# DCR3790B42

## Phase Control Thyristor

Replaces DS5809-4 DS5809-5 July 2022 (LN41920)

## FEATURES

- Double Side Cooling
- High Surge Capability

## APPLICATIONS

- High Power Drives
- High Voltage Power Supplies
- Static Switches

## KEY PARAMETERS

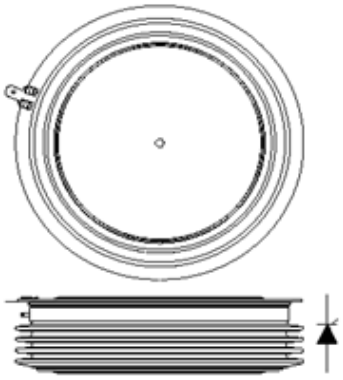
| | |
|---|---|
| $V_{DRM}$ | **4200V** |
| $I_{T(AV)}$ | **3740A** |
| $I_{TSM}$ | **53500A** |
| **dV/dt*** | **1500V/µs** |
| **dI/dt** | **400A/µs** |

*** Higher dV/dt selections are available on request**

## VOLTAGE RATINGS

| Part and Ordering Number | Repetitive Peak Voltages $V_{DRM}$ and $V_{RRM}$ (V) | Conditions |
|---|---|---|
| DCR3790B42<br>DCR3790B40<br>DCR3790B35<br>DCR3790B30 | 4200<br>4000<br>3500<br>3000 | $T_{vj}$ = -40°C to 125°C, $I_{DRM}$ = $I_{RRM}$ = 200mA, $V_{DRM}$, $V_{RRM}$ $t_p$ = 10ms $V_{DSM}$ & $V_{RSM}$ = $V_{DRM}$ & $V_{RRM}$ + 100V respectively |

Lower voltage grades available.



**Outline type code: B**

(See Package Details for further information)

**Fig. 1 Package outline**

## ORDERING INFORMATION

When ordering, select the required part number shown in the Voltage Ratings selection table.

For example:

**DCR3790B42**

Note: Please use the complete part number when ordering and quote this number in any future correspondence relating to your order.

## CURRENT RATINGS

**$T_{case}$ = 60°C unless stated otherwise**

| Symbol | Parameter | Test Conditions | Max. | Units |
|---|---|---|---|---|
| **Double Side Cooled** | | | | |
| $I_{T(AV)}$ | Mean on-state current | Half wave resistive load | 3740 | A |
| $I_{T(RMS)}$ | RMS value | - | 5870 | A |
| $I_T$ | Continuous (direct) on-state current | - | 5330 | A |

## SURGE RATINGS

| Symbol | Parameter | Test Conditions | Max. | Units |
|---|---|---|---|---|
| $I_{TSM}$ | Surge (non-repetitive) on-state current | 10ms half sine, $T_{case}$ = 125°C<br>$V_R$ = 0 | 53.5 | kA |
| $I^2t$ | $I^2t$ for fusing | | 14.3 | $MA^2s$ |

## THERMAL AND MECHANICAL RATINGS

| Symbol | Parameter | Test Conditions | | Min. | Max. | Units |
|---|---|---|---|---|---|---|
| $R_{th(j-c)}$ | Thermal resistance - junction to case | Double side cooled | DC | - | 7.0 | °C/kW |
| | | Single side cooled | Anode DC | - | 11.5 | °C/kW |
| | | | Cathode DC | - | 18.1 | °C/kW |
| $R_{th(c-h)}$ | Thermal resistance - case to heatsink | Clamping force 76kN (with mounting compound) | Double side | - | 1.4 | °C/kW |
| | | | Single side | - | 2.8 | °C/kW |
| $T_{vj}$ | Virtual junction temperature | Blocking $V_{DRM}$ / $V_{RRM}$ | | - | 125 | °C |
| $T_{stg}$ | Storage temperature range | | | -55 | 125 | °C |
| $F_m$ | Clamping force | | | 68 | 84 | kN |

## DYNAMIC CHARACTERISTICS

| Symbol | Parameter | Test Conditions | | Min. | Max. | Units |
|---|---|---|---|---|---|---|
| $I_{RRM}/I_{DRM}$ | Peak reverse and off-state current | At $V_{RRM}/V_{DRM}$, $T_{case}$ = 125°C | | - | 200 | mA |
| $V_{TM}$ | Instantaneous forward voltage | At 4000A peak, $T_j$ = 125°C | | 1.35 | 1.55 | V |
| dV/dt | Max. linear rate of rise of off-state voltage | To 67% $V_{DRM}$, $T_j$ = 125°C, gate open | | - | 1500 | V/µs |
| dI/dt | Rate of rise of on-state current | From 67% $V_{DRM}$ to 2x $I_{T(AV)}$<br>Gate source 30V, 10Ω<br>$t_r$ < 0.5µs, $T_j$ = 125°C | Repetitive 50Hz | - | 200 | A/µs |
| | | | Non-repetitive | - | 400 | A/µs |
| $V_{T(TO)}$ | Threshold voltage - Low level | 500A to 2500A at $T_{case}$ = 125°C | | - | 0.80 | V |
| | Threshold voltage - High level | 2500A to 7000A at $T_{case}$ = 125°C | | - | 1.00 | V |
| $r_T$ | On-state slope resistance - low level | 500A to 2500A at $T_{case}$ = 125°C | | - | 0.22 | mΩ |
| | On-state slope resistance - High level | 2500A to 7000A at $T_{case}$ = 125°C | | - | 0.14 | mΩ |
| $t_{gd}$ | Delay time | $V_D$ = 67% $V_{DRM}$, gate source 30V, 10Ω<br>$t_r$ = 0.5µs, $T_j$ = 25°C | | - | 3 | µs |
| $t_q$ | Turn-off time | $T_j$ = 125°C, $V_R$ = 200V, dI/dt = 1A/µs,<br>$dV_{DR}/dt$ = 20V/µs linear | | 250 | 500 | µs |
| $Q_S$ | Stored charge | $I_T$ = 2000A, $T_j$ = 125°C, dI/dt = 1A/µs<br>$V_{R(peak)}$ ~ 2500V, $V_{RM}$ ~ 1700V | | 2250 | 5410 | µC |
| $I_{RR}$ | Reverse recovery current | | | 36 | 62 | A |
| $I_L$ | Latching current | $T_j$ = 25°C, $V_D$ = 5V | | - | 3 | A |
| $I_H$ | Holding current | $T_j$ = 25°C, $R_{G-K}$ = ∞, $I_{TM}$ = 500A, $I_T$ = 5A | | - | 300 | mA |

## GATE TRIGGER CHARACTERISTICS AND RATINGS

| Symbol | Parameter | Test Conditions | Max. | Units |
|---|---|---|---|---|
| $V_{GT}$ | Gate trigger voltage | $V_{DRM}$ = 5V, $T_{case}$ = 25°C | 1.5 | V |
| $V_{GD}$ | Gate non-trigger voltage | At 50% $V_{DRM}$, $T_{case}$ = 125°C | 0.4 | V |
| $I_{GT}$ | Gate trigger current | $V_{DRM}$ = 5V, $T_{case}$ = 25°C | 350 | mA |
| $I_{GD}$ | Gate non-trigger current | At 50% $V_{DRM}$, $T_{case}$ = 125°C | 10 | mA |

## CURVES

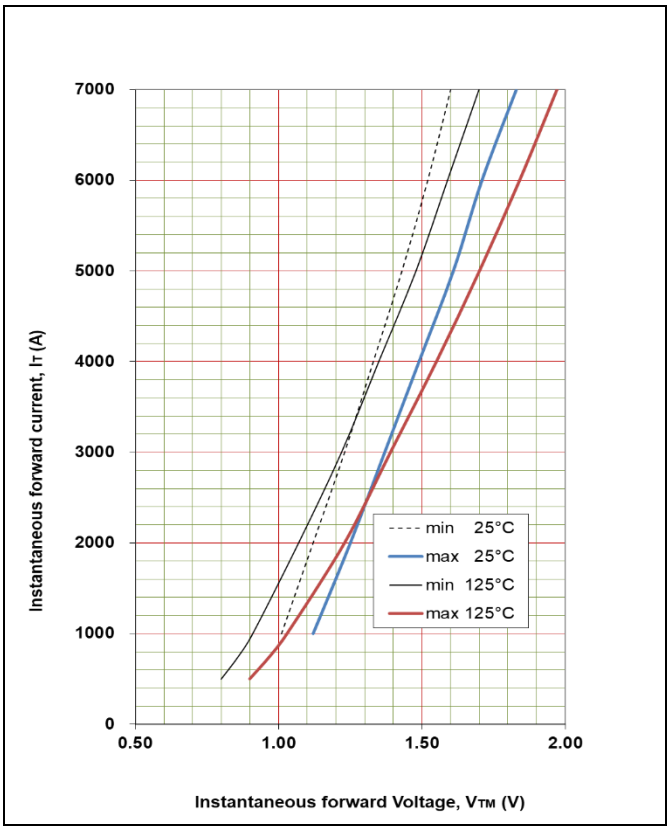



**Fig. 2 Maximum & minimum on-state characteristics**

## $V_{TM}$ EQUATION

$V_{TM} = A + B.\ln(I_T) + C.I_T + D.\sqrt{I_T}$

Where A = 0.348874
B = 0.066800
C = 0.000102
D = 0.003786

These values are valid for $T_j$ = 125°C for $I_T$ 500A to 7000A

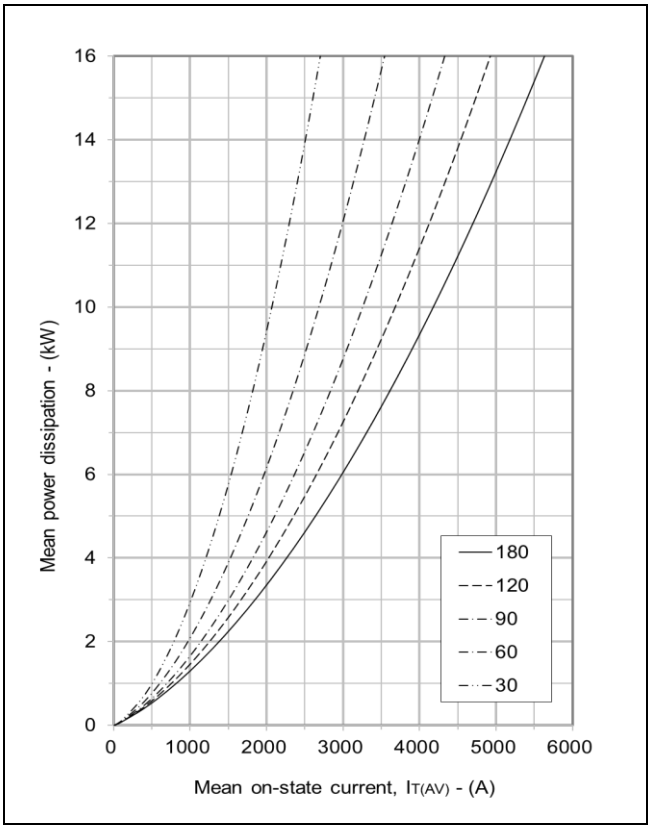



**Fig. 3 On-state power dissipation - sine wave**

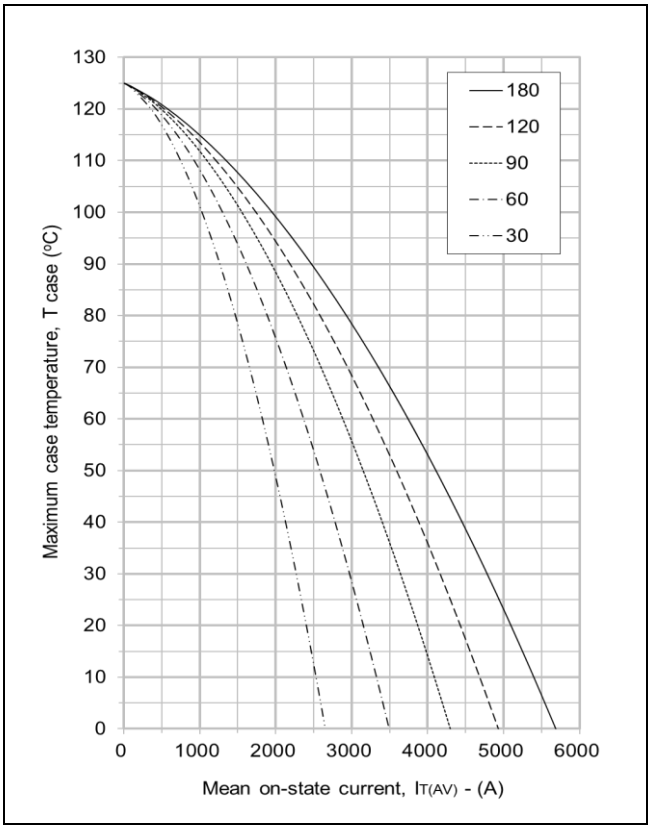



**Fig. 4 Maximum permissible case temperature, double side cooled - sine wave**

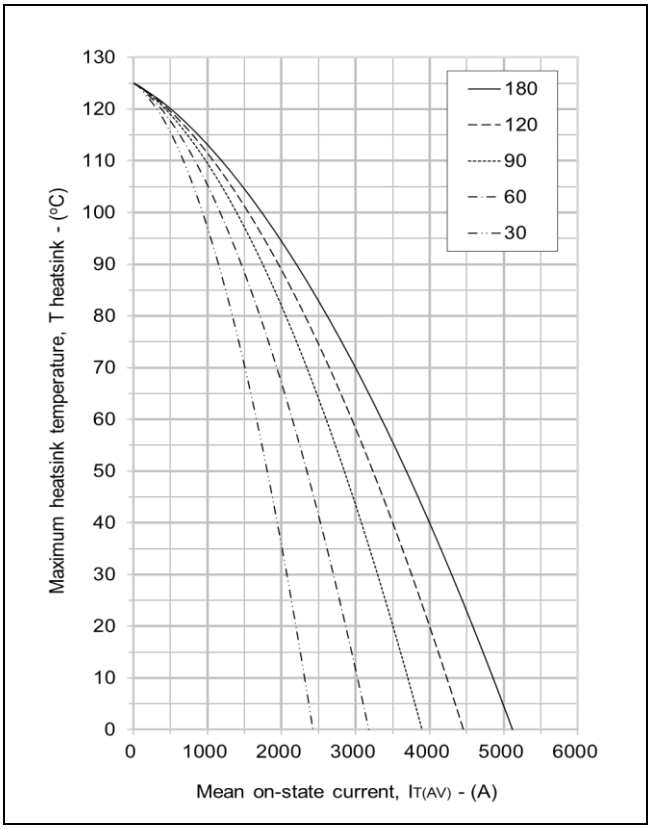



**Fig. 5 Maximum permissible heatsink temperature, double side cooled - sine wave**

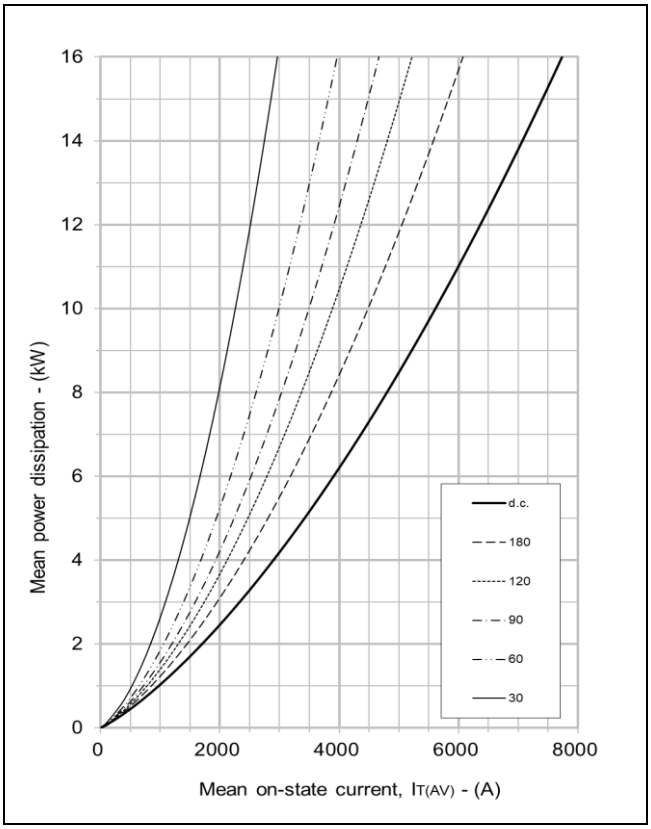



**Fig. 6 On-state power dissipation - rectangular wave**

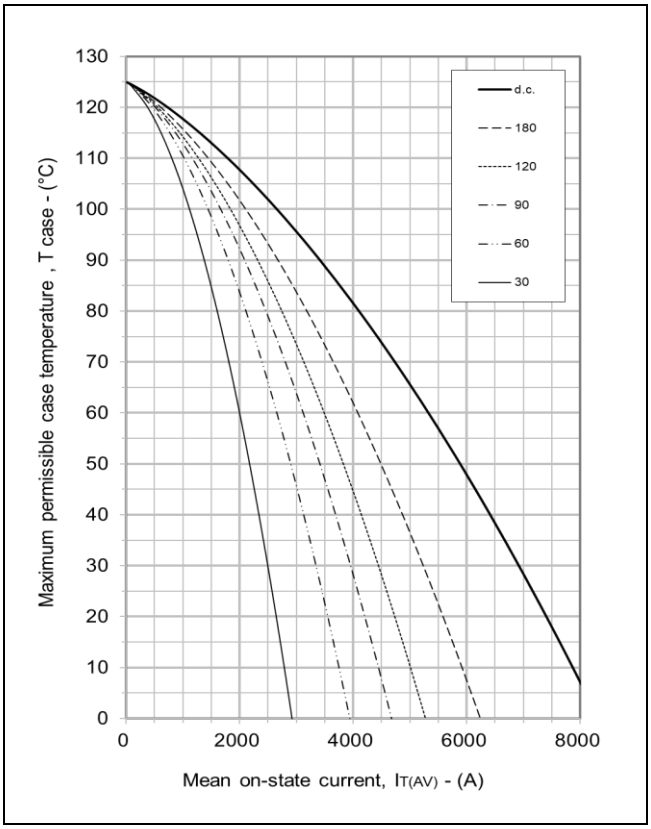



**Fig. 7 Maximum permissible case temperature, double side cooled - rectangular wave**

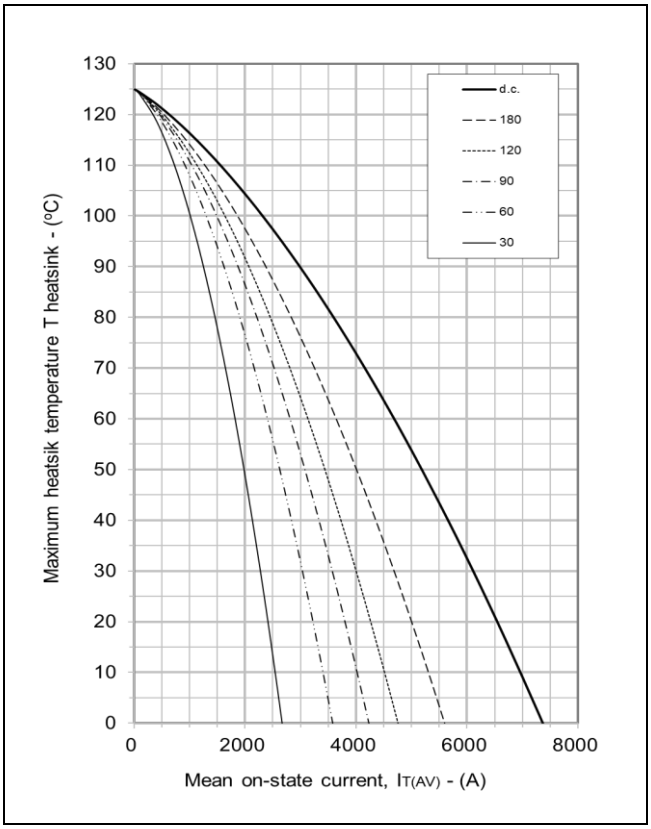



**Fig. 8 Maximum permissible heatsink temperature, double side cooled - rectangular wave**

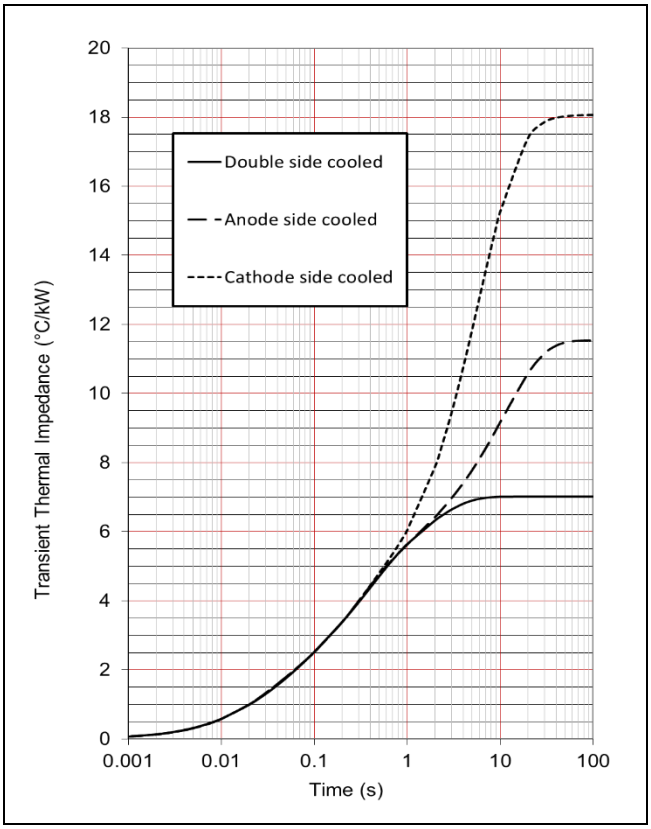



**Fig. 9 Maximum (limit) transient thermal impedance – junction to case (degC/kW)**

| | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Double side cooled | Ri(°C/kW) | 0.502 | 1.333 | 2.956 | 2.234 |
| | Ti(s) | 0.014 | 0.055 | 0.331 | 1.691 |
| Anode side cooled | Ri(°C/kW) | 1.304 | 3.138 | 1.186 | 5.914 |
| | Ti(s) | 0.025 | 0.241 | 1.081 | 11.002 |
| Cathode side cooled | Ri(°C/kW) | 1.262 | 2.622 | 13.360 | 0.830 |
| | Ti(s) | 0.025 | 0.201 | 5.785 | 16.765 |

$$Z_{th} = \sum_{i=1}^{i=4} R_i \cdot \left(1 - \exp\left(-\frac{T}{T_i}\right)\right)$$

$\Delta R_{th(j-c)}$ Conduction

Tables show the increments of thermal resistance $R_{th(j-c)}$ when the device operates at conduction angles other than d.c.

| Double side cooling | | |
|---|---|---|
| | $\Delta Z_{th}$ (z) | |
| θ° | sine. | rect. |
| 180 | 0.70 | 0.48 |
| 120 | 0.80 | 0.68 |
| 90 | 0.90 | 0.78 |
| 60 | 1.00 | 0.89 |
| 30 | 1.07 | 1.01 |
| 15 | 1.10 | 1.07 |

| Anode Side Cooling | | |
|---|---|---|
| | $\Delta Z_{th}$ (z) | |
| θ° | sine. | rect. |
| 180 | 0.67 | 0.47 |
| 120 | 0.77 | 0.66 |
| 90 | 0.87 | 0.75 |
| 60 | 0.95 | 0.86 |
| 30 | 1.02 | 0.96 |
| 15 | 1.05 | 1.02 |

| Cathode Sided Cooling | | |
|---|---|---|
| | $\Delta Z_{th}$ (z) | |
| θ° | sine. | rect. |
| 180 | 0.67 | 0.47 |
| 120 | 0.77 | 0.66 |
| 90 | 0.87 | 0.76 |
| 60 | 0.95 | 0.86 |
| 30 | 1.02 | 0.96 |
| 15 | 1.05 | 1.02 |

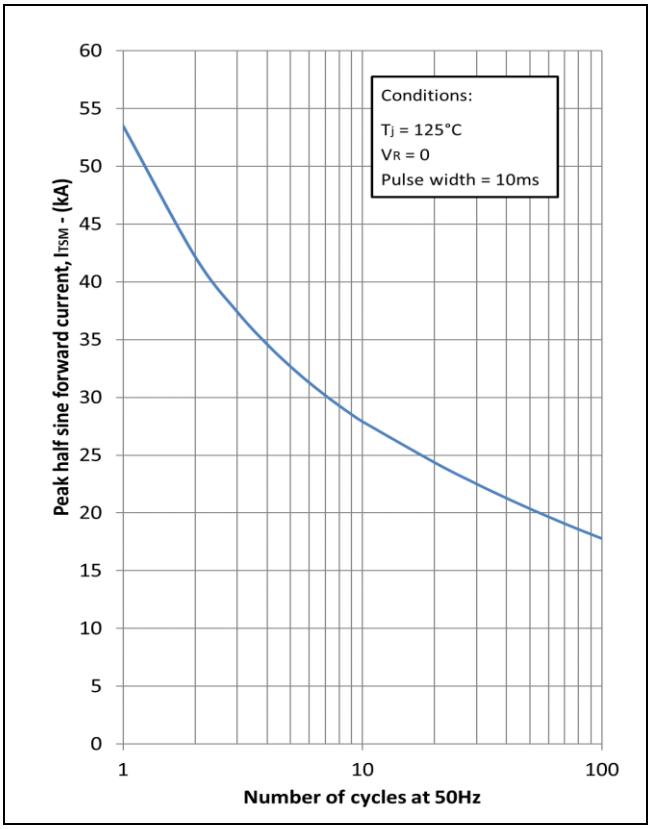



Fig. 10 Multi-cycle surge current

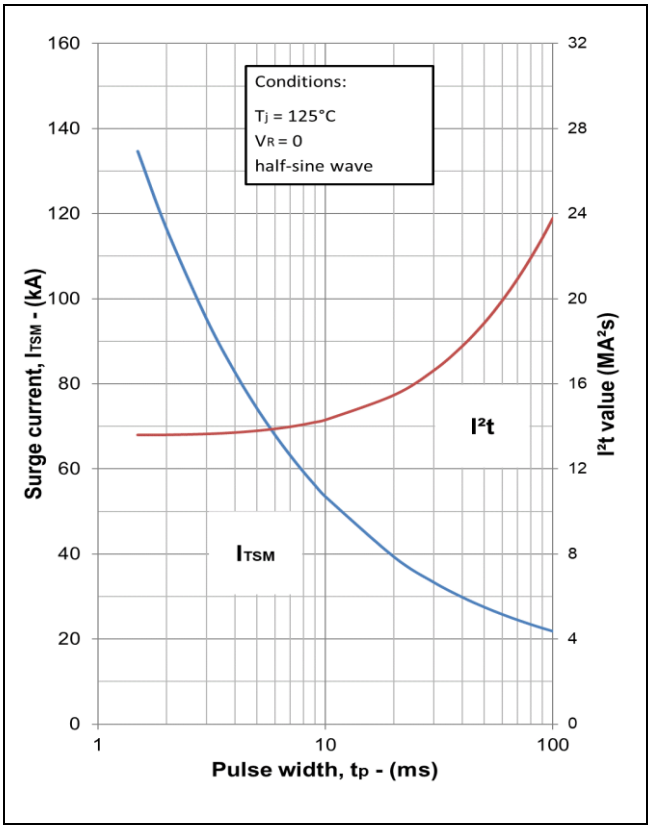



Fig. 11 Single-cycle surge current

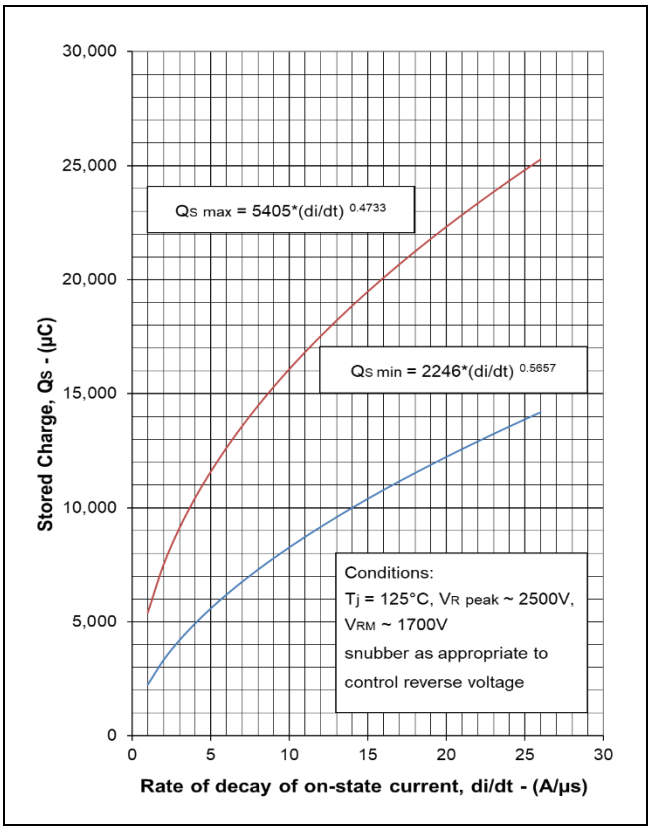



Fig. 12 Reverse recovery charge

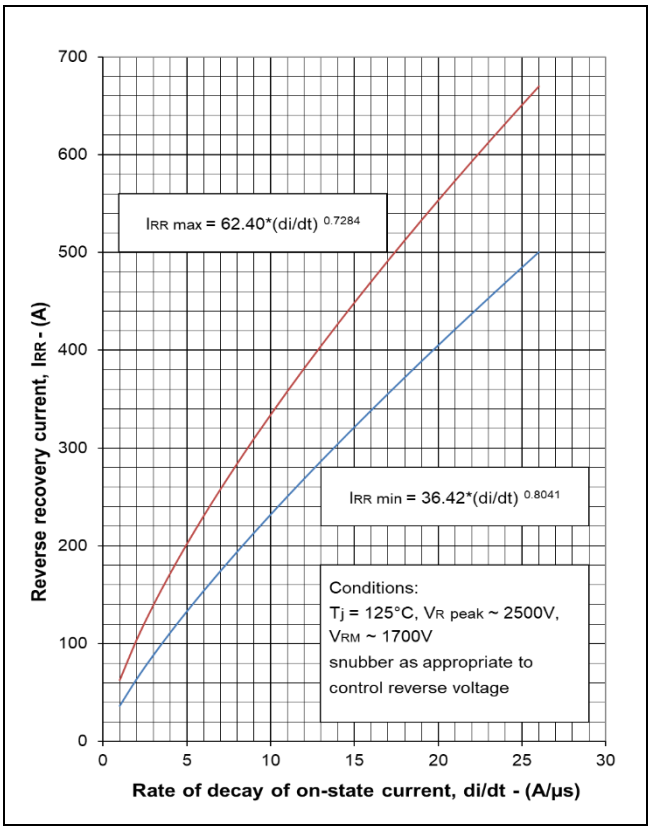



Fig. 13 Reverse recovery current

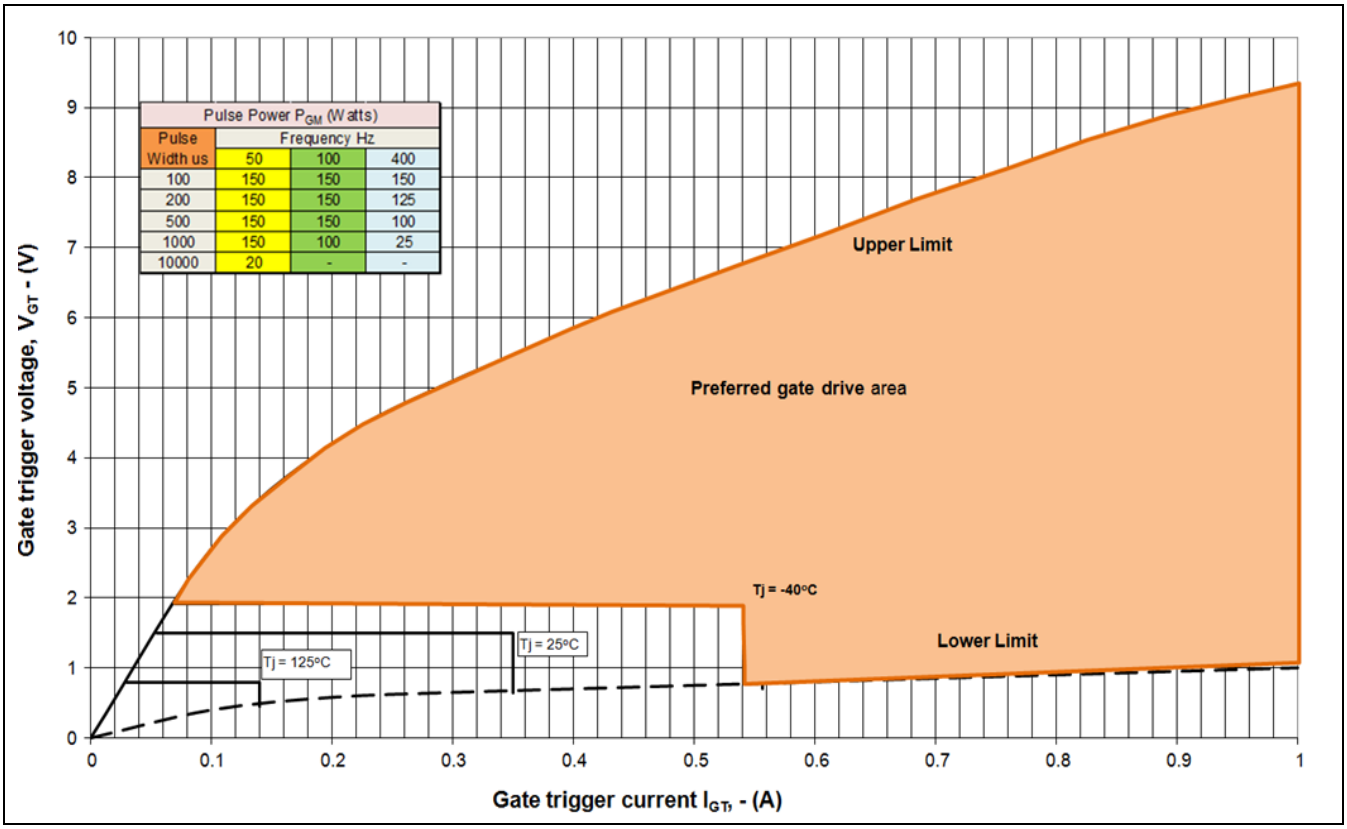



**Fig. 14 Gate characteristics**

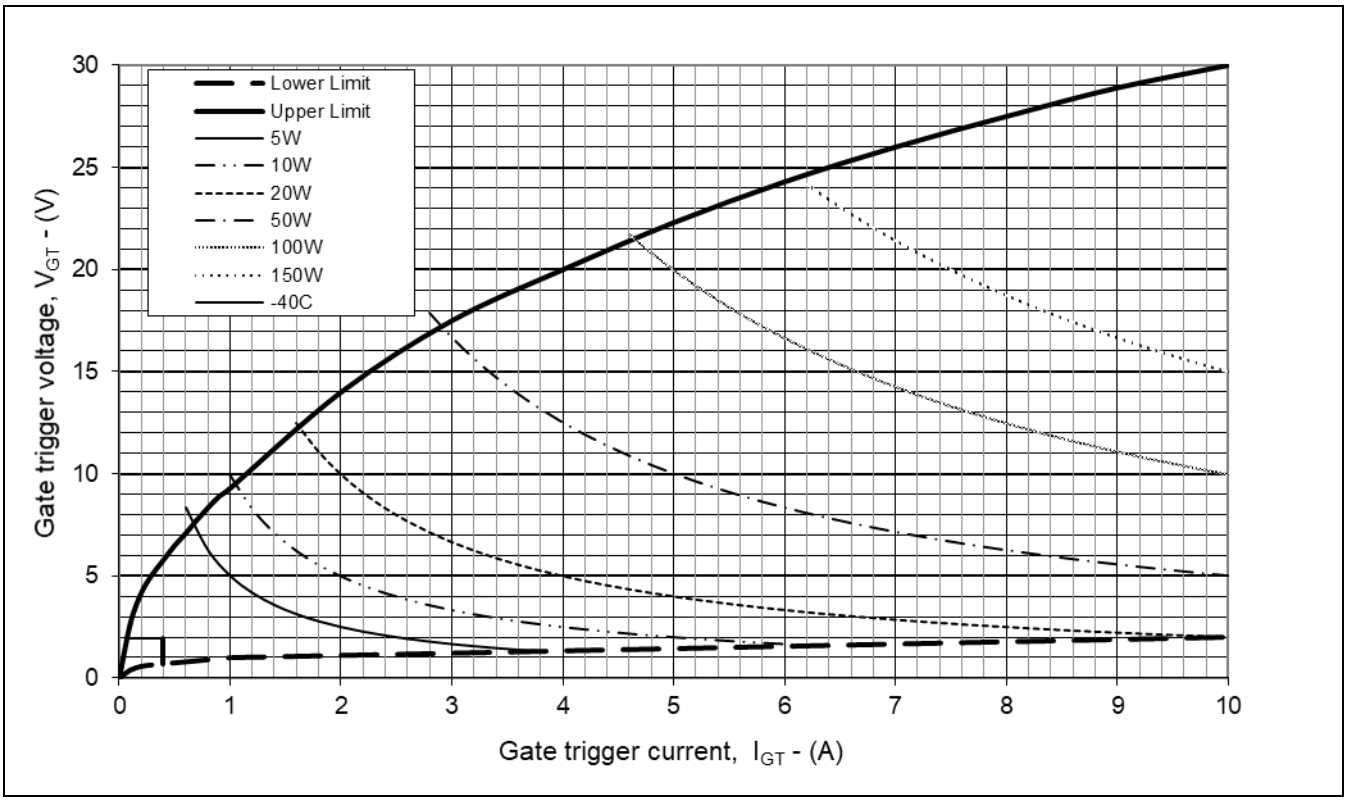


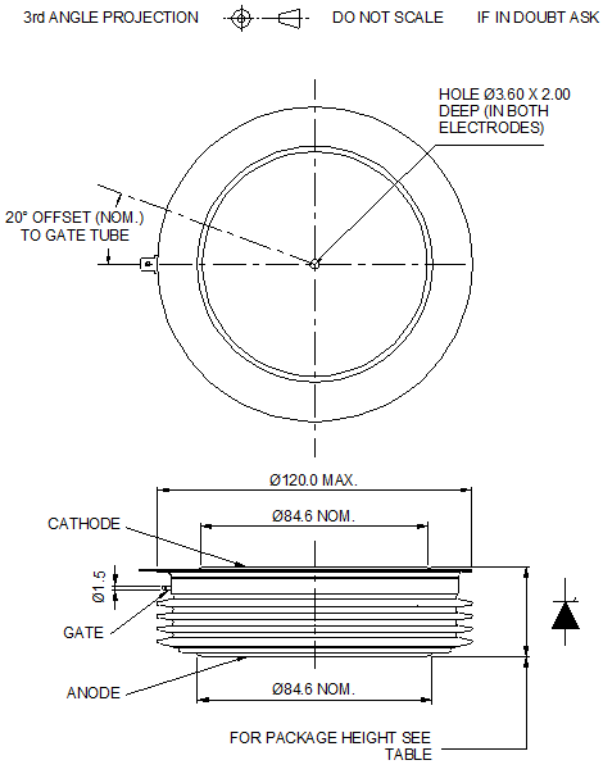

**Fig. 15 Gate characteristics**

## PACKAGE DETAILS

For further package information, please contact Customer services.

All dimensions in mm, unless stated otherwise.

DO NOT SCALE




| Device | Maximum Thickness (mm) | Minimum Thickness (mm) |
|---|---|---|
| DCR2400B85 | 35.6 | 35.2 |
| DCR2880B65 | 35.3 | 34.8 |
| DCR3480B52 | 35.0 | 34.6 |
| **DCR3790B42** | **34.9** | **34.4** |
| DCR4590B28 | 34.7 | 34.2 |
| DCR5050B22 | 34.6 | 34.1 |

Clamping force: 76kN ± 10%

Lead length: 420mm

Lead terminal connector: M4 ring

**Package outline type code: B**

**Fig. 16 Package outline**

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