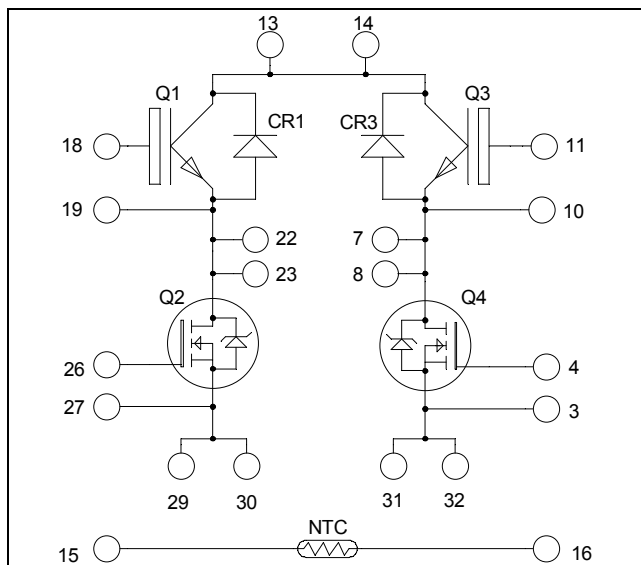


**Full - Bridge  
NPT & Trench + Field Stop IGBT3  
Power module**

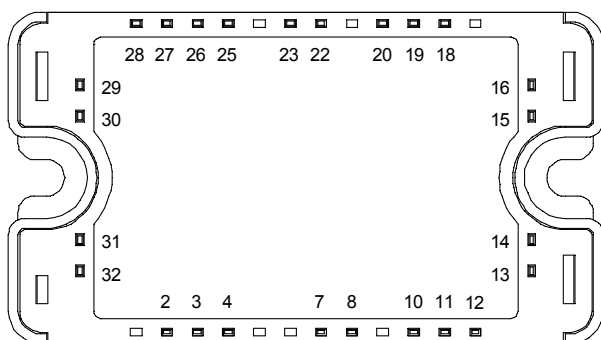
**Trench & Field Stop IGBT3 Q1, Q3:**  
 $V_{CES} = 600V$  ;  $I_C = 50A$  @  $T_c = 80^\circ C$

**CoolMOS™ Q2, Q4:**  
 $V_{CES} = 600V$  ;  $I_C = 49A$  @  $T_c = 25^\circ C$



Top switches : Trench + Field Stop IGBT3

Bottom switches : CoolMOS™



All multiple inputs and outputs must be shorted together  
13/14 ; 15/16 ; 26/27 ; 31/32

## Application

- Solar converter

## Features

- **Q2, Q4 CoolMOS™**
  - Ultra low  $R_{DSon}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated
- **Q1, Q3 Trench & Field Stop IGBT3**
  - Low voltage drop
  - Switching frequency up to 20 kHz
  - RBSOA & SCSOA rated
  - Low tail current
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

## Benefits

- Optimized conduction & switching losses
- 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
- Easy paralleling due to positive  $T_c$  of  $V_{CESat}$
- RoHS Compliant

**All ratings @  $T_j = 25^\circ C$  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](http://www.microsemi.com)

## 1. Top switches

### 1.1 Top Trench + Field Stop IGBT3 characteristics

#### Absolute maximum ratings

| Symbol    | Parameter                             | Max ratings                                                      | Unit |
|-----------|---------------------------------------|------------------------------------------------------------------|------|
| $V_{CES}$ | Collector - Emitter Breakdown Voltage | 600                                                              | V    |
| $I_C$     | Continuous Collector Current          | $T_C = 25^\circ\text{C}$<br>80<br>$T_C = 80^\circ\text{C}$<br>50 | A    |
| $I_{CM}$  | Pulsed Collector Current              | $T_C = 25^\circ\text{C}$<br>100                                  |      |
| $V_{GE}$  | Gate – Emitter Voltage                | $\pm 20$                                                         | V    |
| $P_D$     | Maximum Power Dissipation             | $T_C = 25^\circ\text{C}$<br>176                                  | W    |
| RBSOA     | Reverse Bias Safe Operating Area      | $T_J = 150^\circ\text{C}$<br>100A @ 550V                         |      |

#### Electrical Characteristics

| Symbol        | Characteristic                       | Test Conditions                                                                                      | Min | Typ        | Max | Unit          |
|---------------|--------------------------------------|------------------------------------------------------------------------------------------------------|-----|------------|-----|---------------|
| $I_{CES}$     | Zero Gate Voltage Collector Current  | $V_{GE} = 0\text{V}$ , $V_{CE} = 600\text{V}$                                                        |     |            | 250 | $\mu\text{A}$ |
| $V_{CE(sat)}$ | Collector Emitter Saturation Voltage | $V_{GE} = 15\text{V}$<br>$I_C = 50\text{A}$<br>$T_J = 25^\circ\text{C}$<br>$T_J = 150^\circ\text{C}$ |     | 1.5<br>1.7 | 1.9 | V             |
| $V_{GE(th)}$  | Gate Threshold Voltage               | $V_{GE} = V_{CE}$ , $I_C = 600\mu\text{A}$                                                           | 5.0 | 5.8        | 6.5 | V             |
| $I_{GES}$     | Gate – Emitter Leakage Current       | $V_{GE} = 20\text{V}$ , $V_{CE} = 0\text{V}$                                                         |     |            | 600 | nA            |

#### Dynamic Characteristics

| Symbol       | Characteristic                      | Test Conditions                                                                                                                                          | Min | Typ          | Max  | Unit               |
|--------------|-------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----|--------------|------|--------------------|
| $C_{ies}$    | Input Capacitance                   | $V_{GE} = 0\text{V}$                                                                                                                                     |     | 3150         |      | pF                 |
| $C_{oes}$    | Output Capacitance                  | $V_{CE} = 25\text{V}$                                                                                                                                    |     | 200          |      |                    |
| $C_{res}$    | Reverse Transfer Capacitance        | $f = 1\text{MHz}$                                                                                                                                        |     | 95           |      |                    |
| $T_{d(on)}$  | Turn-on Delay Time                  | Inductive Switching ( $25^\circ\text{C}$ )<br>$V_{GE} = \pm 15\text{V}$<br>$V_{Bus} = 300\text{V}$<br>$I_C = 50\text{A}$<br>$R_G = 8.2\Omega$            |     | 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 ( $150^\circ\text{C}$ )<br>$V_{GE} = \pm 15\text{V}$<br>$V_{Bus} = 300\text{V}$<br>$I_C = 50\text{A}$<br>$R_G = 8.2\Omega$           |     | 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            | $V_{GE} = \pm 15\text{V}$<br>$V_{Bus} = 300\text{V}$<br>$I_C = 50\text{A}$<br>$R_G = 8.2\Omega$<br>$T_J = 25^\circ\text{C}$<br>$T_J = 150^\circ\text{C}$ |     | 0.3<br>0.43  |      | mJ                 |
| $E_{off}$    | Turn-off Switching Energy           | $T_J = 25^\circ\text{C}$<br>$T_J = 150^\circ\text{C}$                                                                                                    |     | 1.35<br>1.75 |      |                    |
| $R_{thJC}$   | Junction to Case Thermal resistance |                                                                                                                                                          |     |              | 0.85 | $^\circ\text{C/W}$ |

## 1.2 Top fast diode characteristics

| Symbol     | Characteristic                          | Test Conditions                                     |                     | Min | Typ | Max | Unit         |
|------------|-----------------------------------------|-----------------------------------------------------|---------------------|-----|-----|-----|--------------|
| $V_{RRM}$  | Maximum Peak Repetitive Reverse Voltage |                                                     |                     | 600 |     |     | V            |
| $I_{RM}$   | Maximum Reverse Leakage Current         | $V_R = 600V$                                        | $T_j = 25^\circ C$  |     |     | 25  | $\mu A$      |
|            |                                         |                                                     | $T_j = 125^\circ C$ |     |     | 500 |              |
| $I_F$      | DC Forward Current                      |                                                     | $T_c = 80^\circ C$  |     | 30  |     | A            |
| $V_F$      | Diode Forward Voltage                   | $I_F = 30A$                                         |                     |     | 1.8 | 2.3 | V            |
|            |                                         | $I_F = 60A$                                         |                     |     | 2.1 |     |              |
|            |                                         | $I_F = 30A$                                         | $T_j = 125^\circ C$ |     | 1.5 |     |              |
| $t_{rr}$   | Reverse Recovery Time                   | $I_F = 30A$<br>$V_R = 400V$<br>$di/dt = 200A/\mu s$ | $T_j = 25^\circ C$  |     | 25  |     | ns           |
|            |                                         |                                                     | $T_j = 125^\circ C$ |     | 160 |     |              |
| $Q_{rr}$   | Reverse Recovery Charge                 |                                                     | $T_j = 25^\circ C$  |     | 35  |     | nC           |
|            |                                         |                                                     | $T_j = 125^\circ C$ |     | 480 |     |              |
| $R_{thJC}$ | Junction to Case Thermal resistance     |                                                     |                     |     |     | 1.2 | $^\circ C/W$ |

## 2. Bottom switches

### 2.1 Bottom CoolMOS™ characteristics

#### Absolute maximum ratings

| Symbol            | Parameter                                         |                       | Max ratings | Unit |
|-------------------|---------------------------------------------------|-----------------------|-------------|------|
| V <sub>DSS</sub>  | Drain - Source Breakdown Voltage                  |                       | 600         | V    |
| I <sub>D</sub>    | Continuous Drain Current                          | T <sub>c</sub> = 25°C | 49          | A    |
|                   |                                                   | T <sub>c</sub> = 80°C | 38          |      |
| I <sub>DM</sub>   | Pulsed Drain current                              |                       | 130         |      |
| V <sub>GS</sub>   | Gate - Source Voltage                             |                       | ±20         | V    |
| R <sub>DSon</sub> | Drain - Source ON Resistance                      |                       | 45          | mΩ   |
| P <sub>D</sub>    | Maximum Power Dissipation                         | T <sub>c</sub> = 25°C | 290         | W    |
| I <sub>AR</sub>   | Avalanche current (repetitive and non repetitive) |                       | 15          | A    |
| E <sub>AR</sub>   | Repetitive Avalanche Energy                       |                       | 3           | mJ   |
| E <sub>AS</sub>   | Single Pulse Avalanche Energy                     |                       | 1900        |      |

#### Electrical Characteristics

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

**Dynamic Characteristics**

| Symbol              | Characteristic                      | Test Conditions                                                                                                                         | Min | Typ  | Max | Unit |
|---------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|------|
| C <sub>iss</sub>    | Input Capacitance                   | V <sub>GS</sub> = 0V ; V <sub>DS</sub> = 25V                                                                                            |     | 7.2  |     | nF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance        | f = 1MHz                                                                                                                                |     | 0.29 |     |      |
| Q <sub>g</sub>      | Total gate Charge                   | V <sub>GS</sub> = 10V<br>V <sub>Bus</sub> = 300V<br>I <sub>D</sub> = 49A                                                                |     | 150  |     | nC   |
| Q <sub>gs</sub>     | Gate – Source Charge                |                                                                                                                                         |     | 34   |     |      |
| Q <sub>gd</sub>     | Gate – Drain Charge                 |                                                                                                                                         |     | 51   |     |      |
| T <sub>d(on)</sub>  | Turn-on Delay Time                  | <b>Inductive Switching (125°C)</b><br>V <sub>GS</sub> = 10V<br>V <sub>Bus</sub> = 400V<br>I <sub>D</sub> = 49A<br>R <sub>G</sub> = 4.7Ω |     | 21   |     | ns   |
| T <sub>r</sub>      | Rise Time                           |                                                                                                                                         |     | 30   |     |      |
| T <sub>d(off)</sub> | Turn-off Delay Time                 |                                                                                                                                         |     | 100  |     |      |
| T <sub>f</sub>      | Fall Time                           |                                                                                                                                         |     | 45   |     |      |
| E <sub>on</sub>     | Turn-on Switching Energy            | <b>Inductive switching @ 25°C</b><br>V <sub>GS</sub> = 10V ; V <sub>Bus</sub> = 400V<br>I <sub>D</sub> = 49A ; R <sub>G</sub> = 4.7Ω    |     | 675  |     | μJ   |
| E <sub>off</sub>    | Turn-off Switching Energy           |                                                                                                                                         |     | 520  |     |      |
| E <sub>on</sub>     | Turn-on Switching Energy            | <b>Inductive switching @ 125°C</b><br>V <sub>GS</sub> = 10V ; V <sub>Bus</sub> = 400V<br>I <sub>D</sub> = 49A ; R <sub>G</sub> = 4.7Ω   |     | 1100 |     | μJ   |
| E <sub>off</sub>    | Turn-off Switching Energy           |                                                                                                                                         |     | 635  |     |      |
| R <sub>thJC</sub>   | Junction to Case Thermal resistance |                                                                                                                                         |     |      | 0.5 | °C/W |

**3. Temperature sensor**

**NTC** (see application note APT0406 on [www.microsemi.com](http://www.microsemi.com) for more information).

| Symbol             | Characteristic             | Min | Typ  | Max | Unit |
|--------------------|----------------------------|-----|------|-----|------|
| R <sub>25</sub>    | Resistance @ 25°C          |     | 50   |     | kΩ   |
| B <sub>25/85</sub> | T <sub>25</sub> = 298.15 K |     | 3952 |     | K    |

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

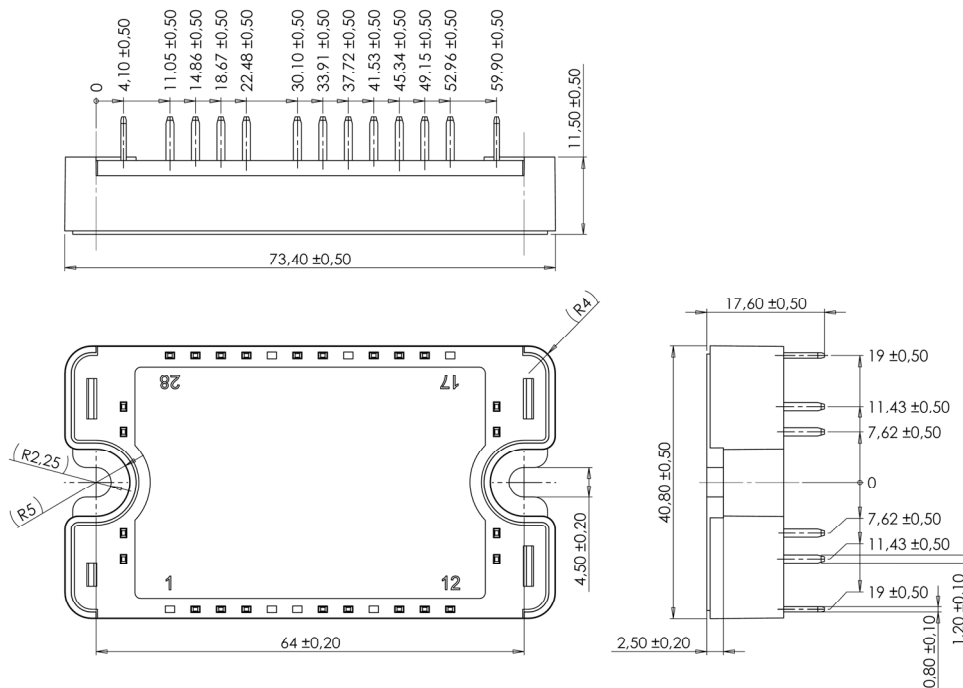
T: Thermistor temperature  
R<sub>T</sub>: Thermistor value at T

**4. Package characteristics**

| Symbol            | Characteristic                                                |             |    | Min  | Typ | Max  | Unit |
|-------------------|---------------------------------------------------------------|-------------|----|------|-----|------|------|
| V <sub>ISOL</sub> | RMS Isolation Voltage, any terminal to case t =1 min, 50/60Hz |             |    | 4000 |     |      | V    |
| T <sub>J</sub>    | Operating junction temperature range                          |             |    | -40  |     | 150* | °C   |
| T <sub>STG</sub>  | Storage Temperature Range                                     |             |    | -40  |     | 125  |      |
| T <sub>C</sub>    | Operating Case Temperature                                    |             |    | -40  |     | 100  |      |
| Torque            | Mounting torque                                               | To heatsink | M4 | 2    |     | 3    | N.m  |
| Wt                | Package Weight                                                |             |    |      |     | 110  | g    |

T<sub>j</sub> = 175°C for Trench & Field Stop IGBT3

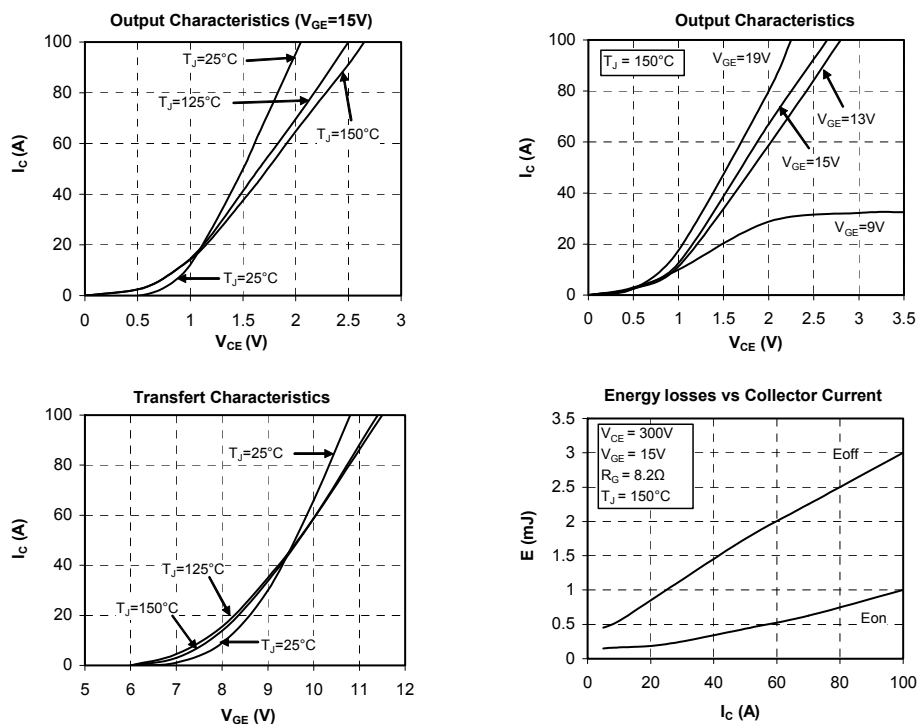
## 5. SP3 Package outline (dimensions in mm)

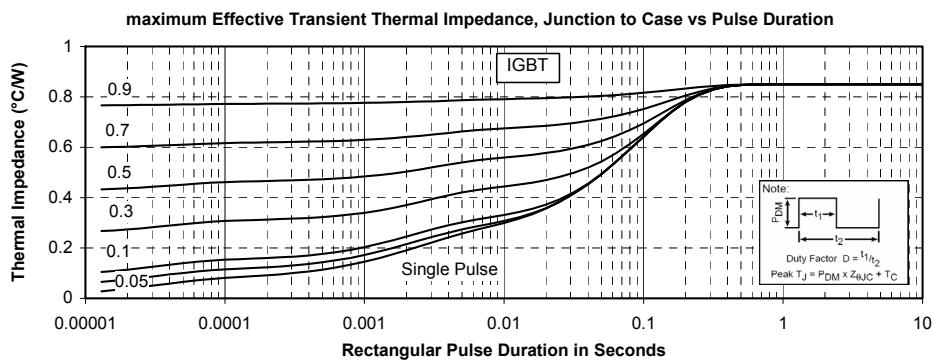
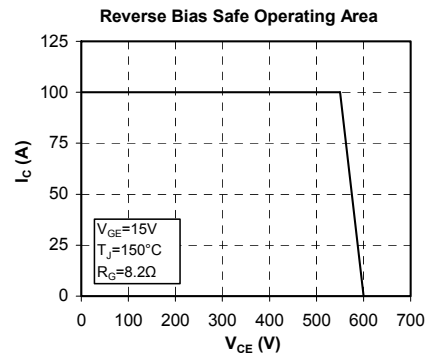
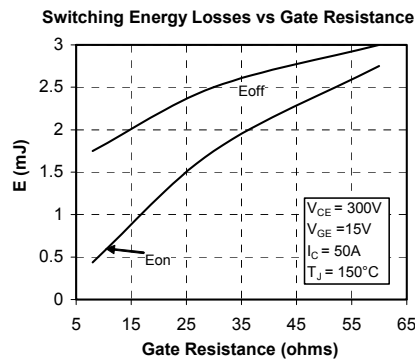


See application note 1901 - Mounting Instructions for SP3 Power Modules on [www.microsemi.com](http://www.microsemi.com)

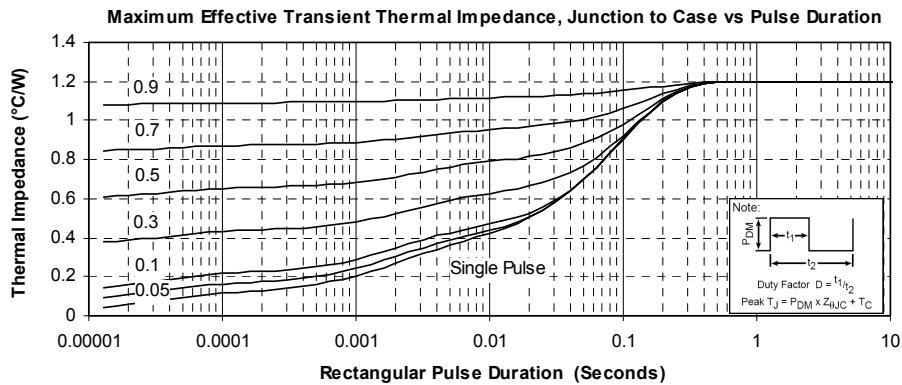
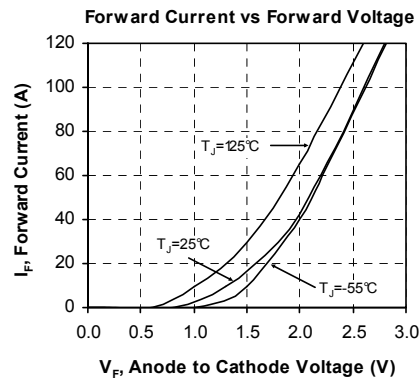
## 6. Top switches curves

### 6.1 Top Trench + Field Stop IGBT3 typical performance curves



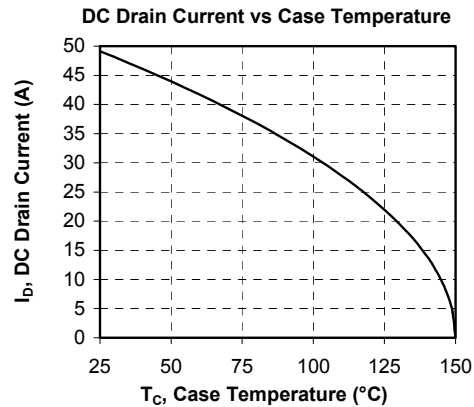
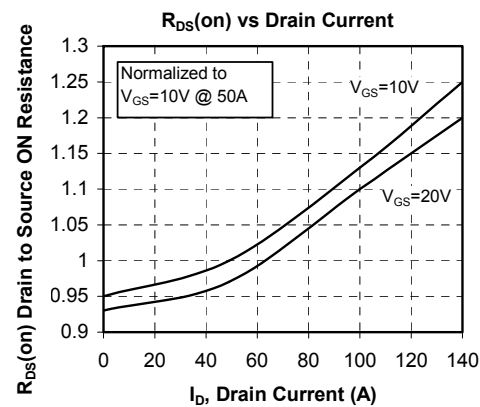
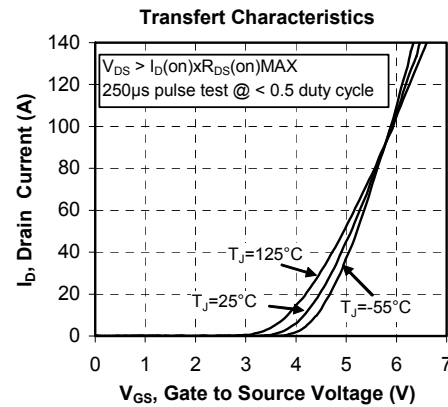
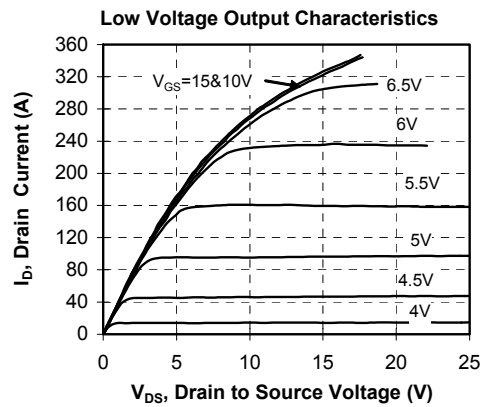
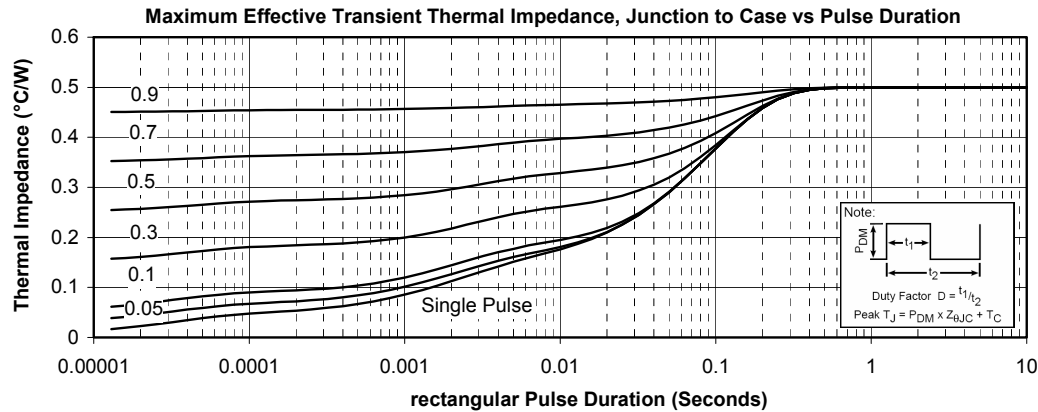


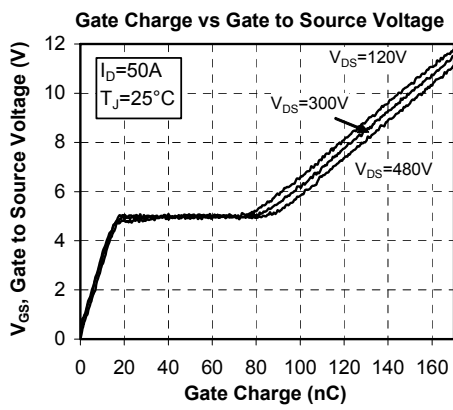
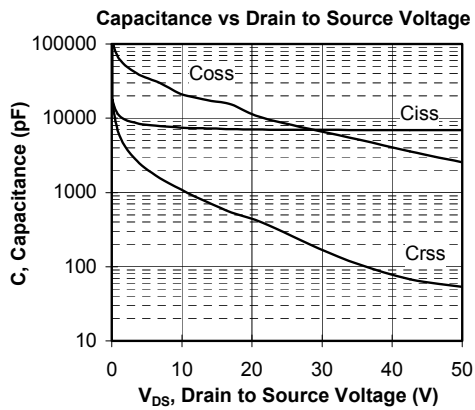
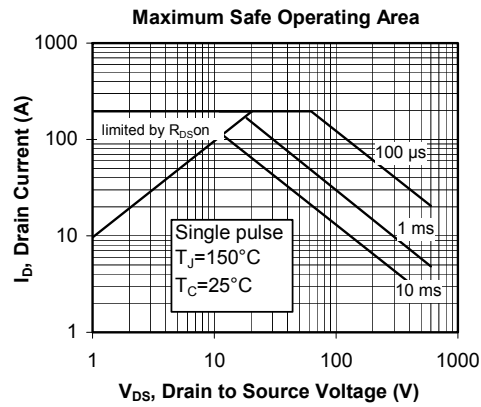
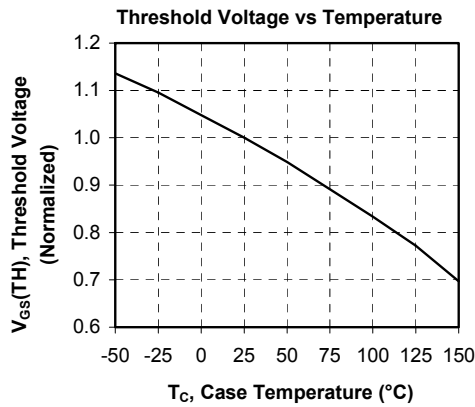
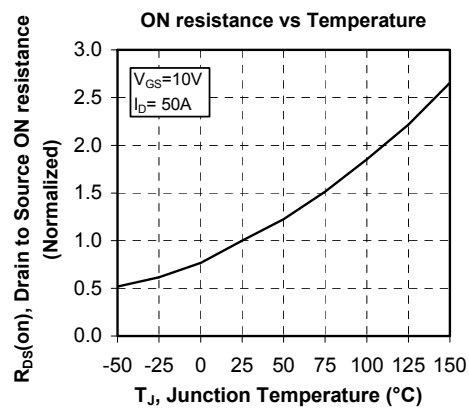
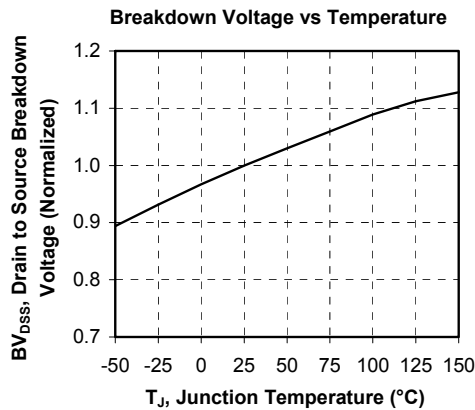
## 6.2 Top Fast diode typical performance curves

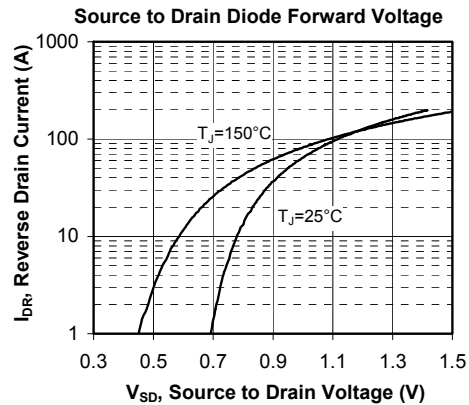
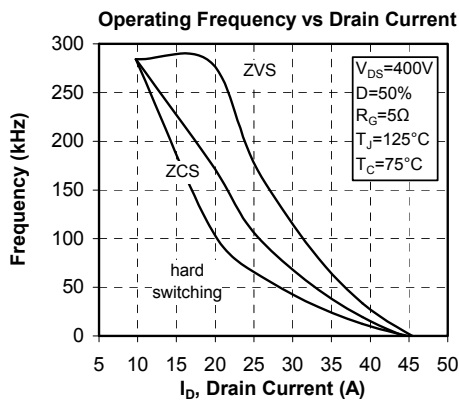
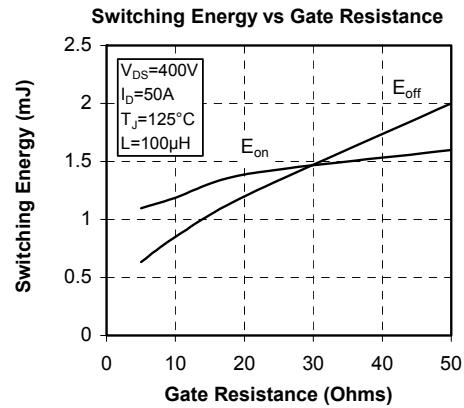
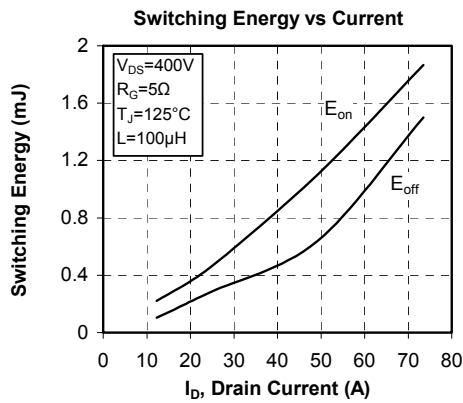
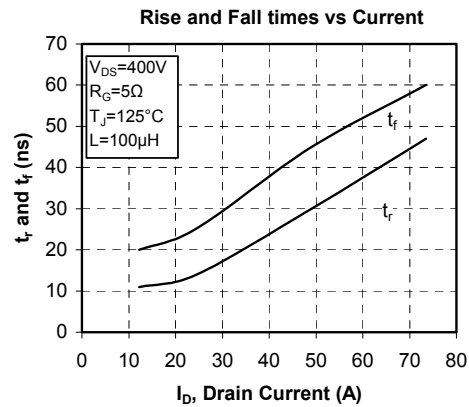
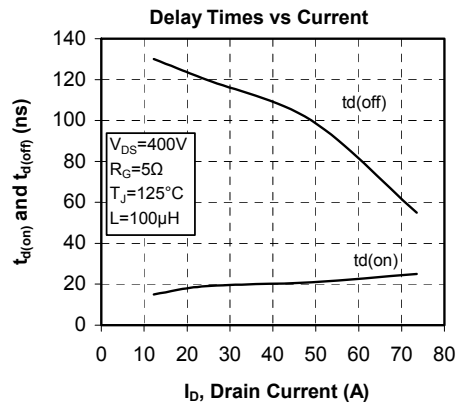


## 7. Bottom switches curves

### 7.1 Bottom CoolMOS™ typical performance curves







“COOLMOS™” comprise a new family of transistors developed by Infineon Technologies AG. “COOLMOS” is a trademark of Infineon Technologies AG.

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