

#### Product Summary

| $V_{DS}$ (V) | $R_{DS(on),max}$ (mΩ) | $I_D$ (A)          |
|--------------|-----------------------|--------------------|
| 60           | 1.3 @ $V_{GS} = 10V$  | 420 <sup>(1)</sup> |

#### Features

- ❖ Low  $R_{DS(on)}$
- ❖ Trench power MOSFET
- ❖ Low Gate Charge

#### Application

- ❖ Stored energy
- ❖ Electric motorcycle

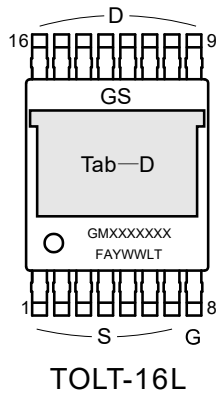
#### General Information

##### Shipping

- ❖ One shipping options is offered as standard
- ❖ Un-sawn wafer

##### Handling

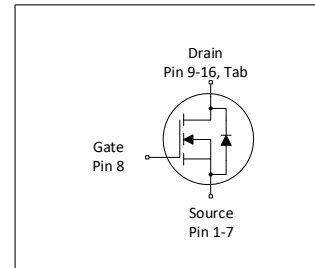
- ❖ Product must be handled only at ESD safe workstations. Standard ESD precautions and safe work environments are as defined in MIL-HDBK-263.
- ❖ Product must be handled only in a class 10,000 or better-designated clean room environmen



TOLT

NOTE:  
 LOGO - GS  
 GM - Part number code  
 F - Fab location code  
 A - Assembly location code  
 Y - Year code  
 WW - Week code  
 L&T - Assembly lot code

#### Equivalent circuit



#### Absolute Maximum Rating ( $T_a=25^\circ\text{C}$ )

| Parameter                                        | Symbol         | Limit      | Unit             |
|--------------------------------------------------|----------------|------------|------------------|
| Drain-source voltage                             | $V_{DS}$       | 60         | V                |
| Gate-source voltage                              | $V_{GS}$       | $\pm 20$   |                  |
| Continuous drain current                         | $I_D$          | 420        | A                |
|                                                  |                | 294        |                  |
| Pulsed drain current <sup>(2)</sup>              | $I_{D,pulse}$  | 1678       |                  |
| Avalanche energy, single pulse <sup>(3)</sup>    | $E_{AS}$       | 1750       | mJ               |
| Power dissipation                                | $P_D$          | 431        | W                |
| Operating junction and storage temperature range | $T_J, T_{stg}$ | -55 to 175 | $^\circ\text{C}$ |

#### Thermal Characteristic ( $T_a=25^\circ\text{C}$ )

| Parameter                                              | Symbol          | Max. | Unit               |
|--------------------------------------------------------|-----------------|------|--------------------|
| Thermal resistance, junction-to-case                   | $R_{\theta JC}$ | 0.29 | $^\circ\text{C/W}$ |
| Thermal resistance, junction-to-ambient <sup>(4)</sup> | $R_{\theta JA}$ | 40   |                    |

**Electrical characteristics (Ta=25°C ± 3°C)**

| Parameter                               | Symbol               | Test conditions                                                                                    | Min. | Typ. | Max. | Unit |
|-----------------------------------------|----------------------|----------------------------------------------------------------------------------------------------|------|------|------|------|
| Static parameter                        |                      |                                                                                                    |      |      |      |      |
| Drain to source breakdown voltage       | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0 V, I <sub>D</sub> = 1 mA                                                       | 60   |      |      | V    |
| Gate-source threshold voltage           | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA                                        | 2.0  | 3.0  | 4.0  | V    |
| Gate-body leakage                       | I <sub>GSS</sub>     | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = ±20 V                                                     |      |      | ±100 | nA   |
| Zero gate voltage drain current         | I <sub>DSS</sub>     | V <sub>DS</sub> = 60 V, V <sub>GS</sub> = 0 V                                                      |      |      | 1    | μA   |
| Drain-source on-resistance              | R <sub>DS(on)</sub>  | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 20 A                                                      |      | 1.1  | 1.3  | mΩ   |
| Forward transconductance <sup>(5)</sup> | g <sub>fs</sub>      | V <sub>DS</sub> = 5 V, I <sub>D</sub> = 20 A                                                       |      | 56   |      | S    |
| Gate resistance                         | R <sub>g</sub>       | f = 1 MHz, open drain                                                                              |      | 2.4  |      | Ω    |
| Dynamic <sup>(5)</sup>                  |                      |                                                                                                    |      |      |      |      |
| Total gate charge                       | Q <sub>g</sub>       | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 20 A, V <sub>GS</sub> = 10 V                              |      | 108  |      | nC   |
| Gate-source charge                      | Q <sub>gs</sub>      |                                                                                                    |      | 26   |      |      |
| Gate-drain charge                       | Q <sub>gd</sub>      |                                                                                                    |      | 24   |      |      |
| Turn-on delay time                      | t <sub>d(on)</sub>   | V <sub>DS</sub> = 30 V, I <sub>D</sub> = 20 A, V <sub>GS</sub> = 10 V,<br>R <sub>GEN</sub> = 3.0 Ω |      | 28   |      | ns   |
| Rise time                               | t <sub>r</sub>       |                                                                                                    |      | 45   |      |      |
| Turn-off delay time                     | t <sub>d(off)</sub>  |                                                                                                    |      | 73   |      |      |
| Fall time                               | t <sub>f</sub>       |                                                                                                    |      | 95   |      |      |
| Input capacitance                       | C <sub>iss</sub>     | V <sub>DS</sub> = 30 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                           |      | 7204 |      | pF   |
| Output capacitance                      | C <sub>oss</sub>     |                                                                                                    |      | 3129 |      |      |
| Reverse transfer capacitance            | C <sub>rss</sub>     |                                                                                                    |      | 202  |      |      |
| Reverse Diode Characteristics(5)        |                      |                                                                                                    |      |      |      |      |
| Diode forward voltage                   | V <sub>SD</sub>      | V <sub>GS</sub> = 0 V, I <sub>F</sub> = 2.0 A                                                      |      | 0.7  | 1.2  | V    |
| Reverse recovery time                   | t <sub>rr</sub>      | I <sub>F</sub> = 20 A, di/dt = 100 A/μs                                                            |      | 73   |      | ns   |
| Reverse recovery charge                 | Q <sub>rr</sub>      |                                                                                                    |      | 95   |      | nC   |

## Notes

- (1) Package limited.
- (2) Pulse width limited by maximum junction temperature.
- (3)  $V_{DD} = 60\text{ V}, V_{GS} = 10\text{ V}, L = 1.0\text{ mH}$ .
- (4)  $R_{\theta JA}$  is determined with the device mounted on a 1 in<sup>2</sup> pad 2 oz copper pad on a 1.5x1.5 in. board of FR-4 material.
- (5) Guaranteed by design, not subject to production testing.

## Electrical characteristics diagrams

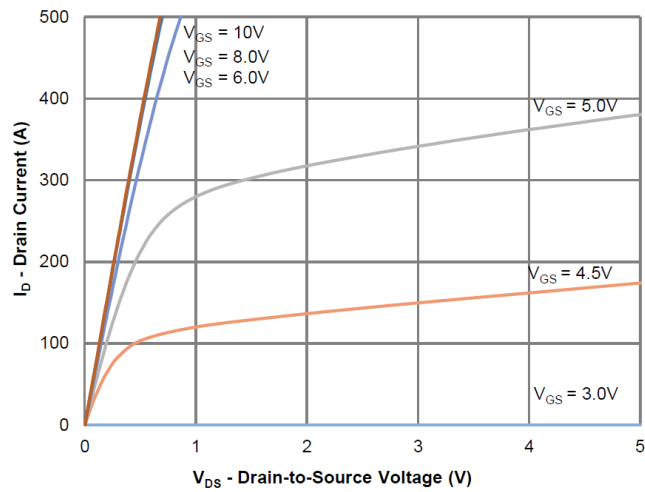


Figure 1: Output Characteristics

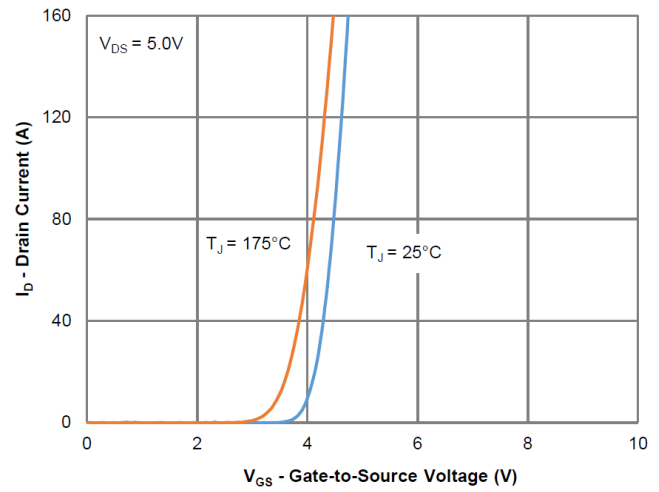


Figure 2: Transfer Characteristics

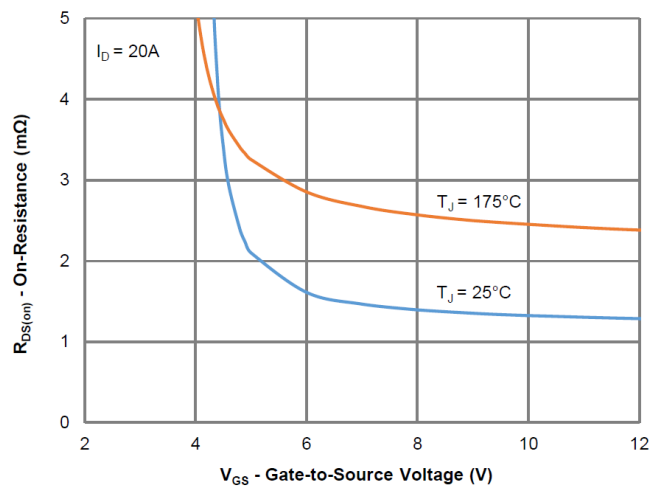


Figure 3: On-Resistance vs. Gate-Source Voltage

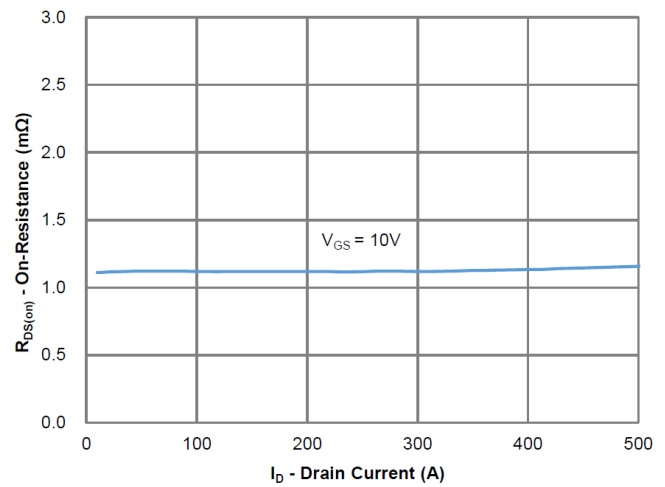


Figure 4: On-Resistance vs. Gate-Source Voltage

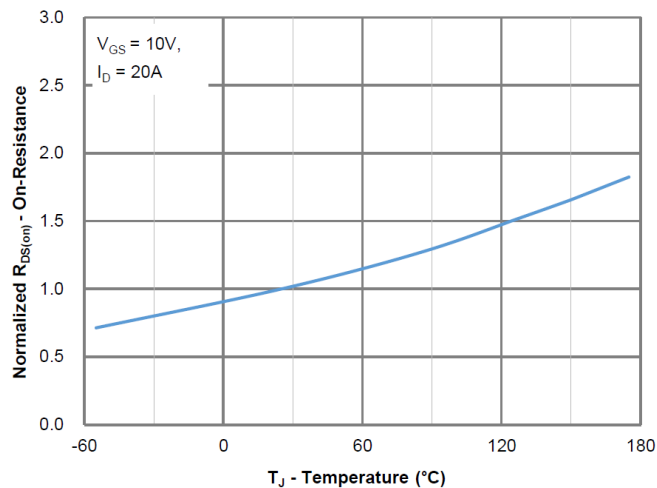


Figure 5: On-Resistance vs. Junction Temperature

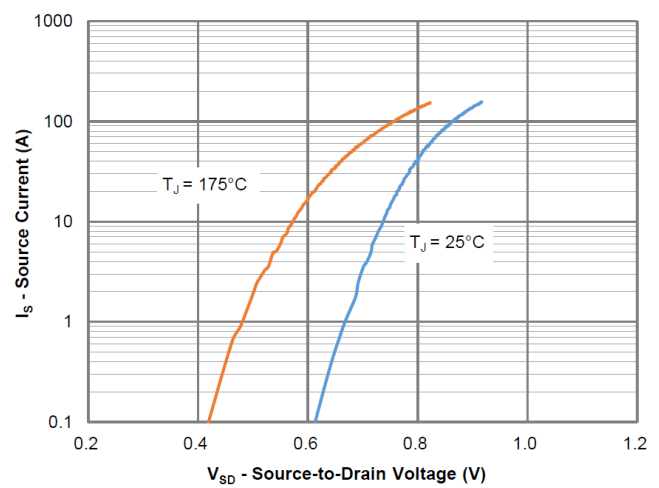


Figure 6: Source-Drain Diode Forward Voltage

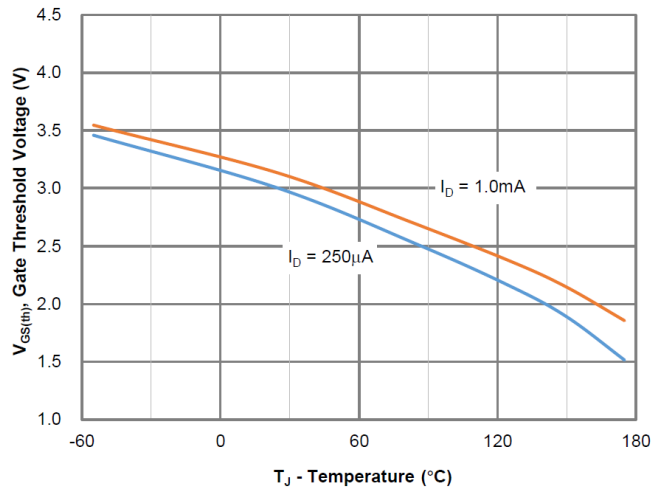


Figure 7: Gate Threshold Variation vs. Junction Temperature

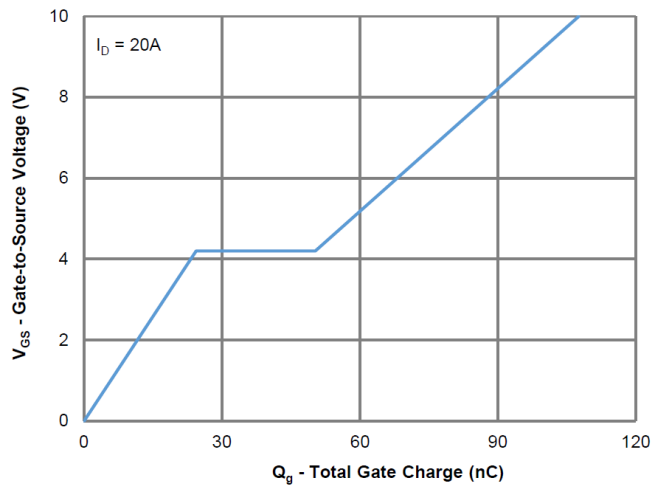


Figure 8: Gate Charge Characteristics

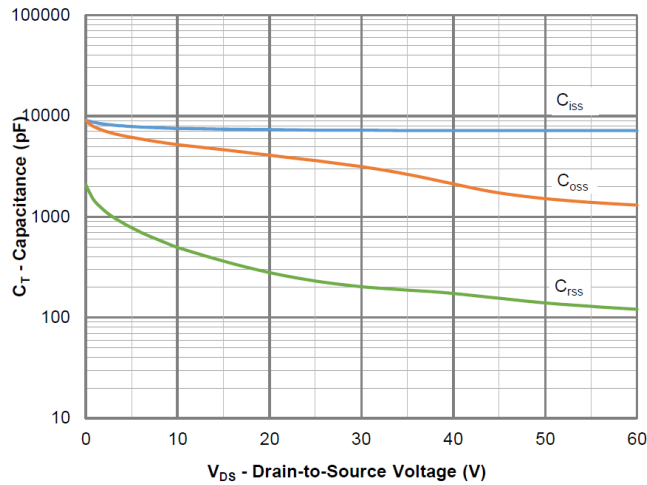


Figure 9: Capacitance Characteristics

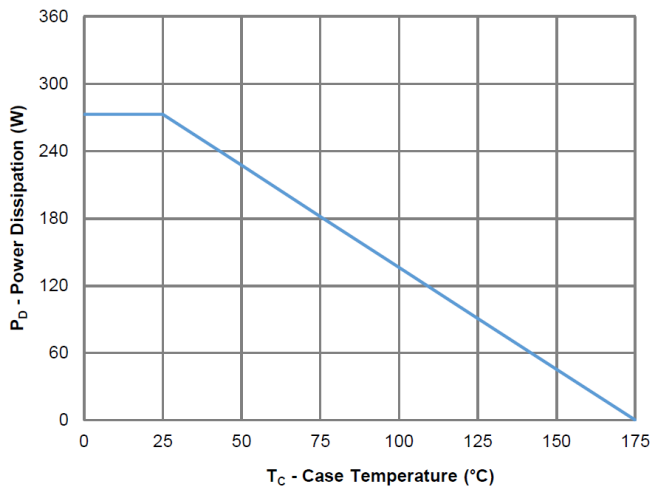


Figure 10: Power Derating

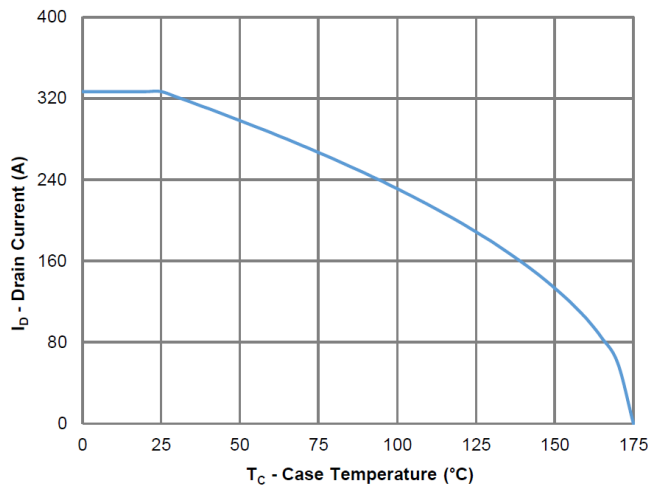


Figure 11: Current Derating

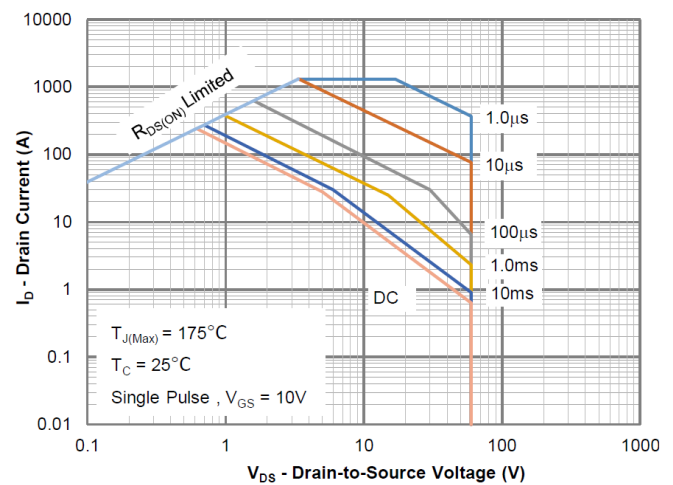


Figure 12: Safe Operating Area

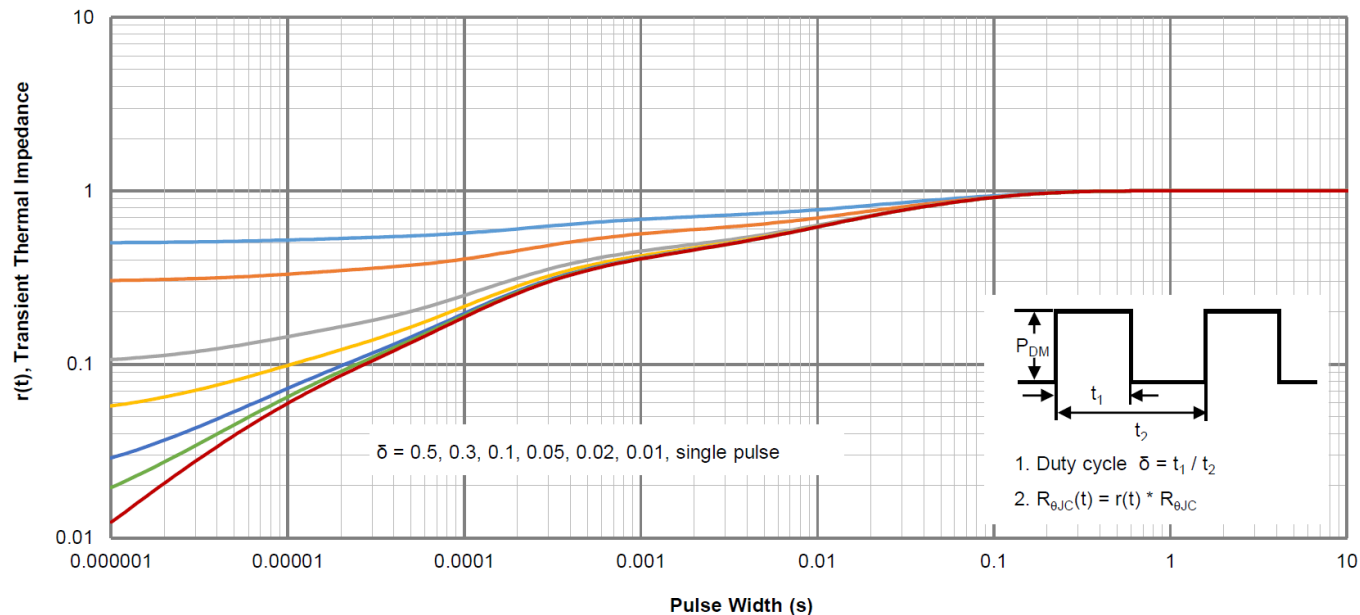
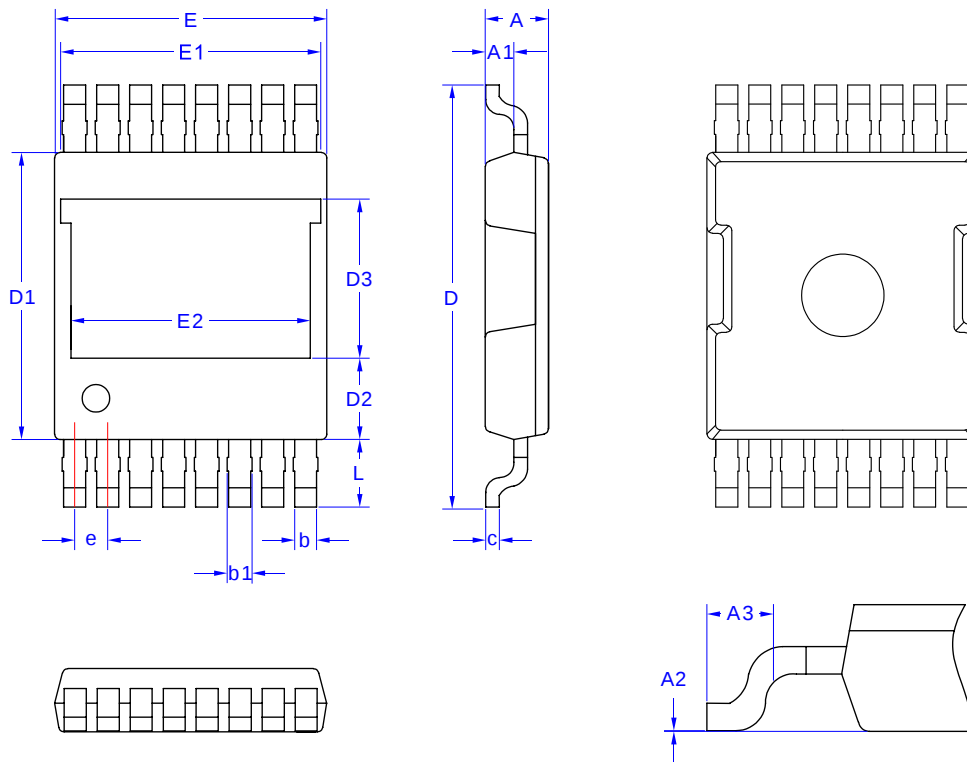


Figure 13: Normalized Maximum Transient Thermal Impedance

**Package outline dimensions: TOLT**


| Symbol | Dimensions in Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | MIN                       | NOM   | MAX   |
| A      | 2.20                      | 2.30  | 2.40  |
| A1     | 0.99                      | 1.04  | 1.09  |
| A2     | 0.00                      | 0.08  | 0.16  |
| A3     | 1.50 REF                  |       |       |
| b      | 0.70                      | 0.75  | 0.80  |
| b1     | 0.65                      | 0.70  | 0.75  |
| c      | 0.45                      | 0.50  | 0.55  |
| D      | 14.50                     | 15.00 | 15.50 |

| Symbol | Dimensions in Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | MIN                       | NOM   | MAX   |
| D1     | 9.60                      | 10.10 | 10.60 |
| D2     | 2.30                      | 2.80  | 3.30  |
| D3     | 5.77 REF                  |       |       |
| E      | 9.40                      | 9.90  | 10.40 |
| E1     | 9.46 REF                  |       |       |
| E2     | 8.70 REF                  |       |       |
| e      | 1.15                      | 1.20  | 1.25  |
| L      | 2.40                      | 2.45  | 2.50  |

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