



# DIM2400ESM17-A000

## Single Switch IGBT Module

Replaces May 2001, version 5447-2.0

DS5447-3.0 March 2002

### FEATURES

- 10μs Short Circuit Withstand
- High Thermal Cycling Capability
- Non Punch Through Silicon
- Isolated MMC Base with AlN Substrates

### APPLICATIONS

- High Reliability Inverters
- Motor Controllers
- Traction Drives

The Powerline range of modules includes half bridge, dual and single switch configurations covering voltages from 600V to 3300V and currents up to 2400A.

The DIM2400ESM17-A000 is a single switch 1700V, n channel enhancement mode, insulated gate bipolar transistor (IGBT) module. The IGBT has a wide reverse bias safe operating area (RBSOA) plus full 10μs short circuit withstand. This module 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:

**DIM2400ESM17-A000**

Note: When ordering, please use the whole part number.

### KEY PARAMETERS

|                 |       |              |
|-----------------|-------|--------------|
| $V_{CES}$       |       | <b>1700V</b> |
| $V_{CE(sat)}$ * | (typ) | <b>2.7V</b>  |
| $I_C$           | (max) | <b>2400A</b> |
| $I_{C(PK)}$     | (max) | <b>4800A</b> |

\*(measured at the power busbars and not the auxiliary terminals)

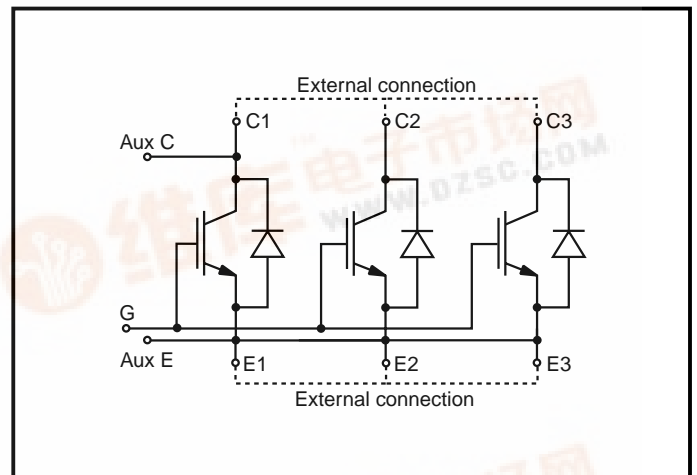


Fig. 1 Single switch circuit diagram

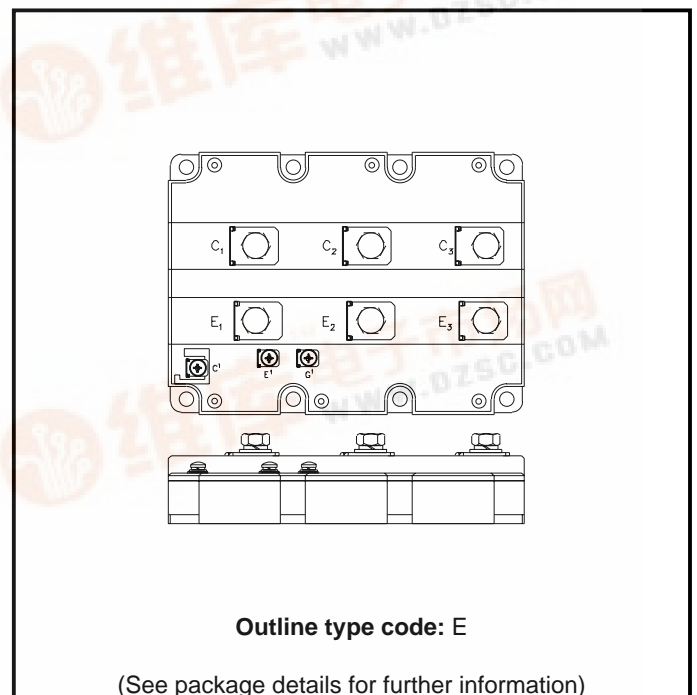


Fig. 2 Electrical connections - (not to scale)

## 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.

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

| Symbol             | Parameter                         | Test Conditions   | Max.     | Units                 |
|--------------------|-----------------------------------|---|----------|-----------------------|
| $V_{\text{CES}}$   | Collector-emitter voltage         | $V_{\text{GE}} = 0\text{V}$   | 1700     | V                     |
| $V_{\text{GES}}$   | Gate-emitter voltage              | -   | $\pm 20$ | V                     |
| $I_{\text{C}}$     | Continuous collector current      | $T_{\text{case}} = 75^{\circ}\text{C}$  | 2400     | A                     |
| $I_{\text{C(PK)}}$ | Peak collector current            | 1ms, $T_{\text{case}} = 105^{\circ}\text{C}$  | 4800     | A                     |
| $P_{\text{max}}$   | Max. transistor power dissipation | $T_{\text{case}} = 25^{\circ}\text{C}$ , $T_{\text{j}} = 150^{\circ}\text{C}$             | 20.8     | kW                    |
| $I^2t$             | Diode $I^2t$ value (IGBT arm)     | $V_{\text{R}} = 0$ , $t_{\text{p}} = 10\text{ms}$ , $T_{\text{vj}} = 125^{\circ}\text{C}$ | 1080     | $\text{kA}^2\text{s}$ |
| $V_{\text{isol}}$  | Isolation voltage - per module    | Commoned terminals to base plate. AC RMS, 1 min, 50Hz                                     | 4000     | V                     |
| $Q_{\text{PD}}$    | Partial discharge - per module    | IEC1287. $V_1 = 1500\text{V}$ , $V_2 = 1100\text{V}$ , 50Hz RMS                           | 10       | PC                    |

## THERMAL AND MECHANICAL RATINGS

Internal insulation material: AlN  
 Baseplate material: AlSiC  
 Creepage distance: 32mm  
 Clearance: 20mm  
 CTI (Critical Tracking Index): 175

| Symbol        | Parameter   | Test Conditions                               | Min. | Typ. | Max. | Units |
|---------------|---|---|------|------|------|-------|
| $R_{th(j-c)}$ | Thermal resistance - transistor                       | Continuous dissipation -<br>junction to case  | -    | -    | 6    | °C/kW |
| $R_{th(j-c)}$ | Thermal resistance - diode                            | Continuous dissipation -<br>junction to case  | -    | -    | 13.3 | °C/kW |
| $R_{th(c-h)}$ | Thermal resistance - case to heatsink<br>(per module) | Mounting torque 5Nm<br>(with mounting grease) | -    | -    | 6    | °C/kW |
| $T_j$         | Junction temperature                                  | Transistor                                    | -    | -    | 150  | °C    |
|               |   | Diode   | -    | -    | 125  | °C    |
| $T_{stg}$     | Storage temperature range                             | -   | -40  | -    | 125  | °C    |
| -             | Screw torque  | Mounting - M6                                 | -    | -    | 5    | Nm    |
|               |   | Electrical connections - M4                   | -    | -    | 2    | Nm    |
|               |   | Electrical connections - M8                   | -    | -    | 10   | Nm    |

## ELECTRICAL CHARACTERISTICS

$T_{case} = 25^{\circ}\text{C}$  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>                             |                | -    | -     | 3    | mA    |
|                                   |                                      | V <sub>GE</sub> = 0V, V <sub>CE</sub> = V <sub>CES</sub> , T <sub>case</sub> = 125°C |                | -    | -     | 75   | mA    |
| I <sub>GES</sub>                  | Gate leakage current                 | V <sub>GE</sub> = ±20V, V <sub>CE</sub> = 0V   |                | -    | -     | 12   | μA    |
| V <sub>GE(TH)</sub>               | Gate threshold voltage               | I <sub>C</sub> =120mA, 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> = 2400A  |                | -    | 2.7   | 3.2  | V     |
|                                   |                                      | V <sub>GE</sub> = 15V, I <sub>C</sub> = 2400A, , T <sub>case</sub> = 125°C           |                | -    | 3.4   | 4.0  | V     |
| I <sub>F</sub>                    | Diode forward current                | DC   |                | -    | -     | 2400 | A     |
| I <sub>FM</sub>                   | Diode maximum forward current        | t <sub>p</sub> = 1ms   |                | -    | -     | 4800 | A     |
| V <sub>F</sub> <sup>†</sup>       | Diode forward voltage                | I <sub>F</sub> = 2400A   |                | -    | 2.2   | 2.5  | V     |
|                                   |                                      | I <sub>F</sub> = 2400A, T <sub>case</sub> = 125°C                                    |                | -    | 2.3   | 2.6  | V     |
| C <sub>ies</sub>                  | Input capacitance                    | V <sub>CE</sub> = 25V, V <sub>GE</sub> = 0V, f = 1MHz                                |                | -    | 180   | -    | nF    |
| L <sub>M</sub>                    | Module inductance                    | -  |                | -    | 10    | -    | nH    |
| R <sub>INT</sub>                  | Internal transistor resistance       | -  |                | -    | 0.27  | -    | mΩ    |
| SC <sub>Data</sub>                | Short circuit. I <sub>SC</sub>       | T <sub>j</sub> = 125°C, V <sub>CC</sub> = 1000V,                                     | I <sub>1</sub> | -    | 11000 | -    | A     |
|                                   |                                      | t <sub>p</sub> ≤ 10μs, V <sub>CE(max)</sub> = V <sub>CES</sub> - L*. di/dt           | I <sub>2</sub> | -    | 9600  | -    | A     |
|                                   |                                      | IEC 60747-9  |                |      |       |      |       |

**Note:**

$\dagger$  Measured at the power busbars and not the auxiliary terminals)

\* L is the circuit inductance +  $L_M$

## ELECTRICAL CHARACTERISTICS

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

| Symbol       | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Units         |
|--------------|-------------------------------|---|------|------|------|---------------|
| $t_{d(off)}$ | Turn-off delay time           | $I_C = 2400\text{A}$<br>$V_{GE} = \pm 15\text{V}$<br>$V_{CE} = 900\text{V}$<br>$R_{G(ON)} = R_{G(OFF)} = 1.0\Omega$<br>$L \sim 50\text{nH}$ | -    | 2000 | -    | ns            |
| $t_f$        | Fall time                     |   | -    | 200  | -    | ns            |
| $E_{OFF}$    | Turn-off energy loss          |   | -    | 900  | -    | mJ            |
| $t_{d(on)}$  | Turn-on delay time            |   | -    | 800  | -    | ns            |
| $t_r$        | Rise time                     |   | -    | 300  | -    | ns            |
| $E_O$        | Turn-on energy loss           |   | -    | 475  | -    | mJ            |
| $Q_g$        | Gate charge                   |   | -    | 27   | -    | $\mu\text{C}$ |
| $Q_{rr}$     | Diode reverse recovery charge | $I_F = 2400\text{A}, V_R = 50\% V_{CES},$<br>$dI_F/dt = 8500\text{A}/\mu\text{s}$   | -    | 450  | -    | $\mu\text{C}$ |
| $I_{rr}$     | Diode reverse current         |   | -    | 1200 | -    | A             |
| $E_{REC}$    | Diode reverse recovery energy |   |      | 300  |      | mJ            |

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

| Symbol       | Parameter                     | Test Conditions   | Min. | Typ. | Max. | Units         |
|--------------|-------------------------------|---|------|------|------|---------------|
| $t_{d(off)}$ | Turn-off delay time           | $I_C = 2400\text{A}$<br>$V_{GE} = \pm 15\text{V}$<br>$V_{CE} = 900\text{V}$<br>$R_{G(ON)} = R_{G(OFF)} = 1.0\Omega$<br>$L \sim 50\text{nH}$ | -    | 2300 | -    | ns            |
| $t_f$        | Fall time                     |   | -    | 250  | -    | ns            |
| $E_{OFF}$    | Turn-off energy loss          |   | -    | 1200 | -    | mJ            |
| $t_{d(on)}$  | Turn-on delay time            |   | -    | 900  | -    | ns            |
| $t_r$        | Rise time                     |   | -    | 300  | -    | ns            |
| $E_{ON}$     | Turn-on energy loss           |   | -    | 750  | -    | mJ            |
| $Q_{rr}$     | Diode reverse recovery charge | $I_F = 2400\text{A}, V_R = 50\% V_{CES},$<br>$dI_F/dt = 8000\text{A}/\mu\text{s}$   | -    | 750  | -    | $\mu\text{C}$ |
| $I_{rr}$     | Diode reverse current         |   | -    | 1400 | -    | A             |
| $E_{REC}$    | Diode reverse recovery energy |   | -    | 600  | -    | mJ            |

TYPICAL CHARACTERISTICS

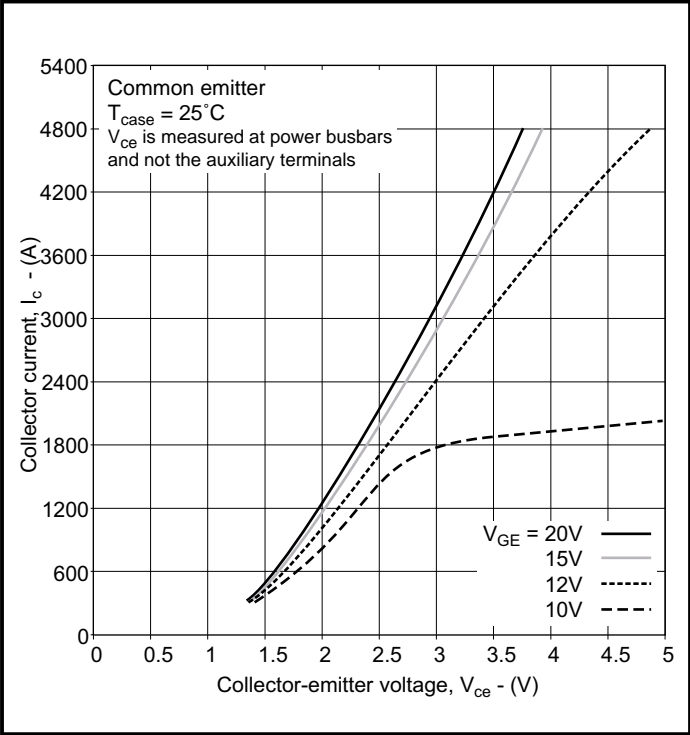


Fig. 3 Typical output characteristics

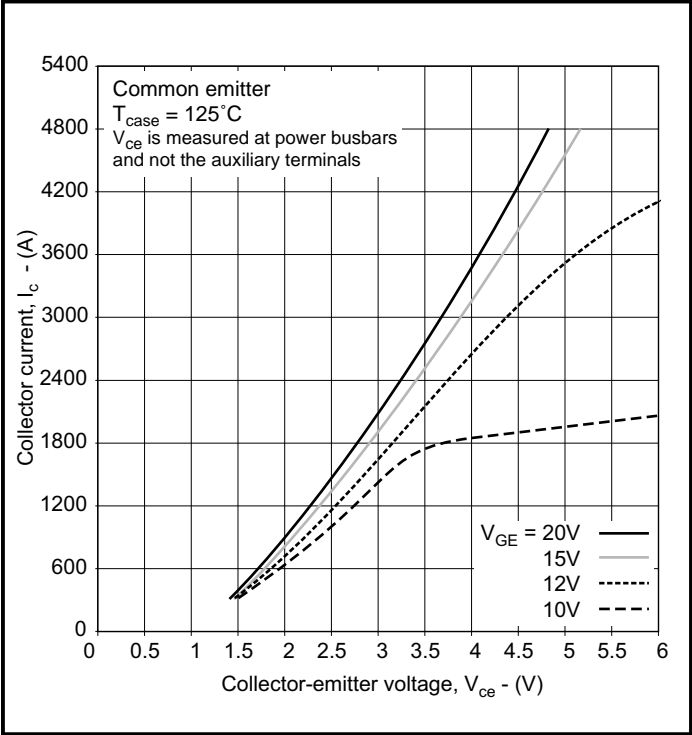


Fig. 4 Typical output characteristics

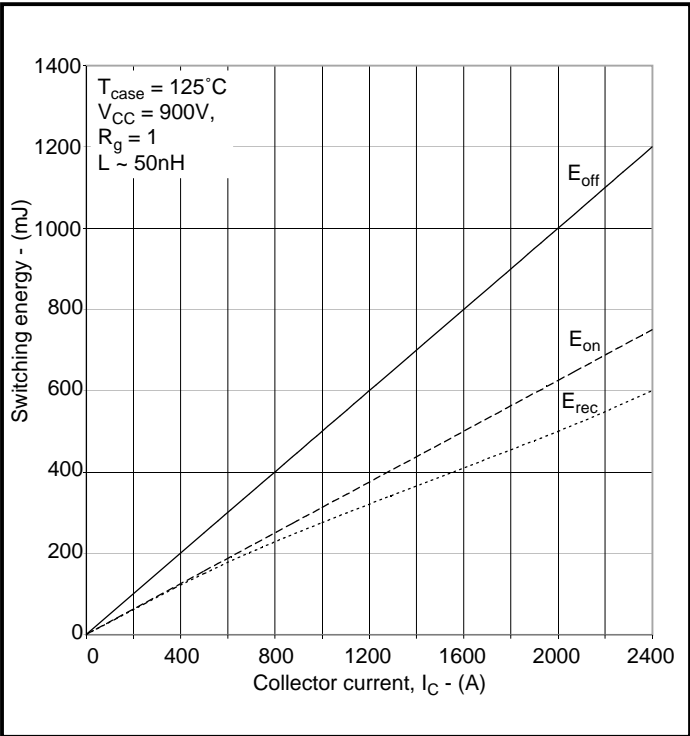


Fig. 5 Typical switching energy vs collector current

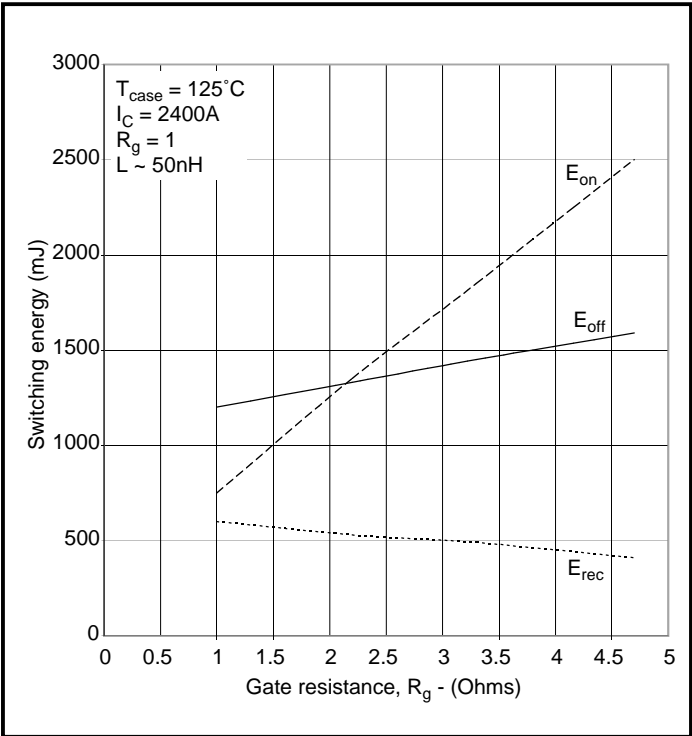
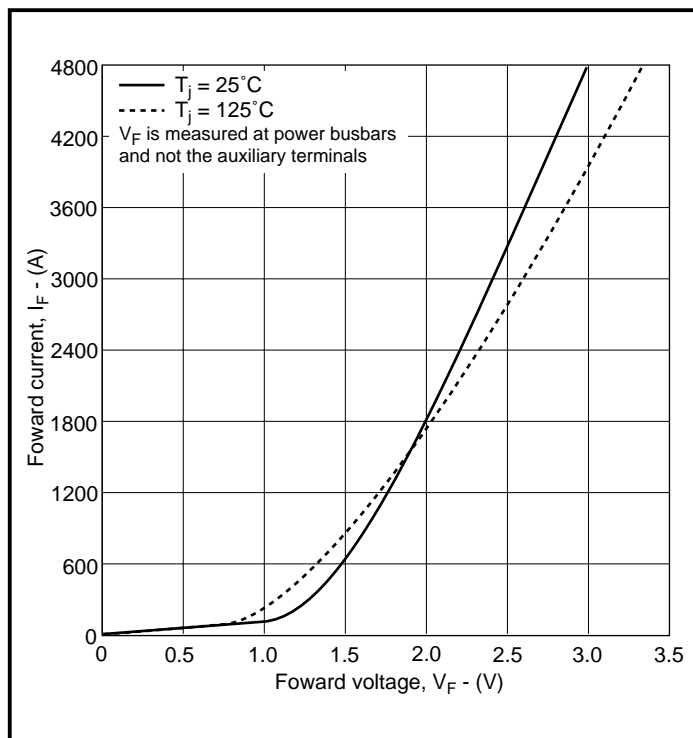
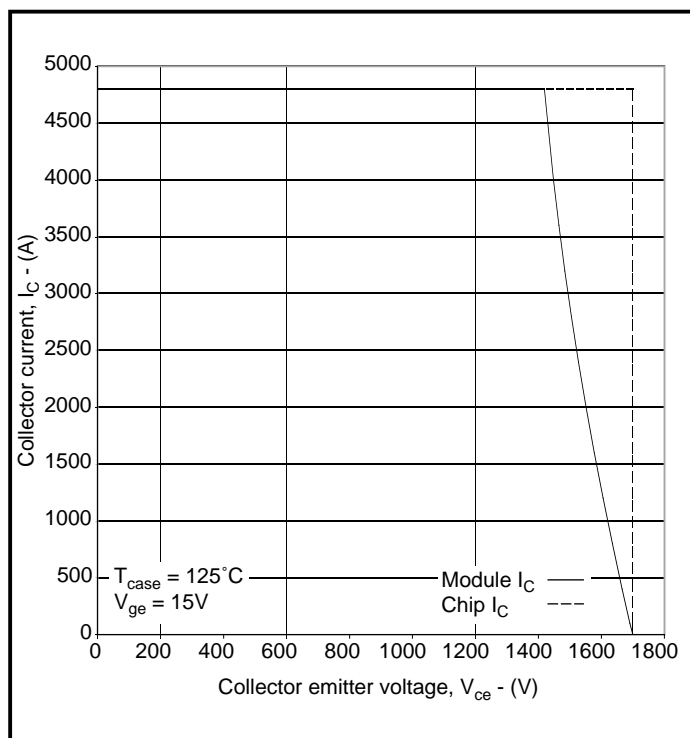
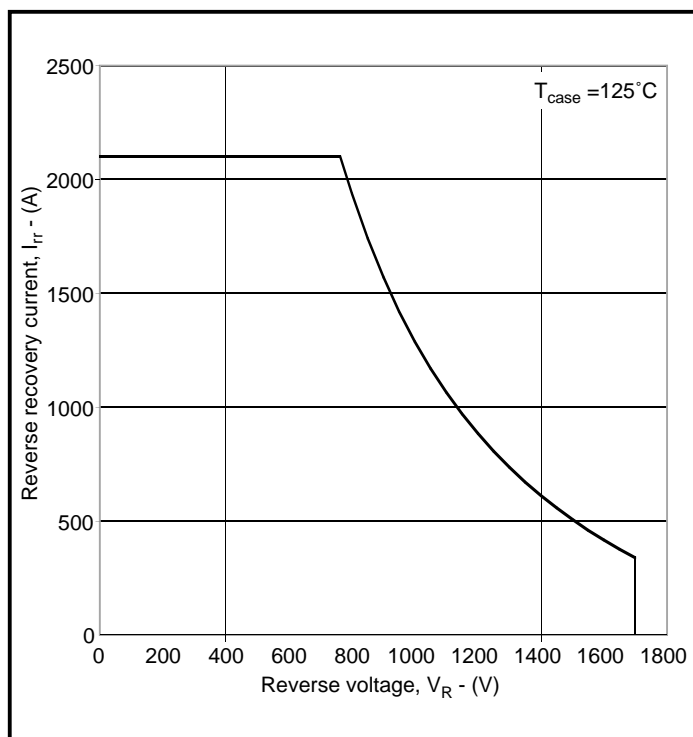
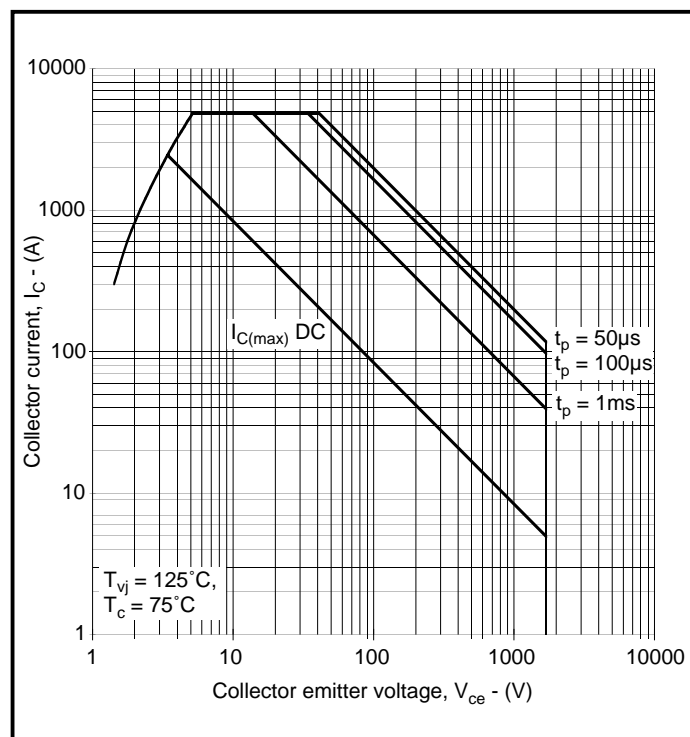


Fig. 6 Typical switching energy vs gate resistance


**Fig. 7 Diode typical forward characteristics**

**Fig. 8 Reverse bias safe operating area**

**Fig. 9 Diode reverse bias safe operating area**

**Fig. 10 Forward bias safe operating area**

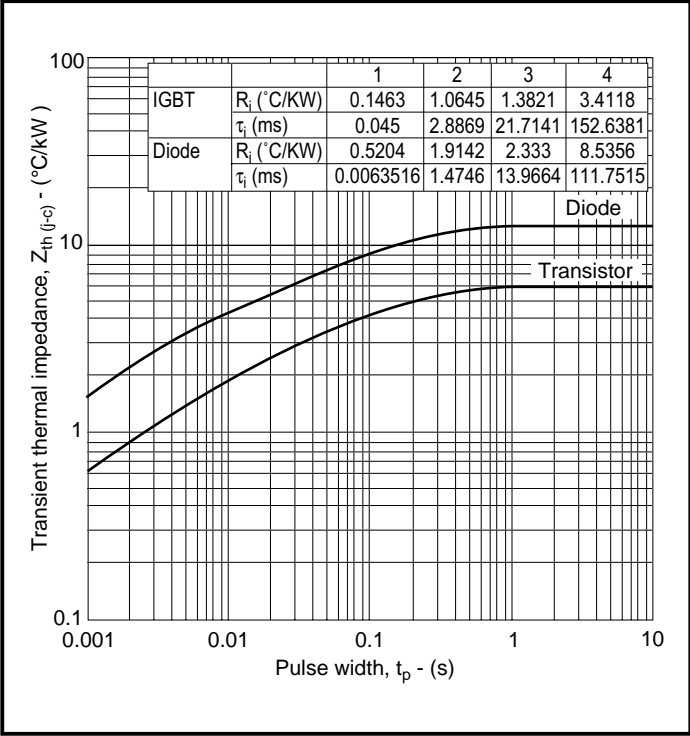


Fig. 11 Transient thermal impedance

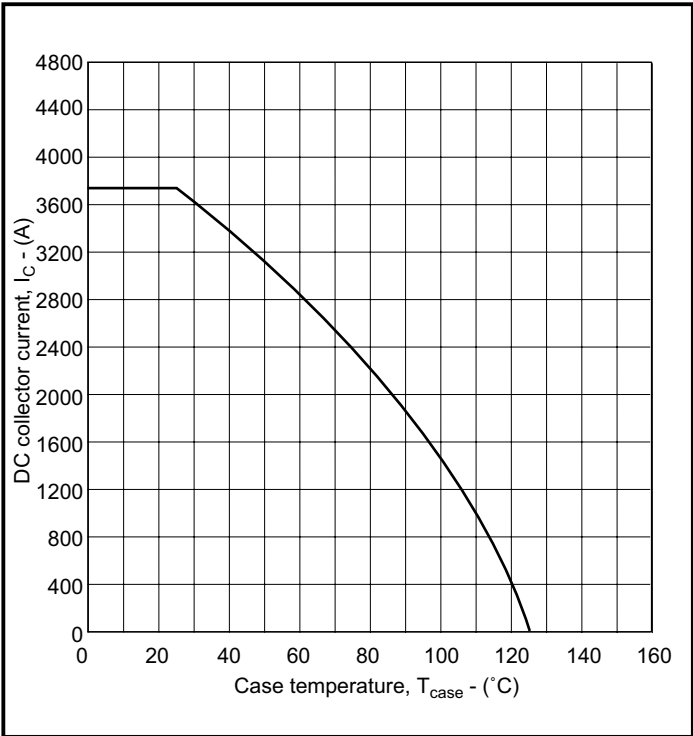
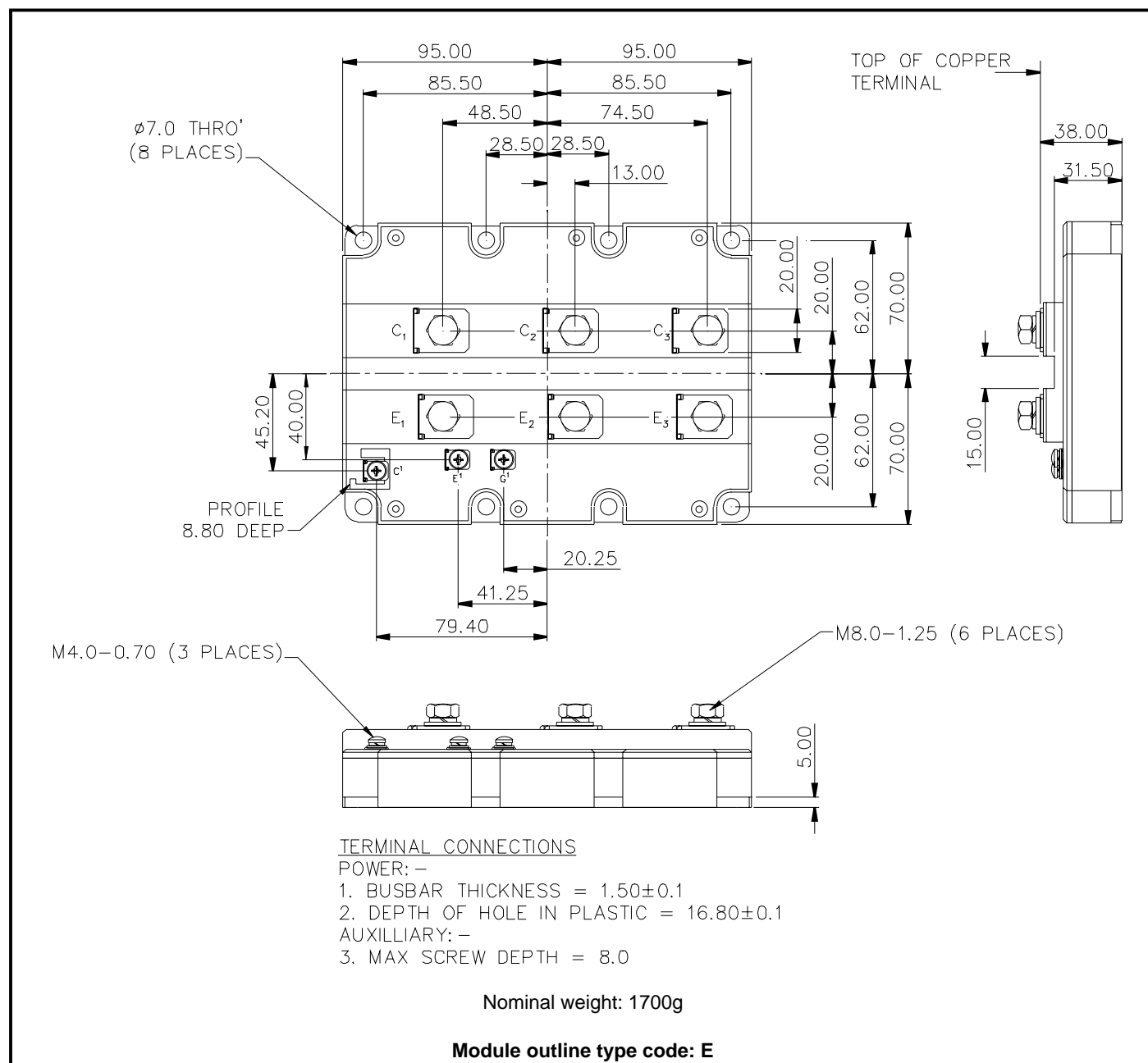


Fig. 12 DC current rating vs case temperature



## PACKAGE DETAILS

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



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The Power Assembly group was set up to provide a support service for those customers requiring more than the basic semiconductor, and has developed a flexible range of heatsink and clamping systems in line with advances in device voltages and current capability of our semiconductors.

We offer an extensive range of air and liquid cooled assemblies covering the full range of circuit designs in general use today. The Assembly group continues to offer high quality engineering support dedicated to designing new units to satisfy the growing needs of our customers.

Using the latest CAD methods our team of design and applications engineers aim to provide the Power Assembly Complete Solution (PACs).

## HEATSINKS

The Power Assembly group has its own proprietary range of extruded aluminium heatsinks. They have been designed to optimise the performance of Dynex semiconductors. Data with respect to air natural, forced air and liquid cooling (with flow rates) is available on request.

For further information on device clamps, heatsinks and assemblies, please contact your nearest sales representative or customer service office.



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