# IV2Q12040D7Z – 1200V 40mΩ Gen2 Automotive SiC MOSFET

## Features

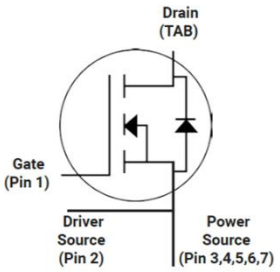
- 2nd Generation SiC MOSFET Technology with +18V gate drive
- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- High operating junction temperature capability
- Very fast and robust intrinsic body diode
- Kelvin gate input easing driver circuit design

## Applications

- Motor drivers
- Solar inverters
- Automotive DC/DC converters
- Automotive compressor inverters
- Switch mode power supplies

## Outline:


TO263-7




## Marking Diagram:

| |
|---|
| YYWWZ |
| XXXX |
| 2Q12040D7Z |

2Q12040D7Z = Specific Device Code
YY = Year
WW = Work Week
Z = Assembly Location
XXXX = 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 | $V_{GS}$=0V, $I_D$=100μA | |
| $V_{GSmax}$ (DC) | Maximum DC voltage | -5 to 20 | V | Static (DC) | |
| $V_{GSmax}$ (Spike) | Maximum spike voltage | -10 to 23 | V | Duty cycle<1%, and pulse width<200ns | |
| $V_{GSon}$ | Recommended turn-on voltage | 18±0.5 | V | | |
| $V_{GSoff}$ | Recommended turn-off voltage | -3.5 to -2 | V | | |
| $I_D$ | Drain current (continuous) | 65 | A | $V_{GS}$=18V, $T_C$=25°C | Fig. 23 |
| | | 48 | A | $V_{GS}$=18V, $T_C$=100°C | |
| $I_{DM}$ | Drain current (pulsed) | 162 | A | Pulse width limited by SOA | Fig. 26 |
| $P_{TOT}$ | Total power dissipation | 417 | W | $T_C$=25°C | Fig. 24 |
| $T_{stg}$ | Storage temperature range | -55 to 175 | °C | | |
| $T_J$ | Operating junction temperature | -55 to 175 | °C | | |
| $T_L$ | Solder Temperature | 260 | °C | wave soldering only allowed at leads, 1.6mm from case for 10 s | |

## Thermal Data

| Symbol | Parameter | Value | Unit | Note |
|---|---|---|---|---|
| $R_{\theta(J-C)}$ | Thermal Resistance from Junction to Case | 0.36 | °C/W | Fig. 23 |

## 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 | | 5 | 100 | μA | $V_{DS}$=1200V, $V_{GS}$=0V | |
| $I_{GSS}$ | Gate leakage current | | | ±100 | nA | $V_{DS}$=0V, $V_{GS}$=-5~20V | |
| $V_{TH}$ | Gate threshold voltage | 1.8 | 2.8 | 4.5 | V | $V_{GS}$=$V_{DS}$, $I_D$=9mA | Fig. 8, 9 |
| | | | 2.1 | | | $V_{GS}$=$V_{DS}$, $I_D$=9mA @ $T_J$=175°C | |
| $R_{ON}$ | Static drain-source on-resistance | | 40 | 52 | mΩ | $V_{GS}$=18V, $I_D$=20A @$T_J$=25°C | Fig. 4, 5, 6, 7 |
| | | | 75 | | mΩ | $V_{GS}$=18V, $I_D$=20A @$T_J$=175°C | |
| $C_{iss}$ | Input capacitance | | 2160 | | pF | $V_{DS}$=800V, $V_{GS}$=0V, f=1MHz, $V_{AC}$=25mV | Fig. 16 |
| $C_{oss}$ | Output capacitance | | 100 | | pF | | |
| $C_{rss}$ | Reverse transfer capacitance | | 5.8 | | pF | | |
| $E_{oss}$ | $C_{oss}$ stored energy | | 40 | | μJ | | Fig. 17 |
| $Q_g$ | Total gate charge | | 110 | | nC | $V_{DS}$=800V, $I_D$=30A, $V_{GS}$=-3 to 18V | Fig. 18 |
| $Q_{gs}$ | Gate-source charge | | 25 | | nC | | |
| $Q_{gd}$ | Gate-drain charge | | 59 | | nC | | |
| $R_g$ | Gate input resistance | | 2.1 | | Ω | f=1MHz | |
| $E_{ON}$ | Turn-on switching energy | | 571.7 | | μJ | $V_{DS}$=800V, $I_D$=30A, $V_{GS}$=-3.5 to 18V, $R_{G(ext)}$=3.3Ω, L=200μH $T_J$=25°C | Fig. 19, 20 |
| $E_{OFF}$ | Turn-off switching energy | | 62.2 | | μJ | | |
| $t_{d(on)}$ | Turn-on delay time | | 11.0 | | ns | | |
| $t_r$ | Rise time | | 19.6 | | | | |
| $t_{d(off)}$ | Turn-off delay time | | 20.8 | | | | |
| $t_f$ | Fall time | | 11.6 | | | | |
| $E_{ON}$ | Turn-on switching energy | | 872.1 | | μJ | $V_{DS}$=800V, $I_D$=30A, $V_{GS}$=-3.5 to 18V, $R_{G(ext)}$=3.3Ω,L=200μH $T_J$=175°C | Fig. 22 |
| $E_{OFF}$ | Turn-off switching energy | | 56.9 | | μJ | | |

## 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 | | 4.1 | | V | $I_{SD}$=20A, $V_{GS}$=0V | Fig. 10, 11, 12 |
| | | | 4.0 | | V | $I_{SD}$=20A, $V_{GS}$=0V, $T_J$=175°C | |
| $t_{rr}$ | Reverse recovery time | | 47 | | ns | $V_{GS}$=-3.5V/+18V, $I_{SD}$=30A, $V_R$=800V, $R_{G(ext)}$=13Ω L=200μH di/dt=3000A/μs | |
| $Q_{rr}$ | Reverse recovery charge | | 203 | | nC | | |
| $I_{RRM}$ | Peak reverse recovery current | | 16.4 | | A | | |

## Typical Performance (curves)

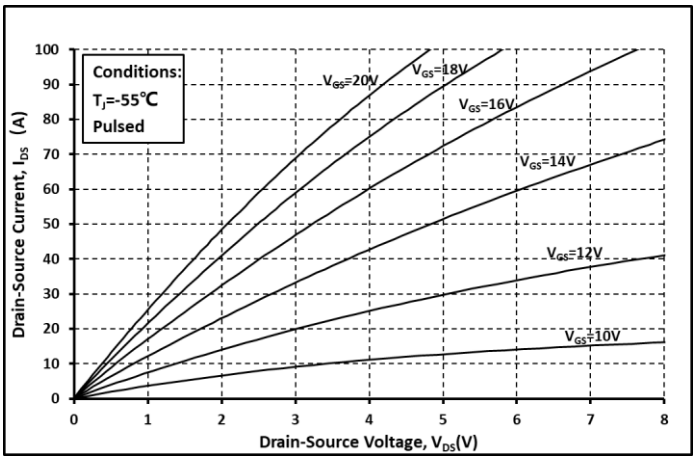



Fig. 1 Output Curve @ $T_J$=-55℃

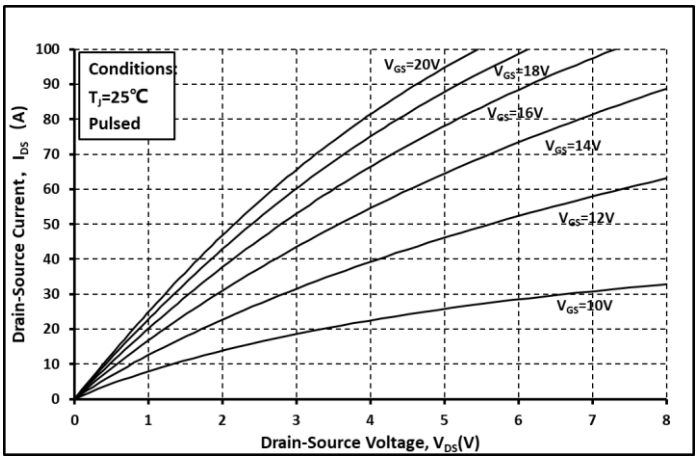



Fig. 2 Output Curve @ $T_J$=25℃

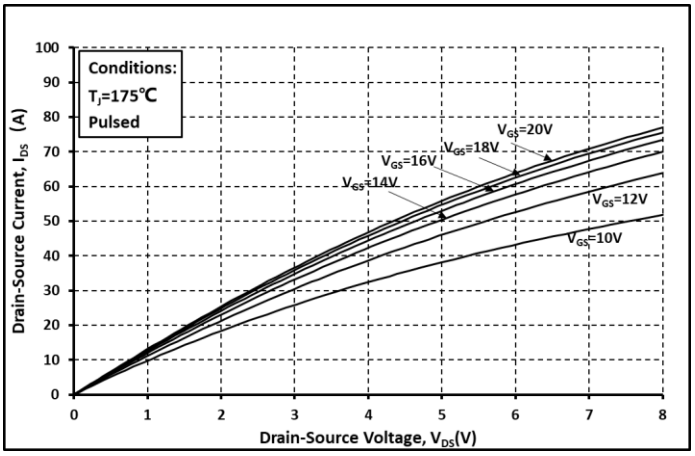



Fig. 3 Output Curve @ $T_J$=175℃

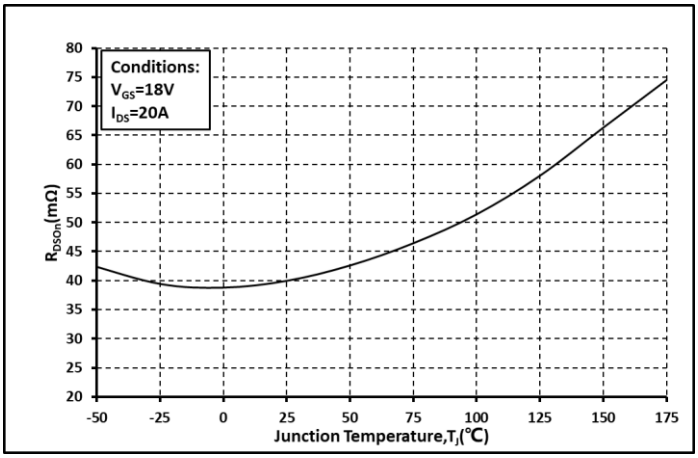



Fig. 4 Ron vs. Temperature

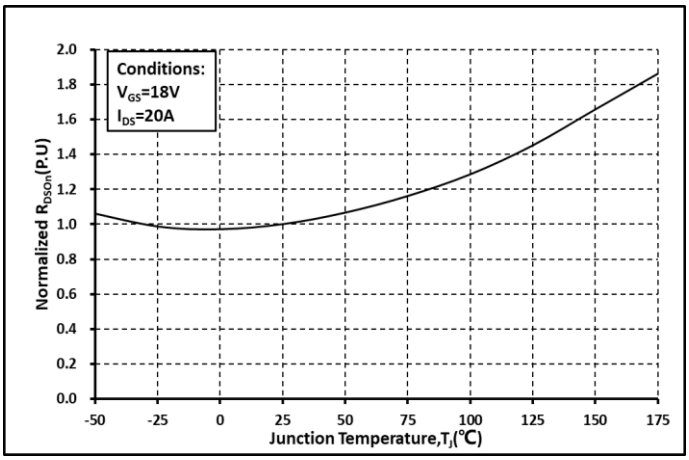



Fig. 5 Normalized Ron vs. Temperature

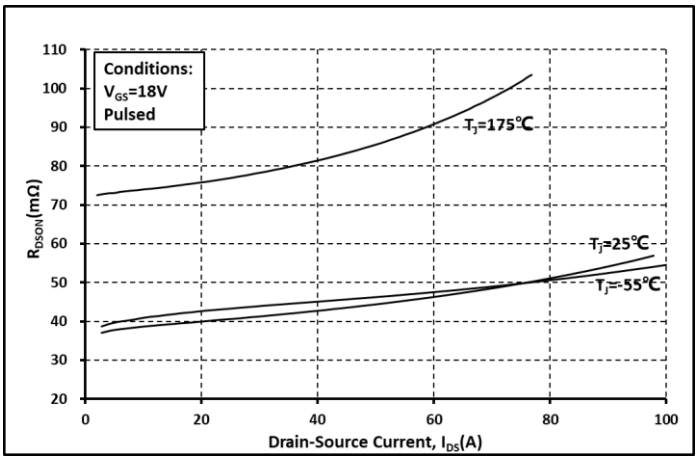



Fig. 6 Ron vs. $I_{DS}$ @ Various Temperature

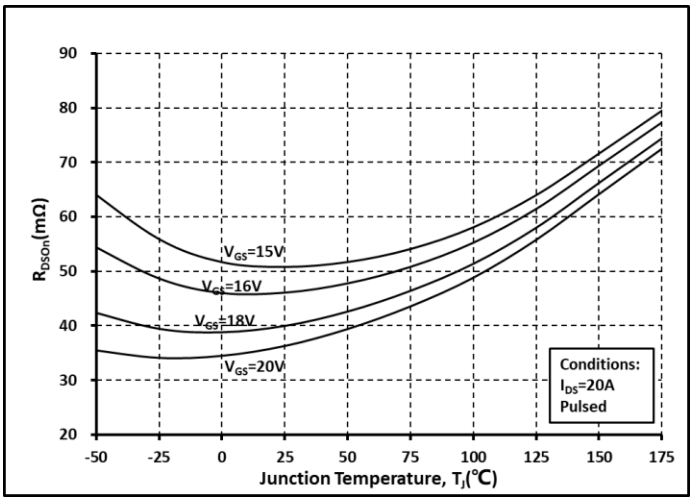



Fig. 7 Ron vs. Temperature @ Various $V_{GS}$

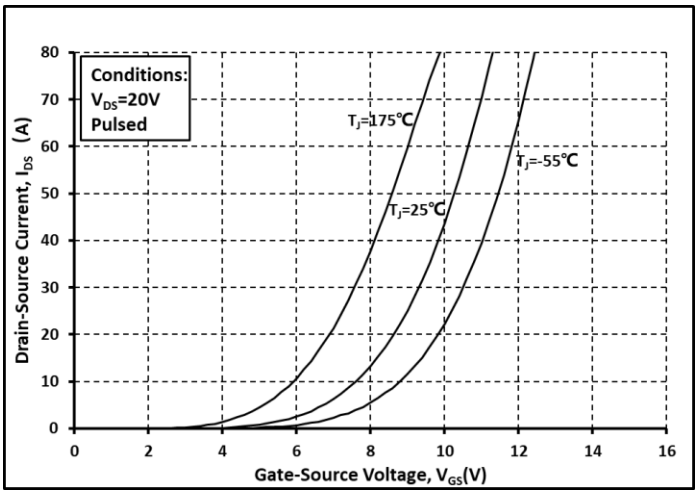



Fig. 8 Transfer Curves @ Various Temperature

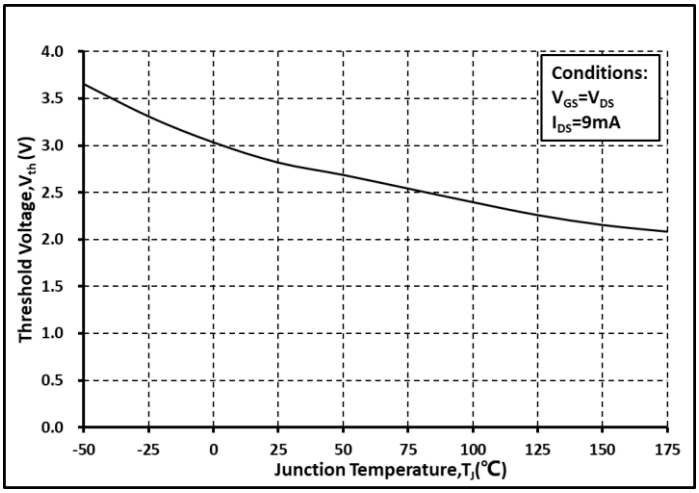



Fig. 9 Threshold Voltage vs. Temperature

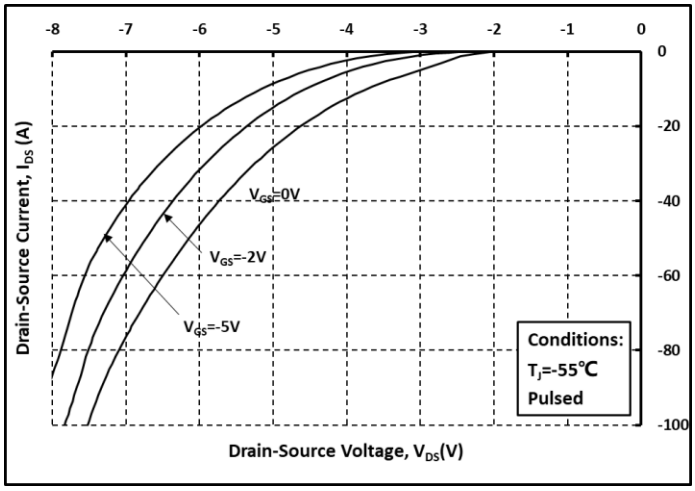



Fig. 10 Body Diode curves @ $T_J$=-55℃

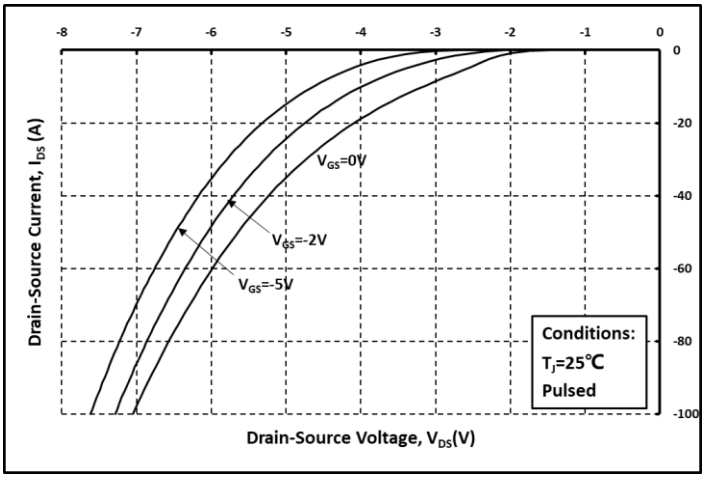



Fig. 11 Body Diode curves @ $T_J$=25℃

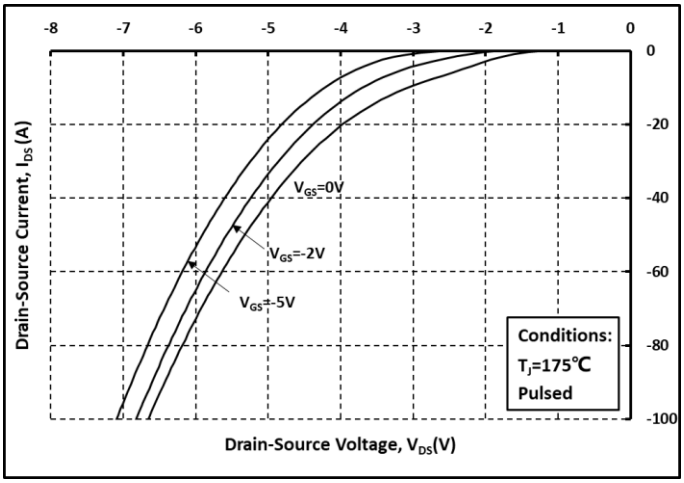



Fig. 12 Body Diode curves @ $T_J$=175℃

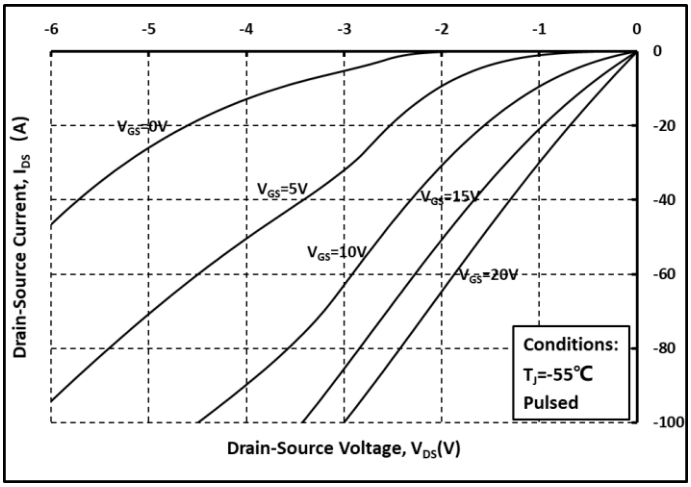



Fig. 13 3rd Quadrant curves @ $T_J$=-55°C

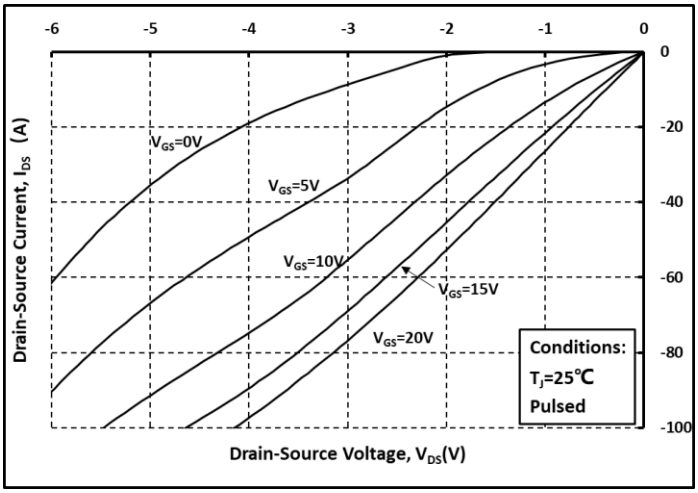



Fig. 14 3rd Quadrant curves @ $T_J$=25°C

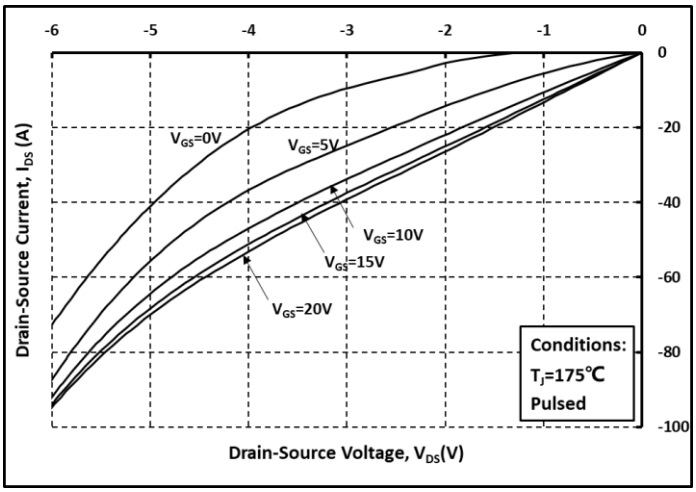



Fig. 15 3rd Quadrant curves @ $T_J$=175°C

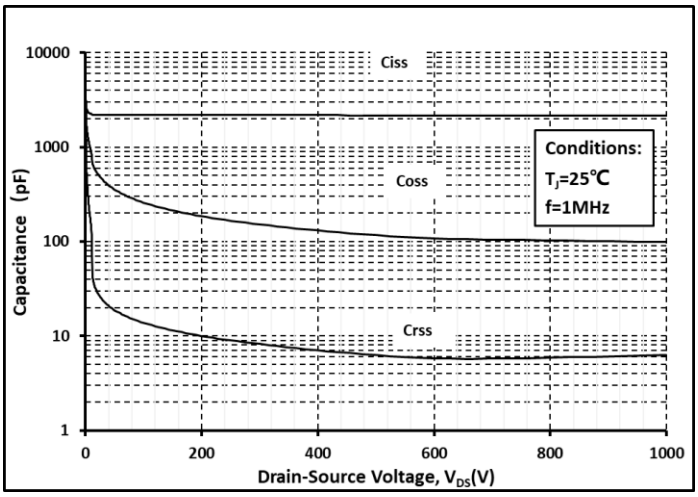



Fig. 16 Capacitance vs. $V_{DS}$

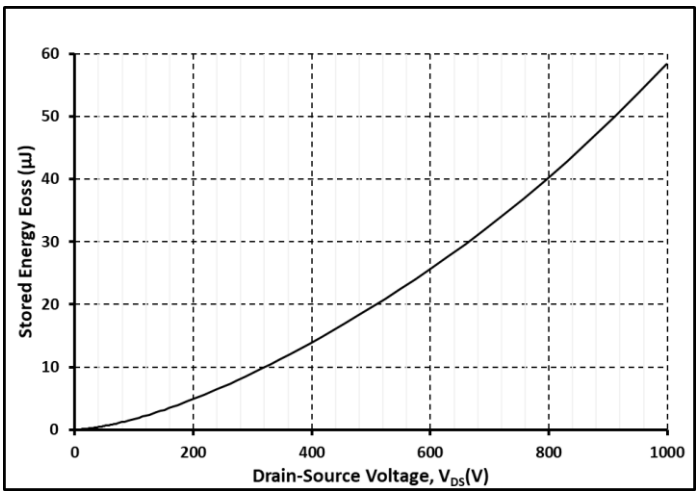



Fig. 17 Output Capacitor Stored Energy

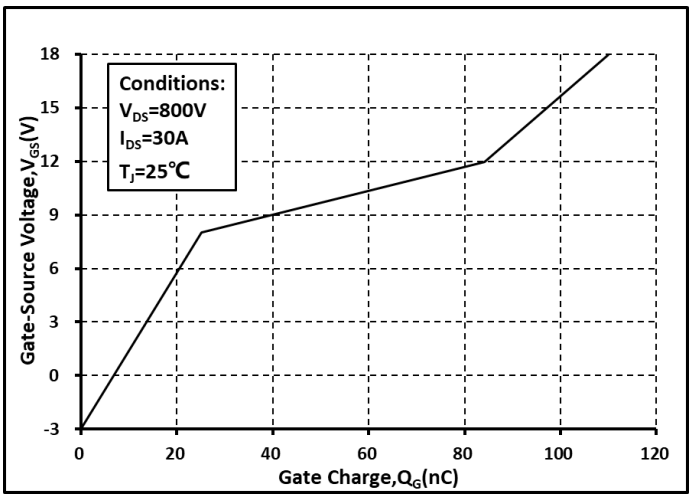



Fig. 18 Gate Charge Characteristics

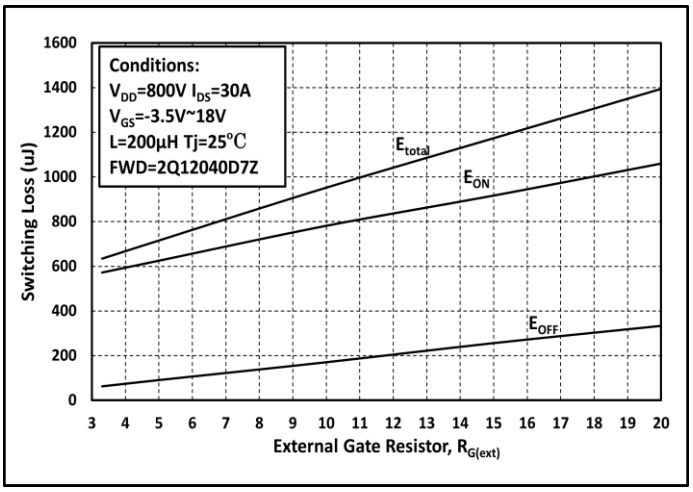



Fig. 19 Switching Energy vs. $R_{G(ext)}$

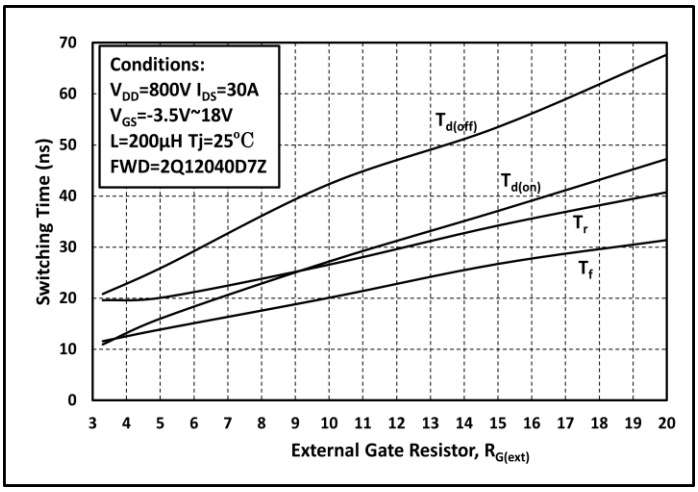



Fig. 20 Switching Times vs. $R_{G(ext)}$

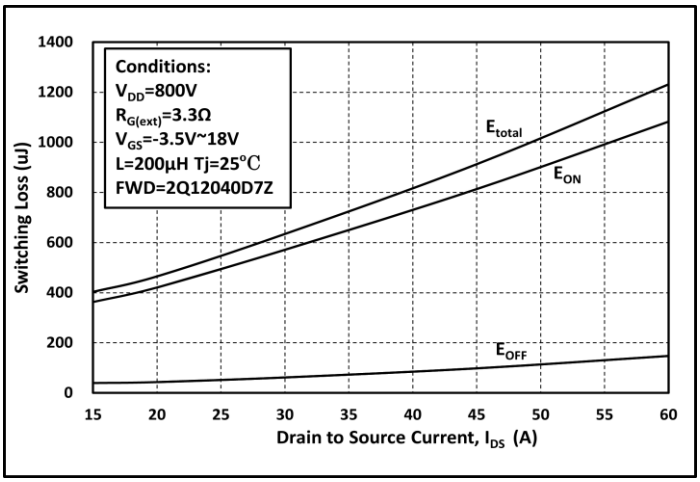



Fig. 21 Switching Energy vs. $I_{DS}$

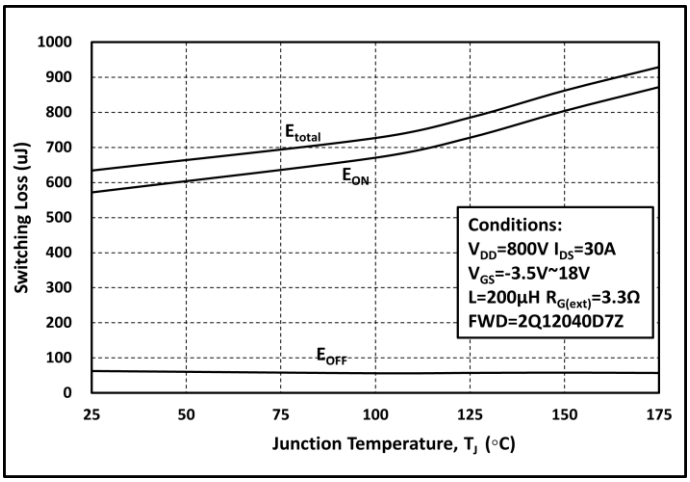



Fig. 22 Switching Energy vs. Temperature

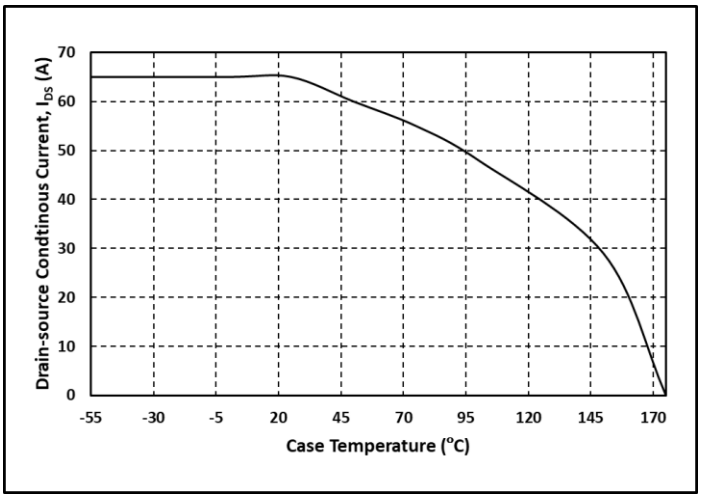



Fig. 23 Continuous Drain Current vs. Case Temperature

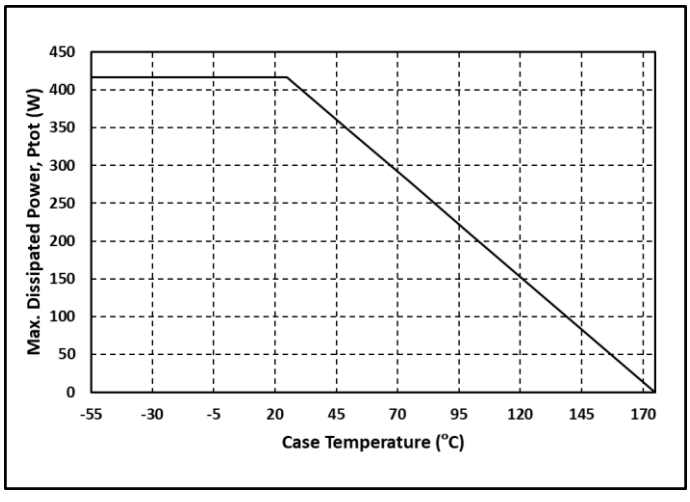



Fig. 24 Max. Power Dissipation Derating vs. Case Temperature

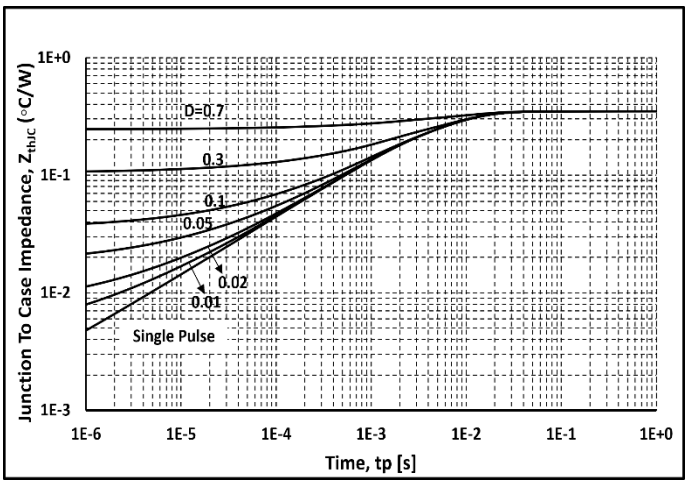



Fig. 25 Thermal impedance

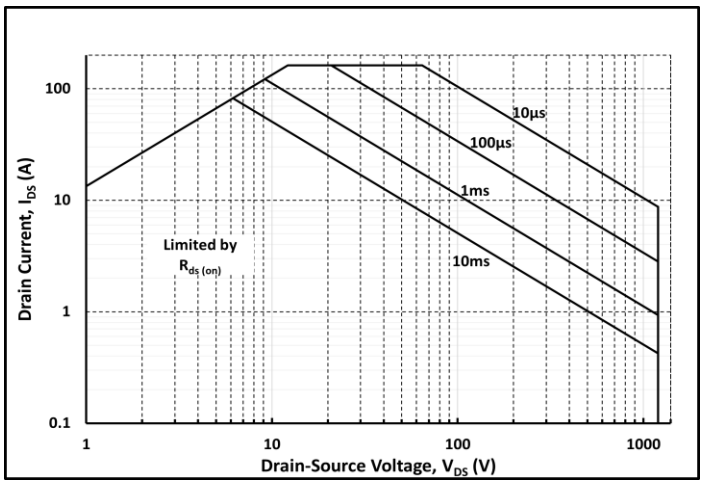
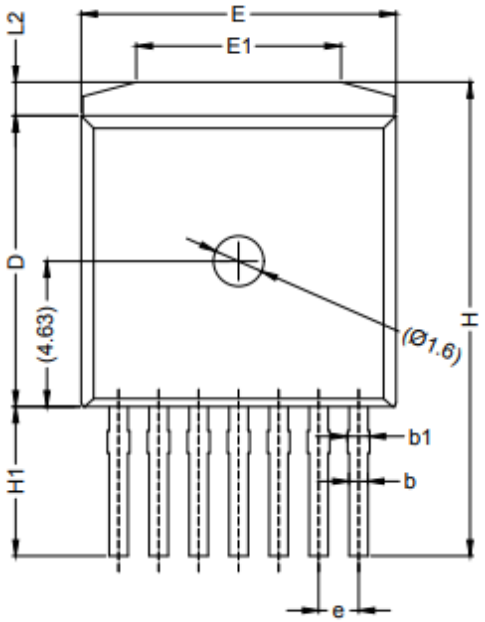
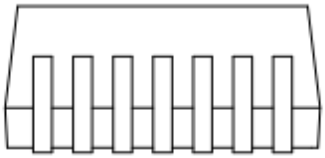
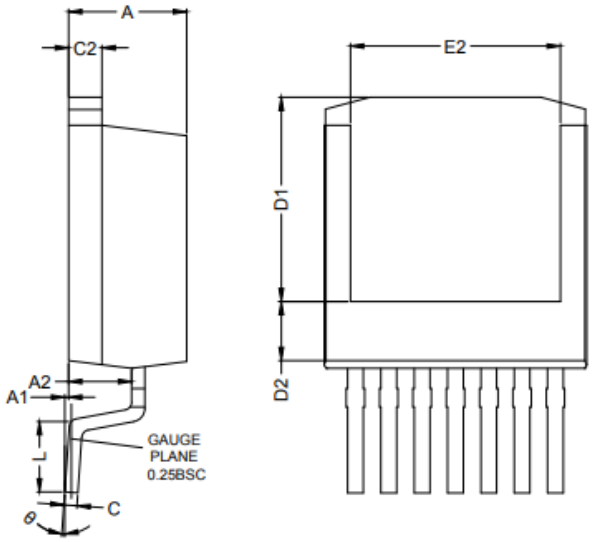


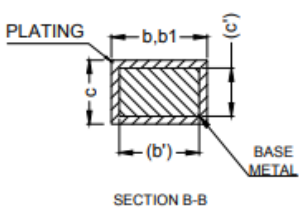

Fig. 26 Safe Operating Area

# Package Dimensions






| Items | Min | Max |
|---|---|---|
| A | 4.30 | 4.70 |
| A1 | - | 0.25 |
| A2 | 2.20 | 2.60 |
| b | 0.52 | 0.72 |
| b' | 0.50 | 0.70 |
| b1 | 0.60 | 0.80 |
| c | 0.42 | 0.62 |
| c' | 0.40 | 0.60 |
| c2 | 1.07 | 1.47 |
| D | 9.05 | 9.45 |
| D1 | 7.58 | 7.98 |
| D2 | 2.05 | 2.45 |
| e | 1.27 BSC | |
| E | 9.80 | 10.20 |
| E1 | 6.30 | 6.70 |
| E2 | 7.80 | 8.20 |
| L | 2.48 | 2.88 |
| L2 | 0.87 | 1.27 |
| H | 14.87 | 15.27 |
| H1 | 4.55 | 4.95 |
| θ | 0° | 8° |

**Note:**

1. Package Reference: JEDEC TO263, Variation AD
2. All Dimensions are in mm
3. Subject to Change Without Notice