



# Engineering Product Specification

## 3216FF

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REV. #	Revision Description	Date	Author	Appr.
F	Add -R option (for RoHS Compliant version) and China mfg location	11/2/04	MJ	MJ
E	Add reference to min/max resistance, remove 1.75A device, add glass color reference, add -T option.	10/30/03	MJ	MJ
D	Update marking symbols.	10/31/02	DU	HS
C	Add 1.25A and 1.75A device.	6/08/01	DB	RS
B	Update TCC to show 7A device.	5/8/01	VK	DB
A	Original	8/28/00	DG	DB

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## 1. SCOPE

1.1 This Specification applies to 3216FF series fuses.

## 2. GENERAL

### 2.1 General Information

- Rapid interruption of excessive current
- Compatible with reflow and wave solder
- Rugged ceramic and glass construction
- Excellent environmental integrity
- One time positive disconnect

### 2.2 General Description

3216FF Chip fuses set the industry standard for performance, reliability and quality. The solder-free design provides excellent on-off and temperature cycling characteristics during use and also makes our Chip fuses more heat and shock tolerant than typical subminiature fuses.

## 3. MANUFACTURER AND PRODUCTION FACILITY

3.1 Manufacturer                      Cooper Electronic Technologies  
3601 Quantum Boulevard  
Boynton Beach, FL 33426  
Telephone: 561-752-5000  
Fax: 561-752-0134

3.2 Production Facility            a) Cooper Bussmann  
114 Old State Road  
Ellisville, MO 63021 (USA)

b) Xin Min Industrial Estate  
Changan DongGuan  
Guandong Province, China

3.3 ISO Registration                a) ISO 9002 File Number A4916  
b) ISO 9002, Certificate No. Q2273

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#### 4. CATALOG SYMBOL AND PART NUMBERING SYSTEM

##### 4.1 Catalog Symbol

##### 4.1.1 RoHS Compliant Example - TR/3216FF500-R

<u>TR/</u>	<u>3216</u>	<u>FF</u>	<u>500</u>	<u>-R</u>
1	2	3	4	5

- |                               |                 |
|-------------------------------|-----------------|
| 1. Packaging Code:            | TR/             |
| 2. Series Number:             | 3216            |
| 3. Electrical Characteristic: | FF              |
| 4. Ampere Rating:             | 500 (for 500mA) |
| 5. RoHS Compliant:            | -R              |

##### 4.1.2 Tin/Lead Plated Example - TR/3216FF-500MA

<u>TR/</u>	<u>3216</u>	<u>FF</u>	<u>-500MA</u>
1	2	3	4

- |                               |       |
|-------------------------------|-------|
| 1. Packaging Code:            | TR/   |
| 2. Series Number:             | 3216  |
| 3. Electrical Characteristic: | FF    |
| 4. Ampere Rating:             | 500MA |

##### 4.2 Part Numbering System

##### 4.2.1 Packaging Code

Catalog	Designation
TR/	3,000 pieces of fuses on 8mm tape-and-reel on a 7 inch (178mm) reel per EIA Standard 481.

##### 4.2.2 Electrical Characteristic

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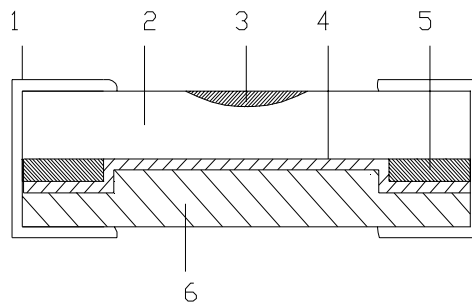
Catalog Symbol	Characteristic
FF	Fast Acting

#### 4.2.3 Ampere Rating

Catalog Symbol	Description
3216FF-250mA	250mA Fuse
3216FF-375mA	375mA Fuse
3216FF-500mA	500mA Fuse
3216FF-750mA	750mA Fuse
3216FF-1A	1A Fuse
3216FF-1.25A	1.25A Fuse
3216FF-1.5A	1.5A Fuse
3216FF-2A	2A Fuse
3216FF-2.5A	2.5A Fuse
3216FF-3A	3A Fuse
3216FF-4A	4A Fuse
3216FF-4.5A	4.5A Fuse
3216FF-5A	5A Fuse
3216FF-6.5A	6.5A Fuse
3216FF-7A	7A Fuse

### 5. MECHANICAL SPECIFICATIONS

#### 5.1 Construction (Not to scale)



1. End termination
  - a. Nickel Underplate – 200 to 400 microinches
  - b. Either:
    - i. SnPb Plate: 300-600 microinches (87% Sn)  
or
    - ii. 100% Sn Plate (if -R): 300-600 microinches
2. Ceramic substrate (white)
3. Numeric ampere marking
4. Metal film fusible element
5. Silver termination pad
6. Fused glass cover (green)

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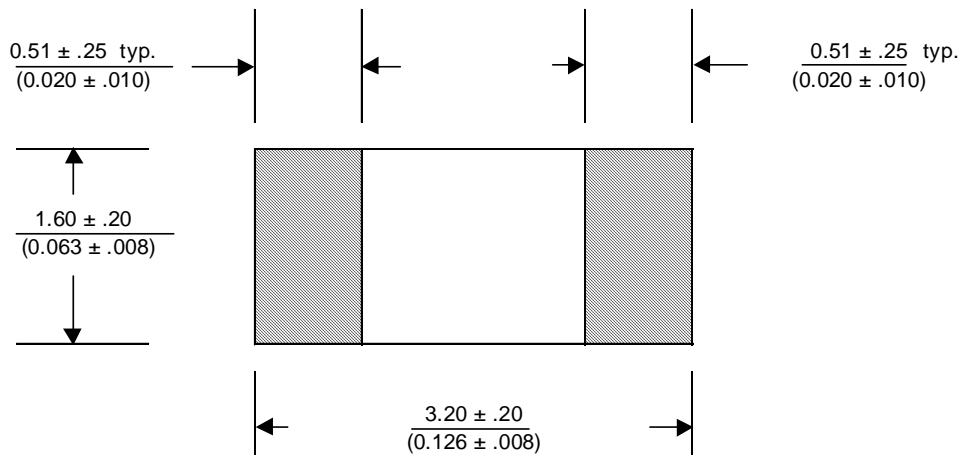
5.2 Dimensions

(Drawings not to scale)

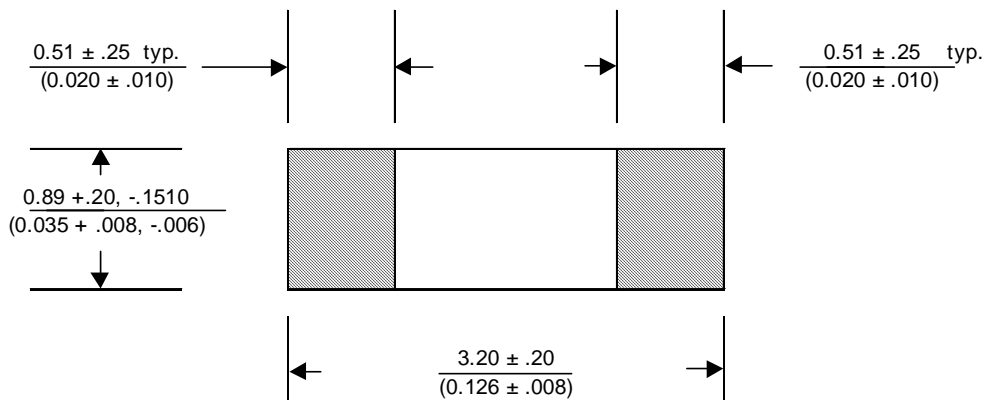
5.2.1 End View mm  
inches



5.2.2 Top View mm  
inches



5.2.3 Side View mm  
inches



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## 6. ELECTRICAL SPECIFICATIONS

### 6.1 Voltage Rating

Catalog Symbol	Voltage Rating	
	(AC)	(DC)
3216FF-250mA	32V	63V
3216FF-375mA	32V	63V
3216FF-500mA	32V	63V
3216FF-750mA	32V	63V
3216FF-1A	32V	63V
3216FF-1.25A	32V	63V
3216FF-1.5A	32V	63V
3216FF-2A	32V	63V
3216FF-2.5A	32V	63V
3216FF-3A	32V	63V
3216FF-4A	32V	32V
3216FF-4.5A	32V	32V
3216FF-5A	32V	32V
3216FF-6.5A	32V	32V
3216FF-7A	32V	32V

### 6.2 Interrupting Rating

6.2.1 AC interrupting rating (Measured at rated voltage with a unity power factor)

6.2.2 DC Interrupting Rating (Measured at rated voltage, time constant of less than 50 microseconds, battery source)

Catalog Symbol	Interrupting
	Rating AC/DC
3216FF-250mA	50A
3216FF-375mA	50A
3216FF-500mA	50A
3216FF-750mA	50A
3216FF-1A	50A
3216FF-1.25A	50A
3216FF-1.5A	50A
3216FF-2A	50A
3216FF-2.5A	50A
3216FF-3A	50A
3216FF-4A	50A
3216FF-4.5A	50A
3216FF-5A	50A
3216FF-6.5A	50A
3216FF-7A	50A

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### 6.3 Time vs. Current Characteristic (Measured with a constant current power supply)

Ampere Rating	% of Amp Rating	Opening Time
250mA - 7A	100%	4 hours minimum
1.25A - 3A	200%	60 seconds maximum
250mA -3A	250%	5 seconds maximum
4A - 7A	350%	1 second maximum

### 6.4 DC Cold Resistance (Measured at 10% of rated current)

Catalog Symbol	Resistance (ohms) Typ.	Resistance (ohms) Min.*	Resistance (ohms) Max.*
3216FF-250mA	3.50	2.3000	4.7000
3216FF-375mA	1.7500	1.2000	2.3000
3216FF-500mA	0.980	0.6600	1.3000
3216FF-750mA	0.750	0.3800	0.7000
3216FF-1A	0.2190	0.1480	0.2900
3216FF-1.25A	0.1350	0.1350	0.2050
3216FF-1.5A	0.1190	0.0930	0.1450
3216FF-2A	0.0660	0.0530	0.0800
3216FF-2.5A	0.0460	0.0380	0.0540
3216FF-3A	0.0360	0.0260	0.0450
3216FF-4A	0.0180	0.0130	0.0230
3216FF-4.5A	0.0160	0.0120	0.0200
3216FF-5A	0.0140	0.0110	0.0180
3216FF-6.5A	0.0085	0.0068	0.0103
3216FF-7A	0.0085	0.0055	0.0085

\* - FOR REFERENCE ONLY - CONTROLLED VALUES HELD BY PLANT AND SUBJECT TO CHANGE WITHOUT NOTICE.

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6.5 Typical Melting  $I^2t$  (Measured with a battery bank at rated DC voltage, 50A ,  
time constant of calibrated circuit less than 50 microseconds)

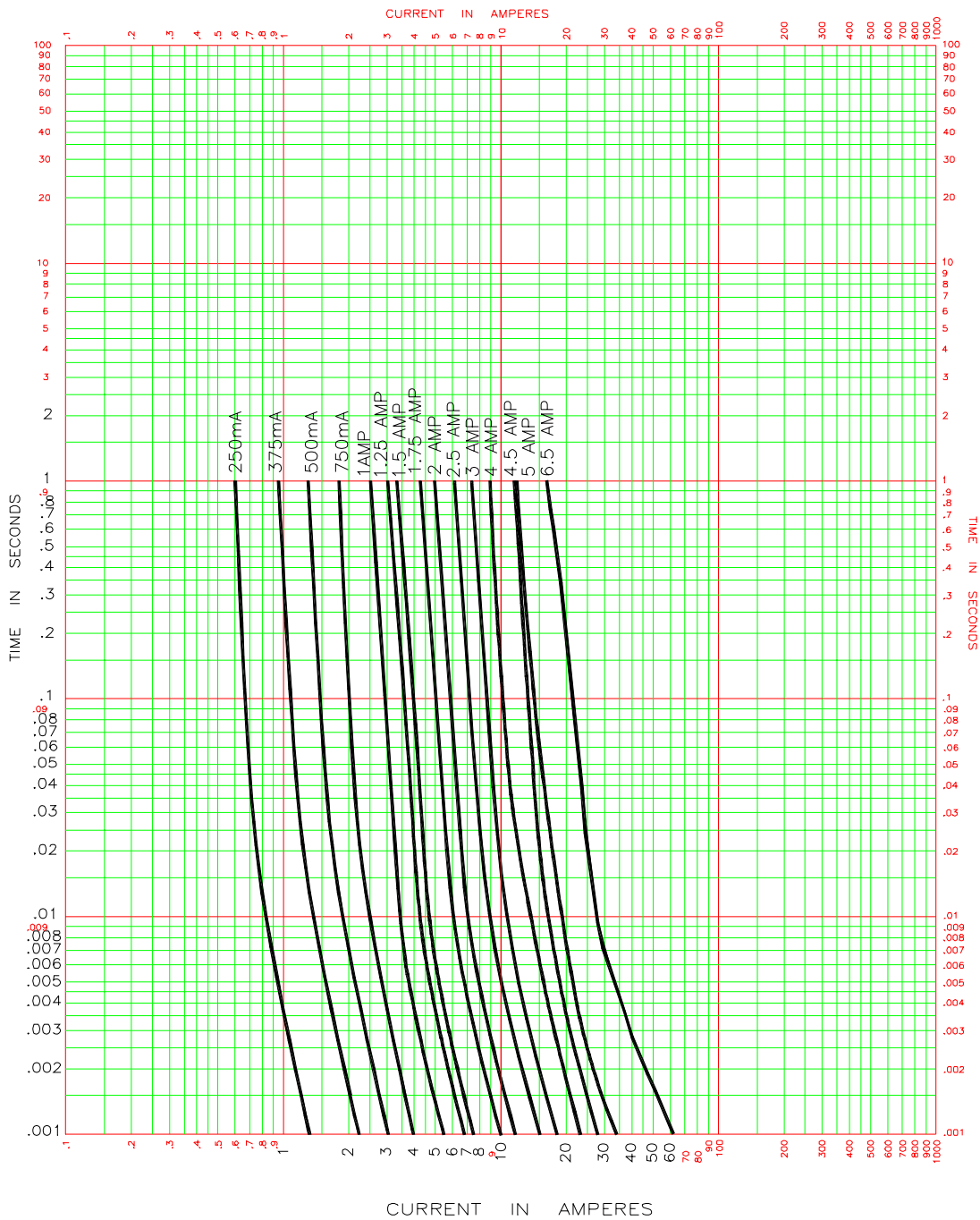
Catalog Symbol	Typical Melt $I^2t$	
	AC	DC
3216FF-250mA	0.00016	0.000084
3216FF-375mA	0.001	0.0002
3216FF-500mA	0.0014	0.0019
3216FF-750mA	0.0033	0.00095
3216FF-1A	0.012	0.007
3216FF-1.25A	0.035	0.022
3216FF-1.5A	0.047	0.029
3216FF-2A	0.116	0.081
3216FF-2.5A	0.206	0.171
3216FF-3A	0.426	0.359
3216FF-4A	0.187	0.164
3216FF-4.5A	0.546	0.463
3216FF-5A	0.663	0.619
3216FF-6.5A	2.18	3.21
3216FF-7A	2.40	3.53

6.6 Typical Voltage Drop (Measured at rated current after temperature stabilizes)

Catalog Symbol	Typical Voltage Drop (V)
3216FF-250mA	1.4
3216FF-375mA	0.73
3216FF-500mA	0.66
3216FF-750mA	0.63
3216FF-1A	0.20
3216FF-1.25A	0.18
3216FF-1.5A	0.18
3216FF-2A	0.16
3216FF-2.5A	0.14
3216FF-3A	0.13
3216FF-4A	0.11
3216FF-4.5A	0.10
3216FF-5A	0.09
3216FF-6.5A	0.076
3216FF-7A	0.078

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### 6.7 Time Current Curve Average Melting



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## 7. STANDARDS AND AGENCY INFORMATION

### 7.1 UL Card



Northbrook, Illinois • (847) 272-8800  
 Mahwah, New York • (516) 271-6200  
 Santa Clara, California • (408) 985-2411  
 Research Triangle Park,  
 North Carolina • (919) 549-1400  
 Camas, Washington • (360) 817-5500

COOPER INDUSTRIES INC  
 BUSSMANN DIV  
 MR W CURTIS  
 PO BOX 14460  
 ST LOUIS MO 63178

RE: Project Number(s) - 99NK6781

Your most recent listing is shown below. Please review this information and report any inaccuracies to the UL Engineering staff member who handled your project.

For information on placing an order for UL Listing Cards in a 3 x 5 inch format, please refer to the enclosed ordering information.

JDYX2 March 16, 1999  
 Fuses, Miscellaneous, Miniature, and Micro - Component

COOPER INDUSTRIES INC BUSSMANN DIV  
 PO BOX 14460, ST LOUIS MO 63178

E19180

With pigtail leads.  
 Micro. Cat. No. GFA, 1/200-5 A, 125 v.  
 For printed wiring board mounting.  
 Micro. Cat. Nos. PCB, PCC, PCF, PCH, PCK, 0.5-2.5 A, 250 v, ac, 450 v, dc; Cat. Nos. PCB, PCC, PCF, PCH, PCK, 2.6-3 A, 250 v, ac, 350 v, dc;  
 Cat. Nos. PCD, PCE, PCL, 0.5-2.5 A, 125 v, ac, 450 v, dc; Cat. Nos. PCD, PCE, PCL, 2.6-3 A, 125 v, ac, 350 v, dc; Cat. Nos. PCD, PCE, PCC, PCL, 3.1-5 A, 125 v, ac, 250 v, dc; Cat. No. PCJ, 1 A, 250 v, ac, 750 v, dc.  
 Cat. No. DO-35, 250 mA-3.5 A, 32 v, ac and dc.  
 Cat. Nos. 6125FA, 6125TD, 1/2 A-5 A, 125 v, ac, 60 v, dc.  
 For use with fuse holders.  
 Micro. Cat. No. GMW, 0-5 A, 125 v.  
 Miniature. Cat. No. MKC, 1/16 A, 125 v.  
 Cat. No. AGC+, 11-30 A, 32 v; Cat. No. AGC-CW+, 3.5-7.5 A, 32 v.  
 Cat. No. AGA, 5.1-12 A, 32 v.  
 Cat. Nos. AGA, GKN, 2-5 A, 125 v, ac.  
 Cat. No. ABC+, -18, 20 A, 250 v, -25, 30 A, 125 v; Cat. No. WP-91768L followed by 117-119 incl.  
 Cat. No. GLW+, 20 A, 250 v, 25 A, 125 v.  
 Cat. No. MDL, 8.1-30 A, 32 v; Cat. No. MDV, 8.1-20 A, 32 v.  
 Cat. No. MDQ, 7.1-30 A, 32 v; Cat. No. 1A6267, 7.1-30A, 32 v.  
 Cat. No. AGX, 5.1-7 A, 125 v; 7.1-20 A, 32 v.  
 Cat. No. AGD, 3-12 A, 32 v.  
 Cat. No. ABS, 0-20A, 250 v, 25-30, 125 v.  
 Cat. No. ABC-V, 25 A, 125 v, 20 A, 250 v; Cat. No. ABC-V, 18 A, 250 v, 30 A, 125 v; Cat. No. WP-91768L followed by 17-19; Cat. No. MDL-V,  
 8.1-30 A, 32 v; Cat. No. AGC-V, 11-30 A, 32 v; Cat. No. AGA-V, 5.1-12 A, 32 v; Cat. No. AGX-V, 5.1-20 A, 32 v; Cat. No. MDQ-V, 8.1-30 A, 32 v.  
 Cat. No. MDA-V 25-30 A, 125/250 vac; Cat. No. AGC-V, 11-30A .  
 Cat. No. MDA 25-30 A, 125/250 v ac.  
 Miscellaneous. Cat. No. KTO, 4-6 A, 600 v.  
 Cat. No. DMM, rated 44/100 and 11 A, 1000 v, ac and dc; Cat. Nos. DMM-B-11, DMM-B-44/100, 1000 v, ac and dc.  
 Alarm indicator fuses. Type 70 followed by A-H incl., I, J, K, P, R or X, followed by 1/10-5 incl.; Type GKB followed by 10.  
 Type 80 followed by additional suffixes, 0-5 A; Type 81 followed by additional suffixes 0-12 A; Type 80M 1 1/3 A.  
 Micro. Type 74 followed by A, B, C, D, E, F, G, H, J, 1.25-20, 60 v, dc.  
 Cat. No. GLD/GBA, 6A, 125 v, ac; Cat. No. GLD/GBA, 8-15A, 50 v, ac and dc.  
 Cat. No. MCR/TRW, 1/16A-5A, 125 v, ac and dc; Cat. No. MCR-A/TRW, 6A-10A, 60 v, ac and 90 v, dc; Cat. No. TMR, 1/16, 250 v, ac.  
 Cat. No. SFT, 0-5A, 125 ac/dc; Cat. Nos. SFT, 5.1-10A, 60 v, ac/90 v, dc; SFT, 12.5A, 48 v, ac.  
 Cat. No. 3216FF, 1/4-3A, 32 v, ac, 63 v, dc; Cat. No. 3216FF, 4-6.5A, 32 v, ac/dc; Cat. No. 3216LV, 0.1-5A, 125 v, ac/dc; Cat. No. 3216-1J0289, rated  
 0.2A, 125 v, ac/dc.  
 Cat. No. 1608FE, 250 ma-4A, 24 v, dc.  
 Circuit protectors. Cat. No. 3216CP, 1/4-5A, 24 v, dc, 4-5A, 32 v, ac, 32 v, dc.  
 Cat. No. ETE, 0.080-6.3A, 250 v, ac.

579980001

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A not-for-profit organization  
 dedicated to public safety and  
 committed to quality service

#### 7.1.1 Marking: The UL Recognition symbol appears on the label affixed to the packaging container.

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## 7.2 CSA Certification Record



# CERTIFICATION RECORD

The company named below has been authorized by CSA to represent the products listed in this record as "CSA Certified" and to affix the CSA Mark to these products according to the terms and conditions of the CSA Service Agreement and applicable CSA program requirements (including additional Markings).

File No: 053787 C 000

Class No: 1422 30 FUSES Supplemental Fuses - Component Acceptance

### SUBMITTOR

4500672 Bussmann Division  
Cooper Industries, Incorporated  
St. Louis, MO 63178-4460  
USA

### FACTORY

4502401 Bussmann Division  
Cooper Industries, Incorporated  
114 Old State Rd.  
Ellisville, MO 63021-5942  
USA

February 26, 1999(Replaces:August 21, 1998)

- 1608FF, 250mA-4.0A, 24V dc, IR24-35A.
- JNXXL, 0-60A, 300V ac max, IR-300-200KA.
- TPA, 3-50A, 170V dc max, IR170-100kA.
- TPA-B 20, WP-92955L7, 20A, 65V dc max, IR65-20kA.
- TPA-B25, WP-92955L8, 25A, 65V dc max, IR65-20kA.
- TPN or WP9246121-229, 1-600A, 170V dc max; IR170-100kA.
- TPL-B followed by A, B, D, F, H, K or L, 70, 80, 100, 150, 200, 225 and 250A, 170V ac/dc max, IR170-100kA.
- TPL-C followed by N, R, V or Z, 300, 400, 500 and 600A, TPL-CHZ 800, 800A, 170V ac/dc max, IR170-100kA.
- TPS 1L to -30L, 1-30A, 170V dc max, IR170-100kA.
- TPS 0 to 70, or WP2461L100 to L111, 0-70A, 170V dc max, IR170-100kA.
- TPS-50v, 50A, 170V dc max, IR170-100kA.
- ABC, ABC-V and GLW, 18A, 250V ac max, IR250-400A.
- ABC, ABC-V and GLW, 20A, 250V ac max, IR250-400A.
- ABC, ABC-V and GLW, 25A, 30A, 125V ac max, IR 125-1000A.
- AGC-V, 11-30A, 32V and less, IR-32-10kA.
- Micro fuse, SFT, 0-1/8A, 125V ac/dc and less, IR125V ac-50A, IR125V dc-300A.
- Micro fuse, MCR, 0-1/8A, 125V ac/dc and less, IR 125V ac-50A, IR125V dc-300A.
- Micro fuse, 3216FF, 0-1A, 4-6.5A, 32V ac/63V dc and less, IR32V-50A, IR63V-50A.

DQD No. 548 99/04/08

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7.2.1 Marking: The CSA symbol appears on the label affixed to the packaging.

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## 8. MARKING SPECIFICATION

8.1 Ampere rating to be marked on the ceramic (white) side in ink. Glass (green) side to be unmarked.

### 8.1.1 Table of fuse markings

Catalog Symbol	Marking
3216FF-250mA	.25
3216FF-375mA	E
3216FF-500mA	.5
3216FF-750mA	.75
3216FF-1A	1
3216FF-1.25A	▲
3216FF-1.5A	1.5
3216FF-2A	2
3216FF-2.5A	2.5
3216FF-3A	3
3216FF-4A	4
3216FF-4.5A	4.5
3216FF-5A	5
3216FF-6.5A	6.5
3216FF-7A	7

### 8.1.2 Example of 2A fuse



## 9. SOLDERING METHOD

### 9.1 Wave Solder

9.1.1 Reservoir Temperature: 260°C (500°F)

9.1.2 Time in Reservoir: 10 Seconds Maximum

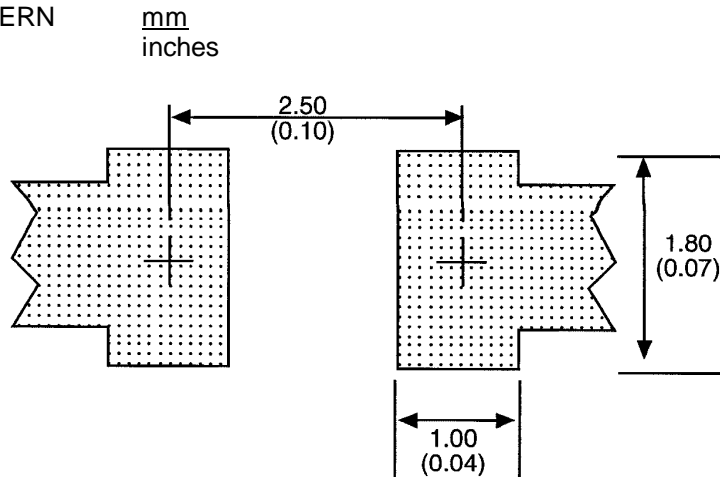
### 9.2 Infrared Reflow

9.2.1 Temperature: 260°C (500°F)

9.2.2 Time: 30 Seconds Maximum

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10. LAND PATTERN

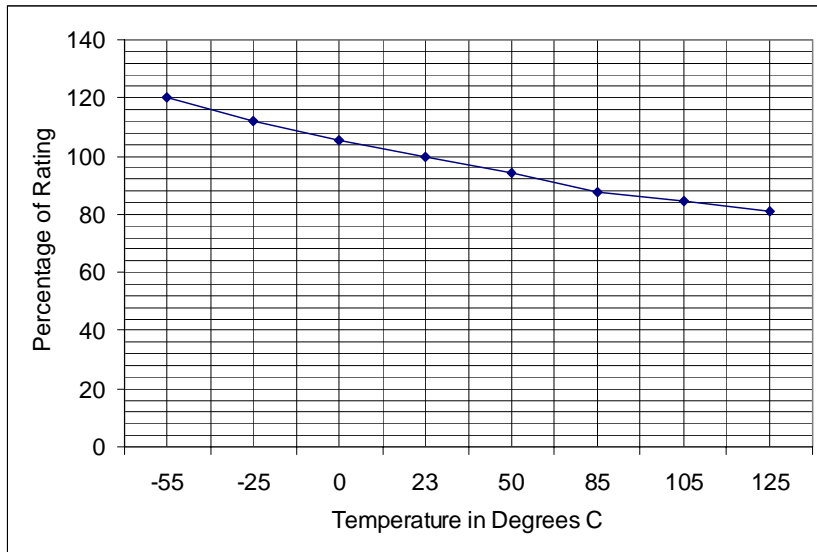


11. TEMPERATURE DERATING CURVE

11.1 Normal Ambient Temperature:  $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$  ( $74^{\circ}\text{F} \pm 3.6^{\circ}\text{F}$ )

11.2 Operating Temperature:  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ , with proper correction factor applied

11.2.1 Chart of correction factor



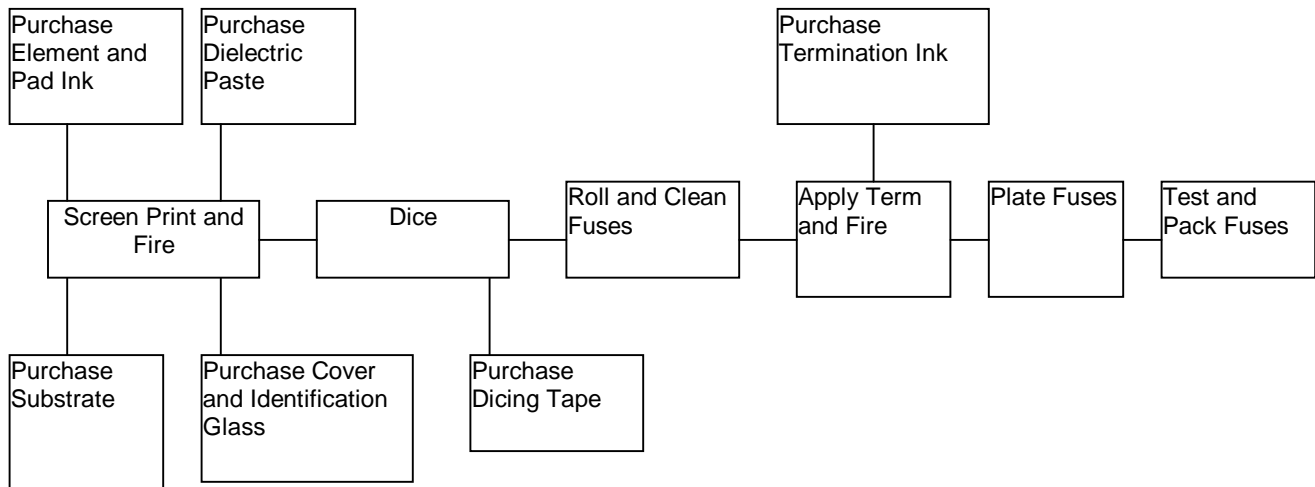
11.3 Storage Temperature:  $-55^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  ( $-67^{\circ}\text{F}$  to  $257^{\circ}\text{F}$ )

This bulletin is intended to clearly present comprehensive product data and provide technical information that will help the end user with design applications. Bussmann reserves the right, without notice, to change design or construction of any products and to discontinue or limit distribution of any products. Bussmann also reserves the right to change or update, without notice, any technical information contained in this bulletin. Once a product has been selected, it should be tested by the user in all possible applications

## 12. PACKAGING SPECIFICATION

- 12.1 SP: 50 pieces of fuses on 8mm tape packaged in a plastic box per EIA Standard RS481
- 12.2 TR: 3,000 pieces of fuses on 8mm tape and reeled on a 7 inch (178mm) reel per EIA Standard RS481
- 12.3 The fuses are orientated in embossed pockets with the ceramic (white) side facing up to facilitate proper mounting. It is recommended that fuses be mounted with the ceramic (white) side facing up.

## 13. PROCESS FLOW CHART



## 14. ENVIRONMENTAL (RELIABILITY/QUALIFICATION) DATA

- 14.1 Thermal Shock:  
MIL-STD-202, Method 107, Test Condition B (-65°C to 125°C)
- 14.2 Vibration:  
MIL-STD-202, Method 204, Test Condition C (55 to 2000 Hz, 10G)
- 14.3 Moisture Resistance:  
MIL-STD-202, Method 106, 10 day cycle
- 14.4 Solderability:  
ANSI/J-STD-002, Test B

15. End