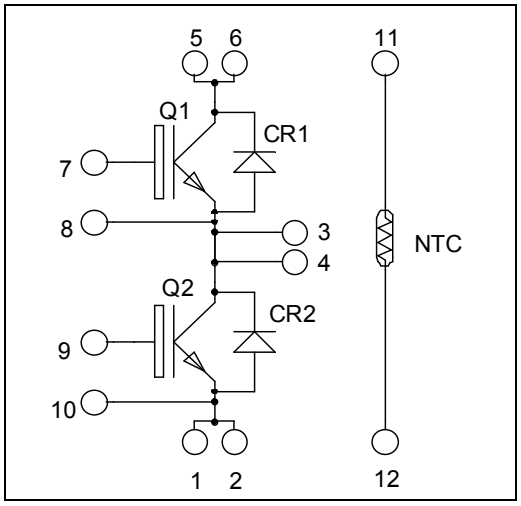
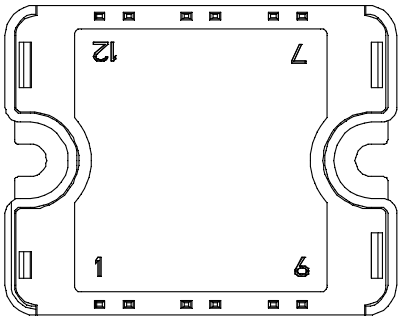
***Phase leg***
***High speed Trench + Field Stop IGBT4***
***Power Module***

$V_{CES}$ = 650V
$I_C$ = 100A @ Tc = 60°C




Pins 3/4 must be shorted together

**Application**

- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Motor control

**Features**

- ***High speed Trench + Field Stop IGBT 4***
  - Low voltage drop
  - Low leakage current
  - Low switching losses
- Very low stray inductance
- Internal thermistor for temperature monitoring

**Benefits**

- Outstanding performance at high frequency operation
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Low profile
- RoHS compliant

**All ratings @ $T_j$ = 25°C unless otherwise specified**

**Absolute maximum ratings** (per IGBT)

| *Symbol* | *Parameter* | | *Max ratings* | *Unit* |
|---|---|---|---|---|
| $V_{CES}$ | Collector - Emitter Voltage | | 650 | V |
| $I_C$ | Continuous Collector Current | $T_C$ = 25°C | 135 | A |
| | | $T_C$ = 60°C | 100 | |
| $I_{CM}$ | Pulsed Collector Current | $T_C$ = 25°C | 270 | |
| $V_{GE}$ | Gate – Emitter Voltage | | ±20 | V |
| $P_D$ | Power Dissipation | | 350 | W |

CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.

## Electrical Characteristics (per IGBT)

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Zero Gate Voltage Collector Current | $V_{GE}$ = 0V, $V_{CE}$ = 650V | | | | 50 | µA |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $V_{GE}$ =15V<br>$I_C$ = 100A | $T_j$ = 25°C | 1.4 | 1.85 | 2.3 | V |
| | | | $T_j$ = 150°C | | 2.2 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$ , $I_C$ = 1.6 mA | | 4.2 | 5.1 | 5.6 | V |
| $I_{GES}$ | Gate – Emitter Leakage Current | $V_{GE}$ = 20V, $V_{CE}$ = 0V | | | | 150 | nA |

## Dynamic Characteristics (per IGBT)

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | $V_{GE}$ = 0V<br>$V_{CE}$ = 25V<br>f = 1MHz | | | 6100 | | pF |
| $C_{oes}$ | Output Capacitance | | | | 232 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 180 | | |
| $Q_G$ | Gate charge | $V_{GE}$ = 15V, $I_C$ = 100A<br>$V_{CE}$ = 480V | | | 630 | | nC |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C)<br>$V_{GE}$ = ±15V<br>$V_{Bus}$ = 400V<br>$I_C$ = 100A<br>$R_G$ = 3.6Ω | | | 19 | | ns |
| $T_r$ | Rise Time | | | | 33 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 197 | | |
| $T_f$ | Fall Time | | | | 21 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (150°C)<br>$V_{GE}$ = ±15V<br>$V_{Bus}$ = 400V<br>$I_C$ = 100A<br>$R_G$ = 3.6Ω | | | 19 | | ns |
| $T_r$ | Rise Time | | | | 29 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 227 | | |
| $T_f$ | Fall Time | | | | 22 | | |
| $E_{on}$ | Turn on Energy | $V_{GE}$ = ±15V<br>$V_{Bus}$ = 400V<br>$I_C$ = 100A<br>$R_G$ = 3.6Ω | $T_j$ = 150°C | | 2.4 | | mJ |
| $E_{off}$ | Turn off Energy | | $T_j$ = 150°C | | 2 | | |
| $R_G$ | Integrated gate resistor | | | | 2 | | Ω |
| $I_{sc}$ | Short Circuit data | $V_{GE}$ ≤15V ; $V_{Bus}$ = 400V<br>$t_p$ ≤5µs ; $T_j$ = 150°C | | | 700 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 0.44 | °C/W |

## Diode ratings and characteristics (per diode)

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Peak Repetitive Reverse Voltage | | | | | 650 | V |
| $I_{RM}$ | Reverse Leakage Current | $V_R$ = 650V | | | | 50 | µA |
| $I_F$ | DC Forward Current | | Tc = 25°C | | 100 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 100A<br>$V_{GE}$ = 0V | $T_j$ = 25°C | | 1.6 | 2 | V |
| | | | $T_j$ = 150°C | | 1.5 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 100A<br>$V_R$ = 300V<br>di/dt =2000A/µs | $T_j$ = 25°C | | 125 | | ns |
| | | | $T_j$ = 150°C | | 220 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 4.7 | | µC |
| | | | $T_j$ = 150°C | | 9.9 | | |
| $E_{rr}$ | Reverse Recovery Energy | | $T_j$ = 25°C | | 1.1 | | mJ |
| | | | $T_j$ = 150°C | | 2.4 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 0.77 | °C/W |

## Temperature sensor NTC (see application note APT0406 on www.microsemi.com).

| Symbol | Characteristic | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $R_{25}$ | Resistance @ 25°C | | | 50 | | kΩ |
| $\Delta R_{25}/R_{25}$ | | | | 5 | | % |
| $B_{25/85}$ | $T_{25}$ = 298.15 K | | | 3952 | | K |
| $\Delta B/B$ | | $T_C$=100°C | | 4 | | % |

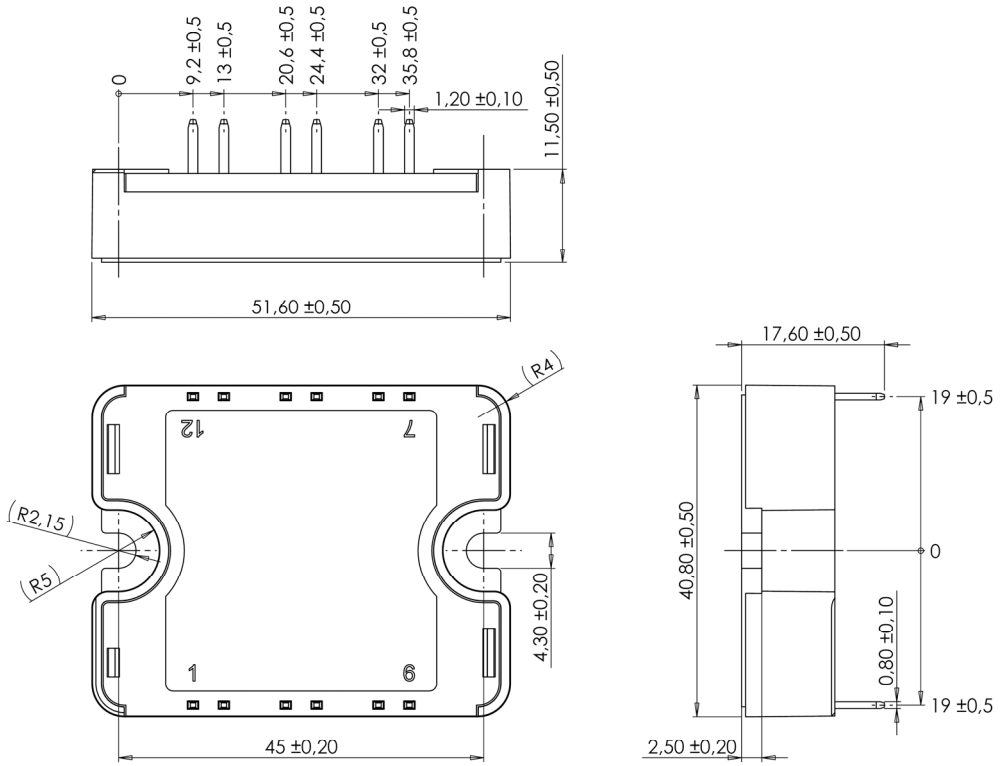
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature
$R_T$: Thermistor value at T

## Thermal and package characteristics

| Symbol | Characteristic | | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz | | | 4000 | | V |
| $T_J$ | Operating junction temperature range | | | -40 | 175 | °C |
| $T_{JOP}$ | Recommended junction temperature under switching conditions | | | -40 | $T_J$max -25 | |
| $T_{STG}$ | Storage Temperature Range | | | -40 | 125 | |
| $T_C$ | Operating Case Temperature | | | -40 | 125 | |
| Torque | Mounting torque | To heatsink | M4 | 2 | 3 | N.m |
| Wt | Package Weight | | | | 80 | g |

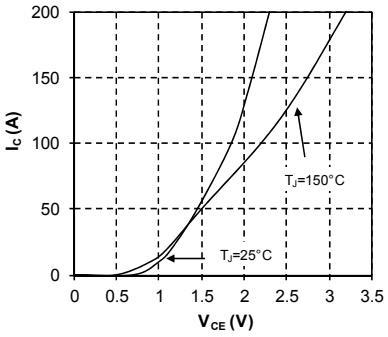
## Package outline (dimensions in mm)



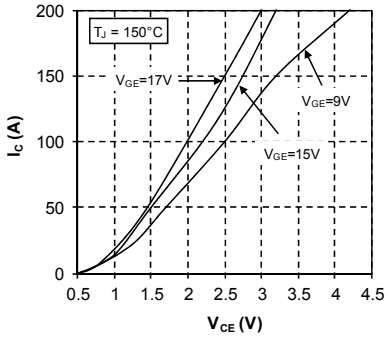

See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

## Typical performance curve

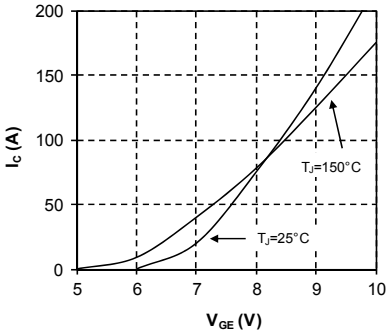
Output Characteristics ($V_{GE}$=15V)



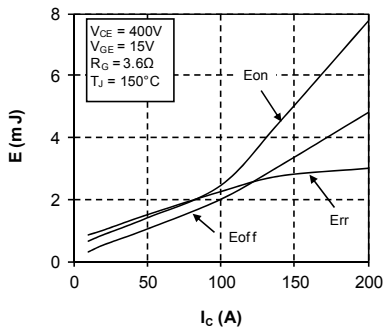

Output Characteristics



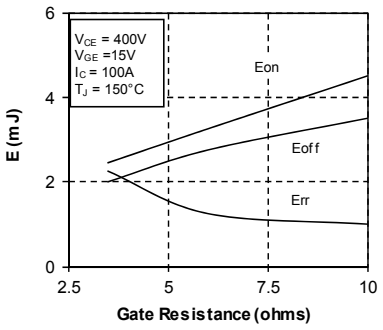

Transfert Characteristics



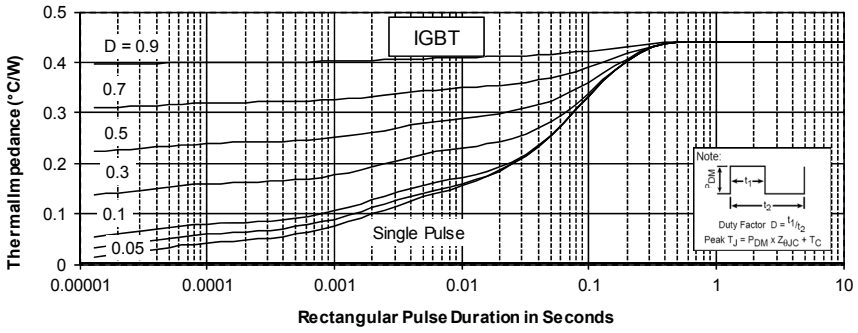

Energy losses vs Collector Current



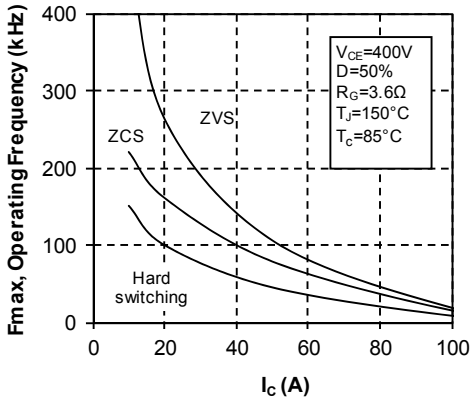

Switching Energy Losses vs Gate Resistance



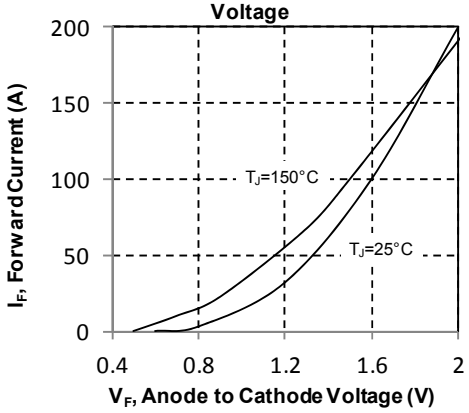

maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration



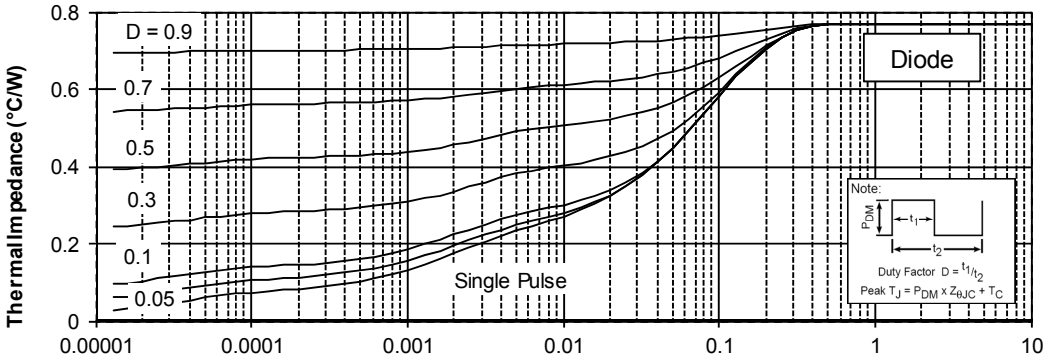
**Operating Frequency vs Collector Current**




**Forward Current vs Forward Voltage**




**maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration**



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