

# DCR890F65

# **Phase Control Thyristor**



DS5924-2 April 2012 (LN29417)

#### **FEATURES**

- Double Side Cooling
- High Surge Capability

### **APPLICATIONS**

- Medium Voltage Soft Starts
- High Voltage Power Supplies
- Static Switches

#### **VOLTAGE RATINGS**

| Part and<br>Ordering<br>Number                    | Repetitive Peak<br>Voltages<br>V <sub>DRM</sub> and V <sub>RRM</sub><br>V | Conditions   |
|---|---|--|
| DCR890F65*<br>DCR890F60<br>DCR890F55<br>DCR890F50 | 6500<br>6000<br>5500<br>5000  | $\begin{split} T_{vj} &= \text{-}40^{\circ}\text{C to 125}^{\circ}\text{C}, \\ I_{DRM} &= I_{RRM} = 200\text{mA}, \\ V_{DRM}, \ V_{RRM} \ t_p = 10\text{ms}, \\ V_{DSM} \ \& \ V_{RSM} = \\ V_{DRM} \ \& \ V_{RRM} + 100V \\ respectively \end{split}$ |

Lower voltage grades available. \*6200V @ -40°C, 6500V @ 0°C

### **ORDERING INFORMATION**

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

For example:

### DCR890F65

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

### **KEY PARAMETERS**

| $V_{DRM}$        | 6500V    |
|------------------|----------|
| $I_{T(AV)}$      | 894A     |
| I <sub>TSM</sub> | 12000A   |
| dV/dt*           | 1500V/µs |
| dI/dt            | 200A/μs  |

\* Higher dV/dt selections available

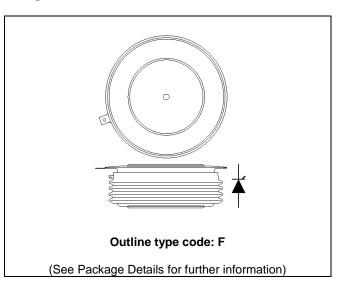


Fig. 1 Package outline





## **CURRENT RATINGS**

## $T_{\text{case}}$ = 60°C unless stated otherwise

| Symbol              | Parameter                            | Test Conditions          | Max. | Units |
|---------------------|--------------------------------------|--------------------------|------|-------|
| Double Si           | de Cooled                            |                          |      |       |
| I <sub>T(AV)</sub>  | Mean on-state current                | Half wave resistive load | 894  | А     |
| I <sub>T(RMS)</sub> | RMS value                            | -                        | 1404 | А     |
| I <sub>T</sub>      | Continuous (direct) on-state current | -                        | 1371 | А     |

# **SURGE RATINGS**

| Symbol Parameter |   | Test Conditions                           | Max. | Units             |
|------------------|---|---|------|-------------------|
| I <sub>TSM</sub> | Surge (non-repetitive) on-state current | 10ms half sine, T <sub>case</sub> = 125°C | 12.0 | kA                |
| l <sup>2</sup> t | I <sup>2</sup> t for fusing             | $V_R = 0$                                 | 0.72 | MA <sup>2</sup> s |

## THERMAL AND MECHANICAL RATINGS

| Symbol               | Parameter                             | Test Conditions                             |             | Min. | Max.   | Units |
|----------------------|---------------------------------------|---|-------------|------|--------|-------|
| R <sub>th(j-c)</sub> | Thermal resistance – junction to case | Double side cooled                          | DC          | -    | 0.0184 | °C/W  |
|                      |                                       | Single side cooled                          | Anode DC    | -    | 0.0333 | °C/W  |
|                      |                                       |   | Cathode DC  | -    | 0.0418 | °C/W  |
| R <sub>th(c-h)</sub> | Thermal resistance – case to heatsink | Clamping force 23 kN                        | Double side | -    | 0.004  | °C/W  |
|                      |                                       | (with mounting compound)                    | Single side | -    | 0.008  | °C/W  |
| T <sub>vj</sub>      | Virtual junction temperature          | Blocking V <sub>DRM</sub> / <sub>VRRM</sub> |             | -    | 125    | °C    |
| T <sub>stg</sub>     | Storage temperature range             |   |             | -55  | 125    | °C    |
| F <sub>m</sub>       | Clamping force                        |   |             | 20.0 | 25.0   | kN    |





# **DYNAMIC CHARACTERISTICS**

| Symbol                             | Parameter                                     | Test Conditio   | ns                      | Min. | Max.   | Units |
|------------------------------------|---|---|-------------------------|------|--------|-------|
| I <sub>RRM</sub> /I <sub>DRM</sub> | Peak reverse and off-state current            | At V <sub>RRM</sub> /V <sub>DRM</sub> , T <sub>case</sub> = 125°C                                     |                         | -    | 200    | mA    |
| dV/dt                              | Max. linear rate of rise of off-state voltage | To 67% V <sub>DRM</sub> , T <sub>j</sub> = 125°C, ga  | ite open                | -    | 1500   | V/µs  |
| dl/dt                              | Rate of rise of on-state current              | From 67% V <sub>DRM</sub> to 2x I <sub>T(AV)</sub>  | Repetitive 50Hz         | -    | 100    | A/µs  |
|                                    |   | Gate source 30V, 10Ω,   | Non-repetitive          | -    | 200    | A/µs  |
|                                    |   | $t_r < 0.5 \mu s, T_j = 125 ^{\circ} C$   |                         |      |        |       |
| V <sub>T(TO)</sub>                 | Threshold voltage – Low level                 | 100A to 870A at T <sub>case</sub> = 125°  | С                       | -    | 1.000  | V     |
|                                    | Threshold voltage – High level                | 870A to 3000A at T <sub>case</sub> = 125°C  |                         | -    | 1.1847 | V     |
| r <sub>T</sub>                     | On-state slope resistance – Low level         | 100A to 870A at T <sub>case</sub> = 125°C   |                         | -    | 1.1429 | mΩ    |
|                                    | On-state slope resistance – High level        | 870A to 3000A at T <sub>case</sub> = 125°C  |                         | -    | 0.9472 | mΩ    |
| t <sub>gd</sub>                    | Delay time                                    | $V_D = 67\% V_{DRM}$ , gate source 30V, $10\Omega$  |                         | -    | 3      | μs    |
|                                    |   | $t_r = 0.5 \mu s, T_j = 25^{\circ}C$  |                         |      |        |       |
| tq                                 | Turn-off time                                 | $T_j$ = 125°C, I <sub>peak</sub> = 1000A, t <sub>p</sub> = 1000us, $V_R$ = 100V, dI/dt = 5A/ $\mu$ s, |                         | 600  | 1000   | μs    |
|                                    |   | dV <sub>DR</sub> /dt = 20V/μs linear to 25  | 000V                    |      |        |       |
| I <sub>RR</sub>                    | Reverse Recovery current                      | $I_T = 1000A$ , $tp = 1000us$ , $T_j = 125$ °C, $dI/dt = -5A/\mu s$ , $V_{Rpeak} = 100V$              |                         | 90   | 120    | Α     |
| Qs                                 | Stored charge                                 |   |                         | 2500 | 4000   | μC    |
| IL                                 | Latching current                              | $T_{j} = 25^{\circ}C, V_{D} = 5V$   |                         | -    | 3      | Α     |
| lμ                                 | Holding current                               | $T_j = 25^{\circ}C, R_{G-K} = \infty, I_{TM} = 500$   | 0A, I <sub>T</sub> = 5A | -    | 300    | mA    |





### **GATE TRIGGER CHARACTERISTICS AND RATINGS**

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

## **CURVES**

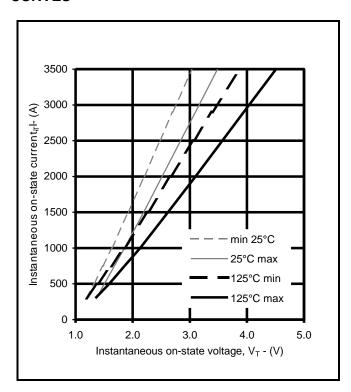


Fig.2 Maximum & minimum on-state characteristics

 $V_{TM}$  **EQUATION** Where A = 0.874878 B = 0.001945

 $V_{TM} = A + Bln (I_T) + C.I_T + D.\sqrt{I_T}$  C = 0.000808

D = 0.013372

these values are valid for  $T_j = 125$ °C for  $I_T 300$ A to 3500A



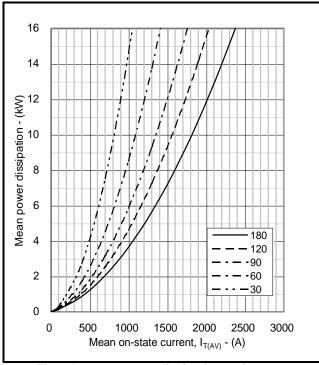


Fig.3 On-state power dissipation – sine wave

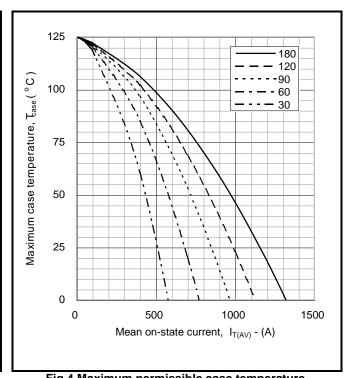


Fig.4 Maximum permissible case temperature, double side cooled – sine wave

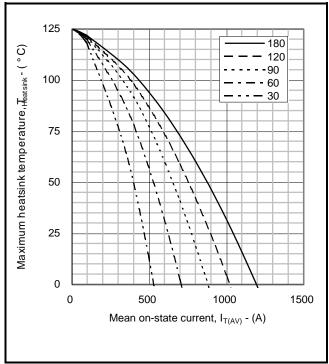


Fig.5 Maximum permissible heatsink temperature, double side cooled – sine wave

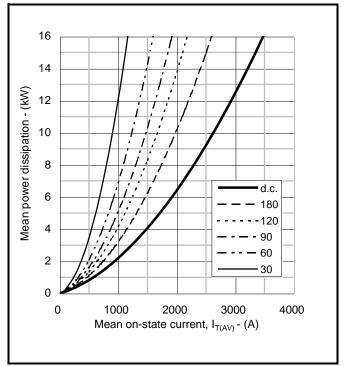


Fig.6 On-state power dissipation - rectangular wave



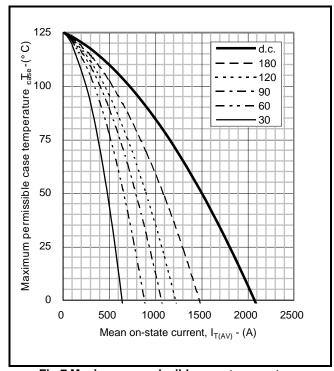


Fig.7 Maximum permissible case temperature, double side cooled – rectangular wave

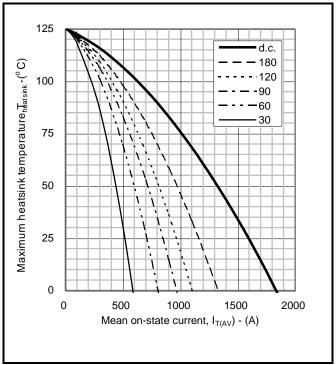
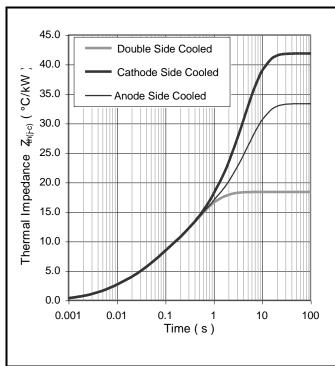


Fig.8 Maximum permissible heatsink temperature, double side cooled – rectangular wave



|                     |                        | 1       | 2      | 3       | 4       |
|---------------------|------------------------|---------|--------|---------|---------|
| Double side cooled  | R <sub>i</sub> (°C/kW) | 7.5608  | 4.0772 | 3.8420  | 2.8671  |
|                     | T <sub>i</sub> (s)     | 0.6877  | 0.2537 | 0.0614  | 0.0101  |
| Anode side cooled   | R <sub>i</sub> (°C/kW) | 6.7211  | 4.6219 | 15.5387 | 14.8631 |
|                     | T <sub>i</sub> (s)     | 0.1910  | 0.0158 | 5.0011  | 3.3169  |
| Cathode side cooled | R <sub>i</sub> (°C/kW) | 11.5564 | 8.5810 | 4.7942  | 8.3643  |
|                     | T <sub>i</sub> (s)     | 4.2216  | 6.0269 | 0.0166  | 0.2255  |

$$Z_{th} = \sum_{i=1}^{i=4} [R_i \times (1 - \exp(-T/T_i))]$$

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

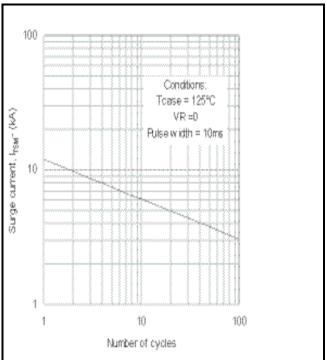
Tables show the increments of thermal resistance  $R_{\text{th(j-c)}}$  when the device operates at conduction angles other than d.c.

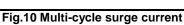
| Double side cooling |                    |       |  |            | Anode Side   | Cooling          |
|---------------------|--------------------|-------|--|------------|--------------|------------------|
|                     | $\Delta Z_{th}(z)$ |       |  |            | $\Delta Z_t$ | <sub>h</sub> (z) |
| θ°                  | sine.              | rect. |  | $\theta$ ° | sine.        | rect.            |
| 180                 | 3.19               | 2.14  |  | 180        | 2.97         | 2.03             |
| 120                 | 3.72               | 3.10  |  | 120        | 3.43         | 2.89             |
| 90                  | 4.29               | 3.64  |  | 90         | 3.92         | 3.36             |
| 60                  | 4.81               | 4.23  |  | 60         | 4.36         | 3.87             |
| 30                  | 5.22               | 4.88  |  | 30         | 4.69         | 4.41             |
| 15                  | 5.40               | 5.22  |  | 15         | 4.84         | 4.70             |

| Ca  | tnoae Sided         | node Sided Cooling |  |  |  |  |
|-----|---------------------|--------------------|--|--|--|--|
|     | $\Delta Z_{th}$ (z) |                    |  |  |  |  |
| θ°  | sine.               | rect.              |  |  |  |  |
| 180 | 2.95                | 2.02               |  |  |  |  |
| 120 | 3.40                | 2.87               |  |  |  |  |
| 90  | 3.88                | 3.34               |  |  |  |  |
| 60  | 4.31                | 3.84               |  |  |  |  |
| 30  | 4.64                | 4.37               |  |  |  |  |
| 15  | 4.79                | 4.65               |  |  |  |  |

Fig.9 Maximum (limit) transient thermal impedance - junction to case (°C/kW)







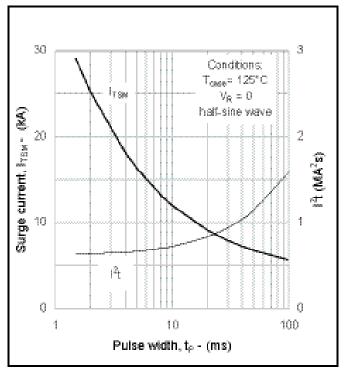


Fig.11 Single-cycle surge current

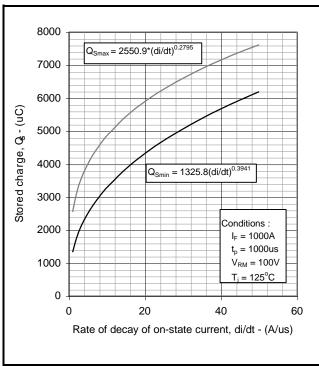


Fig.12 Stored charge

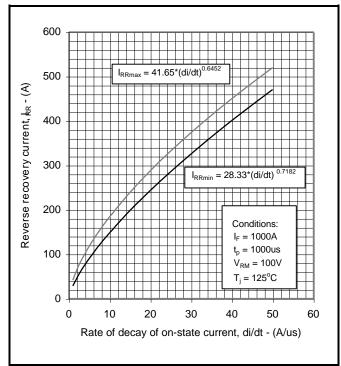


Fig.13 Reverse recovery current



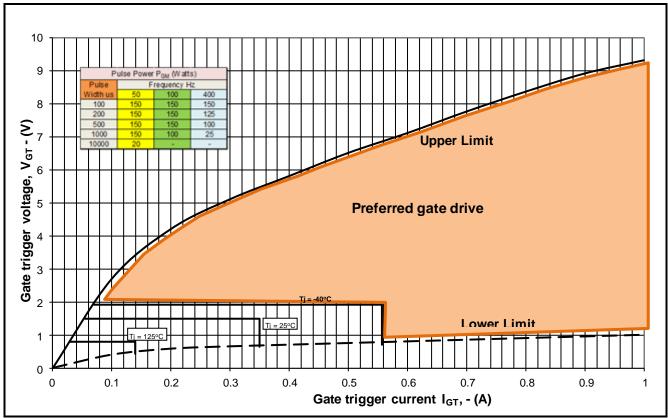


Fig14 Gate Characteristics

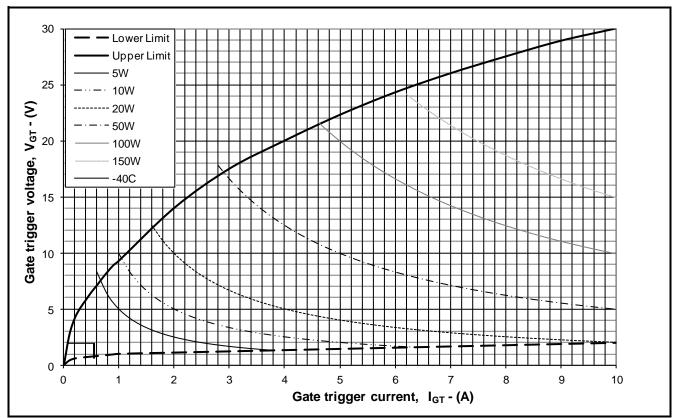


Fig. 15 Gate characteristics

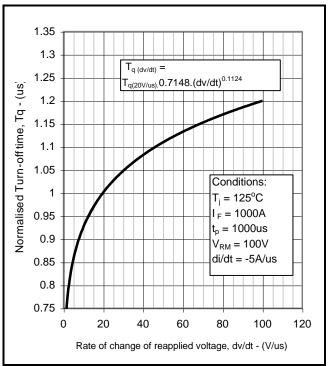


Fig.16 Turn-off time



#### **PACKAGE DETAILS**

For further package information, please contact Customer Services. All dimensions in mm, unless stated otherwise. DO NOT SCALE.

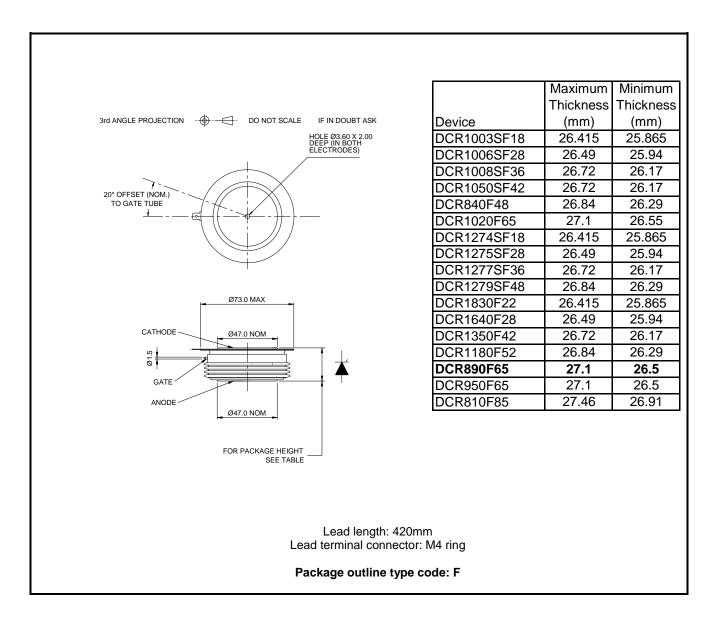


Fig.17 Package outline





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