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RF CONNECTORS TUTORIAL

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ZHENJIANG LENORF INDUSTRY CO.,LTD

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6. What is RF cable assembly

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What is RF connectors?

basic knowledge

Definition of nouns

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1.Radio frequency: The frequency range between 3 KHZ ∽ 110 GHZ radio waves. RF is short for Radio frequency, it is a kind of high frequency alternating current electromagnetic wave abbreviation. Alternating current that varies less than 1,000 times per second is called low frequency current, and higher than 10,000 is called high frequency current, and radio frequency is such a high frequency current.

2. Coaxial：It refers to that there are two concentric conductors, and the conductor and the shielding layer share the same axis.



3. Connectors：It is usually attached to cable or device. It is a separable element for the electrical connection of a transmission line system. In simplest words, connector is a device that provides a quick connection and disconnection to the end of cable. In addition to the switch, the connector mainly plays the role of circuit connection and signal transmission, rather than just a switch.



RF Connector = Radio frequency connector , also called COAXIAL CONNECTOR.
Because in general, the RF connectors must be coaxial.

RF coaxial connectors development overview

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RF coaxial connectors (hereinafter referred to as RF connectors) are generally considered to be an component assembling on cable or instrument, using as a transmission line for electrical connection or separation of component. It belongs to electromechanical integration product. In brief ,It mainly acts as a bridge. Compared with other electronic components, RF connector has a short history. The UHF connector that appeared in 1930 is the earliest RF connector. By the time of world war ii, in need of war, with the development of radar, radio and microwave communications, it occurs medium-sized series such as N, C, BNC, TNC. After 1958, SMA, SMB, SMC and other miniaturized products appeared. In 1964, the us military standard MIL-C-39012 *general specification for radio-frequency coaxial connectors* was formulated. From then on, RF connector began to develop towards standardization, serialization and generalization.
In more than 80 years, through the joint efforts of experts from various countries, RF connector has formed an independent and complete professional system and become an important part of the connector family. It is an indispensable key component of coaxial transmission system. RF connector development technology in the United States, Britain, France and other countries in the leading position, its design, production, testing, using technology has formed a complete set, tend to improve, not only formed a complete standard system, but also raw materials, transport materials, testing system, assembly tools have been standardized, and specialized scale production.

Professional features：
1.Variety and specification：More than 20 international common series, more varieties and specifications.
2.It relies on the mechanical structure to ensure the electrical characteristics, it is an electromechanical integration products, and it has the essential difference between other low-frequency connector.
3.Its parts processing is mainly turning machine processing, manual assembly operations, it is difficult to carry out automatic assembly.
4.Product update is slow.
5.It is an important part of the electrical connector, belongs to a certain technical content of labor-intensive products.
6.Product reliability, failure mode and failure mechanism are complex.



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Common structural components of RF connectors

Take the SMA connector as an example.

Basic structure

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Body, outer conductor

It is also known as the shell, corresponding to the shield layer connected to the coaxial cable, the shell of the equipment. The main function is to protect the inner conductor and fix the connector. The material is usually 591 brass. Use non-magnetic brass 3603 if LOW PIM is required. Plating is usually nickel, ternary alloy, silver plating.



Contact, inner conductor

The materials is usually brass, phosphorous bronze, beryllium bronze, corresponding to the central conductor of coaxial cable.
It is divided into MALE(PLUG) and FEMALE(JACK). It is the key component of the connector, can transmit high frequency signal. Plating is usually gold plated, silver plated, military requirements of high phosphorus nickel bottom gold plated, wear resistance and high life.



Insulator

The material is usually Teflon (PTFE), ABS,PEI. The insulating layer corresponding to the coaxial cable. Good insulation resistance, voltage resistance and ease of processing are the basic requirements for selecting insulating materials to be machined into insulators. The interface size is controlled by fixing the inner conductor by insulating physical fitness.



Accessory

The accessory is divided into structural accessory and installation accessory. Structural accessories such as pressure takeover, card ring, positioning key, positioning pin, guide pin, connection ring, cable clamp, sealing ring, gasket and so on. Install accessories such as screws, nuts, screws, spring rings, etc.
Most accessories have standard parts and common parts.
Plating requirements are generally nickel plating, but in high requirements of the scene Plating requirements are generally nickel plating gold.

Pictures

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body



INSULATOR



CONTACT



ACCESSORY

Common RF Connector Structure classification

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By mounting

- 2 hole Flange
- 4 hole Flange
- Bulkhead front mounting
- Bulkhead rear mounting

By direction

- Straight
- Right angle

By polarity

- MALE(PLUG)
- FEMALE(JACK)
- Reverse polarity male
- Reverse polarity female

By termination

- Crimping
- Soldering
- Clamping
- PCB Welding
- PCB SMD wave-soldering
- PCB Angle welding

Taking SMA connector as an example, how to describe an RF connector.

SMA was born in 1960, has been 59 years of history, it is a miniaturized threaded fastening connector, characteristic impedance 50 ohms, 1/4-36 thread, operating frequency 0-18G, this product is widely used in automobiles, wireless networks, telecommunications, aviation, precision testing equipment and so on.



SMA PLUG CRIMPING FOR RG58

The male is usually hexagonal nut construction, this SMA and RG58 coaxial cable connected by crimping method. Must and can only be compatible with SMA female.



SMA JACK CRIMPING FOR RG316

The female is threaded structure, this product is used for fixing on the panel, so it is equipped with waterproof seal ring, inner tooth washer and nut. Must and can only be compatible with SMA male.

More structure examples

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SMA PLUG BEND CRIMPING RG316



SMA JACK STRAIGHT PCB ANGLE WELDING



SMA JACK STRAIGHT RG316，2 HOLE FLANGE PANEL MOUNTED



SMA JACK STRAIGHT 4 HOLE FLANGE PANEL MOUNTED



SMA JACK STRAIGHT PCB



SMA JACK BEND PCB



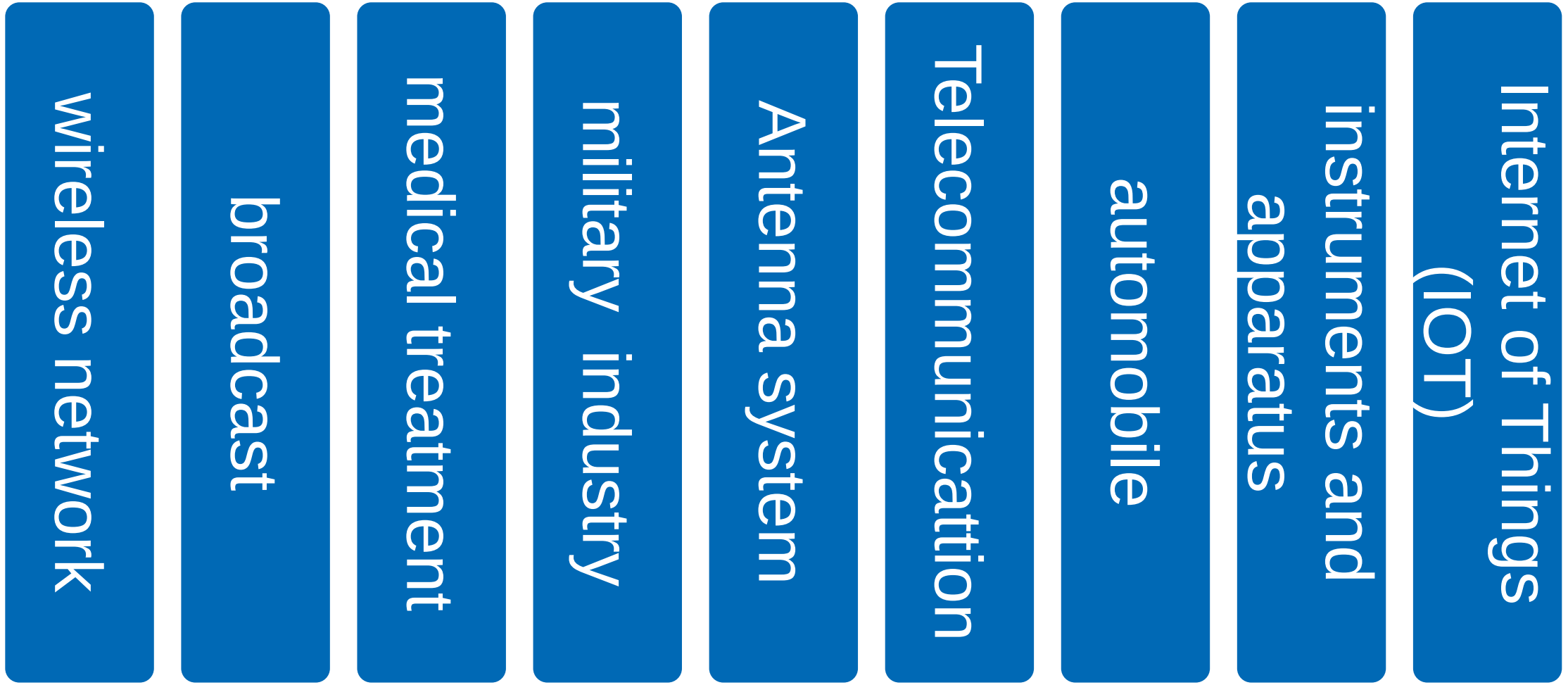
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Application of RF connectors

Typical application

Application of RF connectors

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/04 How to select RF connectors?

The basic points on how to select RF connectors

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1.Working Frequency

Different connectors should be used for different working frequencies. For example, the maximum frequency of SMA is 18G, and the maximum frequency of 7/16 connector is 8.4G.

2.Characteristic Impedance

There are 2 kinds of popular characteristic impedance, 50 ohm and 75 ohm, most connectors are 50 ohm, 75 ohm is generally used in CATV, CCTV system such as BNC,F,TNC.

3.Working Voltage

In general voltage is 500V, the current RF system tends to low power consumption, long standby, working voltage is lower and lower.

4.Polarity and apperance

Polarity is divided into male and female, plus the reverse-polarity, there are 4 different polarity.

The shape should be based on the requirements of the project, the equipment and the situation of the scene to select the corresponding RF connectors, international standard RF connectors have more than 20 kinds, from the miniature-type IPX, u.f. L to the large 7/16.

The basic points on how to select RF connectors

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5.Reliability

Conventional connectors provide 500 inserts.It depends on the connector material and plating requirements, whether it is used outdoors or indoors, whether it is frequently plugged in, etc.

6.Connection method

Connection method usually has threaded connection, fast plug, S-type lock buckle.

Threaded connection is more reliable, but the plug is not convenient, fast plug reliability is low, but the plug is fast.

7.Operating environment

The ordinary use temperature is -65 C to +165 C, and its waterproof rating is IP65,67,68.

8.Performance

The main performance indicators are below:

a.RETURN LOSS(VSWR)

The smaller the value, the smaller the signal loss.

b.INSERTION LOSS

The smaller the value, the smaller the signal loss due to the connector

c.PIM3

The smaller the value is, the interference in the mixed state of multi-channel signals will be represented



/05 Common RF connectors

International frequency division table

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Frequency	Designation	Abbreviation
3 - 30 Hz	Extremely low frequency	ELF
30 - 300 Hz	Super low frequency	SLF
300 - 3000 Hz	Ultra low frequency	ULF
3 - 30 kHz	Very low frequency	VLF
30 - 300 kHz	Low frequency	LF
300 kHz - 3 MHz	Medium frequency	MF
3 - 30 MHz	High frequency	HF
30 - 300 MHz	Very high frequency	VHF
300 MHz - 3 GHz	Ultra high frequency	UHF
3 - 30 GHz	Super high frequency	SHF
30 - 300 GHz	Extremely high frequency	EHF

Connector frequency range table

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Connector type	max frequency (G)
2.4mm	50
2.92mm	40
SSMA	35
SMP	26.5
3.5mm	26.5
BMA	22
NEX10	20
SMA	18
QMA	18
Airline BNC	18
SSMC	12.4
SSMB	12.4
N-type	11
TNC	11
DIN 1.6-5.6	3

Connector type	max frequency (G)
SMC	10
PSMP	10
DIN 1.0-2.3	10
DIN 7-16	8.4
DIN 4.1-9.5	6
MMCX	6
MCX	6
DIN 4.3-10	6
BNC	4
SMB	4
FAKRA	4
Mini-UHF	2.5
MHV	0.5
UHF	0.3
FME	0.2
F	0.2

Production Ability

Products line

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N CONNECTOR







SMA CONNECTOR







7/16 CONNECTOR







Production Ability

Products line

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MINI DIN 4.3/10 CONNECTOR



BNC CONNECTOR



MCX &MMCX CONNECTOR



Production Ability

Products line

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SMB CONNECTOR







SMC CONNECTOR





SMZ CONNECTOR







Production Ability

Products line

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1.0/2.3 CONNECTOR







1.6/5.6 CONNECTOR







F CONNECTOR






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TNC CONNECTOR







UHF CONNECTOR






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ADAPTORS














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Products line

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Surge Protector











Production Ability

Products line

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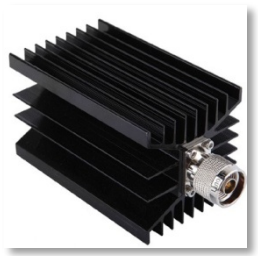
Loads & Attenuator













Production Ability

Products line

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Combiner&Splitter









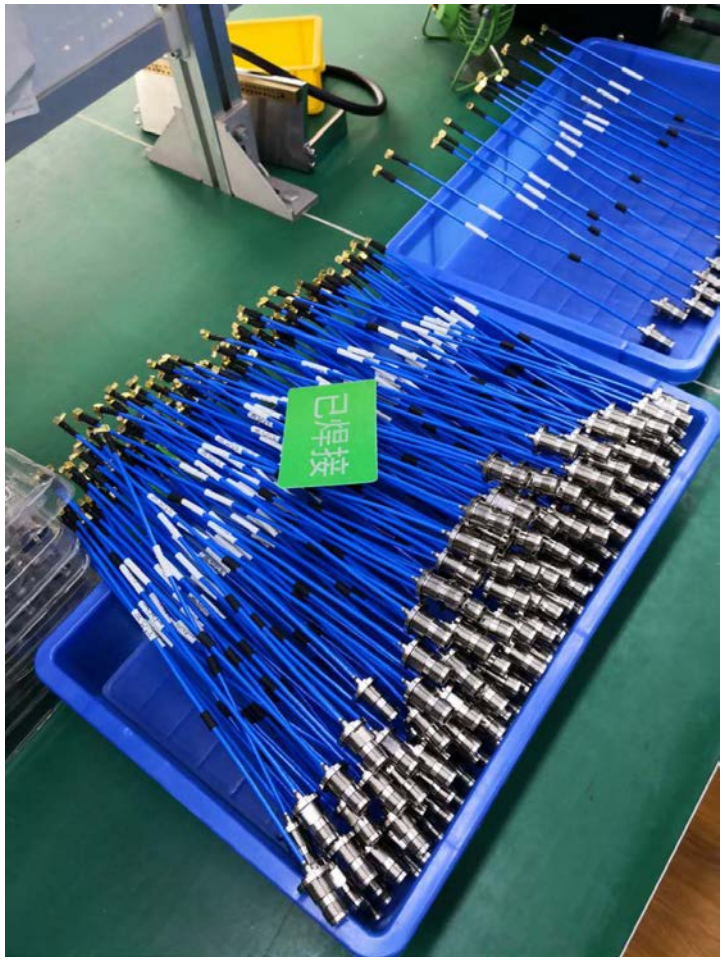


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What is RF cable assembly?

RF cable assembly

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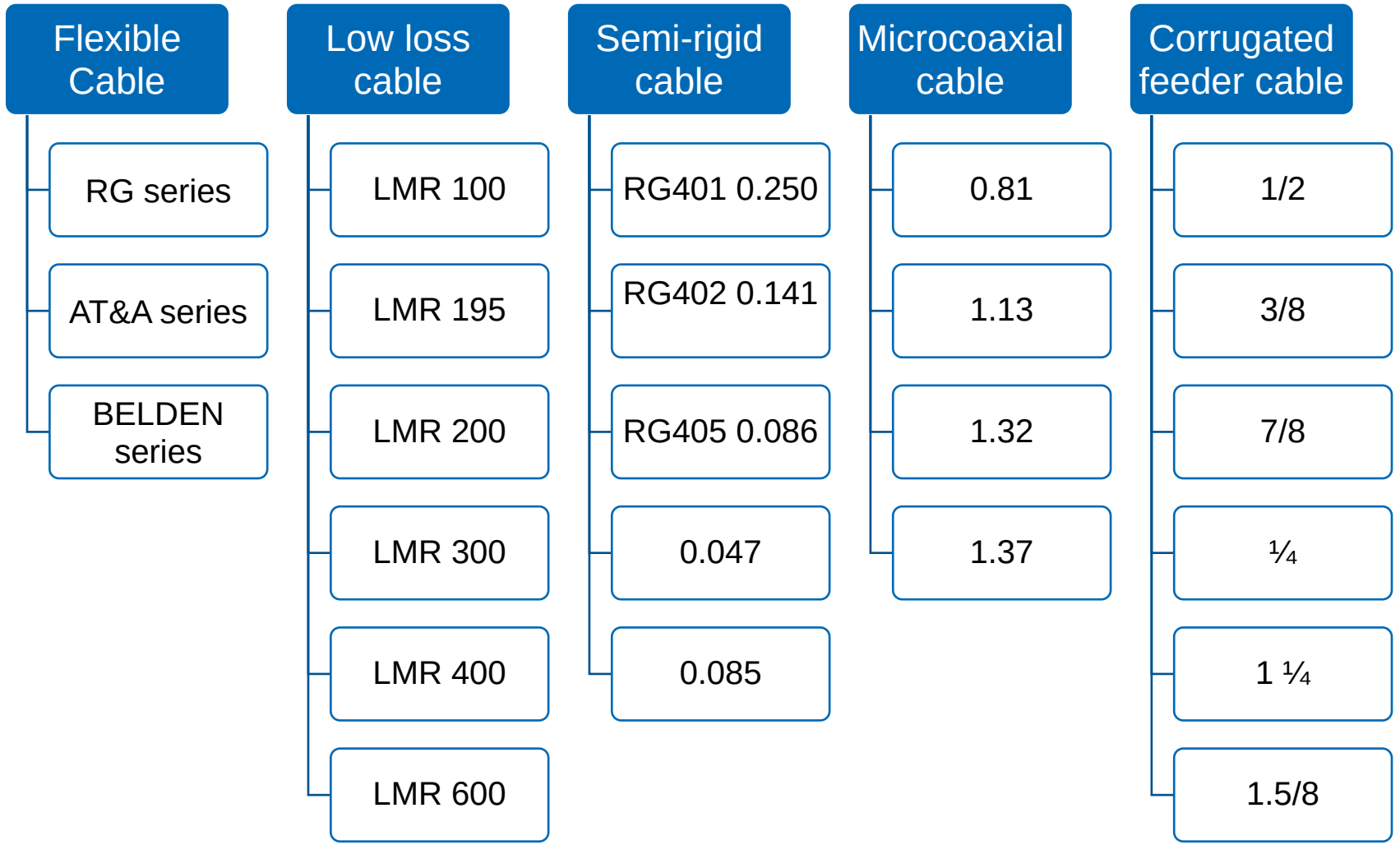
RF cable assembly, as the name suggests, is composed of RF coaxial connectors and coaxial cables, which are assembled according to the different requirements of the corresponding connectors and cables.
For example, the feeder components commonly used in 4G communication are N-type, for 4.3/10,7/16 connectors, use corrugated feeders for cables.
WIFI amplifier antenna is generally N-type,SMA connector, cable RG series or LMR series.

Similar to RF connectors, RETURN LOSS(VSWR), INSERTION LOSS, PIM, and characteristic impedance are required to be considered in design.

Common series of coaxial cables are shown in the table below.

RF cable common classification table

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Production Ability

Products line

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Cable Assembly



SMA MALE TO MALE RG174



SMA FEMALE TO IPX 1.13



IPX UFL WFL



N FEMALE TO SMA SMA RG58



7/16 MALE TO MALE ½”



7/16 MALE TO MALE ½”



7/16 MALE TO MALE ½”



N FEMALE TO SMA MALE RG58



SMA MALE TO MALE RG402



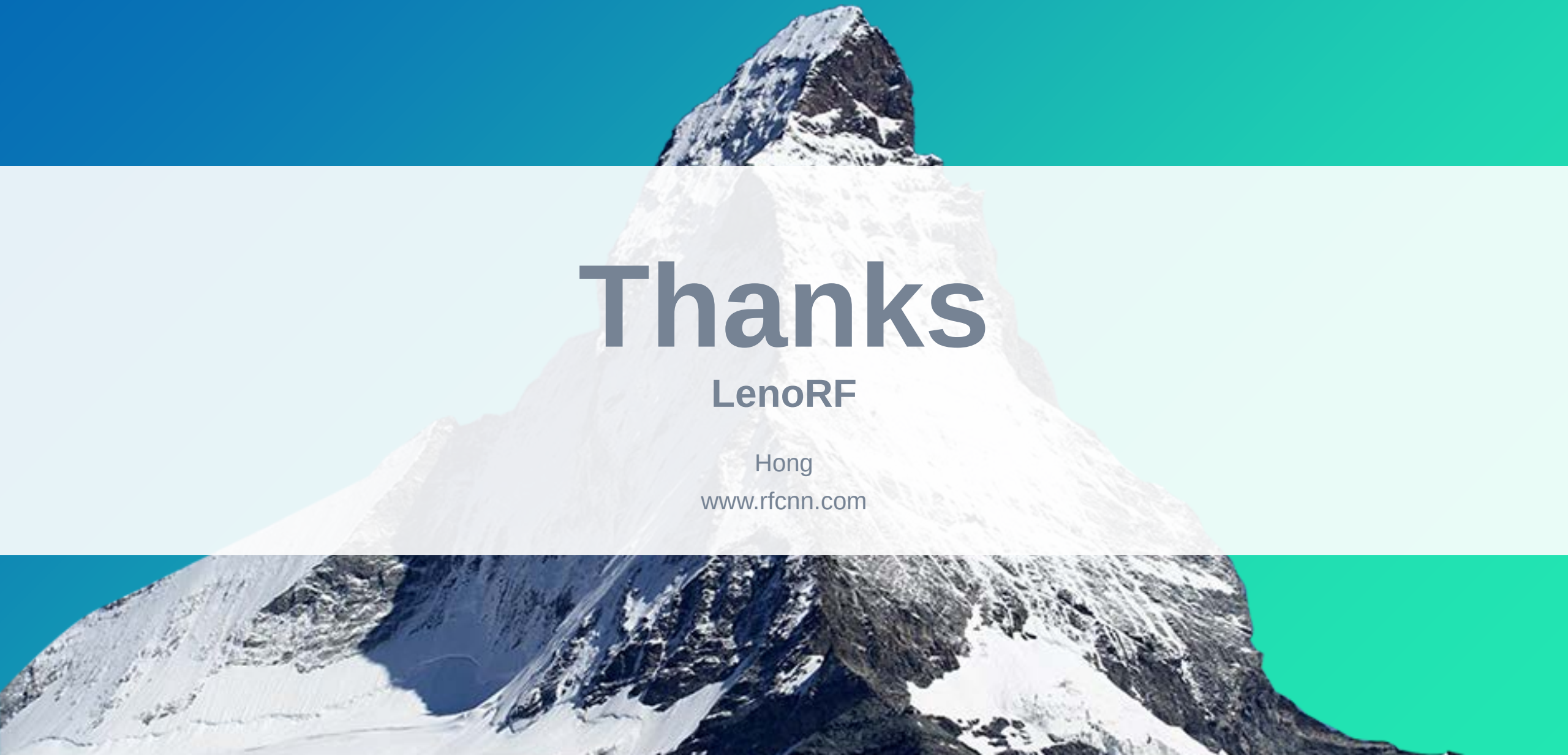
BMA FEMALE



N FEMALE TO MCX RG401



N FEMALE TO SMA MALE 086



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