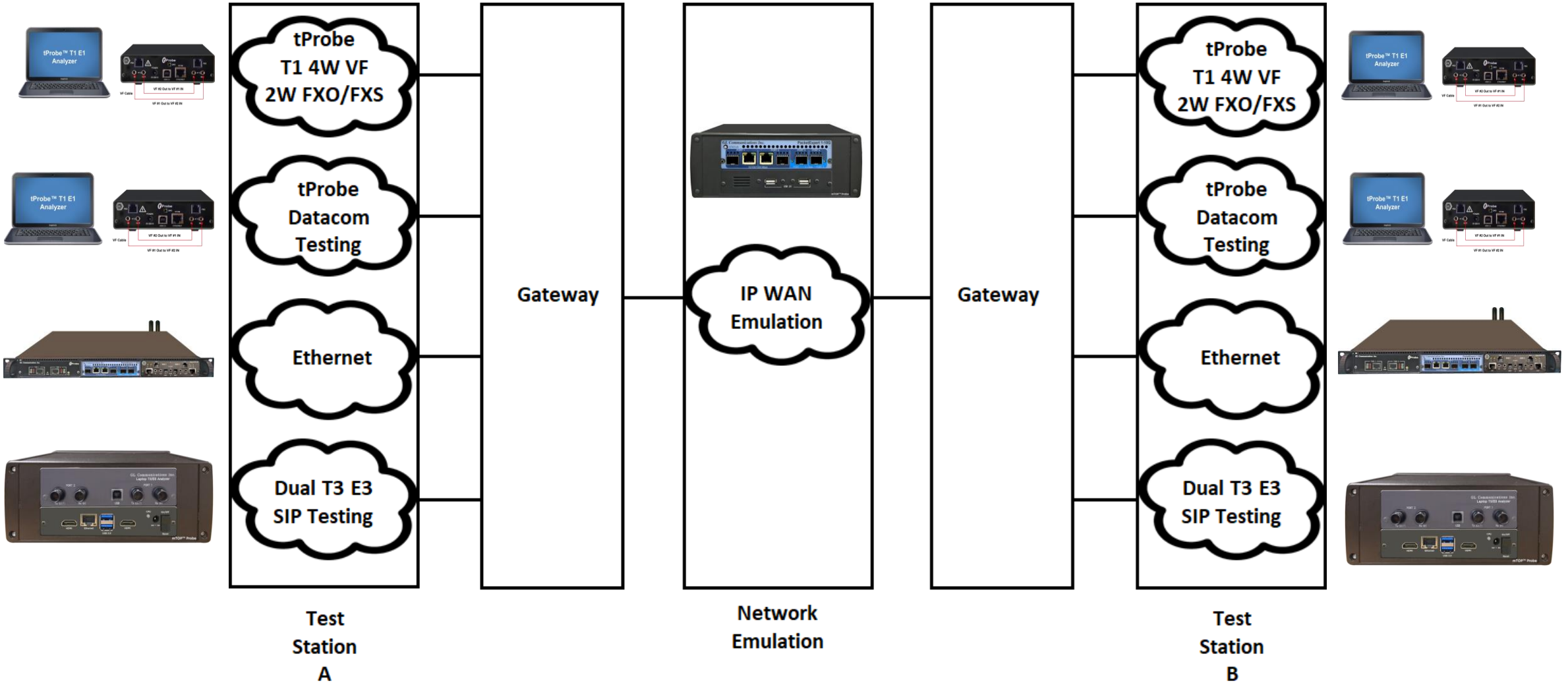
Voiceband Measurements Using 4-Wire VF and 2-Wire FXO FXS Interfaces for VG3 and VG6

GL Communications Inc.
818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: https://www.gl.com

Overall Scope of FENS Testing



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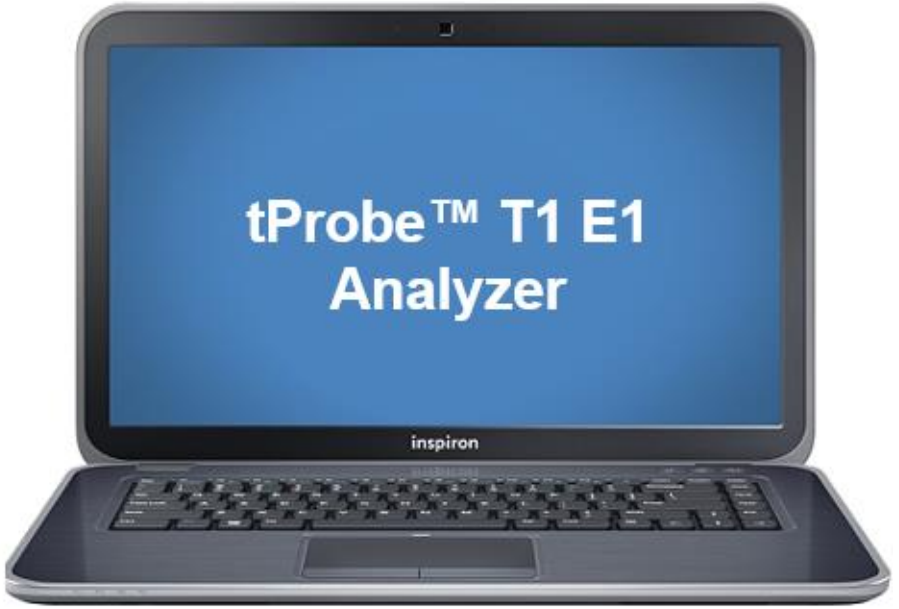
Connecting 4-Wire VF Ports on tProbe™ in Self Test

- The test procedure requires tProbe™ T1 Analyzer and optional MAPS™ APS Emulator licenses
- tProbe T1 Analyzer should be installed on the system
- Cross-connect VF ports with VF audio cables as shown below for self test

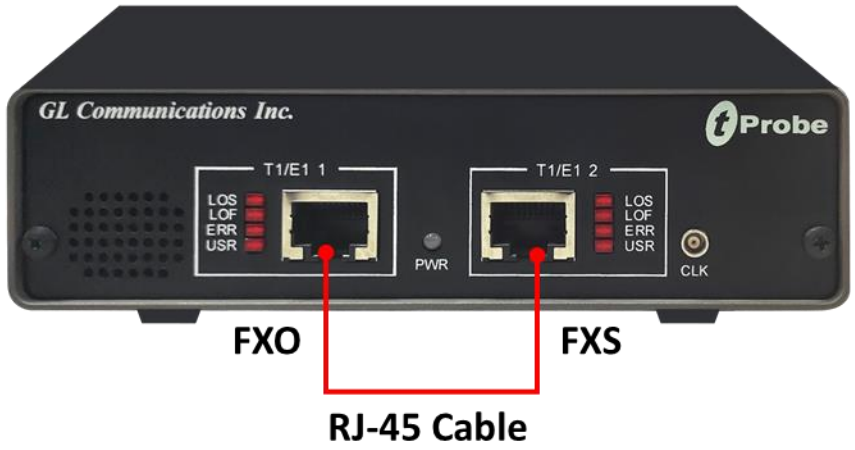
VF1 IN → VF2 OUT

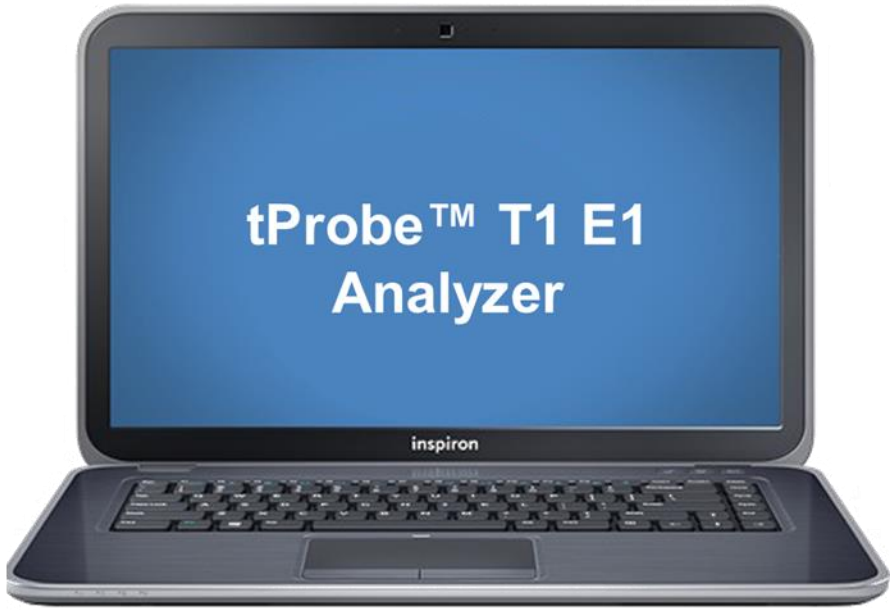
VF2 IN → VF1 OUT



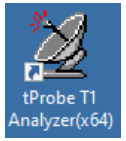
Connecting 2-Wire FXO FXS Ports on tProbe™ in Self Test

- The test procedure requires tProbe™ T1 Analyzer and optional MAPS™ APS Emulator licenses
- tProbe T1 Analyzer should be installed on the system
- Cross-connect FXO FXS ports with RJ-45 cable as shown below for self test

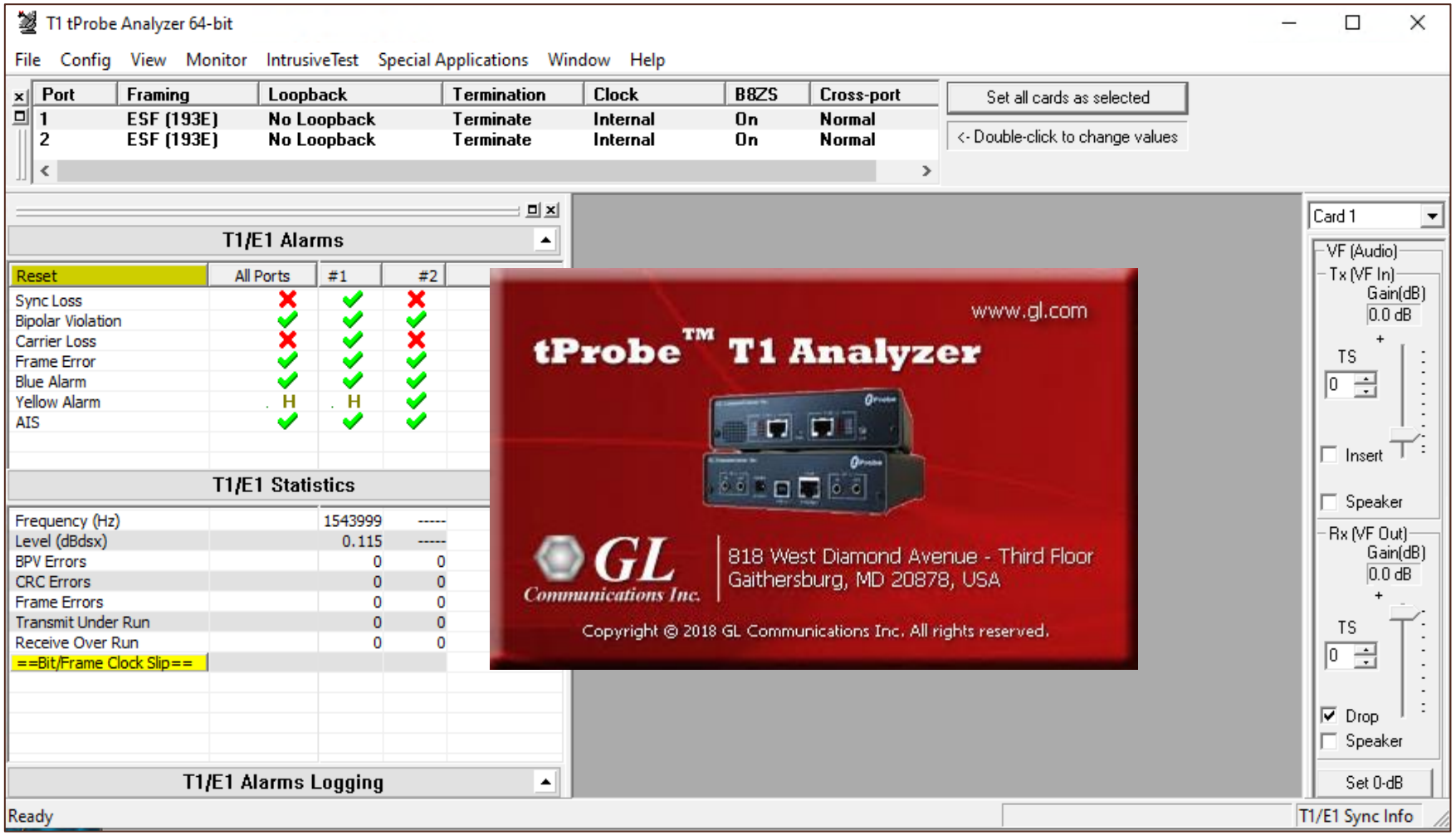




Invoking tProbe™ T1 Analyzer

- Invoke **tProbe T1 Analyzer** from the shortcut icon 

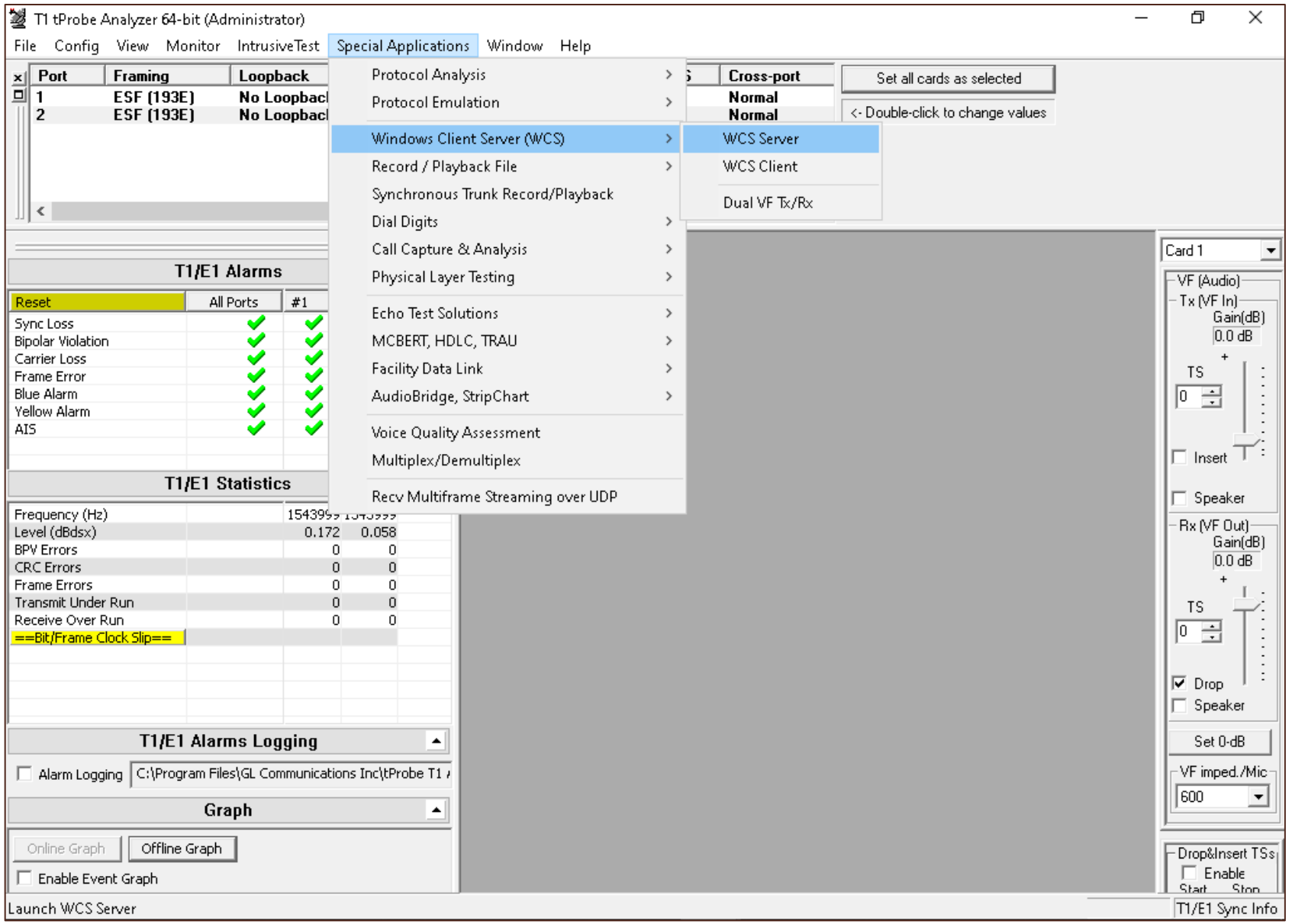
  created on the desktop or from the following path
  C:\Program Files\GL Communications Inc\tProbe T1 Analyzer\UsbNGT1.exe



Invoking GL Server

Start GL Server

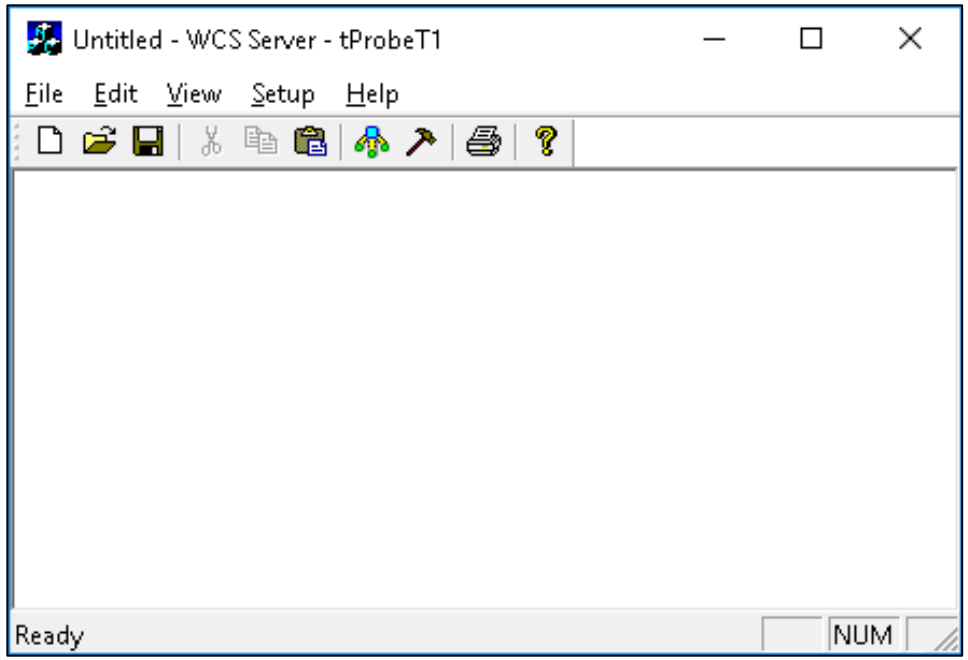
- Open the WCS Server: **Special Applications → Windows Client Server (WCS) → WCS Server**
- WCS server allows automation of voiceband testing measurements



GL Server Settings

Start GL Server

- Listen Port = 17080 for T1 (17090 for E1)
- Messaging = Binary
- Version = 4
- Click OK to start GL server



WCS Server Window

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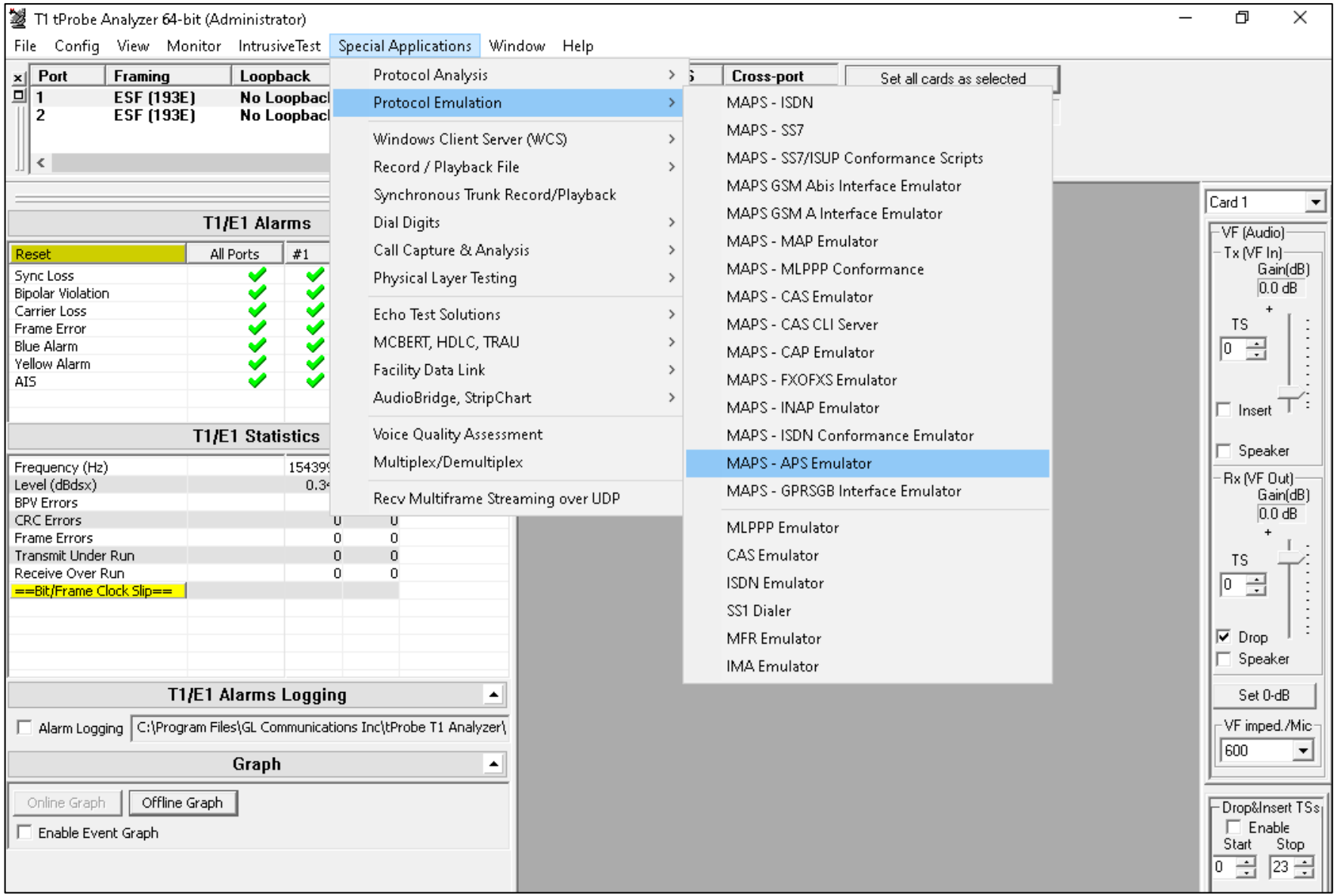
Invoke MAPS™ APS Emulator (Client)

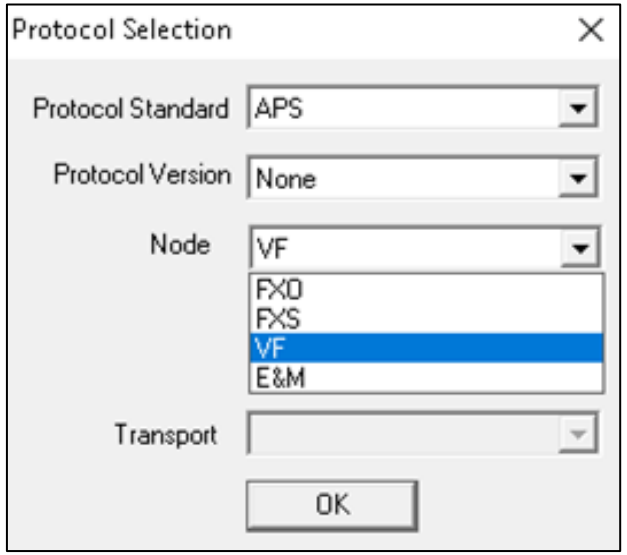
- From the **tProbe T1 Analyzer,** select **Special Applications → Protocol Emulation → MAPS APS Emulator** to invoke MAPS APS Emulator (client)
- This client passes commands to the WCS server



Procedure for 4-Wire VF Voiceband Measurement Test

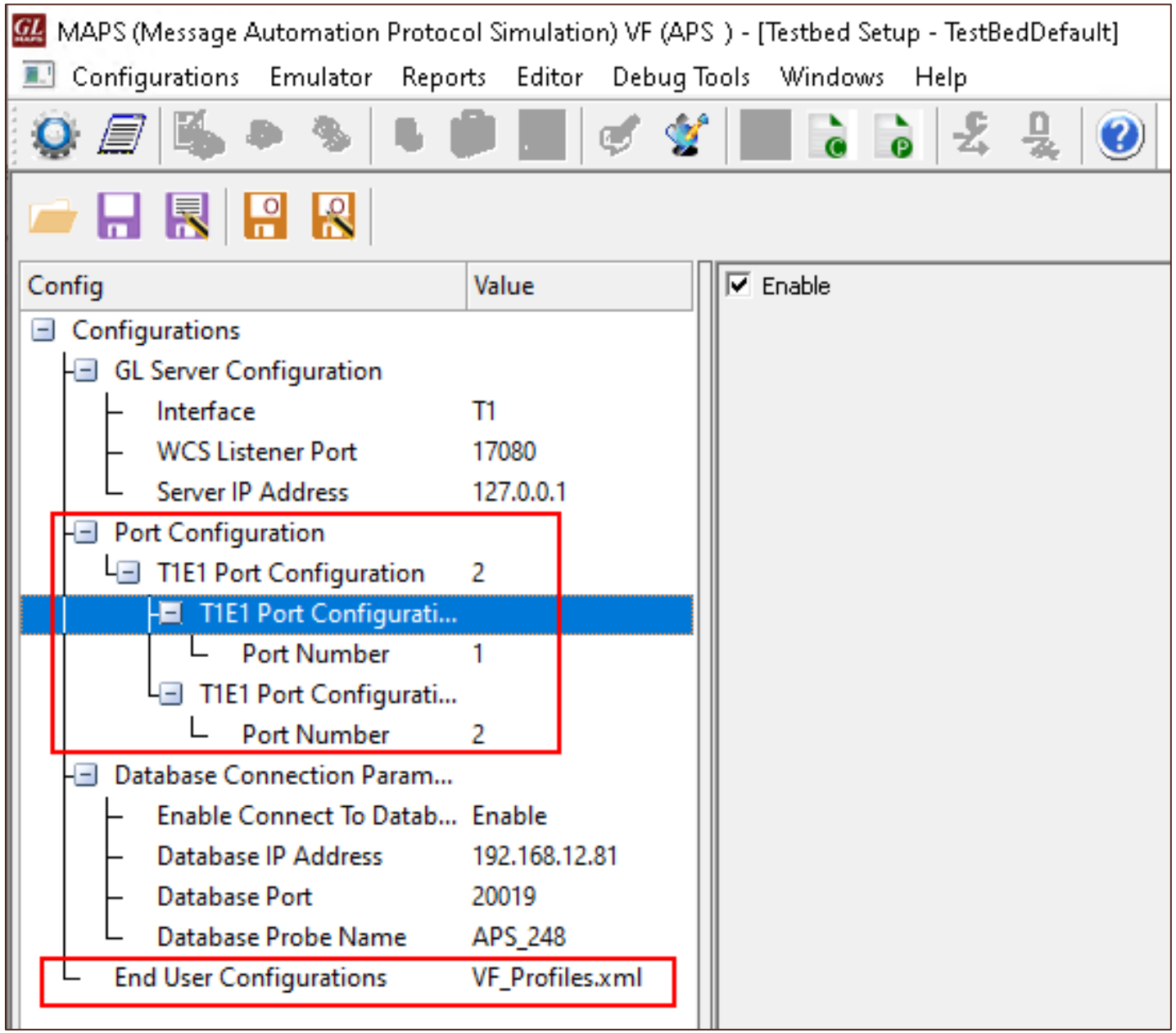
Protocol Selection 4-Wire VF

- Protocol Selection window is prompted after invoking **MAPS™ APS Emulator**, select the following:
  - Protocol Standard - APS
  - Protocol Version - None
  - Node - VF
- Click **OK** to continue



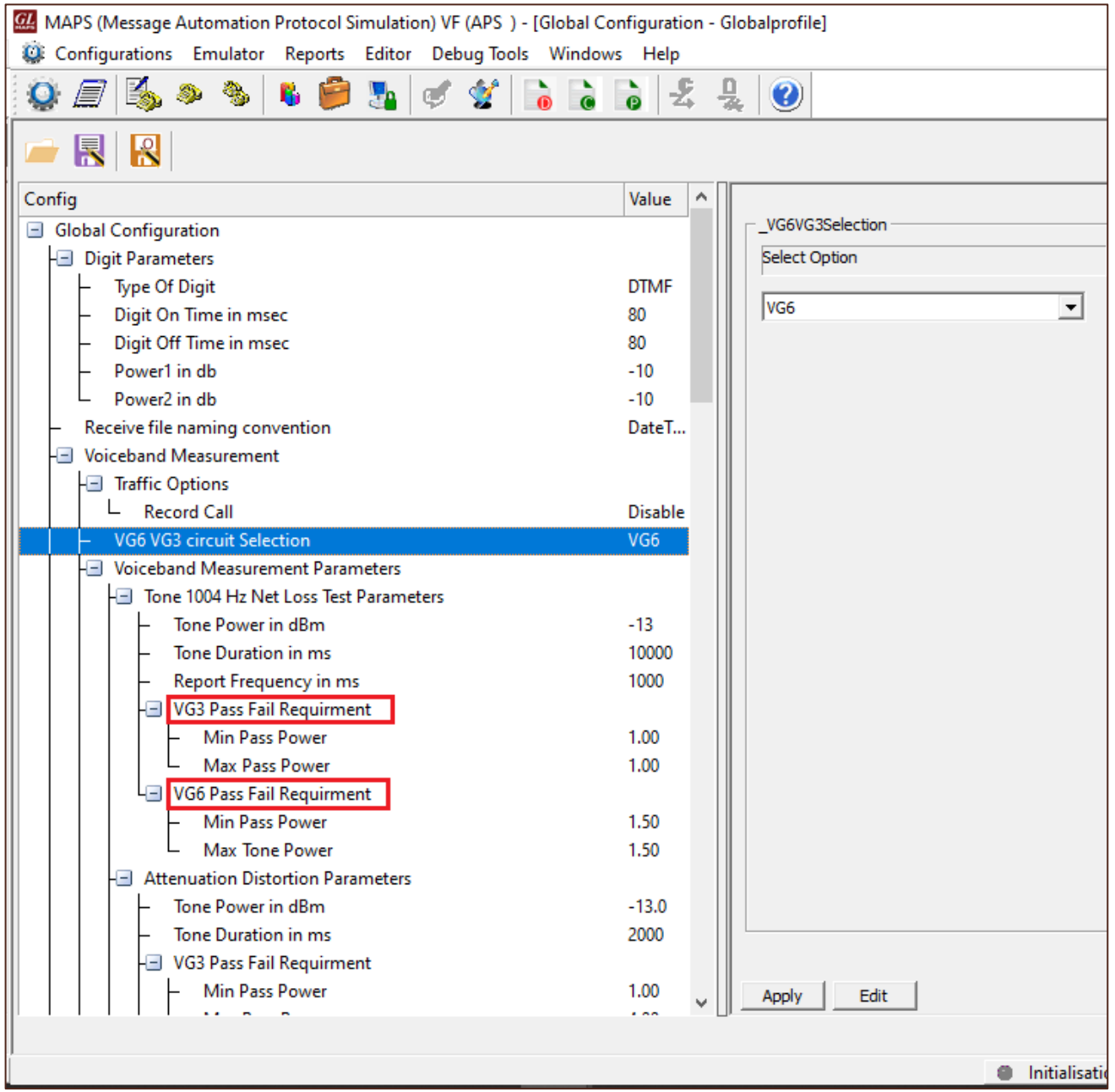
Configure Testbed in MAPS™ APS Emulator

- By default, it will display Testbed Setup window
- Observe that default Testbed Setup is displayed. Verify the highlighted settings to get started with the testing
- Click on **Start** to start the Testbed setup



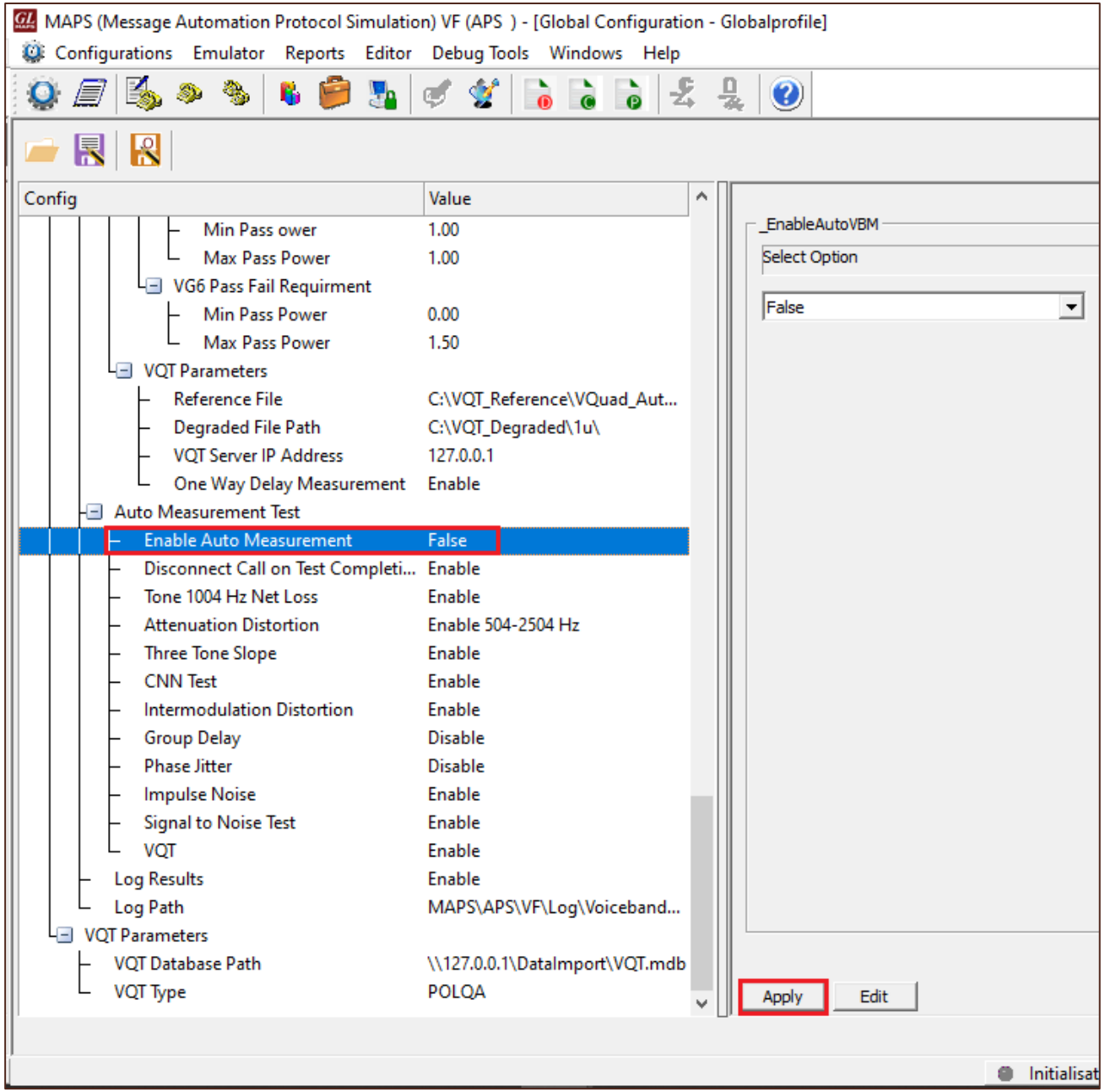
Procedure to Load and Configure the Global Profile

- Global Profiles is used to configure test parameters for all VF lines
- On the MAPS Client main GUI, select **Configurations → Global Configuration**
- Click on open icon and select **GlobalProfile_VBM_FENS** and click on **OK**
- In the Global configuration window, select the required test. Test parameters can be configured for all the tests
- **VG6 or VG3 circuit** can be selected. The selection will be applied for all the tests
- **VG6 and VG3 Pass/Fail** Requirement are configured in Global profiles for all the tests. User can edit the Pass/Fail criteria



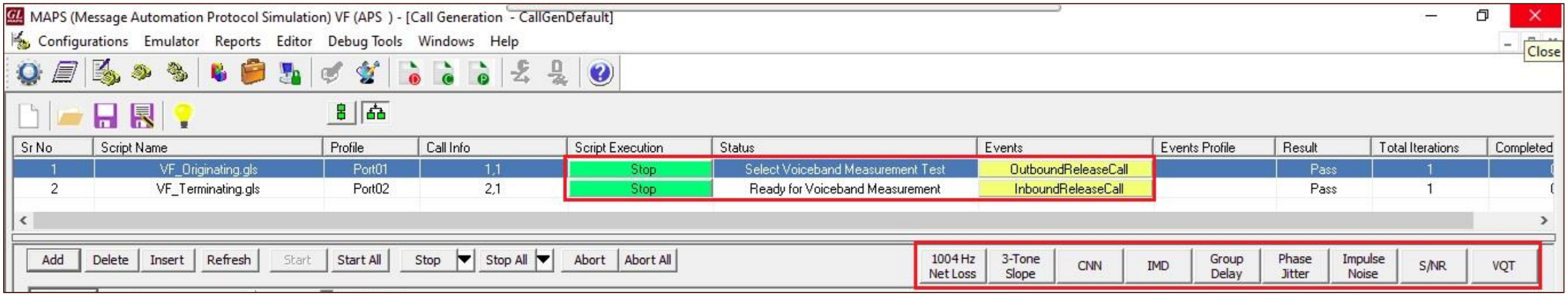
Procedure to Load and Configure Global Profile (Contd.)

- Auto Measurement Test parameters allow users to automate voiceband measurement tests and select which test(s) to run. Call disconnects automatically upon completion
- After making changes to Global Profile, Click on **Apply** icon
- Close the Global Profile window



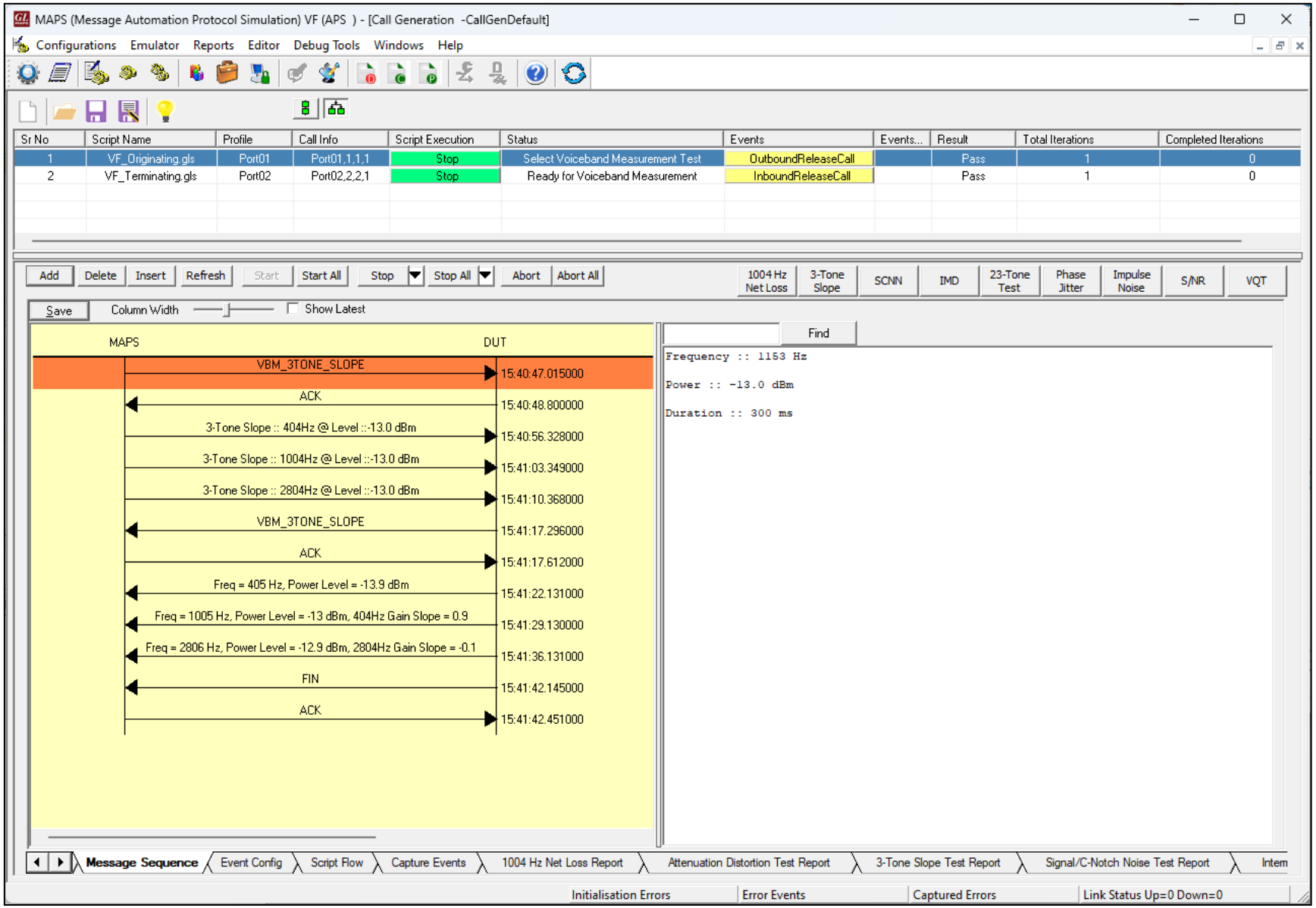
Procedure to Start MAPS™ APS VF

- Click on **Start All** button to start both VF_Originating.gls and VF_Terminating.gls
- Observe that both the scripts are started (indicating Green color) and the VF_Originating status is displayed as “Select Voiceband Measurement Test”
- Now, user clicks on the required test button. For example, click on ‘Impulse Noise’ button to run the Impulse Noise test



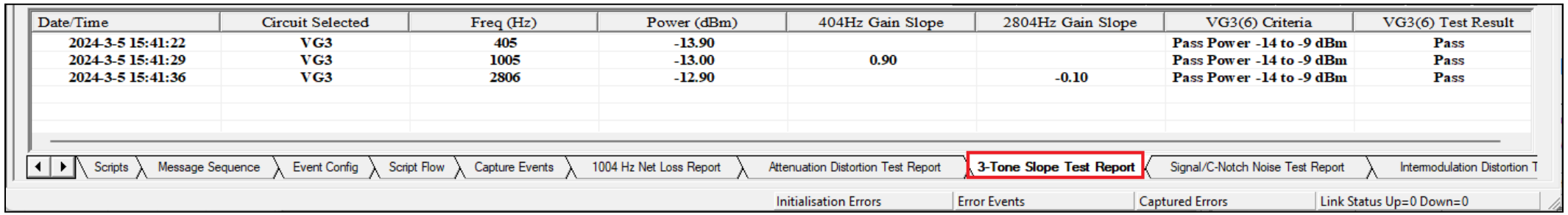
Procedure to Perform Voiceband Measurement Tests

- The **VF_Originating.gls** and **VF_Terminating.gls** will set up a call between **Port01** and **Port02**
- **VF_Originating.gls** script has the options to perform various voiceband measurement tests
- Click on any of the voiceband measurement test buttons to start a test. Note the **VF_Originating.gls** status indicates “Select Voiceband Measurement Test” and the **VF_Terminating.gls** status indicates “Ready for Voiceband Measurement”
- Voiceband Measurement tests can only be started from the **VF_Originating.gls**



Test Results

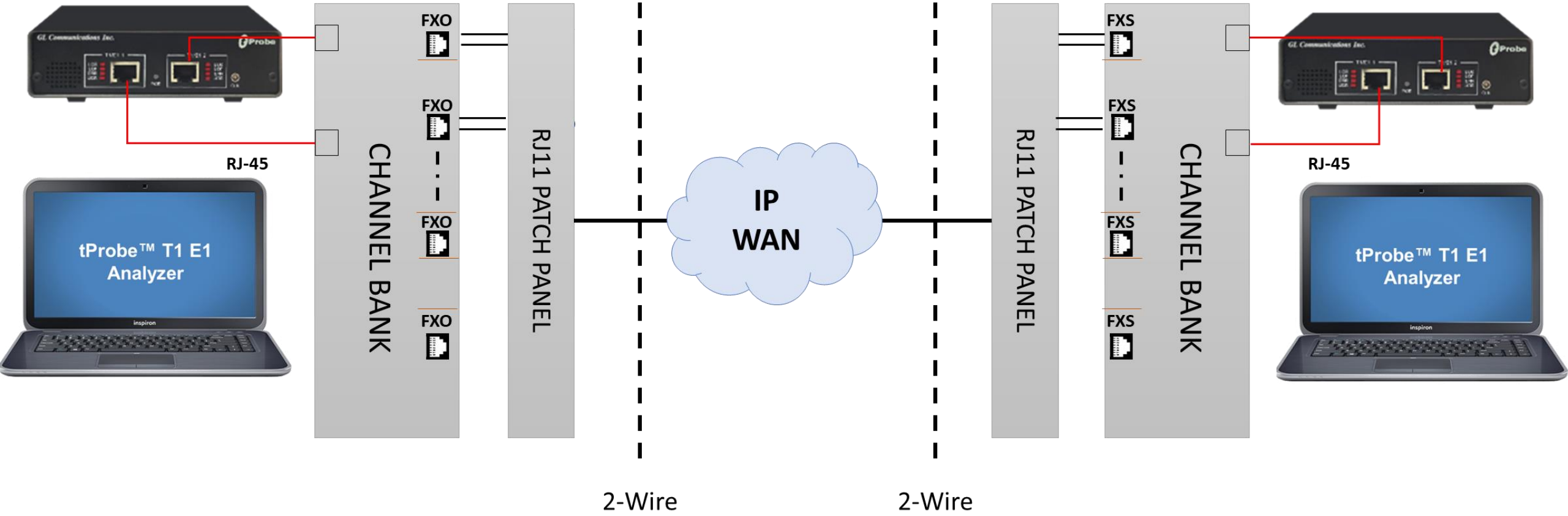
- Test results are shown in the respective tabs as shown in the screenshot



Date/Time	Circuit Selected	Freq (Hz)	Power (dBm)	404Hz Gain Slope	2804Hz Gain Slope	VG3(6) Criteria	VG3(6) Test Result
2024-3-5 15:41:22	VG3	405	-13.90			Pass Power -14 to -9 dBm	Pass
2024-3-5 15:41:29	VG3	1005	-13.00	0.90		Pass Power -14 to -9 dBm	Pass
2024-3-5 15:41:36	VG3	2806	-12.90		-0.10	Pass Power -14 to -9 dBm	Pass

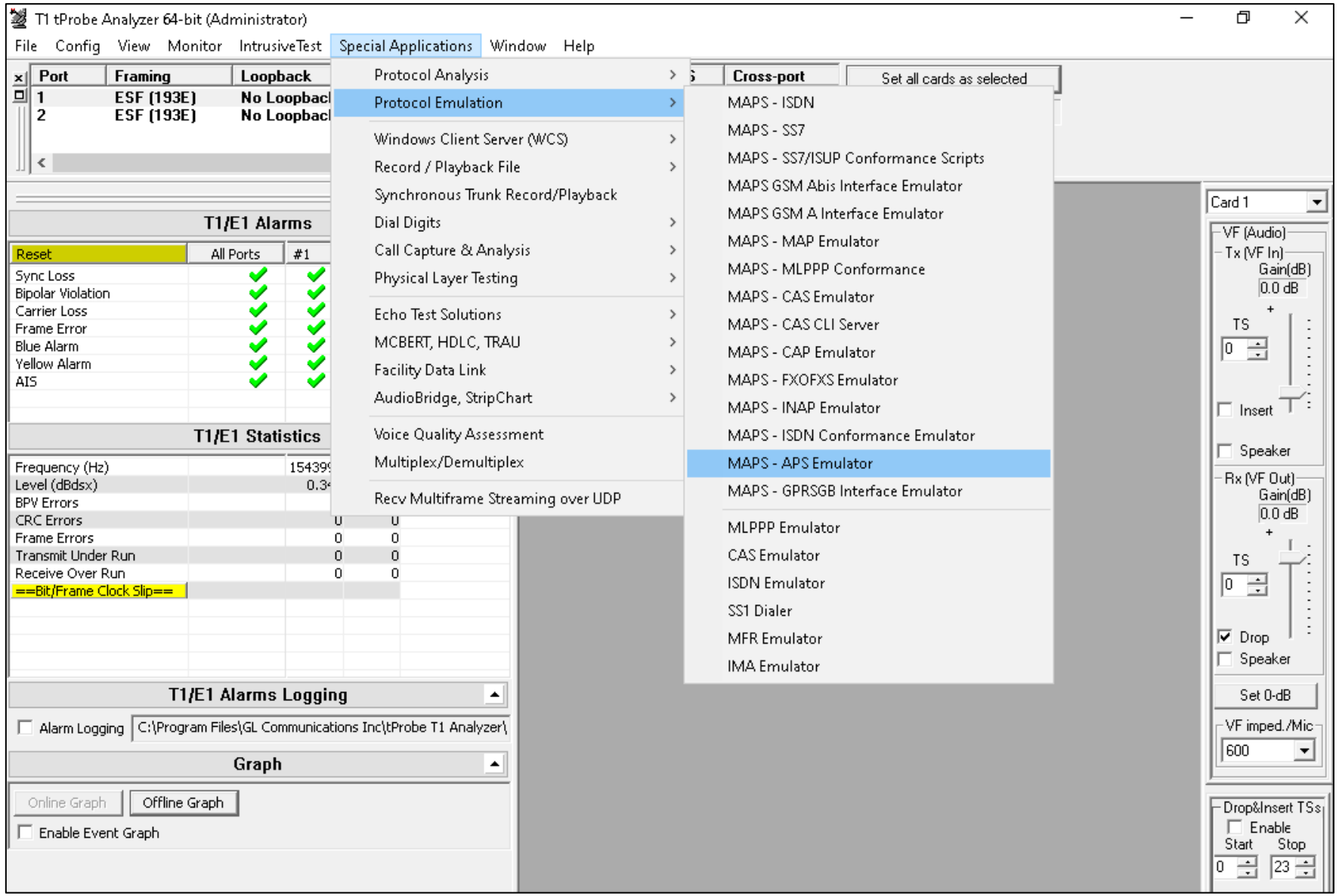
Procedure for 2-Wire FXO FXS Voiceband Measurement Test

MAPS™ APS 2-Wire FXO FXS Setup



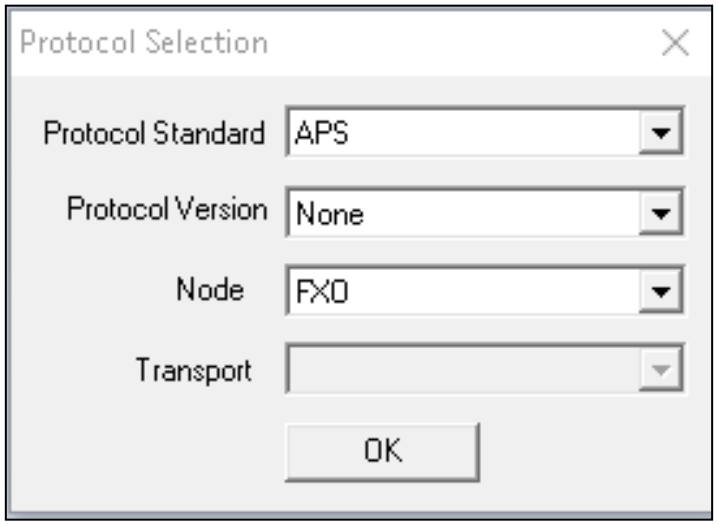
Invoke MAPS™ APS Emulator (Client)

- From the **tProbe T1 Analyzer,** select **Special Applications → Protocol Emulation → MAPS APS Emulator** to invoke MAPS™ APS Emulator (client)
- This client passes commands to the WCS server



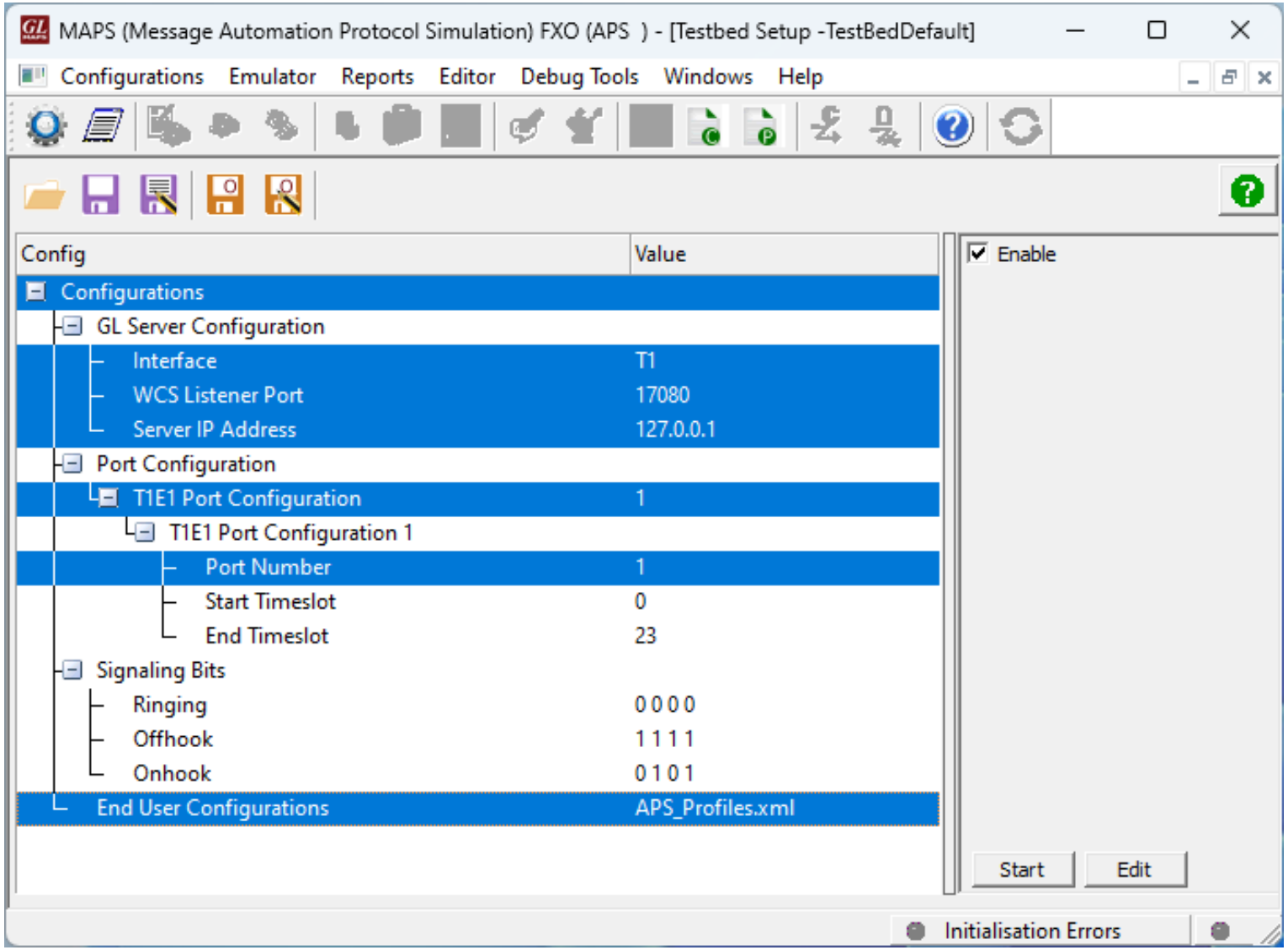
Protocol Selection 2-Wire FXO

- Protocol Selection window is prompted, select the following:
  - Protocol Standard - **APS**
  - Protocol Version - **None**
  - Node - **FXO**
- Click **OK** to continue



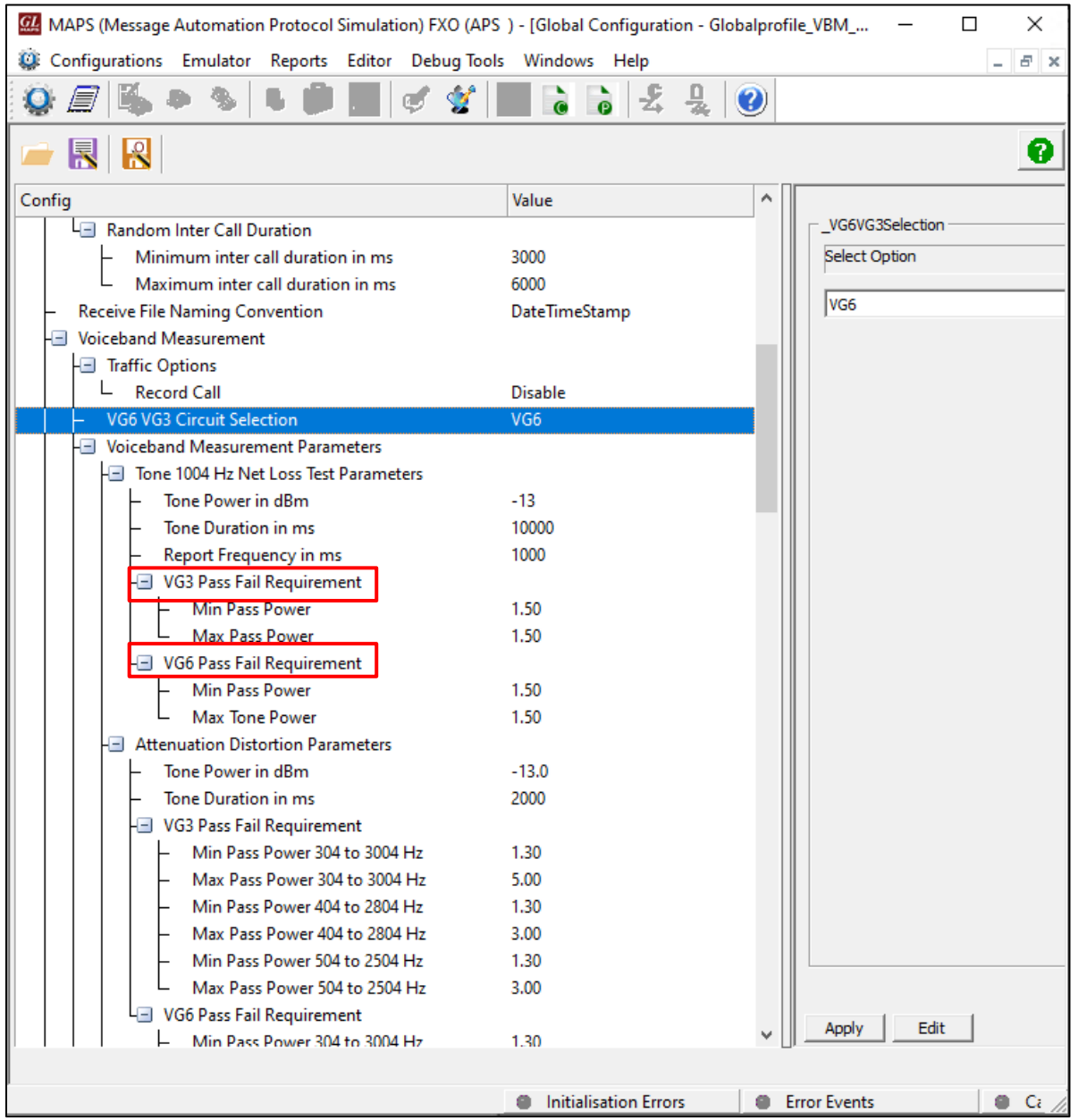
Configure Testbed in FXO

- By default, it will display Testbed Setup window
- Observe that default Testbed Setup is displayed. Verify the highlighted settings to get started with the testing
- Click on **Start** to start the Testbed setup



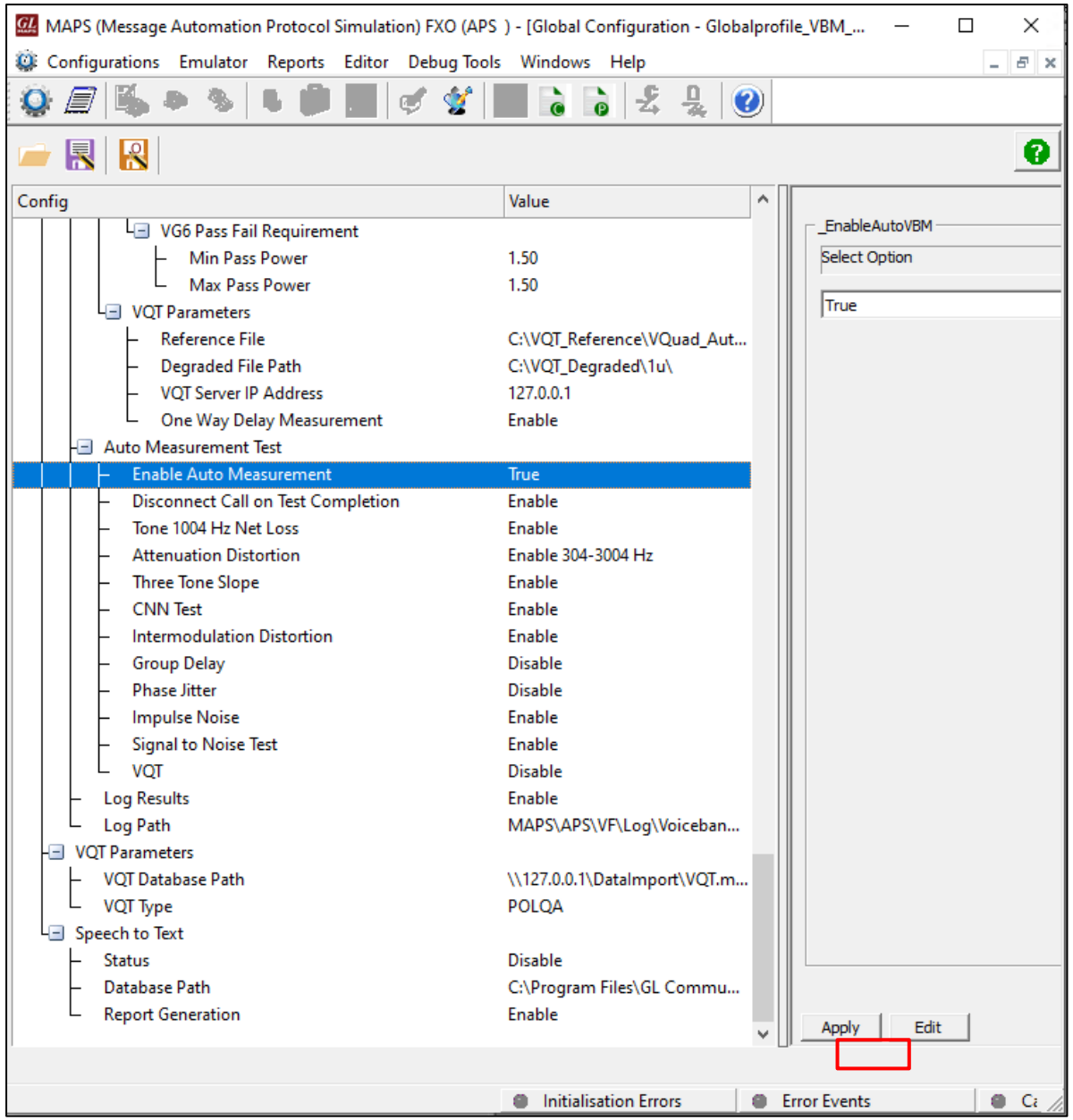
Procedure to Load and Configure the Global Profile

- Global Profiles is used to configure test parameters for all FXO lines
- On the MAPS Client main GUI, select **Configurations →Global Configuration**
- Click on open icon and select **GlobalProfile_VBM_FENS** and click on **OK**
- In the Global configuration window, select the required test. Test parameters can be configured for all the tests
- **VG6 or VG3 circuit** can be selected. The selection will be applied for all the tests
- **VG6 and VG3 Pass/Fail Requirement** are configured in Global profiles for all the tests. User can edit the Pass/Fail criteria



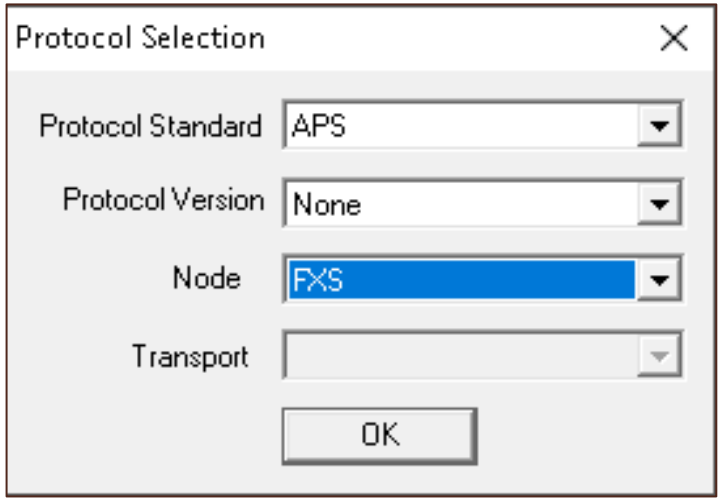
Procedure to Load and Configure Global Profile (Contd.)

- Auto Measurement Test parameters allow users to automate voiceband measurement tests and select which test to run. Call disconnects automatically upon completion
- After making changes to Global Profile. Click on **Apply** icon
- Close the Global Profile window



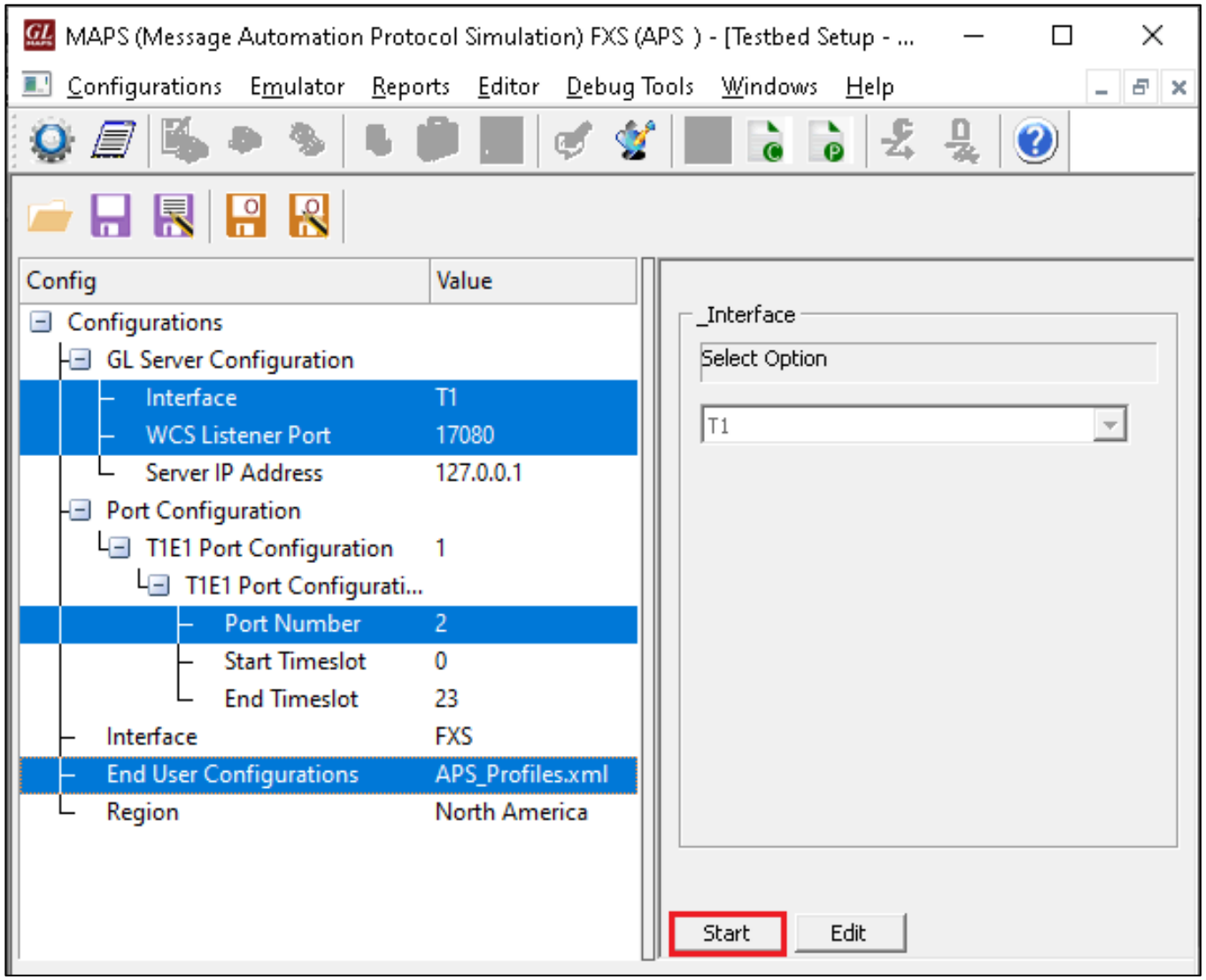
Protocol Selection 2-Wire FXS

- From the tProbe T1 Analyzer, select **Special Applications** → **Protocol Emulation** → **MAPS APS Emulator** to invoke MAPS APS Emulator (client)
- Protocol Selection window is prompted, select the following:
  - Protocol Standard - **APS**
  - Protocol Version - **None**
  - Node - **FXS**
  - Click **OK** to continue



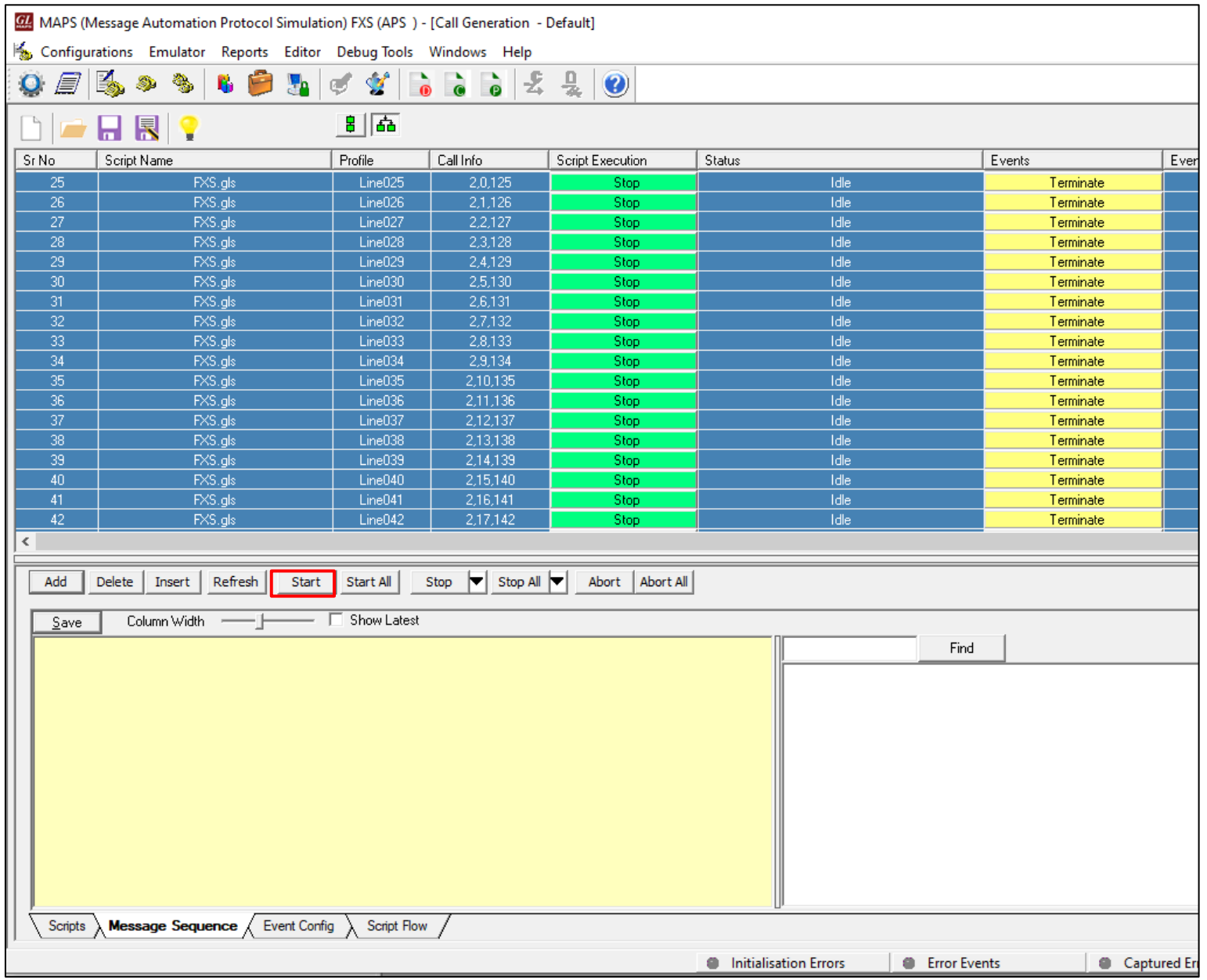
Configure Testbed in FXS

- By default, it will display Testbed Setup window
- Observe that default Testbed Setup is displayed. Verify the highlighted settings to get started with the testing
- Click on **Start** to start the Testbed setup



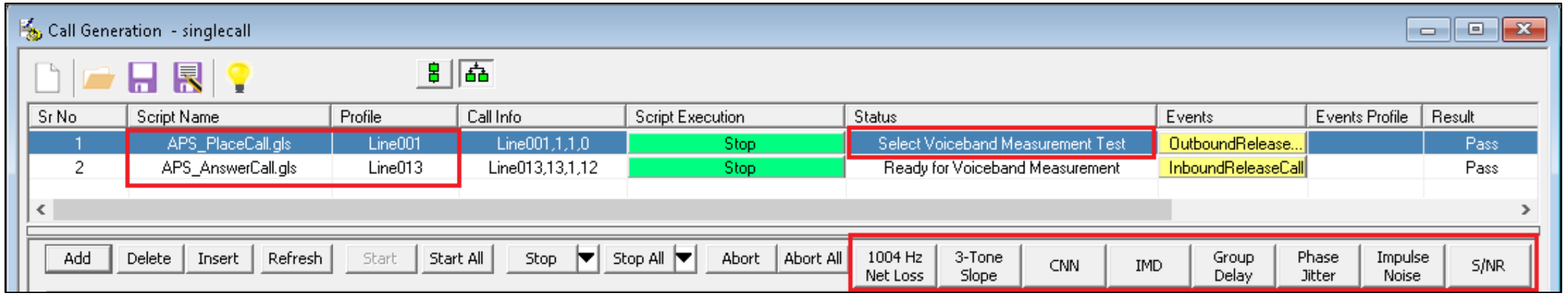
Configuring Call Generation Window in FXS

- On MAPS™ APS FXS, select **Emulator** → **Call Generation**. This will invoke Call Generation window
- Click on **Open** icon, select **Default**, and click **OK**. This will load the Default configuration
- Now, select **Line025** to **Line048** (These belong to **T1 Port 2**)
- Click on **Start** to start FXS lines



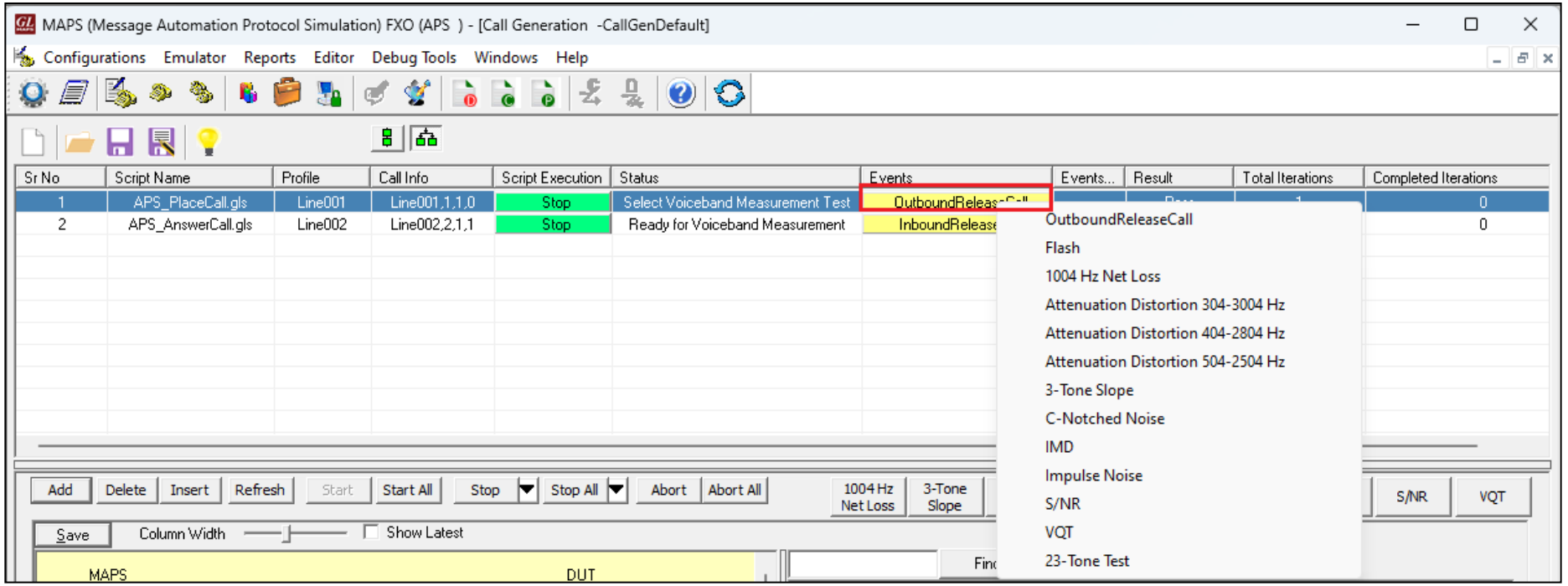
Procedure to Start Voiceband Measurement Tests in FXO

- On MAPS™ APS FXO GUI, select **Emulator** → **Call Generation**. This will invoke Call Generation window
- Click on **Open** icon, select **Default**, and click **OK**. This will load the Default configuration
- Now, select **Line001** and verify that it is loaded with **APS_PlaceCall.gls** script
- Similarly, **Line013** should be loaded with **APS_AnswerCall.gls** script
- Click on **Start** button to start both PlaceCall and AnswerCall script
- Observe that both the scripts are started (indicating Green color) and the PlaceCall status is displayed as “Select Voiceband Measurement Test”
- Now, user clicks on the required test button. For example, click on ‘3-Tone Slope’ button, to run the 3-Tone Slope test



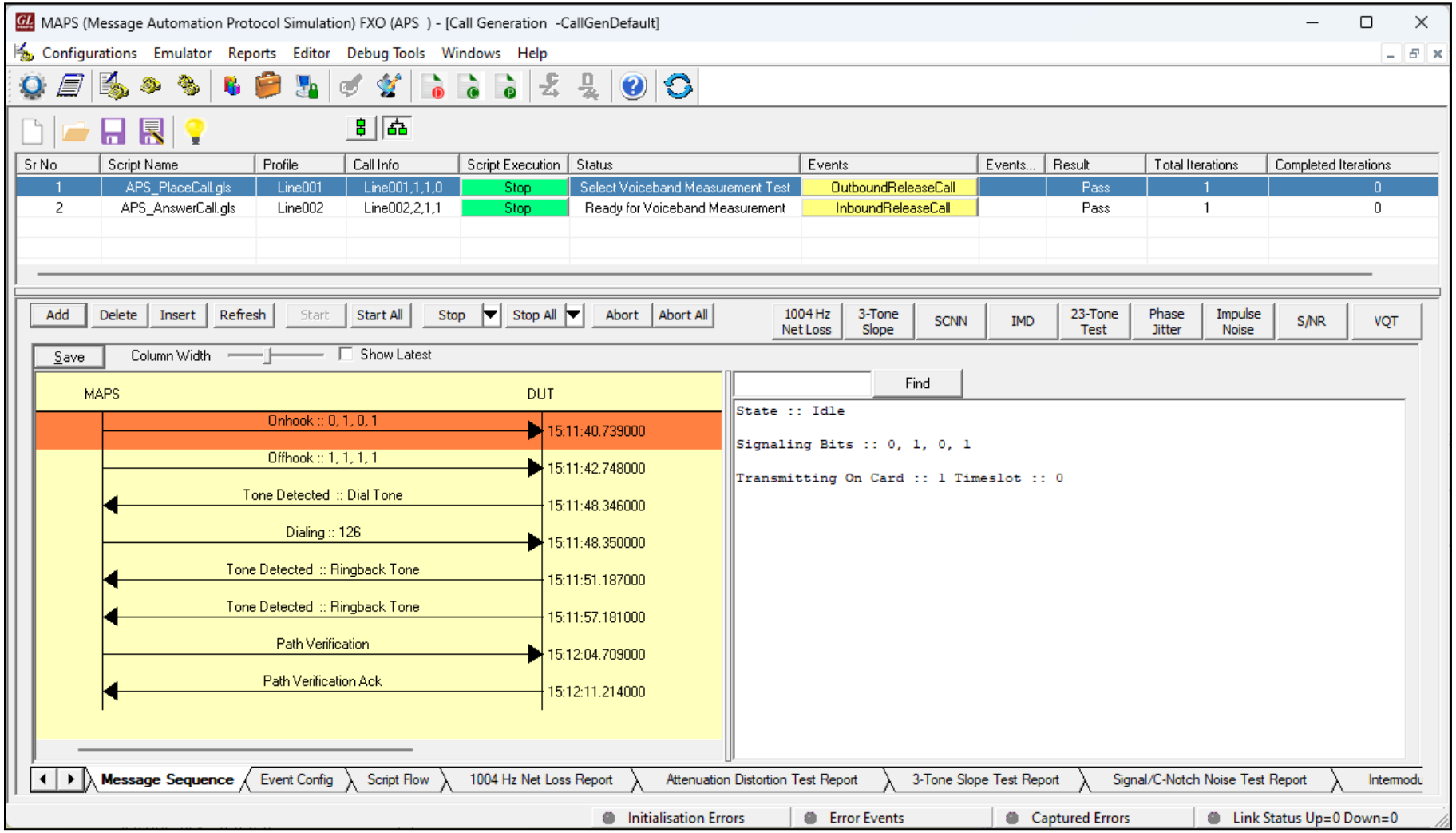
Procedure to Start Voiceband Measurement Tests in FXO (Contd.)

- On MAPS™ APS FXO GUI, select **Emulator** → **Call Generation**. This will invoke Call Generation window
- Click on **Open** icon, select **Default**, and click **OK**. This will load the Default configuration
- Now, select **Line001** and verify that it is loaded with **APS_PlaceCall.gls** script
- Similarly, **Line002** should be loaded with **APS_AnswerCall.gls** script
- Click on **Start** button to start both PlaceCall and AnswerCall script
- Observe that both the scripts are started (indicating Green color) and the PlaceCall status is displayed as “Select Voiceband Measurement Test”
- Now, under **Events** column, user can select the required test. For example, select ‘3-Tone Slope’ to run the 3-Tone Slope test



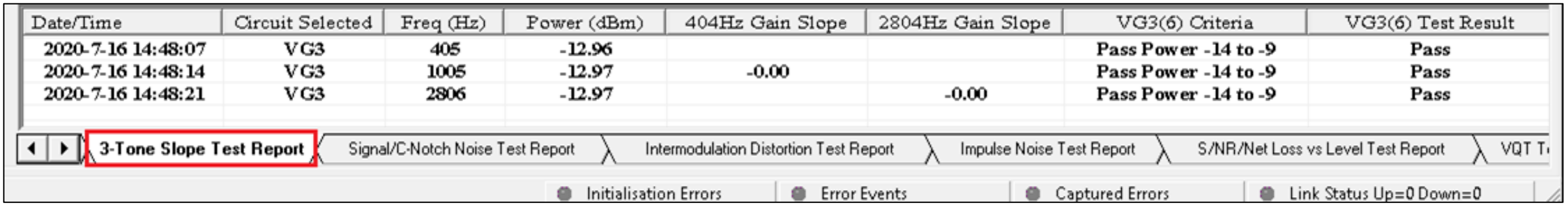
Procedure to Start Voiceband Measurement Tests in FXO (Contd.)

- The **APS_PlaceCall.gls** and **APS_AnswerCall.gls** will set up a call between **Line001** and **Line02**
- **APS_PlaceCall.gls** script has the options to perform various voiceband measurement tests
- Click on any of the voiceband measurement test buttons to start a test. Note that **APS_PlaceCall.gls** status indicates “Select Voiceband Measurement Test” and the **APS_AnswerCall.gls** status indicates “Ready for Voiceband Measurement”
- Voiceband Measurement tests can only be started from the **APS_PlaceCall.gls**



Test Results

- Test results are shown in the respective tabs as shown in the screenshot



Date/Time	Circuit Selected	Freq (Hz)	Power (dBm)	404Hz Gain Slope	2804Hz Gain Slope	VG3(6) Criteria	VG3(6) Test Result
2020-7-16 14:48:07	VG3	405	-12.96			Pass Power -14 to -9	Pass
2020-7-16 14:48:14	VG3	1005	-12.97	-0.00		Pass Power -14 to -9	Pass
2020-7-16 14:48:21	VG3	2806	-12.97		-0.00	Pass Power -14 to -9	Pass

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Voiceband Measurements

Voiceband Measurements

Voiceband measurement includes below tests:

- Signal-to-Noise Ratio and Level
- Three Tone Slope (Gain Slope)
- 23-Tone Test
- Signal-to-C-Notched Noise Test
- Attenuation Distortion
- 1004 Hz tone
- Intermodulation Distortion (IMD)
- Impulse Noise
- VQT

Synchronization Codes

- Frequencies are used by MAPS™ APS FXO scripts to synchronize the transmit and receive actions of each test

S/NR/Net Loss vs Level Synchronization Tones	
S/NR Sync	Send tone @ 853Hz to indicate the start of S/N test
S/NR Ack	Send tone @ 2351Hz to indicate the S/N measurement has been started
S/NR Ack Next Tone	Send tone @ 1004Hz to send next tone level for the S/N test
CNN Synchronization Tones	
CNN	Send Tone @ 1049Hz to indicate the start of CNN test
CNN Ack	Send tone @ 2351Hz to indicate 3-Tone Slope measurements has been started
3-Tone Synchronization Codes	
3-Tone Slope	Send tone @ 1153Hz to indicate the start of 3-Tone Slope test
3-Tone Slope Ack	Send tone @ 2351Hz to indicate 3-Tone Slope measurements has been started
Attenuation Synchronization Tones	
Attenuation Distortion Test (304Hz to 3004Hz)	Send tone @ 1249Hz to indicate the start of Attenuation Distortion test
Attenuation Distortion Test (404Hz to 2804Hz)	Send tone @ 1361Hz to indicate the start of Attenuation Distortion test
Attenuation Distortion Test (504Hz to 2504Hz)	Send tone @ 1549Hz to indicate the start of Attenuation Distortion test
Attenuation Distortion Test Ack	Send tone @ 2351Hz to indicate Attenuation Distortion measurements has been started

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Synchronization Codes (Contd.)

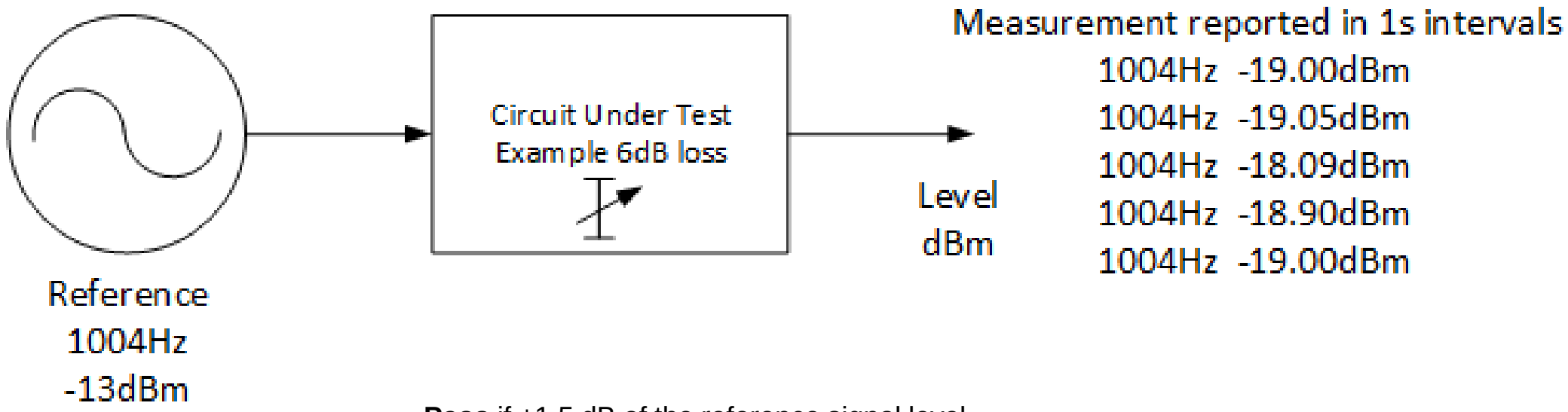
1004Hz Net Loss Synchronization Tones	
1004Hz Net Loss	Send Tone @ 1657Hz to indicate the start of 1004Hz tone test
1004Hz Net Loss Ack	Send tone @ 2351Hz to indicate 1004Hz tone measurements has been started
IMD Synchronization Tones	
IMD Sync	Send tone a2 1741Hz" to indicate start of IMD test
IMD Sync Ack	Send tone @ 2351Hz to acknowledge start of IMD test
Impulse Noise Synchronization Tones	
Impulse Noise Sync	Send tone @ 1867Hz to indicate the start of Impulse Noise test
Impulse Noise Ack	Send tone @ 2351Hz to indicate that Impulse test has been started
VQT Synchronization Tones	
VQT Sync	Send tone @ 751Hz to indicate the start of Voice Quality Testing
VQT Ack	Send tone @ 2351Hz to indicate that Voice Quality Testing has been started
23 - Tone Synchronization Tones	
23-Tone	Send tone @ 1781Hz to indicate the start of 23-Tone Test
23-Tone Ack	Send tone @ 2351Hz to indicate that 23-Tone has been started

Synchronization Codes (Contd.)

Common Synchronization Tones to end the Voice Measurement Test	
FIN	Send tone @1949 to indicate the end of the current voice measurement test
FIN Ack	Send tone @ 2351Hz to acknowledge the end of current voice measurement test
Common Synchronization Tones to complete the Voice Measurement Test	
Complete	Send tone @2251 to indicate the complete of the transmission from source to destination or destination to source
Common Synchronization Tones to Continue the Voice Measurement Test	
Continue	Send tone @2153 to indicate the continuation of next tone from source to destination or destination to source

1004 Hz Tone Test

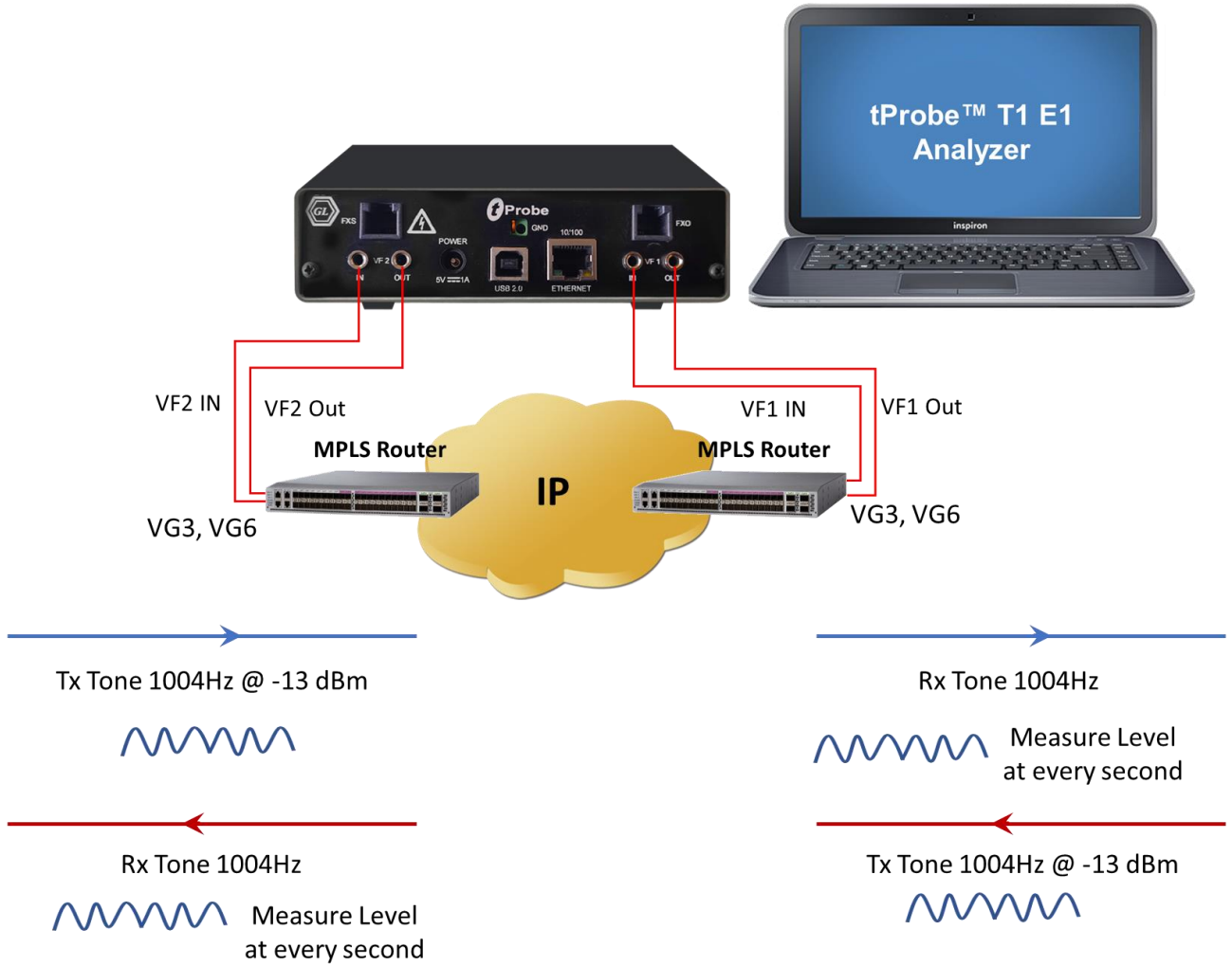
1004 Hz Tone Test



Pass if ±1.5 dB of the reference signal level.

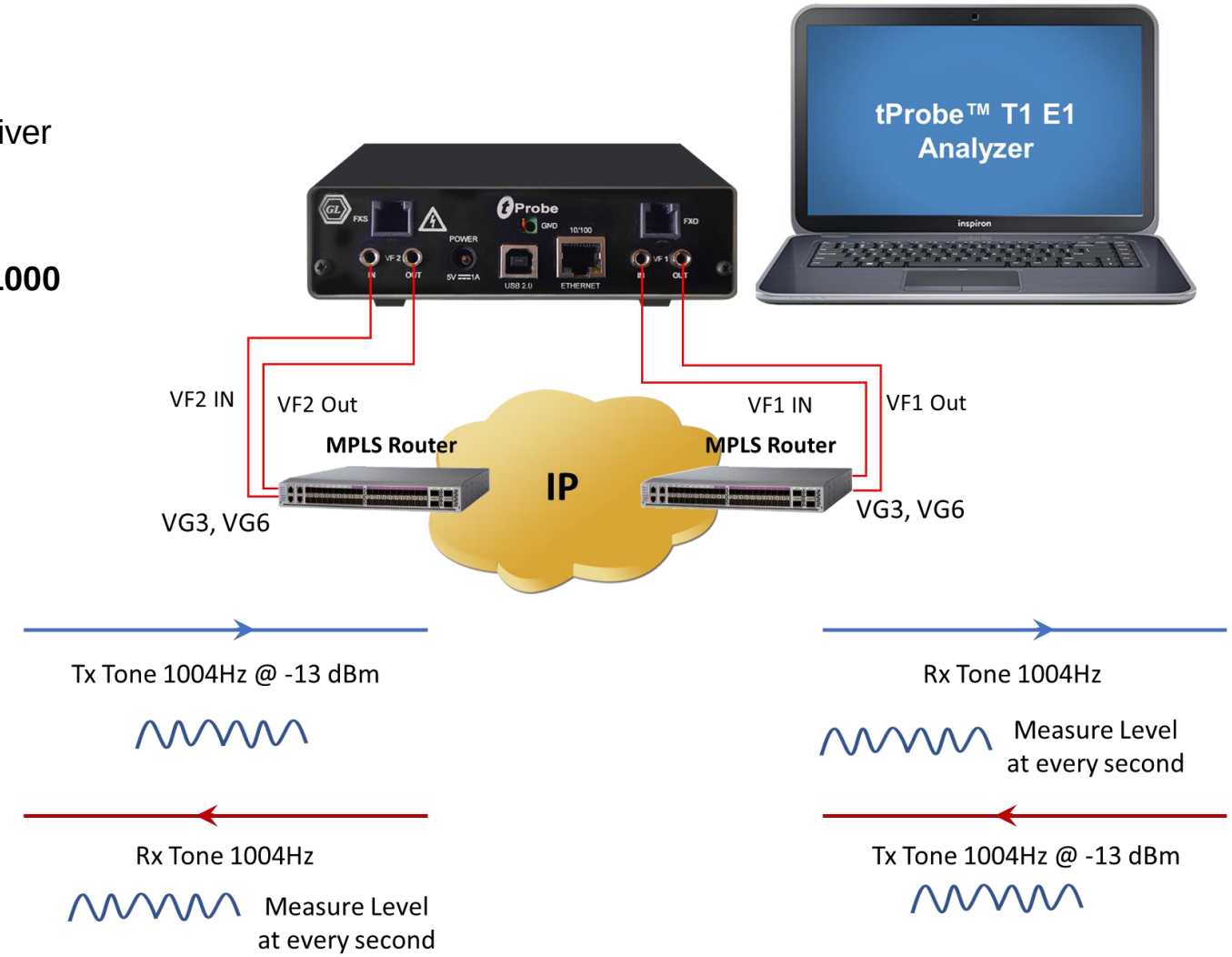
1004 Hz Tone Test

- This test is used to test 1004 Hz net loss and periodically report received tone level of a continuous 1004 Hz tone
- This is a measure of the change in net loss as the frequency of a signal on the line varies across the Voice Frequency (VF) bandwidth
- Tone (1004 Hz,-13 dBm) is sent and monitored at the receiver side. Below are the WCS commands to send and receive tones
  - **monitor freq window 500 msec # 2 : 5 report 1000 msec;**
  - **tx tone(1004,-13.000000) #1:1 10000 msec;**



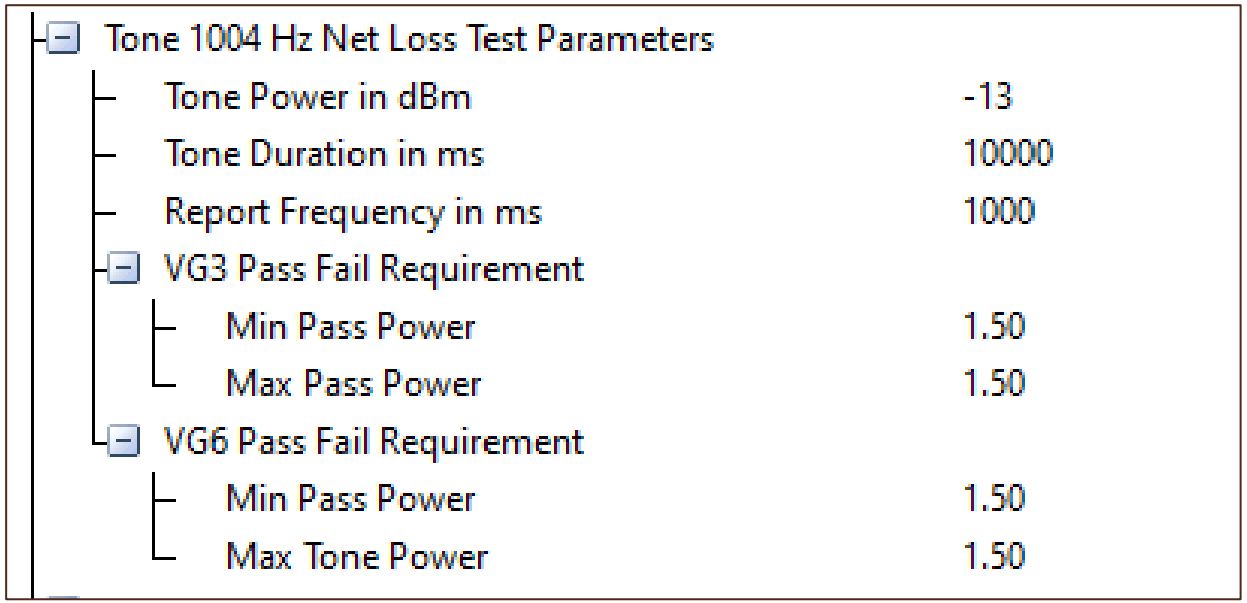
WCS Commands and Tasks used for 1004 Hz Tone Test

- Tone (1004 Hz,-13 dBm) is sent and monitored at the receiver side
- Below are the WCS commands to receive and send tones
  - **monitor freq window 500 msec # 2 : 5 report 1000 msec ;**
  - **tx tone(1004,-13.000000) #1:1 10000 msec;**



1004 Hz Net Loss Test Configuration

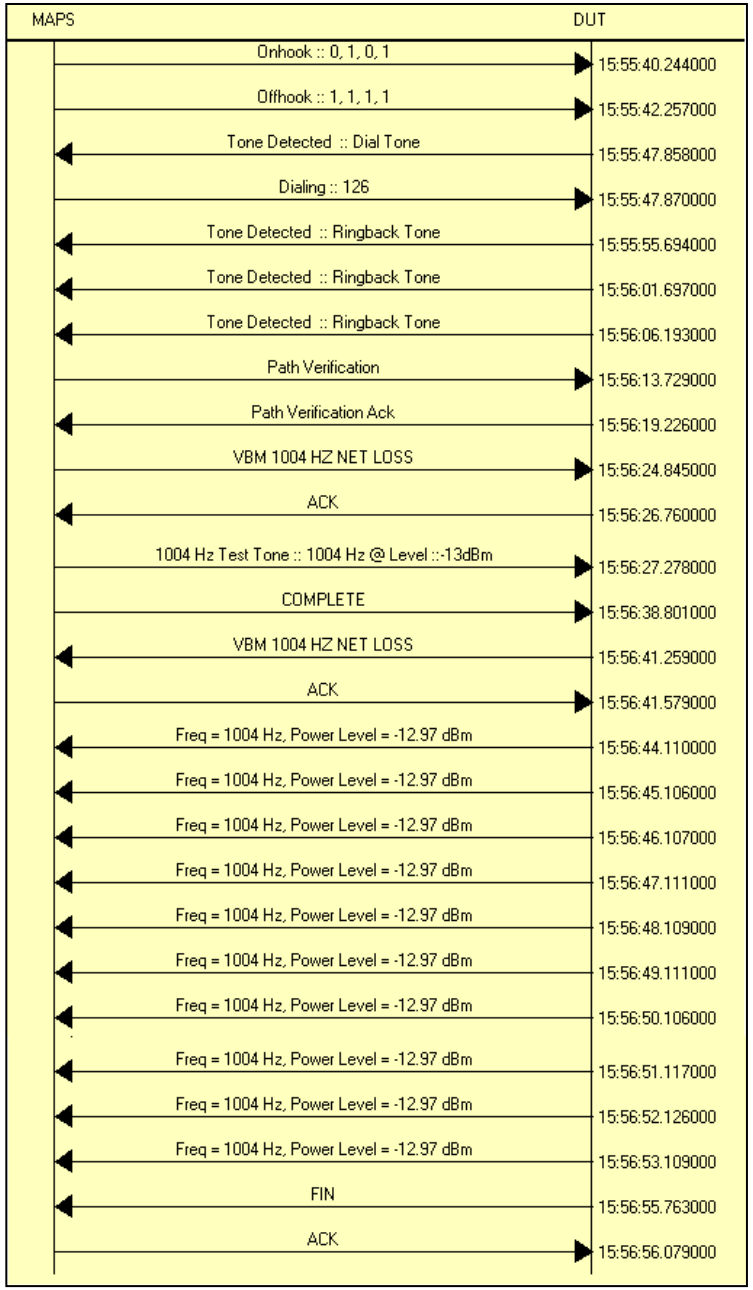
- The following parameters can be configured in the **Global profile** for 1004 Hz Net Loss Test:
  - Tone Power in dBm
  - Tone Duration in ms
  - Report Frequency in ms
- VG3 Pass Fail Requirement
  - Min Pass Power in dBm
  - Max Pass Power in dBm
- VG6 Pass Fail Requirement
  - Min Pass Power
  - Max Pass Power e.g. Pass criteria for -13 dBm Tone Power is -14.5 to -11.5 dBm



GL Communications

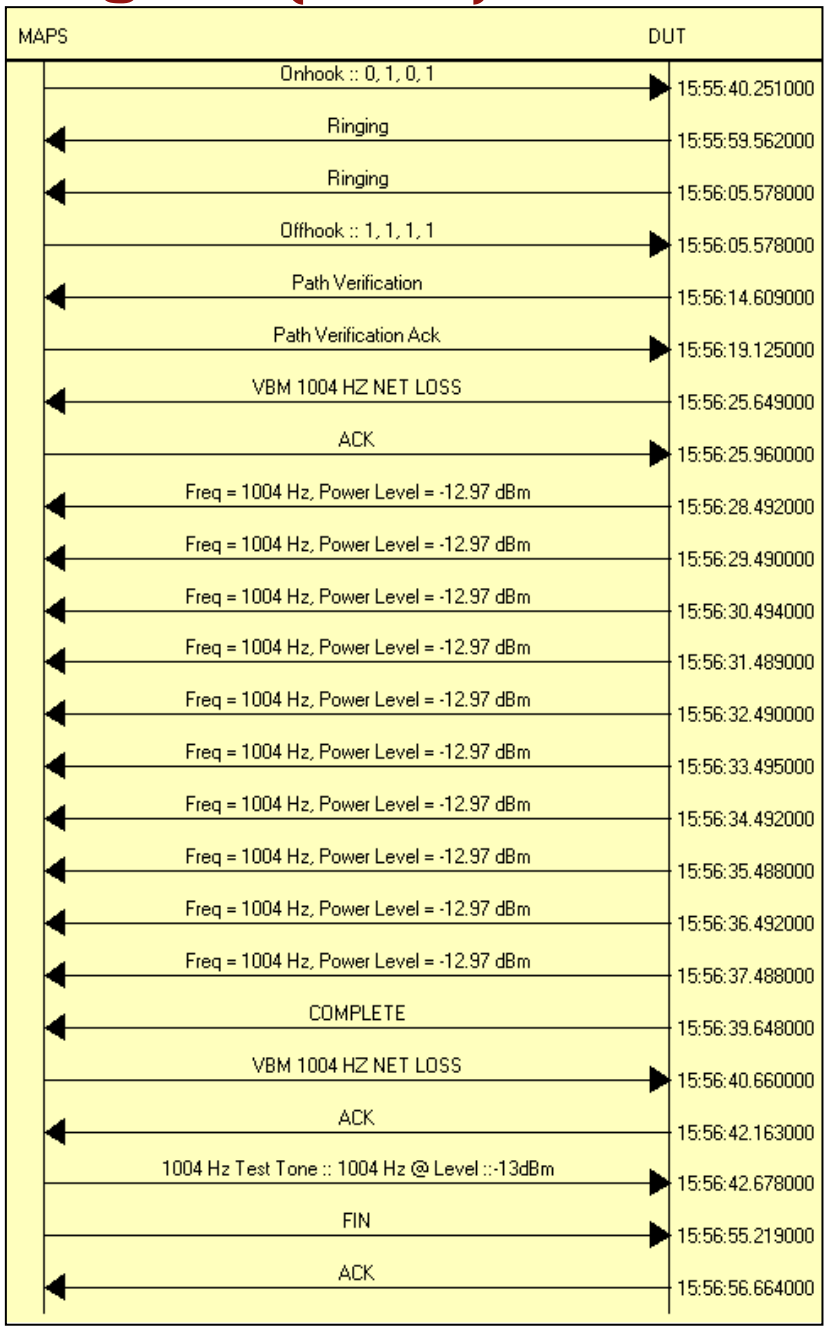
VF_Originating.gls Ladder Diagram (Master)

- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under **Events** column, right-click on the select **1004Hz Tone Test** then **VBM 1004HZ NET LOSS** request tone (**Frequency:1657Hz, Power: -13dBm and Duration:300ms**) is sent
- After receiving the **ACK** (**Frequency:2351Hz, Power: -13dBm and Duration:300ms**) PlaceCall side sends the **1004HZ** test tone
- Finally, a **FIN** (**Frequency:1949Hz, Power: -13dBm and Duration:300ms**) is received to end the test and subsequently an **ACK** is sent to indicate that call will be terminated



VF_Terminating.gls Call Ladder Diagram (Slave)

- Initially both sides are On-Hook
- An incoming call is detected, When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack Answercall side receives **VBM 1004HZ NET LOSS** request tone (**Frequency: 1657Hz, Power: -13dBm and Duration: 300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration: 300ms**)
- Then AnswerCall side measures the **1004HZ** test tone and keeps the result in the **1004Hz Tone Test Report** tab
- After receiving **COMPLETE** (**Frequency: 2251Hz, Power: -13dBm and Duration: 300ms**) tone, AnswerCall side sends **VBM 1004HZ NET LOSS r**equest tone and receives the **ACK**
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration: 300ms**), and subsequently sending **ACK**



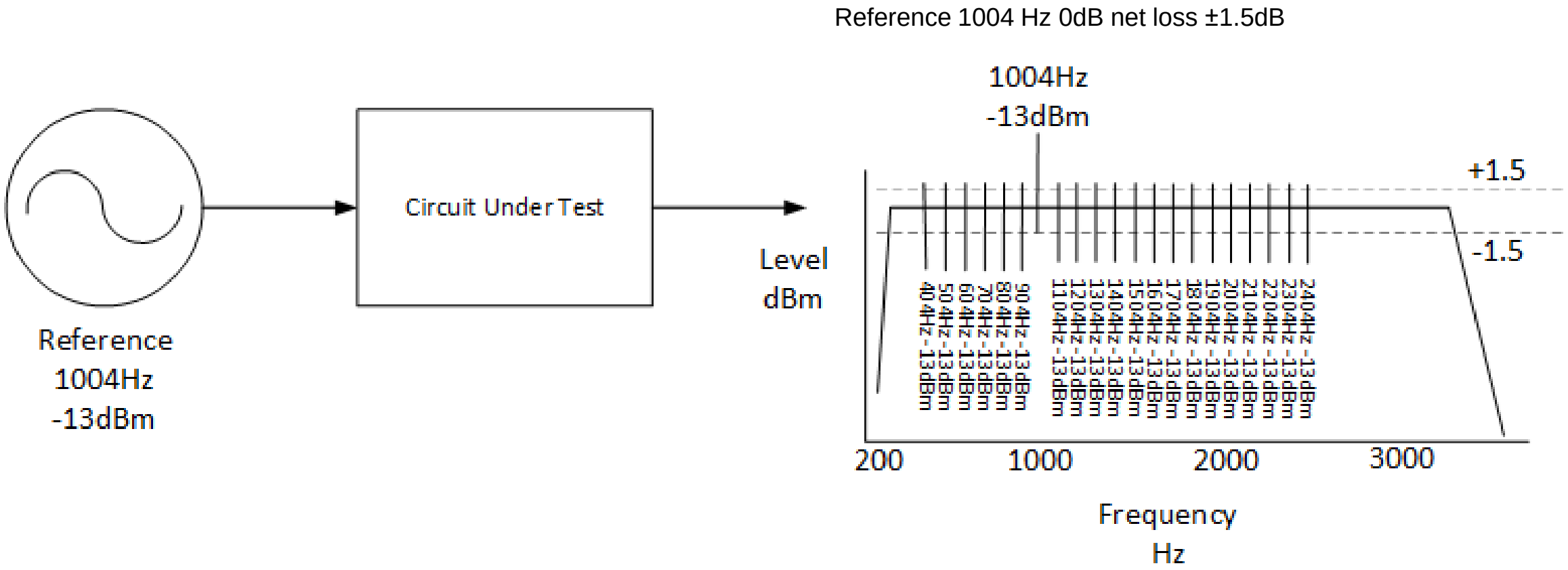
1004 Hz Net Loss Test Results

- 1004 Hz measurement results are logged in the “1004 Hz Tone Test Report” tab for the current test. Results include the received frequency and power level

Date/Time	Circuit Selected	Freq (Hz)	Power (dBm)	VG3(6) Criteria	VG3(6) Test Result
2020-7-21 14:14:04	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:05	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:06	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:07	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:08	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:09	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:10	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:11	VG6	1004	-12.98	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:12	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:14:13	VG6	1004	-12.97	Pass Power -14.5 to -11.5 dBm	Pass

Attenuation Distortion Test

Attenuation Distortion

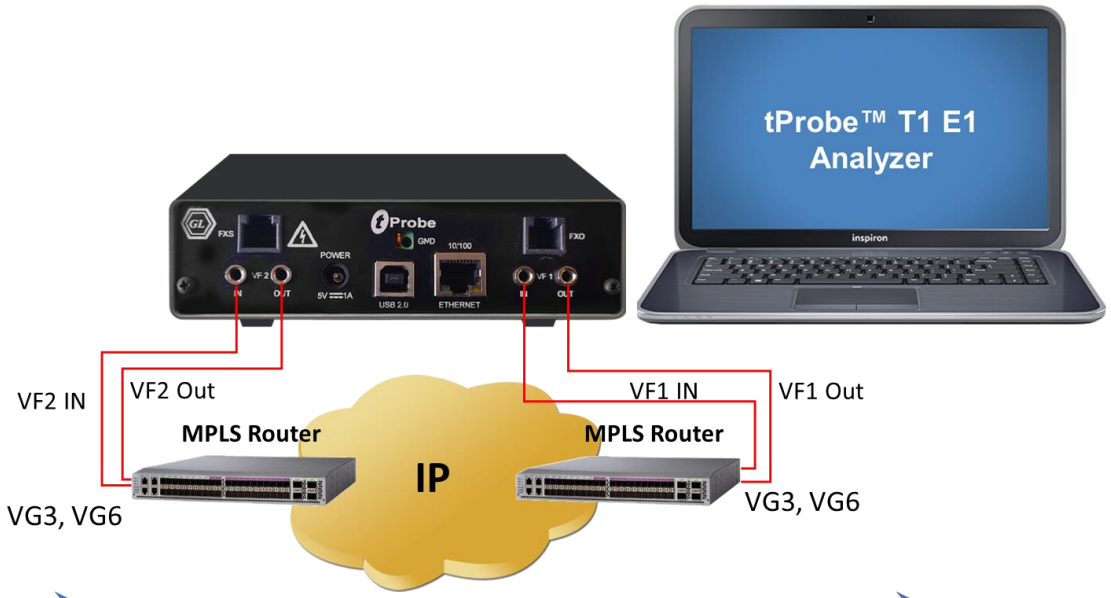


Pass if all points from 404 - 2804 Hz are between -1dB to +4dB of Reference level

GL Communications

Attenuation Distortion Test

- This is a measure of the change in net loss as the frequency of a signal on the line varies across the Voice Frequency (VF) bandwidth
- Reference tone is sent with (1004 Hz, -13 db) and level is monitored at receiver side. This will be the reference level to calculate net loss with the received level with the different frequencies



Tx Tone (Reference)
1004Hz, -13dBm

Rx Tone : 1004Hz
Measure level : (Reference Level)

Tx Tone 304Hz, -13dBm
Tx Tone 404Hz -13dBm
Tx Tone 504Hz -13dBm

Rx Tone and Measure Levels
Calculate Net Loss

Rx Tone : 1004Hz
Measure level : (Reference Level)

Rx Tone and Measure Levels
Calculate Net Loss

Rx Tone (Reference)
1004Hz, -13dBm

Rx Tone 304Hz, -13dBm
Rx Tone 404Hz -13dBm
Rx Tone 504Hz -13dBm

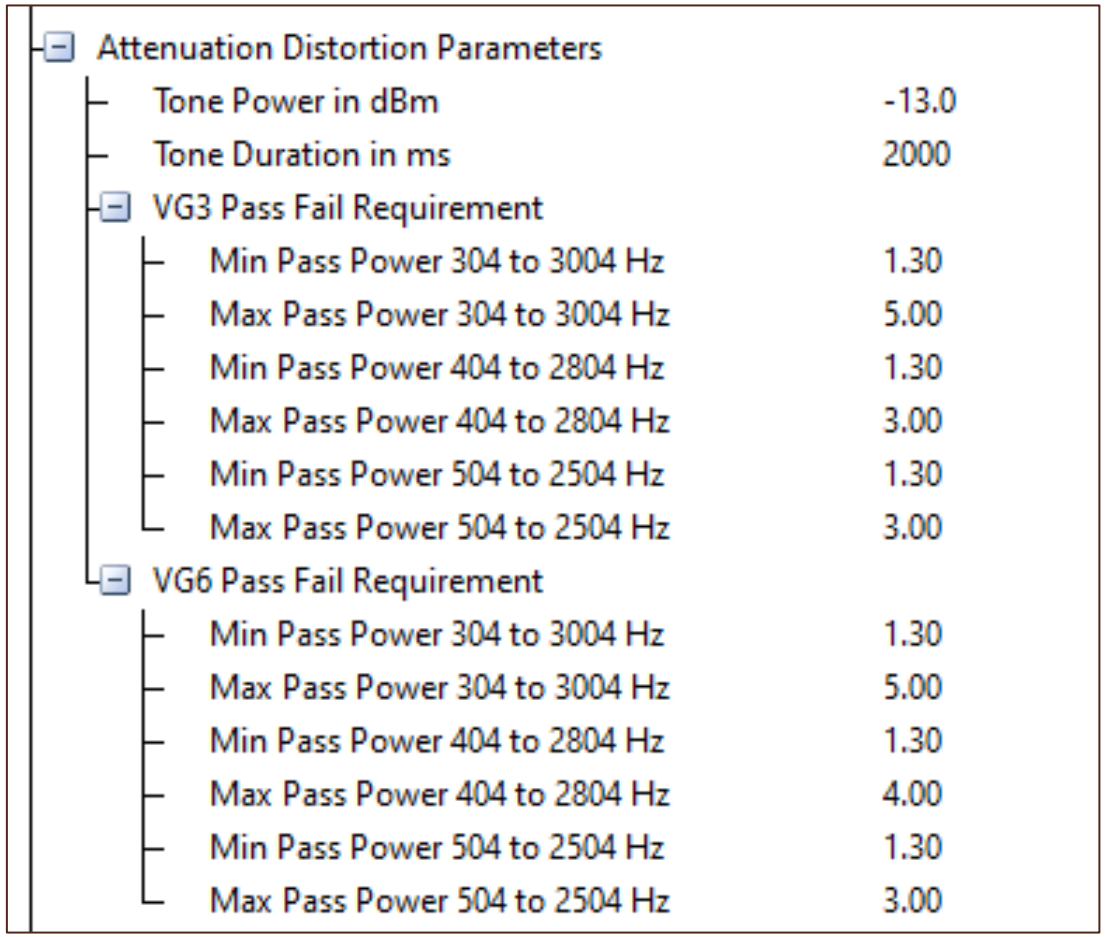
GL Communications

WCS Commands and Tasks used for Attenuation Distortion Test

- WCS Commands to monitor and transmit reference tone
  - **monitor tones ("MAPS\APS\VF\MTD Files/AttenuationDistortion.mtd") # 2 : 5 ;**
  - **tx tone(1004,-13.000000) #1:1 2000 msec;**
- Tone is sent with the different frequencies but with the same level and the net loss is calculated
- Commands to send tones with the difference of 100 Hz
  - **tx tone(304,-13.000000) #1:1 2000 msec;**
  - **tx tone(404,-13.000000) #1:1 2000 msec;**
  - **tx tone(504,-13.000000) #1:1 2000 msec;**

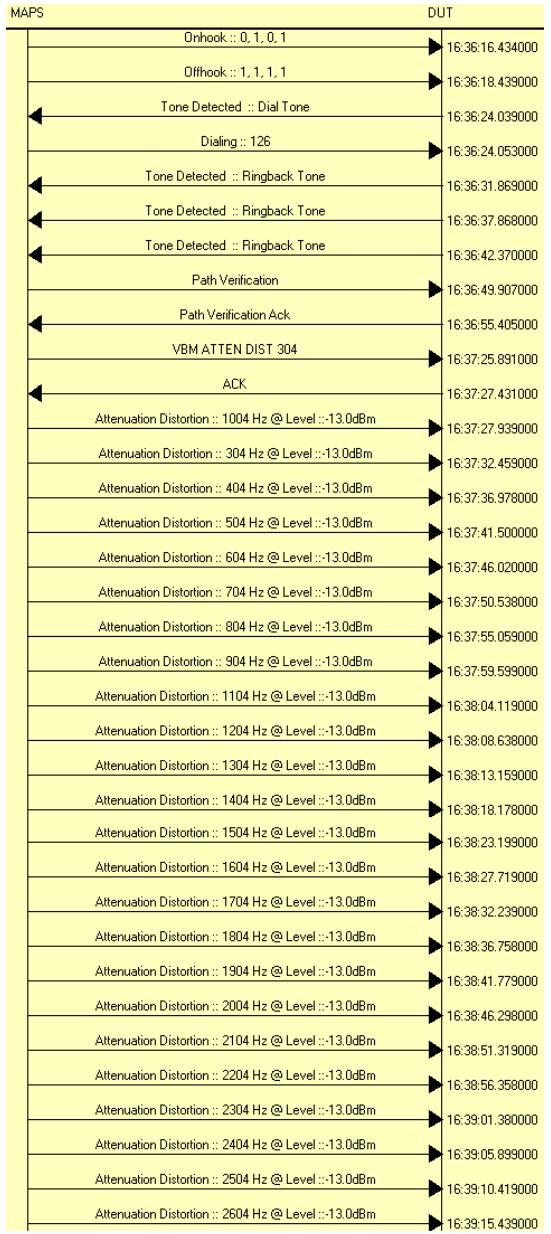
Attenuation Distortion Test Configuration

- The following parameters can be configured in the **Global profile** for Attenuation Distortion Test:
  - Tone Power in dBm
  - Tone Duration in ms
- VG3 Pass Fail Requirement
  - Min Pass Power
  - Max Pass Power
- VG6 Pass Fail Requirement
  - Min Pass Power
  - Max Pass Power e.g. For Frequency range 304 to 3004 Hz
  - If send level is 1004 Hz, -13 dBm and received level is -13.24 dBm (reference level)
  - For: (Min 1.3, Max 5 dBm), the pass criteria is -14.54 to -8.24 dBm



VF_Originating.gls Ladder Diagram (Master)

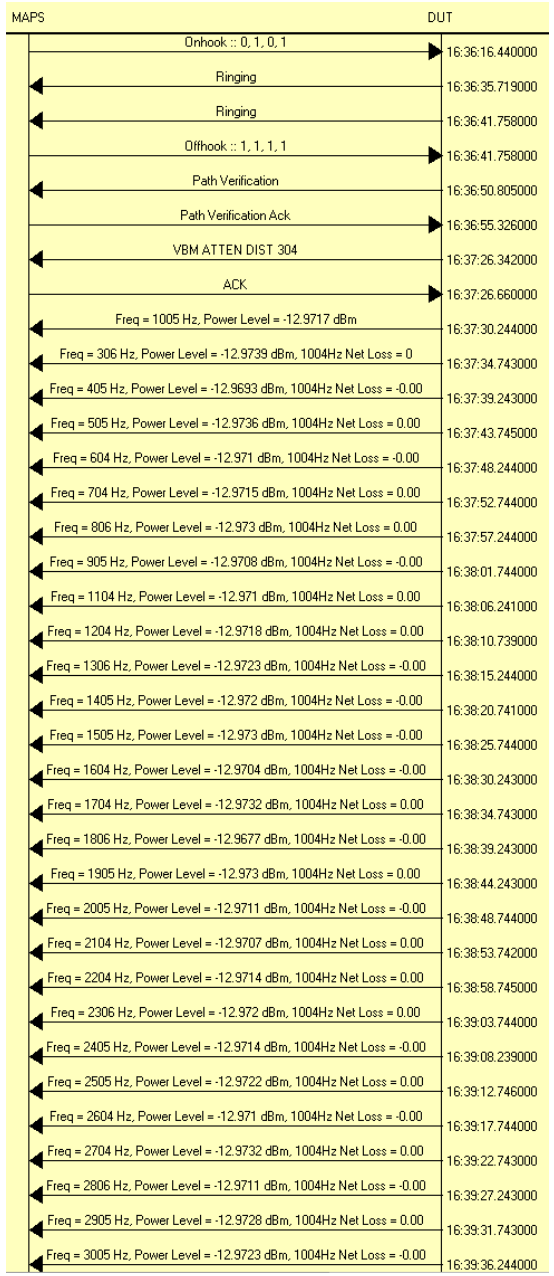
- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed and ring back tone is received
- Connection is established and **Path Verification** is done
- Waiting for user input. Under **Events** column, right-click and select the **Attenuation Distortion Test** (i.e. 304 – 3004Hz, 404 – 2804Hz, or 504 – 2504Hz) then **VBM ATTEN DIST 304 request** tone (**Frequency: 1249Hz, Power: -13dBm and Duration: 300ms**) is sent
- After receiving **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration: 300ms**), PlaceCall sends the **Attenuation Distortion** test tones
- After receiving **COMPLETE** (**Frequency: 2251Hz,Power: -13dBm and Duration: 300ms**) tone, AnswerCall side will send **VBM ATTEN DIST 304** request tone and receives the ACK
- After receiving the **ACK**, Answercall sends the Attenuation Distortion test tones
- Finally, a **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration: 300ms**) is received to end the test and subsequently an **ACK** is sent to indicate that call will be terminate

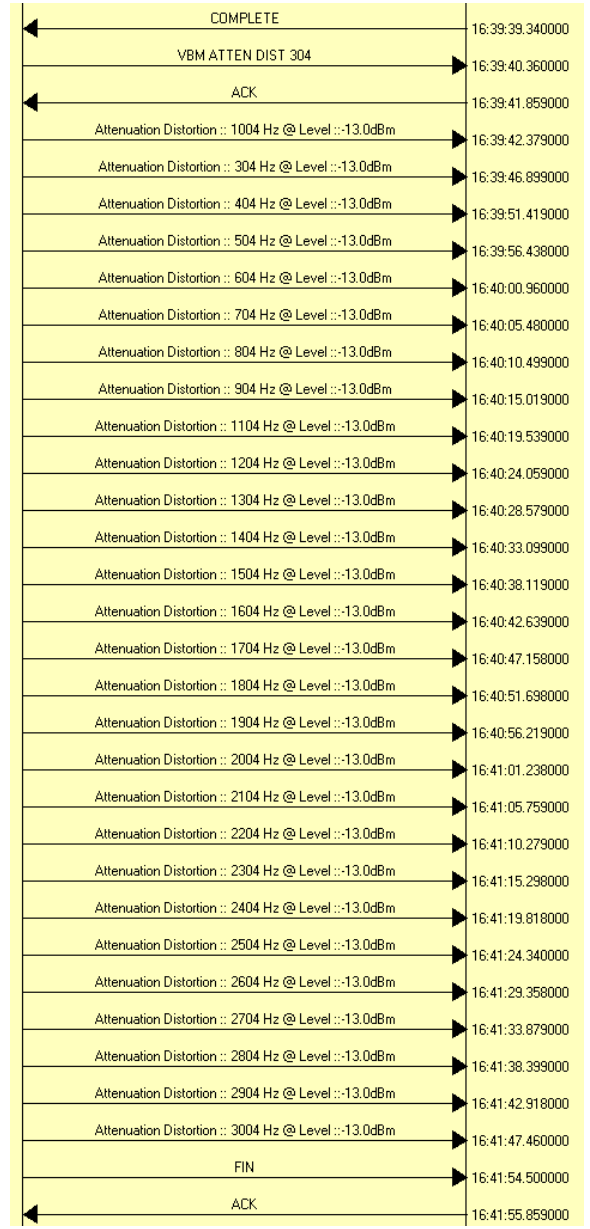


GL Communications

VF_Terminating.gls Ladder Diagram (Slave)

- Initially both sides are On-Hook
- An incoming call is detected. When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack, Answercall side receives **VBM ATTEN DIST 304** request tone (**Frequency:1249Hz, Power: -13 dBm and Duration:300ms**) and acknowledged by sending **ACK**(**Frequency: 2351Hz, Power: -13dBm and Duration:300ms**)
- Then AnswerCall side measures the received Attenuation Distortion tones and keep the result in the **Attenuation Distortion Test Report** tab
- After receiving **COMPLETE** (**Frequency:2251Hz, Power: -13dBm and Duration:300ms**) tone, AnswerCall side will send **VBM ATTEN DIST 304** request tone and receives the ACK
- Now Answercall side sends the **Attenuation Distortion** test tones.
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration:300ms**), and subsequently sending an **ACK**





Attenuation Distortion Results

- Attenuation Distortion measurement results are logged in the “Attenuation Distortion Test Report” tab for the current test. Results include the received frequency, power level, and 1004 Hz Net Loss

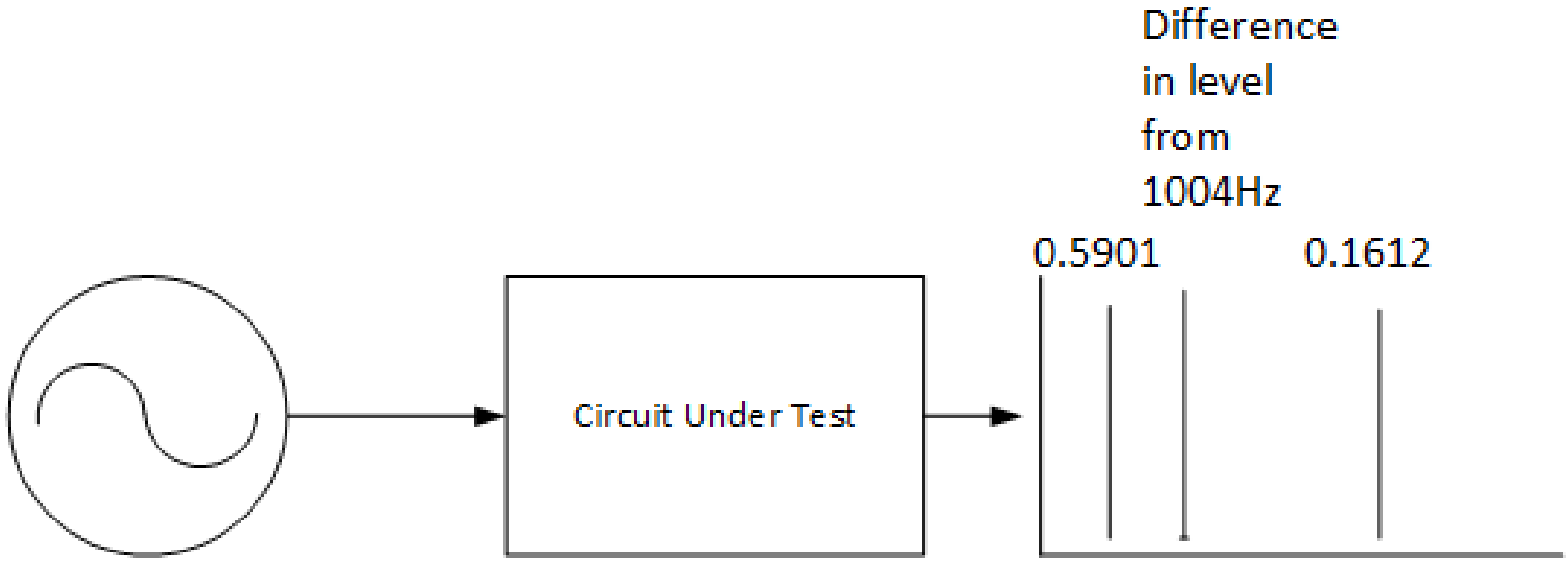
Date/Time	Circuit Selected	Freq Range	Freq (Hz)	Power (dBm)	1004Hz Net Loss	VG3(6) Criteria	VG3(6) Test Result
2020-7-21 14:16:46	VG6	304-3004	1005	-12.97	0.0237999	Pass Power -14.5 to -11.5 dBm	Pass
2020-7-21 14:16:51	VG6	304-3004	306	-13.79	-0.81	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:16:55	VG6	304-3004	405	-13.49	-0.52	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:00	VG6	304-3004	505	-13.33	-0.36	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:04	VG6	304-3004	604	-13.20	-0.22	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:09	VG6	304-3004	704	-13.12	-0.15	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:14	VG6	304-3004	806	-13.04	-0.06	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:18	VG6	304-3004	905	-12.98	-0.00	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:23	VG6	304-3004	1104	-12.94	0.02	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:27	VG6	304-3004	1204	-12.90	0.06	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:32	VG6	304-3004	1306	-12.89	0.08	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:36	VG6	304-3004	1405	-12.87	0.09	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:41	VG6	304-3004	1505	-12.87	0.10	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:46	VG6	304-3004	1604	-12.85	0.12	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:51	VG6	304-3004	1704	-12.85	0.11	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:17:55	VG6	304-3004	1806	-12.83	0.13	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:18:00	VG6	304-3004	1905	-12.82	0.15	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:18:04	VG6	304-3004	2005	-12.82	0.14	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:18:09	VG6	304-3004	2104	-12.82	0.15	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:18:14	VG6	304-3004	2204	-12.82	0.15	Pass Power -14.27 to -7.97 dBm	Pass
2020-7-21 14:18:18	VG6	304-3004	2306	-12.82	0.14	Pass Power -14.27 to -7.97 dBm	Pass

Attenuation Distortion Test Report | 3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | Impulse Noise Test Report | S/NR/Net Loss vs Level Test Report

GL Communications

Three Tone Slope (Gain Slope) Test

Three Tone Slope (Gain Slope) Test



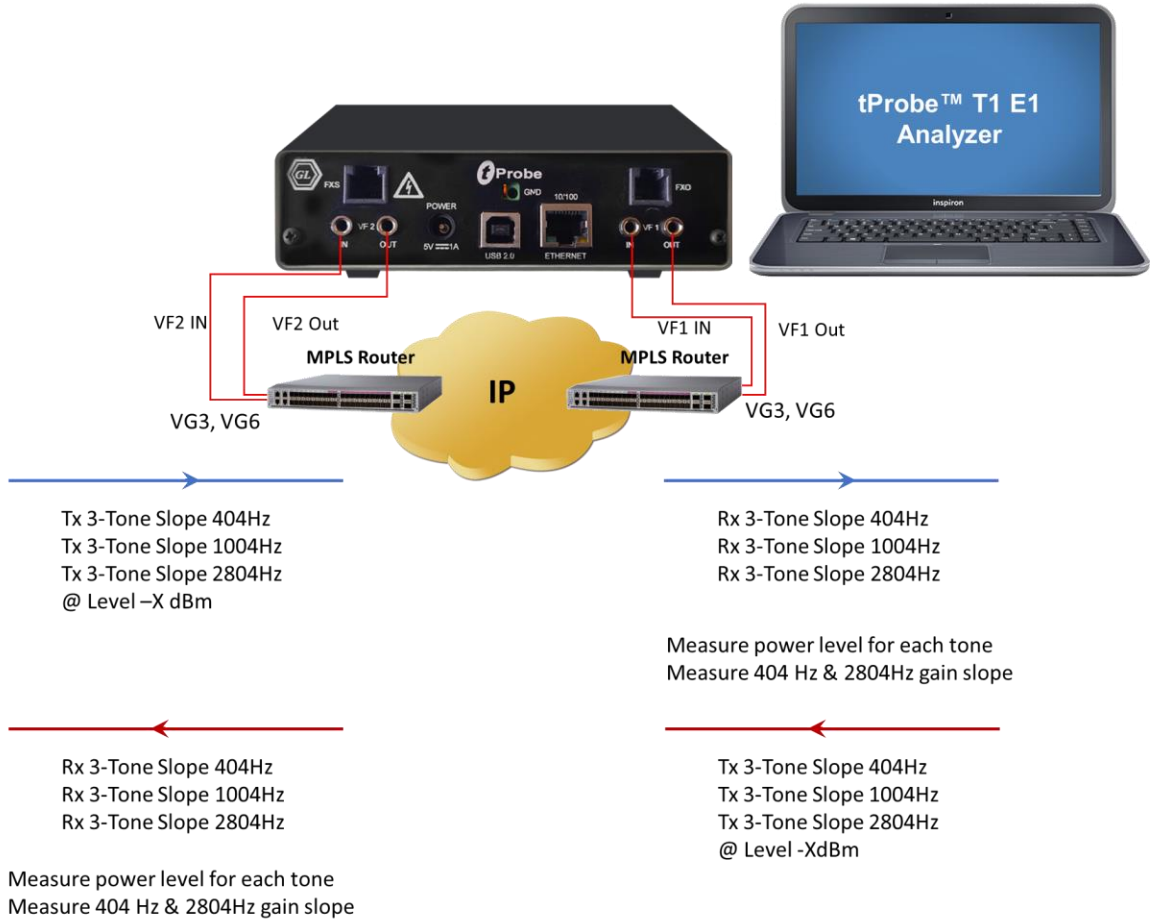
Reference 1004 Hz -13 dB ±1.5dB
404 - 2804 Hz Reference -1dB +4 dB

Three Tone Slope (Gain Slope)

- The measurement of loss or received level vs. frequency while the transmitted level is held constant is referred to as frequency response or attenuation distortion. The specific term gain-slope refers to the measurement of received level at 404 Hz, 1004 Hz, and 2804 Hz and calculation of the difference between levels at 404 Hz and 1004 Hz for 404 Hz gain-slope and the difference between levels at 2804 Hz and 1004 Hz for 2804 Hz gain-slope. Conventionally, + means more loss and - means less loss than the 1004 Hz value. The nominal 4 Hz offset prevents beating problems in level measurements on PCM systems as a result of the test frequencies being small submultiples of the 8 kHz sampling rate

- IEEE Standard Equipment Requirements and Measurement Techniques for Analog Transmission Parameters for Telecommunications, IEEE Std 743-1995

  - **Level(1004) - Level(404) = “404Hz” Gain Slope**
  - **Level(1004) - Level(2804) = “2804Hz” Gain Slope**



WCS Commands and Tasks used for Three Tone Slope Measurements

To send 404, 1004 and 2804 Hz tone, MAPS™ APS uses the WCS “Tx Tone” command:

tx tone (<Freq> , <Power Level>) # <Card No> : <Timeslot> <Duration> msec ;

MAPS™ APS sends the below commands to WCS server:

tx tone(404,-13.000000) #1:1 3000 msec;

tx tone(1004,-13.000000) #1:1 3000 msec;

tx tone(2804,-13.000000) #1:1 3000 msec;

To measure power level, MAPS™ APS uses the WCS “Monitor Tone” commands. Responses given by WCS Server are presented to in Message Sequence and the **Three Tone Slope Report Tab** in the Call Generation window

monitor tones ("<MTD File Name>") # <Card No> : <Timeslot> ;

Measure “404 Hz” Gain Slope and “2804 Hz” Gain Slope using below formulas:

404Hz Gain Slope = Level(1004) - Level(404)

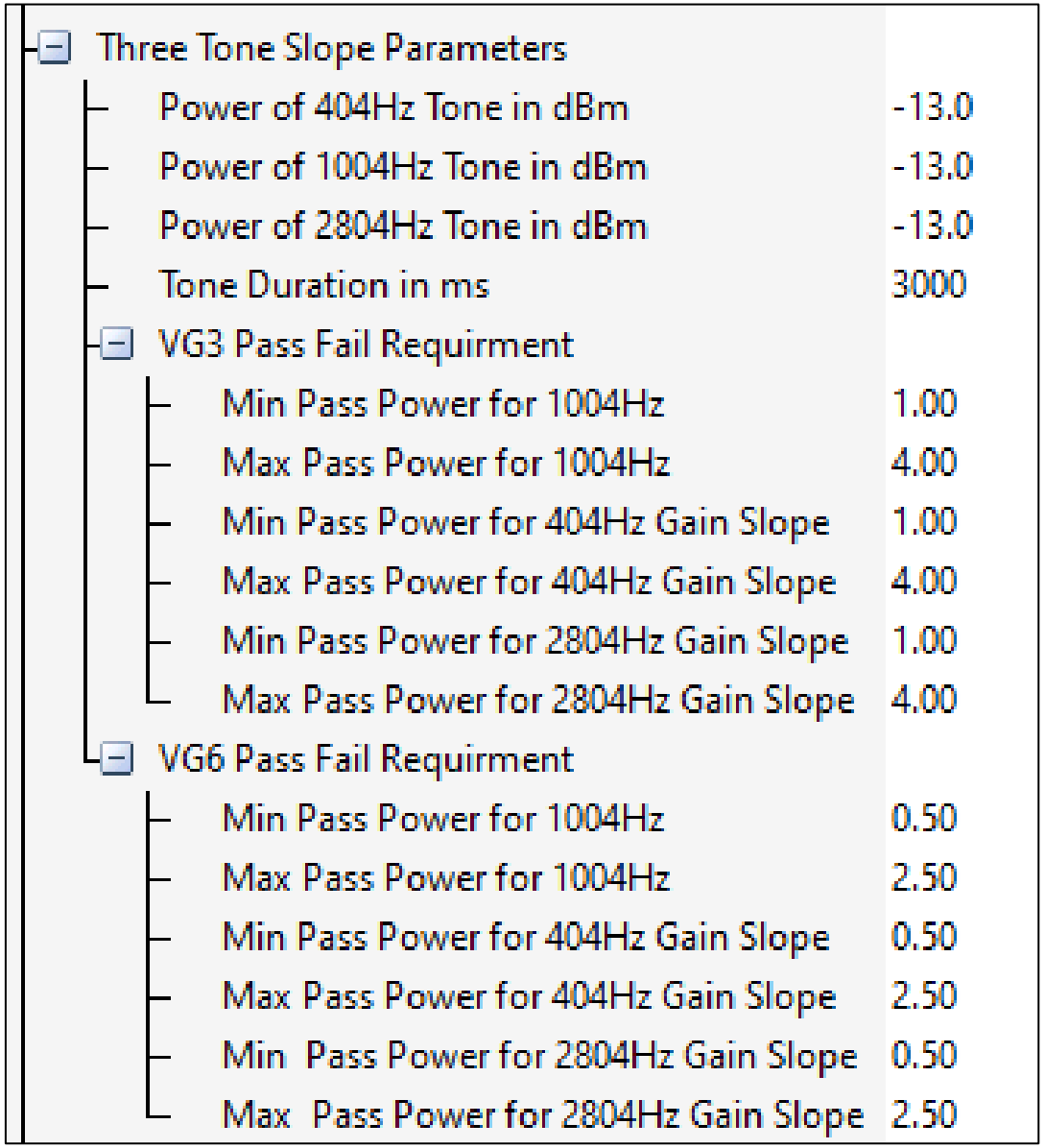
2804Hz Gain Slope = Level(1004) - Level(2804)

MAPS™ APS sends the below command to WCS server:

monitor tones ("MAPS\APS\VF\MTD Files/3ToneSlope.mtd") # 2 : 5;

Three Tone Slope Test Configuration

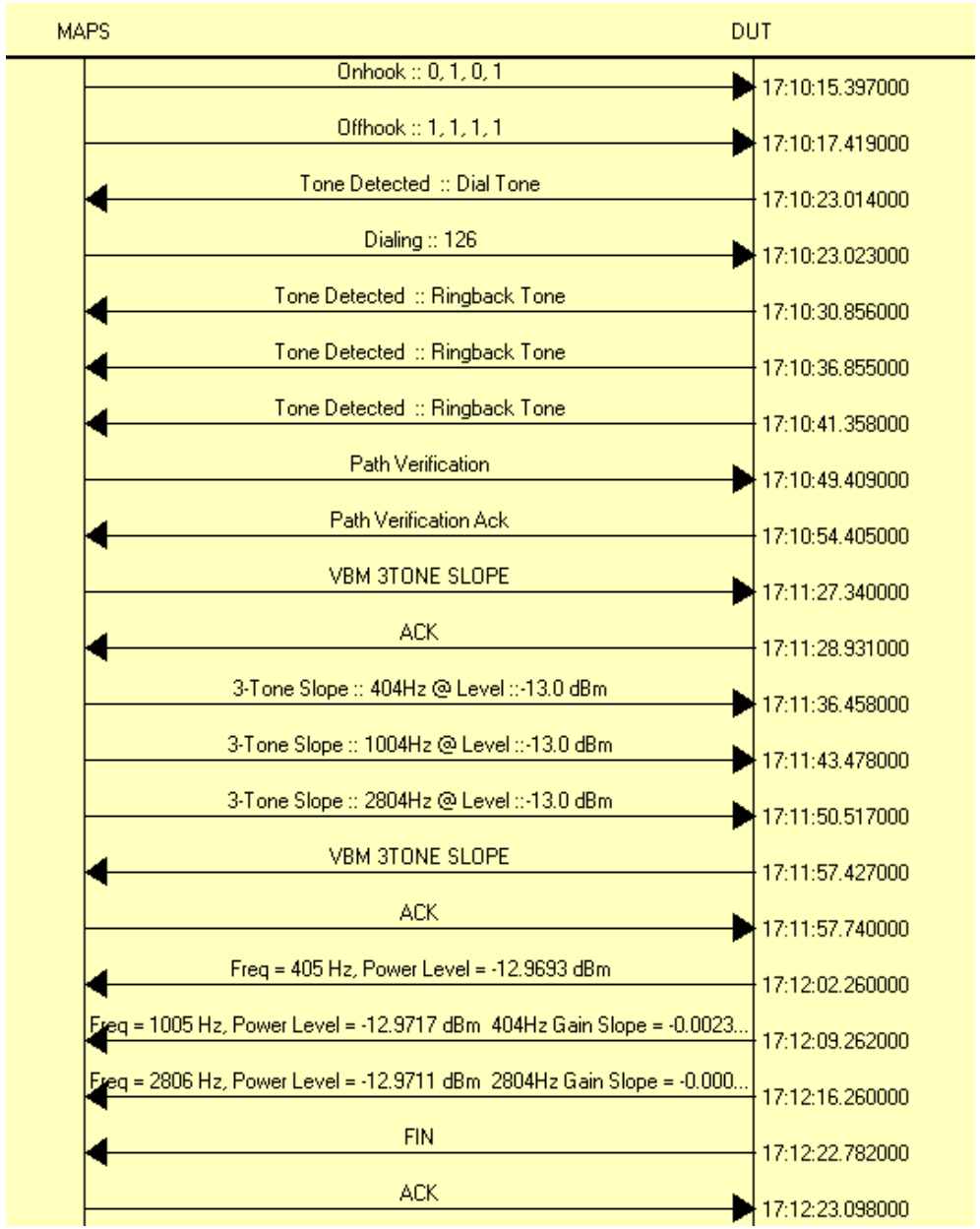
- The following parameters can be configured in the **Global profile** for Three Tone Slope test:
  - Power of three tones in dBm
  - Tone Duration in ms
- VG3 Pass Fail Requirement
  - Max Pass Power of three tones
  - Min Pass Power of three tones e.g. the pass criteria for -13 dBm is -14 to -9 dBm
- VG6 Pass Fail Requirement
  - Min Pass Power
  - Max Pass Power e.g. the pass criteria for -13 dBm is -13.5 to -10.5 dBm



GL Communications

VF_Originating.gls Ladder Diagram (Master)

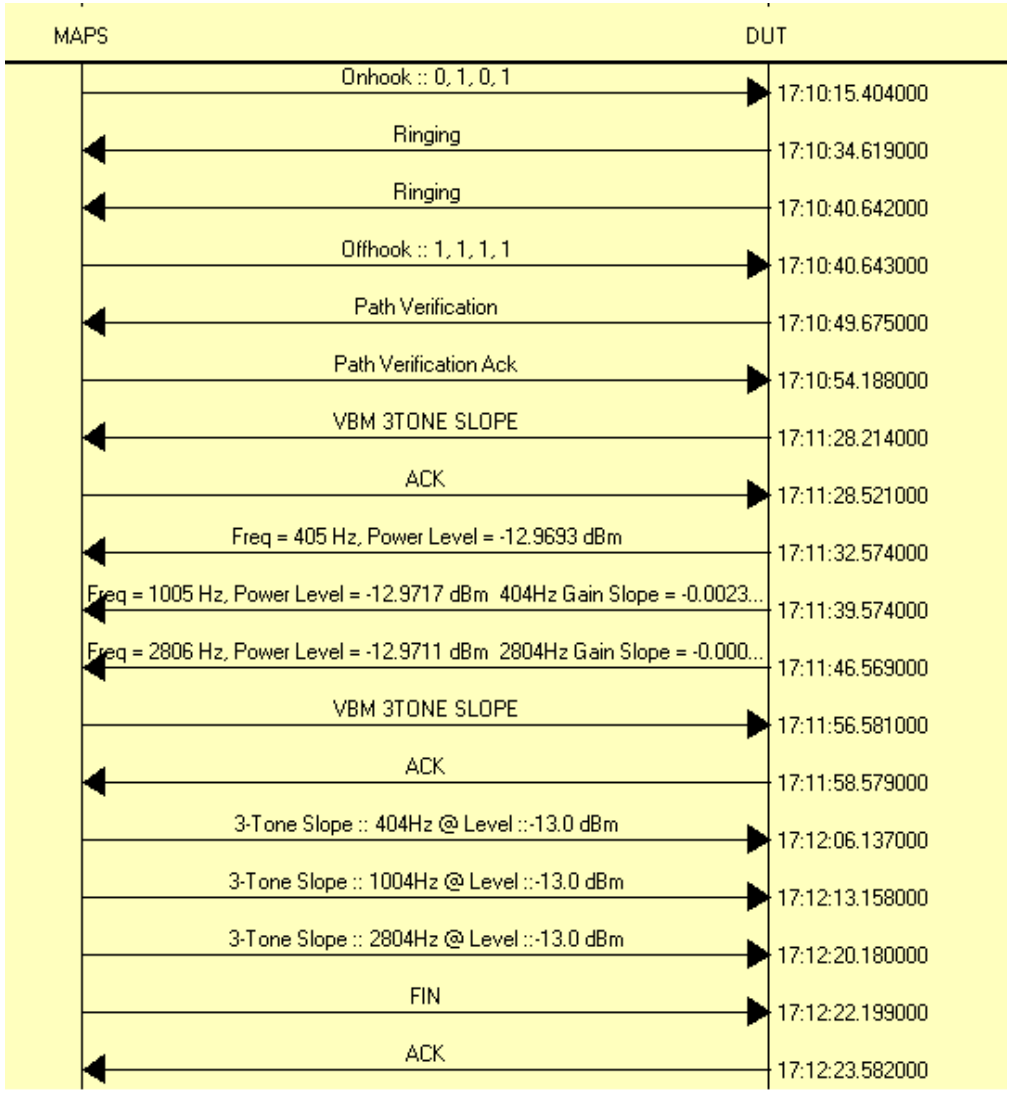
- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed, and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under **Events** column, right-click on the call and select the required **3 Tone Slope Test** then **VBM 3TONE SLOPE** request tone (**Frequency:1153Hz, Power: -13dBm and Duration:300ms**) is sent
- After receiving the **ACK** (**Frequency:2351Hz ,Power: -13dBm and Duration:300ms**), PlaceCall side sends 3-Tone i.e., 404Hz, 1004Hz, 2804Hz at -13dBm
- After receiving the **VBM 3TONE SLOPE** request, **ACK** will be sent to receive the frequencies i.e., **404Hz, 1004Hz, 2804Hz** with Power Level and Gain Slope.
- Finally, a **FIN** (**Frequency:1949Hz,Power: -13dBm and Duration:300ms**) is received to end the test and subsequently an **ACK** is sent to indicate that call will be terminated



GL Communications

VF_Terminating.gls Ladder Diagram (Slave)

- Initially both sides are On-Hook
- An incoming call is detected. When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack, AnswerCall side receives **VBM 3TONE SLOPE** request tone (**Frequency:1153Hz, Power: -13 dBm and Duration:300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration:300ms**)
- After receiving **the VBM 3TONE SLOPE** request, **ACK** will be sent to receive the frequencies i.e. 404Hz, 1004Hz, 2804Hz with Power Level and Gain Slope
- After sending the **VBM 3TONE SLOPE** request ACK is received
- Then answercall sends 3-Tone i.e. 404Hz, 1004Hz and 2804Hz at 10dBm
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration:300ms**), and subsequently sending an **ACK**



3-Tone Measurement Results

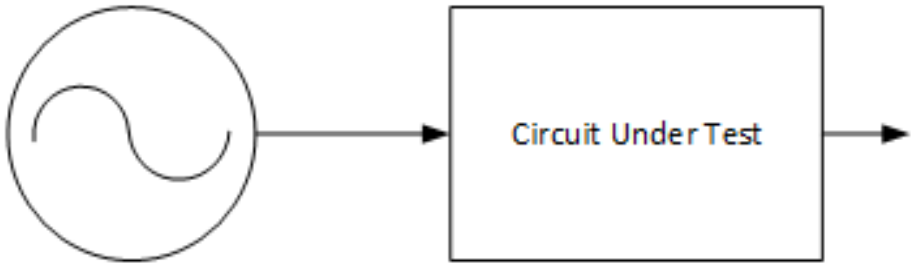
- 3-Tone measurement results are logged in the "**3-Tone Slope Test Report**" tab for the current test. Results include the received frequency, power level, 404Hz Gain Slope, and 2804Hz Gain Slope

Date/Time	Circuit Selec...	Freq (Hz)	Power (dBm)	404Hz Gain Slope	2804Hz Gain Slope	VG3(6) Criteria	VG3(6) Test Result
2020-7-21 11:21:14	VG6	405	-13.37			Pass Power -13.5 to -10.5 dBm	Pass
2020-7-21 11:21:21	VG6	1005	-13.34	0.03		Pass Power -13.5 to -10.5 dBm	Pass
2020-7-21 11:21:28	VG6	2806	-13.32		-0.01	Pass Power -13.5 to -10.5 dBm	Pass

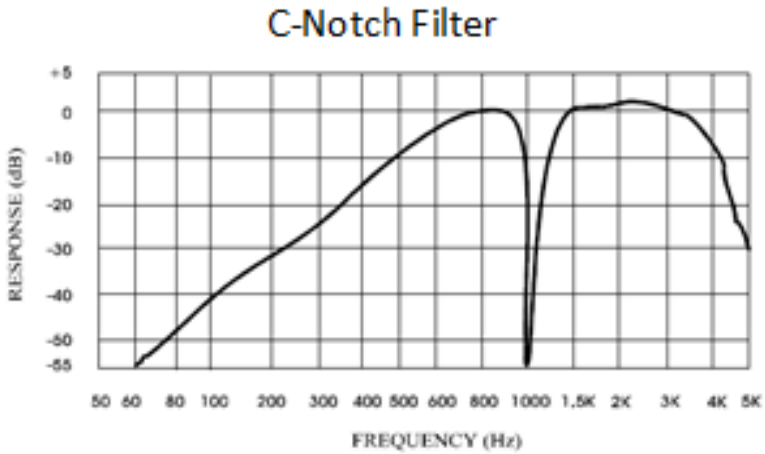
3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | Impulse Noise Test Report | S/NR/Net Loss vs Level Test Report | VQT Test Report

Signal/C-Notch Noise Test

Signal/C-Notch Noise Test



Reference
1004Hz
-13dBm



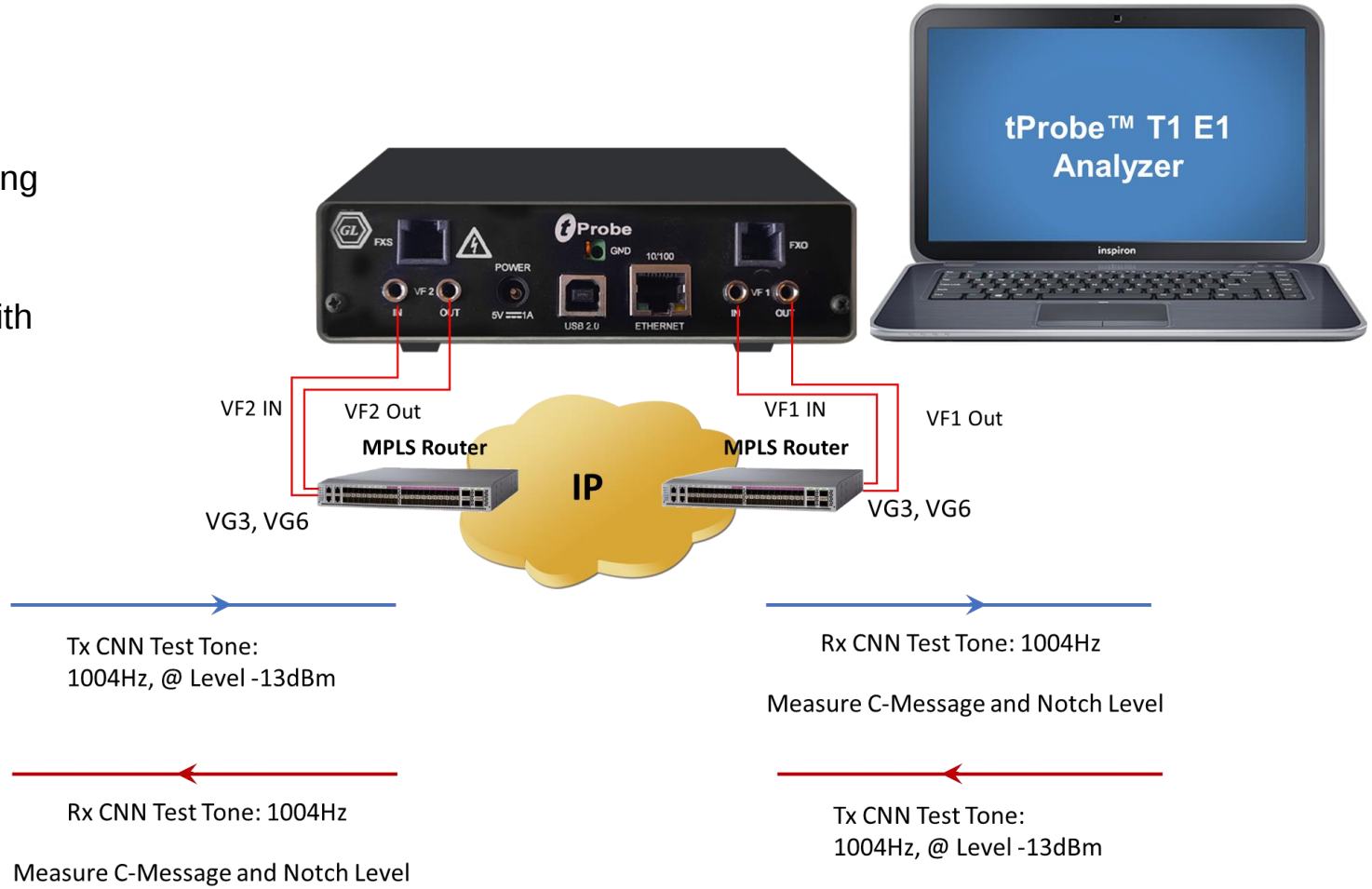
Measurement reported in 1s intervals
C Notched Noise -54.9dBmC
C Notched Noise -54.9dBmC
C Notched Noise -54.9dBmC

Signal-to-C-notched-noise ratio Standard 32dB Pass ≥ 30 dB

GL Communications

S/CNN Test

- **Signal/C-Notched Noise Level (dBrnC)** - The noise power on a channel with a holding tone (signal) at the transmit end, measured through a C-Message weighting filter and a 1004 Hz notch filter in tandem
- The noise level measured in reference to the 0 TLP with C-message weighting has the units dBrnC0
- This test measures that noise level after a 1004 Hz notch filter is applied



WCS Commands and Tasks used for CNN Test

To send 1004 Hz tone at -13 dbm, MAPS APS uses WCS Tx Tone command:

tx tone (<Freq> , <Power Level>) # <Card No> : <Timeslot> <Duration> msec ;

Below are commands sent by MAPS™ APS to WCS server

tx tone (1004 , -13) # 1 : 1 15000 msec ;

To measure C-Message and Notch Level MAPS™ APS uses WCS Commands. Here C-Message and Notch Filters are applied to the received data and then Power levels are measured.

dspop { NOTCH=filter(rx(#2:5), "filter files\Notch8K.IIR"),CMSG=filter(rx(#2:5), "filter files\cmessage.IIR"), NOTCHMon=power monitor(NOTCH), NOTCHMon,CMSGMon=power monitor(CMSG), CMSGMon} continuous report events;

Signal/C-Notch Noise Test Configuration

The following parameters can be configured in the **Global profile** for Signal/C-Notch Noise test :

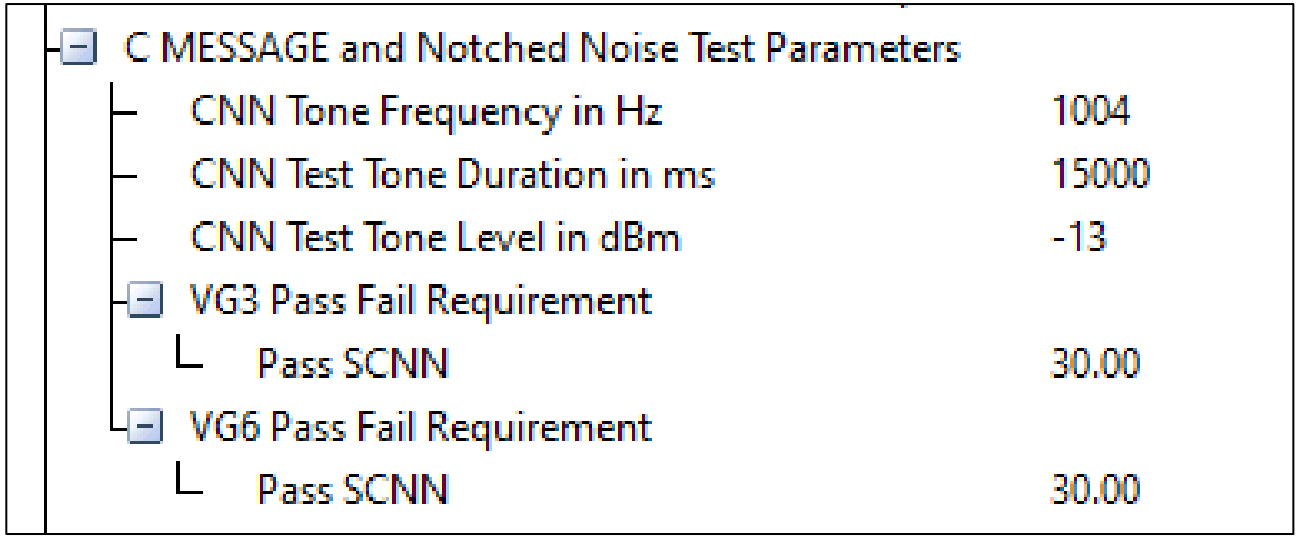
- CNN Tone Frequency in Hz
- CNN Test Tone Duration in dBm

VG3 Pass Fail Requirement

- Pass SCNN e.g.: 30 indicates pass criteria is S/CNN >= 30

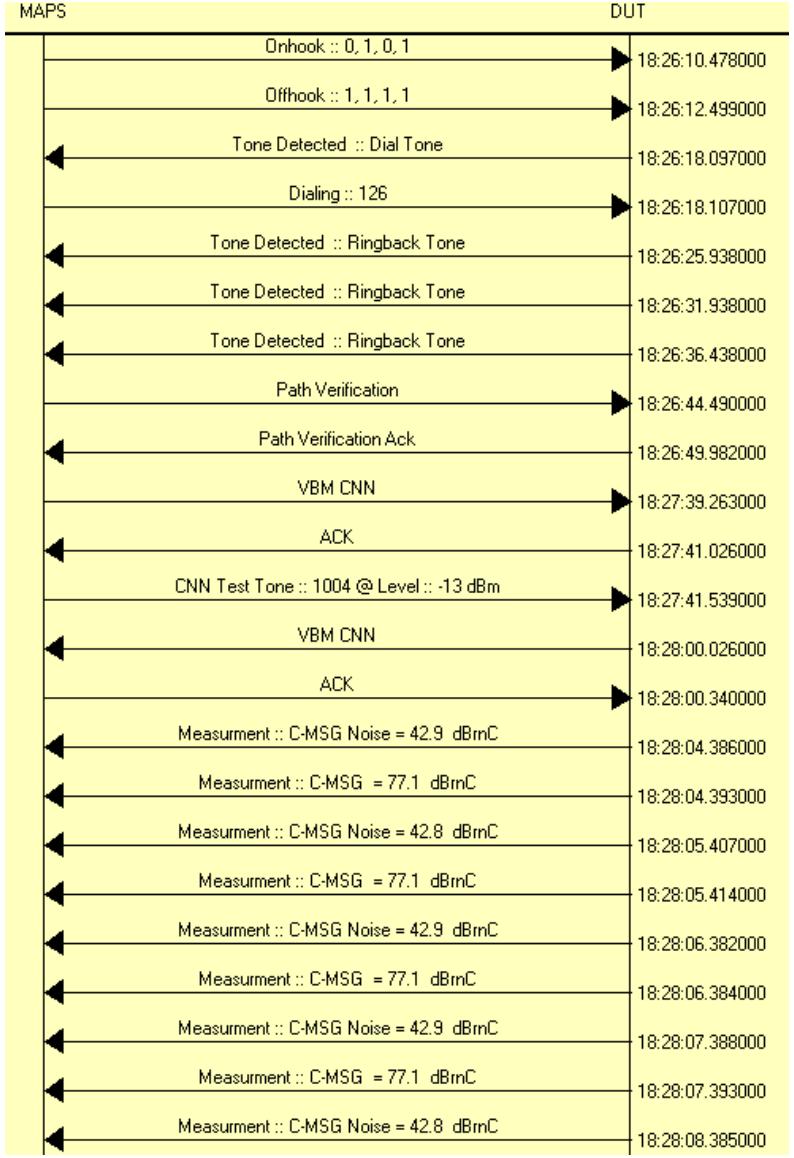
VG6 Pass Fail Requirement

- Pass SCNN e.g.: 30 indicates pass criteria is S/CNN >= 30



VF_Originating.gls Ladder Diagram (Master)

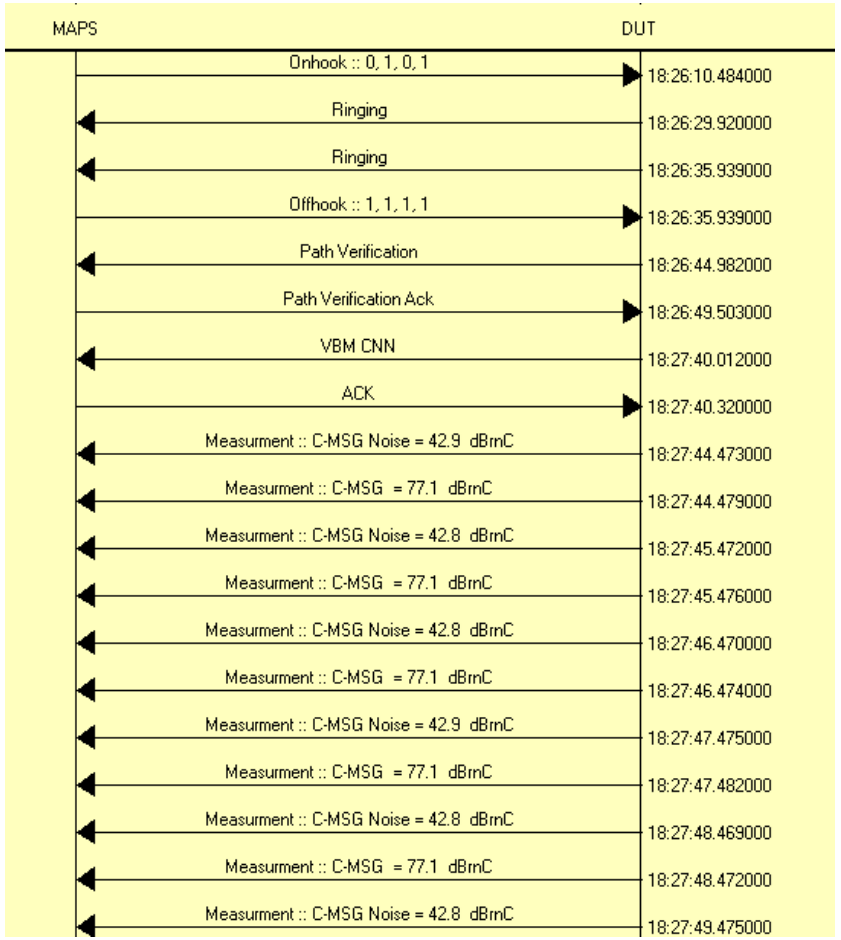
- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under **Events** column, right-click and select the **CNN Test** then **VBM CNN** request tone (**Frequency:1049Hz, Power: -13dBm and Duration: 300ms**) is sent
- After receiving the **ACK** (F**requency: 2351Hz , Power: -13dBm and Duration: 300ms**) PlaceCall side sends **CNN Test Tone 1004Hz** at **-13dBm**
- After receiving the **VBM CNN** request, **ACK** will be sent to receive the C-Messages
- Finally, a **FIN** (**Frequency:1949Hz, Power: -13dBm and Duration: 300ms**) is received to end the test and subsequently an **ACK** is sent to indicate that call will be terminated

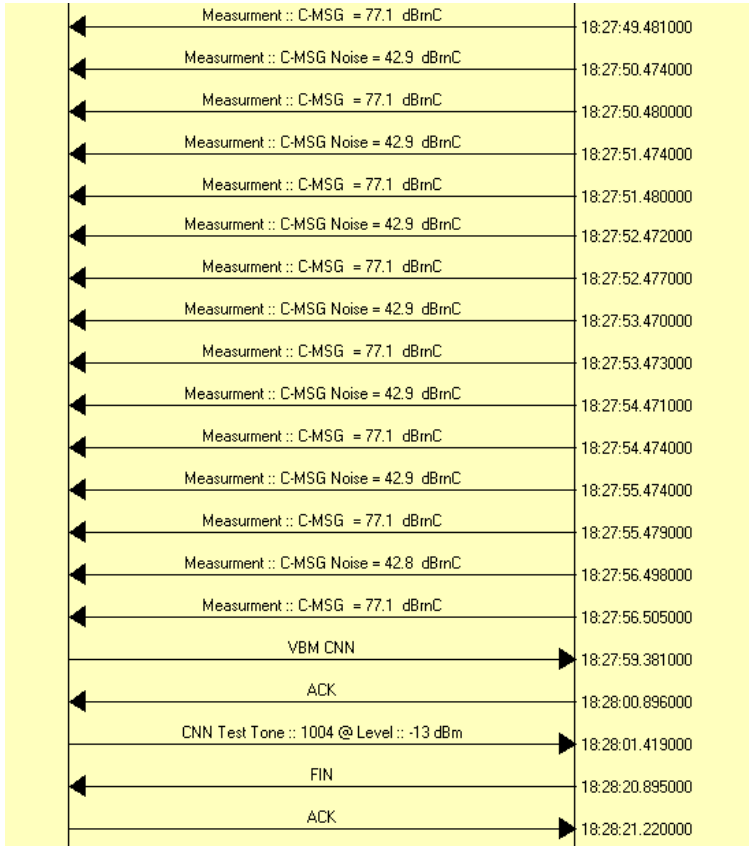


GL Communications

VF_Terminating.gls Ladder Diagram (Slave)

- Initially both sides are On-Hook
- An incoming call is detected. When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack Answercall side receives **VBM CNN** request tone (**Frequency:1049Hz, Power: -13 dBm and Duration:300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration: 300ms**)
- AnswerCall side measures the C Messages and keeps the result in the **C-Message Test Report** tab
- Then AnswerCall side sends **VBM CNN Request** tone and receives the **ACK**
- Now Answercall side sends **CNN Test Tone 1004Hz** at **-13dBm** and is being measured at PlaceCall side
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration: 300ms**), and subsequently sending an **ACK**





GL Communications

Signal/C-Notch Noise Test Results

- C-Notch Noise measurement results are logged in the **Signal/C-Notch Noise Test Report** tab for the current test. Results include the received frequency, power level in dBrnC, Notched C-message noise levels, and signal to C-Notch Noise level

Date/Time	Circuit Selected	Freq (Hz)	C-MSG Power (dBrnC)	C-MSG Noise Power (d...	S/CNN (dB)	VG3(6) Criteria	VG3(6) Test Result
2020-7-21 14:20:36	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:37	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:38	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:39	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:40	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:41	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:42	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:43	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:44	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:45	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:46	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:47	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass
2020-7-21 14:20:48	VG6	1004	77.1	43.3	33.8	S/CNN > 30 dB	Pass

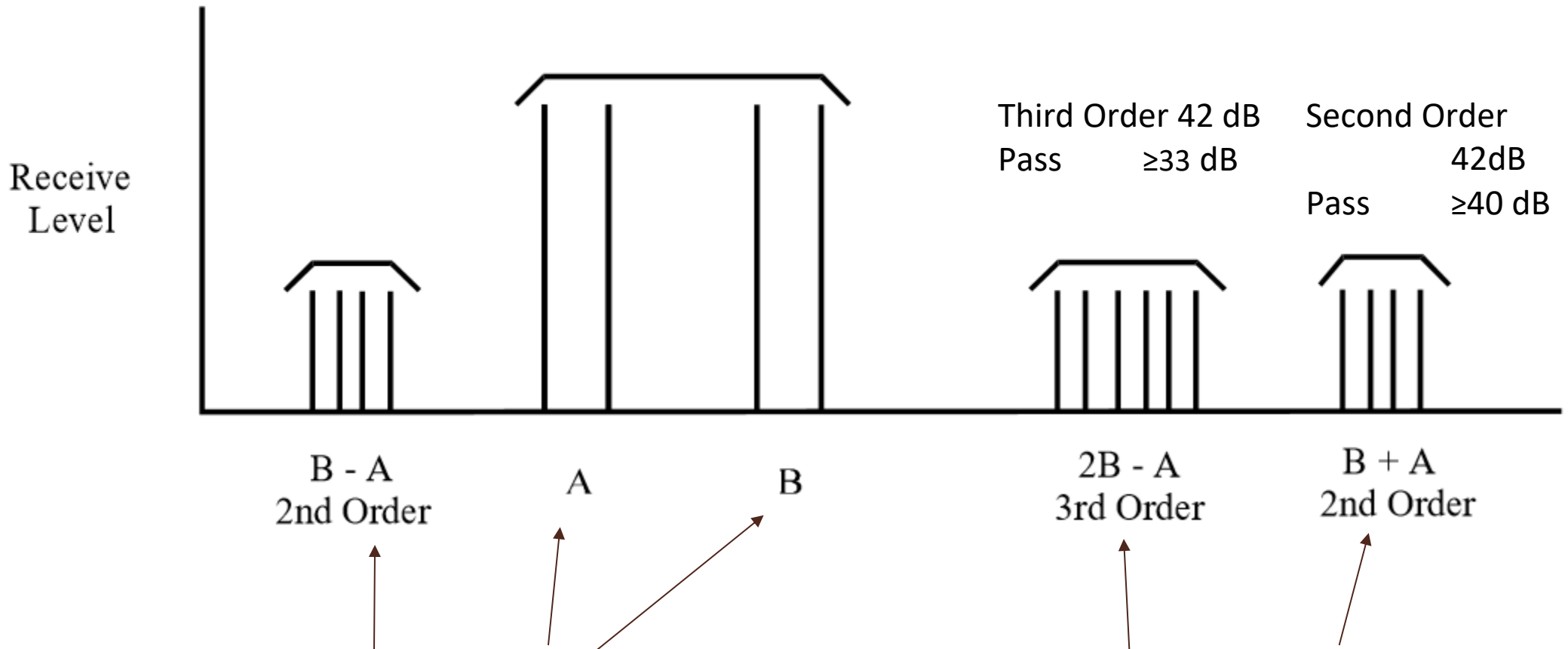
3-Tone Slope Test Report | **Signal/C-Notch Noise Test Report** | Intermodulation Distortion Test Report | Impulse Noise Test Report | S/NR/Net Loss vs Level Test Report | VQT Test Report

- dBrnC - dB relative noise (0dBrn=-90dBm) C-weighted

GL Communications

Intermodulation Distortion (IMD) Test

Intermodulation Distortion Test



Transmit tones at VF_Originating.gls

Intermodulation products, if present

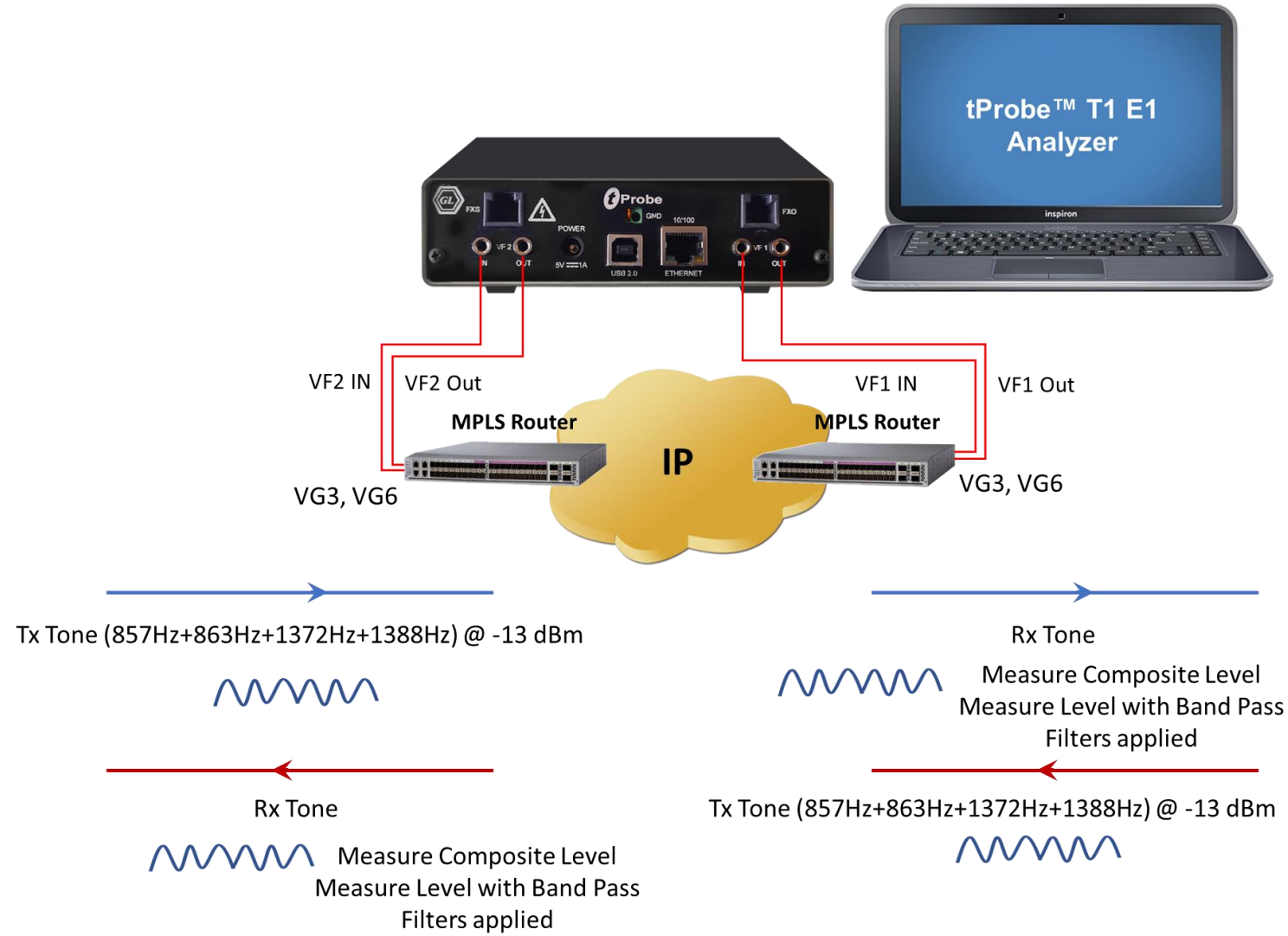
GL Communications

Intermodulation Distortion Test

- Side A sends 4 frequency tone continuously using the below command. User can enter the composite tone level through the profile, and we calculate the individual level in script. In this case the composite level is set to -13 dBm and each tone level is calculated to be -19.0206 dBm

  tx(sum(tone(857, -19.0206), tone(863, -19.0206), tone(1372, -19.0206), tone(1388, -19.0206)), # 1:1) continuous;

- Side B runs 4 power monitors simultaneously for the following. Power values are reported on every second

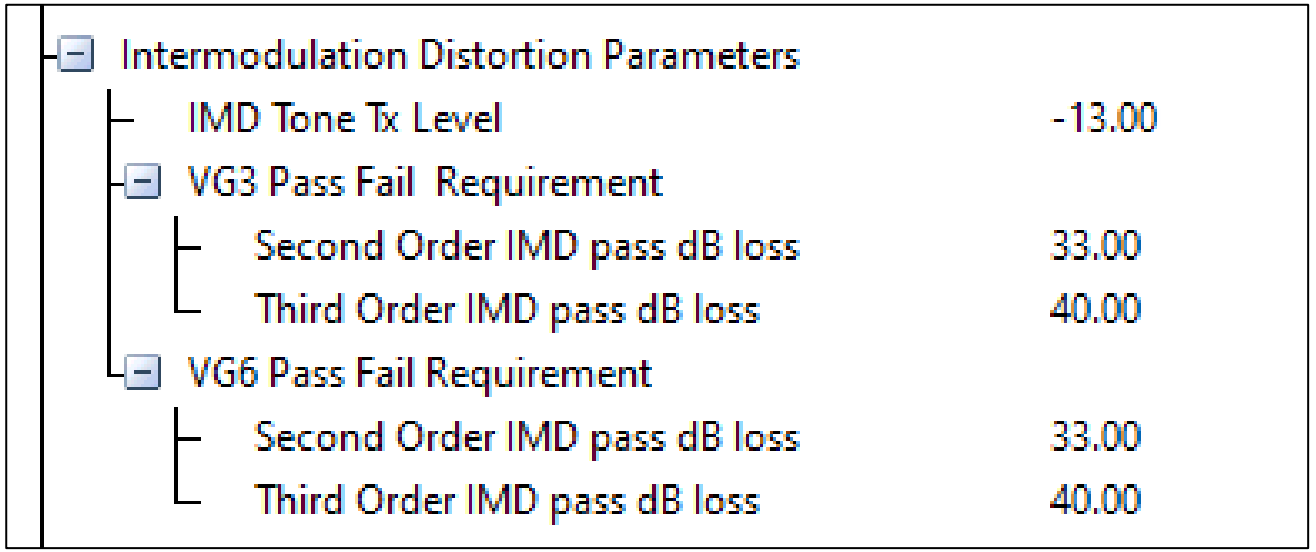


Intermodulation Distortion Test

- Monitor Power without filter that looks for the power of the 4 tones (composite tone level around -13 dBm)
- IMD test uses IIR filter
- Power monitor with 505-530 bandpass filter applied. This looks for the power of the 2nd order (B-A product)
- Power monitor with 2225-2255 bandpass filter applied. This looks for the power of the 2nd order (B+A product)
- Power monitor with 1875-1925 bandpass filter applied. This looks for the power of the 3rd order product
  - **dspop {IMD=rx(# 2 : 5), IMD520=filter(rx(# 2 : 5), "filter files\505-530bandpass.IIR"), IMD2240=filter(rx(# 2 : 5), "filter files\2225-2255bandpass.iir"), IMD1900=filter(rx(# 2 : 5), "filter files\1875-1925bandpass.iir"), power monitor(IMD), power monitor (IMD520), power monitor(IMD2240), power monitor(IMD1900)} report event;**
  - Verify power of the 4 tones to be around -13 dBm for 4 seconds
- Then start reporting values in MAPS ladder diagram:
  - Power level of the 4 tones
  - 2nd order signal power and S/IMD when compared to the received power of the 4 tones
  - 3rd order signal power and S/IMD when compared to the received power of the 4 tones

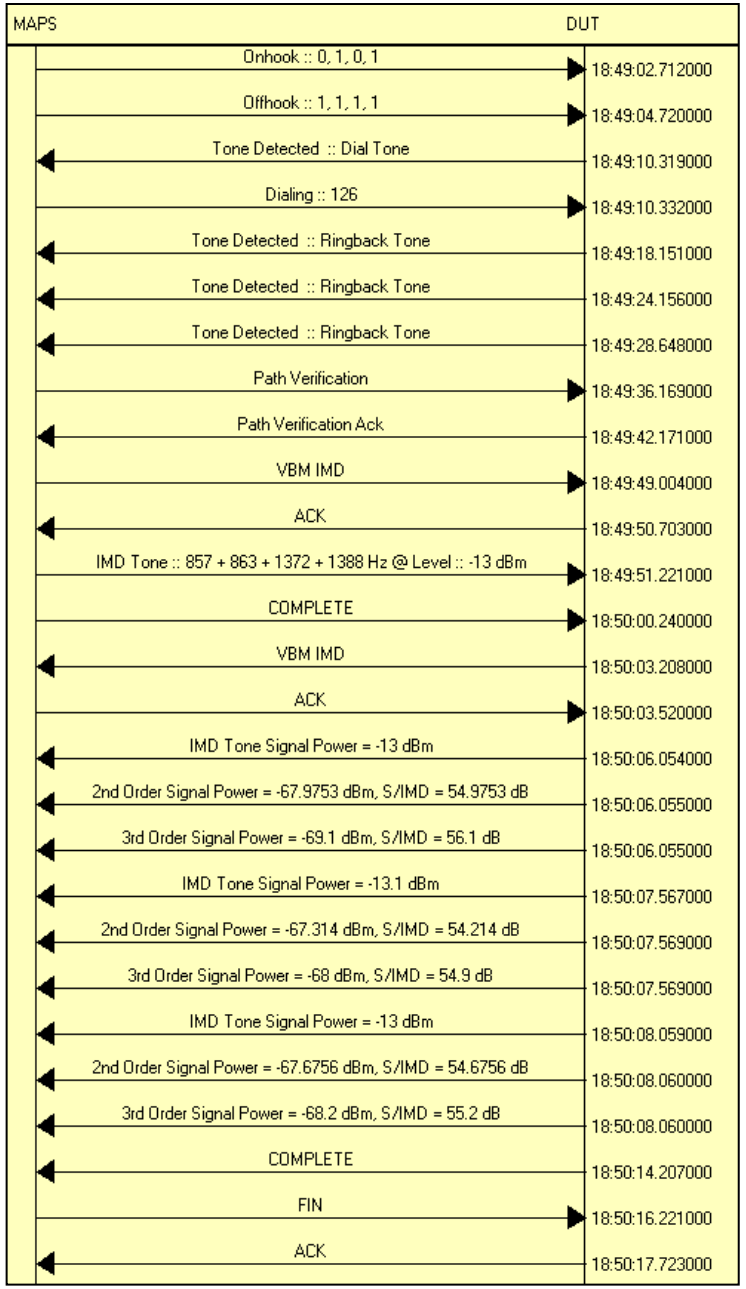
Intermodulation Distortion Test Configuration

- The following parameters can be configured in the **Global profile** for IMD Test:
  - IMD Tone Tx Level
- VG3 Pass Fail Requirement
  - Second Order IMD pass dB loss
  - Third Order IMD pass dB loss e.g.: Pass criteria for -13 dBm is “Second Order S/IMD >33 AND Third Order S/IMD>40”
- VG6 Pass Fail Requirement
  - Second Order IMD pass dB loss
  - Third Order IMD pass dB loss e.g.: Pass criteria for -13 dBm indicates, “Second Order S/IMD >33 AND Third Order S/IMD>40”



VF_Originating.gls Ladder Diagram (Master)

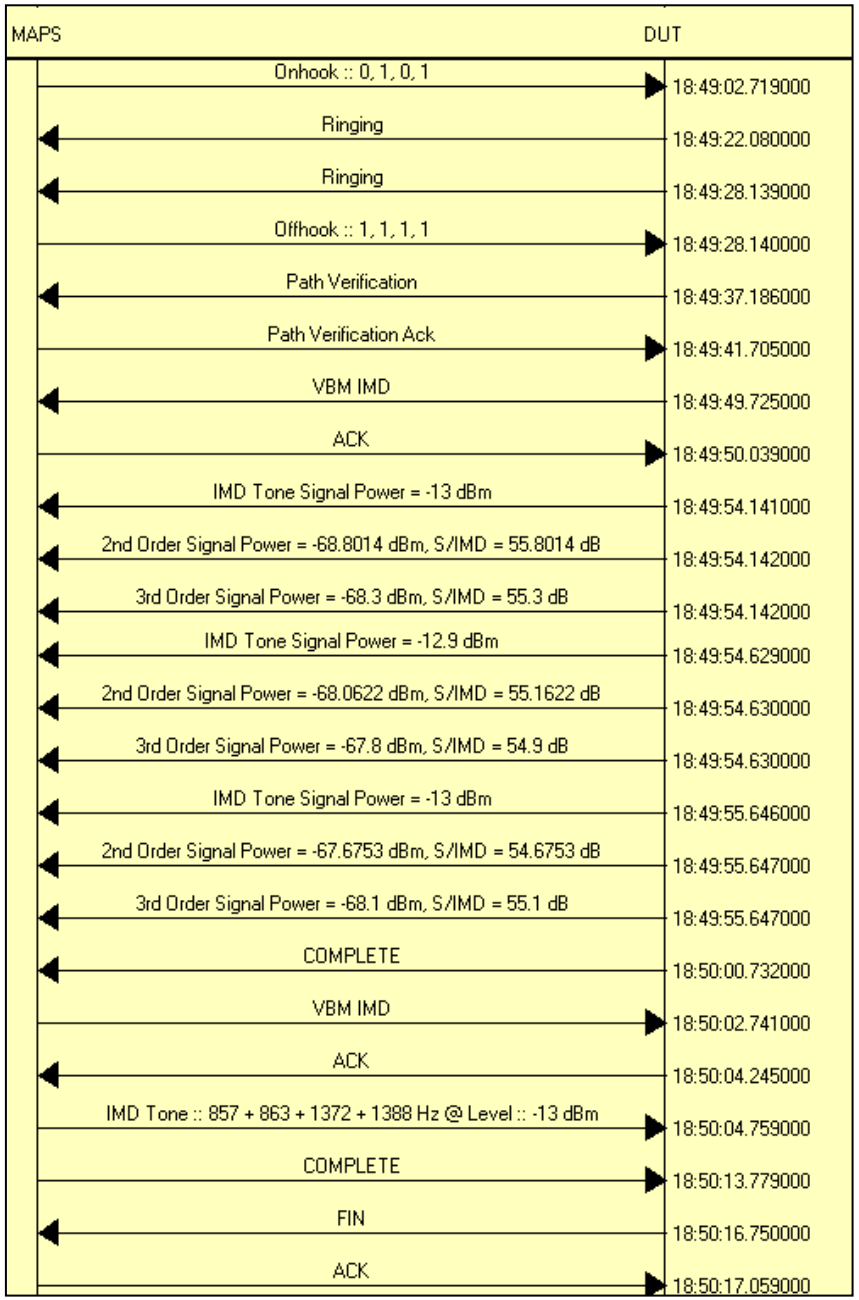
- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed, and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under **Events** column, right-click and select the required IMD Test then VBM IMD request tone (**Frequency:1741Hz, Power: -13dBm and Duration:300ms**) is sent
- After receiving the **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration: 300ms**), PlaceCall sends 4 tones at **-13dBm** power
- The Composite signal level, 2nd and 3rd order intermodulation power measurement and S/IMD ratio are measured at AnswerCall side
- Finally, PlaceCall side receives **COMPLETE** (**Frequency: 2251Hz,Power: -13dBm and Duration: 300ms**) tone, sends **FIN** (**Frequency:1949Hz,Power: -13dBm and Duration: 300ms**) and subsequently **ACK** is received to indicate that call will be terminated



GL Communications

VF_Terminating.gls Ladder Diagram (Slave)

- Initially both sides are On-Hook
- An incoming call is detected. When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack AnswerCall side receives **VBM IMD** request tone (**Frequency:1741Hz, Power: -13dBm and Duration:300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration: 300ms**)
- Measures level of composite tone, calculates 2nd and 3rd order Intermodulation product levels and S/IMD ratio which are displayed on the arrows in the ladder diagram and send these measurements to **IMD Test Report** Tab
- Then AnswerCall side sends 4 tones and **COMPLETE** (**Frequency:2251Hz, Power: -13dBm and Duration:300ms**) tone
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration: 300ms**), and subsequently sending an **ACK**



GL Communications

IMD Test Results

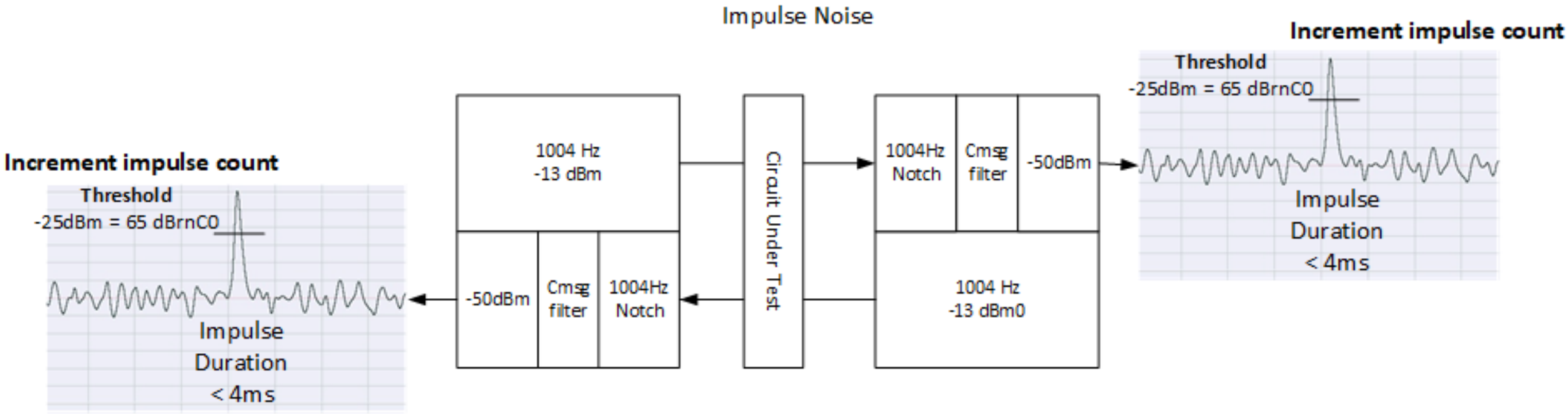
- Intermodulation Distortion measurement results are logged in the “Intermodulation Distortion Test Report” tab for the current test. Results include the received power level, 2nd Order IMD Power in dB, 2nd Order S/IMD in dB, 3rd Order IMD Power in dB, and 3rd Order S/IMD in dB

IMD Tone Power...	2nd Order IMD ...	2nd Order S/IMD (dB)	3rd Order IMD Power (dBm)	3rd Order S/IMD (dB)	VG3(6) Criteria	VG3(6) Test Resu
-13.00	-68.89	55.89	-64.69	51.69	2nd Order S/IMD > 33 dB and 3rd Order S/IMD > 40 dB	Pass
-13.00	-68.44	55.44	-64.90	51.90	2nd Order S/IMD > 33 dB and 3rd Order S/IMD > 40 dB	Pass
-13.00	-69.00	56.00	-64.69	51.69	2nd Order S/IMD > 33 dB and 3rd Order S/IMD > 40 dB	Pass

3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | **Intermodulation Distortion Test Report** | Impulse Noise Test Report | S/NR/Net Loss vs Level Test Report | VQT Test Report

Impulse Noise Test

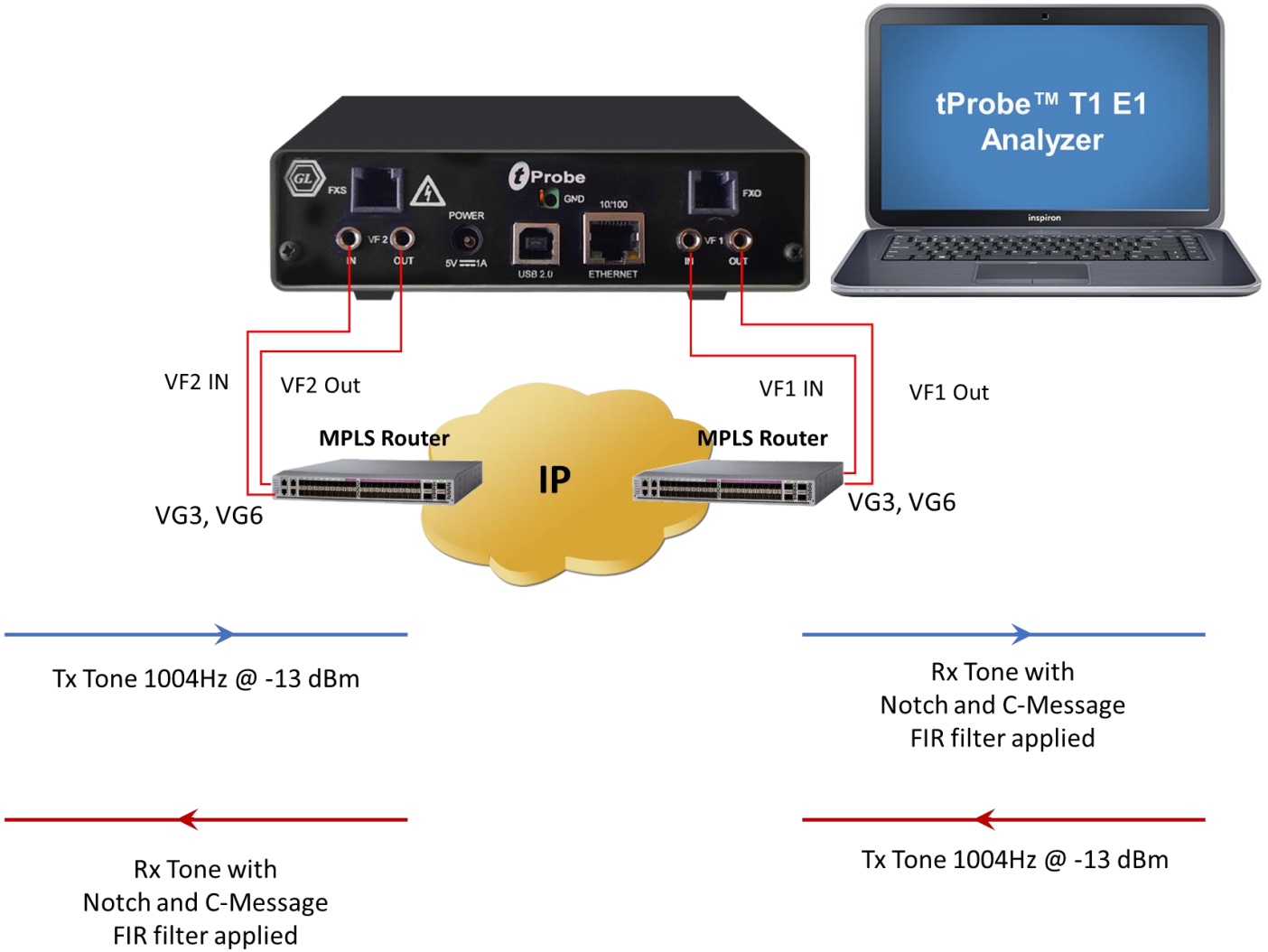
Impulse Noise Test



Pass criteria - No more than 15 counts in 15 minutes at -25 dBm (65 dBrnC0)

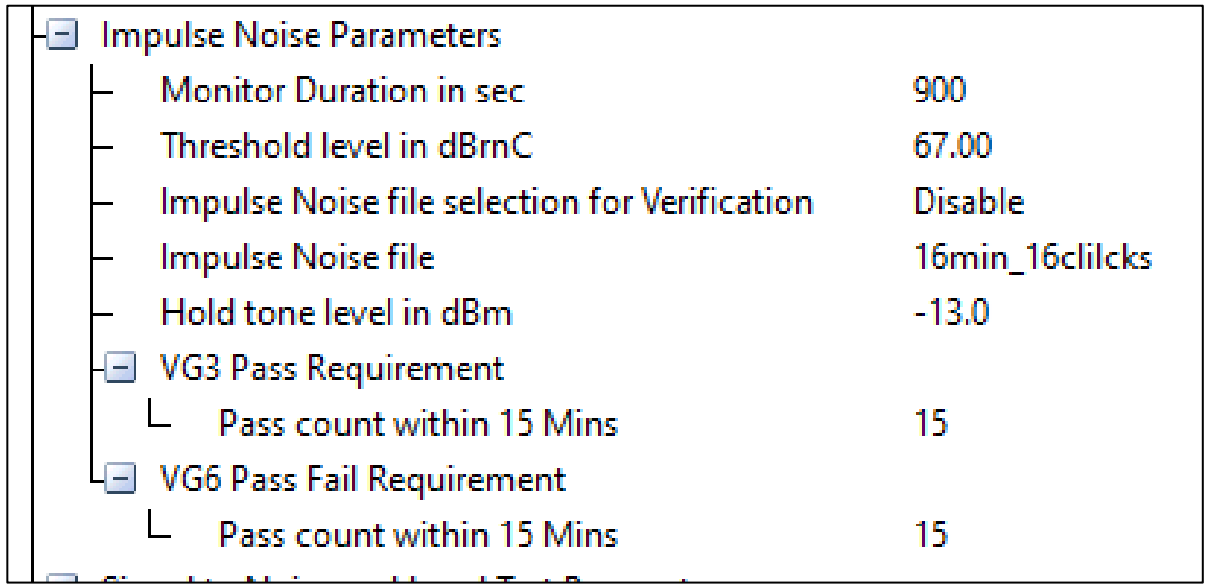
Impulse Noise Test (Contd.)

- Impulse Noise as any momentary occurrence of the noise on a line significantly exceeding the normal noise peaks. It is analyzed by counting the number of occurrences that exceed a threshold during a specified period of time



Impulse Noise Test Configuration

- The following parameters can be configured in the **Global profile** for Impulse Noise Test:
  - Monitor Duration in sec
  - Threshold level in dBrnC
  - Impulse Noise file selection for Verification
  - Impulse Noise file
  - Hold tone level in dBm
- VG3 Pass Fail Requirement
  - Pass count within 15 mins e.g.: The pass criteria is “Impulse Noise count <= 15” within duration of 15 mins
- VG6 Pass Fail
  - Pass count within 15 mins e.g.: The pass criteria is “Impulse Noise count <= 15” within duration of 15 mins



WCS Commands and Tasks for Impulse Noise Test

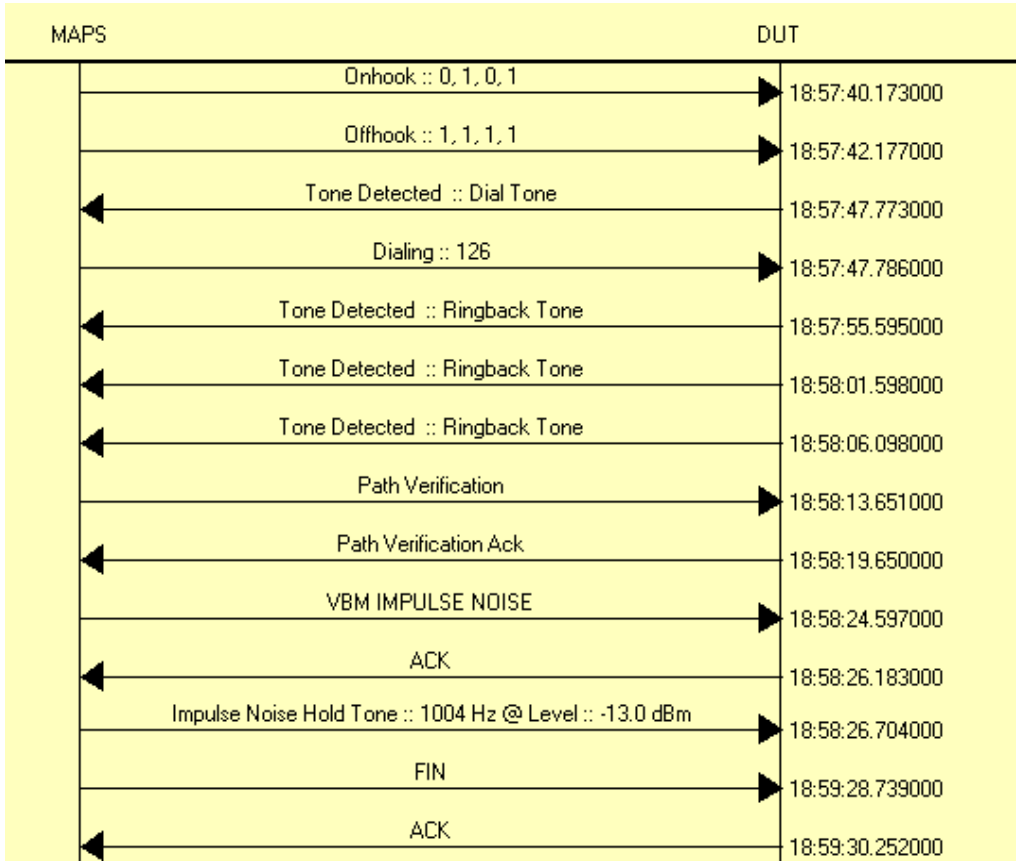
- Start impulse noise detector at side **A** and **B**
  - **dspop {ImpulseNoise=dtmfdigitmonitor(mulaw(filter(filter(rx(# 2 : 5), "filter files\CMessage8K.XFR"), "filter files\Notch8K.FIR"), compress), "configini\1004HzWithPops.ini")} report events;**
- Send 1004 Hz hold tone from both sides
- Report every burst event which meets below conditions

  A) Exceeds the threshold level (65 dBrnC configured in Profile Editor)

  B) Did not occur during the 125 ms blanking interval, then increase impulse noise counter
- Monitor until the Monitor Duration is satisfied, (default duration configured in Profile Editor is 900 sec)

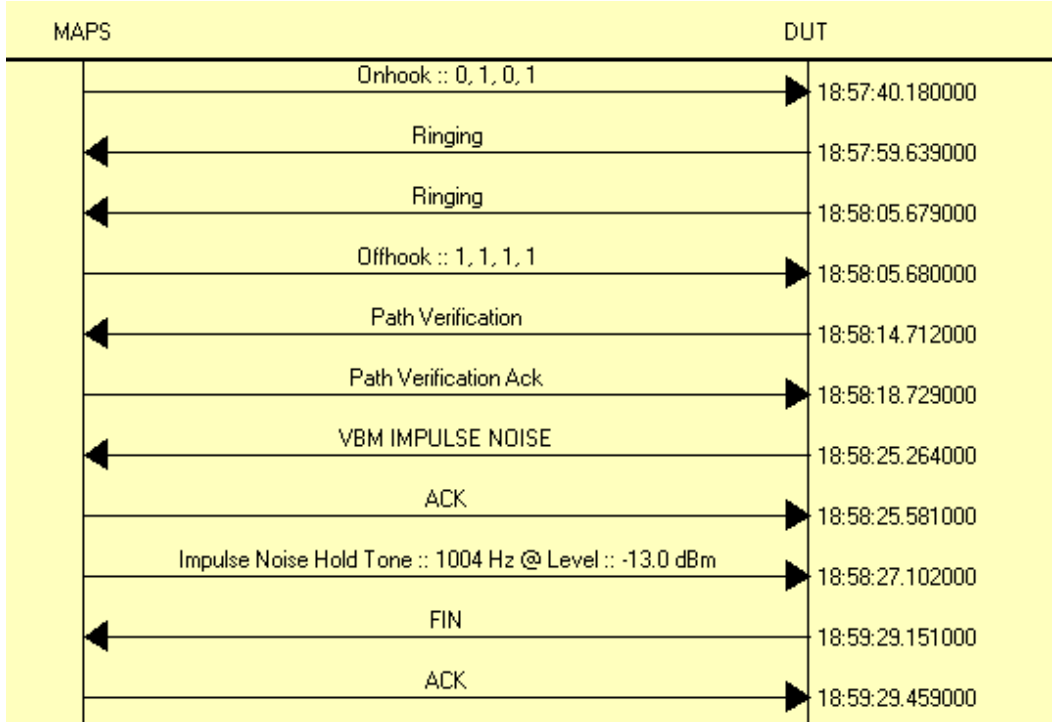
VF_Originating.gls Ladder Diagram

- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under **Events** column, right-click and select the **VBM Impulse Noise Test** then VBM IMPULSE NOISE request tone (**Frequency:1867Hz, Power: -13dBm and Duration:300ms**) is sent
- After receiving the **ACK** (**Frequency:2351Hz ,Power: -13dBm and Duration: 300ms**) PlaceCall side sends **Holding** tone (**1004Hz, -13dBm**) and monitors Impulse Noise for the configured interval of time
- Finally, a **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration: 300ms**) is received to end the test and subsequently an **ACK** is sent to indicate that call will be terminated



VF_Terminating.gls Ladder Diagram

- Initially both sides are On-Hook
- An incoming call is detected. When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack, Answercall side receives **VBM IMPULSE NOISE** request tone (**Frequency:1867Hz, Power: -13dBm and Duration:300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration: 300ms**)
- Then AnswerCall side sends **Holding tone** (**1004Hz -13.dBm**) and monitors Impulse Noise for the configured interval of time.
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency:1949Hz, Power: -13dBm and Duration:300ms**), and subsequently sending an **ACK**



Impulse Noise Test Results

- Intermodulation Distortion measurement results are logged in the “Impulse Noise Test Report” tab for the current test. Results will be empty if no impulse hits occur. When there are counts it will report the received noise level and total counts

Date/Time	Circuit Selected	dBrnC	Count	VG3(6) Criteria	VG3(6) Test Result	
2020-7-21 14:36:46	VG6	N/A	0	Pass Count <= 15 in 15 m...	Pass	

3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | **Impulse Noise Test Report** | S/NR/Net Loss vs Level Test Report | VQT Test Report

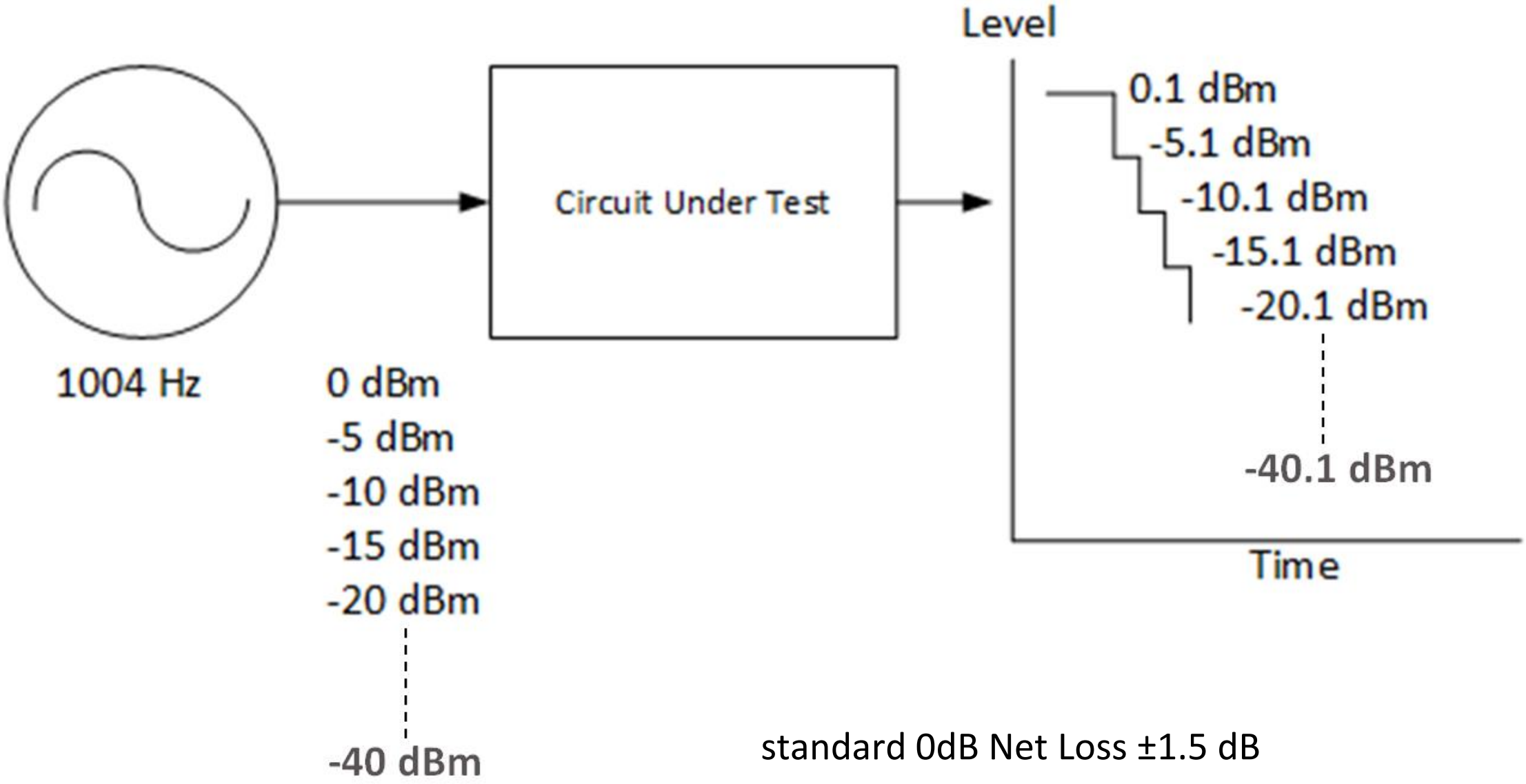
Date/Time	Circuit Selected	dBrnC	Count	VG3(6) Pass Criteria	VG3(6)_TestResult	
2020-5-26 16:32:56	VG6	75	1	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:33:56	VG6	75.1	2	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:34:56	VG6	75	3	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:35:56	VG6	75	4	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:36:56	VG6	75	5	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:37:56	VG6	75.1	6	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:38:56	VG6	74.9	7	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:39:56	VG6	74.9	8	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:40:56	VG6	75	9	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:41:56	VG6	74.8	10	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:42:56	VG6	74.9	11	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:43:56	VG6	74.8	12	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:44:56	VG6	74.9	13	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:45:56	VG6	71.9	14	Pass Count =< 15 in 15 mins	Pass	
2020-5-26 16:46:56	VG6	75	15	Pass Count =< 15 in 15 mins	Pass	

3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | **Impulse Noise Test Report** | S/NR/Net Loss vs Level Test Report | VQT Test Report

GL Communications

S/N Ratio and Net Loss Vs Level

S/N Ratio and Net Loss Vs Level

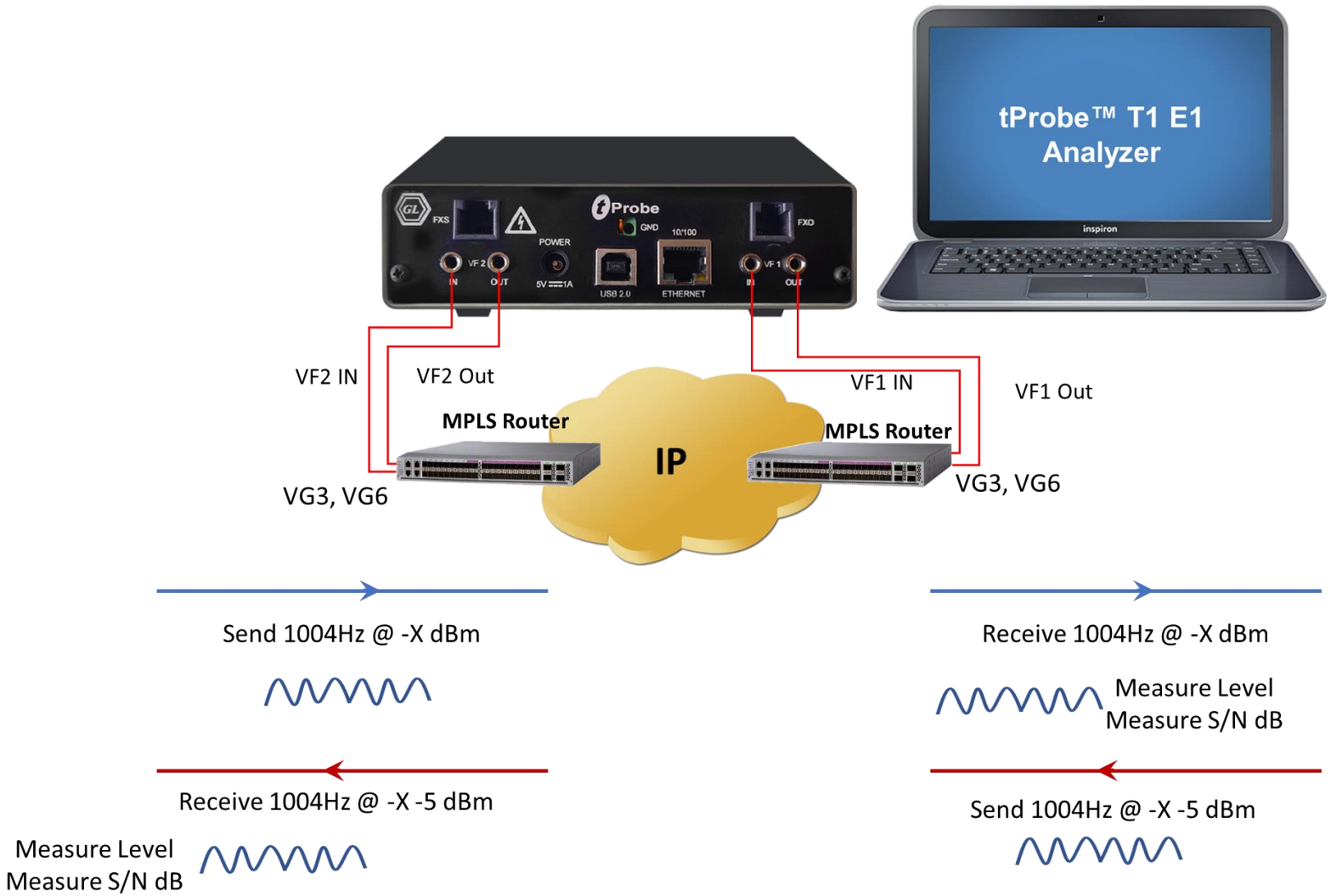


standard 0dB Net Loss ±1.5 dB

GL Communications

S/N Ratio and Net Loss Vs Level

- **Signal-to-Noise Ratio and Level** - Transmission of 1004 Hz (reference tone) with incrementing level of the tone at every iteration (example, by 5 dBm). At the reception side, measure levels and S/N ratio. This can be done in both the directions in a single test



WCS Commands and Tasks used for SNR Measurements

- To send 1004 Hz tone with different levels, MAPS APS uses WCS Tx Tone command

  tx tone (<Freq> , <Power Level>) # <Card No> : <Timeslot> <Duration> msec ;

- Below is the command sent by MAPS APS to WCS server

  tx tone (1004 , -45) # 1 : 1 3000 msec ;

- To Measure SNR Level and Signal to Noise Ratio, MAPS APS uses WCS Monitor Tone and Monitor SNR commands respectively. Responses given by WCS Server are presented to user In Ladder Diagram and SNR Report Tab in the Call Generation window

  monitor tones ("<MTD File Name>") # <Card No> : <Timeslot> ;

  monitor s/n ratio # <Card No> : <Timeslot> ;

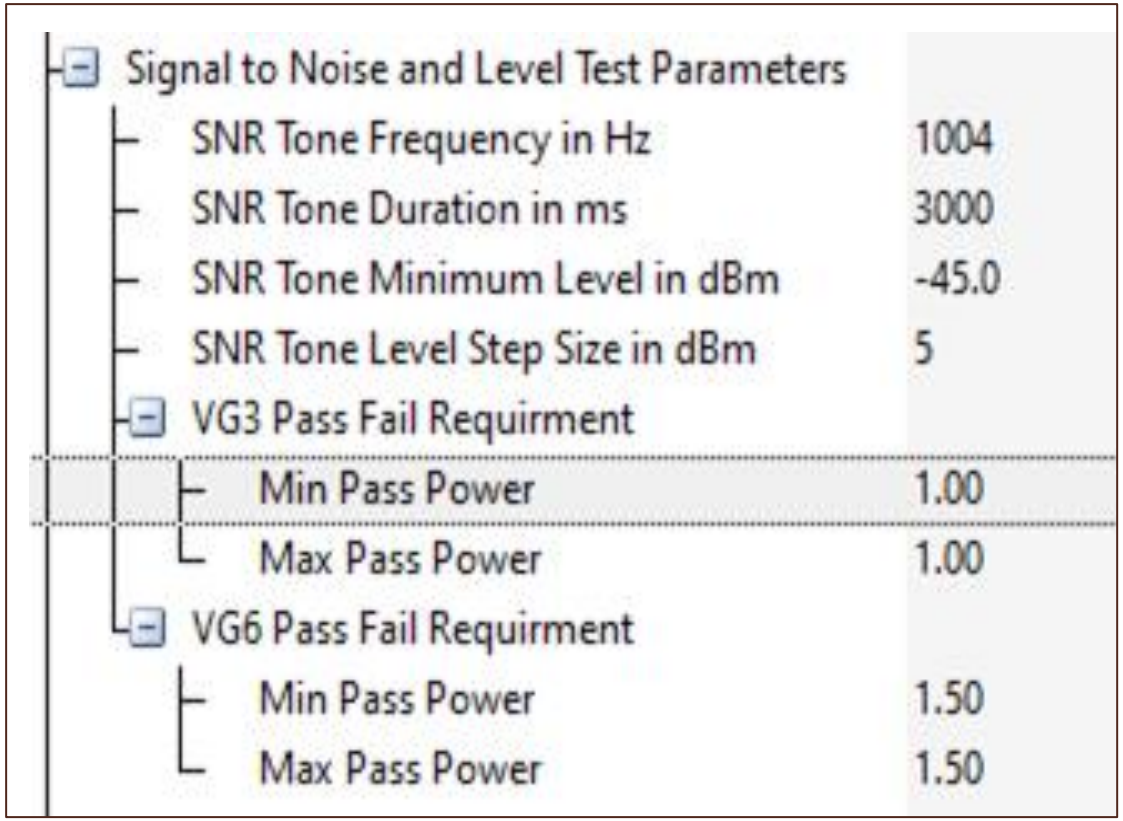
- Below are commands sent by MAPS APS to WCS server

  monitor tones ("MAPS\APS\VF\MTD Files/Voicebandsignal.mtd") # 2 : 5 ;

  monitor s/n ratio # 2

S/N Ratio Net Loss vs Level Test Configuration

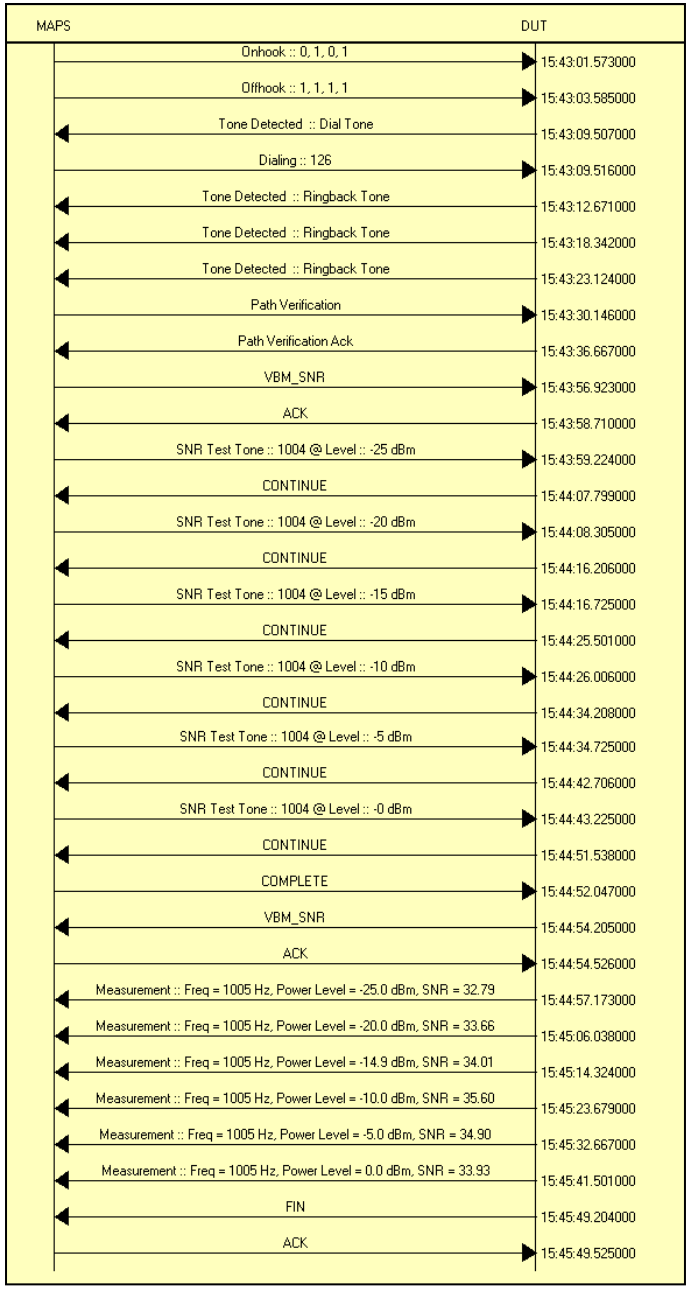
- The following parameters can be configured in the **Global profile** for SNR test:
  - SNR Tone Frequency
  - SNR Tone Duration
  - SNR Tone Minimum (starting) Level
  - SNR Tone Level step: tone levels are increased at this defined step
- VG3 Pass Fail Requirement
  - Min Pass Power in dBm
  - Max Pass Power in dBm e.g.: Pass criteria for -45 dBm is -46 to -44 dBm
- VG6 Pass Fail Requirement
  - Min Pass Power
  - Max Pass Power e.g.: Pass criteria for -45 dBm is -46.5 to -43.5 dBm



GL Communications

VF_Originating.gls Ladder Diagram (Master)

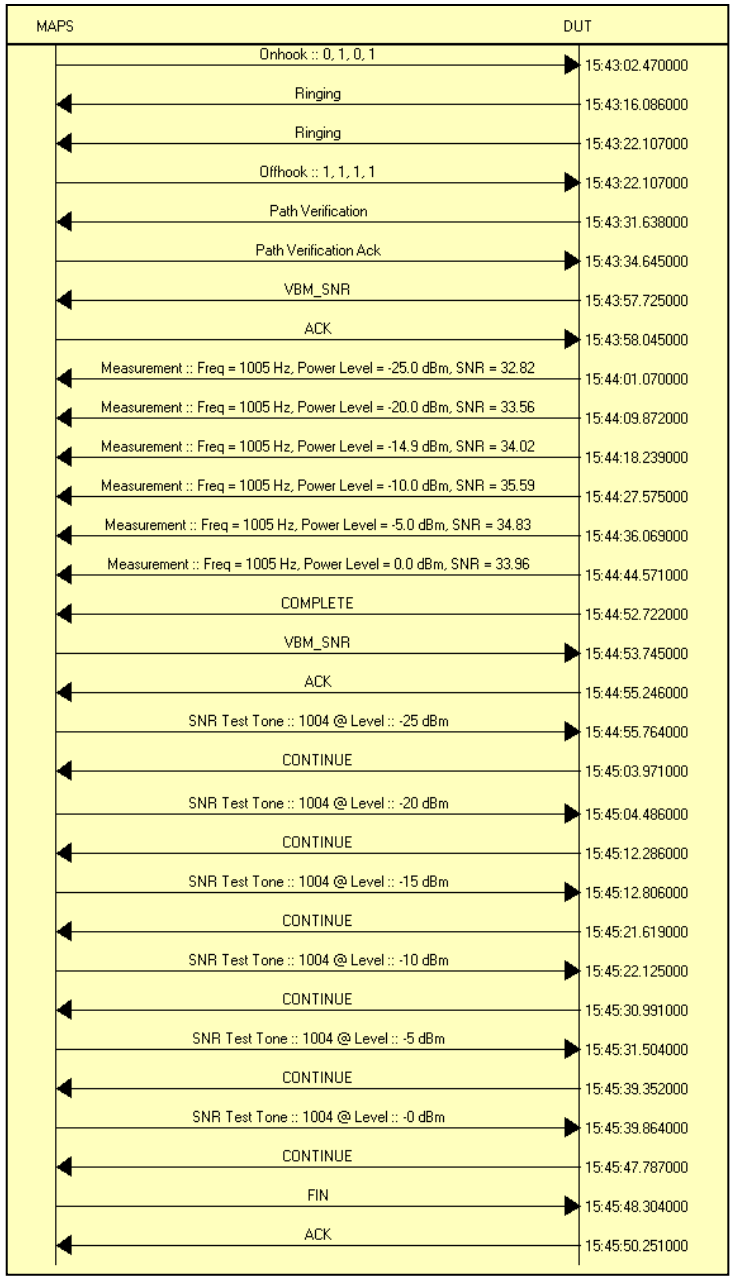
- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under Events column, right-click and select the **SNR** then **VBM SNR** request tone (**Frequency:853Hz, Power: -13dBm and Duration:300ms**) is sent
- After receiving the **ACK** (**Frequency:2351Hz ,Power: -13dBm and Duration:300ms**) PlaceCall sends **SNR Test Tone** of **1004Hz** at **-25dBm**
- After receiving **CONTINUE** (**Frequency:2153Hz, Power: -13dBm and Duration:300ms**) tone, it sends **1004Hz** at -20dBm Similarly, send the next tone by incrementing 5dBm till 0dBm
- After receiving **COMPLETE** (**Frequency:2251Hz, Power: -13dBm and Duration:300ms**) tone, the other end will send **VBM SNR** (**Frequency: 853Hz, Power: -13dBm and Duration:300ms**) to indicate start of **SNR** test in the reverse direction and start sending tone of **1004Hz** from **-25dBm** incrementing by 5dBm at each level
- Finally, a **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration:300ms**) is received to end the test and subsequently an **ACK** is sent to indicate that call will be terminated



GL Communications

VF_Terminating.gls Ladder Diagram (Slave)

- Initially both sides are On-Hook
- An incoming call is detected. When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack AnswerCall side receives **VBM_SNR** (**Frequency:853Hz, Power: -13 dBm and Duration:300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration:300ms**) and it starts monitoring tones and **Signal to Noise Ratio**
- Then AnswerCall side measures **SNR Test Tone** of **1004Hz** is received at **-25dBm**, **Signal to Noise Ratio** measurements are started and requesting for the next level of tone by sending **CONTINUE** (**Frequency:2153Hz,Power: -13dBm and Duration:300ms**) tone. Now, the tones are constantly being received incremented by **5dBm** till **0dBm**
- After receiving **COMPLETE** (**Frequency:2251Hz,Power: -13dBm and Duration:300ms**) tone from PlaceCall to indicate the test is completed
- Now AnswerCall side will start the test from reverse direction and **SNR** Test tone is sent from **-25 dBm** and incremented by **5dBm** till **0dBm**
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration: 300ms**), and subsequently sending an **ACK**



GL Communications

S/N Ratio Measurement Results

- SNR measurement results are logged in the “SNR and Level Test Report” tab for the current test. Results include the received frequency, power level, and signal-to-noise ratio

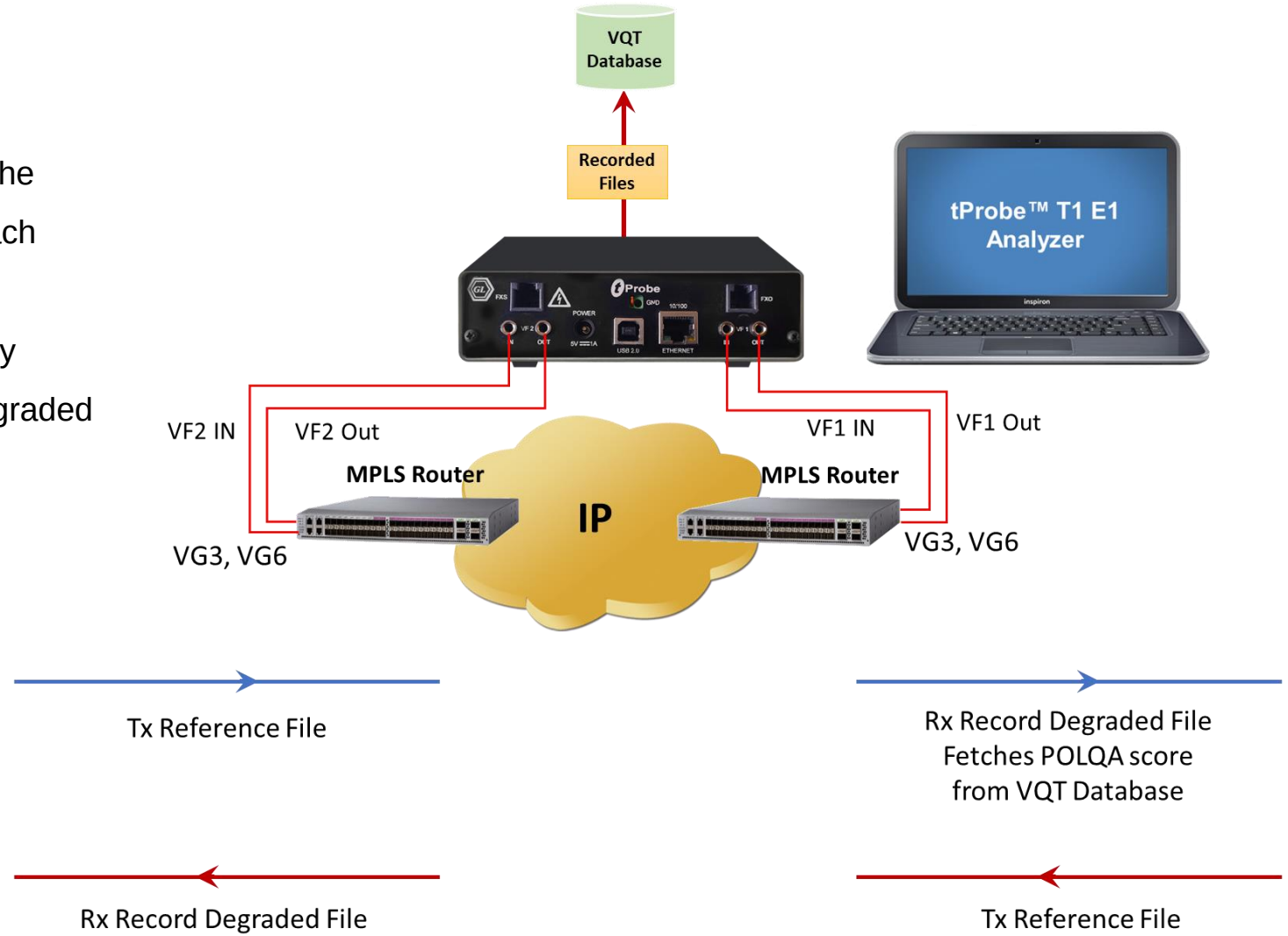
Date/Time	Circuit Selected	Freq (Hz)	Power (dBm)	SNR	VG3(6) Criteria	VG3(6) Test Result	
2020-7-21 11:39:06	VG6	1005	-44.9	25.11	Pass Power -46.5 to -43.5 dBm	Pass	
2020-7-21 11:39:15	VG6	1005	-40.2	27.97	Pass Power -41.5 to -38.5 dBm	Pass	
2020-7-21 11:39:23	VG6	1005	-35.3	31.22	Pass Power -36.5 to -33.5 dBm	Pass	
2020-7-21 11:39:32	VG6	1005	-30.3	32.99	Pass Power -31.5 to -28.5 dBm	Pass	
2020-7-21 11:39:40	VG6	1005	-25.4	32.15	Pass Power -26.5 to -23.5 dBm	Pass	
2020-7-21 11:39:49	VG6	1005	-20.4	33.70	Pass Power -21.5 to -18.5 dBm	Pass	
2020-7-21 11:39:57	VG6	1005	-15.3	35.24	Pass Power -16.5 to -13.5 dBm	Pass	
2020-7-21 11:40:06	VG6	1005	-10.4	35.78	Pass Power -11.5 to -8.5 dBm	Pass	
2020-7-21 11:40:14	VG6	1005	-5.4	34.25	Pass Power -6.5 to -3.5 dBm	Pass	
2020-7-21 11:40:22	VG6	1005	-0.4	34.55	Pass Power -1.5 to 1.5 dBm	Pass	

Attenuation Distortion Test Report | 3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | Impulse Noise Test Report | **S/NR/Net Loss vs Level Test Report** | VQT Test Report

Voice Quality Testing (VQT)

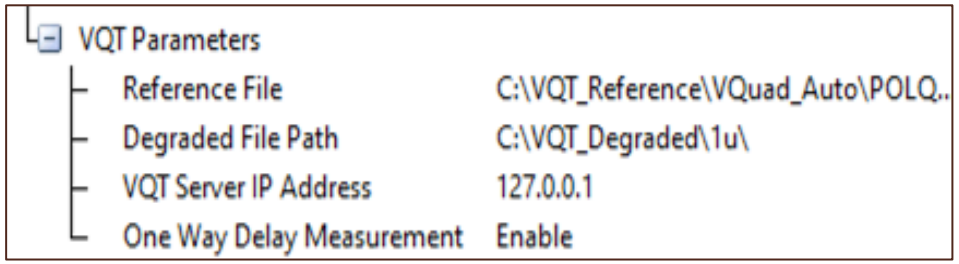
VQT Test

- **Voice Quality Test (VQT)** - This test involves transmission of reference file and recording of the degraded file in two sequential tests, one for each direction
- The VQT software calculates a POLQA score by comparing and analyzing the reference and degraded files



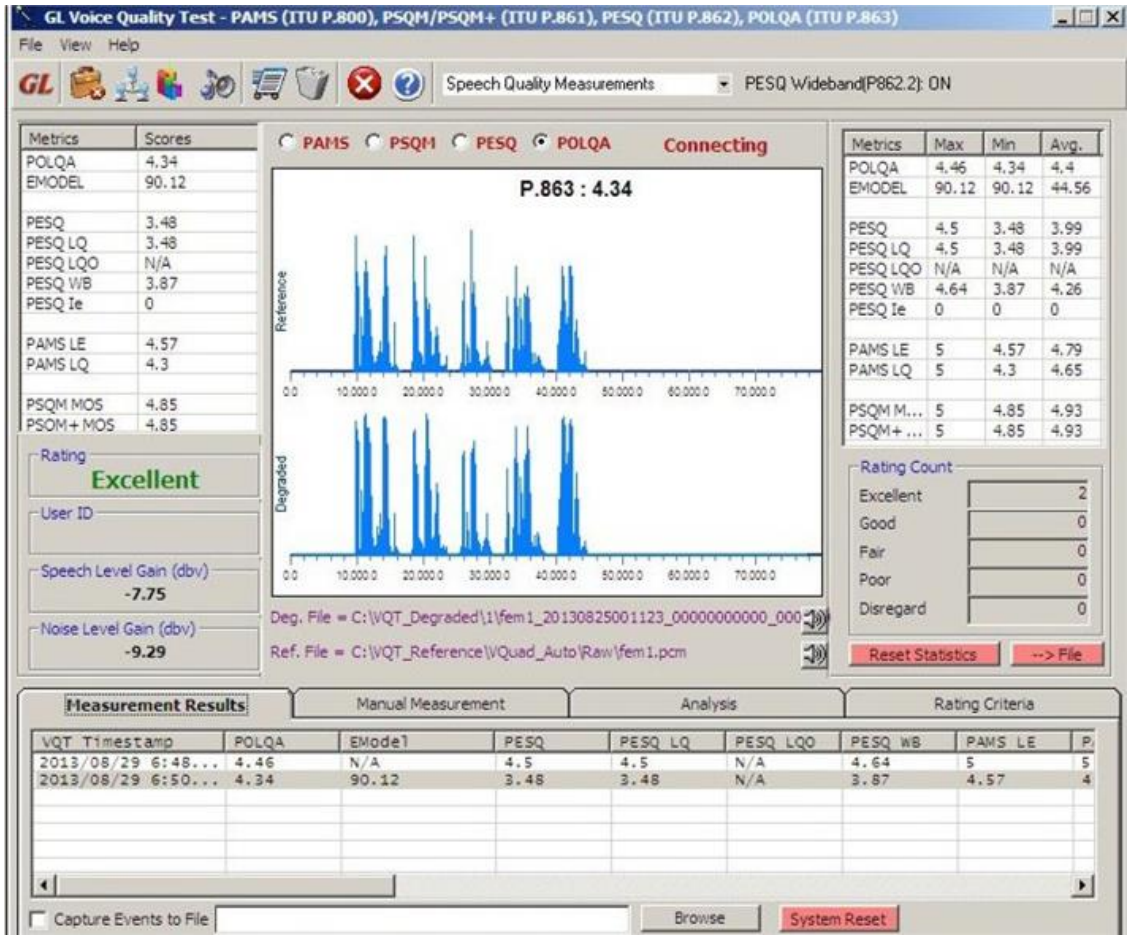
VQT Test Configuration

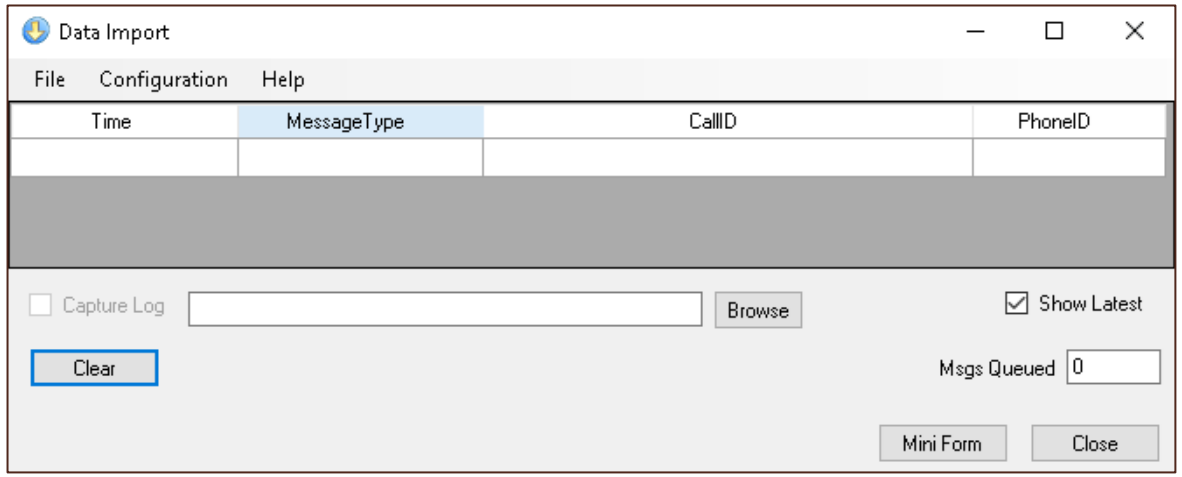
- The following parameters can be configured in the **Global profile** for VQT Test:
  - VQT parameters such as the reference file and degraded file path can be configured in the Global Configuration
  - Reference file is a ITU standard reference voice file. File path should exist on the Server system under C:\VQT_Reference
  - Degraded File Path defines where the recorded files are stored
  - VQT Database Path is the location of the VQT.mdb database file where VQT results are stored. This is typically under C:\Program Files (x86)\GL Communications Inc\DataImport\VQT.mdb



VQT Test

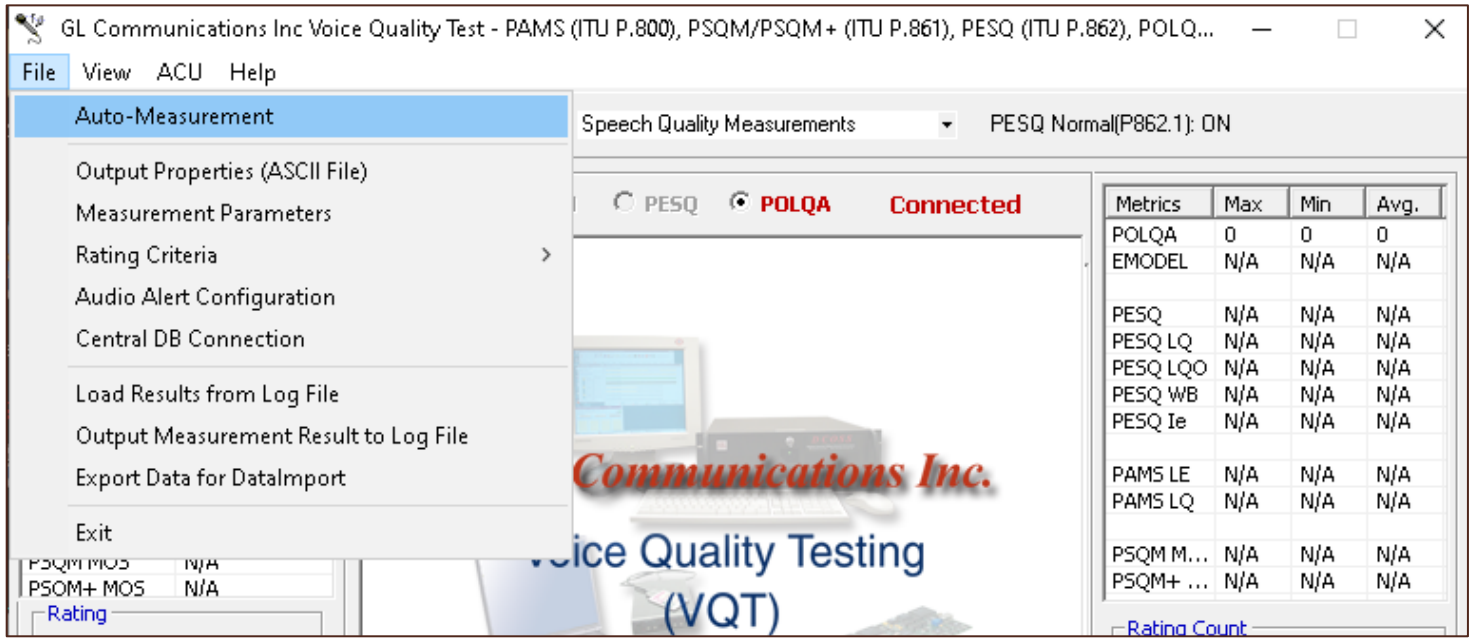
- Double-click on the GL VQT shortcut icon created on the desktop to invoke the application
- Double click on Data Import shortcut icon created on the desktop to start the database
- MAPS™ APS records degraded files into designated directories. VQT Auto Measurement automatically performs analysis when new degraded file is detected
- POLQA results are stored into a database via Data Import and results are read by MAPS™ APS

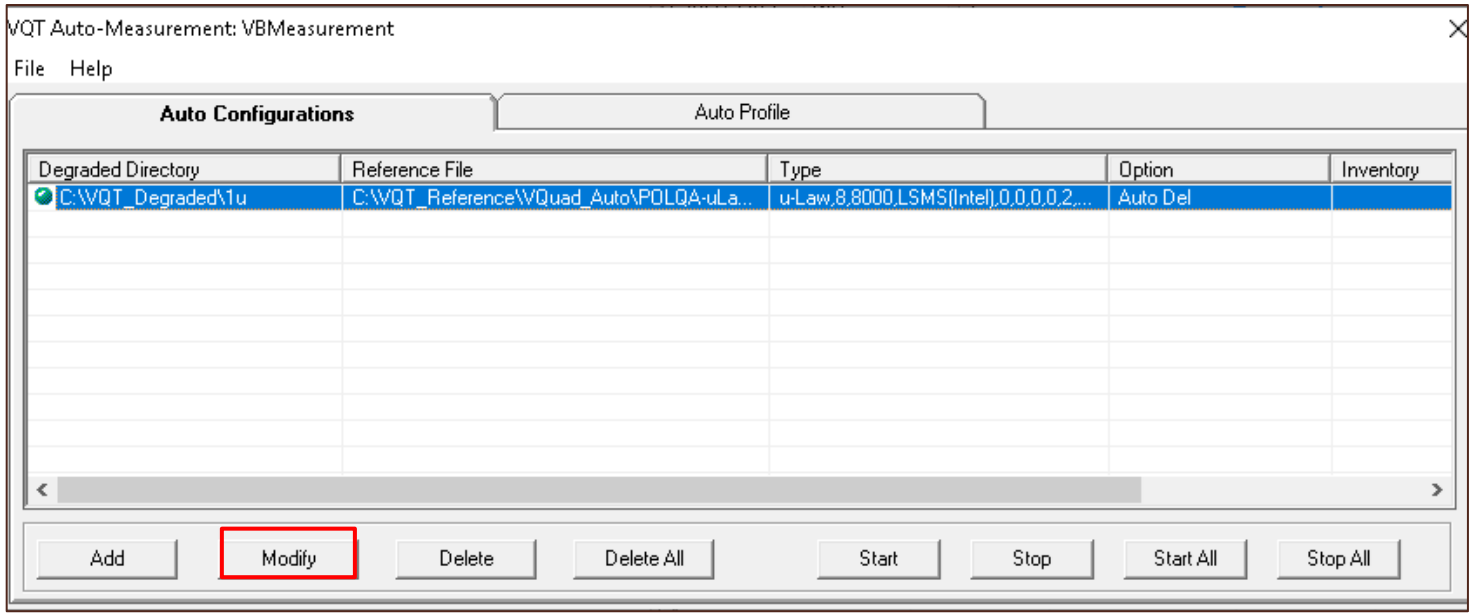




VQT Test Parameters

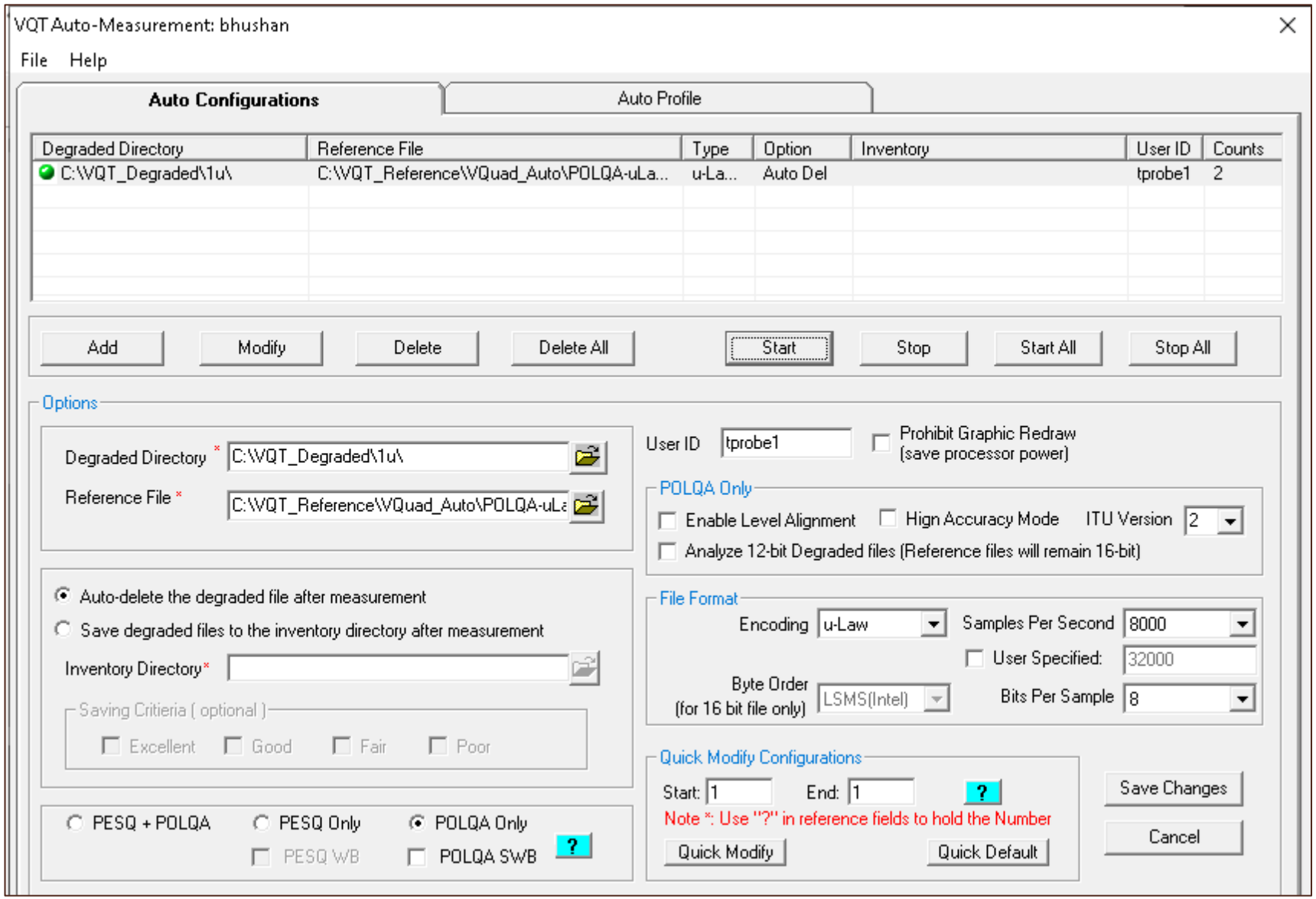
- On the VQT application, click on **File** → **Auto-Measurement** to invoke VQT Auto-Measurement window
- Click on **Modify** to configure Auto-Measurement parameters





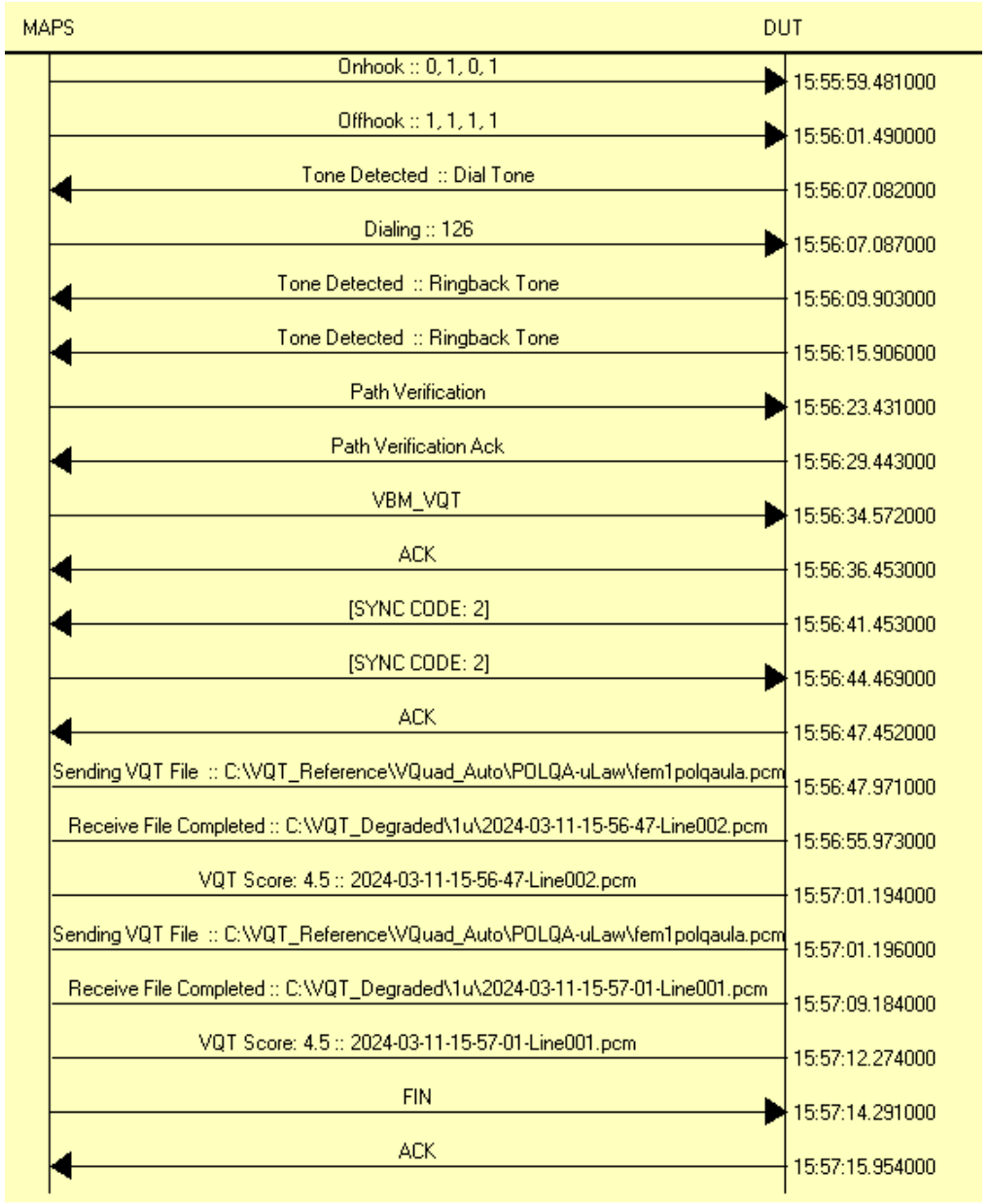
VQT Test Parameters

- Degraded File Path should match the Degraded Directory defined in the MAPS™ APS VQT parameters in profiles
- Reference File should match the Reference File specified in the MAPS™ APS VQT parameters
- After configuring, click on **Start**
- VQT Auto Measurement monitors files recorded to that directory and automatically performs POLQA analysis. VQT scores are stored in a database which is read by MAPS™



VF_Originating.gls Ladder Diagram (Master)

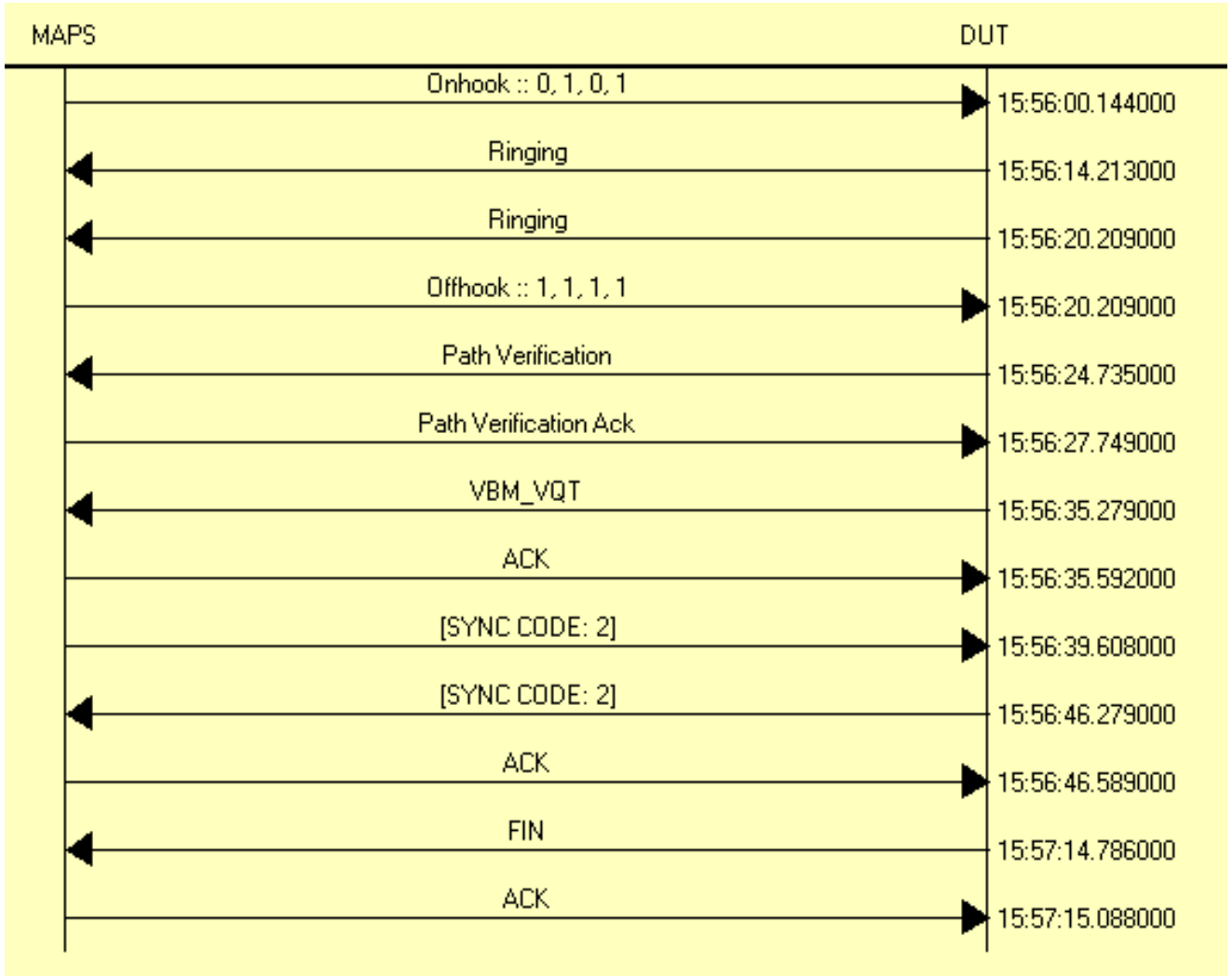
- Initially both sides are On-hook
- When it goes Off hook, dial tone is detected, the number is dialed and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under **Events** column, right-click and select the **VQT Test** then **VBM VQT** request tone (**Frequency:751Hz, Power: -13dBm and Duration:300ms**) is sent
- After receiving the **ACK** (**Frequency:2351Hz , Power: -13dBm and Duration: 300ms**) PlaceCall sends a reference file
- Test the reverse direction: After receiving the **VBM VQT** request, **ACK** will be sent to receive the Degraded files and calculates the POLQA Score and Retrieve VQT results from VQT database
- Finally, a **FIN** (**Frequency:1949Hz,Power: -13dBm and Duration:300ms**) is received to end the test and subsequently an ACK is sent to indicate that call will be terminated



GL Communications

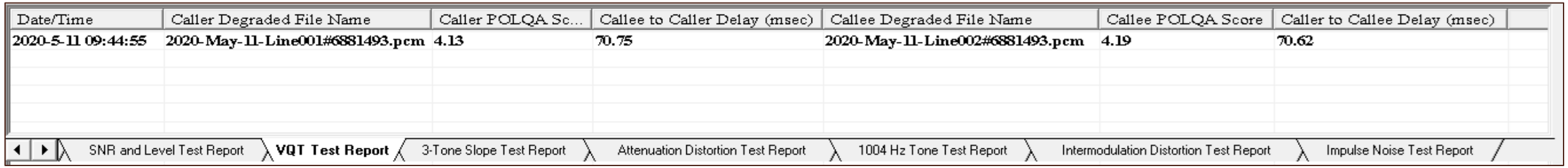
VF_Terminating.gls Ladder Diagram (Slave)

- Initially both sides are on-hook
- An incoming call is detected When the call is answered on the second ring, an Off-Hook is sent.
- After the Path Verification Ack AnswerCall side receives **VBM VQT** request tone (**Frequency:751Hz, Power: -13 dBm and Duration:300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power:-13dBm and Duration:300ms**)
- After sending the **VBM VQT** request, **ACK** is received, and then AnswerCall sends reference file
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency:1949Hz, Power:-13dBm and Duration:300ms**), and subsequently sending an **ACK**



Test Results

- VQT measurement results are logged in the **VQT Test Report** tab for the current test. VQT test report contains Caller POLQA Score, Callee to Caller Delay (in msec), Callee Degraded File Name, Callee POLQA Score, and Caller to Callee Delay (in msec)



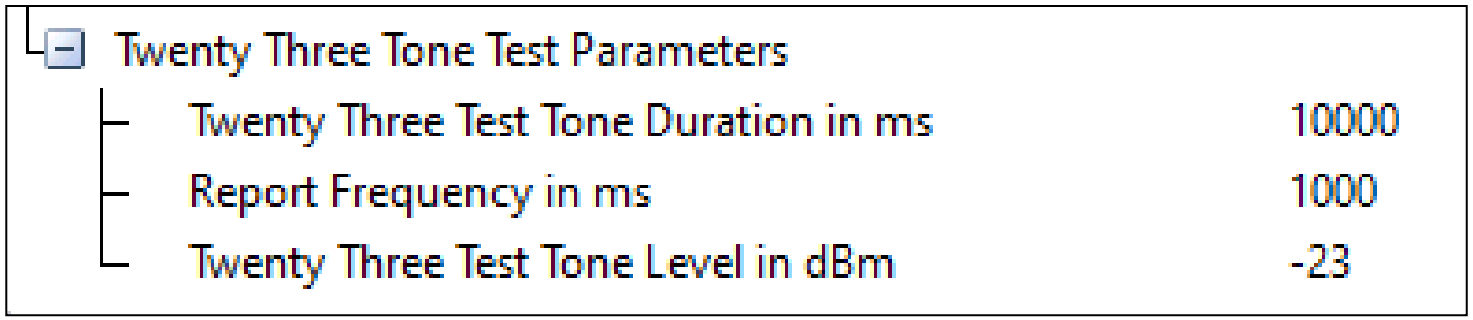
Date/Time	Caller Degraded File Name	Caller POLQA Sc...	Callee to Caller Delay (msec)	Callee Degraded File Name	Callee POLQA Score	Caller to Callee Delay (msec)
2020-5-11 09:44:55	2020-May-11-Line001#6881493.pcm	4.13	70.75	2020-May-11-Line002#6881493.pcm	4.19	70.62

SNR and Level Test Report | **VQT Test Report** | 3-Tone Slope Test Report | Attenuation Distortion Test Report | 1004 Hz Tone Test Report | Intermodulation Distortion Test Report | Impulse Noise Test Report

Twenty-Three Tone Test

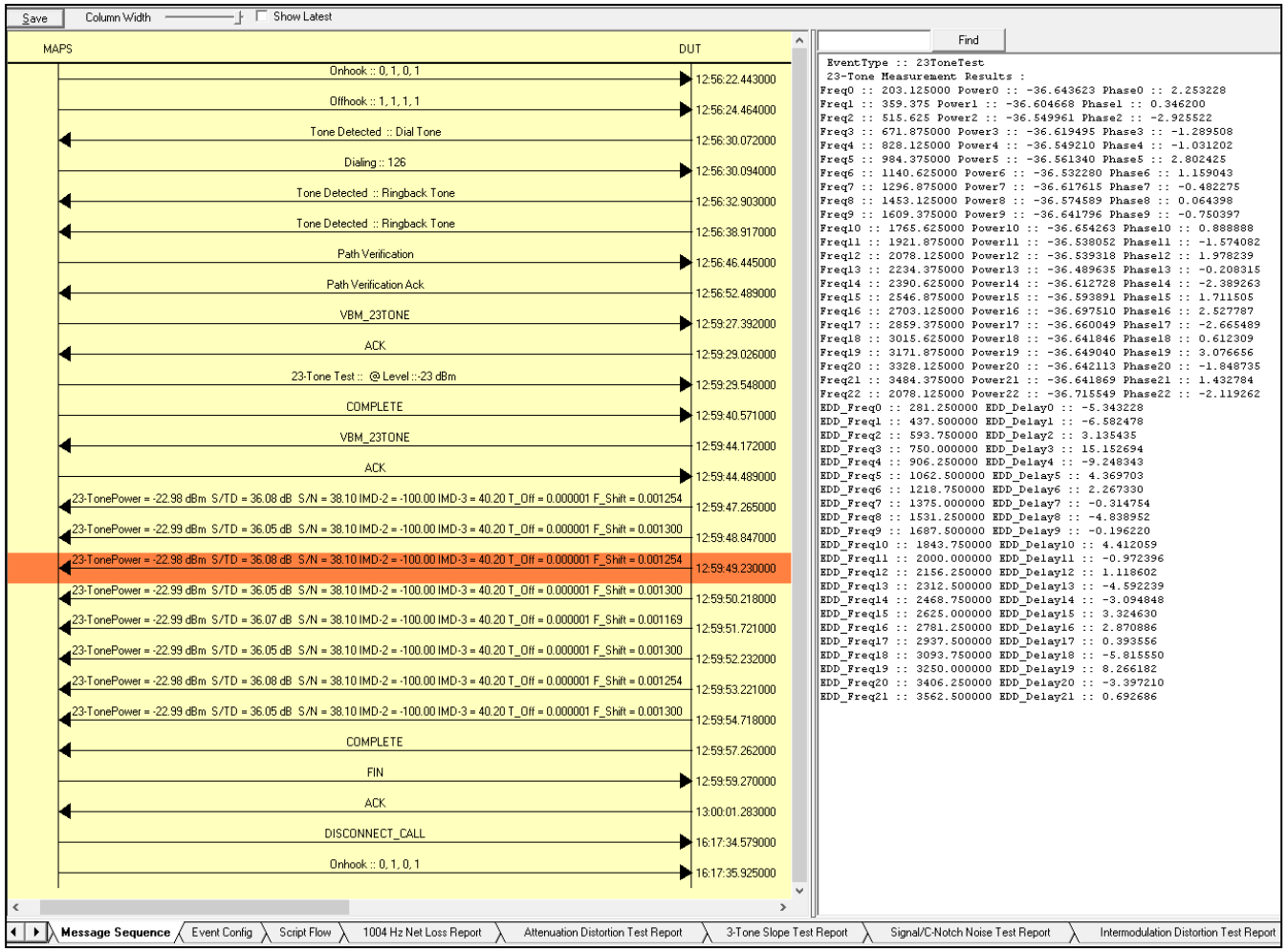
Twenty-Three Tone Test

- The Twenty-Three test signal consists of 23 equally spaced tones from 203.125Hz to 3640.625Hz with known phase relationships. Since the phases of the 23 tones are known, straightaway envelope delay distortion measurements made at 22 frequencies. At the same time, the frequency response (or attenuation distortion) at the 23 transmitted frequencies measured along with other measurements
- The following parameters can be configured in the Global profile for Twenty-Three Tone Test Parameters:
  - Twenty-Three Tone Test Duration in ms
  - Report Frequency in ms
  - Twenty-Three Test Tone Level in dBm



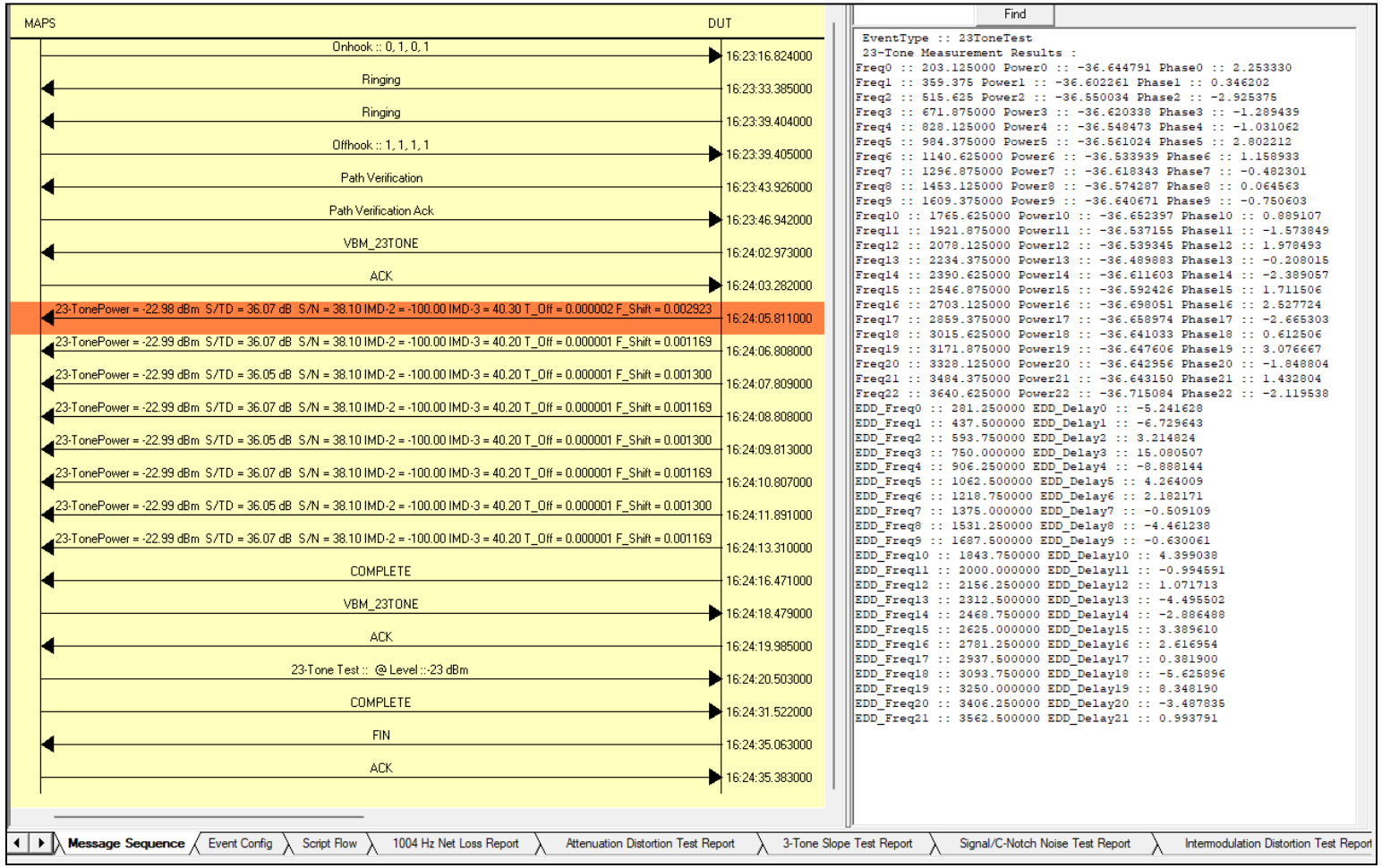
VF_Originating.gls Ladder Diagram (Master)

- Initially both sides are On-Hook
- When it goes Off hook, dial tone is detected, the number is dialed and ring back tone is received
- Connection is established and Path Verification is done
- Waiting for user input. Under Events column, right-click on the running call and select the required **23 Tone Test** then **VBM-23 Tone** request tone **(Frequency: 1781Hz, Power: -13dBm and Duration:300ms)** is sent
- After receiving **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration:300ms**), PlaceCall sends the 23 tone test.
- After receiving **COMPLETE (Frequency:2251Hz,Power: -13dBm and Duration:300ms)** tone, AnswerCall side will send **VBM 23 Tone** request tone and receives the ACK
- After receiving the ACK, Answercall sends the 23 tone test.
- Finally, a **FIN (Frequency: 1949Hz, Power: -13dBm and Duration:300ms)** is received to end the test and subsequently a **ACK (Frequency: 2351Hz, Power: -13 dBm and Duration:300ms)** is sent to indicate that call will be terminated



VF_Terminating.gls Ladder Diagram (Slave)

- Initially both sides are On-Hook
- An incoming call is detected. When the call is answered on the second ring, an Off-Hook is sent
- After the Path Verification Ack, Answercall side receives **VBM 23 Tone** request tone (**Frequency:1781Hz, Power: -13 dBm and Duration:300ms**) and acknowledged by sending **ACK** (**Frequency: 2351Hz, Power: -13dBm and Duration:300ms**)
- Then AnswerCall side detects the received **23** tone at **-23dBm** level for duration of 10sec and keep the result in the **23 Tone Test Report t**ab
- After receiving **COMPLETE** (**Frequency:2251Hz, Power: -13dBm and Duration:300ms**) tone, AnswerCall side will send **VBM 23 Tone** request tone and receives the **ACK**
- Now Answercall side sends the 23 tone test.
- AnswerCall side terminates the call by receiving the **FIN** (**Frequency: 1949Hz, Power: -13dBm and Duration:300ms**), and subsequently sending an **ACK**



Test Results

- The **23-Tone tab** results are as follows:

Date/Time	Total Signal P...	Total 23-Tone Power (...	S/TDR	SNR	IMD 2nd Order	IMD 3rd Order	T_Off	F_Shift
2024-3-1 12:59:31	-22.988426	-22.989771	36.085354	38.160557	-100.000000	40.288956	0.000001	0.001254
2024-3-1 12:59:32	-22.988659	-22.990009	36.058861	38.134090	-100.000000	40.262421	0.000001	0.001300
2024-3-1 12:59:33	-22.988426	-22.989771	36.085354	38.160557	-100.000000	40.288956	0.000001	0.001254
2024-3-1 12:59:34	-22.988947	-22.990295	36.071377	38.149170	-100.000000	40.270748	0.000001	0.001169
2024-3-1 12:59:35	-22.988947	-22.990295	36.071377	38.149170	-100.000000	40.270748	0.000001	0.001169
2024-3-1 12:59:36	-22.988947	-22.990295	36.071377	38.149170	-100.000000	40.270748	0.000001	0.001169
2024-3-1 12:59:37	-22.988426	-22.989771	36.085354	38.160557	-100.000000	40.288956	0.000001	0.001254
2024-3-1 12:59:38	-22.988659	-22.990009	36.058861	38.134090	-100.000000	40.262421	0.000001	0.001300

Date/Time	Freq0	Power0	Phase0	Freq1	Power1	Phase1	Freq2	Power2	Phase2	Freq3	Power3	Phase3
2024-3-1 12:59:31	203.125000	-36.643623	2.253228	359.375	-36.604668	0.346200	515.625	-36.549961	-2.925522	671.875000	-36.619495	-1.28950
2024-3-1 12:59:32	203.125000	-36.644096	2.253417	359.375	-36.603668	0.346299	515.625	-36.550247	-2.925542	671.875000	-36.620953	-1.28948
2024-3-1 12:59:33	203.125000	-36.643623	2.253228	359.375	-36.604668	0.346200	515.625	-36.549961	-2.925522	671.875000	-36.619495	-1.28950
2024-3-1 12:59:34	203.125000	-36.642929	2.253314	359.375	-36.606075	0.346297	515.625	-36.550179	-2.925689	671.875000	-36.620110	-1.28954
2024-3-1 12:59:35	203.125000	-36.642929	2.253314	359.375	-36.606075	0.346297	515.625	-36.550179	-2.925689	671.875000	-36.620110	-1.28954
2024-3-1 12:59:36	203.125000	-36.642929	2.253314	359.375	-36.606075	0.346297	515.625	-36.550179	-2.925689	671.875000	-36.620110	-1.28954
2024-3-1 12:59:37	203.125000	-36.643623	2.253228	359.375	-36.604668	0.346200	515.625	-36.549961	-2.925522	671.875000	-36.619495	-1.28950
2024-3-1 12:59:38	203.125000	-36.644096	2.253417	359.375	-36.603668	0.346299	515.625	-36.550247	-2.925542	671.875000	-36.620953	-1.28948

Event Config | Script Flow | 1004 Hz Net Loss Report | Attenuation Distortion Test Report | 3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | Impulse Noise Test Report | S/NR/Net Loss vs Level Test Report | VQT Test Report | **23-Tone Test Report**

Initialisation Errors | Error Events | Captured Errors | Link Status Up=0 Down=0

Phase3	Freq4	Power4	Phase4	Freq5	Power5	Phase5	Freq6	Power6	Phase6	Freq7	Power7	Phase7	Freq8	Power8	Phase8	Freq9	Power9	Phase9	Freq10	Power10
-1.289508	828.125000	-36.549210	-1.031202	984.375000	-36.561340	2.802425	1140.625000	-36.532280	1.159043	1296.875000	-36.617615	-0.482275	1453.125000	-36.574589	0.064398	1609.375000	-36.641796	-0.750397	1765.625000	-36.65426
-1.289480	828.125000	-36.549305	-1.031278	984.375000	-36.560146	2.802326	1140.625000	-36.533222	1.159161	1296.875000	-36.619900	-0.482354	1453.125000	-36.574665	0.064586	1609.375000	-36.642254	-0.750467	1765.625000	-36.65445
-1.289508	828.125000	-36.549210	-1.031202	984.375000	-36.561340	2.802425	1140.625000	-36.532280	1.159043	1296.875000	-36.617615	-0.482275	1453.125000	-36.574589	0.064398	1609.375000	-36.641796	-0.750397	1765.625000	-36.65426
-1.289549	828.125000	-36.550041	-1.031418	984.375000	-36.560459	2.802540	1140.625000	-36.531563	1.159270	1296.875000	-36.619171	-0.482328	1453.125000	-36.574970	0.064422	1609.375000	-36.643379	-0.750260	1765.625000	-36.65632
-1.289549	828.125000	-36.550041	-1.031418	984.375000	-36.560459	2.802540	1140.625000	-36.531563	1.159270	1296.875000	-36.619171	-0.482328	1453.125000	-36.574970	0.064422	1609.375000	-36.643379	-0.750260	1765.625000	-36.65632
-1.289549	828.125000	-36.550041	-1.031418	984.375000	-36.560459	2.802540	1140.625000	-36.531563	1.159270	1296.875000	-36.619171	-0.482328	1453.125000	-36.574970	0.064422	1609.375000	-36.643379	-0.750260	1765.625000	-36.65632
-1.289508	828.125000	-36.549210	-1.031202	984.375000	-36.561340	2.802425	1140.625000	-36.532280	1.159043	1296.875000	-36.617615	-0.482275	1453.125000	-36.574589	0.064398	1609.375000	-36.641796	-0.750397	1765.625000	-36.65426
-1.289480	828.125000	-36.549305	-1.031278	984.375000	-36.560146	2.802326	1140.625000	-36.533222	1.159161	1296.875000	-36.619900	-0.482354	1453.125000	-36.574665	0.064586	1609.375000	-36.642254	-0.750467	1765.625000	-36.65445

Event Config | Script Flow | 1004 Hz Net Loss Report | Attenuation Distortion Test Report | 3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | Impulse Noise Test Report | S/NR/Net Loss vs Level Test Report | VQT Test Report | **23-Tone Test Report**

Phase10	Freq11	Power11	Phase11	Freq12	Power12	Phase12	Freq13	Power13	Phase13	Freq14	Power14	Phase14	Freq15	Power15	Phase15	Freq16	Power16	Phase16	Freq17	Power17	Phase17	Freq18
0.888888	1921.875000	-36.538052	-1.574082	2078.125000	-36.539318	1.978239	2234.375000	-36.489635	-0.208315	2390.625000	-36.612728	-2.389263	2546.875000	-36.593891	1.711505	2703.125000	-36.697510	2.527787	2859.375000	-36.660049	-2.665489	3015.625000
0.888954	1921.875000	-36.538307	-1.573882	2078.125000	-36.538395	1.978411	2234.375000	-36.489132	-0.208278	2390.625000	-36.613186	-2.389193	2546.875000	-36.592304	1.711459	2703.125000	-36.699184	2.527588	2859.375000	-36.661018	-2.665371	3015.625000
0.888888	1921.875000	-36.538052	-1.574082	2078.125000	-36.539318	1.978239	2234.375000	-36.489635	-0.208315	2390.625000	-36.612728	-2.389263	2546.875000	-36.593891	1.711505	2703.125000	-36.697510	2.527787	2859.375000	-36.660049	-2.665489	3015.625000
0.888735	1921.875000	-36.539204	-1.574114	2078.125000	-36.538368	1.978157	2234.375000	-36.488888	-0.208578	2390.625000	-36.614307	-2.389398	2546.875000	-36.593769	1.711458	2703.125000	-36.698643	2.527651	2859.375000	-36.662094	-2.665557	3015.625000
0.888735	1921.875000	-36.539204	-1.574114	2078.125000	-36.538368	1.978157	2234.375000	-36.488888	-0.208578	2390.625000	-36.614307	-2.389398	2546.875000	-36.593769	1.711458	2703.125000	-36.698643	2.527651	2859.375000	-36.662094	-2.665557	3015.625000
0.888735	1921.875000	-36.539204	-1.574114	2078.125000	-36.538368	1.978157	2234.375000	-36.488888	-0.208578	2390.625000	-36.614307	-2.389398	2546.875000	-36.593769	1.711458	2703.125000	-36.698643	2.527651	2859.375000	-36.662094	-2.665557	3015.625000
0.888888	1921.875000	-36.538052	-1.574082	2078.125000	-36.539318	1.978239	2234.375000	-36.489635	-0.208315	2390.625000	-36.612728	-2.389263	2546.875000	-36.593891	1.711505	2703.125000	-36.697510	2.527787	2859.375000	-36.660049	-2.665489	3015.625000
0.888954	1921.875000	-36.538307	-1.573882	2078.125000	-36.538395	1.978411	2234.375000	-36.489132	-0.208278	2390.625000	-36.613186	-2.389193	2546.875000	-36.592304	1.711459	2703.125000	-36.699184	2.527588	2859.375000	-36.661018	-2.665371	3015.625000

Event Config | Script Flow | 1004 Hz Net Loss Report | Attenuation Distortion Test Report | 3-Tone Slope Test Report | Signal/C-Notch Noise Test Report | Intermodulation Distortion Test Report | Impulse Noise Test Report | S/NR/Net Loss vs Level Test Report | VQT Test Report | **23-Tone Test Report**

Thank you