# IV2Q12160T4Z – 1200V 160mΩ Gen2 Automotive SiC MOSFET

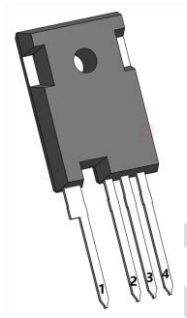
## Features

- 2nd Generation SiC MOSFET Technology with +15V~+18V gate drive
- High blocking voltage with low on-resistance
- High speed switching with low capacitance
- 175℃ operating junction temperature capability
- Ultra fast and robust intrinsic body diode
- Kelvin gate input easing driver circuit design
- AEC-Q101 qualified

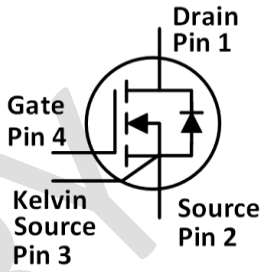
## Applications

- EV chargers and OBCs
- Solar boosters
- Automotive compressor inverters
- AC/DC power supplies

## Outline:



TO247-4




RoHS COMPLIANT

HF

## Marking Diagram:

| |
|---|
| 2Q12160T4Z |
| YYWWZ |
| XXXX |

2Q12160T4Z= 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 | Fig. 27 |
| $V_{GSmax}$ (Transient) | Maximum transient voltage | -10 to 23 | V | Duty cycle<1%, and pulse width<200ns | |
| $V_{GSon}$ | Recommended turn-on voltage | 15 to 18 | V | | |
| $V_{GSoff}$ | Recommended turn-off voltage | -5 to -2 | V | Typical -3.5V | |
| $I_D$ | Drain current (continuous) | 20 | A | $V_{GS}$=18V, $T_C$=25°C | Fig. 23 |
| | | 15 | A | $V_{GS}$=18V, $T_C$=100°C | |
| $I_{DM}$ | Drain current (pulsed) | 50 | A | Pulse width limited by SOA and dynamic $R_{θ(J-C)}$ | Fig. 25, 26 |
| $I_{SM}$ | Body diode current (pulsed) | 50 | A | Pulse width limited by SOA and dynamic $R_{θ(J-C)}$ | Fig. 25, 26 |
| $P_{TOT}$ | Total power dissipation | 136 | 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 |
|---|---|---|---|---|
| $R_{θ(J-C)}$ | Thermal Resistance from Junction to Case | 1.1 | °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 | | 1 | 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 | 3.0 | 4.5 | V | $V_{GS}$=$V_{DS}$, $I_D$=2mA | Fig. 8, 9 |
| | | | 2.2 | | | $V_{GS}$=$V_{DS}$, $I_D$=2mA @ $T_J$=175°C | |
| $R_{ON}$ | Static drain-source on-resistance | | 160 | 208 | mΩ | $V_{GS}$=18V, $I_D$=5A @$T_J$=25°C | Fig. 4, 5, 6, 7 |
| | | | 260 | | mΩ | $V_{GS}$=18V, $I_D$=5A @$T_J$=175°C | |
| | | | 210 | | mΩ | $V_{GS}$=15V, $I_D$=5A @$T_J$=25°C | |
| | | | 280 | | mΩ | $V_{GS}$=15V, $I_D$=5A @$T_J$=175°C | |
| $E_{AS}$ | Single pulse avalanche energy | | 400 | | mJ | $V_{DD}$ =50V L=10mH | |
| $C_{iss}$ | Input capacitance | | 580 | | pF | $V_{DS}$=800V, $V_{GS}$=0V, f=1MHz, $V_{AC}$=25mV | Fig. 16 |
| $C_{oss}$ | Output capacitance | | 35 | | pF | | |
| $C_{rss}$ | Reverse transfer capacitance | | 2.5 | | pF | | |
| $E_{oss}$ | $C_{oss}$ stored energy | | 14 | | μJ | | Fig. 17 |
| $Q_g$ | Total gate charge | | 29 | | nC | $V_{DS}$=800V, $I_D$=10A, $V_{GS}$=-3 to 18V | Fig. 18 |
| $Q_{gs}$ | Gate-source charge | | 6.6 | | nC | | |
| $Q_{gd}$ | Gate-drain charge | | 14.4 | | nC | | |
| $R_g$ | Gate input resistance | | 10 | | Ω | f=1MHz | |
| $E_{ON}$ | Turn-on switching energy | | 115 | | μJ | $V_{DS}$=800V, $I_D$=10A, $V_{GS}$=-3.5 to 18V, $R_{G(ext)}$=3.3Ω, L=300μH $T_J$=25°C | Fig. 19, 20 |
| $E_{OFF}$ | Turn-off switching energy | | 22 | | μJ | | |
| $t_{d(on)}$ | Turn-on delay time | | 2.5 | | ns | | |
| $t_r$ | Rise time | | 9.5 | | | | |
| $t_{d(off)}$ | Turn-off delay time | | 7.3 | | | | |
| $t_f$ | Fall time | | 11.0 | | | | |
| $E_{ON}$ | Turn-on switching energy | | 194 | | μJ | $V_{DS}$=800V, $I_D$=10A, $V_{GS}$=-3.5 to 18V, $R_{G(ext)}$=3.3Ω,L=300μH $T_J$=175°C | Fig. 22 |
| $E_{OFF}$ | Turn-off switching energy | | 19 | | 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 | | 4.0 | | V | $I_{SD}$=5A, $V_{GS}$=0V | Fig. 10, 11, 12 |
| | | | 3.7 | | V | $I_{SD}$=5A, $V_{GS}$=0V, $T_J$=175°C | |
| $I_S$ | Diode forward current (continuous) | | | 23 | A | $V_{GS}$=-2V, $T_C$=25°C | |
| | | | | 13 | A | $V_{GS}$=-2V, $T_C$=100°C | |
| $t_{rr}$ | Reverse recovery time | | 26 | | ns | $V_{GS}$=-3.5V/+18V, $I_{SD}$=10A, $V_R$=800V, $R_{G(ext)}$=15Ω L=300μH di/dt=3000A/μs | |
| $Q_{rr}$ | Reverse recovery charge | | 92 | | nC | | |
| $I_{RRM}$ | Peak reverse recovery current | | 10.6 | | A | | |

## Typical Performance (curves)

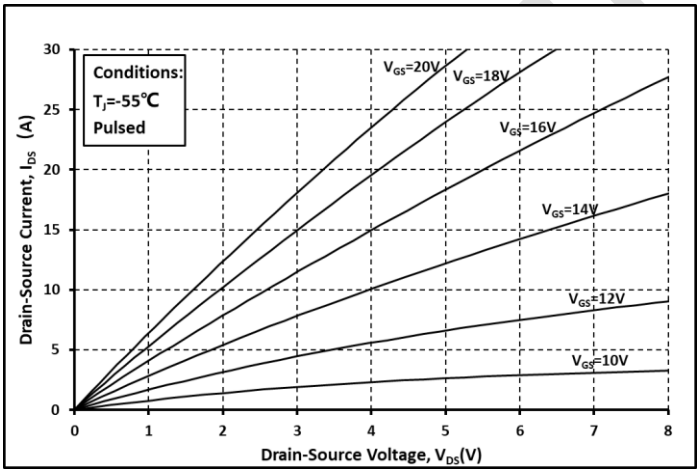



Fig. 1 Output Curve @ $T_J$=-55°C

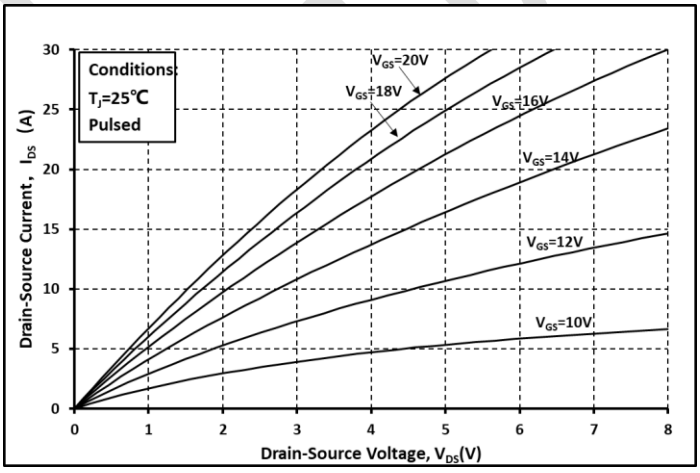



Fig. 2 Output Curve @ $T_J$=25°C

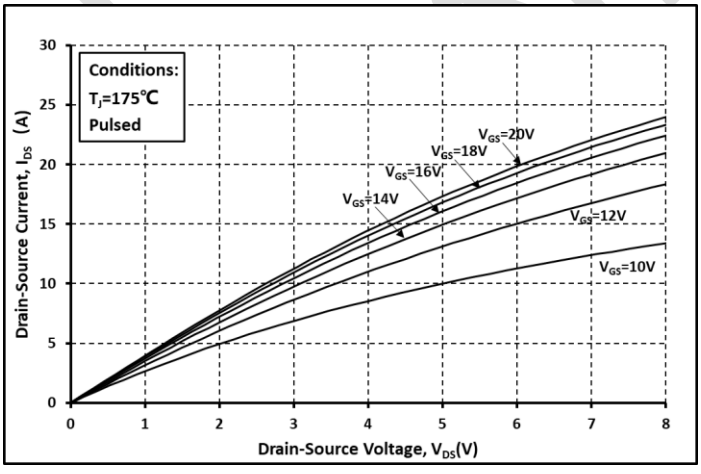



Fig. 3 Output Curve @ $T_J$=175°C

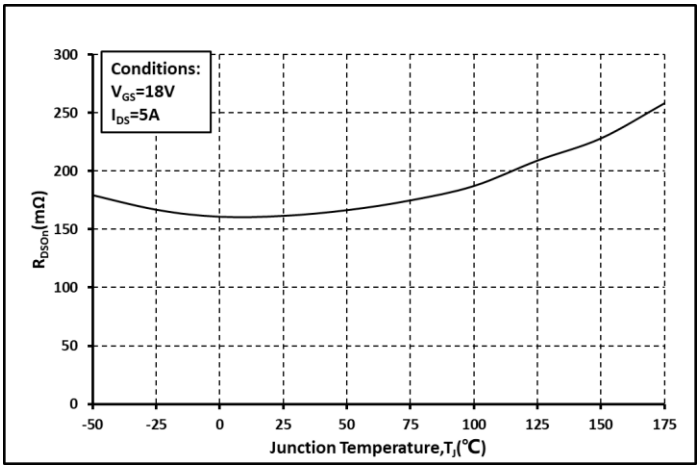



Fig. 4 Ron vs. Temperature

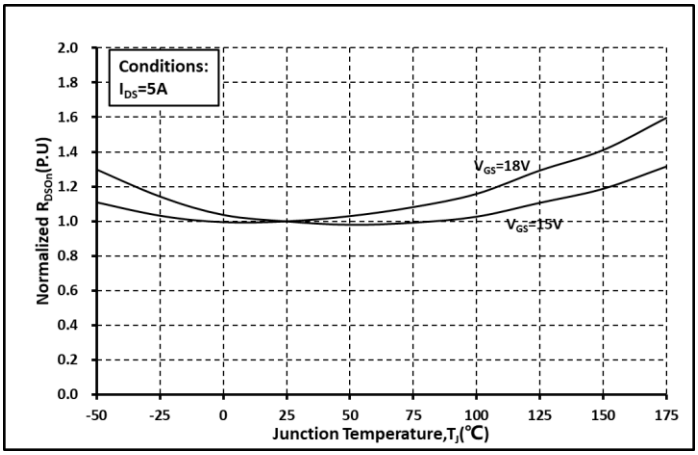



Fig. 5 Normalized Ron vs. Temperature

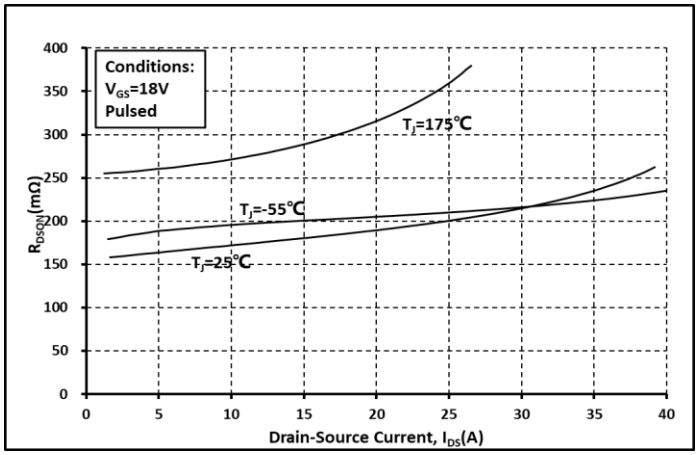



Fig. 6 Ron vs. $I_{DS}$ @ Various Temperature

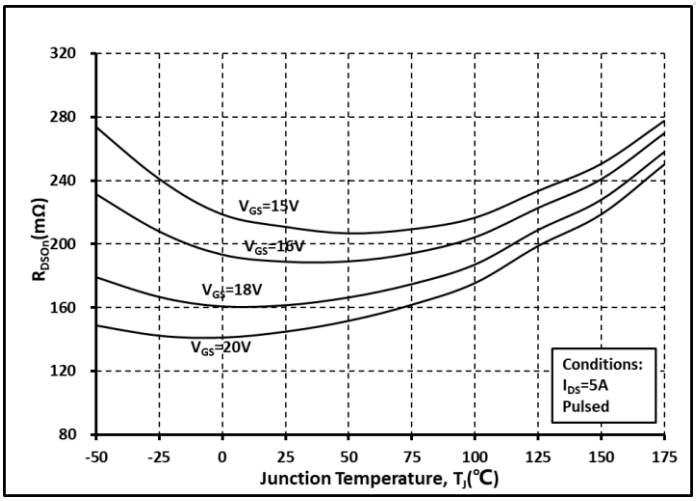



Fig. 7 Ron vs. Temperature @ Various $V_{GS}$

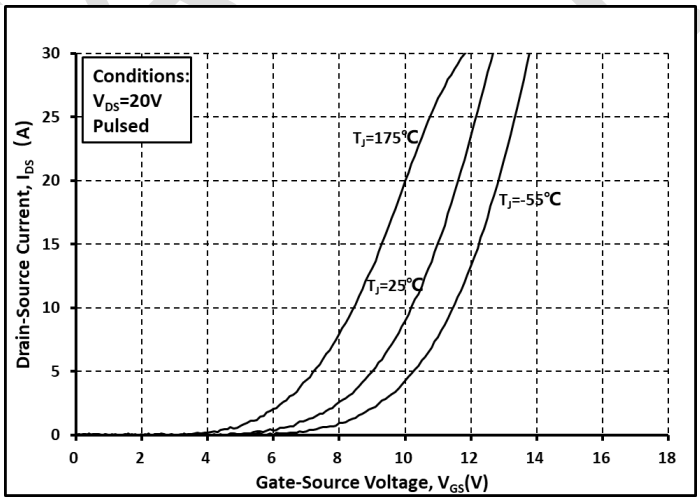



Fig. 8 Transfer Curves @ Various Temperature

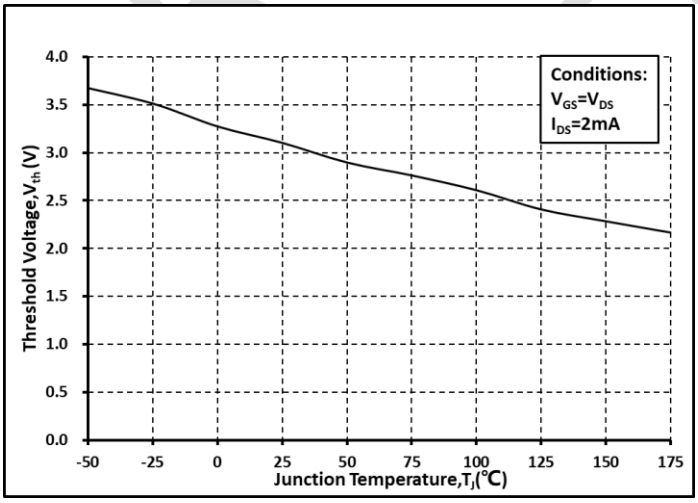



Fig. 9 Threshold Voltage vs. Temperature

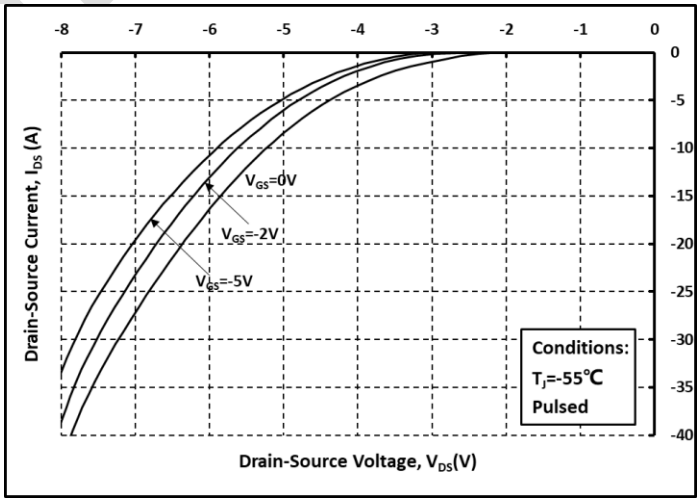



Fig. 10 Body Diode Curves @ $T_J$=-55℃

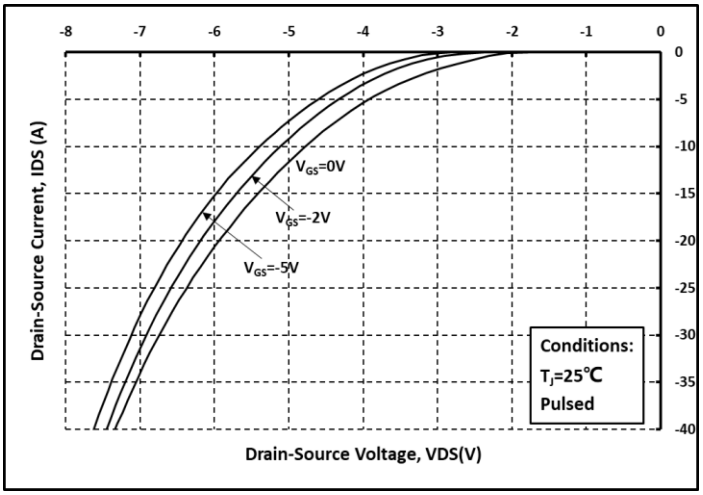



Fig. 11 Body Diode Curves @ $T_J$=25°C

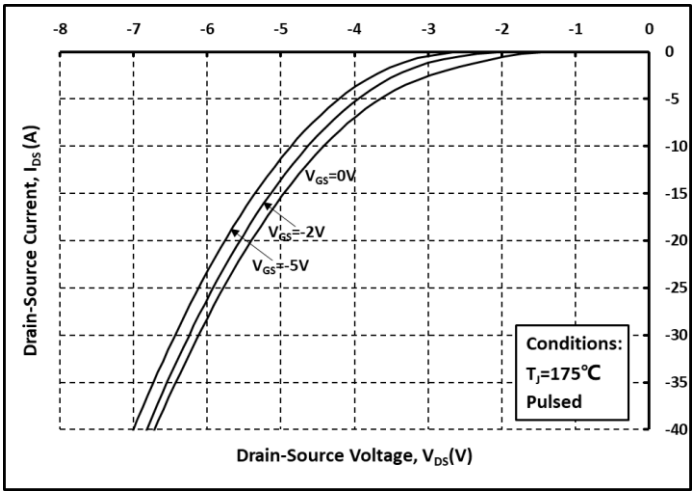



Fig. 12 Body Diode Curves @ $T_J$=175°C

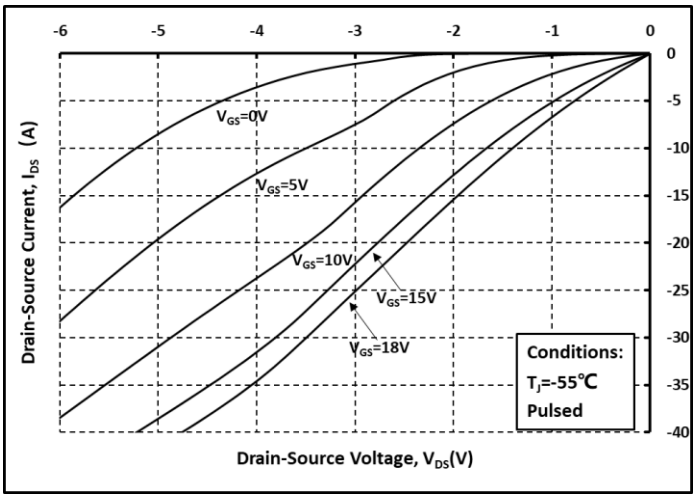



Fig. 13 3rd Quadrant Curves @ $T_J$=-55°C

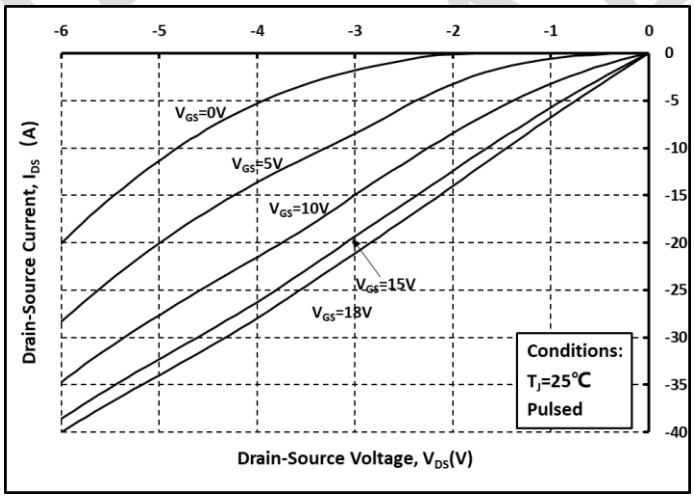



Fig. 14 3rd Quadrant Curves @ $T_J$=25°C

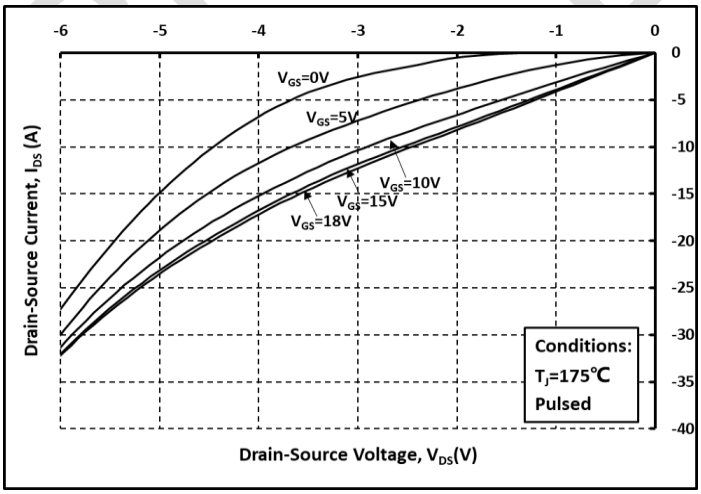



Fig. 15 3rd Quadrant Curves @ $T_J$=175°C

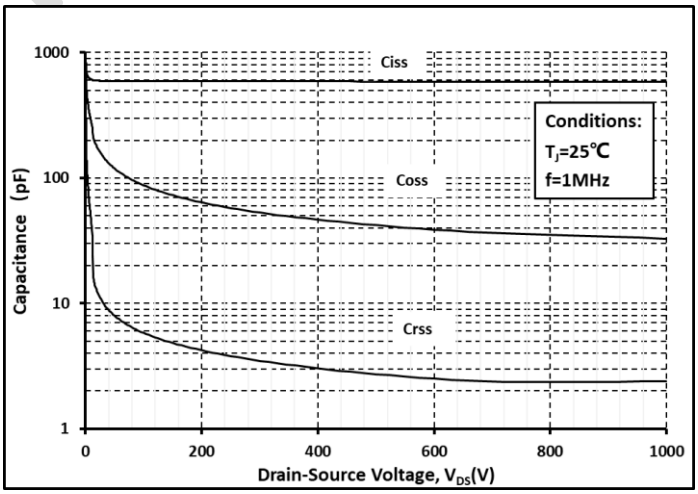



Fig. 16 Capacitance vs. $V_{DS}$

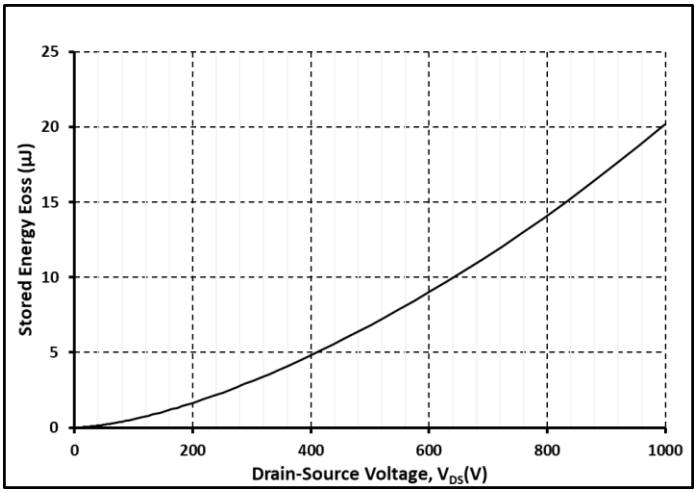



Fig. 17 Output Capacitor Stored Energy

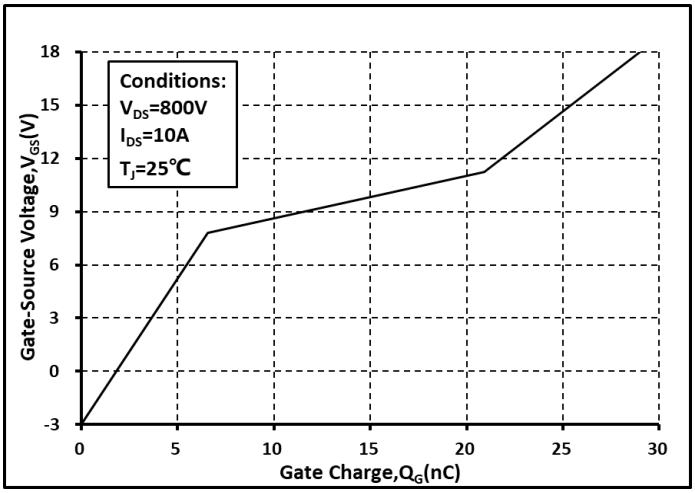



Fig. 18 Gate Charge Characteristics

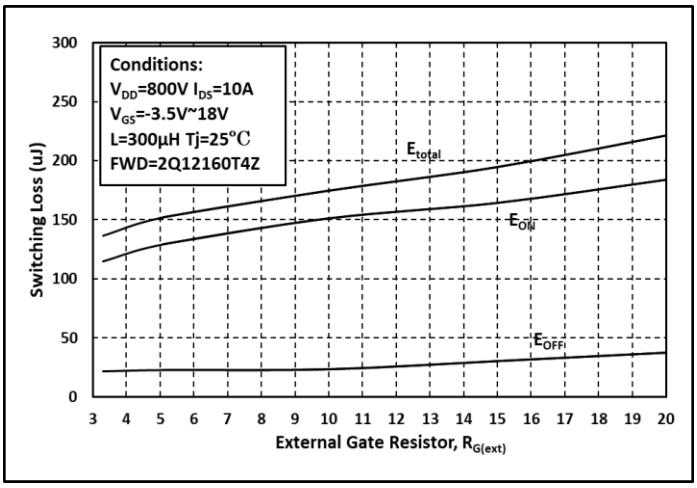



Fig. 19 Switching Energy vs. $R_{G(ext)}$

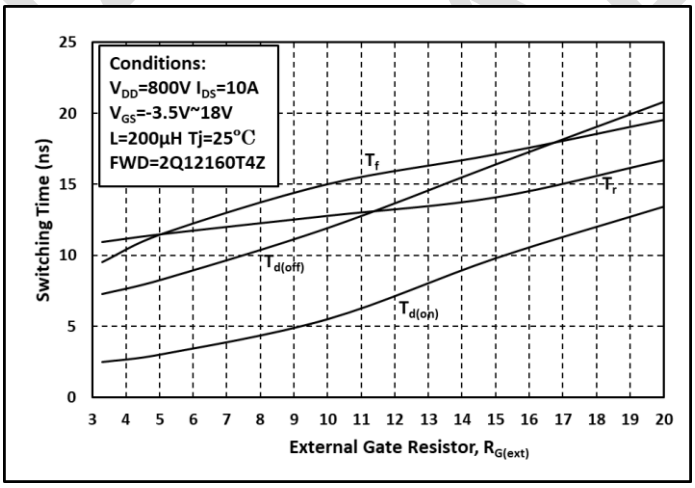



Fig. 20 Switching Times vs. $R_{G(ext)}$

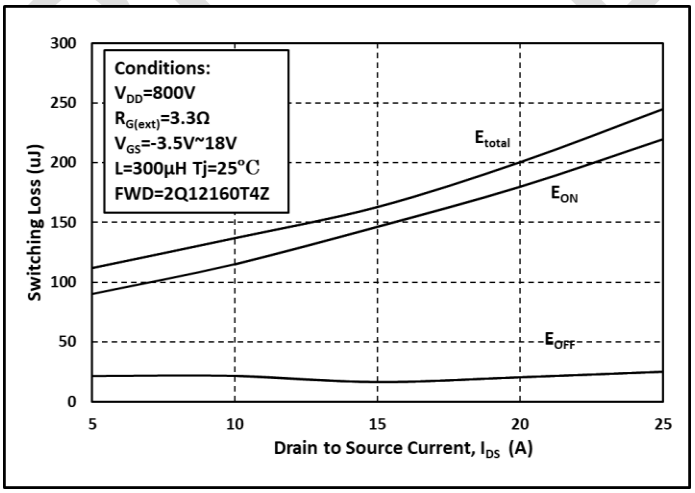



Fig. 21 Switching Energy vs. $I_{DS}$

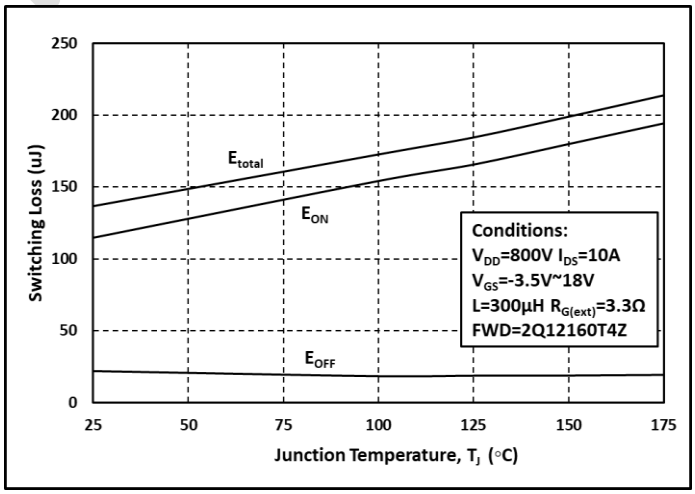



Fig. 22 Switching Energy vs. Temperature

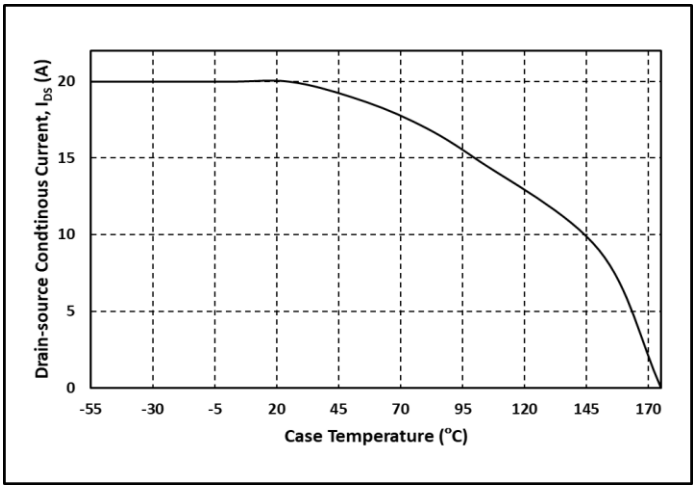



Fig. 23 Continuous Drain Current vs. Case Temperature

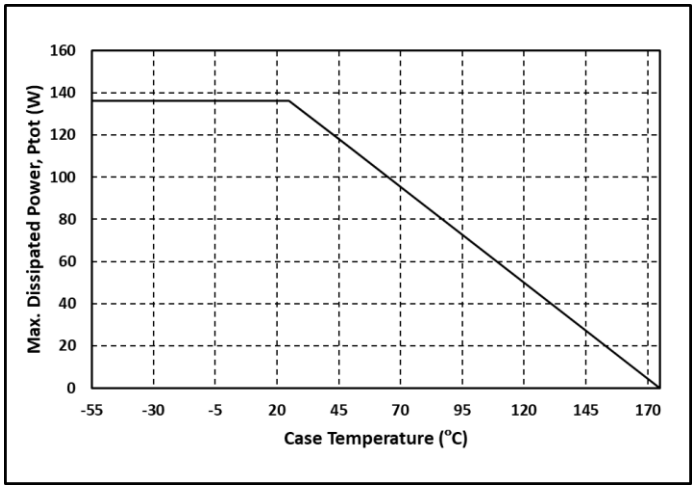



Fig. 24 Max. Power Dissipation Derating vs. Case Temperature

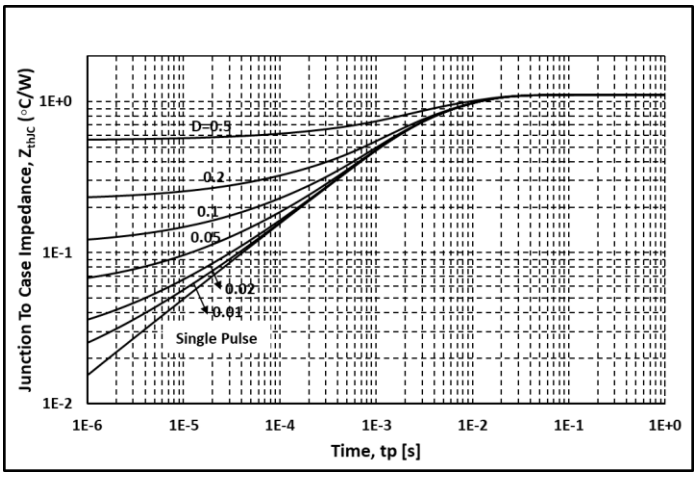



Fig. 25 Thermal Impedance

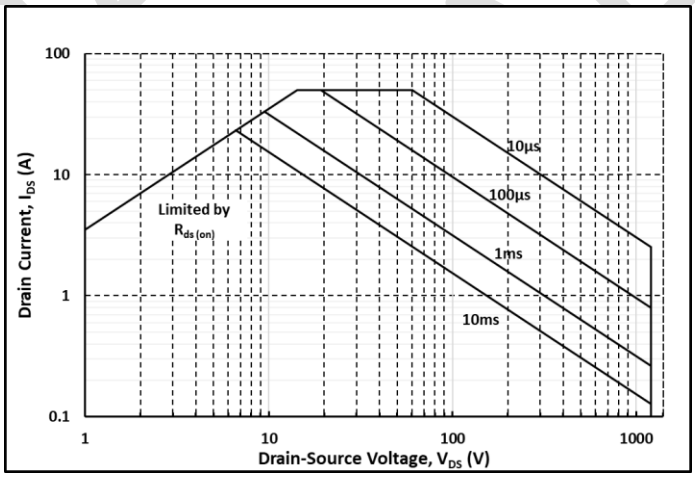



Fig. 26 Safe Operating Area

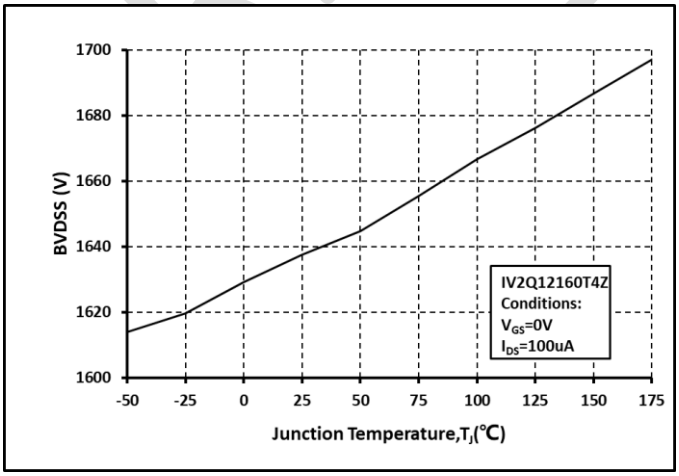
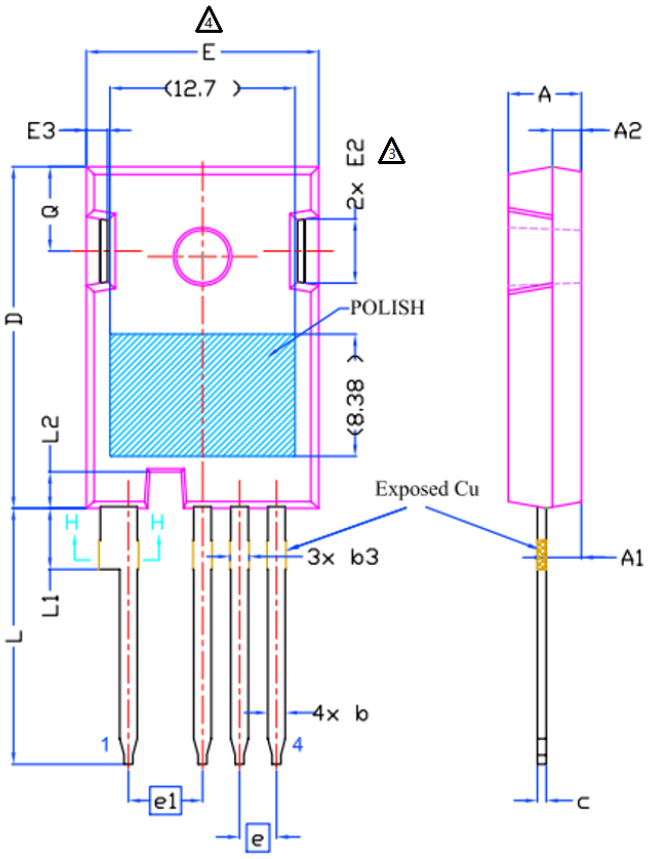
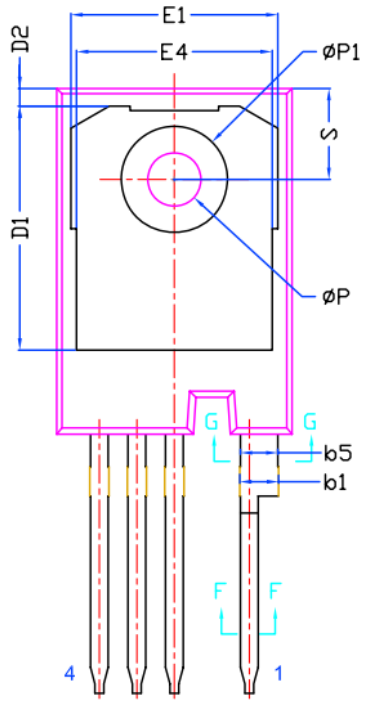


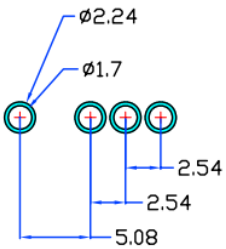

Fig. 27 BVDSS vs. Temperature

# Package Dimensions

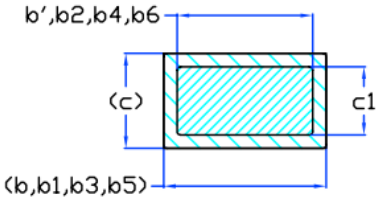



| Dimensions In Millimeters | | |
|---|---|---|
| SYMBOL | MIN. | MAX. |
| A | 4.83 | 5.21 |
| A1 | 2.29 | 2.54 |
| A2 | 1.91 | 2.16 |
| b | 1.07 | 1.33 |
| b' | 1.07 | 1.28 |
| b1 | 2.39 | 2.94 |
| b2 | 2.39 | 2.84 |
| b3 | 1.07 | 1.60 |
| b4 | 1.07 | 1.50 |
| b5 | 2.39 | 2.69 |
| b6 | 2.39 | 2.64 |
| c | 0.55 | 0.68 |
| c1 | 0.55 | 0.65 |
| D | 23.30 | 23.60 |
| D1 | 16.25 | 17.65 |
| D2 | 0.95 | 1.25 |
| E | 15.75 | 16.13 |
| E1 | 13.10 | 14.15 |
| E2 | 3.68 | 5.10 |
| E3 | 1.00 | 1.90 |
| E4 | 12.38 | 13.43 |
| e | 2.54 BSC | |
| e1 | 5.08 BSC | |
| L | 17.31 | 17.82 |
| L1 | 3.97 | 4.37 |
| L2 | 2.35 | 2.65 |
| N | 4 | |
| ϕP | 3.51 | 3.65 |
| ϕP1 | 7.18 REF. | |
| Q | 5.49 | 6 |
| S | 6.04 | 6.3 |




Recommended Solder Pad Layout




Section F--F, G--G, H--H

**Note:**

1. Package Reference: JEDEC TO247, Variation AD
2. All Dimensions are in mm
3. Slot Required, Notch May Be Rounded
4. Dimension D&E Do Not Include Mold Flash
5. Subject to Change Without Notice

## Notes

For further information please contact IVCT's office.

The Information in this document is subject to change without notice.

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