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With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!


## Contact us

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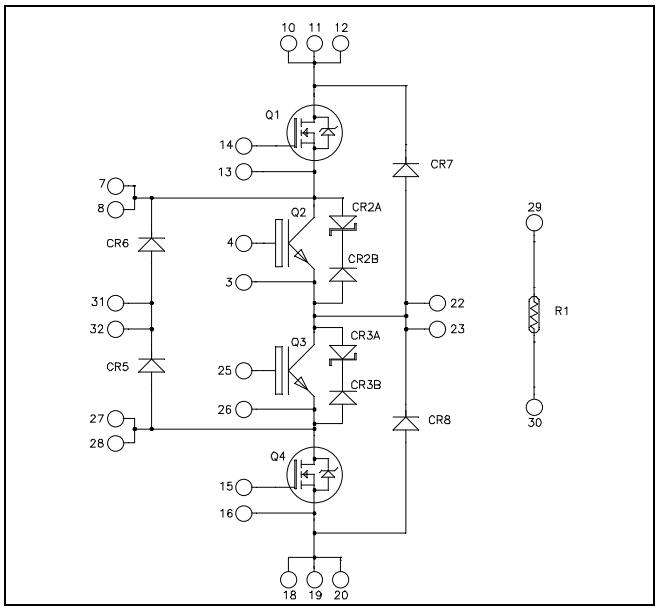
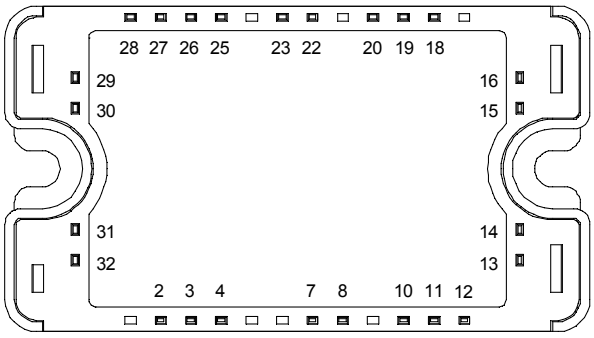
# APTCV60TLM45T3G

***Three level inverter***
***CoolMOS & Trench + Field Stop IGBT3***
***Power Module***

**Trench & Field Stop IGBT3 Q2, Q3:**
**$V_{CES}$ = 600V ; $I_C$ = 75A @ Tc = 80°C**

**CoolMOS™ Q1, Q4:**
**$V_{DSS}$ = 600V ; $I_D$ = 38A @ 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**

- ***Q2, Q3 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
- ***Q1, Q4 CoolMOS™***
  - Ultra low $R_{DSon}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
  - Very rugged
- 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

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

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

## Q1 & Q4 Absolute maximum ratings (per CoolMOS™)

| Symbol | Parameter | | Max ratings | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain - Source Breakdown Voltage | | 600 | V |
| $I_D$ | Continuous Drain Current | $T_c$ = 25°C | 49 | A |
| | | $T_c$ = 80°C | 38 | |
| $I_{DM}$ | Pulsed Drain current | | 130 | |
| $V_{GS}$ | Gate - Source Voltage | | ±20 | V |
| $R_{DSon}$ | Drain - Source ON Resistance | | 45 | mΩ |
| $P_D$ | Maximum Power Dissipation | $T_c$ = 25°C | 250 | W |
| $I_{AR}$ | Avalanche current (repetitive and non repetitive) | | 15 | A |
| $E_{AR}$ | Repetitive Avalanche Energy | | 3 | mJ |
| $E_{AS}$ | Single Pulse Avalanche Energy | | 1900 | |

## Q1 & Q4 Electrical Characteristics (per CoolMOS™)

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{DSS}$ | Zero Gate Voltage Drain Current | $V_{GS}$ = 0V, $V_{DS}$ = 600V | $T_j$ = 25°C | | | 250 | µA |
| | | $V_{GS}$ = 0V, $V_{DS}$ = 600V | $T_j$ = 125°C | | | 500 | |
| $R_{DS(on)}$ | Drain – Source on Resistance | $V_{GS}$ = 10V, $I_D$ = 24.5A | | | 40 | 45 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$ = $V_{DS}$, $I_D$ = 3mA | | 2.1 | 3 | 3.9 | V |
| $I_{GSS}$ | Gate – Source Leakage Current | $V_{GS}$ = ±20 V, $V_{DS}$ = 0V | | | | 100 | nA |

## Q1 & Q4 Dynamic Characteristics (per CoolMOS™)

| Symbol | Characteristic | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_{iss}$ | Input Capacitance | $V_{GS}$ = 0V ; $V_{DS}$ = 25V<br>f = 1MHz | | 7.2 | | nF |
| $C_{oss}$ | Output Capacitance | | | 8.5 | | |
| $Q_g$ | Total gate Charge | $V_{GS}$ = 10V<br>$V_{Bus}$ = 300V<br>$I_D$ = 49A | | 150 | | nC |
| $Q_{gs}$ | Gate – Source Charge | | | 34 | | |
| $Q_{gd}$ | Gate – Drain Charge | | | 51 | | |
| $T_{d(on)}$ | Turn-on Delay Time | **Inductive Switching (125°C)**<br>$V_{GS}$ = 10V<br>$V_{Bus}$ = 400V<br>$I_D$ = 49A<br>$R_G$ = 5Ω | | 21 | | ns |
| $T_r$ | Rise Time | | | 30 | | |
| $T_{d(off)}$ | Turn-off Delay Time | | | 100 | | |
| $T_f$ | Fall Time | | | 45 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 25°C**<br>$V_{GS}$ = 10V ; $V_{Bus}$ = 400V<br>$I_D$ = 49A ; $R_G$ = 5Ω | | 675 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 520 | | |
| $E_{on}$ | Turn-on Switching Energy | **Inductive switching @ 125°C**<br>$V_{GS}$ = 10V ; $V_{Bus}$ = 400V<br>$I_D$ = 49A ; $R_G$ = 5Ω | | 1100 | | µJ |
| $E_{off}$ | Turn-off Switching Energy | | | 635 | | |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | 0.5 | °C/W |

## Q2 & Q3 Absolute maximum ratings (per IGBT)

| Symbol | Parameter | | Max ratings | Unit |
|---|---|---|---|---|
| $V_{CES}$ | Collector - Emitter Breakdown Voltage | | 600 | V |
| $I_C$ | Continuous Collector Current | $T_C$ = 25°C | 100 | A |
| | | $T_C$ = 80°C | 75 | |
| $I_{CM}$ | Pulsed Collector Current | $T_C$ = 25°C | 140 | |
| $V_{GE}$ | Gate – Emitter Voltage | | ±20 | V |
| $P_D$ | Maximum Power Dissipation | $T_C$ = 25°C | 250 | W |
| RBSOA | Reverse Bias Safe Operating Area | $T_J$ = 150°C | 150A @ 550V | |

## Q2 & Q3 Electrical Characteristics (per IGBT)

| 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, $I_C$ = 75A | $T_j$ = 25°C | | 1.5 | 1.9 | V |
| | | | $T_j$ = 150°C | | 1.7 | | |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{GE}$ = $V_{CE}$, $I_C$ = 600µA | | 5.0 | 5.8 | 6.5 | V |
| $I_{GES}$ | Gate – Emitter Leakage Current | $V_{GE}$ = 20V, $V_{CE}$ = 0V | | | | 600 | nA |

## Q2 & Q3 Dynamic Characteristics (per IGBT)

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $C_{ies}$ | Input Capacitance | $V_{GE}$ = 0V<br>$V_{CE}$ = 25V<br>f = 1MHz | | | 4620 | | pF |
| $C_{oes}$ | Output Capacitance | | | | 300 | | |
| $C_{res}$ | Reverse Transfer Capacitance | | | | 140 | | |
| $Q_G$ | Gate charge | $V_{GE}$=±15V, $I_C$=75A<br>$V_{CE}$=300V | | | 0.8 | | µC |
| $T_{d(on)}$ | Turn-on Delay Time | Inductive Switching (25°C)<br>$V_{GE}$ = ±15V<br>$V_{Bus}$ = 300V<br>$I_C$ = 75A<br>$R_G$ = 4.7Ω | | | 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>$I_C$ = 75A<br>$R_G$ = 4.7Ω | | | 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>$I_C$ = 75A<br>$R_G$ = 4.7Ω | $T_j$ = 25°C | | 0.35 | | mJ |
| | | | $T_j$ = 150°C | | 0.6 | | |
| $E_{off}$ | Turn-off Switching Energy | | $T_j$ = 25°C | | 2.2 | | mJ |
| | | | $T_j$ = 150°C | | 2.6 | | |
| $I_{sc}$ | Short Circuit data | $V_{GE}$ ≤15V ; $V_{Bus}$ = 360V<br>$t_p$ ≤ 6µs ; $T_j$ = 150°C | | | 380 | | A |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 0.60 | °C/W |

## CR2 & CR3 diode ratings and characteristics (per device)

| Symbol | Characteristic | Test Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_F$ | Diode + tranzorb Forward Voltage | $I_F$ = 10A | | | 10 | | V |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 8 | °C/W |

## CR5 & CR6 diode ratings and characteristics (per diode)

| 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 | | | | 25 | µA |
| $I_F$ | DC Forward Current | | Tc = 80°C | | 30 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 30A | | | 1.8 | 2.2 | V |
| | | $I_F$ = 60A | | | 2.2 | | |
| | | $I_F$ = 30A | $T_j$ = 125°C | | 1.5 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 30A<br>$V_R$ = 400V<br>di/dt =200A/µs | $T_j$ = 25°C | | 25 | | ns |
| | | | $T_j$ = 125°C | | 160 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 35 | | nC |
| | | | $T_j$ = 125°C | | 480 | | |
| $E_{rr}$ | Reverse Recovery Energy | $I_F$ = 30A<br>$V_R$ = 400V<br>di/dt =1000A/µs | $T_j$ = 125°C | | 0.6 | | mJ |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 1.2 | °C/W |

## CR7 & CR8 diode ratings and characteristics (per diode)

| 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 | | | | 100 | µA |
| $I_F$ | DC Forward Current | | Tc = 80°C | | 30 | | A |
| $V_F$ | Diode Forward Voltage | $I_F$ = 30A | | | 2.6 | 3.1 | V |
| | | $I_F$ = 60A | | | 3.2 | | |
| | | $I_F$ = 30A | $T_j$ = 125°C | | 1.8 | | |
| $t_{rr}$ | Reverse Recovery Time | $I_F$ = 30A<br>$V_R$ = 800V<br>di/dt =200A/µs | $T_j$ = 25°C | | 300 | | ns |
| | | | $T_j$ = 125°C | | 380 | | |
| $Q_{rr}$ | Reverse Recovery Charge | | $T_j$ = 25°C | | 360 | | nC |
| | | | $T_j$ = 125°C | | 1700 | | |
| $E_{rr}$ | Reverse Recovery Energy | $I_F$ = 30A<br>$V_R$ = 800V<br>di/dt =1000A/µs | $T_j$ = 125°C | | 1.6 | | mJ |
| $R_{thJC}$ | Junction to Case Thermal Resistance | | | | | 1.2 | °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 |
| $\Delta B/B$ | | $T_C$=100°C | | 4 | | % |

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

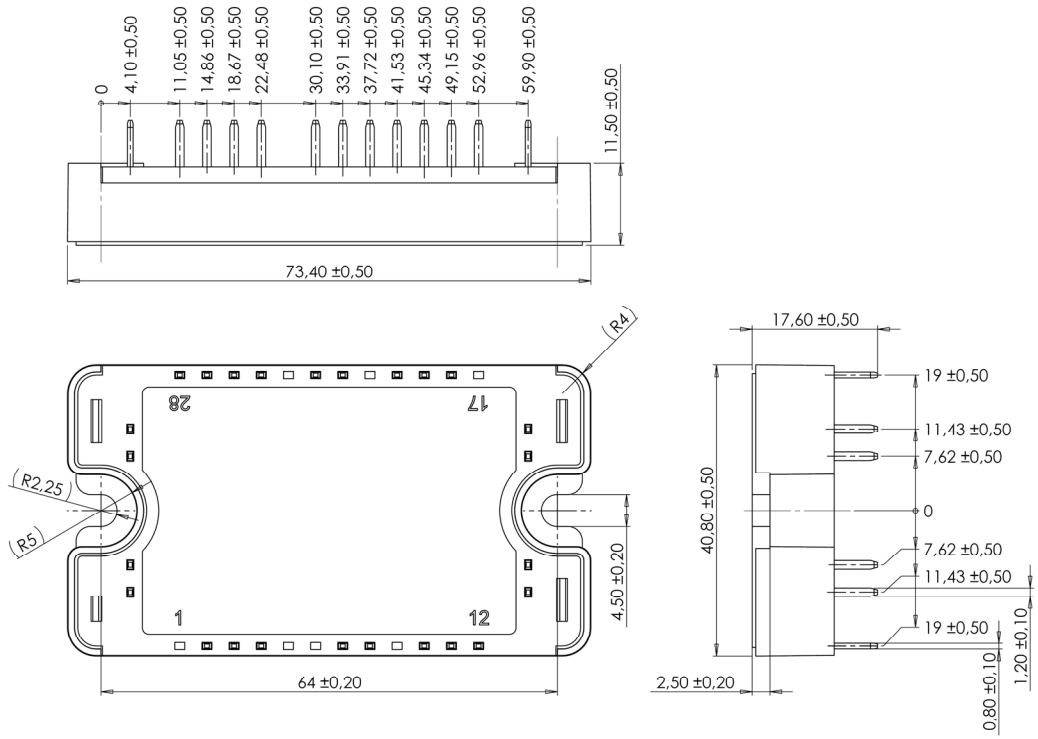
T: Thermistor temperature
$R_T$: Thermistor value at T

## Thermal and package characteristics

| *Symbol* | *Characteristic* | | | *Min* | *Typ* | *Max* | *Unit* |
|---|---|---|---|---|---|---|---|
| $V_{ISOL}$ | RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz | | | 4000 | | | 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 | | 3 | N.m |
| Wt | Package Weight | | | | | 110 | g |

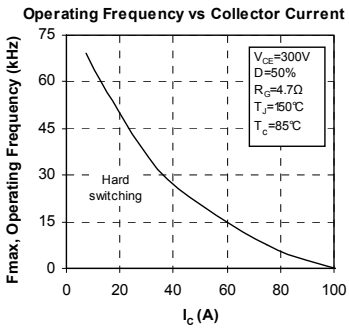
* Tjmax = 150°C for Q1 & Q4

## SP3 Package outline (dimensions in mm)

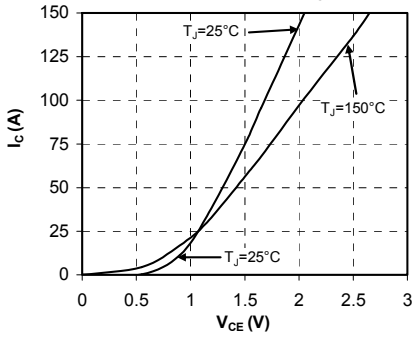



See application note 1901 - Mounting Instructions for SP3 Power Modules on www.microsemi.com

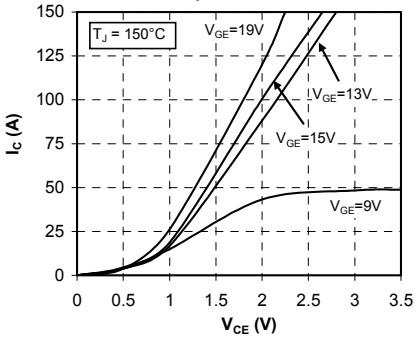
## Q2 & Q3 Typical performance curve



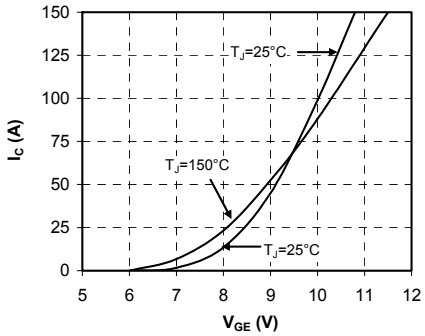
**Output Characteristics ($V_{GE}$=15V)**



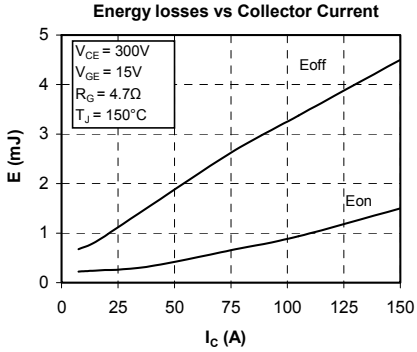

**Output Characteristics**



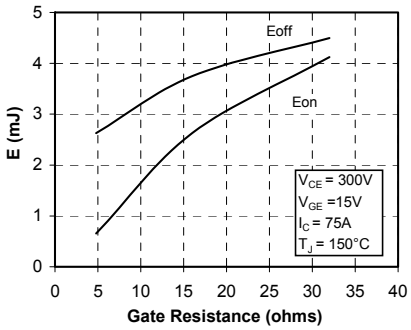

**Transfert Characteristics**



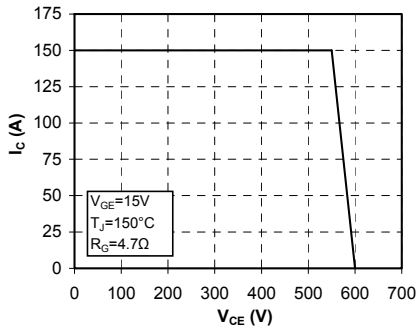

**Energy losses vs Collector Current**



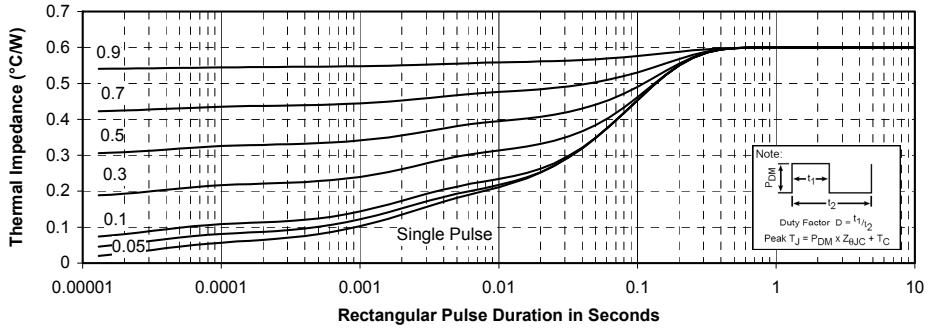

**Switching Energy Losses vs Gate Resistance**



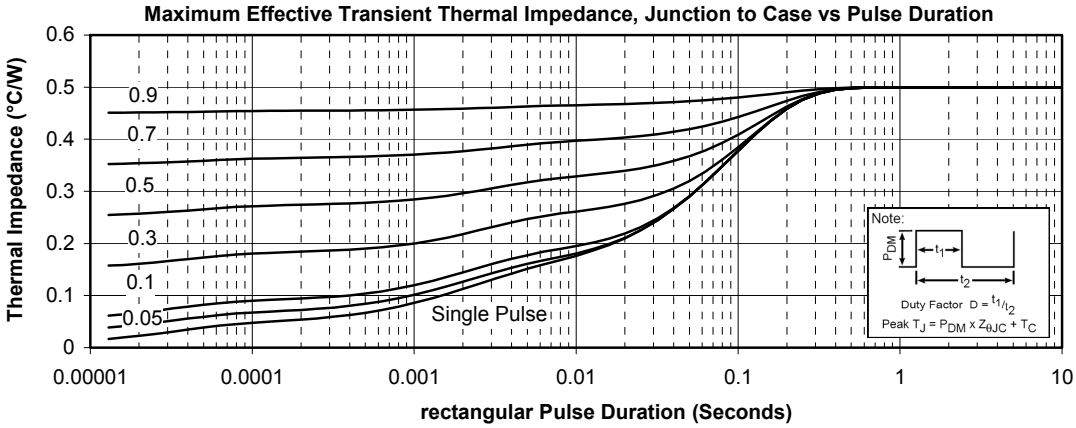

**Reverse Bias Safe Operating Area**

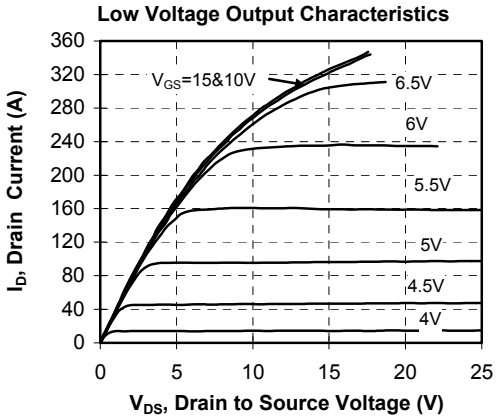


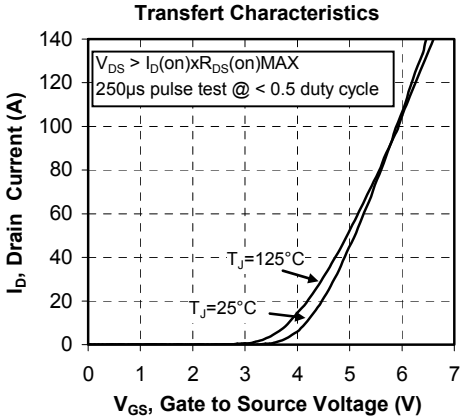

**maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration**

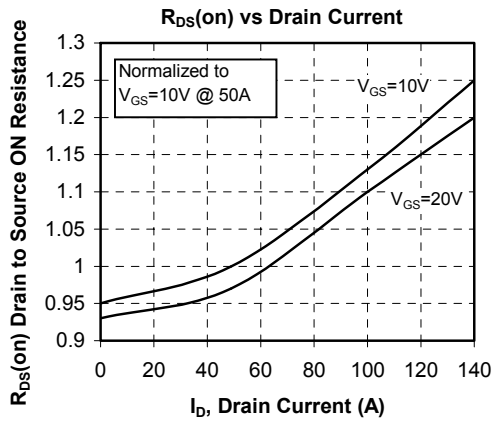


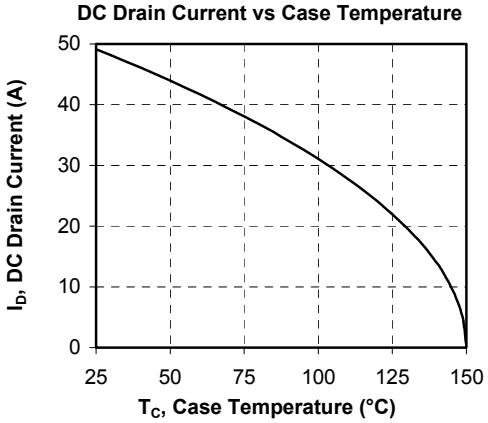
## Q1 & Q4 Typical performance curve



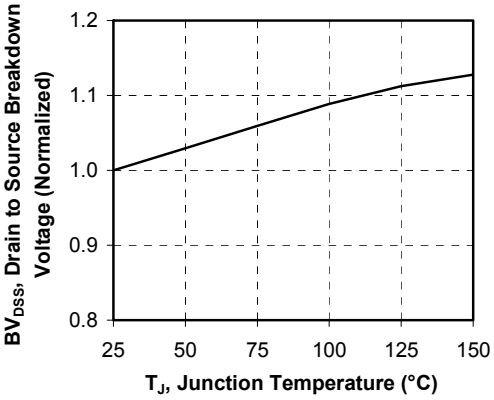



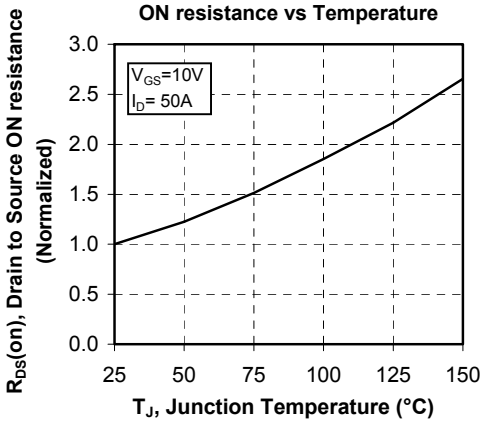



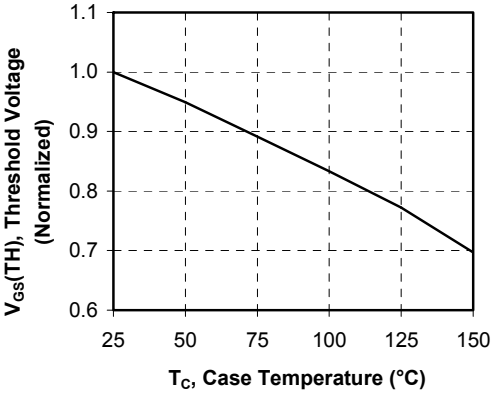
**Breakdown Voltage vs Temperature**



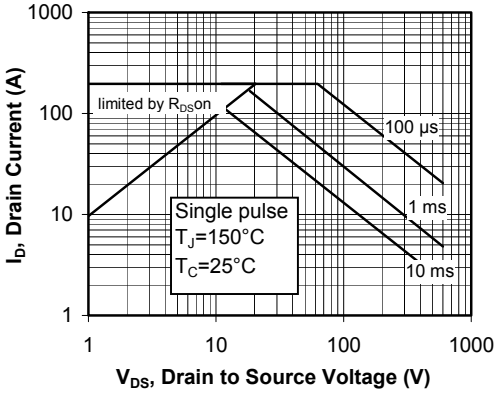

**ON resistance vs Temperature**



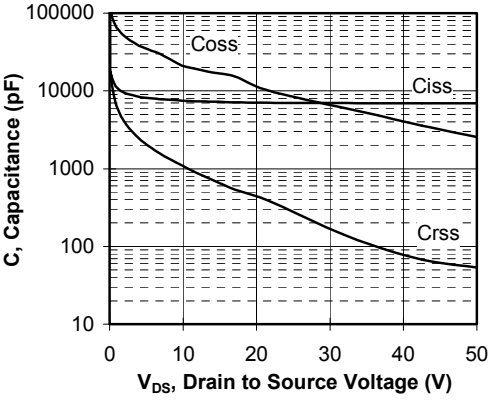

**Threshold Voltage vs Temperature**



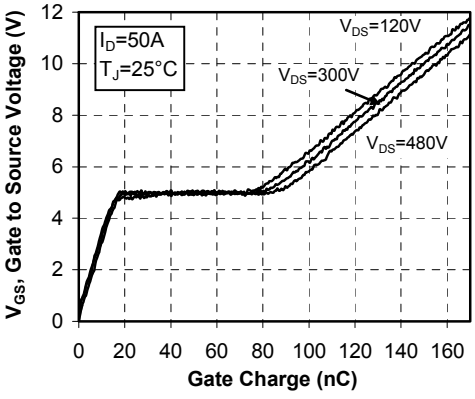

**Maximum Safe Operating Area**



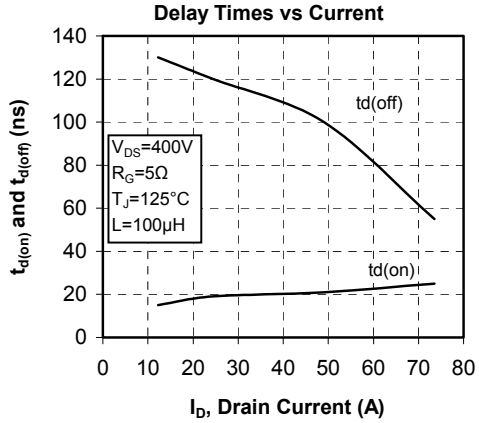

**Capacitance vs Drain to Source Voltage**



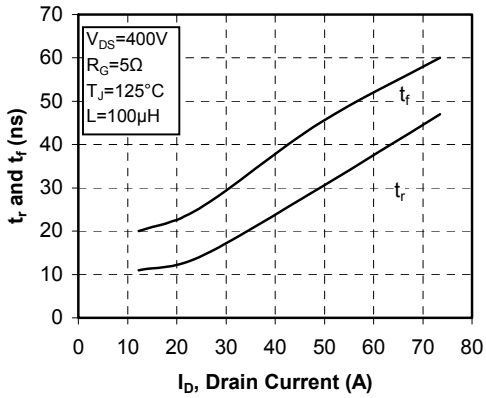

**Gate Charge vs Gate to Source Voltage**



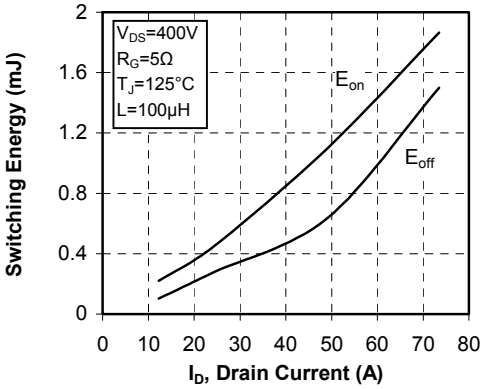
**Delay Times vs Current**



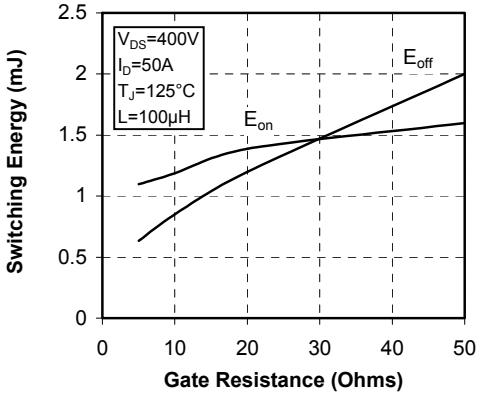

**Rise and Fall times vs Current**



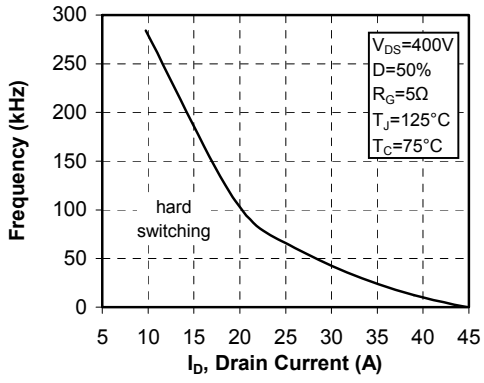

**Switching Energy vs Current**



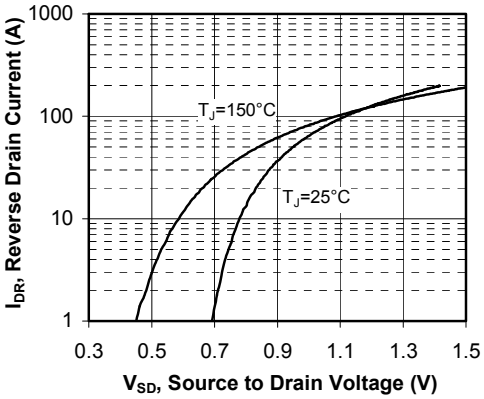

**Switching Energy vs Gate Resistance**




**Operating Frequency vs Drain Current**

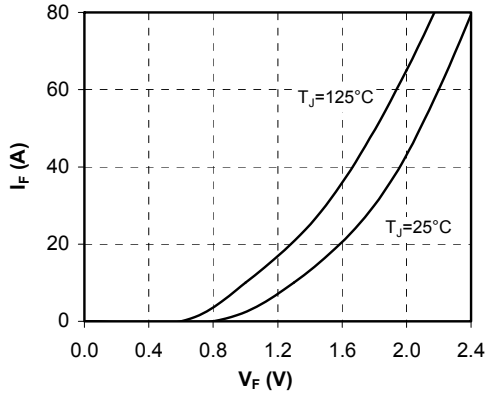



**Source to Drain Diode Forward Voltage**

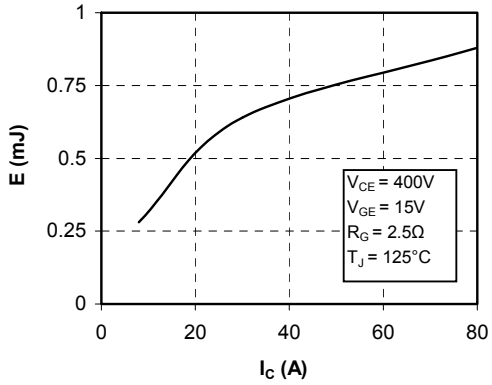


## CR5 & CR6 Typical performance curve

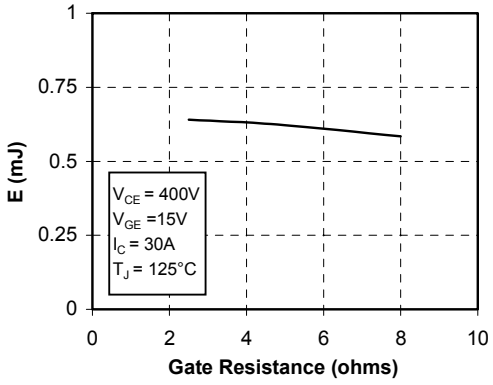
Forward Characteristic of diode



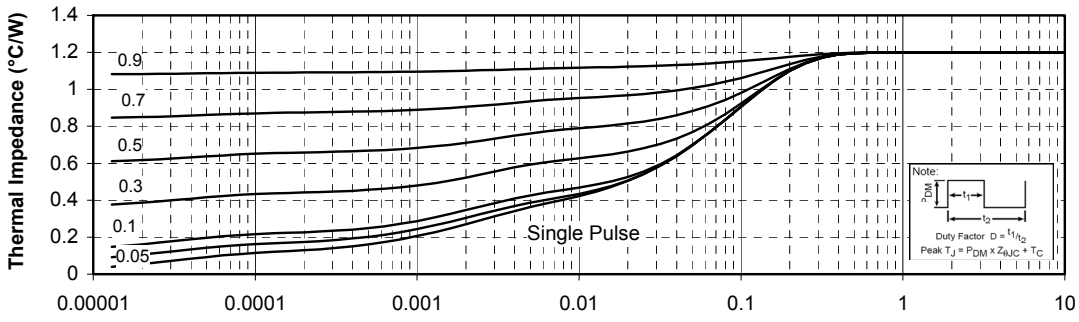

Energy losses vs Collector Current



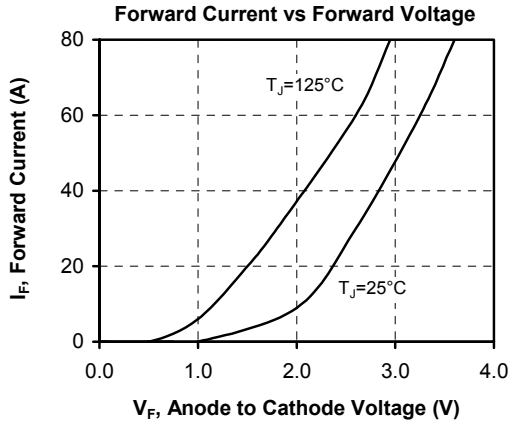

Switching Energy Losses vs Gate Resistance

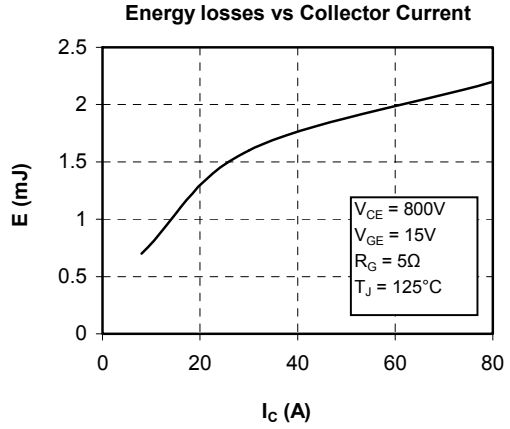


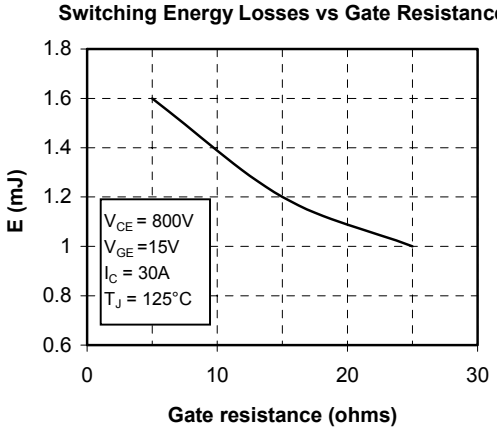

Maximum Effective Transient Thermal Impedance, Junction to Case vs Pulse Duration

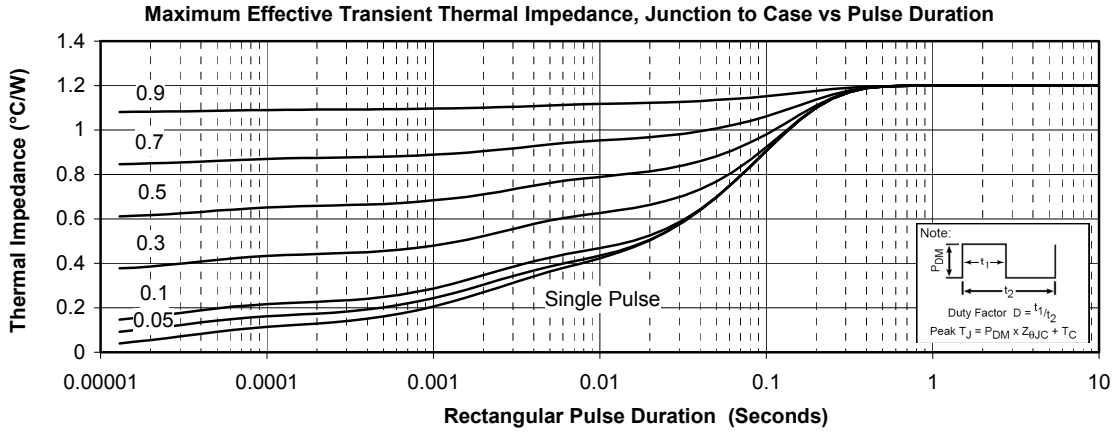


## CR7 & CR8 Typical performance curve



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