

Products: All instruments operating at 26GHz and above like FSP, FSQ, FSMR, FSU, ESIB, SMP, SMR, FSET, FSEM, FSEK, FSIQ

Interchangeable Port Connector System Test Port Adapter System

Application Note

A Test Port Adapter System is implemented for all Rohde & Schwarz equipment, which operates above 26 GHz in order to protect the RF front-end from mechanical damage. The Test Port Adapter System consists of a RF front-end interface called the Test Port Adapter Body, and the Test Port Adapter Head which is attached to the Body. The Head provides an interface to a cable or device under test. This Application Note identifies the various types of Test Port Adapters, their parameters, compatibilities and usages.



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1 Overview

We often get questions about the **Interchangeable Port Connector System**, which is generally used for Rohde & Schwarz microwave instruments.

In our data sheets we call the **Interchangeable Port Connector System** mainly **Test Port Adapter**. In the following documentation the term **Test Port Adapter** will be used.

2 What you will learn from this documentation:

There are two different kinds of **Test Port Adapter Bodies** (Figure 1) available, which differ mechanically:

- Higher Frequency Range (up to 50 GHz)
- Lower Frequency Range (up to 30 GHz)

For these **Test Port Adapter Bodies** Rohde & Schwarz provides different kind of **Connector Heads** as shown in Table 1.

Alpha Indicator	Mechanical Indicator	e.g. available at these instruments
N		All
	3.50 mm	FSQ26
K	2.92 mm	FSQ40, SMR, ZV
Q	2.40 mm	FSU50, SMR, ZV

Table 1: Provided Connector Heads for Rohde & Schwarz microwave instruments

Some microwave instruments (SMR50, SMR60) are equipped with non-exchangeable connectors called 1.85mm (V).

Mechanical compatibility:

#1 You can mechanically connect: SMA, 3.50 mm and 2.92 mm (K).

#2 You can mechanically connect: 2.40 mm (Q) and 1.85 mm (V).

Never connect a part from #1 to a part from #2 or vice versa.

3 The Test Port Adapter System

Figure 1 shows a picture of the **Test Port Adapter Body**, which is generally used in Rohde & Schwarz microwave instruments. This **Body** is the base for further **Connector Heads**. This Body is available for a lower frequency range of up to 30 GHz and a higher frequency range of up to 50 GHz. Rohde & Schwarz provides **Connector Heads** in N, 3.50 mm, 2.92 mm and 2.40mm. The mechanics for the lower and the higher frequency ranges differ mechanically, please refer to chapter 8.



Figure 1: Test Port Adapter Body

4 Advantage of the Test Port Adapter

- If the connector (N, 3.50 mm etc.) breaks, then the **Connector Head** just has to be exchanged. No service costs. No waiting time due to repair.
- The **Connector Heads** are available in different standards. This reduces the need for additional adapters (e.g. 2.40 mm to N which is mechanically very instable).

5 Attached Connector Heads

Figure 2 shows a 2.92 mm **Connector Head** which is similar to the 3.50 mm and 2.40 mm connector Heads, which are attached to the **Test Port Adapter Body**.

Figure 3 shows the N-standard **Connector Head** attached to the **Test Port Adapter Body**.

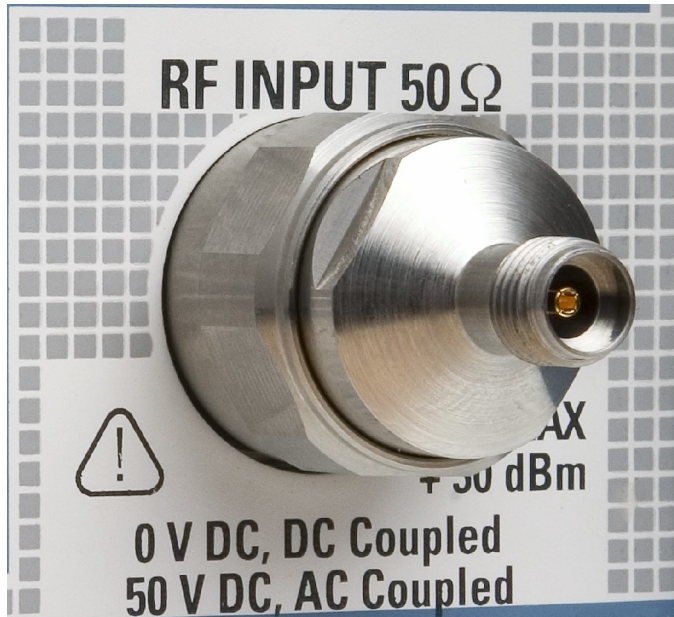


Figure 2: Attached Test Port Adapter Head (2.92 mm female)



Figure 3: Attached Test Port Adapter Head (N female)

6 Different Female Connector Heads

Figure 4 shows two examples of female **Connector Heads**, which can be attached to the **Test Port Adapter Body**. Example a) shows the part of the **Connector Head** that interfaces with the **Test Port Adapter Body**. Examples b) and c) show the part of the **Connector Head** that typically connects to a cable.

a) and b) represent female **Connector Heads** in the N-standard. c) represents female **Connector Heads** in 3.50 mm, 2.92 mm (as shown in the picture) and 2.40 mm standards.

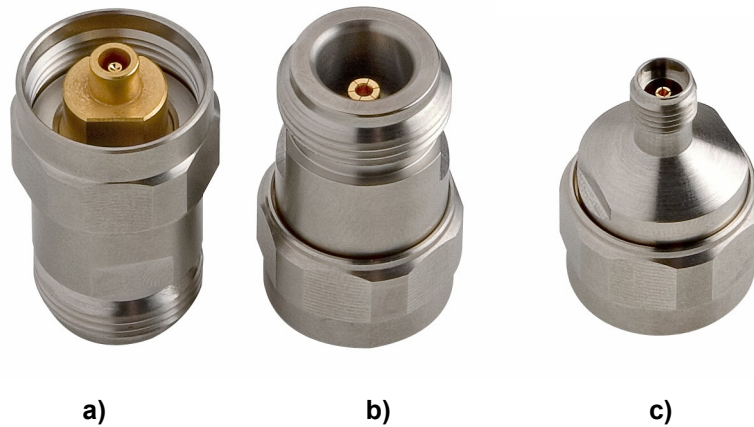


Figure 4: Different female Connector Heads

7 Male Type Connector Heads

There are also male type **Connector Heads** available in 3.50 mm, N and 2.92 mm standards.



Figure 5: Different male Connector Heads

8 Compatibility of the Test Port Adapter Body

There are two different interconnecting **Test Port Adapter Bodies** available. As you can see in Figure 6. The mechanics of each are different. The large golden blocks and the small golden rings vary in size.

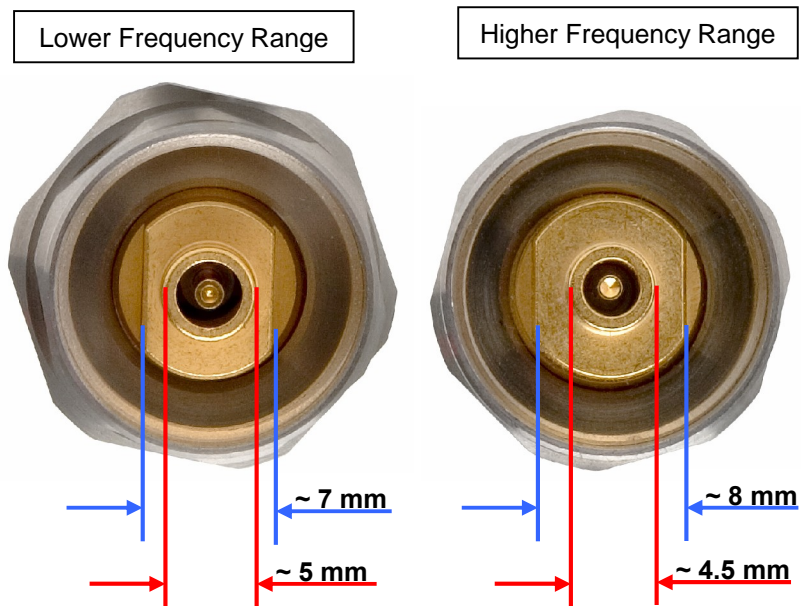


Figure 6: Dimensions of the Head Body mechanics

9 Compatibility of (SMA, 3.50 mm, 2.92 mm) versus (2.40 mm, 1.85 mm)

The 2.92 mm connector is also known as a K-connector. The 2.40 mm connector is also known as a Q-connector. The 1.85 mm connector is also known as a V-connector. The SMA, 3.50 mm, 2.92 mm, 2.40 mm and 1.85 mm connectors all have different electrical specifications. Please refer to Table 2. SMA connectors have a dielectric interface, while 3.50 mm, 2.92 mm, 2.40 mm and 1.85 mm connectors are air interface connectors. The air interface provides for a more repeatable connection with better electrical performance. The 3.50 mm (Figure 7) or 2.92 mm (Figure 8) or 2.40 mm (Figure 9) etc. connector description refers to the inside diameter of the connector's outer conductor. Please bear in mind, all electrical and mechanical systems have some manufacturing tolerances. In this document only nominal values are used.

Figure 7, Figure 8 and Figure 9 show female type **Connector Heads**.

The center connector's outer diameter also differs: 3.50 mm -> 1.52 mm, 2.92 mm -> 1.27 mm, 2.40 mm -> 1.04 mm, 1.85 mm -> 0.804 mm. The ratio between inner and outer conductors provide the 50-ohm nominal impedance of these connectors. But this part of the inner connector does not provide the connectivity between the male and female connector. The inner diameter of the inner connectors is equal for the SMA, 3.50 mm (Figure 7) and 2.92 mm (Figure 8) connectors. This inner diameter is 0.92 mm. Therefore, the SMA, 3.50 mm and 2.92 mm connectors can connect together.

The inner diameter of the inner connectors of the 2.40 mm (Figure 9) and 1.85 mm connectors is 0.51 mm, meaning that the 2.40mm and 1.85mm can connect together.

Please bear in mind; this description of connecting the different connector types together refers only to the mechanical data. The electrical data is always different for connecting different systems together. There is no electrical data available about connections between different standards, e.g. 2.92mm with 3.50mm. If carrying out measurements, please only use one system, which covers the appropriate frequency range.

Interchangeable Port Connector System Test Port Adapter System

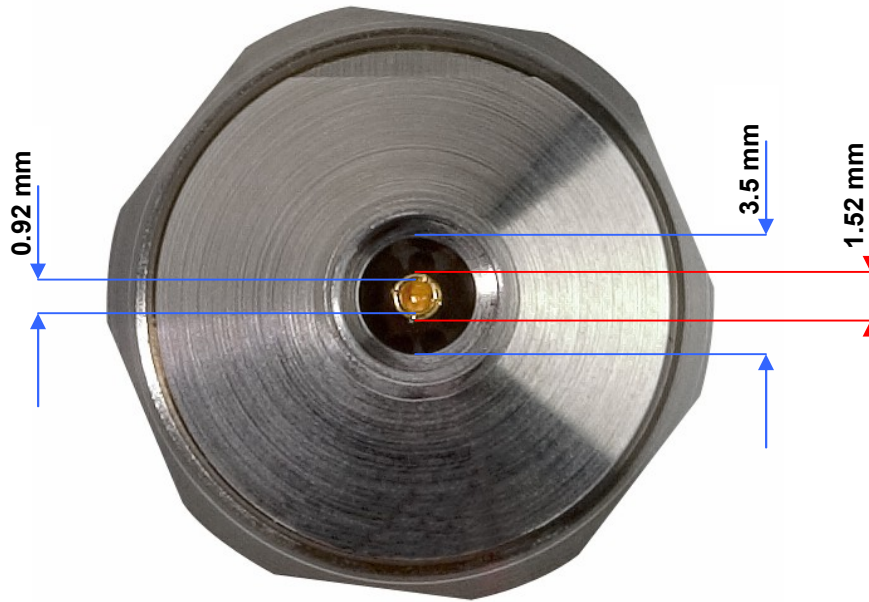


Figure 7: Test Port Adapter 3.50mm (female)

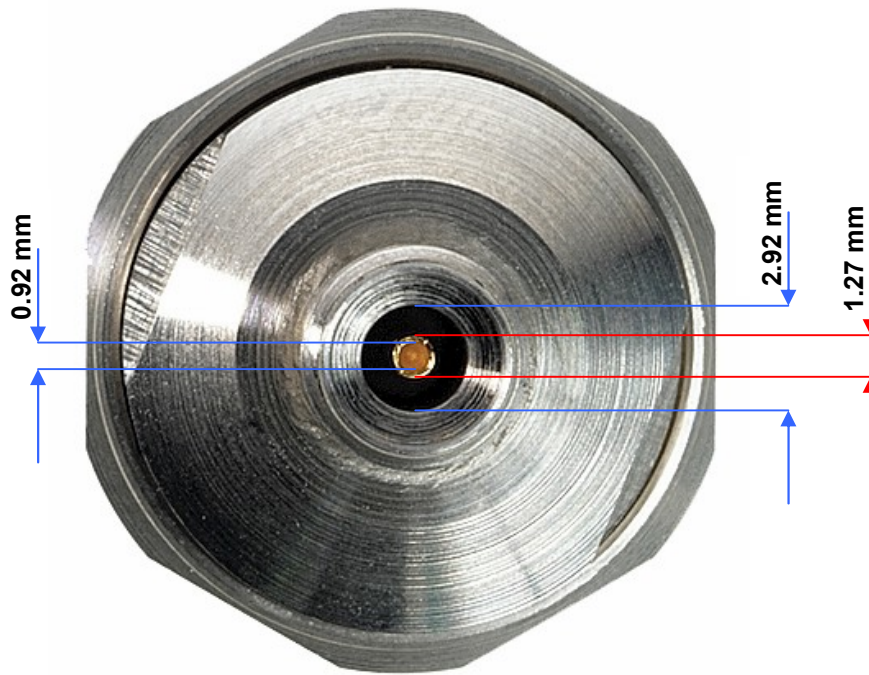


Figure 8: Test Port Adapter 2.92 mm (female)

Interchangeable Port Connector System
Test Port Adapter System

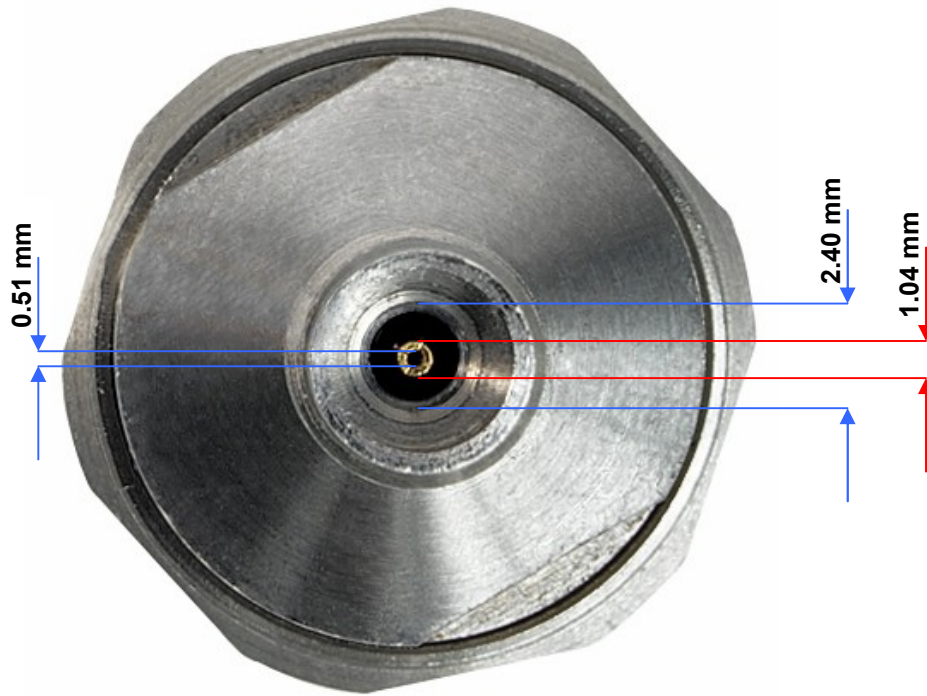


Figure 9: Test Port Adapter 2.40 mm (female)

10 The Thread of the Connectors

The SMA, 3.50 mm and 2.92 mm standards are equipped with 0.25 inch, 36 tpi (thread per inch) threads.

The 2.40 mm and 1.85 mm standards are equipped with a metric thread M7 x 0.75-6G. M7 characterizes a 7mm metric thread. The pitch is 0.75mm and is manufactured in the 6G-tolerance field.

Both threads are similar in size and can accidentally be screwed together. But to do so, you need an unusually high torque.

11 Conclusion

You can mechanically connect SMA, 3.50 mm and 2.92 mm standards together. The 2.92 mm standard is also named the “K standard”.

You can mechanically connect 2.40 mm and 1.85 mm standards together. The 2.40 mm standard is also named the “Q standard”. The 1.85 mm standard is also named the “V standard”.

Please compare the inner diameter of the inner conductor in Figures 7 and 8 to the inner diameter of the inner conductor in Figure 9.

Important:

The Rohde & Schwarz microwave generators SMR50 and SMR60 are equipped with 1.85 mm female connectors. Do not connect a wrong connector. You may only connect 1.85 mm or 2.40 mm connectors to SMR50 and SMR60. Attaching other connectors to it will create very high repair costs. Remember, SMR50 and SMR60 do not use the Test Port Adapter System.

The Rohde & Schwarz microwave instruments FSU50 and FSMR50 are equipped with a 2.40 mm female Connector Head. Do not connect a wrong connector. You may only connect 1.85 mm or 2.40 mm connectors with the Connector Head.

Caution

Even just trying to connect a wrong connector to a 2.40 mm or 1.85 mm female connector will destroy the inner conductor in an irreversible way. 1.85 mm and 2.40 mm connectors are very expensive.

12 Recommended Torque and Frequency Range

Table 2 gives an overview of the recommended torque ranges to tighten different kinds of connectors. Table 2 also shows information on the highest frequency, which can be used by a specific connector. Please also refer to the manufacturer's data sheets. The specifications of selected connectors (measured by the manufacturer) may differ from the general information in Table 2.

Connector System	Frequency	Coupling torque recommended
N	18 GHz	0.68 Nm...1.13 Nm
SMA	18 GHz (some up to 26 GHz)	~0.56 Nm
3.50 mm	26.5 GHz	0.8 Nm...1.1 Nm
2.92 mm	40 GHz (some up to 46 GHz)	0.8 Nm...1.1 Nm
2.40 mm	50 GHz (some up to 60 GHz)	0.8 Nm...1.1 Nm
1.85 mm	65 GHz (some up to 75 GHz)	0.8 Nm...1.1 Nm
Test Port Adapter to Body		~2 Nm

Table 2: Torque and Frequency Range of Connector Systems

13 Which Connector Head matches to which R&S Instrument?

In general, Rohde & Schwarz instruments use two different kinds of **Test Port Adapter Bodies** in conjunction with several different **Connector Heads**. For details please refer to Table 3,

Interchangeable Port Connector System Test Port Adapter System

Connector System	Also named	G	Body Frequency Range	R&S Order Number	R&S Name	FSIQ26	FSU26	FSU46	FSU50
N		F	LOWER	1021.0535.00		D	D		
N		M	LOWER	1021.0541.00		A	A		
N		F	HIGHER	1036.4777.00				D	D
N		M	HIGHER	1036.4783.00				A	A
3.5mm		F	LOWER	1021.0512.00		D	D		
3.5mm		M	LOWER	1021.0529.00		A	A		
2.92mm	K	F	HIGHER	1036.4790.00				D	A
2.92mm	K	M	HIGHER	1036.4802.00				A	A
2.4mm		F	HIGHER	10881627.02	FSE-Z5			A	D
Cable with 2 Interchangeable Connectors			LOWER	1046.2002.02	FSE-Z15	P	A		
1.85mm	V	F		not exchangeable					

Table 4 and Table 5. Please keep in mind; the microwave generators SMR50 and SMR60 are equipped with a 1.85mm connector (also called V connector). These 1.85mm connectors are not interchangeable. The **Test Port Adapter System** is not used on SMR50 and SMR60.

Table 3 and

Connector System	Also named	G	Body Frequency Range	R&S Order Number	R&S Name	FSIQ26	FSU26	FSU46	FSU50
N		F	LOWER	1021.0535.00		D	D		
N		M	LOWER	1021.0541.00		A	A		
N		F	HIGHER	1036.4777.00				D	D
N		M	HIGHER	1036.4783.00				A	A
3.5mm		F	LOWER	1021.0512.00		D	D		
3.5mm		M	LOWER	1021.0529.00		A	A		
2.92mm	K	F	HIGHER	1036.4790.00				D	A
2.92mm	K	M	HIGHER	1036.4802.00				A	A
2.4mm		F	HIGHER	10881627.02	FSE-Z5			A	D
Cable with 2 Interchangeable Connectors			LOWER	1046.2002.02	FSE-Z15	P	A		
1.85mm	V	F		not exchangeable					

Table 4 contain information regarding which **Test Port Adapter Connector Head** matches which spectrum analyzer or receiver. Table 5 contains information regarding which **Test Port Adapter Connector Head** matches which Generator.

Interchangeable Port Connector System Test Port Adapter System

Connector System	Also named	G	Body Frequency Range	R&S Order Number	R&S Name	FSP30	FSP40	FSQ26	FSQ40	FSMR26	FSMR50	FSET22	FSEM	FSEK	ESIB26	ESIB40
N		F	LOWER	1021.0535.00		D		D		D		D	D		D	
N		M	LOWER	1021.0541.00		A		A		A		P	A		P	
N		F	HIGHER	1036.4777.00			D		D		D			D		D
N		M	HIGHER	1036.4783.00			A		A		A			A		P
3.5mm		F	LOWER	1021.0512.00		D		D		D		D	D		D	
3.5mm		M	LOWER	1021.0529.00		A		A		A		P	A		P	
2.92mm	K	F	HIGHER	1036.4790.00			D		D		A			D		D
2.92mm	K	M	HIGHER	1036.4802.00			A		A		A			A		P
2.40mm		F	HIGHER	1088.1627.02	FSE-Z5		A		A		D			A		P
FSE-Z15			LOWER	1046.2002.02		A		A		A		P			A	
1.85mm	V	F		not exchangeable												

Table 3: Spectrum Analyzer and Receiver (Part 1)

Legend:

G = Gender

F = Female Type Connector

M = Male Type Connector

LOWER = Lower Frequency Range (up to 30 GHz)

HIGHER = Higher Frequency Range (up to 50 GHz)

D = Delivered with instrument

(D) = Connector not interchangeable (Test Port Adapter not in use)

A = Additionally available according to the data sheet

P = Possible but not announced in the data sheet

**Interchangeable Port Connector System
Test Port Adapter System**

Connector System	Also named	G	Body Frequency Range	R&S Order Number	R&S Name	FSIQ26	FSU26	FSU46	FSU50	ESU26	ESU40		
N		F	LOWER	1021.0535.00		D	D			D			
N		M	LOWER	1021.0541.00		A	A			P			
N		F	HIGHER	1036.4777.00				D	D		D		
N		M	HIGHER	1036.4783.00				A	A		P		
3.5mm		F	LOWER	1021.0512.00		D	D			D			
3.5mm		M	LOWER	1021.0529.00		A	A			P			
2.92mm	K	F	HIGHER	1036.4790.00				D	A		D		
2.92mm	K	M	HIGHER	1036.4802.00				A	A		P		
2.4mm		F	HIGHER	10881627.02	FSE-Z5			A	D		P		
Cable with 2 Interchangeable Connectors			LOWER	1046.2002.02	FSE-Z15	P	A			A			
1.85mm	V	F		not exchangeable									

Table 4: Spectrum Analyzer and Receiver (Part 2)

Legend:

- G = Gender
- F = Female Type Connector
- M = Male Type Connector
- LOWER = Lower Frequency Range (up to 30 GHz)
- HIGHER = Higher Frequency Range (up to 50 GHz)
- D = Delivered with instrument
- (D) = Connector not interchangeable (Test Port Adapter not in use)
- A = Additionally available according to the data sheet
- P = Possible but not announced in the data sheet

**Interchangeable Port Connector System
Test Port Adapter System**

Connector System	Also named	G	Body Frequency Range	R&S Order Number	R&S Name	SMP02	SMP03	SMP04	SMP22	SMR20	SMR27 SMR30 SMR40	SMR50 SMR60	SMF22
N		F	LOWER	1021.0535.00		P	P		P	A			A
N		M	LOWER	1021.0541.00		A	A		A	A			A
N		F	HIGHER	1036.4777.00				A			A		
N		M	HIGHER	1036.4783.00				A			A		
3.5mm		F	LOWER	1021.0512.00		D	D		D	D			D
3.5mm		M	LOWER	1021.0529.00		A	A		A	A			A
2.92mm	K	F	HIGHER	1036.4790.00				D			D		
2.92mm	K	M	HIGHER	1036.4802.00				A			A		
2.4mm		F	HIGHER	10881627.02	FSE-Z5			P			P		
Cable with 2 Interchangeable Connectors			LOWER	1046.2002.02	FSE-Z15	P	P		P	P			P
1.85mm	V	F		not exchangeable								(D)	

Table 5: Generators

Legend:

G = Gender

F = Female Type Connector

M = Male Type Connector

LOWER = Lower Frequency Range (up to 30 GHz)

HIGHER = Higher Frequency Range (up to 50 GHz)

D = Delivered with instrument

(D) = Connector not interchangeable (Test Port Adapter not in use)

A = Additionally available according to the data sheet

P = Possible but not announced in the data sheet

Interchangeable Port Connector System Test Port Adapter System

14 Literature

Rohde & Schwarz, Instrument Data Sheets

Doug Skinner, NPL, National Physical Laboratory, Anamet Connector Guide, Second Edition

15 Thank you

The content and quality of this Application Note was reviewed by M. Hershfeld (also suggested very helpful inputs), W. Fisher, G. O'Banion, Lisa Gardner (all Customer Support Center at RSA)

16 Ordering information

For ordering information about the **Test Port Adapter Connector Heads**, please refer to Table 3,

Connector System	Also named	G	Body Frequency Range	R&S Order Number	R&S Name	FSIQ26	FSU26	FSU46	FSU5
N		F	LOWER	1021.0535.00		D	D		
N		M	LOWER	1021.0541.00		A	A		
N		F	HIGHER	1036.4777.00				D	D
N		M	HIGHER	1036.4783.00				A	A
3.5mm		F	LOWER	1021.0512.00		D	D		
3.5mm		M	LOWER	1021.0529.00		A	A		
2.92mm	K	F	HIGHER	1036.4790.00				D	A
2.92mm	K	M	HIGHER	1036.4802.00				A	A
2.4mm		F	HIGHER	10881627.02	FSE-Z5			A	D
Cable with 2 Interchangeable Connectors			LOWER	1046.2002.02	FSE-Z15	P	A		
1.85mm	V	F		not exchangeable					

Table 4, and Table 5

FSE-Z15 contains:
1021.2650.00 Microwave Cable

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1021.0529.00 Test Port Adapter Connector Head 3.50mm (male)
1021.0541.00 Test Port Adapter Connector Head N (male)

Additional Accessories can be found under www.rohde-schwarz.com/accessories.



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