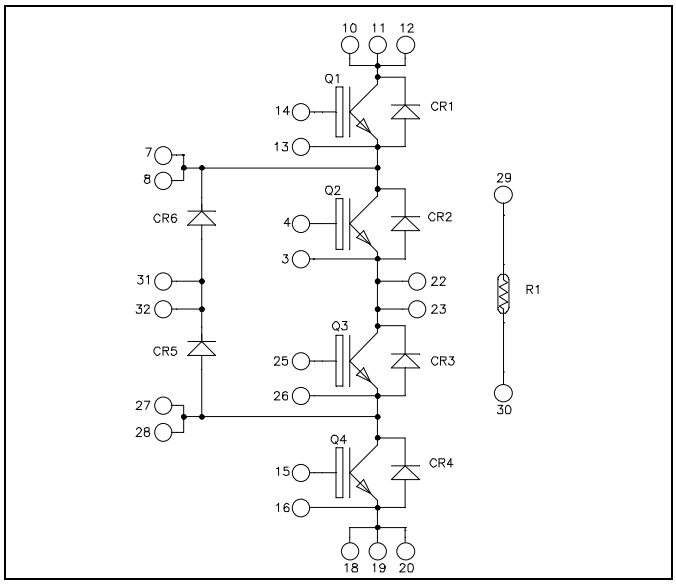
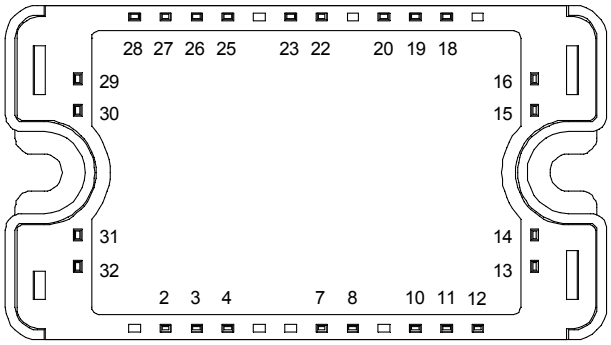
***Three level inverter***
***Trench + Field Stop IGBT***
***Power Module***

$V_{CES}$ = 600V
$I_C$ = 20A @ Tc = 80°C




All multiple inputs and outputs must be shorted together
Example: 10/11/12 ; 7/8 …

**Application**

- Solar converter
- Uninterruptible Power Supplies

**Features**

- Trench + Field Stop IGBT 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
- High level of integration
- Internal thermistor for temperature monitoring

**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

## Q1 to Q4 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 | 32 | A |
| | | $T_C$ = 80°C | 20 | |
| $I_{CM}$ | Pulsed Collector Current | $T_C$ = 25°C | 40 | |
| $V_{GE}$ | Gate – Emitter Voltage | | ±20 | V |
| $P_D$ | Maximum Power Dissipation | $T_C$ = 25°C | 62 | W |
| RBSOA | Reverse Bias Safe Operating Area | $T_J$ = 150°C | 40A @ 550V | |

**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**

## Q1 to Q4 Electrical Characteristics

| *Symbol* | *Characteristic* | *Test Conditions* | | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|---|
| $I_{CES}$ | Zero Gate Voltage Collector Current | $V_{GE}$ = 0V, $V_{CE}$ = 600V | | | | 250 | µA |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $V_{GE}$ =15V<br>$I_C$ = 20A | $T_j$ = 25°C | | 1.5 | 1.9 | V |
| | | | $T_j$ = 150°C | | 1.7 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$ , $I_C$ = 300µA | | 5.0 | 5.8 | 6.5 | V |
| $I_{GES}$ | Gate – Emitter Leakage Current | $V_{GE}$ = 20V, $V_{CE}$ = 0V | | | | 300 | nA |

## Q1 to Q4 Dynamic Characteristics

| *Symbol* | *Characteristic* | *Test Conditions* | | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | $V_{GE}$ = 0V<br>$V_{CE}$ = 25V<br>f = 1MHz | | | 1100 | | pF |
| $C_{oes}$ | Output Capacitance | | | | 70 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 35 | | |
| $Q_G$ | Gate charge | $V_{GE}$=±15V, $I_C$=20A<br>$V_{CE}$=300V | | | 0.2 | | µC |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C)<br>$V_{GE}$ = ±15V<br>$V_{Bus}$ = 300V<br>$I_C$ = 20A<br>$R_G$ = 12Ω | | | 110 | | ns |
| $T_r$ | Rise Time | | | | 45 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 200 | | |
| $T_f$ | Fall Time | | | | 40 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (150°C)<br>$V_{GE}$ = ±15V<br>$V_{Bus}$ = 300V<br>$I_C$ = 20A<br>$R_G$ = 12Ω | | | 120 | | ns |
| $T_r$ | Rise Time | | | | 50 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 250 | | |
| $T_f$ | Fall Time | | | | 60 | | |
| $E_{on}$ | Turn-on Switching Energy | $V_{GE}$ = ±15V<br>$V_{Bus}$ = 300V<br>$I_C$ = 20A<br>$R_G$ = 12Ω | $T_j$ = 25°C | | 0.11 | | mJ |
| | | | $T_j$ = 150°C | | 0.2 | | |
| $E_{off}$ | Turn-off Switching Energy | | $T_j$ = 25°C | | 0.5 | | mJ |
| | | | $T_j$ = 150°C | | 0.7 | | |
| $I_{sc}$ | Short Circuit data | $V_{GE}$ ≤15V ; $V_{Bus}$ = 360V<br>$t_p$ ≤ 6µs ; $T_j$ = 150°C | | | 100 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 2.4 | °C/W |

## CR1 to CR6 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 | | | 150 | µA |
| | | | $T_j$ = 150°C | | | 350 | |
| $I_F$ | DC Forward Current | | Tc = 80°C | | 20 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 20A<br>$V_{GE}$ = 0V | $T_j$ = 25°C | | 1.6 | 2 | V |
| | | | $T_j$ = 150°C | | 1.5 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 20A<br>$V_R$ = 300V<br>di/dt =1600A/µs | $T_j$ = 25°C | | 100 | | ns |
| | | | $T_j$ = 150°C | | 150 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 1.1 | | µC |
| | | | $T_j$ = 150°C | | 2.3 | | |
| $E_{rr}$ | Reverse Recovery Energy | | $T_j$ = 25°C | | 0.23 | | mJ |
| | | | $T_j$ = 150°C | | 0.50 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 3.25 | °C/W |

## 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 |
| $\Delta R_{25}/R_{25}$ | | | | 5 | | % |
| $B_{25/85}$ | $T_{25}$ = 298.15 K | | | 3952 | | K |
| ΔB/B | | $T_C$=100°C | | 4 | | % |

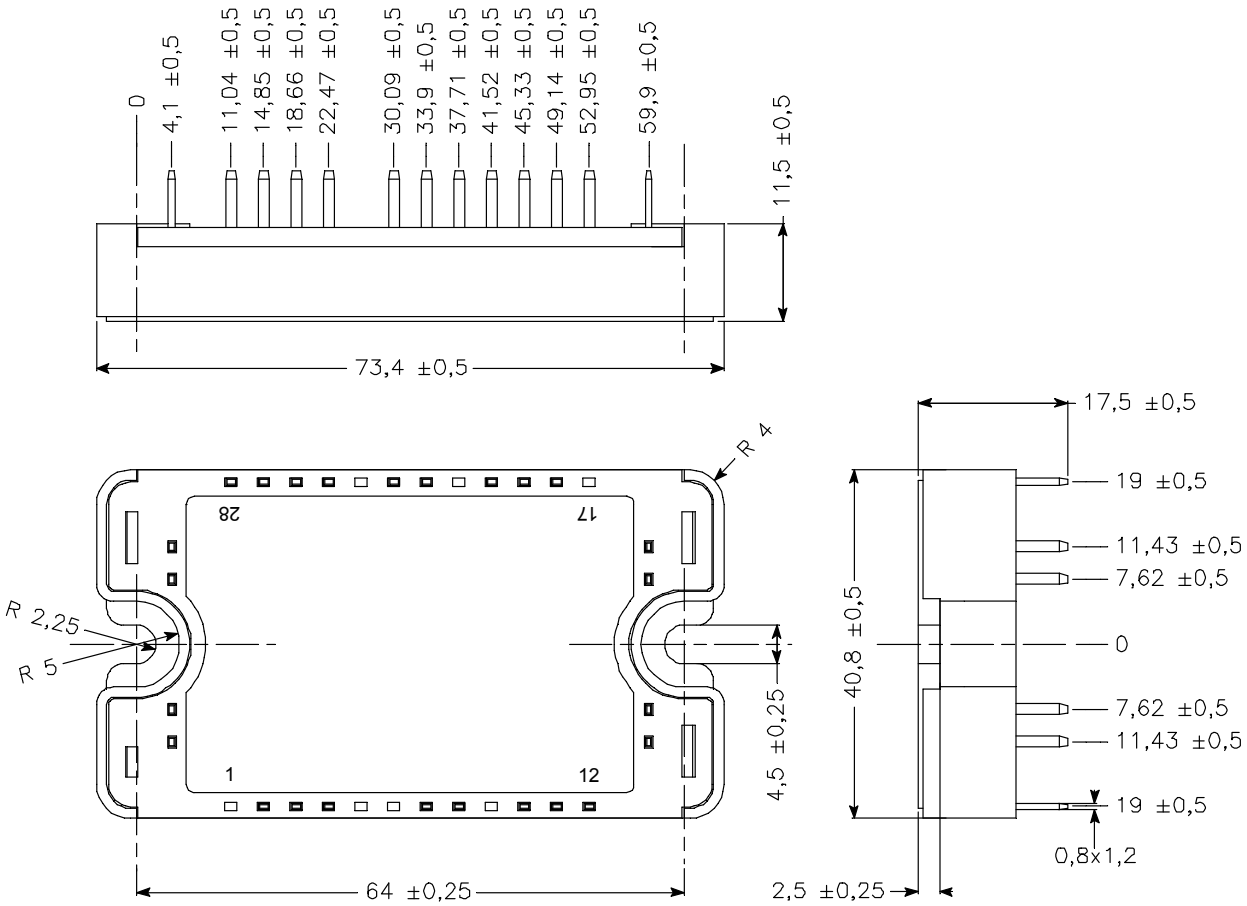
$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

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

## Thermal and package characteristics

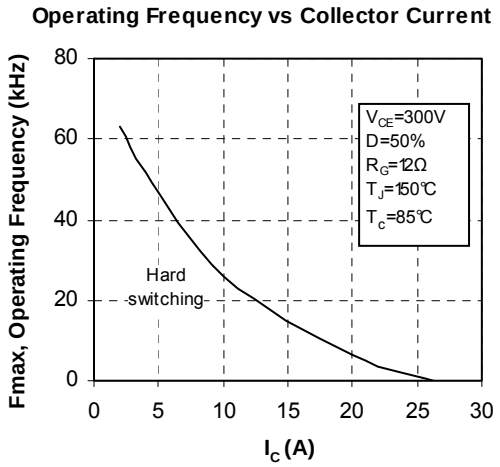
| Symbol | Characteristic | | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, I isol<1mA, 50/60Hz | | | 2500 | | | V |
| $T_J$ | Operating junction temperature range | | | -40 | | 175 | °C |
| $T_{STG}$ | Storage Temperature Range | | | -40 | | 125 | |
| $T_C$ | Operating Case Temperature | | | -40 | | 100 | |
| Torque | Mounting torque | To heatsink | M4 | 2.5 | | 4.7 | N.m |
| Wt | Package Weight | | | | | 110 | g |

## SP3 Package outline (dimensions in mm)

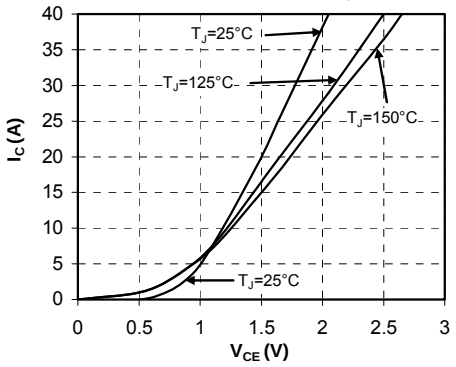



See application note 1901 - Mounting Instructions for SP3 Power Modules on www.microsemi.com

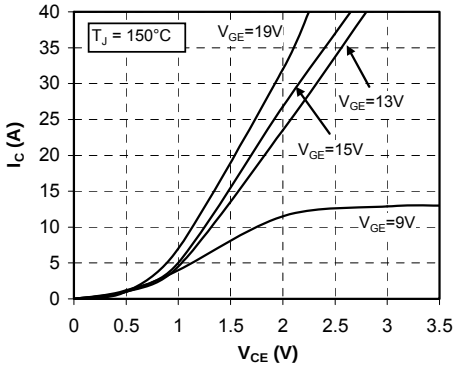
## Q1 to Q4 Typical performance curve



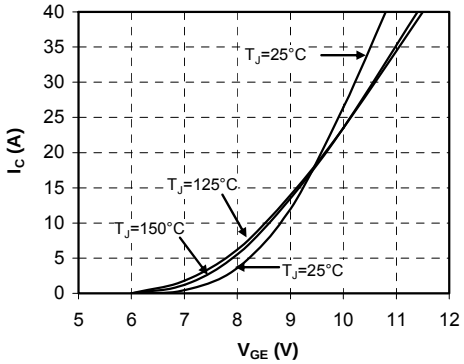
**Output Characteristics ($V_{GE}$=15V)**



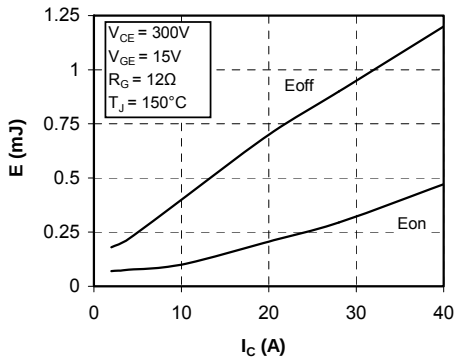

**Output Characteristics**



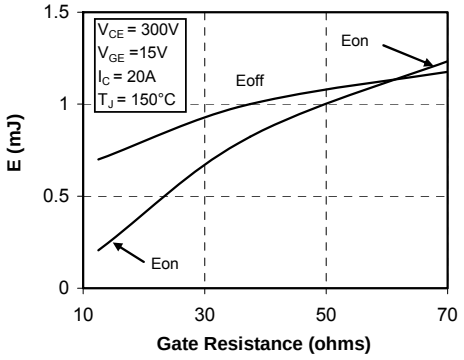

**Transfert Characteristics**



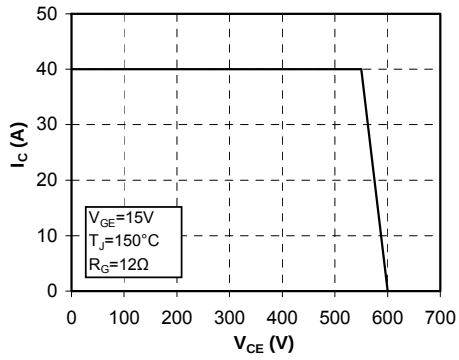

**Energy losses vs Collector Current**



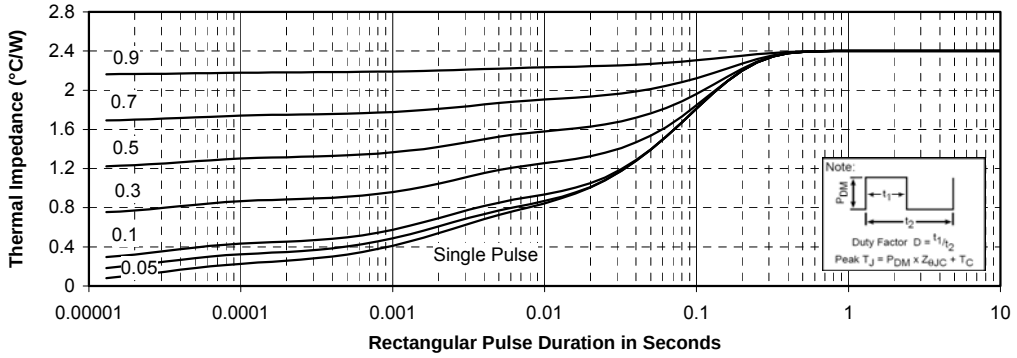

**Switching Energy Losses vs Gate Resistance**




**Reverse Bias Safe Operating Area**




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



## CR1 to CR6 Typical performance curve