



◀||| APPLICATION NOTE |||▶

Using Sage SMOS for VoIP Testing, IP Phone to IP Phone

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Introduction

This instruction describes how to use a pair of appropriately optioned Sage Instruments 935AT or 930A L3 Communications Test Sets to conduct the SMOS test between two IP phones. It assumes the user also has two Sage phone interface boxes. The equipment arrangement for this test is illustrated by **Figure 1**, below.

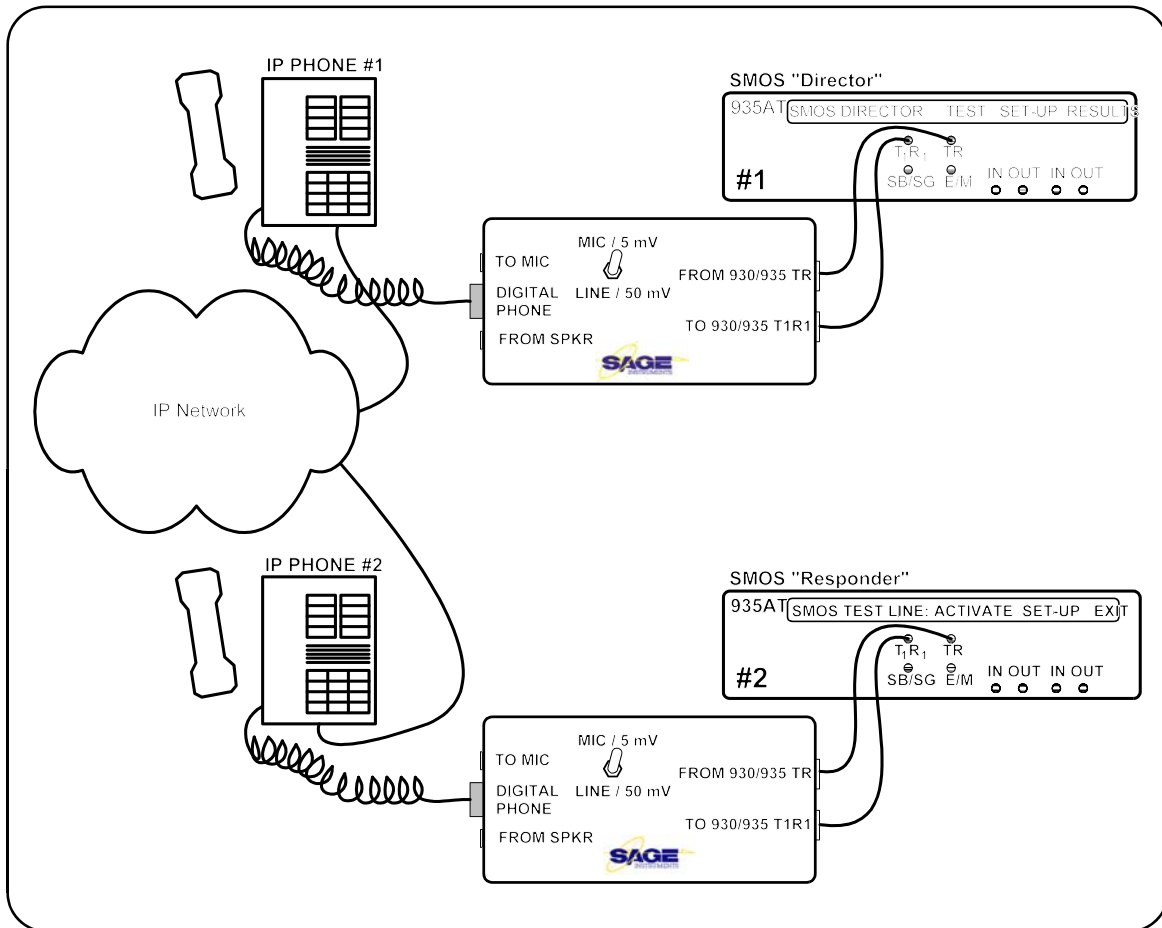


Figure 1 — VoIP Test Arrangement

As shown in **Figure 1**, the most practical interface to an IP phone is via the coil cord interface from the telephone base to the handset. This interface has some important characteristics:

1. It is a 4-wire interface — two wires connect to the handset microphone element, and another pair connects to the handset earphone element.
2. None of the interface pairs employ signaling supervision (i.e., On- and Off-Hook supervision). In fact, application of such voltages could damage the telephone base interface.
3. At the telephone base, the interface to the handset microphone is quite sensitive, so it can easily be over driven by even moderate signal levels.

To accommodate the two pairs of wires, the 935AT will be configured for a 4-wire test interface. By using the 935AT “Dry Circuit” mode, we insure no voltages are applied to the telephone base interfaces. This mode also has the advantage of allowing the Responder function to answer the Director’s call, without requiring DC signaling supervision. Finally, the Sage interface box will be employed to attenuate 935AT test signals to a comfortable level.

Configuring 935AT #1 and #2 for 4-Wire Dry Circuit Operation

1. Repeatedly press the TRUNK TYPE button (top left black button on the front panel) until the red LED beside it illuminates. Note that three quick pushes of the Trunk Type button will force the 935AT to this function, regardless of what menu it may have been in. You will see a display which may resemble the example below. If you don't see "NORMAL LOOP" at the left side of the display, press the Up-Arrow (▲) button until you do.



2. If the display shows "BATTERY" instead of "CONTACT", press Softkey 3 to change it to Contact.
3. If the display shows anything other than "4W 600", repeatedly press Softkey 4 until it does.
4. Press the OPTION MENU button three times, then use the numeric keypad to enter "95", then press the OPTION MENU button again. The display should look like the example below:



5. Press Softkey 1 to go into the function. The display should now look like the example below:



6. Press Softkey 2 (YES). The display will change to look like the one below:



7. Press Softkey 2 (BRIDGE) to change the state to TERM. The screen should now resemble the sample below:



Configuring 935AT #1 for the SMOS Director Function (Menu Option 76)

Note that steps 1 through 3 below are required to enable the SMOS Director function to dial DTMF "7243" and activate the far end SMOS Test Line (responder) unit under Dry Circuit mode.

1. Insure the 935AT front panel On-/Off-Hook switch (often called the "hook switch") is in the On-Hook position.
2. Press the 935AT Dial/Ring function button. The 935AT screen should change to look similar to the illustration below:



3. If there are digits to the left of "RPT?", clear them by pressing the grey CLR button which is located at the right of the 935AT numeric key pad. If "DTMF" is not displayed, repeatedly press Softkey 3 until it is. Then, use the numeric keypad to enter the digits "7243" (SAGE on a telephone keypad). The screen should now look like the one below:

7243 RPT? DTMF TR

4. Press the Option Menu button three (3) times to insure you completely back out of any other menu. Now, using the numeric keypad, enter "76", then press the grey "ENT" button. Your display should now look like the example below:

SMOS DIRECTOR TEST SET-UP RESULTS

5. Press Softkey 3 (Setup). The display will change to look like the one below.

DURATION: 9s DEFAULT SET TLP EXIT

6. The default test *Duration* is 9 seconds. If you want to use the default test duration, and "9s" is not displayed, press Softkey 2 (DEFAULT) or use the 935AT front panel numeric keypad to enter "9". Otherwise, enter the duration you desire.

7. Press Softkey 3 (SET TLP). The display will now look like the example below:

SET TLP: 0 dB USER -2 dB

8. If you want to set both Transmit and Receive TLP's to 0 dBm, press Softkey 2 (0 dBm), then go to Step 10. If you want to set them for -2 dBm, press Softkey 4 (-2 dBm), then go to Step 10. If you want different TLP values or want to set independent TLP's for Transmit and Receive, press Softkey 3 (USER). The display will then change to resemble the illustration below:

SEND: +0.0 dBm RECV: +0.0 dBm EXIT

9. To set the SEND TLP, press Softkey 1, then use the numeric keypad to enter the desired level. To Set the RECV TLP, press Softkey 3, then use the numeric keypad to enter the desired level. Once the TLP's are set to your satisfaction, press Softkey 4 (EXIT). The display will then return to the opening setup screen, as in the example below:

DURATION: 9s DEFAULT SET TLP EXIT

10. Press Softkey 4 (EXIT). The display will return to the SMOS opening screen, as illustrated below:

SMOS DIRECTOR TEST SET-UP RESULTS

11. This completes setup of the 935AT SMOS Director function.

report of the wink Guard and duration times. Press Softkey 3 (YES) or 4 (NO). Once you have made your selection, the 935AT returns to the opening Remote Control display, as shown below:

OPTION MENU #: 3 REMOTE CONTROL

17. This completes preparation of 935AT #1 for automatic logging of test results.

Note: When connecting a PC to the 935AT remember to use a *straight-through*, NOT null-modem cable.

Configuring 935AT #2 as an SMOS Test Line (Responder) — Menu Option 77

1. Press the Option Menu button three (3) times to insure you completely back out of any other menu. Then, using the numeric keypad, enter "77", then press the Option Menu button again. Your display should now look something like the example below:

OPTION MENU #: 77 SMOS TEST LINE

2. Press Softkey 1 to go into the function. The display should now be like the illustration below:

SMOS TEST LINE: ACTIVATE SET-UP EXIT

3. Press Softkey 3 (SET-UP). The display should change to look like the one below:

SET-UP: TPT TLP EXIT

4. Press Softkey 2 (TPT). The display will now look something like the example below:

TPT BURST LENGTH 3.5 SEC DEFAULT EXIT

5. This screen allows you to adjust the length of Test Progress Tone (answer tone) the Responder function transmits when seized. The default length is 3.5 seconds. If you want to stay with 3.5 seconds but it is not displayed, press Softkey 3 (DEFAULT) or use the 935AT numeric keypad to enter "35". If you want some other value, use the numeric keypad to enter the desired number.

6. Press Softkey 4 (EXIT). The display will return to the opening setup screen, as illustrated below:

SET-UP: TPT TLP EXIT

7. Press Softkey 3 (TLP). The display will change to look like the one below:

SET TLP: 0 dB USER -2 dB

8. If you want to set both Transmit and Receive TLP's to 0 dBm, press Softkey 2 (0 dBm), then go to Step 10. If you want to set them for -2 dBm, press Softkey 4 (-2 dBm), then go to Step 10. If you want different TLP values or want to set independent TLP's for Transmit and Receive, press Softkey 3 (USER). The display will then change to resemble the illustration below:

SEND: +0.0 dBm RECV: +0.0 dBm EXIT

9. To set the SEND TLP, press Softkey 1, then use the numeric keypad to enter the desired level. To Set the RECV TLP, press Softkey 3, then use the numeric keypad to enter the desired level. Once the TLP's are set to your satisfaction, press Softkey 4 (EXIT). The display will then return to the opening setup screen, as in the example below:

SET-UP: TPT TLP EXIT

10. Press Softkey 4 (EXIT). The display will then return to the main SMOS Test Line screen, as shown below:

SMOS TEST LINE: ACTIVATE SET-UP EXIT

11. To “arm” the SMOS Test Line function, press Softkey 2 (ACTIVATE). The display will change to look like the one below:

WAITING FOR SEIZURE FORCE EXIT

12. The SMOS Test Line function is now ready to accept a call. It will answer upon detecting an incoming seizure (In Dry Circuit mode, it will treat an incoming DTMF “7243” digit string as a seizure). If you wish to force the function to answer as if it had received a seizure, press Softkey 3 (FORCE). When the Test Line function has answered a seizure or been “forced” to answer, the display will change to look like the example below:

CALL IN PROGRESS EXIT

Configuring the Sage Interface Box

1. Flip the attenuator switch to the “MIC / 5mV” position.

VoIP Codec Setup

1. If possible, configure the IP phone to disable Silence Detection/Suppression. Some silence suppression implementations are very aggressive, and may cut the audio path when test signals go below a certain level threshold.
2. If possible, disable any IP phone automatic gain control. The automatic gain control function on some units don't have quick "attack" times, often resulting in distortion of one or more DTMF digits used by the 93x "Director" function. When this distortion happens, the far end "Responder" functions don't recognize the digits, and never answer the "Director's" call.

Cable Connections

1. Locate a 310-plug-to-310-plug cable. Plug one end into the 935AT #1 "TR" jack. Plug the other end into the "From 930/935 TR" jack of the Sage Interface box.
2. Locate a second 310-plug-to-310-plug cable. Plug one end into the 935AT #1 "T₁R₁" jack. Plug the other end into the "From 930/935 T₁R₁" jack of the Interface box.
3. Locate the IP phone handset coil-cord. If possible, disconnect this cord from the handset, and plug that end into the "DIGITAL PHONE" RJ-22 jack of the Interface box. If the IP phone coil-cord cannot be disconnected from the handset, unplug that cord from the IP phone base unit. Then, locate another coil cord and use it to connect the Interface box in place of the IP phone handset.
4. Repeat the above steps for 935AT #2.
5. If you plan to log test results to a PC, locate a "straight through" (NOT a null modem) RS-232 serial cable. Connect one end to the RS-232 serial port on the rear panel of 935AT #1. Connect the other end to an available working COM port on the PC.

Configuring a Communications Program on PC #1 For Data Logging

1. If a PC serial port is not connected to the 935AT #1 rear panel serial port using a "straight through" RS-232 cable, connect it now.
2. Start your communications program on PC #1 and configure it to use the COM port terminating the PC to 935AT serial cable.
3. Configure the PC program's communication parameters for 9600 baud, 8 data bits, No parity, and 1 stop bit.
4. To confirm you have a working serial link, transmit a capital "X" to 935AT #1. You should see the current 935AT display appear on the PC screen.
5. Enable the logging function of your communication program.

Level/Gain Adjustment Procedure

Due to the varying input sensitivity and output level of IP phones, it is prudent to adjust IP phones for proper test levels.

1. If you have not already configured and connected the equipment as described above, do so now.
2. Establish a VoIP telephone connection between the two IP phones.
3. On 935AT #1, press the Send Tone button. The 935AT display should now look something like the example below.

SENDTONE: 1010 Hz -16.0 dBm OFF

4. If "1010 Hz" is not displayed, press Soft key 1 and use the numeric keypad to enter "1010", then press the grey "ENT" key located at the bottom right of the numeric keypad.

- If "-0.0 dBm" is not displayed, press Softkey 3 and use the numeric keypad to enter "0", then press the grey "ENT" key located at the bottom right of the numeric keypad. The 935AT display should now look like the example below:

SENDTONE: 1010 Hz +0.0 dBm OFF

- Press Softkey 4 to toggle "OFF" to "TR". This starts the 935AT transmitting the tone. The display should now look like the one below:

SENDTONE: 1010 Hz +0.0 dBm TR

- On 935AT #2, press the Measure Tone button. You should see a display similar to the illustration below:

1010 Hz -10.0 dBm AVERAGE T1R1

- Adjust the receive volume control on IP phone #2 for a 935AT #2 displayed level of between -10.0 dBm and -27.0 dBm.
- Repeat steps 3 through 7, above, to set levels in the opposite direction.

Note: If you can't achieve a Measure Tone reading between -10.0 dBm and -27.0 dBm, consult **Appendix A** on supplementary adjustments you can make to the Director and Responder TLP settings.

- Once the levels are set for each direction of transmission, you can proceed to conduct an SMOS test as described in the following steps.

Running the Test

- If you haven't already done so, configure 935AT #1 as an SMOS Director, as described the earlier section of this document titled ***Configuring 935AT #1 for the SMOS Director Function (Menu Option 76)***.
- Likewise, configure 935AT #2 as an SMOS Test Line (responder), as described in the section titled ***Configuring 935AT #2 as an SMOS Test Line (Responder) — Menu Option 77***.
- At 935AT #1, the display should look like the example below:

SMOS DIRECTOR TEST SET-UP RESULTS

- At 935AT #2, the display should look like the one below:

WAITING FOR SEIZURE FORCE EXIT

- Use the base unit of IP phone #1 to make a call to IP Phone #2. Use the base unit of IP phone #2 to answer the call.
- At 935AT #1, press Softkey 2 ("TEST") to initiate the test.

NOTE: The SMOS test is designed to run continuously. However, you can terminate a test cycle at any time by pressing the Option Menu button on either 935AT. You will know the first test cycle has completed when the display changes from “CALL COMPLETION TIME:” to “NF CODEC: PCM FN CODEC: PCM” or something similar.

Sample Log of SMOS Test Results with 935AT Set for Printer Mode:

This output mode is most useful if you intend to make many measurements over a period of time. The format is designed to resemble a “CSV” (Comma Separated Values) file. Therefore, if the text is saved as a standard text file with a “.csv” file extension instead of a “.txt” file extension, it can be read by most spreadsheet programs, such as Microsoft Excel and Corel Quattro Pro.

```

Monday 12-17-01 20:57:22
      7243 SMOS ACCESS # DTMF
CALL COMPLETION TIME: 0.6 SEC. 20:57

----- SMOS REPORT -----
DURATION:      9s
SEND TLP:    +0.0          RECV TLP:  +0.0
DATE, TIME, NF_MOS, FN_MOS, NF_NOISE, FN_NOISE, NF_+FS, FN_+FS, NF_-FS, FN_-FS, NF_BW, FN_BW, NF_GAIN, FN_GAIN, NF_CODEC, FN_CODEC, DELAY
12-17-01, 20:58:03, 4.57, 4.57, 19, 16, 0, 0, 0, 0, 98.8, 98.7, +0, +0, PCM, PCM, 0.0
12-17-01, 20:58:41, 4.57, 4.58, 19, 16, 0, 0, 0, 0, 98.8, 98.7, +0, +0, PCM, PCM, 0.0
12-17-01, 20:59:19, 4.57, 4.57, 19, 16, 0, 0, 0, 0, 98.8, 98.7, +0, +0, PCM, PCM, 0.0
12-17-01, 20:59:57, 4.57, 4.58, 19, 16, 0, 0, 0, 0, 98.8, 98.7, +0, +0, PCM, PCM, 0.0

```

Sample SMOS Output Obtained by Changing From Printer to Computer Mode:

In Computer mode, the 935AT will send a “bell” character (ASCII 07) to the compute at the start of a test. It will then send a second “bell” character when the results of a test cycle are available. To retrieve the results, use the PC keyboard to send a capital (uppercase) “W” to the 935AT.

```

----- SMOS REPORT -----
DURATION:      9s
SEND TLP:    +0.0          RECV TLP:  +0.0

NF_MOS: 4.57          FN_MOS: 4.57
NF_NOISE: 20dBBrnC   FN_NOISE: 17dBBrnC
NF_+FS: 0mS          FN_+FS: 0mS
NF_-FS: 0mS          FN_-FS: 0mS
NF_BW: 98.8%         FN_BW: 98.7%
NF_GAIN: +0dB        FN_GAIN: +0dB
NF_CODEC: PCM        FN_CODEC: PCM
DELAY: 0.0mS

```

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Compensating for High Circuit Losses

Introduction

Variations in current IP phone base-to-handset interfaces can result in excessive end-to-end circuit losses presented to the 935AT Communications Test Set and interface box. And, the somewhat loose transmission plans occasionally employed to interface IP networks and classic public networks can add to the loss. You may therefore encounter call connection paths which introduce so much loss that you can't achieve the minimum -27.0 dBm receive tone level as described in the *Level/Gain Adjustment Procedure* section in the main body of this document. If this is the case, you may find the SMOS test cannot be reliably run.

In such instances, you may be able to compensate by using the TLP (Test Level Point) settings in the SMOS “Director” and “Test Line” (responder) functions. This Appendix will guide you in making those compensating adjustments.

As a general rule of thumb, you should first try to increase the sensitivity of a 935AT's receiver. After increasing the receive sensitivity to its limit, you can move to increase the far end's transmit level.

NOTE: The example below illustrates how you can adjust the *receive* sensitivity of an SMOS “Director” 935AT, and increase the *transmit* level of the far end SMOS “Test Line” (responder). However, you can use the same procedure to increase the receive sensitivity of the “Test Line” and the transmit level of the “Director”.

How to Increase the Receive Sensitivity of the SMOS “Director”

You may recall that the *Level/Gain Adjustment Procedure* section of this document called for a Measure Tone reading of between -10.0 dBm and -27.0 dBm, when the far end unit was transmitting a 1010 Hz @ 0.0 dBm test signal. Let's assume you read -37 dBm instead of the minimum -27 dBm. Let's further assume you want a bit of cushion, and would therefore like to see -20 dBm. So, the SMOS “Director” unit is displaying -37 dBm, and you were hoping for -20 dBm. That's a difference of 37 minus 20, or 17 dB.

1. At 935AT #1, go to the SMOS Director Setup screen. When you are there, the display should look like the example below:

```
DURATION:    9s  DEFAULT SET TLP  EXIT
```

2. Press Softkey 3 (SET TLP). The screen should change to look like the one below:

```
SET TLP:           0 dB    USER  -2 dB
```

3. Press Softkey 3 (USER). The display should now look similar to the illustration below:

```
SEND:    +0.0 dBm  RECV:  +0.0 dBm  EXIT
```

4. Since, in this example, we want to increase the receive sensitivity by 17 dB, press Softkey 3, then use the numeric keypad to enter “170”, then press Softkey 3 again to enter the change. The display should now look like the example below:

```
SEND:    +0.0 dBm  RECV:  -17.0 dBm  EXIT
```

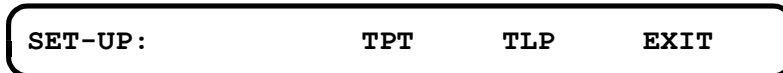
NOTE: When you recheck the received Measure tone level, the 935AT will still display -27 dBm. However, our TLP adjustment increased the internal sensitivity of the unit to compensate.

The SMOS Director function allows you to compensate up to 30 dB, using this method.

How to Increase the Transmit Level of the SMOS “Responder”

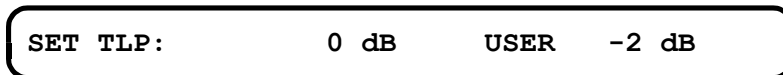
If your circuit loss is such that you have already turned up the telephone's receive volume and employed the maximum 30 dB of *Receive* TLP adjustment at the SMOS “Director” 935AT, you can go to the far end SMOS “Test Line” (responder) and adjust its *Transmit* TLP.

1. At 935AT #2, go to the SMOS Test Line Setup screen. When you are there, the display should look like the example below:



SET-UP: TPT TLP EXIT

2. Press Softkey 3 (SET TLP). The screen should change to look like the one below:



SET TLP: 0 dB USER -2 dB

3. Press Softkey 3 (USER). The display should now look similar to the illustration below:



SEND: +0.0 dBm RECV: +0.0 dBm EXIT

4. Press Softkey 1, and use the numeric keypad to enter the desired transmit TLP level. You then press Softkey 3 again to implement the change.