RF ELECTROMAGNETIC RELAY, LATCHING, SMT, Micro-SPDT, BREAK-BEFORE-MAKE, LOW POWER, DC TO 32GHz

ESCC Detail Specification No. 3603/007

Issue 2	May 2024

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

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DOCUMENTATION CHANGE NOTICE

(Refer to https://escies.org for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION
1650	Specification updated to incorporate changes per DCR.

TABLE OF CONTENTS

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. 3603.

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: 36030070106V

- Detail Specification Reference: 3603007
- Component Type Variant Number: 01 (as required)
- Characteristic code: Nominal Rated Coil Voltage (6Vdc): 06V (as required)

1.4.1.1 Characteristics and/or Ratings Codes

Characteristics and/or ratings to be codified as part of the ESCC Component Number shall be as follows:

(a) Nominal Rated Coil Voltage expressed by means of the following codes:

Nominal Rated Coil Voltage (Vdc)	Code
12	12V
6	06V

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	Description	Nominal Rated Coil Voltage (Vdc)	Weight max (g)
01	Micro-SPDT, DC to 32GHz, SMT	6	10
02	Micro-SPDT, DC to 32GHz, SMT	12	10

1.5 MAXIMUM RATINGS

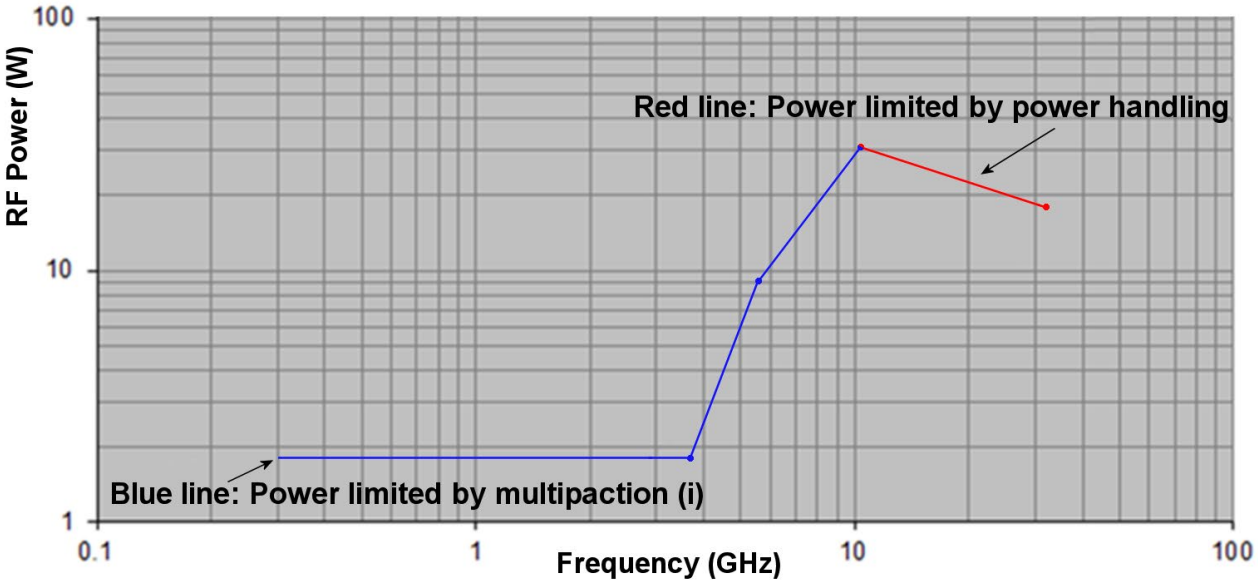
The maximum ratings shall not be exceeded at any time during use or storage.

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.

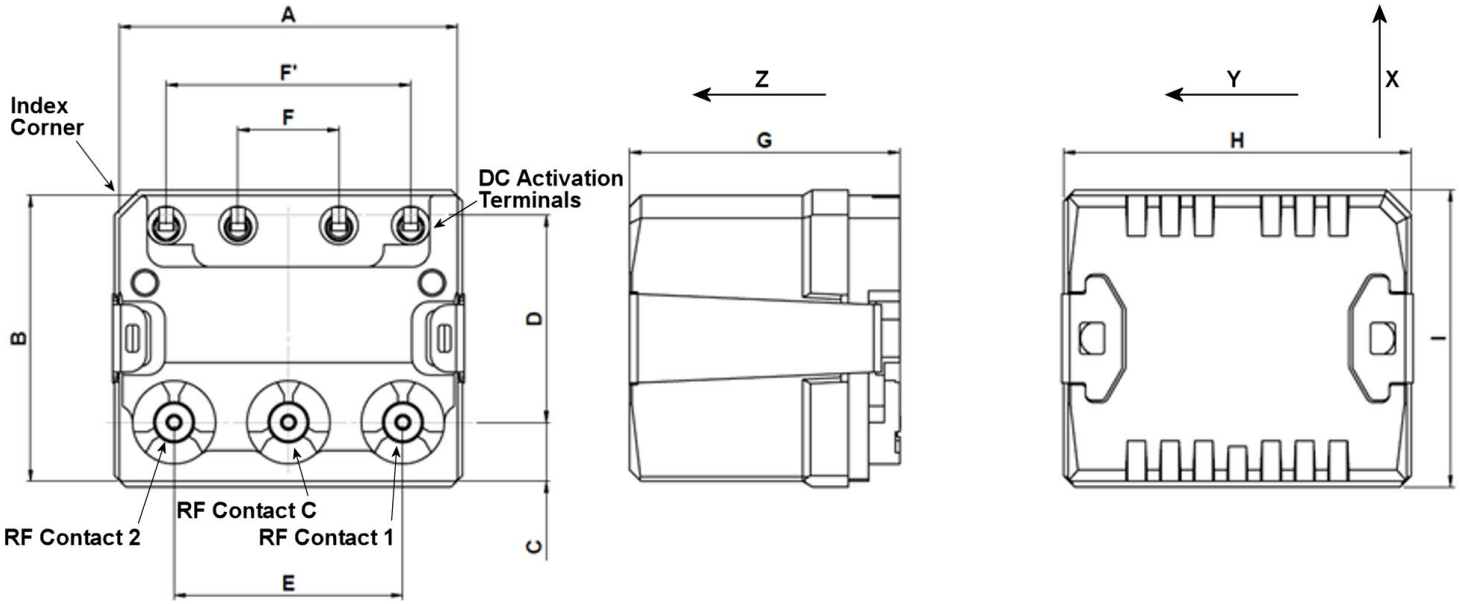
Characteristics	Symbols	Maximum Ratings	Units	Remarks
RF Operating Frequency Range	f	DC to 32	GHz	
Rated Coil Voltage Range (Minimum, Maximum) Variant 01: Variant 02:	V_{CR}	 5.1 to 6.6 10.2 to 13	Vdc	Note 1 Nominal Rated Coil Voltage: 6Vdc Nominal Rated Coil Voltage: 12Vdc
RF Power	P_{RF}	1.8 ≤ 3.7Ghz 9.1 at 5.6GHz 31.2 at 10.3GHz 18 at 32GHz	W	Note 3
Operating Temperature Range	T_{op}	-40 to +85	°C	T_{amb}
Storage Temperature Range	T_{stg}	-55 to +95	°C	T_{amb}
Soldering Temperature	T_{sol}	+260	°C	Note 2

NOTES:

1. Maximum coil current at Minimum Operating Temperature and Maximum Rated Coil Voltage:
   - For Variant 01: I_C = 169mA
   - For Variant 02: I_C = 97mA
2. Duration 10s maximum at +260°C, and 50s maximum ≥ +200°C.
3. RF Power is limited by multipaction at lower frequencies (see blue line) and by power handling capability at higher frequencies (see red line) as indicated by the following theoretical curve based on heritage test results:
   i. The part of the curve limited by multipaction (i.e., blue line) takes into account a 6dB margin as recommended by ESA.



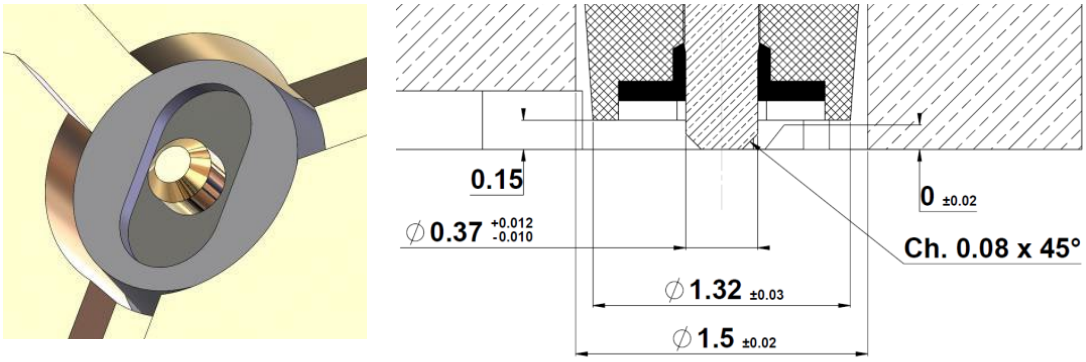
1.6 PHYSICAL DIMENSIONS AND TERMINAL IDENTIFICATION



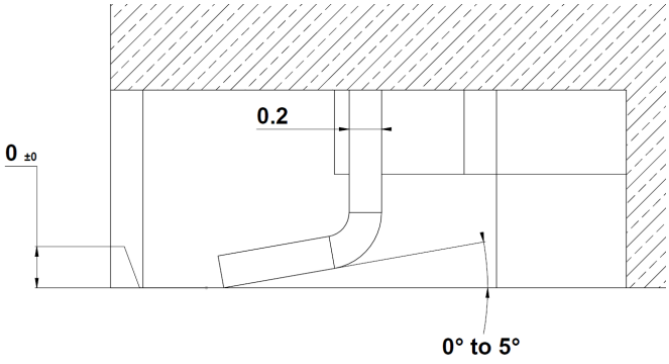
Symbols	Dimensions (mm)	
	Min	Max
A	14.9	15.3
B	12.5	12.9
C	2.42	2.62
D	9	9.4
E	10.1	10.3
F	4.3	4.7
F’	10.7	11.1
G	11.9	12.3
H	15.5	15.9
I	13.1	13.5
X Y Z	Directional Axes	

NOTES:

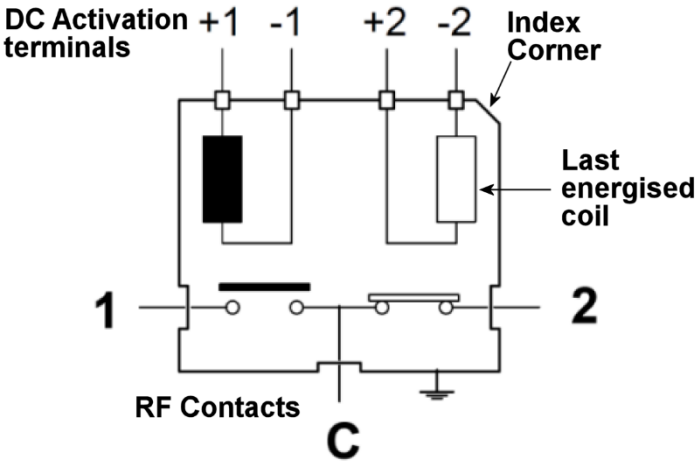
1. Terminal identification is specified by reference to the body corner chamfer index as indicated; see Para. 1.7.
2. The interface details for the RF Contacts 1, C, 2 shown above, are as follows (dimensions in mm):



3. The interface details for the DC Activation Terminals shown above, are as follows (dimensions in mm):



1.7 FUNCTIONAL DIAGRAM



NOTES:

1. As viewed from the top of the case.
2. The relay is shown in Position 2 (RF Contact 2 closed; RF Contact 1 open).
3. The RF contacts type shall be Break-Before-Make (BBM).
4. Individual terminal and contact designations are for reference purposes only.

1.8 MATERIALS AND FINISHES

1.8.1 Case

Hermetically sealed. Cover: aluminium alloy with chromate finish. RF plate: brass with 0.1 to 0.2µm gold over 2 to 5µm nickel plating.

1.8.2 Terminals

(a) RF Contacts: Leaded Beryllium Copper with 2 to 3µm gold over 2 to 3µm nickel plating.

(b) DC Activation Terminals: Copper alloy with 0.1 to 0.2µm gold over 2 to 3µm nickel plating.

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 to Screening Tests – Chart F3

(a) Para. 6.4.1, Check for Lot Failure: shall exclude any electrical parameter failures during Parameter Drift Values.

(b) Para. 8.11, Seal: Fine and Gross Leak shall not be performed.

2.1.1.2 Deviations to Qualification and Periodic Testing – Chart F4

(a) Para. 8.6.3, Sine Vibration: The sweep frequency range shall be 26 to 100Hz.

(b) Para. 8.11, Seal: Fine Leak shall not be performed (Gross Leak shall be performed).

(c) Para. 8.12, Resistance to Soldering Heat: MIL-STD-202, Test Method 210, Test Condition K shall apply.

(d) Para. 8.22, Terminal Strength: shall not be performed.

2.2 MARKING

The marking shall be in accordance with the requirements of ESCC Basic Specification No. 21700 and as follows.

The information to be marked on the component shall be:

(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 ELECTRICAL MEASUREMENTS AT ROOM, HIGH AND LOW TEMPERATURES

Electrical measurements shall be performed at room, high and low temperatures. Consolidated notes are given in Para. 2.3.3.

2.3.1 Room Temperature Electrical Measurements

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

Characteristics	Symbols	Test Method and Conditions	Nominal Rated Coil Voltage (Vdc)	Limits		Units
				Min	Max	
Pick-up Voltage	U_P	ESCC No. 3603 Note 1				V
		Variant 01:	6V	-	4.5	
		Variant 02:	12V	-	9	
Switching Time	t_{SW}	ESCC No. 3603 Note 1	All	-	5	ms
Breaking Time	t_B	ESCC No. 3603 Note 1	All	-	3	ms
Switching Type	-	ESCC No. 3603 Note 1	All	BBM		-
Insulation Resistance	R_I	ESCC No. 3603 Note 2	All	100	-	MΩ
Voltage Proof (Test Voltage)	VP	ESCC No. 3603 Note 2	All	300	-	Vrms
Coil Resistance	R_B	ESCC No. 3603 Note 1 Both Coils				Ω
		Variant 01:	6V	49	60	
		Variant 02:	12V	189	221	
RF Contact Resistance	R_{RF}	ESCC No. 3603 Note 1	All	-	100	mΩ
Insertion Loss	IL	ESCC No. 3603 Applied Power: ≤ 1mW, Note 3	All			dB
		Note 4, Frequency:				
		DC to 3GHz:		-	0.2	
		3 to 6GHz:		-	0.4	
		6 to 8GHz:		-	0.5	
		8 to 12.4GHz:		-	0.6	
		12.4 to 18GHz:		-	1	
		18 to 32GHz:		-	1	
Isolation	ISO	ESCC No. 3603 Applied Power: ≤ 1mW, Note 3	All	45	-	dB
Voltage Standing Wave Ratio	VSWR	ESCC No. 3603 Applied Power: ≤ 1mW, Note 3				-
		Note 4, Frequency:				
		DC to 3GHz:		-	1.25	
		3 to 6GHz:		-	1.35	
		6 to 8GHz:		-	1.4	
		8 to 12.4GHz:		-	1.5	
		12.4 to 18GHz:		-	1.7	
		18 to 32GHz:		-	2	
		Note 5, Frequency: DC to 32GHz		-	1.25	

2.3.2 High and Low Temperatures Electrical Measurements

The measurements shall be performed at T_{amb} = +85 (+0 -5)°C and -40 (+5 -0)°C.

Characteristics	Symbols	Test Method and Conditions	Nominal Rated Coil Voltage (Vdc)	Limits		Units
				Min	Max	
Pick-up Voltage	U_P	ESCC No. 3603 Note 1				V
		Variant 01:	6V	-	4.5	
		Variant 02:	12V	-	9	
Switching Time	t_{SW}	ESCC No. 3603 Note 1	All	-	5	ms
Breaking Time	t_B	ESCC No. 3603 Note 1	All	-	3	ms
Switching Type	-	ESCC No. 3603 Note 1	All	BBM		-
Insulation Resistance	R_I	ESCC No. 3603 Note 2	All	100	-	MΩ
Voltage Proof (Test Voltage)	VP	ESCC No. 3603 Note 2	All	300	-	Vrms
Coil Resistance	R_B	ESCC No. 3603 Note 1 Both Coils				Ω
		Variant 01:	6V	39	72	
		Variant 02:	12V	145	271	
RF Contact Resistance	R_{RF}	ESCC No. 3603 Note 1	All	-	100	mΩ

2.3.3 Notes to Electrical Measurements Tables

1. Test details as follows:
   - RF Contact Test Current: 10mA maximum.
   - RF Contact Test Voltage: 6V maximum.
   - Coil Activation Voltage: Nominal Rated Coil Voltage (see Para. 1.5).
   - Coil Activation Voltage Rise Time: < $0.1t_{SW}$.
   - Coil Activation Voltage Duration: $10t_{SW}$ minimum.
2. Coil de-energised.
3. This test shall not be performed during Chart F2 of the Generic Specification
4. The limits specified for this characteristic apply only to the test performed using a suitable non-destructive RF test set-up during Chart F3 of the Generic Specification. The effect of the test set-up on the measurements shall be taken into account.
5. The limit specified for this characteristic is guaranteed but not tested during Chart F3 of the Generic Specification, and is only tested during Electrical Measurements at Room Temperature during Chart F4 of the Generic Specification (see Para. 2.5 herein).

   The limit specified reflects the performance of the component when used in real applications.

2.4 PARAMETER DRIFT VALUES

Parameter Drift Values shall be measured as specified in the ESCC Generic Specification.

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

The test methods and test conditions shall be as per the corresponding test defined in Para. 2.3.1 Room Temperature Electrical Measurements.

The corresponding absolute limit values for each characteristic shall not be exceeded.

Characteristics	Symbols	Limits			Units
		Drift Value Δ	Absolute		
			Min	Max	
Pick-up Voltage	U_P	Note 1	Note 2	Note 2	V
Switching Time	t_{SW}	Note 1	Note 2	Note 2	ms

NOTES:

1. Drift Value (Δ) limits are not specified. Drift Values shall be recorded for information purposes only.
2. The limit specified in Para. 2.3.1 shall apply.

2.5 INTERMEDIATE AND END-POINT ELECTRICAL MEASUREMENTS

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

Unless otherwise specified, the test methods and test conditions shall be as per the corresponding test defined in Para. 2.3.1 Room Temperature Electrical Measurements.

Test Reference per ESCC No. 3603	Characteristics	Symbols	Limits		Units
			Min	Max	
Electrical Measurements at Room Temperature (initial and final) (Note 2)	Pick-up Voltage	U_P	Note 1		V
	Switching Time	t_{SW}	Note 1		ms
	Breaking Time	t_B	Note 1		ms
	Coil Resistance	R_B	Note 1		Ω
	RF Contact Resistance	R_{RF}	Note 1		mΩ
	Insulation Resistance	R_I	Note 1		MΩ
	Voltage Proof	VP	Note 1		Vrms
	Insertion Loss	IL	Note 1		dB
	Voltage Standing Wave Ratio (Note 3)	VSWR	-	1.25	-
	Isolation	ISO	Note 1		dB
Sine Vibration	Final Measurements				
	Check for change of contact position (Note 5)	-	Note 6		-
Random Vibration	Final Measurements				
	Check for change of contact position (Note 5)	-	Note 6		-
	Pick-up Voltage	U_P	Note 1		V
	Pick-up Voltage Drift	$\Delta U_P/U_P$	Note 4		%
	Switching Time	t_{SW}	Note 1		ms
	Switching Time Drift	$\Delta t_{SW}/t_{SW}$	Note 4		%
	Breaking Time	t_B	Note 1		ms
	Breaking Time Drift	$\Delta t_B/t_B$	Note 4		%
	Coil Resistance	R_B	Note 1		Ω
	RF Contact Resistance	R_{RF}	Note 1		mΩ
Mechanical Shock	Final Measurements				
	Check for change of contact position (Note 5)	-	Note 6		-
	Pick-up Voltage	U_P	Note 1		V
	Pick-up Voltage Drift	$\Delta U_P/U_P$	Note 4		%
	Switching Time	t_{SW}	Note 1		ms
	Switching Time Drift	$\Delta t_{SW}/t_{SW}$	Note 4		%
	Breaking Time	t_B	Note 1		ms
	Breaking Time Drift	$\Delta t_B/t_B$	Note 4		%
	Coil Resistance	R_B	Note 1		Ω
	RF Contact Resistance	R_{RF}	Note 1		mΩ

Test Reference per ESCC No. 3603	Characteristics	Symbols	Limits		Units
			Min	Max	
Thermal Endurance	Before & After Steps 1 & 2				
	Pick-up Voltage	U_P	Note 1		V
	Pick-up Voltage Drift	$\Delta U_P/U_P$	Note 4		%
	Switching Time	t_{SW}	Note 1		ms
	Switching Time Drift	$\Delta t_{SW}/t_{SW}$	Note 4		%
	Breaking Time	t_B	Note 1		ms
	Breaking Time Drift	$\Delta t_B/t_B$	Note 4		%
	Coil Resistance	R_B	Note 1		Ω
	RF Contact Resistance	R_{RF}	Note 1		mΩ
	During Step 2				
	Pick-up Voltage	U_P	Note 7		V
	Switching Time	t_{SW}	Note 7		ms
	Breaking Time	t_B	Note 7		ms
	Coil Resistance	R_B	Note 7		Ω
	RF Contact Resistance	R_{RF}	Note 7		mΩ
Operating Life (Note 8)	During Cycles 1 & 2				
	RF Contact Resistance	R_{RF}	Note 7		mΩ
	RF Contact Resistance Drift	ΔR_{RF}	Note 4		mΩ
	At End of Cycles 1 & 2				
	Pick-up Voltage	U_P	Note 1		V
	Switching Time	t_{SW}	Note 1		ms
	Breaking Time	t_B	Note 1		ms
	Coil Resistance	R_B	Note 1		Ω
	After Cycle 2				
	Pick-up Voltage	U_P	Note 1		V
	Pick-up Voltage Drift	$\Delta U_P/U_P$	Note 4		%
	Switching Time	t_{SW}	Note 1		ms
	Switching Time Drift	$\Delta t_{SW}/t_{SW}$	Note 4		%
	Breaking Time	t_B	Note 1		ms
	Breaking Time Drift	$\Delta t_B/t_B$	Note 4		%
	Coil Resistance	R_B	Note 1		Ω
	RF Contact Resistance	R_{RF}	Note 1		mΩ
	RF Contact Resistance Drift	ΔR_{RF}	Note 4		mΩ
Electromagnetic Compatibility	RF Leakage	RFL			dBi
	0.5Ghz ≤ f < 8GHz:		-	-40	
	8Ghz ≤ f < 15GHz:		-	-20	
	15Ghz ≤ f ≤ 32GHz:		-	-30	

Test Reference per ESCC No. 3603	Characteristics	Symbols	Limits		Units
			Min	Max	
Electrical Measurements at High and Low Temperatures	At high temperature: T_{amb} = +85 (+3 -0)°C				
	Pick-up Voltage	U_P	Note 7		V
	Switching Time	t_{SW}	Note 7		ms
	Breaking Time	t_B	Note 7		ms
	Coil Resistance	R_B	Note 7		Ω
	RF Contact Resistance	R_{RF}	Note 7		mΩ
	Insulation Resistance	R_I	Note 7		MΩ
	Voltage Proof	VP	Note 7		Vrms
	Insertion Loss	IL	Note 1		dB
	Voltage Standing Wave Ratio (Note 3)	VSWR	-	1.25	-
	Isolation	ISO	Note 1		dB
	At low temperature: T_{amb} = -40 (+0 -3)°C				
	Pick-up Voltage	U_P	Note 7		V
	Switching Time	t_{SW}	Note 7		ms
	Breaking Time	t_B	Note 7		ms
	Coil Resistance	R_B	Note 7		Ω
	RF Contact Resistance	R_{CRF}	Note 7		mΩ
	Insulation Resistance	R_I	Note 7		MΩ
	Voltage Proof	VP	Note 7		Vrms
	Insertion Loss	IL	Note 1		dB
	Voltage Standing Wave Ratio (Note 3)	VSWR	-	1.25	-
	Isolation	ISO	Note 1		dB

NOTES:

1. The limits specified in Para. 2.3.1 shall apply.
2. Prior to the initial Electrical Measurements at Room Temperature, components shall be soldered to a suitable RF test fixture and be maintained on the fixture for all subsequent tests in Chart F4 of the Generic Specification.
3. For VSWR, the effect of the RF test fixture on the measurements shall be taken into account. Frequency: DC to 32GHz.
4. Parameter Drift shall be calculated referenced to the measurement immediately prior to the test in question. An additional initial measurement may be performed prior to the test in question if considered necessary. Drift limits are not specified. Drift Values shall be recorded for information purposes only.
5. The contacts of the component under test shall be put in the following positions prior to the test (see Paras. 1.6 and 1.7):
   - For Sine Vibration: Position 1 for all axes.
   - For Random Vibration: Position 1 for all axes.
   - For Mechanical Shock:
     - Position 1 for all axes X, Z
     - Position 2 for all axis Y
6. For a component that has exhibited a change in contact position after testing, correct activation shall be confirmed with the first application of a $10t_{SW}$ duration activation pulse (see Para. 2.3.1) of Nominal Rated Coil Voltage (see Para. 1.5).

7. The limits specified in Para. 2.3.2 shall apply.
8. Activation pulse details during Operating Life:
   - Coil Activation Voltage: Nominal Rated Coil Voltage (see Para. 1.5).
   - Coil Activation Voltage Rise Time: < $0.1t_{SW}$ (see Para. 2.3.1).
   - Coil Activation Voltage Duration: $10t_{SW}$ (see Para. 2.3.1).

2.6 RUN-IN CONDITIONS

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

(a) Activation pulse details:
   - Coil Activation Voltage: Nominal Rated Coil Voltage (see Para. 1.5).
   - Coil Activation Voltage Rise Time: < $0.1t_{SW}$ (see Para. 2.3.1).
   - Coil Activation Voltage Duration: $10t_{SW}$ (see Para. 2.3.1).

APPENDIX A

AGREED DEVIATIONS FOR RADIALL (F)

ITEMS AFFECTED	DESCRIPTION OF DEVIATIONS
Para. 2.1.1, Deviations from the Generic Specification: Deviations from Production Control – Chart F2	Para. 5.2.2 Internal Visual Inspection Internal Visual Inspection may be replaced by the inspection of all component piece-parts during the assembly process, in accordance with Radiall inspection documentation. Note: Pre-Encapsulation Customer Source Inspection during assembly is not available.

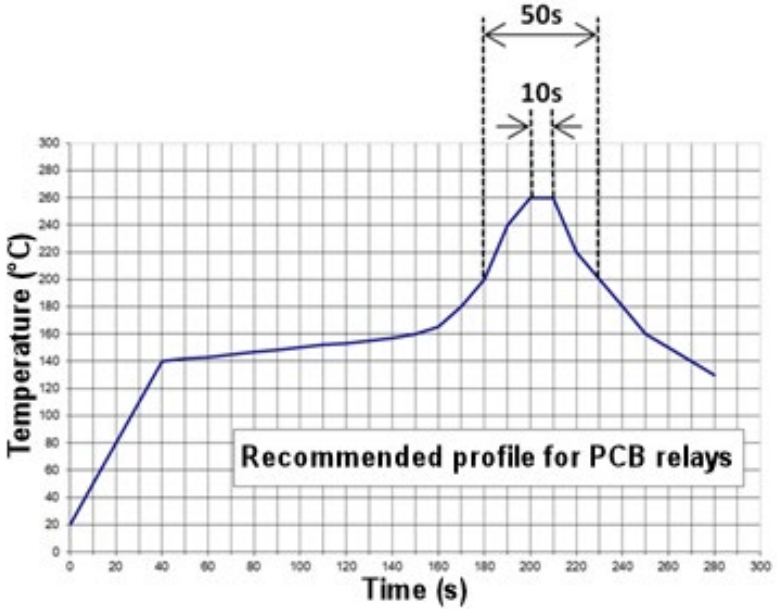
APPENDIX B

ADDITIONAL DATA – RADIALL (F)

(a) Radiall Recommended Mounting Process

For mounting of components specified herein, a soldering procedure using automatic pick and place equipment is recommended with the following details:

1. Solder Paste:
   Lead Free Sn95.8/Ag3.5/Cu0.7 solder cream may be used as well as standard Sn63/Pb35/Ag2. Radiall recommends using a no-clean, low residue solder cream (with 5% solid residue of flux quantity) that will permit the elimination of the cleaning operation step after soldering.
   Note: Due to the gold plating of the relay PCB interface, it is important to use a paste made with silver. This will help in avoiding formation of intermetallics as part of the solder joint.
2. Solder Paste Deposition:
   Solder cream may be applied on the PCB with screen printing or dispenser technologies. For either method, the solder paste must be coated to the appropriate thickness and shape to achieve good solder wetting. Optically verify that the edges of the zone are clean and without contaminates, and that the PCB zoned areas have not oxidised. The design of the mounting pads and the stencilling area are available upon request from Radiall, for a thickness of the silk-screen printing of 0.15 mm.
3. Placement of the Component:
   For small, lightweight components such as chip components, a self-alignment effect can be expected if small placement errors exist. However, this effect is not as expected for relays components and they require an accurate positioning on their soldering pads, typically +/- 0.1mm.
   Place the relay onto the PCB with automatic pick and place equipment. Various types of suction can be used.
   Radiall does not recommend using adhesive agents on the component or on the PCB.
4. Soldering: Infra-Red Process:
   Follow the Radiall recommended max temperature soldering profile for infra-red reflow or forced air convection as follows:



Note: Higher temperature (> 260°C) and longer process duration will permanently damage the relays.

5. Cleaning Procedure:
   On miniature relays, high frequency cleaning may cause the contacts to stick. If cleaning is needed, please avoid ultrasonic cleaning and use alcohol-based cleaning solutions.
   In-line cleaning process, spraying, immersion, especially under temperature, may cause a risk of degradation of internal contacts. For such cleaning process please contact Radiall.
6. Quality Check:
   Verify by visual inspection that the component is centred on the mounting pads.
   Solder joints: verify by visual inspection that the formation of meniscus on the pads are proper.

(b) Radiall Multipaction and Power Handling Data

The following Radiall heritage test data, which correlates with the ESA evaluation analysis results (ref. ESA test report: ESA-TECE-LAB-TR-024382), is available:

Note: Multipaction classification type 2 applies in accordance with ECSS-E-ST-20-01.

Type of Test	Temperature (°C)	Frequency (GHz)	Lowest Discharge Threshold (W)
Multipactor	+85	10.7	110
Multipactor	+85	4.8	42
Power Handling	+85	10.7	38
Power Handling	+85	21.5	22
Power Handling	+85	29	18