APPNOTE

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Harris MOVs

The ABCs of MOVs

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The ABCs of MOVs

The material in this guide has been arranged in 3 parts for easy reference; Section A, Section B and Section C.

"A" is for Applications

This section provides general guidelines on what types of MOV products are best suited for particular environments.

"B" is for Basics

This section explains what Metal Oxide Varistors are, and the basic function they perform.

"C" is for Common Questions

This section helps clarify important information about MOVs for the design engineer, and answers questions that are asked most often.

Want to know more? For a copy of the latest Harris MOV data book, please contact your local Harris sales representative. Also available is the companion document "The ABC's of Multilayer Suppressors", AN9671. For technical assistance, call 1-800-4-HARRIS (US) or visit us on the World Wide Web at http://www.harris.com/

Applications

To properly match the right MOV with a particular application, it is desirable to know:

1. The maximum system RMS or DC voltage.
2. The MOV continuous voltage at 10 - 25% above maximum system voltage.
3. The worst-case transient energy that will need to be absorbed by the MOV.

When the above information is available, these charts offer basic application guidelines:

VOLTAGE (V)	ENERGY (J)	PACKAGING AND OTHER CONSIDERATIONS	PREFERRED SERIES
AC APPLICATIONS			
130-1000	11-360	Through-Hole Mounting Low/Medium AC Power Lines	LA "C"III
130-660	70-250	Shock/Vibration Environment Quick Connect Terminal	PA
130-275	11-23	Surface Mount Leadless Chip	CH
130-750	270-1050	High-Energy Applications Shock/Vibration Environment	DA HA NA DB
130-880	450-3200	Rigid Terminals Primary Power Line Heavy Industrial	BA
1100-2800	3800-10000	Rigid Terminals Heavy Industrial	BB
DC APPLICATIONS			
4-460	0.1-35	Through-Hole Mounting Automotive and Low Voltage Applications	ZA
10-115	0.8-23	Surface Mount Leadless Chip	CH
9-431	0.06 - 1.70	Axial Leaded	MA
3.5-68	0.1-1.2	Surface Mount Multilayer Leadless Chip	ML, MLE
18	3-25.0	Automotive Surface Mount Leadless Chip	AUML

APPLICATION EXAMPLE	TYPICAL SERIES SELECTED
TV/VCR/White Goods Office Equipment	ZA, LA, “C” III, CH, MA and ML Series
Motor Control	ZA, LA, “C” III, PA, HA, NA, BA, BB, DA and DB Series
Transformer (Primary Protection)	ZA, LA, “C” III, PA, BA, BB, DA, DB, HA and NA Series
Instrumentation	MA, ZA, ML and CH Series
Automotive (Primary/Secondary Protection)	ZA, CH and AUML Series
Noise Suppression	MA, ML, MLE, CH, ZA, LA and “C” III Series
Power Supply	PA, LA, “C” III, ZA, HA, NA, BA, BB, DA and DB Series
Transient Voltage Suppressor AC Power Strip	LA and “C” III Series
AC Distribution Panels	LA, “C” III, HA and NA Series
ESD Protection	MLE, ML Series

Basics

What is a Harris MOV?

A Harris MOV is a Metal Oxide Varistor. Varistors are voltage dependent, nonlinear devices which have an electrical behavior similar to back-to-back Zener diodes. The varistor's symmetrical, sharp breakdown characteristics enable it to provide excellent transient suppression performance. When exposed to high voltage transients, the varistor impedance changes many orders of magnitude – from a near open circuit to a highly conductive level – and clamps the transient voltage to a safe level. The potentially destructive energy of the incoming transient pulse is absorbed by the varistor, thereby protecting vulnerable circuit components and preventing potentially costly system damage.

What is a Harris MOV Made Of?

The Harris varistor is composed primarily of zinc oxide with small additions of bismuth, cobalt, manganese and other metal oxides. The structure of the body consists of a matrix of conductive zinc oxide grains separated by grain boundaries which provide P-N junction semiconductor characteristics.

What is the Scope of the Harris MOV Product Line?

Standard Harris varistors are available with AC operating voltages from 2.5V to 3200V. Higher voltages are limited only by packaging ability. Peak current handling exceeds 70,000 amps, and energy capability extends beyond 10,000 joules for the larger units. Package styles include the tiny tubular device used in connectors, and progress in size up to the rugged industrial blocks.

Common Questions

Agency Listings

Q. Are MOVs listed to Safety Agency standards?

A. This depends upon the MOV’s intended usage. For example, all Harris MOVs rated at $130V_{RMS}$ or higher are UL-listed under file number E75961 and/or E56529. (These include all BA/BB, DA/DB, LA and PA series devices as well as ZA devices.) The epoxy encapsulant complies with UL flammability code UL94-VO. Under UL Standard 497B, all ZA and LA series devices are UL approved to file number E135010. Many Harris MOVs are CSA listed, including LA and PA series types. Check the latest copy of the Harris MOV data book for complete, up-to-date listings. Radial devices have also received CECC certification

High Temperature Environments

Q. How can a radial MOV meet the requirements for temperature cycle and 125^oC operating temperatures?

A. On request. Harris radial MOVs can be encapsulated with a special phenolic material that withstands these harsh conditions. Special part number designations will be assigned. ML, AUML, MLE, CH and RA series parts are designed to operate from -55^oC to 125^oC without derating.

Connecting MOVs for Added Protection

Q. Can MOVs be connected in parallel?

A. Yes. The paralleling of MOVs provides increased peak current and energy-handling capabilities for a given application. The determination of which MOVs to use is a critical one in order to ensure that uniform current sharing occurs at high transient levels. It is recommended that Harris performs this screening and selection process.

Q. Can MOVs be connected in series for special voltage applications?

A. Yes. MOVs can be connected in series to provide voltage ratings higher than those normally available, or to provide ratings between the standard offerings.

Q. How are MOVs connected for single-phase and three-phase protection?

A. FOR SINGLE-PHASE AC: The optimum protection is to connect evenly rated MOVs from hot-neutral, hot-ground and neutral-ground. If this configuration is not possible, connection between hot-neutral and hot-ground is best. FOR THREE-PHASE AC: This depends upon the 3-phase configuration. Please refer to the Harris MOV data book.

Current Steering or Directing

Q. Does an MOV simply steer current?

A. No. It is incorrect to believe that an MOV device merely re-directs energy. In fact, the MOV dissipates heat energy within the device by actually absorbing this energy. The degree or level to which this absorption can take place is dependent on the energy rating of the device.

Date Codes

Q. Can you explain the date codes when branded on a Harris MOV?

A. The date codes tell you when the device was manufactured. Presently there are two methods used. A “character-digit” (month-year) system or a “four digit” (year-year-week-week) system where the first two digits represent the year (97 = 1997) and the second two digits represent the sequential week of the year. Eventually, all product will utilize the "four digit" method. In addition to the date code, the parts will carry the Harris logo and UL, CSA monograms where appropriate.

Failure of Device and Fuse Selection

Q. How does an MOV fail?

A. When subjected to stresses above its ratings, an MOV can fail as a short circuit. If applied conditions significantly exceed the energy rating of the device, and current is not limited, the MOV may be completely destroyed. For this reason, the use of current-limiting fuses is suggested.

Q. How do you select a fuse to prevent failure of an MOV?

A. Fuses should be chosen to limit current below the level where damage to the MOV package could occur. Specific guidance is provided in the Harris MOV data book. Generally, the fuse should be placed in series with either the varistor or the source ahead of the varistor.

Heavy Metals/CFCs

Q. Are heavy metals such as cadmium or mercury or CFCs used in the manufacture of Harris MOVs?

A. No. There are no heavy metals or CFCs used in the manufacture of Harris MOVs.

Lead Inductance/Lead Forms/Lead Coating

Q. Does lead inductance/capacitance affect MOV performance?

A. Yes. Transient wave forms with steep fronts ($\leq 1\mu s$) and in excess of several amps produce an increase in voltage across the varistor. This is a characteristic of all leaded devices including Zeners, known as overshoot. Unlike Zeners, MOVs such as our CH, CPV/CS and ML/AUML series are leadless and do not exhibit overshoot.

Q. What standard lead forms are available on Harris radial MOVs?

A. Radial lead types include outcrimp, undercrimp and inline configurations and meet several criteria for circuit board components (e.g., mechanical stability, lead length and solderability). Harris radial MOVs are also available in tape-and-reel packaging to accommodate auto-insertion equipment.

Q. Are MOV leads coated or tinned?

A. Yes. All leads are electroplated to provide a uniform surface. This process ensures that a subsequent solder coat may be evenly applied.

Part Numbering

Q. What information does an MOV part number provide?

A. MOV part numbers were created to impart product data. Each designation follows the pattern: LETTER/NUMBER/LETTER/NUMBER/LETTER.

Letter . . . . The prefix "V" stands for Varistor.

Number . . Depending on the product family, this number indicates either a) the maximum $AC_{(RMS)}$ continuous voltage the device can handle or b) the nominal DC voltage (measured with a 1mA test current through the varistor).

Letter . . . . These two letters (LA, DB, PA, etc.) correspond to a specific product series and package configuration.

Number . . . This number represents the relative energy rating.

Letter . . . . This final letter indicates the voltage selection of the device.

Q. Why isn't the entire part number branded on the device?

A. The small size of some components cannot accommodate the relatively lengthy part number. Consequently, abbreviated brands are used. The Harris MOV data book lists these abbreviated brands (along with their corresponding factory part numbers) in the device ratings and characteristics tables of each series.

Sensitivity

Q. Are MOVs sensitive to polarity?

A. No. Since MOVs provide bidirectional clamping, they are not a polarized device.

Q. Are MOVs sensitive to electrostatic discharge?

A. No. In fact, MOVs are specifically designed to protect sensitive integrated circuits from ESD transients, such as with the ML or MLE Series of multilayer suppressors.

Q. Generally speaking, are MOVs sensitive to chemical/pressure when potted?

A. No.

Speed of Response, Compared to Zeners

Q. Are Zeners significantly faster than MOVs?

A. No, not to the extent of the claims made. The intrinsic response time of MOV material is 500 picoseconds. As the vast majority of transients have a slower rise time than this, it is of little or no significance to compare speeds of response. The response time of a leaded MOV or Zener is affected by circuit configuration and lead inductance.

Voltage Regulation, Voltage Limits

Q. Can an MOV be used as a voltage regulator?

A. No. MOVs function as nonlinear impedance devices. They are exceptional at dissipating transient voltage spikes, but they cannot dissipate continuous low level power.

Q. Is it possible to get MOVs with voltages other than those listed in the data book?

A. Yes. The Harris MOV data book discusses standard voltages only. Application-specific MOVs, with voltages tailored to customer requirements, can be manufactured upon request. Contact your Harris sales representative to discuss your individual needs.