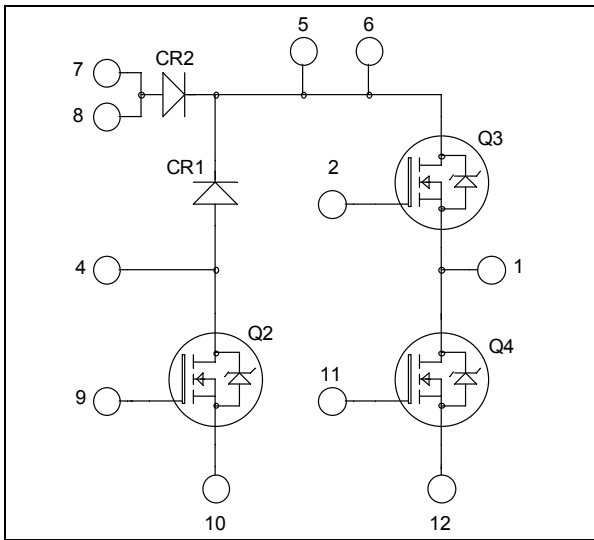


**Boost chopper & Phase Leg
Super Junction MOSFET
Power Module**

$V_{DSS} = 600V$

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

$I_D = 49A \text{ @ } T_c = 25^\circ C$



Application

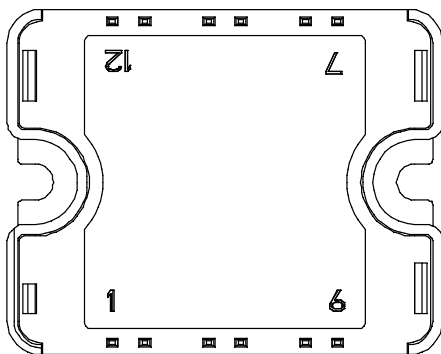
- Welding converters
- Switched Mode Power Supplies
- Uninterruptible Power Supplies
- Solar converter

Features

- **CoolMOS™**
 - Ultra low R_{DSon}
 - Low Miller capacitance
 - Ultra low gate charge
 - Avalanche energy rated
 - Very rugged
- **SiC Schottky Diode (CR1)**
 - Zero reverse recovery
 - Zero forward recovery
 - Temperature Independent switching behavior
 - Positive temperature coefficient on VF
- **By pass FRED diode (CR2)**

Benefits

- Very low stray inductance
- High level of integration
- Outstanding performance at high frequency operation
- 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
- RoHS Compliant



Pins 7/8 ; 5/6 must be shorted together

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

1. Phase leg (Q3 & Q4)
Absolute maximum ratings

| Symbol | Parameter | Max ratings | Unit |
|---------------------|---|-----------------------|------|
| V _{DSS} | Drain - Source Breakdown Voltage | 600 | V |
| I _D | Continuous Drain Current | T _c = 25°C | 49 |
| | | T _c = 80°C | 38 |
| I _{DM} | Pulsed Drain current | 130 | A |
| V _{GS} | Gate - Source Voltage | ±20 | V |
| R _{DS(on)} | Drain - Source ON Resistance | 45 | mΩ |
| P _D | Maximum Power Dissipation | T _c = 25°C | 250 |
| 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} = 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 |

Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|---|-----|-----|-----|------|
| C _{iss} | Input Capacitance | V _{GS} = 0V ; V _{DS} = 25V f = 1MHz | | 7.2 | | nF |
| C _{oss} | Output Capacitance | | | 8.5 | | |
| Q _g | Total gate Charge | V _{GS} = 10V V _{Bus} = 300V 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) V _{GS} = 10V V _{Bus} = 400V I _D = 49A R _G = 5Ω | | 21 | | ns |
| T _r | Rise Time | | | 30 | | |
| T _{d(off)} | Turn-off Delay Time | | | 100 | | |
| T _f | Fall Time | | | 45 | | |
| R _{thJC} | Junction to Case Thermal Resistance | | | | 0.5 | °C/W |

Source - Drain diode ratings and characteristics

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

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

$$I_S \leq -49A \quad di/dt \leq 100A/\mu s \quad V_R \leq V_{DSS} \quad T_j \leq 150^\circ C$$

2. Boost chopper (CR1 & Q2)
Absolute maximum ratings

| Symbol | Parameter | Max ratings | Unit |
|---------------------|---|-----------------------|------|
| V _{DSS} | Drain - Source Breakdown Voltage | 600 | V |
| I _D | Continuous Drain Current | T _c = 25°C | 49 |
| | | T _c = 80°C | 38 |
| I _{DM} | Pulsed Drain current | 130 | A |
| V _{GS} | Gate - Source Voltage | ±20 | V |
| R _{DS(on)} | Drain - Source ON Resistance | 45 | mΩ |
| P _D | Maximum Power Dissipation | T _c = 25°C | 250 |
| I _{AR} | Avalanche current (repetitive and non repetitive) | | 15 |
| E _{AR} | Repetitive Avalanche Energy | | 3 |
| 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} = 0V, V _{DS} = 600V | | | 250 | μA |
| | | T _j = 25°C | | | | |
| | | V _{GS} = 0V, V _{DS} = 600V | | | 500 | |
| | | T _j = 125°C | | | | |
| 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 |

Dynamic Characteristics

| Symbol | Characteristic | Test Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|---|-----|-----|-----|------|
| C _{iss} | Input Capacitance | V _{GS} = 0V ; V _{DS} = 25V f = 1MHz | | 7.2 | | nF |
| C _{oss} | Output Capacitance | | | 8.5 | | |
| Q _g | Total gate Charge | V _{GS} = 10V V _{Bus} = 300V 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) V _{GS} = 10V V _{Bus} = 400V I _D = 49A 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 V _{GS} = 10V ; V _{Bus} = 400V I _D = 49A ; R _G = 5Ω | | 405 | | μJ |
| E _{off} | Turn-off Switching Energy | | | 520 | | |
| E _{on} | Turn-on Switching Energy | Inductive switching @ 125°C V _{GS} = 10V ; V _{Bus} = 400V I _D = 49A ; R _G = 5Ω | | 660 | | μJ |
| E _{off} | Turn-off Switching Energy | | | 635 | | |
| R _{thJC} | Junction to Case Thermal Resistance | | | | 0.5 | °C/W |

SiC schottky diode ratings and characteristics (CR1)

| <i>Symbol</i> | <i>Characteristic</i> | <i>Test Conditions</i> | | <i>Min</i> | <i>Typ</i> | <i>Max</i> | <i>Unit</i> |
|--------------------|---|--|------------------------|------------|------------|------------|-------------|
| V _{RRM} | Maximum Peak Repetitive Reverse Voltage | | | 600 | | | V |
| I _{RM} | Maximum Reverse Leakage Current | V _R =600V | T _j = 25°C | | 10 | 60 | μA |
| | | | T _j = 175°C | | 20 | 300 | |
| I _{F(AV)} | Maximum Average Forward Current | 50% duty cycle | | | 10 | | A |
| V _F | Diode Forward Voltage | I _F = 10A | T _j = 25°C | | 1.6 | 1.8 | V |
| | | | T _j = 175°C | | 2 | 2.4 | |
| Q _C | Total Capacitive Charge | I _F = 10A, V _R = 300V di/dt = 500A/μs | | | 14 | | nC |
| C | Total Capacitance | f = 1MHz, V _R = 200V | | | 65 | | pF |
| | | f = 1MHz, V _R = 400V | | | 50 | | |
| R _{thJC} | Junction to Case Thermal Resistance | | | | | 2.5 | °C/W |

3. By pass FRED diode (CR2)
Diode ratings and characteristics

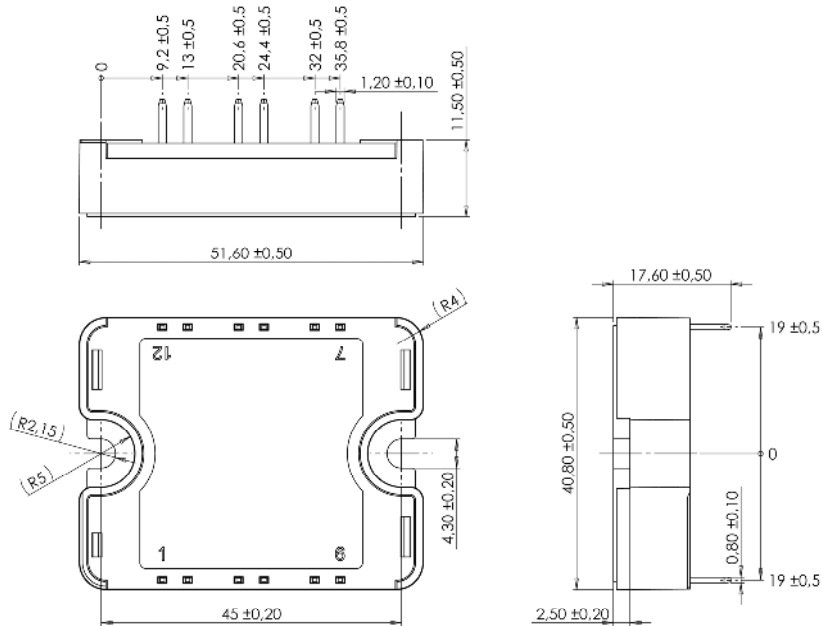
| <i>Symbol</i> | <i>Characteristic</i> | <i>Test Conditions</i> | | <i>Min</i> | <i>Typ</i> | <i>Max</i> | <i>Unit</i> |
|-------------------|---|---|------------------------|------------|------------|------------|-------------|
| V _{RRM} | Maximum Peak Repetitive Reverse Voltage | | | 600 | | | V |
| I _{RM} | Maximum Reverse Leakage Current | V _R =600V | T _j = 25°C | | | 100 | μA |
| | | | T _j = 150°C | | | 350 | |
| I _F | DC Forward Current | | | | 30 | | A |
| V _F | Diode Forward Voltage | I _F = 30A V _{GE} = 0V | T _j = 25°C | | 1.6 | 2 | V |
| | | | T _j = 150°C | | 1.5 | | |
| t _{rr} | Reverse Recovery Time | | T _j = 25°C | | 100 | | ns |
| | | | T _j = 150°C | | 150 | | |
| Q _{rr} | Reverse Recovery Charge | I _F = 30A V _R = 300V di/dt = 1800A/μs | T _j = 25°C | | 1.5 | | μC |
| | | | T _j = 150°C | | 3.1 | | |
| E _{rr} | Reverse Recovery Energy | | T _j = 25°C | | 0.34 | | mJ |
| | | | T _j = 150°C | | 0.75 | | |
| R _{thJC} | Junction to Case Thermal Resistance | | | | | 2.45 | °C/W |

4. Thermal & Package characteristics

| <i>Symbol</i> | <i>Characteristic</i> | | | <i>Min</i> | <i>Typ</i> | <i>Max</i> | <i>Unit</i> |
|-------------------|--|-------------|----|------------|------------|------------|-------------|
| 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 | M4 | 2 | | 3 | N.m |
| Wt | Package Weight | | | | | 80 | g |

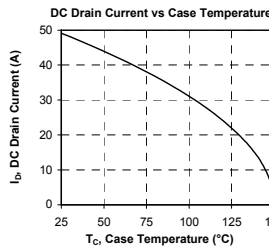
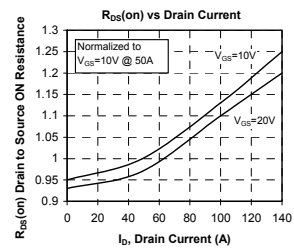
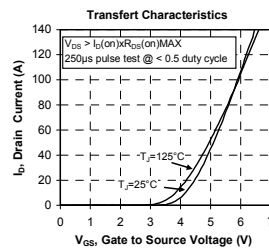
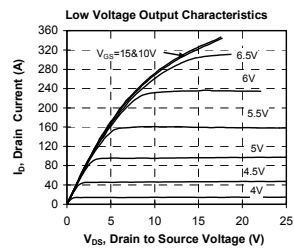
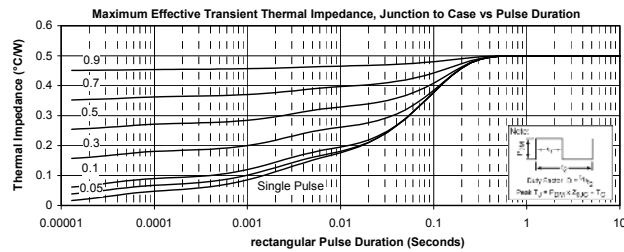
* T_{jmax} = 175°C for by pass and SiC diode

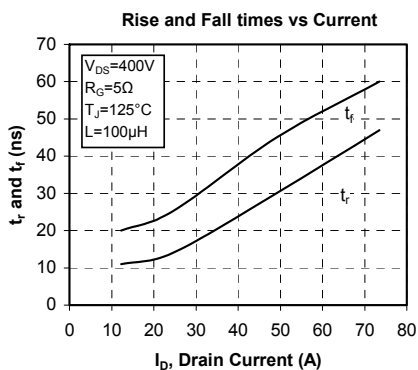
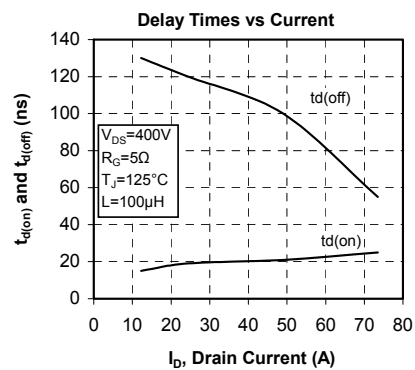
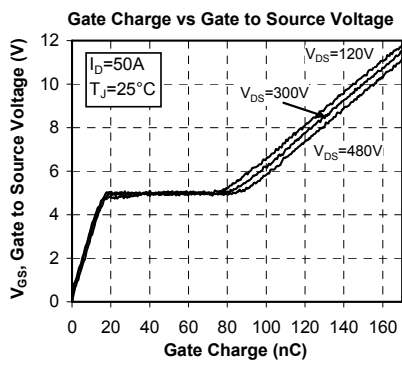
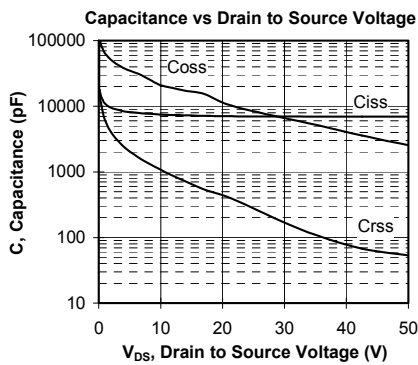
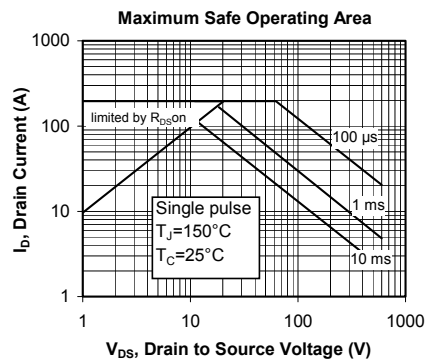
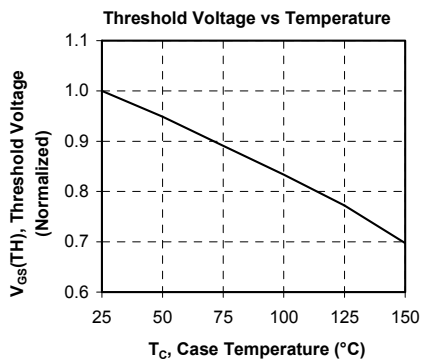
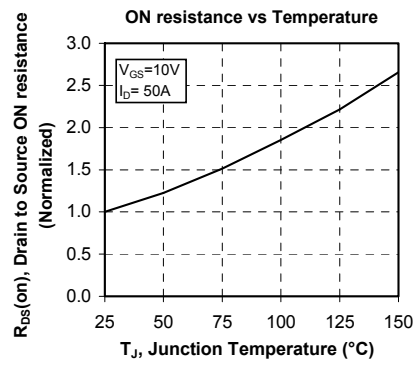
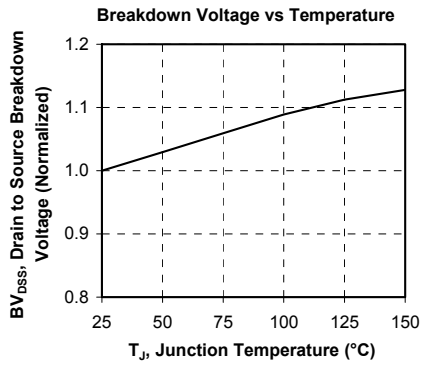
SP1 Package outline (dimensions in mm)



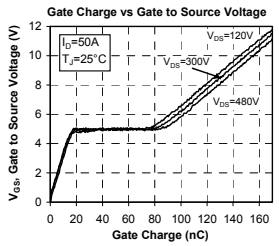
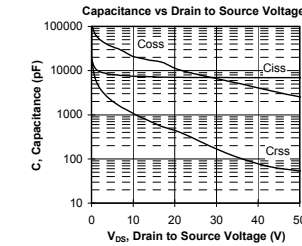
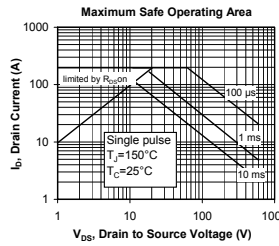
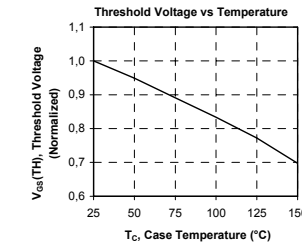
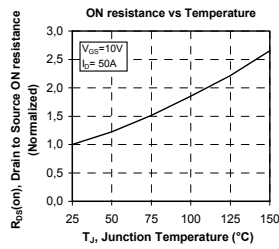
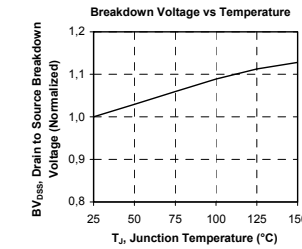
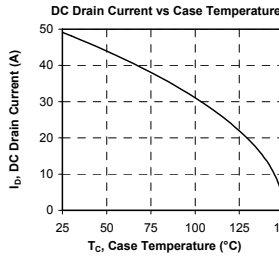
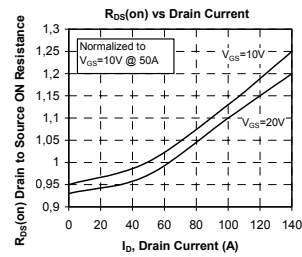
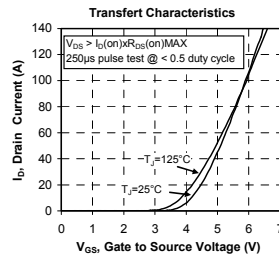
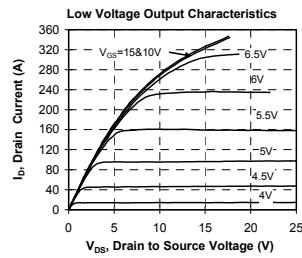
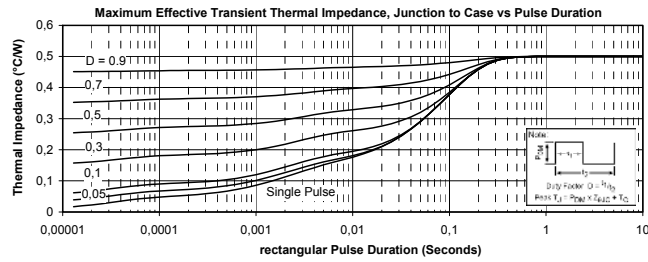
See application note 1904 - Mounting Instructions for SP1 Power Modules on www.microsemi.com

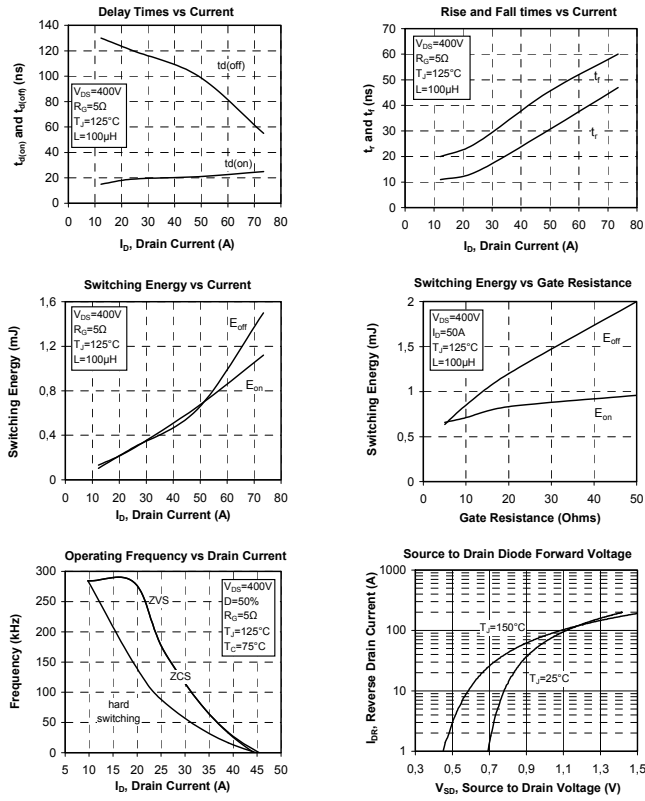
5. Typical CoolMOS Performance Curve (Phase leg)



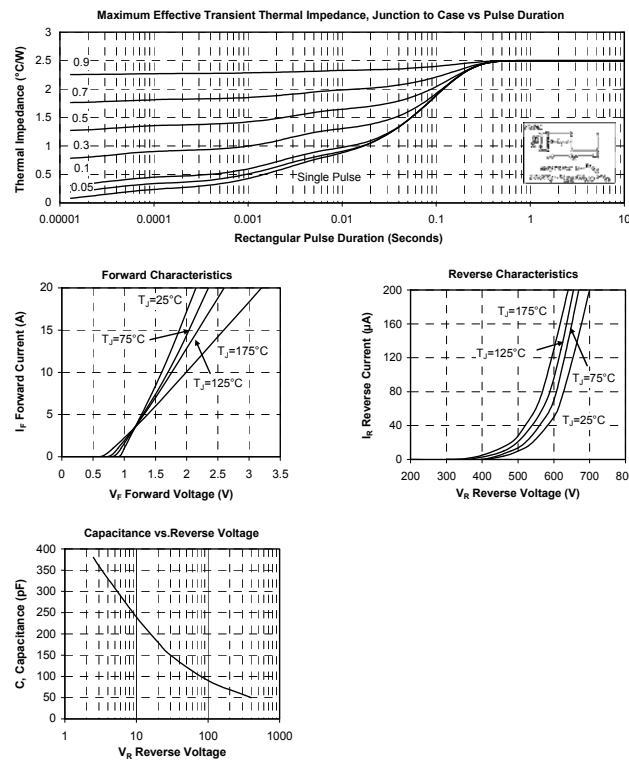


6. Typical CoolMOS Performance Curve (Boost chopper)

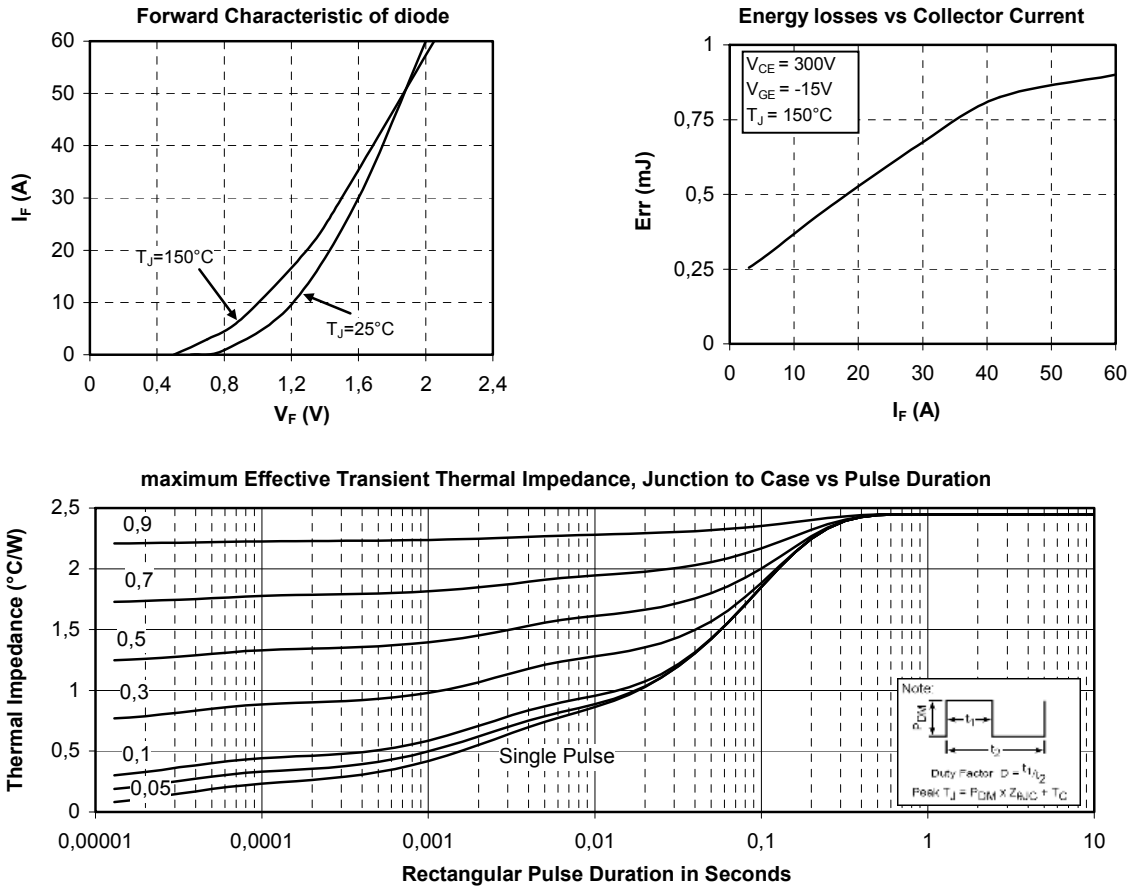




7. SiC Typical Performance Curve (CR1)



8. Typical By pass Performance Curve (CR2)



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