

Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from, Europe, America and south Asia, supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of "Quality Parts, Customers Priority, Honest Operation, and Considerate Service", our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip, ALPS, ROHM, Xilinx, Pulse, ON, Everlight and Freescale. Main products comprise IC, Modules, Potentiometer, IC Socket, Relay, Connector. Our parts cover such applications as commercial, industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



# Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China









# **Engineering Product Specification**

3216FF

- The information contained in this document is the property of Cooper Industries, Inc. It is not for public disclosure. Possession of the information
does not convey any right to loan, sell or disclose the CONFIDENTIAL information. Unauthorized reproduction or use of the information is
prohibited. This document is to be returned to Cooper Industries, Inc. Upon completion of the purposes for which it is loaned or upon request.

REV.#	Revision Description	Date	Author	Appr.
F	Add –R option (for RoHS Compliant version) and China mfg location	11/2/04	MJ	MJ
Е	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
С	Add 1.25A and 1.75A device.	6/08/01	DB	RS
В	Update TCC to show 7A device.	5/8/01	VK	DB
Α	Original	8/28/00	DG	DB

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 2 of 15

### **Table of Contents**

Section	Title	Page
1.	Scope	3
2.	General	3
3.	Manufacturer and Production Facility	3
4.	Catalog Symbol and Part Numbering System	4
5.	Mechanical Specifications	4
6.	Electrical Specifications	7
7.	Standards and Agency Information	11
8.	Marking Specification	13
9.	Soldering Method	13
10.	Land Pattern	14
11.	Temperature Derating Curve	14
12.	Packaging Specification	15
13.	Process Flow Chart	15
14.	Environmental (Reliability / Qualification) Data	15
15.	End	15

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 3 of 15

#### 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

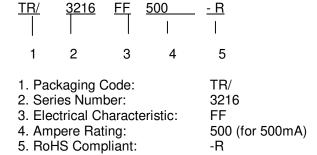
a) ISO 9002 File Number A4916b) ISO 9002, Certificate No. Q2273

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 4 of 15

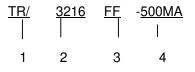
### 4. CATALOG SYMBOL AND PART NUMBERING SYSTEM

### 4.1 Catalog Symbol

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



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



Packaging Code: TR/
 Series Number: 3216
 Electrical Characteristic: FF
 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

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 5 of 15

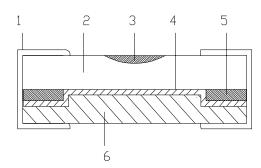
Catalog Symbol	Characteristic
FF	Fast Acting

### 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)



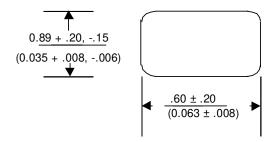
- 1. End termination
  - a. Nickel Underplate 200 to 400 microinches
  - b. Either:
    - i. SnPb Plate: 300-600 microinches (87% Sn) or
    - ii. 100% Sn Plate (if -R): 300-600 microinches
- 2. Ceramic substrate (white)
- 3. Numeric ampere marking
- 4. Metal film fusible element
  - 5. Silver termination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

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 6 of 15

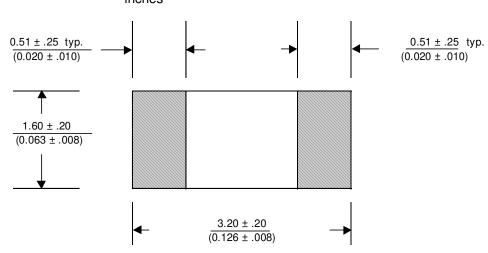
#### 5.2 Dimensions

(Drawings not to scale)

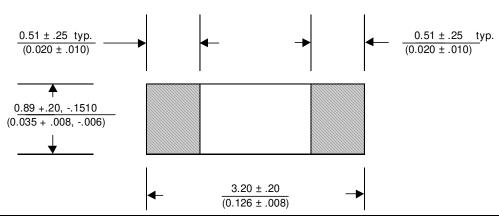
# 5.2.1 End View <u>mm</u> inches



# 5.2.2 Top View <u>mm</u> inches



# 5.2.3 Side View <u>mm</u> inches



Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 7 of 15

#### 6. ELECTRICAL SPECIFICATIONS

## 6.1 Voltage Rating

	Voltage Rating	
Catalog Symbol	(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)

	Interrupting
Catalog Symbol	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

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 8 of 15

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)

	Resistance (ohms)	Resistance (ohms)	Resistance (ohms)
Catalog Symbol	Typ.	Min.*	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

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

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 9 of 15

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

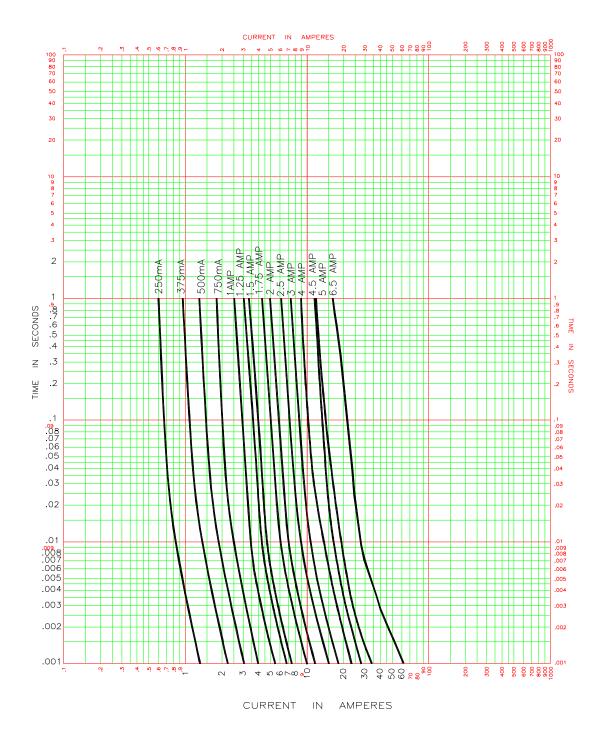
Catalog Symbol	Typical Melt I <sup>2</sup> t	
	AC	DC
3216FF-250mA	0.00016	0.000084
3216FF-375mA	0.001	0.0002
3216FF-500mA	0.0014	0.0019
3216FF-750mA	0.0033	0.00095
3216FF-1A	0.012	0.007
3216FF-1.25A	0.035	0.022
3216FF-1.5A	0.047	0.029
3216FF-2A	0.116	0.081
3216FF-2.5A	0.206	0.171
3216FF-3A	0.426	0.359
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)

	Typical Voltage
Catalog Symbol	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

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 10 of 15

#### 6.7 Time Current Curve Average Melting



Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 11 of 15

#### 7. STANDARDS AND AGENCY INFORMATION

7.1 UL Card

Metalle, New York • (516) 271-6200 Santa Ciara California • (408) 985-2400 Research Trangle Park North Carolina • (919) 549-1400 Camas, Washington • (360) 817-5500

Northbrook Illinois • (847) 272-8800

# (UL) Underwriters Laboratories Inc. 🖪

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

579980001

#### 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

A not-for-profit organization

dedicated to public safety and committed to quality service

```
PO BOX 14460, ST LOUIS MO 63178

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, 05-2.5 A, 250 v. ac, 450 v. dc; Cat. Nos. PCB, PCC, PCF, PCH, FCK, 2.6-3 A, 250 v. ac, 350 v. dc;
Cat. Nos. PCD, PCE, PCI, 05-2.5 A, 125 v. ac, 450 v. dc; Cat. Nos. PCD, PCE, PCI, 2.6-3 A, 125 v. ac, 350 v. dc; Cat. Nos. PCD, PCE, PCI, 3.1-5 A, 125 v. ac, 250 v. dc; Cat. No. PCI, 1 A, 250 v. ac, 750 v. dc.
Cat. No. DO.35, 250 m.4-35 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. 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. No. AGA, 5.1-12 A, 32 v.
Cat. No. BGC+, -18, 20 A, 250 v. 25, 30 A, 125 v., Cat. No. WP-91768L followed by 117-119 incl.
Cat. No. GIW+, 20 A, 250 v. 25, 30 A, 125 v.
Cat. No. MDU, 8.1-30 A, 32 v., Cat. No. MDV, 8.1-20 A, 32 v.
Cat. No. MDU, 8.1-30 A, 32 v., Cat. No. MDV, 8.1-20 A, 32 v.
Cat. No. AGS, 5.1-7 A, 125 v. 71-20 A, 32 v.
Cat. No. AGS, 5.1-7 A, 125 v., 71-20 A, 32 v.
Cat. No. AGS, 5.1-7 A, 125 v., 71-20 A, 32 v.
Cat. No. AGS, 5.1-7 A, 125 v., 71-20 A, 32 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 125/250 v. ac.
Cat. No. ABG, 20-30 A, 250 v., 25-30, 125 v.
Cat. No. ABG, 20-30 A, 125/250 v., 25-30, 125 v.
Cat. No. AB
```

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

Page 1 of 2

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 12 of 15

#### 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** 

**Bussmann** Division

4500672

Cooper Industries, Incorporated

St. Louis, MO 63178-4460

USA

**FACTORY** 

**Bussmann Division** 

4502401

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.
- JJNXXL, 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

Page 1

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

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 13 of 15

#### 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

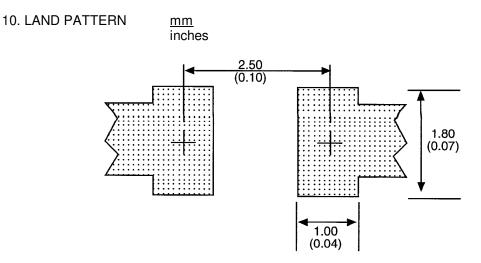
9.1 Wave Solder

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

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 14 of 15

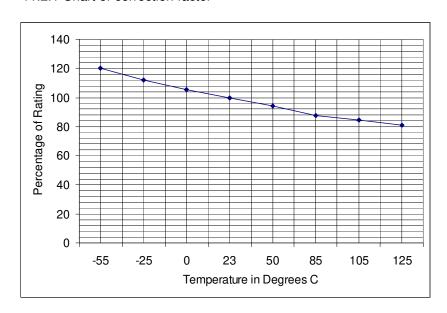


#### 11. TEMPERATURE DERATING CURVE

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

11.2 Operating Temperature: -55°C to 125°C, with proper correction factor applied

### 11.2.1 Chart of correction factor



### 11.3 Storage Temperature: -55°C to 125°C (-67°F to 257°F)

Title Engineering Product Specification 3216FF	Revision: F
Printed on: 11/10/04	Sheet 15 of 15

#### 12. PACKAGING SPECIFICATION

12.1 SP: 50 pieces of fuses on 8mm tape packaged in a plastic box per EIA

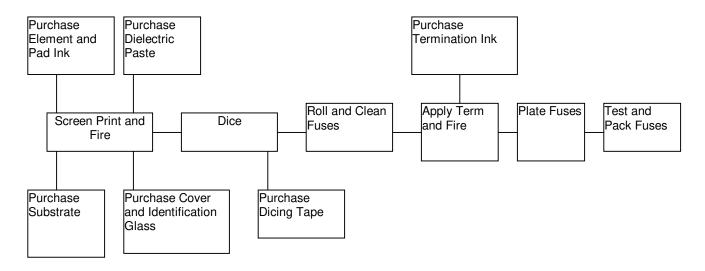
Standard RS481

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