

Technical Information



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Connectivity has a profound and dramatic impact on the lives of people throughout the world. Because of advancements in technology, **our** lives are more convenient, more secure, more enjoyable and richer than ever. The speed of data enables communication in the **most** remote areas so people can reach all corners of the globe, allows for **important** defense and security, and facilitates space exploration. But technology doesn't just happen. It starts in the mind with ideas, making **connections** never considered in ways that nobody dreamed possible. Seeing the future in ways previously unimagined **is** the act of innovation and it begins with people—the inventors, the dreamers, the pioneers and the engineers—enriching the lives of billions. At Radiall, we have one single, solitary mission; Empower the people that enrich our lives. Enable their innovation by providing reliability and durability. Give them useful information and provide them with valuable guidance when determining the best course for success. We don't invent the future, we enable it. We inspire innovation, we embrace challenges, we challenge the conventional and we collaborate **with** you to succeed. At Radiall, we're proud to say – Our most important connection is with **you**.

Table of Contents

Technical Information	1
SPDT	2
DP3T and SPDT Terminated	3
DPDT	4
SPnT	5
Low Pim	6
Space	7
Other	8

Go online for data sheets & assembly instructions.



Visit www.radial.com and enter the part number.

Company Profile

Our Most Important Connection is with You™

Radiall is a global leader in the design, development and manufacturing of leading edge interconnect solutions. Dedicated to understanding its customers' needs since 1952, Radiall has earned the reputation of being "the best of the best" in engineering ingenuity by providing a constant flow of creative system solutions serving the defense, telecommunications, aerospace, instrumentation, automotive, industrial, medical and broadcast markets.

Best Value-added Services

Collaboration: We work closely with your engineers to understand your business, your technical needs, and your budgetary issues.

Wide Product Range: We manage our product lines thru the entire lifecycle in order to offer you a wide selection of standard products at an affordable cost.

Custom Products: We can tailor products to specific equipment and application needs.

Global Presence: We're everywhere you need us, with worldwide sales, engineering support, R&D in North America, Europe, and Asia, and manufacturing facilities strategically located in the United States, Mexico, France, India, and China.

Responsive Support and Service: From the design stage, planning to post-installation support, we're with you at every step, whether you need sales support or engineering expertise.

On-time Delivery: We support your logistical needs so you get the products when and where you need them.

Warranty: We proudly stand behind our products.

Certifications and Environmental

Radiall is ISO 9001: 2008 certified and dedicated to continuous improvement programs that have resulted in also being AS9100, TS16949 and ISO 14001 certified. In addition, Radiall is committed to investing in its people, future technologies and the environment, such as being RoHS (Restriction of Hazardous Substances) and REACH (Registration, Evaluation, Authorization and Restriction of Chemical substances) compliant.



The Best End-to-End Interconnect Solutions

We offer an extensive range of solutions that supports the most demanding signal transmission applications. 4G wireless infrastructure, active array radars, IED's detection, electrical wiring in aircrafts, soldier tactical radios, in-vehicle communications networks, and magnetic resonance imaging systems are just a few of the complex applications that we support.

- RF coaxial connectors
- Fiber optic connectors and transceivers
- Coaxial and fiber optic cable assemblies and harnesses
- High frequency microwave components
- Coaxial switches, including the smallest and most reliable SPDT relay
- Multipin rectangular connectors
- Rack and panel connectors
- Antennas for tactical networks, aerospace and instrumentation



Technical information and sales contacts are available at:
www.radiall.com

Radiall at a Glance

Worldwide Presence

Radiall has a global manufacturing presence. Our International sales network and qualified distributors cover every region around the world. The result is quick and insightful answers to all your requests.

- International Sales Network
- Low cost facilities
- Local manufacturing, logistics and technical support



North America



Asia



Europe



Market Focus

Aerospace



Defense



Industrial



Space



Telecom



Instrumentation



Medical



Radiall Technologies

- Milling
- Plating & plastic metallization
- Molding
- Characterization
- Polishing
- Laser, ultrasonic, vapor, soldering
- Stamping
- Thin & thick film processes
- Etching on Si
- Thick film on AlN
- Test & measurement
- Simulation
- Cable & PTFE wrapping
- Automatic assembly
- Micro-machining



A Global Range to Meet Your Needs



RF Coaxial Connectors

Radiall proudly offers the widest range of RF Coaxial Connectors in the Industry with over 12,000 part numbers and 72 product series including AEP® Mil QPL connectors. These precision-made components are a significant part of our heritage and essential to who we are.



Microwave Components

Radiall has a wide range of coaxial devices, including terminations, attenuators, and couplers using standard interfaces from low to high power. Our state of the art techniques enable us to produce microwave components for use in commercial, military, and space applications.



Multipin Connectors

Radiall has an unmatched range of rack and panel connectors and the most innovative modular and tool-less connectors used in harnesses and equipment connections. Our modern designs combine light weight, high performance levels and user friendly features to simplify even the most complex connections.



Space Qualified

Industry leaders across the globe recognize the Radiall brand for quality, reliability, and performance. Our Space Qualified passive product offering includes a wide range of coaxial connectors, cable assemblies, microwave components, and switches with a frequency range up to Ka band.



Harnesses

The combination of design and manufacturing of RF and microwave cables as well as multipin connectors (EPX, ARINC 404 and 600) allows Radiall to be a specialist of harnesses for onboard or land equipment or communications systems. All types of contacts can be used and mixed such as signal, power, RF, quadrx, fiber optic...



RF & Microwave Switches

All Radiall switches provide exceptional reliability and performance. A unique modular and patented design of the actuator and transmission link enables Radiall to guarantee operation up to 10 million cycles with excellent repeatability, while reducing delivery times.



Antennas

Radiall provides highly reliable antenna solutions for industrial and military applications. Our solutions include Line-Of-Sight tactical communications, vehicular mount, GPS, telemetry, and mesh networks. For optimum performance requirements, Radiall offers custom antenna solutions and support.



RF Cable Assemblies

Radiall has an extensive range of cable assemblies with outstanding electrical performance, low loss, and high frequency. Our range includes flexible, semi rigid and handformable cable assemblies. Our TestPro™ range meets the stringent requirements needed for test and lab applications.



D-Lightsys®

Active Optical Solutions Optimized by D-Lightsys® for harsh environments. From optical transceivers to the world's smallest parallel optics, D-Lightsys® technologies support the most challenging applications, including harsh environments and avionics applications.



Fiber Optics

Radiall designs and supports high performance end-to-end Optical Interconnect solutions. Our offer includes standard interfaces, termini, connectors, harnesses and custom design optical links and subsystems. The flexibility and high quality of our product range supports harsh environments and demanding applications.

Contents

TECHNICAL INFORMATION

Coaxial Switches Activity Information..... 1-2 to 1-6

Manufacturing & Quality Assurance Flow 1-7

RAMSES Concept 1-8 to 1-9

RF Arrangement 1-10

Glossary (including RF Power Rating Chart page 1-13)..... 1-11 to 1-14

RF Repeatability & Life Test Parameters 1-15

Conversions..... 1-16 to 1-20

User Handbook..... 1-21

Applications..... 1-22

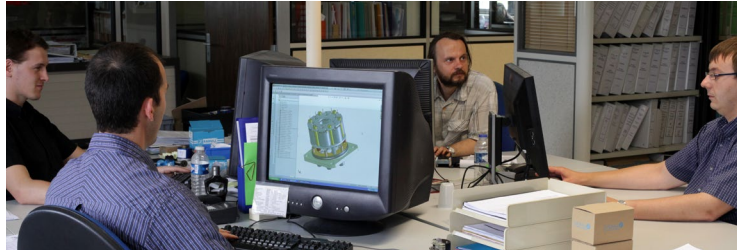
Coaxial Switches Activity Information

EXPERIENCE

With over 60 years of experience and continuous efforts in R&D, Radiall has become Europe's number one source for coaxial connectors. Radiall's position as a market leader has enabled the company to excel in the passive microwave component field for more than 50 years. Radiall's expertise in design, development and manufacturing of passive microwave components is widely acknowledged in today's industry.

A WIDE RANGE OF SOLUTIONS

Specialized in passive microwave components, Radiall's design team and engineering staff manufactures a wide range of standard coaxial devices including: terminations, attenuators, couplers, coaxial detectors, coaxial and waveguide switches covering a frequency range from DC to 50 GHz.



RESEARCH AND DEVELOPMENT

Due to the increased complexity of microwave systems more high performance components are required.

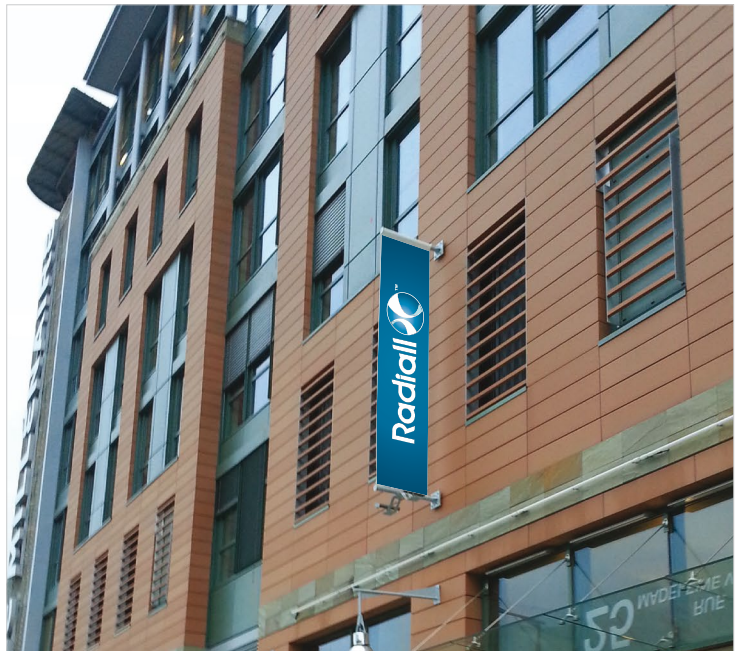
To meet these requirements, Radiall's R&D department is constantly working on development of new products and improvement on existing products.

Equipped with microwave and mechanical CAD and the latest generation of microwave test equipment up to 60 GHz, Radiall uses state-of-the-art technology to optimize products and quickly respond to specific customer requests.



CAPACITIES AND FACILITIES

Radiall's global presence and worldwide facilities offer expertise in the following: marketing, research and development, industrialization, manufacturing and quality control. This strong heritage enables Radiall to produce a range of high performance and low cost devices for industrial applications, and high reliability components for severe requirements in military and space markets.



Head office - Aubervilliers France

Coaxial Switches Activity Information

PRODUCTION

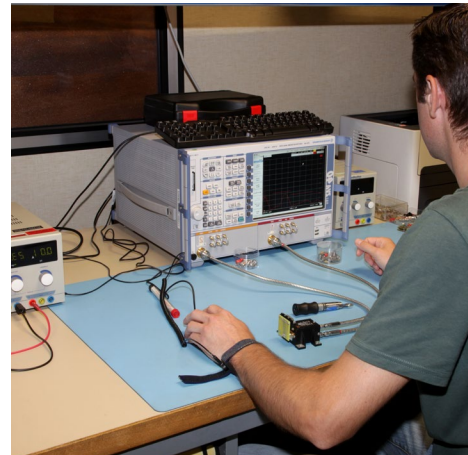
Electrical performance of microwave products is determined by machining quality of individual piece parts and associated plating.

Equipped with computer-controlled machinery, and an in-house plating department, Radiall is able to manufacture high quality piece parts that are compatible with existing components.

Due to the thick and thin film etching equipment, Radiall's production department guarantees the quality of the resistive cells used in most terminated switching products. A prototype workshop allows Radiall to quickly respond to special customer request.

All the phases of manufacturing and test are strictly inspected by our quality department, so as to warrant the constancy of our products and to achieve general and specific requirements.

Radiall's quality department inspects products through all phases of manufacturing and testing, to ensure consistency to all products for customer satisfaction.



QUALITY AND RELIABILITY AND PATENTS

Radiall's main focus for passive microwave components are quality and reliability. ISO 9001 V2008 label is the best evidence of quality assurance interfaces at every stage of a product from designing to manufacturing.

All new products are subject to a rigid qualification program before massive production begins. Additionally, product quality is reviewed and tested periodically.

NATO CODE

Radiall is a qualified microwave components manufacturer under military label (manufacturer code F0503 and F6507), and offers quality assurance developed in accordance with N.A.T.O. standards.



TECHNICAL INFORMATION

Coaxial Switches Activity Information

A TESTING LABORATORY

As an illustration of Radiall's commitment to quality and reliability, Radiall has an in-house test laboratory qualified by CECC which permits Radiall to complete the majority of tests required by customers.

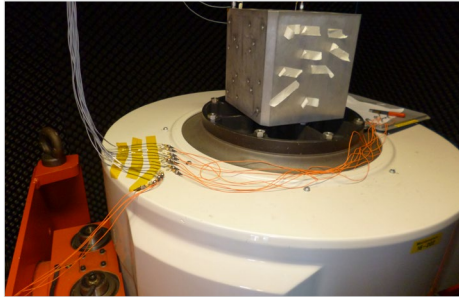
PARTIAL LIST OF TEST MEANS

Electrical



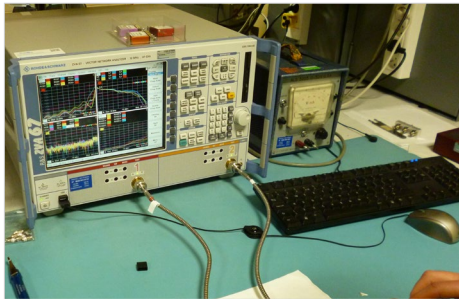
Breakdown voltage	12 KVolts
Insulation resistance	40.103 MOhms
Contact resistance	1μOhms

Environmental



Vibrations: Sine random	0 - 120 g; 5 to 4000 Hz
Shocks	30 to 1000g
Shakes	25 to 40g 6 ms
Thermal vacuum	10-5 TORR; -45 to +100°C
Thermal shock	-70°C +200°C / transfert 20s
Storage temperature	-70°C to +200°C
Humidity	20 to 98 % HR
Salt Spray	-35°C to +55°C
Hermeticity	Helium 10-5 to 10-8 atm cm3 /s

Microwave



V.S.W.R. insertion loss Isolation	Vector Network Analyzer From 0.04 up to 60 GHz TDR 150ps
RF Leakage/EMC	Reverberation chamber method 0.5 to 20 GHz / Noise 100 dB
Power Handling	400 W CW at 936 MHz 400 W CW at 17.8 GHz 20 W CW 8 up to 18 GHz 100 W CW at 420 MHz

Coaxial Switches Activity Information

CAPABILITIES

Radiall offers a wide variety of coaxial switches to answer customer needs. This catalog is intended to be used as a guide in selecting the right type of switch for a given application. It is important to note that Radiall is not limited to catalog products and has the flexibility to design a specific product on a tight schedule at a reasonable cost. Radiall is always available to discuss specific customer requests.



RELIABILITY

Radiall's coaxial switches offer exceptional reliability and performance. A unique patented design of the actuator and transmission link enables Radiall to guarantee operation up to 10 million cycle for Terminated SPnT, others series as well, with excellent repeatability.



LIST OF APPLICABLE DOCUMENTS

AIR 7304	NFC 93563	MIL C 39012
DIN 47295	NFC 93564	MIL E 5400
NFC 93561	NFC 96317	MIL STD 202
NFC 93562	MIL DTL 3928	154 IEC

List of related covering the general mechanical and environmental tests applicable to the devices described in this catalog.

Coaxial Switches Activity Information

GENERAL SPECIFICATIONS DESIGNED TO MEET MIL DTL 3928 AND MIL STD 202

Environmental Characteristics

Vibrations Method 204	10 - 2000 Hz 10g	Operating
Shocks Method 213	50g, 1/2 sine	Non-operating

These requirements are guaranteed according to MIL standard, see applicable product section to get more accurate and detailed information.

Mechanical Characteristics, Material and Finished

RF body	Aluminium, Gold plated Aluminium, Nickel plated Aluminium with Cr3 passivation
Contacts	Beryllium Copper, Gold plated
Insulator	PTFE, ULTEM 1000
Connectors	Stainless steel, passivated brass, Nickel plated
Construction	Splash proof
Cover	Aluminium, blue anodized

All materials and finishes are in accordance with applicable MIL and NF specifications. All connectors are in accordance with applicable MIL, DIN, NF and CEI specifications. All dimensions in this catalog are given in millimeters. The non specified dimensions are given within +/- 0.5 mm.

Manufacturing and Quality Assurance

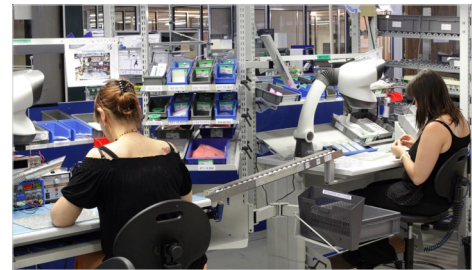
Radiall's RF switches product line is made of approximately 20 series of switches, with each series divided into a large number of configurations. Part numbers consist of 9 digits, each digit designating a portion of the parts actual identity (such as series, frequency, actuator voltage, etc...).

For each digit, 2 to 10 options are available. A complete part number represents a unique configuration.

Overall, there are more than 80,000 different configurations available with very few subassemblies due to the modularity of the RAMSES switching line (less than 300 different subassemblies).

A Push-Pull manufacturing process has been implemented to reduce both lead time and inventory. Based upon marketing forecast and monthly updates, various subassemblies are manufactured.

When an order is received, an automated MRP system selects the appropriate subassemblies from stock to manufacture the requested products within a short time frame (a few days to a few weeks) depending on the complexity of the product.



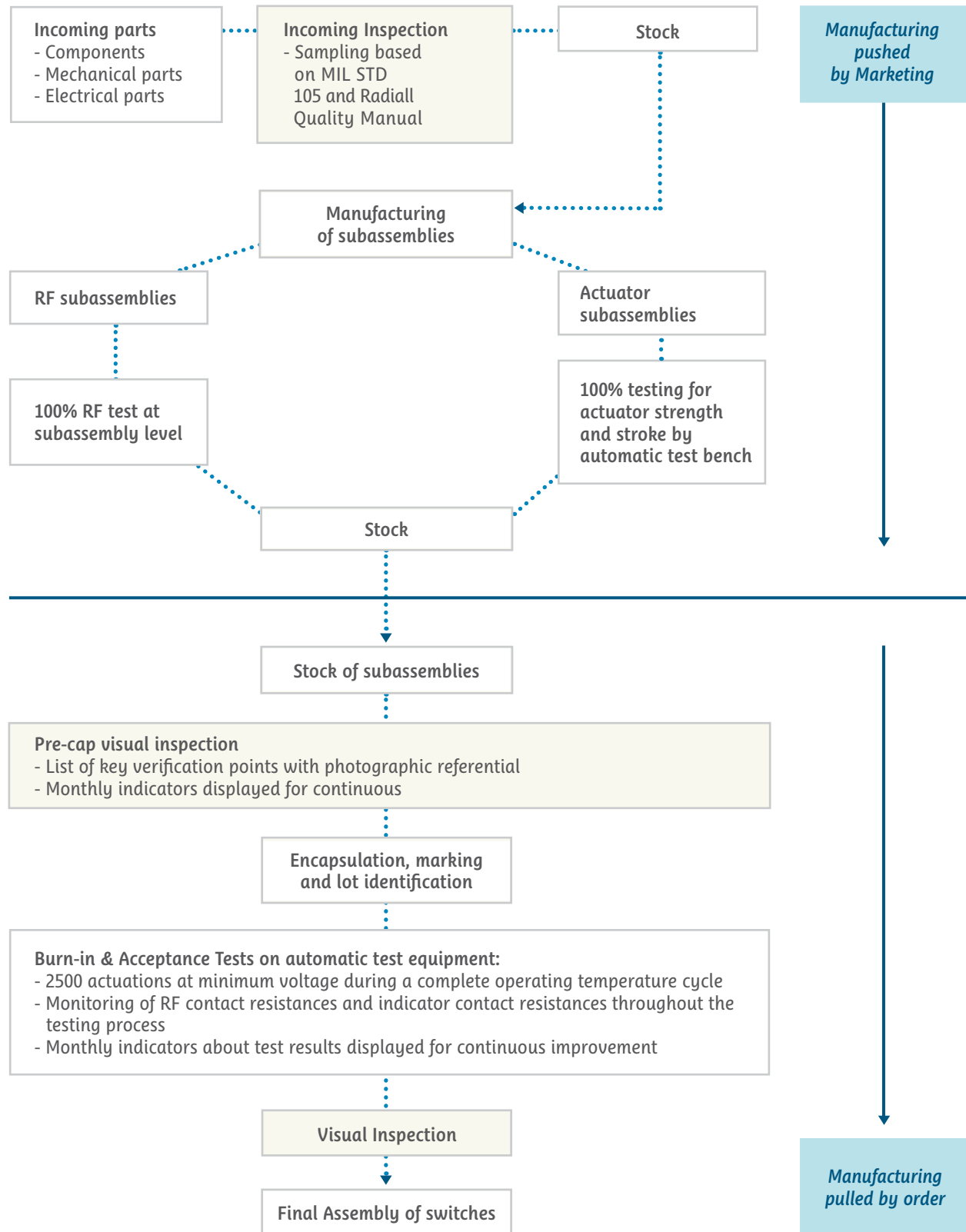
Radiall has adopted the process management philosophy of "Lean Manufacturing".

This process enables the best possible price and lead times on coaxial products by eliminating unnecessary stages of the administrative processes.

The lean manufacturing concept, was first applied to the RAMSES SPDT and SP6T non terminated coaxial products and is now being expended over all coaxial switches.

Manufacturing and Quality Assurance Flow

Quality

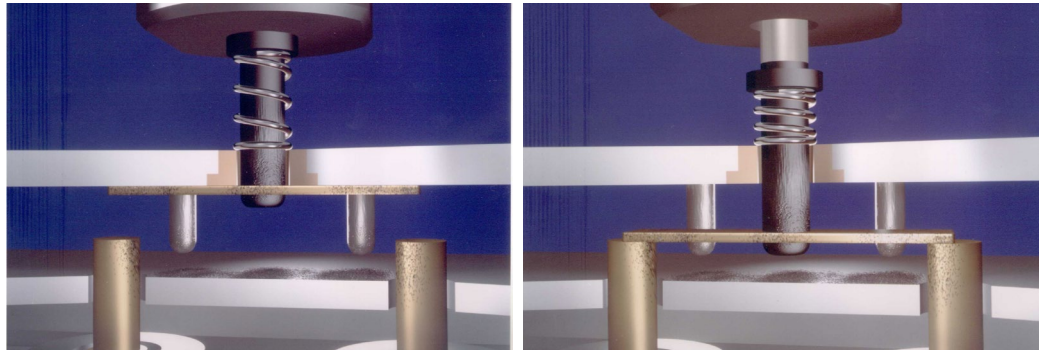


TECHNICAL INFORMATION

RAMSES Concept

An innovative system has been designed for constructing electromechanical coaxial RF switches with increased long-term reliability. Radiall's Modular System for Electromechanical Switches (RAMSES) is a patented concept that enables microwave coaxial switches to be produced with a typical operating life of 10 million cycles while suffering no decrease in contact resistance reliability over time. In addition, the unique internal construction makes the switches cost-competitive with traditional switches.

Figure 1: conventional switch contacts after one million cycles



a) RF line open

(b) RF line closed

Friction Effects

The unique design of RAMSES is based on the reduction of friction, which minimizes particle deposits that can interfere with the transmission of lower frequency signals (up to 3 GHz).

This particle elimination effect is particularly important for telecommunication applications that are currently in the 900 MHz and 2 GHz range. In addition, the design involves fewer components compared to other microwave switches, making it quick and easy to assemble.

These savings directly relate to lower cost for improved performance. Many of the existing coaxial electromechanical switches also are able to function mechanically for 10 million operations.

However, the reliability and quality of the electrical contact can decrease over the life cycle.

In general, these traditional switches operate by moving a rectangular switching blade section inside a rectangular cavity. The blades are linked with pushers constructed of dielectric material that travel inside an access hole between the RF cavity and switch actuator. The pushers are directed by dielectric material guides. These dielectric parts rub on the blades and inside the access hole and generate isolating particles in the RF cavity that pollute the electrical contacts and ultimately cause running defects.

Figure 1 shows the build-up of minute dielectric particles on a set of conventional switch contacts after one million cycles. These defects are not particularly noticeable at very high frequencies since the contact is established by a capacitive effect. However the insertion loss of the contacts increases considerably at lower frequencies (3 GHz below).

RAMSES Concept

A New Actuator Configuration

To eliminate this problem of increased insertion loss in the contacts, RAMSES devices incorporate a patented system. This system, compresses two parallel blades suspended from a bearer, which enables the guiding and positioning of the commutation blades to be accomplished entirely outside the RF cavity. These blades impose a rectilinear motion on the switching pusher, suppressing both friction and the production of particles inside the RF cavity. The unique system is extremely small and can be used in all of RAMSES series switches.

Figure 2: cutaway view

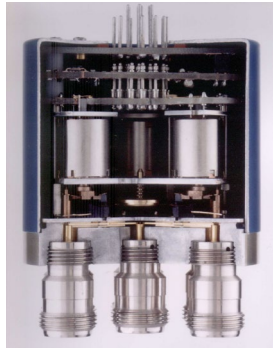
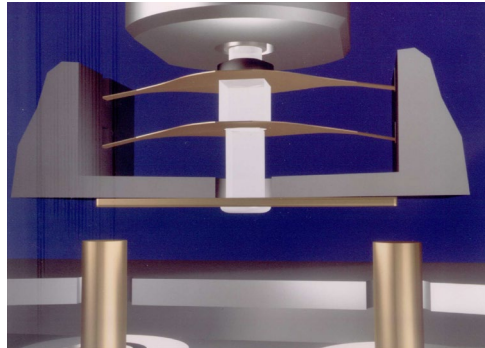
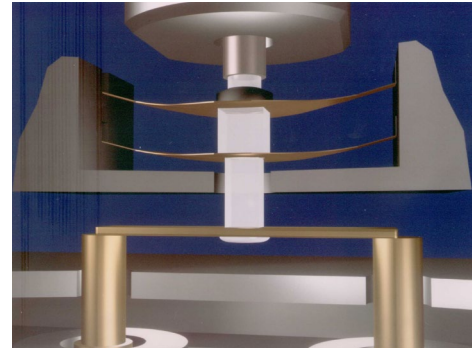


Figure 3: a RAMSES set of contacts



a) RF line open



(b) RF line closed

Figure 2 shows a cutaway view of a RAMSES coaxial switch displaying the actuator mechanism. A second improvement involves a new rectilinear actuator design using high energy magnets and a switching performance in relation to its size.

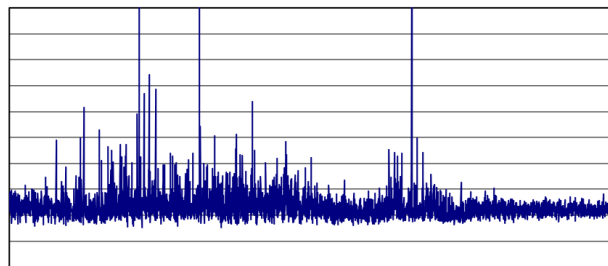
The system is used in the production of both failsafe and latching actuators, depending on how it is applied in the switch. These actuators are either 500g locking forces or 300 to 800g current forces for a power consumption of 100mA at 28V.

The new actuator has the added advantage of very low magnetic leakage, allowing actuators to be used in close proximity to one another without performance degradation. The use of a dry, solid lubricant and the control of friction areas provide an actuator life expectancy of over 50 million operations without defect when temperature range exceeds -55° to +85°C.

Switch Performances

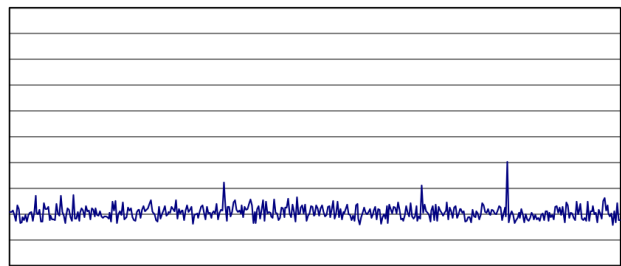
RAMSES series switches have successfully survived tests of 10 million switching temperature cycles from -55° to +85°C while demonstrating good contact resistance stability. Visual inspection of these switches after testing has indicated that the RF lines were free of much of the contamination found during similar tests on traditional switches. A comparison of the actual measured contact resistance obtained from monitoring both conventional and RAMSES switches using several parts that have already been actuated one million cycles is shown in figure 4. Although the conventional switch may not be considered failure, its contact resistance has become unstable, thus degrading its reliability.

Figure 4: A comparison of (a) conventional and



CYCLES

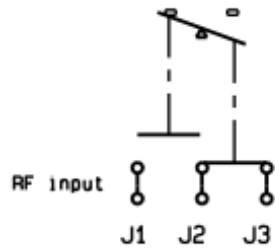
(b) RAMSES switch design contact resistance during one million cycles



CYCLES

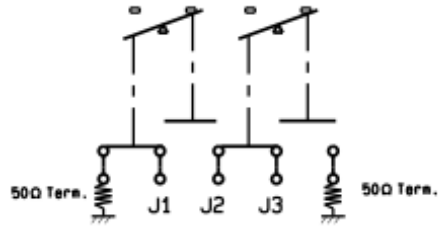
RF Arrangement

Coaxial SPDT Switch
(Single Pole Double Throw)



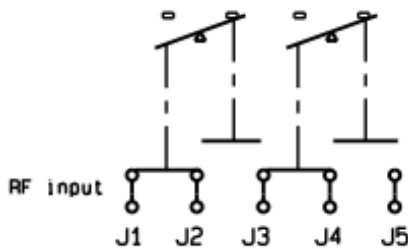
Single pole Double Throw Switch
A switch with one input port and two selectable output ports

Coaxial SPDT Terminated Switch
(Single Pole Double Throw terminated)



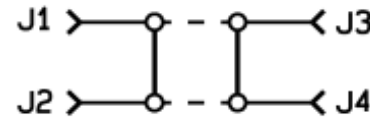
Single Pole Double Throw, Terminated switch
Same as SPDT, but the unused output port is automatically terminated by a 50 Ohm resistive load.

Coaxial DP3T Switch
(Double Pole Three Throw)



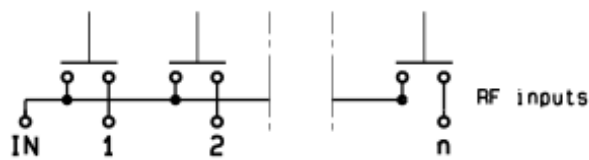
Double Pole Three Throw switch
A switch with two input ports and three output ports. Each input (J2 - J4) can be switched between two adjacent outputs with one output being common to both inputs

Coaxial DPDT Switch
(Double Pole Double Throw)



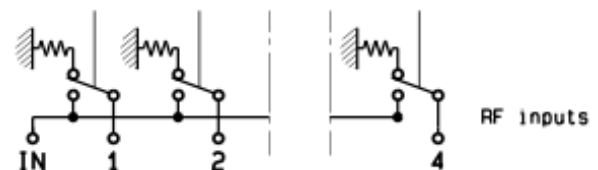
Double Pole Double Throw Switch
A four port switch with two independent paths that operate simultaneously in one of two selected positions. In a DPDT / Transfer switch, the two transmission paths are provided as shown above

Coaxial Multiposition Switch
(Single Pole n Throw)



Single Pole n Throw Switch (n<13)
A switch with one input port and more than two output ports. The multiposition switch allows direct access to any individual output port by energizing the respective actuator. Radiall SPnT switches provide up to 12 Output ports

Coaxial Multiposition Terminated Switch
(Single Pole n Throw Terminated)



Single Pole n Throw Terminated Switch (n<13)
Same as SPnT, but each unused output port is automatically terminated in an internal 50 Ohm resistive load.

Glossary

Actuator Voltage: All RAMSES series relays are either 12 or 28 Vdc nominal voltage over the entire temperature range. The switches can be operated with a voltage between -15 % and +10 % of the nominal value. Other voltage as 5, 15 or 24 Volts can be supplied at the customer's request.

Automatic "Reset": All Latching version multiposition switches (or SPnT) cause the following scenario:

When a RF path is closed, it remains in the closed position after the voltage is cut-off (latching function). To switch to another path, the first path must be opened via a "RESET" driver, followed by the closing of the second RF path. Without the "RESET" driver, both paths would remain in the ON position at the same time.

To simplify the use of latching products, an "automatic RESET" is recommended. The auto reset feature is accomplished by an electronic circuit which brings about the automatic opening of a previously closed path during changes of position of the switches.

Note: This option produces a higher current consumption during a few milliseconds (see voltage & current values listed on the product's individual Technical Data Sheet).

BCD (Binary Code Decimal) Driver Interface

BCD logic coding				RF & Microwave ways position
E4	E3	E2	E1	
0	0	0	0	Latching models: all ways in "OFF" position
0	0	0	0	Normally Open models: memory of last position
0	0	0	1	Way IN - 1 in "ON" position
0	0	1	0	Way IN - 2 in "ON" position
0	0	1	1	Way IN - 3 in "ON" position
0	1	0	0	Way IN - 4 in "ON" position
0	1	0	1	Way IN - 5 in "ON" position
0	1	1	0	Way IN - 6 in "ON" position
0	1	1	1	Way IN - 7 in "ON" position
1	0	0	0	Way IN - 8 in "ON" position
1	0	0	1	Way IN - 9 in "ON" position
1	0	1	0	Way IN - 10 in "ON" position
1	0	1	1	Way IN - 11 in "ON" position
1	1	0	0	Way IN - 12 in "ON" position
1	1	1	1	Latching models: memory of last position
1	1	1	1	Normally Open models: all ways are in "OFF" position

Note: E1, E2, E3, E4 are BCD driver pins of the product. E4 applies only with 8 positions or more. E3 applies only 4 positions or more.

Break Before Make: Radiall coaxial relays are considered "break before make". In a break before make product the contact of the first path leaves its state before the final contact has been established.

Failsafe: A switch with an actuator that contains a return mechanism, either mechanical or magnetic, that provides RF connection to one selected position when no voltage is applied to the power terminals. This type of switch requires continuous voltage to maintain RF connection to any other position.

Frequency Range: The frequency range for each device indicates the maximum frequency Radiall will guarantee for the products performance.

Indicator Contacts: Electrical contacts of an "open circuit, short-circuit" type, mechanically linked to the actuator and synchronized with switched RF paths, ensure the recopy of positions of RF transmission paths. When a microwave path is switched, the corresponding indicator contact is closed. It is generally used with pilot lamps to indicate position of RF contacts (characteristics are given for a resistive load).

Glossary

Intermodulation (PIM): or intermod for short, is a form of signal distortion that occurs whenever signals of two or more frequencies are produced in a passive device which contains some linear response. This interference includes low contact pressure, dirty interconnects, magnetic materials or other anodic effect.

The typical value for Radiall switches is around 120 dBc (with 2 carriers at +43 dBm), however products can be designed for higher performance upon request.

Isolation: The RF leakage from a connected path to any connector outside that path. Isolation is measured in decibels below the input power.

Latching: A switch with an actuator that contains a mechanism, either mechanical or magnetic, that will maintain a chosen RF contact path whether voltage is maintained or not after switching is accomplished. A pulse length of a duration equal to the maximum switching time is enough to change the switch position.

Life: Number of toggles a product is able to carry out. Relays and switches of RAMSES, PLATINUM and TITANIUM ranges have a life cycle of 2 to 10 million cycles.

Normally Open: is a mode of operation in which all output ports of the switch are disconnected from the input port until a voltage is applied to a selected position.

Switches family	Type of		Pin number	Comments
	Series	Connector		
RAMSES SPDT	SPDT => R570	D-Sub (male)	9 pins	Available only on products described on page 2-20
	SPDT => R572	N/A		Only solder pins
PLATINUM SPDT	SPDT => R595	D-Sub (male)	9 pins	Non terminated models
RAMSES DPDT	DPDT => R577	D-Sub (male)	9 pins	--
TITANIUM DPDT	DPDT => R513	HE10 ribbon receptacle (male)	10 pins	Delivered with ribbon cable 750 mm (30 inches) + HE10 connector (female)
PLATINUM DPDT	DPDT => R593			
RAMSES DP3T (1)	DP3T => R585	N/A		Only solder pins
PLATINUM DP3T (1)	DP3T => R595	D-Sub (male)	9 pins	--
RAMSES & Subminiature SPnT	SPnT => R573/ R574 3 to 10 positions 11 and 12 positions	D-Sub (male)	25 pins	--
			44 pins	High density
	SPnT => R591 4 and 6 positions	Micro-D receptacle (female)	9 pins	--
TITANIUM SPnT	SPnT => R514 4 and 6 positions	HE10 ribbon receptacle (male)	16 pins	Delivered with ribbon cable 750 mm (30 inches) + HE10 connector (female)
PLATINUM SPnT	SPnT => R594 4 and 6 positions			

Note (1): Terminated RAMSES & PLATINUM SPDT are included in R585 & R595

PLATINUM and TITANIUM series: The RAMSES concept (without friction) and over 40 years of expertise in manufacturing coaxial switches, Radiall's introduces a new range of high performance coaxial switches to the market place: PLATINUM Series.

Following an increasing need in the instrumentation market, Radiall's PLATINUM coaxial switches are optimized for use in automatic test benches or measurement equipment. With a guarantee insertion loss repeatability of 0.03 dB over the life of the product (10 million), PLATINUM Series switches are perfectly suited for applications requiring excellent RF performance. The full range of coaxial switches, such as SPDT-DP3T (R595 series), transfer relay DPDT (R593 series) and multithrow switches SPnT (R594 series), offer the same level of RF performance and are suitable for use in stringent environments.

TITANIUM series offer the same RF performance as PLATINUM series. TITANIUM products are more economically priced due to the reduced number of life cycles guaranteed (2.5M vs 10M for PLATINUM). This product line is ideal for the Instrumentation market, where RF performance is more critical than the number of actuations guaranteed.

Glossary

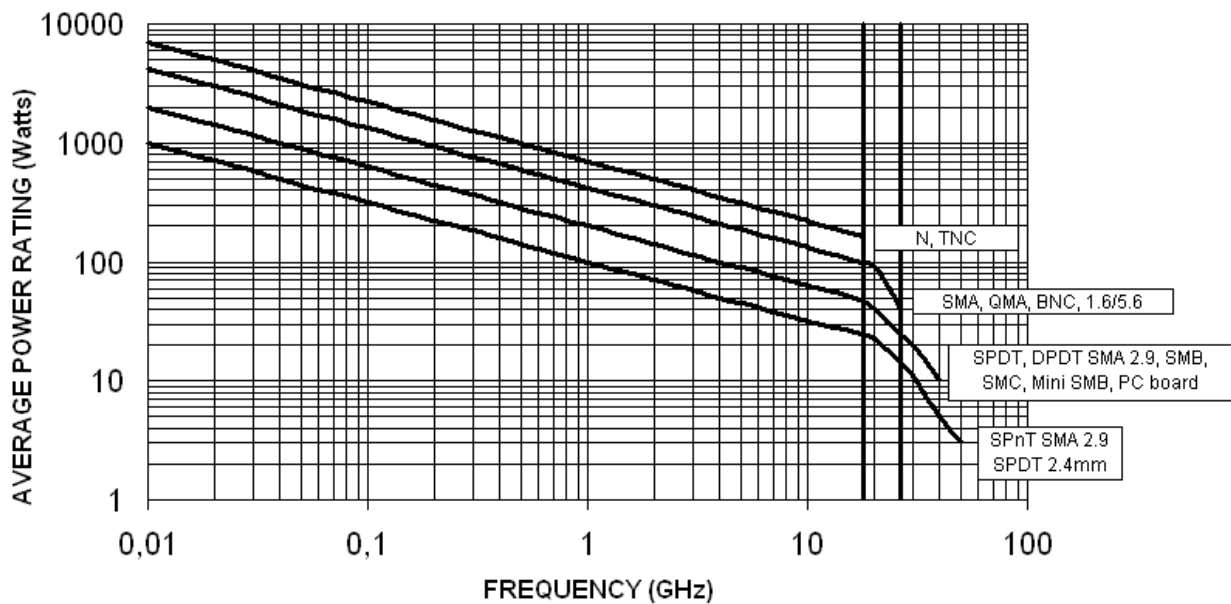
Polarity: A common negative polarity is chosen by Radiall for its standard products. An inverted polarity (common plus) is available on RAMSES range, contact Radiall for availability.

Note: For PLATINUM and TITANIUM series, Common plus polarity potential is chosen for its standard products.

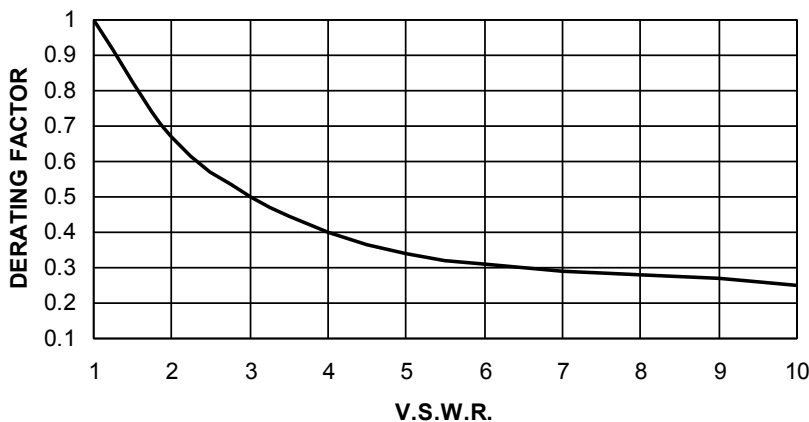
RF Power Chart: The RF power rating is the capability of handling RF power (CW power) through closed contacts. The RF power should be removed during switching. Power ratings assume unity V.S.W.R. (matched load) at room temperature (25°C), sea level pressure (14.7 p.s.i.) and cold switching. See below the CW power capability Vs. Frequency Chart. Changes in these specifications require power derating (see derating factor versus V.S.W.R.).

This graph is based on the following conditions:

- Ambient temperature: +25°C
- Sea Level
- V.S.W.R.: 1:1 and cold switching



Derating Factor: The average power input must be reduced for load V.S.W.R. above 1:1.



Glossary

Peak Power Handling: The maximum peak power, when applied at room temperature under a pulse of one microsecond every millisecond, will not permanently change the specifications of the switch. Power applied over this limit will alter the RF performance of the switch.

Repeatability: The maximum standard deviation in insertion loss specifications on each path over the life of the product. Insertion loss repeatability is specified for all PLATINUM series (0.03dB over 10 million) and all TITANIUM series (0.03dB over 2.5 million).

RF Connectors: RF connectors are 50 or 75 Ohms female, unless otherwise specified. The applicable mating dimensions, materials and finish are in accordance with applicable sections of international standard (MIL C 39012, DIN 47295).

NB RADIAL 75 Ohm coaxial switches are only available with DIN 1.6/5.6 (screw, snap and slide connector) and mini SMB RF connectors.

Self Cut Off: The ability of a switch to disconnect the actuator voltage as soon as the switching of the position is carried out. The system applies to latching relays and is achieved with solid state circuitry. Self Cut-Off time for our RAMSES coaxial switches is from 40ms to 120ms.

Solder Pin: RAMSES relays are equipped with solder pins for the control and indicator contacts. The maximum temperature during soldering should not exceed 250°C for 30 seconds or 300°C for 10 seconds for leadfree soldering process.

Suppression Diodes: Diodes connected in parallel with the coil of a switch to suppress transient voltage generated by the self inductance of the coil during the driver signal cut-off. This option is systematically enclosed in all TTL, SELF CUT-OFF and all electronic interfaces.

Switching Time: The total amount of time between applying voltage to the actuator terminals and the completion of switching (including all contact bounce - if any). Total switching time consists of three parts, namely inductive delay in the actuator coil, transfer time of the RF contacts, and bounce time of the RF contacts.

TTL Driver Interface: The interface of an electronic circuit which enables driving either relays or switches by TTL logic signals. Products equipped with this option have a pin for the voltage of the actuator (12 V or 28 V) as well as a TTL driver pin shared per position. The polarity is not relevant to applications for switches with this option. The logic used is positive, therefore high level nominal +5V (2.2 to 5.5 V) of TTL signal means logic «1» which enables the corresponding microwave way. Low level i.e logic contacts 0, voltage is 0-0.8 V.

V.S.W.R.: The Voltage Standing Wave Ratio is a measure of the return loss or level of the reflected signal of a device connected on a transmission line. V.S.W.R. is linked to the coefficient of reflection (r) by the equation:

$$VSWR = \frac{1+r}{1-r} \quad r = \frac{Z-Z_0}{Z+Z_0}$$

V.S.W.R. varies from 1 to ∞, a value equal to 1 represents a perfect matching

with:

“r” is the coefficient of reflection

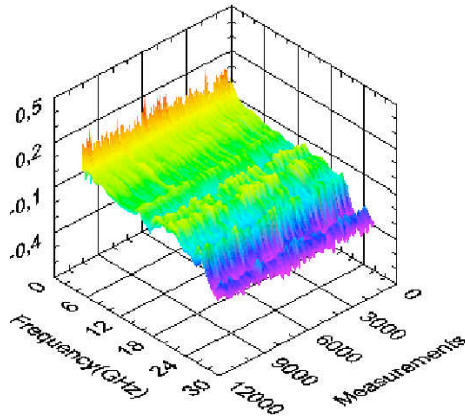
“Z₀” is the characteristic impedance of the line

“Z” is the impedance of the line

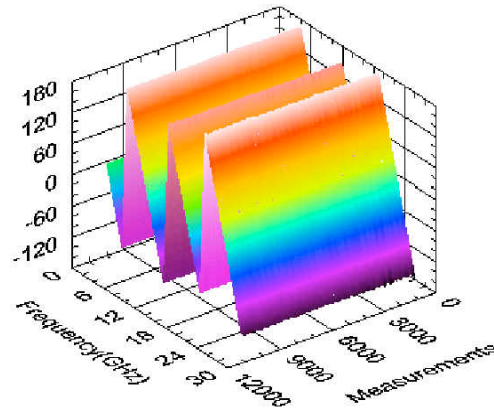
RF Repeatability and Life Test Parameters

Radiall has built an Automatic Test Bench composed by a Vector Network Analyzer (VNA), Digital Multi-Meters (DMM), PC and a switch driver. This approach is to qualify over the complete life of the switch (2.5 million to 10 million cycles depending on switch models). This ATE extracts and stores the RF parameters or contacts resistances of the switch according to our own internal procedure. For each frequency point a calculation of VSWR, insertion loss and standard deviation are computed. All measurements are performed at room temperature (RF switch is toggled at 3Hz).

The curves in 3D illustrate the RF characteristics over 10 million switching cycles on SP6T-26.5GHz Ramses switch.



Insertion loss over 10 million cycles



Phase over 10 million cycle

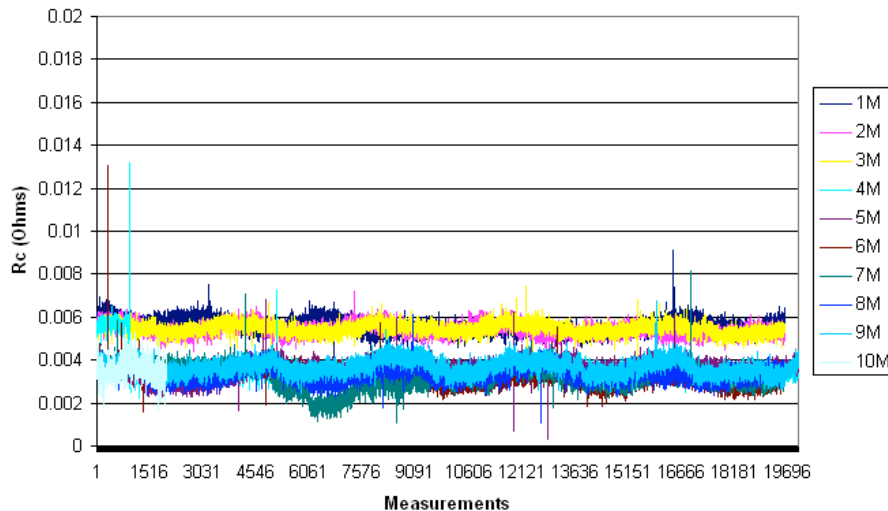
The contribution due to only Rc can be calculated as follows:

$$RL = 20 \text{ Log}_{10} |\Gamma| = 20 \text{ Log}_{10} \frac{R_c}{2R_o + R_c}$$

$$VSWR = 1 + \frac{R_c}{R_o}$$

$$IL = 10 \text{ Log}_{10} \frac{R_o}{R_o + R_c}$$

The following curve shows RF contact resistance up to 10 million. Switch was toggled at 3Hz with Rc recorded each 50 cycles.



Conversions

CONVERSION MEASUREMENT UNIT

- Convert Inch to millimeters: 1 Inch=25.4mm / 1 meter=39.3 Inches
- Convert centimeters to feet: 1 foot=30.48 cm / 1 meter=3.28 feet
- Convert kilogram to pounds: 1 kg=2.20 Lb / 1 pound=0.45 kg

REFLECTION COEFFICIENT RETURN LOSS CONVERSION

Reflection coefficient (ρ)

Standard Wave Ratio $(1 + \rho) / (1 - \rho)$

Return Loss (dB) $(-20 \log_{10}\rho)$

Reflection coefficient	V.S.W.R.	Return loss (dB)	Reflection coefficient	V.S.W.R.	Return loss (dB)
0	1.00	∞	0.195	1.48	14.2
0.01	1.02	40.0	0.2	1.5	14.0
0.015	1.03	36.5	0.205	1.52	13.8
0.02	1.04	34.0	0.21	1.53	13.6
0.025	1.05	32.0	0.215	1.55	13.4
0.03	1.06	30.5	0.22	1.56	13.2
0.035	1.07	29.1	0.225	1.58	13.0
0.04	1.08	28.0	0.23	1.6	12.8
0.045	1.09	26.9	0.235	1.61	12.6
0.046	1.10	26.7	0.24	1.63	12.4
0.05	1.11	26.0	0.245	1.65	12.2
0.055	1.12	25.2	0.25	1.67	12.0
0.06	1.13	24.4	0.255	1.68	11.9
0.065	1.14	23.7	0.26	1.7	11.7
0.07	1.15	23.1	0.265	1.72	11.5
0.075	1.16	22.5	0.27	1.74	11.4
0.08	1.17	21.9	0.275	1.76	11.2
0.085	1.19	21.4	0.28	1.78	11.1
0.09	1.20	20.9	0.285	1.80	10.9
0.095	1.21	20.4	0.29	1.82	10.8
0.1	1.22	20.0	0.295	1.84	10.6
0.105	1.23	19.6	0.3	1.86	10.5
0.11	1.25	19.2	0.305	1.88	10.3
0.115	1.26	18.8	0.31	1.90	10.2
0.12	1.27	18.4	0.32	1.94	9.9
0.125	1.29	18.1	0.33	1.99	9.6
0.13	1.30	17.7	0.34	2.03	9.4
0.135	1.31	17.4	0.35	2.08	9.1
0.14	1.33	17.1	0.36	2.13	8.9
0.145	1.34	16.8	0.37	2.17	8.6
0.15	1.35	16.5	0.38	2.23	8.4
0.155	1.37	16.2	0.39	2.28	8.2
0.16	1.38	15.9	0.4	2.33	8.0
0.165	1.4	15.7	0.41	2.39	7.7
0.17	1.41	15.4	0.42	2.45	7.5
0.175	1.42	15.1	0.43	2.51	7.3
0.18	1.44	14.9	0.44	2.57	7.1
0.185	1.45	14.7	0.45	2.64	6.9
0.19	1.47	14.4	0.5	3.00	6.0

Conversions

POWER CONVERSION

$\text{dBm} = 10 \times \text{Log}_{10} P \text{ (milliwatts)}$

$P \text{ (milliwatts)} = 10^{(\text{dBm}/10)}$

Power (dBm)	Power (W)	Power (dBm)	Power (W)
-49	0.01 μW	1	1.26 mW
-48	0.02 μW	2	1.58 mW
-47	0.02 μW	3	2.00 mW
-46	0.03 μW	4	2.51 mW
-45	0.03 μW	5	3.16 mW
-44	0.04 μW	6	3.98 mW
-43	0.05 μW	7	5.01 mW
-42	0.06 μW	8	6.31 mW
-41	0.08 μW	9	7.94 mW
-40	0.10 μW	10	10 mW
-39	0.13 μW	11	12.59 mW
-38	0.16 μW	12	15.85 mW
-37	0.20 μW	13	19.95 mW
-36	0.25 μW	14	25.12 mW
-35	0.32 μW	15	31.62 mW
-34	0.40 μW	16	39.81 mW
-33	0.50 μW	17	50.12 mW
-32	0.63 μW	18	63.10 mW
-31	0.79 μW	19	79.43 mW
-30	1 μW	20	100 mW
-29	1.26 μW	21	125.89 mW
-28	1.58 μW	22	158.49 mW
-27	2 μW	23	199.53 mW
-26	2.51 μW	24	251.19 mW
-25	3.16 μW	25	316.23 mW
-24	3.98 μW	26	398.11 mW
-23	5.01 μW	27	501.19 mW
-22	6.31 μW	28	630.96 mW
-21	7.94 μW	29	794.33 mW
-20	10 μW	30	1 W
-19	12.59 μW	31	1.26 W
-18	15.85 μW	32	1.58 W
-17	19.95 μW	33	2 W
-16	25.12 μW	34	2.51 W
-15	31.62 μW	35	3.16 W
-14	39.81 μW	36	3.98 W
-13	50.12 μW	37	5.01 W
-12	63.10 μW	38	6.31 W
-11	79.43 μW	39	7.94 W
-10	100.00 μW	40	10 W
-9	125.89 μW	41	12.59 W
-8	158.49 μW	42	15.85 W
-7	199.53 μW	43	19.95 W
-6	251.19 μW	44	25.12 W
-5	316.23 μW	45	31.62 W
-4	398.11 μW	46	39.81 W
-3	501.19 μW	47	50.12 W
-2	630.96 μW	48	63.10 W
-1	794.33 μW	49	79.43 W
0	1 mW	50	100 W

Conversions

TEMPERATURE EQUIVALENCE

Temp (°C) = ((°F - 32) x 5) / 9

Temp (°F) = ((9 x °C) / 5) + 32

°C	°F	°C	°F	°C	°F
-80	-112.0	22	71.6	73	163.4
-70	-94.0	23	73.4	74	165.2
-60	-76.0	24	75.2	75	167.0
-50	-58.0	25	77.0	76	168.8
-45	-49.1	26	78.8	77	170.6
-40	-40.0	27	80.6	78	172.4
-35	-31.0	28	82.4	79	174.2
-30	-22.0	29	84.2	80	176.0
-25	-13.0	30	86.0	81	177.8
-20	-4.0	31	87.8	82	179.6
-19	-2.2	32	89.6	83	181.4
-18	-0.4	33	91.4	84	183.2
-17	1.4	34	93.2	85	185.0
-16	3.2	35	95.0	86	186.6
-15	5.0	36	96.8	87	188.8
-14	6.8	37	98.6	88	190.4
-13	8.6	38	100.4	89	192.2
-12	10.4	39	102.2	90	194.0
-11	12.2	40	104.0	91	195.8
-10	14.0	41	105.8	92	197.6
-9	15.8	42	107.6	93	199.4
-8	17.6	43	109.4	94	201.2
-7	19.4	44	111.2	95	203.0
-6	21.2	45	113.0	96	204.8
-5	23.0	46	114.8	97	206.6
-4	24.8	47	116.6	98	208.4
-3	26.6	48	118.4	99	210.2
-2	28.4	49	120.2	100	212.0
-1	30.2	50	122.0	105	221.0
0	32.0	51	123.8	110	230.0
1	33.8	52	125.6	115	239.0
2	35.6	53	127.4	120	248.0
3	37.4	54	129.2	130	266.0
4	39.2	55	131.0	140	284.0
5	41.0	56	132.8	150	302.0
6	42.8	57	134.6	160	320.0
7	44.6	58	136.4	170	338.0
8	46.4	59	138.2	180	356.0
9	48.2	60	140.0	190	374.0
10	50.0	61	141.8	200	392.0
11	51.8	62	143.6	250	482.0
12	53.6	63	145.4	300	572.0
13	55.4	64	147.2	350	662.0
14	57.2	65	149.0	400	752.0
15	59.0	66	150.8	500	932.0
16	60.8	67	152.6	600	1112.0
17	62.6	68	154.4	700	1292.0
18	64.4	69	156.2	800	1472.0
19	66.2	70	158.0	900	1652.0
20	68.0	71	159.8	1000	1832.0
21	69.8	72	161.6		

DERATING TEMPERATURE INFORMATION

The temperature at which the switches are used has an effect on the coil resistance. This is due to the temperature and variation of the resistivity of copper and the pick up voltage.

Formula of the variation of coil resistance versus the temperature is:

$R' = R (1 + K (t' - t))$

K = Temperature coefficient (0.0038 for copper)

R = Coil resistance (ohms) at temperature t (°C)

R' = Coil resistance (ohms) at temperature t' (°C)

Example of calculation:

Device: SPDT Failsafe R570413000

How to calculate current at 70°C with this relay?

In reference to specifications outlined in the technical data sheet:

Coil resistance 275 Ohms at 25°C (R = 275, t = 25, t' = 70)

Nominal current = 102 mA at 25°C

Nominal voltage = 28 volts

New coil resistance at 70°C will be:

$R' = 275 (1 + 0.0038 (70 - 25))$

$R' = 275 \times 2.71$

$R' = 323 \text{ Ohms}$

According to the Ohm law (U = R I), at 70°C:

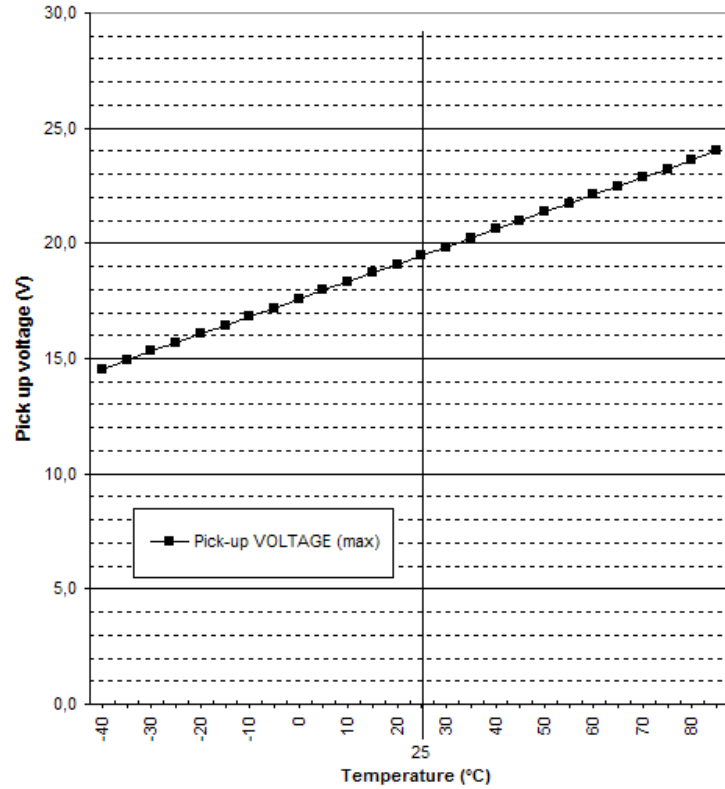
$U = R \times I$

$I = 87 \text{ mA}$

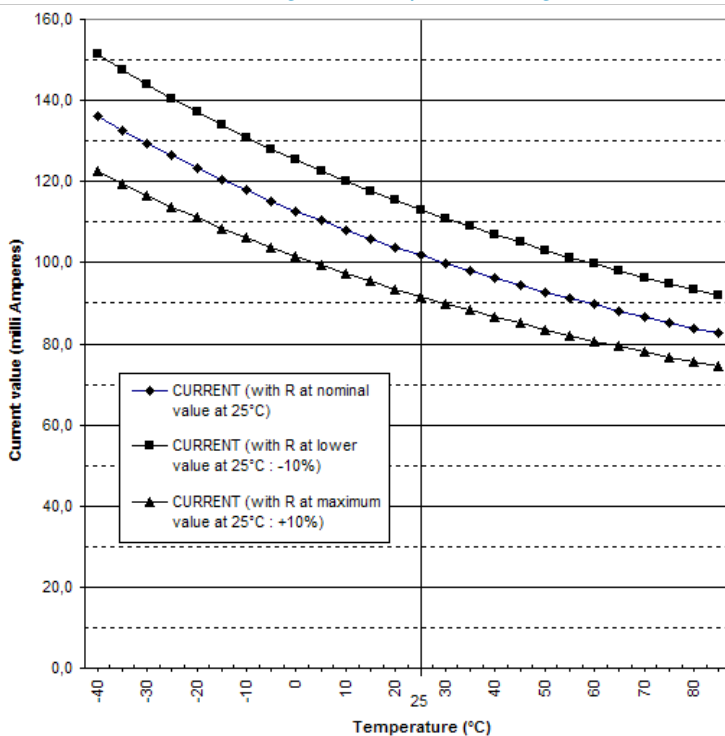
Conversions

The following graphs are examples of calculation for the same product R570413000 (SPDT SMA)

Maximum pick up voltage versus temperature



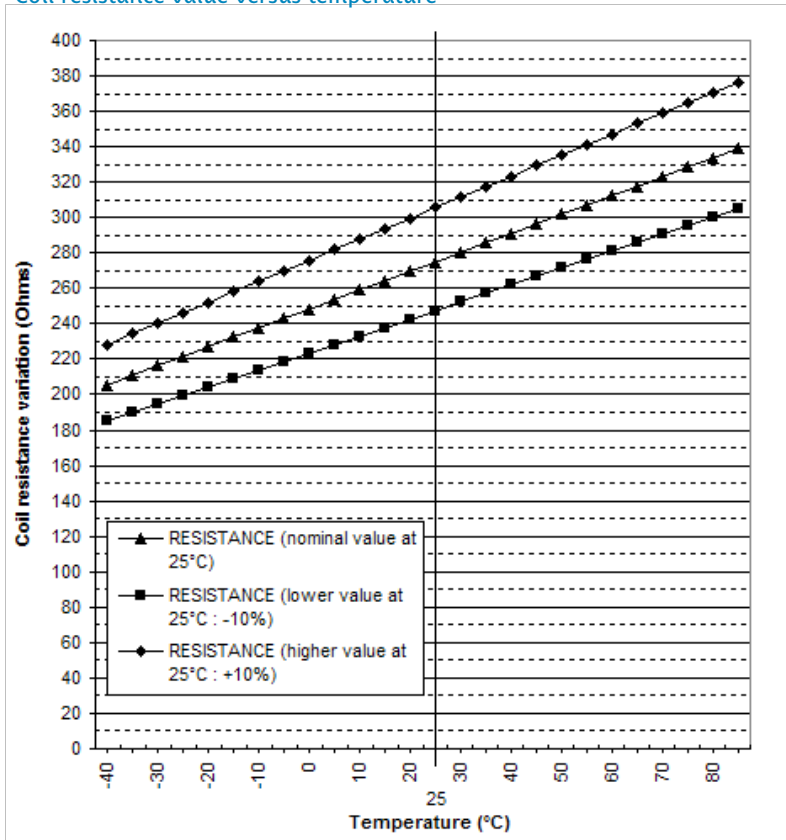
Current value versus voltage over temperature range



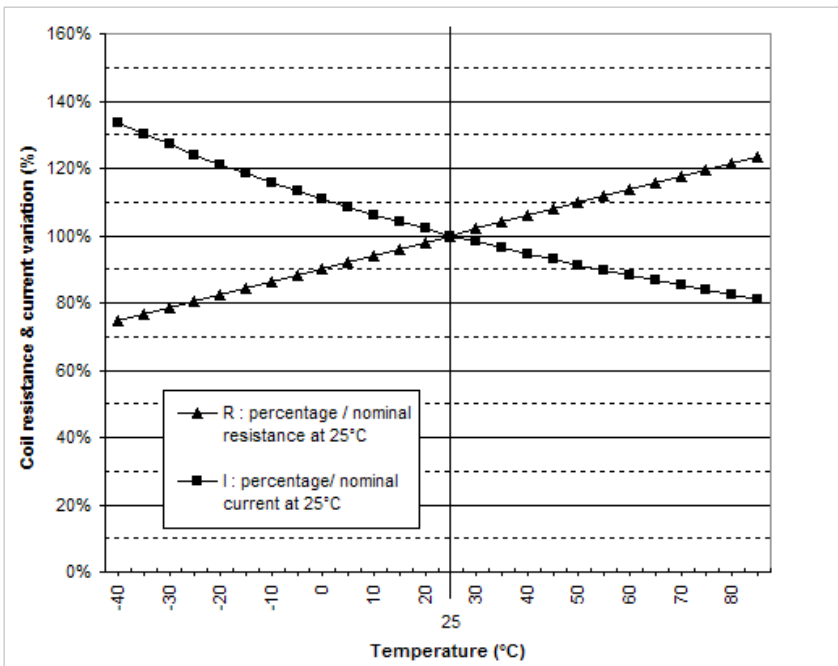
For customer support and more technical information contact a Radiall sales representative.

Conversions

Coil resistance value versus temperature



Maximum pick up voltage variation versus temperature

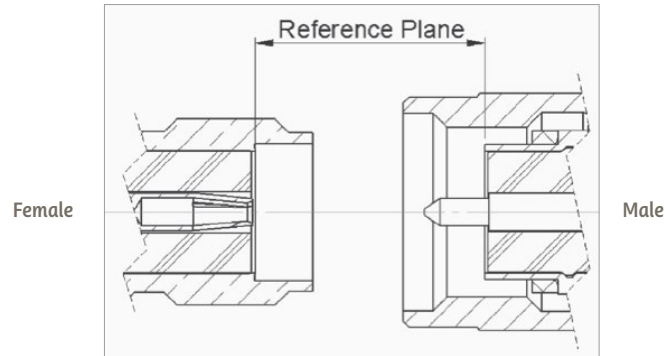


User Handbook

USER HANDBOOK FOR CONNECTOR ASSEMBLY ON COAXIAL SWITCHES

When connecting RF coaxial connectors to Radiall switches precaution should be taken to avoid irreversible damage on the RF switches.

Use only connectors with the correct interface dimensions



To ensure appropriate torque on the connector, and avoid damage on the contacts it is recommended to use a specific tool with calibrated torque. Apply the recommended torque as shown below:

SMA Connectors	from 80 to 120 N.cm
TNC Connectors	265 N.cm

Connection of semi rigid cable using the center contact of the cables as pin for connecting the female connector

If the center contact is not in alignment with the female socket, the switch RF connector could be damaged.

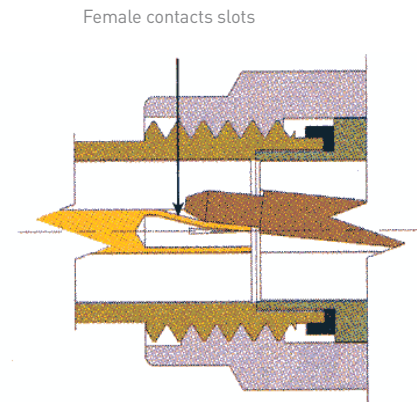


Fig A: Misaligned pin between insulator and female contacts slots

RF connectors with removable nut allow visual confirmation that the center contact is correctly positioned.

Cable	Connector
.085	R125 052 500
.141	R125 055 500

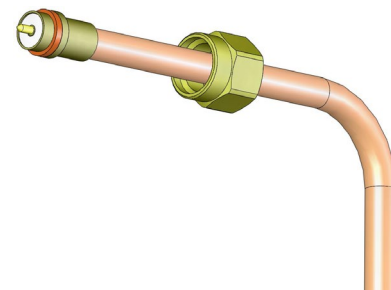






Fig B: Semi rigid cable with removable nut SMA contact

Applications

Applications	SLIM Line series	RAMSES series	TITANIUM	PLATINUM	Tvac products	Space components
Instrumentation 	Automated test					Not applicable
	Measurement equipments					
	Monitoring devices					
	Test network					
Wireless communication 	Telecommunication				Not applicable	
	Tower mount amplifiers					
	BTS					
	Radio links					
	ECM equipments					
	Repeaters					
	Base stations					
	Point to point link					
Military 	Military radios				Not applicable	
	Electronic warfare					
	Radar					
Space 	Pay-loaded: not applicable					Pay-loaded: Various satellites Communication Observation
	Ground segment					
	Test equipments					
	Earth stations					