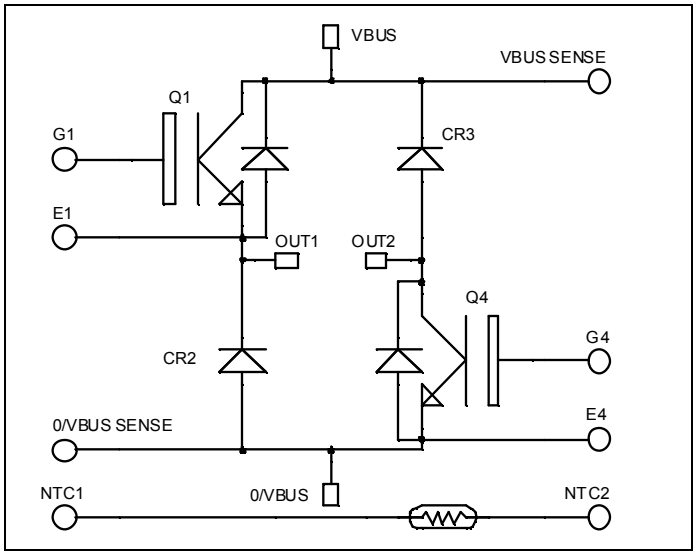
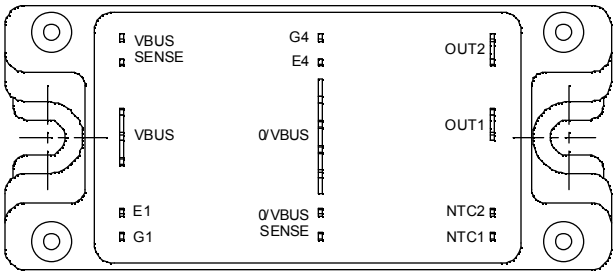
# Asymmetrical - Bridge NPT IGBT Power Module

$V_{CES}$ = 600V
$I_C$ = 50A @ Tc = 80°C




**Application**

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

**Features**

- Non Punch Through (NPT) Fast IGBT®
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 100 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - Avalanche energy rated
  - RBSOA and SCSOA rated
- Kelvin emitter for easy drive
- Very low stray inductance
  - Symmetrical design
  - Lead frames for power connections
- Internal thermistor for temperature monitoring
- High level of integration

**Benefits**

- Outstanding performance at high frequency operation
- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Solderable terminals both for power and signal for easy PCB mounting
- Easy paralleling due to positive TC of VCEsat
- Low profile
- RoHS compliant

## Absolute maximum ratings

| *Symbol* | *Parameter* | | *Max ratings* | *Unit* |
|---|---|---|---|---|
| $V_{CES}$ | Collector - Emitter Breakdown Voltage | | 600 | V |
| $I_C$ | Continuous Collector Current | $T_C$ = 25°C | 65 | A |
| | | $T_C$ = 80°C | 50 | |
| $I_{CM}$ | Pulsed Collector Current | $T_C$ = 25°C | 230 | |
| $V_{GE}$ | Gate – Emitter Voltage | | ±20 | V |
| $P_D$ | Maximum Power Dissipation | $T_C$ = 25°C | 250 | W |
| RBSOA | Reverse Bias Safe Operating Area | $T_j$ = 125°C | 100A@500V | |

**CAUTION:** These Devices are sensitive to Electrostatic Discharge. Proper Handing Procedures Should Be Followed. See application note APT0502 on www.microsemi.com

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

## Electrical Characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Zero Gate Voltage Collector Current | $V_{GE}$ = 0V, $V_{CE}$ = 600V | $T_j$ = 25°C | | | 250 | µA |
| | | | $T_j$ = 125°C | | | 500 | |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $V_{GE}$ =15V, $I_C$ = 50A | $T_j$ = 25°C | 1.7 | 2.0 | 2.45 | V |
| | | | $T_j$ = 125°C | | 2.2 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 1mA | | 4 | | 6 | V |
| $I_{GES}$ | Gate – Emitter Leakage Current | $V_{GE}$ = 20V, $V_{CE}$ = 0V | | | | 400 | nA |

## Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | $V_{GE}$ = 0V, $V_{CE}$ = 25V, f = 1MHz | | 2200 | | pF |
| $C_{oes}$ | Output Capacitance | | | 323 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | 200 | | |
| $Q_g$ | Total gate Charge | $V_{GE}$ = 15V, $V_{Bus}$ = 300V, $I_C$ = 50A | | 166 | | nC |
| $Q_{ge}$ | Gate – Emitter Charge | | | 20 | | |
| $Q_{gc}$ | Gate – Collector Charge | | | 100 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C) $V_{GE}$ = 15V, $V_{Bus}$ = 400V, $I_C$ = 50A, $R_G$ = 2.7Ω | | 40 | | ns |
| $T_r$ | Rise Time | | | 9 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 120 | | |
| $T_f$ | Fall Time | | | 12 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (125°C) $V_{GE}$ = 15V, $V_{Bus}$ = 400V, $I_C$ = 50A, $R_G$ = 2.7Ω | | 42 | | ns |
| $T_r$ | Rise Time | | | 10 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 130 | | |
| $T_f$ | Fall Time | | | 21 | | |
| $E_{on}$ | Turn-on Switching Energy | $V_{GE}$ = 15V, $V_{Bus}$ = 400V, $I_C$ = 50A, $R_G$ = 2.7Ω, $T_j$ = 125°C | | 0.5 | | mJ |
| $E_{off}$ | Turn-off Switching Energy | | | 1 | | |

## Diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Maximum Peak Repetitive Reverse Voltage | | | 600 | | | V |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$=600V | $T_j$ = 25°C | | | 250 | µA |
| | | | $T_j$ = 125°C | | | 500 | |
| $I_F$ | DC Forward Current | | Tc = 70°C | | 60 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 60A | | | 1.6 | 1.8 | V |
| | | $I_F$ = 120A | | | 1.9 | | |
| | | $I_F$ = 60A | $T_j$ = 125°C | | 1.4 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 60A, $V_R$ = 400V, di/dt =200A/µs | $T_j$ = 25°C | | 130 | | ns |
| | | | $T_j$ = 125°C | | 170 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 220 | | nC |
| | | | $T_j$ = 125°C | | 920 | | |

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

| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{25}$ | Resistance @ 25°C | | 50 | | kΩ |
| $B_{25/85}$ | $T_{25}$ = 298.15 K | | 3952 | | K |

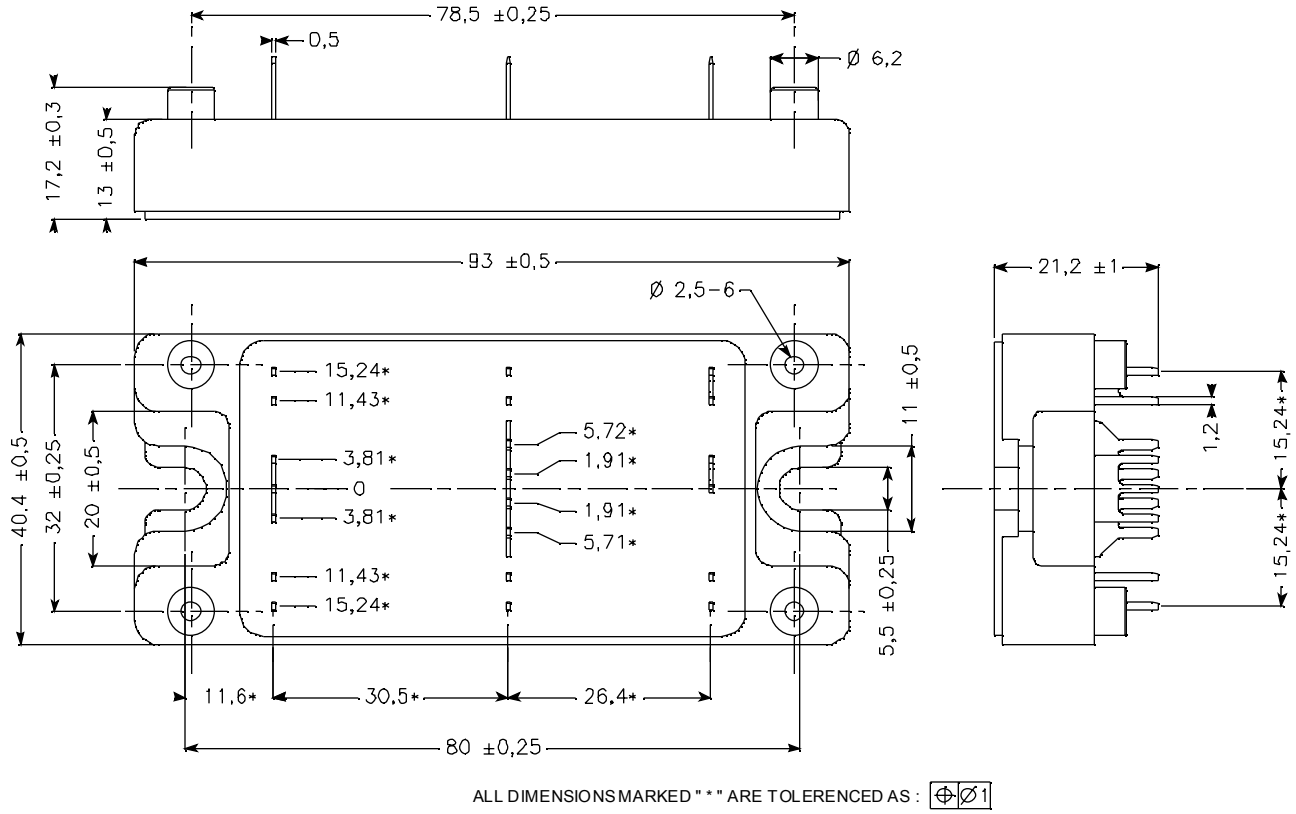
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

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

## Thermal and package characteristics

| Symbol | Characteristic | | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction to Case Thermal Resistance | | IGBT | | | 0.5 | °C/W |
| | | | Diode | | | 0.9 | |
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz | | | 2500 | | | V |
| $T_J$ | Operating junction temperature range | | | -40 | | 150 | °C |
| $T_{STG}$ | Storage Temperature Range | | | -40 | | 125 | |
| $T_C$ | Operating Case Temperature | | | -40 | | 100 | |
| Torque | Mounting torque | To heatsink | M5 | 2.5 | | 4.7 | N.m |
| Wt | Package Weight | | | | | 160 | g |

## SP4 Package outline (dimensions in mm)

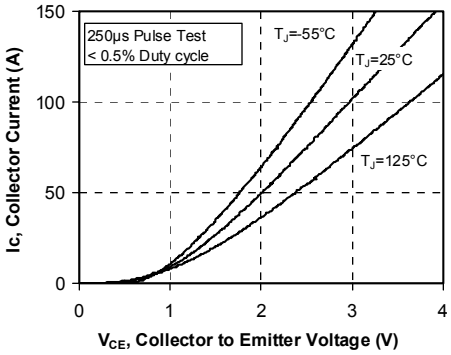



ALL DIMENSIONS MARKED " * " ARE TOLERENCED AS : ⌖ Ø 1

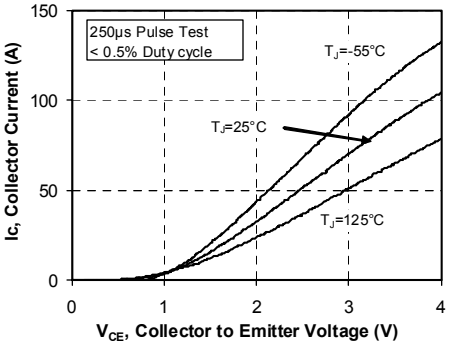
See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

## Typical Performance Curve

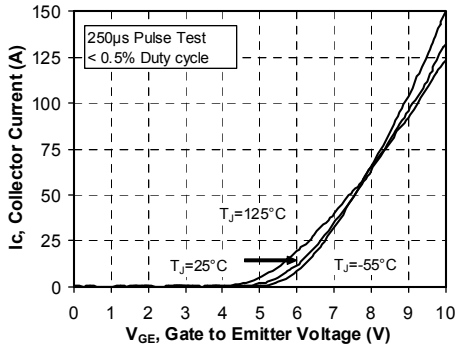
Output characteristics ($V_{GE}$=15V)



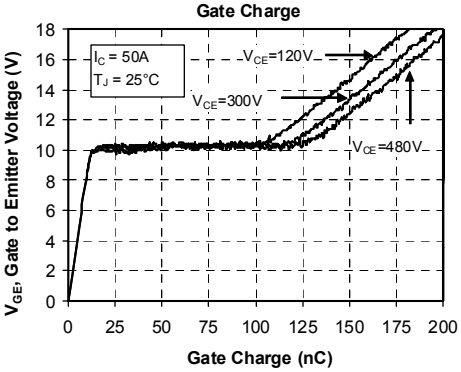

Output Characteristics ($V_{GE}$=10V)



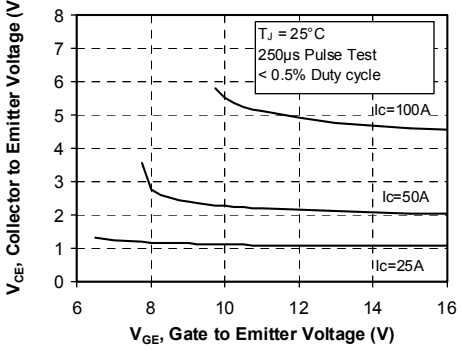

Transfer Characteristics



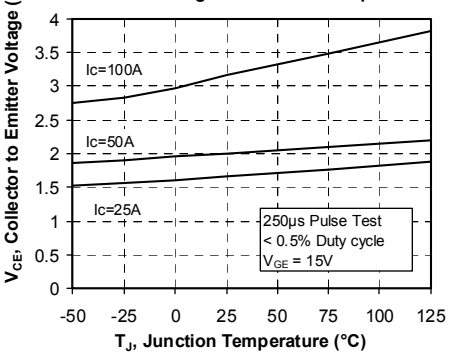

Gate Charge



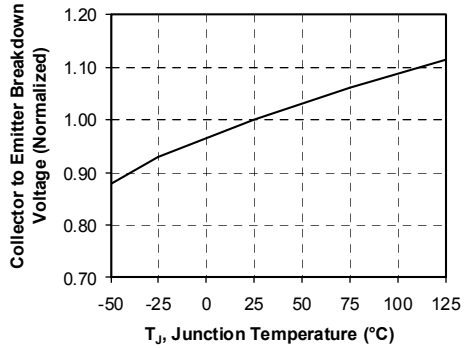

On state Voltage vs Gate to Emitter Volt.



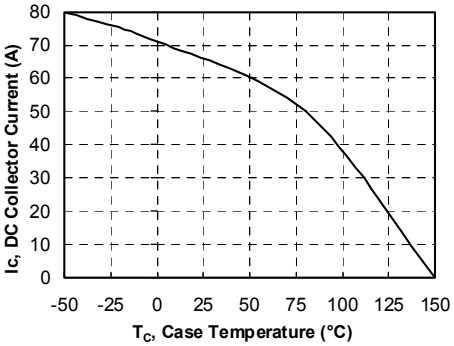

On state Voltage vs Junction Temperature



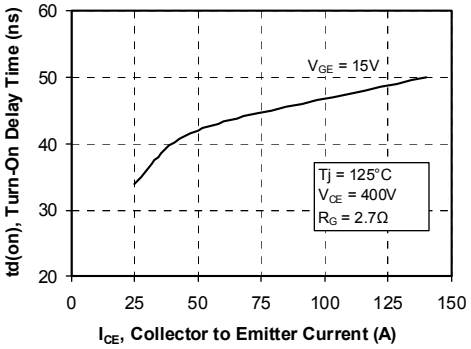

Breakdown Voltage vs Junction Temp.



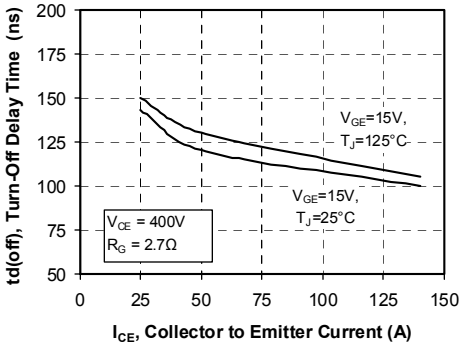

DC Collector Current vs Case Temperature



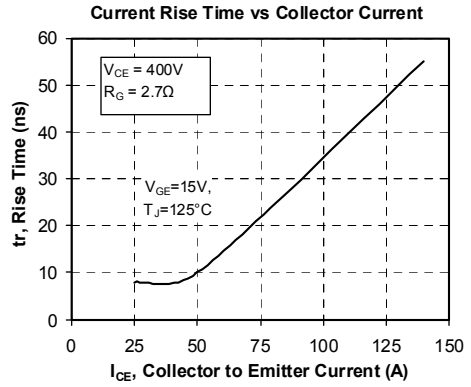
**Turn-On Delay Time vs Collector Current**



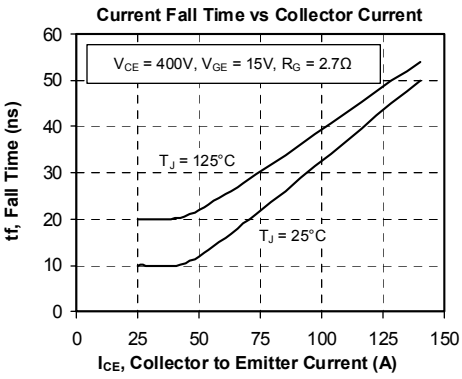

**Turn-Off Delay Time vs Collector Current**



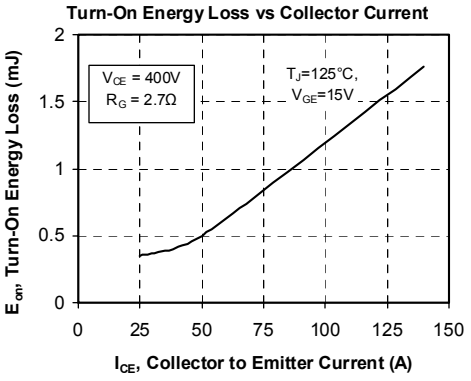

**Current Rise Time vs Collector Current**



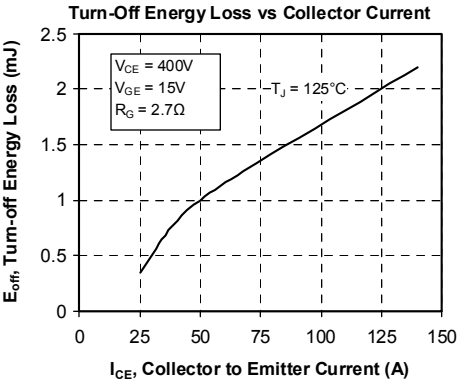

**Current Fall Time vs Collector Current**



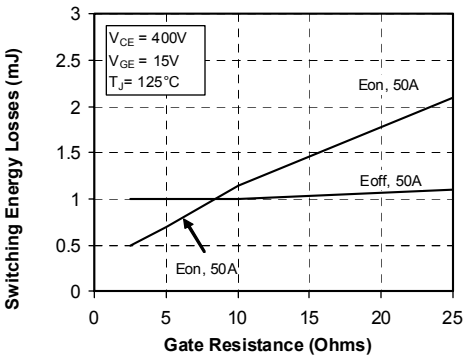

**Turn-On Energy Loss vs Collector Current**




**Turn-Off Energy Loss vs Collector Current**




**Switching Energy Losses vs Gate Resistance**




**Reverse Bias Safe Operating Area**