

### 60R Series



#### Agency Approvals

| AGENCY  | AGENCY FILE NUMBER | 60R010X & 60R017X |
|---|--------------------|-------------------|
|  | E183209            | E183209           |
|  | R50119318          | N/A               |

#### Description

The 60R Series radial leaded device is designed to provide overcurrent protection for ( $\leq 60V$ ) applications where space is not a concern and resettable protection is preferred.

#### Features

- Cured, flame retardant epoxy polymer insulating material meets UL 94V-0 requirements
- Fast time-to-trip
- RoHS compliant, Lead-Free and Halogen-Free\*

#### Applications

- USB hubs, ports and peripherals
- IEEE1394 ports
- Computers & peripherals
- Motor protection
- General electronics
- Automotive applications
- Industrial controls
- Transformers

#### Electrical Characteristics

| Part Number | $I_{hold}$ (A) | $I_{trip}$ (A) | $V_{max}$ (Vdc) | $I_{max}$ (A) | $P_d$ typ. (W) | Maximum Time To Trip |             | Resistance             |                         | Agency Approvals  |   |
|-------------|----------------|----------------|-----------------|---------------|----------------|----------------------|-------------|------------------------|-------------------------|---|---|
|             |                |                |                 |               |                | Current (A)          | Time (Sec.) | $R_{min}$ ( $\Omega$ ) | $R_{1max}$ ( $\Omega$ ) |  |  |
| 60R010X     | 0.10           | 0.20           | 60              | 40            | 0.38           | 0.50                 | 4.00        | 2.500                  | 7500                    | X   |   |
| 60R017X     | 0.17           | 0.34           | 60              | 40            | 0.48           | 0.85                 | 3.00        | 3.300                  | 8.000                   | X   |   |
| 60R020X     | 0.20           | 0.40           | 60              | 40            | 0.41           | 1.00                 | 2.20        | 1.830                  | 4.400                   | X   | X   |
| 60R025X     | 0.25           | 0.50           | 60              | 40            | 0.45           | 1.25                 | 2.50        | 1.250                  | 3.000                   | X   | X   |
| 60R030X     | 0.30           | 0.60           | 60              | 40            | 0.49           | 1.50                 | 3.00        | 0.880                  | 2.100                   | X   | X   |
| 60R040X     | 0.40           | 0.80           | 60              | 40            | 0.56           | 2.00                 | 3.80        | 0.550                  | 1.290                   | X   | X   |
| 60R050X     | 0.50           | 1.00           | 60              | 40            | 0.77           | 2.50                 | 4.00        | 0.500                  | 1.170                   | X   | X   |
| 60R065X     | 0.65           | 1.30           | 60              | 40            | 0.88           | 3.25                 | 5.30        | 0.310                  | 0.720                   | X   | X   |
| 60R075X     | 0.75           | 1.50           | 60              | 40            | 0.92           | 3.75                 | 6.30        | 0.250                  | 0.600                   | X   | X   |
| 60R090X     | 0.90           | 1.80           | 60              | 40            | 0.99           | 4.50                 | 7.20        | 0.200                  | 0.470                   | X   | X   |
| 60R110X     | 1.10           | 2.20           | 60              | 40            | 1.50           | 5.50                 | 8.20        | 0.150                  | 0.380                   | X   | X   |
| 60R135X     | 1.35           | 2.70           | 60              | 40            | 1.70           | 6.75                 | 9.60        | 0.120                  | 0.300                   | X   | X   |
| 60R160X     | 1.60           | 3.20           | 60              | 40            | 1.90           | 8.00                 | 11.40       | 0.090                  | 0.220                   | X   | X   |
| 60R185X     | 1.85           | 3.70           | 60              | 40            | 2.10           | 9.25                 | 12.60       | 0.080                  | 0.190                   | X   | X   |
| 60R250X     | 2.50           | 5.00           | 60              | 40            | 2.50           | 12.50                | 15.60       | 0.050                  | 0.130                   | X   | X   |
| 60R300X     | 3.00           | 6.00           | 60              | 40            | 2.80           | 15.00                | 19.80       | 0.040                  | 0.100                   | X   | X   |
| 60R375X     | 3.75           | 7.50           | 60              | 40            | 3.20           | 18.75                | 24.00       | 0.030                  | 0.080                   | X   | X   |

$I_{hold}$  = Hold current: maximum current device will pass without tripping in 20°C still air.  
 $I_{trip}$  = Trip current: minimum current at which the device will trip in 20°C still air.  
 $V_{max}$  = Maximum voltage device can withstand without damage at rated current ( $I_{max}$ )  
 $I_{max}$  = Maximum fault current device can withstand without damage at rated voltage ( $V_{max}$ )  
 $P_d$  = Power dissipated from device when in the tripped state at 20°C still air.

$R_{min}$  = Minimum resistance of device in initial (un-soldered) state.  
 $R_{typ}$  = Typical resistance of device in initial (un-soldered) state.  
 $R_{1max}$  = Maximum resistance of device at 20°C measured one hour after tripping or reflow soldering of 260°C for 20 sec.

**Caution:** Operation beyond the specified rating may result in damage and possible arcing and flame.

\* Effective January 1, 2010, all 60R PTC products will be manufactured Halogen Free (HF). Existing Non-Halogen Free 60R PTC products may continue to be sold, until supplies are depleted.

**Temperature Derating**

| Part Number | Ambient Operation Temperature |       |      |      |      |      |      |      |      |
|-------------|-------------------------------|-------|------|------|------|------|------|------|------|
|             | -40°C                         | -20°C | 0°C  | 20°C | 40°C | 50°C | 60°C | 70°C | 85°C |
|             | Hold Current (A)              |       |      |      |      |      |      |      |      |
| 60R010X     | 0.16                          | 0.14  | 0.12 | 0.10 | 0.08 | 0.07 | 0.06 | 0.05 | 0.04 |
| 60R017X     | 0.26                          | 0.23  | 0.20 | 0.17 | 0.14 | 0.12 | 0.11 | 0.09 | 0.07 |
| 60R020X     | 0.31                          | 0.27  | 0.24 | 0.20 | 0.16 | 0.14 | 0.13 | 0.11 | 0.08 |
| 60R025X     | 0.39                          | 0.34  | 0.30 | 0.25 | 0.20 | 0.18 | 0.16 | 0.14 | 0.10 |
| 60R030X     | 0.47                          | 0.41  | 0.36 | 0.30 | 0.24 | 0.22 | 0.19 | 0.16 | 0.12 |
| 60R040X     | 0.62                          | 0.54  | 0.48 | 0.40 | 0.32 | 0.29 | 0.25 | 0.22 | 0.16 |
| 60R050X     | 0.78                          | 0.68  | 0.60 | 0.50 | 0.41 | 0.36 | 0.32 | 0.27 | 0.20 |
| 60R065X     | 1.01                          | 0.88  | 0.77 | 0.65 | 0.53 | 0.47 | 0.41 | 0.35 | 0.26 |
| 60R075X     | 1.16                          | 1.02  | 0.89 | 0.75 | 0.61 | 0.54 | 0.47 | 0.41 | 0.30 |
| 60R090X     | 1.40                          | 1.22  | 1.07 | 0.90 | 0.73 | 0.65 | 0.57 | 0.49 | 0.36 |
| 60R110X     | 1.71                          | 1.50  | 1.31 | 1.10 | 0.89 | 0.79 | 0.69 | 0.59 | 0.44 |
| 60R135X     | 2.09                          | 1.84  | 1.61 | 1.35 | 1.09 | 0.97 | 0.85 | 0.73 | 0.54 |
| 60R160X     | 2.48                          | 2.18  | 1.90 | 1.60 | 1.30 | 1.15 | 1.01 | 0.86 | 0.64 |
| 60R185X     | 2.87                          | 2.52  | 2.20 | 1.85 | 1.50 | 1.33 | 1.17 | 1.00 | 0.74 |
| 60R250X     | 3.88                          | 3.40  | 2.98 | 2.50 | 2.03 | 1.80 | 1.58 | 1.35 | 1.00 |
| 60R300X     | 4.65                          | 4.08  | 3.57 | 3.00 | 2.43 | 2.16 | 1.89 | 1.62 | 1.20 |
| 60R375X     | 5.81                          | 5.10  | 4.46 | 3.75 | 3.04 | 2.70 | 2.36 | 2.03 | 1.50 |

**Average Time Current Curves**



The average time current curves and Temperature Derating curve performance is affected by a number of variables, and these curves provided as guidance only. Customer must verify the performance in their application.

**Temperature Derating Curve**



Note:  
Typical Temperature derating curve, refer to table for derating data

### Soldering Parameters - Wave Soldering

|                         |   |
|-------------------------|---|
| <b>Pre-Heating Zone</b> | Refer to the condition recommended by the flux manufacturer.<br>Max. ramping rate should not exceed 4°C/Sec.  |
| <b>Soldering Zone</b>   | Max. solder temperature should not exceed 260°C<br>Time within 5°C of actual Max. solder temperature within 3 - 5 seconds<br>Total time from 25°C room to Max. solder temperature within 5 minutes including Pre-Heating time |
| <b>Cooling Zone</b>     | Cooling by natural convection in air.<br>Max. ramping down rate should not exceed 6°C/Sec.  |



### Physical Specifications

|                                  |  |
|----------------------------------|--|
| <b>Lead Material</b>             | .20-.40A: Tin-plated Copper clad steel<br>.50-3.75A: Tin-plated Copper |
| <b>Soldering Characteristics</b> | Solderability per MIL-STD-202, Method 208                              |
| <b>Insulating Material</b>       | Cured, flame retardant epoxy polymer meets UL94V-0 requirements.       |
| <b>Device Labeling</b>           | Marked with 'LF', voltage, current rating, and date code.              |

### Environmental Specifications

|  |   |
|--|---|
| <b>Operating/Storage Temperature</b>                       | -40°C to +85°C  |
| <b>Maximum Device Surface Temperature in Tripped State</b> | 125°C   |
| <b>Passive Aging</b>                                       | +85°C, 1000 hours<br>-/+ 5% typical resistance change           |
| <b>Humidity Aging</b>                                      | +85°C, 85% R.H., 1000 hours<br>-/+ 5% typical resistance change |
| <b>Thermal Shock</b>                                       | +85°C to -40°C 10 times<br>-/+ 5% typical resistance change     |
| <b>Solvent Resistance</b>                                  | MIL-STD-202, Method 215   |
| <b>Moisture Resistance Level</b>                           | Level 1, J-STD-020  |

### Additional Information



**Datasheet**



**Resources**



**Samples**

**Dimensions**



**Part Marking System**



| Part Number | A      |       | B      |      | C      |      | D      |      | E      |      | F      |      | Physical Characteristics |      |          |
|-------------|--------|-------|--------|------|--------|------|--------|------|--------|------|--------|------|--------------------------|------|----------|
|             | Inches | mm    | Inches | mm   | Inches | mm   | Inches | mm   | Inches | mm   | Inches | mm   | Lead (dia)               |      | Material |
|             | Max.   | Max.  | Max.   | Max. | Typ.   | Typ. | Min.   | Min. | Max.   | Max. | Typ.   | Typ. | Inches                   | mm   |          |
| 60R010X     | 0.29   | 7.4   | 0.50   | 12.7 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/CuFe  |
| 60R017X     | 0.29   | 7.4   | 0.50   | 12.7 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/CuFe  |
| 60R020X     | 0.29   | 7.4   | 0.46   | 11.7 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/CuFe  |
| 60R025X     | 0.29   | 7.4   | 0.50   | 12.7 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/CuFe  |
| 60R030X     | 0.29   | 7.4   | 0.50   | 12.7 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/CuFe  |
| 60R040X     | 0.30   | 7.6   | 0.53   | 13.5 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/CuFe  |
| 60R050X     | 0.31   | 7.9   | 0.54   | 13.7 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/Cu    |
| 60R065X     | 0.37   | 9.4   | 0.57   | 14.5 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/Cu    |
| 60R075X     | 0.40   | 10.2  | 0.59   | 15   | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/Cu    |
| 60R090X     | 0.44   | 11.2  | 0.62   | 15.8 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.047  | 1.2  | 0.02                     | 0.51 | Sn/Cu    |
| 60R110X     | 0.51   | 13    | 0.72   | 18.2 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.055  | 1.4  | 0.03                     | 0.81 | Sn/Cu    |
| 60R135X     | 0.53   | 13.58 | 0.78   | 19.8 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.055  | 1.4  | 0.03                     | 0.81 | Sn/Cu    |
| 60R160X     | 0.60   | 15.36 | 0.85   | 21.6 | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.055  | 1.4  | 0.03                     | 0.81 | Sn/Cu    |
| 60R185X     | 0.66   | 16.76 | 0.91   | 23   | 0.20   | 5.1  | 0.30   | 7.6  | 0.12   | 3.1  | 0.055  | 1.4  | 0.03                     | 0.81 | Sn/Cu    |
| 60R250X     | 0.78   | 19.93 | 1.03   | 26.2 | 0.40   | 10.2 | 0.30   | 7.6  | 0.12   | 3.1  | 0.055  | 1.4  | 0.03                     | 0.81 | Sn/Cu    |
| 60R300X     | 0.91   | 23.11 | 1.15   | 29.3 | 0.40   | 10.2 | 0.30   | 7.6  | 0.12   | 3.1  | 0.055  | 1.4  | 0.03                     | 0.81 | Sn/Cu    |
| 60R375X     | 1.04   | 26.3  | 1.22   | 31.1 | 0.40   | 10.2 | 0.30   | 7.6  | 0.12   | 3.1  | 0.055  | 1.4  | 0.03                     | 0.81 | Sn/Cu    |

**Part Ordering Number System**



**Packaging**

| Part Number | Ordering Number | I <sub>hold</sub> (A) | I <sub>hold</sub> Code | Packaging Option | Quantity | Quantity & Packaging Codes |
|-------------|-----------------|-----------------------|------------------------|------------------|----------|----------------------------|
| 60R010X     | 60R010XU        | 0.10                  | 010                    | Bulk             | 500      | U                          |
|             | 60R010XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R017X     | 60R017XU        | 0.20                  | 020                    | Bulk             | 500      | U                          |
|             | 60R017XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R020X     | 60R020XU        | 0.20                  | 020                    | Bulk             | 500      | U                          |
|             | 60R020XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R025X     | 60R025XU        | 0.25                  | 025                    | Bulk             | 500      | U                          |
|             | 60R025XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R030X     | 60R030XU        | 0.30                  | 030                    | Bulk             | 500      | U                          |
|             | 60R030XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R040X     | 60R040XU        | 0.40                  | 040                    | Bulk             | 500      | U                          |
|             | 60R040XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R050X     | 60R050XU        | 0.50                  | 050                    | Bulk             | 500      | U                          |
|             | 60R050XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R065X     | 60R065XU        | 0.65                  | 065                    | Bulk             | 500      | U                          |
|             | 60R065XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R075X     | 60R075XU        | 0.75                  | 075                    | Bulk             | 500      | U                          |
|             | 60R075XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R090X     | 60R090XU        | 0.90                  | 090                    | Bulk             | 500      | U                          |
|             | 60R090XPR       |                       |                        | Tape and Ammo    | 2000     | PR                         |
| 60R110X     | 60R110XU        | 1.10                  | 110                    | Bulk             | 500      | U                          |
|             | 60R110XMR       |                       |                        | Tape and Ammo    | 1000     | MR                         |
| 60R135X     | 60R135XF        | 1.35                  | 135                    | Bulk             | 200      | F                          |
|             | 60R135XMR       |                       |                        | Tape and Ammo    | 1000     | MR                         |
| 60R160X     | 60R160XF        | 1.60                  | 160                    | Bulk             | 200      | F                          |
|             | 60R160XMR       |                       |                        | Tape and Ammo    | 1000     | MR                         |
| 60R185X     | 60R185XF        | 1.85                  | 185                    | Bulk             | 200      | F                          |
|             | 60R185XMR       |                       |                        | Tape and Ammo    | 1000     | MR                         |
| 60R250X     | 60R250XF        | 2.50                  | 250                    | Bulk             | 200      | F                          |
|             | 60R250XMR       |                       |                        | Tape and Ammo    | 1000     | MR                         |
| 60R300X     | 60R300XF        | 3.00                  | 300                    | Bulk             | 200      | F                          |
| 60R375X     | 60R375XH        | 3.75                  | 375                    | Bulk             | 100      | H                          |

### Tape and Ammo Specifications

Devices taped using EIA468-B/IE286-2 standards. See table below and Figure 1 for details.

| Dimension   | EIA Mark             | IEC Mark             | Dimensions      |              |
|---|----------------------|----------------------|-----------------|--------------|
|   |                      |                      | Dim. (mm)       | Tol. (mm)    |
| Carrier tape width                                  | <b>W</b>             | <b>W</b>             | 18              | -0.5 / +1.0  |
| Hold down tape width                                | <b>W<sub>4</sub></b> | <b>W<sub>0</sub></b> | 11              | min.         |
| Top distance between tape edges                     | <b>W<sub>6</sub></b> | <b>W<sub>2</sub></b> | 3               | max.         |
| Sprocket hole position                              | <b>W<sub>5</sub></b> | <b>W<sub>1</sub></b> | 9               | -0.5 / +0.75 |
| Sprocket hole diameter*                             | <b>D<sub>0</sub></b> | <b>D<sub>0</sub></b> | 4               | -0.32 / +0.2 |
| Abscissa to plane(straight lead)                    | <b>H</b>             | <b>H</b>             | 18.5            | -/+ 3.0      |
| Abscissa to plane(kinked lead)                      | <b>H<sub>0</sub></b> | <b>H<sub>0</sub></b> | 16              | -/+ 0.5      |
| Abscissa to top 60R010-60R090                       | <b>H<sub>1</sub></b> | <b>H<sub>1</sub></b> | 32.2            | max.         |
| Abscissa to top 60R110-60R300                       | <b>H<sub>1</sub></b> |                      | 47.5            | max.         |
| Overall width without lead protrusion:60R010-60R090 | <b>C<sub>1</sub></b> |                      | 42.5            | max.         |
| Overall width without lead protrusion:60R110-60R300 |                      |                      | 57              |              |
| Overall width with lead protrusion:60R010-60R090    | <b>C2</b>            |                      | 43.2            | max.         |
| Overall width with lead protrusion:60R110-60R300    |                      |                      | 58              |              |
| Lead protrusion                                     | <b>L<sub>1</sub></b> | <b>I<sub>1</sub></b> | 1.0             | max.         |
| Protrusion of cut out                               | <b>L</b>             | <b>L</b>             | 11              | max.         |
| Protrusion beyond hold-down tape                    | <b>I<sub>2</sub></b> | <b>I<sub>2</sub></b> | Not specified   |              |
| Sprocket hole pitch:60R010-60R090                   | <b>P<sub>0</sub></b> | <b>P<sub>0</sub></b> | 12.7            | -/+ 0.3      |
| Sprocket hole pitch:60R110-60R300                   | <b>P<sub>0</sub></b> | <b>P<sub>0</sub></b> | 25.4            | -/+ 0.5      |
| Pitch tolerance                                     |                      |                      | 20 consecutive. | -/+ 1        |
| Device pitch:60R010-60R090                          |                      |                      | 12.7            |              |
| Device pitch:60R110-60R300                          |                      |                      | 25.4            |              |
| Tape thickness                                      | <b>t</b>             | <b>t</b>             | 0.9             | max.         |
| Tape thickness with splice                          | <b>t<sub>1</sub></b> |                      | 2.0             | max.         |
| Splice sprocket hole alignment                      |                      |                      | 0               | -/+ 0.3      |
| Body lateral deviation                              | <b>Δh</b>            | <b>Δh</b>            | 0               | -/+ 1.0      |
| Body tape plane deviation                           | <b>Δp</b>            | <b>Δp</b>            | 0               | -/+ 1.3      |
| Ordinate to adjacent component lead*:60R010-60R090  | <b>P<sub>1</sub></b> | <b>P<sub>1</sub></b> | 3.81            | -/+ 0.7      |
| Ordinate to adjacent component lead*:60R110-60R300  |                      |                      | 7.62            | -/+ 0.7      |
| Lead spacing:60R010-60R185                          | <b>F</b>             | <b>F</b>             | 5.08            | -/+ 0.8      |
| Lead spacing:60R250-60R300                          | <b>F</b>             | <b>F</b>             | 10.18           | -/+ 0.8      |

\*Differs from EIA Specification

**Tape and Ammo Diagram**



**WARNING**

- Users shall independently assess the suitability of these devices for each of their applications
- Operation of these devices beyond the stated maximum ratings could result in damage to the devices and lead to electrical arcing and/or fire
- These devices are intended to protect against the effects of temporary over-current or over-temperature conditions and are not intended to perform as protective devices where such conditions are expected to be repetitive or prolonged in duration
- Exposure to silicon-based oils, solvents, electrolytes, acids, and similar materials can adversely affect the performance of these PPTC devices
- These devices undergo thermal expansion under fault conditions, and thus shall be provided with adequate space and be protected against mechanical stresses
- Circuits with inductance may generate a voltage ( $L di/dt$ ) above the rated voltage of the PPTC device.