

IV1Q12030T4G – 1200V 30mΩ SiC MOSFET

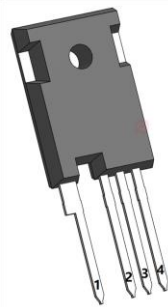
Features

- 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
- Kelvin gate input easing driver circuit design

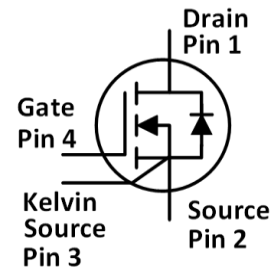
Applications

- Solar inverters
- UPS
- Motor drivers
- High voltage DC/DC converters
- Switch mode power supplies

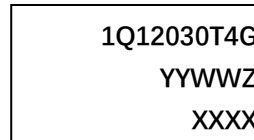
Outline:



TO247-4



Marking Diagram:



1Q12030T4G= Specific Device Code
 YY = Year
 WW = Work Week
 Z = Assembly Location
 XXXX = Lot Traceability

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

| Symbol | Parameter | Value | Unit | Test Conditions | Note |
|--------------------|--------------------------------|-------------|------------------|--|---------|
| V_{DS} | Drain-Source voltage | 1200 | V | $V_{GS}=0V, I_D=100\mu A$ | |
| $V_{GSmax}(DC)$ | 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) | 79 | A | $V_{GS}=20V, T_c=25^\circ\text{C}$ | Fig. 23 |
| | | 58 | A | $V_{GS}=20V, T_c=100^\circ\text{C}$ | |
| I_{DM} | Drain current (pulsed) | 197 | A | Pulse width limited by SOA | Fig. 26 |
| P_{TOT} | Total power dissipation | 410 | W | $T_c=25^\circ\text{C}$ | Fig. 24 |
| T_{stg} | Storage temperature range | -55 to 175 | $^\circ\text{C}$ | | |
| T_J | Operating junction temperature | -55 to 175 | $^\circ\text{C}$ | | |
| T_L | Solder Temperature | 260 | $^\circ\text{C}$ | 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 | 0.365 | $^\circ\text{C}/\text{W}$ | Fig. 25 |

Electrical Characteristics ($T_c=25^\circ\text{C}$ unless otherwise specified)

| Symbol | Parameter | Value | | | Unit | Test Conditions | Note |
|---------------------|-----------------------------------|-------|------|-----------|------------------|--|-----------------|
| | | Min. | Typ. | Max. | | | |
| I_{DSS} | Zero gate voltage drain current | | 5 | 100 | μA | $V_{DS}=1200\text{V}, V_{GS}=0\text{V}$ | |
| I_{GSS} | Gate leakage current | | | ± 100 | nA | $V_{DS}=0\text{V}, V_{GS}=-5\sim 20\text{V}$ | |
| V_{TH} | Gate threshold voltage | 1.8 | 2.8 | 5 | V | $V_{GS}=V_{DS}, I_D=9.4\text{mA}$ | Fig. 8, 9 |
| | | | 2.1 | | | $V_{GS}=V_{DS}, I_D=9.4\text{mA}$ @ $T_J=175^\circ\text{C}$ | |
| R_{ON} | Static drain-source on-resistance | | 30 | 40 | $\text{m}\Omega$ | $V_{GS}=20\text{V}, I_D=40\text{A}$ @ $T_J=25^\circ\text{C}$ | Fig. 4, 5, 6, 7 |
| | | | 52 | | $\text{m}\Omega$ | $V_{GS}=20\text{V}, I_D=40\text{A}$ @ $T_J=175^\circ\text{C}$ | |
| C_{iss} | Input capacitance | | 3980 | | pF | $V_{DS}=800\text{V}, V_{GS}=0\text{V},$ $f=100\text{kHz},$ $V_{AC}=25\text{mV}$ | Fig. 16 |
| C_{oss} | Output capacitance | | 166 | | pF | | |
| C_{rss} | Reverse transfer capacitance | | 10.1 | | pF | | |
| E_{oss} | C_{oss} stored energy | | 66 | | μJ | | Fig. 17 |
| Q_g | Total gate charge | | 168 | | nC | $V_{DS}=800\text{V}, I_D=40\text{A},$ $V_{GS}=-5\text{ to }20\text{V}$ | Fig. 18 |
| Q_{gs} | Gate-source charge | | 80 | | nC | | |
| Q_{gd} | Gate-drain charge | | 24.8 | | nC | | |
| R_g | Gate input resistance | | 2.4 | | Ω | $f=1\text{MHz}$ | |
| E_{ON} | Turn-on switching energy | | 684 | | μJ | $V_{DS}=800\text{V}, I_D=40\text{A},$ $V_{GS}=-3.5\text{ to }20\text{V},$ $R_{G(\text{ext})}=3.3\Omega,$ $L=200\mu\text{H}$ | Fig. 19, 20 |
| E_{OFF} | Turn-off switching energy | | 244 | | μJ | | |
| $t_{d(\text{on})}$ | Turn-on delay time | | 16.4 | | ns | | |
| t_r | Rise time | | 29.6 | | | | |
| $t_{d(\text{off})}$ | Turn-off delay time | | 31.6 | | | | |
| t_f | Fall time | | 18 | | | | |

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

| Symbol | Parameter | Value | | | Unit | Test Conditions | Note |
|-----------|-------------------------------|-------|-------|------|-------------|---|-----------------|
| | | Min. | Typ. | Max. | | | |
| V_{SD} | Diode forward voltage | | 3.3 | | V | $I_{SD}=20\text{A}, V_{GS}=0\text{V}$ | Fig. 10, 11, 12 |
| | | | 3.1 | | V | $I_{SD}=20\text{A}, V_{GS}=0\text{V},$ $T_J=175^\circ\text{C}$ | |
| t_{rr} | Reverse recovery time | | 20.0 | | ns | $V_{DS}=800\text{V}, I_D=40\text{A},$ $V_{GS}=-3\text{ to }20\text{V},$ $R_{G(\text{ext})}=12\Omega,$ $L=272\mu\text{H}$ $di/dt=3000\text{A}/\mu\text{s}$ | |
| Q_{rr} | Reverse recovery charge | | 238.4 | | nC | | |
| I_{RRM} | Peak reverse recovery current | | 22.8 | | A | | |

Typical Performance (curves)

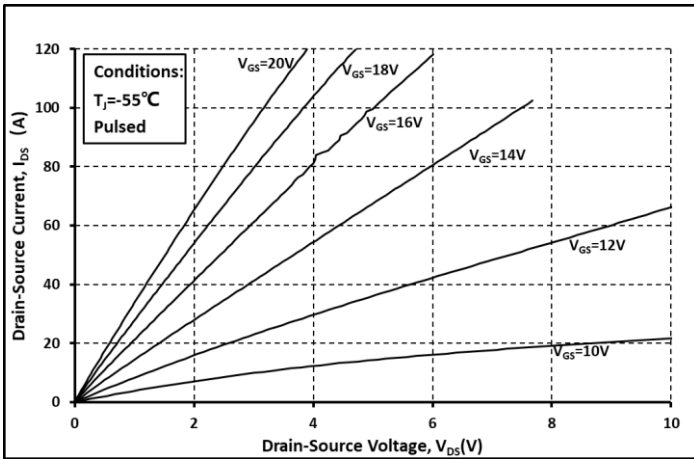


Fig. 1 Output Curve @ $T_j = -55^\circ\text{C}$

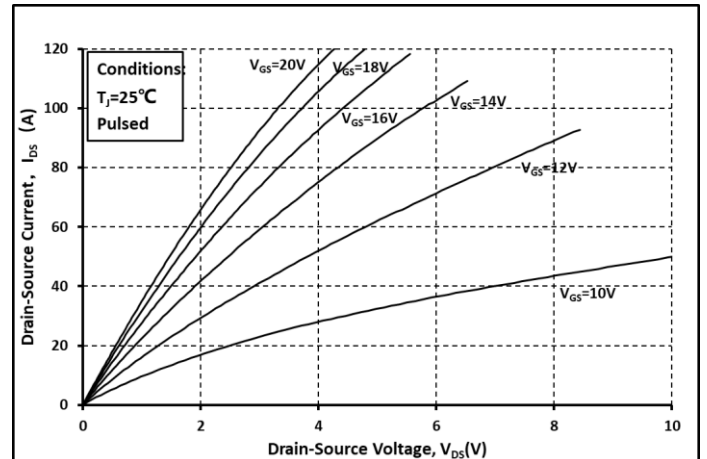


Fig. 2 Output Curve @ $T_j = 25^\circ\text{C}$

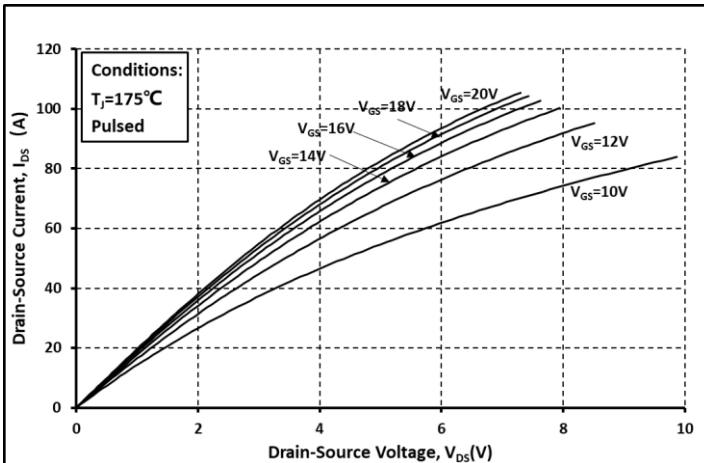


Fig. 3 Output Curve @ $T_j = 175^\circ\text{C}$

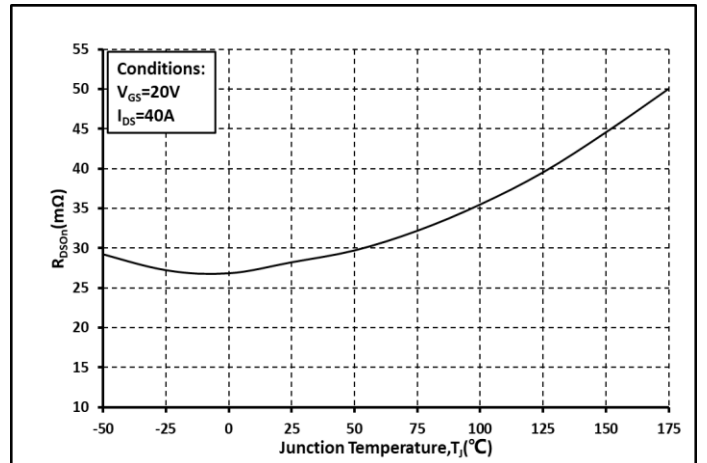


Fig. 4 R_{on} vs. Temperature

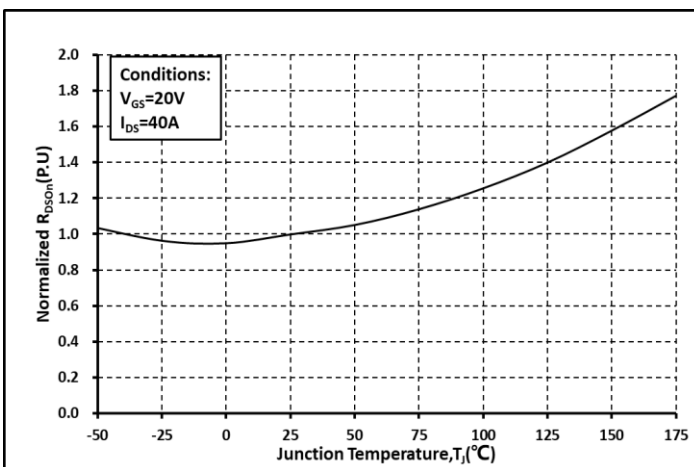


Fig. 5 Normalized R_{on} vs. Temperature

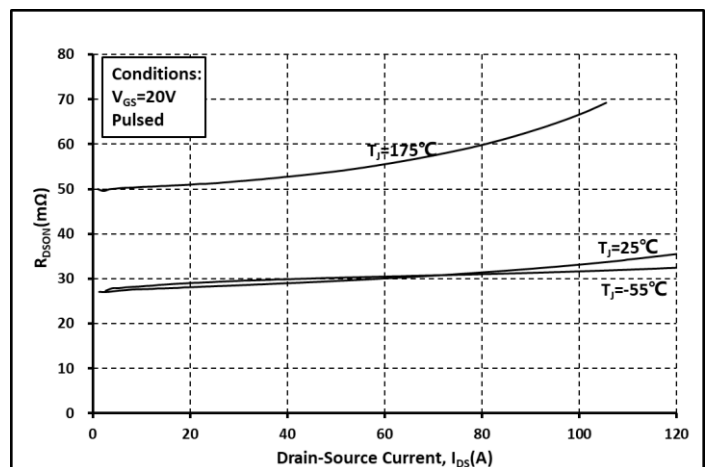


Fig. 6 R_{on} vs. I_{ds} @ Various Temperature

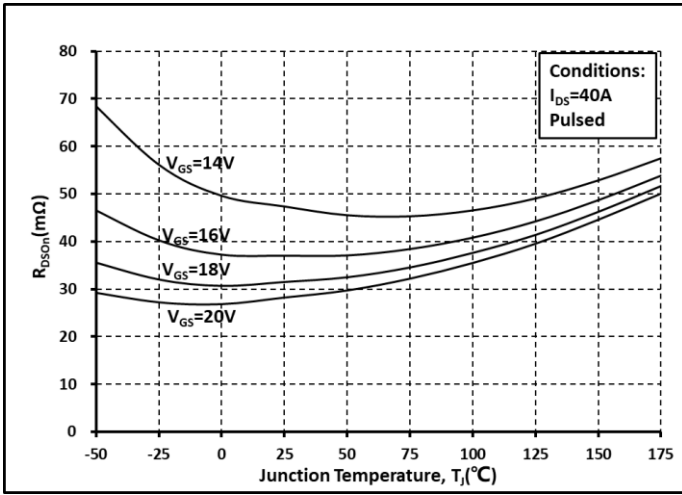


Fig. 7 Ron vs. Temperature @ Various V_{GS}

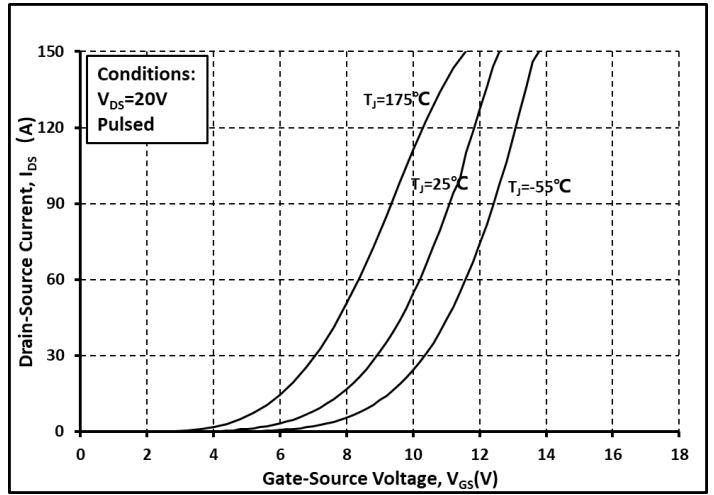


Fig. 8 Transfer Curves @ Various Temperature

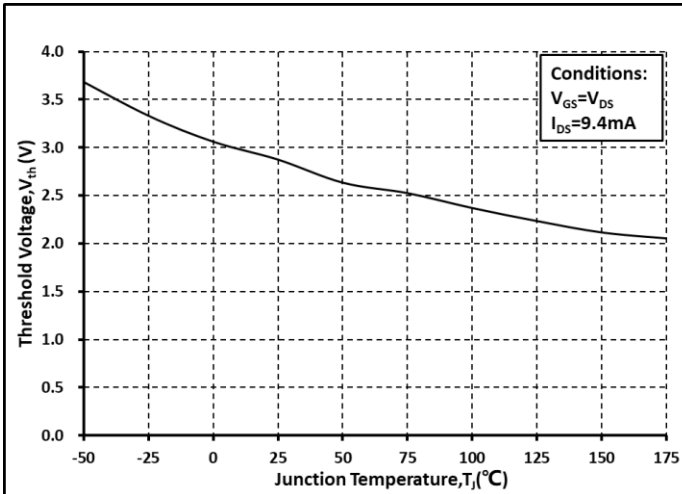


Fig. 9 Threshold Voltage vs. Temperature

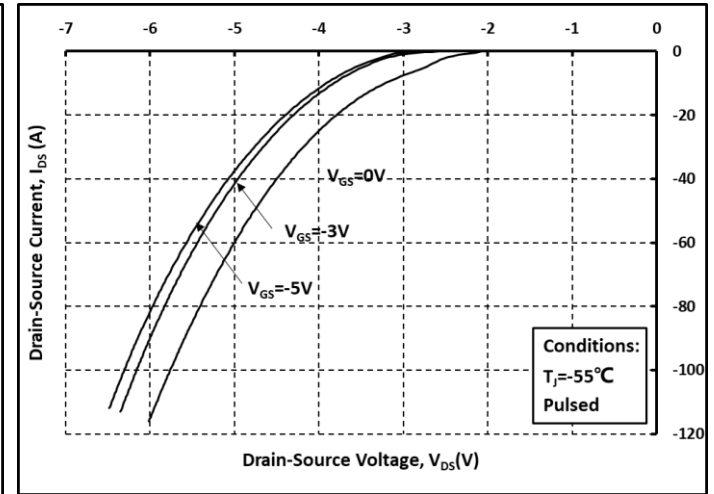


Fig. 10 Body Diode curves @ $T_j=-55^\circ C$

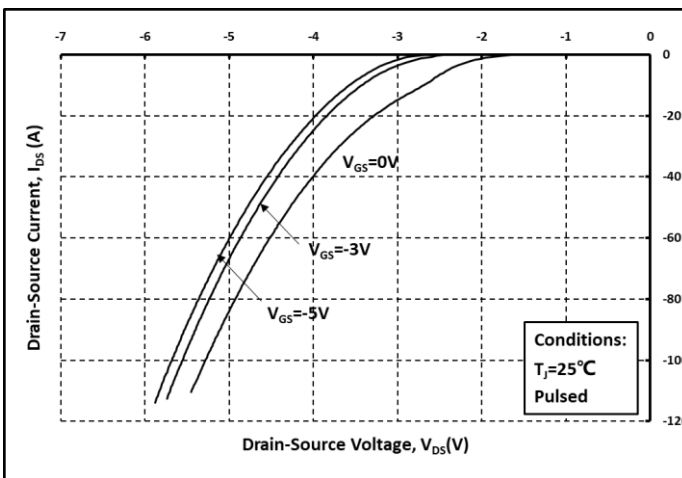


Fig. 11 Body Diode curves @ $T_j=25^\circ C$

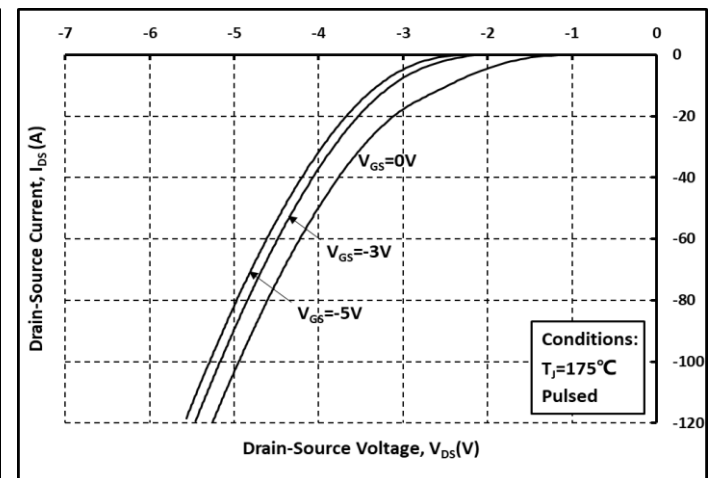


Fig. 12 Body Diode curves @ $T_j=175^\circ C$

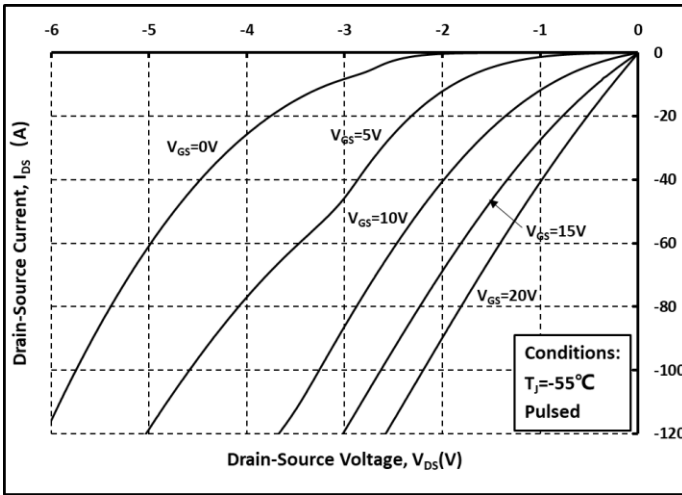


Fig. 13 3rd Quadrant curves @ $T_j = -55^\circ\text{C}$

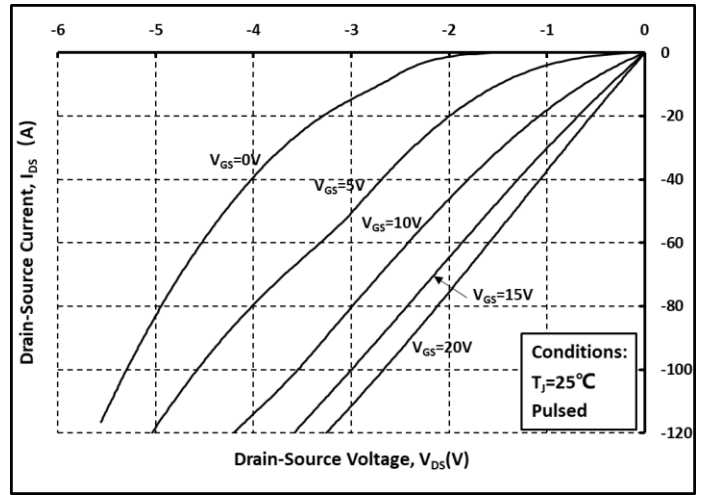


Fig. 14 3rd Quadrant curves @ $T_j = 25^\circ\text{C}$

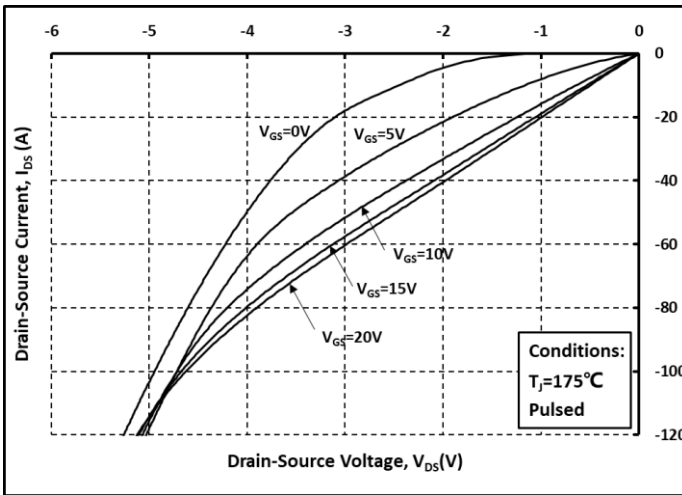


Fig. 15 3rd Quadrant curves @ $T_j = 175^\circ\text{C}$

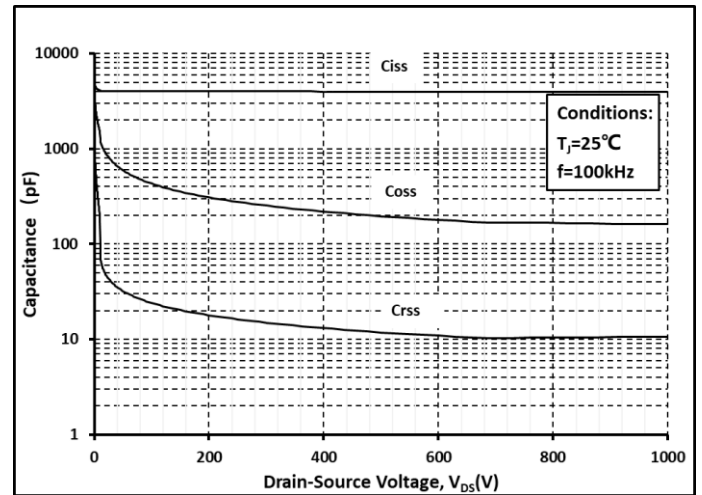


Fig. 16 Capacitance vs. V_{DS}

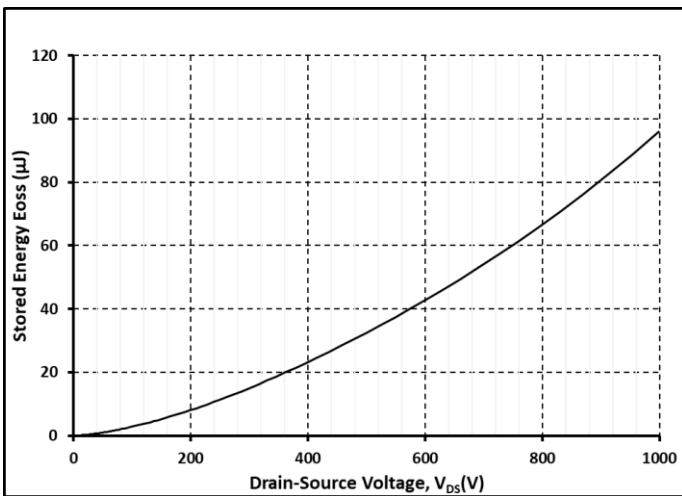


Fig. 17 Output Capacitor Stored Energy

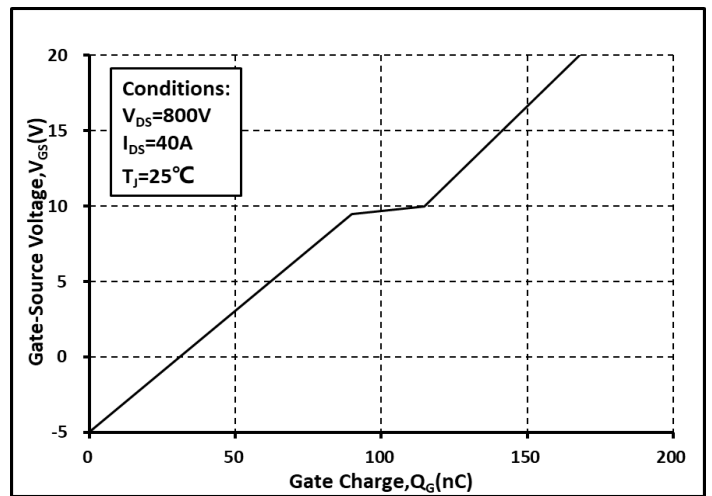


Fig. 18 Gate Charge Characteristics

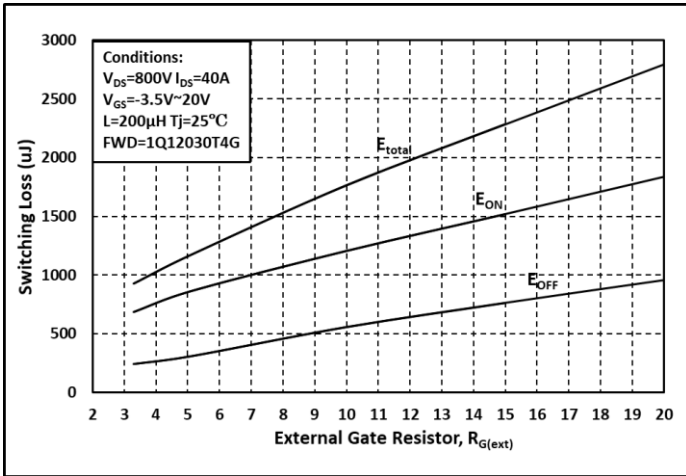


Fig. 19 Switching Energy vs. $R_{G(ext)}$

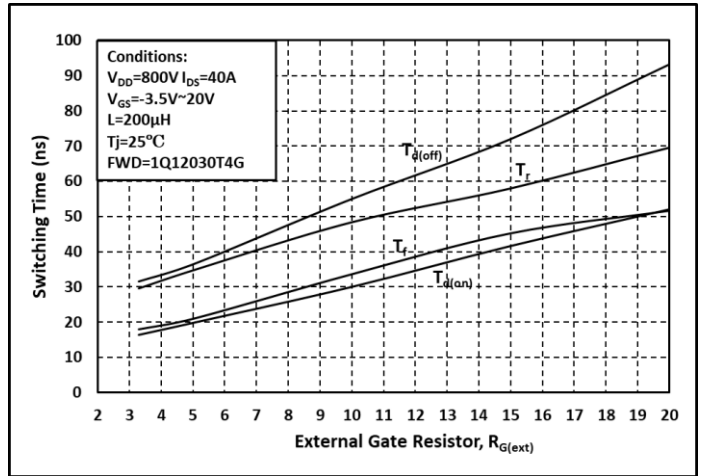


Fig. 20 Switching Times vs. $R_{G(ext)}$

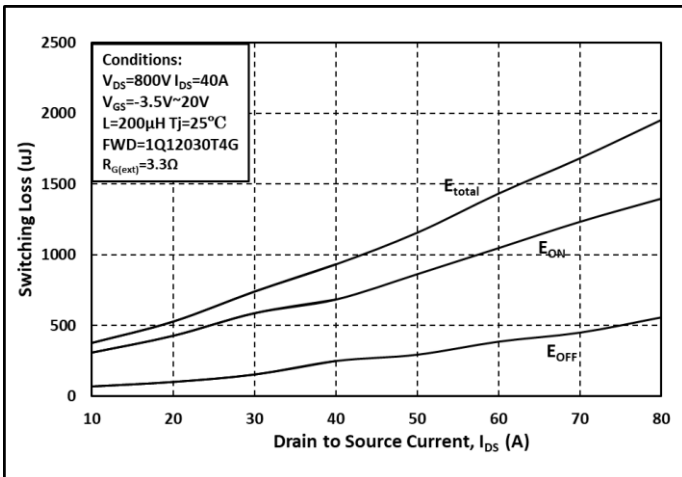


Fig. 21 Switching Energy vs. I_{DS}

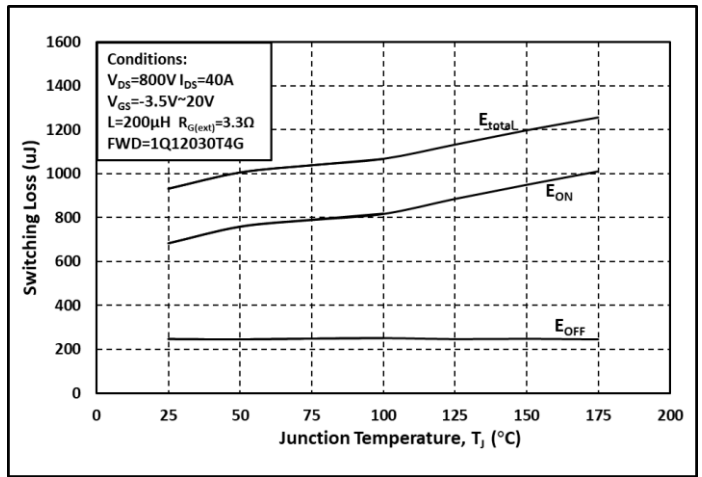


Fig. 22 Switching Energy vs. T_J

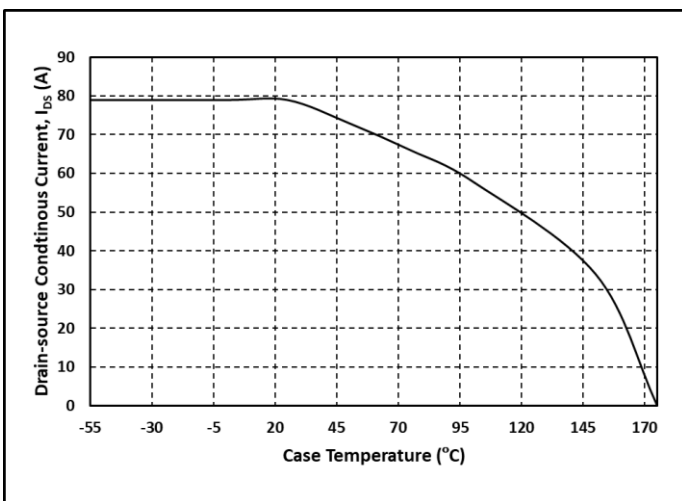


Fig. 23 Continuous Drain Current vs. Case Temperature

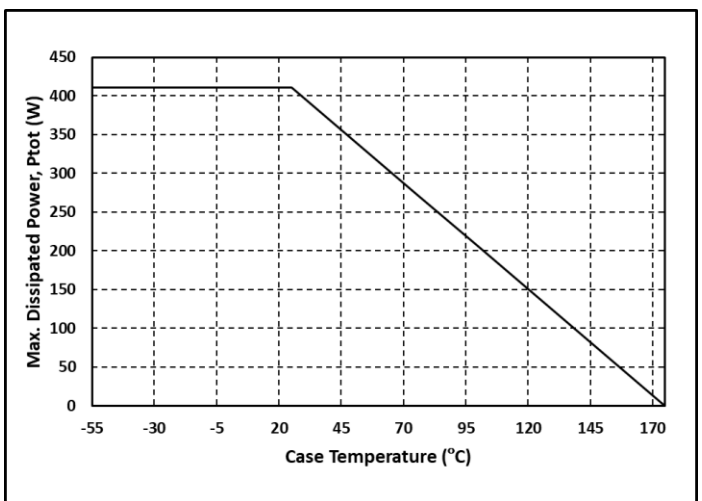


Fig. 24 Max. Power Dissipation Derating vs. Case Temperature

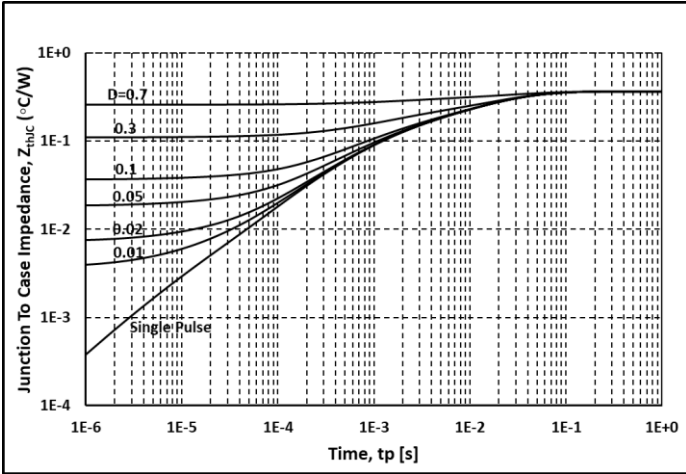


Fig. 25 Thermal impedance

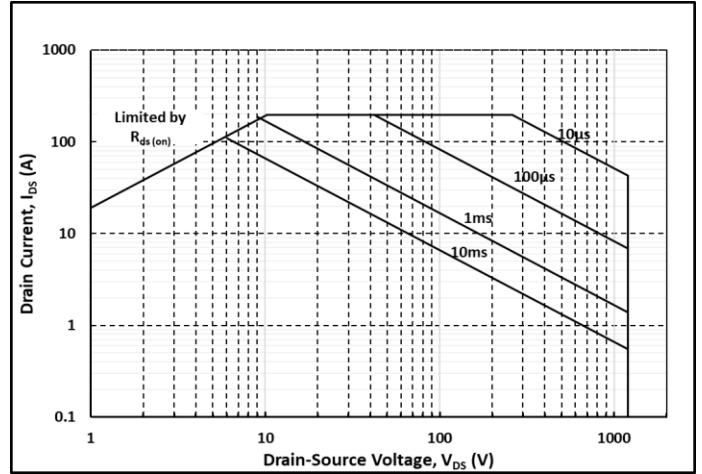
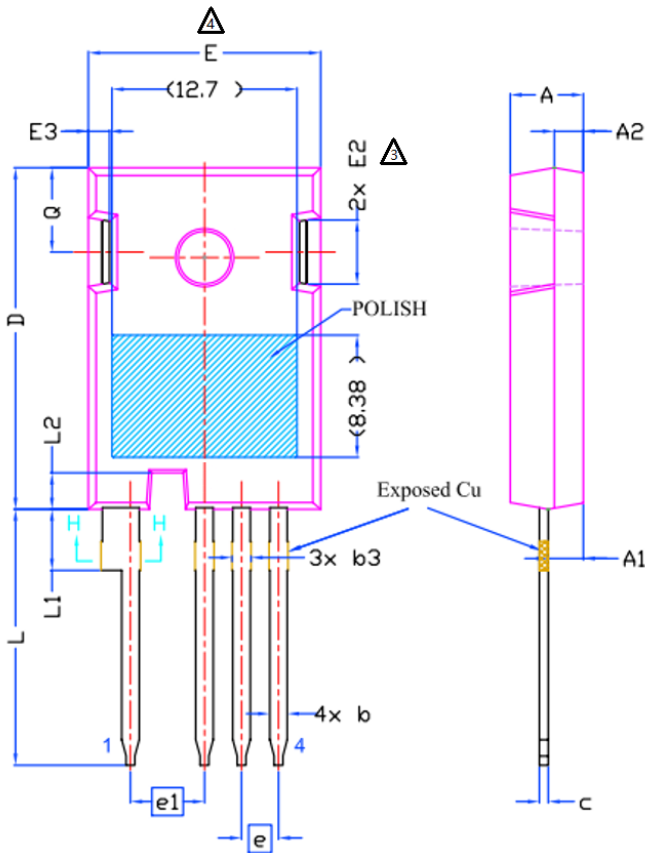
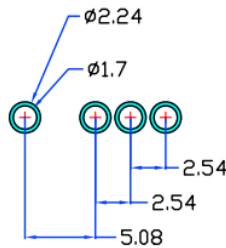
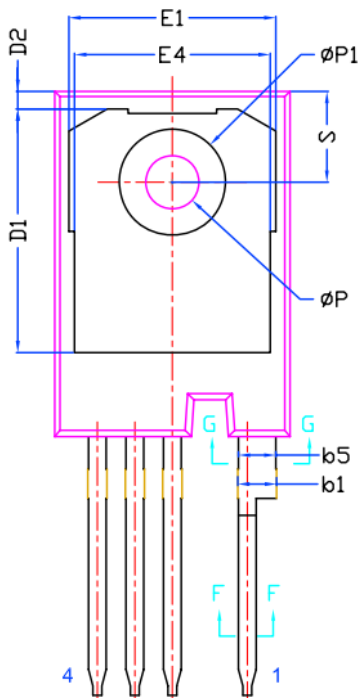


Fig. 26 Safe Operating Area

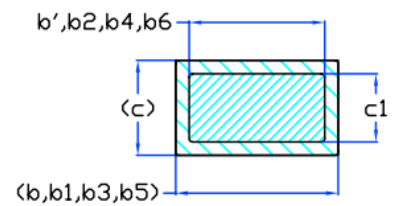
Package Dimensions



| 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

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