

Company Overview

AEM Inc. is a leading high-tech American company involved in the design and manufacturing of quality SolidMatrix[®] fuses, ferrite beads, chip inductors, ceramic inductors, surface mount multilayer varistors, and high-reliability passive components. AEM's products are used globally in the aerospace, military, PC, telecommunication, and consumer electronics industries.

AEM fuses have been in orbit for 30-plus years with zero reported failures.

AEM entered into the circuit protection market by acquiring Mepcopal (a joint venture by Philips of Holland and Copal of Japan) in 1995. Since then, AEM has used its technological expertise to successfully grow its current limiting micro-fuse production and holds a dominant position in the circuit protection market in the aerospace industry. AEM is the sole supplier of FM12 style high-reliability fuses listed on the DSCC approved QPL. AEM high-reliability fuses are used by NASA and every other major manufacturer of satellites, spacecraft and space related hardware throughout the world.

AEM has received a number of accolades from its customers, business partners, and government agencies. Northrop Grumman's "Gold Supplier Award" and TRW's "Supplier Excellence Award" were given to AEM for achieving a perfect supplier rating out of thousands of vendors.

AEM SolidMatrix[®] Chip Fuses

AEM SolidMatrix[®] Surface Mount Chip Fuses are recognized by Underwriters Laboratories (UL). These fuses are the result of AEM's combined strengths in both circuit protection components and multilayer components manufacturing. Constructed as a multilayer monolithic structure using a co-firing process, these fuses offer superior mechanical integrity and are ideal for applications in LCD monitors, PC cards, disk drives, portable communication products, PDAs, digital cameras, DVDs, TVs, cell phones, rechargeable battery packs, battery chargers, etc.

AEM Multilayer Varistors

AEM Surface Mount Multilayer Varistors (MLV) are manufactured with zinc oxide based semi-conductive ceramics using multilayer co-firing technology. These varistors are designed to protect electronics systems from surge and transient over-voltages by limiting surge voltage and absorbing energy. The MLV products have a wide range of applications, such as cell phones, digital cameras, PDAs, MP3, notebooks, telecommunications, automotive systems, data systems, power supplies, etc.

AEM Quality Assurance

AEM's San Diego and Suzhou, China facilities are ISO 9001:2000 certified.

AEM's quality policy is to meet or exceed customer expectations, needs, and requirements by providing quality products and services. We are committed to constantly striving for excellence and perfection in providing products and customer service of the highest quality and value.



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SolidMatrix® 1206 Fast Acting Surface Mount Fuses



Features:

- Multilayer monolithic structure with glass ceramic body and silver fusing element
- Silver termination with nickel and pure-tin solder plating, providing excellent solderability
- Compatible with both wave and reflow soldering processes
- Operating temperature range: -55°C to +125°C (with de-rating)
- RoHS compliant



Clear-Time Characteristics (Fast Acting):

% of current rating	Clear-time at 25 °C
100%	4 hours min.
250%	5 seconds max.
400%	0.05 seconds max.

Agency Approval: Recognized Under the Components Program of Underwriters Laboratories, File Number: E232989

Patents: U.S. Patent numbers 6,034,589, 6,228,230, 6,602,766, and other pending patents

Interrupting Ratings:

0.25A—3A 50A at rated voltages
4A—8A 45A at rated voltages

Ordering Information:

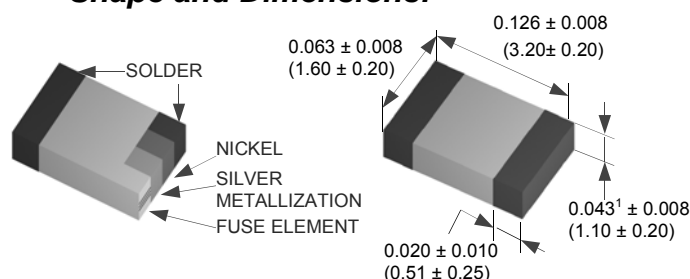
Part Number	Current Rating (A) ³	Voltage Rating (VDC)	Nominal Cold DCR (Ω) ²
F1206FA0500V063T	0.5	63	0.500
F1206FA0750V063T	0.75	63	0.330
F1206FA1000V063T	1.0	63	0.220
F1206FA1500V063T	1.5	63	0.120
F1206FA1750V063T	1.75	63	0.100
F1206FA2000V063T	2.0	63	0.050
F1206FA2500V032T	2.5	32	0.035
F1206FA3000V032T	3.0	32	0.031
F1206FA4000V032T	4.0	32	0.022
F1206FA5000V032T	5.0	32	0.015
F1206FA6000V024T	6.0	24	0.013
F1206FA7000V024T	7.0	24	0.011
F1206FA8000V024T	8.0	24	0.008

1. Nominal height of 0.023" is available.

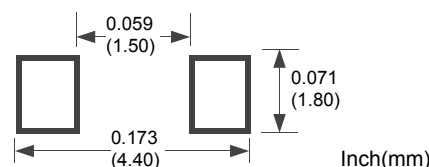
2. Measured at ≤ 10% rated current and 25°C ambient.

3. Other current ratings are available. Please contact factory.

Shape and Dimensions:



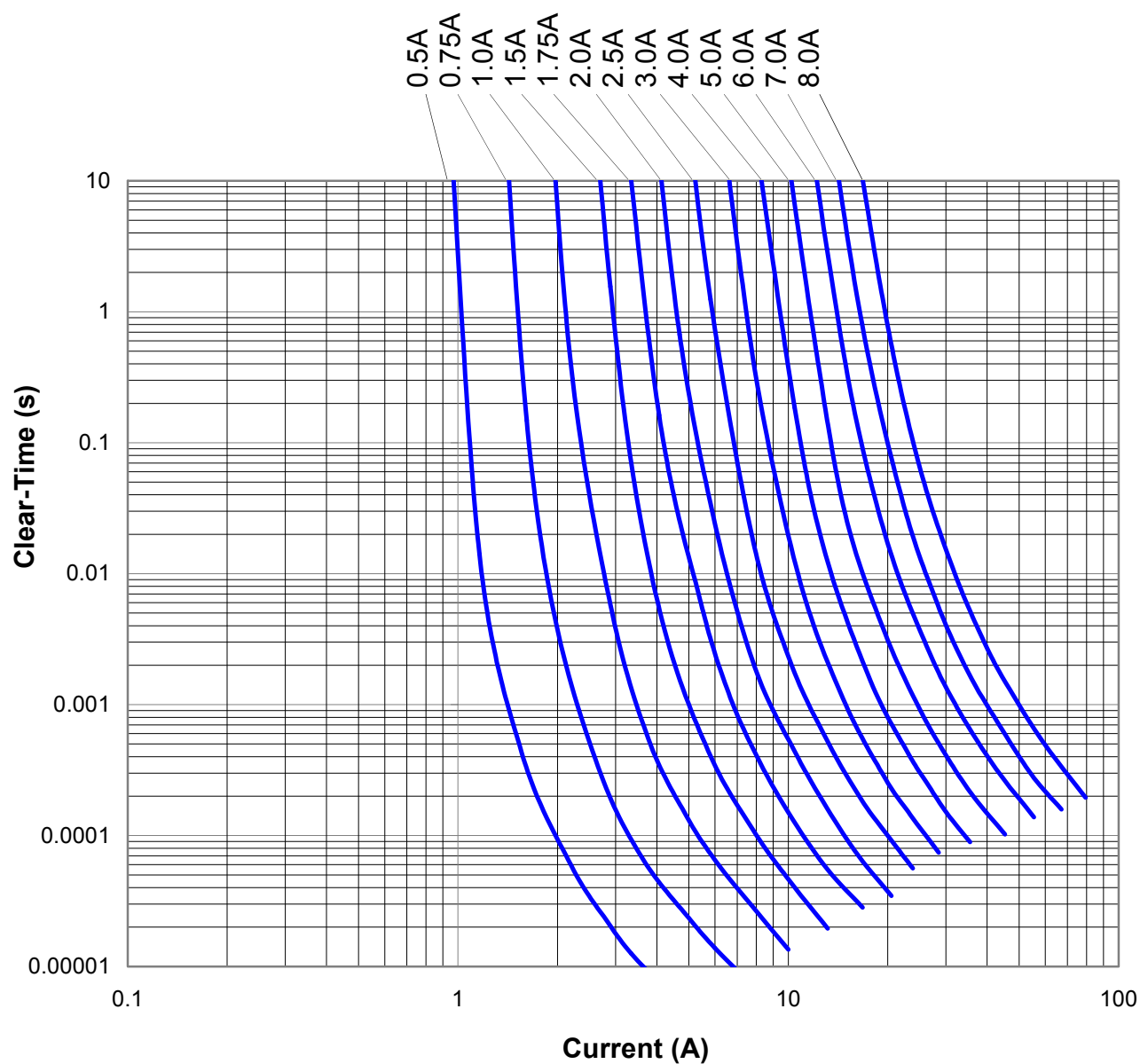
Recommended Land Pattern:



SolidMatrix® 1206 Fast Acting Surface Mount Fuses

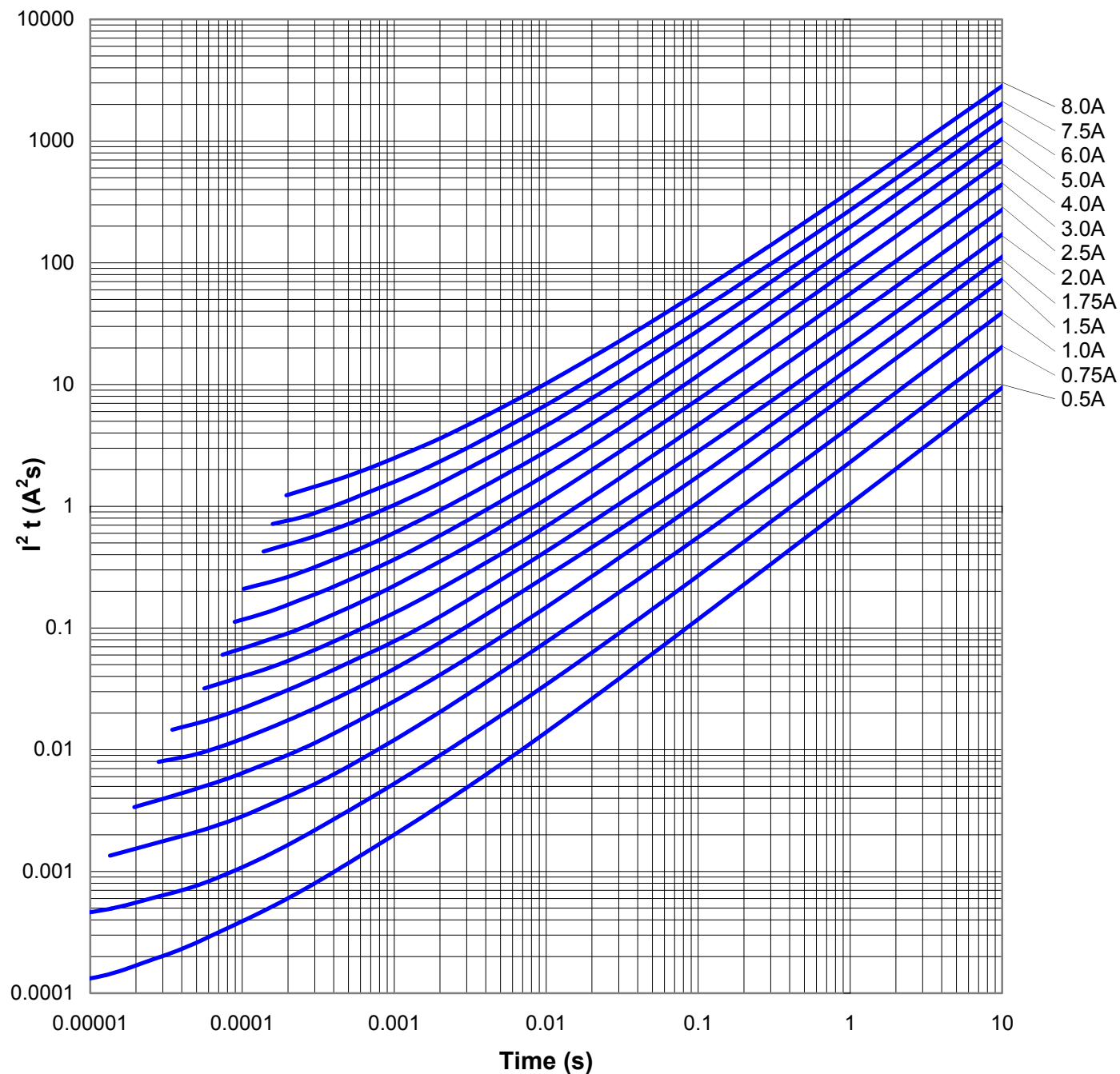


Average Clear-Time Curves



SolidMatrix® 1206 Fast Acting Surface Mount Fuses

I^2t vs. t Curves



SolidMatrix® 0603 Fast Acting Surface Mount Fuses



Features:

- Multilayer monolithic structure with glass ceramic body and silver fusing element
- Silver termination with nickel and pure-tin solder plating, providing excellent solderability
- Compatible with both wave and reflow soldering processes
- Operating temperature range: -55°C to +125°C (with de-rating)
- RoHS compliant



Clear-Time Characteristics (Fast Acting):

% of current rating	Clear-time at 25 °C
100%	4 hours min.
250%	5 seconds max.
400%	0.05 seconds max.

Agency Approval: Recognized Under the Components Program of Underwriters Laboratories, File Number: E232989.

Patents: U.S. Patent numbers 6,034,589, 6,228,230, 6,602,766, and other pending patents

Interrupting Ratings:

0.25A—1A 50A at rated voltage
1.5A—6A 35A at rated voltages

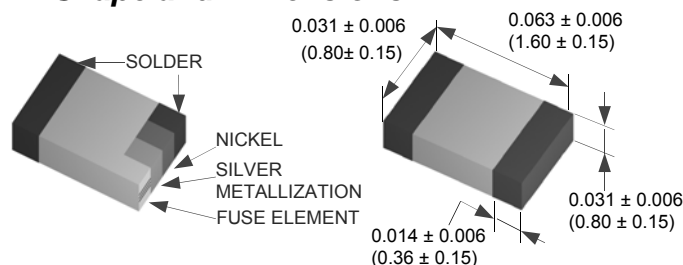
Ordering Information:

Part Number	Current Rating (A) ²	Voltage Rating (VDC)	Nominal Cold DCR (Ω) ¹
F0603FA0500V032T	0.5	32	0.485
F0603FA0750V032T	0.75	32	0.254
F0603FA1000V032T	1.0	32	0.131
F0603FA1500V032T	1.5	32	0.059
F0603FA2000V032T	2.0	32	0.044
F0603FA2500V032T	2.5	32	0.032
F0603FA3000V032T	3.0	32	0.025
F0603FA3500V032T	3.5	32	0.024
F0603FA4000V032T	4.0	32	0.018
F0603FA5000V032T	5.0	32	0.013
F0603FA6000V024T	6.0	24	0.010

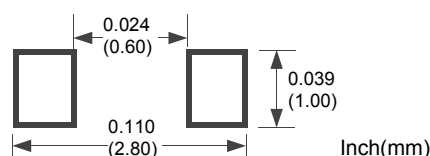
1. Measured at ≤ 10% rated current and 25°C ambient .

2. Other current ratings are available. Please contact factory.

Shape and Dimensions:



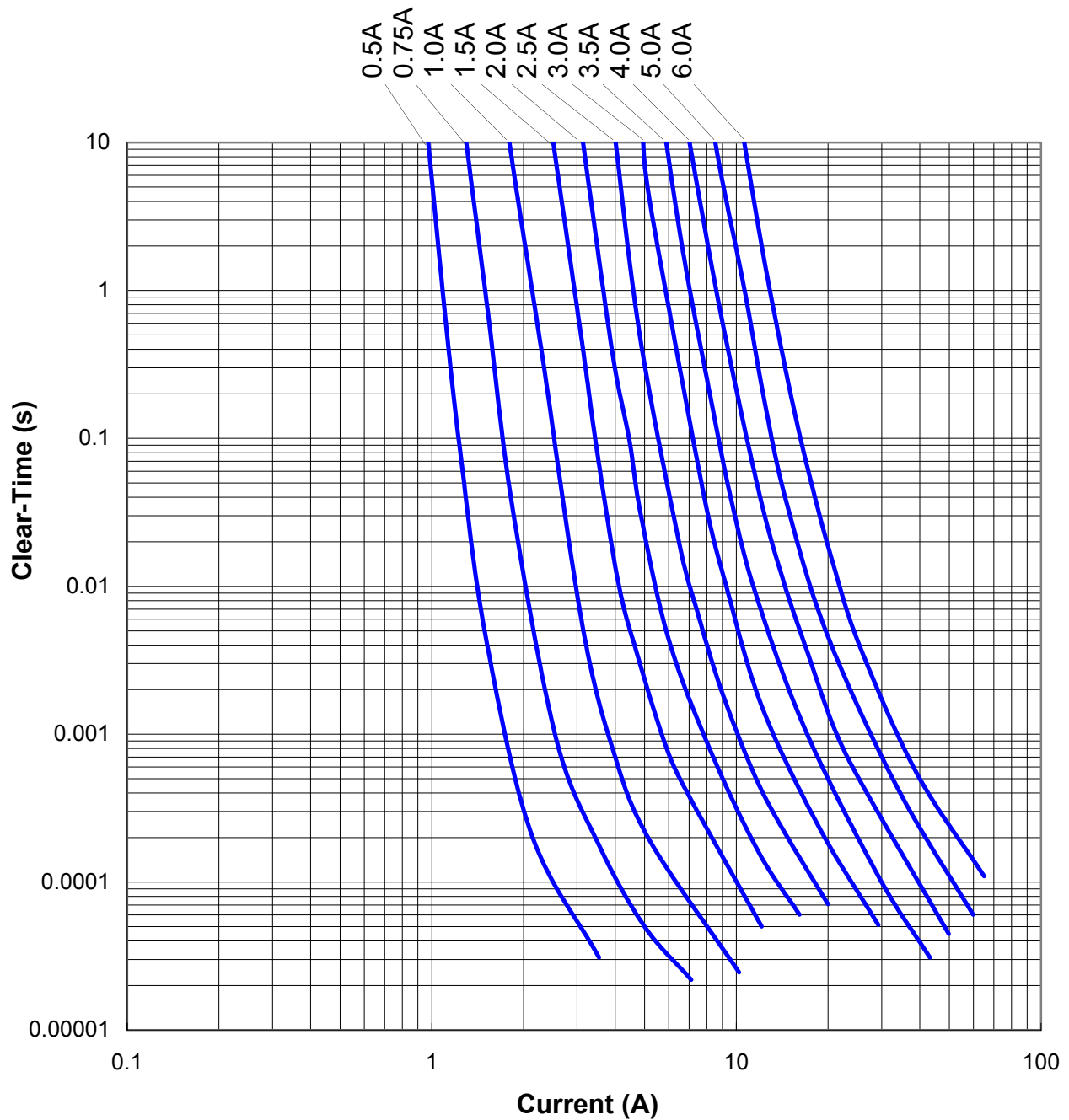
Recommended Land Pattern:



SolidMatrix® 0603 Fast Acting Surface Mount Fuses



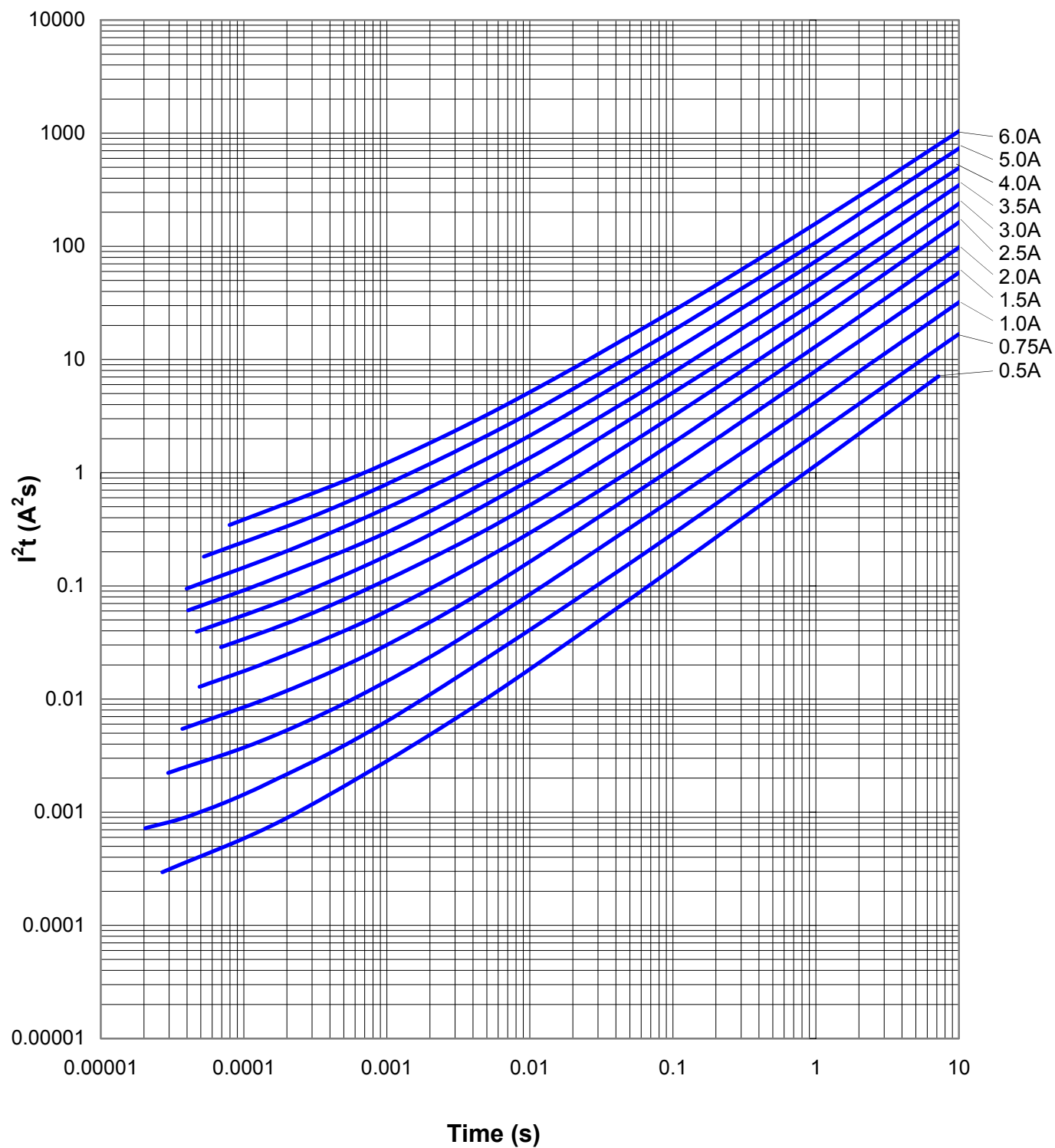
Average Clear-Time Curves



SolidMatrix® 0603 Fast Acting Surface Mount Fuses



I^2t vs. t Curves



SolidMatrix® 0402 Fast Acting Surface Mount Fuses

Features:

- Multilayer monolithic structure with glass ceramic body and silver fusing element
- Silver termination with nickel and pure-tin solder plating, providing excellent solderability
- Compatible with both wave and reflow soldering processes
- Operating temperature range: -55°C to +125°C (with de-rating)
- RoHS compliant



Clear-Time Characteristics (Fast Acting):

% of current rating	Clear-time at 25 °C
100%	4 hours min.
250%	5 seconds max.
400%	0.05 seconds max.

Agency Approval: Recognized Under the Components Program of Underwriters Laboratories, File Number: E232989

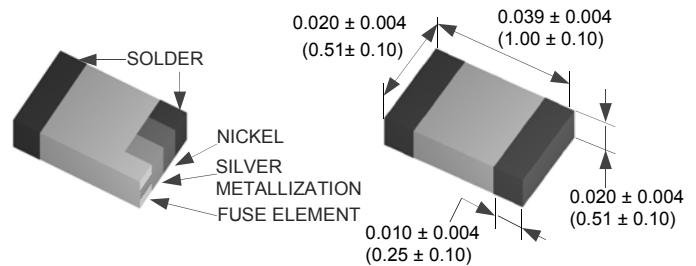
Patents: U.S. Patent numbers 6,034,589, 6,228,230, 6,602,766, and other pending patents

Interrupting Ratings:

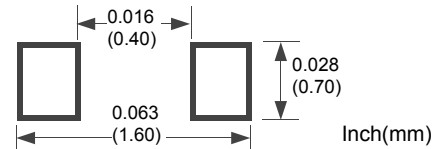
35A at rated voltage

Ordering Information:

Shape and Dimensions:



Recommended Land Pattern:



Part Number	Current Rating (A) ²	Voltage Rating (VDC)	Nominal Cold DCR (Ω) ¹
F0402FA0500V024T	0.5	24	0.380
F0402FA0750V024T	0.75	24	0.210
F0402FA1000V024T	1.0	24	0.120
F0402FA1500V024T	1.5	24	0.056
F0402FA2000V024T	2.0	24	0.035
F0402FA3000V024T	3.0	24	0.021
F0402FA4000V024T	4.0	24	0.014

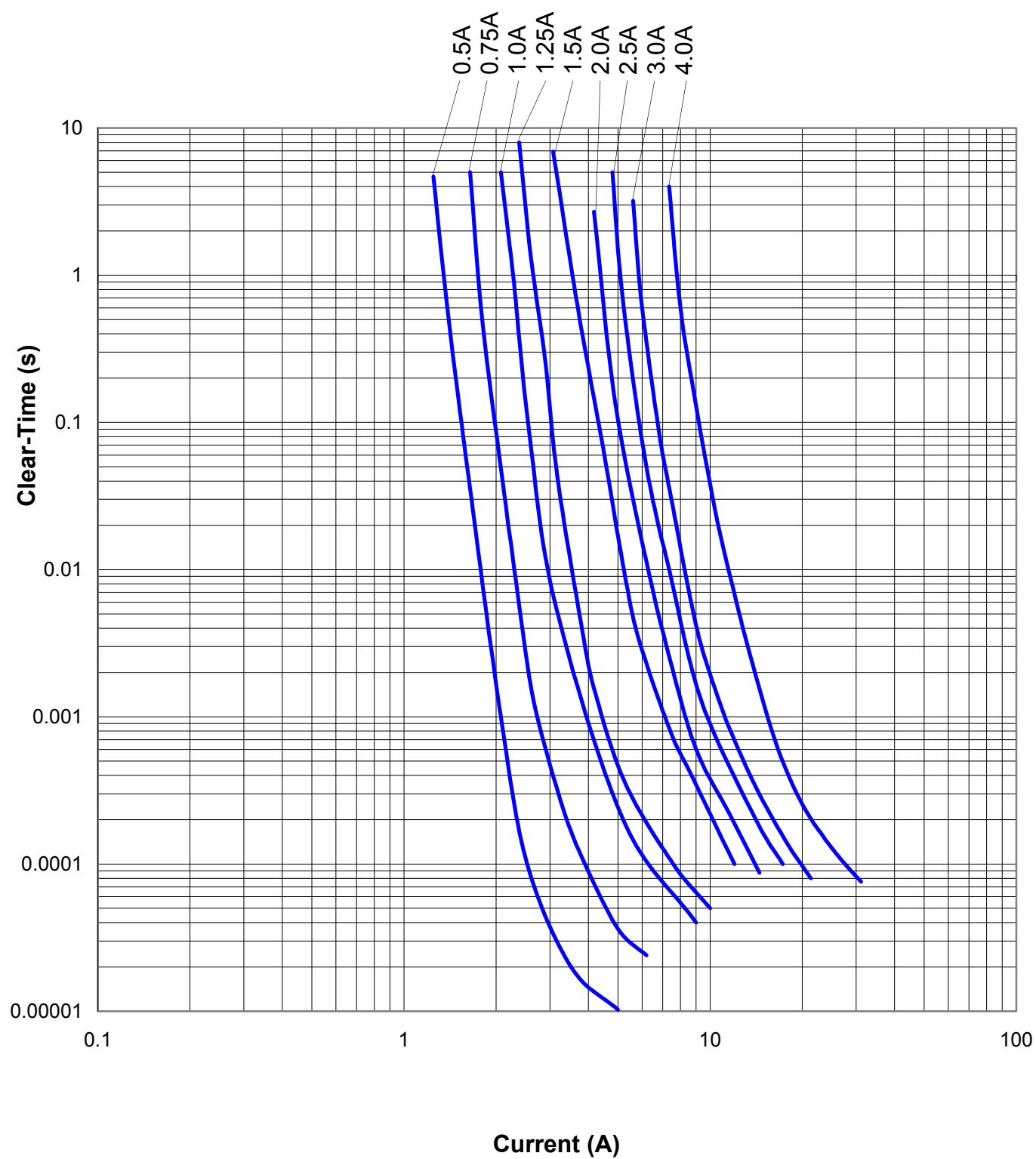
1. Measured at ≤ 10% rated current and 25°C ambient.

2. Other current ratings are available. Please contact factory.

SolidMatrix® 0402 Fast Acting Surface Mount Fuses

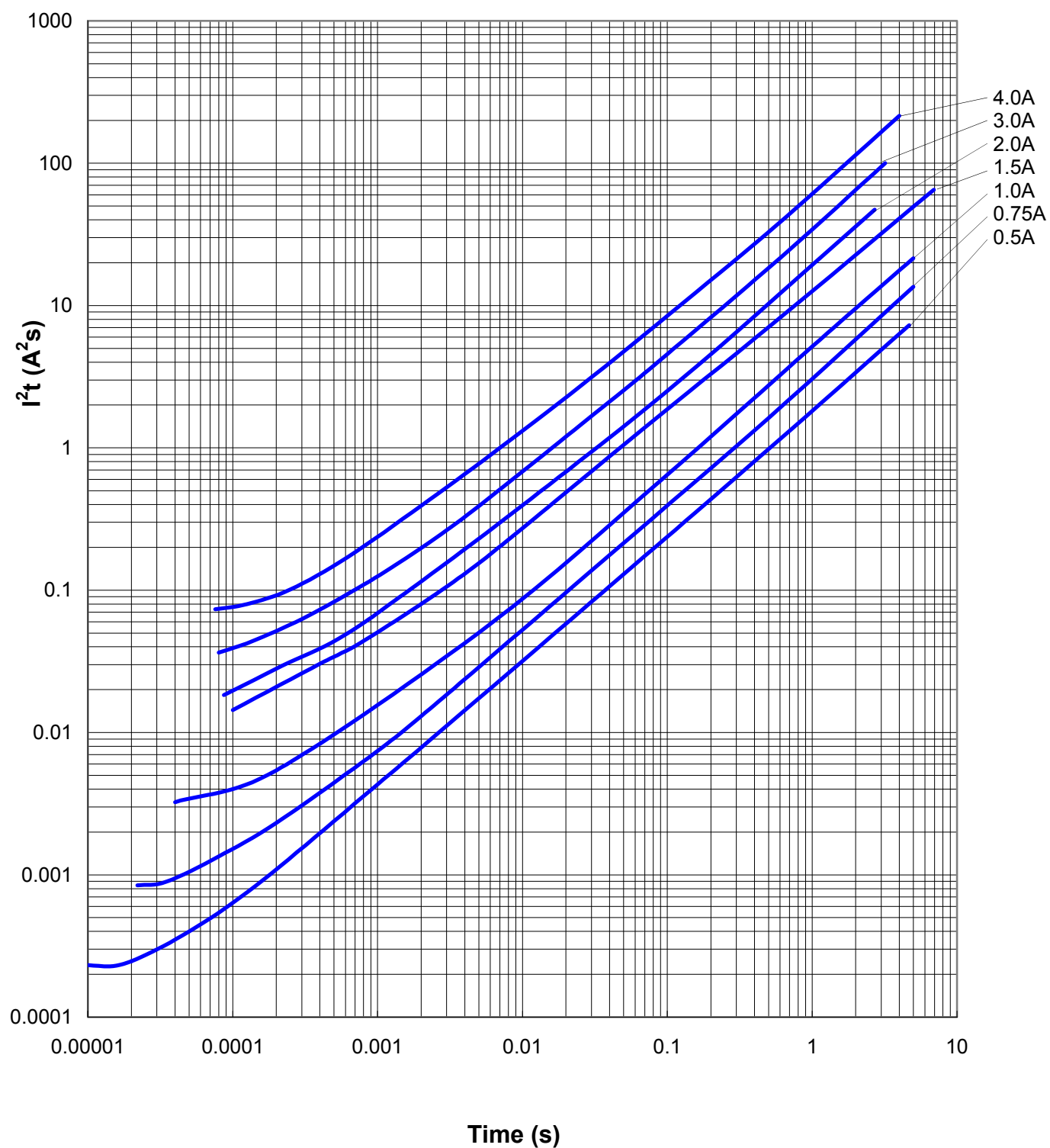


Average Clear-Time Curves



SolidMatrix® 0402 Fast Acting Surface Mount Fuses

I^2t vs. t Curves



SolidMatrix® 1206 Slow Blow Surface Mount Fuses

NEW!


Features:

- High inrush current withstanding capability
- Multilayer monolithic structure with glass ceramic body and silver fusing element
- Silver termination with nickel and pure-tin solder plating, providing excellent solderability
- Compatible with both wave and reflow soldering processes
- Operating temperature range: -55°C + 125°C (with de-rating)
- RoHS compliant



Clear-Time Characteristics (Slow Blow):

% of current rating	Clear-time at 25 °C	
100%	4 hours (Min)	
200%	1 second (Min)	120 seconds (Max)
300%	0.1 seconds (Min)	3 seconds (Max)
800%	0.002 seconds (Min)	0.05 seconds (Max)

Agency Approval: UL approval pending

Patents: U.S. Patent numbers 6,034,589, 6,228,230, 6,602,766, and other pending patents

Interrupting Ratings:

1A-5.5A 50A at rated voltages
6A-8A 60A at rated voltage

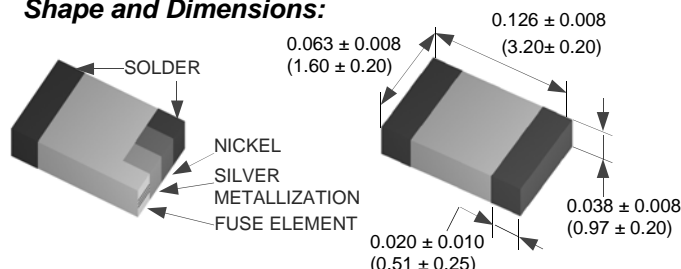
Ordering Information:

Part Number	Current Rating (A)	Voltage Rating (VDC)	Nominal Cold DCR (Ω) ¹	Nominal I^2t (A ² s) ²
F1206SB1000V063T	1.0	63	0.360	0.11
F1206SB1250V063T	1.25	63	0.200	0.22
F1206SB1500V063T	1.5	63	0.150	0.23
F1206SB2000V063T	2.0	63	0.082	0.63
F1206SB2500V032T	2.5	32	0.070	0.90
F1206SB3000V032T	3.0	32	0.032	1.20
F1206SB3500V032T	3.5	32	0.028	1.60
F1206SB4000V032T	4.0	32	0.024	2.20
F1206SB4500V032T	4.5	32	0.020	3.60
F1206SB5000V032T	5.0	32	0.016	5.30
F1206SB5500V024T	5.5	24	0.014	6.40
F1206SB6000V024T	6.0	24	0.011	8.50
F1206SB7000V024T	7.0	24	0.010	10.0
F1206SB8000V024T	8.0	24	0.009	16.9

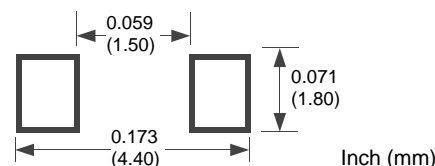
1. Measured at 10% of rated current and 25°C ambient

2. Melting I^2t at 0.001 sec clear-time

Shape and Dimensions:



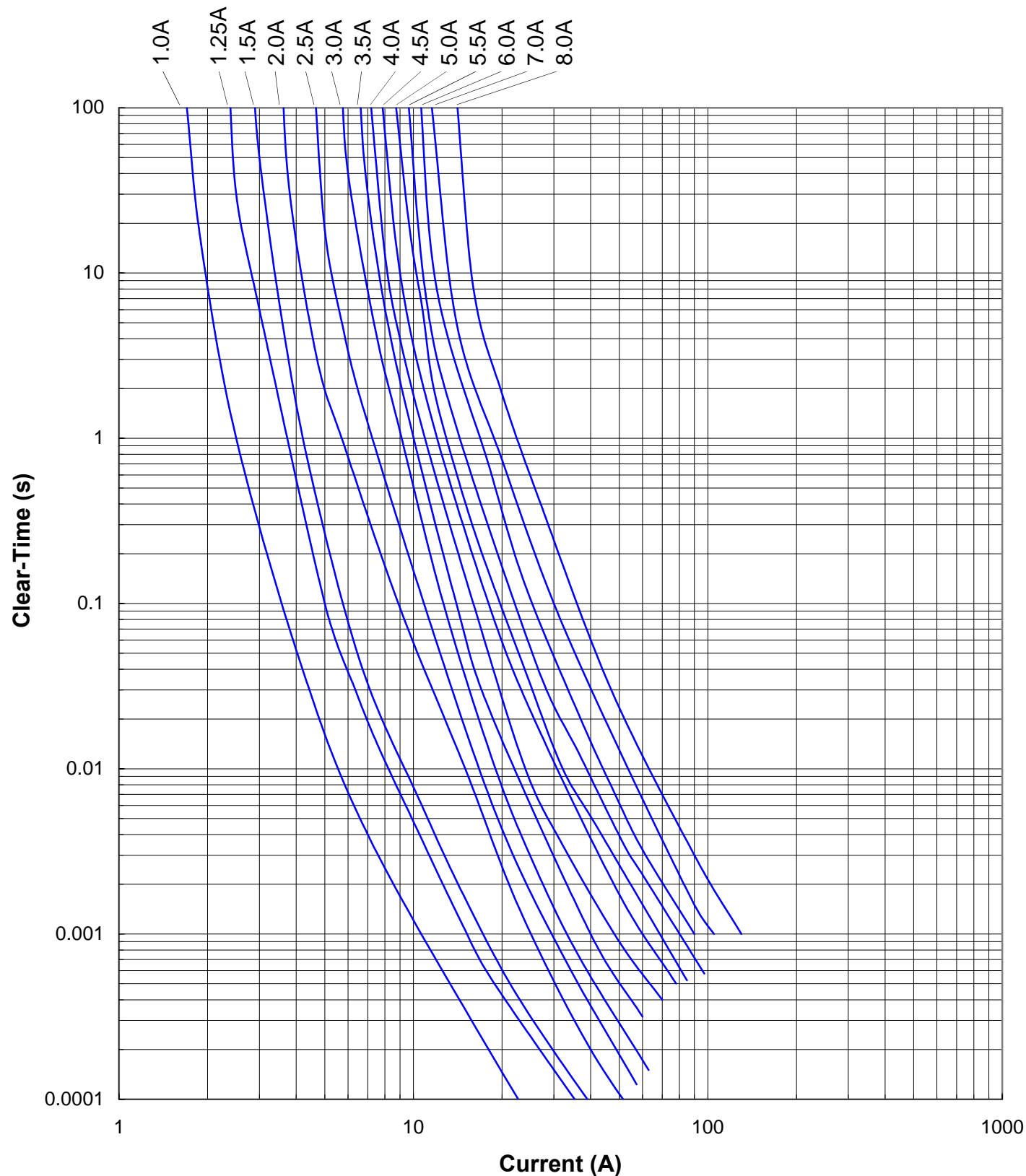
Recommended Land Pattern:



SolidMatrix® 1206 Slow Blow Surface Mount Fuses

NEW!


Average Clear-Time Curves

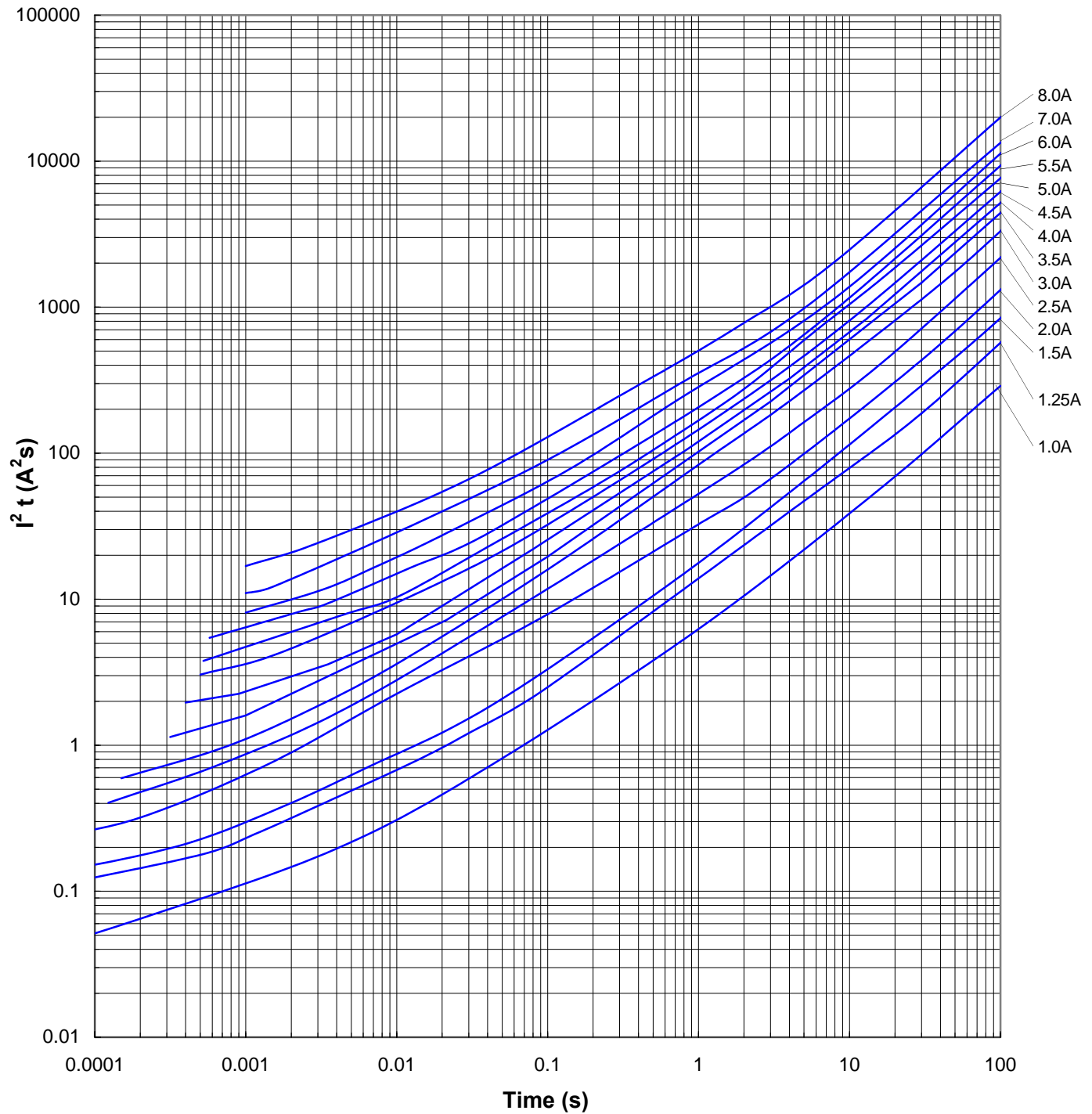


SolidMatrix® 1206 Slow Blow Surface Mount Fuses

NEW!



I^2t vs. t Curves



SolidMatrix® Surface Mount Fuses

Product Identification:

F 0402 FA 1000 V024 T
(1) (2) (3) (4) (5) (6)

- (1) **Series code:** F — Chip Fuse
- (2) **Size code:** Standard EIA Chip Size
- (3) **Action code:** FA — Fast Acting; SB — Slow Blow
- (4) **Current rating code:** 1000 — 1000 mA
- (5) **Voltage rating code:** V024 — 24 VDC
- (6) **Package code:** T — Tape & Reel, B — Bulk

Reliability Tests:

No.	Test	Requirement	Test condition	Test reference
1	Soldering heat resistance	DCR change $\leq \pm 10\%$ No mechanical damage	One dip at 260°C for 60 sec.	MIL-STD-202 Method 210
2	Solderability	Minimum 95% coverage	One dip at 235°C for 5 sec.	MIL-STD-202 Method 208
3	Thermal shock	DCR change $\leq \pm 10\%$ No mechanical damage	100 cycles between -65°C and +125°C	MIL-STD-202 Method 107
4	Moisture resistance	DCR change $\leq \pm 15\%$ No excessive corrosion	10 cycles	MIL-STD-202 Method 106
5	Salt spray	DCR change $\leq \pm 10\%$ No excessive corrosion	48 hour exposure	MIL-STD-202 Method 101
6	Mechanical vibration	DCR change $\leq \pm 10\%$ No mechanical damage	0.4" D.A. or 30 G between 5 – 3000 Hz	MIL-STD-202 Method 204
7	Mechanical shock	DCR change $\leq \pm 10\%$ No mechanical damage	1500 G, 0.5 ms, half-sine shocks	MIL-STD-202 Method 213
8	Terminal strength	DCR change $\leq \pm 10\%$ No mechanical damage	30 sec. hanging for 1206 (1.5kg) and 0603 (0.5kg) 2 lb pushing for 0402	

Electrical Specifications:

Clear-Time Characteristics: Same as specified on the Short Form Data Sheet

Insulation Resistance after Opening: 20,000 ohms minimum when cleared with rated voltage applied. Fuse clearing under low voltage conditions may result in lower after clearing insulation resistance values. (Note: Under normal fault conditions (low or rated voltage conditions), AEM SolidMatrix fuses provide sufficient after clearing insulation resistance values for circuit protection.)

Current Carrying Capacity: 100% rated current at +25°C ambient for 4 hours minimum when evaluated per MIL-PRF-23419

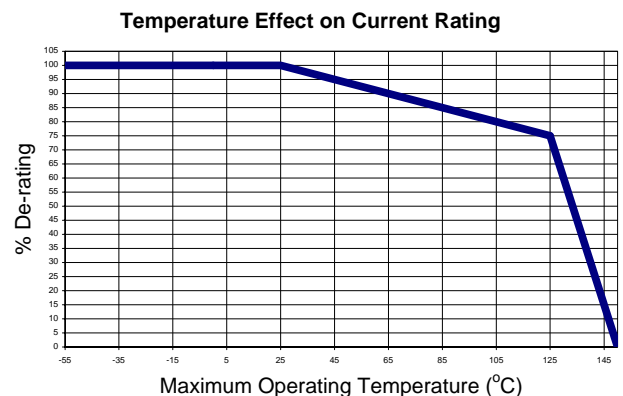
Interrupt Ratings: Same as specified on the Short Form Data Sheet

Fuse Selection and Temperature De-rating Guideline:

The ambient temperature affects the current carrying capacity of fuses. When a fuse is operating at a temperature higher than 25°C, the fuse shall be "de-rated".

To select a fuse from the catalog, the following rule may be followed:
Catalog Fuse Current Rating = Nominal Operating Current / 0.75 / % De-rating at the maximum operating temperature.

Example: At maximum operating temperature of 65°C, % De-rating is 90%. The nominal operating current is 4A. The current rating for fuse selected from the catalog shall be:
 $4 / 0.75 / 90\% = 5.9$ or 6A.

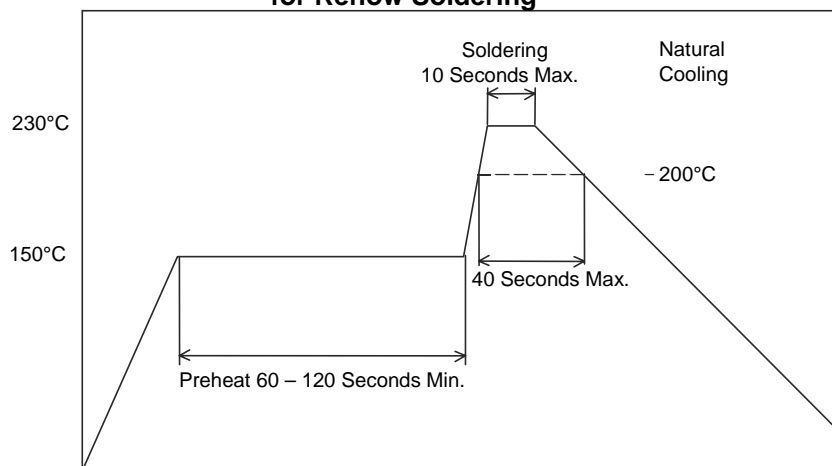


Specifications and descriptions in this literature are as accurate as known at the time of publish, but are subject to change without notice.

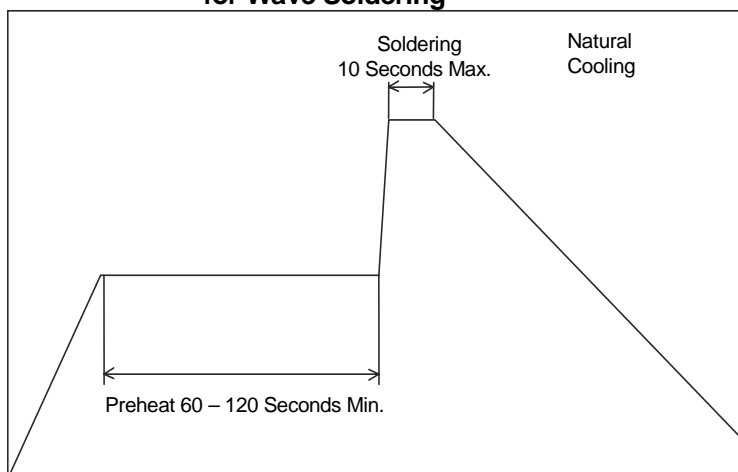
SolidMatrix® Surface Mount Fuses

Soldering Temperature Profiles

Recommended Temperature Profile for Reflow Soldering



Recommended Temperature Profile for Wave Soldering



Maximum peak temperature 260°C for maximum 60 seconds

ES Series of Surface Mount Multilayer Varistors

Features:

- Fast Response < 0.5ns
- Low Working Voltage 3.3V
- Low Capacitance
- Low Leakage Current < 0.1μA
- Low Clamping Voltage

Applications:

- Cell Phones
- Digital Cameras
- PDAs
- MP3
- Notebooks

Part Number	Working Voltage (max)	Clamping Voltage (max)	Leakage Current	Cap.	Tolerance of Cap.
	DC (V)	(V)	I _{LDC} (μA)	(pF)	(%)
MLV0402ES005V0100N	5	28	0.1	100	± 30
MLV0402ES005V0082N	5	35	0.1	82	± 30
MLV0402ES005V0056N	5	35	0.1	56	± 30
MLV0402ES005V0033N	5	35	0.1	33	± 30
MLV0402ES005V0022N	5	35	0.1	22	± 30
MLV0402ES005V0010N	5	50	0.1	10	± 30
MLV0402ES005V0005P	5	45	0.1	5	+80 / -20
MLV0402ES012V0100N	12	35	0.1	100	± 30
MLV0402ES012V0082N	12	45	0.1	82	± 30
MLV0402ES012V0056N	12	45	0.1	56	± 30
MLV0402ES012V0033N	12	45	0.1	33	± 30
MLV0402ES012V0022N	12	45	0.1	22	± 30
MLV0402ES012V0010N	12	60	0.1	10	± 30
MLV0402ES012V0005P	12	65	0.1	5	+80 / -20
MLV0402ES024V02R5P	24	200	0.1	2.5	+80 / -20
MLV0603ES005V0100N	5	28	0.1	100	± 30
MLV0603ES005V0082N	5	35	0.1	82	± 30
MLV0603ES005V0056N	5	35	0.1	56	± 30
MLV0603ES005V0033N	5	35	0.1	33	± 30
MLV0603ES005V0022N	5	35	0.1	22	± 30
MLV0603ES005V0010N	5	50	0.1	10	± 30
MLV0603ES005V0005P	5	50	0.1	5	+80 / -20
MLV0603ES012V0100N	12	40	0.1	100	± 30
MLV0603ES012V0082N	12	45	0.1	82	± 30
MLV0603ES012V0056N	12	45	0.1	56	± 30
MLV0603ES012V0033N	12	45	0.1	33	± 30
MLV0603ES012V0022N	12	45	0.1	22	± 30
MLV0603ES012V0010N	12	60	0.1	10	± 30
MLV0603ES012V0005P	12	72	0.1	5	+80 / -20
MLV0603ES024V02R5P	24	200	0.1	2.5	+80 / -20

NA Series of Surface Mount Multilayer Varistors

Features:

- Fast Response < 0.5ns
- Low Capacitance
- Low Clamping Voltage and High Energy Absorption

Applications:

- Telecommunications
- Automotive Systems
- Data Systems
- Power Supplies

Part Number	Working Voltage (max)		Breakdown Voltage	Peak Current (max)	Clamping Voltage (max)		Energy Absorption (max)	Typical Capacitance
	AC (V _{RMS})	DC (V)	1mA (V)	8/20μs (A)	(A)	(V)	10/1000μs (J)	1KHz (pF)
MLV0402NA003V0020	2.5	3.3	5(4.0~6.0)	20	1	10	0.05	390
MLV0402NA006V0020	4	5.5	8(6.4~9.6)	20	1	16	0.05	295
MLV0402NA009V0020	6	9	12(10.2~13.8)	20	1	20	0.05	190
MLV0402NA011V0020	8	11	15(12.8~17.3)	20	1	25	0.05	160
MLV0402NA014V0020	11	14	18(16.2~19.8)	20	1	30	0.05	135
MLV0402NA017V0020	12	16.5	22(19.8~24.2)	20	1	36	0.05	105
MLV0402NA018V0020	14	18	24(21.6~26.4)	20	1	40	0.05	93
MLV0402NA022V0020	17	22	27(24.3~29.7)	20	1	45	0.05	75
MLV0402NA026V0020	20	26	33(29.7~36.3)	20	1	54	0.05	54
MLV0402NA030V0020	25	30	39(35.1~42.9)	20	1	65	0.05	45
MLV0402NA038V0020	30	38	47(42.3~51.7)	20	1	77	0.05	27
MLV0603NA003V0030	2.5	3.3	5(4.0~6.0)	30	1	10	0.1	1250
MLV0603NA006V0030	4	5.5	8(6.4~9.6)	30	1	16	0.1	800
MLV0603NA009V0030	6	9	12(10.2~13.8)	30	1	20	0.1	680
MLV0603NA011V0030	8	11	15(12.8~17.3)	30	1	25	0.1	460
MLV0603NA014V0030	11	14	18(16.2~19.8)	30	1	30	0.1	350
MLV0603NA017V0030	12	16.5	22(19.8~24.2)	30	1	36	0.1	300
MLV0603NA018V0030	14	18	24(21.6~26.4)	30	1	39	0.1	270
MLV0603NA022V0030	17	22	27(24.3~29.7)	30	1	44	0.1	235
MLV0603NA026V0030	20	26	33(29.7~36.3)	30	1	54	0.1	200
MLV0603NA030V0030	25	30	39(35.1~42.9)	30	1	65	0.1	120
MLV0603NA038V0030	30	38	47(42.3~51.7)	30	1	77	0.1	100
MLV0603NA045V0030	35	45	56(50.4~61.6)	30	1	90	0.1	80
MLV0805NA003V0040	2.5	3.3	5(4.0~6.0)	40	1	10	0.1	2450
MLV0805NA006V0080	4	5.5	8(6.4~9.6)	80	1	16	0.1	1600
MLV0805NA009V0080	6	9	12(10.2~13.8)	80	1	20	0.1	1180
MLV0805NA011V0100	8	11	15(12.8~17.3)	100	1	25	0.1	1050
MLV0805NA014V0100	11	14	18(16.2~19.8)	100	1	30	0.1	750
MLV0805NA017V0100	12	16.5	22(19.8~24.2)	100	1	36	0.2	680
MLV0805NA018V0100	14	18	24(21.6~26.4)	100	1	39	0.2	550

NA Series of Surface Mount Multilayer Varistors

Part Number	Working Voltage (max)		Breakdown Voltage	Peak Current (max)	Clamping Voltage (max)		Energy Absorption (max)	Typical Capacitance
	AC (V _{RMS})	DC (V)	1mA (V)	8/20μs (A)	(A)	(V)	10/1000μs (J)	1KHz (pF)
MLV0805NA022V0100	17	22	27(24.3~29.7)	100	1	44	0.2	400
MLV0805NA026V0100	20	26	33(29.7~36.3)	100	1	54	0.3	350
MLV0805NA030V0100	25	30	39(35.1~42.9)	100	1	65	0.3	310
MLV0805NA038V0100	30	38	47(42.3~51.7)	100	1	77	0.3	280
MLV0805NA045V0080	35	45	56(50.4~61.6)	80	1	90	0.3	195
MLV0805NA056V0080	40	56	68(61.2~74.8)	80	1	110	0.3	145
MLV0805NA065V0060	50	65	82(73.8~90.2)	60	1	135	0.3	85
MLV1206NA003V0060	2.5	3.3	5(4.0~6.0)	60	1	10	0.1	3850
MLV1206NA006V0100	4	5.5	8(6.4~9.6)	100	1	16	0.2	3200
MLV1206NA009V0100	6	9	12(10.2~13.8)	100	1	20	0.2	2200
MLV1206NA011V0100	8	11	15(12.8~17.3)	100	1	25	0.2	1300
MLV1206NA014V0100	11	14	18(16.2~19.8)	100	1	30	0.3	1150
MLV1206NA017V0100	12	16.5	22(19.8~24.2)	100	1	36	0.3	1000
MLV1206NA018V0100	14	18	24(21.6~26.4)	100	1	38	0.3	900
MLV1206NA022V0100	17	22	27(24.3~29.7)	100	1	44	0.4	840
MLV1206NA026V0100	20	26	33(29.7~36.3)	100	1	54	0.5	490
MLV1206NA030V0100	25	30	39(35.1~42.9)	100	1	65	0.6	440
MLV1206NA038V0100	30	38	47(42.3~51.7)	100	1	77	0.7	400
MLV1206NA045V0100	35	45	56(50.4~61.6)	100	1	90	0.8	310
MLV1206NA056V0100	40	56	68(61.2~74.8)	100	1	110	1.0	280
MLV1206NA065V0100	50	65	82(73.8~90.2)	100	1	135	0.5	240
MLV1206NA085V0100	60	85	100(90.0~110.0)	100	1	165	0.6	160
MLV1206NA090V0100	70	90	110(99.0~121.0)	100	1	180	0.6	120
MLV1210NA006V0250	4	5.5	8(6.4~9.6)	250	2.5	16	0.4	6200
MLV1210NA009V0250	6	9	12(10.2~13.8)	250	2.5	20	0.5	4400
MLV1210NA011V0250	8	11	15(12.8~17.3)	250	2.5	25	0.6	3520
MLV1210NA014V0250	11	14	18(16.2~19.8)	250	2.5	30	0.7	3260
MLV1210NA017V0250	12	16.5	22(19.8~24.2)	250	2.5	36	0.8	2100
MLV1210NA018V0250	14	18	24(21.6~26.4)	250	2.5	38	0.8	1950
MLV1210NA022V0250	17	22	27(24.3~29.7)	250	2.5	44	1.0	1720
MLV1210NA026V0250	20	26	33(29.7~36.3)	250	2.5	54	1.2	1090
MLV1210NA030V0250	25	30	39(35.1~42.9)	250	2.5	65	1.4	920
MLV1210NA038V0250	30	38	47(42.3~51.7)	250	2.5	77	1.6	780
MLV1210NA045V0250	35	45	56(50.4~61.6)	250	2.5	90	2.0	470

NA Series of Surface Mount Multilayer Varistors

Part Number	Working Voltage (max)		Breakdown Voltage	Peak Current (max)	Clamping Voltage (max)		Energy Absorption (max)	Typical Capacitance
	AC (V _{RMS})	DC (V)	1mA (V)	8/20μs (A)	(A)	(V)	10/1000μs (J)	1KHz (pF)
MLV1210NA056V0250	40	56	68(61.2~74.8)	250	2.5	110	2.3	390
MLV1210NA065V0250	50	65	82(73.8~90.2)	250	2.5	135	1.2	320
MLV1210NA085V0200	60	85	100(90.0~110.0)	200	2.5	165	1.4	220
MLV1210NA090V0200	70	90	110(99.0~121.0)	200	2.5	180	1.4	200
MLV1812NA009V0500	6	9	12(10.2~13.8)	500	5	20	0.9	9150
MLV1812NA011V0500	8	11	15(12.8~17.3)	500	5	25	1.2	7320
MLV1812NA014V0500	11	14	18(16.2~19.8)	500	5	30	1.4	6100
MLV1812NA017V0500	12	16.5	22(19.8~24.2)	500	5	36	1.6	4300
MLV1812NA018V0500	14	18	24(21.6~26.4)	500	5	38	1.7	3930
MLV1812NA022V0500	17	22	27(24.3~29.7)	500	5	44	2.0	3500
MLV1812NA026V0500	20	26	33(29.7~36.3)	500	5	54	2.5	2900
MLV1812NA030V0500	25	30	39(35.1~42.9)	500	5	65	2.9	2500
MLV1812NA038V0500	30	38	47(42.3~51.7)	500	5	77	3.5	2200
MLV1812NA045V0500	35	45	56(50.4~61.6)	500	5	90	4.2	1950
MLV1812NA056V0500	40	56	68(61.2~74.8)	500	5	110	4.8	1650
MLV1812NA065V0400	50	65	82(73.8~90.2)	400	5	135	4.5	1060
MLV1812NA085V0400	60	85	100(90.0~110.0)	400	5	165	5.8	870
MLV1812NA090V0400	70	90	110(99.0~121.0)	400	5	180	5.8	790
MLV1812NA127V0300	95	127	150(135.0~165.0)	300	5	248	5.8	420
MLV2220NA009V1000	6	9	12(10.2~13.8)	1000	10	20	1.9	36500
MLV2220NA011V1000	8	11	15(12.8~17.3)	1000	10	25	2.3	18400
MLV2220NA014V1000	11	14	18(16.2~19.8)	1000	10	30	2.7	15300
MLV2220NA017V1000	12	16.5	22(19.8~24.2)	1000	10	36	2.9	12500
MLV2220NA018V1000	14	18	24(21.6~26.4)	1000	10	38	3.1	11800
MLV2220NA022V1000	17	22	27(24.3~29.7)	1000	10	44	3.8	10400
MLV2220NA026V1000	20	26	33(29.7~36.3)	1000	10	54	4.3	8900
MLV2220NA030V1000	25	30	39(35.1~42.9)	1000	10	65	5.5	7500
MLV2220NA038V1000	30	38	47(42.3~51.7)	1000	10	77	6.3	4600
MLV2220NA045V1000	35	45	56(50.4~61.6)	1000	10	90	7.7	4000
MLV2220NA056V1000	40	56	68(61.2~74.8)	1000	10	110	8.8	3500
MLV2220NA065V0800	50	65	82(73.8~90.2)	800	10	135	5.6	2850
MLV2220NA085V0800	60	85	100(90.0~110.0)	800	10	165	6.8	1800
MLV2220NA090V0800	70	90	110(99.0~121.0)	800	10	180	6.8	1500

HA Series of Surface Mount Multilayer Varistors

Features:

- Fast Response < 0.5ns
- Low Capacitance
- Low Clamping Voltage and High Energy Absorption

Applications:

- Telecommunications
- Automotive Systems
- Data Systems
- Power Supplies

Part Number	Working Voltage (max)		Breakdown Voltage	Peak Current (max)	Clamping Voltage (max)		Energy Absorption (max)	Typical Capacitance
	AC (V _{RMS})	DC (V)	1mA (V)	8/20μs (A)	(A)	(V)	10/1000μs (J)	1KHz (pF)
MLV1206HA014V0200	11	14	18(15.3~20.7)	200	1	30	0.5	1500
MLV1206HA018V0200	14	18	24(21.6~26.4)	200	1	39	0.5	1160
MLV1206HA022V0200	17	22	27(24.3~29.7)	200	1	44	0.6	1080
MLV1206HA026V0200	20	26	33(29.7~36.3)	200	1	54	0.7	680
MLV1206HA030V0200	25	30	39(35.1~42.9)	200	1	65	1.0	620
MLV1206HA038V0200	30	38	47(42.3~51.7)	200	1	77	1.1	550
MLV1206HA045V0200	35	45	56(50.4~61.6)	200	1	90	0.8	400
MLV1210HA011V0400	8	11	15(12.8~17.3)	400	2.5	25	1.0	4050
MLV1210HA014V0400	11	14	18(15.3~20.7)	400	2.5	30	1.2	3860
MLV1210HA017V0400	12	16.5	22(19.8~24.2)	400	2.5	36	1.4	2600
MLV1210HA018V0400	14	18	24(21.6~26.4)	400	2.5	39	1.4	2380
MLV1210HA022V0400	17	22	27(24.3~29.7)	400	2.5	44	1.7	2100
MLV1210HA026V0400	20	26	33(29.7~36.3)	400	2.5	54	1.9	1400
MLV1210HA030V0400	25	30	39(35.1~42.9)	400	2.5	65	1.7	1180
MLV1210HA038V0400	30	38	47(42.3~51.7)	400	2.5	77	2.0	1000
MLV1210HA045V0400	35	45	56(50.4~61.6)	400	2.5	90	2.0	660
MLV1812HA014V0800	11	14	18(15.3~20.7)	800	5	30	1.9	7030
MLV1812HA018V0800	14	18	24(21.6~26.4)	800	5	38	2.3	4650
MLV1812HA022V0800	17	22	27(24.3~29.7)	800	5	44	2.7	4150
MLV1812HA026V0800	20	26	33(29.7~36.3)	800	5	54	3.0	3400
MLV1812HA030V0800	25	30	39(35.1~42.9)	800	5	65	3.7	2950
MLV1812HA038V0800	30	38	47(42.3~51.7)	800	5	77	4.2	2550
MLV1812HA045V0800	35	45	56(50.4~61.6)	800	5	90	4.2	2400
MLV2220HA011V1200	8	11	15(12.8~17.3)	1200	10	25	4.2	21200
MLV2220HA014V1200	11	14	18(15.3~20.7)	1200	10	30	5.4	17700

HA Series of Surface Mount Multilayer Varistors

Part Number	Working Voltage (max)		Breakdown Voltage	Peak Current (max)	Clamping Voltage (max)		Energy Absorption (max)	Typical Capacitance
	AC (V _{RMS})	DC (V)	1mA (V)	8/20μs (A)	(A)	(V)	10/1000μs (J)	1KHz (pF)
MLV2220HA017V1200	12	16.5	22(19.8~24.2)	1200	10	36	5.8	14500
MLV2220HA018V1200	14	18	24(21.6~26.4)	1200	10	39	5.8	13600
MLV2220HA022V1200	17	22	27(24.3~29.7)	1200	10	44	7.2	12000
MLV2220HA026V1200	20	26	33(29.7~36.3)	1200	10	54	7.8	10500
MLV2220HA030V1200	25	30	39(35.1~42.9)	1200	10	65	9.6	8900
MLV2220HA038V1200	30	38	47(42.3~51.7)	1200	10	77	12.0	5700
MLV2220HA045V1200	35	45	56(50.4~61.6)	1200	10	90	7.7	4800

Product Identification

MLV 0402 ES 012V 0100 N P
(1) (2) (3) (4) (5) (6) (7)

(1) Series Code:

MLV – Surface Mount Multilayer Varistor

(2) Size Code:

Standard EIA Chip Size

(3) Application Code:

ES – Electro-static Discharge Protection

NA – Normal Surge Protection

HA – High Surge Protection

(4) Max. Working Voltage:

012V – 12V

(5) Capacitance for ES Series:

0100 – 100pF

02R5 – 2.5pF

Peak Current for HA/NA Series:

0100 – 100A

(6) Capacitance Tolerance for ES Series:

N – ±30%

P – +80% / -20%

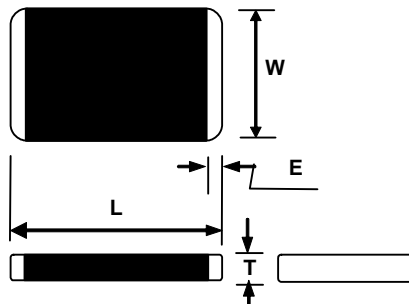
(7) Packaging Code:

T – Tape & Reel

B – Bulk

Surface Mount Multilayer Varistors

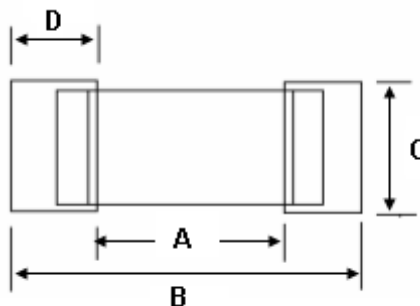
Shape and Dimensions



Size	L (mm)	W (mm)	T (mm)	E (mm)
0402	1.00 ± 0.10	0.50 ± 0.10	0.60 max.	$0.25 +0.10/-0.10$
0603	1.60 ± 0.15	0.80 ± 0.10	0.90 max.	$0.30 +0.10/-0.10$
0805	2.00 ± 0.20	1.25 ± 0.15	1.00 max.	$0.30 +0.10/-0.10$
1206	3.20 ± 0.20	1.60 ± 0.15	1.50 max.	$0.50 +0.20/-0.20$
1210	3.20 ± 0.20	2.50 ± 0.20	1.50 max.	$0.50 +0.20/-0.20$
1812	4.50 ± 0.20	3.20 ± 0.20	2.00 max.	$0.50 +0.30/-0.10$
2220	5.70 ± 0.20	5.00 ± 0.20	2.50 max.	$0.50 +0.30/-0.10$

Recommended Land Patterns

Size	Solder pad layout			
	A (mm)	B (mm)	C (mm)	D (mm)
0402	0.4~0.6	1.4~1.8	0.5~0.6	0.6~1.2
0603	0.8~1.2	2.2~2.8	0.6~1.0	0.9~1.5
0805	1.0~1.5	2.6~3.2	1.2~1.5	1.1~1.8
1206	1.8~2.5	4.2~5.2	1.2~1.8	1.2~1.8
1210	1.8~2.5	4.2~5.2	2.2~3.0	1.3~2.0
1812	2.5~3.3	5.5~6.7	2.8~3.6	1.3~2.2
2220	3.8~4.6	6.6~7.8	4.8~5.5	1.3~2.2



Surface Mount Multilayer Varistors

Terms and Definitions

Term	Definition
Max. Working Voltage	Maximum steady-state DC operating voltage with typical leakage current less than 50 μ A at 25
Varistor Voltage (BDV)	Breakdown DC voltage measured at current of 1mA
Max. Clamping Voltage	Maximum peak voltage across the part, measured at a specified pulse current and waveform
Surge Current	Maximum peak current with the specified 8/20 μ s waveform without damage
Surge Shift V/V	The change of varistor voltage after applying the specified surge current
Energy Absorption	Maximum energy dissipated with a specified 10/1000 μ s waveform without damage
Typical Capacitance	Capacitance measured with voltage bias less than 0.5V _{RMS} at 1KHz
Nonlinear Exponent	$= [\log (V_{1mA}/V_{0.1mA}) / \log (I_{V1mA}/I_{V0.1mA})]$
Leakage Current	Measured at working voltage

Operating Temperatures:

-55°C to +85°C for size 0603 or smaller

-55°C to +125°C for size 0805 or larger

Surface Mount Multilayer Varistors

Reliability Tests

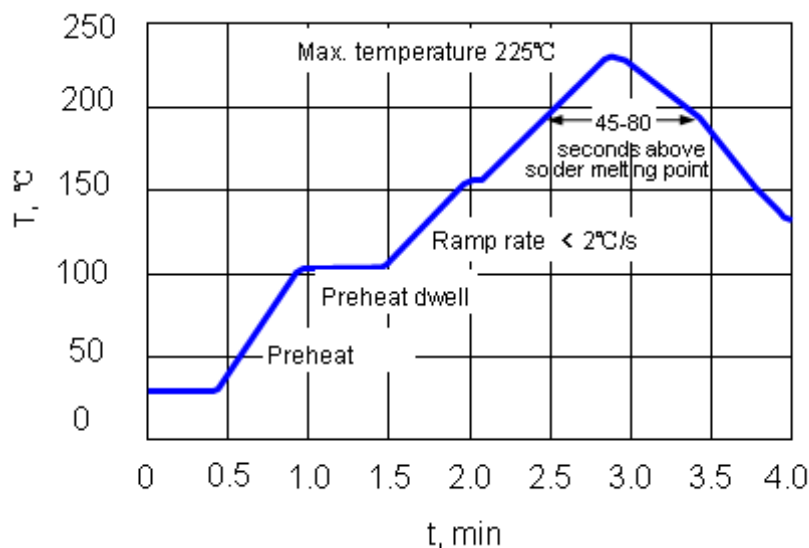
No.	Test	Requirement	Test condition	Test reference
1	Soldering heat resistance	BDV change $\leq \pm 10\%$ No mechanical damage	One dip at 260 for 5 sec.	MIL-STD-202 Method 210 IEC 60068-2-20
2	Solderability	New solder coverage $\geq 75\%$	One dip at 235 for 5 sec. Non-active flux	MIL-STD-202 Method 208 IEC 60068-2-20
3	Maximum surge current	BDV change $\leq \pm 10\%$ No mechanical damage	100 pulses of 8/20 μ s with maximum surge current and 30 sec. interval at 25 and 30~65% RH	CECC 42000 IEC 1051-1 Test 4.5
4	Maximum surge energy	BDV change $\leq \pm 10\%$ No mechanical damage	100 pulses of 10/1000 μ s with maximum surge current and 90 sec. interval at 25 and 30~65% RH	CECC 42000
5	Thermal cycling	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu$ A	5 cycles between -40 and 125 with 30 min. dwell time at the temperature extremes and 60 min. dwell time at 25	CECC 42000 IEC 60068-2-14
6	Low temperature resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu$ A	1000 hr at -50	IEC 60068-2-1
7	Low temperature load resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu$ A	1000 hr at -50 with working voltage applied	IEC 60068-2-1
8	High temperature resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu$ A	1000 hr at 150	MIL-STD-202 Method 108 CECC 42000
9	High temperature load resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu$ A	1000 hr at 85 with working voltage applied	CECC 42000
10	Humidity resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu$ A	500 hr at 40 and 90~95% RH	MIL-STD-202 Method 103 IEC 60068-2-3 CECC 42000;
11	Humidity load resistance	BDV change $\leq \pm 10\%$ No mechanical damage Leakage current $\leq 200 \mu$ A	500 hr at 40°C and 90~95% RH with working voltage applied	MIL-STD-202 Method 103 IEC 60068-2-3 CECC 42000
12	ESD contact test*	Varistor voltage change >115% working voltage	Contact electrostatic discharge 100 times with 1 second intervals at 8KV (Level 4) and polarity: +,-	IEC 61000-4-2
13	ESD air test*	Varistor voltage change >115% working voltage	Air contact electrostatic discharge 100 times with 1 second intervals at 15KV (Level 4) and polarity: +,-	IEC 61000-4-2

* For ES series only.

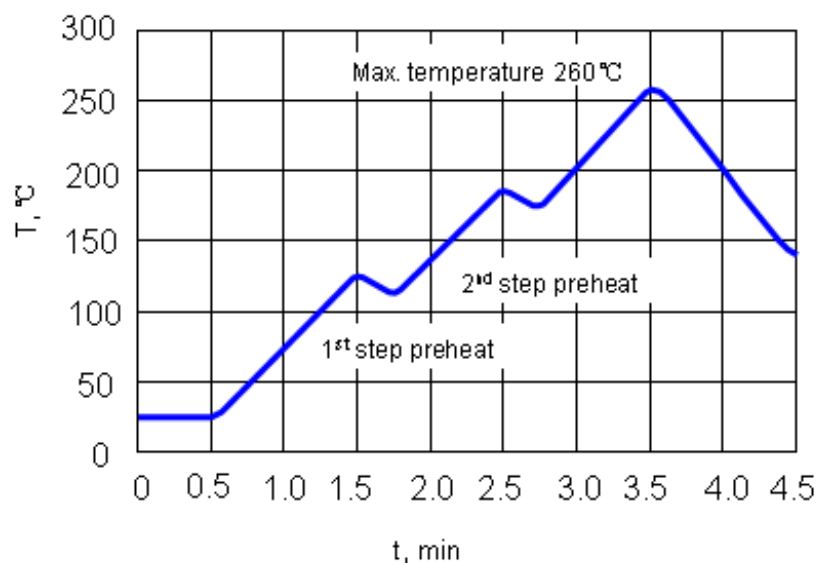
Surface Mount Multilayer Varistors

Soldering Temperature Profiles

Recommended Temperature Profile
for Reflow Soldering



Recommended Temperature Profile
for Wave Soldering



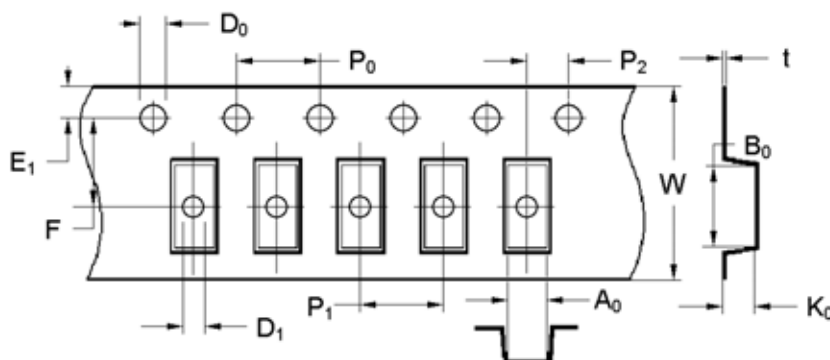
Packaging and Storage

Packaging

AEM's multilayer components are provided on tape-and-reel for use in pick-and-place machines or in bulk for special applications. Both tape-and-reel and bulk products are sealed in plastic bags with desiccant. The reel size can be 7 inches or 13 inches, depending on customers' preference.

Dimensions of Tape in Inches (mm)

Size	Ao	Bo	Ko	Type
0402 (1005)	0.026 ± 0.004 (0.67 ± 0.10)	0.046 ± 0.004 (1.17 ± 0.10)	0.025 ± 0.004 (0.63 ± 0.10)	Paper
	0.026 ± 0.004 (0.67 ± 0.10)	0.045 ± 0.004 (1.15 ± 0.10)	0.031 ± 0.004 (0.80 ± 0.10)	Plastic
0603 (1608)	0.045 ± 0.004 (1.15 ± 0.10)	0.07 ± 0.004 (1.85 ± 0.10)	0.043 ± 0.004 (0.93 ± 0.10)	Paper
	0.043 ± 0.004 (1.10 ± 0.10)	0.075 ± 0.004 (1.90 ± 0.10)	0.043 ± 0.004 (1.10 ± 0.10)	Plastic
0805 (2012)	0.063 ± 0.004 (1.60 ± 0.10)	0.093 ± 0.004 (2.40 ± 0.10)	0.046 ± 0.004 (1.20 ± 0.10)	Plastic
1206 (3216)	0.071 ± 0.004 (1.80 ± 0.10)	0.138 ± 0.004 (3.50 ± 0.10)	0.048 ± .004 (1.20 ± 0.10)	Plastic
1210 (3225)	0.106 ± 0.004 (2.69 ± 0.10)	0.137 ± 0.004 (3.48 ± 0.10)	0.056 ± 0.004 (1.43 ± 0.10)	Plastic
1812 (4532)	0.144 ± 0.004 (3.66 ± 0.10)	0.195 ± 0.004 (4.95 ± 0.10)	0.072 ± 0.004 (1.83 ± 0.10)	Plastic
2220 (5750)	0.201 ± 0.004 (5.10 ± 0.10)	0.235 ± 0.004 (5.97 ± 0.10)	0.110 ± 0.004 (2.80 ± 0.10)	Plastic



Size	E_1	F	W	P_1	P_o	P_2	D_o	D_1	t
0402(1005)	0.069 ± 0.004 (1.75 \pm 0.10)	0.138 ± 0.002 (3.50 \pm 0.05)	0.318 ± 0.004 (8.00 \pm 0.10)	0.079 ± 0.004 (2.00 \pm 0.10)	0.157 ± 0.004 (4.00 \pm 0.10)	0.040 ± 0.002 (1.00 \pm 0.05)	0.059 ± 0.004 (1.50 \pm 0.10/-0.00)	N/A	0.009 ± 0.001 (0.23 \pm 0.02)
0603(1608)				0.157 ± 0.004 (4.00 \pm 0.10)		0.079 ± 0.002 (2.00 \pm 0.05)		0.039 max (1.00 max)	
0805(2012)									
1206(3216)			0.472 ± 0.004 (12.00 \pm 0.10)	0.318 ± 0.004 (8.00 \pm 0.10)				0.059 max (1.50 max)	
1210(3225)									
1812(4532)									
2220(5750)									

Packaging Data

Chip Size	Parts on 7 inch (178 mm) Reel
0402(1005)	10,000
0603(1608)	4,000
0805(2012)	3,000
1206(3216)	3,000
1210(3225)	2,000
1812(4532)	1,000
2220(5750)	1,000

Packaging and Storage

Storage

The maximum ambient temperature shall not exceed 40°C. Storage temperatures higher than 40°C could result in the deformation of packaging materials. The maximum relative humidity recommended for storage is 70%. High humidity with high temperature can accelerate the oxidation of the solder plating on the termination and reduce the solderability of the components. Sealed plastic bags with desiccant shall be used to reduce the oxidation of the termination and shall only be opened prior to use. The products shall not be stored in areas where harmful gases containing sulfur or chlorine are present.