

# Switch-mode Power Rectifiers

## NHP820LFS, NRVHP820LFS

This LFAK ultrafast rectifier provides fast switching performance with soft recovery in a compact thermally efficient package. The LFAK package provides an excellent alternative to the DPAK, offering thermal performance nearly as good in a package occupying less than half the board space. Its low profile makes it a good option for flat panel display and other applications with limited vertical clearance. The device offers low leakage over temperature making it a good match for applications requiring low quiescent current.

### Features

- New Package Provides Capability of Inspection and Probe After Board Mounting
- Low Forward Voltage Drop
- 175°C Operating Junction Temperature
- Excellent Ability to Absorb Stresses Associated with Power Temperature Cycling
- NRV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q101 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

### Mechanical Characteristics:

- Case: Epoxy, Molded
- Epoxy Meets Flammability Rating UL 94-0 @ 0.125 in.
- Lead Finish: 100% Matte Sn (Tin)
- Lead and Mounting Surface Temperature for Soldering Purposes: 260°C Max. for 10 Seconds
- Device Meets MSL 1 Requirements

### Applications

- Excellent Alternative to DPAK in Space-Constrained Automotive Applications
- Very Low Leakage for Higher Temperature Operation
- Output Rectification in Compact Portable Consumer Applications
- Freewheeling Diode used with Inductive Loads



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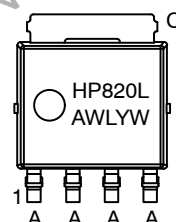
## ULTRAFAST RECTIFIERS 8 AMPERES 200 VOLTS

1,2,3,4 ○ —▶— ○ 5



**LFAK4  
CASE 760AB**

### MARKING DIAGRAM



HP820L = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
W = Work Week

### ORDERING INFORMATION

| Device        | Package            | Shipping†             |
|---------------|--------------------|-----------------------|
| NHP820LFS1G   | LFAK4<br>(Pb-Free) | 3000 /<br>Tape & Reel |
| NRVHP820LFS1G | LFAK4<br>(Pb-Free) | 3000 /<br>Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

# NHP820LFS, NRVHP820LFS

## MAXIMUM RATINGS

| Rating                                                                                                      | Symbol                          | Value       | Unit             |
|-------------------------------------------------------------------------------------------------------------|---------------------------------|-------------|------------------|
| Peak Repetitive Reverse Voltage<br>Working Peak Reverse Voltage<br>DC Blocking Voltage                      | $V_{RRM}$<br>$V_{RWM}$<br>$V_R$ | 200         | V                |
| Average Rectified Forward Current<br>(Rated $V_R$ , $T_C = 168^\circ\text{C}$ )                             | $I_{F(AV)}$                     | 8.0         | A                |
| Peak Repetitive Forward Current,<br>(Rated $V_R$ , Square Wave, 20 kHz, $T_C = 158^\circ\text{C}$ )         | $I_{FRM}$                       | 16          | A                |
| Non-Repetitive Peak Surge Current<br>(Surge Applied at Rated Load Conditions Halfwave, Single Phase, 60 Hz) | $I_{FSM}$                       | 175         | A                |
| Storage Temperature Range                                                                                   | $T_{stg}$                       | -65 to +175 | $^\circ\text{C}$ |
| Operating Junction Temperature                                                                              | $T_J$                           | -55 to +175 | $^\circ\text{C}$ |
| ESD Rating (Human Body Model)                                                                               |                                 | 3B          |                  |
| ESD Rating (Machine Model)                                                                                  |                                 | C5          |                  |
| Controlled Avalanche Energy (See Test Circuit in Figures 9 & 10)                                            | $W_{AVAL}$                      | 50          | mJ               |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

## THERMAL CHARACTERISTICS

| Characteristic                                                                                                               | Symbol          | Max  | Unit               |
|------------------------------------------------------------------------------------------------------------------------------|-----------------|------|--------------------|
| Thermal Resistance, Junction-to-Ambient, Steady State<br>(Assumes 645 mm <sup>2</sup> 2 oz. copper bond pad, on a FR4 board) | $R_{\theta JA}$ | 44   | $^\circ\text{C/W}$ |
| Thermal Resistance, Junction-to-Case, Steady State<br>(Assumes 645 mm <sup>2</sup> 2 oz. copper bond pad, on a FR4 board)    | $R_{\theta JC}$ | 1.07 | $^\circ\text{C/W}$ |

## ELECTRICAL CHARACTERISTICS

| Characteristic                                                                                                                                    | Symbol   | Max          | Unit          |
|---------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------------|---------------|
| Instantaneous Forward Voltage (Note 1)<br>( $I_F = 8\text{ A}$ , $T_J = 125^\circ\text{C}$ )<br>( $I_F = 8\text{ A}$ , $T_J = 25^\circ\text{C}$ ) | $V_F$    | 0.88<br>1.00 | V             |
| Instantaneous Reverse Current (Note 1)<br>(Rated dc Voltage, $T_J = 125^\circ\text{C}$ )<br>(Rated dc Voltage, $T_J = 25^\circ\text{C}$ )         | $i_R$    | 100<br>1.0   | $\mu\text{A}$ |
| Maximum Reverse Recovery Time<br>( $I_F = 1.0\text{ A}$ , $di/dt = 50\text{ A}/\mu\text{s}$ , $V_R = 30\text{ V}$ )                               | $T_{rr}$ | 35           | ns            |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

1. Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

TYPICAL CHARACTERISTICS

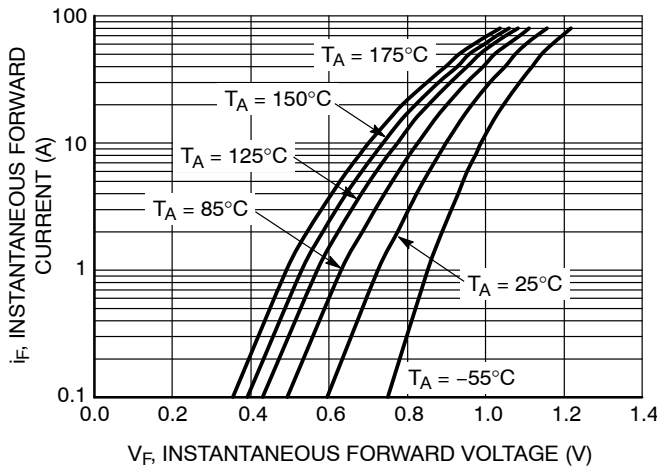


Figure 1. Typical Instantaneous Forward Characteristics

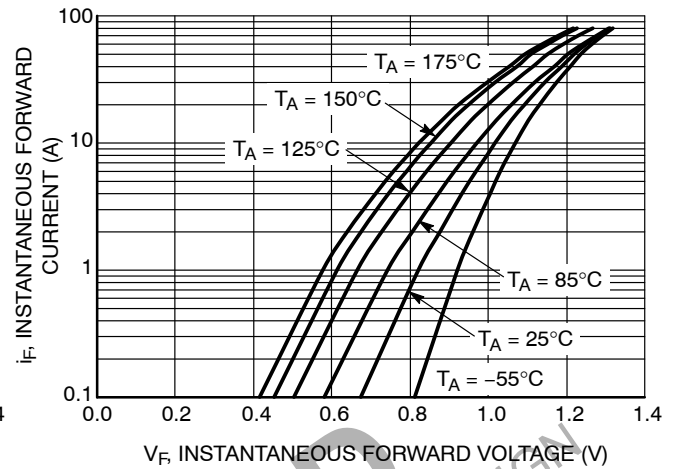


Figure 2. Maximum Instantaneous Forward Characteristics

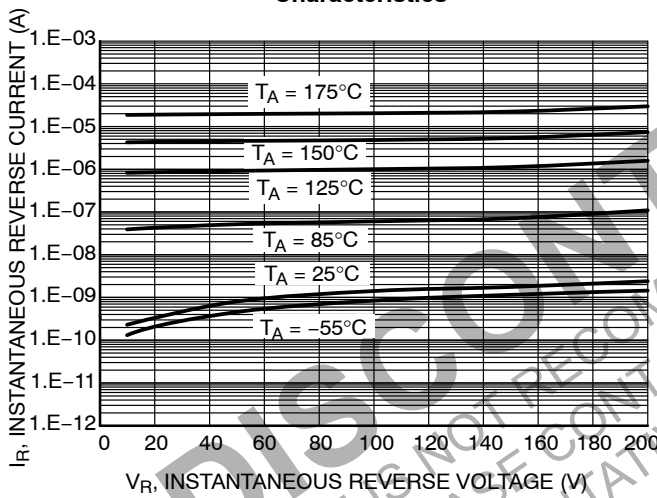


Figure 3. Typical Reverse Characteristics

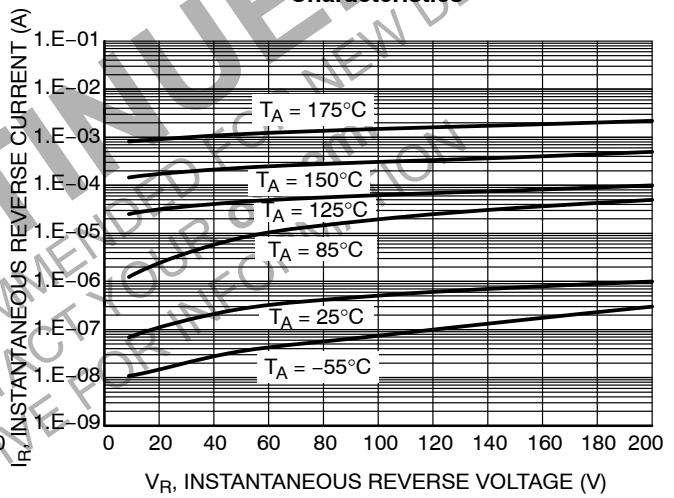


Figure 4. Maximum Reverse Characteristics

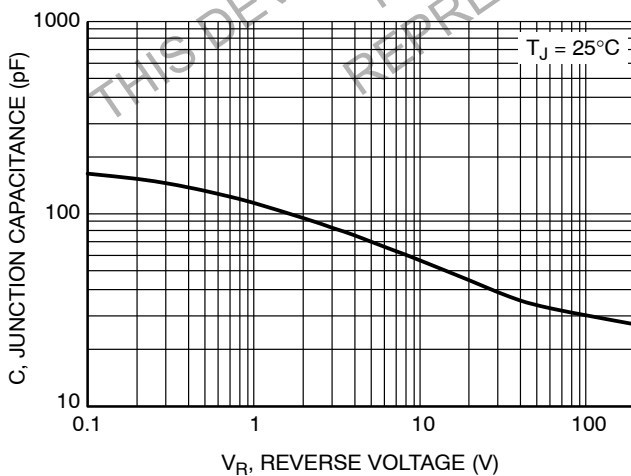


Figure 5. Typical Junction Capacitance

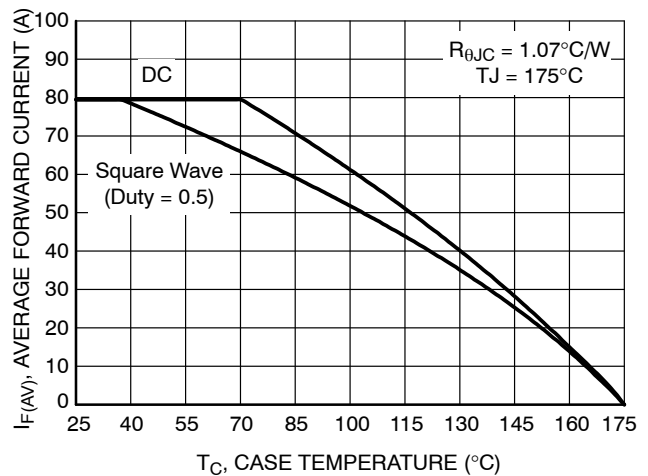


Figure 6. Current Derating per Device

# NHP820LFS, NRVHP820LFS

## TYPICAL CHARACTERISTICS

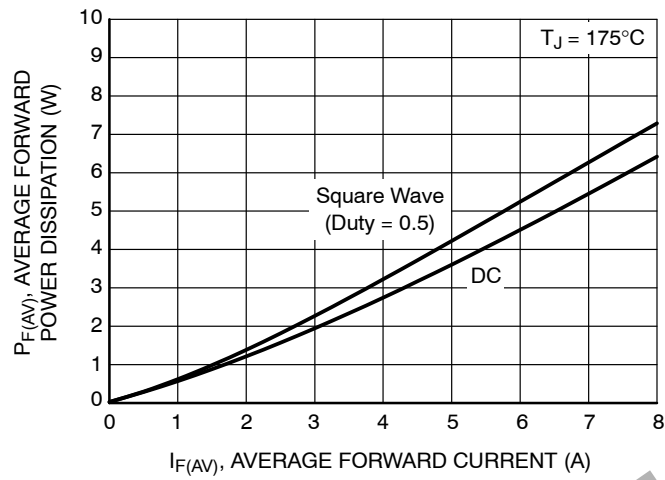


Figure 7. Forward Power Dissipation

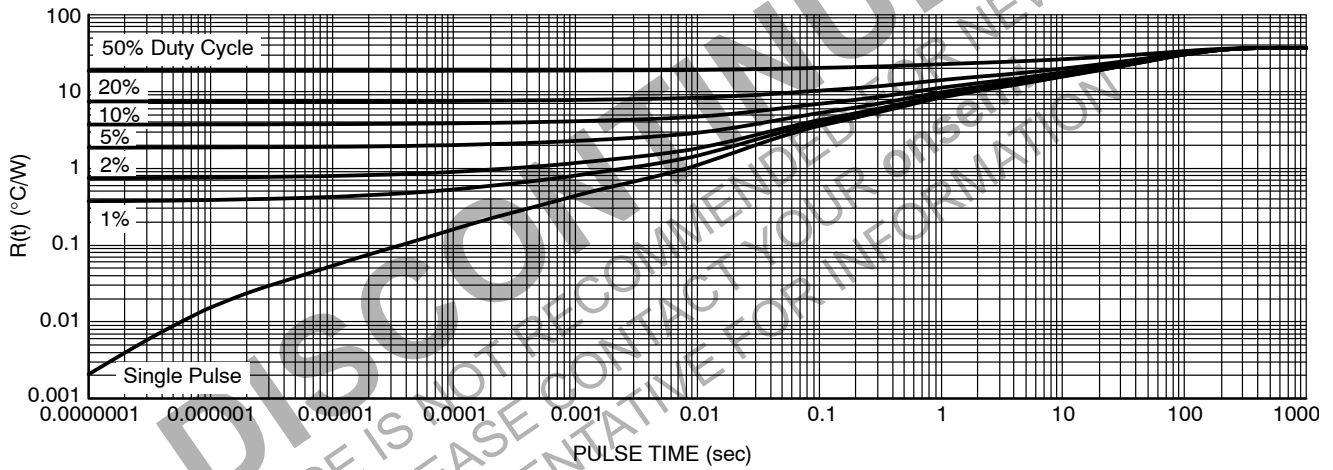


Figure 8. Typical Thermal Characteristics, Junction-to-Ambient

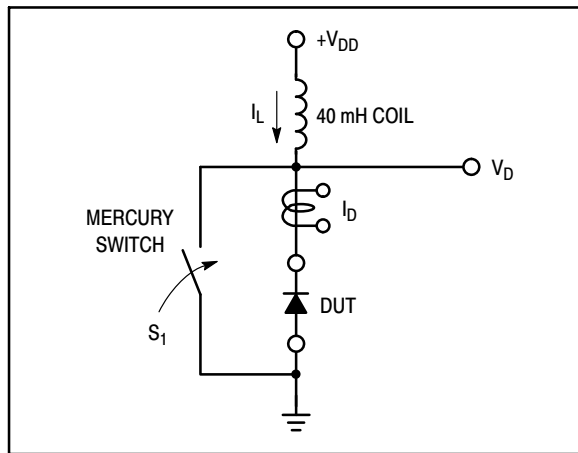


Figure 9. Test Circuit

The unclamped inductive switching circuit shown in Figure 9 was used to demonstrate the controlled avalanche capability of the new “E” series Ultrafast rectifiers. A mercury switch was used instead of an electronic switch to simulate a noisy environment when the switch was being opened.

When  $S_1$  is closed at  $t_0$  the current in the inductor  $I_L$  ramps up linearly; and energy is stored in the coil. At  $t_1$  the switch is opened and the voltage across the diode under test begins to rise rapidly, due to  $di/dt$  effects, when this induced voltage reaches the breakdown voltage of the diode, it is clamped at  $BV_{DUT}$  and the diode begins to conduct the full load current which now starts to decay linearly through the diode, and goes to zero at  $t_2$ .

By solving the loop equation at the point in time when  $S_1$  is opened; and calculating the energy that is transferred to the diode it can be shown that the total energy transferred is equal to the energy stored in the inductor plus a finite amount of energy from the  $V_{DD}$  power supply while the diode is in breakdown (from  $t_1$  to  $t_2$ ) minus any losses due to finite

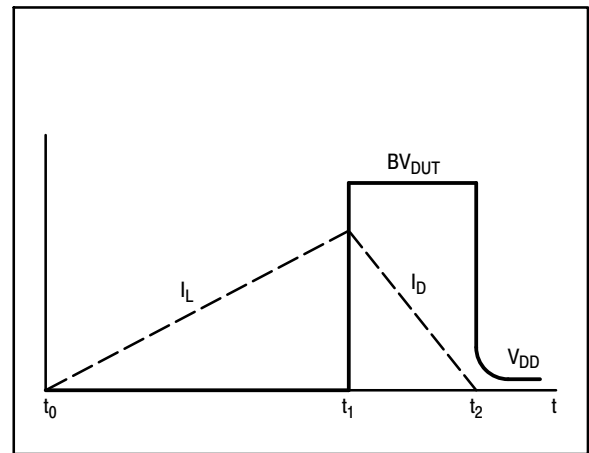


Figure 10. Current-Voltage Waveforms

component resistances. Assuming the component resistive elements are small Equation (1) approximates the total energy transferred to the diode. It can be seen from this equation that if the  $V_{DD}$  voltage is low compared to the breakdown voltage of the device, the amount of energy contributed by the supply during breakdown is small and the total energy can be assumed to be nearly equal to the energy stored in the coil during the time when  $S_1$  was closed, Equation (2).

EQUATION (1):

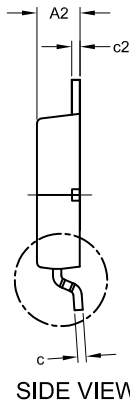
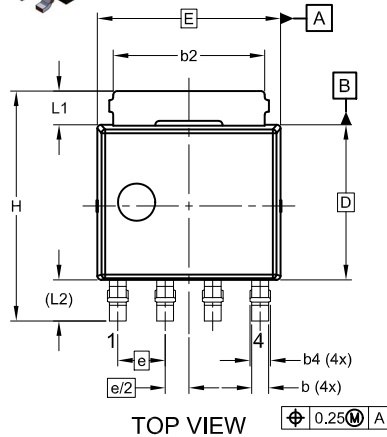
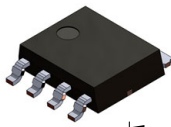
$$W_{AVAL} \approx \frac{1}{2} L I_{LPK}^2 \left( \frac{BV_{DUT}}{BV_{DUT} - V_{DD}} \right)$$

EQUATION (2):

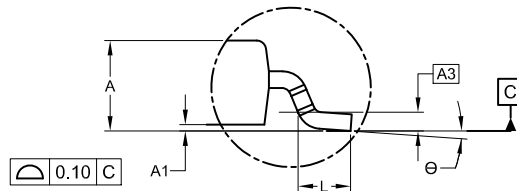
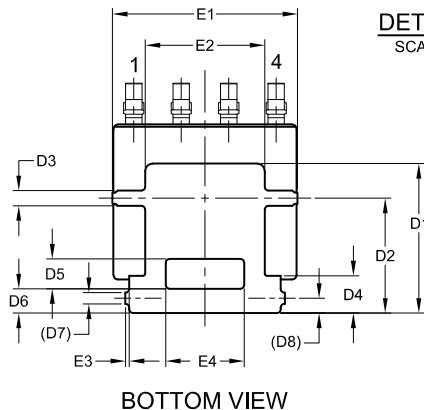
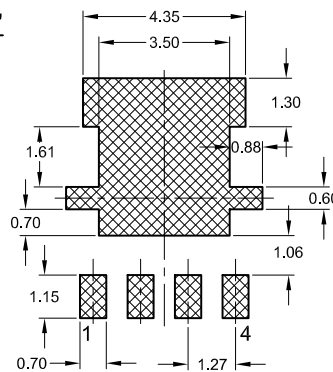
$$W_{AVAL} \approx \frac{1}{2} L I_{LPK}^2$$

**LFP4K4 4.90x4.15x1.15MM, 1.27P**  
**CASE 760AB**  
**ISSUE D**

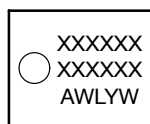
DATE 22 MAY 2024


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 2018.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR BURRS. MOLD FLASH PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.150mm PER SIDE.
4. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.


**DETAIL 'A'**  
SCALE: 2:1

**BOTTOM VIEW**

**RECOMMENDED LAND PATTERN**

\*FOR ADDITIONAL INFORMATION ON OUR PB-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ONSEMI SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERRM/D.

**GENERIC MARKING DIAGRAM\***


XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
W = Work Week

\*This information is generic. Please refer to device data sheet for actual part marking. Some products may not follow the Generic Marking.

| MILLIMETER |           |      |      |
|------------|-----------|------|------|
| DIM        | MIN       | NOM  | MAX  |
| A          | 1.10      | 1.20 | 1.30 |
| A1         | 0.00      | 0.08 | 0.15 |
| A2         | 1.10      | 1.15 | 1.20 |
| A3         | 0.25 BSC  |      |      |
| b          | 0.40      | 0.45 | 0.50 |
| b2         | 3.80      | 4.10 | 4.40 |
| b4         | 0.45      | 0.55 | 0.65 |
| c          | 0.19      | 0.22 | 0.25 |
| c2         | 0.19      | 0.22 | 0.25 |
| D          | 4.15 BSC  |      |      |
| D1         | 3.80      | 4.00 | 4.20 |
| D2         | 3.00      | 3.10 | 3.20 |
| D3         | 0.30      | 0.40 | 0.50 |
| D4         | 0.90      | 1.00 | 1.10 |
| D5         | 0.70      | 0.80 | 0.90 |
| D6         | 0.55      | 0.65 | 0.75 |
| D7         | 0.31 REF  |      |      |
| D8         | 0.40 REF  |      |      |
| E          | 4.90 BSC  |      |      |
| E1         | 4.85      | 4.95 | 5.05 |
| E2         | 3.10      | 3.20 | 3.30 |
| E3         | 0.00      | 0.10 | 0.20 |
| E4         | 2.00      | 2.10 | 2.20 |
| e          | 1.27 BSC  |      |      |
| e/2        | 0.635 BSC |      |      |
| e1         | 0.40 REF  |      |      |
| H          | 6.00      | 6.15 | 6.30 |
| L          | 0.50      | 0.70 | 0.90 |
| L1         | 0.80      | 0.90 | 1.00 |
| L2         | 1.10 REF  |      |      |
| Θ          | 0°        | 4°   | 8°   |

**DOCUMENT NUMBER:** 98AON82777G

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**DESCRIPTION:** LFP4K4 4.90x4.15x1.15MM, 1.27P

**PAGE 1 OF 1**

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