VF / DSL Cable Qualifier

CableSHARK P3

NETWORK TESTING

USER GUIDE

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Telecommunications Test and Measurement

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EXPERTISE REACHING OUT

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CableSHARK *P3*
VF / DSL Cable Qualifier

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Patent Information

The End-to-End DMT test used by the EXFO CableSHARK is patent protected.

ADSL Data Rate Prediction (End to End): United States Patent # US 6,445,773 B1   September 3, 2002

ADSL Data Rate Prediction (End to End): Canada Patent # 2,297,871 December 28, 2004

The Single-Ended DMT test used by the EXFO CableSHARK is patent pending.

ADSL Data Rate Prediction (Single End):   United States Patent Pending # 10/133,408

Section 1   Introduction

The EXFO CableSHARK *P3* VF/DSL Cable Qualifier (called CableSHARK hereafter) is designed to measure frequency response and perform time domain reflectometry on twisted pair telecommunication cable in the local subscriber loop. These measurements determine the capability of the cable to carry digitized xDSL technology. In addition, the CableSHARK utilizes Noise Measurements, a DSL Data Rate Prediction Tests (ADSL, SHDSL, ADSL2, and ADSL2+), Longitudinal Balance testing and Power Spectral Density tests to further assist in the installation, maintenance, and troubleshooting of copper cable.

The CableSHARK features a lightweight plastic molded case, large 640 x 480 pixel backlit graphic LCD display, internal rechargeable battery and a USB slot for easy storage of results to external USB memory.

The CableSHARK is extremely easy to use, however it is recommended that you read this operating manual in order to fully understand all the features of the unit. Once familiar with the CableSHARK, this manual can be used as a reference guide. Notice that each function of the tester is listed in the Table of Contents.

Section 5.2 explains connecting the CableSHARK to the local loop while Section 7 features a 'Quick Start' guide to performing all the available tests with the CableSHARK *P3* VF/DSL Cable Qualifier.

1.1 *How to Use This Operating Manual*

Upon initial receipt of your CableSHARK, it is recommended that you read Section 1 of this operating manual as it explains unpacking of the instrument. Failure to do this may cause improper operation of the instrument and perhaps damage to the unit.

If you are unfamiliar with, and require background information on xDSL technology, then it is recommended that you read through Section 2, which offers a brief overview of xDSL technologies and Section 3 looks at Time Domain Reflectometry (TDR).

1.2 *Unpacking the CableSHARK*

EXFO has shipped the CableSHARK with a soft-pack carrying case (optional accessory), internal rechargeable battery, AC mains power adapter, testing cable(s) (optional accessory), and this operating manual.

The CableSHARK has been shipped in a recyclable cardboard shipping container, which may be saved for reuse in the event that you need to transport the CableSHARK by commercial courier in the future. It is recommended that for day-to-day use, the CableSHARK need not be repackaged into its shipping carton,

but use of the optional CableSHARK softpack case offers enough protection against damage. A Samsonite carrying case is also available as an optional accessory. It is a lightweight briefcase style unit.

Be certain when unpacking the instrument that you identify all of the pieces that have been shipped with the unit. Also, inspect the instrument for damage during shipment. Any damage should be reported immediately to the carrier and your EXFO representative as soon as possible in order to institute an insurance claim.

After unpacking, the user can refer to Section 4.0 "Physical Features and Power Supply". It is strongly suggested that Section 4.0 be read before operating the unit.

1.3 Caring for the CableSHARK

The CableSHARK has been designed to be a rugged and portable piece of test equipment. However, the unit should be kept away from extremes of heat, cold, moisture and dust. Failure to do this may shorten the life of the instrument.

The CableSHARK's display should be cleaned using a soft, lint-free cloth and an anti-static cleaning solution. Ordinary detergents and other cleaning solutions may cloud or scratch the surface and should be avoided.

If the CableSHARK needs to be stored for a long period of time, the internal battery pack should be periodically charged. Failure to do this may lead to damage of either the battery or the CableSHARK itself. The CableSHARK should be stored in a cool, dry place.

If the CableSHARK is to be transported in the optional soft pack carrying case, please do not place the shoulder strap of the soft pack in the same compartment as the CableSHARK unit itself. The clips on the shoulder strap may scratch the CableSHARK's display. If the shoulder strap is not used, place the strap in the front pouch of the soft pack carrying case. This also applies to the CableSHARK's test cables.

Section 2   Digital Subscriber Line (DSL) Overview

The need for faster and cheaper Internet access, video-on-demand, simplex video, remote LAN access and interactive multimedia by residential and business customers alike has been a driving force in the creation of Digital Subscriber Line (DSL) technologies.

xDSL (the "x" in xDSL stands for the various kinds of digital subscriber line technologies) is a digital public end-to-end network technology that delivers high bandwidth over conventional copper local loop wiring (currently used for plain old telephone service (POTS)) at limited distances. By utilizing higher frequencies than that of a POTS network, xDSL can encode more information to achieve higher data rates than would otherwise be possible. This is a more economical venture than the use of fiber optic technology to get the speed necessary for large bandwidth applications.

There are several different kinds of DSL technologies such as ADSL and HDSL. These technologies all are provisioned via modem pairs, with one modem located at the Central Office (CO) and the other at the customer premise. ISDN (Integrated Services Digital Network) is very similar to that of xDSL in that it is a digital technology and uses the existing telephone company copper cabling infrastructure. However, ISDN differs from pure xDSL technologies in that it is a public switched service, whereas xDSL is a point-to-point digital access service. Some of the more popular xDSL technologies are described here.

Integrated Services Digital Network - ISDN can be considered one of the first xDSL technologies developed to simultaneously carry digital voice, data, and images over conventional copper cables. Basic Rate ISDN is comprised of three logical channels operating over a single copper pair. Two bearer channels (B Channels) carry voice, data, and images while the one D channel is used for signaling; commonly referred to as 2B+D. Basic Rate ISDN offers speeds of up to 160 kbps symmetrically. ISDN is also available with a Primary Rate Interface (PRI). The PRI interface offers data / voice / image transfers of up to 1.544 Mbps (T1) over 23 B channels and one D channel or up to 2.048 Mbps (E1) over 30 B channels and one D channel. Each channel in PRI operates at 64 kbps and is commonly referred to as 23B+D or 30B+D.
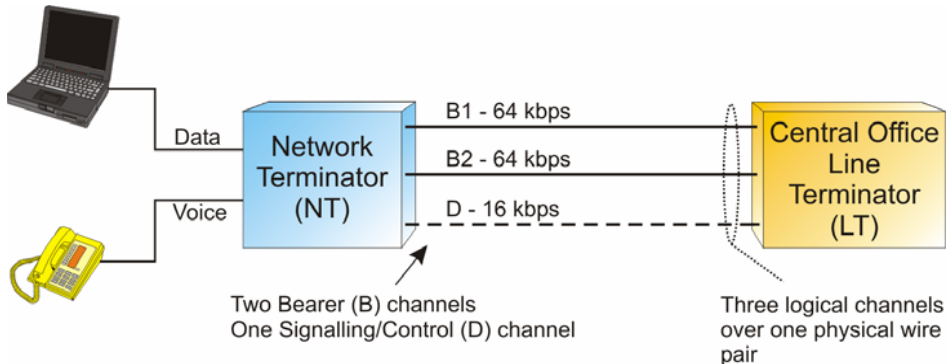
Figure 2A – Basic Rate ISDN Architecture

ISDN uses a 2B1Q line coding (2 Binary, 1 Quaternary) to represent information. 2B1Q maps two bits of data into one quaternary symbol. (for example, onto four voltage levels at a regular clocking rate).

High bit-rate Digital Subscriber Line - HDSL is a symmetric DSL similar to T1 or E1 in that it delivers a bit rate of 1.544 or 2.048 Mbps of bandwidth. Most systems use two copper twisted pairs, although some early 2.048 Mbps systems required three copper twisted pairs. HDSL is comprised of an HTU-C (HDSL Transceiver Unit – CO) in the Central Office and a HTU-R (HDSL Transceiver Unit – Remote). Because HDSL's speeds match those of T1 or E1 pipes, local telcos have been using the technology to provision local access to T1 / E1 services whenever possible. It should also be noted that traditional T1 transmission uses 2 copper pairs as well, so the transition from traditional T1 to HDSL T1 is fairly easy. HDSL's operating range is more limited than that of ADSL since that after 15,000 feet signal repeaters are needed to extend the service. Because HDSL requires two twisted pairs it is deployed primarily for businesses that require PBX network connections, Virtual Private Networks (VPNs), Frame Relay Circuits, Internet Access, and private data networks. HDSL is also preferred over traditional T1 because it is more spectrally compatible with other technologies in the loop than AMI or B8ZS coded T1 or E1.
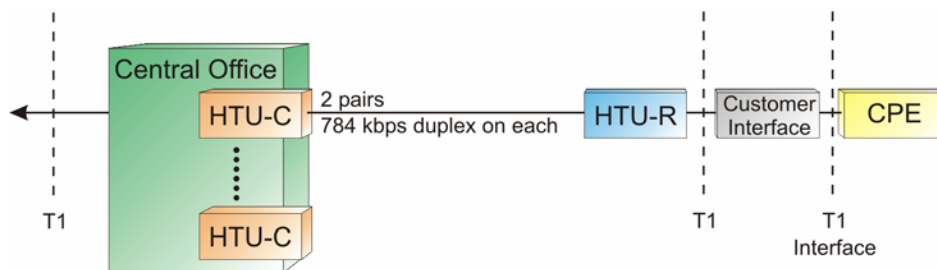
Figure 2B – HDSL Architecture

HDSL uses 2B1Q or CAP based line coding.

HDSL2 / SDSL– Similar to HDSL in operation but is capable of achieving HDSL rates over a single pair of wires. This tends to limit transmission distances but it is still a successful technology. Most HDSL-2 systems are based on non-standard, proprietary protocols. Little or no interoperability exists between vendors.

Asymmetric Digital Subscriber Line - ADSL provides delivery of high bit rate digital technology for consumer based Internet access. ADSL delivers more bandwidth downstream (from the CO to the Customer Premise) than upstream (Customer Premise to the CO). As most users view far more information than they create ADSL is optimal. Downstream rates range from 256 kbits/s to 9 Mbps, while upstream bandwidth ranges from 16 kbps to 640 kbps. ADSL transmissions may work at distances of more than 18,000 feet over a single copper twisted pair, although it should be noted that only the lowest bit rates are available at these lengths.
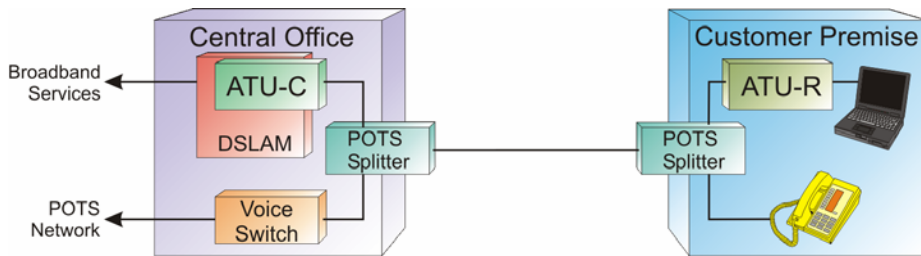
Figure 2C – ADSL Architecture

For service providers and customers alike, ADSL allows users to use their existing phone line to have both high-speed Internet access as well as regular (including vital life-line) Plain Old Telephone Service (POTS). ADSL signals are able to co-exist on the same loop with POTS service because they occupy a higher frequency band than does POTS. ADSL typically will use the band of about 25 kHz to 1.104 MHz while POTS uses 300 Hz to 3400 Hz. As a necessary precaution, a low pass filter is placed on the line to separate ADSL signals from POTS signals. These so called POTS splitters or micro-filters must be in place for correct operation. These small devices allow voice band frequencies to pass through to analog telephones while keeping the high frequency signals of ADSL away from the phones. Likewise the input filters in ADSL modems eliminate telephone signals from entering. In a similar fashion to ADSL and POTS on the same line, ADSL can also co-exist with ISDN. However, since ISDN operates in the bandwidth up to 150 kHz, there are fewer ADSL sub-channels that can be used resulting in a lower achievable data rate.

Two types of line coding exist for ADSL. An early scheme used a non-standards compliant CAP (Carrier-less Amplitude / Phase Modulation) method. These days most ADSL DSLAMs and modems use the DMT (Discrete Multi-Tone) technique. This book focuses on the DMT line coding as it is the DMT line code that is recommended by ADSL standards bodies. These include ITU-T (G.992.1, G.992.2), ETSI, and ANSI / Committee T1 (North America) (T1.413 Issue 2).

The DMT transmission scheme divides the frequency band from 0 Hz to 1.104 MHz into equally spaced sub-channels or bins; this works out to 256 bins. Each bin occupies 4.3125 kHz of bandwidth. Since ADSL is asymmetrical, the 1.104 MHz band is split once again into Upstream and Downstream bands. The Upstream band carries information from the Customer Premise to the Network. The Downstream band carries information from the Network to the Customer Premise.
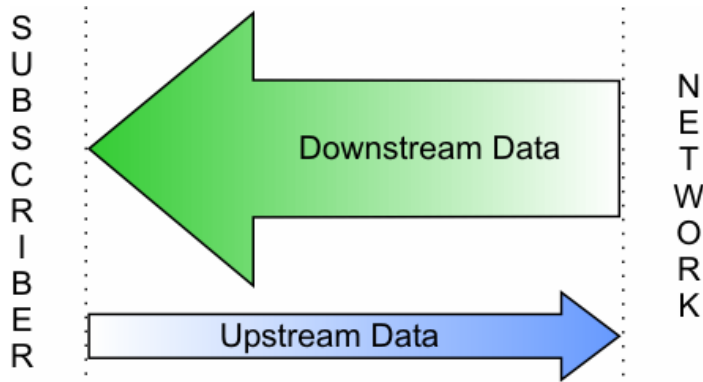
Figure 2D – Asymmetric Nature of ADSL

There are actually 32 bins allocated for Upstream and up to 250 bins allocated for Downstream; 250 can only be used with echo cancellation. For the most part, however, DMT implementations will use 218 bins for Downstream. Guard bands that separate the POTS signals from the ADSL signals use some of the possible carrier allocations. There is also a guard band between the upstream and downstream carriers.
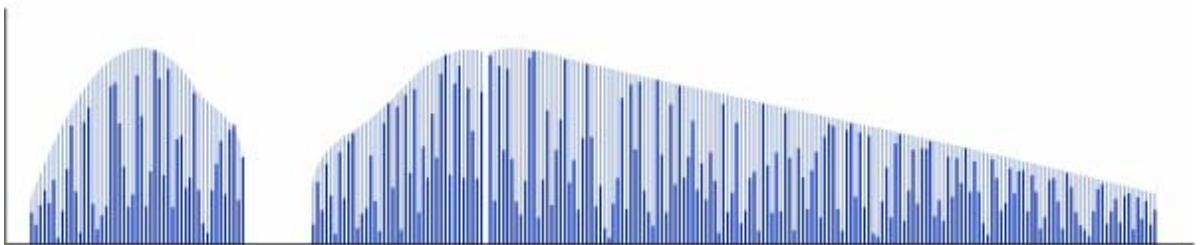
Figure 2E – ADSL DMT
ADSL uses 256 amplitude modulated carriers. The dark bars represent a "snapshot" of the modulation at any one point in time. The light bars represent the maximum modulation state amplitude available for each carrier frequency. Notice how at higher frequencies there are fewer available positions due to the diminishing signal to noise ratio.

DMT standards suggest that equipment can use up to 15 bits/bin to encode data per sub-channel. However, using the maximum 15 bits/bin may result in the ADSL modems having to transmit at a higher power than would be practical or allowed in a cable bundle. For the most part, ADSL makers have limited their designs to use 13 or 14 bits/bin. This lowers the power transmitted between modems and maximizes the reach of transmission without compromising potential data rates.

Rate adaptive Digital Subscriber Line - R-ADSL. This was an early name for a specific type of ADSL. These days most ADSL modems are rate adaptive. They adjust the transmission speed dynamically to the length and quality of the local loop. Most DSLAM network management systems allow the transmission speed to be set or limited to a maximum bit rate.

G.Lite – A 'lighter' version of ADSL where downstream rates are limited to approx. 1.5 Mbps. G.Lite uses 128 bins rather than 256 (still using 4.3125 kHz sub-channel bandwidth) and only up to 8 bits/bin can be encoded per sub-channel.

ADSL2 – ADSL2 offers data rates of up to 12 – 15 Mbps.

ADSL2+ – ADSL2+ offers data rates of up to 24 Mbps by increasing the frequency range to 2.2 MHz.

Symmetrical High-Speed Digital Subscriber Line – SHDSL is a technology that is similar to HDSL and HDSL2. SHDSL operates over a single pair or 2 pairs of wire depending upon the application. For single pair operation, SHDSL offers data rates from 192 kbps to 2.3 Mbps while two pair operation offers data rates ranging from 384 kbps to 4.72 Mbps.
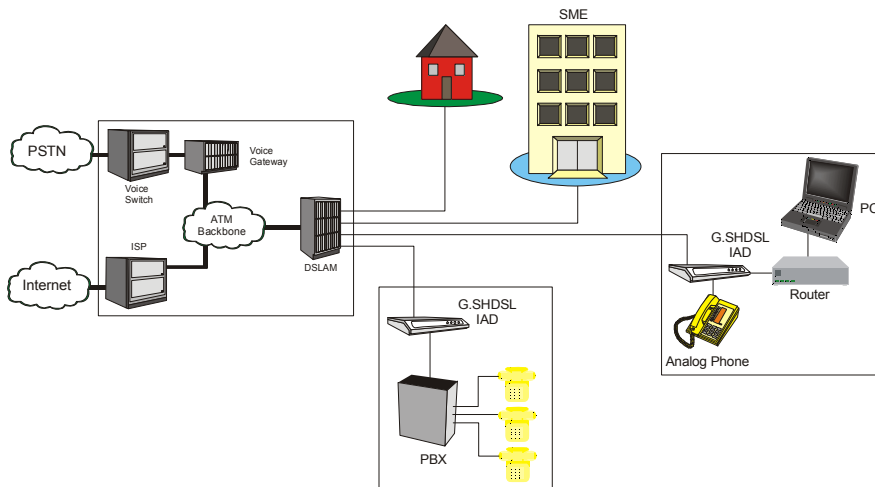
Figure 2F – SHDSL Architecture

SHDSL is designed to be more of a business solution than a residential service due to its symmetry. It can be used as a T1 / E1 replacement technology and is also well suited for VoDSL solutions.

SHDSL has been developed to be spectrally compatible with other technologies within bundles of local loops. SHDSL owes this to the Trellis Coded Pulse Amplitude Modulation (TC-PAM) line coding. This coding technique maximizes the use of the lower frequencies of available loop bandwidth thus avoiding higher frequencies where signals are more susceptible to crosstalk.

The key benefit of xDSL is that by transmitting on an existing telephone line, there is no cable installation costs to be incurred whereas if fibre optic cable were installed to achieve the higher bit rates, the cable installation cost would be great.

Section 3   Time Domain Reflectometry Overview

Time Domain Reflectometry (TDR) is a cable testing technique that is used to detect faults along power transmission lines. Using this technique, voltage pulses are sent out over the line and voltage reflections caused by cable abnormalities are monitored. Reflection times are measured from the reflection location on the cable to the TDR device, which is attached to one end of the cable.

TDR technology can be compared to sonar. In sonar, a ship sends out an energy pulse through the water. If an object, such a submarine, fish, ship, or underwater mountain is in close proximity, part or all of the pulse is reflected back. The distance to the object can be calculated from a measurement of the time that it takes for sound to travel through water.

In TDR, a pulse of energy is transmitted down a length of cable. When the energy pulse encounters the end of the cable or a possible problem area (like a bridge tap or an open circuit), part or all of the energy is reflected back to the TDR device. The TDR device measures the time it takes for the energy pulse to travel down the cable and to be reflected. A calculation is made using the total pulse travel time and the Velocity of Propagation (VOP) of the cable to determine the distance from the TDR equipment to the cable problem. The VOP varies and depends on the cable size, material, etc.
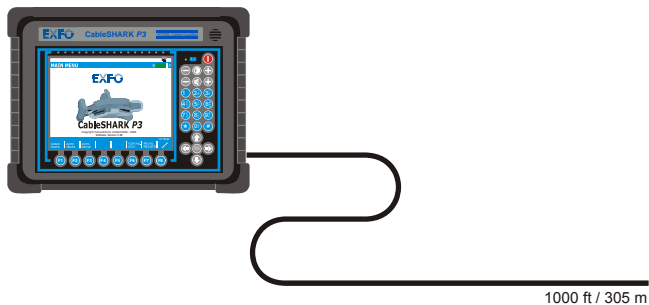
1000 ft / 305 m

Figure 3A - CableSHARK using TDR on a 1000 ft (305 m) cable

1000 ft / 305 m
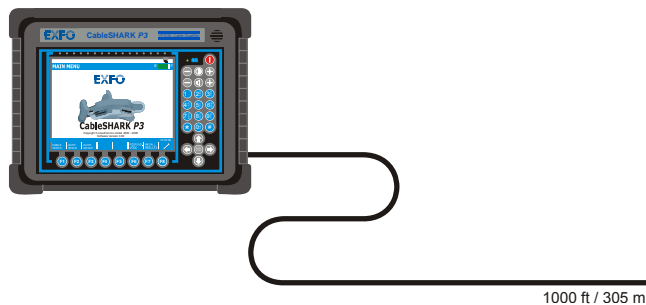
Figure 3B - A Pulse Reflection indicates a load coil at 500 ft (152 m)

TDR's can use various methods of testing to determine the location of problems along the length of the cable under test. Impedance is a major player. The TDR equipment looks for a change in impedance which could be caused by improper installation, cable damage (caused by water, etc.), end of cable, and a bridged tap. The magnitude of the impedance changes determines the amplitude of the reflection.

There is a direct relationship between voltage pulse width sent down the cable and the distance that it travels along the cable. The smaller the pulse, the less the energy it contains, and therefore, the distance that it travels along the cable is less. Voltage pulses of greater width travel further distances. When using this technique, it is best to start testing with voltage pulse of small width and to work up to pulses of larger width. Voltage pulse width is typically measured in nanoseconds.

Several factors affect the operation of TDR devices and the results they display. As mentioned earlier in this section, VOP, or Velocity of Propagation is a very important value to know in determining the distance to an impairment. VOP represents the speed at which energy travels through a medium. In the case of xDSL, the medium is a copper twisted pair. VOP is measured as a percentage of the speed of light in a vacuum. Users of TDR's may see the VOP expressed as 0.66 or 66%; both are acceptable.

VOP is an extremely important parameter. It must be correct, as any deviations may give the user false readings. Most cable manufactures will indicate the VOP for their particular cable. The VOP depends upon cable diameter, material out of which the cable is made, and on impurities in this material.
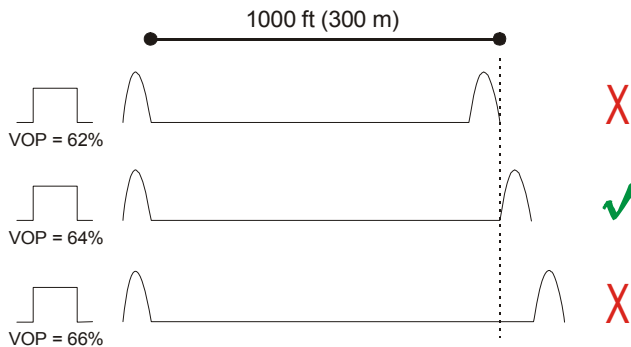
Figure 3C – Selecting the correct VOP means knowing the correct distance

When using the TDR technique, the cable under test should not be terminated. Cables that are terminated absorb most or all of the energy pulse sent down the cable which, in turn, means that no energy is reflected back to the TDR device. When using the CableSHARK's TDR function, ensure that the far end of the cable is configured as an OPEN or SHORT circuit.

Not all cables are the same, hence the variations in VOP. Conversely, not all local loops are the same. Some local loops are longer than others and susceptibility to noisy environments varies. All signals on these loops, regardless of cable length or environment, are subject to attenuation. Attenuation affects both transmitted and reflected signals and, if the signal-to-noise ratio is low enough, impairments may not be identifiable. To overcome the affects of attenuation, use a larger pulse width (more energy) to locate impairments or take measure from both ends of the cable.

The following diagrams depict possible TDR traces and their causes.
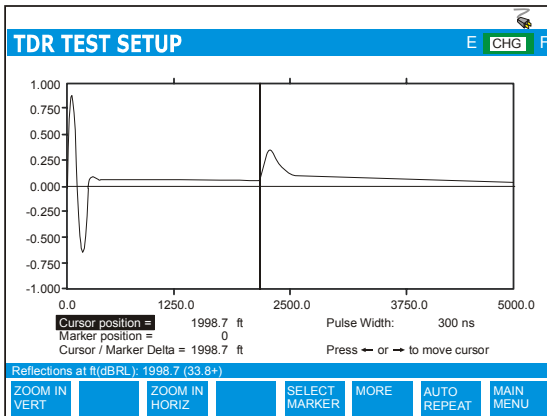
The above figure depicts an OPEN circuit or a high impedance fault. Depending upon the size of the reflected pulse, the OPEN could be an partial (small pulse) or complete (large pulse) open circuit. Of course, the length of the cable, attenuation on the line, and the size of the outgoing pulse will play a big role in determining the reflection.
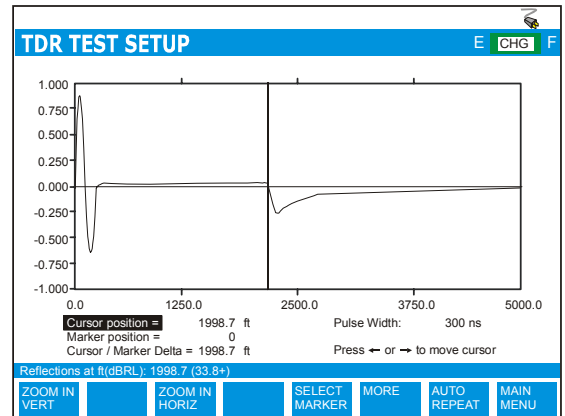
The above figure depicts a SHORT circuit or a low impedance fault. Depending upon the size of the reflected pulse, the SHORT could be an partial (small pulse) or complete (large pulse) short circuit. Of course, the length of the cable, attenuation on the line, and the size of the outgoing pulse will play a big role in determining the reflection.
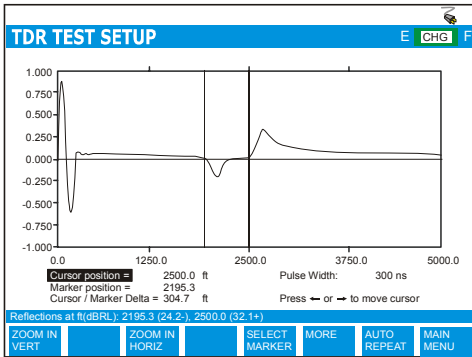
The above figure depicts a bridge tap. The bridge tap is composed of a negative pulse (start of the bridged tap) and a positive pulse (end of the bridged tap).

The above figure depicts a water soaked cable with a OPEN circuit. The water section could have appear anywhere along the cable. Generally, a 'noisy' reflection could mean water.
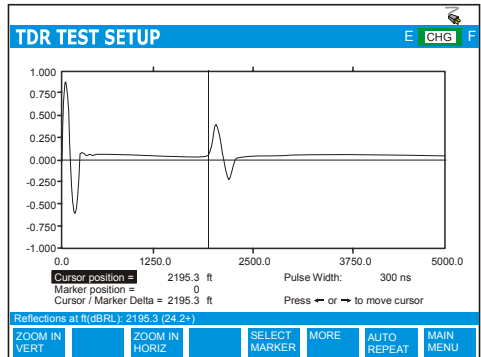
This figure shows a HIGH RESISTANCE JOINT or SPLICE. This is composed of a high impedance reflection followed by a low impedance reflection. Generally, the better the splice, the smaller the reflection. A large reflection, as denoted above, would signify a poor splice.
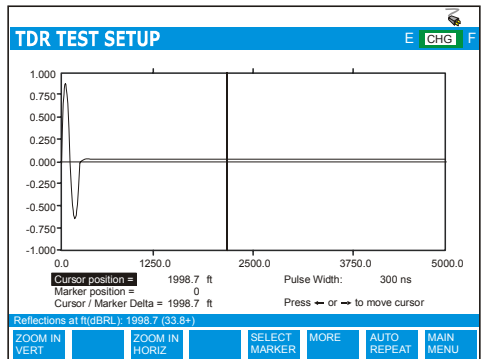
This figure depicts a terminated cable. The terminated cable absorbs the send pulse and causes no reflection. For the purposes of TDR testing, it is best to use an un-terminated cable to ensure a reflection is send to the CableSHARK.

TDR TEST SETUP   E CHG F

Cursor position =	2995.2 ft
Marker position =	0
Cursor / Marker Delta = 2995.2 ft	

Pulse Width: 300 ns

Press ← or → to move cursor

Reflections at ft(dBRL): 1998.7 (33.8+)

ZOOM IN VERT		ZOOM IN HORIZ		SELECT MARKER	MORE	AUTO REPEAT	MAIN MENU

TDR TEST SETUP   E CHG F

Cursor position =	3999.4 ft
Marker position =	0
Cursor / Marker Delta = 3999.4 ft	

Pulse Width: 300 ns

Press ← or → to move cursor

Reflections at ft(dBRL): 3999.4 (24.2+)

ZOOM IN VERT		ZOOM IN HORIZ		SELECT MARKER	MORE	AUTO REPEAT	MAIN MENU

This figure shows a typical response from a LOAD COIL. It resembles a complete OPEN. Although LOAD COILS are placed at specific intervals, a TDR will typically not 'see' past the first LOAD COIL.
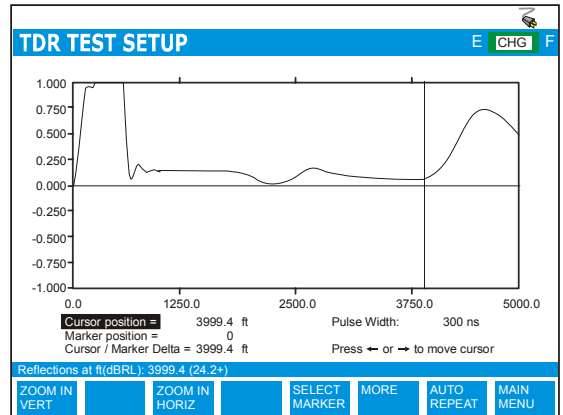
This figure shows a test run through a POTS Splitter, ending in a complete OPEN circuit.

Section 4   Physical Features and Power Supply

4.1 Physical Features of the CableSHARK

4.1.1 The Front Panel

The illustration below shows the front panel features of the CableSHARK. These features are described following the illustration.

Figure 4.1.1A - CableSHARK Front Panel

1.   AC Mains Plug Symbol
This symbol indicates if the CableSHARK is receiving power from an AC mains supply. There will be no symbol if power is disconnected from the unit.

2.   Battery Status Indicator
Indicates status of battery. Battery Gas Gauge will move between E and F. E represents EMPTY (battery needs recharging) and F represents FULL (battery is fully recharged). A percentage will appear indicating the amount of battery capacity left.

3.   Power On LED
This LED indicates the ON/Off status of the CableSHARK. It also shows the status of the internal battery and the condition of the charging circuit.

4.   Power On/Off Button
This push button switch turns the instrument on or off.

5.   Contrast Controls
Adjusts the contrast of the LCD display. The contrast required will depend on the lighting conditions of the environment. Battery life will be enhanced if the LCD Backlighting is turned off when not

needed (i.e. when there is sufficient ambient light). Press the   symbol to toggle the backlight on and off.

6.   Volume Controls
Not used.

7.   Integral Keypad
Used for entering alphanumeric values, names, and other information.

8.   LCD Display
640 x 480 pixel backlit LCD display. The CableSHARK can be ordered with either a monochrome display or a colour display.

9.   Cursor Pad
The arrow keys move the cursor through the displayed menu options. A Run/Stop button is located in the center of the cursor pad, which is used to start and stop tests.

10.   Function Buttons
Used in conjunction with the screen menu, the eight buttons provide the majority of the functions that control the CableSHARK.

4.1.2 The Rear Panel

The illustration below shows the back panel features of the latest CableSHARK. Each item is described following the illustration.
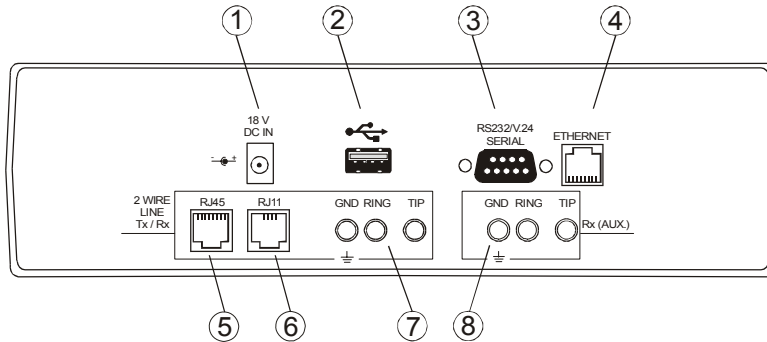
Figure 4.1.2A – The CableSHARK's Rear Panel

1.   Power Connector for AC Adapter
Provides connection of the CableSHARK to the power mains via the AC adapter provided with the unit. The internal battery is automatically charged once the instrument is plugged in, even when the instrument is switched off.

2.   Universal Serial Bus (USB) Series A Receptacle
This USB connection provides the user with the ability to save results to a USB Memory. Users can save   results to the optional 256 MB USB Memory available from EXFO. Users can also upgrade the CableSHARK via the USB port using the USB Memory.

The CableSHARK works with the following other USB Memory devices:

- Universal Smart Drive USB1.1 (64 Meg)
- Universal Smart Drive USB1.1 (32 Meg)
- Sandisk cruzer mini USB2.0 (32 Meg)
- USB 007 USB1.1 (32 Meg)

- Shikatronics Flash Drive USB2.0 (32 Meg)
- Kingston USB1.1 (32 Meg)
- Intelligent Stick USB1.1 (32 Meg)

3.   **Serial Communication Port (Male)**

The 9-pin connector provides serial communication with a computer. The CableSHARK can download its results to a terminal program or be remote controlled via the optional Microsoft Windows® based Visi-SHARK program. This   port is also used to upgrade the software version resident within the CableSHARK.

4.   **Ethernet 10BaseT Port**

The Ethernet connector provides high-speed communication with a computer. The CableSHARK can   download its results to a terminal program or be remote controlled via the optional Microsoft Windows® based Visi-SHARK program. This port is also used to upgrade the software version resident within the   CableSHARK.. Users will   have to define their IP address, Gateway address and subnet mask under   System Setup.

5.   **RJ-45 connector**

RJ-45 connector for connection to the line. Supports 2 wire TX and RX functionality.

6.   **RJ-11 connector**

RJ-11 connector for connection to the line. Supports 2 wire TX and RX functionality.

7.   **2 Wire TX & RX 3 Pin Connector**

3 Pin connector for connection to the line and acting as a transmitter and receiver. This connector can be   used in conjunction with the Rx (AUX.) connector and acts as the transmitter for 4 Wire implementations.

8.   **Rx (AUX.) 3 Pin Connector**

3 Pin connector for connection to the line and acting as a receiver (RX) only. This allows access to the 4 wire features of the CableSHARK . Features Tip, Ring, and Ground connections. The Rx (AUX) connector is also used for the "Good Pair" connection in RFL (Yellow and Green telco clip cable).

4.1.3 The Serial Interface Connection

The serial interface is used to connect the CableSHARK to a PC terminal. The connector for this is a male 9 pin D-type on the rear panel. When connecting to your equipment, a 9 pin "D" to 25 pin "D" type cable or conversion adapter may be required. The serial interface is compatible with the EIA RS-232 and ITU V.24 specifications. The pin assignments for this are as follows:

PIN	MNEMONIC	DIRECTION	DESCRIPTION
1	N.C.	-----	Not Connected
2	RD	TO CableSHARK	RECEIVED DATA
3	TD	FROM CableSHARK	TRANSMITTED DATA
4	DTR	FROM CableSHARK	DATA TERMINAL READY
5	SG	COMMON	SIGNAL GROUND
6	DSR	TO CableSHARK	DATA SET READY
7	RTS	FROM CableSHARK	REQUEST TO SEND
8	CTS	TO CableSHARK	CLEAR TO SEND
9	N.C.	-----	Not Connected
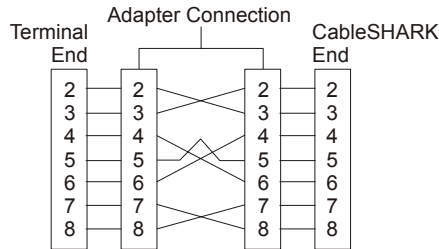
Figure 4.1.3A - Serial Interface Connection

The connector is configured as a **DTE** (Data Terminal Equipment). It is recommended that the cable length be 50 feet or less to reduce the possibility of errors from signal distortion. Also, the connectors should be secured with the proper screws to enable reliable operation. All necessary serial cables should be double shielded where appropriate.

If the unit is connected to a terminal or computer, a **Null Modem** cable is required. This null modem cable is available from EXFO and should be ordered with the CableSHARK. Null modem cables are available in various configurations. The configuration on Figure 4.1.3A above gives the pin arrangement of a typical null modem cable.

4.1.4 The Ethernet 10BaseT Connection

The Ethernet 10BaseT port is used to connect the CableSHARK to a PC terminal via a LAN or the Internet. The connector for this is a female RJ-45 connector on the rear panel of the CableSHARK. When connecting to your equipment, a crossover cable or straight cable can be used (defined below) depending upon the network infrastructure. The Ethernet interface is compatible with the TIA/EIA T568A and TIA/EIA T568B specifications. The pin assignments for this are as follows:
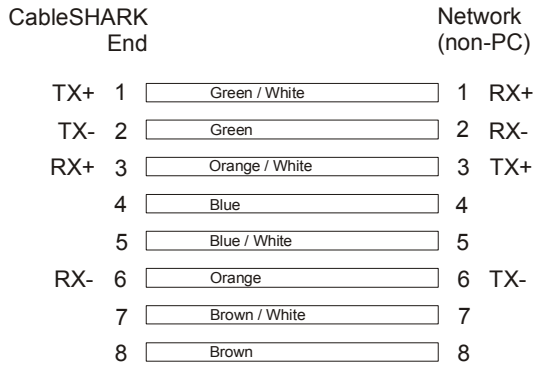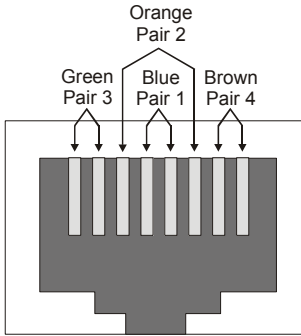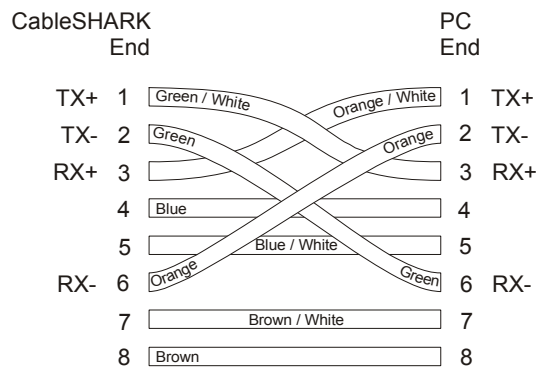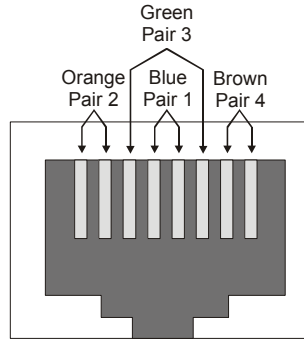
4.2 Powering the CableSHARK

4.2.1 The CableSHARK's External Mains Adapter

The CableSHARK gets power from an external mains adapter which can operate at voltages from 100 V.A.C to 240 V.A.C and frequencies from 50 to 60 Hz. The AC mains adapter is automatic and requires no selection for different line voltages and frequencies. The CableSHARK also has an internal NiMH rechargeable battery.

> *Although this rechargeable NiMH battery was fully charged before it left the factory, it is recommended that you fully charge the CableSHARK before using it for the first time in case there has been a long time delay between the time the unit left our factory and the time you first use the CableSHARK.*

To power the CableSHARK with the adapter, first locate the power connector at the rear of the instrument. Plug the adapter to the AC mains and the CableSHARK. Only the supplied Power Adapter should be used (EXFO Part Reference CSK-ACx3). Spare or replacement Power Adapters can be ordered from your local EXFO distributor.

The CableSHARK is switched on by pressing the Power button (located on the top right of the unit) for *2 seconds*. The CableSHARK will cycle through its Self-test sequence and will indicate any fault conditions. The CableSHARK is switched off by pressing the Power button for *2 seconds*. It is recommended that the CableSHARK be switched off when not in use to preserve battery charge.

When the CableSHARK is connected to AC mains power, its internal battery will be automatically charged and charging will occur whether the CableSHARK is switched On or Off. A full charge cycle takes between 2 and 4 hours, during which time the unit may be used. The CableSHARK will operate from the internal battery for up to 3.5 hours of typical use on a full charge with the standard Monochrome display. Note that the battery will slowly discharge over time even when the instrument is OFF. To charge the CableSHARK simply connect it to AC power using the AC adapter supplied.

4.2.2 The CableSHARK's Internal Battery

The CableSHARK uses a Nickel Metal Hydride (NiMH) rechargeable battery. These cells are particularly well suited for deep cycle and deep discharge applications.

> CAUTION: *ONLY USE BATTERIES SUPPLIED BY EXFO (*EXFO Part Reference *CSK-BATT2).* **Return Old Batteries to EXFO for recycling.** Nickel Metal Hydride Cells are maintenance-free and are non-spillable, and therefore can be operated in any position. They should be kept clean and dry during use and operation.

CAUTION: *Danger of explosion if battery is incorrectly replaced. Replace only with same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacture's instructions.*

Charging: It is recommended that charging of the battery be performed between 0 to +40^{0}C.
Storage and Self-discharge: It is recommended that storage of the battery is done between –10 to +50^{0}C.

Long-term storage has no permanent effect on battery capacity. Losses in capacity due to self-discharge are reversible. After Long-term storage (e.g. more than one year at room temperature) up to three full cycles may be necessary to obtain full capacity.

Repeated charging, operating and storage in extreme temperatures may effect battery life.

NOTE: Should the battery be subjected to a deep discharge, the unit may have to be plugged in to AC mains for about 2 minutes before the unit can be turned on.

4.2.2.1 Replacing the CableSHARK'S Internal Battery

The Battery is user-replaceable without the need for re-calibration. Extra batteries are available from your EXFO representative (CSK-BATT2). Accompanying the battery will be instructions for replacing and charging. The CableSHARK has been designed such that the user can change the battery easily with very few tools. Extra batteries are available from your EXFO representative. To change the battery, locate the battery compartment door on the underside of the unit.

Please note that any stored data in non-volatile RAM will not be lost by changing the rechargeable battery.

After removing the two slotted screws from the battery cover, the cover must be carefully pried; with the slotted screwdriver ; to loosen and release the sealing tape between the cover and the battery. Note: The battery is friction fitted into the battery compartment. Once the battery cover has been removed, the battery can be removed from the battery compartment by placing ones hand over the battery, turning the unit so the display is facing upwards and then gently tap the CableSHARK against the same hand. Once the battery is freed from its compartment, the black connector with the flying clip must be removed from the small slot in the battery compartment. The black clip is then pressed to release the male and female connector.

To reinstall the battery, the mating connectors are latched in place with the retaining clip. Carefully insert the black connector into the side slot of the battery compartment on a 45 degree angle with the mating clip

positioned to the inside of the battery compartment. In some CableSHARK's, this may require some maneuvering to position the connector in place. The excess battery wire should be carefully inserted into the side slot of the battery compartment. Install the battery in the compartment; replace the battery cover and tighten the two slotted screws in place.

Return the old battery to EXFO for recycling. Immediately, (same day) plug the CableSHARK into the mains so that the battery will be charged. The power LED should be green at this time. Charge the unit until fully charged.

4.2.3 The LED Power Status Indicator

The CableSHARK's dual color Power Status LED is designed to indicate the instrument's power status:

State	Explanation
Bright Green	Running on mains power, the battery is fully charged
Dull Green	Running on the battery
Flashing Green	The battery is charging
Red	The battery is exhausted or there is a malfunction in the battery

Note: The LED can also illuminate so it is orange in colour.

Orange	Both the red and green LED's will illuminate (looks orange) to indicate the unit is in Responder mode.

Section 5   General Operating Instructions

The CableSHARK is easy to operate, with a simple to understand top panel consisting of a large 640 x 480 graphic Liquid Crystal Display, eight function buttons, menu control buttons, alphanumeric keypad, contrast controls, easy access connectors at the rear, and a power on/off button.

To begin operation, press the power button for *__2 seconds__* to turn the unit on and the screen will display the "**MAIN MENU**" after a brief self-test sequence. The Self-test sequence will take less than 60 seconds to complete (typically 30 seconds).

Note: All test leads can be purchased from EXFO. These twisted pair cables have been manufactured to ensure maximum protection against radio frequency and electromagnetic radiation. If any of the cables used with the CableSHARK become lost or broken, please contact EXFO or your local representative for replacements. If time does not permit, use only 24 AWG twisted pair cable providing the twist is maintained. These cables must be less than 6 ft (2m) to prevent any noise to be induced upon the test.

5.1 Self Tests and Resetting the CableSHARK

5.1.1 Self Tests

The CableSHARK is equipped with a self-test feature. The function is performed each time the unit is turned on. To repeat a self-test, turn the instrument off, **wait a few seconds** and then turn it back on. There are actually two self tests (calibration tests) that can be performed at start-up. The 'warm' self test is a quick calibration that is performed at start-up. A full calibration is performed once the unit is reset or when the start-up program detects any variations of hardware and/or environmental conditions.

If any of the circuits are defective, the screen will display a list of the faults. If one or more of these messages appear on the screen, ensure the unit is within the operating conditions specified in this manual. Condensation and/or temperature extremes may cause failure conditions. If the failure persists, the unit should be serviced by EXFO or a certified EXFO repair and serving facility to enable reliable operation.

5.1.2 Resetting the CableSHARK

The CableSHARK comes with a reset feature so that the user can reset all settings to their factory defaults. To reset the CableSHARK, enable the Set Factory Defaults option under the System Setup. Once enabled, the CableSHARK will be reset to its default settings and commence normal startup procedures.

Any changes made by the user to the settings of a test will revert back to its factory default settings in most cases.

5.2 Connecting the CableSHARK to the Line

The CableSHARK *P3* VF/DSL Cable Qualifier is used to qualify copper telco cable of the local loop to see if it is suitable to carry Digital Subscriber Line (DSL) technologies. The CableSHARK can be configured to perform Single-Ended (one unit) and End-to-End (two units) tests. The following sections will describe how to connect the CableSHARK *P3* VF/DSL Cable Qualifier to the line for each of these tests.

5.2.1 Test Cable and Connector Requirements

The CableSHARK can be ordered with an optional Siemens (CF) connector to three colour coded Telco clips. The CF connector inserts into the CableSHARK CF jack on the rear panel, while the three telco clips are color coded for Tip, Ring, and Ground and are for use with the service provider's equipment. The following is a diagram showing the cable:
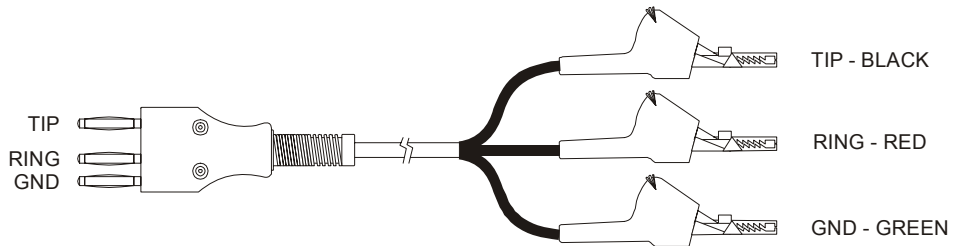
Figure 5.2.1A – Optional "All Purpose" Test Cable
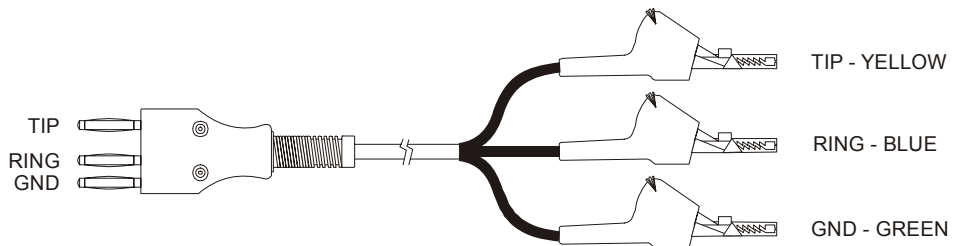
Figure 5.2.1B – Optional RFL Test Cable

5.2.2 Single-Ended Testing

The CableSHARK can perform Single-Ended tests on a copper telco cable to see if the line can carry DSL technologies such as ADSL2+, SHDSL, and VDSL. Frequency Response (Single-Ended selected), Time Domain Reflectometry, Digital MultiMeter, Power Spectral Density and Impulse Noise tests are examples of single-ended tests with the CableSHARK. For single-ended tests, ensure that the cable to be tested is not match-terminated at the far end. The far end should be an open or short circuit for best results. The CableSHARK can operate, using most measurements, if there is an active ADSL CPE modem, subscriber telephone, POTS Splitter/microfilter, active DSLAM, or Class 5 Voice Switch at the far end however these devices may affect the measurements. For optimal results, measure the cable from both ends using the included Single-Ended tests. This will help compensate for any irregularities caused by cable type, cable size and any impairments that can occur or are resident on the line at the time of testing.

> ⚠️ *Note: Single-Ended testing can only give a partial picture of cable quality if testing is done from one end only. For an accurate picture of cable quality, single-ended testing should be done from both ends of a cable. This is a benefit to the user since they will get a total view of cable quality plus the added bonus of increasing their test distances.*

Figure 5.2.2A shows the CableSHARK connected to the line. Notice that at the Central Office end, the cable is not match terminated. Testing from the Central Office to Subscriber can also be completed this way. Appendix A - Ideal Cable Results, will show what an ideal cable frequency response should resemble.

DSLAM   CableSHARK

Figure 5.2.2A - Examples of Circuit where Single Ended Measurements can be used
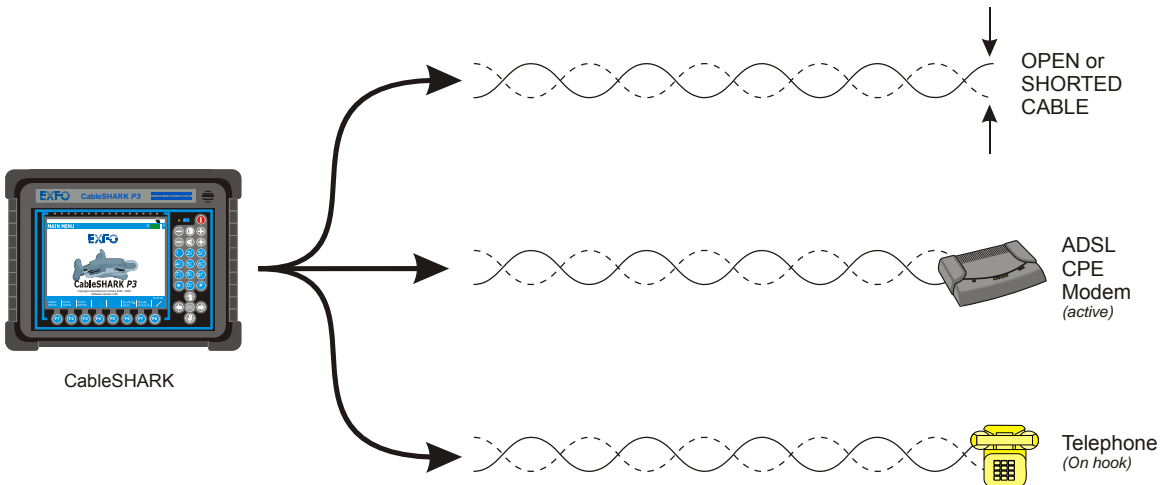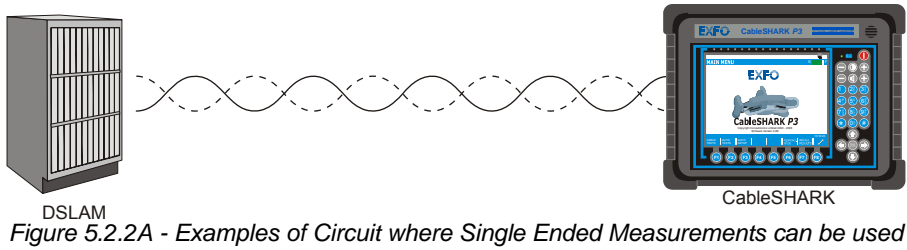
5.2.3 End-to-End Testing

End-to-End testing allows two CableSHARK's to connect to the same line to perform a variety of tests (as shown in Figure 5.2.3A). Tests include End-to-End Frequency Response, DMT tests, and Load Coil Detection. A CableSHARK at the Far End is the Tx unit, which is running in Remote Responder Mode. It responds to all End-to-End test requests from the Rx unit as a controller and sends signals for the requested test down the line to the Rx unit, which in turn converts the signal and analyzes the results. The Rx unit is the one that analyzes and displays the information.

RX unit
(initiating test)

TX unit
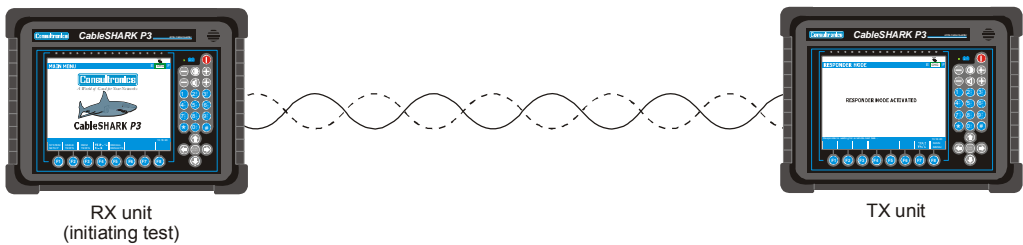
Figure 5.2.3A- Example of a End to End Measurement

5.2.4 High Voltage Detection

The CableSHARK will provide the user with visual feedback on the CableSHARK's LCD if a voltage over 60VAC or 60 VDC is detected. This message will appear only once a test has been executed and is meant to protect the unit from damage and highlight to the user that a high voltage exists on the circuit under test.

Figure 5.2.4A- Example of High Voltage Detection Screen

5.3 Saving and Recalling Results

Test results can be saved to and recalled from the CableSHARK's non-volatile internal memory in addition to an optional USB Memory. A user can save up to 128 results into internal memory and over 1000 results to a 16 Mbyte USB Memory.

5.3.1 Saving Results

Once a test has completed and been successfully displayed on the screen, the user can elect to save the results to internal memory or to an optional USB Memory. This can be done by selecting the appropriate function key; either **SAVE TO MEMORY** or **SAVE TO USB**.

Pressing either the **SAVE TO MEMORY** or **SAVE TO USB** button will display a dialog box allowing the user to enter an alphanumeric file name as seen in the following screen:
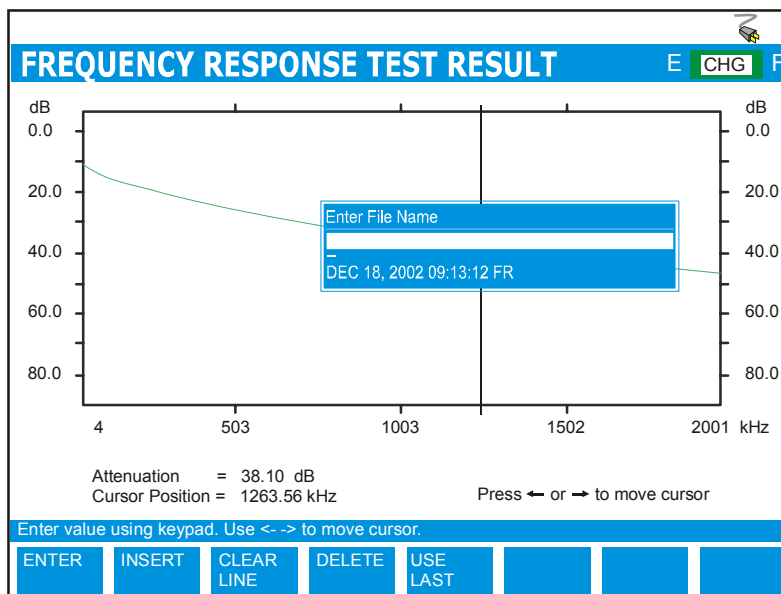
Figure 5.3.1A – Saving a Test Result

Using the alphanumeric keypad, enter a file name for this result. The operation of the SAVE AS dialog box is similar to cell/mobile phone – once a character is pressed, the cursor will automatically move to the right for the next character to be enter. Up to 8 characters (no spaces allowed) can be entered using the alphanumeric keypad to define a file name. Once the file name is completely entered, press the function key associated with **ENTER** or press the **RUN/STOP** key to accept the entry.

The **USE LAST** button recalls the last used file name so if a number of tests are being run at a particular location, users do not need to keep entering long filenames when they would only need to change the test number. The **USE LAST** feature can also be used if the same file name is going to be used without changes to it. The CableSHARK data and time stamps all results but each filename MUST have a different alphanumeric name.

Once the **ENTER** key or the **RUN/STOP** key is pressed to accept a file name, the user is returned to the test result.

5.3.2 *Recalling Results*

From the Main Menu, a user can recall results that have been saved to the CableSHARK's non-volatile internal memory or from optional USB Memory. Press the function key on the Main Menu corresponding to **RECALL RESULTS**. The CableSHARK will display all results currently saved into the units memory as well as those stored on the optional USB Memory if it is installed.
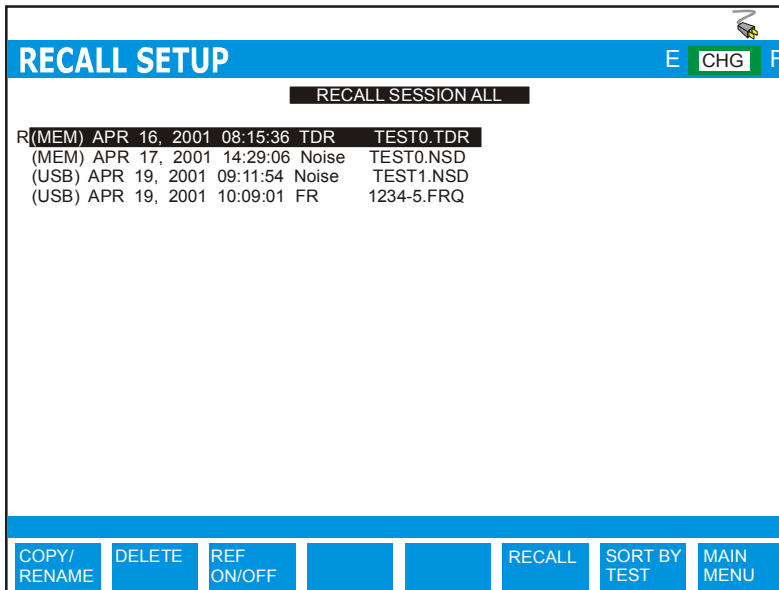
Figure 5.3.2A- Recall Screen

Should a user wish to sort the result list based on a single test type, they simply need to use the arrow keys to cursor up and down the list to highlight a specific type of test (i.e. **FR**, which represents Frequency Response Data or **Noise** for PSD and Impulse noise data). Once highlighted, the user simply has to press the function key representing **SORT BY TEST** and all saved files of that specific test type will be displayed on screen.
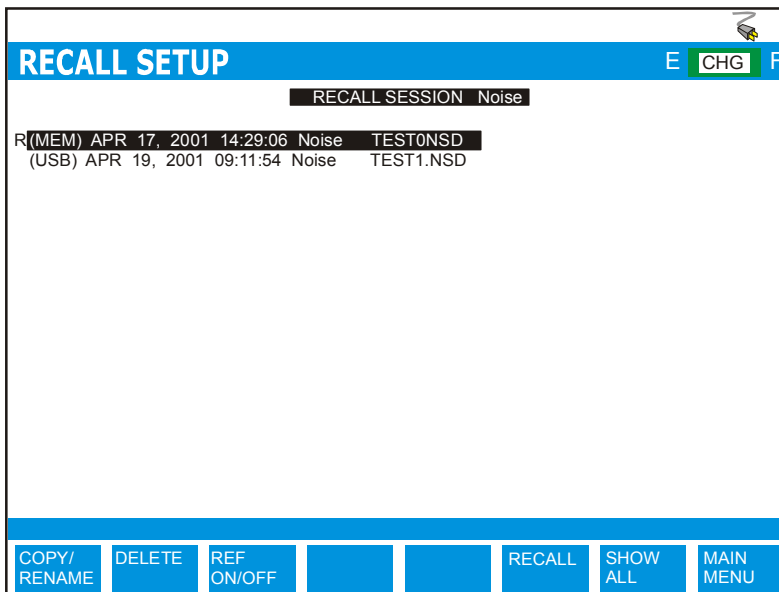
Figure 5.3.2B- Recall Screen: Sort By Test

To view all saved results at this point, press the function key associated with **SHOW ALL**.

Note that the CableSHARK will display 16 results per page. If there are more than 128 results in total (all memory locations), a PREVIOUS PAGE and NEXT PAGE button will appear which will allow a user "scroll" through multiple results.

Once the user has decided on a test to recall, highlight that result and press the **RECALL** function key. The result will be displayed on the CableSHARK.

5.3.3 Renaming and Deleting Results

The CableSHARK will allow a user to rename and delete results stored internally and on a USB memory device.

By pressing the COPY/RENAME button from the RECALL SETUP screen, users can rename a file.

By pressing the DELETE button from the RECALL SETUP screen, users will be prompted to decide whether to delete the currently highlighted file, to delete ALL results in internal memory or to delete ALL results on the USB memory device.

NOTE: The DELETE function is not reversible. Results will be lost forever !

5.3.4 Bulk Transfer of Results

The CableSHARK will allow a user to perform a bulk transfer of results from internal memory to USB memory.

By pressing the COPY/RENAME button from the RECALL SETUP screen, users can transfer all internal results to an attached USB memory device. The time to transfer a result is approximately 500 ms.

NOTE: If a filename exists already on the USB memory device, a warning message will appearing asking the user if they wish to overwrite the file in question.

5.4 Reference Masks

Users can designate a saved graphical result as a reference for all other similar tests to be compared against. This test is useful in determining how a circuit may change from day to day or week to week. This feature is also beneficial in evaluating similar circuits with the same benchmark criteria. Results saved to the CableSHARK's internal non-volatile memory or external USB Memory can be designated as REFERENCE MASKS.
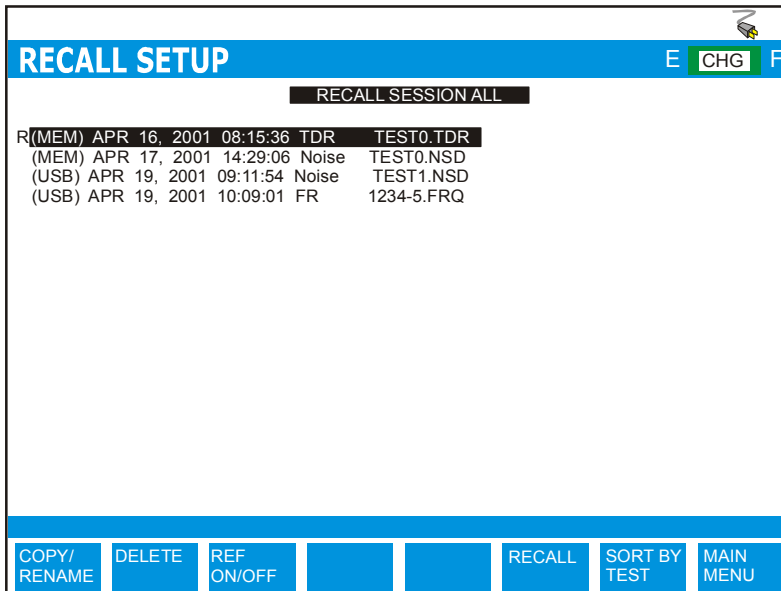
Figure 5.4A – Setting a file as a Reference Mask

Any result can be set up as a REFERENCE MASK. Using the UP/DOWN arrow keys on the CableSHARK's keypad, users can highlight a saved result and by pressing the REF ON/OFF key, can set up or a remove a REFERENCE mask from the highlighted file. The capitol letter "R" beside a file name denotes this result as a REFERENCE MASK. Multiple results can be designated as REFERENCE MASKS.

5.4.1 Comparing a Result to a Reference Mask

After the completion of a test, any result can be view against a REFERENCE MASK. By selecting the function key that represents **SHOW REF**, users will be shown the results in internal memory and on an external USB Memory that have been designated REFERENCE MASKS. Highlighting the needed REFERENCE MASK using the UP/DOWN arrow keys, users can then press the **SHOW REF** key again to load the highlighted REFERENCE MASK and plot it against the result displayed on the CableSHARK's screen. It is up to the user to compare the result with the REFERENCE MASK.
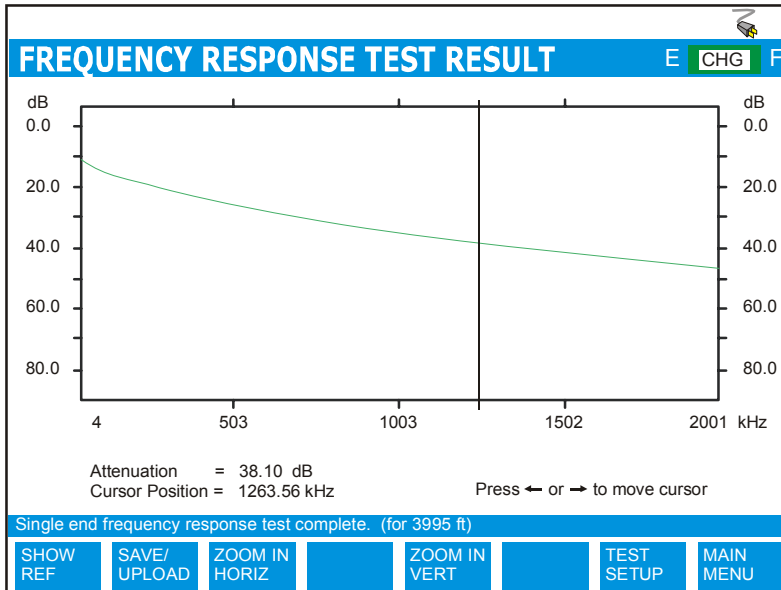
Figure 5.4.1A – Select the Show Ref key
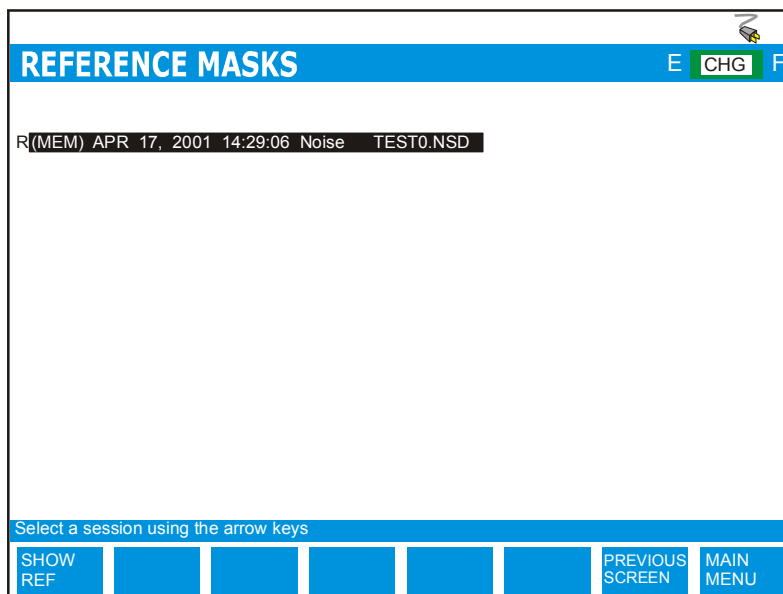
Figure 5.4.1B – Select A Reference Mask

The REFERENCE MASK level shown to the right of the Test Result Level
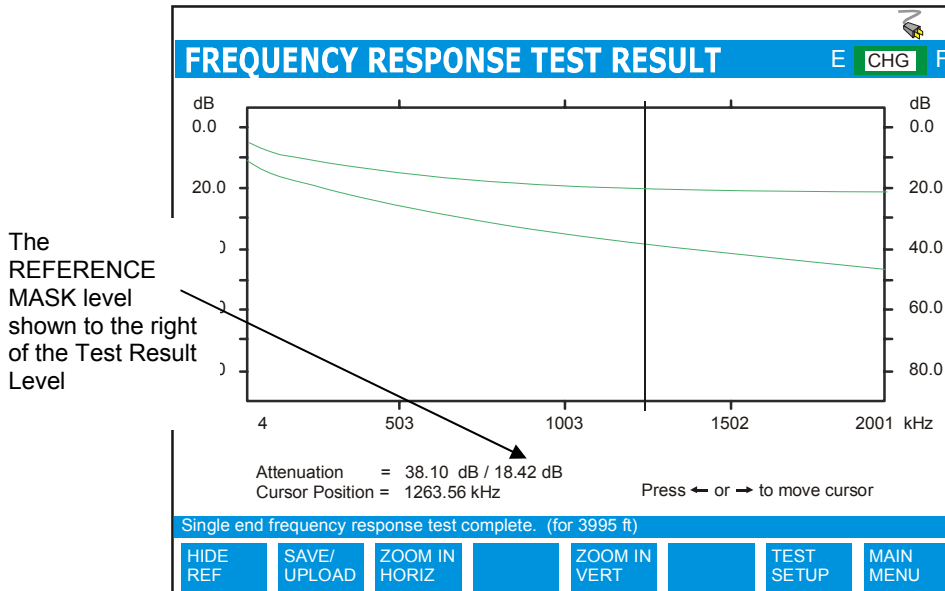
Figure 5.4.1C – Overlay of a Reference Mask

The result screen will change as depicted above once a REFERENCE MASK is recalled. In addition to the REFERENCE MASK being displayed, the **SHOW REF** function has been relabeled **HIDE REF** (removes REFERENCE MASK overlay), and the level of the REFERENCE MASK is shown to the right of the Test Result level.

To exit to the Main Menu, press the function key associated with **MAIN MENU**.

5.5 Industry Standard Test Loops

ADSL, HDSL, and ISDN modems are generally designed to operate on Industry Standard Test Loops. It is quite possible to have a real local loop, which is shorter (distance) than one of the various test loops (see Appendix A - Ideal Cable Results) and not have error free transmission.

This is usually caused by:

1. Bridge taps,
2. Load coils,
3. Uneven pair twisting
4. Bad splices,
5. Water in cable, etc.

Please note that ISDN U Interface devices are designed to work on the sixteen test loops as designated by ANSI T1.601-1995. HDSL modems are designed to work on Customer Service Area (CSA) test loops and ADSL modems are designed to work on ANSI T1.413 test loops (see Appendix A).

Also note that Rate adaptive Asymmetric Digital Subscriber Line (R-ADSL) operates at a lower speed when confronted with a local loop which is longer than one of the standard test loops, has a bridge tap longer than those of the standard test loops or cables which are impaired with noise or other anomalies.

ISDN, HDSL, and ADSL (plus all other types of DSL) will not connect on local loops which have load coils.

5.6 Bandwidth Requirements

The various DSL technologies need different bandwidths on the line to operate a full potential. The CableSHARK will help identify if a particular DSL is supported.

- ISDN requires approximately 200 kHz of bandwidth in order to operate.
- HDSL requires approximately 400 kHz of bandwidth in order to operate.
- G.SHDSL requires approximately 1 MHz of bandwidth in order to operate.
- ADSL requires approximately 1.1 MHz of bandwidth in order to operate.
- ADSL2 requires approximately 1.1 MHz of bandwidth in order to operate.
- ADSL2+ requires approximately 2.2 MHz of bandwidth in order to operate.

Section 6   Main Menu

Once the unit is powered on and the self-test sequence has been completed, the Main Menu will appear on the screen. At the bottom of the screen, various commands associated with the units' various function buttons are located. The command selection at the bottom of the screen consists of up to seven major options available to the user. See the illustration below.

Figure 6A - Main Menu Screen

The following are brief descriptions of each of the Main Menu options. Each of these menu options are described in detail in the following sections. To activate a menu option, simply press the corresponding blue function button on the front panel (near the bottom) of the CableSHARK.

CABLE TESTS   Selecting the function button corresponding to **CABLE TESTS** displays a primary pop-up menu where the user can select from all tests installed in the unit. From this primary pop-up menu, the user can select from the variety of cable tests available from the CableSHARK, including "**FR TEST**" (Frequency Response Testing), "**TDR TEST**" (Time Domain Reflectometry Testing), "**DMT TEST**" (Discrete Multi-Tone Testing), "**NOISE TEST**", "**LONG BAL TEST**" (Longitudinal Balance Testing), and "**LOAD COIL**" (Load Coil Detection Testing), and **"DMM"** (Voltage, Resistance, Capacitance). Another PSD test called "**SPECT DETECT"** will be displayed once the SPECTRAL DETECTIVE option key is installed. The SPECTRAL DETECTIVE is capable of bridging onto an active circuit to perform a PSD measurement.   Other Cable Tests are available and depends upon the CableSHARK package purchased (Bronze, Silver, Gold, or Platinum).

AUTO TESTS   Allows access to the individual Automatic tests available on the CableSHARK.

VF AUTO POTS: Performs an automatic test on an active POTS circuit
VF AUTO NO POTS: Designed for testing a circuit for POTS capabilities but is not currently provisioned for POTS or there is no POTS service currently on the line.
ADSL AUTO: Performs an automatic test to qualify a circuit for ADSL
ADSL2 AUTO: Performs an automatic test to qualify a circuit for ADSL2
ADSL2+ AUTO: Performs an automatic test to qualify a circuit for ADSL2+
SHDSL AUTO: Performs an automatic test to qualify a circuit for SHDSL

AUTO SETUP   This function defines the PASS / FAIL criteria for the VF AUTO POTS, VF AUTO NO POTS, ADSL AUTO, ADSL2 AUTO, ADSL2+ AUTO, and SHDSL AUTO tests. Users can define minimum upstream and downstream ADSL data rate criteria, minimum SHDSL data rate criteria, minimum longitudinal balance, voltages and resistance for T-R, R-G, T-G.

RESPOND. MODE   The function button associated with **RESPOND. MODE** allows the CableSHARK to be placed into Remote Responder Mode. This is used for End-to-End tests where the unit that has the RESPOND. MODE activated will only transmit signals to a Receiving unit. It is the Receiving unit that will display the test results.

NOTE: The unit will automatically enter Responder Mode if there are no keypad presses on the Main Menu screen for 3 minutes.

NOTE: This button will be replaced with ACTIVATE REMOTE if Remote Device is set under System Setup.

RECALL RESULTS   The function button associated with **RECALL RESULTS** invokes the RECALL SETUP screen, allowing users to recall saved results found in non-volatile RAM or on a PC Memory card.

Selecting the function button displaying a wrench calls up the SYSTEM SETUP menu and it allows the user to set global system parameters such as **Date**, **Time**, **Communication Parameters (baud rate, data rate, parity, modem initialization string)** and **Keyboard Backlight** options. There is also a Yes/No selection for the **Keyboard Beeper**.

The CableSHARK has been designed to be an easy to use piece of telecommunications test equipment. However, the safety of the user is paramount. As such, the CableSHARK continuously monitors the circuit it is connected to for dangerous levels of voltage and current that may be on the line. If a voltage of 20 V or greater is detected, the CableSHARK will display a warning message to the user indicating the line has potentially hazardous levels of voltage / current on the line and extreme care must be taken when operating in such an environment. The user can still run a test in this regard.

From time to time, other Function keys will appear depending upon the test that has been selected. However, some of these Functions are the same, regardless of any specific test. These Functions are described here.

EDIT/SELECT   There are two functions provided by the **EDIT/SELECT** button. Depending upon the highlighted parameter, the **EDIT/SELECT** button may show a pop-up window where a user can select from a variety of preset parameters specific to the test (i.e. Baud Rate can be set to 300, 1200, 2400, etc).

Another test may allow the user to enter alphanumeric data into a highlighted field by using the Alphanumeric Keypad to enter the desired value. To enter letters, for example the letter 'C', press the '2' button 4 times (2,A,B,C) rapidly. Existing value(s) can be changed by moving the cursor to the position of the value to be changed using the **Cursor Pad**, pressing **DELETE** to erase the old value, pressing **INSERT** to make a space for the new value and then entering the new value with the **Alphanumeric Keypad**. **CLEAR LINE** is a convenient way to erase an entire value.

Press **ENTER** when the value is correctly selected / entered to save any changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

SELECT PREVIOUS   For parameters that are preset in the CableSHARK (i.e. Baud Rate), the user can press the function key related to **SELECT PREVIOUS** to step backwards through the available options for a specific highlighted parameter. Press **ENTER** when the

value is correctly selected to save any changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

SELECT NEXT For parameters that are preset in the CableSHARK (i.e. Baud Rate), the user can press the function key related to **SELECT NEXT** to step forwards through the available options for a specific highlighted parameter. Press **ENTER** when the value is correctly selected to save any changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

6.1 The Cable Test Menu

Selecting the Cable Tests option displays the **CABLE TESTS** pop-up menu and sub-menu. From this first pop-up menu, the user can select from the variety of cable tests available from the CableSHARK, including FREQUENCY RESPONSE, TDR, PSD NOISE, and LOAD COIL DETECTION. The sub-menu is available to some cable tests and allows the user to more easily select the desired test that they would like to run. Simply use the arrow keys to select the test and press the RUN/STOP key.
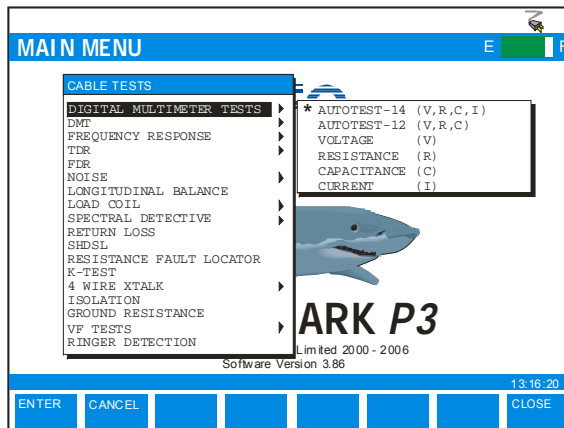
Figure 6.1A – The Cable Tests Pop-Up Menu
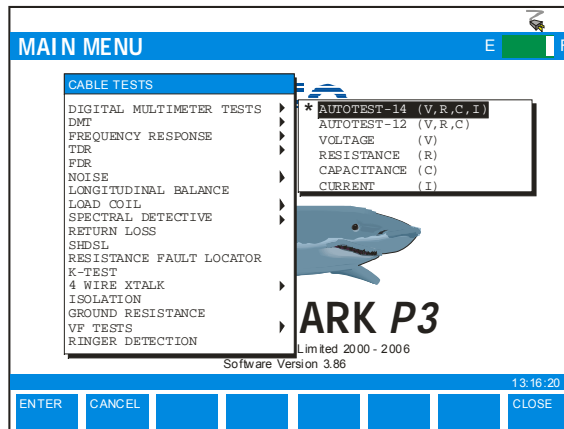
Figure 6.1B – The Cable Tests Pop-Up Menu

Each of the **CABLE TESTS** menu options is described in more detail below. Section 8 explains how to perform each of the tests in detail.

DIGITAL MULTIMETER	Selecting **DIGITAL MULTIMETER** from the CABLE TESTS pop-up menu invokes the **DMM TESTS SETUP** menu, allowing the measurement of **AC RMS Voltage**, **DC Voltage**, **AC RMS Current**, **DC Current**, **Resistance and Capacitance**. Tests for AC/DC Voltage, AC/DC Current, Resistance and Capacitance can be done from Tip to Ring, Tip to Ground and Ring to Ground.
DMT:	*Discrete Multi-Tone -* Selecting **DMT** from the CABLE TESTS pop-up menu invokes the **DMT TEST SETUP** menu. The DMT Tes*t* determines the signal and noise floor every 4.3125 kHz as per T1.413, G.DMT (G.992.1) and G.Lite (G.992.2) for DMT line coding. The CableSHARK is able to determine the maximum achievable bit rate on the line independent of line coding and modem type by determining the number of bits per bin for both Upstream and Downstream ADSL.
FREQUENCY RESPONSE:	Selecting **FREQUENCY RESPONSE** from the CABLE TESTS pop-up menu invokes the **FREQUENCY RESPONSE SETUP** menu. The Frequency Response test (also known as insertion loss or attenuation) measures the responsiveness of the copper cable under test to a range of frequencies (ISDN, HDSL, and ADSL) to determine if the cable to carry these digital technologies. See Appendix A - Ideal Cable Results for ideal cable response information.

TDR: *Time Domain Reflectometry* - Selecting **TDR** from the CABLE TESTS pop-up menu invokes the **TDR SETUP** menu. The TDR determines if the copper cable is suitable to carry DSL technologies by locating potential faults along the line such as a bridge tap or end of cable. Similar to FDR.

FDR: *Frequency Domain Reflectometry* - Selecting **FDR** from the CABLE TESTS pop-up menu invokes the **FDR SETUP** menu. The FDR determines if the copper cable is suitable to carry DSL technologies by locating potential faults along the line such as a bridge tap or end of cable. Similar to TDR.

NOISE: Selecting **NOISE** from the CABLE TESTS pop-up menu invokes the **NOISE TEST SETUP** menu. The noise test setup allows a user to perform a Power Spectral Noise, Impulse Noise, and Impulse Noise Histogram test on the line. These noise tests help determine if the line has too much noise to properly qualify the cable under test. Impulse Noise is a definite source of data transmission errors.

LONGITUDINA L BALANCE: Selecting **LONGITUDINAL BALANCE** from the CABLE TESTS pop-up menu invokes the **LONGITUDINAL BALANCE SETUP** menu. The longitudinal balance test ensures that the twisted pair is balanced. A properly balanced cable allows the cable to be resistant to common mode noise.

LOAD COIL: Selecting **LOAD COIL** from the CABLE TESTS pop-up menu invokes the **LOAD COIL SETUP** menu. The load coil test assists the user in determining if there is any load coil on the cable under test.

SPECTRAL DETECTIVE: *Spectral Detective* – Used to determine whether or not a signal from an adjacent pair is too strong thus causing spectral incompatibility to the circuit under test. This function button will only appear if the SPECTRAL DETECTIVE option is installed on the CableSHARK.

RETURN LOSS: The function associated with **RETURN LOSS** invokes the RETURN LOSS SETUP screen. This test allows users to run a Return Loss measurement over 2 pairs of wires. The CableSHARK measures voltage ratios, comparing the built-in reference impedance to the external measured impedance and calculating the return loss from that.

SHDSL The function associated with **SHDSL** invokes the SHDSL DATA RATE PREDICTION TEST SETUP screen. This test allows users to determine the predicted data rate possible on a circuit by evaluating the reflected signal and the measured background noise. Tests for SHDSL Annex A and Annex B are available.

RESISTANCE FAULT LOCATOR: The function button associated with **RESISTANCE FAULT LOCATOR** invokes the RFL SETUP screen. This test allows users to determine the distance to a short, ground or battery cross by using a separate good pair to evaluate the faulty pair against.

K-TEST: The function button associated with **K-TEST** invokes the K-TEST SETUP screen. This test allows users to determine the distance to a short, ground or battery cross by using a single pair of wires.

4 WIRE XTALK: The function associated with **4 WIRE XTALK** invokes the 4 WIRE XTALK SETUP screen. This test allows users to run a Near End Crosstalk measurement over 2 pairs of wires. The CableSHARK is able to transmit a signal over one pair of wires and is able to measure the effects of crosstalk on an adjacent pair of wires.

ISOLATION or **STRESS LEAKAGE:** The function associated with **ISOLATION TEST** or STRESS LEAKAGE (depends on unit setup) invokes the ISOLATION or STRESS LEAKAGE TEST SETUP screen. This test allows users to evaluate the integrity of the insulation surrounding the copper pair using a 100 VDC input. Results presented are up to 999 Mohm.

GROUND RESISTANCE: The function associated with **GROUND RESISTANCE** invokes the GROUND RESISTANCE TEST SETUP screen. This test allows users to evaluate the resistance at the Central Office to ensure that it is < 25 ohms.

VF TESTS: The function associated with **VF TESTS** invokes the VF TESTS SETUP screen. Users can select from TX/RX VF, Noise tests, and Impulse Noise tests, all in the voice frequency band.

RINGER DETECTION Selecting **RINGER DETECTION** from the CABLE TESTS pop-up menu invokes the **RINGER DETECTION SETUP** menu, allowing the CableSHARK to evaluation a telephone line for the presence, quantity, and quality of ringers.

6.2 Responder Mode

Selecting **RESPOND. MODE** from the Main Menu invokes the **REMOTE RESPONDER** mode. This is used for End-to-End tests where the unit that has the RESPOND. MODE activated will only transmit signals to a Receiving unit. It is the Receiving unit that will display the test results. The illustration below shows the Responder Mode screen.
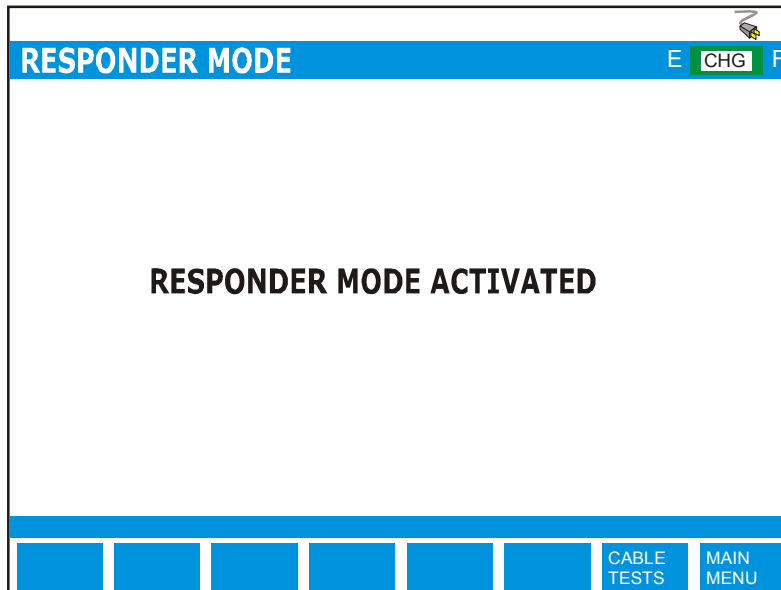
Figure 6.2A – The Responder Mode screen

CABLE TESTS   Pressing the function button corresponding to CABLE TESTS will take the user to the CABLE TESTS pop-up menu.

MAIN MENU   Pressing the function button for MAIN MENU returns the user to the Main Menu.

6.3 Recall Results

Selecting **RECALL RESULTS** from the Main Menu invokes the **RECALL SETUP** screen. Users can recall saved results from non-volatile memory or from USB memory. See Section 5.3.2 for more information.

6.4 The System Setup Menu

Selecting the Wrench (   ) option from the **MAIN MENU** (see Section 6) displays the **SYSTEM SETUP** menu and it enables the user to set global system parameters such as **Date**, **Time**, **Baud Rate** and **Keyboard Backlight** options. There is also a Yes/No selection for the **Keyboard Beeper**.

Figure 6.4A – The System Setup Menu

Date: To change the Date setting, use the Arrow Keys to move the cursor so that the current Date value is highlighted. Use the Alphanumeric Keypad to enter the desired value. The format is yyyymmdd meaning 4 digit year followed by the 2 digit numerical representation of the month (i.e. January = 01, February = 02, etc), and followed by the date (2 digits). Press **ENTER** when the value is correctly entered to save your changes. More parameters can be changed at this point, or press **MAIN MENU** to

return to the Main Menu.

Time: To change the Time setting, use the Arrow Keys to move the cursor so that the current Time value is highlighted. Use the Alphanumeric Keypad to enter the desired value. The format is hhmmss meaning 2 digit hour (24 hour clock) followed by the 2 digit minute and then followed by seconds (2 digits). Press **ENTER** when the value is correctly entered to save your changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

Baud Rate: To change the Baud Rate setting, use the Arrow Keys to move the cursor so that the current Baud Rate value is highlighted. Available options are 300, 1200, 2400, 9600, 19200, 38400, 57600, and 115200. Press **ENTER** when the value is correctly selected to save your changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

Parity: To change the Parity setting, use the Arrow Keys to move the cursor so that the current Parity value is highlighted. Available options are None, Even, and Odd. Press **ENTER** when the value is correctly selected to save your changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

Flow Control: XON / XOFF Every command and response is controlled by the CableSHARK using this software flow control method (XON resumes transmission of data and XOFF pauses it). The XON / XOFF flow control compensates for overflow errors that may exist at higher baud rates or can exist if the user sends a command to the CableSHARK when the CableSHARK is still processing information. In this instance, the XON / XOFF flow control will indicate to the PC that the CableSHARK is busy.

Modem Init. String: To change the Modem Initialization String, use the Arrow Keys to move the cursor so that the current Modem Initialization String is highlighted. Use the Alphanumeric Keypad to enter the desired string. The Modem Initialization String follows the industry standard Hayes Modem command Set. Press **ENTER** when the value is correctly entered to save your changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

Set Factory Default: Allows the user to force a COLD START REBOOT of the unit to clear NVRAM and invoke the factory default settings. Setting SET FACTORY DEFAULT to YES will reset the unit, clear the NVRAM, and invoke the factory default settings.

NOTE: THIS FUNCTION WILL ERASE ALL SAVED RESULTS THAT ARE STORED IN THE CABLESHARK's NVRAM. There is no effect on results saved to USB Memory.

Auto Shut Off (min):   Allows the user to specify the length of time after the last key press that the unit will automatically turn off to conserve the battery. Available options are 0 (continuous operation) up to 60 minutes in 1 minute increments. Press **ENTER** when the value is correctly entered to save your changes. More parameters can be changed at this point, or press **MAIN MENU** to return to the Main Menu.

        NOTE: THIS FUNCTION ONLY WORKS WHEN THE UNIT IS OPERATING FROM THE CABLESHARK's INTERNAL BATTERY AND <u>IS NOT</u> IN REMOTE RESPONDER MODE.

Live Signal Thr (dBm)   This parameter allows the user to specify the live signal threshold used by the CableSHARK. Values are from –25 to –45 dBm, with the default being –30 dBm.

        When the CableSHARK detects a live signal on the line during the execution of a test the unit will not perform the measurement. Instead, the CableSHARK will prompt the user with "Live Signal Detected". A live signal could be from AC influence, excessive crosstalk, etc. The test is not performed as the live signal may influence a test in such a way that the CableSHARK may present inaccurate results.

Measurement Standard: Allows the user to specify the operating environment of the CableSHARK; either ANSI (North America) or ITU (Europe and the rest of the world). If using ANSI, measurement names are changed to support OPENS meter, SHORTS meter, and STRESS/LEAKAGE meter.

Distance Units: Allows the user to specify the default units for distance used by the CableSHARK. Options are FEET and METERS.

Wire Size: Allows the user to specify the default wire size used by the CableSHARK. Options are AWG (North America) or mm (Europe and the rest of the world).

Language: Allows a user to load a new language library into the CableSHARK. All text and results will be displayed in the new language.

IP Address: Allows the user to place the CableSHARK into a network. Set up an IP address for the CableSHARK. Contact your IT department for an IP address to use.

Subnet Mask: Allows the user to set the subnet mask for the network the CableSHARK is being placed in. Contact your IT department for an IP address to use.

Gateway: Allows the user to define the Gateway IP Address for the network the CableSHARK is

being placed in. Contact your IT department for an IP address to use.

External Cap. Detection:	If the External Capacitance Detection parameter is YES the cable length is estimated taking into account the external capacitance. If the External Capacitance Detection parameter is NO the cable length is estimated using the actual readings. If some capacitance is connected to the end of the cable (i.e. telephone, modem, etc.) the length estimation calculation would be bigger then actual cable length when using External Cap. Detection set to YES.
Remote Device:	If the Remote Device option is installed, the CableSHARK can work in conjunction with a "Smart NID". The "Smart NID" can place an OPEN or a SHORT circuit at the user premise. This means the customers equipment can be "switched out" of the test path and will not interfere with the measurement. Examples include the Nexans RTD and the 3M FED.
Visi-SHARK Enable:	Allows a user to enable or disable remote control of the CableSHARK with the PC based Visi-SHARK software if the Visi-SHARK support is enabled in the CableSHARK unit. See OPTIONS button below.

At the bottom of the setup screen, there are additional buttons that invoke other parameters. These are **UPGRADE SOFTWARE**, **SYSTEM CONFIG**, **OPTIONS**, **INIT MODEM** and **MAIN MENU**.

UPGRADE SOFTWARE	Pressing the function key corresponding to UPGRADE SOFTWARE allows a user to upgrade the CableSHARK's software via Ethernet, USB Memory or serial (RS232/V.24). The user will be asked to press YES (F1) to continue or NO (F2) to return to the System Setup menu.
SYSTEM CONFIG.	The System Config. button loads the System Configuration screen which informs the user about the serial number of the unit as well as hardware version. ***NOTE: The internal serial number will be the same as the serial number on the outside bottom of the unit.***
OPTIONS	Pressing the function key corresponding to OPTION invokes the OPTION screen. This screen displays the serial number of the CableSHARK and any options that have been purchased and installed onto the CableSHARK. Press the VIEW DETAIL button to view installed measurements and options.
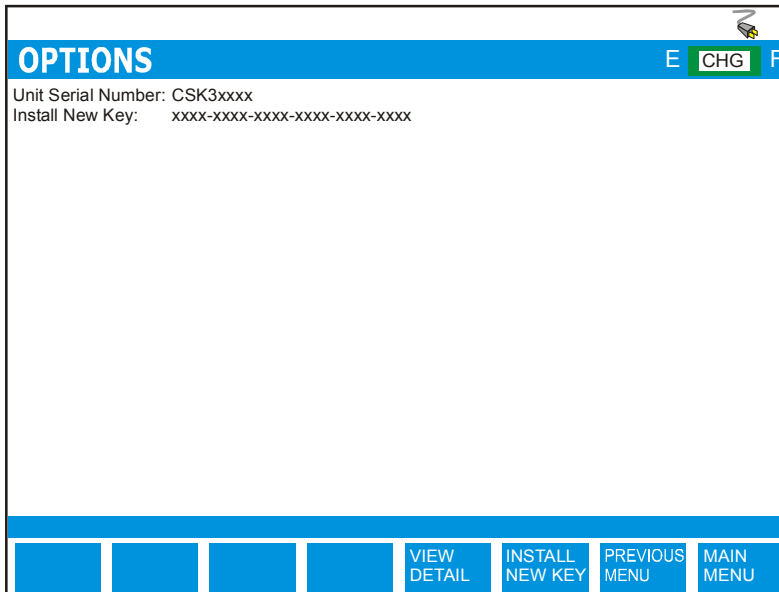
Figure 6.4B – The Options Menu

To install a new option, a special software key needs to be input by pressing the **INSTALL NEW KEY** button. An **EDIT** box will appear in which the user will need to input the key using the alphanumeric keypad. Press the CableSHARK alphanumeric keys to enter the Software KEY. Use the right and / or left arrow keys to enter the next character or edit the previous character respectively. Press **ENTER** when the key is fully entered. An incorrectly entered key will display an error message. To view what tests and options are available on your unit, press the **VIEW DETAIL** button.

INIT MODEM   The CableSHARK attempts to initialize the attached modem.

To exit from the **OPTIONS** menu, press the **PREVIOUS MENU** button to go back to the **SYSTEM SETUP** or press the **MAIN MENU** button to return to the Main Menu.

Section 7   Quick Start Guide to CableSHARK Tests

7.1 Introduction

xDSL implementation can be affected by signal attenuation, signal cancellation due to reflections caused by bridge taps, crosstalk noise, impulse noise and random electrical noise from the environment. To qualify a circuit for an xDSL application, or when a circuit has a problem with the cable impairments, CableSHARK allows the user to perform various tests for the cable qualification or troubleshooting purposes.

For all tests, if the termination impedance is unknown, it can be left as default since the CableSHARK will find the best impedance matching automatically for each test.

The Noise Filter parameter for some tests can be set to different filters. For normal cases, it should be set to NO FILTER to measure the characteristics of the cable. For some applications and cases where the effect of adding a noise filter is required, the technician can set the noise filter to the appropriate one. A summary of the noise filter setting for DMT, PSD Noise, and Spectral Detective Tests are as follows:

  NO FILTER or G FILTER for ADSL Application
  NO FILTER or F FILTER for HDSL Application
  NO FILTER or E FILTER for ISDN Application

The following subsections feature an easy to understand description on running the various tests with the CableSHARK.

7.2 TDR Tests

The TDR test is used to identify and locate all types of faults as well as bridge taps (multiple appearances) and load coils. For optimal results, perform a TDR from either end of the cable to precisely locate any faults and overcome any concerns caused by cable type, cable size, or impairments on the line.

7.2.1 Automatic TDR Test

Note: this is a Single-Ended test.

1. From the Main Menu, select CABLE TESTS (function button F1)
2. Choose TDR from the pop-up menu, and AUTO – CABLE END from the sub-menu. Press the RUN/STOP key.
3. Set any other parameters as required for the particular situation (Cable Type, VOP, and Horizontal Units).

4. Press the RUN / STOP button located on the front of the unit to initiate the TDR test.
5. Once the AUTO TDR finds any valid reflection, up to four reflections could be plotted on screen. The TDR test will automatically place the cursor at the initial rising slope (leading edge) of a major reflection.
6. When the test is completed, the user can move the cursor or marker, zoom in and out, change reading units, or press the function button corresponding to MORE to save the resultant trace. Pressing the function buttons associated with ZOOM IN / OUT VERT and ZOOM IN / OUT HORIZ will enable the user to see all reflections in detail (not as much detail as with a Manual TDR Test, however).

The Automatic TDR test is a 'quick test' to locate faults while the Manual TDR test is a much more detailed rendering of the physical aspect of the twisted copper pairs under test. The Auto TDR also returns the found (determined ideal) pulse width to the TDR Test Setup menu so that the user can use the width for the Manual TDR Test.

To repeat the test, press the RUN/STOP key or press the function button associated with Test Setup, should you wish to change some settings.

7.2.2 Manual TDR Test

Note: this is a Single-Ended Test

1. From the Main Menu, select CABLE TESTS (function button F1)
2. Choose TDR from the pop-up menu, and MANUAL from the sub-menu. Press the RUN/STOP key.
3. Select the appropriate Graph Scale option to a scale that is greater than the actual distance of the line under test
4. Be sure to set the most critical parameter: Pulse Width and any other parameters as required for the particular situation (cable type, Smoothing).
5. Press the RUN/STOP located on the front of the unit to initiate the TDR test.
6. When the test is completed, the results screen will appear and the cursor will reside on the rising slope of the first major reflection found. The user can move the cursor or marker, zoom in and out, change reading units or press the function button corresponding to MORE to save the resultant trace. Pressing the function buttons associated with ZOOM IN / OUT VERT and ZOOM IN / OUT HORIZ will enable the user to see all reflections in detail. If no reflection was found, the message, "TDR test complete. …" is displayed on the status bar.

To repeat the test, press the RUN / STOP key. You can also change option settings if you wish by pressing the function button associated with Test Setup.

Note: When using a Manual TDR, be sure to use the CableSHARK's zoom function to amplify results. Often, the reflected pulse is difficult to see, so by using the zoom function, the faults can more easily be seen. Ensuring that the correct VOP and appropriate pulse width and other parameters are selected will allow for a successful TDR test (refer to Section 8.2.1 and 8.2.4.6 for more details).

7.3 Frequency Response Tests

The Frequency Response test is used to indicate the frequency response of the twisted copper pair cable. Frequency Response test can be run End-to-End or Single-Ended; both are explained in Section 7.3.1 and 7.3.2.

7.3.1 Single Ended Frequency Response Test

Note: This is a Single-Ended test

The Single-End test is actually performing the frequency response test from the cable connection point to the point of the cable where the first major reflection occurs. It gives the user the picture of frequency response of the cable from the connection point to the first reflection point. If the first reflection point is the end of the cable, then the test result is the frequency response of the whole cable.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose Frequency Response from the pop-up menu, and SINGLE END from the sub-menu. Press the RUN/STOP key.
3. Press the RUN / STOP button to start the Single-End test. When the test is completed, the user can move the cursor to get all the information numerically and graphically. If the test failed, a warning label will be displayed indicating that the: Loop fault, try end-to-end frequency response test.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.3.2 End to End Frequency Response Test

Note: This is an End-to-End test

The End-To-End Frequency Response test is doing the frequency response test from the two ends of the cable. Therefore, the CableSHARK can give the user information about the whole cable as well as load coils, interference and many types of cable faults. Multiple load coils inserted in a 24 AWG cable up to 45,000 ft can be detected.

Setting up the Transmit (Tx) unit

To set one of the CableSHARK's in TX mode, select the **RESPOND. MODE** from the **MAIN MENU**. This mode is enabled to allow hands free operation so only one person is needed to do testing. This mode works

for all CableSHARK end-to-end tests. Press the function button associated with Main Menu to exit out of the Remote Responder mode.

Setting up the Receive (Rx) unit

1.   From the Main Menu, select CABLE TESTS (function button F1).
2.   Choose Frequency Response from the pop-up menu. Modify the Test Type parameter to End-To-End Rx and set the other parameters as required.
3.   Press the RUN / STOP button to start the End-To-End Test.

The Rx unit will calibrate itself first and then try to synchronize with the Tx unit. Once both units are synchronized, the test will be carried out. The whole process is automatic. When a test is completed, the CableSHARK's large graphical display will show the Frequency Response of the cable. The user can then move the cursor to get all the information. The Rx unit can initiate another End-To-End test again and again since the Tx unit is set to Remote Responder mode. To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.4 ADSL Data Rate Prediction (DMT) Tests

The ADSL Data Rate Prediction (DMT) test will tell the user the cable insertion loss, the cable noise and the possible number of bits allocated for an individual DMT subchannel as well as the estimated maximum bit rate for the whole cable with respective to full-rate ADSL and/or G.Lite ADSL specifications. The current CableSHARK's DMT test is generating the downstream/upstream data rates for an ideal ADSL modem with maximum resolution ADC, 4.2dB coding gain, 1dB loading gain, at least 6dB performance margin and 8 tone separation for FDM mode. Normally, the data rates are higher than the ones that the current ADSL modems can achieve since they have only 12-13 bit ADC resolution and a number of limitations in their hardware and software.

The DMT test can be used to analyze a problem where a pair of ADSL modems or an ADSL service fails with the cable by looking at the signal level and noise level at the ADSL modem synchronization frequencies. Also, it can be used to estimate the service and data rates for other standards of xDSL application when applicable.

The DMT Test provides a Signal-to-Noise Ratio (SNR) result of the modem receiver respective of the ADSL standard at the tone frequency or the tone frequency band of 4.3125 kHz. To obtain the SNR for other xDSL standards at a certain frequency, the difference between the signal level of ADSL and the signal level of the standard of question should be taken into consideration.

7.4.1 Single-Ended DMT Test (Optional)

Note: This is a Single-Ended test

The Single-Ended DMT Test is a predictive test where the results display are extrapolated from measured results obtain before graphing.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose DMT Test from the pop-up menu. Press the RUN/STOP key.
3. For Test Type, select ADSL FROM CUSTOMER (was ADSL CPE) and an ADSL Evaluation of ANSI FULL RATE/POTS.
4. Press the RUN / STOP button to start the Single-End test. When the test is completed, the user can move the cursor to get all the information numerically and graphically. If the test failed, a warning label will be displayed indicating that a loop fault exists and the user should you the end-to-end DMT test.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.4.2 End-to-End DMT Test

Note: This is an End-to-End test

Setting up the Transmit (Tx) unit

To set one of the CableSHARK's in TX mode, select the **RESPOND. MODE** from the **MAIN MENU**. This mode is enabled to allow hands free operation so only one person is needed to do testing. This mode works for all CableSHARK end-to-end tests. Press the function button associated with Main Menu to exit out of the Remote Responder mode.

Setting up the Receive (Rx) unit

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose DMT Test from the pop-up menu.
3. Set Test Type to ADSL End to End
4. The Rx Test Resolution option can be set to Coarse or Fine. Choose Coarse for this Quick Test. The Coarse test is a quick test that looks at the signal level of many DMT tones and extrapolates this information to cover the rest of the tones. It is designed to give the user an overview of what throughput can be expected on the circuit under test. The Fine test looks at the signal level of every DMT tone to give the user the exact details.
4. The ADSL Evaluation option allows the user to choose from DMT tests for ANSI FULL RATE/POTS, G.LITE/POTS, ITU-T AnnexB/ISDN, ETSI FULL RATE/ISDN, ETSI FULL RATE/POTS, and ITU-T AnnexA/POTS.
5. Press the RUN / STOP button to start the DMT Test.

The Rx unit will calibrate itself first and then try to synchronize with Tx unit. Once both units are synchronized, the test will be carried out. The whole process is automatic. When a test is completed, the CableSHARK's large graphical display will show the results of the DMT test. The user can then move the cursor to get all the information presented both graphically and numerically. The Rx unit can initiate another End-To-End test again and again since the Tx unit is set to Remote Responder mode. To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.5 Noise Tests

Note: This is a Single-Ended test.

The CableSHARK noise test performs Noise PSD (Power Spectral Density), Impulse Noise and Impulse Histogram Measurements.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose NOISE from the pop-up menu.
3. Select Noise PSD Next/Fext or the Impulse Noise Test or the Impulse Histogram Test and set the other parameters if required. Parameters for the Impulse Noise test include Impulse Noise Threshold and Impulse Noise Measurement Time which allows the user to configure the Impulse Noise test to meet their requirements, for the Impulse Histogram, parameters include Impulse Noise Threshold, Plot Interval and Impulse Noise Measurement Time.
4. Press the RUN / STOP button to start the test. The results will be displayed on screen in an easy to understand format.

To repeat the test, press the RUN/STOP button.

7.6 Longitudinal Balance Test

Note: This is a Single-Ended test.

Longitudinal balance ratio is defined in ITU-T Rec. O.9, which is important when it comes to reducing the effects of common-mode voltage to ground. The CableSHARK can perform a longitudinal balance measurement to determine if the longitudinal balance ratios are compliant with a standard. The CableSHARK displays results for ADSL applications respective of the ANSI T1.413 standard. The test results can also be used for ISDN and HDSL applications. The better the balance of the cable pair under test, the higher the dB reading resulting from the measurement.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose LONGITUDINAL BALANCE from the pop-up menu.
3. Test Type is Long Bal Near End, and set Term Impedance as required.
4. Press the RUN / STOP button to start the Longitudinal Balance Test. When a test is completed, the CableSHARK will display the longitudinal balance characteristics of the cable. The ANSI T1.413 standard states that the Longitudinal Balance must be greater than 40 dB for frequencies between 30 kHz and 1104 kHz for full-rate ADSL applications.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.7 Load Coil Detection Test

Note: This is an example of an End-to-End test however, single-ended testing is possible using the Single Ended test type.

It used to be common practice to install loading coils on local loops to improve the flatness of the first 4 kHz of bandwidth. While loading coils improve (flatten) the frequency response to 4 kHz they actually cause it to roll off at an even faster rate above 4 kHz. Since all types of DSL (ISDN, HDSL, SDSL, ADSL, VDSL) use frequencies well above the voice region, loading coils prohibit the use of DSL technology. Typically only lines that are greater than 18,000 feet contain Load Coils. They are usually inserted at 4500-6000 ft intervals along the line. The CableSHARK Load Coil Detection Test can detect if there are any load coils along the line and inform the user to perform an auto or manual TDR test to locate the load coil(s). When running a TDR test, a load coil on the line acts like an open circuit on the line. When running FR or DMT tests with a line, the test results will show the severe roll off in frequencies from 4 kHz to some 100 kHz when loading coils exist.

Setting up the Transmit (Tx) unit

To set one of the CableSHARK's in TX mode, select the **RESPOND. MODE** from the **MAIN MENU**. This mode is enabled to allow hands free operation so only one person is needed to do testing. This mode works for all CableSHARK end-to-end tests. Press the function button associated with Main Menu to exit out of the Remote Responder mode.

Setting up the Receive (Rx) unit

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose LOAD COIL from the pop-up menu.
3. Modify the Test Type parameter to Load Coil RX.
4. Press the RUN / STOP button to start the Load Coil Detection Test. The Rx unit will calibrate itself first and then try to synchronize with the Tx unit. Once both units are synchronized, the test will be carried out. The whole process is automatic. When a test is completed, the CableSHARK will display the test result.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.8 Spectral Detective

Note: This is an optional Single-Ended test.

The CableSHARK's Spectral Detective is a PSD noise test that uses a high impedance bridge to measure an **active** circuits PSD to ensure it meets with spectral compatibility guidelines.

1.   From the Main Menu, select CABLE TESTS (function button F1).
2.   Choose SPECTRAL DETECTIVE from the pop-up menu.
3.   Ensure that the Noise Filter is set to NONE (disturber ID on) for an unbiased look at the cable.
4.   Press the RUN / STOP button to start the test. The results will be displayed on screen in an easy to understand format.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with FREEZE, and then TEST SETUP.

7.9 Digital Multimeter (DMM) Test

Note: This is a Single-ended test.

A DMM is a useful tool for performing metallic type testing on a loop to identify voltage or current on the line as well as to measure the resistance or capacitance of the line. The loop length can be estimated by measuring capacitance.

1.   From the Main Menu, select CABLE TESTS (function button F1).
2.   Choose DIGITAL MULTIMETER TESTS from the pop-up menu.
3.   Using the SELECT NEXT or SELECT PREVIOUS function keys, select the desired Test Type (Auto-12, Voltage, Current, Resistance or Capacitance).
4.   Press the RUN / STOP button to start the test. The results will be displayed on screen in an easy to understand format. Users can also switch between Tip and Ring, Tip and Ground, and Ring and Ground.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with DMM.

7.10 Return Loss

Note: This is a Single-ended test.

The Return Loss measurement is useful in determining the affect of impedance mismatches.

1.   From the Main Menu, select CABLE TESTS (function button F1)
2.   Choose RETURN LOSS from the pop-up menu.
3.   Press the RUN / STOP button to start the test. The results will be displayed on screen in an easy to understand format. Values between 50 to 60 dB are considered excellent. 30 to 50 dB is considered good.

To repeat the test, press the RUN/STOP button.

7.11 SHDSL Data Rate Prediction

Note: This is a Single-ended test.

The Single-Ended SHDSL Test is a predictive test that allows a user to evaluate a circuits capabilities of supporting SHDSL data rates from 192 kbps to 2.312 Mbps.

1.   From the Main Menu, select CABLE TESTS (function button F1)
2.   Choose SHDSL from the pop-up menu.
3.   Select SHDSL EVALUATION of ITU-T Annex A, NOISE MARGIN set to AUTO, and CABLE TYPE set to AUTO.
4.   Press the RUN / STOP button to start the test.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.12 4 Wire Xtalk

Note: This is a Single-ended test.

The 4 Wire Xtalk (Crosstalk) measurement is useful in determining the affect of crosstalk on adjacent pairs due to bad splices, split pairs, etc. The user need to attached one pair of wire to the TX side of the CableSHARK and another pair of wires to the RX side of the CableSHARK.

1.   From the Main Menu, select CABLE TESTS (function button F1)
2.   Choose 4 WIRE XTALK from the pop-up menu.
3.   Using the SELECT NEXT or SELECT PREVIOUS function keys, select the Wideband Test Type.

4. Press the RUN / STOP button to start the test. The results will be displayed on screen in an easy to understand format. Users will be able to a plot of the effects of crosstalk.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.13 Isolation Test or Stress Leakage Test

Note: This is a Single-ended test.

The Isolation Test or Stress Leakage Test will allow user to determine the quality of the copper pairs insulation (sheathing). Measures are done by injecting a 100 VDC signal onto the circuit under test and the CableSHARK loops for break downs in the insulation. A good reading is >30 Mohm.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose ISOLATION TEST or STRESS LEAKAGE from the pop-up menu.
3. Using the SELECT NEXT or SELECT PREVIOUS function keys, select a Test Type of **Tip to Ring**
4. Press the RUN / STOP button to start the test. A countdown timer will allow users how long the test has left to finish and will indicate the current Isolation resistance. A failure will be indicated by a resistance result of less than 30 Mohm.

To repeat the test, press the RUN/STOP button. You can also change option settings if you wish by pressing the function button associated with TEST SETUP.

7.14 ADSL Auto Test

Note: This is a Single-ended test.

The ADSL Auto test quickly evaluates a cable to see if it is acceptable for ADSL based on pre-defined PASS / FAIL criteria. The ADSL auto test will perform a DMM test, Longitudinal Balance, Load Coil test, Capacitive Imbalance, DMT test, and a TDR test.

1. From the Main Menu, select ADSL AUTO (function button F2). This test will take place automatically.

Figure 7.14A – ADSL Auto Test Results

7.15 SHDSL Auto Test

Note: This is a Single-ended test.

The SHDSL Auto test quickly evaluates a cable to see if it is acceptable for SHDSL based on pre-defined PASS / FAIL criteria. The SHDSL auto test will perform a DMM test, Longitudinal Balance, Load Coil test, Capacitive Imbalance, SHDSL bit rate test, and a TDR test.

1. From the Main Menu, select SHDSL AUTO (function button F3). This test will take place automatically.
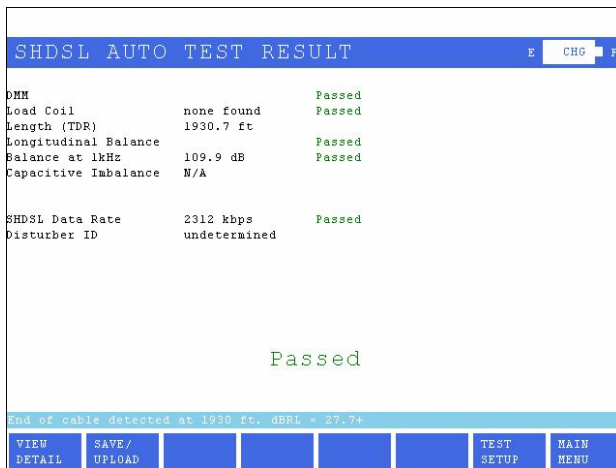
Figure 7.15A – SHDSL Auto Test Results

7.16 VF Auto Test

Note: This is a Single-ended test.

The VF Auto test quickly evaluates a cable to see if it is acceptable for voice frequencies based on pre-defined PASS / FAIL criteria. The VF Auto test will perform a DMM test, Load Coil test, a Capacitive Imbalance test and a Longitudinal Balance test. If a Load Coil is found, the distance to the Load Coil is given.

1.   From the Main Menu, select VF AUTO (function button F4). This test will take place automatically.
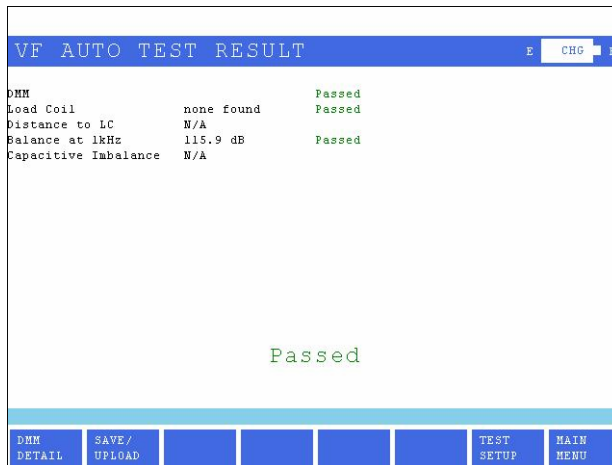
Figure 7.16A – VF Auto Test Results

7.17 Ground Resistance Test

Note: This is a Single-ended test.

The CableSHARK's Ground Resistance (also known as Station Ground) test allows technicians to verify that correct grounding rules are being followed at the location under test. An adequate station ground and ground distribution system provides a common electrical reference point for all telecommunications equipment in the installation and minimizes the danger of electrical potential between various equipments and between equipments and the earth.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose GROUND RESISTANCE from the pop-up menu. Ensure the RING connection of the CableSHARK is connected to the lead on the negative side of the CO battery, the TIP connection connected to the lead on the positive side of the CO battery and the GROUND connection to ground at the CO.
3. Press the RUN / STOP button to start the test. Depending upon the CO line card properties and whether it is active or not, the Ground Resistance measurement will give the user the station voltage, the loop current, the loop impedance and the ground resistance. Resistance values of less than 25 ohms are considered acceptable. Anything over 25 ohms means there is a ground resistance problem.

To repeat the test, press the RUN/STOP button.

7.18 Resistance Fault Locator (RFL)

Resistance Fault Locator (RFL) testing is a powerful measurement that is able to locate shorts between tip to ring, tip to ground or ring to ground. These faults can be called shorts, grounds or crosses. The RFL measurement used by the CableSHARK is referred to as a "separate good pair" test. This means the user must have a good pair to compare against.

1. Attached a test cable to the 2Wire TX/RX port of the CableSHARK and connect the Tip, Ring, and Ground leads to the circuit. Attach the RFL test cable (Yellow and Green leads) to a separate good pair.
2. From the Main Menu, select CABLE TESTS (function button F1).
3. Choose RESISTANCE FAULT LOCATOR from the pop-up menu.
4. Press the RUN / STOP button to start the test. Follow the instructions on screen to determine where the far end strap is to be placed.
5. Results will provide a user with a clear indication of the distance to the fault, the distance from the fault to the strap and the distance from the CableSHARK to the strap.

To repeat the test, press the RUN/STOP button.

7.19 K-Test

K-test testing is a powerful measurement that is able to locate shorts between tip to ring, tip to ground or ring to ground. These faults can be called shorts, grounds or crosses. This test does not need a separate good pair like the RFL test does.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose K-TEST from the pop-up menu.
3. Press the RUN / STOP button to start the test. Follow the instructions on screen to determine how to connect the test cable and where the far end strap is to be placed.
4. Results will provide a user with a clear indication of the distance to the fault, the distance from the fault to the strap and the distance from the CableSHARK to the strap.

To repeat the test, press the RUN/STOP button.

7.20 Ringer Detection

The CableSHARK Ringer Detection Test measures the Ringer Equivalency Number (REN) of a circuit. The REN is impacted most by telephones and modems connected to the circuit. The Service Provider will only be able to supply enough current to the user to support 5.0 REN. Most new residential telephones measure at <1.0 REN.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose RINGER DETECTION from the pop-up menu.
3. Press the RUN / STOP button to start the test.
4. Results will provide a user with the number of REN's for T-R, R-G, and T-G in addition to the capacitance for each of these legs.

To repeat the test, press the RUN/STOP button.

7.21 VF Tests

The CableSHARK's VF Tests perform voice frequency measurements on the circuit. The VF Tests include TX/RX VF measurements, a RMS Noise measurement, and an Impulse Noise Measurement.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose VF TESTS from the pop-up menu.
3. Choose NOISE from the secondary pop-up menu
4. Press the RUN / STOP button to start the test.
5. Results will provide a user with the RMS noise of the circuit under test

To repeat the test, press the RUN/STOP button.

7.22 LoopMapper™ Tests

The CableSHARK's LoopMapper Tests combines Frequency Domain Reflectometry (FDR) test and looks for faults similar to the TDR. Results of the FDR, TDR, and DMM tests are graphically displayed and a plain text readout will assist users in determining the distance to faults.

1. From the Main Menu, select CABLE TESTS (function button F1).
2. Choose Loop Mapper from the pop-up menu.
3. Press the RUN / STOP button to start the test.
4. Results will provide a user with a distance to the fault(s).

To repeat the test, press the RUN/STOP button.

Section 8   In Depth Guide to Cable Testing with the CableSHARK

The following sections describe the measurements that the CableSHARK is capable of performing. Some measurements will be optional based on the CableSHARK software package installed, therefore may not be applicable to your unit.

8.1 Frequency Response Testing

Frequency response (also known as Insertion Loss or Attenuation) testing with the CableSHARK enables the operator to determine the quality of copper cabling to ensure that it is capable of carrying ISDN, HDSL, ADSL (including ADSL2/2+), or VDSL technologies. This test is offered in two variations; Single-Ended and End-to-End Frequency Response tests *(note that End-to-End does not support VDSL)*.

Using the single-ended test, a cable can be evaluated with only one CableSHARK. This allows for great flexibility. For single-ended tests, it takes less than 45 seconds for the CableSHARK to locate the reflection from the end of the cable or a major impairment and perform its measurement. The Auto-TDR method is employed to locate the end of the cable or major impairment. Knowing the distance to the cause of the reflection allows the CableSHARK to accurately measure the frequency response of the cable.

8.1.1 Setting up a Frequency Response Test

From the Main Menu, pressing Function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing FREQUENCY RESPONSE from the pop-up menu will invoke the Frequency Response Test Setup menu. Figure 8.1.1A below, shows this menu.
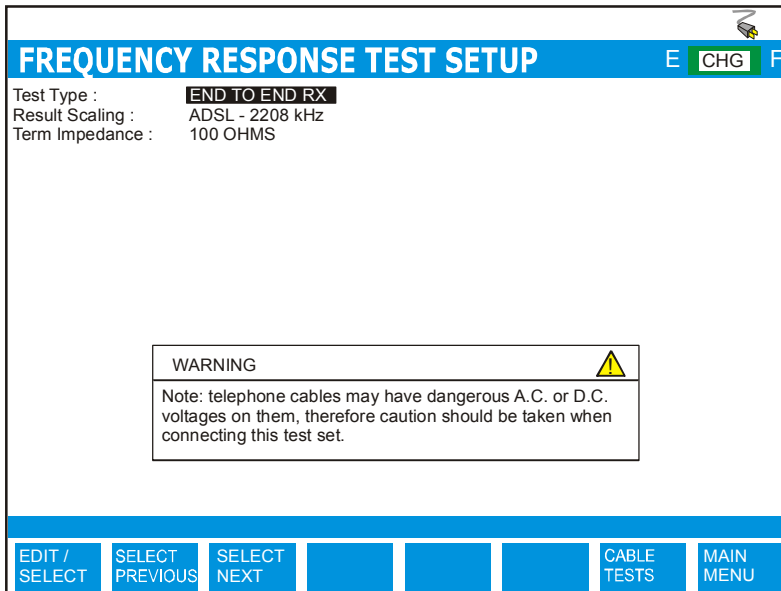
Figure 8.1.1A - Frequency Response Test Setup Menu

The Frequency Response Test Setup menu has several options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a frequency response test. The following describes the frequency response test setup options:

TEST TYPE: The user can choose from Single End or End-to-End RX. Each of these tests are described in Sections 5.2.2 – 5.2.3. For End-to-End testing, activate one CableSHARK to Responder Mode from its Main Menu.

RESULT SCALING: Result Scaling allows the user to select a horizontal scale for which to plot test results. Options are ISDN – 500 kHz, HDSL – 1000 kHz, ADSL – 2208 kHz, VDSL – 6000 kHz *(Note the VDSL option is not available for End-to-End test type)*.

TERMINATION IMPEDANCE: The CableSHARK's impedance needs to match the characteristic impedance of the cable. This causes the CableSHARK at either end of a test circuit not to reflect back any test signals or unnecessarily attenuate the test signal. The options are 100 ohms, 135 ohms, and AUTO (older hardware will still show 120 and 150 ohms).

If the SINGLE END Test Type is selected, the following settings are available.

MAX. CAP. IMBALANCE (%):   Allows the user to specify the maximum capacitive length imbalance between T-G and R-G. The default setting is 10%. Setting of Imbalance can be from 0.1% to 100% where 100% is the worst case scenario. If the imbalance is greater than the user defined setting the CableSHARK will not complete the test and will report ***"Measurement not possible. Tip and Ring wires are substantially different lengths."***

F1 LENGTH: Optional Feature: The CableSHARK is capable of bridging into the middle of a circuit (intrusive) to measure from remote to CPE and ignore the cable from remote to CO (called F1 circuit). This setting affects more measurements such as Frequency Response, TDR, and DMT test. The F1 length is assumed to be longer than the distance between the Remote Cabinet and the Customer.

Setting to 0 deactivates the function.

CABLE TYPE: This setting is used to select the appropriate cable type or more appropriately the appropriate diameter. It is best however to ensure the correct VOP for the cable as all cables are manufactured differently. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE , and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

The AUTO selection is based on an optimized algorithm whereby the user does not need to know the cable gauge. It takes into account Resistance per unit length, Capacitance per unit length and Attenuation per unit length, in addition to POTS splitters.

VOP: *Velocity of Propagation* – VOP determines how quickly a pulse of energy travels along a length of wire. It is entered as a ratio of the speed of light. (i.e., 0.6 of the speed of light). A correct VOP will ensure accuracy in the test results. An incorrect VOP can mean a result that indicates the loop is too long or too short. Changes made to VOP will automatically be reflected in the VOP (m/μs) setting and vice versa. (Range is from 0.400 to 0.999)

VOP (m/μs):   Rather than specify the ratio of the speed of light for pulses traveling along a length of wire, users can specify the speed in meters per microsecond. Changes made to VOP (m/μs) will automatically be reflected in the VOP setting and vice versa. (Range is from 120 to 299 m/μs)

Here are some *examples of typical VOP values* for various telephone cables, given for insulation type and wire gauge / size. :

Pulp

AWG 22	0.6 mm	VOP = 0.68 (102 m/µs)
AWG 24	0.5 mm	VOP = 0.67 (100 m/µs)
AWG 26	0.4 mm	VOP = 0.66 (99 m/µs)

PIC

AWG 19	0.9 mm	VOP = 0.72 (108 m/µs)
AWG 22	0.6 mm	VOP = 0.67 (100 m/µs)
AWG 24	0.5 mm	VOP = 0.66 (99 m/µs)
AWG 26	0.4 mm	VOP = 0.64 (96 m/µs)

Jelly Filled

AWG 19	0.9 mm	VOP = 0.68 (102 m/µs)
AWG 22	0.6 mm	VOP = 0.62 (93 m/µs)
AWG 24	0.5 mm	VOP = 0.60 (90 m/µs)
AWG 26	0.4 mm	VOP = 0.58 (87 m/µs)

Polyethylene	VOP = 0.66	(99 m/µs)
Polypropylene	VOP = 0.66	(99 m/µs)
Teflon	VOP = 0.67	(100 m/µs

Figure 8.1.1B – Single End Frequency Response Test Setup Menu

If the AUTO CABLE TYPE is <u>NOT</u> selected, the following settings are available. These are necessary to provide the user with the most accurate results.

CAPACITANCE nF/mi or nF/km: Allows the user to specify the cable's capacitance constant. See Appendix B for more information on loop characteristics.

RESISTANCE Ohm/mi or Ohm/km Allows the user to specify the cable's resistance constant. See Appendix B for more information on loop characteristics.

ATTN at 300kHz dB/mi or dB/km Allows the user to specify the cable's attenuation constant. See Appendix B for more information on loop characteristics.

The Function button command selection at the bottom of the Frequency Response Test Setup Menu consists of five options available to the operator. The first three options (EDIT/SELECT, SELECT PREVIOUS, SELECT NEXT) enable the modification of the test parameters (residing near the upper part of the screen). The last two options at the bottom of the screen are CABLE TESTS and MAIN MENU. For some options for which a numeric value must be entered, only three options may appear: EDIT/SELECT, CABLE TESTS and MAIN MENU.

To modify a test parameter, it must first be highlighted with the cursor. A test parameter can be highlighted by moving the cursor to the desired parameter with the Cursor Pad UP/DOWN arrow buttons. The following are brief descriptions of each of the function button options:

EDIT/SELECT Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.

SELECT PREVIOUS Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.

SELECT NEXT Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.

CABLE TESTS Pressing the function button corresponding to CABLE TESTS causes the CABLE TESTS pop-up menu to appear.

MAIN MENU Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.1.2 Running a Frequency Response Test

Once the test is set up, press the RUN/STOP key located on the front panel of the CableSHARK. A screen similar to Figure 8.1.2A will appear. The layout of the screen shows a graphic and numeric representation of the information received by the CableSHARK. The graph's vertical scale depicts the relative Attenuation Level or Insertion Loss (in dB) and the horizontal scale depicts frequency (kHz). The distance to the found valid reflection is shown on the status line.

Note: For the Single-Ended FR test, the CableSHARK can only measure the returned reflection signals with up to 75 dB of attenuation.

The Cursor Position (kHz) and Attenuation (dB) are numeric representations of the solid cursor line bisecting the result line of the test. By using the Cursor Pad LEFT/RIGHT arrow keys on the front panel of the CableSHARK, the user can move the cursor line to different positions along the result line to see the different values of frequency samples.
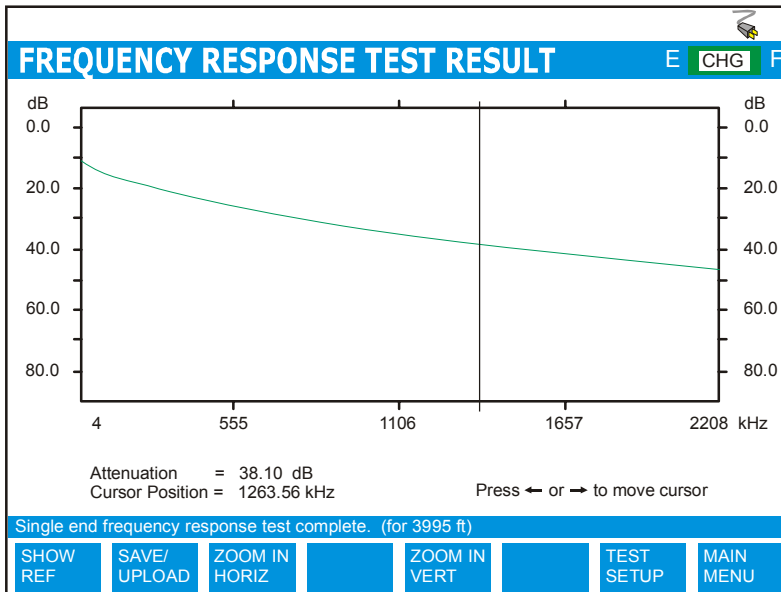
Figure 8.1.2A - Running a Frequency Response Test

Once the test has been completed, the status bar may indicate that the test was completed and/or to what distance it was tested to or that no reflection was detected. At the completion of a test, the function button

command selection at the bottom of the Frequency Response Test screen consists of seven options available to the operator. The following are brief descriptions of each of the function button options:

SHOW REF	Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT	Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.
SAVE TO MEM	Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.
SAVE TO USB	Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

ZOOM IN HORIZ/ ZOOM OUT HORIZ	Use these function buttons to zoom in and out based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disable as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.
ZOOM IN VERT / ZOOM OUT VERT	Use these function buttons to zoom in and out based on the vertical graph scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disable as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.
TEST SETUP	Pressing the function button corresponding to TEST SETUP activates the Frequency Response Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.1.3 Examples of Frequency Response Test Results
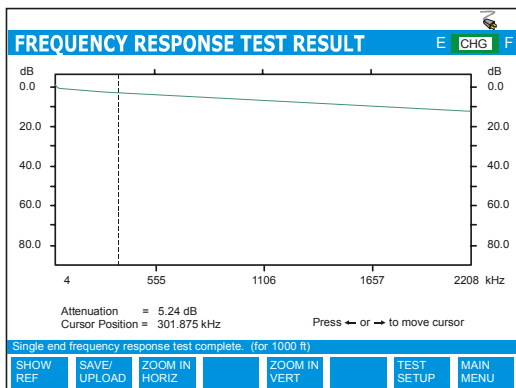
FIGURE 8.1.3A – 1000 FT / 300 M
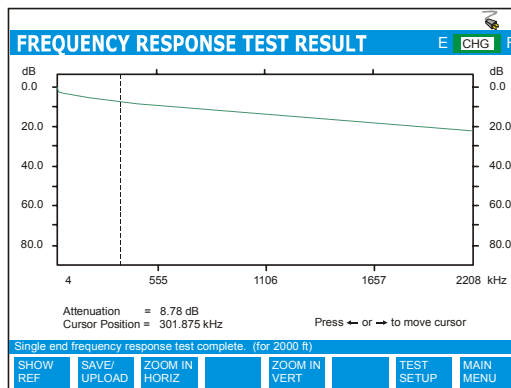
FIGURE 8.1.3B – 2000 FT / 600 M
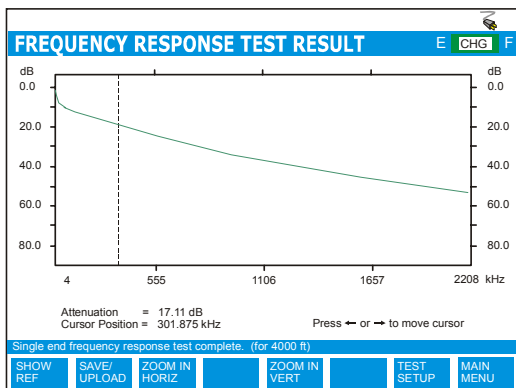
FIGURE 8.1.3C – 4000 FT / 1200 M
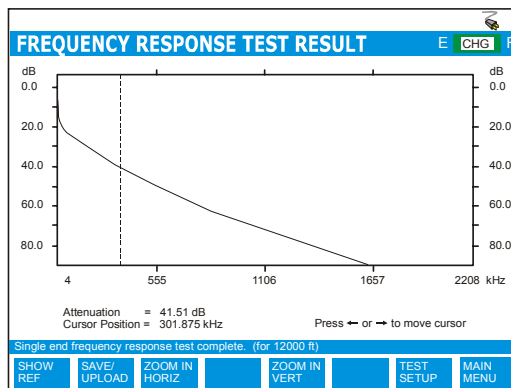
FIGURE 8.1.3D – 12000 FT / 3650 M
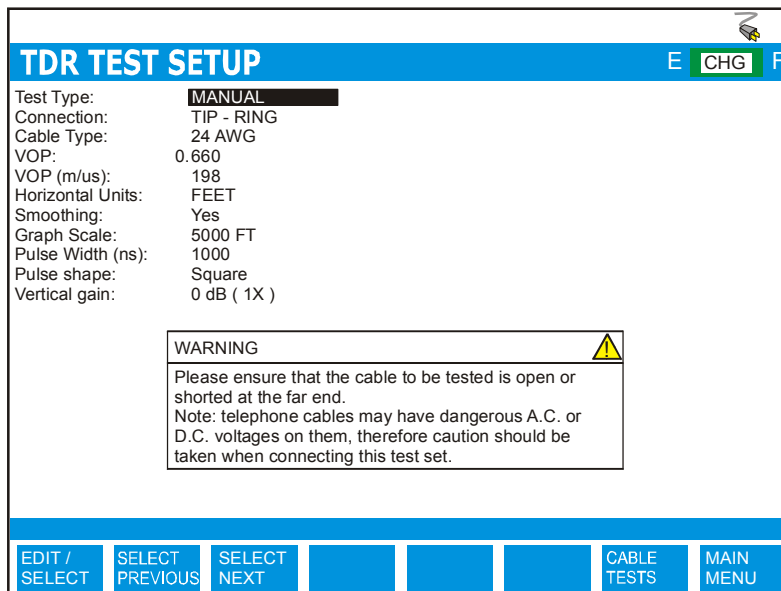
8.2 *Time Domain Reflectometry Testing*

Time Domain Reflectometry (TDR) allows the user of the CableSHARK to easily identify faults (if any) along a given section of cable. Results can be displayed in feet, meters, or nanoseconds. This test is extremely useful in locating bridge taps (multiple appearances) and the end of the cable. Faults such as opens, shorts, splices, split pairs and wet sections can easily be found using a high quality TDR such as the CableSHARK's integrated TDR solution. See Section 3 for more details on Time Domain Reflectometry.

8.2.1 *Setting up a TDR Test*

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing TDR from the pop-up menu (and subsequently Auto-Cable End, Auto-Bridge Tap, Manual, or Manual-4 Wire) will invoke the TDR TEST SETUP menu. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear. Figure 8.2.1A below shows the TDR Test Menu.

FIGURE 8.2.1A – MANUAL TDR TEST SETUP MENU

The TDR Test Setup menu has several options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a TDR Test. The following describes the TDR test setup options:

TEST TYPE: This option can be set to AUTO – CABLE END, AUTO – BRIDGE TAP, MANUAL, or MANUAL – 4 WIRE. AUTO – CABLE END is an automatic search for any valid reflection(s) denoting the end of the cable. AUTO – BRIDGE TAP is designed to automatically search for bridge taps connected to the cable. The user need only set Cable Type, VOP, and Horizontal Units.

The MANUAL setting is a more detailed analysis of the cable plant. Users can modify any setting to "customize" the test. The MANUAL setting is also used to look for any reflections beyond the capability of the AUTO TDR test. The MANUAL – 4 WIRE test type uses the 2 Wire TX / RX and the RX (Aux.) connectors on the rear panel of the CableSHARK (see section 4.1.2A). The 4 WIRE TDR sends a pulse of energy down one pair of wires and looks for any reflections on the RX pair of wires.

CONNECTION: Connection is for TIP-RING.

CABLE TYPE: The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. It is best however to ensure the correct VOP for the cable as all cables are manufactured differently. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE, and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

The AUTO selection is based on an optimized algorithm whereby the user does not need to know the cable gauge. It takes into account Resistance per unit length, Capacitance per unit length and Attenuation per unit length, in addition to POTS splitters.

VOP: Velocity of Propagation sets at what velocity the pulse travels along the wire. It is entered as a ratio of the speed of light. The two tables near the end of this section provide more information about VOP. A correct VOP will ensure accuracy in the test results. An incorrect VOP can mean a result that indicates the loop is too long or too short.

VOP (m/μs): Rather than specify the ratio of the speed of light for pulses traveling along a length of wire, users can specify the speed in meters per microsecond. Changes made to VOP (m/μs) will automatically be reflected in the VOP setting and vice versa. (Range is from 120 to 299 m/μs)

HORIZONTAL UNITS: The horizontal units on the graph once the test is run can be displayed in FEET, METERS, or in NANOSECONDS. The initial setting is reflective of the selected option under Measurement Units under System Setup.

SMOOTHING: An anti-aliasing filter that smoothes out the reflected and measured pulse to allow for easier interpretation of the results.

GRAPH SCALE: The Graph Scale setting selects the horizontal scale for displaying the test result. Each setting is listed in Imperial and Metric measurements. The options are 1000 ft (300 m), 2000 ft (600 m), 5000 ft (1500 m), 10000 ft (3000 m), 20000 ft (6000 m), 45000 ft (15000 m), and 180 kft (60 km).

Be sure to select a graph scale that is greater than the estimated length of the cable to be tested. Choosing a graph scale that is shorter will hide the result from view (off screen). The measurements units are configured to FEET or METERS depending upon the Distance Units setting under System Setup.

NOTE: If using a Graph Scaling of 180 kft (60 km) than users can enter a pulse width of 0.5 ms (500,000 ns). The step size of the graph changes to 36.8 ft (11.2 m) from 9.2 ft (2.8 m) for a VOP of 0.66.

PULSE WIDTH (NS):   The pulse width should be set here. The valid range is 28 ns to 20μs and the default value is 1000 ns for manual tests. The wider the pulse width the greater the energy pulse. Therefore, the larger pulses can travel further along the cable and longer cable lengths can be tested. In Manual TDR mode, if the cable length is unknown or there may be some impairments to be found in the shorter distance on the cable, the user should always start from the shorter pulse width. If no cable end or no large impairment can be found, the user can then move to the next wider pulse width. For example, start with pulse width of 200ns and look for any impairments up to 2500ft (760m), then change the pulse width to 400ns and look for any impairments up to 3500ft (1060m), then 800ns and look for any impairments up to 5000ft (1520m), and so on, until the cable is completely tested. Sometimes, it can be too overwhelming to decipher between many impairments, so starting small is sometimes best.

NOTE: If using a Graph Scaling of 180 kft (60 km) than users can enter a pulse width of 0.5 ms (500,000 ns). The step size of the graph changes to 36.8 ft (11.2 m) from 9.2 ft (2.8 m) for a VOP of 0.66.

PULSE SHAPE: Allows the user to specify the shape of the outgoing pulse for the TDR test. Options are: Square wave, Sine half wave, Sine compensated 50%, Sine compensated 75%,

and Sine full wave.

A Square wave is useful for detecting impairments close to a user.
A Sine Half wave and a Sine compensated (50% and 75%) wave are useful for mid-range faults.

A Sine full wave pulse is excellent for locating impairments up to 20,000 ft away from the user.

VERTICAL GAIN: Allows the user to specify a vertical gain factor to apply to the TDR result. The default setting is 0 dB (1X). The available options are 0 dB, 12 dB, 24 dB, and 36 dB. By applying a 36 dB vertical scaling factor to the TDR result, the user is actually increasing each reflection point 64 times its original size.

If TDR TEST TYPE is set to AUTO – CABLE END or AUTO – BRIDGE TAP, the following option will be displayed.

MAX. CAP. IMBALANCE (%): Allows the user to specify the maximum capacitive length imbalance between T-G and R-G. The default setting is 10%. Setting of Imbalance can be from 0.1% to 100% where 100% is the worst case scenario. If the imbalance is greater than the user defined setting the CableSHARK will not complete the test and will report *"Measurement not possible. Tip and Ring wires are substantially different lengths."*

If TDR TEST TYPE is set to AUTO – CABLE END only the following option will be displayed.

F1 LENGTH: Optional Feature: The CableSHARK is capable of bridging into the middle of a circuit (intrusive) to measure from remote to CPE and ignore the cable from remote to CO (called F1 circuit). This setting affects more measurements such as Frequency Response, TDR, and DMT test. The F1 length is assumed to be longer than the distance between the Remote Cabinet and the Customer.

Setting to 0 deactivates the function.

The function button command selection at the bottom of the TDR Test Setup Menu consists of five options available to the operator. The first three options (EDIT/SELECT, SELECT PREVIOUS, SELECT NEXT) enable the modification of the test parameters (residing near the upper part of the screen). The last two options at the bottom of the screen are CABLE TESTS and MAIN MENU. For some options for which a numeric value must be entered, only three options may appear: EDIT/SELECT, CABLE TESTS and MAIN MENU.

To modify a test parameter, it must first be highlighted with the cursor. A test parameter can be highlighted by moving the cursor to the desired parameter with the Cursor Pad UP/DOWN arrow buttons.

The following are brief descriptions of each of the function button options:

EDIT/SELECT   Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.

SELECT PREVIOUS   Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.

SELECT NEXT   Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.

CABLE TESTS   Pressing the function button corresponding to CABLE TESTS causes the CABLE TESTS pop-up menu to appear.

MAIN MENU   Select the function button corresponding to MAIN MENU to return to the Main Menu.

The following gives an indication of what the ideal Pulse Width and V.O.P. should be set to for various lengths of cable and wire gauges.

Wire Gauge Vs. V.O.P.

Here are some ***examples of typical VOP values*** for various telephone cables, given for insulation type and wire gauge / size. :

Pulp
AWG 22   0.6 mm   VOP = 0.68 (102 m/μs)
AWG 24   0.5 mm   VOP = 0.67 (100 m/μs)
AWG 26   0.4 mm   VOP = 0.66 (99 m/μs)

PIC
AWG 19   0.9 mm   VOP = 0.72 (108 m/μs)
AWG 22   0.6 mm   VOP = 0.67 (100 m/μs)

AWG 24   0.5 mm   VOP = 0.66 (99 m/μs)
AWG 26   0.4 mm   VOP = 0.64 (96 m/μs)
Jelly Filled
AWG 19   0.9 mm   VOP = 0.68 (102 m/μs)
AWG 22   0.6 mm   VOP = 0.62 (93 m/μs)
AWG 24   0.5 mm   VOP = 0.60 (90 m/μs)
AWG 26   0.4 mm   VOP = 0.58 (87 m/μs)

Polyethylene   VOP = 0.66   (99 m/μs)

Polypropylene   VOP = 0.66   (99 m/µs)   **Teflon**   VOP = 0.67   (100 m/µs

Pulse Width Vs. Test Distance

Assuming a V.O.P. of 66%

Pulse Width	Maximum Range
100 ns	50 ft / 16 m to 2000 ft / 660 m
1 µs	400 ft / 120 m to 6000 ft / 2000 m
6 µs	1850 ft / 560 m to 16000 ft / 4850 m

Calculating the Correct VOP

The exact VOP of a cable of known-length can be determined with the CableSHARK by running a successful TDR test and reading the time (in ns) between the sent pulse and the reflection pulse from the end of the cable, regardless of whatever the VOP setting is for the TDR test. Then, the exact VOP of the cable can be calculated as:

Metric Calculation

VOP = cable length (m) / time reading (s) / light speed / 2
Where the speed of light is 299792458 m/s

Imperial Calculation

VOP = cable length (ft) / time reading (s) / light speed / 2
Where the speed of light is 983559096 ft/s

The division by 2 is due to the return trip that the pulse has traveled.

Determining the Correct VOP

Given a cable of known length, users can determine the correct VOP of that cable. By manually adjusting the VOP, users can test from both ends of the cable until the CableSHARK measures the exact length of the cable.

Once the test is set up, press the RUN / STOP key located on the front panel of the CableSHARK to start the test. Another screen will appear indicating to the user that the TDR test has been started. When a TDR test is complete, the test result is displayed on the screen.

8.2.2   Manual TDR Testing

With the appropriate pulse width selected, the CableSHARK should be able to automatically locate any reflection, up to four reflections, from 30 feet (9 meters) up to 20,000 feet (6000 meters) of AWG 24 cable (lab conditions). Results will be displayed in feet, meters, or nanoseconds. Figure 8.2.2A shows a sample TDR test screen (with TEST TYPE set to MANUAL).
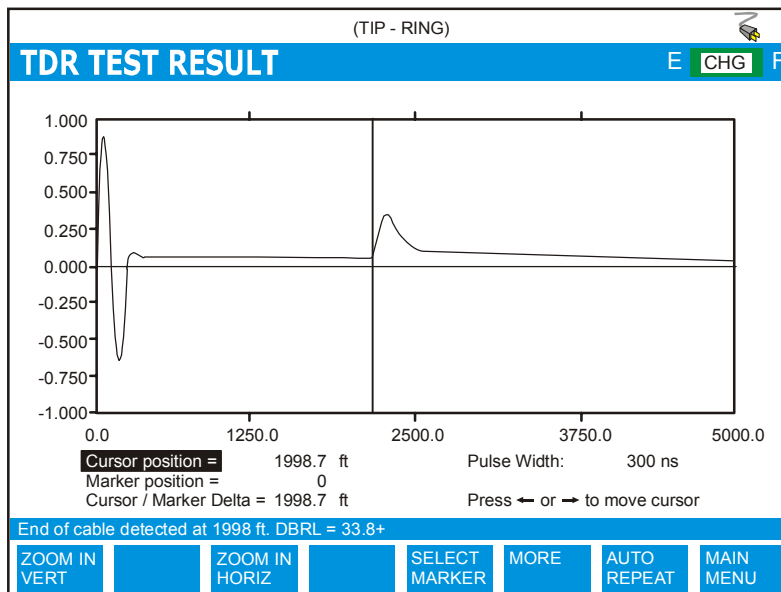
FIGURE 8.2.2A - RUNNING A MANUAL TDR TEST

The information about reflections that are found is shown on the status line in several formats, including "End of cable detected at x ft. dBRL = y" or "Reflections at distance (dBRL +/-): ...", where the distance will be in feet, meters or nanoseconds as selected. dBRL stands for the reflection loss of the sent pulse at the reflection point in dB and the +/- sign indicates the polarity of the reflection with reference to the sent pulse.

A message of "TDR test complete. Use the cursor and marker to determine reflection location." is displayed if no significant reflection can be automatically found after a pulse is sent.

If the CableSHARK has successfully found any reflections, it will place the cursor onto the first reflection and adjust the Graph Scale automatically if necessary so that the first reflection is within the display screen.

The layout of the screen shows a graphic and numeric representation of the information received by the CableSHARK. The graphs' vertical scale depicts a relative scale where 0 to +1 indicates that a discontinuity was found whose impedance is higher than the characteristic impedance of the tested cable. Values from 0 to -1 indicate a relatively low impedance. The horizontal scale shows the location of the fault or end of cable in either feet, meters, or nanoseconds.

The numeric results are listed under the graph and they are very easy to understand. There is Cursor Distance and Level, Marker Distance & Level and Delta, which, when the Cursor and Marker are at different fault locations, is the distance (or time) between these two points.
To start another test with the same pulse width, the user should simply press the RUN/STOP key.

At the completion of a test, the function button command selection at the bottom of the TDR Test Result screen consists of several options available to the operator. The following are brief descriptions of each of the function button options:

ZOOM IN VERT / ZOOM OUT VERT	Use these function buttons to zoom in and out based on the vertical level scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.
ZOOM IN HORIZ / ZOOM OUT HORIZ	Use these function buttons to zoom in and out based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.
SELECT MARKER / SELECT CURSOR	The Cursor and Marker can be moved by pressing the associated function button for SELECT MARKER and SELECT CURSOR and by using the Cursor Pad LEFT/RIGHT arrow keys on the front panel of the CableSHARK to move the Marker or Cursor.
	The Cursor position text will be highlighted whenever the cursor is selected. The Marker position text will be highlighted whenever the marker is selected.
MORE	The function button corresponding to MORE takes you to additional options including UPLOAD RESULT and the saving of the results. To view more

options, press the function button associated with MORE.

AUTO REPEAT   Enables continuous TDR pulses to be transmitted and reflections measured.

When AUTO REPEAT is enabled, the following options are shown:

CHANGE TO ns /   The scale of the graph can be displayed in feet, meters or nanoseconds by
CHANGE TO FEET /   pressing the function button associated with CHANGE TO METER, CHANGE
CHANGE TO METER   TO FEET, or CHANGE TO NANOSECONDS.

FREEZE   This command freezes the TDR result (disables AUTO REPEAT).

CHANGE SCALE   Pressing CHANGE SCALE changes the horizontal scale of the display.

In addition, the GUI changes to include the phrase "Press Up/Down key to change pulse/gain".

```
7897.6           11846.4           15795.2 ft
   Pulse Width:              2000 ns
   Gain:                     24 dB
   Press Up/Down key to change pulse/gain


    SELECT      CHANGE      FREEZE      CHANGE
    MARKER      TO Meter                SCALE
```
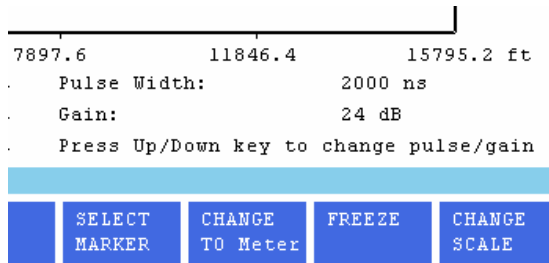
FIGURE 8.2.2B – CHANGING PULSE/GAIN

MAIN MENU   Select MAIN MENU to return to the Main Menu. ***This is not display when AUTO REPEAT is enabled.***

The following is a description of the function button command selection at the bottom of the TDR Test Result screen that will appear when the function button associated with MORE is pressed. To return to the command selection listed previously, please press the function button corresponding to MORE once again.

SHOW REF   Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the

two. See Section 5.4 for more information about the REFERENCE MASK feature.

NOTE: When using REFERENCE MASKS for the TDR, ensure that the loop lengths of the REFERENCE MASKS and the result on screen are similar or the resultant graph may be difficult to interpret

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT	Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.
SAVE TO MEM	Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.
SAVE TO USB	Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

CHANGE TO ns / CHANGE TO FEET / CHANGE TO METER	The scale of the graph can be displayed in feet, meters or nanoseconds by pressing the function button associated with CHANGE TO METER, CHANGE TO FEET, or CHANGE TO NANOSECONDS.
PREVIOUS MENU	The function button corresponding to PREVIOUS MENU takes the user to the command selections listed previously. To exit this menu level, press the function button associated with PREVIOUS MENU or TEST SETUP.
TEST SETUP	This function bottom takes the user back to the TDR SETUP menu.
MAIN MENU	Select MAIN MENU to return to the Main Menu.

8.2.2.1 Testing Cables with the Manual TDR

Figure 8.2.2.1A shows an example of a MANUAL TDR test result on a 2000-ft cable with an open cable end, with the correct VOP setting and proper pulse width selected. The large pulse near 0 distance is the sent pulse, the reflected pulse near 2000 ft is the reflection coming from the open end of the cable. The CableSHARK will attempt to place the cursor at the bottom of the rising edge of the reflected pulse. The user can choose to move the cursor or marker from where the CableSHARK has placed them.
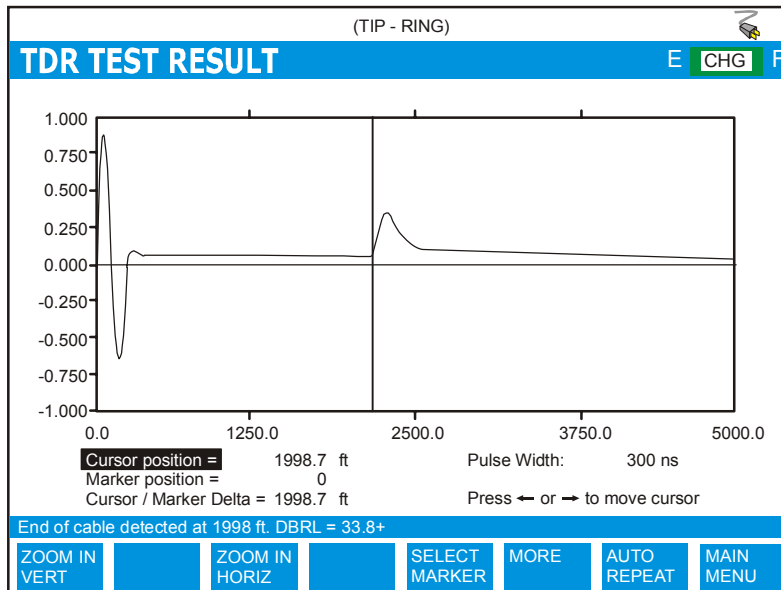
FIGURE 8.2.2.1A - RUNNING A MANUAL TDR TEST WITH THE CABLE END OPEN

Typically any fault that produces a positive reflection indicates a high impedance. Some examples of high impedance faults include end of cable, end of bridge tap, or an open circuit.

Figure 8.2.2.1B shows the MANUAL TDR test result on the same cable of Figure 8.2.2.1A with the cable end shorted, with the same VOP setting and pulse width selected. Please note that the reflected pulse is of opposite polarity to the sent pulse.
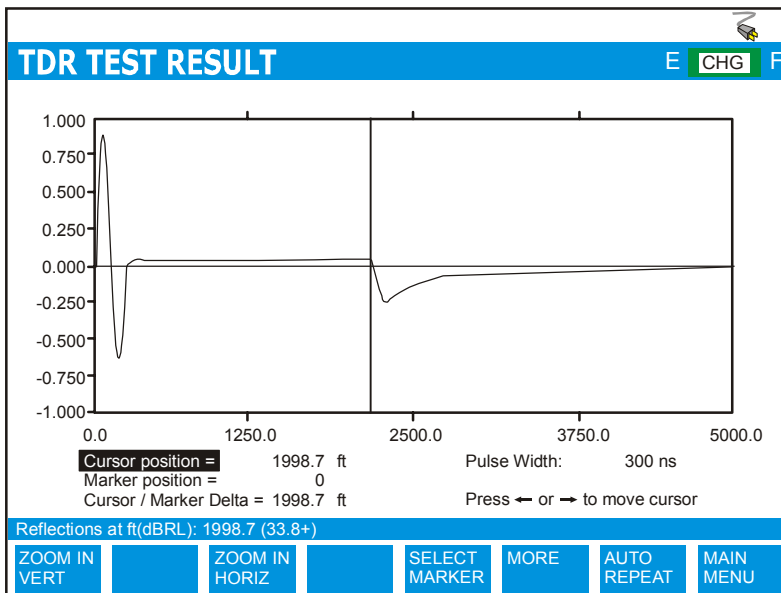
FIGURE 8.2.2.1B - RUNNING A MANUAL TDR TEST WITH THE CABLE END SHORTED

Typically any fault that produces a negative reflection indicates a low impedance. An example of a low impedance fault is a short circuit.

Figure 8.2.2.1C shows the MANUAL TDR test result on a cable of 2500 ft with a bridge tap branch of 305 ft connected at 2195 ft (Marker Line M) of the cable and the ends of the cable and the branch are open. The distance from Marker Line (M) to Cursor Line (C) in the figure indicates the length of the bridge tap (about 305 feet).
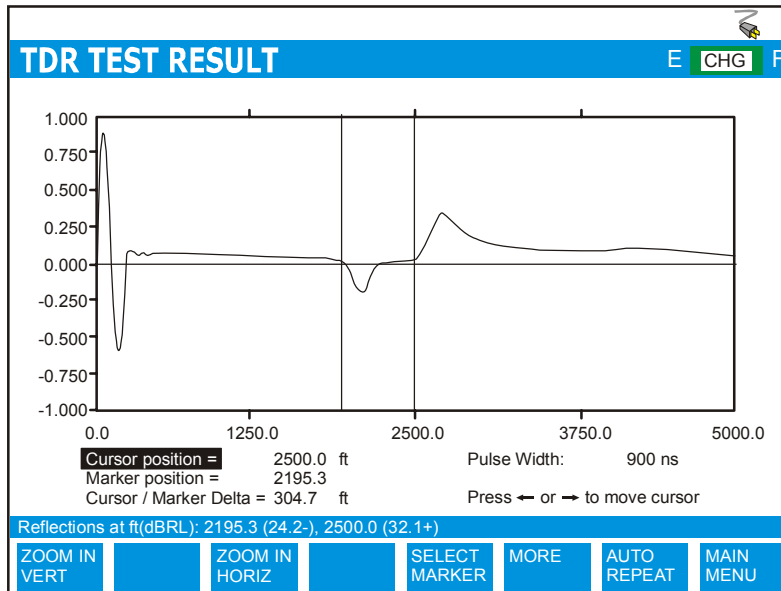
FIGURE 8.2.2.1C - RUNNING A MANUAL TDR TEST WITH A CABLE AND BRIDGE TAP BRANCH

Note: When using a manual TDR test, be sure to use the CableSHARK's zoom function to amplify the result. Often, the reflected pulse is difficult to see, so by using the vertical/horizontal zoom function, the faults can be seen easily.

8.2.3 Auto TDR Testing

The Auto – Cable End and Auto – Bridge Tap TDR functions of the CableSHARK allow a user to do a quick test without having to worry about what graph scaling to use or what the correct pulse width should be. Based on line conditions, the CableSHARK calculates what the best pulse width to use as well as what the best pulse shape is to use. Using Auto TDR mode, the CableSHARK should be able to locate any reflection from 500 feet (150 meters) up to 20,000 feet (6000 meters) of AWG 24 cables (lab conditions). Results can be displayed in units of feet, meters and nanoseconds.

Once the AUTO TDR finds any valid reflection, (up to four reflections), the CableSHARK will place the cursor onto the first reflection and adjust the Graph Scale automatically if necessary so that the first reflection is within the display screen. If the AUTO – BRIDGE TAP test is selected, only the bridge tap will be shown, not the end of the cable.

The information about all the reflections found by the AUTO TDR test is shown on the status line in the format of "Reflections at distance (dBRL +/-): ...", where distance will be in feet or meters or nanoseconds as selected. dBRL stands for the reflection loss of the sent pulse at the reflection point in dB and the +/- sign indicates the polarity of the reflection relative to the sent pulse.

Use the ZOOM IN / OUT VERT and ZOOM IN / OUT HORIZ to focus on specific points of interest on the resultant TDR graph.

NOTE: For AUTO-BRIDGE TAP mode, results can be gather if the following criteria can be met:

   1. *the bridge tap location should be less than 1/3 of the total cable length*
   2. *the bridge tap length should be less than ¼ of the total cable length and more than 1/10 of the length to the bridge tap location*

8.2.4 TDR Application Hints

8.2.4.1 Blind Spots

When the TDR test is sending the test pulse, reflections that may occur during the time interval or period of the outgoing test pulse may be obscured from the user. The interval of time that this effect occurs in is known as the *blind spot*. If a fault is suspected within the blind spot range of the cable under test, it is advisable to add a length of cable between the CableSHARK and the cable being tested. Any faults that may have been hidden in the blind spot may now be visible. Be sure to subtract the extra length from the result that the CableSHARK provides or you will be digging for a fault in the wrong spot! Make sure the extra length of wire does not influence the test by ensuring the extra wire is twisted (i.e. CAT3 or higher) and shielded. Another alternative is to vary the pulse width – smaller pulse widths will reduce or eliminate the blind spot but at the expense of distance (see Pulse Width section below).

8.2.4.2 Pulse Width

The wider the pulse width, the larger the energy. The larger the energy, the further the pulse can travel along the cable and the longer the cable length that can be tested. Normally, if the cable length is unknown or there may be some impairments to be found in the near distance of the cable, one should always start from the shorter pulse width. If no cable end or no large impairment can be found, one can then move to the next wider pulse width. For example, start with pulse width of 200ns and look for any impairments up to 2500ft (760m), then change the pulse width to 400ns and look for any impairments up to 3500ft (1060m), then

800ns and look for any impairments up to 5000ft (1520m), and so on, until the cable end is found or the test is completed. Wider pulse widths makes it easier to detect small faults on the cable or faults located at a farther distance. Starting from the shorter pulse width is useful for locating any fault that may otherwise be hidden in the blind spot (see 8.2.4.1 Blind Spots) of a sent pulse of wider width. Increasing the pulse width gradually is necessary to avoid a pulse that is so wide that one reflection is hidden behind another or to prevent the reflections from two or more faults from overlapping each other.

8.2.4.3 Reflection polarity

The phase relationship between the sent pulse and the reflected pulses can be used to determine the cause of a reflection. Reflections from sharp, increasing points of impedance are in-phase; such as open-end, load coil, lower impedance wire connected to higher impedance wire, series resistance fault, etc. Reflections from sharp, decreasing points of impedance are out-of-phase, such as shorted end, connection point of a bridge tap, higher impedance wire connected after lower impedance wire, wet splice, water in the cable etc.

8.2.4.4 Detecting Load Coils

For detecting load coils, it is easier to use the Load Coil Detection Test of the CableSHARK first, rather than guess whether or not an open-like reflection is a load coil. If the Load Coil Detection Test indicates that there is a load coil on the line, the user can use the TDR test to quickly locate and remove any load coils on the cable.

When finding the location of load coils *with TDR*, remember that the waveform will generally show a more rounded appearance than an open at the location of a load coil.

Load coils come in two values: the H88 (88mH), which is normally placed every 3000 ft (900 m) or 6000 ft (1800 m) apart, and the D66 (66mH), which is normally placed every 4500 ft (1370 m) apart. Depending on the location in the section, load coil spacing is very particular – at 3000 feet (900 m) or 6000 feet (1800 m) intervals for H88 load coils. Suspect a load coil if you see an open-like reflection on the waveform at approximately 6000 feet (1800 m) from the TDR, although not all load coils look the same. The first load coil is all that you will see, since the TDR's signal cannot pass through a load coil. Once you have found the first load coil, remove it and retest the cable.

8.2.4.5 Test from Both Ends of the Cable

It is always good practice to test a cable from both ends to locate and confirm any faults. It can reduce errors in the VOP setting and uncover any hidden faults. For example, there is a cable of 5000 ft (1500 m) length with a fault located at 2000 ft (600 m) on a cable. If the test result shows that the fault is at 2050 ft (600 m) when tested from one end and that the fault is at 3075 ft (930 m) when tested from the other end, it will indicate that the VOP setting is too fast. If, in this case, the user tested only from the first end and started to dig the ground to fix the fault, he or she would be digging in the wrong place.

8.2.4.6 How to Determine the VOP of a Cable

<ins>*Calculating the Correct VOP*</ins>

The exact VOP of a cable of known-length can be determined with the CableSHARK by running a successful TDR test and reading the time (in ns) between the sent pulse and the reflection pulse from the end of the cable, regardless of whatever the VOP setting is for the TDR test. Then, the exact VOP of the cable can be calculated as:

Metric Calculation

VOP = cable length (m) / time reading (s) / light speed / 2
Where the speed of light is 299792458 m/s

Imperial Calculation

VOP = cable length (ft) / time reading (s) / light speed / 2
Where the speed of light is 983559096 ft/s

The division by 2 is due to the return trip that the pulse has traveled.

<ins>*Determining the Correct VOP*</ins>

Given a cable of known length, users can determine the correct VOP of that cable. By manually adjusting the VOP, users can test from both ends of the cable until the CableSHARK measures the exact length of the cable.

Once the test is set up, press the RUN / STOP key located on the front panel of the CableSHARK to start the test. Another screen will appear indicating to the user that the TDR test has been started. When a TDR test is complete, the test result is displayed on the screen.

8.3 ADSL Data Rate Prediction (ADSL, ADSL2, ADSL2+) Measurements

The DMT test or ADSL, ADSL2 or ADSL2+ Data Rate Prediction tests are unique in that they are independent of any modem or line coding being carried on the line. This makes the EXFO CableSHARK ideally suited for use in qualifying any twisted copper pair lines in the local loop to carry DSL technologies.

DMT is based on Frequency Division Multiplexing (FDM). Each frequency division is also known as a "bin" or "tone" and occupies 4.3125 kHz of bandwidth. ADSL, ADSL2, and ADSL2+ use the DMT line code.

For ADSL, there are 256 bins for a maximum bandwidth of 1.104 MHz in which to encode information. This permits a downstream rate of approximately 8 Mbps. ADSL is defined by ANSI T1.413 Issue 2 and G.992.1 (G.DMT)

For ADSL2, there are 256 bins for a maximum bandwidth of 1.104 MHz. ADSL2 allows data rates up to approximately 15 Mbps. ADSL2 is defined by G.992.3.

ADSL2+ uses 512 bins for a maximum bandwidth of 2.208 MHz. ADSL2+ allows data rates of up to 24 Mbps. ADSL2+ is defined by G.992.5

8.3.1 Setting up a DMT Test

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up Menu. Choosing DMT TEST will invoke the DMT TEST SETUP Menu. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear. Figure 8.3.1A below shows the DMT Test Setup Menu.
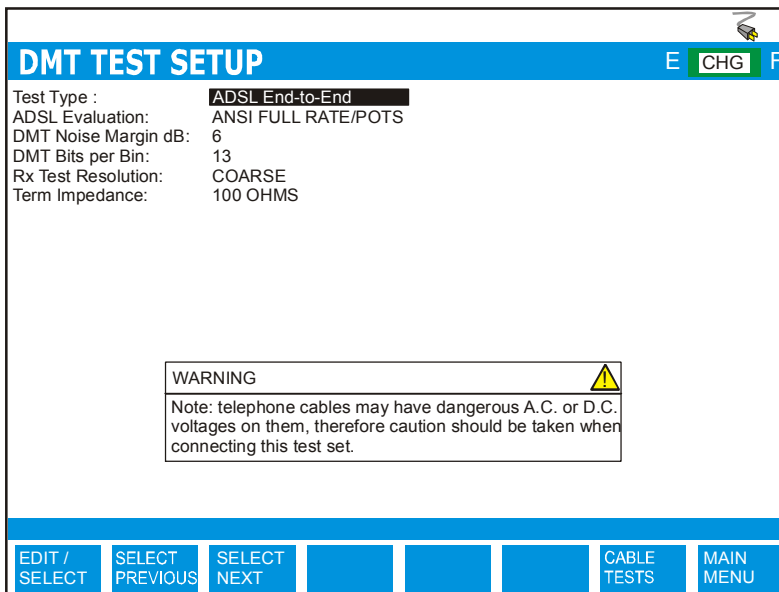
FIGURE 8.3.1A - DMT TEST SETUP MENU

The DMT TEST SETUP menu has several options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a DMT test. The following describes the DMT test setup options:

TEST TYPE: The user can choose from DMT End-to-End (end-to-end test) or from the many optional Single End tests. For end-to-end testing, activate one CableSHARK to Responder Mode from its Main Menu.
For Single Ended testing, the options are:

ADSL FROM CUSTOMER (was ADSL CPE): means the CableSHARK is emulating a generic CPE device

ADSL FROM CO/EXCH: means the CableSHARK is emulating a generic DSLAM

ADSL2 FROM CUSTOMER (was ADSL2 CPE): means the CableSHARK is emulating an ADSL2 CPE device

ADSL2 FROM CO/EXCH: means the CableSHARK is emulating an ADSL2 DSLAM

ADSL2+ FROM CUSTOMER (was ADSL2+ CPE) means the CableSHARK is emulating an ADSL2+ CPE device

ADSL2+ FROM CO/EXCH means the CableSHARK is emulating an ADSL2+ DSLAM

ADSL EVALUATION: Six options are available when ADSL FROM CUSTOMER or ADSL FROM CO/EXCH is selected: ANSI FULL RATE/POTS, ITU-T AnnexA/POTS, ETSI FULL RATE/POTS, G.LITE/POTS, ITU-T AnnexB/ISDN, and ETSI FULL RATE/ISDN. These evaluation types allow a user to more accurately model the modems and ADSL standards found in their particular region or country.

When ADSL2 or ADSL2+ is selected, the options are ITU-T Annex A/POTS, ITU-T Annex B/ISDN, ITU-T Annex J/ISDN, and ITU-T Annex L/POTS.

DMT NOISE MARGIN dB: Allows users to set the desired noise margin in dB. This is the amount of increased noise relative to the measured noise power that the system would able to tolerate to maintain a bit error rate of 10^{-7}. The industry standard is for a target value of 6 dB. Typically, a noise margin that is greater than the target set in the ATU-C is considered acceptable because it will allow for the possibility of better than expected bit rates. Set to AUTO if you are not sure. This assumes a –140 dBm/Hz noise floor.

DMT BITS PER BIN: Allows a user to modify the number of bits used per ADSL DMT bin. The default is 14 bits/bin for full rate ADSL and 8 bits for G.Lite. No modem uses the maximum 15 bits/bin as outlined by the ADSL standards.

RX TEST RESOLUTION: *ONLY AVAILABLE FOR ADSL END-TO-END SETTING*. The options are Coarse and Fine. Coarse gives the user a rough estimate of what the estimated data throughput will be. The CableSHARK will analyze the signal level every third tone and extrapolate to fill in the missing tones to estimate the data throughput. This option is disabled for the Single-Ended DMT test. The Fine setting analyzes every DMT tone (256 for full rate ADSL, 128 for G.Lite). This allows for an accurate estimation of the data throughput for both upstream and downstream traffic.

TERM IMP: The CableSHARK's impedance needs to match the characteristic impedance of the cable. This causes the CableSHARK at either end of a test (including Single End) not to reflect back any test signals or unnecessarily attenuate the test signal. The options are 100 ohms, 135 ohms, and AUTO (older hardware will still show 120 and 150 ohms). TERM IMP is disabled for Single-end DMT.

If the **TEST TYPE** is set to **SINGLE END**, the following additional parameters appear.

MAX. CAP. IMBALANCE (%):
Allows the user to specify the maximum capacitive length imbalance between T-G and R-G. The default setting is 10%. Setting of Imbalance can be from 0.1% to 100% where 100% is the worst case scenario. If the imbalance is greater than the user defined setting the CableSHARK will not complete the test and will report
"Measurement not possible. Tip and Ring wires are substantially different lengths."

F1 LENGTH:
Optional Feature: The CableSHARK is capable of bridging into the middle of a circuit (intrusive) to measure from remote to CPE and ignore the cable from remote to CO (called F1 circuit). This setting affects more measurements such as Frequency Response, TDR, and DMT test. The F1 length is assumed to be longer than the distance between the Remote Cabinet and the Customer.

Setting to 0 deactivates the function.

CABLE TYPE:
The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. It is best however to ensure the correct VOP for the cable as all cables are manufactured differently. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE , and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

The AUTO selection is based on an optimized algorithm whereby the user does not need to know the cable gauge. It takes into account Resistance per unit length, Capacitance per unit length and Attenuation per unit length, in addition to POTS splitters.

VOP:
Velocity of Propagation sets at what velocity the pulse travels along the wire. It is entered as a ratio of the speed of light. The two tables near the end of this section provide more information about VOP. A correct VOP will ensure accuracy in the test results. An incorrect VOP can mean a result that indicates the loop is too long or too short.

VOP (m/μS):
Rather than specify the ratio of the speed of light for pulses traveling along a length of wire, users can specify the speed in meters per microsecond. Changes made to VOP (m/μS) will automatically be reflected in the VOP setting and vice versa. (Range is from 120 to 299 m/μS)

If the AUTO CABLE TYPE is <u>NOT</u> selected, the following settings are available. These are necessary to provide the user with the most accurate results.

CAPACITANCE
NF/MI OR NF/KM:

Allows the user to specify the cable's capacitance constant. See Appendix B for more information on loop characteristics.

RESISTANCE
OHM/MI OR
OHM/KM

Allows the user to specify the cable's resistance constant. See Appendix B for more information on loop characteristics.

ATTENUATION
dB/MI OR dB/KM

Allows the user to specify the cable's attenuation constant. See Appendix B for more information on loop characteristics.
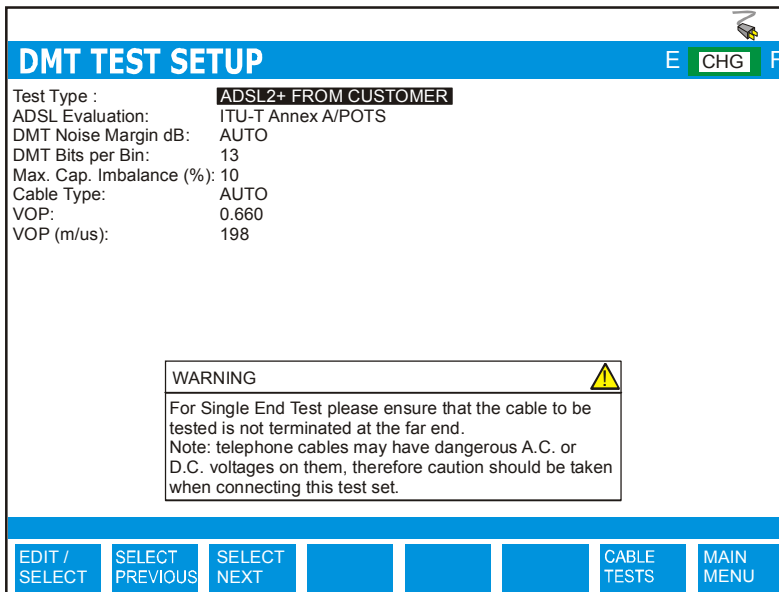
FIGURE 8.3.1B – SINGLE END DMT TEST SETUP MENU

The function button command selection at the bottom of the DMT Test Setup Menu consists of five options available to the operator. The first three options (EDIT/SELECT, SELECT PREVIOUS, SELECT NEXT) enable the modification of the test parameters (residing near the upper part of the screen). The last two options at the bottom of the screen are CABLE TESTS and MAIN MENU. For some options for which a numeric value must be entered, only three options may appear: EDIT/SELECT, CABLE TESTS and MAIN MENU. To modify a test parameter, it must first be highlighted with the cursor. A test parameter can be highlighted by moving the cursor to the desired parameter with the Cursor Pad UP/DOWN arrow buttons.

The following are brief descriptions of each of the function button options:

EDIT/SELECT   Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.

SELECT PREVIOUS   Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.

SELECT NEXT   Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.

CABLE TESTS   Pressing the function button corresponding to CABLE TESTS causes the CABLE TESTS pop-up menu to appear.

MAIN MENU   Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.3.2 Running an ADSL Test

Please see Section 8.3.3 for information on running an ADSL2 and ADSL2+ tests

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the RUN / STOP button on the front of the CableSHARK to initiate the test. If the TEST TYPE was set to DMT End-to-End, the CableSHARK will first perform a calibration and then attempt to synchronize with the other CableSHARK running in Remote Responder mode. Please note that the CableSHARK that is set to Remote Responder mode should be started first. The RUN/STOP button can be pressed at any time to stop a test that is running.

For SINGLE END tests, the CableSHARK will first determine the length of the cable (up to the first major impairment which could be the end of the cable), then perform a noise test, attenuation test, and determine the bits/bin for ADSL upstream and downstream parameters.

Figure 8.3.2A shows an example of the results obtained from a DMT Test Measurement with ANSI FULL RATE/POTS selected under the ADSL Evaluation option.
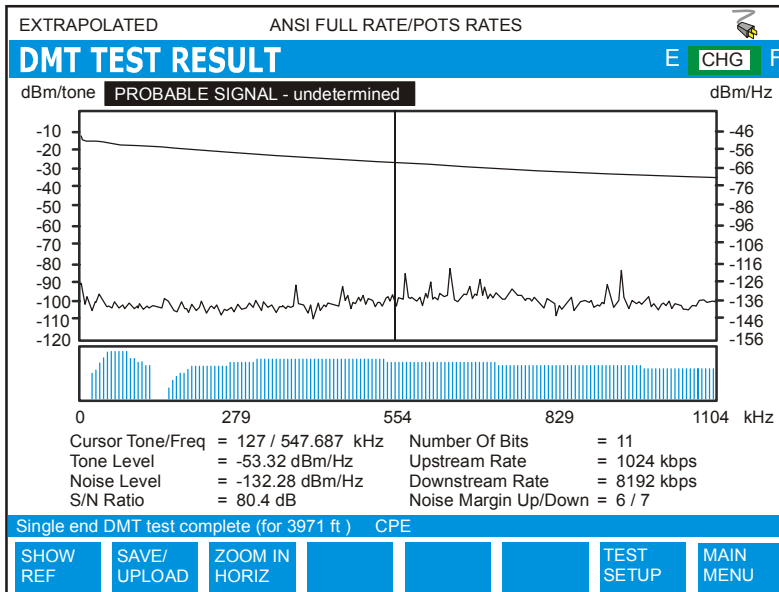
FIGURE 8.3.2A - A DMT TEST RESULT (ANSI FULL RATE/POTS SELECTED)

The ADSL FROM CUSTOMER and ADSL FROM CO/EXCH type DMT Tests display three types of important information. The first is the Tone Level or Signal Power Spectral Density (PSD) in units of dBm/tone and dBm/Hz, where dBm/tone is the signal energy within the 4kHz bandwidth of DMT tones. It is the received signal level measured at the input of an ADSL DMT modem respective of the T1.413 and G.992.2 standards. This can be located at the top of the DMT graph is typically a smooth line.

The second is the noise level or noise PSD in units of dBm/tone and dBm/Hz, where dBm/tone is the noise energy within the 4kHz bandwidth. The relation between the two units is x dBm/Hz = (x + 36) dBm/tone. This graph is normally not smooth; typically comprised of many peaks and valleys.

The third and greatest feature is the lower 'bit/bin' or 'bit/tone' graph, which indicates the maximum bits that can be allocated to an individual DMT tone according to the measured tone level and noise level at that tone frequency. This graph shows an easy to understand representation of the effects of signal attenuation and

noise floor on potential data rate. A 'bit/bin' graph showing a relatively filled in box will indicate a cable that is capable of transmitting / receiving at very high data rates.

Use the Cursor Pad LEFT/RIGHT arrow keys to move the cursor from left to right and back on the screen. The cursor position indicates Cursor Tone, Cursor Frequency, Tone Level, Noise Level, and number of bits/bin, etc..

Interference from radio transmission towers can be seen affecting the DMT line coding even though they only occupy a very small bandwidth. Figure 8.3.2B shows the test result on a cable with G.Lite / POTS selected as Rx ADSL Evaluation.
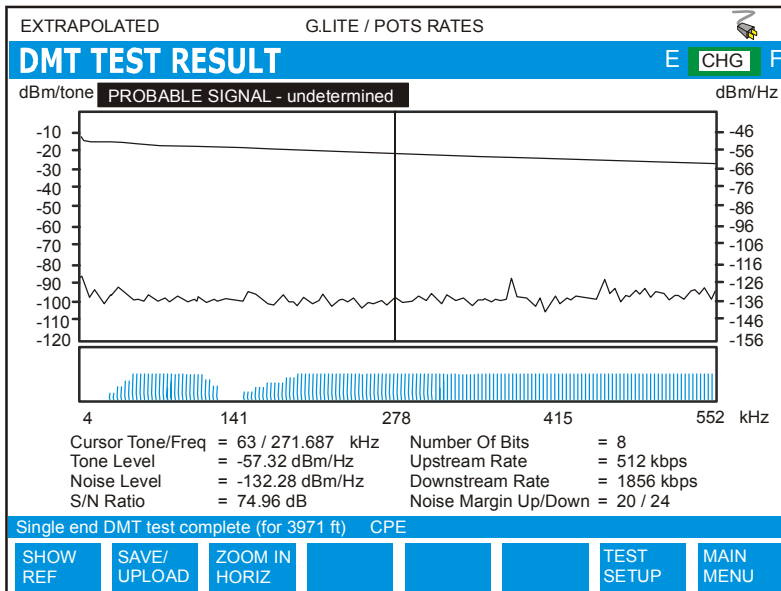
FIGURE 8.3.2B - RESULTS OF A G.LITE TEST

At the completion of a test, the function button command selection at the bottom of the DMT Test Result screen consists of seven options available to the operator. The following are brief descriptions of each of the Function button options:

SHOW REF   Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT	Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.
SAVE TO MEM	Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.
SAVE TO USB	Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

ZOOM IN HORIZ / ZOOM OUT HORIZ	Use these function buttons to zoom IN and OUT based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disabled, as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.
TEST SETUP	Pressing the function button corresponding to TEST SETUP activates the DMT Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.
MAIN MENU	Select MAIN MENU to return to the Main Menu.

8.3.3 ADSL2 and ADSL2+ Data Rate Prediction

The CableSHARK's ADSL2 and ADSL2+ Data Rate Prediction tests will qualify the copper loop's ability to carry these new DMT based asymmetrical technologies.

Set the TEST TYPE to ADSL2 FROM CUSTOMER, ADSL2 FROM CO/EXCH, ADSL2+ FROM CUSTOMRE, or ADSL2+ FROM CO/EXCH depending upon the testing you want to do. Select the FROM CUSTOMER variant to test from the CPE outwards into the network. Select the FROM CO/EXCH variant to test from the CO inwards to the customer premise.

Press the RUN / STOP button on the front of the CableSHARK to initiate the test.

Figure 8.3.3A shows an example of the results obtained from an ADSL2+ Test
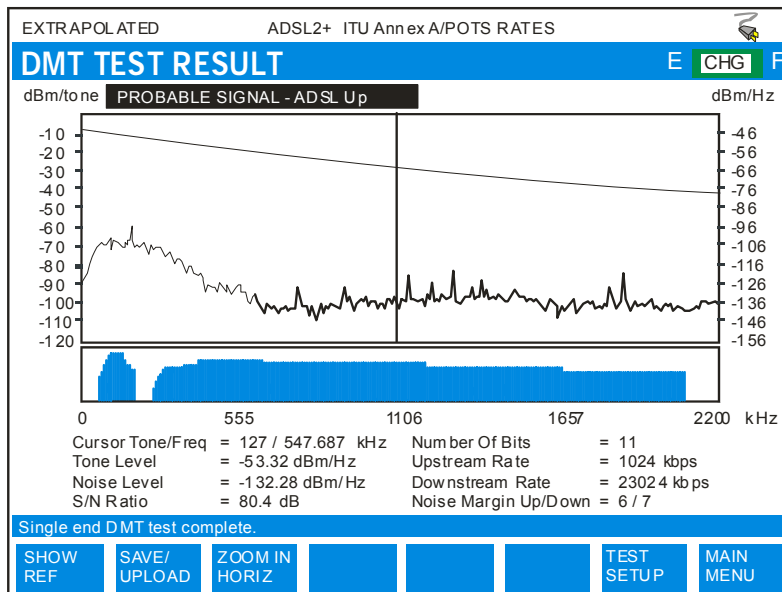
FIGURE 8.3.3A – ADSL2+ DATA RATE PREDICTION TEST

The ADSL2 / ADSL2+ Data Rate Prediction test looks at the attenuation of the ATU PSD Mask rather than the simple frequency response of the original DMT test. This process provides a more accurate estimation of the data rate expected by the customer.

Here are the PSD masks for ATU-R (CPE) and ATU-C (CO). The transmit level of the signal will depend upon the length of the circuit under test. For short lengths, a low transmit level will be used to prevent unnecessary crosstalk in adjacent pairs. For long lengths, a higher transmit level will be used to allow the signal to reach the far end.

Example of a ADSL2 ATU-C (downstream) mask (non-overlapped spectrum)

Example of a ADSL2 ATU-R (downstream) mask (non-overlapped spectrum)

Example of a ADSL2+ ATU-C (downstream) mask (non-overlapped spectrum)

PSD in dBm/Hz

−18 dB/octave

−36.5 dBm/Hz peak PSD

−3 dB/octave

36 dB/octave

−65 dB/octave

4.63 dB/octave

−78 dB/octave

−100 dBm/Hz peak PSD in 10 kHz window

−97.5 peak +15 dBrn 0-4 kHz

−46.5 dBm/Hz

peak PSD in 1 MHz window above 3750 kHz

−44.2 dBm/Hz

−47.8 dBm/Hz

−72.5 dBm/Hz

−92.5 dBm/Hz

−59.4 dBm/Hz

−80 dBm/Hz

−100 dBm/Hz

−110 dBm/Hz

−112 dBm/Hz

Frequency in kHz

0   4   80 138   1104   1622   2208   3001.5   3750 4545   7225   12000

2500   3175

Example of a ADSL2+ ATU-R (downstream) mask (non-overlapped spectrum)

PSD in dBm/Hz

−34.5 dBm/Hz peak PSD

21.5 dB/octave

-72 dB/octave

−100 dBm/Hz peak PSD in 10 kHz window

−97.5 peak +15 dBrn 0-4 kHz

-15 dB/dec

peak PSD in 1 MHz window above 3750 kHz

-93.2 dBm/Hz

−92.5 dBm/Hz

−100 dBm/Hz

−110 dBm/Hz

−112 dBm/Hz

Frequency in kHz

0   4   25.875   138   243   686   1411 1630   5275   12000

8.3.4 CPE Modem Detection and DSLAM Detection

The CableSHARK's DMT test will automatically determine if there is a CPE modem or DSLAM connected to the far end of the circuit and will use the training frequency patterns as described by ANSI T1.413 to predict the expected data rate of the circuit. The test will work provided that the equipment conforms to ADSL specifications ANSI T1.413, G.DMT, or G.Lite. The DMT test will provide the user with an indication on the status bar what device was detected – either an Annex A or Annex B modem or DSLAM.
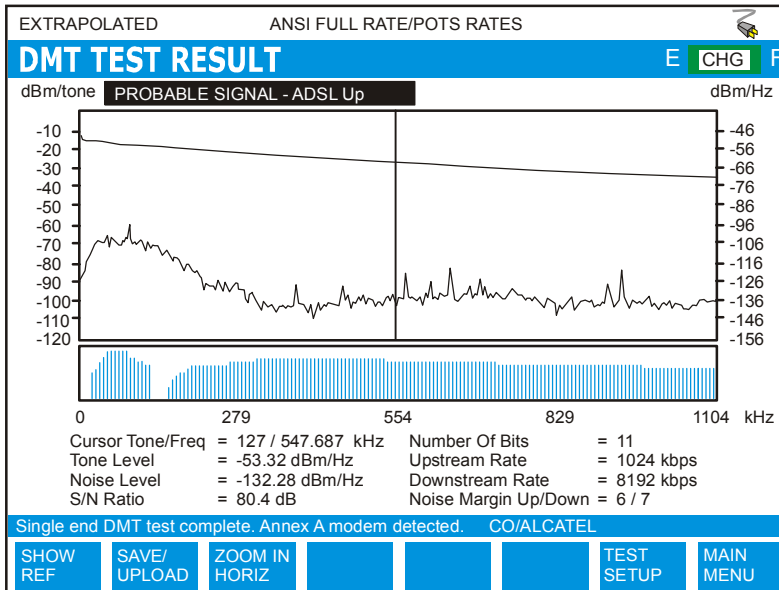
FIGURE 8.3.4A – ADSL MODEM DETECTED

8.3.5 DMT Test Application Hints

1   Single-Ended DMT test results provide EXTRAPOLATED data rates only!

2   The DMT test can be used to analyze the problem in which a pair of ADSL modems or an ADSL service fails with the cable. This is done by looking at the signal level and noise level at the ADSL modem synchronization frequencies. For example, a pair of ADSL modems compliant with the ANSI T1.413 standard employs some twelve tones ranging from 34.5kHz to 310.5kHz at a level of -1.65dBm to -3.65dBm at 100 ohm to handshake and to maintain synchronization with each other. If a pair of ADSL modems fails to synchronize, one should look at the cable noise, interference and/or attenuation at any of those frequencies. Normally, to ensure reliable ADSL service on a cable, the tone signal level at those synchronization frequencies should be at least 20 dB above the noise level.

3   The insertion loss or attenuation level of the cable at a tone frequency can be obtained by subtracting the measured tone signal PSD in dBm/Hz at that tone from the normal transmitting tone signal PSD of – 40 dBm/Hz as specified by the T1.413 and G.Lite standards.

4   The DMT test can also be used to predict the data rates for other standards of xDSL applications where applicable.

5   The powerful noise PSD measurement can be used for applications where the PSD measurement of noise is required for the frequency range available. Even with one CableSHARK unit, the DMT test can complete the noise PSD test while it is showing the message of "No Signal Detected! (showing noise only)".

8.4..Noise Measurements

Noise on the line is the greatest negative factor in delivering xDSL services to a subscriber. Noise can be caused by a variety of things including bad splices, changes in wire gauge, adjacent twisted pairs, and a T1 or 2 Mbit/s (E1) line or another xDSL technology bundled in the same cable. The CableSHARK can measure up to 2.2 MHz or 6 MHz.

NOTE: When turning on the backlight on a monochrome unit, the backlight inverter will induce some low level interference onto the PSD measurement. This will not affect the measurements.

8.4.1 Setting up a Noise Test

From the Main Menu, pressing Function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choose NOISE to invoke the NOISE TEST SETUP menu. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear. Figure 8.4.1A below shows the Noise Test Setup Menu.
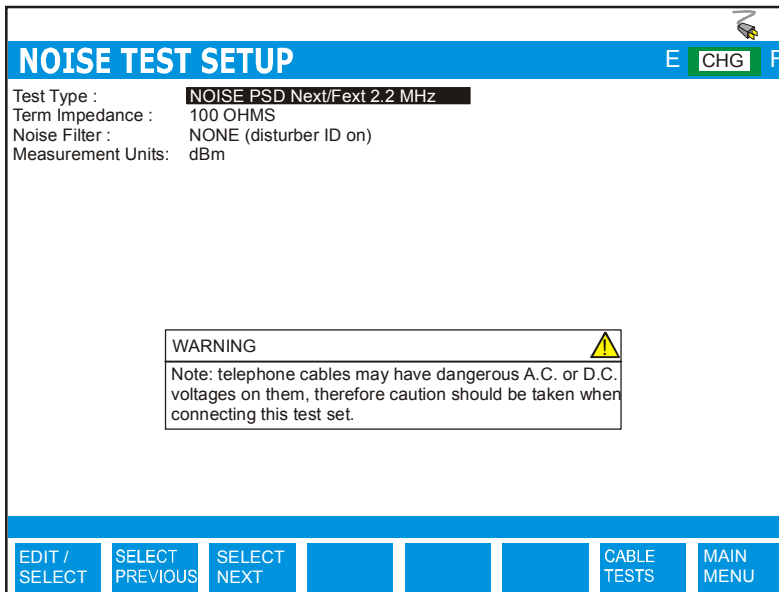
FIGURE 8.4.1A – POWER SPECTRAL DENSITY NOISE TEST SETUP MENU
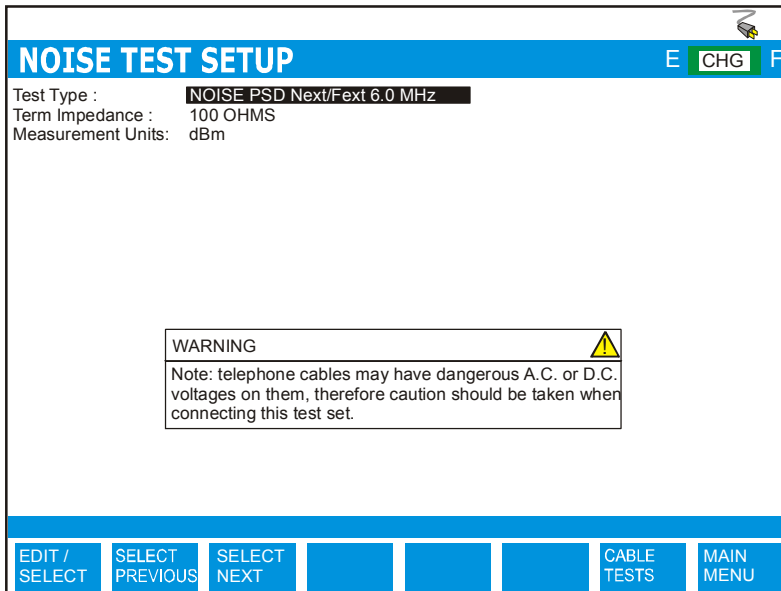
FIGURE 8.4.1B – PSD MENU FOR 6 MHZ

NOISE TEST SETUP   E CHG F

Test Type :	IMPULSE NOISE
Term Impedance :	100 OHMS
Termination:	TERMINATED
Noise Filter :	NO FILTER
Imp Nse Threshold:	- 43
Measurement Units:	dBm
Imp Nse Meas Time:	1 Minute

WARNING ⚠️

Note: telephone cables may have dangerous A.C. or D.C. voltages on them, therefore caution should be taken when connecting this test set.

EDIT / SELECT	SELECT PREVIOUS	SELECT NEXT				CABLE TESTS	MAIN MENU

FIGURE 8.4.1C – IMPULSE NOISE TEST SETUP MENU
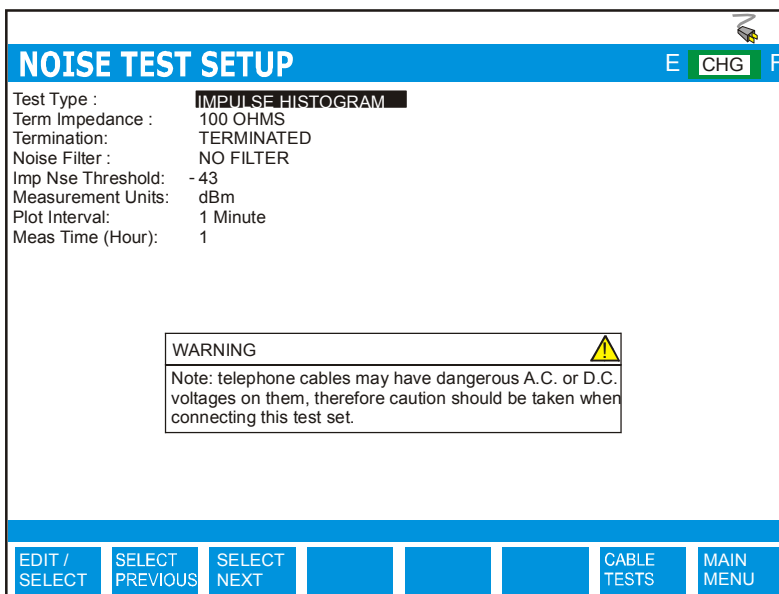
FIGURE 8.4.1D – IMPULSE HISTOGRAM TEST SETUP MENU

The NOISE TEST SETUP Menu has several options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a noise test. The noise test setup options are described as follows:

TEST TYPE: Select from NOISE PSD Next/Fext 2.2 MHz, NOISE PSD Next/Fext 6.0MHz, IMPULSE NOISE and IMPULSE HISTOGRAM.

The PSD NOISE test measures the PSD noise energy and displays the result in terms of dBm/Hz. For this test, no test signal is impressed onto the line under test. The background cable signal is converted to a RMS voltage reading.

For Impulse Noise, no test signal is impressed onto the line under test. The background cable signal is analyzed for a predetermined time to count the number of noise spikes higher than the user selected threshold.

For Impulse Histogram, the CableSHARK plots impulse noise spikes over a user definable time period.

TERM IMP: The CableSHARK's impedance needs to match the characteristic impedance of the cable. This causes the CableSHARK at either end of a test (including Single

End) not to reflect back any test signals or unnecessarily attenuate the test signal. The options are 100 ohms, 135 ohms, and AUTO (older hardware will still show 120 and 150 ohms). For single-ended tests, the AUTO impedance setting is recommended because it gives better accuracy by measuring the cable and selecting the most appropriate attenuation.

NOISE FILTER: The options are ISDN E Filter, HSDL F Filter, ADSL G Filter and No Filter. No Filter is the most ideal selection since it gives the user an unbiased analysis of the results.

NOTE: The Noise Filter is not available when Test Type is set to the PSD 6 MHz setting.

MEASUREMENT UNITS Allows the user to specify the measurement units for the test. The choices are dBm and dBrn.

The following items pertain to the Test Type of Impulse Noise

IMP NSE THRESHOLD: Allows the user to preset a threshold (minimum) level of an acceptable noise spike. The default value is –43 dBm or 47 dBrn.

MEASUREMENT UNITS Allows the user to specify the measurement units for the test. The choices are dBm and dBrn.

IMP NSE MEAS TIME: Allows the user to determine the time during which to count impulse noise spikes. The options are 1 minute, 5 minutes, 15 minutes, 60 minutes, or 24 hours of testing. Impulse Histogram

The following items pertain to the Test Type of Impulse Histogram

IMP NSE THRESHOLD: Allows the user to preset a threshold (minimum) level of an acceptable noise spike. The default value is –43 dBm or 47 dBrn.

MEASUREMENT UNITS Allows the user to specify the measurement units for the test. The choices are dBm and dBrn.

PLOT INTERVAL: Allows the user to determine the time during which to count impulse noise spikes before displaying results on screen. The options are 1 minute, 5 minutes, 15 minutes, or 60 minutes.

MEAS TIME (HOUR):	Allows the user to specify the maximum test time in hours.

The function button command selection at the bottom of the Noise Test Setup menu consists of five options available to the operator. The first three options (EDIT/SELECT, SELECT PREVIOUS, SELECT NEXT) enable the modification of the test parameters (residing near the upper part of the screen). The last two options at the bottom of the screen are CABLE TESTS and MAIN MENU. For some options for which a numeric value must be entered, only three options may appear: EDIT/SELECT, CABLE TESTS and MAIN MENU.

To modify a test parameter, it must first be highlighted with the cursor. A test parameter can be highlighted by moving the cursor to the desired parameter with the Cursor Pad UP/DOWN arrow buttons.
The following are brief descriptions of each of the function button options:

EDIT/SELECT	Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.
SELECT PREVIOUS	Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.
SELECT NEXT	Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.
CABLE TESTS	Pressing the function button corresponding to CABLE TESTS causes the CABLE TESTS pop-up window to appear.
MAIN MENU	Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.4.2 Running a Noise Test

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the RUN/STOP button on the front of the CableSHARK to initiate the test. The RUN/STOP button can be pressed at any time to stop a test that is running. Figure 8.4.2A shows an example of the results obtained from an Impulse Noise Measurement test.
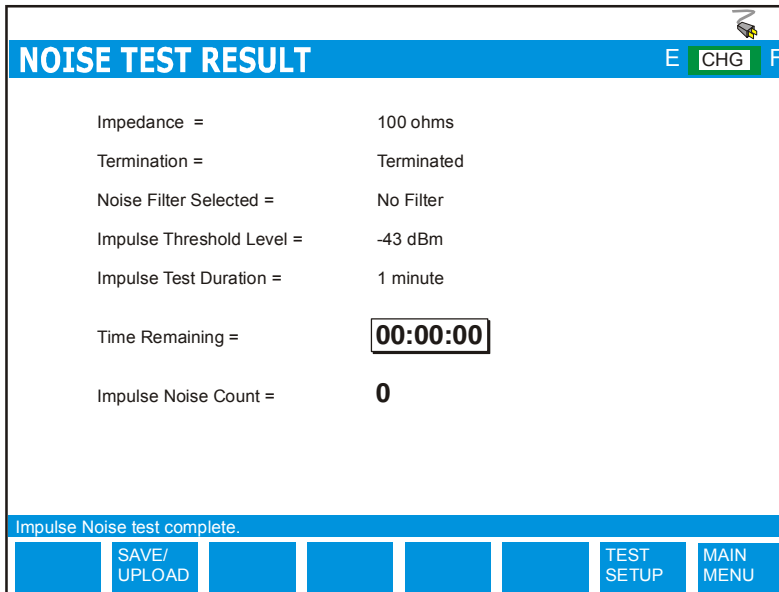
FIGURE 8.4.2A - IMPULSE NOISE RESULTS

For IMPULSE NOISE, the user can see the threshold that was set, the time remaining to perform the test and how many impulse noise spikes that are above the threshold have occurred. Once the Impulse Noise test is complete, the Time Remaining will indicate 0 s. The test has been completed.

For NOISE PSD, the test measures the power spectral density (PSD) of the noise as well as the RMS noise energy. The test result will be shown in two portions as shown in Figure 8.4.2B. The first portion is the PSD result, which consists of a graph showing the PSD to 2 MHz (or 6 MHz) of the measured noise with resolution of 2.15625 kHz (or 4.3125 for 6 MHz bandwidth), a cursor frequency indicator and the PSD value at the cursor location in terms of dBm/Hz. The second portion is the RMS noise energy measured value in terms of dBm. ***NOTE: Press the FREEZE button to stop the continuous NOISE TEST.***
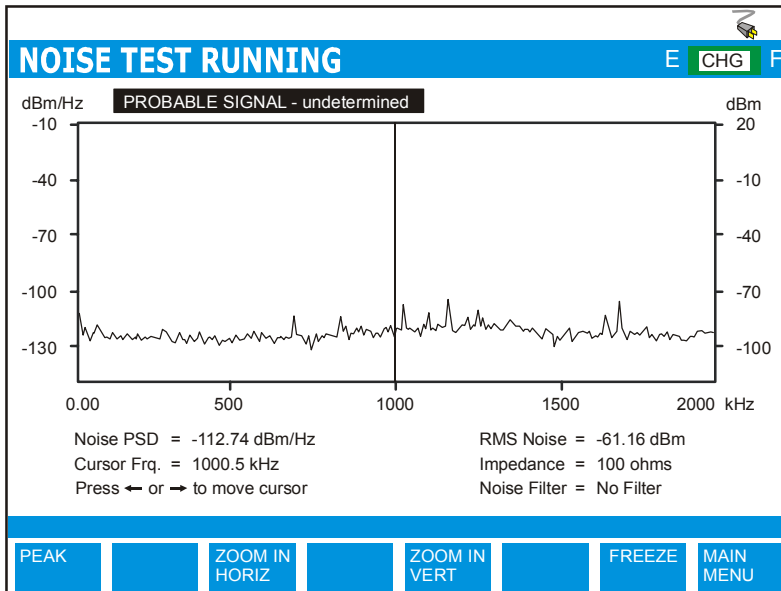
FIGURE 8.4.2B - NOISE PSD RESULTS
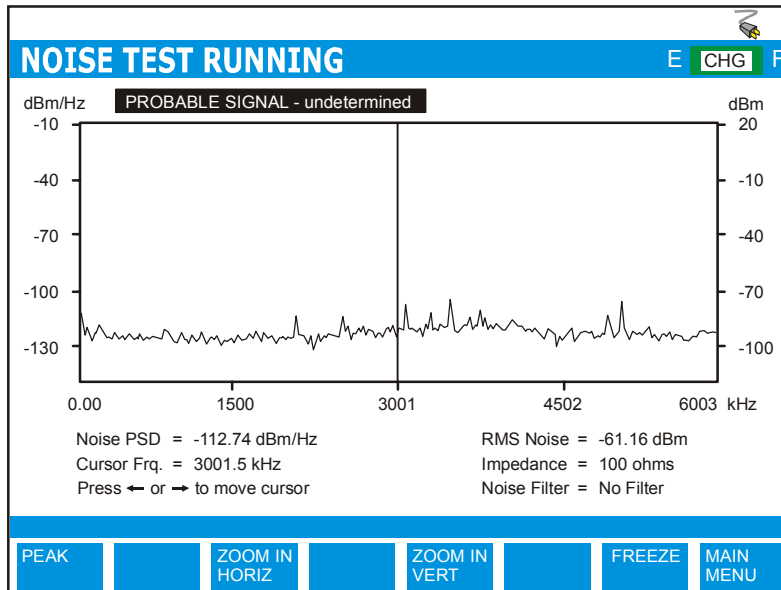
FIGURE 8.4.2C - NOISE PSD RESULTS FOR 6 MHZ BANDWIDTH

The PSD test can also be run continuously or in PEAK mode where PEAK mode redraws a new point if this point is greater in level than the previous. The PEAK mode is ideal for long term analysis of a circuit to help identify transients or intermittent crosstalk / noise.

NOTE: Press the FREEZE button to stop the continuous NOISE TEST.
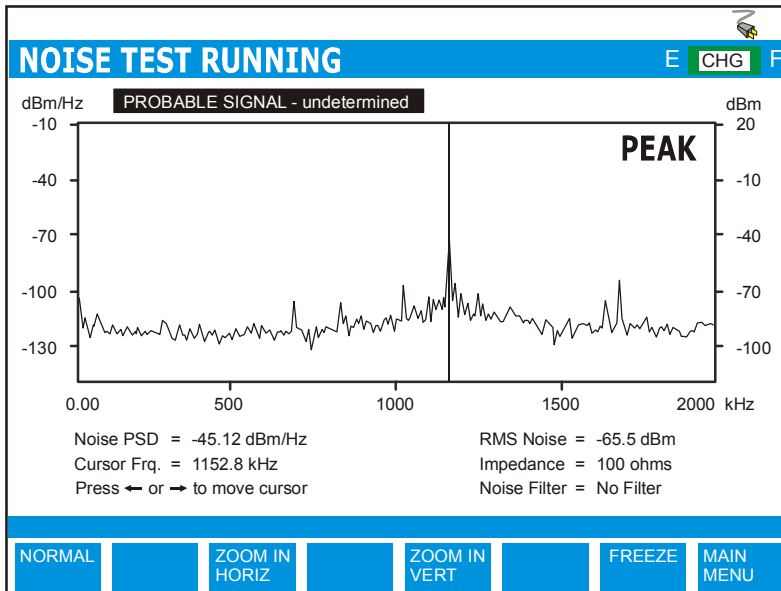
FIGURE 8.4.2D - NOISE PSD RESULTS WITH PEAK ENABLED
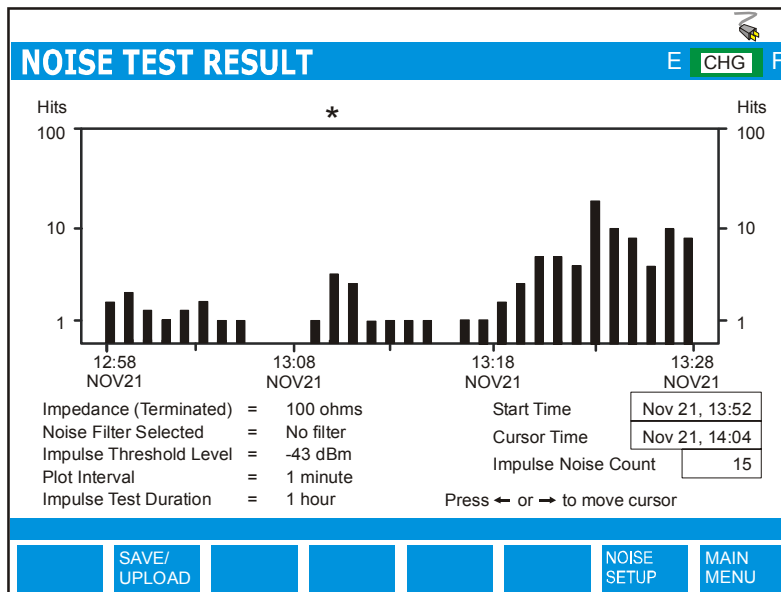
FIGURE 8.4.2E – IMPULSE HISTOGRAM RESULTS

At the completion of a test *(press FREEZE button to stop PSD tests),* the function button command selection at the bottom of the Noise Test Result screen consists of several options available to the operator. The following are brief descriptions of each of the function button options:

SHOW REF Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainders of the buttons are as follows:

ZOOM IN VERT /
ZOOM OUT VERT   Use these function buttons to zoom in and out based on the vertical level scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.

ZOOM IN HORIZ /
ZOOM OUT HORIZ   Use these function buttons to zoom in and out based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the Noise Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

8.5..Longitudinal Balance Test

The longitudinal balance test ensures that the twisted pair is balanced. Longitudinal balance ratio is defined in ITU-T Rec. O.9, which is important when it comes to reducing the effects of common-mode voltage to ground. The CableSHARK can perform a longitudinal balance measurement to determine if the longitudinal balance ratios are compliant with this standard. The CableSHARK displays results for ADSL applications respective of the ANSI T1.413 standard. The better the balance of the cable pair under test, the higher the dB reading resulting from the measurement.

8.5.1 Setting up a Longitudinal Balance Test

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing LONGITUDINAL BALANCE will invoke the LONGITUDINAL BALANCE TEST SETUP menu. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear. Figure 8.5.1A below shows the Longitudinal Balance Test Setup Menu.
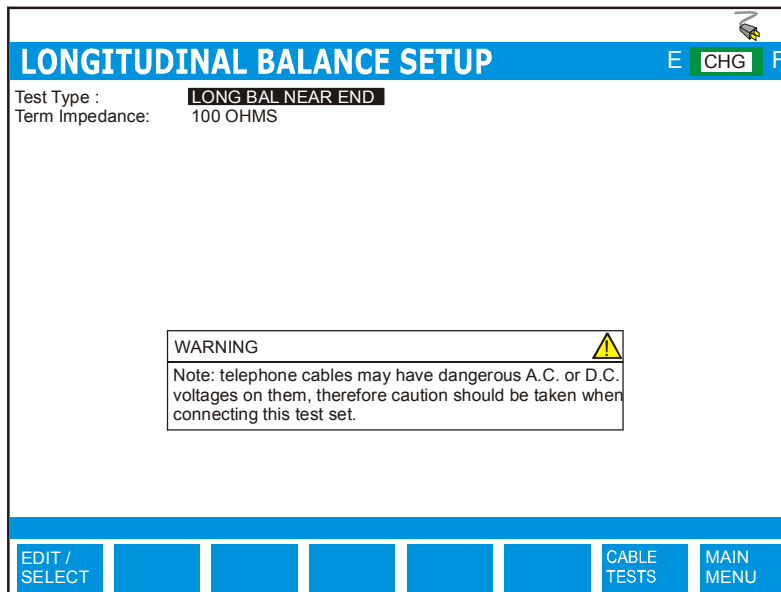
FIGURE 8.5.1A – LONGITUDINAL BALANCE TEST SETUP

The Longitudinal Balance Test Setup menu has several options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a Longitudinal Balance test. The Longitudinal Balance test setup options are described as follows:

TEST TYPE:	**LONG BAL NEAR END**. This test is a single ended longitudinal balance test where the resultant is plotted from 26 kHz to 2208 kHz.
TERM IMPEDANCE:	The options are 100 ohms, 135 ohms, and AUTO (older hardware will still show 120 and 150 ohms). For single-ended tests, the AUTO impedance setting is recommended because it gives better accuracy by measuring the cable and selecting the most appropriate attenuation.

8.5.2 Running a Longitudinal Balance Test

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them. The CableSHARK will not run a Longitudinal Balance if the voltage on the line is greater than 10 volts.

Press the RUN / STOP button on the front of the CableSHARK to initiate the test. Figure 8.5.2A shows an example of the results obtained from a Longitudinal Balance Test.
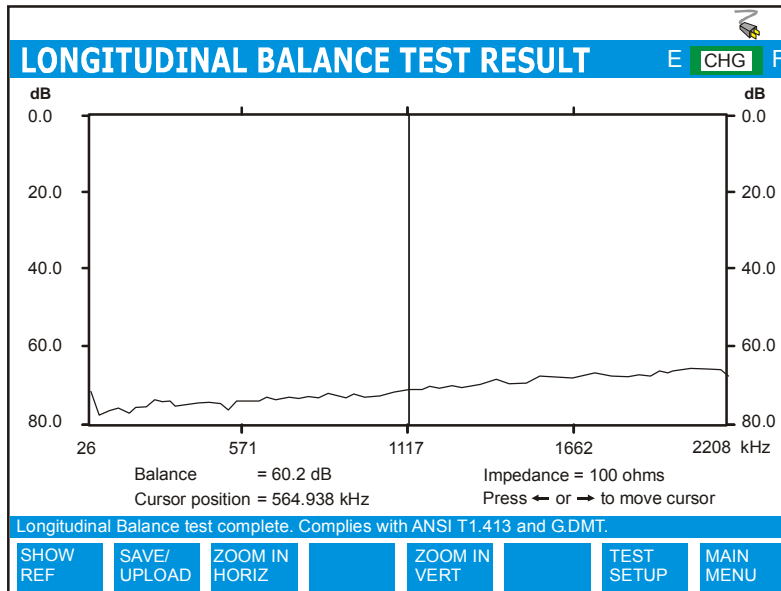
FIGURE 8.5.2A - RESULTS OF A LONGITUDINAL BALANCE TEST

The better the balance, the higher the dB readings resulting from the measurement. The CableSHARK will analyze the results and will indicate whether the readings comply with the T1.413 and G.DMT standards or not.
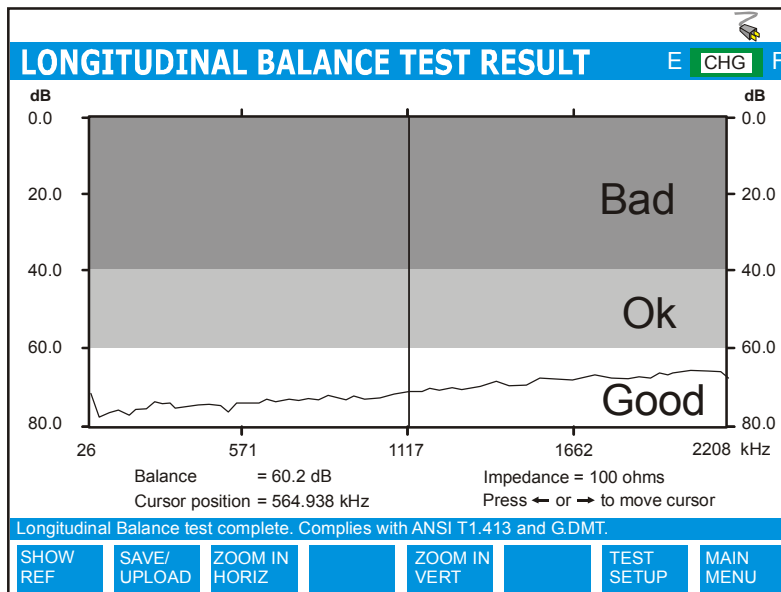
FIGURE 8.5.2B – GOOD VS BAD RESULT

At the completion of a test, the Function button command selection at the bottom of the LONGITUDINAL BALANCE TEST RESULT screen consists of six options available to the operator. The following are brief descriptions of each of the Function button options:

SHOW REF   Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT   Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

ZOOM IN VERT /
ZOOM OUT VERT   Use these function buttons to zoom in and out based on the vertical level scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.

ZOOM   IN   HORIZ   /
ZOOM OUT HORIZ   Use these function buttons to zoom in and out based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the Longitudinal Balance Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

8.6..Load Coil Detection Test

The CableSHARK Load Coil Detection Test can detect if there is any load coil along the line and advise the user to perform an auto or manual TDR test to locate the load coil(s). When running a TDR test, a load coil on the line acts like an open circuit on the line. When running FR or DMT tests with a line, the test results will show the severe roll off in frequencies from 4 kHz to some 10 kHz should loading coils exist on the line.

8.6.1 Setting up a Load Coil Detection Test

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing LOAD COIL will invoke the LOAD COIL DETECTION SETUP menu. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear. Figure 8.6.1A below shows the Load Coil Test Setup Menu.
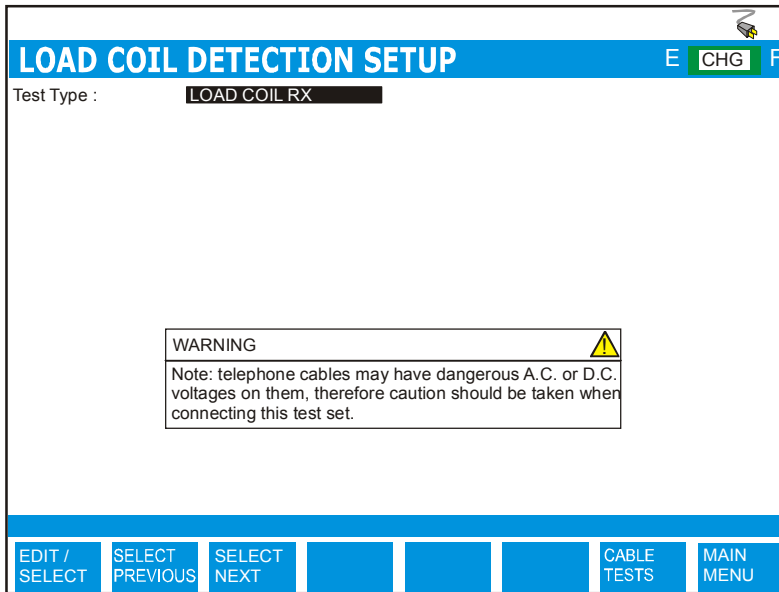
FIGURE 8.6.1A – LOAD COIL DETECTION SETUP MENU

The Load Coil Detection Setup menu has several options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a Load Coil Detection test. The Load Coil Detection test setup options are described as follows:

TEST TYPE: Select from either **LOAD COIL RX** (receiver mode) or **LOAD COIL SINGLE END**. LOAD COIL SINGLE END will plot a results graph up to 10 kHz. If a load coil(s) is found, they will be represented graphically. **LOAD COIL RX** is an end-to-end test. Another CableSHARK will need to be set to Remote Responder mode.

8.6.2 Running a Load Coil Detection Test

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the function button corresponding to the RUN / STOP button on the front of the CableSHARK to initiate the test. The CableSHARK will first perform a calibration and then attempt to synchronize with the other CableSHARK running in Remote Responder mode (assuming **LOAD COIL RX** was selected). Please note that the CableSHARK that is set to Remote Responder mode should be started first. Figure 8.6.2A shows an example of the results obtained from a Load Coil Detection Test. The CableSHARK that is set to **LOAD COIL SINGLE END** will display the results of the test graphically.

LOAD COIL TEST RESULT

E CHG F

Load Coil Detection Test Results:

No load coils detected.

Load coil detection test complete.

| | SAVE/ UPLOAD | | | | | TEST SETUP | MAIN MENU |
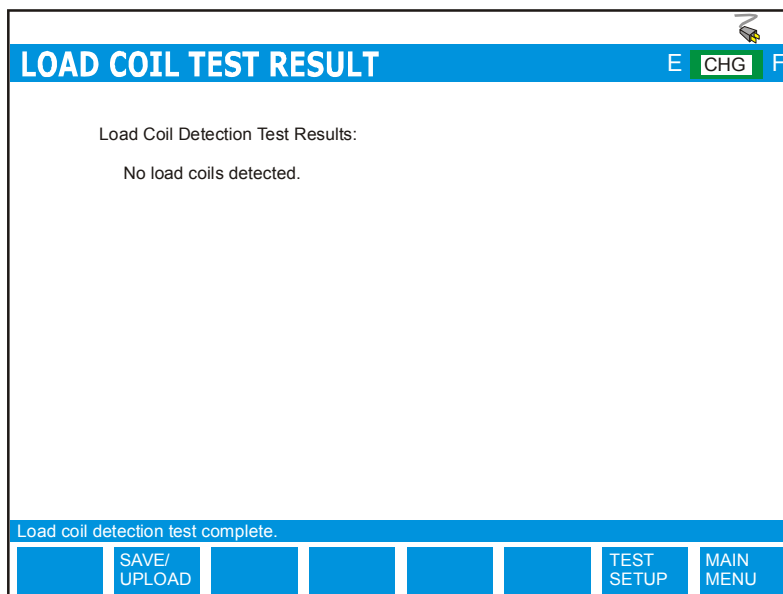
FIGURE 8.6.2A - RESULTS OF AN END-TO-END LOAD COIL DETECTION TEST
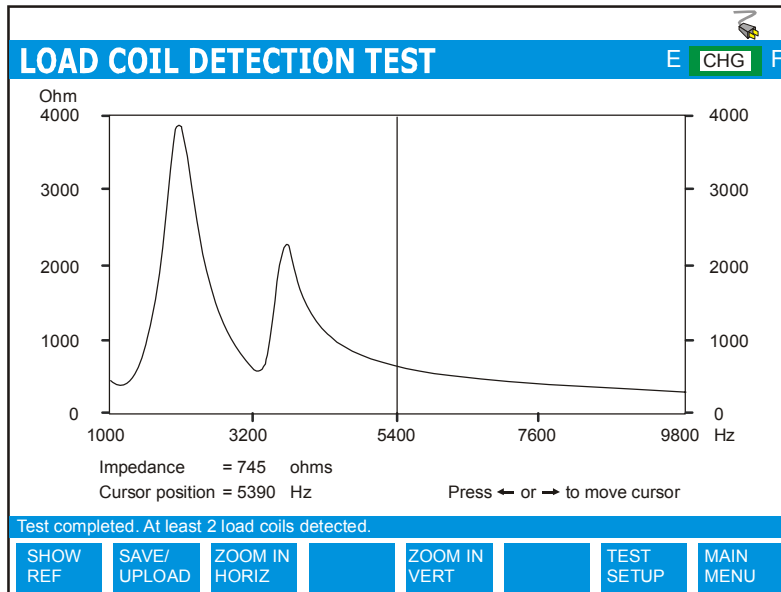
FIGURE 8.6.2B - RESULTS OF A SINGLE END LOAD COIL DETECTION TEST

As shown in the figure above, the CableSHARK will indicate whether or not there are load coils on the line. If the Load Coil Detection Test indicates that there is a load coil on the line, the user can use the TDR test to quickly locate and remove any load coils on the cable.

When finding the location of load coils *with TDR*, remember that the waveform will generally show a more rounded appearance than an open at the location of a load coil. Loading coils come in two values: the H88 (88 mH), which is normally placed every 6000 ft apart, and the D66 (66 mH), which is normally placed every 4500 ft apart. Depending on the location in the section, load coil spacing is very particular – at 3000 feet (914 m) or 6000 feet (1829 m) intervals for H88 load coils. Suspect a load coil if you see an open-like reflection on the waveform at approximately 6000 feet (1829 m) from the TDR, although not all load coils look the same. The first load coil is all that you will see, since the TDR's signal cannot pass through a load coil. Once you have found the first load coil, remove it and retest the cable.

At the completion of a test, the function button command selection at the bottom of the LOAD COIL TEST RESULT screen consists of several options available to the operator for a LOAD COIL RX test. The following are brief descriptions of each of the function button options:

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT   Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainders of the buttons are as follows:

TEST SETUP   Pressing the function button associated with TEST SETUP activates the Load Coil Detection Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

If a LOAD COIL test is run that is using a Test Type set to LOAD COIL SINGLE END, the user will have the following options:

SHOW REF   Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT   Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainders of the buttons are as follows:

ZOOM IN VERT /   Use these function buttons to zoom in and out based on the vertical level
ZOOM OUT VERT   scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.

ZOOM IN HORIZ /   Use these function buttons to zoom in and out based on the horizontal graph
ZOOM OUT HORIZ   scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the Load Coil Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

8.7   Digital Multimeter (DMM) Test

The CableSHARK's Digital Multimeter Test or *DMM Test* can detect AC/DC voltages & current and measure resistance and capacitance on a circuit. Using this test allows technicians to identify whether a line is live (voice line) or not in use (no voltage or current). The Resistance and Capacitance measurements will also provide the user with an estimated loop length after the completion of this test.

NOTE: If Measurement Standards under System Setup is set to ANSI, then the CableSHARK's RESISTANCE Measurement will be titled SHORTS METER and the CAPACITANCE Measurement will be titled OPENS METER.

8.7.1 Setting up a DMM Test

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choose DIGITAL MULTIMETER to invoke the DMM TEST SETUP screen. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear. Figure 8.7.1A below shows the DMM Test Setup Menu when the EDIT/SELECT button is pressed.

The DMM circuits will be calibrated each time the CableSHARK is powered on and the user enters the DMM Test Setup for the first time. Calibration of the DMM internal circuitry will take less than 1 minute to complete.

NOTE: For best results, use grounded connector cables when performing any DMM tests. Performing Tip to Ground or Ring to Ground measurements may give incorrect results if an ungrounded cable is not used.
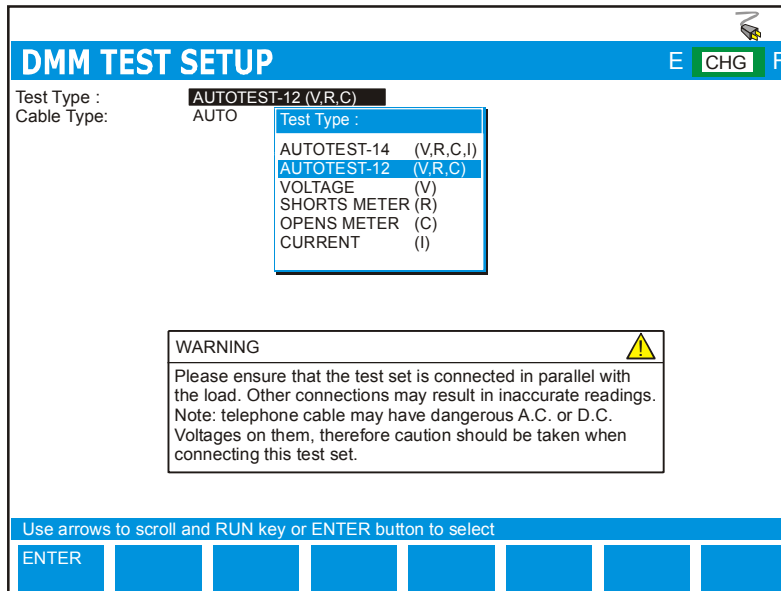
FIGURE 8.7.1A – DMM SETUP MENU

The DMM Test Setup menu has several options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a DMM Test. The DMM Test setup options are described as follows:

TEST TYPE: Select from **Autotest-14, Autotest-12, Voltage, Resistance, Capacitance** or **Current**. Please following the warning screens on the CableSHARK for best use practices. Use common sense when connecting the CableSHARK to the line. Telecommunication lines can carry hazardous voltages.

The Autotest selections allow the user to do an automatic DMM test. The unit will test, in order, Voltage, Resistance and Capacitance. The Autotest-14 will also do a Current test.

NOTE: If Measurement Standards under System Setup is set to ANSI, then the CableSHARK's RESISTANCE Measurement will be titled SHORTS METER and the CAPACITANCE Measurement will be titled OPENS METER.

The AUTOTEST-14 will perform all DMM measurements (V, R, C, I) for all three legs of the circuit (T-R, R-G, T-G) except the Current test which is only tested on T-R. Selecting the AUTOTEST-14 (V,R,C,I) test from the Test Type menu will call up three other menu selections:

CABLE TYPE: The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. It is best however to ensure the correct VOP for the cable as all cables are manufactured differently. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE, and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

The AUTO selection is based on an optimized algorithm whereby the user does not need to know the cable gauge. It takes into account Resistance per unit length, Capacitance per unit length and Attenuation per unit length, in addition to POTS splitters.

If the AUTO CABLE TYPE is <u>NOT</u> selected, the following settings are available. These are necessary to provide the user with the most accurate results.

CAPACITANCE NF/MI OR NF/KM: Allows the user to specify the cable's capacitance constant. See Appendix B for more information on loop characteristics.

CAPACITANCE NF/MI OR NF/KM TO GND: Allows the user to specify the cable's capacitance to GND constant.

RESISTANCE Ohm/mi or Ohm/km Allows the user to specify the cable's resistance constant. See Appendix B for more information on loop characteristics.

The AUTOTEST-12 will perform Voltage, Resistance, and Capacitance tests for all three legs of the circuit (T-R, R-G, T-G). Selecting the AUTOTEST-12 (V,R,C) test from the Test Type menu will call up three other menu selections:

CABLE TYPE: The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. It is best however to ensure the correct VOP for the cable as all cables are manufactured differently. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE, and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

The AUTO selection is based on an optimized algorithm whereby the user does not need to know the cable gauge. It takes into account Resistance per unit length, Capacitance per unit length and Attenuation per unit length, in addition to POTS splitters.

If the AUTO CABLE TYPE is <u>NOT</u> selected, the following settings are available. These are necessary to provide the user with the most accurate results.

CAPACITANCE NF/MI OR NF/KM:
Allows the user to specify the cable's capacitance constant. See Appendix B for more information on loop characteristics.

CAPACITANCE NF/MI OR NF/KM TO GND:
Allows the user to specify the cable's capacitance to GND constant.

RESISTANCE ohm/mi or ohm/km
Allows the user to specify the cable's resistance constant. See Appendix B for more information on loop characteristics.

For Voltage, Resistance and Capacitance tests, the following menu selection is available; allowing a user to test each circuit leg separately or automatically.

CONNECTION:
Allows the user to specify the connection to be tested. TIP-RING, TIP-GROUND, and RING-GROUND are options. In addition, there is an ALL setting which will cycle through TIP-RING, TIP-GROUND, and RING-GROUND without any involvement by the user except to ensure the CableSHARK is properly connected to the line under test.

Please note that the Current Measurement test is only performed over TIP-RING.

CABLE TYPE:
The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. It is best however to ensure the correct VOP for the cable as all cables are manufactured differently. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE , and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

The AUTO selection is based on an optimized algorithm whereby the user does not need to know the cable gauge. It takes into account Resistance per unit length, Capacitance per unit length and Attenuation per unit length, in addition to POTS splitters.

Selecting the CAPACITANCE test from the Test Type menu one further parameter will appear:

Capacitance (nF/mile or nF/km):
The default setting is 83 nF/mile or 51.6 nF/km for Tip-Ring measurements (see Table 8.7.1A for more information). See Appendix B for more information on loop characteristics.

Please check with the cable manufacturer for specific details concerning the cables capacitance constant. The Capacitance Constant is used to calculate the length of the cable based on the Capacitance measurement. The following table lists the most common values.

Metric (mm)	AWG	nF/mile	nF/km
0.40 PE		80.5	50
0.405	26 PIC	83.0	51.6
0.50 PE		80.5	50
0.511	24 PIC	83.0	51.6
0.60 PE		64.4	40
0.644	22 PIC	83.0	51.6
0.90 PE		64.4	40
0.912	19 PIC	83.0	51.6

Table 8.7.1A – Capacitance Constants –
Metric & AWG Wire Gauges (0Hz/DC, 20℃ or 70℉)

For measurements for T-G and R-G, the CableSHARK is set to 125 nF/mile or 77.7 nF/km.

Please note that cables containing any impairments including bridge taps may severely affect the distance results based only on capacitance. It should be noted that a TDR test will provide the most accurate determination of the length of a cable.

CAPACITANCE nF/mi or nF/km to GND: Allows the user to specify the cable's capacitance to GND constant. The default setting is 125 nF/mile or 77.7 nF/km.

Selecting the RESISTANCE test from the Test Type menu one further parameter will appear:

Resistance (ohm/mile or ohm/km): See Table 8.7.1A for more information. See Appendix B for more information on loop characteristics.

Please check with the cable manufacturer for specific details concerning the cables capacitance constant. The Resistance Constant is used to calculate the length of the cable based on the Resistance measurement. The following table lists the most common values.

Metric (mm)	AWG	ohm/mile	ohm/km
0.40 PE		451	280
0.405	26 PIC	439	273
0.50 PE		288	179
0.511	24 PIC	276	172
0.60 PE		198	123
0.644	22 PIC	174	108
0.90 PE		88.5	55
0.912	19 PIC	86.6	53.8

Table 8.7.1B – Resistance Constants –
Metric & AWG Wire Gauges (0Hz/DC, 20℃ or 70℉)

Please note that cables containing any impairments including bridge taps may severely affect the distance results based only on resistance. It should be noted that a TDR test will provide the most accurate determination of the length of a cable.

The function button command selection at the bottom of the DMM Tests Setup menu consists of five options available to the operator. The first three options (EDIT/SELECT, SELECT PREVIOUS, SELECT NEXT) enable the modification of the test parameters (residing near the upper part of the screen). In addition, CABLE TESTS and MAIN MENU. For some options for which a numeric value must be entered, only three options may appear: EDIT/SELECT, CABLE TESTS and MAIN MENU.

To select an appropriate test, it must first be highlighted with the cursor. A specific test can be highlighted by moving the cursor to the desired parameter with the Cursor Pad UP/DOWN arrow buttons. The following are brief descriptions of each of the function button options:

EDIT/SELECT Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.

SELECT PREVIOUS   Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.

SELECT NEXT   Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.

CABLE TESTS   Pressing the function button corresponding to CABLE TESTS causes the CABLE TESTS pop-up window to appear.

MAIN MENU   Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.7.2 Running a DMM Test

⚠️   Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the function button corresponding to the RUN / STOP button on the front of the CableSHARK to initiate or stop the test. Figure 8.7.2A shows an example of the results obtained from a partial AUTOTEST-12 DMM Test that has been run on the same circuit. Autotest can be completed in less than 15 seconds.
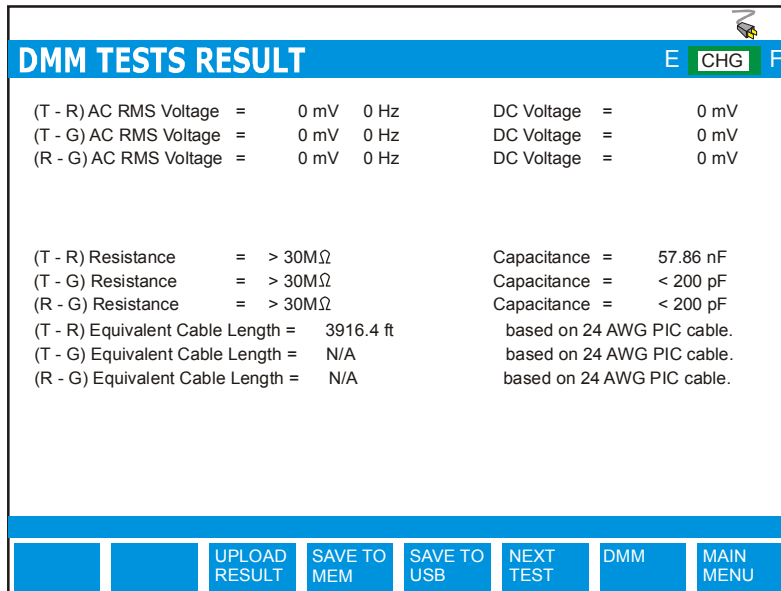
FIGURE 8.7.2A - RESULTS OF A AUTO-12 DMM TEST

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NOTE: Warning messages may appear at the bottom of the DMM result screen signifying that there is additional T-R capacitance, a missing shield or ground connection or grounded Tip or Ring wires.

NOTE: For manually executed resistances tests, the maximum resistance will be up to 999 Mohm

For all tests, a user will have to press the RUN / STOP button to halt operation since all tests monitor the link continuously for changes except for the Autotests and the Capacitance test.

Multiple tests results can be seen on the screen provided that NEXT TEST or DMM TESTS buttons are selected to change the test type to another test rather than pressing the function button for MAIN MENU. If a user presses MAIN MENU before a result(s) is saved or uploaded to a PC, all information on the screen will be lost. NEXT TEST and DMM TESTS remember the last test result so another test can be run without losing any information.

At the completion of a test, the function button command selection at the bottom of the DMM TESTS RESULT screen consists of several options available to the operator. The following are brief descriptions of each of the function button options:

TIP-RING, TIP-GND, RING-GND   Pressing the function button (F1) associated with these selections allows the user to test between (a) Tip and Ring, (b) Tip and Ground, and (c) Ring and Ground. These manual selections are not available for AUTOTEST-14, AUTOTEST-12, or CURRENT (I) tests.

UPLOAD RESULT   Pressing the function button corresponding to UPLOAD RESULT sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEMORY   Selecting the function button corresponding to SAVE TO MEMORY invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Selecting the function button corresponding to SAVE TO USB invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

NEXT TEST   Selecting the function button corresponding to NEXT TEST allows the user to select another type of test to run.

DMM TESTS   Pressing the function button associated with DMM TESTS activates the DMM Tests Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

8.8.. 4-Wire Crosstalk Test

The CableSHARK's 4 Wire Crosstalk test or *4 WIRE XTALK Test* or Stressed Noise test allows users to measure and observe crosstalk on cable pairs that are currently in use or being provisioned for xDSL. One major impairment for which the 4wire crosstalk measurement is well suited for is for detecting and determining the severity of split pairs.

Service Providers have often had to resort to using split pairs to add a subscriber. Using the good conductors from two defective pairs, a split pair is created. While this works well for plain old telephone service (POTS), it is disastrous for the broadband signals of DSL. Telephone cables are twisted to minimize the amount of induced differential noise caused by crosstalk from adjacent pairs. When a split pair is used, the two conductors are no longer twisted together to form the correct cancellation effect. This causes crosstalk to occur.

8.8.1 Setting up a 4-Wire Crosstalk Test

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. The following sections will explain the operation of this test. Figure 8.8.1A below shows the 4 Wire Crosstalk Test Setup Menu.
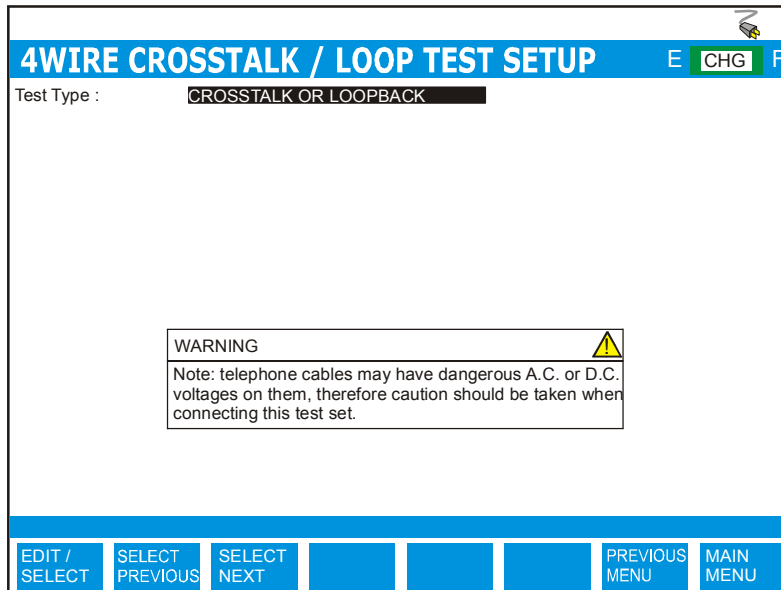
FIGURE 8.8.1A – 4 WIRE CROSSTALK SETUP MENU

The 4-Wire Crosstalk test setup options are described as follows:

TEST TYPE: Select from either **CROSSTALK / LOOPBACK** or **SINGLE FREQUENCY**.

CROSSTALK / LOOPBACK will display a plot of the crosstalk. Background loop noise is rejected.

SINGLE FREQUENCY will display a power level in dB for a user specified frequency.

FREQUENCY (kHz):   The Frequency setting is only available when the 4 Wire Crosstalk Test Type is set to **SINGLE FREQUENCY**.

8.8.2 Running a 4-Wire Crosstalk Test

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the function button corresponding to the RUN / STOP button on the front of the CableSHARK to initiate the test. Figure 8.8.2A shows an example of the results obtained from a 4 Wire Crosstalk Test.
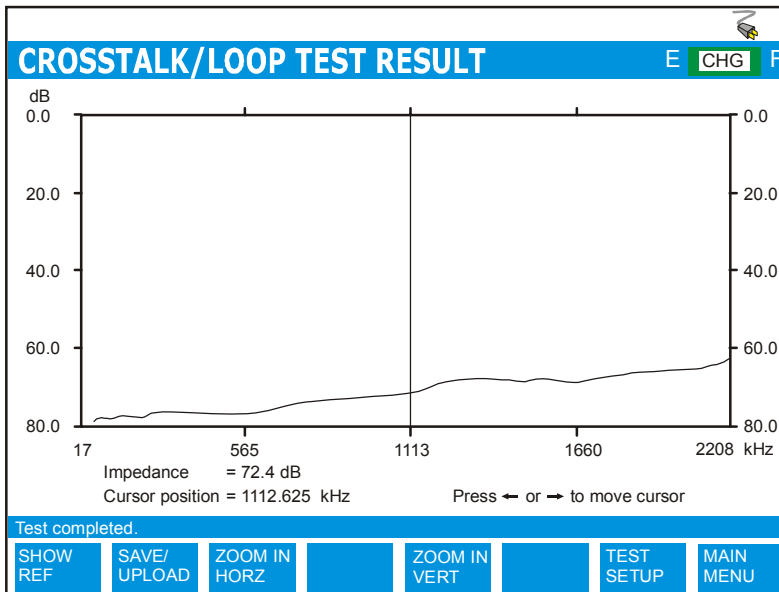
FIGURE 8.8.2A - RESULTS OF 4 WIRE CROSSTALK TEST

At the completion of a test, the Function button command selection at the bottom of the 4 WIRE XTALK RESULT screen consists of a minimum of five options available to the operator. The following are brief descriptions of each of the Function button options:

SHOW REF   Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT	Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.
SAVE TO MEM	Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.
SAVE TO USB	Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

ZOOM IN VERT / ZOOM OUT VERT	Use these function buttons to zoom IN and OUT based on the vertical level scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.
ZOOM IN HORIZ / ZOOM OUT HORIZ	Use these function buttons to zoom IN and OUT based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.
TEST SETUP	Pressing the function button associated with TEST SETUP activates the 4-WIRE XTALK Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.
MAIN MENU	Select MAIN MENU to return to the Main Menu.

Running a SINGLE FREQUENCY test will yield a screen similar to Figure 8.8.2B (below).
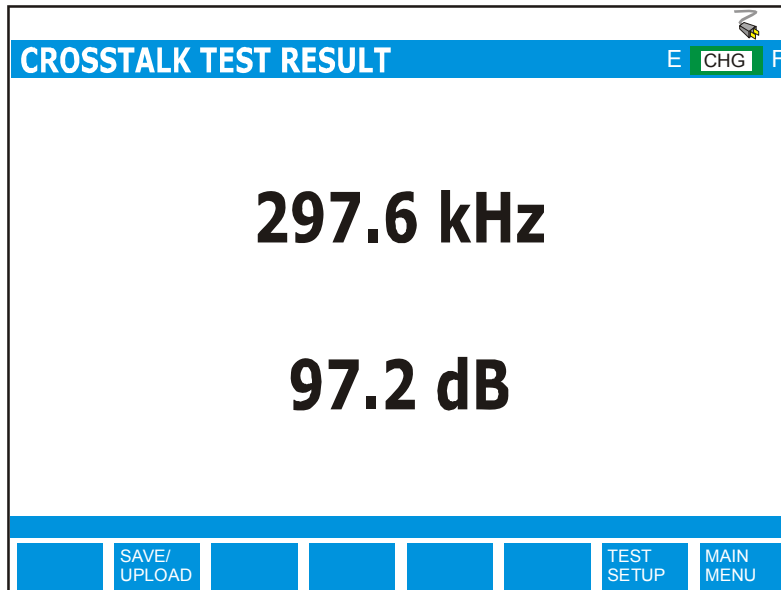
FIGURE 8.8.2B - RESULTS OF 4-WIRE CROSSTALK TEST

This test allows a user to continuous monitor the effects of crosstalk at a single frequency (until the RUN/STOP key is pressed) and to adjust the frequency by using the UP and DOWN ARROW keys (from 17.3 kHz to 2.208 MHz).

8.9   Isolation Resistance Test

The CableSHARK's Isolation Resistance Test allows users to generate a high voltage onto the copper pair to measure the isolation between tip and ring, between two pairs, and from tip or ring to ground. The measured resistance of the fault is displayed. The time the voltage is applied, in other words the "soak" time is programmable by the user. The amount of current is low and controlled to protect the user. This test is not only useful for identifying high resistance faults but also locating them.

NOTE: If Measurement Standards under System Setup is set to ANSI, then the CableSHARK's ISOLATION RESISTANCE Measurement will be titled STRESS/LEAKAGE METER.

8.9.1   Setting up an Isolation Resistance Test

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing ISOLATION TEST from the pop-up menu will invoke the ISOLATION TEST setup menu. The following sections will explain the operation of this test. Figure 8.9.1A below shows the Isolation Setup Menu.
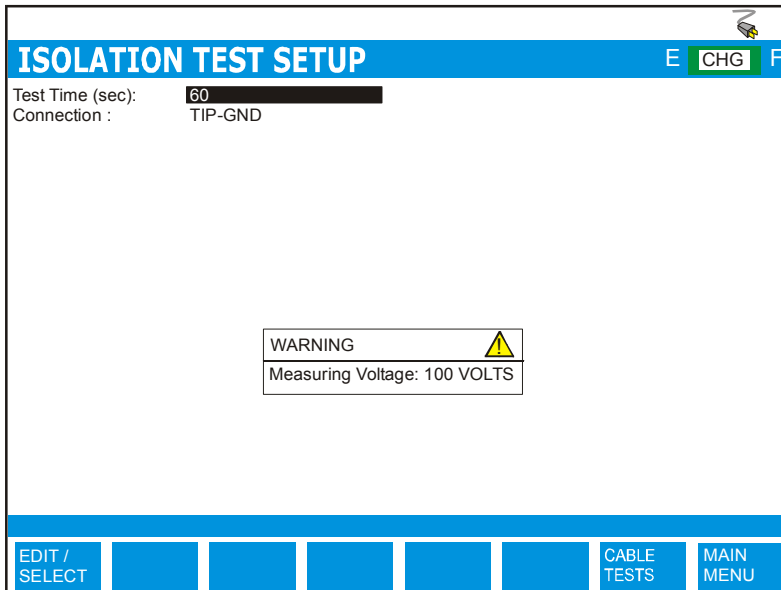

FIGURE 8.9.1A – ISOLATION RESISTANCE SETUP MENU

The Isolation Resistance test setup options are described as follows:

TEST TIME (SEC):   The user can specify the "soak" time or the duration of the test in which 100 VDC is applied to the circuit. Allowable times are from 1 to 99 seconds.
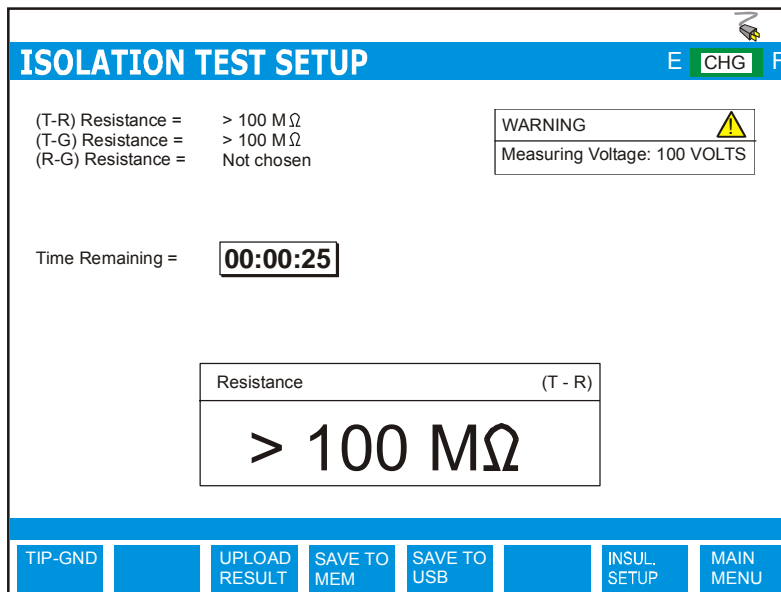
CONNECTION: The user can select ALL, TIP-RING, TIP-GROUND, and RING-GROUND for which to perform the test on.

8.9.2 Running an Isolation Resistance Test

⚠ Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them. The Isolation Resistance Test injects 100 VDC onto the line however it is current limited.

Press the function button corresponding to the RUN / STOP button on the front of the CableSHARK to initiate the test. Figure 8.9.2A shows an example of the results obtained from an Isolation Resistance Test.

ISOLATION TEST SETUP   E CHG F

(T-R) Resistance =   > 100 MΩ
(T-G) Resistance =   > 100 MΩ
(R-G) Resistance =   Not chosen

WARNING ⚠
Measuring Voltage: 100 VOLTS

Time Remaining =   **00:00:25**

Resistance   (T - R)

> 100 MΩ

TIP-GND		UPLOAD RESULT	SAVE TO MEM	SAVE TO USB		INSUL. SETUP	MAIN MENU

FIGURE 8.9.2A - RESULTS OF THE ISOLATION TEST

Results showing >100 Mohm indicates that there is no chance of isolation break down at the present time. Values less than 25 Mohm means that the circuit may be unstable and therefore potentially unsuitable for xDSL.

At the completion of a test, the Function button command selection at the bottom of the ISOLATION TEST SETUP screen consists of a minimum of five options available to the operator. The following are brief descriptions of each of the Function button options:

TIP-RING, TIP-GND, RING-GND	These will only be displayed to the user when the test stops. This selection allows the user to test the next leg of the circuit without exiting out to the Isolation Test Setup Menu.
UPLOAD RESULT	Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.
SAVE TO MEM	Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.
SAVE TO USB	Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.
TEST SETUP	Pressing the function button associated with TEST SETUP activates the 4 Wire Crosstalk Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.
MAIN MENU	Select MAIN MENU to return to the Main Menu.

8.10 LoopMapper™

LoopMapper™ allows the user of the CableSHARK to easily identify faults (if any) with increased resolution using TDR and FDR. Results can be displayed in feet or meters. This test is extremely useful in locating bridge taps (multiple appearances) and the end of the cable. Faults such as opens and shorts can easily be found using the enhanced resolution that the CableSHARK's integrated FDR solution offers.

8.10.1 Setting up a LoopMapper Test

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing LoopMapper from the pop-up menu will invoke the LoopMapper TEST SETUP menu. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear. Figure 8.10.1A below shows the LoopMapper Test Menu.
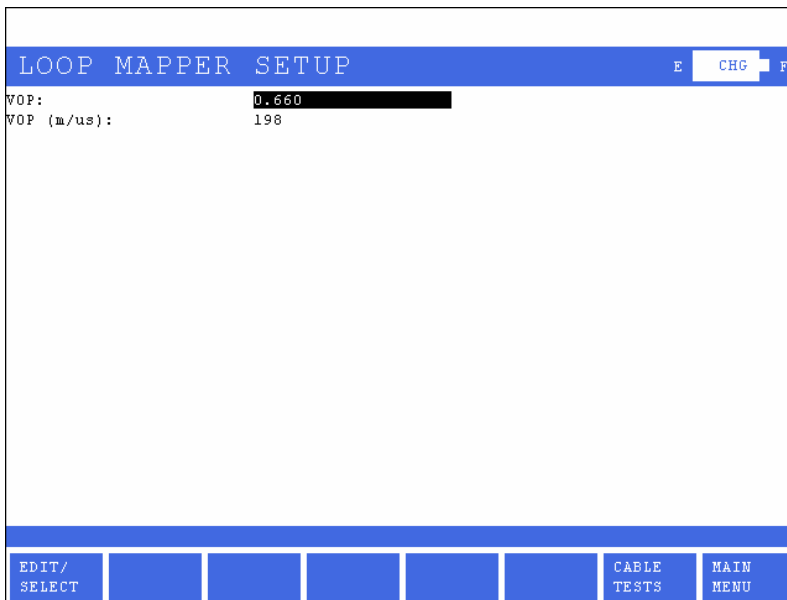

FIGURE 8.10.1A – MANUAL LOOPMAPPER TEST SETUP MENU

The LoopMapper Test Setup menu has two options that appear at the upper part of the screen (see the previous illustration). The parameters can be modified to customize a LoopMapper Test. The following describes the LoopMapper test setup options:

VOP:	Velocity of Propagation sets at what velocity the pulse travels along the wire. It is entered as a ratio of the speed of light. The table near the end of this section provides more information about VOP. A correct VOP will ensure accuracy in the test results. An incorrect VOP can mean a result that indicates the loop is too long or too short.
HORIZONTAL UNITS:	The horizontal units on the graph once the test is run can be displayed in FEET, METERS. The initial setting is reflective of the selected option under Measurement Units under System Setup.

The function button command selection at the bottom of the LoopMapper Test Setup Menu consists of five options available to the operator. The first three options (EDIT/SELECT, SELECT PREVIOUS, SELECT NEXT) enable the modification of the test parameters (residing near the upper part of the screen). The last two options at the bottom of the screen are CABLE TESTS and MAIN MENU. For some options for which a numeric value must be entered, only three options may appear: EDIT/SELECT, CABLE TESTS and MAIN MENU.

To modify a test parameter, it must first be highlighted with the cursor. A test parameter can be highlighted by moving the cursor to the desired parameter with the Cursor Pad UP/DOWN arrow buttons.

The following are brief descriptions of each of the function button options:

EDIT/SELECT	Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.
SELECT PREVIOUS	Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.
SELECT NEXT	Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.
CABLE TESTS	Pressing the function button corresponding to CABLE TESTS causes the CABLE TESTS pop-up menu to appear.
MAIN MENU	Select the function button corresponding to MAIN MENU to return to the Main Menu.

Wire Gauge Vs. V.O.P.

Here are some ***examples of typical VOP values*** for various telephone cables, given for insulation type and wire gauge / size. :

Pulp AWG 22 0.6 mm   VOP = 0.68 (102 m/μs)
         AWG 24 0.5 mm   VOP = 0.67 (100 m/μs)
         AWG 26 0.4 mm   VOP = 0.66 (99 m/μs)

PIC   AWG 19 0.9 mm   VOP = 0.72 (108 m/μs)
         AWG 22 0.6 mm   VOP = 0.67 (100 m/μs)
         AWG 24 0.5 mm   VOP = 0.66 (99 m/μs)
         AWG 26 0.4 mm   VOP = 0.64 (96 m/μs)

Jelly AWG 19 0.9 mm   VOP = 0.68 (102 m/μs)

Filled AWG 22 0.6 mm   VOP = 0.62 (93 m/μs)
         AWG 24 0.5 mm   VOP = 0.60 (90 m/μs)
         AWG 26 0.4 mm   VOP = 0.58 (87 m/μs)

Polyethylene   VOP = 0.66   (99 m/μs)
Polypropylene   VOP = 0.66   (99 m/μs)
Teflon   VOP = 0.67   (100 m/μs)

8.10.2 LoopMapper Testing

With the appropriate VOP and horizontal units selected, the CableSHARK should be able to automatically locate any cable reflection. Results will be displayed in feet or meters. Figure 8.10.2A shows a sample LoopMapper test screen.
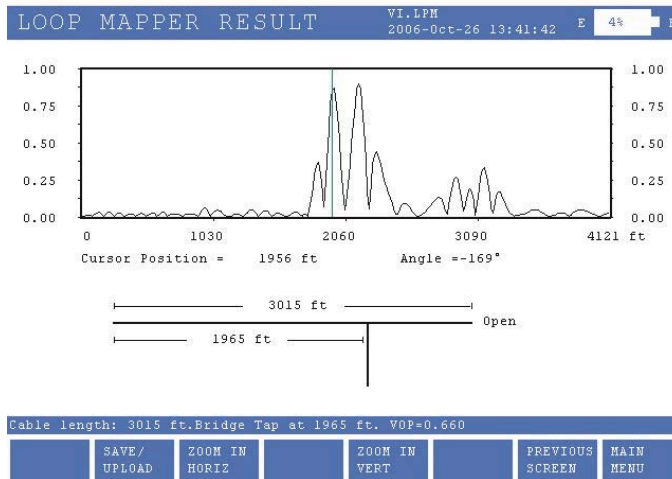
FIGURE 8.10.2A - RUNNING A LOOPMAPPER TEST

The layout of the screen shows a graphic and numeric representation of the information received by the CableSHARK. The graphs' vertical scale depicts a relative scale where 0 to +1 indicates that a discontinuity was found whose impedance differs from the characteristic impedance of the tested cable. The horizontal scale shows the location of the fault or end of cable in either feet or meters.

The numeric results are listed under the graph and they are very easy to understand. If the CableSHARK has successfully found any reflections, it will place the cursor onto the first reflection and adjust the Graph Scale automatically if necessary so that the first reflection is within the display screen.

The information about reflections that are found is shown on the screen, including a graphical representation of the cable topology, where the length of each segment of the bridge tap (if present) is shown in feet, or meters as selected.

The cursor position, representing the location on the loop is clearly indicated, as well as the angle or phase for the reflected signal at this point. This angle will determine the type of fault located at a specific point of the loop. The LoopMapper technique is able to identify a reflection caused by an Open Circuit because of its 0° angle reflection, similarly, the origin of a Bridge Tap or Short Circuit produces a 180° reflection. The following table summarizes the cable condition versus the angle of the reflection it produces.

TABLE 8.10.2 – CABLE VS. REFLECTED ANGLE

Reflected Angle	Fault Type
0°	Open Circuit
180°	Short Circuit, origin of Bridge Tap

To start another test with the same conditions, the user should simply press the RUN/STOP key.

At the completion of a test, the function button command selection at the bottom of the LoopMapper Test Result screen consists of several options available to the operator. The following are brief descriptions of each of the function button options:

ZOOM IN VERT / ZOOM OUT VERT   Use these function buttons to zoom in and out based on the vertical level scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.

ZOOM IN HORIZ / ZOOM OUT HORIZ   Use these function buttons to zoom in and out based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disabled as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT   Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO	Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the
USB	SAVE SESSION menu. From here, the test results can be saved to external
	USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

PREVIOUS MENU	The function button corresponding to PREVIOUS MENU takes the user to the command selections listed previously. To exit this menu level, press the function button associated with PREVIOUS MENU or TEST SETUP.
MAIN MENU	Select MAIN MENU to return to the Main Menu.

8.10.2.1 Testing Cables with the LoopMapper

Figure 8.10.2.1A shows an example of a LoopMapper test result on a 1000-ft cable with an open cable end. The large pulse near 0 distance is reflection from the CableSHARK coupling with the head of the cable, the reflected pulse near 1000 ft is the reflection coming from the open end of the cable. The cursor is currently located at this point, please note the Angle= $0°$ confirming the open cable end. At the bottom is the graphical representation of the cable topology indicating the total length for that segment and the open circuit condition, which is automatically determined by the CableSHARK . The user can choose to move the cursor from where the CableSHARK has placed it.
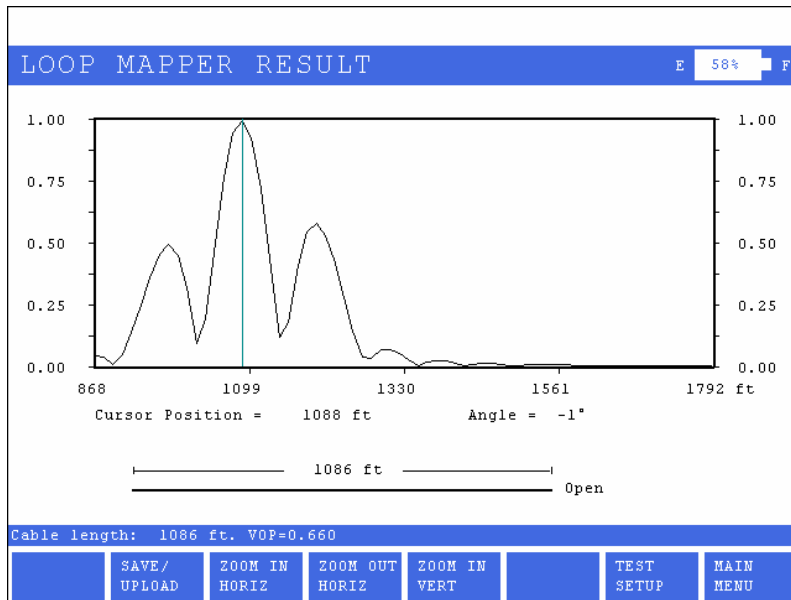
FIGURE 8.10.2.1A - RUNNING A LOOPMAPPER TEST WITH THE CABLE END OPEN

Figure 8.10.2.1B shows a LoopMapper test result on the same cable of Figure 8.10.2.1A with the cable end shorted. Even though both images look similar, please note that now the angle at the reflected point is 180°. The short condition is also automatically detected and presented by the CableSHARK at the bottom of the screen
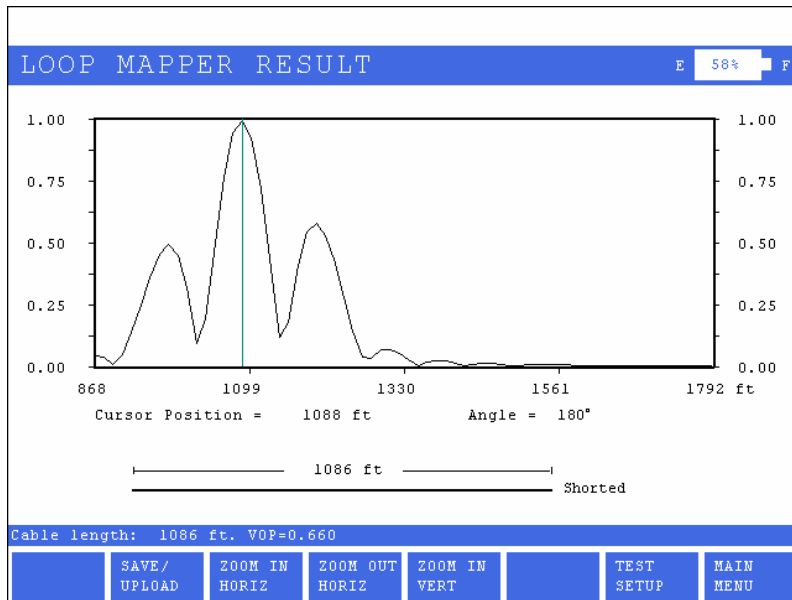
FIGURE 8.10.2.1B - RUNNING A LOOPMAPPER TEST WITH THE CABLE END SHORTED

Figure 8.10.2.1C shows the LoopMapper test result on a cable with a bridged tap. Please note that the angle at the reflected point is 180°, confirming the existence of a Bridge Tap. The Bridge Tap condition is automatically detected and presented by the CableSHARK at the bottom of the screen.
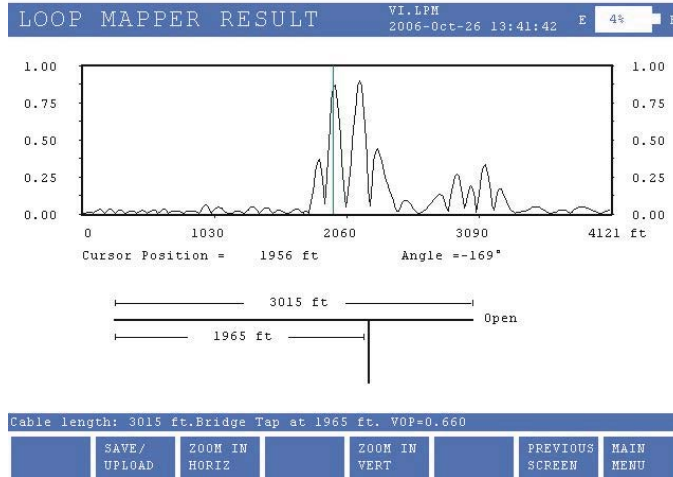
FIGURE 8.10.2.1C - RUNNING A LOOPMAPPER TEST WITH A CABLE AND BRIDGE TAP BRANCH

Note: When using the LoopMapper test, be sure to use the CableSHARK's zoom function to amplify the result. Often, the reflected pulse is difficult to see, so by using the vertical/horizontal zoom function, the faults can be seen easily.

8.11 Automatic Testing

The CableSHARK is capable of performing automatic testing for ADSL, SHDSL and Voice Frequency (VF) pre-qualification, installation and maintenance. The CableSHARK's ADSL AUTO, SHDSL AUTO and VF AUTO tests feature a range of difference tests that compare measured results against stored threshold for PASS / FAIL results to the user. The results are provided in both textual and graphical formats.

NOTE: The Automatic tests use the currently set parameters for the tests it runs. Please review the setup for each test by going to that tests setup menu before continuing with the Auto-Test.

8.11.1 Auto Test Setup

From the Main Menu, pressing function button F3 (AUTO SETUP) to view / configure the pass / fail thresholds against which the ADSL AUTO, ADSL2 AUTO, ADSL2+ AUTO, SHDSL AUTO and VF AUTO tests are evaluated against. Each selection is self-explanatory.

8.11.1.1 ADSL Auto, ADSL2 Auto, ADSL2+ Auto Test Setup

Once entering the AUTO TEST SETUP screen, users can press F3 to access the ADSL AUTO TEST SETUP screen, or F4 to access the ADSL2 AUTO TEST SETUP, or F5 to access the ADSL2+ AUTO TEST SETUP. These setup screens allows you to configure specific PASS/FAIL criteria for the ADSL, ADSL2, or ADSL2+ Auto Test respectively.

```
ADSL  AUTO  TEST  SETUP                        E    20%    F
DMT Test Type:            ADSL FROM CUSTOMER
ADSL Evaluation:          ANSI FULL RATE/POTS
DMT Noise Margin dB:      AUTO
DMT Bits per Bin:         14
Min. ADSL Up Rate(kbps):  256
Min. ADSL Dn Rate(kbps):  1024
VOP:                      0.680
Capacitance nF/mi T-R:    76.0
Capacitance nF/mi to GND:125.0
Max. AC Voltage T-R (V):  10
Max.AC Voltage to GND(V): 25
Max. DC Voltage T-R (V):  50
Max.DC Voltage to GND(V): 50
Min. Res. T-R(MOhm):      2.5
Min. Res. T-G(MOhm):      2.5
Min. Res. R-G(MOhm):      2.5
Max. Cap. Imbalance (%):  5
Min. Long. Balance (dB):  50


 EDIT/      SELECT     SELECT    DEFAULT                    AUTO       MAIN
 SELECT     PREVIOUS   NEXT      VALUES                     SETUP      MENU
```

FIGURE 8.11.1.1A – ADSL AUTO TEST SETUP

```
ADSL2  AUTO  TEST  SETUP                       E    24%    F
DMT Test Type:            ADSL FROM CUSTOMER
ADSL Evaluation:          ITU-T Annex A / POTS
DMT Noise Margin dB:      AUTO
DMT Bits per Bin:         14
Min. ADSL2 Up Rate(kbps):256
Min. ADSL2 Dn Rate(kbps):1024
VOP:                      0.680
Capacitance nF/mi T-R:    76.0
Capacitance nF/mi to GND:125.0
Max. AC Voltage T-R (V):  10
Max.AC Voltage to GND(V): 25
Max. DC Voltage T-R (V):  50
Max.DC Voltage to GND(V): 50
Min. Res. T-R(MOhm):      2.5
Min. Res. T-G(MOhm):      2.5
Min. Res. R-G(MOhm):      2.5
Max. Cap. Imbalance (%):  5
Min. Long. Balance (dB):  50


 EDIT/      SELECT     SELECT    DEFAULT                    AUTO       MAIN
 SELECT     PREVIOUS   NEXT      VALUES                     SETUP      MENU
```

FIGURE 8.11.1.1B – ADSL2 AUTO TEST SETUP

```
ADSL2+ AUTO TEST SETUP                           E  20%   F
DMT Test Type:          ADSL FROM CUSTOMER
ADSL Evaluation:        ITU-T Annex A / POTS
DMT Noise Margin dB:    AUTO
DMT Bits per Bin:       14
Min.ADSL2+ Up Rate(kbps):256
Min.ADSL2+ Dn Rate(kbps):1024
VOP:                    0.680
Capacitance nF/mi T-R:  76.0
Capacitance nF/mi to GND:125.0
Max. AC Voltage T-R (V): 10
Max.AC Voltage to GND(V):25
Max. DC Voltage T-R (V): 50
Max.DC Voltage to GND(V):50
Min. Res. T-R(MOhm):    2.5
Min. Res. T-G(MOhm):    2.5
Min. Res. R-G(MOhm):    2.5
Max. Cap. Imbalance (%): 5
Min. Long. Balance (dB): 50



 EDIT/    SELECT   SELECT   DEFAULT                  AUTO     MAIN
 SELECT   PREVIOUS NEXT     VALUES                   SETUP    MENU
```

FIGURE 8.11.1.1C – ADSL2+ AUTO TEST SETUP

The options at the bottom of the ADSL AUTO TESTS SETUP screen represent the following:

EDIT/SELECT   Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.

SELECT PREVIOUS Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.

SELECT NEXT   Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.

DEFAULT VALUES   Sets the ADSL AUTO TEST parameters to their factory defaults.

MAIN MENU   Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.11.1.2 SHDSL Auto Test Setup

From the Auto Test Setup screen, pressing the F6 button will activate the SHDSL Auto Test Setup screen. The SHDSL Auto Test setup screen allows you to configure the PASS/FAIL criteria for the SHDSL Auto Test.

FIGURE 8.11.1.2A – SHDSL AUTO TEST SETUP

The options at the bottom of the SHDSL AUTO TESTS SETUP screen represent the following:

EDIT/SELECT   Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.

SELECT PREVIOUS   Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.

SELECT NEXT	Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.
DEFAULT VALUES	Sets the ADSL AUTO TEST parameters to their factory defaults.
ADSL SETUP	Allows the user to setup the ADSL Auto Test
VF SETUP	Allows the user to setup the VF Auto Test.
MAIN MENU	Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.11.1.3 VF Auto Test Setup

From the Auto Test Setup screen, pressing the F1 button will activate the VF Auto POTS Setup screen, or F2 to activate the VF Auto No POTS . These VF Auto Test setup screens allow you to configure the PASS/FAIL criteria for the VF Auto Tests.

NOTE: The CableSHARK will work with milliwatt sources providing a tone or a tone + silence. The CableSHARK's VF Auto-test will not test to a quiet termination source. For non-working pairs, set the DIAL TYPE to NON-WORKING PAIR.

FIGURE 8.11.1.3A – VF POTS AUTO TEST SETUP
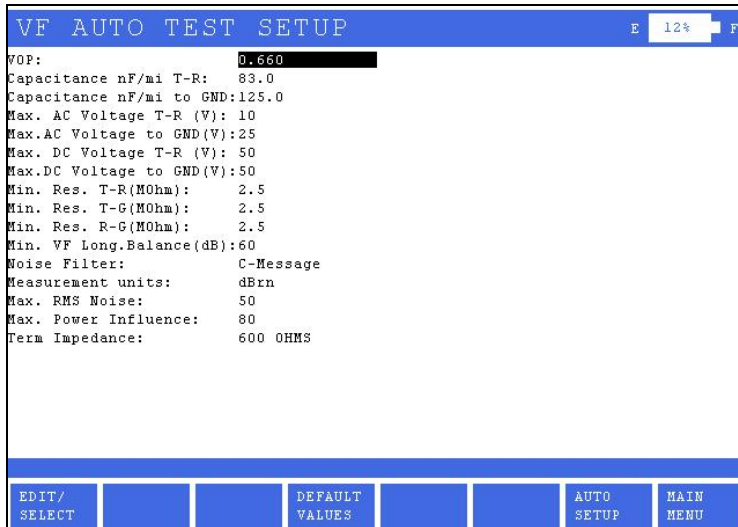

FIGURE 8.11.1.3B – VF NO POTS AUTO TEST SETUP

The options at the bottom of the VF AUTO TESTS SETUP screens represent the following:

EDIT/SELECT   Pressing the function button corresponding to EDIT/SELECT invokes a menu wherein a desired parameter can be highlighted by using the Cursor Pad UP/DOWN arrow buttons and/or the function buttons corresponding to PAGE UP and PAGE DOWN (should they exist). Press the function button corresponding ENTER to select the highlighted parameter.

When pressing the EDIT/SELECT button when Dial Type is highlighted, users can select from DTMF or Pulse.

When pressing the EDIT/SELECT button when Name or Tel. Number is highlighted, the CableSHARK's Phone Book will appear.
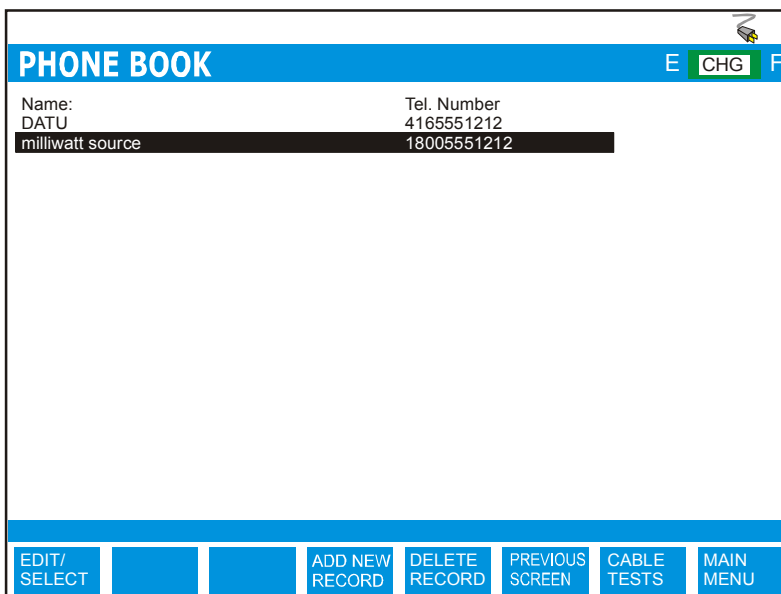
FIGURE 8.11.1.3C – PHONE BOOK

- Pressing the EDIT/SELECT key allows a user to modify a highlighted name/number
- Pressing the ADD NEW RECORD key allows a user to add a new name/number to the Phone Book
- Pressing the DELETE RECORD key allows a user to delete a highlighted entry
- Pressing the PREVIOUS SCREEN key returns the user to the VF AUTO TEST SETUP screen

SELECT PREVIOUS   Pressing the function button corresponding to SELECT PREVIOUS scrolls backward through each of the parameters that are available for the highlighted option.

SELECT NEXT   Pressing the function button corresponding to SELECT NEXT scrolls forward through each of the parameters that are available for the highlighted option.

DEFAULT VALUES   Sets the ADSL AUTO TEST parameters to their factory defaults.

ADSL SETUP   Allows the user to setup the ADSL Auto Test

VF SETUP	Allows the user to setup the VF Auto Test.
MAIN MENU	Select the function button corresponding to MAIN MENU to return to the Main Menu.

8.11.2 Running an ADSL, ADSL2 or ADSL2+ AUTO Test

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

NOTE: ADSL, ADSL2 or ADSL2+ AUTO Test will only be available if the SINGLE END DMT option has been purchased. Please contact your local EXFO representative for further information and to purchase this option.

NOTE: Please review the setup for each test by going to that tests setup menu before continuing with the Auto-Test.

From the Main Menu, press the AUTO TESTS function button (F2) to access the AUTO TEST MENU. Start the ADSL, ADSL2 or ADSL2+ AUTO Test by pressing F3, F4 or F5 respectively. The CableSHARK will perform a DMM test (Voltage, Resistance, Capacitance), a Load Coil Test, a TDR, a Longitudinal Balance test, Capacitive Imbalance and a Single End DMT test. Results are presented in both a text format as well as a graphical format.
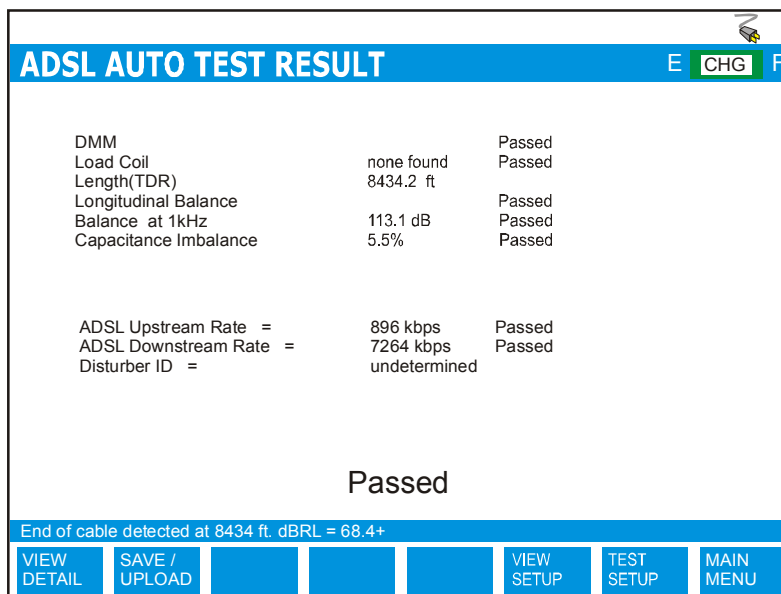
FIGURE 8.11.2A - RESULTS OF THE ADSL AUTO TEST - PASS

At the conclusion of the ADSL, ADSL2 or ADSL2+ AUTO Test, the CableSHARK will report PASSED if all the user defined thresholds are not compromised. Otherwise, the CableSHARK will report FAILED. Note that some parameters may be skipped as well depending upon test environment.

If the CableSHARK detects a load coil on the line as shown in Figure 8.11.2B, the auto test will halt. Load Coils must be removed from the circuit before xDSL services can be installed. The Single-End DMT test will not be performed if this state arises.
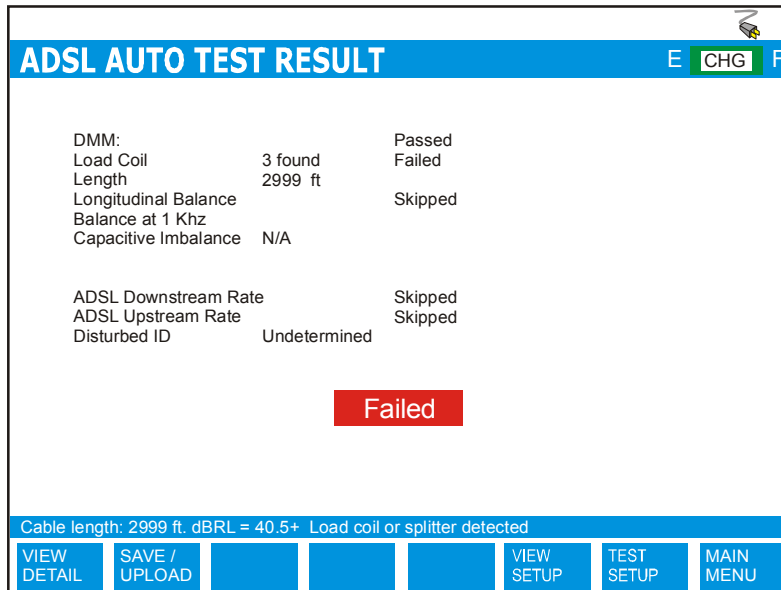
FIGURE 8.11.2B - RESULTS OF THE ADSL AUTO TEST - FAIL

The functions buttons at the bottom of the screen are as follows:

VIEW DETAIL   Allows a user to view the results of each test making up a completed ADSL Auto test. The ADSL Auto test will not do a Single-End DMT test if a Load Coil is detected.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT   Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

VIEW SETUP   This function allows users to view the pass/fail thresholds used for the automatic tests.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the AUTO Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

8.11.3 Running a VF AUTO Test

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

NOTE: The Automatic tests use the currently set parameters for the tests it runs. Please review the setup for each test by going to that tests setup menu before continuing with the Auto-Test.

NOTE: The CableSHARK will work with milliwatt sources providing a tone or a tone + silence. The CableSHARK's VF POTS Auto-test will not test to a quiet termination source. For non-working pairs, execute the VF AUTO NO POTS TEST option

From the Main Menu, press the AUTO TESTS function button (F2) to access the AUTO TEST MENU. Start the VF AUTO POTS test by pressing F1 or VF AUTO NO POTS test by pressing F2. The CableSHARK will perform a DMM test (Voltage, Resistance, Capacitance), a Load Coil Test, a TDR test, a Longitudinal Balance test at 1 kHz, a Dial test including Loss, Frequency, Noise, and a Power Influence Test. Results are presented in both a text format as well as a graphical format.
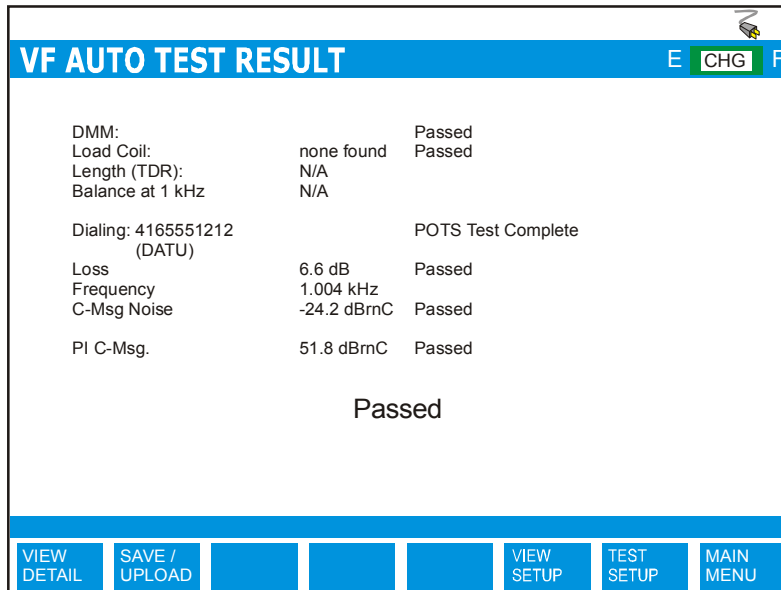
FIGURE 8.11.3A - RESULTS OF THE VF AUTO TEST - PASS

At the conclusion of the VF AUTO POTS (or NO POTS) test, the CableSHARK will report PASSED if all the user defined thresholds are not compromised. Otherwise, the CableSHARK will report FAILED.

The functions buttons at the bottom of the screen are as follows:

VIEW DETAIL   Allows a user to view the results of each test making up a completed VF Auto test.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT   Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

VIEW SETUP   This function allows users to view the pass/fail thresholds used for the automatic tests.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the AUTO Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

8.11.4 Running an SHDSL AUTO Test

⚠️ Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

NOTE: SHDSL AUTO Test will only be available if the SHDSL option has been purchased. Please contact your local EXFO representative for further information and to purchase this option.

NOTE: The Automatic tests use the currently set parameters for the tests it runs. Please review the setup for each test by going to that tests setup menu before continuing with the Auto-Test.

From the Main Menu, press the AUTO TESTS function button (F2) to access the AUTO TEST MENU. Start the SHDSL AUTO test by pressing F6. The CableSHARK will perform a DMM test (Voltage, Resistance, Capacitance), a Load Coil Test, a TDR, a Longitudinal Balance test, Capacitive Imbalance and a Single End SHDSL test. Results are presented in both a text format as well as a graphical format.
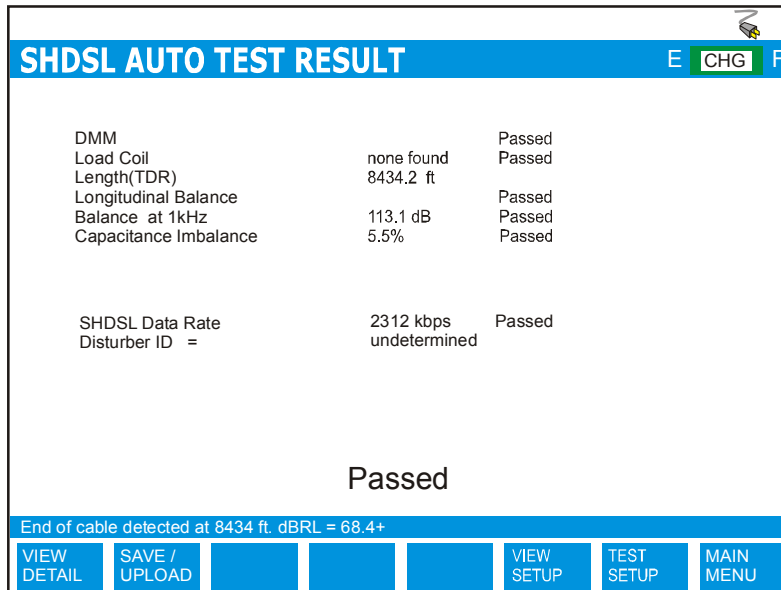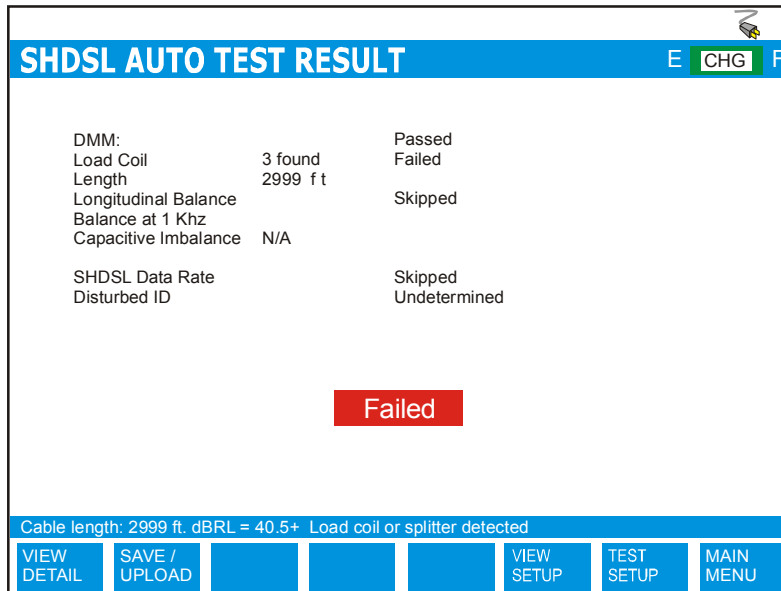
FIGURE 8.11.4A - RESULTS OF THE SHDSL AUTO TEST - PASS

At the conclusion of the SHDSL AUTO test, the CableSHARK will report PASSED if all the user defined thresholds are not compromised. Otherwise, the CableSHARK will report FAILED.

If the CableSHARK detects a load coil on the line as shown in Figure 8.11.4B, the SHDSL AUTO test will halt and the CableSHARK will display NO DSL SERVICE POSSIBLE plus the distance to the load coil. Load Coils must be removed from the circuit before xDSL services can be installed. The Single-End SHDSL test will not be performed if this state arises.

FIGURE 8.11.4B - RESULTS OF THE SHDSL AUTO TEST - FAIL

The functions buttons at the bottom of the screen are as follows:

VIEW DETAIL   Allows a user to view the results of each test making up a completed SHDSL Auto test. The SHDSL Auto test will not do a Single-End SHDSL test if a Load Coil is detected.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT   Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

VIEW SETUP   This function allows users to view the pass/fail thresholds used for the automatic tests.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the AUTO Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

Section 9   Spectral Detective

The CableSHARK's Spectral Detective test allows user to bridge onto a live circuit to measure the Power Spectral Density Noise of the line. The Spectral Detective measures up to 2.2 MHz (or optional 6 MHz) so users will be able to characterize loops utilizing ISDN, T1 / 2 MBIT/S (E1), HDSL, HDSL2, ADSL, G.SHDSL, etc. to determine (a) the technology that is being transmitted over the link and (b) the power associated with the transmitted technology to ensure it is not disruptive to adjacent pairs and technologies.
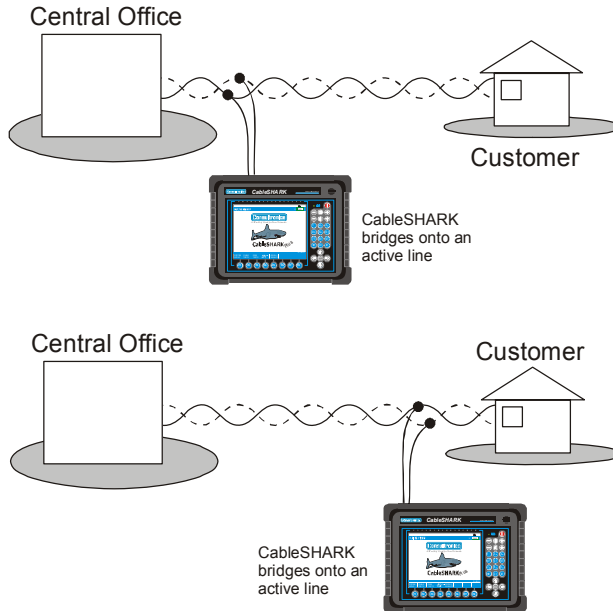

FIGURE 9A – THE CABLESHARK BRIDGES ONTO A LIVE CIRCUIT

The Spectral Detective provides accurate feedback on PSD shape and power. Users can verify circuits used in line sharing applications are being properly deployed. Too much transmit power on one circuit can be spectrally incompatible with adjacent pairs, causing unnecessary truck rolls, frustrated customers, and lost revenue.

The Spectral Detective test is best performed at the CO or the Customer Premise, where the effects of NEXT and FEXT can truly be analyzed. Measuring at the crossbox can be useful as well as many technologies typically converge here before heading to the Customer Premise.

This option can be ordered from EXFO. A special alphanumeric software key will be sent to the purchaser based upon each CableSHARK's unique serial number. To determine the options currently installed in the CableSHARK or to view the units unique serial number, go to SYSTEM SETUP and select the OPTIONS function key (see Section 6.4). Once the key is properly entered, the user can exit to the MAIN MENU, select CABLE TESTS, and then select SPECTRAL DETECTIVE from the pop-up menu. The following setup screen will appear.

FIGURE 9B – SPECTRAL DETECTIVE TEST SETUP MENU

The Spectral Detective Test Setup menu has the following configuration options.

TEST TYPE: Options are SPECTRAL DETECTIVE 2.2 MHz and SPECTRAL DETECTIVE 6.0 MHz

REFERENCE IMP.   To measure the proper noise level it is desirable to know what the cable is typically terminated at. This provides the CableSHARK with the proper conversion factor for voltage to power. Examples: ADSL uses 100 ohm termination, SHDSL uses 135 ohm termination.

MEASUREMENT UNITS   Allows the user to specify the measurement units for the test. The choices are dBm and dBrn.

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NOISE FILTER: The options are ISDN E Filter, HSDL F Filter, ADSL G Filter and NONE. NONE is the most ideal selection since it gives the user an unbiased analysis of the results. If the E, F, or G filters are enabled, the Disturber Identification is turned off as the analysis of the available bandwidth is limited. To determine of a circuit has a specific technology riding over it, ensure that the NOISE FILTER is set to NONE.

NOTE: The NOISE FILTER setting is not available for TEST TYPE equal to SPECTRAL DETECTIVE 6.0 MHz.

9.1   Running a Spectral Detective Test

Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

NOTE: Before connecting the CableSHARK to the live line, ensure that the unit is in the Spectral Detective Mode before proceeding!! Once in the Spectral Detective Mode is when the 15 kohm bridging impedance is activated.

Press the RUN / STOP button on the front of the CableSHARK to initiate the continuous Spectral Detective test. Figure 9.1A shows an example of the results obtained from a Spectral Detective Test.
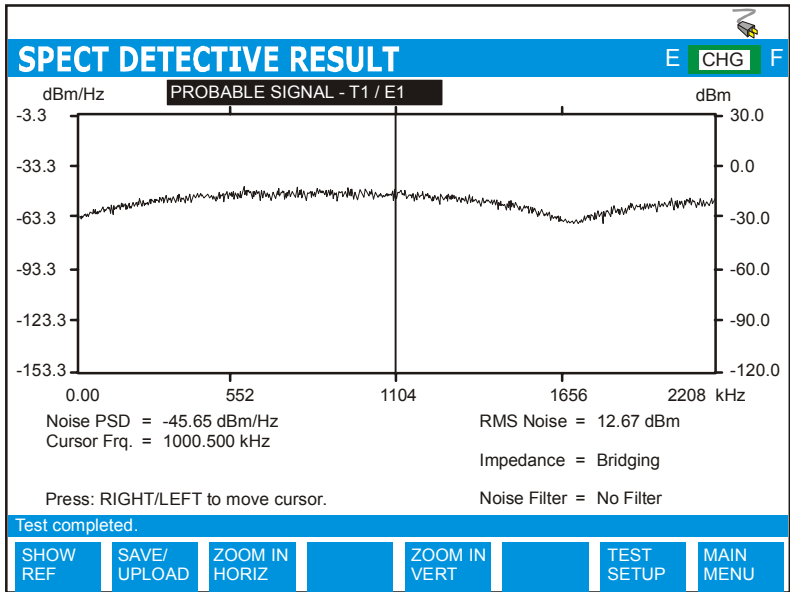
FIGURE 9.1A – T1 DISTURBER WITH QRSS PATTERN (VOICE)

At the completion of a test *(press FREEZE button to stop the Spectral Detective test),* the function button command selection at the bottom of the Spectral Detective Test Result screen consists of several options available to the operator. The following are brief descriptions of each of the function button options:

SHOW REF Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

ZOOM IN VERT /   Use these function buttons to zoom in and out based on the vertical level
ZOOM OUT VERT   scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disable as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.

ZOOM   IN   HORIZ   /   Use these function buttons to zoom in and out based on the horizontal graph
ZOOM OUT HORIZ   scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disable as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the Spectral Detective Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

The Spectral Detective test can be run continuously or in PEAK mode where PEAK mode redraws a new point if this point is greater in level than the previous. The PEAK mode is ideal for long term analysis of a circuit to help identify transients or intermittent crosstalk / noise.

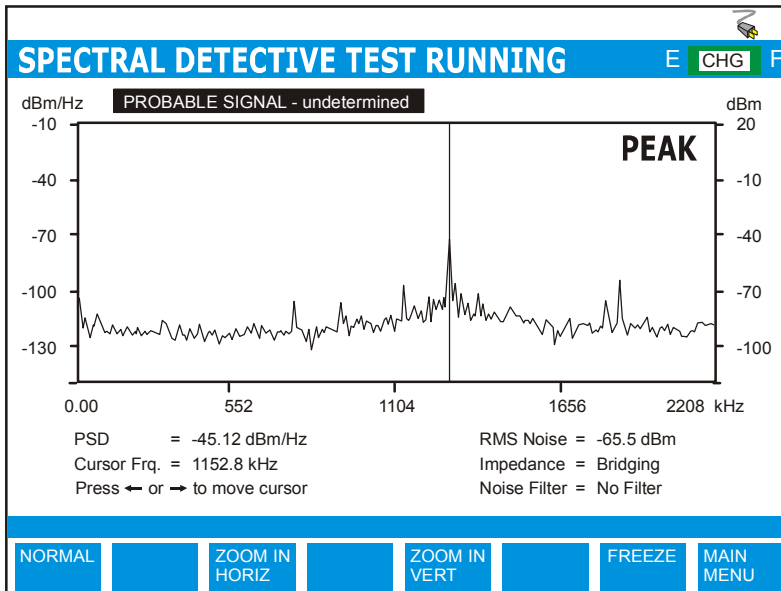*NOTE: Press the FREEZE button to stop the continuous Spectral Detective TEST.*

FIGURE 9.1B – SPECTRAL DETECTIVE RESULTS WITH PEAK ENABLED

9.2   Spectral Detective Samples

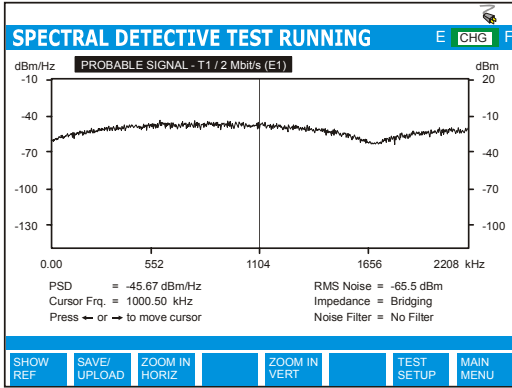The following figures show examples of broadband technology disturbers.
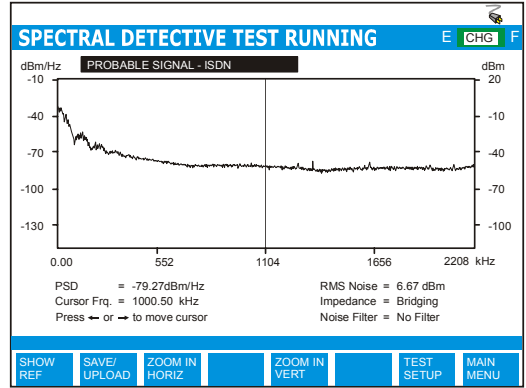

FIGURE 9.2A – T1 DISTURBER (QRSS)

FIGURE 9.2C – 2B1Q ISDN SPECTRAL ANALYSIS
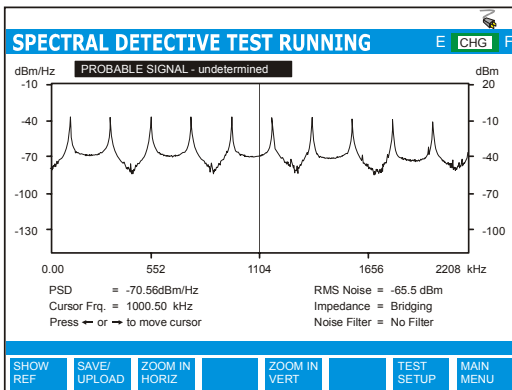

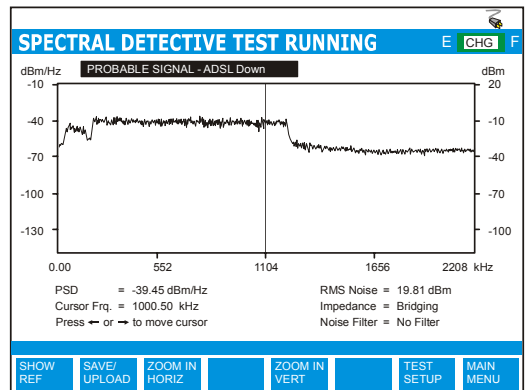*FIGURE 9.2B – T1 DISTURBER (1IN 8 PATTERN)*

FIGURE 9.2D – ADSL AT CO SIDE

Section 10   Return Loss

There are two major causes of Return Loss: discontinuities and impedance mismatches. Discontinuities and impedance mismatches occur at connections where cable is improperly terminated, changing from one wire gauge to another of greater or lesser diameter, or from cable splices. When a transmitted signal pulse hits one of these discontinuities, part or all of a signal is reflected back and return loss occurs. The Return Loss result is expressed in dB.

This option can be ordered from EXFO. A special alphanumeric software key will be sent to the purchaser based upon each CableSHARK's unique serial number. To determine the options currently installed in the CableSHARK or to view the units unique serial number, go to SYSTEM SETUP and select the OPTIONS function key (see Section 6.4). Once the key is properly entered, the user can exit to the MAIN MENU, select CABLE TESTS, and then select RETURN LOSS from the pop-up menu. The following setup screen will appear.

FIGURE 10A – RETURN LOSS TEST SETUP MENU

The Return Loss Test Setup menu has the following configuration options.

TEST TYPE: Fixed at Return Loss.

TERM IMP: The CableSHARK's impedance needs to match the characteristic impedance of the cable. This causes the CableSHARK at either end of a test (including Single End) not to reflect back any test signals or unnecessarily attenuate the test signal. The options are 100 ohms and 135 ohms (no AUTO option for Return Loss test, older units will show 120 ohms and 150 ohms)

10.1 Running a Return Loss Test

⚠️ Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the RUN / STOP button on the front of the CableSHARK to initiate the Return Loss test. Figure 10.1A shows an example of the results obtained from a Return Loss Test.
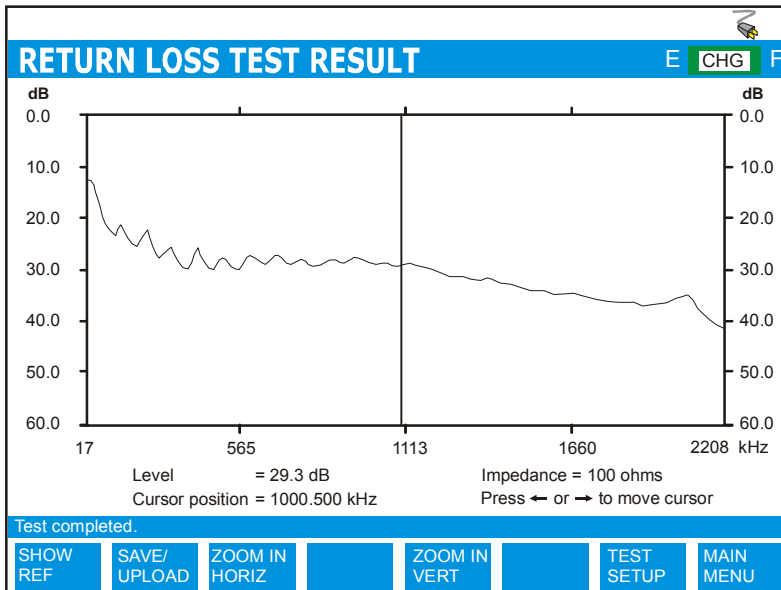

FIGURE 10.1A – COMPLETED RETURN LOSS TEST

The better the return loss, the higher the dB readings resulting from the measurement.
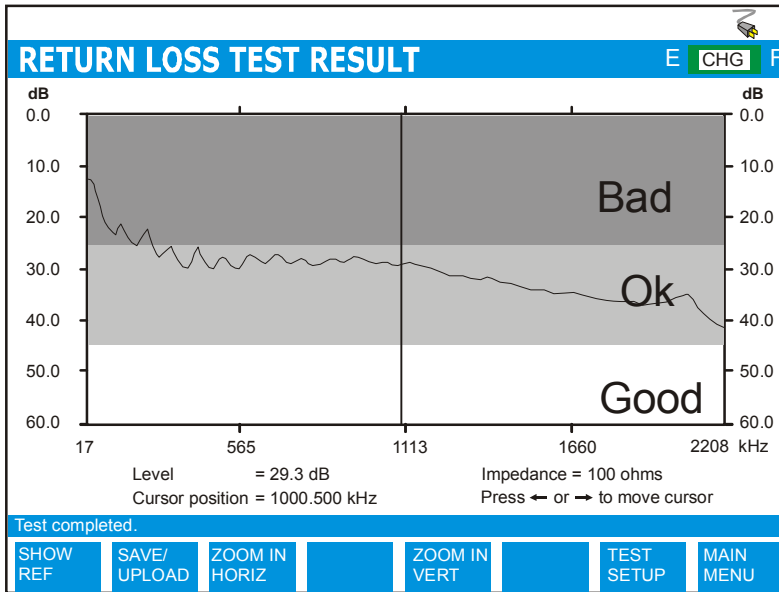
FIGURE 10.1B – GOOD VS BAD RESULT

At the completion of a test, the function button command selection at the bottom of the Return Loss Test Result screen consists of several options available to the operator. The following are brief descriptions of each of the function button options:

SHOW REF Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM   Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB   Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

ZOOM IN VERT /   Use these function buttons to zoom in and out based on the vertical level
ZOOM OUT VERT   scale. Please note after the completion of a test, the ZOOM OUT VERT option will be disable as it is impossible to ZOOM OUT. Press the ZOOM IN VERT button once or multiple times and the ZOOM OUT VERT button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN VERT button will disappear.

ZOOM IN HORIZ /   Use these function buttons to zoom in and out based on the horizontal graph
ZOOM OUT HORIZ   scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disable as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.

TEST SETUP   Pressing the function button associated with TEST SETUP activates the Return Loss Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU   Select MAIN MENU to return to the Main Menu.

Section 11   SHDSL Data Rate Prediction

The SHDSL test is unique in that it is independent of any modem or line coding being carried on the line. This makes the EXFO CableSHARK ideally suited for use in qualifying any twisted copper pair lines in the local loop to carry xDSL technologies.

This test is similar to our Patented End-to-End ADSL DMT test and Patent Pending Single-End DMT test. The G.SHDSL Data Rate Prediction test uses the CableSHARK's Single-End Frequency Response and PSD test to determine the probable achievable SHDSL data rate. Data rates will be reported from 192 kbps to 2312 kbps.

This option can be ordered from EXFO. A special alphanumeric software key will be sent to the purchaser based upon each CableSHARK's unique serial number. To determine the options currently installed in the CableSHARK or to view the serial number, go to SYSTEM SETUP and select the OPTIONS function key (see Section 6.4). Once the key is properly entered, the user can exit to the MAIN MENU, select CABLE TESTS, and then select SHDSL from the pop-up menu. The following setup screen will appear.
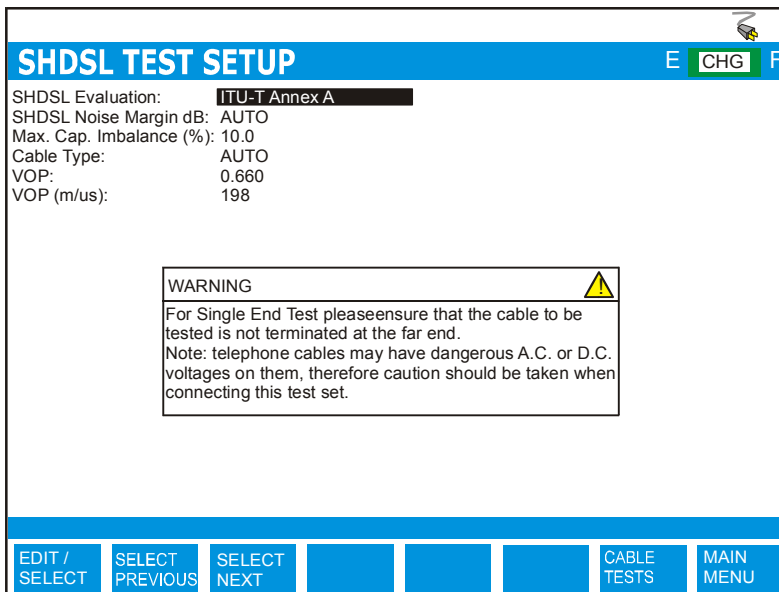

FIGURE 11A – SHDSL TEST SETUP MENU

The SHDSL Test Setup menu has the following configuration options.

SHDSL EVALUATION:

Options include ITU-T Annex A and ITU-T Annex B. The SHDSL standards reflects two regions – Annex A is for North America and Annex B is for Europe. There is not a huge difference between the two unless you are looking for a replacement technology for T1 (1.544 Mbps) or E1 (2.048 Mbps).

NOISE MARGIN dB:

Allows users to set the desired noise margin in dB. This is the amount of increased noise relative to the measured noise power that the system would able to tolerate to maintain a bit error rate of 10^{-7}. The industry standard is for a target value of 6 dB. Typically, a noise margin that is greater than the target set in the ATU-C is considered acceptable because it will allow for the possibility of better than expected bit rates. Set to AUTO if you are not sure. This assumes a −140 dBm/Hz noise floor.

MAX. CAP. IMBALANCE (%):

Allows the user to specify the maximum capacitive length imbalance between T-G and R-G. The default setting is 10%. Setting of Imbalance can be from 0.1% to 100% where 100% is the worst case scenario. If the imbalance is greater than the user defined setting the CableSHARK will not complete the test and will report *"Measurement not possible. Tip and Ring wires are substantially different lengths."*

CABLE TYPE:

The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. It is best however to ensure the correct VOP for the cable as all cables are manufactured differently. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE , and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

The AUTO selection is based on an optimized algorithm whereby the user does not need to know the cable gauge. It takes into account Resistance per unit length, Capacitance per unit length and Attenuation per unit length, in addition to POTS splitters.

VOP:

Velocity of Propagation sets at what velocity the pulse travels along the wire. It is entered as a ratio of the speed of light. The two tables near the end of this section provide more information about VOP. A correct VOP will ensure accuracy in the test results. An incorrect VOP can mean a result that indicates the loop is too long or too short.

VOP (m/μS):

Rather than specify the ratio of the speed of light for pulses traveling along a length of wire, users can specify the speed in meters per microsecond. Changes made to VOP (m/μs) will automatically be reflected in the VOP setting and vice versa. (Range is from 120 to 299 m/μs)

11.1..Running a SHDSL Test

⚠️ Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

The SHDSL test transmits a shaped signal onto the circuit under test as described by the ITU-T G.991.2 specification. The received result will be based on the transmitted signal but will also be shaped and attenuated based on cable characteristics and noise on the line.

Press the RUN / STOP button on the front of the CableSHARK to initiate the SHDSL test. Figure 11.1A shows an example of the results obtained from a SHDSL Test.
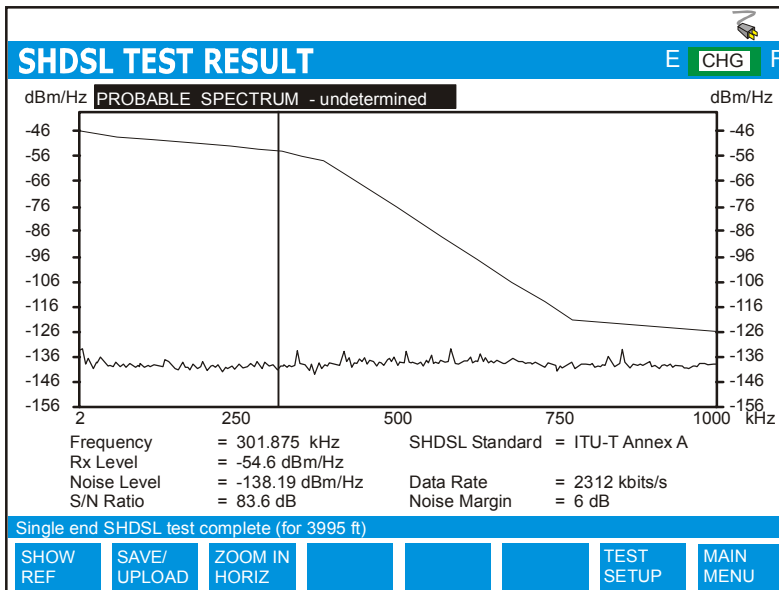
FIGURE 11.1A – COMPLETED SHDSL TEST

The SHDSL test result screen shows the Rx Level and the Noise Level of the circuit under test. The CableSHARK will use these two values to predict the maximum achievable SHDSL Data Rate for this circuit.

At the completion of a test, the function button command selection at the bottom of the SHDSL Test Result screen consists of several options available to the operator. The following are brief descriptions of each of the function button options:

SHOW REF Pressing the function button corresponding to SHOW REF allows a user to overlay a REFERENCE MASK over the test result on screen to compare the two. See Section 5.4 for more information about the REFERENCE MASK feature.

Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

UPLOAD RESULT Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

ZOOM IN HORIZ / ZOOM OUT HORIZ Use these function buttons to zoom IN and OUT based on the horizontal graph scale. Please note after the completion of a test, the ZOOM OUT HORIZ option will be disable as it is impossible to ZOOM OUT. Press the ZOOM IN HORIZ button once or multiple times and the ZOOM OUT HORIZ button will appear. Likewise, when the maximum zoom level is achieved, the ZOOM IN HORIZ button will disappear.

TEST SETUP Pressing the function button associated with TEST SETUP activates the SHDSL Test Setup menu. Test parameters can be modified and the test can be run once again from this screen.

MAIN MENU Select MAIN MENU to return to the Main Menu.

Section 12   Resistive Fault Location

12.1 Resistive Fault Location (RFL) Testing

Resistive Fault Location (RFL) testing is a powerful measurement that is able to locate shorts between tip to ring, tip to ground or ring to ground. These faults can be called shorts, grounds or crosses.

A short is when TIP is shorted to RING
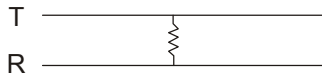
FIGURE 12.1A – SHORT BETWEEN TIP AND RING

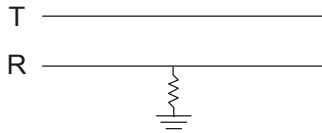A ground is when either TIP or RING is shorted to GROUND

FIGURE 12.1B – SHORT BETWEEN RING AND GROUND

A Cross or Battery Cross is when TIP or RING is shorted (typically by water or moisture) to a lead that contains CO voltage. This is typically at the point where there is a faulty splice and moisture can easily enter into the splice thus completing a current path.
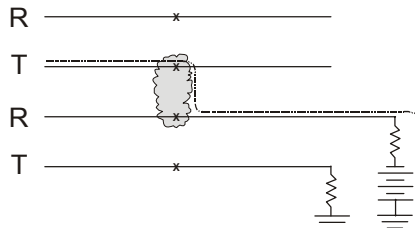

FIGURE 12.1C – BATTERY CROSS

The RFL measurement used by the CableSHARK is referred to as a "separate good pair" test. This means the user must have a good pair to compare against.

12.1.1 Setting up for a RFL Test

12.1.1.1 Disconnecting the Station Battery and the Customer

Before an RFL test can take place, the circuit that is to be tested must be disconnected from the CO station battery and from the customer. The RFL test is an end-to-end test meaning that the CableSHARK is placed at one end of the circuit (typically on the CO side of the circuit) and a strap is placed on the customer side of the circuit.

IMPORTANT*: Attachment of the strap should not take place until the CableSHARK has indicated how to hook up the strap.*

12.1.1.2..Connecting the CableSHARK to a Suspect Faulty Pair

To perform a RFL test, the user must determine what is the faulty pair and whether there is a good pair in the bundle to connect to. The CableSHARK has two sets of connections on the rear of the unit. The 2 Wire Line TX/RX is used to connect to a suspect wire pair to determine if it is faulty, and if so, where is the fault.
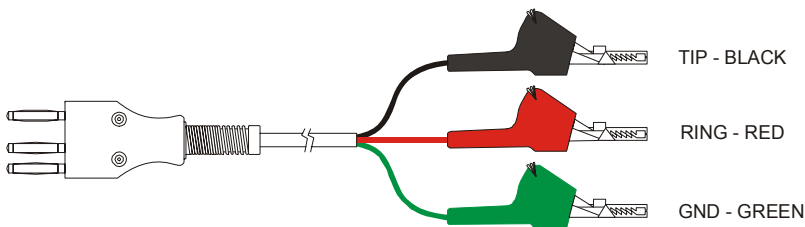

TIP - BLACK

RING - RED

GND - GREEN

FIGURE 12.1.1.2A – 2 WIRE TX/RX CABLE

The initial connection to the circuit should be as follows using the three telco clip cable above.
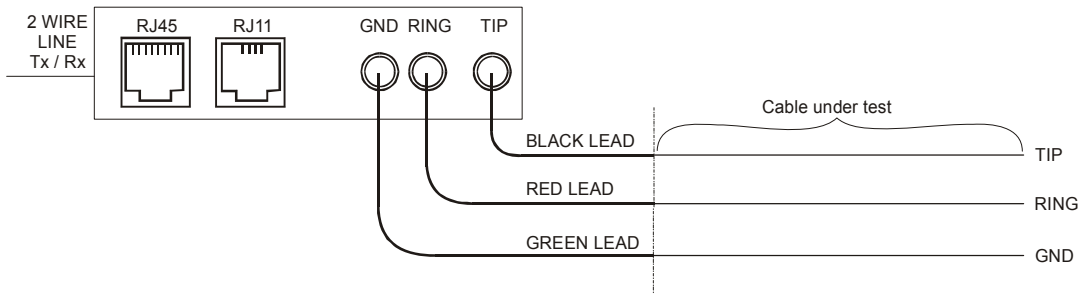
FIGURE 12.1.1.2B – INITIAL HOOK-UP

12.1.1.3 Connecting to a Good Pair

A good pair may be difficult to find especially if it is suspected that an entire cable bundle has been damaged by water. In most cases, a good pair should have an isolation resistance of greater than 3.3 Mohms. Of course, an isolation resistance measurement of greater than 20 Mohms would be the best. The CableSHARK's RX (AUX) connector must be used with the YELLOW, BLUE and GREEN leads. Attach these leads to the good pair – YELLOW to TIP, BLUE to RING, and GREEN to GROUND.
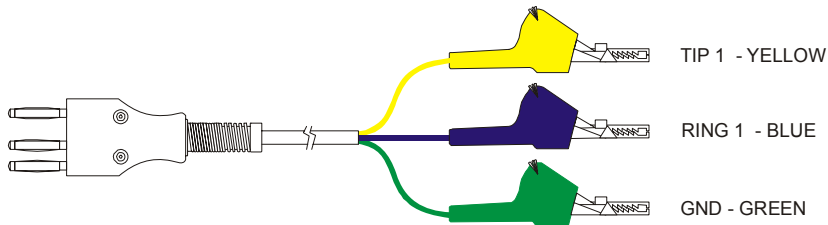
FIGURE 12.1.1.3A – RFL CABLE

In cases where a good pair cannot be found, the user may have to install a separate pair to perform the test. In fact, the good pair can be of a different gauge and of a different length.

12.1.1.4 Connecting the CableSHARK to the Faulty Pair and a Good Pair

Once a faulty pair is identified, the user does not have to change around the telco clips connected to the faulty or good pair. However, the strap may have to be adjusted to accommodate the test. The CableSHARK will indicate to the user how to re-configure the strap.

12.1.1.5 Initial RFL Testing

From the Main Menu, pressing Function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing **RESISTIVE FAULT LOCATION** (RFL) from the pop-up menu activates the RFL test.

The CableSHARK will measure the combinations of TIP-RING, RING-GROUND, and TIP-GROUND using the CableSHARK voltage and resistance tests to determine if RFL is possible on the faulty pair selected. If the measured resistance is <10 Mohms, or the voltage is > 2 VDC or negative, there may be a fault on the line.

Any fault that measures less than <3.3 Mohms <u>must</u> be repaired.

If there is a voltage on the line, the RFL test will display the following message: "**RFL isolation test is not complete, live voltage detected.**" At this point the user should verify that the station battery has been disconnected on the pairs under test.
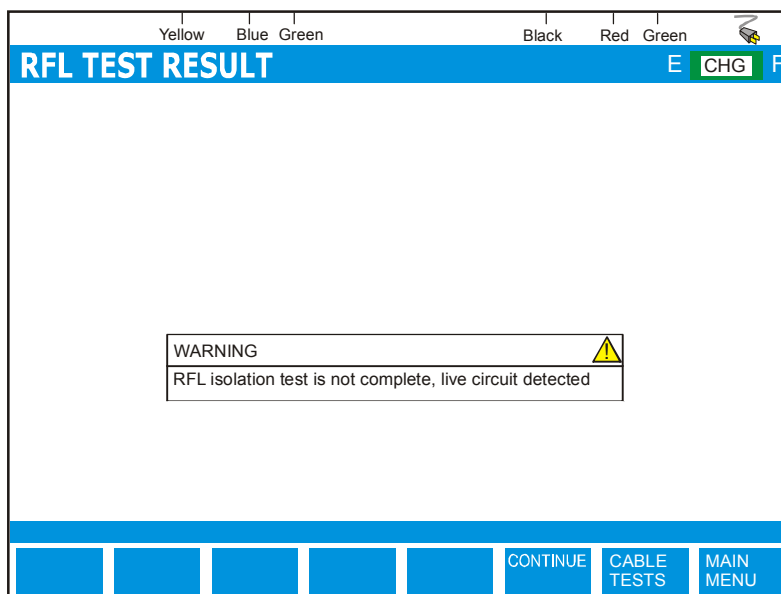
FIGURE 12.1.1.5A – RFL WARNING MESSAGE FOR LIVE CIRCUIT

If the pair does not have a fault on it, the CableSHARK will display the following message:

```
CONGRATULATIONS                                    ⚠
No fault found in the cable. Test another pair,
or go back to Main Menu.
```

FIGURE 12.1.1.5A – NO FAULT DETECTED

If there is a small voltage on the line and there is a resistive fault, this is likely a battery cross situation. The RFL test will indicate the following:

FIGURE 12.1.1.5C – RFL MESSAGE INDICATING PLACEMENT OF STRAP

Connect the strap (**see Section 12.1.1.6**) as indicated and press the CONTINUE button.

For only resistive faults, the CableSHARK's RFL test will instruct the user how to attach the strap (**see Section 12.1.1.6**) at the far end.

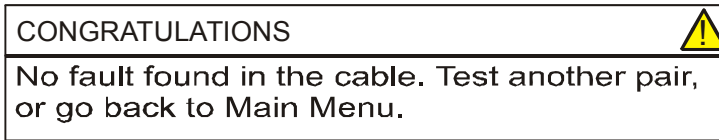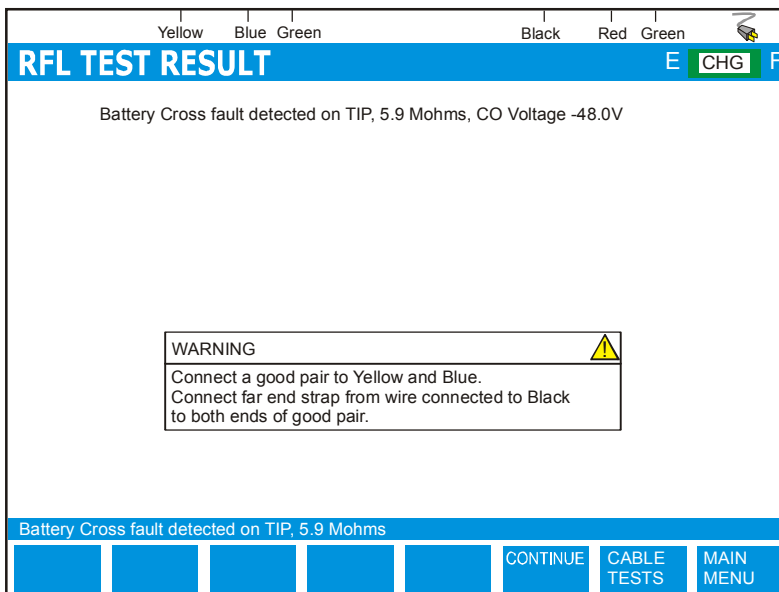| WARNING ⚠️ |
|---|
| Fault found between RING and GROUND.
Connect a good pair to Yellow and Blue.
Connect far end strap from wire connected to Red
to both ends of good pair. |
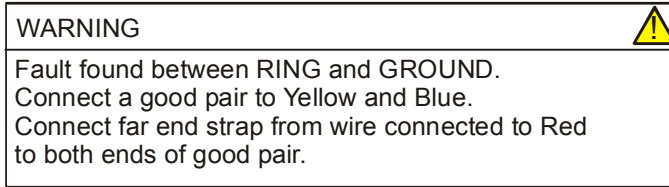
FIGURE 12.1.1.5D – RFL MESSAGE INDICATING PLACEMENT OF STRAP #2

At the conclusion of the RFL Isolation test, a WARNING box will appear indicating where the fault is (i.e. T-R, R-G, T-G, not distance) and how to connect the strap (**see Section 12.1.1.6**) at the far end. Once the strap is hooked up, the user can press the CONTINUE button to advance to the RFL SETUP menu.

NOTE: The user should locate a good pair before actually proceeding to the RFL SETUP menu.

12.1.1.6 Connecting the Strap

A strap is typically a wire that connects the ends of a good pair to a wire on the faulty pair. The strap should be made of 18AWG (1.0 mm) and be very short because it will have a very low resistance and will not affect the measurement. Alternatively, the same gauge of cable can be used but again must be very short as to not adversely affect the measurement.

Here are the possible hook-ups that can be done, depending upon the fault (others can exist).

Fault TIP-RING

GURE 12.1.1.6A – TIP-RING FAULT: STRAP PLACEMENT

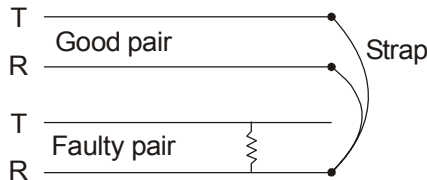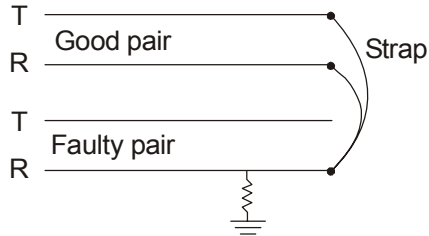Fault TIP-GROUND or RING-GROUND

FIGURE 12.1.1.6B – TO GROUND FAULT: STRAP PLACEMENT

Battery Cross Fault
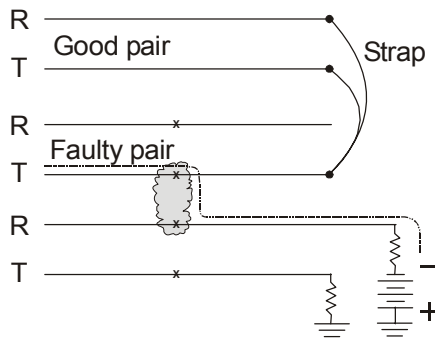
FIGURE 12.1.1.6C – BATTERY CROSS: STRAP PLACEMENT

> **IMPORTANT: Follow the CableSHARK's instructions for the correct Strap configuration.**
> **An improperly connected strap will force the RFL test to give misleading results.**

12.1.1.7 Setting up Cable Characteristics

The CableSHARK's RFL test needs to be configured in detail now that the faulty pair and good pairs have been identified and the strap properly attached.

The following screen will appear.

FIGURE 12.1.1.7A – RFL TEST SETUP SCREEN

At the top of the screen you can see colors corresponding to the test leads. Ensure that the connection to the faulty pair and the good pair corresponds to these colors.

For single section testing (i.e. the length of circuit under test is the same gauge) the user needs to enter / verify information about Cable Type, Resistance per length, Distance, Temperature and whether or not there are load coils on the line.

CABLE TYPE: The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE , and 0.8 mm PE. *Note: AWG =*

American Wire Gauge.

RESISTENCE PER LENGTH   Allows the user to specify the cable's resistance constant. See Appendix B for more information on loop characteristics.

NOTE: When the Cable Type or Temperature changes, this value will automatically change to reflect a new cable type or a lower or higher temperature. The initial setting is based on nominal room temperature (68°F or 20°C).

DISTANCE   Allows the user to specify the cable section length under test. This is one gauge of wire only.

NOTE: If DISTANCE is entered, the TEMPERATURE setting will be ignored. To enter an unknown distance, input the # sign.

TEMPERATURE   Allows the user to specify the temperature of the cable section under test.

NOTE: If TEMPERATURE is entered, the DISTANCE setting must be set to #.

NOTE: To enter negative temperatures, highlight the Temperature Edit box, press the EDIT/SELECT button to change the temperature and press the * (asterisk) key twice to enter the negative sign. Press the RIGHT ARROW key to advance to the next character position and start to enter the numerical temperature.

LOAD COIL   Allows the user to specify whether the section under test contains load coils. Load coils will add approximately 150 feet or 45 meters to the measurement for each load coil (based on 88 mH load coils).

Press the EDIT/SELECT button to change a setting or enter a new value. Use the LEFT/RIGHT ARROW keys to navigate to the different settings.

12.1.1.8 Setup the RFL Test for Multi-Section Testing

Users can enter loop characteristics for multi-section loops into the CableSHARK by pressing the MULTI-SECTION key. Users can enter characteristics of up to 5 sections into the CableSHARK. Typically a section is a different gauge of wire.

12.2 Running a RFL Test

Once the test is set up, press the RUN/STOP key located on the front panel of the CableSHARK. A screen similar to the screen shot below will appear.

The user is presented with the loop characteristics as entered during the setup phase as well as results in distance and resistance for the location of the fault.
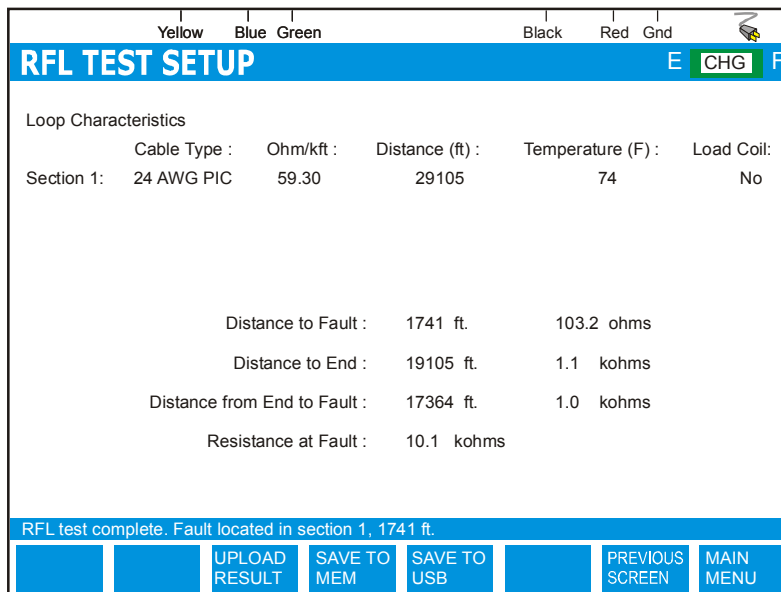

FIGURE 12.2A – RFL RESULT SCREEN

There are three parts of the circuit under test that are presented to the user. These parts are based on the location of the CableSHARK, the location of the fault and the location of the strap. The user will be given the following information: Distance to Fault, Distance to End, and Distance from End to Fault. The following image shows this in more detail.
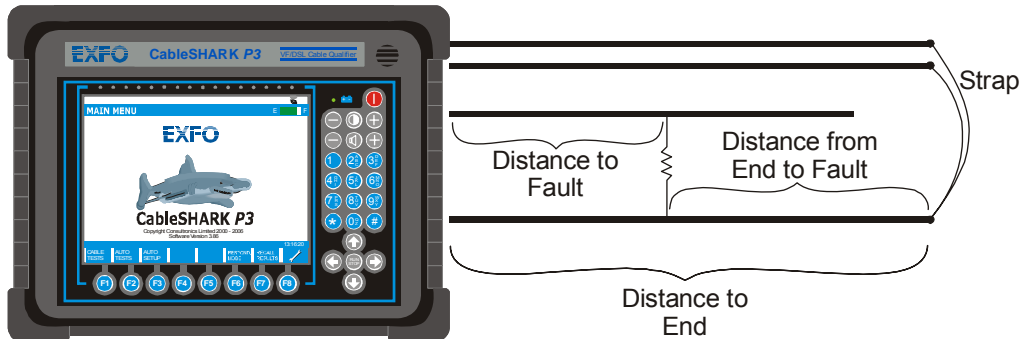
FIGURE 12.2B – DISTANCES EXPLAINED

Once the test has been completed, the status bar at the bottom of the screen will indicate that the test was complete what section the fault is located in, and the distance to the fault. The status screen will also show any errors and will ask the user to re-check the distances entered into each section and the strap connection.

At the completion of a test, the function button command selection at the bottom of the RFL Test screen consists of five options available to the operator. The following are brief descriptions of each of the function button options:

UPLOAD RESULT	Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.
SAVE TO MEM	Choosing SAVE TO MEM invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.
SAVE TO USB	Choosing SAVE TO USB invokes the SAVE SESSION menu. From here, the test results can be saved to an installed USB Memory. See Section 5.3 for more information.
TEST SETUP	Takes the user back to the RFL Setup Menu
MAIN MENU	Select the function button corresponding to MAIN MENU to return to the Main Menu.

12.3 RFL Hints

The following are useful hints for using the CableSHARK RFL function.

1. Use a strap that is made of 18 AWG (1.0 mm) cable. Strap together the faulty conductor to the good pair. Do not use smaller gauge of wire for the strap as this will have a higher resistance and will affect the measurement.

2. If AC voltage is being induced into the circuit under test, the RFL measurement will be incorrect. The best solution for this matter is to move closer to the Central Office as the CO as a lower impedance compared to testing in the middle of the cable.

3. 88mH Load coils typically add 4.5 ohms to the distance reading. That is about 150 ft (45 meters). Using the CableSHARK's Load Coil Detection test, determine how many load coils are on the line and subtract 150 feet (45 meters) for every load coil that is part of the distance reading. 88 mH load coils are placed 3000 ft from the CO and then every 6000 ft towards the customer. If the RFL indicates a problem at 12,000 ft, subtract 300 ft from that distance (2 load coils x 150 feet).

4. It may be necessary to put 10kohm matched resistor on the input of the RFL measurement to discharge voltage on the line before taking a measurement if voltage is detected.

5. Temperatures play an important part in determining the length of a cable (cable resistance changes with temperature). Temperatures can vary over the length of a cable and can be extreme. Aerial cables in direct sunlight will have a higher temperature than the air temperature.

6. To convert temperatures from Fahrenheit to Celsius and vice versa, use the following calculations:

    $$F = [(9 / 5) \times C] + 32$$

    $$C = (5 / 9) \times (F - 32)$$

7. If a Bridge Tap has a fault, the RFL measurement will indicate the location of the start of the Bridge Tap only.

8. If the RFL measurement gives a negative distance, there can be AC voltage being induced on the line or one of the cable section information entered into the CableSHARK's RFL Setup screen contains erroneous information.

9. Different gauges of cable have different loop resistances. The following table is for typical wire gauges and can be different from region to region and manufacturer to manufacturer.

Table 12.3.1
Loop Resistance @ 68°F or 20°C

Wire Gauge		Resistance		
mm	AWG	Ω/km	Ω/kft	Ω/mi
0.32 PE	28	409	125	658
0.40 PE		280	84.4	451
	26 PIC	273	83.1	439
0.50 PE		179	54.5	288
	24 PIC	172	52.3	276
0.60 PE		123	37.5	198
0.63 PE		113	34.5	182
	22 PIC	108	32.9	174
0.80 PE		69	21.0	111
0.90 PE		55	16.8	88.5
	19 PIC	53.8	16.4	86.6
NOTES:				
	PE = metric Polyethylene insulated cable			
	PIC = AWG Polyethylene insulated cable			
	Metric & AWG Wire Gauges: R & C (0Hz/DC, 20°C or 68°F)			

10. For a resistance at a temperature other than 68°F or 20°C, use the following formula. Note that these calculations are for copper cabling only.

For temperatures in Fahrenheit:

$$R_{TF} = R_{68°F} + [\ 0.0022 * (\ T_F - 68°F\ ) * R_{68°F}\ ]$$

Where R_{TF} = new resistance based on new temperature in Fahrenheit
T_F = new temperature
$R_{68°F}$ = resistance of the cable @ 68°F

For temperatures in Celsius:

$$R_{TC} = R_{20°C} + T_C - 20°C\ )\ *\ 0.00393\ *\ R_{20°C}]$$

Where R_{TC} = new resistance based on new temperature in Celsius
   T_C = new temperature
   $R_{20°C}$ = resistance of the cable @ 20°C

11. The RFL measurement is designed to find a single fault. If multiple faults exist, an incorrect measurement will be given. If the result does not coincide with a splice point or equipment location, then the test will have to re-done and the loop under test sectionalized to narrow down the location of the impairment.
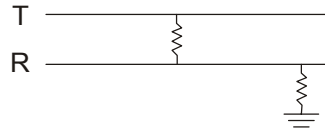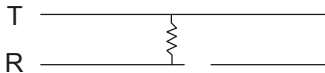
Section 13   Ground Resistance

13.1 Ground Resistance Testing

The CableSHARK's Ground Resistance (also known as Station Ground) test allows technicians to verify that correct grounding rules are being followed at the location under test. An adequate station ground and ground distribution system provides a common electrical reference point for all telecommunications equipment in the installation and minimizes the danger of electrical potential between various equipments and between equipments and the earth.

The CableSHARK's Ground Resistance measurement provides results based on three possibilities focused around the CO line card:

#1: Constant voltage source (old style)
#2: Constant current source (new style)
#3: Grounded source (such as AT&T #5ESS)

This option can be ordered from EXFO. A special alphanumeric software key will be sent to the purchaser based upon each CableSHARK's unique serial number. To determine the options current installed in the CableSHARK or to view the units unique serial number, go to SYSTEM SETUP and select the OPTIONS function key (see Section 6.4). Once the key is properly entered, the user can exit to the MAIN MENU, select CABLE TESTS, and then select GROUND RESISTANCE from the pop-up menu. The following setup screen will appear.

13.1.1 Setting up a Ground Resistance Test

To test Ground Resistance, the CableSHARK needs to be hooked up one of two configurations. The first configuration is when there is no ground connection such as the case is with Constant Voltage or Constant Current source line cards.
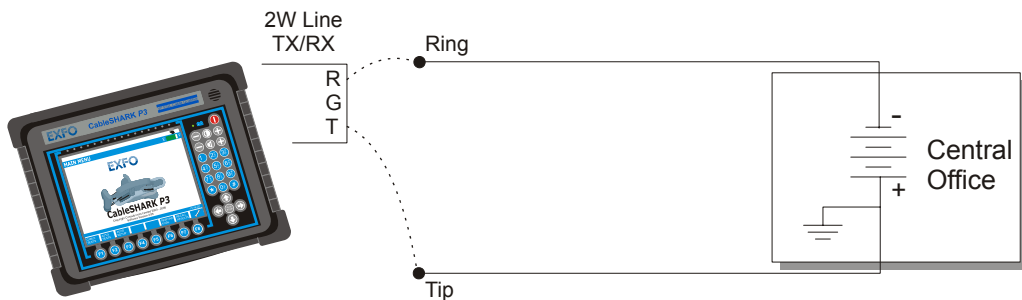
FIGURE 13.1.1A – GROUND RESISTANCE CONNECTION DIAGRAM #1

The second configuration is when there is a ground connection. The CableSHARK will tell you user how to attach the cables on screen, to avoid confusion.
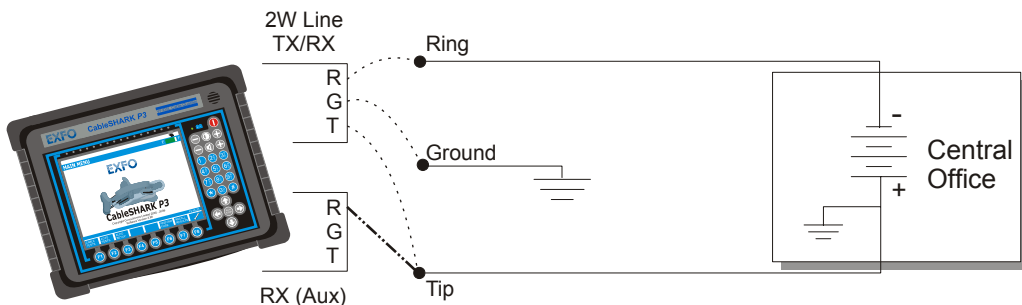
FIGURE 13.1.1B – GROUND RESISTANCE CONNECTION DIAGRAM #2

From the Main Menu, pressing function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing GROUND RESISTANCE will invoke the GROUND RESISTANCE SETUP menu. The sections that follow will explain the operation as each of the control keys is pressed and their respective screens appear.
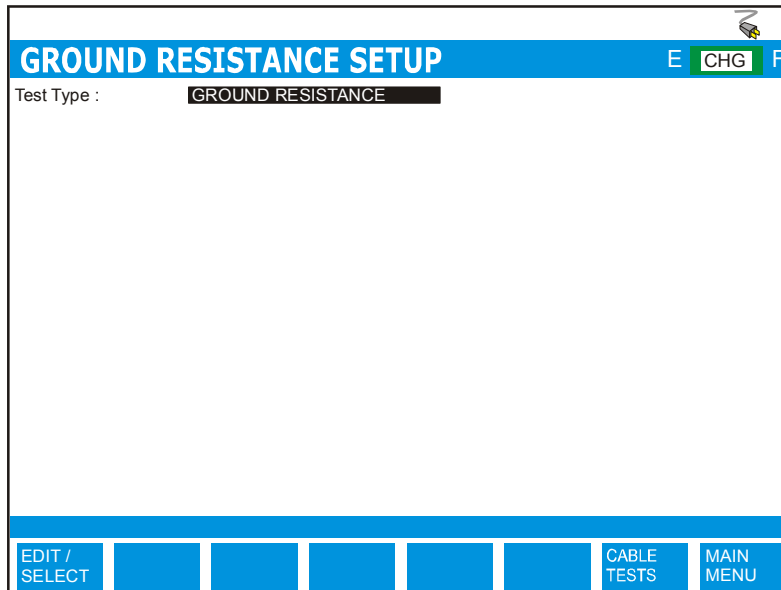
FIGURE 13.1.1C – GROUND RESISTANCE SETUP MENU

13.2 Running a Ground Resistance Test

⚠ Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the function button corresponding to the RUN / STOP button on the front of the CableSHARK to initiate the test. Depending upon the CO line card properties and whether it is active or not, the Ground Resistance measurement can give the following possibilities.

13.2.1 Constant Voltage Source

The CableSHARK will display voltage, loop current, and loop resistance information. Since there is no ground connection, a ground resistance measurement is not given.

```
GROUND RESISTANCE TEST RESULT        E   CHG   F

   Line Card = Voltage Source, no GND

   On Hook Voltage = -48 V

   Loop Current =  23 mA

   Loop Resistance =   1359 ohms




       SAVE/                              TEST   MAIN
       UPLOAD                             SETUP  MENU
```

FIGURE 13.2.1A – RESULT OF MEASUREMENT WHEN SOURCE IS VOLTAGE

13.2.2 Constant Current Source

The CableSHARK will display voltage and loop current. Since there is no ground connection, a ground resistance measurement is not given.

FIGURE 13.2.2A – RESULT OF MEASUREMENT WHEN SOURCE IS CURRENT

13.2.3 Voltage Source plus Ground

The CableSHARK will display voltage, loop current, loop resistance and ground resistance.
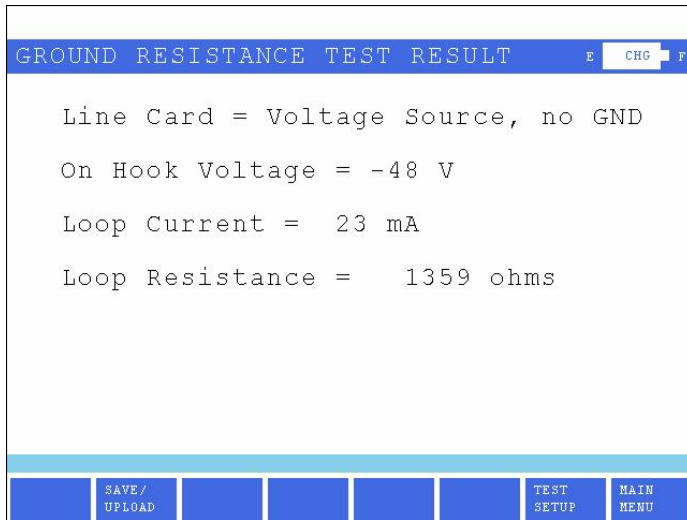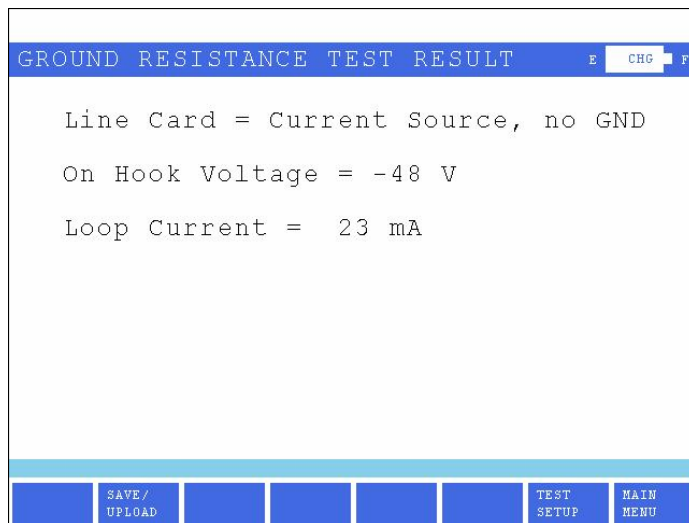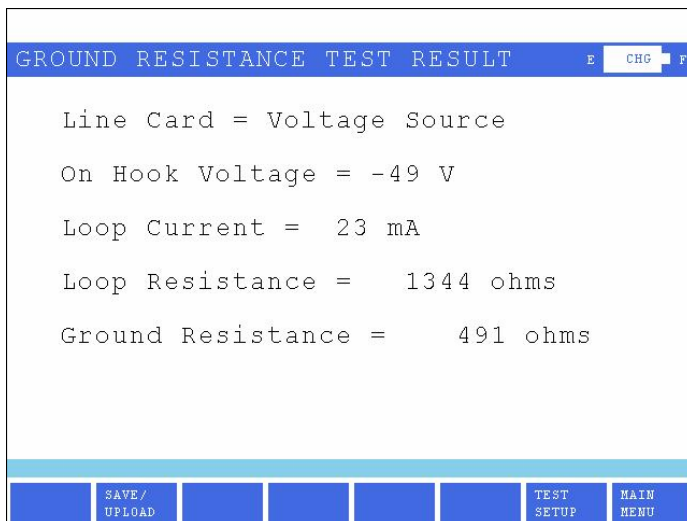

FIGURE 13.2.3A – RESULT OF MEASUREMENT WHEN SOURCE IS VOLTAGE

13.2.4 Current Source plus Ground

The CableSHARK will display voltage, loop current, loop resistance and ground resistance.
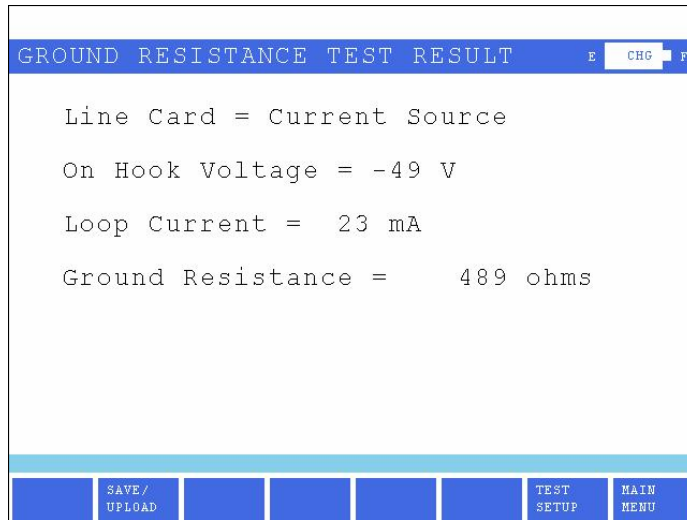
FIGURE 13.2.4A – RESULT OF MEASUREMENT WHEN SOURCE IS CURRENT

Resistance values of less than 25 ohms is considered acceptable. Anything over 25 ohms means there is a ground resistance problem.

If the line card is not connected or is not detectable by the CableSHARK, the Ground Resistance test displays the following screen.
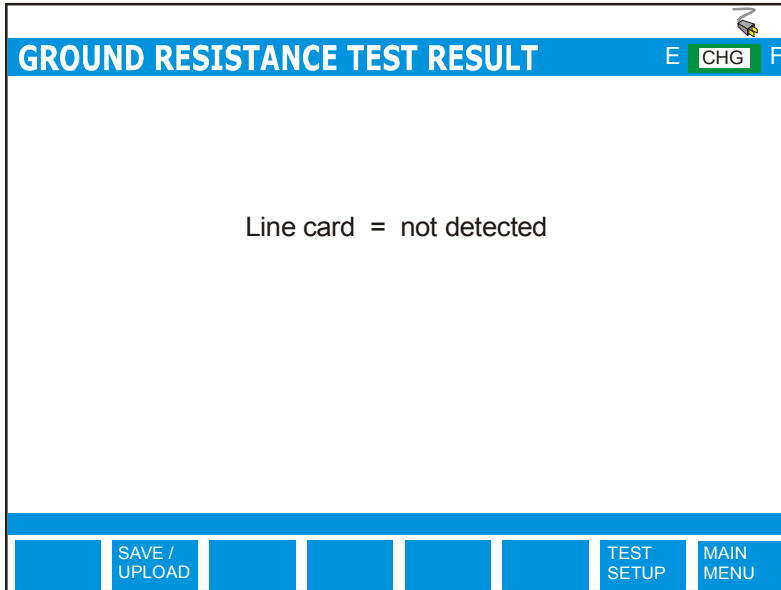
FIGURE 13.2.4B – LINE CARD NOT DETECTED

The Ground Resistance measurement is executed in the following fashion.

1. Measure the open loop (on hook) tip-ring voltage (Station voltage). The voltage must be negative. If not an error message reporting "Tip & Ring polarity reversed" will be displayed.

2. The CableSHARK will detect the balanced-unbalanced source (on hook) by measuring the ring-ground voltage. For a grounded system it must be ≤5 V. If the ring-ground voltage is ≥5 V, the line is balanced.

3. The CableSHARK measures the loop current (off hook) by seizing the line with a 435 ohm internal load

4. For the constant voltage sources, the CableSHARK measures the tip-ring voltage (off hook) with the 435 ohm load.

5. For the grounded system, the CableSHARK switches the loop current path with the 435 ohm load (currently off hook), from tip-ring to tip-ground. The CableSHARK measure both the ring-ground voltage and the loop current.

The Ground Resistance measurement sequence is based on the following assumptions:

1. The ground lead of the instrument is connected reliably to the ground of the CO

2. The standard CO voltage is nominally -48 VDC. The twisted pair is connected to the CO with tip as positive and ring as negative.
3. The grounded constant current source limits the current on the –48 V side only.

Section 14   Ringer Detection Testing

14.1 Ringer Detection Testing

The CableSHARK is capable of performing a ringer detection test to determine the ringer equivalency number (REN) and capacitiance of T-R, R-G, T-G.

Telephone companies define a "ringer equivalency number" (REN) for each device that rings when your telephone number is called. This number represents the current each device draws. The maximum number of REN's per circuit is going to be a number less than 4.0 or 5.0. The exact number is set by the capabilities of your local telecom supplier. As more devices are connected to the phone line the total REN value increases. When the total REN value starts to approach the maximum value set by the telecom supplier your telephones and/or modems may not ring.

14.1.1 Setting up a Ringer Detection Test

To set up a Ringer Detection test, select the Ringer Detection option from the CABLE TESTS pop-up menu.

The Ringer Detection Test Setup menu has the following configuration option.

TEST TYPE: Fixed at Ringer Detection

14.2   Running a Ringer Detection Test

⚠️ Use caution when connecting the test set, as telephone cables may have dangerous A.C. or D.C. voltages on them.

Press the RUN / STOP button on the front of the CableSHARK to initiate the Ringer Detection test. Figure 14.2A shows an example of the results obtained from a Ringer Detection Test.

RINGER DETECTION RESULT   E CHG F

Ringer Detection (T-R)   : 1.0 REN, Cap = 0.47 uF

Ringer Detection (T-G)   : 0.0 REN, Cap = 0.00 uF

Ringer Detection (R-G)   : 0.0 REN, Cap = 0.00 uF

SAVE / UPLOAD   PREVIOUS SCREEN   MAIN MENU

FIGURE 14.2A – RINGER DETECTION TEST COMPLETE

At the completion of a test, the function button command selection at the bottom of the Ringer Detection Test Result screen consists of several options available to the operator. The following are brief descriptions

of each of the function button options: Pressing the **SAVE / UPLOAD** button shows a pop-up window where the user is allowed to upload results, and save results to internal memory or to external USB memory.

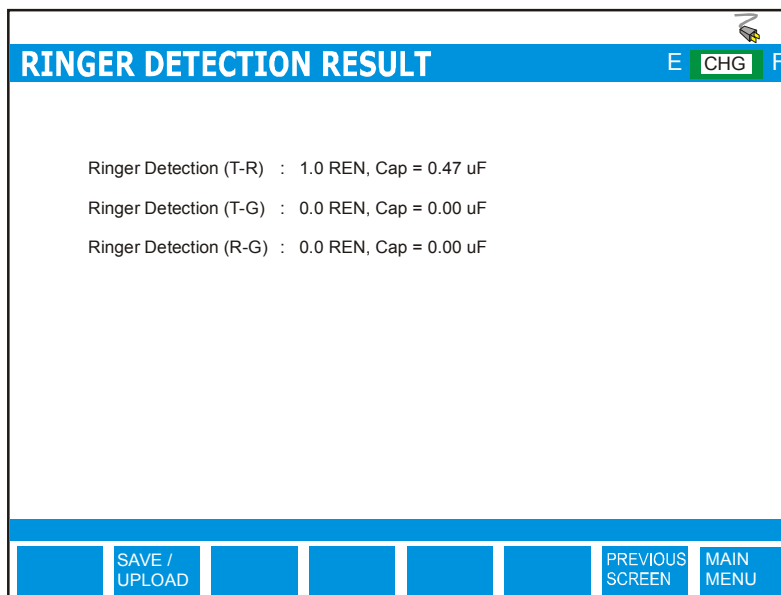|	
UPLOAD RESULT	Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.
SAVE TO MEM	Choosing SAVE TO MEM from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.
SAVE TO USB	Choosing SAVE TO USB from the SAVE / UPLOAD pop-up menu invokes the SAVE SESSION menu. From here, the test results can be saved to external USB memory. See Section 5.3 for more information.

The remainder of the buttons are as follows:

PREVIOUS SCREEN	Pressing the function button associated with PREVIOUS SCREEN returns the user to the Ringer Detection test setup screen.
MAIN MENU	Select MAIN MENU to return to the Main Menu.

Section 15 VF Testing

The CableSHARK is capable of performing voice frequency (VF) tests from 300 Hz to 4 kHz (some tests go up to 20 kHz). The VF tests include transmitting level/frequency, receiving level/frequency, measuring Noise, measuring Influence and measuring Impulse Noise.

15.1 Sending Tone (Transmitting Level/Frequency)

The Sending Tone function allows a user to send a single tone or multiple tones to a far end device, be it another CableSHARK or a EXFO Auto-TIMS III Transmission Impairment Measuring Set. The options under the Send Tone umbrella include Spot, Variable, 3 Tone Slope and Tracing Tone.

15.1.1 Sending Spot Frequencies

To send a Spot Frequency, select the VF TESTS option from the CABLE TESTS pop-up menu. Select SEND TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.

FIGURE 15.1.1A - SETTING UP THE SPOT TEST

specified Level as designated in the LEVEL column. Selecting the EDIT/SELECT button will allow the user to modify the LEVEL and the FREQUENCY if desired.

15.1.2 Sending Variable Frequencies

To send a Variable frequency, select the VF TESTS option from the CABLE TESTS pop-up menu. Select SEND TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.

VF TEST SETUP	E CHG F
Test Type :	SEND TONE
Term Impedance:	600 OHMS
Level (dBm):	0
Frequency Mode:	VARIABLE

EDIT / SELECT	SELECT PREVIOUS	SELECT NEXT				CABLE TESTS	MAIN MENU

FIGURE 15.1.2A - SETTING UP THE VARIABLE FREQUENCY TEST

The VF TEST menu has the following configuration option.

TEST TYPE: Select SEND TONE

TERM IMP: 600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).

Level (dBm):   Level can be set from –16 dBm to +18 dBm. Use the asterisk key (*) to toggle between minus (-) and plus (+) symbols.

Frequency Mode: Allows user to select from SPOT, VARIABLE, TX 3 TONE SLOPE and TRACING TONE.

With VARIABLE frequency selected, press the RUN/STOP key to start the test. The following screen will appear.

FIGURE 15.1.2B - RUNNING A VARIABLE FREQUENCY TEST

The VARIABLE frequency screen allows a user to modify what is being transmitted from the CableSHARK. Selecting the EDIT/SELECT button will allow the user to modify the LEVEL and the FREQUENCY if desired.

15.1.3 Sending 3 Tone Slope

To send 3 Tone Slope, select the VF TESTS option from the CABLE TESTS pop-up menu. Select SEND TONE from the VF TESTS sub-menu. Press RUN/STOP to continue.
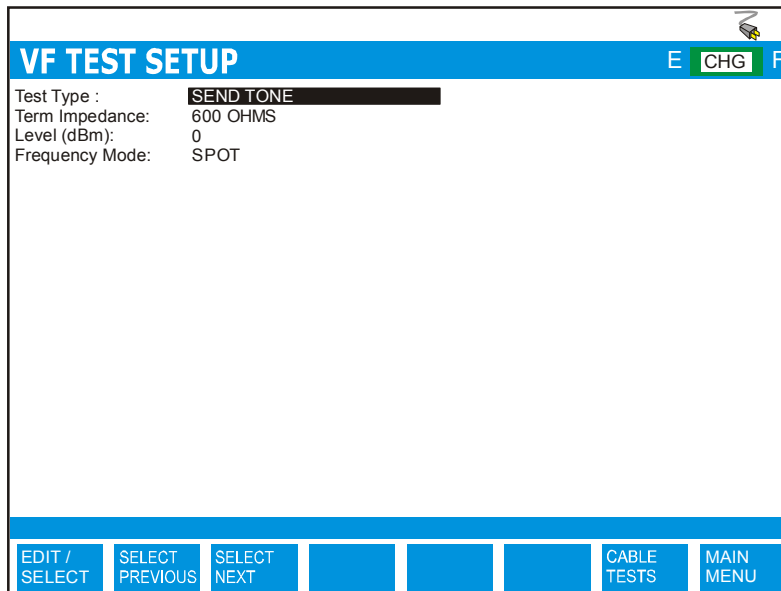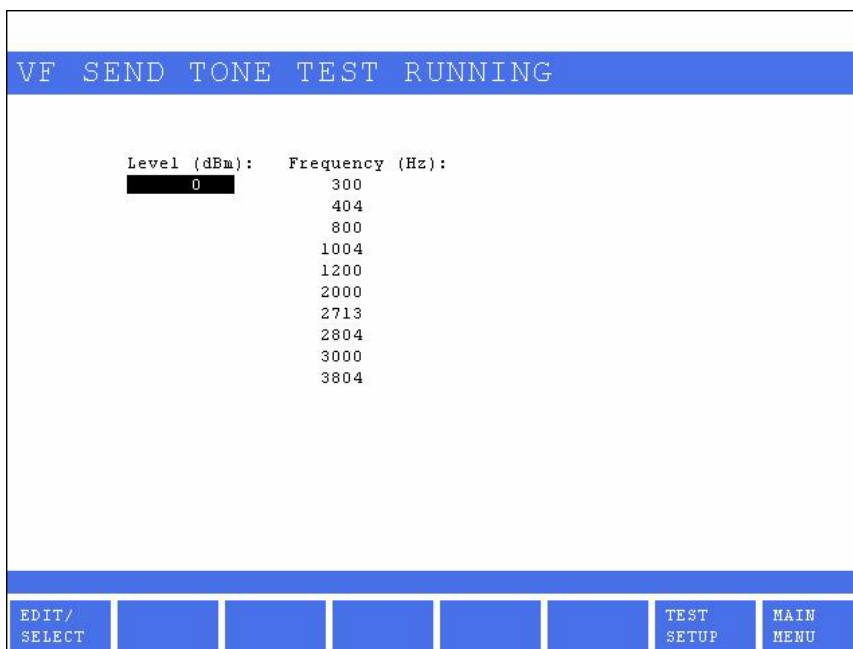

FIGURE 15.1.3A - SETTING UP THE 3 TONE SLOPE test

The VF TEST menu has the following configuration option.

TEST TYPE:	Select SEND TONE
TERM IMP:	600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).
Level (dBm):	Level can be set from –16 dBm to +18 dBm. Use the asterisk key (*) to toggle between minus (-) and plus (+) symbols.
Frequency Mode:	Allows user to select from SPOT, VARIABLE, TX 3 TONE SLOPE and TRACING TONE.
Time / Tone (sec)	Allows user to specify the time between tones sent when using the TX 3 Tone Slope test. Options are from 1 to 10 seconds.

With TX 3 TONE SLOPE selected, press the RUN/STOP key to start the test. The following screen will appear.
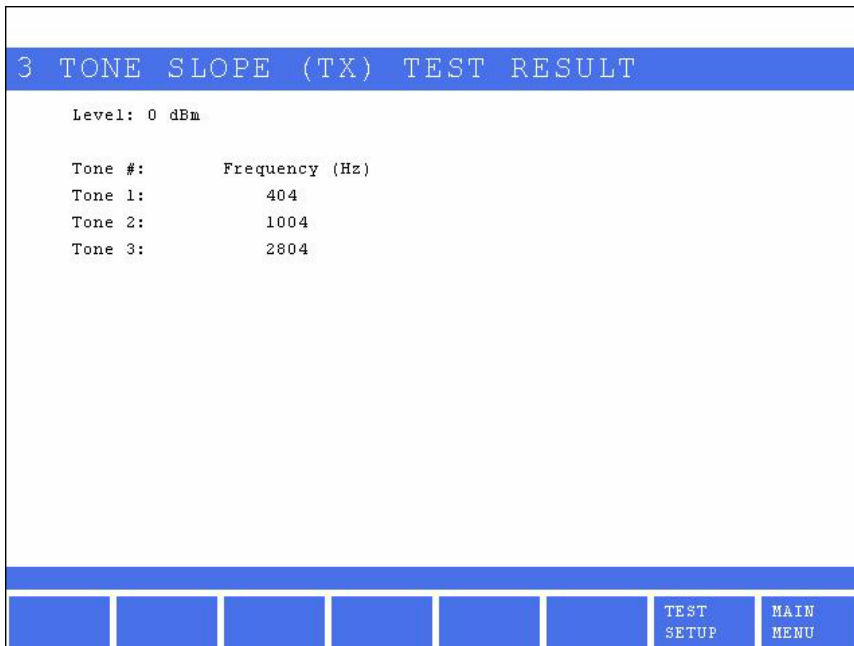
FIGURE 15.1.3B - RUNNING THE 3 TONE SLOPE test

The TX 3 TONE SLOPE screen shows the tones (frequencies) being transmitted. Selecting the EDIT/SELECT button will allow the user to modify FREQUENCY if desired.

15.1.4 Sending a Tracing Tone

The Tracing Tone function places a continuous tone on the line for use in cable pair detection to ensure the technician is measuring the correct pair at the far end.

To send a Tracing Tone onto the line, select the VF TESTS option from the CABLE TESTS pop-up menu. Select SEND TONE from the VF TESTS sub-menu. Press RUN/STOP to continue.

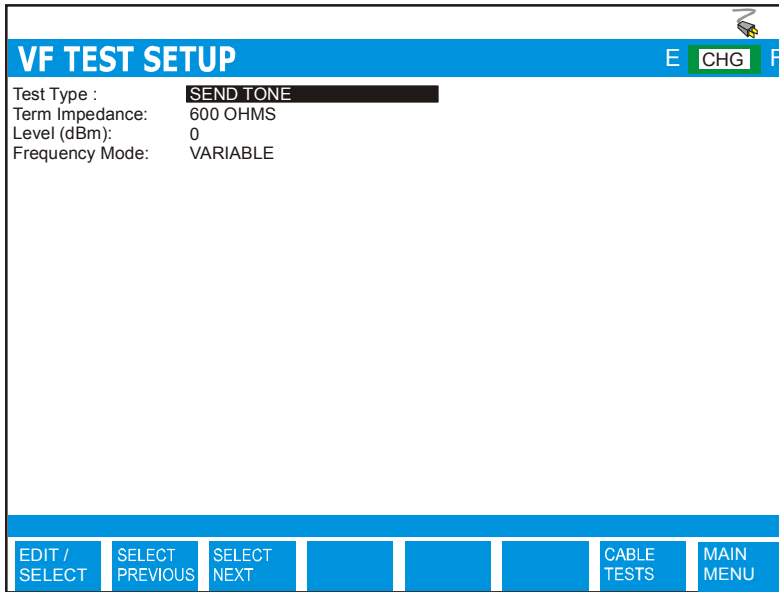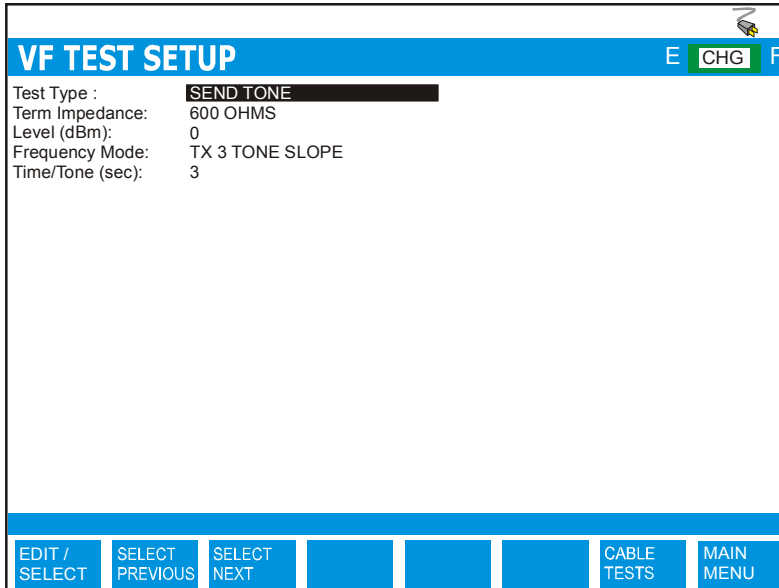*FIGURE 15.1.4A - SETTING UP THE TRACING TONE*

The VF TEST menu has the following configuration option.

TEST TYPE: Select SEND TONE

TERM IMP: 600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).

Level (dBm):   Level can be set from –16 dBm to +18 dBm. Use the asterisk key (*) to toggle between minus (-) and plus (+) symbols.

Frequency Mode: Allows user to select from SPOT, VARIABLE, TX 3 TONE SLOPE and TRACING TONE.

With TRACING TONE selected, press the RUN/STOP key to start the test. The following screen is displayed.
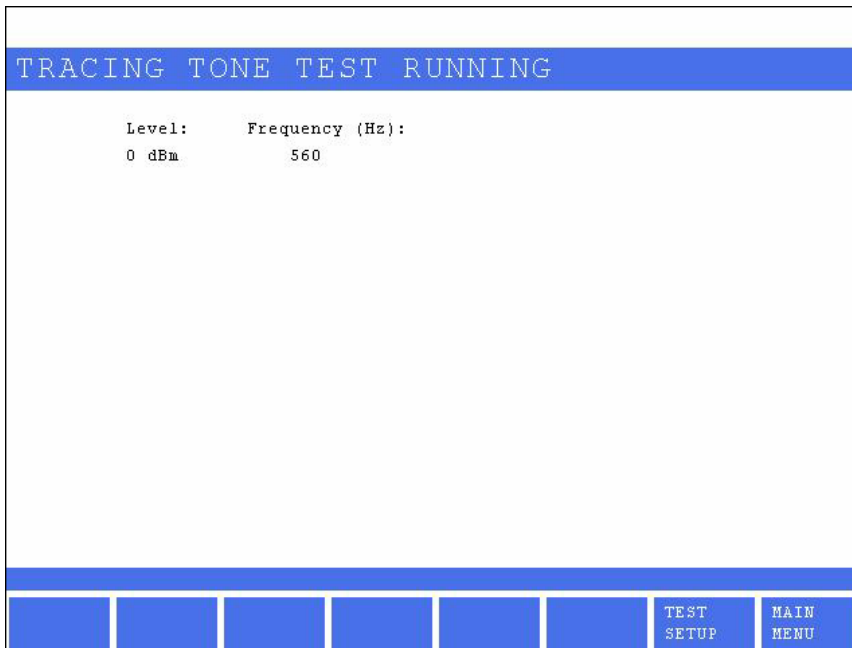
FIGURE 15.1.4B - RUNNING THE TRACING TONE TEST

The TRACING TONE screen shows what is being transmitted from the CableSHARK.

15.2 Receive Tone (Receiving Level/Frequency)

The Receive Tone function allows a user to measure incoming signals and provides the level and frequency of the signal. The transmitting device could be another CableSHARK or a EXFO Auto-TIMS III Transmission Impairment Measuring Set. The options under the Receive Tone umbrella include Numerical, Graphical, and RX 3 Tone Slope.

15.2.1 Numerical Level/Frequency

To measure level/frequency numerically, select the VF TESTS option from the CABLE TESTS pop-up menu. Select RECEIVE TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.

FIGURE 15.2.1A - SETTING UP RX TONE NUMERICAL TEST

The VF TEST menu has the following configuration option.

TEST TYPE: Select RECEIVE TONE

TERM IMP: 600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).

Receiver Mode: Allows user to select from NUMERICAL, GRAPHICAL, and RX 3 TONE SLOPE.

With NUMERICAL selected, press the RUN/STOP key to start the test. The following screen will appear. Press the FREEZE button to stop the test. Results can be saved by pressing the SAVE/UPLOAD button.
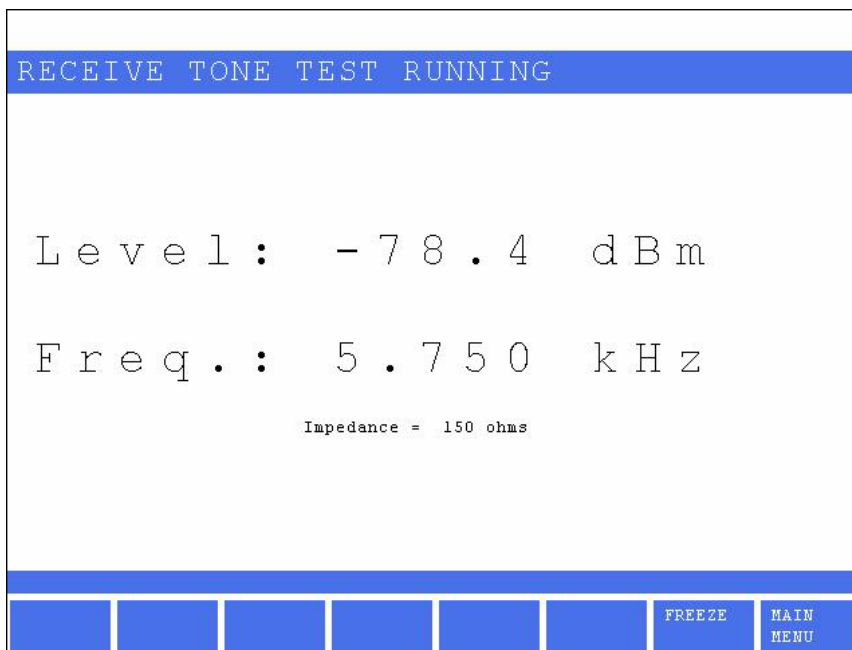
FIGURE 15.2.1B - RUNNING THE RX TONE NUMERICAL TEST

15.2.2 Graphical Level/Frequency

To measure level/frequency graphically, select the VF TESTS option from the CABLE TESTS pop-up menu. Select RECEIVE TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.
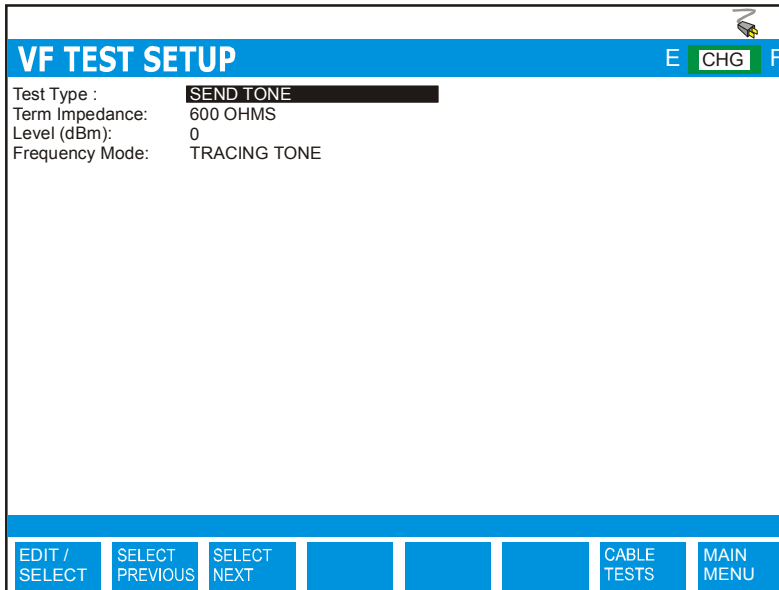
*FIGURE 15.2.2A - SETTING UP RX TONE GRAPHICAL TEST*

The VF TEST menu has the following configuration option.

TEST TYPE: Select RECEIVE TONE

TERM IMP: 600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).

Receiver Mode: Allows user to select from NUMERICAL, GRAPHICAL, and RX 3 TONE SLOPE.

Graph Scale: Allows user to select from 300 Hz to 4 kHz or 300 Hz to 20 kHz.

With GRAPHICAL selected, press the RUN/STOP key to start the test. The following screen will appear.
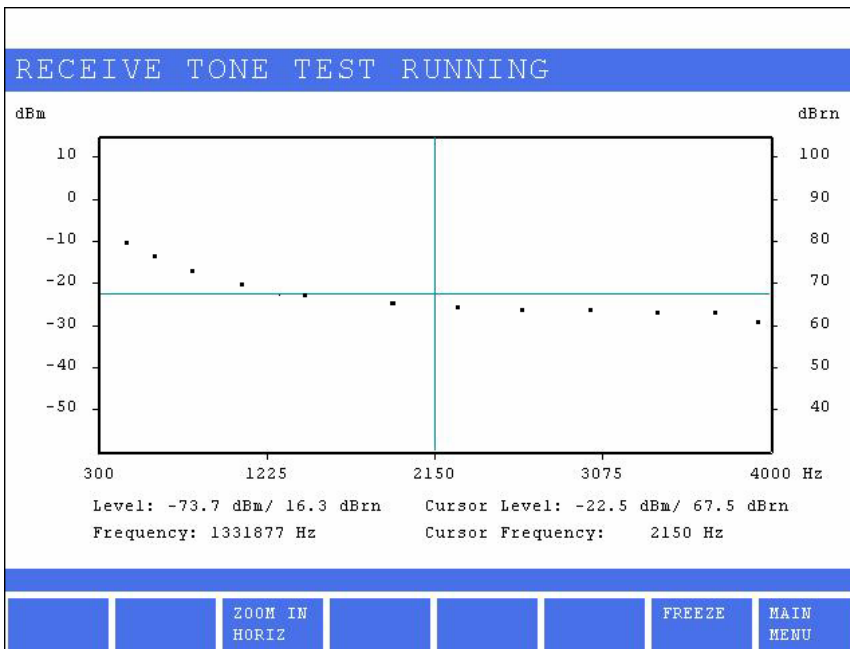
FIGURE 15.2.2B - RUNNING THE RX TONE GRAPHICAL TEST

The result screen allows a user to graphically see the levels and frequencies that the CableSHARK is receiving (see lower left numerical results for current level/frequency being measured by the CableSHARK. By moving the LEFT/RIGHT and UP/DOWN arrow keys, users can move the cursors on screen to pin-point precise points on screen. The Level/Frequency of the point highlighted by the cursor is displayed on the right hand of the screen.

15.2.3 RX 3 Tone Slope

To measure 3 Tone Slope, select the VF TESTS option from the CABLE TESTS pop-up menu. Select RECEIVE TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.
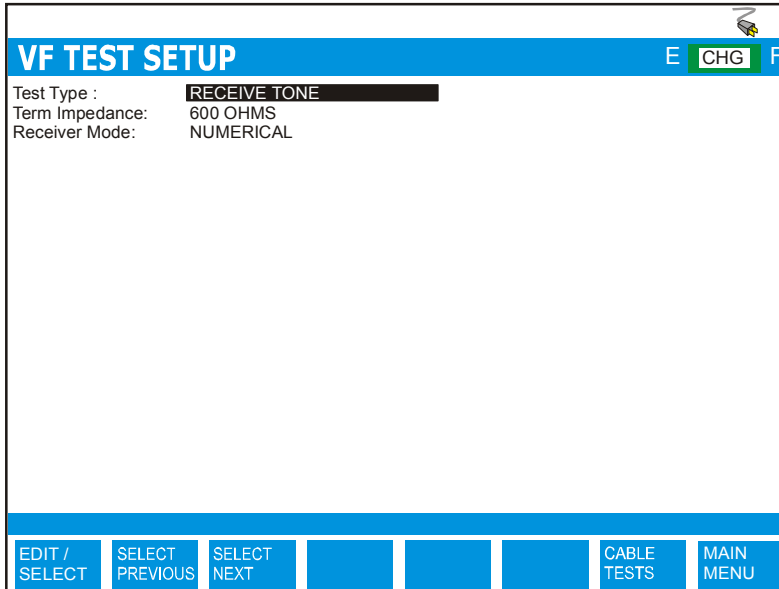
FIGURE 15.2.2A - SETTING UP RX TONE GRAPHICAL TEST

The VF TEST menu has the following configuration option.

TEST TYPE: Select RECEIVE TONE

TERM IMP: 600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).

Receiver Mode: Allows user to select from NUMERICAL, GRAPHICAL, and RX 3 TONE SLOPE.

With RX 3 TONE SLOPE selected, press the RUN/STOP key to start the test. The following screen will appear.

```
┌──────────────────────────────────────────────────┐
│                                                    │
│ RECEIVE TONE TEST RUNNING                          │
│                                                    │
│                                                    │
│ ┌───────────────┬─────────┬─────────┬─────────┐   │
│ │Frequency (Hz) │  N/A    │  N/A    │  N/A    │   │
│ ├───────────────┼─────────┼─────────┼─────────┤   │
│ │Level (dBm)    │  N/A    │  N/A    │  N/A    │   │
│ ├───────────────┼─────────┼─────────┼─────────┤   │
│ │Slope (dBm)    │  N/A    │  N/A    │  N/A    │   │
│ └───────────────┴─────────┴─────────┴─────────┘   │
│                                                    │
│              Impedance =  150 ohms                 │
│                                                    │
│                                                    │
│                                                    │
│                                                    │
│                                           FREEZE  MAIN │
│                                                   MENU │
└──────────────────────────────────────────────────┘
```

FIGURE 15.2.2B - RUNNING THE RX 3 TONE SLOPE TEST

The result screen shows the user the level, frequency, and slope of the incoming signal.

15.3 Noise Test

The Noise function allows a user to measure RMS noise on the circuit under test.

To measure Noise, select the VF TESTS option from the CABLE TESTS pop-up menu. Select RECEIVE TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.

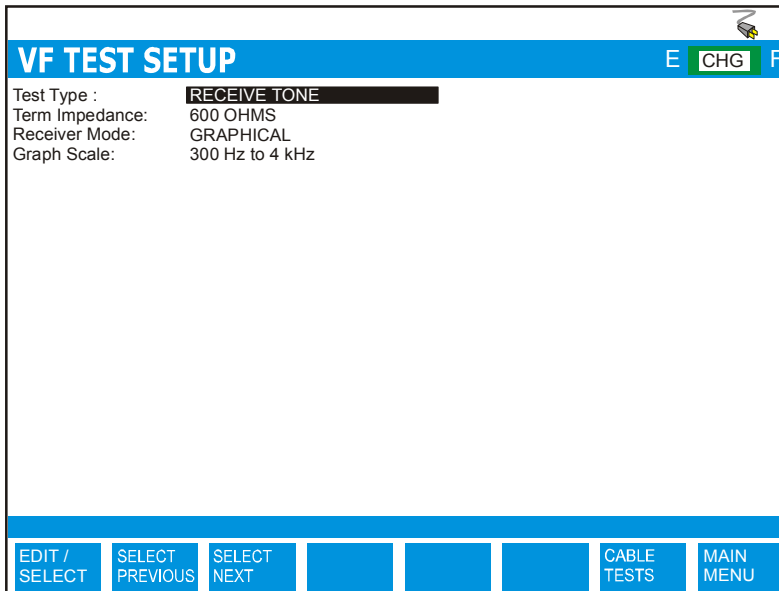*FIGURE 15.3A - SETTING UP NOISE TEST*

The VF TEST menu has the following configuration option.

TEST TYPE:	Select NOISE
TERM IMP:	600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).
Noise Filter	Allows user to select from NONE, C-Message, C-Notched, 3 kHz Flat, 15 kHz Flat, 50 kbit, and IEEE 743 D Filter. For ITU, Psophometric and P-Notched are available.
Measurement Units:	Allows user to select from displaying results in dBm or dBrnC.

With NOISE selected, press the RUN/STOP key to start the test. The following screen will appear.

FIGURE 15.3B - RUNNING THE NOISE TEST

Users can change the measurement units (dBm & dBrnC) and filters by pressing the buttons dBm/dBrnC and Cycle Filter respectively.

Press the FREEZE button to stop the test. Results can be saved by pressing the SAVE/UPLOAD button.

15.4 *Impulse Noise Test*

The Impulse Noise function allows a user to measure Impulse Noise on the circuit under test.

To measure Impulse Noise, select the VF TESTS option from the CABLE TESTS pop-up menu. Select RECEIVE TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.
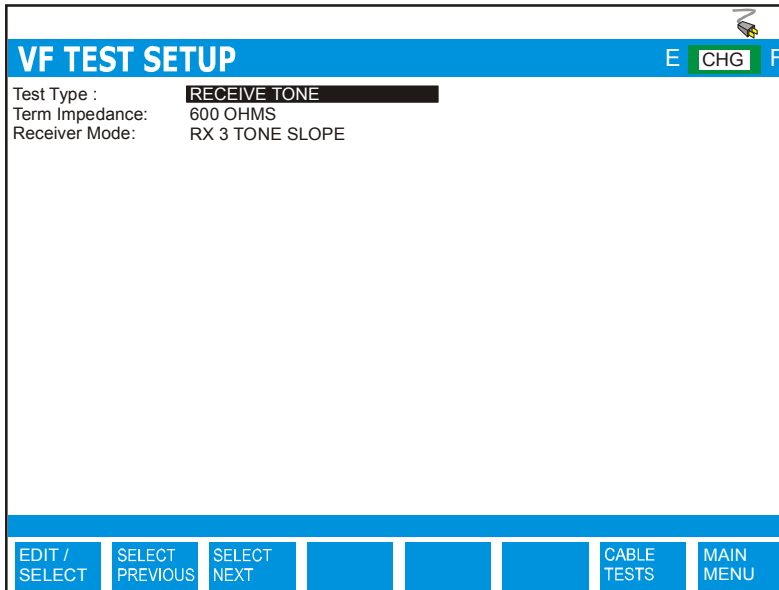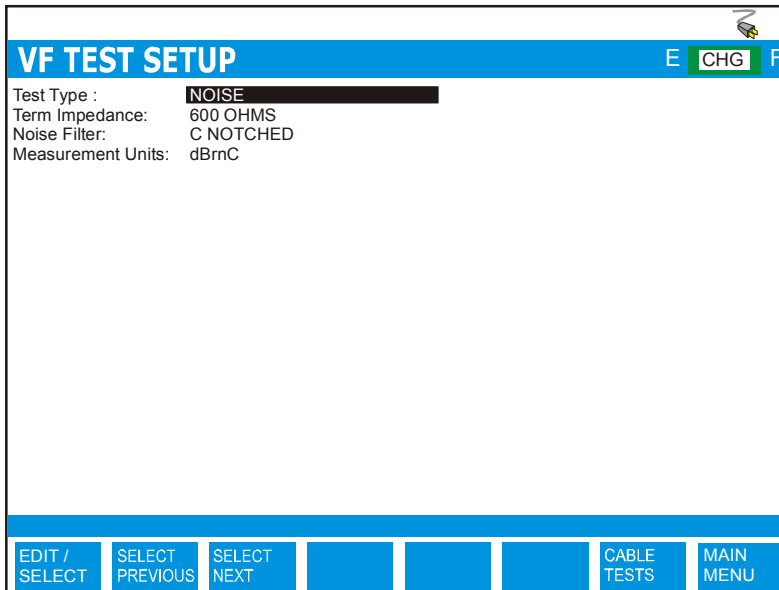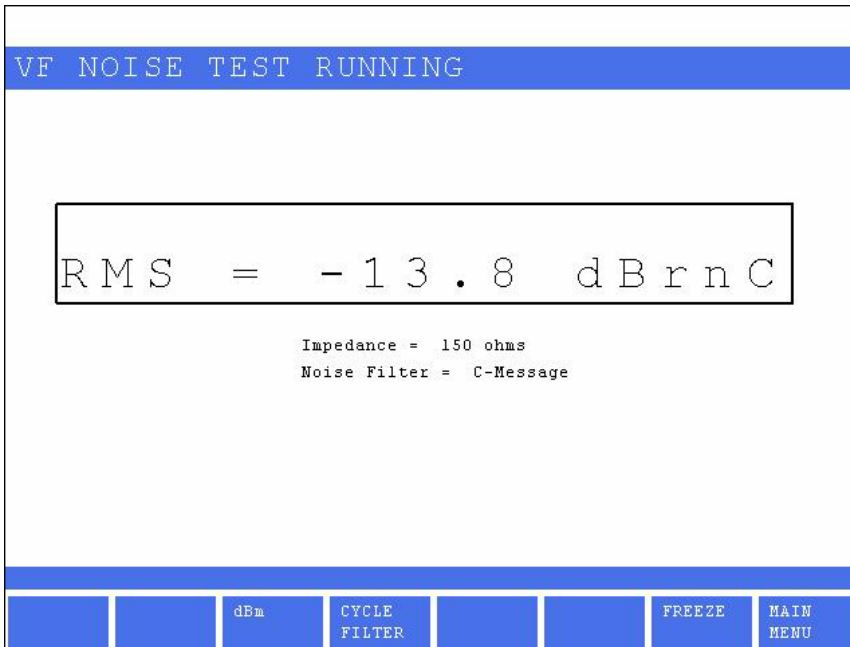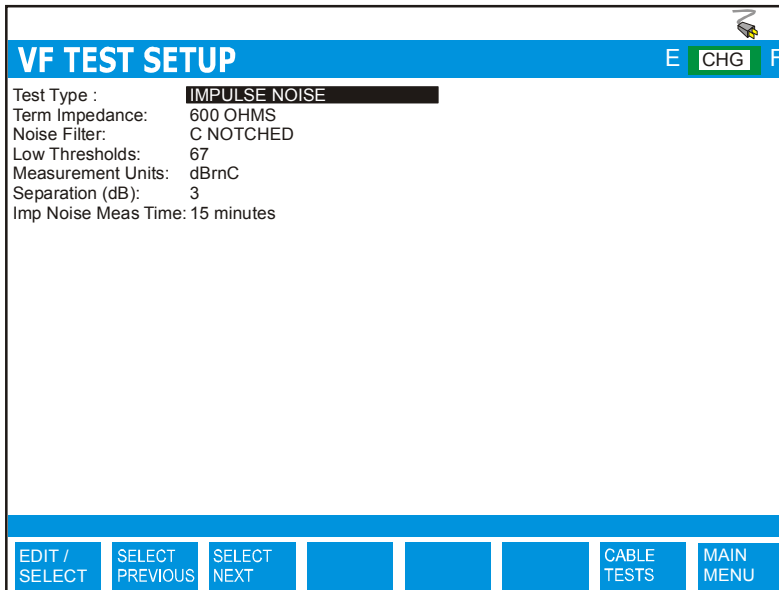

FIGURE 15.4A - SETTING UP NOISE TEST

The VF TEST menu has the following configuration option.

TEST TYPE: Select IMPULSE NOISE

TERM IMP: 600 ohms (or 100, 150 ohms if your unit does not have 600 ohms installed).

Noise Filter   Allows user to select from NONE, C-Message, C-Notched, 3 kHz Flat, 15 kHz Flat, 50 kbit, and IEEE 743 D Filter. For ITU, Psophometric and P-Notched are available.

Low Thresholds   Allows user to select the low threshold for the impulse noise test.

Measurement Units:	Allows user to select from displaying results in dBm or dBrnC.
Separation (dB)	Allows user to specify the level difference between the low, mid and high thresholds in dB. 1 to 6 dB is the available range for separation.
Imp Noise Meas Time:	Allows user to select the test duration. Options are from 1 minute to 24 hours. 15 minutes is the default.

With IMPULSE NOISE selected, press the RUN/STOP key to start the test. The following screen will appear.
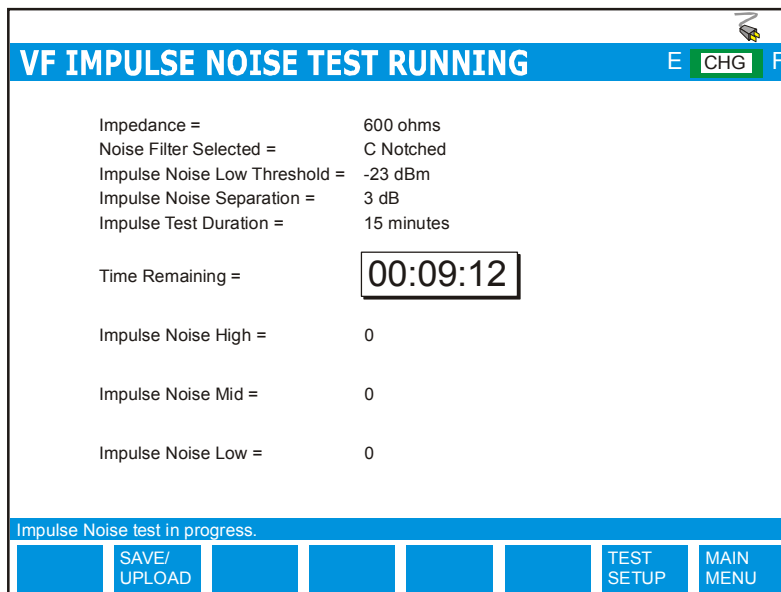
FIGURE 15.4B - RUNNING THE IMPULSE NOISE TEST

Press the RUN/STOP button to stop the test before the timer runs out if desirable.

Results can be saved by pressing the SAVE/UPLOAD button.

15.5 Power Influence

The Power Influence test measures the affects that 50 Hz and 60 Hz power line (AC Mains) interference has on the circuit under test. Up to the 9th Harmonic is displayed.

To measure Power Influence, select the VF TESTS option from the CABLE TESTS pop-up menu. Select RECEIVE TONE from the VF TESTS sub-menu. To continue, press RUN/STOP.
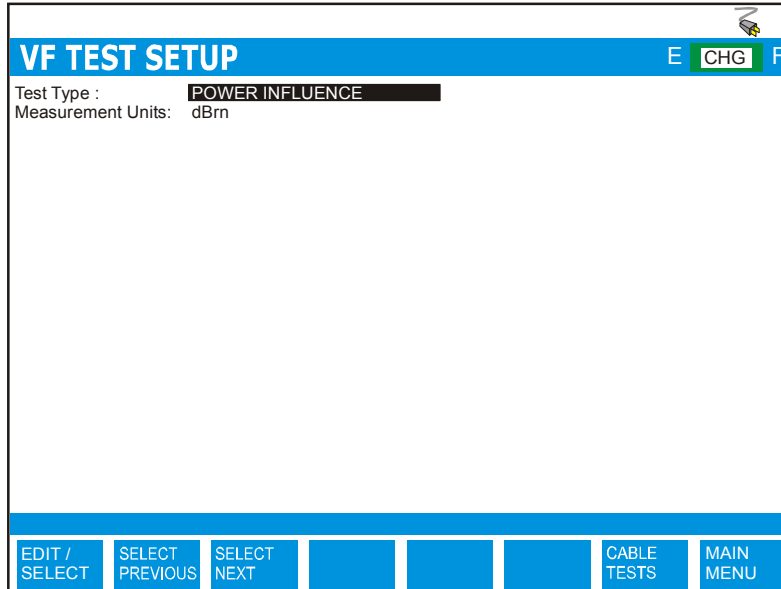

FIGURE 15.5A - SETTING UP THE POWER INFLUENCE TEST

The VF TEST menu has the following configuration option.

TEST TYPE: Select POWER INFLUENCE

Measurement Units: Allows user to select from displaying results in dBm or dBrn.

With POWER INFLUENCE selected, press the RUN/STOP key to start the test. The following screen is displayed.
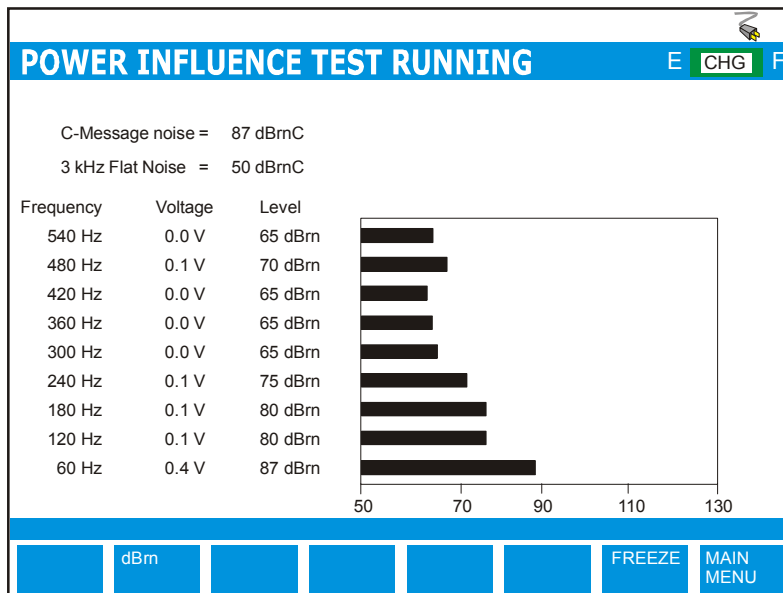
FIGURE 15.5B - RUNNING THE POWER INFLUENCE TEST

Press the FREEZE button or the RUN/STOP key to stop the test. Results can be saved by pressing the SAVE/UPLOAD button.

Section 16   K-Test

16.1   K-Test

The K-test or **Kupfmuller** test can be used to find the approximate distance to a resistance fault when both wires in a single pair are faulted at the same place and a separate good pair is not available (see RFL Test).
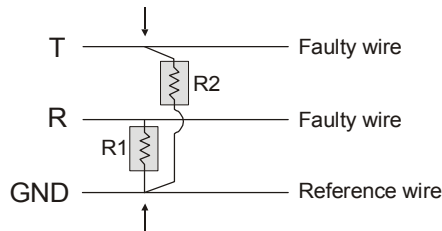
NOTE: R1 and R2 are faulted resistances

FIGURE 16.1A – SHORT BETWEEN TIP AND RING TO GROUND

Additional requirements for use of this test are as follows (but don't worry, the CableSHARK will also look for these and make the decision for you):

- One fault must be at least twice as "heavy" as the other fault (e.g., 5kΩ is twice as "heavy" as 10kΩ). **I.e. R1 > 2 x R2   or   R2 > 2 x R1**

- The sum of both faults must be at least 100 times the loop resistance (for instance, if the loop resistance is 50W, the "lighter" fault must be 5kW or greater). **I.e. R1 + R2 > 100 * Loop resistance**

16.2   Setting up a K-test

16.2.1 Disconnecting the Station Battery and the Customer

Before a K-test can take place, the circuit that is to be tested must be disconnected from the CO station battery and from the customer. The K-test is an end-to-end test meaning that the CableSHARK is placed at one end of the circuit (typically on the CO side of the circuit) and a strap is placed on the customer side of the circuit.

IMPORTANT*: Attachment of the strap should not take place until the CableSHARK has indicated how to hook up the strap. A visual indication will be displayed on screen.*

16.3   Running the K-test

From the Main Menu, pressing Function button F1 (CABLE TESTS) will bring the user to the CABLE TESTS pop-up menu. Choosing **K-Test** from the pop-up menu actives the K-Test measurement.

The CableSHARK will measure the combinations of TIP-RING, RING-GROUND, and TIP-GROUND using the CableSHARK voltage and resistance tests to determine if K-Test is possible on the faulty pair selected. If the measured resistance is <10 Mohms, or the voltage is > 2 VDC or negative, there may be a fault on the line.
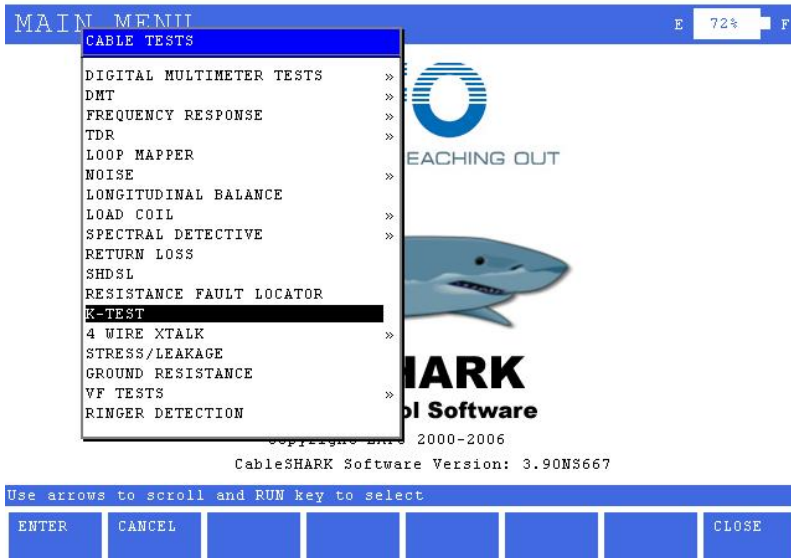
FIGURE 16.3A – SELECTING TH E K-TEST FROM THE MAIN MENU

If there is a voltage on the line, the K-Test will display the following message: "**K-Test isolation test is not complete, live voltage detected.**" At this point the user should verify that the station battery has been disconnected on the pairs under test.

Select K-test from the Main Menu pop-up screen and press the "RUN STOP" button to execute the test. The following screen is displayed:

FIGURE 16.3B– K-TEST SETUP SCREEN

Connect Tip to Aux. Tip and Ring to Aux Ring. Connect Tip and ring to the faulted pair, and Ground to the reference wire. Disconnect the far end strap then press the "F6" or "RUN/STOP" button to execute the test. The following screen may be displayed:

FIGURE 16.3C– K-TEST PRE-TEST SCREEN

16.3.1 Connecting the Strap

A strap is typically a wire that connects the ends of a good pair to a wire on the faulty pair. The strap should be made of 18AWG (1.0 mm) and be very short because it will have a very low resistance and will not affect the measurement. Alternatively, the same gauge of cable can be used but again must be very short as to not adversely affect the measurement.

Here a possible hook-up that can be done, depending upon the fault (others can exist).
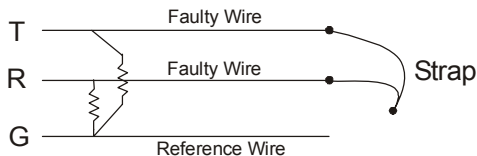
FIGURE 16.3.1A – STRAP PLACEMENT

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> **_IMPORTANT_**_: Follow the CableSHARK's instructions for the correct Strap configuration._
> _An improperly connected strap will force the K-Test test to give misleading results._
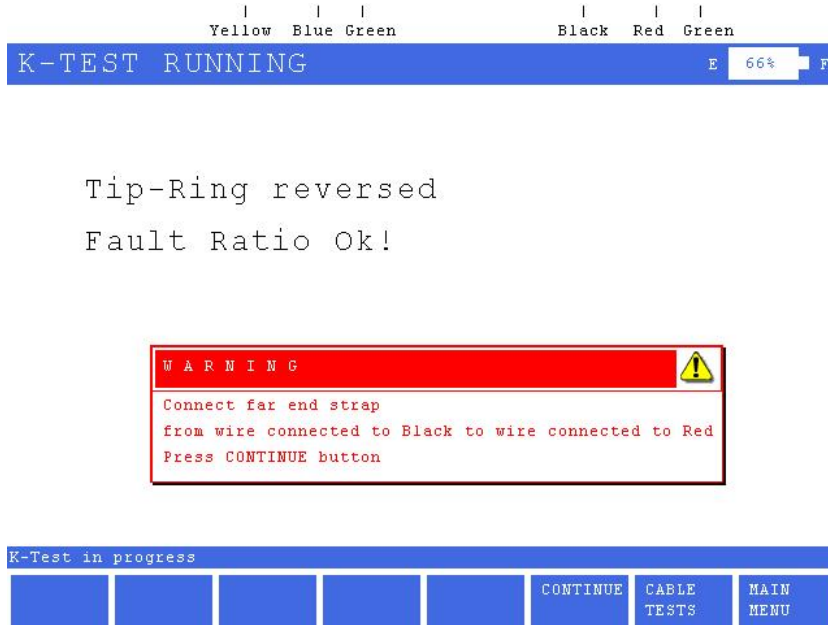
FIGURE 16.3.1B– K-TEST, CONNECTING THE STRAP

16.3.2   Setting up Cable Characteristics

The CableSHARK's K-test needs to be configured in detail now that the faulty wires have been identified and the strap is properly attached at the far end.

The following screen is displayed.

```
          |      |   |                      |      |    |
          Yellow Blue Green                 Black  Red  Green
 K-TEST  SETUP                                    E  66%    F

 Loop Characteristics:
          Cable Type:   Ohm/kft:   Distance(ft):  Temperature(F):   Load Coil:
 Section 1: 26 AWG PIC    83.33         #               68              No




                   Total Distance:      0
```

EDIT/ SELECT	SELECT PREVIOUS	SELECT NEXT			MULTI SECTION	CABLE TESTS	MAIN MENU
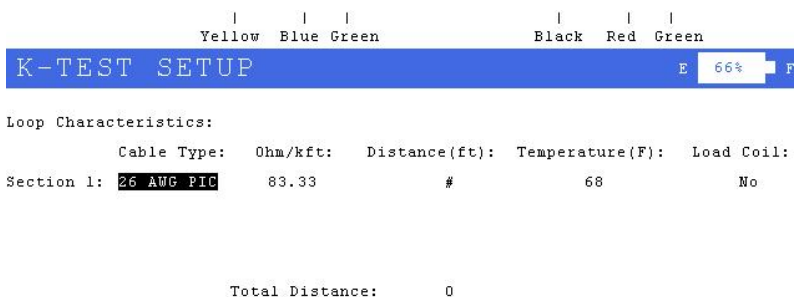
FIGURE 16.3.2A – K-TEST CABLE CHARACTERISTICS SETUP SCREEN

At the top of the screen you can see colors corresponding to the test leads. Ensure that the connection to the faulty pair corresponds to these colors.

For single section testing (i.e. the length of circuit under test is the same gauge) the user needs to enter / verify information about Cable Type, Resistance per length, Distance, Temperature and whether or not there are load coils on the line.

CABLE TYPE: The CABLE TYPE setting is used to select the appropriate cable type or more appropriately the appropriate diameter. The available options for Imperial Measurement Units are 19, 22, 24, and 26 AWG. For METRIC Measurement Units, the options are 0.4 mm PE, 0.5 mm PE, 0.6 mm PE , and 0.8 mm PE. *Note: AWG = American Wire Gauge.*

RESISTENCE PER LENGTH Allows the user to specify the cable's resistance constant. See Appendix B for more information on loop characteristics.

NOTE: When the Cable Type or Temperature changes, this value will automatically change to reflect a new cable type or a lower or higher temperature. The initial setting is based on nominal room temperature (68°F or 20°C).

DISTANCE   Allows the user to specify the cable section length under test. This is one gauge of wire only.

                       NOTE: If DISTANCE is entered, the TEMPERATURE setting will be ignored. To enter an unknown distance, input the # sign.

TEMPERATURE   Allows the user to specify the temperature of the cable section under test.

                       NOTE: If TEMPERATURE is entered, the DISTANCE setting <u>must</u> be set to #.

                       NOTE: To enter negative temperatures, highlight the Temperature Edit box, press the EDIT/SELECT button to change the temperature and press the * (asterisk) key twice to enter the negative sign. Press the RIGHT ARROW key to advance to the next character position and start to enter the numerical temperature.

LOAD COIL   Allows the user to specify whether the section under test contains load coils. Load coils will add approximately 150 feet or 45 meters to the measurement for each load coil (based on 88 mH load coils).

Press the EDIT/SELECT button to change a setting or enter a new value. Use the LEFT/RIGHT ARROW keys to navigate to the different settings.

16.3.2.1 Setup the K_test Test for Multi-Section Testing

Users can enter loop characteristics for multi-section loops into the CableSHARK by pressing the MULTI-SECTION key. Users can enter characteristics of up to 5 sections into the CableSHARK. Typically a section is a different gauge of wire.

FIGURE 16.3.2.1A – K-TEST CABLE CHARACTERISTICS SETUP SCREEN FOR MULTI-SECTION TESTING

16.3.3 Running a Test

Once the test is set up, press the RUN/STOP key located on the front panel of the CableSHARK. A screen similar to the screen shot below will appear.

The user is presented with the loop characteristics as entered during the setup phase as well as results in distance and resistance for the location of the fault.

```
              |        |    |                    |       |    |
            Yellow  Blue Green               Black   Red  Green
```

K-TEST RESULT   E 66% F

Loop Characteristics:

	Cable Type:	Ohm/kft:	Distance(ft):	Temperature(F):	Load Coil:
Section 1:	26 AWG PIC	83.33	3899	68	No

Distance to Fault:	3179 ft.	132.4 ohms
Distance to End:	3899 ft.	162.4 ohms
Distance from Fault to End:	720 ft.	30.0 ohms

K-Test complete. Fault located in section 1, 3179 ft.

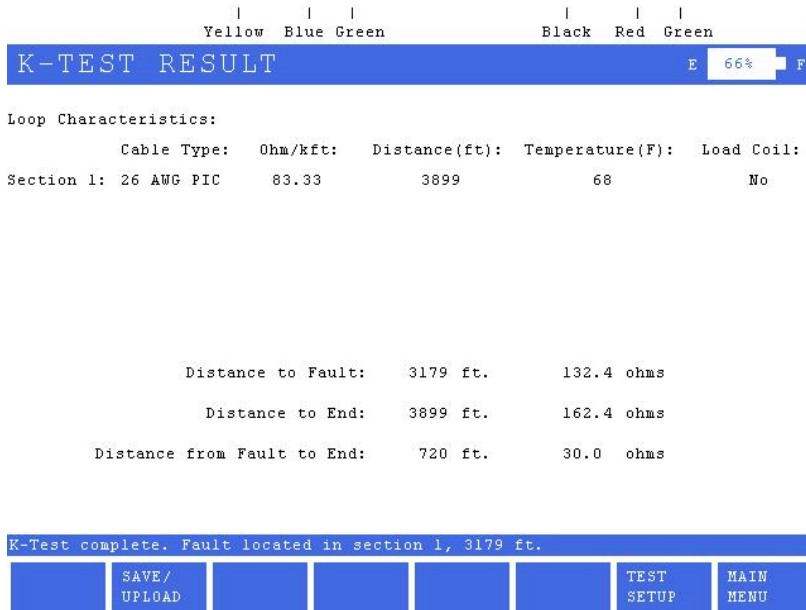| | SAVE/ UPLOAD | | | | | TEST SETUP | MAIN MENU |

FIGURE 16.3.3A – K-TEST RESULTS

There are three parts of the circuit under test that are presented to the user. These parts are based on the location of the CableSHARK, the location of the fault and the location of the strap. The user will be given the following information: Distance to Fault, Distance to End, and Distance from End to Fault. The following image shows this in more detail.
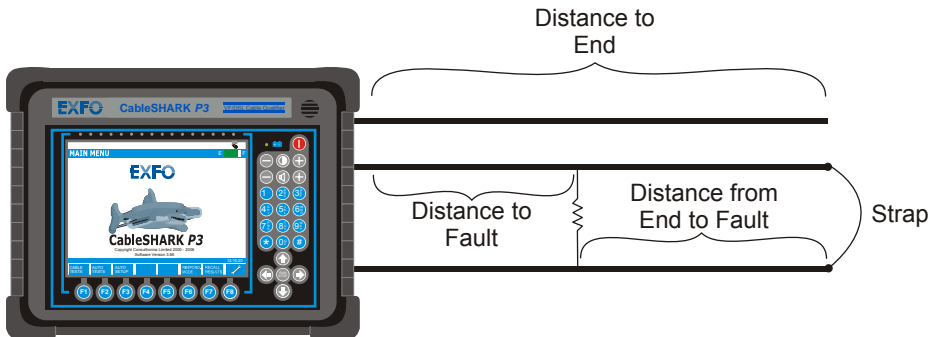
FIGURE 16.3.3B – DISTANCES EXPLAINED

Once the test has been completed, the status bar at the bottom of the screen will indicate that the test was complete what section the fault is located in, and the distance to the fault. The status screen will also show any errors and will ask the user to re-check the distances entered into each section and the strap connection.

At the completion of a test, the function button command selection at the bottom of the K-Test screen consists of five options available to the operator. The following are brief descriptions of each of the function button options:

UPLOAD RESULT Choosing UPLOAD RESULT from the SAVE / UPLOAD pop-up menu sends the result that appears on the CableSHARK screen (current test or recalled test) to a PC via a NULL modem cable. The remote control program Visi-SHARK can be used to capture and analyze the results on a PC.

SAVE TO MEM Choosing SAVE TO MEM invokes the SAVE SESSION menu. From here, the test results can be saved to internal non-volatile memory. See Section 5.3 for more information.

SAVE TO USB Choosing SAVE TO USB invokes the SAVE SESSION menu. From here, the test results can be saved to an installed USB Memory. See Section 5.3 for more information.

TEST SETUP Takes the user back to the K-Test Setup Menu

MAIN MENU Select the function button corresponding to MAIN MENU to return to the Main Menu.

Appendix A   Ideal Cable Results

A.1 Loop Topologies

CSA and Extended CSA Loops

CSA 1
26 AWG 5900 ft — 26 AWG 1800 ft
26 AWG 600 ft

CSA 2
26 AWG 3000 ft — 24 AWG 700 ft — 24 AWG 350 ft — 26 AWG 3000 ft
26 AWG 700 ft
26 AWG 650 ft

CSA 4
26 AWG 550 ft — 26 AWG 6250 ft — 26 AWG 800 ft
26 AWG 400 ft
26 AWG 800 ft

Extended CSA 9
26 AWG 9000 ft — 24 AWG 1000 ft
24 AWG 500 ft

CSA 5
26 AWG 5800 ft — 24 AWG 150 ft — 26 AWG 1200 ft — 24 AWG 300 ft — 26 AWG 300 ft
26 AWG 1200 ft
26 AWG 650 ft

CSA 6
26 AWG 9000 ft

CSA 7
24 AWG 10500 ft

CSA 8
24 AWG 12000 ft

Extended CSA 10
26 AWG 7500 ft — 24 AWG 4500 ft — 26 AWG 500 ft

Mid CSA Loops

MCSA 0
26 AWG 9000 ft — 24 AWG 1000 ft
24 AWG 500 ft

MCSA 1
26 AWG 2400 ft — 24 AWG 4100 ft — 24 AWG 1100 ft
26 AWG 100 ft
26 AWG 100 ft

MCSA 2
26 AWG 2400 ft — 24 AWG 4100 ft — 24 AWG 1100 ft
26 AWG 100 ft
26 AWG 100 ft

MCSA 3
24 AWG 8000 ft

MCSA 4
26 AWG 7500 ft — 24 AWG 4500 ft — 26 AWG 500 ft

MCSA 5
24 AWG 300 ft — 26 AWG 2400 ft — 26 AWG 1500 ft — 24 AWG 500 ft
26 AWG 500 ft

MCSA 6
26 AWG 6000 ft

ANSI Loops

ANSI Loop #2

26 AWG 13500 ft · 24 AWG 3000 ft · 24 AWG 1500 ft

ANSI Loop #3

26 AWG 7500 ft · 24 AWG 6000 ft · 24 AWG 500 ft · 24 AWG 1500 ft · 22 AWG 1000 ft · 22 AWG 1000 ft · 24 AWG 500 ft · 24 AWG 1000 ft · 24 AWG 1500 ft

ANSI Loop #4

26 AWG 7500 ft · 24 AWG 4500 ft · 22 AWG 2000 ft · 26 AWG 3000 ft

ANSI Loop #5

26 AWG 9000 ft · 24 AWG 6000 ft · 26 AWG 1500 ft

ANSI Loop #6

26 AWG 4500 ft · 24 AWG 12000 ft · 24 AWG 500 ft · 24 AWG 1000 ft · 24 AWG 500 ft

ANSI Loop #7

26 AWG 13500 ft

ANSI Loop #8

24 AWG 9000 ft · 22 AWG 1000 ft · 26 AWG 6000 ft · 24 AWG 1000 ft

ANSI Loop #9

26 AWG 3000 ft · 26 AWG 6000 ft · 26 AWG 1500 ft · 26 AWG 1500 ft · 26 AWG 1500 ft · 26 AWG 1500 ft

ANSI Loop #11

26 AWG 12000 ft · 26 AWG 1500 ft

ANSI Loop #12

26 AWG 7500 ft · 24 AWG 4500 ft · 26 AWG 1500 ft

ANSI Loop #13

26 AWG 9000 ft · 24 AWG 2000 ft · 24 AWG 500 ft · 24 AWG 500 ft · 26 AWG 1500 ft · 26 AWG 1500 ft
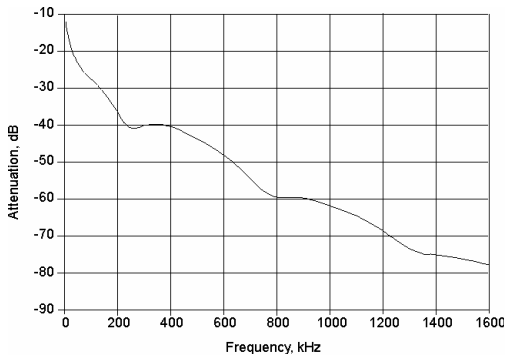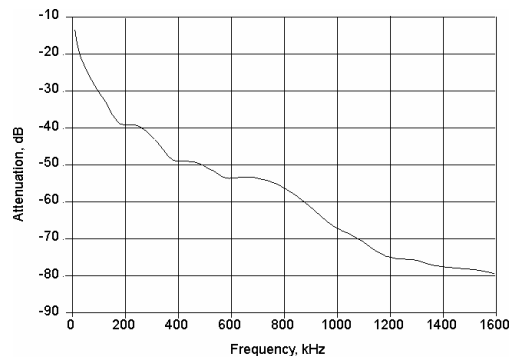
ANSI Loop #15

26 AWG 12000 ft

A.2 Attenuation Responses

The following graphs depict Attenuation responses to CSA, Extended CSA, Mid-CSA, and ANSI loop topologies (curve = calculated attenuation of ideal cable). These graphs represent the loop topologies outlined in Appendix A.1
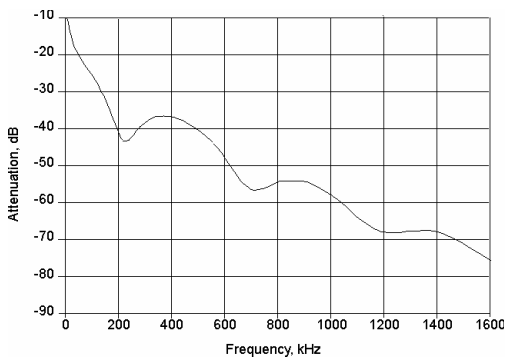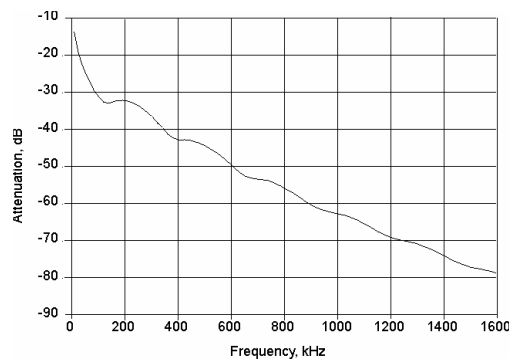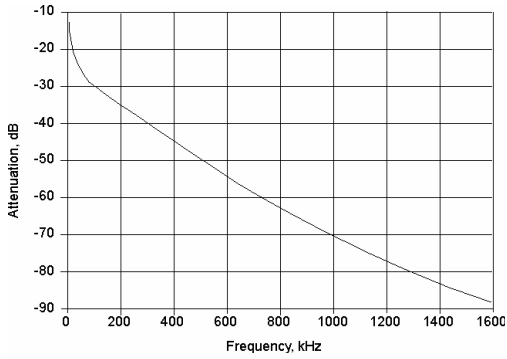
CSA Loop #1
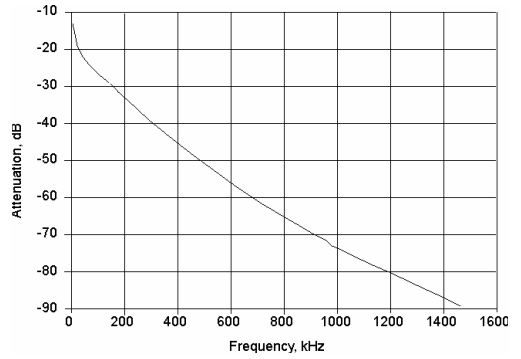

CSA Loop #2

CSA Loop #4

CSA Loop #5

CSA Loop #6

CSA Loop #8

CSA Loop #7
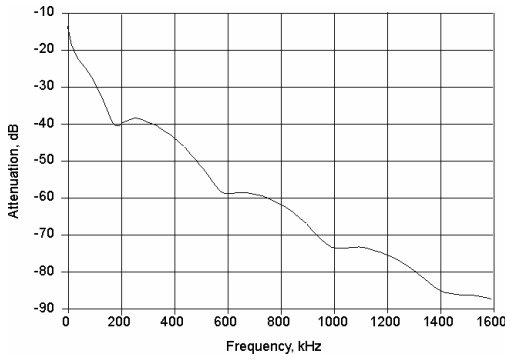
Extended CSA Loop #9
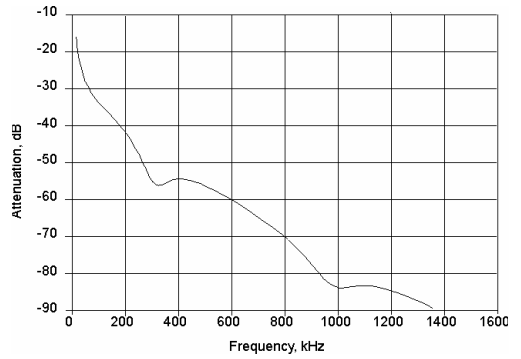
Extended CSA Loop #10
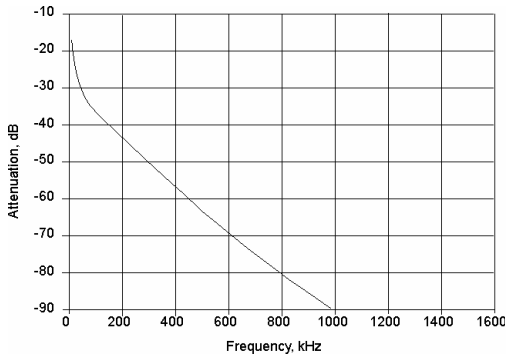
Mid CSA Loop #1
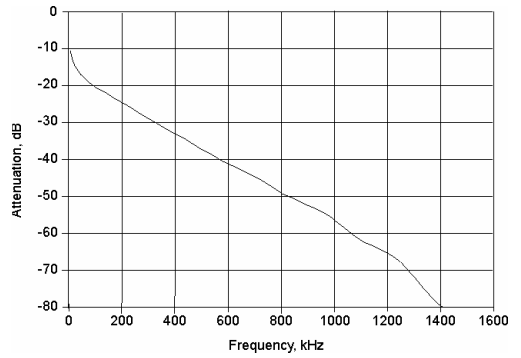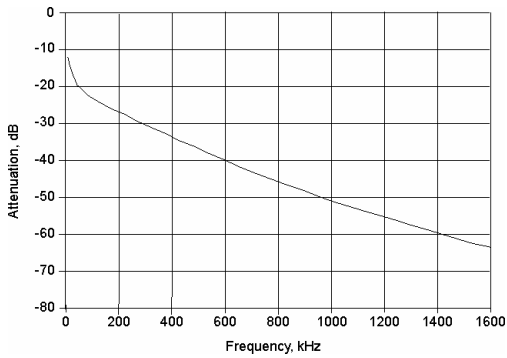
Mid CSA Loop #2

Mid CSA Loop #0

Mid CSA Loop #3

Mid CSA Loop #4

Mid CSA Loop #5

Mid CSA Loop #6

ANSI Loop #2
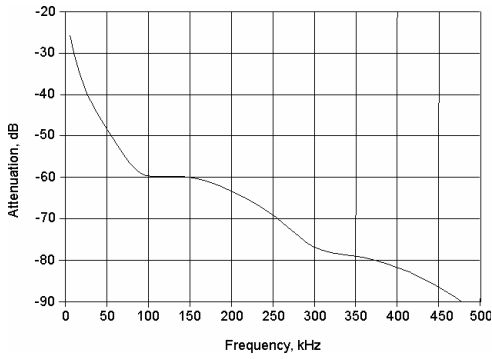
ANSI Loop #4
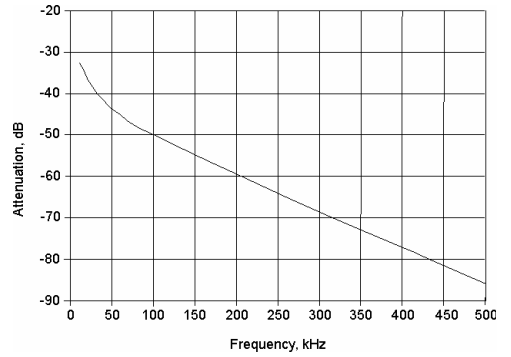
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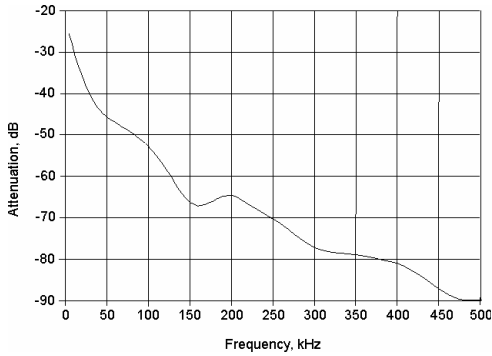
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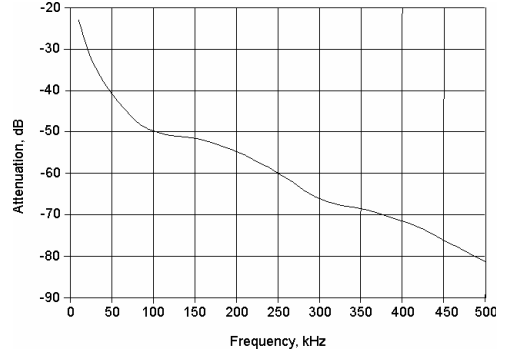
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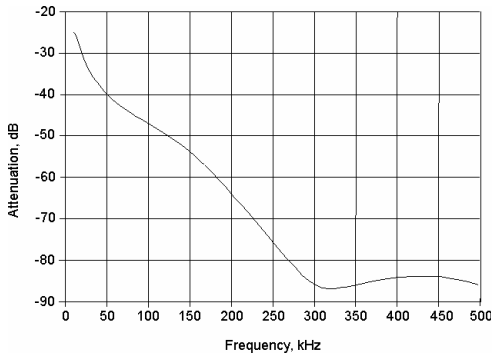
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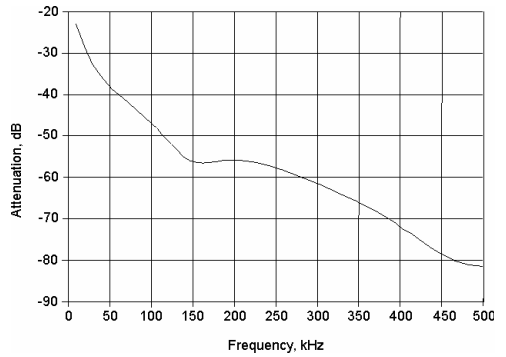
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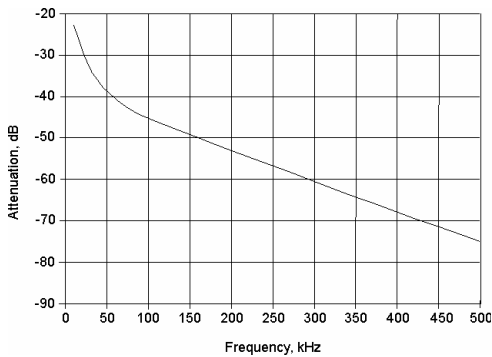
ANSI Loop #9
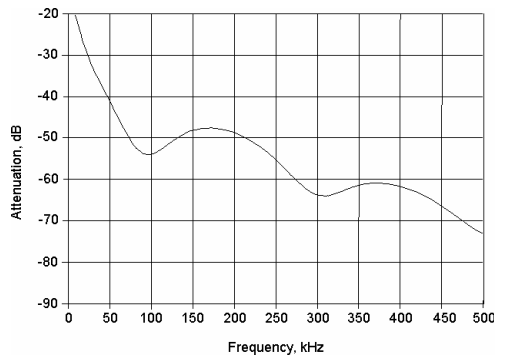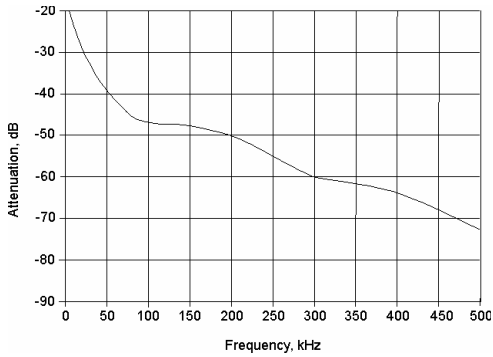
ANSI Loop #13
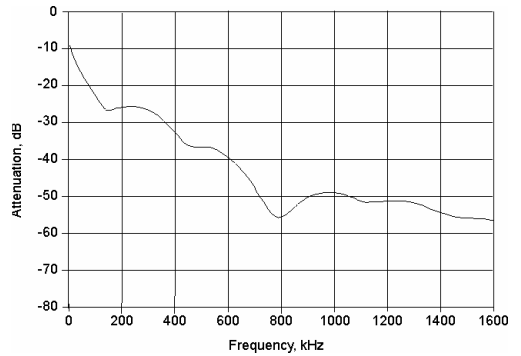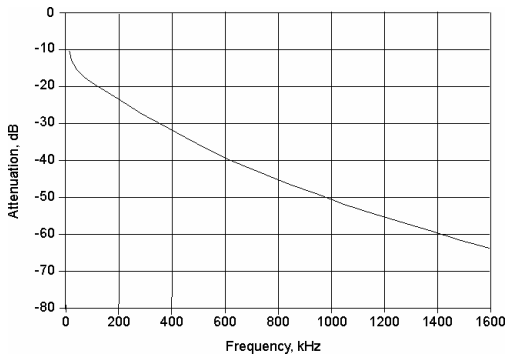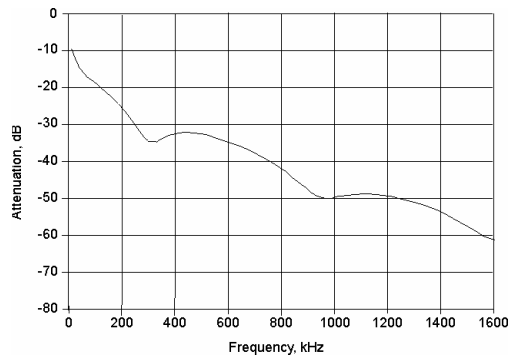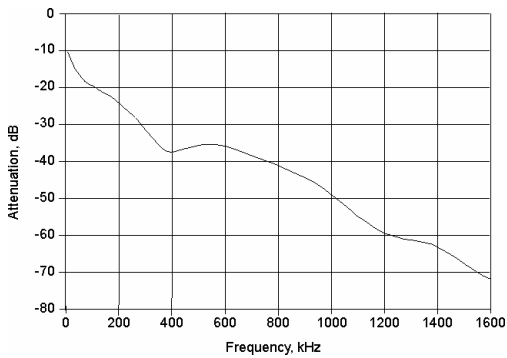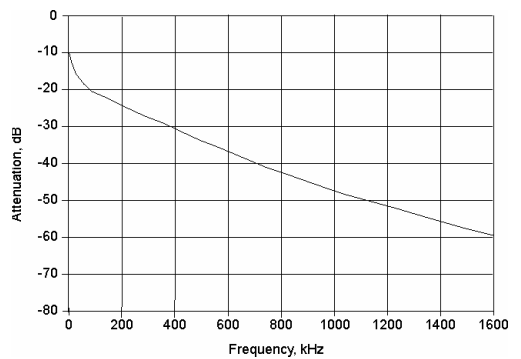

ANSI Loop #11

ANSI Loop #15
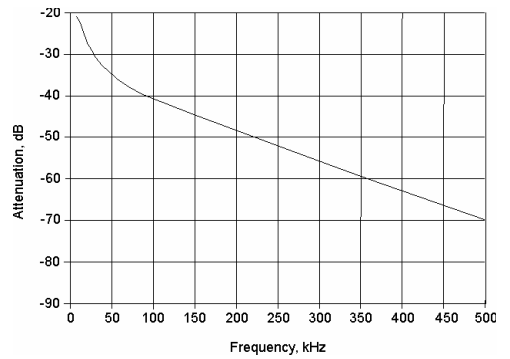
ANSI Loop #12
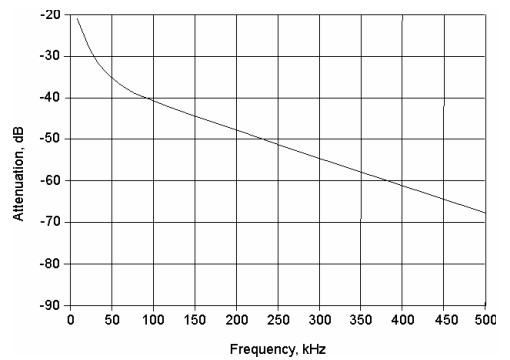
Appendix B   Loop Characteristics

Wire Gauge		Capacitance		Resistance			Attenuation @ 300 kHz	
mm	AWG	nF/km	nF/mi	Ω/km	Ω/kft	Ω/mi	dB/km	dB/mi
(0.253)	30	40	64.4	677	206	1090		
0.30 PE		40	64.4	494	150	792		
0.32 PE	28	40	64.4	409	125	658	21.0	
0.40 PE		50	80.5	280	84.4	451	14.2	
(0.405)	26 PIC	51.6	83.0	273	83.1	439		23.5
0.50 DW10		50.9	82.0	181	55.1	291		
0.50 DUG		55	88.5	179	55.6	288		
0.50 PE		50	80.5	179	54.5	288	10.1	
(0.511)	24 PIC	51.6	83.0	172	52.3	276		18.0
0.60 PE		40	64.4	123	37.5	198	8.6	
0.63 PE		45	72.4	113	34.5	182		
(0.644)	22 PIC	51.6	83.0	108	32.9	174		14.1
0.70 PE		40	64.4	90	27.5	145		
0.80 PE		40	64.4	69	21.0	111	7.1	
0.90 DW12		51.1	82.3	55.5	16.9	89.3		
0.90 PE		40	64.4	55	16.8	88.5		
(0.912)	19 PIC	51.6	83.0	53.8	16.4	86.6		10.0
NOTES:	( ) = AWG conductor diameter → (mm) = not a normal metric size							
	PE = metric Polyethylene insulated cable							
	PIC = AWG Polyethylene insulated cable, sometimes called "plastic insulated cable"							
	as contrasted to older pulp or paper insulated cable.							
	PVC = Polyvinyl chloride insulated cable							
	DW = European drop wire, overhead/aerial							
	DUG = European underground drop cable							
	Metric & AWG Wire Gauges: R & C (0Hz/DC, 20°C or 70°F)							

COMMITTEE T1 --- Working Group T1E1.4 ---ftp://ftp.t1.org/T1E1/E1.4/Dir2001/1E140023.pdf

Appendix C   CableSHARK Specifications

General Features

Dimensions:	Approx. 6.9" x 9.25" x 2.6" (175 x 235 x 65 mm)
Weight:	Approx. 4.8 lbs (2.2 kg) (including power adapter).
Operating temperature:	Monochrome VGA : 32° to $120\,^oF$ (0° to $+50^oC$).
	Colour VGA (optional) : 32° to $110\,^oF$ (0° to $+43^oC$).
Storage temperature:	$14\,^o$ to $140\,^oF$ (-10 to $+60^oC$).
Humidity:	Up to 95% relative, non-condensing.
Power supply:	16-18VDC input via external AC Mains adapter (95 - 250 volts, 43 - 63 Hz, 2.5 A).
Battery:	Internal Rechargeable Nickel Metal Hydride (NiMH) battery, with battery state indication.
Display:	640 x 480 pixels. 6.9" x 4.7" (175 mm x 120 mm) with backlight.
Test connections:	Main TX/RX **-** 3 pin CF (Siemens), RJ-45, RJ-11.
	Auxiliary RX - 3 Pin CF (Siemens). Also used for RFL.
	Differential voltage protection 125 V_{RMS} or 400 VDC max.
	Common mode voltage protection 1000 $V_{RMS.}$
Serial port:	RS232 9-pin D-type with flow Control (XON/XOFF, or none).
	For upgrading software / downloading results / remote control.
USB port:	Series A receptacle. Host USB port for upgrading software / saving results.
Ethernet port:	10BaseT port for upgrading software / downloading results / remote control.
Self-test:	Routine on power-up.
Voltage detection:	>20V will trigger alarm message.
Result storage:	Up to 128 in non-volatile internal memory, 1000 for each 16 MB of optional USB memory.
Languages:	Up to 8 user selectable languages.
Phone Book:	Stores up to 20 records
Dial/Loop Holding:	Approximately 30 mA (Tx or Rx), supports DTMF and Pulse Dialing

VF Auto-Test (Expert system automatic test)

- ➢ Automatic test providing pass / fail results in both text and graphic formats
- ➢ DMM-12 Auto-test (Voltage, Resistance, Capacitance & Capacitive Imbalance), Load Coil Test, TDR, VF Balance, VF Noise, Power Influence.

> ➤ Dialup test to a milliwatt source also measures Loss, Tone Frequency, and Noise with quiet termination.
> ➤ Phone book allows up to 20 entries, where the Name can be up to 32 characters long
> ➤ DTMF or Pulse dialing of digits 0-9 and characters * and #, up to 32 digits
> ➤ DTMF dialing uses 200 ms / 100 ms make/break signal
> ➤ Pulse dialing uses 400 ms / 600 ms make/break signal

ADSL, ADSL2, ADSL2+ Auto-Test (Expert system automatic test)
Requires Single-End DMT Option

> ➤ Automatic test providing pass / fail results in both text and graphic formats
> ➤ DMM-12 Auto-test (Voltage, Resistance, Capacitance & Capacitive Imbalance), Load Coil Test, Longitudinal and VF Balance test, TDR, Single-end ADSL test evaluating up & downstream rate prediction.

SHDSL Auto-Test (Expert system automatic test)

Requires Single End SHDSL Data Rate Prediction Option

> ➤ Automatic test providing pass / fail results in both text and graphic formats
> ➤ DMM-12 Auto-test (Voltage, Resistance, Capacitance & Capacitive Imbalance), Load Coil Test, Longitudinal and VF Balance test, TDR, Single-end SHDSL test evaluating rate prediction.

Transmitter Characteristics

Transmit frequency:	300 Hz to 2.2 MHz, 1 Hz steps.
Frequency accuracy:	±0.3 Hz
Transmit level:	0 to 24 dBm @ 100 Ω or 135 Ω
	-16 to +10 dBm @ 600 Ω
Level accuracy:	-0.5 dB @ 300 Hz, @ 0 dBm
	±0.2 dB @ 1 kHz to 200 kHz @ 0 dBm
	±0.5 dB for 200 kHz to 1 MHz
	±1 dB for 1 MHz to 2.2 MHz
Impedance:	100 Ω, 135 Ω, 600 Ω

Transmitter Functions

Single tone:	Any frequency within the transmit frequency range
Tracing tone:	577 Hz
3-tone slope:	420 Hz, 1020 Hz and 2820 Hz, 1-10 seconds/step
VF sweep:	300 Hz to 4kHz, 100 Hz steps

Spot frequencies: Any 10 tones (user settable) within the transmit frequency range

Receiver Characteristics

Characteristics are subject to instrument noise floor (approx –70 dBm). Levels below –70 dBm can be measured using the PSD Noise test.

Receive frequency:	300 Hz to 2.2 MHz, resolution 1 Hz (optionally to 6 MHz range)
Receive level:	**-**90 to +24 dBm @ 100 Ω or 135 Ω, resolution 0.1 dB
	-90 to +10 dBm @ 600 Ω, resolution 0.1 dB
Level accuracy:	-0.5 dB @ 300 Hz @ 0 dBm
	±0.2 dB for 1 kHz to 200 kHz @ 0 dBm
	±0.5 dB for 200 kHz to 1 MHz @ 0 dBm
	±1 dB for 1 MHz to 2.2 MHz @ 0 dBm
	±3 dB at 6 MHz @ 0 dBm
Frequency accuracy:	±2 Hz from –40 dBm to +24 dBm
Impedance:	100 Ω, 135 Ω, 600 Ω, bridging (100 kΩ)

Receiver Functions

Single tone:	Numeric display of any tone in the receiver range
Plot:	300 Hz to 4 kHz or 300 Hz to 20 kHz
3-tone slope:	404 Hz, 1004 Hz, and 2804 Hz (ITU: 420 Hz, 1020 Hz and 2820 Hz)

VF Noise Measurement

Range:	0 to -90 dBm subject to instrument noise floor
Accuracy:	±1 dB @ ≥60 dBm
	±2 dB @ ≥80 dBm
Filters:	None, 3 kHz flat, C-message, C-notched, 50 kbit, 15 kHz flat, D filter (D is defined by IEEE 743-1995)

VF Impulse Noise

Low threshold:	–40 dBm to 0 dBm in 1 dB steps
Mid threshold:	Low threshold plus separation
High threshold:	Mid threshold plus separation
Separation:	1 to 6 dB in 1 dB steps
Filters:	None, C-message, C-notched, D Filter (D is defined by IEEE 743-1995)
Counter:	Maximum 999 for each threshold

Power influence

Numeric display of the common mode C-Message and 3 kHz flat weighted noise and a plot of the fundamental as well as up to the 9th harmonic of the common mode interference voltage.

Noise range:	-90 to +40 dBm (0 to 130 dBrn), resolution 1.0 dB
Voltage range:	0 to 30 V typically, resolution 0.1 V

Ringer detection

Ringer range:	0 to 5 REN (ringer equivalent number based on 0.47 µF / ringer) measured Tip to Ring, Tip to Ground and Ring to Ground.

Time Domain Reflectometry (TDR)

Plot and numeric display of reflection, reflection loss and distance with cursor and zoom.

Mode:	One shot, continuous (auto-repeat) with cursor and zoom
2 Wire single-end test type:	Auto-Cable End, Auto-Bridge Tap, Manual mode
4 Wire single-end test type:	Manual mode
Distance range:	100 ft up to 20,000 ft (30 m to 6000 m). Manual mode can test up to 45,000 ft (13,500 m) when using 330 µs pulse width *** range will depend on cable type and condition* *** specifications based on 24 AWG (0.5 PE mm) cabling*
Auto-bridge tap detection range:	10% to 50% of total cable length from measuring end
Auto-bridge tap	

length range:	10% to 25% of total cable length
Pulse width:	28 ns to 20 μs (auto-selected in Auto TDR test) 330 μs in Manual mode
Test signals:	Sine wave, Compensated Sine wave, Half-Sine wave, Square wave
Amplitude:	10 V p-p on cable, 20 V p-p open circuit
V.O.P.:	0.400 to 0.999 or 120 to 299 m/μS
Distance accuracy:	± 3 m (± 9 ft) increments ± 1% of reading
Units:	Feet, meters, and nanoseconds
Horizontal scale:	Automatic or 1000 ft (300 m), 2000 ft (600 m), 5000 ft (1500 m), 10,000 ft (3000 m),
	20,000 ft (6000 m), 45,000 ft (13,500 m)

Frequency Domain Reflectometry (FDR)

As part of LoopMapper. Plot and numeric display of reflection with distance and phase angle. Includes cursor and zoom.

Distance range:	100 ft up to 10,000 ft (30 m to 3000 m).
V.O.P.:	0.400 to 0.999 or 120 to 299 m/s
Distance accuracy:	For measurements below 2000 ft (655 m): ± 12 ft (± 4 m) increments ± 1% of reading
	For measurements above 2000 ft (655 m): ± 58 ft (± 19 m) increments ± 1% of reading
Units:	Feet and meters
Horizontal scale:	Automatic
Type of fault to detect:	Automatic
Display of result:	Text, Graphic and circuit drawing with distances (when applicable)

Single End Frequency Response

Extrapolated result plot with cursor and zoom.

Distance range:	300 ft to 16000 ft (100 m to 5000 m)
	** range will depend on cable type and condition
	** specifications based on 24 AWG (0.5 PE mm) cabling
Frequency range:	Up to 2.2 MHz, optional 6 MHz support available
Frequency accuracy:	± 50 ppm
Accuracy:	± 1.0 dB typical
Resolution:	0.1 dB
Horizontal scale:	ISDN 500 kHz, HDSL 1 MHz, ADSL 2.2 MHz, optional VDSL 6 MHz.
Vertical scale:	0 to +90 dB

End-to-End Frequency Response

Plot with cursor and zoom

Distance range:	300 ft to 45000 ft (100 m to 13,500 m)
	*** range will depend on cable type and condition*
	*** specifications based on 24 AWG (0.5 PE mm) cabling*
Frequency range:	4.3 kHz to 2.0 MHz (2.2 MHz or 6 MHz not supported)
Frequency accuracy:	$\pm$ 50 ppm
Accuracy:	$\pm$ 0.5 dB
Resolution:	0.1 dB
Horizontal scale:	ISDN 500 kHz, HDSL 1 MHz, ADSL 2.2 MHz
Vertical scale:	0 to +90 dB

Load Coil Detection

Can detect up to 6 load coils

Test methodology:	End-to-End, Single-End (plot to 10 kHz)
Distance range:	**U**p to 24,000 ft (up to 7,500 m)
	*** range will depend on cable type and condition*
	*** specifications based on 24 AWG (0.5 PE mm) cabling*

End-to-End DMT Test

Combined Frequency Response, PSD Noise / Crosstalk, Signal-to-Noise Ratio, Disturber Identification and Data Rate Estimation test plot with cursor and zoom.

The End-to-End DMT test used by the EXFO CableSHARK is patent protected.

ADSL Data Rate Prediction (End to End):
US Patent # US 6,445,773 B1 Sep 3, 2002

Distance range:	300 ft to 45000 ft (100 m to 14000 m)
	*** range will depend on cable type and condition*
	*** specifications based on 24 AWG (0.5 PE mm) cabling*
Test resolution:	Coarse, Fine
ADSL setups:	ANSI Full Rate/POTS, ITU-T Annex A / POTS
	ETSI Full Rate / POTS, G.LITE/POTS

ITU-T Annex B / ISDN, ETSI Full Rate / ISDN

Bits/bin setting: 8 – 15 bits per bin.
14 is default for full rate ADSL
8 is default for G.Lite
Noise margin range: AUTO-CPE, AUTO-CO/EXCH, 0 to 32 dB in 1 dB steps
Frequency range: 4.3 kHz to 1.104 MHz
Frequency accuracy: $\pm$ 50 ppm
DMT tone & noise accuracy: $\pm$ 0.5 dB
Level resolution: 0.1 dB
Horizontal scale: 0 - 1.104 MHz
Vertical scale: -36 dBm/Hz to -156 dBm/Hz
Bits/bin vertical scale: 0 to 15 bits
Noise filters: None or E, F, G (IEEE-743 / 1995)

Single End ADSL, ADSL2, ADSL2+ (DMT) Test

Extrapolated Results - Combined Frequency Response, PSD Noise / Crosstalk, Signal-to-Noise Ratio, Disturber Identification, and Data Rate Estimation test plot with cursor and zoom.

The Single-Ended DMT test used by the EXFO CableSHARK is patent pending.

ADSL Data Rate Prediction (Single End):
US Patent Pending # 10/133,408

Distance range: 300 ft to 16000 ft (100 m to 5000 m)
** range will depend on cable type and condition
** specifications based on 24 AWG (0.5 PE mm) cabling

ADSL test type: Test from CO and test from CPE
ADSL2 test type: Test from CO and test from CPE
ADSL2+ test type: Test from CO and test from CPE
ADSL evaluation: ASI Full Rate/POTS, G.LITE/POTS, ITU-T Annex A / POTS,
ETSI Full Rate / POTS, ITU-T Annex B / ISDN, ETSI Full Rate / ISDN
ADSL2/2+ evaluation: ITU-T Annex A/POTS, ITU-T Annex B/ISDN, ITU-T Annex I/POTS, ITU-T Annex J/ISDN, ITU-T

Annex L/M/POTS

Bits/bin setting: 8 – 15 bits per bin.
14 is default for full rate ADSL
8 is default for G.Lite
Noise margin range: Auto or 0 to 32 dB in 1 dB steps
Frequency range: ADSL: 4.3 kHz to 1.104 MHz
ADSL2: 4.3 kHz to 1.104 MHz

ADSL2+: 4.3 kHz to 2.208 MHz
Horizontal scale: Depends on Frequency Range (see above)
Vertical scale: -36 dBm/Hz to -156 dBm/Hz or
                               0 to – 120 dBm
CPE / DSLAM detection: ADSL Annex A, ADSL Annex B, ADSL2, ADSL2+

SHDSL Data Rate Test

Extrapolated Results - Combined Frequency Response, PSD Noise / Crosstalk, Signal-to-Noise Ratio, Disturber Identification, and Data Rate Estimation test plot with cursor and zoom.

Distance range: 300 ft to 16000 ft (100 m to 5000 m)
                               ** range will depend on cable type and condition
                               ** specifications based on 24 AWG (0.5 PE mm) cabling
SHDSL setups: ITU-T Annex A or ITU-T Annex B
Noise margin range: Auto, 0 to 20.0 dB in 1 dB steps
Frequency range: 4.3 kHz to 1.104 MHz
Horizontal scale: 0 - 1.104 MHz
Vertical scale: -36 dBm/Hz to -156 dBm/Hz Hz or 0 to – 120 dBm

PSD Noise Measurement

Single-end test plot of Power Spectral Density / crosstalk noise spectrum with disturber identification, cursor and zoom.

Mode: Continuous or Peak-hold display of (PSD)
Vertical scale: -10 to –153.3 dBm/Hz or +20 to -120 dBm
Horizontal scale: 2.16 kHz to 2.2 MHz, in 2.16 kHz steps, optional 6 MHz support available
Noise filters: None or E, F, G (IEEE-743 / 1995)

DSL Impulse Noise Measurement

Threshold: -50 dBm (40 dBrn) to 0 dBm (90 dBrn) in 1 dB steps
Counter: Maximum 65000
Test duration: 1 minute, 5 minutes, 10 minutes, 15 minutes, 60 minutes, 24 hours, or
                               continuous (up to 360 hours)
Histogram plot interval: 1, 5, 10, 15 or 60 minutes
Accuracy: ± 2 dB

Longitudinal Balance Test

Single-end test:	Near-End test plot with cursor & zoom
Frequency accuracy:	$\pm$ 50 ppm
Accuracy:	$\pm$ 2 dB
Vertical scale:	0 to 80.0 dB
Horizontal scale:	26 kHz to 2.2 MHz

DMM (Digital Multimeter)

For use on normal telephone network and broadband circuits

Mode: DMM-12 autotest, DMM-14 autotest or individual measurements

DC voltage:
Range: 0 to 400 V auto-ranging
Resolution: 3 significant digits
Accuracy: ±1% of reading ±1 LSD

AC voltage
Range: 0 to 250 Vrms auto-ranging
Resolution: 3 significant digits
Accuracy: ±1% of reading ±1 LSD

Resistance:
Range: 0 to 999 MΩ auto-ranging (30 MΩ for auto-test)
Resolution: 3 significant digits
Accuracy: 0 - 999 Ω, ±1% or ±5 Ω
                       1 kΩ - 99 MΩ, ±1% of reading ±1 LSD
                       100 MΩ to 999 MΩ, ±5% of reading ±1 LSD
Distance: Up to 100,000 ft (30,000 m)

Capacitance:
Range: 200 pF to 10 μF auto ranging, auto zeroing
Resolution: 3 significant digits
Accuracy: ±2% of reading ±1 LSD
Distance: Up to 100,000 ft (30,000 m)

Current:
DC Current: 0 to 110 mA

AC Current: 0 to 77 mA
Accuracy: ±2% of reading ±1 LSD

Isolation resistance

Source: 100VDC
Current: safely limited to < 0.5 mA
Range: 0 to 999 MΩ auto-ranging
Resolution: 3 significant digits
Accuracy: 0 - 999 Ω, ±1% or ±5 Ω
                 1 kΩ - 99 MΩ, ±1% of reading ±1 LSD
                 100 MΩ to 999 MΩ, ±5% of reading ±1 LSD
Soak timer: 1 to 99 sec

Spectral Detective

Allows the CableSHARK to bridge (high-impedance) onto a live circuit to display a plot of transmitted levels and spectrum (PSD). The Spectral Detective Test can be referenced to any user-selected impedance. The Impedance reference setting is required to display proper readings in dBm/Hz or dBm.

Mode: Continuous or Peak-hold plot with cursor and zoom
Bridging impedance: 15 kΩ
Vertical scale: -10 to –153.3 dBm/Hz or +20 to -120 dBm
Horizontal scale: 2.16 kHz to 2.2 MHz, in 2.16 kHz steps, optional 6 MHz support available
Noise filters: None or E, F, G (IEEE-743 / 1995)

4-Wire Crosstalk

Single frequency measurement or plot of crosstalk with cursor and zoom. Crosstalk levels below 60 dB may be affected by internal crosstalk of the unit itself.

Plot mode
Horizontal scale: 2 MHz
Vertical scale: 0 to -90 dB
Accuracy: ±2dB

Single frequency mode
Frequency setting: 17 kHz to 2.2 MHz.
Crosstalk result: 0 to -90 dB

Accuracy: ±2dB

<u>Return Loss Test</u> (Plot with cursor and zoom)

Range: 0 to 60 dB
Resolution: 0.1 dB
Accuracy: +/- 1 dB from 0 to 40 dB
Horizontal scale: 17 kHz to 2.2 MHz
Vertical scale: 0 to 60 dB

<u>RFL</u>

Resistive Fault Location. Detects faults such as shorts, grounds, and battery crosses.
Displays total loop resistance, resistance to fault & resistance from fault to strap and
equivalent distances.

Fault detection: 0 to 20 MΩ, resolution 3 significant digits
Loop resistance: 7 kΩ maximum
Wire gauges: 0.4, 0.5, 0.6 or 0.8 mm (19, 22, 24, 26 AWG)
Cable temperature range: -40ºF to +140ºF (-40ºC to +60ºC)
Multiple cable sections: 5 (includes gauge and temperature setting)
Fault location: Total resistance, near-end to fault resistance, fault to strap resistance (4 significant digits)

Total length, distance to fault, distance from fault to strap (1 ft (3 m) resolution
Accuracy: 0.1% ±1 LSB for loop resistance of 0 to 99.99Ω
                       0.2% ±1 LSB for loop resistance of 100Ω - 999.99Ω
                       1% ± 1LSB for loop resistance of 1kΩ – 7kΩ

<u>Ground Resistance</u>

Detects CO voice switch line cards with constant voltage source, constant current source or grounded
balanced source.

Range: 0 to 500 Ω
Resolution: 1 Ω
Accuracy: ±3 Ω ±1% of reading

Visi-SHARK

A graphic user interface between the CableSHARK and a PC.

> ➢ Full graphic remote control of the CableSHARK from a PC.
> ➢ Allows downloading of results or showing results saved in USB memory into Microsoft Excel® format.
> ➢ Enables graphic screen captures and recall of test results from computer memory.
> ➢ Allows a graphic printout of any CableSHARK display screen on any graphic printer used with the PC.

*This option consists of an option key for the   CableSHARK and software for an IBM PC or   compatible   running Windows 98, Windows 2000 or XP. Certain functions are available even if the option is not enabled in the CableSHARK (Result printing, etc.)

EXFO reserves the right to change or upgrade specifications at any time without notice.

In order for the CableSHARK Unit to meet safety specifications, the operating environment must meet the following conditions for temperature and humidity.

Temperature:
The CableSHARK Unit may be operated in the temperature range of 0°C to 50°C.

Humidity:
The CableSHARK Unit may be operated in environments within the range of 10 to 60°C humidity. Do not expose the equipment to any environmental condition or changes to environmental conditions that can cause condensation to form inside the instrument.

Appendix D   Safety

Information

Before Operating the CableSHARK Unit:

- Inspect the equipment for any signs of damage, and read the Operating Manual thoroughly.

- Become familiar with all safety symbols and instructions in this manual to ensure that the equipment is operated and maintained safely.

Mains Supply Power Requirements:

The CableSHARK unit is provided with an External AC Power Supply Adapter which can operate from any single-phase AC power source that supplies between 100 V and 240 V at a frequency range of 50/60 Hz. The maximum rated current is 1.0A

WARNING: *To avoid electrical shock, do not operate the equipment if it bears any sign of damage to any portion of its exterior surface, such as the outer casing or panels.*

Connections to Mains Supply Power:

In accordance with international safety standards, the External AC Power Supply Adapter uses a two-wire power supply cord. When connected to an appropriate AC power receptacle, unit may be safely operated.

WARNING: *To avoid risk of injury or death, ALWAYS observe the following precautions before operating the CableSHARK Unit.*

- *Only use the supplied external power supply adapter with this unit.*
- *Do not use power supply cords that are in disrepair (frayed, broken, bent)*

Operating Environment:

WARNING: To prevent potential fire or shock hazard when using the CableSHARK unit outdoors, do not expose the equipment to any source of excessive moisture.

Instructions

The following safety instructions must be observed whenever the CableSHARK Unit is operated, serviced or repaired. Failing to comply with any of these instructions or with any precaution or warning contained in this manual is in direct violation of the standards of design, manufacturer and intended use of the equipment. EXFO Electro-optical Engineering Inc. assumes no liability for the customer's failure to comply with any of these safety requirements.

Before Operating the CableSHARK Unit:

• Inspect the equipment for any signs of damage and read the manual thoroughly.
• Ensure that equipment and any devices or cords are in good condition.

Operating the CableSHARK Unit:

• Do not operate the equipment with its covers or panels removed.

• Use only the type of fuse specified by the manufacturer as appropriate for this equipment.

• Do not use repaired fuses and avoid any situations that could short circuit the fuse.

• Unless absolutely necessary, do not attempt to adjust or perform any maintenance or repair procedure when the equipment is opened and connected to a power source at the same time. Any such procedure should only be carried out by a qualified service professional.

• Do not attempt any adjustment, maintenance or repair procedure to the equipment if immediate first aid is not accessible.

• Disconnect the power supply cord from the equipment before adding or removing any components.

• Operating the equipment in the presence of flammable gases or fumes is extremely hazardous.

• Do not perform any operating or maintenance procedure that is not described in this manual.

Symbols

WARNING

Refer to the Operating and Reference Manual for instructions on handling and operating the equipment safely.

This procedure can result in serious injury or loss of life if not carried out in proper compliance with all safety instructions. Ensure that all conditions necessary for safe handling and operation are met before proceeding.

NOTE   **If the CableSHARK is not used in the manner outlined in this operating manual, the protection provided by the CableSHARK may be impaired.**

Appendix E   Warranty

General Information

EXFO Electro-Optical Engineering Inc. (EXFO) warrants this equipment against defects in material and workmanship for a period of one year from the date of original shipment. EXFO also warrants that this equipment will meet applicable specifications under normal use. During the warranty period, EXFO will, at its discretion, repair, replace, or issue credit for any defective product, as well as verify and adjust the product free of charge should the equipment need to be repaired or if the original calibration is erroneous. If the equipment is sent back for verification of calibration during the warranty period and found to meet all published specifications, EXFO will charge standard calibration fees.

IMPORTANT

The warranty can become null and void if:

> ➢ unit has been tampered with, repaired, or worked upon by unauthorized individuals or non-EXFO personnel.
> ➢ warranty sticker has been removed.
> ➢ case screws, other than those specified in this guide, have been removed.
> ➢ case has been opened, other than as explained in this guide.
> ➢ unit serial number has been altered, erased, or removed.
> ➢ unit has been misused, neglected, or damaged by accident.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL EXFO BE LIABLE FOR SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Liability

EXFO shall not be liable for damages resulting from the use of the product, nor shall be responsible for any failure in the performance of other items to which the product is connected or the operation of any system of which the product may be a part.

EXFO shall not be liable for damages resulting from improper usage or unauthorized modification of the product, its accompanying accessories and software.

Exclusions

EXFO reserves the right to make changes in the design or construction of any of its products at any time without incurring obligation to make any changes whatsoever on units purchased. Accessories, including but not limited to fuses, pilot lamps, batteries and universal interfaces (EUI) used with EXFO products are not covered by this warranty. This warranty excludes failure resulting from: improper use or installation, normal

wear and tear, accident, abuse, neglect, fire, water, lightning or other acts of nature, causes external to the product or other factors beyond EXFO's control.

Certification

EXFO certifies that this equipment met its published specifications at the time of shipment from the factory.

Appendix F   Software Policy and Upgrades

F.1 Software Policy

EXFO wants its customers to have the very best and most up-to-date software for the CableSHARK. EXFO uses the industry standard for software numbering. Pre-releases of software have a value of less than 1.0 (i.e. 0.8) and are designated as preliminary. The first commercial release will be designated as 1.00. Any minor improvements on the software will be designated by a change in the least significant digit (i.e. from 1.00 to 1.01). Major releases are designated by changes in the most significant digit (i.e. 1.07 to 2.00). Minor releases are usually made for the release of customized software, minor new features, language changes, or for the correction of minor software bugs. It is not recommended that you upgrade your software for minor releases, unless you have requested specific changes for your application. Major releases are made in order to offer new functions. You will only be informed about major releases. All new software releases are available at no charge to existing customers. Simply contact EXFO to obtain a copy. Internet FTP and Web downloads are also available. These software downloads can be arranged by calling your nearest EXFO representative or by using the contact information in this manual.

From time-to-time, EXFO adds new optional measurements, features, and/or functions to various software packages that are not free of charge. Therefore, customers are not entitled to receive any of these options under the EXFO free upgrade policy.

EXFO reserves the right to decide what constitutes a free upgrade versus a chargeable option.

F.2 Upgrading Software

The CableSHARK software upgrade instructions are as follows:

If you have received the newest version of software, it is recommended that the user copy the CableSHARK software files into a directory called NEWSOFT (on your hard drive). This is recommended so that the download corresponds with these specific instructions.

Note: The CableSHARK can be upgraded via a serial null modem cable, USB memory, or via Ethernet.

Important: Upon initial receipt of any and all EXFO firmware or operating software contained on a floppy diskette(s), CD-ROM, obtained through email or Internet FTP / World Wide Web, please make a back-up copy of the software and place the original EXFO software in a safe place. Use the back-up file(s) for all installations that are required.

From System Setup, press the UPGRADE SOFTWARE function key. The CableSHARK will ask you if you are sure to want to proceed and prompt you if your hardware has any software version limitations. Press Yes to continue or NO to return to the System Setup menu. If YES is pressed, the CableSHARK will indicate Waiting for Connection….

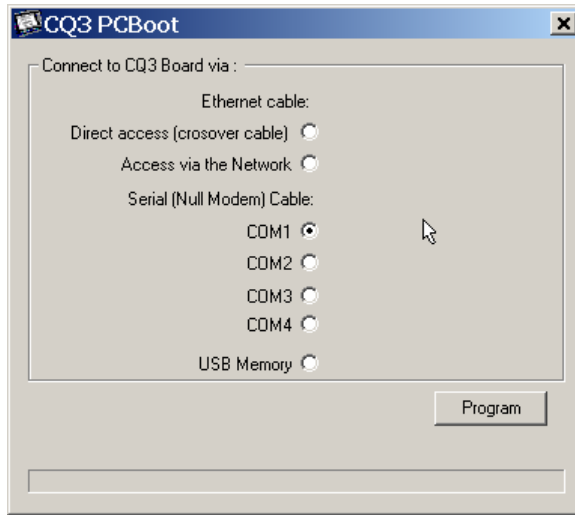On the PC, run the CableSHARK upgrade executable. You can select from several connection types.

FIGURE F.2A - SELECTING AN UPGRADE METHOD

Ethernet Cable: Crossover	Select if connection to the CableSHARK directly from a PC (using a crossover cable). See Section 4.1.4. Press the Program button to upgrade the unit.
Ethernet Cable: Via the Network	Select if connection to the CableSHARK is over a LAN or the Internet (using a straight cable). See Section 4.1.4. Press the Program button to upgrade the unit.
Serial (Null Modem) Cable	Select if connection to the CableSHARK is by a serial null modem cable. See Section 4.1.3. Press the Program button to upgrade the unit.
USB Memory	Select if upgrading via USB. Using a USB memory device, plug this device into the

PC's USB receptacle. Press Program. The PC program will install the necessary files onto the USB memory device. Once ready, plug this USB memory device into the CableSHARK and then start the upgrade process.

EXFO commits to providing product service and repair for five years following the date of purchase.

To send any equipment for service or repair:

1. Call one of EXFO's authorized service centers (see EXFO Service Centers Worldwide). Support personnel will determine if the equipment requires service, repair, or calibration.

2. If equipment must be returned to EXFO or an authorized service center, support personnel will issue a Return Merchandise Authorization (RMA) number and provide an address for return.

3. If possible, back up your data before sending the unit for repair.

4. Pack the equipment in its original shipping material. Be sure to include a statement or report fully detailing the defect and the conditions under which it was observed.

5. Return the equipment, prepaid, to the address given to you by support personnel. Be sure to write the RMA number on the shipping slip. EXFO will refuse and return any package that does not bear an RMA number.

Note: A test setup fee will apply to any returned unit that, after test, is found to meet the applicable specifications.

After repair, the equipment will be returned with a repair report. If the equipment is not under warranty, you will be invoiced for the cost appearing on this report. EXFO will pay return-to-customer shipping costs for equipment under warranty. Shipping insurance is at your expense.

Routine recalibration is not included in any of the warranty plans. Since calibrations/verifications are not covered by the basic or extended warranties, you may elect to purchase FlexCare Calibration/Verification Packages for a definite period of time. Contact an authorized service center (see EXFO Service Centers Worldwide)

EXFO Service Centers Worldwide

If your product requires servicing, contact your nearest authorized service center.

EXFO Headquarters Service Center

400 Godin Avenue	1 866 683-0155 (USA and Canada)
Vanier (Quebec) G1M 2K2	Tel.: 1 418 683-5498
CANADA	Fax: 1 418 683-9224
	quebec.service@exfo.com

EXFO Europe Service Center

Le Dynasteur	Tel.: +33.1.40.83.85.85
10/12, rue Andras Beck	Fax: +33.1.40.83.04.42
92366 Meudon la Forêt Cedex	europe.service@exfo.com
FRANCE	

EXFO China Service Center/Beijing OSIC

Beijing New Century Hotel	Tel.: +86 (10) 6849 2738
Office Tower, Room 1754-1755	Fax: +86 (10) 6849 2662
No. 6 Southern Capital Gym Road	beijing.service@exfo.com
Beijing 100044	
P.R.CHINA	

Appendix J   Visi-SHARK Software

Visi-SHARK is a MS Windows® 95/98/ME/2000/XP software package which enables you to use your PC to remote control the CableSHARK. In addition to making remote controlled measurements, Visi-SHARK allows you to view, print or save to disk information from your local and remote CableSHARK(s), whether you are a few meters from the CableSHARK or thousands of kilometers away.

To run a test using Visi-SHARK, you simply use your PC's mouse to command the CableSHARK. Visi-SHARK's intuitive controls will be instantly recognizable to any CableSHARK user. Clicking on the graphical buttons on the screen of your PC has exactly the same effect as pushing the buttons on the CableSHARK front panel. The information on the screen changes as you operate the unit. Alternatively, you can use your PC arrow keys, <ENTER> key, and numerical keys to control the CableSHARK using Visi-SHARK.

NOTE: If the Visi-SHARK option is not installed on the CableSHARK, only the SCREEN RECALL feature will be available to the user. The SCREEN RECALL function will save the screenshots as JPEG's.

J.1 Installing the Software

The Visi-SHARK software can be downloaded of the EXFO webs site (free) or ordered on a CD-ROM. The CD-ROM will be labeled with "Version X.XX", where "X.XX" is the version of the software you received.

The software can be installed under Windows® 95/98/ME/2000/XP. When the installation program is run, follow the instructions on the screen.

The SETUP program expands and places the contents of the Visi-SHARK Program disks into the default destination directory "C:\Program Files\EXFO Ltd.\VisiSHARK", or a different user-defined directory.

J.2 Connecting the CableSHARK to the PC

See Section 4.1.3 for Serial connections or Section 4.1.4 for Ethernet based connections.

J.3 Operation

J.3.1 Running Visi-SHARK

Visi-SHARK can be run from a Visi-SHARK shortcut icon on the Desktop, the Start Menu, and Windows® Explorer.

J.3.1.1 Running Visi-SHARK from a Shortcut Icon on the Desktop

The most convenient way to run the Visi-SHARK application is to use a shortcut icon on the Desktop. But first, a Visi-SHARK icon must created and be moved to the desktop.

If you have installed the Visi-SHARK application to the default directory, run Windows® Explorer from the Start menu by clicking the Start button on the Taskbar, clicking Programs and then clicking on Windows® Explorer. Browse to the directory C:\Program Files\EXFO\VisiSHARK. Ensure that the Explorer window is not maximized so that you can see some of your desktop. Look for the icon "visishark.exe". Click the icon. On the File menu, click Create Shortcut. Drag the newly created shortcut icon onto your Desktop. Now, to start Visi-SHARK, you only need to double-click on the icon.

If you have installed the software to a custom directory of your choice, then you must browse to that drive and directory and then create a shortcut icon as described above. If you cannot remember which drive and directory the software is installed to, use the Windows® Find function to locate the file visishark.exe.

J.3.1.2 Running Visi-SHARK from the Start Menu

To run the application from the Start Menu, click the Start button the Taskbar, next click on Programs and then click on Visi-SHARK.

J.3.1.3   Running Visi-SHARK from Explorer

If you have installed the software to the default directory and would like to run it using Windows® Explorer, activate Explorer from the Start menu by clicking the Start button on the Taskbar, clicking Programs and

then clicking on Windows® Explorer. Browse to C:\Program Files\EXFO Ltd.\visi-shark and double-click on visi-shark.exe.

If you have installed the software to a custom directory of your choice, then you must browse to that drive and directory and double-click on visi-shark.exe to run it. If you cannot remember which drive and directory the software is installed to, use the Windows® Find function to locate and run the file visi-shark.exe.

J.4   Setting up a New Connection with Visi-SHARK

To set up a connection between the PC and the CableSHARK, click the New Connection icon that resides on the toolbar.

The user can also click on New Connection on the menu bar as shown below.

FIGURE J.4A – SELECTING SETUP CONNECTION FROM THE NEW CONNECTION MENU

Next, click on "Setup Connection" on the pull-down menu that appears. The "Setup Connection Through…" menu shown below appears.
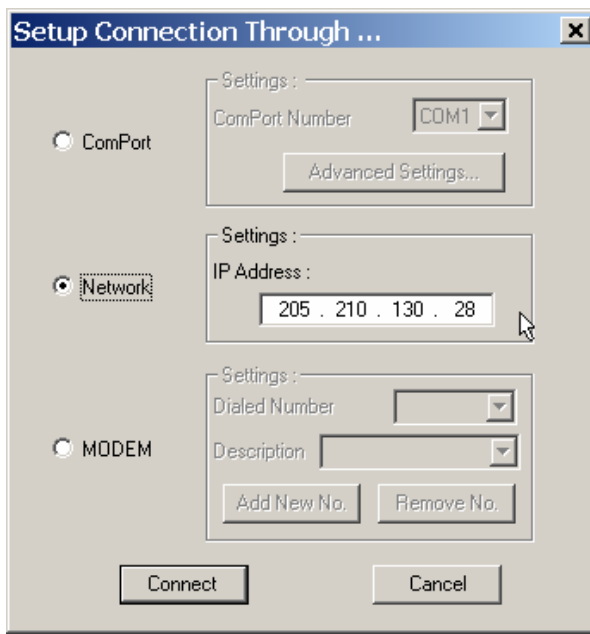
FIGURE J.4B - THE SETUP CONNECTION THROUGH…. DIALOG BOX

The radio buttons to the left-hand side of the menu allow the user to select from Setup Connection through a COM port, Ethernet port, or connection through a MODEM. These three functions are described below.

J.4.1 Setup Connection Via COM Ports

If you wish to connect via a COM port, click the radio button next to the label "COM PORT" on the left-hand side of the "Setup Connection Through…" menu shown in the above figure.

On the Setup Connection Through… dialog box, there is a small field next to the label "Com Port Number" where the desired COM port can be selected (see Figure J.4b). To select the COM port, click the button that has a downward pointing arrow on it that is to the right of the small field and click on the desired COM port number on the drop-down menu that is dislayed. If "Auto" is chosen, Visi-SHARK will check each COM port in turn and attempt to connect to the first CableSHARK that it finds.

Next, click on the Advanced Settings button on the upper right of the dialog box. This will activate the Flow Control dialog box as shown in the figure below.
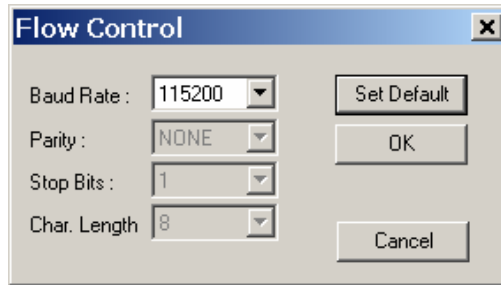
FIGURE J.4.1A - SETTINGS IN THE FLOW CONTROL DIALOG BOX

Check to see that the settings in the Flow Control dialog box match the RS-232 settings in the Change Setup menu of the CableSHARK to which you wish to connect (consult your CableSHARK operating manual for more information on the RS-232 settings of the CableSHARK). If the settings in the Flow Control do not match the RS-232 settings of the CableSHARK to which you wish to connect, then the settings in the Flow Control and/or the RS-232 settings of the CableSHARK must be changed so that the settings match. Otherwise, proper communication cannot take place and Visi-SHARK will respond with the error message, "Failed to Connect to CableSHARK". Clicking on the "Set Default" button sets the Flow Control settings to their default values, which correspond to the default RS-232 settings of the CableSHARK.

Once all of the above parameters are set as desired, click on the "Connect" button to connect to the CableSHARK or click "Cancel" to abort the connection.

If the error message "No COM Port Available" appears, it may indicate one or more of the following problems:

a) The CableSHARK is already connected to the computer via another direct connection.
b) The cable connection at the CableSHARK is loose or disconnected.
c) The cable connection at the computer is loose or disconnected.
d) The cable is faulty.

If the error message "Failed to Connect to CableSHARK" appears, it may indicate one or more of the following problems:

a) The settings in the Flow Control do not match the RS-232 settings of the CableSHARK. The user should ensure that the settings of the CableSHARK and the settings in the flow control match. See above.
b) A RS-232 Null Modem may be required. See section 4.1.3.

J.4.2 Connecting Through a Network via Ethernet

If you wish to connect via Ethernet, click the radio button next to the label "NETWORK" on the left-hand side of the "Setup Connection Through…" menu shown in the figure below.

On the Setup Connection Through… dialog box, there is a small field next to the label "IP address" where the desired IP address can be entered (see Figure J.4A).
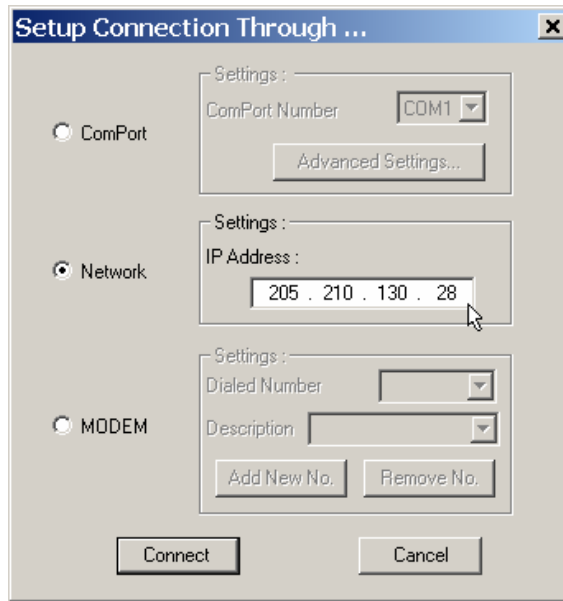

FIGURE J.4.2A – SETTING THE IP ADDRESS

Click on the "Connect" button to connect to the CableSHARK over a network (LAN or Internet).

If the error message "Socket Error: The attempt to connect" or "Failed to Connect to CableSHARK" appears, it may indicate one or more of the following problems:

a) The CableSHARK is already connected to the computer via another direct connection.
b) The cable connection at the CableSHARK is loose or disconnected.
c) The cable connection at the computer is loose or disconnected.
d) The cable is faulty.

e) Possibility that a crossover was used instead of a straight cable or vice versa. See Section 4.1.4 for more information.
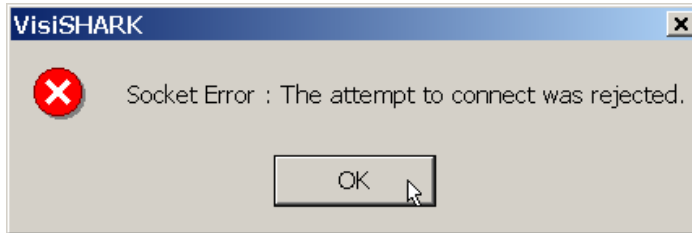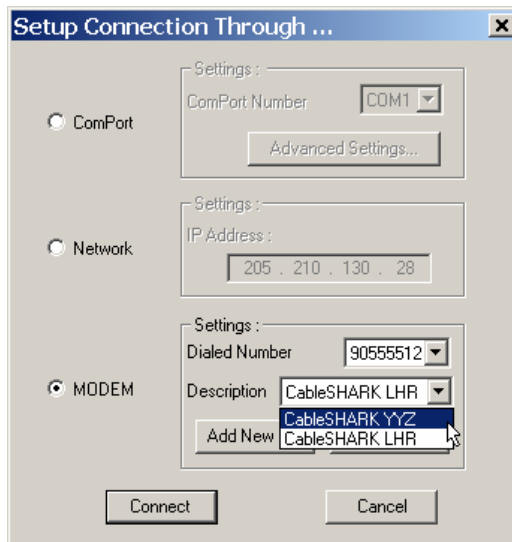

FIGURE J.4.2B – SOCKET ERROR

J.4.3 Connecting Through a MODEM

If you wish to connect via a MODEM, click the radio button next to the label "MODEM" on the left-hand side of the "Setup Connection Through…" menu shown in the figure below.

FIGURE J.4.3A - THE SETUP DIRECT CONNECTION DIALOG

If you have already pre-programmed Dialed Number(s), you can select one of those numbers by clicking the button that has a downward pointing arrow on it that is to the right of the "Dialed Number" or the "Description" field. Select the number or description from the pull-down list that is displayed.
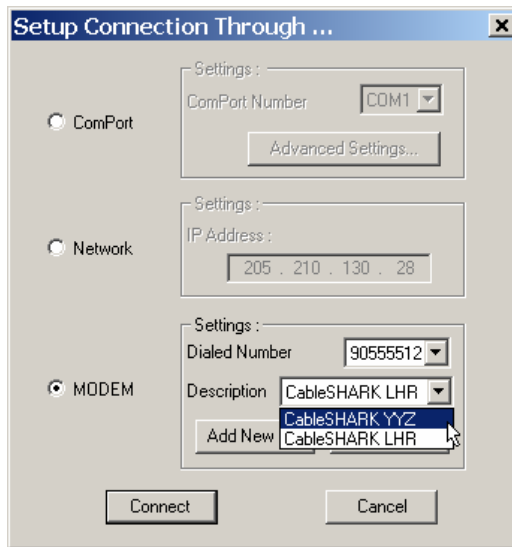
FIGURE J.4.3B - SELECTING A PRE-PROGRAMMED NUMBER

If you have not pre-programmed any Number(s) or wish to add a new number, click on the button labeled "Add New No…" to invoke the Add Dialed Number dialog as shown below. Enter the phone number in the "Dialed Number:" field. If you wish, you can enter a descriptive name for this connection in the "Description:" field. Next, click the OK button to save the Number, or click Cancel to abort the connection.
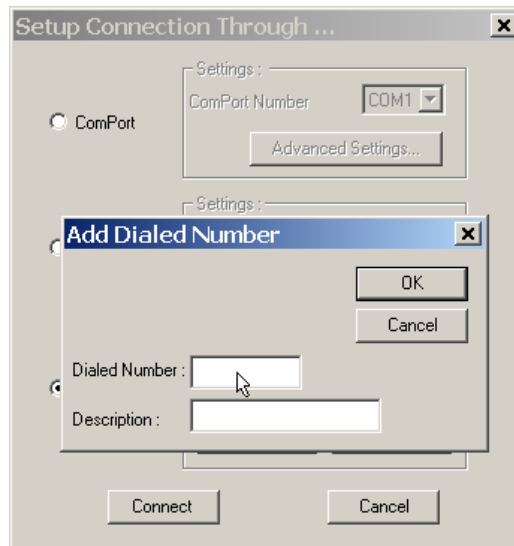
FIGURE J.4.3C - ADDING A NEW DIALED NUMBER

To remove a pre-programmed Dialed Number, select the Number by clicking the button that has a downward pointing arrow on it that is to the right of the "Dialed Number" or "Description" field. Select the Number to be removed from the pull-down list that appears. Click the "Remove No." button.

J.5 Controlling the CableSHARK with Visi-SHARK

Once the Visi-SHARK software has established communication with an CableSHARK, a window is displayed containing the simulated Main Menu of the CableSHARK, along with its familiar function keys and alphanumeric keypad.

FIGURE J.5A - A CABLESHARK IS CONNECTED VIA ETHERNET

By clicking the on-screen buttons with the mouse, the user can control the remotely connected CableSHARK. The CableSHARK responds in the same manner as if the user was actually pressing the buttons on the CableSHARK unit. The simulated on-screen CableSHARK display changes accordingly, to reflect what the remotely connected CableSHARK is displaying.

Similarly, the Visi-SHARK simulated display will change when the actual buttons on the CableSHARK unit are pressed.

J.6   Menu Bar and Toolbar Functions

The Menu Bar resides near the upper left of the Visi-SHARK screen. All of the Visi-SHARK functions can be controlled from the menu bar. Clicking each of the Menu Bar items invokes a pull-down menu containing one or more functions.
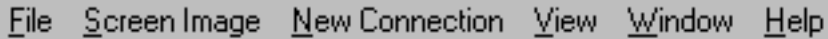
File   Screen Image   New Connection   View   Window   Help

FIGURE J.6A - THE MENU BAR

Some Menu Bar items may be unavailable in certain circumstances. For instance, the "Window" item will be unavailable when no windows are currently open. The toolbar also resides near the upper left of the Visi-SHARK screen and it consists of several convenient icons that can be used to activate some of the most common functions.

FIGURE J.6B - THE TOOLBAR

In some cases, certain Toolbar icons will be "grayed out" if the corresponding function is unavailable. For instance, if no CableSHARK is connected and no result files are open, the Save Image icon will be unavailable since there is no on-screen image that can be saved.

J.6.1 File Menu

The File menu contains such menu functions as Upload Result, Print and Exit.

To open the file menu, click on the "File" entry on the Menu Bar to open the File menu as shown below.

J.6.1.1 Upload Result

The Upload Result function enables the operator to upload current or saved CableSHARK results to a PC.

To activate the Upload Results function, click on the Upload Results icon.

Alternatively, the Upload Results function can be activated by clicking on the "File" entry on the Menu Bar and then clicking on the "Upload Results" entry on the menu that appears.

Invoking the Upload Result function transfers the on-screen CableSHARK result to the users PC through Visi-SHARK. Visi-SHARK then attempts to load Microsoft Excel and show the tabular and charted results.

If Microsoft Excel is not installed on a PC, this function will not work!

J.6.1.2   Print

The Print function enables the operator to print a previously stored set of test results, or a screen capture. When printing test results, this function is most useful for printing the entire set of results. If you wish to print a partial set of results, or certain pages only, then printing from the Print Preview function is a better choice, because you can view what information appears on each page before you print.

To activate the Print function, click on the Print icon.

Alternatively, the Print function can be activated by clicking on the "File" entry on the Menu Bar and then clicking on the "Print" entry on the menu that appears. A quicker way to activate the Print function is to hold down the CTRL key and press the "P" key.

Invoking the Print function causes a Windows® print dialog box to be displayed. The print dialog box facilitates the selection of the desired printer, number of copies as well as which pages to print (if there is more than one page). Select the desired printer by clicking on the button with a downward pointing arrow (to the left of the properties button) and select the desired printer from the drop-down list that appears. To print, make the desired selections and click on the "OK" button. To cancel the print dialog, click on the Cancel button.

If it is necessary to change the properties of the printer such as paper size, paper orientation, print quality etc, click on the Properties button. The properties dialog lists several options that are intrinsic to your printer. For a description of the options for your particular printer, please consult the User's Guide for your printer, as options and settings vary among printer manufacturers. After you have set the printer's properties, click OK to accept the new settings or click Cancel to abort this operation.

Please note that your printer settings are saved until you terminate your Visi-SHARK session. When you start Visi-SHARK again, your printer properties are automatically set to the Windows® default values. However, you can change the default settings for your printer in Windows® Control Panel. Consult Windows® Help for more information.

To print, make the desired selections and click on the "OK" button. To cancel the print dialog, click on the "Cancel" button.

J.6.1.3   Print Preview

Print Preview will give you a full-screen preview of what the actual printout will look like. It is especially useful for printing individual pages when you want to check and see what information will appear on each page.

Click on the Print Preview icon to activate print preview.

Alternatively, the Print Preview function can be activated by clicking on the "File" entry on the Menu Bar and then clicking on the "Print Preview" entry on the menu that is displayled.

J.6.1.4 Print Setup

This function enables you to set up the printer options and parameters just as for the Print function. However, this function allows setup for later printing only and it has no option to print.

This function does not change the Windows® default printer or its settings. The Print Setup settings will be lost when you close the Visi-SHARK application.

The Print Setup function can be activated by clicking on the "File" entry on the Menu Bar and then clicking on the "Print Setup" entry.

See also **Print** for more information.

J.6.1.5 Exit

Exit terminates the Visi-SHARK application and closes all test result files that are open. You will be prompted to save any unsaved result files to disk before any such files are closed.

Exit the Visi-SHARK application by clicking on the "File" entry on the Menu Bar and then clicking on the "Exit" entry.

J.6.2 Screen Image menu

The Screen Image menu contains the functions "Recall from file…" and "Capture to file…" which enable the operator to load a screen capture from disk and save a screen capture to disk, respectively.

Click on the "Screen Image" entry on the menu bar to open the Screen Image menu as shown below.
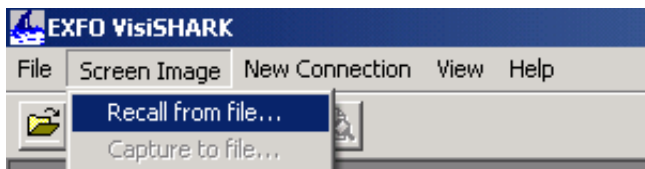

FIGURE J.6.2A – SELECTING THE SCREEN IMAGE MENU

The user can now click on "Recall from file…" to recall a previously saved screen capture from disk or click on "Capture to File" to take a screen capture of the active window on the screen and save it to disk.

There are also two convenient menu bar icons that perform the Recall and Capture functions:

Click the Recall Image icon to recall a previously saved screen capture from disk.

Click the Save Image to take a screen capture of the active window on the screen and save it to disk.

J.6.2.1   Recall from file…

The Recall from File function allows the operator to open a previously saved Screen Capture from disk.

This function is invoked by clicking the "Screen Image" item on the Menu Bar and then clicking the "Recall from File…" item on the menu that appears or by clicking on the Recall Image icon. An Open dialog box will appear with "Screen Image Files (*.jpg, *.dib, *.vsi)" listed in the "Files of Type" field. Therefore, only CableSHARK files with the extension ".jpg", ".dib" or ".vsi" will appear in the large field.
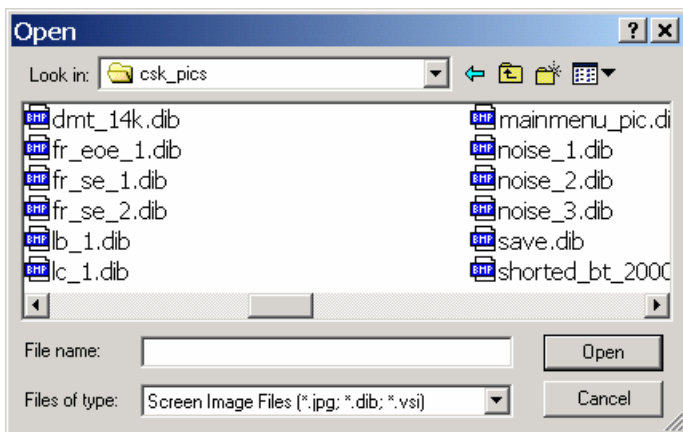

FIGURE 13.6.2.1A – RECALLING A SCREEN IMAGE FILE

To open a Visi-SHARK Screen Image, browse to the drive and directory where your screen image files are saved. Simply click on the file name and then click the Open button, or simply double-click on the file name.

J.6.3 New Connection Menu

To set up a connection between the PC to the CableSHARK, click on New Connection on the menu bar as shown below.

FIGURE J.6.3A – SELECTING DIRECT CONNECTION FROM THE NEW CONNECTION MENU

Next, click on Setup Connection on the pull-down menu that is displayed.   The "Setup Connection Through…" menu shown below is displalyed.
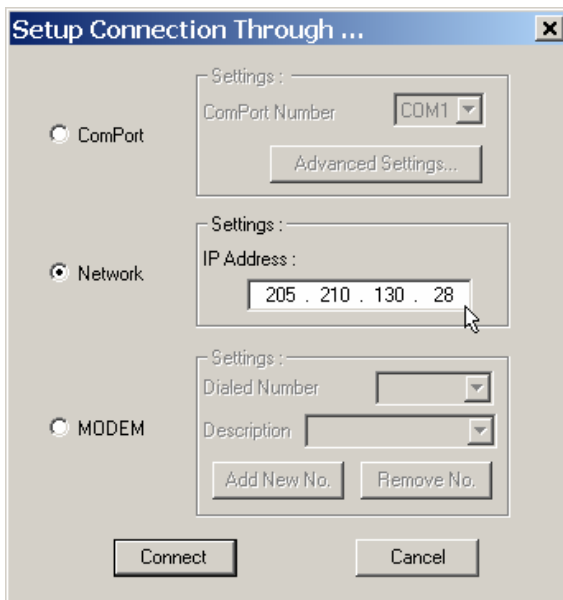

FIGURE J.6.3B – THE SETUP DIRECT CONNECTION DIALOG

The radio buttons to the left-hand side of the menu allow the user to select from Setup Connection Through…. a COM port, an Ethernet port, or connection through a MODEM.

The user can also click the Direct Connection icon on the toolbar to invoke the "Setup Connection Through…" menu shown above.

J.6.4 View Menu

The View Menu contains two selections that control whether or not the Toolbar at the top of the screen is displayed and whether the Status Bar at the bottom of the screen is displayed. In some cases, it may be advantageous not to display the Status Bar and / or Toolbar so that more space in the main window is available to view results. To activate the View menu, simply click the "View" item on the Menu Bar.

The Toolbar and/or the Status Bar can now be activated/deactivated.

J.6.4.1 View Toolbar

Click the "Tool bar" item on the View menu to toggle the display of the Toolbar at the top of the screen on or off. A check mark next to this item indicates that the Toolbar is enabled.

13.6.4.2 View Status Bar

Click the "Status bar" item on the View menu to toggle the display of the Status Bar at the bottom of the screen on or off. A check mark next to this item indicates that the Status Bar is enabled.

J.6.5 Window Menu

The Window Menu contains menu items such as Cascade and Tile, which enable the user to more easily organize test and/or result windows on the screen.

To activate the Window menu, click the Window item on the Menu Bar. A drop down menu will appear with entries such as Cascade, and Tile. Just click on the desired entry on the menu to perform that function.

J.6.5.1   Cascade

Cascade arranges the test and/or result windows so that they are stacked on top of each other with a slight overlap.

J.6.5.2   Tile

The Tile function arranges the test and/or result windows so that they are "tiled" on the screen. Use this function to give a good view of several windows at once.

Appendix K   Glossary of Terms

ADSL (Asymmetrical Digital Subscriber Line) - a standard for transmitting at speeds up to 8 Mbps over a single copper pair. Asymmetrical means that the download speed is faster than the upload speed.

ATM (Asynchronous Transfer Mode) - technology that uses fixed-length packets or cells to switch voice, data, and video traffic over local and wide area networks.

Attenuation - the dissipation of the power of a transmitted signal as it travels over the copper line

B-Channel *Bearer Service Channel* - Operates at 56 or 64 Kbps and carries user voice and data. The bit rate depends on the location of the service provider.

BRI- *Basic Rate Interface* - One of the access methods of an ISDN circuit. Comprising of 2B+D channels.

Bridge Tap - A bridged tap is a piece of open circuit transmission line connected in parallel somewhere between the ends of an operating telephone pair. The balance of the original circuit is not cut off but remains in place as an unterminated (open circuit) pair of wires.

BRITL *Basic Rate Interface Dial-Up Test Line* - A feature of AT&T switches.

CODEC *Coder/Decoder* - Device used to convert analog signals to digital bit streams and vice versa.

CPE *Customer Premise Equipment* - Devices or equipment that the customer provides to interface with the telephone company.

CRC *Cyclic Redundancy Check* - A mathematical algorithm used to detect bit errors in data transmission.

D-Channel - The out of band signaling channel that carries ISDN network signals. It can also be used to carry packet-mode user data. The D-channel operates at 16Kbps in the BRI and 64 Kbps in the PRI.

DCE Data Circuit-Terminating Equipment

DSL Digital Subscriber Line

DTE Data Terminal Equipment

Echo Cancellation - A technique used by ADSL, V.32, and V.34 modems that isolates and filters unwanted signal energy from the echoes caused by the main transmitted signal.

HDLC High-level Data Link Control

HDSL *High bit-rate Digital Subscriber Line -* an xDSL technology in which modems on either end of two or more twisted pair lines deliver symmetric T1 and 2 MBIT/S (E1) speeds. Currently, T1 requires two lines and 2 MBIT/S (E1) requires three.

ISDN- Integrated Services Digital Network

Load Coil - An induction device employed in local loops exceeding 18,000 feet in length, that compensates for wire capacitance and boosts voice grade frequencies. Load coils prevent high frequencies from passing through so they must be removed to allow xDSL technologies to operate on the local loop.

Local Loop - The line from the subscriber to the telephone company central office exchange

Multi-Point - A configuration that supports multiple terminal equipment devices.

National ISDN - A standard call control for NI-1,2, and 3.

NT1 *Network Termination type 1 -* The ISDN device responsible for the termination of the ISDN transmission facility at the customer premise.

NT2 *Network Termination type 2 -* An ISDN device responsible for on premise communications distribution, such as a PBX, LAN, or host computer.

Octet - An eight bit quantity. Used in reference to digital transmission, same as a byte.

Point to Point - A direct connection, normally from an NT1 to a TE.

POTS - Plain Old Telephone Service.

PRI- *Primary Rate Interface -* One of the access methods to an ISDN circuit. Comprising of 23 B-channels and 1 D-channel (North American) and 30 B-channels and 1 D-channel (ETSI).

PSTN - Public Switched Telephone Network

S/T Interface The standard 4 wire (2 Rx, 2 Tx) ISDN interface used by ISDN terminals. It is the physical interface on the terminal side of the NT1.

TE *Terminal Equipment -* Any ISDN compatible device that may be placed on the network such as a telephone, PBX, TV, PC, etc.

TE1 *Terminal Equipment type 1 -* ISDN compatible terminal equipment.

TE2 *Terminal Equipment type 2 -* Non-ISDN compatible terminal equipment.

2B1Q *Two Binary One Quaternary* - A signaling method used across the 2-wire BRI (U reference point). 2B1Q is a four level line code associating 2 bits to each line signal.

U Interface - The physical 2-wire echo canceling interface on the network side of the NT1.

Appendix L   Recycling and Disposal

Applies to European Union Only

Recycle or dispose of your product (including electric and electronic accessories) properly, in accordance with local regulations. Do not dispose of it in ordinary garbage receptacles.

Unless otherwise noted in a separate agreement between EXFO and a customer, distributor or commercial partner, EXFO will cover costs related to the collection, treatment, recovery and disposal of end-of-lifecycle waste generated by electronic equipment introduced after August 13, 2005 to an European Union member state with legislation regarding Directive 2002/96/EC.

Except for reasons of safety or environmental benefit, equipment manufactured by EXFO, under its brand name, is generally designed to facilitate dismantling and reclamation.

For complete recycling/disposal procedures and contact information, visit the EXFO Web site at www.exfo.com/recycle.

Notes

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