

**TM70P02D**

**P -Channel Enhancement Mosfet**

**General Description**

- Low  $R_{DS(ON)}$
- RoHS and Halogen-Free Compliant

**Applications**

- Load switch
- PWM

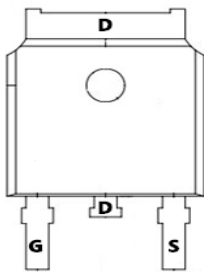
**General Features**

$V_{DS} = -20V$   $I_D = -70A$

$R_{DS(ON)} = 6.5m\Omega$ (typ.)@  $V_{GS} = -4.5V$

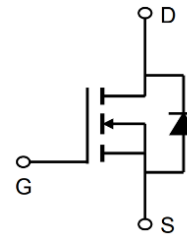
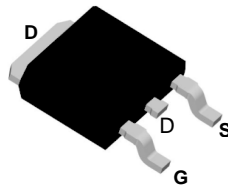
100% UIS Tested

100%  $R_g$  Tested



Marking: 70P02

**D:TO-252-3L**



**Absolute Maximum Ratings ( $T_C=25^\circ C$  unless otherwise noted)**

| Symbol          | Parameter                               | Max.                | Units        |
|-----------------|---|---------------------|--------------|
| $V_{DSS}$       | Drain-Source Voltage                    | -20                 | V            |
| $V_{GSS}$       | Gate-Source Voltage                     | $\pm 12$            | V            |
| $I_D$           | Continuous Drain Current                | $T_C = 25^\circ C$  | -70          |
|                 |   | $T_C = 100^\circ C$ | -39          |
| $I_{DM}$        | Pulsed Drain Current <sup>note1</sup>   | -240                | A            |
| $P_D$           | Power Dissipation                       | 70                  | W            |
| $R_{\theta JC}$ | Thermal Resistance, Junction to Ambient | 2.1                 | $^\circ C/W$ |
| $T_J, T_{STG}$  | Operating and Storage Temperature Range | -55 to +175         | $^\circ C$   |

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

| Symbol  | Parameter   | Test Condition  | Min. | Typ. | Max.      | Units      |
|---|---|---|------|------|-----------|------------|
| <b>Off Characteristic</b>                                     |   |   |      |      |           |            |
| $V_{(BR)DSS}$   | Drain-Source Breakdown Voltage                            | $V_{GS}=0V, I_D = -250\mu A$  | -20  | -    | -         | V          |
| $I_{DSS}$   | Zero Gate Voltage Drain Current                           | $V_{DS} = -20V, V_{GS} = 0V,$   | -    | -    | -1        | $\mu A$    |
| $I_{GSS}$   | Gate to Body Leakage Current                              | $V_{DS} = 0V, V_{GS} = \pm 12V$   | -    | -    | $\pm 100$ | nA         |
| <b>On Characteristics</b>                                     |   |   |      |      |           |            |
| $V_{GS(th)}$  | Gate Threshold Voltage                                    | $V_{DS} = V_{GS}, I_D = -250\mu A$  | -0.5 | -0.7 | -1.0      | V          |
| $R_{DS(on)}$  | Static Drain-Source on-Resistance<br><small>note3</small> | $V_{GS} = -4.5V, I_D = -15A$  | -    | 6.5  | 8.5       | m $\Omega$ |
|   |   | $V_{GS} = -2.5V, I_D = -12A$  | -    | 8    | 12        |            |
| <b>Dynamic Characteristics</b>                                |   |   |      |      |           |            |
| $C_{iss}$   | Input Capacitance   | $V_{DS} = -10V, V_{GS} = 0V,$<br>$f = 1.0MHz$                             | -    | 4590 | -         | pF         |
| $C_{oss}$   | Output Capacitance  |   | -    | 505  | -         | pF         |
| $C_{rss}$   | Reverse Transfer Capacitance                              |   | -    | 440  | -         | pF         |
| $Q_g$   | Total Gate Charge   | $V_{DS} = -10V, I_D = -15A,$<br>$V_{GS} = -4.5V$                          | -    | 46   | -         | nC         |
| $Q_{gs}$  | Gate-Source Charge  |   | -    | 7.3  | -         | nC         |
| $Q_{gd}$  | Gate-Drain("Miller") Charge                               |   | -    | 10   | -         | nC         |
| <b>Switching Characteristics</b>                              |   |   |      |      |           |            |
| $t_{d(on)}$   | Turn-on Delay Time  | $V_{DD} = -10V, I_D = -14A,$<br>$R_{GEN} = 2.7\Omega,$<br>$V_{GS} = -10V$ | -    | 8    | -         | ns         |
| $t_r$   | Turn-on Rise Time   |   | -    | 59   | -         | ns         |
| $t_{d(off)}$  | Turn-off Delay Time                                       |   | -    | 111  | -         | ns         |
| $t_f$   | Turn-off Fall Time  |   | -    | 43   | -         | ns         |
| <b>Drain-Source Diode Characteristics and Maximum Ratings</b> |   |   |      |      |           |            |
| $I_S$   | Maximum Continuous Drain to Source Diode Forward Current  |   | -    | -    | -70       | A          |
| $I_{SM}$  | Maximum Pulsed Drain to Source Diode Forward Current      |   | -    | -    | -240      | A          |
| $V_{SD}$  | Drain to Source Diode Forward Voltage                     | $V_{GS} = 0V, I_S = -20A$   | -    | -    | -1.2      | V          |
| $t_{rr}$  | Reverse Recovery Time                                     | $T_J = 25^{\circ}\text{C}, I_{SD} = -15A,$                                | -    | 18   | -         | ns         |
| $Q_{rr}$  | Reverse Recovery Charge                                   | $V_{GS} = 0V$<br>$di/dt = -100A/\mu s$                                    | -    | 7.7  | -         | nC         |

- Notes: 1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature  
 2. EAS condition:  $T_J = 25^{\circ}\text{C}, V_{DD} = -10V, V_G = -10V, R_G = 5.9\Omega, L = 0.5\text{mh}, I_{AS} = -13.2A$   
 3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 0.5\%$



### Typical Performance Characteristics

Figure 1: Output Characteristics

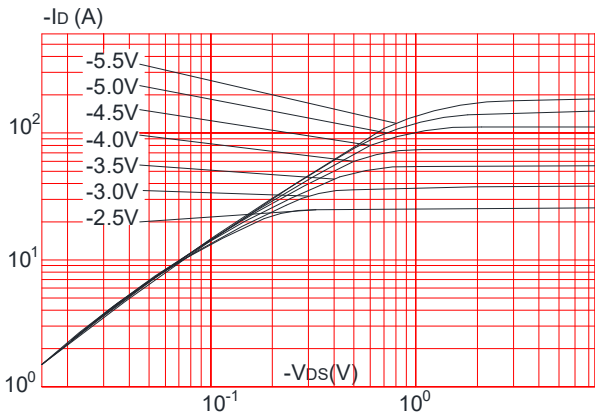


Figure 2: Typical Transfer Characteristics

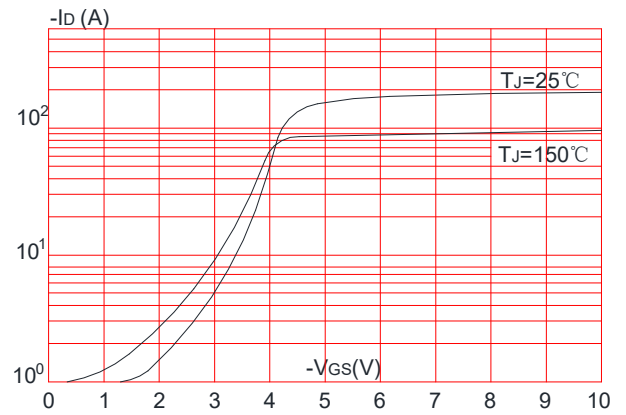


Figure 3: On-resistance vs. Drain Current

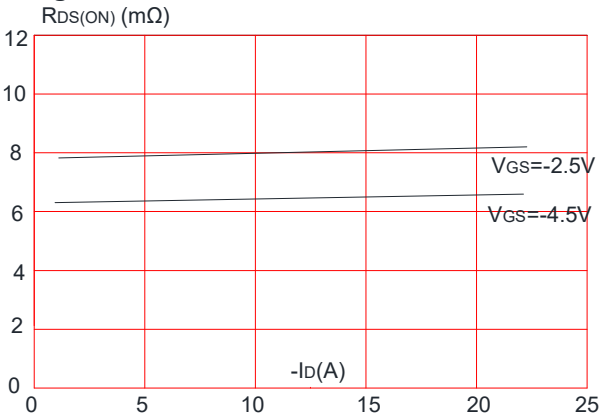


Figure 4: Body Diode Characteristics

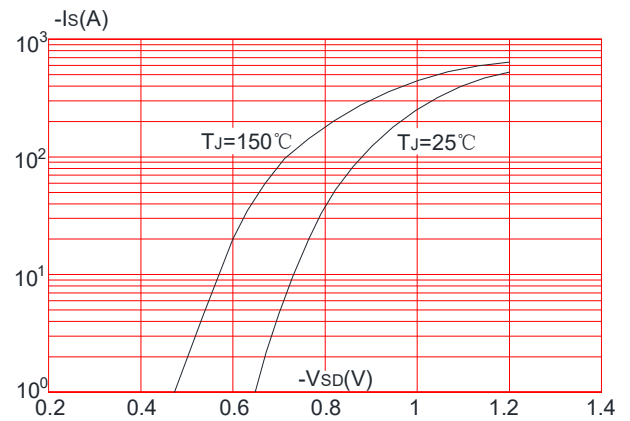


Figure 5: Gate Charge Characteristics

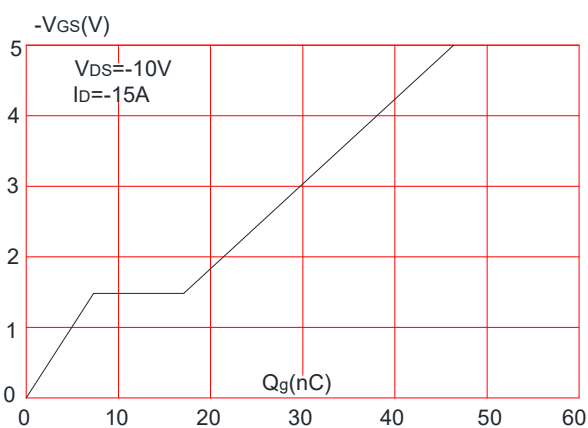
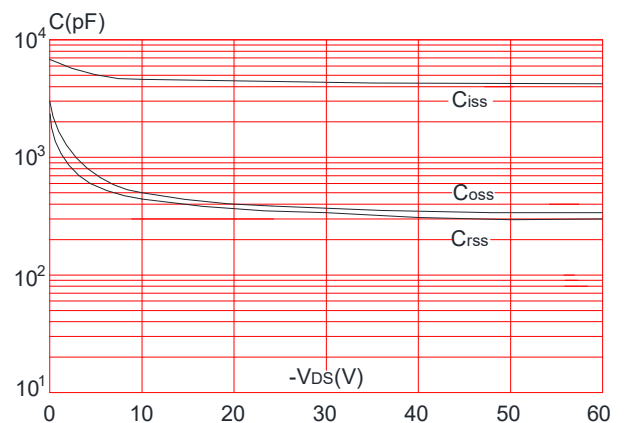


Figure 6: Capacitance Characteristics



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Figure 7: Normalized Breakdown Voltage vs. Junction Temperature

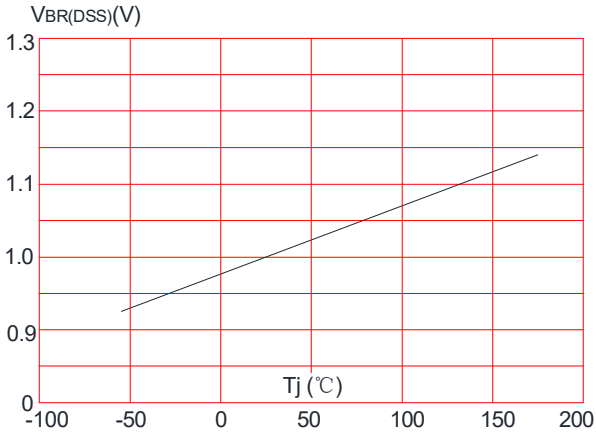


Figure 8: Normalized on Resistance vs. Junction Temperature

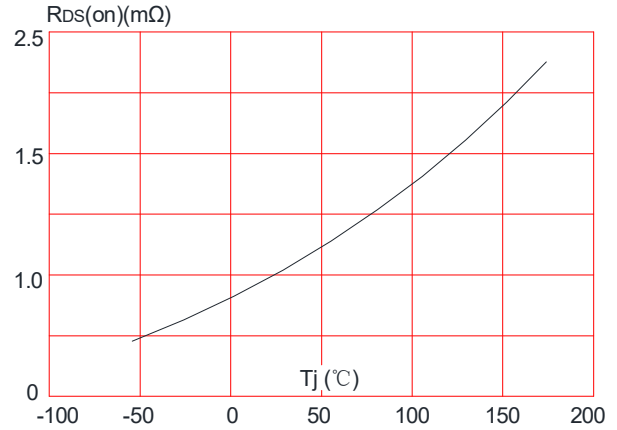


Figure 9: Maximum Safe Operating Area

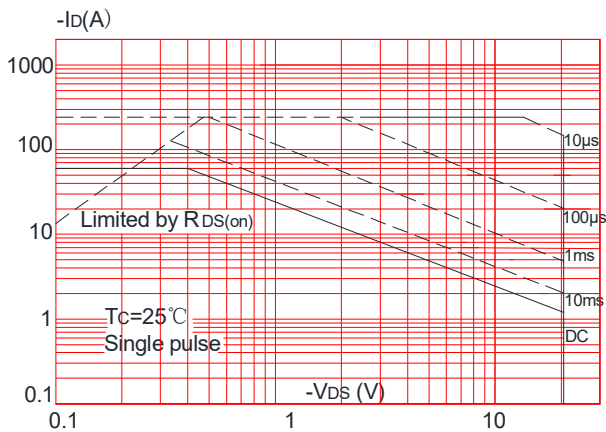


Figure 10: Maximum Continuous Drain Current vs. Case Temperature

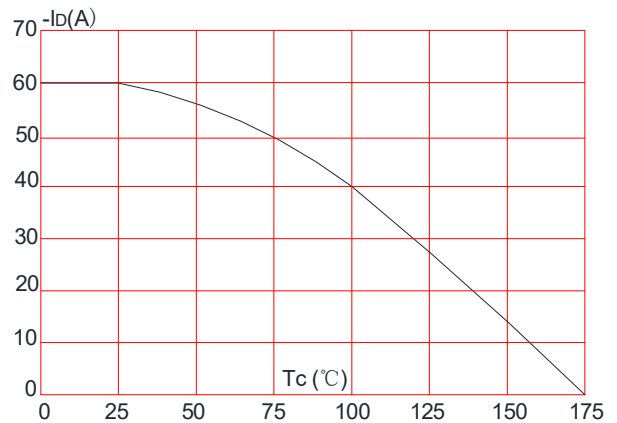
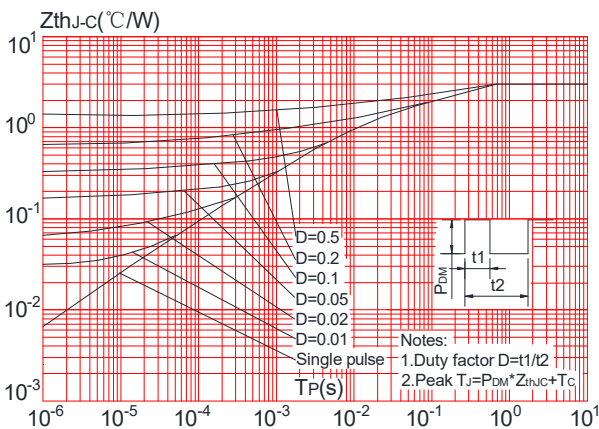
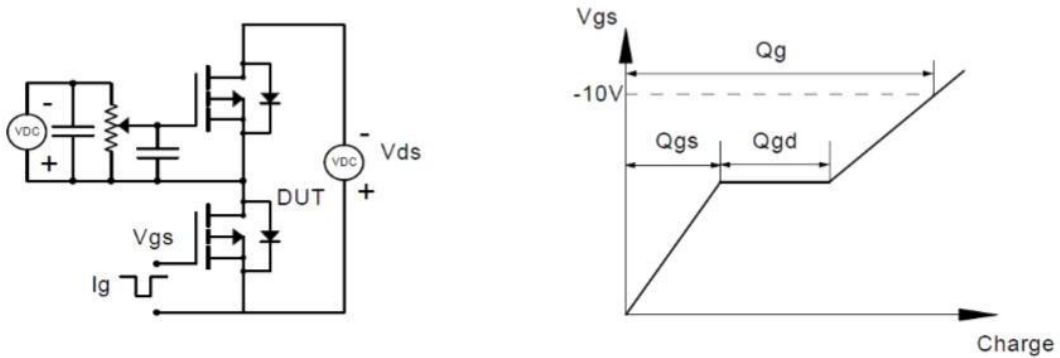


Figure.11: Maximum Effective Transient Thermal Impedance, Junction-to-Case

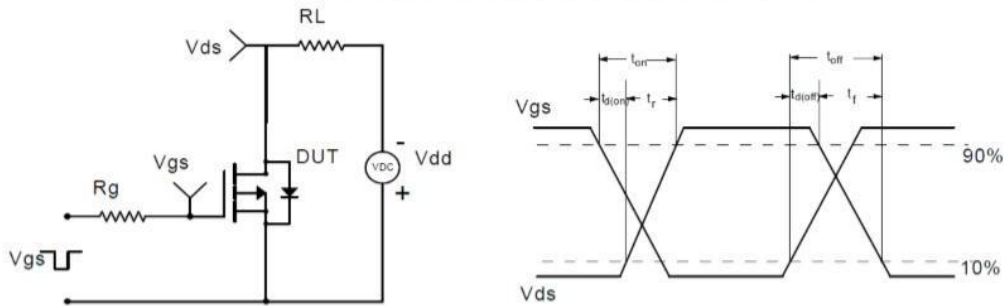


**Test Circuit**

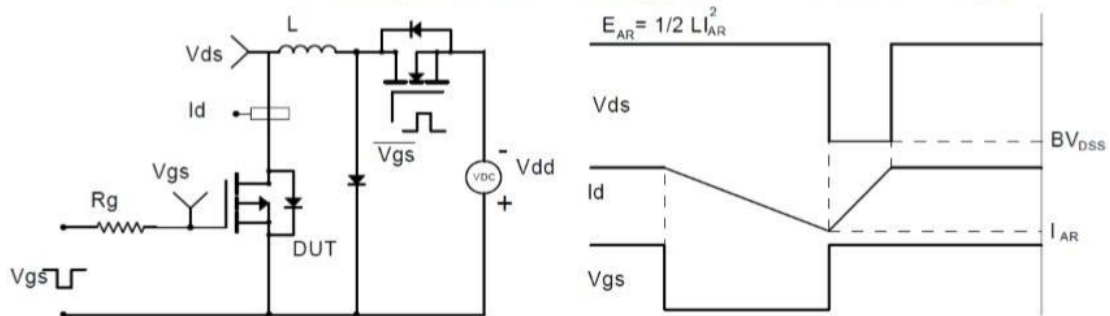
Gate Charge Test Circuit & Waveform



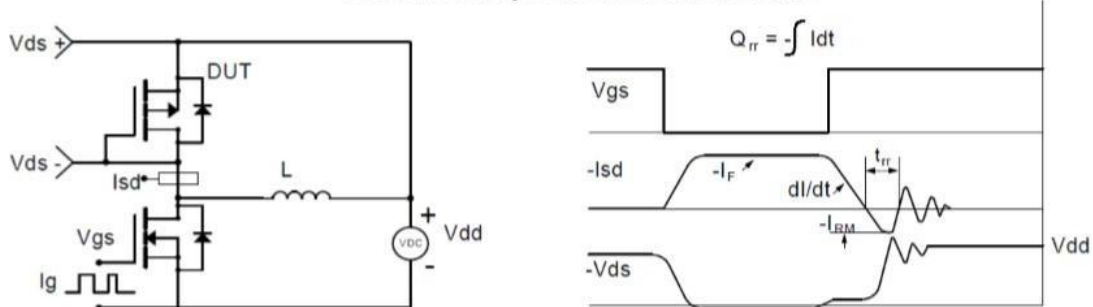
Resistive Switching Test Circuit & Waveforms



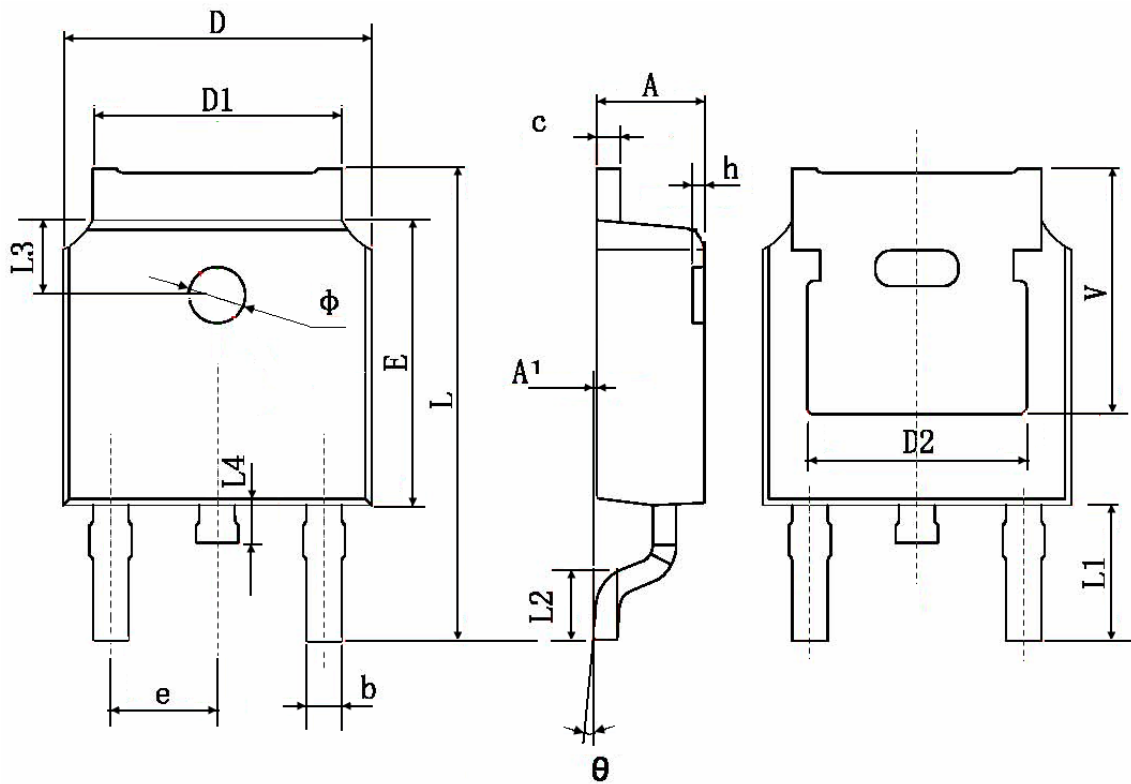
Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



## Package Mechanical Data: TO-252-3L



| Symbol | Dimensions In Millimeters |        | Dimensions In Inches |       |
|--------|---------------------------|--------|----------------------|-------|
|        | Min.                      | Max.   | Min.                 | Max.  |
| A      | 2.200                     | 2.400  | 0.087                | 0.094 |
| A1     | 0.000                     | 0.127  | 0.000                | 0.005 |
| b      | 0.660                     | 0.860  | 0.026                | 0.034 |
| c      | 0.460                     | 0.580  | 0.018                | 0.023 |
| D      | 6.500                     | 6.700  | 0.256                | 0.264 |
| D1     | 5.100                     | 5.460  | 0.201                | 0.215 |
| D2     | 4.830 TYP.                |        | 0.190 TYP.           |       |
| E      | 6.000                     | 6.200  | 0.236                | 0.244 |
| e      | 2.186                     | 2.386  | 0.086                | 0.094 |
| L      | 9.800                     | 10.400 | 0.386                | 0.409 |
| L1     | 2.900 TYP.                |        | 0.114 TYP.           |       |
| L2     | 1.400                     | 1.700  | 0.055                | 0.067 |
| L3     | 1.600 TYP.                |        | 0.063 TYP.           |       |
| L4     | 0.600                     | 1.000  | 0.024                | 0.039 |
| Φ      | 1.100                     | 1.300  | 0.043                | 0.051 |
| θ      | 0°                        | 8°     | 0°                   | 8°    |
| h      | 0.000                     | 0.300  | 0.000                | 0.012 |
| V      | 5.350 TYP.                |        | 0.211 TYP.           |       |

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