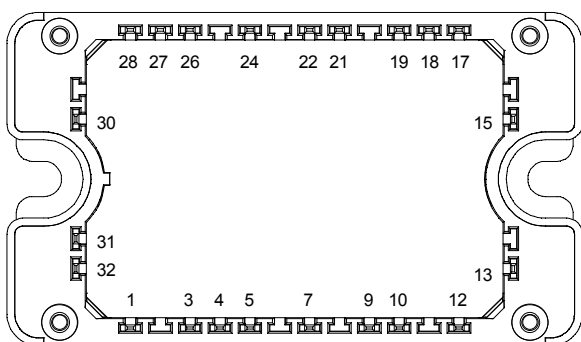
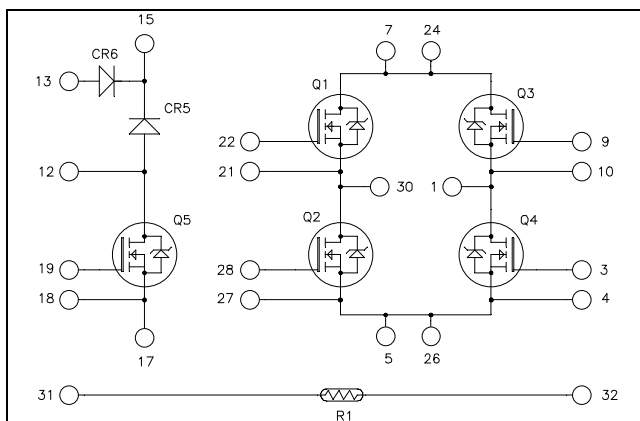


**Full – Bridge + boost chopper  
CoolMOS Power module**



All multiple inputs and outputs must be shorted together  
7/24 ; 5/26

**All ratings @  $T_j = 25^\circ\text{C}$  unless otherwise specified**

## 1. Full bridge switches

### 1.1 CoolMOS™ characteristics (Per CoolMOS™)

#### Absolute maximum ratings

| Symbol     | Parameter                                         | Max ratings              | Unit       |
|------------|---------------------------------------------------|--------------------------|------------|
| $V_{DSS}$  | Drain - Source Breakdown Voltage                  | 600                      | V          |
| $I_D$      | Continuous Drain Current                          | $T_c = 25^\circ\text{C}$ | A          |
|            |                                                   | $T_c = 80^\circ\text{C}$ |            |
| $I_{DM}$   | Pulsed Drain current                              | 160                      |            |
| $V_{GS}$   | Gate - Source Voltage                             | $\pm 20$                 | V          |
| $R_{DSon}$ | Drain - Source ON Resistance                      | 70                       | m $\Omega$ |
| $P_D$      | Maximum Power Dissipation                         | $T_c = 25^\circ\text{C}$ | W          |
| $I_{AR}$   | Avalanche current (repetitive and non repetitive) | 20                       | A          |
| $E_{AR}$   | Repetitive Avalanche Energy                       | 1                        | mJ         |
| $E_{AS}$   | Single Pulse Avalanche Energy                     | 1800                     |            |



**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)

#### CoolMOS™ Q1 to Q4:

$V_{DSS} = 600\text{V}$

$R_{DSon} = 70\text{m}\Omega$  max @  $T_j = 25^\circ\text{C}$

#### CoolMOS™ Q5:

$V_{DSS} = 600\text{V}$

$R_{DSon} = 45\text{m}\Omega$  max @  $T_j = 25^\circ\text{C}$

#### Application

- Solar converter

#### Features

- CoolMOS™**
  - Ultra low  $R_{DSon}$
  - Low Miller capacitance
  - Ultra low gate charge
  - Avalanche energy rated

- Very low stray inductance
- Kelvin source for easy drive
- Internal thermistor for temperature monitoring
- High level of integration

#### 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

**Electrical Characteristics**

| Symbol              | Characteristic                  | Test Conditions                                                      | Min | Typ | Max  | Unit |
|---------------------|---------------------------------|----------------------------------------------------------------------|-----|-----|------|------|
| I <sub>DSS</sub>    | Zero Gate Voltage Drain Current | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 600V, T <sub>j</sub> = 25°C  |     |     | 25   | μA   |
|                     |                                 | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 600V, T <sub>j</sub> = 125°C |     |     | 250  |      |
| R <sub>DS(on)</sub> | Drain – Source on Resistance    | V <sub>GS</sub> = 10V, I <sub>D</sub> = 39A                          |     |     | 70   | mΩ   |
| V <sub>GS(th)</sub> | Gate Threshold Voltage          | V <sub>GS</sub> = V <sub>DS</sub> , I <sub>D</sub> = 2.7mA           | 2.1 | 3   | 3.9  | V    |
| I <sub>GSS</sub>    | Gate – Source Leakage Current   | V <sub>GS</sub> = ±20 V, V <sub>DS</sub> = 0V                        |     |     | ±100 | nA   |

**Dynamic Characteristics**

| Symbol              | Characteristic                      | Test Conditions                                                                                                                       | Min                    | Typ  | Max | Unit |
|---------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------|------|-----|------|
| C <sub>iss</sub>    | Input Capacitance                   | V <sub>GS</sub> = 0V                                                                                                                  |                        | 7    |     | nF   |
| C <sub>oss</sub>    | Output Capacitance                  | V <sub>DS</sub> = 25V                                                                                                                 |                        | 2.56 |     |      |
| C <sub>rss</sub>    | Reverse Transfer Capacitance        | f = 1MHz                                                                                                                              |                        | 0.21 |     |      |
| Q <sub>g</sub>      | Total gate Charge                   | V <sub>GS</sub> = 10V                                                                                                                 |                        | 259  |     | nC   |
| Q <sub>gs</sub>     | Gate – Source Charge                | V <sub>Bus</sub> = 300V                                                                                                               |                        | 29   |     |      |
| Q <sub>gd</sub>     | Gate – Drain Charge                 | I <sub>D</sub> = 39A                                                                                                                  |                        | 111  |     |      |
| T <sub>d(on)</sub>  | Turn-on Delay Time                  | <b>Inductive Switching @ 125°C</b><br>V <sub>GS</sub> = 15V<br>V <sub>Bus</sub> = 400V<br>I <sub>D</sub> = 39A<br>R <sub>G</sub> = 5Ω |                        | 21   |     | ns   |
| T <sub>r</sub>      | Rise Time                           |                                                                                                                                       |                        | 30   |     |      |
| T <sub>d(off)</sub> | Turn-off Delay Time                 |                                                                                                                                       |                        | 283  |     |      |
| T <sub>f</sub>      | Fall Time                           |                                                                                                                                       |                        | 84   |     |      |
| E <sub>off</sub>    | Turn-off Switching Energy           | V <sub>GS</sub> = 15V<br>V <sub>Bus</sub> = 400V<br>I <sub>D</sub> = 39A<br>R <sub>G</sub> = 5Ω                                       | T <sub>j</sub> = 25°C  | 980  |     | μJ   |
| E <sub>off</sub>    | Turn-off Switching Energy           |                                                                                                                                       | T <sub>j</sub> = 125°C | 1206 |     |      |
| R <sub>thJC</sub>   | Junction to Case Thermal resistance |                                                                                                                                       |                        |      | 0.5 | °C/W |

**Source - Drain diode ratings and characteristics**

| Symbol          | Characteristic                         | Test Conditions                                 | Min                   | Typ | Max | Unit |
|-----------------|----------------------------------------|-------------------------------------------------|-----------------------|-----|-----|------|
| I <sub>S</sub>  | Continuous Source current (Body diode) | T <sub>C</sub> = 25°C                           |                       | 39  |     | A    |
|                 |                                        | T <sub>C</sub> = 80°C                           |                       | 29  |     |      |
| V <sub>SD</sub> | Diode Forward Voltage                  | V <sub>GS</sub> = 0V, I <sub>S</sub> = - 39A    |                       |     | 1.2 | V    |
| dv/dt           | Peak Diode Recovery ❶                  |                                                 |                       |     | 6   | V/ns |
| t <sub>rr</sub> | Reverse Recovery Time                  | I <sub>S</sub> = - 39A<br>V <sub>R</sub> = 350V | T <sub>j</sub> = 25°C | 580 |     | ns   |
| Q <sub>rr</sub> | Reverse Recovery Charge                | di/dt = 100A/μs                                 | T <sub>j</sub> = 25°C | 23  |     | μC   |

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.

I<sub>S</sub> ≤ - 39A    di/dt ≤ 100A/μs    V<sub>R</sub> ≤ V<sub>DSS</sub>    T<sub>j</sub> ≤ 150°C

## 2. Boost chopper Q5, CR5

### 2.1 Q5 CoolMOS™ characteristics

#### Absolute maximum ratings

| Symbol       | Parameter                                         | Max ratings              | Unit       |
|--------------|---------------------------------------------------|--------------------------|------------|
| $V_{DSS}$    | Drain - Source Breakdown Voltage                  | 600                      | V          |
| $I_D$        | Continuous Drain Current                          | $T_c = 25^\circ\text{C}$ | A          |
|              |                                                   | $T_c = 80^\circ\text{C}$ |            |
| $I_{DM}$     | Pulsed Drain current                              | 130                      |            |
| $V_{GS}$     | Gate - Source Voltage                             | $\pm 20$                 | V          |
| $R_{DS(on)}$ | Drain - Source ON Resistance                      | 45                       | m $\Omega$ |
| $P_D$        | Maximum Power Dissipation                         | $T_c = 25^\circ\text{C}$ | 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                     |            |

#### Electrical Characteristics

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

#### Dynamic Characteristics

| Symbol       | Characteristic                      | Test Conditions                                                                                                                 | Min | Typ  | Max | Unit               |
|--------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----|------|-----|--------------------|
| $C_{iss}$    | Input Capacitance                   | $V_{GS} = 0\text{V}; V_{DS} = 25\text{V}$                                                                                       |     | 7.2  |     | nF                 |
| $C_{oss}$    | Output Capacitance                  | $f = 1\text{MHz}$                                                                                                               |     | 8.5  |     |                    |
| $Q_g$        | Total gate Charge                   | $V_{GS} = 10\text{V}$<br>$V_{Bus} = 300\text{V}$<br>$I_D = 49\text{A}$                                                          |     | 150  |     | nC                 |
| $Q_{gs}$     | Gate – Source Charge                |                                                                                                                                 |     | 34   |     |                    |
| $Q_{gd}$     | Gate – Drain Charge                 |                                                                                                                                 |     | 51   |     |                    |
| $T_{d(on)}$  | Turn-on Delay Time                  | <b>Inductive Switching (125°C)</b><br>$V_{GS} = 10\text{V}$<br>$V_{Bus} = 400\text{V}$<br>$I_D = 49\text{A}$<br>$R_G = 5\Omega$ |     | 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            | <b>Inductive switching @ 25°C</b><br>$V_{GS} = 10\text{V}; V_{Bus} = 400\text{V}$<br>$I_D = 49\text{A}; R_G = 5\Omega$          |     | 675  |     | $\mu\text{J}$      |
| $E_{off}$    | Turn-off Switching Energy           |                                                                                                                                 |     | 520  |     |                    |
| $E_{on}$     | Turn-on Switching Energy            | <b>Inductive switching @ 125°C</b><br>$V_{GS} = 10\text{V}; V_{Bus} = 400\text{V}$<br>$I_D = 49\text{A}; R_G = 5\Omega$         |     | 1096 |     | $\mu\text{J}$      |
| $E_{off}$    | Turn-off Switching Energy           |                                                                                                                                 |     | 635  |     |                    |
| $R_{thJC}$   | Junction to Case Thermal resistance |                                                                                                                                 |     |      | 0.5 | $^\circ\text{C/W}$ |

**Source - Drain diode ratings and characteristics**

| Symbol          | Characteristic                         | Test Conditions                                 | Min                   | Typ | Max | Unit |
|-----------------|----------------------------------------|-------------------------------------------------|-----------------------|-----|-----|------|
| I <sub>S</sub>  | Continuous Source current (Body diode) |                                                 | T <sub>C</sub> = 25°C | 49  |     | A    |
|                 |                                        |                                                 | T <sub>C</sub> = 80°C | 38  |     |      |
| V <sub>SD</sub> | Diode Forward Voltage                  | V <sub>GS</sub> = 0V, I <sub>S</sub> = - 49A    |                       |     | 1.2 | V    |
| dv/dt           | Peak Diode Recovery ❶                  |                                                 |                       |     | 4   | V/ns |
| t <sub>rr</sub> | Reverse Recovery Time                  | I <sub>S</sub> = - 49A<br>V <sub>R</sub> = 350V | T <sub>j</sub> = 25°C | 600 |     | ns   |
| Q <sub>rr</sub> | Reverse Recovery Charge                | di <sub>S</sub> /dt = 100A/μs                   | T <sub>j</sub> = 25°C | 17  |     | μC   |

❶ dv/dt numbers reflect the limitations of the circuit rather than the device itself.

I<sub>S</sub> ≤ - 49A    di/dt ≤ 100A/μs    V<sub>R</sub> ≤ V<sub>DSS</sub>    T<sub>j</sub> ≤ 150°C

**2.2 Chopper diode characteristics (CR5)**

| Symbol            | Characteristic                          | Test Conditions                               | Min                    | Typ | Max | Unit |
|-------------------|-----------------------------------------|-----------------------------------------------|------------------------|-----|-----|------|
| V <sub>RRM</sub>  | Maximum Peak Repetitive Reverse Voltage |                                               | 600                    |     |     | V    |
| I <sub>RM</sub>   | Maximum Reverse Leakage Current         | V <sub>R</sub> =600V                          | T <sub>j</sub> = 25°C  |     | 25  | μA   |
|                   |                                         |                                               | T <sub>j</sub> = 125°C |     | 500 |      |
| I <sub>F</sub>    | DC Forward Current                      |                                               | T <sub>C</sub> = 80°C  | 30  |     | A    |
| V <sub>F</sub>    | Diode Forward Voltage                   | I <sub>F</sub> = 30A                          |                        | 1.8 | 2.2 | V    |
|                   |                                         | I <sub>F</sub> = 60A                          |                        | 2.2 |     |      |
|                   |                                         | I <sub>F</sub> = 30A                          | T <sub>j</sub> = 125°C | 1.5 |     |      |
| t <sub>rr</sub>   | Reverse Recovery Time                   | I <sub>F</sub> = 30A<br>V <sub>R</sub> = 400V | T <sub>j</sub> = 25°C  | 25  |     | ns   |
|                   |                                         |                                               | T <sub>j</sub> = 125°C | 160 |     |      |
| Q <sub>rr</sub>   | Reverse Recovery Charge                 | di/dt = 200A/μs                               | T <sub>j</sub> = 25°C  | 35  |     | nC   |
|                   |                                         |                                               | T <sub>j</sub> = 125°C | 480 |     |      |
| R <sub>thJC</sub> | Junction to Case Thermal resistance     |                                               |                        |     | 1.2 | °C/W |

**3. By pass diode (CR6)**
**Absolute maximum ratings**

| Symbol           | Parameter                               | Max ratings | Unit |
|------------------|-----------------------------------------|-------------|------|
| V <sub>R</sub>   | Maximum DC reverse Voltage              | 1600        | V    |
| V <sub>RRM</sub> | Maximum Peak Repetitive Reverse Voltage |             |      |
| I <sub>F</sub>   | DC Forward Current                      | 40          | A    |
| I <sub>FSM</sub> | Non-Repetitive Forward Surge Current    | 400         |      |
|                  | t=10ms                                  |             |      |

**Electrical Characteristics**

| Symbol            | Characteristic                      | Test Conditions        | Min                    | Typ  | Max | Unit |
|-------------------|-------------------------------------|------------------------|------------------------|------|-----|------|
| I <sub>R</sub>    | Reverse Current                     | V <sub>R</sub> = 1600V | T <sub>j</sub> = 25°C  | 20   |     | μA   |
|                   |                                     |                        | T <sub>j</sub> = 125°C | 2    |     | mA   |
| V <sub>F</sub>    | Forward Voltage                     | I <sub>F</sub> = 40A   | T <sub>j</sub> = 25°C  | 1.3  |     | V    |
|                   |                                     |                        | T <sub>j</sub> = 125°C | 1.1  |     |      |
| V <sub>T</sub>    | On – state Voltage                  |                        |                        | 0.8  |     | V    |
| r <sub>T</sub>    | On – state Slope resistance         |                        |                        | 10.5 |     | mΩ   |
| R <sub>thJC</sub> | Junction to Case Thermal resistance |                        |                        |      | 1.5 | °C/W |

#### 4. Temperature sensor

**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   |
| ΔR <sub>25</sub> /R <sub>25</sub> |                            |     | 5    |     | %    |
| B <sub>25/85</sub>                | T <sub>25</sub> = 298.15 K |     | 3952 |     | K    |
| ΔB/B                              | T <sub>C</sub> = 100°C     |     | 4    |     | %    |

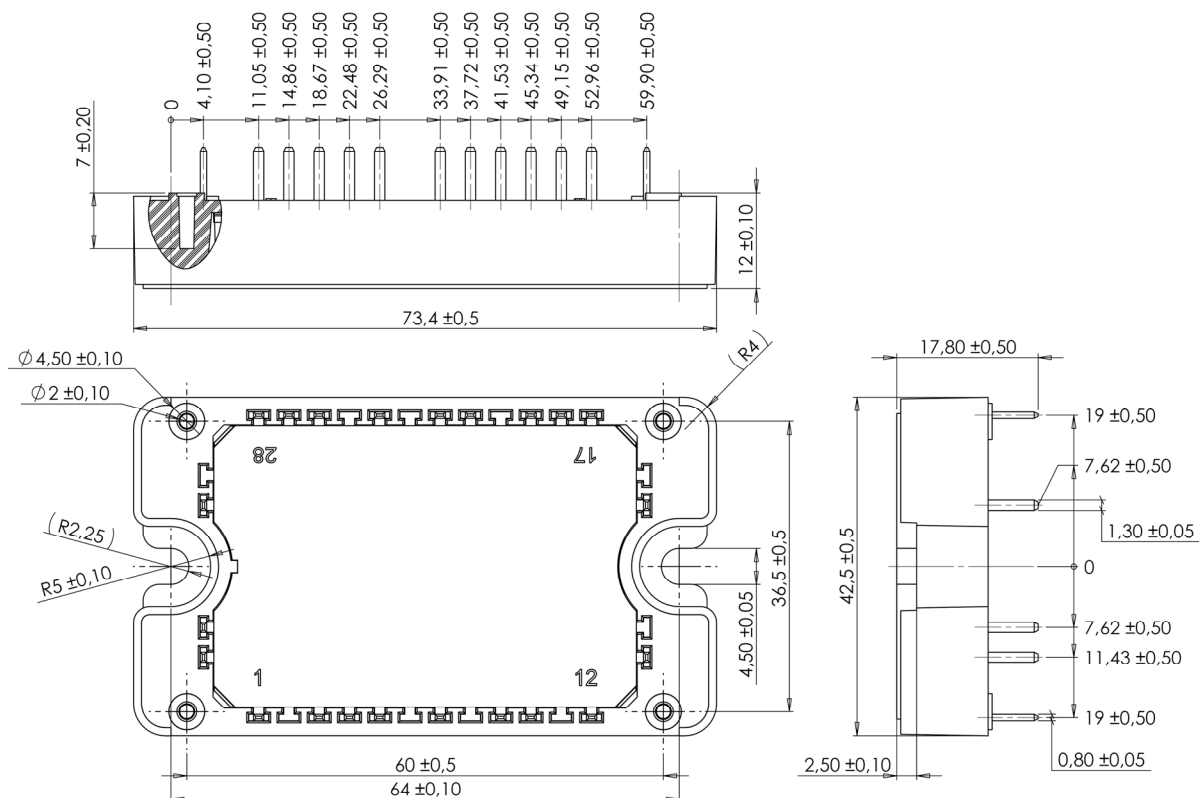
$$R_T = \frac{R_{25}}{\exp \left[ B_{25/85} \left( \frac{1}{T_{25}} - \frac{1}{T} \right) \right]}$$

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

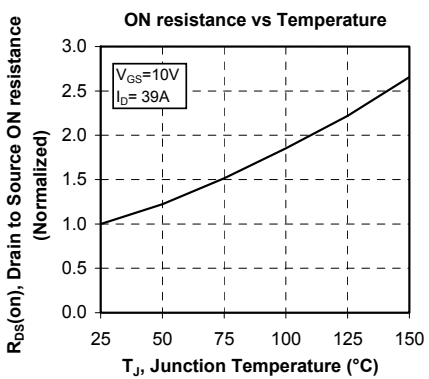
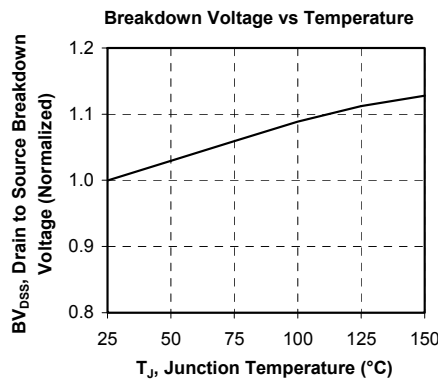
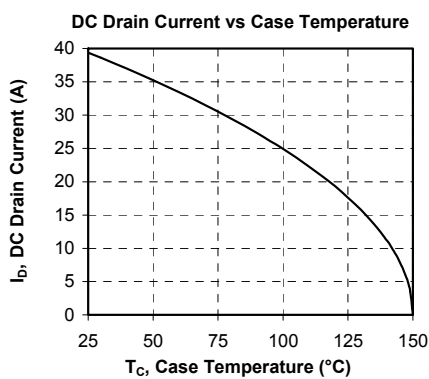
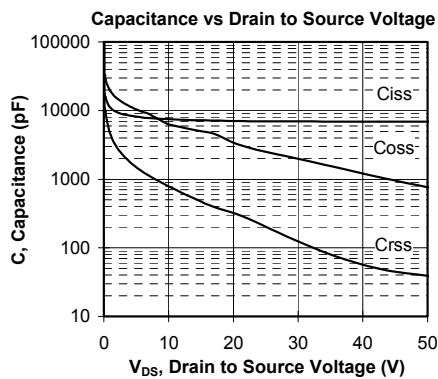
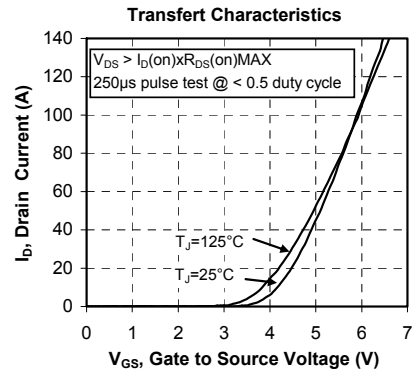
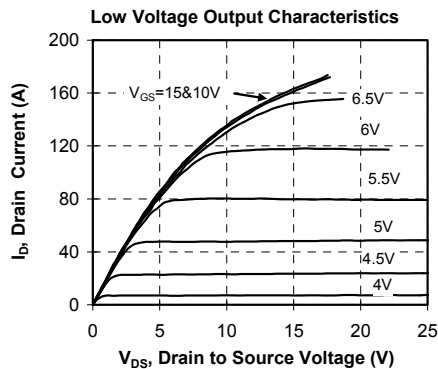
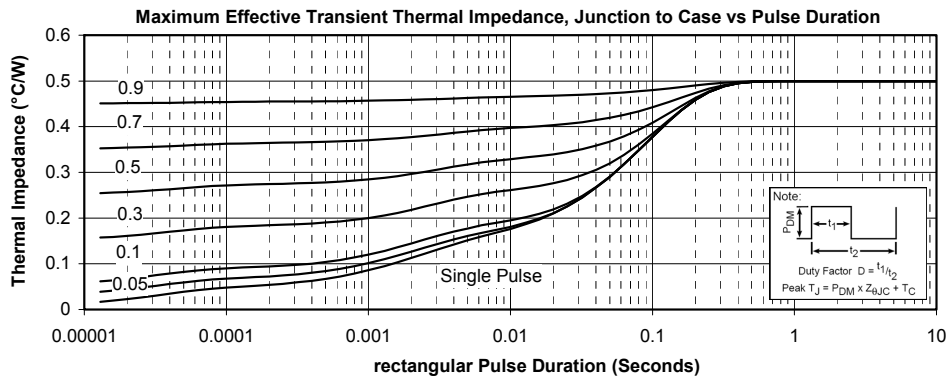
#### 5. Package characteristics

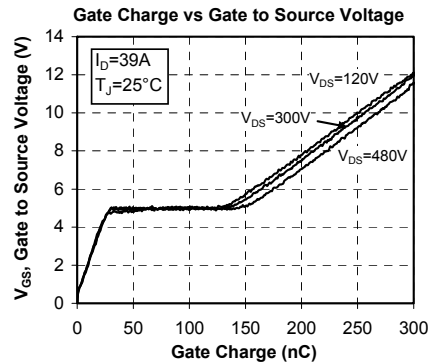
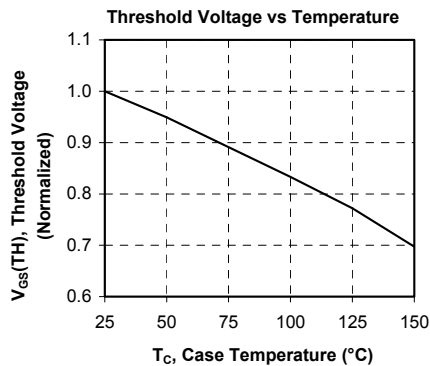
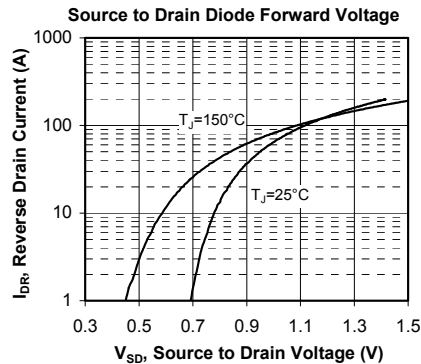
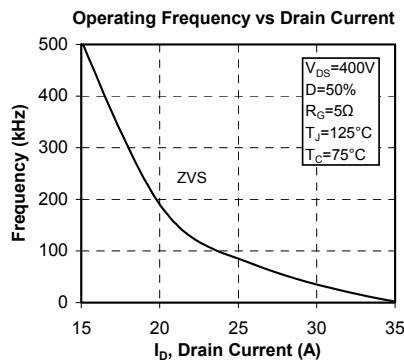
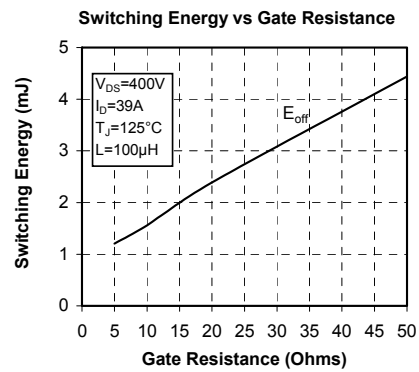
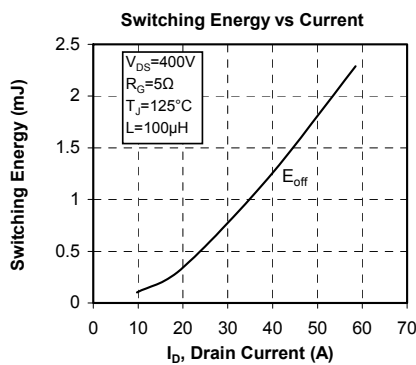
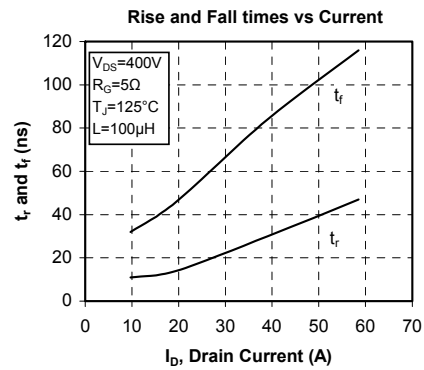
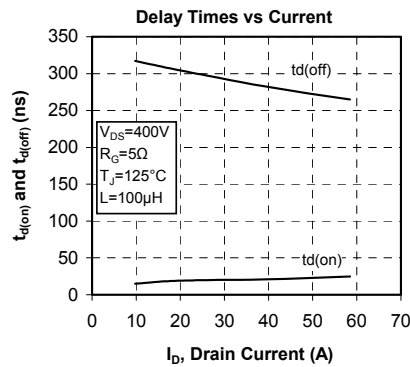
| Symbol            | Characteristic                                                |             |    | Min  | Typ | Max | Unit |
|-------------------|---------------------------------------------------------------|-------------|----|------|-----|-----|------|
| V <sub>ISOL</sub> | RMS Isolation Voltage, 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    |

#### 6. SP3F Package outline (dimensions in mm)

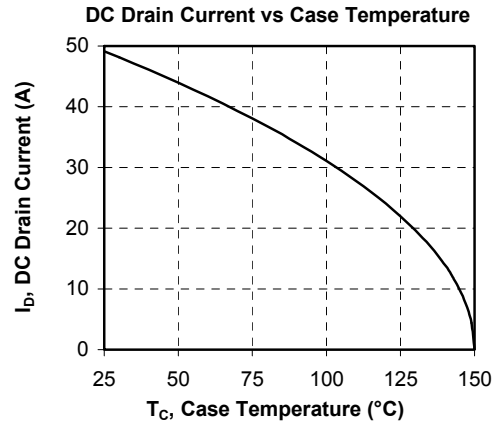
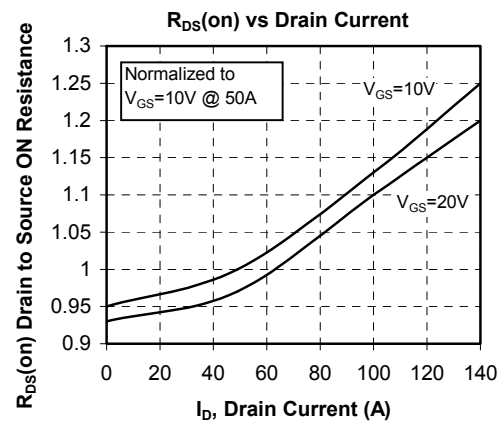
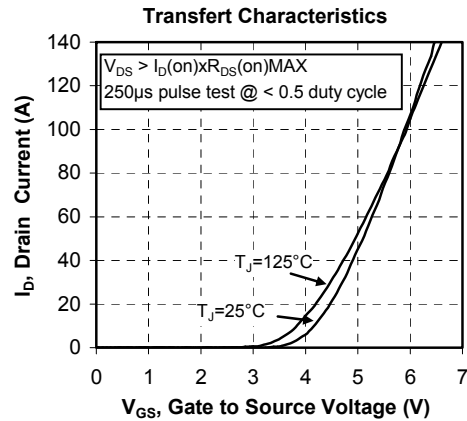
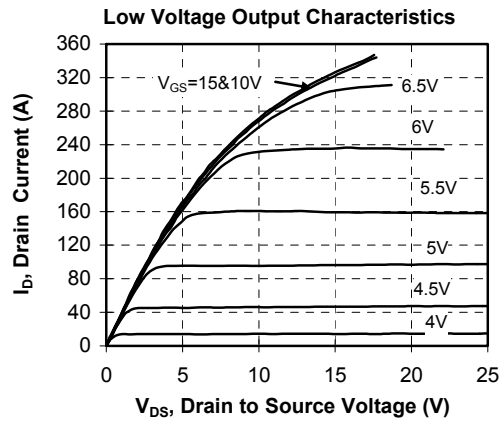
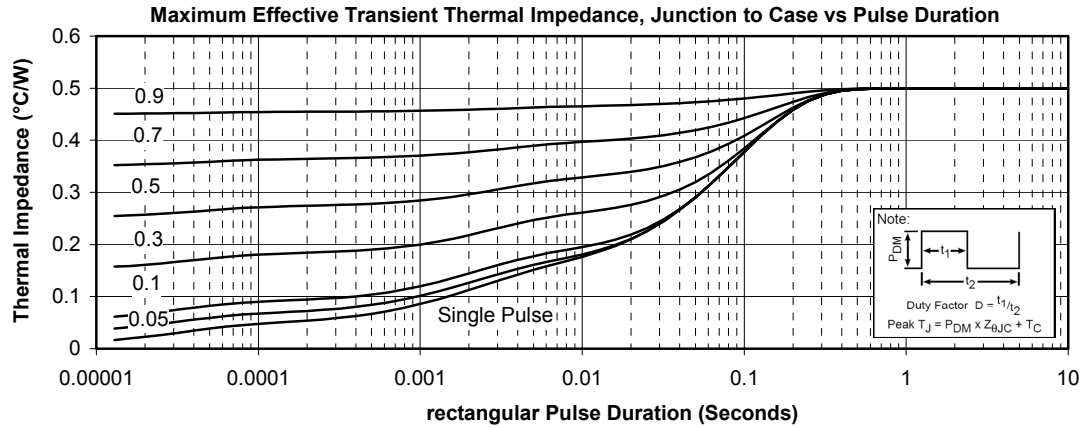


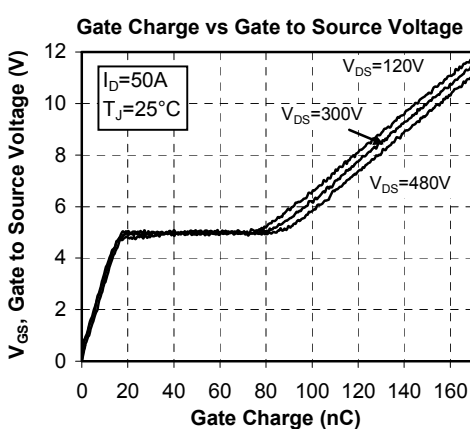
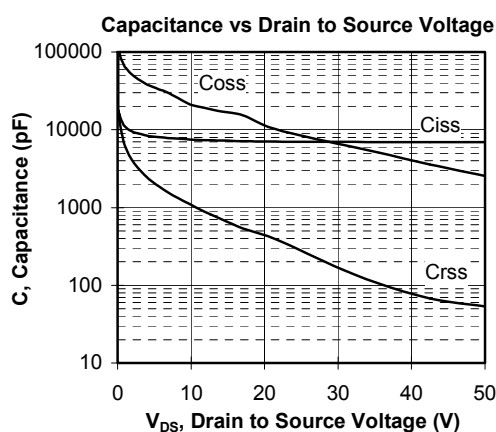
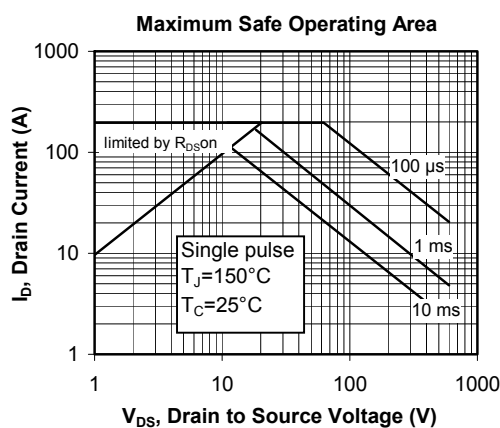
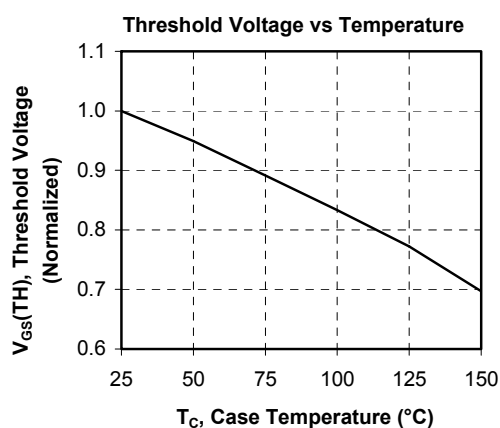
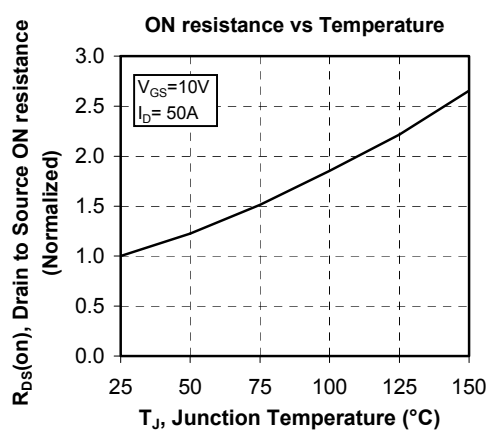
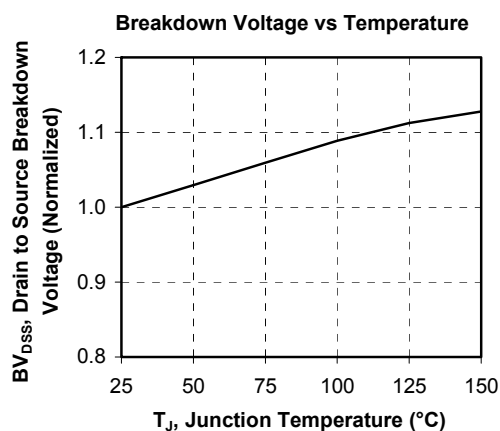
## 7. Full bridge switches curves (Per CoolMOST™)

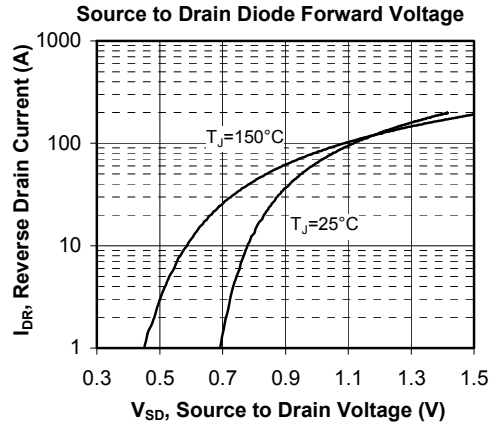
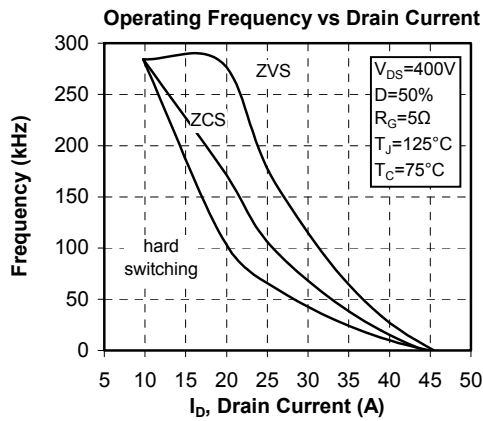
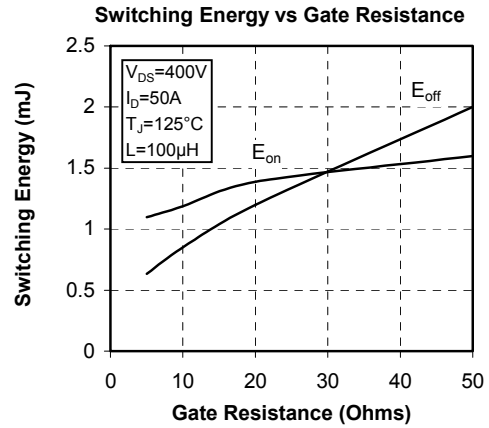
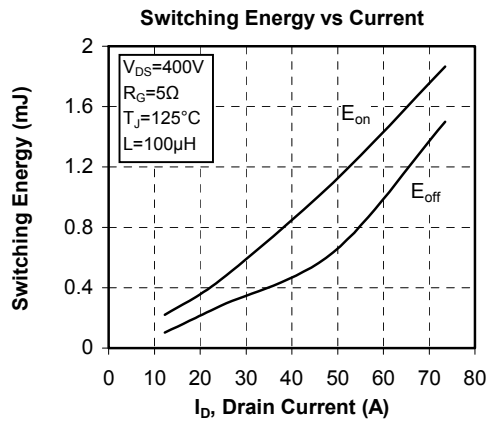
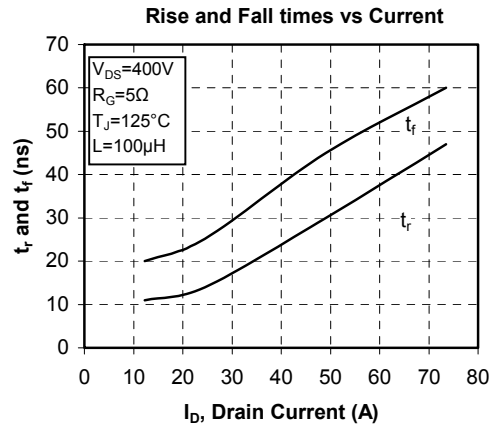
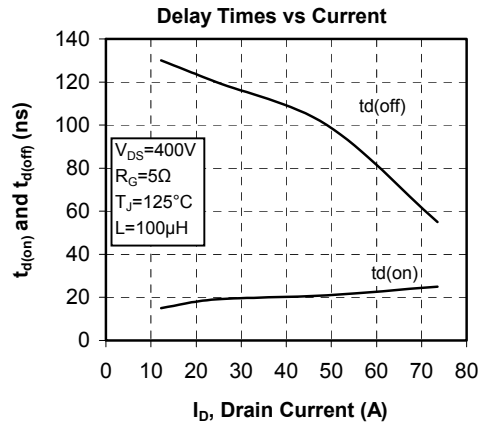




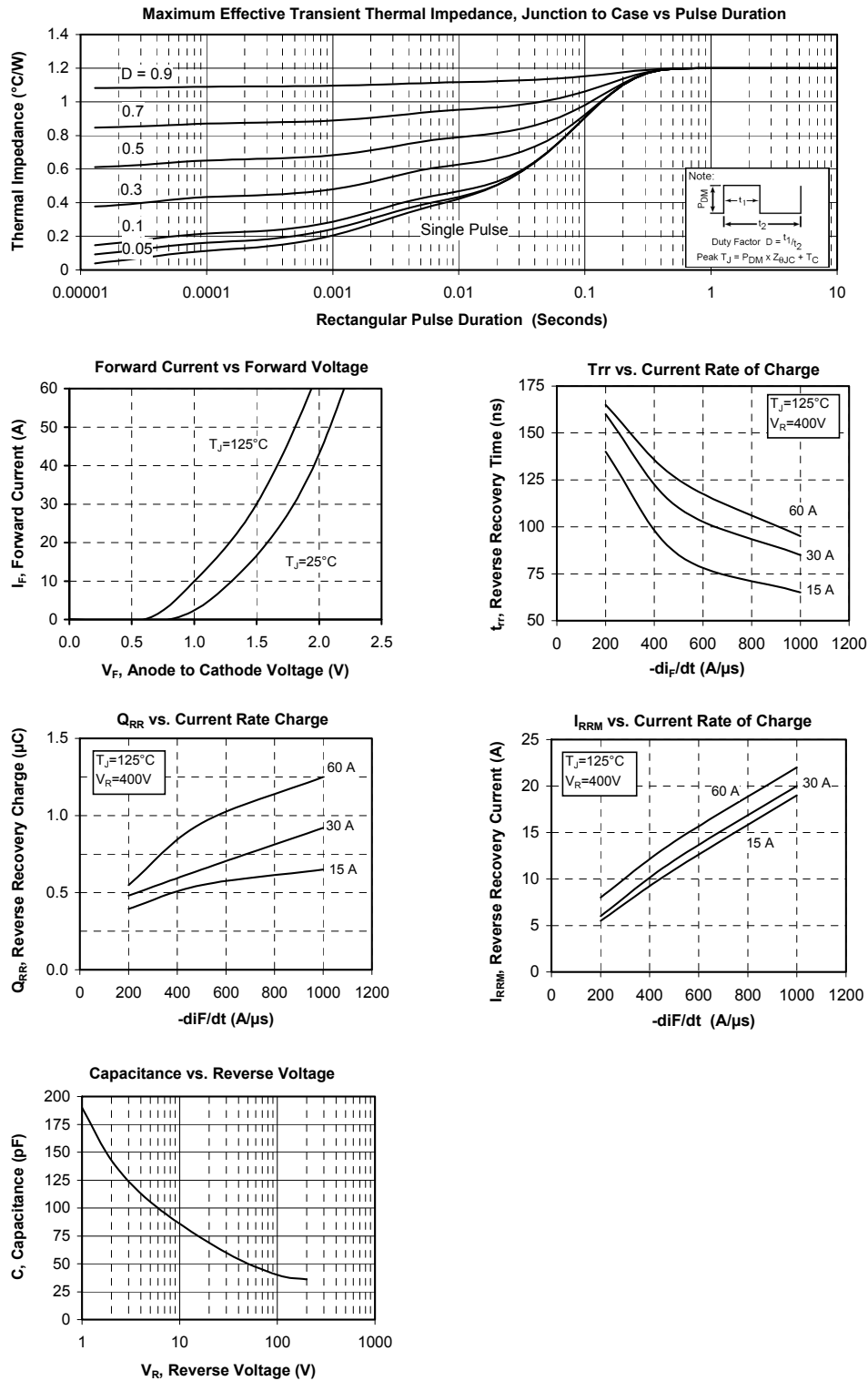
## 8. Chopper CoolMOS™



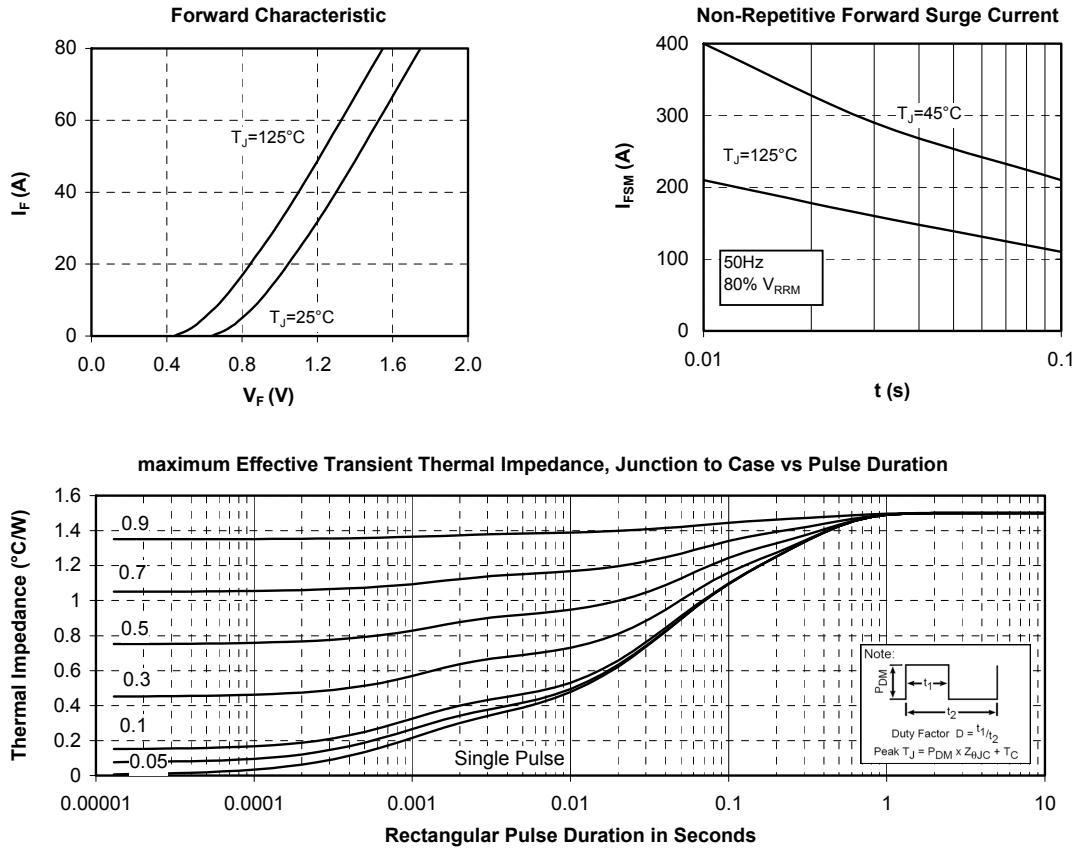




## 9. Chopper diode curves



## 10. Typical by pass CR6 diode curves



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