TALAN™ 3.0

Telephone & Line Analyzer

User Manual

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TALAN™ 3.0

Telephone & Line Analyzer

User Manual

This document is intended to provide guidance and instruction on using the TALAN 3.0 Telephone and Line Analyzer for telephone testing.

The overall effectiveness of this product, and of any surveillance countermeasure, is dependent on the threat level and the user's ability to properly utilize the appropriate equipment.

REI offers the world's largest commercially available Technical Security training facility. Training courses include classroom instruction and hands-on exercises where students perform sweep exercises in "live" environments utilizing "target rich" project rooms. The progressive course curriculum is designed for the beginner or the seasoned Technical Security Technician.

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Revision 3.02.01

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This manual contains proprietary information intended solely for use with the TALAN Telephone and Line Analyzer.

Information contained in this manual including product operation and specifications is subject to change without notice.

Any product or brand names contained in this manual are used only for identification purposes and are trademarks or registered trademarks of their respective holders.

NOTE: The overall effectiveness of any technical surveillance countermeasure is directly dependent on the level of threat and the user's ability to properly deploy the appropriate countermeasure. REI's Center for Technical Security offers training on technical surveillance countermeasure equipment.

OWNER'S RECORD

The Serial Number of each TALAN is located on the underside of the unit. Please record this number and refer to it whenever you contact your dealer or Research Electronics International concerning this product. Note: Removal or alteration of the serial number automatically voids all warranties of this product.

MODEL: TALAN

SERIAL NUMBER: _____

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BASIC TALAN OPERATIONS

Battery Charging and Power Control

The TALAN has a built-in battery charger. To charge the battery, simply plug the power adapter into the AC adapter port while the battery is in the TALAN.

Expected charge time: 1.5 hours with the TALAN off (3+ hours with TALAN operational).
Expected run time (on battery): 4 hours.

Note: It is recommended that the TALAN battery be recharged on a regular basis during extended periods of storage (3 months or more) to prevent damage to the battery.

Additionally, when storing TALAN for long periods (1 month or more), it is recommended that the battery be removed from the unit and placed in the storage compartment in the case. Storing the TALAN with the battery in the unit can deplete it more rapidly, potentially shortening the life of the battery.

Updating the Software and Firmware

- Software updates (in the form of a .FIX file) will be available on-line or by contacting REI at sales@reiusa.net.
- Place the downloaded .FIX file on a USB thumb drive.
- Plug the thumb drive (with .FIX update file) into the TALAN.
- Press the **F6** (System) button and choose Update from the pop-up menu.
- Highlight the .FIX file and press the **OK** button.
- The TALAN will now update the software/firmware. Follow any on-screen directions as the TALAN may need to be restarted for the update to take effect.
- Remove the thumb drive and save the .FIX file as a back-up.

Note: Check REI's website or the REI TSCM Newsletter for software update notification.
If you have any questions, contact REI at sales@reiusa.net.

Saving Screen Shots to Thumb Drive

To assist in report writing, the TALAN provides the ability to capture screen shots from the TALAN display. These images are created as BMP (bitmap) images and stored to a thumb drive. To use this function, the thumb drive must be inserted in the USB port on the front of the TALAN. Press the following key sequence to store the current screen image:

- **SHIFT**
- **HELP**

If the screen shot is successful, the TALAN logo in the upper right corner will cycle through background colors of green and yellow before returning to black. If the screen shot is not successful (e.g., no USB drive), the TALAN logo will cycle through background colors of blue and

red before returning to black. If the volume is turned up, there will be an audible sound that indicates the image is being saved.

Touch Screen and Keypad

The easiest method to access and control TALAN functions is to use the built-in touch screen. There is a stylus located in the left grip which will give the most precise control of the touch screen.

To calibrate the touch screen, press the **F6** (System) button and select Touch Screen from the menu. Follow the on-screen instructions. Calibration should only be required after a complete software update is performed.

Common Functions

In using the TALAN, you will discover that there are several functions that are accessed very often. The user interface was designed to quickly access these functions using hard buttons. Some of the most common functions or button/display pairs are:

Hard Button	Function
A	Audio Dashboard
B	Line Bias Dashboard
C	Connection Dashboard
MANUAL	Manual Test Menu
F4	Test Options and Summary Dashboards
OPTIONS	Test Options and Summary Dashboards
START/STOP	Start/Stop a test

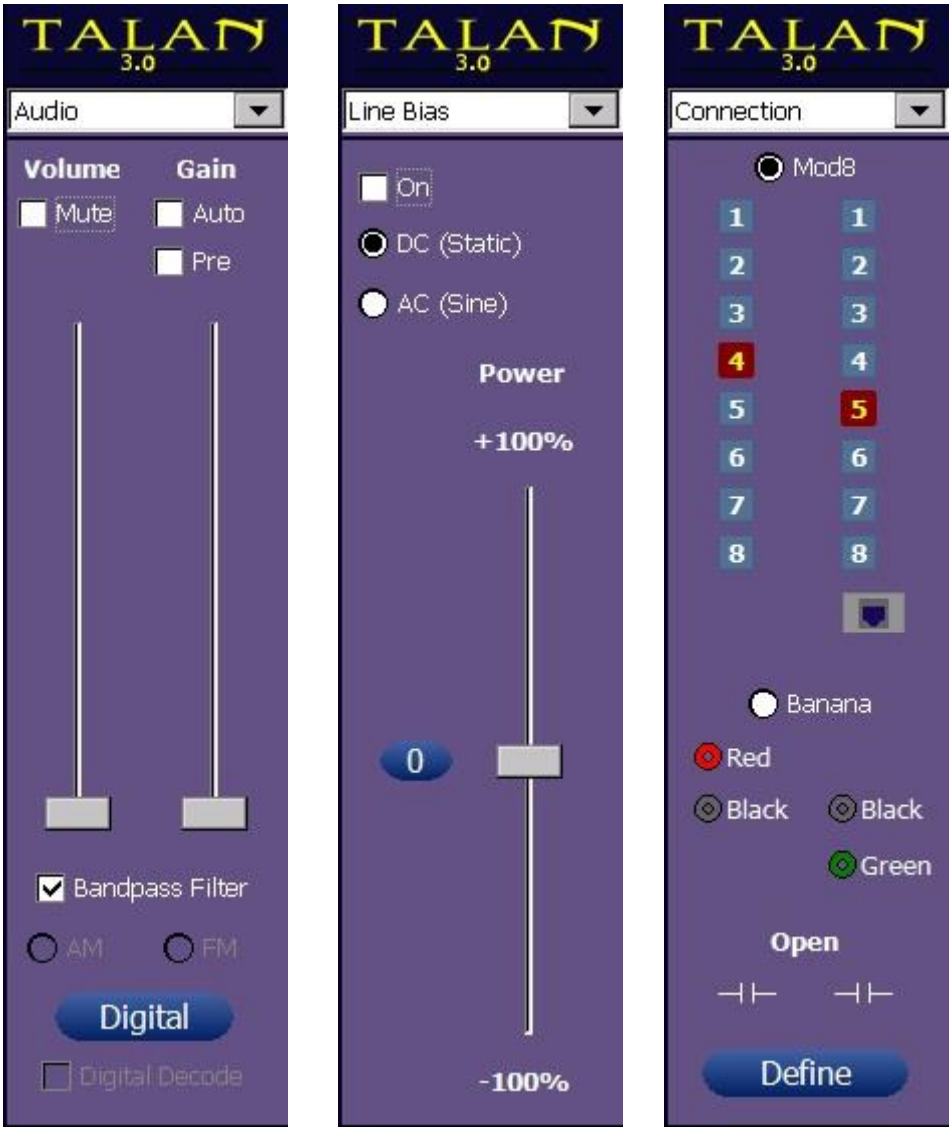
Information Display

While using the TALAN, the right hand side of the display is used for the dashboard functions and to provide overall information about the testing process. You can always return to this high-level summary dashboard by pressing the **F4** (Summary) button. It may be necessary to press **F4** multiple times depending on the currently displayed dashboard. You can access various dashboards by using the pull-down menu at the top of the display.

All dashboards can be accessed using the pull-down menu at the top each dashboard.

Images of dashboard screens are below: Audio, Line Bias, and Connection. These are accessed by pressing **A** (Audio), **B** (Bias), or **C** (Connection) buttons. Since these dashboards are accessed often, they were assigned special hard buttons for quick access.

A **B** **C**

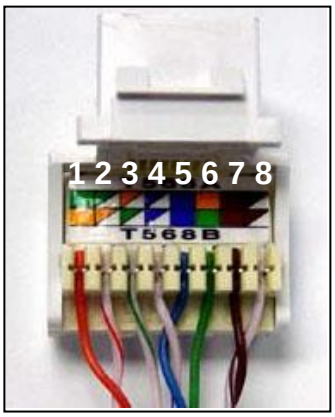


INPUTS AND AUTOMATIC SWITCHING

The TALAN provides modular 8 type connectors (Line, Phone), banana plug connectors (Black/Ring, Red/Tip, Green/Earth), an expansion port (for future applications), and an RF antenna input.

- The Expansion port will be used for future upgrades as developed, but currently has NO function.
  Warning: Even though the Expansion port is currently unused, it is still connected to the test input circuitry. Devices other than those provided by REI should NEVER be attached to this connector.
- The RF Antenna port is used for RF broadband analysis using the 2 provided antennas.
- The banana plugs can be used for any type of miscellaneous testing.
  Warning: The TALAN circuitry is designed for testing sensitive phone networks and equipment. The banana plugs should NOT be connected to high current or high voltage test points such as power outlets.
- The modular 8 connectors provide for switching between selected pairs for most types of wiring. For example, if a cable has 8 conductors, the typical wiring pairs are as follow:

  4:5 is typically the primary pair.
  3:6 is the secondary pair
  1:2 is an auxiliary pair
  7:8 is an auxiliary pair



  Using these 8 conductors, it is important to note there are 28 possible combinations to consider.

  For example:

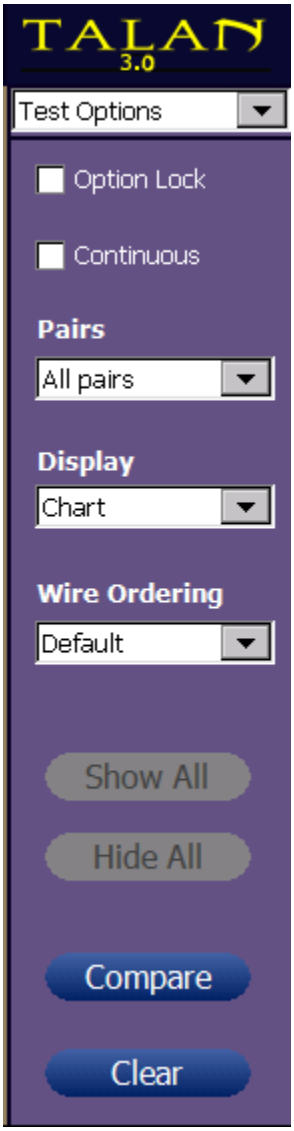
  1:2, 1:3, 1:4, 1:5, 1:6, 1:7, 1:8
  2:3, 2:4, 2:5, 2:6, 2:7, 2:8
  3:4, 3:5, 3:6, 3:7, 3:8
  4:5, 4:6, 4:7, 4:8
  5:6, 5:7, 5:8
  6:7, 6:8
  7:8

With ***TALAN 3.0***, conductors 1:8 can also be tested against the Shield on the MOD8 connector, and also against the EarthGround Banana Jack Connector.

The switching matrix in the TALAN provides for automatic switching and test measurement for all of these possible combinations. Users can also specify only testing a single wire pair or the balanced pair combinations as described later in this manual. For most test functions press the **F4** (Options) button and select All Pairs, Balanced Pairs, or Single Pair.

Note: the Continuous function allows for repeated sequential testing of the selected function and wire pair(s).

Note: the Option Lock function provides a way to maintain or 'lock' the current test option settings while navigating between multiple manual tests and touch screen taps.



TEST DATABASE MANAGEMENT

All TALAN test data can be saved to an external memory system. This memory system can be either a USB thumb drive or a Compact Flash card. Ports for both of these memory media are located at the base of the unit. Once test data has been saved, it can be further analyzed using the TALAN's A/B Comparison function detailed later in this manual.

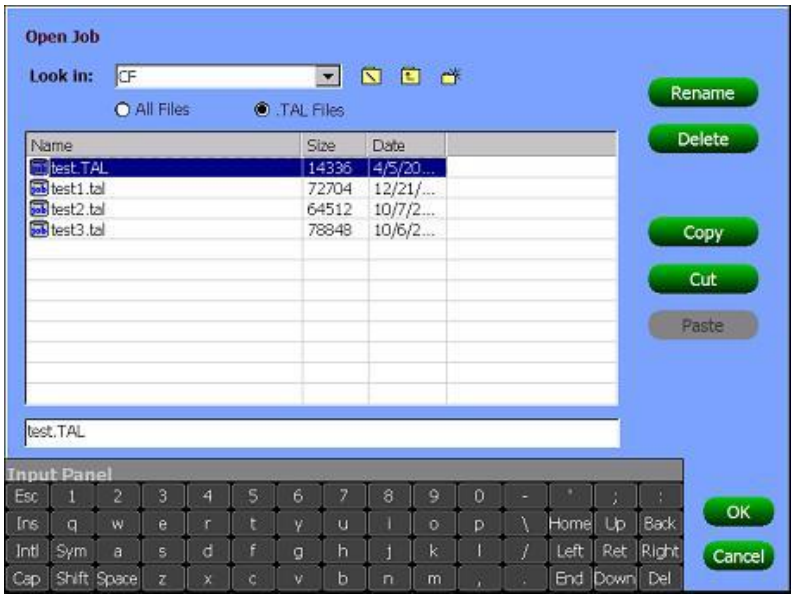
The USB thumb drives may be installed or removed at any time while the product is in use. However, the Compact Flash memory must be installed in the TALAN on startup to be properly recognized and accessed.

A USB keyboard may be connected to the TALAN to facilitate alphanumeric entry for various input fields.

USB storage devices must be formatted with a FAT file system, such as FAT32, for use with the TALAN unit. Devices that are formatted with the NTFS file system will not be recognized by the TALAN. Windows operating systems limit the storage capacity of a FAT32 partition to less than 32 GB when formatting. Third party software does exist which will allow you to format a larger partition using FAT32.

Prior to saving data, it is necessary to define a Job Name. This creates a unique database under the Job Name so that all test data associated with this Job can be saved in the same database structure. Press the **F1** (Job) button and select New Job (see below).

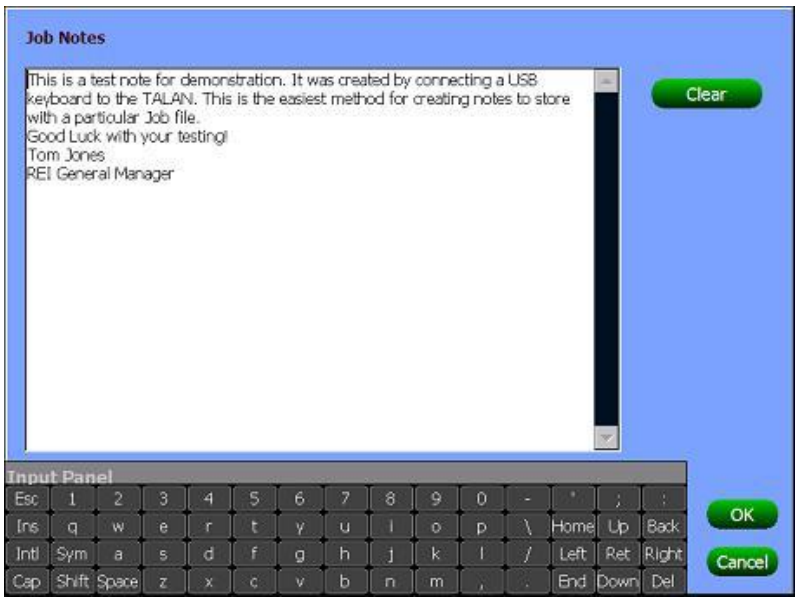
You can define the Job name using the stylus and the provided keypad. Press the **OK** button to accept the Job name. You can also select the storage medium, either USB for the thumb drive or CF for the Compact Flash card.



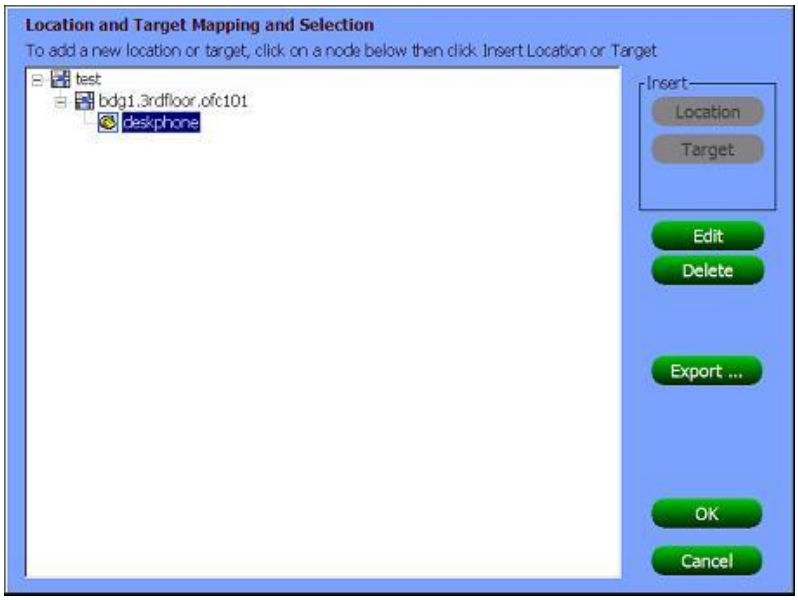
You can also use this screen to cut and paste a complete Job Database from one storage medium to another.

To enter specific notes about a Job, select the Job Notes from the **F1** (Job) menu.

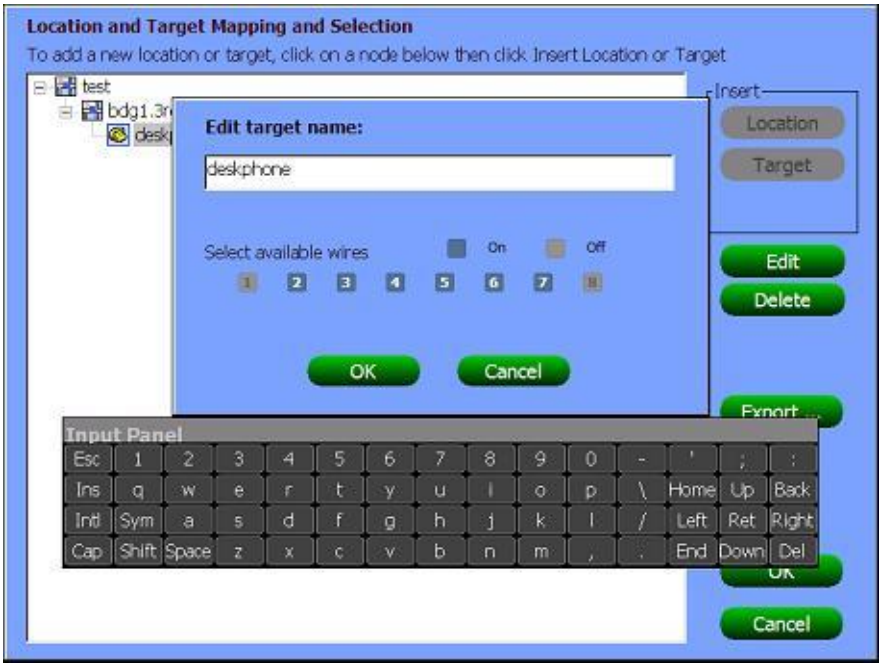
A USB keyboard is recommended for entering text quickly.



You will also notice Targets and Locations under the Job menu. This selection is used to define additional information about the particular target being tested. Locations will be used to identify specific locations (address, building number, building floor, office number etc.) within a Job. Target will be used to identify a specific target (phone set, network access point, etc.) to analyze within a location.

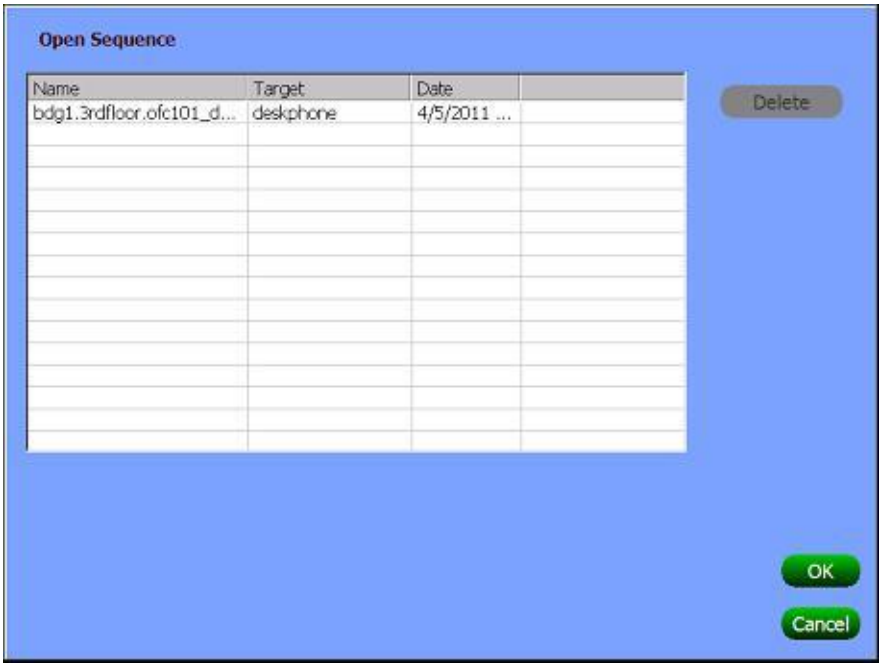


Available Wires define how many wires are used in the phone cord. A maximum of 8 conductors may be in a phone cord and the conducting pairs should always be defined from the center outward. For example, a 2-wire system should be defined with 4 and 5 selected and all unused pairs de-selected. If a 4-conductor phone cord is used, then the 1, 2, 7, and 8 should be de-selected. The example below shows a typical 6 wire system setup.



TEST DATABASE MANAGEMENT

Prior to beginning testing, it is important to define the test sequence. The test sequence name is used by the database to identify the series of tests that are performed on a target. For a single target on a job, you may perform multiple test sequences.



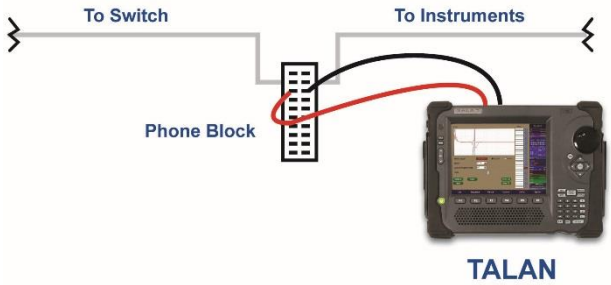
TESTING CONCEPTS AND RECOMMENDED TEST SEQUENCE

Testing Locations

The TALAN can be used to test a phone line from several different testing points.

Testing at Phone Set

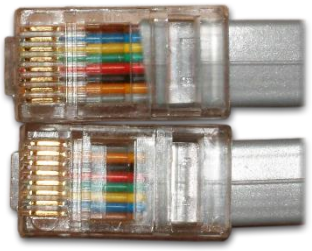
Block Testing



It is important to understand that prior to interrupting the phone line you should first verify that there is no audio passing down the line. Therefore, regardless of where you test the line, you should first use the banana plugs, connect to the main audio pair and test for audio. This is often easier at an intermediate block. Then, it is recommended that the user start testing at the phone set. For the remainder of this document, it is assumed that the testing is performed at the phone set.

VoIP Wiring and Using the TALAN VoIP Adapter

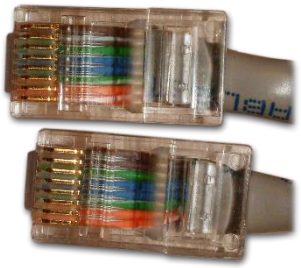
Traditional Telecom Cables



Typical analog and digital phone systems use a “reversed” modular 8-conductor cable (where Pin 1 on one end of the cable corresponds to Pin 8 on the other end of the cable, Pin 2 to Pin 7, and so on). Flat modular cords are most often in this reversed format. This reversed wiring can be seen in the image at the right (note the reversed colored conductors on each connector).

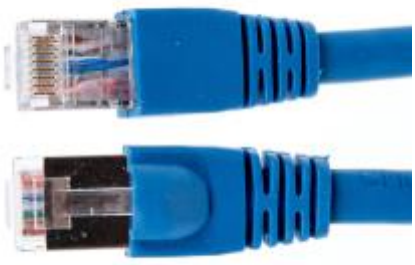
The TALAN can be used “in-line” with a phone system using the TALAN’s two modular jacks which are identified as LINE and PHONE. The modular jacks on the TALAN are wired straight through to allow for most common telephone systems without the use of a special crossover or special test adapter cable. Pin 1 on the LINE jack corresponds to Pin 1 on the PHONE jack and so on.

Cat5 Cables



Unlike the reversed modular flat cables found in most voice systems, Cat5 twisted pair cables, which are used in VoIP phone systems and some digital phone systems, are wired in a “straight though” manner (Pin 1 to Pin 1, Pin 2 to Pin 2, etc.). Typically, VoIP systems use Pins 1, 2, 3 and 6 of an eight wire twisted pair cable. This straight through wiring is shown in the image to the right (note the colored conductors are in the same order in both connectors).

Cat6 Shielded Cables



CAT6 cables are based on the CAT5 design, however, CAT6 cables utilize shielding and potentially a drain wire and/or braid to help reduce interference between conductors and also help reduce interference between the CAT6 cable and other cables. However, this additional shielding could be used as a carrier for electronic information. For example: placing one lead of a microphone on the shield and placing the other lead of the microphone to one of the 8 CAT6 conductors.

TALAN 3.0 provides methods to test MOD8 conductors against shields in CAT6 shielded cables.

TESTING CONCEPTS AND RECOMMENDED TEST SEQUENCE

Testing Stages

When testing with the TALAN, there are different testing conditions that must be considered. We have defined these conditions as test stages and they are:

1. On-Hook Test Stage
2. Off-Hook Test Stage
3. Phone Disconnected Stage
4. Open Circuit Stage
5. End-of-Line Stage

It is not necessary to conduct all possible tests in each of these test stages; therefore we have provided a description and benefit for each of these stages.

1. On-Hook Test Stage

Handset on hook, TALAN in line with phone set.

- No audio should exist on any pair.
- Characterize system parameters such as voltage.
- Test for RF Carrier Current signals

Tests: DMM, Audio analysis, Broadband RF and Activity level

2. Off-Hook Test Stage

Handset off hook, a call is in progress, audio should be passing through the line only on the main pair.

- To validate Audio Testing. Test for audio on odd pairs.
- Characterize system parameters such as voltage and compare with On-Hook Case.
- Test for RF Carrier Current signals

Tests: DMM, Audio analysis, Broadband RF and Activity level

3. Phone Disconnected Stage

Phone disconnected from line, but line is connected to digital switch.

- Characterize system parameters such as voltage.
- Analyze Line with FDR, and compare FDR results between pairs to look for taps

Tests: DMM, FDR

4. Open Circuit Stage

Line is not connected to switch or phone set. No electronic connections should exist anywhere on the line. Line is completely isolated from everything except the TALAN.

- Test Line with bias voltage for attached microphones
- Analyze Line with FDR, and compare FDR results between pairs
- Test Line for taps and microphones

Tests: NLJD, FDR, Capacitance

5. End-of-Line Stage

The line is isolated as in the above stage however, there is a passive load (no electronics, only a resistive network) attached to the end of the line to improve FDR sensitivity and provide loop resistance test.

- Analyze Line with FDR, and compare FDR results between pairs and with Open Circuit stage
- Test Line for serial taps using loop resistance

Tests: FDR, Loop resistance

Summary of Recommended Tests

The testing stages listed above result in large amounts of test data. However, it is important to consider which tests provide the most benefit in the shortest amount of time. For this situation we recommend the following simplified and reduced test outline:

Set-Up

1. Set-up the TALAN prior to making test measurements. Methods for performing these steps are provided later in the manual.
    a. Enter a Job Name prior to testing.
    b. Enter the Location and Target information.
    c. Define the number of conductors that exist on the line.
    d. Define a Sequence Name.
    e. Install digital phone type (i.e., Avaya, Nortel, Samsung…).

Non-Alerting

2. Without disconnecting the line or altering the handset, test the line for audio using the banana plugs.
    a. Find a place somewhere on the line to gain access to the pairs.
    b. Test each pair for voltage to verify the main active pair.
    c. Test each pair for both analog and digital Audio.
    d. Test each pair for carrier current signals with the RF Level & Spectrum tests.
3. Using the RF Antennas, test for RF energy coming from the telephone.

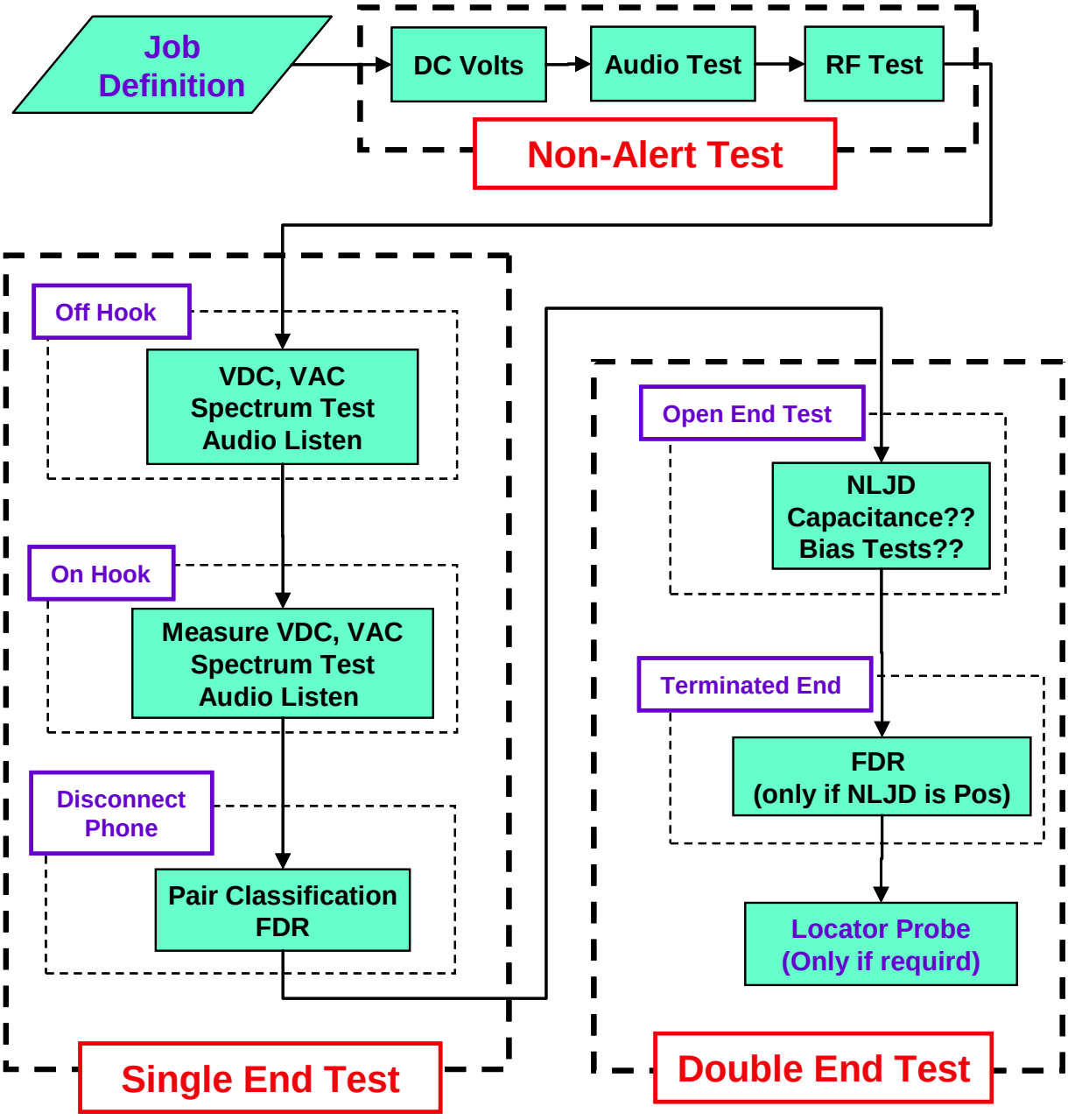
Single Ended Testing

4. At the phone set, connect the TALAN in line.
    a. If the Telephone cable is a FLAT cable, then a FLAT patch cable should be used between the TALAN and the wall jack.
    b. If the Telephone cable is a Twisted Pair cable, a Twisted Pair patch cable (typically CAT5) should be used between the TALAN and the wall jack.
5. With the Phone ON HOOK (Stage 1)
    a. Test all pairs for DC voltage to get a basis for operating voltage & DC current.
    b. Test all pair combinations for audio. There should be NO audio.
6. With the Phone OFF HOOK and a call in progress (Stage 2)
    a. Test all pairs for audio (Note: you may also hear audio on any pair combination that has either conductor from the main pair because the TALAN audio system can pull audio from one wire in a balanced pair).
    b. Test all pairs for DC voltage. This gives a basis for the operating voltage.
7. With the Phone Disconnected (Stage 3)
    a. Classify the Pairs (define balanced pairs).
    b. Test the main pairs with the FDR. Put all FDR traces on the screen and visually compare. They should be very similar. It is recommended to concentrate only on the balanced pairs.

Double Ended Testing

8. With the Phone Set Disconnected and the Switch Disconnected (Stage 4)
    a. Test all pair combinations with the NLJD. There should be NO response on any pair combinations. THIS IS THE MOST RELIABLE TEST.
9. With the Phone Set Disconnected, the Switch Disconnected, and the End-Of-Line terminator placed on the line (Stage 5)
    a. Test main pairs with the FDR to indicate locations of electronic connections.
10. Use the Locator Probe as needed to find the tap.

Recommended Test Sequence



Automated Sequencing and Manual Operation

The TALAN has many test functions that can be performed in either an Automated Sequence Mode or Manual Mode. The main difference is that the Automated Sequence Mode is designed to walk the user through the previously recommended test sequence while the Manual Mode is designed to allow the user to go to any specific tests and completely control the parameters and conditions of the tests. Manual Mode is most useful for testing for specific items of interest while the Automated Sequencing is recommended for a complete evaluation of the line. In both modes, the testing screens are very similar; however, the Automated Sequencing Mode test screens have a green background while the Manual Mode test screens have a brown background.

DMM Sequence Tests

DMM Manual Tests

This section will describe how to utilize the Sequence mode. However, the details of the actual tests being performed will be described later as Manual Tests functions.

To access the Sequence testing, press the **F2** (Sequence) button and simply begin selecting the desired tests under the Stage submenu. It is highly recommended that the test stages and test functions be performed in the order that they are presented.

Within the test Sequence, different stages will be defined as previously described and specific tests will be available under these test stages as indicated by the example menu structure below.

Test Types

When executing the tests under the Sequencing Mode, the tests that the TALAN will perform includes those selected using the **TEST TYPE** selection. The TALAN will automatically utilize default settings for the various test functions.

The **TEST TYPE** can be configured by the user as necessary. There are "quick set" buttons for **Block**, **Phone**, **ALL**, and **NONE**. These buttons will set the appropriate set of tests for **VDC** (Volts DC), **VAC** (Volts AC), **RES** (Resistance), **CAP** (Capacitance), **IDC** (current DC), and **IAC** (current AC). Below is an example of the Stage 1 (On-Hook) DMM tests where the **TEST TYPE** was set to All Pairs and All Wires for all test types.

Subsequently, when **START** is pressed, the TALAN will test all pairs and wires for all tests.

The default factory settings for **BLOCK** and **PHONE** are as follows:

TEST TYPE	Block	Phone
VDC (Voltage DC)	Balanced Pairs	Balanced Pairs
VAC (Voltage AC)	None	None
RES (Resistance)	Balanced Pairs	Balanced Pairs
CAP (Capacitance)	None	None
IDC (DC Current)	All Wires	None
IAC (AC Current)	None	None

If a test combination other than **BLOCK**, **PHONE**, or **ALL** is desired, then the **TEST TYPE** pair / wire selections can be set using the **CUSTOM** button.

Using the above shown display, each individual **TEST TYPE** can be modified to the desired setting.

VDC, VAC, RES and CAP **TEST TYPEs** options are:

None	This test type will not be performed on any pairs
Balanced	For all balanced pairs where each wire in the pair is available, this test will be performed.
All Pairs	For all pairs available for this location, if each wire is available, then this test will be performed.

IDC and IAC **TEST TYPEs** options are:

None	This test type will not be performed on any wires
All Wires	For all wires identified as available for this location, this test will be performed.

When you have made the changes to the set of tests you want to run, select **OK** to exit the TEST TYPE selection screen, which will save your changes for this test run, then select **START** to run the test type configuration you have just defined. The TALAN will automatically progress through the different **TEST TYPEs** using the settings you defined.

While on the **TEST TYPE** pair / wire selection screen, pressing **Cancel** will exit the TEST TYPE pair / wire selection screen and cancel type selections you have made in this session of the Test Type selection screen.

The **TEST TYPEs** selected when pressing **BLOCK** and **PHONE** can be changed for this TALAN. The **TEST TYPEs** for this TALAN are remembered through power cycles.

To change the **TEST TYPEs** selected when pressing **PHONE** on the Sequence Mode DMM screen, do the following:

Access the **Test Type** pair/wire selection menu by pressing the **CUSTOM** button
Setup the **TEST TYPE** configuration you want for **PHONE** for each **TEST TYPE**
Press **Save As PHONE Test Types**.

Likewise,
To change the **TEST TYPEs** selected when pressing **BLOCK** on the Sequence Mode DMM screen, do the following:

Access the **Test Type** pair/wire selection menu by pressing the **CUSTOM** button
Setup the **TEST TYPE** configuration you want for **BLOCK** for each **TEST TYPE**
Press **Save As BLOCK Test Types**.

If at any time you want to go back to the factory settings as it was shipped from REI for **PHONE** and **BLOCK**, then press the **Restore BLOCK/PHONE to Suggested Defaults** button.

The **PHONE** and **BLOCK** Test Type settings are retained during power cycles.
The **Suggested Defaults** cannot be changed.

Test Type Configuration Tips

It is not advisable to perform a Resistance test on pairs that have not been checked for **VDC** because the TALAN applies DC Voltage to perform the Resistance test. Therefore, when you select a Resistance test combination that has a pair that is not going to get tested due to the current **TEST TYPE** selected for **VDC TEST TYPE**, the TALAN will **automatically** change the **VDC TEST TYPE** to the same **TEST TYPE** as you selected for the **Resistance TEST TYPE**. A warning message will be shown reminding you that this change automatically occurred to the **VDC TEST TYPE**.

For example, assume you do the following:

Set **VDC TEST TYPE** to **Balanced Pairs**
Then set **Resistance TEST TYPE** to **All Pairs**

The TALAN will **automatically** change **VDC TEST TYPE** to **All Pairs**.
A Warning Message will appear.

However, the TALAN will allow you to select a lower set of pairs for VDC once the **Resistance TEST TYPE** is set.
For example, assume you do the following:

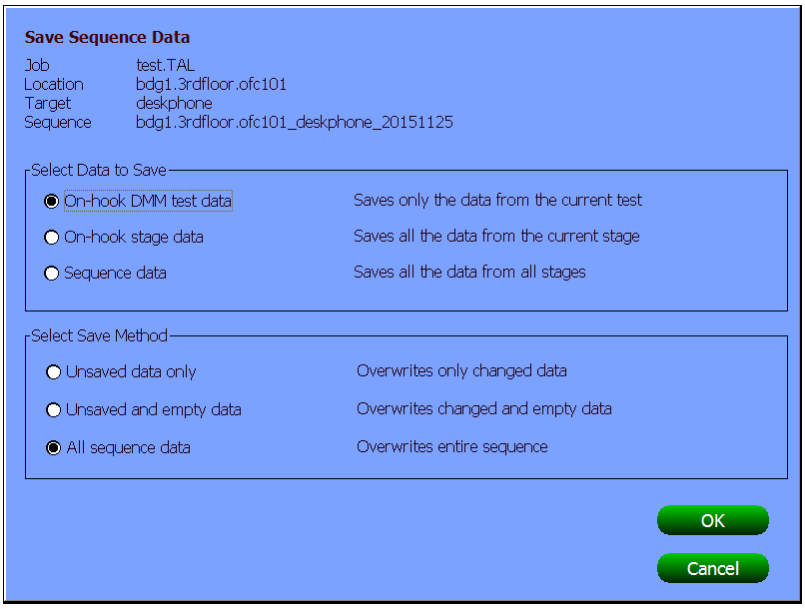
Set **Resistance TEST TYPE** to **All Pairs**,
Then Set **VDC TEST TYPE** to **Balanced** or **None**.

The TALAN will permit this change, because it assumes that your selection is based on knowledge of the state of the wires/pairs, however a Warning Message will appear.

Save Sequence Data Functions

As shown below, when data has been measured but not saved, the surrounding field will be indicated in **red** on the summary dashboard to the right. To save this data, select Save as… to store this data into the database structure. When data is saved, it will be indicated with a **blue** field.

Red background indicates data has **NOT** been saved.

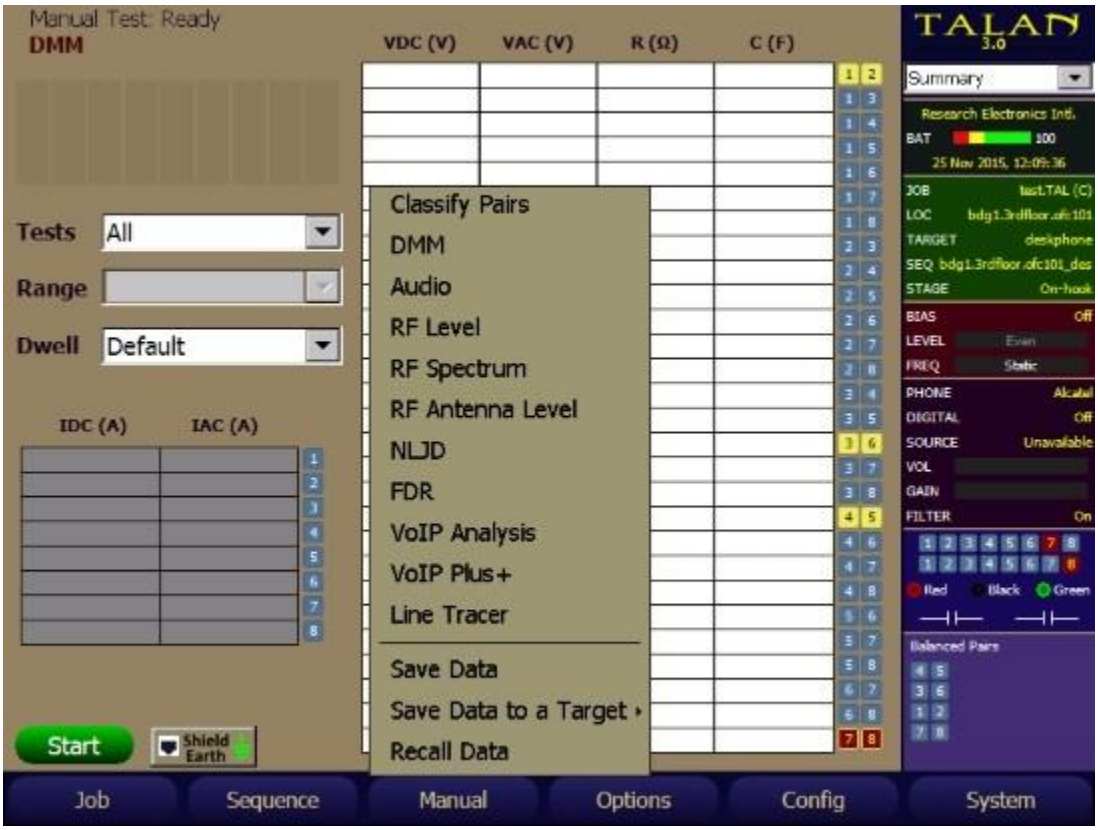


Blue background indicates data **HAS BEEN SAVED.**

All of the remaining sequencing can be completed by selecting the testing stages and suggested tests in the order that they appear on the screen. For example, after the DMM test sequence is completed, it is recommended to continue the sequence with other available tests within this Stage. It is recommended that each Stage be tested in order. All test functions are described in detail in the following section entitled Manual Test Functions.

MANUAL TEST FUNCTIONS

This section provides an overview of all TALAN testing functions. The figure below shows the available manual testing options accessible via the **F3** (Manual) or the **MANUAL** push button. The manual test functions are CLASSIFY PAIRS, DMM, AUDIO, RF LEVEL, RF SPECTRUM, RF ANTENNA LEVEL, NLJD, FDR, VOIP ANALYSIS, VOIP PLUS+, and LINE TRACER.



The manual test controls for each function are very similar. For each test, once the test pairs have been defined (single, balanced or all) under the Test Options dashboard, and any other test parameters have been specified, the test is started by pressing the **START/STOP** button or tapping Start on the screen.

Save/Recall for Manual Test Functions

For all Manual Test functions, the user can save the current active measurement data for later review and / or comparison with previous measurements.

There are two methods to save data that has been collected by the Manual Test functions.

The first method is to store the data to an open Job using the **Save Data** item under the **F3** (Manual) button. This data can be recalled on the TALAN at a later date. It can also be transferred to a PC via USB or a Compact Flash card and viewed in the **Manual Data** section of TALAN Data Viewer. The data is organized by test method, e.g. DMM, FDR, etc. This method requires careful naming of the data captured so that the user will understand where this data actually came from when reviewing it on the PC with TALAN Data viewer.

The second method is to store the data to a target within an open Job using the **Save Data to a Target** item under the **F3** (Manual) button. This data can be transferred to a PC via USB or a Compact Flash card and viewed in the **Sequence Data** section of TALAN Data Viewer. The data is accessible in a logical tree structure that starts with the highest level location designation (e.g. company name **REIHQ**). It can then be broken down into as many sub locations as necessary, e.g. **TrainingRoom**, or **PhoneCloset4** or **PresidentsOffice**, then finally to a given Target, such as **Deskphone** or **WallJackA231**. This **Save Data to a Target** method places the manually collected measurements into the same target that data is stored from the Sequence DMM tests as outlined in the section titled **Save Sequence Data Functions**.

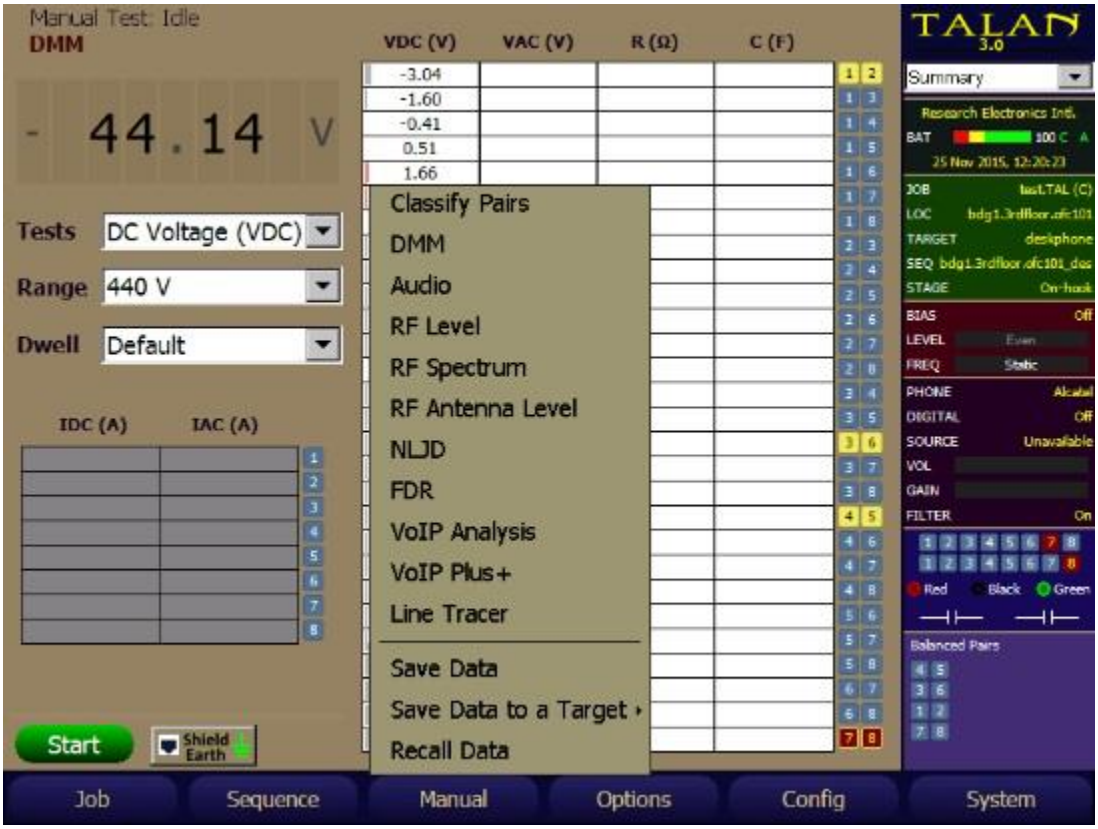
Using the **Save Data** method requires that the data name for the given measurements contain sufficient information to identify all of the locations/sub-locations/targets. This makes the **Save Data to a Target** method a more logical approach to organizing data for future retrieval / comparison using the TALAN Data Viewer.

Save/Recall Data Example

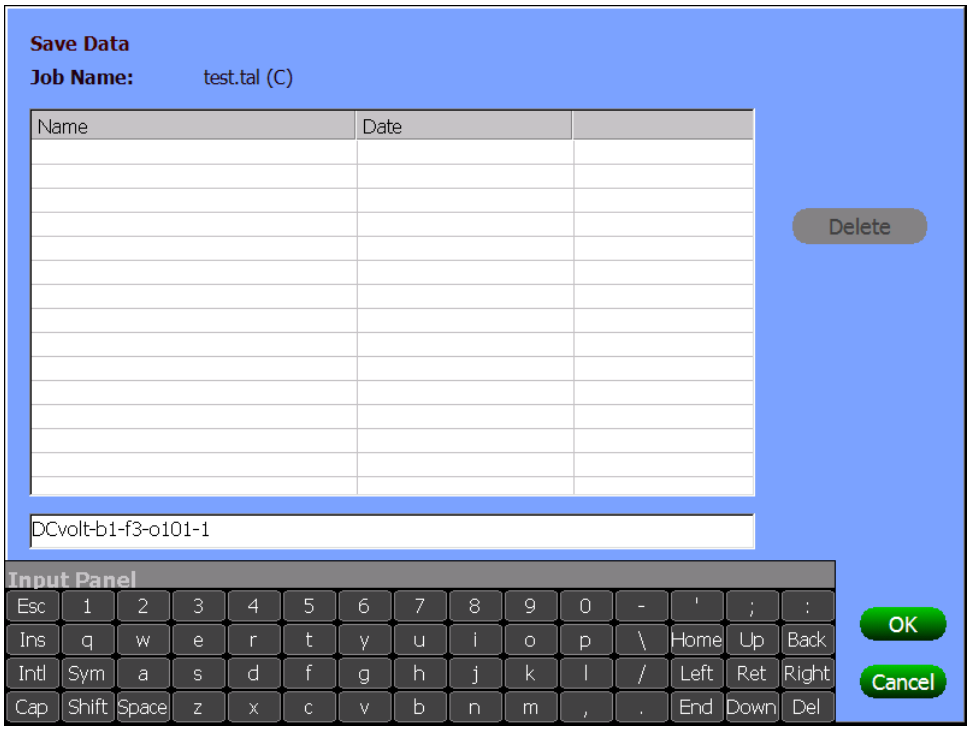
To demonstrate the basic Save and Recall Data functionality, we have taken simple DC voltage measurements of a full set of pairs (this test is explained later under Test Functions portion of the manual). It is important to note that any measurements that are taken with the TALAN (i.e. DMM, FDR, NLJD, Audio level, RF Spectrum trace, etc…) that are stored using the **Store Data** method can be stored and associated with a Job in a Job Name Database. This data can later be recalled for review or comparison on the TALAN or using the TALAN Data Viewer on a PC.

To save data so that it will be associated with a Job, that specific Job Database must be open.

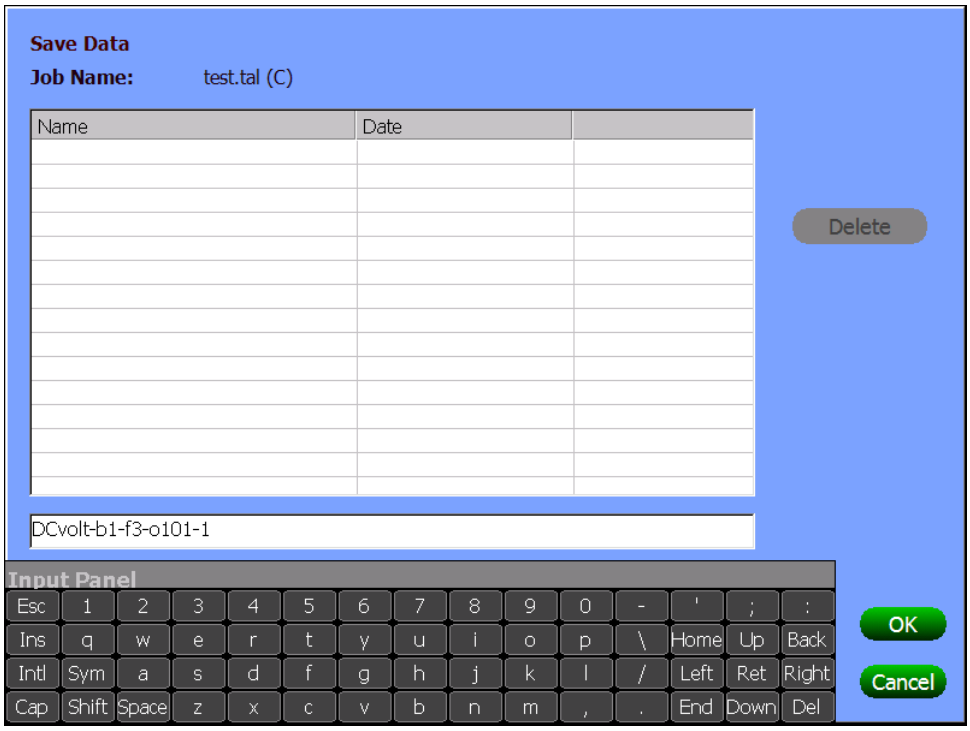
To save the DC Voltage measurements taken in the Manual DMM test, select **F3** (Manual) then select **Save Data**.



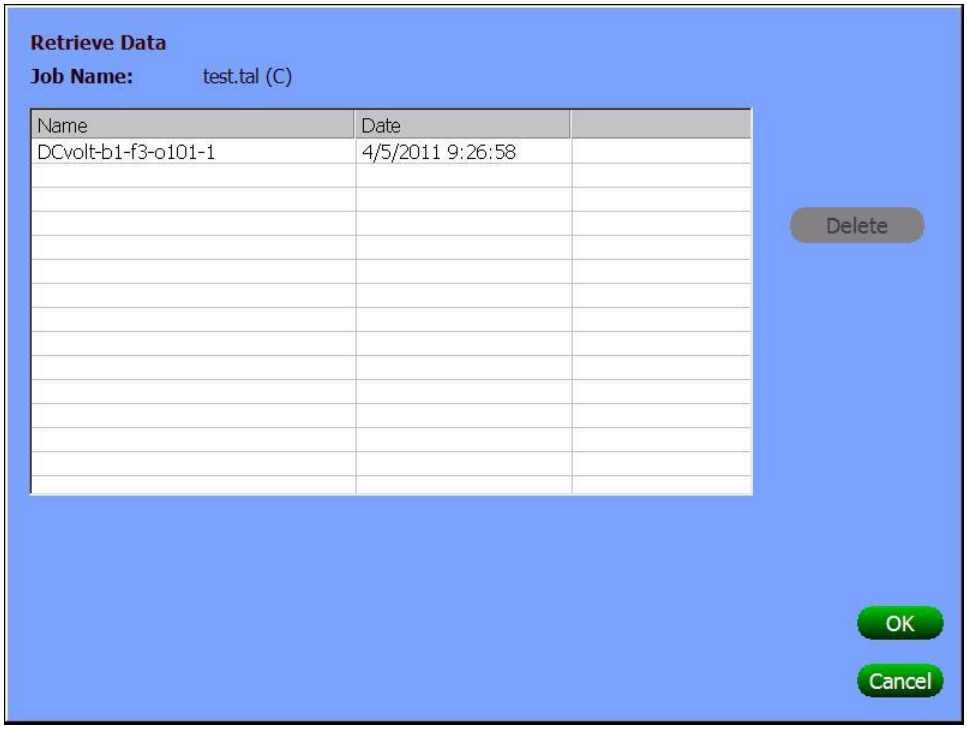
Enter a name for this data, and press **OK**. You must be careful to document your filename and data set name to keep track of the data that was stored.



To retrieve data from the manual database, select **F3** (Manual) then select **Recall Data**. This is beneficial when comparing current readings with previous readings looking for anomalies.



Select the name of the data set you want to recall, and select **OK**.



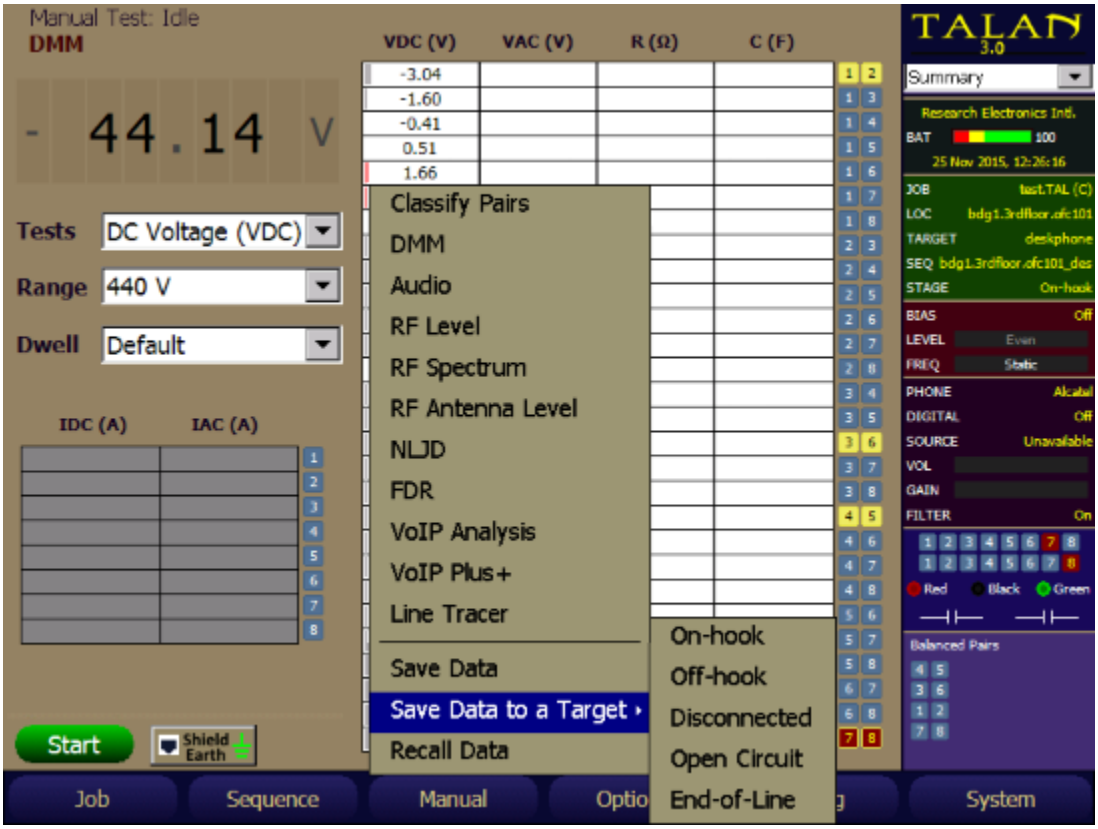
Save Data to a Target Example

Saving data so that it is associated with a target means that the data will get placed into the **Sequence Data** for a target within a given Job database. This data can be accessed in the **Sequence Data** section of TALAN Data Viewer.

The **Sequence Data** section presents the data in a tree representation starting with the main top level location, through the various sub-locations, ending up at a given target.

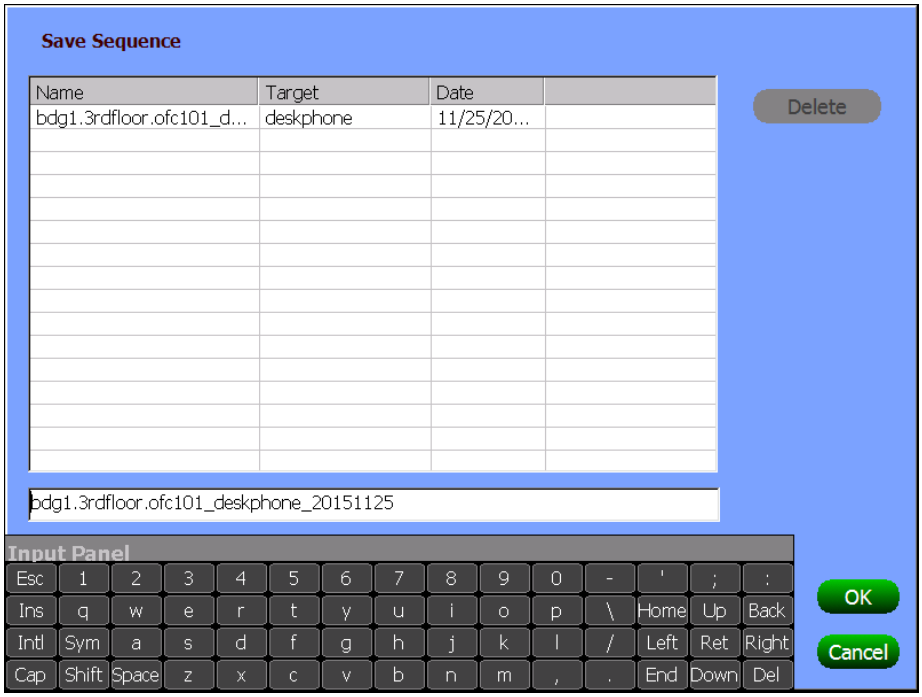
To save data so that it will be associated with a Target, that specific target and its respective Job Database must be open.

To save the DC Voltage measurements taken in the Manual DMM test, select **F3** (Manual) then select **Save Data to a Target**.

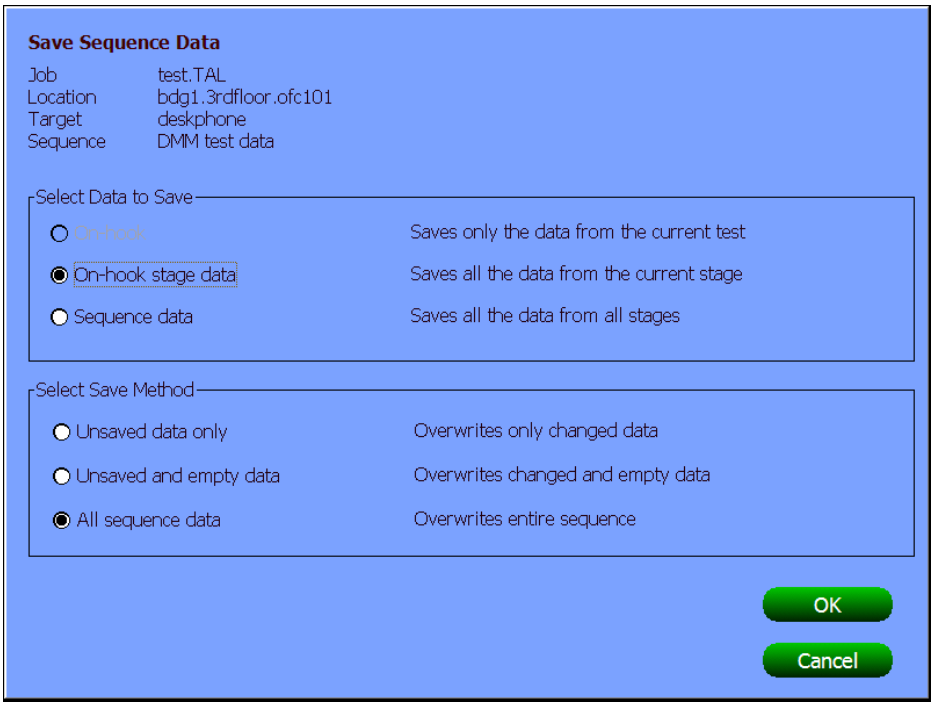


Select the stage for this test, e.g. **On-Hook**, **Off-Hook**, **Disconnected**, etc. for the appropriate test type and physical setup. Note: This list of stages varies depending upon the test type (DMM, Audio, etc.) and the stage selected.

Verify the name automatically created for this test, correct it if necessary, and select **OK**.



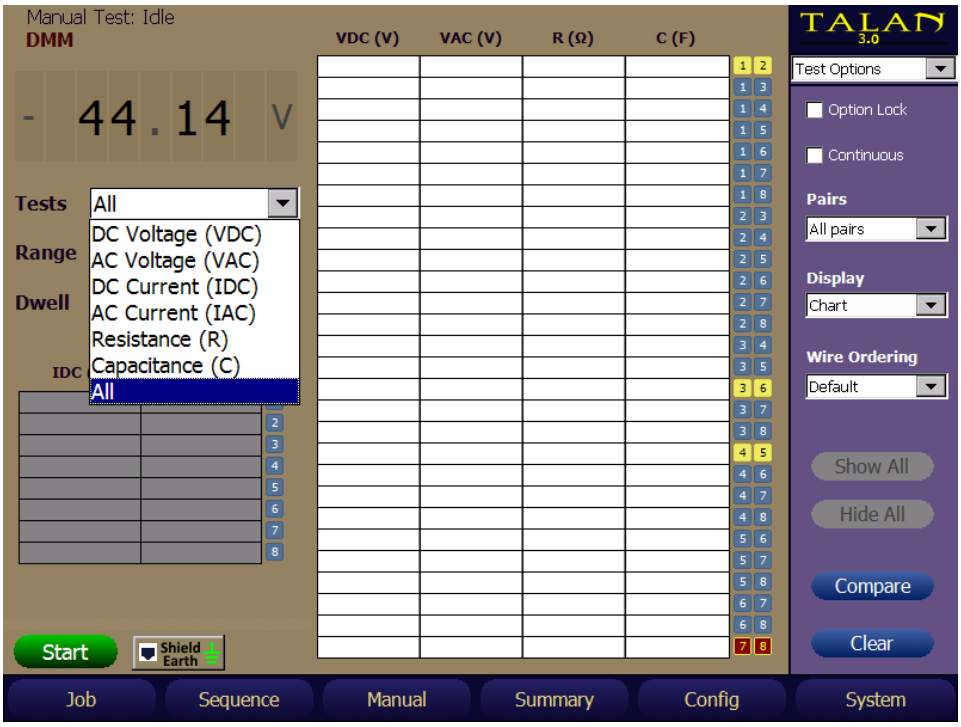
Verify the Data to save and Save Method (normally just use the defaults), and select **OK**.



The saved data can now be recalled on the PC using TALAN Data Viewer selecting the appropriate TAL file for this job, in the **Sequence Data** section.

DMM – Digital Multimeter

Open the DMM test screen by pressing the **F3** (Manual) button, and then press the **Options** button to display the Test Option dashboard where you can specify whether to test a single pair, balanced pairs or to test all pair combinations. Also, the continuous box specifies whether or not to continually update the test results.



Then, select which tests to measure as shown above. It should be noted that to prevent a non-practical test there are automatic conditions for performing some of the tests (for example, you cannot measure capacitance on a line that is terminated or powered).

These conditions are as follows:

- Resistance – Only measured if there is no voltage on the line.
- Capacitance – Only measured if there is no voltage on the line and the resistance is very high indicating an open line.

Also, if all tests and all pairs are selected, then there is a built-in automatic ranging function to ensure that each measurement is meaningful. But, if a single test is specified, then the range must be manually selected.

- If the display reads “+++”, the measurement is OUT OF RANGE. For the Resistance measurement, it may indicate a very high resistance or “open”.
- If the display reads ”Active “, the test was not performed because a high DC voltage indicates the line may be in use.
- If the display reads “Lo-Z”, it means that the capacitance was not measured because Capacitance can only be measured on an open line.

A wire must be available for the associated wire or pair to be tested, even if the pair is defined as a balanced pair.

It should be noted that capacitance measurements may vary greatly because capacitive coupling varies greatly between unbalanced pairs. However, balanced pairs should have very consistent capacitance measurements.

The example below shows a Samsung digital phone system that uses a 45-volt supply on the main pair of 4:5. In this example, the balanced pairs are 1:2, 3:6, 4:5 and 7:8.

The balanced pairs should have the same capacitance values (2.97nF in this example) as indicated for pairs 1:2, 3:6, and 7:8. The capacitance value of 4:5 is not measured because the pair is active with voltage on the line.

There may be situations where signal conditions are such that a given test does not remain on the pairs or wire long enough to be able to give a reliable reading. For these instances, the user can change the **Dwell** time selection from **Default** to **Extended**.

The **Dwell** selection is available in the Manual DMM and Audio tests, as well as the Sequence DMM and Audio tests.

While the Dwell selection is remembered and used when going between different test types and test screens, it is NOT retained when the TALAN is powered off then back on.

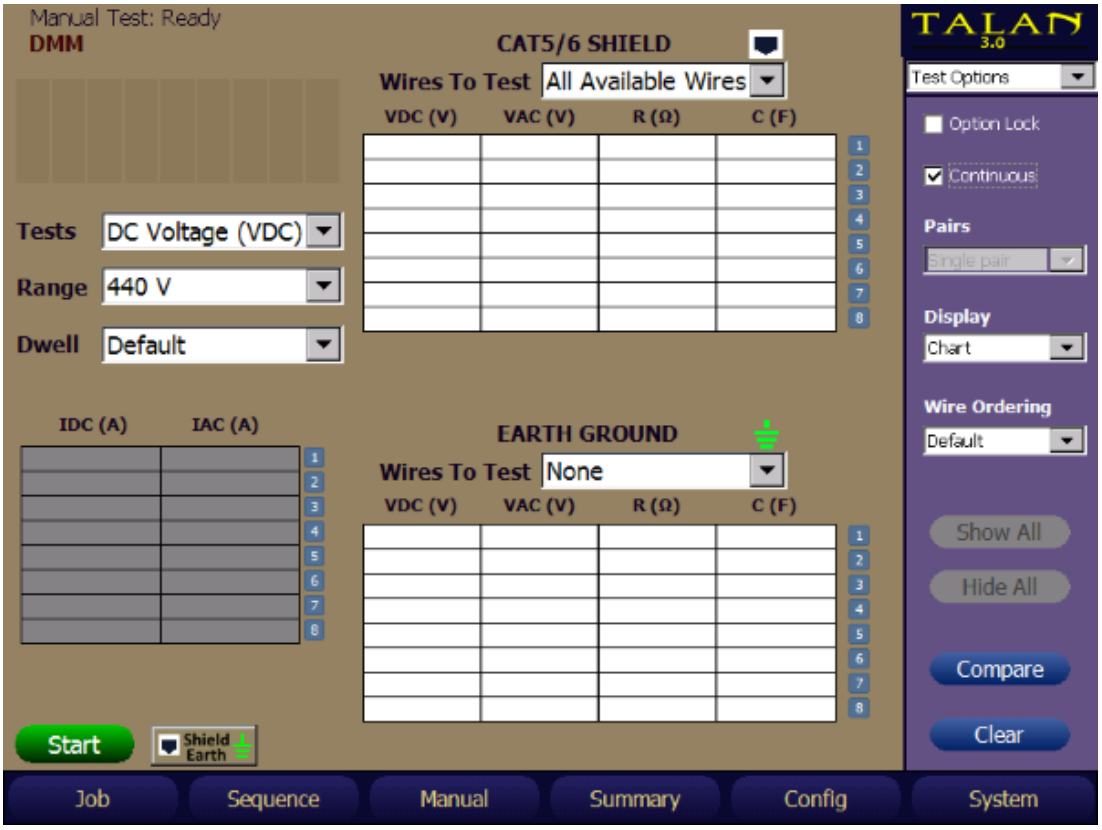
DMM (Advanced Shield and EarthGround Testing)

TALAN 3.0 provides Manual DMM testing of the Phone / Line wires against either:

- The **Shield** of an RJ45 cable plugged into the Phone or Line Jack of the TALAN
  - or -
- An additional wire fed into the **EarthGround** Green Banana Jack of the TALAN

Testing Phone / Line wires against the **EarthGround** jack gives a way to determine if a stray wire in an Ethernet Junction box is being used as a tap or for some other illicit purpose.

To perform this testing, from the Manual DMM test page, press the **Shield Earth** button that resides just to the right of the **START** button. This will bring up the following display:

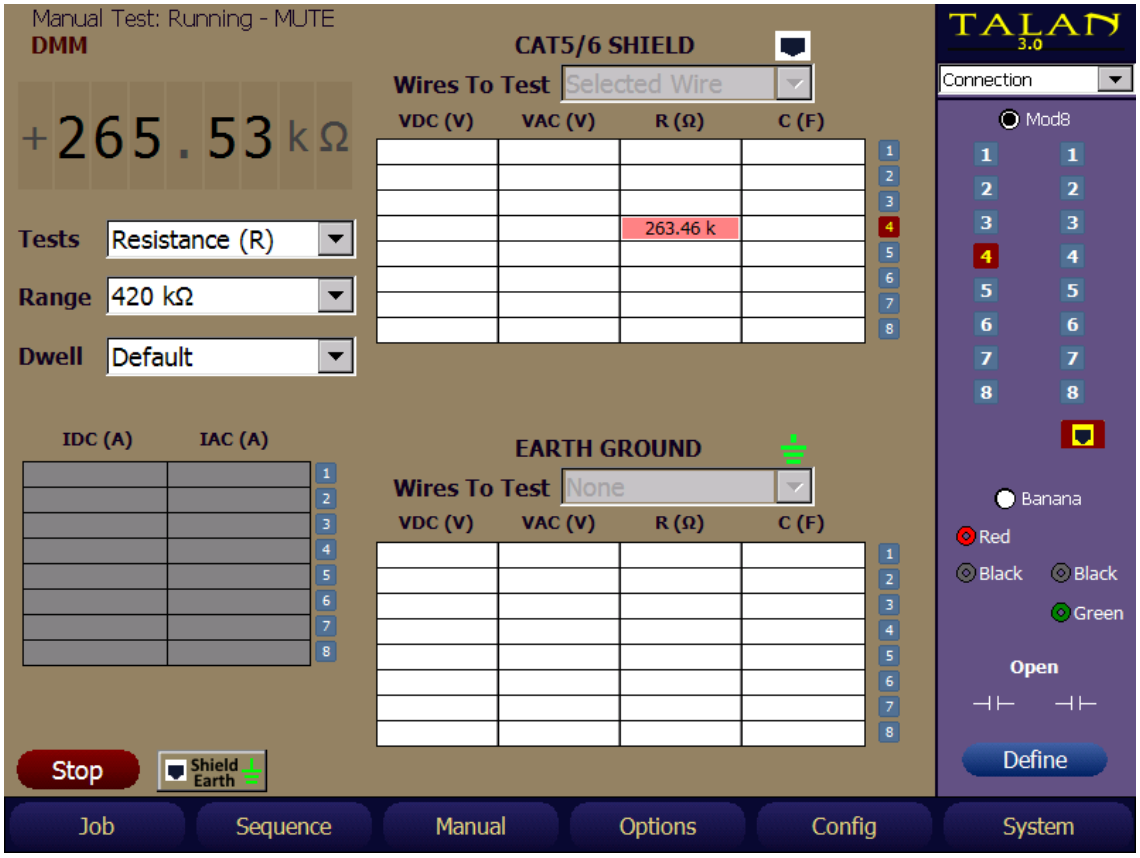


The **Shield** and **EarthGround** testing interfaces are shown. The normal **Test Options** selection for **Pairs** is not functional for **Shield** or **EarthGround** testing. However, there is an individual selection for each now. This allows the testing event to be customized. The **Wires To Test** can be customized through the drop down menu item individually for the **Shield** or the **EarthGround** to **All Available Wires**, **Selected Wire**, or **None**.

Note: When selecting the **Shield** to do a specific test, the **EarthGround** selection will be forced to **None**. Likewise, when selecting the **EarthGround** to do a specific test, the **Shield** selection will be forced to **None**.

The same testing controls for Manual DMM is permitted for the **Shield** and **EarthGround** tests. E.g. Selection of **Tests**, **Range**, **Dwell**, etc.

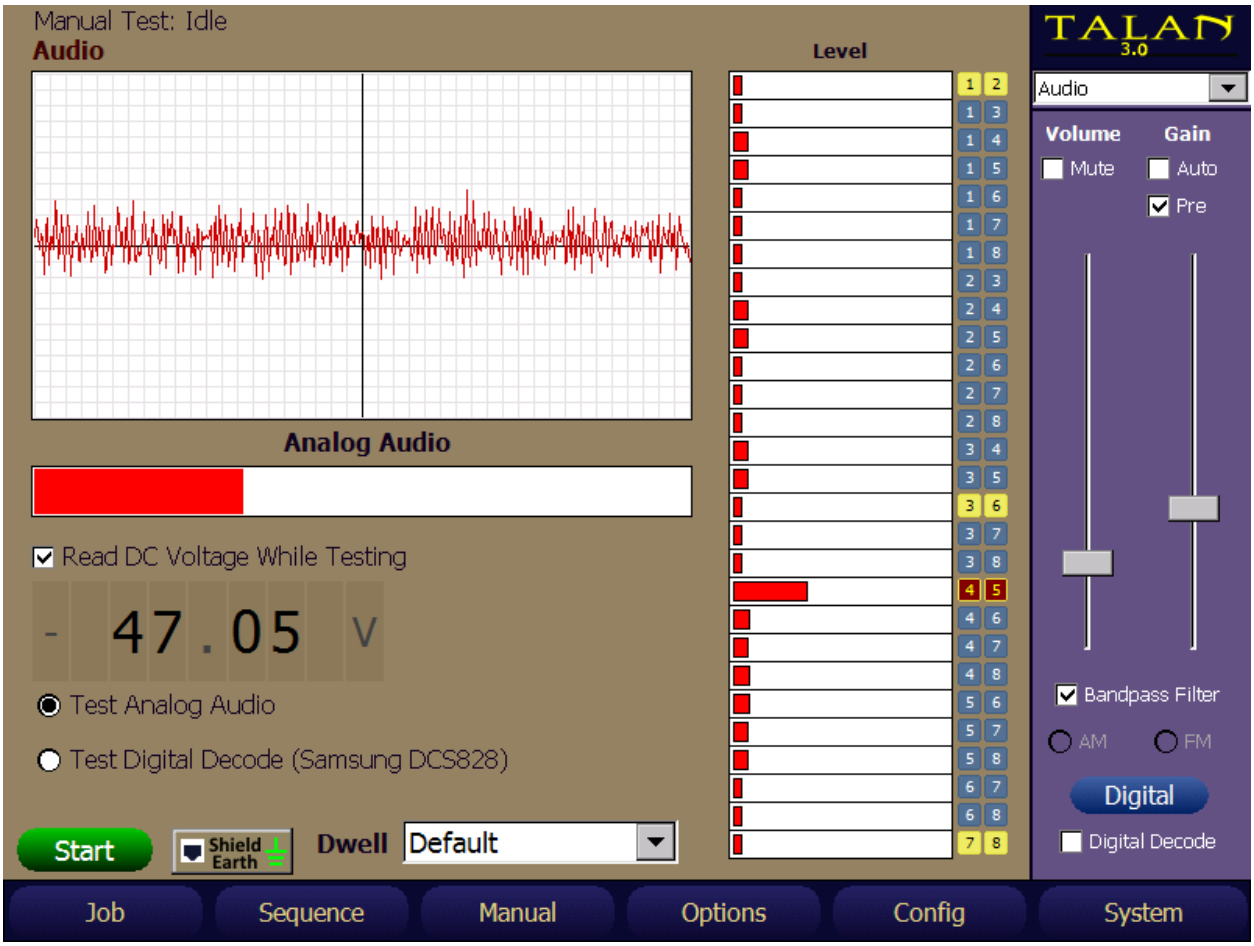
The right dashboard **Connection**s display can be used to control the selections when the **Wire To Test** is set to **Selected Wire**. The following figure shows a test of resistance with 265K resistance between **Wire 4** of a CAT6 cable plugged into the Phone jack and the **Shield** of the CAT6 cable:



The DMM Measurements taken against **Shield** and **EarthGround** connections can be saved in a TALAN Job file which can then be viewed on a PC running the TALAN Data Viewer V3.0 in the Manual Test data section.

Audio

The Audio test provides for listening to both Digital and Analog Audio. Select the Audio option from the Manual menu to access the Audio test screen.



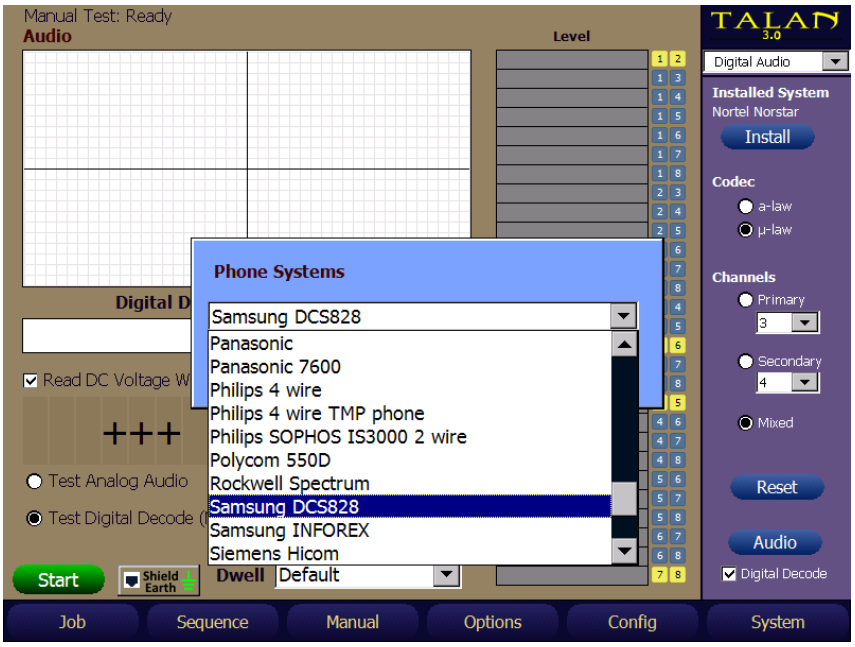
After opening the Audio screen, there are several methods to select the desired pair.

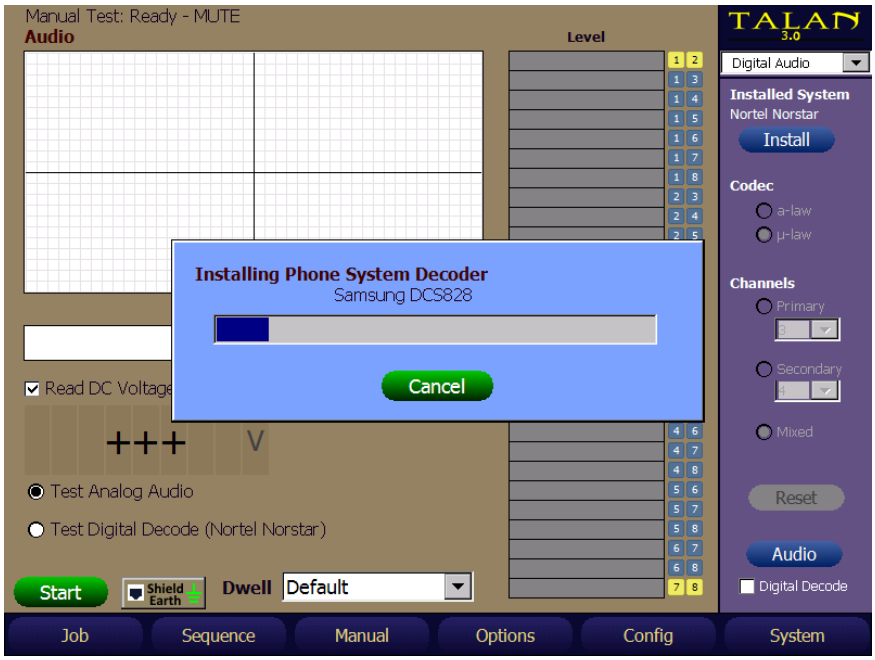
- Tap the desired pair listed (4:5 is shown on the test display)
- Tap the Input portion of the Summary dashboard to bring up the Connection dashboard.
- Press the **C** button on the keypad to bring up the Connection dashboard.

In most cases the center pair should be selected (Pair 4:5).

When you have more than one pair, and you have Pairs in the Test Options dashboard set to either **All Pairs** or **Balanced Pairs**, a test run will cycle through those pairs when you press **Start**. Similar to the DMM tests, there will be times when you want to sit on the pairs and listen longer than the normal default time. For those instances, the **Dwell** can be set to **Extended**.

To select the proper digital demodulation, you must specify the proper digital system. Press the Digital button on the Audio dashboard to open the Digital Audio dashboard, and then select Install to load the proper Digital system. You must select Upload to program the TALAN for this system. It will take approximately 1 minute to upload the system demodulation program for a particular digital system.



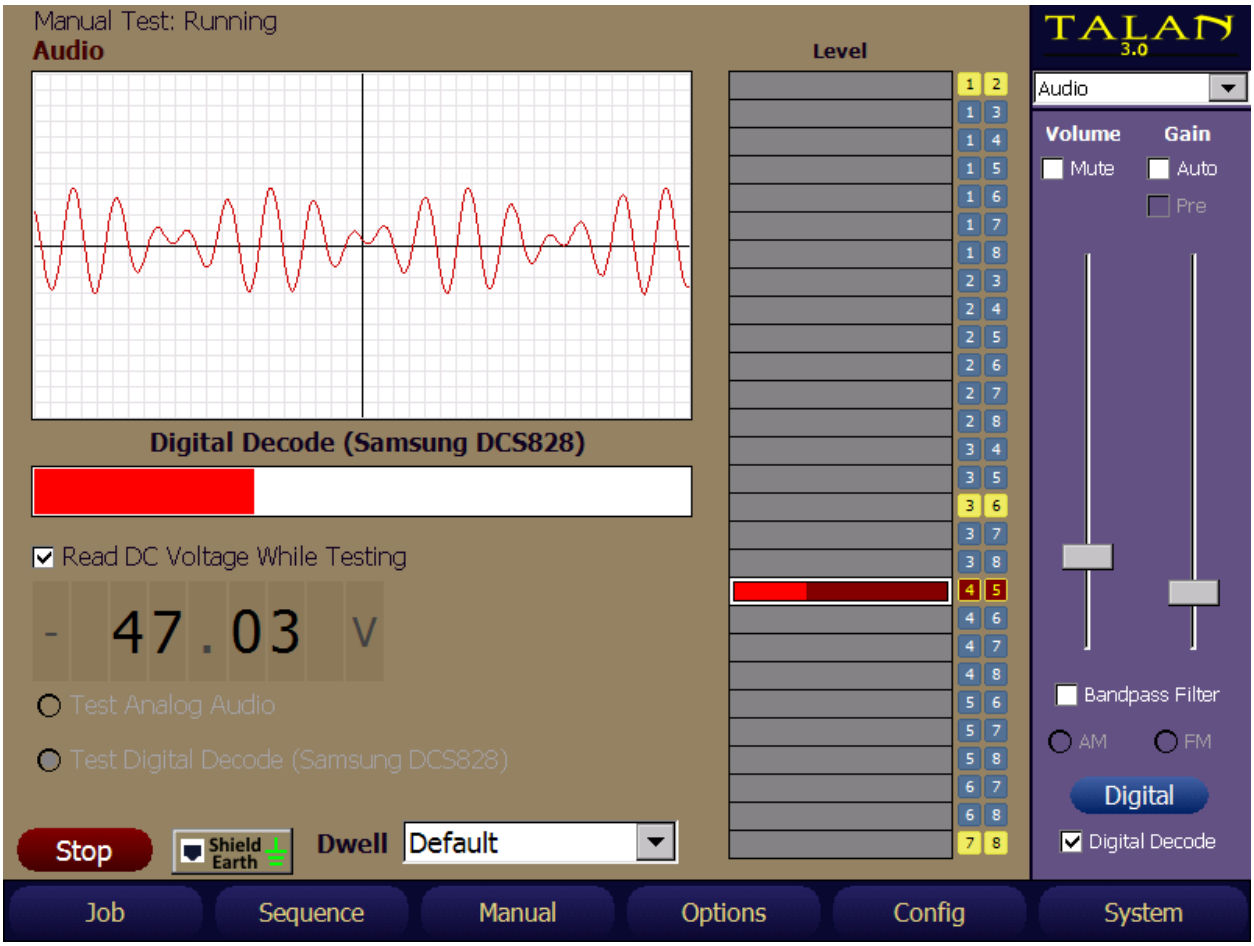


In the Digital Audio dashboard, Channels indicates which side of conversation is being demodulated. Select Mixed in order to hear both sides of the phone conversation, Primary to hear only the handset, or Secondary to select the audio coming from the switch. To listen to normal analog audio, Digital Decode should be unselected.

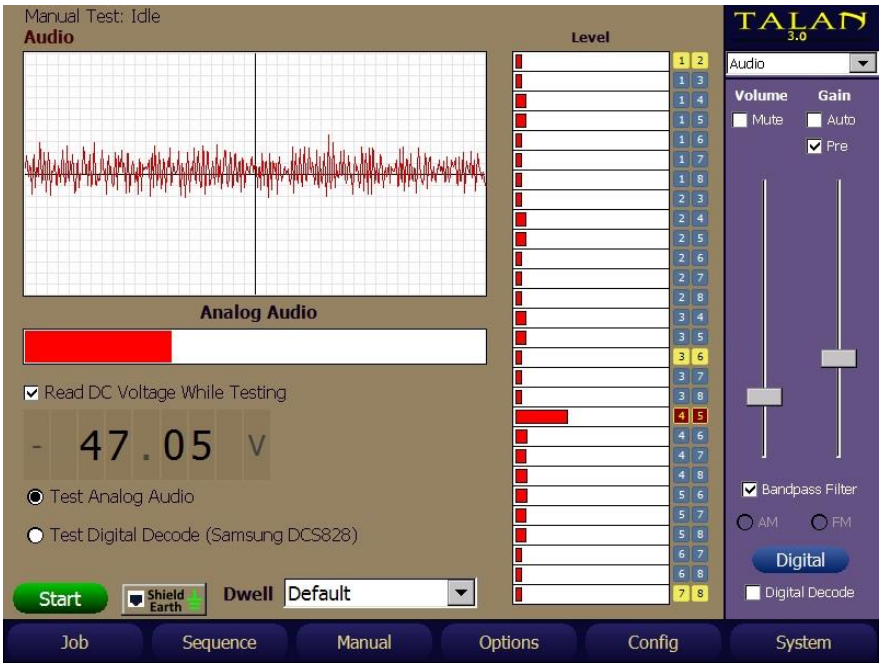
The Codec indicates the type of modulation that is used. µ-law is used primarily in North America and Japan while a-law is prominent in the rest of the world.

To adjust Volume and Gain Control, the controls are on the default audio dashboard. You can access the Audio dashboard by pressing the **A** button, or by selecting the Audio button on the Digital Audio dashboard.

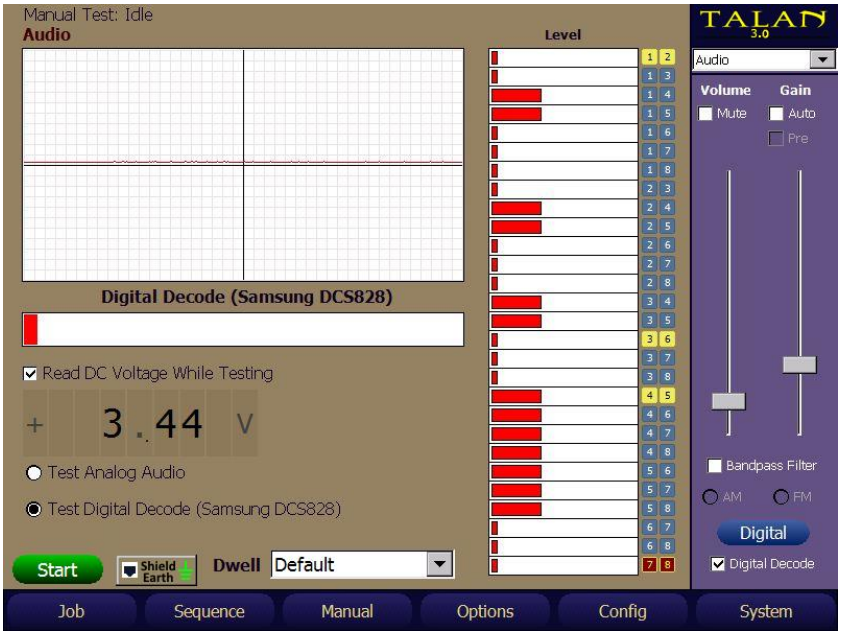
For audio analysis, the Mute and Bandpass Filter should be off. Initially, start with the Volume and Gain settings very low and increase as needed. If the Gain level is set too high, it will overload the Automatic Gain Control Circuit and the audio board will basically turn off. Also, care should be taken to avoid feedback with the phone system. It is recommended that headphones be used with the TALAN to avoid feedback and to be non-alerting while testing. When the set-up is performed properly, the user should be able to generate good audio including Oscilloscope views of the digital audio as shown below. The example below shows a typical dial tone signal on a single pair.



Note: in the example below, the Test Options dashboard was used to test all pairs for audio. In this particular case, the cable that was tested was only a 2-wire system, but an 8 conductor Cat 5 cable was used in the system. Hence, any combination of 4 or 5 results in some audio because the system is capable of demodulating the audio even if only ½ of the signal is present.



It is also interesting to note that the audio levels are basically the same for the combinations that contain audio. This is because the strength of the digital system is not indicated through the digital demodulation process. In other words, a weak digital signal and strong digital signal will basically result in the same analog audio level after the demodulation.



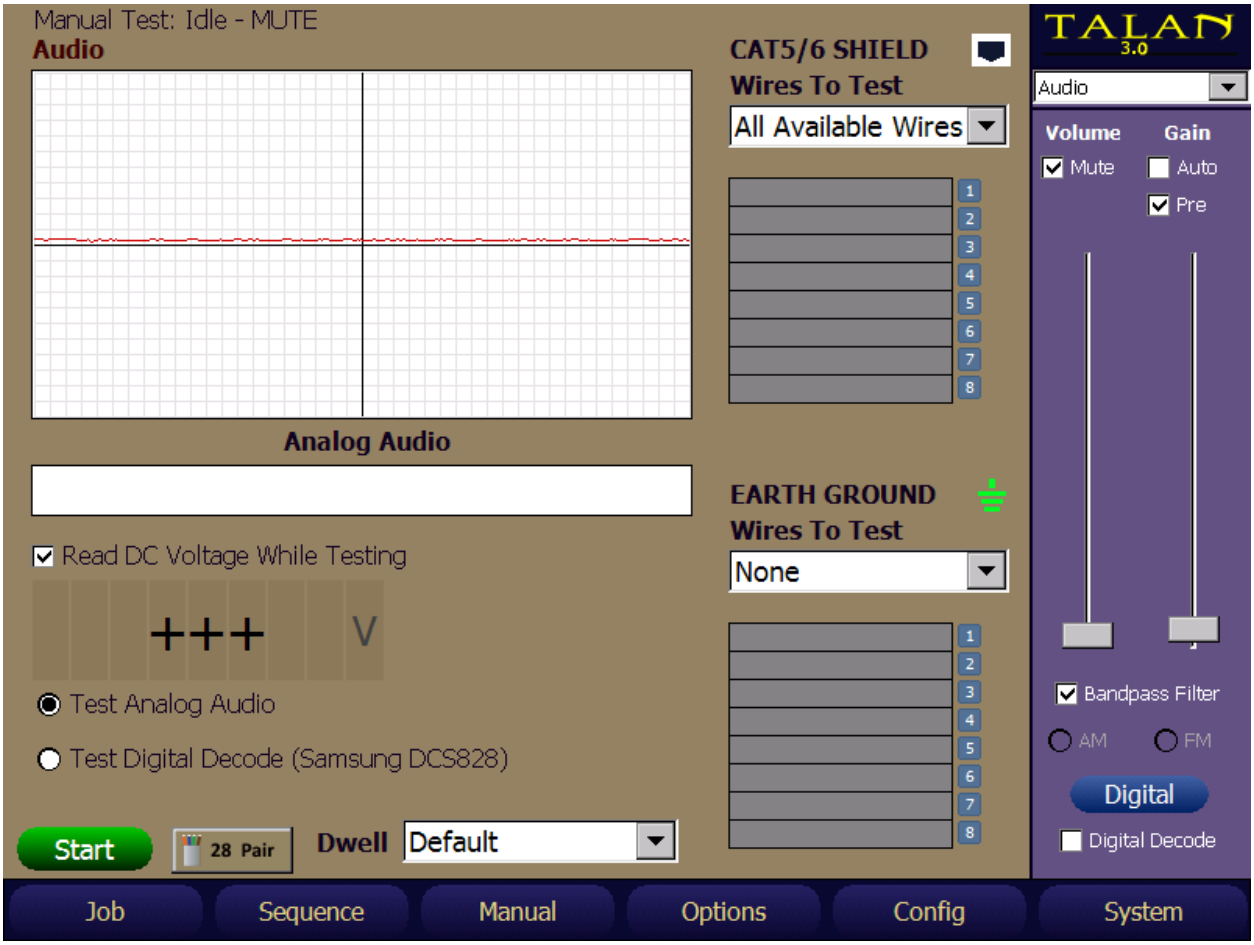
Audio (Advanced Shield and EarthGround Testing)

TALAN 3.0 provides Manual Audio testing of the Phone / Line wires against either:

- The **Shield** of an RJ45 cable plugged into the Phone or Line Jack of the TALAN
  - or -
- An additional wire fed into the **EarthGround** Green Banana Jack of the TALAN

Testing Phone / Line wires against the **EarthGround** jack gives a way to determine if a stray wire in an Ethernet Junction box is being used as a tap or for some other other illicit purpose.

To perform this testing, from the Manual Audio test page, press the **Shield Earth** button that resides just to the right of the **START** button. This will bring up the following display:

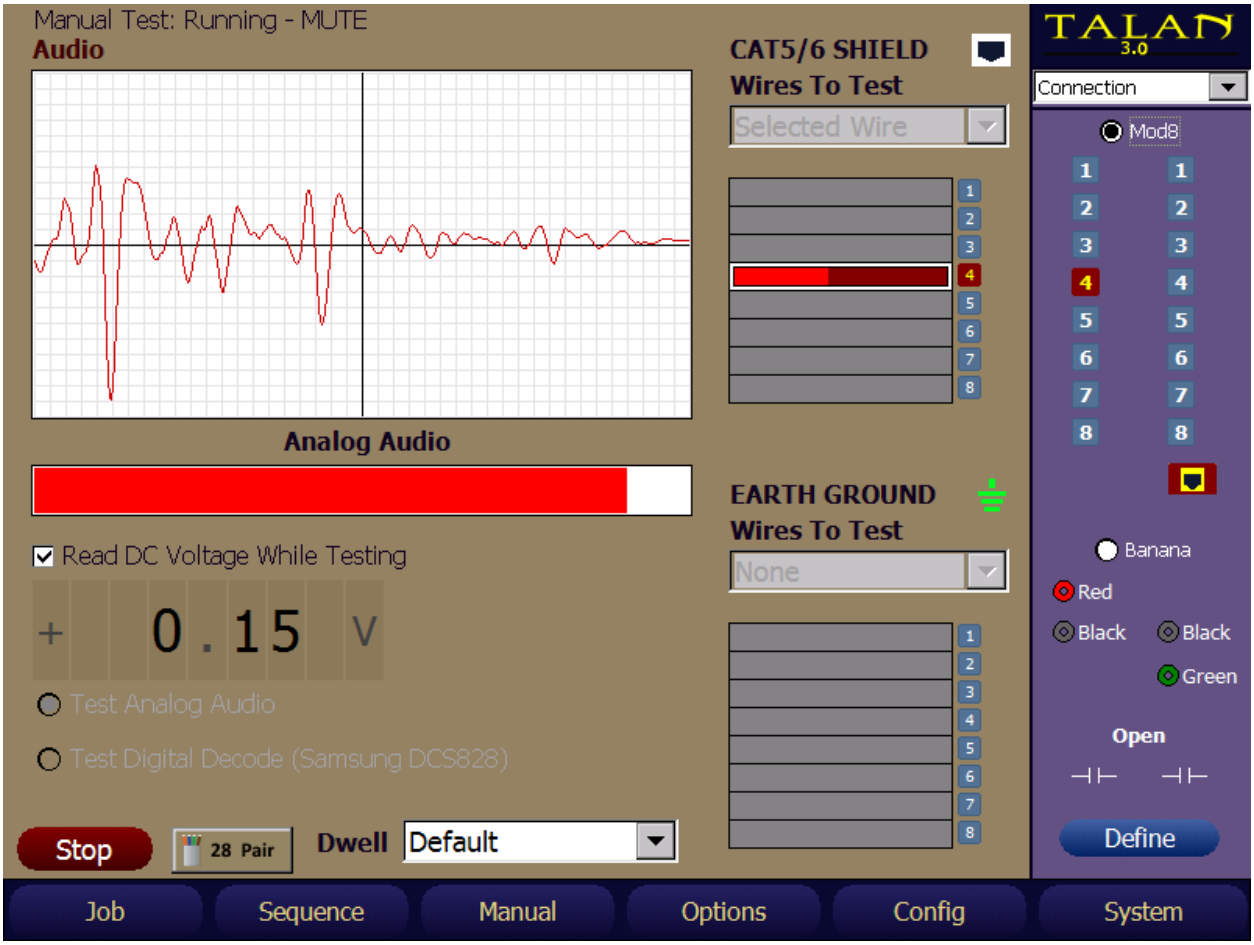


The **Shield** and **EarthGround** testing interfaces are shown. The normal **Test Options** selection for **Pairs** is not functional for **Shield** or **EarthGround** testing. However, there is an individual selection for each now. This allows the testing event to be customized. The **Wires To Test** can be customized through the drop down menu item individually for the **Shield** or the **EarthGround** to **All Available Wires**, **Selected Wire**, or **None**.

Note: When selecting the **Shield** to do a specific test, the **EarthGround** selection will be forced to **None**. Likewise, when selecting the **EarthGround** to do a specific test, the **Shield** selection will be forced to **None**.

The same testing controls for Manual Audio is permitted for the **Shield** and **EarthGround** tests. E.g. Selection of **Test Analog Audio**, **Test Digital Audio**, **Read DC**, etc.

The right dashboard **Connection**s display can be used to control the selections when the **Wire To Test** is set to **Selected Wire**. The following figure shows a test of Analog Audio with a speaker between **Wire 4** of a CAT6 cable plugged into the Phone jack and the **Shield** of the CAT6 cable:



The DMM Measurements taken against **Shield** and **EarthGround** connections can be saved in a TALAN Job file which can then be viewed on a PC running the TALAN Data Viewer V3.0 in the Manual Test data section.

Classify Pairs

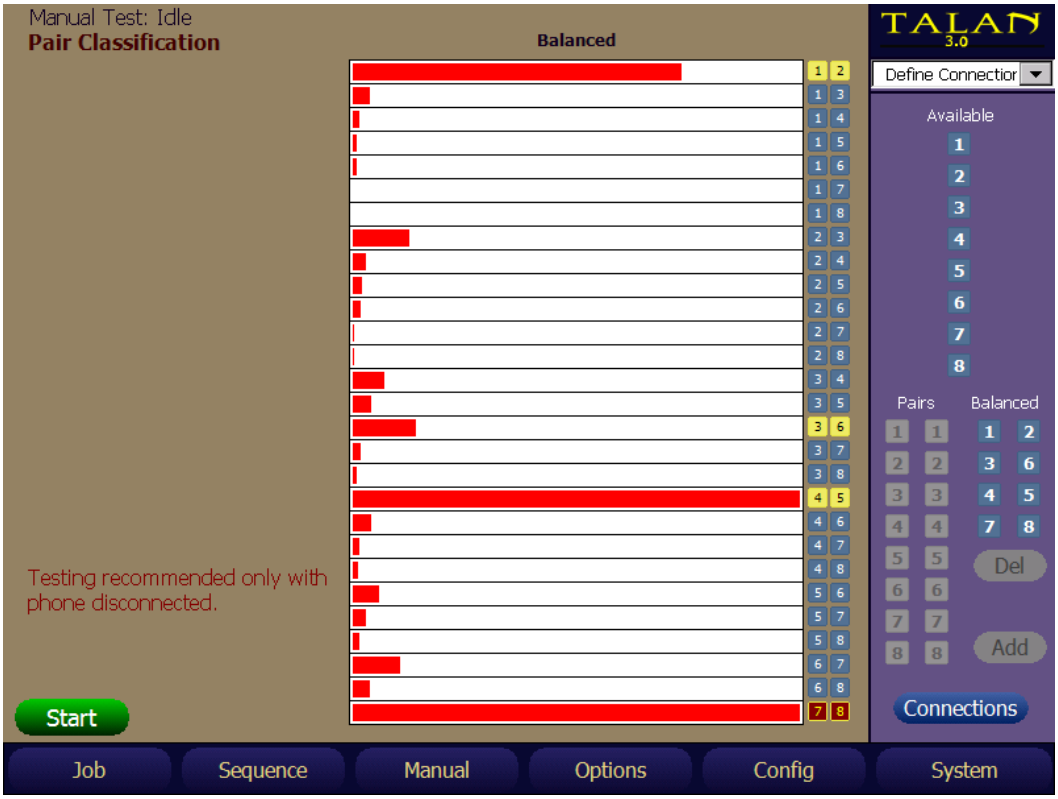
When planning to test a telephone line, it is important to be able to identify the balanced pair combinations. The TALAN provides some test functions that will assist in identifying which pair combinations are the balanced pairs. This is very useful because for many testing functions it is sufficient to only test the balanced pairs and to save time by NOT testing all of the odd pair combinations.

To classify the appropriate balanced pairs, press the **F3** (Manual) button at the bottom of the screen and select Classify Pairs.

To Run the pair classification test:

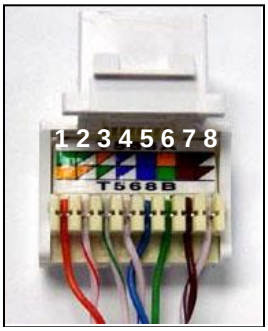
1. Ensure that the phone is disconnected and that the TALAN is only connected to the line that goes to the switch.
2. Press the **START** button.

This test is a line impedance test that measures the coupling between balanced line pairs. The pair combinations with the strongest bar graphs should be balanced pairs. In the example below, the balanced pairs are clearly 1:2, 3:6, 4:5, and 7:8.



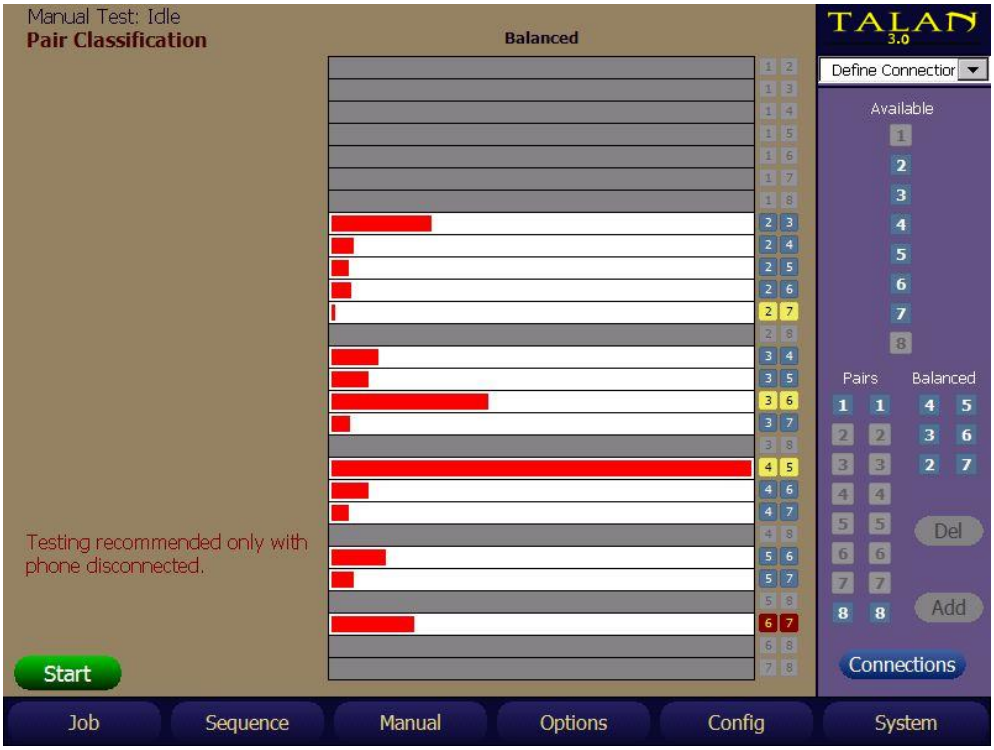
After reviewing the balanced line data, you should manually define the combinations of balanced pairs by selecting them in the Define Connections dashboard. Tap the connector numbers that make up the pair and select Add to define the pair as a balanced pair. Once the balanced pairs have been defined, all other test screens will display the balanced pairs with a yellow background.

It is important to note that depending on the length of the cable and the type of cable, this test will have varying results. It is intended only as a guide, and if the test does not result in definitive results, the user can always simply look at the pair combinations within the cable itself to determine proper pair combinations. Note: the plug shows the balanced pairs of 1:2, 3:6, 4:5 and 7:8.



It is also important to note that flat cables will have some interesting results. For example a 4 conductor flat cable will have strong coupling between all the pairs that are adjacent to each other in the cable. For example: 1:2, 2:3, 3:4 will all have strong responses. The standard for flat cable is that the center pair is the main pair and the outer pair is the secondary, therefore the correct cable pairing for this situation is 2:3 and 1:4, and must be manually implemented.

In the example below, a six conductor flat cable is analyzed. In this case, adjacent conductors always couple with each other as indicated by the test. However, the actual standard pairs are defined from the inside out as 4:5, 3:6, and 2:7.



FDR Frequency Domain Reflectometer

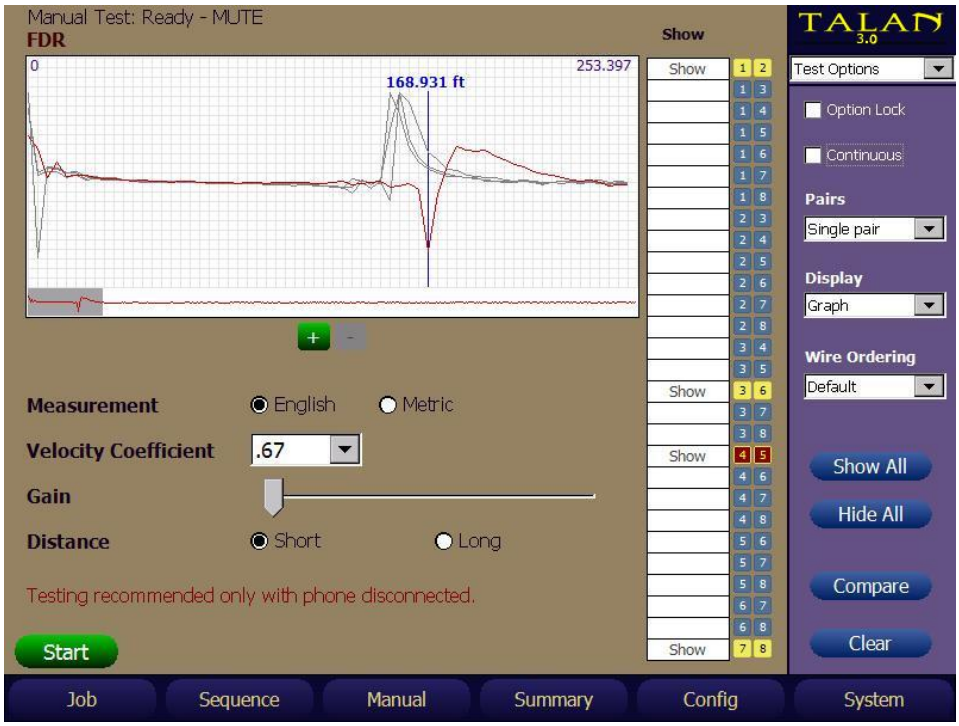
The FDR (Frequency Domain Reflectometer) functions very similarly to a TDR (Time Domain Reflectometer), however the FDR function provides similar results based on a different physics principal.

To provide the best comparison of multiple pairs, the TALAN provides the ability to plot multiple FDR traces on the same display.

The Distance and Gain can be adjusted using the on-screen controls. You must specify the Measurement Units, the Velocity Coefficient, Gain and Distance, but you do NOT specify a pulse width (as required with a TDR).

To get the range to any point simply tap on the screen and a blue vertical line will indicate the range.

Furthermore, multiple FDR traces can be plotted on the same graph. In the example shown below, all pair combinations were automatically acquired, however, only the main pairs are being displayed. This is accomplished by tapping the desired pair for display using the stylus. In this example, pair 4:5 is the main pair (shown in red) and is connected to the phone switch; however pairs 1:2, 3:6, and 7:8 are not connected to the switch. These unused pairs are terminated at the patch panel before the switch with a slightly shorter cable length. Furthermore, the switch is located 169 ft. from the TALAN, and the few spikes at very short range are showing the short cable that is connected from the TALAN to the wall jack.



RF Analysis

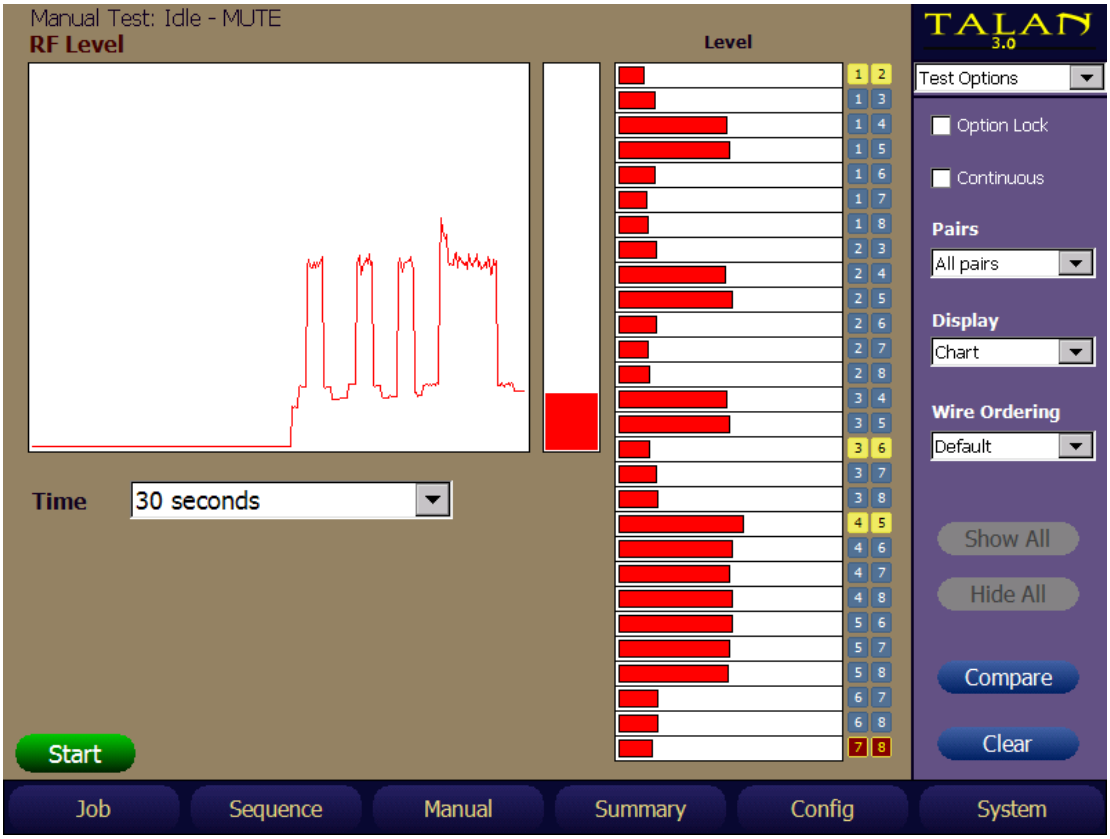
RF analysis is broken into 3 testing functions:

1. RF Level
2. RF Spectrum
3. RF Antenna Level

The RF Level function is a broadband detector analysis that covers a frequency range to 600MHz, the RF Spectrum function is a spectrum analyzer function to 85 MHz and the RF Antenna Level function is to be used with the supplied antennas to a frequency range of 8 GHz.

Broadband Line RF Level Analysis

Select the RF Level test to access the screen below.



In this screen, all pairs were tested for general broadband RF energy. As you can see from the screen in this example, all pair combinations containing a 4 or 5 contain reasonable RF energy. This is because pair 4:5 in this particular system is active and currently communicating with the phone handset. The time level graph plots the changes in broadband level over time. In this example, the data was captured by automatically switching through the pairs so the time graph roughly reflects the same data as shown in the bar graph representation of each pair.

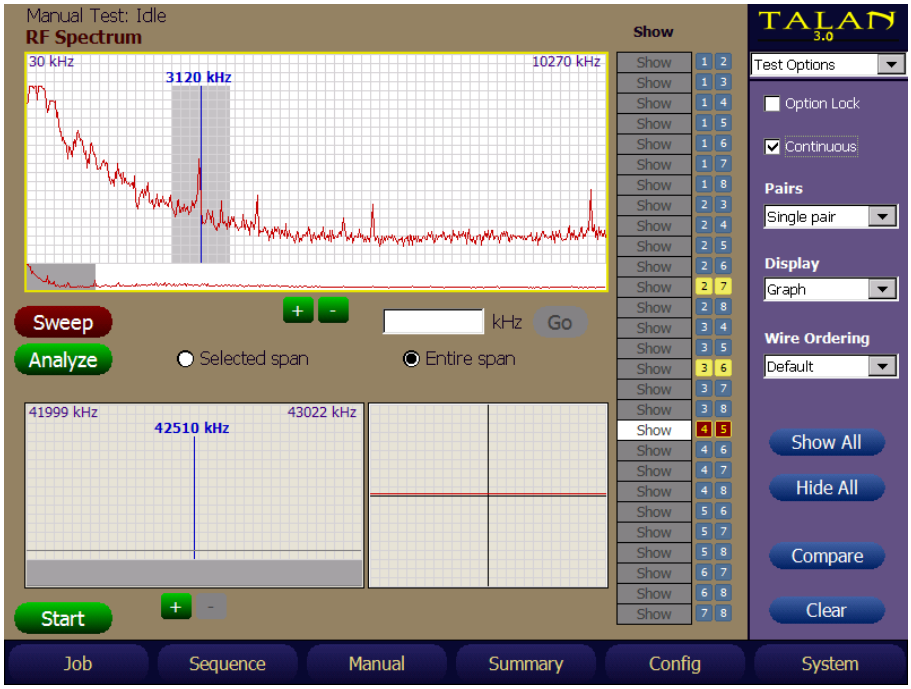
RF Spectrum Analysis

Select the RF Spectrum test function to access the RF spectrum analyzer. This mode is strictly designed to analyze the RF spectrum of telephone wiring up to 85 MHz in a method very similar to the OSCOR.

It is recommended that the desired pair is selected by first selecting the “Single pair” option and then tapping the desired pair for analysis as indicated in the figure below.

The RF Spectrum Screen will be updated after the **START** button is pressed.

The + and – buttons are used to zoom into the spectrum and look at specific signals or portions of the spectrum. This is accomplished by positioning the cursor with a stylus and then using the + and – to zoom in or out.



Sweep and Analyze Screens

The RF Spectrum Analyzer screen is divided into two sections, “Sweep” and “Analyze”. The Sweep screen is the wider top window that shows the full spectrum to 85 MHz. The two windows below the Sweep screen are the Analyze windows: the window on the left is the frequency spectrum window, and the window on the right is the time domain window. The time domain window is basically an oscilloscope view of the demodulated signal.

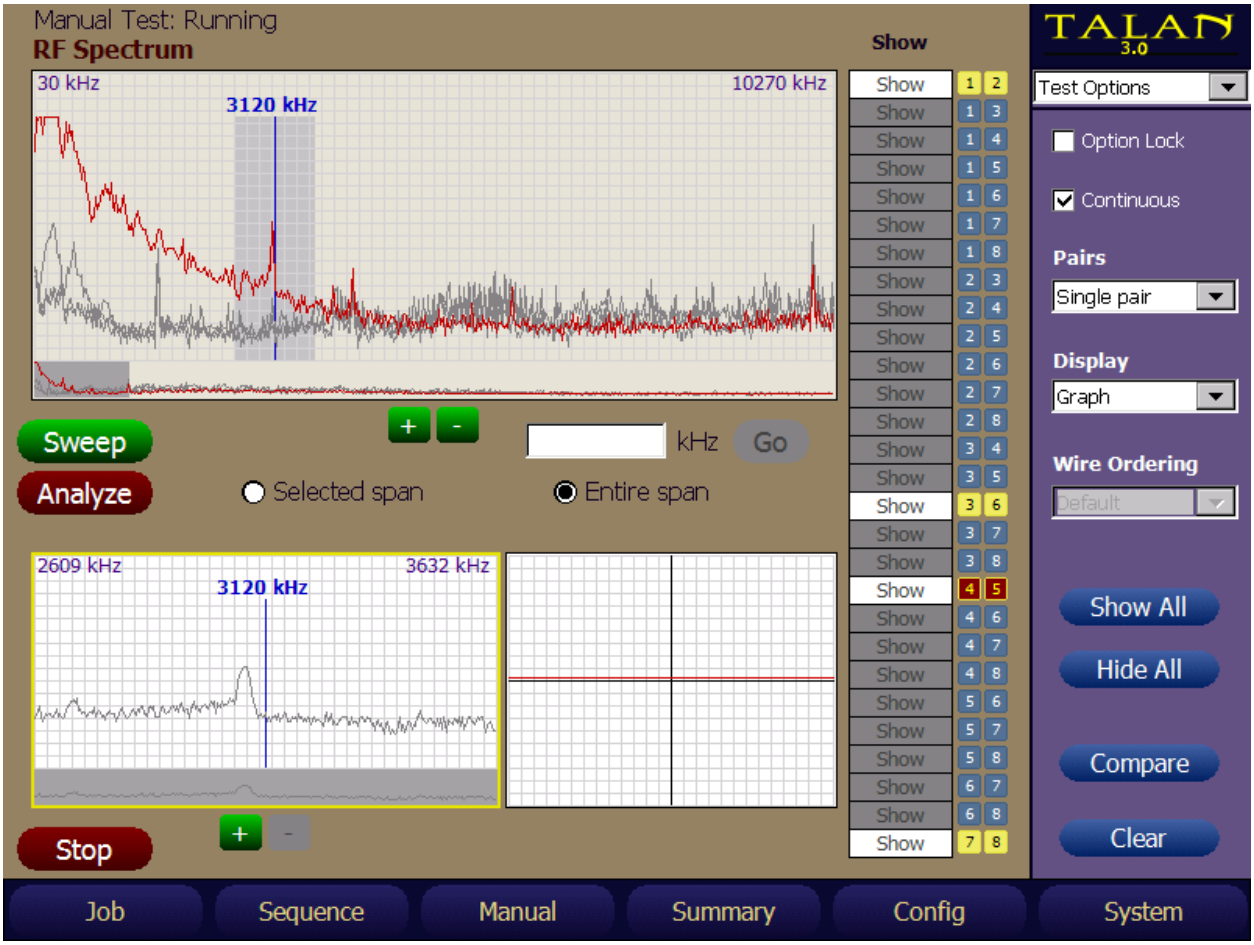
The main difference between the Sweep and Analyze modes is that the Sweep mode scans across the entire frequency spectrum in 10 kHz steps, but the Analyze mode locks the receiver to a fixed frequency so that a signal may be demodulated and listened to. Hence, if the Analyze mode is selected, the Sweep window will not be updated as shown in the next figure.

Selecting and Analyzing a Signal

While in the Sweep screen you can select a signal by tapping on the Sweep window at the desired frequency using the stylus. Then, simply press the Analyze button to go into the Analyze mode. You may need to re-adjust the frequency by tapping the analyze screen at the appropriate frequency location or turning the rotary dial to adjust the frequency.

Displaying Multiple Traces for Comparison

You can have the unit display multiple RF traces simultaneously. For example, it may be useful to capture an RF trace of the main 4:5 pair as well as the other balanced pairs. This can be done by classifying the balanced pairs and having the TALAN automatically capture these spectrum traces or simply by manually selecting the pairs of interest and displaying the spectrum traces simultaneously. In the figure below, combinations 1:2, 3:6, 4:5, and 7:8 have been captured and are being shown. Pair 4:5 is the current active pair and shown in red.

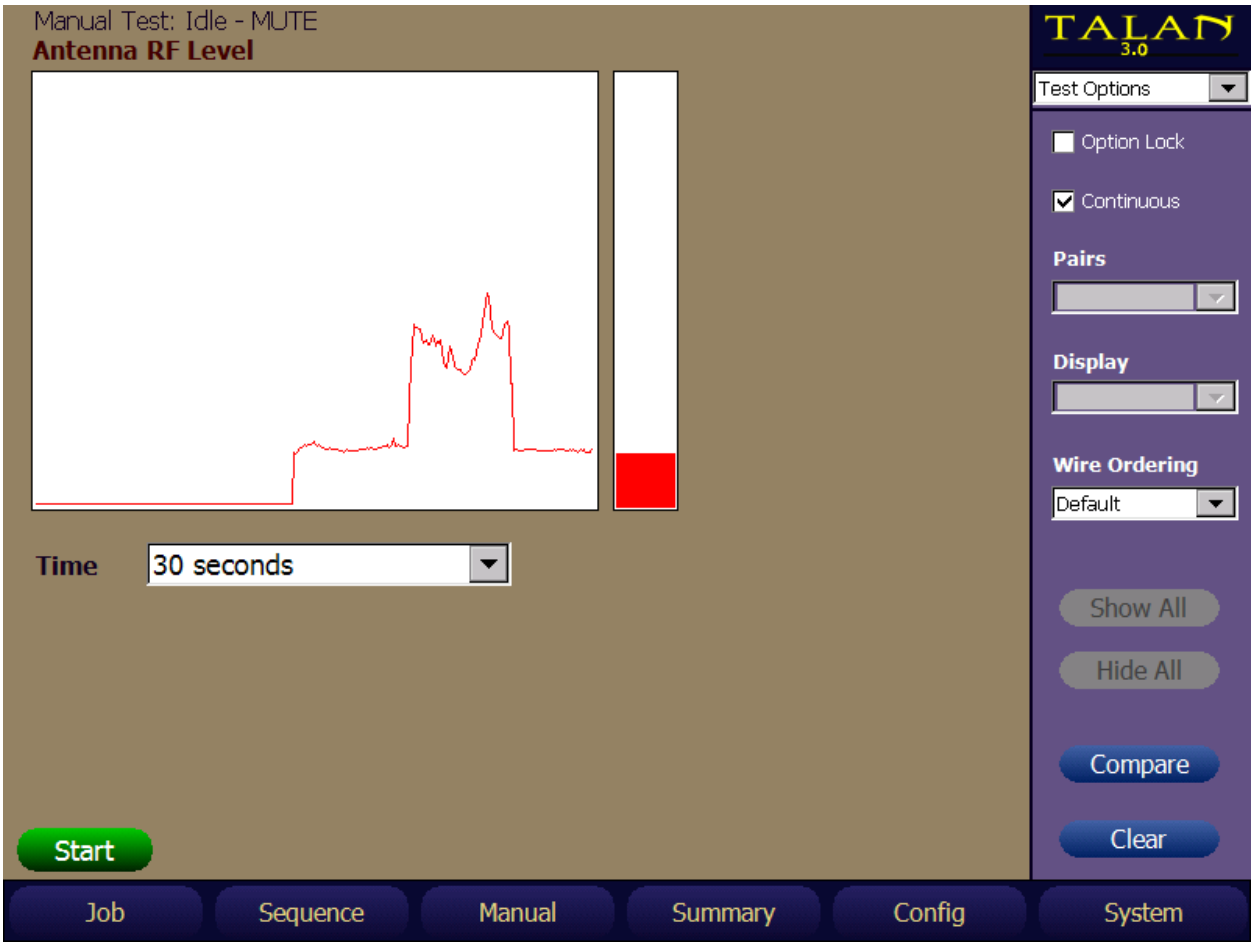


RF Antenna Level

In this mode, the unit only takes data from the RF antenna port and displays a bar graph very similar to a CPM-700 Broadband Detector but with the additional advantage of having the time window to observe changes over time as the product is used as a broadband RF detector. It is important to note that the frequency ranges of the supplied antennas are:

Whip Antenna: 10 MHz to 2 GHz
High Frequency Antenna: extends the range up to 8 GHz

The example below was taken with the whip antenna as the antenna was passed near a low power transmitter. The peaks in the time level graph indicate when the antenna was closest to the transmitter.

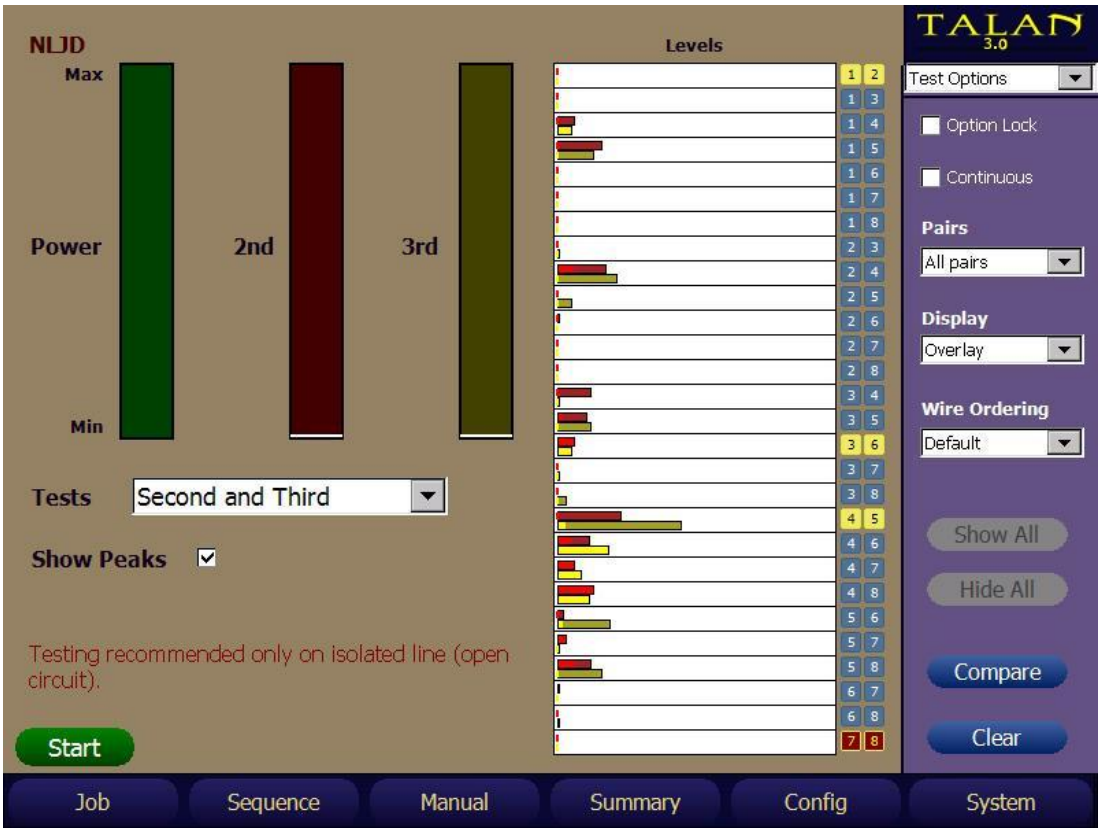


NLJD Line Non-Linear Junction Detection

The Non-Linear Junction Detector function is one of the most powerful tests in the TALAN. It is very reliable for determining if there are additional electronics attached to a line. Additionally, you can easily identify which conductors have the additional electronics, and you can identify the connection as a series or parallel connection.

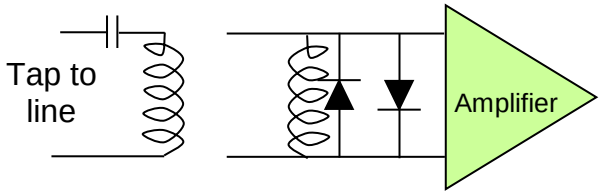
Furthermore, when testing a line for an NLJD response, you must consider that a strong 3rd harmonic response is typically not the result of a corrosive line, rather it may be the result of limiting diodes in a phone tap.

It is highly recommended that you only use the NLJD function on a dry line meaning the phone should be disconnected and the line should be disconnected from the switch. Ideally, there should be no electronics on the line. However, in the first example below, the line was still connected to the switch, and it appears that there are electronics on many pairs, but if you look closely, it is clear that the transmit power is turned off and therefore, the response that you are seeing is merely the digital signals on the line that are in the frequency range of the NLJD detection circuit. In other words, the indicated responses in the figure below are not threat NLJD signals. You should always be careful when using the NLJD function to make sure that the signals that you are detecting are not part of the phone system.

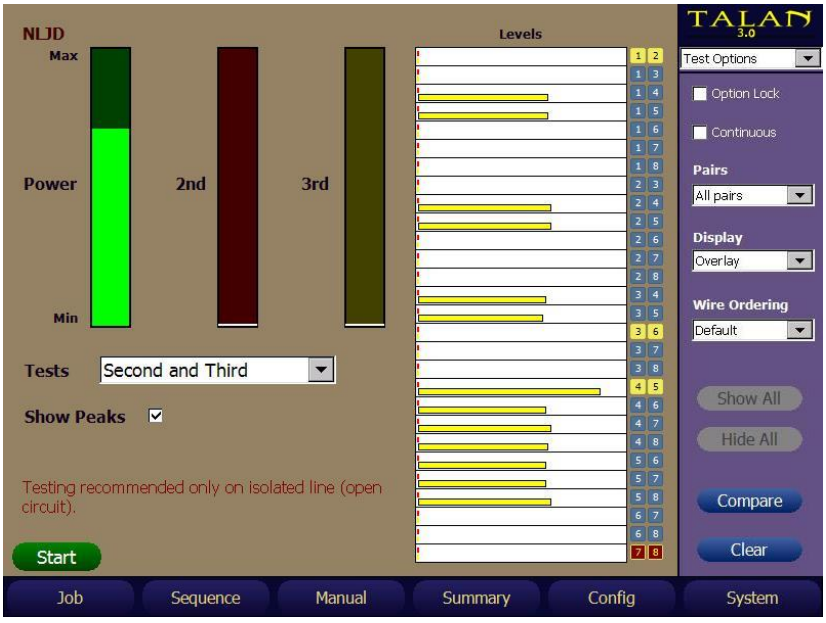


Analyzing 2nd and 3rd Harmonic Results

In classic NLJD technology that is used for detecting bugging devices, a strong 2nd harmonic is indication of an electronic device while a strong 3rd harmonic typically indicates a corrosive false alarm junction. However, when using NLJD technology for looking for taps, you cannot expect that a strong 3rd harmonic indicates a false corrosive junction. The reason is that many telephone tap circuits rely on parallel diode limiting circuits. The figure below shows a portion of a tap circuit that uses a transformer to isolate the tap electronics, a blocking capacitor to isolate DC voltage (for a parallel tap), and 2 diodes to limit the input to the amplifier circuit. These 2 diodes in parallel create an NLJD response that results in a strong 3rd harmonic response.

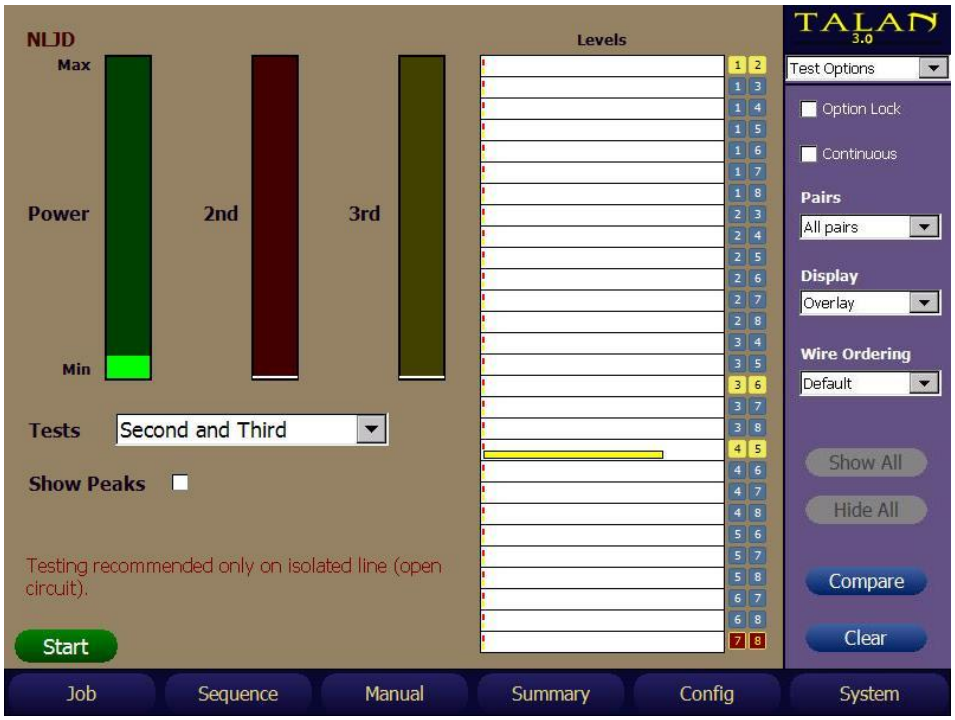


The next two examples will show responses to this type of tap. In the figure below, there is a parallel tap installed on an isolated 8 conductor line on pair 4:5. Again, you can see that every pair with either a 4 or 5 has strong harmonic level (even though 4:5 indicates the strongest response). It is also important to note that the transmit power is about 70% of maximum power. The reason that the response is showing up on combinations of either 4 or 5 is that there is sufficient power to get good response even though only 1 wire of the pair is connected to the tap device.

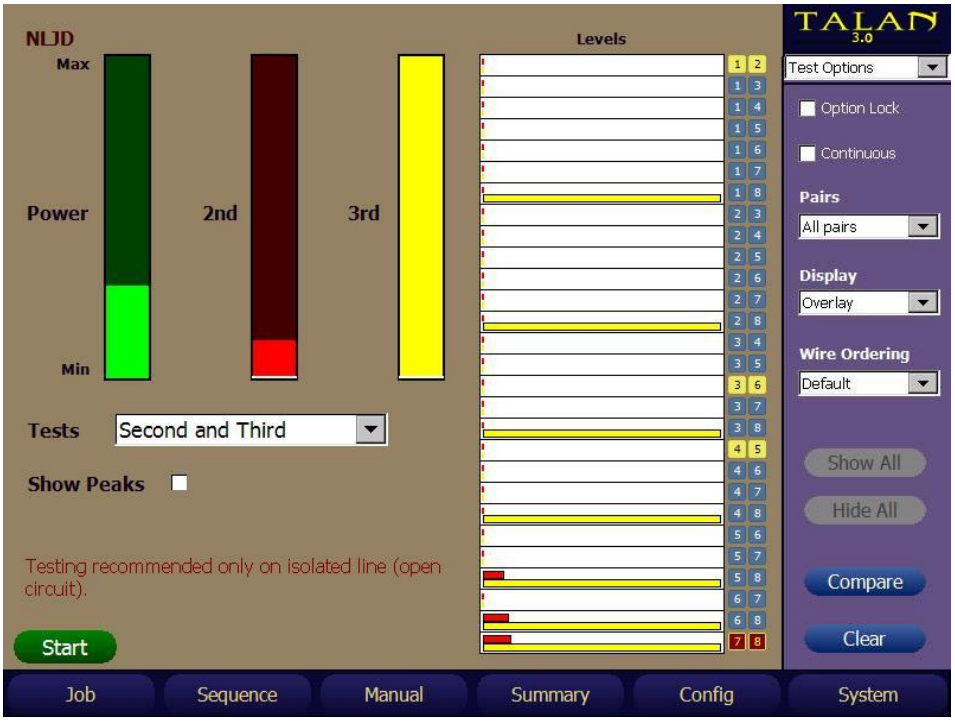


To determine the proper pair with the tap, the transmit power is manually decreased until only the true pair shows an NLJD response.

In this case, the Tx power was reduced to less than 10%, and hence, the parallel tap is clearly being displayed only on pair 4:5.

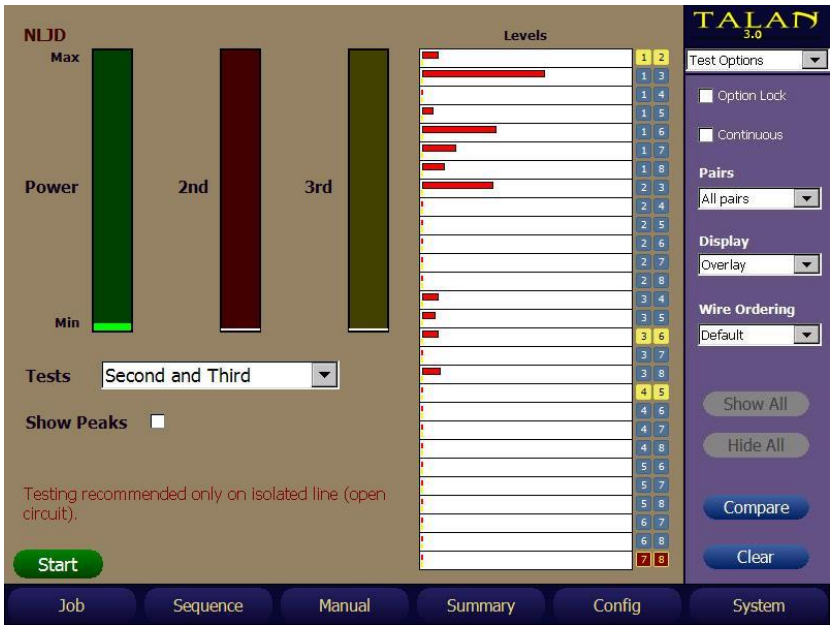


In the next example, there is a serial tap only on conductor number 8. Therefore, only combinations that contain conductor 8 will get a response.



In the next example below, there is an electret microphone that is placed on an unbalanced pair combination of 1:3. You can see a strong 2nd harmonic response on many pair combinations that contain 1 or 3, and also some response on the unbalanced 2:6 pair whose conductors are balanced with 1 and 3. This is an excellent example of inductive coupling that can occur in a telephone line.

By further reducing the transmit power, it is easy to see that the pair that is tapped is 1:3.



From studying these types of responses it is easy to quickly identify different types of taps.

VoIP (Overview, Connections, Mirroring…)

Voice over IP (VoIP) technology encodes speech for transmission over IP (internet protocol) networks. TALAN has the ability to monitor IP packet traffic using its built-in network interface card (NIC) and to display, analyze and save those packets to assess the threat of illicit VoIP phone system intrusions. With the ***TALAN 3.0***, VoIP Plus+ was added to help identify VoIP traffic based upon characteristics of VoIP packets. VoIP Plus+ is intended for Ethernet type traffic, and brings with it several features that normal Network Analyzers either cannot do, or can do with great difficulty or extensive filtering.

To analyze VoIP traffic with either VoIP Analysis or with VoIP Plus+, the TALAN should be connected via the TALAN network port (under the right grip) between the phone and the phone system network. Some VoIP phone handsets have a non-switched internet port which can be connected directly to the TALAN's network port allowing the TALAN to see the VoIP traffic between the phone and the network.

A common scenario is a phone with no extra port or a phone with a switched port allowing network access but does NOT include the phone traffic. In these scenarios (no network port or switched port that does not include phone traffic), the VoIP Test Adapter must be used in-line with the phone network line (see diagram below).

Using an additional CAT5 cable (included), connect the VoIP Test Adapter in-line using the PHONE and NETWORK ports on the test adapter. This allows normal phone activity to take place. Using a 2nd additional CAT5 cable (also included), connect the TALAN network port (under right grip) to either the Rx or Tx port on the test adapter to monitor either the information being received (Rx) by the phone or transmitted (Tx) from the phone. The adapter acts as a passive tap on 10/100 Mbps networks. If connected to a network that operates at faster rates (1Gbps+), the tap is designed to force the network to auto-negotiate down to the 100Mbps rate compatible with TALAN.

Caution – Phones and PCs may auto-negotiate the physical hardware interface setup with the router/switch/hub that they are connected to. Typically this only sets the speed, duplex, etc., but sometimes this also means they can swap the lines normally used for Rx and Tx. The way to tell is to look at the Source IP Address. If the Source IP address is the IP address of the phone, then you are on the Tx lines of the phone. If the Dst IP address is the IP address of the phone, then you are on the Rx lines of the Phone.

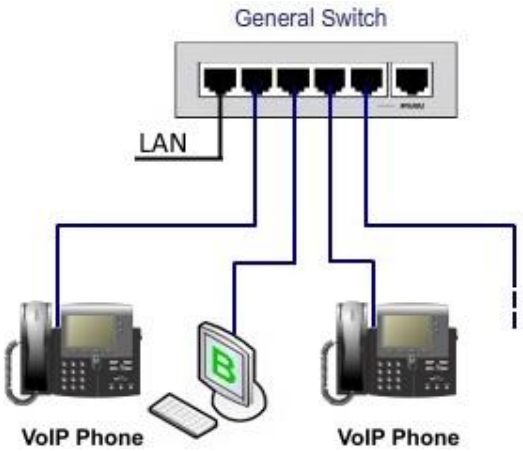
Notes:

- To connect the TALAN to Gigabit systems that will not auto-negotiate down to 100 Mbps, a third party switch could be used to provide a mirrored port at 100 Mbps while not affecting the gigabit traffic.

- Disconnecting a VoIP phone to connect the VoIP Test Adapter will disrupt any active network traffic on that line. Leaving a VoIP Test Adapter in place on a specific phone line provides the capability to test the phone at any time without having to disrupt the line. Additional VoIP Test Adapters can be purchased from REI.

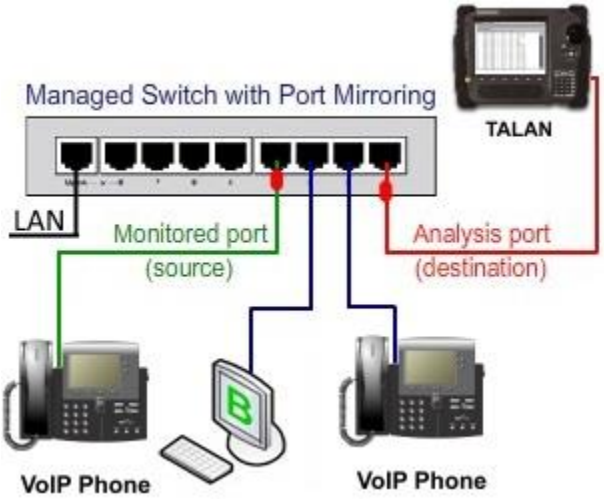
- The VoIP Test Adapter (black box) is used to analyze VoIP traffic from a VoIP phone using the TALAN's Ethernet port. The VoIP Adapter Cable is used when performing TALAN's other test functions (DMM, Audio, FDR, RF Analysis, etc…) by inserting it between the VoIP phone and the PHONE jack on the back of the TALAN.

Most VoIP phones and VoIP capable PCs are connected to a network using a General Switch, or a Managed switch, as shown below:



Usage of the VoIP Test Adapter brings with it items that need to be noted:

- When using a PoE phone, if a specific VoIP Phone is suspected of sending audio data when it is on-hook, then installing the VoIP Test Adapter will remove power from the phone, which will interrupt the audio transfer in process, and possibly disconnect the session, thereby alerting the intruder. For this case, if the phone is connected to a managed switch, and you have the capability to configure port mirroring to an unused port on that switch, this will not interrupt the audio transfer in process. Port Mirroring, also known as SPAN (Switched Port ANalyzer), is a method of monitoring all network traffic seen on one (or more) port(s) (the Monitored port), to another port (the Analysis port). This is visualized in the following figure:

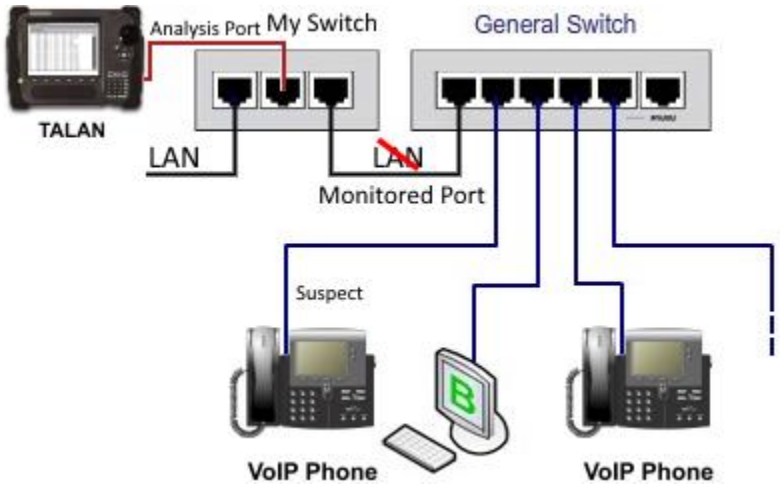


- This same “Mirrored Port” method can be used with VoIP Phones not using PoE or even on PCs to see if they are passing audio using programs such as Skype.

- If the VoIP Phone is not using PoE, but has an external power supply, and it is in the processing of sending audio, meaning, a connection is made and someone is “listening” from another phone, then it is possible, with practice to connect the VoIP Test Adapter and not lose the connection nor the audio transfer. This requires that the VoIP Test Adapter already have one of the short CAT5 cables connected on the Network side of the VoIP Test Adapter, and quickly remove the VoIP Phone’s cable from the router/wall, and plug it into the Phone side of the VoIP Test Adapter, then plug the VoIP Test Adapter Network cable back into the same physical port on the router/wall. This is relying on TCP to maintain the connection after a less than a second data loss.

- Whereas it is possible to monitor more than one port via Port Mirroring (e.g. mirror both VoIP Phones and the PC shown above), one should keep performance in mind. If you mirror traffic from multiple ports, the mirrored traffic may exceed the capacity of the TALAN. To help reduce the possibility of dropping packets in the TALAN, it is possible to set up packet filters in the TALAN, see VoIP Plus+ for more information on how to set/adjust Receive Filters.

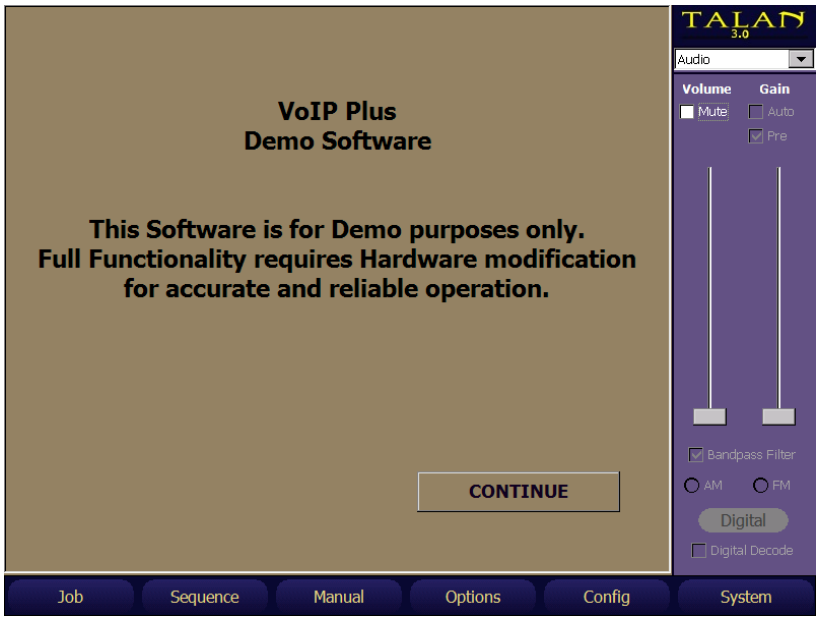
- When the network administrator, or one of the technicians, is suspect in setting up a VoIP phone for unauthorized audio broadcast, then the Port Mirroring method can still be utilized. However, instead of modifying any settings in the suspect router/switch, a router/switch that has already been setup for Port Mirroring can be utilized.
    - Disconnect their router from the network
    - Patch it through your router
    - As shown below, the cable from the general switch that went to the LAN is now connected to [My Switch], and [My Switch] is connected to the LAN. The middle port shown would be set up with Port Mirroring, to monitor the port from the General Switch:



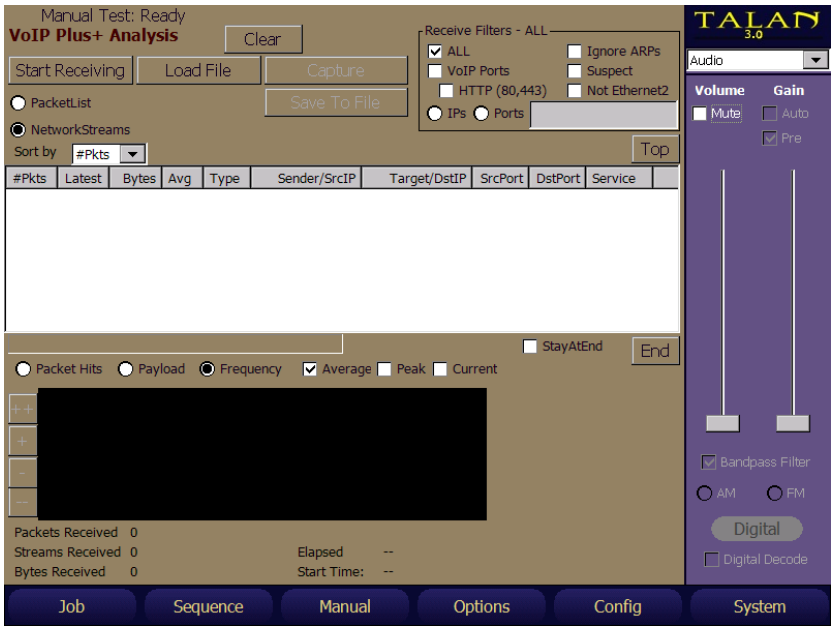
The TALAN Ethernet Interface is set up so that it does not annunciate itself with the network server, meaning, that the TALAN will not be detected by anything used to monitor network access, including network monitoring packages such as wireshark or even the nework administration / server software. However, the TALAN does work at the hardware layer so that the when plugged into a switch or router, the hardware of that switch or router will make a hardware level connection, but still is invisible to any other devices on the network. The software and hardware in the TALAN are designed so that it will not transmit any packets of any sort on the network. It is only a **listening** device so the network interface is non-alerting to potential threats. This is a very big benefit when using the TALAN instead of a laptop to look for illicit traffic. Laptops will be seen on the network by system administrators, whereas the TALAN will not be visible on the network.

VoIP Plus+ (Advanced Detection and Analysis)

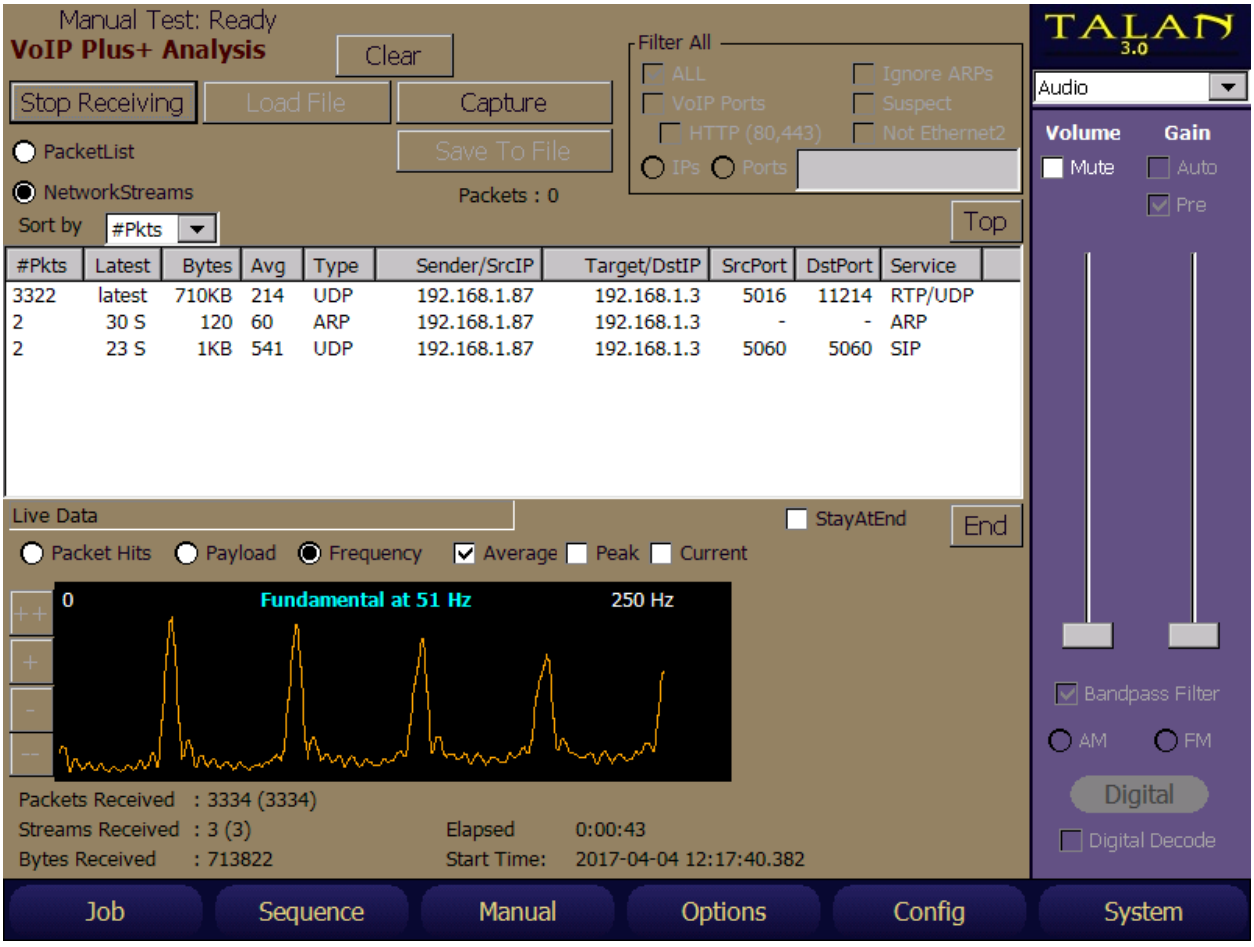
When the ***TALAN 3.0*** Hardware is installed, the TALAN provides a VoIP Plus+ Analysis intended to make detection of VoIP traffic easier and more reliable. To activate the VoIP Plus+ feature, select VoIP Plus+ from the **F3** (Manual) menu. If the ***TALAN 3.0*** Hardware is not installed you will see the following screen:



Selecting **Continue** permits the Control Interface to be displayed, but it is non-functional in that it will not receive packets nor load and run files. The figure below shows the fully functional TALAN VoIP Plus+ Control interface:.



VoIP Plus+ has a lot of features that can be selected, but, in the default state it is meant to simply collect the Ethernet Packet data and determine if there is a probability of VoIP, or not. Most of the time, the user will simply select **Start Receiving**, and view the **Network Streams** at the top and the **Frequency** graph at the bottom of the screen. When **Start Receiving** is pressed, VoIP Plus+ starts processing packets it sees on the Ethernet.

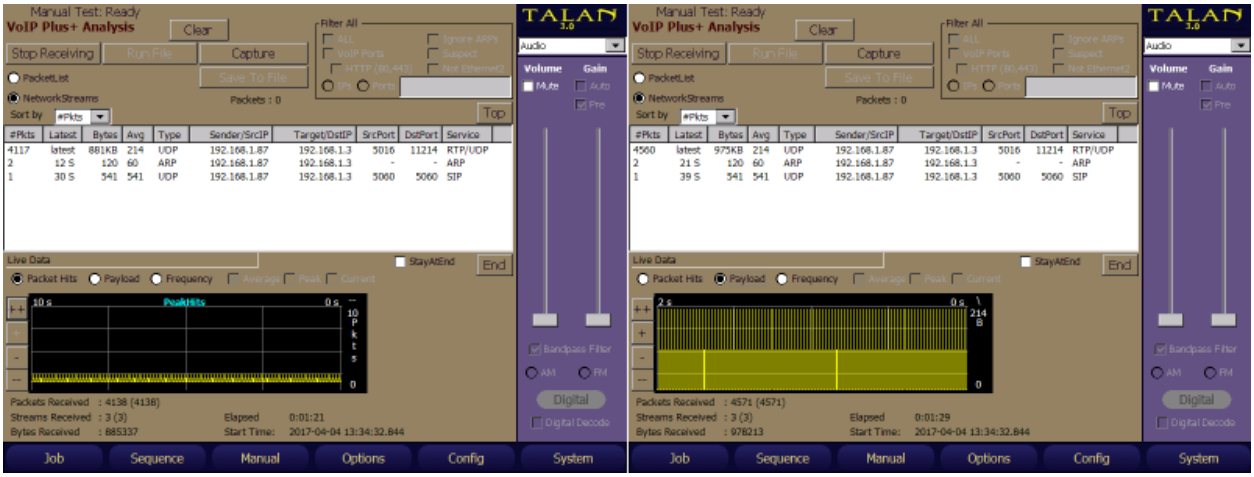


The above figure shows a typical VoIP signature when the TALAN is connected between a VoIP Phone and it's router using the VoIP Test Adapter. The type of data to show in the list is set to **NetworkStreams**. This is the default.

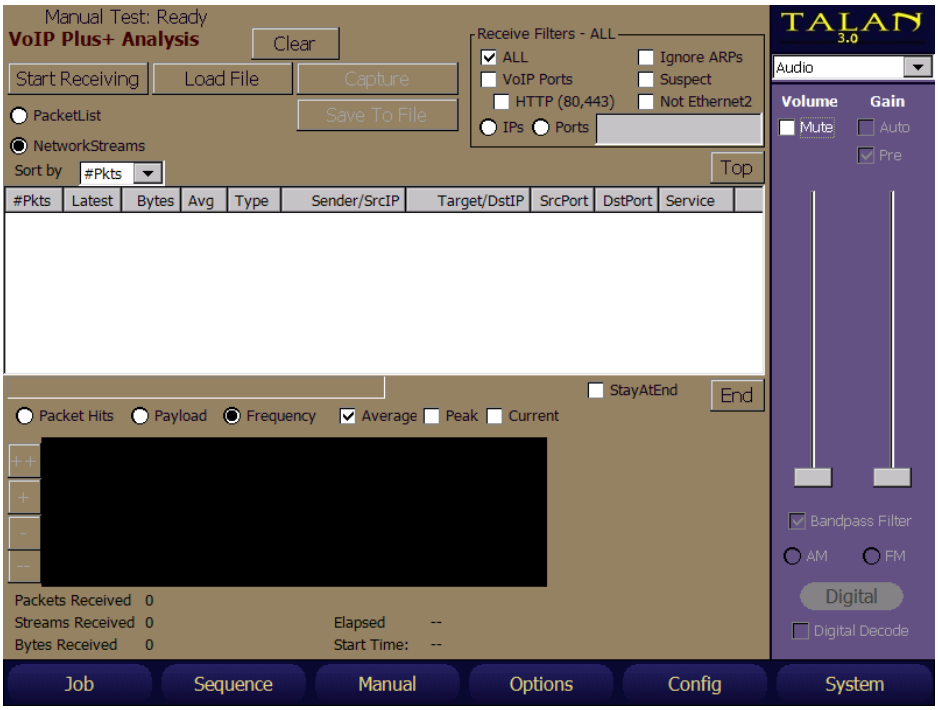
The list of packets collected can be viewed by selecting the **PacketList** above **NetworkStreams**. However, due to processing overhead, it is advised to try to do all of the analysis using **NetworkStreams** unless the intent is to isolate a specific packet in time. The number of packets stored for view in the **PacketList** is also very limited, and old packets are thrown out over time.

The type of graph shown at the bottom of the screen is set to the default **Frequency** graph. The data shown can be set to "Average" or "Peak" or "Current". Average is the default. Peak is very useful in finding something when left running over night. Current is helpful in showing exactly what is happening right now.

The data to show in the graph can be set to **PacketHits** (the count of packets over time), or **Payload** (the size of data in the packets over time). The time duration of the displayed data for **PacketHits** and **Payload** can be adjusted using the **++**, **+**, **-**, and **—** buttons to the left of the graph. Below are two screens showing PacketHits of the same 50Hz data stream, shown at the maximum 10s time frame, and also the Payload showing the default 2s time frame.



Look at the original VoIP Plus+ Control interface. It shows the main two analysis methods of **Start Receiving** and **Load File**.

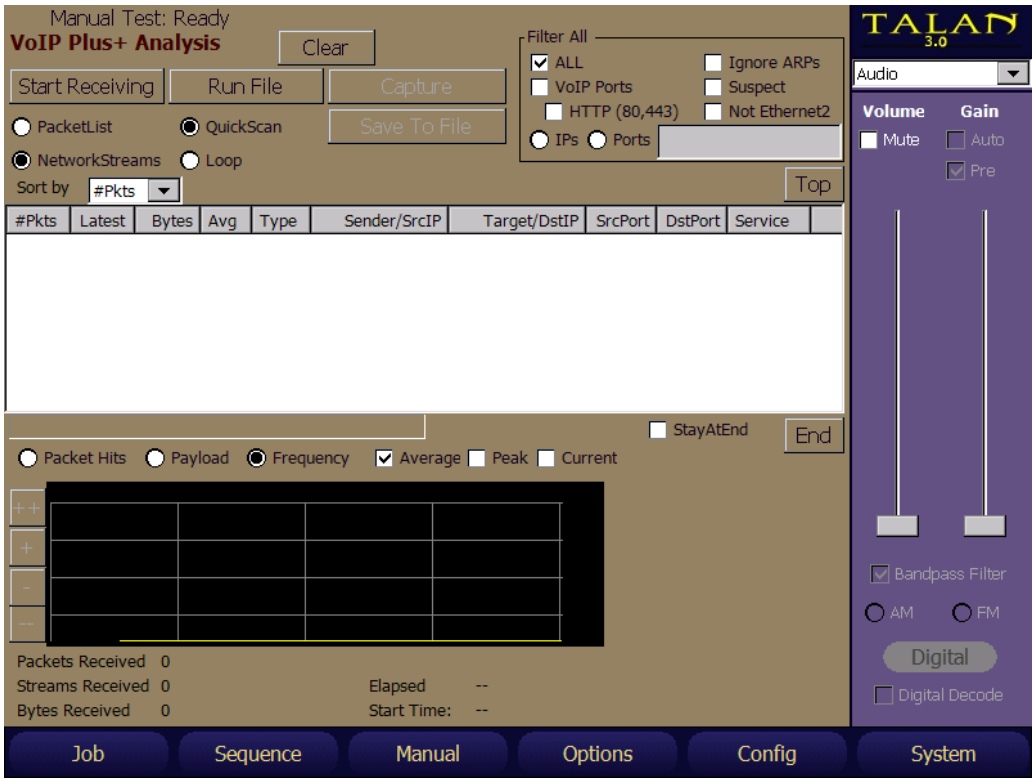


Start Receiving performs analysis of actual network traffic happening right now.
Load File performs analysis of data that has already been collected in a file. The file types accepted are standard **PCAP** files.

PCAP files have the same format as files collected by other known network analyzers such as Wireshark or Cain & Abel. This also means that the TALAN can analyze PCAP files captured by other network analyzers, place them on the root folder of a USB memory stick, install it into the TALAN, and then select **Load File**, Select the file to run, then select **Run File**. The same functions that can be used in real time can also be used when running a loaded file. The file will run until all packets are processed, or select **Stop File** to stop at any time. The TALAN can save packets that are being received to a file. First, Start Receiving, then select the Capture button to start capturing packets. Then when ready to stop and save the captured files, select Stop Capturing, then Save To File. If a USB memory stick is installed, it will be saved to the USB and the file name will be shown. If the USB memory stick is not installed, the file will be saved to the Compact Flash with the shown name.

There are two options for running a file. When you have a file loaded, ready to run, the options **QuickScan** and **Loop** appear, the default is **QuickScan** enabled and **Loop** disabled.

- **QuickScan** permits the TALAN to process through the packets as fast as possible. This is very helpful when data has been collected for a long period of time and it is desirable to get through non-VoIP traffic as fast as possible without wasting time in order to get to the real VoIP traffic. Disabling QuickScan will run the file analysis at the rate at which packets were received.
- **Loop** will continue to run through this file over and over again. Good for demonstrations.



When Receiving or Running a file, all of the analysis is performed on all of the packets received or run from the file. To help narrow down details on a specific stream, select a specific stream by tapping it in the **NetworkStream**s list. Below is the result of selecting the first **NetworkStream**. There is a new status window in the lower right of the screen, showing more details about this specific stream. Including:

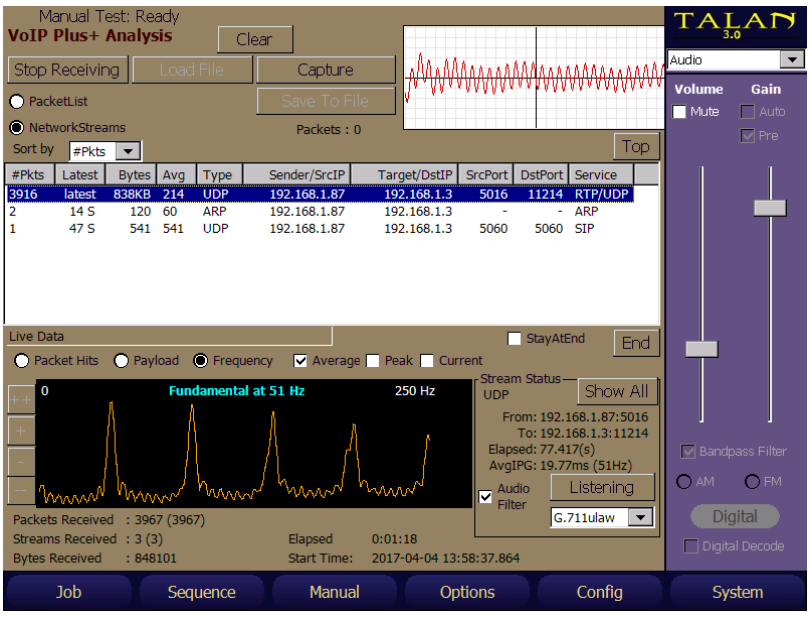
- **From** – Identifies the Source IP address and the Source Port
- **To** – Identifies the destination IP address and the destination Port
- **Elapsed** – identifies the elapsed time this receive has been running.
- **AvgIPG** – identifies the Average Inter Packet Gap, showing the average time between subsequent packets in this stream, and the calculated frequency of this specific streams packet arrivals in Hz (in parenthesis).

For this next screen, **Listen** was also selected, showing an audio graph in the upper right window of the decoded audio from this network stream.

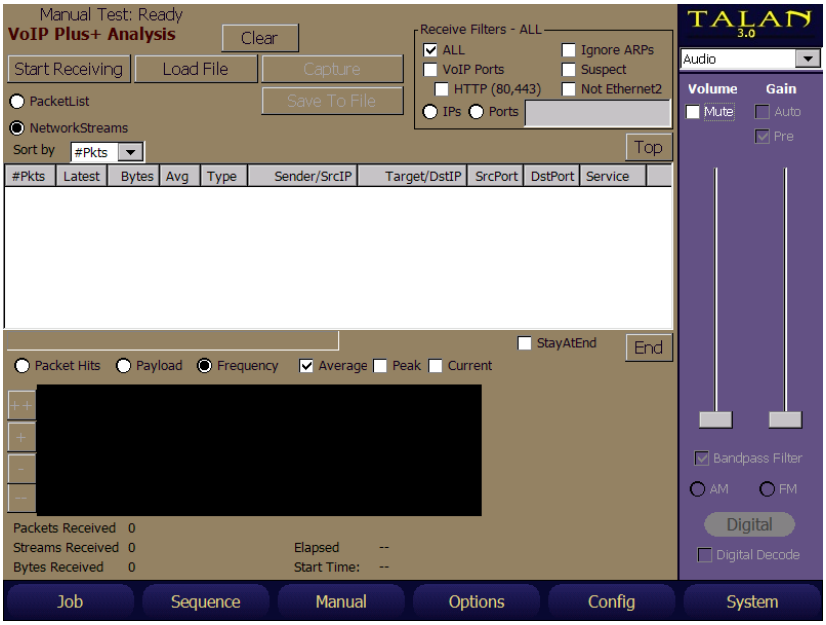
The Gain slider in the right dashboard adjusts visually the level in the audio graph. The Volume slider in the right dashboard adjusts the audible level in the speaker/headphone of the recovered audio.

The type of audio can be decoded as if it were either **G.711ulaw**, or **G.711alaw**, or raw **16 bit PCM** audio or raw **8 bit PCM** audio using the decode section in the lower right details selections. Sometimes using 8 bit PCM on data that is of a different format is sufficient to listen to in order to know that when things are silent, there is a given sound in the audio, and when there is speech, there is a definite change in that recovered audio sound.

An **Audio Filter** can be enabled to improve the sound of the audio, if it is indeed audio.



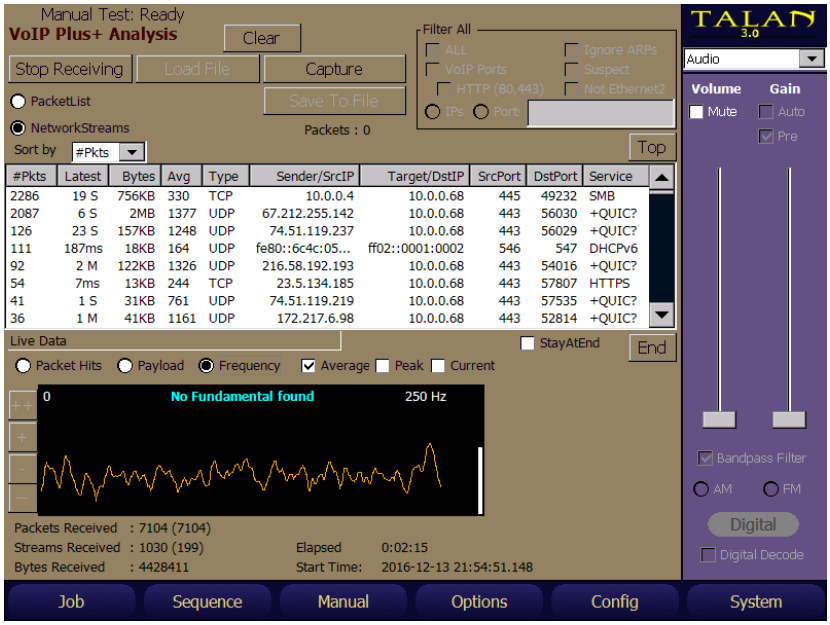
Up to this point, all data has been collected, and processed and shown in both the **NetworkStreams** list and in the **Frequency** graph. Look at the original VoIP Plus+ Control interface. It shows filter selections in the upper right of the display that can be enabled to limit the type of packets analyzed.



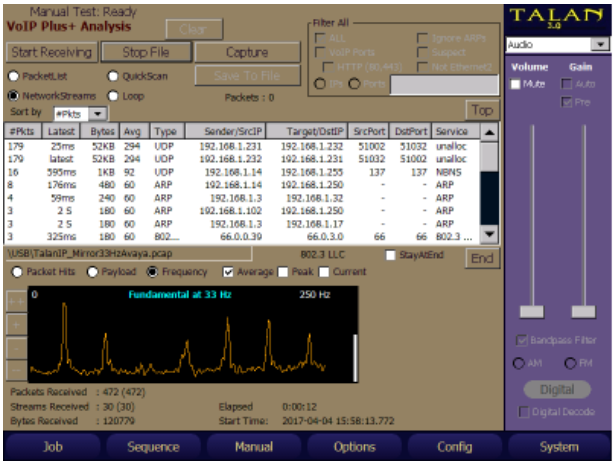
The receive filter options are:

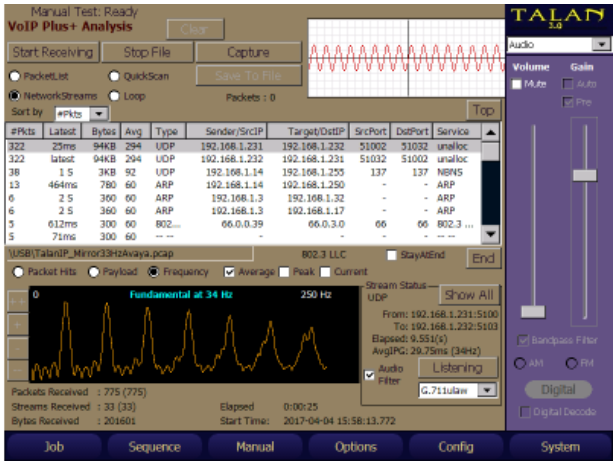
- **All** (Default) – All receive or file data is processed and included in the **NetworkStreams** list and **Frequency** graph, unless customized by other settings.
- **Ignore ARPs** – When enabled, ARPs will not be included in the analysis. Windows 8 and later PCs will search the network for connected devices. This reduces that influence on the data.
- **Suspect** –When enabled, analysis focuses on packets that use ports that have been used in the past for malicious activity.
- **NotEthernet2** – When enabled, analysis focuses on packets that are not classified as "Ethernet2", the latest standard. While it is the most used standard now, there are many business networks that still have Novell, SNAP, and/or 802.3Raw. All three of these should not be present on modern networks. Yet they can exist and modern Network Analyzers might not see them because newer network cards in PCs today are not set up to receive them. SNAP and 802.3Raw do not require a server, but have been used for tunneling or unauthorized VPNs in the past, and do reside on networks today, such as an iDevice tunnel in to a VPN and would go unnoticed by modern network analyzers and therefore might not be seen by network administrators.
- **VoIPPorts** – When enabled, analysis is performed on packets that use known VoIP Ports only. This can be done in other Network Analyzer programs, but, it is a LONG list of ports that are known VoIP ports and takes a lot of time to set up the filter manually.
- **HTTP** (80, 443) – This is reliant on checking VoIP Ports, you can further isolate the VoIP Ports by specifically leaving out 80 and 443 data. These are typically used for HTTP traffic (meaning the web page itself). BUT, google and others have been experimenting with a QUIC protocol for VoIP based on UDP that is sent via normal HTTP ports 80/443. This permits you to find those specifically.

Here is a screen shot of a capture collecting PC traffic that has a lot of YouTube downloads running, but there is no VoIP traffic. This is evident by the fact that the Frequency graph is very erratic. There is no fundamental frequency and there are no repeating harmonics.



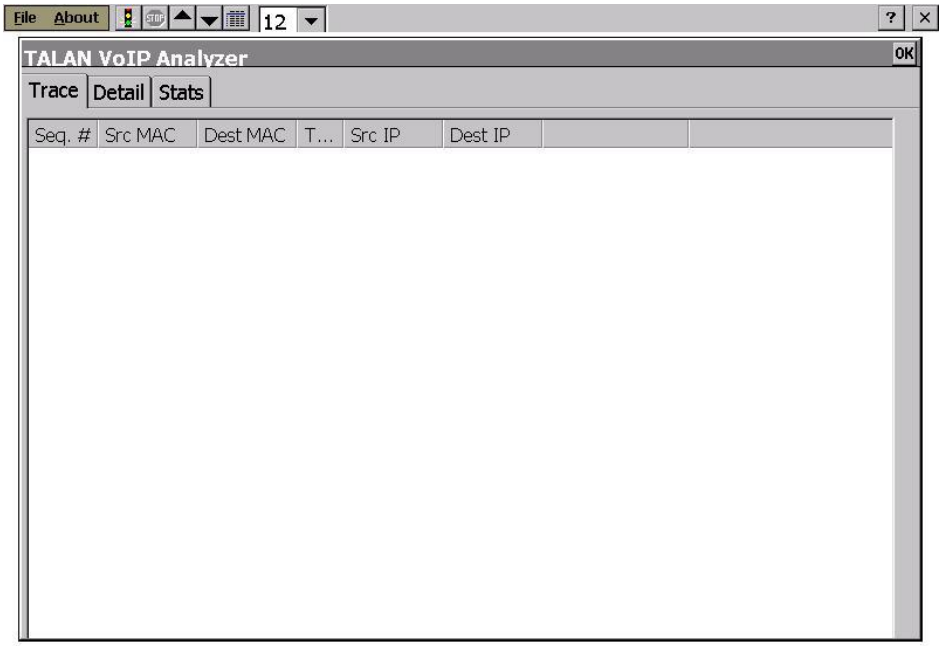
Here are two screen shots of what it looks like to have VoIP on a mirrored port. Remember, a mirrored port on one device will show both inbound and outbound traffic. Meaning, it will include both the Tx audio and the Rx audio. The screen shot on the left shows the two 33Hz streams, and the resultant Frequency graph due to rate of the two streams not exactly in phase at exactly 33Hz. The screen shot on the right shows the individual selected 33Hz stream. Notice the difference in the two frequency graphs. Neither should be relied on to determine solely if it is VoIP, but both are indicative of needing further investigation.



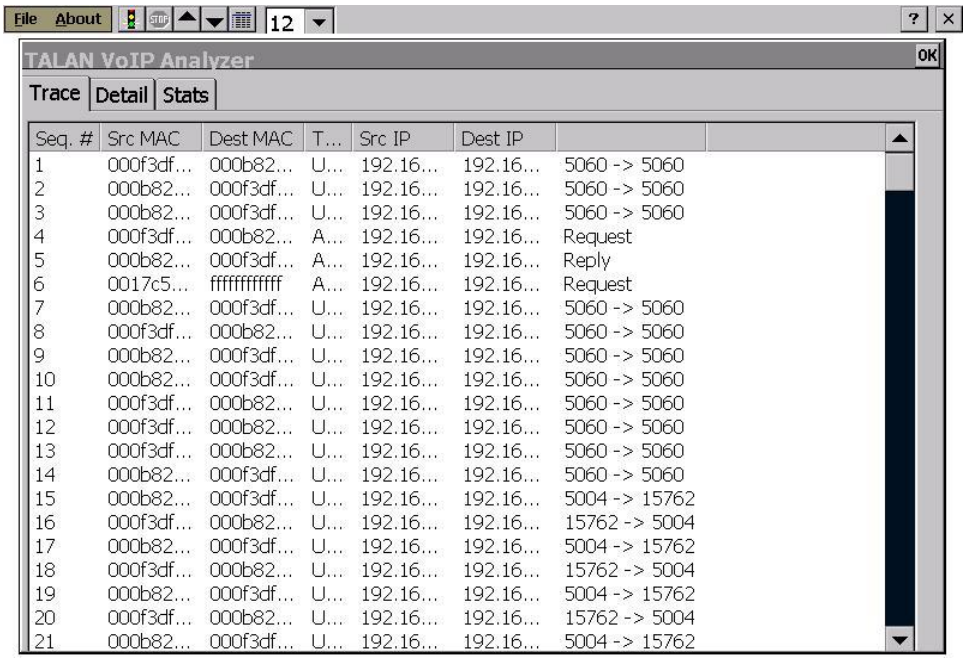


VoIP Analysis

The TALAN provides a VoIP Analysis interface that does not require the ***TALAN 3.0*** Hardware. To activate the VoIP packet analyzer select VoIP Analysis from the **F3** (Manual) menu and then press **START**. The TALAN VoIP Analyzer interface below will appear.



Once the TALAN is correctly attached to the VoIP network, the VoIP traffic (IP packets) can then be collected, displayed, and analyzed by the TALAN VoIP Analyzer software.



To access the functionality of the VoIP Analyzer, do the following:

Interface	Function
File→Start Trace *or* Traffic light icon	Start data collection
File→Stop Trace *or* Stop sign icon	Stop data collection
Details Tab	View highlighted packet details
Stats Tab	View overall collection statistics
File→Export	Save collected data to file on USB/CF
File→Clear	Clear collected data from memory
File→Properties	Access setup and filter definitions
File→Enable Filtering	Apply defined filter to new collection
File→Close	Close Analyzer program
Close icon [x]	Close Analyzer program

Features of the TALAN VoIP Analyzer include:

- displaying the source/destination MAC addresses, type of packet (ARP, TCP, UDP), and source/destination IP addresses
- calculating statistics (Stats tab) for each collection: total number of packets collected, total average rate for all packets, running average rate for the last 5 seconds, peak 5 seconds average rate, & run time
- allowing the user to setup custom filters to determine the type of packet captures (e.g. only to/from specific sources)
- providing for the export of packet files in text format or in WinPCap format for import into a PC-based network packet analyzer, such as WireShark or Cain & Abel

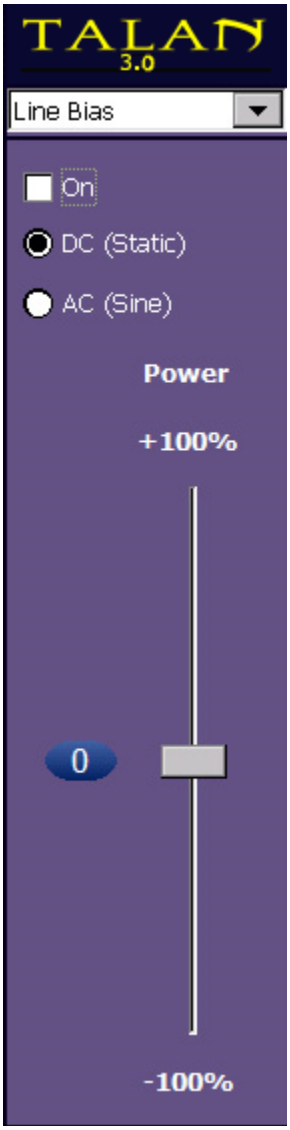
Line Bias

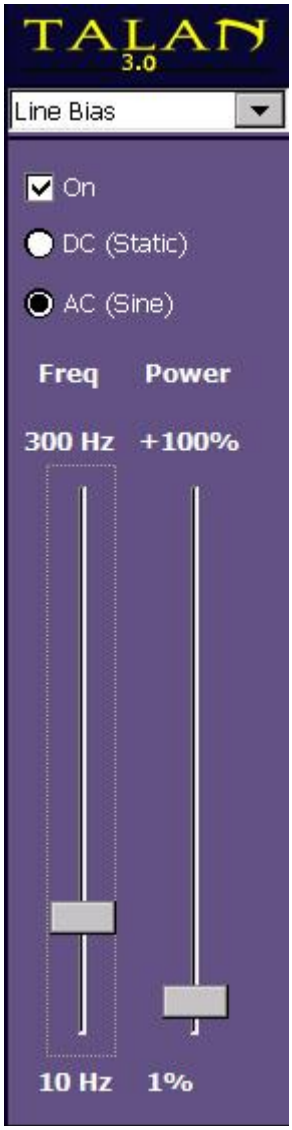
The TALAN provides the ability to put a voltage bias on the line to enhance other types of testing. This line bias voltage can range up to +/- 80 volts DC. TALAN can also provide AC bias ranging from 10 Hz to 300 Hz.

Application of a line bias should only be performed on an isolated line that is not connected to a switch.

By placing voltage on a line, you may power an electret microphone or provide power to a tap to increase the probability of detection.

To activate line bias function, press the **B** button to access the following dashboard.

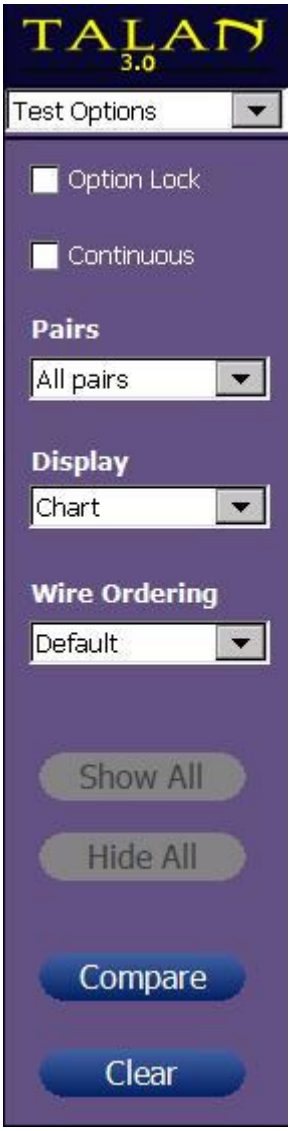




It is highly recommended that the rotary dial be used to adjust the power level of the Line bias function. The rotary dial provides a much finer control, while the stylus may provide quick, large, jumps in voltage. You should be careful not to put too much voltage on a line.

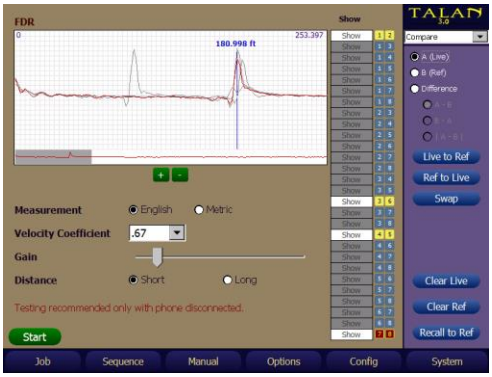
A/B Comparison

The TALAN is equipped to evaluate the results from multiple tests by comparing a live test against a known good reference. The Compare dashboard can be accessed from either the dropdown list or from the Compare button on the Test Options dashboard.

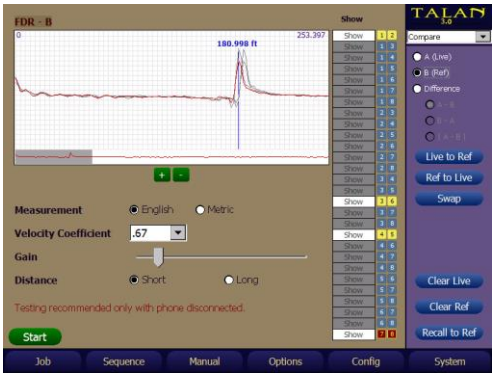


During any test mode, the results are saved in the **A** or **"Live"** position. They can then be compared to a previous test or reference file loaded into the **B** or **"Ref"** position. All TALAN Test functions can be compared using this A/B Comparison mode, however, only an FDR example is provided in this manual as an example.

The first image below shows an FDR test for the **"Live"** position. The second image shows a known good FDR test on a similar line in the **"Ref"** position.

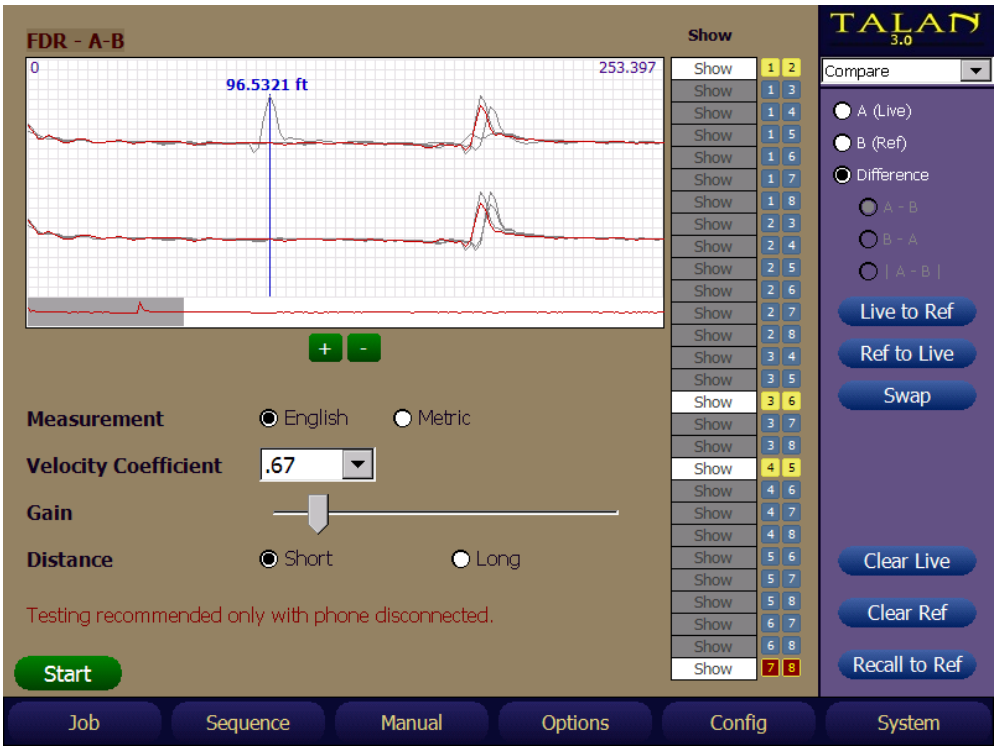


Live Data Selected



Reference Data Selected

Finally, we see the comparison of the two tests on the same screen which shows a fault on the **"Live"** line at approximately 96 feet.



Comparison of "Live" and Known Good Reference

*HARMONIC LOCATOR PROBE: LINE TRACING AND TAP DETECTION

*Note: The Harmonic Locator Probe used with TALAN's built-in Line Tracer function was discontinued in 2023, and is now replaced with the Noyafa NF-826 external Line Tracer transmitter and probe.

Instructions for using the Noyafa NF-826 Line Tracer are included in the TALAN case in a separate User Manual.

Warning: Line tracing should only be performed on a completely isolated line.

It is possible that a device connected to the line being tested could be damaged by the transmitted signal from TALAN or from the NF-826 Line Tracer.

A connected device such as a switch could also transmit signals that appear in the same frequency range as the HLP receive function or the NF-826 and cause false detections.

Introduction

When doing a technical surveillance countermeasures investigation, it is important to analyze all of the wiring in the environment to ensure that building wiring is not being utilized to transport audio or video information. This wiring may include but is not limited to telephone wiring, LAN wiring, security system or access control wiring, intercom speaker wiring, heating and cooling wiring, etc. The HLP-7000 Harmonic Locator Probe is an ideal tool to work with the TALAN to track miscellaneous wiring and/or identify the location of a semiconductor device on the wire.

The TALAN Harmonic Locator Probe provides two basic capabilities:

1. An RF Line Tracer that operates at 225 kHz.
2. A harmonic detector to locate the existence of an electronic tap.

This system consists of a split Non-Linear Junction Detector in which the TALAN provides the transmit function, and the HLP hand-held locator probe provides the receive function.

Set up

TALAN SET UP

1. Connect the cable to be tested to the TALAN Line or Banana connector. Verify that it is an isolated dry line using the DMM function and physical inspection. There should be no other device on the line such as a phone or switch.

2. Select Line tracing from the TALAN manual menu.
3. Use the Connection dashboard to select the conductors to be tested. Because balanced pair technology is specifically designed to emit very little leakage, for best results select a wire pair that includes the conductor to be tested with a second conductor chosen from a different balanced pair. The TALAN screen image shown below shows a test of wire #4 paired with wire #3 selected, Normally wires #4 and #5 comprise a balanced pair. See **Classify Pairs** in the TALAN manual for help. Even so, there will be diminished effectiveness when used with some modern twisted pair cables such as Cat 5 and Cat 6 cables (and their variations) as well as shielded cables.
4. As a general rule, do not use the green Earth Ground connection. The tracer signal can radiate from any nearby ground conductor which may cause misleading results.
5. Adjust the transmit power level using the stylus.

HLP SET UP

Various environments produce different levels of ambient noise that may affect sensitivity. Fluorescent and LED lighting, computers and other electronic equipment have been known to emit RF energy in the HLP detection range.

For best results, the HLP needs to be acclimated, or calibrated to the current environment.

Follow these instructions each time the HLP is powered on, or at any time to obtain the best sensitivity.

1. Start with the HLP off.
2. Hold the HLP so that the tip is in free space, away from the TALAN, cables or noisy devices such as fluorescent lighting.
3. Turn on the HLP.
4. The HLP will self calibrate to the ambient noise floor of the environment indicated by the LEDs flashing an alternating pattern. Hold the HLP steady until the LEDs return to normal.
5. Start the trace by holding the HLP so that the tip is located close to where the cable connects to the TALAN. Adjust the Line Tracer transmit power with a stylus until the green trace bargraph on the HLP reaches its highest level. For long runs of wire, it may be necessary to come back and increase the transmit power as the distance increases from the main TALAN unit.

Figure 1

Initial calibration display

Modes of Operation

WARNING: Care should be taken when tracing wires to ensure that the Locator Probe never comes in contact with high voltage wiring.

The Harmonic Locator Probe (HLP) has three operation modes as described below selected with the **MODE** button. On the first press, the indication for the current mode is displayed:

The upper green LEDs will pulse indicating Trace mode is active.

The upper red LEDs will pulse indicating Device Detection mode is active.

Both green and red upper LEDs will pulse indicating the Trace and Detection combination mode is active.

Repeatedly press the Mode key while the mode indication is active to step to the next mode. The display will return to normal operation once the Mode key is released.

1. Tracing Mode

The Tracing Mode is used to locate and follow a wire which may be hidden behind a wall or under carpet, etc. Start at the TALAN and point the tip of the HLP at the wire and follow it until it becomes hidden. Then, with a sweeping motion, watch the green bar and follow the path with the highest bar. The audio feature with Tone enabled provides additional feedback to assist tracing.

The Tracing Mode utilizes a 225 kHz signal that is generated by the TALAN and is injected into the wire to be traced. Enabling Tone on the TALAN adds a tone modulation to the signal which may be discernable before seeing a change in the bargraph.

Figure 2

Tracing Mode

2. Device Detection Mode

The Device Detection Mode operates as a split Non-Linear Junction Detector. The TALAN provides the transmit function, and the HLP hand-held locator probe provides the receive function. The purpose is to transmit a signal onto the wire, excite a semi-conductor device which then emits a signal that is double the transmit frequency (called a second harmonic). The HLP tunes to the second harmonic and displays the result on the red bargraph. The closer the HLP is to the semi-conductor device the stronger the received signal becomes. The audio feature also assists in device detection mode.

The Device Detection Mode utilizes the injected 225 kHz signal generated by the TALAN and tunes to the 450 kHz second harmonic.

Figure 3

Device Detection Mode

3. Combination Mode

The third mode is a combination mode of the Tracing and Detection modes. The HLP receiver will alternate between the two modes. The green and red bars are both active. This is the power-on default.

For the example shown in Figure 4, the received 225 kHz fundamental (green LEDs) and the received 450 kHz second harmonic (red) have a similar RSSI level. This indication is typical of a situation where the HLP is close to a semiconductor on the line of interest. Enable an audio tone by the Tone check box on the TALAN Line Tracer screen.

Figure 4

Combination Mode with device detected

The Figure 5 example shows a strong Trace signal, but weak second harmonic signal. This indicates that no semiconductor has been detected in close proximity of the HLP tip. Note though, the second harmonic return will be weaker than the fundamental, therefore, a device located at a distance from the HLP probe may not be detected. It is important to trace the wire along its entire length.

Figure 5

Combination Mode with no device detected

Display

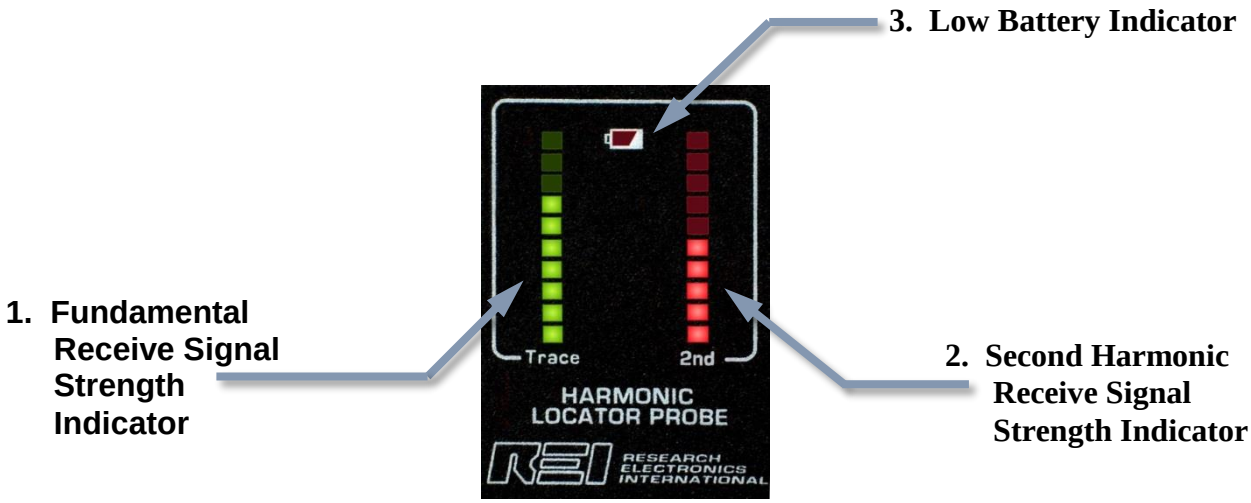


Figure 6

Please refer to Figure 6 for the following function descriptions.

NOTE: The indicators are shown as they would be seen in a normal operating condition.

A solid green bar is used to show the relative Received Signal Strength Indication (RSSI) of the 225 kHz injected onto the wire to be traced.

A solid red bar is used to show the relative RSSI of 450 kHz. This frequency indicates the presence of a semiconductor. The injected 225 kHz from the TALAN is sent into the wire and the generated harmonic is being re-radiated.

The LOW BATTERY indicator is lit when the 9 V battery nears end of life.

Other status indications are described later.

Controls

Figure 7

Control Buttons

- **POWER** – Turns the unit on and off.
  As with any battery powered device, removed the battery if the unit is to be stored for an extended period.
- **UP** Increases the volume.
- **MODE** Selects the mode of operation.
- **DOWN** Decreases the volume.

In addition, pressing the MODE with either the UP or DOWN button at the same time initiates special functions, as described in later sections.

Volume

The speaker or headphone volume can be changed by pressing the UP or DOWN buttons.

The volume control is active when the top green lamp is blinking.

A solid green dot indicates the relative audio volume level.

The display will return to normal operation once the volume up or volume down key is released.

Figure 8

Volume

Mode

One of the three operating modes can be selected with the MODE button. The upper four LEDs will pulse indicating the selected mode:

TRACE: The upper green LEDs will pulse indicating Trace mode is active.

DETECT: The upper red LEDs will pulse indicating Device Detection mode is active.

COMBO: Both green and red upper LEDs will pulse indicating the Trace and Detection combination mode is active.

On the first press, the indication for the current mode is displayed. Repeatedly press the Mode key while the mode indication is active to step to the next mode. The display will return to normal operation once the Mode key is released.

Calibration

Various environments produce different levels of ambient noise that may affect sensitivity. The Calibration feature is available to acclimate the device to its current environment. Use this function when needed to reset the detection baselines.

Warning: There will be diminished effectiveness when used with some modern twisted pair cables such as Cat 5 and Cat 6 cables (and their variations) as well as shielded cables.

Figure 9

Calibration in progress.

1. Press **MODE** and **UP** to initialize the receiver to the default state. Let it work for a second or two.

2. Press **MODE** and **DOWN** buttons at the same time to start the baseline acclimation, or calibration.

During calibration, be sure to hold the HLP so that the tip is in free space, away from the TALAN, cables or noisy devices such as fluorescent lighting.

Calibration in progress is indicated by the lamps flashing an alternating pattern as shown in Figure 9. The display will return to normal operation once the **MODE** key is released.

Battery Compartment

The power source is a 9 V alkaline battery.
There is a sliding door that is used to retain the battery.
Insert the battery in the correct orientation as indicated by the label inside the compartment.

Figure 10

Battery Compartment

Headphone Jack

The headphone jack is located on the left side of the unit. It accepts a standard mono 3.5 mm plug.
It is recommended that headphones be used to be non-alerting, if required.
Using headphones instead of the speaker can also extend battery life.

Figure 11

Headphone Jack

TALAN SPECIFICATIONS

CONTROL SYSTEM
Primary Computer: 32 bit RISC processor, 520 MHz
Internal Memory: 64 MB SDRAM (OS), 64 MB Flash
External Memory: Compact Flash Type III,
USB mass storage

DIGITAL I/O
Network: 10/100 Ethernet Controller for IP Packet Detection
USB: USB Device (A Type) supports external keyboard, mouse, and USB mass storage device; USB Host (B type) for future use.

ANALOG I/O
Headphone Output: 3.5 mm connector
Microphone Input: 3.5 mm input

USER INTERFACE
Hard Keys: 6 Soft Menu Keys, 5 Button Quadrant Navigation & other dedicated keys
Encoder: High-Resolution Optical Encoder
Integrated Touch Screen with Stylus
Test Inputs:

Dual MOD8:	Supports 2, 4, 6, & 8 wire Modular Phone Jacks with Shield (With TALAN 3.0)
Banana Type:	Standard sleeved sockets: Ring, Tip, and Earth
SMB RF Input:	RF/Antenna Connection to 8 GHz Broadband Detector
Expansion Port:	Supports communication and measurement for use with future accessories

All Inputs Electrically Isolated

RF SYSTEM
Spectrum Analyzer:
Dual Conversion, Super-Heterodyne Receiver
Frequency Range: 30 kHz to 85 MHz
Sweep Time: 2 Seconds
Step Size: 1 kHz
Bandwidth: 18 kHz
Sensitivity: -100 dBm

Broadband Detector:
RF SMB Input: 100 kHz to 8 GHz
Line Level Test: 100 kHz to 600 MHz
Sensitivity: -65 dBm

DIGITAL MULTIMETER
Quick Response Auto-Ranging: 500msec Sample Rate
AC/DC Volts: 0 to 250V Maximum
AC/DC Current: 0 to 300mA Maximum
Resistance: 0 to 42MΩ
Capacitance: 50pF to 40µF

BIAS GENERATOR
Optically Isolated, Direct Digital Control: High voltage DAC
Output Ceiling: ±80V
Output Ceiling (Shield): ±65VDC, ±33VAC
Modulation: Fixed voltage, or variable rate Sine wave (10 Hz – 300 Hz)

AUDIO
Audio Bandwidth: 20 Hz – 20 kHz
Gain: Up to 80 dB total system gain
AGC: Digitally Controlled Automatic Gain
Filter: Analog Voice band filter (300 Hz to 3 kHz)

POWER SYSTEM
External Input: 15VDC @3A
Universal Power Supply: 100-240VAC, 50-60Hz
Removable Battery: Rechargeable Lithium ion,
4-hour runtime (typical)

MECHANICAL
Dimensions: 10.0 in x 12.9 in x 2.7 in
(25.4 cm x 32.8 cm x 6.9 cm)
Weight with Battery: 6 lbs. (2.7 kg)
Case Dimensions: 5.4 in x 14.9 in x 19.5 in
(13.7 cm x 37.8 cm x 49.5 cm)
Loaded Case Weight: 19.0 lbs. (7.1 kg)
Operating Temperature: 0°C to +50°C

HARMONIC LOCATOR PROBE
Operational Frequency: 225 kHz & 450 kHz
Antenna Type: Balanced Loopstick
Headphone Audio Output: 16Ω, 105dB SPL limited
Battery: 9V Alkaline
Run-Time: 10 hours average, 22 hours (headphones)
Size: 17.5 in x 1.5 in (44.45 cm x 3.8 cm) stored
63.75 in x 1.5 in (162 cm x 3.8 cm) fully extended
Weight: 1 lbs. (.5 kg)

CE