# IV1B12013HA1L – 1200V 13mohm SiC MODULE

## Features

- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- High operating junction temperature capability
- Very fast and robust intrinsic body diode

## Applications

- Solar applications
- UPS system
- Motor drivers
- High voltage DC/DC converters

## Package



### Marking Diagram

| IV1B12013HA1L | Specific Device Code | |
|---|---|---|
| YYWWZ-XXXXX | YY | Year |
| | WW | Work Week |
| | Z | Assembly Location |
| | XXXXX | Lot Traceability |

## Absolute Maximum Ratings (T_c=25°C unless otherwise specified)

| Symbol | Parameter | Value | Unit | Test Conditions | Note |
|---|---|---|---|---|---|
| $V_{DS}$ | Drain-Source voltage | 1200 | V | | |
| $V_{GSmax}$(DC) | Maximum DC voltage | -5 to 22 | V | Static (DC) | |
| $V_{GSmax}$(Spike) | Maximum spike voltage | -10 to 25 | V | <1% duty cycle, and pulse width<200ns | |
| $V_{GSon}$ | Recommended turn-on voltage | 20±0.5 | V | | |
| $V_{GSoff}$ | Recommended turn-off voltage | -3.5 to -2 | V | | |
| $I_D$ | Drain current (continuous) | 96 | A | $V_{GS}$=20V, $T_h$=50°C, $T_{vj}$≤150°C | |
| | | 102 | A | $V_{GS}$=20V, $T_h$=50°C, $T_{vj}$≤175°C | |
| $I_{DM}$ | Drain current (pulsed) | 204 | A | Pulse width limited by SOA | Fig.26 |
| $P_{TOT}$ | Total power dissipation | 210 | W | $T_{vj}$≤150°C | Fig.24 |
| $T_{stg}$ | Storage temperature range | -40 to 150 | °C | | |
| $T_J$ | Maximum virtual junction temperature under switching conditions | -40 to 150 | °C | Operation | |
| | | -55 to 175 | °C | Intermittent with reduced life | |

## Thermal Data

| Symbol | Parameter | Value | Unit | Note |
|---|---|---|---|---|
| $R_{\theta(J-H)}$ | Thermal Resistance from Junction to Heatsink | 0.596 | °C/W | Fig.25 |

## Electrical Characteristics (T$_C$=25°C unless otherwise specified)

| Symbol | Parameter | Value | | | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | | |
| I$_{DSS}$ | Zero gate voltage drain current | | 10 | 200 | μA | V$_{DS}$=1200V, V$_{GS}$=0V | |
| I$_{GSS}$ | Gate leakage current | | | ±200 | nA | V$_{DS}$=0V, V$_{GS}$=-5~20V | |
| V$_{TH}$ | Gate threshold voltage | 1.8 | 3.2 | 5 | V | V$_{GS}$=V$_{DS}$, I$_D$=24mA | Fig.9 |
| | | | 2.3 | | | V$_{GS}$=V$_{DS}$, I$_D$=24mA @ T$_C$=150°C | |
| R$_{ON}$ | Static drain-source on-resistance | | 12.5 | 16.3 | mΩ | V$_{GS}$=20V, I$_D$=80A @T$_J$=25°C | Fig.4-7 |
| | | | 18 | | mΩ | V$_{GS}$=20V, I$_D$=80A @T$_J$=150°C | |
| C$_{iss}$ | Input capacitance | | 11 | | nF | V$_{DS}$=800V, V$_{GS}$=0V, f=100kH$_Z$, V$_{AC}$=25mV | Fig.16 |
| C$_{oss}$ | Output capacitance | | 507 | | pF | | |
| C$_{rss}$ | Reverse transfer capacitance | | 31 | | pF | | |
| E$_{oss}$ | C$_{oss}$ stored energy | | 203 | | μJ | | Fig.17 |
| Q$_g$ | Total gate charge | | 480 | | nC | V$_{DS}$=800V, I$_D$=80A, V$_{GS}$=-5 to 20V | Fig.18 |
| Q$_{gs}$ | Gate-source charge | | 100 | | nC | | |
| Q$_{gd}$ | Gate-drain charge | | 192 | | nC | | |
| R$_g$ | Gate input resistance | | 1.0 | | Ω | f=100kH$_Z$ | |
| E$_{ON}$ | Turn-on switching energy | | 783 | | μJ | V$_{DS}$=600V, I$_D$=60A, V$_{GS}$=-5 to 20V, R$_{G(ext)on}$/ R$_{G(ext)off}$ =2.5Ω/1.43Ω, L=120 μH | Fig.19-22 |
| E$_{OFF}$ | Turn-off switching energy | | 182 | | μJ | | |
| t$_{d(on)}$ | Turn-on delay time | | 30 | | ns | | |
| t$_r$ | Rise time | | 5.9 | | | | |
| t$_{d(off)}$ | Turn-off delay time | | 37 | | | | |
| t$_f$ | Fall time | | 21 | | | | |
| L$_{sCE}$ | Stray inductance | | 7.6 | | nH | | |

## Reverse Diode Characteristics (T$_c$=25°C unless otherwise specified)

| Symbol | Parameter | Value | | | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | | |
| V$_{SD}$ | Diode forward voltage | | 4.9 | | V | I$_{SD}$=80A, V$_{GS}$=0V | Fig.10-12 |
| | | | 4.5 | | V | I$_{SD}$=80A, V$_{GS}$=0V, T$_J$=150°C | |
| t$_{rr}$ | Reverse recovery time | | 17.4 | | ns | V$_{GS}$=-5V/+20V, I$_{SD}$=60A, V$_R$=600V, di/dt=13.28A/ns, R$_{G(ext)}$=2.5Ω,L=120µH | |
| Q$_{rr}$ | Reverse recovery charge | | 1095 | | nC | | |
| I$_{RRM}$ | Peak reverse recovery current | | 114 | | A | | |

## NTC Thermistor Characteristics

| Symbol | Parameter | Value | | | Unit | Test Conditions | Note |
|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | | |
| R$_{NTC}$ | Rated Resistance | | 5 | | kΩ | T$_{NTC}$=25°C | Fig.27 |
| ΔR/R | Resistance Tolerance at 25°C | -5 | | 5 | % | | |
| β$_{25/50}$ | Beta Value | | 3380 | | K | ±1% | |
| P$_{max}$ | Power Dissipation | | 5 | | mW | | |

# Typical Performance (curves)
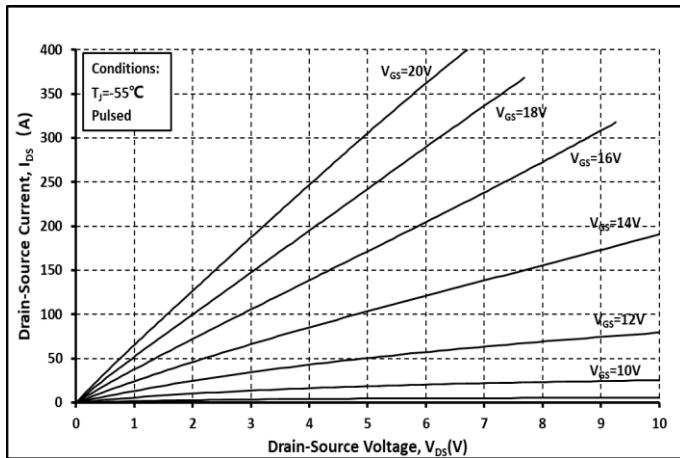


Fig. 1 Output Curve @ Tj=-55℃
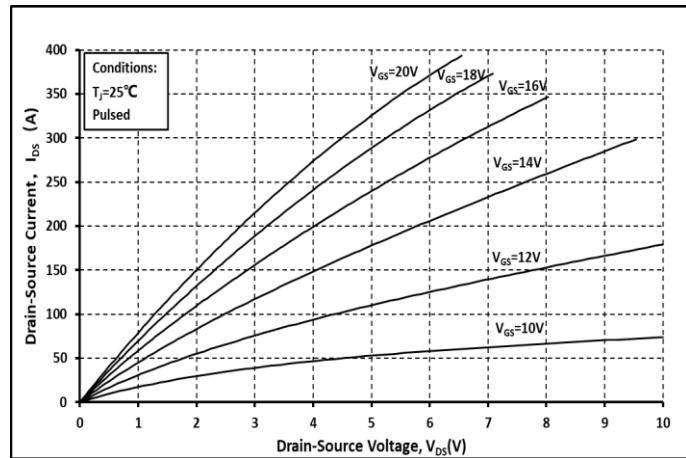


Fig. 2 Output Curve @ Tj=25℃
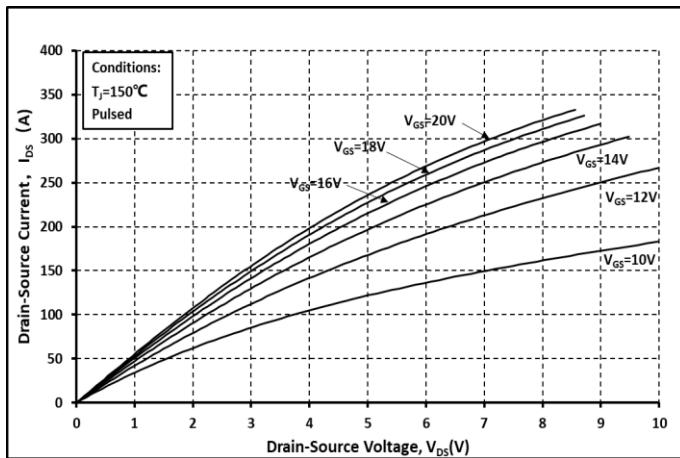


Fig. 3 Output Curve @ Tj=150℃
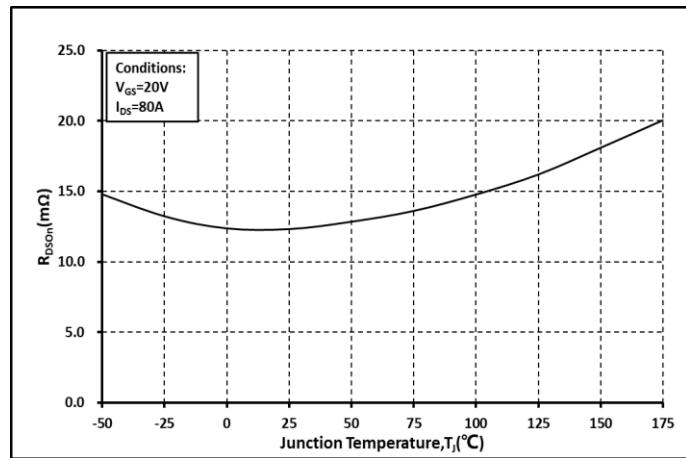


Fig. 4 Ron vs. Temperature
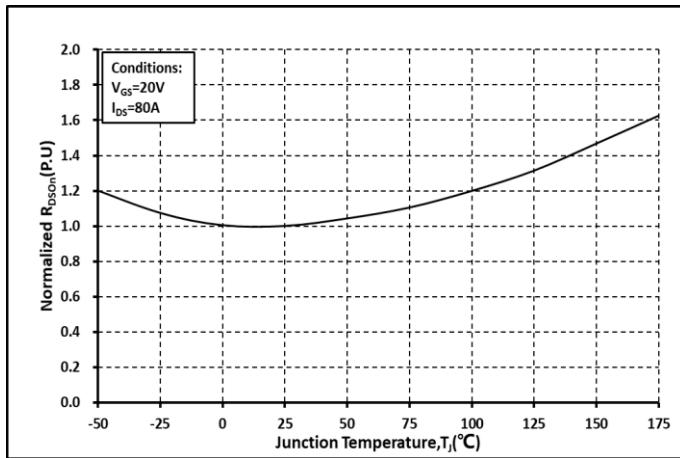


Fig. 5 Normalized Ron vs. Temperature
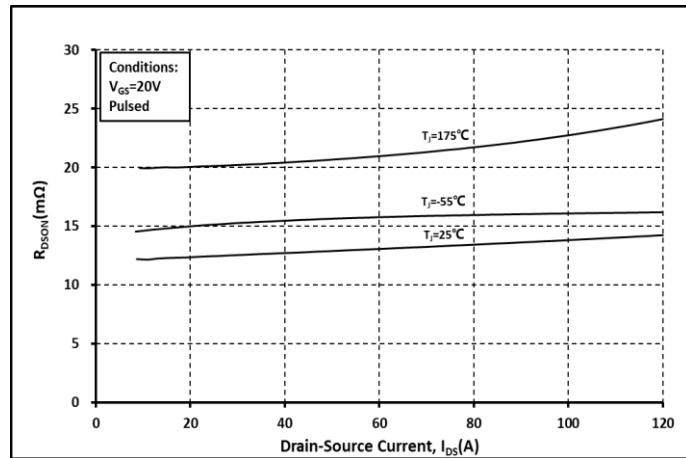


Fig. 6 Ron vs. $I_{DS}$ @ Various Temperature
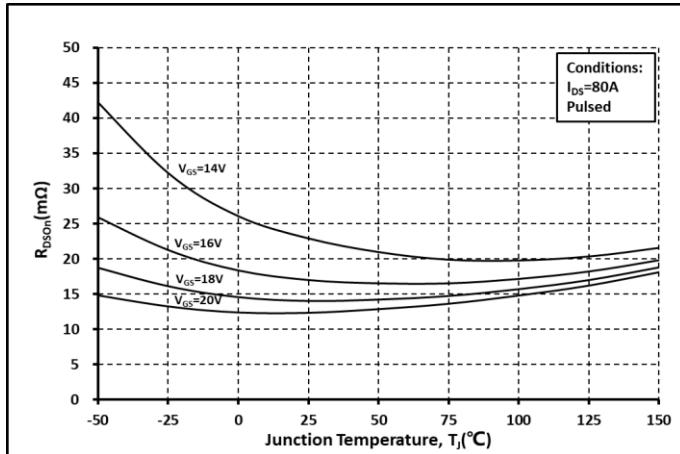
Fig. 7 Ron vs. Temperature @ Various V<sub>GS</sub>
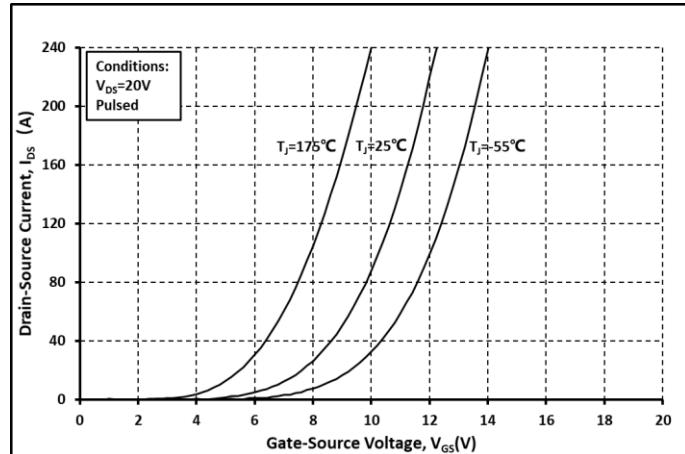


Fig. 8 Transfer Curves @ Various Temperature
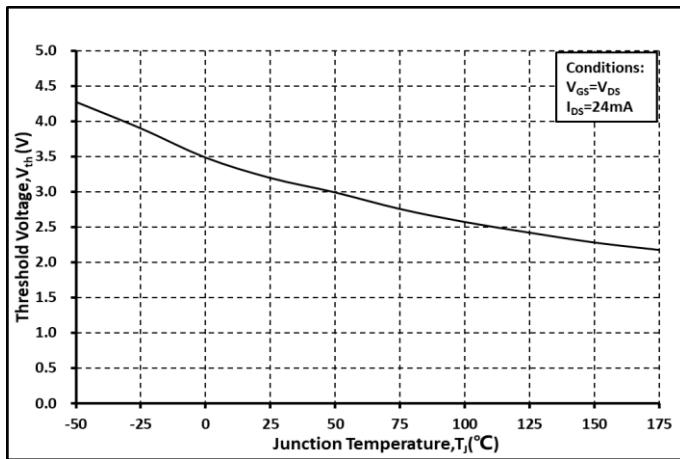


Fig. 9 Threshold Voltage vs. Temperature
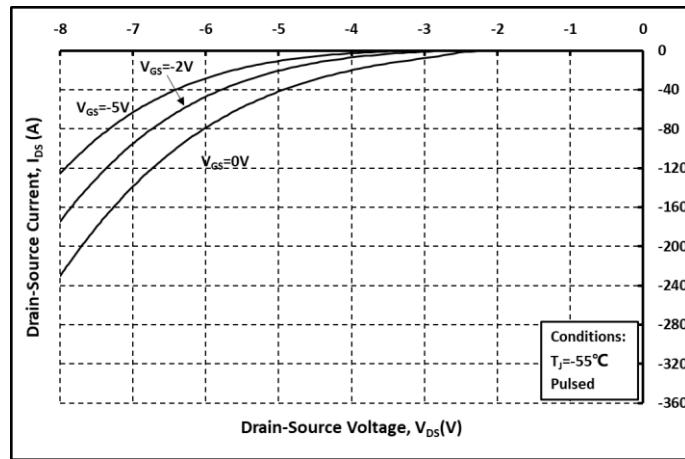


Fig. 10 Body Diode Curves @ T<sub>J</sub>=-55℃
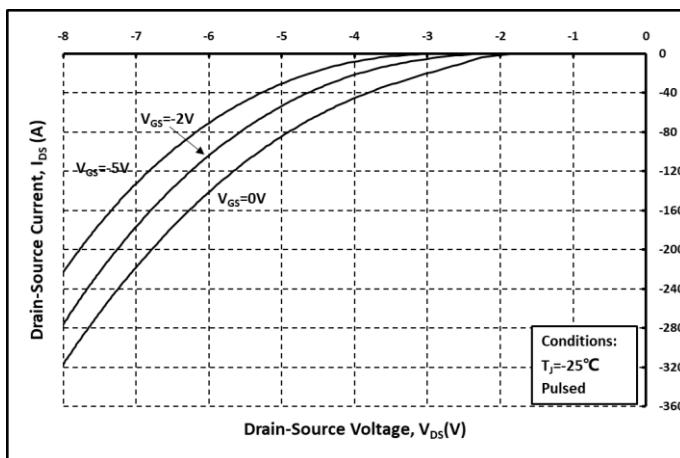


Fig. 11 Body Diode Curves @ T<sub>J</sub>=25℃
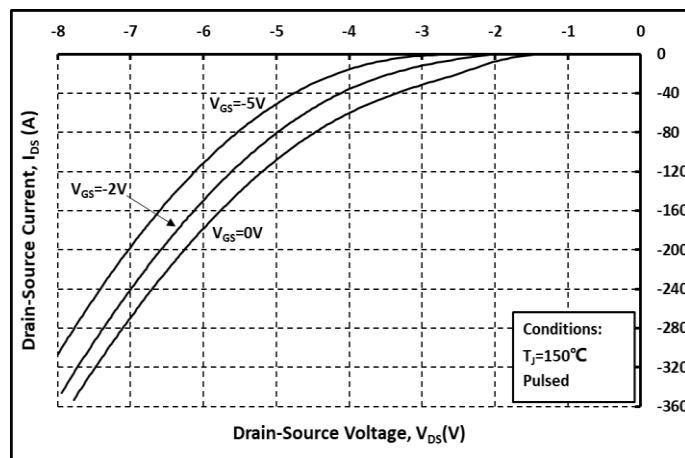


Fig. 12 Body Diode Curves @ T<sub>J</sub>=150℃
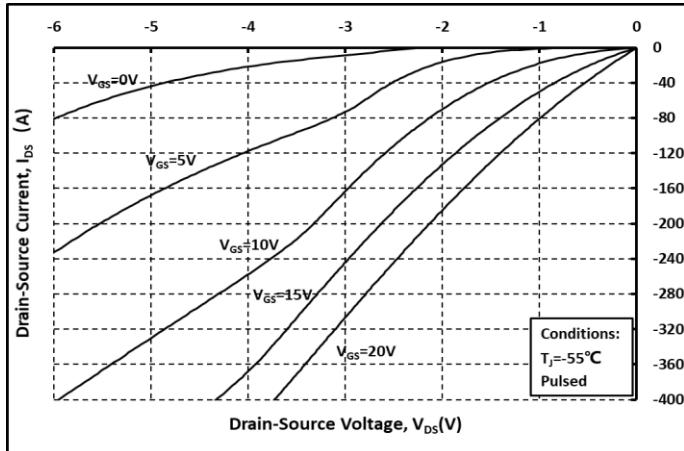
Fig. 13 3$^{rd}$ Quadrant Curves @ T$_J$=-55℃
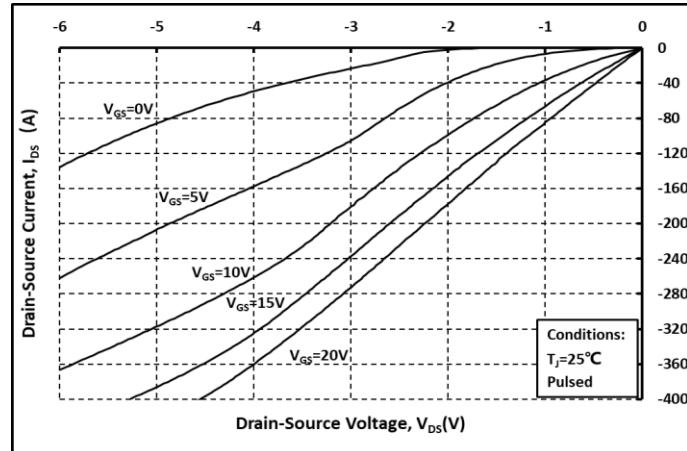
Fig. 14 3$^{rd}$ Quadrant Curves @ T$_J$=25℃
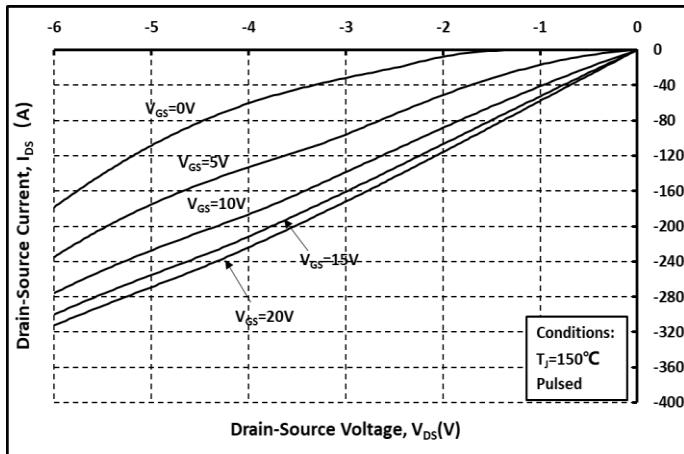
Fig. 15 3$^{rd}$ Quadrant Curves @ T$_J$=150℃
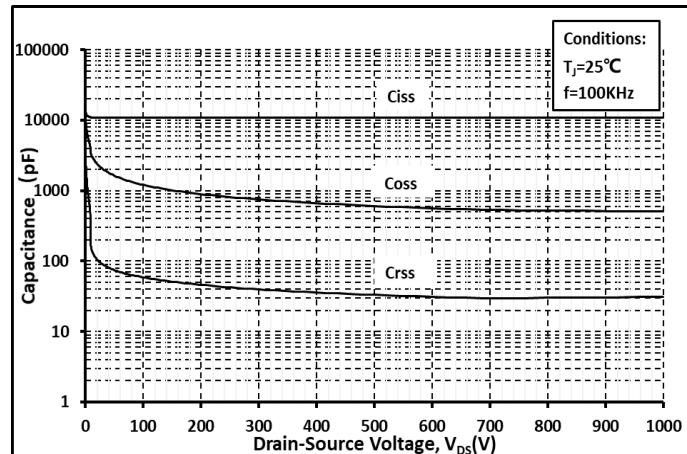
Fig. 16 Capacitance vs. V$_{DS}$
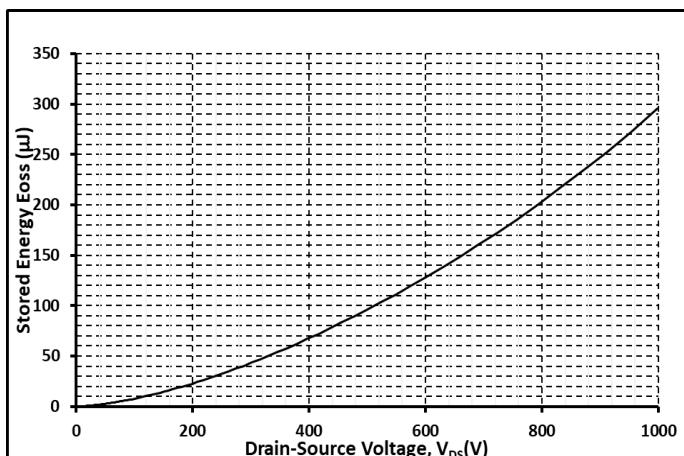
Fig. 17 Output Capacitor Stored Energy
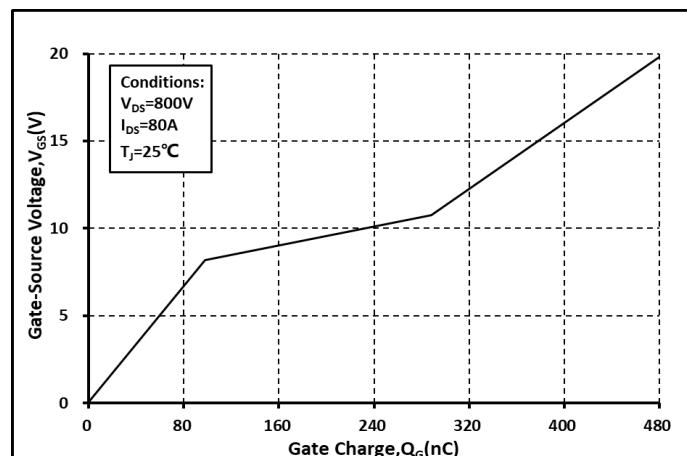
Fig. 18 Gate Charge Characteristics
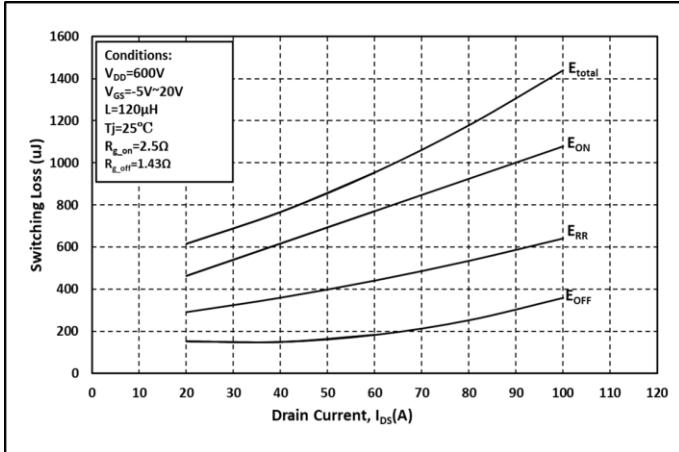
Fig. 19 Switching Energy vs. Drain Current
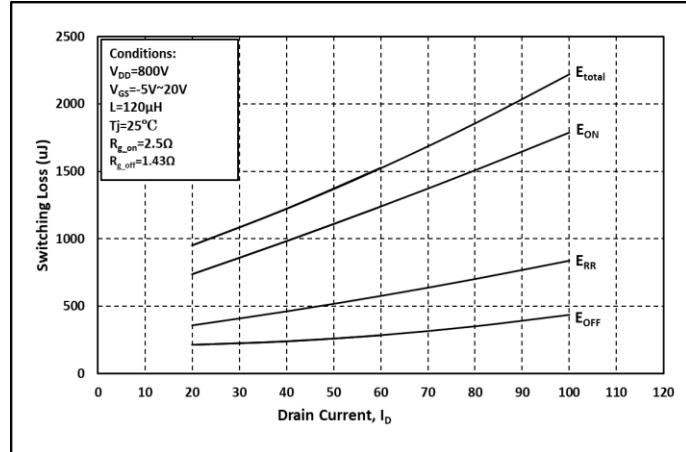


Fig. 20 Switching Energy vs. Drain Current
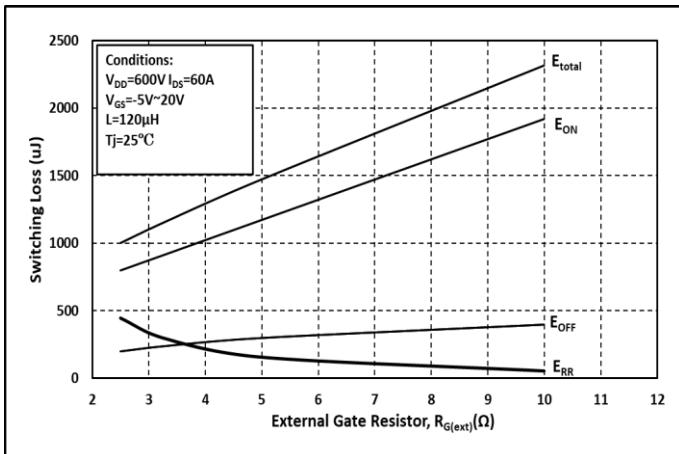


Fig. 21 Switching Energy vs. $R_{G(ext)}$
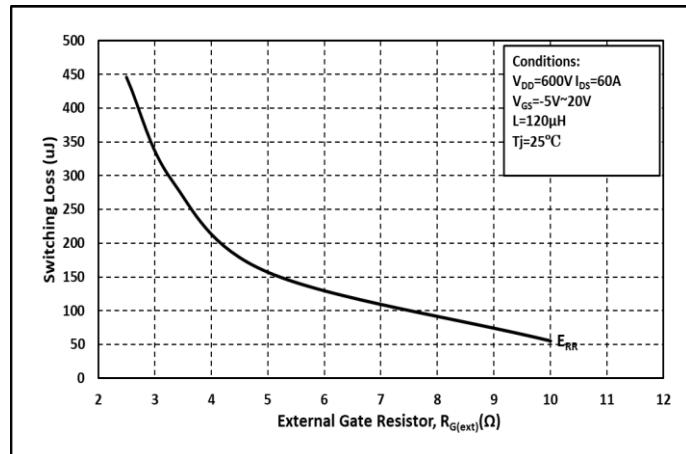


Fig. 22 Reverse Recovery Energy vs. $R_{G(ext)}$
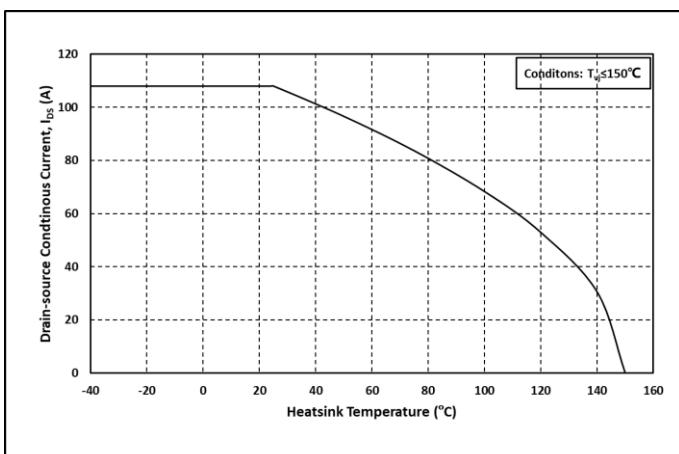


Fig. 23 Continuous Drain Current vs.
Heatsink Temperature
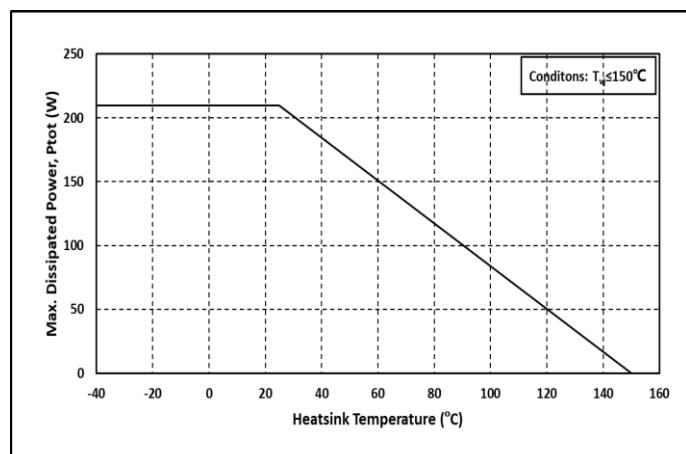


Fig. 24 Max. Power Dissipation Derating vs.
Heatsink Temperature
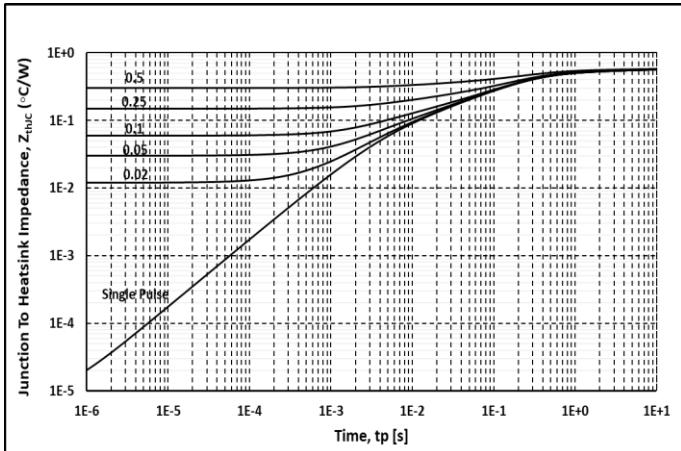
Fig. 25 Thermal Impedance
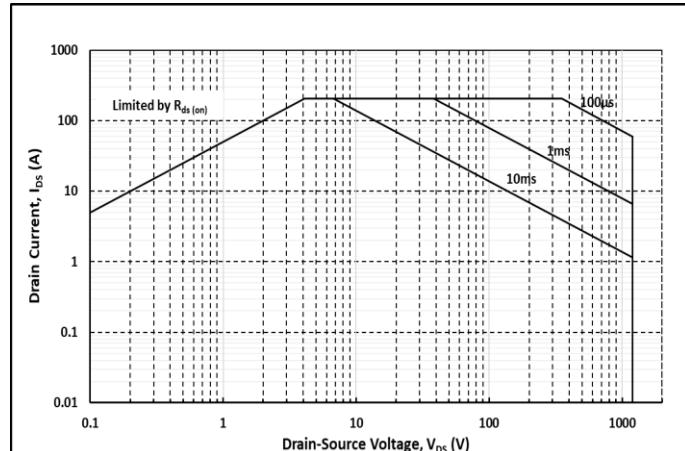


Fig. 26 Safe Operating Area
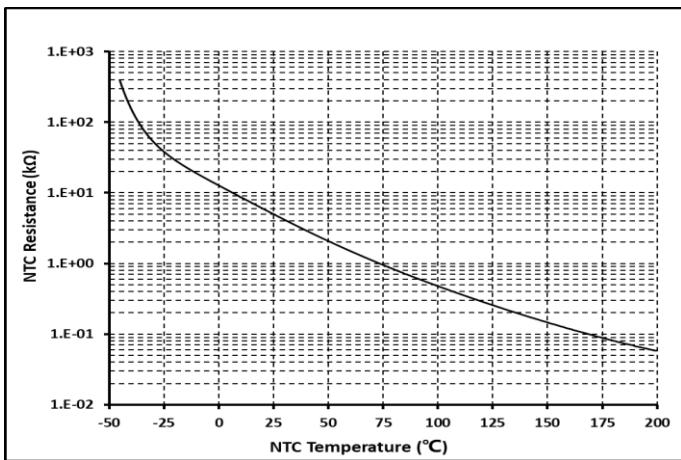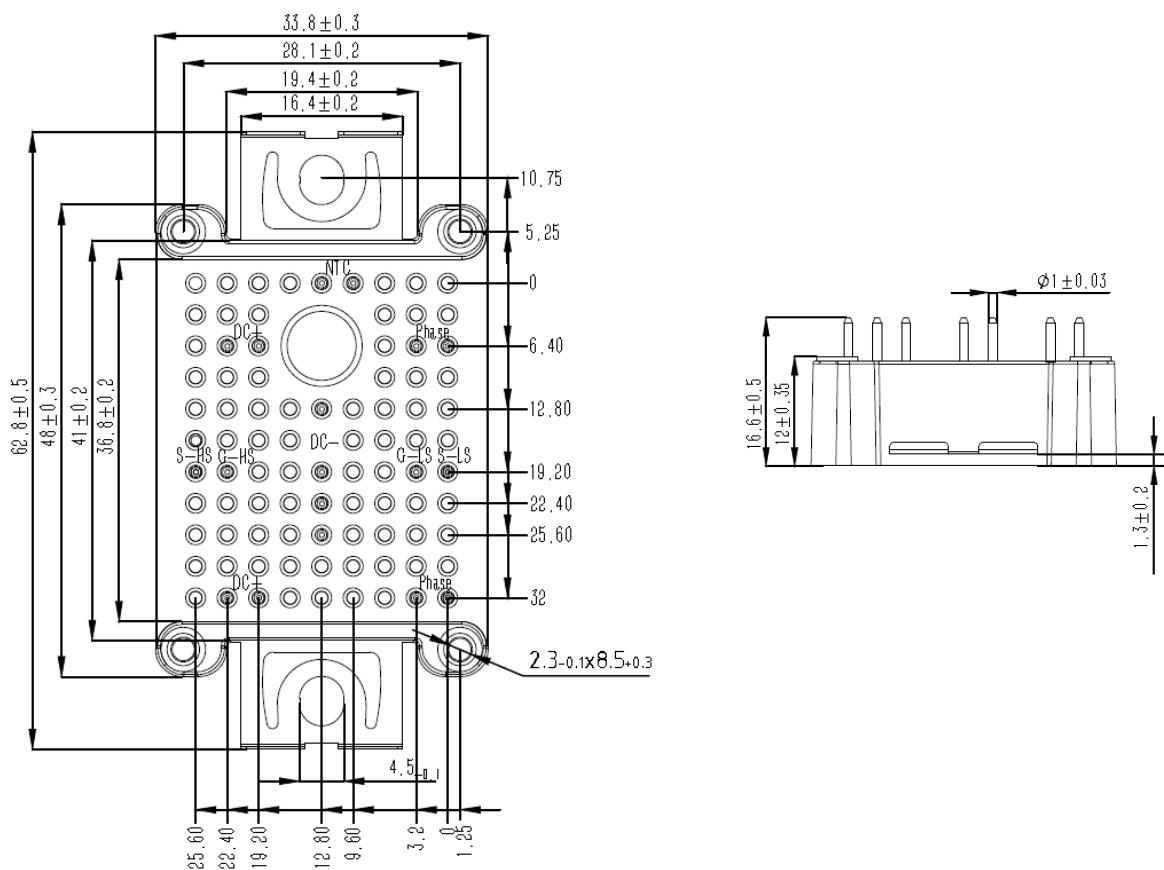


Fig. 27 NTC Resistance vs. Temperature

## Package Dimensions (mm)

# Notes

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