

Varistor Products

Aerospace and Military

High Reliability Varistors

MIL QPL

The high reliability Littelfuse varistor is the latest step in increased product performance, and is available for applications requiring quality and reliability assurance levels consistent with military or other standards. (MIL-STD-19500, MIL-S-750, Method 202). Additionally, Littelfuse varistors are inherently radiation hardened compared to silicon diode suppressors as illustrated in Figure 1.

This series of high-reliability varistors involve five categories:

- DSSC Qualified Parts List (QPL) MIL-R-83530 4 Types Presently Available
- DSSC Standard Military Drawings Based on MIL-R 83530 63 Types Presently Available:
 - ZA Series - Drawing # 87063
 - DB Series - Drawing # 90065
- Littelfuse High Reliability Series Offers TX Equivalents 29 Types Presently Available
- Custom Types Processed to Customer-Specific Requirements - (SCD) or to Standard Military Flow
- Commercial Items have been identified for Government use as follows:
 - Commercial Item Description AA-55564-3 - Littelfuse ZA Series
 - Commercial Item Description AA-55564-2 - Littelfuse DA, DB Series
 - Commercial Item Description AA-55564-1 - Littelfuse PA Series

AGENCY APPROVALS

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

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VARISTOR PRODUCTS

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

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 |

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.

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MIL-R-83530 Inspections

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 |

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DSSC Standard Military Drawing # 87063

Based on MIL-R-83530

TABLE 3. ZA SERIES RATINGS AND SPECIFICATIONS

| 87063 DASH NO. | (SEE CHAPTER 2) NEAREST COMM. EQUIV. | (PAGE 143) SIZE | MAXIMUM RATINGS (85°C) | | | | SPECIFICATIONS (25°C) | | | | | |
|----------------------|--|--------------------|------------------------|---------------------|-----------------------|-----------------------------|--|------------------|------|---|-----|------------------------|
| | | | CONTINUOUS | | TRANSIENT | | VARISTOR VOLTAGE AT 1mA _{DC} TEST CURRENT | | | MAXIMUM CLAMPING VOLTAGE V _C AT TEST CURRENT (8/20μs) | | TYPICAL CAPACITANCE |
| | | | RMS | DC | ENERGY (10/1000μs) | PEAK CURRENT (8/20μs) | | | | | | |
| | | | V _M (AC) | V _M (DC) | W _{TM} | I _{TM} | (V) | (V) | (V) | (V) | (A) | f = 1MHz (pF) |
| 001 | V22ZA05 | 1 | 14 | 18 | 0.2 | 35 | 18.7 | 22 | 26 | 51 | 2 | 400 |
| 002 | V22ZA1 | 2 | 14 | 18 | 0.9 | 150 | 18.7 | 22 | 26 | 47 | 5 | 1600 |
| 003 | V22ZA2 | 3 | 14 | 18 | 2.0 | 350 | 18.7 | 22 | 26 | 43 | 5 | 4000 |
| 004 | V22ZA3 | 4 | 14 | 18 | 4.0 | 750 | 18.7 | 22 | 26 | 43 | 10 | 9000 |
| 005 | V24ZA50 | 5 | 14 | 18 | 6.5 | 1500 | 19.2 | 24 (PAGE 143) | 26 | 43 | 20 | 18000 |
| 006 | V27ZA05 | 1 | 17 | 22 | 0.25 | 35 | 23 | 27 | 31.1 | 59 | 2 | 300 |
| 007 | V27ZA1 | 2 | 17 | 22 | 1.0 | 150 | 23 | 27 | 31.1 | 57 | 5 | 1300 |
| 008 | V27ZA2 | 3 | 17 | 22 | 2.5 | 350 | 23 | 27 | 31.1 | 53 | 5 | 3000 |
| 009 | V27ZA4 | 4 | 17 | 22 | 5.0 | 750 | 23 | 27 | 31.1 | 53 | 10 | 7000 |
| 010 | V27ZA60 | 5 | 17 | 22 | 8.0 | 1500 | 23 | 27 (PAGE 143) | 31.1 | 50 | 20 | 15000 |
| 011 | V33ZA05 | 1 | 20 | 26 | 0.3 | 35 | 29.5 | 33 | 38 | 67 | 2 | 250 |
| 012 | V33ZA1 | 2 | 20 | 26 | 1.2 | 150 | 29.5 | 33 | 36.5 | 68 | 5 | 1100 |
| 013 | V33ZA2 | 3 | 20 | 26 | 3.0 | 350 | 29.5 | 33 | 36.5 | 64 | 5 | 2700 |
| 014 | V33ZA5 | 4 | 20 | 26 | 6.0 | 750 | 29.5 | 33 | 36.5 | 64 | 10 | 6000 |
| 015 | V33ZA70 | 5 | 21 | 27 | 9.0 | 1500 | 29.5 | 33 (PAGE 143) | 36.5 | 58 | 20 | 13000 |
| 016 | V36ZA80 | 5 | 23 | 31 | 10.0 | 1500 | 32 | 36 (PAGE 143) | 40 | 63 | 20 | 12000 |
| 017 | V39ZA05 | 1 | 25 | 31 | 0.35 | 35 | 35 | 39 | 46 | 79 | 2 | 220 |
| 018 | V39ZA1 | 2 | 25 | 31 | 1.5 | 150 | 35 | 39 | 43 | 79 | 5 | 900 |
| 019 | V39ZA3 | 3 | 25 | 31 | 3.5 | 350 | 35 | 39 | 43 | 76 | 5 | 2200 |
| 020 | V39ZA6 | 4 | 25 | 31 | 7.2 | 750 | 35 | 39 | 43 | 76 | 10 | 5000 |
| 021 | V47ZA05 | 1 | 30 | 38 | 0.4 | 35 | 42 | 47 | 55 | 90 | 2 | 200 |
| 022 | V47ZA1 | 2 | 30 | 38 | 1.8 | 150 | 42 | 47 | 52 | 92 | 5 | 800 |
| 023 | V47ZA3 | 3 | 30 | 38 | 4.5 | 350 | 42 | 47 | 52 | 89 | 5 | 2000 |
| 024 | V47ZA7 | 4 | 30 | 38 | 8.8 | 750 | 42 | 47 | 52 | 89 | 10 | 4500 |
| 025 | V56ZA05 | 1 | 35 | 45 | 0.5 | 35 | 50 | 56 | 66 | 108 | 2 | 180 |

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TABLE 3. ZA SERIES RATINGS AND SPECIFICATIONS (Continued)

| 87063 DASH NO. | (SEE SECTION 4) NEAREST COMM. EQUIV. | (NOTE 1) SIZE | MAXIMUM RATINGS (85°C) | | | | SPECIFICATIONS (25°C) | | | | | |
|----------------------|--|------------------|------------------------|--------------------|-----------------------|-----------------------------|--|--------------------|-----|---|----------------|--|
| | | | CONTINUOUS | | TRANSIENT | | VARISTOR VOLTAGE AT 1mA _{DC} TEST CURRENT | | | MAXIMUM CLAMPING VOLTAGE V _C AT TEST CURRENT (8/20µs) | | TYPICAL CAPACITANCE f = 1MHz |
| | | | RMS | DC | ENERGY (10/1000µs) | PEAK CURRENT (8/20µs) | | | | V _C | I _C | |
| | | | V _{M(AC)} | V _{M(DC)} | W _{TM} | I _{TM} | MIN | V _{N(DC)} | MAX | V _C | I _C | |
| | | | (V) | (V) | (J) | (A) | (V) | (V) | (V) | (V) | (A) | (pF) |
| 026 | V56ZA2 | 2 | 35 | 45 | 2.3 | 150 | 50 | 56 | 62 | 107 | 5 | 700 |
| 027 | V56ZA3 | 3 | 35 | 45 | 5.5 | 350 | 50 | 56 | 62 | 103 | 5 | 1800 |
| 028 | V56ZA8 | 4 | 35 | 45 | 10.0 | 750 | 50 | 56 | 62 | 103 | 10 | 3900 |
| 029 | V68ZA05 | 1 | 40 | 56 | 0.6 | 35 | 61 | 68 | 80 | 127 | 2 | 150 |
| 030 | V68ZA2 | 2 | 40 | 56 | 3.0 | 150 | 61 | 68 | 75 | 127 | 5 | 600 |
| 031 | V68ZA3 | 3 | 40 | 56 | 6.5 | 350 | 61 | 68 | 75 | 123 | 5 | 1500 |
| 032 | V68ZA10 | 4 | 40 | 56 | 13.0 | 750 | 61 | 68 | 75 | 123 | 10 | 3300 |
| 033 | V82ZA05 | 1 | 50 | 66 | 1.2 | 70 | 73 | 82 | 97 | 145 | 2 | 120 |
| 034 | V82ZA2 | 2 | 50 | 66 | 3.5 | 300 | 73 | 82 | 91 | 135 | 10 | 500 |
| 035 | V82ZA4 | 3 | 50 | 66 | 7.3 | 750 | 73 | 82 | 91 | 135 | 25 | 1100 |
| 036 | V82ZA12 | 4 | 50 | 66 | 13.0 | 1500 | 73 | 82 | 91 | 145 | 50 | 2500 |
| 037 | V100ZA05 | 1 | 60 | 81 | 1.5 | 70 | 90 | 100 | 117 | 175 | 2 | 90 |
| 038 | V100ZA3 | 2 | 60 | 81 | 4.3 | 300 | 90 | 100 | 110 | 165 | 10 | 400 |
| 039 | V100ZA4 | 3 | 60 | 81 | 8.9 | 750 | 90 | 100 | 110 | 165 | 25 | 900 |
| 040 | V100ZA15 | 4 | 60 | 81 | 16.0 | 1500 | 90 | 100 | 110 | 175 | 50 | 2000 |
| 041 | V120ZA05 | 1 | 75 | 102 | 1.8 | 100 | 108 | 120 | 138 | 205 | 2 | 70 |
| 042 | V120ZA1 | 2 | 75 | 102 | 5.3 | 400 | 108 | 120 | 132 | 205 | 10 | 300 |
| 043 | V120ZA4 | 3 | 75 | 102 | 11.0 | 1000 | 108 | 120 | 132 | 200 | 25 | 750 |
| 044 | V120ZA6 | 4 | 75 | 102 | 19.0 | 2000 | 108 | 120 | 132 | 210 | 50 | 1700 |
| 045 | V150ZA05 | 1 | 92 | 127 | 2.3 | 100 | 135 | 150 | 173 | 240 | 2 | 60 |
| 046 | V150ZA1 | 2 | 95 | 127 | 6.5 | 400 | 135 | 150 | 165 | 250 | 10 | 250 |
| 047 | V150ZA4 | 3 | 95 | 127 | 13.0 | 1000 | 135 | 150 | 165 | 250 | 25 | 600 |
| 048 | V150ZA8 | 4 | 95 | 127 | 23.0 | 2000 | 135 | 150 | 165 | 255 | 50 | 1400 |
| 049 | V180ZA05 | 1 | 110 | 153 | 2.7 | 150 | 162 | 180 | 207 | 290 | 2 | 50 |
| 050 | V180ZA1 | 2 | 115 | 153 | 7.7 | 500 | 162 | 180 | 198 | 295 | 10 | 200 |
| 051 | V180ZA5 | 3 | 115 | 153 | 16.0 | 1500 | 162 | 180 | 198 | 300 | 25 | 500 |
| 052 | V180ZA10 | 4 | 115 | 153 | 27.0 | 3000 | 162 | 180 | 198 | 300 | 50 | 1100 |

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DSSC Standard Military Drawing # 90065

Based on MIL-R-83530

| 90065 DASH NO. | VOLTAGE RATING MAX (RMS) | ENERGY MAX (J) | PEAK CURRENT (A) | NOMINAL VARISTOR VOLTAGE (V) | | MAX CLAMPING VOLTAGE AT TEST CURRENT | | TYPICAL CAPACITANCE (pF) |
|----------------------|-----------------------------------|----------------------|------------------------|---------------------------------------|-----------|--|-----|--------------------------------|
| | | | | | | (V) | (I) | |
| 012 | 130 | 170 | 22500 | 200 | +28, -16 | 345 | 200 | 10000 |
| 013 | 150 | 200 | 22500 | 240 | ±28 | 405 | 200 | 8000 |
| 014 | 250 | 270 | 22500 | 390 | +39, -36 | 650 | 200 | 5000 |
| 015 | 275 | 300 | 22500 | 430 | ±43 | 730 | 200 | 4500 |
| 016 | 320 | 350 | 22500 | 510 | +29, -48 | 830 | 200 | 3800 |
| 017 | 420 | 460 | 28800 | 680 | +68, -70 | 1130 | 200 | 3000 |
| 018 | 480 | 510 | 28800 | 750 | +74, -80 | 1240 | 200 | 2700 |
| 019 | 510 | 550 | 28800 | 820 | +91, -85 | 1350 | 200 | 2500 |
| 020 | 575 | 600 | 28800 | 910 | +95, -105 | 1480 | 200 | 2200 |
| 021 | 660 | 690 | 28800 | 1050 | ±110 | 1720 | 200 | 2000 |
| 022 | 750 | 810 | 28800 | 1200 | ±120 | 2000 | 200 | 1800 |

NOTE: See Section 4 (DB Series) for nearest equivalent commercial type.

TABLE 4. DB SERIES RATINGS AND SPECIFICATIONS

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 | 7mm | 8TX1 | V8ZA1 |
| V8ZTX2 | 10mm | 8TX2 | V8ZA2 |
| V12ZTX1 | 7mm | 12TX1 | V12ZA1 |
| V12ZTX2 | 10mm | 12TX2 | V12ZA2 |
| V22ZTX1 | 7mm | 22TX1 | V22ZA1 |
| V22ZTX3 | 14mm | 22TX3 | V22ZA3 |
| V24ZTX50 | 20mm | 24TX50 | V24ZA50 |
| V33ZTX1 | 7mm | 33TX1 | V33ZA1 |
| V33ZTX5 | 14mm | 33TX5 | V33ZA5 |
| V33ZTX70 | 20mm | 33TX70 | V33ZA70 |
| V68ZTX2 | 7mm | 68TX2 | V68ZA2 |
| V68ZTX10 | 14mm | 68TX10 | V68ZA10 |
| V82ZTX2 | 7mm | 82TX2 | V82ZA2 |
| V82ZTX12 | 14mm | 82TX12 | V82ZA12 |
| V130LTX2 | 7mm | 130TX | V130LA2 |
| V130LTX10A | 14mm | 130TX10 | V130LA10A |
| V130LTX20B | 20mm | 130TX20 | V130LA20A |

| TX MODEL | MODEL SIZE | DEVICE MARK | (SEE SECTION 4) NEAREST COMMERCIAL EQUIVALENT |
|------------|------------|-------------|--|
| V150LTX2 | 7mm | 150TX | V150LA2 |
| V150LTX10A | 14mm | 150TX10 | V150LA10A |
| V150LTX20B | 20mm | 150TX20 | V150LA20B |
| V250LTX4 | 7mm | 250TX | V250LA4 |
| V250LTX20A | 14mm | 250TX20 | V250LA20A |
| V250LTX40B | 20mm | 250TX40 | V250LA40B |
| V420LTX20A | 14mm | 420TX20 | V420LA20A |
| V420LTX40B | 20mm | 420TX40 | V420LA40B |
| V480LTX40A | 14mm | 480TX40 | V480LA40A |
| V480LTX80B | 20mm | 480TX80 | V480LA80B |
| V510LTX40A | 14mm | 510TX40 | V510LA40A |
| V510LTX80B | 20mm | 510TX80 | V510LA80B |

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

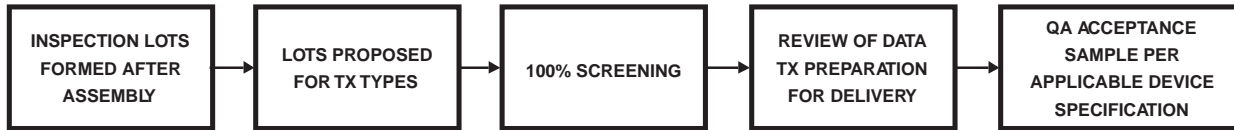


TABLE 6. TX EQUIVALENTS SERIES 100% SCREENING

| | 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% R.H., 168Hr. | 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% |

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Custom Types

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

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 |
| Flammability | UL1414 | 3 x 15s Torching |
| Cyclical Moisture Resistance | MIL-STD-202-106 | 10 Days |
| Steady-State Moisture Resistance | | 85/85 96Hr |
| Biased Moisture Resistance | | 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 |

2
VARISTOR PRODUCTS

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 in Figure 1.

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.

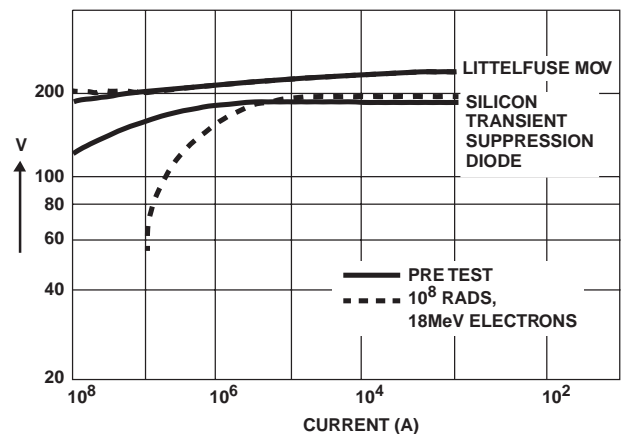


FIGURE 1. RADIATION SENSITIVITY OF LITTELFUSEV130LA1 AND SILICON TRANSIENT SUPPRESSION DIODE

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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 10^{15} N/cm². It is apparent that in contrast to the large change in the zener, the MOV is unaltered. At higher-currents where the MOV's clamping voltage is again unchanged, the zener device clamping voltage increases by as much as 36%.

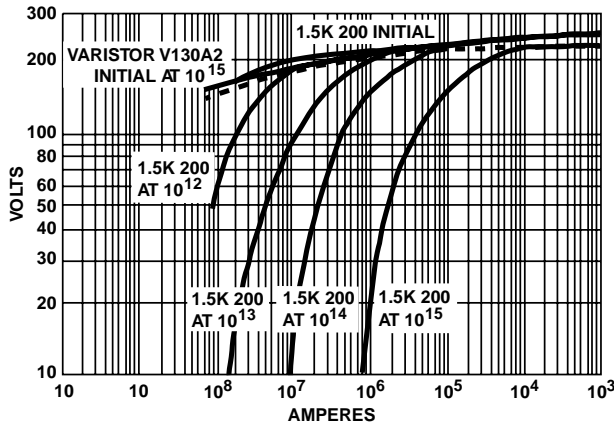


FIGURE 2. V-I CHARACTERISTIC RESPONSE TO NEUTRON IRRADIATION FOR MOV AND ZENER DIODE DEVICES

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 PN-Junction is shown in Figure 3.

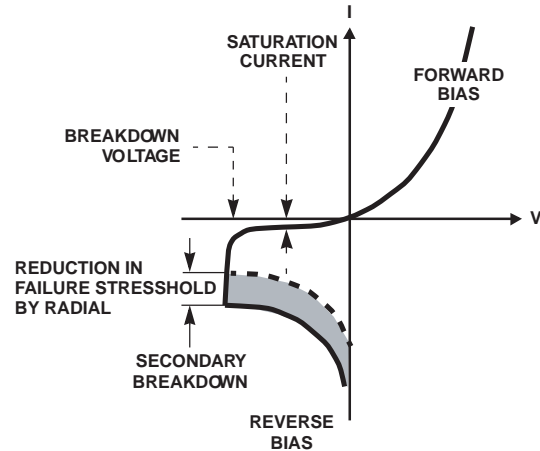


FIGURE 3. V-I CHARACTERISTIC OF PN-JUNCTION

At low reverse voltage, the device will conduct very little current (the saturation current). At higher reverse voltage V_{BO} (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 Zinc Oxide 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 10^6 rads Co⁶⁰ gamma radiation.

Both show no change, within experimental error, after irradiation.

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Commercial Item Descriptions

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

- A-A-55564-3 ZA Series
- A-A-55564-2 DA/DB Series
- A-A-55564-1 PA 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)

e.g. AA55564 + 02 + -001 = AA5556402-001

ZA Series A-A-55564-3

| DASH NUMBER AA5556403- | EQUIV. LITTELFUSE COMMERCIAL PART | DASH NUMBER AA5556403- | EQUIV. LITTELFUSE COMMERCIAL 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 | |

Varistor Products

Aerospace and Military

High Reliability Varistors

DA/DB SERIES A-A-55564-2

| DASH NUMBER AA5556402- | MFR'S CAGE | EQUIV. LITTELFUSE COMMERCIAL PART | DASH NUMBER AA5556402- | MFR'S CAGE | EQUIV. LITTELFUSE COMMERCIAL PART |
|---------------------------|---------------|--|------------------------------|---------------|--|
| 001 | S6019 | V131DA40 | 012 | S6019 | V131DB40 |
| 002 | | V151DA40 | 013 | | V151DB40 |
| 003 | | V251DA40 | 014 | | V251DB40 |
| 004 | | V271DA40 | 015 | | V271DB40 |
| 005 | | V321DA40 | 016 | | V321DB40 |
| 006 | | V421DA40 | 017 | | V421DB40 |
| 007 | | V481DA40 | 018 | | V481DB40 |
| 008 | | V511DA40 | 019 | | V511DB40 |
| 009 | | V571DA40 | 020 | | V571DB40 |
| 010 | | V661DA40 | 021 | | V661DB40 |
| 011 | | V751DA40 | 022 | | V751DB40 |

PA SERIES A-A-55564-1

| DASH NUMBER AA5556401- | MFR'S CAGE | EQUIV. LITTELFUSE COMMERCIAL PART | DASH NUMBER AA5556401- | MFR'S CAGE | EQUIV. LITTELFUSE COMMERCIAL PART |
|---------------------------|---------------|--|------------------------------|---------------|--|
| 001 | S6019 | V130PA20A | 011 | S6019 | V420PA40A |
| 002 | | V130PA20C | 012 | | V420PA40C |
| 003 | | V150PA20A | 013 | | V480PA80A |
| 004 | | V150PA20C | 014 | | V480PA80C |
| 005 | | V250PA40A | 015 | | V510PA80A |
| 006 | | V250PA40C | 016 | | V510PA80C |
| 007 | | V275PA40A | 017 | | V575PA80A |
| 008 | | V275PA40C | 018 | | V575PA80C |
| 009 | | V320PA40A | 019 | | V660PA100A |
| 010 | | V320PA40C | 020 | | V660PA100C |