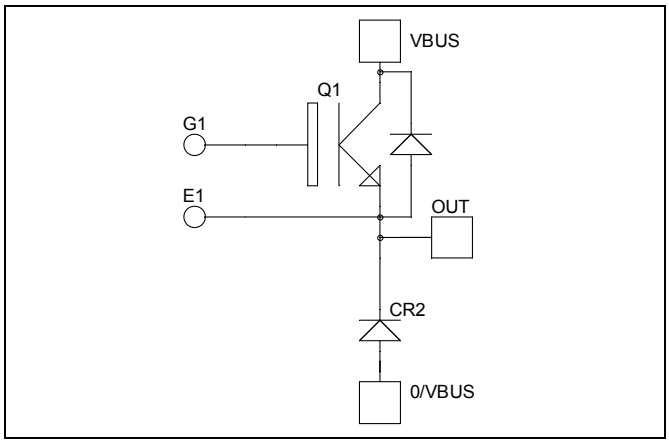
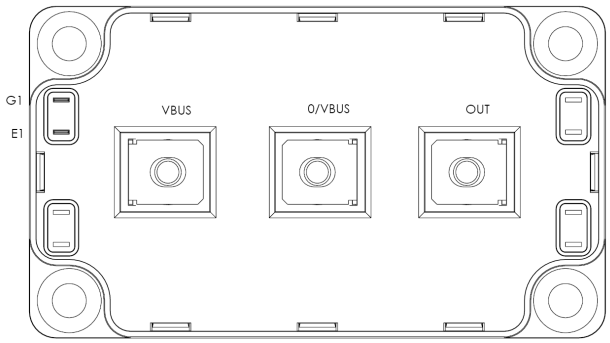
# *Buck chopper Trench + Field Stop IGBT3 Power Module*

$V_{CES}$ = 1700V
$I_C$ = 225A @ Tc = 80°C




**Application**

- AC and DC motor control
- Switched Mode Power Supplies

**Features**

- Trench + Field Stop IGBT3 Technology
  - Low voltage drop
  - Low tail current
  - Switching frequency up to 20 kHz
  - Soft recovery parallel diodes
  - Low diode VF
  - Low leakage current
  - RBSOA and SCSOA rated
- Kelvin emitter for easy drive
- Very low stray inductance
  - Symmetrical design
  - M5 power connectors
- High level of integration

**Benefits**

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- 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 | | 1700 | V |
| $I_C$ | Continuous Collector Current | $T_C$ = 25°C | 340 | A |
| | | $T_C$ = 80°C | 225 | |
| $I_{CM}$ | Pulsed Collector Current | $T_C$ = 25°C | 450 | |
| $V_{GE}$ | Gate – Emitter Voltage | | ±20 | V |
| $P_D$ | Maximum Power Dissipation | $T_C$ = 25°C | 1250 | W |
| RBSOA | Reverse Bias Safe Operating Area | $T_j$ = 125°C | 450A @ 1600V | |

**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, $V_{CE}$ = 1700V | | | | 500 | µA |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $V_{GE}$ = 15V<br>$I_C$ = 225A | $T_j$ = 25°C | | 2.0 | 2.4 | V |
| | | | $T_j$ = 125°C | | 2.4 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$ , $I_C$ = 4mA | | 5.0 | 5.8 | 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 | | | 20 | | nF |
| $C_{oes}$ | Output Capacitance | | | | 0.8 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 0.66 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C)<br>$V_{GE}$ = 15V<br>$V_{Bus}$ = 900V<br>$I_C$ = 225A<br>$R_G$ = 3.3Ω | | | 370 | | ns |
| $T_r$ | Rise Time | | | | 40 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 650 | | |
| $T_f$ | Fall Time | | | | 180 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (125°C)<br>$V_{GE}$ = 15V<br>$V_{Bus}$ = 900V<br>$I_C$ = 225A<br>$R_G$ = 3.3Ω | | | 400 | | ns |
| $T_r$ | Rise Time | | | | 50 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 800 | | |
| $T_f$ | Fall Time | | | | 300 | | |
| $E_{on}$ | Turn-on Switching Energy | $V_{GE}$ = 15V<br>$V_{Bus}$ = 900V<br>$I_C$ = 225A<br>$R_G$ = 3.3Ω | $T_j$ = 125°C | | 72 | | mJ |
| $E_{off}$ | Turn-off Switching Energy | | $T_j$ = 125°C | | 70.5 | | |

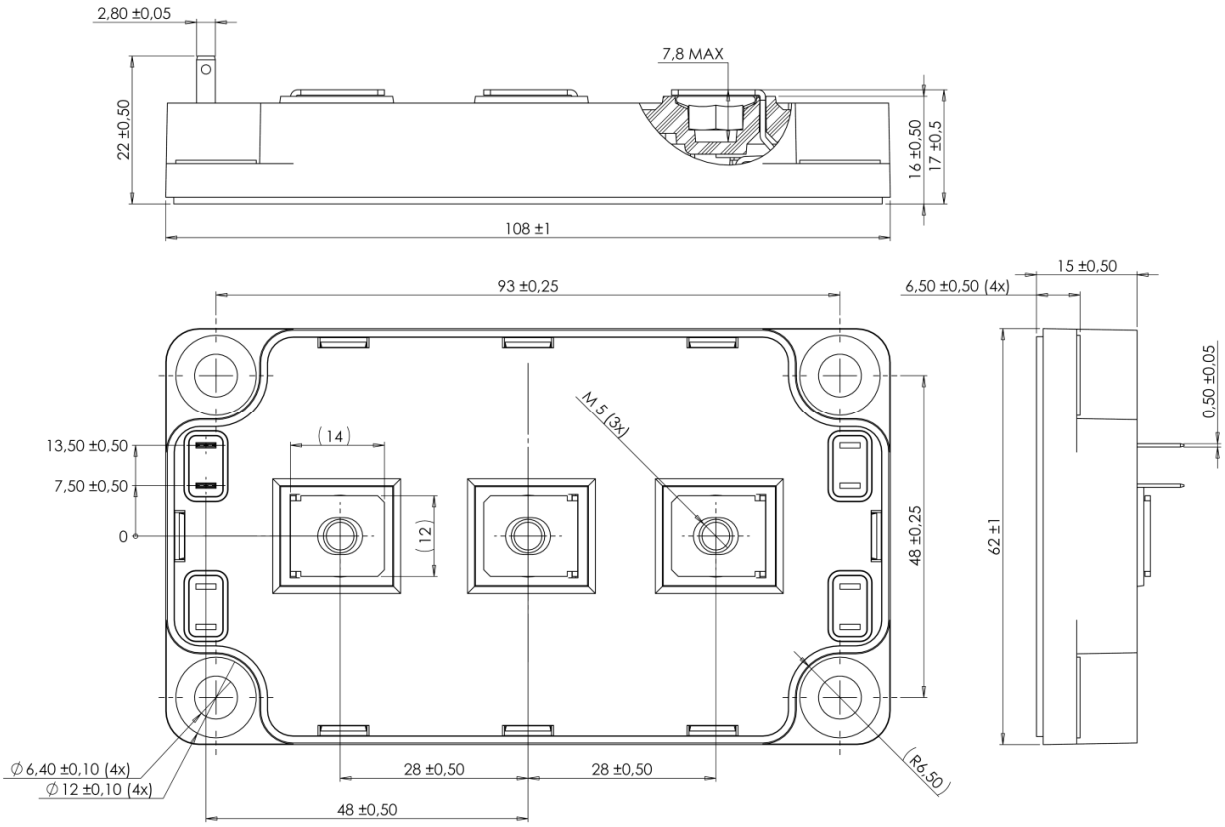
## Chopper diode ratings and characteristics

| *Symbol* | *Characteristic* | *Test Conditions* | | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|---|
| $V_{RRM}$ | Maximum Peak Repetitive Reverse Voltage | | | 1700 | | | V |
| $I_{RM}$ | Maximum Reverse Leakage Current | $V_R$=1700V | $T_j$ = 25°C | | | 500 | µA |
| | | | $T_j$ = 125°C | | | 750 | |
| $I_F$ | DC Forward Current | | Tc = 80°C | | 225 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 225A | $T_j$ = 25°C | | 1.8 | 2.2 | V |
| | | | $T_j$ = 125°C | | 1.9 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 225A<br>$V_R$ = 900V<br>di/dt =2400A/µs | $T_j$ = 25°C | | 385 | | ns |
| | | | $T_j$ = 125°C | | 490 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 57 | | µC |
| | | | $T_j$ = 125°C | | 93 | | |
| $E_r$ | Reverse Recovery Energy | | $T_j$ = 25°C | | 26 | | mJ |
| | | | $T_j$ = 125°C | | 52 | | |

## Thermal and package characteristics

| *Symbol* | *Characteristic* | | | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction to Case Thermal Resistance | | IGBT | | | 0.1 | °C/W |
| | | | Diode | | | 0.18 | |
| $V_{ISOL}$ | 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 | M6 | 3 | | 5 | N.m |
| | | For terminals | M5 | 2 | | 3.5 | |
| Wt | Package Weight | | | | | 300 | g |

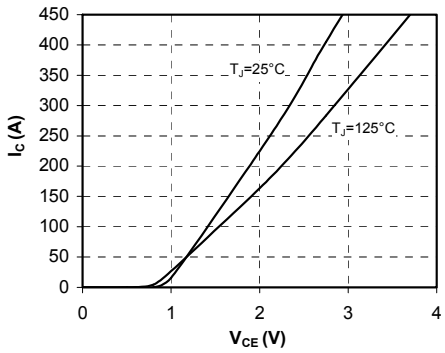
## SP6 Package outline (dimensions in mm)



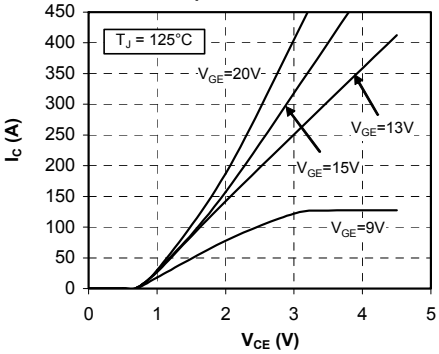

See application note APT0601 - Mounting Instructions for SP6 Power Modules on www.microsemi.com

## Typical Performance Curve

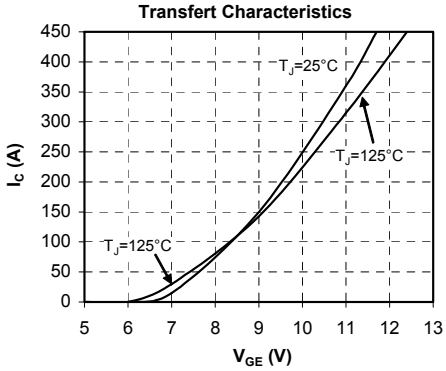
Output Characteristics ($V_{GE}$=15V)



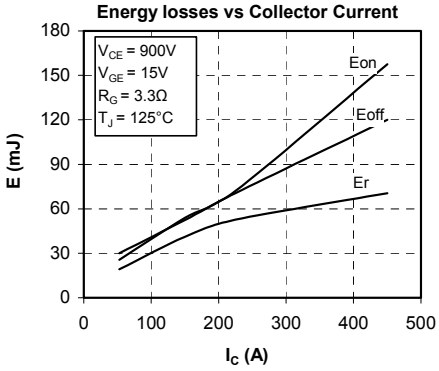

Output Characteristics



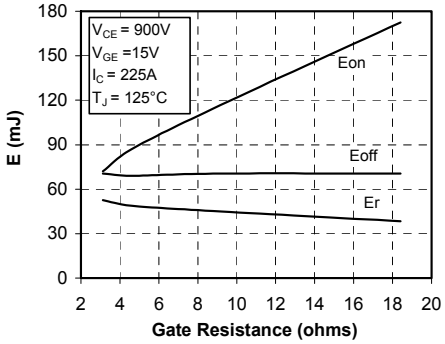

Transfert Characteristics



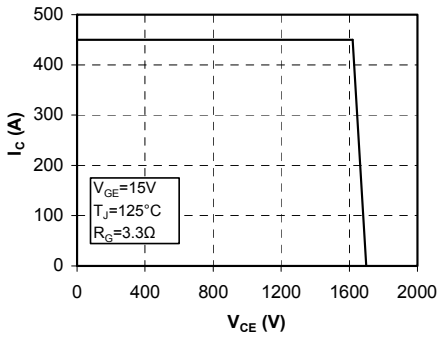

Energy losses vs Collector Current



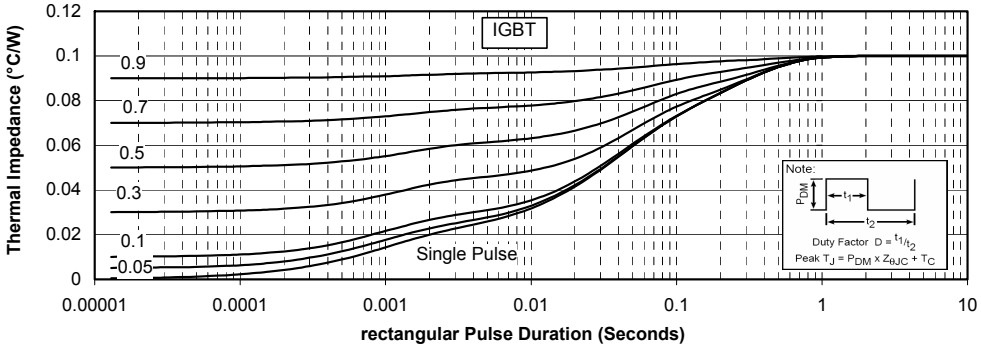

Switching Energy Losses vs Gate Resistance

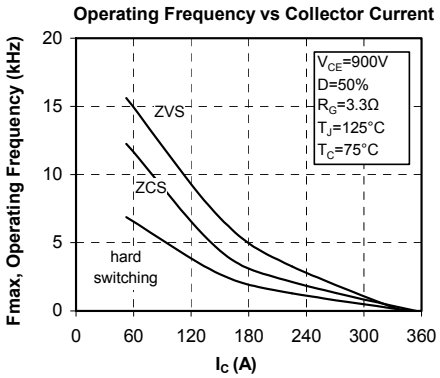


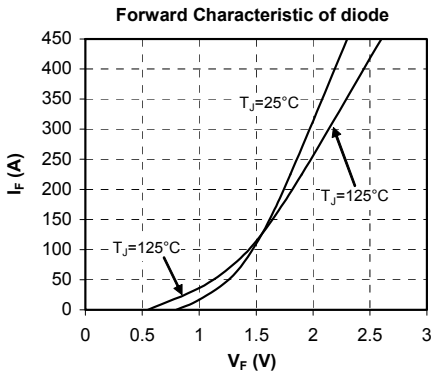

Reverse Bias Safe Operating Area

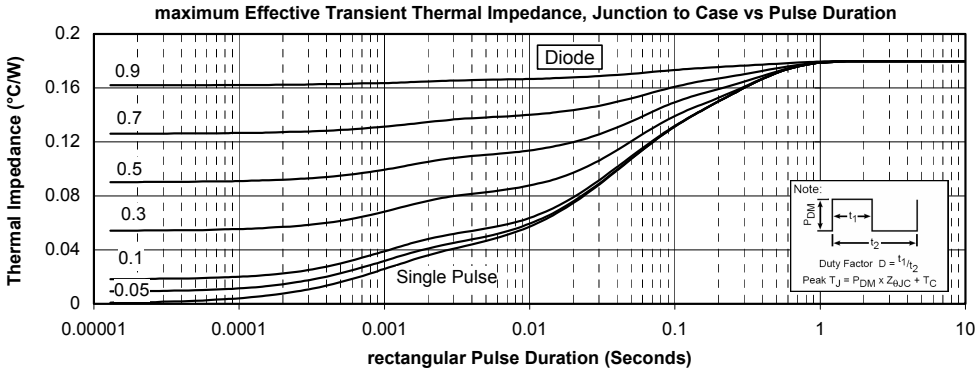



maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration




Operating Frequency vs Collector Current
Fmax, Operating Frequency (kHz)
20
15
10
5
0
0
60
120
180
240
300
360
$I_C$ (A)
$V_{CE}$=900V
D=50%
$R_G$=3.3Ω
$T_J$=125°C
$T_C$=75°C
ZVS
ZCS
hard
switching


Forward Characteristic of diode
$I_F$ (A)
450
400
350
300
250
200
150
100
50
0
0
0.5
1
1.5
2
2.5
3
$V_F$ (V)
$T_J$=25°C
$T_J$=125°C
$T_J$=125°C


maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
Thermal Impedance (°C/W)
0.2
0.16
0.12
0.08
0.04
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:
$P_{DM}$
$t_1$
$t_2$
Duty Factor D = $t_1/t_2$
Peak $T_J$ = $P_{DM}$ x $Z_{\theta JC}$ + $T_C$

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