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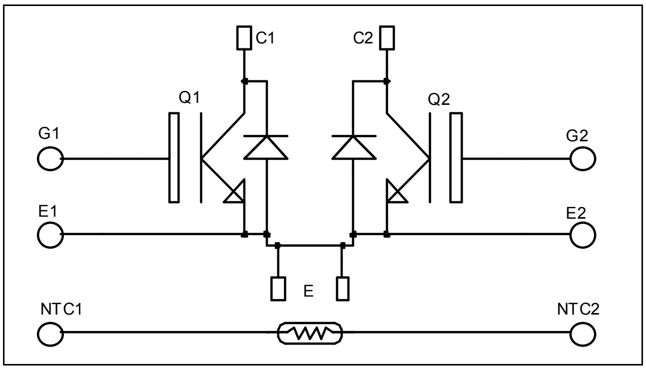
# *Dual common source NPT IGBT Power Module*

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

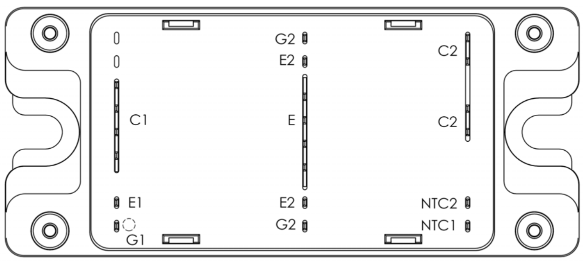
**Application**

- AC Switches
- Switched Mode Power Supplies
- Uninterruptible Power Supplies




**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
- 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 | | 1200 | V |
| $I_C$ | Continuous Collector Current | $T_c$ = 25°C | 135 | A |
| | | $T_c$ = 80°C | 100 | |
| $I_{CM}$ | Pulsed Collector Current | $T_c$ = 25°C | 300 | |
| $V_{GE}$ | Gate – Emitter Voltage | | ±20 | V |
| $P_D$ | Maximum Power Dissipation | $T_c$ = 25°C | 568 | W |
| RBSOA | Reverse Bias Safe Operating Area | $T_j$ = 150°C | 200A @ 1200V | |

**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<br>$V_{CE}$ = 1200V | $T_j$ = 25°C | | | 350 | µA |
| | | | $T_j$ = 125°C | | | 600 | |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $V_{GE}$ = 15V<br>$I_C$ = 100A | $T_j$ = 25°C | | 3.2 | 3.7 | V |
| | | | $T_j$ = 125°C | | 4.0 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 2 mA | | 4.5 | | 6.5 | V |
| $I_{GES}$ | Gate – Emitter Leakage Current | $V_{GE}$ = 20 V, $V_{CE}$ = 0V | | | | 150 | 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 | | | 6900 | | pF |
| $C_{oes}$ | Output Capacitance | | | | 660 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 440 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 15V<br>$V_{Bus}$ = 600V<br>$I_C$ = 100A | | | 660 | | nC |
| $Q_{ge}$ | Gate – Emitter Charge | | | | 70 | | |
| $Q_{gc}$ | Gate – Collector Charge | | | | 400 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C)<br>$V_{GE}$ = 15V<br>$V_{Bus}$ = 600V<br>$I_C$ = 100A<br>$R_G$ = 2.5 Ω | | | 35 | | ns |
| $T_r$ | Rise Time | | | | 65 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 320 | | |
| $T_f$ | Fall Time | | | | 30 | | |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (125°C)<br>$V_{GE}$ = 15V<br>$V_{Bus}$ = 600V<br>$I_C$ = 100A<br>$R_G$ = 2.5 Ω | | | 35 | | ns |
| $T_r$ | Rise Time | | | | 65 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | | 360 | | |
| $T_f$ | Fall Time | | | | 40 | | |
| $E_{on}$ | Turn-on Switching Energy | $V_{GE}$ = 15V<br>$V_{Bus}$ = 600V<br>$I_C$ = 100A<br>$R_G$ = 2.5 Ω | $T_j$ = 125°C | | 13.9 | | mJ |
| $E_{off}$ | Turn-off Switching Energy | | $T_j$ = 125°C | | 6.1 | | |

## Reverse 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 | | | 350 | µA |
| | | | $T_j$ = 125°C | | | 600 | |
| $I_F$ | DC Forward Current | | Tc = 70°C | | 120 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 120A | | | 2.0 | 2.5 | V |
| | | $I_F$ = 240A | | | 2.3 | | |
| | | $I_F$ = 120A | $T_j$ = 125°C | | 1.8 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 120A<br>$V_R$ = 800V<br>di/dt =800A/µs | $T_j$ = 25°C | | 370 | | ns |
| | | | $T_j$ = 125°C | | 500 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 2.64 | | µC |
| | | | $T_j$ = 125°C | | 13.8 | | |

## Thermal and package characteristics

| Symbol | Characteristic | | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{thJC}$ | Junction to Case Thermal Resistance | | IGBT | | | 0.22 | °C/W |
| | | | Diode | | | 0.32 | |
| $V_{ISOL}$ | 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 | M5 | 2.5 | | 4.7 | N.m |
| Wt | Package Weight | | | | | 160 | g |

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

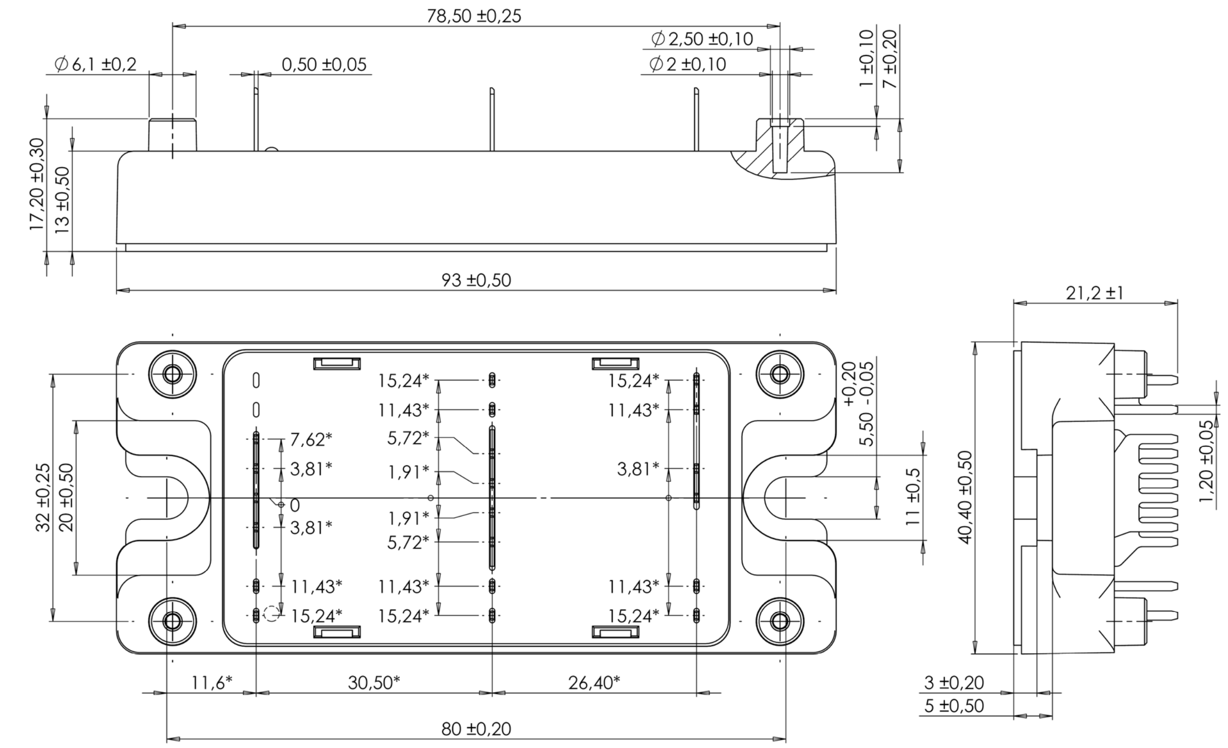
| Symbol | Characteristic | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| $R_{25}$ | Resistance @ 25°C | | 50 | | kΩ |
| $B_{25/85}$ | $T_{25}$ = 298.15 K | | 3952 | | K |

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

T: Thermistor temperature

$R_T$: Thermistor value at T

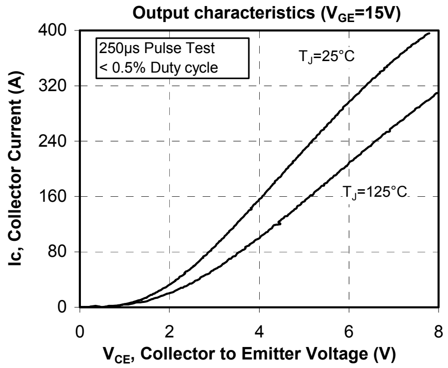
## SP4 Package outline (dimensions in mm)

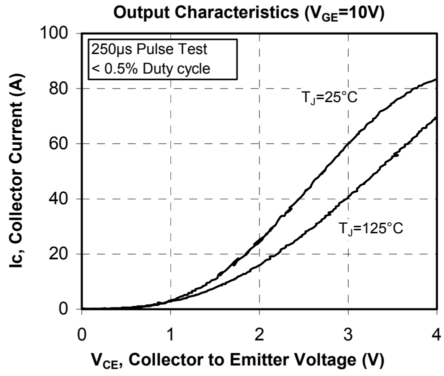


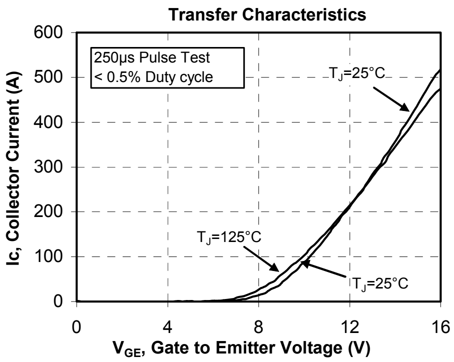

ALL DIMENSIONS MARKED "*" ARE TOLERANCED AS : ⌖ Ø 1

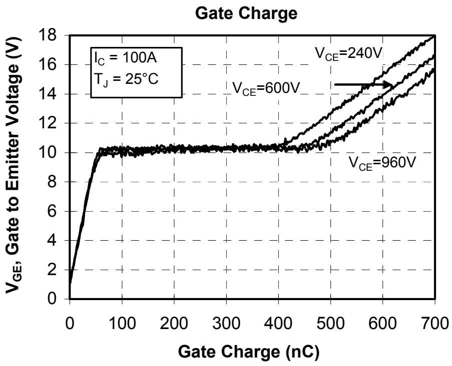
See application note APT0501 - Mounting Instructions for SP4 Power Modules on www.microsemi.com

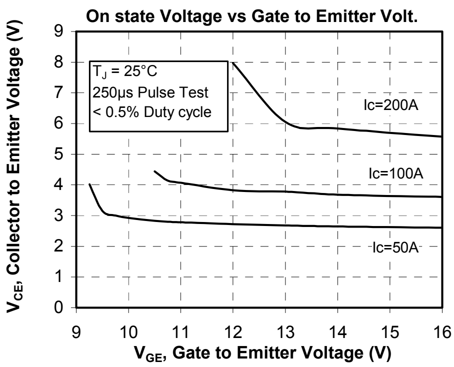
## Typical Performance Curve

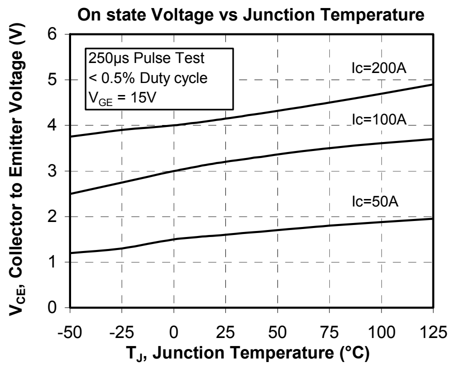


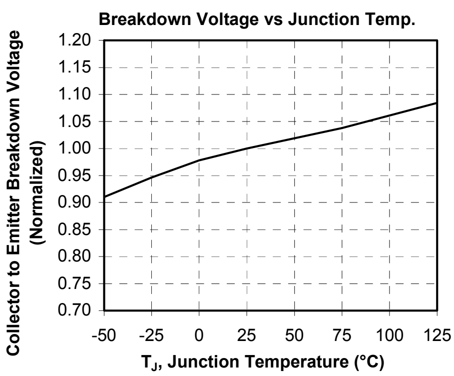



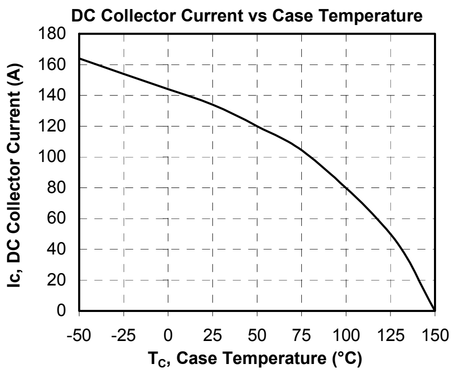



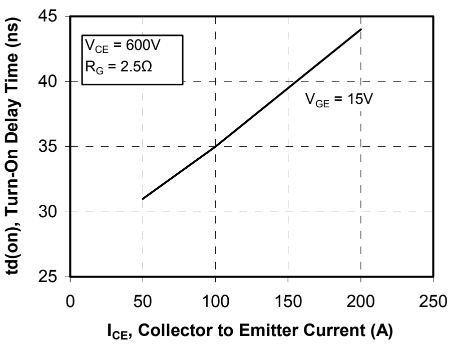



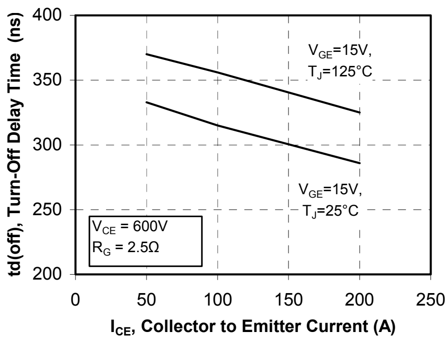



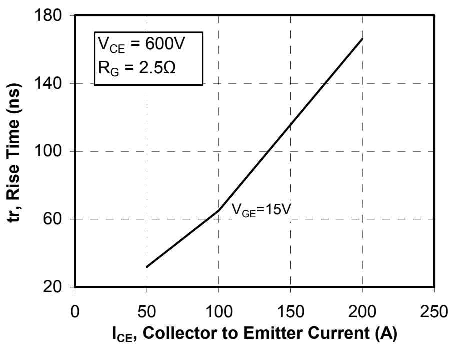
Turn-On Delay Time vs Collector Current



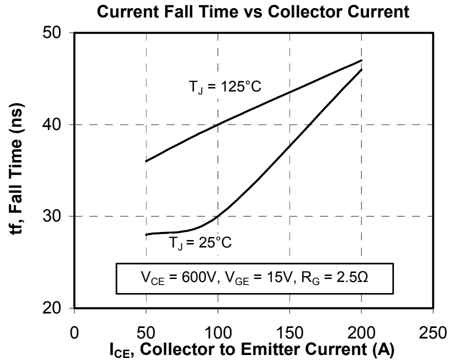

Turn-Off Delay Time vs Collector Current



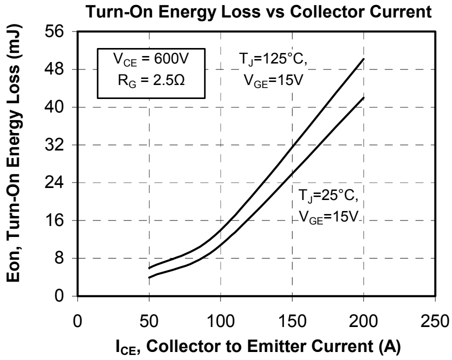

Current Rise Time vs Collector Current



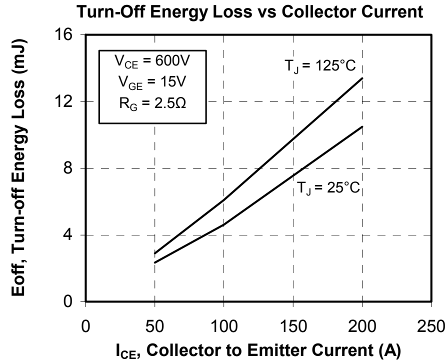

Current Fall Time vs Collector Current



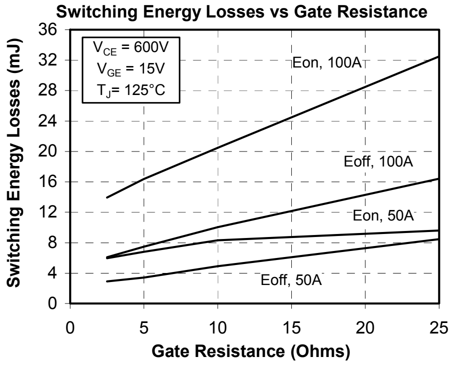

Turn-On Energy Loss vs Collector Current



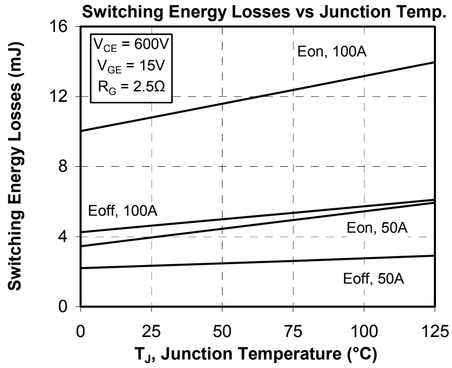

Turn-Off Energy Loss vs Collector Current

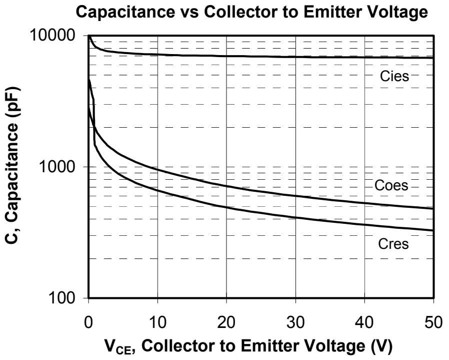


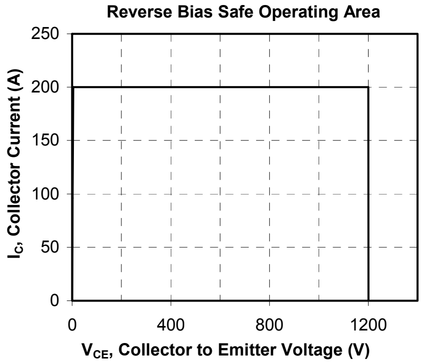

Switching Energy Losses vs Gate Resistance

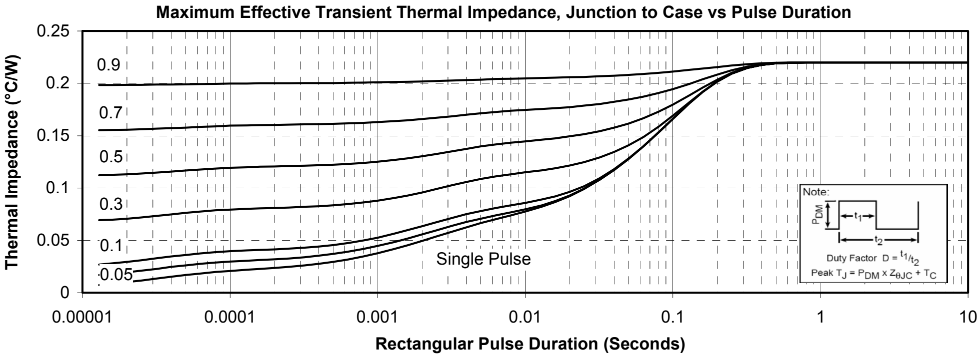


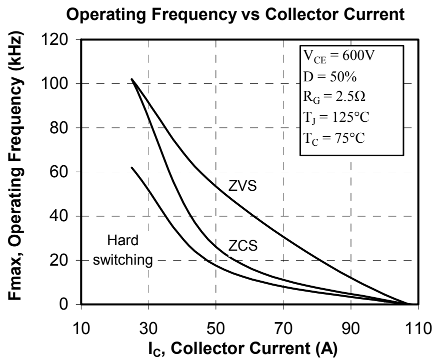

Switching Energy Losses vs Junction Temp.




Capacitance vs Collector to Emitter Voltage
10000
1000
100
C, Capacitance (pF)
Cies
Coes
Cres
0
10
20
30
40
50
$V_{CE}$, Collector to Emitter Voltage (V)


Reverse Bias Safe Operating Area
250
200
150
100
50
0
$I_C$, Collector Current (A)
0
400
800
1200
$V_{CE}$, Collector to Emitter Voltage (V)


Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration
0.25
0.2
0.15
0.1
0.05
0
Thermal Impedance (°C/W)
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 $T_J = P_{DM} \times Z_{\theta JC} + T_C$
0.00001
0.0001
0.001
0.01
0.1
1
10
Rectangular Pulse Duration (Seconds)


Operating Frequency vs Collector Current
120
100
80
60
40
20
0
Fmax, Operating Frequency (kHz)
$V_{CE}$ = 600V
D = 50%
$R_G$ = 2.5Ω
$T_J$ = 125°C
$T_C$ = 75°C
ZVS
ZCS
Hard switching
10
30
50
70
90
110
$I_C$, Collector Current (A)

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