

SPINNER Test & Measurement

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PIM Testing Portfolio



HIGH FREQUENCY PERFORMANCE WORLDWIDE
www.spinner-group.com





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SPINNER has been optimizing infrastructure components for mobile communication applications since the advent of the mobilcom industry. As a technology leader in this field, we know that one of the most important and challenging goals is to achieve extremely low 3rd order intermodulation products.

Passive intermodulation (PIM) is a form of intermodulation caused by the (generally very small) nonlinearities present in all passive components. When two or more frequencies are applied simultaneously, new and typically unwanted frequencies are generated. If these frequencies are of sufficient power and fall into the frequency range of the receiving signal, they can significantly disturb the receivers of mobile base stations and negatively impact the quality of service.

Symptoms include reduced bandwidth and even dropped calls. Fixing the problem involves additional and often repeated investments for locating and replacing components with bad PIM behavior. At SPINNER we believe in avoiding these issues from the start.

SPINNER was the first vendor to recognize the potential risks of PIM, and has been warning customers of them since the early days of mobile communication systems. Current mobile networks based on different technologies utilize multiple frequency bands in parallel to maximize the use of available spectrum. However, this makes it more important than ever to minimize PIM. Today's carriers are aware of the impact that PIM has on the performance of their networks and insist that it be as low as possible.

SPINNER understands how PIM performance can affect the growth of cellular networks and for decades has been devoting a huge R&D effort to offer a comprehensive portfolio of low-PIM products. We also set extraordinarily high standards with our definition of „low PIM“. Even most of our standard products such as connectors and jumpers feature a value of -160 dBc or better. Of course, while this is enough for many applications, some situation require even better performance. And accurately measuring PIM is one of the greatest challenges.

Measuring the PIM properties of a component or system requires a measuring environment of sufficiently higher precision than the device under test. When we discovered that no equipment was available with the high precision we wanted, we decided to develop our own.

Over the years, we have developed a large portfolio of specialized equipment with outstandingly low PIM for testing and measurement. Nothing comparable is available anywhere else. It includes self-aligning connectors, diplexers, rotary joints, loads, switch matrices, reference standards and more. We provide these products for hand-operated on-site testers and fully automated test systems in manufacturing environments to boost productivity while ensuring the highest standards of quality.

The following pages present a sampling of our large low PIM test and measurement portfolio, concentrating on the 4.3-10 and 7-16 connector systems.

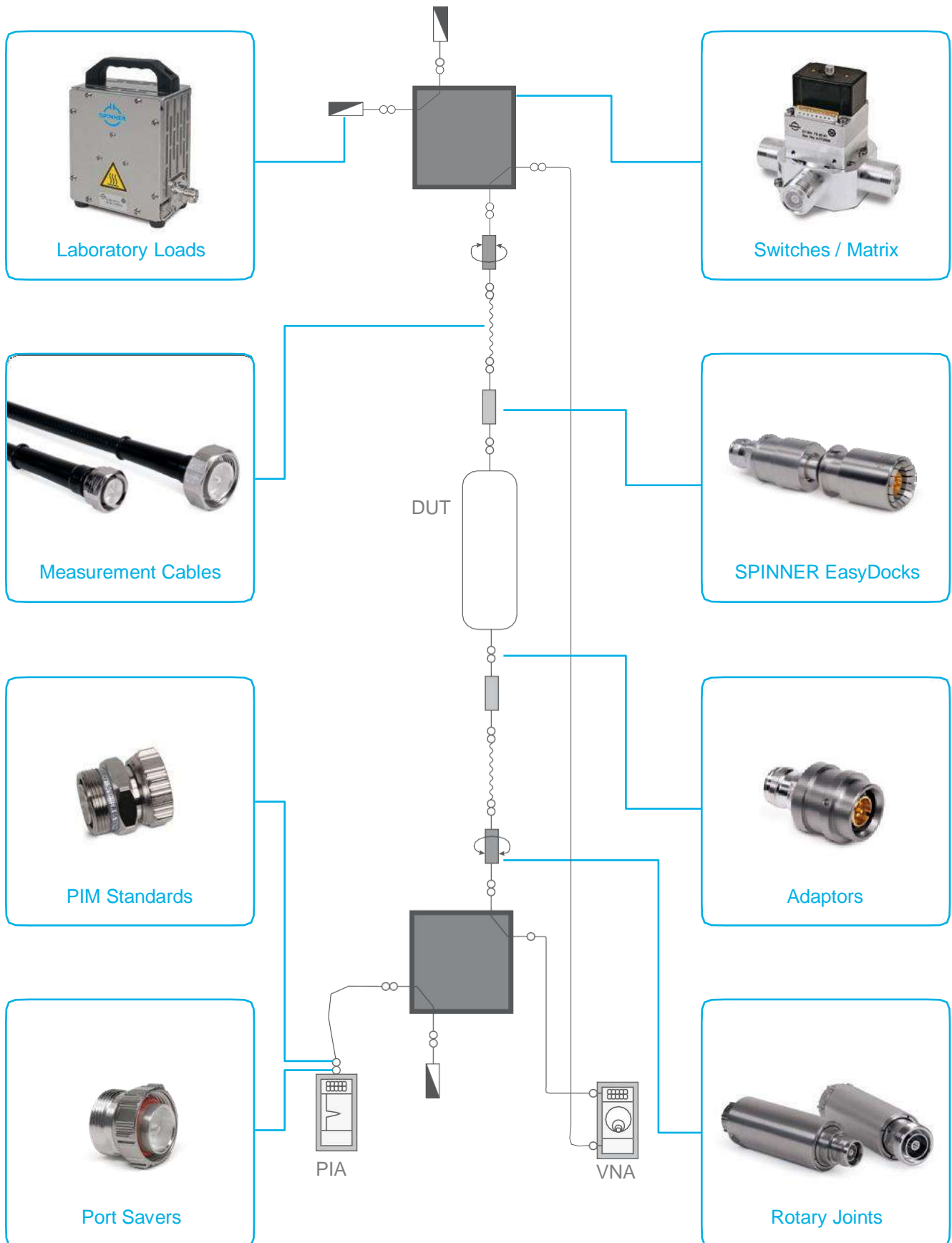


Please let us know your particular requirements!

Low PIM Product Range

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru



Passive Intermodulation Reference Standards

<http://www.tt-telecom.ru> e-mail: market@tt-telecom.ru

Generates a Defined Intermodulation Product for Test Purposes



- Guaranteed intermodulation
- High accuracy
- Excellent repeatability

General							
Frequency range		DC to 4 GHz					
Passive intermodulation level 3rd order*		-70 dBm	-80 dBm	-90 dBm	-100 dBm	-110 dBm	-120 dBm
*±3 dB at 2 x 43 dBm / 2 x 20 W carrier							
Coaxial interface connector		7-16 male - female (50 Ω)					
Frequency band		Part number starting with BN 756616.... To specify a type, please add a suffix from the table below.					
GSM 900 fIM3: 890.3 MHz	f1: 925.1 MHz f2: 959.9 MHz	C0070	C0080	C0090	C0100	C0110	C0120
GSM 1800 fIM3: 1730 MHz	f1: 1805 MHz f2: 1880 MHz	C1070	C1080	C1090	C1100	C1110	C1120
UMTS fIM3: 2050 MHz	f1: 2110 MHz f2: 2170 MHz	C2070	C2080	C2090	C2100	C2110	C2120
LTE 2.6 fIM3: 2550 MHz	f1: 2620 MHz f2: 2690 MHz	C3070	C3080	C3090	C3100	C3110	C3120

More information:



BN 756616Cxxxx

Coaxial interface connector		4.3-10 male - female (50 Ω)					
Frequency band		Part number starting with BN 756617.... To specify a type, please add a suffix from the table below.					
GSM 900 fIM3: 890.3 MHz	f1: 925.1 MHz f2: 959.9 MHz	C0070	C0080	C0090	C0100	C0110	C0120
GSM 1800 fIM3: 1730 MHz	f1: 1805 MHz f2: 1880 MHz	C1070	C1080	C1090	C1100	C1110	C1120
UMTS fIM3: 2050 MHz	f1: 2110 MHz f2: 2170 MHz	C2070	C2080	C2090	C2100	C2110	C2120
LTE 2.6 fIM3: 2550 MHz	f1: 2620 MHz f2: 2690 MHz	C3070	C3080	C3090	C3100	C3110	C3120

More information:



BN 756617Cxxxx

Example:

BN 756616C1090: Intermodulation standard with -90 dBm for band GSM 1800, interface 7-16 male-female

Low PIM Measurement Cable Assemblies

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru

Spinner Flex® TopFit SF 3/8" and SF 1/2"



- Outstanding IM performance
- 100% PIM tested; with protocol
- Straight and right angle 7-16 or 4.3-10 connectors
- Lengths: min. 0.13 m; max. 30 m
- Optimized for repeated bending
- Reinforced cable ends
- For indoor use only
(no O-ring in connector interface)

Article	Low PIM Cable SF 3/8"			
	≤ 0.96 GHz	≤ 2.2 GHz	≤ 2.7 GHz	≤ 3.8 GHz
Frequency range	≤ 0.96 GHz	≤ 2.2 GHz	≤ 2.7 GHz	≤ 3.8 GHz
VSWR (≤ 6 m) ¹⁾	1.2			
Insertion loss	13.8 dB/100 m	21.7 dB/100 m	25.8 dB/100 m	30.4 dB/100 m
Power rating, max. (40°C)	0.57 kW	0.36 kW	0.31 kW	0.26 kW

Article	Low PIM Cable SF 1/2"			
	≤ 0.96 GHz	≤ 2.2 GHz	≤ 2.7 GHz	≤ 3.8 GHz
Frequency range	≤ 0.96 GHz	≤ 2.2 GHz	≤ 2.7 GHz	≤ 3.8 GHz
VSWR (≤ 6 m) ¹⁾	1.07	1.10	1.14	1.16
Insertion loss	11.56 dB/100 m	18.64 dB/100 m	21.06 dB/100 m	25.90 dB/100 m
Power rating, max. (40°C)	0.91 kW	0.56 kW	0.49 kW	0.42 kW

¹⁾ The provided VSWR values are maintained within all global cellular frequency bands.

More information:

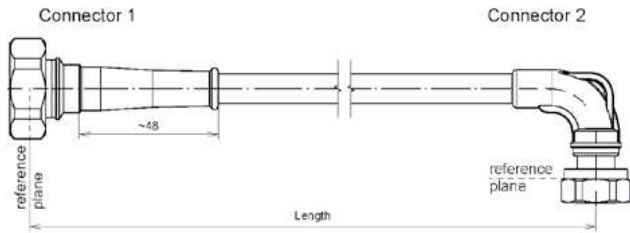


Low PIM coaxial cables



View Video
4.3-10 and 7-16 low PIM jumpers - PIM test at SPINNER

Low PIM Measurement Cable Assemblies - Sales Article Numbers



<http://www.tt-telecom.ru>

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Jumper	Cable Type	Cable Size	Connector 1	Connector 2	Length	Unit	Length	Extra Features		
J	Z	X	-	XZ	XZ	-	X	Z	X	-Z
SF	S		Any combination of connectors below is possible. Please specify XZ combination for connectors 1 and 2.							Leave blank if N/A
		3/8"	38							
		1/2"	12							
X = Connector System		Z = Connector Style		X	Z					
7-16		Male		7	M					
		Male right angle			R					
		Female			F					
		Female bulkhead			B					
		Female four-hole			P					
4.3-10		Male; screw		43	MS					
		Male right angle; screw			RS					
		Male right angle; handscrew			RH					
		Female			F					
		Female bulkhead			B					
		Female four-hole			P					
Length in meters/feet (dependent on unit specified)										
Meter							M			
Feed							F			
Length in decimeters/inch (dependent on unit specified)										
Low PIM Measurement Cable (only available with PE jacket)										
- Passive intermodulation (IM3) @ 2 x 20 W ≤ -160 dBc ¹⁾ , inspection certificate 3.1 ²⁾ , per jumper									-10	
- Passive intermodulation (IM3) @ 2 x 20 W ≤ -160 dBc ¹⁾ , inspection certificate 3.1 ²⁾ , per order									-11	
- Passive intermodulation (IM3) @ 2 x 20 W ≤ -165 dBc ¹⁾ , inspection certificate 3.1 ²⁾ , per jumper									-12	
- Passive intermodulation (IM3) @ 2 x 20 W ≤ -165 dBc ¹⁾ , inspection certificate 3.1 ²⁾ , per order									-13	
- Passive intermodulation (IM3) @ 2 x 20 W ≤ -170 dBc ¹⁾ , inspection certificate 3.1 ²⁾ , per jumper									-14	
- Passive intermodulation (IM3) @ 2 x 20 W ≤ -170 dBc ¹⁾ , inspection certificate 3.1 ²⁾ , per order									-15	

¹⁾ According to IEC 62037-2 and WN 20 000

²⁾ According to EN 10204

Examples of sales article numbers:

JS38-7M7F-2M-I4: SF 3/8" jumper with 7-16 male and 7-16 female; length 2.0 meter; low PIM performance with ≤ -165 dBc; test protocol per order.

JS12-7M43RS-1M3-I5: SF 1/2" jumper with 7-16 male and 4.3-10 female right angle screw; length 1.3 meter; low PIM performance with ≤ -170 dBc; test protocol per jumper.

Rotary Joints

Eliminating Torsional Forces



- No torsion on test cables
- Lowest intermodulation
- Contactless
- Guaranteed service life

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Part Number	BN 835103	BN 835089
Coaxial interface connector	4.3-10 male - female	7-16 male - female
Frequency range	0.69 to 0.96 GHz 1.71 to 2.69 GHz	
Peak power capability	6 kW	
Average power capability	300 W	
VSWR	Max. 1.16 @ 0.69 to 0.79GHz Max. 1.10 @ 0.79 to 0.96GHz Max. 1.10 @ 1.71 to 2.69GHz	
VSWR variation over rotation	Max. 0.04 @ 0.69 to 0.79GHz Max. 0.03 @ 0.79 to 0.96GHz Max. 0.03 @ 1.71 to 2.69GHz	
Passive intermodulation (IM3) @ 2 x 20 W	Max. ≤-165 dBc; typ. ≤-168 dBc	
Rotating speed	Max. 60 / nominal 30 rpm	
Life	Min. 5 x 10 ⁶ revolutions	
Dimensions (L x D)	191.7 mm x 35 mm	
Weight	900 g	

More information:


BN 835103


BN 835089



View Video
PIM Test at SPINNER with Low PIM rotary joints

SPINNER EasyDocks

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru

Jig Operated Test Applications in Production Lines



- For jig automated coupling movements to multiple DUT ports
- Lowest intermodulation
- Self-aligning
- Non-locking
- Enables top productivity in large-volume production
- Quick & reliable connection
- Guaranteed matings

Part Number	BN 432014	BN 293809	BN 293810	BN 194476
Coaxial DUT port interface connector	4.3-10 male push-pull	7-16 male push-pull	7-16 male push-pull	7-16 male push-pull
Coaxial outgoing (analyzer) port interface connector	4.3-10 female	7-16 female	7-16 female	4.3-10 female
Mounting	Bulkhead ¹⁾			
Frequency range	DC to 6 GHz			
VSWR	Max. 1.02 @ DC to 2 GHz Max. 1.06 @ 2 to 6 GHz			
Passive intermodulation (IM3) @ 2 x 20 W	Max. ≤ -162 dBc (for first 5,000 matings)			
Insertion loss	Max. 0.05 dB			
Maximum allowable misalignment corrections				
Transverse	±2 mm			
Axial	6 mm			
Angular (at minimum stroke of 1.5 mm)	±1.5°			
Contact force during measurement	≈ 80 N			
Matings	Min. 5,000 at PIM / min. 10,000 at VSWR			
Special feature			Supports enhanced screening effectiveness	

¹⁾Please refer to data sheet for other mounting options.

More information:

BN 432014

BN 293809

BN 293810

BN 194476



View Video
SPINNER EasyDock test cases featuring 4.3-10, 7-16 and PIM

SPINNER EasyDocks

<http://www.tt-telecom.ru>

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Robotic Operated Test Applications in Production Lines



- For robotic based coupling movements to DUT
- Pick & connect – suitable for 2-jaw gripper
- Lowest intermodulation
- Self-aligning
- Lockable
- Enables top productivity in large-volume production
- Quick & reliable connection
- Guaranteed matings

Part Number	BN 293820	BN 194482C0002	BN 432047C0002	
Coaxial DUT port interface connector	7-16 male push-pull, lockable		4.3-10 male push-pull, lockable	
Coaxial outgoing (analyzer) port interface connector	7-16 female	4.3-10 female		
Operation	2-jaw gripper, e.g. handled by robot			
Frequency range	DC to 6 GHz			
VSWR	Max. 1.02 @ DC to 2 GHz Max. 1.06 @ 2 to 6 GHz			
Passive intermodulation (IM3) @ 2 x 20 W	Max. ≤ -163 dBc (for first 5,000 matings)			
Insertion loss	Max. 0.05 dB			
Maximum allowable misalignment corrections				
Transverse				±1.5 mm
Axial				6 mm
Angular (at minimum stroke of 1.5 mm)	±1.5°			
Contact force	≈ 80 N			
Matings	Min. 5,000 at PIM / min. 10,000 at VSWR			
Weight	510 g	450 g	420 g	

More information:

BN 293820

BN 194482C0002

BN 432047C0002

SPINNER EasyDocks

<http://www.tt-telecom.ru>

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Manually Operated Test Applications in Production Environments



- Grasp & clasp – for manual coupling to DUT
- Lowest intermodulation
- Lockable
- Quick & reliable connection
- Highly ergonomic design
- Save time – easy latching
- Guaranteed matings
- Suitable for calibrated setup
- Resistant to shocks and vibrations

Part Number	BN 293825	BN 432066	BN 432061
Coaxial DUT port interface connector	7-16 male push-pull, lockable	4.3-10 male push-pull, lockable	
Coaxial outgoing (analyzer) port interface connector	7-16 female	4.3-10 female	7-16 female
Frequency range	DC to 6 GHz		
VSWR, max.	Max. 1.02 @ DC to 2 GHz Max. 1.06 @ 2 to 6 GHz		
Passive intermodulation (IM3) @ 2 x 20 W	Max. ≤ -165 dBc (for first 5,000 matings)		
Insertion loss	Max. 0.05 dB		
Contact force	80 N		
Matings	Min. 5,000 at PIM / min. 10,000 at VSWR		
Weight	350 g	250 g	290 g

More information:



BN 293825



BN 432066



BN 432061



View Video
Lockable SPINNER EasyDock - low PIM Push Pull measurement adaptor

Coaxial 2-Way Switches

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- Lowest intermodulation
- Maximum phase and amplitude stability
- Fast switching
- Hot switching
- Guaranteed cycles
- Cascadable
- Suitable for calibrated setup

Part Number	BN 754082 4.3-10 female BN 754081 7-16 female	
	Frequency range	0.69 to 2.69 GHz
Return loss	Min. 20 dB	Min. 20 dB
Isolation	Min. 55 dB	Min. 50 dB
Insertion loss	Max. 0.1 dB	Max. 0.1 dB
Average power capability	300 W	
Peak voltage	1 kV	
Passive intermodulation (IM3) @ 2 x 20 W	Max. \leq -165 dBc; typ. \leq -168 dBc	
Switching time	100 ms	
Switching frequency	Max. 30 cycles per minute	
Service life	Min. 500,000 cycles	
Dimensions (L x W x H)	128.8 mm x 128.8 mm x 116.34 mm	
Weight	\approx 1.75 kg	

More information:



BN 754081



BN 754082



View Video
 RF Test: Switching between VSWR and PIM using
 SPINNER's low PIM switch/EasyDock

Switching Matrix – Low IM, 8 In / 8 Out

<http://www.tt-telecom.ru>

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Figure similar

- Contactless switching
- Lowest intermodulation
- Maximum phase and amplitude stability
- Fast switching
- Hot switching
- Guaranteed cycles
- Cascadable

Part Number	BN 5344xx		
Interface type (16 connections)	4.3-10-f (50 Ω) per IEC 61169-54		
Characteristic impedance	50 Ω		
Frequency range	0.69 to 0.96 GHz	0.96 to 2.69 GHz	3.4 to 3.8 GHz
Return loss	Min. 13 dB	Min. 18 dB	Min. 16 dB
Return loss repeatability	Min. 40 dB		
Isolation	Min. 55 dB		
Insertion loss	Max. 0.7 dB	Max. 0.7 dB	Max. 0.9 dB
Passive intermodulation (IM3) @ 2 x 20 W	Max. ≤-155 dBc; typ. ≤-165 dBc		
Switching time	100 ms		
Switching frequency	Max. 30 cycles per minute		
Life	Min. 500,000 cycles		
Dimensions (L x W x H)	666 mm x 482.6 mm x 443.7 mm		
Weight	≈ 40 kg		
Control interface	Controlled via USB Ethernet Other protocols on request		

More information available on request

Laboratory Loads

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru



- Lowest intermodulation
- Lead-free
- BeO-free
- Convection cooling
- For indoor use

Part Number	BN 157151	BN 157157
Coaxial interface connector	4.3-10 female	7-16 female
Frequency range	0.25 to 3.8 GHz	
VSWR	Max. 1.20	
Passive intermodulation (IM3) @ 2 x 20 W	Max. ≤-165 dBc; typ. ≤-170 dBc	
Average power capability	Max. 50 W	
Dimensions (L x W x H)	150 mm x 91.5 mm x 180 mm	
Weight	≈ 3.0 kg	
Maximum surface temperature	50°C	

More information:



BN 157151



BN 157157

Push-Pull-Adaptors

<http://www.tt-telecom.ru>

 e-mail: market@tt-telecom.ru

Quick Connector as Cable Port Saver



- For port or connector saving tasks
- Lowest intermodulation
- Lockable
- Unlockable in jig via automated handling
- Quick & reliable connection
- Extremely compact
- Save time – easy latching
- Guaranteed matings



Part Number	BN 432051
Coaxial DUT port interface connector	4.3-10 male push-pull
Coaxial outgoing (Analyzer) port interface connector	4.3-10 female
Frequency range	DC to 2.7 GHz
VSWR, max.	Max. 1.08 @ DC to 2.7 GHz
Passive intermodulation (IM3) @ 2 x 20 W	Max. \leq -165 dBc; typ. \leq -168 dBc
Insertion loss	Max. 0.05 dB
Isolation	90 dBc
Matings	Min. 500 ¹⁾
Weight	190 g

¹⁾ For optimal measurement results, cleaning must be regularly performed and assessed by expert staff.

More information:



BN 432051

Port Savers

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru

Protects Damageable PIM Test Equipment



- For sensitive testing and measurement applications
- Lowest intermodulation
- Abrasion-proof
- Tarnishing and corrosion proof
- Nickel-free
- RoHS-compliant



Part Number		BN 432017	BN 756404
Coaxial interface connector	Side A	4.3-10 male	7-16 male
	Side B	4.3-10 female	7-16 female
Frequency range		DC to 6 GHz	DC to 7.5 GHz
VSWR		Max.1.02 @ DC to 2GHz Max.1.04 @ 2 to 3 GHz Max.1.06 @ 3 to 6GHz	Max.1.01 @ DC to 1 GHz Max.1.04 @ 1 to 3 GHz Max.1.06 @ 3 to 7.5 GHz
Passive intermodulation (IM3) @ 2 x 20 W		Max. ≤-165 dBc	
Weight		≈ 95 g	

More information:



BN 432017



BN 756404

Adaptors

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru



- For test & measurement applications
- Lowest intermodulation
- Abrasion-proof
- Tarnishing and corrosion proof
- Nickel-free
- RoHS-compliant

Part Number		BN 432029	BN 432049	BN 432019	BN 393370	BN 196400
Coaxial interface connector	Side A	4.3-10 male screw	4.3-10 female	4.3-10 female bulkhead	7-16 male	7-16 female
	Side B	4.3-10 male screw	4.3-10 female	4.3-10 female	7-16 male	7-16 female
Frequency range		DC to 6 GHz			DC to 8 GHz	DC to 7.5 GHz
VSWR		Max.1.02 @ DC to 2 GHz Max.1.04 @ 2 to 3 GHz Max.1.06 @ 3 to 6 GHz			Max.1.01 @ DC to 1 GHz Max.1.04 @ 1 to 3 GHz Max.1.06 @ 3 to 8 GHz	
Passive intermodulation (IM3) @ 2 x 20 W		Max. ≤-165 dBc				
Weight		55 g	60 g	70 g	95 g	95 g

More information:



BN 432029



BN 432049



BN 432019



BN 393370



BN 196400

Inter-Series Adaptors 7-16 to 4.3-10

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru



- For sensitive testing and measurement applications
- Lowest intermodulation
- Abrasion-proof
- Tarnishing and corrosion proof
- Nickel-free
- RoHS-compliant

Part Number		BN 432008	BN 432005	BN 432001	BN 432016	BN 432002	BN 432011
Coaxial interface connector	Side A	7-16 male			7-16 female		
	Side B	4.3-10 male		4.3-10 female	4.3-10 male		4.3-10 female
		push-pull	screw		push-pull	screw	
Frequency range		DC to 6 GHz					
VSWR, max.		Max. 1.02 @ DC to 2 GHz Max. 1.04 @ 2 to 3 GHz Max. 1.06 @ 3 to 6 GHz					
Passive intermodulation (IM3) @ 2 x 20 W		Max. ≤-165 dBc					
Weight		≈ 95 g					

More information:

BN 432008	BN 432005	BN 432001	BN 432016	BN 432002	BN 432011

Preventing PIM – Precise Mating

<http://www.tt-telecom.ru>

e-mail: market@tt-telecom.ru



Preparation of Test Equipment

The following requirements must be met to obtain comparable PIM measurements:

- PIM measurement must always be done by experienced and skilled staff, otherwise there is a risk that results will be misinterpreted.
- Measurement equipment (frequency sources, spectrum analyzers and power meters) must be regularly calibrated based on the applicable national or international calibration standard.

Best Practices

- Avoid all damage and contamination that may affect PIM values.
- Make sure that all RF-relevant electrical connections used for PIM measurement are free of metal particles, dust, oxides and other contamination.
- All interseries adapters used for measurement should be designed as “PIM free” solutions with a single-piece inner conductor and a single-piece outer conductor.
- It is strongly recommended to use a dial gauge to ensure the right pin depths on each connector, otherwise there is a risk of damage and/or deformation.
- When a bad connection is discovered, sometimes the first reaction is to overtighten it. Instead, all coupling nuts and cable inputs should be tightened using a torque wrench that is adjusted to the right torque as given in the installation instructions. This will help minimize PIM.

Dial Gauges

<http://www.tt-telecom.ru> e-mail: market@tt-telecom.ru

Ensures precise mating of every PIM test setup component.




- Designed to properly gauge the contact pin locations and pin depth of the connectors used
- Marked tolerance limits for different connector grades
- Calibration standard for zero reset

Part Number	BN 533315	BN 533317	BN 533318	BN 537011
Coaxial interface connector	4.3-10 male	4.3-10 female inner conductor	4.3-10 female outer conductor	7-16 female
Accuracy level	Grade 0			
Tolerance range	0.1 mm			0.08 mm
Pin offset	2.9 to 2.8 mm	3.1 to 3.2 mm		5.28 to 5.36 mm
Gauge range	5 mm			
Scale marking	0.01 mm			
Measurement accuracy	0.005 mm			

More information:


 BN 533315


 BN 533317


 BN 533318


 BN 537011

Torque Wrenches

Properly tightening connectors improves the reliability of PIM measurements.



- Preset to the precise torque needed for 4.3-10 and 7-16 connectors

Part Number	BN 238740C0001	BN 238736
Coaxial interface connector	4.3-10 male	7-16 male
Wrench size	22 mm	32 mm
Preset torque	2.5 Nm +0.226/-0	30 Nm +2.71/-0

More information:


 BN 2387430c0001


 BN 238736

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HIGH FREQUENCY PERFORMANCE WORLDWIDE

SPINNER designs and builds cutting-edge radio frequency systems, setting performance and longevity standards for others to follow. The company's track record of innovation dates back to 1946, and many of today's mainstream products are rooted in SPINNER inventions.

Industry leaders continue to count on SPINNER's engineering excellence to drive down their costs of service and ownership with premium-quality, off-the-shelf products and custom solutions. Headquartered in Munich, Germany, the global frontrunner in RF components remains the first choice in simple-yet-smart RF solutions.

www.spinner-group.com

SPINNER GmbH

Headquarters

Erzgiessereistr. 33
80335 Munich

GERMANY

Phone: +49 89 12601-0
Fax: +49 89 12601-1292
info@spinner-group.com

SPINNER Austria GmbH

Triester Str. 190
1230 Vienna

AUSTRIA

Phone: +43 1 66277 51
Fax: +43 1 66277 5115
info-austria@spinner-group.com

SPINNER Electrotécnica S.L.

c/ Perú, 4 – Local nº 15
28230 Las Rozas (Madrid)

SPAIN

Phone: +34 91 6305 842
Fax: +34 91 6305 838
info-iberia@spinner-group.com

SPINNER France S.A.R.L.

24 Rue Albert Priolet
78100 St. Germain en Laye

FRANCE

Phone: +33 1 74 13 85 24
info-france@spinner-group.com

SPINNER ICT Inc.

5126 S. Royal Atlanta Drive
Tucker, GA 30084-3052

USA

Phone: +1 770 2636 326
Fax: +1 770 9343 384
info-atlanta@spinner-group.com

SPINNER Nordic AB

Kråketorpsgatan 20
43153 Mölndal

SWEDEN

Phone: +46 31 7061670
Fax: +46 31 7061679
info-nordic@spinner-group.com

SPINNER Telecommunication

Devices (Shanghai) Co., Ltd.
351 Lian Yang Road
Songjiang Industrial Zone
Shanghai 201613

P.R. CHINA

Phone: +86 21 577 45377
Fax: +86 21 577 40962
info-china@spinner-group.com

SPINNER UK Ltd.

Suite 8 Phoenix House
Golborne Enterprise Park,
High Street
Golborne, Warrington
WA3 3DP

UNITED KINGDOM

Phone: +44 1942 275222
Fax: +44 1942 275221
info-uk@spinner-group.com