DIM200PKM33-F000

# IGBT Chopper Module

DS5465- 1.0 September 2005 (LN24183)

## FEATURES

- 10µs Short Circuit Withstand
- Soft Punch Through Silicon
- Isolated AlSiC Base with AlN substrates
- High thermal cycling capability

## APPLICATIONS

- Choppers
- Motor Controllers
- Power Supplies
- Traction Auxiliaries

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

The DIM200PKM33-F000 is a 3300V, n channel enhancement mode, insulated gate bipolar transistor (IGBT) chopper module configured with the upper arm of the bridge controlled. The IGBT has a wide reverse bias safe operating area (RBSOA) plus full 10µs 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:

**DIM200PKM33-F000**

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

## KEY PARAMETERS

| | | |
|---|---|---|
| $V_{CES}$ | | **3300V** |
| $V_{CE\ (sat)}$ * | **(typ)** | **2.8V** |
| $I_C$ | **(max)** | **200A** |
| $I_{C(PK)}$ | **(max)** | **400A** |

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

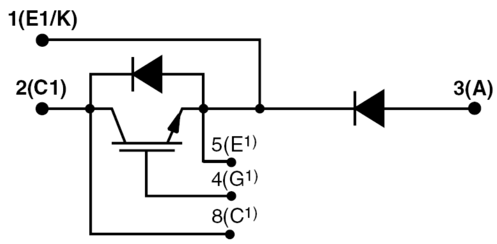



**Fig. 1 Chopper circuit diagram**

**Outline type code: P**

**(See package details for further information)**

Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures.

**Fig. 2 Electrical connections (not to scale)**

## ABSOLUTE MAXIMUM RATINGS - PER ARM

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.

**Tcase = 25°C unless stated otherwise**

| Symbol | Parameter | Test Conditions | Max. | Units |
|---|---|---|---|---|
| $V_{CES}$ | Collector-emitter voltage | $V_{GE}$ = 0V | 3300 | V |
| $V_{GES}$ | Gate-emitter voltage | | ±20 | V |
| $I_C$ | Continuous collector current | $T_{case}$ = 90°C | 200 | A |
| $I_{C(PK)}$ | Peak collector current | 1ms, $T_{case}$ =115°C | 400 | A |
| $P_{max}$ | Max. transistor power dissipation | $T_{case}$ = 25°C, $T_j$ = 150°C | 2.6 | W |
| $I^2t$ | Diode $I^2t$ value (IGBT arm) | $V_R$ = 0, $t_P$ = 10ms, $T_{vj}$ = 125°C | 20 | $kA^2S$ |
| | Diode $I^2t$ value (Diode arm) | | 20 | |
| $V_{isol}$ | Isolation voltage – per module | Commoned terminals to base plate. AC RMS, 1 min, 50Hz | 6000 | V |
| $Q_{PD}$ | Partial discharge - per module | IEC1287. $V_1$ = 3500V, $V_2$ = 2600V, 50Hz RMS | 10 | pC |

## THERMAL AND MECHANICAL RATINGS

Internal insulation material: AIN
Baseplate material: AlSiC
Creepage distance: 33mm
Clearance: 20mm
CTI (Critical Tracking Index): 175

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $R_{th(j-c)}$ | Thermal resistance - transistor | Continuous dissipation – junction to case | - | - | 48 | °C/kW |
| $R_{th(j-c)}$ | Thermal resistance – diode (IGBT arm)<br>Thermal resistance- diode ( Diode arm) | Continuous dissipation – junction to case | - | - | 96<br>96 | °C/kW<br>°C/kW |
| $R_{th(c-h)}$ | Thermal resistance – case to heatsink (per module) | Mounting torque 5Nm (with mounting grease) | - | - | 16 | °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 – M5 | - | - | 4 | Nm |

## ELECTRICAL CHARACTERISTICS

**$T_{case}$ = 25°C unless stated otherwise.**

| Symbol | Parameter | Test Conditions | | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|---|
| $I_{ces}$ | Collector cut-off current | $V_{GE}$ = 0V, $V_{CE}$ = $V_{CES}$ | | - | - | 1 | mA |
| | | $V_{GE}$ = 0V, $V_{CE}$ = $V_{CES}$, $T_{case}$ = 125°C | | - | - | 15 | mA |
| $I_{ces}$ | Gate leakage current | $V_{GE}$ = ±20V, $V_{CE}$ = 0V | | - | - | 1 | µA |
| $V_{GE(TH)}$ | Gate threshold voltage | $I_C$ = 40mA, $V_{GE}$ = $V_{CE}$ | | 5.5 | 6.5 | 7.0 | V |
| $V_{CE(sat)}$† | Collector-emitter saturation voltage | $V_{GE}$ = 15V, $I_C$ = 200A | | - | 2.8 | - | V |
| | | $V_{GE}$ = 15V, $I_C$ = 200A, $T_{case}$ = 125°C | | - | 3.6 | - | V |
| $I_F$ | Diode forward current | DC | | - | - | 200 | A |
| $I_{FM}$ | Diode maximum forward current | $t_p$ = 1ms | | - | - | 400 | A |
| $V_F$† | Diode forward voltage (IGBT arm)<br>Diode forward voltage (Diode arm) | $I_F$ = 200A | | - | 2.9<br>2.9 | -<br>- | V |
| | Diode forward voltage (IGBT arm)<br>Diode forward voltage (Diode arm) | $I_F$ = 200A, $T_{case}$ = 125°C | | - | 3.0<br>3.0 | -<br>- | V |
| $C_{ies}$ | Input capacitance | $V_{CE}$ = 25V, $V_{GE}$ = 0V, f = 1MHz | | - | 36 | - | nF |
| $L_M$ | Module inductance – per arm | - | | - | 40 | - | nH |
| $R_{INT}$ | Internal resistance – per arm | - | | - | 0.5 | - | mΩ |
| $SC_{Data}$ | Short circuit. $I_{sc}$ | $T_j$ = 125°C, $V_{cc}$ = 2500V,<br>$t_p$ ≤ 10µs,<br>$V_{CE(max)}$ = $V_{CES}$ - L*×di/dt<br>IEC 60747-9 | $I_1$ | - | 1000 | - | A |
| | | | $I_2$ | - | 930 | - | A |

**Note:**
† Measured at the power busbars and not the auxiliary terminals
* L is the circuit inductance + $L_M$

## ELECTRICAL CHARACTERISTICS

**$T_{case}$ = 25°C unless stated otherwise.**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $t_{d(off)}$ | Turn-off delay time | $I_C$ = 200A | - | 1950 | - | ns |
| $t_f$ | Fall time | $V_{GE}$ = ±15V | - | 170 | - | ns |
| $E_{OFF}$ | Turn-off energy loss | $V_{CE}$ = 1800V | - | 220 | - | mJ |
| $t_{d(on)}$ | Turn-on delay time | $R_{G(ON)}$ = $R_{G(OFF)}$ = 16.5Ω | - | 1180 | - | ns |
| $t_r$ | Rise time | L ~ 100nH | - | 225 | - | ns |
| $Q_g$ | Gate charge | $C_{ge}$ = 56nF | - | 5 | - | µC |
| $E_{ON}$ | Turn-on energy loss | $R_{G(ON)}$ = 7.5Ω | - | 290 | - | mJ |
| $Q_{rr}$ | Diode reverse recovery charge | $I_F$ = 200A, $V_R$ = 1800V, | - | 80 | - | µC |
| $I_{rr}$ | Diode reverse current | $dI_F/dt$ = 1600A/µs | - | 144 | - | A |
| $E_{REC}$ | Diode reverse recovery energy | Diode arm | - | 75 | - | mJ |

**$T_{case}$ = 125°C unless stated otherwise.**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| $t_{d(off)}$ | Turn-off delay time | $I_C$ = 200A | - | 2200 | - | ns |
| $t_f$ | Fall time | $V_{GE}$ = ±15V | - | 190 | - | ns |
| $E_{OFF}$ | Turn-off energy loss | $V_{CE}$ = 1800V | - | 265 | - | mJ |
| $t_{d(on)}$ | Turn-on delay time | $R_{G(ON)}$ = $R_{G(OFF)}$ = 16.5Ω | - | 1150 | - | ns |
| $t_r$ | Rise time | L ~ 100nH, $C_{ge}$ = 56nF | - | 280 | - | ns |
| $E_{ON}$ | Turn-on energy loss | $R_{G(ON)}$ = 7.5Ω | - | 390 | - | mJ |
| $Q_{rr}$ | Diode reverse recovery charge | $I_F$ = 200A, $V_R$ = 1800V, | - | 125 | - | µC |
| $I_{rr}$ | Diode reverse current | $dI_F/dt$ = 1600A/µs | - | 155 | - | A |
| $E_{REC}$ | Diode reverse recovery energy | Diode arm | - | 130 | - | mJ |

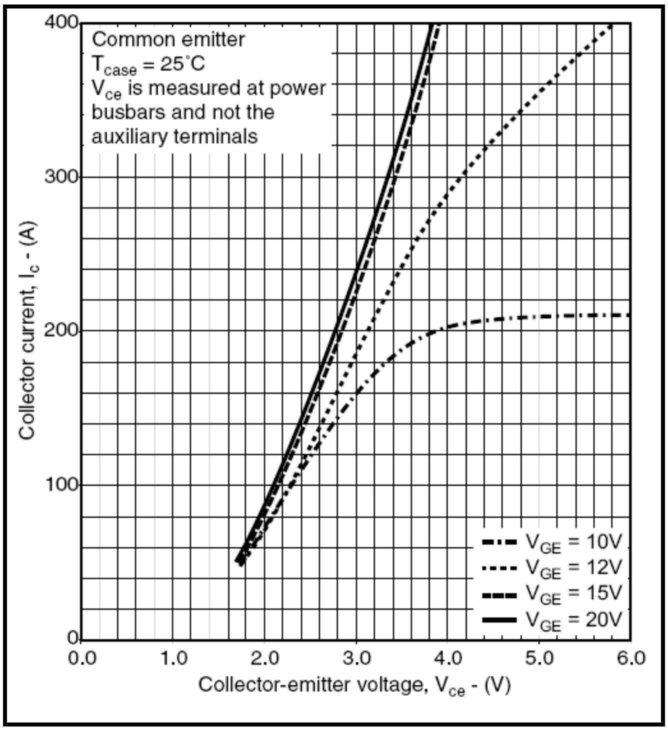



Fig.3 Typical output characteristics

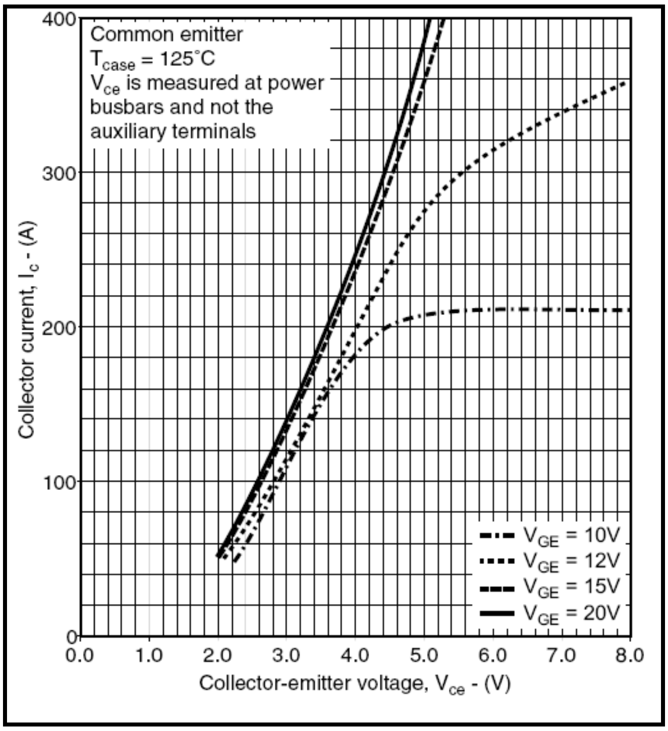



Fig.4 Typical output characteristics

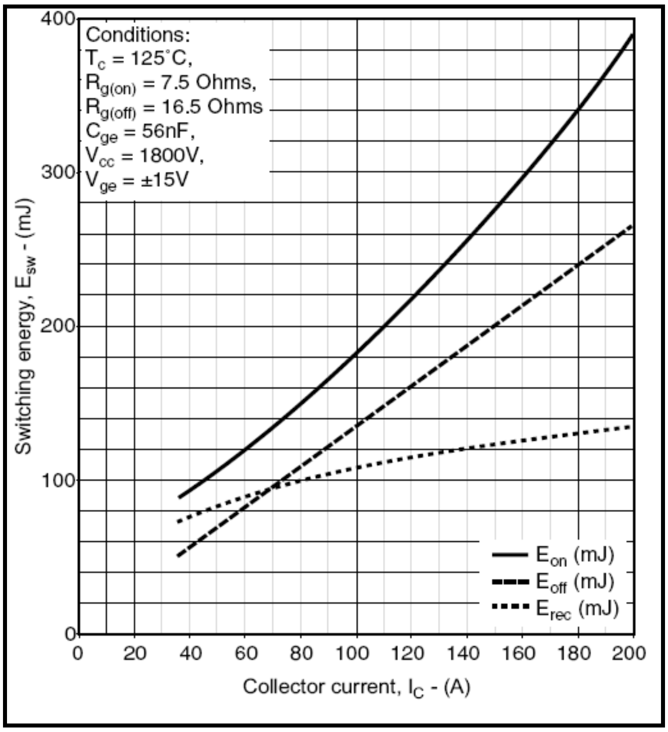



Fig.5 Typical switching energy vs collector current

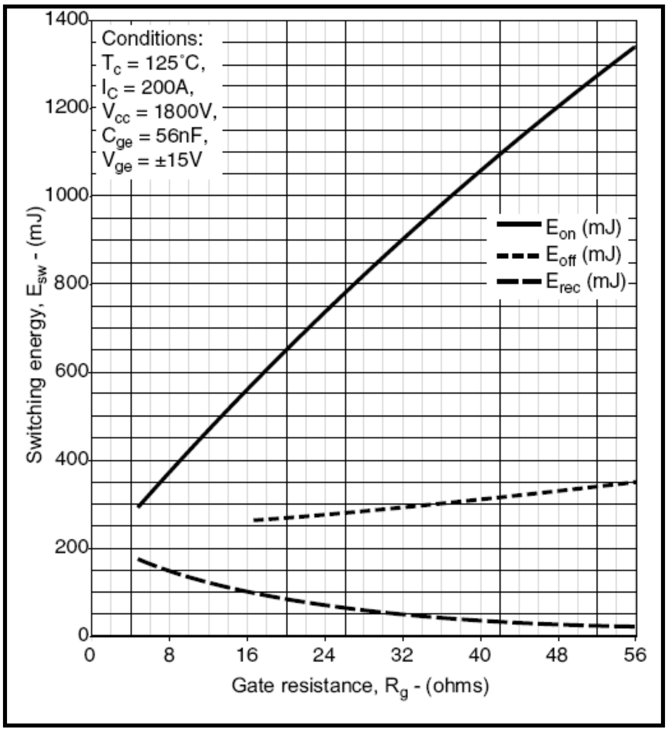



Fig.6 Typical switching energy vs gate resistance

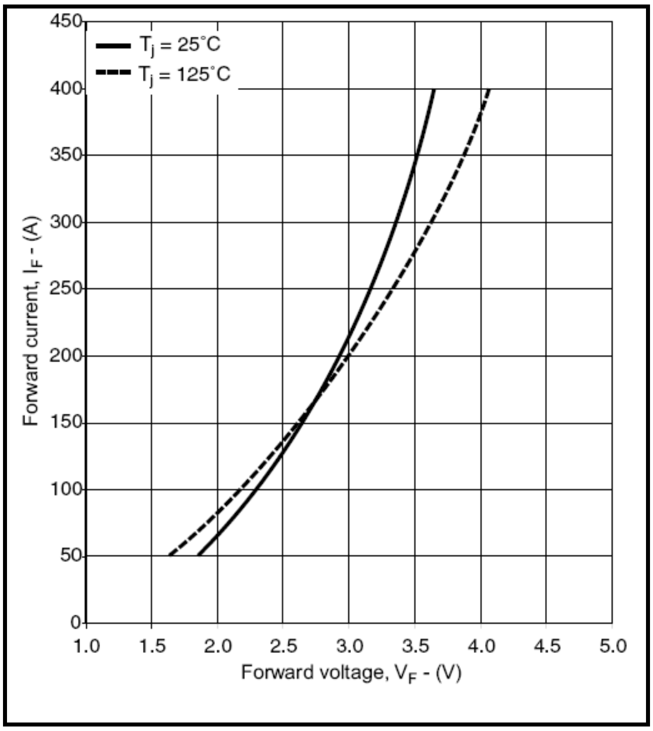



Fig.7 Diode typical forward characteristics

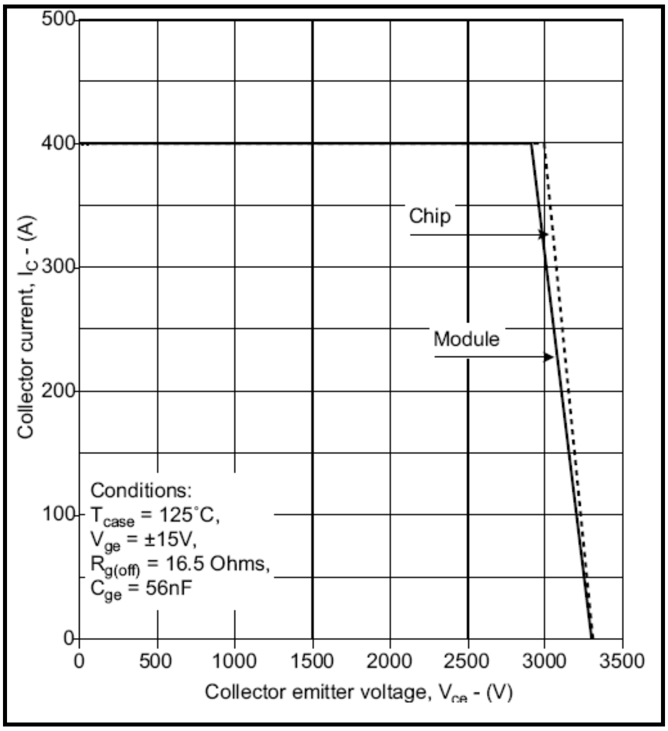



Fig.8 Reverse bias safe operating area

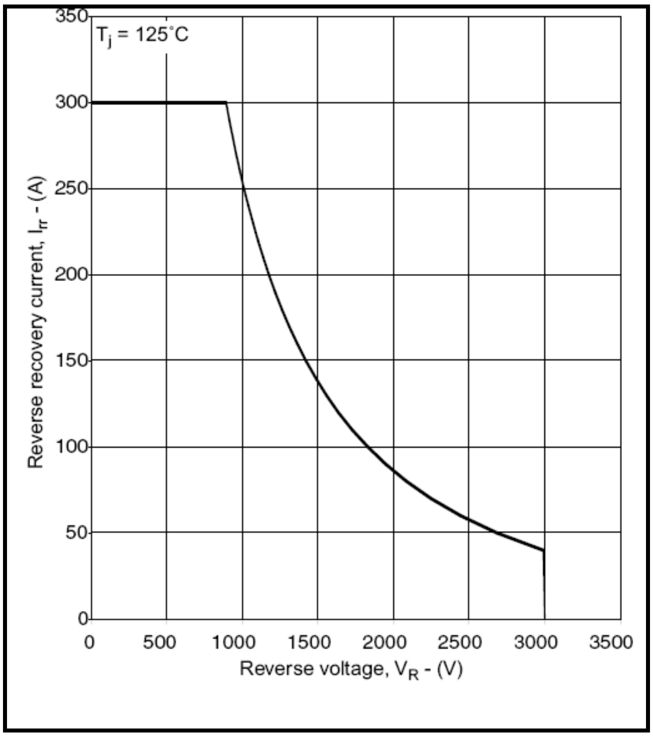
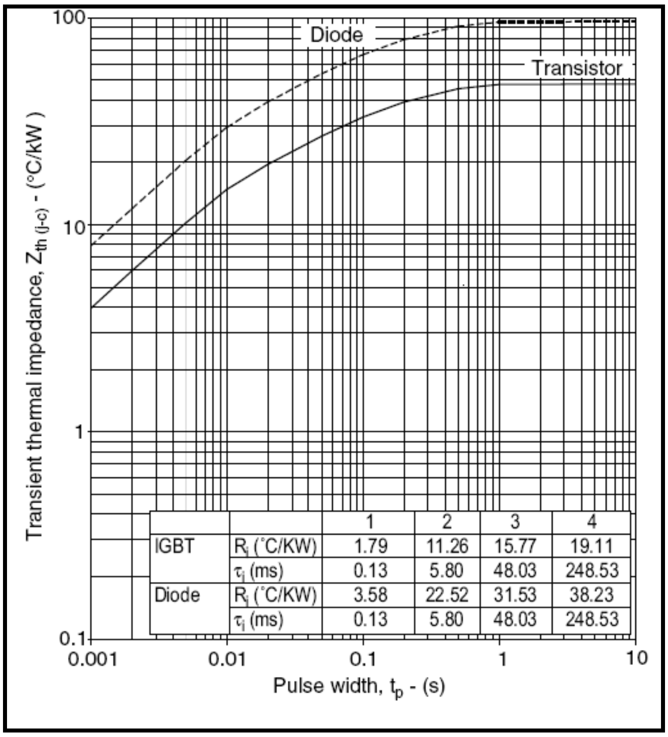



Fig.9 Diode reverse bias safe operating area

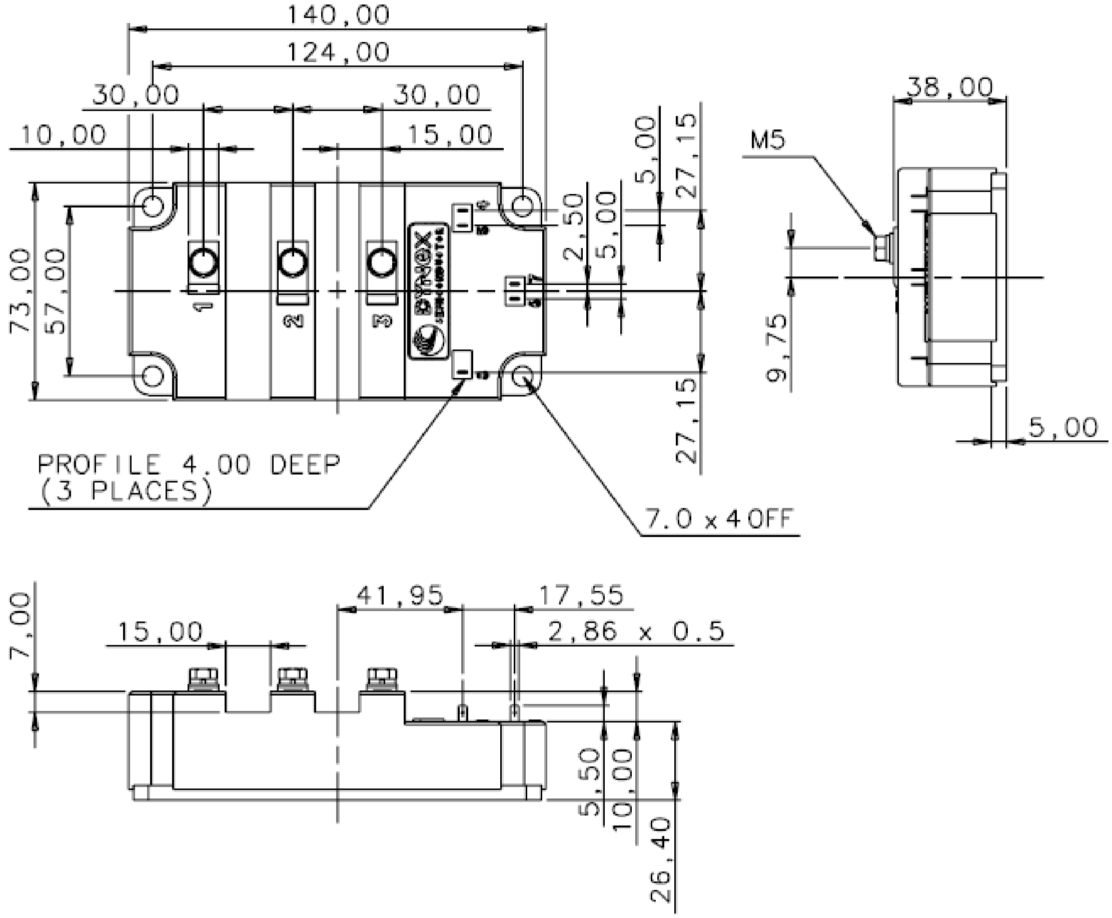



| | | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| IGBT | $R_i$ (˚C/KW) | 1.79 | 11.26 | 15.77 | 19.11 |
| | $\tau_i$ (ms) | 0.13 | 5.80 | 48.03 | 248.53 |
| Diode | $R_i$ (˚C/KW) | 3.58 | 22.52 | 31.53 | 38.23 |
| | $\tau_i$ (ms) | 0.13 | 5.80 | 48.03 | 248.53 |

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: 750 g

**Module outline type code: P**

## POWER ASSEMBLY CAPABILITY

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 offers 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 which 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 Services.

http://www.dynexsemi.com

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Datasheet Annotations:

Dynex Semiconductor annotate datasheets in the top right hand corner of the front page, to indicate product status. The annotations are as follows:-

**Target Information:** This is the most tentative form of information and represents a very preliminary specification. No actual design work on the product has been started.

**Preliminary Information:** The product is in design and development. The datasheet represents the product as it is understood but details may change.

**Advance Information:** The product design is complete and final characterisation for volume production is well in hand.

**No Annotation:** The product parameters are fixed and the product is available to datasheet specification.



Caution: This device is sensitive to electrostatic discharge. Users should follow ESD handling procedures