

CCS020M12CM2

1.2kV, 80 mΩ Silicon Carbide Six-Pack (Three Phase) Module

C2M MOSFET and Z-Rec[®] Diode

| | |
|---|---------|
| V_{DS} | 1.2 kV |
| $E_{sw, Total} @ 20A, 150\text{ }^{\circ}C$ | 0.48 mJ |
| $R_{DS(on)}$ | 80 mΩ |

Features

- Ultra Low Loss
- High-Frequency Operation
- Zero Reverse Recovery Current from Diode
- Zero Turn-off Tail Current from MOSFET
- Normally-off, Fail-safe Device Operation
- Ease of Paralleling
- Copper Baseplate and Aluminum Nitride Insulator

System Benefits

- Enables Compact and Lightweight Systems
- High Efficiency Operation
- Mitigates Over-voltage Protection
- Reduced Thermal Requirements
- Reduced System Cost

Applications

- Solar Inverter
- 3-Phase PFC
- Regen Drive
- UPS and SMPS
- Motor Drive

Package



| Part Number | Package | Marking |
|--------------|----------|--------------|
| CCS020M12CM2 | Six-Pack | CCS020M12CM2 |

Maximum Ratings ($T_C = 25\text{ }^{\circ}C$ unless otherwise specified)

| Symbol | Parameter | Value | Unit | Test Conditions | Notes |
|----------------|------------------------------------|-------------|-------------|---|---------|
| V_{DSmax} | Drain - Source Voltage | 1.2 | kV | | |
| V_{GSmax} | Gate - Source Voltage | -10/+25 | V | Absolute maximum values | |
| V_{GSop} | Gate - Source Voltage | -5/20 | V | Recommended operational values | |
| I_D | Continuous MOSFET Drain Current | 29.5 | A | $V_{GS} = 20\text{ V}, T_C = 25\text{ }^{\circ}C$ | Fig. 25 |
| | | 20 | | $V_{GS} = 20\text{ V}, T_C = 90\text{ }^{\circ}C$ | |
| $I_{D(pulse)}$ | Pulsed Drain Current | 80 | A | Pulse width t_p limited by $T_{J(max)}$ | |
| I_F | Continuous Diode Forward Current | 46 | A | $V_{GS} = -5\text{ V}, T_C = 25\text{ }^{\circ}C$ | |
| | | 27 | | $V_{GS} = -5\text{ V}, T_C = 90\text{ }^{\circ}C$ | |
| T_{Jmax} | Junction Temperature | -40 to +150 | $^{\circ}C$ | | |
| T_C, T_{STG} | Case and Storage Temperature Range | -40 to +125 | $^{\circ}C$ | | |
| V_{isol} | Case Isolation Voltage | 4.5 | kV | AC, 50 Hz, 1 min | |
| L_{Stray} | Stray Inductance | 30 | nH | Measured between terminals 25, 26 and 27, 28 | |
| P_D | Power Dissipation | 167 | W | $T_C = 25\text{ }^{\circ}C, T_J = 150\text{ }^{\circ}C$ | Fig. 26 |



Electrical Characteristics ($T_c = 25^\circ\text{C}$ unless otherwise specified)

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions | Note |
|---------------|----------------------------------|------|------|------|---------------|---|------------|
| $V_{(BR)DSS}$ | Drain - Source Breakdown Voltage | 1.2 | | | kV | $V_{GS} = 0\text{ V}, I_D = 100\ \mu\text{A}$ | |
| $V_{GS(th)}$ | Gate Threshold Voltage | 1.7 | 2.2 | | V | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$ | Fig. 7 |
| | | | 1.6 | | | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}, T_J = 150^\circ\text{C}$ | |
| I_{DSS} | Zero Gate Voltage Drain Current | | 1 | 100 | μA | $V_{DS} = 1.2\text{ kV}, V_{GS} = 0\text{V}$ | |
| I_{DSS} | Zero Gate Voltage Drain Current | | 10 | 250 | μA | $V_{DS} = 1.2\text{ kV}, V_{GS} = 0\text{V}, T_J = 150^\circ\text{C}$ | |
| I_{GSS} | Gate-Source Leakage Current | | 1 | 250 | nA | $V_{GS} = 20\text{ V}, V_{DS} = 0\text{V}$ | |
| $R_{DS(on)}$ | On State Resistance | | 80 | 98 | m Ω | $V_{GS} = 20\text{ V}, I_{DS} = 20\text{ A}$ | Fig. 4-6 |
| | | | 145 | 208 | | $V_{GS} = 20\text{ V}, I_{DS} = 20\text{ A}, T_J = 150^\circ\text{C}$ | |
| g_{fs} | Transconductance | | 9.8 | | S | $V_{DS} = 20\text{ V}, I_{DS} = 20\text{ A}$ | Fig. 8 |
| | | | 8.5 | | | $V_{DS} = 20\text{ V}, I_D = 20\text{ A}, T_J = 150^\circ\text{C}$ | |
| C_{iss} | Input Capacitance | | 900 | | pF | $V_{DS} = 800\text{ V}, f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$ | Fig. 16,17 |
| C_{oss} | Output Capacitance | | 181 | | | | |
| C_{rss} | Reverse Transfer Capacitance | | 5.9 | | | | |
| E_{on} | Turn-On Switching Energy | | 0.41 | | mJ | $V_{DD} = 800\text{ V}, V_{GS} = -5\text{V}/+20\text{V}$ $I_D = 20\text{ A}, R_{G(ext)} = 2.5\ \Omega$ Load = 412 $\mu\text{H}, T_J = 150^\circ\text{C}$ Note: IEC 60747-8-4 Definitions | Fig. 22 |
| E_{off} | Turn-Off Switching Energy | | 0.07 | | | | |
| $R_{G(int)}$ | Internal Gate Resistance | | 3.8 | | Ω | $f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$ | |
| Q_{GS} | Gate-Source Charge | | 16.1 | | nC | $V_{DD} = 800\text{ V}, V_{GS} = -5\text{V}/+20\text{V},$ $I_D = 20\text{ A},$ Per JEDEC24 pg 27 | Fig. 15 |
| Q_{GD} | Gate-Drain Charge | | 20.7 | | | | |
| Q_G | Total Gate Charge | | 61.5 | | | | |
| $t_{d(on)}$ | Turn-on delay time | | 10 | | ns | $V_{DD} = 800\text{V}, V_{GS} = -5/+20\text{V},$ $I_D = 20\text{ A}, R_{G(ext)} = 2.5\ \Omega,$ Timing relative to V_{DS} Note: IEC 60747-8-4, pg 83 Resistive load | Fig. 24 |
| $t_{r(on)}$ | V_{SD} fall time 90% to 10% | | 14 | | | | |
| $t_{d(off)}$ | Turn-off delay time | | 22.4 | | | | |
| $t_{r(off)}$ | V_{SD} rise time 10% to 90% | | 53 | | | | |
| V_{SD} | Diode Forward Voltage | | 1.5 | 1.7 | V | $I_F = 20\text{ A}, V_{GS} = 0, T_J = 25^\circ\text{C}$ | Fig. 10 |
| | | | 1.8 | 2.3 | | $I_F = 20\text{ A}, V_{GS} = 0, T_J = 150^\circ\text{C}$ | Fig. 11 |
| Q_C | Total Capacitive Charge | | 0.27 | | μC | $I_{SD} = 20\text{ A}, V_{DS} = 800\text{V}$ $di/dt = 1500\text{ A}/\mu\text{s}, V_{GS} = -5\text{V}$ | |

Thermal Characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions | Note |
|-------------|--|------|------|------|---------------------------|-----------------|---------|
| R_{thJCM} | Thermal Resistance Junction-to-Case for MOSFET | | 0.7 | 0.75 | $^\circ\text{C}/\text{W}$ | | Fig. 27 |
| R_{thJCD} | Thermal Resistance Junction-to-Case for Diode | | 0.8 | 0.85 | | | Fig. 28 |

Additional Module Data

| Symbol | Condition | Max. | Unit | Test Condition |
|--------|--------------------|-------|------|---------------------------|
| W | Weight | 180 | g | |
| M | Mounting Torque | 5.0 | Nm | To Heatsink and terminals |
| | Clearance Distance | 14.09 | mm | Terminal to terminal |
| | Creepage Distance | 14.11 | mm | Terminal to terminal |
| | | 17.46 | mm | Terminal to baseplate |

Typical Performance

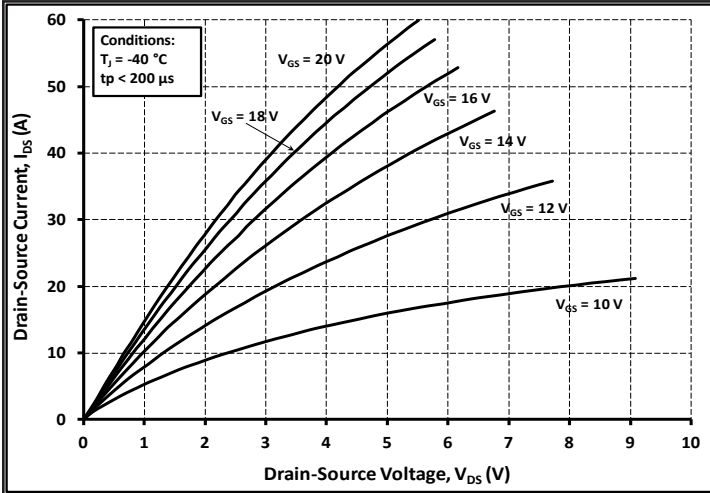


Figure 1. Output Characteristics $T_j = -40\text{ }^\circ\text{C}$

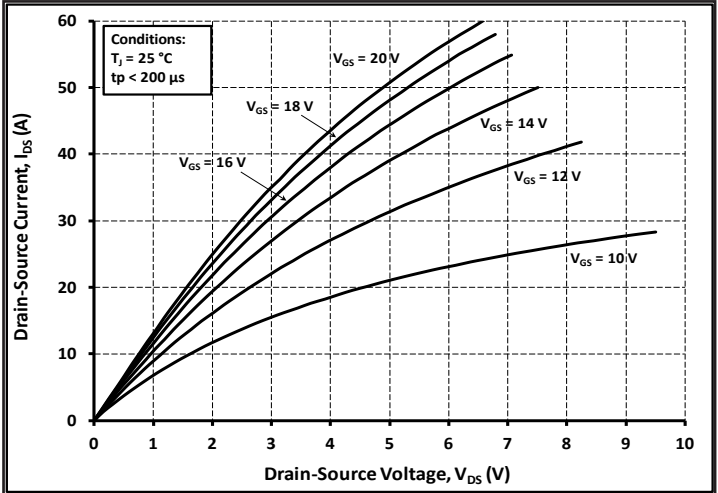


Figure 2. Output Characteristics $T_j = 25\text{ }^\circ\text{C}$

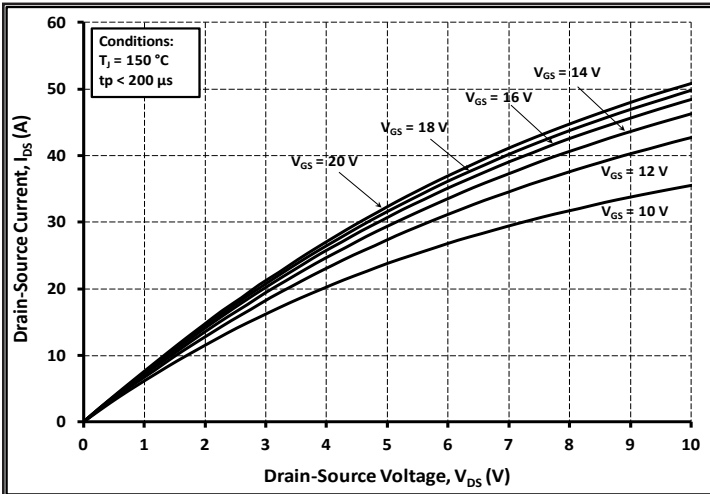


Figure 3. Output Characteristics $T_j = 150\text{ }^\circ\text{C}$

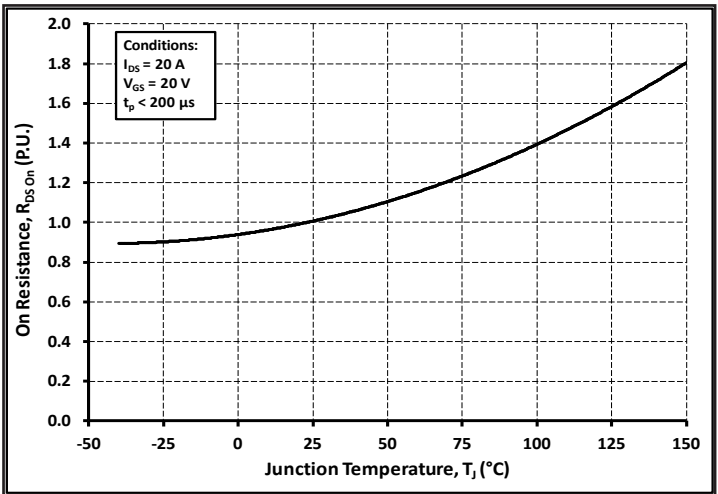


Figure 4. Normalized On-Resistance vs. Temperature

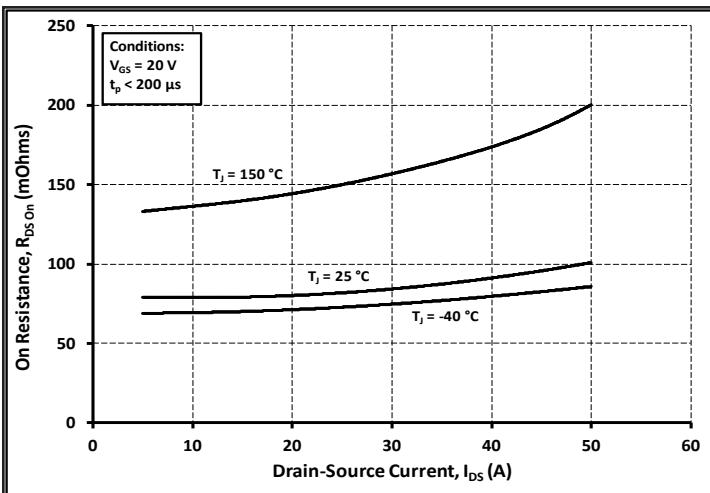


Figure 5. On-Resistance vs. Drain Current For Various Temperatures

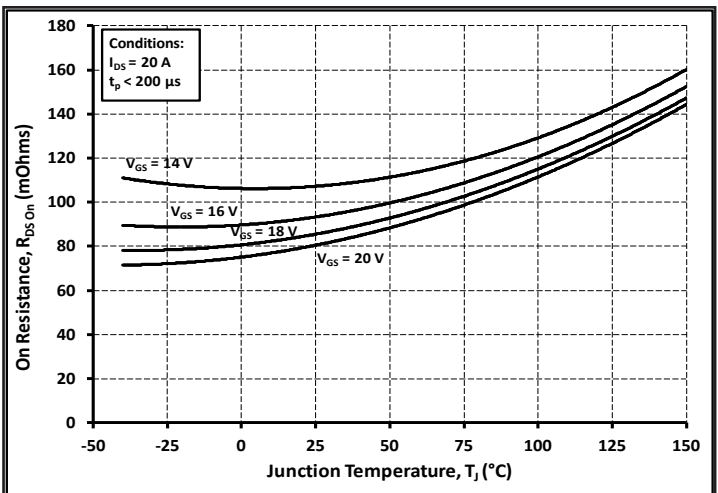


Figure 6. On-Resistance vs. Temperature for Various Various Gate-Source Voltages

Typical Performance

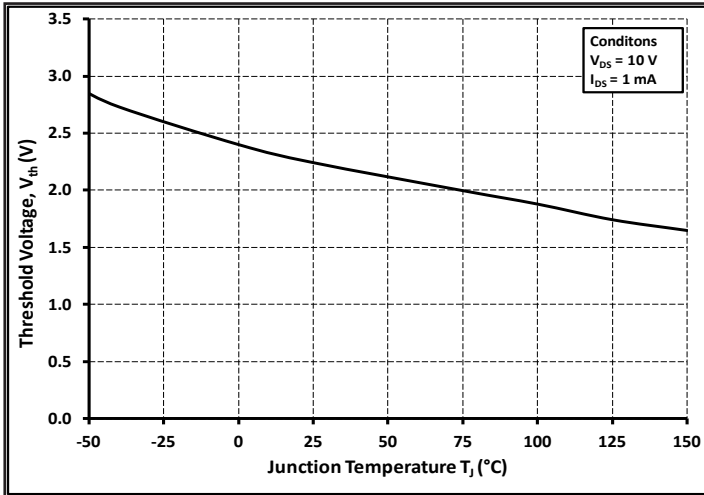


Figure 7. Threshold Voltage vs. Temperature

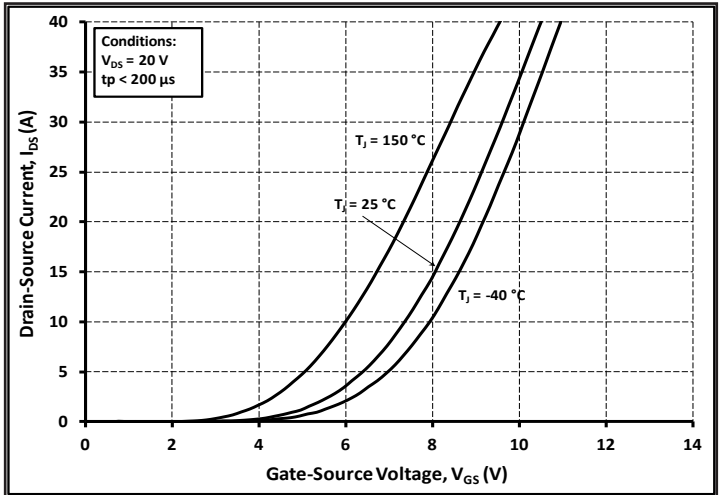


Figure 8. Transfer Characteristic for Various Junction Temperatures

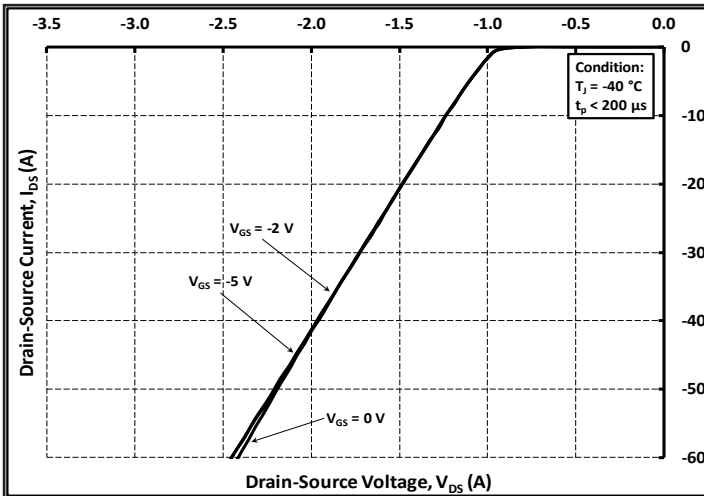


Figure 9. Diode Characteristic at -40 °C

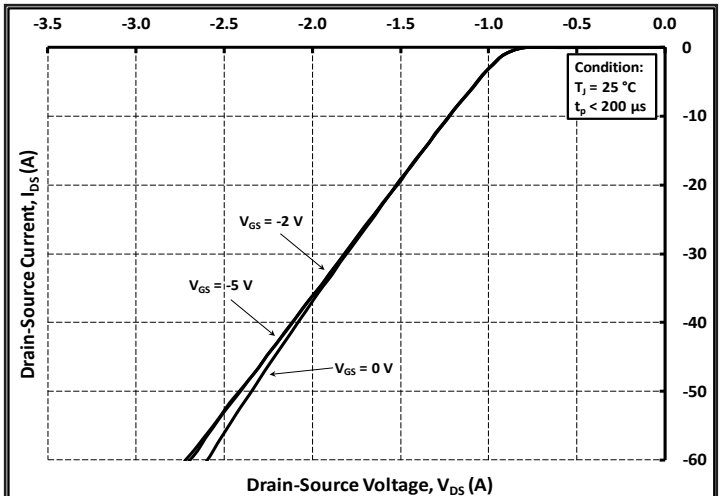


Figure 10. Diode Characteristic at 25 °C

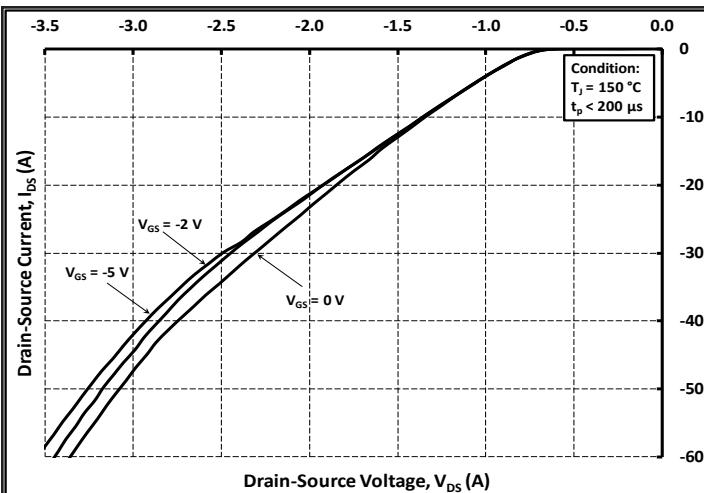


Figure 11. Diode Characteristic at 150 °C

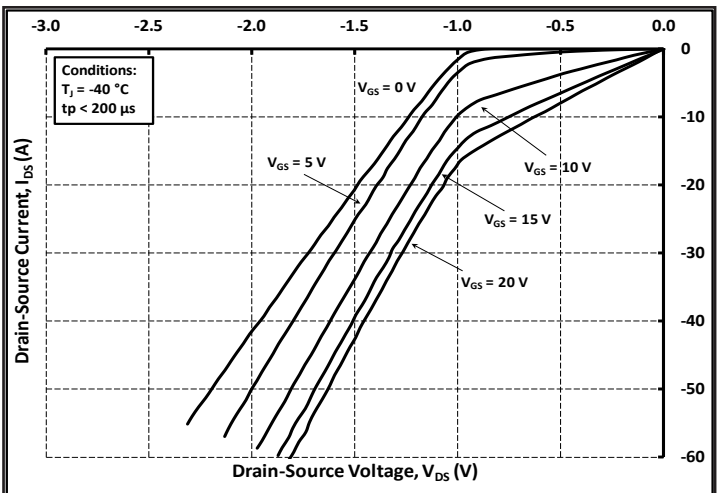


Figure 12. 3rd Quadrant Characteristic at -40 °C

Typical Performance

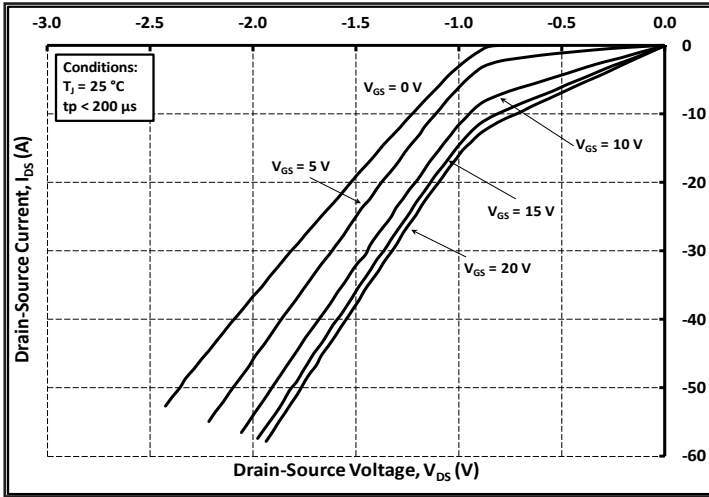


Figure 13. 3rd Quadrant Characteristic at 25 °C

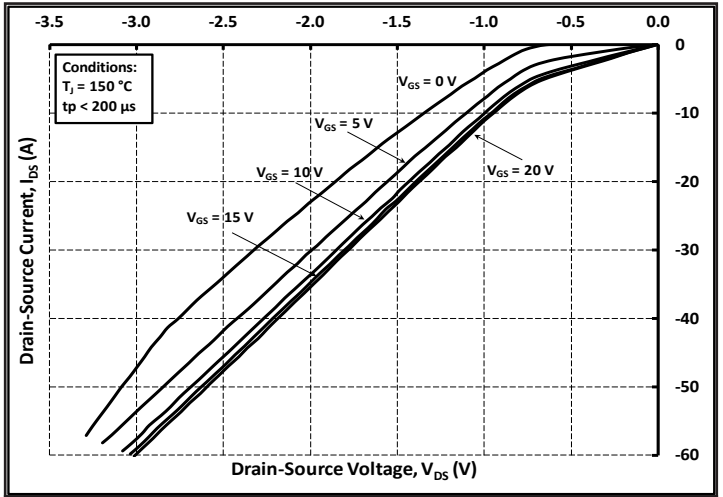


Figure 14. 3rd Quadrant Characteristic at 150 °C

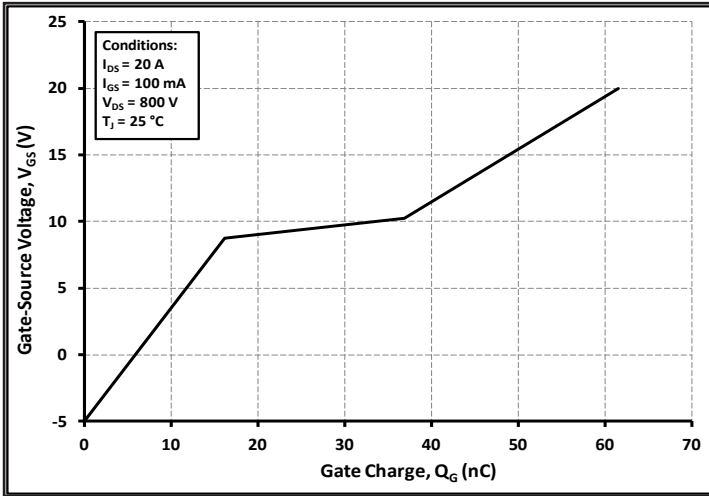


Figure 15. Gate Charge Characteristics

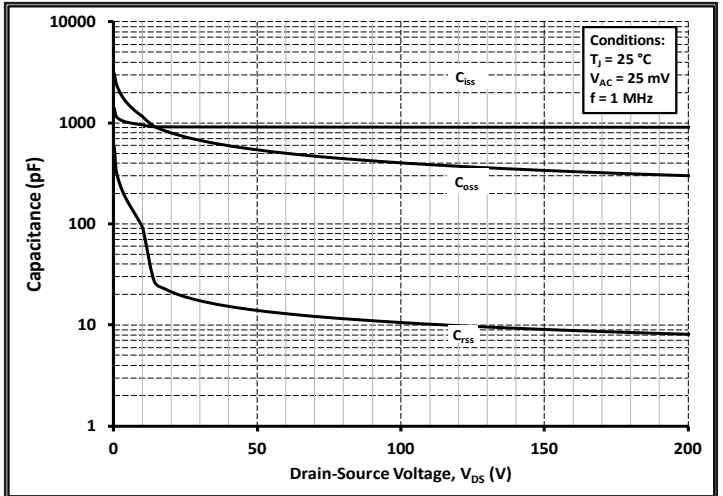


Figure 16. Capacitances vs. Drain-Source Voltage (0 - 200 V)

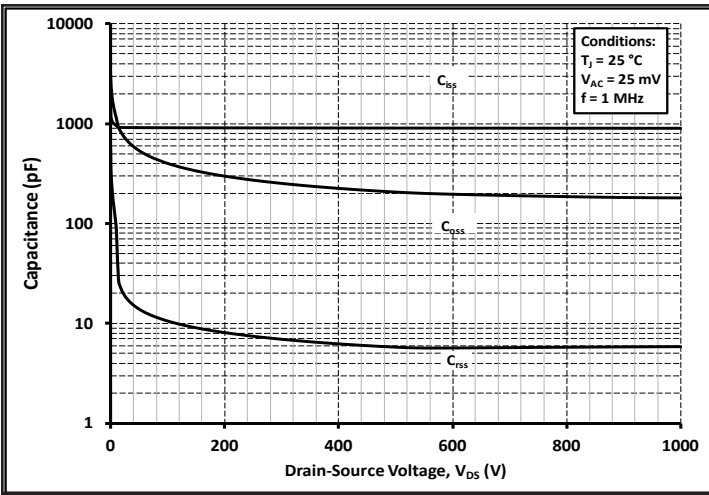


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 1 kV)

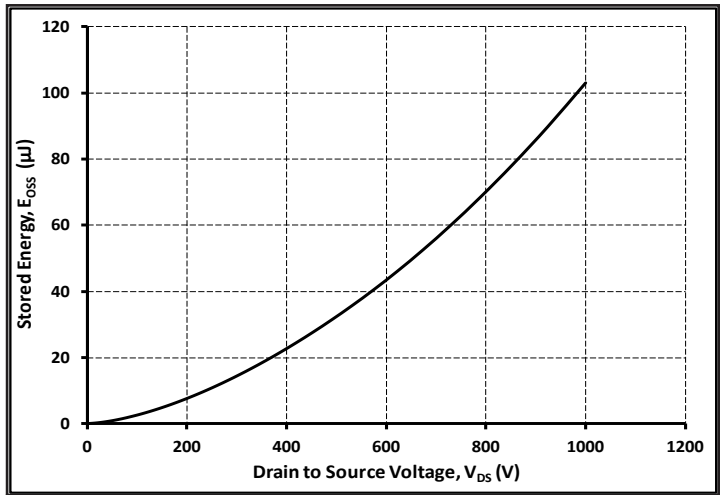


Figure 18. Output Capacitor Stored Energy

Typical Performance

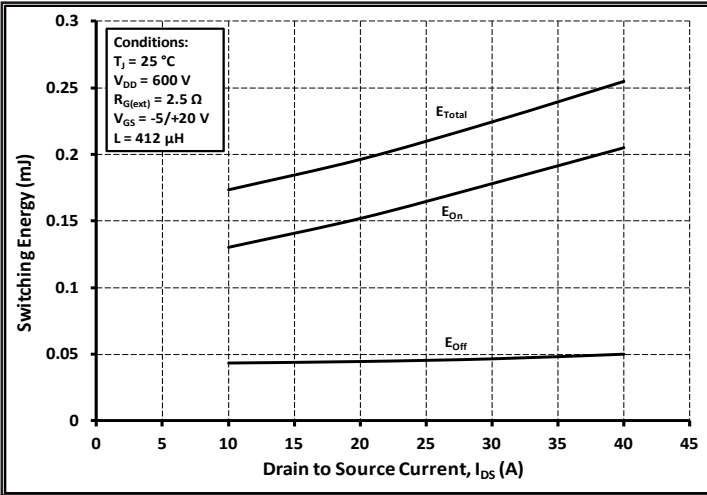


Figure 19. Inductive Switching Energy vs. Drain Current For $V_{DS} = 600\text{V}$

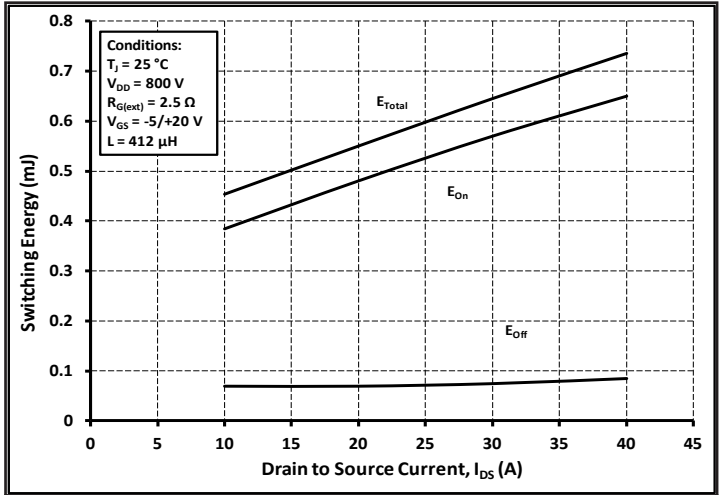


Figure 20. Inductive Switching Energy vs. Drain Current For $V_{DS} = 800\text{V}$

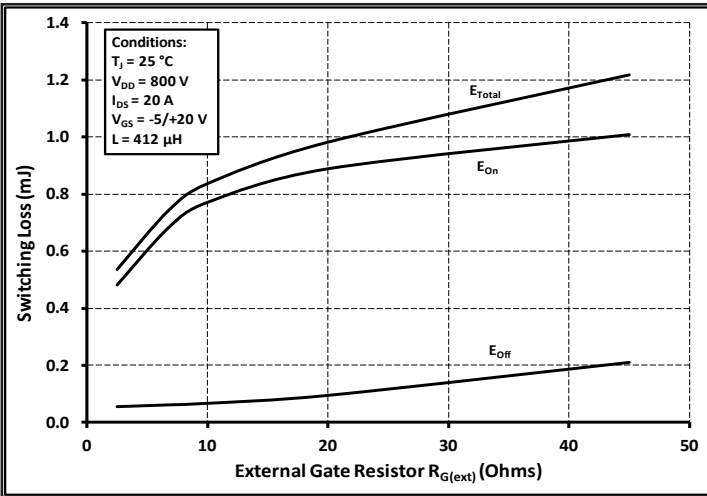


Figure 21. Inductive Switching Energy vs. $R_{G(\text{ext})}$

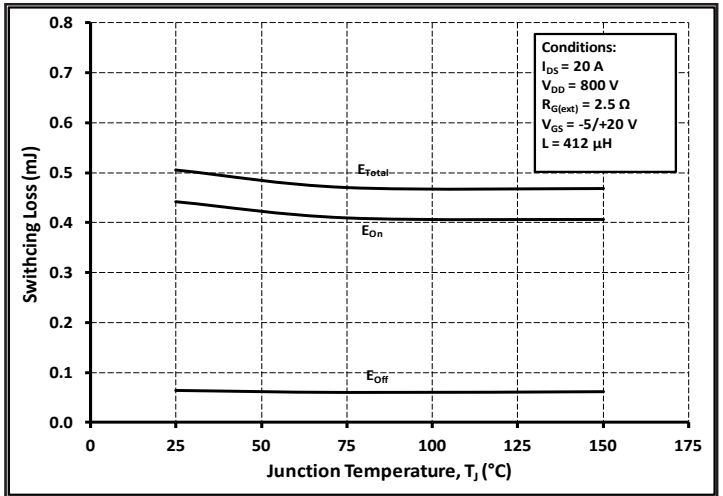


Figure 22. Inductive Switching Energy vs. Temperature

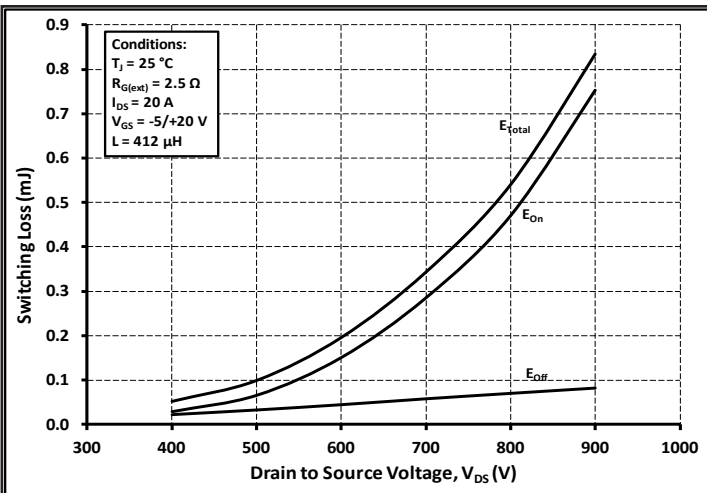


Figure 23. Inductive Switching Energy vs. V_{DS}

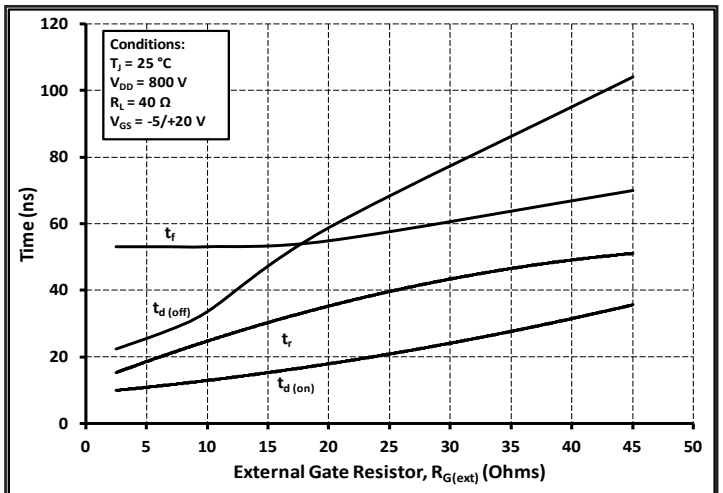


Figure 24. Timing vs. $R_{G(\text{ext})}$

Typical Performance

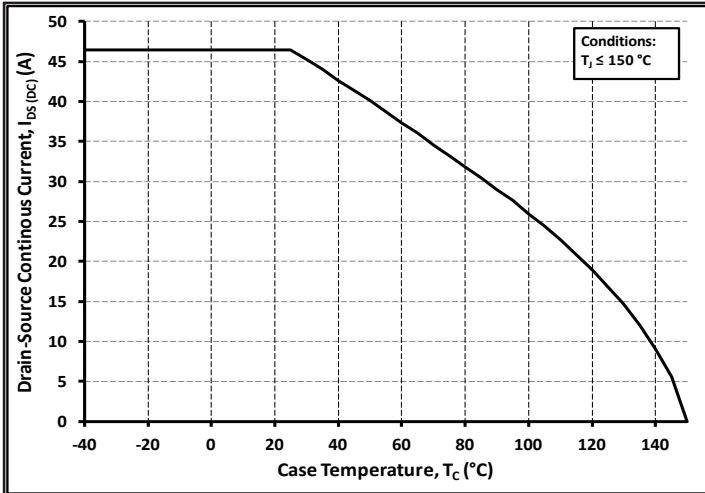


Figure 25. Continuous Drain Current Derating vs. Case Temperature

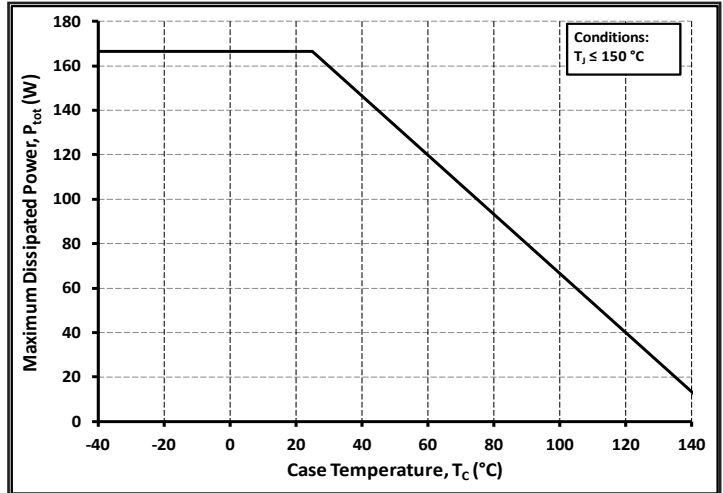


Figure 26. Maximum Power Dissipation (MOSFET) Derating vs Case Temperature

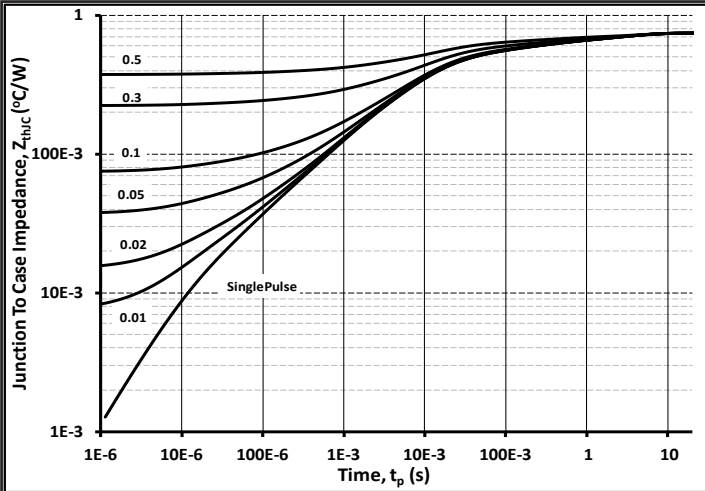


Figure 27. MOSFET Junction to Case Thermal Impedance

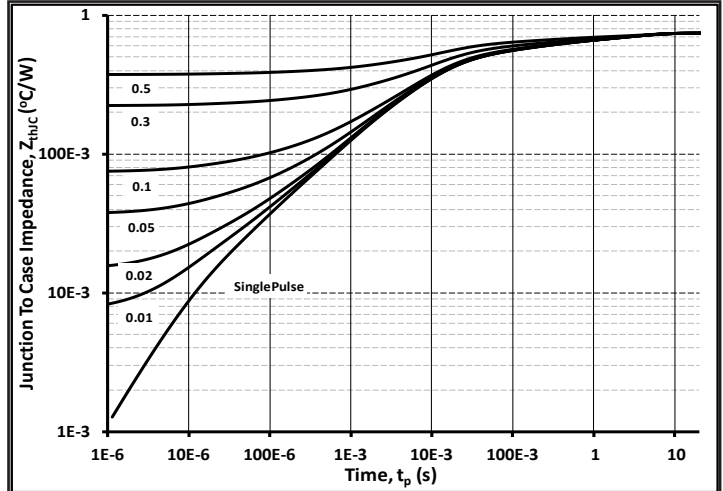


Figure 28. Diode Junction to Case Thermal Impedance

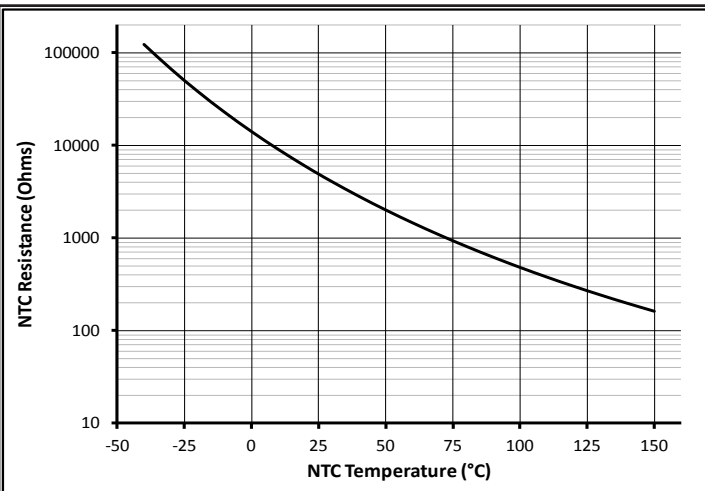


Figure 29. NTC Resistance vs NTC Temperature

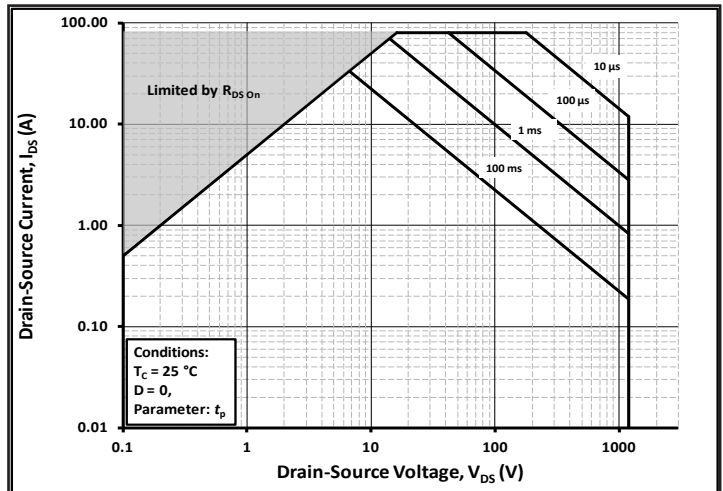


Figure 30. MOSFET Safe Operating Area

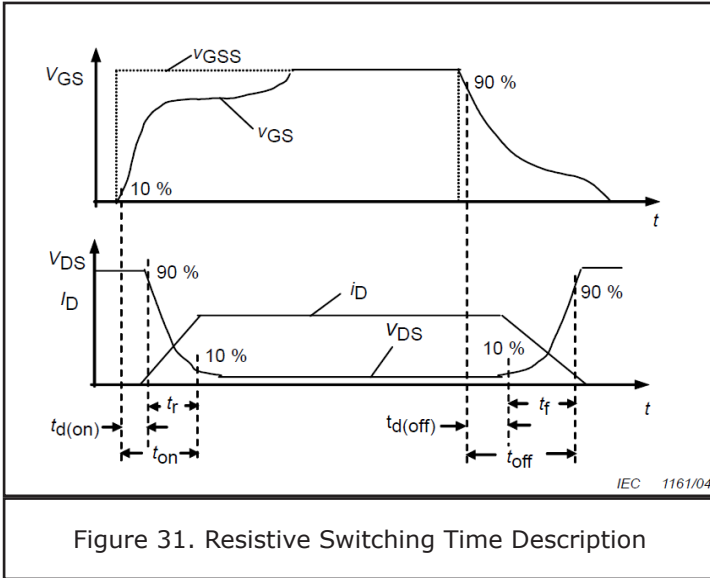
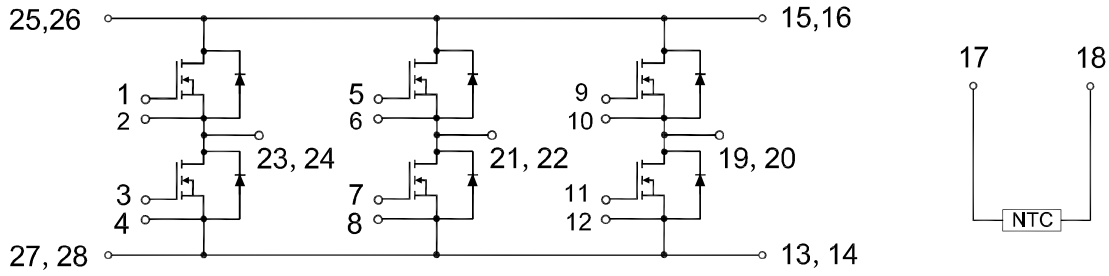


Figure 31. Resistive Switching Time Description

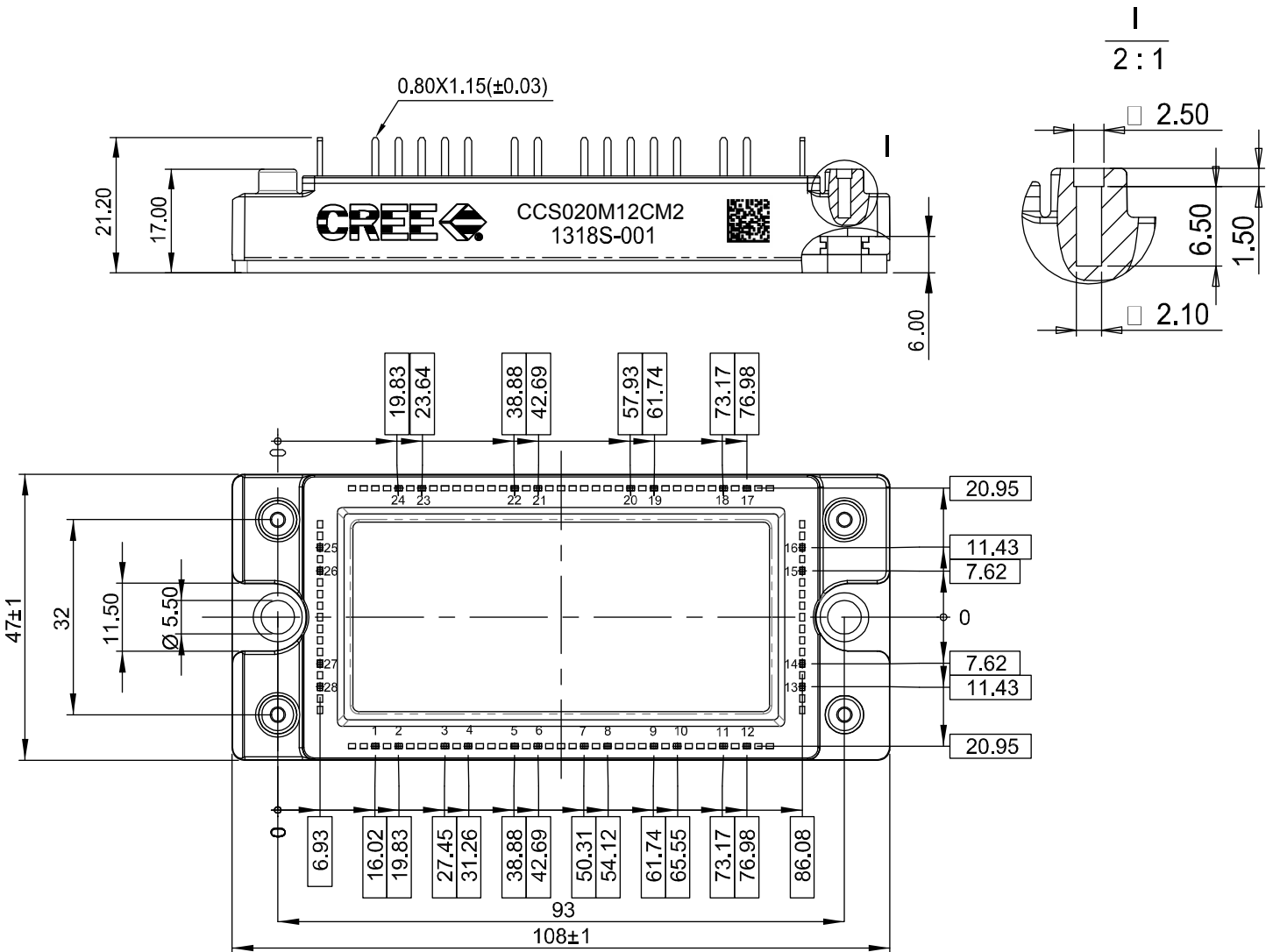
NTC Characteristics

| Symbol | Condition | Typ. | Max. | Unit |
|-------------|--|------|---------|------------------|
| R_{25} | $T_c = 25\text{ }^\circ\text{C}$ | 5 | | $\text{k}\Omega$ |
| Delta R/R | $T_c = 100\text{ }^\circ\text{C}, R_{100} = 481\ \Omega$ | | ± 5 | % |
| P_{25} | $T_c = 25\text{ }^\circ\text{C}$ | | 20 | mW |
| $B_{25/50}$ | $R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298.15\text{K}))]$ | 3380 | | K |
| $B_{25/80}$ | $R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298.15\text{K}))]$ | 3440 | | K |

Schematic



Package Dimensions (mm)





Notes

- **RoHS Compliance**

The levels of RoHS restricted materials in this product are below the maximum concentration values (also referred to as the threshold limits) permitted for such substances, or are used in an exempted application, in accordance with EU Directive 2011/65/EC (RoHS2), as implemented January 2, 2013. RoHS Declarations for this product can be obtained from your Cree representative or from the Product Documentation sections of www.cree.com.

- **REACH Compliance**

REACH substances of high concern (SVHCs) information is available for this product. Since the European Chemical Agency (ECHA) has published notice of their intent to frequently revise the SVHC listing for the foreseeable future, please contact a Cree representative to insure you get the most up-to-date REACH SVHC Declaration. REACH banned substance information (REACH Article 67) is also available upon request.

- This product has not been designed or tested for use in, and is not intended for use in, applications implanted into the human body nor in applications in which failure of the product could lead to death, personal injury or property damage, including but not limited to equipment used in the operation of nuclear facilities, life-support machines, cardiac defibrillators or similar emergency medical equipment, aircraft navigation or communication or control systems, air traffic control systems.

Module Application Note:

The SiC MOSFET module switches at speeds beyond what is customarily associated with IGBT based modules. Therefore, special precautions are required to realize the best performance. The interconnection between the gate driver and module housing needs to be as short as possible. This will afford the best switching time and avoid the potential for device oscillation. Also, great care is required to insure minimum inductance between the module and link capacitors to avoid excessive V_{DS} overshoots.

Please Refer to application note: Design Considerations when using Cree SiC Modules Part 1 and Part 2. [CPWR-AN12, CPWR-AN13]

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

С конца 2013 года компания активно расширяет линейку поставок компонентов по направлению коаксиальный кабель, кварцевые генераторы и конденсаторы (керамические, пленочные, электролитические), за счёт заключения дистрибьюторских договоров

Мы предлагаем:

- Конкурентоспособные цены и скидки постоянным клиентам.
- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
- Сертификаты соответствия на поставляемую продукцию (по желанию клиента).
- Тестирование поставляемой продукции.
- Поставку компонентов, требующих военную и космическую приемку.
- Входной контроль качества.
- Наличие сертификата ISO.

В составе нашей компании организован Конструкторский отдел, призванный помогать разработчикам, и инженерам.

Конструкторский отдел помогает осуществить:

- Регистрацию проекта у производителя компонентов.
- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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