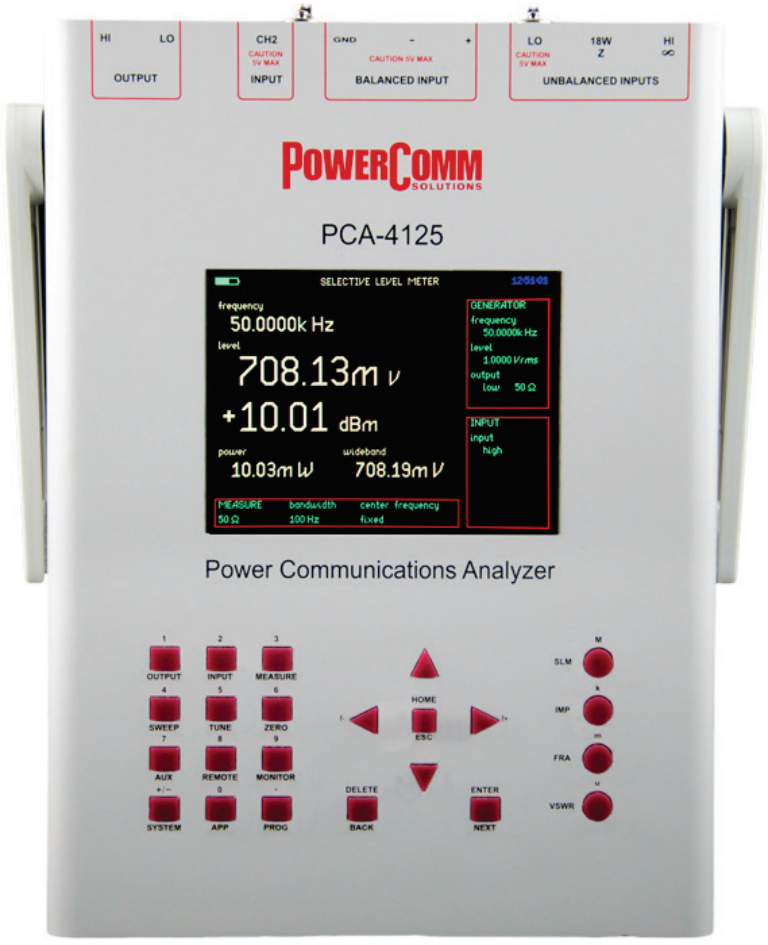
POWERCOMM
SOLUTIONS

# PCA-4125

## POWER COMMUNICATIONS ANALYZER




# INSTRUCTION MANUAL

# WARRANTY

This product is guaranteed to be free from defects in materials and workmanship for a period of 12 months from the date of purchase. In the unlikely event of any problem within this guarantee period, first contact PowerComm Solutions, LLC or your local representative and provide a description of the problem. Please prepare with as much relevant information as possible – particularly the serial number and release numbers (press SYSTEM then left arrow). If the problem cannot be resolved directly then you will be given an RMA number and asked to return the unit. The unit will be repaired or replaced at the sole discretion of PowerComm Solutions.

This guarantee is limited to the cost of the PCA-4125 itself and does not extend to any consequential damage or losses whatsoever including, but not limited to, any loss of earnings arising from a failure of the product or software. In the event of any problem with the instrument outside of the guarantee period, PowerComm Solutions offers a full repair and re-calibration service – contact us at (908) 806-7025 or www.powercommsolutions.com. It is recommended that the PCA-4125 be re-calibrated annually.

# DISCLAIMER

PowerComm Solutions, LLC has made every effort to ensure that the information in this document is accurate and complete. However, PowerComm Solutions, LLC assumes no liability for any errors that may occur in this document, or for any damages that may occur from the use of this document or the accompanying equipment.

PowerComm Solutions, LLC reserves the right to make changes to this document or the product it describes at any time, without notice, and without a commitment to update the contents of this particular document.

Contact PowerComm Solutions, LLC to obtain information concerning the latest release of this document.

# IMPORTANT NOTICE

**Firmware Upgrades & Revised Instruction Manuals**:

It is very important that the product's ultimate user register with the PowerComm Solutions website: www.powercommsolutions.com. This will ensure that PowerComm Solutions can notify all users of any important or critical firmware or manual updates that may occur. PowerComm Solutions is constantly improving the features and functionality of the PCA-4125 Power Communications Analyzer. With each enhancement, new firmware is available, and the instruction manual is revised to reflect those changes. We strongly recommend that the PCA-4125 user check our website periodically to identify if any firmware upgrades and revised instruction manuals are available for download. PowerComm Solutions will mail a copy of the latest instruction manual upon request.

# *Table of Contents*

# *CHAPTER 1 - Introduction*

The PCA-4125 Power Communications Analyzer is designed to provide a single instrument solution for multiple applications in the communications industry and specifically the Power System Communication environment. This instrument is microprocessor based and the firmware is upgraded on a regular basis to enhance its functionality. The firmware updates are available on the PowerComm Solutions website at www.powercommsolutions.com.

## 1.1 Instrument Functions

The following is a list of the different instrument functions that the PCA-4125 offers:

- Signal Generator
- Frequency Selective Level Meter (RMS Voltmeter)
- Impedance Analyzer
- VSWR Meter
- Frequency Response Analyzer
- Oscilloscope
- LCR Meter (Inductance, Capacitance, Resistance Measurements)
- Bit Error Rate (BER)

## 1.2 Data & Event Recording

The PCA-4125's test functions will provide the technician with invaluable data that can be stored either internally or externally. The user may store and retrieve field data using the one gigabyte of internal memory or an external USB memory stick. The data results are stored in a standard CSV (comma delimited) file format along with the standard parameters for each meter test function. Also included in each file saved is a time and date stamp, serial number, firmware version, last calibration date and more. The PCA-4125 will help your company document the characteristics of your individual Power Line Carrier equipment system-wide.

## 1.3 Field Instrument

Designed for the substation environment, the PCA-4125 has a strong external aluminum housing and comes complete with a rugged carrying case and multiple accessories as standard equipment. The PCA-4125 uses a state of the art 5.7" color display to maximize visibility in all conditions, including full sunlight. Its' tablet size (12" x 9" x 1.75") and relative light weight (5 lbs) provides a compact solution that can become the technician's primary diagnostic and test tool. The PCA-4125 can

operate off internal rechargeable batteries, an AC/DC power source, or an external 12V vehicle battery.

## 1.4 Power Line Carrier Applications

- Power Line Carrier Alignment & Maintenance
- Line Trap Testing
- Line Tuner Testing
- PLC Transmitter & Receiver Test & Set-up
- Audio Tone Protection Relay Channel Test & Setting

## 1.5 Instruction Manual

This instruction manual is laid out in a manner to introduce you to the PCA-4125 and to help you become familiar with the performance and functionality of the instrument. While it is possible to use the manual to review specific features and meter functions, it is recommended that you read the complete manual before using the instrument for the first time. A good understanding of the keypad layout, the display nomenclature and the menu structures will provide the user with a solid foundation for using the instrument.

# *CHAPTER 2 - Safety*

READ THIS INSTRUCTION MANUAL AND SAFETY INFORMATION BEFORE USING THIS INSTRUMENT

- Use the instrument only under the conditions and the purpose for which it was intended.
- Ensure that the AC supply Voltage and the unit supplied are at the same ratings. AC operation is intended for indoor use only.
- This instrument is NOT field repairable. Contact PowerComm Solutions for instructions to return the unit for repair or replacement.
- The instrument is NOT waterproof or airtight. Return the unit to PowerComm Solutions for evaluation if exposed to environmentally unusual conditions.
- Do not operate or store under conditions where condensation may occur or where conducting debris may enter the case.
- Keep the ventilation holes on the top and bottom ends of the instrument free from obstruction.
- **WARNING:** Operators should follow all standard safety procedures and their specific company safety procedures when utilizing this product and accessories. Special personal precautions must be adhered to when working with or around antennas, power lines, radio frequency sources, etc. **FAILURE TO COMPLY WITH SAFETY RULES MAY RESULT IN INJURY OR DEATH.**
- When using this product, you may need to access other products or system parts. Read and follow the safety instructions of all components utilized.

**Note: PowerComm Solutions, LLC shall not be liable for any consequential damages, losses, costs or expenses arising from the use or misuse of this product however caused.**

# *CHAPTER 3 - Getting Started*

## 3.1 Unpacking the Instrument

Your instrument was shipped in a custom designed carrying case. Upon receipt of the equipment, inspect all cartons and packaging for visible damage. If any damage is identified, report immediately to PowerComm Solutions so we may notify the carrier for a claim. If the packaging damage is noticeable while the delivery person is present, obtain a written statement from the carrier.

## 3.2 Contents of Shipment

1 - PCA-4125 Power Communications Analyzer
1 - Transit/Carrying Case w/custom foam accessory cut outs
1 - Shoulder Strap
1 - Model 410 (50 Ohm) or Model 411 (75 Ohm) Directional Coupler
1 - 12V 70W external Power Supply Unit
1 - US Mains/Adapter Plug
1 - 12V Car Socket Adapter – Fused (5A) 20 feet long
1 - BNC Male to Binding Post Adapter (in case foam)
2 - BNC "Y" Adapters (M-F-F) (in case foam)
1 - BNC "T" Female-Male-Female (in case foam)
1 - BNC Female to Female Adapter (in case foam)
1 - BNC Male to UHF Female Adapter (in case foam)
2 - UHF Male to BNC Female Adapters (in case foam)
1 - BNC Male Test Lead with Strain Relief's approx. 12" long
2 - BNC RG-58A Coaxial Cables 6' long
1 - BNC Female to Alligator Clip Test Lead
1 - BNC Female to Banana Plug Test Lead
1 - BNC Female to Pin Tip Plug Test Lead
1 - BNC Female to Mini Grabber Test Lead
2 - 9 ft. Banana to Large Alligator Clip Test Leads (1 Black & 1 Red)
1 - 6 ft. Green Ground Cable (BNC Male to Large Alligator Clip)
2 - Communication Cables (1 white USB & 1 Gray RS232 Null)

### 3.2.1 Documents

2 - Calibration Certificate with Test Data (in case lid pouch)
1 - Laminated dBm Conversion Chart (in case lid pouch)
1 – Instruction Manual (in case lid pouch)

## 3.3 Power Sources

The PCA-4125 can be powered by multiple sources; directly from the AC/DC adapter, from the internal battery source (3-3.7V lithium ion batteries), or directly through the DC input (9-18V source required). The instrument also ships with a 25 foot car adapter standard that permits use through a car DC source (cigarette lighter).

### 3.3.1 AC/DC Adapter

The AC/DC adapter can accept a wide AC input range (100 to 240 VAC). Various standard adapter plugs are available to accommodate different country standards.

### 3.3.2 Battery Power

The instrument is shipped with a battery source consisting of three lithium ion rechargeable batteries. They are factory installed onto the battery board.

### 3.3.3 DC Input

The PCA-4125 is supplied with a 25 foot car adapter/cigarette lighter cord that can be used to power and charge the PCA-4125 from your car or truck. The DC input will operate with a 9-18V dc source; however the equipment warranty does not cover any damage caused by any other source than the ones provided with this instrument.

### 3.3.4 Charging the Batteries

The PCA-4125 has a sophisticated battery monitoring and charging circuit which provides the user with the current battery status. When running on battery, the monitor goes from green to orange and then red to indicate the state of the batteries. The instrument will beep and prompt on the screen when power levels are at a stage where data or set-up information should be stored. The monitoring system provides the following indications while the batteries are charging:

- When charging - blue with >>>>.
- When finished charging, but power still connected- blank.

### 3.3.5 Changing the Batteries

PowerComm Solutions does not recommend that the end user change out the batteries. The internal cable to the video screen is easily damaged if disconnected or installed wrong. PowerComm Solutions recommends that the end user return the instrument to the factory for battery replacement.

## 3.4 Instrument Connections

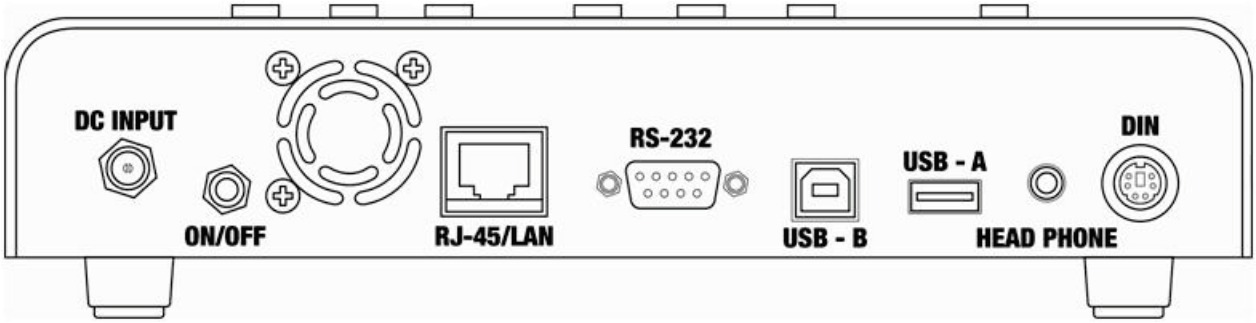



**FIGURE 3.4-1 – BOTTOM VIEW OF PCA-4125**

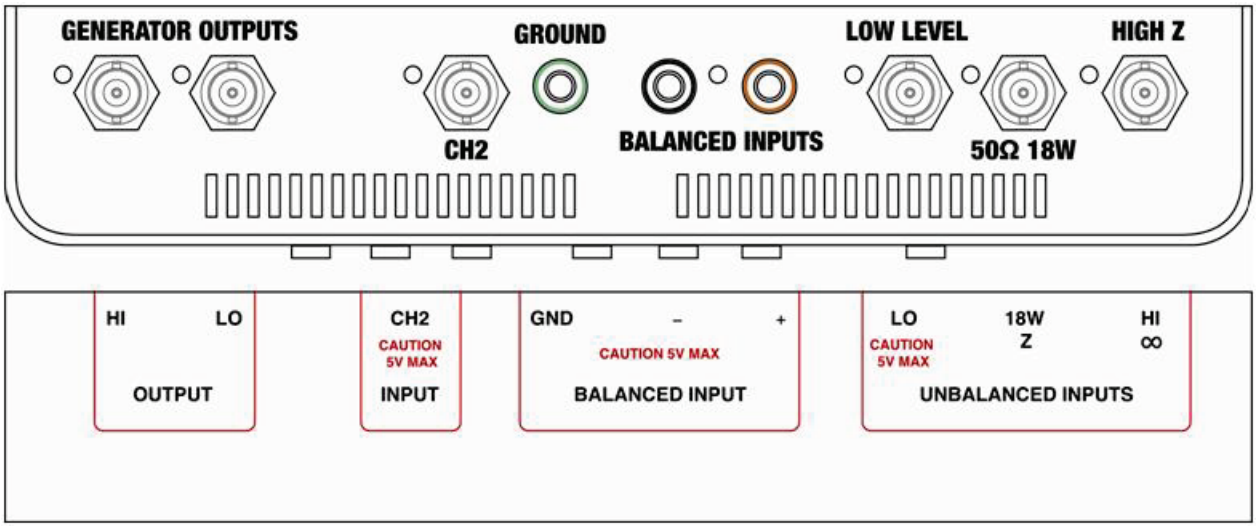



**FIGURE 3.4-2 – TOP VIEW OF PCA-4125**

# *CHAPTER 4 - Menus and Keypad (Controls)*

The PCA-4125 is a menu driven instrument. All functions are controlled from the keypad and the menu screens. The keypad has 23 keys that control its operation. Figure 4-1 is an illustration of the keypad. The function of each key is displayed above or below the key with the primary function below the key. The number or function above each key is only active under certain options. For example, the numeric keys are for entering a specific frequency for the selective level meter or signal generator. Full detailed descriptions for the keys are provided in the individual instrument sections of this manual.

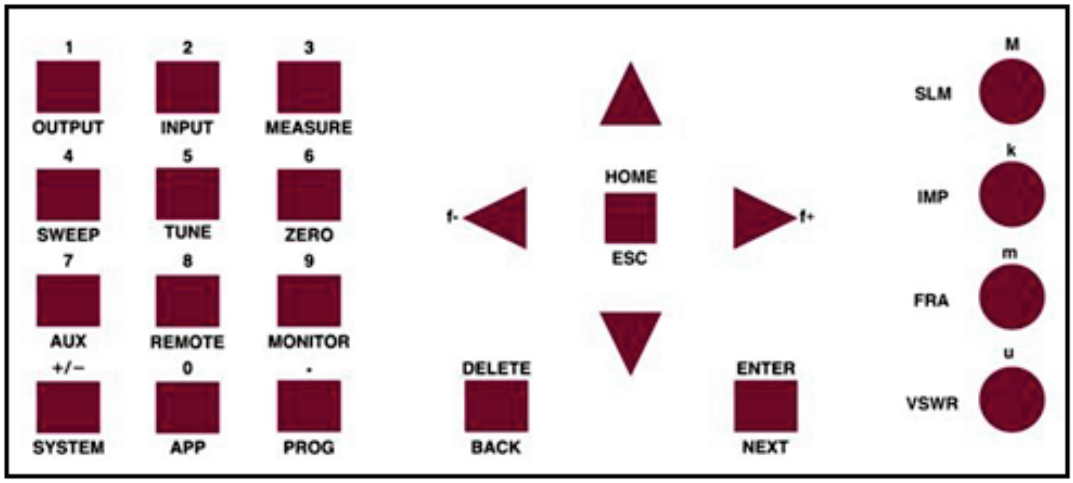



**FIGURE 4-1 - PCA-4125 KEYPAD**

The four round keys on the right of the keypad are labeled: SLM, IMP**,** FRA, and VSWR and allow direct access to those functions of the instrument. The 'OUTPUT' key '1' controls the signal generator.

**SLM** – Selective Level Meter – Selects the *Selective Level Meter* function.

**IMP** – Impedance Analyzer - Selects the *Impedance Analyzer* function.

**FRA** – Frequency Response Analyzer - Selects the *Frequency Response Analyzer* function.

**VSWR** – Voltage Standing Wave Ratio – Selects the *Voltage Standing Wave Ratio* function.

**OUTPUT** – Signal Generator – Selects the *Signal Generator* function.

The four keys ‘SLM’, ‘IMP’, ‘FRA’, and ‘VSWR’ each have a second function. The letter above each key is a numeric multiplier **‘M’** for mega, **‘k’** for kilo, **‘m’** for milli and **‘µ’** for micro. When entering large or small numbers these multipliers may be used to save keystrokes.

**Arrow Keys -** The four arrow keys are used to navigate within the menus. Use the ‘UP/DOWN’ arrow keys to move the red highlight box up/down to select an option. Use the ‘RIGHT’ arrow key to show any options under that selection. Activate the desired highlighted option using the ‘ENTER’ key. The ‘UP/DOWN’ arrow keys also adjust the level of the generator by the amplitude step selected under the Generator Settings screen accessed through the Output function. The ‘LEFT/RIGHT’ arrow keys step the frequency up or down (If no Output is selected, then the ‘LEFT/RIGHT’ arrow keys will control the selective level meter frequency. If the low or high Output is selected, then the LEFT/RIGHT arrow keys will control the generator frequency).

**Keypad -** The 12 keys on the left side all have three functions. The function below the key is the primary function. The function above the key is the secondary function. A third function, not displayed, is an alphanumeric keypad similar to the keypad of a phone.

Accessing the primary function of the 12 alphanumeric keys displays a menu. The left column is the function and the right column displays the options available for that function. Use the ‘UP/DOWN’ arrow keys to place the ***highlight*** box around the desired option. Use the right arrow key to display other options if available. Use the ‘UP/DOWN’ arrow keys to place the highlight box around the desired option and then the ‘ENTER’ key to activate it. When the right column selection has a numeric value, it can be changed by using the keypad to enter the desired value and then hit the ‘ENTER’ key. Press the HOME/ESC key ***once or twice*** to return to the active instrument. A brief description of each key is provided below.

## 4.1 OUTPUT Key

Pressing the ‘OUTPUT’ key brings up the signal generator settings screen. Figure 4.1-1 displays the different options available for the signal generator with the signal generator turned off. Section 5.1 provides full operational instructions for the signal generator.

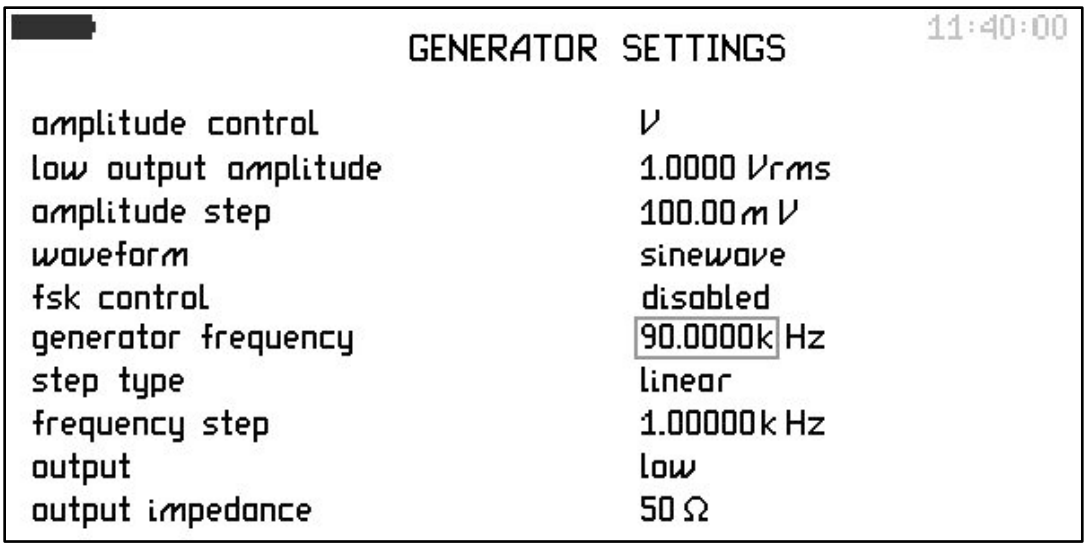



**FIGURE 4.1-1 – SIGNAL GENERATOR**

## 4.2 INPUT Key

Pressing the 'INPUT' key brings up the input settings screen. This option controls the different inputs that are available. There are three options on the left side: input, scale factor and CH1 input ranging. Figure 4.2-1 displays this screen.

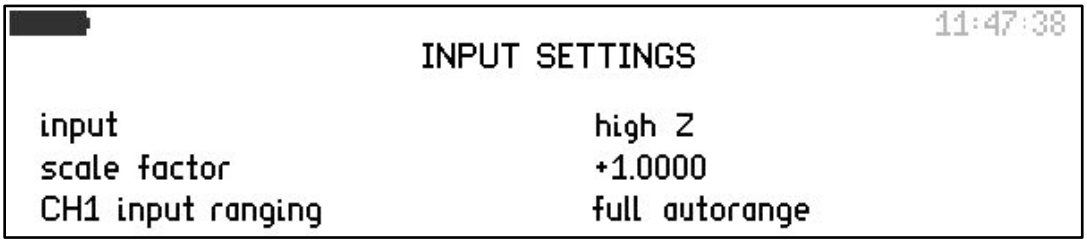



**FIGURE 4.2-1 - INPUT SETTINGS**

### 4.2.1 Inputs

Allows the user to select one of four different input options for the different instruments. These options are: high Z, 50Ω 18W, low level, and balanced. Figure 4.2.1-1 displays these options. The 'high Z' input is the default input as it can handle up to 150 volts. ***All other inputs have limited voltage capability***. See ***Caution*** below.

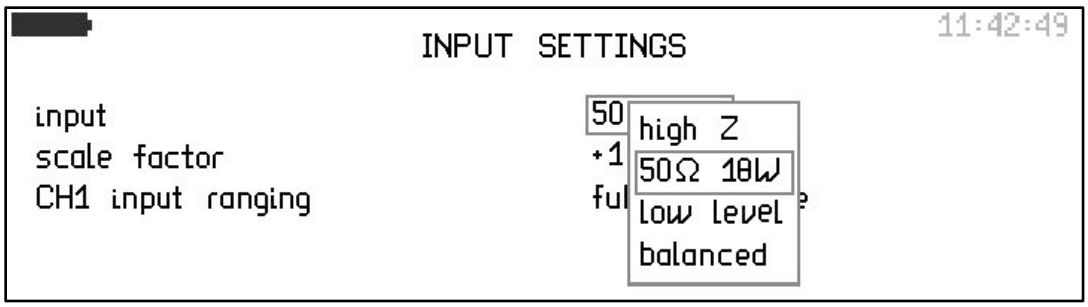



**FIGURE 4.2.1-1 INPUT OPTIONS**

### 4.2.2 High Z Input

The 'high Z' input is the high impedance unbalanced "bridged" input. Use it for all readings when possible. This will prevent possible damage to the lower voltage inputs. **Use the 'high Z' input to verify that the voltage being measured is less than 5 volts before switching to one of the other low voltage inputs.**

CAUTION: THE LOW VOLTAGE INPUTS (BALANCED INPUT, LOW LEVEL (UNBALANCED) INPUT AND CH2) ARE RATED 5 VOLTS MAXIMUM RMS. APPLYING A HIGHER VOLTAGE WILL DAMAGE THE INPUT(S) REQUIRING FACTORY REPAIR. USE THE LOW VOLTAGE INPUT(S) ONLY AFTER CONFIRMING THE INPUT SIGNAL WILL NOT EXCEED THE MAXIMUM RATING.

### 4.2.3 50 Ω 18W

The 50Ω 18 Watt input is a "terminated" input. It puts a 50 Ω load on the circuit it is connected to. Use this input to set transmitter output if they are less than 18 watts (30V RMS).

### 4.2.4 Low Level Input

The *Low Level* input should only be used after verifying that the input voltage does not exceed 5.0 volts. The *Low Level* input is more accurate than the High Z input and that is why it is provided, to measure small voltages. Check this using the High Z input. Selecting the *Low Level* input adds another option 'Impedance' to the display. See Section 4.2.6 below for the impedance option.

### 4.2.5 Balanced Input

The *Balanced Input* is for measuring audio tone signals or balanced signals. This input can only handle a maximum of 5.0 volts. Exceeding 5.0 volts could damage this input.

### 4.2.6 Impedance

The ‘low level’ and ‘balanced’ inputs have the option to be used in either the bridged (high impedance) or terminated mode. The terminated mode has the options for 50Ω, 75Ω or 600Ω terminations. These three options will put a load on the meter output at the selected ohmic value. The maximum voltage is 5 V RMS for the ‘low level’ and ‘balanced’ inputs. Figure 4.2.6-1 displays the low level ‘impedance’ input options.

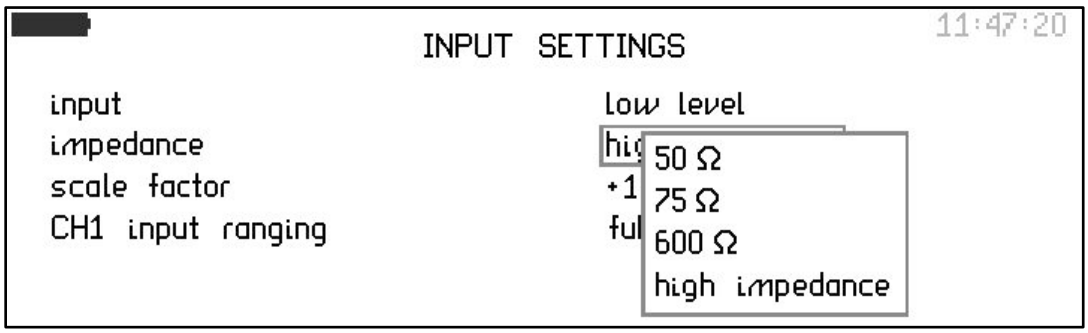



**FIGURE 4.2.6-1 – LOW LEVEL INPUT IMPEDANCE OPTIONS**

### 4.2.7 Scale Factor

The scale factor option is used to compensate for an attenuator or a scope probe. If the scope probe is an X10 probe, putting ‘10’ in as the scale factor gives the correct value for voltage. Figure 4.2.7-1 displays the scale factor set for ‘1.0000’.

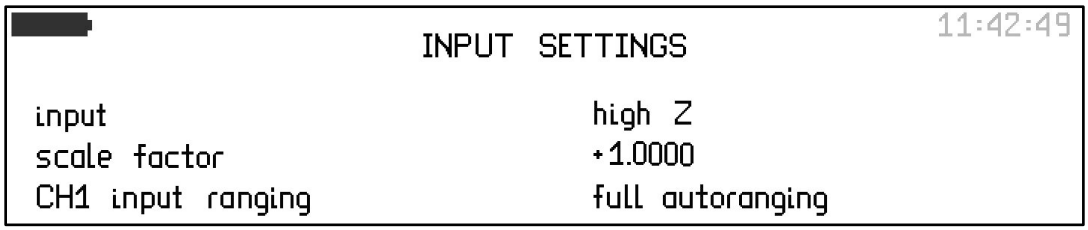



**FIGURE 4.2.7-1 – INPUT SETTINGS SCALE FACTOR**

### 4.2.8 CH1 Input Ranging

There are three options for CH1 input ranging – ‘full autorange’, ‘range up only’, and ‘manual’. Full autorange will display the measured voltage or dBm even if it is varying over a wide range. ‘Range up only’ will display a voltage or dBm change only if it goes up in value. Manual allows the user to set the maximum range from as low as 1mV to as high as 300V. Figure 4.2.8-1 displays CH1 input ranging options.

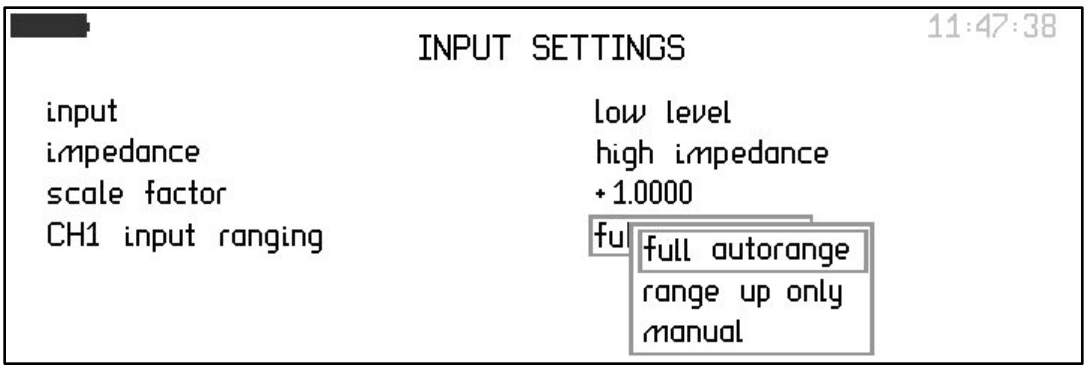



**FIGURE 4.2.8-1 – CH1 INPUT RANGING OPTIONS**

## 4.3 MEASURE > Measurement Settings

This is a multifunction key. The screen in Figure 4.3-1 appears when MEASURE is selected. The options displayed on the left side will change based on the mode (instrument) selected.

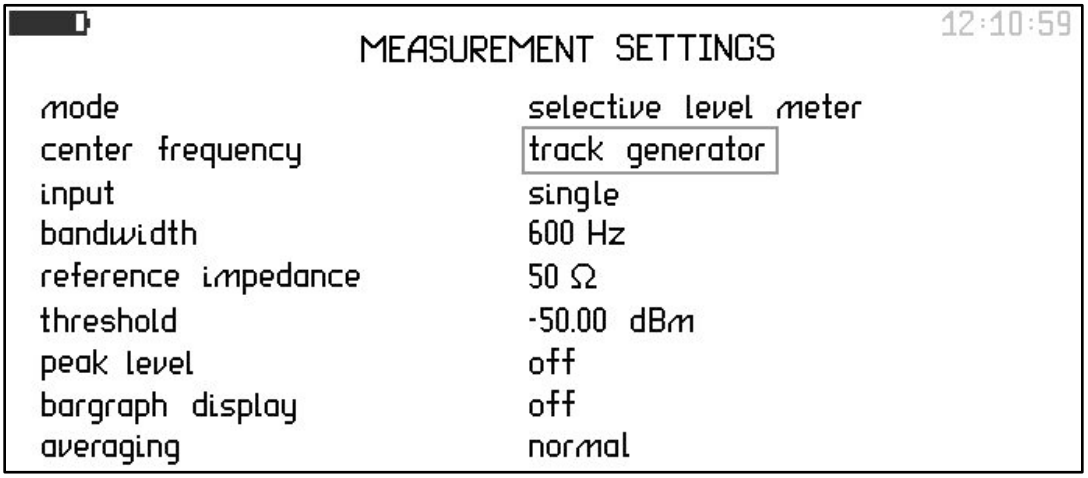



**FIGURE 4.3-1 - MEASUREMENT SETTINGS**

### 4.3.1 Mode

Mode provides the option to select five different instruments. The screen in Figure 4.3.1-1 appears when this function is selected. Four of these instruments, selective level meter (SLM), impedance meter (IMP), frequency response meter (FRA) and voltage standing wave ratio (VSWR) meter, may be selected by the four round keys on the right-side of the keypad. The only way to select the oscilloscope is from this menu.

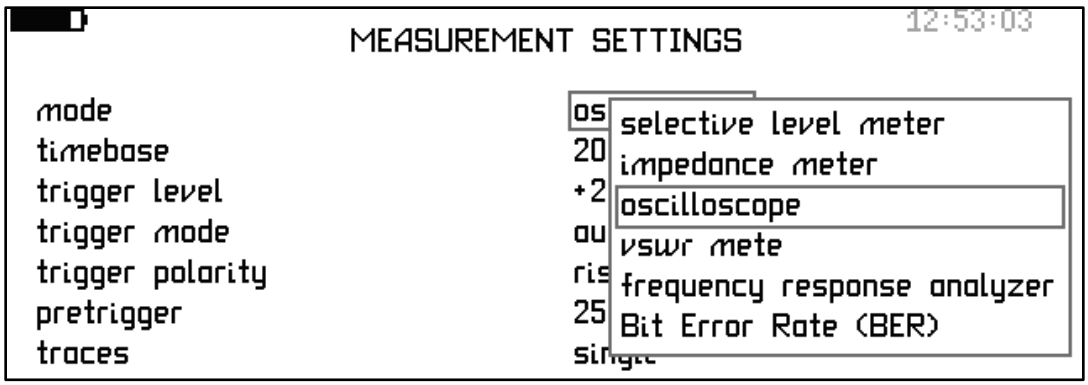



**FIGURE 4.3.1-1 - MODE OPTIONS**

### 4.3.2 Center Frequency

Center Frequency has five options: track generator, AFC, fixed, dual fixed and input frequency. The screen in Figure 4.3.2-1 appears when this function is selected. These options control how the input(s) determine the frequency displayed on the screen. *Track generator* tells the instrument to tune itself to the signal generator's frequency. *AFC* looks for the frequency with the highest voltage within the bandwidth selected (except wideband) and displays this frequency on the screen. This function does not always work in a high noise environment. *Fixed* tunes the instrument to a 'fixed' frequency and adds two functions, tuned frequency and frequency step, to the left side of the screen. *Dual Fixed* allows the user to monitor two independent frequencies at one time. See Section 5.2 – Selective Level Meter – for more information. *Input frequency* looks for any frequency present and displays the signal with the highest level.

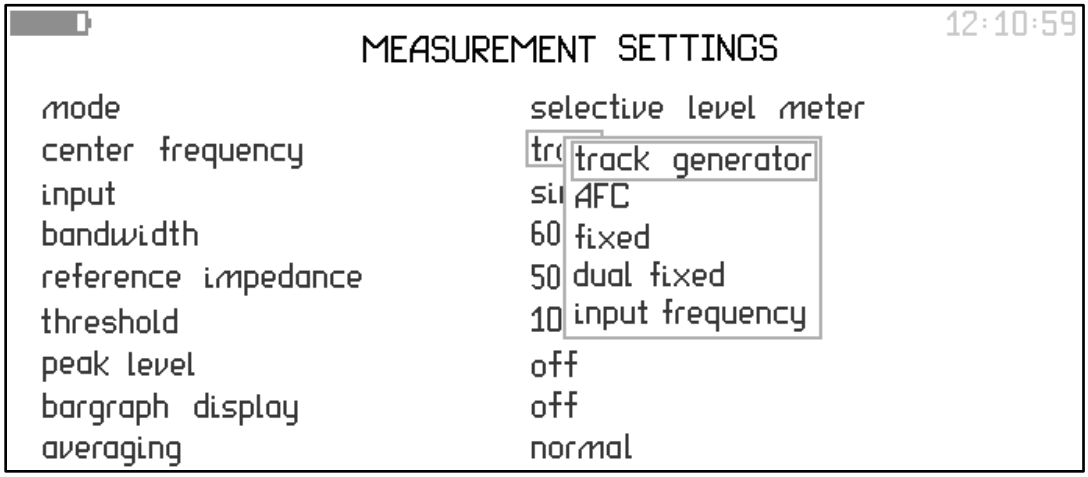



**FIGURE 4.3.2-1 - CENTER FREQUENCY OPTIONS**

### 4.3.3 Tuned Frequency

Operating the selective level meter in the 'fixed' mode adds the *tuned frequency* option to the menu. This option allows the user to set the SLM to a specific frequency. Refer to Figure 4.3.4-1 below.

### 4.3.4 Step Type

Step type has two options: logarithmic or linear. Selecting the 'logarithmic' option makes each frequency step larger in value (logarithmic). Selecting the 'linear' option makes each frequency step a specific value in size. The screen in Figure 4.3.4-1 appears when this function is selected.

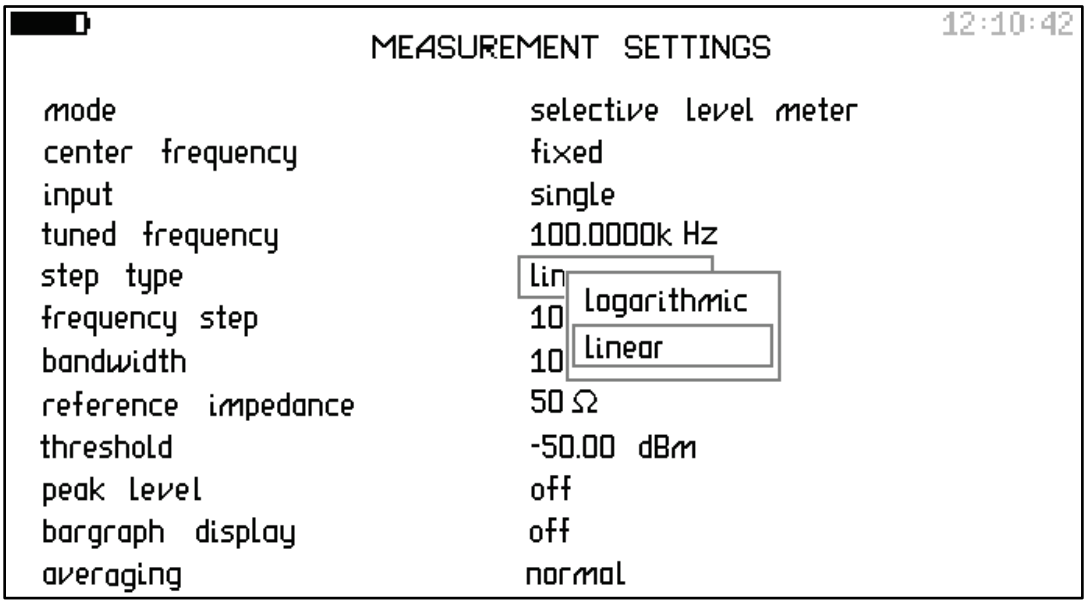



**FIGURE 4.3.4-1 – FREQUENCY STEP TYPE**

### 4.3.5 Frequency Step

Frequency step sets the size of each step when the 'LEFT/RIGHT' arrow keys are used to raise or lower the frequency. For the selective level meter (SLM) this changes the frequency of the SLM. For the impedance meter, frequency response analyzer and VSWR meter, the 'LEFT/RIGHT' arrow keys change the frequency of the signal generator. (Note: In the oscilloscope mode, the LEFT/RIGHT arrow keys change the time base.)

### 4.3.6 Bandwidth

Bandwidth has six options: wide, 3.1 kHz, 1.95 kHz, 600 Hz, 100 Hz, and 25 Hz. These set the input bandwidth for the different meters. The screen in Figure 4.3.6-1 appears when this function is selected.

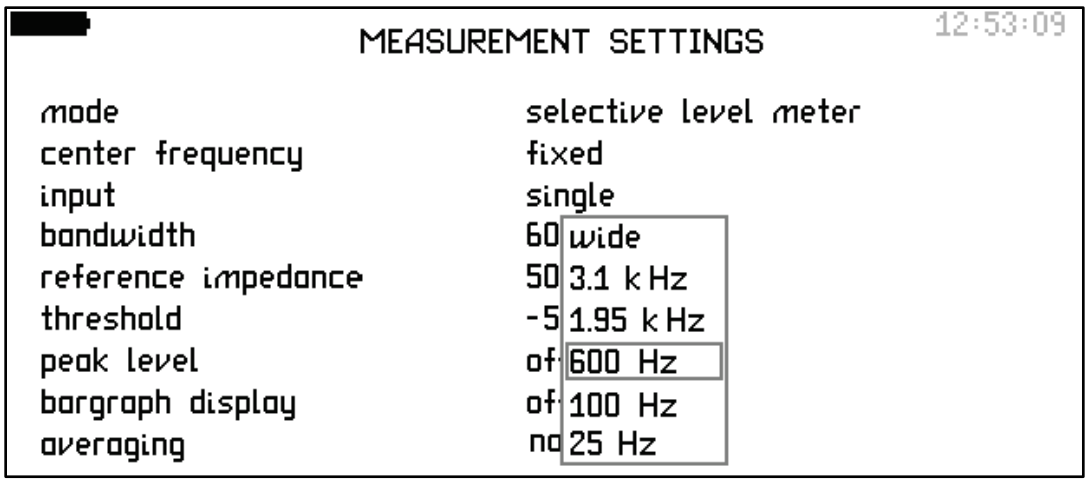



**FIGURE 4.3.6-1 - BANDWIDTH OPTIONS**

### 4.3.7 Reference Impedance

Reference impedance has four options: 50 Ω, 75 Ω, 135 Ω and 600 Ω. These options set the internal reference impedance that the selective level meter uses when displaying decibels. The screen in Figure 4.3.7-1 appears when this function is selected.

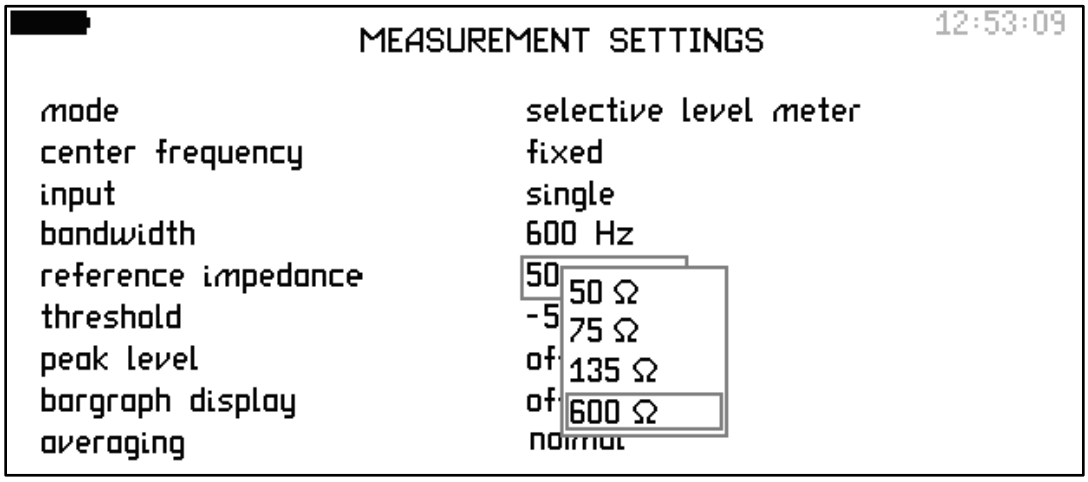



**FIGURE 4.3.7-1 - REFERENCE IMPEDANCE**

### 4.3.8 Threshold

Threshold sets the minimum voltage the instrument will read. The default setting is -50dB. The SLM meter will ignore all voltages less than the threshold setting.

### 4.3.9 Peak Level

Peak level captures the highest value of a varying input signal.

### 4.3.10 Bargraph Display

Bargraph display has two options: on or off. Turning the *bargraph display* on adds a bargraph to the selective level meter's screen and two more options to the measurement settings screen: bargraph maximum and bargraph minimum. Figure 4.3.10-1 displays these options.

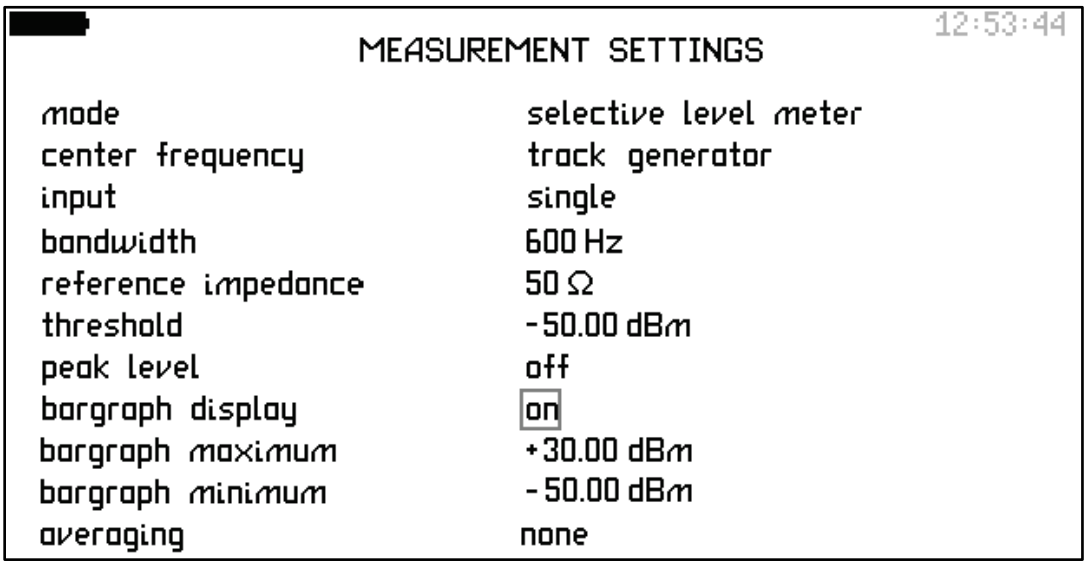



**FIGURE 4.3.10-1 BARGRAPH DISPLAY**

### 4.3.11 Averaging

Averaging has three options: normal, slow and none. Use the 'slow' option for erratic signals. Use 'none' for quicker screen update times. The screen in Figure 4.3.11-1 appears when this function is selected.

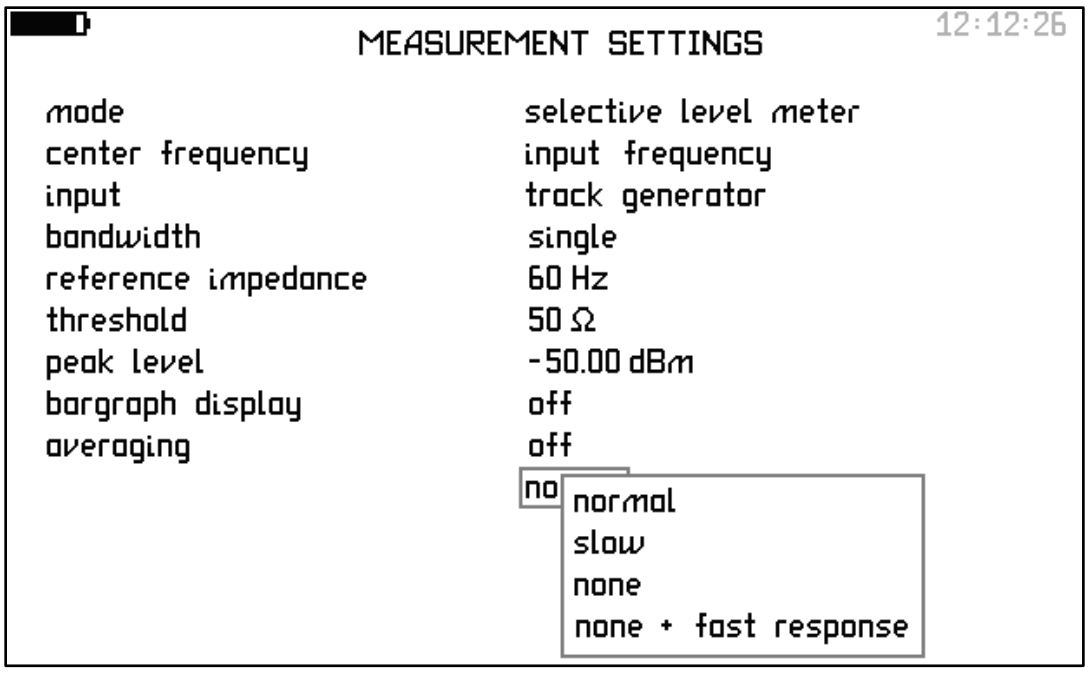



**FIGURE 4.3.11-1 – AVERAGING OPTIONS**

## 4.4 SWEEP > Sweep Settings

The sweep works in SLM, IMP, FRA, and VSWR modes. In VSWR mode, the sweep function only works with the impedance method. The general sweep functions are presented below. More information on the sweep function is provided in Section 5 of the manual. The screen in Figure 4.4-1 appears when this function is selected.

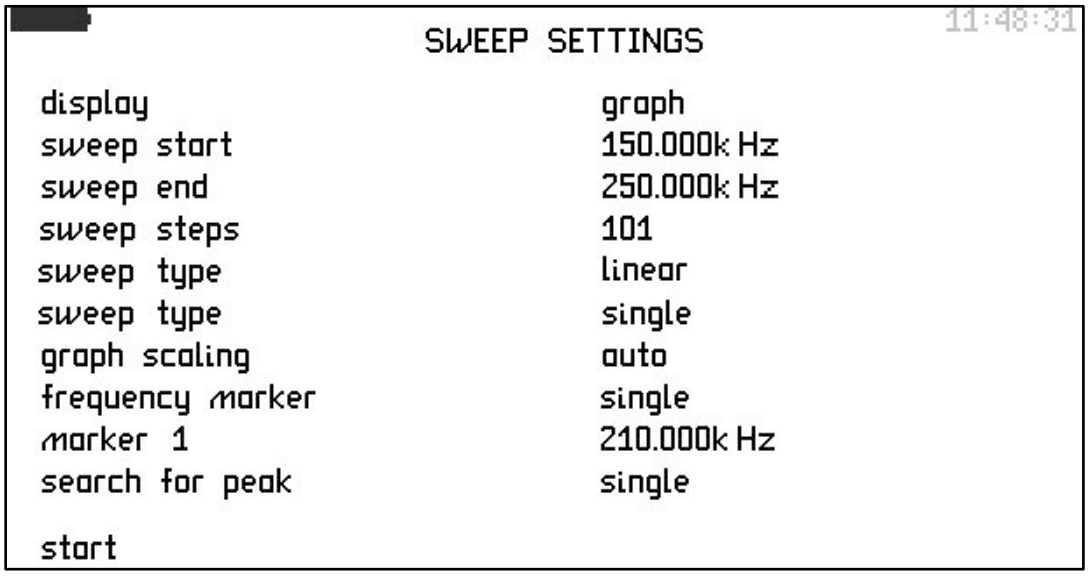



**FIGURE 4.4-1 – SWEEP SETTINGS**

### 4.4.1 Display

Display has three options: real time, table, and graph. Sweeping a range of frequencies stores each step into a table. This information may be displayed as either a table or a graph. After a sweep is completed, the display may be changed between real time, table, or graph by pressing the appropriate meter key. This information may be saved via the 'PROG' key either internally or on a memory stick. The screen in Figure 4.4.1-1 appears when this function is selected.

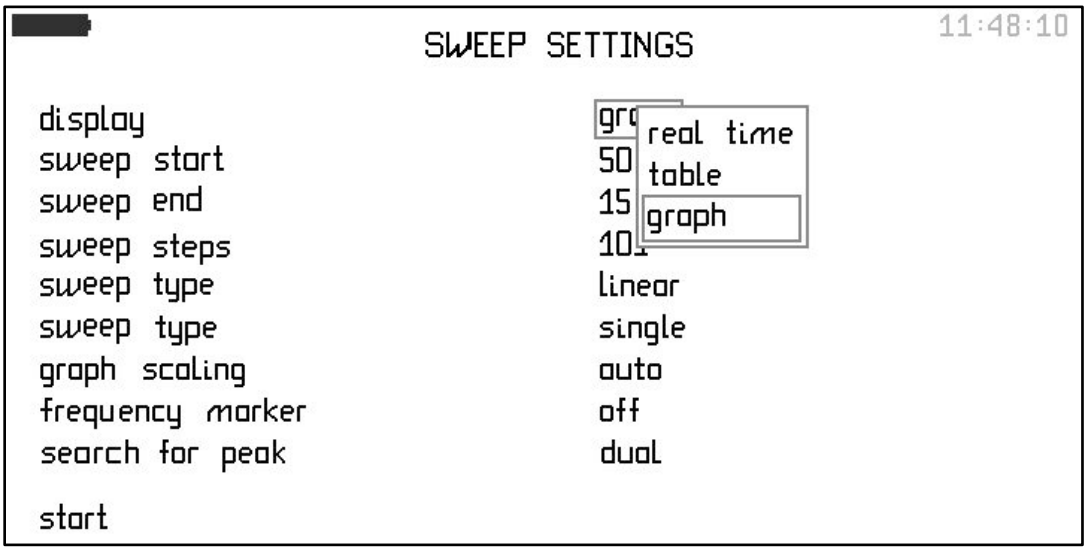



**FIGURE 4.4.1-1– DISPLAY OPTIONS**

### 4.4.2 Sweep Start, Sweep End and Sweep Steps

The frequency range to sweep across is set with these functions. Sweep steps determine how often the meter takes a reading. Maximum steps are 2000.

### 4.4.3 Sweep Type

*Sweep type* is displayed twice as there are two different settings: 'linear/ logarithmic' and 'single/continuous'. The example below uses linear steps and single sweep. For logarithmic steps, each step is larger than the previous step. For more information see Section 5.3.

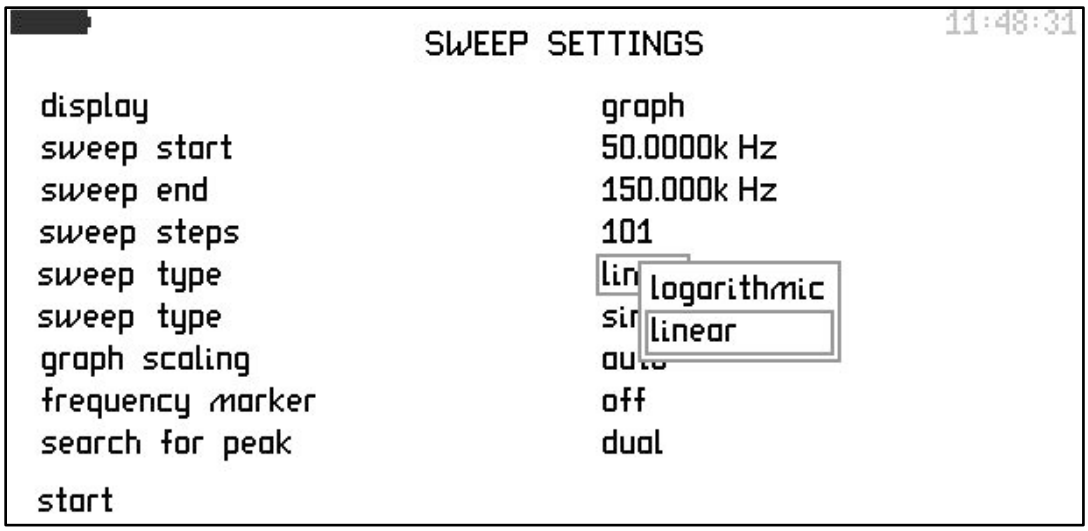



**FIGURE 4.4.3-1 SWEEP TYPE**

The user needs to calculate the number of steps (linear) between sweep start and sweep stop. To sweep from 100 kHz to 200 kHz in 1 kHz steps, start by subtracting 100 kHz from 200 kHz. This gives the difference of 100 kHz. Set the number of steps for 100 plus one or 101. This sets each step 1 kHz apart. The 'continuous' sweep mode repeats the sweep until the user presses the 'HOME/ESC' key. This key stops the sweep.

### 4.4.4 Graph Scaling, Graph Maximum and Graph Minimum

*Graph scaling* has two options, auto and manual. In most cases auto scaling will work. When a special graph scale is needed then the manual mode may be selected and the desired scaling can be set. The screen in Figure 4.4.4-1 appears when graph scaling is selected.

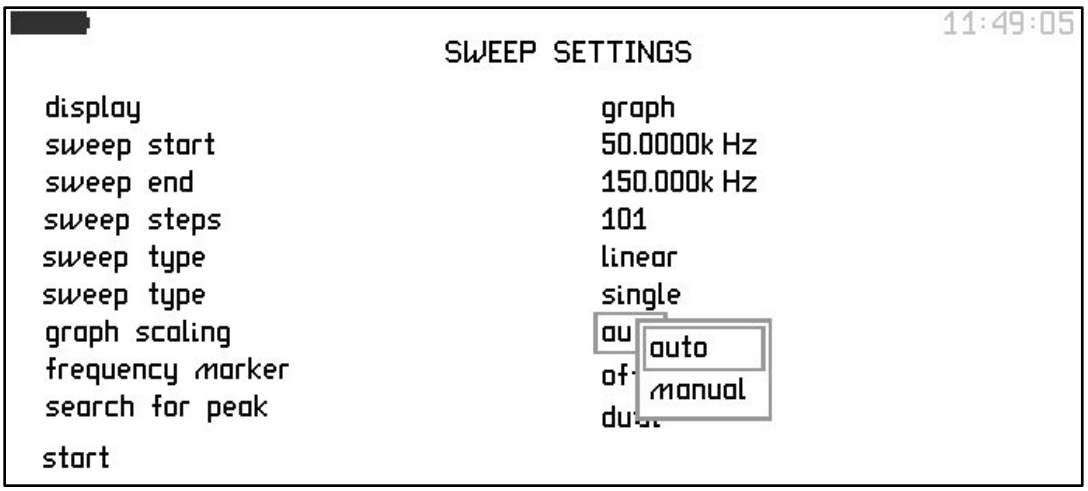



**FIGURE 4.4.4-1 – GRAPH SCALING**

The screen in Figure 4.4.4-2 appears when 'manual' is selected for graph scaling.

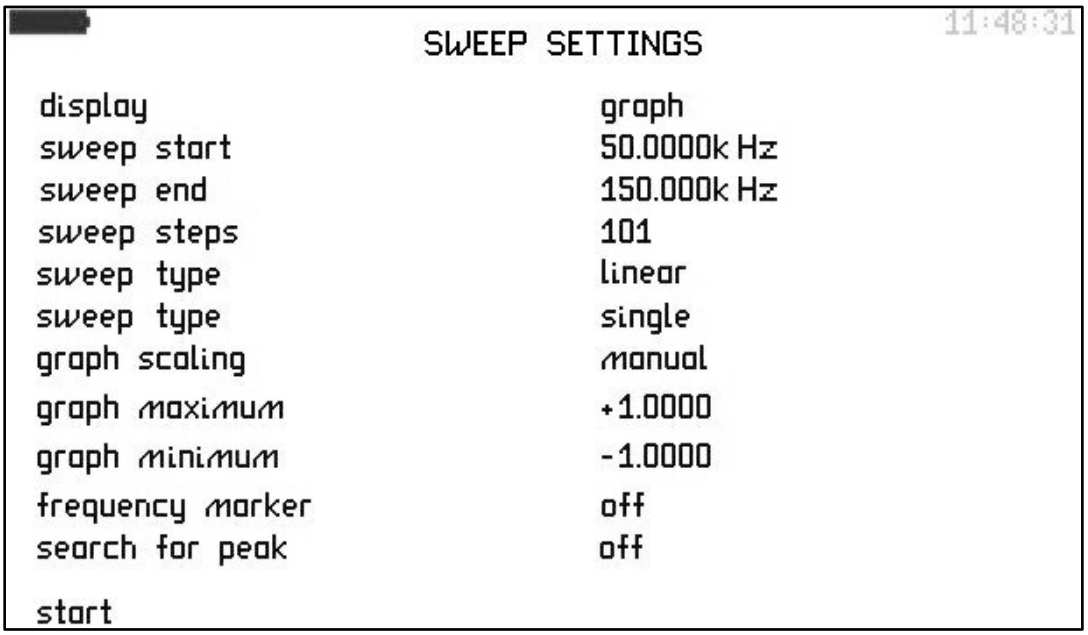



**FIGURE 4.4.4-2 – GRAPH SCALING MANUAL**

### 4.4.5 Frequency Marker

*Frequency Marker* has three options: off, single, or dual. *Off* turns off the marker function. *Single* allows the user to set one specific frequency marker (i.e. tuned frequency of a line trap) in the sweep mode and it draws a vertical line on the graph at that frequency allowing the user to determine how close the measured impedance is to the desired impedance. *Dual* allows the user to set two specific frequency markers

in the sweep mode and it draws two vertical lines on the graph at those frequencies allowing the user to determine how close the measured impedance is to the desired impedance. The screen in Figure 4.4.5-1 appears when this function is selected. The screen in Figure 4.4.5-2 displays a sweep with this option set to 'dual'.

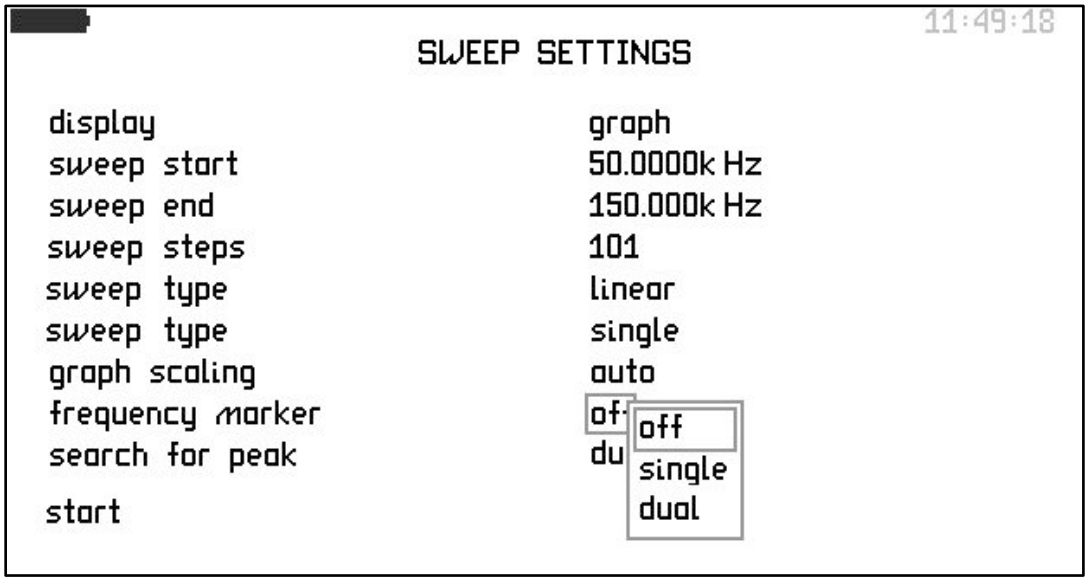



**FIGURE 4.4.5-1 – SWEEP SETTINGS FREQUENCY MARKER**

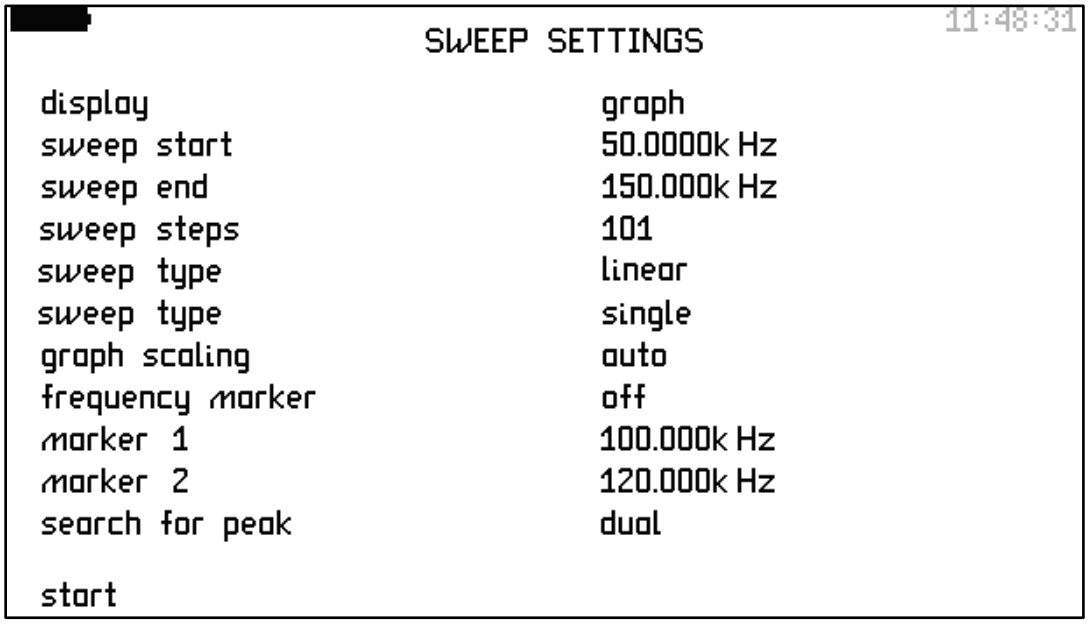



**FIGURE 4.4.5-2 – FREQUENCY MARKER ON**

### 4.4.6 Search for Peak

*Search for peak* has three options: off, single, or dual. *Off* turns this function off. *Single* draws a vertical line at the peak measured impedance and displays the frequency and impedance of the peak. *Dual* draws two vertical lines at the peak measured impedances and displays the frequency and impedance of each peak. Dual only works with the impedance meter. Figure 4.4.6-1 displays this function.

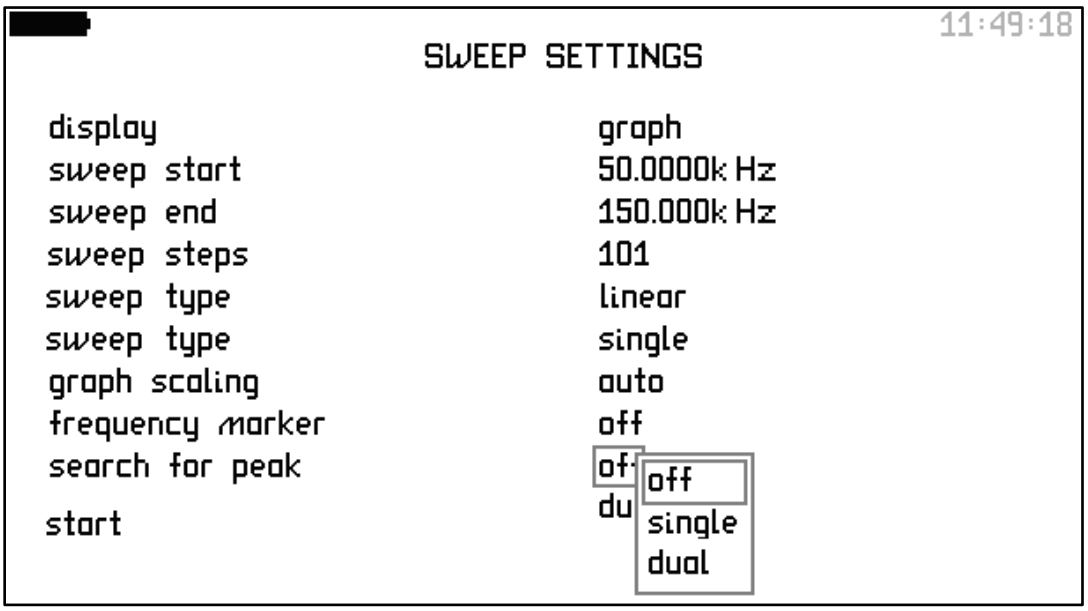



**FIGURE 4.4.6-1 – SWEEP SETTINGS MARKER ON AND SEARCH FOR PEAK ON**

### 4.4.7 Start

The 'start' function starts the sweep.

## 4.5 TUNE

Tune Settings allows the user to directly set either the generator frequency or any of the other meters frequency. The SLM meter has both options as the IMP, FRA, and VSWR meters offer only one option to set the frequency. The screen in Figure 4.5-1 appears when this function is selected.

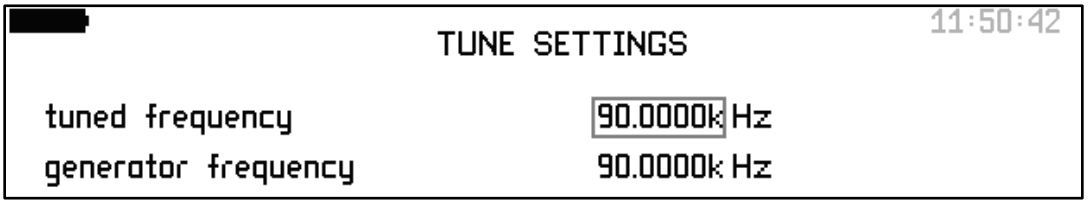



**FIGURE 4.5-1 – TUNE SETTINGS**

## 4.6 ZERO

Zero has two options; 0 dB Reference in the SLM mode and Zero Compensation in the Impedance mode. 0 dB reference is available when the meter is in the SLM mode. Zero Compensation is available when the meter is in the impedance mode. The screen that appears depends on the active meter mode that is selected.

### 4.6.1 0 dB Reference

0 dB reference has two options: set present measurement as 0 dB reference and enter a specific number as a reference dB. When 0 dB reference is selected, the *set present measurement as 0dB reference* option takes the current reading and makes it the 0dB reference. When *zero reference* is selected the user enters a fixed dB level for the active input. The screen in Figure 4.6.1-1 appears when this function is selected.

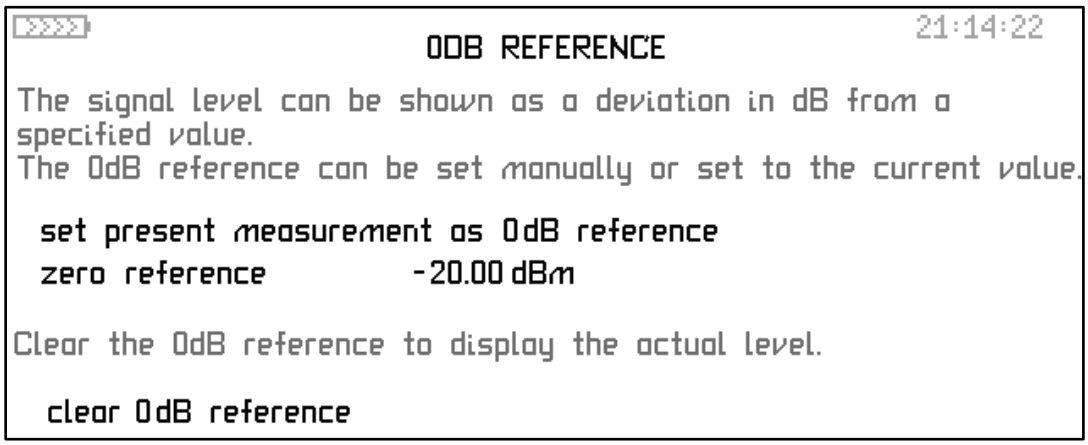



**FIGURE 4.6.1-1 – 0DB REFERENCE**

### 4.6.2 Zero Compensation

Zero compensation is used to remove the capacitance of test leads from the measured impedance. This option only works with the impedance meter. The screen in Figure 4.6.2-1 appears when this function is selected. The word “DUT” in Figure 4.6.2-1 stands for ‘Device Under Test’. Be sure to clear compensation before doing further testing.

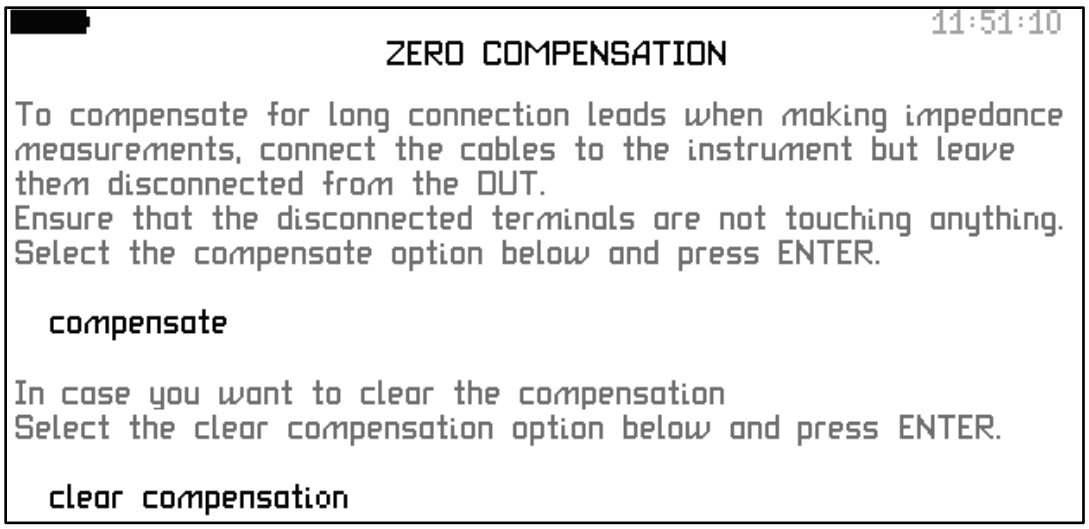



**FIGURE 4.6.2-1 – ZERO COMPENSATION**

## 4.7 AUX > Auxiliary Port Settings

This option is for future applications and is not functional at this time. The screen in Figure 4.7-1 appears when this function is selected.

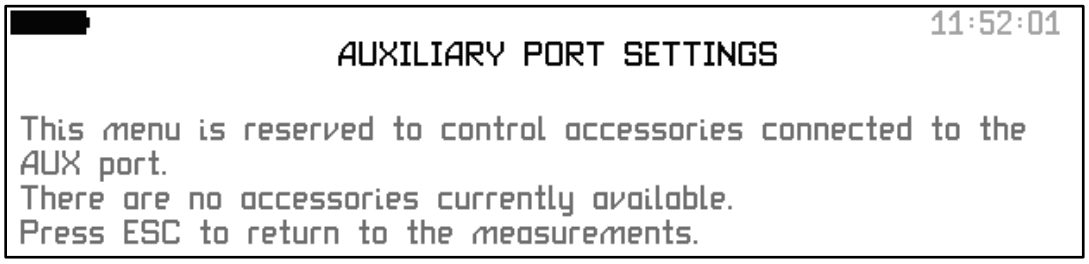



**FIGURE 4.7-1 - AUXILIARY PORT SETTINGS**

## 4.8 REMOTE > Remote Settings

This option is used to communicate with the PCA-4125 and allows the user to do a screen capture direct to the USB memory stick. Remote settings have four options: resolution, interface, baud rate and screen print to USB drive. Baud rate only appears when the RS-232 port is selected. An I.P. address appears when the LAN port is selected. USB is self-connecting and only requires the user to tell the program in the computer which COM port the USB is connected to. The screen in Figure 4.8-1 appears when this function is selected.

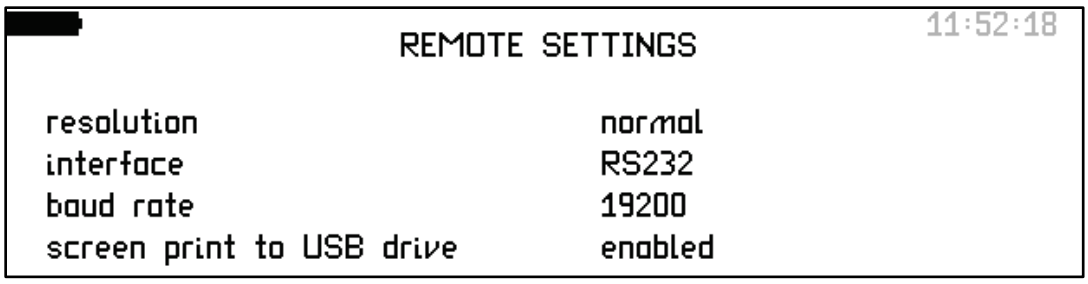



**FIGURE 4.8-1 – REMOTE SETTINGS – RS-232 PORT**

### 4.8.1 Resolution

Resolution has two options: normal and high. Normal resolution stores the data as a 5 digit number. High resolution stores the data as a six digit number. The screen in Figure 4.8.1-1 appears when this function is selected.

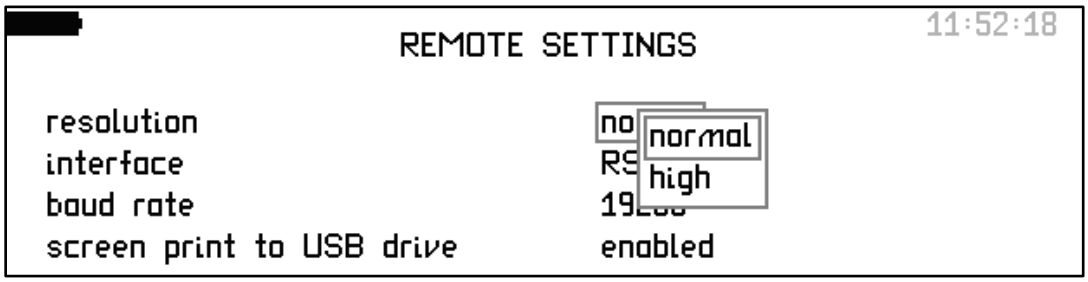



**FIGURE 4.8.1-1 –RESOLUTION**

### 4.8.2 Interface

Interface has three options: RS232, USB and LAN. The screen in Figure 4.8.2-1 appears when this function is selected.

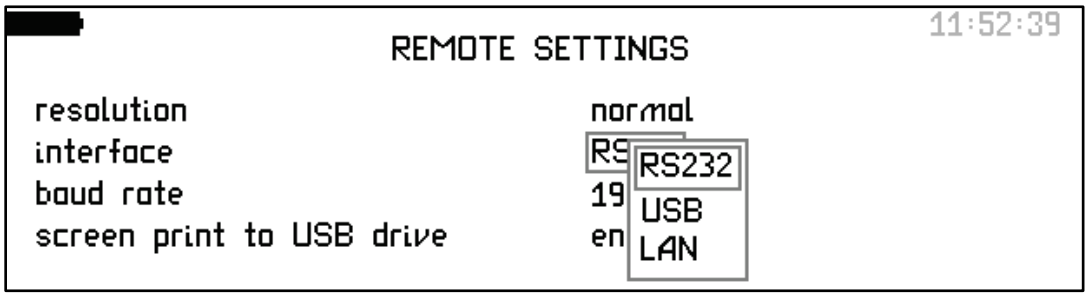



**FIGURE 4.8.2-1 –INTERFACE**

### 4.8.3 Baud Rate

Baud rate has four settings: 38400, 19200, 9600, and 1200. The screen in Figure 4.8.3-1 appears when this function is selected.

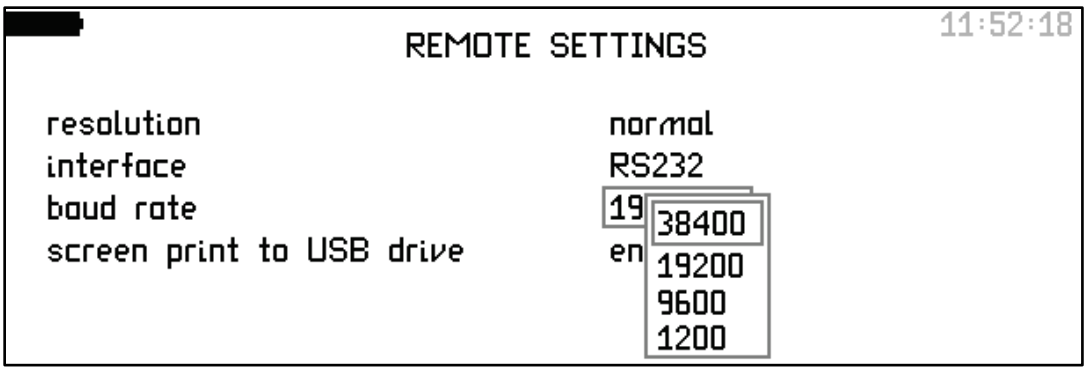



**FIGURE 4.8.3-1 – BAUD RATE**

### 4.8.4 USB Option

The USB option activates the Type B connector at the bottom of the meter. The screen in Figure 4.8.4-1 appears when the USB option is selected.

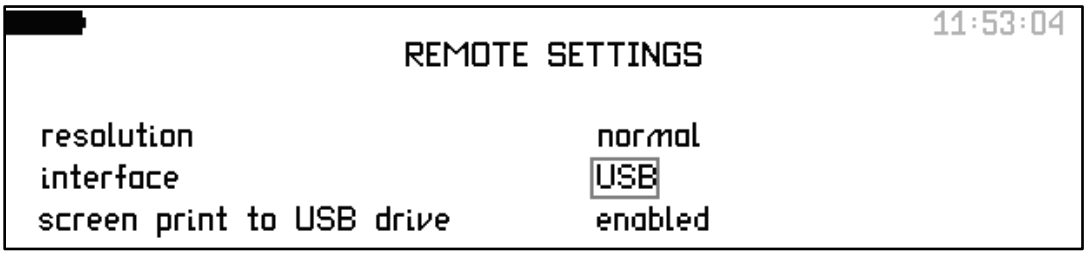



**FIGURE 4.8.4-1 – USB OPTION**

### 4.8.5 LAN Option

The LAN option activates the LAN connector at the bottom of the meter. The screen in Figure 4.8.5-1 appears when the LAN option is selected.

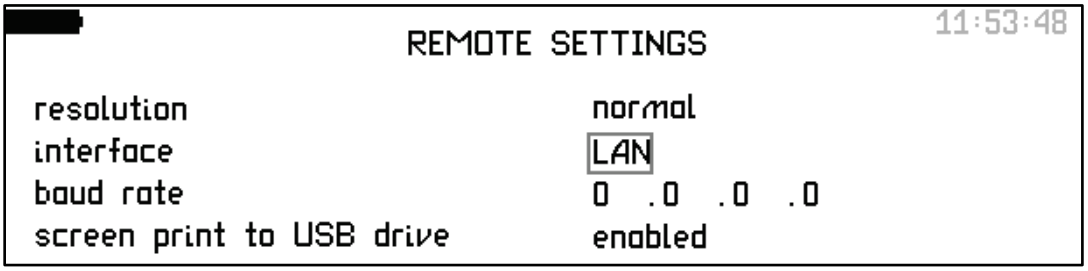



**FIGURE 4.8.5-1 – LAN OPTIONS**

### 4.8.6 Screen Print to USB Drive

The screen print to USB drive option saves the display to the USB drive. Once the option is enabled and a USB drive is recognized by the instrument, than the

"ENTER" is used to save the display to the USB drive as a 'PCS_0001.bmp' file. Holding the "ENTER" key down for approximately two (2) seconds saves the display to the USB drive. The instrument will automatically change the last four digits of the file name as long as the USB memory stick is not removed.

## 4.9 MONITOR > Monitor Settings

This option is for future applications and is not functional at this time. The screen in Figure 4.9-1 appears when this function is selected.

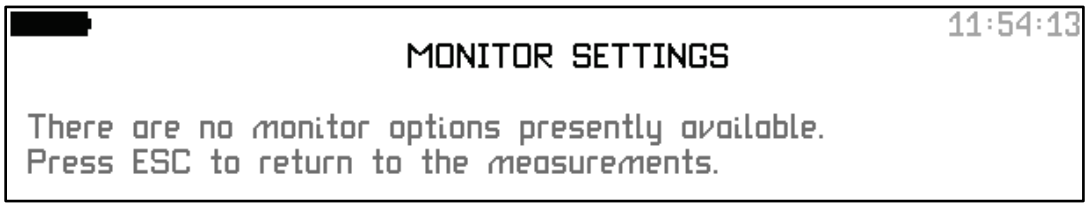



**FIGURE 4.9-1 – MONITOR SETTINGS**

## 4.10 SYSTEM – System Options

System Options has nine functions in the left column. These functions are: initial settings, set clock, set date, display, brightness, enlarge results, phase convention, keyboard beep, and step message. The screen in Figure 4.10-1 appears when this function is selected. The left and right arrow keys will bring up two other menus: User Settings and PCA-4125 data screen discussed below.

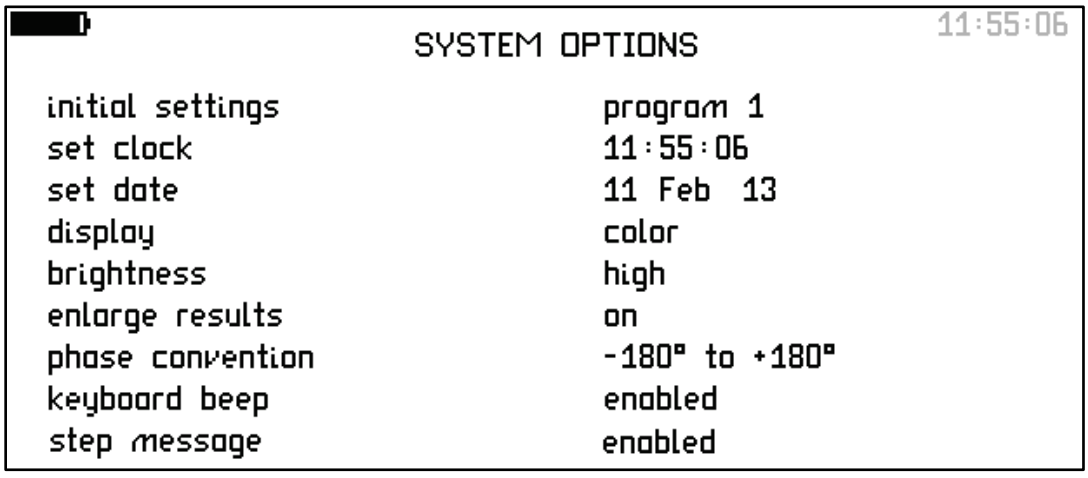



**FIGURE 4.10-1 – SYSTEM OPTIONS**

### 4.10.1 Initial Settings

*Initial Settings* has three options: program 1, factory default, and as last used. Program 1 is the default setting. Whatever instrument setup is stored in program 1 (see *program* key) is loaded into the PCA-4125 upon power-up. Factory default is the setup that the instrument came with from the factory. The as last used option is just what it says. Selecting this option allows the user to turn off the PCA-4125 to save battery power and when you turn it back on, the PCA-4125 loads the last setup that was used at the time it was turned off. The screen in 4.10.1-1 appears when this option is selected.

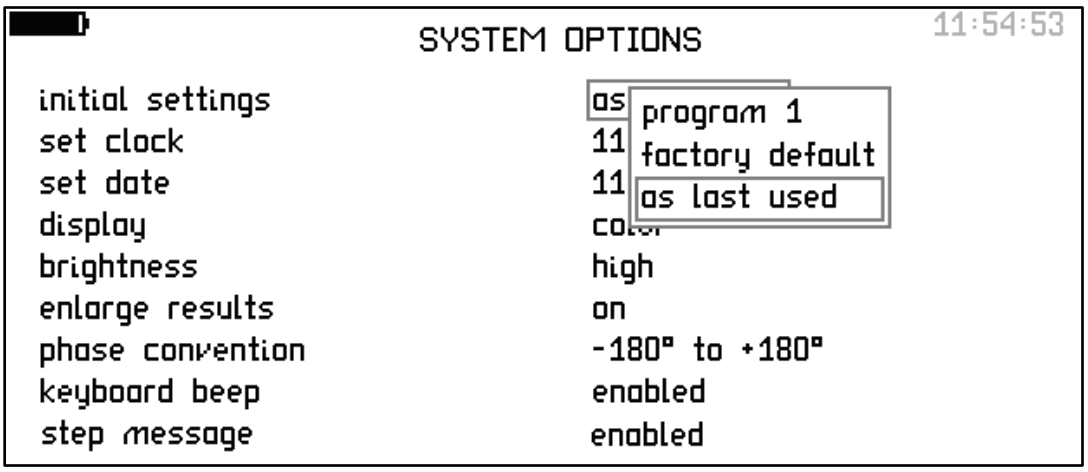



**FIGURE 4.10.1-1 – INITIAL SETTINGS**

### 4.10.2 Set Clock

This option sets the time on the clock. Use the UP/DOWN arrow keys to highlight hours, minutes, or seconds, and the LEFT/RIGHT arrow keys to change the time.

### 4.10.3 Set Date

This option sets the date. Use the UP/DOWN arrow keys to highlight the month, day, or year, and the LEFT/RIGHT arrow keys to change the date.

### 4.10.4 Display

Display has three options: color, white on black and black on white. The white on black is easy to see when the instrument is used outside. Due to shielding in the glass of the display, glare does occur in direct sunlight. The screen in Figure 4.10.4-1 appears when this function is selected.

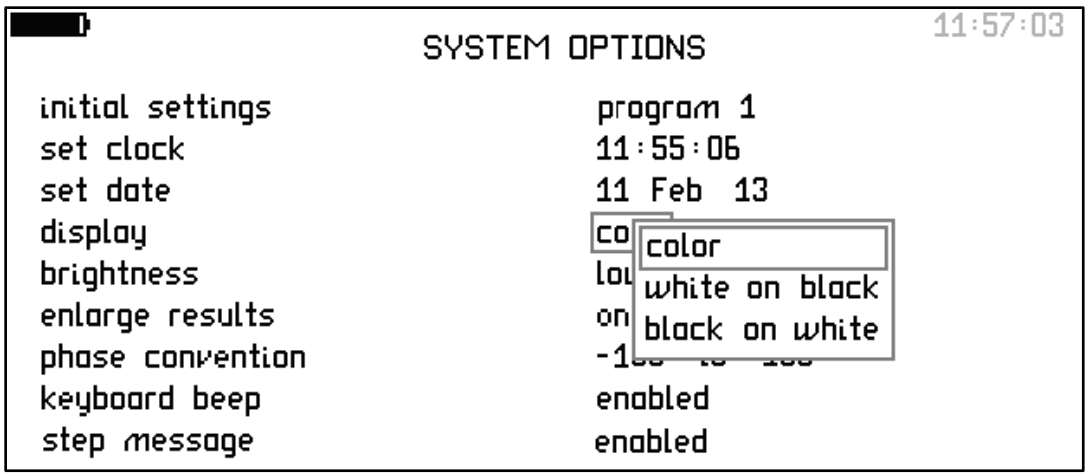



**FIGURE 4.10.4-1 – DISPLAY OPTIONS**

### 4.10.5 Brightness

The instrument's display has two levels of illumination, low and high. The default setting is 'low' to conserve battery power. This option works best in the 'color' or 'white on black' mode and makes the display easier to see outside. Figure 4.10.5-1 appears when this option is selected.

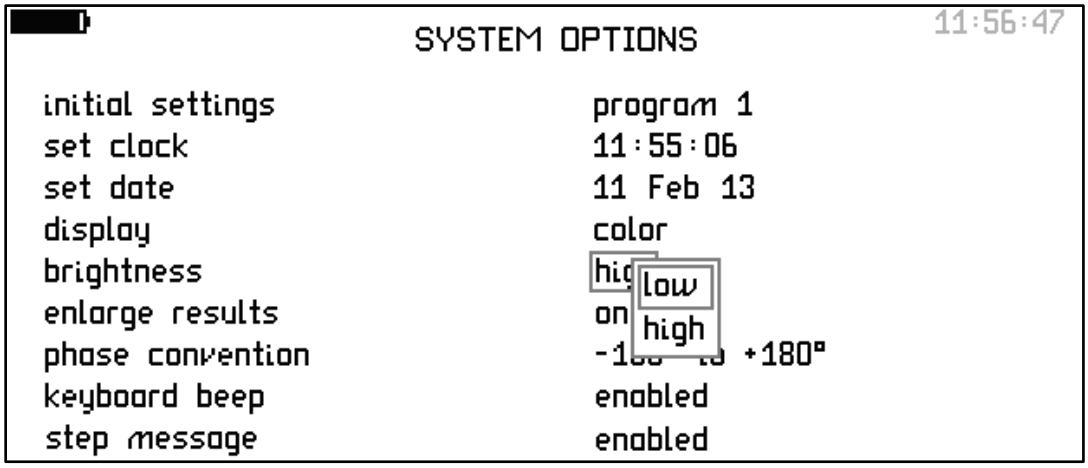



**FIGURE 4.10.5-1 – BRIGHTNESS**

### 4.10.6 Enlarge Results

Enlarge results changes the size of the text/numbers on the display. Each meter is different. The SLM meter changes volts and dBm. The impedance meter changes impedance. The VSWR meter changes percent reflected power. The FRA meter changes the gain.

### 4.10.7 Phase Convention

The impedance meter displays the phase angle between the signal generator's current and the measured voltage at the input. This phase angle may be displayed three different ways: -180° to +180°, 0° to -360° or 0° to +360°. The screen in Figure 4.10.7-1 appears when this function is selected.

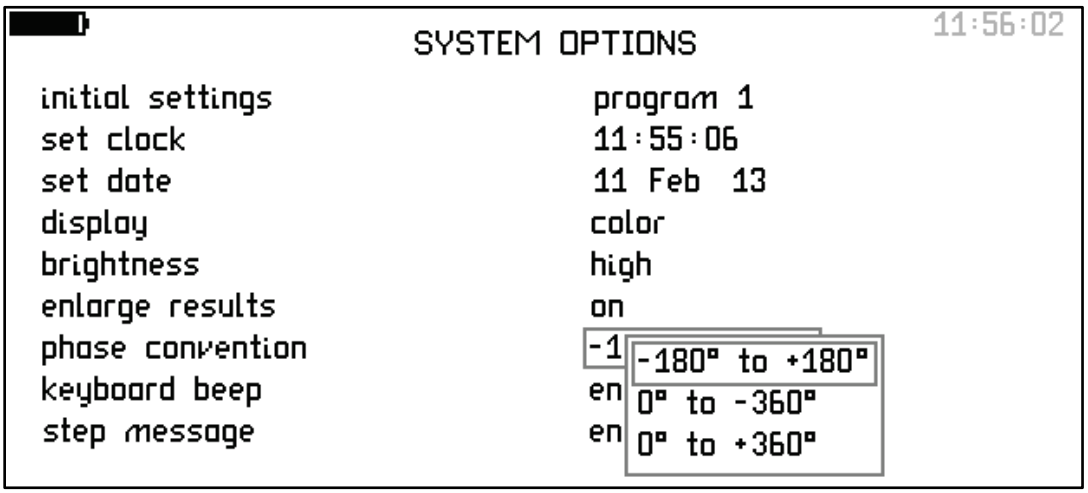



**FIGURE 4.10.7-1 – PHASE CONVENTION**

### 4.10.8 Keyboard Beep

An audible 'beep' sounds every time a key is pressed. The 'beep' may be disabled if the sound is not required.

### 4.10.9 Step Message

When stepping the frequency or amplitude up or down using the arrow keys in real time mode, a message is displayed showing the new value. The 'step message' may be disabled via the 'system option' screen.

## 4.11 USER SETTINGS

The 'USER SETTINGS' screen can be accessed by pressing the 'SYSTEM' button followed by the right arrow key. This brings up the screen in Figure 4-11.1. This option allows the user to enter three separate lines of information that are saved in the date file internally in the instrument. Figure 4-11-2 displays an example showing the station name, line name and technician name. The third 'user data' (in this case the technician name) is the same 'user data' that is displayed on the *'PROGRAM STORE/RECALL'* display screen in Figure 4.14-1. Whatever information is entered on the third "user data' line, it will appear in the 'user data' line on the Program/Recall screen as shown in Figure 4.14-1

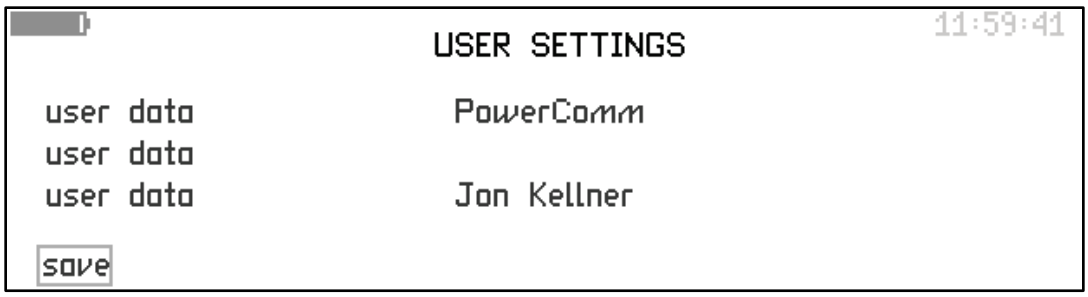



**FIGURE 4.11-1 – USER SETTINGS**

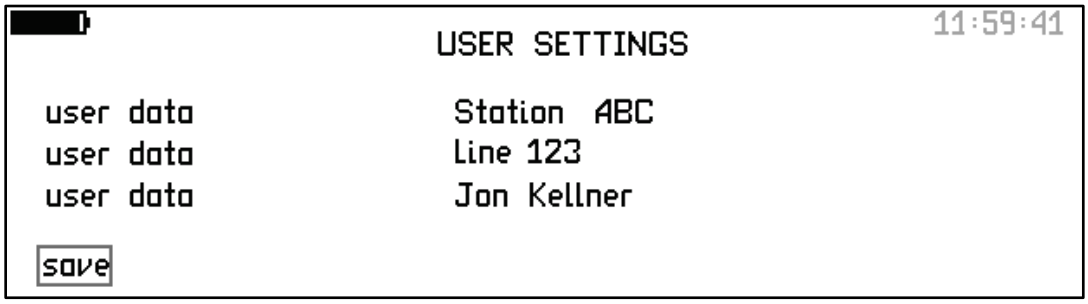



**FIGURE 4.11-2 - USER SETTINGS EXAMPLE**

## 4.12 PCA-4125 Data Screen

The PCA-4125 Data screen is accessed from the 'System Options' display. From the 'System Options' display press the 'left' arrow key to access the PCA-4125 Data screen. This screen displays the following information: serial number, impedance, manufacturing code, main release, DSP release, FPGA release, boot release, and last calibration. Figure 4.12-1 displays this screen.

This screen is for the user to determine if the instrument has the latest firmware updates and the last time the instrument was calibrated by the factory or a factory trained representative.

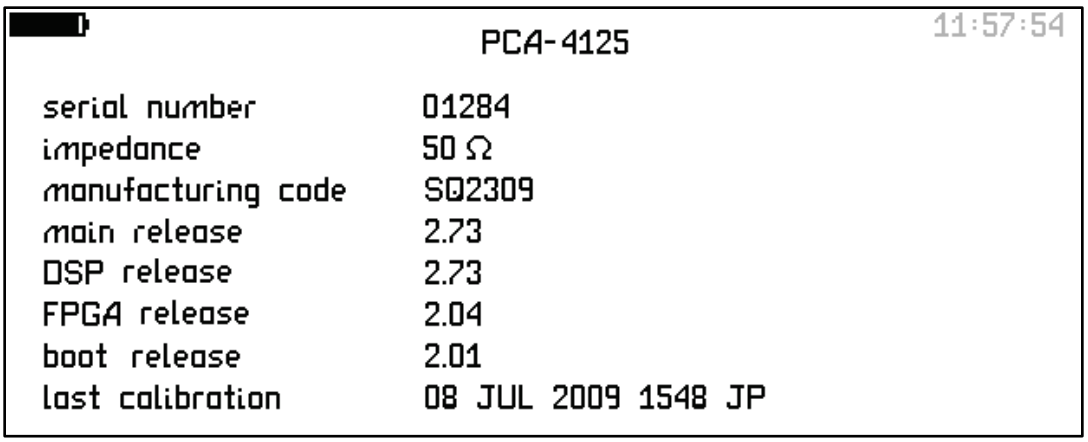



**FIGURE 4.12-1 - PCA-4125 DATA**

## 4.13 Application Selection

Application Selection allows the user to directly select different test functions. The options available are: normal, oscilloscope, capacitance, inductance, and resistance. Figure 4.13-1 displays this option.

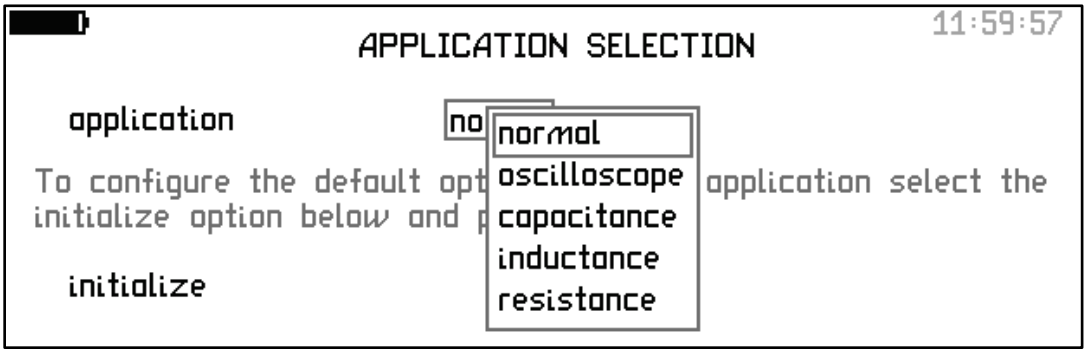



**FIGURE 4.13-1 - APPLICATION SELECTION**

Each of the instrument functions listed: oscilloscope, capacitance, inductance, and resistance require the PCA-4125 to be set up or *initialized*. Initializing any of these functions sets up the instrument to allow the initialized function to be used. After the tests are completed for that function, the PCA-4125 **must** be returned to the *normal* mode of operation to use any of the four primary instrument functions.

Section 5.7 of this manual provides a detailed explanation of the use of the PCA-4125 to test capacitors, inductors, or resistors. Section 5.6 of this manual covers the operation of the oscilloscope.

## 4.14 PROG – Program Store/Recall

Program store and recall allows the user to store and recall both meter setups and readings, internally or externally. Figure 4.14-1 displays this option. The left side of the display has the following functions: memory, file type, action, location, name, user data, and execute. The three functions: memory status, available files, and free space which appear in red towards the bottom of the display apply to the internal memory or the USB memory stick, whichever is selected. They inform the user of the memory status, how many files are available in memory, and how much memory space is still available. The last function 'Press SLM to view file directory' displays a directory of either the set ups or results stored internally or on the USB memory stick (whichever is selected).

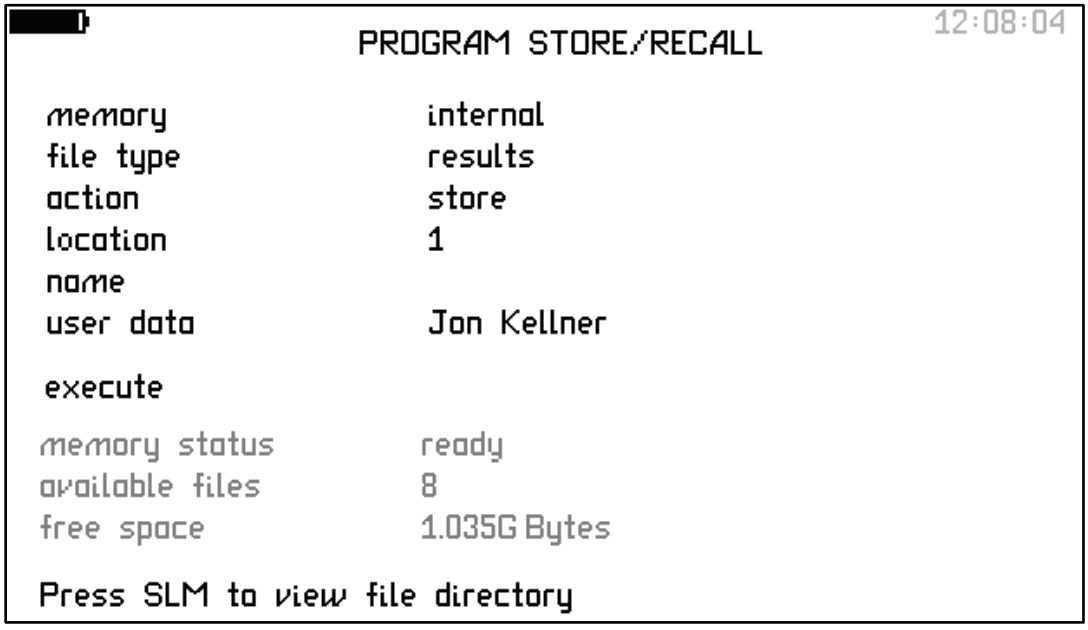



**FIGURE 4.14-1 – PROGRAM STORE/RECALL**

### 4.14.1 Memory

Memory has two options: **'**internal' and 'USB memory stick'. The instrument has one gigabyte of internal memory. Figure 4.14.1-1 displays the memory options. If a memory stick is not attached to the USB port, the 'USB memory stick' is displayed in blue. If a memory stick is attached to the USB port, the 'USB memory stick' is displayed in yellow.

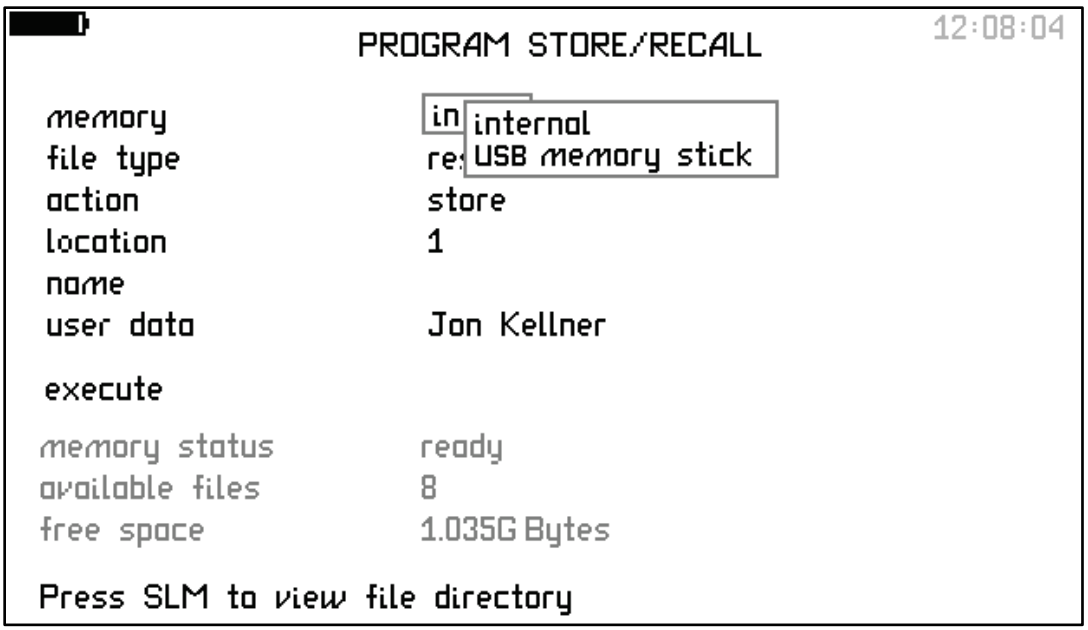



**FIGURE 4.14.1-1 – MEMORY OPTIONS**

### 4.14.2 File Type

File type has two options: 'set up' and 'results'. Set up stores the specific instrument setups that may be used to test specific equipment. Results allow the user to store results from a specific reading or a sweep. Figure 4.14.2-1 displays this option.

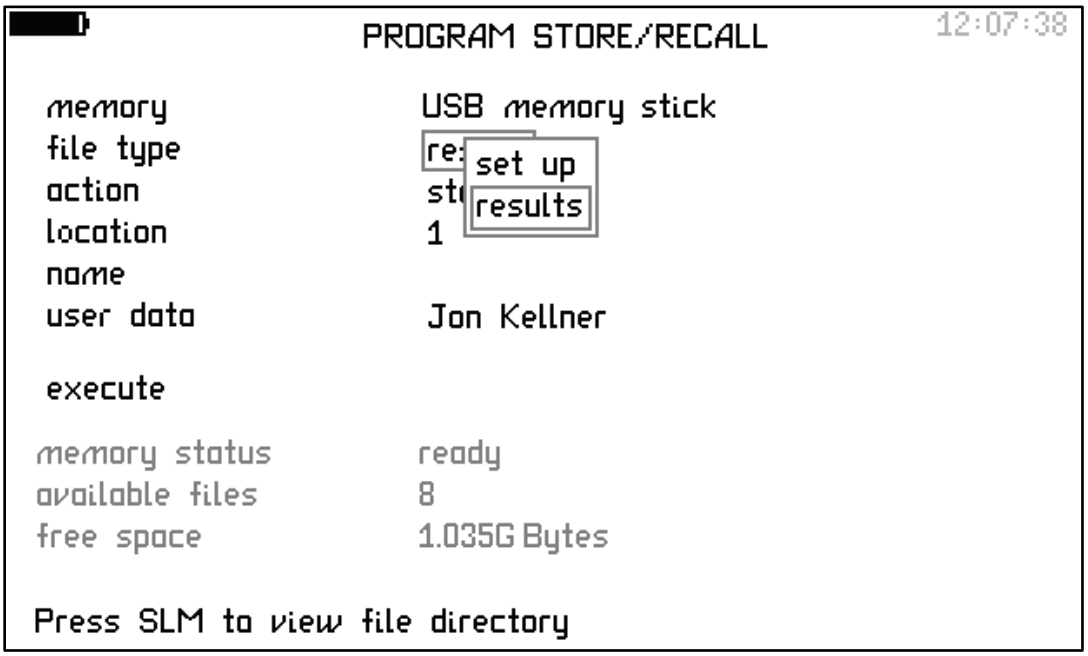



**FIGURE 4.14.2-1 – DATA OPTIONS - SETUP/RESULTS**

### 4.14.3 Action

Action has three options: recall, store and delete. The user may store up to 999 setups. Each setup must have a unique number (1-999) and may have its own name. Memory location '0' is the 'factory default' setting. The user may store up to 999 readings or sweeps. Each reading or sweep must have a unique number (1-999) and may have its own name. The 'delete' option allows the user to delete any setup or reading. Figure 4.14.3-1 displays this option.

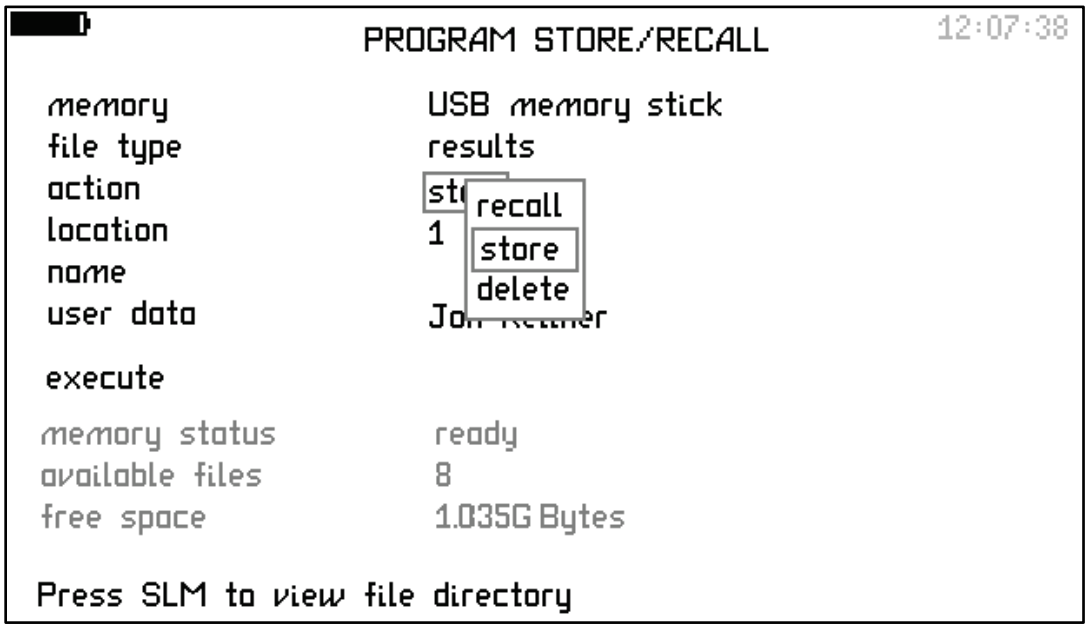



**FIGURE 4.14.3-1 – ACTION OPTIONS**

### 4.14.4 Location, Name, and User Data

The first two functions, 'location' and 'name' are used to give a file a directory number and a name. Every stored setup or reading must have a location number (from 1-999). 'Name' is optional. User data may be used to enter any information about the test. Figure 4.14.4-1 displays these options.

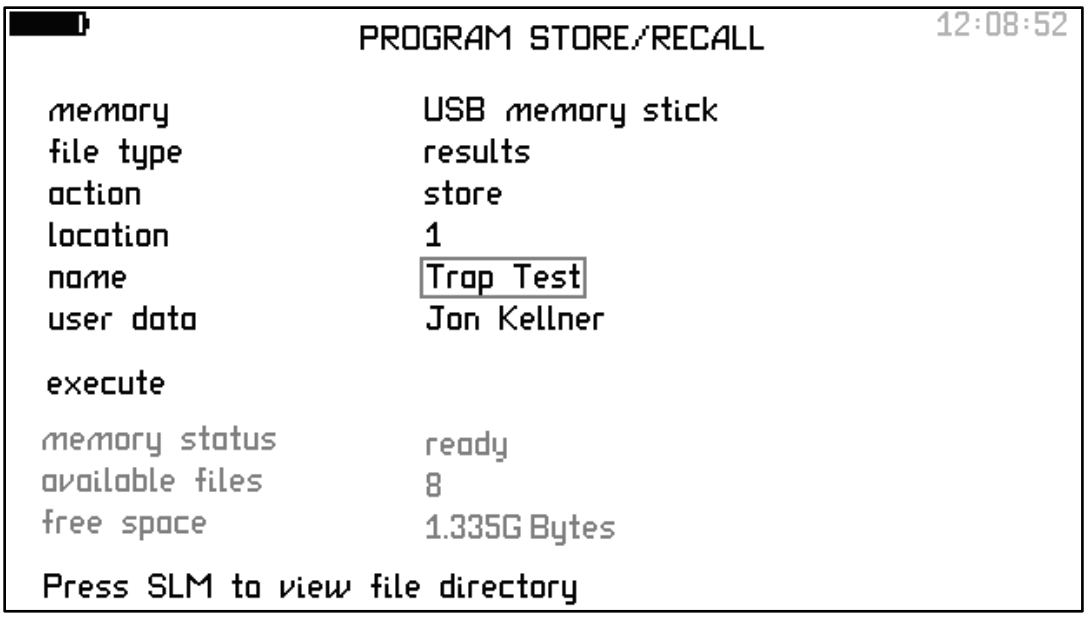



**FIGURE 4.14.4-1 – LOCATION AND NAME OPTIONS**

### 4.14.5 Execute

Highlighting 'execute' as shown in figure 4.14.5-1 and pressing the 'ENTER' key will run the desired 'action' (store, recall or delete). If the memory location number already has a result or setup stored in that location, then the option 'select here and press ENTER to overwrite' appears warning you that that location "number" already has data stored in it.

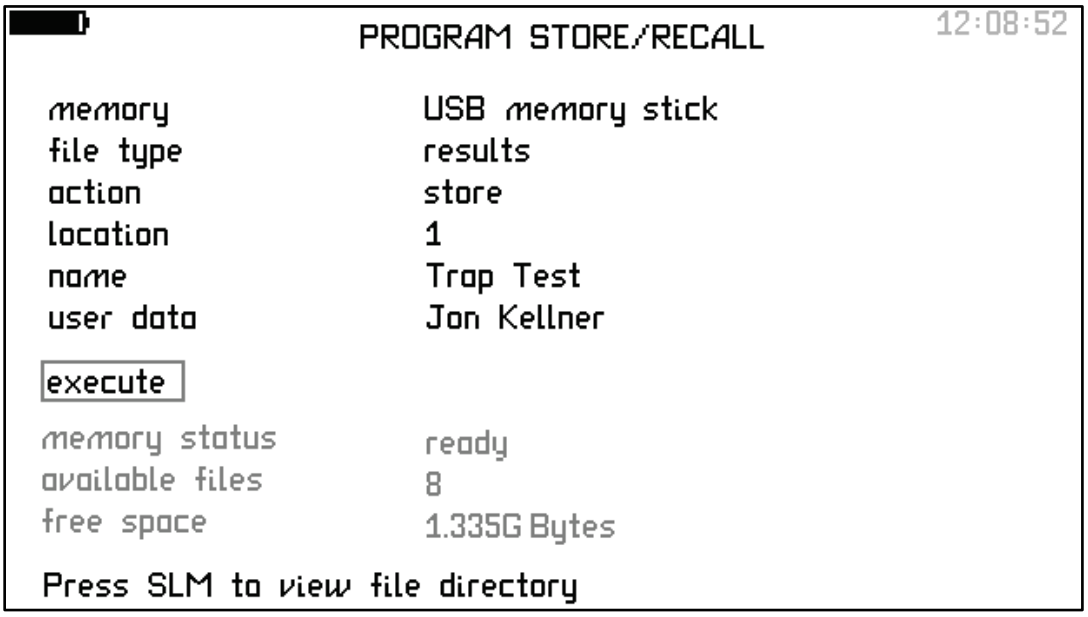



**FIGURE 4.14.5-1 – EXECUTE OPTION**

### 4.14.6 Memory Status, Available Files, and Free Space

'Memory status' monitors one of two items. It lets you know how much memory is available either internally or on the USB memory stick. The 'available files' function lets the user know how many data files are stored either internally or on the USB memory stick depending on which option is selected. 'Free space' displays how much internal memory or USB memory stick memory is available. Figure 4.14.5-1 above has the 'internal memory' option active and 132 files are displayed for 'available files'.

### 4.14.7 Press SLM to view file directory

The SLM key is used in the Program Store/Recall mode to pull up the menu for either Results or Setups for the internal memory or USB memory stick, whichever options are selected. Pressing the SLM key a second time returns to the Program Store/Recall menu. Figure 4.14.7-1 displays the Directory Menu. The files are listed in numerical order.

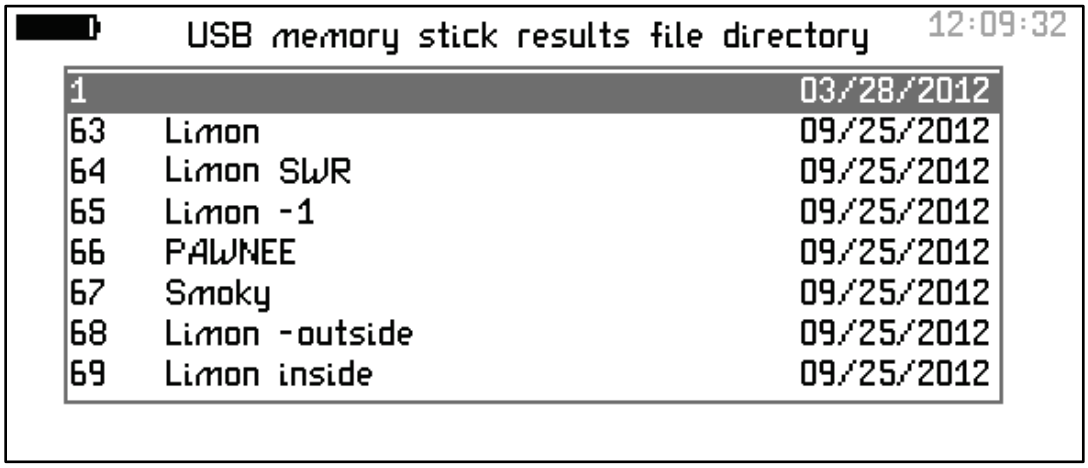



**FIGURE 4.14.7-1 – INTERNAL RESULTS FILE DIRECTORY**

## 4.15 Delete/Back

The Delete/Back key is used to delete mistakes made when entering information.

## 4.16 Enter/Next (Screen Captures)

The Enter/Next key has three functions. First it is used to enter data. For example: after changing the generator's frequency, pressing the "ENTER' key changes the frequency.

The second function is used for screen captures. During active measurements, pressing the 'ENTER' key for less than one second will freeze the instruments screen and change the time in the upper right corner from a dark blue color to a light blue color. Now this reading may be save to the internal memory or to the external USB Memory stick.

The third functions is to save the screen directly to the USB memory stick if the "Screen print to USB drive" is enabled under 'REMOTE SETTINGS' Figure 4.16-1 displays the REMOTE SETTINGS screen with Screen print to USB drive enabled.

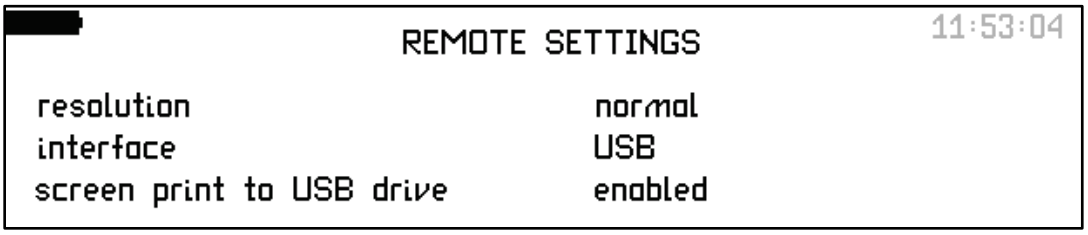



**FIGURE 4.16-1 – ENTER/NEXT KEY OPTIONS**

## 4.17 USB Memory Stick

Storing data to the memory stick creates two files. One file extension is '.pcs' and is used by the software interface communications program "PowerCommView" provided by PowerComm Solutions. The other file is a comma delimited text file with the '.txt' extension. Full information is provided in the appendix on this file format.

# *CHAPTER 5 - Instruments*

The PCA-4125 is a multi-function microprocessor based instrument. The following is a list of the instrument functions the PCA-4125 may be used for:

- Signal Generator
- Selective Level Meter
- Impedance Meter
- Frequency Response Analyzer
- Standing Wave Ratio Meter
- Oscilloscope
- Bit Error Rate (BER)
- Capacitance Meter
- Inductance Meter
- Ohmmeter

Chapter 5 explains how to use each of these instruments. Each function has its own section in Chapter 5 except for the capacitance, inductance and ohm meters. They are combined into Section 5.7.

## 5.1 Signal Generator (OUTPUT Key)

The signal generator is a Direct Digital Synthesis (DDS) frequency generator. The frequency range is from 5Hz to 5MHz. The signal generator's low level output is capable of putting out 0.2 watts into a 50 ohm load. ***The signal generator's low level output must be used to take any impedance measurement.*** The high level output is rated 2 watts into a 50 ohm load. It may be used independent of the other instruments that are components of the PCA-4125 or in conjunction with them. The signal generator screen is displayed in Figure 5.1-1. Press the 'OUTPUT' key to activate the screen.

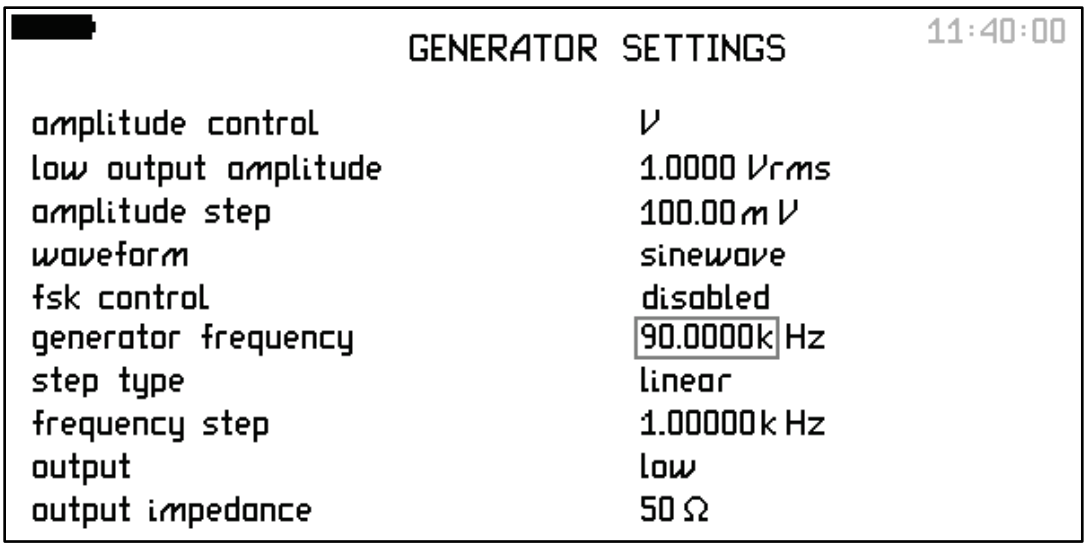



**FIGURE 5.1-1 GENERATOR SETTINGS DEFAULT SCREEN**

The left side of the screen has the following functions: amplitude control, low output amplitude, high output amplitude, amplitude step, waveform, fsk control, generator frequency, step type, frequency step and output. The list of options on the left will change when some options in the right column are selected.

### 5.1.1 Amplitude Control

Amplitude control has two options: V or dBm. This setting controls how 'amplitude control' and 'amplitude step' are displayed on the settings screen. Amplitude control is displayed in either volts or dBm. Figure 5.1-1 above displays the volts option. Figure 5.1.2-1 displays the dBm option.

### 5.1.2 Reference Impedance

Changing from V to dBm adds the reference impedance option. Leaving the reference impedance on 'auto' allows the instrument to select how dBm is displayed based on the generators output impedance. The reference impedance can be set manually to 50Ω, 75Ω or 600Ω.

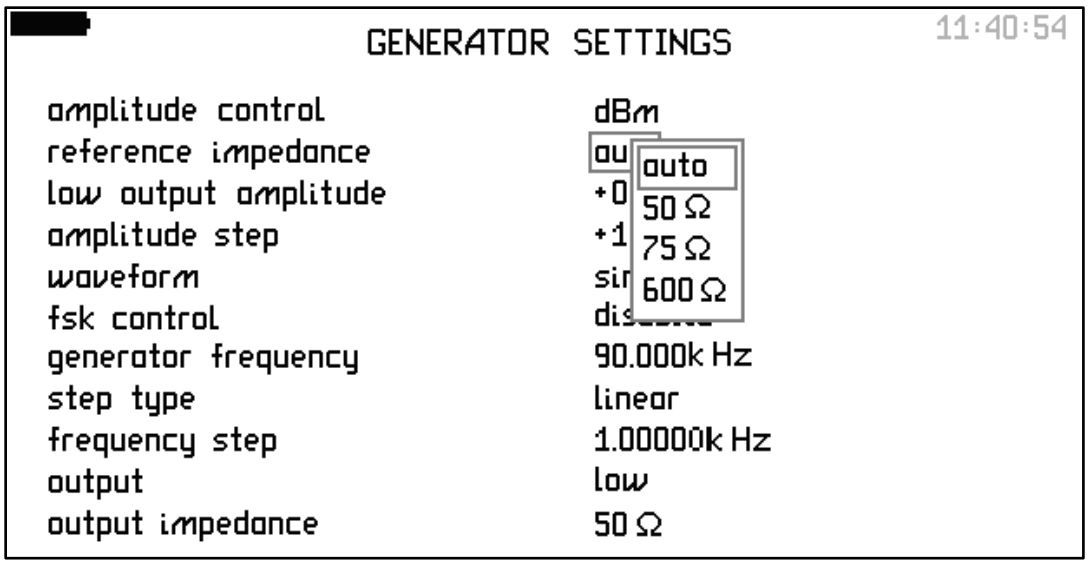



**FIGURE 5.1.2-1 REFERENCE IMPEDANCE**

### 5.1.3 Low Output Amplitude

Low output amplitude sets the output level of the signal generator when the low output is active.

### 5.1.4 High Output Amplitude

High output amplitude sets the output level of the signal generator when the high output is active.

### 5.1.5 Amplitude Step

Amplitude step is set in either volts times the step value or dBm times the step value. The amplitude steps can be set as small as one millivolt or 0.001 dBm. The 'UP/DOWN' arrow keys adjust the amplitude of the signal generator.

### 5.1.6 Waveform

The signal generator can generate four different waveforms: sinewave, triangle, squarewave, and white noise. The use of the different waveforms is dependent on the user's needs. The sinewave is used for all power line carrier testing. Figure 5.1.5-1 displays these options.

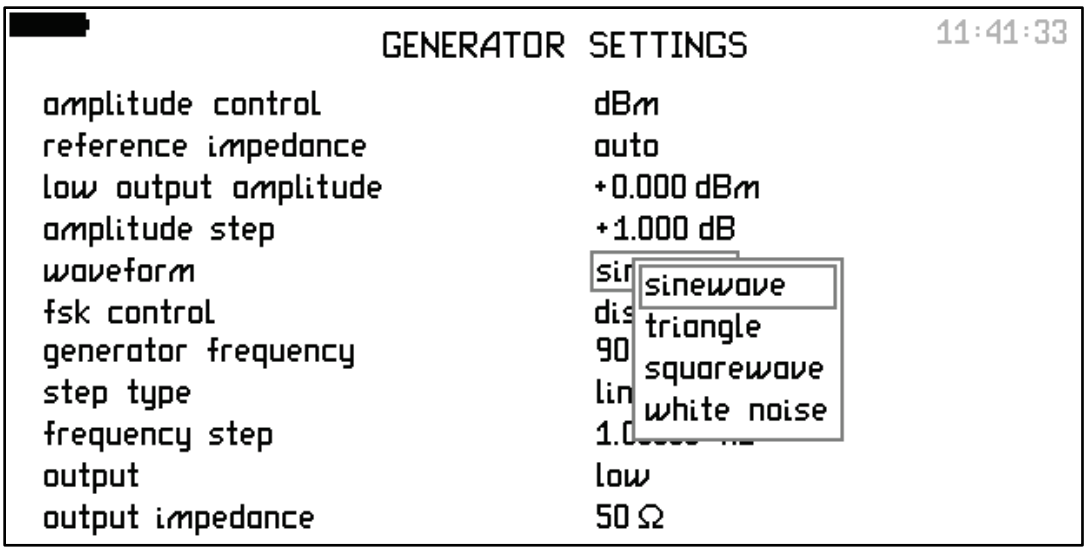



**FIGURE 5.1.6-1 - WAVEFORMS**

### 5.1.7 FSK Control

Enabling FSK Control changes the functions available to the generator. The functions are: FSK Mode, Frequency 0, Frequency 1, and FSK Timer. FSK Control is used to check the operation of Guard before Trip timers and other "Loss of Signal" timers. Figure 5.1.6-1 displays these options.

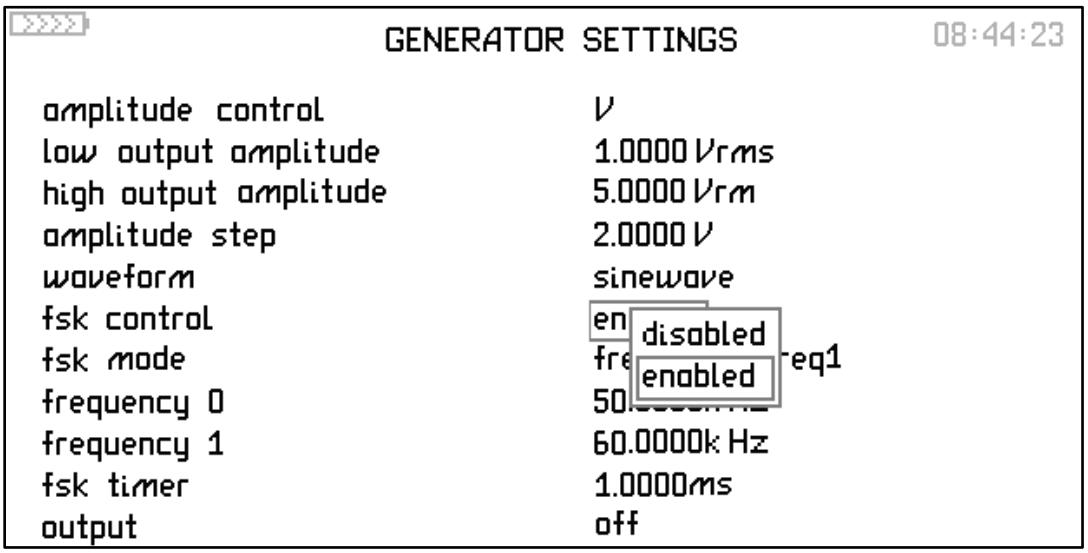



**FIGURE 5.1.6-1 – FSK CONTROL**

### 5.1.8 FSK Mode, Frequency 0, Frequency 1, and FSK Timer

FSK Mode has four options:

- Off-Freq0-Freq1
- Freq0-Off-Freq1
- Freq0-Freq1-Freq0
- Switch F0 and F1.

Off-Freq0-Freq1, Freq0-Off-Freq1, and Freq0-Freq1-Freq0 use the fsk timer. Switch F0 and F1 changes from F0 to F1. The ***left*** and ***right*** arrow keys are used to change the frequencies. When Off-Freq0-Freq1 or Freq0-Off-Freq1 are selected the fsk timer setting turns "OFF" the generators' output for the amount of time set on the ***fsk timer***. Selecting Freq0-Freq1-Freq0 changes the generators' output to Freq1 for the amount of time set on the fsk timer.

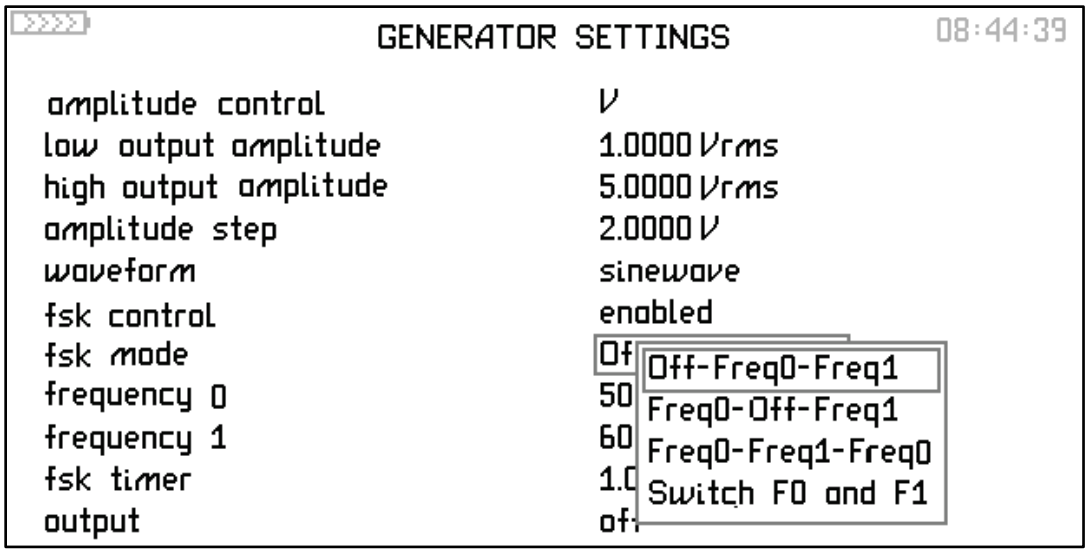



**FIGURE 5.1.8-1 – FSK MODE**

### 5.1.9 Generator Frequency

The generator frequency is set with this option. Enter the desired frequency using the numeric keys and then press the 'Enter' key. Figure 5.1.9-1 displays the generator frequency set to 90kHz with steps set at 1.0kHz.

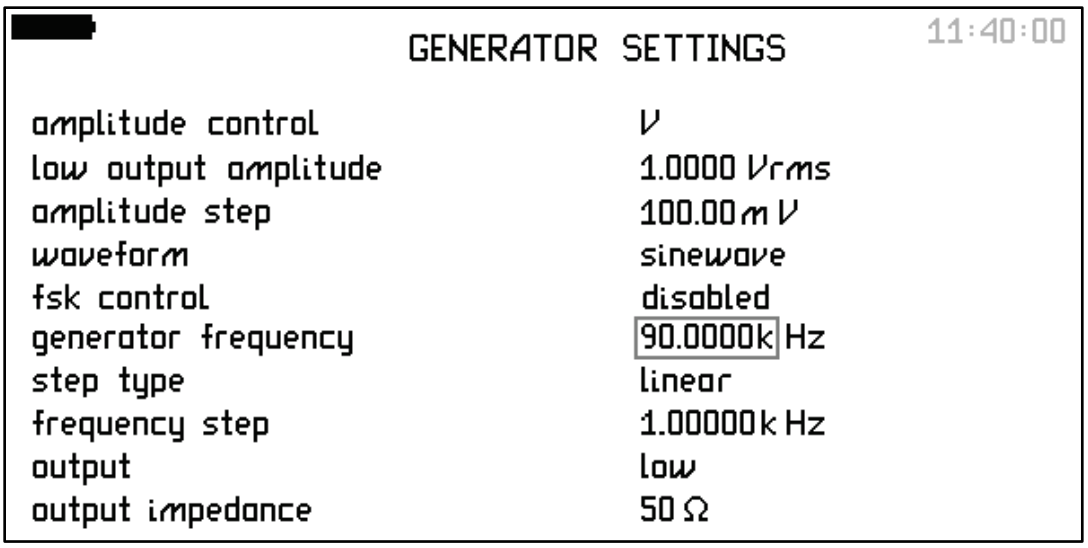



**FIGURE 5.1.9-1 GENERATOR FREQUENCY AND LINEAR STEP TYPE**

### 5.1.10 Step Type and Frequency Step

Step type has two options linear or logarithmic. The linear option sets the 'frequency step' option to a numeric value that may be changed via the number keypad. The default frequency step is 100 Hz. The step may be set to any value above 1Hz. The 'frequency step' option determines the amount the frequency changes when the 'LEFT/RIGHT' arrow keys are used. The 'LEFT/RIGHT' arrow keys only control the frequency of the generator if it is turned on. Figure 5.1.8-1 displays the linear option. The logarithmic option sets the 'frequency step' option to a multiple of the frequency. Figure 5.1.10-1 displays the logarithmic option.

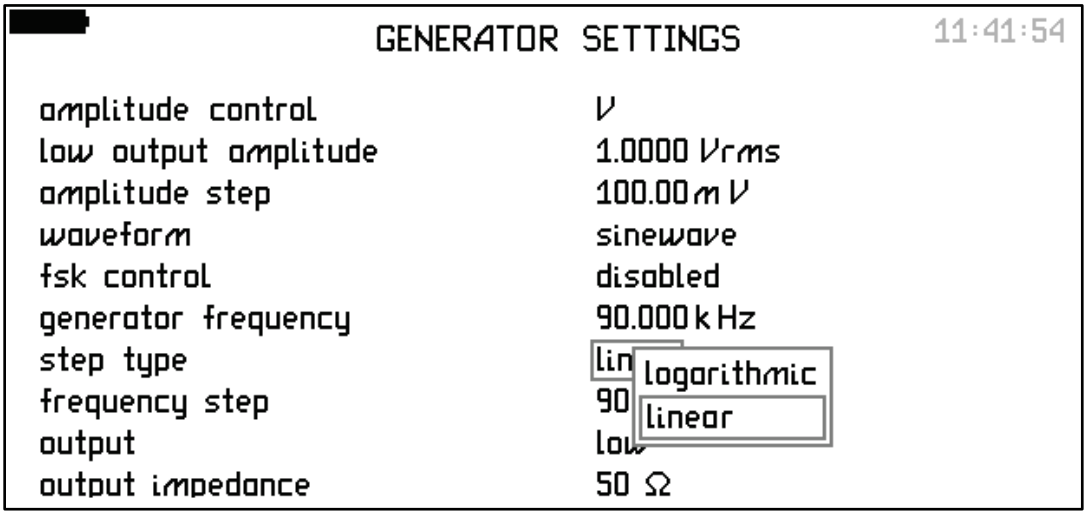



**FIGURE 5.1.10-1 – LOGARITHMIC STEP TYPE**

### 5.1.11 Output

The signal generator's output is turned off and on by this option. The output has three options: off, low, and 50Ω high. Figure 5.1.11-1 displays these options.

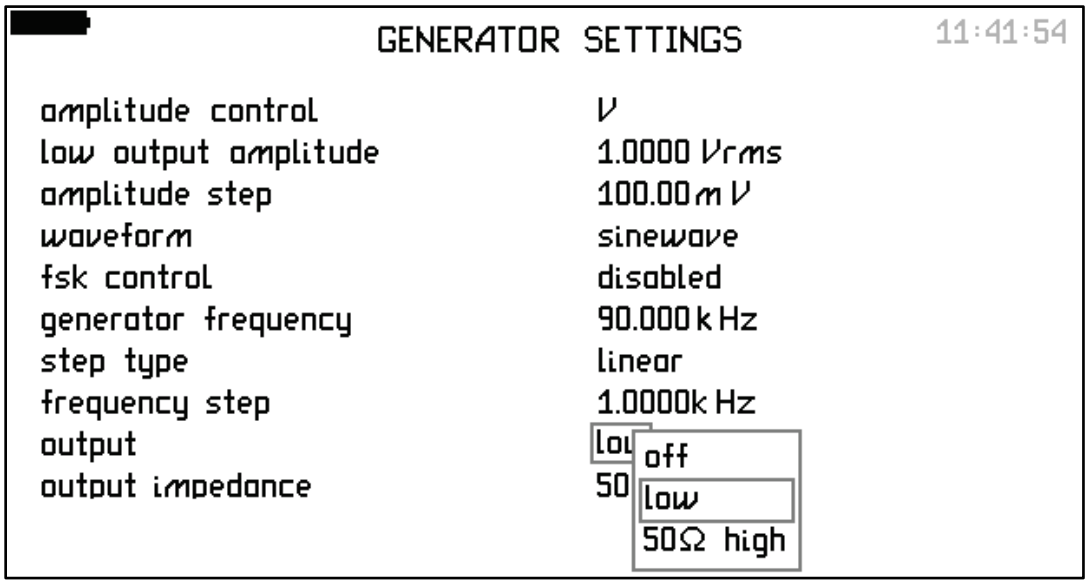



**FIGURE 5.1.11-1 – OUTPUT OPTIONS**

The selection of the 50Ω high output turns on the 'high" output. The power used by this output will drain the battery in 20 to 30 minutes. It is recommended that the instrument be connected to an external power source when using this output. Figure 5.1.11-2 displays this option. The selection of the low output adds another option to the menu, 'output impedance'.

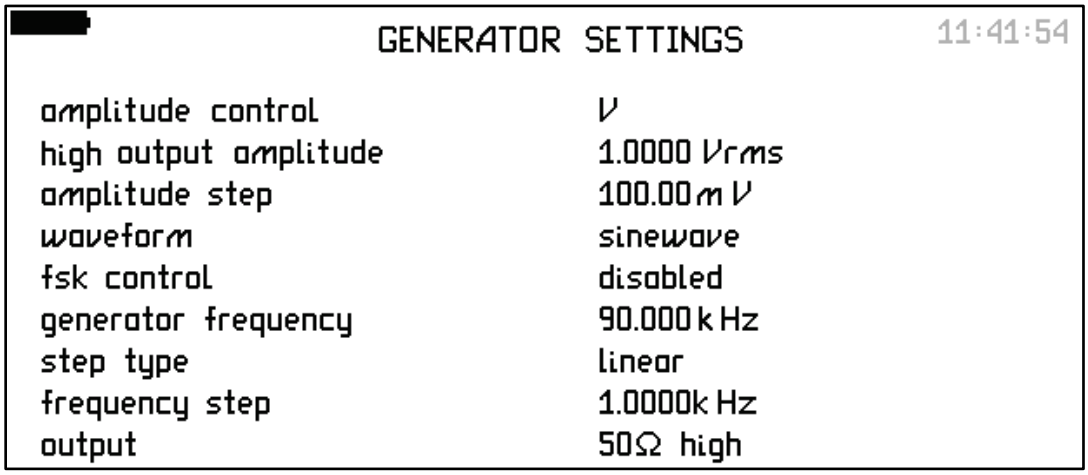



**FIGURE 5.1.11-2 – 50Ω HIGH OUTPUT**

### 5.1.12 Output Impedance

The low level outputs impedance may be set to 50Ω, 75Ω or 600Ω. Figure 5.1.12-1 displays this option. The 50Ω high level output has no impedance options.

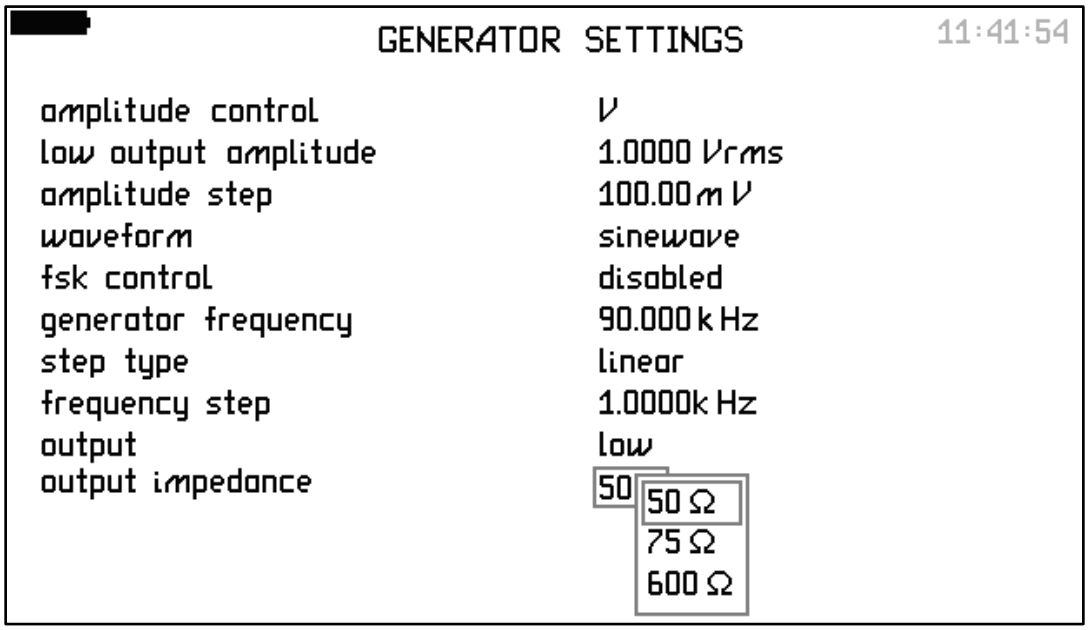



**FIGURE 5.1.12-1 – LOW OUTPUT IMPEDANCE**

## 5.2 Frequency Selective Level Meter

The frequency selective level meter (SLM) is designed to measure the signal level of individual frequencies from 5 Hz to 5 MHz. The SLM meter screen is divided into 4 areas, the main screen, the generator settings, the selected input, and its ohmic reference, measure/bandwidth/center frequency area. Figure 5.2-1 displays the SLM meter screen.

The main screen displays the frequency the SLM meter is adjusted to and the voltage and dBm level at that frequency. The wideband voltage display shows the composite voltage across the frequency range (5Hz to 5MHz) of the instrument. This is useful for determining if there is another signal present or noise. Activating the *bargraph* option replaces the wideband voltage display with a bargraph display.

CAUTION: USE THE HI ∞ INPUT FOR ALL POWER LINE CARRIER (PLC) READINGS. THE OTHER AVAILABLE INPUTS COULD BE DAMAGED BY THE HIGH VOLTAGE THAT PLC'S OPERATE AT. THE 18W Z INPUT WILL HANDLE A 10W TRANSMITTER OUTPUT.

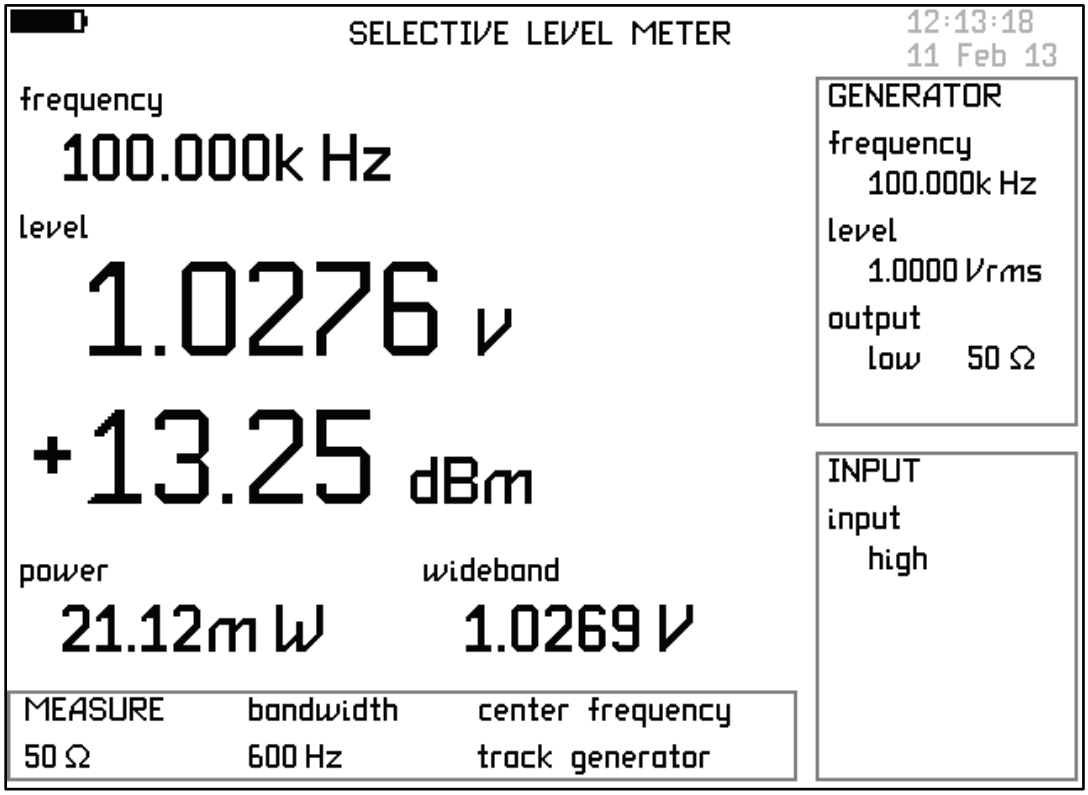



**FIGURE 5.2-1 – SELECTIVE LEVEL METER**

The ‘GENERATOR’ portion of the screen displays the generator frequency, the output level of the generator and if the output is ‘off’, set to ‘low’, or ‘high’. The output level of the generator when connected to one of the inputs of the SLM meter may or may not be equal to the reading on the SLM meter. When the load isn’t equal to the generator ohmic setting, these readings will differ.

The ‘INPUT’ portion of the screen displays the input that is active. When the INPUT displays anything but ‘high’ it is in the ‘terminate’ mode. The inputs available are: high Z, 50Ω 18 W, low level, and balanced. Channel 2 is not available in the SLM mode.

The ‘MEASURE’ portion of the screen displays its ohmic reference, the bandwidth and how the frequency that the SLM is tuned to is controlled. Although the input impedance may be set to high, the dBm reading must be referenced to an ohmic value, normally 50Ω for carrier applications. Some utilities still use 600Ω to take carrier readings.

### 5.2.1 Meter Inputs

The SLM has four independent inputs. Three of the inputs are unbalanced inputs (BNC) located at the top right side of the instrument. The three unbalanced inputs are high Z, 50Ω 18W, and low level. The fourth input is the balanced input. Select the desired input by pressing the “INPUT” key. This displays the INPUT SETTINGS menu. The “UP” and “DOWN” arrow keys are used to put the ‘selection box’ on the desired input, then press the ‘enter’ key to select that input. Figure 5.2.1-1 displays the input menu screen with ‘high Z’ selected. Figure 5.2.1-2 displays the different input options. The ‘balanced’ and ‘low level’ inputs have the ability to select three different impedances, 50Ω, 75Ω, and 600Ω. These impedance selections will put the selected ohmic load on the source (i.e. the terminate mode). Figure 5.2.1-3 displays the different impedance options. The fourth selection ‘high Z’ is the bridged mode and puts no load on the source.

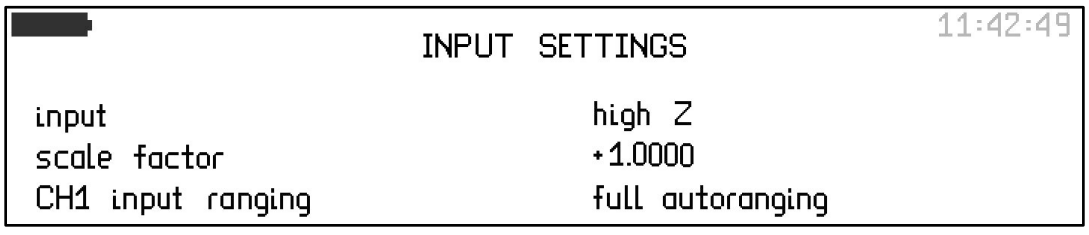



**FIGURE 5.2.1-1 – INPUT SETTINGS MENU**

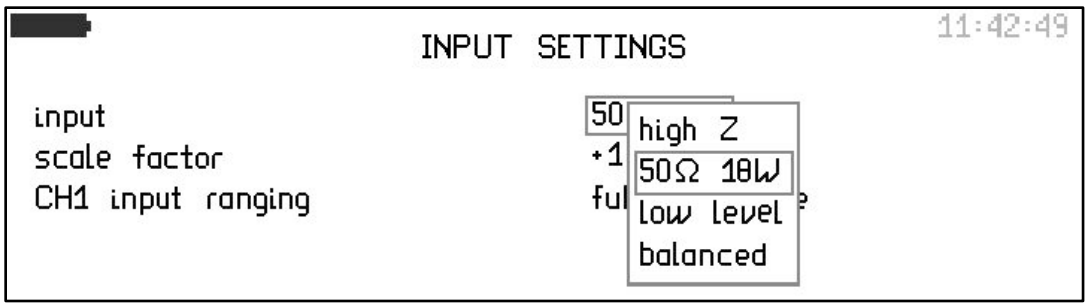



**FIGURE 5.2.1-2– INPUT OPTIONS**

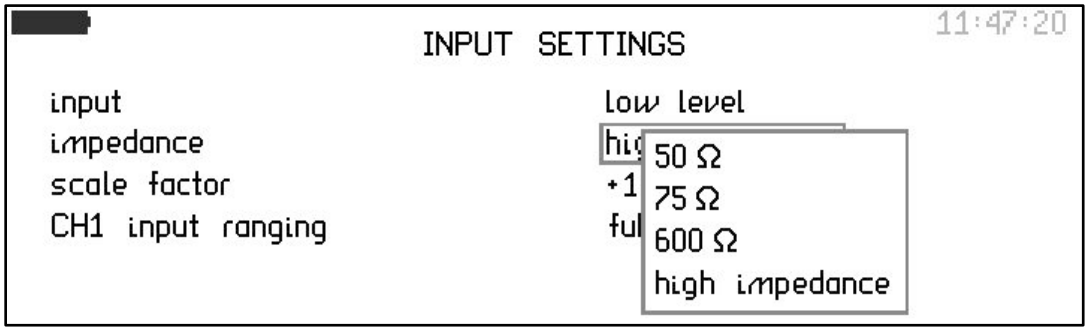



**FIGURE 5.2.1-3 – INPUT IMPEDANCE OPTIONS**

Each input has a red LED next to it. The LED that is "ON" will be the active input. Figure 5.2.1-4 displays the five different inputs. The high Z, low level, and balanced inputs are bridged inputs. They put no load on the signal being measured. The 50Ω 18W input is used to set transmitters outputs as this input provides termination. The 'high Z' input should be used when measuring RF carrier signals in most cases.

WARNING: IT IS CRITICAL THAT THE CORRECT INPUT BE USED AS THE INSTRUMENT WILL BE DAMAGED IF HIGH VOLTAGE IS APPLIED TO THE LOW LEVEL OR BALANCE INPUTS. THE 'HIGH Z' INPUT CAN HANDLE INPUT LEVELS TO 200V RMS. THE 50Ω 18W INPUT CAN HANDLE INPUT LEVELS UP TO 18 WATTS. THE LOW LEVEL AND BALANCED INPUTS ARE GOOD FOR A MAXIMUM OF 5 VOLTS RMS.

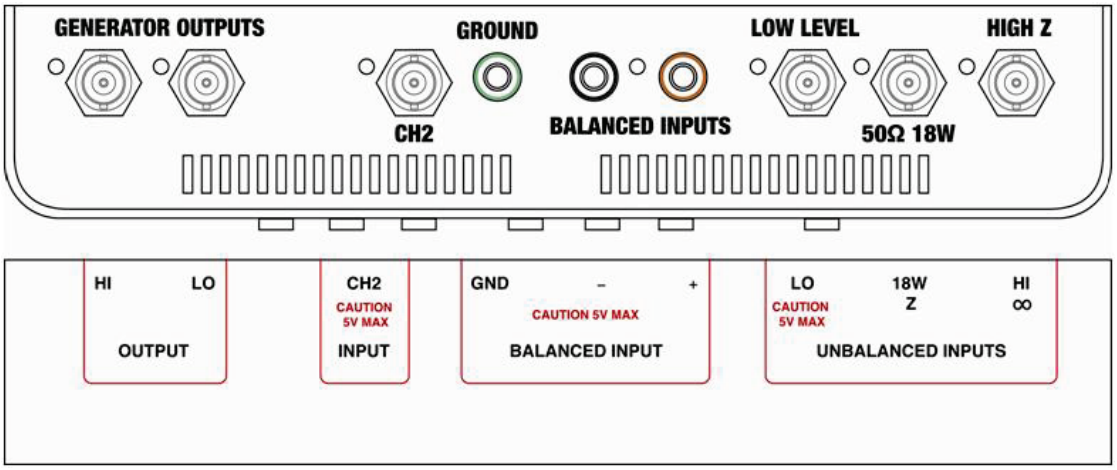



**FIGURE 5.2.1-4 - METER INPUTS/OUTPUTS**

### 5.2.2 Center Frequency

The SLM meter has five methods to identify frequency – track generator, AFC, fixed, dual fixed, and input frequency. Figure 5.2.2-1 displays the five different frequency options.

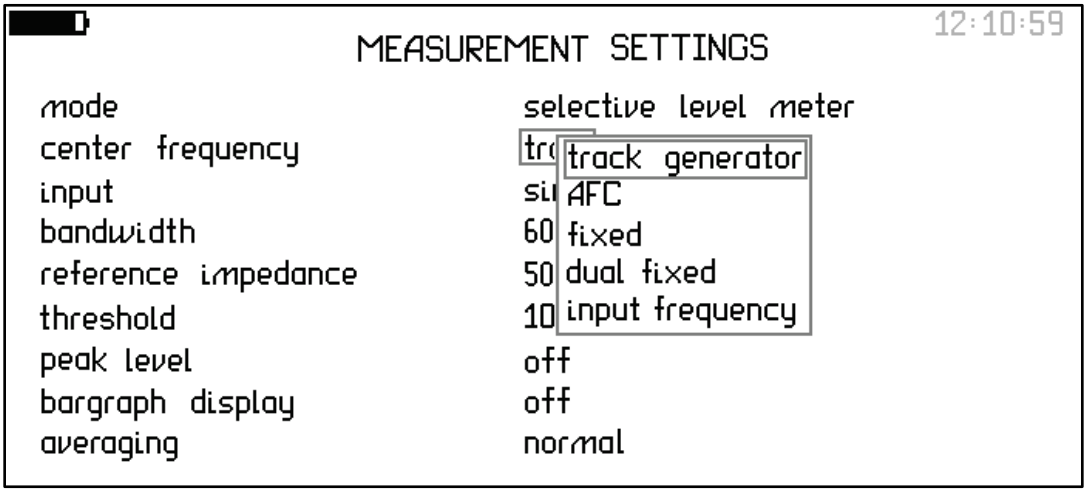



**FIGURE 5.2.2-1 – CENTER FREQUENCY OPTIONS**

**Track Generator -** Track generator follows the frequency of the generator. If you change the frequency of the generator, the SLM meter changes to the new generator frequency. Figure 5.2.2-2 displays the 'track generator' option.

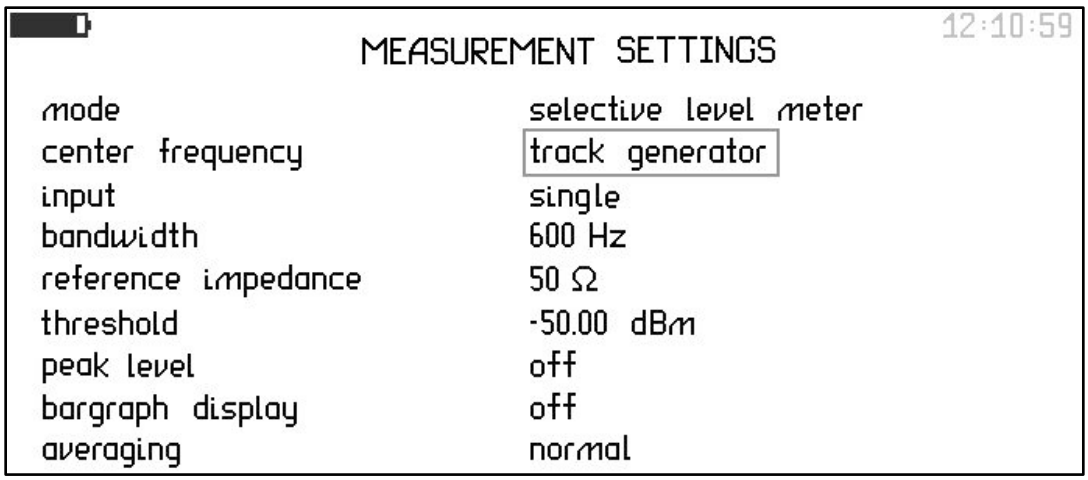



**FIGURE 5.2.2-2 – TRACK GENERATOR**

**AFC -** AFC looks for the highest signal in the bandwidth of the SLM meter and displays that frequency. AFC should not be used if wideband bandwidth is selected. AFC may be used as a frequency counter. If the frequency changes within the bandwidth and the SLM loses the signal, simply hit the HOME/ESC key and the SLM will research for the peak frequency within bandwidth starting from tuned frequency entered. Figure 5.2.2-3 displays the 'AFC' option. The 'AFC' option adds three more options: AFC gain, step type, and frequency step. AFC gain sets the sensitivity for AFC. The normal setting is +1.000 and should work for most applications. Step type has two options: linear and logarithmic. Linear sets the size of the frequency step when the LEFT/RIGHT arrow keys are pressed. Logarithmic allows the user to set the size of the step logarithmic i.e. each step is larger than the previous step. Figure 5.2.2-4 displays the 'Step Type' option. **Note: if the generator is turned on, the LEFT/RIGHT arrow keys control the generator frequency**.

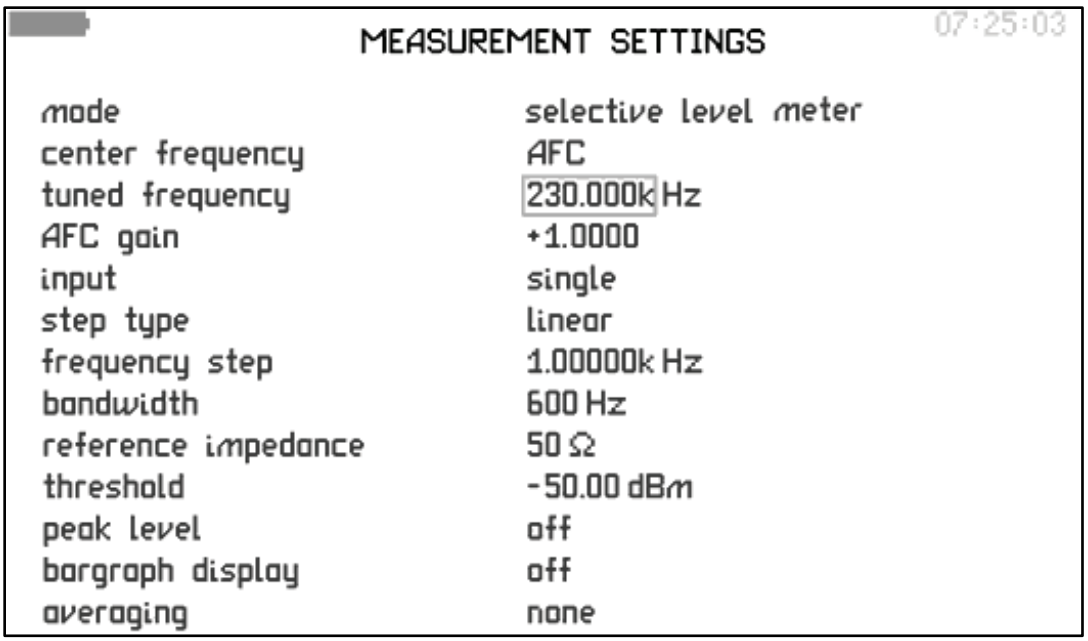



**FIGURE 5.2.2-3 – AFC TUNING**

**Step Type -** Step type has two options: linear or logarithmic. Linear sets the size of the frequency step when the LEFT/RIGHT arrow keys are pressed. Note: if the generator is turned on, the LEFT/RIGHT arrow keys control the generator frequency. Figure 5.2.2-4 displays the 'Step Type' option.

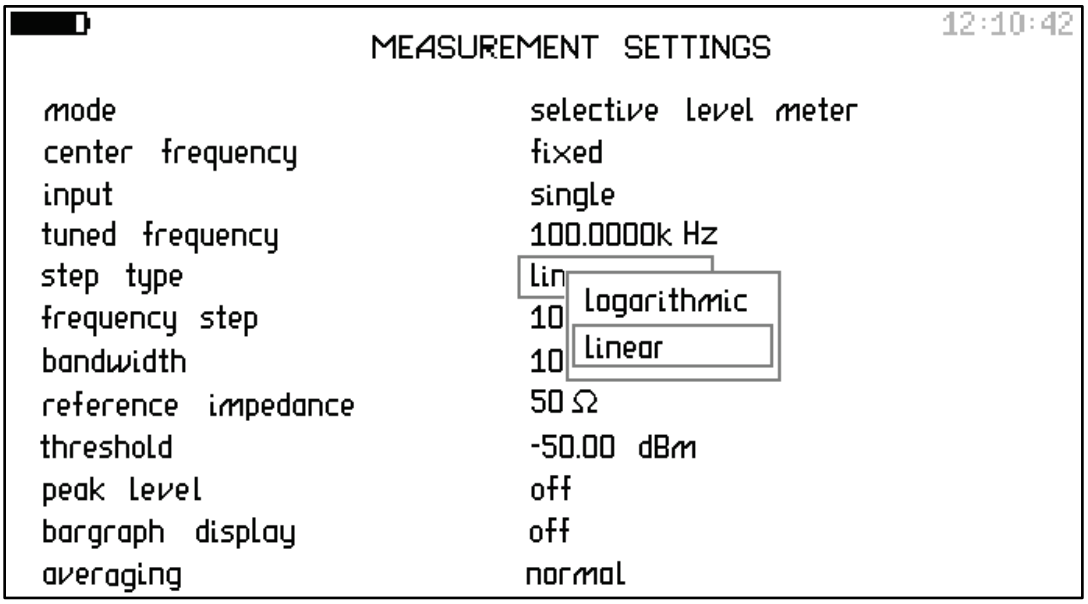



**FIGURE 5.2.2-4 – AFC STEP TYPE**

**Fixed -** Fixed allows the user to 'LOCK' the SLM meter to a specific frequency. Selecting 'fixed' adds a new function to the MEASUREMENT SETTINGS menu. This function is 'tuned frequency'. The "UP" or "DOWN" arrow key is used to put the 'selection box' around the displayed frequency. Use the number keys to change the frequency and then press the 'enter' key to change the SLM meter to that frequency. Press the "HOME/ESC" key to return to the SLM meter screen. Dual fixed allows you to 'LOCK' the SLM meter to two specific frequencies. Selecting 'dual fixed' adds two options to the display: 'center frequency 1' and 'center frequency 2'.

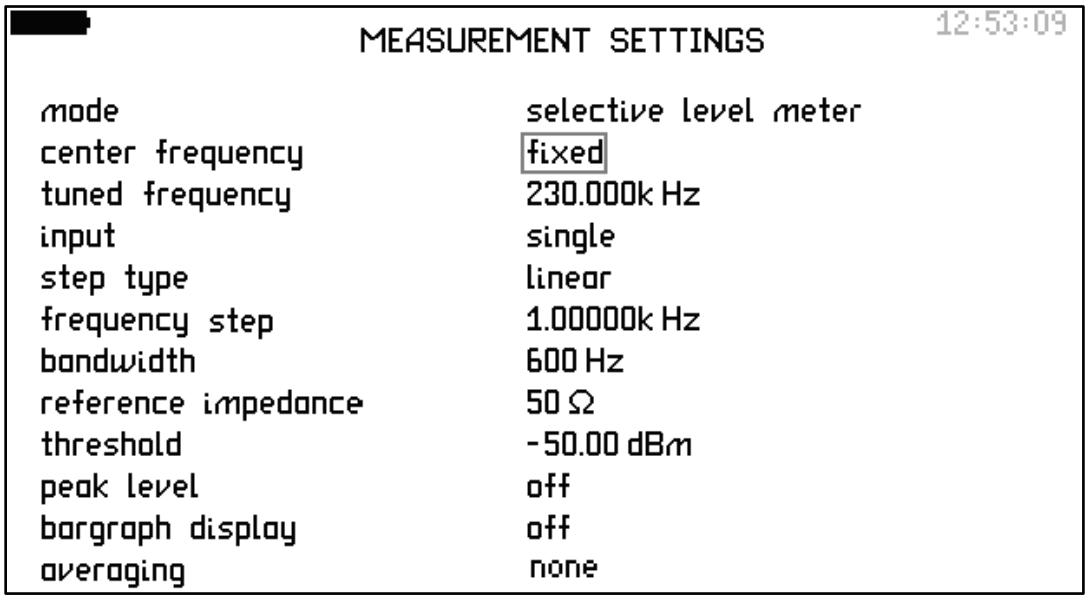



**FIGURE 5.2.2-5 – FIXED TUNING**

**Dual Fixed-** Dual fixed functions identical to 'Fixed' above with the ability to monitor two frequencies at the same time. Selecting 'dual fixed' adds two options to the display: 'center frequency 1' and 'center frequency 2'. The bandwidth must be 100 Hz or less for this function to operate correctly. Figure 5.2.2-6 displays the dual fixed tuning option. Figure 5.2.2-6 displays the two bandwidth options 100 ohms and 25 ohms for 'dual fixed' tuning. Figure 5.2.2-7 displays the real time screen for 'dual fixed' tuning.

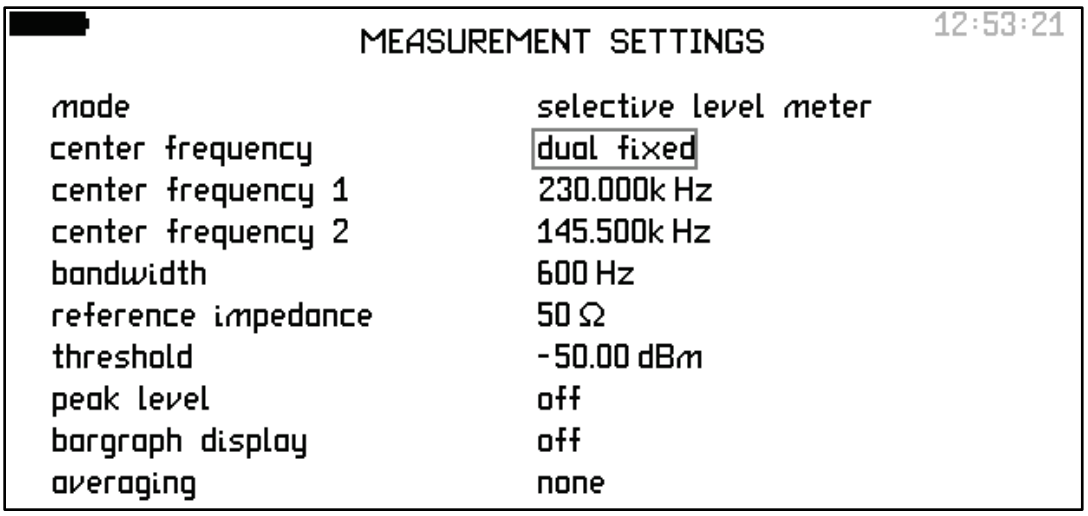



**FIGURE 5.2.2-6– DUAL FIXED TUNING**

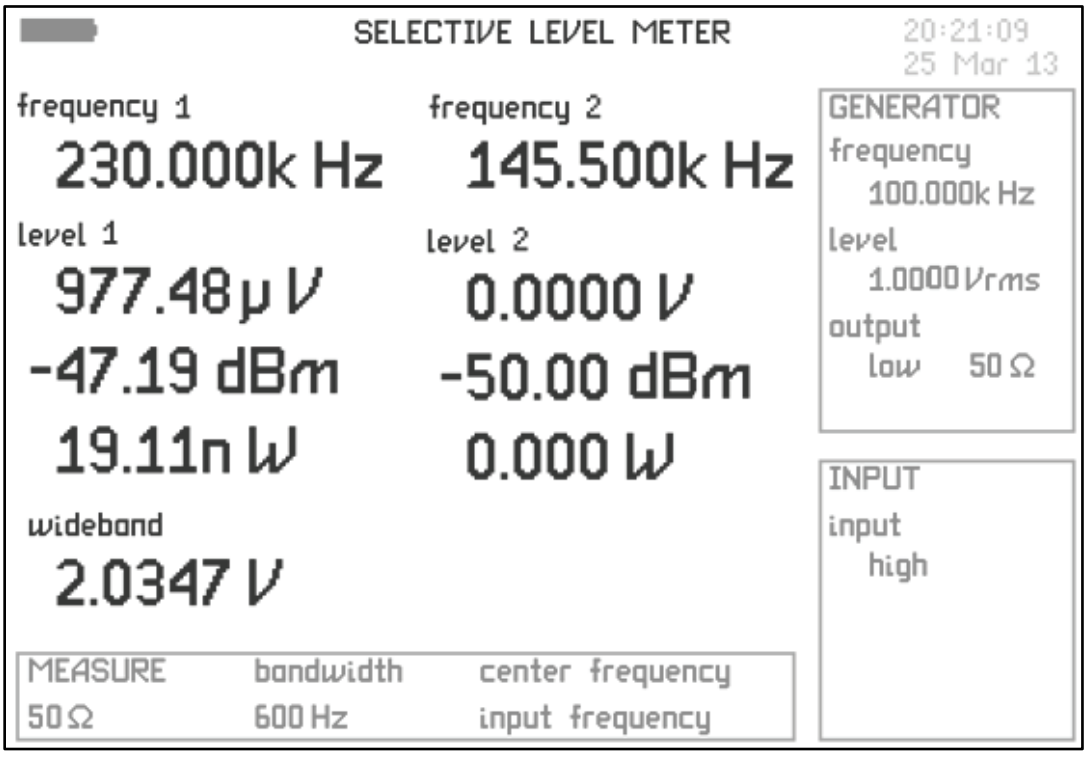



**FIGURE 5.2.2-7 – DUAL FIXED TUNING REAL TIME DISPLAY**

**Input Frequency -** Input frequency looks for all frequencies between 5 Hz and 5 MHz and displays the signal with the highest level. Figure 5.2.2-8 displays the Measurement Settings Screen with the input frequency selected.

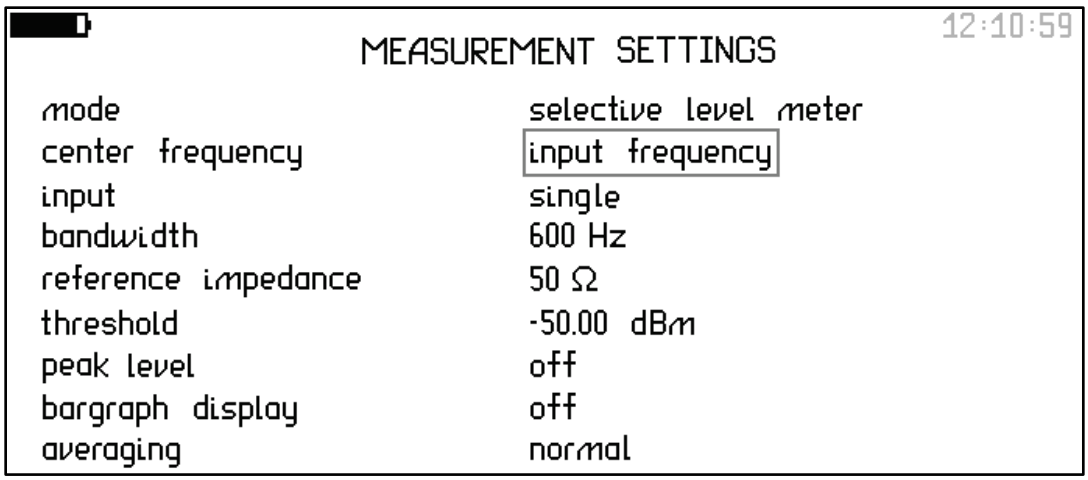



**FIGURE 5.2.2-8 – INPUT FREQUENCY TUNING**

### 5.2.3 Input

Input has two options: single or dual. Dual turns on channel 2. This option should only be used with audio tones since channel 2 is only rated 5 volts or with an attenuator for carrier signals. Figure 5.2.3-1 displays this option. Figure 5.2.3-2 displays the 'Real Time" screen.

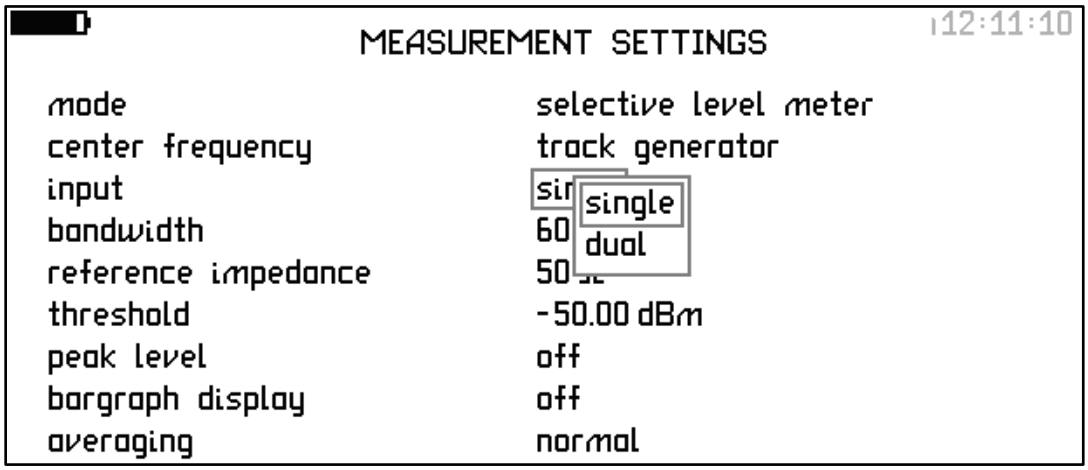



**FIGURE 5.2.3-1 – INPUT OPTION**

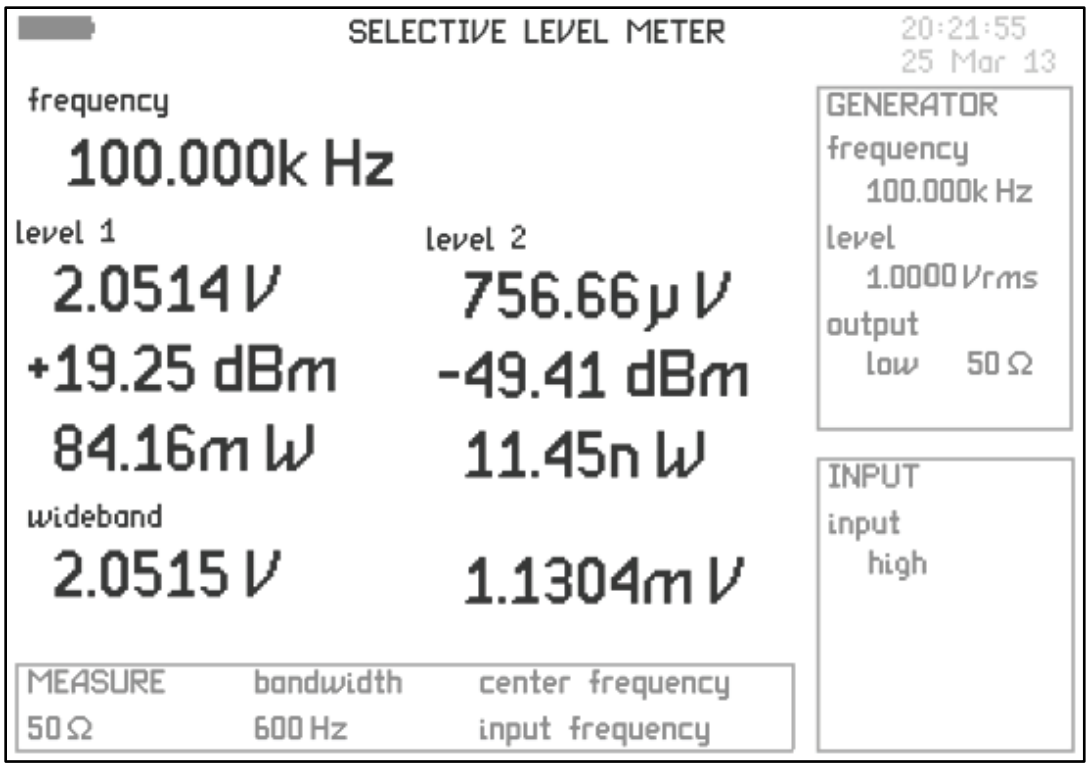



**FIGURE 5.2.3-2 – DUAL INPUT REAL TIME DISPLAY**

### 5.2.4 Meter Bandwidth

The meter has five bandwidths available and the sixth option is 'wide' which turns the meter into a non-selective RMS voltmeter. The 'wide' setting lets the meter see all frequencies across the range (5Hz to 5MHz) of the instrument, but should not be used in AFC mode. This reading is always displayed on the bottom of the SLM screen even when not selected. The 100Hz bandwidth (±50Hz) is normally used with RF carrier frequencies. The 25Hz bandwidth is normally used with audio tones or when frequencies are closely spaced where the 100Hz filter would not work. Figure 5.2.4-1 displays the measurement screen with the bandwidth option selected.

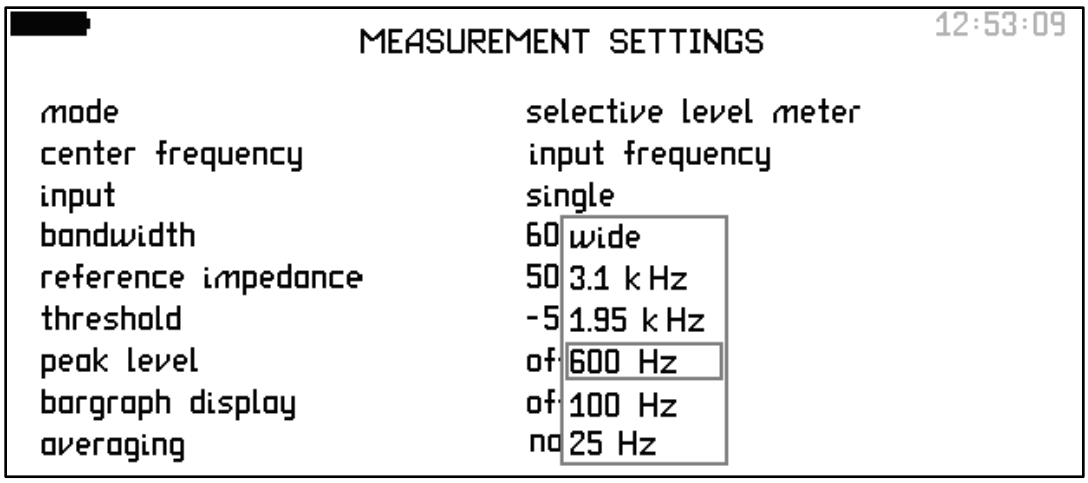



**FIGURE 5.2.4-1 - BANDWIDTH SETTINGS**

### 5.2.5 Reference Impedance

'Reference impedance' has four options: 50 Ω, 75 Ω, 135 Ω, and 600 Ω. Power level readings displayed in dBm must have a reference impedance to show the correct power level. For PLC in the United States, this is usually 50 Ω. Audio tone signals are usually measured at 600 Ω. Figure 5.2.5-1 displays the 'reference impedance' option.

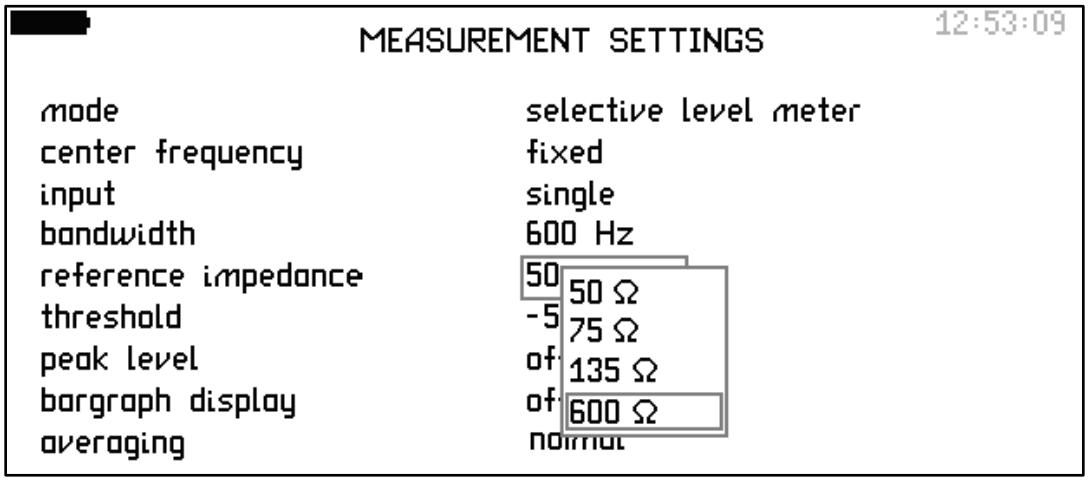



**FIGURE 5.2.5-1 - REFERENCE IMPEDANCE**

### 5.2.6 Threshold

Threshold sets the minimum voltage the instrument will read. The default setting is -50dB. The SLM meter will ignore all voltages less than the threshold setting.

### 5.2.7 Peak Level

Peak level has two options: ON and OFF. Figure 5.2.7-1 displays these options. Figure 5.2.7-2 displays the peak level screen.

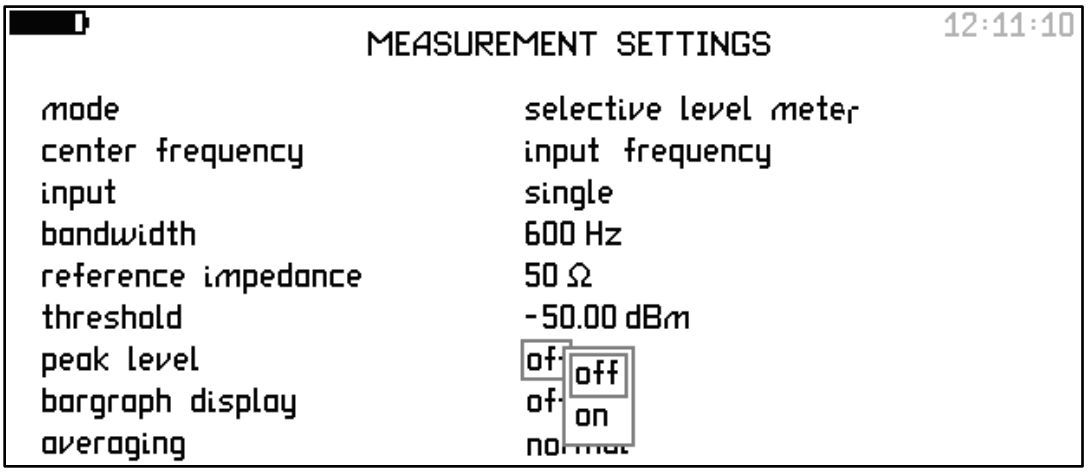



FIGURE 5.2.7-1 – PEAK LEVEL OPTION

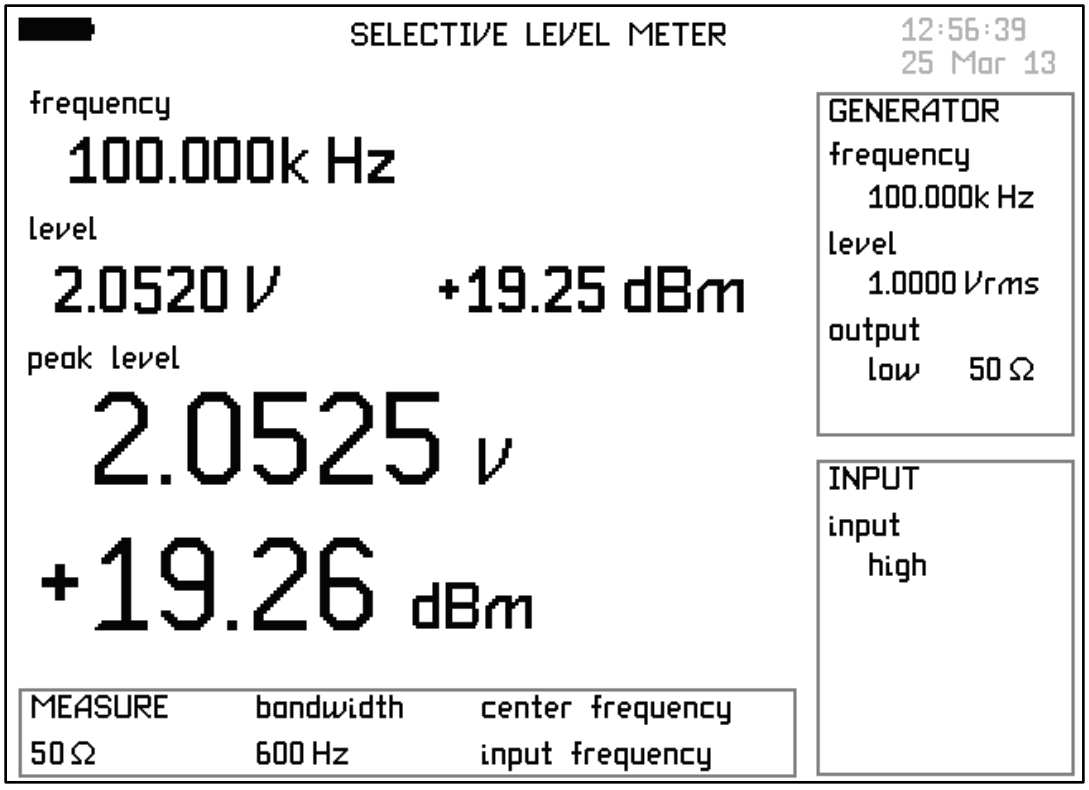



FIGURE 5.2.7-2 – SLM WITH PEAK LEVEL ON

### 5.2.8 Bargraph Display

Bargraph display has two options: on or off. Turning the *bargraph display* on adds a bargraph to the selective level meter's screen. The bargraph replaces the wideband voltage reading with the bargraph. Figure 5.2.8-1 displays the Selective Level Meter Screen with the bargraph.

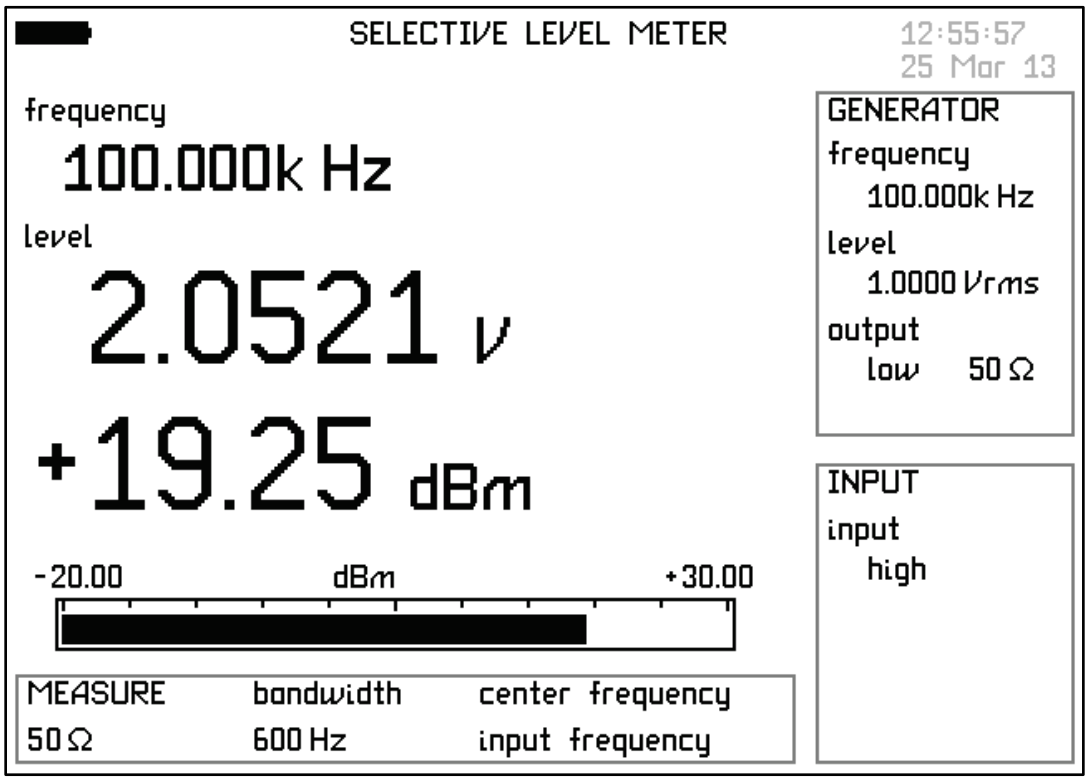



**FIGURE 5.2.8-1 – SELECTIVE LEVEL METER WITH BARGRAPH**

### 5.2.9 Averaging

The averaging option has three settings – normal, slow, and none. This function sets how many samples the instrument takes before updating the display. If the signal level on the display is erratic, set averaging to 'slow'. If you want immediate updates, set averaging to 'none'. Use the "UP/DOWN' arrow keys to place the 'selection box' around the current setting and then the 'RIGHT' arrow key to pull up the three options. Then place the 'selection box' around the desired setting and hit the enter key. Figure 5.2.9-1 displays the averaging options.

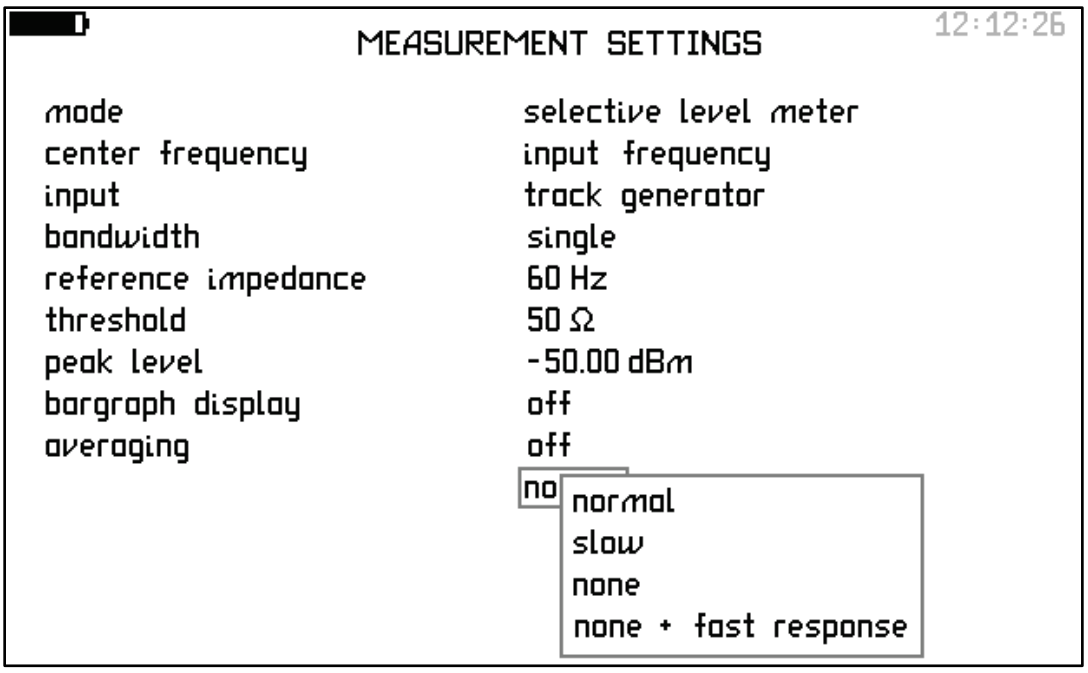



**FIGURE 5.2.9-1 AVERAGING OPTIONS**

### 5.2.10 0 dB Reference

0 dB reference has two options: set present measurement as 0 dB reference and enter a specific number as a reference dB. When 0 dB reference is selected, the *set present measurement as 0dB reference* option takes the current reading and makes it the 0dB reference. When *zero reference* is selected the user enters a fixed dB level for the active input. The screen in Figure 5.2.10-1 appears when this function is selected. Figure 5.2.10-2 displays the 0 dB reference set at -20.00 dBm.

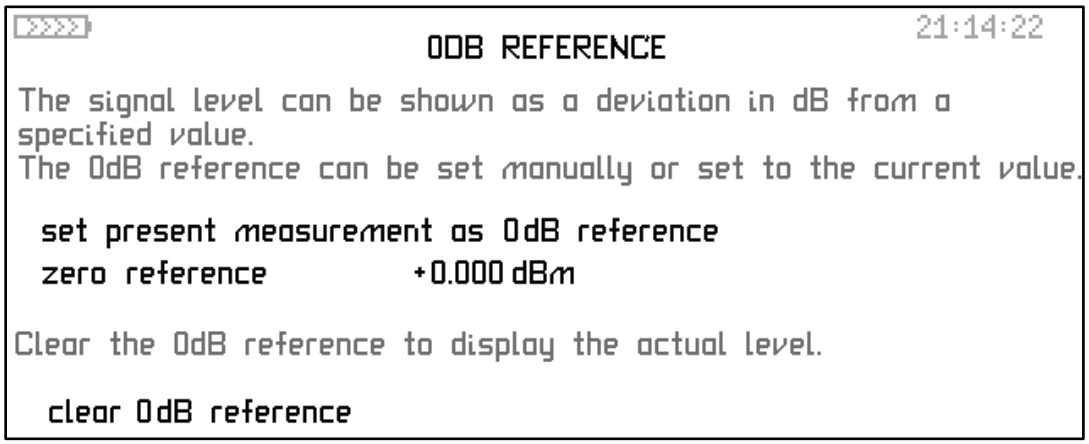



**FIGURE 5.2.10-1 0 DB REFERENCE**

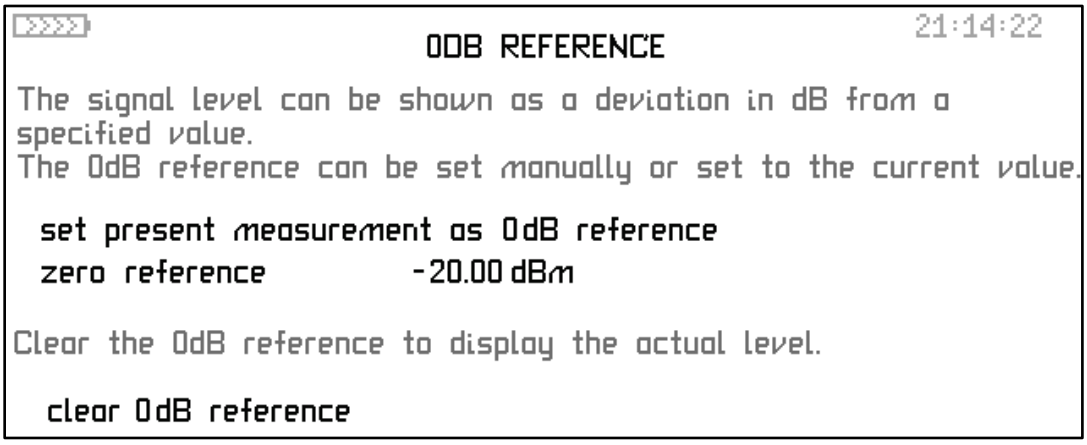



**FIGURE 5.2.10-2 ZERO REFERENCE**

### 5.2.11 Carrier Testing Setup

The normal setup for carrier testing is: input high, impedance reference 50Ω, and bandwidth 100Hz. The normal setup for audio tones is: balance input, reference 600 ohms, and bandwidth 25Hz.

The input is set by pressing the "INPUT" key and then use the "DOWN" and "RIGHT" arrow keys to put the 'selection box' around the desired input and then press the 'enter' key to select that input. Figure 5.2.11-1 shows the arrow keys. Figure 5.2.1-2 shows the "INPUT" menu with 'high Z' selected.

The bandwidth is set from the Measurement Settings screen. Figure 5.2.3-1 displays the Measurement Settings screen. Use the "DOWN" and "RIGHT" arrow keys to put the 'selection box' around the desired bandwidth and press the 'Enter' key to select that bandwidth.

Connect a coaxial cable to the selected input. From the Measurement Settings screen, set the desired frequency and connect the coaxial cable to the point where the carrier signal is to be measured. If no signal is displayed on the screen at the programmed frequency, change the center frequency option to AFC. If there is still no signal present, check the "wideband" level at the bottom of the screen. If there is a signal present, the wideband reading should indicate a measurable voltage. See Figure 5.2.1-1 for a reference.

**Note: After entering a selection, the "HOME/ESC" key must be pressed to activate the selected function(s) and return to the meter screen. You may change multiple options before pressing the "HOME/ESC" key.**

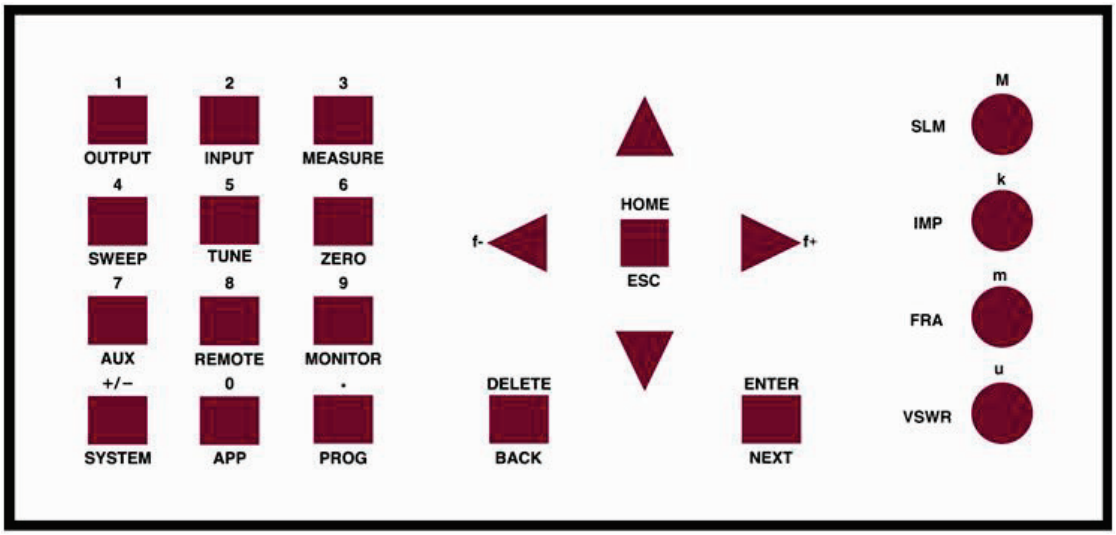



**FIGURE 5.2.11-1 – KEYPAD**

## 5.3 Impedance Meter

The Impedance Meter is used to measure the impedance of different circuits used in power line carrier applications. This could be a line trap, parallel L/C unit in a line tuner, or even capacitance or inductance (using the capacitance or inductance meter option). **The impedance meter may also be used to tune a line tuner**. This option is explained in Section 5.3.6 of this manual. The low level signal generator is automatically turned on in the impedance mode. Connect the low output of the signal generator into the 'HI ∞' unbalanced input for impedance measurements. Figure 5.3-1 displays the Impedance Meter screen.

The impedance screen displays five quantities – frequency, impedance, phase (angle) in degrees, voltage, and current. The impedance meter takes the current output of the signal generator and compares that to the voltage measured across the circuit being tested and calculates the impedance based on the phase angle between the two quantities.

The 'IMP' key turns on the impedance meter and at the same time it turns on the signal generator. Putting the PCA-4125 in the 'as last used' option under 'initial settings' under the SYSTEM OPTIONS menu allows the instrument to be powered down when not being used and when turned back on – the instrument powers up with the last setup active. This allows the PCA-4125 to be turned off to conserve power when not taking readings.

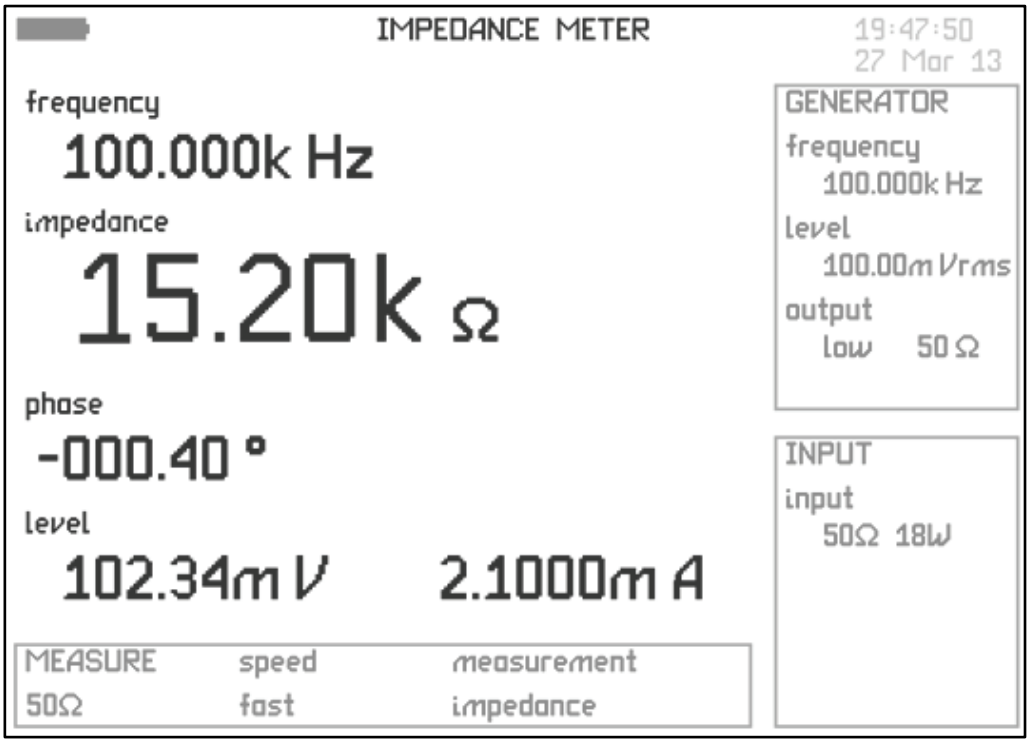


**FIGURE 5.3-1 – IMPEDANCE METER**

**Note: Measuring impedance requires keeping the lead between the signal generator's output and the HI ∞ input of the meter as short as possible to limit the amount of error caused by the capacitance of the coaxial lead. The higher the frequency, the more error is introduced into the reading.**

### 5.3.1 Impedance Measurement Settings

There are four options on the 'MEASUREMENT SETTINGS' screen. They are 'mode', 'measurement', 'speed', and 'averaging'. Mode allows the user to select any of the five different instruments that the PCA-4125 has available to the user. Measurement has three options: 'impedance magnitude', 'parallel circuit' and 'series circuit'. These options allow the user to measure the impedance of different types of electrical circuits. Figure 5.3.1-1 displays the MEASUREMENT SETTINGS screen for the impedance meter.

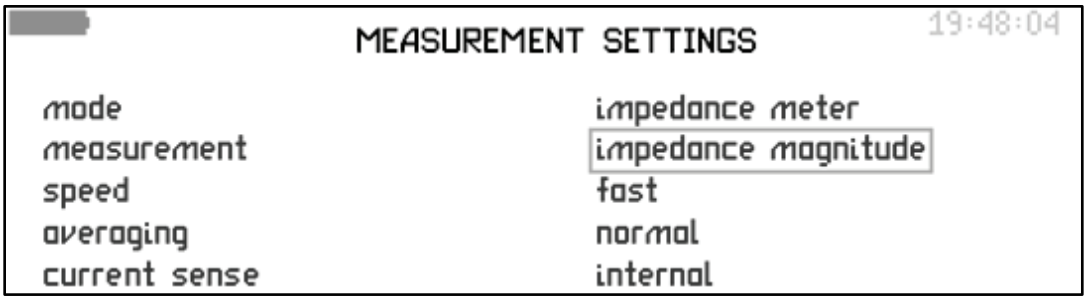



**FIGURE 5.3.1-1 – IMPEDANCE MEASUREMENT SETTINGS**

### 5.3.2 Measurement

Measurement has three options: impedance magnitude, parallel circuit, and series circuit. The 'impedance magnitude' function is used for measuring the impedance of line traps or parallel L/C circuits. The 'parallel circuit' function is used for measuring the inductance of an inductor or the capacitance of a capacitor. The 'series circuit' is for measuring inductance. Measuring inductance requires keeping the frequency at 50 kHz or less to eliminate error caused by inter-winding capacitance on the inductor. Figure 5.3.2-1 displays the 'measurement' functions with the 'impedance magnitude' option selected.

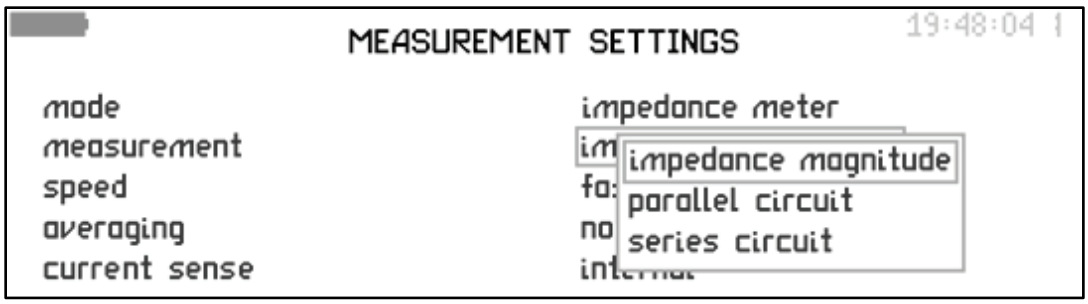



**FIGURE 5.3.2-1 – IMPEDANCE MEASUREMENT OPTIONS**

### 5.3.3 Speed

Speed sets the sample rate of the instrument. There are five 'speed' options: 'very slow', 'slow', 'medium', 'fast' (default setting), and 'very fast'. Setting the option to 'fast' when doing a sweep function decreases the time it takes for the sweep. Figure 5.3.3-1 displays the 'speed' options.

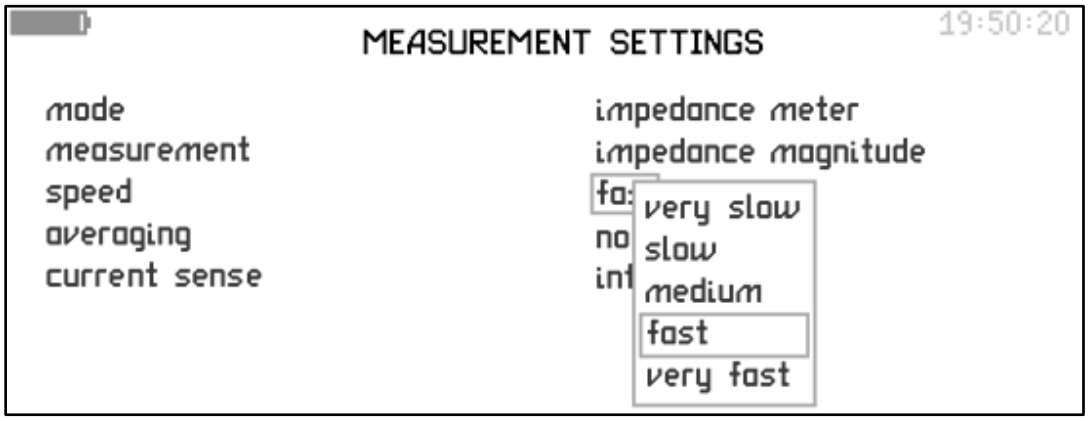



**FIGURE 5.3.3-1 – SPEED OPTIONS**

### 5.3.4 Averaging

Averaging is used to change how many samples the instrument takes before it updates the screen. There are three options for the averaging filters: 'slow', 'normal', and 'none'. For real time measurements in the SLM mode, normal averaging is recommended. When performing any sweep, the averaging should be set to 'none'. Figure 5.3.4-1 displays the 'averaging' options.

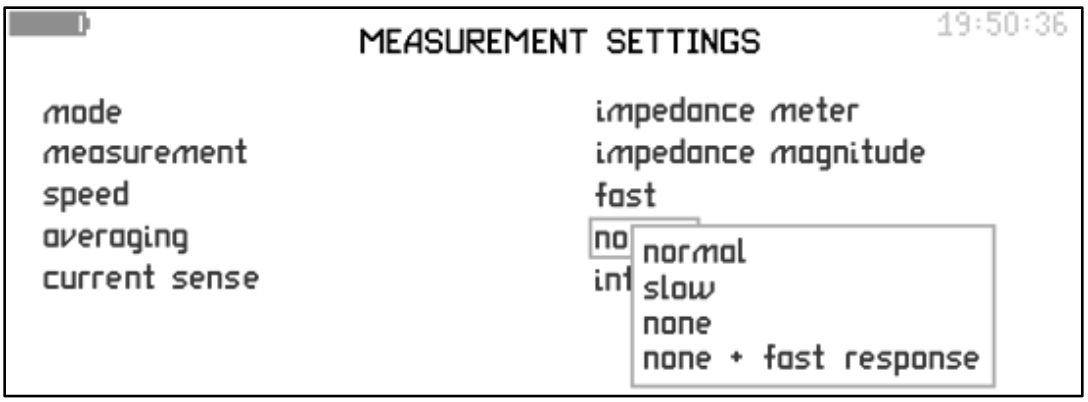



**FIGURE 5.3.4-1 – AVERAGING OPTIONS**

### 5.3.5 Current Sense

This option is used for the PCA-4125 that is used with the railroads.

### 5.3.6 Testing Line Traps

The resonant frequency of a line trap is identified by determining the frequency at which the maximum impedance is set. This is its' resonant frequency. If the 'as found' resonant frequency is not the desired resonant frequency, then the line trap needs to be adjusted. This is accomplished by setting the 'impedance meter' to the desired resonant frequency and adjusting the line trap for maximum impedance at that frequency. After the line trap is adjusted to its' resonant frequency, the trap may be swept to look at the resulting waveform to verify that it conforms to the manufacturer's specifications. The drawing in Figure 5.3.6-1 shows how the PCA-4125 should be connected to test a line trap using the 'high Z' input. Any of the inputs may be used to test a trap.

---

**CAUTION:** WHEN THE TRAP IS CONNECTED TO THE LINE, CARE MUST BE TAKEN TO ENSURE THAT HIGH INDUCED VOLTAGE FROM THE LINE IS NOT APPLIED TO THE INPUT OF THE PCA-4125. MAKE SURE A PORTABLE GROUND IS APPLIED BETWEEN THE LINE TRAP AND THE LINE.

---

The generator must be tuned to the resonant frequency to adjust the line trap to maximum impedance. The default amplitude level of 1.0V is sufficient for testing line traps. Use the 'low level' output for impedance readings. The signal generator's low level output is capable of putting out approximately 3.8 V into a 50 ohm load and over 5V into high impedance. To change the frequency press the 'OUTPUT' key to access the GENERATOR SETTINGS display. The generator frequency is already highlighted. Use the number keypad and the multiplier keys to enter the desired

frequency. Press the ‘ENTER’ key to change the frequency. Press the ‘HOME/ESC’ key to return to the impedance meter.

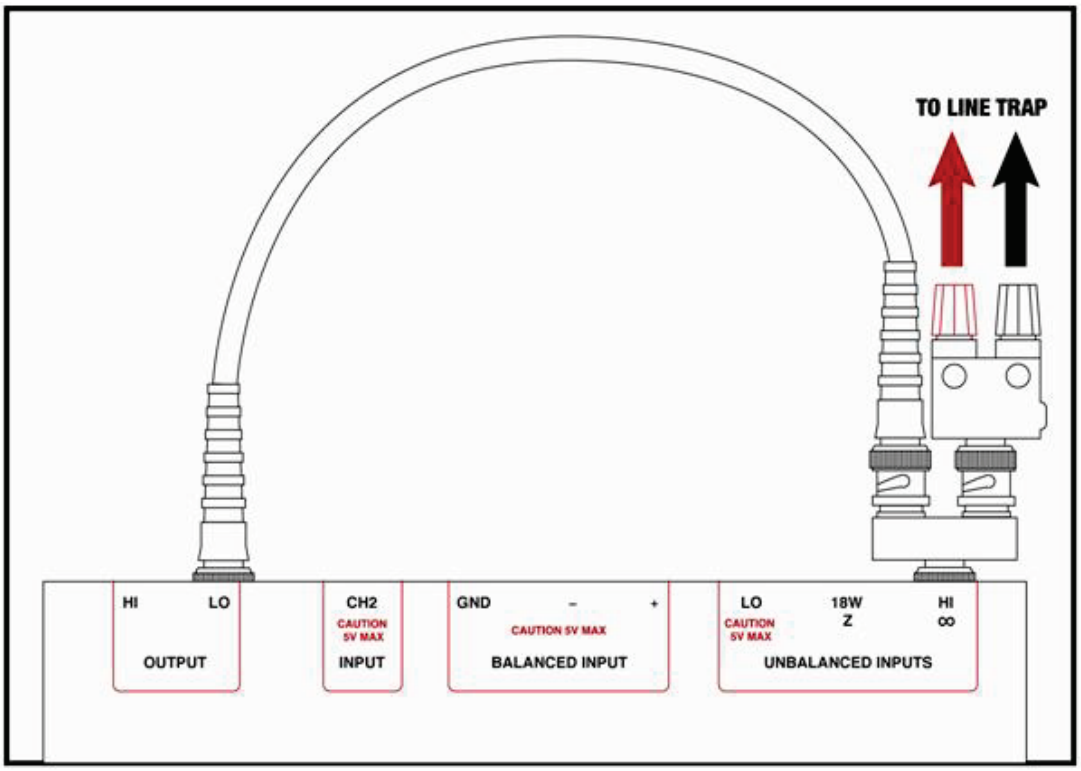



**FIGURE 5.3.6-1 - LINE TRAP TEST CONNECTIONS**

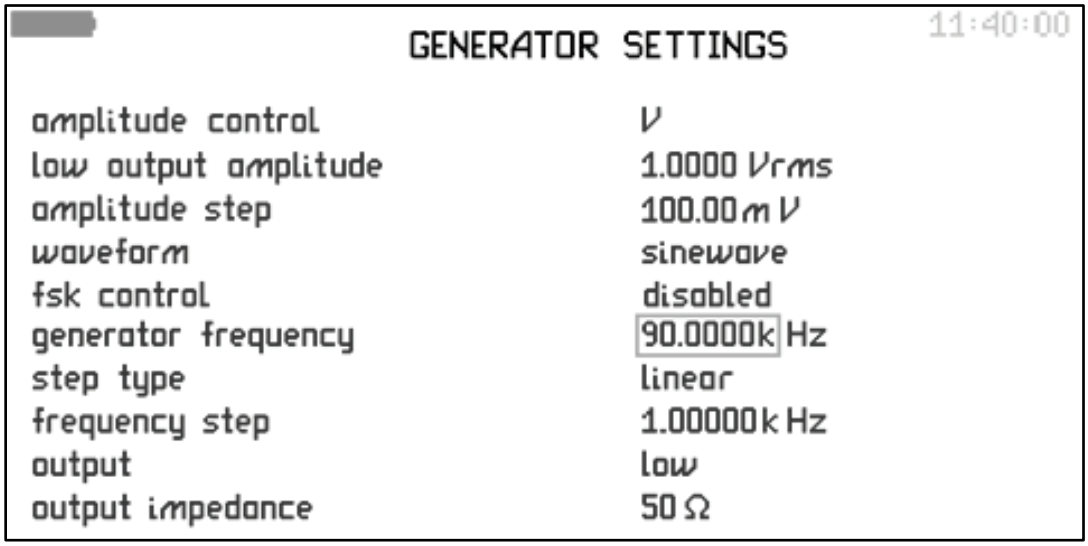



**FIGURE 5.3.6-2 – GENERATOR SETTINGS**

Figure 5.3.6-2 displays the 'GENERATOR SETTINGS' screen with the generator's frequency set at 130 kHz. Figure 5.3.6-3 displays the IMPEDANCE METER screen where a line trap has been tuned to 130 kHz. Figure 5.3.6-5 displays a graph of the sweep of the line trap tuned to 130 kHz. Figure 5.3.6-6 displays a portion of the table generated during a sweep of the line trap. Figure 5.3.6-4 displays the 'sweep setting' screen setup to sweep from 160 kHz to 250 kHz. There are 91 steps giving a step size of 1 kHz.

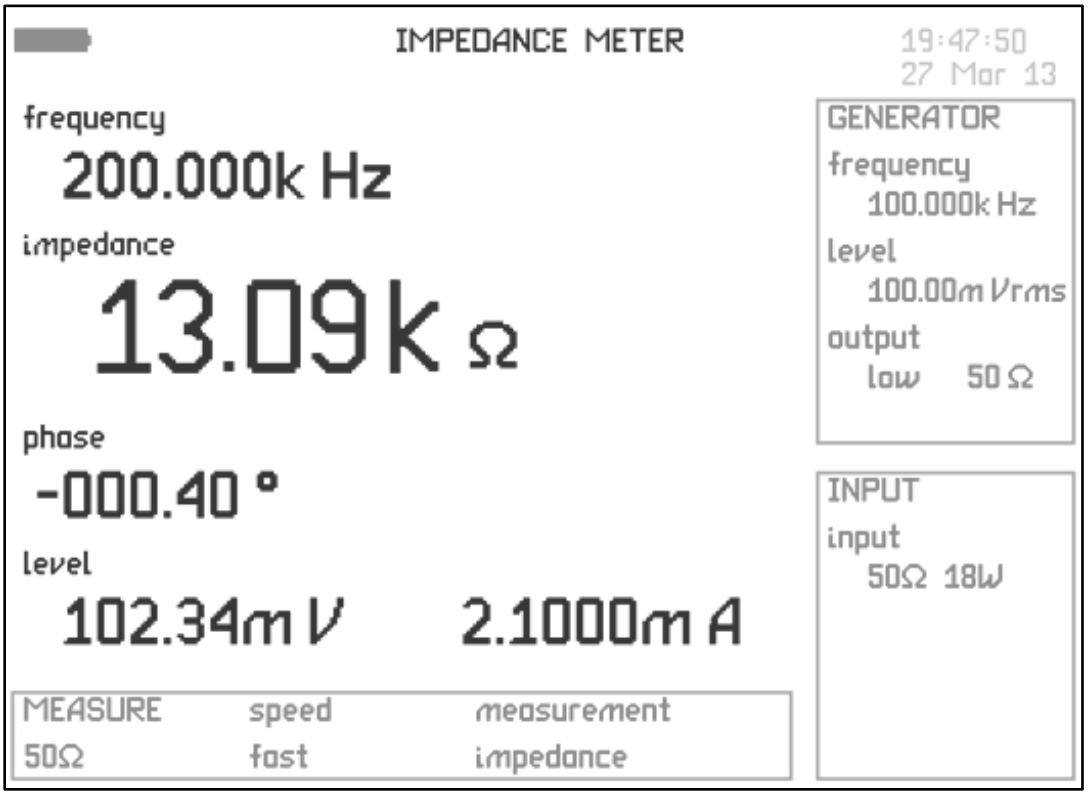



**FIGURE 5.3.6-3 – LINE TRAP IMPEDANCE**

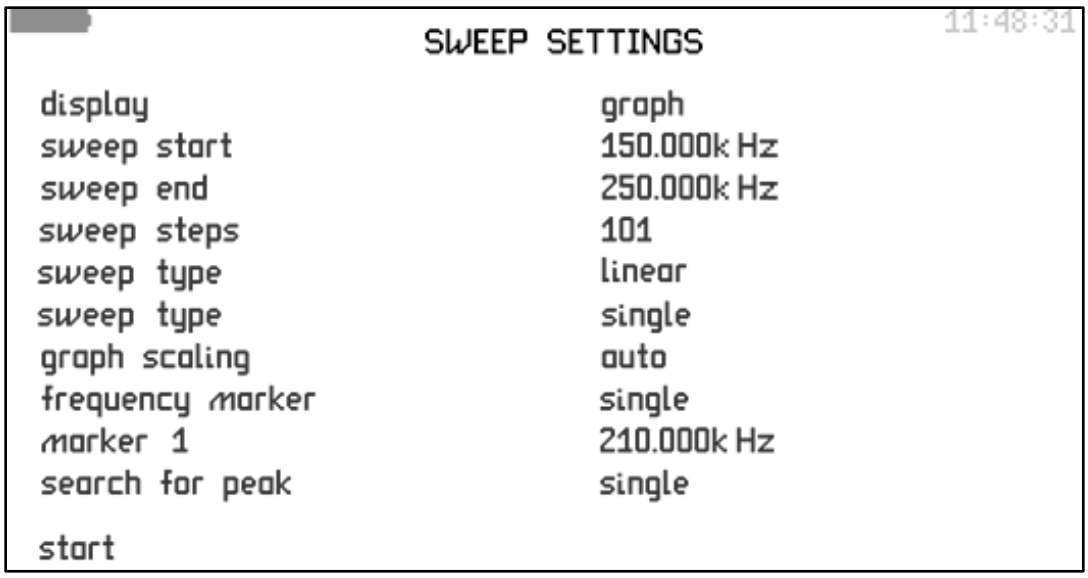



**FIGURE 5.3.6-4 - IMPEDANCE SWEEP SETTINGS**

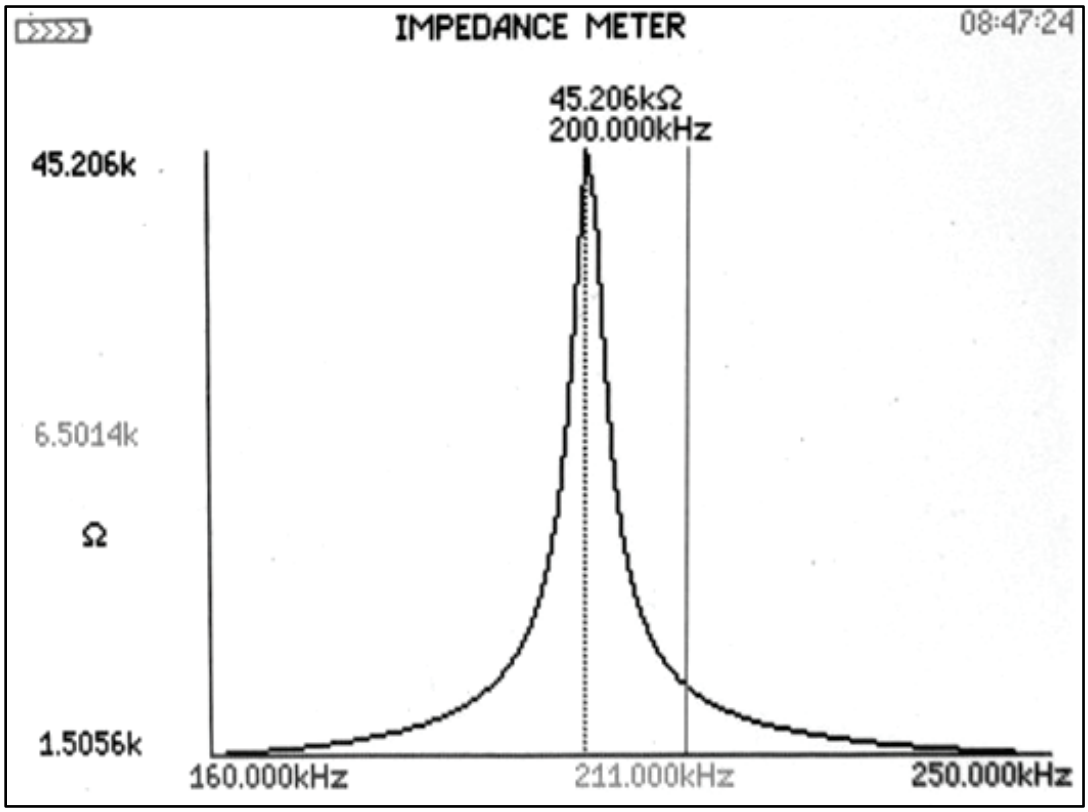



**FIGURE 5.3.6-5 – IMPEDANCE SWEEP GRAPH**

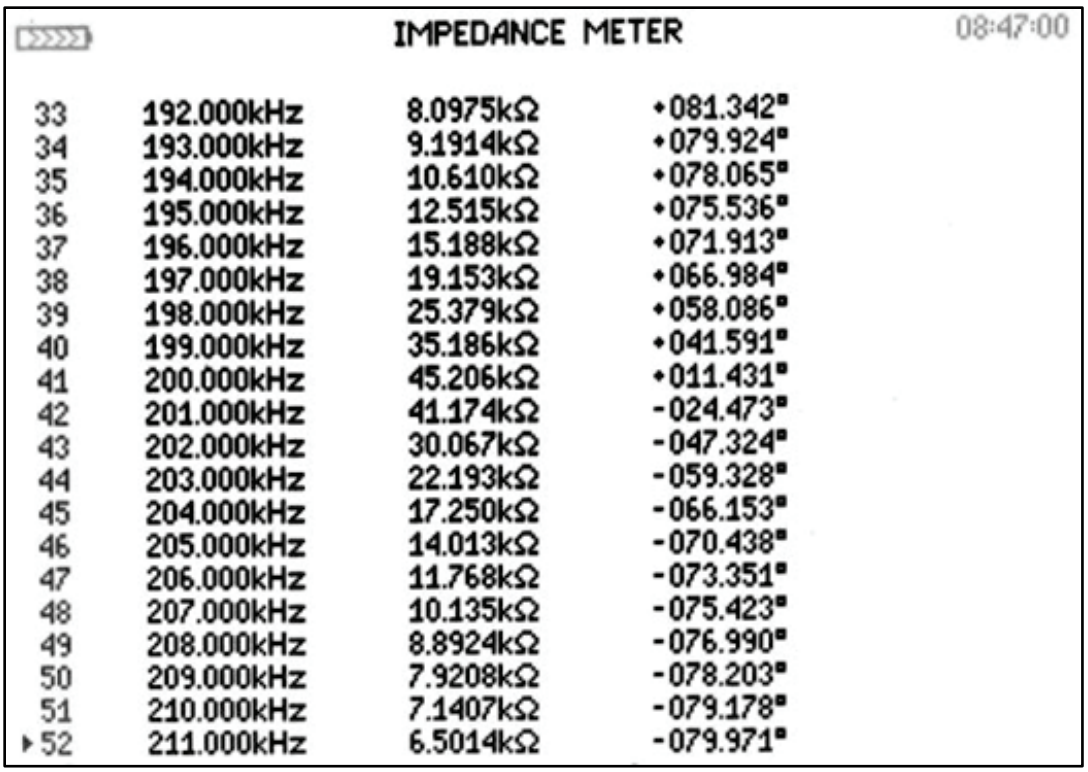



**FIGURE 5.3.6-6 - IMPEDANCE SWEEP TABLE**

### 5.3.7 Testing Line Tuners (Impedance Method)

The PCA-4125's impedance meter may be used to test line tuners. This concept requires an explanation of how a line tuner works. The purpose of a line tuner is to couple the carrier signal to the power line with a minimum of loss. This is accomplished using the impedance matching transformer and the series inductor in a single frequency line tuner.

The impedance matching transformer (IMT) takes the power line's impedance and makes it appear to be 50 ohms. All transmitters sold for use in the United States have an output impedance of 50 ohms. The impedance of a power line for phase-to-ground coupling is normally between 200 to 500 ohms. For maximum power transfer to occur, the line impedance must appear to be at 50 ohms. The tap adjustments on the impedance matching transformer are used to accomplish this.

The series inductor is used to correct for the capacitive reactance of the coupling capacitor voltage transformer (CCVT) and the 60 Hz blocking capacitor in the line tuner. The series inductor should cancel out the $X_C$ of the CCVT and blocking capacitor. When this occurs, the phase angle between the applied voltage and the current is 0°. Figure 5.3.7-1 displays the proper connections for testing line tuners (impedance method).

The PCA-4125 impedance meter displays both the measured impedance and the phase angle of the current with respect to the applied voltage. A line tuner may be tuned using these two quantities. The method is simple and is explained below. Figure 5.3.7-2 displays the impedance meter screen.

**WARNING:** THE USER SHOULD BE FULLY TRAINED IN THEIR COMPANY'S PROPER SAFETY PROCEDURES NECESSARY TO TEST LINE TUNERS AS THESE PROCEDURES DO NOT COVER THAT INFORMATION.

**CAUTION:** MAKE SURE THE TRANSMITTER IS TURNED OFF AT THE LOCAL END BEFORE REMOVING THE COAXIAL CABLE FROM THE LINE TUNER TO PREVENT DAMAGE TO THE TRANSMITTER. MAKE SURE THE REMOTE TRANSMITTER IS TURNED OFF AS THE PCA-4125'S SIGNAL GENERATOR MAY BE DAMAGED IF TOO STRONG A SIGNAL IS FED BACK INTO THE SIGNAL GENERATOR.

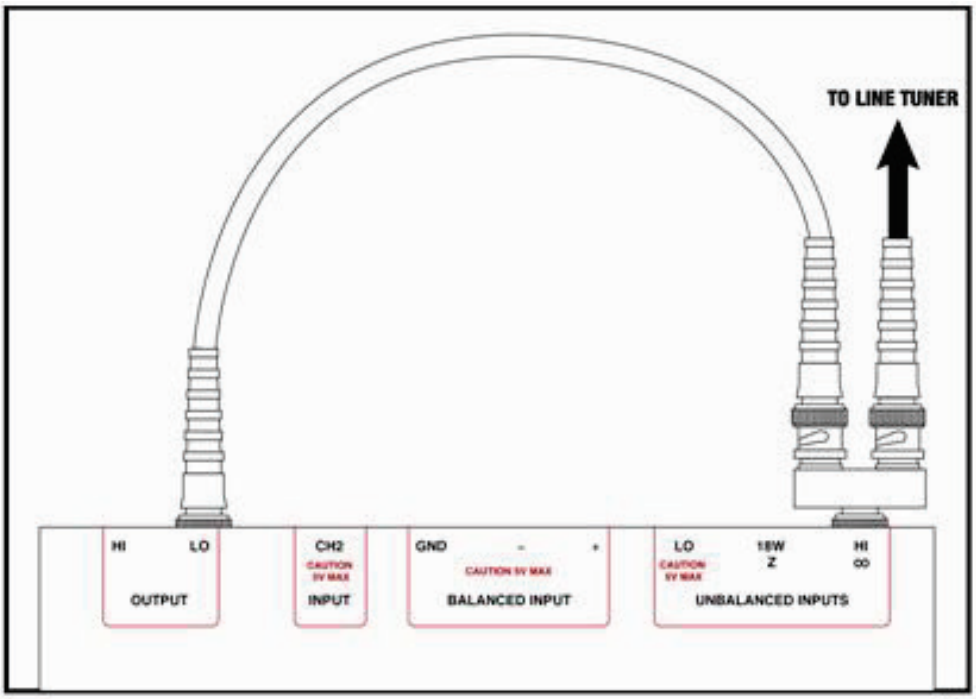



**FIGURE 5.3.7-1 – CONNECTIONS FOR LINE TUNER TESTS**

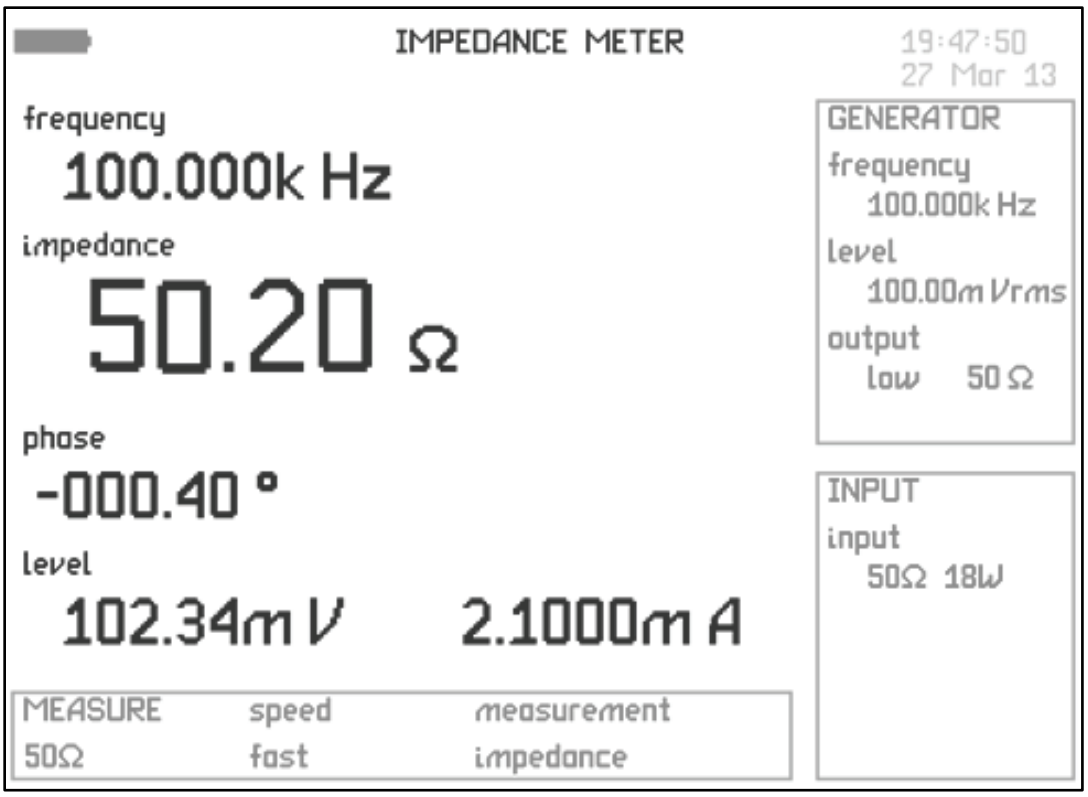



**FIGURE 5.3.7-2 – IMPEDANCE METER**

The screen in Figure 5.3.7-2 displays 50.20 ohms and a phase angle of -000.40 degrees. This would be an acceptable adjustment for the line tuner using the impedance meter. Any reading within zero degrees ±10 degrees and 50 ohms ±5 ohms will give a good VSWR reading. All line tuner adjustments are made exactly the same as the VSWR method except the final adjustment on the impedance meter should be as close to 50 ohms and zero degrees as possible.

Using this method, the user may actually read the phase angle of the current and determine if more or less inductance is needed. The same is true with the impedance (ohms). If the impedance is less than 50 ohms, the IMT needs to be adjusted for less impedance. If the impedance is more than 50 ohms, the IMT needs to be adjusted for more impedance. Experimenting with a line tuner and a dummy load connected to the line tuner will help understand these concepts.

## 5.4 VSWR Meter

The VSWR Meter measures the standing wave ratio on a communications circuit. The PCA-4125 uses two different methods to make these measurements. The first method uses impedance to measure VSWR. The second method uses an external directional coupler.

The impedance method uses the signal from the PCA-4125 signal generator as the current source and the HI∞ input as the voltage source and calculates the VSWR from these two quantities. The directional coupler method requires connecting an external directional coupler to the balanced input of the PCA-4125. The information from the directional coupler is used to calculate the VSWR. Figure 5.4-1 displays the impedance method.

The VSWR screen displays the frequency, reflected power, forward power in dB, reflected power in dB, power in watts and VSWR as a ratio. The top right dB reading is the difference between forward and reflected power. The number on the bottom right of the screen is the VSWR reading in dB. This number is covered by the "LOW LEVEL OUTPUT TURNED ON". When the VSWR meter is selected, it automatically turns on the low-level generator output.

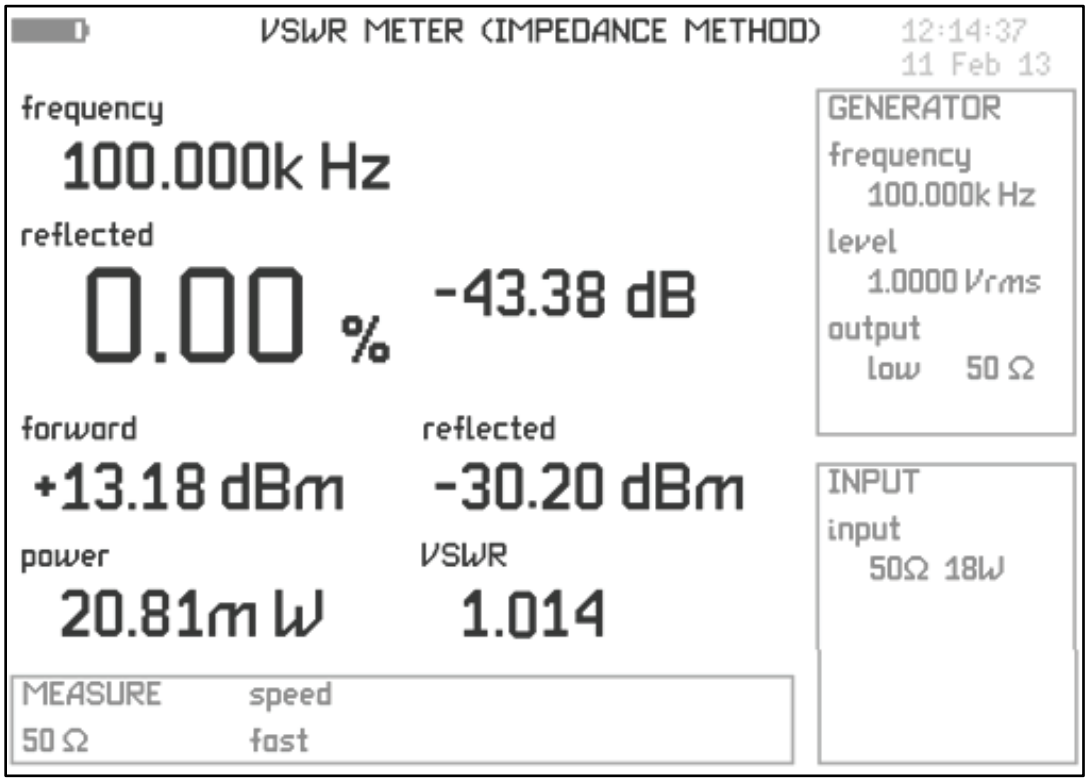



**FIGURE 5.4-1 – VSWR IMPEDANCE METHOD**

### 5.4.1 VSWR Measurement Settings

There are six options on the 'MEASUREMENT SETTINGS' screen. They are 'mode', 'method', 'reference impedance', 'graph', 'speed', and 'averaging'. 'Mode' allows the user to select any of the five different instruments that the PCA-4125 has available to the user. Figure 5.4.1-1 displays the VSWR 'MEASUREMENT SETTINGS' menu.

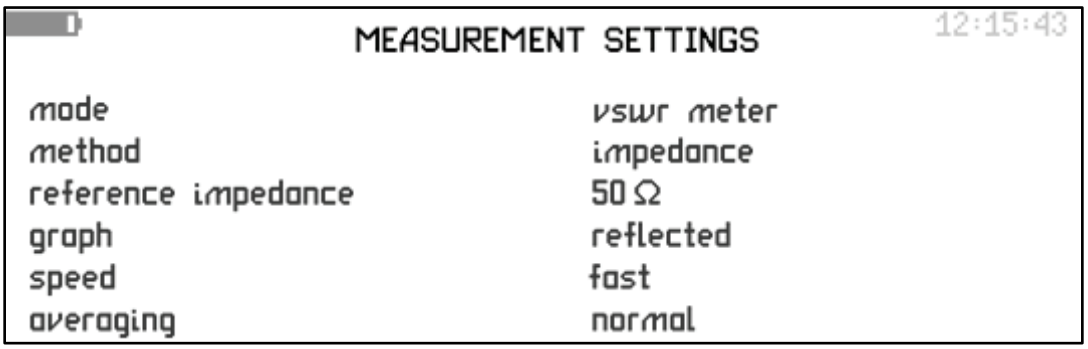



**FIGURE 5.4.1-1 – VSWR MEASUREMENT SETTINGS**

### 5.4.2 Mode

'Mode' allows the user to select from any of the five different instruments available from this option.

### 5.4.3 Method

'Method' has four options: 'impedance', 'directional coupler', 'impedance magnitude', and 'BNC directional coupler'. Figure 5.4.3-1 displays the 'method' option.

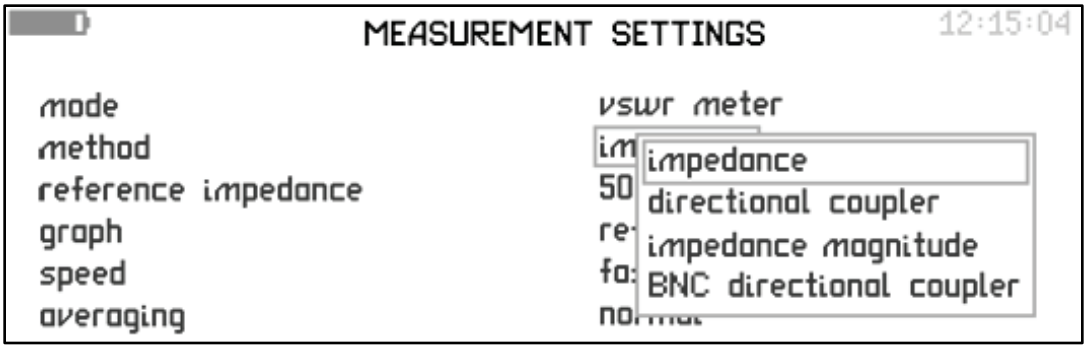



**FIGURE 5.4.3-1 – METHOD OPTION**

### 5.4.4 Reference Impedance

'Reference impedance' has four options: 50 Ω, 75 Ω, 135 Ω, and 600 Ω. Figure 5.4.4-1 displays the 'reference impedance' option.

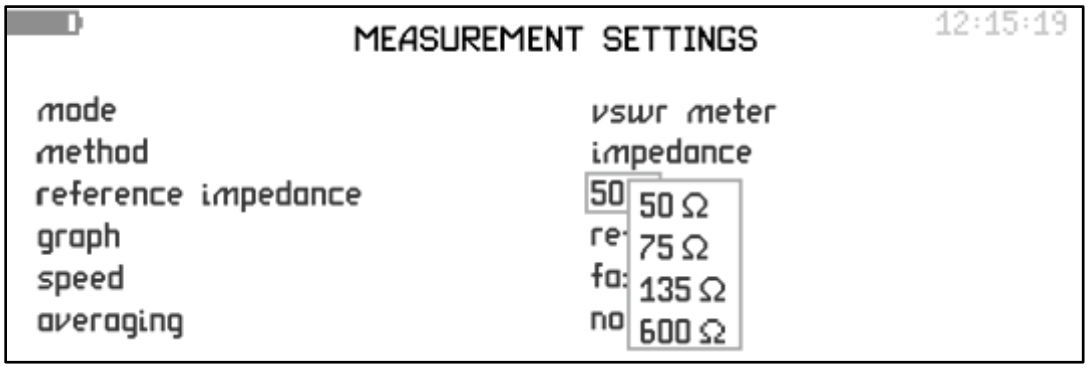



**FIGURE 5.4.4-1 – REFERENCE IMPEDANCE OPTION**

### 5.4.5 Graph

'Graph' provides three methods to display the data generated by a sweep. The three methods are: 'reflected' (power), 'return loss', and 'VSWR'. Reflected power is the default setting.

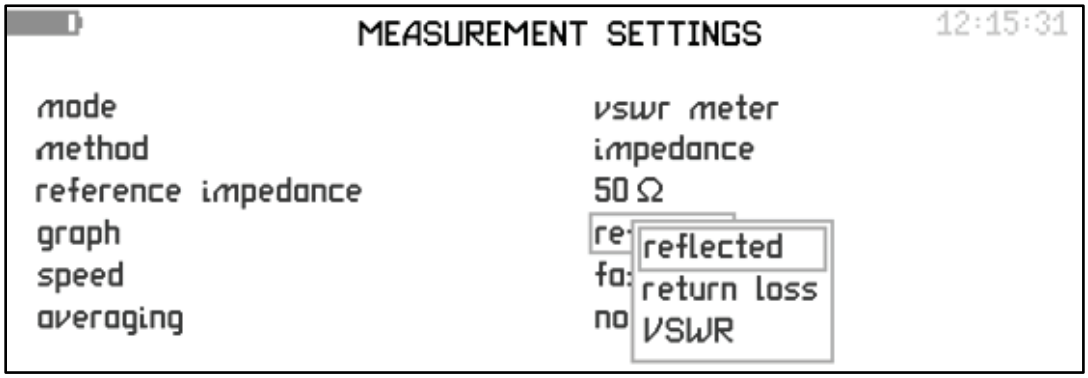



**FIGURE 5.4.5-1 –GRAPH OPTION**

### 5.4.6 Speed

'Speed' sets the sample rate of the instrument. There are five 'speed' options: 'very slow', 'slow', 'medium', 'fast' (default setting), and 'very fast'. Setting the option to 'fast' when doing a sweep function decreases the time it takes for the sweep. Figure 5.4.6-1 displays the 'speed' options.

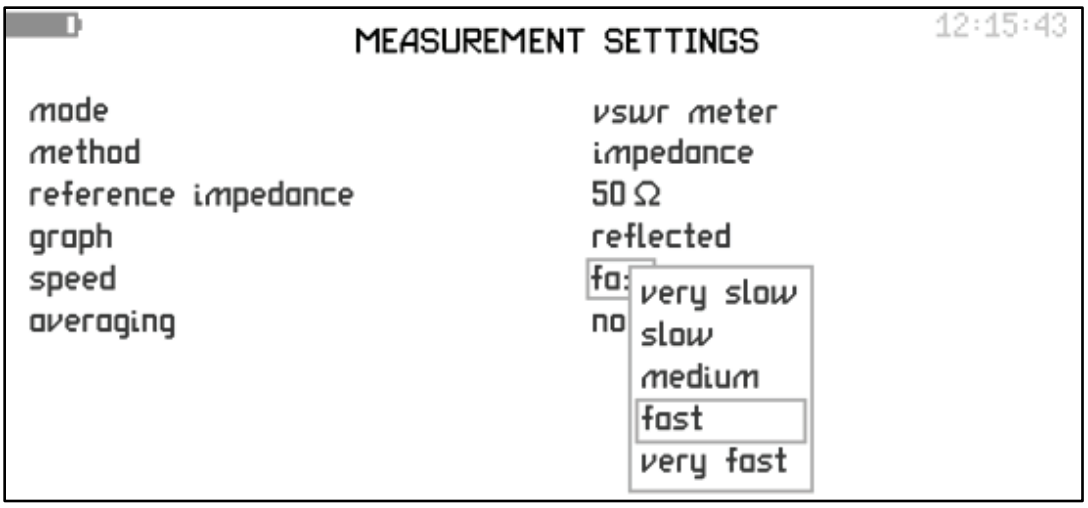



**FIGURE 5.4.6-1 –SPEED OPTION**

### 5.4.7 Averaging

'Averaging' sets how many samples the instrument takes before updating the display. There are three options for averaging: 'slow', 'normal', and 'none'. An erratic screen display may be eliminated by using the 'slow' averaging function. Figure 5.4.7-1 displays the 'averaging' options.

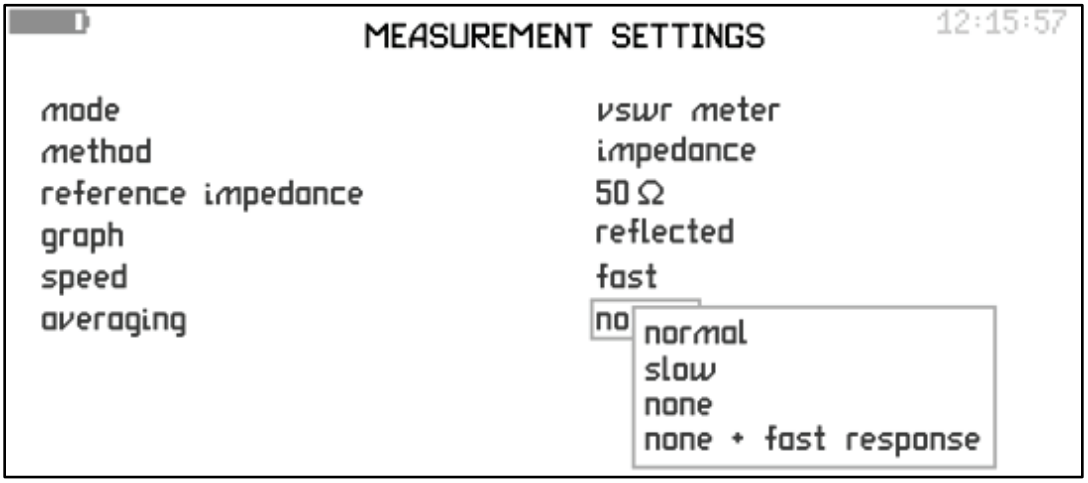



**FIGURE 5.4.7-1 – AVERAGING OPTION**

### 5.4.8 VSWR Impedance Method

Taking VSWR readings using the impedance method requires connecting the low output of the signal generator to the 'high Z' input of the PCA-4125. Figure 5.4.8-2 displays this connection. Only the 'low' output of the generator may be used to take VSWR readings in the 'impedance method'. Remember to turn off and disconnect the transmitter before connecting the PCA-4125 to the coaxial cable or line tuner.

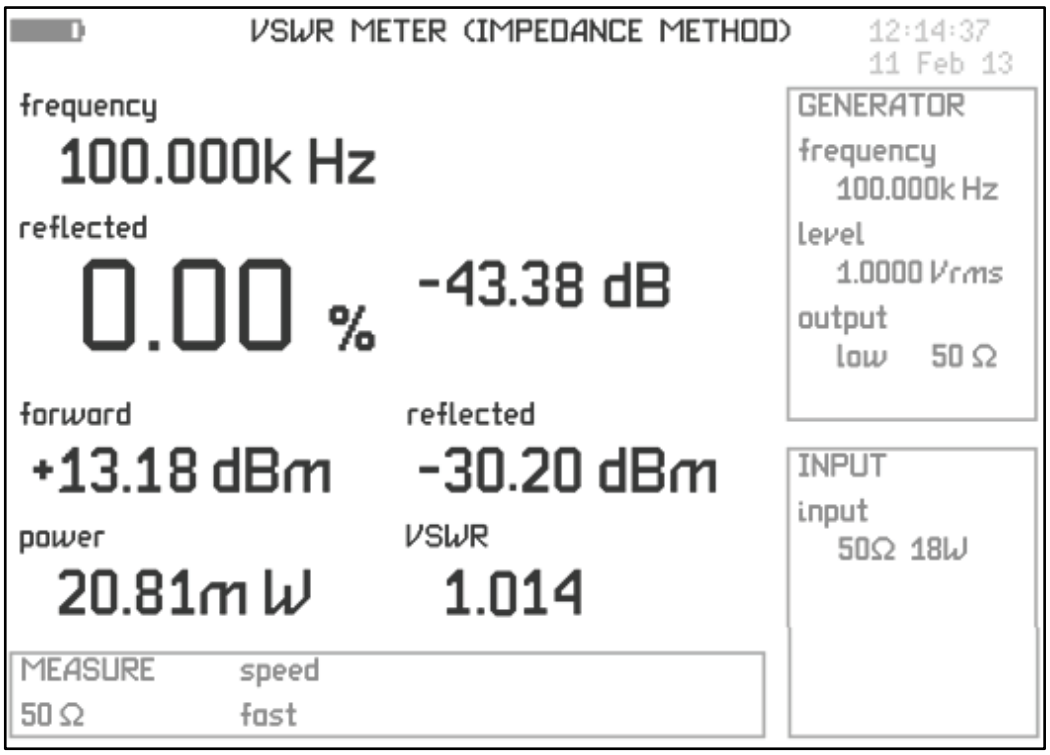



**FIGURE 5.4.8-1 – VSWR METER (IMPEDANCE METHOD) SCREEN**

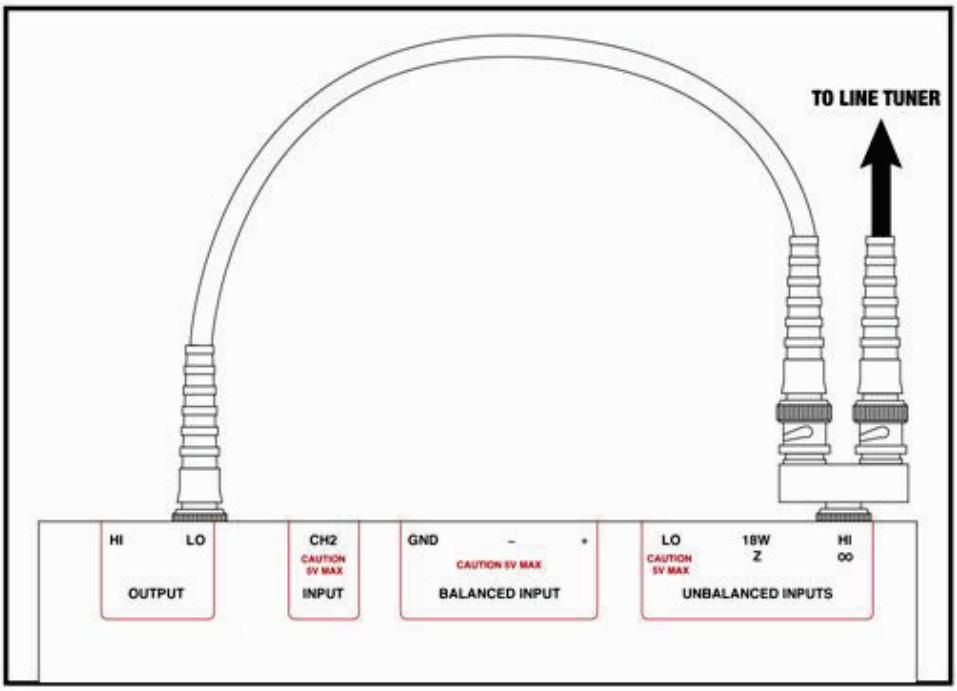



**FIGURE 5.4.8-2 – IMPEDANCE METHOD CONNECTION**

### 5.4.9 VSWR Sweep

The sweep function of the PCA-4125 is enabled in the 'VSWR impedance' mode. The line tuner may be swept to determine the frequency it is tuned to. Once the line tuner is adjusted to its 'tuned frequency', a sweep may be performed to determine the bandwidth of the line tuner. ***The sweep function only works in the 'impedance' mode, not the 'directional coupler' mode.***

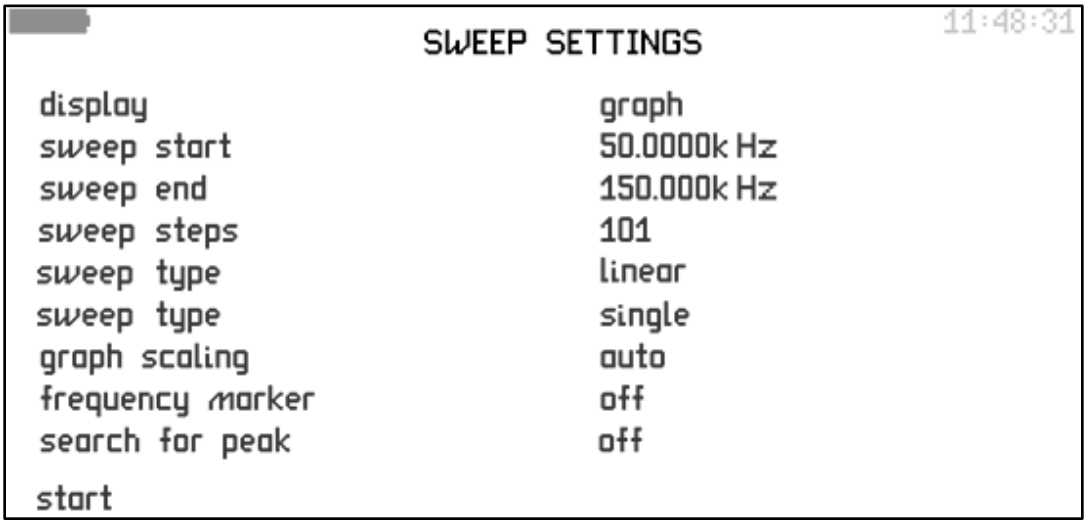



**FIGURE 5.4.9-1– VSWR IMPEDANCE SWEEP**

Using the same setup as in Figure 5.4.8-2 above, press the 'sweep' key and the screen in Figure 5.4.9-1 is displayed. Set the start and stop frequencies by using the 'UP/DOWN' arrow keys to highlight 'sweep start' or 'sweep stop' and enter the start and stop frequencies. Use the 'UP' or 'DOWN' arrow keys to highlight the 'start' function. Press the 'ENTER' key to start the sweep.

### 5.4.10 VSWR Directional Coupler Method

The 'directional coupler' method is used to take VSWR readings using the local transmitter as the signal source. Some options for the directional coupler are different than the impedance method. The scale factor, center frequency, and bandwidth options have been added to the menu. Figure 5.4.10-1 displays these options.

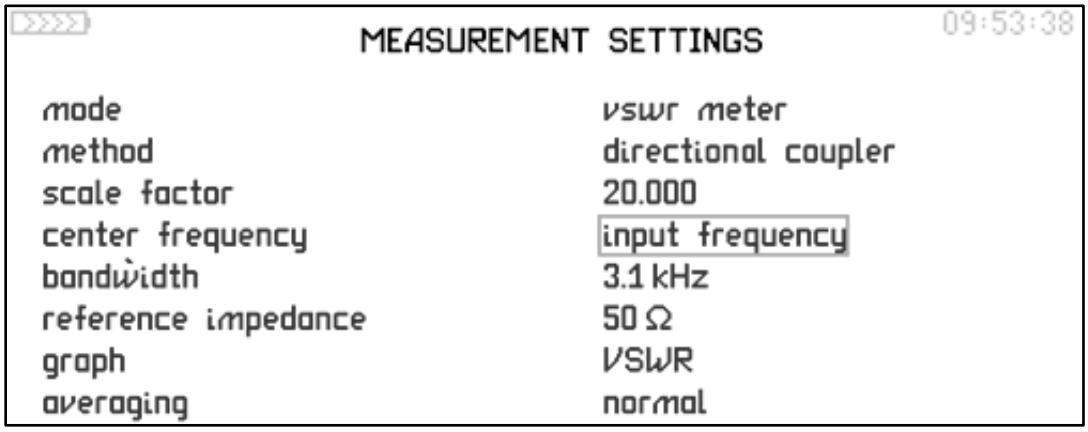



**FIGURE 5.4.10-1 – DIRECTIONAL COUPLER OPTIONS**

### 5.4.11 Scale Factor

Scale factor is used to provide the proper signal levels on the screen when the directional coupler is used. The directional coupler is designed to attenuate the measured signal by -20dBm since the balanced input is only rated 5 volt RMS. Figure 5.4.10-1 displays the scale factor set to 20 (-20dBm).

### 5.4.12 Center Frequency

Center frequency has three options: 'track generator', 'input frequency', and 'fixed'. Track generator follows the frequency of the generator. If you change the frequency of the generator, the VSWR meter changes to the new generator frequency. Input frequency looks for the highest signal level within the bandwidth at the input of the VSWR meter and displays that frequency and SWR reading. Fixed frequency allows the user to set the VSWR meter to a specific frequency and adds three options: 'tuned frequency', 'step type', and 'step size'. Figure 5.4.12-1 displays the center frequency options.

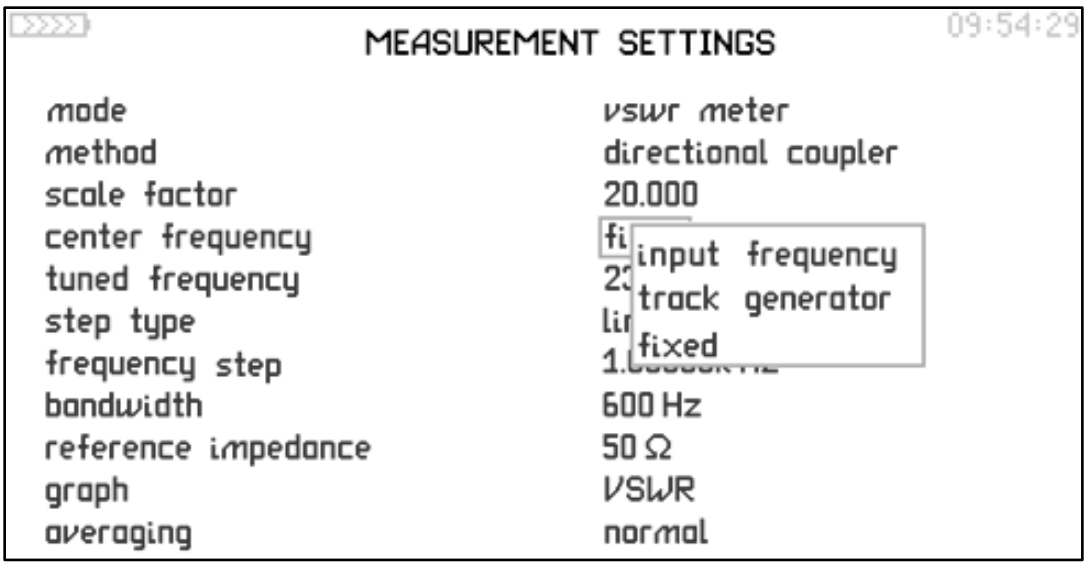



**FIGURE 5.4.12-1 – CENTER FREQUENCY OPTIONS**

### 5.4.13 Step Type

Step type has two options: logarithmic or linear. Selecting the 'logarithmic' option makes each frequency step larger in value (logarithmic) Selecting the 'linear' option makes each frequency step size as set by 'frequency step'. The screen in Figure 5.4.13-1 appears when this function is selected.

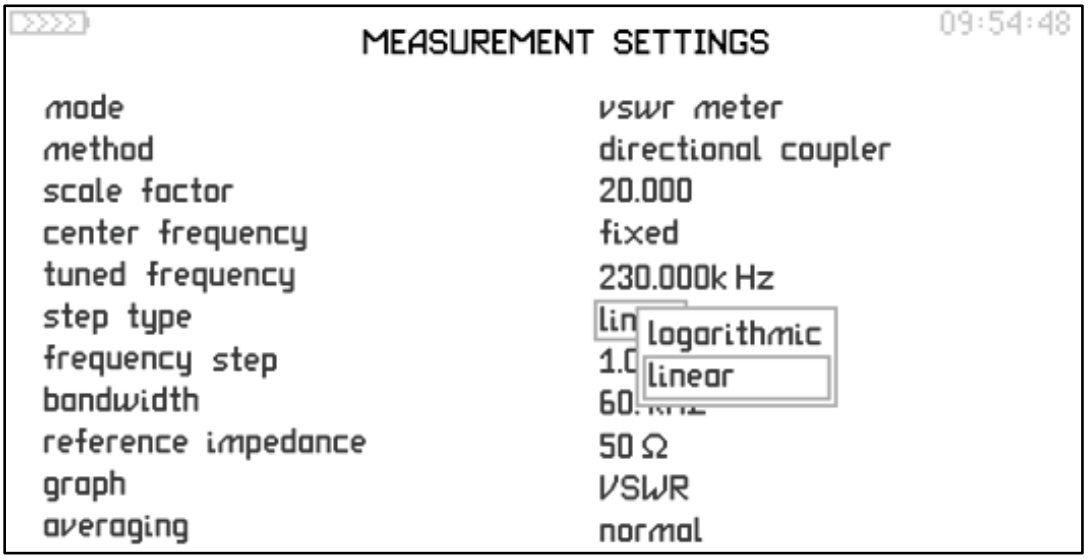



**FIGURE 5.4.13-1 - STEP TYPE**

### 5.4.14 Frequency Step

Frequency step sets the size of each step when the 'LEFT/RIGHT' arrow keys are used to raise or lower the frequency.

### 5.4.15 Bandwidth

The meter has five bandwidths: 3.1kHz, 1.95kHz, 600Hz, 100Hz and 25Hz. The 100Hz bandwidth (±50Hz) is normally used with RF carrier frequencies. The 25Hz bandwidth is normally used with audio tones or when frequencies are closely spaced were the 100Hz filter would not work.

### 5.4.16 Reference Impedance

'Reference impedance' has four options: 50 Ω, 75 Ω, 135 Ω and 600 Ω. Power level readings displayed in dBm must have a reference impedance to show the correct power level.

### 5.4.17 Graph

Graph has three options: reflected, return loss and VSWR.

### 5.4.18 Averaging

The averaging option has four options – normal, slow, none and none + fast response. This function sets how many samples the instrument takes before updating the display. If the signal level on the display is erratic, set averaging to 'slow'. If you want immediate updates, set averaging to 'none'.

### 5.4.19 Directional Coupler Method

The directional coupler is connected in series between the transmitter and the line tuner. The local transmitter's output is connected to the input of the directional coupler. The output of the directional coupler is connected to the coax cable that was removed from the transmitter. Figure 5.4.19-1 shows the directional coupler connections and Figure 5.4.15-2 displays the 'directional coupler' screen.

---

**CAUTION:** REMOVE THE PROTECTIVE BNC CAPS FROM THE CH 2 INPUT AND THE LO UNBALANCED INPUT BEFORE CONNECTING THE 'DIRECTIONAL COUPLER' TO THE INSTRUMENT. THE BNC CAPS COULD SHORT OUT THE CARRIER SIGNAL GIVING ERRONEOUS READINGS.

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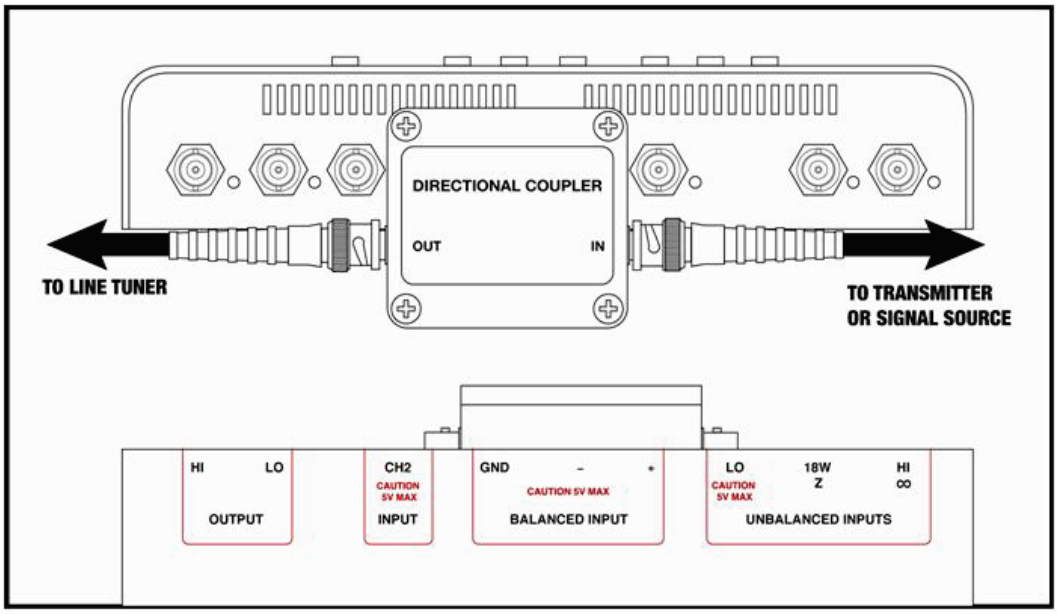


**FIGURE 5.4.19-1 - DIRECTIONAL COUPLER CONNECTIONS**

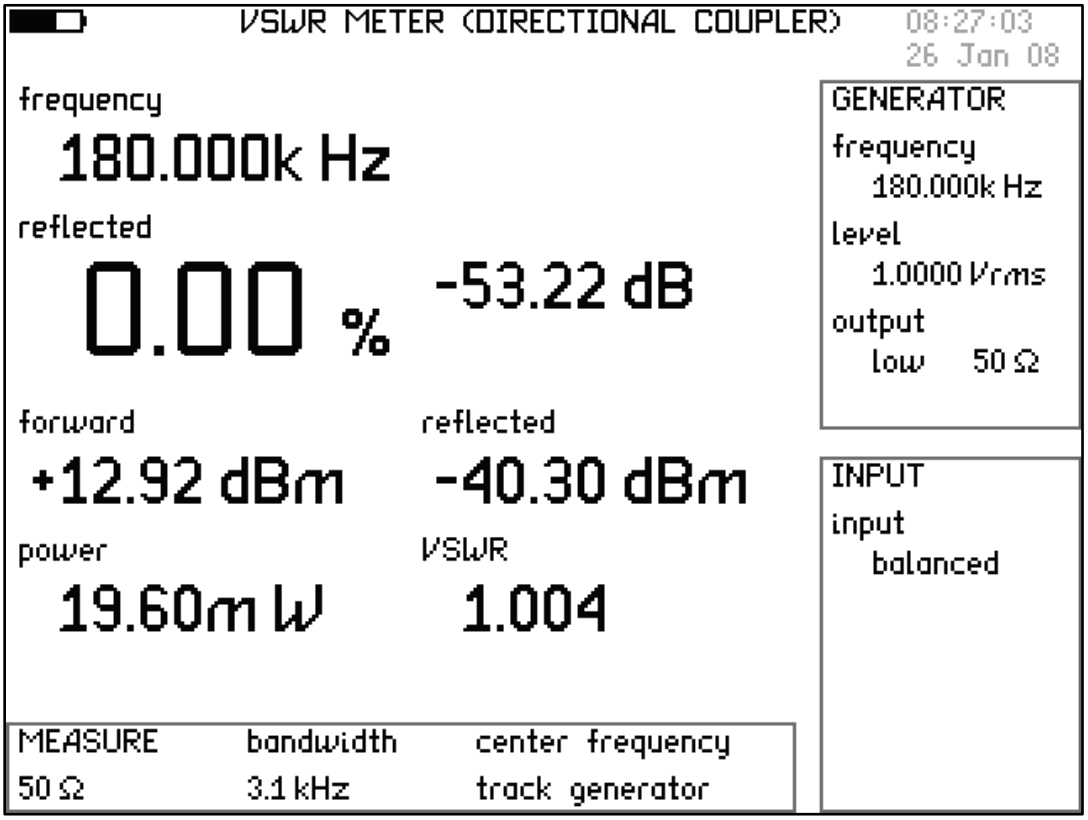


**FIGURE 5.4.19-2 – DIRECTIONAL COUPLER METHOD**

## 5.5 Frequency Response Analyzer

The Frequency Response Analyzer (FRA) is used to measure the dynamic response of a system or piece of equipment. A sine wave is applied to the input and the phase and gain of the output is measured to determine the frequency response of the equipment/system under test. Figure 5.5-1 shows the display of the PCA-4125's Frequency Response Analyzer. The FRA is accessed from the round 'FRA' key on the right side of the instrument or from the 'MEASURE' menu. Figure 5.5-2 displays the frequency response analyzer MENU or 'MEASUREMENT SETTINGS'.

The FRA screen displays the frequency, gain, phase and CH1 and CH2 voltage levels. Two input channels are required to use the frequency response analyzer. The signal source may be from the internal signal generator or from an external source.

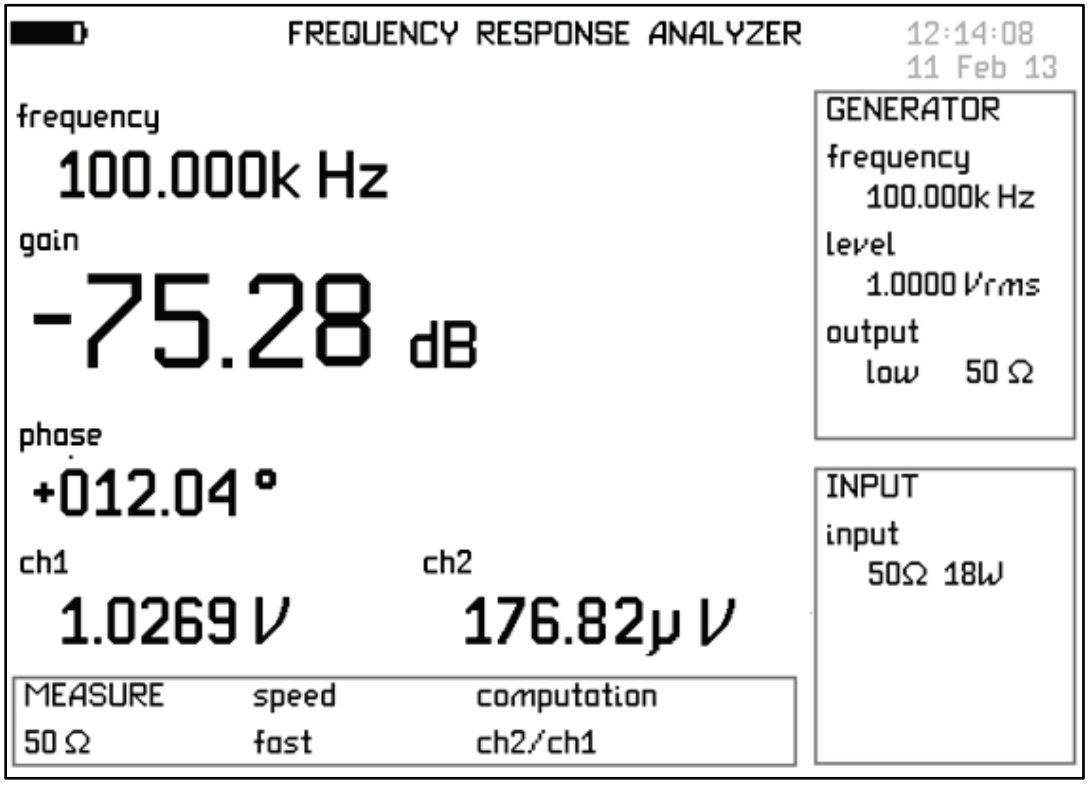


**FIGURE 5.5-1 – FREQUENCY RESPONSE ANALYZER**

The FRA has five functions: mode, speed, averaging, graph, and computation. 'Mode' allows the user to select any of the five different instruments available on the PCA-4125. 'Speed' sets the sample rate of the instrument. 'Averaging' sets how many samples the instrument takes before updating the display. 'Graph' sets how the frequency response is displayed. 'Computation' sets the inputs. Figure 5.5-2 displays the frequency response analyzer MENU.

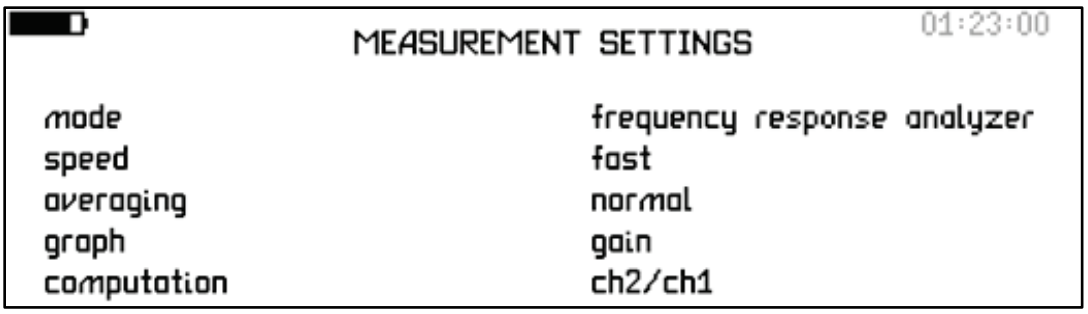


**FIGURE 5.5-2 – FREQUENCY RESPONSE ANALYZER MENU**

### 5.5.1 Mode

**'**Mode' allows the user to select from any of the five different instruments available.

### 5.5.2 Speed

'Speed' sets the sample rate of the instrument. There are five 'speed' options: 'very slow', 'slow', 'medium', 'fast' (default setting), and 'very fast'. Figure 5.5.2-1 displays the 'speed' options.

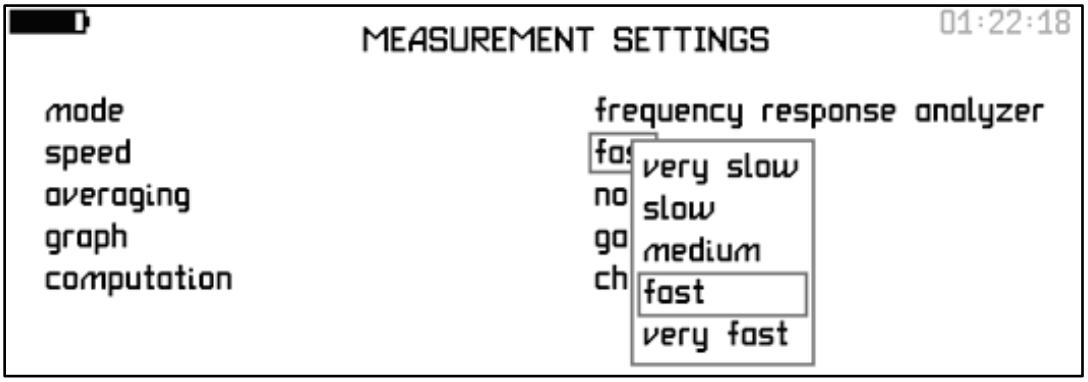


**FIGURE 5.5.2-1 – SPEED OPTIONS**

### 5.5.3 Averaging (Filter)

'Averaging' sets how many samples the instrument takes before updating the display. There are three options for averaging: 'slow', 'normal', and 'none'. An erratic screen display may be eliminated by using the 'slow' averaging function. Figure 5.5.3-1 displays the 'averaging' options.

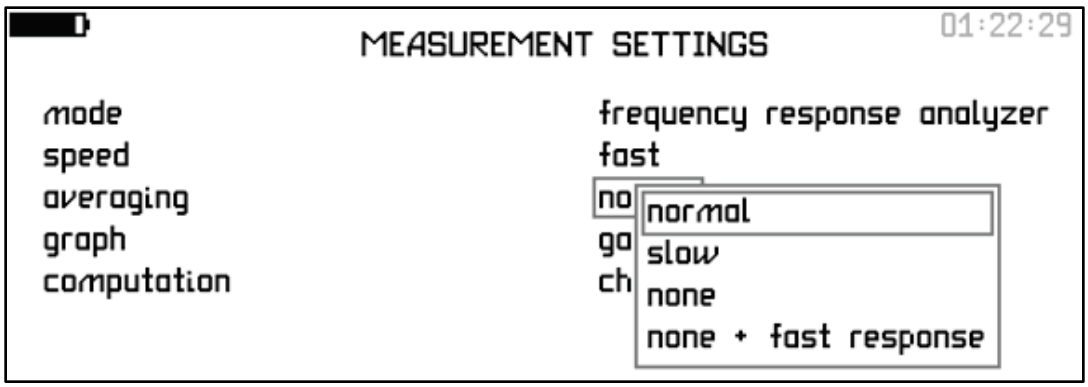


**FIGURE 5.5.3-1 – AVERAGING (FILTER) OPTIONS**

### 5.5.4 Graph

'Graph' sets how the frequency response is displayed. 'Graph' has two options: gain or phase. These options work in conjunction with the computation option. Selecting 'gain' plots the gain or loss of the signal levels between the two channels. 'Phase' plots the phase angle difference between the two channels. Figure 5.5.4-1 displays this option.

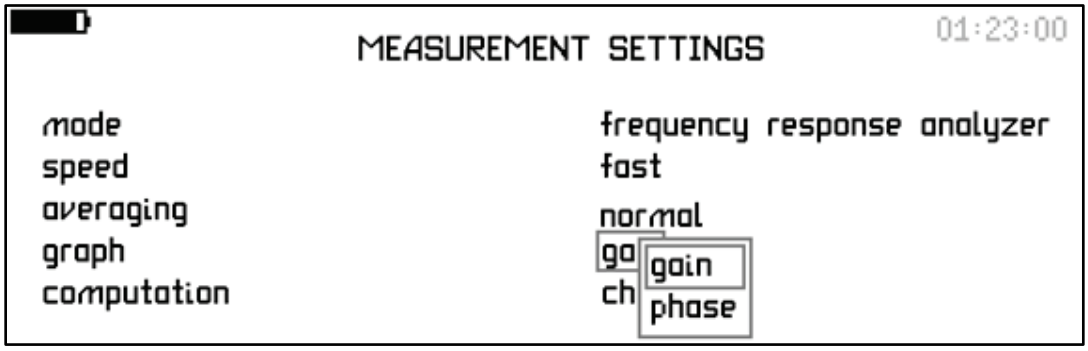


**FIGURE 5.5.4-1 – GAIN OPTIONS**

### 5.5.5 Computation

'Computation' sets up the inputs. 'Computation' has two options: 'ch2/ch1' or 'ch1/ch2'. Setting this option determines how the graph displays the results of the frequency response sweep. Figure 5.5.5-1 displays the 'computation' option.

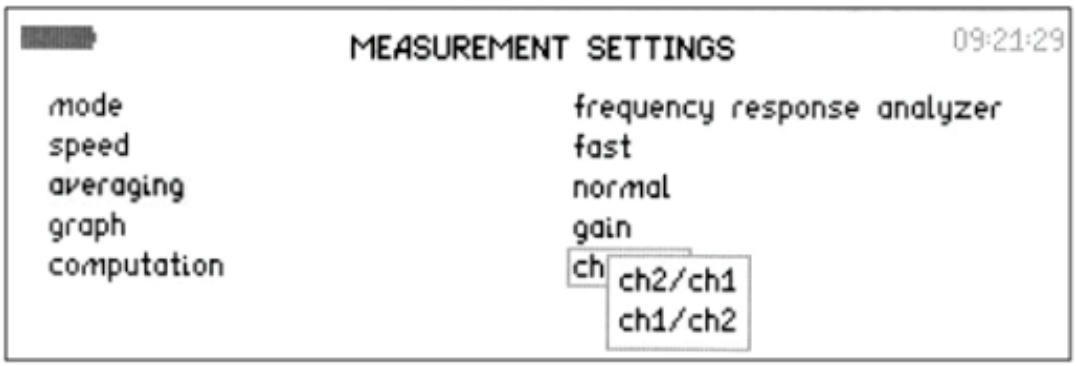


**FIGURE 5.5.5-1 COMPUTATION OPTION**

### 5.5.6 Inputs

In most cases the 'HI ∞' unbalanced input and 'CH2' input should be used.

---

**CAUTION:** DO NOT USE THE 'BALANCED INPUT' IN FRA APPLICATIONS. USE THE 'HI ∞' INPUT (WHEN POSSIBLE) AND 'CH2' INPUT. BE AWARE THAT THE 'CH2' INPUT IS ONLY GOOD FOR 5 VOLTS WITH A DIRECT CONNECTION AND THE 'HI ∞' UNBALANCED INPUT IS ONLY GOOD FOR 150 VOLTS. USE AN ATTENUATOR (NOT PROVIDED) WITH THE 'CH2' INPUT IF THE VOLTAGE WILL EXCEED 5 VOLTS.

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### 5.5.7 Hybrid Testing using the Frequency Response Analyzer

Resistance hybrids and skewed hybrids have fixed loses between their ports. These losses may be measured using an FRA function on the PCA-4125. Reactance hybrids are adjustable and the FRA function may be used to adjust this type of hybrid. The connections are the same for all hybrids. Connect the H∞ input from the PCA-4125 to input port 1 on the hybrid. Connect a 50 Ω dummy load to the output port of the hybrid. Connect the CH2 input from the PCA-4125 to input port 2 on the hybrid. Figure 5.5.7-1 displays the FRA real time results from a skewed hybrid test between the XMIT port and REC port.

---

**CAUTION:** THE CH2 INPUT USED WITH THE FRA IS LIMITED TO A MAXIMUM OF 5 V RMS. IF THE ADJUSTMENTS ARE MADE USING THE LOCAL TRANSMITTERS' OUTPUT, THE CH2 INPUT COULD BE DAMAGED. AN INPUT ATTENUATOR SHOULD BE USED IN THESE CASES. CONTACT POWERCOMM SOLUTIONS FOR MORE INFORMATION.

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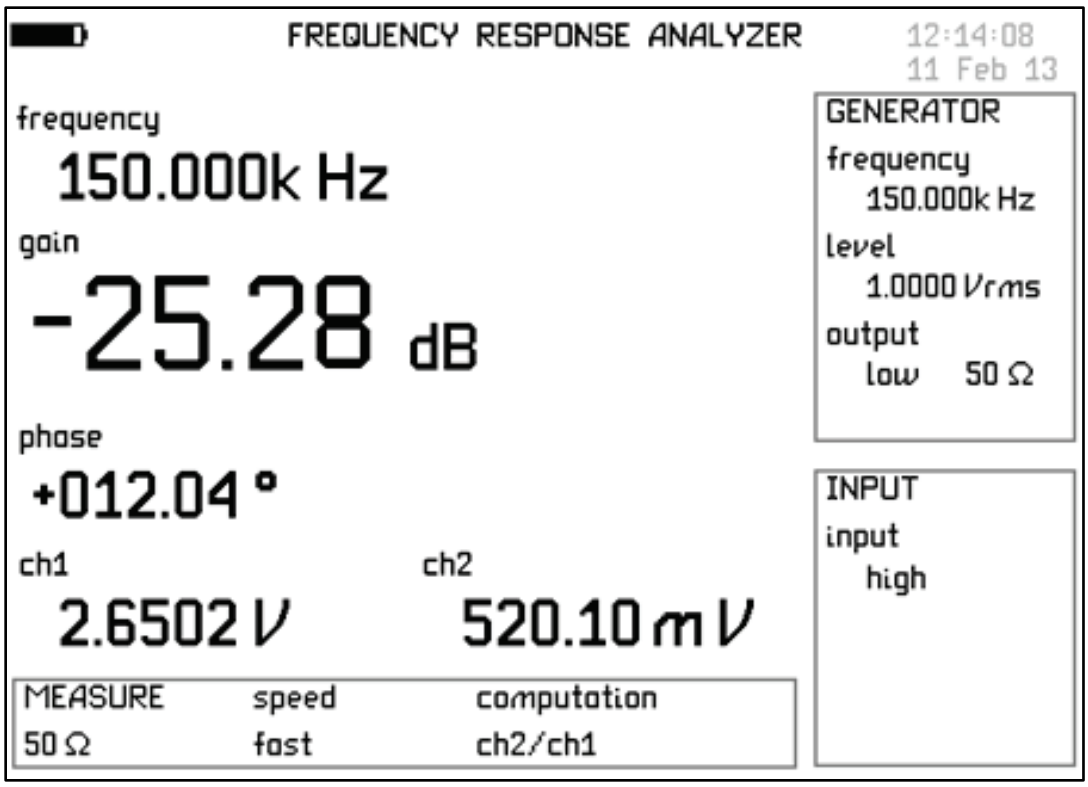


**FIGURE 5.5.7-1 - SKEWED HYBRID FRA TEST**

Figure 5.5.7-2 displays the connection to a GE reactance hybrid and the PCA-4125.

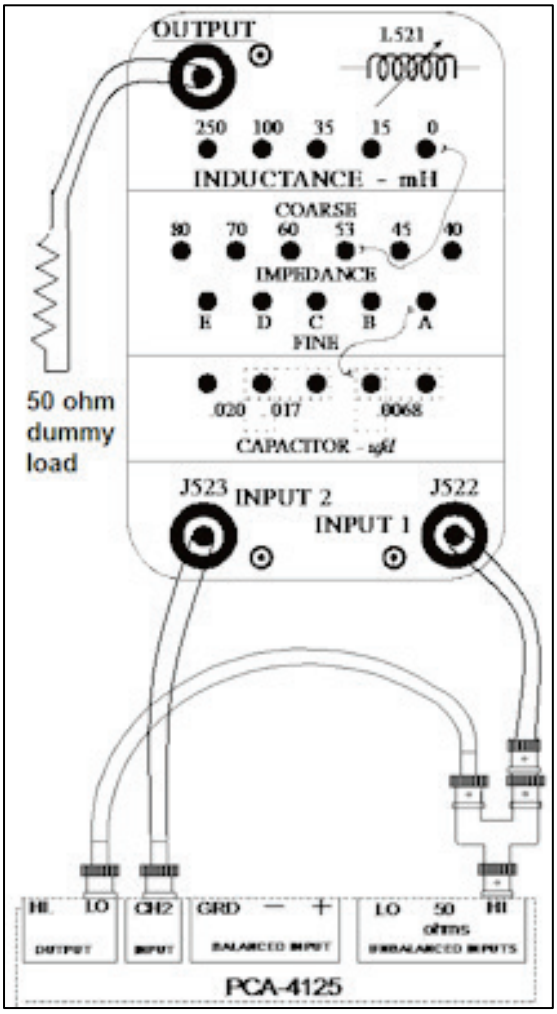


**FIGURE 5.5.7-2 – CONNECTIONS TO TEST A REACTANCE HYBRID**

## 5.6 Oscilloscope

The oscilloscope has many uses and the user may determine when they will use this meter function. Provided below is the information needed to use the oscilloscope. The oscilloscope is a dual trace scope. Use the '*HI* ∞' input as channel 1 and '*CH2*' input as channel 2. The setting for both inputs should be '*high Z*'. Confirm this setting before using the oscilloscope.

**CAUTION:** DO NOT USE THE 'BALANCED INPUT' FOR OSCILLOSCOPE OPERATION. ONLY USE THE 'HI ∞' INPUT AND 'CH2' INPUT. BE AWARE THAT THE 'CH2' INPUT IS ONLY GOOD FOR 5 VOLTS WITH A DIRECT CONNECTION AND 50 VOLTS WITH A 10X PROBE. THE 'HI ∞' INPUT IS GOOD FOR 150 VOLTS WITH A DIRECT CONNECTION AND 1000 VOLTS WITH A 10X PROBE.

The oscilloscope may be accessed from the 'MEASURE' key or the 'APP' key. Press the 'MEASURE' key to display the measurement screen. Use the *UP/DOWN* arrow keys to highlight the 'mode' options. Use the *RIGHT* arrow key to display these options. Use the *UP/DOWN* arrow keys to highlight the '*oscilloscope*' function. Press the ENTER key to activate the oscilloscope. Figure 5.6-1 displays the oscilloscope function selected.

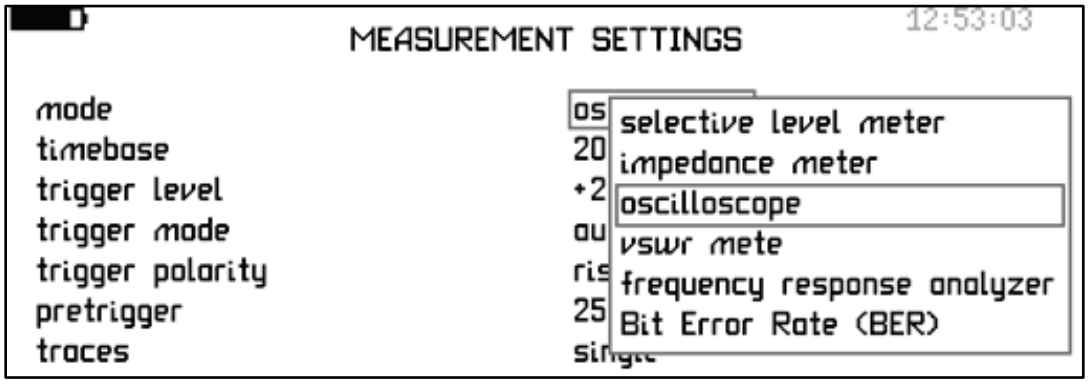


**FIGURE 5.6-1 – OSCILLOSCOPE FUNCTION**

Access the oscilloscope using the 'APP' display by pressing the 'APP' key. Use the *UP/DOWN* arrow keys to highlight the '*oscilloscope'* function. Press the ENTER key to select the oscilloscope. Use the *UP/DOWN* arrow keys to highlight the *'initialize'* function. Press the ENTER key to activate the oscilloscope. Figure 5.6-2 displays the 'Application Selection' selected. Figure 5.6-3 displays the oscilloscope function selected.

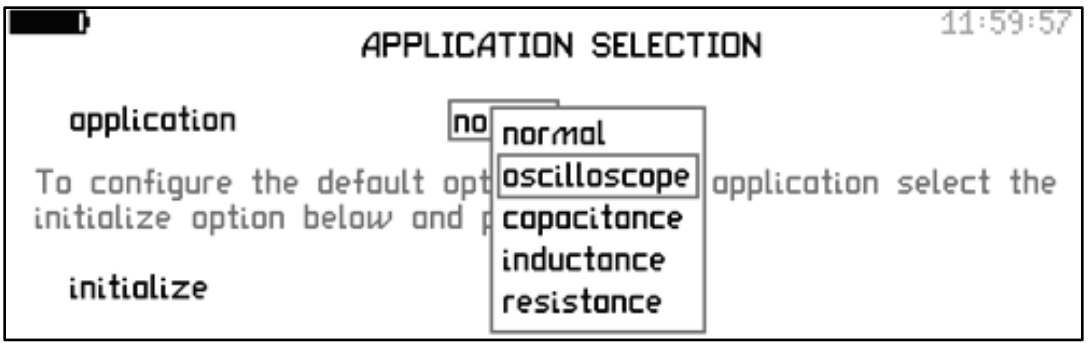


**FIGURE 5.6-2 – APPLICATION SELECTION**


**FIGURE 5.6-3 – OSCILLOSCOPE FUNCTION**

### 5.6.1 Oscilloscope Settings

There are seven functions that appear on the 'APPLICATION SELECTION' screen after initializing the oscilloscope application. They are 'mode', 'timebase', 'trigger level', 'trigger mode', 'trigger polarity', 'pretrigger' and 'traces'. 'Mode' allows the user to select any of the five different instruments available on the PCA-4125. 'Timebase' sets the sweep rate of the oscilloscope. 'Trigger level' sets the minimum voltage required to start a sweep. 'Trigger mode' determines the method in which the oscilloscope is triggered. 'Trigger polarity' determines if the oscilloscope is triggered by a rising voltage or a falling voltage. 'Pretrigger' sets how much of the display is still available from the trigger point. 'Traces' sets up the oscilloscope in either a single trace or dual trace mode. Figure 5.6.1-1 displays the seven options.

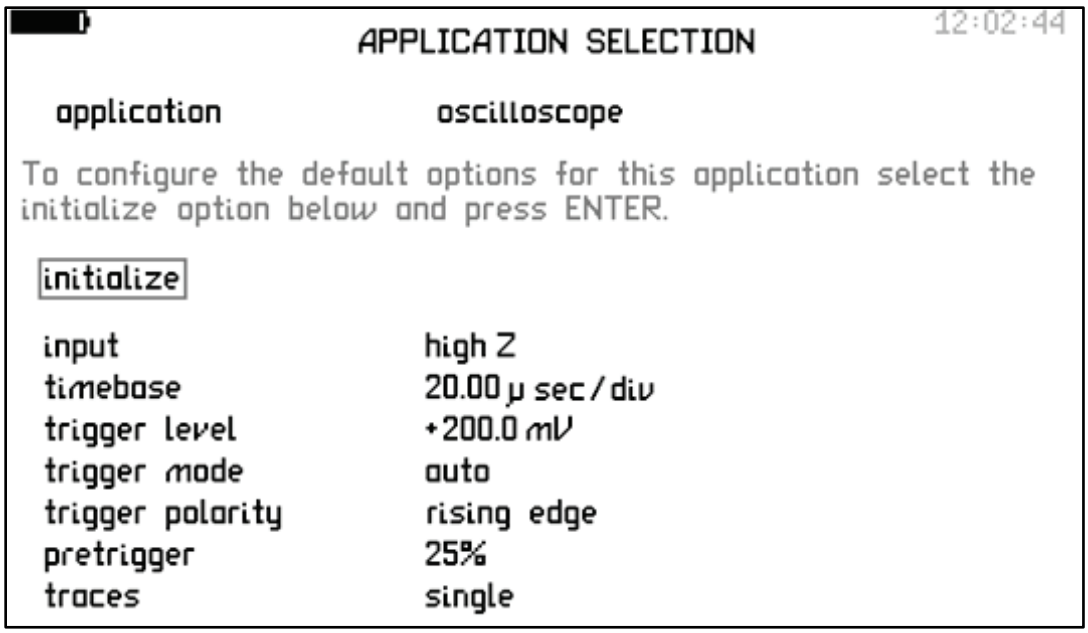


**FIGURE 5.6.1-1 – OSCILLOSCOPE OPTIONS**

### 5.6.2 Trigger Mode

Trigger mode has three options: 'auto', 'normal', and 'single shot'. 'Auto' puts the oscilloscope in the *auto run* mode. The trigger is synchronized to the trigger event, but draws a trace even if there is no trigger event. 'Normal' sets the trigger to respond to each trigger event. If there are no trigger events, the display is not updated until a trigger event occurs. In the 'single shot' mode, the oscilloscope responds only to the first trigger event. Figure 5.6.2-1 displays the three trigger modes.

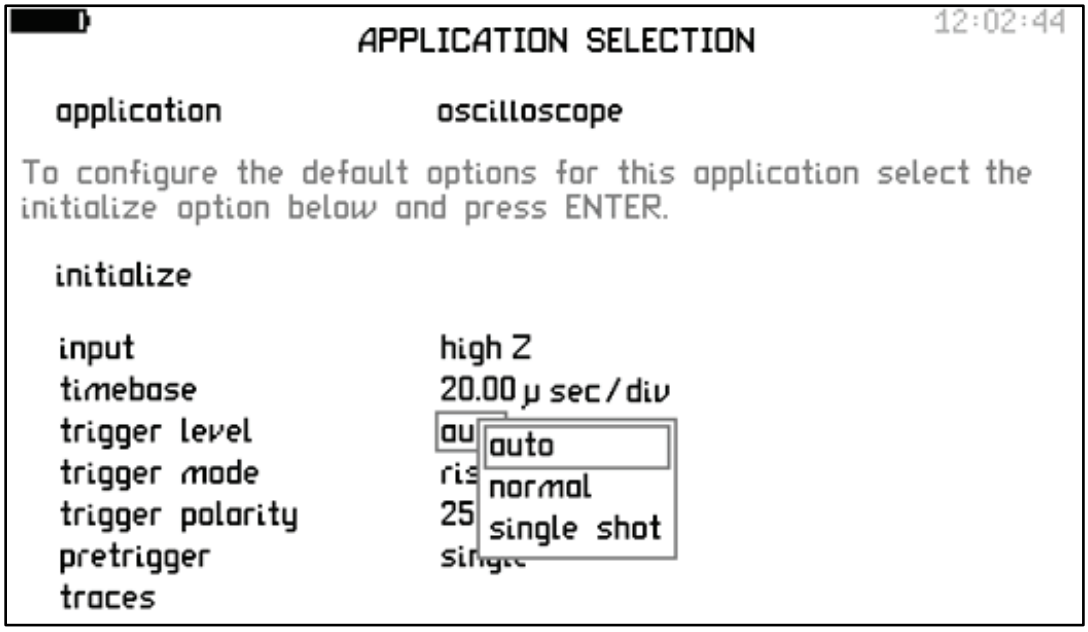

FIGURE 5.6.2-1 –TRIGGER MODE OPTIONS

### 5.6.3 Trigger Polarity

Trigger polarity has two options: 'rising edge' and 'falling edge'. Selecting 'rising edge' sets up the oscilloscope to trigger the sweep when the trigger voltage goes positive. Selecting 'falling edge' will setup the oscilloscope to trigger the sweep when the trigger voltage goes negative. Figure 5.6.3-1 displays the trigger polarity options.

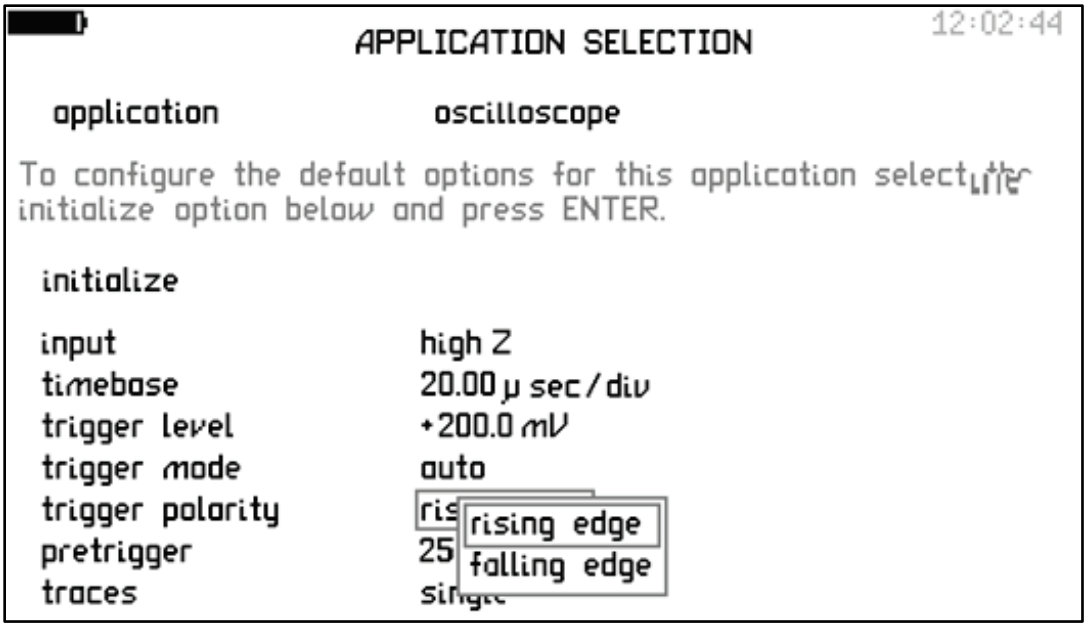


FIGURE 5.6.3-1 – TRIGGER POLARITY OPTIONS

### 5.6.4 Pretrigger

Pretrigger has four options: 'none', '25%', '50%', and '75%'. This option determines how much of the display is still available after the trigger point. 'None' starts the trigger point at the left side of the display. '25%' starts the trigger point one-quarter of the display's width from the left side of the display. '50%' starts the trigger point one-half of the display's width from the left side of the display. '75%' starts the trigger point three-quarters of the display's width from the left side of the display. Figure 5.6.4-1 displays the pretrigger options.

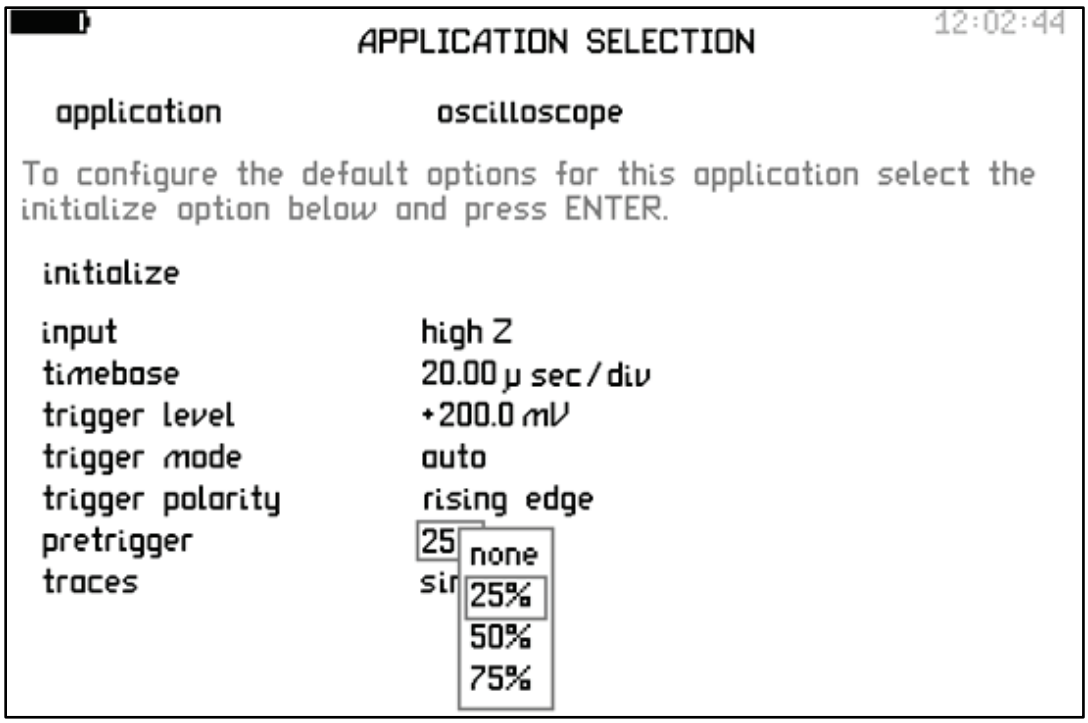


**FIGURE 5.6.4-1 – PRETRIGGER OPTIONS**

### 5.6.5 Traces

Traces has three options: single, dual and ch2 current. Figure 5.6.5-1 displays the traces options. Figure 5.6.5-2 shows the oscilloscope display in the dual trace mode of operation. Note the two voltage scales at the top right corner of the display. The yellow scale is Channel 1 and the red scale is Channel 2. The same is true for the traces yellow scale is Channel 1 and the red scale is Channel 2.

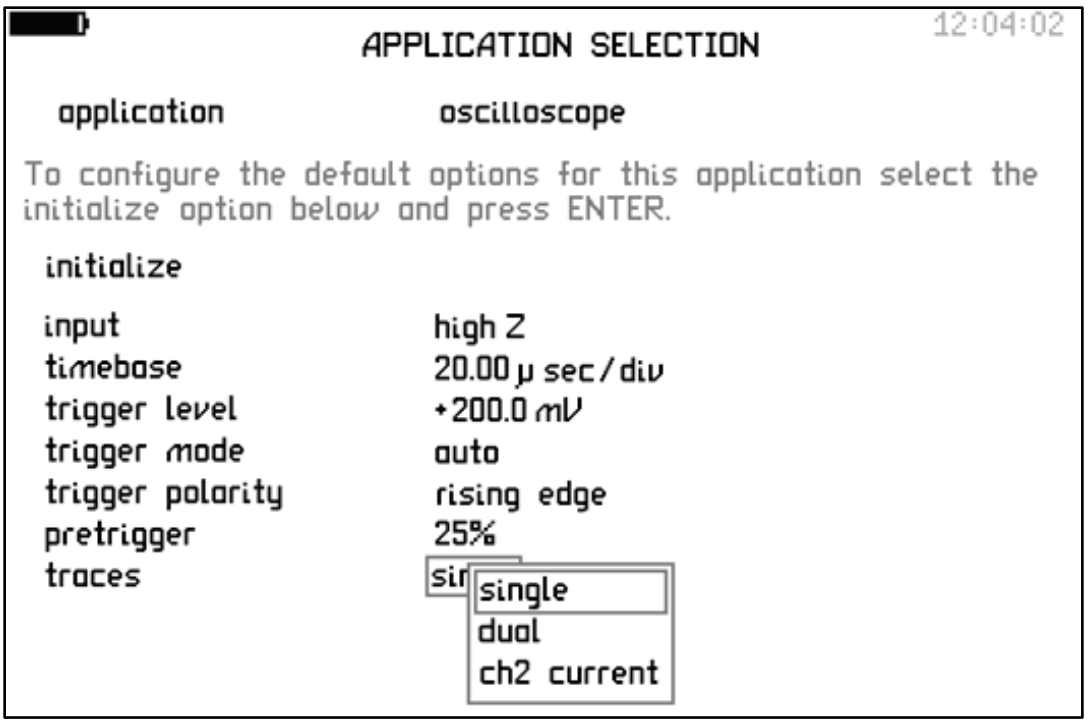


**FIGURE 5.6.5-1 – TRACES OPTIONS.**

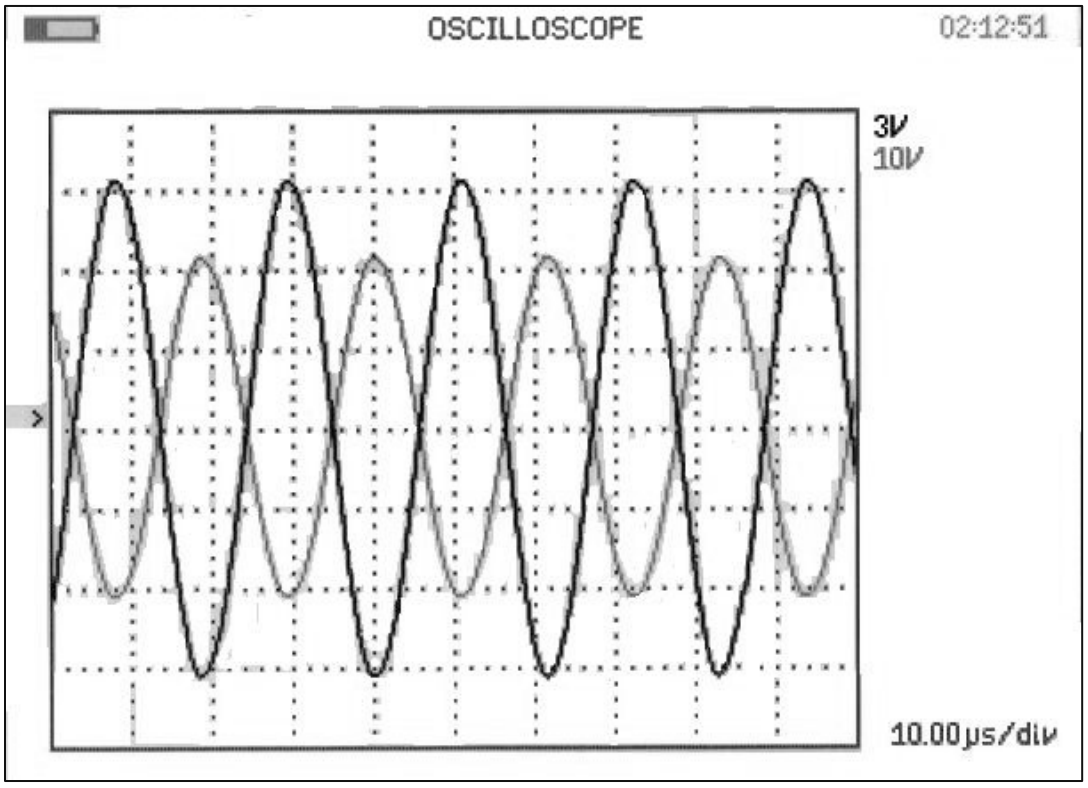


**FIGURE 5.6.5-2 – DUAL TRACE DISPLAY**

## 5.7 Capacitance, Inductance, and Resistance

The PCA-4125 measures capacitance, inductance and resistance using the '*impedance'* function of the meter. The 'APP' key pulls up the menu to access these functions. Each of these applications requires that the 'initialize' action be selected to bring up the application specific settings. Figure 5.7-1 displays the 'Application Selection' menu.

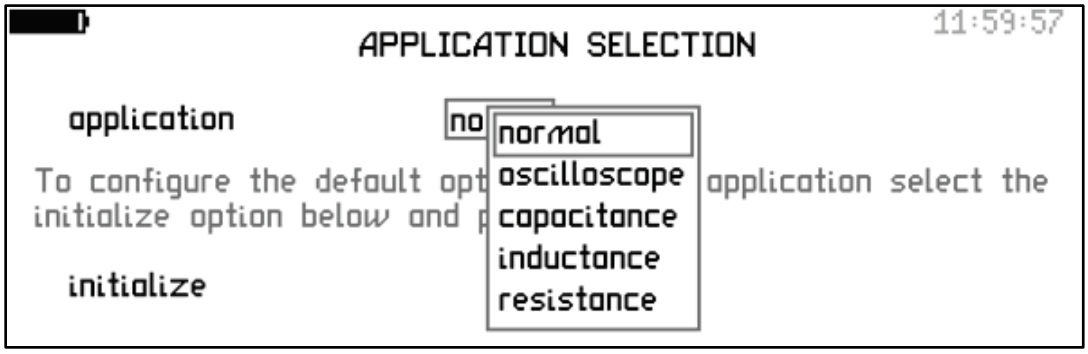


**FIGURE 5.7-1 – APPLICATION SELECTION MENU**

### 5.7.1 Capacitance Meter

The PCA-4125 uses the impedance function to measure capacitance. The external connections to take capacitance readings require using the signal generators' low level output and the low level unbalanced input. These two options are automatically turned on when the capacitance option is activated. Access the capacitance option from the 'APP' display by pressing the 'APP' key. Use the *UP/DOWN* arrow keys to highlight the '*capacitance'* function. Press the ENTER key to select capacitance. Use the *UP/DOWN* arrow keys to highlight the *'initialize'* function. Press the ENTER key to activate the capacitance option. Figure 5.7-1 displays the 'Application Selection' menu. Figure 5.7.1-1 displays the capacitance function selected. Figure 5.7.1-2 displays the capacitance function initialized.


**FIGURE 5.7.1-1 – CAPACITANCE OPTION**

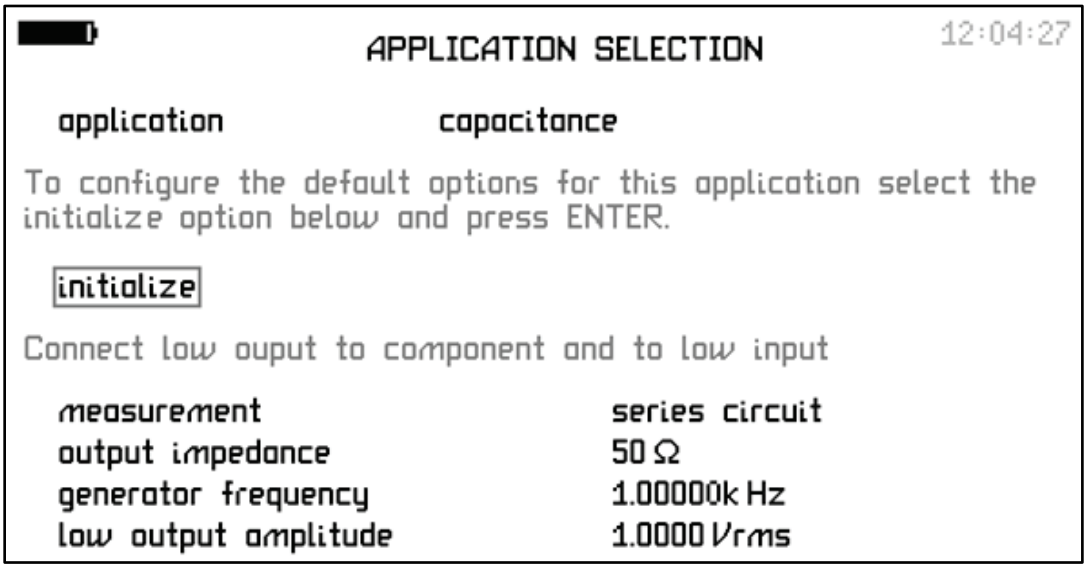


**FIGURE 5.7.1-2 – CAPACITANCE INITIALIZED**

Press the HOME/ESC key twice to activate the capacitance meter. Figure 5.7.1-3 will appear.

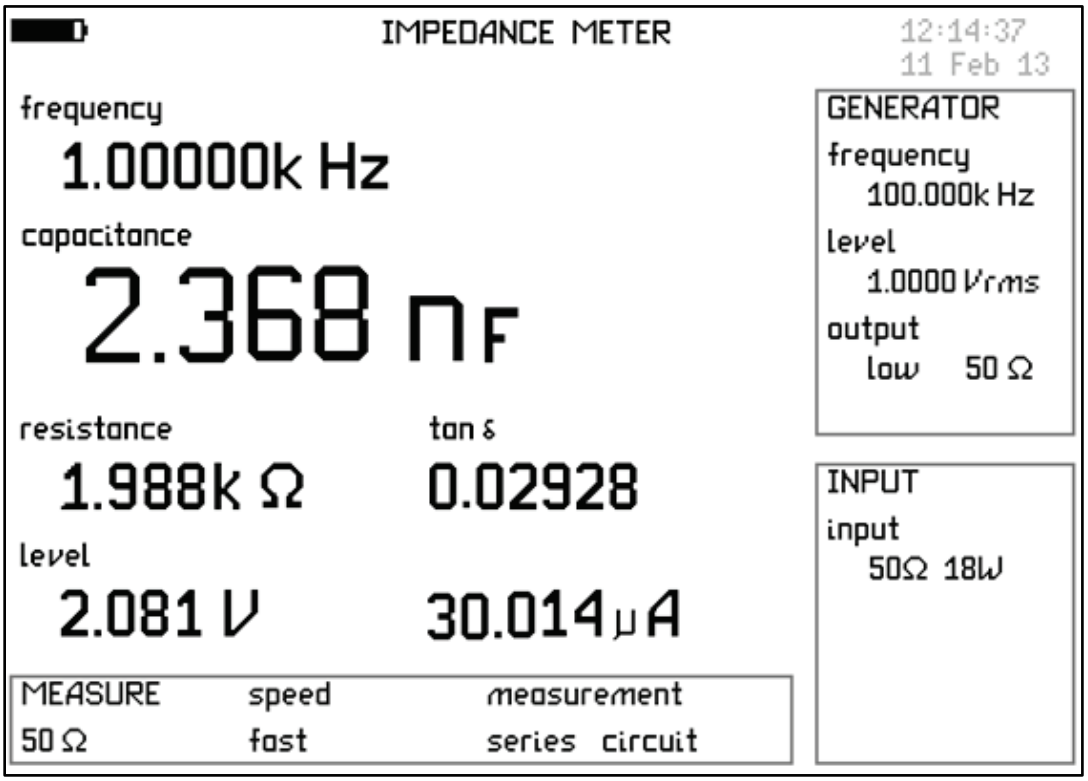


**FIGURE 5.7.1-3 – CAPACITANCE SCREEN**

The Impedance Meter screen is used to measure capacitance. Note that all the parameters are preset after initializing the capacitance option. The generator is set for 1 kHz with an output of 1.000 volts rms. The input is set to 'low level' and 'high impedance'. The measurement is set for 'series circuit'. These are the standard settings used to measure capacitance in most capacitance meters. Realize that the value at the carrier frequency may vary slightly.

**Note: Keep all leads used to measure capacitance as short as possible. All leads have capacitance. This capacitance will cause error in your readings.**

### 5.7.2 Inductance Meter

The PCA-4125 uses the impedance function to measure inductance. The external connections to take inductance readings require using the signal generators' low level output and the low level unbalanced input. These two options are automatically turned on when the inductance option is activated. Access the inductance option from the 'APP' display by pressing the 'APP' key. Use the *UP/DOWN* arrow keys to highlight the '*inductance'* function. Press the ENTER key to select inductance. Use the *UP/DOWN* arrow keys to highlight the *'initialize'* function. Press the ENTER key to activate the inductance option. Figure 5.7-1 displays the 'Application Selection' menu. Figure 5.7.2-1 displays the inductance function selected. Figure 5.7.2-2 displays the inductance function initialized. Press the HOME/ESC key twice to activate the inductance meter. Figure 5.7.2-3 will appear.

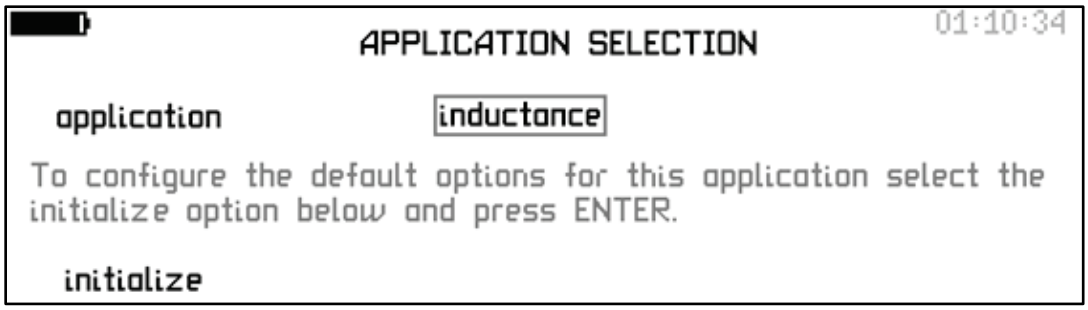


**FIGURE 5.7.2-1 – INDUCTANCE OPTION**

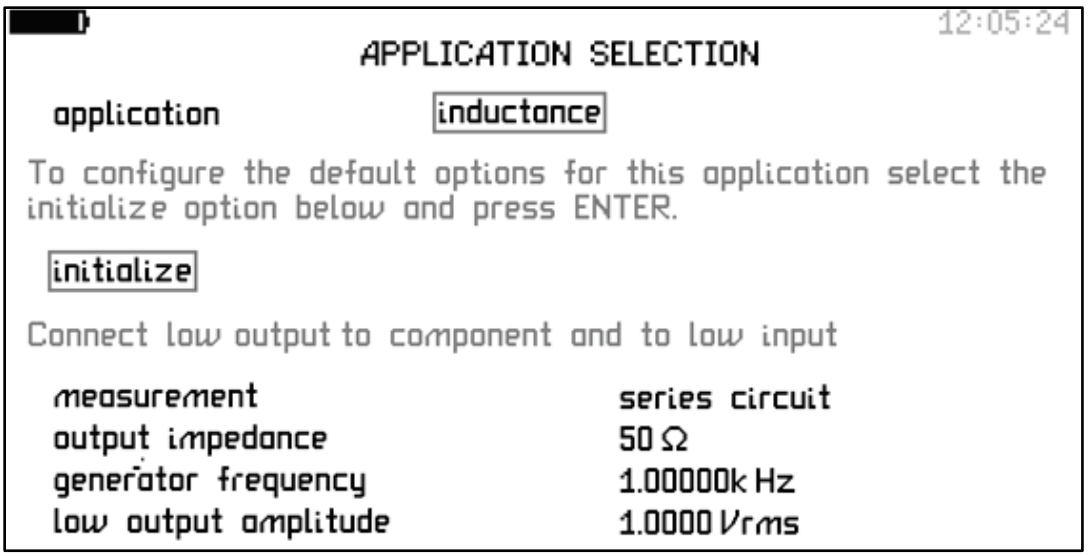


**FIGURE 5.7.2-2 – INDUCTANCE INITIALIZED**

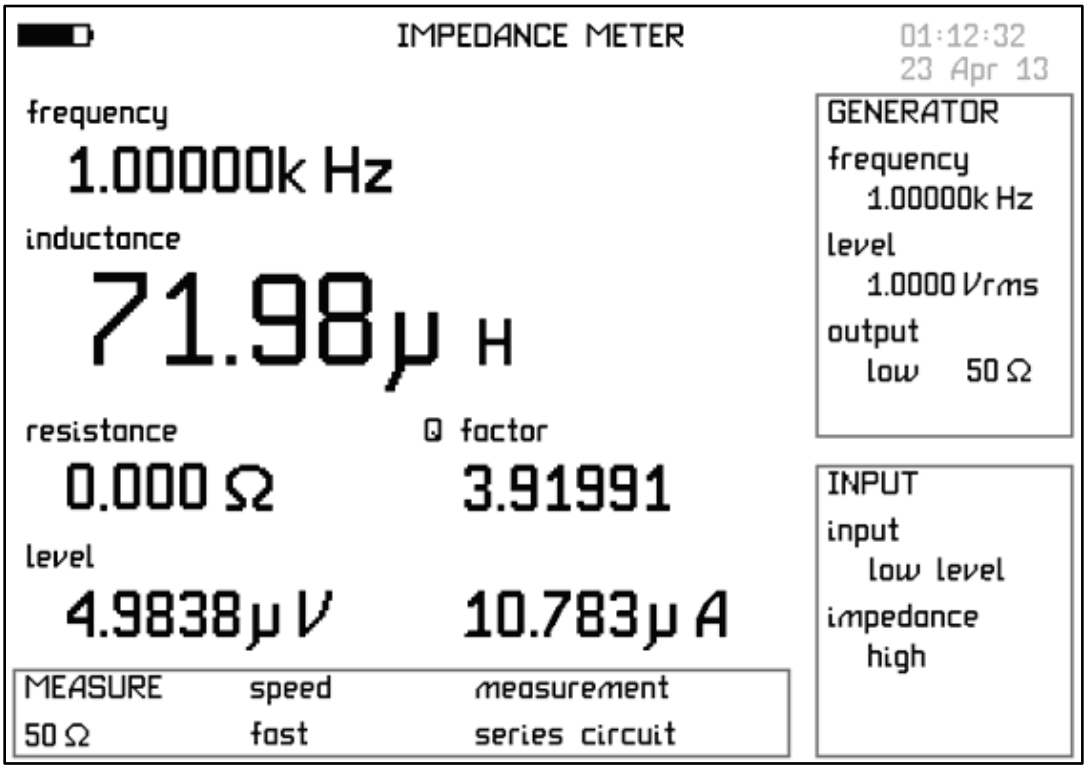


**FIGURE 5.7.2-3 – INDUCTANCE SCREEN**

The Impedance Meter screen is used to measure inductance. Note that all the parameters are preset after initializing the inductance option. The generator is set for 1 kHz with an output of 1.000 volts rms. The input is set to 'low level' and 'high impedance'. The measurement is set for 'series circuit'. These are the standard

settings used to measure inductance in most inductance meters. Realize that the value at the carrier frequency may vary slightly.

### 5.7.3 Resistance Meter (AC)

The PCA-4125 uses the impedance function to measure resistance. The external connections to take resistance readings require using the signal generators' low level output and the low level unbalanced input. These two options are automatically turned on when the resistance option is activated. Access the resistance option from the 'APP' display by pressing the 'APP' key. Use the *UP/DOWN* arrow keys to highlight the '*resistance'* function. Press the ENTER key to select resistance. Use the *UP/DOWN* arrow keys to highlight the *'initialize'* function. Press the ENTER key to activate the resistance option. Figure 5.7-1 displays the 'Application Selection' menu. Figure 5.7.3-1 displays the inductance function selected. Figure 5.7.3-2 displays the inductance function initialized.

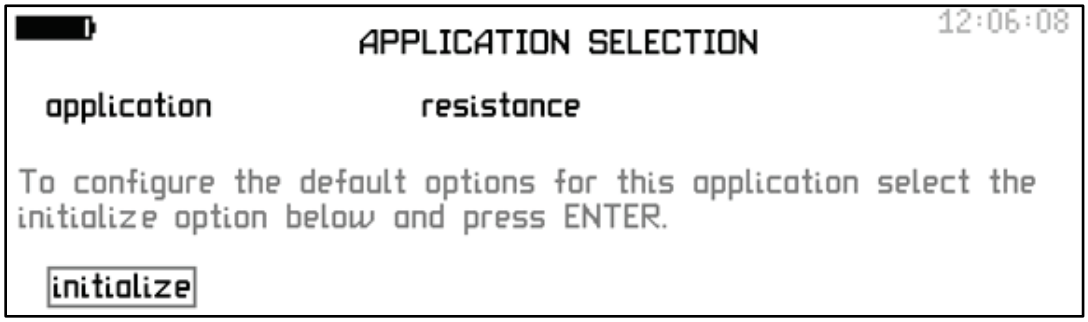


**FIGURE 5.7.3-1 – RESISTANCE OPTION**

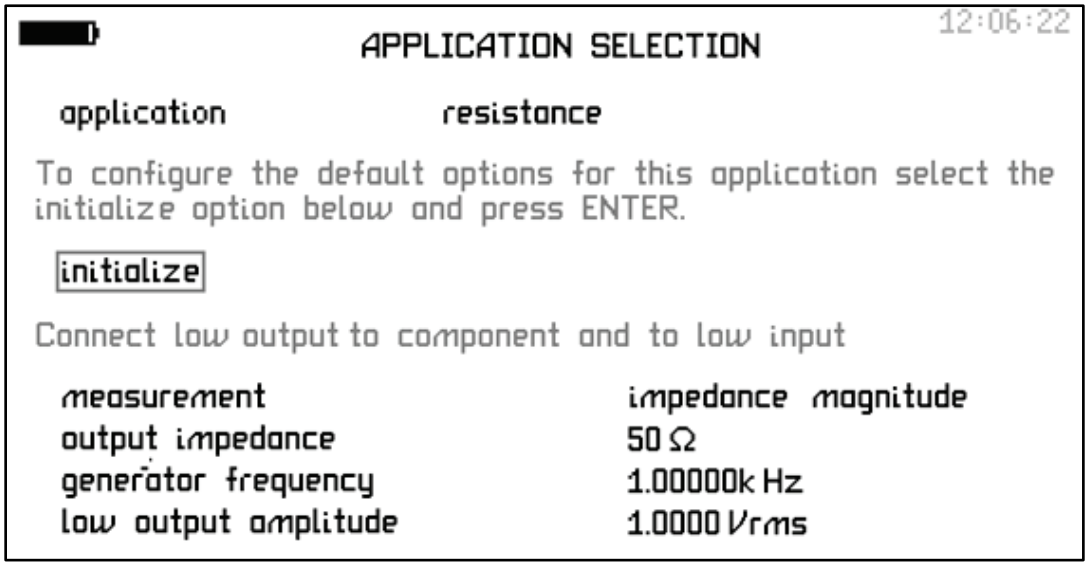


**FIGURE 5.7.3-2 – RESISTANCE INITIALIZED**

Press the HOME/ESC key twice to activate the resistance meter. Figure 5.7.3-3 will appear.

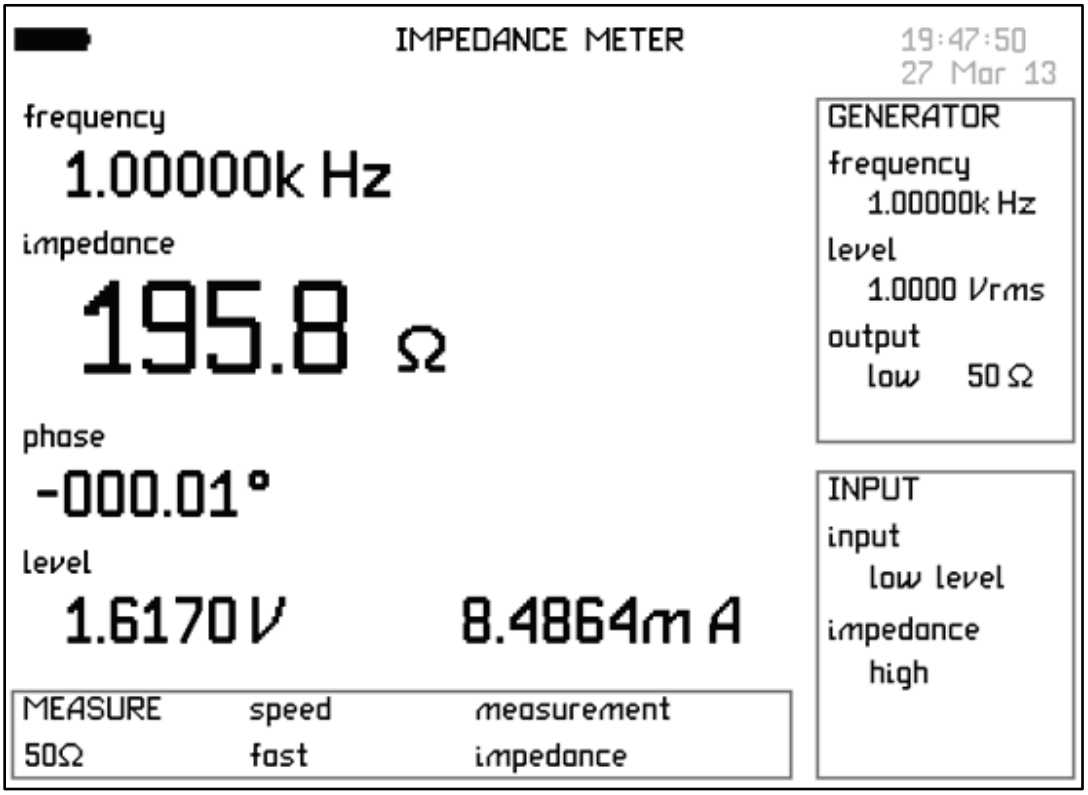


**FIGURE 5.7.3-3 – RESISTANCE SCREEN**

## 5.8 Bit Error Rate (BER)

Bit Error Rate (BER) is the ratio between the number of bit errors transmitted and the number of bits received. When BER mode is enabled, the system expects to receive the same pattern that it's transmitting. The total number of bits transmitted, error bits and the BER (%) is displayed on the screen. Figure 5.8-1displays the BER screen in the 'Transmit and Receive' mode.

The Bit Error Rate test involves sending a Pseudo-Random Binary Sequence (PRBS), a sequence of binary 1's and 0's which exhibits certain randomness and autocorrelation properties. The Bit Error Rate tester consists of:

- PRBS Generator
- PRBS Receiver

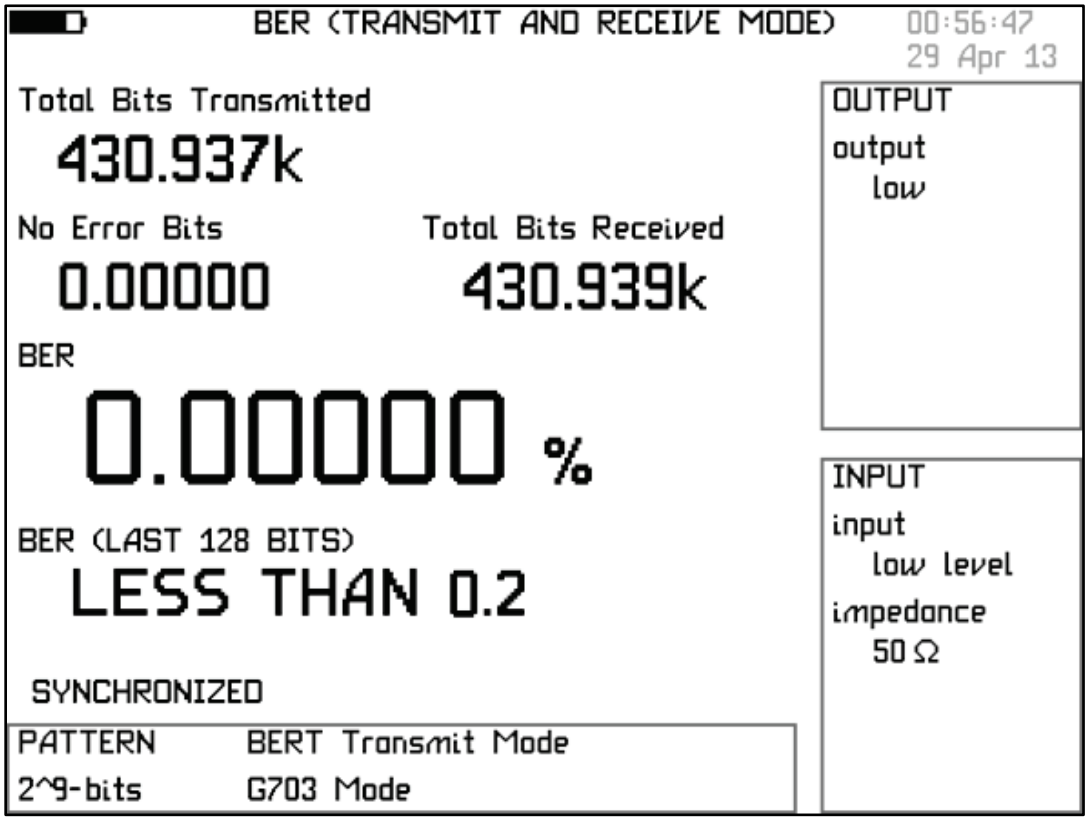


**FIGURE 5.8-1 - BER SCREEN IN THE 'TRANSMIT AND RECEIVE' MODE**

### 5.8.1 Mode

The Bit Error Rate may be accessed from the 'MEASURE' key. Press the 'MEASURE' key to display the measurement screen. Use the *UP/DOWN* arrow keys to highlight the 'mode' options. Use the *RIGHT* arrow key to display these options.

Use the *UP/DOWN* arrow keys to highlight the 'Bit Error Rate (BER)' function. Press the ENTER key to access the BER function. Figure 5.8.1-1 displays the BER function selected.

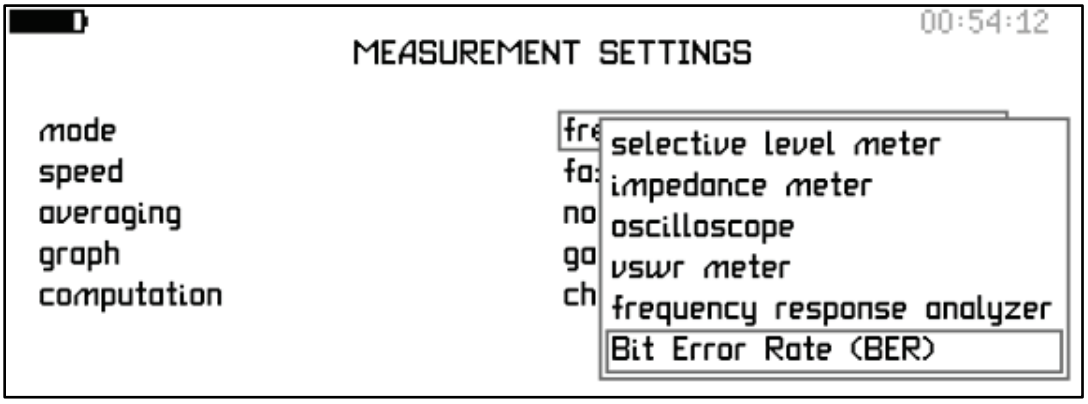


**FIGURE 5.8.1-1 BIT ERROR RATE OPTION**

### 5.8.2 Pattern

The Pseudo-Random test patterns generated by the BER mode conform to the ITU-T standards 0.150, 0.151, 0.152 and 0.153. Table 5.8.2-1 below describes the test patterns supported.

| PRBS Type | PRBS Shift Reg Length (X) | No Of Bits (m) | Standard | Suggested Data Rate (Kbps) |
|---|---|---|---|---|
| 2^9 - 1 | 9 | 512 | ITU-T 0.150/0.153 | Up to 14.4 |
| 2^11 - 1 | 11 | 2047 | ITU-T 0.150/0.152 /0.153 | 64, n*64 (n=1..31) |
| 2^15 - 1 | 15 | 32767 | ITU-T 0.150/0.151 | 1544, 1028, 6312, 8448, 32064, 44736 |
| 2^20 - 1 | 20 | 1048575 | ITU-T 0.150/0.151 | 1544, 6312, 32064, 44736 |

**TABLE 5.8.2-1 ITU-T STANDARDS**

### 5.8.3 BER Send Mode

'Continuous' is the only option available at this time. A 'Fixed' mode involving sending a fixed number of bits will be implemented at a later date. Figure 5.8.3-1 displays this option.

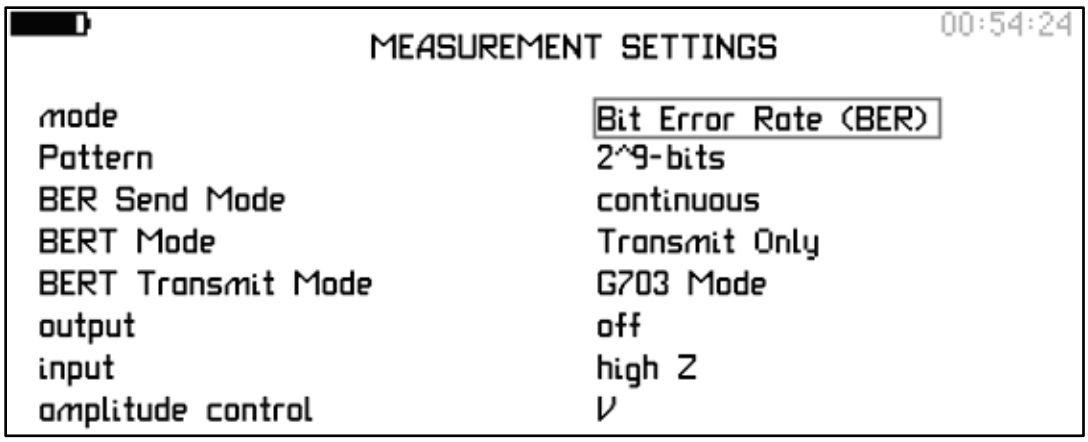


**FIGURE 5.8.3-1 – BER SEND MODE**

### 5.8.4 BERT Mode

The BERT Mode has three options: 'Transmit Only' mode, 'Receive Only' mode, and 'Transmit and Receive' mode. The 'Transmit Only' option and the 'Receive Only' option allow the 'Transmit' PCA-4125 to send a BERT signal to the other end of a 2-wire circuit where a second PCA-4125 will 'Receive' the signal. The 'Transmit and Receive' option allows two PCA-4125's to communicate over a 4-wire circuit. Figure 5.8.4-1 displays these options.

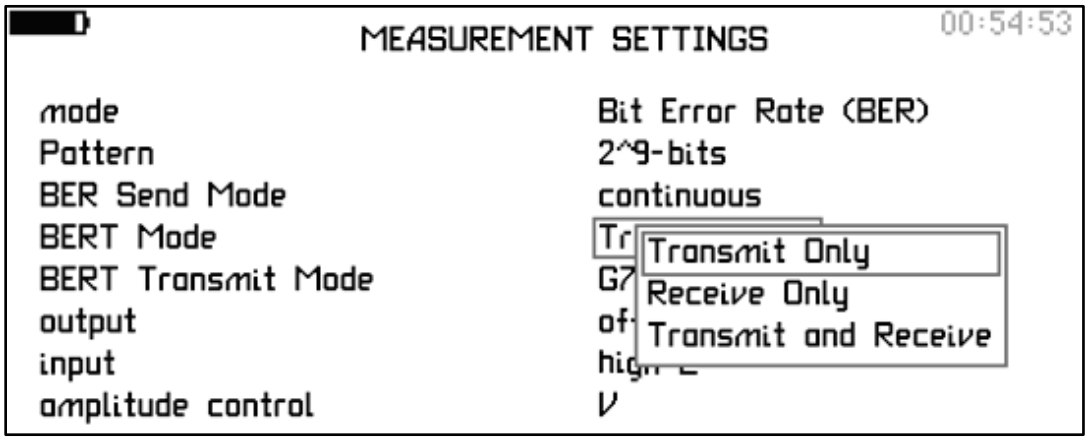


**FIGURE 5.8.4-1 – BERT MODE**

### 5.8.5 BERT Transmit Mode

BERT Transmit Mode has only one option: G703 Mode.

### 5.8.6 Output

Output has three options: off, low, and 50Ω high. The low output is used to send all BER test modes. Figure 5.8.1-5 displays these options.

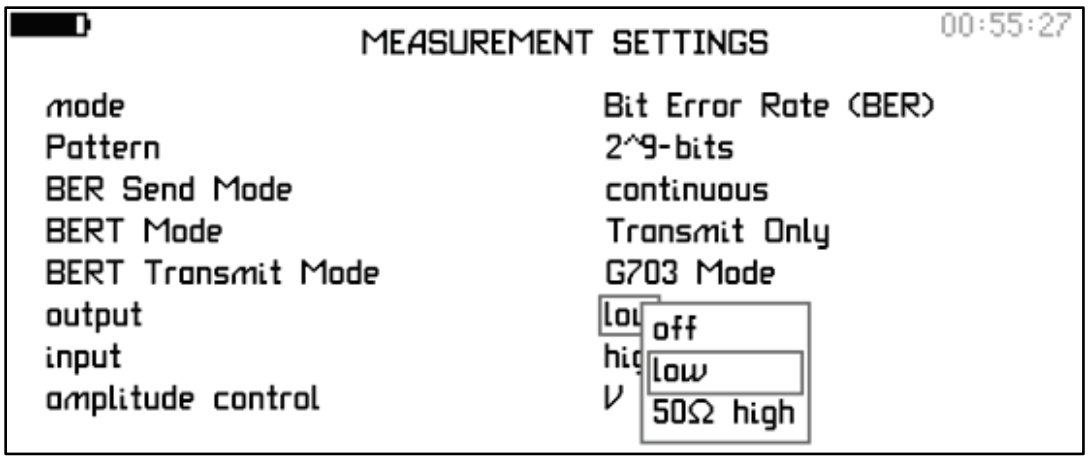


**FIGURE 5.8.6-1 – OUTPUT OPTIONS**

### 5.8.7 Input

Input has four options: high Z, 50Ω 18 W, low level, and balanced. What input to use will be dependent on the test being done and the equipment being tested. It is left to the user to determine the correct input to use for the test being performed. Figure 5.8.7-1 displays these options.

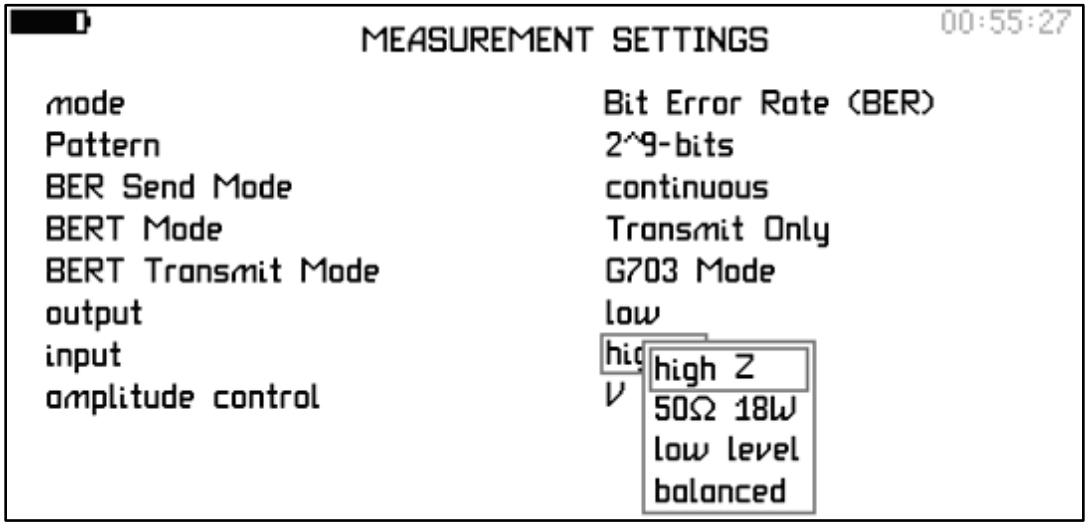


**FIGURE 5.8.7-1 – INPUT OPTIONS**

### 5.8.8 Amplitude Control

Amplitude control has two options: V (Volts) or dBm. The signal level is raised or lowered in either voltage steps or dBm steps with the up or down arrow keys.. Figure 5.8.8-1 displays this option.

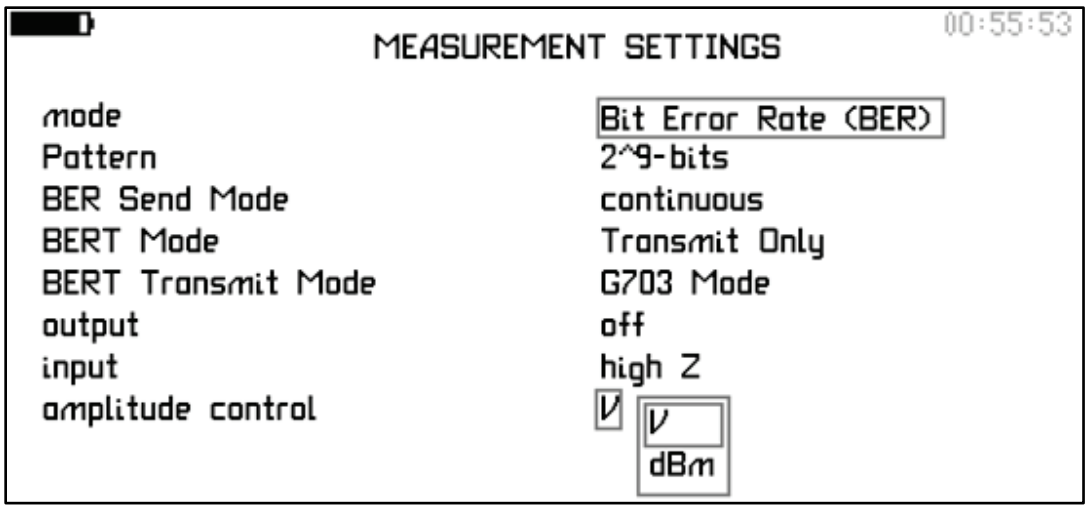


**FIGURE 5.8.8-1 – AMPLITUDE CONTROL**

# *CHAPTER 6 - Specifications*

| **SELECTIVE LEVEL METER** | |
|---|---|
| Frequency Range | 5Hz to 5MHz |
| Frequency Accuracy | ±5ppm over all temperature range |
| Magnitude Accuracy | ±0.05% range ± 0.05% reading ± 1%/MHz |
| Inputs (Unbalanced) Type & Connection | differentially isolated & isolated BNC |
| Measurement Bandwidths: | 25Hz, 100Hz, 600Hz 1.95kHz, 3.1kHz, Wideband (RMS Voltmeter) |
| **High Voltage Input** | |
| Max Input | 150V rms |
| Input Impedance | 1MΩ ±5% // 30pF |
| | |
| **50Ω Input (select 50 or 75 Ohm)** | |
| Max Input | 18W (30V rms) |
| Input Impedance | 50Ω ±1% // 30pF |
| | |
| **75Ω input (select 50 or 75 Ohm)** | |
| Max Input | 18W (37V rms) |
| Input Impedance | 75Ω ±1% // 30pF |
| | |
| **Low Level Unbalanced Input** | |
| Max Input | 5V rms |
| Input Impedance | 50Ω ±1% // 30pF<br>75Ω ±1% // 30pF<br>600Ω ±1% // 30pF<br>1MΩ ±5% // 30pF |
| **CH2 Input Same As Low Level** | |
| **Balanced Input** | |
| Max Input | 5V rms |
| Input Impedance | 50Ω ±1% // 30pF<br>75Ω ±1% // 30pF<br>600Ω ±1% // 30pF<br>1MΩ ±5% // 30pF |
| Input Type | differential |
| Input Connection | 3 x 4mm connectors - positive, negative, and ground |

| **SIGNAL GENERATOR** | |
|---|---|
| Generator Type | Direct Digital Synthesis (DDS), single frequency or sweep |
| Generator Waveforms | sinewave, square, triangle, white noise |
| Frequency Accuracy | ±5ppm over all temperature range |
| Magnitude Accuracy | ±0.05% range ± 0.05% reading ± 1%/MHz |
| **Hi Level Output (select 50 or 75 Ohm)** | |
| Frequency Range | 10kHz to 5MHz |
| Output Level | 2W into 50Ω (10V rms) |
| Output Impedance | 50Ω ±2%<br>75Ω ±2% |
| Lo Level Output | |
| Frequency Range | 5Hz to 5MHz |
| Output Level | 7 Vrms into high impedance |
| Frequency Shift Delay Timer | 0 to 1s (1ms steps) |
| Frequency Accuracy | ±5ppm over all temperature range |
| Magnitude Accuracy | ±1% + 2%/MHz |

| **IMPEDANCE ANALYZER** | |
|---|---|
| Impedance Range | 100 milliOhm to 100 kiloOhm |
| Accuracy | +/- 0.2% + 2%/MHz |
| Features | LCR Measurements (Inductance, Capacitance, Resistance, tan delta, QF) |
| | Lead compensation |

| | |
|---|---|
| | (zero lead function) |
| | Frequency versus Impedance Curve |
| **OSCILLOSCOPE** | |
| Sample Rate | 5 Msamples/s |
| Timebase | 5us/div to 5s/div |
| Trigger | auto, normal or single shot |
| Pretrigger | none, 25%, 50%, 75% |
| Input Ranges | as per Frequency Selective Volt Meter |
| **VSWR METER** | |
| Accuracy | 1% of reading up to 1MHz<br>5% of reading above 1MHz to 5MHz<br>for power measurements (forward and reflected) at VSWR = 3. |
| Features | Forward Power, Reflected Power, & % Reflected Power |

| **GENERAL** | |
|---|---|
| Interface | USB, RS232, LAN |
| Set-up and Data Storage | Up to 100 analyzer set-ups or readings can be stored |
| Real Time Clock | Time and Date Stamp for data stores |
| Data Storage | Internal 1Gb flash memory, external USB memory stick |
| Display Type | 5.7” ¼VGA color high brightness backlight |
| Display Resolution | 6 digit frequency, 5 digit voltage, 4 digit dBm |
| Size: | approx 12” x 9” x 1.75” “tablet” style |
| Power Source | 9 – 18V<br>~1A @ 12V + charge current<br>AC adapter or 12V dc from car or external batteries |
| Battery Type | 10 x AA size NiMH |
| Battery Life | approx 2 hours |
| Temperature Range | -5 to +50°C |

# *APPENDIX A - Text File Format*

Saving test results generates two files. The file name is represented by the number location chosen (1-999) from the 'PROGRAM STORE/RECALL' menu. For example, if the file location chosen is: 11, the files generated would be PCA_R011.pcs and PCA_R011.txt. Each file has the same name but different extensions. The first file with the .pcs extension name is the file that the PCA-4125 uses to display the test results when that file is recalled.

The second file is a comma delimited text file (CSV) and may be viewed using any text editing/viewing program. The text file has two parts, the header section and the data/results section. The header includes the status of the instrument at the time the test results were taken. This information includes all three USER data inputs from the 'USER SETTINGS' menu, the file name, time and date stamp, serial number, last calibration date and other pertinent information. The data may be imported into Excel or other programs that can access comma delimited files.

Below is the header information from a sample impedance sweep file. Where each line of information in the header comes from is explained in the 'Header Format' following the example file. The header information will vary based on the setup of the PCA-4125.

```
POWERCOMM SOLUTIONS
Instrument,type,PCA-4125
,serial number,1216
,firmware version,2.13
,calibration,10_DEC_2008_1029_SBC
User ID
,user name 1,PowerComm Solutions
,user name 2,
,user name 3,John Doe
Record,file name,PCA_R011.TXT
,name,Test
,datestamp (mmddyyyy),05262009
,timestamp,1132
measurement settings,mode,impedance meter
,measurement,impedance magnitude
,speed,medium
,filter,normal
generator settings,amplitude control,V
,low output amplitude, 2.0000E+00,Vrms
,amplitude step, 1.1000E+00
,fsk control,disabled
,generator frequency, 5.0000E+04,Hz
,frequency step, 1.0000E+02,Hz
,waveform,sinewave
```

,output,low
,output impedance,50 Ohms
input settings,input,high Z
,scale factor, 1.0000E+00
,CH1 input ranging,full autorange
sweep settings,display,graph
,sweep start, 3.0000E+04,Hz
,sweep end, 5.0000E+05,Hz
,sweep steps,32
,sweep type,linear
,sweep type,single
,graph scaling,auto
,marker,off
,search for peak,off

## A.1 Header Format

1. The first line 'POWERCOMM SOLUTIONS' is the name of the company that sells the PCA-4125 and is embedded in the firmware.
2. Lines two through five are the serial number of the instrument, manufacturing code, firmware release versions and date of last calibration. This information is accessed in the instrument by pressing the 'SYSTEM' key and the 'LEFT ARROW' key.
3. Lines six through nine are the 'user data' area. This information is accessed in the instrument by pressing the 'SYSTEM' key and the 'RIGHT ARROW' key.
4. Lines ten through thirteen are from the 'PROGRAM STORE/RECALL' menu. These lines provide the number (000 to 999) of the file (location), the name of the file and the date and time stamp that the instrument provided at the time the data was saved in the instrument.
5. Lines 14 through 17 are from the 'MEASUREMENT SETTINGS' menu. These lines provide the mode the instrument was in when the data was acquired, how the measurement was taken and the speed and filter settings.
6. Lines 18 through 26 are from the 'GENERATOR SETTINGS' menu. These lines provide the settings of the generator at the time the data was acquired.
7. Lines 27 through 29 are from the 'INPUT SETTINGS' menu. These lines provide the input settings at the time the data was acquired.
8. Lines 30 through 38 are from the 'SWEEP SETTINGS' menu. These lines provide the input settings at the time the data was acquired.

The data portion of the file starts at 'Results, sweep data'. This example is an impedance sweep. There are five columns of data: Frequency (Hz), Impedance (Ohms), Phase (degrees), Resistance (Ohms), and Reactance (Ohms). The two columns Frequency and

Impedance may be used in Excel to plot a frequency versus impedance graph. All information is given in scientific notation.

In this example the frequency starts at 150 kHz and goes to 210 kHz. The impedance starts at 252 ohms and goes to a peak impedance of 6700 ohms and then down to 235 ohms. Notice that the headers and columns do not line up.

## A.2 Results Sweep Data

Frequency(Hz),Impedance(Ohm),Phase(deg),Resistance(Ohm),Reactance (Ohm)
1.5000E+05, 2.5299E+02, 8.9272E+01, 1.9924E+04, 2.5301E+02
1.5122E+05, 2.6595E+02, 8.9195E+01, 1.8921E+04, 2.6597E+02
1.5245E+05, 2.8018E+02, 8.9104E+01, 1.7916E+04, 2.8021E+02
1.5367E+05, 2.9589E+02, 8.8996E+01, 1.6897E+04, 2.9594E+02
1.5490E+05, 3.1331E+02, 8.8875E+01, 1.5960E+04, 3.1337E+02
1.5612E+05, 3.3274E+02, 8.8739E+01, 1.5113E+04, 3.3282E+02
1.5735E+05, 3.5461E+02, 8.8583E+01, 1.4334E+04, 3.5471E+02
1.5857E+05, 3.7929E+02, 8.8400E+01, 1.3579E+04, 3.7944E+02
1.5980E+05, 4.0746E+02, 8.8190E+01, 1.2898E+04, 4.0767E+02
1.6102E+05, 4.4011E+02, 8.7904E+01, 1.2031E+04, 4.4040E+02
1.6225E+05, 4.7794E+02, 8.7612E+01, 1.1468E+04, 4.7835E+02
1.6347E+05, 5.2246E+02, 8.7259E+01, 1.0924E+04, 5.2306E+02
1.6469E+05, 5.7575E+02, 8.6835E+01, 1.0430E+04, 5.7663E+02
1.6592E+05, 6.4062E+02, 8.6313E+01, 9.9621E+03, 6.4195E+02
1.6714E+05, 7.2129E+02, 8.5656E+01, 9.5223E+03, 7.2337E+02
1.6837E+05, 8.2443E+02, 8.4810E+01, 9.1143E+03, 8.2782E+02
1.6959E+05, 9.6025E+02, 8.3673E+01, 8.7134E+03, 9.6614E+02
1.7082E+05, 1.1480E+03, 8.2109E+01, 8.3617E+03, 1.1589E+03
1.7204E+05, 1.4224E+03, 7.9769E+01, 8.0082E+03, 1.4454E+03
1.7327E+05, 1.8611E+03, 7.5908E+01, 7.6439E+03, 1.9189E+03
1.7449E+05, 2.6516E+03, 6.8864E+01, 7.3535E+03, 2.8428E+03
1.7571E+05, 4.3198E+03, 5.2361E+01, 7.0735E+03, 5.4552E+03
1.7694E+05, 6.7700E+03, 6.1537E+00, 6.8092E+03, 6.3152E+04
1.7816E+05, 4.6626E+03,-4.4704E+01, 6.5601E+03,-6.6282E+03
1.7939E+05, 2.8250E+03,-6.3450E+01, 6.3203E+03,-3.1581E+03
1.8061E+05, 1.9707E+03,-7.1084E+01, 6.0789E+03,-2.0832E+03
1.8184E+05, 1.5017E+03,-7.5157E+01, 5.8618E+03,-1.5535E+03
1.8306E+05, 1.2105E+03,-7.7630E+01, 5.6503E+03,-1.2393E+03
1.8429E+05, 1.0138E+03,-7.9289E+01, 5.4552E+03,-1.0318E+03
1.8551E+05, 8.7227E+02,-8.0463E+01, 5.2643E+03,-8.8450E+02
1.8674E+05, 7.6550E+02,-8.1345E+01, 5.0871E+03,-7.7432E+02
1.8796E+05, 6.8228E+02,-8.2022E+01, 4.9162E+03,-6.8895E+02
1.8918E+05, 6.1556E+02,-8.2563E+01, 4.7553E+03,-6.2078E+02
1.9041E+05, 5.6086E+02,-8.3000E+01, 4.6022E+03,-5.6507E+02
1.9163E+05, 5.1521E+02,-8.3355E+01, 4.4521E+03,-5.1870E+02
1.9286E+05, 4.7641E+02,-8.3605E+01, 4.2773E+03,-4.7939E+02
1.9408E+05, 4.4332E+02,-8.3859E+01, 4.1438E+03,-4.4587E+02

1.9531E+05, 4.1459E+02,-8.4073E+01, 4.0149E+03,-4.1682E+02
1.9653E+05, 3.8945E+02,-8.4259E+01, 3.8935E+03,-3.9142E+02
1.9776E+05, 3.6727E+02,-8.4421E+01, 3.7777E+03,-3.6902E+02
1.9898E+05, 3.4753E+02,-8.4561E+01, 3.6662E+03,-3.4910E+02
2.0020E+05, 3.2988E+02,-8.4684E+01, 3.5609E+03,-3.3131E+02
2.0143E+05, 3.1396E+02,-8.4787E+01, 3.4556E+03,-3.1526E+02
2.0265E+05, 2.9957E+02,-8.4880E+01, 3.3566E+03,-3.0077E+02
2.0388E+05, 2.8649E+02,-8.4962E+01, 3.2622E+03,-2.8760E+02
2.0510E+05, 2.7451E+02,-8.5035E+01, 3.1716E+03,-2.7555E+02
2.0633E+05, 2.6356E+02,-8.5098E+01, 3.0842E+03,-2.6452E+02
2.0755E+05, 2.5345E+02,-8.5156E+01, 3.0014E+03,-2.5436E+02
2.0878E+05, 2.4412E+02,-8.5210E+01, 2.9231E+03,-2.4497E+02
2.1000E+05, 2.3547E+02,-8.5255E+01, 2.8464E+03,-2.3628E+02

# *APPENDIX B - Software Interface*

PCAView is a software application for Microsoft Windows that can be used to communicate with the PCA-4125 via USB, RS-232, or Ethernet to perform the following tasks:

- Firmware Upgrades
- Test Results Download & Upload
- Program Setups Download & Upload
- Screen Captures

**PCAView requires firmware v2.87 or higher on the PCA-4125 Power Communications Analyzer.** To identify which firmware version your PCA-4125 is presently running, press the System button then the LEFT arrow. The main release identifies the firmware version. To exit this screen, press the 'Home/Esc' key.

The PCAView software, PCA-4125 firmware updates and USB drivers are available for download on our website http://www.powercommsolutions.com. All are provided at no charge to PCA-4215 customers but registration is required in order to gain access to the customer support portal.

## B.1 Installing the PCAView Software

PCAView is distributed as a self-contained executable which does not require that the user go through a traditional installation process. To "install" and run PCAView, simply copy the executable to a known location on your computer's hard disk and double-click.

## B.2 Installing the Windows USB Driver

**a.** Press the REMOTE key on the PCA-4125 keypad and set the interface setting to USB.

**b.** Connect the cable to the USB type B port of the PCA-4125 and the other end to your computer. Once connected, the Windows operating system should recognize that new hardware is connected and begin the New Hardware Wizard. If this does not occur, try the following to ensure Windows is recognizing the PCA-4125:

- Open the Windows Device Manager and check to see if there are any unknown devices listed marked with a yellow exclamation icon. If found, right click and select Properties. In the General tab of the Properties window, click the Update Driver button and jump to **step c** below.

- If no unknown devices are listed in the Device Manager, it is possible that the driver has already been installed as the PCA-4125 uses an off the shelf driver that is commonly used in other commercial devices. If this is the case, you will see listed under Ports (COM & LPT) a USB Serial Port (COMX). To verify that it is the correct driver, right click USB Serial Port (COMX) and select Properties. In the Properties window, select the Driver Tab and confirm that the Driver Provider is "FTDI" and that the driver version is at least version 2.x. If both are a match, jump to section **B.3.1 USB Connection** to test USB communications. If the version number is not at least 2.x, click the Update Driver button and continue to **step c** below.

**c.** Choose the "Have Disk" option that permits you to manually locate the directory where you stored the unzipped driver files. Once you have identified the folder, follow the instructions to complete the driver installation. Once completed, your computer will now recognize the PCA-4125 whenever it is connected via USB.

## B.3 Connecting to the PCA-4125

### B.3.1 USB Connection

**a.** Press the REMOTE key on the PCA-4125 keypad and set the interface setting to USB.

**b.** Double click the PCAView executable.

**c.** Select USB from the "Interface" select box and the appropriate COM port number that has been assigned to the PCA-4125 in the "COM Port" select box. If you are unsure of the port number, open up your Windows Device Manager and look under Ports (COM & LPT) for USB Serial Port (COMX).

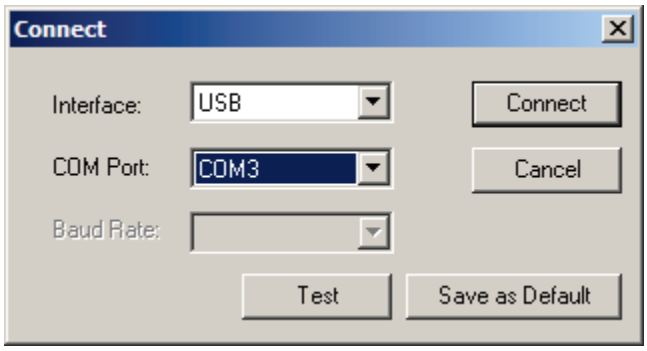


**FIGURE B.3.1-1 PCAVIEW USB CONNECTION SETTINGS**

**d.** Click the connect button to establish communications. If successful, a Connection dialog box will appear with a "Connection Successful" message. Press OK to acknowledge and the Main Menu will become active.

### B.3.2 RS-232 Connection

a. Press the REMOTE key on the PCA-4125 keypad and set the interface setting to RS-232.
b. If the default baud rate of 19200 is not appropriate, change the setting to 1200, 9600 or 38400 baud.
c. Double click the PCAView executable.
d. Select "Serial" from the "Interface" select box and the appropriate COM port number for the connected local PC serial port.
e. Select the appropriate rate from step b above in the "Baud Rate" select box.

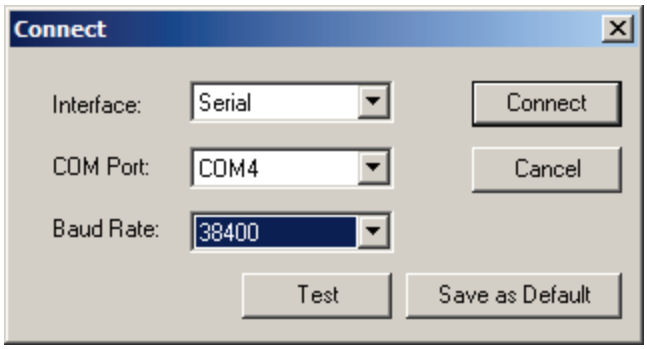


**FIGURE B.3.2-1 PCAVIEW SERIAL/RS-232 CONNECTION SETTINGS**

f. Click the connect button to establish communications. If successful, a Connection dialog box will appear with a "Connection Successful" message. Press OK to acknowledge and the Main Menu will become active.

### B.3.3 Ethernet (LAN) Connection

The Ethernet (LAN) port can be used to connect the PCA-4125 as a client to an existing IP network or for direct connection to a computer. The port does not support dynamic IP assignment from a DHCP server and a static IP address must be assigned in the Remote Settings menu.

If connecting as a client to an existing network, make sure that the proper addressing scheme is used and that the IP address is unique to prevent a conflict with another device. If connecting directly to a computer, the computer's IP address will also need to be statically assigned in the IPv4 Properties window of the connected network adapter.

a. Press the REMOTE key on the PCA-4125 keypad and set the interface setting to LAN.
b. Enter the desired static IP address in the IP address field.
c. Double click the PCAView executable
d. Select LAN from the “Interface” select box.
e. Enter the IP address of the PCA-4125 or press the magnifying glass button to automatically list all PCA-4125’s that are accessible to your computer via Ethernet.

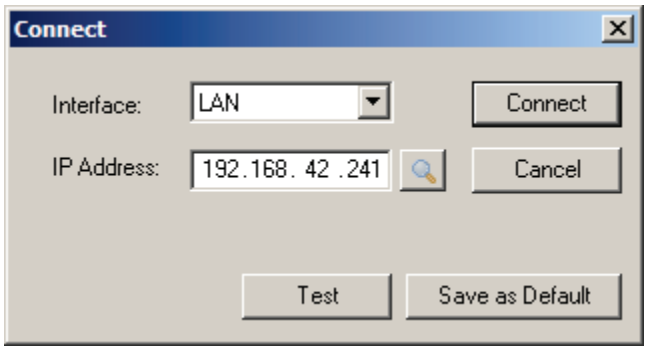


**FIGURE B.3.3-1 PCAVIEW LAN EXAMPLE CONNECTION SETTINGS**

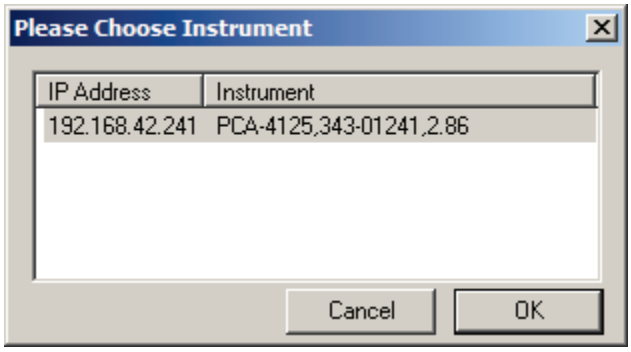


**FIGURE B.3.3-2 PCAVIEW SAMPLE LIST OF NETWORK ACCESSABLE PCA’S**

f. Click the connect button to establish communications. If successful, a Connection dialog box will appear with a “Connection Successful” message. Press OK to acknowledge and the Main Menu will become active.

## B.4 Upgrading the PCA-4125 Firmware

To check what firmware version your PCA-4125 is presently running, hit the "SYSTEM" key on the PCA-4125 and then the "left arrow/ -f" key. The “main release” is the firmware version that your instrument is presently running.

### B.4.1 Firmware Files

The PCA-4125 firmware is packaged in a zip archive to simplify the download process from our website. Once downloaded, the firmware files need to be extracted from the zip archive to a known location on your computer's hard disk before they are sent to the PCA-4125 via PCAView. Once extracted, there should be a number of ".hex" files and a single .UPG file.

### B.4.2 Firmware Upgrade Process

**a.** In the PCAView software, select the Instrument menu and click on the Upgrade Firmware menu option.

**b.** You will then be prompted to browse and locate the new firmware files that you extracted from the zip archive.

**c.** Select the file ".UPG" and click the 'Open' button.

**d.** A Firmware Files List window will appear to confirm the proposed firmware upgrade operation.

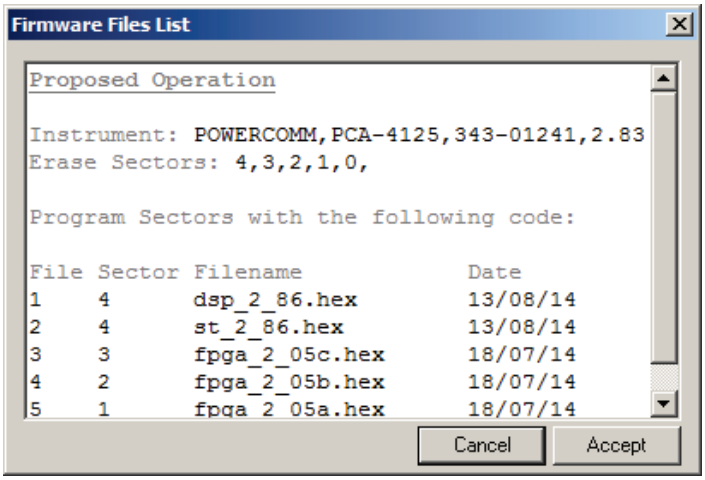


**FIGURE B.4.2-1 PCAVIEW FIRMWARE FILES LIST WINDOW**

**e.** Click the "Accept" button to initiate the upgrade process.

**f.** At this point the instrument screen will go blank and PCAView will display the "Upgrade Firmware" window containing a progress bar to track the firmware upgrade process through its various stages. When the upgrade is complete, the instrument will automatically re-boot running the new firmware version and the window will display the message "Firmware sent OK".

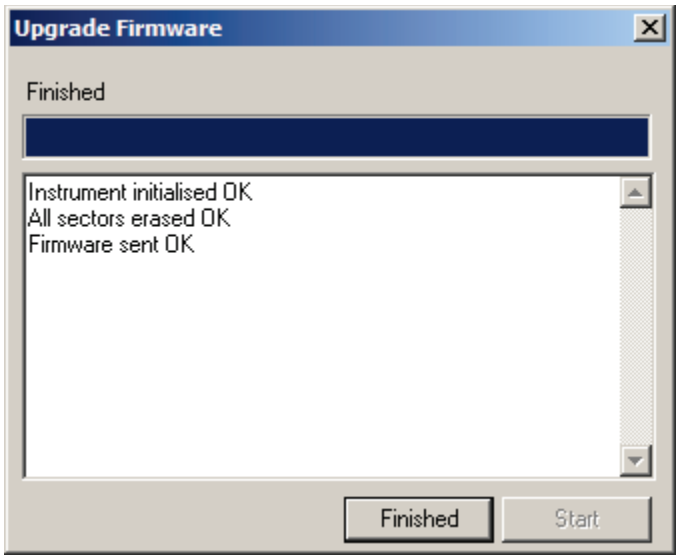


**FIGURE B.4.2-2 PCAVIEW UPGRADE FIRMWARE WINDOW**

**g.** Once the unit has re-booted, confirm that the main release version reflects the new firmware version by pressing the "SYSTEM" key on the PCA-4125 and then the "left arrow/ -f" key.

## B.5 Screen Captures

The Screen Capture function in PCAView will generate an image of the current screen being displayed on the PCA-4125. Once the image is generated in PCAView, it can then be saved to disk as a bitmap or copied to the Windows clipboard for a quick paste into another program like Excel or Word. The image can be in color or black and white.

### B.5.1 Downloading a Screen Capture

**a.** Check that the instrument is currently displaying the screen you wish to capture. Note that a capture can be taken during test time or after by recalling a test result from internal memory.

**b.** In the PCAView software, select the Instrument menu and click on the Download Screen Capture menu option.

**c.** The Screen Capture window will appear and offer a choice of either color or black and white. Note that the color image will take longer to generate than the black and white.

**d.** Press the 'Download Screen Shot' button

**e.** The display of the PCA-4125 will freeze when the capture is initiated and the image will take about 10-15 seconds to generate in PCAView.

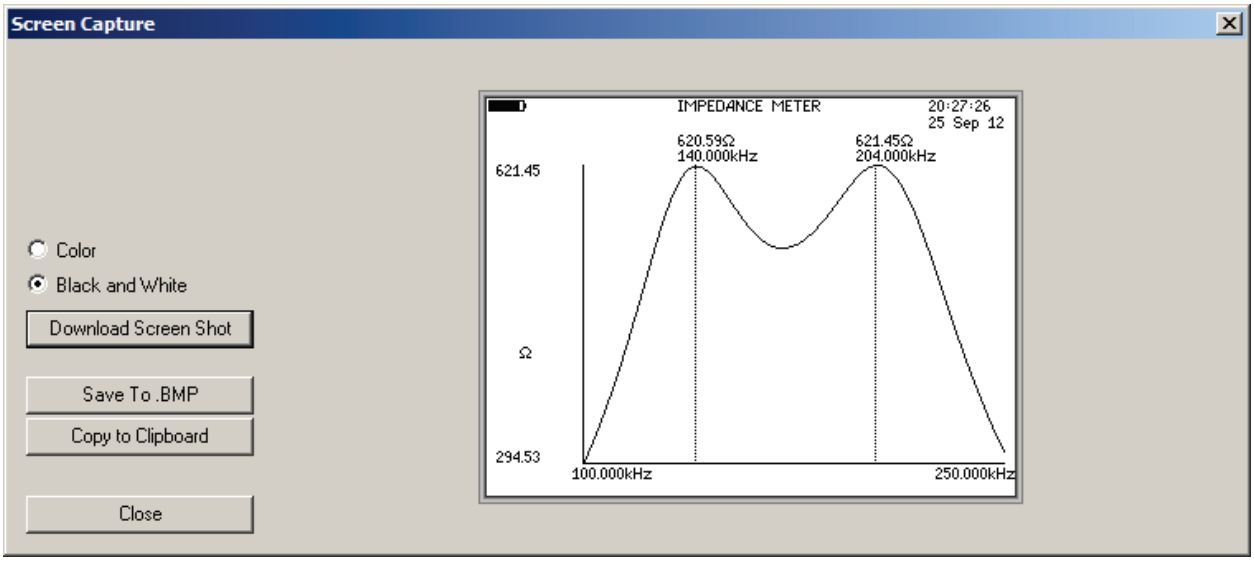


**FIGURE B.5.1-1 – CAPTURED SCREEN/READING**

**f.** Once captured, the generated image can then be either saved as a bitmap image to disk or copied to the Windows clipboard to be pasted into another program.

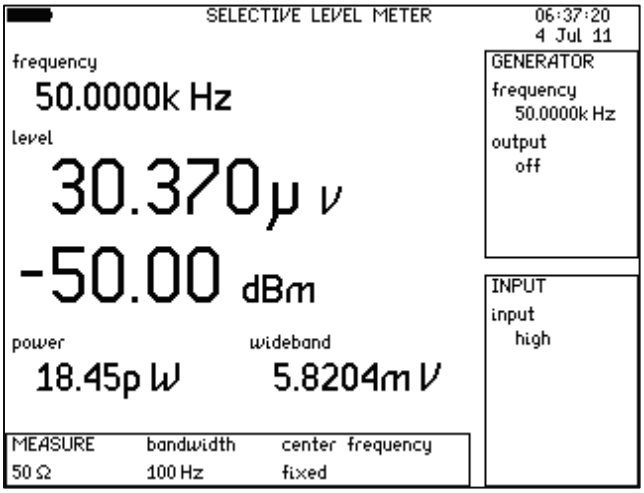


**FIGURE B.5.1-2 – EXAMPL BLACK & WHITE SCREEN CAPTURE**

## B.6 Test Results

Using PCAView, test results can be downloaded directly from the PCA-4125 to a computer connected via USB, RS-232 or Ethernet. A test result can also be uploaded from a connected computer to the internal memory of the PCA-4125.

When downloading, test results can be saved as either a text file or a '.PCS' file. The text file contains the test result data as comma separated values to allow for easy import into a

spreadsheet, database or report template. The '.PCS' file is the native file type of the PCA-4125's internal file system and it can be stored (using the upload function in PCAView) and recalled by any PCA-4125.

Multiple test results can be downloaded at one time using PCAView, and each result is given a filename that reflects its location ID in the internal file system of the PCA-4125 at the time of download. For example, a test result stored in location 99 would be named 'PCA_R099.txt' or 'PCA_R099.pcs'.

When uploading a '.PCS' file, the test result is renamed to 'remote program' and stored in a memory location selected in the upload tab of PCAView.

### B.6.1 Downloading Test Results

a. In PCAView, select the 'Instrument' menu and click on the 'Test Results' menu option.
b. The Test Results window will appear and immediately trigger a scan of the PCA-4125's file system. Once completed, the list of test results available for download will appear in the in the table labeled 'PCA-4125 Results'.
c. Click the 'Download Directory' field and select a location where you would like to save the files.

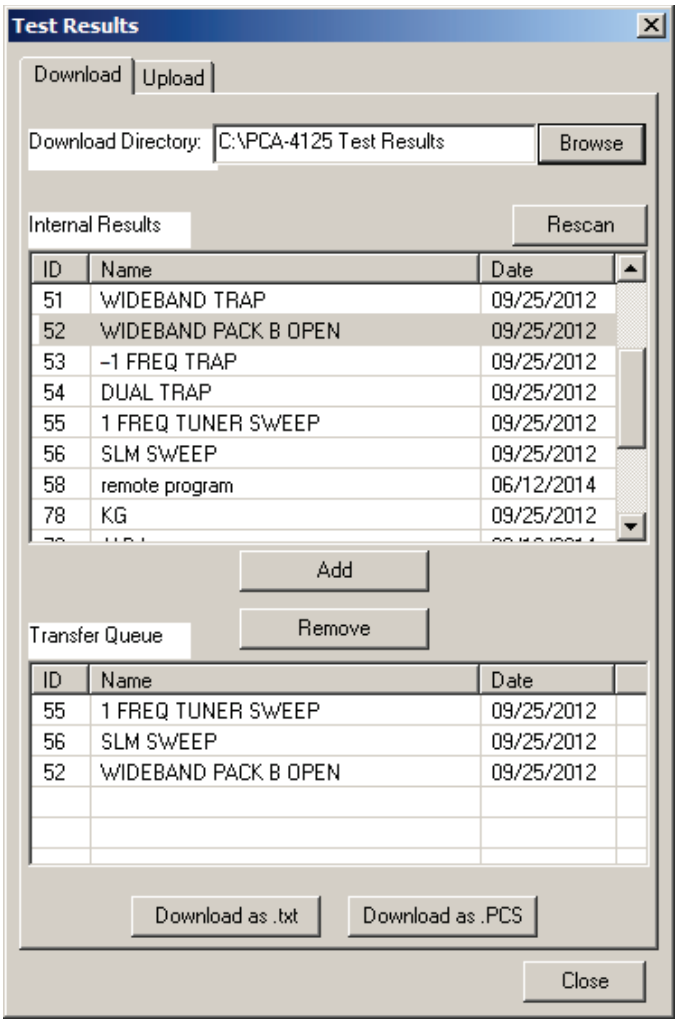


**FIGURE B.6.1-1 – TEST RESULT DOWNLOAD TAB**

d. To select a result for download, double-click or click then press the 'Add' button to add it to the Transfer Queue. Repeat until the Transfer Queue lists all results you would like to download.
e. Press the 'Download as .txt' button or 'Download as .PCS' button to start downloading files.
f. A 'Download Complete' window will be displayed when the download process is complete.

### B.6.2 Uploading Test Results

a. In PCAView, select the 'Instrument' menu and click on the 'Test Results' menu option.
b. Click the Upload tab at the top of the window.
c. Select an empty memory location and press the 'Upload PCS File' button.

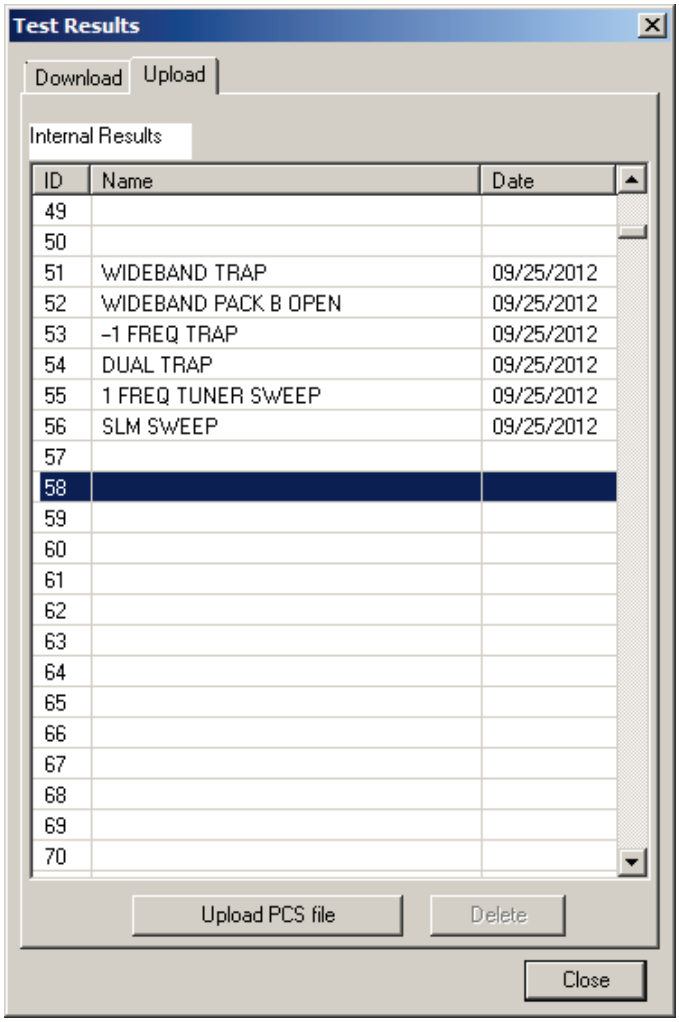


**FIGURE B.6.2-1 – TEST RESULT UPLOAD TAB**

d. Browse and select the '.PCS' file you would like to upload.
e. The test result will then be immediately uploaded into the PCA-4125 file system in the selected location and renamed to the generic 'remote program'.

## B.7 Test Set-ups

Using PCAView, test setups can be downloaded directly from the PCA-4125 to a computer connected via USB, RS-232 or Ethernet. A test setup can also be uploaded from a connected computer to the internal memory of the PCA-4125.

When downloading, test setups are saved as a '.PCS' file. The '.PCS' file is the native file type of the PCA-4125's internal file system and it can be stored (using the upload function in PCAView) and recalled by any PCA-4125.

Multiple test setups can be downloaded at one time using PCAView, and each setup is given a filename that reflects its location ID in the internal file system of the PCA-4125 at the time of download. For example, a test setup stored in location 99 would be named 'PCA_C099.pcs'.

When uploading, the test setup is renamed to 'remote program' and stored in a memory location selected in the upload tab of PCAView.

### B.7.1 Downloading Test Results

a. In PCAView, select the 'Instrument' menu and click on the 'Test Setups' menu option.
b. The Test Setups window will appear and immediately trigger a scan of the PCA-4125's file system. Once completed, the list of test setups available for download will appear in the in the table labeled 'PCA-4125 internal setups'.
c. Click the 'Download Directory' field and select a location where you would like to save the files.

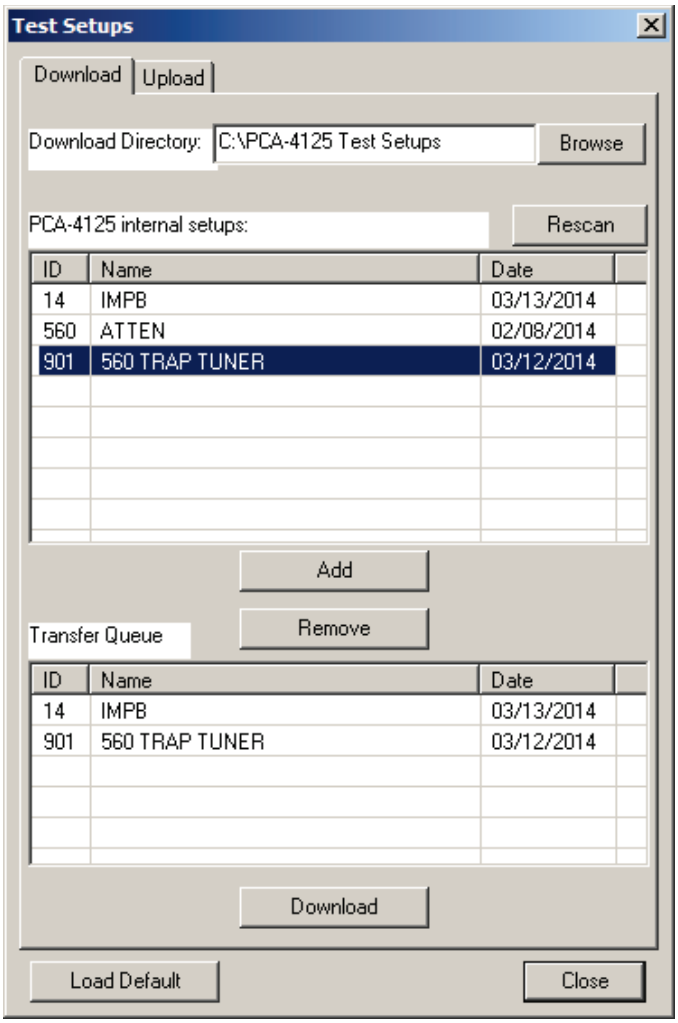


**FIGURE B.7.1-1 – TEST SETUP DOWNLOAD TAB**

d. To select a setup for download, double-click or click then press the 'Add' button to add it to the Transfer Queue. Repeat until the Transfer Queue lists all setups you would like to download.
e. Press the 'Download' button to start downloading files.
f. A 'Download Complete' window will be displayed when the download process is complete.

## B.7.2 Uploading Test Results

a. In PCAView, select the 'Instrument' menu and click on the 'Test Setups' menu option.
b. Click the Upload tab at the top of the window.
c. Select an empty memory location and press the 'Upload PCS File' button.

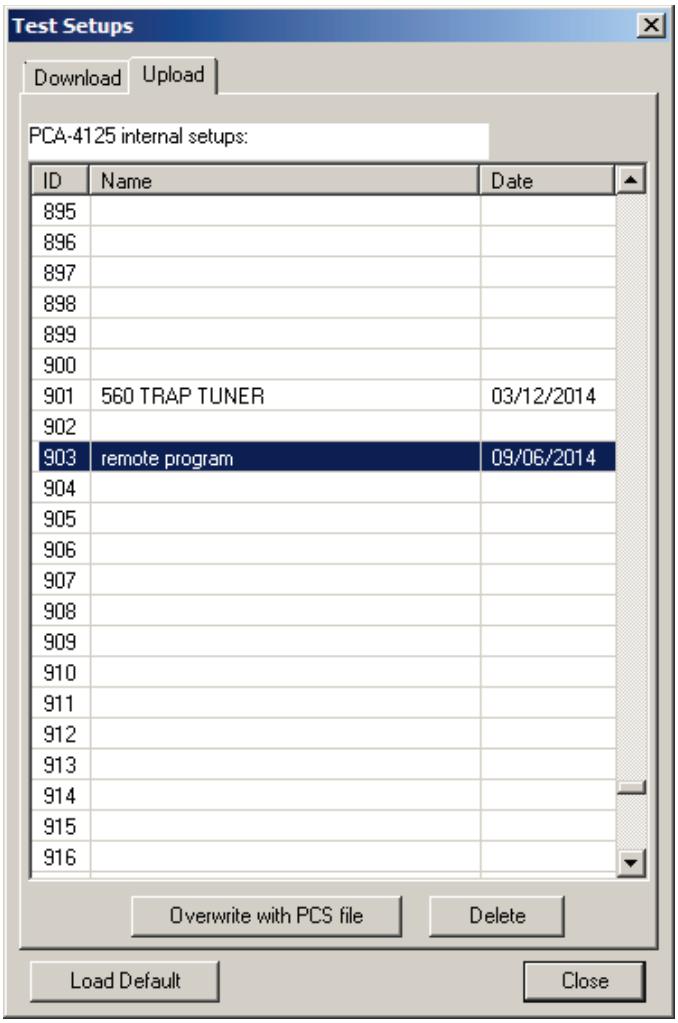


**FIGURE B.7.2-1 – TEST SETUPS UPLOAD TAB**

d. Browse and select the '.PCS' file you would like to upload.
e. The test setup will then be immediately uploaded into the PCA-4125 file system in the selected location and renamed to the generic 'remote program'.