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RESISTOR, FIXED, CHIP, METAL FOIL

BASED ON TYPE SMP-PW, SMS-PW, SMT-PW

ESCC Detail Specification No. 4001/027

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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, Metal Foil based on type SMP-PW, SMS-PW, SMT-PW. 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.
- (b) A-QS-009, Isabellenhuetten Test Procedure for Infrared Measurement.

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	Type	Style (Note 1)	Resistance Range R_n		Tolerance ($\pm\%$)	Temperature Coefficient TC ($\pm 10^{-6}/^{\circ}\text{C}$)	Value Series	Weight max (g)
			Min (Ω)	Max (Ω)				
01	SMP-PW	2010	0.005	1.000	0.5, 1	Note 2	Any value in Ω in the resistance range to 3 decimal places	0.06
02	SMS-PW	2512	0.003	1.000	0.5, 1	Note 2		0.10
03	SMT-PW	2817	0.004	2.000	0.5, 1	Note 2		0.15

NOTES:

1. See Figure 2
- 2.

Temperature Coefficient/ ($\pm 10^{-6}/^{\circ}\text{C}$)	Remarks
-100, +0	over $T_{\text{amb}} = -55^{\circ}\text{C}$ to $+22^{\circ}\text{C}$
± 60	over $T_{\text{amb}} = +22^{\circ}\text{C}$ to $+170^{\circ}\text{C}$
± 50	over $T_{\text{amb}} = -55^{\circ}\text{C}$ to $+60^{\circ}\text{C}$

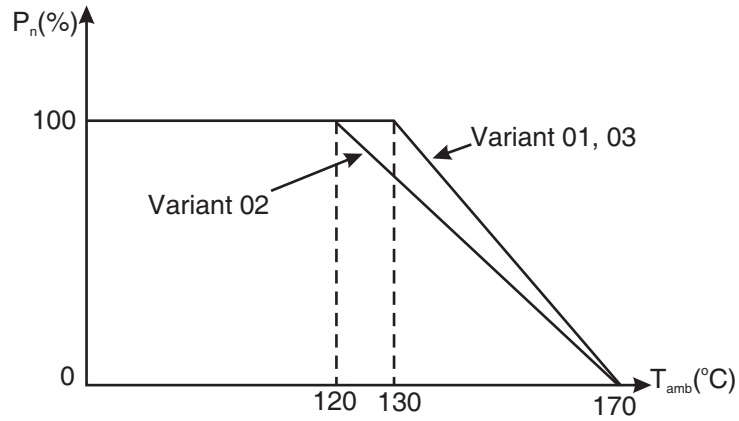
Table 1(b) MAXIMUM RATINGS

No.	Characteristics	Variant	Style	Symbol	Maximum Rating	Unit	Remarks
1	Rated Dissipation	01	2010	P_n	1	W	Note 1
		02	2512		2		Note 2
		03	2817		3		Note 1
2	Rated Voltage	All	All	U_R	$\sqrt{(P_n \times R_n)}$	V	Note 3
3	Insulation Voltage	All	All	U_I	200	V	-
4	Operating Temperature Range	All	All	T_{op}	-55 to +170	$^{\circ}\text{C}$	T_{amb}
5	Storage Temperature Range	All	All	T_{stg}	-55 to +170	$^{\circ}\text{C}$	-
6	Soldering Temperature	All	All	T_{sol}	+260	$^{\circ}\text{C}$	Note 4

NOTES:

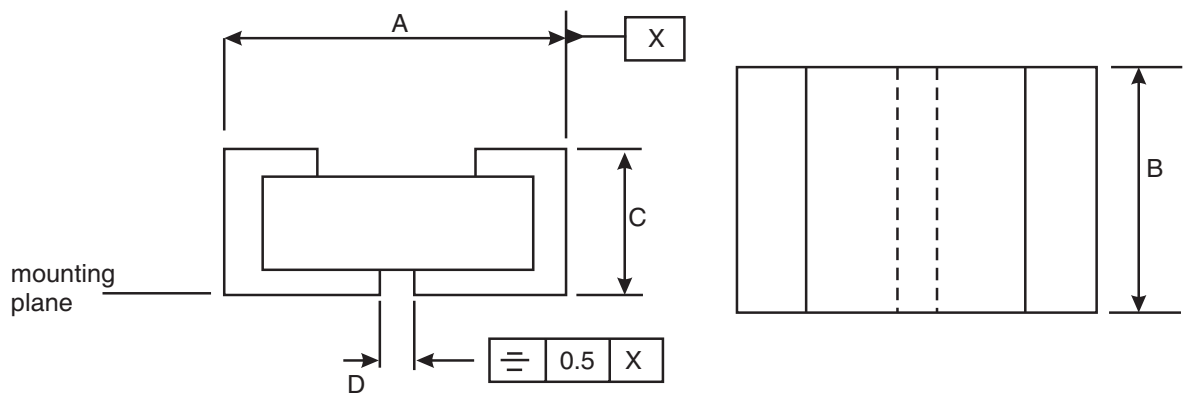
1. At $T_{\text{amb}} \leq +130^{\circ}\text{C}$. For derating at $T_{\text{amb}} > +130^{\circ}\text{C}$, see Figure 1.
2. At $T_{\text{amb}} \leq +120^{\circ}\text{C}$. For derating at $T_{\text{amb}} > +120^{\circ}\text{C}$, see Figure 1.
3. R_n = rated resistance.
4. Duration 5 seconds maximum.

FIGURE 1- PARAMETER DERATING INFORMATION



Rated Dissipation versus Temperature

FIGURE 2 - PHYSICAL DIMENSIONS



Variant	Style	Dimensions (mm)							
		A		B		C		D	
		Min	Max	Min	Max	Min	Max	Min	Max
01	2010	4.98	5.18	2.44	2.64	0.5	0.9	0.6	1.2
02	2512	6.15	6.55	2.95	3.15	0.6	1	0.6	1.2
03	2817	6.9	7.3	4.1	4.3	0.6	1	0.6	1.2

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: Not applicable
- (b) Para. 9.2, Third Harmonic Control or Current Noise: Not applicable.
- (c) Add Infrared Measurement in accordance with A-QS-009 after Marking.
Applied Voltage:
Variant 01: $\sqrt{(12P_n \times R_n)}$
Variant 02: $\sqrt{(7.5P_n \times R_n)}$
Variant 03: $\sqrt{(6.7P_n \times R_n)}$
Duration: 10ms

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

- (a) Testing Level C is not applicable.
- (b) Screening Sub-lot Samples Selection, Mounting and Testing
A quantity of 20 components shall be selected at random from the production lot and mounted in accordance with ESCC Generic Specification No. 4001 Para. 9.20. These Screening Sub-lot samples shall be subjected to testing in accordance with Chart III, Burn-in and Electrical Measurements in parallel with the 100% testing. These samples shall not form part of the delivery lot.
- (c) Add Para. 9.1 Overload, prior to initial Parameter Drift Value Measurements to be performed only on the mounted Screening Sub-lot samples. Measurement of Resistance shall be performed both before and after Overload in accordance with Table 2 of this specification. Change in Resistance shall be calculated and shall not exceed the limit as follows.
Voltage: $\sqrt{(5P_n \times R_n)}$
Duration: 5s
Change in Resistance: $\pm 0.3\%$ max
- (d) Para. 7.1.1 Burn-in:
For the 100% Testing during Chart III the passive burn-in duration shall be 24 (+24, -0)h in accordance with Table 5(a) of this specification.
For the testing of the mounted Screening Sub-lot samples during Chart III the burn-in duration shall be 168 (+24 -0)h in accordance with Table 5(b) of this specification.
- (e) Para. 7.4 Check for Lot Failure: 0 failures are allowed during testing of the Screening Sub-lot

samples. In the event of any failure the lot shall be considered as failed.

4.2.4 Deviations from Qualification Tests (Chart IV)

- (a) Para. 9.1, Overload: Voltage: $\sqrt{(5P_n \times R_n)}$
Duration: 5s
- (b) Para. 9.6, Insulation Resistance: Not applicable
- (c) Para. 9.10, Robustness of Terminations: Not applicable.
- (d) Duration: 5s

4.2.5 Deviations from Lot Acceptance Tests (Chart V)

- (a) Para. 9.6, Insulation Resistance: Not applicable.
- (b) Para. 9.10, Robustness of Terminations: 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).

4.4 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 Terminations

The termination finish shall be electroplated tin-lead Sn60 to a maximum thickness of 20 μ m.

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) The ESCC Component Number.
- (b) Electrical Characteristics and Ratings

(c) Traceability Information

4.5.2 ESCC Component Number

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

Example: 400102701B

- Detail Specification Reference: 4001027
- Component Type Variant Number: 01 (as required)
- Testing Level: B

4.5.3 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

The information shall be constituted and marked as follows:

Example: 1R490D

- Resistance Value (1.490Ω): 1R490
- Tolerance ($\pm 0.5\%$): D

4.5.3.1 *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
0.XXX	RXXX
X.XXX	XRXXX

The letter “R” is used to indicate the decimal point. The code used shall always include 3 decimal places including any non-significant zeros.

4.5.3.2 *Tolerance*

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

Tolerance ($\pm\%$)	Code Letter
0.5	D
1	F

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 $T_{amb}=+22\pm3^{\circ}C$.

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.

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 $T_{amb}=+22\pm3^{\circ}C$. 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 and Para. 4.2.3 of this specification. The conditions for Burn-in shall be as specified in Tables 5(a) and 5(b) of this specification.

After the specified burn-in period, the resistors shall be removed from the chamber and allowed to cool under normal atmospheric conditions for a minimum of 1 hour. 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 Figures 5(a) and 5(b) of this specification.

Table 2 - ELECTRICAL MEASUREMENTS AT ROOM TEMPERATURE

No.	Characteristics	Symbol	ESCC 4001 Test Method	Test Conditions	Tolerance ($\pm\%$)	Limits		Unit
						Min	Max	
1	Resistance	R_A	Para. 9.5.1	Para. 9.5.1	0.5	0.995 R_n	1.005 R_n	Ω
					1	0.99 R_n	1.01 R_n	

Table 3 - ELECTRICAL MEASUREMENTS AT HIGH AND LOW TEMPERATURES

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

No.	Characteristics	Symbol	ESCC 4001 Test Method	Test Conditions	Limits		Unit
					Min	Max	
3	Resistance change between +170 (+0 -3)°C and +22 ± 3°C	$\Delta R_A/R_A$	Para. 9.5.1	Para. 9.5.1 TC = $\pm 60 \times 10^{-6}/^{\circ}\text{C}$ Note 1	-0.906	+0.906	%
4	Resistance change between +60 ± 3°C and +22 ± 3°C	$\Delta R_A/R_A$	Para. 9.5.1	Para. 9.5.1 TC = $\pm 50 \times 10^{-6}/^{\circ}\text{C}$	-0.22	+0.22	%

NOTES:

1. During Burn-in and Electrical Measurements (Chart III) of ESCC Generic Specification No. 4001, shall only be tested on the mounted Screening Sub-lot samples.

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	±0.2	%

Table 5 - CONDITIONS FOR BURN-IN AND OPERATING LIFE

Table 5(a) - CONDITIONS FOR PASSIVE BURN-IN FOR 100% TESTING

No.	Characteristics	Symbol	Condition (Note 1)	Unit
1	Ambient Temperature	T_{amb}	+170(+0 -5)	°C
2	Test Voltage	V_T	No Bias	V
3	Duration	-	24(+24 -0)	h

NOTES:

1. Passive Burn-in (High Temperature Bake) shall be performed on components that are not mounted.

Table 5(b) - CONDITIONS FOR BURN-IN FOR SCREENING SUB-LOT SAMPLES AND OPERATING LIFE

No.	Characteristics	Symbol	Condition (Note 1)	Unit
1	Terminal Temperature Variants 01, 03 Variant 02	T_{amb}	+130(+0 -3) +120(+0 -3)	°C
2	Test Voltage	V_T	$\sqrt{P_n \times R_n}$	V
3	Duration Burn-in Operating Life (Qualification) Operating Life (LAT)	-	168(+24 -0) 2000 ± 24 1000 ± 24	h

NOTES:

1. Burn-in and Operating Life shall be performed on the applicable sample components that are mounted in accordance with ESCC Generic Specification No. 4001 Para. 9.20.

FIGURE 5(a) - ELECTRICAL CIRCUIT FOR PASSIVE BURN-IN FOR 100% TESTING

Not applicable.

FIGURE 5(b) - ELECTRICAL CIRCUIT FOR BURN-IN FOR SCREENING SUB-LOT SAMPLES AND OPERATING LIFE

Not applicable.

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.

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 $T_{amb}=+22\pm3^{\circ}C$.

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 $T_{amb}=+22\pm3^{\circ}C$.

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 $T_{amb}=+22\pm3^{\circ}C$.

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(b) 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(b) 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 $T_{amb} = +170(+0 -5)^{\circ}C$.

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 4.2.4 of this spec.	<u>Initial Measurements</u>	Table 2 Item 1 After a recovery period of 1-2 hrs No evidence of damage and marking legible	R_A	Record Values		Ω
			<u>Resistance</u>					
			<u>Final Measurements</u>					
			Visual Examination		-	-	-	
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	-	± 0.5	%
02	Seal Test (Hermetically Sealed only)	Para. 9.3	Not applicable	-	-	-	-	-

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	
03	Insulation Resistance	Para. 9.6	Not applicable	-	-	-	-	-
04	Temperature Coefficient	Para. 9.7 Procedure I	Temperature Coefficient	Table 3 Items 2, 3, 4	TC	Table 3		10 ⁻⁶ /°C
05	Voltage Proof	Para. 9.8.2	<u>During test</u>	1.4 x U _I for 60 ± 5 sec (Note 3)	-	-	-	-
			Visual Examination	No breakdown or flashover	-	-	-	-
06	Solderability	Para. 9.9 Procedure I	<u>Initial Measurements</u> Resistance	After Drying Table 2 item 1	R _A	Record Values		Ω
			<u>Final Measurements</u> Resistance Change	24 ± 4hrs after soldering Table 2 Item 1	ΔR _A /R _A	-	±0.1	%
07	Robustness of Terminations	Para. 9.10	Not applicable	-	-	-	-	-
08	Resistance to Soldering Heat	Para. 9.11 Procedure I	<u>Initial Measurements</u> Resistance	After Drying Table 2 Item 1	R _A	Record Values		Ω
			<u>Final Measurements</u> Visual Examination	No evidence of damage and marking legible	-	-	-	
			Resistance Change	Table 2 Item 1	ΔR _A /R _A	-	±0.1	%
09	Rapid Change of Temperature	Para. 9.12	<u>Initial Measurements</u> Resistance	Table 2 item 1	R _A	Record Values		Ω
			<u>Final Measurements</u> Visual Examination	After a recovery period of 1-2 hrs No evidence of damage	-	-	-	
			Resistance Change	Table 2 Item 1	ΔR _A /R _A	-	±0.2	%
10	Vibration	Para. 9.13	<u>Initial Measurement</u> Resistance	Table 2 Item 1	R _A	Record Values		Ω
			<u>Final Measurement</u> Visual examination	No evidence of damage	-	-	-	
			Resistance Change	Table 2 Item 1	ΔR _A /R _A	-	±0.2	%
11	Climatic Sequence	Para. 9.14 Procedure I	<u>Initial Measurements</u> Resistance	After Drying Table 2 Item 1	R _A	Record Values		Ω
			<u>Final Measurements</u> Visual Examination	Following completion of DC load test and after a recovery period of 1-2 hrs No evidence of damage and marking legible	-	-	-	
			Resistance Change	Table 2 Item 1	ΔR _A /R _A	-	±0.3	%
			Insulation Resistance	Not applicable	-	-	-	
12	Operating Life	Para. 9.15 Chart IV	<u>Initial Measurements</u> Resistance <u>Intermediate Measurements</u> (1000 hrs)	Table 2 Item 1 After a recovery period of 1-2 hrs	R _A	Record Values		Ω

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			
			Visual Examination	No evidence of damage	-	-	-	-		
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	-	± 0.2	%		
			<u>Final Measurements</u> (2000 hrs)	After a recovery period of 1-2 hrs	-	-	-	-	-	
			Visual Examination	No evidence of damage	-	-	-	-	-	
			Resistance Change	Table 2, Item 1	$\Delta R_A/R_A$	-	± 0.2	%		
					Insulation Resistance	Not applicable	-	-	-	-
			Para. 9.15 Chart V	<u>Initial Measurements</u> Resistance	Table 2 Item 1	R_A	Record Values		Ω	
				<u>Final Measurements</u> (1000 hrs)	After a recovery period of 1 -2 hrs	-	-	-	-	
				Visual Examination	No evidence of damage	-	-	-	-	
					Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	-	± 0.2	%
			Insulation Resistance	Not applicable	-	-	-	-		
13	High Temperature Storage	Para. 9.16	<u>Initial Measurements</u> Resistance	Table 2 Item 1	R_A	Record Values		Ω		
			<u>Intermediate Measurements</u> (1000 hrs)	After a recovery period of 1-2 hrs	-	-	-	-		
			Visual Examination	No evidence of damage	-	-	-	-		
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	-	± 1	%		
			<u>Final Measurements</u> (2000 hrs)	After a recovery period of 1-2 hrs	-	-	-	-		
			Visual Examination	No evidence of damage	-	-	-	-		
			Resistance Change	Table 2 Item 1	$\Delta R_A/R_A$	-	± 1	%		
			Insulation Resistance	Not applicable	-	-	-			
14	Permanence of Marking	Para. 9.19	Visual Examination	No evidence of damage and marking legible	-	-	-	-		

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 3.

APPENDIX A

AGREED DEVIATIONS FOR ISABELLENHUETTE (D)

Items Affected	Description of Deviation
Deviations from Qualification Tests (Chart IV) and Table 6	Para. 9.8.2, Voltage Proof: Not applicable.
	Para. 9.14, Climatic Sequence: Para. 9.14.5, Low Air Pressure: Not applicable Para. 9.14.7, d.c. Load: Not applicable
	Para. 9.19, Permanence of Marking: Not applicable
Deviations from Lot Acceptance Tests (Chart V) and Table 6	Para. 9.8.2, Voltage Proof: Not applicable.
	Para. 9.14, Climatic Sequence: Para. 9.14.5, Low Air Pressure: Not applicable Para. 9.14.7, d.c. Load: Not applicable
	Para. 9.19, Permanence of Marking: Not applicable
Marking of Tolerance on Resistance Value	The tolerance on resistance value may be marked using the actual numeric value (0.5% or 1%) instead of the specified code letter.
Marking of Traceability Information	The manufacturing date code may be marked using a three-digit code where the first digit is a letter to indicate the year of manufacture in accordance with the 20-year cycle code per Table 10a of IEC Publication No. 60062, and the last two digits indicate the week of the year (i.e. 01 to 52) during which encapsulation of the final production process occurred. For example: W41 for week 41 of 2008