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PIA Gen3 Remote Interface

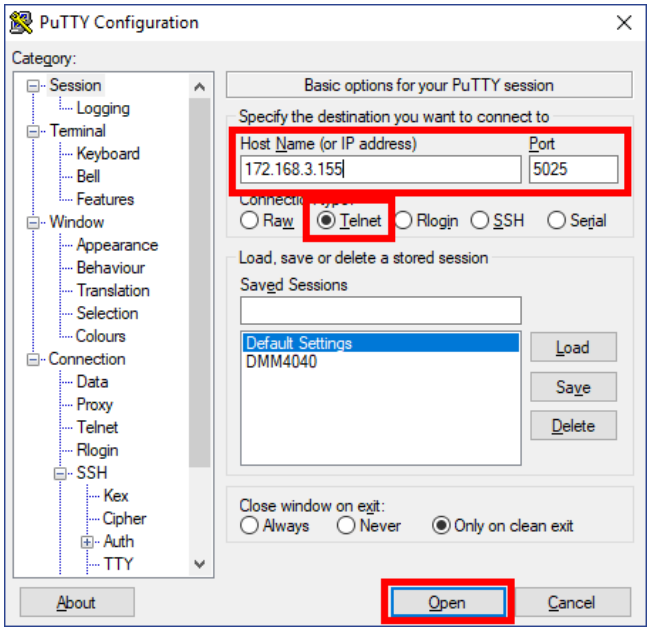
Passive Intermodulation Analyzer

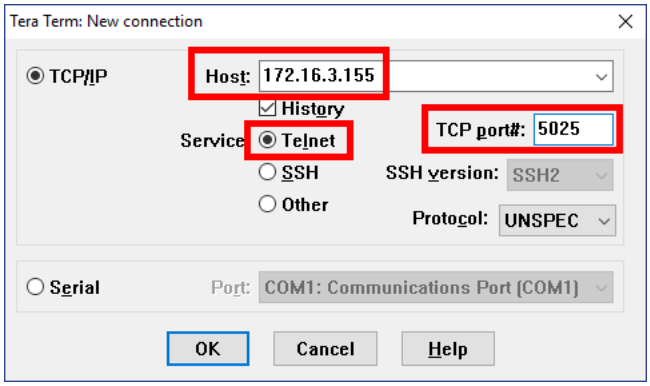
IM-A-xxxx, IM-B-xxxx, IM-R-xxxx Series

1 Connection Setup

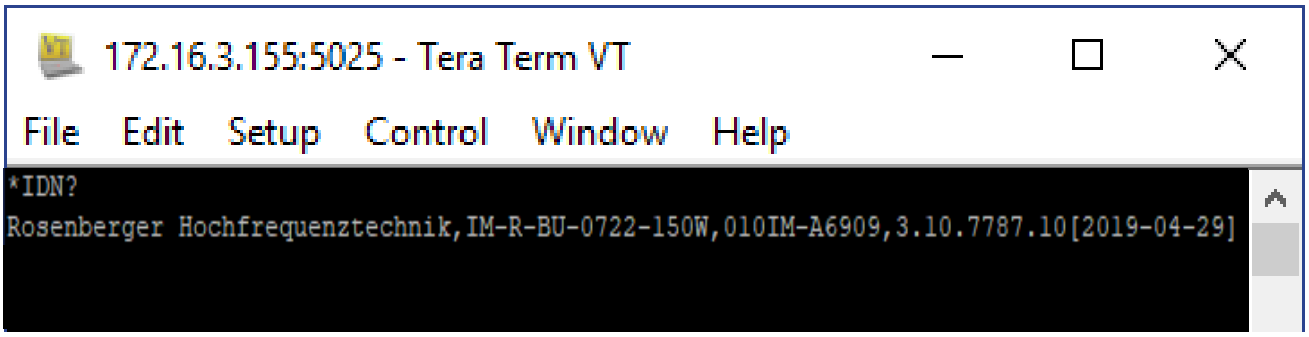
Communication is done via a **Telnet** connection over TCP/IP **Port 5025**. The IP Address of PIM Analyzer is shown in the bottom right corner on the desktop background, if the application is minimized.

There are various simple Telnet programs available, e.g. PuTTY, TeraTerm etc., or open a Socket in your own program:





Once a connection is established, you could test the availability using ***IDN?**:



Congratulations, you are now ready to use the SCPI commands described in Chapter 2!

Please consider: We preserve the right to add and modify SCPI commands with future development!

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2 Table of Commands

	Command	Parameter	Unit	Page
General	*IDN?		string	7
	*RST			7
	*OPC?	0 | 1	bool	7
	SYSTem:ERRor[:NEXT]?		string	7
	SYSTem:ERRor:COUnt?		int	7
	SYSTem:SERRor[:NEXT]?		string	7
	SYSTem:SERRor:COUnt?		int	7
	SYSTem:SHUTdown			7
System & Setup	SYSTem:INIT	„YourName“[, 0 … 999]	string, uint [s]	8
	SYSTem:DEINit			8
	SYSTem:CALDate?		string	8
	BATTery:INFos?		string	8
	REFerence:CONNected?	0 | 1	bool	8
	FILTer[:NAMe]:LIST?		string	8
	FILTer[:NAMe][?]	One of <FILTer[:NAMe]:LIST?>	string	9
	FILTer:BAND:LIST?		string	9
	FILTer:BAND[?]	One of <FILTer:BAND:LIST?>	string	9
	FILTer:FREQuencies?		string	9
	FILTer:MINPower?		float [dBm]	9
	FILTer:MAXPower?		float [dBm]	10
	FILTer:MODel?		string	10
	FILTer:SERial?		string	10
	FILTer:CALDate?		string	10
Manual Mode	OUTPut<1|2>[:STATe][?]	0 | 1 | OFF | ON	bool	10
	SOURce<1|2>:FREQuency[?]	Limits from <FILT:FREQ?>	float	10
	SOURce<1|2>:POWer[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	10
	INPut<1|2>[:STATe][?]	0 | 1 | OFF | ON	bool	11
	INPut<1|2>:FREQuency[?]	Limits from <FILT:FREQ?>	float	11
	INPut1:PATH[?]	PIM | FWD	enum	11
	INPut2:PATH[?]	ISO | REF	enum	11
	INPut<1|2>:POWer?		float [dBm]	11
	INPut:DFIMorder	3 | 5 | 7 … 19	uint	11
	INPut:DETector	AVG | PEAK	enum	11

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	Command	Parameter	Unit	Page
2-Tone	MEAS:TWOTone:CONFigure?	<Parameter Name> <Value>	string	12
	:F1[?]	Limits from <FILT:FREQ?>	float	12
	:F2[?]	Limits from <FILT:FREQ?>	float	12
	:P1[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	12
	:P2[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	12
	:IMORder[?]	3 | 5 | 7 … 19	uint	12
	:DFIMorder	3 | 5 | 7 … 19	uint	12
	:DURation[?]	0 … 2 147 483 648	int [s]	12
	:REFCheck[?]	0 | 1 | OFF | ON	bool	12
	:DETector[?]	AVG | PEAK	mnemonic	13
	MEAS:TWOTone:STARt	„<Time1>;<Value1>“, „<Time2>;<Value2>“, …	String [ms];[dBm]	13
	MEAS:TWOTone:STOP			13
Frequency Sweep	MEAS:FSWeep:CONFigure?	<Parameter Name> <Value>	string	13
	:F1Low[?]	Limits from <FILT:FREQ?>	float	13
	:F1High[?]	Limits from <FILT:FREQ?>	float	13
	:F1Fix[?]	Limits from <FILT:FREQ?>	float	14
	:F1STep[?]	1 …	float	14
	:F2Low[?]	Limits from <FILT:FREQ?>	float	14
	:F2High[?]	Limits from <FILT:FREQ?>	float	14
	:F2Fix[?]	Limits from <FILT:FREQ?>	float	14
	:F2STep[?]	1 …	float	14
	:P1[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	14
	:P2[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	14
	:IMORder[?]	3 | 5 | 7 … 19	uint	15
	:DFIMorder	3 | 5 | 7 … 19	uint	15
	:REFCheck[?]	0 | 1 | OFF | ON	bool	15
	:DETector[?]	AVG | PEAK	mnemonic	15
	MEAS:FSWeep:STARt	„<Freq1Up>;<Value1>“, „<Freq2Up>;<Value2>“, … CRLF „<Freq1Down>;<Value1>“, „<Freq2Down>;<Value2>“, …	String [Hz];[dBm]	15
	MEAS:FSWeep:STOP			15

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	Command	Parameter	Unit	Page
Power Sweep	MEAS:PSWeep:CONFigure?	<Parameter Name> <Value>	string	
	:F1[?]	Limits from <FILT:FREQ?>	float	
	:F2[?]	Limits from <FILT:FREQ?>	float	
	:STARt[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:STOP[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:STEP[?]	0.1 …	float [dBm]	
	:IMORder[?]	3 | 5 | 7 … 19	uint	
	:DFIMorder	3 | 5 | 7 … 19	uint	
	:REFCheck[?]	0 | 1 | OFF | ON	bool	
	:DETector[?]	AVG | PEAK	mnemonic	
	MEAS:PSWeep:STARt	„<TXPower1>;<Value1>“, „<TXPower2>;<Value2>“, …	String [dBm];[dBm]	
	MEAS:PSWeep:STOP			
Isolation Sweep	MEAS:ISOLation:CONFigure?	<Parameter Name> <Value>	string	
	:STARt[?]	Limits from <FILT:FREQ?>	float	
	:STOP[?]	Limits from <FILT:FREQ?>	float	
	:STEP[?]	1 …	float	
	:POWer[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:REFCheck[?]	0 | 1 | OFF | ON	bool	
	MEAS:ISOLation:STARt	„<Freq1>;<Value1>“, „<Freq2>;<Value2>“, …	String [Hz];[dBm]	
	MEAS:ISOLation:STOP			
ReturnLoss Frequency Sweep	MEAS:RLFRequency:CONFigure?	<Parameter Name> <Value>	string	
	:STARt[?]	Limits from <FILT:FREQ?>	float	
	:STOP[?]	Limits from <FILT:FREQ?>	float	
	:STEP[?]	1 …	float	
	:POWer[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:FWDCheck[?]	0 | 1 | OFF | ON	bool	
	MEAS:RLFRequency:STARt	„<Freq1>;<Value1>“, „<Freq2>;<Value2>“, …	String [Hz];[dBm]	
	MEAS:RLFRequency:STOP			

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	Command	Parameter	Unit	Page
Spectrum Sweep	MEAS:SPECtrum:CONFigure?	<Parameter Name> <Value>	string	
	:STARt[?]	Limits from <FILT:FREQ?>	float	
	:STOP[?]	Limits from <FILT:FREQ?>	float	
	:RBW[?]	1E3 | 2E3 | 5E3 | 1E4 | 2E4 | 5E4 | 1E5 | 2E5 | 5E5 | 1E6	float	
	:VBW[?]	1E3 | 2E3 | 5E3 … <RBW>	float	
	MEAS:SPECtrum:STARt	„<Freq1>;<Value1>“, „<Freq2>;<Value2>“, …	String [kHz];[dBm]	
	MEAS:SPECtrum:STOP			
PIM Location	MEAS:PIMLocation:CONFigure?	<Parameter Name> <Value>	string	
	:P1[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:P2[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:VELocity[?]	<Section0:Factor1>, <Section1:Factor2>, …	float [m]:[%*100]	
	:IMORder[?]	3 | 5 | 7 … 19	uint	
	:REFCheck[?]	0 | 1 | OFF | ON	bool	
	MEAS:PIMLocation:STARt	„<Count>;<Freq1>;<Freq2>; <Freq3>“ CRLF „<Dist1>;<Value1>“, „<Dist2>;<Value2>”, … CRLF „<Uncertainty1Neg>; <Uncertainty1Pos>; <ExactValue1>”, …	String [kHz];[dBm]	
	MEAS:PIMLocation:STOP			
ReturnLoss Location	MEAS:RLLocation:CONFigure?	<Parameter Name> <Value>	string	
	:P1[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:P2[?]	Limits from <FILT:MINP?; MAXP?>	float [dBm]	
	:VELocity[?]	<Section0:Factor1>, <Section1:Factor2>, …	float [m]:[%*100]	
	:OUTPut[?]	1 | 2	uint	
	:FWDCheck[?]	0 | 1 | OFF | ON	bool	
	MEAS:RLLocation:STARt	„<Count>;<Freq1>;<Freq2>; <Freq3>“ CRLF „<Dist1>;<Value1>“, „<Dist2>;<Value2>”, … CRLF „<Uncertainty1Neg>; <Uncertainty1Pos>; <ExactValue1>”, …	String [kHz];[dBm]	
	MEAS:RLLocation:STOP			

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3 SCPI Commands

3.1 Common Interface Notations

- Commands:
  - SCPI is not case sensitive
  - It is enough to write the (capital) abbreviation of commands, e.g.:
    `syst:cald?` instead of `system:caldate?`
  - Commands within the same node can be nested with a semicolon e.g.:
    `meas:twot:conf:f1 1.805E9;f2 1.880E9;p1 43.3;p2 43.5;dur 20`
    is a single line short form of:
    ```
    meas:twot:conf:f1 1.805E9
    meas:twot:conf:f2 1.880E9
    meas:twot:conf:p1 43.3
    meas:twot:conf:p2 43.5
    meas:twot:conf:dur 20
    ```
- Variables: Variables to be replaced by an actual value are written in parenthesis as <Variable>
- Strings: Text inputs are written in quotation marks `"<This is a text variable>"`
  They do not contain a new line, unless otherwise noted (`CRLF`)
- Bool: Bool parameters can be sent as:
  `0` or `OFF`
  `1` or `ON`
  Results are always sent as a number: `0` or `1`
- Mnemonic: Some commands are using a mnemonic or enum as setting. It is written as a string but without quotation marks. E.g. `AVG, PEAK, PIM, FWD, ISO, REF …`
- Power: Unit of power is dBm and related to the corresponding input/output interface.
  Corrections to compensate test fixture/cable has to be done by user application!
- Frequencies: Frequencies can be written in following notations (e.g. 1805 MHz):
  `1805000000 | 1805000KHZ | 1805MHZ | 1.805GHZ | 1805E6 | 1.805E9`
  Results are always in Hz and in exponential notation (e.g. 1805 MHz): `1.805E9`
- Lists: Some Queries/Functions are delivering a bunch of grouped results, these are comma separated strings which may contain a semicolon as separator within
  `"<x1>;<y1>","<x2>;<y2>","<x3>;<y3>","<x4>;<y4>"`
- Macro Functions: Each measurement type has a MEAS:<MeasurementType>:STARt function which provides the easiest way to perform a measurement. This macro delivers a stream of measurement results with the highest possible speed.
  The settings of each measurement are predefined with useful defaults and can be modified with the corresponding MEAS:<MeasurementType>:CONF:<Parameter> <Value> commands.
  It is possible to perform user defined measurements using the manual functions of chapter 3.4.

3.2 General

3.2.1 *IDN?

The identification query contains information about manufacturer, model, serial number and version of test equipment.

Result: “Rosenberger Hochfrequenztechnik,<Model>,<Serial>,<Version>”
Example: `“Rosenberger Hochfrequenztechnik,IM-R-BU-0722-150W,010IM-A1234, 3.10.7781.10[2019-04-29]”`

3.2.2 *RST

The reset command resets the test equipment to its default settings and input/outputs to their default state.

3.2.3 *OPC?

The operation complete flag can be polled to check if an asynchronous command has been processed. Configurations (and SYSTem:INIT) are synchronous commands, thus holding back response and delivering a `1` when finished. Measurements are asynchronous and polling results in `0` until measurement is finished.
It does not necessarily mean the command was successful – use SYSTem:ERRor:COUnt? query to check!

Result: <OperationCompleteFlag> [bool]
Example: `1`

3.2.4 SYSTem:ERRor[:NEXT]?

System error query delivers the last of an error queue with ID and description string. It is recommended to check for error after each command.

Result: <Error ID>,”<Error Description>” [uint],[string]
Example: `4711,“Cannot set default values for IM9, frequencies out of range!"`

3.2.5 SYSTem:ERRor:COUnt?

System error count delivers the number of errors in queue.

Result: <ErrorCount> [uint]
Example: `1`

3.2.6 SYSTem:SERRor[:NEXT]?

System Static Error delivers the last of a system error queue with ID and description string. It is only deleted when problem cause is removed!
Note: A local disconnect at the GUI (see SYSTem:DEINit) causes a static error seen by remote operator also.

Result: <Error ID>,”<Error Description>” [uint],[string]
Example: `4,“SBC disconnect”`

3.2.7 SYSTem:SERRor:COUnt?

System error count delivers the number of system errors in queue.

Result: <ErrorCount> [uint]
Example: `0`

3.2.8 SYSTem:SHUTdown

Shutdown closes application and shuts down the device.

Result: 1 [uint]

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3.3 Setup

3.3.1 SYSTem:INIT

Without initialization, commands are limited to *IDN?, SYSTem:ERROr? and *OPC?
Proper initialization is mandatory to control all measurement functions and to prevent unintended RF power at the output. Init is used to establish a connection to the device.
Use a meaningful ID to login into the unit (e.g. UserName or Workstation ID), which can be added to the trusted list and shown at the device screen. First login always needs a local authentication, later logins are authenticated through the trusted list.
Remote control is limited to one IP address, thus one user at a time! But initialization survives a socket disconnect.
Local control is blocked while a remote control is established, but remote user can be disconnected manually or through timeout.
Define a proper timeout [s] which ensures that a stopped user application unblocks the device. Timeout is optional, if left blank session expires after 30s. Use timeout `0` for infinite sessions.

Parameter: “<User Name>”[, <Timeout>] [string],[uint]
Example: `"Worker: John Deere",60`

3.3.2 SYSTem:DEINit

Closes the connection and unblocks the device.

3.3.3 SYSTem:CALDate?

Used to query the last calibration date of base unit in format YYYY-MM-DD (see 0 for filter calibration date).

Result: “<Date>” [string]
Example: `"2019-02-04"`

3.3.4 BATTery:INFos?

Used to get information about inserted battery packs in portable units IM-A-BU-xxxx and IM-B-BU-xxxx.

Result: “<Status>”,”<SystemBattery>”,”<PA1Battery>”,”<PA2Battery>”

- <Status> “0;1;1;1;0;0”:
  - Field1: System battery connected [bool]
  - Field2: PA1 battery connected [bool]
  - Field3: PA2 battery connected [bool]
  - Field4: Supply connected [bool]
  - Field5: LowPowerCharger connected [bool]
  - Field6: System battery supported [bool]
    (IM-A-BU-xxxx has system battery, IM-B-BU-xxxx has not!)
- <Battery> “88;98;26;02F9;2019-04-08”:
  - Field1: State of charge [%]
  - Field2: Health [%]
  - Field3: Temperature [°C]
  - Field4: Serial number [hex]
  - Field5: Production date of battery [YYYY-MM-DD]

3.3.5 REFerence:CONNected?

Used to check if external 10 MHz reference source is locked.

Result: <RefConnected> [bool]
Example: `1`

3.3.6 FILTer[:NAMe]:LIST?

This command lists all available filter units which are initialized by the base unit during application boot. Most filters have only one band (which equal to the filter name), some have two bands (e.g. LTE 700L + LTE 700U, PCS + AWS).

Result: “<Filter1>“,“<Filter2>“,“<Filter3>”,…[string]

- <Filter1> “<Filter1Name>;<Filter1Band1>;<Filter1Band2>”
  - Field1: Filter name [string]
  - Field2: Name of main filter band 1 [string]
  - [Field3:] Name of filter band 2 [optional] [string]
- <Filter2> “<Filter2Name>;<Filter2Band1>;<Filter2Band2>”
  - Field1: Filter name [string]
  - Field2: Name of main filter band 1 [string]
  - [Field3:] Name of filter band 2 [optional] [string]
- <Filter3> “<Filter3Name>;<Filter3Band1>;<Filter3Band2>”
  - Field1: Filter name [string]
  - Field2: Name of main filter band 1 [string]
  - [Field3:] Name of filter band 2 [optional] [string]

Example: `"LTE 700LU;LTE 700L;LTE 700U","EGSM 900;EGSM 900","PCS/AWS 1900;PCS;PCS/AWS"`

3.3.7 FILTer[:NAMe][?]

This command selects an available filter unit (one of FILTer[:NAMe]:LIST?) and sets switch matrix accordingly.

Parameter: “<FilterName>” [string]
Example: “DIGDIV 800”

3.3.8 FILTer:BAND:LIST?

This command lists the available frequency bands covered by the current selected filter. Most filters have only one band (which equal to the filter name), some have two bands (e.g. LTE 700L + LTE 700U, PCS + AWS).

Result: “<Band1>”,”<Band2>”,… [string]
Example: `"LTE 700L","LTE 700U"`

3.3.9 FILTer:BAND[?]

This command selects an available filter frequency band of the current selected filter unit.

Parameter: “<BandName>” [string]
Result: `"LTE 700L"`

3.3.10 FILTer:FREQuencies?

This command lists the available frequency ranges of all bands of current selected filter unit.

Result: “<FilterName>;<NumberOfSupportedBands>;
<Band1>;<B1F1Min>;<B1F1Max>;<B1F2Min>;<B1F2Max>;<B1RXMin>;<B1RXMax>;
<Band2>;<B2F1Min>;<B2F1Max>;<B2F2Min>;<B2F2Max>;<B2RXMin>;<B2RXMax>,…”

- Field1: Filter Name <FILTer[:NAMe]?> [string]
- Field2: Number of supported Bands [uint]
- Field3: Band Name <FILTer:BAND?> [string]
- Field4: Carrier1 minimum frequency [float]
- Field5: Carrier1 maximum frequency [float]
- Field6: Carrier2 minimum frequency [float]
- Field7: Carrier2 maximum frequency [float]
- Field8: Receive minimum frequency [float]

- Field9: Receive maximum frequency [float]
- Field10: Band Name 2…

Example: `"LTE 700LU;2;LTE 700L;7.28E8;7.4E8;7.5E8;7.64E8;6.98E8;7.16E8;LTE 700U;7.28E8;7.4E8;7.5E8;7.64E8;7.76E8;7.98E8"`

3.3.11 FILTer:MINPower?

This command derives the minimum configurable output power within this filter band.

Result: <minPower> [float]
Example: `23`

3.3.12 FILTer:MAXPower?

This command derives the maximum achievable output power within this filter band. It is internally calculated based on maximum amplifier output minus filter and cable losses.

Result: <minPower> [float]
Example: `45.8`

3.3.13 FILTer:MODel?

This query delivers our manufacturer part number of the selected filter unit. It contains a rough frequency notation, the E-UTRA Band number which is compatible to and hardware option description.

Result: “<ModelName>” [string]
Example: `"IM-R-FI-26/B7-R"`

3.3.14 FILTer:SERial?

This query delivers the serial number of the selected filter unit.

Result: <FilterSerial> [string]
Example: `"010IM-A0815"`

3.3.15 FILTer:CALDate?

Used to query the last calibration date of filter unit in format YYYY-MM-DD (see 3.3.30 for base unit calibration date).

Result: “<Date>”
Example: `"2019-04-08"`

3.4 Manual Measurement

3.4.1 OUTPut<1|2>[:STATe][?]

This command is used to activate the power amplifier 1 or 2.

Parameter: 0 | 1 | OFF | ON [bool]
Default: OFF

3.4.2 SOURce<1|2>:FREQuency[?]

This command is used to set the transmitter frequencies. Settings are limited to current <FILTer:FREQuencies?>.

Parameter: <Frequency> [float]

3.4.3 SOURce<1|2>:POWer[?]

This command is used to set the transmitter output powers. Settings are limited to current <FILTer:MINPower?> and <FILTer:MAXPower?>.

Result: <Output#Power> [float]

3.4.4 INPut<1|2>[:STATe][?]

This command activates or disables the input.

Parameter: 0 | 1 | OFF | ON [bool]

3.4.5 INPut<1|2>:FREQuency[?]

This command is used to set the frequency of corresponding input. Settings are limited to current <FILTer:FREQuencies?>.

Parameter: <Frequency> [float]

3.4.6 INPut1:PATH[?]

This command is used to select the input path of receiver 1 which can be either PIM or FWD.

Parameter: <Input1Path> [mnemonic]

3.4.7 INPut2:PATH[?]

This command is used to select the input path of receiver 2 which can be either ISO or REF.

Parameter: <Input2Path> [mnemonic]

3.4.8 INPut<1|2>:POWer?

This query is used to read the receiver input value in dBm

Result: <RFPower> [float]
Example: `-128.7`

3.4.9 INPut:DFIMorder

This command calculates and sets the TX & RX frequencies depending on the defined order and filter frequency limits.

Parameter: <IM-Order> [uint]
Example: `5`

3.4.10 INPut:DETector

This command is used to select either AVG or PEAK detector for both receivers.
AVG Detector: Bandwidth 1kHz, average of 20 samples per result (available each 20ms)
Peak Detector: Bandwidth 10kHz, maximum of 200 samples per result (available each 20ms)

Parameter: <DetectorType> [mnemonic]
Example: `AVG`

3.5 PIM 2-Tone Measurement

A 2-Tone or Timesweep PIM Measurement measures PIM over time with two static TX carriers. It is used for dynamic PIM testing to measure PIM during mechanical stress.

3.5.1 MEAS:TWOTone:CONFigure?

This query lists the configured settings for 2-Tone measurement. All queries of MEAS:TWOT:CONF:xx are grouped in one big string. See command definitions below.

It can also be used as a nested command to set all parameters at once.

Result: "F1 <FrequencyTX1>;F2 <FrequencyTX2>;P1 <PowerTX1>;P2 <PowerTX2>;IMORDER <IM Order>;DURATION <Duration>;REFCHECK <Refcheck>;DETECTOR <Detector>"

Example: `"F1 9.25E8;F2 9.60E8;P1 43.7;P2 43.8;IMORDER 3;DURATION 12;REFCHECK 1;DETECTOR PEAK"`

3.5.2 MEAS:TWOTone:CONFigure:F1[?]

This command is used to set the frequency of carrier 1 (TX1). Settings are limited to current <FILTer:FREQuencies?>.

Parameter: <Frequency> [float]

3.5.3 MEAS:TWOTone:CONFigure:F2[?]

This command is used to set the frequency of carrier 2 (TX2). Settings are limited to current <FILTer:FREQuencies?>.

Parameter: <Frequency> [float]

3.5.4 MEAS:TWOTone:CONFigure:P1[?]

This command is used to set the power of carrier 1 (TX1). Settings are limited to current <FILTer:MINPower?> and <FILTer:MAXPower?>.

Parameter: <Power> [float]

3.5.5 MEAS:TWOTone:CONFigure:P2[?]

This command is used to set the power of carrier 2 (TX2). Settings are limited to current <FILTer:MINPower?> and <FILTer:MAXPower?>.

Parameter: <Power> [float]

3.5.6 MEAS:TWOTone:CONFigure:IMORder[?]

This command sets the IM order for PIM measurement and is used for calculation of corresponding RX frequency. It is recommended to use MEAS:TWOT:CONF:DFIMorder to avoid frequency-out-of-range errors and need for your own calculation.

Parameter: <IM-Order> [uint]

3.5.7 MEAS:TWOTone:CONFigure:DFIMorder

This command calculates and sets the TX & RX frequencies depending on the defined order and filter frequency limits.

Parameter: <IM-Order> [uint]

3.5.8 MEAS:TWOTone:CONFigure:DURation[?]

This command sets the duration of 2-Tone measurement in seconds.

Parameter: <Duration> [uint, s]

Example: `10`

3.5.9 MEAS:TWOTone:CONFigure:REFCheck[?]

This command activates or deactivates a return loss check prior measurement. Amplifier turn on time is faster without check, but measuring with very bad VSWR is not recommended because it stresses components.

Parameter: 0 | 1 | OFF | ON [bool]

3.5.10 MEAS:TWOTone:CONFigure:DETector[?]

This command is used to select either AVG or PEAK detector.
AVG Detector: Bandwidth 1kHz, average of 20 samples per result (available each 20ms)
Peak Detector: Bandwidth 10kHz, maximum of 200 samples per result (available each 20ms)

Parameter: <DetectorType> [mnemonic]
Example: `PEAK`

3.5.11 MEAS:TWOTone:STARt

This command initiates a 2-Tone measurement macro. The amplifiers will ramp up to the configurated power and receiver read out continuously every 20ms. The result is a stream of “<Time>;<Value>” pairs and ends with CRLF. Unit of time is milli-seconds [ms].

Result: “<Time1>;<Result1>”,”<Time2>;<Result2>”,…CRLF
Example: `"0;-62.1",”20;-62.1”,”40;-60.8”,...CRLF`

3.5.12 MEAS:TWOTone:STOP

This command interrupts the 2-Tone measurement macro before the configured <MEAS:TWOT:CONF:DURation>. The amplifiers will ramp down and stream is stopped.

3.6 PIM Frequency Sweep Measurement

A (Frequency-) Sweep PIM Measurement measures PIM sweeping one TX carrier while the second is kept static. It is the recommended additional test method because a ripple in resulting graph indicates two or more PIM sources.

3.6.1 MEAS:FSWeep:CONFigure?

This query lists the configured settings for PIM sweep measurement. All queries of MEAS:FSW:CONF:xx are grouped in one big string, sorted by Uplink and Downlink parameters. See command definitions below.

It can also be used as a nested command to set all parameters at once.

Result: “F1LOW <StartFreqTX1>;F1HIGH <StopFreqTX1>;F1STEP <StepsizeTX1>;
F2FIX <FixFreqTX2>;F2HIGH <StartFreqTX2>;F2LOW <StopFreqTX2>;
F2STEP <StepsizeTX2>;F1FIX <FixFreqTX1>;P1 <PowerTX1>;P2 <PowerTX2>;
IMORDER <IM Order>;REFCHECK <Refcheck>;DETECTOR <Detector>”
Example: `"F1LOW 9.25E8;F1HIGH 9.35E8;F1STEP 1E6;F2FIX 9.6E8;F2HIGH 9.6E8;F2LOW 9.4E8;F2STEP 1E6;F1FIX 9.25E8;P1 43.7;P2 43.8;IMORDER 3;REFCHECK 1;DETECTOR AVG”`

3.6.2 MEAS:FSWeep:CONFigure:F1Low[?]

This command is used to set the start frequency for upsweep of carrier 1 (F1Low). Settings are limited to current <FILTer:FREQuencies?>.
Default is derived from IM Order (MEAS:FWS:CONF:DFIMorder) to achieve widest possible sweep range.

Parameter: <Frequency> [float]

3.6.3 MEAS:FSWeep:CONFigure:F1High[?]

This command is used to set the stop frequency for upsweep of carrier 1 (F1High). Settings are limited to current <FILTer:FREQuencies?>.
Default is derived from IM Order (MEAS:FWS:CONF:DFIMorder) to achieve widest possible sweep range.

Parameter: <Frequency> [float]

3.6.4 MEAS:FSWeep:CONFigure:F1Fix[?]

This command is used to set the fixed frequency (F1Fix) for downsweep of carrier 2. Settings are limited to current <FILTer:FREQuencies?>.
Default is derived from IM Order (MEAS:FWS:CONF:DFIMorder) to achieve widest possible sweep range.

Parameter: <Frequency> [float]

3.6.5 MEAS:FSWeep:CONFigure:F1STep[?]

This command is used to set the frequency step size for upsweep of carrier 1 (F1STep).

Parameter: <Frequency> [float]

3.6.6 MEAS:FSWeep:CONFigure:F2Low[?]

This command is used to set the stop frequency for downsweep of carrier 2 (F2Low). Settings are limited to current <FILTer:FREQuencies?>.
Default is derived from IM Order (MEAS:FWS:CONF:DFIMorder) to achieve widest possible sweep range.

Parameter: <Frequency> [float]

3.6.7 MEAS:FSWeep:CONFigure:F2High[?]

This command is used to set the start frequency for downsweep of carrier 2 (F2High). Settings are limited to current <FILTer:FREQuencies?>.
Default is derived from IM Order (MEAS:FWS:CONF:DFIMorder) to achieve widest possible sweep range.

Parameter: <Frequency> [float]

3.6.8 MEAS:FSWeep:CONFigure:F2Fix[?]

This command is used to set the fixed frequency (F2Fix) for downsweep of carrier 1. Settings are limited to current <FILTer:FREQuencies?>.
Default is derived from IM Order (MEAS:FWS:CONF:DFIMorder) to achieve widest possible sweep range.

Parameter: <Frequency> [float]

3.6.9 MEAS:FSWeep:CONFigure:F2STep[?]

This command is used to set the frequency step size for downsweep of carrier 2 (F2STep).

Parameter: <Frequency> [float]

3.6.10 MEAS:FSWeep:CONFigure:P1[?]

This command is used to set the power of carrier 1 (TX1). Settings are limited to current <FILTer:MINPower?> and <FILTer:MAXPower?>.

Parameter: <Power> [float]

3.6.11 MEAS:FSWeep:CONFigure:P2[?]

This command is used to set the power of carrier 2 (TX2). Settings are limited to current <FILTer:MINPower?> and <FILTer:MAXPower?>.

Parameter: <Power> [float]

3.6.12 MEAS:FSWeep:CONFigure:IMORder[?]

This command sets the IM order for PIM measurement and is used for calculation of corresponding RX frequency. It is recommended to use MEAS:FSW:CONF:DFIMorder to avoid frequency-out-of-range errors and need for your own calculation of proper sweep range.

Parameter: <IM-Order> [uint]

3.6.13 MEAS:FSWeep:CONFigure:DFIMorder

This command calculates and sets the optimum sweep frequencies depending on the defined order and filter frequency limits.

Parameter: <IM-Order> [uint]

3.6.14 MEAS:FSWeep:CONFigure:REFCheck[?]

This command activates or deactivates a return loss check prior measurement. Amplifier turn on time is faster without check, but measuring with very bad VSWR is not recommended because it stresses components.

Parameter: 0 | 1 | OFF | ON [bool]

3.6.15 MEAS:FSWeep:CONFigure:DETector[?]

This command is used to select either AVG or PEAK detector.
AVG Detector: Bandwidth 1kHz, average of 20 samples per result (available each 20ms)
Peak Detector: Bandwidth 10kHz, maximum of 200 samples per result (available each 20ms)

Parameter: <DetectorType> [mnemonic]
Example: `PEAK`

3.6.16 MEAS:FSWeep:STARt

This command initiates a sweep measurement macro. The amplifiers will ramp up to the configurated power and receiver read out. Carrier1 will be increased by F1Step and receiver read again, …. until upsweep is completed. Then carrier2 will be decreased by F2Step until downsweep is finished. The result is a stream of "<Frequency>;<Value>" pairs with "\r\n" between up- and downsweep and ends with "\r\n".

Result: "<Frequency1Up>;<Result1Up>","<Frequency2Up>;<Result2Up>",…CRLF
"<Frequency1Down>;<Result1Down>","<Frequency2Down>;<Result2Down>",…CRLF
Example: `"8.9E8;-62.1","8.92E8;-62.5","8.94E8;-63.8",...CRLF`
`"8.9E8;-62.2","8.91E8;-62.3","8.92E8;-62.5",...CRLF`

3.6.17 MEAS:FSWeep:STOP

This command interrupts the sweep measurement macro before the configured upsweep and downsweep are finished. The amplifiers will ramp down and stream is stopped.

4 Programming Examples using SCPI

The following examples describe how to perform a simple PIM test using a Terminal program.
;Comments are just for clarification – they are not transferred!

4.1 Derive Model, Serial and Calibration Date

Input	Response
*IDN? ;Query Instrument ID & Serial	Rosenberger Hochfrequenztechnik,IM-B-BU-0727,010IM-A4711,3.11.7791.10[2019-04-30]
SYSTEM:SERROR? ;Test for static Errors	0,"No error"
SYSTEM:INIT "Hans",0 ;Init instrument with User Name "Hans" and infinite timeout	
SYSTEM:ERROR:COUNT? ;Test for Errors	0
SYSTEM:CALDATE? ;Query Caldate of Base Unit	"2017-01-16"
FILTER:MODEL? ;Query Model of Filter Unit	"IM-B-FI-700/B13+14"
FILTER:SERIAL? ;Query Serial of Filter Unit	"010IM-A7518"
FILTER:CALDATE? ;Query Caldate of Filter Unit	"2017-09-14"
SYSTEM:ERROR:COUNT? ;Test for Errors – just to be sure	0

4.2 2-Tone Measurement

Input	Response
MEAS:TWOTONE:CONF:F1 730 MHZ;F2 762 MHZ;P1 43;P2 43;IMORDER 3;DURATION 2;REFCHECK ON;DETECTOR AVG ;**Optional reconfiguration** to ;customize a 2-Tone measurement ;Omit if defaults are acceptable	
SYSTEM:ERROR:COUNT? ;Test for errors	0
MEAS:TWOTONE:START ;Start a Measurement and get results immediately	"0;-134.9","20;-137.1","40;-134.9", "60;-134.9","80;-134.9","100;-137.1", "120;-134.9","140;-134.9","160;-134.9", "180;-137.1","200;-134.9","220;-134.9", "240;-134.9","260;-137.1","280;-134.9", "300;-134.9","320;-134.9","340;-137.1", "360;-134.9","380;-134.9","400;-134.9", . . . "1760;-134.9","1780;-137.1","1800;-134.9", "1820;-134.9","1840;-134.9","1860;-137.1", "1880;-134.9","1900;-134.9","1920;-134.9", "1940;-137.1","1960;-134.9","1980;-134.9", "2000;-134.9"CRLF ;Newline (CRLF) when finished
MEAS:TWOTONE:STOP ;Optional to abort measurement	
*OPC? ;Poll until measurement is complete (1)	1
SYSTEM:ERROR:COUNT? ;Finally test if an error occurred	0

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4.3 Sweep Measurement

Input	Response
MEAS:FSWEEP:CONF:F1LOW 728.6 MHZ;F1HIGH 740 MHZ;F2FIX 763.3 MHZ;F2HIGH 763.3 MHZ;F2LOW 752.3 MHZ;F1FIX 728.6 MHZ;F1STEP 1 MHZ;F2STEP 1 MHZ;P1 43;P2 43;IMORDER 3;REFCHECK ON;DETECTOR AVG ;**Optional reconfiguration** to ;customize a sweep measurement ;Omit if defaults are acceptable	
SYSTEM:ERROR:COUNT? ;Test for errors	0
MEAS:FSWEEP:START ;Start a Measurement and get results immediately	;Upsweep "7.98e+8;-130.0","7.97e+8;-129.5", "7.96e+8;-127.7","7.95e+8;-127.2", "7.94e+8;-127.5","7.93e+8;-128.2", "7.92e+8;-128.9","7.91e+8;-129.2", "7.9e+8;-128.6","7.89e+8;-127.8", "7.88e+8;-128.3","7.87e+8;-128.5"CRLF ;Newline (CRLF) after upsweep ;Downsweep "7.98e+8;-128.6","7.96e+8;-129.6", "7.94e+8;-127.2","7.92e+8;-129.4", "7.9e+8;-127.9","7.88e+8;-127.9", "7.86e+8;-128.5","7.84e+8;-128.4", "7.82e+8;-128.7","7.8e+8;-129.4", "7.78e+8;-129.9","7.76e+8;-127.6"CRLF ;Newline (CRLF) when finished
MEAS:FSWEEP:STOP ;Optional to abort measurement	
*OPC? ;Poll until measurement is complete (1)	1
SYSTEM:ERROR:COUNT? ;Finally test if an error occurred	0