

## IV1Q12080T3Z – 1200V 80mΩ Automotive SiC MOSFET

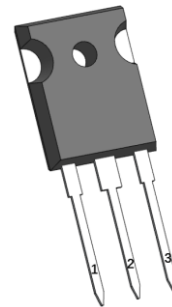
### Features

- 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
- AEC-Q101 qualified

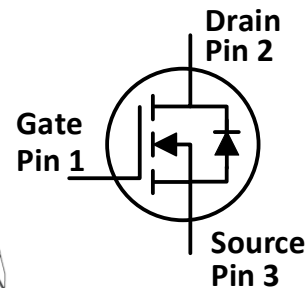
### Applications

- On-board chargers
- Automotive compressor inverters
- Automotive DC/DC
- Solar inverters
- Switch mode power supplies

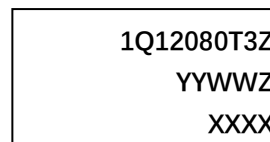
### Outline:



TO247-3



### Marking Diagram:



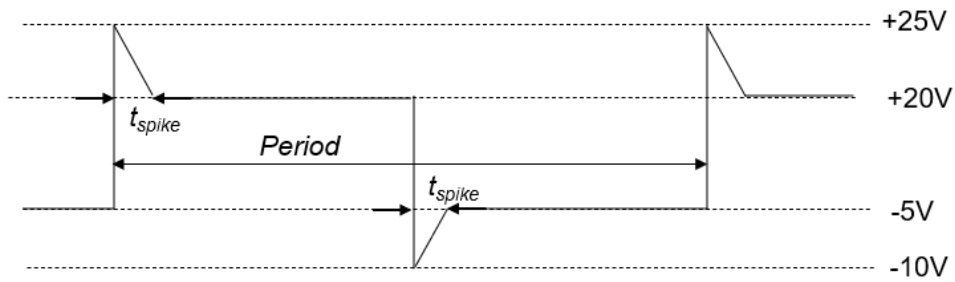
1Q12080T3Z= Specific Device Code  
 YY = Year  
 WW = Work Week  
 Z = Assembly Location  
 XXXX = Lot Traceability

### Absolute Maximum Ratings (T<sub>c</sub>=25°C unless otherwise specified)

| Symbol                     | Parameter                      | Value      | Unit | Test Conditions  | Note    |
|----------------------------|--------------------------------|------------|------|--|---------|
| V <sub>DS</sub>            | Drain-Source voltage           | 1200       | V    | V <sub>GS</sub> =0V, I <sub>D</sub> =100μA                           |         |
| V <sub>GSmax</sub> (DC)    | Maximum DC voltage             | -5 to 22   | V    | Static (DC)  |         |
| V <sub>GSmax</sub> (Spike) | Maximum spike voltage          | -10 to 25  | V    | t <sub>spike</sub> ≤ 200ns and<br>t <sub>spike</sub> /Period < 2%    | Note1   |
| V <sub>GSon</sub>          | Recommended turn-on voltage    | 20±0.5     | V    |  |         |
| V <sub>GSoff</sub>         | Recommended turn-off voltage   | -3.5 to -2 | V    |  |         |
| I <sub>D</sub>             | Drain current (continuous)     | 42         | A    | V <sub>GS</sub> =20V, T <sub>c</sub> =25°C                           | Fig. 21 |
|                            |                                | 31         | A    | V <sub>GS</sub> =20V, T <sub>c</sub> =100°C                          |         |
| I <sub>DM</sub>            | Drain current (pulsed)         | 70         | A    | Pulse width limited by SOA   | Fig. 24 |
| P <sub>TOT</sub>           | Total power dissipation        | 300        | W    | T <sub>c</sub> =25°C   | Fig. 22 |
| T <sub>stg</sub>           | Storage temperature range      | -55 to 175 | °C   |  |         |
| T <sub>J</sub>             | Operating junction temperature | -55 to 175 | °C   |  |         |
| T <sub>L</sub>             | Solder Temperature             | 260        | °C   | wave soldering only<br>allowed at leads, 1.6mm<br>from case for 10 s |         |

## Note

1. Definition of acceptable  $V_{GS}$  waveform



## Thermal Data

| Symbol            | Parameter                                | Value | Unit                        | Note    |
|-------------------|--|-------|-----------------------------|---------|
| $R_{\theta(j-c)}$ | Thermal Resistance from Junction to Case | 0.5   | $^{\circ}\text{C}/\text{W}$ | Fig. 23 |

### Electrical Characteristics (T<sub>c</sub>=25°C unless otherwise specified)

| Symbol              | Parameter                         | Value |      |      | Unit | Test Conditions   | Note            |
|---------------------|-----------------------------------|-------|------|------|------|---|-----------------|
|                     |                                   | Min.  | Typ. | Max. |      |   |                 |
| I <sub>DSS</sub>    | Zero gate voltage drain current   |       | 5    | 100  | μA   | V <sub>DS</sub> =1200V, V <sub>GS</sub> =0V   |                 |
| I <sub>GSS</sub>    | Gate leakage current              |       |      | ±100 | nA   | V <sub>DS</sub> =0V, V <sub>GS</sub> =-5~20V  |                 |
| V <sub>TH</sub>     | Gate threshold voltage            | 1.8   | 3.6  | 5    | V    | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =3.8mA  | Fig. 8, 9       |
|                     |                                   |       | 2.7  |      | V    | V <sub>GS</sub> =V <sub>DS</sub> , I <sub>D</sub> =3.8mA<br>@ T <sub>J</sub> =175°C                                   |                 |
| R <sub>ON</sub>     | Static drain-source on-resistance |       | 80   | 100  | mΩ   | V <sub>GS</sub> =20V, I <sub>D</sub> =10A<br>@ T <sub>J</sub> =25°C   | Fig. 4, 5, 6, 7 |
|                     |                                   |       | 130  |      | mΩ   | V <sub>GS</sub> =20V, I <sub>D</sub> =10A<br>@ T <sub>J</sub> =175°C  |                 |
| C <sub>iss</sub>    | Input capacitance                 |       | 1680 |      | pF   | V <sub>DS</sub> =800V, V <sub>GS</sub> =0V,<br>f=1MHz, V <sub>AC</sub> =25mV  | Fig. 16         |
| C <sub>oss</sub>    | Output capacitance                |       | 69   |      | pF   |   |                 |
| C <sub>rss</sub>    | Reverse transfer capacitance      |       | 6.7  |      | pF   |   |                 |
| E <sub>oss</sub>    | C <sub>oss</sub> stored energy    |       | 27   |      | μJ   |   | Fig. 17         |
| Q <sub>g</sub>      | Total gate charge                 |       | 76   |      | nC   | V <sub>DS</sub> =800V, I <sub>D</sub> =20A,<br>V <sub>GS</sub> =-5 to 20V   | Fig. 18         |
| Q <sub>gs</sub>     | Gate-source charge                |       | 29   |      | nC   |   |                 |
| Q <sub>gd</sub>     | Gate-drain charge                 |       | 34   |      | nC   |   |                 |
| R <sub>g</sub>      | Gate input resistance             |       | 4.2  |      | Ω    | f=1MHz  |                 |
| E <sub>ON</sub>     | Turn-on switching energy          |       | 337  |      | μJ   | V <sub>DS</sub> =800V, I <sub>D</sub> =20A,<br>V <sub>GS</sub> =-3.5 to 20V,<br>R <sub>G(ext)</sub> =2.0Ω,<br>L=290μH | Fig. 19, 20     |
| E <sub>OFF</sub>    | Turn-off switching energy         |       | 44   |      | μJ   |   |                 |
| t <sub>d(on)</sub>  | Turn-on delay time                |       | 22   |      | ns   |   |                 |
| t <sub>r</sub>      | Rise time                         |       | 17   |      |      |   |                 |
| t <sub>d(off)</sub> | Turn-off delay time               |       | 17   |      |      |   |                 |
| t <sub>f</sub>      | Fall time                         |       | 12   |      |      |   |                 |

### Reverse Diode Characteristics (T<sub>c</sub>=25°C unless otherwise specified)

| Symbol           | Parameter                     | Value |      |      | Unit | Test Conditions   | Note            |
|------------------|-------------------------------|-------|------|------|------|---|-----------------|
|                  |                               | Min.  | Typ. | Max. |      |   |                 |
| V <sub>SD</sub>  | Diode forward voltage         |       | 4.7  |      | V    | I <sub>SD</sub> =10A, V <sub>GS</sub> =0V                           | Fig. 10, 11, 12 |
|                  |                               |       | 4.2  |      | V    | I <sub>SD</sub> =10A, V <sub>GS</sub> =0V,<br>T <sub>J</sub> =175°C |                 |
| t <sub>rr</sub>  | Reverse recovery time         |       | 40   |      | ns   | V <sub>GS</sub> =0V, I <sub>SD</sub> =20A,<br>V <sub>R</sub> =800V, |                 |
| Q <sub>rr</sub>  | Reverse recovery charge       |       | 57   |      | nC   | di/dt=1100A/μs,   |                 |
| I <sub>RRM</sub> | Peak reverse recovery current |       | 4.7  |      | A    | R <sub>G(ext)</sub> =11.0Ω  |                 |

## Typical Performance (curves)

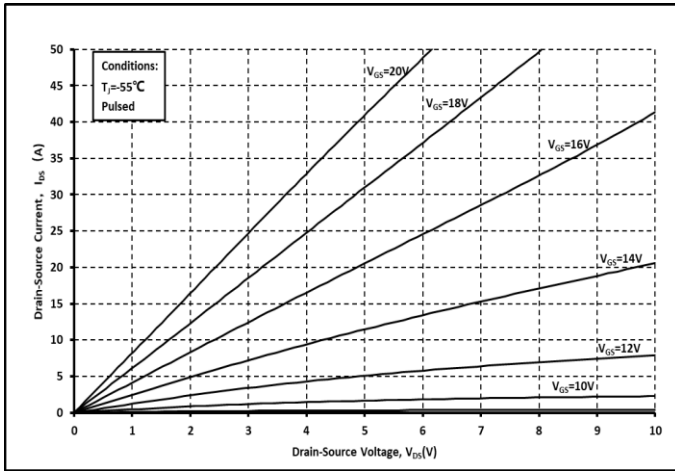


Fig. 1 Output Curve @  $T_j = -55^\circ\text{C}$

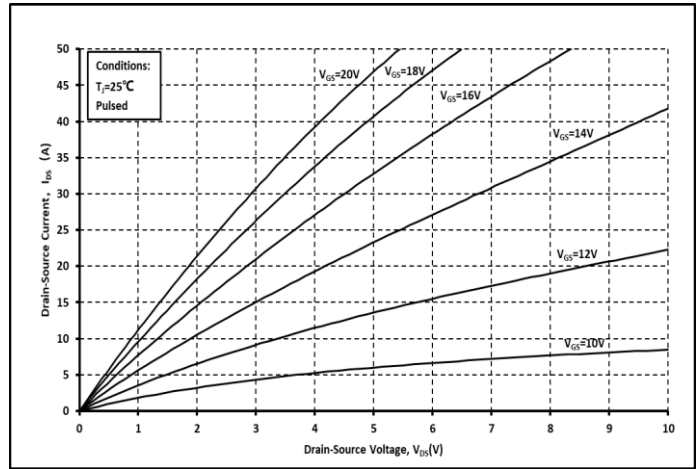


Fig. 2 Output Curve @  $T_j = 25^\circ\text{C}$

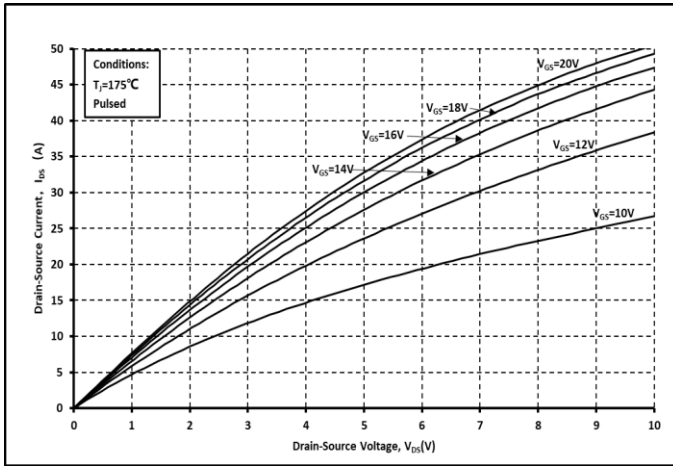


Fig. 3 Output Curve @  $T_j = 175^\circ\text{C}$

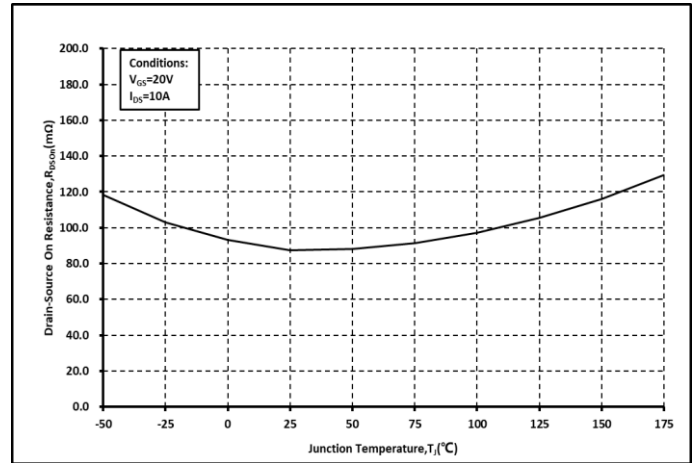


Fig. 4  $R_{on}$  vs. Temperature

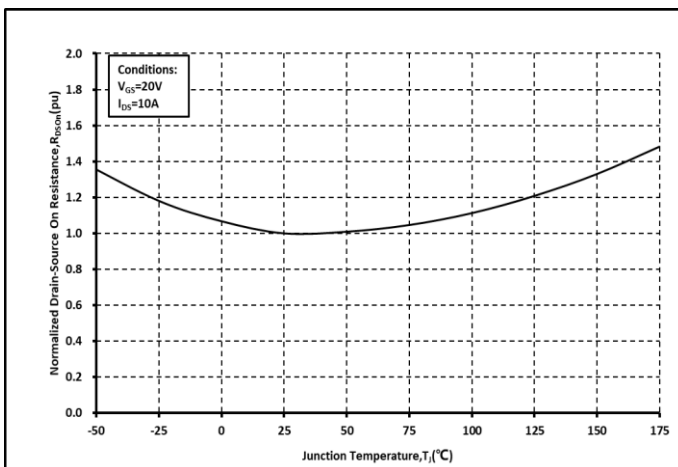


Fig. 5 Normalized  $R_{on}$  vs. Temperature

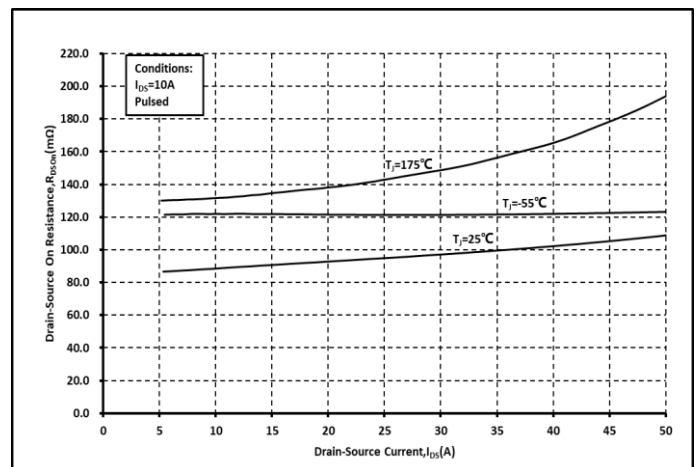


Fig. 6  $R_{on}$  vs.  $I_{DS}$  @ Various Temperature

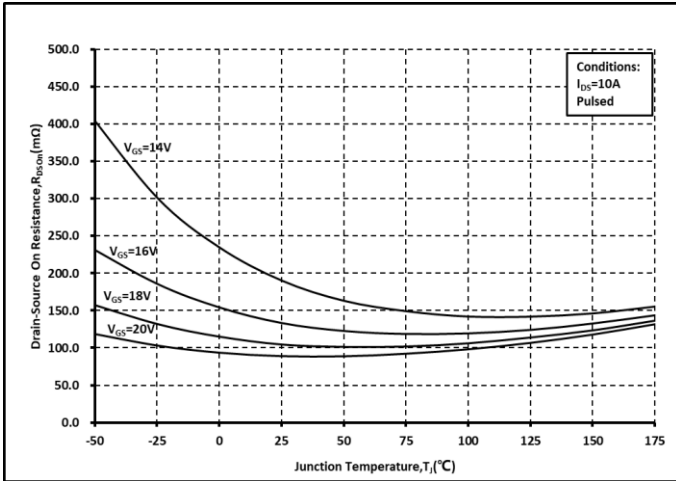


Fig. 7  $R_{on}$  vs. Temperature @ Various  $V_{GS}$

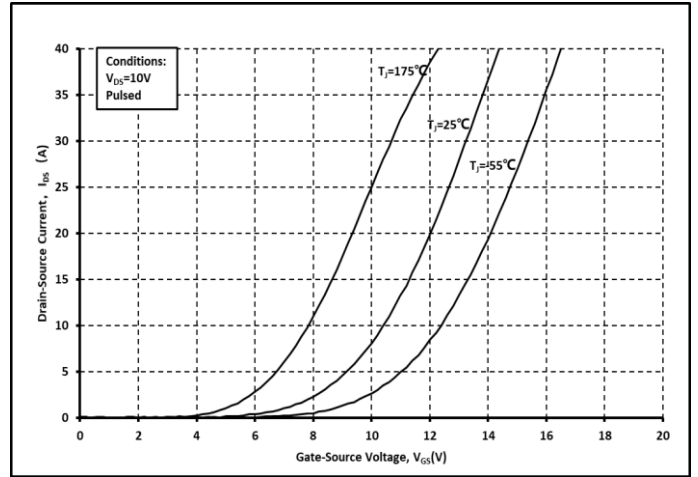


Fig. 8 Transfer Curves @ Various Temperature

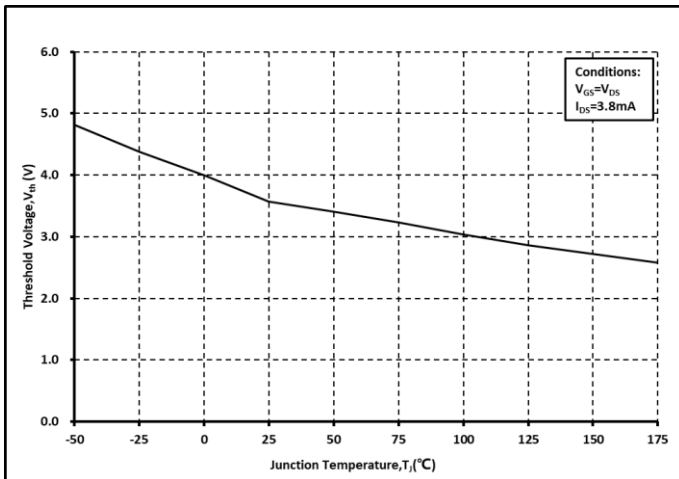


Fig. 9 Threshold Voltage vs. Temperature

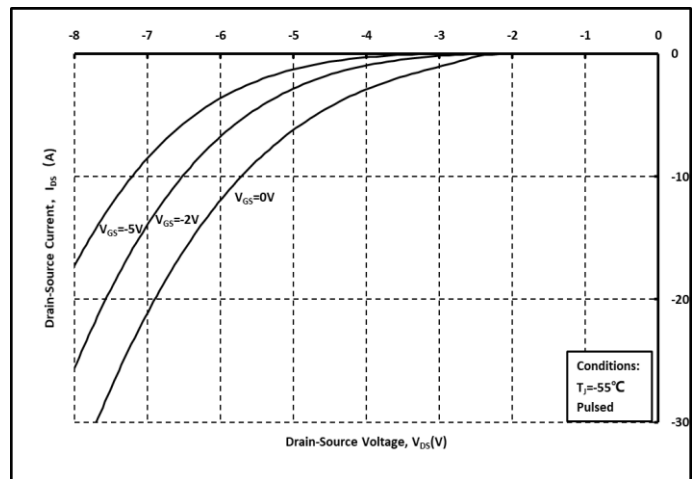


Fig. 10 Body Diode curves @  $T_J = -55^\circ C$

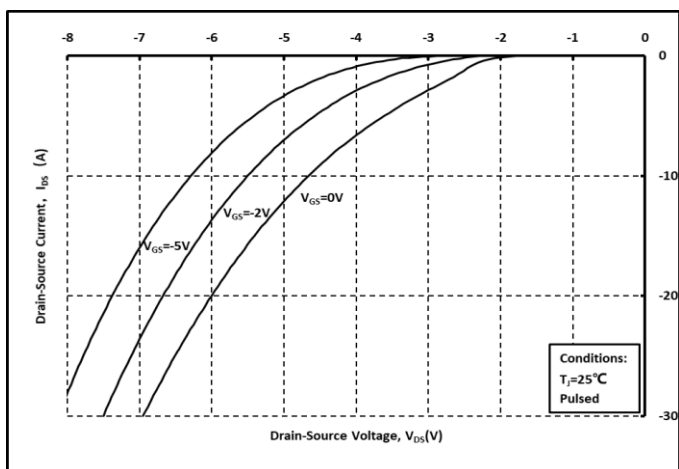


Fig. 11 Body Diode curves @  $T_J = 25^\circ C$

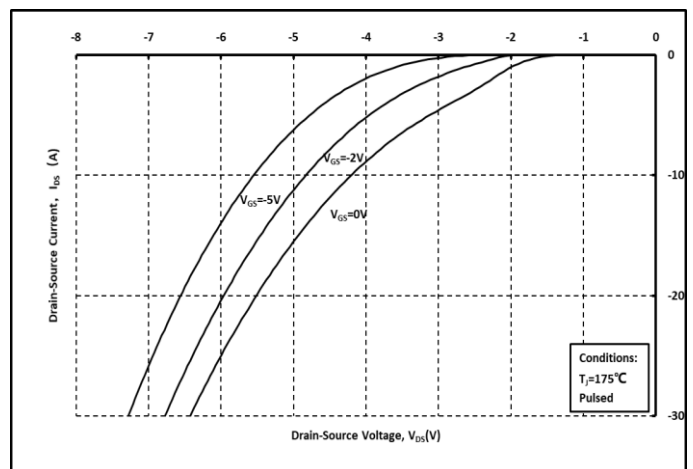


Fig. 12 Body Diode curves @  $T_J = 175^\circ C$

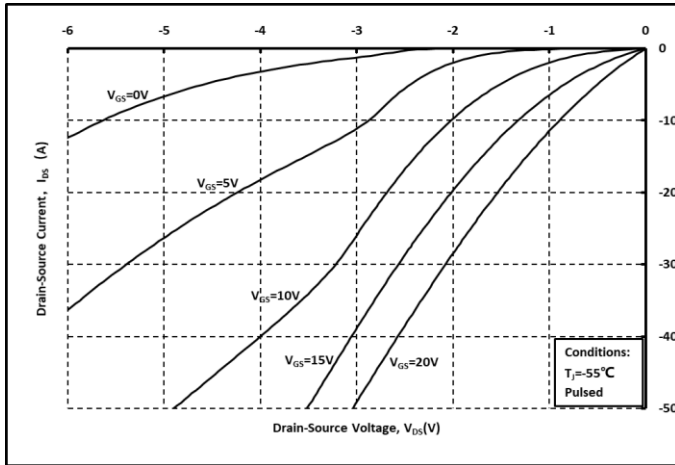


Fig. 13 3<sup>rd</sup> Quadrant curves @  $T_J = -55^\circ\text{C}$

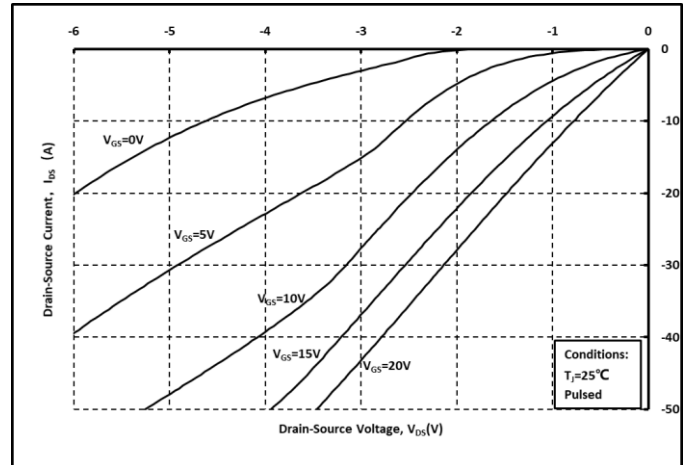


Fig. 14 3<sup>rd</sup> Quadrant curves @  $T_J = 25^\circ\text{C}$

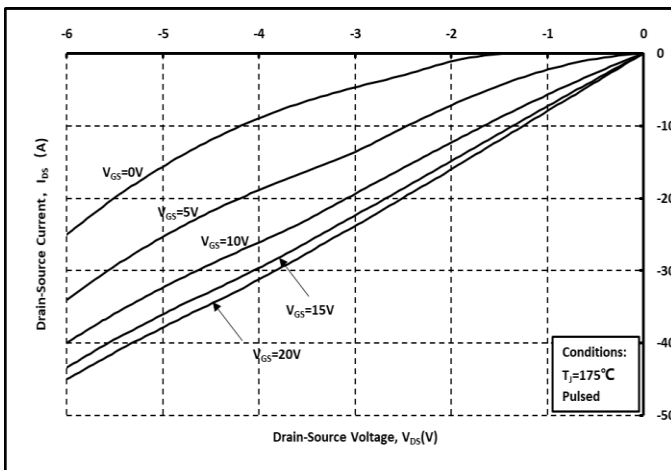


Fig. 15 3<sup>rd</sup> Quadrant curves @  $T_J = 175^\circ\text{C}$

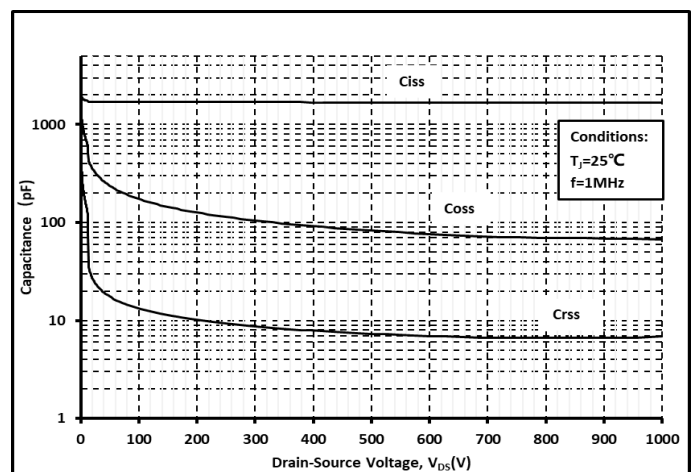


Fig. 16 Capacitance vs.  $V_{DS}$

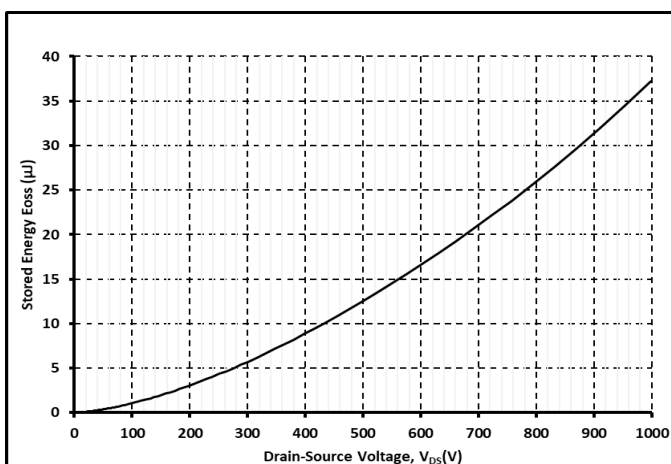


Fig. 17 Output Capacitor Stored Energy

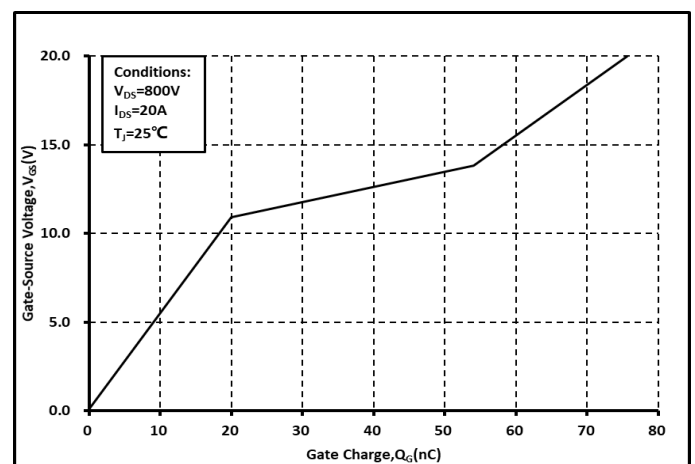


Fig. 18 Gate Charge Characteristics

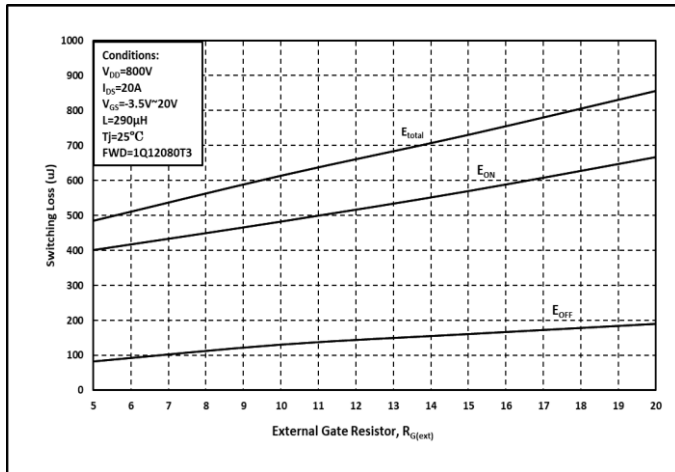


Fig. 19 Switching Energy vs.  $R_{G(ext)}$

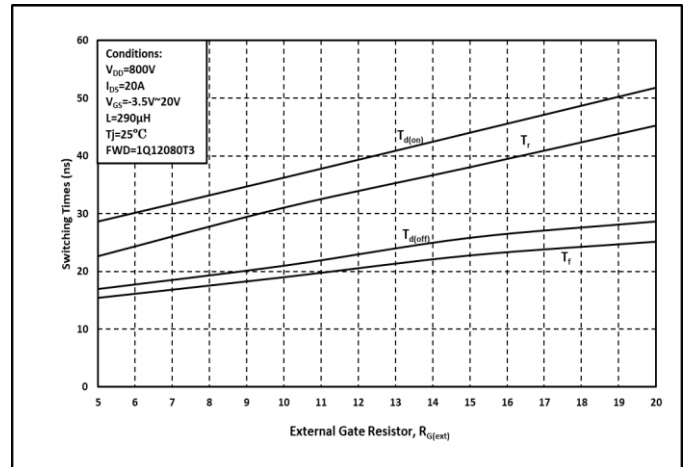


Fig. 20 Switching Times vs.  $R_{G(ext)}$

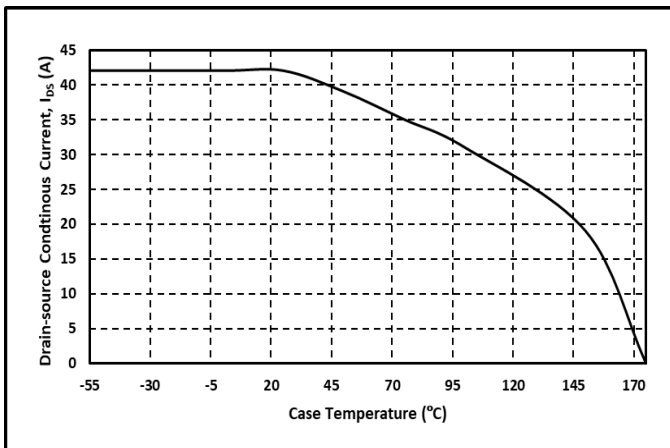


Fig. 21 Continuous Drain Current vs. Case Temperature

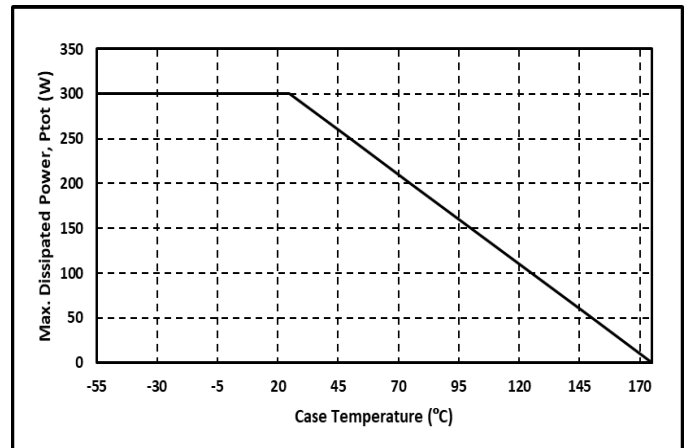


Fig. 22 Max. Power Dissipation Derating vs. Case Temperature

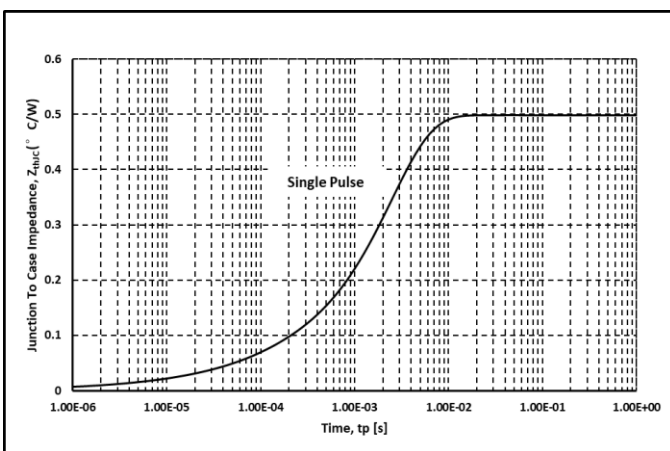


Fig. 23 Thermal impedance

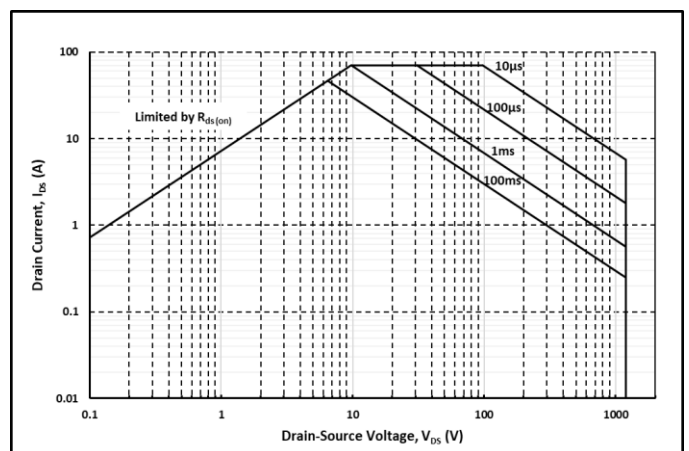
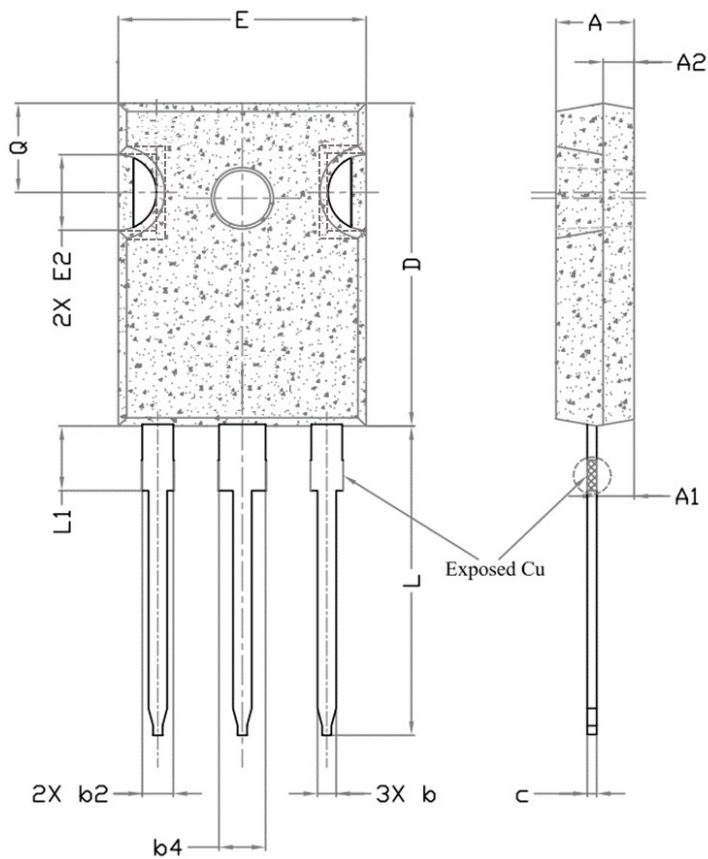
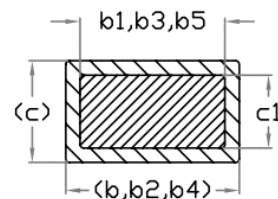
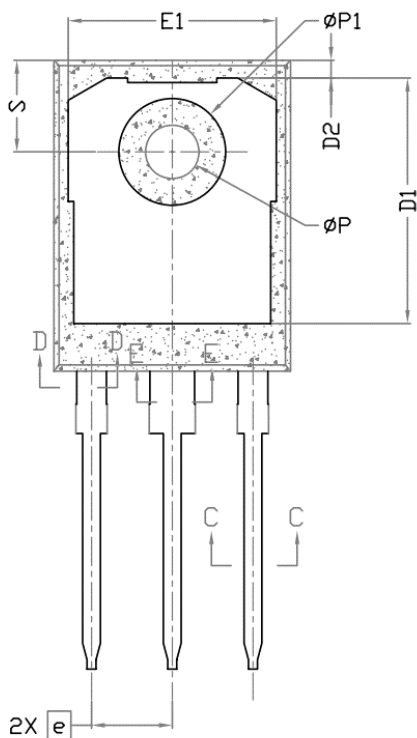


Fig. 24 Safe Operating Area

## Package Dimensions



| Dimensions In Millimeters |          |       |
|---------------------------|----------|-------|
| SYMBOL                    | MIN.     | MAX.  |
| A                         | 4.83     | 5.21  |
| A1                        | 2.29     | 2.55  |
| A2                        | 1.50     | 2.49  |
| b                         | 1.07     | 1.33  |
| b1                        | 1.07     | 1.28  |
| b2                        | 1.91     | 2.41  |
| b3                        | 1.91     | 2.34  |
| b4                        | 2.87     | 3.38  |
| b5                        | 2.87     | 3.18  |
| c                         | 0.55     | 0.69  |
| c1                        | 0.55     | 0.65  |
| D                         | 20.80    | 21.10 |
| D1                        | 16.25    | 17.65 |
| D2                        | 0.51     | 1.35  |
| E                         | 15.70    | 16.13 |
| E1                        | 13.10    | 14.16 |
| E2                        | 3.68     | 5.49  |
| e                         | 5.44 BSC |       |
| L                         | 19.80    | 20.32 |
| L1                        | 3.95     | 4.40  |
| φP                        | 3.50     | 3.70  |
| φP1                       | 7.00     | 7.40  |
| Q                         | 5.39     | 6.20  |
| S                         | 6.04     | 6.30  |



Section C--C, D--D, E--E

### Note:

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



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