# HCM2G0040120D

1200V N-Channel Silicon Carbide Power MOSFET

| | | |
|---|---|---|
| $V_{DS}$ | = | 1200 V |
| $R_{DS(on)}$ | = | 37 mΩ |
| $I_D$ | = | 75 A |

## Features

- Optimized package with separate driver source pin
- High blocking voltage with low on-resistance
- High-speed switching with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Easy to parallel
- RoHS compliant

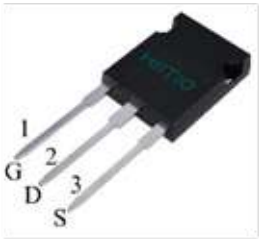
## Benefits

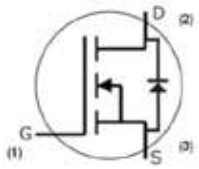
- Higher System Efficiency
- Reduce cooling requirements
- Increased power density
- Enabling higher frequency
- Minimize gate ringing
- Reduction of system complexity and cost

## Applications

- Switch Mode Power Supplies
- DC/DC converters
- Solar Inverters
- Battery Chargers
- Motor Drives

Package




| Part Number | Package | Marking |
|---|---|---|
| HCM2G0040120D | TO-247-3 | HCM2G0040120D |

## Maximum Ratings, at $T_J$ = 25℃ , unless otherwise specified

| Symbol | Parameter | Value | Unit | Test Conditions | Note |
|---|---|---|---|---|---|
| $V_{DSmax}$ | Drain-Source Breakdown Voltag | 1200 | V | $V_{GS}$= 0 V, $I_D$ = 100 μA | |
| $I_D$ | Continuous Drain Current | 75 | A | $V_{GS}$= 20 V, $T_C$ = 25 ℃ | Fig. 18 |
| | | 53 | A | $V_{GS}$= 20 V, $T_C$ = 100 ℃ | |
| $I_{D(pluse)}$ | Pulsed Drain Current | 150 | A | Pulsed width $t_p$ limited by $T_{jmax}$ | Fig. 21 |
| $P_D$ | Power Dissipation | 330 | W | $T_C$ = 25 ℃ | Fig. 19 |
| $V_{GS,op}$ | Recommend Gate Source Voltage (static) | -5/+20 | V | | |
| $V_{GSmax}$ | Maximum Gate Source Voltage (dynamic) | -10/+25 | V | AC（f＞1Hz) | |
| $T_J$, $T_{stg}$ | Operating Junction and Storage Temperature Range | -55 to +175 | ℃ | | |
| $T_L$ | Soldering Temperature | 260 | ℃ | | |

## Electrical Characteristics, at $T_J$ = 25℃, unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| Static | | | | | | | |
| $BV_{DS}$ | Drain-Source Breakdown Voltag | 1200 | -- | -- | V | $V_{GS}$= 0 V, $I_D$ = 100 μA | |
| $I_{DSS}$ | Zero Gate Voltage Drain Current | --1 | 100 | μA | | $V_{DS}$= 1200 V, $V_{GS}$= 0 V | |
| $I_{GSS}$ | Gate-Source Leakage Current | -- | 10 | 25 | nA | $V_{GS}$= 20 V | |
| $V_{GS(th)}$ | Gate-Source Threshold Voltage | 2 | 2.7 | 4 | V | $I_D$ = 10 mA, $V_{GS}$= $V_{DS}$ | Fig. 11 |
| | | -- | 2.0 | -- | V | $I_D$ = 10 mA, $V_{GS}$= $V_{DS}$, $T_J$= 175 ℃ | |
| $R_{DS(on)}$ | Drain-Source On-Resistance | -- | 37 | 55 | mΩ | $V_{GS}$= 20 V, $I_D$ = 40 A | Fig. 7 |
| | | -- | 42 | -- | mΩ | $V_{GS}$= 18 V, $I_D$ = 40 A | |
| | | -- | 59 | -- | mΩ | $V_{GS}$= 15 V, $I_D$ = 40 A | |
| | | -- | 51 | -- | mΩ | $V_{GS}$= 20 V, $I_D$ = 40 A, $T_J$= 175 ℃ | |
| | | -- | 54 | -- | mΩ | $V_{GS}$= 18 V, $I_D$ = 40 A, $T_J$= 175 ℃ | |
| | | -- | 67 | -- | mΩ | $V_{GS}$= 15 V, $I_D$ = 40 A, $T_J$= 175 ℃ | |
| Dynamic | | | | | | | |
| $C_{iss}$ | Input Capacitance | -- | 2193 | -- | pF | $V_{GS}$= 0 V, $V_{DS}$= 1000 V<br>f = 1.0 MHz, $V_{AC}$ = 25 mV | Fig. 17 |
| $C_{oss}$ | Output Capacitance | -- | 153 | -- | | | |
| $C_{rss}$ | Reverse Transfer Capacitance | -- | 8 | -- | | | |
| $E_{OSS}$ | $C_{OSS}$ Stored Energy | -- | 83 | -- | μJ | | Fig. 16 |
| $Q_g$ | Total Gate Charge | -- | 99 | -- | nC | $V_{DS}$= 800 V<br>$I_D$ = 40 A<br>$V_{GS}$= -5/+20 V | Fig. 12 |
| $Q_{gs}$ | Gate-Source Charge | -- | 32 | -- | | | |
| $Q_{gd}$ | Gate-Drain Charge | -- | 29 | -- | | | |
| $t_{d(on)}$ | Turn-on Delay Time | -- | 18 | -- | ns | $V_{DS}$= 800 V<br>$V_{GS}$= -5/+20 V<br>$I_D$ = 40 A<br>$R_{G(ext)}$= 2.5 Ω | |
| $t_r$ | Turn-on Rise Time | -- | 65 | -- | | | |
| $t_{d(off)}$ | Turn-off Delay Time | -- | 36 | -- | | | |
| $t_f$ | Turn-off Fall Time | -- | 15 | -- | | | |
| $R_{G(int)}$ | Internal Gate Resistance | -- | 2.0 | -- | Ω | f = 1.0 MHz, $V_{AC}$ = 25 mV | |

## Body Diode Characteristics, at $T_J$ = 25℃, unless otherwise specified

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| $I_S$ | Continuous Diode Forward Current | -- | -- | 75 | A | $V_{GS}$= -5 V | |
| $I_{S(pluse)}$ | Diode pulse Current | -- | -- | 150 | A | Pulse width $t_P$ limited by Tjmax | |
| $V_{SD}$ | Diode Forward Voltage | -- | 4.0 | -- | V | $V_{GS}$= 0 V, $I_S$ = 20 A | Fig. 8, 9, 10 |
| | | -- | 3.8 | -- | V | $V_{GS}$= 0 V, $I_S$ = 20 A, $T_J$= 175 ℃ | |
| $t_{rr}$ | Reverse Recovery Time | -- | 28 | -- | ns | $I_S$ = 20 A, $V_{DS}$= 800 V<br>$V_{GS}$= -5 V<br>di/dt = 2100 A/us | |
| $Q_{rr}$ | Reverse Recovery Charge | -- | 232 | -- | nC | | |
| $I_{rrm}$ | Peak Reverse Recovery Current | -- | 13 | -- | A | | |

## Thermal Characteristics

| Symbol | Parameter | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| $R_{\theta JC}$ | Thermal Resistance from Junction to Case | / | 0.39 | / | ℃/W | Fig. 20 |

## Typical Performance

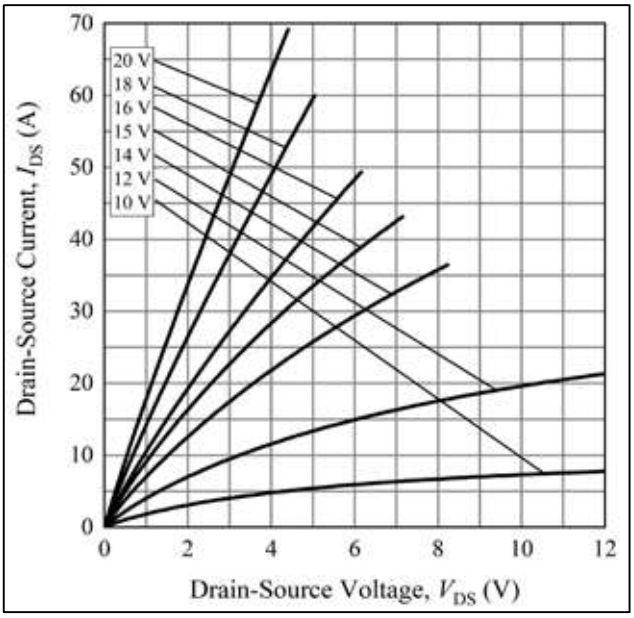



Figure 1: Typical Output Characteristics at $T_J$ = -55 ℃

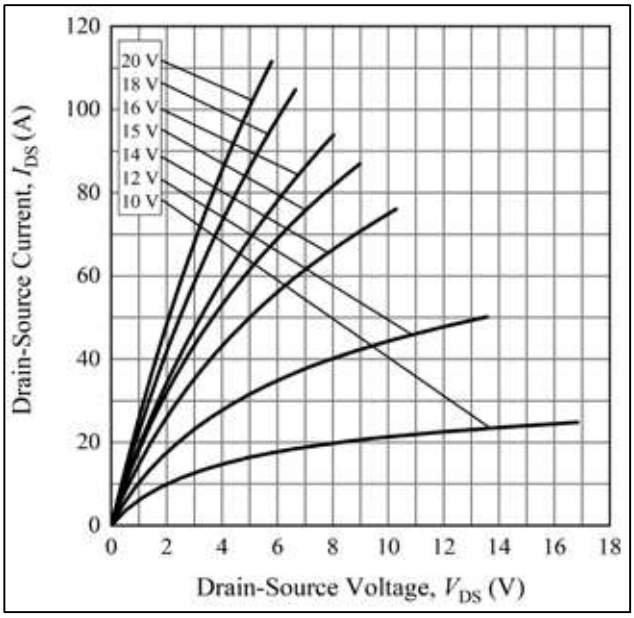



Figure 2: Typical Output Characteristics at $T_J$ = 25 ℃

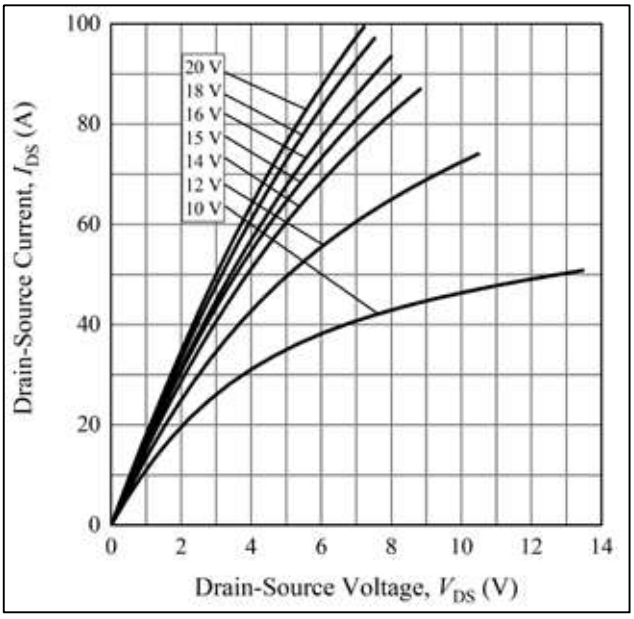



Figure 3: Typical Output Characteristics at $T_J$ = 175 ℃

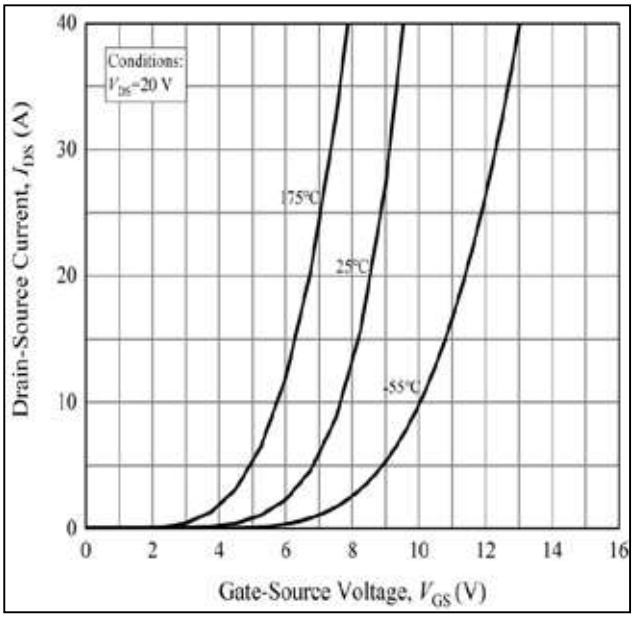



Figure 4: Typical Transfer Characteristics for Various Temperature

## Typical Performance

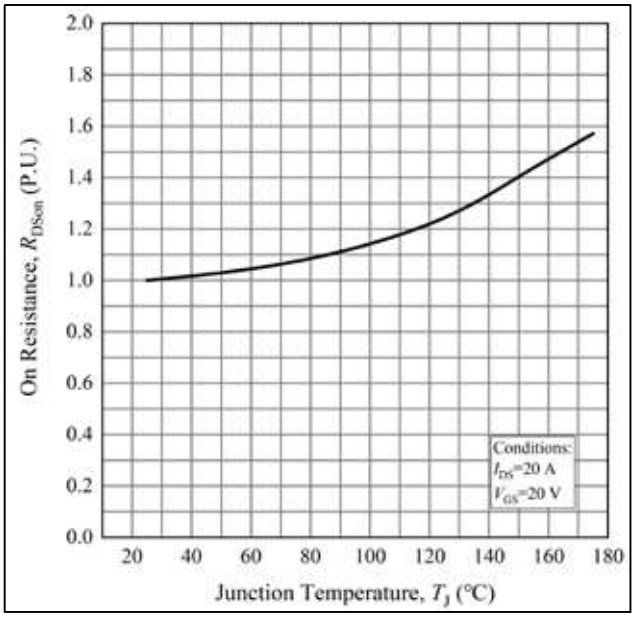



Figure 5: Normalized On-Resistance vs. Temperature

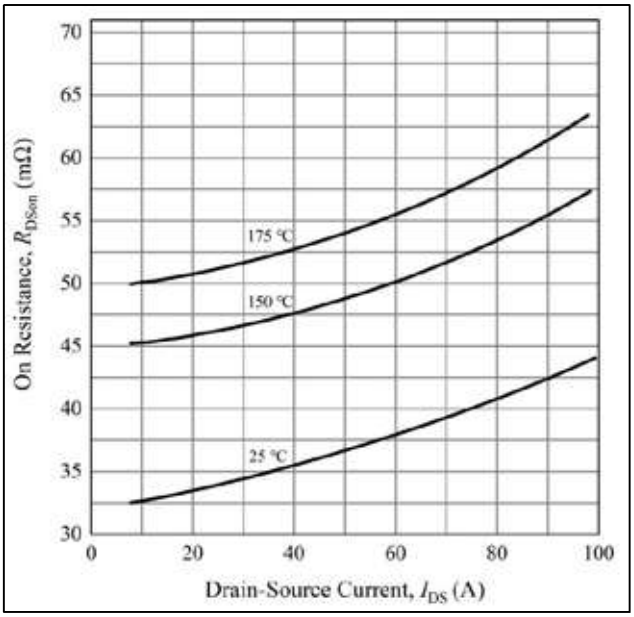



Figure 6: On-Resistance vs. Drain Current for Gate Various Temperatures

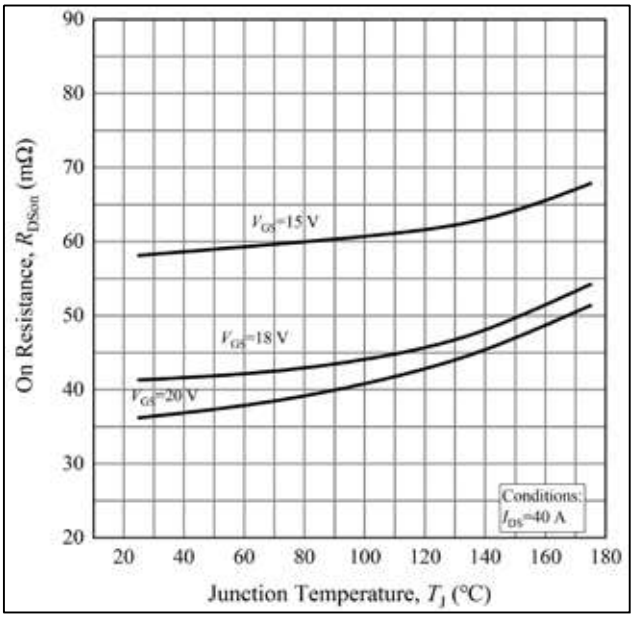



Figure 7: On-Resistance vs. Temperature for Various Voltage

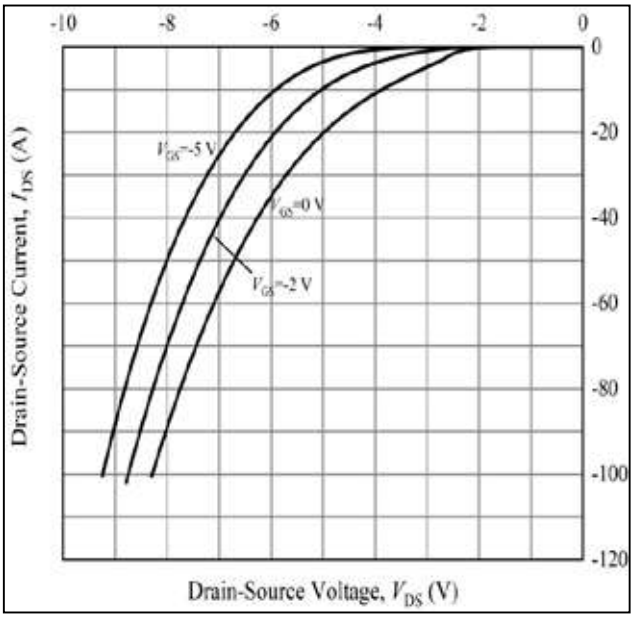



Figure 8: Typical Body Diode Characteristics at $T_J$= -55 ℃

## Typical Performance

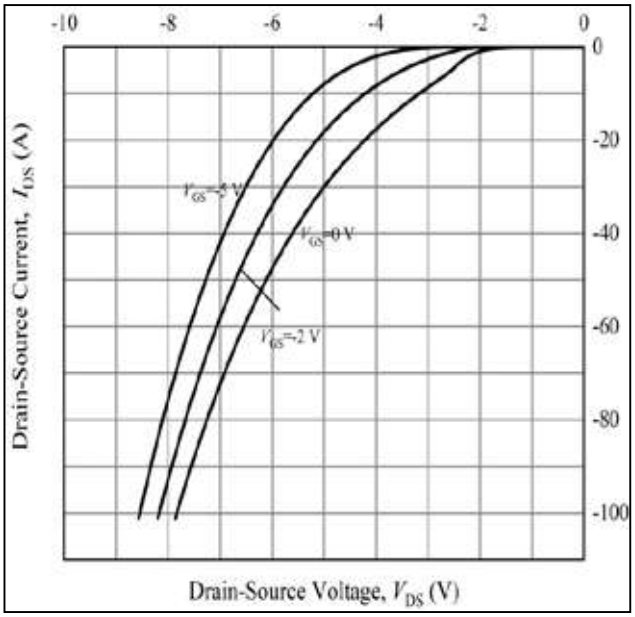



Figure 9: Typical Body Diode Characteristics at $T_J$= 25 ℃

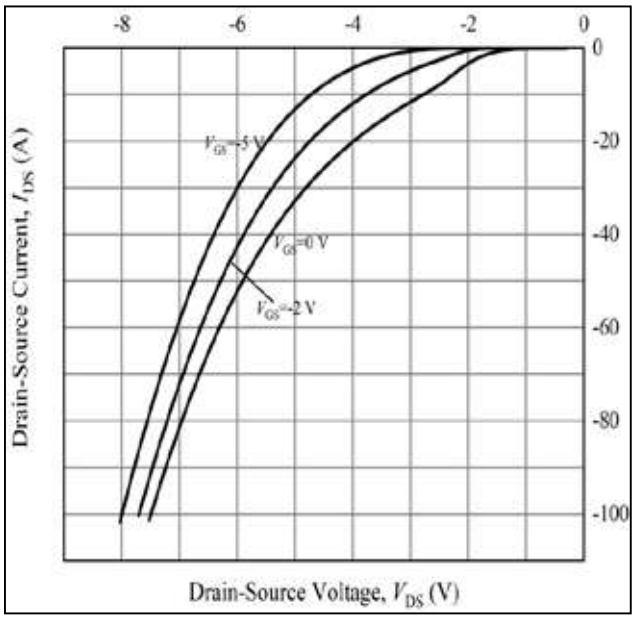



Figure 10: Typical Body Diode Characteristics at $T_J$= 175 ℃

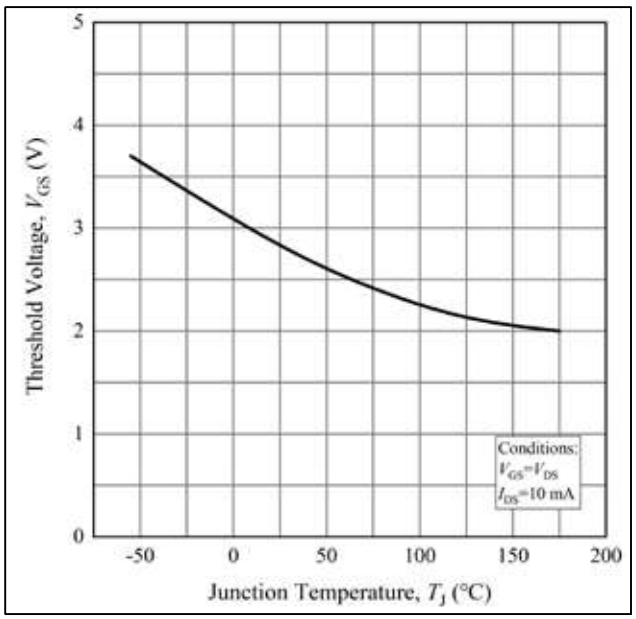



Figure 11: Typical Threshold Voltage vs. Temperature

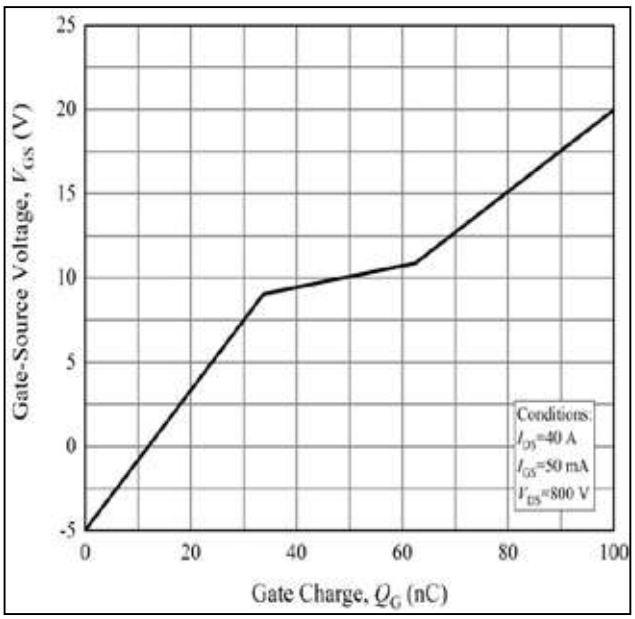



Figure 12: Typical Gate Charge Characteristics at $T_J$= 25 ℃

## Typical Performance

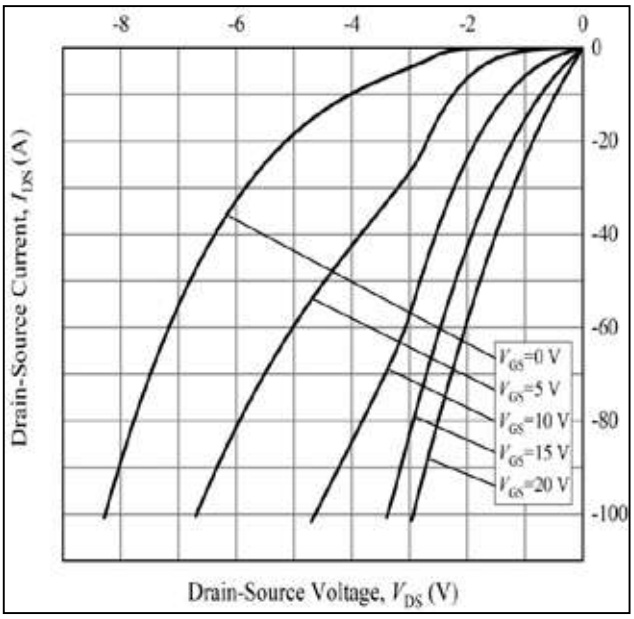



Figure 13: Typical 3rd Quadrant Characteristics at $T_J$= -55 ℃

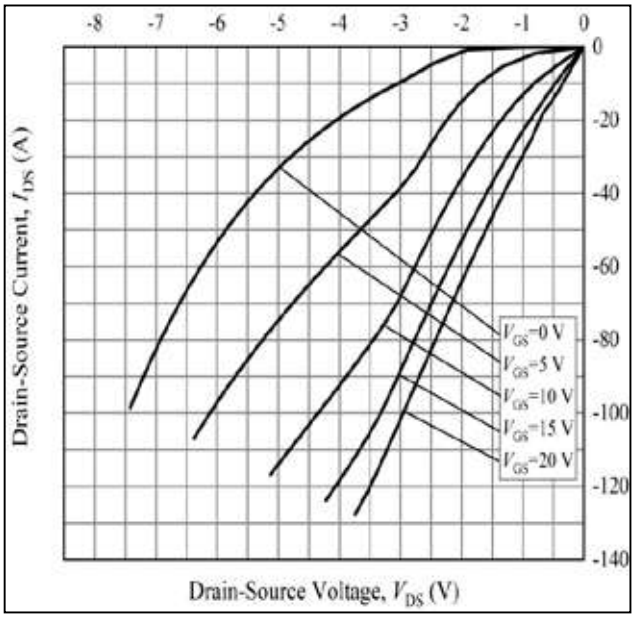



Figure 14: Typical 3rd Quadrant Characteristics at $T_J$=25 ℃

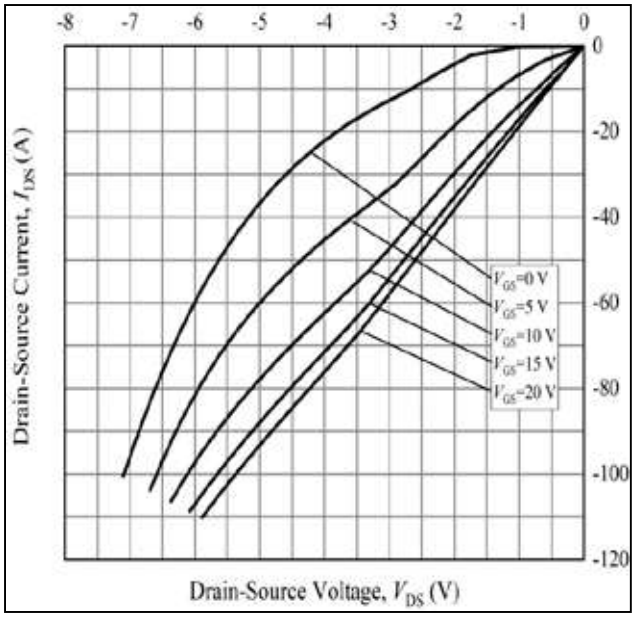



Figure 15: Typical 3rd Quadrant Characteristics at $T_J$= 175 ℃

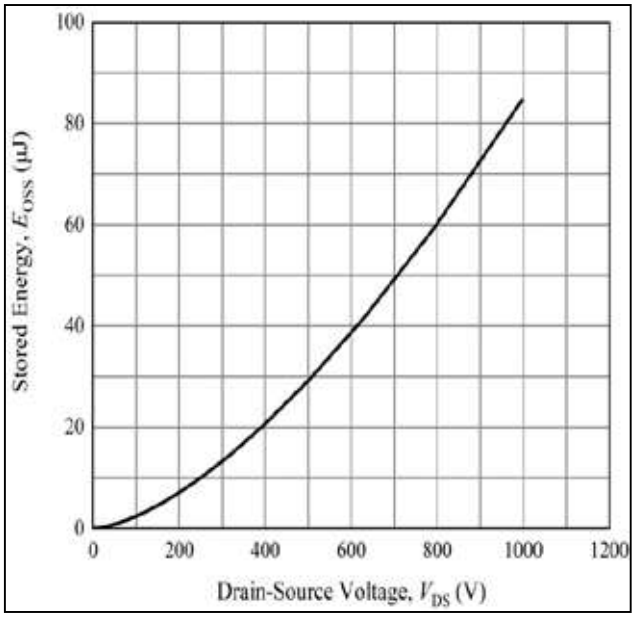



Figure 16: Typical Output Capacitor Stored Energy

## Typical Performance

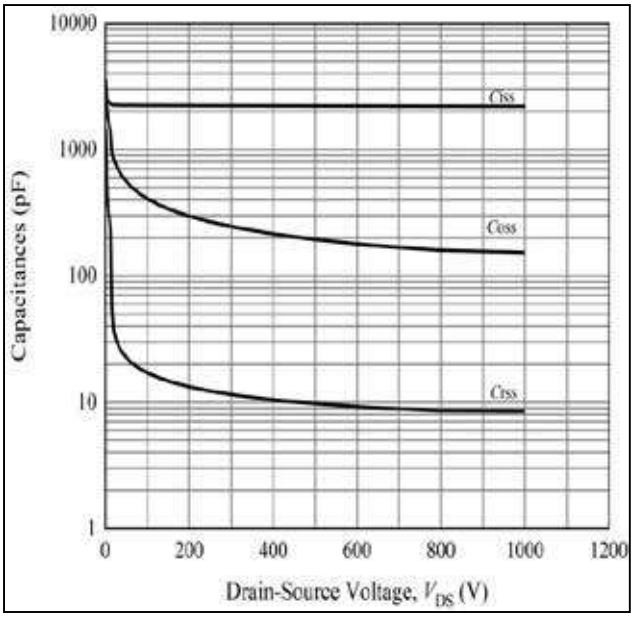



Figure 17: Typical Capacitances vs. Drain-Source Voltage

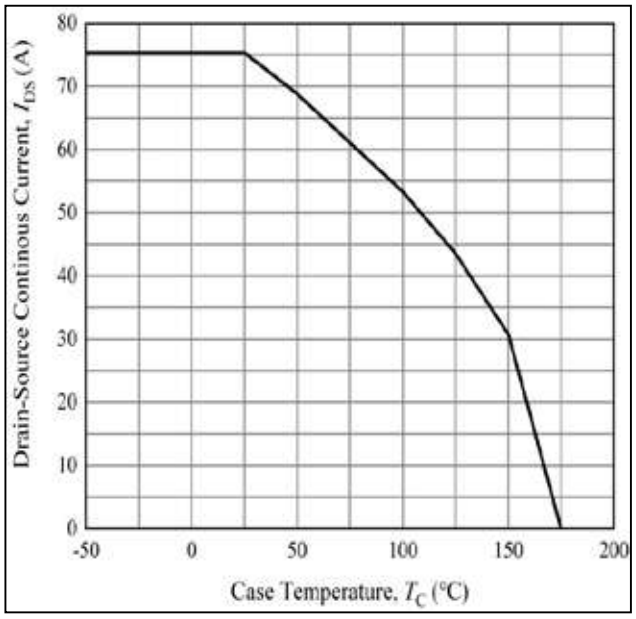



Figure 18: Continuous Drain Current Derating Curve

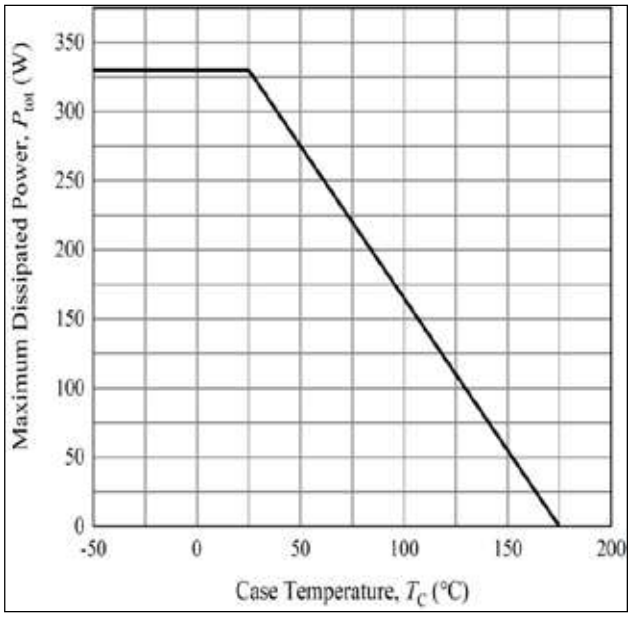



Figure 19: Power Dissipation Derating Curve

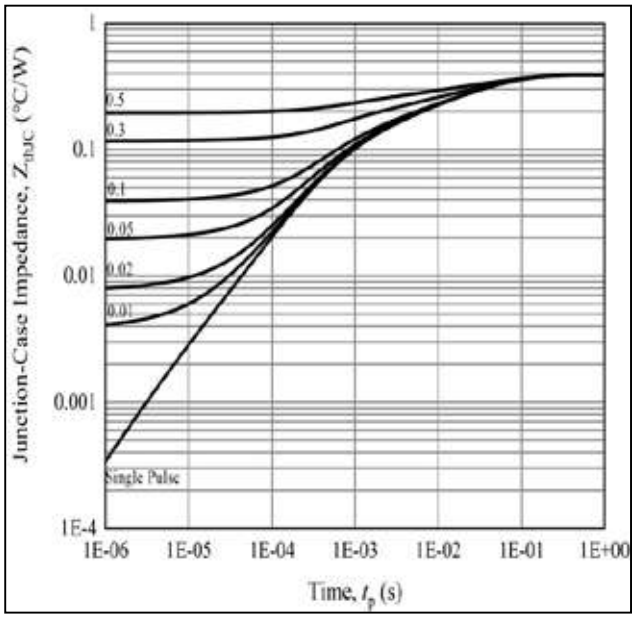



Figure 20: Typical Transient Thermal Impedance (Junction – Case) with Duty Cycle

## Typical Performance

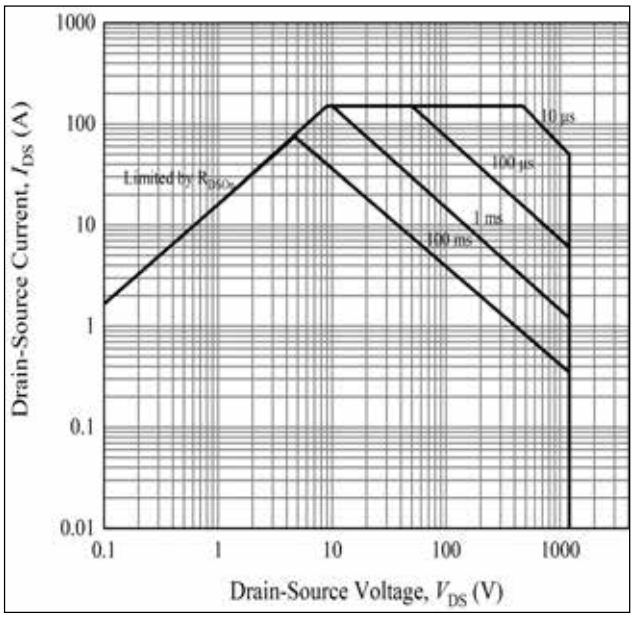



Figure 21: Safe Operate Area

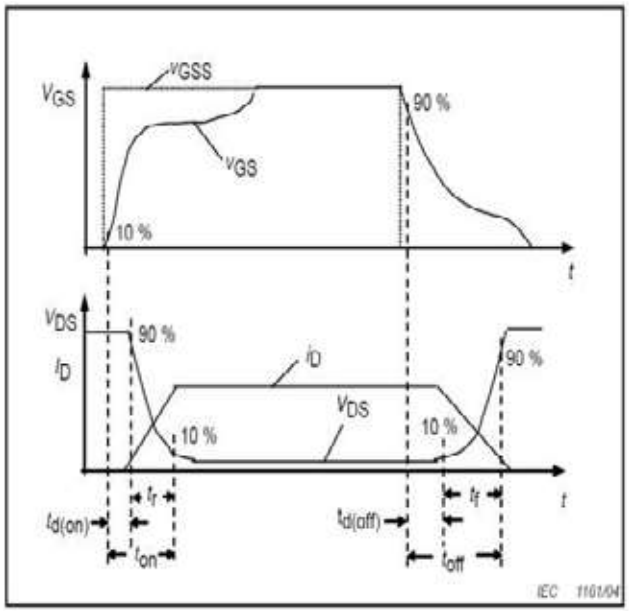



Figure 22: Resistive Switching Time Description

## Test Circuit Schematic

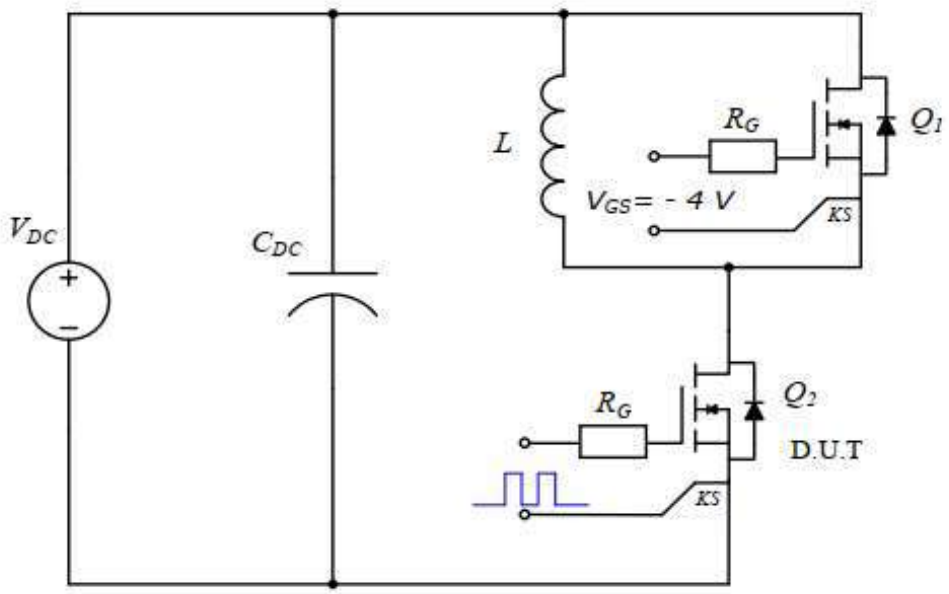
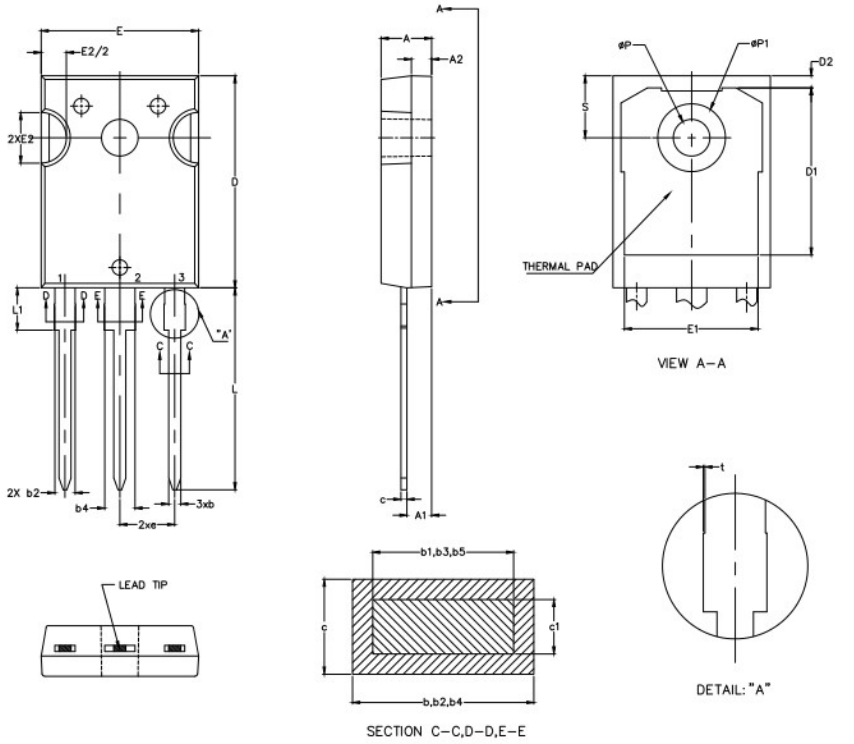



Figure 23: Clamped Inductive Switching Waveform Test Circuit

## Package Dimensions

Package TO-247-3




| SYMBOLS | DIMENSIONS | | | |
|---|---|---|---|---|
| | mm | | inch | |
| | MIN. | MAX. | MIN. | MAX. |
| A | 4.90 | 5.10 | 0.193 | 0.201 |
| A1 | 2.31 | 2.51 | 0.091 | 0.099 |
| A2 | 1.90 | 2.10 | 0.075 | 0.083 |
| b | 1.16 | 1.26 | 0.046 | 0.050 |
| b1 | 1.15 | 1.22 | 0.045 | 0.048 |
| b2 | 1.96 | 2.06 | 0.077 | 0.081 |
| b3 | 1.95 | 2.02 | 0.077 | 0.080 |
| b4 | 2.96 | 3.06 | 0.117 | 0.120 |
| b5 | 2.95 | 3.02 | 0.116 | 0.119 |
| c | 0.59 | 0.66 | 0.023 | 0.026 |
| c1 | 0.58 | 0.62 | 0.023 | 0.024 |
| D | 20.90 | 21.10 | 0.823 | 0.831 |
| D1 | 16.25 | 16.85 | 0.640 | 0.663 |
| D2 | 1.05 | 1.35 | 0.041 | 0.053 |
| E | 15.75 | 15.90 | 0.620 | 0.626 |
| E1 | 13.26 | — | 0.552 | — |
| E2 | 4.90 | 5.10 | 0.193 | 0.201 |
| e | 5.44BSC | | 0.214BSC | |
| L | 19.80 | 20.10 | 0.780 | 0.791 |
| L1 | — | 4.30 | — | 0.169 |
| øP | 3.50 | 3.70 | 0.138 | 0.146 |
| øP1 | — | 7.40 | — | 0.291 |
| S | 6.05 | 6.25 | 0.238 | 0.246 |
| t | 0.00 | 0.15 | 0.000 | 0.006 |

## Revision History

| Document Version | Description of Changes |
|---|---|
| Rev.1.0 | Released |
| Rev.2.0 | Static parameters at different temperatures are added |
| | |

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