

# MJ P-Channel Enhancement Mode Power MOSFET

## Description

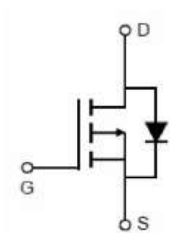
The MJ60P14AK uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This device is well suited for use as a load switch or in PWM applications.

## General Features

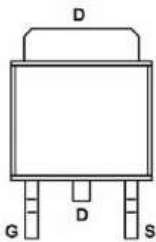
- ◆  $V_{DS} = -60V, I_D = -14A$   
 $R_{DS(ON)} < 75m\Omega @ V_{GS} = -10V$   
 $R_{DS(ON)} < 96m\Omega @ V_{GS} = -4.5V$
- ◆ High density cell design for ultra low  $R_{dson}$
- ◆ Fully characterized avalanche voltage and current
- ◆ Excellent package for good heat dissipation

## Application

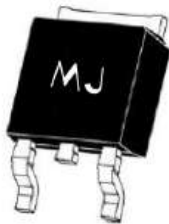
- ◆ Load switch
- ◆ PWM application



Schematic diagram



Marking and pin assignment



TO-252-2L top view

100% UIS TESTED! 100%  $\Delta V_{ds}$  TESTED!

## Package Marking and Ordering Information

| Device Marking | Device    | Device Package | Reel Size | Tape width | Quantity |
|----------------|-----------|----------------|-----------|------------|----------|
| MJ60P14AK      | MJ60P14AK | TO-252-2L      | -         | -          | -        |

## Absolute Maximum Ratings ( $T_c = 25\text{ }^{\circ}\text{C}$ unless otherwise noted)

| Parameter  | Symbol         | Limit      | Unit               |
|--|----------------|------------|--------------------|
| Drain-Source Voltage                             | $V_{DS}$       | -60        | V                  |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | V                  |
| Drain Current-Continuous                         | $I_D$          | -14        | A                  |
| Pulsed Drain Current                             | $I_{DM}$       | -56        | A                  |
| Maximum Power Dissipation                        | $P_D$          | 50         | W                  |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 175 | $^{\circ}\text{C}$ |

## Thermal Characteristic

|  |                 |     |                      |
|--|-----------------|-----|----------------------|
| Thermal Resistance, Junction-to-Case <sup>(Note 2)</sup> | $R_{\theta JC}$ | 3.0 | $^{\circ}\text{C/W}$ |
|--|-----------------|-----|----------------------|

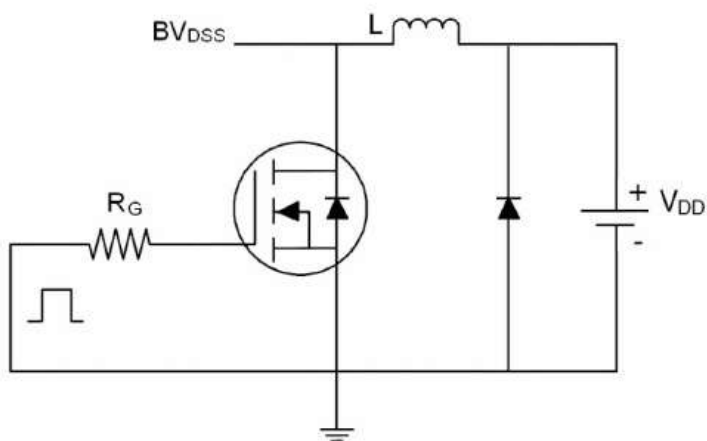
Electrical Characteristics (T<sub>c</sub> =25℃unless otherwise noted)

| Parameter   | Symbol              | Condition   | Min  | Typ  | Max  | Unit |
|---|---------------------|---|------|------|------|------|
| Off Characteristics                               |                     |   |      |      |      |      |
| Drain-Source Breakdown Voltage                    | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V I <sub>D</sub> =-250μA  | -60  | -    | -    | V    |
| Zero Gate Voltage Drain Current                   | I <sub>DSS</sub>    | V <sub>DS</sub> =-60V,V <sub>GS</sub> =0V   | -    | -    | -1   | μA   |
| Gate-Body Leakage Current                         | I <sub>GSS</sub>    | V <sub>DS</sub> =±20V,V <sub>GS</sub> =0V   | -    | -    | ±100 | nA   |
| On Characteristics <small>(Note 3)</small>        |                     |   |      |      |      |      |
| Gate Threshold Voltage                            | V <sub>GS(th)</sub> | V <sub>DS</sub> =V <sub>GS</sub> ,I <sub>D</sub> =-250μA                              | -1.0 | -1.5 | -2.0 | V    |
| Drain-Source On-State Resistance                  | R <sub>DS(ON)</sub> | V <sub>GS</sub> =-10V, I <sub>D</sub> =-14A   | -    | 63   | 75   | mΩ   |
|   |                     | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-10A  | -    | 74   | 96   | mΩ   |
| Forward Transconductance                          | g <sub>FS</sub>     | V <sub>DS</sub> =-5V,I <sub>D</sub> =-14A   | -    | 10   | -    | S    |
| Dynamic Characteristics <small>(Note 4)</small>   |                     |   |      |      |      |      |
| Input Capacitance                                 | C <sub>iss</sub>    | V <sub>DS</sub> =-30V,V <sub>GS</sub> =0V<br>F=1.0MHz                                 | -    | 930  | -    | PF   |
| Output Capacitance                                | C <sub>oss</sub>    |   | -    | 85   | -    | PF   |
| Reverse Transfer Capacitance                      | C <sub>rss</sub>    |   | -    | 35   | -    | PF   |
| Switching Characteristics <small>(Note 4)</small> |                     |   |      |      |      |      |
| Turn-on Delay Time                                | t <sub>d(on)</sub>  | V <sub>DD</sub> =-30V, R <sub>L</sub> =2Ω<br>V <sub>GS</sub> =-10V,R <sub>G</sub> =3Ω | -    | 8    | -    | nS   |
| Turn-on Rise Time                                 | t <sub>r</sub>      |   | -    | 4    | -    | nS   |
| Turn-Off Delay Time                               | t <sub>d(off)</sub> |   | -    | 32   | -    | nS   |
| Turn-Off Fall Time                                | t <sub>f</sub>      |   | -    | 7    | -    | nS   |
| Total Gate Charge                                 | Q <sub>g</sub>      | V <sub>DS</sub> =-30V,I <sub>D</sub> =-14A<br>V <sub>GS</sub> =-10V                   | -    | 25   | -    | nC   |
| Gate-Source Charge                                | Q <sub>gs</sub>     |   | -    | 3    | -    | nC   |
| Gate-Drain Charge                                 | Q <sub>gd</sub>     |   | -    | 7    | -    | nC   |
| Drain-Source Diode Characteristics                |                     |   |      |      |      |      |
| Diode Forward Voltage <small>(Note 3)</small>     | V <sub>SD</sub>     | V <sub>GS</sub> =0V,I <sub>S</sub> =-14A  | -    | -    | -1.2 | V    |
| Diode Forward Current <small>(Note 2)</small>     | I <sub>S</sub>      |   | -    | -    | -14  | A    |
| Reverse Recovery Time                             | t <sub>rr</sub>     | T <sub>J</sub> =25°C, I <sub>F</sub> =-14A<br>di/dt=-100A/μs <small>(Note 3)</small>  | -    | 25   | -    | nS   |
| Reverse Recovery Charge                           | Q <sub>rr</sub>     |   | -    | 31   | -    | nC   |

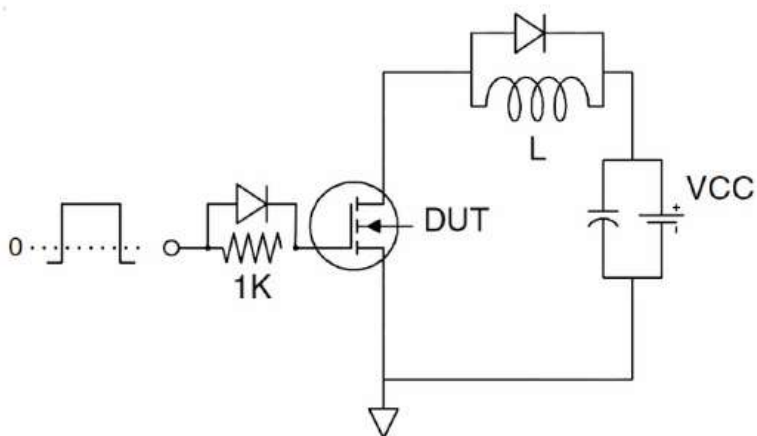
Notes:

- ① Repetitive Rating: Pulse width limited by maximum junction temperature.
- ② Surface Mounted on FR4 Board, t ≤ 10 sec.
- ③ Pulse Test: Pulse Width ≤ 300μs, Duty Cycle ≤ 2%.
- ④ Guaranteed by design, not subject to production

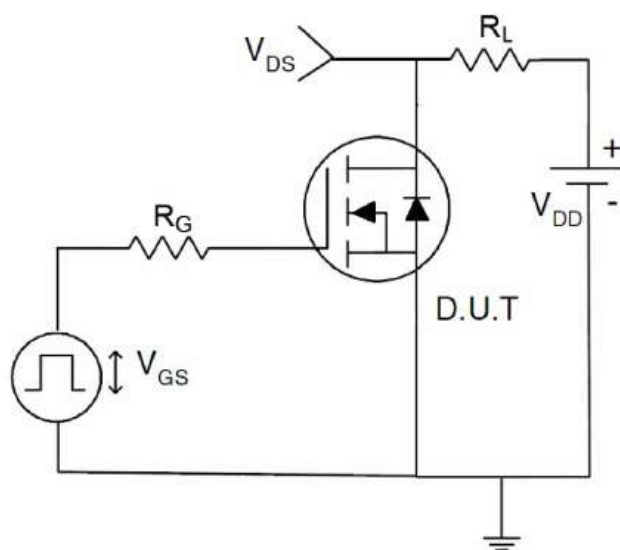
## Test circuit



EAS test Circuit

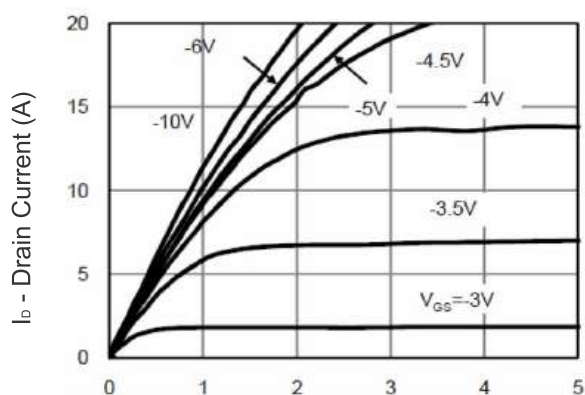


Gate charge test Circuit



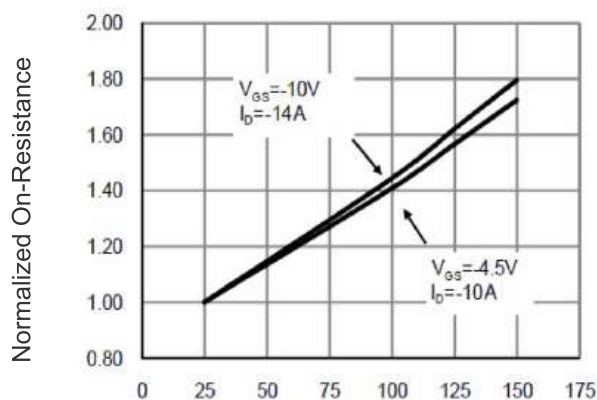
Switch Time Test Circuit

## Typical Electrical and Thermal Characteristics (Curves)



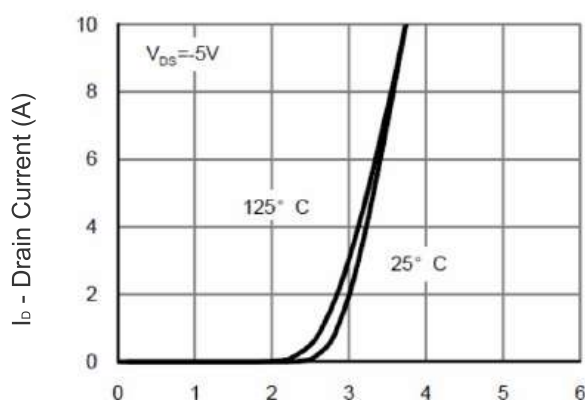
Vds Drain-Source Voltage (V)

Figure 1 Output Characteristics



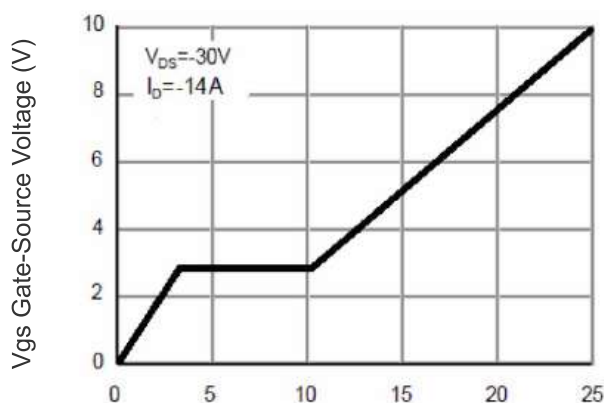
Tj -Junction Temperature(°C)

Figure 4 Rdson-Junction Temperature



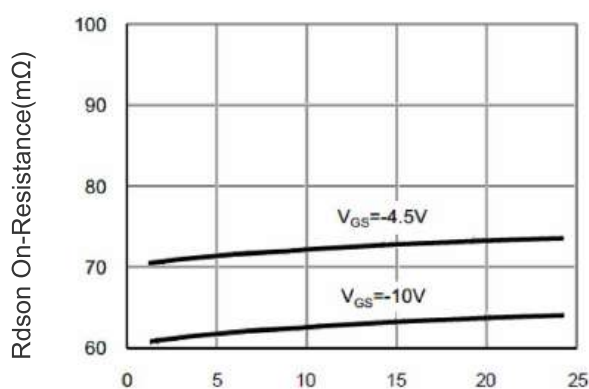
Vgs Gate-Source Voltage (V)

Figure 2 Transfer Characteristics



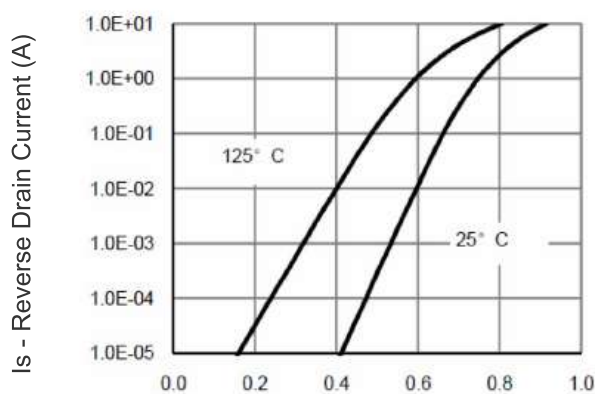
Qg Gate Charge (nC)

Figure 5 Gate Charge



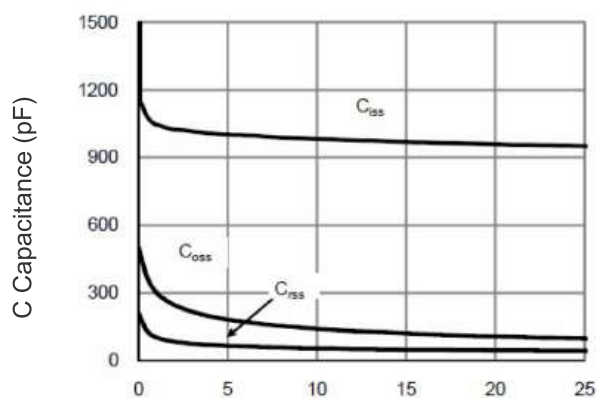
-Id - Drain Current (A)

Figure 3 Rdson- Drain Current

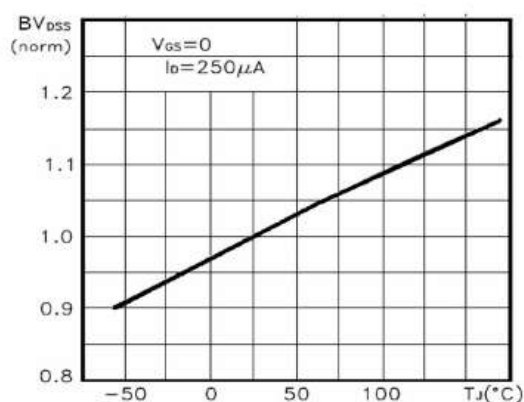


-Vsd Source-Drain Voltage (V)

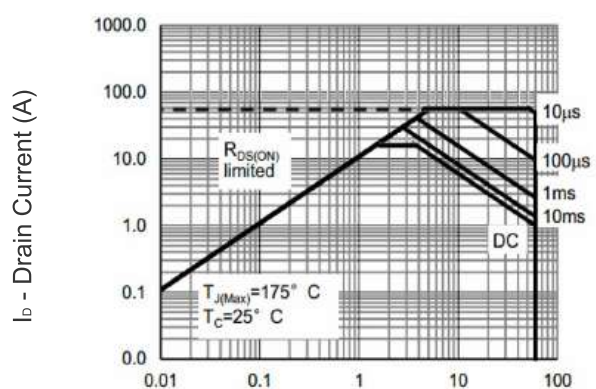
Figure 6 Source- Drain Diode Forward



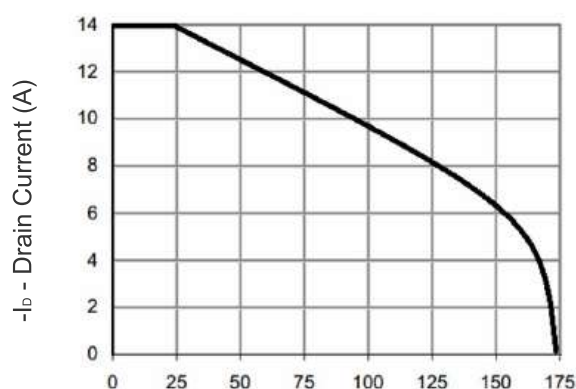
-Vds Drain-Source Voltage (V)  
Figure 7 Capacitance vs Vds



T<sub>J</sub> -Junction Temperature(°C)  
Figure 9 BV<sub>DSS</sub> vs Junction Temperature



-Vds Drain-Source Voltage (V)  
Figure 8 Safe Operation Area



T<sub>J</sub> -Junction Temperature(°C)  
Figure 10 I<sub>D</sub> Current De-rating

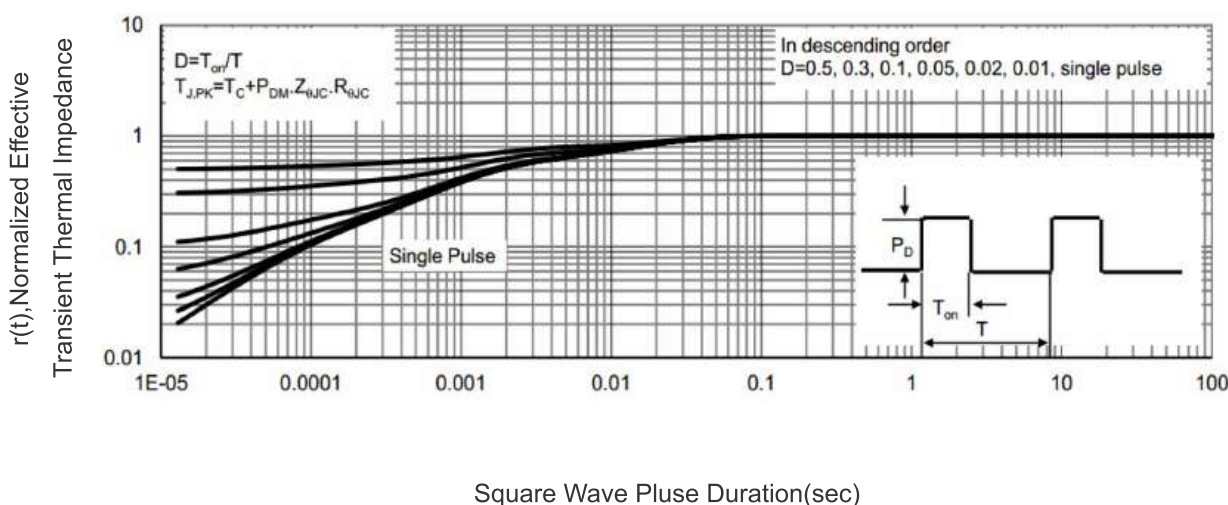
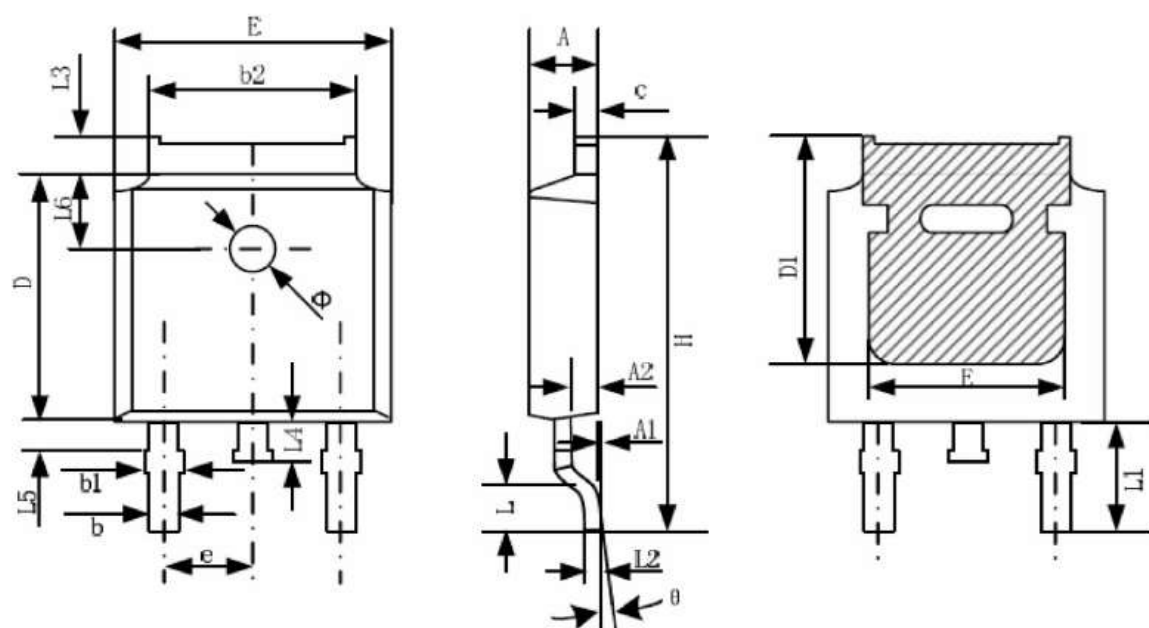


Figure 11 Normalized Maximum Transient Thermal Impedance

## TO-252-2L Package Information



| Symbol   | Dimensions In Millimeters |       | Dimensions In Inches |       |
|----------|---------------------------|-------|----------------------|-------|
|          | Min.                      | Max.  | Min.                 | Max.  |
| A        | 2.20                      | 2.38  | 0.087                | 0.094 |
| A1       | 0.00                      | 0.10  | 0.000                | 0.004 |
| A2       | 0.90                      | 1.10  | 0.035                | 0.043 |
| b        | 0.72                      | 0.85  | 0.028                | 0.033 |
| b1       | 0.72                      | 0.90  | 0.028                | 0.035 |
| b2       | 5.13                      | 5.46  | 0.202                | 0.215 |
| c        | 0.47                      | 0.60  | 0.019                | 0.024 |
| D        | 6.00                      | 6.20  | 0.236                | 0.244 |
| D1       | 5.25                      | --    | 0.207                | --    |
| E        | 6.50                      | 6.70  | 0.256                | 0.264 |
| E1       | 4.70                      | --    | 0.185                | --    |
| e        | 2.19                      | 2.39  | 0.086                | 0.094 |
| H        | 9.80                      | 10.40 | 0.386                | 0.409 |
| L        | 1.40                      | 1.70  | 0.055                | 0.067 |
| L1       | 2.90 REF                  |       | 0.114 REF            |       |
| L2       | 0.508 BSC                 |       | 0.020 BSC            |       |
| L3       | 0.90                      | 1.25  | 0.035                | 0.049 |
| L4       | 0.60                      | 1.00  | 0.024                | 0.039 |
| L5       | 0.15                      | 0.75  | 0.006                | 0.030 |
| L6       | 1.80 REF                  |       | 0.071 REF            |       |
| $\Phi$   | 1.20                      | 1.40  | 0.047                | 0.055 |
| $\theta$ | 0°                        | 8°    | 0°                   | 8°    |



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