Metal Oxide Varistors

Applications of MNR Varistors

As mentioned in the introduction, MNRs have many and varied applications, some of which are listed below for easy reference:

- Telephone and PABX equipment.
- Motor speed control systems.
- Power supplies.
- Automotive electronic systems.
- Elevator and conveyor controls.
- Control systems.
- AC operated smoke detectors.
- AC operated alarm systems.
- Transient suppression from AC power lines.
- Suppression of transients caused by interrupting inductive loads, such as: a) transformers, b) relay coils, c) solenoids, d) motors, e) filter reactors.
- Relay contact protection.
- ICs and microprocessor protection.
- Protection of transistor switching inductive and capacitance loads.
- Protection of motor winding insulation.
- Traffic and railway signal systems.
- Automatic control devices for power distribution.
- Centralized meter reading equipment.
- Cable TV systems.
- Broadcast relay equipment.
- Protection of equipment where loads are switched with vacuum relays and switches.
- Ground fault interrupters.
- RFI filters.
- Digital weighing systems.

In the foregoing list of applications, there are two forms of transients developed; those that are extraneous such as lightning and those that are manmade such as switching surges and ground faults. Both of these have very disastrous results on voltage sensitive equipment and micro circuitry. Lightning transients are all extraneous, so protection is needed on incoming power lines, whereas the switching and ground fault transients can be generated within the equipment itself. Direct lightning transients have a voltage peak value of about 5000KV, beyond the capability of MNRs, so lightning arresters are essential. Induced lightning transients are generally speaking 50KV and below, with peak current values of 1000 amps or less, well within the design parameter of varistors, where they fill their role as suppression devices.

There is a distinct difference between power line surges and voltage transients. Line surges are slower (greater than 8.3 milliseconds) and are produced from low impedance sources. In general they do not exceed 2 to 3 times the nominal operating voltage. Transients on the other hand are faster than 8.3 milliseconds and are related to high impedance sources and can range from a few millivolts to 20KV. A typical rise time for lightning is 600 volts to 1000 volts and power line surges can be from 100 volts to 300 volts per microsecond, electro-magnetic pulses (EMP) are typically in the nanoseconds area requiring the fast turn-on characteristics, the lower capacitance and the lower overshoot characteristics of the Stetron MNR. Some designers are of the opinion that voltage regulation/isolation transformers act as transient suppressors. However, these are effective only in the millisecond area, (typically 25 ms) due to capacitive effects etc. They pass faster rise time transients readily, so additional protection is required to protect delicate semiconductor devices. Certain classes of semiconductors, particularly LSI and VLSI circuits may have as many as 20,000 components in a 1/4" x 1/4" area, with damage thresholds below 100 micro joules, and are most susceptible to transients.

Another problem encountered is caused by the demand on power companies. Some localities are increasing their demands faster than the ability of the power companies to produce, so loads are constantly being switched from one line to the other in the power grid system. This causes surges, and those in turn cause high speed transients of short duration. All of these factors coupled with widespread use of semiconductor devices, require fast turn on time transient suppression devices provided by the Stetron MNR. Here we have a decided advantage over competitive products with 35 nanosecond turn-on time, lower capacitance and better transient characteristics.

Switching and internally generated surges refer to those generated by back EMF from motors and other inductive loads and ground faults either within or outside of the equipment. Voltage surges caused by load switching with vacuum switches or relays are particularly large and wherever this type of equipment is used, particular attention should be paid to transient suppression devices. Transient voltages can also be caused by load and no load switching, by thyristor commutation, and by the transmission of electrostatic and electromagnetic energy. It is beyond the scope of this catalog to go into details of all of these conditions, but they do exist and transient protection devices are of paramount importance for equipment protection.

Metal Oxide Varistors

ELECTRICAL CHARACTERISTICS

MNR Varistors have a non-linear voltage/current characteristic as expressed by the relationship:

$$I = KV^n$$

WHERE I = The current in amperes
V = The voltage
K = A constant
n = A constant which shows the dependance of the voltage V upon the current I. It is called the voltage-dependant index

MNR Metal Oxide Varistors feature a patented barrier layer that gives the user fast response time—less than 35 nano seconds. The barrier layer used in MNR varistors, is composed of finely crystallized semi-conductive glass, that has been specially treated to make it resistant to high temperatures and shock. This treatment gives the device a high transient current handling capability, as a result of reduced resistance between the boundary layers, when high voltage is applied. Static resistance is, however, very high under low voltage conditions, permitting low standby drain currents. By utilizing a new special process to seal the edge of the varistor pellet, flashover problems are eliminated and leakage factors vastly reduced. MNR Varistors are available in three different series:

1. The NA Series—cylindrical type with axial leads.
2. The NR Series.
   a) NR = disc type with radial leads.
   b) NE = uncoated NR disc without the leads.
   c) NS = NR disc type with spade lugs.
3. The ZR Series.
   a) ZR = disc type with radial leads: low voltage.
   b) ZE = uncoated ZR disc without the leads.
   c) ZS = ZR disc type with spade lugs.

FEATURES

- High transient current capability—up to 6500A.
- Fast response time—less than 35 ns.
- Excellent voltage clamping characteristics.
- Very low temperature coefficient.
- Low standby current.
- Compact and lightweight.
- High energy capability.
- The value for "n" is greater.
- Very low leakage current.
- Low capacitance.
- Low overshoot characteristics.
- Low leakage factor.

ELECTRICAL RATINGS

1. Varistor Voltage: Voltage across the varistor at a DC current of 1.0mA, or 0.1mA for case size "0".

2. Energy: The maximum electrical energy which can be dissipated within the varistor by a single impulse of 10 × 1000 μs current waveform with continuous voltage applied. Energy ratings are based on a shift of varistor voltage of less than 10% of the initial value. The unit is expressed in joules.

3. Peak Current: The maximum current allowable for a single pulse of 8 × 20μs exponential waveform.

	NR Series	NA Series	ZR Series
Operating Ambient Temperature	−40 to +85°C	−40 to +85°C	−40 to +85°C
Storage Temperature	−40 to +125°C	−40 to +125°C	−40 to +125°C
Response Time	<35ns	<35ns	<35ns
Voltage Temperature Coefficient	<0.05%/°C	<0.05%/°C	<0.05%/°C
Non Linear Exponent	>40	19 ~ 60	15 ~ 50
Maximum Leakage Current*	10μA	2μA	10μA

*Measured before life test.

MNR FAILURE MODE

MNR varistors are highly reliable and exhibit a very low failure rate. Careful designers should plan for the effect of potential failures on circuitry being protected and must take the following into consideration:

- MNR varistors short-circuit when subjected to surges beyond their peak current and energy ratings
- MNR varistors short-circuit when operated at steady-state voltages well beyond their voltage ratings, which may eventually result in open-circuiting leaving the circuit without protection.

The following precautions should be taken to minimize this potential hazard:

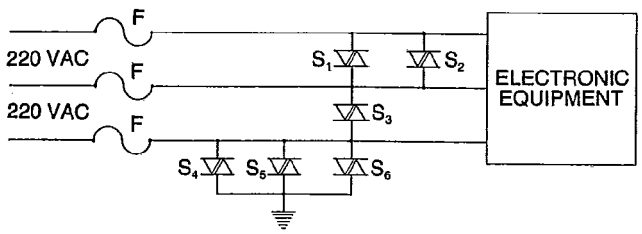
- Fusing the MNR varistor to limit high fault currents.
- Protecting the surrounding circuitry by physical shielding.
- Locating the MNR varistor away from other components.

Metal Oxide Varistors

Typical Circuits

Absorption of Lightning and Power Line Transients

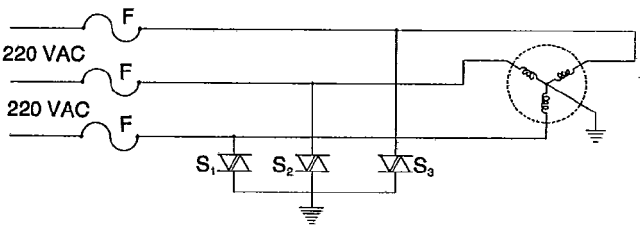
3 Phase Circuit



Between 220 VAC lines and between lines and ground S_1, S_2, and S_3—383NR or higher rating.
S_4, S_5 and S_6—765NR
F—Fuse
In a 3 phase circuit the MNRs can be placed between the 240 VAC lines
(S_1,S_2 and S_3 only) between lines to ground only (S_4,S_5 and S_6) or with 6 MNRs as shown.

Absorption of Switching Transients

3 Phase Induction Motor

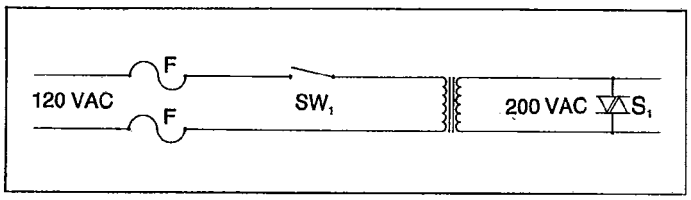


S_1,S_2 and S_3—800NR and over
S in a diagram indicates an MNR—the types of MNRs indicated are only examples. Circuit parameters would have to be taken into account in order to select the proper operating voltage and element diameter.

As the failure mode of an MNR is punch through (short circuit) it is recommended all circuits using MNRs be fused as indicated.

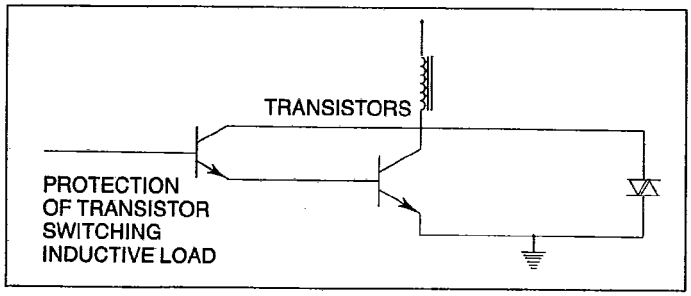
Other typical application circuits:

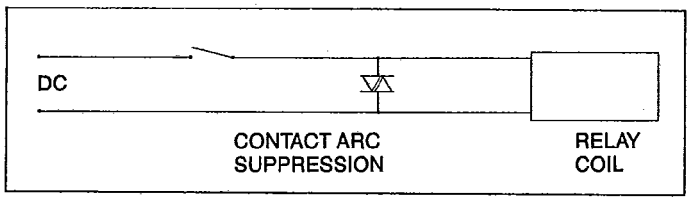
Switching Transients

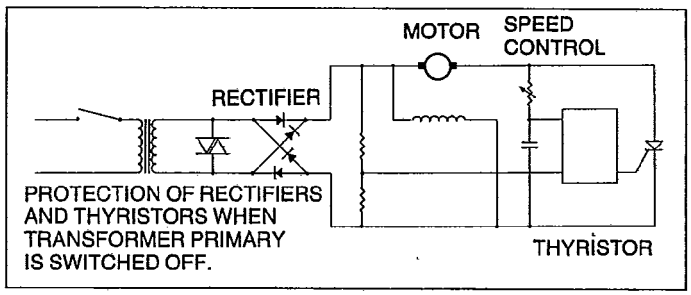


S_1—383NR. In this circuit when switch SW_1 is opened back EMF from the transformer, damage can occur to a rectifier bridge without transient protection.

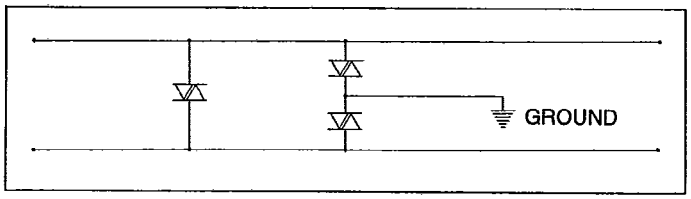
Protection of switching devices from inductive loads







Transient Protection in Telephone and Alarm Circuits



24 VDC Lines—47ZR Series and above
48 VDC Lines—82ZR Series and above

Selection of MNR dependant on Circuit Parameters.

These can be 24 volt lines used in a fire alarm or 48 volt telephone circuits. In either case, the MNRs are used to protect the electronic equipment from externally generated transients.

Metal Oxide Varistors

NR Series

ELECTRICAL CHARACTERISTICS TABLE

PART NUMBER	SIZE	STEADY STATE		TRANSIENT (@ 85°C)			CHARACTERISTICS (@ 25°C)				
		MAX. APPLIED Vrms	MAX. APPLIED Vdc	ENERGY (10X1000μs)	AVERAGE POWER DISSIPATION	PEAK CURRENT (8X20 μs)	VARISTOR VOLTAGE		MAX. CLAMPING VOLTAGE @ TEST CURRENT (8X20 μs)		TYP. CAP. (1KHz)
		VOLTS	VOLTS	JOULES	WATTS	AMP.	VOLTS	TOL.	VOLTS	AMP.	pF.
0117NR05-0	0	75	95	2.5	0.10	400	117	±10%	220	5	95
0117NR07-1	1	75	95	5.0	0.25	1200	117	±10%	205	10	160
0117NR12-2	2	75	95	13.0	0.40	2500	117	±10%	205	35	630
0117NR14-3	3	75	95	21.0	0.60	4500	117	±10%	205	50	940
0117NR20-4	4	75	95	40.0	1.00	6500	117	±10%	205	100	1450
0150NR05-0	0	95	125	3.0	0.10	400	150	±10%	265	5	75
0150NR07-1	1	95	125	7.0	0.25	1200	150	±10%	250	10	120
0150NR12-2	2	95	125	18.0	0.40	2500	150	±10%	250	35	490
0150NR14-3	3	95	125	29.0	0.60	4500	150	±10%	250	50	740
0150NR20-4	4	95	125	50.0	1.00	6500	150	±10%	250	100	1520
0183NR05-0	0	115	150	4.0	0.10	400	183	±10%	315	5	60
0183NR07-1	1	115	150	10.0	0.25	1200	183	±10%	305	10	100
0183NR12-2	2	115	150	22.0	0.40	2500	183	±10%	305	35	400
0183NR14-3	3	115	150	35.0	0.60	4500	183	±10%	305	50	600
0183NR20-4	4	115	150	69.0	1.00	6500	183	±10%	305	100	1250
0216NR05-0	0	135	180	4.5	0.10	400	216	±10%	370	5	50
0216NR07-1	1	135	180	10.0	0.25	1200	216	±10%	355	10	85
0216NR12-2	2	135	180	25.0	0.40	2500	216	±10%	355	35	340
0216NR14-3	3	135	180	39.0	0.60	4500	216	±10%	355	50	510
0216NR20-4	4	135	180	72.0	1.00	6500	216	±10%	355	100	1050
0250NR05-0	0	160	210	5.0	0.10	400	250	±10%	430	5	45
0250NR07-1	1	160	210	10.0	0.25	1200	250	±10%	410	10	75
0250NR12-2	2	160	210	30.0	0.40	2500	250	±10%	410	35	300
0250NR14-3	3	160	210	40.0	0.60	4500	250	±10%	410	50	450
0250NR20-4	4	160	210	80.0	1.00	6500	250	±10%	410	100	930
0283NR05-0	0	180	220	6.0	0.10	400	283	±10%	485	5	40
0283NR07-1	1	180	220	12.0	0.25	1200	283	±10%	465	10	65
0283NR12-2	2	180	220	33.0	0.40	2500	283	±10%	465	35	260
0283NR14-3	3	180	220	49.0	0.60	4500	283	±10%	465	50	390
0283NR20-4	4	180	220	90.0	1.00	6500	283	±10%	465	100	810
0330NR05-0	0	210	265	7.0	0.10	400	330	±10%	565	5	35
0330NR07-1	1	210	265	13.0	0.25	1200	330	±10%	545	10	55
0330NR12-2	2	210	265	40.0	0.40	2500	330	±10%	545	35	225
0330NR14-3	3	210	265	52.0	0.60	4500	330	±10%	545	50	340
0330NR20-4	4	210	265	95.0	1.00	6500	330	±10%	545	100	700
0350NR05-0	0	220	285	7.0	0.10	400	350	±10%	600	5	32
0350NR07-1	1	220	285	15.0	0.25	1200	350	±10%	580	10	53
0350NR12-2	2	220	285	42.0	0.40	2500	350	±10%	580	35	210
0350NR14-3	3	220	285	60.0	0.60	4500	350	±10%	580	50	320
0350NR20-4	4	220	285	119.0	1.00	6500	350	±10%	580	100	650
0383NR05-0	0	240	320	8.0	0.10	400	383	±10%	655	5	30
0383NR07-1	1	240	320	20.0	0.25	1200	383	±10%	630	10	48
0383NR12-2	2	240	320	45.0	0.40	2500	383	±10%	630	35	190
0383NR14-3	3	240	320	70.0	0.60	4500	383	±10%	630	50	290
0383NR20-4	4	240	320	129.0	1.00	6500	383	±10%	630	100	590
0416NR05-0	0	260	330	8.5	0.10	400	416	±10%	715	5	27
0416NR07-1	1	260	330	20.0	0.25	1200	416	±10%	685	10	45
0416NR12-2	2	260	330	50.0	0.40	2500	416	±10%	685	35	180
0416NR14-3	3	260	330	72.0	0.60	4500	416	±10%	685	50	270
0416NR20-4	4	260	330	135.0	1.00	6500	416	±10%	685	100	560
0450NR05-0	0	280	370	10.0	0.10	400	450	±10%	770	5	25
0450NR07-1	1	280	370	22.0	0.25	1200	450	±10%	740	10	40
0450NR12-2	2	280	370	55.0	0.40	2500	450	±10%	740	35	165
0450NR14-3	3	280	370	79.0	0.60	4500	450	±10%	740	50	250
0450NR20-4	4	280	370	145.0	1.00	6500	450	±10%	740	100	510
0500NR05-0	0	315	400	10.0	0.10	400	500	±10%	660	5	23
0500NR07-1	1	315	400	24.0	0.25	1200	500	±10%	825	10	37
0500NR12-2	2	315	400	60.0	0.40	2500	500	±10%	825	35	150
0500NR14-3	3	315	400	85.0	0.60	4500	500	±10%	825	50	230
0500NR20-4	4	315	400	155.0	1.00	6500	500	±10%	825	100	470
0550NR05-0	0	350	445	10.0	0.10	400	550	±10%	945	5	20
0550NR07-1	1	350	445	24.0	0.25	1200	550	±10%	910	10	34
0550NR12-2	2	350	445	60.0	0.40	2500	550	±10%	910	35	135
0550NR14-3	3	350	445	85.0	0.60	4500	550	±10%	910	50	200
0550NR20-4	4	350	445	155.0	1.00	6500	550	±10%	910	100	420
0700NR14-3	3	440	550	90.0	0.60	4500	700	±10%	1200	50	160
0700NR20-4	4	440	550	160.0	1.00	6500	700	±10%	1200	100	330
0765NR14-3	3	480	630	105.0	0.60	4500	765	±10%	1300	50	145
0765NR20-4	4	480	630	180.0	1.00	6500	765	±10%	1300	100	300
0800NR14-3	3	500	660	110.0	0.60	4500	800	±10%	1350	50	135
0800NR20-4	4	500	660	190.0	1.00	6500	800	±10%	1350	100	290
0850NR14-3	3	540	690	110.0	0.60	4500	850	±10%	1450	50	125
0850NR20-4	4	540	690	190.0	1.00	6500	850	±10%	1450	100	265
1000NR20-4	4	630	825	230.0	1.00	6500	1000	±10%	1700	100	230
1400NR20-4	4	890	1125	360.0	1.00	6500	1400	±10%	2400	100	170

Metal Oxide Varistors

NR Series

MECHANICAL DATA

PART NUMBER	SIZE	D MAX.		H MAX.		T MAX.		L MIN.		L MAX.		S NOM.*		d NOM.	
		inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
0117NR05-0	0	0.275	7.0	0.433	11.0	0.177	4.5	0.043	1.10	0.067	1.70	0.20	5.0	0.023	0.6
0117NR07-1	1	0.334	8.5	0.472	12.0	0.177	4.5	0.043	1.10	0.067	1.70	0.20	5.0	0.023	0.6
0117NR12-2	2	0.551	14.0	0.709	18.0	0.197	5.0	0.051	1.30	0.075	1.90	0.30	7.5	0.031	0.8
0117NR14-3	3	0.630	16.0	0.787	20.0	0.197	5.0	0.051	1.30	0.075	1.90	0.30	7.5	0.031	0.8
0117NR20-4	4	0.866	22.0	1.023	26.0	0.216	5.5	0.055	1.40	0.082	2.10	0.40	10.0	0.039	1.0
0150NR05-0	0	0.275	7.0	0.433	11.0	0.197	5.0	0.055	1.40	0.079	2.00	0.20	5.0	0.023	0.6
0150NR07-1	1	0.334	8.5	0.472	12.0	0.197	5.0	0.055	1.40	0.079	2.00	0.20	5.0	0.023	0.6
0150NR12-2	2	0.551	14.0	0.709	18.0	0.216	5.5	0.063	1.60	0.086	2.20	0.30	7.5	0.031	0.8
0150NR14-3	3	0.630	16.0	0.787	20.0	0.216	5.5	0.063	1.60	0.086	2.20	0.30	7.5	0.031	0.8
0150NR20-4	4	0.866	22.0	1.023	26.0	0.236	6.0	0.071	1.80	0.094	2.40	0.40	10.0	0.039	1.0
0183NR05-0	0	0.275	7.0	0.433	11.0	0.197	5.0	0.055	1.40	0.082	2.10	0.20	5.0	0.023	0.6
0183NR07-1	1	0.334	8.5	0.472	12.0	0.197	5.0	0.055	1.40	0.082	2.10	0.20	5.0	0.023	0.6
0183NR12-2	2	0.551	14.0	0.709	18.0	0.216	5.5	0.063	1.60	0.090	2.30	0.30	7.5	0.031	0.8
0183NR14-3	3	0.630	16.0	0.787	20.0	0.216	5.5	0.063	1.60	0.090	2.30	0.30	7.5	0.031	0.8
0183NR20-4	4	0.866	22.0	1.023	26.0	0.236	6.0	0.071	1.80	0.098	2.50	0.40	10.0	0.039	1.0
0216NR05-0	0	0.275	7.0	0.433	11.0	0.197	5.0	0.063	1.60	0.090	2.30	0.20	5.0	0.023	0.6
0216NR07-1	1	0.334	8.5	0.472	12.0	0.197	5.0	0.063	1.60	0.090	2.30	0.20	5.0	0.023	0.6
0216NR12-2	2	0.551	14.0	0.709	18.0	0.216	5.5	0.071	1.80	0.098	2.50	0.30	7.5	0.031	0.8
0216NR14-3	3	0.630	16.0	0.787	20.0	0.216	5.5	0.071	1.80	0.098	2.50	0.30	7.5	0.031	0.8
0216NR20-4	4	0.866	22.0	1.023	26.0	0.256	6.5	0.079	2.00	0.106	2.70	0.40	10.0	0.039	1.0
0250NR05-0	0	0.275	7.0	0.433	11.0	0.197	5.0	0.067	1.70	0.094	2.40	0.20	5.0	0.023	0.6
0250NR07-1	1	0.334	8.5	0.472	12.0	0.197	5.0	0.067	1.70	0.094	2.40	0.20	5.0	0.023	0.6
0250NR12-2	2	0.551	14.0	0.709	18.0	0.216	5.5	0.075	1.90	0.102	2.60	0.30	7.5	0.031	0.8
0250NR14-3	3	0.630	16.0	0.787	20.0	0.216	5.5	0.075	1.90	0.102	2.60	0.30	7.5	0.031	0.8
0250NR20-4	4	0.866	22.0	1.023	26.0	0.256	6.5	0.082	2.10	0.110	2.80	0.40	10.0	0.039	1.0
0283NR05-0	0	0.275	7.0	0.433	11.0	0.216	5.5	0.071	1.80	0.098	2.50	0.20	5.0	0.023	0.6
0283NR07-1	1	0.334	8.5	0.472	12.0	0.216	5.5	0.071	1.80	0.098	2.50	0.20	5.0	0.023	0.6
0283NR12-2	2	0.551	14.0	0.709	18.0	0.236	6.0	0.079	2.00	0.106	2.70	0.30	7.5	0.031	0.8
0283NR14-3	3	0.630	16.0	0.787	20.0	0.236	6.0	0.079	2.00	0.106	2.70	0.30	7.5	0.031	0.8
0283NR20-4	4	0.866	22.0	1.023	26.0	0.256	6.5	0.086	2.20	0.114	2.90	0.40	10.0	0.039	1.0
0330NR05-0	0	0.295	7.5	0.453	11.5	0.216	5.5	0.082	2.10	0.114	2.90	0.20	5.0	0.023	0.6
0330NR07-1	1	0.354	9.0	0.492	12.5	0.216	5.5	0.082	2.10	0.114	2.90	0.20	5.0	0.023	0.6
0330NR12-2	2	0.571	14.5	0.709	18.0	0.236	6.0	0.090	2.30	0.122	3.10	0.30	7.5	0.031	0.8
0330NR14-3	3	0.670	17.0	0.827	21.0	0.236	6.0	0.090	2.30	0.122	3.10	0.30	7.5	0.031	0.8
0330NR20-4	4	0.905	23.0	1.063	27.0	0.275	7.0	0.098	2.50	0.130	3.30	0.40	10.0	0.039	1.0
0350NR05-0	0	0.295	7.5	0.453	11.5	0.236	6.0	0.086	2.20	0.118	3.00	0.20	5.0	0.023	0.6
0350NR07-1	1	0.354	9.0	0.492	12.5	0.236	6.0	0.086	2.20	0.118	3.00	0.20	5.0	0.023	0.6
0350NR12-2	2	0.571	14.5	0.709	18.0	0.256	6.5	0.094	2.40	0.126	3.20	0.30	7.5	0.031	0.8
0350NR14-3	3	0.670	17.0	0.827	21.0	0.256	6.5	0.094	2.40	0.126	3.20	0.30	7.5	0.031	0.8
0350NR20-4	4	0.905	23.0	1.063	27.0	0.275	7.0	0.102	2.60	0.134	3.40	0.40	10.0	0.039	1.0
0383NR05-0	0	0.295	7.5	0.453	11.5	0.236	6.0	0.094	2.40	0.126	3.20	0.20	5.0	0.023	0.6
0383NR07-1	1	0.354	9.0	0.492	12.5	0.236	6.0	0.094	2.40	0.126	3.20	0.20	5.0	0.023	0.6
0383NR12-2	2	0.571	14.5	0.709	18.0	0.256	6.5	0.102	2.60	0.134	3.40	0.30	7.5	0.031	0.8
0383NR14-3	3	0.670	17.0	0.827	21.0	0.256	6.5	0.102	2.60	0.134	3.40	0.30	7.5	0.031	0.8
0383NR20-4	4	0.905	23.0	1.063	27.0	0.275	7.0	0.110	2.80	0.142	3.60	0.40	10.0	0.039	1.0
0416NR05-0	0	0.295	7.5	0.453	11.5	0.236	6.0	0.102	2.60	0.134	3.40	0.20	5.0	0.023	0.6
0416NR07-1	1	0.354	9.0	0.492	12.5	0.236	6.0	0.102	2.60	0.134	3.40	0.20	5.0	0.023	0.6
0416NR12-2	2	0.571	14.5	0.709	18.0	0.256	6.5	0.110	2.80	0.142	3.60	0.30	7.5	0.031	0.8
0416NR14-3	3	0.670	17.0	0.827	21.0	0.256	6.5	0.110	2.80	0.142	3.60	0.30	7.5	0.031	0.8
0416NR20-4	4	0.905	23.0	1.063	27.0	0.295	7.5	0.118	3.00	0.149	3.80	0.40	10.0	0.039	1.0
0450NR05-0	0	0.295	7.5	0.453	11.5	0.256	6.5	0.106	2.70	0.142	3.60	0.20	5.0	0.023	0.6
0450NR07-1	1	0.354	9.0	0.492	12.5	0.256	6.5	0.106	2.70	0.142	3.60	0.20	5.0	0.023	0.6
0450NR12-2	2	0.571	14.5	0.709	18.0	0.275	7.0	0.114	2.90	0.149	3.80	0.30	7.5	0.031	0.8
0450NR14-3	3	0.670	17.0	0.827	21.0	0.275	7.0	0.114	2.90	0.149	3.80	0.30	7.5	0.031	0.8
0450NR20-4	4	0.905	23.0	1.063	27.0	0.295	7.5	0.122	3.10	0.157	4.00	0.40	10.0	0.039	1.0
0500NR05-0	0	0.295	7.5	0.453	11.5	0.256	6.5	0.118	3.00	0.153	3.90	0.20	5.0	0.023	0.6
0500NR07-1	1	0.354	9.0	0.492	12.5	0.256	6.5	0.118	3.00	0.153	3.90	0.20	5.0	0.023	0.6
0500NR12-2	2	0.571	14.5	0.709	18.0	0.275	7.0	0.126	3.20	0.161	4.10	0.30	7.5	0.031	0.8
0500NR14-3	3	0.670	17.0	0.827	21.0	0.275	7.0	0.126	3.20	0.161	4.10	0.30	7.5	0.031	0.8
0500NR20-4	4	0.905	23.0	1.063	27.0	0.295	7.5	0.134	3.40	0.169	4.30	0.40	10.0	0.039	1.0
0550NR05-0	0	0.295	7.5	0.453	11.5	0.275	7.0	0.130	3.30	0.169	4.30	0.20	5.0	0.023	0.6
0550NR07-1	1	0.354	9.0	0.492	12.5	0.275	7.0	0.130	3.30	0.169	4.30	0.20	5.0	0.023	0.6
0550NR12-2	2	0.571	14.5	0.709	18.0	0.295	7.5	0.138	3.50	0.177	4.50	0.30	7.5	0.031	0.8
0550NR14-3	3	0.670	17.0	0.827	21.0	0.295	7.5	0.138	3.50	0.177	4.50	0.30	7.5	0.031	0.8
0550NR20-4	4	0.905	23.0	1.063	27.0	0.315	8.0	0.145	3.70	0.185	4.70	0.40	10.0	0.039	1.0
0700NR14-3	3	0.689	17.5	0.866	22.0	0.354	9.0	0.149	3.80	0.216	5.50	0.30	7.5	0.031	0.8
0700NR20-4	4	0.945	24.0	1.102	28.0	0.374	9.5	0.157	4.00	0.236	6.00	0.40	10.0	0.039	1.0
0765NR14-3	3	0.689	17.5	0.866	22.0	0.374	9.5	0.149	3.80	0.236	6.00	0.30	7.5	0.031	0.8
0765NR20-4	4	0.945	24.0	1.102	28.0	0.374	9.5	0.157	4.00	0.236	6.00	0.40	10.0	0.039	1.0
0800NR14-3	3	0.689	17.5	0.866	22.0	0.374	9.5	0.165	4.20	0.236	6.00	0.30	7.5	0.031	0.8
0800NR20-4	4	0.945	24.0	1.102	28.0	0.394	10.0	0.173	4.40	0.256	6.50	0.40	10.0	0.039	1.0
0850NR14-3	3	0.689	17.5	0.866	22.0	0.394	10.0	0.173	4.40	0.256	6.50	0.30	7.5	0.031	0.8
0850NR20-4	4	0.945	24.0	1.102	28.0	0.394	10.0	0.181	4.60	0.256	6.50	0.40	10.0	0.039	1.0
1000NR20-4	4	0.984	25.0	1.142	29.0	0.433	11.0	0.208	5.30	0.295	7.50	0.40	10.0	0.039	1.0
1400NR20-4	4	0.984	25.0	1.142	29.0	0.512	13.0	0.275	7.00	0.354	9.60	0.40	10.0	0.039	1.0

* S Dimension tolerance ± (1.0 mm) 0.04 inch

Note: Size 1 is available with S dimension (7.0mm) 0.28 inch upon request.

Metal Oxide Varistors

ZR Series

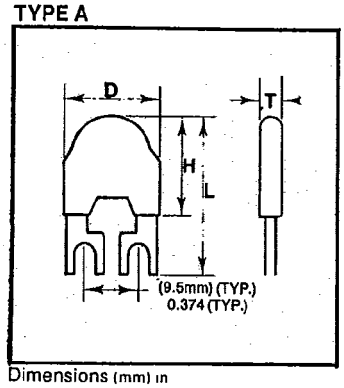
ELECTRICAL CHARACTERISTICS TABLE

PART NUMBER	SIZE	STEADY STATE		TRANSIENT (@ 85°C)			CHARACTERISTICS (@ 25°C)				
		MAX. APPLIED Vrms	MAX. APPLIED Vdc	ENERGY (10X1000 μs)	AVERAGE POWER DISSIPATION	PEAK CURRENT (8X20 μs)	VARISTOR VOLTAGE DC VOLTAGE		MAX. CLAMPING VOLTAGE @ TEST CURRENT (8X20 μs)		TYP. CAP. (1KHz)
		VOLTS	VOLTS	JOULES	WATTS	AMP.	VOLTS	TOL.	VOLTS	AMP.	pF.
0018ZR05-0	0	10	12	0.4	0.01	250	18	±20%	50	1	1400
0018ZR07-1	1	10	12	0.8	0.02	500	18	±20%	45	2.5	3000
0018ZR10-2	2	10	12	1.6	0.05	1000	18	±20%	45	5	6100
0018ZR14-3	3	10	12	3.5	0.10	2000	18	±20%	45	10	12200
0022ZR05-0	0	13	16	0.5	0.01	250	22	±15%	55	1	1200
0022ZR07-1	1	13	16	1.0	0.02	500	22	±15%	50	2.5	2500
0022ZR10-2	2	13	16	2.0	0.05	1000	22	±15%	50	5	5000
0022ZR14-3	3	13	16	4.0	0.10	2000	22	±15%	50	10	10000
0024ZR05-0	0	14	18	0.5	0.01	250	24	±15%	60	1	1100
0024ZR07-1	1	14	18	1.2	0.02	500	24	±15%	55	2.5	2300
0024ZR10-2	2	14	18	2.0	0.05	1000	24	±15%	55	5	4500
0024ZR14-3	3	14	18	4.0	0.10	2000	24	±15%	55	10	9100
0027ZR05-0	0	17	22	0.6	0.01	250	27	±10%	65	1	1100
0027ZR07-1	1	17	22	1.3	0.02	500	27	±10%	60	2.5	2200
0027ZR10-2	2	17	22	2.5	0.05	1000	27	±10%	60	5	4500
0027ZR14-3	3	17	22	5.0	0.10	2000	27	±10%	60	10	9000
0033ZR05-0	0	20	26	0.7	0.01	250	33	±10%	75	1	1000
0033ZR07-1	1	20	26	1.5	0.02	500	33	±10%	70	2.5	2000
0033ZR10-2	2	20	26	3.0	0.05	1000	33	±10%	70	5	4000
0033ZR14-3	3	20	26	6.0	0.10	2000	33	±10%	70	10	9000
0039ZR05-0	0	25	31	0.8	0.01	250	39	±10%	85	1	800
0039ZR07-1	1	25	31	1.7	0.02	500	39	±10%	80	2.5	1700
0039ZR10-2	2	25	31	3.5	0.05	1000	39	±10%	80	5	3500
0039ZR14-3	3	25	31	7.0	0.10	2000	39	±10%	80	10	7000
0047ZR05-0	0	30	38	1.1	0.01	250	47	±10%	105	1	700
0047ZR07-1	1	30	38	2.3	0.02	500	47	±10%	95	2.5	1500
0047ZR10-2	2	30	38	4.5	0.05	1000	47	±10%	95	5	3000
0047ZR14-3	3	30	38	8.5	0.10	2000	47	±10%	95	10	6000
0056ZR05-0	0	35	45	1.3	0.01	250	56	±10%	125	1	600
0056ZR07-1	1	35	45	2.7	0.02	500	56	±10%	110	2.5	1300
0056ZR10-2	2	35	45	5.5	0.05	1000	56	±10%	110	5	2750
0056ZR14-3	3	35	45	10.0	0.10	2000	56	±10%	110	10	5500
0068ZR05-0	0	43	55	1.6	0.01	250	68	±10%	150	1	600
0068ZR07-1	1	43	55	3.2	0.02	500	68	±10%	135	2.5	1200
0068ZR10-2	2	43	55	6.5	0.05	1000	68	±10%	135	5	2500
0068ZR14-3	3	43	55	13.0	0.10	2000	68	±10%	135	10	5000
0082ZR05-0	0	52	66	2.0	0.10	500	82	±10%	160	5	630
0082ZR07-1	1	52	66	4.0	0.20	1000	82	±10%	150	10	1400
0082ZR10-2	2	52	66	9.0	0.40	2500	82	±10%	150	35	1900
0082ZR14-3	3	52	66	14.0	0.60	5000	82	±10%	150	50	3800
0100ZR05-0	0	63	80	2.0	0.10	500	100	±10%	190	5	530
0100ZR07-1	1	63	80	6.0	0.20	1000	100	±10%	175	10	1200
0100ZR10-2	2	63	80	13.0	0.40	2500	100	±10%	175	35	1500
0100ZR14-3	3	63	80	19.0	0.60	5000	100	±10%	175	50	3200

Spade Lug Type

NS and ZS Series

TYPE A



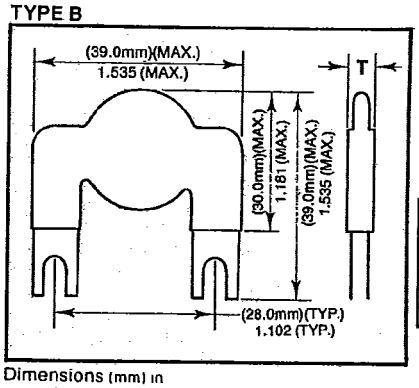
Dimensions (mm) in

Stetron offers spade lug types for specific applications to facilitate ease of assembly at the lowest possible installed cost. Type A is designed to mount under NEMA barrier blocks in microprocessors and addressable Input/Output systems.
Type B is designed to mount under AC input terminals on solid state relays.

SIZE	H (MAX.)		L (MAX.)	
	INCH	mm	INCH	mm
1	0.630	16.0	1.024	26.0
2	0.787	20.0	1.181	30.0
3	0.866	22.0	1.457	37.0

Note: Refer to tables on pages 7 and 9 for other dimensions

TYPE B



Dimensions (mm) in

Available in size 4 only

Metal Oxide Varistors

ZR Series

MECHANICAL DATA

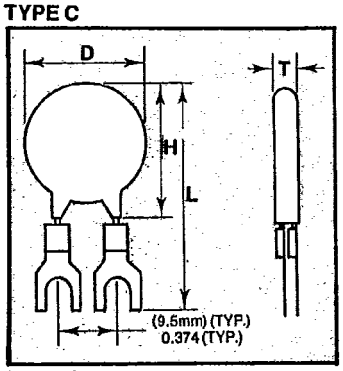
PART NUMBER	SIZE	D MAX.		H MAX.		T MAX.		L MIN.		L MAX.		S NOM.**		d NOM.	
		inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
0018ZR05-0	0	0.27	7	0.43	11	0.13	3.3	0.035	0.9	0.059	1.5	0.19	5	0.023	0.6
0018ZR07-1	1	0.33	8.5	0.51	13	0.13	3.3	0.035	0.9	0.059	1.5	0.19	5	0.023	0.6
0018ZR10-2	2	0.47	12	0.63	16	0.14	3.7	0.039	1.0	0.071	1.8	0.30	7.5	0.031	0.8
0018ZR14-3	3	0.63	16	0.79	20	0.14	3.7	0.039	1.0	0.071	1.8	0.30	7.5	0.031	0.8
0022ZR05-0	0	0.27	7	0.43	11	0.13	3.3	0.035	0.9	0.067	1.7	0.19	5	0.023	0.6
0022ZR07-1	1	0.33	8.5	0.51	13	0.13	3.3	0.035	0.9	0.067	1.7	0.19	5	0.023	0.6
0022ZR10-2	2	0.47	12	0.63	16	0.14	3.7	0.039	1.0	0.075	1.9	0.30	7.5	0.031	0.8
0022ZR14-3	3	0.63	16	0.79	20	0.14	3.7	0.039	1.0	0.075	1.9	0.30	7.5	0.031	0.8
0024ZR05-0	0	0.27	7	0.43	11	0.14	3.6	0.035	0.9	0.071	1.8	0.19	5	0.023	0.6
0024ZR07-1	1	0.33	8.5	0.51	13	0.14	3.6	0.035	0.9	0.071	1.8	0.19	5	0.023	0.6
0024ZR10-2	2	0.47	12	0.63	16	0.15	4.0	0.043	1.1	0.075	1.9	0.30	7.5	0.031	0.8
0024ZR14-3	3	0.63	16	0.79	20	0.15	4.0	0.043	1.1	0.075	1.9	0.30	7.5	0.031	0.8
0027ZR05-0	0	0.27	7	0.43	11	0.14	3.6	0.039	1.0	0.071	1.8	0.19	5	0.023	0.6
0027ZR07-1	1	0.33	8.5	0.51	13	0.14	3.6	0.039	1.0	0.071	1.8	0.19	5	0.023	0.6
0027ZR10-2	2	0.47	12	0.63	16	0.15	4.0	0.047	1.2	0.079	2.0	0.30	7.5	0.031	0.8
0027ZR14-3	3	0.63	16	0.79	20	0.15	4.0	0.047	1.2	0.079	2.0	0.30	7.5	0.031	0.8
0033ZR05-0	0	0.27	7	0.43	11	0.15	4.0	0.043	1.1	0.075	1.9	0.19	5	0.023	0.6
0033ZR07-1	1	0.33	8.5	0.51	13	0.15	4.0	0.043	1.1	0.075	1.9	0.19	5	0.023	0.6
0033ZR10-2	2	0.47	12	0.63	16	0.17	4.4	0.051	1.3	0.082	2.1	0.30	7.5	0.031	0.8
0033ZR14-3	3	0.63	16	0.79	20	0.17	4.4	0.051	1.3	0.082	2.1	0.30	7.5	0.031	0.8
0039ZR05-0	0	0.27	7	0.43	11	0.15	4.0	0.043	1.1	0.082	2.1	0.19	5	0.023	0.6
0039ZR07-1	1	0.33	8.5	0.51	13	0.15	4.0	0.043	1.1	0.082	2.1	0.19	5	0.023	0.6
0039ZR10-2	2	0.51	13	0.63	16	0.17	4.4	0.051	1.3	0.090	2.3	0.30	7.5	0.031	0.8
0039ZR14-3	3	0.67	17	0.79	20	0.17	4.4	0.051	1.3	0.090	2.3	0.30	7.5	0.031	0.8
0047ZR05-0	0	0.27	7	0.43	11	0.16	4.1	0.051	1.3	0.090	2.3	0.19	5	0.023	0.6
0047ZR07-1	1	0.35	9	0.51	13	0.16	4.1	0.051	1.3	0.090	2.3	0.19	5	0.023	0.6
0047ZR10-2	2	0.51	13	0.63	16	0.18	4.5	0.059	1.5	0.098	2.5	0.30	7.5	0.031	0.8
0047ZR14-3	3	0.67	17	0.79	20	0.18	4.5	0.059	1.5	0.098	2.5	0.30	7.5	0.031	0.8
0056ZR05-0	0	0.27	7	0.43	11	0.17	4.4	0.059	1.5	0.098	2.5	0.19	5	0.023	0.6
0056ZR07-1	1	0.35	9	0.51	13	0.17	4.4	0.059	1.5	0.098	2.5	0.19	5	0.023	0.6
0056ZR10-2	2	0.51	13	0.63	16	0.19	4.8	0.067	1.7	0.106	2.7	0.30	7.5	0.031	0.8
0056ZR14-3	3	0.67	17	0.79	20	0.19	4.8	0.067	1.7	0.106	2.7	0.30	7.5	0.031	0.8
0068ZR05-0	0	0.27	7	0.43	11	0.19	4.8	0.059	1.5	0.110	2.8	0.19	5	0.023	0.6
0068ZR07-1	1	0.35	9	0.51	13	0.19	4.8	0.059	1.5	0.110	2.8	0.19	5	0.023	0.6
0068ZR10-2	2	0.51	13	0.63	16	0.20	5.2	0.067	1.7	0.118	3.0	0.30	7.5	0.031	0.8
0068ZR14-3	3	0.67	17	0.79	20	0.20	5.2	0.067	1.7	0.118	3.0	0.30	7.5	0.031	0.8
0082ZR05-0	0	0.27	7	0.43	11	0.20	5.1	0.059	1.5	0.122	3.1	0.19	5	0.023	0.6
0082ZR07-1	1	0.35	9	0.51	13	0.20	5.1	0.059	1.5	0.122	3.1	0.19	5	0.023	0.6
0082ZR10-2	2	0.51	13	0.67	17	0.21	5.5	0.067	1.7	0.130	3.3	0.30	7.5	0.031	0.8
0082ZR14-3	3	0.67	17	0.83	21	0.21	5.5	0.067	1.7	0.130	3.3	0.30	7.5	0.031	0.8
0100ZR05-0	0	0.27	7	0.43	11	0.19	5.0	0.059	1.5	0.138	3.5	0.19	5	0.023	0.6
0100ZR07-1	1	0.35	9	0.51	13	0.19	5.0	0.059	1.5	0.138	3.5	0.19	5	0.023	0.6
0100ZR10-2	2	0.51	13	0.67	17	0.21	5.4	0.067	1.7	0.153	3.9	0.30	7.5	0.031	0.8
0100ZR14-3	3	0.67	17	0.83	21	0.21	5.4	0.067	1.7	0.153	3.9	0.30	7.5	0.031	0.8

** S Dimension tolerance ± (1.0 mm) 0.04 inch

Spade Lug Type

NS and ZS Series

TYPE C



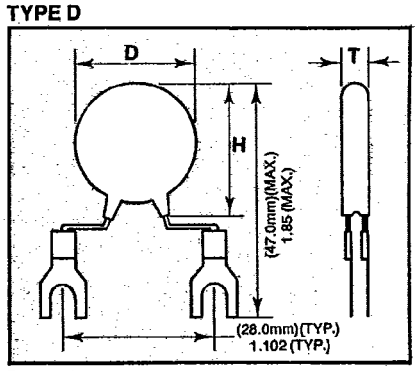
Dimensions (mm) in

Types C and D offer alternate mounting styles and are designed to meet applications which require quick disconnect termination to permit reliable and cost effective assembly.

SIZE	L (MAX.) INCH	mm
1	1.181	30.0
2	1.417	36.0
3	1.457	37.0

Note: Refer to tables on pages 7 and 9 for other dimensions

TYPE D



Dimensions (mm) in

Available in size 4 only

Stetron International Inc.

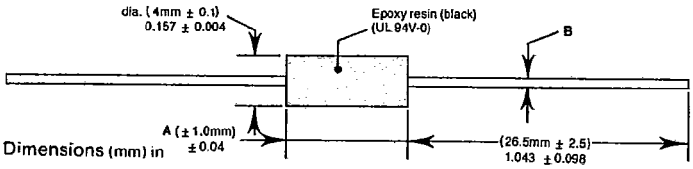
Metal Oxide Varistors

NA Series

ELECTRICAL CHARACTERISTICS

PART NUMBER	STEADY STATE		TRANSIENT (@ 85°C)			CHARACTERISTICS (@ 25°C)			
	RMS APPLIED VOLTAGE (50-60 Hz) AC	DC APPLIED VOLTAGE	ENERGY (10X 1000μs)	AVERAGE POWER DISSIPATION	PEAK CURRENT (8 X 20 μs)	VARISTOR VOLTAGE @ 1 mA DC CURRENT		MAX. CLAMPING VOLTAGE @ 1.0 AMP (8 x 20 μs)	TYP. CAPACITANCE (1KHz)
	VOLTS	VOLTS	JOULES	WATTS	AMPS	VOLTS	TOL.	VOLTS	pF.
0027NA	17	21	0.13	0.1	40	27	±10%	50	340
0033NA	21	26	0.20	0.1	40	33	±10%	60	270
0039NA	25	31	0.20	0.1	40	39	±10%	73	230
0047NA	30	38	0.26	0.1	40	47	±10%	85	190
0056NA	35	45	0.26	0.1	40	56	±10%	103	160
0068NA	43	55	0.40	0.2	40	68	±10%	120	130
0082NA	52	66	0.50	0.2	40	82	±10%	145	110
0100NA	63	81	0.50	0.2	40	100	±10%	170	50
0120NA	76	97	0.50	0.2	100	120	±10%	200	40
0150NA	95	121	0.60	0.2	100	150	±10%	230	30
0180NA	114	145	0.70	0.2	100	180	±10%	285	25
0220NA	140	178	0.90	0.2	100	220	±10%	355	20
0270NA	171	218	1.00	0.2	100	270	±10%	435	17
0330NA	210	267	1.10	0.2	100	330	±10%	535	15
0370NA	235	299	1.10	0.2	100	370	±10%	600	12
0390NA	248	315	1.30	0.2	100	390	±10%	635	10
0430NA	273	348	1.70	0.2	100	430	±10%	695	10

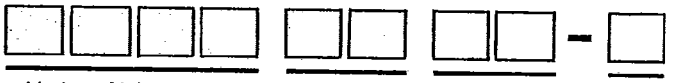
MECHANICAL DATA



Dimensions (mm) in

VOLTAGE	A		B	
	INCH	mm	INCH	mm
27 ~ 82V	0.276	7.0	0.024	0.60
100 ~ 430V	0.295	7.5	0.026	0.65

TYPE NUMBERING SYSTEM

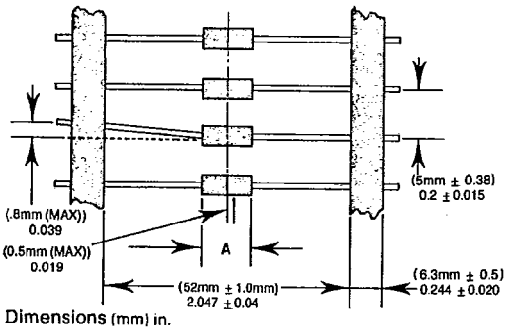


Varistor Voltage | Type | Element Size | Size Code

Examples:

0056 NA
0216NR07-1
0024ZR10-2

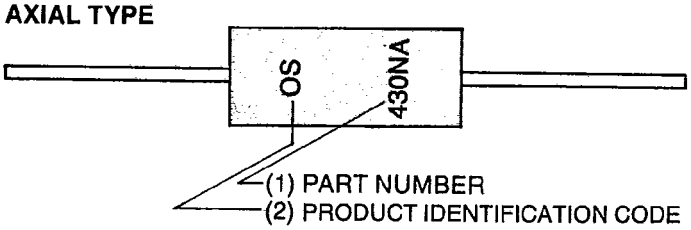
TAPE REEL SPECIFICATIONS



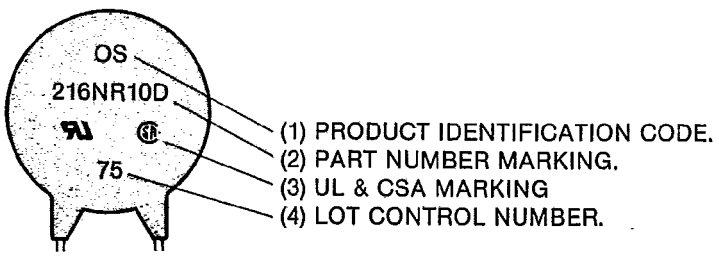
Dimensions (mm) in.

MNR MARKINGS

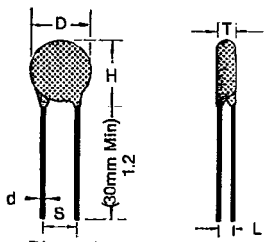
AXIAL TYPE



RADIAL TYPE



OUTLINE DIMENSIONS



Dimensions (mm) in.

Coating material: non-flammable, non toxic.
Lead wire: solder coated copper wire.

CSA #LR 56165-1
UL# E79699(M)

Note: Refer to tables on pages 7 and 9 for other dimensions

Metal Oxide Varistors SUPPLEMENT NR Series

ELECTRICAL CHARACTERISTICS TABLE

PART NUMBER	SIZE	STEADY STATE		TRANSIENT (@85°C)			CHARACTERISTICS(@ 25°C)				
		MAX. APPLIED VRMS	MAX. APPLIED VDC	ENERGY (10X1000µS)	AVERAGE POWER DISSIPATION	PEAK CURRENT (8X20µS)	VARISTOR VOLTAGE		MAX. CLAMPING @ VOLTAGE TEST CURRENT (8X20µS)		TYP. CAP. (1KHZ)
		VOLTS	VOLTS	JOULES	WATTS	AMP	VOLTS	TOL.	VOLTS	AMP.	PF
0117NR10-5	5	75	95	11	0.4	2500	117	±10%	205	25	640
0150NR10-5	5	95	120	15	0.4	2500	150	±10%	250	25	450
0183NR10-5	5	115	150	18	0.4	2500	183	±10%	305	25	350
0216NR10-5	5	135	175	21	0.4	2500	216	±10%	355	25	330
0250NR10-5	5	160	200	25	0.4	2500	250	±10%	410	25	290
0283NR10-5	5	180	230	27	0.4	2500	283	±10%	465	25	280
0330NR10-5	5	210	265	33	0.4	2500	330	±10%	545	25	250
0350NR10-5	5	220	280	35	0.4	2500	350	±10%	580	25	230
0383NR10-5	5	240	310	37	0.4	2500	383	±10%	630	25	200
0416NR10-5	5	260	335	42	0.4	2500	416	±10%	685	25	190
0450NR10-5	5	280	365	45	0.4	2500	450	±10%	740	25	180
0500NR10-5	5	315	405	50	0.4	2500	500	±10%	825	25	160
0550NR10-5	5	350	445	50	0.4	2500	550	±10%	910	25	140
0700NR10-5	5	440	565	58	0.4	2500	700	±10%	1200	25	110
0765NR10-5	5	480	620	65	0.4	2500	765	±10%	1300	25	105
0800NR10-5	5	500	650	70	0.4	2500	800	±10%	1350	25	100
0850NR10-5	5	540	690	75	0.4	2500	850	±10%	1450	25	95
1000NR10-5	5	630	810	80	0.4	2500	1000	±10%	1700	25	85

MECHANICAL DATA

PART NUMBER	SIZE	D		H		T		L				S		D	
		MAX		MAX		MAX		MIN		MAX		NOM*		NOM	
		INCH	MM	INCH	MM	INCH	MM	INCH	MM	INCH	MM	INCH	MM	INCH	MM
0117NR10-5	5	0.492	12.5	0.630	16.0	0.197	5.0	0.051	1.30	0.075	1.90	0.30	7.5	0.03	0.8
0150NR10-5	5	0.492	12.5	0.630	16.0	0.217	5.5	0.063	1.60	0.087	2.20	0.30	7.5	0.03	0.8
0183NR10-5	5	0.492	12.5	0.630	16.0	0.217	5.5	0.063	1.60	0.091	2.30	0.30	7.5	0.03	0.8
0216NR10-5	5	0.492	12.5	0.630	16.0	0.217	5.5	0.071	1.80	0.100	2.50	0.30	7.5	0.03	0.8
0250NR10-5	5	0.492	12.5	0.630	16.0	0.217	5.5	0.075	1.90	0.102	2.60	0.30	7.5	0.03	0.8
0283NR10-5	5	0.492	12.5	0.630	16.0	0.236	6.0	0.079	2.00	0.106	2.70	0.30	7.5	0.03	0.8
0330NR10-5	5	0.512	13.0	0.669	17.0	0.236	6.0	0.091	2.30	0.122	3.10	0.30	7.5	0.03	0.8
0350NR10-5	5	0.512	13.0	0.669	17.0	0.256	6.5	0.094	2.40	0.126	3.20	0.30	7.5	0.03	0.8
0383NR10-5	5	0.512	13.0	0.669	17.0	0.256	6.5	1.102	2.60	0.134	3.40	0.30	7.5	0.03	0.8
0416NR10-5	5	0.512	13.0	0.669	17.0	0.256	6.5	0.110	2.80	0.142	3.60	0.30	7.5	0.03	0.8
0450NR10-5	5	0.512	13.0	0.669	17.0	0.276	7.0	0.114	2.90	0.150	3.80	0.30	7.5	0.03	0.8
0500NR10-5	5	0.512	13.0	0.669	17.0	0.276	7.0	0.126	3.20	0.161	4.10	0.30	7.5	0.03	0.8
0550NR10-5	5	0.512	13.0	0.669	17.0	0.295	7.5	0.138	3.50	0.177	4.50	0.30	7.5	0.03	0.8
0700NR10-5	5	0.531	13.5	0.709	18.0	0.354	9.0	0.150	3.80	0.209	5.30	0.30	7.5	0.03	0.8
0765NR10-5	5	0.531	13.5	0.709	18.0	0.374	9.5	0.161	4.10	0.220	5.60	0.30	7.5	0.03	0.8
0800NR10-5	5	0.531	13.5	0.709	18.0	0.374	9.5	0.169	4.30	0.228	5.80	0.30	7.5	0.03	0.8
0850NR10-5	5	0.531	13.5	0.709	18.0	0.394	10.0	0.177	4.50	0.236	6.00	0.30	7.5	0.03	0.8
1000NR10-5	5	0.531	13.5	0.709	18.0	0.413	10.5	0.209	5.30	0.268	6.80	0.30	7.5	0.03	0.8

*S DIMENSION TOLERANCE ± (1.0MM) 0.04 INCH

(REFER TO PAGE 10 OF MNR VARISTOR BROCHURE FOR OTHER DATA)