



## Features

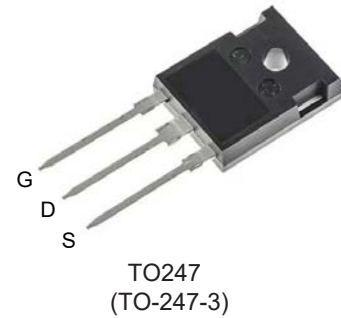
- 3rd generation SiC MOSFET technology
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Halogen free, RoHS compliant

## Benefits

- Reduce switching losses and minimize gate ringing
- Higher system efficiency
- Reduce cooling requirements
- Increase power density
- Increase system switching frequency

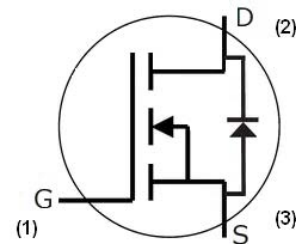
## Applications

- Solar inverters
- EV motor drive
- High voltage DC/DC converters
- Switched mode power supplies
- Load switch



TO247  
(TO-247-3)

## Package



| Part Number          | Package         | Qty(PCS) |
|----------------------|-----------------|----------|
| HIMW120R014M1H XKSA1 | TO247(TO-247-3) | 30       |

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

| Symbol         | Parameter                                  | Value       | Unit             | Test Conditions                                        | Note    |
|----------------|--------------------------------------------|-------------|------------------|--------------------------------------------------------|---------|
| $V_{DSmax}$    | Drain - Source Voltage                     | 1200        | V                | $V_{GS} = 0\text{ V}$ , $I_D = 100\text{ }\mu\text{A}$ |         |
| $V_{GSmax}$    | Gate - Source Voltage (dynamic)            | -8/+19      | V                | AC ( $f > 1\text{ Hz}$ )                               | Note 1  |
| $V_{GSop}$     | Gate - Source Voltage (static)             | -4/+15      | V                | Static                                                 | Note 2  |
| $I_D$          | Continuous Drain Current                   | 115         | A                | $V_{GS} = 15\text{ V}$ , $T_c = 25^\circ\text{C}$      | Fig. 19 |
|                |                                            | 85          |                  | $V_{GS} = 15\text{ V}$ , $T_c = 100^\circ\text{C}$     |         |
| $I_{D(pulse)}$ | Pulsed Drain Current                       | 250         | A                | Pulse width $t_p$ limited by $T_{Jmax}$                |         |
| $P_D$          | Power Dissipation                          | 556         | W                | $T_c = 25^\circ\text{C}$ , $T_J = 175^\circ\text{C}$   | Fig. 20 |
| $T_J, T_{stg}$ | Operating Junction and Storage Temperature | -40 to +175 | $^\circ\text{C}$ |                                                        |         |
| $T_L$          | Solder Temperature                         | 260         | $^\circ\text{C}$ | 1.6mm (0.063") from case for 10s                       |         |
| $M_d$          | Mounting Torque                            | 1<br>8.8    | Nm<br>lbf-in     | M3 or 6-32 screw                                       |         |

Note (1): When using MOSFET Body Diode  $V_{GSmax} = -4\text{V}/+19\text{V}$

Note (2): MOSFET can also safely operate at  $0/+15\text{ V}$



**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             | 1200 |      |      | V             | $V_{GS} = 0\text{ V}, I_D = 100\text{ }\mu\text{A}$                                                                                                                                         |              |
| $V_{GS(th)}$  | Gate Threshold Voltage                     | 1.8  | 2.5  | 3.6  | V             | $V_{DS} = V_{GS}, I_D = 23\text{ mA}$                                                                                                                                                       | Fig. 11      |
|               |                                            |      | 2.0  |      | V             | $V_{DS} = V_{GS}, I_D = 23\text{ mA}, T_J = 175^\circ\text{C}$                                                                                                                              |              |
| $I_{DSS}$     | Zero Gate Voltage Drain Current            |      | 1    | 50   | $\mu\text{A}$ | $V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$                                                                                                                                               |              |
| $I_{GSS}$     | Gate-Source Leakage Current                |      | 10   | 250  | nA            | $V_{GS} = 15\text{ V}, V_{DS} = 0\text{ V}$                                                                                                                                                 |              |
| $R_{DS(on)}$  | Drain-Source On-State Resistance           | 11.2 | 16   | 22.3 | m $\Omega$    | $V_{GS} = 15\text{ V}, I_D = 75\text{ A}$                                                                                                                                                   | Fig. 4, 5, 6 |
|               |                                            |      | 28.8 |      |               | $V_{GS} = 15\text{ V}, I_D = 75\text{ A}, T_J = 175^\circ\text{C}$                                                                                                                          |              |
| $g_{fs}$      | Transconductance                           |      | 53   |      | S             | $V_{DS} = 20\text{ V}, I_{DS} = 75\text{ A}$                                                                                                                                                | Fig. 7       |
|               |                                            |      | 47   |      |               | $V_{DS} = 20\text{ V}, I_{DS} = 75\text{ A}, T_J = 175^\circ\text{C}$                                                                                                                       |              |
| $C_{iss}$     | Input Capacitance                          |      | 6085 |      | pF            | $V_{GS} = 0\text{ V}, V_{DS} = 1000\text{ V}$<br>$f = 100\text{ KHz}$<br>$V_{AC} = 25\text{ mV}$                                                                                            | Fig. 17, 18  |
| $C_{oss}$     | Output Capacitance                         |      | 230  |      |               |                                                                                                                                                                                             |              |
| $C_{rss}$     | Reverse Transfer Capacitance               |      | 13   |      |               |                                                                                                                                                                                             |              |
| $E_{oss}$     | $C_{oss}$ Stored Energy                    |      | 130  |      | $\mu\text{J}$ |                                                                                                                                                                                             | Fig. 16      |
| $E_{ON}$      | Turn-On Switching Energy (SiC Diode FWD)   |      | 4.64 |      | mJ            | $V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/+15\text{ V}, I_D = 75\text{ A},$<br>$R_{G(ext)} = 5\text{ }\Omega, L = 65.7\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$                      | Fig. 26      |
| $E_{OFF}$     | Turn Off Switching Energy (SiC Diode FWD)  |      | 2.93 |      |               |                                                                                                                                                                                             |              |
| $E_{ON}$      | Turn-On Switching Energy (Body Diode FWD)  |      | 7.79 |      | mJ            | $V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/+15\text{ V}, I_D = 75\text{ A},$<br>$R_{G(ext)} = 5\text{ }\Omega, L = 65.7\text{ }\mu\text{H}, T_J = 175^\circ\text{C}$                      | Fig. 26      |
| $E_{OFF}$     | Turn Off Switching Energy (Body Diode FWD) |      | 2.95 |      |               |                                                                                                                                                                                             |              |
| $t_{d(on)}$   | Turn-On Delay Time                         |      | 174  |      | ns            | $V_{DD} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$<br>$R_{G(ext)} = 5\text{ }\Omega, I_D = 75\text{ A}, L = 65.7\text{ }\mu\text{H}$<br>Timing relative to $V_{DS}$ , Inductive load | Fig. 27      |
| $t_r$         | Rise Time                                  |      | 28   |      |               |                                                                                                                                                                                             |              |
| $t_{d(off)}$  | Turn-Off Delay Time                        |      | 84   |      |               |                                                                                                                                                                                             |              |
| $t_f$         | Fall Time                                  |      | 27   |      |               |                                                                                                                                                                                             |              |
| $R_{G(int)}$  | Internal Gate Resistance                   |      | 2.6  |      | $\Omega$      | $f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$                                                                                                                                                   |              |
| $Q_{gs}$      | Gate to Source Charge                      |      | 70   |      | nC            | $V_{DS} = 800\text{ V}, V_{GS} = -4\text{ V}/15\text{ V}$<br>$I_D = 75\text{ A}$<br>Per IEC60747-8-4 pg 21                                                                                  | Fig. 12      |
| $Q_{gd}$      | Gate to Drain Charge                       |      | 60   |      |               |                                                                                                                                                                                             |              |
| $Q_g$         | Total Gate Charge                          |      | 207  |      |               |                                                                                                                                                                                             |              |



**Reverse Diode Characteristics** ( $T_C = 25^\circ\text{C}$  unless otherwise specified)

| Symbol                | Parameter                        | Typ. | Max. | Unit | Test Conditions                                                                                                                                    | Note          |
|-----------------------|----------------------------------|------|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| $V_{SD}$              | Diode Forward Voltage            | 4.6  |      | V    | $V_{GS} = -4\text{ V}$ , $I_{SD} = 37.5\text{ A}$ , $T_J = 25^\circ\text{C}$                                                                       | Fig. 8, 9, 10 |
|                       |                                  | 4.2  |      | V    | $V_{GS} = -4\text{ V}$ , $I_{SD} = 37.5\text{ A}$ , $T_J = 175^\circ\text{C}$                                                                      |               |
| $I_S$                 | Continuous Diode Forward Current |      | 112  | A    | $V_{GS} = -4\text{ V}$ , $T_C = 25^\circ\text{C}$                                                                                                  | Note 1        |
| $I_{S, \text{pulse}}$ | Diode pulse Current              |      | 250  | A    | $V_{GS} = -4\text{ V}$ , pulse width $t_p$ limited by $T_{jmax}$                                                                                   | Note 1        |
| $t_{rr}$              | Reverse Recover time             | 96   |      | ns   | $V_{GS} = -4\text{ V}$ , $I_{SD} = 75\text{ A}$ , $V_R = 800\text{ V}$<br>$\text{diff/dt} = 900\text{ A}/\mu\text{s}$ , $T_J = 175^\circ\text{C}$  | Note 1        |
| $Q_{rr}$              | Reverse Recovery Charge          | 604  |      | nC   |                                                                                                                                                    |               |
| $I_{rrm}$             | Peak Reverse Recovery Current    | 15   |      | A    |                                                                                                                                                    |               |
| $t_{rr}$              | Reverse Recover time             | 58   |      | ns   | $V_{GS} = -4\text{ V}$ , $I_{SD} = 75\text{ A}$ , $V_R = 800\text{ V}$<br>$\text{diff/dt} = 1400\text{ A}/\mu\text{s}$ , $T_J = 175^\circ\text{C}$ | Note 1        |
| $Q_{rr}$              | Reverse Recovery Charge          | 672  |      | nC   |                                                                                                                                                    |               |
| $I_{rrm}$             | Peak Reverse Recovery Current    | 22   |      | A    |                                                                                                                                                    |               |

**Thermal Characteristics**

| Symbol          | Parameter                                   | Typ. | Unit                      | Test Conditions | Note    |
|-----------------|---------------------------------------------|------|---------------------------|-----------------|---------|
| $R_{\theta JC}$ | Thermal Resistance from Junction to Case    | 0.27 | $^\circ\text{C}/\text{W}$ |                 | Fig. 21 |
| $R_{\theta JA}$ | Thermal Resistance From Junction to Ambient | 40   |                           |                 |         |



## Typical Performance

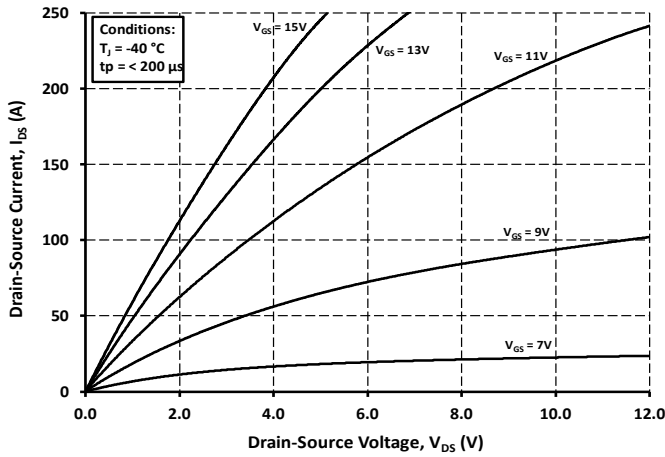


Figure 1. Output Characteristics  $T_j = -40^\circ\text{C}$

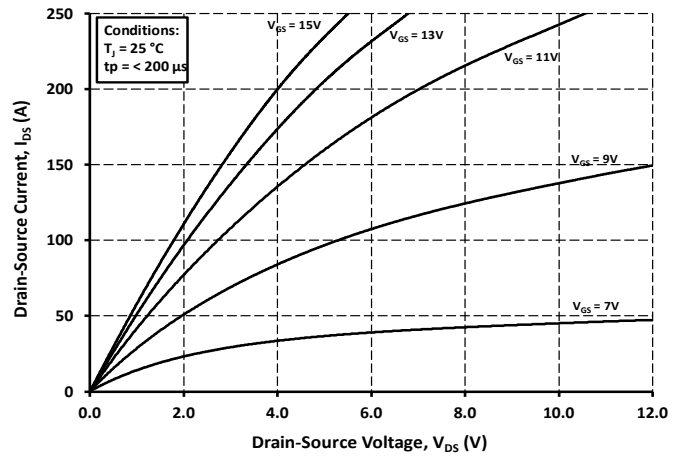


Figure 2. Output Characteristics  $T_j = 25^\circ\text{C}$

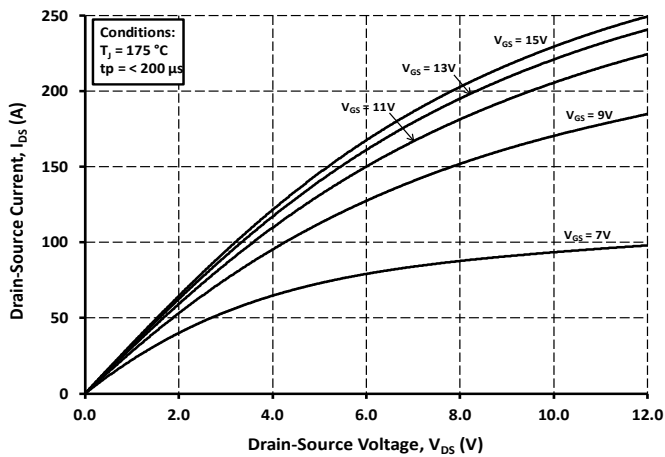


Figure 3. Output Characteristics  $T_j = 175^\circ\text{C}$

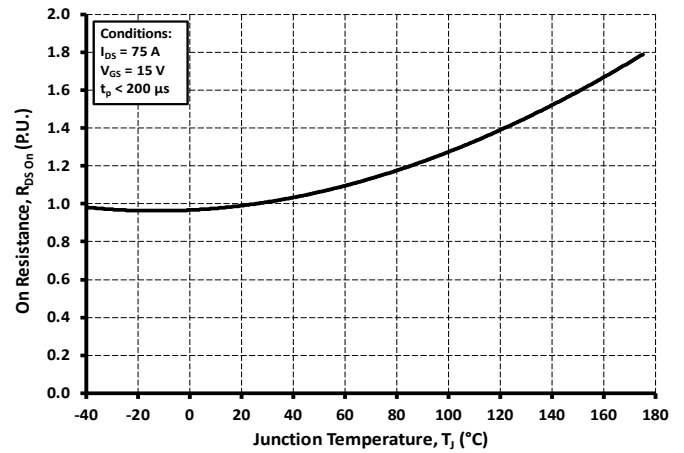


Figure 4. Normalized On-Resistance vs. Temperature

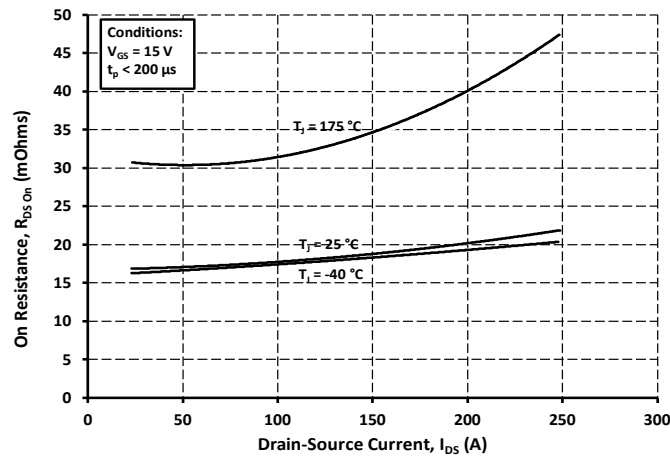


Figure 5. On-Resistance vs. Drain Current  
For Various Temperatures

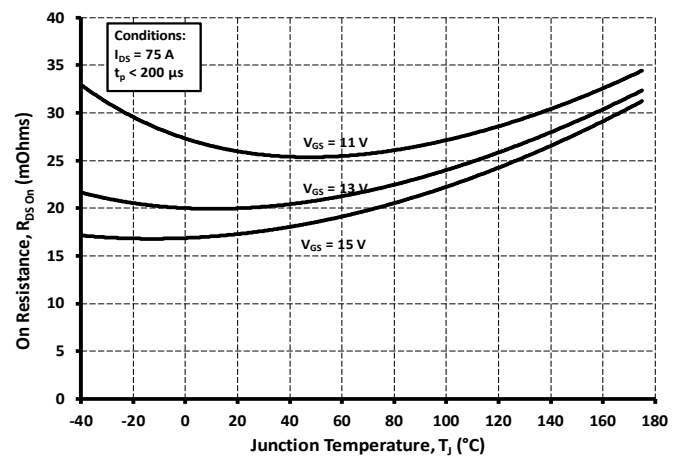


Figure 6. On-Resistance vs. Temperature  
For Various Gate Voltage



## Typical Performance

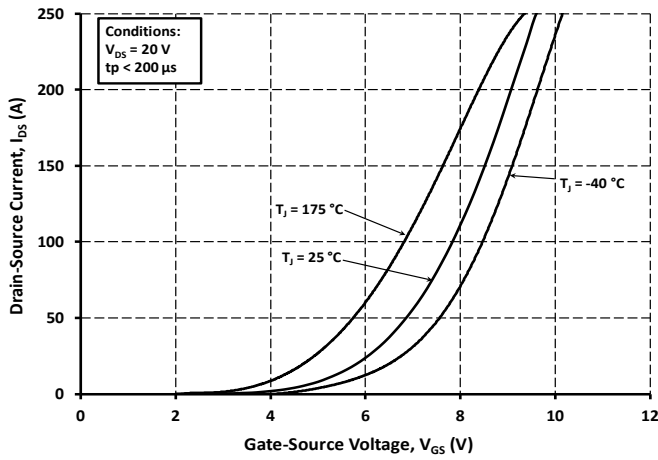


Figure 7. Transfer Characteristic for Various Junction Temperatures

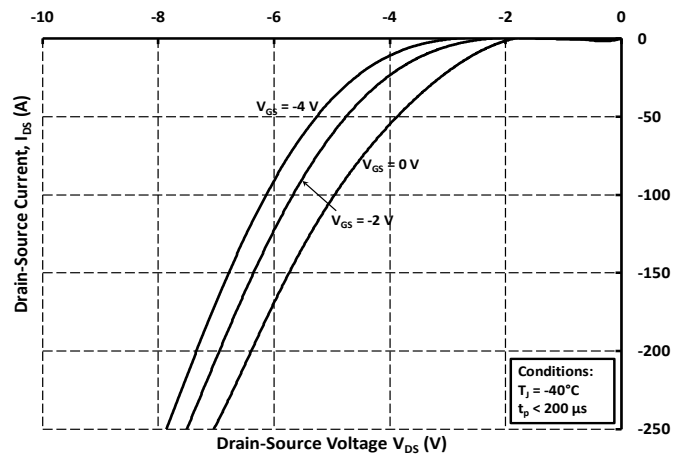


Figure 8. Body Diode Characteristic at  $-40^\circ\text{C}$

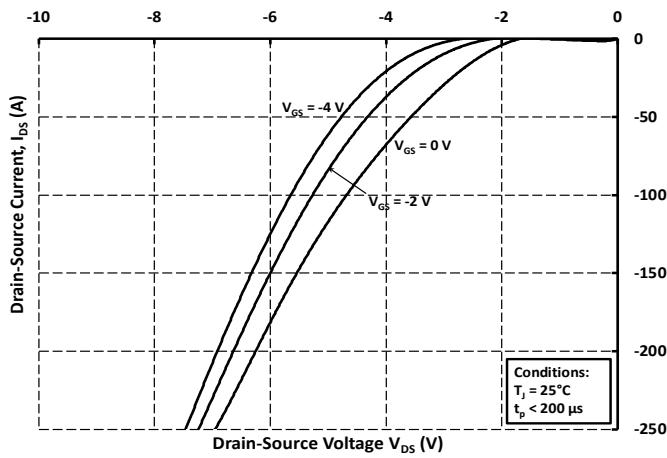


Figure 9. Body Diode Characteristic at  $25^\circ\text{C}$

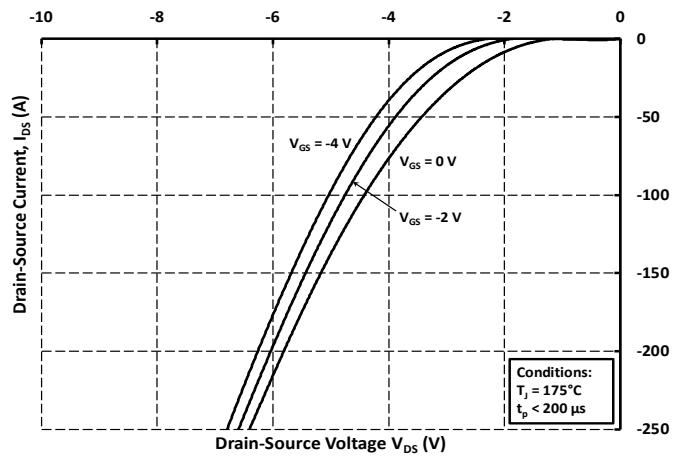


Figure 10. Body Diode Characteristic at  $175^\circ\text{C}$

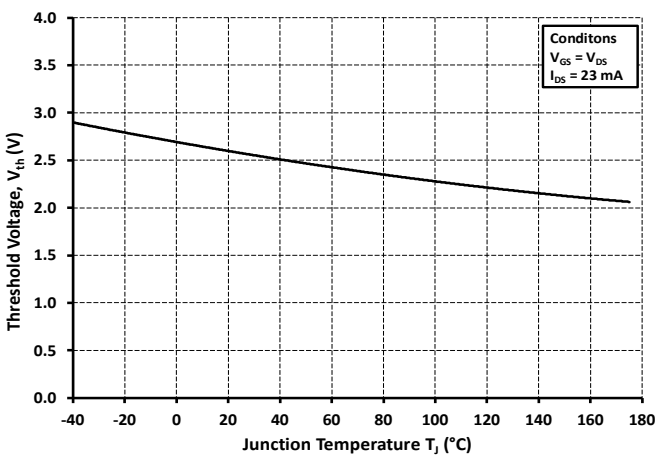


Figure 11. Threshold Voltage vs. Temperature

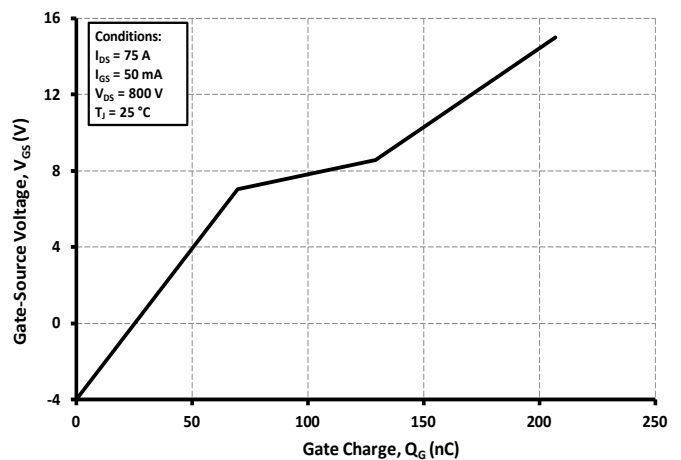


Figure 12. Gate Charge Characteristics



## Typical Performance

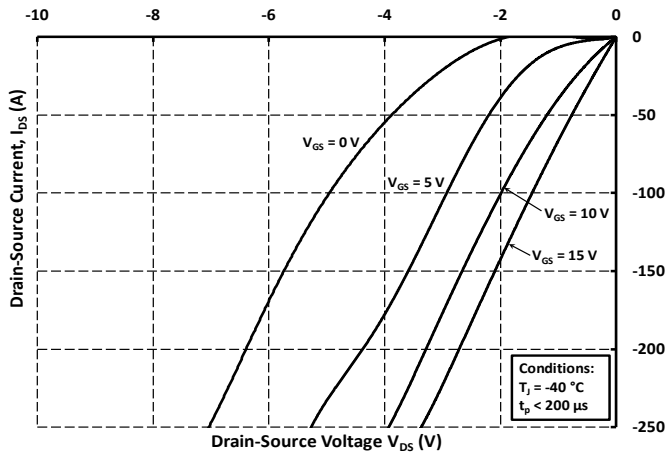


Figure 13. 3rd Quadrant Characteristic at -40 °C

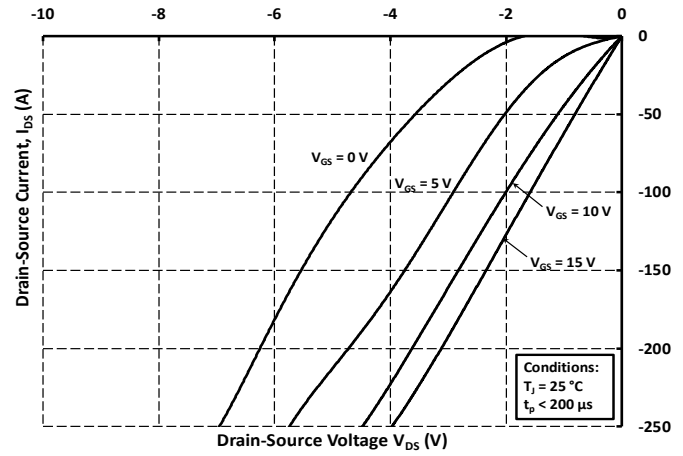


Figure 14. 3rd Quadrant Characteristic at 25 °C

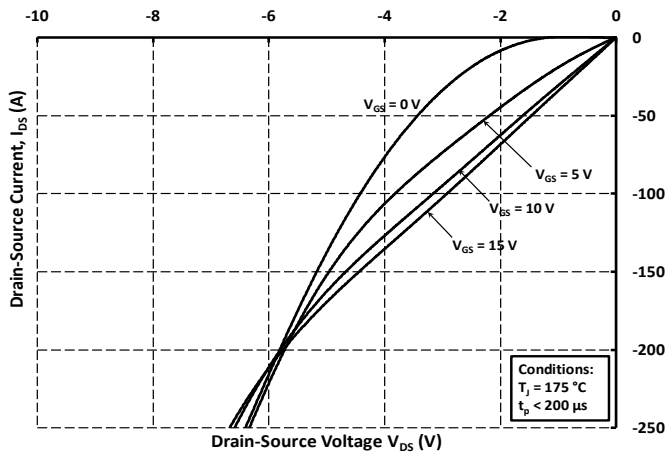


Figure 15. 3rd Quadrant Characteristic at 175 °C

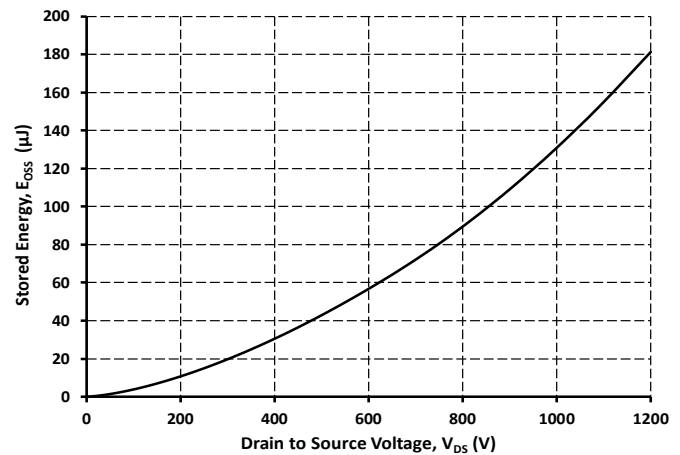


Figure 16. Output Capacitor Stored Energy

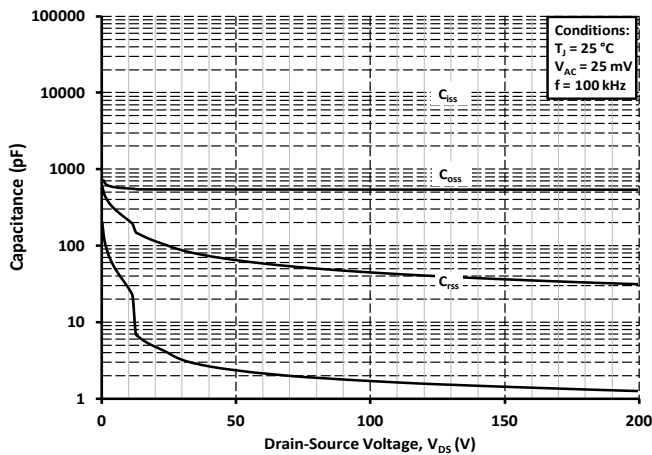


Figure 17. Capacitances vs. Drain-Source Voltage (0 - 200V)

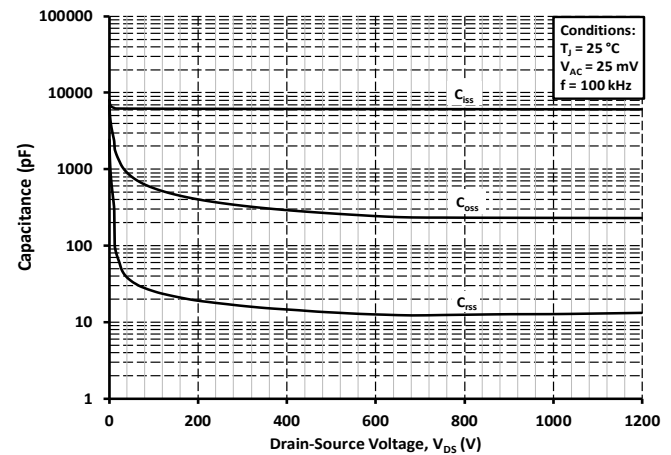


Figure 18. Capacitances vs. Drain-Source Voltage (0 - 1200V)



## Typical Performance

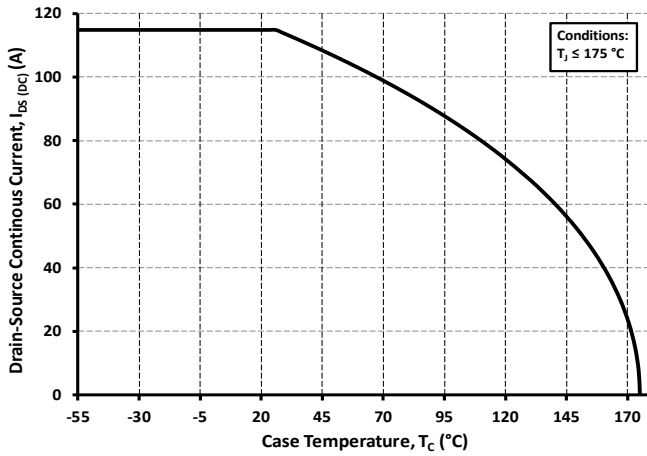


Figure 19. Continuous Drain Current Derating vs. Case Temperature

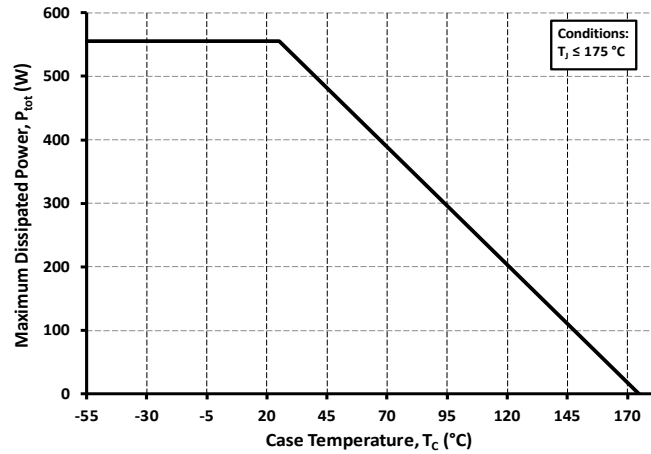


Figure 20. Maximum Power Dissipation Derating vs. Case Temperature

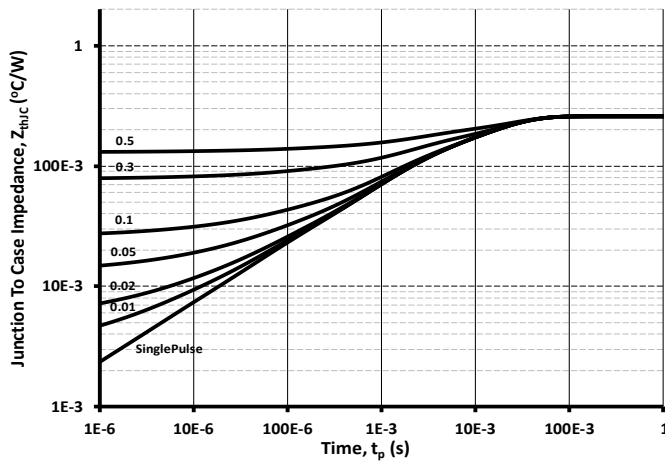


Figure 21. Transient Thermal Impedance (Junction - Case)

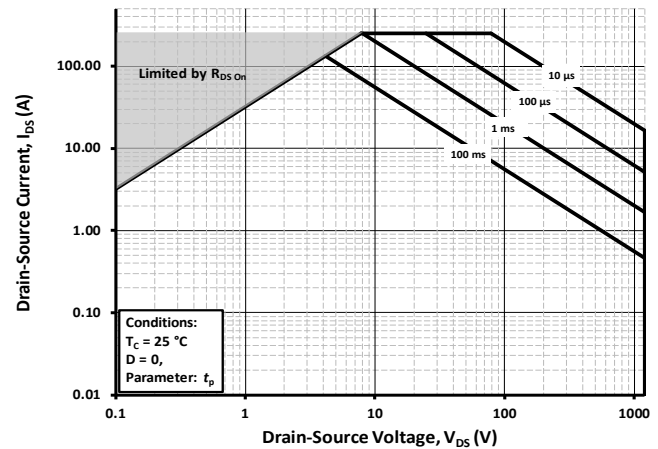


Figure 22. Safe Operating Area

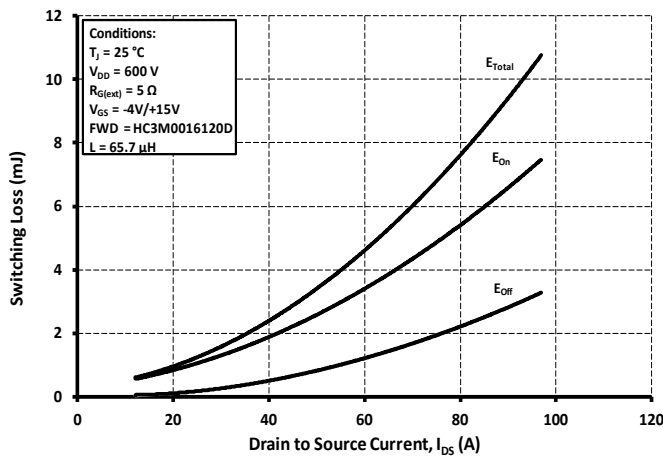


Figure 23. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 600V$ )

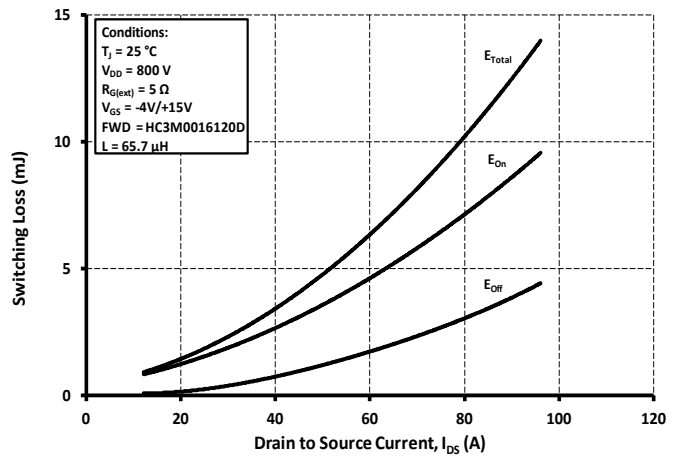


Figure 24. Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800V$ )



## Typical Performance

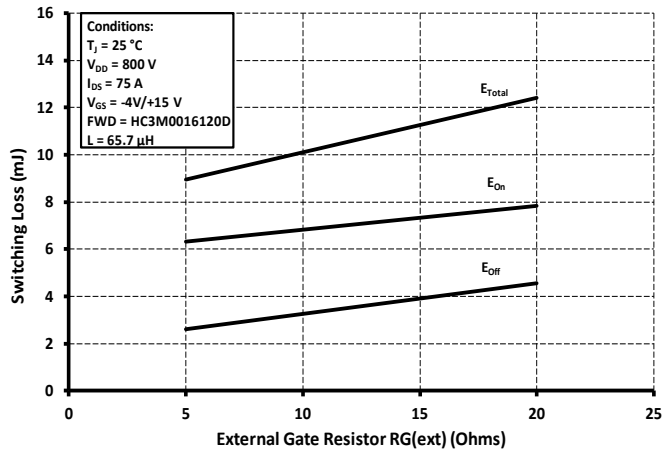


Figure 25. Clamped Inductive Switching Energy vs.  $R_{G(ext)}$

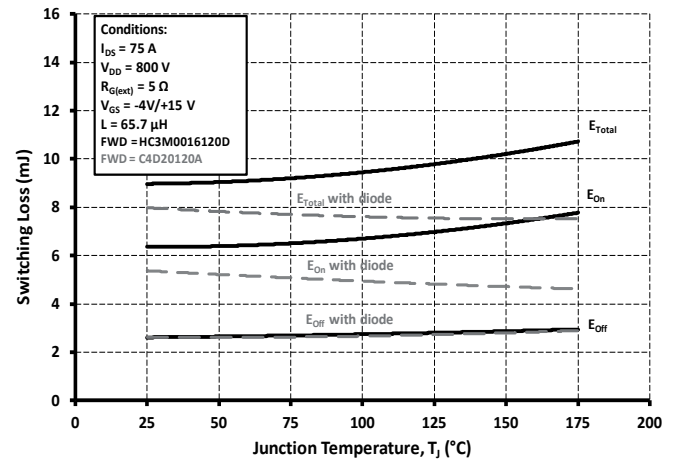


Figure 26. Clamped Inductive Switching Energy vs. Temperature

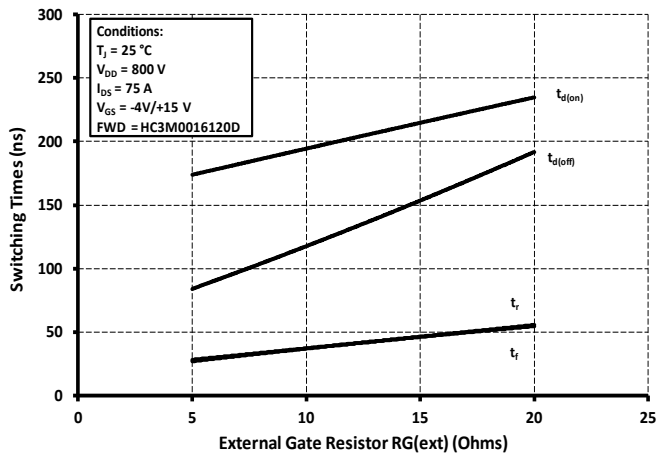


Figure 27. Switching Times vs.  $R_{G(ext)}$

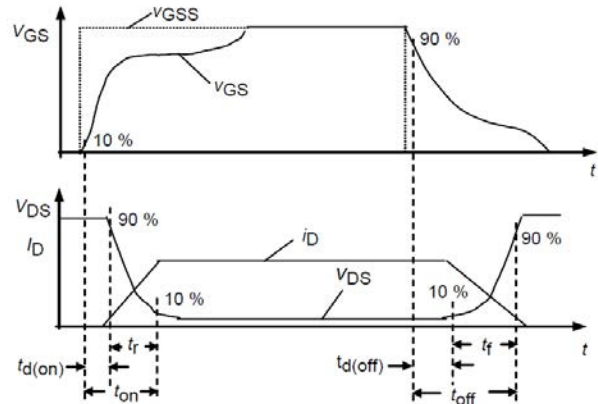


Figure 28. Switching Times Definition



## Test Circuit Schematic

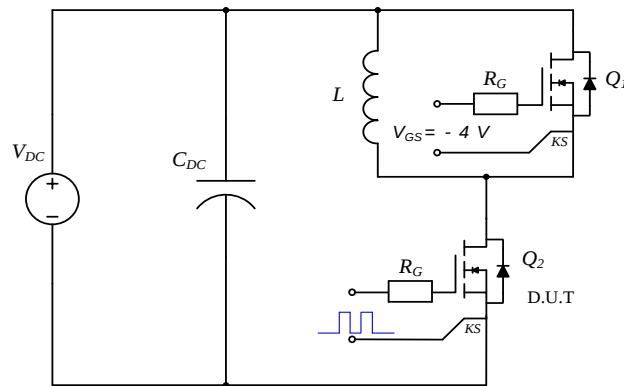


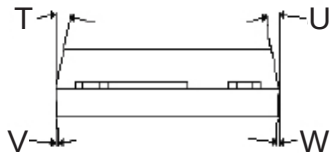
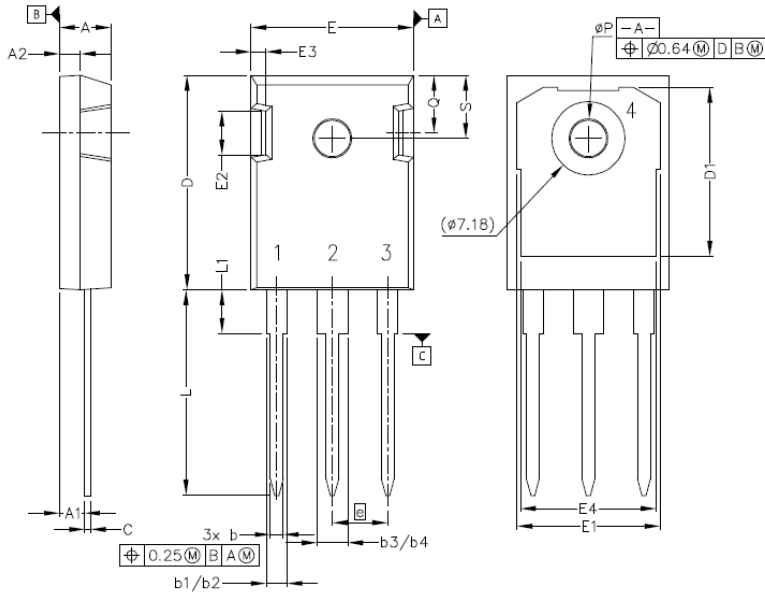
Figure 29. Clamped Inductive Switching  
Waveform Test Circuit

Note (3): Turn-off and Turn-on switching energy and timing values measured using SiC MOSFET Body Diode as shown above.



## Package Dimensions

### Package T0247(TO-247-3)

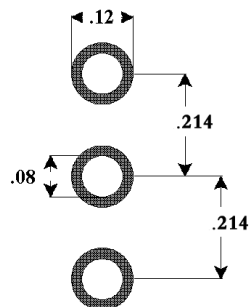


#### Pinout Information:

- Pin 1 = Gate
- Pin 2, 4 = Drain
- Pin 3 = Source

| POS | Inches   |      | Millimeters |       |
|-----|----------|------|-------------|-------|
|     | Min      | Max  | Min         | Max   |
| A   | .190     | .205 | 4.83        | 5.21  |
| A1  | .090     | .100 | 2.29        | 2.54  |
| A2  | .075     | .085 | 1.91        | 2.16  |
| b   | .042     | .052 | 1.07        | 1.33  |
| b1  | .075     | .095 | 1.91        | 2.41  |
| b2  | .075     | .085 | 1.91        | 2.16  |
| b3  | .113     | .133 | 2.87        | 3.38  |
| b4  | .113     | .123 | 2.87        | 3.13  |
| c   | .022     | .027 | 0.55        | 0.68  |
| D   | .819     | .831 | 20.80       | 21.10 |
| D1  | .640     | .695 | 16.25       | 17.65 |
| D2  | .037     | .049 | 0.95        | 1.25  |
| E   | .620     | .635 | 15.75       | 16.13 |
| E1  | .516     | .557 | 13.10       | 14.15 |
| E2  | .145     | .201 | 3.68        | 5.10  |
| E3  | .039     | .075 | 1.00        | 1.90  |
| E4  | .487     | .529 | 12.38       | 13.43 |
| e   | .214 BSC |      | 5.44 BSC    |       |
| N   | 3        |      | 3           |       |
| L   | .780     | .800 | 19.81       | 20.32 |
| L1  | .161     | .173 | 4.10        | 4.40  |
| ØP  | .138     | .144 | 3.51        | 3.65  |
| Q   | .216     | .236 | 5.49        | 6.00  |
| S   | .238     | .248 | 6.04        | 6.30  |
| T   | 9°       | 11°  | 9°          | 11°   |
| U   | 9°       | 11°  | 9°          | 11°   |
| V   | 2°       | 8°   | 2°          | 8°    |
| W   | 2°       | 8°   | 2°          | 8°    |

## Recommended Solder Pad Layout



T0247-3L



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