RF & MICROWAVE COMPONENTS

# Coaxial switching products


ROJONE PTY. LTD.

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RADIALL
The next conneXion

# COMPANY PROFILE

*Radiall was founded in 1952 as a family owned company making coaxial plugs for the television industry. Today, Radiall is an international and global manufacturer of interconnect components including RF coaxial connectors and cable assemblies, antennas, fiber optic and microwave components, and multipin connectors.* ***Radiall serves the Aerospace, Automotive, Defense, Industrial, Medical, Space, and Telecommunication industries.***

## QSE (Quality Safety Environment) POLICY

Radiall maintains a quality management system that is highly recognized by its customers because it conforms to most international standards, including those for environmental protection.

ISO 9001 Certified
AS/EN/JISQ9100-ISOTS 16949-ISO-14001

Since 1994, all Radiall sites are **ISO9001** certified. As a result of Radiall's continuous improvement efforts, some dedicated activities are certified to either AS9100, or TS 16949 or ISO14001. Certain product lines are **MIL ESA/SCC** Qualified products.

Radiall also complies with other industry directives such as **RoHS** for hazardous substance restrictions and EuP for environmentally friendly designs for energy-consuming products.

## A WORLDWIDE ENGINEERING & MANUFACTURING CAPABILITY

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

With expertise centers and manufacturing locations in 3 continents and 12 industrial sites, Radiall offers its customers the proximity needed to provide the best quality, service and delivery performance.

Our facilities feature state of the art equipment for the many technologies involved in the design, manufacturing and assembly of interconnect solutions. Manufacturing plants based in low cost countries give Radiall the opportunity to offer quality at competitive prices.

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# SWITCHING PRODUCTS

## CONTENTS



*All dimensions in this catalog are given in millimeters*

*Head office - Rosny sous Bois FRANCE*

## A WIDE FIELD OF ACTIVITY

Specialized in passive microwave components, RADIALL's engineering staff designs and manufactures a wide range of standard coaxial devices including terminations, attenuators, couplers, coaxial detectors, coaxial and waveguide switches, covering a wide frequency spectrum from DC to 40 GHz.

## EXPERIENCE

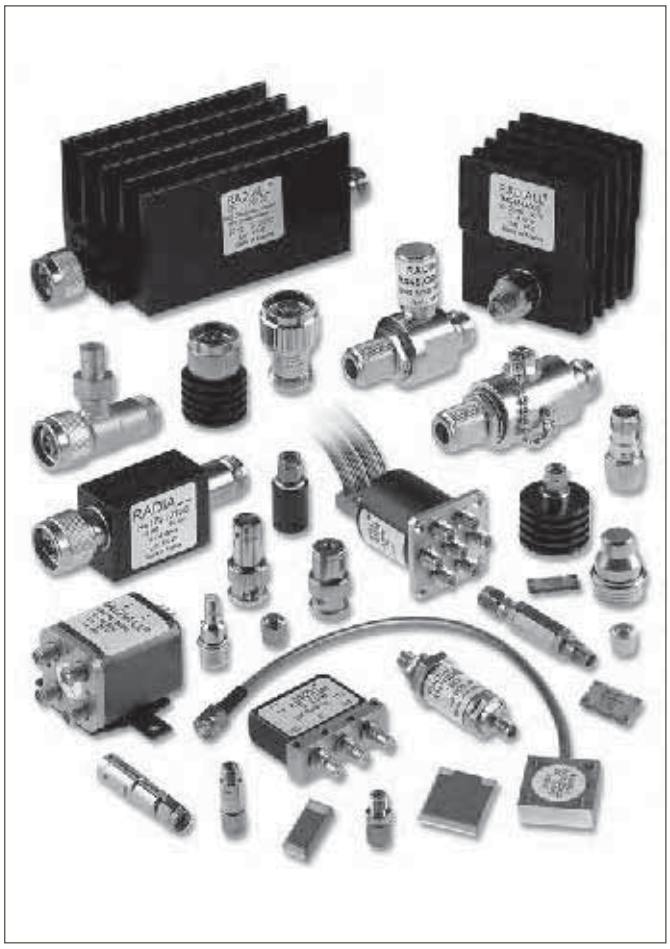
Owing to its 50 years experience, its high level of quality and its constant effort in R&D, **RADIALL** has become the **EUROPEAN "N°1"** in coaxial connectors.

Supported by its position, **RADIALL** has excelled in the passive microwave component field for more than 40 years.

RADIALL's competence in design, development and manufacturing of passive microwave components is today widely acknowledged.

## CAPACITIES AND FACILITIES

The association inside the same plant of all the technical skills : marketing, R&D, industrialization, manufacturing and quality control enable **RADIALL** to produce a range of high performance and low cost devices for industrial applications as well as high reliability components for severe requirements in military and space fields.



## RESEARCH AND DEVELOPMENT

The increasing complexity of microwave systems requires more and more high performance components.

To meet these requirements, the R&D department is constantly engaged in the development of new products as well as improvement on present products.

Fitted out with microwave and mechanical CAD and with the latest generation of microwave test equipment up to 60 GHz, **RADIALL** uses state-of-the-art technology to optimize its products and to give the fastest response to specific customer requirements.

## PRODUCTION

Electrical performances of microwave products are closely dependent upon machining quality of individual piece parts and associated plating.

The latest computer-controlled machinery, and an in-house plating department allow **RADIALL** to manufacture high quality piece parts compatible with the requirement of our components.

Owing to its thick film and thin film etching equipment, our production department warrants the quality and the reproducibility of our resistive cells used in most of our terminated switching products.

A “prototype” workshop enables **RADIALL** to give a fast answer to special customer requirements.

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

## QUALITY AND RELIABILITY AND PATENTS

Quality and reliability : Two major requirements of passive microwave components that **RADIALL** has been taking into account for years. **ISO 9001 V2000** label is the best evidence of quality assurance interfaces at every stage of a product from designing to manufacturing.

All new products are subjected to rigid qualification programs before mass production. In the same way, every element which could affect product quality is tested periodically.


BUREAU VERITAS
Certification

Certification

RADIALL

101 rue Philibert Hoffmann, 93116 ROSNY-SOUS-BOIS, FRANCE

NF EN ISO 9001 : 2000

CONCEPTION, DEVELOPPEMENT, PRODUCTION ET COMMERCIALISATION DE DISPOSITIFS D'INTERCONNEXION HAUTE FIABILITE, DE COMPOSANTS OPTO-ELECTRONIQUES, DE CABLES ET CONNECTEURS COAXIAUX, DE COMPOSANTS PASSIFS HYPERFREQUENCES ET D'ANTENNES.

DESIGN, DEVELOPMENT, PRODUCTION AND SALE OF HIGH RELIABILITY INTERCONNECTION DEVICES, OPTOELECTRONICS COMPONENTS, COAXIAL CABLES AND CONNECTORS, PASSIVE MICROWAVE COMPONENTS AND ANTENNAS.

Date de certification originale : 6 Mars 1994

10 Novembre 2009

Jean-Claude BOR/REGEUS
Président

Also, RADIALL switches are patent protected products.

## NATO CODE

**RADIALL** is a qualified microwave components manufacturer under military label (manufacturer code F0503 and F6507). Its product quality assurance has been developed in accordance with N.A.T.O. standards.

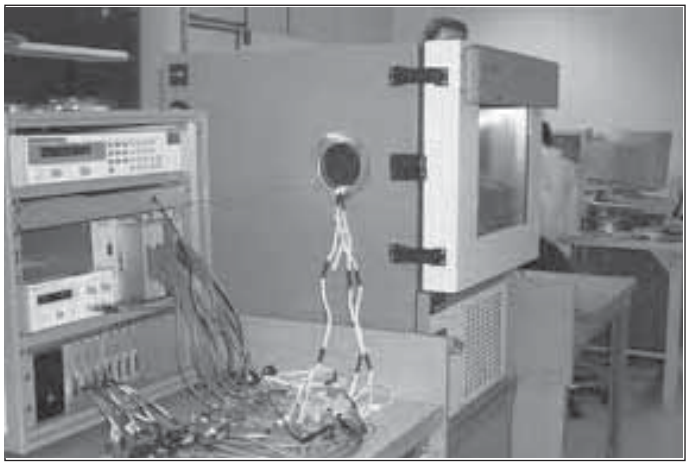
## 1) A TESTING LABORATORY

As an illutration of **RADIALL**'s commitment to quality and reliability, **RADIALL** has an in-house test laboratory qualified by CECC which permits **RADIALL** to carry out most of the tests required by its customers.

## 2) PARTIAL LIST OF TEST MEANS

● ELECTRICALS

| | |
|---|---|
| **Breakdown voltage** | 12 KVolts |
| **Insulation resistance** | $40.10^3$ MOhms |
| **Contact resistance** | 1µOhms |

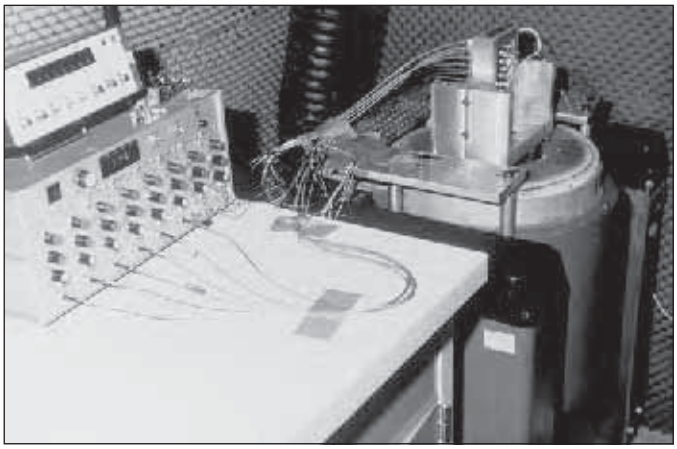


● ENVIRONMENTAL

| | |
|---|---|
| **Vibration :** Sine random | 0 - 120g 5 to 4000 Hz |
| **Shock** | 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 $cm^3/s$ |

● MICROWAVE

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



*For more technical information, consult us / E-mail :* ***USA : rfswitchusa@radiall.com / Rest of the world : switchingproducts@radiall.com***

## 3) CAPABILITIES

**RADIALL** offers coaxial switches in four major markets :

Telecom , Instrumentation, Military and Hi-Rel Space.

**RADIALL** products are currently used in military airborne, earth stations, Automatic Test Equipment, Instrumentation systems, wireless base stations and space applications including ground segment.

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** doesn't limit itself to catalog products and has the flexibility to design a specific product on a tight schedule at a reasonable cost.

RADIALL welcomes discussions of each customer's unique requirements.

## 4) RELIABILITY

All **RADIALL** coaxial switches offer exceptional reliability and performance.The unique patented design of the actuator and transmission link enables **RADIALL** to guarantee operation from 2 million cycles for Terminated SPnT up to 10 million cycles for SPDT with excellent repeatability.

## 5) LIST OF APPLICABLE DOCUMENTS

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

| | | |
|---|---|---|
| AIR 7304 | NFC 93563 | MIL C39012 |
| DIN 47295 | NFC 93564 | MIL E 5400 |
| NFC 93561 | NFC 96317 | MIL STD 202 |
| NFC 93562 | MIL DTL 9328 | 154 IEC |

*For more technical information, consult us / E-mail :* ***USA : rfswitchusa@radiall.com / Rest of the world : switchingproducts@radiall.com***

## 6) GENERAL SPECIFICATIONS designed to meet MIL DTL 3928 and MIL STD 202

### ENVIRONMENTAL CHARACTERISTICS

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

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

### MECHANICAL CHARACTERISTICS, MATERIALS AND FINISHES

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 .

| | |
|---|---|
| RF body | Aluminium, Gold plated<br>Aluminium, Nickel plated<br>Aluminium with Cr3 passivation |
| Contacts | Beryllium Copper, Gold plated |
| Insulator | PTFE, ULTEM 1000 |
| Connectors | Stainless steel, passivated<br>Brass, Nickel plated |
| Construction | Splash proof |
| Cover | Aluminium, blue anodized |

## 7) MANUFACTURING AND QUALITY ASSURANCE

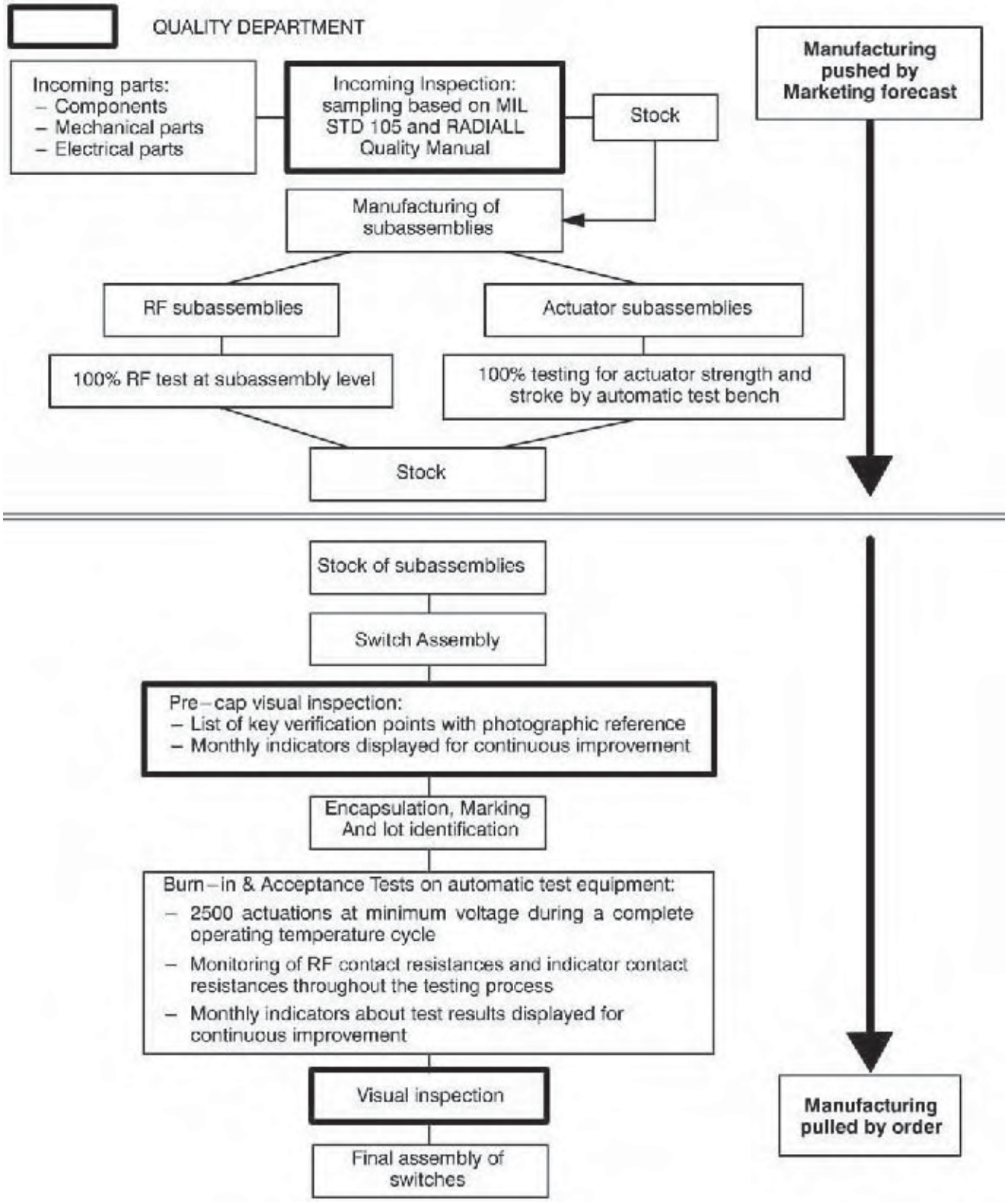
RADIALL's RF switch product line is made of approximately 16 series of switches, with each series divided into a large number of configurations. Part Numbers consist of 9 digits, each digit designating a portion of the part actual identity (such as series, frequency, actuator voltage, etc…). For each 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 sub-assemblies due to the modularity of the **RAMSES** switching line (less than 300 different sub-assemblies).

A PUSH-PULL manufacturing process has been implemented to reduce both lead time and inventory. Based upon Marketing forecast and monthly updates, various sub-assemblies are manufactured.

When an order is received, an automated MRP system selects the appropriate sub-assemblies 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 assurance of the best pricing and lead times on our coaxial products by eliminating all stages without added value of our administrative processes and production. This organization was first applied to our RAMSES SPDT coaxial relays and is being expanded to all other coaxial switches.

## 8) MANUFACTURING AND QUALITY ASSURANCE FLOW CHART

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## 9) RAMSES Concept

An innovative new system has been designed for constructing electromechanical coaxial RF switches with increased long-term reliability. The **RA**diall **M**odular **S**ystem for **E**lectromechanical **S**witches *(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.

### Friction Effects

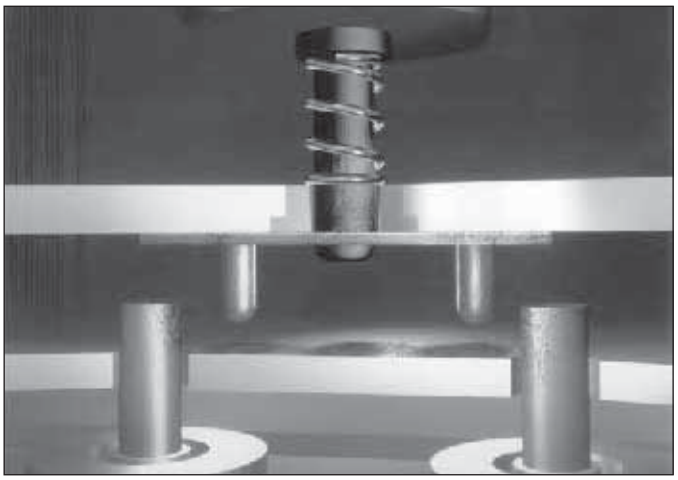
The unique design of *RAMSES* is based on the reduction of friction, which minimizes particle deposits that can interfere with the transmission of lower frequency signals (up to 3 GHz). This particle elimination effect is particularly important for telecommunications applications that are currently in the 900 MHz and 2 GHz regions. In addition, the design involves fewer components than other microwave switches, making it easier and quicker 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. But the reliability and quality of the electrical contact can seriously degrade during that lifetime. 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.

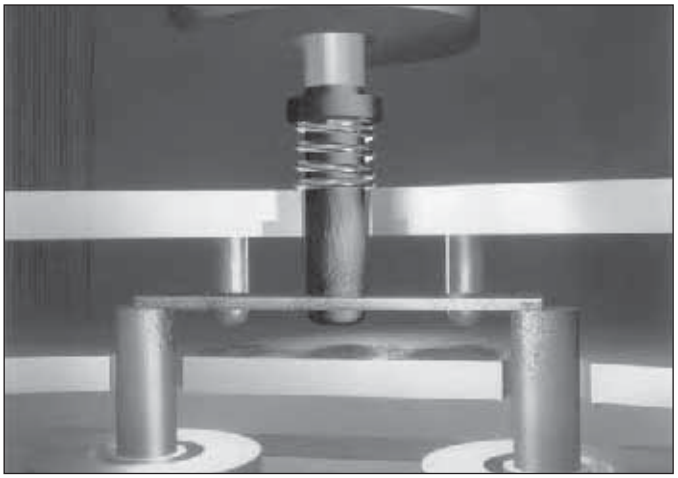
**Figure 1** shows the build-up of minute dielectric particles on a set of conventional switch contacts after one million cycles. These defects are not particularly noticeable at very high frequencies since the contact is established by a capacitive effect. However, the insertion loss of the contacts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

### A new actuator Configuration

To eliminate this problem of increased insertion loss in the contacts, *RAMSES* devices incorporate a patented system compressing 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



*(a) RF line open*



*(b) RF line closed*

***Figure 1*** : *Conventional switch contacts after one million cycles*

system is extremely small and can be used in all of the RAMSES series switches.

**Figure 2** shows a cutaway view of a *RAMSES* coaxial switch displaying the actuator mechanism.

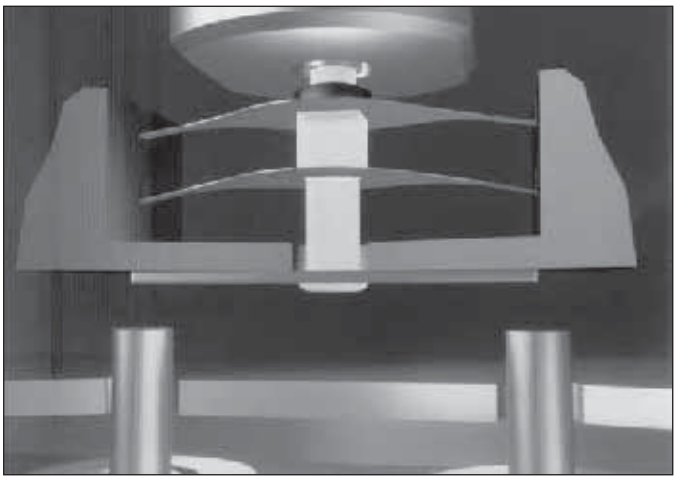
A second improvement involves a new rectilinear actuator design using high energy magnets and a switching performance in relation to its size. The system is used in the production of both fail-safe and latching actuators, depending on how it is applied in the switch. The actuator system also produces sticking forces that far exceed those of traditional actuators; that is, either 500g locking forces or 300 to 800g current forces for a power consumption of 100 mA 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. Finally, the use of a dry, solid lubricant and the control of friction areas produce an

***Figure 2*** : *A Cutaway view of* ***RAMSES*** *coaxial switch*

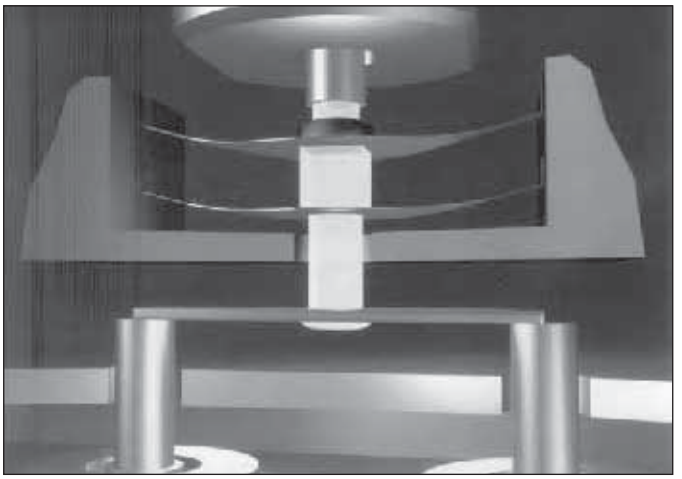
actuator life expectancy of over 50 million operations without defect over a -55° to +85°C temperature range

## Switch Performance

*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 using 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**.



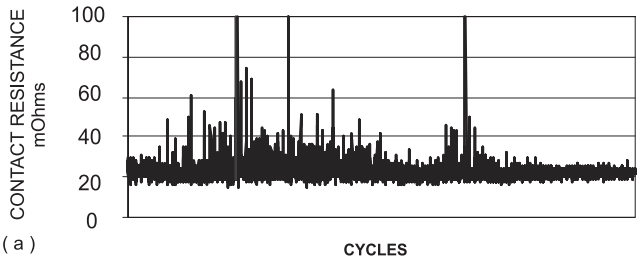
(a) RF line open



(b) RF line closed

***Figure 3*** : *A* ***RAMSES*** *set of contacts.*

Although the conventional switch may not be considered a failure, its contact resistance has become unstable, thus degrading its reliability



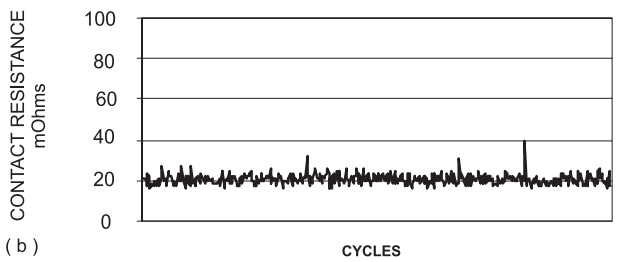
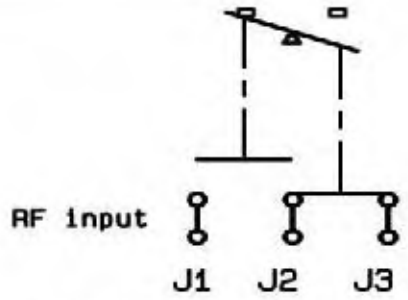




***Figure 4*** : *A comparison of (a) conventional and (b)* ***RAMSES*** *switch design contact resistance during one million cycles*

*For more technical information, consult us / E-mail :* ***USA : rfswitchusa@radiall.com / Rest of the world : switchingproducts@radiall.com***

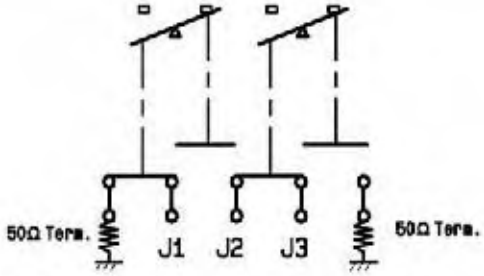
## 10) RF ARRANGEMENT

**COAXIAL SPDT SWITCH**
**( Single Pole Double Throw )**



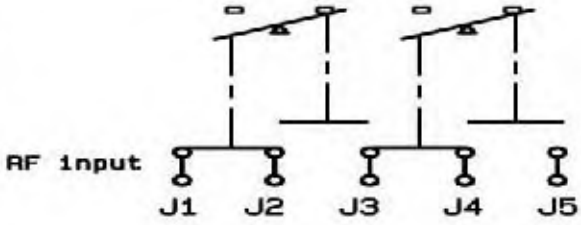

**Single pole Double Throw Switch**
A switch with one input port and two selectable output ports

**COAXIAL SPDT TERMINATED SWITCH**
**( Single Pole Double Throw Terminated )**



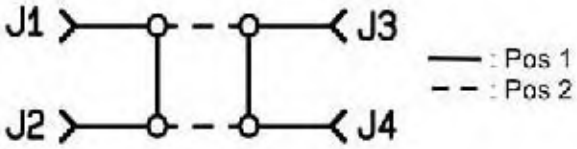

**Single Pole Double Throw, Terminated switch**
Same as SPDT, but the unused output port is automatically terminated by a 50 Ohm resistive load.

**COAXIAL DP3T SWITCH**
**( Double Pole Three Throw )**



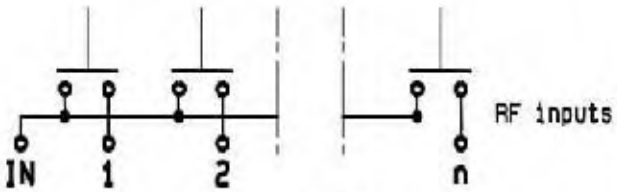

**Double Pole Three Throw switch**
A switch with two input ports and three output ports. Each input ( J2 – J4 ) can be switched between two adjacent outputs with one output being common to both inputs

**COAXIAL TRANSFERT / DPDT SWITCH**
**( Double Pole Double Throw )**



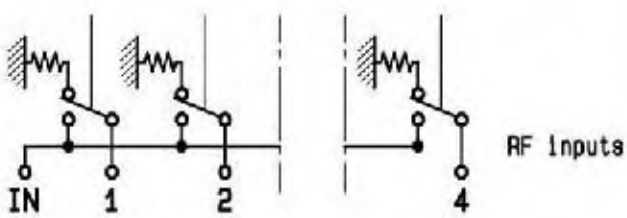

**Double Pole Double Throw Switch**
A four port switch with two independent paths that operate simultaneously in one of two selected positions., In a DPDT / Transfer switch, the two transmission paths are provided as shown above

**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 a internal 50 Ohm resistive load

## 11) 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 voltages, such as 5, 15 or 24 Volts, can be supplied at the customer s request.



### AUTOMATIC "RESET"

Latching version multi-position switches (or SPnT) cause the following scenario :

When an 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 for a few milliseconds (See voltage & current values listed on the product's individual Technical Data Sheet).*

### BCD 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 |

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

## GLOSSARY (continued)

### 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 the RF connection to any other position.

### FREQUENCY RANGE

The frequency range indicated for each device indicates the maximum frequency RADIALL will guarantee the product’s performance.

### INDICATOR CONTACTS

Electrical contacts of “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).

### INSERTION LOSS

The difference in the power level received at the load before and after the insertion of a device in a transmission line. Insertion loss is measured in decibels below the input power.

### INTERMODULATION

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 phenomenon is attributable to many sources such as low contact pressure, dirty interconnects, magnetic materials or other anodic effect. The typical value for RADIALL coaxial switches is around 120 dBc (with 2 carriers at +43dBm), however products can be designed for better performances 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* and *PLATINUM* ranges have a life duration from 2 to 10 million cycles.

## GLOSSARY (continued)

### MULTIPIN CONNECTORS

| Series | Type of Switches | Type of Connector | Pins Number | Comments |
|---|---|---|---|---|
| **RAMSES** SPDT | **SPDT => R570** | D Sub (male) | 9 pins | Available only on products described on page SPDT 16 |
| | **SPDT => R572** | Not Available | | Only solder pins |
| **PLATINUM** SPDT | **SPDT => R595** | D Sub (male) | 9 pins | Non terminated models |
| **RAMSES** DPDT | **DPDT => R577** | Not available | | |
| **PLATINUM** DPDT | **DPDT => R593** | HE10 ribbon receptacle (male) | 10 pins | Delivered with ribbon cable 750 mm ( 30 inches ) HE10 connector ( female ) |
| **RAMSES** DP3T (1) | **DP3T => R585** | Not Available | | Only solder pins |
| **PLATINUM** DP3T (1) | **DP3T => R595** | D Sub (male) | 9 pins | |
| **RAMSES** SPnT | **SPnT => R573/R574** | | | |
| | 3 to 10 positions | D Sub (male) | 25 pins | |
| | 11 and 12 positions | | 44 pins | High density |
| | **SPnT => R591** 4 and 6 positions | Micro D receptacle (female) | 9 pins | |
| **PLATINUM** SPnT | **SPnT => R594** | | | |
| | 4 and 6 positions | HE10 ribbon receptacle (male) | 16 pins | Delivered with ribbon cable 750 mm ( 30 inches ) HE10 connector ( female ) |

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

### NORMALLY OPEN

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.

### PLATINUM series

By adapting our RAMSES concept (without friction) and our knowledge of manufacturing coaxial switches for more than 40 years, RADIALL introduced a new range of high performance coaxial switches to the market place : PLATINUM series

Following an increasing need of the instrumentation market, our PLATINUM coaxial switches are optimized to equip all your automatic test benches or measureament equipment. Indeed, with a guarantee insertion loss repeatability of 0.03 dB over the life of the product (10 million), we answer the highest requirements of RF performance necessary for this type of equipment. Moreover, we offer a full range coaxial switches such as SPDT-DP3T (R595 series), transfer relay DPDT (R593 series) and multithrow switches SPnT (R594 series), with this same level of RF performance, to answer your need.

### POLARITY

Common minus polarity potential is chosen by RADIALL for its standard products. An inverted polarity (common plus) is available on *RAMSES* range, ask RADIALL for availability.

***Note :** For PLATINUM series, common plus polarity potential is chosen for its standard products.*

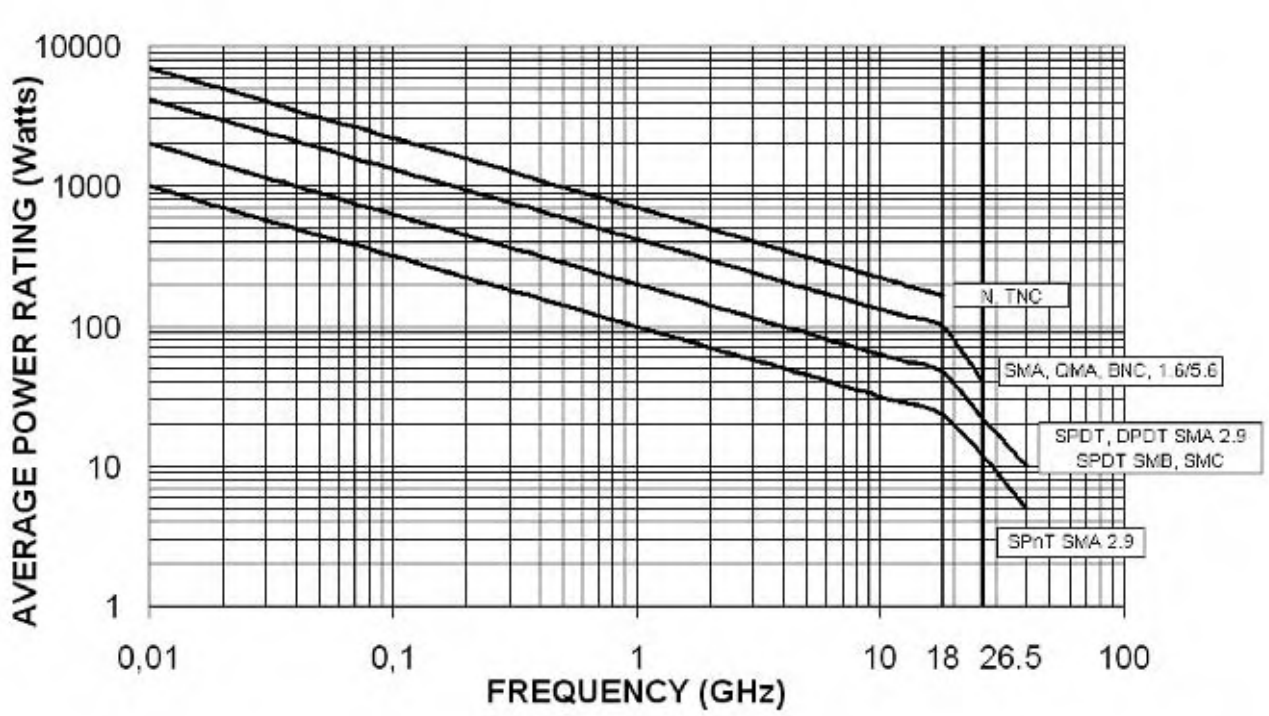
## GLOSSARY (continued)

### RF POWER RATING

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.).

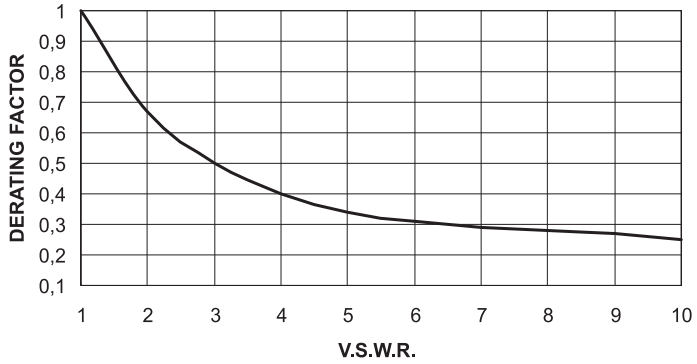
This graph is based on the following conditions :

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




### DERATING FACTOR VERSUS VSWR

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

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## GLOSSARY (continued)

### PEAK POWER HANDLING

The maximum peak power which, when applied at room temperature under a pulse of one microsecond every millisecond, will not permanently change the specifications of the switch. Any overpowering beyond this limit will alter the RF performance of the switch.



### 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).

*N.B RADIALL 75 Ohm coaxial switches are availables with only DIN 1 6/5 6 RF connectors which are "screw, snap and slide". However other connectors such as SSMB 75 Ohm can be designed upon request.*

### REPEATABILITY

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

### SELF CUT OFF

This term refers to the ability of a switch to disconnect the actuator voltage as the switching of the position is carried out. The system applies to latching relays and is achieved with solid state circuity. Self cut-off time for our RAMSES coaxial switches is from 40ms to 120ms.

### SOLDER PINS

*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 DIODE

Diode 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 application of voltage to the actuator terminals and completion of switching including all contact bounces, 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

This term points out an interface realized thanks to an electronic circuit which enables driving either relays or switches by TTL logic signals. Products equipped with such an option have therefore a pin for the voltage of the actuator (12V or 28V) 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 a positive one,that is to say "high level" nominal +5V (2.2-5.5 V) of TTL signal means logic "1" enabling to close the corresponding microwave way. Low level, i.e logic "0", voltage is 0-0.8V.

*For more technical information, consult us / E-mail :* ***USA : rfswitchusa@radiall.com / Rest of the world : switchingproducts@radiall.com***

## GLOSSARY (continued)

**V.S.W.R.**

The Voltage Standing Wave Ratio is a measurement 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 :

$$V.S.W.R = \frac{1+|r|}{1-|r|} \qquad r = \frac{Z-Zo}{Z+Zo}$$

with : **r** is the coefficient of reflection

**Zo** is the characteristic impedance of the line

**Z** the impedance of the line

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

## 12) CONVERSION MEASUREMENT UNIT

- Convert inch to millimeters : 1 Inch = 25.4 mm / 1 meter = 39.3 Inches

- Convert centimeters to feet : 1 foot = 30.40 cm /1 meter = 3.28 feet

- Convert kilogram to pounds : 1 kg = 2.20 Lb / 1 pound = 0.45 Kg

## 13) POWER CONVERSION

### Power (dBm) / Power (W)

| dBm | Power | dBm | Power | dBm | Power | dBm | Power |
|---|---|---|---|---|---|---|---|
| -49 | 0,01 µW | -24 | 3,98 µW | **1** | 1,26 mW | 26 | 398,11 mW |
| -48 | 0,02 µW | -23 | 5,01 µW | 2 | 1,58 mW | 27 | 501,19 mW |
| -47 | 0,02 µW | -22 | 6,31 µW | 3 | 2 mW | 28 | 630,96 mW |
| -46 | 0,03 µW | -21 | 7,94 µW | 4 | 2,51 mW | 29 | 794,33 mW |
| -45 | 0,03 µW | -20 | **10 µW** | 5 | 3,16 mW | **30** | **1 W** |
| -44 | 0,04 µW | **-19** | 12,59 µW | 6 | 3,98 mW | 31 | 1,26 W |
| -43 | 0,05 µW | -18 | 15,85 µW | 7 | 5,01 mW | 32 | 1,58 W |
| -42 | 0,06 µW | -17 | 19,95 µW | 8 | 6,31 mW | **33** | **2 W** |
| -41 | 0,08 µW | -16 | 25,12 µW | 9 | 7,94 mW | 34 | 2,51 W |
| -40 | 0,10 µW | -15 | 31,62 µW | 10 | **10 mW** | 35 | 3,16 W |
| -39 | 0,13 µW | -14 | 39,81 µW | **11** | 12,59 mW | 36 | 3,98 W |
| -38 | 0,16 µW | -13 | 50,12 µW | 12 | 15,85 mW | 37 | 5,01 W |
| -37 | 0,20 µW | -12 | 63,10 µW | 13 | 19,95 mW | 38 | 6,31 W |
| -36 | 0,25 µW | -11 | 79,43 µW | 14 | 25,12 mW | 39 | 7,94 W |
| -35 | 0,32 µW | -10 | 100 µW | 15 | 31,62 mW | **40** | **10 W** |
| -34 | 0,40 µW | -9 | 125,89 µW | 16 | 39,81 mW | 41 | 12,59 W |
| -33 | 0,50 µW | -8 | 158,49 µW | 17 | 50,12 mW | 42 | 15,85 W |
| -32 | 0,63 µW | -7 | 199,53 µW | 18 | 63,10 mW | 43 | 19,95 W |
| -31 | 0,79 µW | -6 | 251,19 µW | 19 | 79,43 mW | 44 | 25,12 W |
| **-30** | **1 µW** | -5 | 316,23 µW | 20 | **100 mW** | 45 | 31,62 W |
| -29 | 1,26 µw | -4 | 398,11 µW | **21** | 125,89 mW | 46 | 39,81 W |
| -28 | 1,58 µW | -3 | 501,19 µW | 22 | 158,48 mW | 47 | 50,12 W |
| **-27** | **2 µW** | -2 | 630,96 µW | 23 | 199,52 mW | 48 | 63,10 W |
| -26 | 2,51 µW | -1 | 794,33 µW | 24 | 251,19 mW | 49 | 79,43 W |
| -25 | 3,16 µW | **0** | **1 mW** | 25 | 316,23 mW | **50** | **100 W** |

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

## 14) REFLECTION COEFFICIENT / RETURN LOSS CONVERSION

| Reflection Coefficient | V.S.W.R | Return Loss (dB) | Reflection Coefficient | V.S.W.R | Return Loss (dB) | Reflection Coefficient | V.S.W.R | Return Loss (dB) |
|---|---|---|---|---|---|---|---|---|
| 0 | 1.00 | ∞ | 0.13 | **1.30** | 17.7 | 0.26 | **1.7** | 11.7 |
| 0.01 | 1.02 | 40.0 | 0.135 | 1.31 | 17.4 | 0.265 | 1.72 | 11.5 |
| 0.015 | 1.03 | 36.0 | 0.14 | 1.33 | 17.1 | 0.27 | 1,74 | 11.4 |
| 0.02 | 1.04 | 34.0 | 0.145 | 1.34 | 16.8 | 0.275 | 1.76 | 11.2 |
| 0.025 | 1.05 | 32.0 | 0.15 | **1,35** | 16.5 | 0.28 | 1,78 | 11,1 |
| 0.03 | 1.06 | 30.5 | 0,155 | 1.37 | 16.2 | 0.285 | **1.80** | 10.9 |
| 0.035 | 1.07 | 29.1 | 0.16 | 1.38 | 15.9 | 0.29 | 1.82 | 10.8 |
| 0.04 | 1.08 | 28.0 | 0.165 | **1.40** | 15.7 | 0.295 | 1.83 | 10.7 |
| 0.045 | 1.09 | 26.9 | 0.17 | 1.41 | 15.4 | 0.3 | 1.85 | 10.5 |
| 0.046 | 1.09 | 26.7 | 0.175 | 1.42 | 15.1 | 0.305 | 1.86 | 10.3 |
| 0.05 | **1.10** | 26.0 | 0.18 | 1.44 | 14.9 | 0.31 | **1.90** | 10.2 |
| 0.055 | 1.11 | 25.2 | 0.185 | **1.45** | 14.7 | 0.32 | 1.94 | 9.8 |
| 0.06 | 1.12 | 24.4 | 0.19 | 1.47 | 14.4 | 0.33 | 1.98 | 9.7 |
| 0.065 | 1.13 | 23.7 | 0.195 | 1.48 | 14.2 | 0.34 | 2.04 | 9.4 |
| 0.07 | **1.15** | 23.1 | 0.2 | **1.50** | 14.0 | 0.35 | 2.08 | 9.2 |
| 0.075 | 1.16 | 22.5 | 0.205 | 1.52 | 13.8 | 0.36 | 2.13 | 8.9 |
| 0.08 | 1.17 | 21.9 | 0.21 | 1.53 | 13.6 | 0.37 | 2.18 | 8.7 |
| 0.085 | 1.18 | 21.4 | 0.215 | 1.55 | 13.4 | 0.38 | 2.23 | 8.4 |
| 0.09 | 1.19 | 20.9 | 0.22 | 1.56 | 13.2 | 0.39 | 2,.8 | 8.2 |
| 0.095 | **1.20** | 20.4 | 0.225 | 1.58 | 13.0 | 0.4 | 2.34 | 7.9 |
| 0.1 | 1.22 | 20.0 | 0.23 | **1.60** | 12.8 | 0.41 | 2.40 | 7.7 |
| 0.105 | 1.23 | 19.6 | 0.235 | 1.61 | 12.6 | 0.42 | **2.45** | 7.6 |
| 0.11 | 1.24 | 19.2 | 0.24 | 1.63 | 12.4 | 0.43 | 2.51 | 7.3 |
| 0.115 | **1.25** | 18.8 | 0.245 | **1.65** | 12.2 | 0.44 | 2.57 | 7.1 |
| 0.12 | 1.27 | 18.4 | 0.25 | 1.67 | 12.0 | 0.45 | 2.63 | 6.9 |
| 0.125 | 1.28 | 18.1 | 0.255 | 1.68 | 11.9 | 0.5 | **3.00** | 6.0 |

*Reflection Coefficient : ( p )*
*Voltage Standing Wave Ratio : ( 1 + p ) / ( 1 - p )*
*Return Loss (dB) : ( -20 $Log_{10}$( 1 -$p^2$ ))*

## 15) TEMPERATURE EQUIVALENCE

CENTIGRADE / FAHRENHEIT

| °C | °F | °C | °F | °C | °F | °C | °F |
|---|---|---|---|---|---|---|---|
| -80 | -112.0 | 9 | 48.2 | 47 | 116.6 | 85 | 185.0 |
| -70 | -94.0 | 10 | 50.0 | 48 | 118.4 | 86 | 186.8 |
| -60 | -76.0 | 11 | 51.8 | 49 | 120.2 | 87 | 188.6 |
| -50 | -58.0 | 12 | 53.6 | 50 | 122.0 | 88 | 190.4 |
| -45 | -49.1 | 13 | 55.4 | 51 | 123.8 | 89 | 192.2 |
| -40 | -40.0 | 14 | 57.2 | 52 | 125.6 | 90 | 194.0 |
| -35 | -31.0 | 15 | 59.0 | 53 | 127.4 | 91 | 195.8 |
| -30 | -22.0 | 16 | 60.8 | 54 | 129.2 | 92 | 197.6 |
| -25 | -13.0 | 17 | 62.6 | 55 | 131.0 | 93 | 199.4 |
| -20 | -4.0 | 18 | 64.4 | 56 | 132.8 | 94 | 201.2 |
| -19 | -2.2 | 19 | 66.2 | 57 | 134.6 | 95 | 203.0 |
| -18 | -0.4 | 20 | 68.0 | 58 | 136.4 | 96 | 204.8 |
| -17 | 1.4 | 21 | 69.8 | 59 | 138.2 | 97 | 206.6 |
| -16 | 3.2 | 22 | 71.6 | 60 | 140.0 | 98 | 208.4 |
| -15 | 5.0 | 23 | 73.4 | 61 | 141.8 | 99 | 210.2 |
| -14 | 6.8 | 24 | 75.2 | 62 | 143.6 | 100 | 212.0 |
| -13 | 8.6 | 25 | 77.0 | 63 | 145.4 | 105 | 221.0 |
| -12 | 10.4 | 26 | 78.8 | 64 | 147.2 | 110 | 230.0 |
| -11 | 12.2 | 27 | 80.6 | 65 | 149.0 | 115 | 239.0 |
| -10 | 14.0 | 28 | 82.4 | 66 | 150.8 | 120 | 248.0 |
| -9 | 15.8 | 29 | 84.2 | 67 | 152.6 | 130 | 266.0 |
| -8 | 17.6 | 30 | 86.0 | 68 | 154.4 | 140 | 284.0 |
| -7 | 19.4 | 31 | 87.8 | 69 | 156.2 | 150 | 302.0 |
| -6 | 21.2 | 32 | 89.6 | 70 | 158.0 | 160 | 320.0 |
| -5 | 23.0 | 33 | 91.4 | 71 | 159.8 | 170 | 338.0 |
| -4 | 24.8 | 34 | 93.2 | 72 | 161.6 | 180 | 356.0 |
| -3 | 26.6 | 35 | 95.0 | 73 | 163.4 | 190 | 374.0 |
| -2 | 28.4 | 36 | 96.8 | 74 | 165.2 | 200 | 392.0 |
| -1 | 30.2 | 37 | 98.6 | 75 | 167.0 | 250 | 482.0 |
| 0 | 32.0 | 38 | 100.4 | 76 | 168.8 | 300 | 572.0 |
| 1 | 33.8 | 39 | 102.2 | 77 | 170.6 | 350 | 662.0 |
| 2 | 35.6 | 40 | 104.0 | 78 | 172.4 | 400 | 752.0 |
| 3 | 37.4 | 41 | 105.8 | 79 | 174.2 | 500 | 932.0 |
| 4 | 39.2 | 42 | 107.6 | 80 | 176.0 | 600 | 1112.0 |
| 5 | 41.0 | 43 | 109.4 | 81 | 177.8 | 700 | 1292.0 |
| 6 | 42.8 | 44 | 111.2 | 82 | 179.6 | 800 | 1472.0 |
| 7 | 44.6 | 45 | 113.0 | 83 | 181.4 | 900 | 1652.0 |
| 8 | 46.4 | 46 | 114.8 | 84 | 183.2 | 1000 | 1832.0 |

Temp (°C) = ((°F-32) x 5) /9

Temp (°F) = ((9 x °C) / 5) + 32

## 16) DERATING TEMPERATURE INFORMATION

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

Mathematical formula of the variation of coil resistance versus the temperature is as follows :

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

**K = temperature coefficient (0.00388 for copper)**

**R = coil resistance (Ω) at temperature t (°C)**

**R' = coil resistance (Ω) 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 as noted in the technical data sheet

Coil resistance 275 Ω 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 + 0.00388 (70 - 25))

R' = 275 x 1.175

R' = 323 Ω

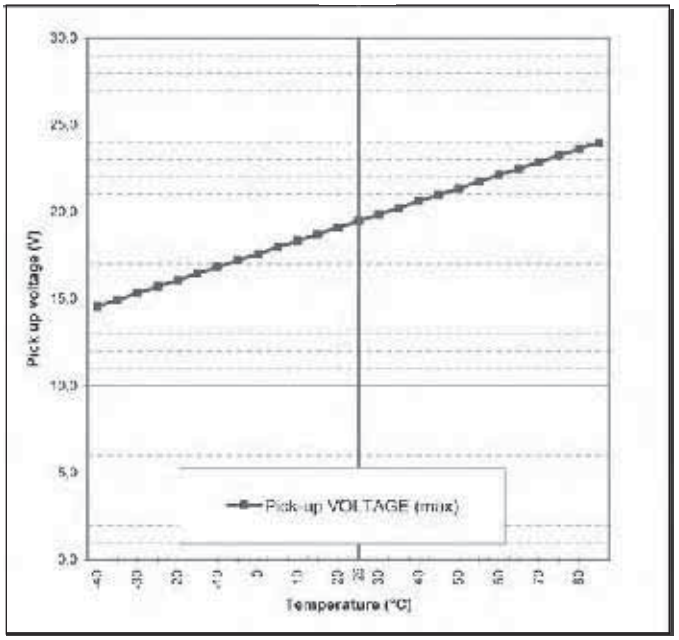
According to the second law (U = R I), at 70°C :

U = R I

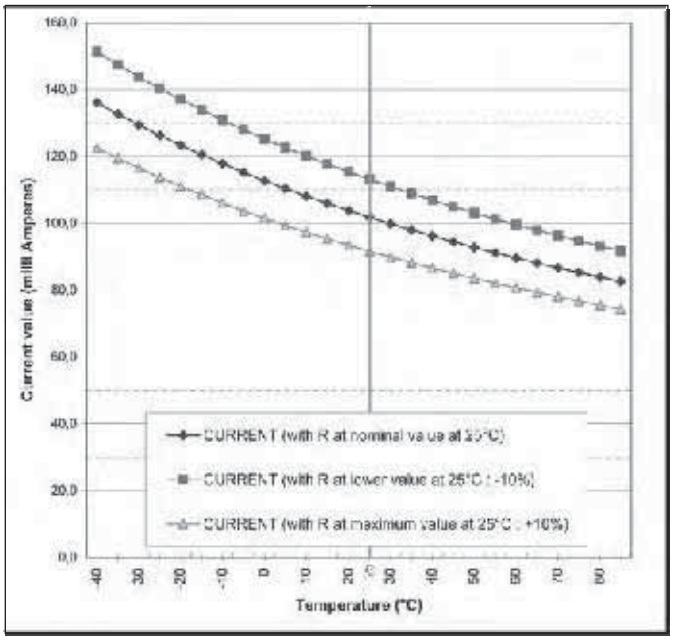
I = 87 mA

The following graphics are examples of calculation for the same product R570413000 (SPDT failsafe)

## Maximum pick up voltage versus temperature




## Current value versus voltage over temperature range




All standard RAMSES reference curves are availables upon request (see adress email below)

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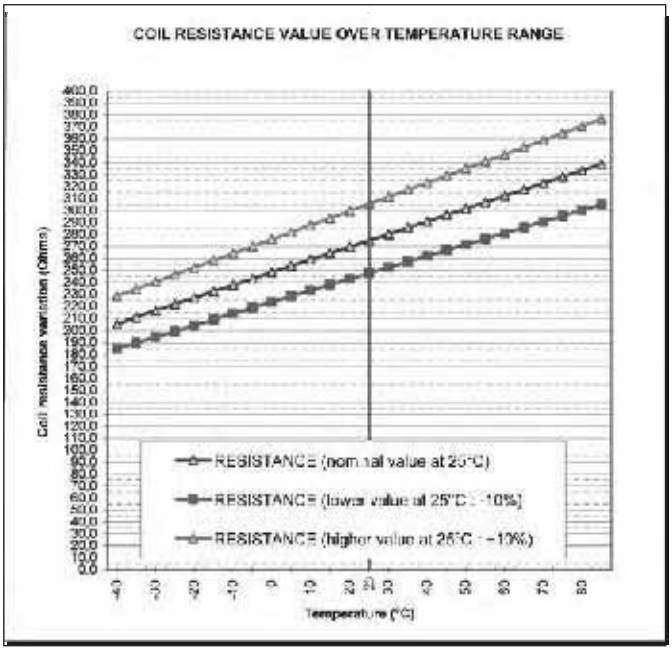
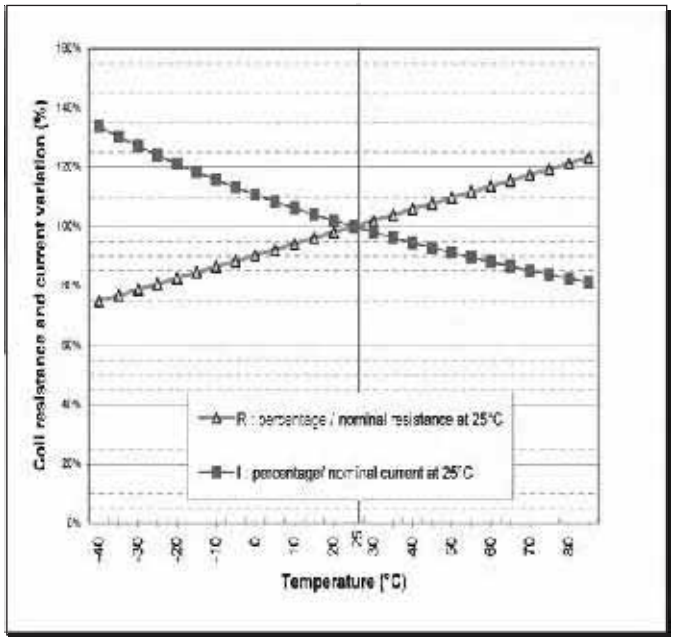
## Coil resistance value versus temperature




## Maximum pick up voltage variation versus temperature

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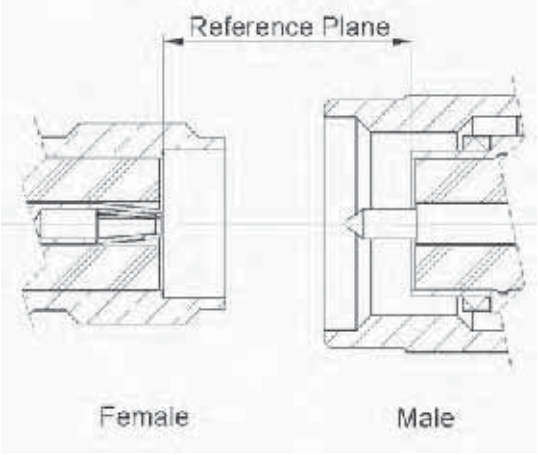
## 17) USER HANDBOOK FOR CONNECTOR ASSEMBLY ON OUR COAXIAL SWITCHES

How to connect RF coaxial connectors to RADIALL Switches?

To avoid irreversible damage on RF Switches some precautions shall be implemented

**a) Connectors with correct interface dimension shall be used**




Appropriate torque on the connector to avoid damage on the contacts. Specific tool with calibrated torque shall be used.

Apply the recommended torque as defined below.

| | |
|---|---|
| **SMA connectors** | From 80 to 120 cm |
| **TNC connectors** | 339 N.cm |

**b) Connection of semi rigid cable using the center contact of the cable as pin for connecting the female connector**

If the center contact is not in the same alignment as the female socket, the Switch RF connector could be damaged

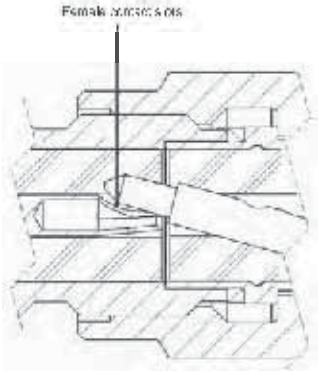


***Fig A :*** *Misaligned pin between insulator and female contacts slots*

RF connector with removable nut can assure by visual control that the center contact is correctly positioned.

| Cable | Connector |
|---|---|
| .085" | **R125 052 500** |
| .141" | **R125 055 500** |

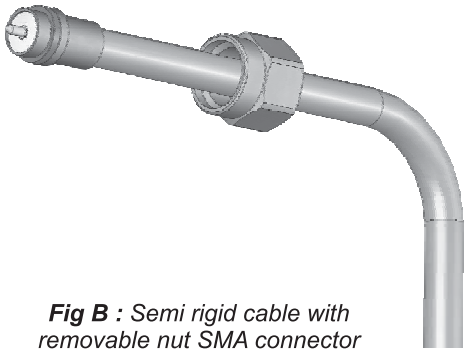


***Fig B :*** *Semi rigid cable with removable nut SMA connector*

## SWITCHING PRODUCTS SELECTION GUIDE

How to find the right product for your application ?..

Model '3' only => Not terminated version
Model '4' only => terminated version

| Family | Type | Serie | Page | connectors | 2.5 GHz | 3 GHz | 6 GHz | 8 GHz | 12.4 GHz | 18 GHz | 26.5 GHz | 40 GHz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPDT / DP3T / DPDT | Micro relay SMT | R596 serie | SPDT-2 | | | | | | | | | |
| | | | | None | Surface Mount Technology | | | | | | | |
| | SPDT or DPDT | | | | | | | | | | | |
| | NEW | R595 serie | SPDT-8 | SMA | High performances and 0.03 dB on the insertion loss / PLATINUM Serie | | | | | | | |
| | | R570 serie | SPDT-14 | DIN 1.6/5.6 | | | | | | | | |
| | | | SPDT-22 | BNC | | | | | | | | |
| | | R572 serie | SPDT-18 | SMB / SMC | | | | | | | | |
| | | R577 serie | DPDT-8 | QMA | | | | | | | | |
| | | | DPDT-12 | N | | | | | | | | |
| | | | | TNC | RAMSES Series | | | | | | | |
| | | | | SMA | | | | | | | | |
| | | | | SMA 2.9 | | | | | | | | |
| | NEW | R593 serie | DPDT-2 | SMA / SMA 2.9 | High performances and 0.03 dB on the insertion loss / PLATINUM Series | | | | | | | |
| | SPDT Terminated or DP3T | R585 serie | DP3T-12 | | | | | | | | | |
| | | | | SMA | Ramses Series | | | | | | | |
| | SPDT Terminated or DP3T | R595 serie | DP3T-2 | NEW | | | | | | | | |
| | | | | SMA | High performances and 0.03 dB on the insertion loss / PLATINUM Series | | | | | | | |
| SPnT | SPnT 3 à 6 pos | R574 serie | SPnT-16 | | | | | | | | | |
| | Model "3" only | R573 serie | SPnT-16 | DIN 1.6/5.6 | | | | | | | | |
| | Model "3" only | | | BNC | | | | | | | | |
| | Model "3" only | | | TNC | | | | | | | | |
| | Model "3" & "4" | | | SMB / SMC | | | | | | | | |
| | Model "3" only | | | QMA | | | | | | | | |
| | Model "3" & "4" | | | N | RAMSES Series | | | | | | | |
| | Model "3" & "4" | | | SMA | | | | | | | | |
| | Model "3" & "4" | NEW | | SMA 2.9 | | | | | | | | |
| | SPnT 4 or 6 pos | R594 serie | SPnT-8 | | | | | | | | | |
| | Model "4" only | | | SMA / SMA 2.9 | High performances and 0.03 dB on the insertion loss / PLATINUM Serie | | | | | | | |
| | SPnT 4 or 6 pos | R591 serie | SPnT-2 | | | | | | | | | |
| | Model "3" only | | | QMA | Small size | | | | | | | |
| | Model "3" only | | | SMA | and long life / Subminiature RAMSES serie | | | | | | | |
| | SPnT 7 à 8 pos | R574 serie | SPnT-16 | | | | | | | | | |
| | Model "3" & "4" | R573 serie | SPnT-16 | N | RAMSES Series | | | | | | | |
| | Model "3" & "4" | | | SMA | | | | | | | | |
| | SPnT 9 à10 pos | R574 serie | SPnT-16 | | | | | | | | | |
| | Model "3" & "4" | R573 serie | SPnT-16 | N | RAMSES Series | | | | | | | |
| | Model "3" & "4" | | | SMA | | | | | | | | |
| | SPnT 11 à 12 pos | R574 serie | SPnT-16 | | | | | | | | | |
| | Model "3" & "4" | R573 serie | SPnT-16 | N | RAMSES Series | | | | | | | |
| | Model "3" & "4" | | | SMA | | | | | | | | |
| | | | | | 2.5 GHz | 3 GHz | 6 GHz | 8 GHz | 12.4 GHz | 18 GHz | 26.5 GHz | 40 GHz |

*All dimensions in this catalog are given in millimeters*