



# 40V 5.0mΩ N-Ch Power MOSFET

### Features

- Ultra-low ON-resistance,  $R_{DS(ON)}$
- Low Gate Charge,  $Q_g$
- 100% UIS and  $R_g$  Tested
- Pb-free Lead Plating
- Halogen-free and RoHS-compliant

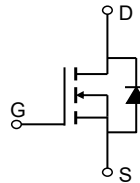
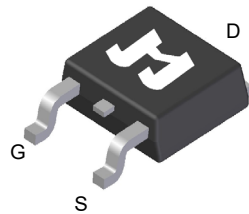
### Product Summary

| Parameter                                | Value | Unit |
|--|-------|------|
| $V_{DS}$                                 | 40    | V    |
| $V_{GS(th\_Typ)}$                        | 2.8   | V    |
| $I_D$ (@ $V_{GS} = 10V$ ) <sup>(1)</sup> | 70    | A    |
| $R_{DS(ON\_Typ)}$ (@ $V_{GS} = 10V$ )    | 5.0   | mΩ   |

### Applications

- Power Management in Computing, CE, IE 4.0, Communications
- Current Switching in DC/DC & AC/DC (SR) Sub-systems
- Load Switching, Quick/Wireless Charging, Motor Driving

TO-252-3L Top View

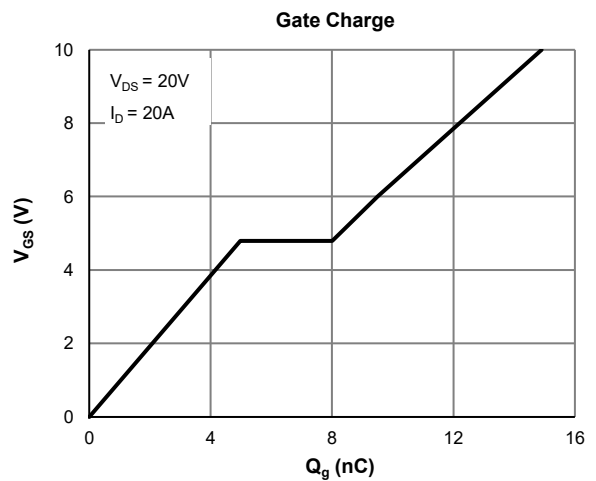
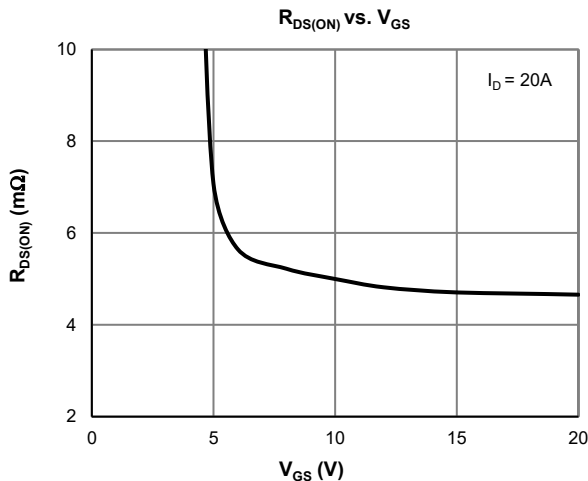


### Ordering Information

| Device        | Package   | # of Pins | Marking | MSL | $T_J$ (°C) | Media        | Quantity (pcs) |
|---------------|-----------|-----------|---------|-----|------------|--------------|----------------|
| JMSH0406AK-13 | TO-252-3L | 8         | SH0406A | 1   | -55 to 150 | 13-inch Reel | 2500           |

### Absolute Maximum Ratings (@ $T_A = 25^\circ C$ unless otherwise specified)

| Parameter                               | Symbol         | Value               | Unit |
|---|----------------|---------------------|------|
| Drain-to-Source Voltage                 | $V_{DS}$       | 40                  | V    |
| Gate-to-Source Voltage                  | $V_{GS}$       | ±20                 | V    |
| Continuous Drain Current <sup>(1)</sup> | $I_D$          | $T_C = 25^\circ C$  | 70   |
|   |                | $T_C = 100^\circ C$ | 44   |
| Pulsed Drain Current <sup>(2)</sup>     | $I_{DM}$       | 279                 | A    |
| Avalanche Energy <sup>(3)</sup>         | $E_{AS}$       | 96                  | mJ   |
| Power Dissipation <sup>(4)</sup>        | $P_D$          | $T_C = 25^\circ C$  | 50   |
|   |                | $T_C = 100^\circ C$ | 20   |
| Junction & Storage Temperature Range    | $T_J, T_{STG}$ | -55 to 150          | °C   |



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

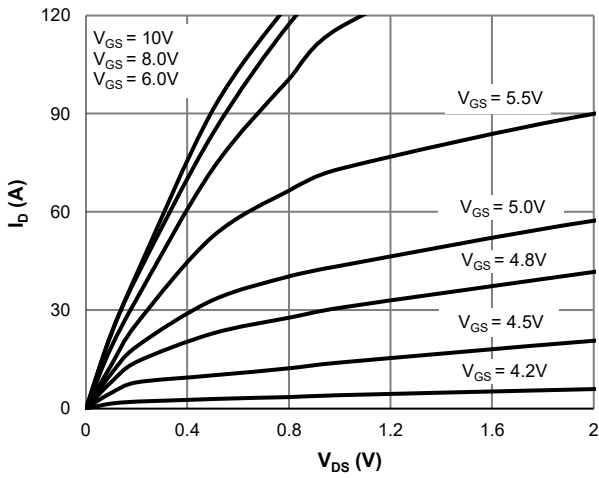
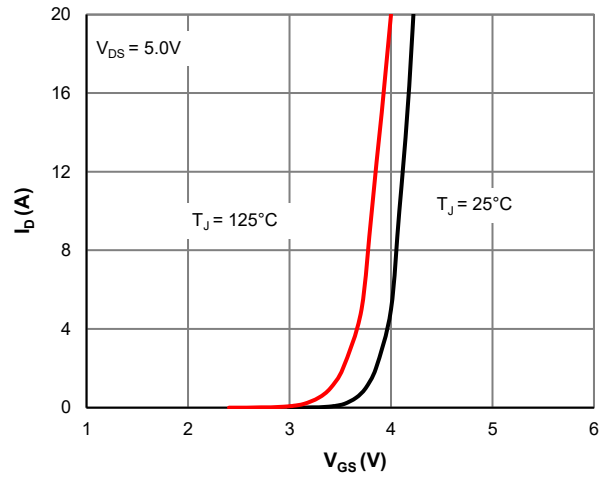
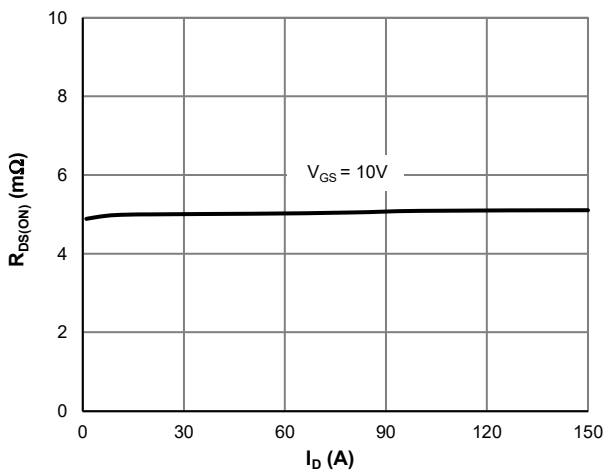
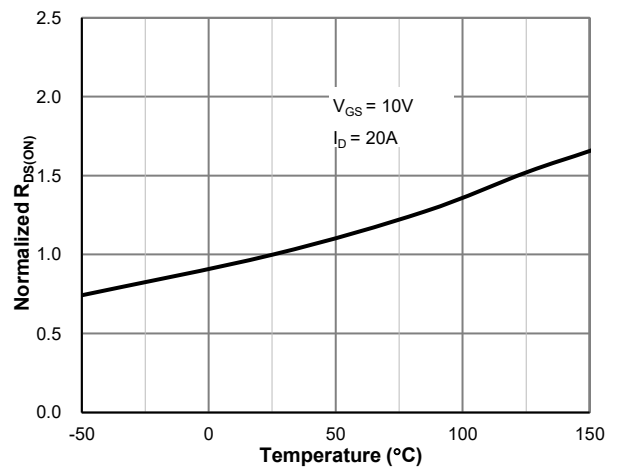
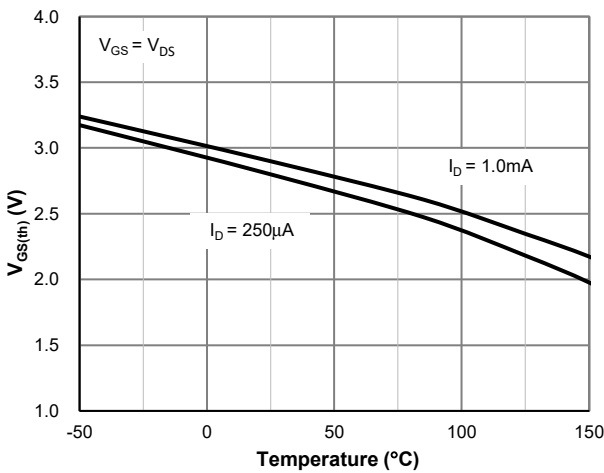
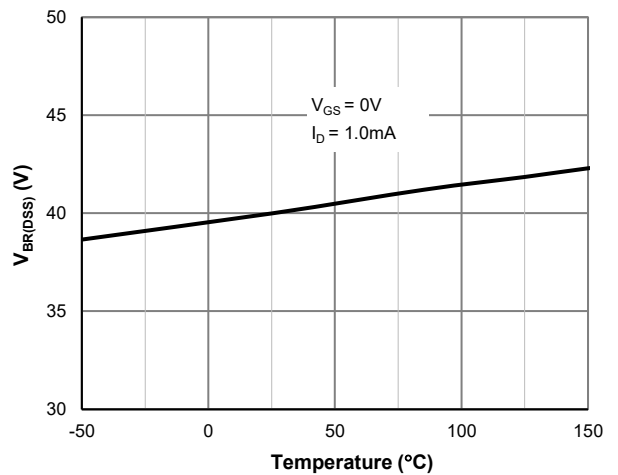
| Parameter                                     | Symbol        | Conditions   | Min.  | Typ. | Max.       | Unit          |
|---|---------------|--|---|------|------------|---------------|
| <b>STATIC PARAMETERS</b>                      |               |  |   |      |            |               |
| Drain-Source Breakdown Voltage                | $V_{(BR)DSS}$ | $I_D = 250\mu\text{A}, V_{GS} = 0\text{V}$   | 40  |      |            | V             |
| Zero Gate Voltage Drain Current               | $I_{DSS}$     | $V_{DS} = 32\text{V}, V_{GS} = 0\text{V}$<br>$T_J = 55^\circ\text{C}$              |   |      | 1.0<br>5.0 | $\mu\text{A}$ |
| Gate-Body Leakage Current                     | $I_{GSS}$     | $V_{DS} = 0\text{V}, V_{GS} = \pm 20\text{V}$                                      |   |      | $\pm 100$  | nA            |
| Gate Threshold Voltage                        | $V_{GS(th)}$  | $V_{DS} = V_{GS}, I_D = 250\mu\text{A}$  | 2.2   | 2.8  | 3.4        | V             |
| Static Drain-Source ON-Resistance             | $R_{DS(ON)}$  | $V_{GS} = 10\text{V}, I_D = 20\text{A}$  |   | 5.0  | 6.2        | m $\Omega$    |
| Forward Transconductance                      | $g_{FS}$      | $V_{DS} = 5\text{V}, I_D = 20\text{A}$   |   | 84   |            | S             |
| Diode Forward Voltage                         | $V_{SD}$      | $I_S = 1\text{A}, V_{GS} = 0\text{V}$  |   | 0.68 | 1.0        | V             |
| Diode Continuous Current                      | $I_S$         | $T_C = 25^\circ\text{C}$   |   |      | 50         | A             |
| <b>DYNAMIC PARAMETERS</b> <sup>(5)</sup>      |               |  |   |      |            |               |
| Input Capacitance                             | $C_{iss}$     | $V_{GS} = 0\text{V}, V_{DS} = 20\text{V}, f = 1\text{MHz}$                         |   | 1027 |            | pF            |
| Output Capacitance                            | $C_{oss}$     |  |   | 662  |            | pF            |
| Reverse Transfer Capacitance                  | $C_{rss}$     |  |   | 105  |            | pF            |
| Gate Resistance                               | $R_g$         | $V_{GS} = 0\text{V}, V_{DS} = 0\text{V}, f = 1\text{MHz}$                          |   | 2.5  |            | $\Omega$      |
| <b>SWITCHING PARAMETERS</b> <sup>(5)</sup>    |               |  |   |      |            |               |
| Total Gate Charge (@ $V_{GS} = 10\text{V}$ )  | $Q_g$         | $V_{GS} = 0 \text{ to } 10\text{V}$<br>$V_{DS} = 20\text{V}, I_D = 20\text{A}$     |   | 14.9 |            | nC            |
| Total Gate Charge (@ $V_{GS} = 6.0\text{V}$ ) | $Q_g$         |  |   | 9.5  |            | nC            |
| Gate Source Charge                            | $Q_{gs}$      |  |   | 5.0  |            | nC            |
| Gate Drain Charge                             | $Q_{gd}$      |  |   | 3.0  |            | nC            |
| Turn-On DelayTime                             | $t_{D(on)}$   | $V_{GS} = 10\text{V}, V_{DS} = 20\text{V}$<br>$R_L = 1.0\Omega, R_{GEN} = 3\Omega$ |   | 10.7 |            | ns            |
| Turn-On Rise Time                             | $t_r$         |  |   | 63   |            | ns            |
| Turn-Off DelayTime                            | $t_{D(off)}$  |  |   | 20   |            | ns            |
| Turn-Off Fall Time                            | $t_f$         |  |   | 85   |            | ns            |
| Body Diode Reverse Recovery Time              | $t_{rr}$      |  | $I_F = 20\text{A}, dI_F/dt = 100\text{A}/\mu\text{s}$ |      | 24         |               |
| Body Diode Reverse Recovery Charge            | $Q_{rr}$      | $I_F = 20\text{A}, dI_F/dt = 100\text{A}/\mu\text{s}$                              |   | 9.6  |            | nC            |

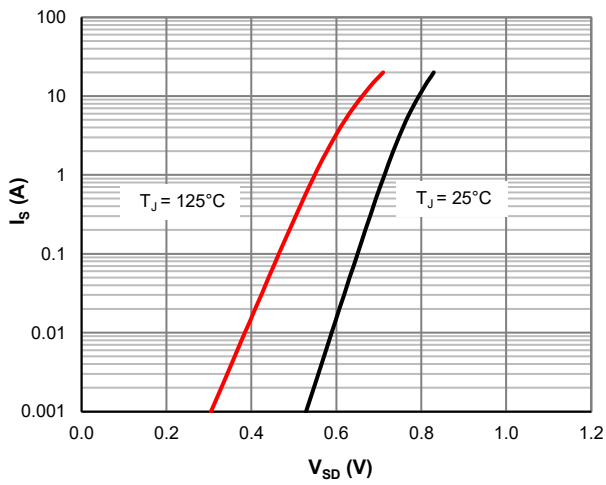
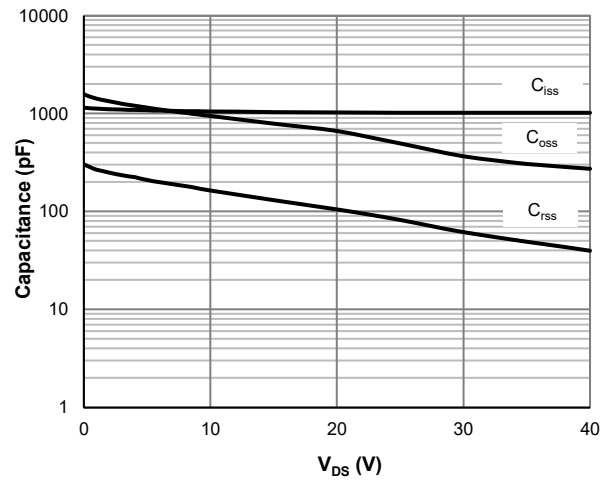
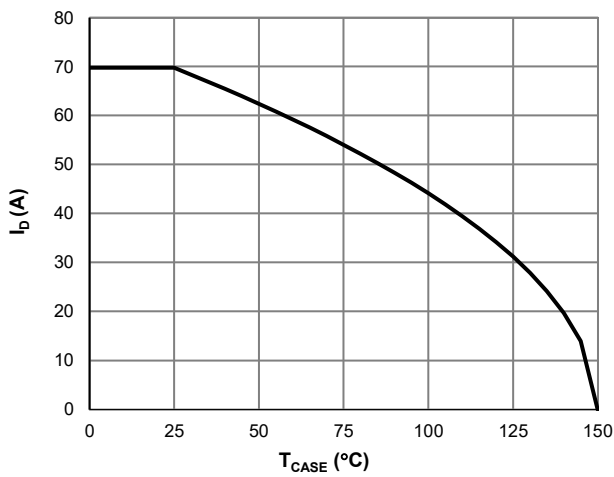
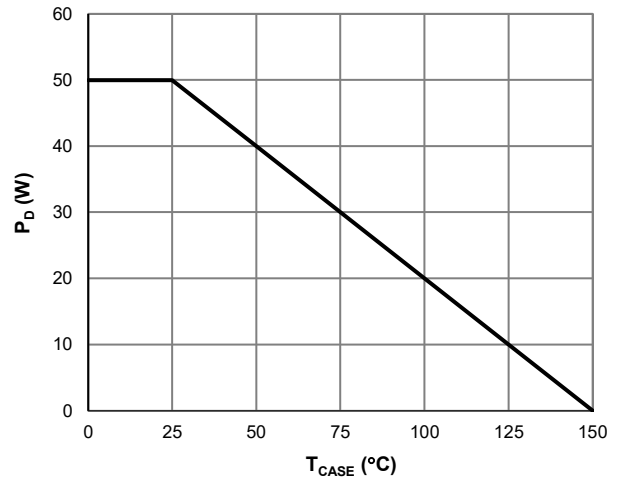
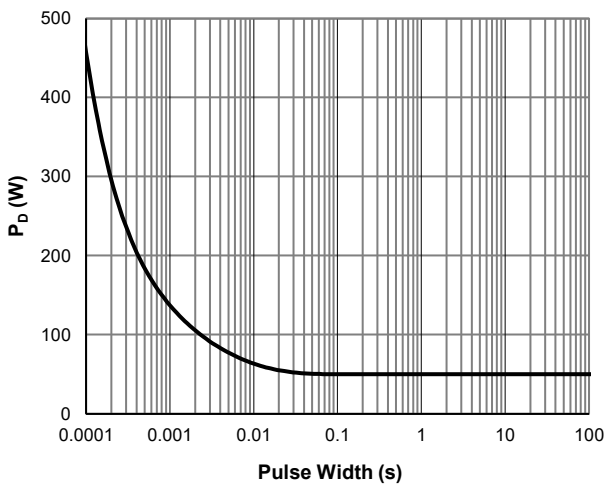
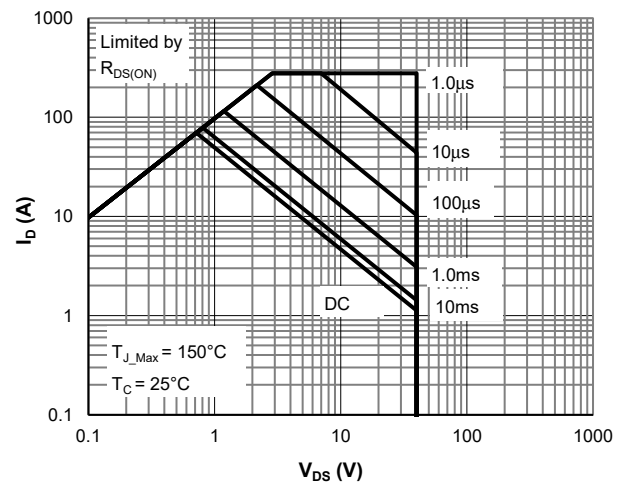
**Thermal Performance**

| Parameter                               | Symbol          | Typ. | Max. | Unit                      |
|---|-----------------|------|------|---------------------------|
| Thermal Resistance, Junction-to-Ambient | $R_{\theta JA}$ | 48   | 58   | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-Case    | $R_{\theta JC}$ | 2.5  | 2.8  | $^\circ\text{C}/\text{W}$ |

**Notes:**

1. Computed continuous current assumes the condition of  $T_{J\_Max}$  while the actual continuous current depends on the thermal & electro-mechanical application board design.
2. This single-pulse measurement was taken under  $T_{J\_Max} = 150^\circ\text{C}$ .
3.  $E_{AS}$  of 96 mJ is based on starting  $T_J = 25^\circ\text{C}, L = 3.0\text{mH}, I_{AS} = 8.0\text{A}, V_{GS} = 10\text{V}, V_{DD} = 20\text{V}; 100\%$  test at  $L = 0.1\text{mH}, I_{AS} = 27\text{A}$ .
4. The power dissipation  $P_D$  is based on  $T_{J\_Max} = 150^\circ\text{C}$ .
5. This value is guaranteed by design hence it is not included in the production test.

**Typical Electrical & Thermal Characteristics**

**Figure 1: Saturation Characteristics**

**Figure 2: Transfer Characteristics**

**Figure 3:  $R_{DS(ON)}$  vs. Drain Current**

**Figure 4:  $R_{DS(ON)}$  vs. Junction Temperature**

**Figure 5:  $V_{GS(th)}$  vs. Junction Temperature**

**Figure 6:  $V_{BR(DSS)}$  vs. Junction Temperature**

**Typical Electrical & Thermal Characteristics**

**Figure 7: Body-Diode Characteristics**

**Figure 8: Capacitance Characteristics**

**Figure 9: Current De-rating**

**Figure 10: Power De-rating**

**Figure 11: Single Pulse Power Rating, Junction-to-Case**

**Figure 12: Maximum Safe Operating Area**



### Typical Electrical & Thermal Characteristics

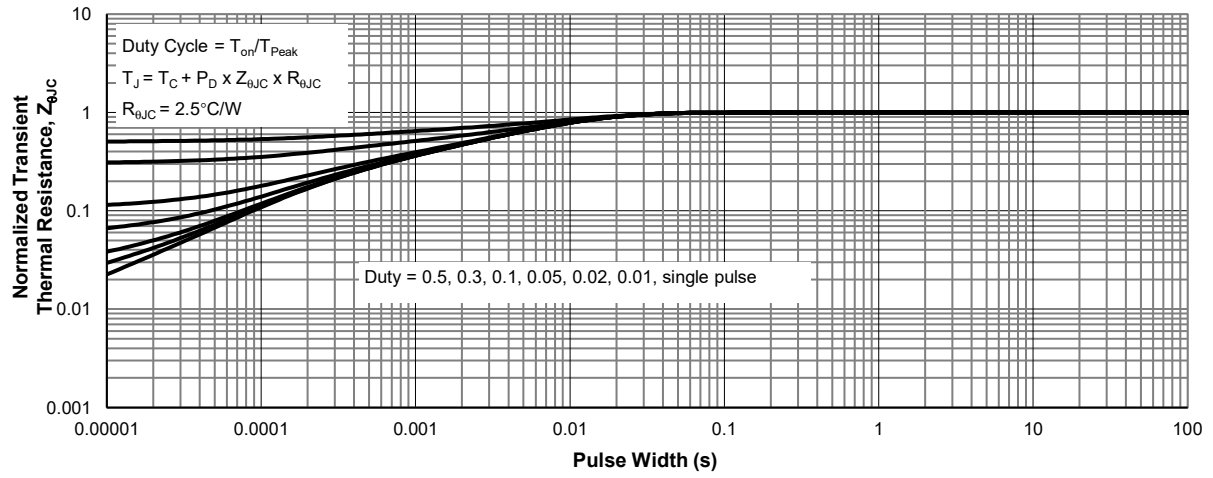
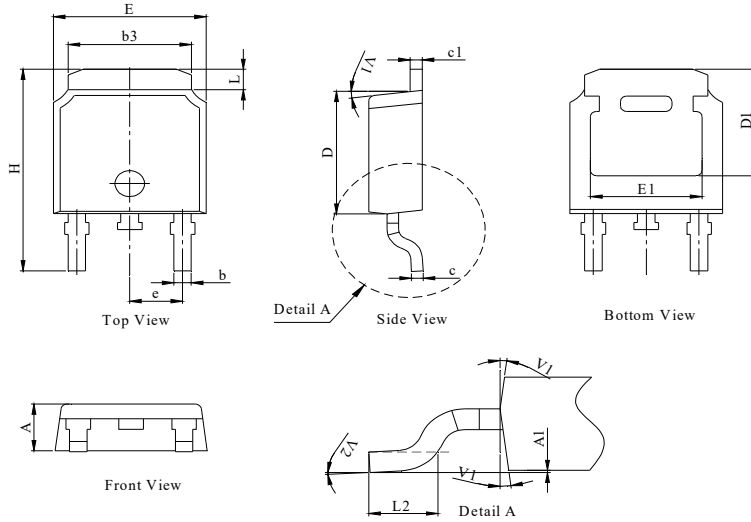
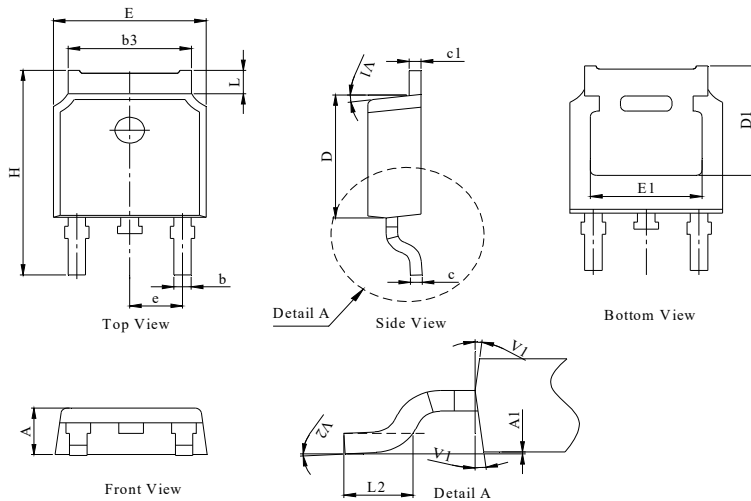


Figure 13: Normalized Maximum Transient Thermal Impedance

**TO-252-3L Package Information**
**Package Outline Type-A**


| DIM. | MILLIMETER |       |       |
|------|------------|-------|-------|
|      | MIN.       | NOM.  | MAX.  |
| A    | 2.18       | 2.30  | 2.39  |
| A1   | 0          | --    | 0.13  |
| b    | 0.64       | 0.76  | 0.89  |
| c    | 0.40       | 0.50  | 0.61  |
| c1   | 0.46       | 0.50  | 0.58  |
| D    | 5.97       | 6.10  | 6.23  |
| D1   | 5.05       | --    | --    |
| E    | 6.35       | 6.60  | 6.73  |
| E1   | 4.32       | --    | --    |
| b3   | 5.21       | 5.38  | 5.55  |
| e    | 2.29 BSC   |       |       |
| H    | 9.40       | 10.00 | 10.40 |
| L    | 0.89       | --    | 1.27  |
| L2   | 1.40       | --    | 1.78  |
| V1   | 7° REF     |       |       |
| V2   | 0°         | --    | 6°    |

**Package Outline Type-B**


| DIM. | MILLIMETER |       |       |
|------|------------|-------|-------|
|      | MIN.       | NOM.  | MAX.  |
| A    | 2.10       | 2.30  | 2.40  |
| A1   | 0          | --    | 0.13  |
| b    | 0.66       | 0.76  | 0.86  |
| b3   | 5.21       | 5.38  | 5.55  |
| c    | 0.40       | 0.50  | 0.60  |
| c1   | 0.44       | 0.50  | 0.58  |
| D    | 5.90       | 6.10  | 6.30  |
| D1   | 5.30REF    |       |       |
| E    | 6.40       | 6.60  | 6.80  |
| E1   | 4.63       | -     | -     |
| e    | 2.29 BSC   |       |       |
| H    | 9.50       | 10.00 | 10.70 |
| L    | 1.09       | --    | 1.21  |
| L2   | 1.35       | --    | 1.65  |
| V1   | 7° REF     |       |       |
| V2   | 0°         | --    | 6°    |

**Recommended Soldering Footprint**
