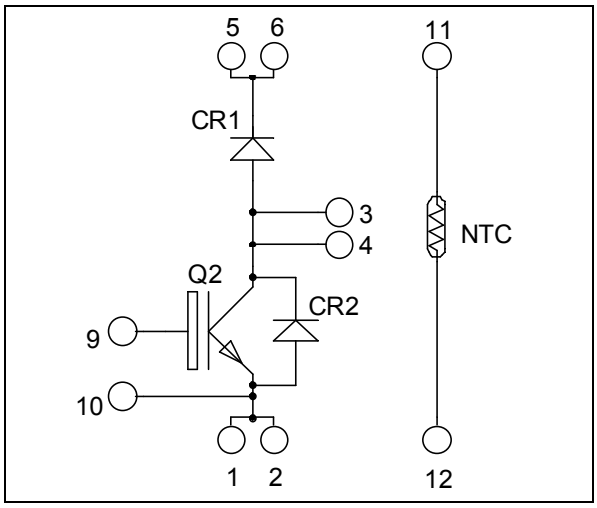
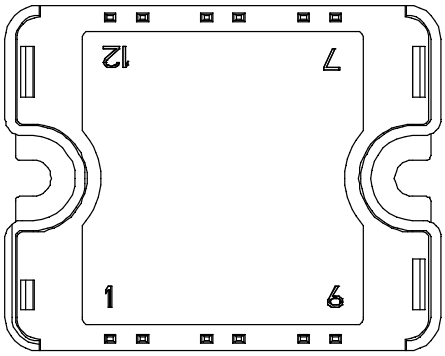
# Boost chopper NPT IGBT Power Module

$V_{CES}$ = 1200V
$I_C$ = 100A* @ Tc = 80°C




Pins 1/2 ; 3/4 ; 5/6 must be shorted together

**Application**

- AC and DC motor control
- Switched Mode Power Supplies
- Power Factor Correction

**Features**

- Non Punch Through (NPT) Fast IGBT
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 50 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
- Very low stray inductance
- Internal thermistor for temperature monitoring
- High level of integration

**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

## Absolute maximum ratings

| *Symbol* | *Parameter* | | *Max ratings* | *Unit* |
|---|---|---|---|---|
| $V_{CES}$ | Collector - Emitter Breakdown Voltage | | 1200 | V |
| $I_C$ | Continuous Collector Current | $T_C$ = 25°C | 130* | A |
| | | $T_C$ = 80°C | 100* | |
| $I_{CM}$ | Pulsed Collector Current | $T_C$ = 25°C | 200 | |
| $V_{GE}$ | Gate – Emitter Voltage | | ±20 | V |
| $P_D$ | Maximum Power Dissipation | $T_C$ = 25°C | 735 | W |
| RBSOA | Reverse Bias Safe Operating Area | $T_J$ = 150°C | 200A @ 1150V | |

Specification of IGBT device but output current must be limited to 75A to not exceed a delta of temperature greater than 30°C for the connectors.

**CAUTION:** These Devices are sensitive to Electrostatic Discharge. Proper Handling 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, $V_{CE}$ = 1200V | | | | 250 | µA |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $V_{GE}$ =15V<br>$I_C$ = 100A | $T_j$ = 25°C | | 3.2 | 3.7 | V |
| | | | $T_j$ = 125°C | | 3.9 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$ , $I_C$ = 4mA | | 4.5 | 5.5 | 6.5 | V |
| $I_{GES}$ | Gate – Emitter Leakage Current | $V_{GE}$ = 20V, $V_{CE}$ = 0V | | | | 600 | nA |

## Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | $V_{GE}$ = 0V<br>$V_{CE}$ = 25V<br>f = 1MHz | | | 6.5 | | nF |
| $C_{oes}$ | Output Capacitance | | | | 1 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 0.5 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C)<br>$V_{GE}$ = ±15V<br>$V_{Bus}$ = 600V<br>$I_C$ = 100A<br>$R_G$ = 5.6Ω | | | 120 | | ns |
| $T_r$ | Rise Time | | | | 50 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 310 | | |
| $T_f$ | Fall Time | | | | 20 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (125°C)<br>$V_{GE}$ = ±15V<br>$V_{Bus}$ = 600V<br>$I_C$ = 100A<br>$R_G$ = 5.6Ω | | | 130 | | ns |
| $T_r$ | Rise Time | | | | 60 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 360 | | |
| $T_f$ | Fall Time | | | | 30 | | |
| $E_{on}$ | Turn-on Switching Energy | $V_{GE}$ = ±15V<br>$V_{Bus}$ = 600V<br>$I_C$ = 100A<br>$R_G$ = 5.6Ω | $T_j$ = 125°C | | 12 | | mJ |
| $E_{off}$ | Turn-off Switching Energy | | $T_j$ = 125°C | | 5 | | |

## Chopper diode ratings and characteristics

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Maximum Peak Repetitive Reverse Voltage | | | 1200 | | | V |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$=1200V | $T_j$ = 25°C | | | 100 | µA |
| | | | $T_j$ = 125°C | | | 500 | |
| $I_F$ | DC Forward Current | | Tc = 90°C | | 100 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 100A | | | 2.4 | 3 | V |
| | | $I_F$ = 150A | | | 2.7 | | |
| | | $I_F$ = 100A | $T_j$ = 125°C | | 1.8 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 100A<br>$V_R$ = 800V<br>di/dt =200A/µs | $T_j$ = 25°C | | 385 | | ns |
| | | | $T_j$ = 125°C | | 480 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 1055 | | nC |
| | | | $T_j$ = 125°C | | 5240 | | |

## Thermal and package characteristics

| Symbol | Characteristic | | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction to Case Thermal Resistance | IGBT | | | | 0.19 | °C/W |
| | | Diode | | | | 0.55 | |
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz | | | 4000 | | | 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 | M4 | 2 | | 3 | N.m |
| Wt | Package Weight | | | | | 80 | g |

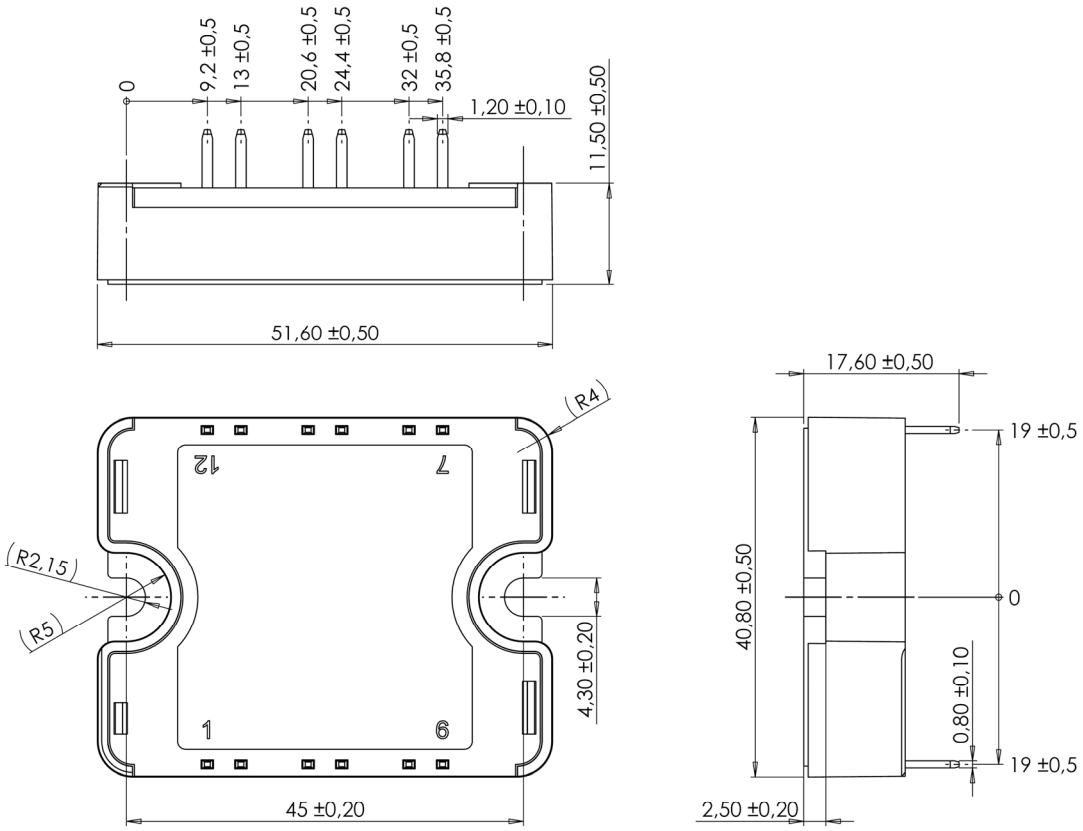
## Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

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

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

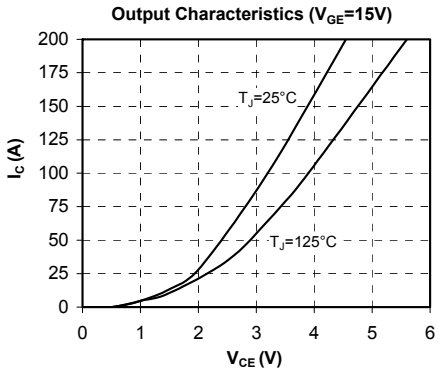
T: Thermistor temperature
$R_T$: Thermistor value at T

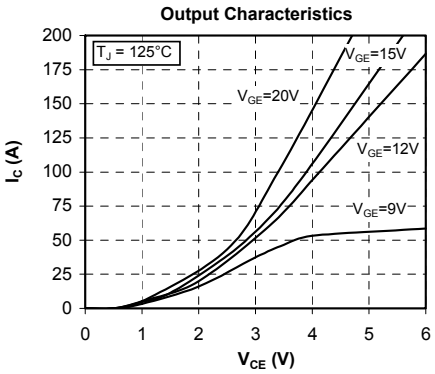
## SP1 Package outline (dimensions in mm)

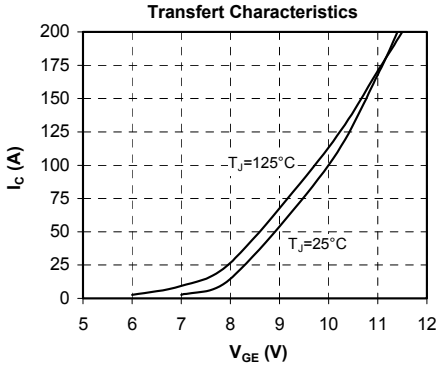


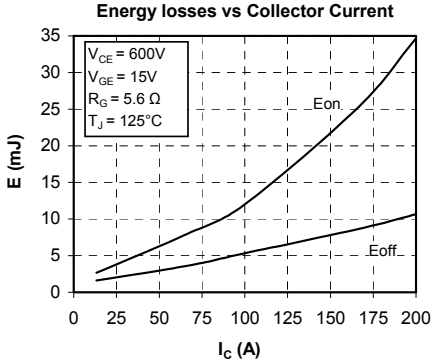

See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

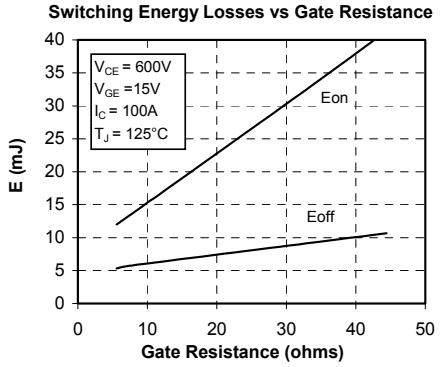
## Typical Performance Curve

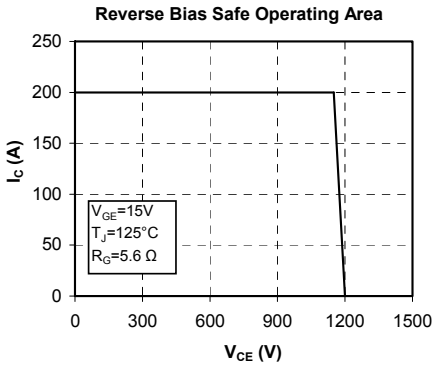


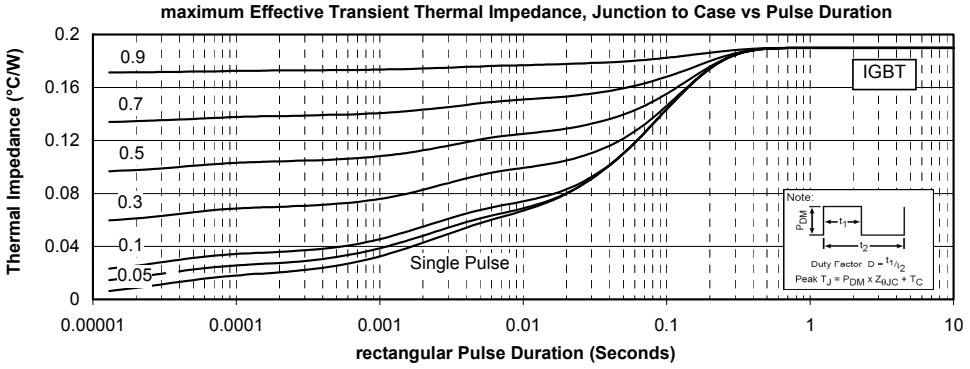



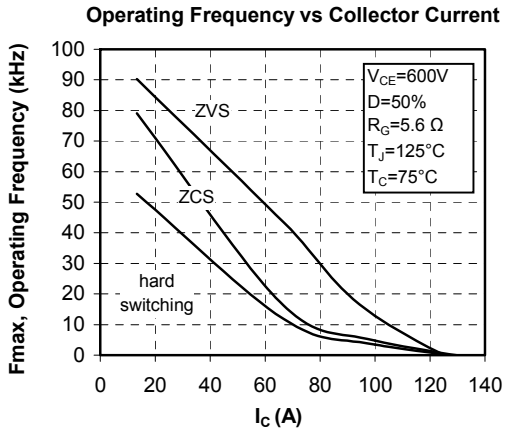



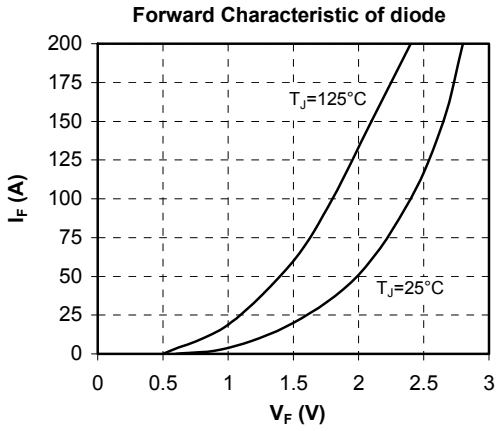



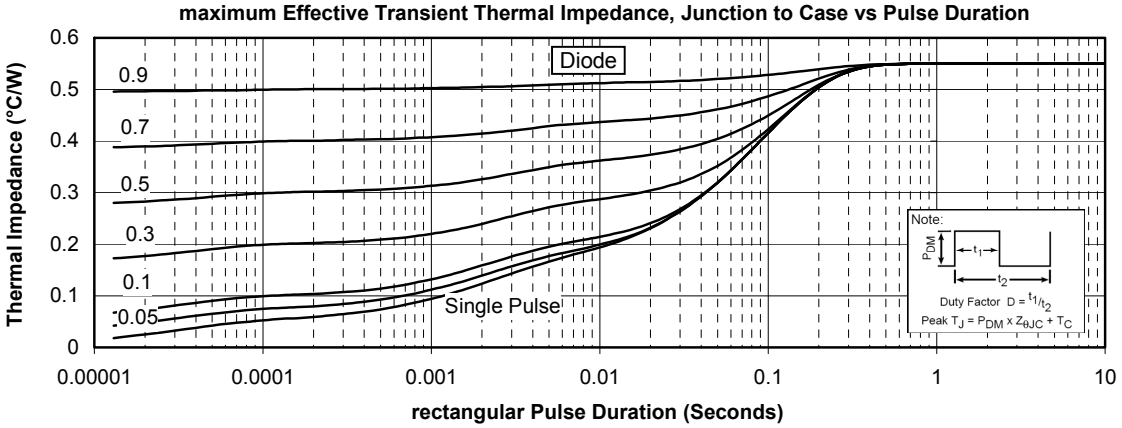




Operating Frequency vs Collector Current
Fmax, Operating Frequency (kHz)
100
90
80
70
60
50
40
30
20
10
0
0
20
40
60
80
100
120
140
IC (A)
ZVS
ZCS
hard
switching
VCE=600V
D=50%
RG=5.6 Ω
TJ=125°C
TC=75°C


Forward Characteristic of diode
IF (A)
200
175
150
125
100
75
50
25
0
0
0.5
1
1.5
2
2.5
3
VF (V)
TJ=125°C
TJ=25°C


maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
0.6
0.5
0.4
0.3
0.2
0.1
0
0.00001
0.0001
0.001
0.01
0.1
1
10
rectangular Pulse Duration (Seconds)
Diode
0.9
0.7
0.5
0.3
0.1
0.05
Single Pulse
Note:
PDM
t1
t2
Duty Factor D = t1/t2
Peak TJ = PDM x ZθJC + TC

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