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# MAPS™ FXO FXS Emulator and tProbe™

Automated Analog Terminal (FXO) and Network Port (FXS)

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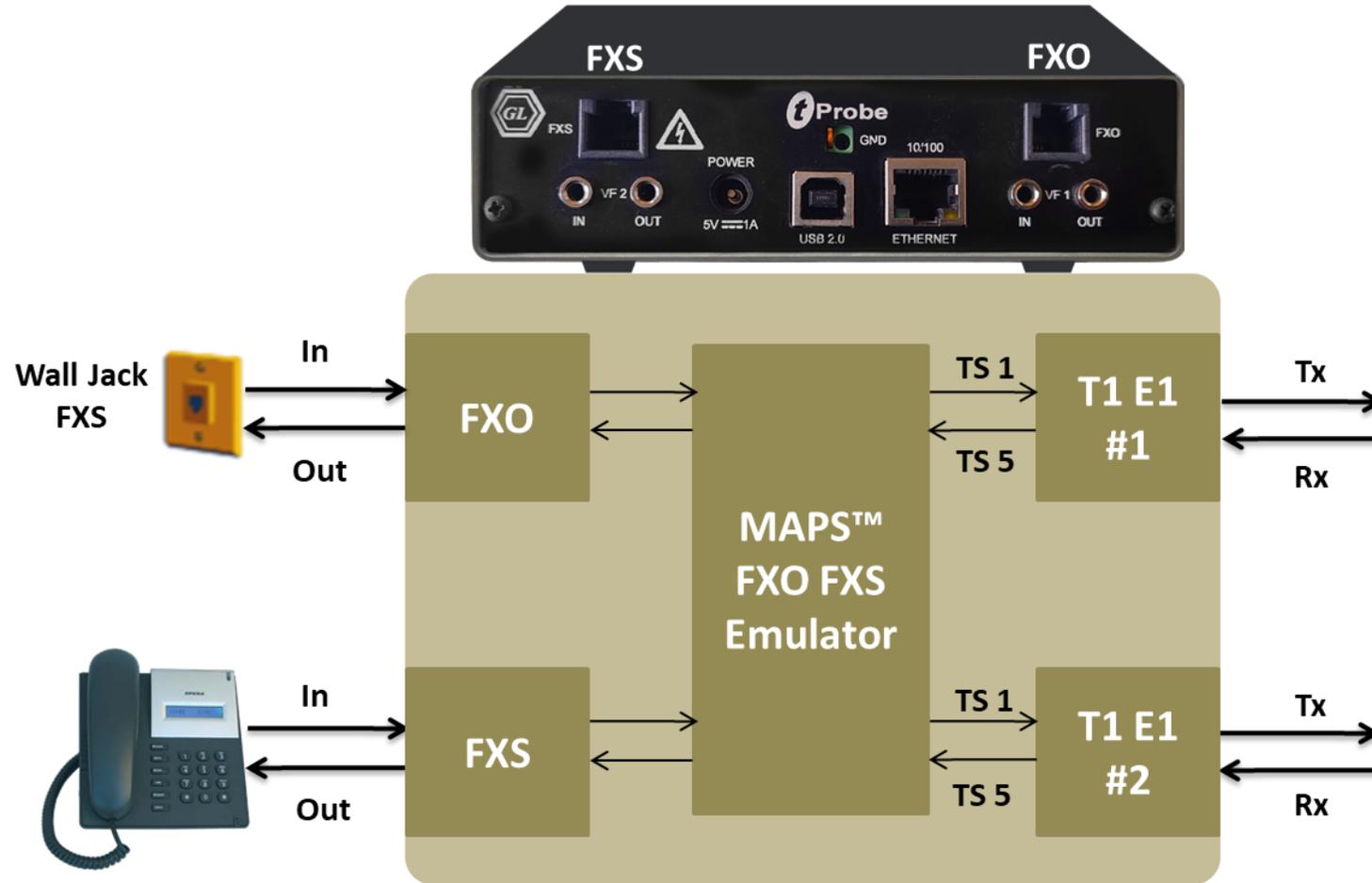


818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878  
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: [info@gl.com](mailto:info@gl.com)  
Website: <https://www.gl.com>

# What is FXO and FXS?

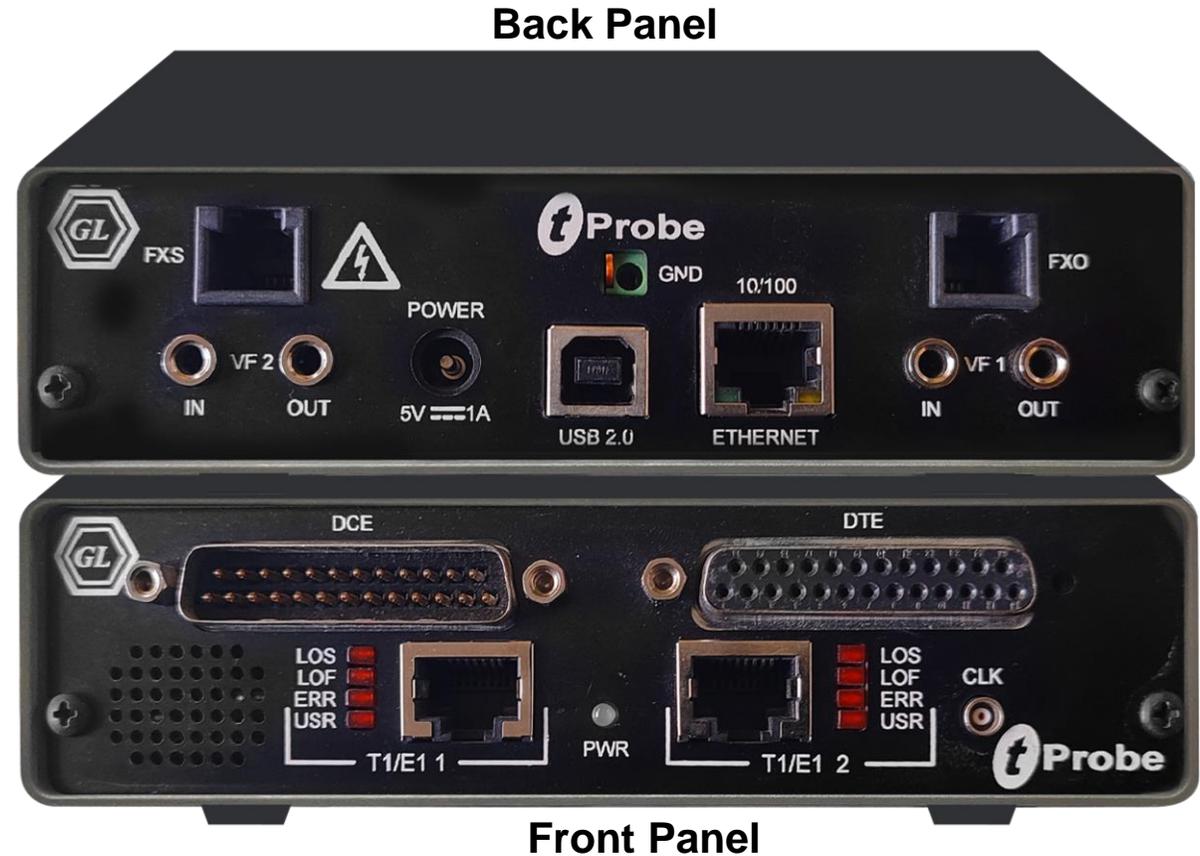
- Foreign Exchange Subscriber (FXS) and Foreign Exchange Office (FXO) are interfaces commonly used with analog phones and phone lines
- FXO stands for Foreign Exchange Office
  - FXO is the plug on the phone or fax machine, or the plug(s) on your analog phone system
  - FXO receives the analog line
- FXS stands for Foreign Exchange Subscriber
  - FXS is the plug on the wall that delivers a ring signal and dial tone
  - FXS delivers the analog line to the subscriber

# MAPS™ FXO FXS Emulator



# tProbe™ Unit

- tProbe™ T1 E1 is an enhanced USB Based T1 and E1 solution that is capable of both T1 and E1 interfacing
- Available with Dual T1 E1, FXO, FXS, DTE, and DCE interfaces
- Forward thinking hardware design for future daughter board expansion applications
- Connects to a PC via a USB 2.0 port
- Access Remotely



# Why the product is superior?

- Portable with advanced test features such as Pulse Shape Analysis and Jitter Management and Analysis
- “Cross-port Through “ Mode and “Cross-port Transmit” Mode- these settings make cabling with Drop insert and Fail-Safe Inline Monitoring very easy
- Enhanced VF Drop and VF Insert Capabilities (Including 3.5mm or Bantam Physical connection options)
- Improved circuitry for very accurate Digital Line Level measurements
- Forward thinking hardware design for future daughter board expansion applications
- Available with Dual T1 E1, FXO, FXS, DTE and DCE Interface

# Main Features

- Script based simulation of 2-Wire Telephone Port (FXO) and Telephone Wall Jack (FXS) for complete automation
- GUI and CLI based testing of FXO/FXS for automation and remote access
- Standalone testing of FXO/FXS with loopback
- Supports input and output signals of 8K samples/sec, u-law, A-law, and 16-bit Linear PCM
- FXO/FXS termination supports for over 70 different termination characteristics (different countries)
- Handle FXO-FXS responses - Caller ID Detection, Continuous monitoring of Voltage and Current, and High and Low Voltage/Currents Triggers
- Loudspeaker provided to hear the voice being transmitted on FXO/FXS ports
- Send /Receive fax image (TIFF format) file over FXO and FXS ports

# Applications

- Testing (simulation, and monitoring) 911, E-911, and NG-911 systems
- Testing gateways, VoIP ATAs, telephone lines, handsets, VoIP PBX
- Voice quality testing, 2wire call automation, Caller ID
- Monitoring signaling, voice, and tones on telephone lines non-intrusively
- Generation and reception of traffic on 2-wire telephone lines
- Provides fault insertion, and erroneous call flows testing capability
- Ready scripts make testing procedure simpler, less time consuming and hence time to market products
- Remote operation of FXO FXS ports over TCP/IP

# Digital Signal Formats

FXO/FXS supports following digital signal formats:

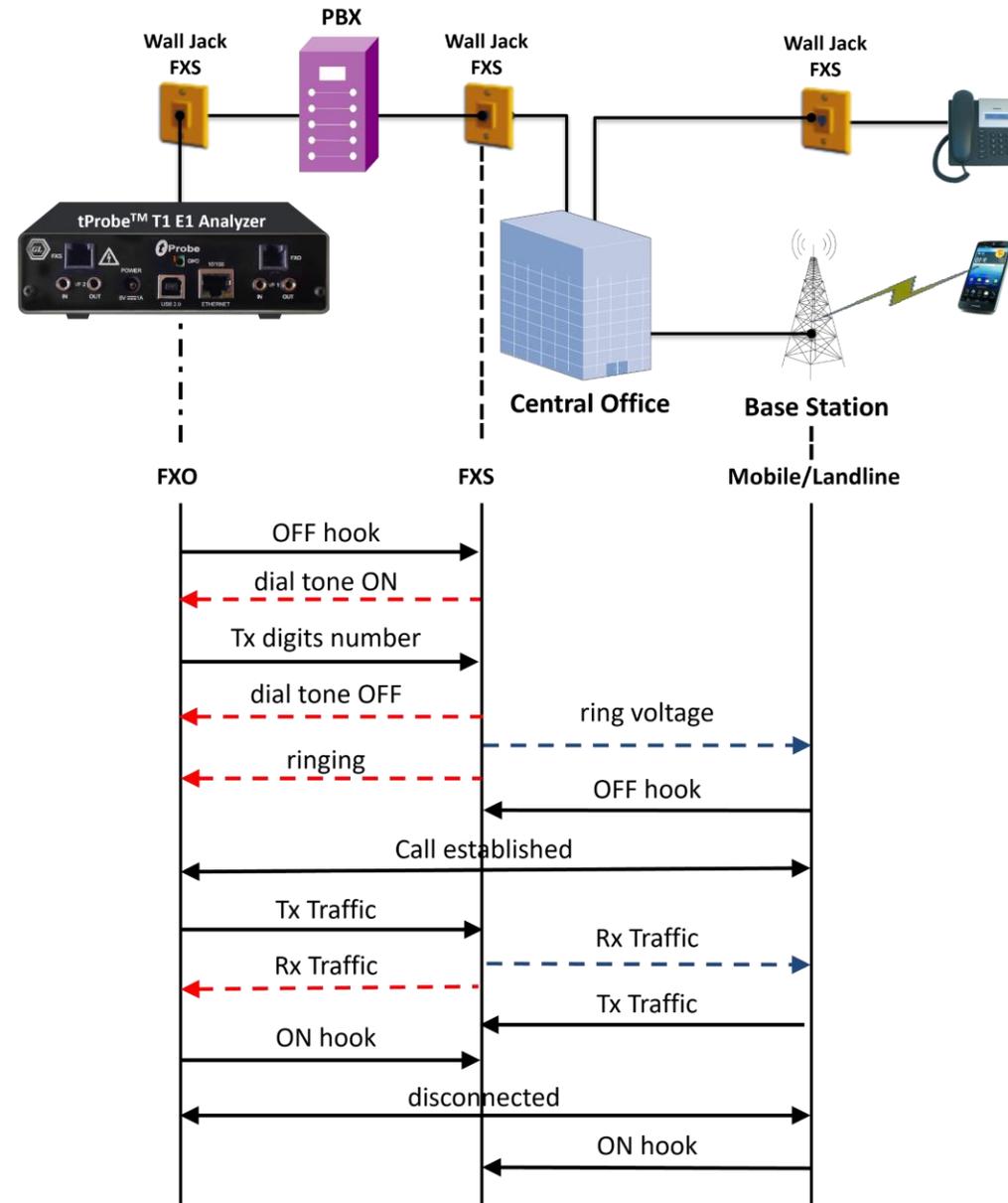
- A-Law: This is the 8-bit codebook format typically used in E1 systems
- Mu-Law: This is the 8-bit codebook format typically used in T1 systems
- 16-bit Linear: This is a 16-bit linear signal. Intel (“little-endian”) byte ordering is used. (Currently this feature is supported only by FXO)

# Supported Protocols

- Script based simulation of 2-Wire Telephone Port (FXO) and Telephone Wall Jack (FXS) for complete automation
- T1 Wink Start (R1 wink)
- T1 Loop Start and T1 Ground Start
- T1 Feature Group D (FGD)
- T1 Immediate Start
- T1 CAMA (Centralized Automated Message Accounting)
- E1 MFC-R2 (All variants, full / semi compelled) - Defined by the ITU Recommendations Q.421-Q.442 - uses multi-frequency compelled signaling protocol to exchange address information
- E1 European Digital CAS (EUC)
- E1 Digital E & M
- E1 International Wink Start
- E1 Sweden P7
- Any User-Defined CAS Protocol

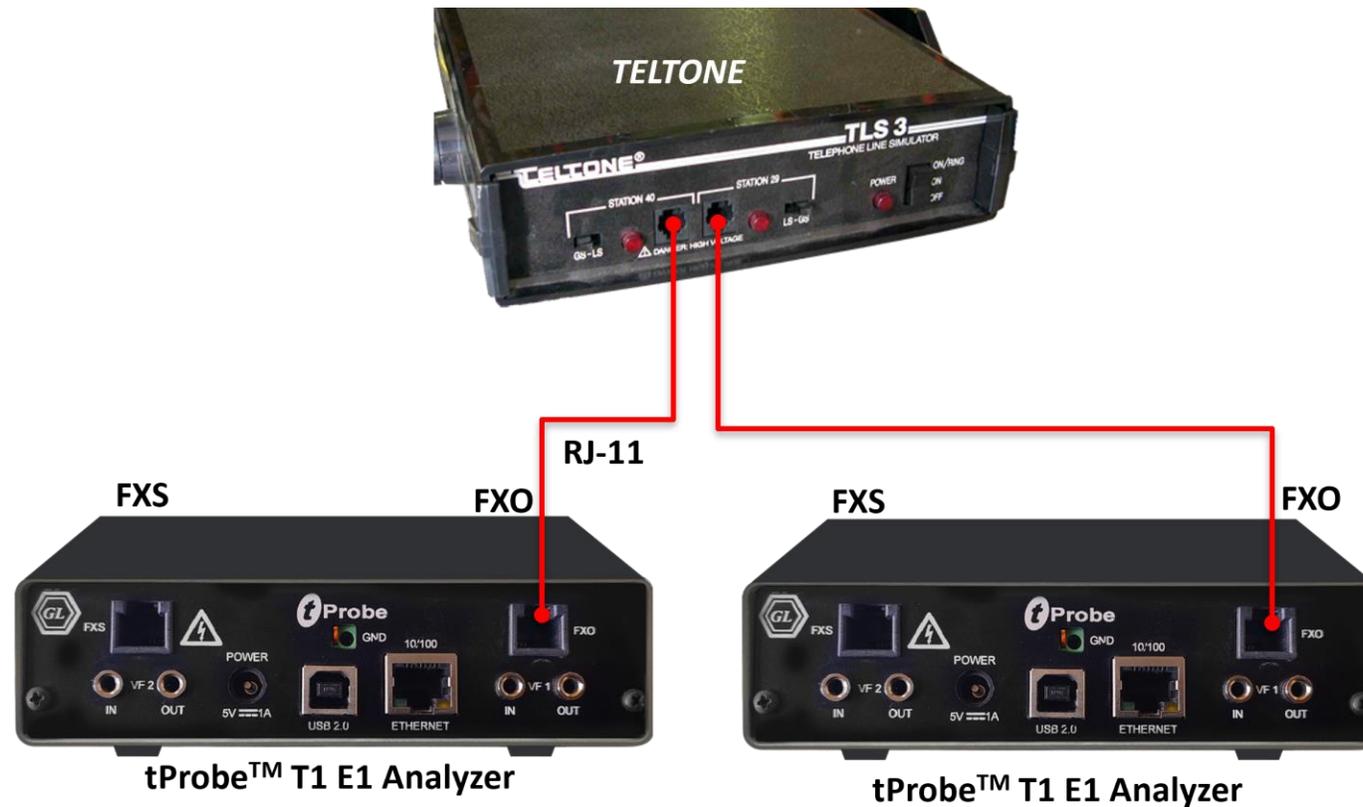
# tProbe™ FXO Port to Mobile or Landline Phone

- MAPS™ FXO FXS sets up the call from tProbe™ FXO port to the Landline or Mobile phone through the wall jack FXS, local PBX, and central office of the service provider and base station



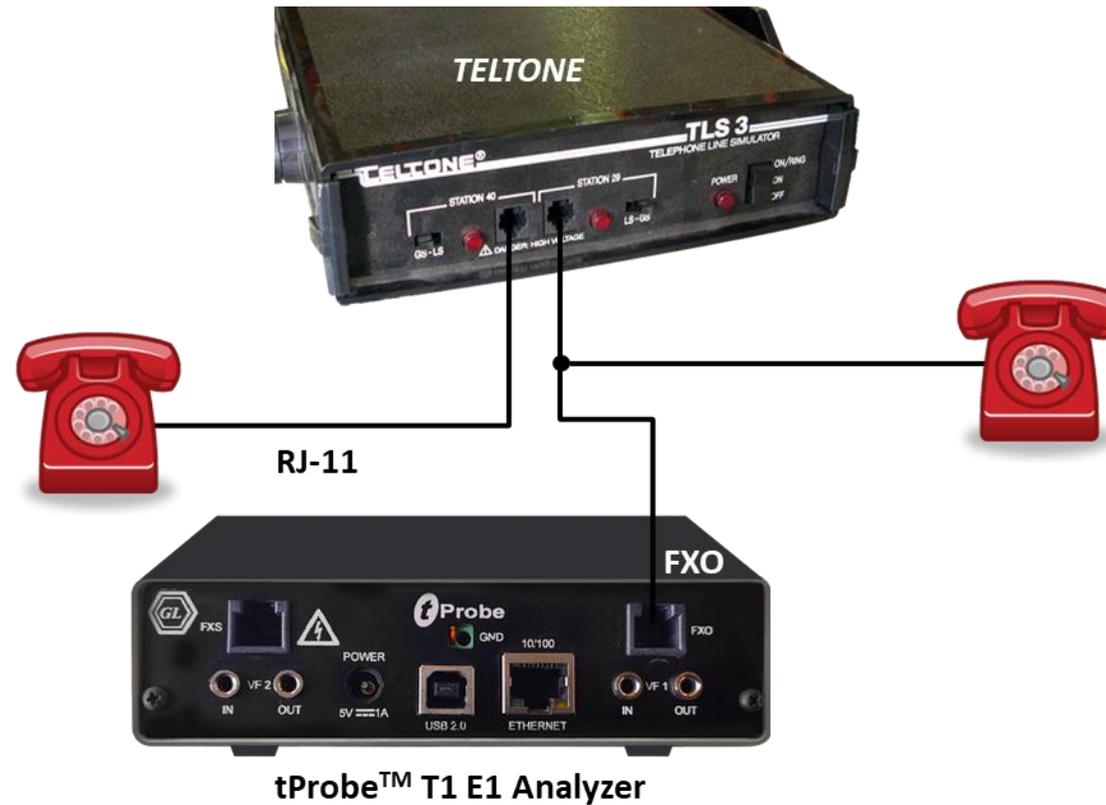
# tProbe1 (FXO) to tProbe2 (FXO) via Teltone TLS 3

- It is also possible to establish call from tProbe™ FXO port to another tProbe™ FXO port via a Teltone Switch. Teltone Switch (TLS) provides two FXS ports in it and acts as a local exchange connecting the two lines



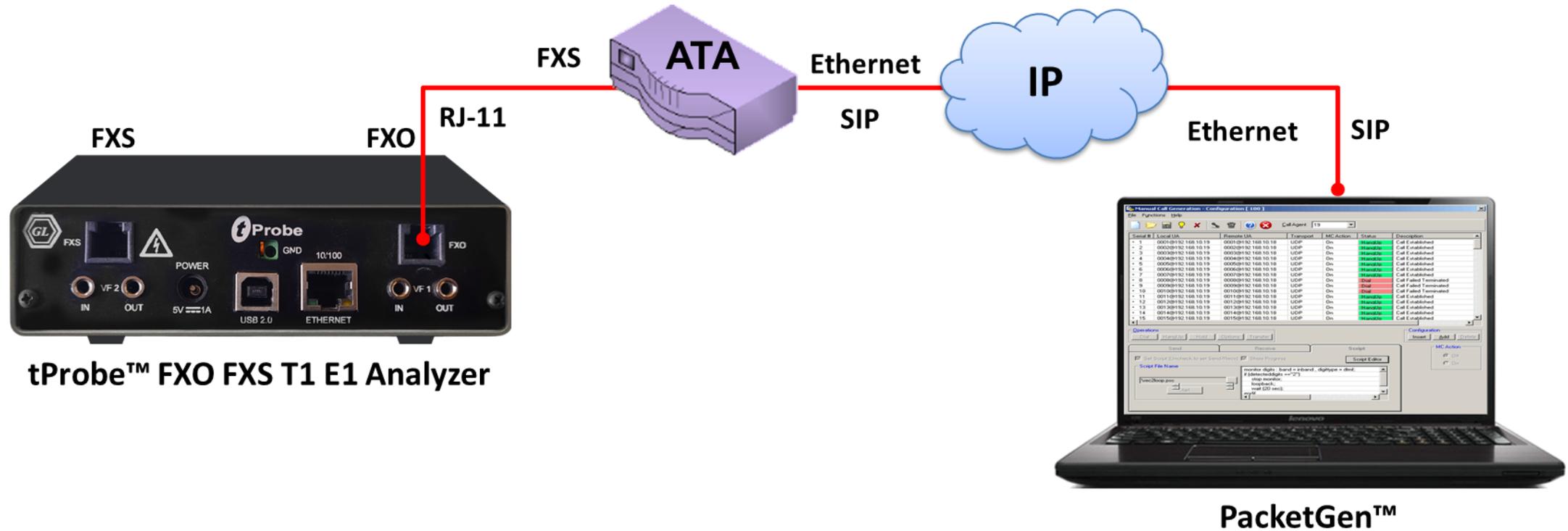
# tProbe™ FXO Call Monitoring

- Connection of tProbe™ FXO port in non-intrusive monitor mode via a Teltone Switch



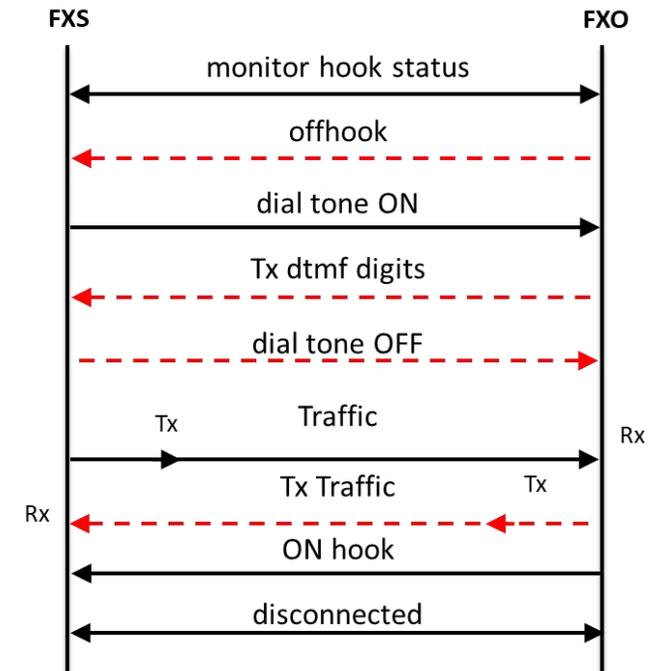
# tProbe™ FXO port to IP via ATA

- FXO port is connected to VoIP phone or PC with a local network via an ATA device
- The test scenario depicts the call established between tProbe™ FXO port and VoIP phone via ATA



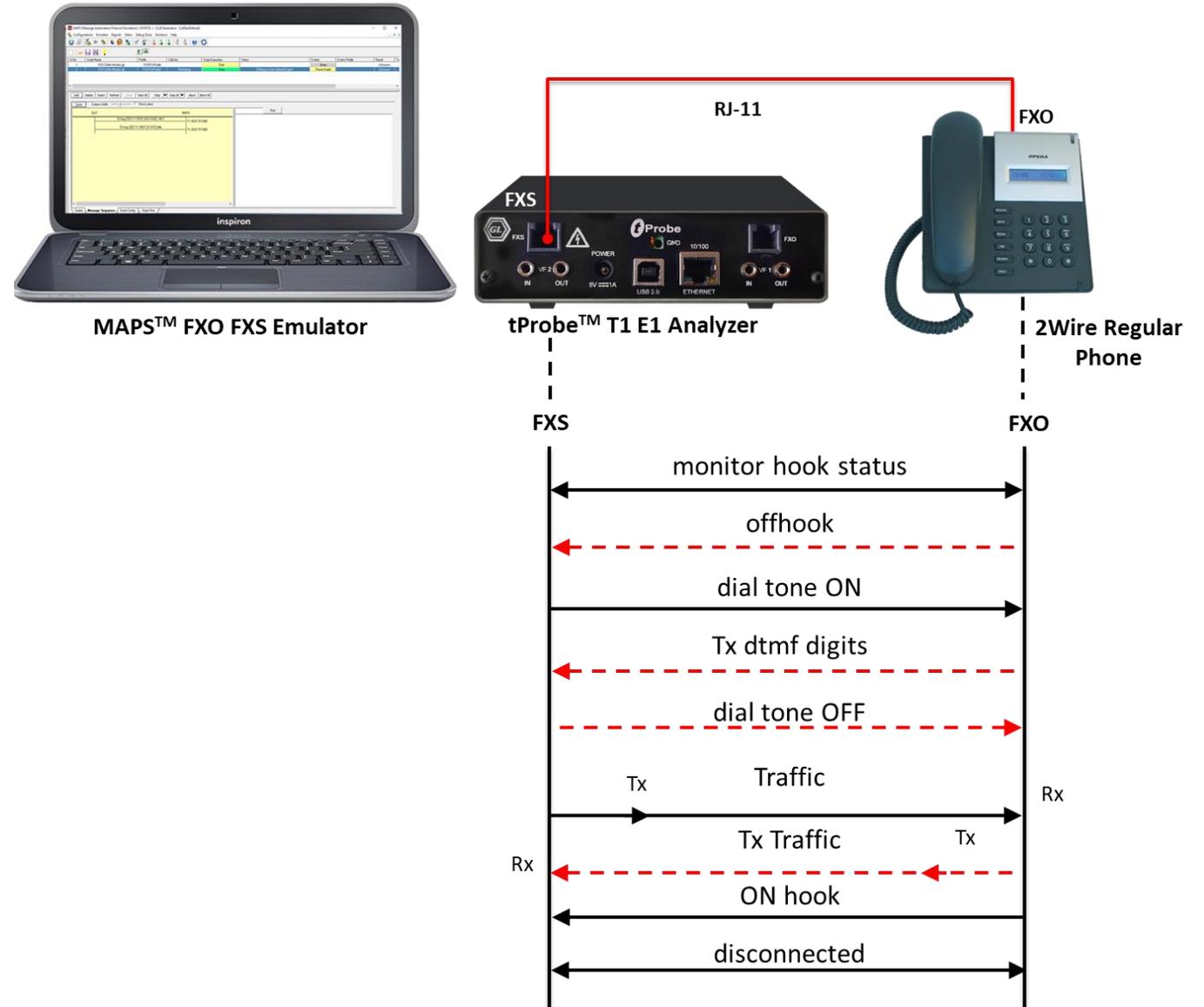
# tProbe™ FXO FXS ports in Loopback

- Script initializes tProbe™ FXO port and tProbe™ port parameters, places the call from the tProbe™ FXO port to tProbFXSe™ FXS port by sending DTMF digits, answers the call by asserting off-hook, captures the incoming traffic into the file and transmits traffic to the other end



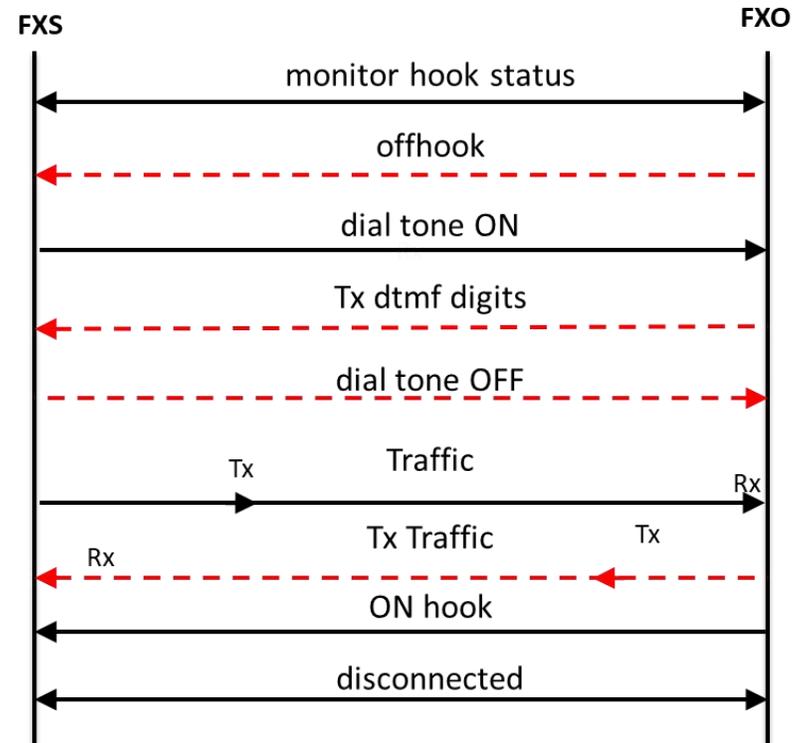
# tProbe™ FXS Port to Mobile or Landline Phone

- Depicts the call from tProbe™ FXS port to regular phone (2-wire phone) via RJ-11 cable. Places the ring to regular phone (2-wire phone), captures the incoming traffic into the file and transmits traffic to the other end



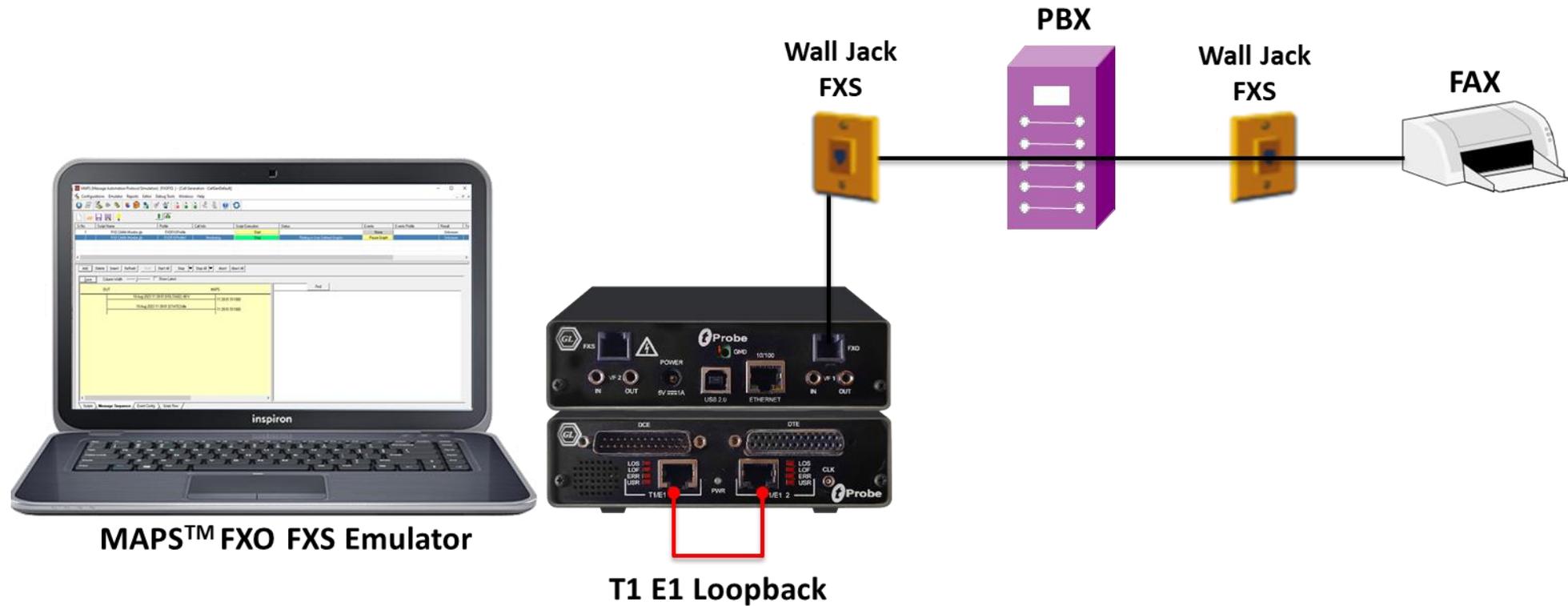
# tProbe™ FXS port to FXO on GL's Dual UTA

- The call flow between tProbe™ FXS port to GL's Dual UTA via RJ-11 cable, with Dual UTA HD initiating call



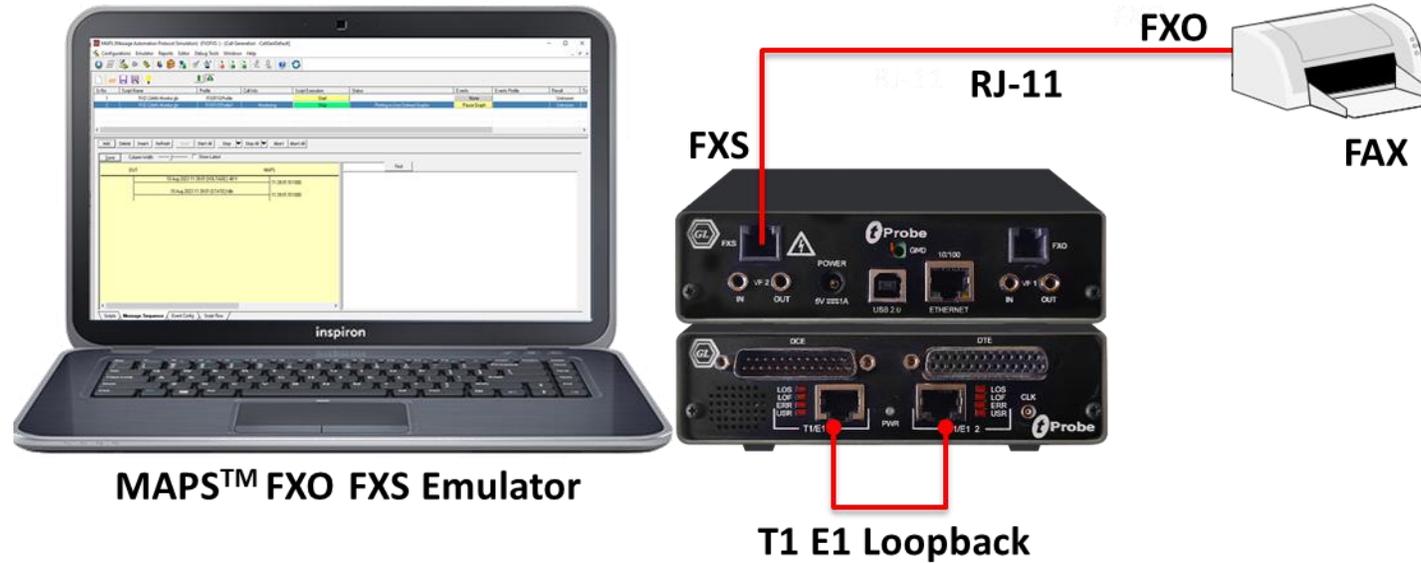
# FAX Simulation over Analog Lines

Send / Receive FAX over FXO Port

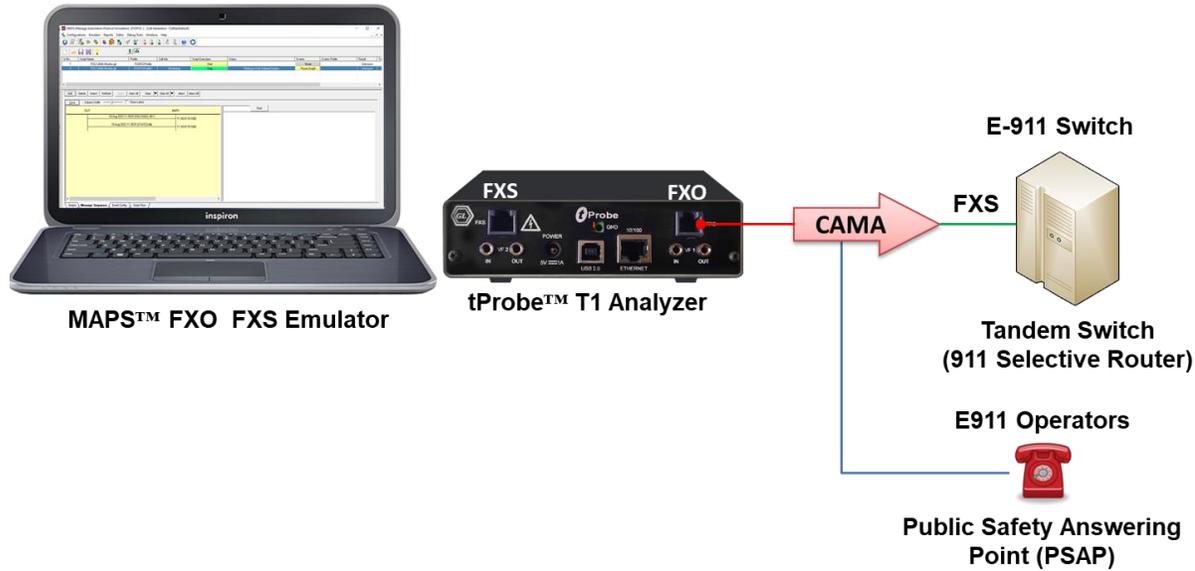


# FAX Simulation over Analog Lines (Contd.)

Send / Receive FAX over FXS Port

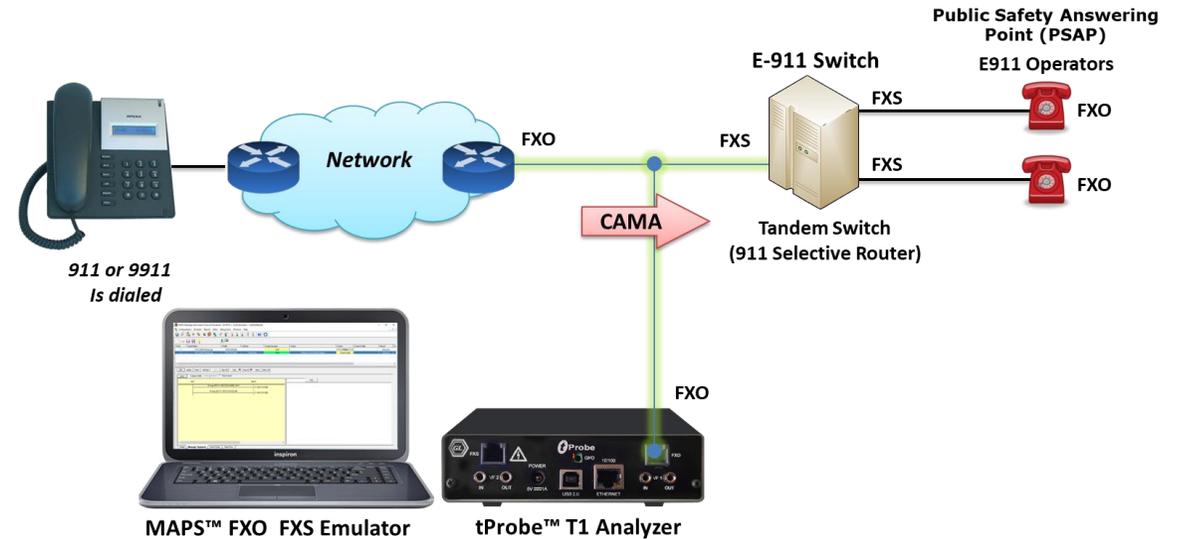


# CAMA Call Generation and Monitor



- The tProbe™ FXO port can be directly connected to 911 selective router or PSAP on CAMA-type circuits for simulation of CAMA calls to the selective router or PSAP
- The script will seize the line, wait for wink, dial ANI and wait for call connect

- The tProbe™ T1 FXO port can be tapped onto CAMA-type circuits for non-intrusive monitoring of 911 service



# FXO Monitoring of CAMA Type Trunks

## FXO CAMA Monitor Message Sequence

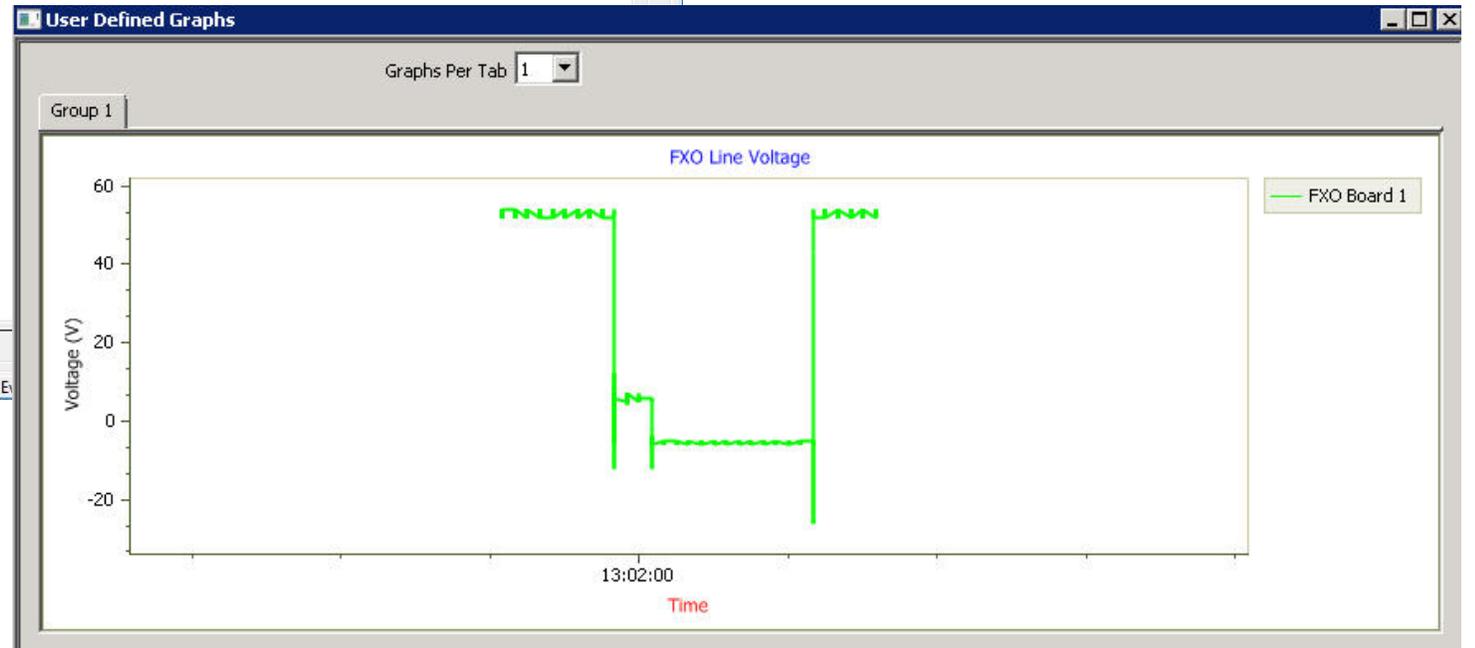
The screenshot shows the MAPS (Message Automation Protocol Simulation) interface. The main window displays a table with the following data:

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	E. Result	Total Iterations	Completed Iterations
1	FXO CAMA Monitor.gls	FXOFXSPProfile	Monitoring	Stop	Plotting in User Defined Graphs	Pause Graph	Unknown	1	0

Below the table, there is a sequence diagram showing the interaction between DUT and MAPS:

- Idle: 12:59:36.267000
- Seize: 12:59:40.083000
- Wink :: 225 msec: 12:59:40.682000
- KP 4242130000: 12:59:42.796000
- Ringback Tone: 12:59:43.068000
- Offhook: 12:59:43.882000

## FXO CAMA Signal Monitoring



# Testbed Configuration

MAPS (Message Automation Protocol Simulation) (FXO/FXS) - [Testbed Setup - USATestBed]

Configurations Emulator Reports Editor Windows Help

Config	Value
Configurations	
FXO FXS Line Parameters	
Enable PCM16 Encoding	Disable
Sample Rate	8 kbps
Enable or Disable Monitoring Current and Voltage	Enable
Monitor Current and Voltage Reporting Time in msec	100
FXO	
In Gain in dB	0.00
Out Gain in dB	0.00
Termination	USA
Start Protocol	Loop
Monitor Line Status	Current
Low Current Trigger in ma	5.00
High Current Trigger in ma	10.00
Low Voltage Trigger in volts	-20.00
High Voltage Trigger in volts	-5.00
FXS	
In Gain 0 dB to 6 dB	0.00
Out Gain 0 dB to 6 dB	0.00
Termination	600
Polarity	Forward(Tip-Ring)
Battery Voltage in volts	48.00
Loop Current Disconnect Duration in msec	200
FXS Ring Parameters	
Frequency in Hz	20
Voltage in volts	70
Ring On Time in msec	2000
Ring Off Time in msec	2000
FXO FXS Tone Parameters	
FXO Multi Tone Detection File	northamerica.mtd usa.xml
End User Configuration	

\_ExchangeType  
Select Option  
USA

Start Edit

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

# Profile Configuration

The screenshot displays the MAPS (Message Automation Protocol Simulation) Profile Editor window. The title bar reads "MAPS (Message Automation Protocol Simulation) (FXO/FXS) - [Profile Editor - USA]". The menu bar includes "Configurations", "Emulator", "Reports", "Editor", "Debug Tools", "Windows", and "Help". The toolbar contains various icons for file operations and simulation control.

The main workspace is divided into three panes:

- Profiles (Edit-F2):** A list showing profile "1 FXO/FXSProfile".
- Config:** A tree view showing the configuration structure for "FXO/FXSProfile".
- Value:** A table displaying the values for the selected configuration items.

The configuration tree is expanded to show the following parameters:

- FXO/FXS Parameters:**
  - FXO Card Number: 1
  - FXS Card Number: 2
  - Rx Timeslot: 1
  - Tx Timeslot: 5
- Dial Digit Parameters:**
  - Dial Digits: 345
  - Dial Digit Power in db: -11
  - OnTime in msec: 100
  - Off time in msec: 100
- Signaling Parameters:**
  - Tone:** 4
    - Tone 1:**
      - Tone Name: Dial Tone
      - Tone name defined in MTD file: Dial Tone
      - Frequency 1 in Hz: 350
      - Frequency 2 in Hz: 440
      - Power in dBm: -10
      - On Time in msec: 3000
      - Off Time in msec: 0
    - Tone 2:**
      - Tone Name: Ringback Tone
      - Tone name defined in MTD file: Ringback Tone
      - Frequency 1 in Hz: 440
      - Frequency 2 in Hz: 480
      - Power in dBm: -10
      - On Time in msec: 2000

The right pane shows a "Enable" checkbox which is checked. At the bottom of the right pane are buttons for "Add", "Insert", "Delete", and "Properties".

At the bottom of the window, there are status indicators for "Initialisation Errors", "Error Events", "Captured Errors", and "Link Status Up=0 Down=0".

# FXO FXS Call Simulation

## Call Simulation

MAPS (Message Automation Protocol Simulation) (FXOFXS) - [Call Generation - CallGenDefault]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Event...	Result	Total Iterations	Completed Iterations
1	FXO Placecall.gls	FXDFXSProfile	1,1	Start	Call Disconnected	None		Pass	1	1
2	FXS AnswerCall.gls	FXDFXSProfile	2,1	Start	Call Disconnected	None		Pass	1	1
3	FXS Placecall.gls	FXDFXSProfile		Start		None		Unknown	1	0
4	FXO Answercall.gls	FXDFXSProfile		Start		None		Unknown	1	0

Add Delete Insert Refresh Start Start All Stop Stop All Abort Abort All

Save Column Width Show Latest

MAPS DUT

SEIZURE::Offhook 16:53:51.958000

Tone Detected :: Dial Tone 16:53:55.066000

DIALING::Digits - 345 16:53:55.066000

Tone Detected :: Ringback Tone 16:54:00.666000

Tone Detected :: Ringback Tone 16:54:06.766000

CONNECTED 16:54:13.278000

File Transmitted :: mu-law samples\vijay.pcm 16:54:33.342000

DISCONNECT :: Low Line Voltage 16:56:04.216000

DISCONNECTED :: Onhook 16:56:04.216000

File Recorded :: MAPS\Recv Files\FxoFxs/E0.pcm 16:56:13.297000

EventType :: File Transmitted

File Name :: mu-law samples\vijay.pcm

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events

## Event Log

Events

Event Log Error Events Captured Errors

Date/Time	Captured Events	Call Trace Id	Script Name	Script Id
2014-12-4 16:57:16.993000	FxoBoardCount = 2	GetBoardCount	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:21.213000	FxoFxsType = FXSIN_OUT	2,1	FXS AnswerCall.gls	CGProtScriptId_24440240-4607-3616
2014-12-4 16:57:21.213000	FxoFxsType = FXSLOOPCUR	2,1	FXS AnswerCall.gls	CGProtScriptId_24440240-4607-3616
2014-12-4 16:57:23.329000	MonitorHiLoopCurrentTaskId = 12	1,1	FXO Placecall.gls	CGProtScriptId_24440958-4608-3616
2014-12-4 16:57:24.940000	Placing the Call	1,1	FXO Placecall.gls	CGProtScriptId_24440958-4608-3616
2014-12-4 16:57:25.067000	FxoFxsType = FXSHOOKSTATUS	2,1	FXS AnswerCall.gls	CGProtScriptId_24440240-4607-3616
2014-12-4 16:57:25.067000	Fxs Hook Status : offhook	2,1	FXS AnswerCall.gls	CGProtScriptId_24440240-4607-3616
2014-12-4 16:57:25.068000	Sending Dial tone	2,1	FXS AnswerCall.gls	CGProtScriptId_24440240-4607-3616
2014-12-4 16:57:26.949000	Monitoring Dial Tone	1,1	FXO Placecall.gls	CGProtScriptId_24440958-4608-3616
2014-12-4 16:57:27.221000	Loop Current = 12.100000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.229000	Fxo Line Voltage = -12.000000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.321000	Loop Current = 12.100000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.331000	Fxo Line Voltage = -11.000000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.423000	Loop Current = 12.100000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.431000	Fxo Line Voltage = -9.000000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.523000	Loop Current = 12.100000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.531000	Fxo Line Voltage = -9.000000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.623000	Fxo Line Voltage = -9.000000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724
2014-12-4 16:57:27.631000	Loop Current = 12.100000	Monitoring In Progress	MonitorCurrent-Voltage.gls	ProtScriptId_24436658-4606-3724

Save Events

Clear  Capture Events to file

# tProbe™ Windows Client Server (WCS)

```
tProbe FXS to tProbe FXO_E1.gls - GLClient
File Edit View Connect Script Log User Help
Task 5: Task 5 started
tx server file "A-Law Samples\count10.pcm" #2:5 15 sec;// transmitting the traffic on FXS Port
Task 6: Task 6 started
Waiting 20000 msec
Task 5: Tx File: #1: 120000 bytes
Task 5: Task 5 complete
Task 6: Tx File: #2: 120000 bytes
Task 6: Task 6 complete
set fxo signaling onhook #1; // disconnecting call(end the call)
OK
Waiting 2000 msec
Task 3: 200000 bytes written to file 'FXS_capture.ala'
Task 3: Task 3 complete
Task 4: 160000 bytes written to file 'FXO_capture.ala'
Task 4: Task 4 complete
set speaker off #1;
OK
set speaker off #2;
OK
// Line monitoring
get fxo loop current #1; // for safety
#1.current=0.0
get fxo tip-ring voltage #1; // for safety
#1.volt=0.0
end task *; // End all running tasks.
OK
Run complete
Task 1: Task 1 terminated
Task 2: Task 2 terminated

// tProbe FXS to tProbe FXO_E1.gls
// For more information refer to the Section 7.2.3 of user manual.
// Note: This script runs automatically without user intervention, recording the traffic
// being sent on FXO and FXS ports.

// Turn on Inward Driver loopback to allow transmission and reception over FXO and FXS
set inward driver loopback on *;

set latency 20 msec; // Set the requesting client's transmit latency to 20 ms.
set response 500 msec; // Set the requesting client's response time to 500 ms.

Ready Ver 4 B NUM
```

## WCS Server Log

```
Untitled - GLServer
File Edit View Setup Help
580: get fxo loop current # 1 ;
580: set fxo signaling offhook # 1 ;
580: run task "FaxSimulatorE1:StartFaxSim";
580: run task "FaxSimulatorE1:StartFaxSim";
580: inform task 17 "START";
580: inform task 17 "TXFAX # 2 : 5 # 2 : 1 TIFF_FILE winclientserver\faxsimulator\send\2.tif CODEC_TYPE
ALAW MIN_DATA_RATE 2400 MAX_DATA_RATE 9600 PAGESIZE_TYPE 1 RESOLUTION_TYPE 1
ECMENABLED 1 ";
580: inform task 16 "START";
580: inform task 16 "RXFAX # 1 : 1 # 1 : 5 TIFF_FILE WinClientServer\FAXSimulator\Recv\FAX_1_5_
13246174-4207-448.tif CODEC_TYPE ALAW MIN_DATA_RATE 2400 MAX_DATA_RATE 9600
PAGESIZE_TYPE 1 RESOLUTION_TYPE 1 ECMENABLED 1 ";
580: get fxs battery voltage # 2 ;
580: get fxs loop current # 2 ;
580: get fxo tip-ring voltage # 1 ;
580: get fxo loop current # 1 ;
580: get fxs battery voltage # 2 ;
580: get fxs loop current # 2 ;
580: get fxo tip-ring voltage # 1 ;
580: get fxo loop current # 1 ;
580: get fxo loop current # 1 ;
Ready NUM
```

# WCS Sample Script

```
tProbe FXO to tProbe FXS_T1.gls - Notepad
File Edit Format View Help
// tProbe FXO to tProbe FXS_T1.gls
// For more information refer to the Section 6.2.3
// Note: This script runs automatically without user intervention, recording the traffic
// being sent on FXO and FXS ports.

// Turn on Inward Driver loopback to allow transmission and reception over FXO and FXS
set inward driver loopback on #*;

set latency 20 msec;           // Set the requesting client's transmit latency to 20 ms.
set response 500 msec;        // Set the requesting client's response time to 500 ms.

// Concurrent mode is appropriate for FXO and FXS scripts in most cases
concurrent:

//FXO port initialization and setting the parameters |
set fxo on #1;                // Enabling the FXO on port 1
get fxo #1;                   // Get the status of FXO on port 1, By default it
allocates TS 0(In) and TS4 (Out)
set fxo termination "usa" #1; // Setting the termination as "USA"
get fxo termination #1;       // Getting the termination, which have been set earlier
set fxo encoding mulaw #1;   // Setting the encoding format as mulaw
get fxo encoding #1;         // Getting the encoding format, which have been set
earlier
set fxo in gain 0.0 db #1;    // Setting the Input gain of FXO on port 1 as 0.0 dB
get fxo in gain #1;          // Getting the Input gain, which have been set earlier
set fxo out gain 0.0 db #1;  // Setting the Output gain of FXO on port 1 as 0.0 dB
get fxo out gain #1;         // Getting the Output gain, which have been set earlier
set fxo sample rate 8 khz #1; // Setting the sampling rate 8000 hz or 8khz on port 1
get fxo sample rate #1;      // Getting the sampling rate, which have been set earlier
```

# Global Configuration

The screenshot shows the MAPS (Message Automation Protocol Simulation) Global Configuration window. The window title is "MAPS (Message Automation Protocol Simulation) (FXOFXS ) - [Global Configuration - Globalprofile]". The menu bar includes "Configurations", "Emulator", "Reports", "Editor", "Windows", and "Help". The toolbar contains icons for settings, help, and other functions.

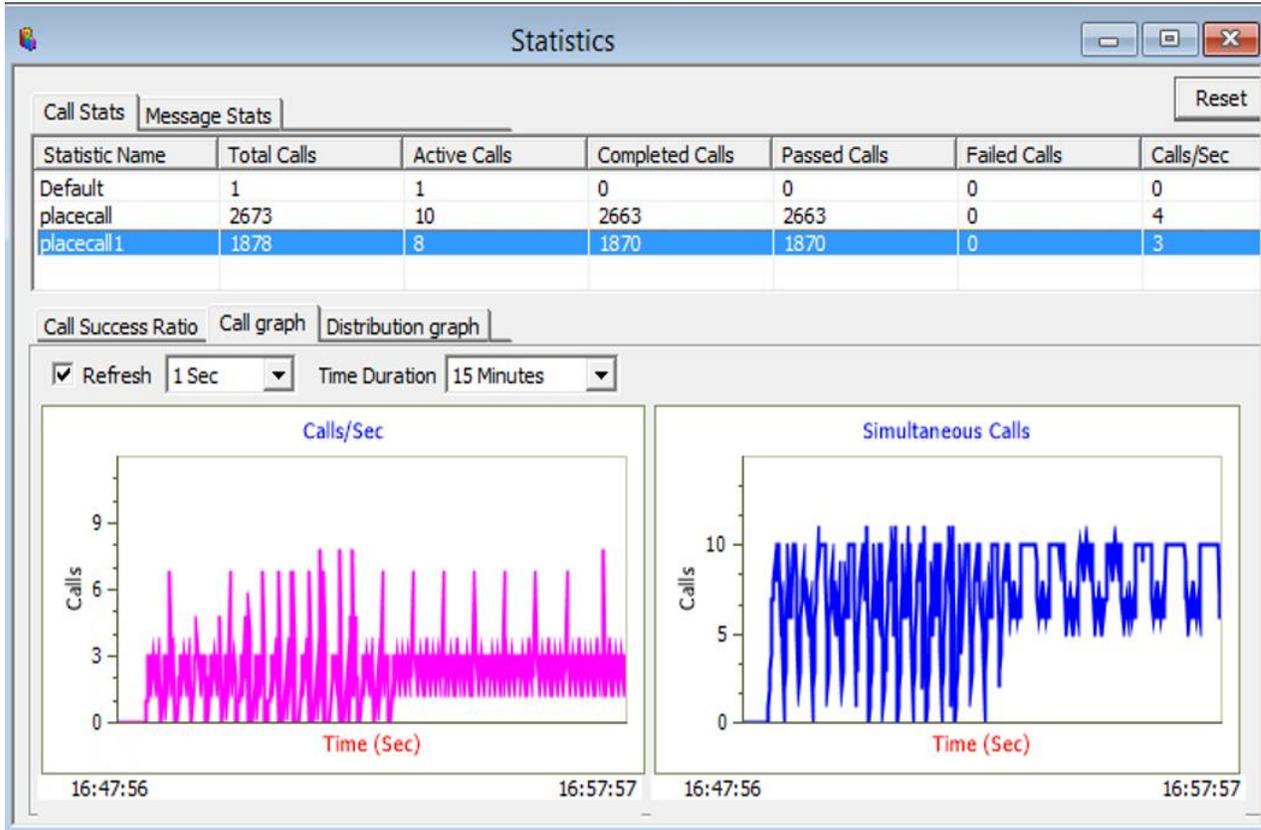
The main area is divided into two panes. The left pane, titled "Config", shows a tree view of the configuration hierarchy. The right pane, titled "\_CallDuration", shows the detailed configuration for the selected parameter, "Call Duration in msec".

Config	Value
Global Configuration	
Timers	
FXO FXS Common Timers	
Call Duration in msec	120000
Call Answer Time in msec	5000
Inter Call Duration in msec	1000
FXO Specific Timers	
Detect Dial Tone Timer in msec	30000
Detect Ringback Tone Timer in msec	30000
FXS SpecificTimers	
Ring Status true Timer in msec	30000
Detect Offhook Timer in msec	30000
RingTimer in msec	40000
Receive Digits Timer in msec	30000
FXO Specific Paramters	
Maximum Number Of Ringback Before Disconnect Call	20
FXS Specific Paramters	
Minimum Expected Number Of Dial Digits	2
FXO FXS Common Parameters	
Rx File Naming Convention	Sequential
Enable or Disable Speaker	
FXO Speaker	Off
FXS Speaker	Off
Vf Output Gain in dB	0.00
Tone acceptance values	
Frequency Deviation in Hz	15
On Time Deviation in msec	50
Off Time Deviation in msec	50

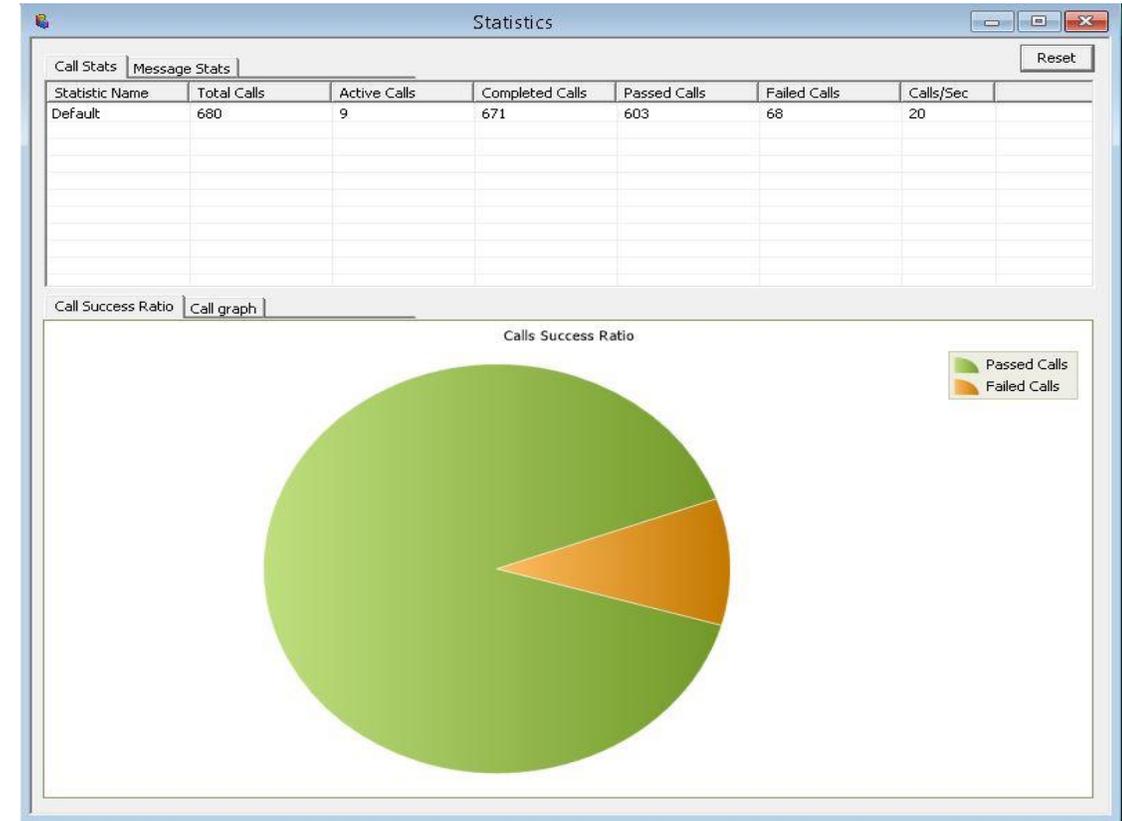
The right pane, "\_CallDuration", shows a text input field labeled "Enter Integer" with the value "120000". A "Help" button is located at the bottom right of this pane. At the bottom of the window, there are buttons for "Apply", "Load", "Save", and "Edit". The status bar at the bottom shows "Error Events", "Captured Errors", and "Link Status Up=0 Down=0".

# FXO FXS Call Ratio Statistics

## Call Graph

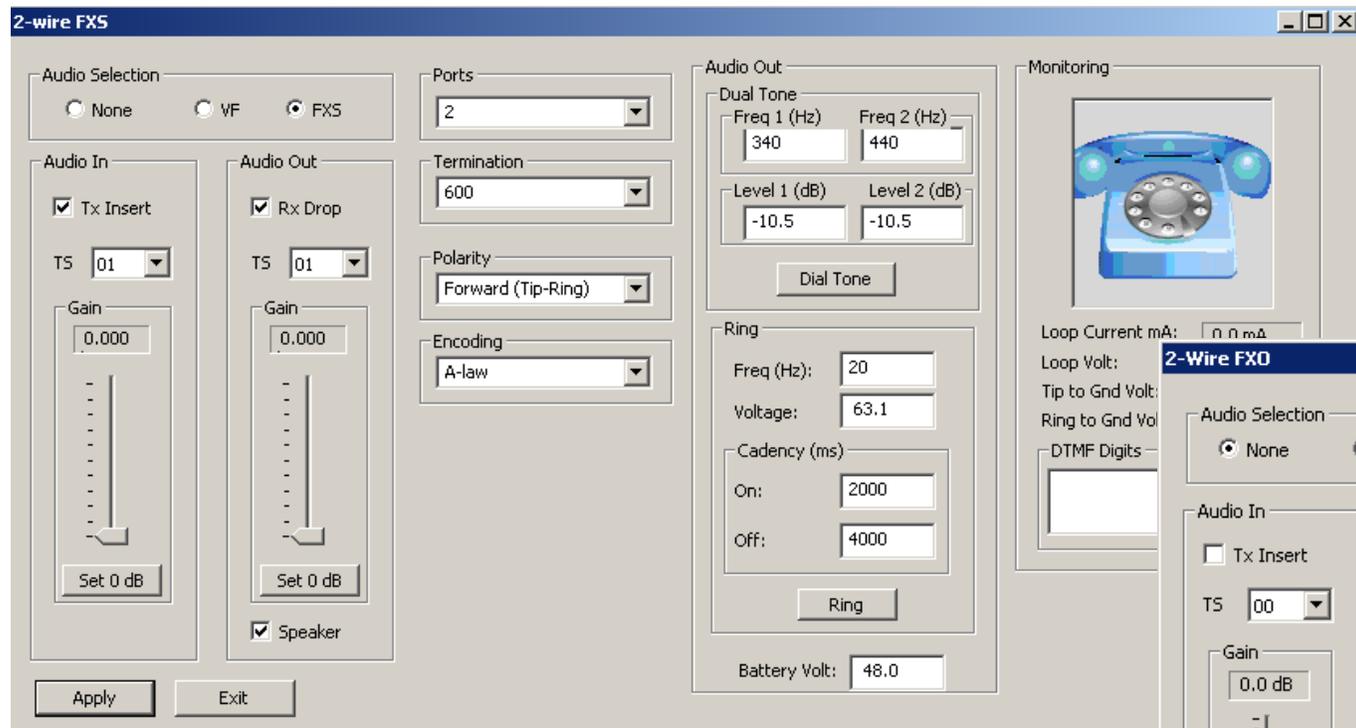


## Call Success Ratio Statistics

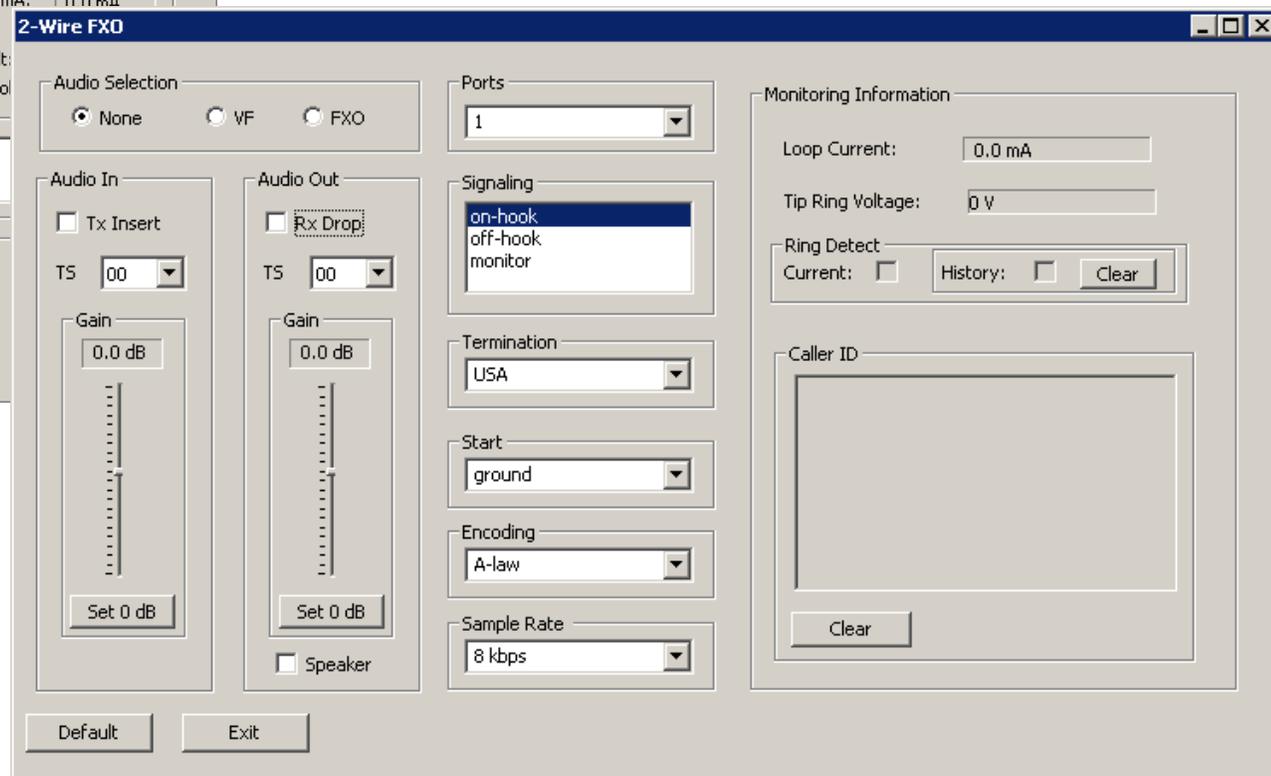


# 2-Wire FXO/FXS

## 2-Wire FXS



## 2-Wire FXO



# 2-Wire FXO/FXS (Contd.)

- FXO port on tProbe™ allows to simulate a two-wire FXO device such as a telephone or a fax machine
- FXO port allows you to capture and analyze data from a two-wire telephone line, as well as to generate and transmit analog data onto that two-wire line
- The FXS port on tProbe™ emulates a two-wire FXS service such as a telephone wall jack
- This feature allows you to interface with an FXO device such as a telephone

# Other Analog Testing Products

- **T1 E1 MAPS™ APS and ALS Simulation**

Using a T1 connection to the APSCB24/48/96, generates a series of up to 384 analog ports with standard FXO interfaces

MAPS™ APS can be connected to any ATS, PSTN, PBX, or Gateway that supports analog FXO interfaces

- **T1 E1 MAPS™ CAS Emulator**

Automated test procedure allowing the users to establish calls and send/receive TDM traffic (DTMF/MF digits, Tones, Fax, Voice)

Supports testing of various protocols - T1 Wink Start (R1 wink), T1 Loop Start and T1 Ground Start, T1 Feature Group D, T1 Immediate Start, E1 MFC-R2 (All variants, full /semi compelled), E1 European Digital CAS (EUC), E1 Digital E & M, E1 International Wink Start, and Any User-Defined CAS Protocol

# Other Analog Testing Products (Contd.)

- **VQuad™ Dual UTA**

Fax Testing using the Dual UTA 2-wire FXO or 4-wire analog interfaces. Supports up to 4 simultaneous T.30 faxes

- **T1 E1 CAS Simulation and Analysis**

It can simulate and analyze any user-defined CAS protocols by providing signaling bit transitions and forward/backward frequency digits and tones. GL's CAS simulator and Analyzer are client-side applications that works along with the GL's T1 E1 Analyzer

Thank you