Littelfuse
Expertise Applied | Answers Delivered

High Reliability Varistors

MIL QPL

Agency Approvals

- DSSC Approved
- QPL Listed
- CECC Certified
- ISO Approved
- UL Recognized
- CSA Certified

Additional Information

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

Description

Littelfuse High Reliability Varistors offer the latest in increased product performance, and are available for applications requiring quality and reliability assurance levels consistent with military or other standards (MIL-STD-19500, MIL-STD-750, Method 202). Additionally, Littelfuse Varistors are inherently radiation hardened compared to Silicon Diode suppressors as illustrated in Figure 1.

Littelfuse High-Reliability Varistors involve four categories:

1. **DSSC Qualified Parts List (QPL) MIL-R-83530**
   (4 items presently available)

2. **Littelfuse High Reliability Series TX Equivalents**
   (29 items presently available)

3. **Custom Types**

   Processed to customer-specific requirements - (SCD) or to Standard Military Flow

4. **Commercial Item Descriptors (CID) identified for Government use:**

   CID AA-55564-3 - Littelfuse ZA Series

Revised: 09/03/14

1) DSSC Qualified Parts List (QPL) MIL-R-83530

This series of varistors are screened and conditioned in accordance with MIL-R-83530 as outlined in Table 2. Manufacturing system conforms to MIL-I-45208; MIL-Q-9858.

Table 1. MIL-R-83530/1 Ratings and Characteristics

Part Number M83530/	Nominal Varistor Voltage (V)	Tolerance (%)	Voltage Rating (V)		Energy Rating (J)	Clamping Voltage at 100A (V)	Capacitance at 1MHz (pF)	Clamping Voltage At Peak Current Rating (V)	I_{TM} (A)	Nearest Commercial Equivalent
			(RMS)	(DC)						
1-2000B	200	-/+10	130	175	50	325	3800	570	6000	V130LA20B
1-2200D	220	+10, -5	150	200	55	360	3200	650	6000	V150LA20B
1-4300E	430	+5, -10	275	369	100	680	1800	1200	6000	V275LA40B
1-5100E	510	+5, -10	320	420	120	810	1500	1450	6000	V320LA40B

Table 2. Mil-R-83530 Group A, B, and C Inspections

Inspection		AQL (Percent Defective)	Major	Minor	Number of Sample Units	Failures Allowed
Group A	SUBGROUP 1					
	High Temperature Life (Stabilization Bake)	100%	-	-	-	-
	Thermal Shock	100%	-	-	-	-
	Power Burn-In	100%	-	-	-	-
	Clamping Voltage	100%	-	-	-	-
	Nominal Varistor Voltage	100%	-	-	-	-
	SUBGROUP 2					
	Visual and Mechanical Examination	-	1.0% AQL 7.6% LQ	25% AQL 13.0% LQ	Per Plan	-
	Body Dimensions	-			Per Plan	-
	Diameter and Length of Leads	-			Per Plan	-
	Marking	-			Per Plan	-
	Workmanship	-			Per Plan	-
	SUBGROUP 3					
	Solderability	-	-	-	Per Plan	-
Group B	SUBGROUP 1					
	Dielectric Withstanding Voltage	-	-	-	Per Plan	-
	SUBGROUP 2					
	Resistance to Solvents	-	-	-	Per Plan	-
	SUBGROUP 3					
	Terminal Strength (Lead Fatigue)	-	-	-	Per Plan	-
	Moisture Resistance	-	-	-	Per Plan	-
	Peak Current	-	-	-	Per Plan	-
	Energy	-	-	-	Per Plan	-
Group C	EVERY 3 MONTHS					
	High Temperature Storage	-	-	-	10	0
	Operating Life (Steady State)	-	-	-	10	0
	Pulse Life	-	-	-	10	0
	Shock	-	-	-	10	0
	Vibration	-	-	-	10	0
	Constant Acceleration	-	-	-	10	0
	Energy	-	-	-	10	0

2) Littelfuse High Reliability Series TX Equivalents

TABLE 5. Available TX Model Types

TX Model	Model Size	Device Mark	(See Section 4) Nearest Commercial Equivalent
V8ZTX1 V8ZTX2	7mm 10mm	8TX1 8TX2	V8ZA1 V8ZA2
V12ZTX1 V12ZTX2	7mm 10mm	12TX1 12TX2	V12ZA1 V12ZA2
V22ZTX1 V22ZTX3	7mm 14mm	22TX1 22TX3	V22ZA1 V22ZA3
V24ZTX50	20mm	24TX50	V24ZA50
V33ZTX1 V33ZTX5 V33ZTX70	7mm 14mm 20mm	33TX1 33TX5 33TX70	V33ZA1 V33ZA5 V33ZA70
V68ZTX2 V68ZTX10	7mm 14mm	68TX2 68TX10	V68ZA2 V68ZA10
V82ZTX2 V82ZTX12	7mm 14mm	82TX2 82TX12	V82ZA2 V82ZA12
V130LTX2 V130LTX10A V130LTX20B	7mm 14mm 20mm	130TX 130TX10 130TX20	V130LA2 V130LA10A V130LA20A
V150LTX2 V150LTX10A V150LTX20B	7mm 14mm 20mm	150TX 150TX10 150TX20	V150LA2 V150LA10A V150LA20B
V250LTX4 V250LTX20A V250LTX40B	7mm 14mm 20mm	250TX 250TX20 250TX40	V250LA4 V250LA20A V250LA40B
V420LTX20A V420LTX40B	14mm 20mm	420TX20 420TX40	V420LA20A V420LA40B
V480LTX40A V480LTX80B	14mm 20mm	480TX40 480TX80	V480LA40A V480LA80B
V510LTX40A V510LTX80B	14mm 20mm	510TX40 510TX80	V510LA40A V510LA80B

The TX Series of varistors are 100% screened and conditioned in accordance with MIL-STD-750. Tests are as outlined in Table 6.

INSPECTION LOTS FORMED AFTER ASSEMBLY > LOTS PROPOSED FOR TX TYPES > 100% SCREENING > REVIEW OF DATA TX PREPARA TION FOR DELIVERY > QA ACCEPTANCE SAMPLE PER APPLICABLE DEVICE SPECIFICATION

TABLE 6. TX Equivalents Series 100% Screening

	MIL-STD-105		LTPD
	LEVEL	AQL	
Electrical (Bidirectional) $V_{N(DC)}$, V_C (Per Specifications Table)	II	0.1	-
Dielectric Withstand Voltage MIL–STD–202, Method 301, 2500V Min. at $1.0\mu A_{DC}$	-	-	15
Solderability MIL–STD–202, Method 208, No Aging, Non-Activated	-	-	15

TABLE 7. Quality Assurance Acceptance Test

Screen	MIL-STD-750 Method	Condition	TX Requirements
High Temperature Life (Stabilization Bake)	1032	24 hours min at max rated storage temperature.	100%
Thermal Shock			
(Temperature Cycling)	1051	No dwell is required at 25°C. Test condition A1, 5 cycles -55°C to +125°C (extremes) >10 minutes.	100%
Humidity Life		85°C, 85% RH, 168 Hrs.	100%
Interim Electrical $V_{N(DC)}$ V_C (Note 3)		As specified, but including delta parameter as a minimum.	100% Screen
Power Burn-In	1038	Condition B, 85°C, rated $V_{M(AC)}$, 72 hours min.	100%
Final Electrical +$V_{N(DC)}$ V_C (Note 3)		As specified - All parameter measurements must be completed within 96 hours after removal from burn-in conditions.	100% Screen
External Visual Examination	2071	To be performed after complete marking.	100%

3) Custom Types

In addition to our comprehensive high-reliability series, Littelfuse can screen and condition to specific requirements. Additional mechanical and environmental capabilities are defined in Table 8.

TABLE 8. Mechanical And Environmental Capabilities (Typical Conditions)

Test Name	Test Method	Description
Terminal Strength	MIL-STD-750-2036	3 Bends, 90° Arc, 16oz. Weight
Drop Shock	MIL-STD-750-2016	1500g's, 0.5ms, 5 Pulses, X_1, V_1, Z_1
Variable Frequency Vibration	MIL-STD-750-2056	20g's, 100-2000Hz, X_1, V_1, Z_1
Constant Acceleration	MIL-STD-750-2006	V_2, 20,000g's Min
Salt Atmosphere	MIL-STD-750-1041	35°C, 24Hr, 10-50g/m^2 Day
Soldering Heat/Solderability	MIL-STD-750-2031/2026	260°C, 10s, 3 Cycles, Test Marking
Resistance to Solvents	MIL–STD–202-215	Permanence, 3 Solvents
Flammability	MIL–STD–202-111	15s Torching, 10s to Flameout
Cyclical Moisture Resistance	MIL–STD–202-106	10 Days
Steady-State Moisture Resistance	MIL–STD–750-1021.3	85/85 96Hr
Biased Moisture Resistance	MIL–STD–750-1021.3	Not Recommended for High-Voltage Types
Temperature Cycle	MIL–STD–202-107	-55°C to 125°C, 5 Cycles
High-Temperature Life (Nonoperating)	MIL-STD-750-1032	125°C, 24Hr
Burn-In	MIL-STD-750-1038	Rated Temperature and V_{RMS}
Hermetic Seal	MIL-STD-750-1071	Condition D

4) Commercial Items

The General Services Administration has authorized the use of the Commercial Item Description (CID) for all government agencies. There are three (3) listed series within Littelfuse leaded/Industrial range:

A-A-55564-3 (ZA Series)

The PIN number should be used to buy commercial product to the CID. The manufacturer's number shown should not be used for ordering purposes.

PIN consists of abbreviated CID number + Applicable Sheet (2 digits) + Dash number (-3 digits)

Example: AA55564 + 02 + -001 = AA5556402-001

Table 9. ZA Series A-A-55564-3

Dash Number AA5556403–	Equiv. Littelfuse Commercial Part	Dash Number AA5556403–	Equiv. Littelfuse Commerical Part	Dash Number AA5556403–	Equiv.littelfuse Commercial Part	MFR's Cage
001	V22ZA05	022	V47ZA1	043	V120ZA4	S6019
002	V22ZA1	023	V47ZA3	044	V120ZA6	
003	V22ZA2	024	V47ZA7	045	V150ZA05	
004	V22ZA3	025	V56ZA05	046	V150ZA1	
005	V24ZA50	026	V56ZA2	047	V150ZA4	
006	V27ZA05	027	V56ZA3	048	V150ZA8	
007	V27ZA1	028	V56ZA8	049	V180ZA05	
008	V27ZA2	029	V68ZA05	050	V180ZA1	
009	V27ZA4	030	V68ZA2	051	V180ZA5	
010	V27ZA60	031	V68ZA3	052	V180ZA10	
011	V33ZA05	032	V68ZA10	053	V8ZA05	
012	V33ZA1	033	V82ZA05	054	V8ZA1	
013	V33ZA2	034	V82ZA2	055	V8ZA2	
014	V33ZA5	035	V82ZA4	056	V12ZA05	
015	V33ZA70	036	V82ZA12	057	V12ZA1	
016	V36ZA80	037	V100ZA05	058	V12ZA2	
017	V39ZA05	038	V100ZA3	059	V18ZA05	
018	V39ZA1	039	V100ZA4	060	V18ZA1	
019	V39ZA3	040	V100ZA15	061	V18ZA2	
020	V39ZA6	041	V120ZA05	062	V18ZA3	
021	V47ZA05	042	V120ZA1	063	V18ZA40	

Radiation Hardness

For space applications, an extremely important property of a protection device is its response to imposed radiation effects.

Electron Irradiation

A Littelfuse MOV and a Silicon transient suppression diode were exposed to electron irradiation. The V-I curves, before and after test, are shown below.

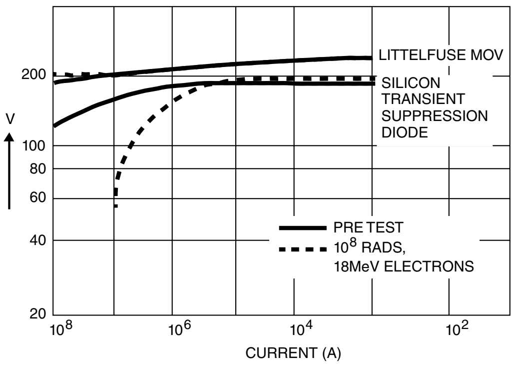

FIGURE 1. RADIATION SENSITIVITY OF LITTELFUSE V130LA1 AND SILICON TRANSIENT SUPPRESSION DIODE

It is apparent that the Littelfuse MOV was virtually unaffected, even at the extremely high dose of 108 rads, while the Silicon transient suppression diode showed a dramatic increase in leakage current.

Neutron Effects

A second MOV-Zener comparison was made in response to neutron fluence. The selected devices were equal in area.

Figure 2 shows the clamping voltage response of the MOV and the Zener to neutron irradiation to as high as 1015 N/cm². It is apparent that in contrast to the large change in the Zener, the MOV is unaltered. At highercurrents where the MOV's clamping voltage is again unchanged, the Zener device clamping voltage increases by as much as 36%.

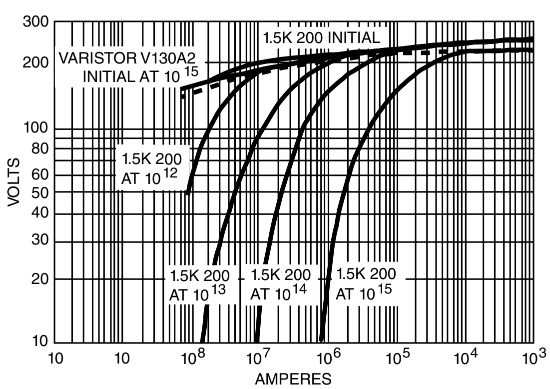

FIGURE 2. V-I CHARACTERISTIC RESPONSE TO NEUTRON IRRADIATION FOR MOV AND ZENER DIODE DEVICES

Counterclockwise rotation of the V-I characteristics is observed in Silicon devices at high neutron irradiation levels; in other words, increasing leakage at low current levels and increasing clamping voltage at higher current levels.

The solid and open circles for a given fluence represent the high and low breakdown currents for the sample of devices tested. Note that there is a marked decrease in current (or energy) handling capability with increased neutron fluence.

Failure threshold of Silicon semiconductor junctions is further reduced when high or rapidly increasing currents are applied. Junctions develop hot spots, which enlarge until a short occurs if current is not limited or quickly removed.

The characteristic voltage current relationship of a P– N Junction is shown below.

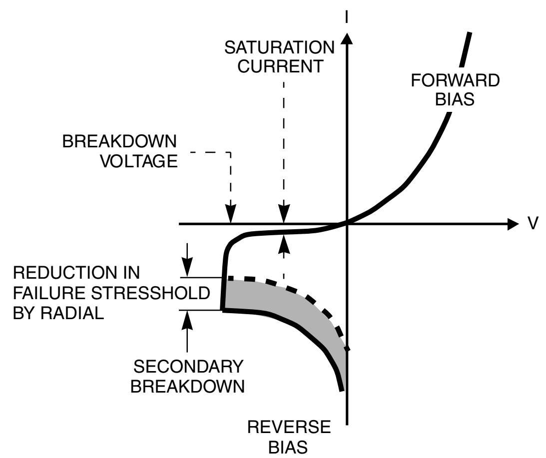

FIGURE 3. V-I CHARACTERISTIC OF PN-JUNCTION

At low reverse voltage, the device will conduct very little current (the saturation current). At higher reverse voltage VBO (breakdown voltage),the current increases rapidly as the electrons are either pulled by the electric field (Zener effect) or knocked out by other electrons (avalanching). A further increase in voltage causes the device to exhibit a negative resistance characteristic leading to secondary breakdown.

This manifests itself through the formation of hotspots, and irreversible damage occurs. This failure threshold decreases under neutron irradiation for Zeners, but not for Z_NO Varistors.

Gamma Radiation

Radiation damage studies were performed on type V130LA2 varistors. Emission spectra and V-I characteristics were collected before and after irradiation with 106 rads Co60 gamma radiation. Both show no change, within experimental error, after irradiation.