RESISTOR, FIXED, CHIP, THICK FILM

BASED ON TYPE CHP

ESCC Detail Specification No. 4001/026

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DCR No.	CHANGE DESCRIPTION

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1. GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics, test and inspection data for a Resistor, Fixed, Chip, Thick Film based on type CHP. It shall be read in conjunction with ESCC Generic Specification No. 4001, the requirements of which are supplemented herein.

1.2 COMPONENT TYPE VARIANTS AND RANGE OF COMPONENTS

Variants of the basic type components and the range of components covered by this specification are given in Table 1(a).

1.3 MAXIMUM RATINGS

The maximum ratings, which shall not be exceeded at any time during use or storage, applicable to the components specified herein, are as scheduled in Table 1(b).

1.4 PARAMETER DERATING INFORMATION

The parameter derating information applicable to the components specified herein is shown in Figure 1.

1.5 PHYSICAL DIMENSIONS

The physical dimensions of the components specified herein are shown in Figure 2.

1.6 FUNCTIONAL DIAGRAM

The functional diagram of the components specified herein is shown in Figure 3.

2. APPLICABLE DOCUMENTS

The following documents form part of this specification and shall be read in conjunction with it:

(a) ESCC Generic Specification No. 4001 for Resistors, Fixed Film.

3. TERMS, DEFINITIONS, ABBREVIATIONS, SYMBOLS AND UNITS

For the purpose of this specification, the terms, definitions, abbreviations, symbols and units specified in ESCC Basic specification No. 21300 shall apply.

Table 1(a) - TYPE VARIANTS AND RANGE OF COMPONENTS

Variant	Style (Note 1)	Resistance Range R_n (Note 2)		Tolerance (± %) (Note 2)	Temperature Coefficient TC ($\pm 10^{-6}/^{o}C$) (Note 2)	Critical Resistance (kΩ)	Weight max (g)
		Min (Ω)	Max (MΩ)				
01	0603	1	10	1, 2, 5	100, 200	25	0.002
02	0805	1	10	1, 2, 5	100, 200	50	0.004
03	1206	1	10	1, 2, 5	100, 200	160	0.008
04	2010	1	10	1, 2, 5	100, 200	180	0.026

Variant	Style (Note 1)	Resistance Range R_n (Note 2)		Tolerance (± %) (Note 2)	Temperature Coefficient TC ($\pm 10^{-6}/^{o}C$) (Note 2)	Critical Resistance (kΩ)	Weight max (g)
		Min (Ω)	Max (MΩ)				
05	2512	1	10	1, 2, 5	100, 200	112	0.042

NOTES:

1. See Figure 2
2.

Resistance (Ω)	Value Series	Available Tolerance (±%)	Available Temperature Coefficient ($\pm 10^{-6}/^{o}C$)
$1 \leq R_n < 10$	Any value in the resistance range to 3 significant figures	2, 5	200
$10 \leq R_n < 1M$		1, 2, 5	100, 200
$R_n \geq 1M$		2, 5	200

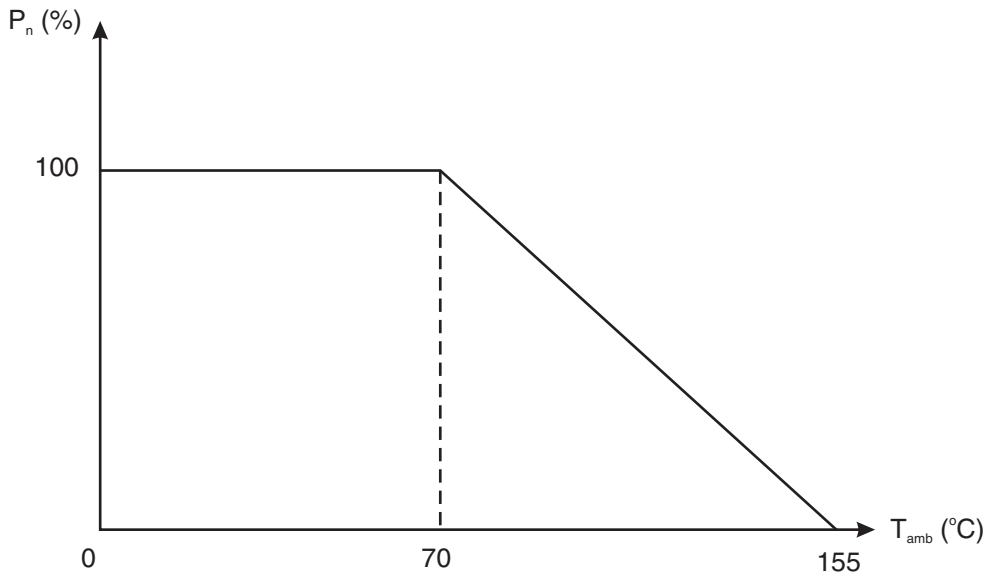
Table 1(b) - MAXIMUM RATINGS

No.	Characteristics	Variant	Style	Symbol	Maximum Rating	Unit	Remarks
1	Rated Dissipation	01 02 03 04 05	0603 0805 1216 2010 2512	P_n	0.1 0.2 0.25 0.5 0.8	W	Note 1
2	Limiting Element Voltage	01 02 03 04 05	0603 0805 1206 2010 2512	U_L	50 100 200 300 300	V	-
3	Rated Voltage	All	All	U_R	$\sqrt{(P_n \times R_n)}$	V	Note 2
4	Insulation Voltage	01 02 03 04 05	0603 0805 1206 2010 2512	U_i	100 200 300 300 300	V	-
5	Operating Temperature Range	All	All	T_{op}	-55 to +155	^{o}C	T_{amb}
6	Storage Temperature Range	All	All	T_{stg}	-55 to +155	^{o}C	-
7	Soldering Temperature	All	All	T_{sol}	+260	^{o}C	Note 3

NOTES:

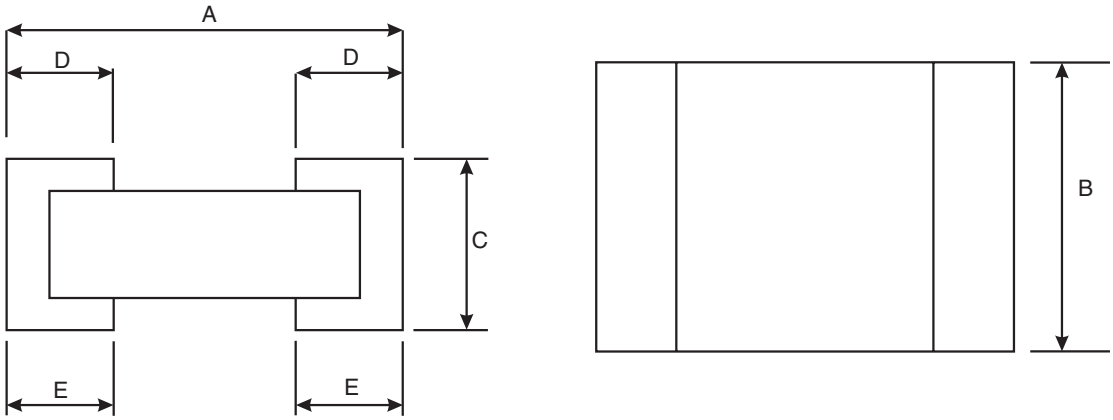
1. At $T_{amb} \leq +70^{o}C$. For derating at $T_{amb} > +70^{o}C$, see Figure 1.
2. Shall never exceed Limiting Element Voltage. R_n = rated resistance.
3. Duration 10 seconds maximum.

FIGURE 1- PARAMETER DERATING INFORMATION



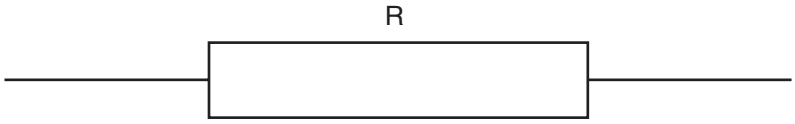
Rated Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS



Variant	Style	Dimensions (mm)							
		A		B		C		D, E	
		Min	Max	Min	Max	Min	Max	Min	Max
01	0603	1.36	1.68	0.72	0.98	0.38	0.53	0.25	0.51
02	0805	1.75	2.07	1.14	1.4	0.38	0.53	0.25	0.51
03	1206	2.89	3.21	1.47	1.73	0.38	0.53	0.25	0.51
04	2010	4.92	5.24	2.41	2.67	0.5	0.63	0.25	0.64
05	2512	6.19	6.51	2.93	3.32	0.5	0.63	0.25	0.64

FIGURE 3 - FUNCTIONAL DIAGRAM



4. REQUIREMENTS

4.1 GENERAL

The complete requirements for procurement of the components specified herein are stated in this specification and ESCC Generic Specification No. 4001. Deviations from the Generic Specification, applicable to this specification only, are detailed in Para. 4.2.

Deviations from the Generic Specification and this Detail Specification, formally agreed with specific Manufacturers on the basis that the alternative requirements are equivalent to the ESCC requirements and do not affect the components' reliability, are listed in the appendices attached to this specification.

4.2 DEVIATIONS FROM GENERIC SPECIFICATION

4.2.1 Deviations from Special In-process Controls

None.

4.2.2 Deviations from Final Production Tests (Chart II)

(a) Para. 9.1, Overload: Voltage $\sqrt{(6.25P_n \times R_n)}$ or $2U_L$, whichever is less.
Duration: 2 seconds minimum.
(b) Para. 9.2, Third Harmonic Control or Current Noise: Not Applicable.

4.2.3 Deviations from Burn-in and Electrical Measurements (Chart III)

None.

4.2.4 Deviations from Qualification Tests (Chart IV)

(a) Para. 9.1, Overload: Test conditions as Para. 4.2.2 (a)
(b) Para. 9.13, Vibration: Not applicable

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

(a) Para. 9.13, Vibration: Not applicable

4.3 MECHANICAL REQUIREMENTS

4.3.1 Dimension Check

The dimensions of the components specified herein shall be verified in accordance with the requirements set out in Para. 9.4 of ESCC Generic Specification No. 4001 and they shall conform to those shown in Figure 2 of this specification.

4.3.2 Weight

The maximum weight of the components specified herein shall be as given in Table 1(a).

4.3.3 Robustness of Terminations

The requirements for the robustness of terminations tests are specified in Para. 9.10.2 of ESCC Generic Specification No. 4001. The test conditions for Bend Strength of the End Face Plating shall be as follows:

Number of bends	: 10
Deflection	: 2mm (Variants 01, 02, 03)
	:1mm (Variants 04, 05)
Duration	: 5 ± 1s

4.4 MATERIALS AND FINISHES

The materials and finishes shall be as specified herein. Where a definite material is not specified, a material which will enable the components specified herein to meet the performance requirements of this specification shall be used. Acceptance or approval of any constituent material does not guarantee acceptance of the finished product.

4.4.1 Case

The alumina substrate shall be covered with a suitable coating.

4.4.2 Terminations

The terminal material shall be Type "E" with Type '4' finish in accordance with the requirements of ESCC Basic Specification No. 23500.

4.5 MARKING

4.5.1 General

The marking of all components delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and the following paragraphs. When the component is too small to accommodate all of the marking specified, as much as space permits shall be marked and the marking information, in full, shall accompany each component in its primary package.

The information to be marked and the order of precedence, shall be as follows:

(a) Electrical Characteristics and Ratings
(b) The ESCC Component Number.
(c) Traceability Information

4.5.2 Electrical Characteristics and Ratings

The electrical characteristics and ratings to be marked in the following order of precedence are:

(a) Resistance Value (R_n)
(b) Tolerance
(c) Temperature Coefficient

The information shall be constituted and marked as follows:

Example: 2490F4

- Resistance Value (249Ω): 2490
- Tolerance (±1%): F
- Temperature Coefficient (100 x 10^{-6}/ºC): 4

4.5.2.1 Resistance Value

The resistance value shall be expressed by means of the following codes. The unit quantity for marking shall be Ohms (Ω).

Resistance Value (Ω)	Code
X.XX	XRXX
XX.X	XXRX
XXX	XXX0
XXX 10^1	XXX1
XXX 10^2	XXX2
XXX 10^3	XXX3
XXX 10^4	XXX4
XXX 10^5	XXX5

For values of less than 100Ω the letter "R" is used to indicate the decimal point. When R is used all successive digits represent significant figures. For values of 100Ω and above the first 3 digits (X) represent significant figures and the last digit specifies the number of zeros to follow.

4.5.2.2 Tolerance

The tolerance on resistance value shall be indicated by the code letters specified hereafter.

Tolerance (±%)	Code Letter
1	F
2	G
5	J

4.5.2.3 Temperature Coefficient

The temperature coefficient shall be indicated by the numerical code specified hereafter.

Temperature Coefficient (± 10^{-6}/ºC)	Code
100	4
200	6

4.5.3 ESCC Component Number

The ESCC Component Number shall be constituted and marked as follows:

Example : 4001xxx01B

- Detail Specification Reference : 4001xxx
- Component Type Variant Number : 01 (as required)
- Testing Level (B or C, as applicable)

4.5.4 Traceability Information

Each component shall be marked in respect of traceability information in accordance with the requirements of ESCC Basic Specification No. 21700.

4.6 ELECTRICAL MEASUREMENTS

4.6.1 Electrical Measurements at Room Temperature

The parameters to be measured at room temperature are scheduled in Table 2. Unless otherwise specified, measurements shall be performed at T_{amb}=+22±3°C.

4.6.2 Electrical Measurements at High and Low Temperatures

The parameters to be measured at high and low temperatures are scheduled in Table 3.

The distribution of the sample shall be as follows:

– 1/3 with lowest resistance value
– 1/3 with highest resistance value
– 1/3 with median resistance value or the critical resistance value if procured

of the procured range.

4.6.3 Circuits for Electrical Measurements (Figure 4)

Not applicable.

4.7 BURN-IN TESTS

4.7.1 Parameter Drift Values

The parameter drift values applicable to Burn-in are as specified in Table 4 of this specification. Unless otherwise stated, measurements shall be performed at T_{amb}=+22±3°C. The parameter drift values (Δ) applicable to the parameters scheduled shall not be exceeded. In addition to these drift value requirements for a given parameter, the appropriate limit values specified in Table 2 shall not be exceeded.

4.7.2 Conditions for Burn-in

The requirements for Burn-in are specified in Section 7 of ESCC Generic Specification No. 4001. The conditions for Burn-in shall be as specified in Table 5 of this specification.

After 168 (+12 -0) hours, the resistors shall be removed from the chamber and allowed to cool under normal atmospheric conditions for a minimum of 4 hours. They shall then be visually examined. There shall be no evidence of damage and marking shall still be legible.

4.7.3 Electrical Circuit for Burn-in

The circuit for use in performing the burn-in test is shown in Figure 5 of this specification.

Table 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

No.	Characteristics	Symbol	ESCC 4001 Test Method	Test Conditions	Tolerance (± %)	Limits		Unit
						Min	Max	
1	Resistance	R_A	Para. 9.5.1	Para. 9.5.1	1	0.99 R_n	1.01 R_n	Ω
					2	0.98 R_n	1.02 R_n	
					5	0.95 R_n	1.05 R_n	

Table 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

No.	Characteristics	Symbol	ESCC 4001 Test Method	Test Conditions (Note 1)	Limits		Unit
					Min	Max	
2	Resistance change between -55 (+3-0)°C and +22 ± 3°C	$\Delta R_A/R_A$	Para. 9.5.1	Para. 9.5.1 TC = ±100 x 10^{-6}/°C TC = ±200 x 10^{-6}/°C	 -0.8 -1.6	 +0.8 +1.6	%
3	Resistance change between +155 (+0 -3)°C and +22 ± 3°C	$\Delta R_A/R_A$	Para. 9.5.1	Para. 9.5.1 TC = ±100 x 10^{-6}/°C TC = ±200 x 10^{-6}/°C	 -1.36 -2.72	 +1.36 +2.72	%

NOTES:

1. The measurements shall be performed on a sample basis in accordance with special inspection Level S-3, Table IIA, AQL = 1% of IEC Publication No. 60410 on the total production lot. In addition, see Para. 4.6.2 for distribution of the sample.

FIGURE 4 - CIRCUITS FOR ELECTRICAL MEASUREMENTS

Not applicable.

Table 4 - PARAMETER DRIFT VALUES

No.	Characteristics	Symbol	Spec. and/or Test Method	Test Conditions	Change Limits (Δ)	Unit
1	Resistance Change	$\Delta R_A/R_A$	As per Table 2	As per Table 2	±0.5 or (1) ±0.05	% Ω

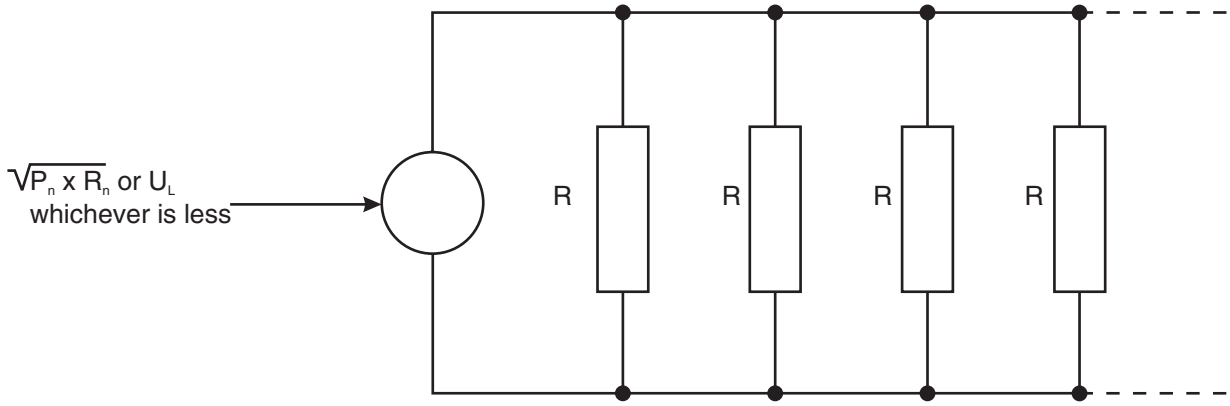
NOTES:

1. Whichever is greater.

Table 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE

No.	Characteristics	Symbol	Condition	Unit
1	Ambient Temperature	T_{amb}	+70 ±3	°C
2	Test Voltage	V_T	$\sqrt{(P_n \times R_n)}$ or U_L whichever is less	V

FIGURE 5 - ELECTRICAL CIRCUIT FOR BURN-IN AND OPERATING LIFE



4.8 ENVIRONMENTAL AND ENDURANCE TESTS (CHARTS IV AND V OF ESCC GENERIC SPECIFICATION NO. 4001)

The resistors shall be mounted as prescribed in ESCC Generic Specification No. 4001, Para. 9.20. The substrate material shall be glass polyimide, except for high and low temperature measurements where alumina is required.

4.8.1 Measurements and Inspections on Completion of Environmental Tests

The parameters to be measured and inspections to be performed on completion of environmental tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at T_{amb}=+22±3°C.

4.8.2 Measurements and Inspections at Intermediate Points During Endurance Tests

The parameters to be measured and inspections to be performed at intermediate points during endurance tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at T_{amb}=+22±3°C.

4.8.3 Measurements and Inspections on Completion of Endurance Tests

The parameters to be measured and inspections to be performed on completion of endurance tests are scheduled in Table 6. Unless otherwise stated, the measurements shall be performed at T_{amb}=+22±3°C.

4.8.4 Conditions for Operating Life

The requirements for operating life test are specified in Section 9 of ESCC Generic Specification No. 4001. The conditions for operating life testing shall be as specified in Table 5 of this specification.

4.8.5 Electrical Circuit for Operating Life (Figure 5)

The electrical circuit for use in performing the operating life test is shown in Figure 5 of this specification.

4.8.6 Conditions for High Temperature Storage Test (Part of Endurance Test)

The requirements for the high temperature storage test are specified in ESCC Generic Specification No. 4001. The conditions for high temperature storage shall be T_{amb} = +155 (+0 -5)°C.

Table 6 - MEASUREMENTS AND INSPECTIONS ON COMPLETION OF ENVIRONMENTAL TESTS AND AT INTERMEDIATE POINTS AND ON COMPLETION OF ENDURANCE TESTING

No.	ESCC Generic Spec. No. 4001		Measurements and Inspections		Symbol	Limits		Unit
	Environmental and Endurance Tests (Note 1)	Test Methods and Conditions	Identification	Conditions		Min	Max	
01	Overload	Para. 9.1 and Paras 4.2.2 and 4.2.4 of this spec.	Initial Measurements Chart IV Resistance Final Measurements	 Table 2 Item 1 After a recovery period of 1-2 hrs	 R_A	 Record Values		 Ω
			Visual Examination	No evidence of damage and marking legible	-	-		-
			Chart II Resistance	 Table 2 item 1	 R_A	 Table 2 Item 1		 Ω
			Chart IV Resistance Change	 Table 2 Item 1	 $\Delta R_A/R_A$	 Note 4		 %
02	Seal Test (Hermetically Sealed only)	Para. 9.3	Not applicable	-	-	-	-	-
03	Insulation Resistance (Insulated only)	Para. 9.6	Final Measurements Insulation Resistance	 Para. 9.6.2 of ESCC 4001 (Note 2)	 R_i	 1000	 -	 MΩ
04	Temperature Coefficient	Para. 9.7 Procedure I	Temperature Coefficient	Para. 9.5.1 of ESCC 4001	TC	-100 -200	+100 +200	10^{-6}/°C
05	Voltage Proof	Para. 9.8.2	During test	1.4 x U_i for 60 ± 5 sec, Note 3	-	-	-	-
			Visual Examination	No breakdown or flashover	-	-	-	-
06	Solderability	Para. 9.9	Initial Measurements Resistance Final Measurements	After Drying Table 2 item 1 24 ± 4hrs after soldering	 R_A	 Record Values		 Ω
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	Note 5		%
07	Robustness of Terminations	Para. 9.10.2	-	After Mounting				
		Adhesion	Initial Measurements Resistance	 Table 2 Item 1	 R_A	 Record Values		 Ω
			Final Measurements Resistance Change	 Table 2 Item 1	 $\Delta R_A/R_A$	 Note 5		 %
			Visual Examination	No damage, lifting, cracking or dry joints	-	-	-	-
		Bend Strength of End Plate Facing	Initial Measurements Resistance Final Measurements	 Table 2 Item 1 Board in bent position	 R_A	 Record Values		 Ω
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	Note 5		%
			Visual Examination	No damage, lifting, cracking or dry joints	-	-	-	-

No.	ESCC Generic Spec. No. 4001		Measurements and Inspections		Symbol	Limits		Unit
	Environmental and Endurance Tests (Note 1)	Test Methods and Conditions	Identification	Conditions		Min	Max	
08	Resistance to Soldering Heat	Para. 9.11 Procedure I	Initial Measurements Resistance	After Drying Table 2 Item 1	R_A	Record Values		Ω
			Final Measurements Visual Examination	No evidence of damage and marking legible	-	-		-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	Note 4		%
09	Rapid Change of Temperature	Para. 9.12	Initial Measurements Resistance	Table 2 item 1	R_A	Record Values		Ω
			Final Measurements Visual Examination	After a recovery period of 1-2 hrs No evidence of damage	-	-		-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	Note 5		%
10	Vibration	Para. 9.13 and Paras 4.2.4 and 4.2.5 of this spec.	Not applicable	-	-	-	-	-
11	Climatic Sequence	Para. 9.14 Procedure I	Initial Measurements Resistance	After Drying Table 2 Item 1	R_A	Record Values		Ω
			Final Measurements Visual Examination	Following completion of DC load test and after a recovery period of 1-2 hrs No evidence of damage and marking legible	-	-	-	-
			Insulation Resistance	Para. 9.6 of ESCC 4001, Note 2	R_i	1000	-	MΩ
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	Note 6		%
12	Operating Life	Para. 9.15 Chart IV	Initial Measurements Resistance	Table 2 Item 1	R_A	Record Values		Ω
			Intermediate Measurements (1000 hrs) Visual Examination	After a recovery period of 1-2 hrs No evidence of damage	-	-	-	-
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	Note 6		%
			Final Measurements (2000 hrs) Visual Examination	After a recovery period of 1-2 hrs No evidence of damage	-	-	-	-
			Resistance Change	Table 2, Item 1	$\Delta R_A/R_A$	Note 7		%
			Insulation Resistance	Para. 9.6 of ESCC 4001, Note 2	R_i	1000	-	MΩ

No.	ESCC Generic Spec. No. 4001		Measurements and Inspections		Symbol	Limits		Unit
	Environmental and Endurance Tests (Note 1)	Test Methods and Conditions	Identification	Conditions		Min	Max	
		Para. 9.15 Chart V	Initial Measurements Resistance Final Measurements (1000 hrs) Visual Examination Resistance Change Insulation Resistance	Table 2 Item 1 After a recovery period of 1 -2 hrs No evidence of damage Table 2 Item 1 Para. 9.6 of ESCC 4001, Note 2	R_A - $\Delta R_A/R_A$ R_i	Record Values - Note 6 1000	- - - -	Ω - % MΩ
13	High Temperature Storage	Para. 9.16	Initial Measurements Resistance Intermediate Measurements (1000 hrs) Visual Examination Resistance Change Final Measurements (2000 hrs) Visual Examination Resistance Change Insulation Resistance	Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage Table 2 Item 1 Para. 9.6 of ESCC 4001, Note 2	R_A - $\Delta R_A/R_A$ - $\Delta R_A/R_A$ R_i	Record Values - Note 6 - Note 7 1000	- - - - - -	Ω - % - % MΩ
14	Permanence of Marking	Para. 9.19	-	-	-	-	-	-

NOTES:

1. The tests in this Table refer to either Chart IV or V and shall be used as applicable.
2. Test Voltage: V_T =100V
3. For value of U_i see Table 1(b) Item 4.
4. $\Delta R_A/R_A$ limit : $\pm(0.5 + (0.05\Omega \times 100/R_n))\%$
5. $\Delta R_A/R_A$ limit : $\pm(0.25 + (0.05\Omega \times 100/R_n))\%$
6. $\Delta R_A/R_A$ limit : $\pm(1 + (0.05\Omega \times 100/R_n))\%$
7. $\Delta R_A/R_A$ limit : $\pm(1.5 + (0.05\Omega \times 100/R_n))\%$

APPENDIX A

AGREED DEVIATIONS FOR VISHAY SFERNICE(F)

Items Affected	Description of Deviations
Deviations from Final Production Tests (Chart II)	Para. 9.4 Dimension Check: Guaranteed but not tested.
Deviations from Qualification Tests (Chart IV)	Para. 9.19 Permanence of Marking: Not applicable
Deviations from Lot Acceptance Tests (Chart V)	Para. 9.19 Permanence of Marking: Not applicable