



OPERATION MANUAL

MODEL 4040D

ADVANCED HFC SIGNAL ANALYSIS METER

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4/99 Rev. B

Manual Part No.

6510-00-0434

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CHAPTER 1: INTRODUCTION

1.1 GENERAL

The SAM4040D field SLM is a full-featured signal performance measurement tool, an advanced field spectrum analyzer that can measure ingress and noise to 5 microsecond bursts, and a digital carrier analysis tool capable of displaying TDMA signal performance characteristics. The SAM4040D field meter is compatible with existing version 9.3 or higher Stealth sweep system products.

A second generation of the existing SAM4040, the SAM4040D's new motherboard, analysis software, and RF design together are the basis of an improved unit that assists the technician in rapid analysis and measurement of CATV & broadband system performance. Easily and quickly make frequency response checks, measure and record signal level performance, hum, carrier-to-noise (C/N) ratio, depth of modulation, and other general performance characteristics. Wavetek offers upgrade paths to current owners of SAM4040 units to step their units up to SAM4040D functionality. SAM4040 and SAM4040D units are upgradable to StealthTrak Sweep if customer testing needs evolve.



1.2 SAM 4040D: MORE THAN A SLM

Supporting Wavetek's Sweepless® sweep, where the carrier itself is used as the sweep signal of signal level measurements, the SAM 4040D is capable of automatically or manually conducting a battery of tests. These include a full scan of the cable spectrum to 1 GHz. A proprietary digital signal processing (DSP) technique measures hum and carrier-to-noise (C/N) ratio on modulated carriers. Spectrum analysis' **Zero Span**, **Peak**, and **Desired/Undesired** modes helps technicians to analyze cablemodem and digital set-top box signals.

The SAM 4040D SLM is a streamlined, hand-held instrument, weighing less than five pounds. A 320 X 240 backlit LCD shows measurement data in both graphical and numerical formats. A new extended life battery (4-5 hours typical) is standard in SAM 4040D. This new battery is compatible with existing SAM 4040 and Stealth Sweep receiver units. Existing StealthTrak and 3SR/V/T batteries can be used in SAM 4040D.

1.3 NEW FEATURES AND BENEFITS IN SAM 4040D

Following the existing SAM4040's capabilities, the SAM4040D adds enhanced ingress and noise measurement capabilities, digital carrier analysis, and increased spectrum analyzer functionality, summarized as follows:

- Faster scanning and spectrum analysis for ingress and noise detection (catch bursty noise as fast as 5 microseconds)
- Desired/undesired TDMA digital carrier analysis tool, which allows technicians to see the quality and performance of cablemodems and digital set-top boxes in the reverse path
- New and simple to use operation through the Navigator user interface
- Built in pre-amp for reverse path alignment and analysis which reduces the jumper cables and 'boxes' that a technician must carry. This drastically simplifies alignment methods. This pre-amp also allows the technician to better see test point ingress and noise

The new StealthTrak features address emerging advanced services such as Internet, IP telephony, digital video and DVB. With them, the StealthTrak is a powerful, "many-tools-in-one" instrument in one

lightweight handheld package. Wavetek offers current Stealth customers upgrade paths for units already purchased.

The benefits of these new features are as follows:

Quickly find entry points for ingress and noise

- Fast peak detection circuits see ingress from even transient noise sources
- “Dwell” on each frequency longer to find more of the noise more quickly
- Programmable dwell time in spectrum mode
- Zero-span offers infinite dwell
- Faster spectrum scanning makes searching for ingress interactive, eliminating the wait for the trace to ‘acquire’
- Observe noise signals clearly with built-in pre-amp. Instead of making a technician guess about a signal that is just above the noise floor, StealthTrak’s built-in pre-amp allows technicians to clearly ‘see’ and diagnose noise
- Easily see the difference between ‘meter-induced’ inter-modulation and system inter-modulation and common path distortion (CPD). A built-in low-pass filter strips away higher power forward path signals to examine just the reverse path
- Save money, connections and time. Carry just one box with all the tools needed to find ingress

Pinpoint the source of return path problems by performing analysis of digital return path signals at any point in the field.

- D/U (desired/undesired) measures signal quality *in-service and in-channel* for examining TDMA signals
- See data packet ‘collisions’
- View relative transmission levels for all the transmitters present in a cascade
- See how heavy network traffic is in a given amplifier cascade
- Level measurements allow alignment for both TDMA and continuous digital channels

1.4 ABOUT THE MANUAL

This SAM 4040D Operation Manual gives you all the information required to use SAM 4040D efficiently in CATV maintenance, presented as in the following listing of chapters.

Chapters 1-3: **Introduces** the SAM 4040D SLM and explains how to use the manual to best advantage.

Chapter 4-6: **Measurement modes, reverse path and digital troubleshooting tools, and Spectrum Analysis mode** are described. Power tools, advanced measurement modes and methods, and new SAM 4040D capabilities are discussed.

Chapter 7-9: **Automated testing, files and data management,** and StealthTrak maintenance are discussed.

Chapter 10: **Channel Plans.** Explains step-by-step the procedure for preparing the SAM 4040D to work on a CATV system.

CHAPTER 2: QUICK START

2.1 GENERAL

Unpacking and Installation

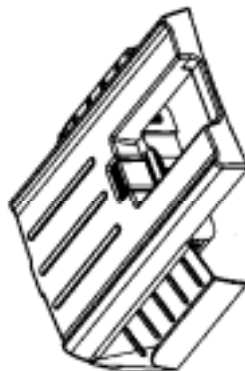
The SAM 4040D SLM was inspected and given thorough final operational and quality control tests prior to being carefully packaged for shipment. The SLM should operate in accordance with the specifications listed in this manual. If it does not, please contact Wavetek Technical Support (800)-851-1198. International Customers, contact your local Wavetek representative. Further web-based support is available at our web-site:

<http://www.wavetek.com/CATVSupport/index.html>

After unpacking, inspect the shipping container and receiver for shipping damage. If the container is damaged, phone Wavetek immediately. Save the shipping carton and packing material for possible future use.

SAM 4040D Power Requirements

The SAM 4040D receiver operates on a 12 VDC battery. A desktop extended life battery charger (included with the product) fully recharges the extended life battery in 5-6 hours. *Note: the extended life battery charger cannot be used with older Stealth batteries. Older Stealth batteries may be used with the SAM 4040D, and new extended Life batteries used in older Stealth units, but the desktop charger must be used.* The receiver can operate on batteries or when connected to the desktop charger.



Channel Plan & Measurements

Chapters 3 and 4 detail the full scope of features available to using, altering, printing, and saving channel plans, and making basic and advanced measurements.

New extended life battery requires unique charger. Old batteries are otherwise inter-changeable between 3SR, 3SRV/T, and SAM4040/D

Turn the unit on, press the **NAV** Support Key to access **Config**. Using the arrow keys, select the crossed tools icon **Config** and press **Enter**. Scroll through the list of **Global, Measurement, Channel Plan, Sweep Receiver**, and **Diagnostics** to **Channel Plan**. Then explore **Setup Channel Plan**, choosing NCTA_Plan to start exploring. If your CATV system does not use this plan, refer to the Channel Plan chapter see how to 'learn' your system. You can start with NCTA_PLAN and edit individual channels.

With an appropriate selected plan or learned plan you can immediately start exploring the measurement capabilities of the SAM 4040D.

Level and Frequency Measurements

Press **Level** to examine the carrier's video and audio levels. At this time, explore with the up/down arrow keys across the channel plan. Press, on the keypad, **Freq** and **Chan** to change display views.

SAM 4040D offers several different level displays optimized to many of the day-to-day tasks in maintaining your cable system:

Level Measurement Mode allows detailed display about a single channel. The video and audio levels are displayed both in bar graph and numeric form. The delta between audio and video level is also computed. Wavetek's digiCheck™ power measurement algorithms are used to accurately read continuous digital carrier. (see Section 3.3.4)

SCAN mode displays a graph of the level of all channels in the current channel plan, either with or without audio and digital carriers. This mode is very useful when first connecting to a test point. It allows a technician to quickly get a general idea of what may be going on with signal levels.

Tilt Measurement Mode provides the information needed to set the equalization in an amplifier. Up to nine selected 'tilt channels' are measured and displayed at the same time. These can be the pilot carriers, or can be channels that are used in each band of the operating cable network. The meter automatically calculates tilt across these channels and displays their levels.

Hum Measurement

Press **Hum** to measure the CATV system's hum component. Note that it is best to make hum measurements without the AC adapter

plugged into the unit. Hum is measured in-service using DSP algorithms. Preprogrammed filters help isolate power supply problems to one times power-frequency, two times-power-frequency, or all low frequency components.

Depth-of-Modulation

Depth-of-modulation, activated by the **MOD** Measurement Mode key, can be measured in service. This display also allows the user to listen to either AM or FM audio carriers to help identify a signal or troubleshoot some problems. If a steady ingress source is found, this feature can be used to help find out what is leaking into the cable network.

Carrier-to-Noise (C/N) Measurement

Press **C/N** to make this performance measurement. The C/N is a two step measurement requiring you to “take down” or turn off the carrier--after the SAM 4040D makes an initial measurement--so that the instrument can measure the noise. The SAM 4040D will prompt you when to turn the carrier off, and then prompt you to turn it back on.

Carrier-to-Noise is measured using an advanced ‘quiet line’ algorithm. The SAM 4040D meter searches for a line of video with no active signal (This typically happens on one or more lines during vertical sync of an analog video channel). This allows the noise measurement to be made in the middle of the channel rather than in an unused side band. Thus, the reading reflects what the CATV subscriber really sees.

Sweepless® Sweep

Activated by pressing the **Sweep** Measurement Mode key, Sweepless® Sweep allows a technician to get sweep information even if no transmitter is available. In Sweepless® Sweep, a SAM 4040D unit measures the stable carrier levels and memorizes them. These levels can then be compared with the levels of the same carriers at a different point in the network, and differences in frequency response can be highlighted.

First, scan and learn the carriers at a point in the CATV network to which you want to normalize all other measurements. In an HFC network, this is typically the first forward test point after the optical

node in a cascade. In analog systems, this should be a reference amplifier test point, or head end test point. After saving these levels, subsequent sweep scans are normalized to them.

In the remainder of the cascade, attach to a desired test point. The SAM 4040D will scan through the start and stop frequencies you program and measure the carriers in the field, computing and displaying the normalized values.

Advanced Field Spectrum Analysis

In **SCAN** Measurement Mode, you can use the SAM 4040D much like a spectrum analyzer. Faster than the original SAM4040 unit, the SAM 4040D catches and displays bursty noise. You can Program start, stop, center frequencies to zoom in and zoom out. Also, you can use Zero Span, Peak, and Desired/Undesired modes for digital carrier analysis.

SAM 4040D features an advanced spectrum analysis capability with many features. This is the ultimate tool for tracking down hard-to-find problems in the cable network. The spectrum analyzer works over the entire 5-1,000 Mhz in frequency range, and can be tuned either by channel or frequency. Several convenient spans are available. Peak hold and dwell time can be varied to track down intermittent signals. A low-pass filter and preamplifier are available to help find difficult return path problems.

CSO and CTB can also be measured using the SAM 4040D spectrum mode. These can help find the source of intermodulation problems and confirm compliance with system performance specifications.

Desired/Undesired TDMA Signal Measurement

This is a powerful digital carrier analysis measurement that requires you to first setup the center frequencies and measurement bandwidths. The display will show the level of the desired cablemodem or other digital TDMA signal carrier frequency (on the reverse path) with the undesired noise. This Zero Span mode of the SAM 4040D allows you to see the real operating conditions, impairments, and noise relevant to cablemodem or digital set-top.

This SAM 4040D spectrum mode includes is based on a powerful zero-span mode display that can be used to measure and analyze many TDMA digital channels and difficult ingress signals. Zero span

mode allows the user to perform in-service and in-channel D/U (desired/undesired) measurements. The user can also see different transmitter levels individually, view data 'collisions', and see how heavy network traffic is.

2.2 QUICK TROUBLESHOOTING

The CATV Support web-site at www.wavetek.com contains many questions and answers about CATV measurement hints and tips.

If you cannot obtain understandable or expected results from the SAM 4040D, the following are the most common causes. Double-check these:

- Wrong channel plan selected or 'cloned'. Scroll through setup to manually check the channel frequencies. The SAM 4040D will generally present the audio carrier on the speaker, so channels are easily recognized.
- Start and stop, center, or other display settings 'squeezed' or 'slid' off-scale or set to a point in the 1 GHz spectrum where no channels are located.
- Connections to splitters, couplers, diplexers, etc., in use to 'patch' the SAM 4040D are bad or wrong.

2.3 TECHNICAL SUPPORT

We've worked hard to make the SAM 4040D as easy-to-use as possible. If you have a problem using your receiver, contact Wavetek's Technical Support for help. You can reach Wavetek's Technical Support, Monday through Friday between 8 AM and 5 PM (U.S.A. Central Standard Time) at (317) 788-5960. Wavetek also maintains a support forum on the Internet. You can leave messages at CATVSUPPORT@wavetek.com, and a Support Specialist will get back to you. or you can visit our Web Site at <http://www.wavetek.com> for immediate solutions.

FOR CUSTOMER SERVICE: call WAVETEK at (800) 851-1198; INTERNATIONAL CUSTOMERS, contact your local Wavetek Representative.

CHAPTER 3: SYSTEM DESCRIPTION AND OPERATION

3.1 GENERAL

3.2 USER INTERFACE ELEMENTS

There are two major methods to control the SAM 4040D:

- The Navigator
- The traditional key controls

The Navigator is displayed at any time by pressing

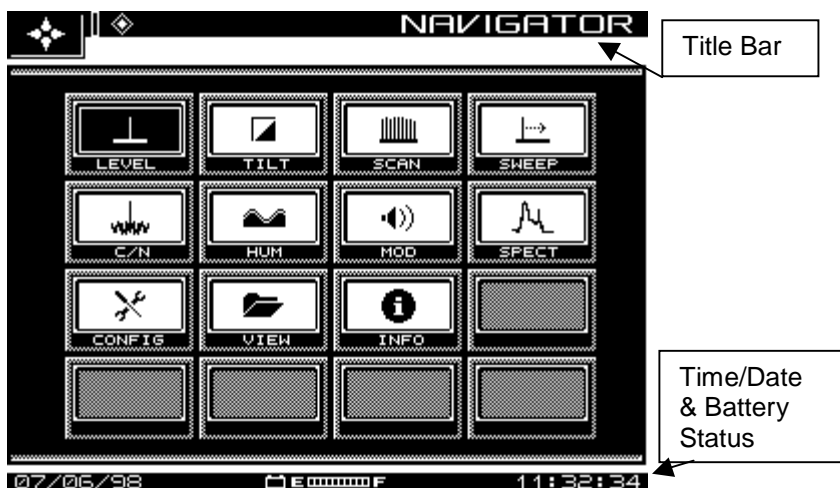
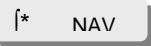
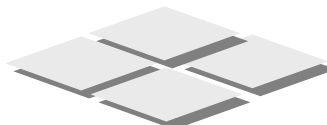


Figure 3-1: The Navigator User Interface

Use the arrow keys to select a Navigator mode or function, followed by the **Enter** key. The Navigator is an easy to use self-guided user interface. You can use the traditional keystrokes used on older Stealth units at any time.



Arrow keys, used for up/down, left/right scrolling, cursor movement, etc.

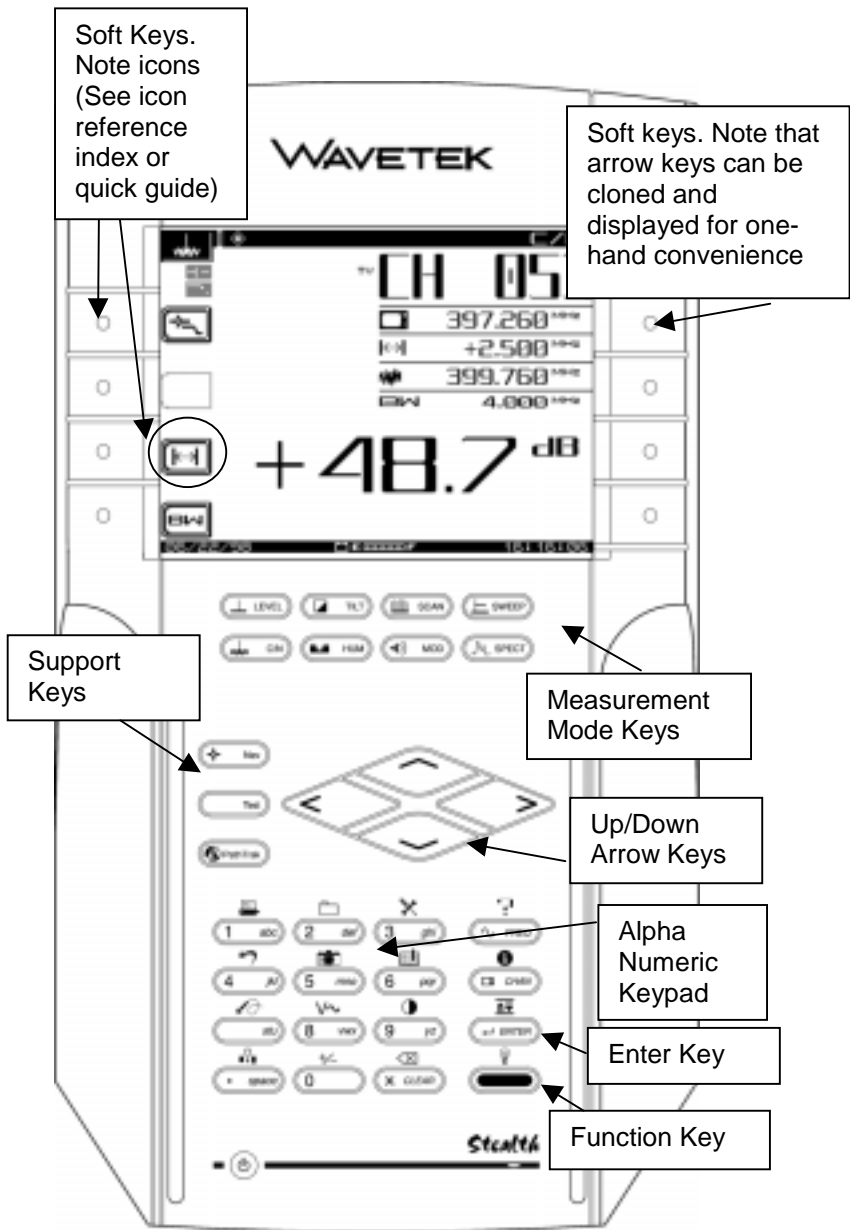


Figure 3-2: SAM 4040D Key Functions

The **Function** key is the green “shift” or second function key at the lower right part of the screen. The ↵**Enter** key is just above it.

To adjust screen contrast, press **Function**, then the **9 / yz** key. The LCD screen back light is activated by pressing the **Function** twice.

Traditional Key Controls

There are five major groups of keys, or buttons, to control the SAM 4040D:

- Eight soft keys, designated in this manual with ***Bold Italics*** text, for example ***60 Hz***. In many cases, icons are used to represent functions for soft keys.
- Eight measurement mode keys, designated with **Bold** text. For example, **Tilt**.
- Three support mode keys,
 - ↵Nav for Navigator, described in the next section,
 - √Test, for direct access to the ***Autotest*** top-level Menu.
 - PathTrak. PathTrak function is not enabled without the PathTrak-StealthModem option.
- Four arrow keys for scrolling menu items, cursors, values, etc.
- A sixteen button alpha numeric keypad.
- Menu modes, or menu titles, are represented in Italics, as in *Global*, *Measurement*, and so forth.

The use of these keys is described as follows:

Soft keys

Icons represent many of the functions of the eight programmable functions that change with mode-to-mode selection. *Tip: to remember what a soft key icon represents, refer to the last section of this chapter.*

Measurement Mode Keys

Measurement modes of the SAM 4040D are activated by pressing one of the eight keys positioned below the LCD. Chapters 4 through 11 describe these modes, particularly sweep and spectrum analysis

functions in extensive detail. The operation of these modes is discussed in Chapter 4.

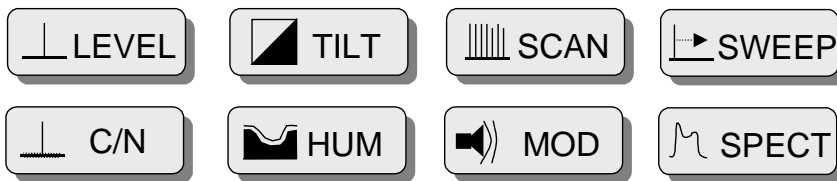


Figure 3-3: Measurement Mode Keys

- Press **LEVEL** to check audio and video levels of a channel simultaneously, or to check a specific frequency.
- To balance pilot Levels, press **TILT**. Nine selected video carrier levels are displayed.
- Press **SCAN** to see absolute carrier levels on a bar graph. All carriers are displayed.
- Press **SWEEP** to test CATV system frequency response using Wavetek's Sweepless® Sweep tool.
- Press **C/N** to measure the carrier-to-noise ratio in dB on the tuned channel or frequency, at a preset frequency offset above the video carrier.
- Press **HUM** to measure low-frequency hum modulation on the selected channel. The measurement is presented in dB or as a percentage. Select either % or dB.
- Press **MOD** to listen to the audio modulation of tuned channel or frequency, and measure the Depth of Modulation on the video carrier. Depth is presented as a percentage.
- Press **SPECT** to activate the spectrum analyzer display, and to measure CSO/CTB harmonic distortions (in conjunction with designated soft key). Also, use the **Desired/Undesired**, **Zero Span**, and **Peak** modes to view digital carriers and to hunt down and display difficult to see noise & ingress on the reverse path/

Alpha Numeric Keypad

The standard keypad is augmented with green colored functions. These are selected or activated by first pressing the green button at the lower right of the keypad, followed by the desired function.

Use the alphanumeric keys as follows:

- Enter numeric values 1 through 0. The **Function** key makes the "0" key toggle between +/- when negative entries are allowed in entry fields.
- Use the **./space** key for decimal points.
- For data fields that accept alpha characters, such as test point names, technician names, or file names, enter letters in the edit box field as required. Press each key 1, 2, or 3 times to choose the letter desired. Pressing a key an "extra" time brings up the number assigned to the key.
- Pressing the **./space** key twice creates a space between letters.
- Use the right and left arrow keys to move the cursor.

Note: Always finishes numeric entries by pressing the **↵Enter** key.



Figure 3-4: Shift, or Second Functions of the Keypad

3.3 PRINTING MEASUREMENTS AND FILES

To print a file, press the **NAV** support mode key, then use the arrow keys to select **View**, then use the icon soft keys or the **Function**, then Print or **1 abc** key. Note: don't forget to attach the printer.

Interface the StealthTrak to a PC with a Stealth-to-PC cable, P/N 1217-50-0158. The Stealth-to-Stealth interface cable is P/N 1217-50-0149. The Stealth-to-Printer interface cable is P/N 1217-50-0159. These three cables are different. Pin-outs and connector types are available by calling Factory Support.

3.4 SYSTEM MODES OF OPERATION

The SAM 4040D Sweep System has the following modes of operation:

Level Measurement

SAM 4040D offers several different level displays optimized to many of the day-to-day tasks in maintaining your cable system:

- **SCAN** mode displays a graph of the level of all channels in the current channel plan, either with or without audio and digital carriers. This mode is very useful when first connecting to a test point. It allows a technician to quickly get a general idea of what may be 'going on' with signal levels.
- **TILT** mode provides the information needed to set the equalization in an amplifier. Up to nine selected 'tilt channels' are measured and displayed at the same time. These can be the pilot carriers or channels. The meter automatically calculates tilt across these channels and displays their level.
- **LEVEL** mode presents a detailed display about a single channel. Video and audio levels are displayed both in bar graph and in numeric form. The delta between audio and video level is also computed. When a digital channel is measured, digiCheck™ power measurement algorithms are used to accurately read continuous digital carrier levels across the entire channel selected.

Chapter 4 outlines level measurements in more detail.

Sweep

Sweep is the most complete way to measure the frequency response of your cable network. SAM 4040D offers Sweepless® Sweep tool to maximize the productivity of your troubleshooting time. Sweepless® Sweep can be used to gain sweep information even when there is no sweep transmitter available. See Chapter 4 for a complete description of SAM 4040D's sweep capability.

Sweepless® Sweep allows a technician to get sweep information even if no transmitter is available. If a transmitter is 'down', or if something is blocking the telemetry channel, Sweepless® Sweep can still be used. In Sweepless® Sweep, a SAM 4040D unit measures the stable carrier levels and memorizes them. These levels can then be compared with the levels of the same carriers at a different point in the network, and differences in frequency response can be highlighted.

Proof-of-Performance Measurement Tools

SAM 4040D provides an extensive suite of tools for troubleshooting and for performing proof-of-performance tests. Carrier-to-noise, hum and depth of modulation are all calculated on analog video channels in-service *and* in-channel. This allows technicians to measure the performance customers really experience, all without any service interruption. See Chapter 6 for more details.

- Carrier-to-noise is measured using an advanced 'quiet line' algorithm. The SAM 4040D meter searches for a line of video with no active signal (this typically happens on one or more lines during vertical sync of an analog video channel). This allows the noise measurement to be made in the middle of the channel rather than in an unused side band. Thus, the reading reflects what the CATV subscriber sees on the picture.
- Hum is also measured in-service using DSP algorithms. Pre-programmed filters help isolate power supply problems to 1-times power-frequency, 2-times power-frequency, or all low frequency components.
- Depth-of-modulation can be measured in-service. This display also allows the user to listen to either AM or FM audio carriers to help identify a signal or troubleshoot some problems. If a steady

ingress source is found, this feature can be used to help find out what is leaking into the cable network.

- SAM 4040D also offers the capability to perform these proof-of-performance tests on an *automated* basis. The user can request a complete battery of tests for any or all channels in the channel plan. The SAM 4040D meter can perform these tests immediately, or take a set of tests over any set of intervals desired. This is useful when taking '24-hour' tests as required by the FCC in the US, and by other international governing bodies.

Spectrum Analysis

SAM 4040D features an advanced spectrum analysis capability. This is a simple but extensive tool for tracking down hard-to-find problems in the cable network. The spectrum analyzer works over the entire 5 MHz to 1 GHz frequency range. Tuning can be by channel or by frequency. Several convenient frequency spans from 3 to 50 MHz are available.

Maximum hold and dwell time can be varied to track down intermittent signals. A low-pass filter and preamplifier are available to help find difficult return path problems.

The SAM 4040D's spectrum mode includes a very powerful zero-span mode display that can be used to measure and analyze TDMA digital channels and difficult ingress signals. Zero span mode allows the user to perform in-service and in-channel D/U (desired/undesired) measurements on TDMA channels. The user can also see different transmitter levels individually, view data 'collisions', and see how heavy the traffic is on the coax.

CSO and CTB can also be measured using Spectrum mode. These measurements can help find the source of inter-modulation problems and confirm compliance with system performance specifications.

3.5 CONFIGURING THE SAM 4040D

Turn the unit on. If the internal transmitter requires self-calibration, you may see a prompt to perform a self-calibration of the internal transmitter. At this time, just press the **NAV** support key, then scroll with the arrow keys to the crossed-tool **Config** icon. Select this icon and you should see:



Figure 3-5: CONFIGURE Menu.

3.5.1 Global Configuration

Select **Global**, and enter appropriate information into the twelve items listed.

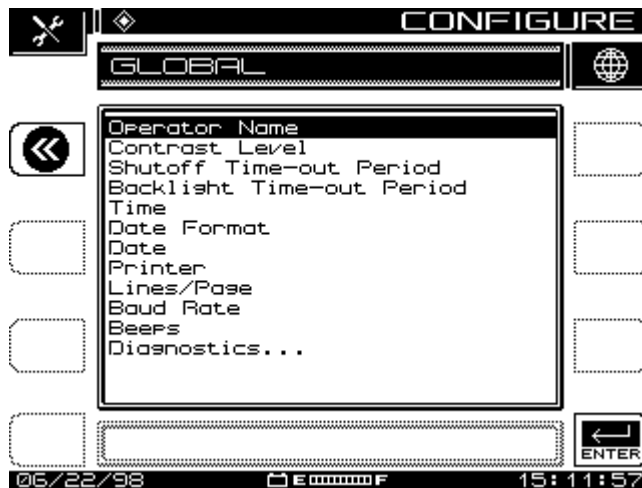


Figure 3-6: GLOBAL Menu

Operator Name. Enter your name, which will appear in the header section of the Auto Test Report.

Contrast Level. Adjusts the contrast level of the LCD for optimum viewing. The level varies on a scale from 1-15.

Shut-off Time-out Period. To conserve battery life, an automatic shut-off feature turns the meter off after a pre-set interval of inactivity: 1, 3, 5 minutes, or Always On.

Backlight Time-out Period. An additional means of conserving battery life is an automatic screen backlight time-out. The time out period is programmable: Always Off, 5 sec, 10 sec, or Always On. You can turn the backlight On/Off manually any time by pressing the Function key.

Time. Use the numeric entry keys to enter the time in the HH:MM:SS format (24 hour).

Date Format. Use the UP and DOWN arrow keys to select the date format. When you change the date format, the new format will appear everywhere the date is displayed or printed. The following formats are available:

MM/DD/YY DD.MM.YY YY.MM.DD

Date. Use the numeric entry keys to enter the date. Select *Date Format, Next,...* to determine date display format.

Printer. Sets the printer interface. Use the UP and DOWN arrow keys to choose between Diconix, Seiko, IBM, or Epson. The required serial printer configuration is as follows:

- Baud rate consistent with SAM 4040D Receiver (recommend 9600 or 19.2K recommended)
- 8 data bits
- 1 stop bit
- No parity
- Flow control - hardware handshaking
- Printing to a parallel printer requires serial-to-parallel converter such as the one manufactured by Black Box Corp. (Phone 412-746-5500). The setup is the same as the serial printer configuration.

Lines/Page. You can specify the number of lines/page (min 30, max 255) for text printouts. This determines the number of lines printed before a form feed command is sent. For *no* form feeds, enter zero (0) for the Lines/Page.

Baud. The Baud or bit rate establishes the speed of communications between the SAM 4040D receiver and another device. Baud values available are: 1200, 2400, 4800, 9600, and 19.2k.

Beeps/Clicks. Use the arrow keys to turn key press clicks and instrument beep functions on/off.

Diagnostics. To enter diagnostics mode, press the **↵ENTER** key.

3.5.2 Diagnostics



Figure 3-7: Diagnostics

In Diagnostics mode you can reset the instrument to original factory configuration, test the LCD, or, when applicable, check out the SAM 4040D's internal transmitter functions.

- **Default to Factory Settings.** Executing this function will cause all saved files, configurations, and memory to be lost. Scroll to Default to Factory Setting, and press the **↵ENTER** key, which

automatically sets all parameters to the factory default values after the unit is turned off and on.

- **Display Test.** Allows you to test the operation of the display. Select *Display Test* and press **↵ENTER**. This activates Figure 3-7, Display Test This test merely checks the on/off properties of the screen.

Any left soft key toggles the screen On/Off.
Any right soft key moves to the previous screen.



Figure 3-7: Display Test

3.5.3 Measurements Configuration

With the Setup Menu of Figure 3-4 visible, press the soft key on either side of **Measurements**. Seven variables are to be adjusted in this part of the configuration. In each case, use the up/down soft keys to scroll through the list, and change the variables as indicated by the Title Bar. Press the **↵ENTER** Soft key when it appears, to select the *edit box* for changes.

- **Temperature Units.** Select the correct temperature units (degrees Celsius or degrees Fahrenheit).

-
- **Signal Level Units.** Select the units to be used for checking signal power levels (dBmV, dBuV, and dBm).
 - **Test Point Compensation.** Insert values in this menu to have the SAM 4040D automatically include compensation levels in readings.
 - **Frequency Tuning Step Size.** Adjust the Tuning Step Size using the up/down arrow keys or the numeric entry keys (0.01 to 100.00 MHz in 10 kHz steps).
 - **Fundamental Hum Frequency.** Select the fundamental HUM frequency to be measured (60 Hz, 50 Hz, 1Hz, or, Auto). With Auto selected, the unit will automatically switch to 50 Hz on PAL type plans and 60 Hz for NTSC plans. 1Hz is for use in the case of a 1Hz Power Supply.
 - **Scan Rate.** Two scan rates are available in the **Scan** mode, **Normal** and **Fast**. The **Fast** scan feature allows for rapid scan displays, but at less accuracy. **Normal** scan rate is slower but more accurate.
 - **Scan Audio Carriers.** Omitting the audio carriers during **Scan** produces a faster scan.
 - **C/N Calibration.** To increase the accuracy of the carrier-to-noise measurements, the measurement algorithm incorporates a Noise floor calibration. To perform the calibration, select C/N calibration and press the **ENTER** key. To get a valid measurement, the program prompts you to be sure that no cable is connected to RF IN connector. Once the measurement is verified, press the **OK** soft key to perform the calibration. The screen will display the system noise level. When the calibration is complete, the screen displays the noise floor, expressed in dBuV.


3.5.4 Sweep Configuration

Sweepless® Sweep requires that the following parameters be setup:

- **Sweep Limit Variable.** The Sweep Limit Variable is "X" in the response flatness expression $(n/10 + X)$ used during sweep measurements to compare actual system response to the formula. "X" is adjustable from 0.0 to 5.0 (default is 1.0).
- **Show Horizontal Markers.** The horizontal markers continuously track Max/Min values in the area of the graph between the vertical markers.
- **Sweep File Overlay.** Sweep file overlay enables you to view a stored sweep response simultaneously with a "live" sweep response for direct comparison. The sweep file overlay option must be enabled for viewing both traces simultaneously. With this option disabled, stored files are displayed for normal viewing without the live response superimposed. If the sweep file overlay option is enabled, the live response overlays the stored response during viewing. Use the up/down arrow keys to enable the option.
- **Include Audio Carriers.** This selection allows the audio carriers to be excluded, resulting in a faster sweep. Use the up/down arrow keys to include (yes) or exclude (no) audio.



















3.5.5 Configuring a Digital Carrier in a Channel Plan

















Follow these instructions to set up digital channels in your channel plan:

- Turn the unit ON and press the **NAV** button, then **Config**.
- From the menu, select **Channel Plan**
- Scroll to **Edit Channel Parameters**, and then press the **↵Enter** button.
- From the channel line-up, highlight the channel that you are going to configure as digital, then press the **Edit** Channel icon, or **↵Enter**. 
- Highlight the **Type** line in the **Parameters** box, then **↵Enter**.
- Press the up/down arrow key until the type is **Digi**.
- Highlight the **Frequency (MHz)** line in the **Parameters** box.
- Using the numeric keypad, type the *center frequency* of the digital carrier, and then press the **↵Enter** button.

-
- Highlight the **Measurement BW (MHz)** line in the *Parameters* box.
 - Using the numeric keypad, type the bandwidth of the digital carrier, and then press the ↵**Enter** button.
 - Highlight the **Enabled** line in the *Parameters* box. Verify that the setting is **Yes**.
 - Press the **Exit** soft key.
 - Highlight the next channel to be configured as digital, and repeat this procedure, and repeat the procedure.

3.6 SOFT ICON GUIDE

<u>Icon / Description</u>	<u>Icon / Description</u>
 Amplifier / Low pass Filter Sub-Menu	 Sweep Enable Video Enable
 Offset Sub-Menu	 Level Sub-Menu
 Bandwidth Sub-Menu	 Noise Scan Enable
 Limit Check Sub-Menu	 Frequency Sub-Menu
 Enable / Disable	 Start Zero Span
 Check Limits	 A or B Marker Toggle
 Maximum Hold	 Start CSO/CTB Test
 Reference Level	 Select High Tilt Pilot Channel
 Tilt Compensation Sub-Menu	 Select Low Tilt Pilot Channel

Icon / Description	Icon / Description
 Hysteresis	 Autoscale
 Video Bandwidth	 Scan Time
 Resolution Bandwidth	 Restart Maximum Hold
 Measurement Bandwidth	 Demodulation Toggle
 Scale	 Volume Up
 Return to Last Mode	 Volume Down
 Audio Enable	 Cancel
 Restart	 Center Frequency

Icon / Description**Icon / Description**120 Hz Filter
Enable / Disable

Log / Linear Toggle



<1 kHz Filter Enable



Dwell



Save This Channel BW



Save BW to All Channels



Trigger On/Off

Desired / Undesired
Marker Toggle

Low Pass Filter Enable



Pre-Amp Enable



Marker to Peak



Span



Stop Frequency



Start Frequency



Manual Trigger

CHAPTER 4: MEASURING SYSTEM PERFORMANCE

4.1 INTRODUCTION

Chapter 4 tells you how to evaluate system performance by measuring key parameters, as part of either routine monitoring or corrective maintenance. Included are: Level, Tilt, Scan, Carrier-to-Noise ratio (C/N), Hum, Modulation-Demodulation, Composite Second Order (CSO) and Composite Triple Beat (CTB).

4.2 ROUTINE/CORRECTIVE MEASUREMENTS

You can start these measurements through the **NAV** main menu or by simply pressing the Measurement Mode keys.

- During many of the following measurements, you will notice that for a given procedure, the display remains essentially the same, but the Icons that guide you through the test change from screen to screen within the same test.
- Press the soft key adjacent to the Icon to activate the specific function.
- The icon will partially darken or “gray out” to indicate change-of-state.

4.3 MEASURING SIGNAL LEVELS

Measure signal levels in the **Level**, **Tilt**, and **Scan** Modes. In **Level** and **Scan** the process measures the difference between Video and Audio for a channel and displays the difference in dB. In **Tilt** Mode, the difference, or **Tilt**, refers to the difference in dB between the upper and lower pilot channels. In terms of SAM 4040D setup, measurement configuration parameters for **Level**, **Frequency**, and **Tilt** interact, and are important factors in all three measurements.

4.3.1 Level Measurements

With **Level** mode selected, you can tune by channel or frequency.

Tune by Channel: When you press **Chan**, the channel number and label appear at the top of the display (Figure 4-1). Use the left and right arrow keys to decrement and increment the channel number. You can also enter the channel number by using the numeric keys, followed by **Chan**.

If you were in *Frequency*, **Chan** tunes to the nearest channel in the channel plan

Frequency: To tune by frequency, use the numeric keys to enter a frequency, followed by **Freq**. See Figure 4-2. Use the left and right arrow keys to decrement and increment the frequency. The step size for these frequency changes is programmed during setup: **NAV (Config, Measurement, frequency Tuning Step Size)**.

If you were tuning by channel, *Frequency* tunes to the video frequency of the current channel or to the center frequency of a digital channel. (For digital channels setup in the channel plan, the measurement algorithm used is for scrambled channels.)

In **Level, Chan** mode, you can measure the difference in video and audio Level (dBmV) for a specific channel, expressed as dB. If one of the readings is off-scale (low or high), use the up/down arrow keys to see both readings on the screen. Use the left/right arrow keys to scroll through the channels one-at-a-time.

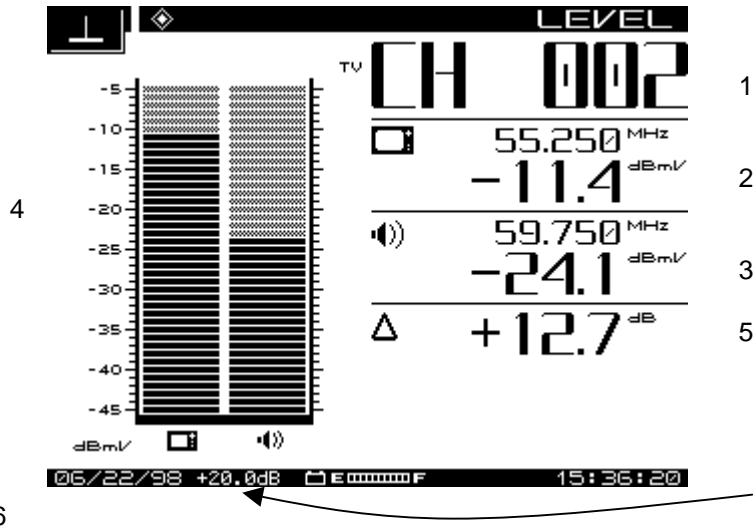


Figure 4-1: Level Mode Display

Information displayed in **Level** mode is as follows:

1. Channel number or frequency
2. Channel label, video carrier frequency, and level (dBmV. Note: can be dBuV—this is a configuration parameter)
3. Audio carrier frequency in MHz and level
4. Graphical display of carrier levels (dBmV)
5. Delta between audio and video levels (dB)
6. Test point compensation (appears only if a non-zero value is programmed during setup); compensates for the test point loss or probe loss from the measurement result to show the signal level "on the system." (20.0 dB in this instance.)

Figure 4-2 shows the display for tuning by frequency. With only a single frequency involved, there is no Delta value. The display is a graphical view of the Level measurement, referred to dBmV.

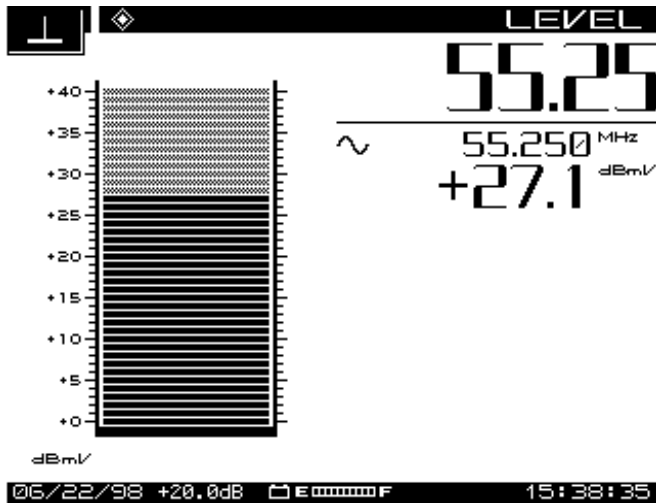


Figure 4-2: Level Mode Display, Specific Frequency Only

- Dual audio carrier channels display two audio graphs.
- Digital carriers show as noise.

Scrambled channels have the same appearance as non-scrambled channels. You must designate scrambled channels in the **Edit Channel Plan** sub-menu of the **Config, Channel** menu.

4.4 TILT MEASUREMENT

Tilt is transmission loss in a coaxial cable. Tilt increases in proportion to the square root of frequency. Tilt compensation adjusts amplifier frequency/gain response to offset Tilt attenuation. As displayed by a SAM 4040D, **Tilt** mode shows levels across a band of channels. Tilt appears as the slope between lowest to highest channel. Levels for each intermediate channel should reach the line.

Tilt Compensation

The tilt compensation feature allows you to enter the cable loss for a particular section of coax and then, using the scan display, adjust the gain of the amplifier to compensate for this loss. You can turn **Tilt Comp** ON/OFF in the **Tilt** sub-menu.

SAM 4040D enables you to designate up to nine Tilt channels. (**Config, Channel Plan, Edit Channel Plan**). The slope for Tilt is a straight line from the lowest (in frequency) to the highest designated **Tilt** channel. The low and high frequency channels are the pilot channels. Pilot carrier's levels establish the slope of the **Tilt** graph that you see on the LCD.

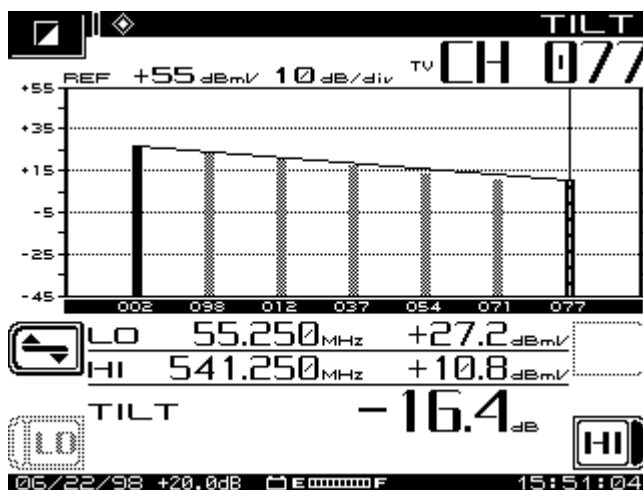


Figure 4-3: Tilt Mode

You can enter **Tilt** measurement mode through the NAV top-level menu, or by pressing the **Tilt** mode key.

Figure 4-3 shows the **Tilt** display. Use the **LO** and **HI** soft keys to select the LO and HI pilot channels for your **Tilt** adjustment.

Use the icons in this menu as follows:

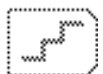
The **LO** or **HI** icon will darken as either is selected.



Pressing this Icon brings up the following three useful functions, then returns the main **Tilt** Menu.



Reference Level allows you to use the up/down arrow keys to make discrete adjustments to the reference Level within in pre-set range(+/-).



Scale allows you to adjust the dB/div on the vertical scales, using the up/down arrow keys to scroll through the pre-set values for best presentation on the screen.



Establishes an optimized AutoScale presentation, based on the previous two settings.

NOTE: The *Reference Value* level is limited by the units selected and the *Scale* setting.

The **Tilt** adjustment uses amplifier gain to compensate for the attenuation of signals moving through the cable. Higher frequencies are attenuated more than lower frequencies. This accounts for the slope of the line in Figure 4-3. Tilt mode simplifies the actual balancing by displaying a bar graph with a representation of up to nine video carrier levels. **Tilt** adjustment compensates for unequal attenuation, so that each channel reaches a customer with about the same gain.

Information displayed in Figure 4-3 is as follows:

- High and low carrier frequencies
- High and low carrier levels
- Tilt measurement
- Reference level and scale
- Test point compensation (appears only if a non-zero value is programmed during setup).

A cable system is designed for unity gain, and the output level of each type of amplifier (trunk, bridger/line extender) should be set or

adjusted to be as close to the same level. The amplifiers are set up with specified levels for signals at the high and low end of the spectrum, used for Automatic Gain Control (AGC) or Automatic Slope Control (ASC), respectively. In the amplifier balancing process, these signals are measured and adjusted to specification.

In practice, before adjusting compensation of the amp, first check that there are no problems in the system requiring repair. Gain control affects all frequencies about equally; but slope control affects lower frequencies more than the high end

To balance the amplifier for **Tilt**:

Select the **Tilt** display, and then select the **HI** Pilot channel.

- Observe the nine Tilt channels by pressing the **Tilt** Measurement Mode key. To include or exclude a channel in the nine Tilt channels, you must choose desired video carriers as Tilt Channels in the **Edit Channel Plan** portion of the **Config, Channel Plan** menus.
- Use the up/down arrow keys to adjust the reference level of the graph.
- Adjust amplifier Tilt as follows:
 1. Switch, on the amplifier, AGC and ASC OFF.
 2. Adjust the high pilot channel to the specified level , using the Manual Gain control.
 3. Adjust the low pilot channel to specified level using manual Slope control.
 4. Due to interaction between these controls, repeat the process until you have the prescribed balance.
 5. Switch AGC and ASC ON, and wait briefly, to be sure AGC and ASC maintain that balance.

4.5 SCAN

Scan Measurement Mode displays the absolute carrier levels across the part or all of the CATV spectrum. SAM 4040D displays a bar graph showing video and audio levels of carriers within the span of selected frequencies. The narrow vertical marker designates the carrier being measured levels. Frequency, video, and audio levels, as well as the Delta between levels is displayed on the bottom-half of the screen

Scan Rates

Two scan rates can be selected in **Scan** Mode, Normal and Fast. Select Scan Rate in the **Config, Measurement** sub-menu. The Fast scan feature allows for rapid scan displays, at reduced accuracy (as much as 2 dB on scrambled channels.) Normal scan rate is slower, but much more accurate. An speeding bullet icon, when **Fast** is selected, appears in the upper left hand corner of the **Scan** display.

Audio Carriers

You can omit audio carriers for a faster scan. Select this in the **Config, Measurement** sub-menu. An "X'd out" audio icon indicator appears in the upper left hand corner of the Scan screen when audio carriers are omitted.

- Use the up/down arrow keys to change the reference level in dBmV.
- Use the left/right arrow keys to move the marker.
- At the top left of the screen are **REF** (value) **dBmV** and Scale as (value) **dB/div**.
- At the lower left and lower right corners you see **Start** and **Stop** frequencies currently in effect for the **Scan**.

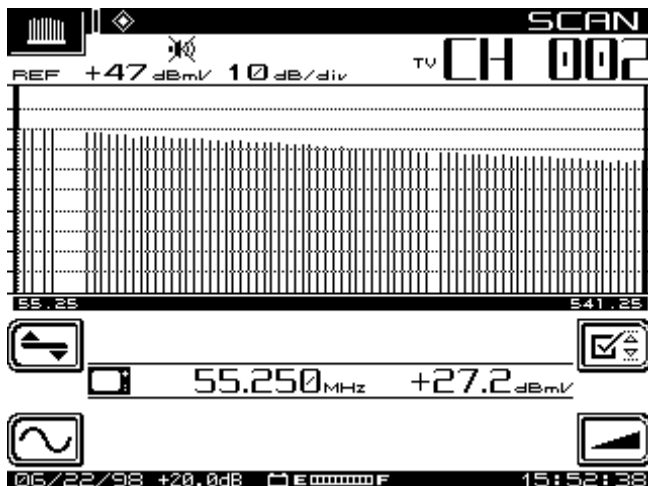


FIGURE 4-4: Scan Mode

Scan Measurement includes sub-menus for **Level** and **Tilt**, each with adjustments for **Freq** and limits.

- If Tilt compensation is ON, you will see a small version of the tilt icon at in the top center of the screen, and at the bottom-center of the screen **Tilt Comp (value)**.
- Immediately below the graph numerical values are displayed.

The basic display shows the following information:

- Channel number
- Video carrier frequency and level (numerical)
- Audio carrier frequency and level (numerical)
- Histogram graph of carrier levels
- Delta between audio and video levels
- Selected channel plan
- Test point compensation (appears only if a non-zero value) is programmed during setup)
- Limits annunciator (If out-of-tolerance conditions exist)

In the **Level**, **FREQ**, **Tilt**, and **LIMIT** submenus, use the Icons as follows:

Level



Press to bring up the **Level** sub-menu, then to return to the Main Scan Menu.



Press to use Auto Reference Level



For manual Reference Level adjustment. Use either numeric up/down arrow keys, then press ↵**Enter** key.



adjust Scaling of the graph. Use up/down arrow keys to through the available. Changing the scale factor changes the display.

Freq



Press to bring up the **Freq** sub-menu, then to return to the Main Scan Menu



When this is active, set Start Freq, and press ↵**Enter** Key.



When this is active, set Stop Freq, and press ↵**Enter** key.



Pressing this resets the **Start/Stop Freq** to full span
Press this to return to values previously set.

Tilt



bring up the **Tilt** sub-menu, then to return to the **Scan** menu



turn **Tilt** Compensation ON/OFF.

Limits



Press to bring up the **Limit** sub-menu, then to return to the main **Scan** menu.



Press to turn **Limit** ON/OFF. Limit errors are shown as:

<CHAN>	Adjacent Channel Error
VIDEO v	Video Level Too High or Low
DVA ^	DVA Too High or Low



Press to run auto check.

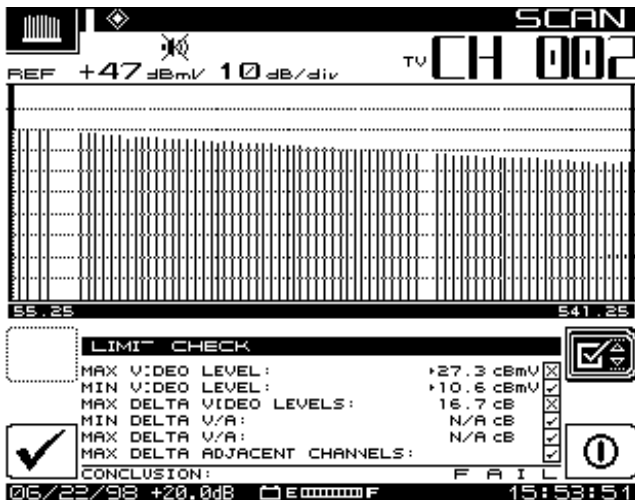


Figure 4-5: Limits

The Limit feature allows for comparison of the current scan measurement with the "FCC" or other conformance/test limits defined during setup and configuration. There are two parts to this feature:

When an out-of-tolerance condition exists, a set of annunciators will appear below the graph. Updated with each scan update, the annunciators indicate the following out of tolerance conditions:

<CHAN>	Adjacent Channel Error
VIDEO v	Video Level Too High or Low
DVA ^	DVA Too High or Low

You can display an "aggregate" result summary by pressing the **Limit** soft key. This performs a limit check of all channels contained within the scan, and reports an overall pass/fail conclusion. The aggregate limit check is not performed with each scan update; however, you can press the **Check** soft key to run the test any time. When **Limit** is off, the annunciators do not appear.

4.6 CARRIER-TO-NOISE

It is a good CATV engineering practice to use a band pass filter on the input of the SAM 4040D when making **C/N** measurements. This ensures accuracy and extends measurement range. If a preamplifier is used to boost test point levels prior to measurement, it should be placed between the band pass filter and the SAM 4040D.

C/N This measurement is simply a comparison in amplitude between the video carrier reference signal and the noise (FCC limit: > 43 dB). The noise measurement must be made at a frequency offset (displacement from the video center frequency) of least 2 to 2.5 MHz from any other carrier on the system.

The **C/N** Measurement Mode displays the carrier-to-noise ratio of the tuned channel or frequency. You can set **C/N** measurement bandwidth and the frequency offset for the noise measurement from the screen. A proprietary DSP technique allows **C/N** measurements on modulated carriers (non-scrambled channels). The **C/N** measurement requires measuring the video carrier level and then tuning to the offset frequency, searching for a quiet line. Once a quiet line is found, the SAM 4040D measures four consecutive *frames*, then averages the values. This value is then corrected for the selected bandwidth, and the **C/N** ratio is computed.

CAUTION: If you select C/N Mode before a carrier is available at the input of the SAM 4040D, the readings will be wrong. If this occurs, change to another mode or channel and then return to the channel you want.

Information displayed in the **C/N** Mode is as follows:

- Channel number
- Channel label
- Carrier frequency
- Noise offset frequency
- Noise frequency
- Bandwidth
- **C/N** ratio
- Channel plan

To make a **C/N** measurement, select a channel, and press the **C/N** Measurement Mode key. For example, selecting channel 2, with a

2.5 MHz noise offset for detecting the noise floor, is 25.0 dB above noise.

If the result of **C/N** measurement is outside the specified range, the numerical result will change from black to gray.

Use Icons as follows:



Amp/Low-Pass. Enter Amplifier/Low-Pass filter sub-menu; return to C/N main menu.



Enable or Disable 13 dB Amplifier



Enable or Disable 50 mHz Low-pass Filter (Icon shows Disabled)



Offset
Enter Offset submenu; return to **C/N** Main Menu.



Store current measurement Offset to current channel parameters in current channel plan.



Store current Measurement Offset to all channels in the current channel plan.



Enter Bandwidth submenu; return to C/N main menu.

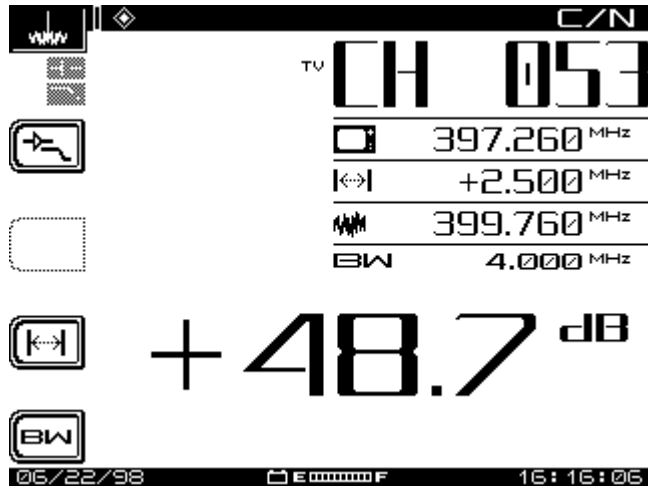


Figure 4-6: Carrier-to-Noise Measurement

NOTE: The US FCC specification for C/N measurements is a bandwidth of 4.000 MHz. CATV organizations outside of the United States may have different requirements.

4.7 HUM MEASUREMENT

Hum is undesirable modulation of the television video carrier by power line frequencies and harmonics (e.g., 50, 60, 100, 120 Hz), or other low frequency disturbances (FCC limit: < 3%). When using Hum Measurement Mode, the icons at the left of the display screen show the hum test frequencies. When you press the related hum frequency soft icon, the left side of the icon darkens. The **dB/%** icon toggles the displayed value between dB and percentage.

When there is an undetectable level of hum the following message appears on the screen:

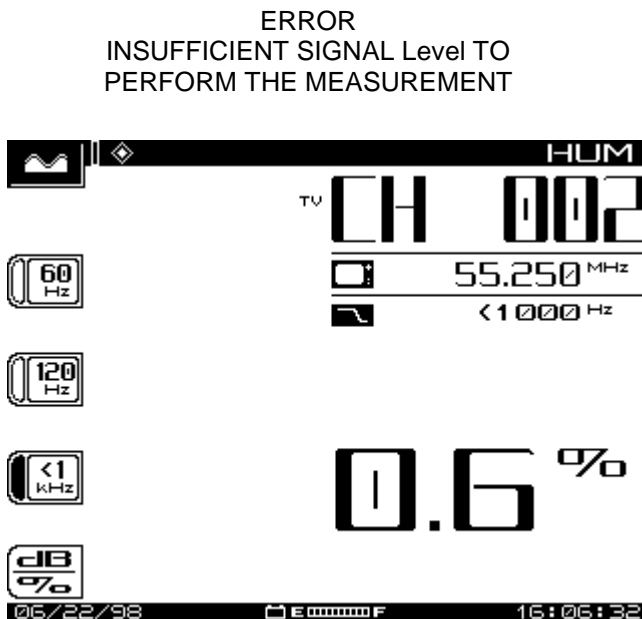


Figure 4-7: HUM Measurement

To measure Hum, simply press the **HUM** Mode key when tuned to any non-scrambled channel.

Soft keys allow you to select 50, 60, 100, 120 Hz, or <1,000 Hz filters for this measurement. A 60 Hz modulation component suggests a possible corroded connector, a 120 Hz component tends to indicate a possible failure related to the DC supply in the amplifier--possibly a capacitor failing and thus causing ripple to increase.

A proprietary DSP technique enables hum measurements on modulated carriers (non-scrambled channels).

SAM 4040D can measure the 1 Hz hum component. To activate this feature, set the fundamental hum frequency in the **Config, Measurement** screen to 1 Hz. The filter options on the **Hum** display will then become; 1 Hz, <50 Hz, and, <1 kHz.

NOTE: The <1 kHz setting does not include the 1 Hz component, it only includes 50 to 1,000 Hz. *Hum measurements taken while the desktop charger is in use will affect the Hum reading. For the most accurate reading disconnect the charger prior to taking Hum measurements.*

4.8 MODULATION MEASUREMENT

The **MOD** Menu allows you to monitor the video depth of modulation in graphical and precise numerical format. The software shows a marker at the optimal modulation level (NTSC 87.5%, PAL 90%) to assist you in making adjustments.

Additionally, you can listen to the audio modulation of the tuned channel or frequency.

Figure 4-8 illustrates the display for Video Depth of Modulation, which is the ratio of peak downward change in modulation to carrier amplitude, expressed as a percentage. Pressing the soft key for the Audio icon activates Figure 4-9, Audio Modulation. A built-in 13 dB amplifier and/or 50 MHz low-pass filter can also be activated.

To measure Modulation, use the **NAV** Menu or press the **MOD** Measurement Mode key. Figure 4-8 shows the Video Menu, with the video icon darkened. Notice the index arrow on the left side of the vertical bar--(87.5%)--indicates the Video icon is active.

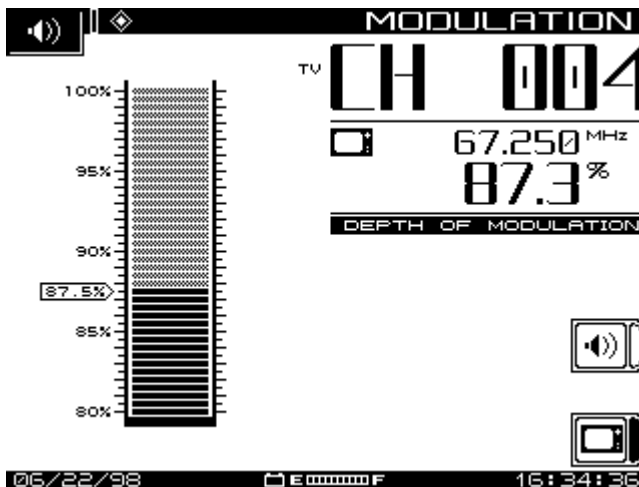


Figure 4-8: MOD Video Menu

In the event of weak or bad signal, the screen displays:

ERROR
Insufficient Signal Level to
perform the measurement

For the Audio sub-menu, press the Speaker icon soft key, shown in Figure 4-9.

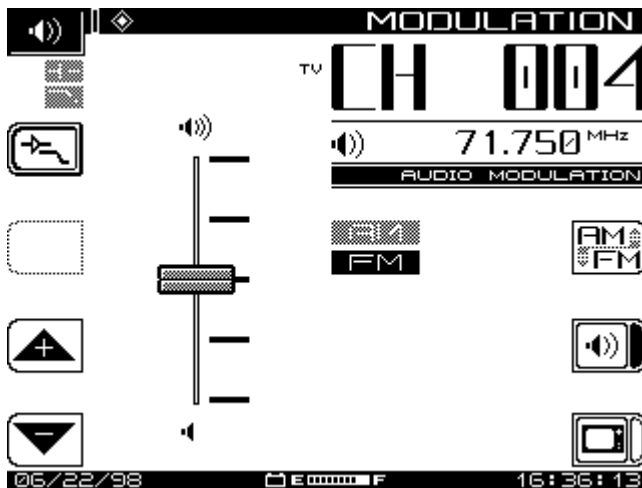


Figure 4-9: Audio Menu

Use Icons as follows:

ENTER Amplifier/Low-Pass submenu/ return to main Audio sub-menu when appropriate.

- Upper Enable/Disable 13dB Amplifier.
- Lower Enable/Disable 50 MHz low-pass filter.

Increase speaker volume.



Decrease speaker volume.



Switch between FM and AM Demodulation





Enable Audio Demodulation (shown disabled)



Enable Video modulation measurement (shown enabled)

Note the AM/FM indicator in the center of the screen (enabled selection is darkened).

4.9 CSO/CTB MEASUREMENT

CSO (Composite Second Order) is a clustering of second order beats at any frequency in the spectrum, which causes interference to picture quality when they fall within the video bandwidth. CTB (Composite Triple Beat) is a clustering of third order distortion products usually around the video carrier frequency.

The capability to make these measurements enables you to troubleshoot and correct the cause of this unwanted distortion.

NOTE: Wavetek recommends that a < 12 MHz band pass filter be used to limit the amount of intermodulation distortion caused by overload of the RF input of the SAM 4040D. If used, a preamplifier should be placed between the band pass filter and the receiver.

In **SPECT** Mode, press the CSO/CTB soft key to initiate CSO/CTB measurements. The SAM 4040D first switches to a 30 kHz Resolution bandwidth (see top part of the display, figure 4-10), measures the carrier and then prompts you to turn the carrier off. The signal must be unmodulated.

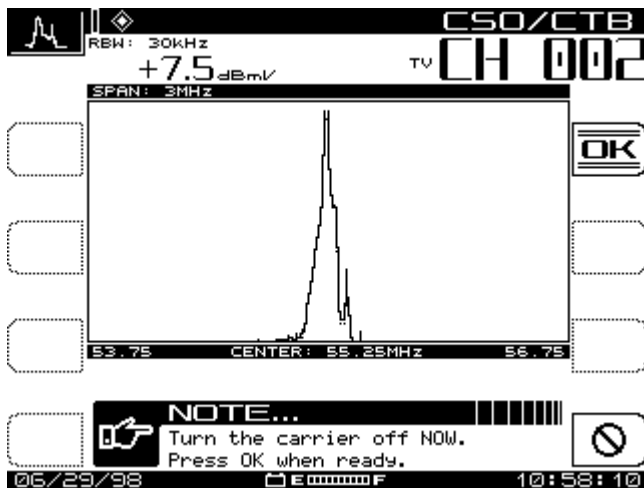


Figure 4-10: CSO/CTB, Carrier ON

- Press OK when carrier has been turned OFF
- Press 2 to turn the Carrier OFF.

After a brief interval, the display at figure 4-11 appears, showing the measurement traces.

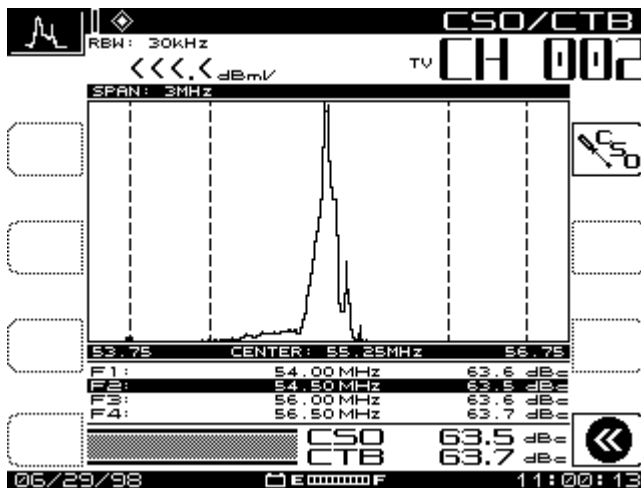


Figure 4-11: CSO/CTB, Carrier OFF

The light trace represents the carrier prior to it being turned off. The dark trace represents the distortion products. The measurement value is computed by the ratio of the peak level of the video carrier to the peak of the distortion products of the second and third order beats. The "worst case" CSO value is highlighted. This is the overall CSO value.

Notice that CSO and CTB levels are about equal, and well below any reasonable minimum.

Press the (CSOCTB Setup) soft key to adjust the offset values for the CSO measurement.



Figure 4-12: CSO/CTB Offsets

Using the UP/ DOWN arrow keys, select the CSO Offset number to change. Use the numeric entry keys or the up/down arrow keys to enter a new CSO Offset value.

Upon exiting the CSO/CTB measurement, the SAM 4040D prompts you to turn the carrier back on.

CHAPTER 5: REVERSE PATH TROUBLESHOOTING

5.0 GENERAL

The following application notes outline some return path troubleshooting problems and techniques that are useful with StealthTrak. For future application notes outlining more techniques, please see your local Wavetek CATV sales representative.

This table offers some ideas on the best application of StealthTrak's capabilities to help you solve troubleshooting problems.

PROBLEM	USE THIS TOOL
INGRESS	SPECTRUM MODE
MODEM CHANNEL HIGH BER	ZERO-SPAN MODE
SIGNAL LEVELS UNBALANCED	REVERSE ALIGNMENT TECHNIQUES
POOR SIGNAL LEVEL IN SOME MODEM CHANNELS	REVERSE SWEEP MODE

5.1 WHAT ARE THE PROBLEMS IN ADVANCED SERVICES?

A. Noise (Ingress) in Return Path Frequencies

For two-way systems, ingress and noise are far greater problems in the reverse path than they are in the forward path. The reasons are fairly straightforward:

Accumulation of Noise means that problems compound far more quickly than in the forward path. In a forward path network, noise or interference generated at one point in the network affects everyone 'downstream' from the noise source.

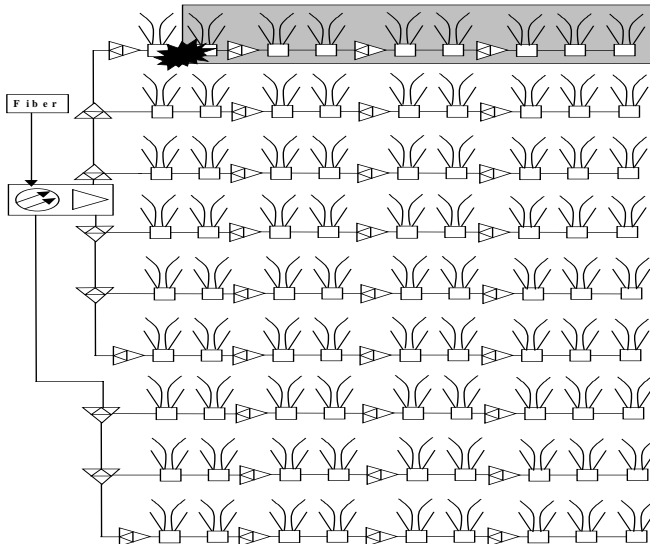


Fig. 5-1 Customers Affected by forward Path Ingress Source

In order to limit these problems, hardline and better quality equipment are used at the upstream connections, and less expensive equipment is used downstream. In the reverse path system, however, a noise problem affects everyone in the same 'leg' of the network all the way back to the Headend receiver. This means that the "quality first close to the Headend and cost first close to the customer" concept no longer works.

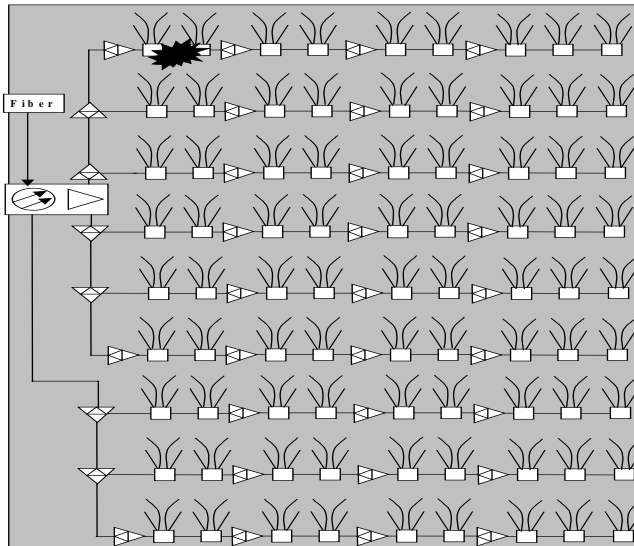


Fig. 5-2 Customers Affected by Return Path Ingress Source

To see how this affects noise floors, think about how much of the network can inject noise that affects a given customer. For forward path signals, the only potential problem areas are the direct path from the customer's home to the Headend. For reverse path signals, problems can come from anywhere in the area 'served' by one Headend receiver.

Many Diverse Ingress Sources- there are more and more varied transmitters of RF energy in the reverse path bands: CB radio, short-wave, ham, paging, and land mobile all use the same frequencies as a cable reverse path. Rather than a few transmitters (even at high power) that are at known locations (where better care can be taken with shielding), there are lots of transmitters that can be right next to the network and are not controlled.

Random Noise- Noise can be generated by non-transmitters too. Electric motor switching, welding, computers, or even power supply switching can have energy in the reverse path band.

Physical Plant Problems- Small cracks in powered coax or dissimilar metal 'diodes' can create CPD or noise.

CSO Intermodulation products from forward path signals are stronger in this previously unused band

B. What does it take to troubleshoot reverse path problems?

Troubleshooting noise in the reverse path is also trickier. It can require five to ten times the time and energy, as well as being infinitely more frustrating:

When a certain customer has a problem, there is a much wider area that must be searched to find it. In the forward path, the problem must be somewhere in the direct line from the customer to the Headend. For a reverse path problem, it can be anywhere in the entire area served by this customer's receiver. This means there are many more test points to check, a far greater possibility for error, and much more money can be wasted if the problem remains incorrectly diagnosed. The forward path technique of 'walking back up the system' and replacing everything until the problem goes away simply doesn't work. You now **MUST** have a tool that accurately indicates whether the problem is 'here' or 'there.'

The sources of interference come and go. CB, ham, and mobile transmitters are not continuous, and they move around. Switching noise is transient, and may last only a few microseconds, but repeat at irregular intervals and render a network useless.

To have any chance for successful in troubleshooting reverse noise problems, you need a **FAST** (peak detecting) spectrum analysis display. You need to be able to catch transient noise spikes. It is also essential to be have a 'peak hold' capability so that a passing burst can be captured and viewed. You can't find the source of something you can't see. There is just too much ground to cover in finding reverse path problems. These are the bare minimum criteria, but many other tools can help 'even the odds' when a system does battle with ingress.

What IMPROVES ACCURACY AND REDUCES WASTED TIME in troubleshooting reverse path problems?

- Being able to compare the Headend noise spectrum to the local spectrum. This allows you to know if a problem you see in the field matches the Headend problem or not.
- Using Dwell Time in spectrum analysis: the more time a meter spends looking for ingress, the more likely it is to catch a random problem.
- Fast scanning gets data in real time, and makes diagnosis much faster. Low-pass filters allow you to separate intermod problems from CPD, and to make the correct diagnosis.
- Preamps allow you to use an amp test point and still see noise accurately. Otherwise, the reverse network must be taken down to get a high level signal for analysis.
- Ease-of-use. Fewer things to carry means less work; long battery life means fewer trips back to the Headend or truck for a new battery; light weight means faster time to get connected (and less worker's compensation money spent).

What 'arms' can be used to "wage war" with reverse ingress:

Use an SLM/sweep meter with spectrum display. The best solution.

Use a spectrum analyzer with battery and filters. More stuff to carry, but it still works.

Use a spectrum analyzer in the Headend, a spare video channel, a modulator, and a TV. Disconnect the Legs of the return path and look at the noise to see if the problem went away. Creates service outages and doesn't work very well.

5-2 EVALUATING TDMA RETURN PATH SIGNALS

Time Domain Multiple Access (TDMA) is a term commonly used in reference to D-AMPS or IS-54B mobile telephone systems. Time Domain Multiple Access implies a signal assigned to a certain frequency that has multiple time-slots for multiple transmitters. Our communications have been TDMA since the dawn of time. The human ear works in the ~20 to 20 kHz frequency range. Our voices are limited to 300 to 3000 Hz. We learned to arrange speech so that only one individual talks at a time. The brain processes the voice frequency separate from the other frequencies and delivers the intended message.

TDMA modems are the same. Each modem knows when talk. The controller deciphers the messages by knowing when each modem is talking. These modems have specific assigned times to send and receive information.

In fig. 5-3 you can see that each user has a time slot assigned for its usage.

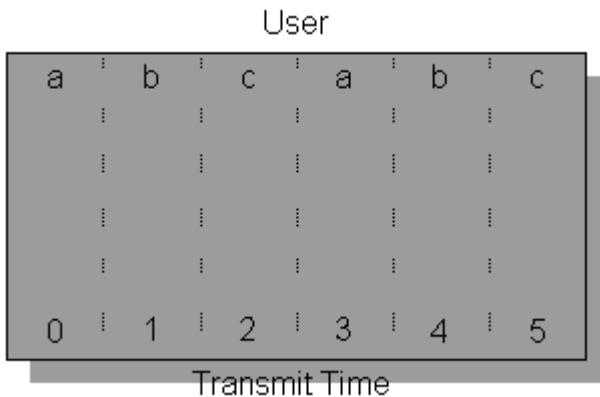


Fig. 5-3: Nominal TDMA Timing

TDMA signals were introduced to the commercial electronic world a few years ago with the advent of digital cellular phones. Data compression and quadrature modulation are used to increase the available modulation bandwidth so that a TDMA cell-phone sends the same information in $1/3^{\text{rd}}$ the time of an AMPS cell-phone.

Through time-interleaving three cell-phones now occupy the same frequency bandwidth that one occupied just a few years ago.

Another area of rapid growth using TDMA is CATV reverse path. Today's CATV system includes many different signal and modulation types. Each advanced service can have one or many different TDMA signals assigned to a particular frequency.

When multiple users are accessing a network via modems, an enormous amount of bandwidth would be occupied if each modem were assigned one frequency channel. The majority of time the user is hooked up to a network is spent idle. Most of the bandwidth would be wasted. The ratio of authoring a typical email to transmitting a typical email is at least a hundred to one. One possible answer would be to use a low transfer rate. This system would work if no large files need to be transmitted. A better answer is variable time TDMA. Variable time TDMA gives more bandwidth when needed and takes just a little bandwidth the rest of the time. More flexibility can be achieved on cable modems due to the high fidelity connection. Therefore, unlike IS-54B, the talk times can be variable. Fig4-4 illustrates that user 'a' is sending more data than users 'b' and 'c'.

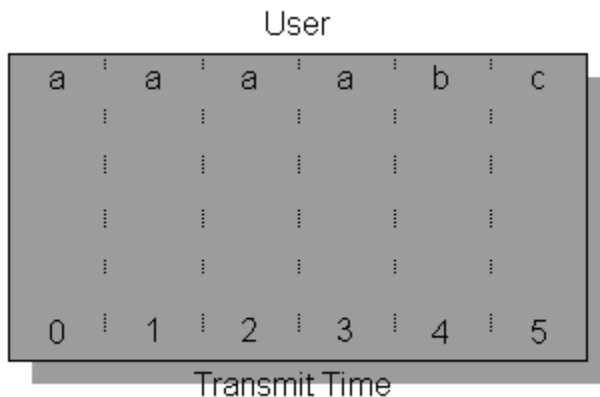


Fig. 5-4: Variable Time Slot TDMA

B. Current reverse path trouble-shooting strategies are not capable of detecting problems inside of a TDMA modem's frequency allocation. Checking the level at each frequency is a good start for characterizing the reverse path performance. A spectrum graph only looks at each frequency for a small percentage of the total time. This leads to two uncertainties.

1. When the spectrum analyzer is at the TDMA frequency will the carrier be there?
2. When a signal is seen in the spectrum graph the question of origin remains. Was that a carrier or some ingress?

While installing and characterizing your system, you realized that certain frequencies were going to be unusable because of the frequent, uncontrolled ingress. The spectrum around these frequencies is wasted. Why spend time measuring these frequencies instead of looking at the frequency(s) the system is using? What you really want to know: is there anything wrong with my modem signals?

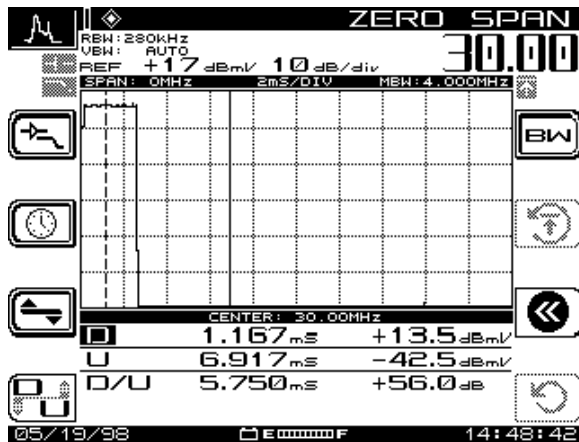
TDMA signals have two modulation techniques. One modulation is QPSK or 16 QAM. This modulation includes overhead and data at the approximate rate of the bandwidth allocated. The second modulation is pulse modulation. Pulse modulation allows the modem to turn off the signal when no transmission is required. This allows multiple modems to transmit at the same frequency. There are two states to these TDMA signals.

1. When all modems are idle, there should be low noise at the modem's frequency.
2. When a modem is active the power level should be at a predetermined level.

Both of these states must be met For optimum operation of the modem,. both of these states must be met Another state occurs in some of the older technology. This is called a collision. Collisions occur when two or more modems try to access the same frequency at the same time. When a collision occurs all messages are lost and must be retransmitted.

The best way to look at a TDMA signal is using a "ZERO SPAN" on a spectrum analyzer. "ZERO SPAN" uses the spectrum analyzer's tuner in a different way. Instead of providing a frequency versus level graph, "ZERO SPAN" provides a time versus level graph at a particular frequency. "ZERO SPAN" can be thought of as tuned oscilloscope, displaying only the frequency of interest's level fluctuations. It is very important to have rising edge triggering when viewing TDMA signals. This will allow the capture of the TDMA events for analysis.

C. "ZERO SPAN" shows a number of parameters from a TDMA signal including the power of the carrier, the noise floor, and interference. Fig. 4-5 shows a "ZERO SPAN" of a TDMA signal with an ideal noise floor. The "D" marker shows the power of the TDMA desired signal. The "U" marker shows the power of the undesired or noise floor. Very seldom are 56 dB desired to undesired ("D/U")



ratios achieved.

Figure 5-5: Time Domain Signal with No Ingress in "ZERO SPAN"

A more realistic case is shown in fig. 5-6. This shows that the noise floor is much higher than in Figure 3. In this case the undesired signal has increased in power from -43 to -30dBmV. This would represent a 45 dB "D/U".

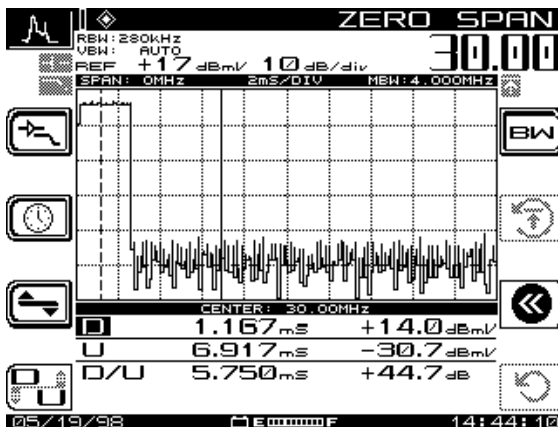


Fig. 5-6 Signal with High Noise Floor in “ZERO SPAN”

Intermittent ingress along with the TDMA signal is a pesky problem when troubleshooting return path issues. This is a hit-or-miss game. With a spectrum graph you are completely at the mercy of luck. As you can see when there is a signal with intermittent ingress in Fig. 5-7, there are additional pulses. The “U” marker in this screen clearly shows a peak “D/U” of 30 dB. The average noise floor is still well over 50 dB down. These impulses are a mere 10 uSec every 5 mSec. This leaves the probability of catching these in the spectrum graph less than 0.2%. They are readily apparent in the “ZERO SPAN” view.

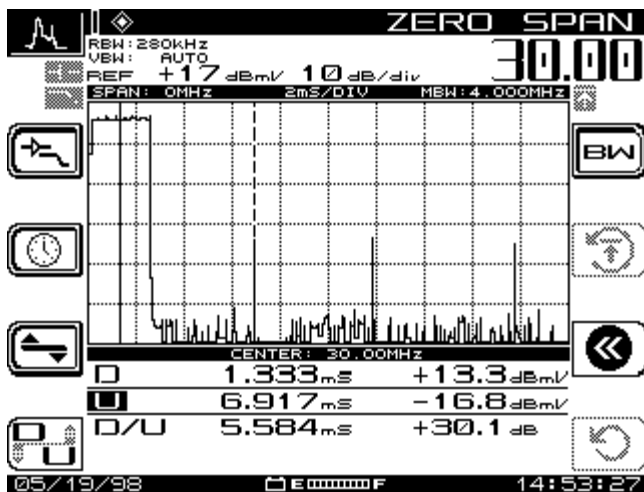


Fig.:5-7 Time Domain Signal with Intermittent Ingress in “ZERO SPAN”

Looking at TDMA signals can be confusing. Implementing return path modem is necessary to keep current customers and attract new revenue. Viewing the reverse path in a spectrum graph can give you a good idea of overall system health. To manage TDMA signals cost-effectively, you need time domain view. TDMA desired signal power, undesired noise power and impulse interference could all be quantified from a “ZERO SPAN” time domain view.

Reference:

1. Cable Television Laboratories, "Data-Over-Cable Service Interface Specification", SP-RFI-102-971008, Interim specification, 1997
2. Cable Television Laboratories, "Characterization of Upstream Transient Impairments on Cable Television Systems", February 12, 1997.
3. Kevin J. Oliver, "Preventing Ingress in the Return Path", CED Magazine, Oct. 1997.
4. Ron Hranac, "Making Two-Way Work", Cable-Tec Exposition Workshop Proceedings 1996.
5. Ron Hranac, "Making Two-Way Work (Part II)", Cable-Tec Exposition Workshop Proceedings 1997.
6. Thomas J. Staniec, "Making Two-Way Work", Cable-Tec Exposition Workshop Proceedings 1996.
7. Thomas J. Staniec, "Making Two-Way Work, A Continuation", Cable-Tec Exposition Workshop Proceedings 1997.
8. Dan Chappell and Jon Vincent, "Troubleshooting Reverse Ingress With Swing & Clear Path", Broadband System & Design, April, 1998

CHAPTER 6: SPECTRUM ANALYZER MODE

6.1 INTRODUCTION

In the **Spect** (Spectrum Analyzer) Mode, the instrument displays all or part of the CATV system spectrum, with variable spans from 3 to 50 MHz. A dynamic range better than 60 dB over the six vertical subdivisions of the display graph allows for comprehensive troubleshooting utility.

Spect Measurement Mode reveals ingress spikes as brief as 5 μ s.

Zero-Span mode of the **Spect** analyzer displays a single frequency over time. You can examine individual TDMA (modems, most return path signals) and continuous carriers (digital video, most forward path signals), with fast, sure information about real power and noise levels.

Pressing the **Spect** Measurement Mode Key activates the spectrum analyzer.

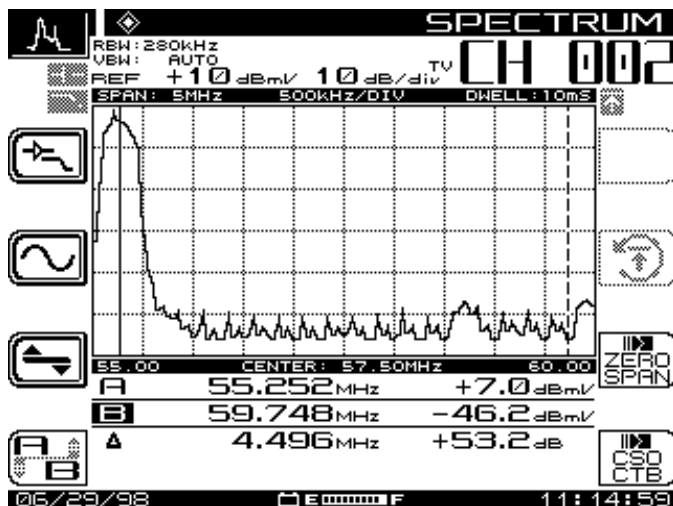


Figure 6-1: Spect Mode Main Menu Display

Enter **SPECT** through the **NAV** menu, or by pressing the **SPECT** Measurement Mode key. Below are the primary functions of the Soft keys in the SPECT top-level menu. Notice that the *Ref Level* in dBmV and Scale Factor in dB/div are always displayed at the top of the graph. The center frequency is displayed below the title bar in the top right corner. The span is displayed in the status bar above the graph.

Return to Menu



Note: This icon is to return to previous menu/mode.

6.2 SPECTRUM MODE

Amplifier / Low-Pass Filter sub-menu



Frequency sub-menu



Level sub-menu



A/B Markers



Soft key to change between marker 'A' and 'B'. Select 'A' or 'B' using the right/left arrow keys. Active marker is emboldened. These are two vertical markers on the display. The Dotted Line is the active Marker; the Solid line does not move. This Icon toggles between the two. You can move the Active marker with the LEFT/RIGHT Arrow Keys The A, B marker lines below the graph show the difference (dB) in level (dBmV) between the two selected frequencies.

Reset Maximum Hold



This soft key will reset the *Maximum Hold* algorithm in the instrument. When 'grayed' the *Maximum Hold* is disabled.

Start Zero Span



This mode displays a frequency versus time.

Start CSO/CTB



This mode guides the user through the measurement of Composite Second Order and Composite Triple Beat products.

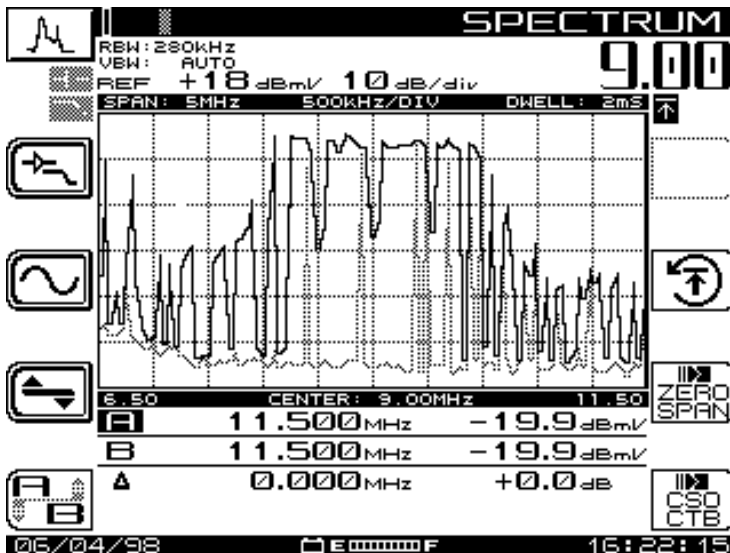


Figure 6-2: SPECT Mode Full Sweep

Notice that the REF level value is in dBmV and scale factor is in dB/div, and are displayed at the top of the graph.

Figure 6-1 is a graphical display of the instrument's capability as spectrum analyzer. The full range is 5 MHz to 1,000 MHz, with a span of ± 1.5 , 2.5, 5, 10, or 25 MHz around the specified center

frequency. For use along the return path, with low pass filters engaged, the spectrum is reduced to 5 MHz to 50 MHz.

There are five sub-menus in **SPECT** Mode: **Level**, **Frequency**, **Amplifier/Low-pass Filter**, **Zero Span**, and **CSO/CTB**. CSO/CTB is discussed in Chapter 4 in the Measurements Mode sections. The following describes soft key functions and operation of the other sub-menus.

1. Level Sub-Menu



Press this to enter the **Level** menu, then to return to the main menu. Use the **Level** icon soft key to adjust the vertical parameters of the graph. These parameters include:

Ref Level



The reference level is located at the top line of the 6 x 10 graph. Adjust Ref Level using the up/down arrow keys, or by entering a numeric value followed by the \downarrow Enter key.

Scale



The scale parameter (1, 2, 5, and 10 dB/div) can be adjusted only with up/down arrow keys. For example, if the reference level is set to 0 dB and the scale is set at 10 dB/div the first horizontal grid line above the center equals -30 dB. Press the Level soft key to return to the main spectrum analyzer display.

Maximum Hold



The Maximum Hold function ensures that the highest amplitude at each frequency over multiple sweeps is displayed. If Maximum Hold is ON, you will see the small icon at the upper right corner of the display, darkened. As multiple sweeps occur, the maximum level trace will change only if new sweep levels exceed the levels of the current trace. A half-tone trace will show you the current data when Maximum Hold is enabled.

A/B Markers



These are two vertical markers on the display. The dotted line is the active marker; the solid line does not move. This icon toggles between the two. You can move the active marker with the arrow keys. The A and B lines below the graph show the difference (dB) in level (dBmV) between the two selected frequencies.

2. Freq Sub-Mode



Press this soft key to enter the Frequency sub-menu; and again to return to the SPECT main menu. The Frequency sub-menu enables you to select/adjust center frequency, set the Span, and move A/B cursors as required to evaluate any part of the display.

Center Frequency



Press to select/adjust center frequency. Use the numeric keypad, then press the **Enter** soft key to place the frequency you want into the Edit Box that is presented.

Span



Press to select the span of coverage. If any frequency becomes lower than 5 MHz or higher than 1,000 MHz, then the lowest or highest center frequency will be used.

Dwell-Time



Selects trace *Dwell-Time* (the time that the instrument looks for signal on each frequency). Longer dwell-time enables you to check for Ingress. Use either the numeric keypad, or **↵Enter** key. Or, use the up/down arrow keys. Dwell is adjustable from 64 μ Sec to 25 mSec. Scan time will Will increase to a maximum of approximately seven seconds when dwell-time is set to 25 mSec.

A/B Markers



Press to select A/B markers, and move markers as required with the left/right arrow keys.

Amplifier/Low-pass Filter



Press this to enter the **Amp/Low-pass Filter** sub-menu, then to return to the main **SPECT** sub-menu. See specs in the next two icons.

3. Amplifier Sub Mode



Press to enable/disable the 13 dB amplifier, as necessary to examine better the signal “in the noise”. Right side darkens when enabled.

Low-Pass Filter



Press to enable/disable 50 MHz low-pass filter, which when-enabled filters out all frequencies above 50 MHz. This is useful for return-path examination.

Marker to Center



Press to change the center frequency to the value of the active marker.

Peak Search



Press to place the active marker at the frequency with the greatest amplitude.

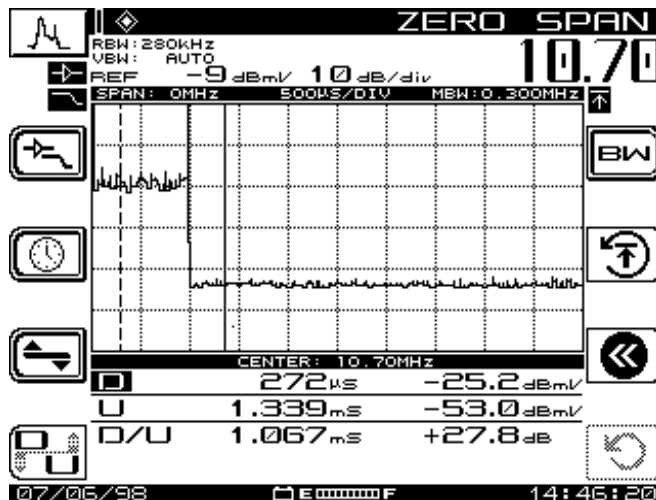


Figure 6-3: Spectrum Analyzer Zero Span

4. Zero-Span



Press this to enter the Zero-Span sub-menu.

In Zero-Span mode, the instrument displays the trace of one discrete frequency versus time. Sweep-time is on the x-axis, and amplitude (dBmV) is on the y-axis. You can change the sweep-time for a closer or wider look, as necessary.

Zero-Span incorporates a large menu of useful features. As in other modes, you can use the 13 dB amplifier and/or the 50 MHz low-pass filter. Also, you can use active/inactive markers, plus elements unique to this operation. You may trigger the sweep manually, or automatically to examine the signal. You can also average successive traces for accurate level measurements.

Notice that the markers change to 'D' and 'U' (Desired and Undesired). The marker values are corrected for white noise and detector crest factor. This will improve the marker accuracy when measuring digital modulated signals and noise floor.

Amplifier/Low-pass Filter



Press this to enter **Amplifier/Low-pass filter** menu, then again to return to Zero-Span main menu.

Time Base



Press to enter Time base sub-menu, then to return to Zero-Span main menu. Use up/down arrow keys to scroll through sweep times offered in the Edit Box, and to turn the auto-sweep trigger ON/OFF.

Level



Press to enter **Level** sub-menu, then return to main Zero-Span menu.

Bandwidth



Press this to enter the Bandwidth sub-menu. The Bandwidth menu allows you to set the resolution bandwidth, video bandwidth and carrier measurement bandwidth.

D/U Desired/Undesired Markers



Press to change active marker between Desired (Signal) and Undesired (Noise). Typically, these markers are used in Zero-Span to clearly identify digital carriers and TDMA signals.

Reset Trace Average



This soft key will reset the *trace averaging* algorithm. When half-toned *Trace Average* is disabled.

Manual Trigger



Press to turn sweep trigger ON/OFF (up/down arrow keys.) With the trigger OFF, the instrument displays continuous update. When ON, the display does not update until incoming signal is above the center line of the graph.

5. Amplifier/Low-pass Filter

Press this to enter the Amplifier/Low-pass sub-menu. this sub-menu allows you to enable and disable the internal low pass filter and amplifier, as well as peak search on the markers.

Amplifier



Press to Enable/Disable the 13dB amplifier when working with low level signals. Shown disabled. Right side darkens when enabled.

Low-Pass Filter



Press to Enable/Disable 50 MHz Low-Pass filter. Enabled, the filter attenuates frequencies above 50 MHz for better evaluation of the return path. Shown disabled. Right side darkens when

enabled. This filter eliminates downstream carriers from the input, which improves dynamic range.

Peak Search



Press to place the active marker at the time with the greatest amplitude.

D/U Markers



Press to toggle the D/U markers between active/inactive, as appropriate

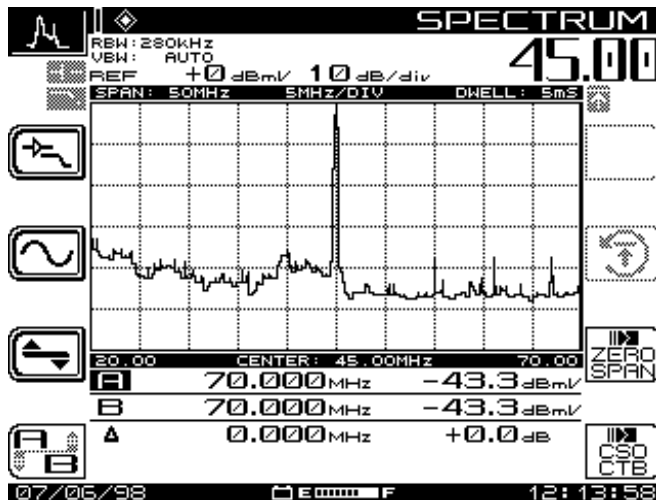


Figure 6-4: Noise spike at 45 MHz

This is an example of the basic use of the Spectrum Analyzer to view a specific frequency.

Timebase

Sweep Time



Press to set sweep time: 20, 10, 05, 02, 01 Seconds; or 500, 200, 100, 50, 20, 05, 20, 10, 02, 01 milliseconds; or 500, 200, 100 microseconds (up/down arrow keys).

Trigger



Press to turn sweep trigger ON/OFF (up/down arrow keys).
Trigger OFF: continuous update. Trigger ON: Updates when carrier level has a rising edge that crosses the horizontal center grid-line. If signal level never reaches trigger point, the *Manual Trigger* soft key (see previous icon) can be used.

Hysteresis Level.



Adjusts the amount of level the signal must change for a rising edge to cause a trigger event.

D/U Markers



Edited with right/left arrows. Active marker is emboldened.

Level

Reference Level



The reference level is located at the top line of the 6 x 10 graph. The Adjust Reference Level using the up/down arrow keys or by entering a numeric value followed by the **Enter** key.

Scale



The scale parameter (1, 2, 5, & 10 dB/div) can be adjusted *only* with up/down arrow keys. For example, if the reference level is set to 0 dB and the scale is set at 10 dB/div the horizontal grid line at the center equals -30 dB

Trace Averaging



Soft key that enables and disables *Trace Averaging*. For use when measuring power levels of TDMA (bursty) transmitters such as cable modems. Useful when measuring D/U (Desired to Undesired) signal quality.

Bandwidth



Press this to enter the Bandwidth sub-menu. The **Bandwidth** menu allows you to set the resolution bandwidth, video bandwidth and carrier measurement bandwidth.

Resolution Bandwidth



Press to set *Resolution Bandwidth*: 30 kHz, 280 kHz or 2 MHz. A value of 280 kHz is used as the nominal value. 30 kHz or 2 MHz may be used when carrier spacing is very narrow or very wide respectively.

Video Bandwidth



Press to set the *Video Bandwidth*: Auto, 100 kHz, 10 kHz, or 100 Hz. Auto should be used to prevent aliasing. You may want to change to a low value when looking at carrier power.

Measurement Bandwidth



Press to adjust the *Measurement Bandwidth*. Any value from 0.01 to 99.999 MHz may be entered. This value is used to correct the power level for losses caused by a narrower resolution bandwidth compared to actual signal bandwidth.

Correction = $10\log(\text{MBW}/\text{RBW})$

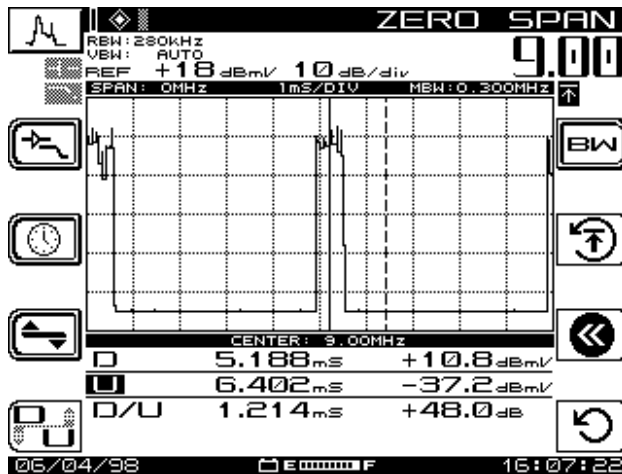


Figure 6-5: Example D/U Display

CHAPTER 7: AUTOMATIC TEST

7.1 INTRODUCTION

Automated tests are easy and provide a convenient way of acquiring proof-of-performance compliance data. Tests can be executed immediately or scheduled over a time period. To conserve battery life, The unit shuts itself off between scheduled intervals. When configuring an Autotest, you can record information about the location at which the test is being performed. Files can be created for commonly tested locations so you need only enter the information once.

Autotest Mode's results are time, date, and temperature stamped and can be viewed on the LCD screen. Limits are applied to the measurement data with out-of-tolerance conditions concisely indicated. You can print a test report for each interval or a comprehensive 24-hour report that summarizes data collected from up to four intervals. Autotest result files can be uploaded to StealthWare.

Autotest performs video & audio carrier level measurements for each enabled channel. Optionally, you can select C/N, hum, or mod tests for each channel. The unit will run these tests in accordance with your **Config** setup.

The basic procedure for initiating an **Autotest** is as follows:

1. Record information about the test location (optional).
2. Log voltage measurements (optional).
3. Enter a compensation value for local measurements.
4. Enter a name for the results file.
5. Select the type of test, either *Immediate* or *Scheduled*.
6. If a *Scheduled* test, set the schedule.
7. Enter the ambient temperature.

To operate in **Autotest**, press the **Test** Key. This activates the screen in Figure 7-1, with **Autotest** in the Title Bar. The **Autotest** menu consists of three submenus: **Test Locations**, **Perform Autotest**, and **Autotest Results**.

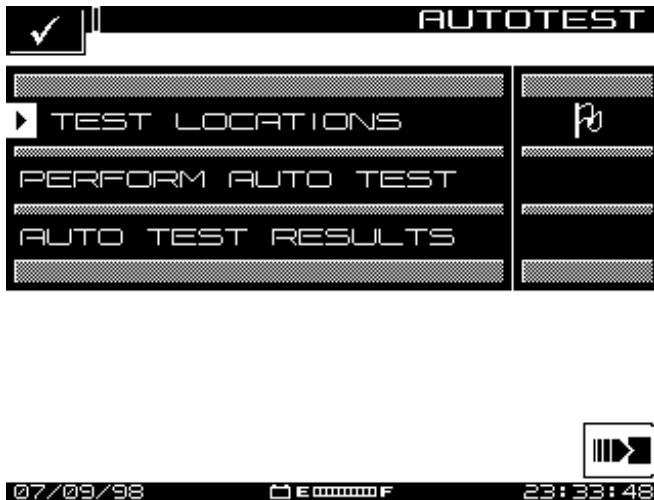


Figure 7-1: Autotest Main Menu

7.2 TEST LOCATIONS

Test locations allows you to record location-parameter-specific data to the test location. You can create a new location, or select one from the list. There are five location types: *Headend*, *Trunk Amp*, *Line Extender*, *Fiber Node*, and *Field Test*. You can create test locations directly on the instrument or use the SteathWare Data Analysis software and download information to the unit. In either case the test location data in the **Autotest Reports** includes test location data.

7.2.1 Parameters and Test Location Types

Tables 7-1 and 7-2 provide information about the five types of test locations (*Headend*, *Trunk Amp*, *Line Extender*, *Fiber Node*, and *Field Test*), and the parameters that apply to each type. Table 7-1 lists the ten Units and Limits of Changes for each type. Table 7-2 shows which parameters apply for each type. NOTE: the *Headend* type has no parameters; a Field Test Location has only the Area Field.

Table 7-1: Parameters

Parameter	Min	Max	Default	Units
1 Area	15	column	alpha-numeric	field
2 Amp Id	15	column	alpha-numeric	field
3 Power Configuration	IN / OUT / THROUGH			
4 Feeder Maker Config	1	9	1	
5 Trunk Termination	NO	YES	NO	
6 Voltage Setting	LOW / MID / HIGH			
7 Reverse Pad	-100.0	+100.0	0.0	dB
8 Reverse Equalizer	-100.0	+100.0	0.0	dB
9 Forward Pad	-100.0	+100.0	0.0	dB
10 Forward Equalizer	-100.0	+100.0	0.0	dB

Table 7-2: Parameters versus Test Location Types

<u>Parameters</u> <u>Field</u>	<u>Trunk</u>	<u>Head</u>	<u>Extender</u>	<u>Fiber</u>
1 Area	yes		yes	yes
2 Amp ID	yes		yes	yes
3 Power Configuration	yes		yes	yes
4 Feeder Maker Configuration	yes		yes	yes
5 Trunk Termination	yes		yes	yes
6 Voltage Setting	yes		yes	yes
7 Reverse Pad	yes		yes	yes
8 Reverse Equalizer	yes		yes	yes
9 Forward Pad	yes		yes	
10 Forward Equalizer	Yes		Yes	

7.2.2 Creating and Editing Test Locations

Use the up/down arrow keys to select **Test Location**, then press any soft key, and Figure 7-2A, **Test Locations** list, appears.



Figure 7-2A: Autotest, Test Locations

- Press the “step back” icon at the upper left to return to Figure 7-1.
- Press the up/down arrow keys to scroll through the list and select an existing location.
- Press **-Flag** to delete the highlighted location from the file.
- Press Pencil/Flag to edit the characteristics of a selected test location, and Figure 7-2B, **Test Locations**, appears. *Note: If you are about to overwrite an existing location: WARNING... a location with this name already exists. Overwrite?*

Entering a NEW location: To establish a new test location, referring to Figure 7-2A on the screen (next page):

1. Press the +Flag soft key. The Edit Box appears and the program prompts you to name the location.
2. Enter the name and press the **Enter** soft key. Figure 7-2B, Edit Locations, appears.
3. Scroll through the list of characteristics, and make necessary adjustments. Edit as necessary and press the **OK** soft key

Deleting an Existing Location: To delete a location, select it on the screen and press **-Flag**.

Editing an Existing Location: Select the location you want, and press the **Edit** (Pencil Flag) soft key. Figure 7-2B, **Test Locations**, appears.



Figure 7-2B: Autotest Location

1. Scroll through the list characteristics, and make any necessary adjustments.
2. When you are satisfied with the adjustments, press the **OK** soft key, which re-activates figure 7-2A.

7.3 PERFORMING AUTOTEST

Use the **NAV** Menu, or press the **Test** support mode key, then use the up/down arrow keys to select **Perform Autotest**, and press any soft key. You are now ready to configure the Autotest.

7.3.1 Choose Location

Refer to Figure 7-3. You can log information about the location at which you are performing the test. The information is stored in the Autotest file along with the measurement data. It will be available during viewing and printing Autotest results. This first screen presents you with a list of available locations.


NOTE: If you are not interested in logging the information, select NONE from the list. The instrument will present you with only the steps required to configure the test.



Figure 7-3: CHOOSE LOCATION

- *Existing Location:* Scroll with the up/down arrow keys to select test location, the press OK.
- *New Location:* Press +Flag to create a *New Location*.

7.3.2 Edit Location

At this screen, enter the information for a new or existing location. Use the up and down arrows to select the item to be edited. The items that appear in the list depend on the type of location you have selected. If you regularly perform tests at this location, you can save it for future use so that you only need to enter the information once. To do this, press the  soft key and enter a name for the location.

When you are done editing, press **OK** to continue configuring the Autotest.

NOTE: The instrument reminds you when you have not stored the location. You need to store the only if you think you will return for another test.



Figure 7-4: New Location

7.3.3 Select Probe Point

Some location types have multiple points at which you can make test measurements. If you have selected such a type, this screen will appear. Use the up/down arrow keys to choose the appropriate probe point from the list, then press the **OK** soft key.

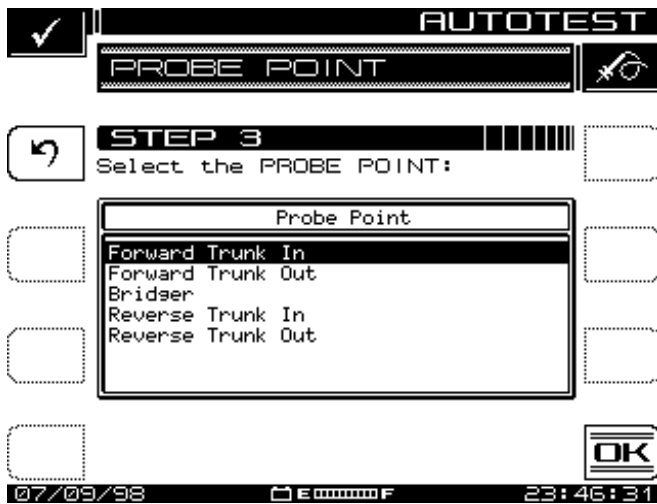


Figure 7-5: Select Probe Points

7.3.4 Measure Voltage

You can log voltage measurements in the field. These will appear when viewing or printing the results of the Autotest. When you have finished entering the measurements, press the **OK** soft key.

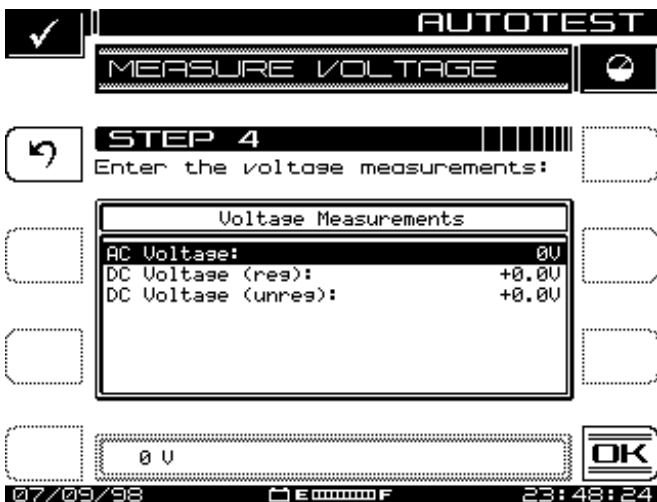


Figure 7-6: Measure Voltage.

7.3.5 Compensation

Compensation is added directly to the signal level measurements. You can use this to compensate for losses associated with probe points found on certain amplifiers. The default is the value specified in the **Testpoint** screen. Enter a different value if necessary. Press the **OK** soft key to continue.



Figure 7-7: Compensation

7.3.6 Results File Name

Enter the name you want to use for the results file . The Autotest software will let you know if you already have used the name. You can overwrite an existing file of the same name. When you are ready for the next step, press the **OK** soft key



Figure 7-8: Results File Name

7.3.7 Type of Test

Tests can be executed immediately or scheduled over a time period. To select, press either the **Immediate** or **Scheduled** soft.

7.3.8 Set Schedule

This screen will appear only if you have selected a scheduled test. The default schedule will perform four intervals over a twenty-four hour period beginning at the present time and date. If you require a different schedule, use the up and down arrows to edit the schedule and then press the **OK** soft key.



Figure 7-9: Set Schedule

7.3.9 Temperature

The ambient temperature at which the test is performed is recorded. The instrument contains an internal temperature sensor for this purpose. If you prefer to use your own thermometer, you can manually enter the temperature here.

NOTE: For scheduled tests, the manual temperature entry is used for the first interval only. Subsequent intervals will record the temperature as measured by the internal sensor. For accurate measurements, the instrument reads the internal temperature sensor immediately upon power-up.

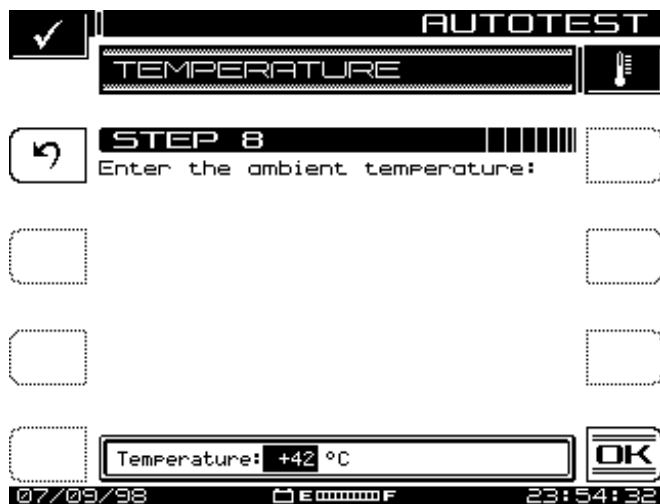




Figure 7-10: Temperature

When you are ready to begin the test, press the  soft key.

While the **Autotest** is in progress, the display indicates the measurement currently being performed (level, hum, or modulation). Progress is displayed during the test. A bar graph on the display shows the percentage of completion.

7.3.10 Canceling an Auto test

While performing an **Autotest**, you will not be able to select other measurement modes without first canceling the test in progress. Doing this will result in an incomplete Autotest. You will not be able to resume the previously configured test.

Press the  soft key to cancel the **Autotest**. The instrument will display a warning message and ask you to confirm your request.

7.4 AUTOTEST RESULTS

Upon completion of the Autotest, the display shows the **Autotest Results** screen. This allows you to view or print Autotest results.

1. Use the up/down arrow keys to select a file, then press the **View** soft key.
2. The **Print All** soft key is available to print all intervals from all files in the directory.
3. The **Info** soft key displays the test location characteristics for the selected file. This is the information that was logged when you configured the test. The items presented depend on the location type that you selected.
4. Information provided on each interval includes viewing Autotest Files: Upon selecting the desired Autotest file, you are presented with a list of intervals that are contained within the file. The list includes the interval number, date, time and temperature when the interval was recorded, and Pass/Fail results.
5. An "X" in the Pass/Fail column indicates an overall failure of the measurements taken during that interval. A check mark indicates that all measurements were within the specified limits.

NOTE: Immediate Autotest sequence run consist only of one interval.

6. A 24-hour report is available to assist you in documenting proof-of-performance compliance measurements. Pressing the **24hr Report** soft key causes the instrument to automatically format and print the highlighted interval plus the next three intervals. The following is an example of a 24 Hour Test Report:

 WAVETEK STEALTHTRAK 24 HOUR TEST REPORT
 Model: 3HRV Serial No: 1234567 Cal Date:
 06/21/95

 Operator: JOHN File: PROOF1

 Location Name: 1028_ELM_ST
 Location Type: Trunk
 Test Point Type: Forward Trunk In
 Test Point Compensation: +0.0 dB

 Area: 00A7
 Amp ID: 12-275Z
 Power Config: In
 Feeder Maker Config: 1
 Trunk Termination: No
 Voltage Setting: Low
 Reverse Pad: +0.0 dB Reverse Equalizer: +0.0 dB
 Forward Pad: +0.0 dB Forward Equalizer: +0.0 dB

 AC Voltage: 110 V DC Voltage (reg): 14.8 V (unreg):
 20.9 V

 Date: #1 #2 #3 #4
 07/04/95 07/04/95 07/05/95 07/05/95
 Time: 17:00:00 23:00:00 05:00:00 11:00:00
 Temp: +75 F +61 F +59 F +83 F
 Video Video Video Video
 24 Hr

Chan	Level	Level	Level	Level	Level
Deviation	(dBmV)	(dBmV)	(dBmV)	(dBmV)	(dB)
2 *	+9.6	+8.8	-17.7 LO	+10.7	28.4
HI					
3 *	+9.9	+8.6	-5.8 LO	+8.9	15.7
HI					
4	+9.2	+8.3	-2.9 LO	+10.1	13.0
HI					
5	+9.3	+8.2	+9.3	+11.5	3.3
6	+8.1	+9.1	+8.6	+11.0	2.9
14	+9.7	+8.7	+9.0	+11.0	2.3
15	+9.3	+7.6	+9.6	+10.6	3.0
16	+10.2	+8.0	+10.7	+10.5	2.7
17	+9.6	+7.4	+9.4	+10.8	3.4
18	+9.2	+8.0	+10.0	+10.2	2.2


LIMIT CHECK	Limit	1	2	3	4
Min Video Carrier Level:	+0.0 dBmV				X
Fail					
Max Delta Video Levels:	10.0 dB		X		
Fail					
Min Delta V/A:	6.5 dB			X	X
Fail					
Max Delta V/A:	17.0 dB	X		X	X
Fail					
Max Delta Adjacent Channels:	3.0 dB	X	X	X	X
Fail					
24 Hour Video Deviation:	8.0 dB				
Fail					
Conclusion:					F A I L

Reviewed: _____

Date: _____

- The channels with the asterisks exceeded the Max Delta Adjacent Channels limit. The limits that the readings were compared to are printed at the bottom of the report. To the right of the limits, the report displays each interval that failed the specific limit. If a particular measurement was not within the specified limit, a HI/LO marker is printed next to the reading indicating the direction that the measurement was out of specification.

VIEWING INTERVALS

To view the measurement data from an interval, use the up/down arrow keys to highlight the interval then press the  soft key.

The first screen displayed is a tabular list that includes the video and audio carrier levels along with the Delta V/A for each channel. Use the up/down arrows to scroll through the list. Indicators appear within the list to flag out-of-limit conditions. The following table relates each indicator with its meaning:

- * adjacent channel limit violation
- ↑ over limit violation
- ↓ under limit violation
- > over range measurement error
- < under range measurement error
- E unlocked measurement error

8. Use the **More** soft key to toggle between level, C/N, hum, and modulation measurements.

9. When viewing the list of level, C/N, hum, and modulation measurements, if an error occurred, the following symbols replace the measurement value:

- < UNDER - under range
- > OVER -over range
- E ERROR - synthesizer unlocked

10. Use the **Print** soft key to print out the following report:

 WAVETEK STEALTHTRAK Autotest REPORT
 Model: 3HRV Serial No: 1234567 Cal Date:
 06/21/95

 Operator: JOHN File: PROOF1 Inverval: 1
 Date: 07/20/95 Time: 15:18:09 Temp: 75
 F

 Location Name: 1028_ELM_ST
 Location Type: Trunk
 Test Point Type: Forward Trunk In
 Test Point Compensation: +0.0 dB

 Area: 00A7
 Amp ID: 12-275Z
 Power Config: In
 Feeder Maker Config: 1
 Trunk Termination: No
 Voltage Setting: Low
 Reverse Pad: +0.0 dB Reverse Equalizer: +0.0 dB
 Forward Pad: +0.0 dB Forward Equalizer: +0.0 dB

 AC Voltage: 110 V DC Voltage (reg): 14.8 V (unreg): 20.9
 V

Chan	Label	Video (dBmV)	Audio (dBmV)	Delta V/A (dB)	C/N (dB)	Hum (%)	Mod (%)
86.3	2 * QVC	-17.7 LO	-18.4	0.7 LO	43.9	1.4	
	3 * TNN	-5.8 LO	-13.9	8.1	---	---	---
	4 USA	-2.9 LO	-15.6	12.7	---	0.9	---
	5 * ESPN	+0.1	-16.1	16.2	48.2	---	---
	6 * MTV	+7.9	-20.3	28.2 HI	---	---	---
88.2	7 FMLY	+9.9	-10.6	20.5 HI	---	---	---
	8 CMDY	+6.9	-11.5	18.4 HI	---	12.7	---
	9 LIFE	+9.1	-11.1	20.2 HI	---	---	---
	10 * VH1	+8.5	-13.3	21.8 HI	57.9	---	---
	11 * CNN	+4.1	-12.0	16.1	---	---	---
	12 A&E	+4.3	-3.4	7.7	---	---	---
87.5	13 CINE	+7.1	-4.2	11.3	---	2.1	---
	14 * SHOW	+6.3	-7.5	3.8	---	---	---
	15 * NICK	+10.2 HI	-8.2	18.4 HI	55.1	---	---
86.9							

```

-----
----
LIMIT CHECK          Limit          Actual
Min Video Carrier Level: +0.0 dBmV    CH 2  -17.7 dBmV
Fail
Max Delta Video Levels:  10.0          CH 2 & 15  27.9 dB
Fail
Min Delta V/A:         6.5 dB          CH 2    0.7 dB
Fail
Max Delta V/A:         17.0 dB          CH 6    28.2 dB
Fail
Max Delta Adjacent :   3.0
Fail
Channels
Conclusion:                                                    F A I L
-----
----

```

Reviewed: _____
Date: _____

CHAPTER 8: FILES

8.1 INTRODUCTION

StealthTrak and SAM 4040D have non-volatile memory that can be used to store data from field measurements for viewing at a later time. You can retain these files in the unit for later review. Or, with Wavetek's StealthWare PC software, you can upload them to a PC. Files loaded onto a PC can be viewed with the computer, printed, and archived. Or, these files can be downloaded into another StealthTrak/SAM 4040D for viewing in the field. The latter use is of benefit with comparing past and current measurements of a given CATV system test point.

In addition to viewing files, they can be printed, either directly from the instrument, or via a PC using StealthWare. These printouts are useful for proof-of-performance reports, troubleshooting and analysis, and for other documentation purposes.

The following types of measurements can be stored as files:

- **Autotests.**
- **Scans.**
- **Sweeps**—including forward sweep, reverse sweep, reverse amplifier alignment, and all sweep references.
- Spectrum scans- including regular, zero-span, and CSO/CTB measurements. Regular measurements can also include peak-hold values.
- Tilt measurements

Channel plans and spectrum mode settings can be stored as files, too.

All the files stored in your unit exist in a common pool of non-volatile memory. When a file is stored, the instrument uses only the memory actually required for the data. Different file types, or different settings within the same type, can use different amounts of memory. To see a display of how much memory is still available, press **Function**, **Chan** keypad buttons. The bar graph next to the **File** soft icon shows what percentage of memory is currently used.

You can also use the **NAV** menu to gain access the **View** screen. To work with the **View** menu, press the green **Function** key, then **2**. Alternatively, enter through the NAV top-level menu. You can Store, View, and Print SWEEP and SPECT files.

1. There are three basic displays in **View** mode:

- File –a screen to store measurement files
- View –a screen to view measurement files
- The display for the Measured File being viewed

2. If you press **Function, 2**, during a measurement, the measurement can be stored as a file. The instrument enters **File** mode to store this current measurement. If you press **Function, 2**, and you are in a mode that does not produce files, such as **Level**, the instrument enters **View** mode to allow you to review existing files.

8.2 STORING FILES

The Stealth meters enable you to store measurements made with **Scan, Spect** (Spectrum Analyzer Mode), **Tilt** and **Sweep** Measurement Mode keys.

To store any one of these three types of files, switch to **File** mode directly from **Scan, Spect**, or **Sweep** measurement menu. Refer to fig. 8-1. Use the numbered icons as indicated.

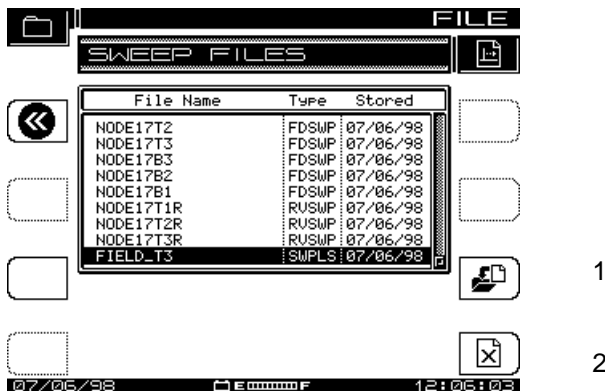


Figure 8-1: File (for Scan, Spect, or Sweep)

1. Press the **Function** key, then **2**, while taking the measurement. The screen displays the **File** for that test (Scan, Spect, Sweep). The instrument displays a list of all files that are the same type as the current measurement.

2. Press the **Store File** soft key (item 1 in figure). The screen prompts you for name, and warns if the name already is in use.

Press the **Enter** soft key. Use the keypad to enter a name, then press **Enter** again. The screen displays View, Measurement Files, the combined file for all three types.

All stored files, except Sweep Reference files, can be uploaded to Wavetek's Stealthware PC software. Each Sweep Reference file is unique, in terms of the meter used, location, and system conditions at the time of the Sweep. The uploaded files are extremely useful in terms of documenting/proving a system, as well as for system alignment and maintenance.

8.3 VIEWING/PRINTING

To view stored measurement files, press **Function, 2**. The screen displays a list of all currently stored measurement files, **View Measurement Files**, as shown in Figure 8-2. Use the up/down arrow keys to select a file.

Use the numbered icon soft keys as indicated.

1. View the file; press Function 2 to return to **Measurement Files**.
2. Print highlighted/selected file. The screen displays a graph of printing progress.
3. Print all marked files. You can print all measurement files, except Scan Files.
4. Use this to delete marked file(s). Press the **Cancel** soft icon to stop.
5. Use this to mark files for printing or deletion.

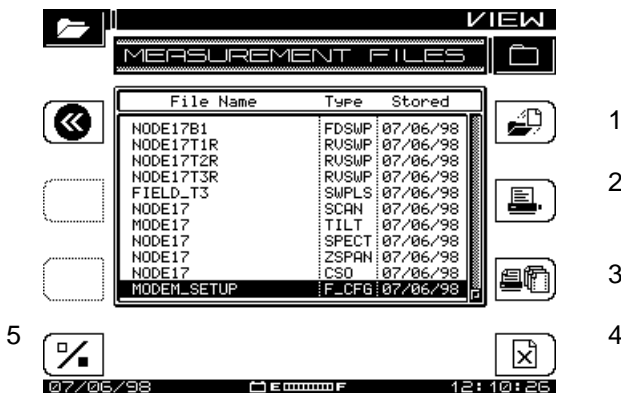


Figure 8-2: View Measurement Files

Refer to the file listings shown in Figure. 8-2. These types include all types of files that can be viewed.

- FWDSWP Forward Sweep
- RVSWP Reverse Sweep
- SCAN SCAN Mode
- TILT TILT Mode
- SPECT Normal Spectrum Mode
- ZSPAN Zero Span Mode
- CSO CSO/CTB

-
- F CFG (just below CSO)-Spectrum Configuration: this stores setting for display purposes. See Section 8-6.

8.4 SWEEP REFERENCES

Sweep References enables you to select, store, or delete sweep files. There are three categories of sweep files:

- FWDSWP (Forward Sweep): (3SR/V/T, StealthTrak only.) In Forward Sweep the instrument communicates with the Headend, but does NOT Transmit. A Headend transmitter provides the sweep signal downstream.
- REVSWP (Reverse Sweep): (3SRV/T, StealthTrak only.) In Reverse Sweep the StealthTrak *does* transmit a signal upstream to the Headend, and communicates with the Headend.
- SWPLS (Sweepless® Sweep). (SAM 4040D, 3SR/V/T, StealthTrak units.) In Sweepless® Sweep, the instrument is completely passive, sweeping its receiver across the allotted spectrum. Only active carriers in the CATV system will register in the sweep.

The **Sweep References** menu enables you to select, store, or delete sweep references. After making a sweep measurement, you can store a sweep reference. The instrument must be in the **Sweep** screen for a minimum amount of time before storing a reference. When the instrument first enters the **Sweep** screen, a wait-indicator icon appears above the sweep graph (upper left). A reference cannot be saved until the wait indicator terminates.

To work with sweep references, press the green **Function** key, then the **6 pqr** key to go to the **Sweep References** menu, shown in Figure 8-3.

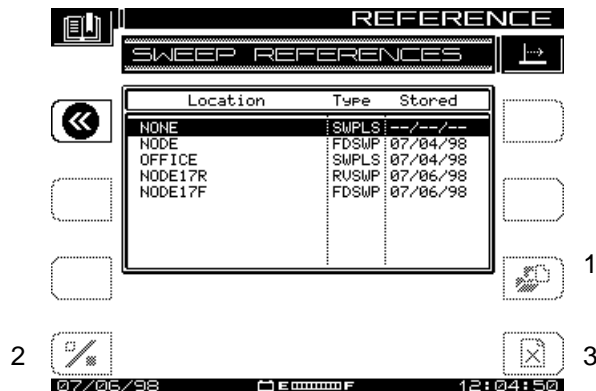


Figure 8-3: Sweep References

To store a sweep as a reference, several traces are averaged. If you do not wait for enough traces before entering the **Sweep References** menu, an error message will appear saying: *“SORRY...not enough sweeps have occurred to store an accurate reference. Please allow more time to sweep.”* With reference to Figure 8-3,

- Use the up/down arrow keys to select a reference.
- To use the currently highlighted file as a reference, press **Enter**.
- To mark several reference files, use the **Mark** button (item #2).
- To delete all the files marked, or the current file, if none are marked, press the **Delete** button (item #3).

Different types of sweeps can be stored as references. The Stealth instruments mark them differently, and displays FDSWP for forward references, RVSWP for reverse references, and SWPLS for Sweepless® Sweep references. The file name and date stored are also shown for each file.

If the channel plan has changed since a reference was stored, the reference is obsolete and can no longer be used. If you select an obsolete reference, a warning message appears when the program enters **Sweep** mode, and the default reference will be used. Wavetek recommends that obsolete references be deleted, to free memory for additional references and files.

8.5 OVERLAY MODE

With **Overlay** mode selected, you can compare a stored sweep file with the current system sweep response. This allows you to compare two locations in the cable system, or to compare two sweeps from the same point, but from different times. By overlaying the files on each other, you can quickly see any differences.

Activate **Overlay** mode in the **Configure ,Sweep Receiver, Sweep** menu by turning on **Sweep File Overlay**. With **Overlay** mode on, a sweep file selected for viewing modifies the current display. Refer to Figure 8-4, an example Sweep File. The sweep file is displayed as a gray area (instead of the usual black), and the current sweep response is displayed as a black line in front of the file.

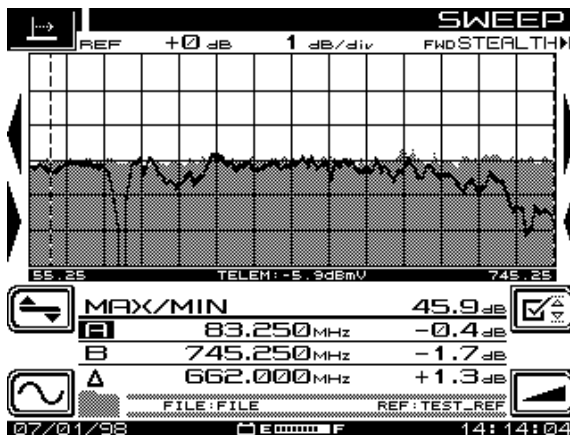


Figure 8-4: Sweep Reference with Live Sweep

In the file shown above, a 'trap' was added after the file was stored. It is very easy to see the change caused by the trap. You can also see the location of the trap in the sweep response. During a file overlay view, you can use the same controls normally available for sweep. Marker values are calculated from the current sweep response. The file name (FILE in this case) and reference (TEST_REF) are displayed near the bottom of the screen next to the folder icon.

If you enabled the **Sweep File Overlay** feature in the **Sweep Receiver Setup** menu, you can select a sweep measurement file to be viewed simultaneously with the "live" sweep.

The sweep file is selected from the View Measurement Files screen the same as if it were to be viewed. To view the Sweep screens, press the **View** soft key. When the **Sweep File Overlay** option has been enabled, the live response will overlay the stored response, *if* the following conditions are met:

1. The current sweep mode (Sweepless, StealthTrak Fwd, StealthTrak Rev) matches the mode under which the sweep file was stored.
2. The channel plans for the stored and live sweep match. If sweep overlay is not possible, a message appears, explaining the situation.
3. The names of the file being viewed and the currently selected reference appear beneath the marker information.
4. The Level and Frequency adjustments affect both the stored and live sweeps. Reference Limits Checking and Tilt Compensation affect the live sweep only. The marker values indicate the levels of the live sweep. Auto Scale affects the live sweep data.

Referring to Figure 8-4, the stored sweep response display is a gray-filled area. The live response appears as a solid line superimposed, or overlaid, on top of the stored sweep response. The live response is updated continuously.

CHAPTER 9: MAINTENANCE

9.1 GENERAL

This section covers routine tasks that the Service Technician may perform on the StealthTrak and Stealth instruments.

9.2 VISUAL, PHYSICAL AND MECHANICAL INSPECTION

Make sure all hardware is properly installed and tightened.

9.3 RF CONNECTOR REPLACEMENT

The RF connector is used often to attach the unit to the cable system. As time passes, this will cause wear on the connectors and they should be replaced.

To replace the connector:

1. Carefully unscrew the connector from the unit using a 7/16-inch wrench.
2. Screw the short end of the new connector into the unit. A longer connector could cause internal damage to the unit. Remember to use a lockwasher.
3. Torque the connector to not more than 5.0 - 6.0 IN.-LBS.

9.4 BATTERY TERMINAL CLEANING

Clean the battery terminal regularly (examine weekly for signs of corrosion or contamination). One acceptable method of cleaning is to use a hard type eraser (such as one for erasing ink; do not use the soft "moldable" types).

9.5 CLEANING THE INSTRUMENT

Do not apply water to the instrument directly. Use a soft cloth, moisten it with water and a gentle detergent, wring water out of it by hand until it is much too dry to drip. Wipe the instrument gently; dry the display screen to prevent spots. Do not use any type of cleanser or polish on the display!

9.6 ANNUAL CALIBRATION

This instrument should be calibrated annually for best performance accuracy. If subjected to difficult conditions (temperature, humidity, physical stress or damage) more frequent calibration and service is appropriate. See the below for a list of Wavetek Service Centers.

9.6 WORLDWIDE SERVICE CENTERS

Austria

Tel: (3) 1-214-5110
Fax: (43) 1-214-5109

France

Tel: (33) 01-4-77-47-89-00
Fax: (33) 01-4-77-47-89-70

Singapore

Tel: (65) 356-2522
Fax: (65) 356-2553

United States

Tel: (317) 788-9351
800-851-1198
Fax: (317) 782-4607

China

Tel: (86) 10-6592-8044
Fax: (86) 10-6500-8199

Germany

Tel: (49) 89-996-410
Fax: (49) 89-996-41160

United Kingdom

Tel: (44) 1603-404-824
Fax: (44) 1603-483-670

CHAPTER 10: CHANNEL PLANS

10.1 INTRODUCTION

Using a channel plan, a StealthTrak/SAM4040D memorizes the frequencies of enabled channels. The instrument retains frequencies, expected levels, and other aspects of your CATV system. Be sure that:

- You have completed the basic setup as described in Chapter 3, under configure, for Global, Measurements, and Sweep Receiver, discussed in Chapter 3.
- You are thoroughly familiar with functions of controls and indicators of the instrument.

10.2 WORKING WITH A CHANNEL PLAN.

To begin, turn power ON, and enter the **Configure** menu, either by pressing **NAV** and using the Navigator menu, or by pressing the green **Function** key and then **3 ghi**.

A. Refer to Figure 10-1. The **Configure** menu includes five categories: **Global, Measurement, Channel Plan, Sweep Receiver, and Diagnostics**.

B. Use the up/down arrow keys to select **Channel Plan**, and press any soft key. The screen displays Figure 10-2, **Configure, Channel Plan** top-level menu.

The remainder of this chapter is sequenced in sections **A** through **I**:

- A.** Selecting a channel plan
- B.** Video signal type settings
- C.** Channel tuning sequence
- D.** "Build" the channel plan
- E.** Editing the channel plan
- F.** Deleting unused channels
- G.** Specifying Autotest measurements
- H.** Editing limits
- I.** Copying a remote plan from another instrument

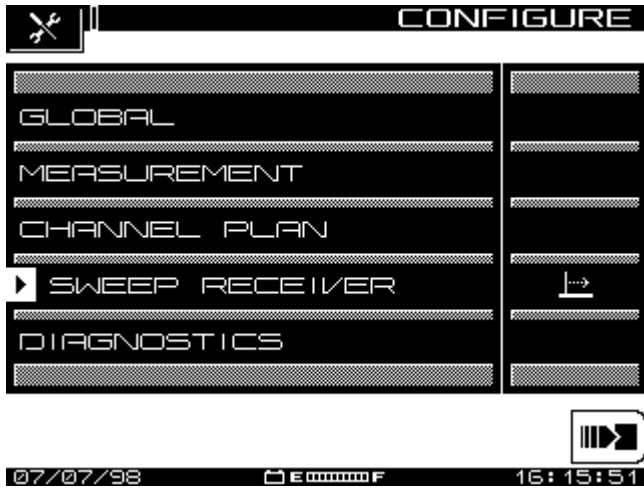


Figure 10-1: Configure Menu

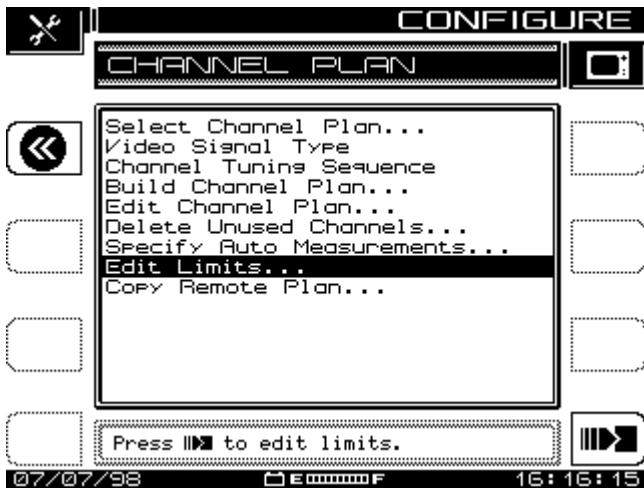


Figure 10-2: Configure, Channel Plan

10.3. SETTING CHANNEL PLAN PARAMETERS.

Fig 10-2 displays the channel plan menu. Follow the prompts of the Edit Box and directions in the text below. The “Exit” icon in the upper left moves the menu back one screen. Press the icon at the lower right, by the Edit Box, to get into each Channel Plan submenu.

A. Select Channel Plan.

Select the top line, which produces Figure 10-3, Select Channel Plan, a list of existing channel plans. If the Stealth is being used for the first time, the only Channel Plan shown is the standard NCTA plan. The process in **Build Channel Plan** (text item D, below) enables you to create, name, and add to the list new channel plans that meet your requirements.

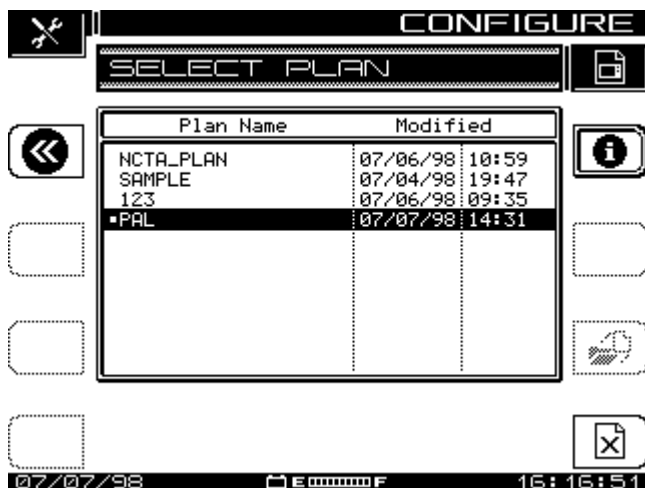


Figure 10-3: Select Plan

1. Scroll through the list to the Plan you want to view, then press the **Load** soft key (a file folder with a paper being taken out).

2. Press the **Info (I)** soft key to view Channel Plan INFO about the current channel plan, Figure 10-4. This is a view-only screen, which displays main features of the plan specified in the top line.



Figure 10-4: Channel Plan Info

3. Press the **i (Info)** soft key to get info on the current plan, Figure 10-3. This selection is available only for the currently active plan.

4. Press **X** soft key to delete a Plan. If you press **X** you can press STOP, or the cancel icon (that replaces **X**), to reverse the deletion. To accept, press **OK** soft key to confirm it.

5. Press **Exit** soft key to return to Figure 10-2, **Channel Plan**.

B. Video Signal Type.

1. With Figure 10-2 displayed, select Video Signal Type and press the **Enter** soft key. The up/down arrow keys toggle between **NTSC** and **PAL** in the Edit Box.

2. Select the Signal Type compatible with your system, and press the **Enter** soft key again. The screen returns to

Channel Plan, Figure 10-2. For more information about these signal types see the Glossary at the end of this manual.

C. Channel Tuning Sequence

With Figure 10-2, **Channel Plan** displayed, select **Channel Tuning Sequence**, and press the **Enter** soft key. The up/down arrow keys toggle between **Numeric Order** and **Frequency Order**.

Select the item desired, press the **Enter** soft key again, then use the up/down arrow keys to scroll to the next parameter.

D. Build Channel Plan

1. With figure-10-2, **Channel Plan**, displayed, select **Build Channel Plan**. The instrument creates a channel plan by memorizing the active channels in the system, and by identifying by default those that are not active.

CAUTION:

Be sure that the Stealth Instrument is correctly connected to the cable system at COAX IN.

2. As prompted by the Edit Box, press the soft key, and Figure 10-5, **Build Plan-Step 1**, appears.



Figure 10-5: BUILD PLAN-STEP 1

- a. At Step 1, the screen prompts you to name the Plan. Using the alphanumeric keys and the arrow keys, make your entry, and press the **OK** soft key.
- b. Press **OK** soft key to overwrite, or press **Stop** soft key to return to Step 1. The screen warns you if there is already a plan with that name entered into the meter. When you are satisfied with the name, press the **OK** soft key. The screen shows Figure 10-6, **Build Plan-Step 2**.



Figure 10-6: Build Plan-STEP 2.

3. At Step 2, select from the menu in the Edit Box a base channel plan to use for building the new plan.
 - a. Use the up/down arrow keys to select a base channel plan to form the basis for the new plan. Press the **OK** soft key when completed.
 - c. The screen displays Figure 10-7, **Build Channel Plan-Step 3**.



Figure 10-7: Build Channel Plan-STEP 3

4. At Step 3, enter the upper frequency at which to stop searching for channels.

CAUTION:
YOU MUST PRESS THE ENTER KEY TO REGISTER THIS FREQUENCY AS THE UPPER LIMIT

- a. Use the keypad and/or the up/down arrow keys to set the frequency, press the **Enter** key, then press the **OK** soft key. As the plan starts, Stealth displays the basic plan information and the channels being taken into the plan.
- b. When building the Channel Plan, Stealth sequences through all channels in the selected base plan up to the Stop Frequency. To halt the process, press the **Stop** soft key. When the Plan is complete, you can edit all channels included in the plan.
- c. When the Channel Plan is complete, the screen displays the name and format for the Plan, along with the number of enabled channels.
- d. The display also confirms that the first and last channels are tilt enabled. Press the **OK** soft key, and Figure 10-2, **Channel Plan**, reappears.

E. Edit Channel Plan

This feature enables you to scroll through the entire list of channels in the Plan, select each channel, and edit parameters for each

With Figure 10-2 displayed, select **Edit Channel Plan** and press the icon prompted by the Edit Box. Fig. 10-8, **Edit Channel Plan**, appears. The eight columns of this screen display the following information about each channel in the Plan, left to right:

Enabled/Type/Channel/Label/Frequency/Sweep/Tilt/Scrambled

(A Checkmark in the left margin means that the channel is enabled; SWP/TILT/SCR channels have asterisks to indicate that status)

	TYPE	CHN	LABL	FREQ	SWP	TLT	SCR
✓	TU	2		55.25	*	*	
✓	TU	3		61.25	*	*	
✓	TU	4		67.25	*	*	
✓	TU	5		77.25	*	*	
✓	TU	6		83.25	*	*	
✓	TU	95		91.25	*	*	*
✓	TU	96		97.25	*	*	*
✓	TU	97		103.25	*	*	*
✓	TU	98		109.28	*	*	*
✓	TU	99		115.28	*	*	*
✓	TU	14		121.26	*	*	
✓	TU	15		127.26	*	*	
✓	TU	16		133.26	*	*	
✓	TU	17		139.25	*	*	
✓	TU	18		145.25	*	*	

Figure 10-8: EDIT Channel Plan

Press the **Edit** soft key, and Figure 10-9, **Edit Channel**, appears.

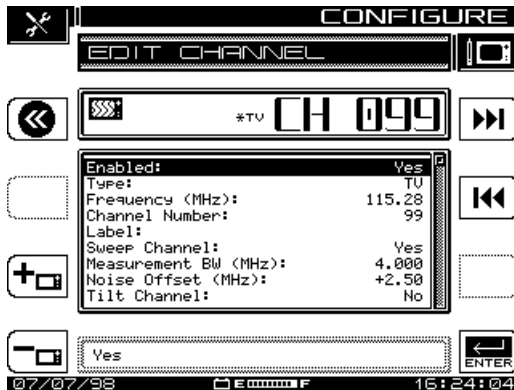


Figure 10-11: Edit Channel

Edit Channel presents, one-at-a-time, a listing in numerical or frequency order of the channels in the current Plan, depending on current setting from paragraph. 10-3C. For each channel there is a list of parameters that you examine and/or adjust.

1. Use the up/down arrow keys to scroll, select, and to uncover the 10th and 11th parameters, if present.
2. Use the left/right arrow keys, or the two arrow icons at the upper right corner to scroll through list of channels.
3. To make adjustments to the highlighted parameter, press the **Enter** soft key, make the changes, then press **Enter** again.
4. **ADD CHANNEL:** Press the **Add** soft key (+TV lower left) to add a new channel to the plan. The new channel will be assigned the next channel number (from the one being viewed, and a frequency set to the smallest in the channel plan (5 MHz).
5. **DELETE CHANNEL:** Press the **Delete** soft key (-TV lower left) to remove the current channel from the plan. The screen warns you about the deletion.

6. When you have finished editing the Channel/Frequency in this screen, press the **Exit** icon and return to the **Edit Channel Plan** menu.

NOTES:

1. Enabled: (Enables the instrument to monitor the channel)
Y/N If the channel is not enabled it will not be included in any measurement mode. At least one channel must be enabled.

2. Type: Use the up/down arrow keys to scroll through the selection offered in the Edit Box. When you select **TYPE**, the program offers four choices in the Edit Box. Press the Edit Box icon to highlight choices, and use the up/down arrow keys to make the choice. For each of the four choices shown below, the screen displays the channel parameters applicable, for you to examine and edit as necessary. Channel type shows in the upper display to the left of the channel number as: DIGI, DUAL, SNG, TV, or SWP.

The four choices are discussed below, and in Table 10-1, Carrier-Types and Parameters.

Digital Carrier(DIGI)- Can be used for continuous digital carriers. Digi is supported only in the Level, Sweep, Spectrum and Scan measurement modes. An RMS detection mode measures the level of a digital channel.

Video + Dual Audio Channels(DUAL)- European system, incorporates video plus two independent audio carriers.

Single Carrier(SNGL)- Can be used as a carrier for FM or data.

Video Channel(TV)- Includes standard video carrier with audio carrier offset.

Table 10-1 Carrier-Types vs. Parameters

	Digital Carrier (DIGI)	Video + Dual Audio Channels (DUAL)	Single Carrier (SNGL)	Video Channel (TV)
Enabled	X	X	X	X
Type	X	X	X	X
Frequency (MHz)	X	X	X	X
Channel Number	X	X	X	X
Label	X	X	X	X
Sweep Channel	X	X	X	X
Measurement Bandwidth (MHz)	X	X	X	X
Noise Offset (MHz)	X	X	X	X
Tilt Channel		X	X	X
Scrambled		X		X
Audio Offset 1 (MHz)		X		X
	DIG	DUAL	SNGL	TV
Audio Offset 2 (MHz)		X		

3. Frequency (MHz): The frequency of the carrier (for TV and DUAL types, this is the frequency of the video carrier). Press the **Enter** soft key, and enter frequency by using the numeric entry keys or the up/down arrow keys, followed again by the **Enter** soft key

4. Channel Number: The channel number of the carrier. Change channel number by pressing the **Enter** soft key, and using the numeric keypad or the up/down arrow keys. Press the **Enter** soft key to finish.

5 Label: The label associates the channel's number to programming. The label can have up to four characters. Use the **Enter** soft key, keypad and/or up/down arrow keys. Up/down keys allow use of special characters. The label appears to the left of the channel number on most screens.

6. Sweep Channel: Y/N - Designates whether the channel will be used for Sweep measurements. Use the **Enter** soft key and up/down arrow keys to select Yes or NO.

7. Measurement Bandwidth (MHz): To edit the bandwidth, select Measurement BW selection. Adjust bandwidth by using the up/down arrow keys or by entering a value using the numeric keypad. Use the **Enter** soft key to start and finish. In the U.S., FCC specification for C/N measurements is a bandwidth of 4.00 MHz. CATV organizations outside of the United States may have different requirements. On a digital channel, this is the bandwidth of the carrier to be measured.

8. Noise Offset (MHz): The frequency at which the noise level is measured is the Carrier frequency plus the Noise Offset. To adjust Noise Offset, select **Noise Offset (MHz)**. Adjust Offset by using the up/down arrow keys or by entering a value using the numeric keypad. Use the **Enter** soft key to start and finish.

9. Tilt Channel: Y/N - Designates whether or not the channel is to be used for the **TILT** mode. Up to nine channels can be designated as Tilt channels. Use the up/down arrow keys and the **Enter** soft key.

10. Scrambled: Y/N - Select **Yes** if the channel is scrambled. Sweeping and measuring a scrambled channel will be slower than for an unscrambled channel. *Tip: To speed up sweep speeds, a stable audio carrier can be used as a sweep point.* Add a "SINGLE" type channel at the frequency of the audio carrier and enable this channel for sweep. For a scrambled channel, a diamond appears in the Title Bar to the left of the channel-type indicator on most screens. Use the up/down arrow keys and the **Enter** soft key.

11. Audio Offset 1 (MHz): Specifies the audio offset of the channel. Use the up/down arrow keys or keypad and the **Enter** soft key.

12. Audio Offset 2 (MHz): Specifies the offset for the second audio carrier of a Dual channel. . Use the up/down arrow keys or keypad and the **Enter** soft key.

F. Delete Unused Channels

When the plan has been built, you can delete unused channels, if appropriate. Doing this frees memory for other uses and "un-clutters" the channel plan.

1. Select **Delete Unused Channels** in the Channel Plan menu, and press the NEXT soft key as prompted by the Edit Bar.
2. The screen warns you that the deletion cannot be undone, that ALL channels not enabled will be deleted.
3. Press the **OK** soft key to delete unused channels; press the **OK** soft key to return to Channel Plan menu.

NOTE:

SOME CHANNEL PLANS HAVE INTERLACED CHANNELS. TO PREVENT STEALTHTRAK FROM INTERFERING. DELETE INTERLACED CHANNELS FROM CHANNEL PLAN PRIOR TO BUILDING SWEEP POINTS.

G. Specify Auto Measurements:

This enables you to specify one or all three measurements (C/N, Hum, Mod) for inclusion at any/all TV channels in your Plan

1. Select Specify **Auto Measurements**, press Edit Bar soft key, and Figure 10-10, **Auto Measurements** appears.

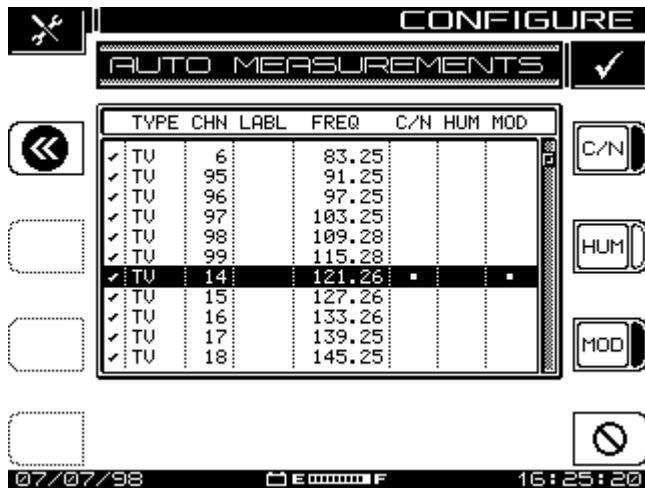


Figure 10-10: Auto Measurements

2. Use the up/down arrow keys to scroll through the listed channels.
3. Use the bottom right icon soft key to program all three at a channel, or use the **C/N**, **Hum**, and **MOD** soft keys separately. When the lower right icon changes to a slotted circle, you can use it to cancel all three tests for a selected channel.
4. Press the backup icon soft key at the upper left to return to the **Channel Plan Menu**.
5. REMINDER:
 - C/N, hum, and modulation cannot be measured on a scrambled channel or a digital carrier.
 - Hum measurements include all components < 1 kHz.
 - Hum is measured in either % or dB, as established during setup.
 - Units cannot be changed once the Autotest has been completed.

H. Edit Limits:

Edit Limits establishes standards incorporated into the performance of an Auto Test. As the Auto Test measurements are running the program, compares measured values to the above limits: Video Level, Level Delta values, and Max 24-hour Level deviation.

1. From the **Configure** Menu, select **Channel Plan**, scroll to **Edit Limits**, and press the Edit Box **Next** icon soft key. Fig. 10-13, **Edit Limits**, appears.

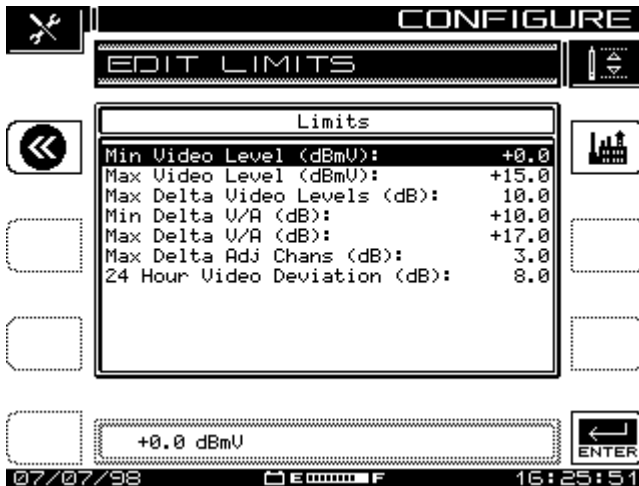


Figure 10-11: Edit Limits

2. Use the up/down arrow keys to select the limit to be edited.
3. Use the numeric entry keys or the up/down arrow keys, and the Edit Box icon soft key.
4. When you have made the adjustment, press the **Enter** hard key or soft key again to update the display

5. You can use the *factory* icon soft key at the upper right of the screen to set FCC-recommended default values, automatically.

I. **Copy Remote Plan:**

This selection enables you to copy a channel plan from one meter to another.

1. First, connect a cable between the serial ports of two meters. Check that the baud rate is set the same for each unit). Wavetek recommends a baud of 19.2K for copying plans.
2. From the **Configure** Menu, select **Channel Plan**, scroll to **Copy Remote Plan**, and press the Edit Box icon soft key.
3. A list of plans located in the remote meter's memory appears on the screen.
4. Select the plan that you want to copy and press the **Copy** soft key.
5. The selected plan is transferred from the remote meter and stored in the meter that you are operating.
6. If there is a problem with the transfer, the screen notifies you.

APPENDIX A: SAM 4040D SPECIFICATIONS

LEVEL Measurement

Range: -40 to +60 dBmV

Resolution: 0.1 dB

Accuracy: ± 1.0 dB from -20 to +50°C ^{1,2}

Signal types: single carrier, video (single or dual audio), audio

Additional uncertainty: ± 0.5 dB for digital (QAM, QPR, QPSK, VSB, CAP-16), TDMA (zero-span spectrum mode) @ 280 kHz RBW

TILT Measurement

Up to 9 pilot carriers or video channels

Hi-Lo Resolution: 0.1dB

SCAN Mode

All video, audio, pilot carrier, and digital channel levels displayed.

SWEEP Mode

Frequency range: 5-1000 MHz

Display span: user definable

Display scale/range: 6 vertical divisions

1, 2, 5, or 10 dB/division

Stability: ± 0.5 dB, normalized

(dependant on stability of referenced carriers)

Carrier-to-Noise Measurement

Non-scrambled channels only.

No pre-selection required for 78 channels at +10 dBmV input level.

Resolution: < 0.5 dB

Range: 52 dB maximum¹

Hum Measurement

carrier > 0 dBmV, non-scrambled channels only

Range: 0 to 10%

Resolution: <0.2%

Accuracy: $\pm 0.7\%$

MOD-Depth of Modulation

Assumes presence of white reference on any VITS line.

Non-scrambled channels only.

Range: 80 to 100%

Resolution: <0.5% at 85%

Audio demodulation of AM and FM carriers

SPECT-Spectrum Mode

Spans: 3, 5, 10, 20, and 50 MHz
(750 ms to 1.75 depending on span)

Sweep Rates:

1 second updates with spans of 50, 20, 10 & 5 MHz

1.7 second updates with 3 MHz span

Display Scaling and Range:

0.5, 1, 2, 5, and 10 dB/div.

6 vertical divisions

Dwell: programmable 0-25 ms

Spurious-Free Dynamic Range: 60 dB¹

Sensitivity:

-40 to +60 dBmV without preamp

-50 to +50 dBmV with preamp

-55 to +55 dBmV typical for f<50 MHz

ZERO-SPAN Mode

Video BW: >1MHz, 100 kHz, 10 kHz, 100 Hz

Resolution BW: 280 kHz, 30 kHz

Measurement BW compensation:

Programmable 1 khz-99 MHz

Pulse measurement accuracy:

Nominal level in 10 μ s

\pm 2 dB from nominal in 5 μ s

(>1 MHz VBW, 280 kHz RBW)

Sweep times:

100 μ s to 20 s (1,2,5 settings)

Intermodulation Distortion (CSO/CTB)

Range: 60 dB maximum

Resolution: 0.4 dB

Frequency

Range: 5 to 1,000 MHz
Accuracy: @ 25°C ±10 ppm
Drift Over Temp ±10 ppm
Aging ± 3 ppm/year
Resolution Bandwidths: 30, 280 kHz, 2 MHz
Tuning Resolution: 10 kHz

Data Storage

Files stored: Autotests, SCAN, SWEEPLESS SWEEP, SPECT
(regular with max hold, ZERO-SPAN or CSO/CTB), TILT, Channel
Plans.

Allocated on demand.

Storage capability: (simultaneous- more of one file type can be
'traded' for less of another)

(typical 78-channel plan)

(all files stored as database, not screen picture)

8 Channel Plans

100 SWEEP references/traces

60 Spectrum (SPECT) displays

20 Autotests

Serial Interface

Serial, RS232; Epson, IBM Printers

General

Log Linearity: $\pm 0.5 \text{ dB}^1$
Flatness: $\pm 0.5 \text{ dB}^3$
Dimensions: 6"x11"x3.5"
Weight: 2.5 kg (5.5 lbs.)
Operating Temperature Range:
-20 to +47°C; -4 to 117°F

Power Sources

Battery: 12V /3.5A-hr replaceable
4 hours continuous use on a single charge

Charger:

Input: 90-265VAC, 47-63 Hz
Aux out: 16V @ 750 mA
Charge: 15V @ 750 mA

- 1) Typical Specifications
- 2) Relative to 25°C
- 3) @25°C and +20 dBmV

APPENDIX B: GLOSSARY

This glossary covers both references in the manual, and others, which help to clarify discussion and procedures in the manual. Sources include Wavetek proprietary documents; the Jones Dictionary for Cable television and Information Infrastructure, 4th edition; and the IEEE Standard Dictionary of Electrical and Electronic Terms, 4th edition and other electronics authorities.

Acronym/ Term	Definition
3HRV V9	Headend Reverse Sweep Receiver. 3HRV incorporates a transmitter, and is used in conjunction with the 3ST Stealth Headend Transmitter for full forward and reverse alignment. 3HRV accommodates up to 10 ten simultaneous reverse sweep inputs.
3SR V9	Stealth Sweep Receiver. Works with carriers as possible and on Seep frequencies transmitted downstream by the 3ST.
3SRT V9	Essentially, a portable 3ST.
3ST	Stealth Sweep Headend Transmitter. Used for sweeping the system forward, inserting sweeps at unused portions of the spectrum. Sends headend level values downstream as reference for 3SRs and StealthTraks.
Analogue-VSB	Vestigial Sideband Modulation: prescribed partial suppression of one of the sidebands. This technique uses less bandwidth than double sideband transmission, and preserves the signal's waveform.

Amplitude Modulation	Amplitude of the high-frequency carrier varies according to the instantaneous value of the low-frequency modulating signal.
Baseband	The band of frequencies occupied by the signal in a carrier before the signal is modulated in the carrier to form the transmitted signal.
BPF	Band Pass Filter
Bursty	Data streams that are sporadic: bursts of data transmission interspersed with periods of little or no activity.
BW	Bandwidth: A measure of information-carrying capacity of a communications channel. BW is the difference between the highest and lowest frequencies carried by a channel. Also the speed (bit-rate velocity at which data can be transferred and presented.
C/N; also CNR	Carrier-to-Noise ratio, normally expressed in dB: the ratio of peak carrier power to root mean square (RMS) noise power (noise floor at video bandwidth) adjacent to the carrier. See Noise Offset.
CATV	Community Antenna Television, commonly used to refer to Cable Television.
Channel	In the US a 6 MHz-wide band of frequencies allocated for use in television broadcasting, designated by number. For example, Channel 7 occupies the band from 174 to 180 MHz. In Europe the standard is 8 MHz
Channel Plan	Analysis and enumeration/identification of television channels present on a CATV system

CPD	Common Path Distortion: a form of inter-modulation distortion caused by mixing when an RF spectrum passes through a non-linear junction. Also caused by material deterioration and irregularities in the transmission line.
CSO	Composite Second Order: clustering of second-order beats at any frequency of the spectrum. CSO in the video bandwidth can cause distortion of video in cable systems. Measured as the ratio, in dB, of the peak level of the visual carrier to the peak of the average level of CSO.
CTB	Composite Triple Beat: spurious frequencies generated by the sum and difference products of any three carriers passing through a non-linear circuit or device. Detected as a voltage.
CW	Continuous Wave. Under steady-state conditions, successive CW oscillations are identical.
D/U	Desired/Undesired, also called Carrier to Garbage
DVA	Ratio of video level to audio level, expressed in dB.
Depth of Modulation	Ratio of peak downward change in modulation to carrier amplitude, expressed as a percentage. (Roddy/Coolen)
DSP	Digital Signal Processor: converts digital input into analogue or pulse-rate outputs.
DTV	Digital TV
Edit Box	On many LCD screens you are required to make changes, or have the option of making changes to system parameters. In these instances the Edit box appears as the last line of the LCD screen. It also carries instructions, when appropriate. such as "Press ENTER...."
Equalization	Reducing distortion of frequency and/or phase by compensating for attenuation and/or time-delay at frequencies within the transmission band.
Frequency Modulation (FM)	A modulating signal varies the frequency of the carrier wave.

HDTV	High Definition TV: can be either analogue or digital.
Headend	The control center of a cable television system. The headend receives incoming signals from satellites, broadcast antennae, etc. , then amplifies, converts, processes and combines signals as required for transmission along cable lines to hubs or nodes for distribution to cable subscribers' house drops.
HFC	Hybrid Fiber Coax
HPF	High Pass Filter
Hub	A signal distribution point that receives signals directly from the headend; a sub-station comprising a collection of nodes. A hub facilitates trouble-shooting and changes within the overall system. Larger cable systems have multiple hub sites.
Hum	Low-Frequency Modulation of a carrier when it passes through an active or passive component. Shows on TV screen as bar(s) scrolling slowly up through the picture. Measured in Stealth as dBmV or as a percentage.
Ingress	RF "leaking in" to a reverse path, interfering with transmission. Interruption into the cable line by through breaks in the integrity of the cable
Inter-modulation	Modulation of a TV carrier frequency by power line frequencies and harmonics, or other low-frequency disturbances.
Inter-modulation Distortion	Nonlinear distortion produced by the presence of inter-modulation. Harmonics are not included in this category
IPPV	Impulse Pay-Per-View
Level	Level is a measurement of signal and reference voltages in the cable system, expressed in dBmV or as a ratio expressed in dB
LPF	Low Pass Filter

Modem	“Modem” is a contraction of Modulator-Demodulator. A Modem converts computer digital signals to analogue for data transmission, or demodulates upon receipt, for use within a computer.
Modulate	To regulate, or adjust, and specifically in the case of communications, to regulate some parameter of a high-frequency carrier wave by means of a low-frequency information signal. (Roddy/Coolen)
NCTA	National Cable Television Association: the trade association for the U. S. cable television industry. Formerly called National Community Television Association.
Node	A point of connection and distribution downstream from the hub. A node supports an average of about 500 subscribers
Noise Offset	For a true indication of Mean Noise value in the system, measure C/N ratio at about 2.4/2.5 MHz above the lower band edge, between video and chrominance modulation.
Overlapping Channel	Many countries have similar but slightly different frequency allocation for channels. To accommodate all possible variations, Stealth base channel plans have some overlapping frequencies. Carrier frequencies are different, but there is some bandwidth overlap. if you use one of these channel plans, delete unused channels that overlap active channels.
NTSC	National Television System Committee: the organization that established a color television standard with the same name used by the US and several other countries. The standard uses a 525-line screen at a rate of sixty fields/thirty frames per second, with a broadcast bandwidth of 4 MHz. Horizontal resolution is approximately 768 pixels.
PAL	Phase Alternate Line: a European color television system, not compatible with the NTSC system used in the United States

PAM	Pulse Amplitude Modulation produces a sequence of possibly overlapped pulses with the amplitude of each modulated by a symbol. QAM, PSK, BPSK, PRK, QPSK, DPSK, and AM-PM are all special cases of passband PAM
Pass band	The range of frequencies accommodated by a given filter, amplifier, or circuit.
Pilot Channel	The Lowest and Highest of the channels (9 max total) selected as criteria for TILT .
Pilot Level	Level in dBmV of Pilot Channel used for TILT .
Pixel	A Pixel (Picture Element) is the smallest area of a television picture capable of being delineated by a signal passing through the system.
PSK	Phase-Shift Keying modulation: shifting the carrier frequency plus or minus 90- degrees in phase to represent "0" and "1", respectively, for digital transmissions.
QAM	Quadrature Amplitude Modulation (QAM) changes both amplitude and phase simultaneously from symbol to symbol. QAM is a special case of pass band pulse amplitude modulation (PAM), two carriers on the same frequency, but 90 degrees out of phase and modulated by the real and imaginary parts of a complex-valued baseband signal. A polar plot of amplitude and phase for each discrete modulation level produces a constellation of points representing the amplitude of the in-phase and quadrature components of the transmitted Cartesian coordinates.
Reverse Sweeping	Sweeping upstream toward the Headend of a CATV system. Usually limited to within 5-42 or 5-65 MHz. See Sweeping.
Reference Level	In Stealth SPECT Mode, the reference level is the top of the screen/graph. In SWEEP mode the reference level is the middle of the screen/graph.

Roll Off	A gradual or sharp attenuation of gain at either or both ends of a transmission pass band.
SCAN	In the Stealth system, SCAN Mode shows on one display the voltage levels of all carriers across a given spectrum. Video and Audio carrier levels are shown, separately, in dBmV.
SLM	Signal Level Meter
Slope	Difference in gain between the ends of a band of frequencies
Suck-Out	Excessive cable transmission loss that affects or several channels acutely, as a function of frequency, due to sharp kinks or bends, or to minor imperfections regularly spaced in the line.
Sweeping	Injecting into the cable and transmitting downstream in a CATV system at selected points in the spectrum a series of output signals that vary in frequency between preset or adjustable limits, at a rate that is also adjustable. Used in conjunction with suitable peripheral equipment, the swept signal can be used for comprehensive testing of a CATV plant.
Sweepless Mode	Passive examination of carrier frequencies.
TASO	Television Allocation Study Organization
TDMA	Time Division Multiple Access: an access methodology that assigns bandwidth only when/as required.
Telemetry Frequency	Frequency selected to transmit data downstream/upstream in a CATV system.
Tilt	Transmission loss in a coaxial cable. Tilt increases in proportion to the square root of frequency. Tilt compensation adjusts amplifier frequency/gain response to offset tilt attenuation. As displayed in a Stealth System, TILT mode shows levels in dBmv across a band of channels; TILT shows up as the slope between lowest to highest channel. Levels for each Intermediate channel should reach the line from lowest to highest channel.

Title Bar	The top line or bar of all LCD screens: shows the Name of the Test/Measurement on the left; and the TIME on the right. When Alpha/Numeric or Multiple Choice adjustments are offered by the Menu, they icon appears in the Title Bar, to the Left of the TIME.
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