

### CH Varistor Series



#### Agency Approvals

Recognized under the components program of Underwriters Laboratories.

| Agency                                                                            | Agency Approval | Agency File Number |
|-----------------------------------------------------------------------------------|-----------------|--------------------|
|  | UL1449          | E320116            |

#### Description

CH Series transient surge suppressors are small, metal-oxide varistors (MOVs) manufactured in leadless chip form. They are intended for use in a variety of applications from low voltage DC to off-line board-level protection. These devices, which have significantly lower profiles than traditional radial lead varistors, permit designers to reduce the size and weight and increase the reliability of their equipment designs.

CH Series varistors are available in a voltage range from 14V to 275V ( $V_{M(AC)RMS}$ ), and energy ratings up to 8J.

See the Littelfuse Multilayer Suppressor Series also.

#### Features

- Lead-free
- Leadless, surface mount chip in 5 x 8mm Size
- Voltage ratings  $V_{M(AC)RMS}$  14V to 275V
- Supplied in tape and reel or bulk pack
- No derating up to 125°C ambient
- High surge rated up to 400A for low voltage devices

#### Absolute Maximum Ratings

- For ratings of individual members of a series, see Device Ratings and Specifications chart

| Continuous                                                                                     |  | CH Series   | Units |
|------------------------------------------------------------------------------------------------|--|-------------|-------|
| Steady State Applied Voltage:                                                                  |  |             |       |
| AC Voltage Range ( $V_{M(AC)RMS}$ )                                                            |  | 14 to 275   | V     |
| DC Voltage Range ( $V_{M(DC)}$ )                                                               |  | 18 to 369   | V     |
| Transient:                                                                                     |  |             |       |
| Peak Pulse Current ( $I_{TM}$ )                                                                |  |             |       |
| For 8/20 $\mu$ s Current (See Figure 2)                                                        |  | 100 to 400  | A     |
| Single Pulse Energy Range                                                                      |  |             |       |
| For 10/1000 $\mu$ s Current Wave ( $W_{TM}$ )                                                  |  | 1.0 to 8.0  | J     |
| Operating Ambient Temperature Range ( $T_A$ )                                                  |  | -55 to +125 | °C    |
| Storage Temperature Range ( $T_{STG}$ )                                                        |  | -55 to +150 | °C    |
| Temperature Coefficient ( $\alpha V$ ) of Clamping Voltage ( $V_C$ ) at Specified Test Current |  | <0.01       | %/°C  |

**CAUTION:** Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

#### Additional Information



**Datasheet**



**Resources**



**Samples**

### Device Ratings and Specifications

| Part Number | Maximum Ratings (125°C) |                    |                          |                             | Specifications (25°C)                    |                    |            |                                                        |              |                                       |
|-------------|-------------------------|--------------------|--------------------------|-----------------------------|------------------------------------------|--------------------|------------|--------------------------------------------------------|--------------|---------------------------------------|
|             | Continuous              |                    | Transient                |                             | Varistor Voltage at 1 mA DC Test Current |                    |            | Max Clamping Volt $V_C$ at Test Current (8/20 $\mu$ s) |              | Typical Capacitance<br>f=1MHz<br>(pF) |
|             | $V_{RMS}$               | $V_{DC}$           | Energy (10/1000 $\mu$ s) | Peak Current (8/20 $\mu$ s) |                                          |                    |            |                                                        |              |                                       |
|             | $V_{M(AC)}$<br>(V)      | $V_{M(DC)}$<br>(V) | $W_{TM}$<br>(J)          | $I_{TM}$<br>(A)             | MIN<br>(V)                               | $V_{N(DC)}$<br>(V) | MAX<br>(V) | $V_C$<br>(V)                                           | $I_P$<br>(A) |                                       |
| V22CH8      | 14                      | 18 (Note 3)        | 1.0 (Note2)              | 100                         | 18.7                                     | 22.0               | 26.0       | 47                                                     | 5            | 1600                                  |
| V27CH8      | 17                      | 22                 | 1.0                      | 100                         | 23.0                                     | 27.0               | 31.1       | 57                                                     | 5            | 1300                                  |
| V33CH8      | 20                      | 26                 | 1.0                      | 100*                        | 29.5                                     | 33.0               | 36.5       | 68                                                     | 5            | 750                                   |
| V39CH8      | 25                      | 31                 | 1.0                      | 100*                        | 35.0                                     | 39.0               | 43.0       | 79                                                     | 5            | 700                                   |
| V47CH8      | 30                      | 38                 | 1.2                      | 100*                        | 42.0                                     | 47.0               | 52.0       | 92                                                     | 5            | 650                                   |
| V56CH8      | 35                      | 45                 | 1.4                      | 100*                        | 50.0                                     | 56.0               | 62.0       | 107                                                    | 5            | 600                                   |
| V68CH8      | 40                      | 56                 | 1.5                      | 100*                        | 61.0                                     | 68.0               | 75.0       | 127                                                    | 10           | 500                                   |
| V120CH8     | 75                      | 102                | 2.0                      | 250                         | 108.0                                    | 120.0              | 132.0      | 200                                                    | 10           | 300                                   |
| V150CH8     | 95                      | 127                | 3.0                      | 250                         | 135.0                                    | 150.0              | 165.0      | 250                                                    | 10           | 250                                   |
| V180CH8     | 115                     | 153                | 4.0                      | 250                         | 162.0                                    | 180.0              | 198.0      | 295                                                    | 10           | 120                                   |
| V200CH8     | 130                     | 175                | 4.0                      | 250                         | 184.0                                    | 200.0              | 228.0      | 340                                                    | 10           | 110                                   |
| V220CH8     | 140                     | 180                | 5.0                      | 250                         | 198.0                                    | 220.0              | 242.0      | 360                                                    | 10           | 105                                   |
| V240CH8     | 150                     | 200                | 5.0                      | 250                         | 212.0                                    | 240.0              | 268.0      | 395                                                    | 10           | 100                                   |
| V360CH8     | 230                     | 300                | 6.0                      | 250                         | 324.0                                    | 360.0              | 396.0      | 595                                                    | 10           | 70                                    |
| V390CH8     | 250                     | 330                | 7.0                      | 250                         | 354.0                                    | 390.0              | 429.0      | 650                                                    | 10           | 60                                    |
| V430CH8     | 275                     | 369                | 8.0                      | 250                         | 389.0                                    | 430.0              | 473.0      | 710                                                    | 10           | 50                                    |

#### NOTES:

1. Power dissipation of transients not to exceed 0.25W.
2. Energy rating for impulse duration of 30ms minimum to one half of peak current value.
3. Also rated to withstand 24V for 5 minutes.
4. The Typical Capacitance is for reference only
5. \*High Surge Option (up to 400A) available for relevant voltage ratings.

### Current, Energy and Power Derating Curve

Continuous power dissipation capability is not an applicable design requirement for a suppressor, unless transients occur in rapid succession. Under this condition, the average power dissipation required is simply the energy (watt-seconds) per pulse times the number of pulses per second. The power so developed must be within the specifications shown on the Device Ratings and Specifications Table for the specific device. Furthermore, the operating values need to be derated at high temperatures as shown in this diagram. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts of average power dissipation.

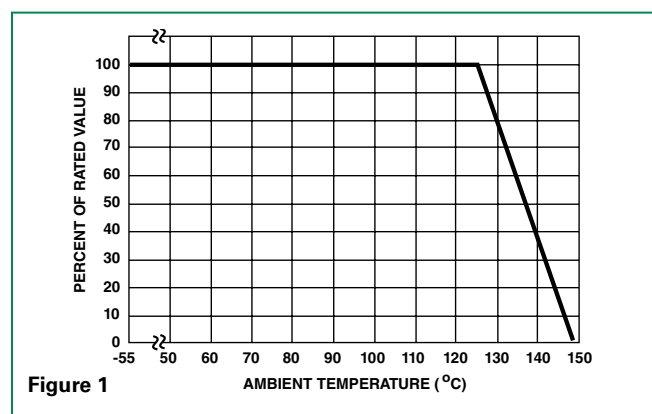


Figure 1

### Peak Pulse Current Test Waveform



Figure 2

$O_1$  = Virtual Origin of Wave  
 $T$  = Time from 10% to 90% of Peak  
 $T_1$  = Rise Time =  $1.25 \times T$   
 $T_2$  = Decay Time  
**Example:**  
 For an 8/20  $\mu$ s Current Waveform:  
 $8\mu$ s =  $T_1$  = Rise Time  
 $20\mu$ s =  $T_2$  = Decay Time

### Clamping Voltage for V22CH8 – V68CH8



Figure 3

### Clamping Voltage for V120CH8 – V430CH8



FIGURE 4. CLAMPING VOLTAGE FOR V120CH8 - V430CH8

Figure 4

### Pulse Rating Curves

#### Surge Current Rating Curves for V22CH8 - V56CH8



Figure 5

#### Surge Current Rating Curves for V120CH8 - V430CH8



Figure 6

NOTE: If pulse ratings are exceeded, a shift of  $V_{N(DC)}$  (at specified current) of more than  $\pm 10\%$  could result. This type of shift, which normally results in a decrease of  $V_{N(DC)}$ , may result in the device not meeting the original published specifications, but it does not prevent the device from continuing to function, and to provide ample protection.

### Lead (Pb) Soldering Recommendations

The principal techniques used for the soldering of components in surface mount technology are IR Re-flow and Wave soldering. Typical profiles are shown on the right.

CH series devices have silver-platinum terminals (Ag/Pt), and the recommended solder is 62/36/2 (Sn/Pb/Ag), 60/40 (Sn/Pb) or 63/37 (Sn/Pb). Littelfuse also recommends an RMA solder flux.

Wave soldering is the most strenuous of the processes. To avoid the possibility of generating stresses due to thermal shock, a preheat stage in the soldering process is recommended, and the peak temperature of the solder process should be rigidly controlled.

When using a reflow process, care should be taken to ensure that the CH chip is not subjected to a thermal gradient steeper than 4 degrees per second; the ideal gradient being 2 degrees per second. During the soldering process, preheating to within 100 degrees of the solder's peak temperature is essential to minimize thermal shock.

Once the soldering process has been completed, it is still necessary to ensure that any further thermal shocks are avoided. One possible cause of thermal shock is hot printed circuit boards being removed from the solder process and subjected to cleaning solvents at room temperature. The boards must be allowed to cool gradually to less than 50°C before cleaning.

### Reflow Solder Profile



Figure 7

### Wave Solder Profile



Figure 8

### Lead-free (Pb-free) Soldering Recommendations

CH series devices have silver-platinum terminals (Ag/Pt), and the recommended Lead-free solder is 96.5/3.0/0.5 (SnAgCu) with an RMA flux, though there is a wide selection of pastes and fluxes available that should be compatible.

The reflow profile must be constrained by the maximums in the Lead-free Reflow Profile. For Lead-free Wave soldering, the Wave Solder Profile still applies.

Note: the Lead-free paste, flux and profile were used for evaluation purposes by Littelfuse, based upon industry standards and practices. There are multiple choices of all three available, it is advised that the customer explores the optimum combination for their process as processes vary considerably from site to site.

### Lead-free Re-flow Solder Profile



Figure 9

## Part Numbering System



## Dimensions

### PAD LAYOUT DIMENSIONS



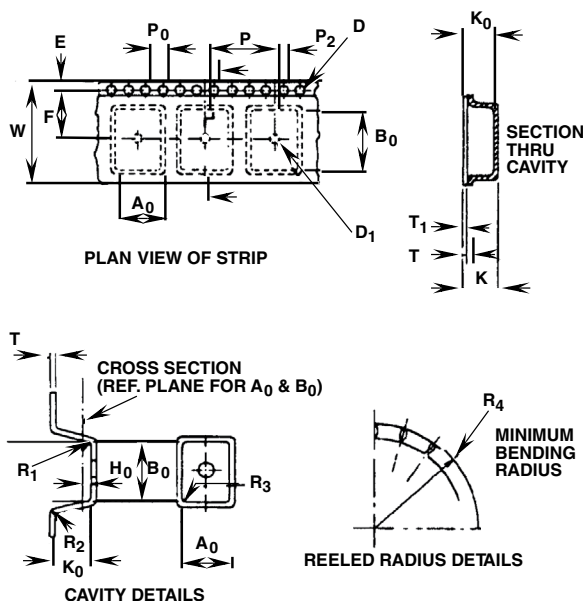
| Symbol   | Inches |       | Millimeters |      |
|----------|--------|-------|-------------|------|
|          | Min    | Max   | Min         | Max  |
| <b>A</b> | 0.402  |       | 10.210      |      |
| <b>B</b> | 0.216  |       | 5.500       |      |
| <b>C</b> | 0.087  |       | 2.210       |      |
| <b>D</b> | -      | 0.080 | -           | 2.00 |
| <b>E</b> | 0.016  | 0.050 | 0.41        | 1.27 |
| <b>L</b> | 0.311  | 0.335 | 7.90        | 8.51 |
| <b>W</b> | 0.185  | 0.207 | 4.70        | 5.26 |

NOTE: Avoid metal runs in this area. Soldering recommendations: Material - 62/36/2 Sn/Pb/Ag or equivalent. Temperature - 230°C Max., 5s. Max. Flux - R.M.A.

### CHIP LAYOUT DIMENSIONS



### Tape and Reel Specifications



| Symbol          | Parameter                       | Size (mm)               |
|-----------------|---------------------------------|-------------------------|
| $B_0$           | Cavity Length                   | 8.8 $\pm$ 0.1           |
| $A_0$           | Cavity Width                    | 5.5 $\pm$ 0.1           |
| $K_0$           | Cavity Depth                    | 2.0 Min.                |
| $H_0$           | Ref. Plane for $A_0$ and $B_0$  | + 0.10<br>0.3<br>- 0.05 |
| $R_1, R_2, R_3$ | Tape Cavity Radii               | 0.5 Max.                |
| $T$             | Carrier Tape Thickness          | 1.0 Max.                |
| $T_1$           | Cover Tape Thickness            | 0.1 Max.                |
| $E$             | Sprocket Hole from Edge         | 1.75 $\pm$ 0.1          |
| $P_0$           | Sprocket Hole Pitch             | 4.0 $\pm$ 0.1           |
| $D$             | Sprocket Hole Diameter          | + 0.1<br>1.5<br>- 0.0   |
| $P_2$           | Hole Centre to Component Centre | 2.0 $\pm$ 0.15          |
| $R_4$           | Min. Bending Radius             | 30.5 Min.               |
| $D_1$           | Ejection Hole Diameter          | 1.5 Min.                |
| $K$             | Overall Thickness               | 3.0 Min.                |
| $P$             | Pitch Of Component              | 8.0 $\pm$ 0.1           |
| $F$             | Sprocket Hole to Ejection Hole  | 7.5 $\pm$ 0.1           |
| $W$             | Carrier Tape Width              | 16.0 $\pm$ 0.3          |

#### Notes :

- Conforms to EIA-481-1, Revision A
- Can be supplied to IEC Publication 286-3

### Standard Packaging\*

CH Series varistors are always shipped in tape and reel. The standard 13-inch reel utilized contains 4000 pieces.

Note also that the CH Series receives no branding on the chip itself.

\*NOTE: It is recommended that parts be kept in the sealed bag provided and that parts be used as soon as possible when removed from bags.

### Ordering Notes:

**X3313:** HIGH SURGE RATING OPTION --

Low voltage (V22~V68) standard parts high surge rating to 100A, to order high surge rated up to 400A with suffix X3313. Example:

| Standard Model | Order As    |
|----------------|-------------|
| V33CH8         | V33CH8X3313 |

### Special Packaging

- Option 1** 7-inch reels containing 1000 pieces are available. To order 7-inch reels add a 'T' suffix to the part number; e.g., V47CH8T.
- Option 2** For small quantities (less than 100 pieces) the units are shipped bulk pack. To order, add a 'S' suffix to the part number; e.g., V47CH8S.

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