SMT Power Micro SPDT with 10 GHz Capabilities

SURFACE MOUNT TECHNOLOGY

Patent pending

Actual Size

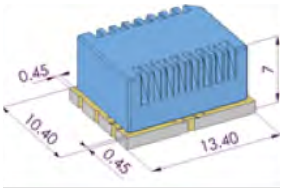
An innovative and original "micro-mechanical" design of the R596 SMT micro-relay offers, excellent RF performance, reliability, and repeatability. The miniature size, and low installation cost make these coaxial switches an ideal solution.

Very low return loss and insertion loss allow this relay to be used in power applications, as well as in typical SMT relay applications such as RF attenuators, RF matrices, spectrum analysers, and telecommunications.

Failsafe models are offered in two RF configurations (direct and inverted). The association of these two products on the same PC board enables the product to perform the bypass function. (For bypass mounting, further information is available on page 2-8).

Example of P/N:
R596813100 is a SPDT SMT 8 GHz, 24 Vdc, failsafe, standard packaging.

Typical Outline Drawing
(All dimensions in mm)



PART NUMBER SELECTION

R 596 ___ 10

Frequency Range:
3: DC – 3 GHz
8: DC – 8 GHz

Type:
1: Failsafe
3: Latching, 2 coils
9: Failsafe, inverted RF path (1)

Actuator Voltage:
2: 12 Vdc
3: 24 Vdc

Packaging style (2):
0: Standard packaging
2: Tape and reel of 200 relays (2)
5: Tape and reel of 500 relays (2)
9: Tape without reel (2) (4)
T: Soldered on a connectorized test fixture (2) (3)

(1): To be associated with a failsafe model, so as to achieve the "BYPASS" function (see application details on page 2-8)
(2): Non standard packaging symbols (2, 5, 9 or T) are not marked on the relay
(3): See details about test fixture dimensions on page 2-4
(4): Tape delivered without reel, available for all specific quantities up to 200 pieces

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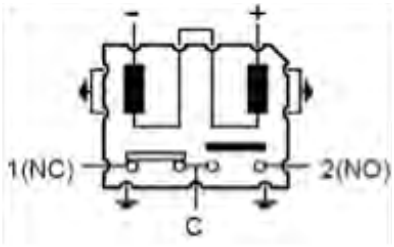
SLIM LINE GENERAL SPECIFICATIONS

Operating mode			Failsafe (types 1 and 9)		Latching (type 3)	
Nominal operating voltage (across temperature range)		Vdc	12 (10.2 to 13)	24 (20.5 to 30)	12 (10.2 to 13)	24 (20.5 to 30)
Coil resistance at 23 °C (+/-10%)		Ω	330	1130	205	865
Operating current at 23 °C		mA	36	25	58	32
RF and command ports			1/2 hole gold plated, Infrared reflow, forced air oven or hand soldering (Compatible with lead free soldering processes)			
Switching time at nominal voltage	Making contacts Breaking contacts		Max 4ms (typical 1.8ms), including contact bounce time Max 1ms (typical 0.5ms)			
Life	- Cold switching (max 120 cycles/min) - Hot switching (max 20 cycles/min)		2 million cycles 500.000 cycles (1W, impedance 50Ω, V.S.W.R. < 1.25)			
Insulation			Dielectric test voltage		300 Vrms	
			Insulation resistance at 500Vdc		> 100 MOhms	
Environmental protection			Lead free construction - Waterproof (acc. To IEC 60529 / IP67)			
Mass			< 2g			
Operating temperature range (with no icing nor condensation)		°C	-25 to +85 (5)		-40 to +85	
Storage temperature range		°C	- 55 to +85			
Sine vibration (MIL STD 202, Method 204D)			- Condition D: 10-2000 Hz, 20g		operating	
			- Condition G: 10-2000 Hz, 30g		non operating	
Random vibration (MIL STD 202, Method 214A, Profile I)			- Condition F: 50-2000 Hz, 20.71g		operating	
			- Condition H: 50-2000 Hz, 29.28g		non operating	
Shocks (According to MIL STD 202, Method 213B, Cond. C)			100g / 6 ms, 1/2 sine		operating	

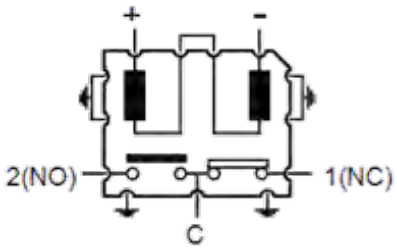
(5): Failsafe models may be used down to –40°C, but if coil remains permanently supplied at nominal voltage, the holding current value must be reduced from 45% to 55% to avoid internal condensation.
(for more details, see Radiall application note AN-R596-51 on page 2-10).

PIN IDENTIFICATION (TOP VIEW)



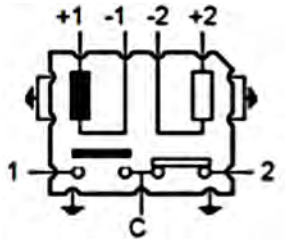
Failsafe model (Type 1)

Voltage	RF continuity
De-energized	C <--> 1(NC)
Energized	C <--> 2(NO)



Inverted failsafe model for Bypass application (Type 9)

Voltage	RF continuity
De-energized	C <--> 1(NC)
Energized	C <--> 2(NO)



Latching model (Type 3)

Voltage	RF continuity
-1 +1	C <--> 1
-2 +2	C <--> 2

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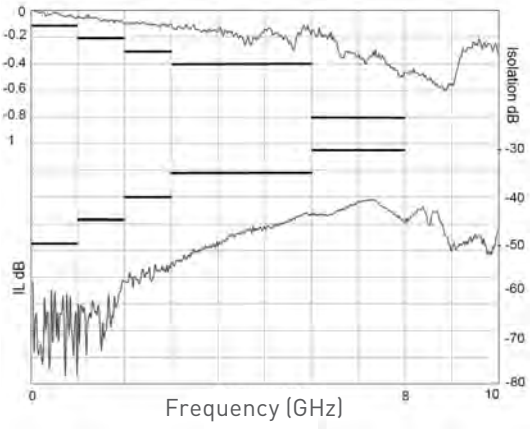
SLIM LINE PERFORMANCE (S PARAMETERS AVAILABLE ON REQUEST)

Frequency range GHz		V.S.W.R. (max)	Insertion loss (max) dB	Isolation (min) dB		Average power W (see page 2-5)		Third order Inter modulation	Impedance Ω
				switch alone	switch + board layout (6)	cold switching	hot switching		
DC – 3 DC – 8	DC - 1	1.10	0.10	50	50	400	50	-120 dBc typical (2 carriers 20W)	50
	1 - 2	1.20	0.20	45	40	280	50		
	2 - 3	1.35	0.30	40	30	175	40		
	3 - 6	1.35	0.40	35	30	50	25		
	6 - 8	1.40	0.80	30	30	35	5		

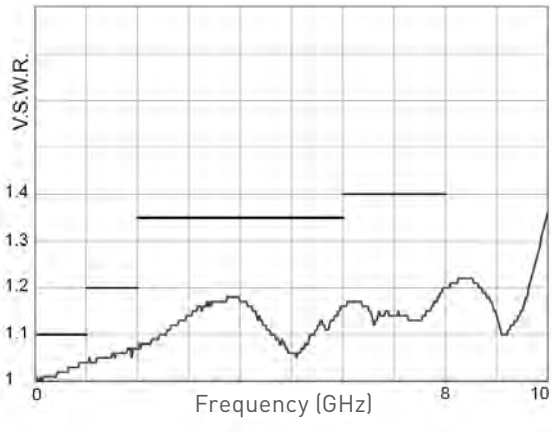
(6): taking account of the reduction of isolation due to coupling between PCB microstrip lines (see isolation dotted curve above and measurement method below)

TYPICAL RF PERFORMANCES

Insertion Loss and Isolation

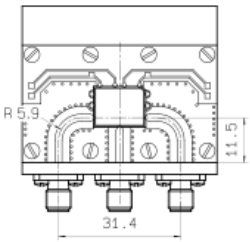


V.S.W.R

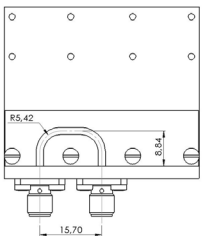


MEASUREMENT METHOD

Relay soldered on text fixture (7)



Calibration board



Inputs/Outputs of the calibration board and test fixture are equipped with SMA type receptacle connectors (Radiall part number R125 510 000). The length of the RF tracks is the same on the calibration board and the test fixture circuits. The insertion loss of the relay itself is calculated by subtracting the insertion loss of the “calibration board” to the insertion loss of the “relay welded on the test fixture”.

(7): Relay soldered on Test Fixture is available. To order, please use the suffix "T" (part number R596 - - - - - T), as explained in page 2-2.

SMT Power Micro SPDT with 10 GHz Capabilities

RF POWER RATING FOR COLD SWITCHING USE

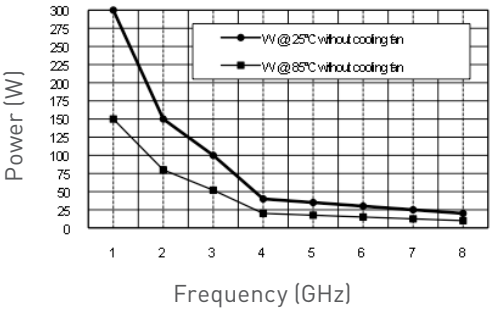
(Impedance 50 Ohms, V.S.W.R. < 1.25)

Power level depends on environmental conditions:

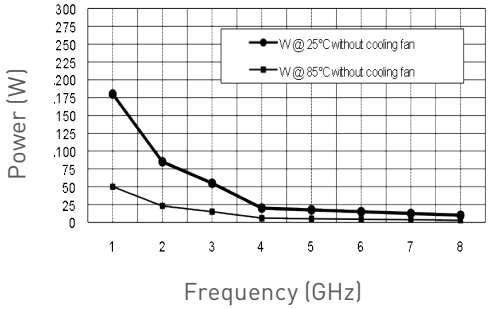
- R596 series have been designed to be used without a cooling fan even for high power applications. However, the power capability may be still improved by using the appropriate cooling fan.

- For failsafe models used with coil permanently supplied (N/O position), the same power level as latching models may be applied: see on application note N° AN-R596-51 on page 2-10, how to implement a "low holding current" function on your PC board, to avoid internal overheating and increase the RF power level.

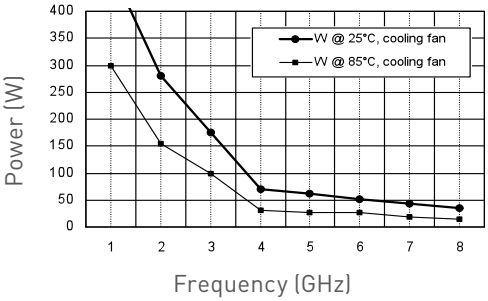
No cooling fan - Latching (all models)
Failsafe: NC pos. & No with low holding voltage



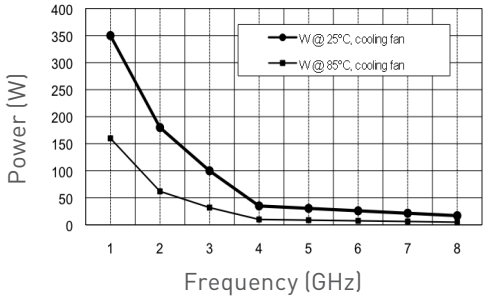
No cooling fan
Failsafe: No pos. Supplied at nominal voltage



With cooling fan - Latching (all models)
Failsafe: NC pos. & NO with low holding voltage



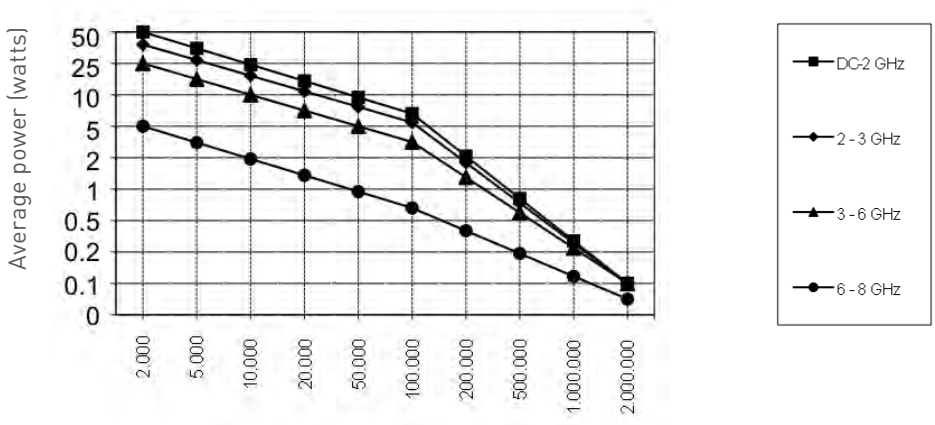
With cooling fan
Failsafe: No pos. Supplied at nominal voltage



LIFE DERATING CURVE FOR HOT SWITCHING USE

(Impedance 50 Ohms, V.S.W.R. < 1.25) General Specifications

Impedance 50Ω
V.S.W.R. < 1.25
max switching frequency:
30 cycles per mn



SMT Power Micro SPDT with 10 GHz Capabilities

RELAY PACKAGING

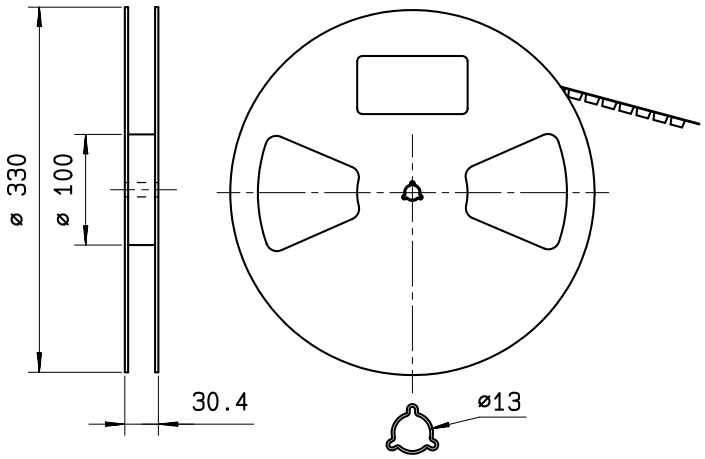
According to IEC 286-3 standard

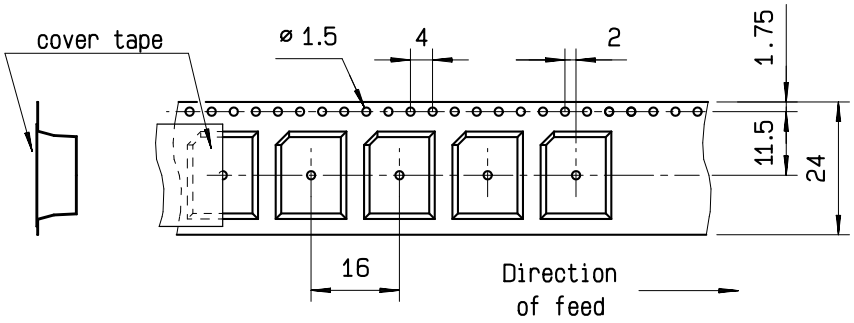
Materials:

Reel: polyester

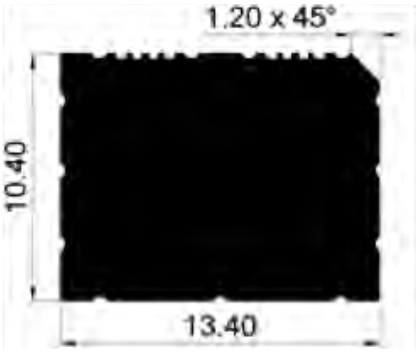
Carrier tape: antistatic PETG (polyester)

Cover tape: polyester

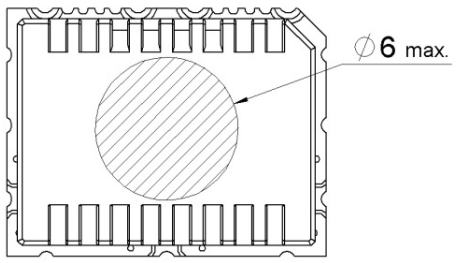




Video shadow of the relay



Aspiration Aera

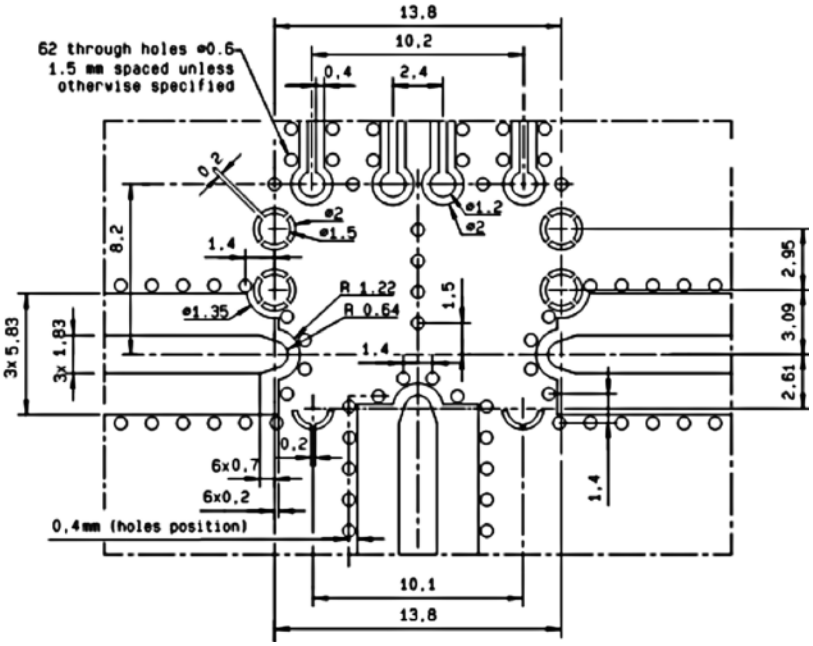


SMT Power Micro SPDT with 10 GHz Capabilities

PC BOARD MOUNTING

Board layout

DXF or Gerber format file
available upon request (8)



Subtrate types

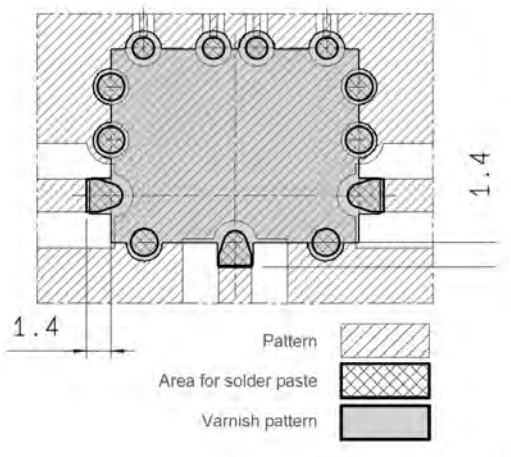
Recommended substrates are **ROGERS RO4003** or **ARLON 25N**

- **Mounting face:** Thickness 0.813 mm Cu double side 17.5µm. Width of track 1.83 mm
Others substrates: **RO4350**, thickness 0.813 mm Cu double side 17.5µm. Width of track 1.80 mm
25FR, thickness 0.813 mm Cu double side 17.5µm**.** Width of track 1.76 mm

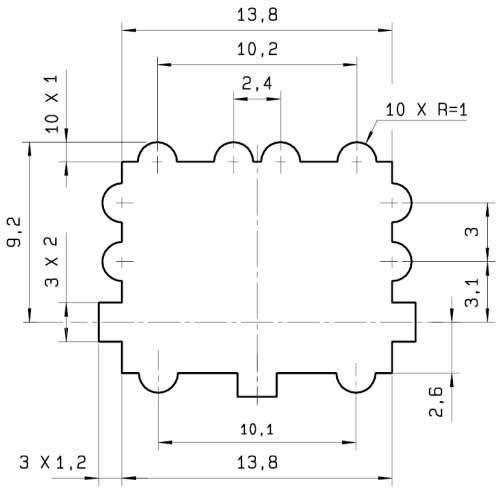
- **Opposite face:** Plating all over the face

Total thickness of the tracks (copper over thickness + plating): 40µm
Other substrates may be used (for instance standard FR4), if provided with adequate modification of the tracks width.

Soldering Pattern



Varnish Pattern

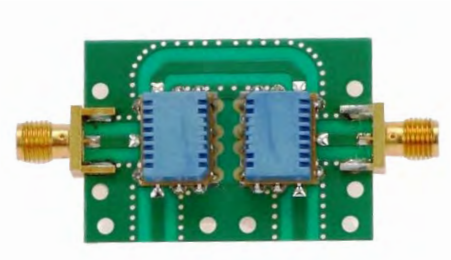


Please contact your local sales representative for additional information

SMT Power Micro SPDT with 10 GHz Capabilities

BYPASS APPLICATION

Failsafe Micro-relay typical implantation

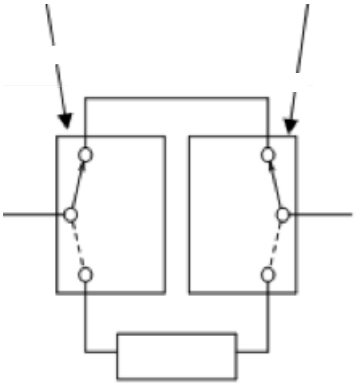


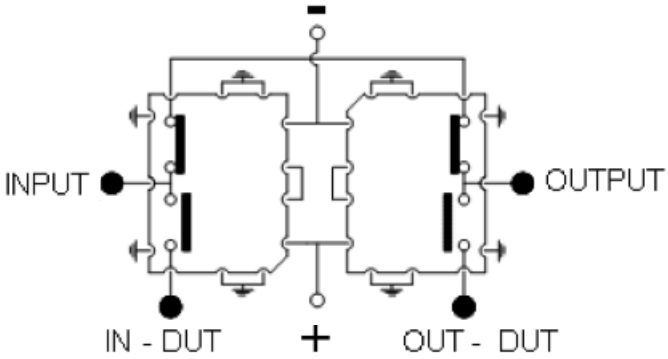
SPDT relays (Single Pole Double Throw) can be used to achieve a bypass switch function. For SMT applications, R596 series, relays are available in two failsafe versions, standard and inverted, to provide symmetric RF ports implantation possibility. The "side by side" implementation of these two versions on a PCB effectively produces the bypass function. The package size is reduced and interconnecting tracks are shortened. Required in order to protect the receiver for transmit/receive applications. Depending on the distance between the two relays, this configuration can achieve high isolation levels, up to 80 dB @ 1GHz, 70 dB @ 2 GHz, and 60 dB @ 6GHz.

BYPASS TYPICAL IMPLANTATION & PIN IDENTIFICATION

(Top View)

R596.X1X.XXX / R596.X9X.XXX

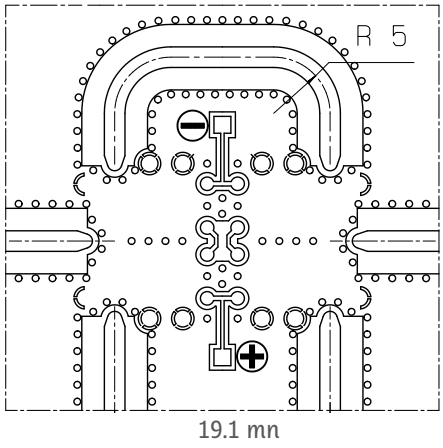




Voltage	RF continuity
De-energized	INPUT <--> OUTPUT (direct line)
Energized	INPUT <--> IN-DUT / OUT-DUT <--> OUTPUT

BYPASS PC BOARD MOUNTING

Example of Board layout for bypass application



(See detailed board layout on page 2-7)

SMT Power Micro SPDT with 10 GHz Capabilities

RECOMMENDED SOLDERING PROCEDURE

A-Soldering procedure using automatic pick and place equipment

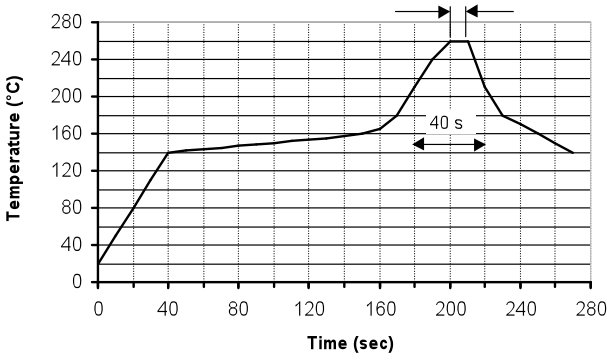
1-Solder paste
R596 series are Lead free. Lead free Sn-Ag3.5-Cu0.7 solder cream may be used as well as standard Sn63–Pb35– Ag2. Radiall recommends using a no clean - low residue solder cream (5% solid residue of flux quantity) that will permit the elimination of the cleaning operation step after soldering.

Note: Due to the gold plating of the switch 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 board with screen printing or dispenser technologies. For either method, the solder paste must be coated to appropriate thickness and shapes to achieve good solder wetting. Please verify that the edges of the zone are clean and without contamination and that the PCB zoned areas have not oxidized. The design of the mounting pads and the stenciling area are given on page 2-7, for a thickness of the silk-screen printing of 0.15 mm (0.006 ‘’).

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 (+/-0.004’’). 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
Please refer to the recommended temperature profile for infra-red reflow or forced air convection:



Higher temperature (>260°C) and longer process duration would permanently damage the switches.

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.

6-Quality check
Verify by visual inspection that the component is centered on the mounting pads. For solder joints, verify by visual inspection that the formation of meniscus on the pads are proper, and have a capillarity amount at least a third of the height.

B– Soldering procedure by manual operation

1-Solder paste and flux deposition
Refer to procedure A – 1
Deposit a thin layer of flux on mounting zone, and allow the flux to evaporate a few seconds before applying the solder paste, in order to avoid dilution of the paste.

2-Solder paste deposition
Radiall recommends depositing a small amount of solder paste on the mounting zone area by syringe. Be careful, not to apply solder paste outside of the zone area.

3-Placement of the component:
During manipulation, avoid contaminating the lead surfaces by contact with fingers. Place the component on the mounting zone by pressing on the top of the relay lid.

4-Hand soldering
Iron wattage 30 to 60 W. Tip temperature 280 to 300°C for maximum 5 seconds to keep good RF characteristics above 3GHz. It is important to solder RF ports first, and apply pressure on the relay lid during all the soldering stage, to reduce the air gap between the PC board and the relay.

5-Cleaning procedure
Refer to procedure A – 5

6-Quality check
Verify by visual inspection that component is centred on the mounting pads. For solder joints, verify by visual inspection that the formation of meniscus on the pads are proper, and have a capillarity amount at least a third of the height.

SMT Power Micro SPDT with 10 GHz Capabilities

APPLICATION NOTE AN-R596-051

Subject: How to use failsafe R596 micro-relays over all the guaranteed temperature range, in or condensation environmental conditions.

RF and electrical characteristics are guaranteed on all failsafe R596 switches over their operating temperature range (-25°C to +85°C), and under "no icing nor condensation" conditions.

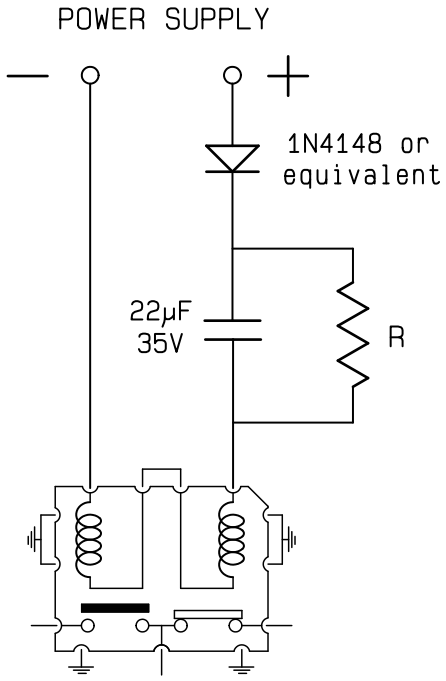
In extreme applications, with failsafe models used at low temperature, continuously in the N/O position (coil permanently supplied), N/C contact failures may occur, due to the high gradient of temperature between the coil (heated by the permanent power 500mW) and the RF paths. N/O contact resistance remains satisfactory, but condensation deposits ice on the open contact N/C, and when power is cut, the N/C position is not correctly established.

Failsafe models can be continuously driven when energized from -40°C, if the coil is not permanently supplied at nominal voltage, and heating and internal condensation is avoided. Once the relay has switched, the operating voltage must be reduced by 50% +/-5%. This low holding voltage is possible on R596 series, as it is enough to maintain the switch in "energized" position (for instance 5.4V to 6.6V for a 12V model). Furthermore it allows the user to save energy, by combining the advantages of latching and failsafe models.

This "holding current" function can be achieved by the implementation of a simple electronic drive on the command PC Board (1 resistor, 1 diode and 1 capacitor), for 12V and 24V models. A typical circuit design is shown on the schematic below. A few milliseconds after switching, the current is divided by two, and the absorbed power is divided by four (i.e. 6V and 110mW for a 12V model).

To reduce the voltage by 50%, the value of resistance R must be equal to the total resistance of the switch coil:

- 12V models: 330 Ohms 1/4W
- 24V models: 1200 Ohms 1/4W



R596 FAILSAFE RELAY

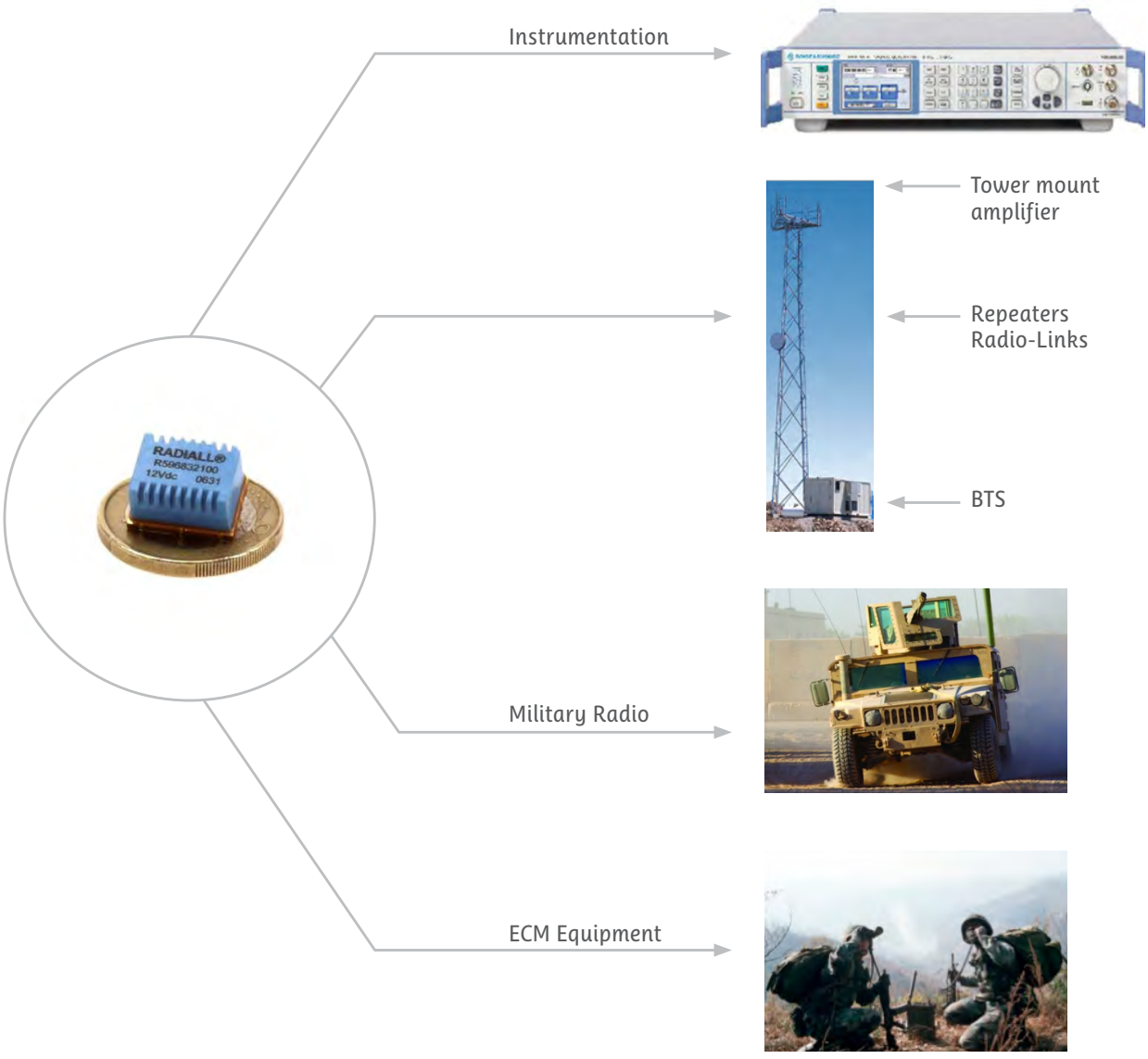
Applications

EXAMPLE OF SMT APPLICATIONS

The SMT Series offers a large range of products which can be used in many applications such as:

- Tower mount amplifiers
- Instrumentation
- Military radios
- ECM equipment
- BTS
- Radio-Links
- Repeaters

These products offer the same RF Board and soldering process as all RF components but with a reduced weight and size. They are designed to meet all market specifications.



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