# HA Varistor Series

## Agency Approvals

| Agency | Agency Approval | Agency File Number |
|---|---|---|
| | UL1449 | E320116 |
| | 22.2-1 | 91788 |

## Additional Information

**Datasheet** | **Resources** | **Samples**

## Description

HA Series transient surge suppressors are industrial high energy Metal-Oxide Varistors (MOVs). They are designed to provide secondary surge protection in the outdoor and service entrance environment (distribution panels) of buildings, and also in industrial applications for motor controls and power supplies used in the oil-drilling, mining, and transportation fields.

The design of the HA Series of MOVs provide rigid terminals for screw mounting. Also available in a clipped lead version for through hole board placement or to accommodate soldered leads designation "HC."

See Ratings and Specifications Table for part number and brand information.

## Features

- Lead–free, Halogen-Free and RoHS compliant.
- Wide operating voltage range $V_{M(AC)RMS}$ 110V to 750V
- Two disc sizes available 32mm and 40mm
- High energy absorption capability $W_{TM}$ = 170J to 1050J
- High peak pulse current capability, ITM = 25,000A to 40,000A
- Rigid terminals for secure mounting
- Available in trimmed version for through hole board mounting – Designation "HC"
- No derating up to 85°C ambient

## Absolute Maximum Ratings

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

| Continuous | HA Series | Units |
|---|---|---|
| Steady State Applied Voltage: | | |
| AC Voltage Range ($V_{M(AC)RMS}$) | 110 to 750 | V |
| DC Voltage Range ($V_{M(DC)}$) | 148 to 970 | V |
| Transients: | | |
| Peak Pulse Current ($I_{TM}$) | | |
| For 8/20$\mu$s Current Wave (See Figure 2) | 25,000 to 40,000 | A |
| Single Pulse Energy Range | | |
| For 2ms Current Squarewave ($W_{TM}$) | 160 to 1050 | J |
| Operating Ambient Temperature Range ($T_A$) | -55 to +85 | °C |
| Storage Temperature Range ($T_{STG}$) | -55 to +125 | °C |
| Temperature Coefficient ($a^V$) of Clamping Voltage ($V_C$) at Specified Test Current | <0.01 | %/°C |
| Hi–Pot Encapsulation (COATING Isolation Voltage Capability) (Dielectric must withstand indicated DC voltage for one minute per MIL–STD 202, Method 301) | 2500 | V |
| COATING Insulation Resistance | 1000 | MΩ |

*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.*

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## HA Series Ratings & Specifications

| Part Number Device Branding | Maximum Rating (85°C) | | | | Specifications (25°C) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Continuous | | Transient | | Varistor Voltage at 1mA DC Test Current | | | Maximum Clamping Volt $V_C$ at 200A Current (8/20$\mu$s) | Typical Capacitance $f$ = 1MHz |
| | $V_{RMS}$ | $V_{DC}$ | Energy (2ms) | Peak Current 8 x 20$\mu$s | | | | | |
| | $V_{M(AC)}$ | $V_{M(DC)}$ | $W_{TM}$ | $I_{TM}$ | Min | $V_{N(DC)}$ | Max | $V_C$ | C |
| | (V) | (V) | Energy | (A) | (V) | (V) | (V) | (A) | (pF) |
| V111HA32 | 110 | 148 | 160 | 25000 | 156 | 173 | 190 | 293 | 5450 |
| V111HA40 | 110 | 148 | 220 | 40000[1] | 156 | 173 | 190 | 288 | 11600 |
| V131HA32 | 130 | 175 | 200 | 25000 | 184.5 | 205 | 225.5 | 350 | 4700 |
| V131HA40 | 130 | 175 | 270 | 40000[2] | 184.5 | 205 | 225.5 | 345 | 10000 |
| V141HA32 | 140 | 188 | 210 | 25000 | 198 | 220 | 242 | 380 | 4230 |
| V141HA40 | 140 | 188 | 290 | 40000[3] | 198 | 220 | 242 | 375 | 9000 |
| V151HA32 | 150 | 200 | 220 | 25000 | 216 | 240 | 264 | 410 | 4000 |
| V151HA40 | 150 | 200 | 300 | 40000[4] | 216 | 240 | 264 | 405 | 8000 |
| V181HA32 | 180 | 240 | 240 | 25000 | 254 | 282 | 310 | 475 | 3200 |
| V181HA40 | 180 | 240 | 330 | 40000 | 254 | 282 | 310 | 468 | 6800 |
| V201HA32 | 200 | 265 | 260 | 25000 | 283 | 314 | 345 | 540 | 3180 |
| V201HA40 | 200 | 265 | 350 | 40000 | 283 | 314 | 345 | 533 | 6350 |
| V251HA32 | 250 | 330 | 330 | 25000 | 351 | 390 | 429 | 650 | 2500 |
| V251HA40 | 250 | 330 | 370 | 40000 | 351 | 390 | 429 | 630 | 5000 |
| V271HA32 | 275 | 369 | 360 | 25000 | 387 | 430 | 473 | 710 | 2200 |
| V271HA40 | 275 | 369 | 400 | 40000 | 387 | 430 | 473 | 690 | 4500 |
| V301HA32 | 300 | 410 | 370 | 25000 | 423 | 470 | 517 | 795 | 2050 |
| V301HA40 | 300 | 410 | 430 | 40000 | 423 | 470 | 517 | 780 | 4100 |
| V321HA32 | 320 | 420 | 390 | 25000 | 459 | 510 | 561 | 845 | 1900 |
| V321HA40 | 320 | 420 | 460 | 40000 | 459 | 510 | 561 | 825 | 3800 |
| V331HA32 | 330 | 435 | 385 | 25000 | 467 | 518.5 | 570 | 860 | 1870 |
| V331HA40 | 330 | 435 | 475 | 40000 | 467 | 518.5 | 570 | 843 | 3750 |
| V351HA32 | 350 | 460 | 390 | 25000 | 495 | 549.5 | 604 | 910 | 1800 |
| V351HA40 | 350 | 460 | 500 | 40000 | 495 | 549.5 | 604 | 894 | 3600 |
| V391HA32 | 385 | 510 | 395 | 25000 | 545 | 604 | 663 | 1020 | 1750 |
| V391HA40 | 385 | 510 | 550 | 40000 | 545 | 604 | 663 | 1000 | 3500 |
| V421HA32 | 420 | 560 | 400 | 25000 | 612 | 680 | 748 | 1120 | 1500 |
| V421HA40 | 420 | 560 | 600 | 40000 | 612 | 680 | 748 | 1100 | 3000 |
| V441HA32 | 440 | 585 | 420 | 25000 | 622 | 690 | 758 | 1200 | 1450 |
| V441HA40 | 440 | 585 | 630 | 40000 | 622 | 690 | 758 | 1147 | 2900 |
| V481HA32 | 480 | 640 | 450 | 25000 | 675 | 750 | 825 | 1290 | 1300 |
| V481HA40 | 480 | 640 | 650 | 40000 | 675 | 750 | 825 | 1230 | 2700 |
| V511HA32 | 510 | 675 | 500 | 25000 | 738 | 820 | 902 | 1355 | 1200 |
| V511HA40 | 510 | 675 | 700 | 40000 | 738 | 820 | 902 | 1295 | 2500 |
| V551HA32 | 550 | 710 | 530 | 25000 | 778 | 863.5 | 949 | 1515 | 1190 |
| V551HA40 | 550 | 710 | 755 | 40000 | 778 | 863.5 | 949 | 1430 | 2390 |
| V571HA32 | 575 | 730 | 550 | 25000 | 819 | 910 | 1001 | 1570 | 1100 |
| V571HA40 | 575 | 730 | 770 | 40000 | 819 | 910 | 1001 | 1480 | 2200 |
| V661HA32 | 660 | 850 | 600 | 25000 | 945 | 1050 | 1155 | 1820 | 1000 |
| V661HA40 | 660 | 850 | 900 | 40000 | 945 | 1050 | 1155 | 1720 | 2000 |
| V681HA32 | 680 | 875 | 610 | 25000 | 962 | 1067.5 | 1173 | 1830 | 850 |
| V681HA40 | 680 | 875 | 925 | 40000 | 962 | 1067.5 | 1173 | 1780 | 1900 |
| V751HA32 | 750 | 970 | 700 | 25000 | 1080 | 1200 | 1320 | 2050 | 800 |
| V751HA40 | 750 | 970 | 1050 | 40000 | 1080 | 1200 | 1320 | 2000 | 1800 |

NOTE: Average power dissipation of transients not to exceed 2.0W per varistor

1. 40kA capability depends on applications rated up to 97Vrms. 30kA applies if > 97 Vrms.
2. 40kA capability depends on applications rated up to 115Vrms. 30kA applies if > 115 Vrms.
3. 40kA capability depends on applications rated up to 123Vrms. 30kA applies if > 123 Vrms.
4. 40kA capability depends on applications rated up to 132Vrms. 30kA applies if > 132Vrms.

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## Power Dissipation Ratings

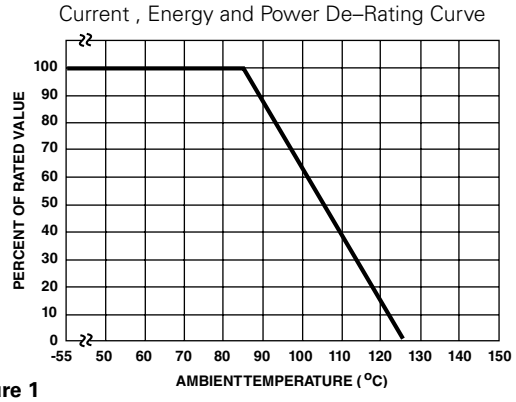


**Figure 1**

Should transients occur in rapid succession, 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 above. Because varistors can only dissipate a relatively small amount of average power they are, therefore, not suitable for repetitive applications that involve substantial amounts for average power dissipation.

## Peak Pulse Current Test Waveform

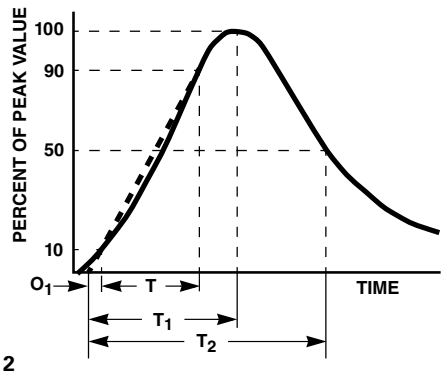


**Figure 2**

$0_1$ = Virtual Origin of Wave
T = Time from 10% to 90% of Peak
$T_1$ = Rise Time = 1.25 x 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

## Maximum Clamping Voltage for 32mm Parts

**V111HA32–V751HA32**

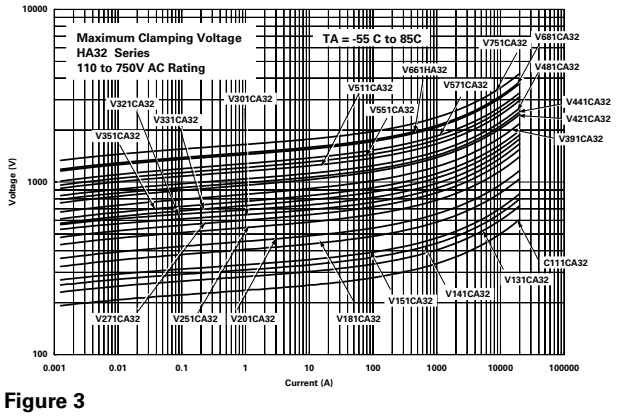


**Figure 3**

## Maximum Clamping Voltage for 40mm Parts

**V111HA40–V751HA40**

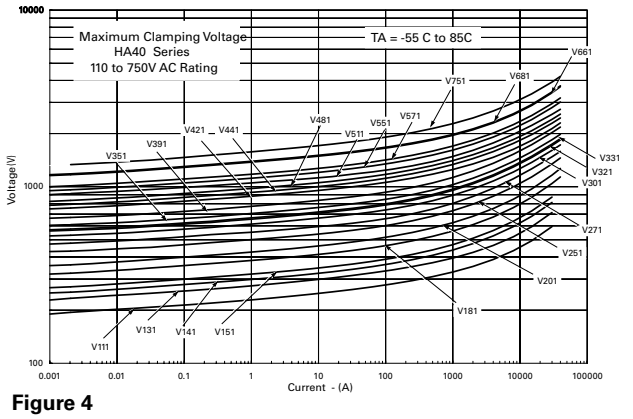


**Figure 4**

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## Repetitive Surge Capability for 32mm Parts

**V111HA32 – V751HA32**

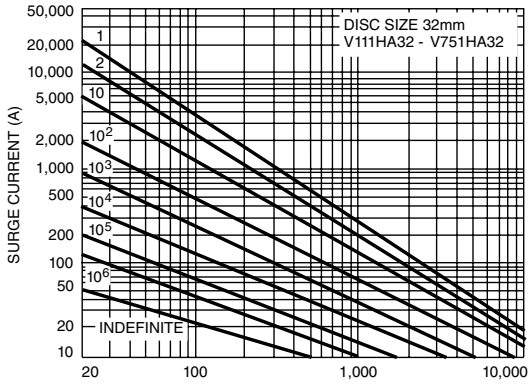


**Figure 5**

## Repetitive Surge Capability for 40mm Parts

**V111HA40 – V751HA40**

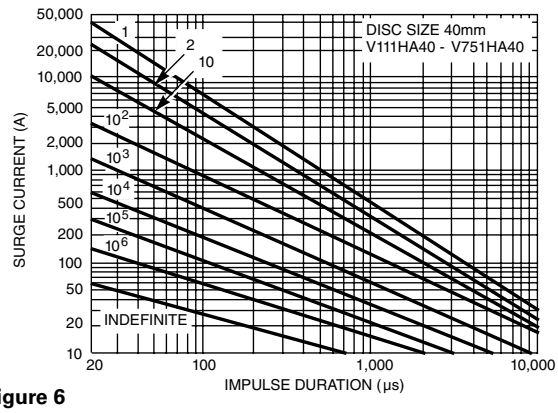


**Figure 6**

## Wave Solder Profile

### Non Lead–free Profile

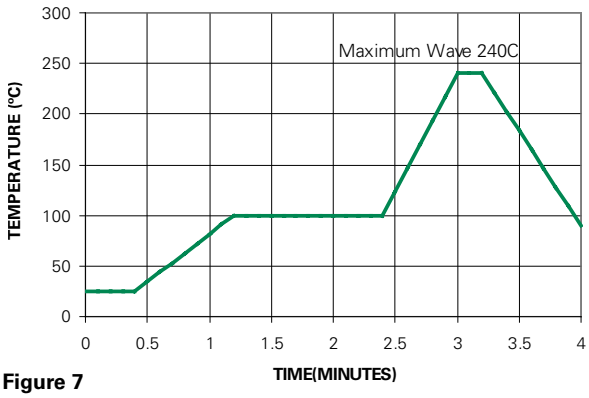


**Figure 7**

### Lead–free Profile

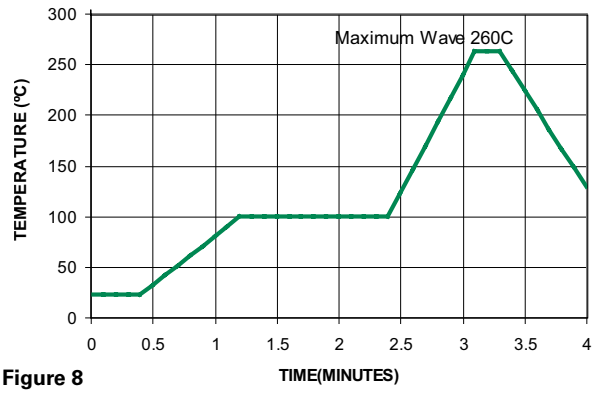


**Figure 8**

## Physical Specifications

| | |
|---|---|
| **Lead Material** | Tin–plated Copper |
| **Soldering Characteristics** | Solderability per MIL–STD–202, Method 208 |
| **Insulating Material** | Cured, flame retardant epoxy polymer meets UL94V–0 requirements. |
| **Device Labeling** | LF, Part Number and date code |

## Environmental Specifications

| | |
|---|---|
| **Operating Temperature** | -55°C to +85°C/ |
| **Storage Temperature** | -55°C to +125°C |
| **Humidity Aging** | +85°C, 85% RH, 1000 hours +/- 10% typical resistance change |
| **Thermal Shock** | +85°C to -40°C 5 times +/- 10% typical resistance change |
| **Solvent Resistance** | MIL–STD–202, Method 215 |
| **Moisture Sensitivity** | Level 1, J-STD-020 |

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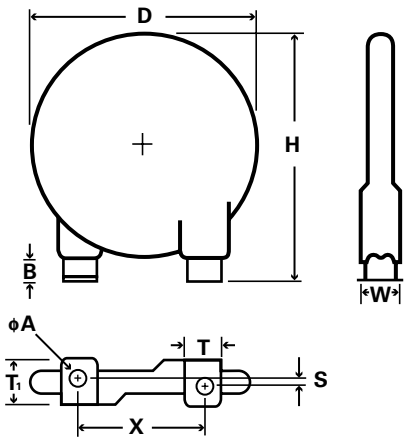
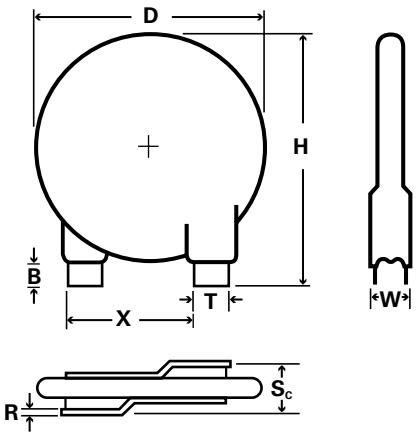
## Dimensions




## HA Series Outline Specifications

(Dimensions in Millimeters)

| | D | H | B | X | T | T1 | øA | s |
|---|---|---|---|---|---|---|---|---|
| | Max | Max | Min | Nom | Nom | Max | Max | Offset |
| HA32 | 35.5 | 50.00 | 3.0 | 25 | 9.3 | 10.4 | 4.2 | Depends on Device Voltage (See Table Below |
| HA40 | 42.5 | 5700 | 3.0 | 25 | 9.3 | 10.4 | 4.2 | |

## HC Series Outline Specifications

(Dimensions in Millimeters)

| | D | H | B | X | T | R | $s_c$ |
|---|---|---|---|---|---|---|---|
| | Max | Max | Min | Nom | Nom | Max | Offset |
| HC32 | 35.5 | 50.00 | 5.0 | 25 | 9.30 | 1.0 | Depends on Device Voltage (See Table Below |
| HC40 | 42.5 | 57.00 | 5.0 | 25 | 9.30 | 1.0 | |

## HA Series Maximum Thickness and Terminal Offsets

(Dimensions in Millimeters)

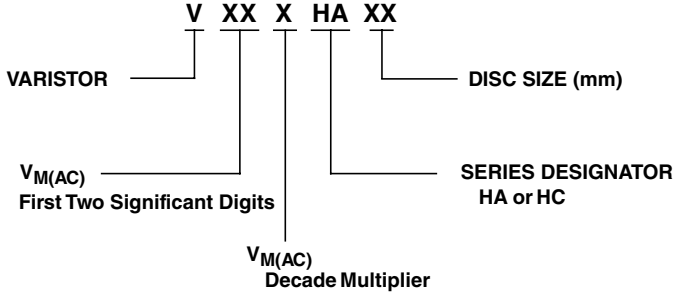
| Voltage | Thickness "W" | | Dimension "S" (-/+1mm) | |
|---|---|---|---|---|
| | HA32 | HA40 | HA32 | HA40 |
| V111 - V351 | 9.00 | 9.00 | 3.90 | 3.90 |
| V391 - V511 | 11.00 | 11.00 | 2.60 | 2.60 |
| V551 - V751 | 13.00 | 13.00 | 1.00 | 1.00 |

## HC Series Maximum Thickness and Terminal Offsets

(Dimensions in Millimeters)

| Voltage | Thickness "W" | | Dimension "$S_C$" (-/+1mm) | |
|---|---|---|---|---|
| | HC32 | HC40 | HC32 | HC40 |
| V111 - V351 | 9.00 | 9.00 | 6.00 | 6.00 |
| V391 - V511 | 11.00 | 11.00 | 7.30 | 8.10 |
| V551 - V751 | 13.00 | 13.00 | 8.90 | 10.00 |

## Part Numbering System

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Телефон: 8 (812) 309-75-97 (многоканальный)
Факс: 8 (812) 320-03-32
Электронная почта: ocean@oceanchips.ru
Web: http://oceanchips.ru/
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, д. 2, корп. 4, лит. А