

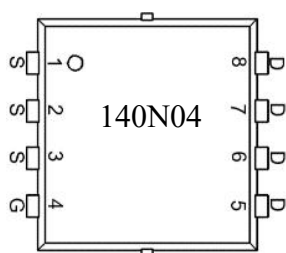
**Features**

- Split Gate Trench MOSFET technology
- 100% EAS Guaranteed
- Fast Switching Speed
- Green Device Available

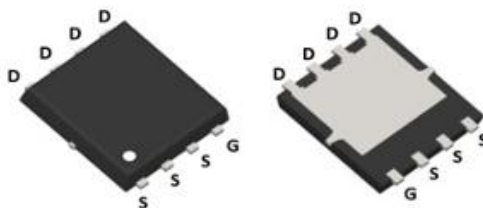
**Bvdss****40V****Rdson****1.65mΩ****ID****140A****Application**

- DC-DC Converters
- Power management functions
- High Frequency Switching and Synchronous Rectification

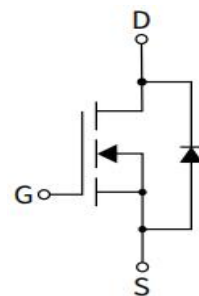
RoHS

**Package**

Marking and pin assignment



PDFN5x6-8L top view



Schematic diagram

**Package Marking and Ordering Information**

| Device Marking | Device     | Device Package | Quantity |
|----------------|------------|----------------|----------|
| 140N04         | HLS140N04F | PDFN5x6-8L     | 5000     |

**Absolute Maximum Ratings** ( $T_J=25^{\circ}\text{C}$  unless otherwise specified)

| Parameter                                   |                                 | Symbol    | Limit           | Unit               |
|---------------------------------------------|---------------------------------|-----------|-----------------|--------------------|
| Drain-Source Voltage                        |                                 | $V_{DS}$  | 40              | V                  |
| Gate-Source Voltage                         |                                 | $V_{GS}$  | $\pm 20$        | V                  |
| Continuous Drain Current <sup>1</sup>       | ( $T_C = 25^{\circ}\text{C}$ )  | $I_D$     | 140             | A                  |
| Continuous Drain Current <sup>1</sup>       | ( $T_C = 100^{\circ}\text{C}$ ) | $I_D$     | -               | A                  |
| Pulsed Drain Current <sup>2</sup>           |                                 | $I_{DM}$  | 560             | A                  |
| Single Pulsed Avalanche Energy <sup>3</sup> |                                 | $E_{AS}$  | 200             | mJ                 |
| Avalanche Current                           |                                 | $I_{AS}$  | -               | A                  |
| Power Dissipation <sup>4</sup>              |                                 | $P_D$     | 83              | W                  |
| Junction Temperature                        |                                 | $T_J$     | $-55 \sim +150$ | $^{\circ}\text{C}$ |
| Storage Temperature                         |                                 | $T_{STG}$ | $-55 \sim +150$ | $^{\circ}\text{C}$ |



## Thermal Resistance Ratings

| Parameter                              | Symbol          | Typ. | Max. | Unit                 |
|----------------------------------------|-----------------|------|------|----------------------|
| Thermal Resistance,Junction-to-Case    | $R_{\theta JC}$ | --   | 1.5  | $^{\circ}\text{C/W}$ |
| Thermal Resistance,Junction-to-Ambient | $R_{\theta JA}$ | --   | 20   | $^{\circ}\text{C/W}$ |

## Ordering Information

| Ordering Number | Package    | Pin Assignment |         |       | Packing   |
|-----------------|------------|----------------|---------|-------|-----------|
| Halogen Free    |            | G              | D       | S     |           |
| HLS140N04F      | PDFN5x6-8L | 4              | 5,6,7,8 | 1,2,3 | Tape Reel |

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

| Parameter                                                | Symbol       | Condition                                                               | Min | Typ   | Max       | Unit          |
|----------------------------------------------------------|--------------|-------------------------------------------------------------------------|-----|-------|-----------|---------------|
| Drain-Source Breakdown Voltage                           | $V_{DS}$     | $V_{GS}=0\text{V}, I_D=250\mu\text{A}$                                  | 40  | -     | -         | V             |
| Zero Gate Voltage Drain Current                          | $I_{DSS}$    | $V_{DS}=30\text{V}, V_{GS}=0\text{V}, T_J=25^{\circ}\text{C}$           | -   | -     | 1         | $\mu\text{A}$ |
| Gate to Body Leakage Current                             | $I_{GSS}$    | $V_{DS}=0\text{V}, V_{GS}=\pm 20\text{V}$                               | -   | -     | $\pm 100$ | nA            |
| Gate Threshold Voltage                                   | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu\text{A}$                                     | 1   | -     | 2.5       | V             |
| Static Drain-Source on-Resistance <sup>3</sup>           | $R_{DS(on)}$ | $V_{GS}=10\text{V}, I_D=20\text{A}$                                     | -   | 1.65  | 2.3       | m $\Omega$    |
|                                                          |              | $V_{GS}=4.5\text{V}, I_D=20\text{A}$                                    | -   | 2.45  | 3.2       | m $\Omega$    |
| Input Capacitance                                        | $C_{iss}$    | $V_{DS}=25\text{V}, V_{GS}=0\text{V},$<br>$f=1.0\text{MHz}$             | -   | 3830  | -         | pF            |
| Output Capacitance                                       | $C_{oss}$    |                                                                         | -   | 2794  | -         |               |
| Reverse Transfer Capacitance                             | $C_{rss}$    |                                                                         | -   | 474   | -         |               |
| Total Gate Charge                                        | $Q_g$        | $V_{DD}=32\text{V}, I_D=10\text{A}$                                     | -   | 66    | -         | nC            |
| Gate-Source Charge                                       | $Q_{gs}$     |                                                                         | -   | 13.6  | -         |               |
| Gate-Drain( "Miller" ) Charge                            | $Q_{gd}$     |                                                                         | -   | 12.6  | -         |               |
| Turn-on Delay Time                                       | $t_{d(on)}$  | $V_{DD}=20\text{V},$<br>$R_D=0.5\Omega, R_G=10\Omega$                   | -   | 892.8 | -         | nS            |
| Turn-on Rise Time                                        | $t_r$        |                                                                         | -   | 21.4  | -         |               |
| Turn-Off Delay Time                                      | $t_{d(off)}$ |                                                                         | -   | 72.28 | -         |               |
| Turn-Off Fall Time                                       | $t_f$        |                                                                         | -   | 34.52 | -         |               |
| Maximum Continuous Drain to Source Diode Forward Current | $I_S$        | --                                                                      | -   | -     | 140       | A             |
| Maximum Pulsed Drain to Source Diode Forward Current     | $I_{SM}$     | --                                                                      | -   | -     | 560       | A             |
| Diode Forward Voltage                                    | $V_{SD}$     | $V_{GS}=0\text{V}, I_S=20\text{A}$                                      | -   | -     | 0.78      | V             |
| Body Diode Reverse Recovery Time                         | $t_{rr}$     | $I_F=I_S, di/dt = 100\text{A}/\mu\text{s},$<br>$T_J=25^{\circ}\text{C}$ | -   | 31    | -         | nS            |
| Body Diode Reverse Recovery Charge                       | $Q_{rr}$     |                                                                         | -   | 110   | -         | nC            |

Notes:

1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature
2. EAS condition:  $T_J=25^{\circ}\text{C}$ ,  $V_D=32\text{V}$ ,  $L=0.5\text{mH}$
3. Pulse Test: Pulse Width $\leq 300\mu\text{s}$ , Duty Cycle $\leq 0.5\%$



## Typical Performance Characteristics

Figure 1: Output Characteristics

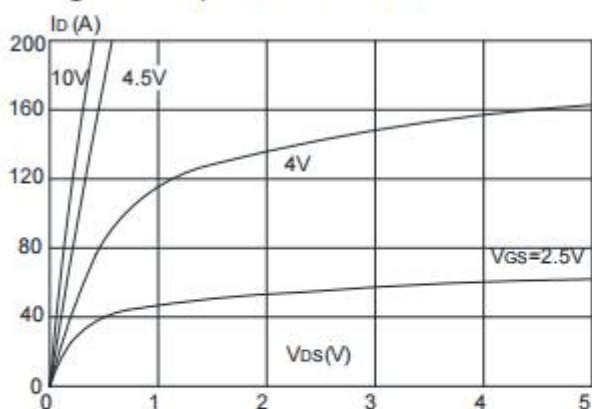


Figure 2: Typical Transfer Characteristics

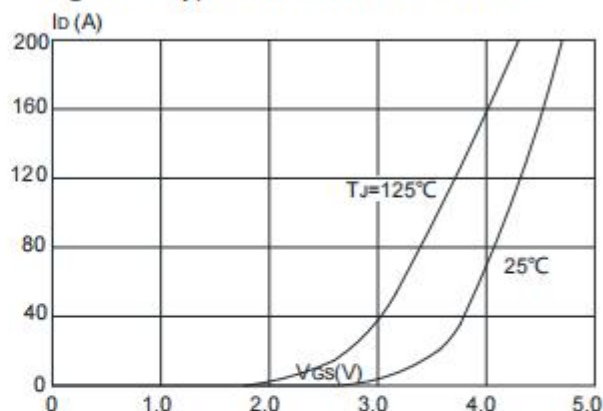


Figure 3: On-resistance vs. Drain Current

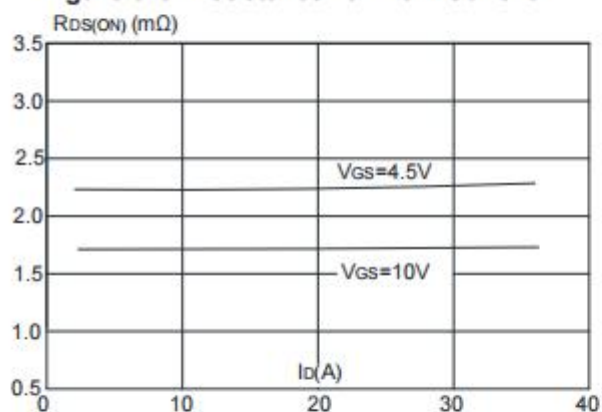


Figure 4: Body Diode Characteristics

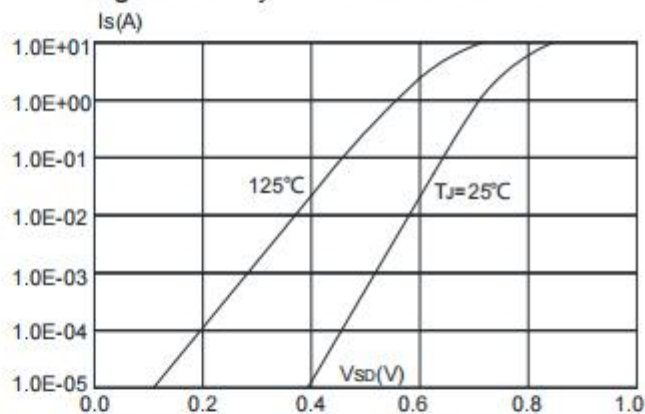


Figure 5: Gate Charge Characteristics

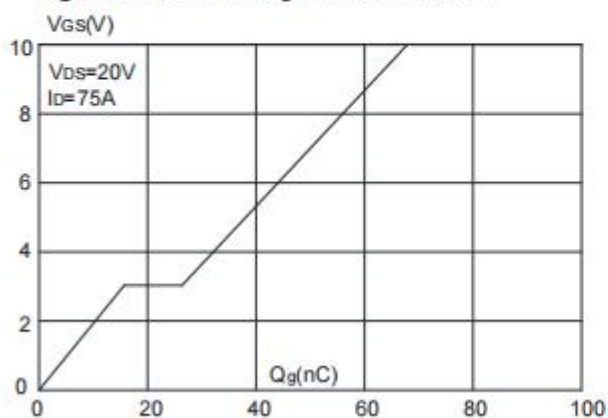
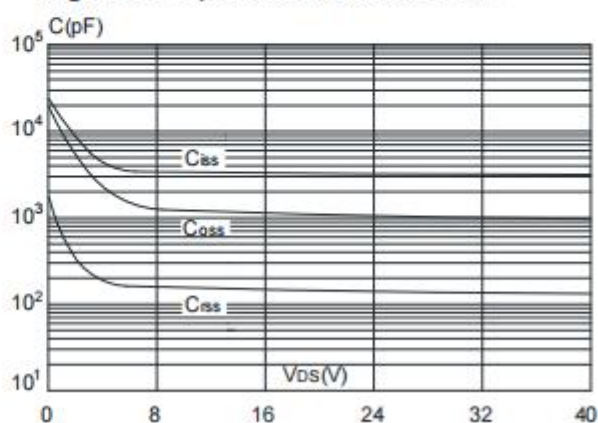
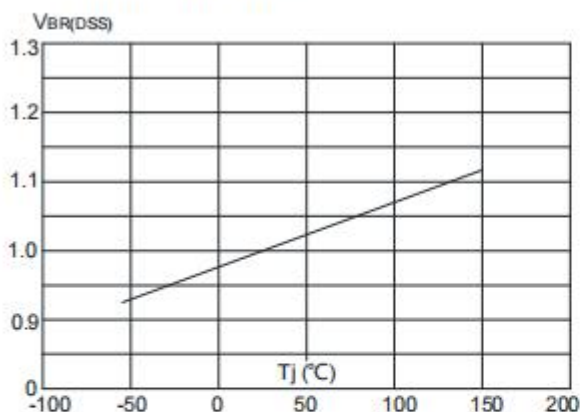
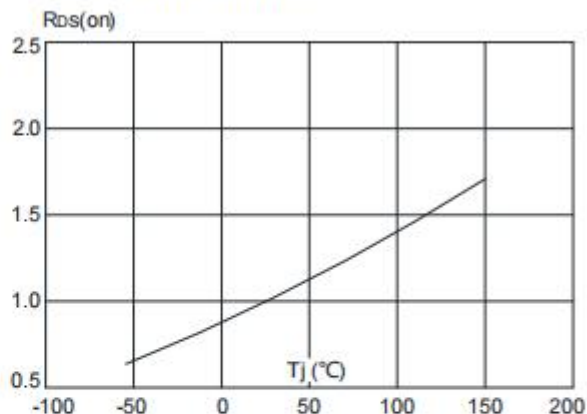
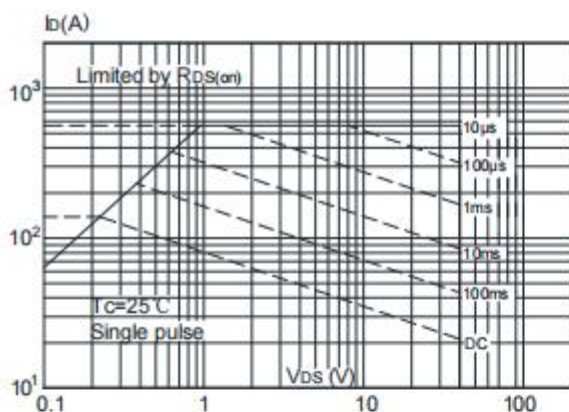
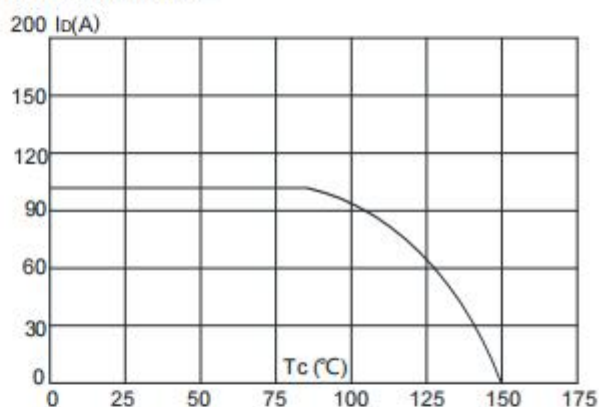
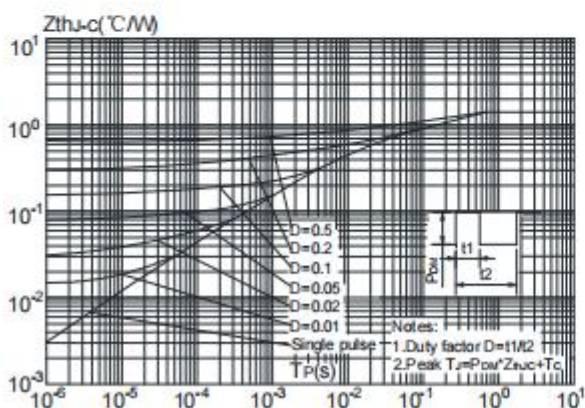


Figure 6: Capacitance Characteristics



**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

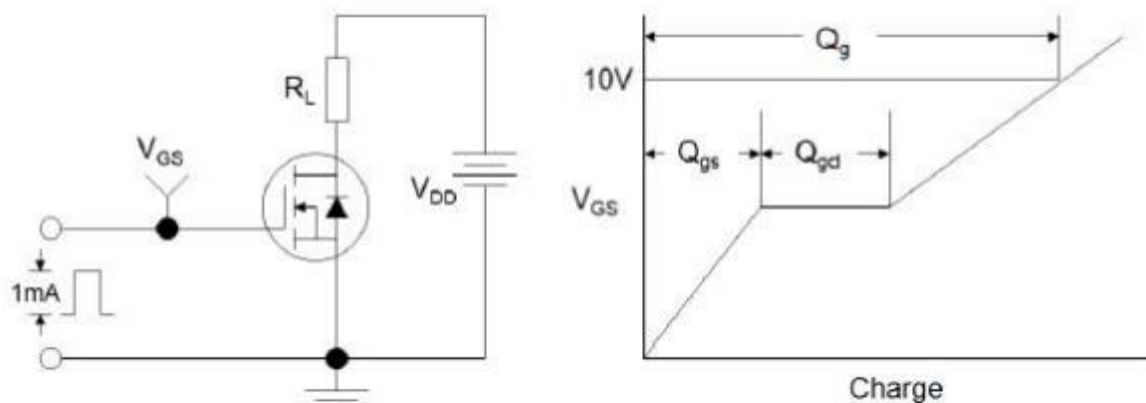


Figure1:Gate Charge Test Circuit &amp; Waveform

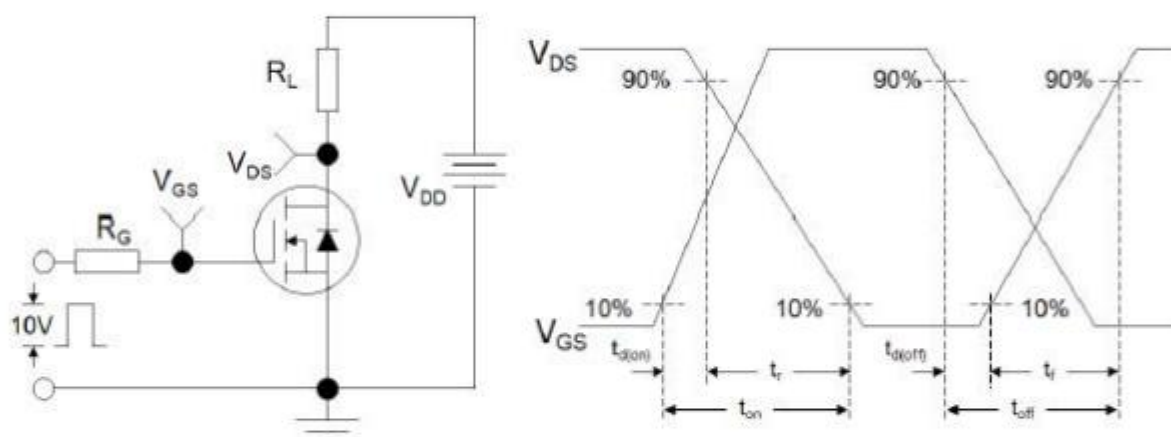


Figure 2: Resistive Switching Test Circuit &amp; Waveforms

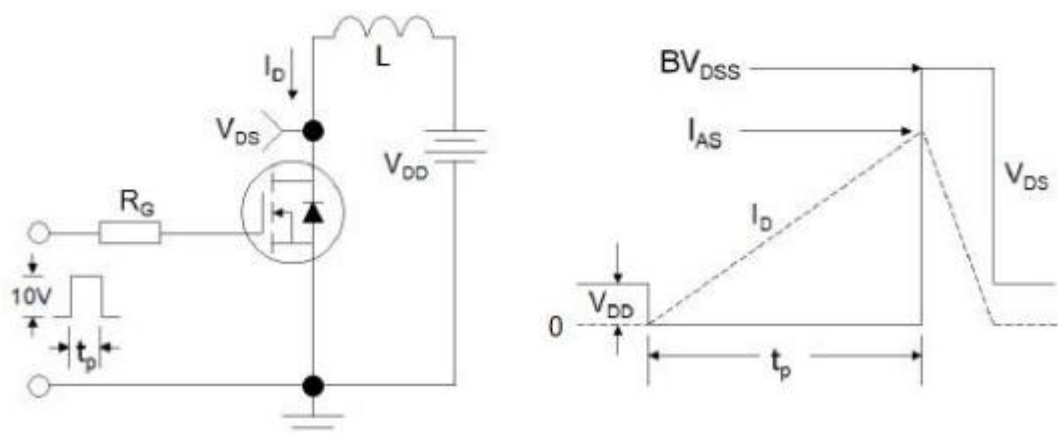
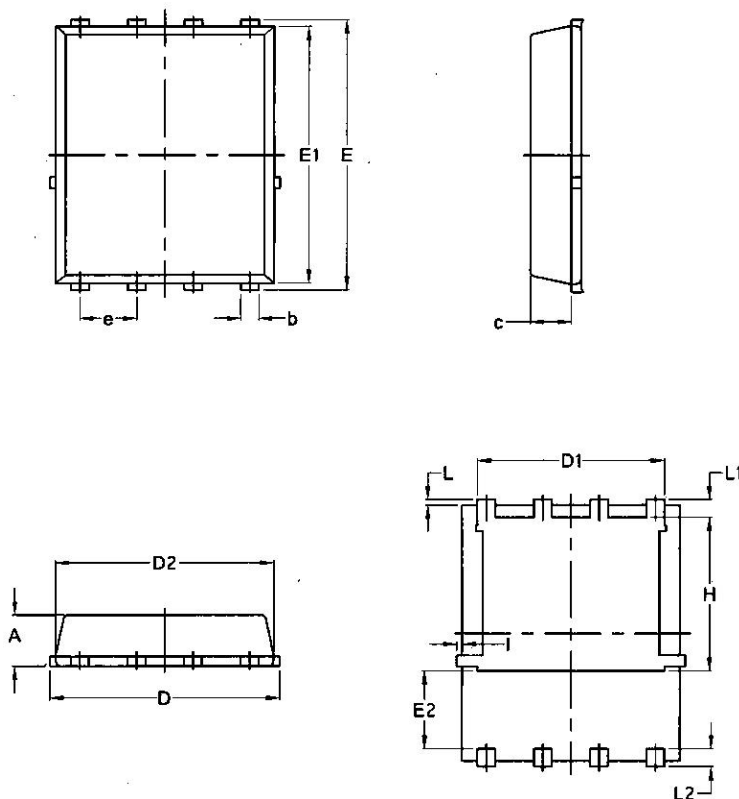


Figure 3:Unclamped Inductive Switching Test Circuit &amp; Waveforms



## Package Dimensions PDFN5x6-8L



| Symbol | Common   |        |          |        |
|--------|----------|--------|----------|--------|
|        | mm       |        | Inch     |        |
|        | Min      | Max    | Min      | Max    |
| A      | 1.03     | 1.17   | 0.0406   | 0.0461 |
| b      | 0.34     | 0.48   | 0.0134   | 0.0189 |
| c      | 0.824    | 0.0970 | 0.0324   | 0.082  |
| D      | 4.80     | 5.40   | 0.1890   | 0.2126 |
| D1     | 4.11     | 4.31   | 0.1618   | 0.1697 |
| D2     | 4.80     | 5.00   | 0.1890   | 0.1969 |
| E      | 5.95     | 6.15   | 0.2343   | 0.2421 |
| E1     | 5.65     | 5.85   | 0.2224   | 0.2303 |
| E2     | 1.60     | /      | 0.0630   | /      |
| e      | 1.27 BSC |        | 0.05 BSC |        |
| L      | 0.05     | 0.25   | 0.0020   | 0.0098 |
| L1     | 0.38     | 0.50   | 0.0150   | 0.0197 |
| L2     | 0.38     | 0.50   | 0.0150   | 0.0197 |
| H      | 3.30     | 3.50   | 0.1299   | 0.1378 |
| I      | /        | 0.18   | /        | 0.0070 |



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## Chip revision change

| Date | Revision | Remarks |
|------|----------|---------|
|      |          |         |