



## 650V SuperJunction Power MOSFET

### Features

- Extremely Low Gate Charge
- Excellent Output Capacitance ( $C_{oss}$ ) Profile
- Fast Switching Capability
- 100% UIS Tested, 100%  $R_g$  Tested
- Pb-free Lead Plating
- Halogen-free and RoHS-compliant

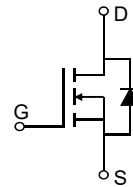
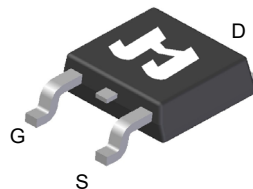
### Product Summary

| Parameter                                | Value | Unit       |
|------------------------------------------|-------|------------|
| $V_{DS}$                                 | 650   | V          |
| $V_{GS(th\_Typ)}$                        | 3.5   | V          |
| $I_D$ (@ $V_{GS} = 10V$ ) <sup>(1)</sup> | 4.0   | A          |
| $R_{DS(ON\_Typ)}$ (@ $V_{GS} = 10V$ )    | 900   | m $\Omega$ |
| $E_{oss@400V}$                           | 0.68  | $\mu J$    |

### Applications

- Telecom / Server Power Supplies
- Industrial Power Supplies
- UPS / Solar
- Lighting / Charger / Adapter

TO-252-3L Top View

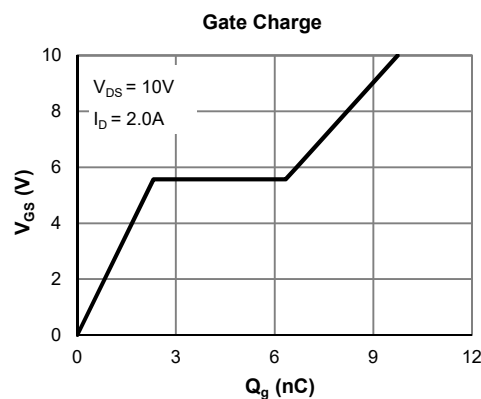
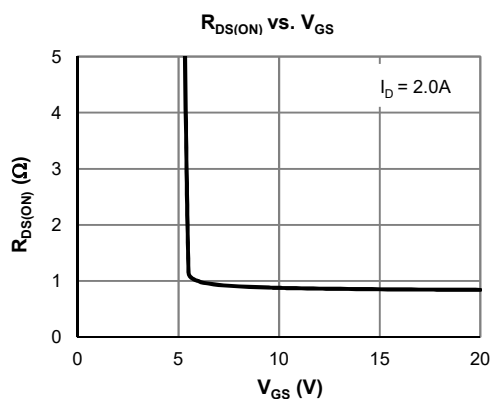


### Ordering Information

| Device         | Package   | # of Pins | Marking  | MSL | $T_J$ (°C) | Media        | Quantity (pcs) |
|----------------|-----------|-----------|----------|-----|------------|--------------|----------------|
| JMH65R980AK-13 | TO-252-3L | 3         | H65R980A | 3   | -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                 | $V_{DS}$       | 650                 | V    |
| Gate-to-Source Voltage                  | $V_{GS}$       | $\pm 20$            | V    |
| Continuous Drain Current <sup>(1)</sup> | $I_D$          | $T_C = 25^\circ C$  | 4.0  |
|                                         |                | $T_C = 100^\circ C$ | 2.4  |
| Pulsed Drain Current <sup>(2)</sup>     | $I_{DM}$       | 16.0                | A    |
| Avalanche Current <sup>(3)</sup>        | $I_{AS}$       | 4.0                 | A    |
| Avalanche Energy <sup>(3)</sup>         | $E_{AS}$       | 80                  | mJ   |
| Power Dissipation <sup>(4)</sup>        | $P_D$          | $T_C = 25^\circ C$  | 37   |
|                                         |                | $T_C = 100^\circ C$ | 14.7 |
| Junction & Storage Temperature Range    | $T_J, T_{STG}$ | -55 to 150          | °C   |





**Electrical Characteristics** (@ T<sub>J</sub> = 25°C unless otherwise specified)

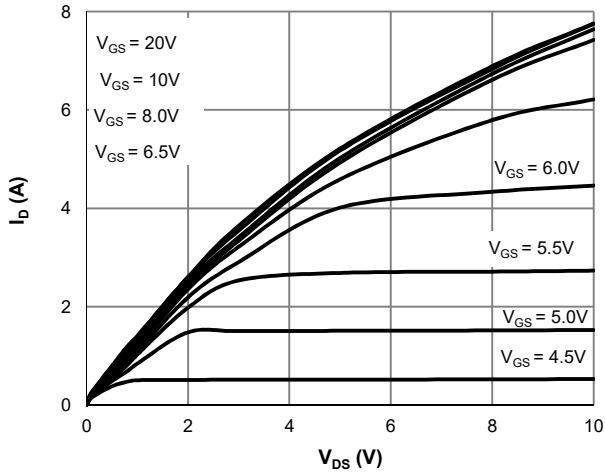
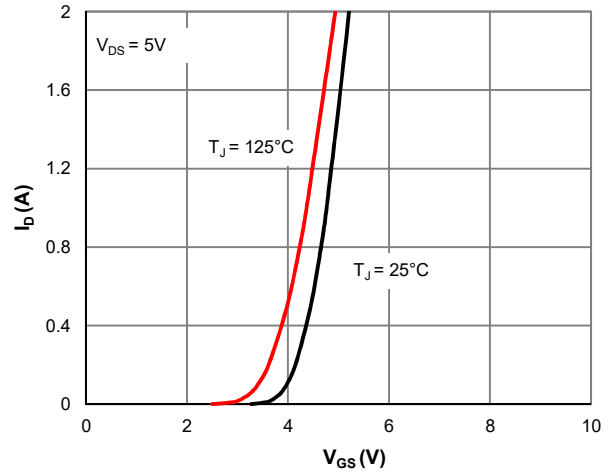
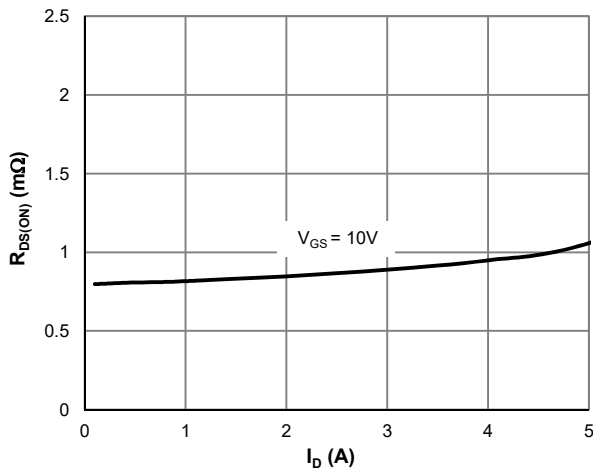
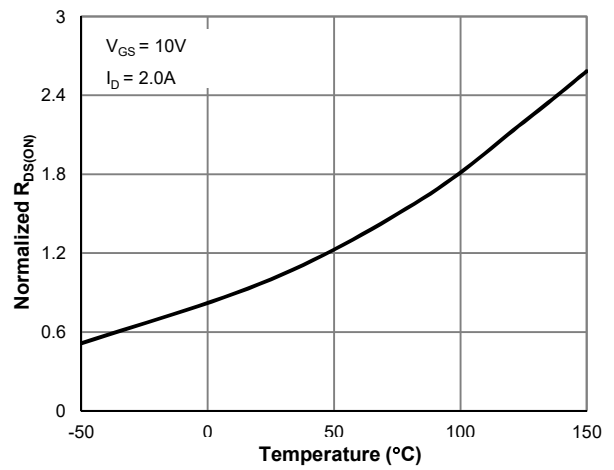
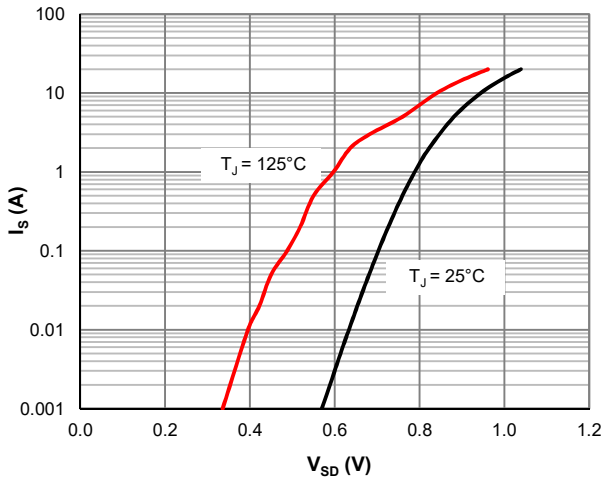
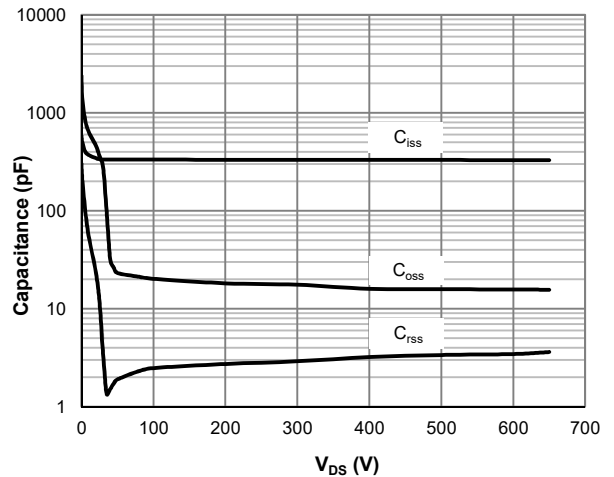
| Parameter                                    | Symbol               | Conditions                                                   | Min. | Typ. | Max. | Unit |
|----------------------------------------------|----------------------|--------------------------------------------------------------|------|------|------|------|
| <b>STATIC PARAMETERS</b>                     |                      |                                                              |      |      |      |      |
| Drain-Source Breakdown Voltage               | V <sub>(BR)DSS</sub> | I <sub>D</sub> = 250μA, V <sub>GS</sub> = 0V                 | 650  |      |      | V    |
| Zero Gate Voltage Drain Current              | I <sub>DSS</sub>     | V <sub>DS</sub> = 650V, V <sub>GS</sub> = 0V                 |      |      | 1.0  | μA   |
| Gate-Body Leakage Current                    | I <sub>GSS</sub>     | V <sub>DS</sub> = 0V, V <sub>GS</sub> = ±20V                 |      |      | ±100 | nA   |
| Gate Threshold Voltage                       | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA   | 2.5  | 3.5  | 4.5  | V    |
| Static Drain-Source ON-Resistance            | R <sub>DS(ON)</sub>  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 2.0A                 |      | 900  | 980  | mΩ   |
| Diode Forward Voltage                        | V <sub>SD</sub>      | I <sub>S</sub> = 1A, V <sub>GS</sub> = 0V                    |      | 0.75 |      | V    |
| Diode Continuous Current                     | I <sub>S</sub>       | T <sub>C</sub> = 25°C                                        |      |      | 10   | A    |
| <b>DYNAMIC PARAMETERS</b> <sup>(5)</sup>     |                      |                                                              |      |      |      |      |
| Input Capacitance                            | C <sub>ISS</sub>     | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 100V, f = 1MHz       |      | 333  |      | pF   |
| Output Capacitance                           | C <sub>OSS</sub>     | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 100V, f = 1MHz       |      | 20   |      | pF   |
| Effective output capacitance, energy related | C <sub>O(er)</sub>   | V <sub>GS</sub> =0V, V <sub>DS</sub> =0...400V               |      | 8.6  |      | pF   |
| Effective output capacitance, time related   | C <sub>O(tr)</sub>   | ID=constant, V <sub>GS</sub> =0V, V <sub>DS</sub> =0...400V  |      | 36   |      | pF   |
| Reverse Transfer Capacitance                 | C <sub>rss</sub>     | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 100V, f = 1MHz       |      | 2.5  |      | pF   |
| Gate Resistance                              | R <sub>g</sub>       | f = 1MHz                                                     |      | 1.2  |      | Ω    |
| <b>SWITCHING PARAMETERS</b> <sup>(5)</sup>   |                      |                                                              |      |      |      |      |
| Total Gate Charge (@ V <sub>GS</sub> = 10V)  | Q <sub>g</sub>       | V <sub>GS</sub> = 0 to 10V                                   |      | 9.7  |      | nC   |
| Gate Source Charge                           | Q <sub>gs</sub>      | V <sub>DS</sub> = 400V, I <sub>D</sub> = 2.0A                |      | 2.3  |      | nC   |
| Gate Drain Charge                            | Q <sub>gd</sub>      | V <sub>DS</sub> = 400V, I <sub>D</sub> = 2.0A                |      | 4.0  |      | nC   |
| Turn-On DelayTime                            | t <sub>D(on)</sub>   | V <sub>GS</sub> = 10V, V <sub>DS</sub> = 400V                |      | 10.0 |      | ns   |
| Turn-On Rise Time                            | t <sub>r</sub>       | R <sub>L</sub> = 200Ω, R <sub>GEN</sub> = 12Ω                |      | 18.6 |      | ns   |
| Turn-Off DelayTime                           | t <sub>D(off)</sub>  | R <sub>L</sub> = 200Ω, R <sub>GEN</sub> = 12Ω                |      | 25   |      | ns   |
| Turn-Off Fall Time                           | t <sub>f</sub>       | R <sub>L</sub> = 200Ω, R <sub>GEN</sub> = 12Ω                |      | 83   |      | ns   |
| Body Diode Reverse Recovery Time             | t <sub>rr</sub>      | I <sub>F</sub> = 2.0A, di/dt = 100A/μs                       |      | 152  |      | ns   |
| Body Diode Reverse Recovery Charge           | Q <sub>rr</sub>      | I <sub>F</sub> = 2.0A, di/dt = 100A/μs                       |      | 1.1  |      | μC   |
| Peak Diode Recovery Voltage Slope            | dv/dt                | I <sub>F</sub> ≤ 2A, di/dt = 200A/μs, V <sub>DS</sub> = 400V |      | 15.0 |      | V/ns |
| MOSFET dv/dt Ruggedness                      | dv/dt                | V <sub>DS</sub> = 0...400V                                   |      | 50   |      | V/ns |

**Thermal Performance**

| Parameter                               | Symbol           | Typ. | Max. | Unit |
|-----------------------------------------|------------------|------|------|------|
| Thermal Resistance, Junction-to-Ambient | R <sub>θJA</sub> | 55   | 68   | °C/W |
| Thermal Resistance, Junction-to-Case    | R <sub>θJC</sub> | 3.4  | 4.0  | °C/W |

**Notes:**

1. Computed continuous current assumes the condition of T<sub>J\_max</sub> while the actual continuous current depends on the thermal & electro-mechanical application board design.
2. This single-pulse measurement was taken under T<sub>J\_max</sub> = 150°C.
3. This single-pulse measurement was taken under the following condition [L = 10mH, V<sub>GS</sub> = 10V, V<sub>DS</sub> = 50V] while its value is limited by T<sub>J\_max</sub> = 150°C.
4. The power dissipation P<sub>D</sub> is based on T<sub>J\_max</sub> = 150°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: Body-Diode Characteristics**

**Figure 6: Capacitance Characteristics**

Typical Electrical & Thermal Characteristics

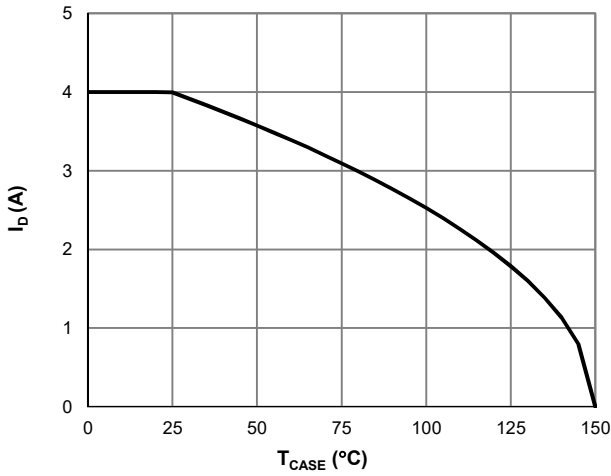


Figure 7: Current De-rating

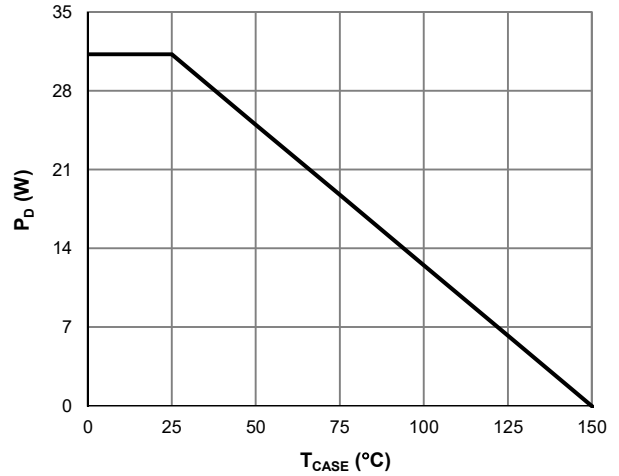


Figure 8: Power De-rating

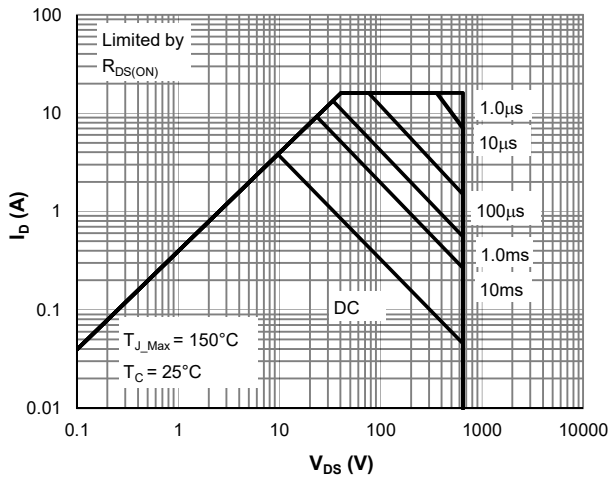


Figure 9: Maximum Safe Operating Area

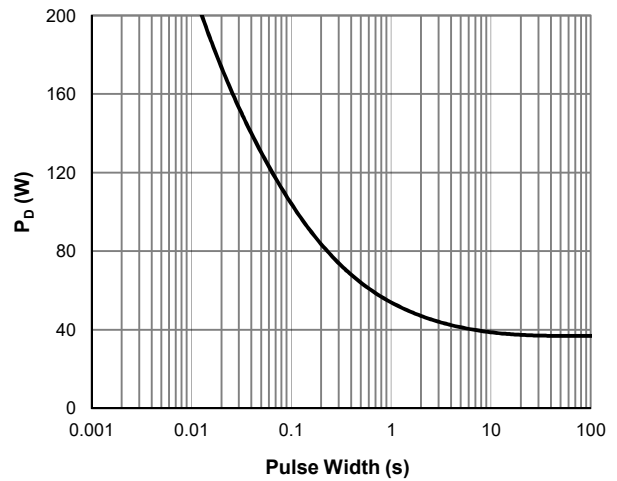


Figure 10: Single Pulse Power Rating, Junction-to-Case

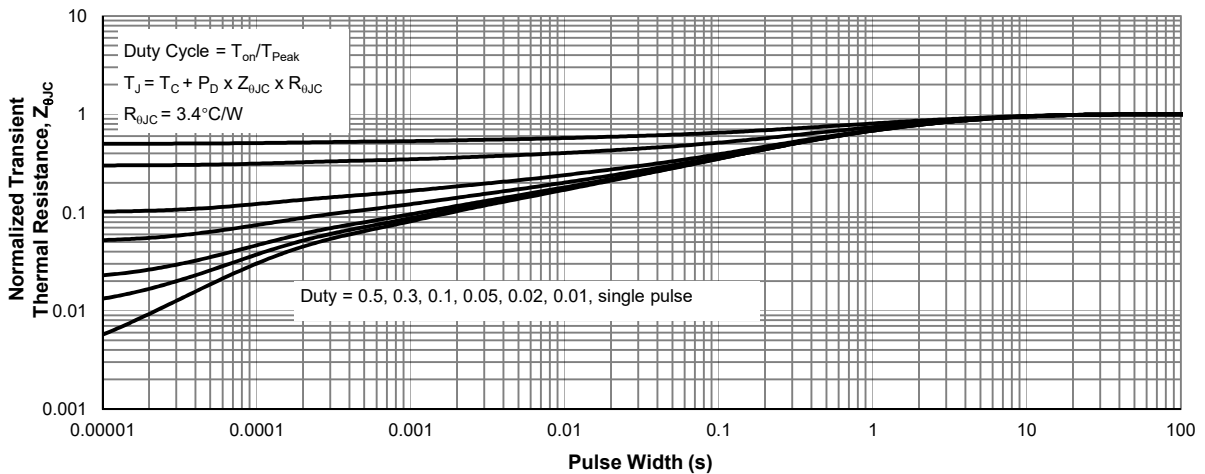
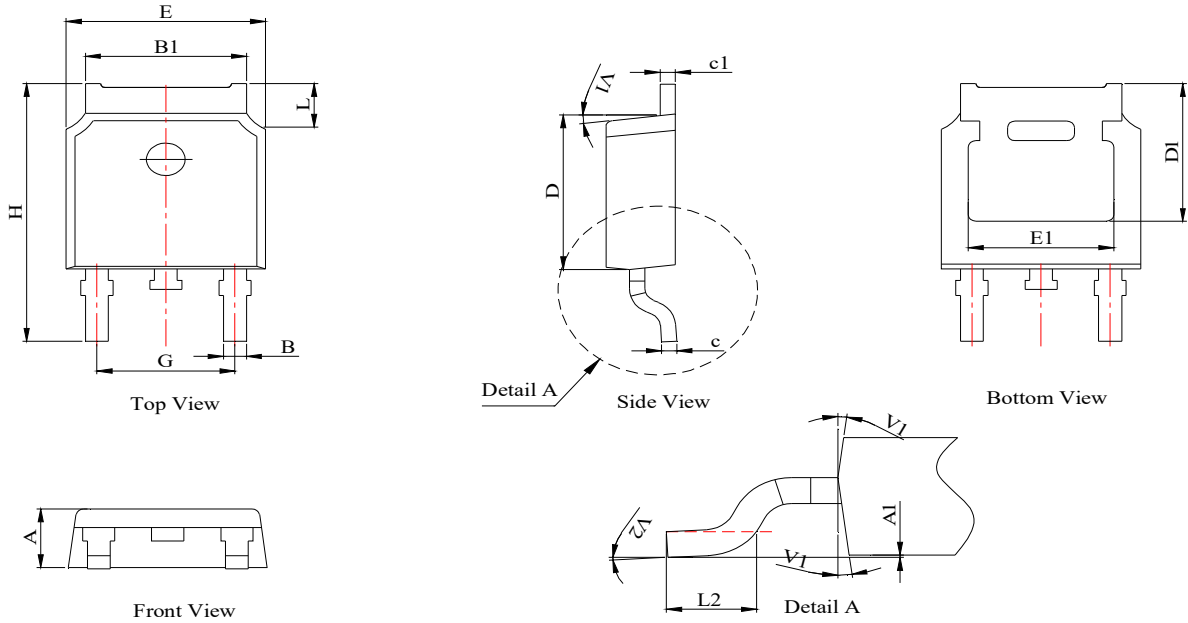
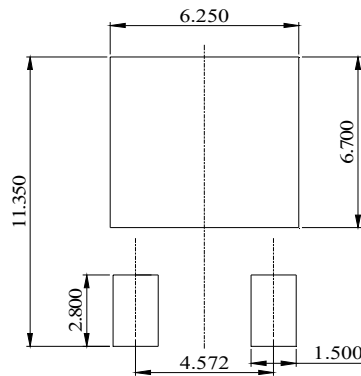


Figure 11: Normalized Maximum Transient Thermal Impedance

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


| DIM. | MILLIMETER |      |       |
|------|------------|------|-------|
|      | MIN.       | NOM. | MAX.  |
| A    | 2.10       |      | 2.50  |
| A1   | 0          | -    | 0.10  |
| B    | 0.66       |      | 0.86  |
| B1   | 5.18       |      | 5.48  |
| c    | 0.40       |      | 0.60  |
| c1   | 0.44       |      | 0.58  |
| D    | 5.90       |      | 6.30  |
| D1   | 5.30REF    |      |       |
| E    | 6.40       |      | 6.80  |
| E1   | 4.63       |      |       |
| G    | 4.47       |      | 4.67  |
| H    | 9.50       |      | 10.70 |
| L    | 1.09       |      | 1.21  |
| L2   | 1.35       |      | 1.65  |
| V1   |            | 7°   |       |
| V2   | 0°         | -    | 6°    |

**Recommend Soldering Footprint**


DIMENSIONS: MILLIMETERS