (red) |
| Power supply voltage OK | LED4 | "Light" when power supply is within specified range | (green) |

Thermal

Maximum rated values ¹⁾

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|---------------------------------|-----------|------------|-----|-----|-----|------|
| Junction operating temperature | T_{vj} | | 0 | | 125 | °C |
| Storage temperature range | T_{stg} | | 0 | | 60 | °C |
| Ambient operational temperature | T_a | | 0 | | 50 | °C |

Characteristic values

| Parameter | Symbol | Conditions | min | typ | max | Unit |
|--|---------------|--------------------|-----|-----|-----|------|
| Thermal resistance junction-to-case of GCT | $R_{th(j-c)}$ | Double side cooled | | | 8.5 | K/kW |
| Thermal resistance case-to-heatsink of GCT | $R_{th(c-h)}$ | Double side cooled | | | 3 | K/kW |

Analytical function for transient thermal impedance:

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

| i | 1 | 2 | 3 | 4 |
|-------------|--------|--------|--------|--------|
| $R_i(K/kW)$ | 5.562 | 1.527 | 0.868 | 0.545 |
| $\tau_i(s)$ | 0.5119 | 0.0896 | 0.0091 | 0.0024 |

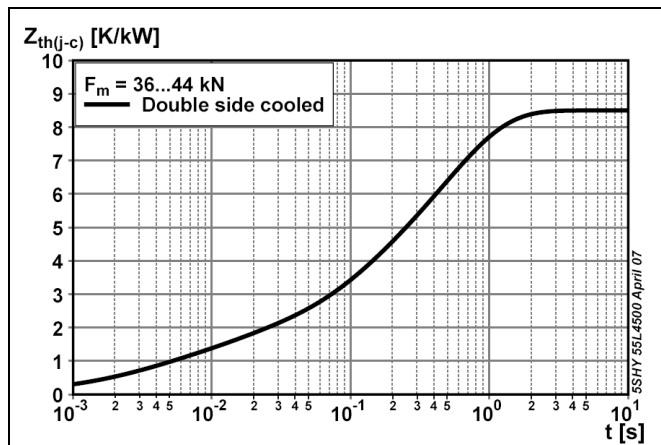


Fig. 1 Transient thermal impedance (junction-to-case) vs. time (max. values)

Max. Turn-off current for Lifetime operation

- calculated lifetime of on-board capacitors 20 years
- with slightly forced air cooling (air velocity > 0.5 m/s)
- strong air cooling allows for increased ambient temperature

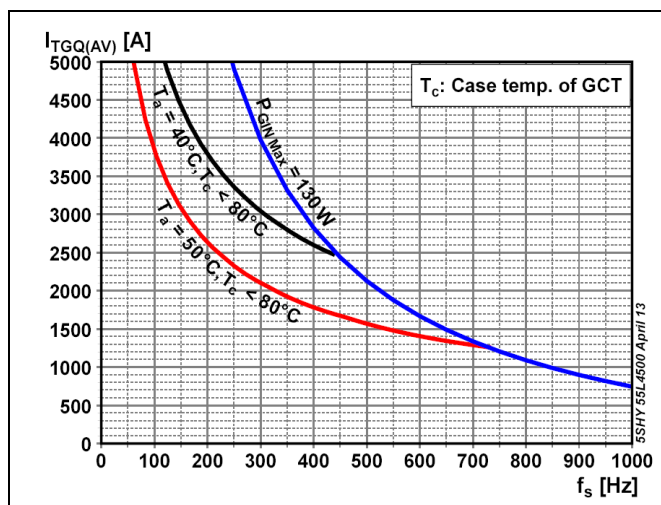


Fig. 2 Max. turn-off current vs. frequency for lifetime operation

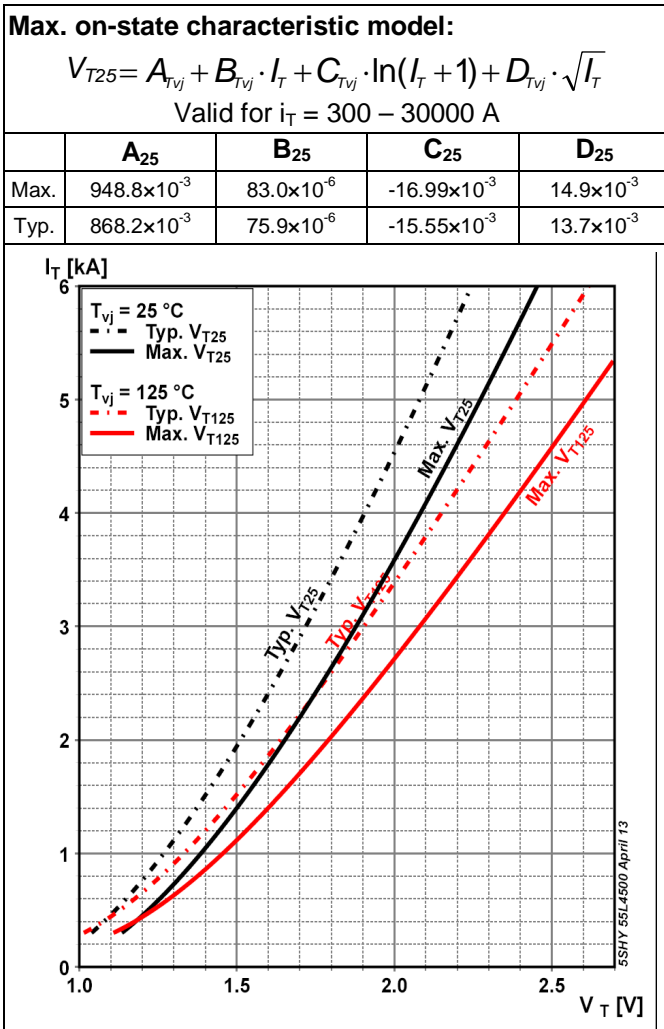


Fig. 3 GCT on-state voltage characteristics

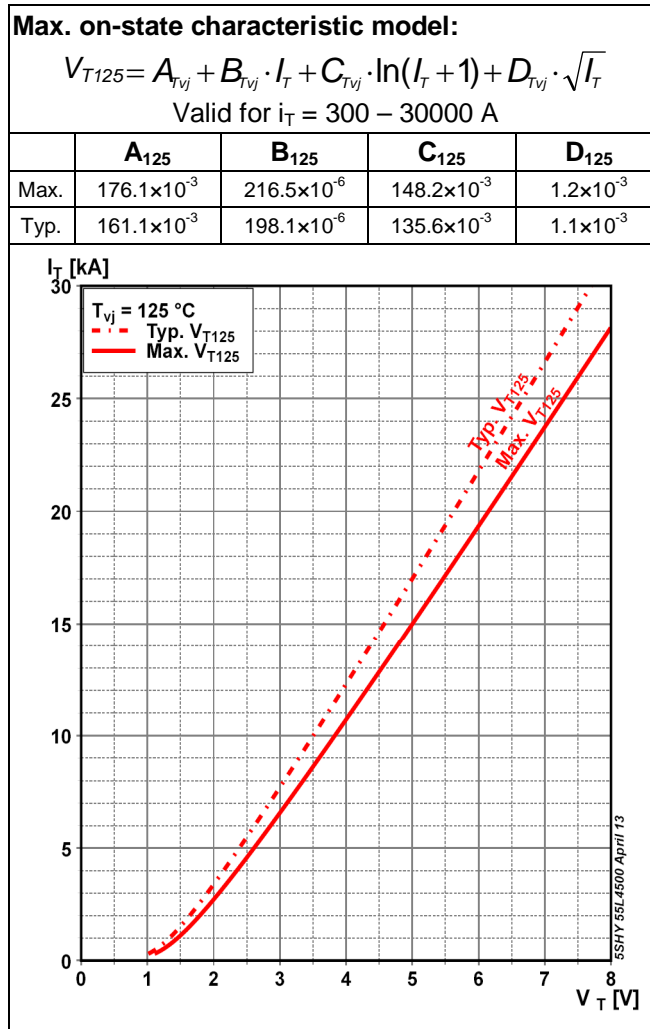


Fig. 4 GCT on-state voltage characteristics

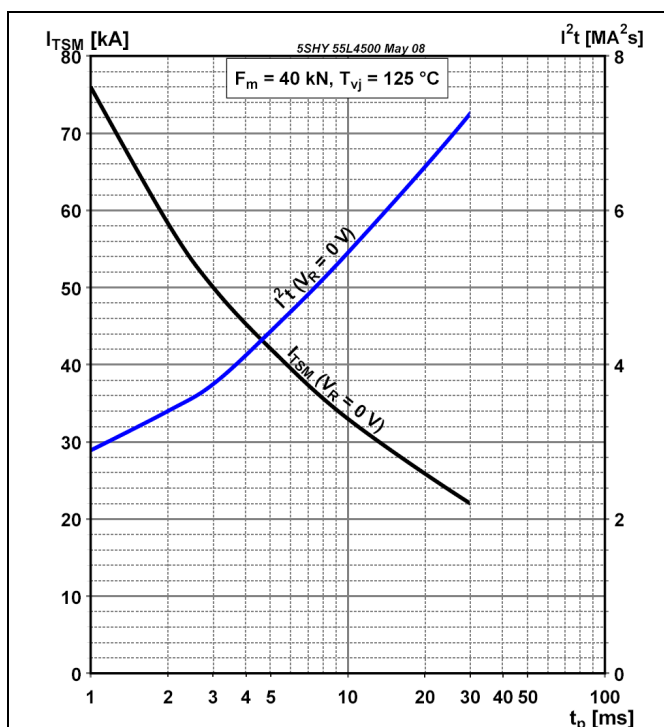


Fig. 5 Surge on-state current vs. pulse length, half-sine wave, no reapplied voltage

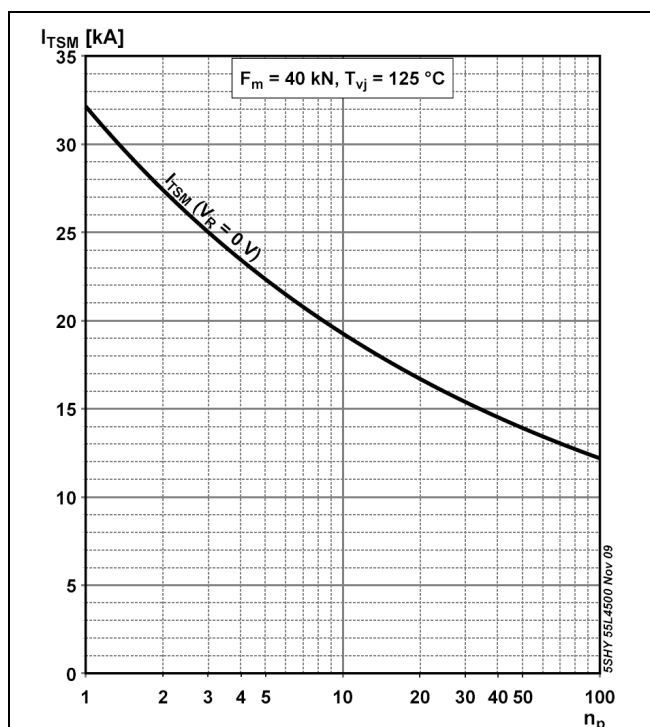


Fig. 6 Surge on-state current vs. number of pulses, half-sine wave, 10 ms, 50 Hz, no reapplied voltage

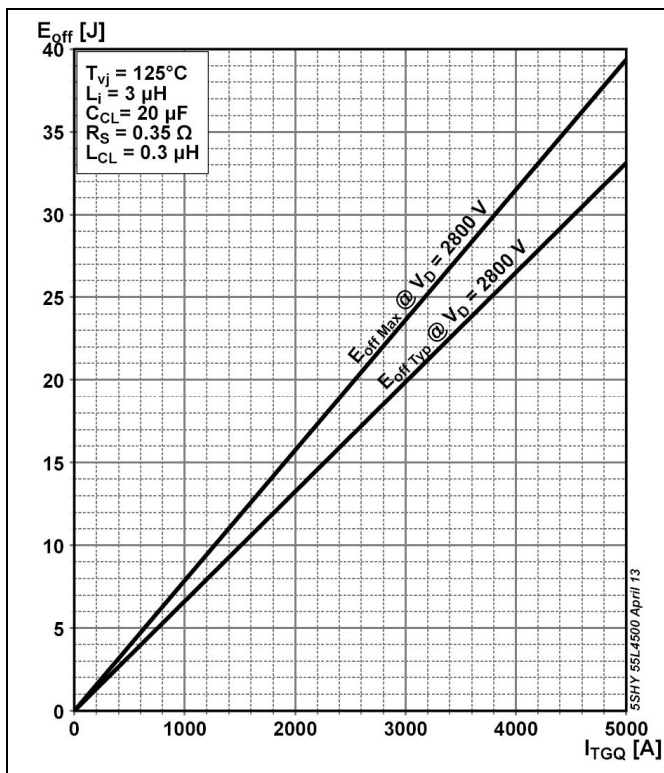


Fig. 7 GCT turn-off energy per pulse vs. turn-off current

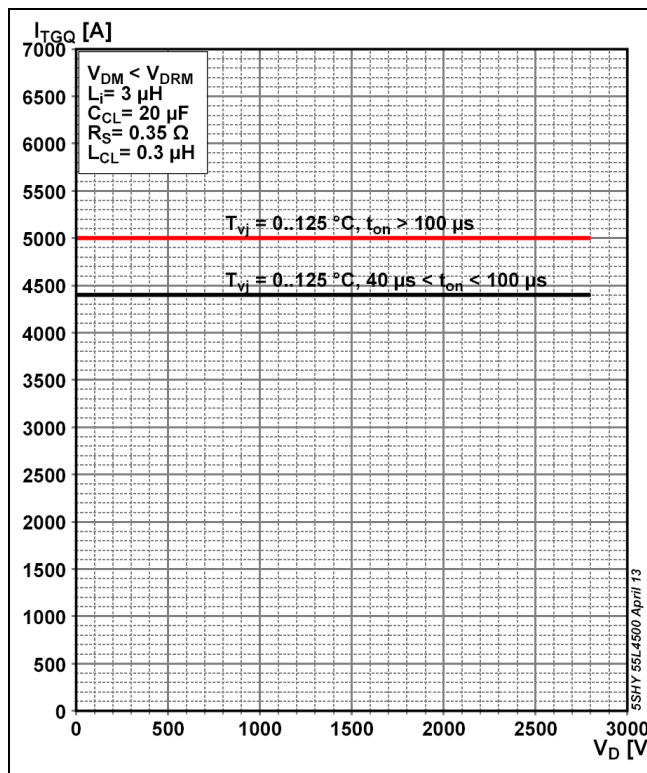


Fig. 8 Safe Operating Area

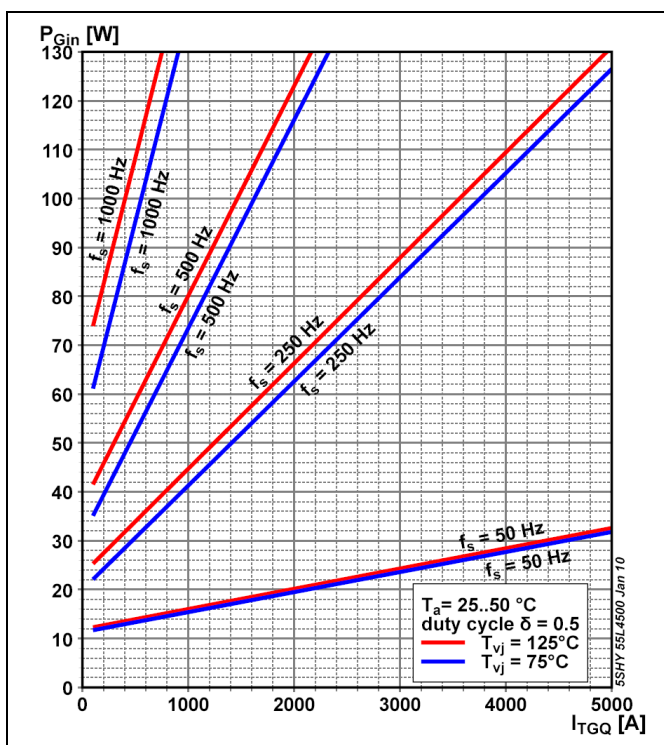


Fig. 9 Max. Gate Unit input power in chopper mode

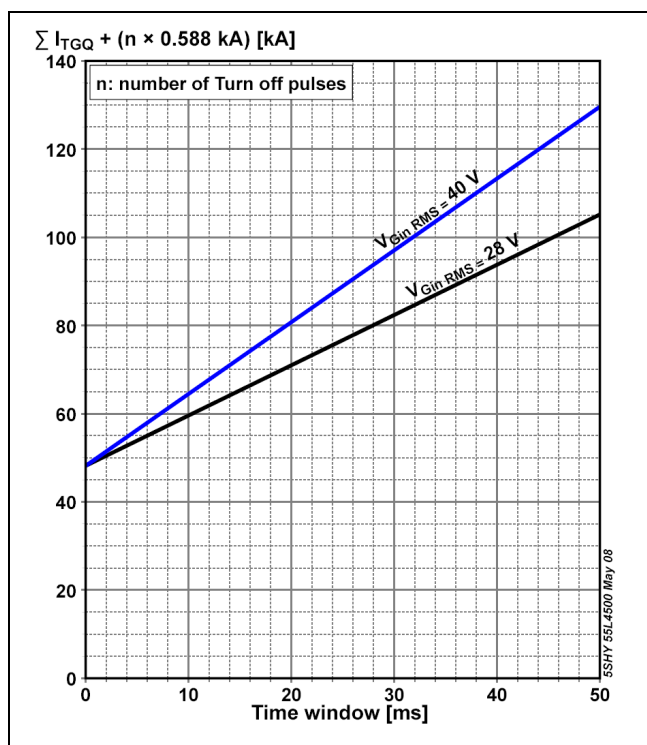


Fig. 10 Burst capability of Gate Unit

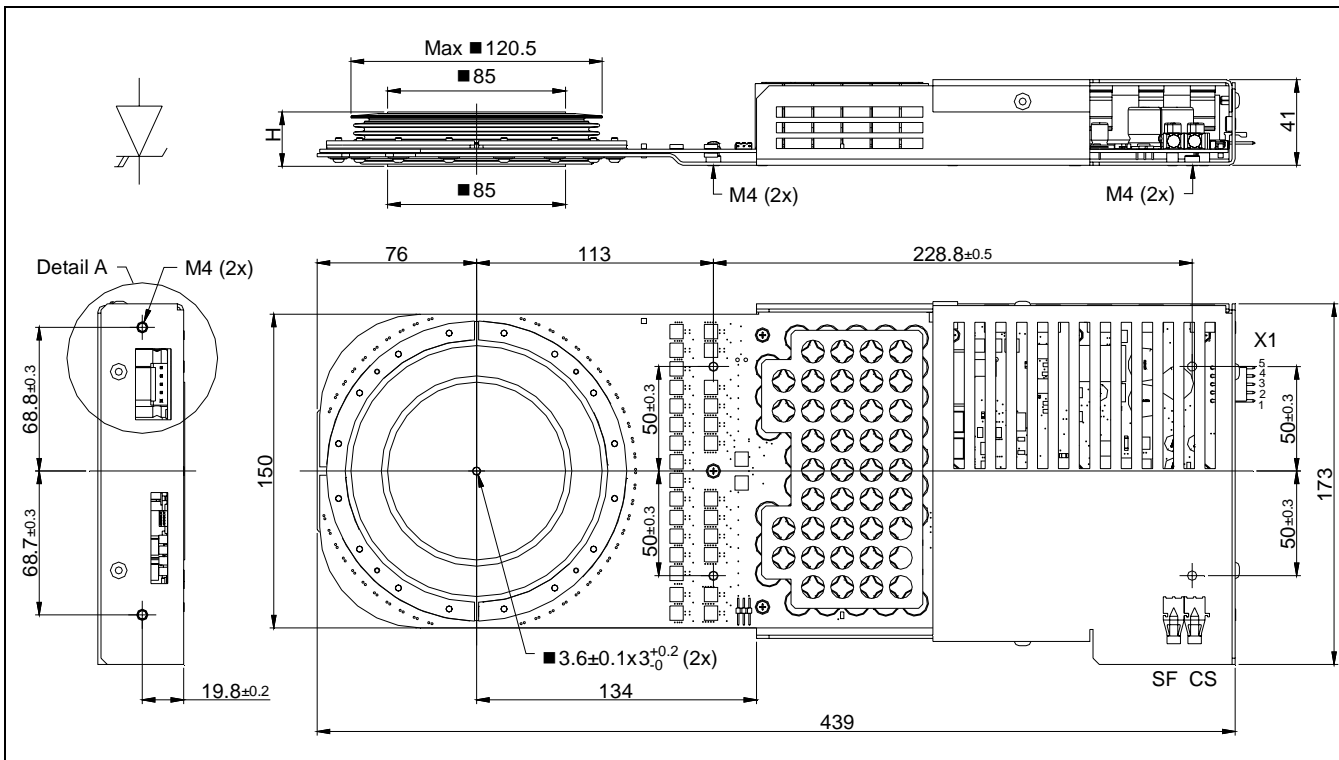


Fig. 11 Outline drawing; all dimensions are in millimeters and represent nominal values unless stated otherwise

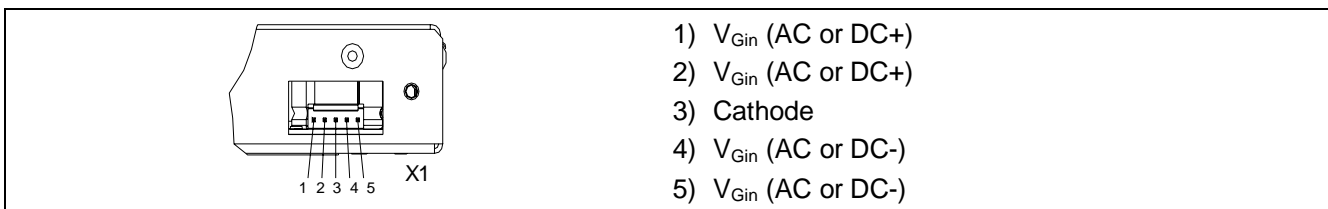


Fig. 12 Detail A: pin out of supply connector X1

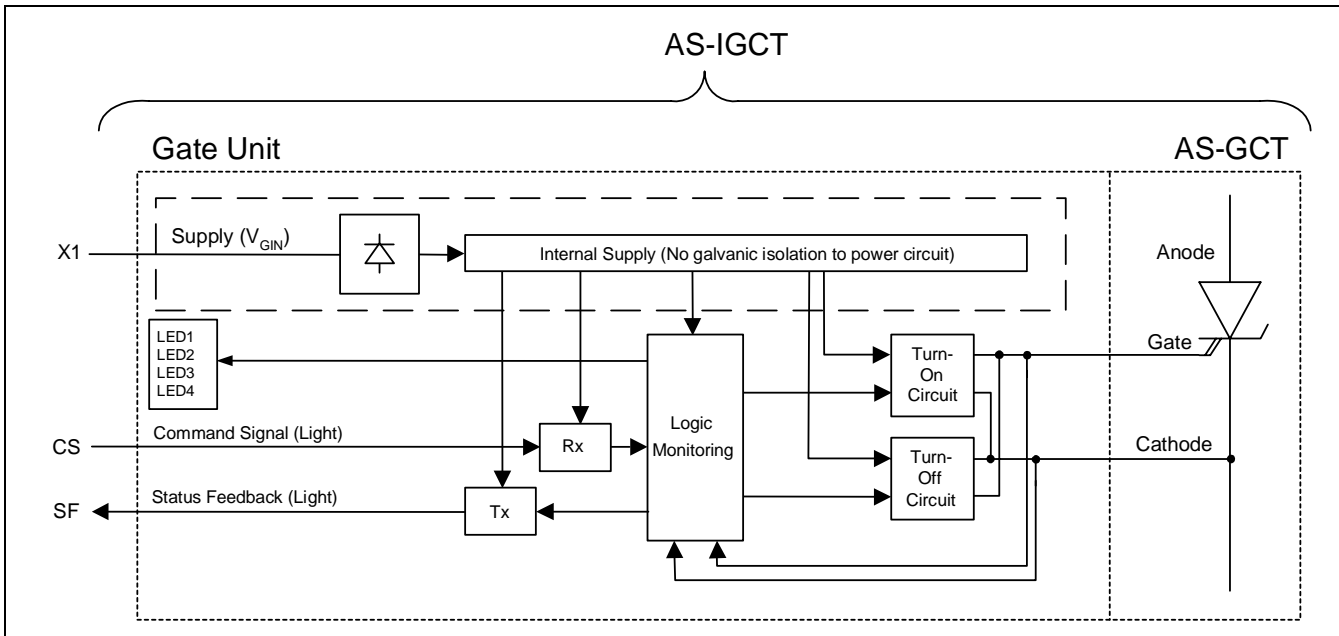


Fig. 13 Block diagram

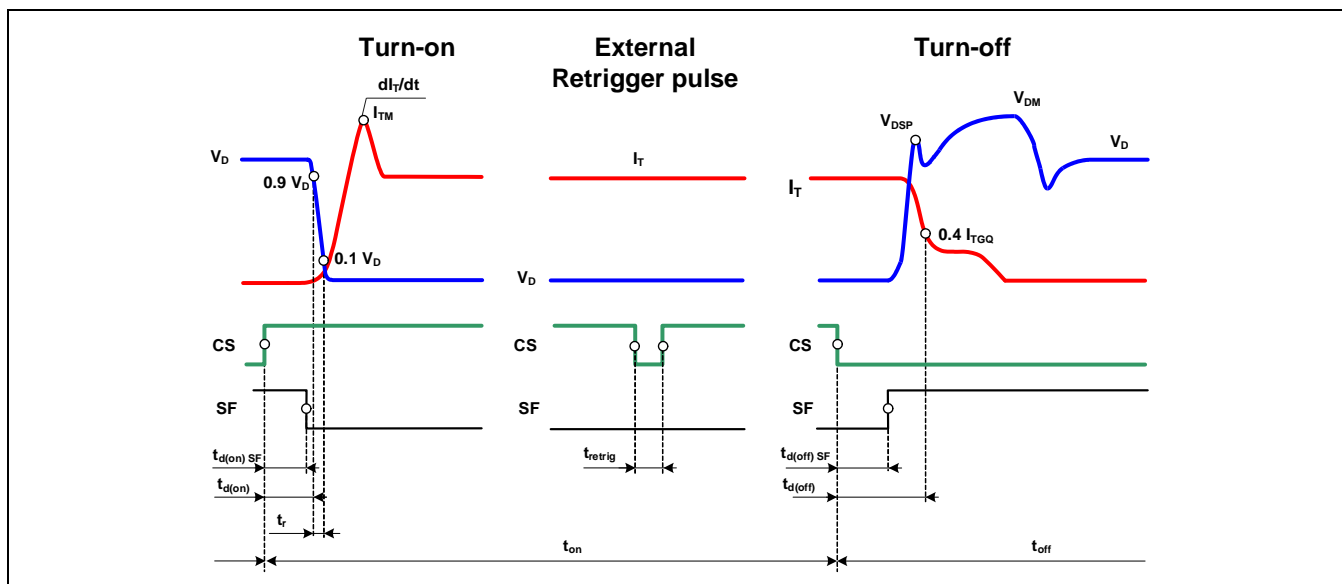


Fig. 14 General current and voltage waveforms with IGCT - specific symbols

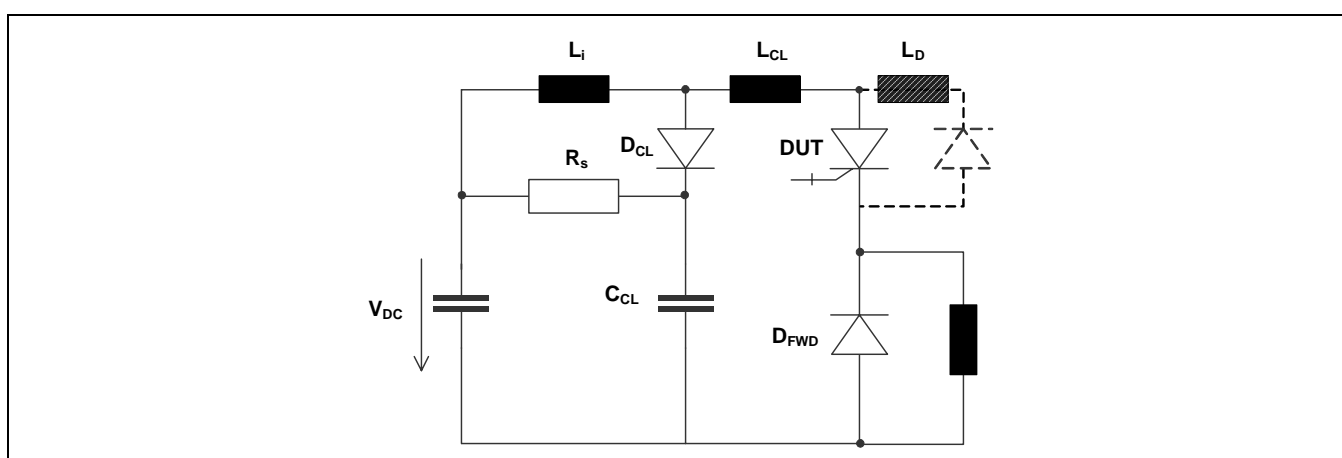


Fig. 15 Test circuit

Related documents:

| | |
|-----------|--|
| 5SYA 2031 | Applying IGCT Gate Units |
| 5SYA 2032 | Applying IGCTs |
| 5SYA 2036 | Recommendations regarding mechanical clamping of Press Pack High Power Semiconductors |
| 5SYA 2046 | Failure rates of IGCTs due to cosmic rays |
| 5SYA 2048 | Field measurements on High Power Press Pack Semiconductors |
| 5SYA 2051 | Voltage ratings of high power semiconductors |
| 5SZK 9107 | Specification of environmental class for pressure contact IGCTs, OPERATION available on request, please contact factory |
| 5SZK 9109 | Specification of environmental class for pressure contact IGCTs, STORAGE available on request, please contact factory |
| 5SZK 9110 | Specification of environmental class for pressure contact IGCTs, TRANSPORTATION available on request, please contact factory |

Please refer to <http://www.abb.com/semiconductors> for current version of documents.

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