

### FEATURES

- 10 $\mu$ s Short Circuit Withstand
- High Thermal Cycling Capability
- Non Punch Through Silicon
- Isolated AISiC Base with AlN Substrates
- Lead Free construction

### APPLICATIONS

- High Reliability Inverters
- Motor Controllers
- Traction Drives

The Powerline range of high power modules includes half bridge, chopper, dual, single and bi-directional switch configurations covering voltages from 1200V to 6500V and currents up to 2400A.

The DIM1600FSM12-A000 is a single switch 1200V, n-channel enhancement mode, insulated gate bipolar transistor (IGBT) module. The IGBT has a wide reverse bias safe operating area (RBSOA) plus 10 $\mu$ s short circuit withstand. This device is optimised for traction drives and other applications requiring high thermal cycling capability.

The module incorporates an electrically isolated base plate and low inductance construction enabling circuit designers to optimise circuit layouts and utilise grounded heat sinks for safety.

### ORDERING INFORMATION

Order As:

### DIM1600FSM12-A000

Note: When ordering, please use the complete part number

### KEY PARAMETERS

|                       |       |
|-----------------------|-------|
| $V_{CES}$             | 1200V |
| $V_{CE(sat)}$ * (typ) | 2.2V  |
| $I_C$ (max)           | 1600A |
| $I_{C(PK)}$ (max)     | 3200A |

\* Measured at the power busbars, not the auxiliary terminals

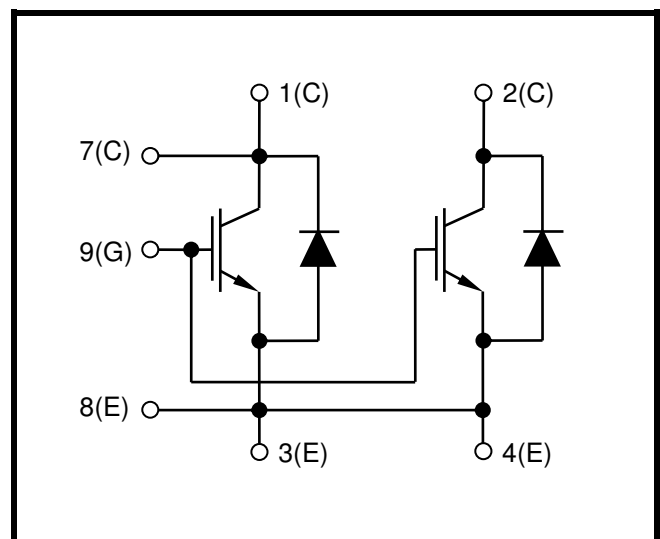
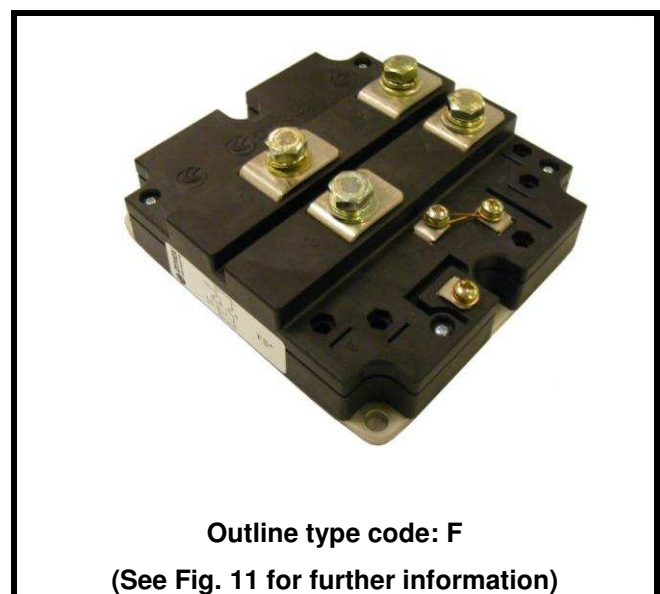


Fig. 1 Circuit configuration



Outline type code: F

(See Fig. 11 for further information)

Fig. 2 Package

## ABSOLUTE MAXIMUM RATINGS

Stresses above those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture of the package. Appropriate safety precautions should always be followed. Exposure to Absolute Maximum Ratings may affect device reliability.

$T_{case} = 25^{\circ}\text{C}$  unless stated otherwise

| Symbol      | Parameter                         | Test Conditions   | Max.     | Units                 |
|-------------|-----------------------------------|---|----------|-----------------------|
| $V_{CES}$   | Collector-emitter voltage         | $V_{GE} = 0V$   | 1200     | V                     |
| $V_{GES}$   | Gate-emitter voltage              |   | $\pm 20$ | V                     |
| $I_C$       | Continuous collector current      | $T_{case} = 85^{\circ}\text{C}$                               | 1600     | A                     |
| $I_{C(PK)}$ | Peak collector current            | 1ms, $T_{case} = 115^{\circ}\text{C}$                         | 3200     | A                     |
| $P_{max}$   | Max. transistor power dissipation | $T_{case} = 25^{\circ}\text{C}$ , $T_j = 150^{\circ}\text{C}$ | 13890    | W                     |
| $I^2t$      | Diode $I^2t$ value                | $V_R = 0$ , $t_p = 10\text{ms}$ , $T_j = 125^{\circ}\text{C}$ | 400      | $\text{kA}^2\text{s}$ |
| $V_{isol}$  | Isolation voltage – per module    | Commoned terminals to base plate.<br>AC RMS, 1 min, 50Hz      | 2500     | V                     |
| $Q_{PD}$    | Partial discharge – per module    | IEC1287, $V_1 = 1300V$ , $V_2 = 1000V$ , 50Hz RMS             | 10       | pC                    |

## THERMAL AND MECHANICAL RATINGS

|                                   |       |
|-----------------------------------|-------|
| Internal insulation material:     | AlN   |
| Baseplate material:               | AlSiC |
| Creepage distance:                | 20mm  |
| Clearance:                        | 10mm  |
| CTI (Comparative Tracking Index): | 350   |

| Symbol        | Parameter   | Test Conditions                               | Min | Typ. | Max | Units                        |
|---------------|---|---|-----|------|-----|------------------------------|
| $R_{th(j-c)}$ | Thermal resistance – transistor                       | Continuous dissipation -<br>junction to case  | -   | -    | 9   | $^{\circ}\text{C}/\text{kW}$ |
| $R_{th(j-c)}$ | Thermal resistance – diode                            | Continuous dissipation -<br>junction to case  | -   | -    | 20  | $^{\circ}\text{C}/\text{kW}$ |
| $R_{th(c-h)}$ | Thermal resistance –<br>case to heatsink (per module) | Mounting torque 5Nm<br>(with mounting grease) | -   | -    | 8   | $^{\circ}\text{C}/\text{kW}$ |
| $T_j$         | Junction temperature                                  | Transistor                                    | -   | -    | 150 | $^{\circ}\text{C}$           |
|               |   | Diode   | -   | -    | 125 | $^{\circ}\text{C}$           |
| $T_{stg}$     | Storage temperature range                             | -   | -40 | -    | 125 | $^{\circ}\text{C}$           |
|               | Screw torque  | Mounting – M6                                 | -   | -    | 5   | Nm                           |
|               |   | Electrical connections – M4                   | -   | -    | 2   | Nm                           |
|               |   | Electrical connections – M8                   | -   | -    | 10  | Nm                           |

**ELECTRICAL CHARACTERISTICS**
**T<sub>case</sub> = 25 °C unless stated otherwise.**

| Symbol                            | Parameter                              | Test Conditions  | Min | Typ  | Max  | Units |
|-----------------------------------|--|--|-----|------|------|-------|
| I <sub>CES</sub>                  | Collector cut-off current              | V <sub>GE</sub> = 0V, V <sub>CE</sub> = V <sub>CES</sub>   |     |      | 2    | mA    |
|                                   |  | V <sub>GE</sub> = 0V, V <sub>CE</sub> = V <sub>CES</sub> , T <sub>case</sub> = 125 °C  |     |      | 50   | mA    |
| I <sub>GES</sub>                  | Gate leakage current                   | V <sub>GE</sub> = ± 20V, V <sub>CE</sub> = 0V  |     |      | 8    | µA    |
| V <sub>GE(TH)</sub>               | Gate threshold voltage                 | I <sub>C</sub> = 80mA, V <sub>GE</sub> = V <sub>CE</sub>   | 4.5 | 5.5  | 6.5  | V     |
| V <sub>CE(sat)</sub> <sup>†</sup> | Collector-emitter saturation voltage   | V <sub>GE</sub> = 15V, I <sub>C</sub> = 1600A  |     | 2.2  | 2.8  | V     |
|                                   |  | V <sub>GE</sub> = 15V, I <sub>C</sub> = 1600A, T <sub>j</sub> = 125 °C   |     | 2.6  | 3.3  | V     |
| I <sub>F</sub>                    | Diode forward current                  | DC   |     |      | 1600 | A     |
| I <sub>FM</sub>                   | Diode maximum forward current          | t <sub>p</sub> = 1ms   |     |      | 3200 | A     |
| V <sub>F</sub> <sup>†</sup>       | Diode forward voltage                  | I <sub>F</sub> = 1600A   |     | 2.1  | 2.4  | V     |
|                                   |  | I <sub>F</sub> = 1600A, T <sub>j</sub> = 125 °C  |     | 2.1  | 2.4  | V     |
| C <sub>ies</sub>                  | Input capacitance                      | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz  |     | 180  |      | nF    |
| Q <sub>g</sub>                    | Gate charge                            | ±15V   |     | 18   |      | µC    |
| C <sub>res</sub>                  | Reverse transfer capacitance           | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz  |     |      |      | nF    |
| L <sub>M</sub>                    | Module inductance                      |  |     | 15   |      | nH    |
| R <sub>INT</sub>                  | Internal transistor resistance         |  |     | 140  |      | µΩ    |
| SC <sub>Data</sub>                | Short circuit current, I <sub>SC</sub> | T <sub>j</sub> = 125 °C, V <sub>CC</sub> = 900V<br>t <sub>p</sub> ≤ 10µs, V <sub>GE</sub> ≤ 15V<br>V <sub>CE(max)</sub> = V <sub>CES</sub> - L* x dl/dt<br>IEC 60747-9 |     | 9000 |      | A     |

**Note:**
<sup>†</sup> Measured at the power busbars, not the auxiliary terminals

<sup>\*</sup> L is the circuit inductance + L<sub>M</sub>

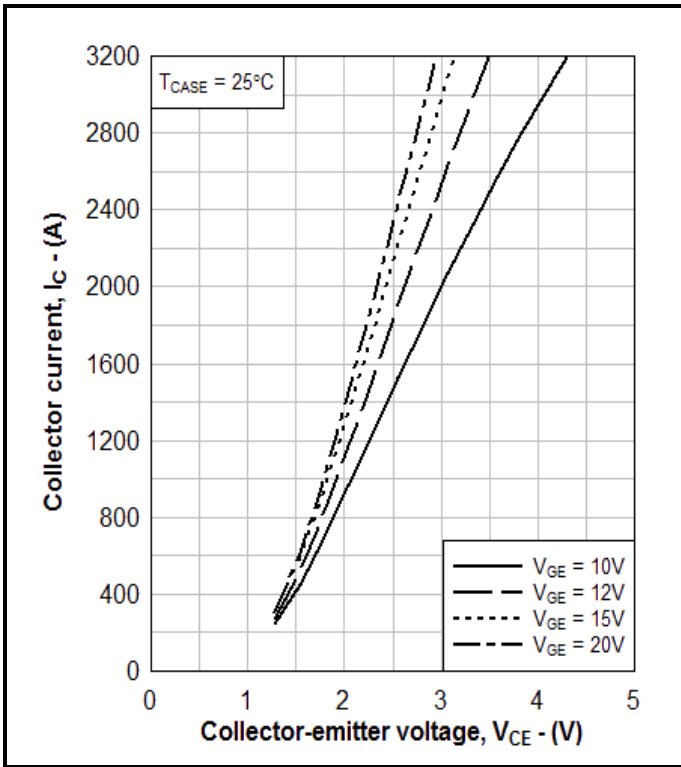
## ELECTRICAL CHARACTERISTICS

$T_{case} = 25^{\circ}C$  unless stated otherwise

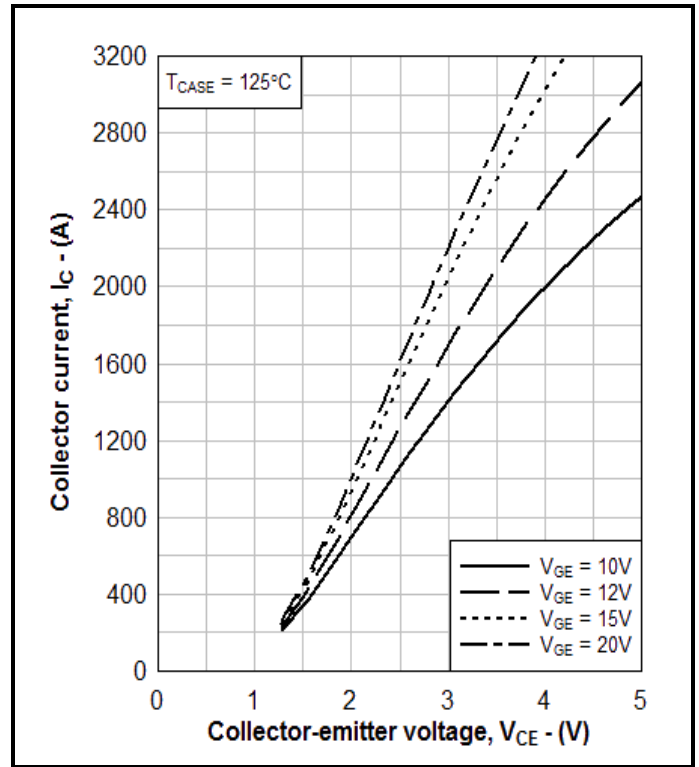
| Symbol       | Parameter                      | Test Conditions   | Min   | Typ. | Max | Units |         |
|--------------|--------------------------------|---|---|------|-----|-------|---------|
| $t_{d(off)}$ | Turn-off delay time            | $I_C = 1600A$<br>$V_{GE} = \pm 15V$<br>$V_{CE} = 600V$<br>$R_{G(ON)} = 1.5\Omega$<br>$R_{G(OFF)} = 1.5\Omega$<br>$L_S \sim 100nH$ |   | 1250 |     | ns    |         |
| $t_f$        | Fall time                      |   |   | 180  |     | ns    |         |
| $E_{OFF}$    | Turn-off energy loss           |   |   |      | 300 |       | mJ      |
| $t_{d(on)}$  | Turn-on delay time             |   |   |      | 250 |       | ns      |
| $t_r$        | Rise time                      |   |   |      | 200 |       | ns      |
| $E_{ON}$     | Turn-on energy loss            |   |   |      | 80  |       | mJ      |
| $Q_{rr}$     | Diode reverse recovery charge  |   | $I_F = 1600A$<br>$V_{CE} = 600V$<br>$di_F/dt = 8200A/\mu s$ |      | 150 |       | $\mu C$ |
| $I_{rr}$     | Diode reverse recovery current |   |   | 750  |     | A     |         |
| $E_{rec}$    | Diode reverse recovery energy  |   |   |      | 90  |       | mJ      |

$T_{case} = 125^{\circ}C$  unless stated otherwise

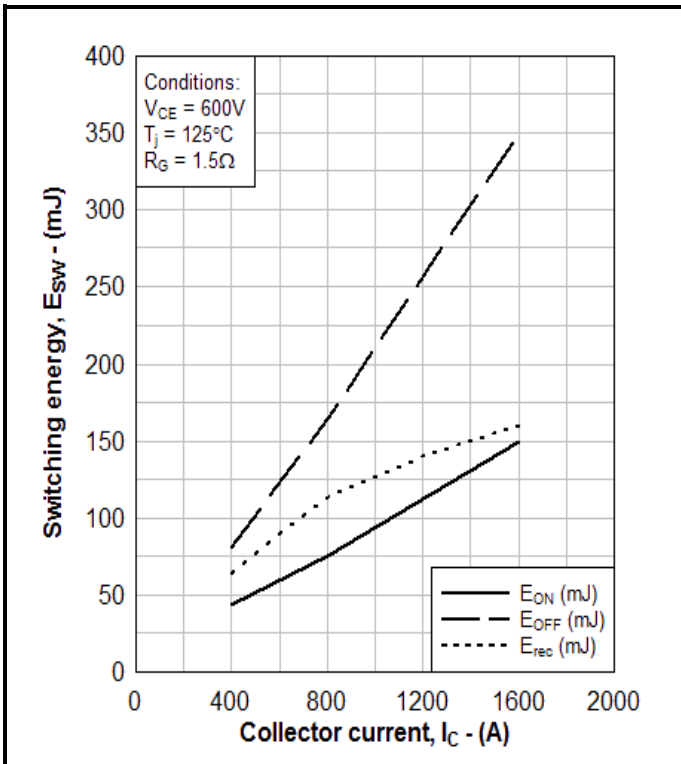
| Symbol       | Parameter                      | Test Conditions   | Min   | Typ. | Max | Units |         |
|--------------|--------------------------------|---|---|------|-----|-------|---------|
| $t_{d(off)}$ | Turn-off delay time            | $I_C = 1600A$<br>$V_{GE} = \pm 15V$<br>$V_{CE} = 600V$<br>$R_{G(ON)} = 1.5\Omega$<br>$R_{G(OFF)} = 1.5\Omega$<br>$L_S \sim 100nH$ |   | 1500 |     | ns    |         |
| $t_f$        | Fall time                      |   |   |      | 200 |       | ns      |
| $E_{OFF}$    | Turn-off energy loss           |   |   |      | 350 |       | mJ      |
| $t_{d(on)}$  | Turn-on delay time             |   |   |      | 350 |       | ns      |
| $t_r$        | Rise time                      |   |   |      | 220 |       | ns      |
| $E_{ON}$     | Turn-on energy loss            |   |   |      | 150 |       | mJ      |
| $Q_{rr}$     | Diode reverse recovery charge  |   | $I_F = 1600A$<br>$V_{CE} = 600V$<br>$di_F/dt = 7500A/\mu s$ |      | 350 |       | $\mu C$ |
| $I_{rr}$     | Diode reverse recovery current |   |   |      | 900 |       | A       |
| $E_{rec}$    | Diode reverse recovery energy  |   |   |      | 160 |       | mJ      |



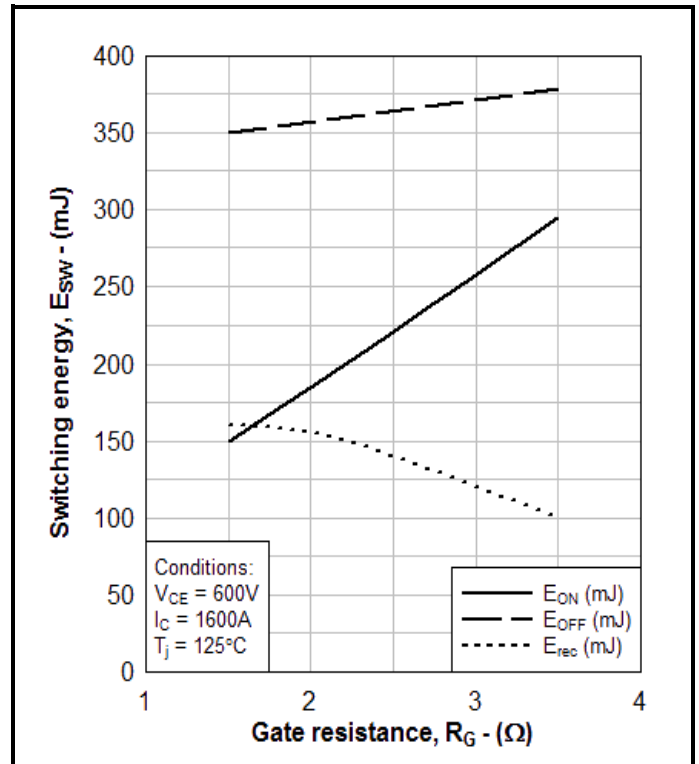
**Fig. 3 Typical output characteristics**



**Fig. 4 Typical output characteristics**



**Fig. 5 Typical switching energy vs collector current**



**Fig. 6 Typical switching energy vs gate resistance**

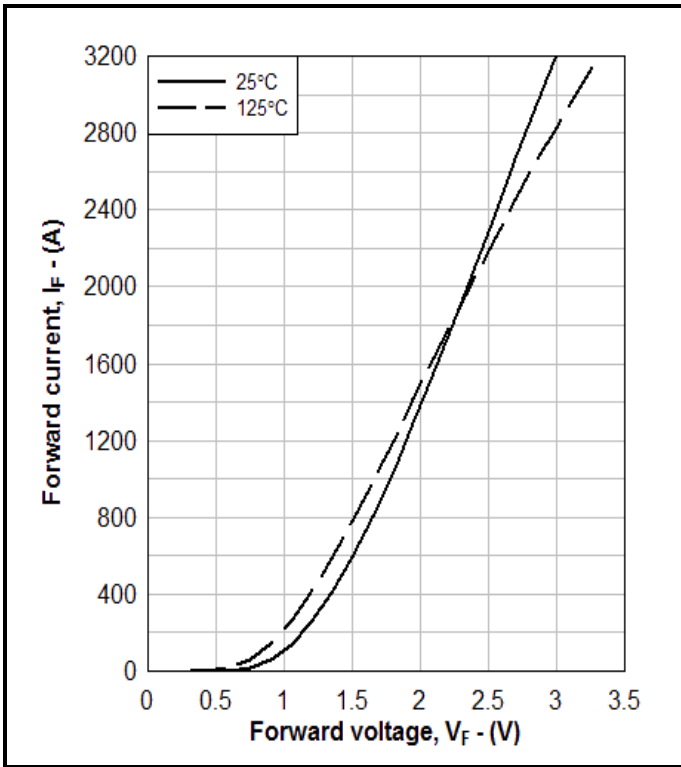


Fig. 7 Diode typical forward characteristics

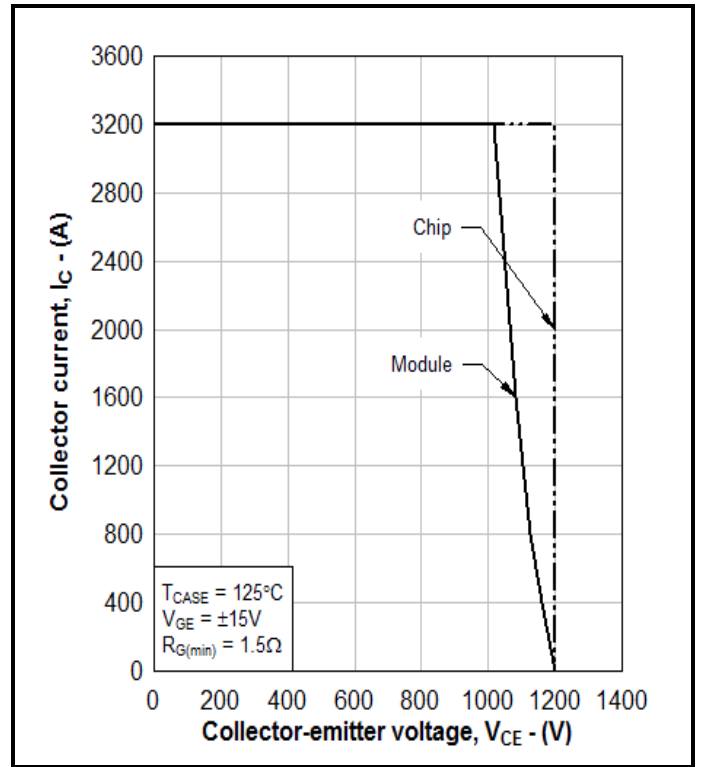


Fig. 8 Reverse bias safe operating area

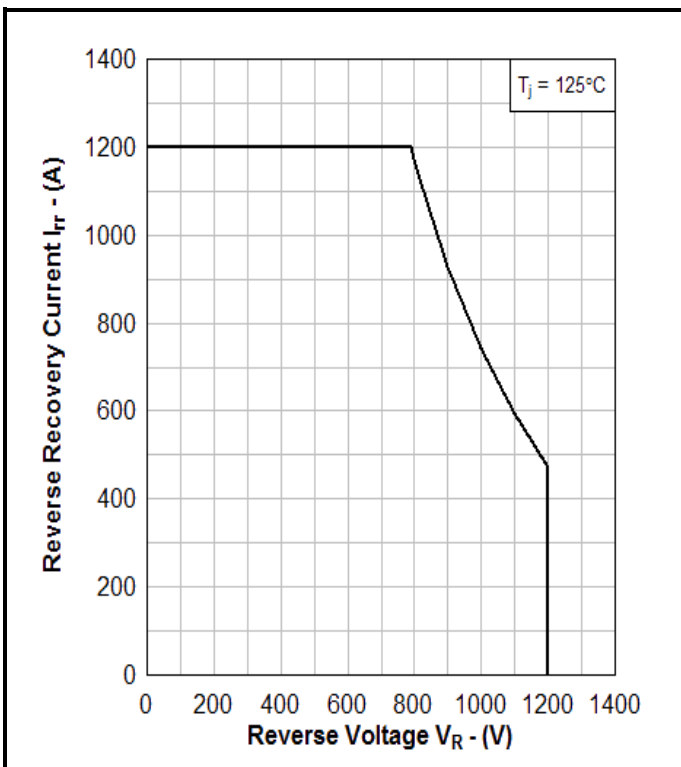


Fig. 9 Diode reverse bias safe operating area

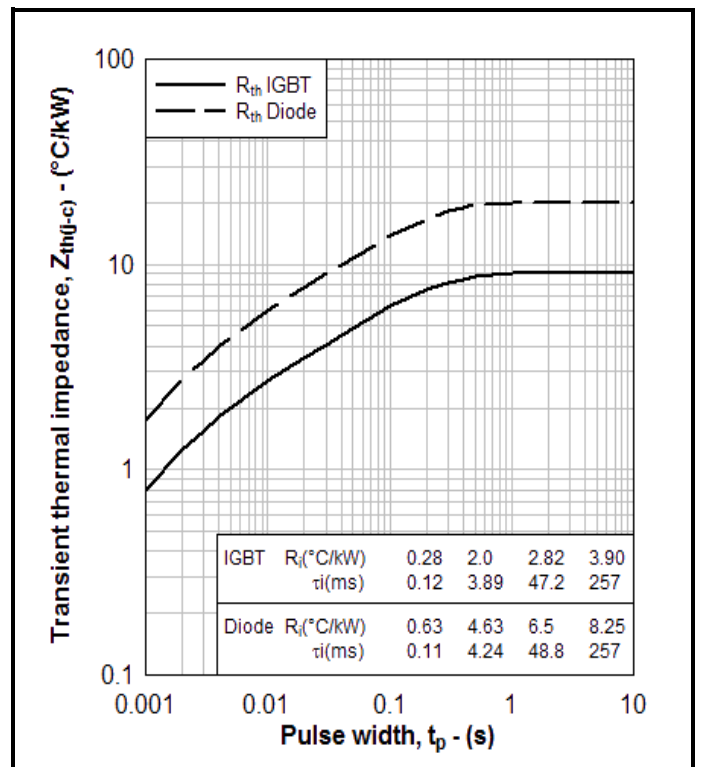
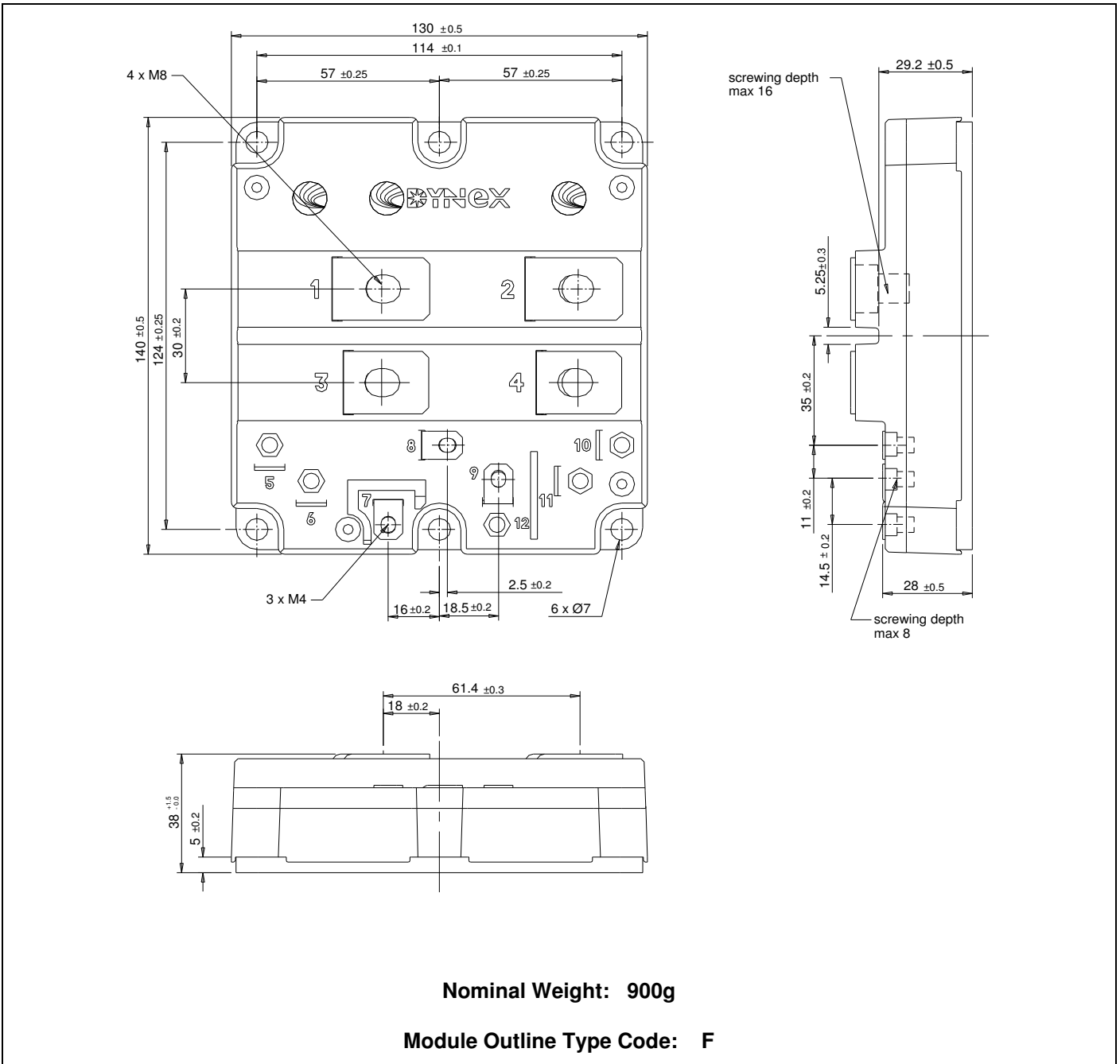


Fig. 10 Transient thermal impedance

**PACKAGE DETAILS**

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



**Nominal Weight: 900g**

**Module Outline Type Code: F**

**Fig. 11 Module outline drawing**

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Extended exposure to conditions outside the product ratings may affect reliability leading to premature product failure. Use outside the product ratings is likely to cause permanent damage to the product. In extreme conditions, as with all semiconductors, this may include potentially hazardous rupture, a large current to flow or high voltage arcing, resulting in fire or explosion. Appropriate application design and safety precautions should always be followed to protect persons and property.

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|                                 |   |
|---------------------------------|---|
| <b>Target Information:</b>      | This is the most tentative form of information and represents a very preliminary specification. No actual design work on the product has been started.  |
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