Keysight D9010SFPC SFP+ Ethernet Compliance Application

KEYSIGHT

PROGRAMMER'S REFERENCE

Notices

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In This Book

This book is your guide to programming the Keysight Technologies D9010SFPC SFP+ Ethernet Compliance Application.

- Chapter 1, “Introduction to Programming,” starting on page 7, describes compliance application programming basics.
- Chapter 2, “Configuration Variables and Values,” starting on page 9, Chapter 3, “Test Names and IDs,” starting on page 15, and Chapter 4, “Instruments,” starting on page 21 provide information specific to programming the D9010SFPC SFP+ Ethernet Compliance Application.

How to Use This Book

Programmers who are new to compliance application programming should read all of the chapters in order. Programmers who are already familiar with this may review chapters 2, 3, and 4 for changes.

Contents

1 Introduction to Programming

This chapter introduces the basics for remote programming a compliance/test application. The programming commands provide the means of remote control. Basic operations that you can do remotely with a computer and a compliance/test app running on an oscilloscope include:

- Launching and closing the application.
- Configuring the options.
- Running tests.
- Getting results.
- Controlling when and were dialogs get displayed
- Saving and loading projects.

You can accomplish other tasks by combining these functions.

Remote Programming Toolkit

The majority of remote interface features are common across all the Keysight Technologies, Inc. family of compliance/test applications. Information on those features is provided in the N5452A Compliance Application Remote Programming Toolkit available for download from Keysight here: www.keysight.com/find/rpi. The D9010SFPC SFP+ Ethernet Compliance Application uses Remote Interface Revision 7.10. The help files provided with the toolkit indicate which features are supported in this version.

In the toolkit, various documents refer to "application-specific configuration variables, test information, and instrument information". These are provided in Chapters 2, 3, and 4 of this document, and are also available directly from the application's user interface when the remote interface is enabled (View>Preferences::Remote tab::Show remote interface hints). See the toolkit for more information.

2 Configuration Variables and Values

The following table contains a description of each of the D9010SFPC SFP+ Ethernet Compliance Application options that you may query or set remotely using the appropriate remote interface method. The columns contain this information:

- GUI Location — Describes which graphical user interface tab contains the control used to change the value.
- Label — Describes which graphical user interface control is used to change the value.
- Variable — The name to use with the SetConfig method.
- Values — The values to use with the SetConfig method.
- Description — The purpose or function of the variable.

For example, if the graphical user interface contains this control on the **Set Up** tab:

- Enable Advanced Features

then you would expect to see something like this in the table below:

Table 1 Example Configuration Variables and Values

GUI Location	Label	Variable	Values	Description
Set Up	Enable Advanced Features	EnableAdvanced	True, False	Enables a set of optional features.

and you would set the variable remotely using:

```
ARSL syntax
-----------
arsl -a ipaddress -c "SetConfig 'EnableAdvanced' 'True'"

C# syntax
```

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```
---------
remoteAte.SetConfig("EnableAdvanced", "True");
```

Here are the actual configuration variables and values used by this application:

NOTE Some of the values presented in the table below may not be available in certain configurations. Always perform a "test run" of your remote script using the application's graphical user interface to ensure the combinations of values in your program are valid.

NOTE The file, "ConfigInfo.txt", which may be found in the same directory as this help file, contains all of the information found in the table below in a format suitable for parsing.

Table 2 Configuration Variables and Values

GUI Location	Label	Variable	Values	Description
Configure	#Averages	NumRiseFallAvgs	(Accepts user-defined text), 2, 4, 8, 16, 32	Number of averages used for the rise/fall time tests.
Configure	#Cycles	NumPRBS9Cycles	(Accepts user-defined text), 256, 512, 1024, 2048, 4096	Number of cycles of the PRBS9 pattern captured for the jitter tests.
Configure	#Hits	NumUJHits	(Accepts user-defined text), 10.0, 50.0, 100.0, 150.0, 200.0	Minimum number of hits on the histogram acquired for UJ test.
Configure	#UI	NumPRBS31UI	(Accepts user-defined text), 750E+3, 1.0E+6, 1.5E+6, 2.0E+6, 3.0E+6	Number of UI captured for the PRBS31 pattern.
Configure	#Waveforms (RN Test)	NumRNWaveforms	(Accepts user-defined text), 20, 40, 60, 80, 100	Number of waveforms used for Relative Noise (RN) test.
Configure	#Waveforms (Eye Mask Test)	NumMaskWaveforms	(Accepts user-defined text), 2, 4, 8, 16	Number of waveforms used for eye mask test.
Configure	#Waveforms (QSQ Test)	NumQsqWaveforms	(Accepts user-defined text), 20, 40, 60, 80, 100	Number of waveforms used for Qsq test.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	8180 Trigger Offset	Wav8180TriggerOffset	(Accepts user-defined text), 10E-3, 20E-3, 30E-3, 50E-3	Amplitude level offset apply to 8180 pattern triggering.
Configure	Acquisition Bandwidth	Bandwidth	(Accepts user-defined text), 12E+9, 16E+9, 25E+9, 33E+9	The acquisition bandwidth for all SFP+/QSFP+ measurements. 12GHz is the specified measurement bandwith for all SFP+ tests.
Configure	Clock Recovery Method	ClockRecovery	FirstOrderPLL, SecondOrderPLL	Oscilloscope channel to use for the TX- signal of the differential pair.
Configure	DUT 1 TX+ Channel	DUT1PosChannel	CHANnel1, CHANnel2, CHANnel3, CHANnel4	Oscilloscope channel to use for the TX+ signal of the differential pair.
Configure	DUT 1 TX- Channel	DUT1NegChannel	CHANnel1, CHANnel2, CHANnel3, CHANnel4	Oscilloscope channel to use for the TX- signal of the differential pair.
Configure	DUT 2 TX+ Channel	DUT2PosChannel	CHANnel1, CHANnel2, CHANnel3, CHANnel4	Oscilloscope channel to use for the TX+ signal of the differential pair.
Configure	DUT 2 TX- Channel	DUT2NegChannel	CHANnel1, CHANnel2, CHANnel3, CHANnel4	Oscilloscope channel to use for the TX- signal of the differential pair.
Configure	DUT TX+ Channel	DUTPosChannel	CHANnel1, CHANnel2, CHANnel3, CHANnel4	Oscilloscope channel to use for the TX+ signal of the differential pair.
Configure	DUT TX- Channel	DUTNegChannel	CHANnel1, CHANnel2, CHANnel3, CHANnel4	Oscilloscope channel to use for the TX- signal of the differential pair.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	Filter Type	FilterType	Brickwall, BT4	Type of filter applied to acquisitions. Brickwall filter is the default filter for Real Time oscilloscopes. 4th Order Bessel Thompson (BT4) filter is the default filter for Sampling Oscilloscopes.
Configure	ISI Filter Lag	ISIFilterLag	(Accepts user-defined text), 6, 8, 10, 12, 15, 18	Number of lagging coefficients used in the ISI filter for jitter test. Note: A larger number will increase the processing time.
Configure	ISI Filter Lead	ISIFilterLead	(Accepts user-defined text), -5, -4, -3, -2, -1	Number of leading coefficients used in the ISI filter for jitter test. Note: A smaller number will increase the processing time.
Configure	Input Type	TestSignalType	diff, diff-2, sing-4	Type of connection to the oscilloscope.
Configure	Offline Waveform, Negative (8180)	Wav8180NegPath	(Accepts user-defined text), -	Set the location for the 8180 waveform, negative lane. (Automated testing)
Configure	Offline Waveform, Negative (PRBS31)	WavPRBS31NegPath	(Accepts user-defined text), -	Set the location for the PRBS31 waveform, negative lane. (Automated testing)
Configure	Offline Waveform, Negative (PRBS9)	WavPRBS9NegPath	(Accepts user-defined text), -	Set the location for the PRBS9 waveform, negative lane. (Automated testing)
Configure	Offline Waveform, Positive (8180)	Wav8180PosPath	(Accepts user-defined text), -	Set the location for the 8180 waveform, positive lane. (Automated testing)
Configure	Offline Waveform, Positive (PRBS31)	WavPRBS31PosPath	(Accepts user-defined text), -	Set the location for the PRBS31 waveform, positive lane. (Automated testing)
Configure	Offline Waveform, Positive (PRBS9)	WavPRBS9PosPath	(Accepts user-defined text), -	Set the location for the PRBS9 waveform, positive lane. (Automated testing)
Configure	PRBS31 Trigger Offset	WavPRBS31TriggerOffset	(Accepts user-defined text), 10E-3, 20E-3, 30E-3, 50E-3	Amplitude level offset apply to PRBS31 pattern triggering.

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Configure	PRBS9 Trigger Offset	WavPRBS9TriggerOffset	(Accepts user-defined text), 10E-3, 20E-3, 30E-3, 50E-3	Amplitude level offset apply to PRBS9 pattern triggering.
Configure	Sampling Rate	SamplingRate	40E+09, 80E+09, 64E+09, 128E+09	The sampling rate for all SFP+/QSFP+ measurements. Sin(x)/x interpolation is applied when a higher sampling rate is required. A sampling rate of 80GSa/s is REQUIRED for bandwidths above 16GHz.
Configure	Signalling Rate	DataRate	9.8304E+9, 9.95328E+9, 10.1376E+9, 10.3125E+9, 10.51875E+9, 11.10E+9, 11.18E+9	Signalling rate (Baud) of the Device Under Test. SFF-8431 defined Rates: 10G WAN PHY: 9.95328 GBd 10G LAN PHY: 10.3125 GBd 10G LRM: 10.3125 GBd 10GSFP+Cu: 10.3125 GBd 10 GFC: 10.51875 GBd 10GBASE-R Encapsulated in G.709 ODU-2 Frame: 11.10 GBd Other Rates: CPRI: 9.8304 GBd CPRI: 10.1376 GBd Custom Application:11.18 GBd
Configure	Verify Pattern	CheckPattern	true, false	Verify the test pattern acquired on the scope is correct before running each test.
Run Tests	Event	RunEvent	(None), Fail, Margin < N, Pass	Names of events that can be used with the StoreMode=Event or RunUntil RunEventAction options
Run Tests	RunEvent=Margin < N: Minimum required margin %	RunEvent_Margin < N_MinPercent	Any integer in range: 0 <= value <= 99	Specify N using the 'Minimum required margin %' control.
Set Up	DeviceSpec	DeviceSpec	SFP+ SFI, 10GSFP+Cu	
Set Up	DeviceType	DeviceType	SFP+, QSFP+	
Set Up	Lane1	Lane1	0.0, 1.0	
Set Up	Lane1	Lane2	0.0, 1.0	
Set Up	Lane3	Lane3	0.0, 1.0	
Set Up	Lane4	Lane4	0.0, 1.0	
Set Up	Lane5	Lane5	0.0, 1.0	

Table 2 Configuration Variables and Values (continued)

GUI Location	Label	Variable	Values	Description
Set Up	Lane6	Lane6	0.0, 1.0	
Set Up	OfflineModeChkBox	OfflineMode	0.0, 1.0	

3 Test Names and IDs

The following table shows the mapping between each test's numeric ID and name. The numeric ID is required by various remote interface methods.

- Name — The name of the test as it appears on the user interface **Select Tests** tab.
- Test ID — The number to use with the RunTests method.
- Description — The description of the test as it appears on the user interface **Select Tests** tab.

For example, if the graphical user interface displays this tree in the **Select Tests** tab:

- All Tests
  - Rise Time
  - Fall Time

then you would expect to see something like this in the table below:

Table 3 Example Test Names and IDs

Name	Test ID	Description
Fall Time	110	Measures clock fall time.
Rise Time	100	Measures clock rise time.

and you would run these tests remotely using:

```
ARSL syntax
-----------
arsl -a ipaddress -c "SelectedTests '100,110'"
arsl -a ipaddress -c "Run"

C# syntax
---------
remoteAte.SelectedTests = new int[]{100,110};
remoteAte.Run();
```

Here are the actual Test names and IDs used by this application. Listed at the end, you may also find:

- Deprecated IDs and their replacements.
- Macro IDs which may be used to select multiple related tests at the same time.

NOTE

The file, "TestInfo.txt", which may be found in the same directory as this help file, contains all of the information found in the table below in a format suitable for parsing.

Table 4 Test IDs and Names

Name	TestID	Description
99% Jitter (J2)(p-p)	113	Verifies the J2 for the module receiver output.
AC Common Mode Output Voltage (rms)	60	Verifies the common mode output voltage of a XLPPI host output.
AC Common Mode Output Voltage (rms)	162	Verifies the common mode voltage of the module output.
Crosstalk Source Amplitude (p-p differential)	102	Verifies the amplitude for the crosstalk source calibration.
Crosstalk Source Fall Time (80%-20%)	172	Verifies the 80%-20% rise time for the crosstalk source calibration.
Crosstalk Source Fall Time (80%-20%)	72	Verifies the fall time for the crosstalk source calibration.
Crosstalk Source Fall Time (80%-20%)	101	Verifies the fall time for the crosstalk source calibration.
Crosstalk Source Rise Time (20%-80%)	171	Verifies the 20%-80% rise time for the crosstalk source calibration.
Crosstalk Source Rise Time (20%-80%)	71	Verifies the rise time for the crosstalk source calibration.
Crosstalk Source Rise Time (20%-80%)	100	Verifies the rise time for the crosstalk source calibration.
Crosstalk source VMA (p-p)	170	Verifies the VMA for the crosstalk source calibration.
Crosstalk source VMA (p-p)	70	Verifies the VMA for the crosstalk source calibration. Target: 700mV.
Data Dependent Jitter (DDJ)(p-p)	20	Verifies the DDJ of a host TX output. Measurement is done using EZJIT.
Data Dependent Pulse Width Shrinkage (DDPWS)(p-p)	50	Verifies the DDPWS of a XLPPI host output. Measurement is done using EZJIT.
Data Dependent Pulse Width Shrinkage (DDPWS)(p-p)	21	Verifies the DDPWS of a host TX output. Measurement is done using EZJIT.
Difference Waveform Dispersion Penalty for LRM (dWDP)	133	Verifies the difference WDP for LRM.
Difference Waveform Dispersion Penalty for SR and LR (dWDP)	132	Verifies the difference WDP for SR and LR.
Differential Voltage Modulation Amplitude for LRM (VMA)(p-p)	141	Verifies the differential VMA for LRM.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Differential Voltage Modulation Amplitude for SR and LR (VMA)(p-p)	140	Verifies the differential VMA for SR and LR.
Differential peak to peak voltage (Vpk-pk)	142	Verifies the differential peak-to-peak voltage for the module receiver output.
Eye Mask Hit Ratio	65	Verifies the hit ratio of the eye mask of a host TX output at TP1a. The ratio of the number of mask hits to the total sampling points must not exceed the compliance limit.
Eye Mask Hit Ratio	35	Verifies the hit ratio of the eye mask of a host TX output. The ratio of the number of mask hits to the total sampling points must not exceed the compliance limit.
Eye Mask Hit Ratio	165	Verifies the hit ratio of the eye mask of a module output at TP4. The ratio of the number of mask hits to the total sampling points must not exceed the compliance limit.
Eye Mask Hit Ratio	114	Verifies the hit ratio of the eye mask of a module receiver TX output. The ratio of the number of mask hits to the total sampling points must not exceed the compliance limit.
J2 Jitter (p-p)	63	Verifies the J2 Jitter of a XLPPI host output.
J2 Jitter (p-p)	163	Verifies the J2 jitter of the module output.
J9 Jitter (p-p)	64	Verifies the J9 Jitter of a XLPPI host output.
J9 Jitter (p-p)	164	Verifies the J9 jitter of the module output.
Output AC Common Mode Voltage (rms)	30	Verifies the Output AC Common Mode Voltage of a host TX output.
Output AC Common Mode Voltage for Cu (rms)	31	Verifies the Output AC Common Mode Voltage of a host TX output supporting passive direct attached cables.
Output AC Common Mode Voltage, Limiting Module (rms)	105	Verifies the output common mode voltage for the module receiver output.
Output AC Common Mode Voltage, Linear Module (rms)	108	Verifies the output common mode voltage for the module receiver output.
Output Fall Time (80%-20%)	111	Verifies the 80%-20% fall time for the module receiver output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.
Output Fall Time (80%-20%)	41	Verifies the 80%-20% fall time of a XLPPI host output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.
Output Fall Time (80%-20%)	151	Verifies the 80%-20% fall time of the module output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Output Rise Time (20%-80%)	110	Verifies the 20%-80% rise time for the module receiver output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.
Output Rise Time (20%-80%)	40	Verifies the 20%-80% rise time of a XLPPI host output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.
Output Rise Time (20%-80%)	150	Verifies the 20%-80% rise time of the module output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.
Qsq (V/V)	42	Verifies the Qsq of a XLPPI host output. Qsq is a measure of SNR of the output.
Reference Noise LR (RNi)	121	Verifies the reference noise of the TP3 tester for LR. This should be no more than 1dBo greater than 0.014.
Reference Noise LRM with post-cursor stressor (RNi)	124	Verifies the reference noise of the TP3 tester for LRM with post-cursor stressor. This should be within 1dBo of 0.0213.
Reference Noise LRM with pre-cursor stressor (RNi)	122	Verifies the reference noise of the TP3 tester for LRM with pre-cursor stressor. This should be within 1dBo of 0.0219.
Reference Noise LRM with split-symmetrical stressor (RNi)	123	Verifies the reference noise of the TP3 tester for LRM with split-symmetrical stressor. This should be within 1dBo of 0.0269.
Reference Noise SR (RNi)	120	Verifies the reference noise of the TP3 tester for SR. This should be no more than 1dBo greater than 0.020.
Reference Waveform Dispersion Penalty for LRM (WDPi)	131	Verifies the reference WDP of the TP3 tester for LRM.
Reference Waveform Dispersion Penalty for SR and LR (WDPi)	130	Verifies the reference WDP of the TP3 tester for SR and LR.
Relative Noise LR (RN)	126	Verifies the RN for LR. The limits for RN are functions of measured dWDP for the module, expressed in optical decibels. The calculation is given by: RN ≤ min[(m1 × dWDP + b1), (m2 × dWDP + b2), RNmax].
Relative Noise LRM with post-cursor stressor (RN)	129	Verifies the RN for LRM with split-symmetrical stressor. The limits for RN are functions of measured dWDP for the module, expressed in optical decibels. The calculation is given by: RN ≤ min[(m1 × dWDP + b1), (m2 × dWDP + b2), RNmax].
Relative Noise LRM with pre-cursor stressor (RN)	127	Verifies the RN for LRM with pre-cursor stressor. The limits for RN are functions of measured dWDP for the module, expressed in optical decibels. The calculation is given by: RN ≤ min[(m1 × dWDP + b1), (m2 × dWDP + b2), RNmax].

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Relative Noise LRM with split-symmetrical stressor (RN)	128	Verifies the RN for LRM with split-symmetrical stressor. The limits for RN are functions of measured dWDP for the module, expressed in optical decibels. The calculation is given by: RN ≤ min[(m1 × dWDP + b1), (m2 × dWDP + b2), RNmax].
Relative Noise SR (RN)	125	Verifies the RN for SR. The limits for RN are functions of measured dWDP for the module, expressed in optical decibels. The calculation is given by: RN ≤ min[(m1 × dWDP + b1), (m2 × dWDP + b2), RNmax].
Signal Fall Time (80%-20%)	11	Verifies the 80%-20% fall time of a host TX output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.
Signal Rise Time (20%-80%)	10	Verifies the 20%-80% rise time of a host TX output. 0% and 100% levels are defined as the logic 0 voltage level and logic 1 voltage level respectively.
Single Ended Output Voltage (Negative)	62	Verifies the Single Ended Output Voltage of a XLPPI host output.
Single Ended Output Voltage (Negative)	161	Verifies the single ended output voltage of the module output.
Single Ended Output Voltage (Positive)	61	Verifies the Single Ended Output Voltage of a XLPPI host output.
Single Ended Output Voltage (Positive)	160	Verifies the single ended output voltage of the module output.
Single Ended Voltage Range (Negative)	33	Verifies the Single Ended Voltage Range of a host TX output. This test is only available when using a differential signal.
Single Ended Voltage Range (Positive)	32	Verifies the Single Ended Voltage Range of a host TX output. This test is only available when using a differential signal.
Single Ended Voltage Tolerance, Limiting Module (Negative)	104	Verifies the single ended voltage tolerance for the module receiver output.
Single Ended Voltage Tolerance, Limiting Module (Positive)	103	Verifies the single ended voltage tolerance for the module receiver output.
Single Ended Voltage Tolerance, Linear Module (Negative)	107	Verifies the single ended voltage tolerance for the module receiver output.
Single Ended Voltage Tolerance, Linear Module (Positive)	106	Verifies the single ended voltage tolerance for the module receiver output.
Total Jitter (TJ)(p-p)	112	Verifies the TJ for the module receiver output. TJ is measured for a BER of 1E-12.
Total Jitter (TJ)(p-p)	34	Verifies the TJ of a host TX output. TJ is measured for a BER of 1E-12.
Transmitter Qsq	12	Verifies the Qsq of a host TX output. Qsq is a measure of SNR of the output.
Transmitter Qsq for Cu	13	Verifies the Qsq of a host TX output supporting passive direct attached cable. Qsq is a measure of SNR of the output.

Table 4 Test IDs and Names (continued)

Name	TestID	Description
Transmitter Waveform Dispersion Penalty for Cu (TWDPc)	23	Verifies the WDP of a host TX output supporting passive direct attached cable.
Uncorrelated Jitter (UJ)(RMS)	22	Verifies the UJ of a host TX output.
Voltage Modulation Amplitude for Cu (VMA)(p-p)	14	Verifies the VMA of a host TX output supporting passive direct attached cable. VMA is the difference between the logic 0 and logic 1 levels of the output.

4 Instruments

The following table shows the instruments used by this application. The name is required by various remote interface methods.

- Instrument Name — The name to use as a parameter in remote interface commands.
- Description — The description of the instrument.

For example, if an application uses an oscilloscope and a pulse generator, then you would expect to see something like this in the table below:

Table 5 Example Instrument Information

Name	Description
scope	The primary oscilloscope.
Pulse	The pulse generator used for Gen 2 tests.

and you would be able to remotely control an instrument using:

```
ARSL syntax (replace [description] with actual parameter)
---------------------------------------------------------------------
arsl -a ipaddress -c "SendScpiCommandCustom 'Command=[scpi
command];Timeout=100;Instrument=pulsegen'"

arsl -a ipaddress -c "SendScpiQueryCustom 'Command=[scpi
query];Timeout=100;Instrument=pulsegen'"


C# syntax (replace [description] with actual parameter)
---------------------------------------------------------------------
SendScpiCommandOptions commandOptions = new SendScpiCommandOptions();
commandOptions.Command = "[scpi command]";
commandOptions.Instrument = "[instrument name]";
commandOptions.Timeout = [timeout];
remoteAte.SendScpiCommand(commandOptions);

SendScpiQueryOptions queryOptions = new SendScpiQueryOptions();
queryOptions.Query = "[scpi query]";
queryOptions.Instrument = "[instrument name]";
```

```
queryOptions.Timeout = [timeout];
remoteAte.SendScpiQuery(queryOptions);
```

Here are the actual instrument names used by this application:

NOTE The file, "InstrumentInfo.txt", which may be found in the same directory as this help file, contains all of the information found in the table below in a format suitable for parsing.

Table 6 Instrument Names

Instrument Name	Description
Infiniium	The primary oscilloscope.
Fg33250Master	The Fg33250 Master.
Fg33250Slave	The Fg33250 Slave.
Fg81150	The Fg81150.
VNA	The Network Analyzer.
SpectrumAnalyzer	The Spectrum Analyzer.

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