

EIA STANDARD

EIA RS-401

*Paper, Paper/Film,
Film Dielectric Capacitors
for Power Semiconductor
Applications*

RS-401



March 1973

Engineering Department

ELECTRONIC INDUSTRIES ASSOCIATION

NOTICE

EIA engineering standards are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such standards shall not in any respect preclude any member or non-member of EIA from manufacturing or selling products not conforming to such standards, nor shall the existence of such standards preclude their voluntary use by those other than EIA members whether the standard is to be used either domestically or internationally.

Recommended standards are adopted by EIA without regard to whether or not their adoption may involve patents on articles, materials, or processes. By such action, EIA does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the recommended standards.

Published by

ELECTRONIC INDUSTRIES ASSOCIATION

Engineering Department

2001 Eye Street, N. W., Washington, D. C. 20006

©Electronic Industries Association 1973

All rights reserved

Price \$5.20

Printed in U.S.A.

PAPER, PAPER/FILM, FILM DIELECTRIC CAPACITORS FOR POWER SEMICONDUCTOR APPLICATIONS

*(From Standards Proposal No. 1120, formulated under the cognizance of EIA Working Group
P-2.2 on Film, Paper and Plastic Dielectric Capacitors)*

TABLE OF CONTENTS

	REFERENCE	PAGE
Scope	Paragraph 1	3
Definitions	" 2	3
Standard Designation	" 3	4, 5, 6
Applicable Documents	" 4	6
Standard Test Conditions	" 5	6
Test Program	" 6	6, 7
Mechanical Inspection	" 7	8
Marking	" 8	8
Dielectric Withstanding Voltage	" 9	8
Capacitance	" 10	8
Dissipation Factor	" 11	8, 9
Seal Test	" 12	9
Heat Rise	" 13	9
Vibration	" 14	9

	REFERENCE	PAGE
Salt Spray	Paragraph 15	9
Terminal Strength	" 16	9, 10
Humidity	" 17	10
Capacitance Change With Temperature	" 18	10
High Temperature Life Test	" 19	10, 11
Application Notes	" 20	11, 12
Appendices Index		13
Appendix 1 Derating Curves		14, 15, 16
Appendix 2 Parts List		17
Appendix 3 Terminals & Ground Lugs		18
Appendix 4 Case & Bracket Detail		19, 20, 21
Appendix 5 Application Data Information Sheet		22
Appendix 6 Description of Waveform Conditions		23, 24
Index		25, 26

1. SCOPE

This standard covers the requirements for paper, paper and film, and film dielectric; oil impregnated; extended foil electrode capacitors, hermetically sealed in metal cases, for general purpose application in power semiconductor circuits. These capacitors are intended for such uses as SCR commutating, snubbers, harmonic filters, EMI/RFI suppression, in motor speed controls, static power supplies, frequency changers, and similar applications.

2. DEFINITIONS

- 2.1 **Effective Voltage** is the voltage used to determine the effective volt-amperes. This voltage is the rms value calculated only during those portions of the total period that the voltage is changing. See Appendix 6, Page 23.
- 2.2 **60-Hz rms Voltage Reference** is the nominal continuous 60-Hz sinewave voltage that may be applied between the capacitor terminals. This rating is primarily intended as a reference value for capacitor design and testing, but excluding temperature-rise testing.
- 2.3 **Peak Voltage Rating** is the maximum voltage change (plus or minus) from zero reference applied between the capacitor terminals. Zero reference is the condition where there is no potential across the terminals of the capacitor. See Appendix 6, Page 23.
- 2.4 **Peak-Peak Voltage** is the maximum total change in voltage applied between the capacitor terminals during one repetitive cycle. See Appendix 6, Page 23.
- 2.5 **Rms Current** is the root-mean-square or effective current and is the value used to determine the effective volt-amperes. See Appendix 6, Page 23.
- 2.6 **Peak Current** is the maximum amplitude of current which occurs repetitively in charging or discharging a capacitor. See Appendix 6, Page 23.
- 2.7 **Current Pulse Width** is the time of current flow in microseconds during the charge or discharge of capacitors. See Appendix 6, Page 23.
- 2.8 **Volt-Amperes** is the product of the effective voltage and effective current applied to a capacitor. This value provides a means of calculating the watts loss and temperature rise of a capacitor. See Appendix 6, Page 23.
- 2.9 **Rise Time** is the time in microseconds required to charge a capacitor from 10% to 90% of the maximum change in voltage (ΔV) applied between the capacitor terminals during one repetitive cycle. See Appendix 6, Page 24.
- 2.10 **Case Temperature Rating** is the maximum allowable hot spot temperature developed at any point on the case surface. (See Paragraph 20.4.)

3. STANDARD DESIGNATION

3.1 E.I.A. standard designation shall consist of 8 constituent parts as illustrated below:

A 0 2 B 1 0 6 P 0 6 K (G)

A	02	B	106	P	06	K	G
Case	Peak Voltage	Characteristic	Capacitance	Finish	Terminal	Capacitance Tolerance	Ground Lug (optional)

3.2 Case type shall be identified by a single letter. All cases shall be of the deep drawn or extruded construction with double rolled cover seams.

NOMINAL DIMENSION OVER SEAM COVER

Case Type	Inches	Millimeters	Configuration
A	2.16 x 1.31	54.8 x 33.4	1-1/4 (Flat Oval)
B	2.69 x 1.56	68.3 x 39.7	1-1/2 (Flat Oval)
C	2.91 x 1.91	73.8 x 48.4	1-3/4 (Flat Oval)
D	3.66 x 1.97	92.9 x 50.3	2 (Flat Oval)
E	4.56 x 2.84	115.8 x 72.3	2-7/8 x 4-9/16 (Rect.)
F	4.56 x 3.75	115.8 x 95.3	Rectangular

3.3 Continuous voltage rating shall be identified by two digits according to the table listed below:

Code	Rated Peak Voltage	Reference rms Volts AC 60-Hz
02	200	120
03	300	200
04	400	260
06	600	400
10	1000	500
15	1500	700
20	2000	800

- 3.4 Characteristic shall be identified by a single letter to denote the rated case temperature range of the capacitor as shown below:

Characteristic	Case Temp. Range	Max. Cap. Change	Max. D.F. at 60Hz at 25°C
A	-40°C to + 80°C	±3%	.1%
B	-40°C to + 80°C	±3%	.4%
C	-30°C to + 80°C	±5%	.1%
D	-30°C to + 80°C	±5%	.4%
E	-30°C to + 80°C	±7%	.1%

Storage Temperature -55°C to +90°C

- 3.5 Capacitance value in picofarads shall be identified by a three digit number; the first two digits represents significant figures and the last digit specifies the number of zeros to follow.

Example:

1 0 6

1 0, 0 0 0, 0 0 0 p F or 10 μ F

- 3.6 Finish shall be identified by a single letter as shown below:

Code Letter	Type of Finish
P	Underwriters' Laboratories Recognized Paint
R	Non-U.L. Paint

- 3.7 Terminals shall be identified by a two digit code as shown below:

Code	Terminal Type
06	Pillar insulator 10-32 screw
07	Pillar insulator 12-24 screw
08	Pillar insulator 1/4-20 screw
09	Pillar insulator 5/16-18 screw
10	Pillar insulator 3/8-16 screw



3.8 Capacitance tolerance shall be identified by a single letter as shown below:

Code Letter	Capacitance Tolerance
H	$\pm 6\%$
K	$\pm 10\%$

3.9 Optional ground lug shall be identified by the letter "G". See Appendix 3, Page 18.

4. APPLICABLE DOCUMENTS

The latest revisions of the following standards, when specified, form part of this document.

- (a) E.I.A. Standard RS-186, Standard Test Methods for Electronic Component Parts.
- (b) Bulletin E.I.A. Source Code and Date Code.

E.I.A. publications may be obtained from Electronic Industries Association, 2001 Eye Street, N.W., Washington, D.C. 20006

5. STANDARD TEST CONDITIONS

- 5.1 Standard atmospheric conditions under which tests are to be conducted or to which referred shall be as shown below unless otherwise specified.

Temperature: 20°C to 35°C (referred to 25°C values)

Barometric Pressure: 28 to 32 inches of mercury

Relative Humidity: Less than 80%

- 5.2 Standard test frequency is at 60-Hz. Measurements of capacitance and D.F. at other frequencies shall be referred to 60-Hz.

6. TEST PROGRAM

- 6.1 Suggested order of tests is shown in Table 1. No sample shall be subjected to more than one group of tests in Group 2, Group 3 or Group 4.
- 6.2 The quantities to be submitted to the tests in Groups 2, 3, and 4 and allowable failures shall be determined by agreement between the supplier and the user. The frequency of testing is to be negotiated between supplier and user.

SUGGESTED TEST PROGRAM

TABLE 1

<u>GROUP 1</u>	<u>Requirements</u>
Mechanical Inspection	Paragraph 7
Marking	Paragraph 8
Dielectric Withstanding Voltage	Paragraph 9
Capacitance	Paragraph 10
Dissipation Factor	Paragraph 11
Seal	Paragraph 12
*Heat Rise	Paragraph 13
 <u>GROUP 2</u>	
Vibration	Paragraph 14
Salt Spray	Paragraph 15
 <u>GROUP 3</u>	
Terminal Strength	Paragraph 16
Humidity	Paragraph 17
 <u>GROUP 4</u>	
Capacitance Change With Temperature	Paragraph 18
High Temperature Life Test	Paragraph 19
*Heat Rise is design proof test to be conducted by equipment manufacturer.	