RESISTOR, FIXED, CHIP, THIN FILM

BASED ON TYPE PHR AND PFRR

ESCC Detail Specification No. 4001/023

Issue 13	June 2025

Document Custodian: European Space Agency – see https://escies.org

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DCR No.	CHANGE DESCRIPTION
1730	Specification upissued to incorporate changes per DCR.

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1 GENERAL

1.1 SCOPE

This specification details the ratings, physical and electrical characteristics and test and inspection data for the component type variants and/or the range of components specified below. It supplements the requirements of, and shall be read in conjunction with, the ESCC Generic Specification listed under Applicable Documents.

1.2 APPLICABLE DOCUMENTS

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

(a) ESCC Generic Specification No. 4001.

1.3 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.

1.4 THE ESCC COMPONENT NUMBER AND COMPONENT TYPE VARIANTS

1.4.1 The ESCC Component Number

The ESCC Component Number shall be constituted as follows:

Example (for Variants 01 to 08, 13, 14; type PHR): 4001023012490P9

- Detail Specification Reference: 4001023
- Component Type Variant Number: 01 (as required)
- Characteristic code: Resistance Value (249Ω): 2490 (as required)
- Characteristic code: Resistance Tolerance (±0.02%): P (as required)
- Characteristic code: Temperature Coefficient (±5 x10^{-6}/°C): 9 (as required)

Example (for Variants 09 to 12, 15 to 20); type PFRR): 400102309R2490W1

- Detail Specification Reference: 4001023
- Component Type Variant Number: 09 (as required)
- Failure Rate Level Letter: R (as applicable; see Note 1)
- Characteristic code: Resistance Value (249 Ω): 2490 (as required)
- Characteristic code: Resistance Tolerance (±0.05%): W (as required)
- Characteristic code: Temperature Coefficient (±10 x10^{-6}/°C): 1 (as required)

NOTES:

1. Failure rate level letter shall be as defined in ESCC Basic Specification No. 26000. When a failure rate level is not applicable the letter shall be omitted.

1.4.1.1 Characteristics Codes

Characteristics to be codified as part of the ESCC Component Number shall be as follows:

(a) Resistance Value expressed by means of the following codes in accordance with ESCC Basic Specification No. 21700. The unit quantity shall be ohm (Ω):

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

(b) Resistance Tolerance expressed by the following codes in accordance with ESCC Basic Specification No. 21700:

Tolerance (± %)	Code Letter
0.01	L
0.02	P
0.05	W
0.1	B

(c) Temperature Coefficient expressed by the following codes:

Temperature Coefficient (± 10^{-6}/°C)	Code	Remarks
5	0	See Para. 1.4.2 Note 3
10	1	
25	2	
5	9	See Para. 1.4.2 Note 3

1.4.2 Component Type Variants and Range of Components

The component type variants and range of components applicable to this specification are as follows:

Variant Number	Type	Style (Note 1)	Resistance Range R_n (Note 2)		Tolerance (± %)	Temperature Coefficient TC (± x10^{-6}/°C)	Limiting Element Voltage (V)	Stability Class (± %) (Note 4)	Terminal Material and Finish	Weight max. (g)
			Min (Ω)	Max (MΩ)						
01	PHR	0603	10	0.5	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	35	0.15	E4	0.003
02	PHR	0805	10	0.75	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	75	0.15	E4	0.004
03	PHR	1206	10	3.5	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	100	0.15	E4	0.01
04	PHR	2010	10	6	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	150	0.15	E4	0.03
05	PHR	0603	10	0.5	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	35	0.15	E2 (Note 5)	0.003
06	PHR	0805	10	0.75	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	75	0.15	E2 (Note 5)	0.004
07	PHR	1206	10	3.5	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	100	0.15	E2 (Note 5)	0.01
08	PHR	2010	10	6	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	150	0.15	E2 (Note 5)	0.03
09	PFRR	0603	100	0.5	0.05, 0.1	10, 25	50	0.25	E4	0.003
10	PFRR	0805	100	0.75	0.05, 0.1	10, 25	100	0.25	E4	0.004
11	PFRR	1206	100	3.5	0.05, 0.1	10, 25	150	0.25	E4	0.01
12	PFRR	2010	100	6	0.05, 0.1	10, 25	200	0.25	E4	0.03
13	PHR	0402	10	0.15	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	30	0.15	E4	0.002
14	PHR	0402	10	0.15	0.01, 0.02, 0.05, 0.1	5 (Note 3), 10, 25	30	0.15	E2 (Note 5)	0.002
15	PFRR	0402	100	0.15	0.05, 0.1	10, 25	40	0.25	E4	0.002
16	PFRR	0402	100	0.15	0.05, 0.1	10, 25	40	0.25	E2 (Note 5)	0.002
17	PFRR	0603	100	0.5	0.05, 0.1	10, 25	50	0.25	E2 (Note 5)	0.003
18	PFRR	0805	100	0.75	0.05, 0.1	10, 25	100	0.25	E2 (Note 5)	0.004
19	PFRR	1206	100	3.5	0.05, 0.1	10, 25	150	0.25	E2 (Note 5)	0.01
20	PFRR	2010	100	6	0.05, 0.1	10, 25	200	0.25	E2 (Note 5)	0.03

NOTES:

1. See Para. 1.7.
2. Any resistance value in the resistance range, to 3 significant figures, is available. Critical resistance is as follows:

Variant Number	Critical Resistance (kΩ)
01, 05	12.25
02, 06	45
03, 07	40
04, 08	45
09, 17	25
10, 18	80
11, 19	90
12, 20	80
13, 14	18
15, 16	32

3. All PHR Types have two ±5 x10^{-6}/°C Temperature Coefficient options, defined below:
   - Temperature Coefficient Code: 0:
     - ±10 x 10^{-6}/°C from -55°C to +22°C
     - ±5 x10^{-6}/°C between +22°C and +70°C
     - ±10 x10^{-6}/°C between +70°C and +155°C
   - Temperature Coefficient Code: 9:
     - ±5 x 10^{-6}/ºC from -55 ºC to +155 ºC
4. Stability class refers to the limit of Change in Resistance, after 2000 hour Operating Life, specified in Para. 2.7 Intermediate and End-Point Electrical Measurements.
5. Variants 05 to 08, 14 and 16 to 20 are not suitable for solder assembly methods. They shall be assembled using glue or wire bond techniques.

1.5 MAXIMUM RATINGS

The maximum ratings shall not be exceeded at any time during use or storage.

Maximum ratings shall only be exceeded during testing to the extent specified in this specification and when stipulated in Test Methods and Procedures of the ESCC Generic Specification.

Characteristics	Variant Number	Style	Symbols	Limits	Units	Remarks
Rated Dissipation	01, 05, 09, 17 02, 06, 10, 18 03, 07, 11, 19 04, 08, 12, 20 13, 14, 15, 16	0603 0805 1206 2010 0402	P_n	100 125 250 500 50	mW	Note 1
Limiting Element Voltage	01, 05 02, 06 03, 07 04, 08 09, 17 10, 18 11, 19 12, 20 13, 14 15, 16	0603 0805 1206 2010 0603 0805 1206 2010 0402 0402	U_L	35 75 100 150 50 100 150 200 30 40	V	-
Rated Voltage	All	All	U_R	$\sqrt{(P_n \times R_n)}$	V	Note 2
Isolation Voltage	01, 05, 09, 17 02, 06, 10, 18 03, 07, 11, 19 04, 08, 12, 20 13, 14, 15, 16	0603 0805 1206 2010 0402	U_i	100 200 300 300 50	Vrms	-
Operating Temperature Range	All	All	T_{op}	-55 to +155	°C	T_{amb}
Storage Temperature Range	All	All	T_{stg}	-55 to +155	°C	-
Soldering Temperature	01 to 04, 09 to 13, 15	All	T_{sol}	+260	°C	Notes 3, 4

NOTES:

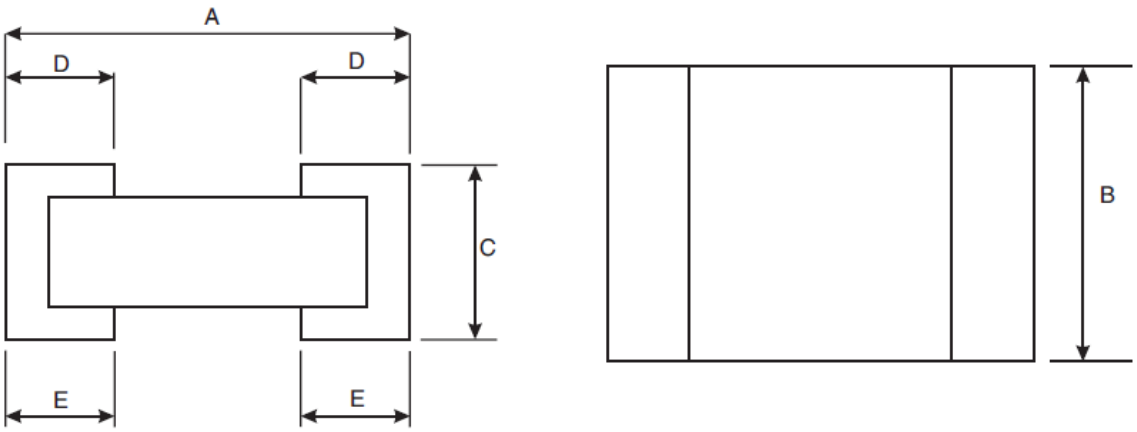
1. At $T_{amb} \leq +70°C$. For $T_{amb} > +70°C$, derate linearly to 0W at $T_{amb} = +155°C$.
2. Shall never exceed Limiting Element Voltage. R_n = Rated Resistance.
3. Duration 10 seconds maximum.
4. Not applicable to Variants 05 to 08, 14 and 16 to 20.

1.6 HANDLING PRECAUTIONS

These devices are susceptible to damage by electrostatic discharge. Therefore, suitable precautions shall be employed for protection during all phases of manufacture, testing, packaging, shipment and any handling.

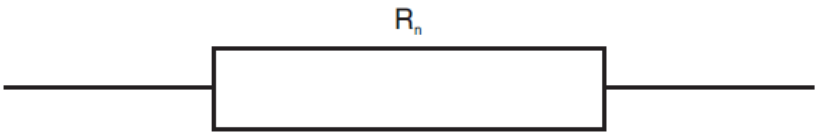
These components are categorised as Class 2 per ESCC Basic Specification No. 23800 with a Minimum Critical Path Failure Voltage of 2500 Volts.

1.7 PHYSICAL DIMENSIONS



Variant Number	Style	Dimensions (mm)									
		A		B		C		D		E	
		Min	Max	Min	Max	Min	Min	Min	Max	Min	Max
01, 05, 09, 17	0603	1.39	2.16	0.62	1.01	0.25	1.02	0.17	0.51	0.25	0.51
02, 06, 10, 18	0805	1.78	2.55	1.14	1.53	0.25	1.02	0.17	0.51	0.25	0.51
03, 07, 11, 19	1206	2.87	3.64	1.47	1.86	0.25	1.02	0.17	0.51	0.25	0.51
04, 08, 12, 20	2010	4.95	5.72	2.41	2.8	0.25	1.02	0.35	0.85	0.35	0.85
13, 14, 15, 16	0402	0.87	1.64	0.47	0.86	0.25	1.02	0.09	0.38	0.12	0.38

1.8 FUNCTIONAL DIAGRAM



1.9 MATERIALS AND FINISHES

1.9.1 Body

The resistive element deposited on the alumina substrate shall be covered with a suitable coating.

1.9.2 Terminations

The terminal material and finish shall be as specified in Para. 1.4.2 Component Type Variants and Range of Components in accordance with the requirements of ESCC Basic Specification No. 23500.

2 REQUIREMENTS

2.1 GENERAL

The complete requirements for procurement of the components specified herein are as stated in this specification and the ESCC Generic Specification. Permitted deviations from the Generic Specification, applicable to this specification only, are listed below.

Permitted 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 requirement and do not affect the component's reliability, are listed in the appendices attached to this specification.

2.1.1 Deviations from the Generic Specification

2.1.1.1 Deviations from Screening Tests - Chart F3

(a) Para. 8.3.2, Room Temperature Electrical Measurements after Burn-in: for ±0.01% and ±0.02% tolerances, components with a resistance outside the limits of Para. 2.6.1 Room Temperature Electrical Measurements after burn-in but remaining within a ±0.03% tolerance shall be rejected but not counted for PDA.

2.1.1.2 Deviations from Qualification and Periodic Tests - Chart F4

(a) Para. 8.9, Vibration: Not applicable.

(b) Para. 8.14, Solderability: Not applicable to Variants 05 to 08, 14 and 16 to 20.

2.2 MARKING

The marking of all components delivered to this specification shall be in accordance with the requirements of ESCC Basic Specification No. 21700. 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 qualified components symbol (for ESCC qualified components only).

(b) The ESCC Component Number (see Para. 1.4.1).

(c) Traceability information.

2.3 OVERLOAD

The test conditions for Overload, tested as specified in the ESCC Generic Specification, shall be as follows:

- Voltage: $\sqrt{(6.25P_n \times R_n)}$ or $2U_L$, whichever is less.
- Duration: 2s minimum.

2.4 ROBUSTNESS OF TERMINATIONS - SUBSTRATE BENDING TEST

The test conditions for the Substrate Bending Test, tested as specified in the ESCC Generic Specification, shall be as follows:

- Number of bends:10
- Deflection:
  - 2mm (Variants 01, 02, 03, 05, 06, 07, 09, 10, 11, 13, 14, 15, 16, 17, 18, 19)
  - 1mm (Variants 04, 08, 12, 20)
- Duration:5 ±1s

2.5 RESISTANCE TO SOLDERING HEAT

The test conditions for Resistance to Soldering Heat, tested as specified in the ESCC Generic Specification, shall be as follows:

- Temperature: +260°C
- Duration:10 (+0 -1) s

2.6 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

2.6.1 Room Temperature Electrical Measurements

The measurements shall be performed at T_{amb} = +22 ±3°C.

Characteristics	Symbols	ESCC No. 4001 Test Method and Conditions	Tolerance (± %)	Limits		Units
				Min	Max	
Resistance	R_A	Para. 8.3.1.1	0.01	0.9999 R_n	1.0001 R_n	Ω
			0.2	0.9998 R_n	1.0002 R_n	
			0.05	0.9995 R_n	1.0005 R_n	
			0.1	0.999 R_n	1.001 R_n	
Insulation Resistance	R_I	Para. 8.3.1.2 V = 100V Note 1	All	1000	-	MΩ

NOTES:

1. Guaranteed but not tested during Screening Tests.

2.6.2 High and Low Temperatures Electrical Measurements

Characteristics	Symbols	ESCC No. 4001 Test Method and Conditions (Note 1)	Limits		Unit
			Min	Max	
Resistance Change between -55 (+3 -0)°C and +22 ±3°C	$\Delta R_A/R_A$	Para. 8.3.1.1 TC = ±5 x10^{-6}/°C (TC code 0): TC = ±10 x10^{-6}/°C (TC code 1): TC = ±25 x10^{-6}/°C (TC code 2): TC = ±5 x10^{-6}/°C (TC code 9):	 -0.08 -0.08 -0.2 -0.04	 +0.08 +0.08 +0.2 +0.04	%
Resistance Change between +155 (+0 -3)°C and +22 ±3 ºC	$\Delta R_A/R_A$	Para. 8.3.1.1 TC = ±5 x10^{-6}/°C (TC code 0): TC = ±10 x10^{-6}/°C (TC code 1): TC = ±25 x10^{-6}/°C (TC code 2): TC = ±5 x10^{-6}/°C (TC code 9):	 -0.136 -0.136 -0.34 -0.068	 +0.136 +0.136 +0.34 +0.068	%
Resistance Change between +70 (+0 -3)°C and +22 ±3°C	$\Delta R_A/R_A$	Para. 8.3.1.1 TC = ±5 x10^{-6}/°C (TC code 0):	 -0.026	 +0.026	%

NOTES:

1. The measurements shall be performed on a sample of 5 components selected from the total production lot. The resistors shall be mounted as specified in the ESCC Generic Specification.

2.7 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

The components shall be mounted as specified in the ESCC Generic Specification.

Unless otherwise specified, the measurements shall be performed at T_{amb} = +22 ±3 ºC.

Unless otherwise specified the test methods and test conditions shall be as per the corresponding test defined in Para. 2.6.1 Room Temperature Electrical Measurements.

Test Reference per ESCC No. 4001	Characteristics	Symbols	Limits		Units
			Min	Max	
Rapid Change of Temperature Robustness of Terminations Resistance to Soldering Heat Solderability (Note 1)	Resistance	R_A	Record Values		
	Change in Resistance	$\Delta R_A/R_A$	± (0.05 + 0.05 x100/R_n)		%
Climatic Sequence Initial Measurements (Procedure 1)	Resistance (after drying)	R_A	Record Values		
Final Measurements	Change in Resistance	$\Delta R_A/R_A$	± (0.1 + 0.05 x100/R_n)		%
	Insulation Resistance (V_T = 100V)	R_I	1000	-	MΩ

Test Reference per ESCC No. 4001	Characteristics	Symbols	Limits		Units
			Min	Max	
Operating Life					
Initial Measurement (0 hour)	Resistance	R_A	Record Values		
Intermediate Measurements (1000 hours)	Change in Resistance	$\Delta R_A/R_A$			%
	Variants 01 to 08, 13, 14:		$\pm (0.1 + 0.05 \times 100/R_n)$		
	Variants 09 to 12, 15 to 20:		$\pm (0.15 + 0.05 \times 100/R_n)$		
Final / Intermediate Measurements (2000 hours)	Change in Resistance	$\Delta R_A/R_A$			%
	Variants 01 to 08, 13, 14:		$\pm (0.15 + 0.05 \times 100/R_n)$		
	Variants 09 to 12, 15 to 20:		$\pm (0.25 + 0.05 \times 100/R_n)$		
	Insulation Resistance (V_T = 100V)	R_I	1000	-	MΩ
Intermediate Measurements (4000 hours) (Notes 2, 3)	Change in Resistance Variants 09 to 12, 15 to 20	$\Delta R_A/R_A$	$\pm (0.5 + 0.05 \times 100/R_n)$		%
Intermediate Measurements (6000 hours) (Notes 2, 3)	Change in Resistance Variants 09 to 12, 15 to 20	$\Delta R_A/R_A$	$\pm (0.75 + 0.05 \times 100/R_n)$		%
Final Measurements (8000 hours) (Note 2)	Change in Resistance Variants 09 to 12, 15 to 20	$\Delta R_A/R_A$	$\pm (1 + 0.05 \times 100/R_n)$		%

NOTES:
1. Solderability is only applicable to Variants 01 to 04, 09 to 12, 13 and 15.
2. These measurements are applicable to Failure Rate Endurance Testing only.
3. These measurements are optional at the Manufacturer's discretion.

2.8 BURN-IN CONDITIONS

Characteristics	Symbols	Test Conditions	Units
Ambient Temperature	T_{amb}	+70 ±5	°C
Test Voltage	V_T	$\sqrt{(P_n \times R_n)}$ or U_L whichever is less	V

NOTES:
1. After Burn-in, the components shall be removed from the chamber and allowed to cool under normal atmospheric conditions for a minimum of 4 hours.

2.9 OPERATING LIFE CONDITIONS

The conditions shall be as specified in Para. 2.8 for Burn-in.

APPENDIX A
AGREED DEVIATIONS FOR VISHAY S.A. DIVISION SFERNICE (F)

Items Affected	Description of Deviations
Para. 2.1.1 Deviations from Generic Specification: Special In-Process Controls - Chart F2	Para. 5.2.1, Dimension Check: Guaranteed but not tested.
Para. 2.1.1.1 Deviations from Screening Tests - Chart F3	Para. 8.2, Non-Linearity: Not applicable.
	Para. 8.3.3, High and Low Temperatures Electrical Measurements: For components with TC code 9, High and Low Temperatures Electrical Measurements may be performed prior to Burn-in.
	For Variants 09 to 12 and 15 to 20, when failure rate level qualification approval in accordance with ESCC Basic Specification No. 26000 has been granted, the following deviations shall apply: • Para. 8.1 (& Para. 2.3 herein), Overload: Resistance and Change in Resistance shall be measured on a GONOGO basis in accordance with Para. 2.6.1 Room Temperature Electrical Measurements herein both before and after the test. Change in Resistance shall be related to the initial measurements. The limit for Change in Resistance shall be: ○ $\Delta R_A/R_A = \pm(0.05 + 0.05 \times 100/R_n)\%$ maximum • Para. 8.4 (& Para. 2.8 herein), Burn-in: Not applicable. • Para. 8.3.3 (& Para. 2.6.2 herein), High and Low Temperatures Electrical Measurements: With the exception of Resistance Change characteristics performed on components with TC code 9, High and Low Temperatures Electrical Measurements shall be guaranteed but not tested based on temperature coefficient measurements performed on each wafer at +25°C and +75°C in accordance with VISHAY specification CM-SF-00210.
Para. 2.1.1.2 Deviations from Qualification and Periodic Tests - Chart F4	Para. 8.15, Permanence of Marking: Not applicable.