

## JMSH04014G4L

### Features

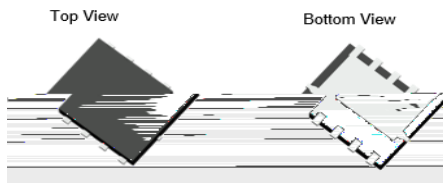
- Excellent  $R_{DS(ON)}$  and Low Gate Charge
- 100% UIS Tested
- 100%  $V_{DS}$  Tested
- Halogen-free; RoHS-compliant

### Applications

- Load Switch
- PWM Application
- Power Management

### Product Summary

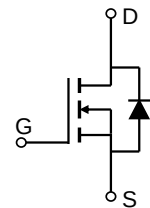
| Parameters                      | Value | Unit       |
|---------------------------------|-------|------------|
| $V_{DSS}$                       | 40    | V          |
| $V_{GS(th)}_{Typ}$              | 2.8   | V          |
| $I_D(@V_{GS}=10V)$              | 209   | A          |
| $R_{DS(ON)}_{Typ}(@V_{GS}=10V)$ | 1.2   | m $\Omega$ |



PDFN5X6-8L



Pin Assignment



Schematic Diagram

### Ordering Information

| Device          | Marking   | MSL | Form      | Package    | Reel(pcs) | Per Carton (pcs) |
|-----------------|-----------|-----|-----------|------------|-----------|------------------|
| JMSH04014G4L-13 | SH040144L | 1   | Tape&Reel | PDFN5x6-8L | 5000      | 50000            |

### Absolute Maximum Ratings (@ $T_C = 25^\circ\text{C}$ unless otherwise specified)

| Symbol         | Parameter                                     | Value                                                 | Unit             |
|----------------|-----------------------------------------------|-------------------------------------------------------|------------------|
| $V_{DS}$       | Drain-to-Source Voltage                       | 40                                                    | V                |
| $V_{GS}$       | Gate-to-Source Voltage                        | $\pm 20$                                              | V                |
| $I_D$          | Continuous Drain Current                      | $T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$ | A                |
| $I_{DM}$       | Pulsed Drain Current <sup>(1)</sup>           | Refer to Fig.4                                        | A                |
| $E_{AS}$       | Single Pulsed Avalanche Energy <sup>(2)</sup> | 389                                                   | mJ               |
| $P_D$          | Power Dissipation                             | $T_C = 25^\circ\text{C}$<br>$T_C = 100^\circ\text{C}$ | W                |
| $T_J, T_{STG}$ | Junction & Storage Temperature Range          | -55 to 175                                            | $^\circ\text{C}$ |

### Thermal Characteristics

| Symbol | Parameter                                              | Max | Unit               |
|--------|--------------------------------------------------------|-----|--------------------|
| R      | Thermal Resistance, Junction to Ambient <sup>(3)</sup> | 46  | $^\circ\text{C/W}$ |
| R      | Thermal Resistance, Junction to Case                   | 1.4 | $^\circ\text{C/W}$ |



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

| Symbol                     | Parameter                                        | Conditions                                                                                  | Min. | Typ. | Max. | Unit |
|----------------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------|------|------|------|------|
| Off Characteristics        |                                                  |                                                                                             |      |      |      |      |
| V <sub>(BR)DSS</sub>       | Drain-Source Breakdown Voltage                   | I <sub>D</sub> = 250μA, V <sub>GS</sub> = 0V                                                | 40   | -    | -    | V    |
| I <sub>DSS</sub>           | Zero Gate Voltage Drain Current                  | V <sub>DS</sub> = 32V, V <sub>GS</sub> = 0V                                                 | -    | -    | 1.0  | μA   |
| I <sub>GSS</sub>           | Gate-Body Leakage Current                        | V <sub>DS</sub> = 0V, V <sub>GS</sub> = ±20V                                                | -    | -    | ±100 | nA   |
| On Characteristics         |                                                  |                                                                                             |      |      |      |      |
| V <sub>GS(th)</sub>        | Gate Threshold Voltage                           | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                                  | 2.0  | 2.8  | 4.0  | V    |
| R <sub>DS(ON)</sub>        | Static Drain-Source ON-Resistance <sup>(4)</sup> | V <sub>GS</sub> = 10V, I <sub>D</sub> = 20A                                                 | -    | 1.2  | 1.4  | mΩ   |
| Dynamic Characteristics    |                                                  |                                                                                             |      |      |      |      |
| R <sub>g</sub>             | Gate Resistance                                  | f = 1MHz                                                                                    | -    | 1.9  | -    | Ω    |
| C <sub>iss</sub>           | Input Capacitance                                | V <sub>GS</sub> = 0V, V <sub>DS</sub> = 20V,<br>f = 1MHz                                    | -    | 3859 | 5250 | pF   |
| C <sub>oss</sub>           | Output Capacitance                               |                                                                                             | -    | 1129 | 1550 | pF   |
| C <sub>rss</sub>           | Reverse Transfer Capacitance                     |                                                                                             | -    | 70   | 150  | pF   |
| Q <sub>g</sub>             | Total Gate Charge                                | V <sub>GS</sub> = 0 to 10V<br>V <sub>DS</sub> = 20V, I <sub>D</sub> = 20A                   | -    | 59   | -    | nC   |
| Q <sub>gs</sub>            | Gate Source Charge                               |                                                                                             | -    | 16   | -    | nC   |
| Q <sub>gd</sub>            | Gate Drain("Miller") Charge                      |                                                                                             | -    | 12   | -    | nC   |
|                            |                                                  |                                                                                             |      |      |      |      |
| Switching Characteristics  |                                                  |                                                                                             |      |      |      |      |
| t <sub>d(on)</sub>         | Turn-On DelayTime                                | V <sub>GS</sub> = 10V, V <sub>DD</sub> = 20V<br>I <sub>D</sub> = 20A, R <sub>GEN</sub> = 3Ω | -    | 25   | -    | ns   |
| t <sub>r</sub>             | Turn-On Rise Time                                |                                                                                             | -    | 26   | -    | ns   |
| t <sub>d(off)</sub>        | Turn-Off DelayTime                               |                                                                                             | -    | 38   | -    | ns   |
| t <sub>f</sub>             | Turn-Off Fall Time                               |                                                                                             | -    | 12   | -    | ns   |
| Body Diode Characteristics |                                                  |                                                                                             |      |      |      |      |
| I <sub>S</sub>             | Maximum Continuous Body Diode Forward Current    |                                                                                             | -    | -    | 209  | A    |
| I <sub>SM</sub>            | Maximum Pulsed Body Diode Forward Current        |                                                                                             | -    | -    | 836  | A    |
| V <sub>SD</sub>            | Body Diode Forward Voltage                       | V <sub>GS</sub> = 0V, I <sub>S</sub> = 20A                                                  | -    |      | 1.2  | V    |
| trr                        | Body Diode Reverse Recovery Time                 | I <sub>F</sub> = 20A, di/dt = 100A/us                                                       | 21   | 41   | 62   | ns   |
| Qrr                        | Body Diode Reverse Recovery Charge               |                                                                                             | -    | 41   | -    | nC   |

- Notes:
1. Repetitive Rating: Pulse Width Limited by Maximum Junction Temperature.
  2.  $E_{AS}$  condition: Starting  $T_J = 25^\circ\text{C}$ ,  $V_{DD} = 20\text{V}$ ,  $V_{GS} = 10\text{V}$ ,  $R_G = 25\text{ohm}$ ,  $L = 3\text{mH}$ ,  $I_{AS} = 16.1\text{A}$ ,  $V_{DD} = 0\text{V}$  during time in avalanche.
  3.  $R$  is measured with the device mounted on a  $1\text{inch}^2$  pad of 2oz copper FR4 PCB.
  4. Pulse Test: Pulse Width  $\leq$   $\leq 0.5\%$ .

## Typical Performance Characteristics

Figure 1: Power De-rating

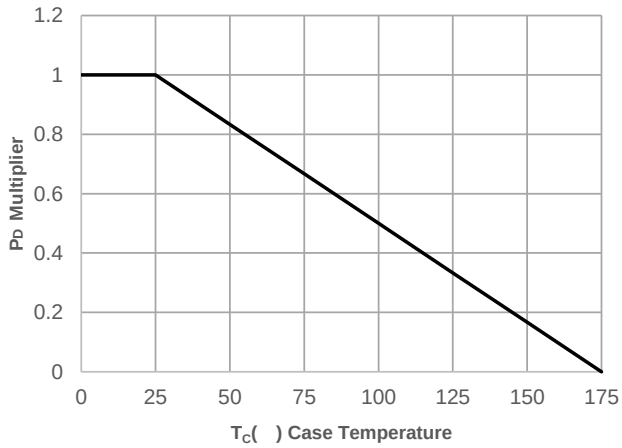


Figure 2: Current De-rating

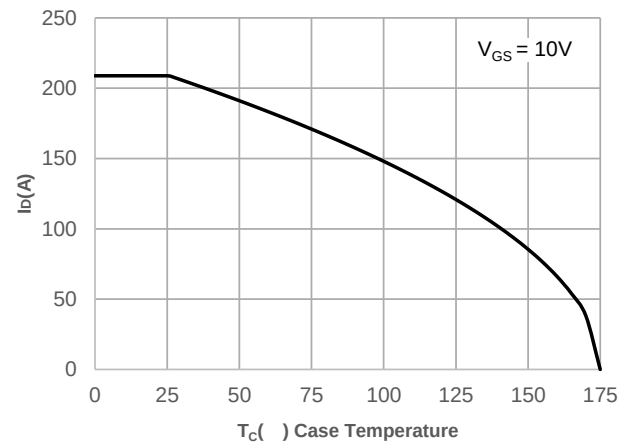


Figure 3: Normalized Maximum Transient Thermal Impedance

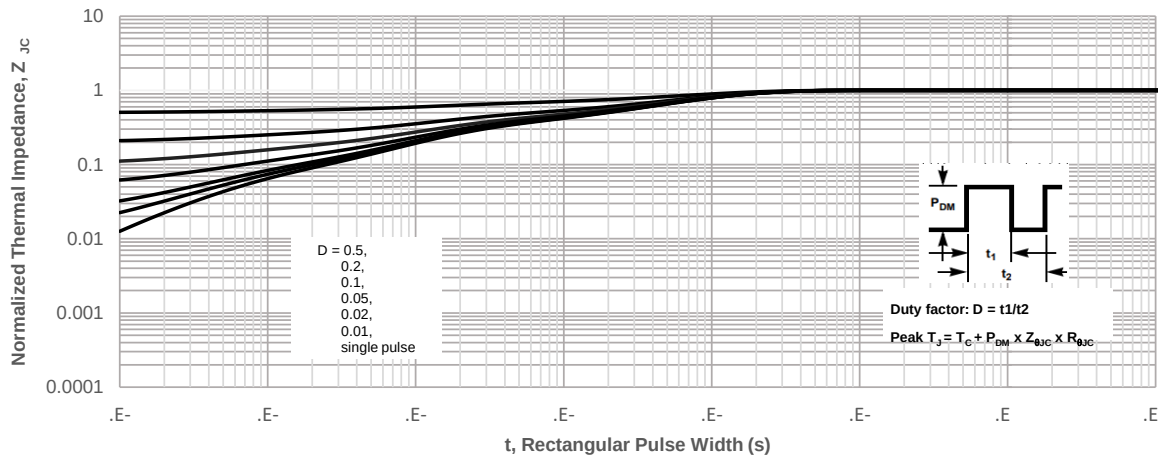
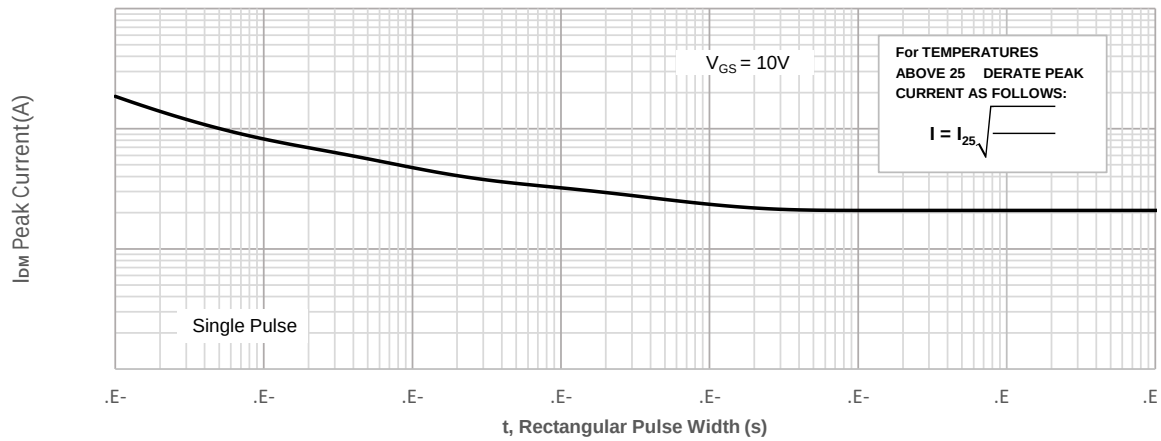


Figure 4: Peak Current Capacity





## Typical Performance Characteristics

Figure 11: Normalized Breakdown Voltage vs. Junction Temperature

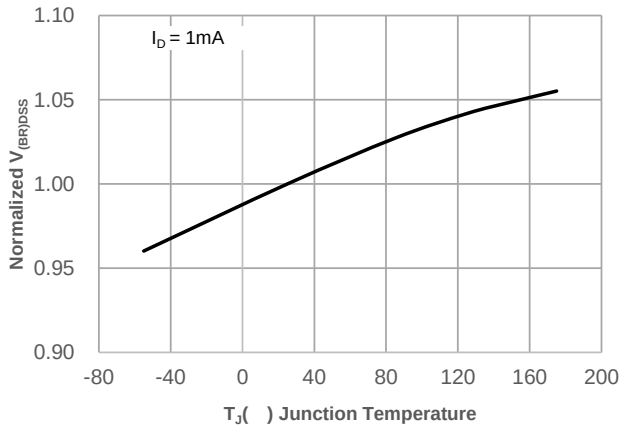


Figure 12: Normalized on Resistance vs. Junction Temperature

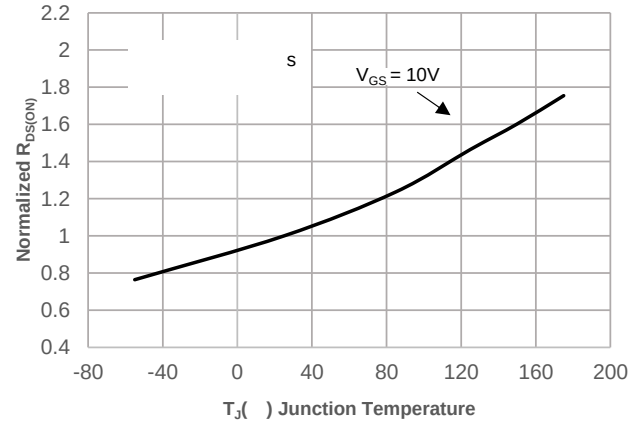


Figure 13: Normalized Threshold Voltage vs. Junction Temperature

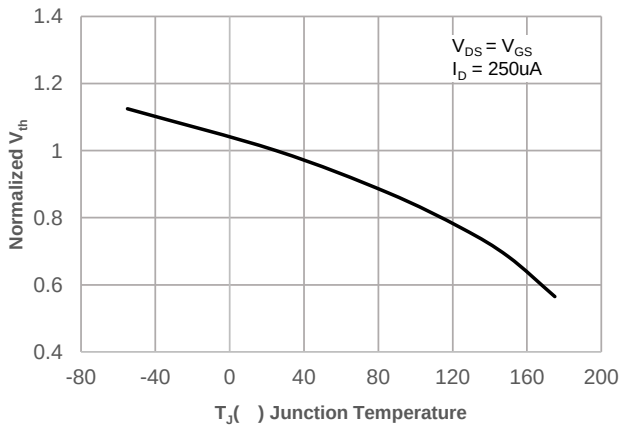


Figure 14:  $R_{DS(ON)}$  vs.  $V_{GS}$

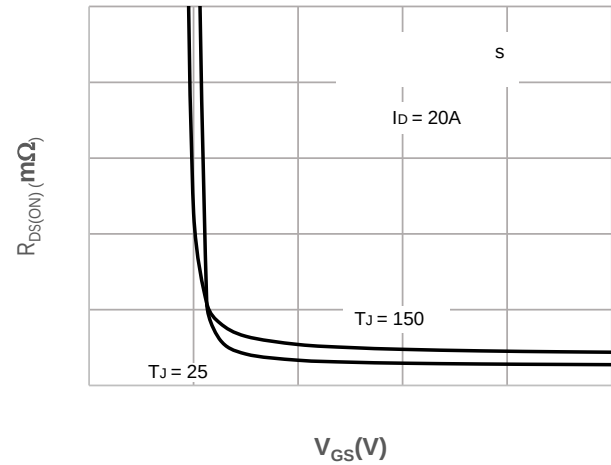
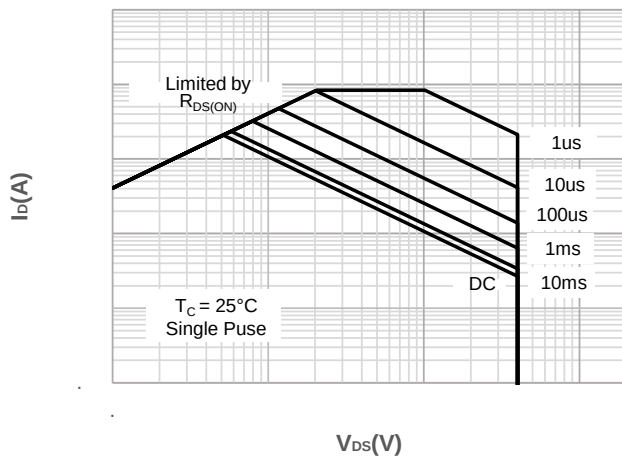


Figure 15: Maximum Safe Operating Area



## Test Circuit



Figure 1: Gate Charge Test Circuit & Waveform

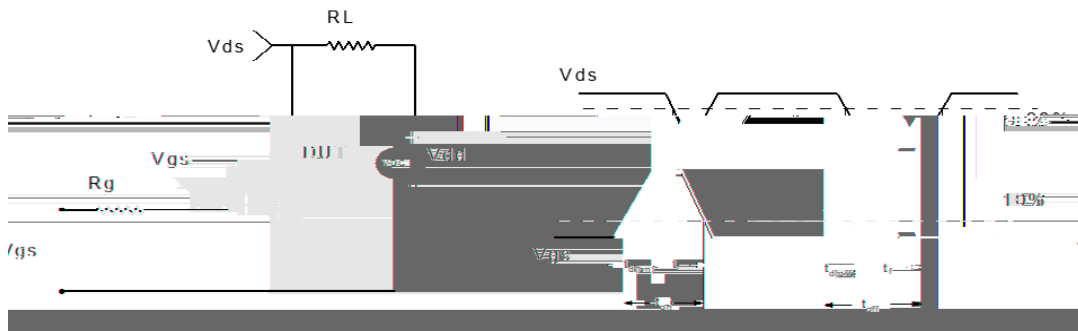


Figure 2: Resistive Switching Test Circuit & Waveform

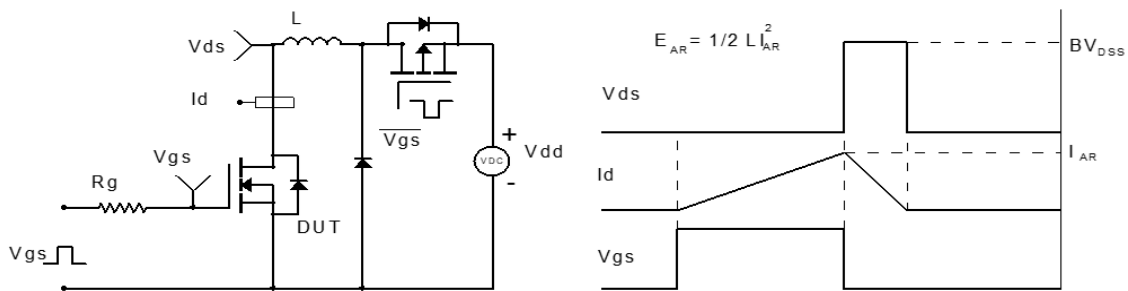


Figure 3: Unclamped Inductive Switching Test Circuit& Waveform

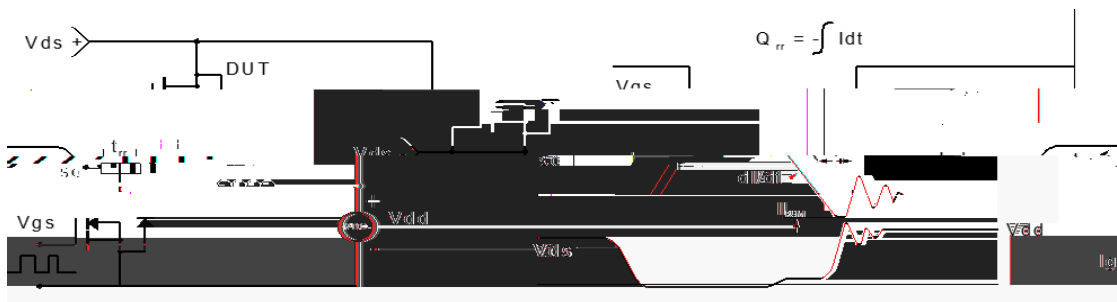
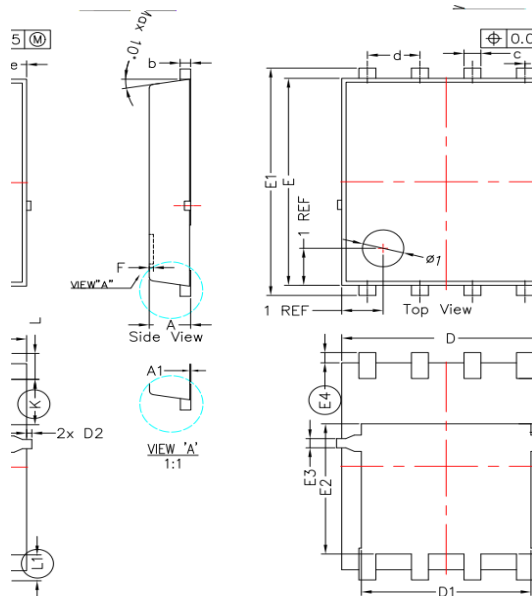


Figure 4: Diode Recovery Test Circuit & Waveform

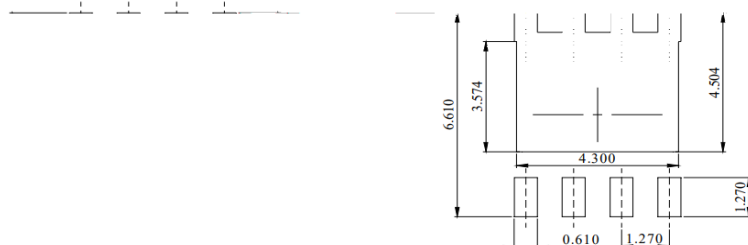


## Package Mechanical Data(PDFN5X6-8L)



| SYMBOLS | MIN   | NOM   | MAX   | MIN   | NOM   | MAX   |
|---------|-------|-------|-------|-------|-------|-------|
| A       | 0.900 | 1.000 | 1.150 | 0.045 | 0.099 | 0.045 |
| A1      | 0.000 | 0.050 | 0.050 | 0.000 | 0.000 | 0.002 |
| b       | 0.246 | 0.254 | 0.350 | 0.010 | 0.010 | 0.014 |
| c       | 0.045 | 0.045 | 0.045 | 0.000 | 0.000 | 0.000 |
| d       | 1.270 | 1.270 | 1.270 | 0.050 | 0.050 | 0.050 |
| D       | 0.190 | 0.190 | 0.190 | 0.195 | 0.199 | 0.200 |
| D1      | 0.000 | 4.100 | 4.200 | 0.157 | 0.161 | 0.165 |
| D2      | 0.125 | 0.125 | 0.125 | 0.000 | 0.000 | 0.000 |
| E       | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| E1      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| E2      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| E3      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| E4      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| F       | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L       | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L1      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L2      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L3      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L4      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L5      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L6      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L7      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L8      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L9      | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L10     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L11     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L12     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L13     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L14     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L15     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L16     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L17     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L18     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L19     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L20     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L21     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L22     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L23     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L24     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L25     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L26     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L27     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L28     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L29     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L30     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L31     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L32     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L33     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L34     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L35     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L36     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L37     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L38     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L39     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L40     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L41     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L42     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L43     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L44     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L45     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L46     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L47     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L48     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L49     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L50     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L51     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L52     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L53     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L54     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L55     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L56     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L57     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L58     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L59     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L60     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L61     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L62     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L63     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L64     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L65     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L66     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L67     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L68     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L69     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L70     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L71     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L72     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L73     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L74     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L75     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L76     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L77     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L78     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L79     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L80     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L81     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L82     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L83     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L84     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L85     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L86     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L87     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L88     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L89     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L90     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L91     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L92     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L93     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L94     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L95     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L96     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L97     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L98     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L99     | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |
| L100    | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 | 0.050 |

## Recommended Soldering Footprint



DIMENSIONS: MILLIMETERS

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