TESCOM

APPLIED INSTRUMENTS, INC.

RF TEST AND MEASUREMENT

XR-3 Modular Test Instrument
TS2 DBS Satellite Meter Module
## Operation Manual

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Revision	1.0
Date	05/02/2023

This manual covers basic operations and functions of the XR-3's TS2 Module. For more detailed instructions on how to use the instrument for different applications, see the Application Notes available on our website, http://www.tedscomusa.com

1. Introduction to XR-3's TS2 Module

The XR-3's TS2 module is used with the XR-3 modular test instrument base unit.

XR-TS2-01 tuner module

XR-3 base unit
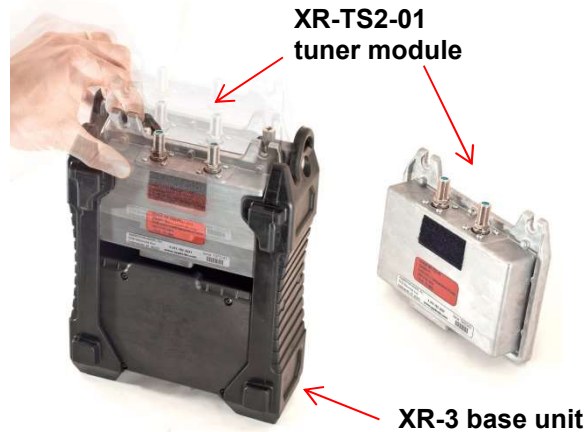
FEATURES
- Compatible with XR-3 Modular Test Instrument
- Friendly user interface
- Satellite ID by "align-to-lock" or "automatic scan"
- ID multi-lock algorithm eliminates false positives
- Powers LNBs and multi-switches
- Use for L, C, X, Ku, or Ka band applications
- High sensitivity assures alignment optimization
- Geo-sensitive "Field Guide" software database stores all compatible satellites and transponders per global region
- Program and store up to 256 custom transponders
- Controls multi-LNBs/switches with 22kHz DiSEqC tone
- Manually tune to custom transponders using front panel keypad
- Audible tone for signal lock or peak
- Store measurements for Proof-of-performance reporting
- "Limit Scan" Pass/Fail for key transponders
- Displays antenna settings (AZ / EL / Skew) based on user's postal code or latitude and longitude coordinates
- Field replaceable type F barrel connectors
- Fast system boot-up time in less than 5 seconds

MEASUREMENTS
- Demodulates DVB-S, DSS / DIRECTV Legacy, Digicipher 2, Turbo FEC, & DVB-S2 (QPSK & 8PSK, CCM) signals
- Signal Level (dBm, dBmV, or dBμV) with present and peak bar graph
- Signal Quality (IRD, C/N, Eb/No, or Es/No)
- BER (Pre FEC / Viterbi & Post FEC / Reed Solomon) for DVB-S, DSS / DIRECTV Legacy, and Digicipher 2 signals
- Bad blocks, corrected blocks, and frame errors for DVB-S2 and Turbo FEC signals
- Voltage output of IRD / IDU (29V max)
- Current draw of LNB
- LNB frequency deviation (LNB LO drift estimate)
- Symbol Rate error
- Spectrum Screen (frequency on x-axis, amplitude on y- axis)
- Constellation Screen (I and Q demodulator values)

STANDARD ACCESSORIES
- No accessories are included with this module

The XR-3 TS2 module represents a new standard in satellite identification capability. Rather than loading a limited set of satellites or a large number of channel plans to select from, the XR-3 TS2 module holds all of the compatible satellite transponder information for the entire continent.

You just tell it where you are, and what type of system you are connected to, and the XR-3 accesses all compatible satellite transponders visible to that system. The basic operation becomes extremely simple:

Left arrow button – goes to next orbit east
Right arrow button – goes to next orbit west
Up arrow button - next higher transponder
Down arrow button – next lower transponder

Connections
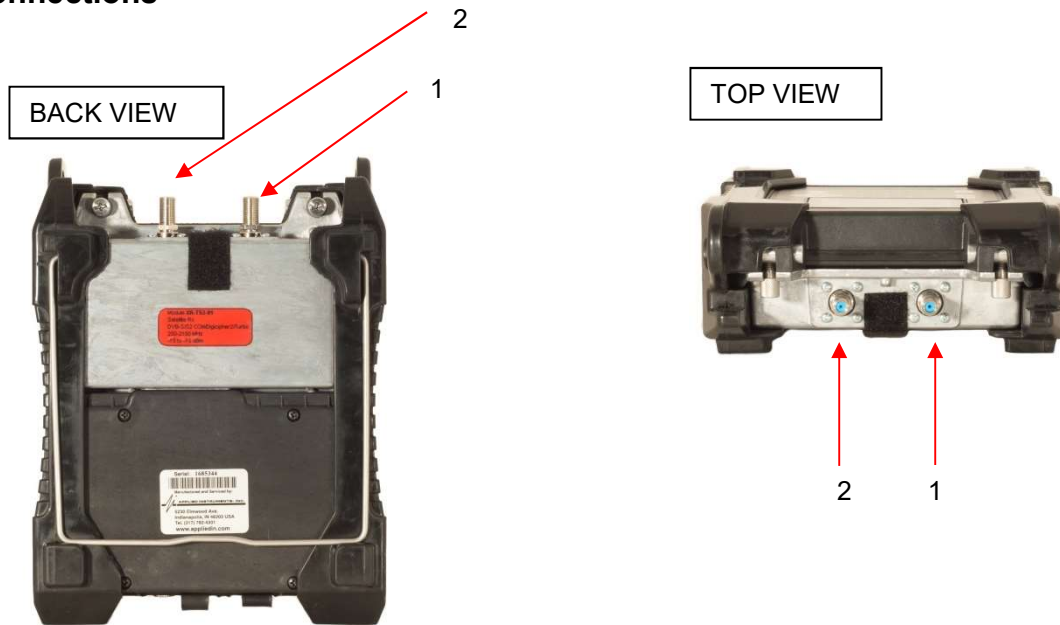
1) ODU / LNB - connects to the LNB (or receiver side of a multi-switch)
2) IDU / IRD - connects to the IRD (receiver or modem) – NOT REQUIRED

ODU / LNB Connection
The ODU / LNB connector has two functions:
- Supplies voltage to power the LNB
- Sends commands to control multi-LNB head or external multi-switch
- Receives RF signals coming from LNB output port or multi-switch output port

IDU/ IRD Connection
The IDU /IRD connector has two functions:
- Measures voltage supplied by the IDU/ IRD

- Allows voltage supplied by IDU / IRD to power the LNB extending the battery life of meter However, the meter itself is always powered by its internal battery or by the external AC to DC switching power supply while connected to AC power.
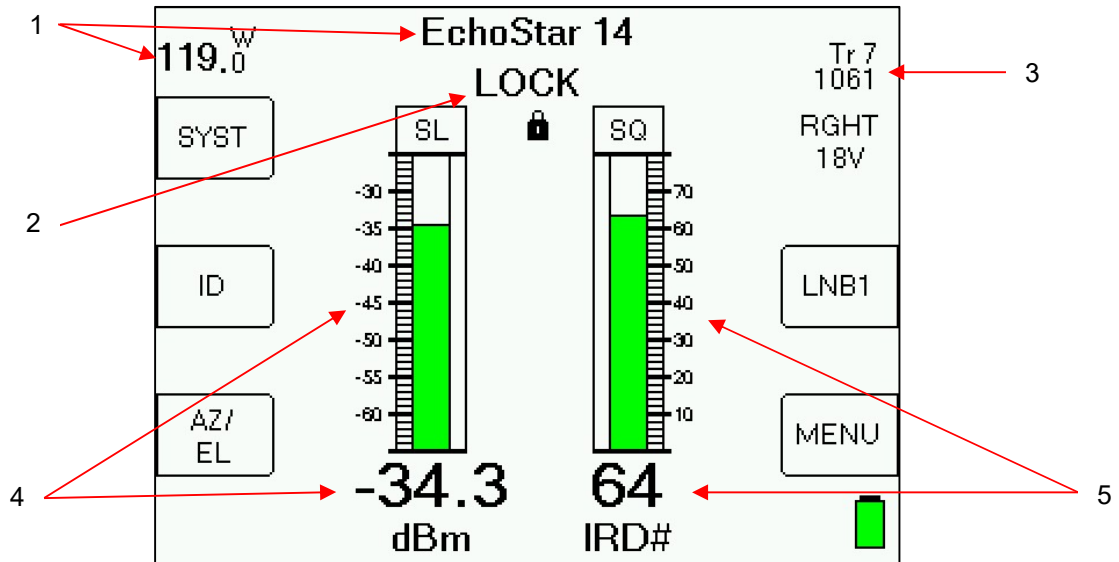
Note: In order to prevent damage to the meter's circuitry, do NOT input more than 30 volts to the XR-3's TS2 module.

2. Run Screen

The Run Screen displays valuable information used when pointing a dish or testing an L-Band network.

1) Selected satellite
    a) Change satellite with left and right arrow keys for single LNB systems (or with the LNB soft key when connected to multi-LNB systems, see Multi-LNB Systems below)
    b) Satellite name is on the top line
    c) Orbital position is shown at upper left
2) Lock status
    a) Search – when searching for a matching signal
    b) LOCK – when signal lock is obtained, this indicates you MIGHT be pointed at the selected satellite, but you must use the ID soft key to confirm the satellite.
3) Transponder information (upper right)
    a) Transponder label
    b) Frequency (L-band or downlink)
    c) Polarity (RGHT, LEFT, HZ or VT)
    d) Voltage provided to LNB (13, 18, 21, or 29 volts)
4) Signal Level
    a) Left bar graph (with peak hold center line)
    b) Numeric value in dBm, dBmV, or dBµV
    c) Scale: -75 to -15 dBm (-26 to +34 dBmV)or (+34 to +94 dBµV)
5) Signal Quality
    a) Right bar graph (with peak hold center line)
    b) Numeric value as IRD equivalent or C/N, Eb/No, or Es/No in dB
    c) Scale: 0 to 20 dB C/N

Soft Keys
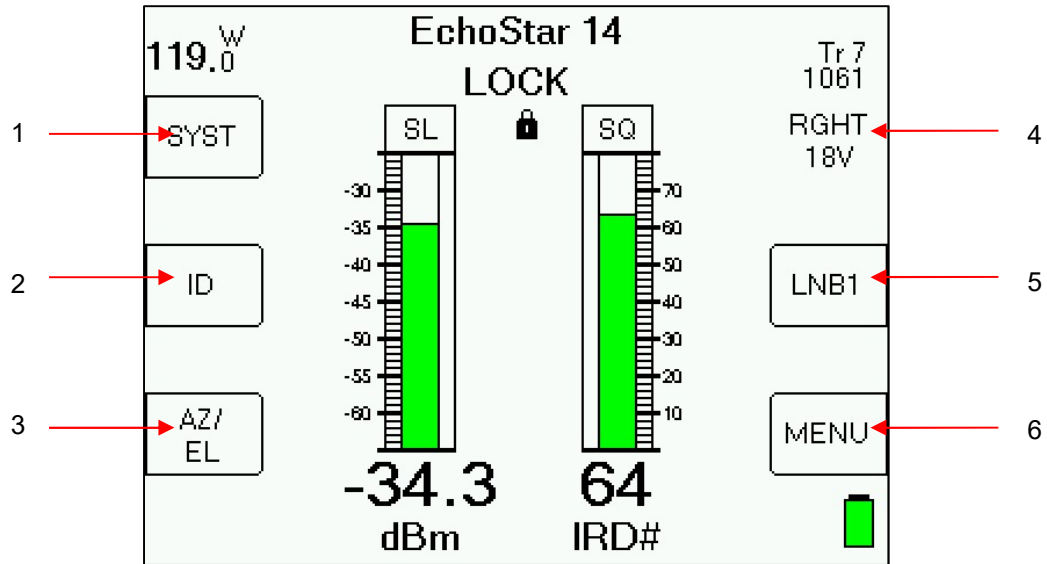
1) SYST   - transfers to the System Setup Screen
2) ID   - starts satellite identification verification function
3) AZ/EL   - transfers to the Azimuth and Elevation Lookup Screen
4) Polarity - displays or selects polarity and LNB voltage
5) LNB   - Turns LNB power on or off (displays present state) and selects switch ports
6) MENU   - transfers to the Main Menu Screen

Changing Satellites

The left and right arrow keys switch to the next east or west satellite visible to the selected LNB. If the LNB polarity can be switched (dual polarity LNBF), the first priority id transponder will be used and the polarity may switch if needed. If the polarity cannot be switched (single polarity LNB with dedicated feed horn for VSAT or commercial TVRO applications), the selected polarity will be maintained.

If you have selected a multi-LNB system, the selected satellite will also change when you use the LNB soft-key to switch between LNBs. (See Multi-LNB Systems below.)

Changing Transponders

The up and down arrow keys take you to the next or previous transponder in the same satellite (actually in the same orbital slot). If the polarity is locked (via single polarity LNB type) then you get the next transponder of the selected polarity. Only transponders visible to your region are used.

Polarity

If the LNB supports polarity switching (i.e. dual polarity LNBF) or is stacked, the polarity key is disabled (as shown above) and the transponder selection determines the polarity.

If you are using a single polarity LNB, the polarity must be selected (to match the orientation of your feed horn) using the polarity key (top right soft-key) and the transponder selection is limited to the selected polarity. See figure below.
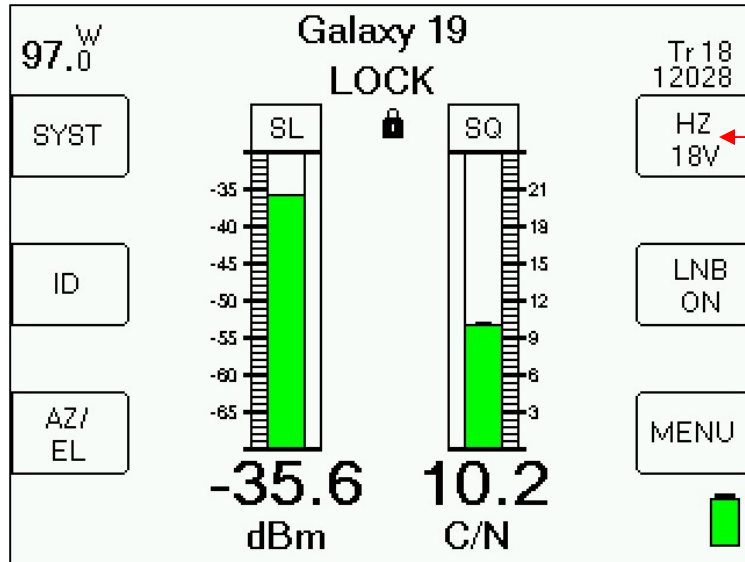
Multi-LNB Systems

When the selected LNB system supports multiple LNBs or multi-head LNBFs via the switch setting, the LNB ON/OFF button also controls the switch setting. Upon pressing the LNB power soft-key, the meter sends a switch command to toggle to the next feed horn and the satellite is automatically changed to the one normally used for that port.
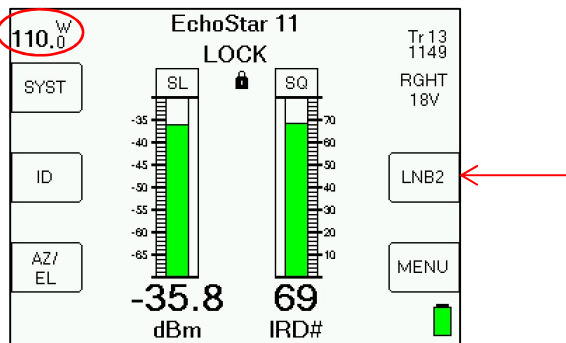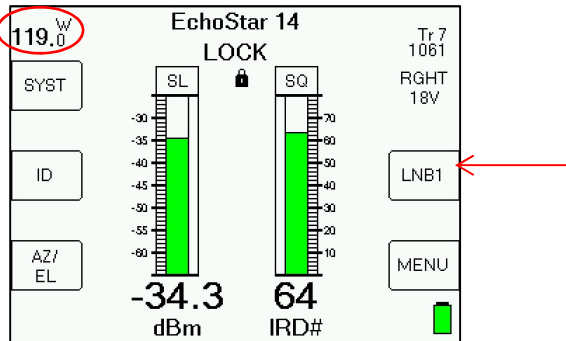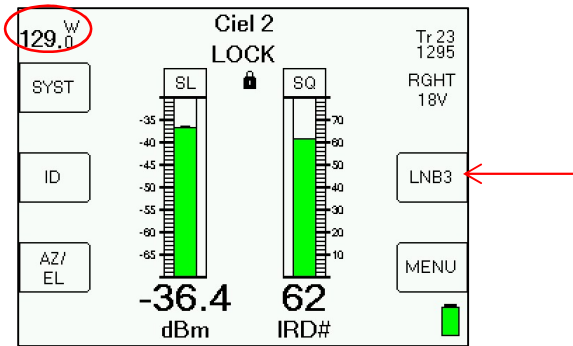
For example, the Dish Network Dish 1000.4 West system is typically used with the 110°, 119°, and 129° satellites. When you press the LNB power soft-key (middle right side of LCD screen) to select LNB1, the meter automatically selects the 119° satellite. Press it again to select LNB2 and the 110° bird is selected. The third press gets you to LNB3 and the 129° bird.

Satellite Identification

Satellites are identified by obtaining locks on one or more transponders. To obtain a lock, the frequency, signal type and symbol rate of the transponder must be known to the instrument. These combinations vary enough between the satellites that they can be used to identify the satellite. Unfortunately, one transponder is not always enough; there may be another satellite using the same combination.

ID Verification

Unlike other meters, the XR-3 has the ability to check one or more transponders looking for a match on a combination that is unique to each satellite. This is what we call the "ID Verification" feature. It is initiated when you press the ID soft-key (middle left side of LCD screen) on the Run Screen.

When you change satellites with the left/right arrow keys (or with the LNB power soft-key if you're connected to a multi-LNBF system), the default transponder shown will be one of the transponders used in ID Verification. Once you get a lock and peak the dish on this transponder, press the ID soft-key and the unit will check any other transponders needed to confirm the identification and display either "VERIFIED" or "ID FAILED".
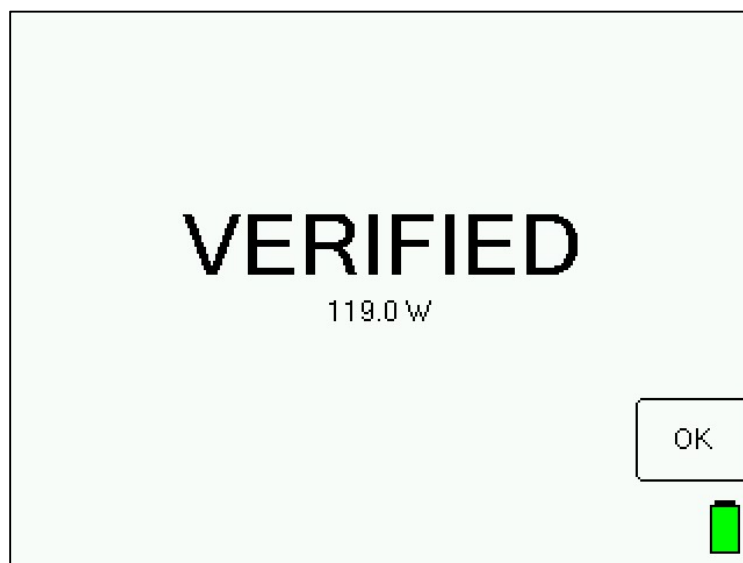
Satellite Scan

If you have peaked up the signal level (left bar graph) on a satellite, but either don't have a signal quality and lock or get an "ID FAILED" message when performing the ID Verification, the XR-3 can try to determine which satellite you are pointed at by performing the ID Verification on different satellites sequentially. This is called the "Satellite Scan" feature.

To run a Satellite Scan, press the ID button to verify the selected satellite. If that succeeds, there is no reason to run the Satellite Scan. If that fails, there will be a "SCAN" button on the "ID FAILED" Error Screen, press that and the scan begins.

The scan will start from the selected satellite, presumably the one you are looking for, and look to the east and west one satellite at a time until a positive ID is found or the horizon is reached, or you abort the scan.
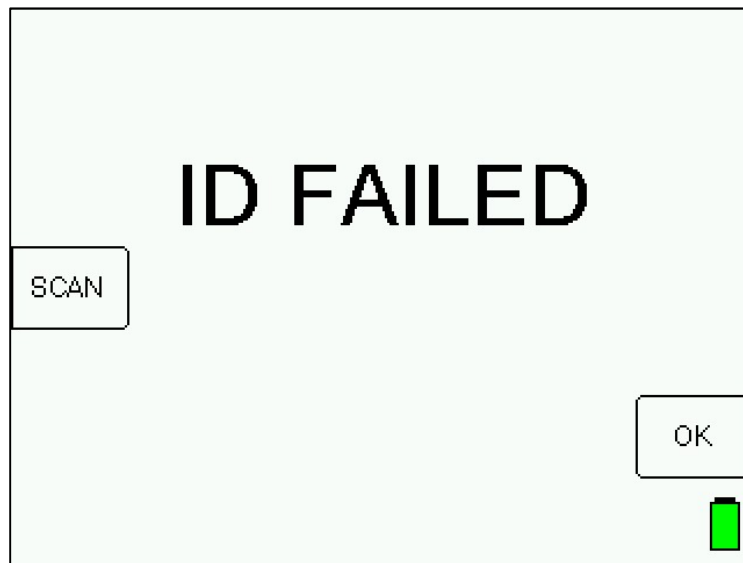
Field Guide Updates

Unfortunately, the satellite identification process is only as good as the transponder definitions that are used. And these change often enough to make the job challenging. That's where Field Guide updates come into play. As we update our software database, we post the revisions on our web site, which you can download into your instrument. See the section on "Updating Your Meter".

Our software database is updated from information gathered from the service providers, other web sites, customers, and our own testing and research. If you know of any omissions or errors in our database, please contact us so that we may pass on what you have learned.

The Hardware version and installed versions of Field Guide, Software, and Postal Codes are displayed in the versions screen. You can access this screen by going into the Menu then Versions.

Main Menu

Limit Scan	Azimuth/El	V/I
	System Setup	
	WiFi	
	Options	
WiFi	Versions	Spec trum
	File Utility	
	OPI/DiSEqC	
	Custom Trans	
Full PoP	SWM Channels	Exit
	SWM Multi-Sat	
	Exit	

Versions

Base Serial#	1689574
Base HW Version	3.01
Base Main	1.81
Base Boot	1.28
Module Name	Turbo-S2
Module Serial#	1705526
Module HW Version	1.00
Module Main	1.46
Module Boot	1.02

Exit
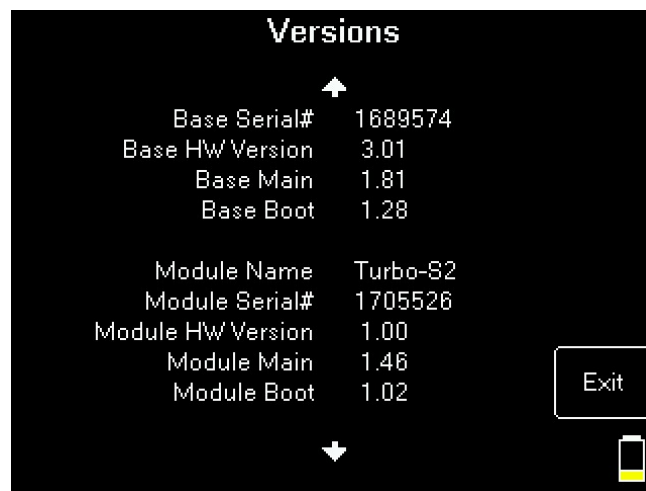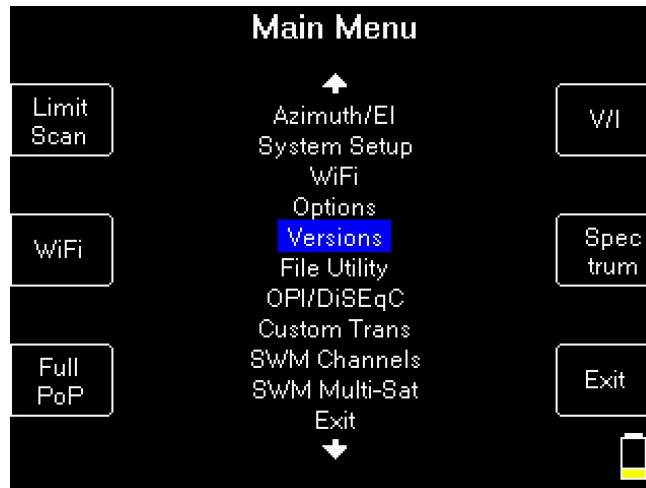
Use the arrow keys to scroll and display the software components.

Versions

Module Serial#	1705526
Module HW Version	1.00
Module Main	1.46
Module Boot	1.02
North American	3.03
USA ZipCodes	1.10
No Limits	1.01
WiFi Serial#	0080A3A00A97
WiFi Main	1.14

Exit

3. Main Menu

The MENU button takes you to a menu of all of the XR-3 screens. Some of these screens are also available via soft keys from the Run Screen.
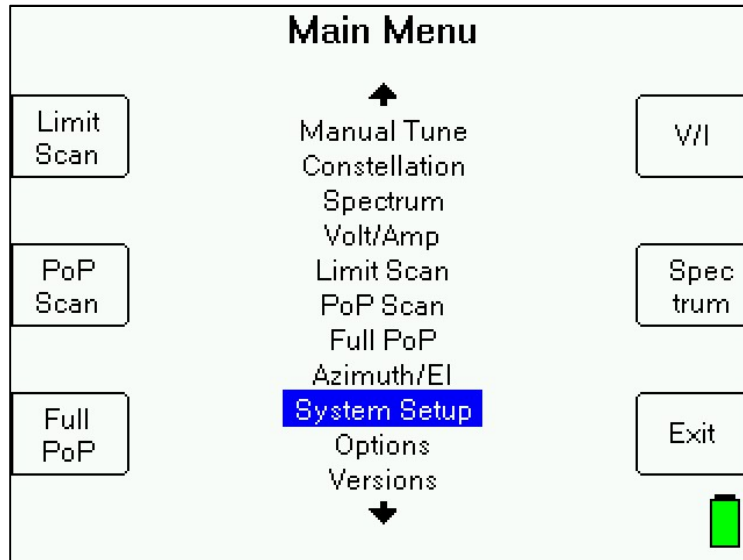
All of the functions are available on the central menu using the up/down and Enter keys. Some functions are also available via soft keys as a shortcut. "Exit" takes you back to the Run Screen.

The functions are described in the sections that follow.

4. System Setup

You **must** use this screen to specify the type of system you are connected to and where you are. **This step is essential**: the XR-3 calculates all frequencies based on this information and displays only the transponders that can actually be received by the selected system in the selected location.

To enter the System Setup, press the SYST soft-key from the Run screen or use your up/down arrow keys to select 'System Setup' from the Main Menu and then press Enter.
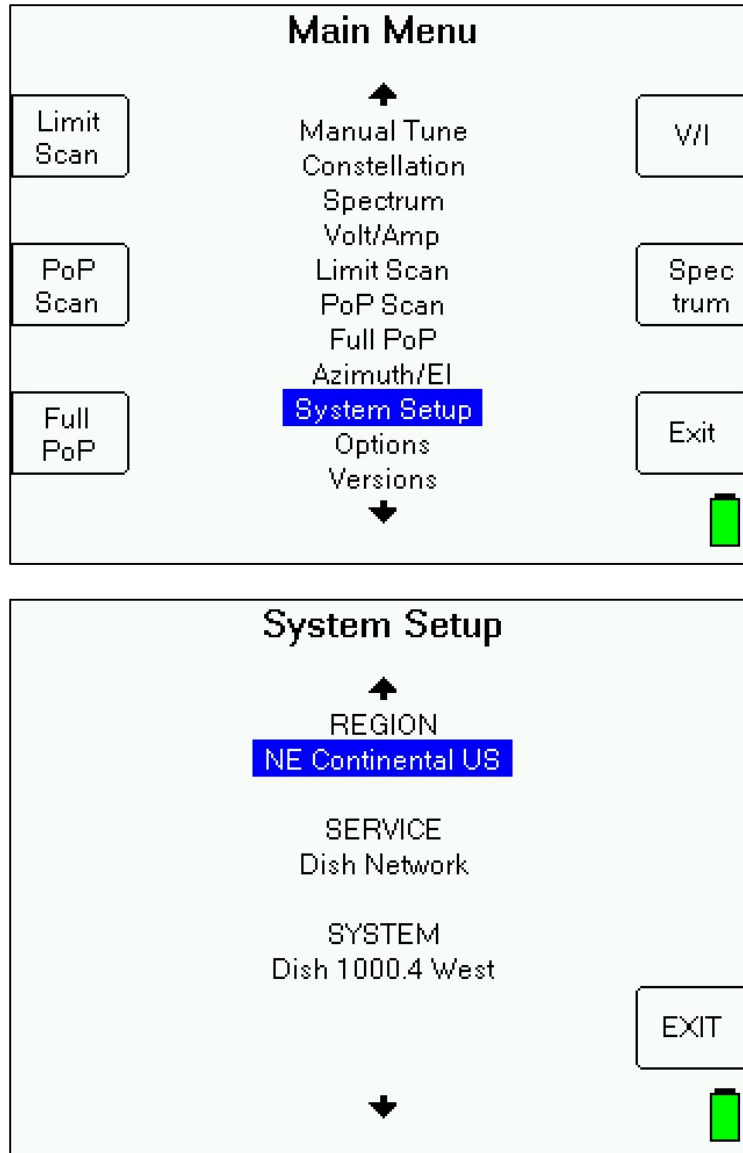
This screen is a simple menu selection. Use the up/down arrows to highlight the selection you want to change and press ENTER.

The system selection actually selects three items:
1) Region
2) LNB system
3) Switch type

Due to the large variety of LNB systems in use, the LNB system selection is divided into three levels:
1) Service
2) System
3) LNB model

Because you will not need to change the region very often (if ever), the second option is highlighted by default. You will need to use the up arrow key to change the region.

The LNB system also defines a default switch type, so this selection is also normally skipped. However, you may override the default switch type if desired.

Regions

When the unit is shipped from the factory, it will have the latest information for North America (except for the Hawaii region, which is found in the NE Pacific Field Guide) loaded into it.   If you are using the XR-3 outside of North America, you must download a different Field Guide from our website. See the Updating chapter for details.

```
                 Select Region

              NE Continental US
              NW Continental US
              SE Continental US
              SW Continental US
                   Alaska
                   Florida
              Eastern Canada
              Western Canada
                  Caribbean
                   Mexico
                                    ┌────────┐
                                    │  EXIT  │
                                    └────────┘
```

You must select a region within the Field Guide that better identifies the area where you will be using the meter. If you are not sure of which region you are in, it probably doesn't matter because there is significant overlap in the regions. For example, the NE Continental US region extends as far south as South Carolina and the SE Continental US region extends as far north as New Jersey.

The region selection is necessary because transponders are pointed only at certain parts of the globe and the XR-3 will use just the transponders that are pointed at your selected region.

Services

The service selection groups the LNB/antenna systems into small sets of choices. The available services may change with Field Guide updates.

```
                    Select Service

                      Dish Network
                        DIRECTV
                        Bell TV
                    Galaxy Broadband
                       HughesNet
                      Shaw Direct
                        Tachyon
                     Other Providers
                    Generic Ku Band
                     Generic C Band          ┌────────┐
                    Generic Ka Band          │  EXIT  │
                     Special Setups          └────────┘
```
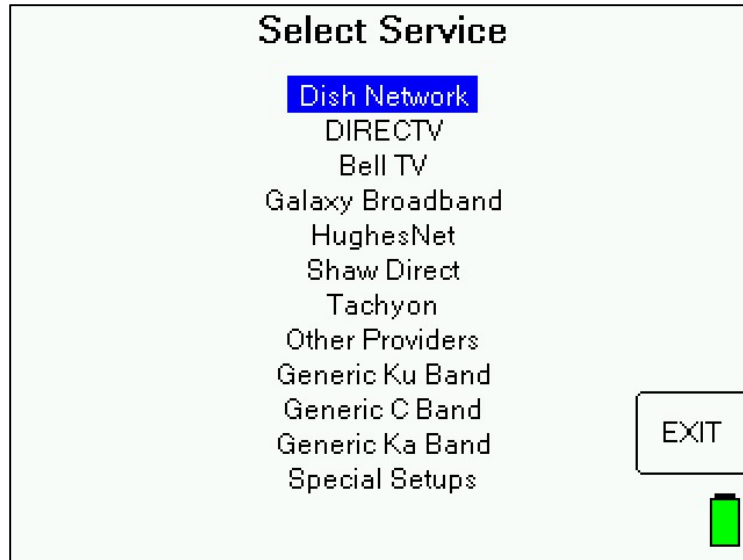
Systems

The system selection lets you pick the type of system within the selected service. In some cases this is the final LNB model selection. In other cases, the system will be broken down further by the LNB model selection.

```
                    Select System

                          ▲
                    Dish 1000.4 West
                    Dish 1000.4 East
                      Dish 1000.2
                       XiP Hopper
                    XiP w/Down Cvter
                      Dish Pro Plus
                        Dish Pro
                     Dish500 Legacy
                     Legacy Single           ┌────────┐
                      FSS Single             │  EXIT  │
                   Dpp500+/Dpp1000+          └────────┘
                          ▼
```

LNB Model

The models listed will depend on the system selected. For example:

Select LNB Model

- 1000.4 West
- 1000.4 West/61.5
- 1000.4 West/72.7
- 1000.4 West/77
- 1000.4 West/118.7
- 1000.4 West/121

EXIT
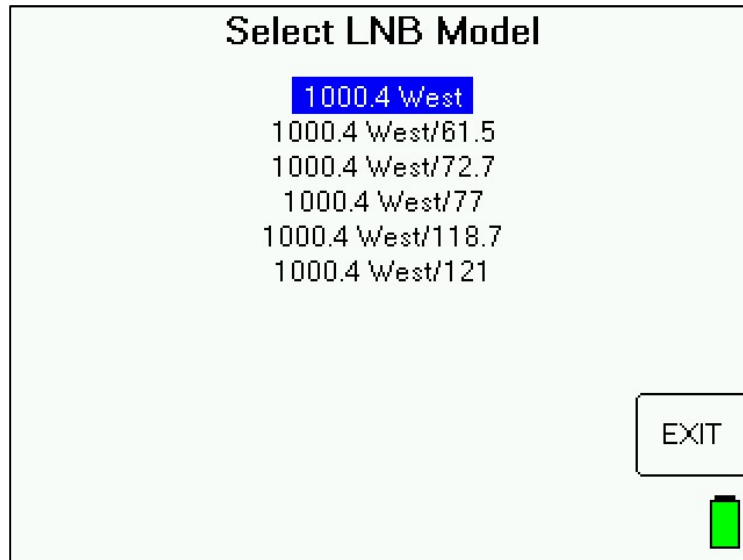
Switch Type

Many multi LNB dishes have a switch that is internal to the multi-LNB head. Other systems may use external switches. When you connect the XR-3 to an external switch rather than directly to the LNB, or when you connect to a multi-LNB head, the XR-3 must know what switch type is connected so it can send the proper type of command to control that switch.

The switch type is usually selected automatically when you pick an LNB Model, but you may wish to change it or select another external switch. If you are installing a system that does not have a switch, you may need to select "none". (Note: additional switch types may have scrolled off the end of the screen. Use your down arrow key to view these.)

Select Switch

- None
- 22kHz
- SW21
- SW42/44
- SW64
- Twin
- Quad
- DiSEqC
- DpTwin
- DpPlus
- Dp34

EXIT
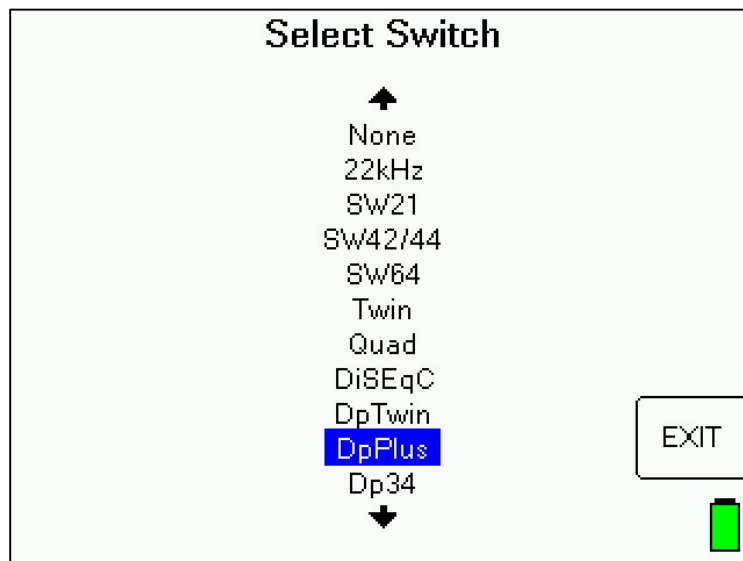
5. Options

There are several options you may select to personalize the operation of your meter.

```
                          OPTIONS
                Level:   dBm           ┌──────┐
              Quality:   IRD#          │ PRE  │
            Frequency:   L-band        │ SET  │
             Sounder:    Lock          └──────┘
            Shutdown:    None
            Freq Dev:    NO            ┌──────┐
            IRD Calc:    New           │ DATE │
           PoP delay:    10            │ TIME │
            Key beep:    ON            └──────┘
       Display Theme:    Light
                                       ┌──────┐
                                       │ EXIT │
                                       └──────┘

            (arrows select)
```
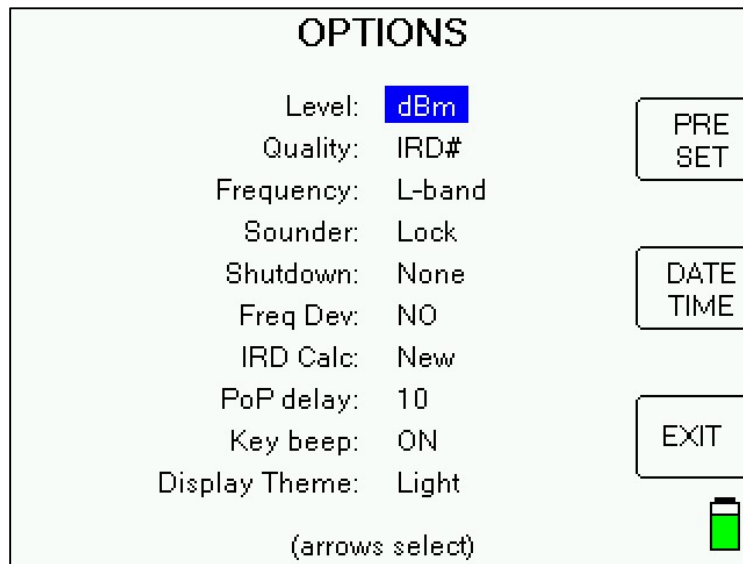
To use this screen, highlight the option you want to change with the up/down arrow keys and select the value you want with the left/right arrow keys. Press EXIT soft-key when done.

Signal Level

The signal level may be displayed in dBm, dBmV or dBµV.

Signal Quality

The signal quality number may be displayed as one of the following:

        C/N (carrier to noise ratio) in dB
        IRD (receiver) equivalent number
        $Eb/N0$ – Energy per bit over noise energy per hertz in dB
        $Es/N0$ – Energy per symbol over noise energy per hertz in dB

IRD numbers for DIRECTV™ range from 0 to 100. Dish Network™ uses two scales: the old scale from 0 to 125 and a new scale with much lower values (approximately 0 to 85).

Frequency

The frequency may be displayed as either the L-band frequency, which the meter is tuned to, or the downlink frequency transmitted by the satellite. Both are displayed in MHz. The L-Band (900-2150 MHz) frequency is the frequency of the signal after being down-converted by the LNB.

Sounder Option

Peaking via the audible tone can be done in two ways: "tone-on-lock" and "peak-o-matic". The "tone-on-lock" method uses the following:

1) Slow beep - the function is on
2) Fast beep – the signal is locked
3) Solid – the signal is locked and at the highest level yet seen

This method works well when the dish is close enough to obtain a signal lock. If you have trouble finding a lock however, you may want to use the "peak-o-matic" method:

1) Slow beep – the function is on
2) Fast beep – the signal is at least 5 dB higher than the lowest level seen
3) Solid – the signal is higher and at the highest level seen so far

Note that the peak-o-matic method does not indicate a lock. It allows you to peak the azimuth and elevation even before a peak is obtained.

In both methods to fully peak the dish, you must move it in one direction until the signal is found, and continue moving it until you move past the peak, then move back to the solid tone.

Shutdown Timer

The unit can be set to automatically shut off after 5, 10, or 15 minutes with no buttons being pressed. This timeout can be disabled by setting the option to "none".

Frequency Deviation

If you select Freq Dev = YES, the lower left corner of the Run screen will display an estimate of the frequency deviation or drift of the LNB. The XR-3 is capable of locking onto a signal up to $\pm$ 10 MHz from the frequency defined for the transponder. A frequency deviation of more than 2 MHz (2000 kHz) may indicate a problem with the LNB. High or low temperatures will cause an LNB to drift and an LNB that works in normal weather with a significant drift may fail to work in hot or cold weather due to the additional drift. Please note that the Frequency Deviation feature will only work while you are receiving a LOCK on a satellite.
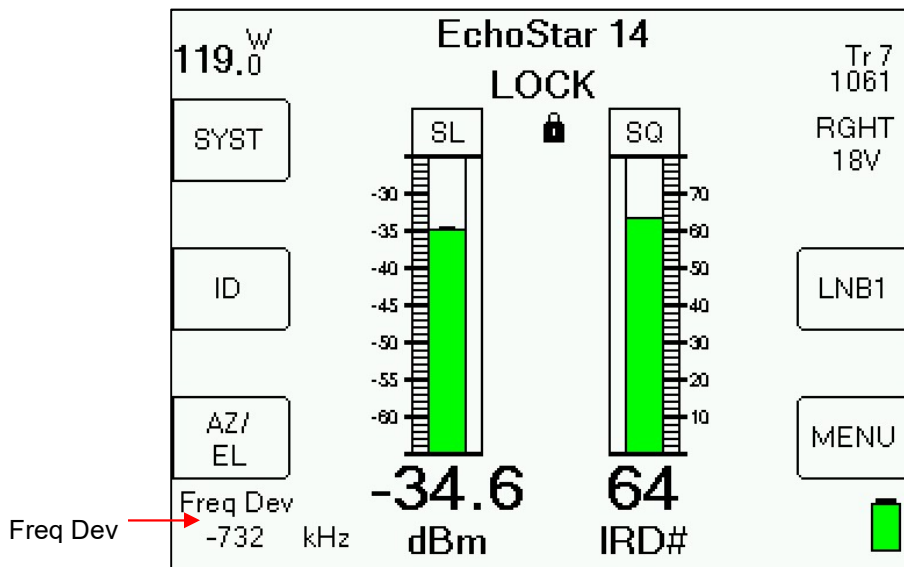
IRD Calc

As mentioned under "Signal Quality" above, Dish Network has an old IRD quality scale from 0 to 125 and a newer scale with much lower values (approximately 0 to 85). Use this option to select which scale to use. The default is "New".

PoP Delay

If you notice transponder results missing from the PoP Scan reports, you may need to introduce a delay into the Proof of Performance scan. The value entered in this field is the number of samples taken if a LOCK isn't obtained. The unit takes 3 samples per second. If 0 is entered in

this field, the PoP Scan will operate normally without any delay. You may experiment with 5, 10, 15, or other values.

Key Beep
By default, key beep is on and you will hear an audible "beep" when any buttons on the meter are pressed. You can turn off the key beep if desired.

Display Theme
By default, display theme is 'Light', with a white screen background. You can select the 'Dark' display theme to enable a black screen background, if desired.

Preset
Pressing the Preset soft-key in the Options menu will return the XR-3's TS2 module settings to its factory default settings (will erase any stored postal code or latitude and longitude setting, will return the RF signal level field to its default dBm value, will return the signal quality field to its default C/N value, etc.).
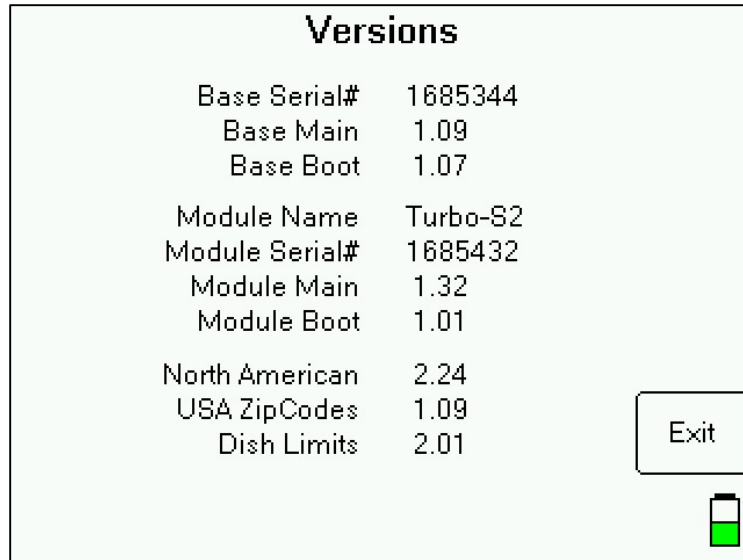
Date / Time
Pressing the DATE TIME soft-key in the Options menu will take you to a new screen that allows you to specify and store the date and time for the meter's internal clock. The date and time are displayed on scan results.

```
               DATE / TIME


                  Date
               (mm/dd/yyyy)
                01/02/2015


                  Time
                (hh:mm:ss)
                10:53:14           ┌──────┐
                                   │ EXIT │
                                   └──────┘
                                        ▐█▌
```
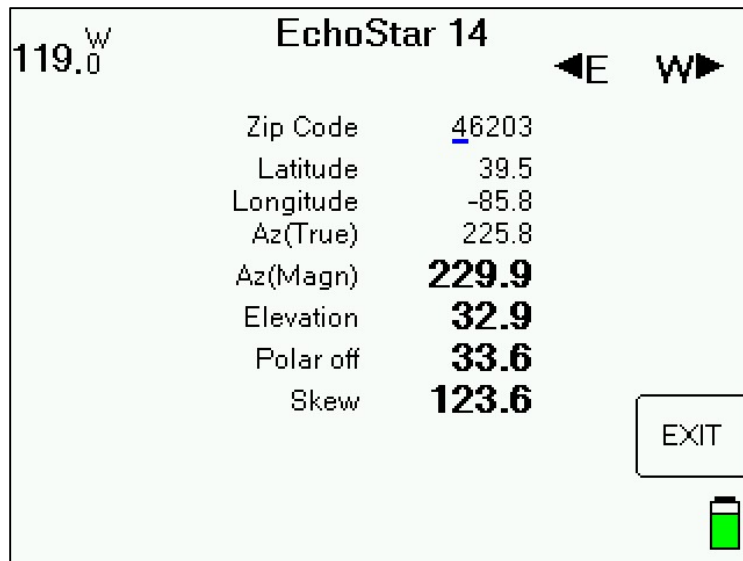
6. <u>Versions</u>

Versions
Selecting Versions from the Main Menu list takes you to a screen that displays versions of software that are loaded in the instrument. It also displays the hardware versions and serial numbers of the XR-3 base unit and any connected module, as well as the active Field Guide and Postal Code and Limits files.

```
              Versions

   Base Serial#    1685344
   Base Main       1.09
   Base Boot       1.07

   Module Name     Turbo-S2
   Module Serial#  1685432
   Module Main     1.32
   Module Boot     1.01

   North American  2.24
   USA ZipCodes    1.09            ┌──────┐
   Dish Limits     2.01            │ Exit │
                                   └──────┘
```

7. Azimuth / Elevation Lookup

The meter can look up the azimuth, elevation, and polarization offset for different satellites based on the latitude and longitude that you specify. The azimuth is given in true north (Azimuth) and in magnetic north (Magnetic) degrees. You should follow the Magnetic field value when using a compass to point the satellite dish. You may change the selected satellite using the left and right arrow keys.

In the United States, enter any zip code and this screen will look up the latitude and longitude for that location and calculate the azimuth and elevation angles for the selected satellite.
The USA ZipCodes database in the meter holds all of the zip codes for the entire United States of America, Puerto Rico, and the US Virgin Islands. There is also a database available for Canada (Canadian Postal). Type in the zip code or postal code using the numeric keypad and press ENTER.

```
119.0W           EchoStar 14        ◄E   W►

           Zip Code      46203
           Latitude       39.5
           Longitude     -85.8
           Az(True)      225.8
           Az(Magn)     229.9
           Elevation     32.9
           Polar off     33.6
           Skew         123.6           ┌──────┐
                                        │ EXIT │
                                        └──────┘
```

The database titled 'No Postal Code' should be chosen if you are located outside of North America. This database allows you to type in and save your latitude and longitude coordinates and look up antenna settings based on those coordinates. Type in the latitude and longitude directly and press ENTER. For locations west of the prime meridian (°W longitude) or south of the equator (°S latitude), type a "-" (dash) in front of the numeric value.
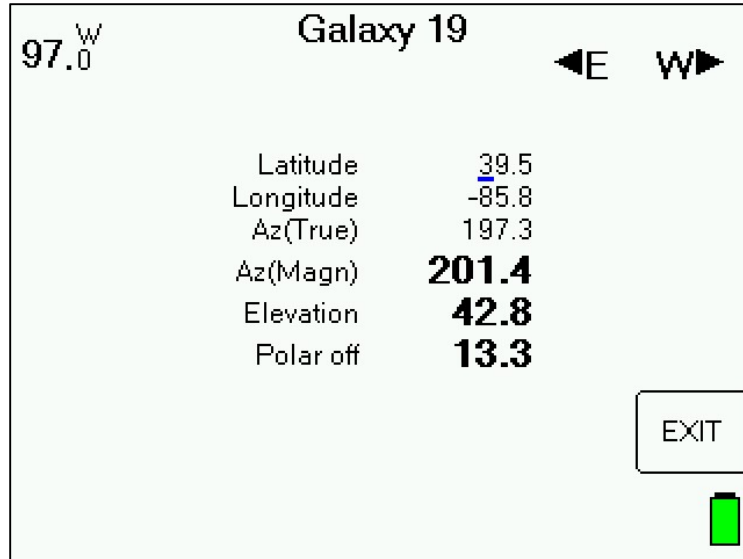
The different postal code databases or 'No Postal Code' database may be downloaded and updated using the FlashUpdate program, which is described further in the Updating section of the manual.

Polarization Offset

The "Polar off" is the polarization offset degrees used for FSS LNBs. If the value is negative, turn the LNB counter-clockwise; if positive turn it clockwise when viewed from behind the antenna looking towards the satellite.
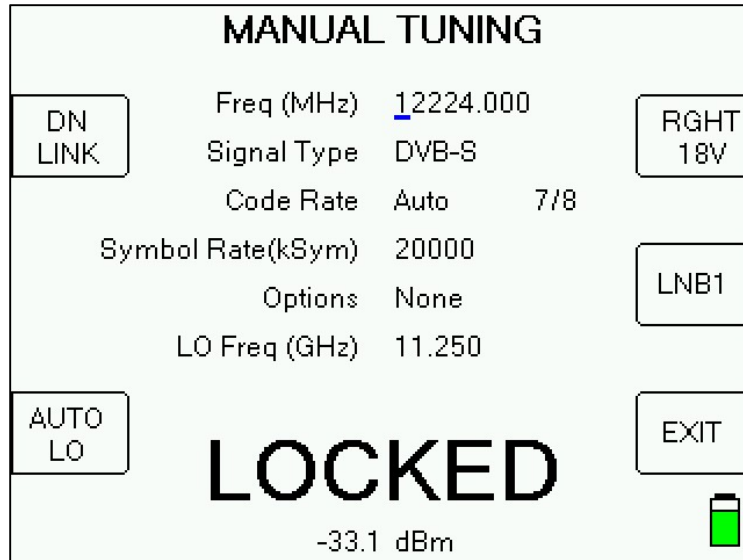
Skew

The skew setting indicates the dish rotation relative to the mounting bracket that is needed to align the multiple LNBs with the satellite arc.

```
111.0 W        Wild Blue 1          ◄E   W►

           Zip Code        46203
           Latitude         39.5
           Longitude       -85.8
           Az(True)        216.5
           Az(Magn)       220.6
           Elevation       37.4
       Polarization Offset  27.3
           SPOT BEAM
              Beam                      ┌──────┐
           Arm angle        19.8       │ EXIT │
              Skew          62.7       └──────┘
              APA            2             ▯
```

8. <u>Manual Tuning</u>

The Manual Tuning Screen may be useful when looking for a signal that has not yet been added to our database and loaded into the instrument or for temporary feed transponders that aren't always active. You can manually enter the tuning parameters. The screen will display the locking status at the bottom. The parameter changes will be kept when you return to the Run Screen but not saved when powering off or changing to other satellites or transponders. If you need to permanently save a transponder to the XR-3's database, then use the Custom Transponder feature.

```
              MANUAL TUNING

 ┌──────┐   Freq (MHz)    974.000    ┌──────┐
 │  IF  │   Signal Type   DVB-S      │ RGHT │
 │ Freq │                            │ 18V  │
 └──────┘   Code Rate     Auto   7/8 └──────┘
       Symbol Rate(kSym)  20000
                                     ┌──────┐
            Options       None       │ LNB1 │
          LO Freq (GHz)   11.250     └──────┘

 ┌──────┐                            ┌──────┐
 │ AUTO │                            │ EXIT │
 │  LO  │     LOCKED                 └──────┘
 └──────┘                                ▯
            -32.4 dBm
```

```
                  MANUAL TUNING

  ┌──────┐     Freq (MHz)   12224.000        ┌──────┐
  │  DN  │     Signal Type  DVB-S            │ RGHT │
  │ LINK │                                   │ 18V  │
  └──────┘     Code Rate    Auto      7/8    └──────┘

          Symbol Rate(kSym)  20000           ┌──────┐
                Options    None              │ LNB1 │
          LO Freq (GHz)    11.250            └──────┘
  ┌──────┐
  │ AUTO │                                   ┌──────┐
  │  LO  │     LOCKED                        │ EXIT │
  └──────┘                                   └──────┘

                 -33.1 dBm
```

Frequency

You may specify the frequency as either the L-band tuning frequency or as the downlink satellite frequency. Press the upper left soft-key to change the frequency type. This soft key also changes the display format on the Run Screen and alters the frequency display option set up in the Options Screen. Type in the frequency and press Enter.

Signal Type

Use the left/right arrows to select the modulation format:
DSS   for legacy DIRECTV™ signals
DVB-S   for DVB-S standard signals (Dish Network SD and most others)
DC2   for Digicipher 2 signals (Shaw Direct SD and some others)
Turbo   for Dish Network's, Bell TV's, and Shaw Direct's high-def signals & more
DVB-S2   for newer (many high-def) satellite broadcast TVRO signals
T-ACM*   for Turbo ACM signals (for 1st generation WildBlue signals & more)
DTV-S2** for DIRECTV proprietary DVB-S2 signals
Other***   for other signal types not compatible with the TS2 module

*TS2 module has limited compatibility with Turbo ACM signals and users may experience a slight delay before signal locks.
**TS2 module has limited compatibility with DIRECTV DVB-S2 signals and locks are not supported, but an estimated carrier to noise ratio is displayed.
***XR-3 will display only RF signal level (i.e. dBm) when tuned to a transponder with an incompatible signal type, but will not display lock or demodulated signal quality.

Code Rate

For Turbo or DVB-S2 modulation, user can select the desired code rate with the left/right arrow keys. Other modulation types use only automatic code rate detection.
Note: Code Rate is also referred to as 'puncture code' or often 'FEC' (Forward Error Correction) rate

Symbol Rate

Use the keypad to enter the symbol rate (in kiloSymbols per second) and press Enter.

Options

Use the left/right arrow keys to toggle through the options related to your chosen signal type.

If DVB-S2 signal type is selected and you have chosen a specific code rate, then you may choose between 'Pilot on' and 'Pilot off'. If your code rate is set to 'Auto', then your pilot status will automatically be set to 'Pilot Auto'.

If DC2 signal type is selected, then you may choose between 'Split I', 'Split Q', 'Orth', 'Orth/I', and ' Orth/Q' and 'None'.

LO Frequency

Normally, the LO frequency of the LNB is obtained from the system type selection and may change with different switch settings and polarities. This is the "AUTO" mode of operation. In rare circumstances, you may want to use the lower left key to change to "CUST" or custom mode and specify an LNB LO frequency directly. The LO (Local Oscillator) frequency is the difference between the downlink frequency and the L-band tuner frequency. High-side LO frequencies like those used in C-band LNBs and some stacking LNBs may be specified using a negative number.

LNB Control

You may use the right side soft keys to change the LNB voltage, turn the LNB on or off, or change switch settings.

9. <u>Custom Transponder</u>

- You can define and permanently save up to 256 custom transponders in the database of the XR-3.
- To enter the Custom Transponder setup screen from the main Run screen, press MENU soft-key (located near bottom right corner of LCD screen). Then use your Up or Down arrow buttons to select 'Custom Trans' near the bottom of the Main Menu list, and press the Enter button.
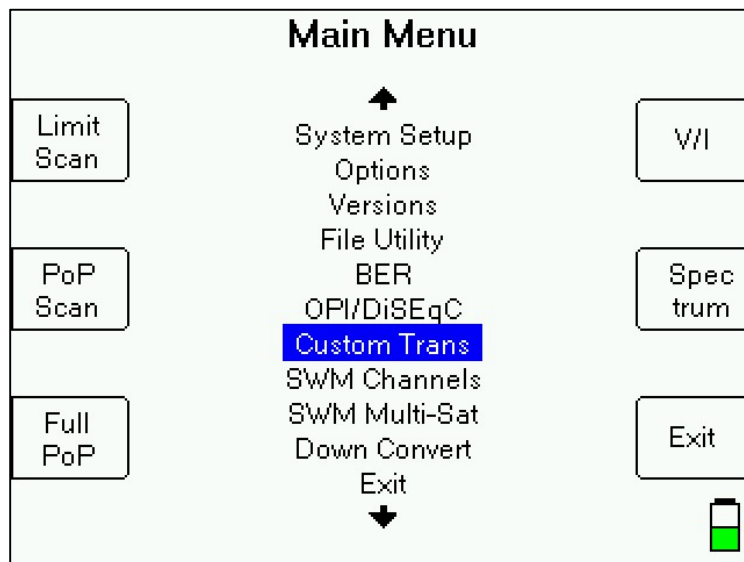
- Any saved custom transponders in the meters database will be shown. If none have been saved, meter will indicate that.

```
                    Custom Transponders

         Orbit Transponder
         -93.1 TEST                              ┌────────┐
         -91.0 Tr 3                              │  Add   │
         -91.0 Tr C248                           └────────┘
         -89.0 TEST 2
         -87.0 CUSTOM                            ┌────────┐
                                                 │  Drop  │
                                                 └────────┘

                                                 ┌────────┐
                                                 │  EXIT  │
                                                 └────────┘

                    Press ENTER to edit.
```
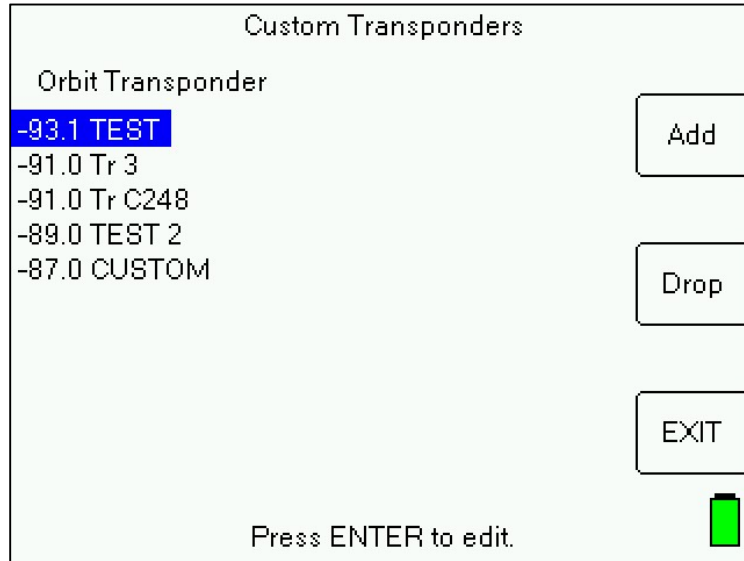
- If you wish to edit those already saved custom transponders, highlight a custom transponder and press Enter button.
- Press "Add" soft-key (located near top right corner of LCD screen) to add a new custom transponder.
- If you wish to delete an already saved custom transponder, highlight a custom transponder and press "Drop" soft-key (located near middle right side of LCD screen).
- If you wish to exit the Custom Transponders screen, press the EXIT soft-key (located near bottom right corner of LCD screen) to return to the Main Menu.
- Add or edit will take you to a screen to define the transponder parameters. The layout of the Custom Transponder parameters screen is similar to the Manual Tune screen. Use alphanumeric keypad to type in field values. After entering a value, press the Enter button. Use Up and Down Arrow buttons to navigate to the next field.

```
                    Custom Transponders

         Orbit   -93.1        ( - = West)
           Sat   G25                          ┌────────┐
         Label   TEST                         │   DN   │
          Freq   12100.000                    │  LINK  │
         Polar   Horiz                        └────────┘
      Sig Type   DVB-S
     Code rate   Auto                         ┌────────┐
      Sym rate   12150      kSym              │  Save  │
         Pilot   AUTO                         └────────┘
       Options   None
       Id tran   NO                           ┌────────┐
                                              │  EXIT  │
                                              └────────┘
```
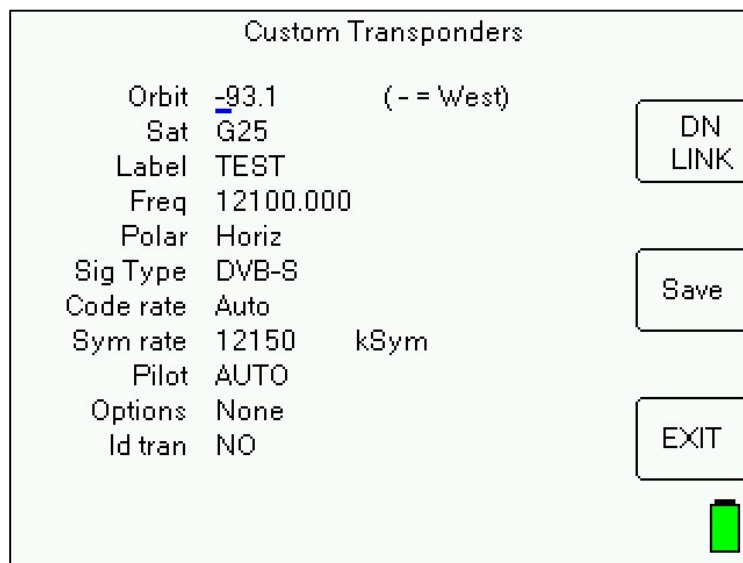
Custom Transponder Parameters Fields editable by you:
- Orbit - Specify orbital location of satellite. For satellites located west of the Prime Meridian, type a "-" in front (i.e. -89.0 for 89.0°W)
- Sat - Specify name of satellite (i.e. Galaxy 28)
- Label - Specify transponder label (i.e. Tr 5)
- Freq - Specify frequency of transponder (i.e. 12149.625).*
- Polar - Using Left or Right arrow buttons, specify polarization of transponder (i.e. Horizontal or Vertical or Left or Right)
- Sig Type - Using Left or Right arrow buttons, specify signal type (i.e. DVB-S, DVB-S2, DC2, Turbo, T-ACM, DTV-S2, Other, or DSS)
- Code rate – For Turbo or DVB-S2 signal types, using Left or Right arrow buttons, specify Code Rate / FEC (i.e. Auto or 1/2 or 2/3 or 3/4)
- Sym rate - Specify Symbol Rate (i.e. 2010 kSym)
- Pilot – For DVB-S2 signals, after you've specified a custom code rate, using Left or Right arrow buttons, specify Pilot status (i.e. AUTO or OFF or ON)
- Optns – For DC2 signals, specify options relevant to the transponder (i.e. Split I, Split Q, Orth, Orth/I, Orth/Q, or None)
- Id - Using Left or Right arrow buttons, specify if you want this custom transponder to be used as an ID transponder for ID verification check on the satellite.**

*It is best to specify the downlink frequency (frequency direct from the satellite before down-conversion by LNB). If you wish to specify the L-Band frequency (frequency of the transponder after down-conversion by LNB), then press the "DN LINK" soft-key (located near top right corner of LCD screen) and you will see the soft-key label change to "IF Freq". Then enter the L-Band frequency. The meter will then calculate the downlink frequency based on your present LNB LO settings that have been defined in the System Setup menu. Modems often display the L-Band frequency of the carrier, but for this information to be useful, you must specify the LO frequency of the LNB in use for that system.

**If there is already an ID transponder for the satellite in the meter's database, then the custom transponder would become a 2nd ID transponder used for an additional level of checking. If there is not presently an ID transponder for the satellite in the meter's database, then the custom transponder would become the default transponder and sole ID transponder for that satellite.

***Remember that the XR-3 satellite meter is only designed to measure the downlink / receive / outbound signal. Please do not enter any transponder parameters for the uplink / transmit / inbound signal, as the parameters will not be of any utility in the meter.

- Press "Save" to save the changes or the new transponder parameters.
- Press the "EXIT" soft-key (located near bottom right corner of LCD screen) if you wish to exit the Custom Transponders editing screen without saving the changes or new transponder parameters.
- The custom transponders will appear in the meter as if they are part of the Field Guide. As such, they will be usable and viewable in the Limit Scan and Proof of Performance (PoP Scan) features.
- You can save up to 256 custom satellite transponders in the meter.
- If the custom transponder is not visible to the selected LNB and feed horn configuration, it won't appear (i.e. If you define a horizontal transponder and select a circular feed horn in the System Setup menu then you won't see it displayed. If you define a C-Band transponder and select a Ku Band LNB in the System Setup menu then you won't see it displayed)
- Custom transponders do not have any beam/footprint info so they are considered visible in all geographic regions and therefore will appear in the meter, regardless of which

geographic Region is chosen in the System Setup menu and which Field Guide is loaded.

10. <u>Voltage / Current</u>

The V/I or Voltage / Current Screen displays:
LNB – voltage output supplied to LNB
mAmps - current draw of LNB
IRD - the voltage output of modem or satellite receiver if connected to meter's IRD / IDU port
Battery - meter's internal battery voltage (Full is approximately 12.6 volts and empty is approximately 11.1 volts).

Ext DC – amount of voltage being supplied to instrument by external AC to DC switching power supply connected to DC charge port on bottom panel of instrument
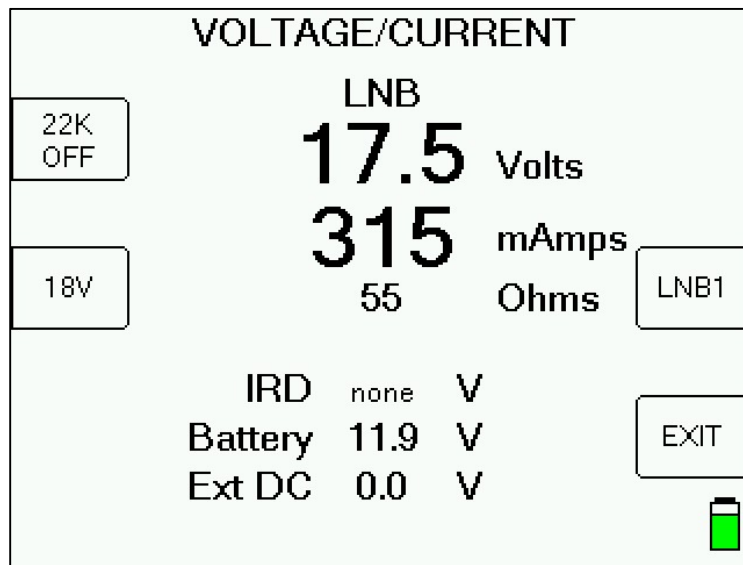
Soft Keys

1) 22K   - Turns the 22 kHz tone on or off
2) Voltage   - Changes LNB voltage (see below)
3) LNB   - Turns LNB power on or off and selects switch ports
4) EXIT   - returns to the Main Menu Screen

For the voltage, the XR-3 can output 13V, 18V, 21V for DIRECTV SWiM LNBs, or 29V.

Note: In the screenshot shown above, approximately 18 volts is being output by the meter to the LNB.

11.   OPI and DiSEqC Monitoring

The OPI/DiSEqC Screen serves two similar purposes. First, it simulates the Hughes™ OPI (Outdoor Pointing Interface) used to check cross-pol alignment of the HughesNet Ku Band transmitters. Second, it decodes and displays other DiSEqC commands received on the IDU / IRD port of the meter.

OPI Simulation

When OPI messages are received it displays them on the screen just like the OPI device.
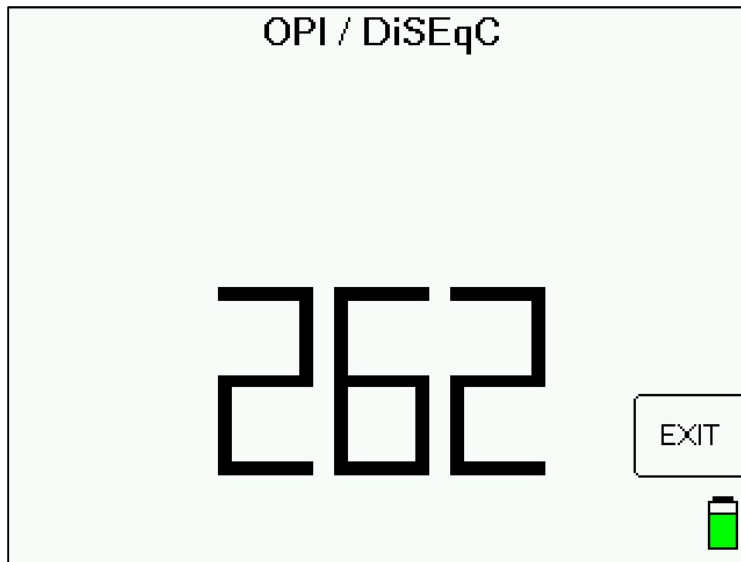
HughesNet™ Cross-Pol Check Procedure

1) Align the dish using the receiving LNB just as you would a normal Ku band dish using the XR-3's main Run Screen.
2) Connect the modem and PC to the transmit and receive cables and run the HughesNet software.

3) Using the PC's internet browser, access the HughesNet modem setup screens. Ensure that the OPI display is enabled and display signal strength. The signal strength must be displayed on the PC to generate the display shown on the meter.
4) Return to the dish and connect the XR-3 into the receiver cable. The XR-3's ODU / LNB port should be connected to the LNB and the IDU / IRD port to the modem's Rx port.
5) Go to the XR-3 OPI/DiSEqC Screen. This screen displays the numbers transmitted from the modem just like the OPI device.
6) Adjust the dish to peak the transmitter cross-pol quality number. The higher the number, the better the quality.

DiSEqC Monitoring

When other DiSEqC commands are received on the IDU / IRD port of the meter, they are displayed on the screen. The most common switch control commands are decoded into switch type and port selection, other commands may be displayed in their hexadecimal format.
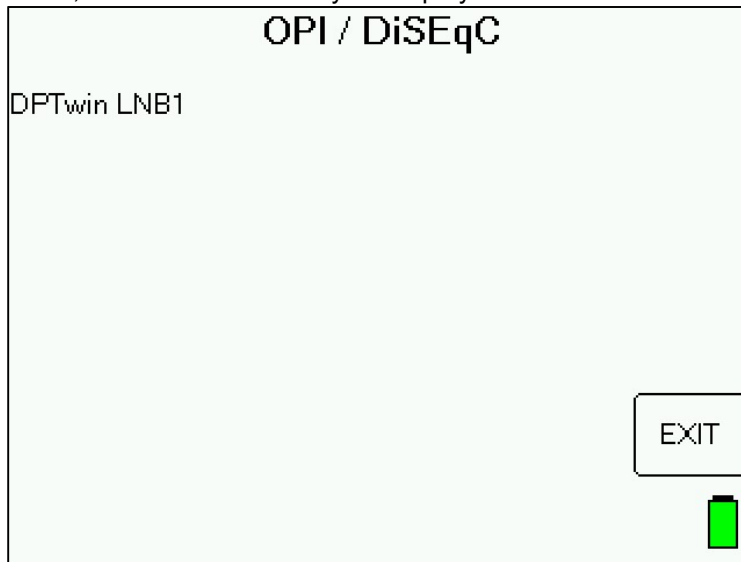
12.   Bit Error Rate / Packet Error Rate

The Bit Error Rate / Packet Error Rate screen (select BER from the Main Menu) displays the bit error rate (BER) or packet error rate (PER) of the signal as detected by the demodulator chipset within the XR-3's TS2 module.

```
            BIT ERROR RATES

         Pre-FEC        1.43E-08
         RS Correct  <  5.38E-09
             RS Bad  <  5.38E-09
         Frame Errs  <  7.09E-03




    ┌─────────┐   Level    -33.2 dBm    ┌────────┐
    │  More   │   IRD#         52        │  EXIT  │
    └─────────┘                          └────────┘
                 LOCKED           ▐█▌
```
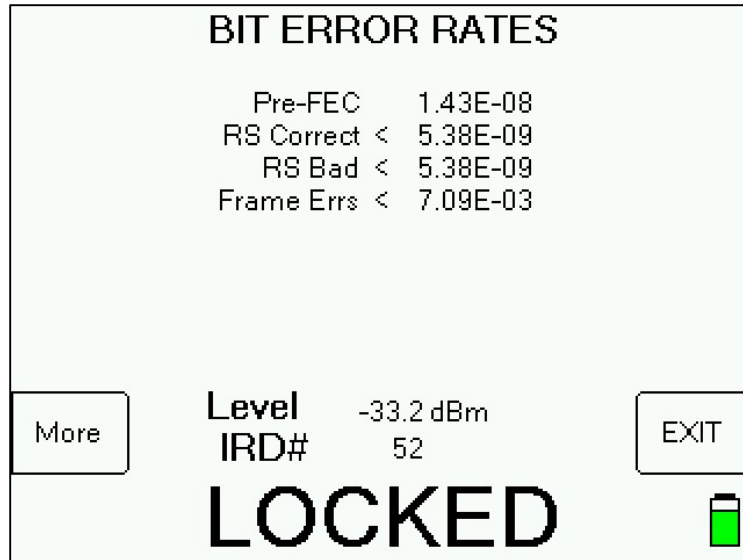
Pre-FEC

The errors that are corrected by the first stage in the decode process, the Viterbi decoder, are displayed for DVB-S, DSS / DIRECTV Legacy, and Digicipher 2 signals. This rate is sometimes referred to as the "pre-FEC" error rate.

There are two Reed-Solomon rates displayed for DVB-S, DSS / DIRECTV Legacy, and Digicipher 2 signals:

Corrected   This is the rate of errors detected and corrected by the Reed-Solomon portion of the Forward Error Correction routine.

Bad   This is the rate of errors detected that the Reed-Solomon decoder was unable to correct. These are the errors which cause tiling or other problems visible to the customer. This is sometimes referred to as the "post-FEC" error rate.

For Turbo and DVB-S2 signals, the meter displays:

Bad blocks   This is the rate of errors detected that the Reed-Solomon decoder was unable to correct. These are the errors which cause tiling or other problems visible to the customer. This is sometimes referred to as the "post-FEC" error rate.

Corrected   This is the rate of errors detected and corrected by the Reed-Solomon portion of the Forward Error Correction routine.

Frame Errors

If the error rate is preceded by a less than sign (<) as in the example above, it indicates that no errors have yet been detected and so the bit error is not known but is less than the number given.

The BER Screen accumulates errors as long as the screen is active. To reset the counters, exit and restart the screen.

This test can only be performed when a signal lock is obtained. If the lock is lost, the rates are not shown and will be restarted when lock is re-obtained.

In most cases, a one minute test is sufficient to determine the BER for the present conditions. As long as both rates continue to read less than some number (the < character is shown), then no errors have been detected and the system is working well. On the other hand, if you are testing during a rainstorm, you can expect some errors to occur.

The MORE button can be used to display additional information about the signal:

```
                ERROR COUNTS

           Pre-          21
      RS Correct         0
         RS Bad          0

      BER Count          0
         Frames          518
      Frame Errs         0


  ┌────────┐   Level    -33.2 dBm      ┌────────┐
  │  More  │   IRD#        52          │  EXIT  │
  └────────┘                           └────────┘
             LOCKED           █
```
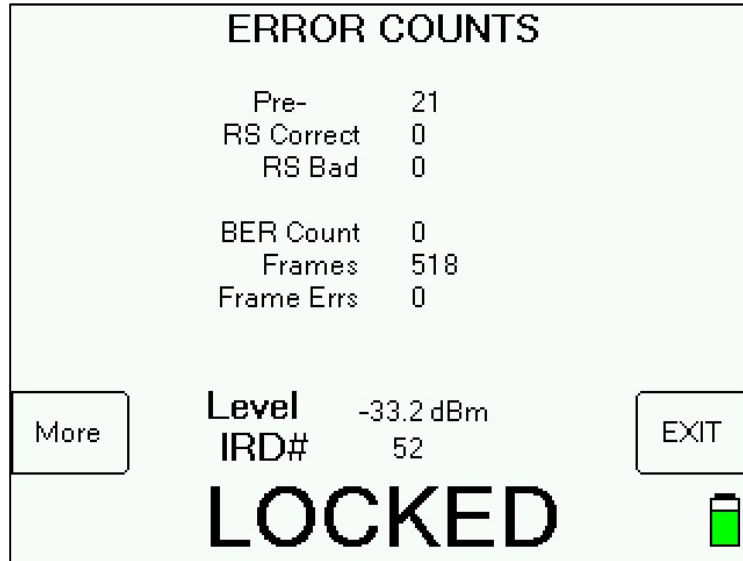
This displays the following additional information:
1)   Pre-FEC error count
2)   Reed Solomon corrected error count
3)   Reed Solomon uncorrected (bad) error count

```
                  BIT RATES

      Symbol Rate    20000      kSym
       Symbol Err    -1         kSym
      Signal Type    DVB-S
        Code Rate    7/8
        Data Rate    30952      kBits
         Bit Rate    35000      kBits
          Elapsed    58         secs


  ┌────────┐   Level    -33.2 dBm      ┌────────┐
  │  More  │   IRD#        52          │  EXIT  │
  └────────┘                           └────────┘
             LOCKED           █
```
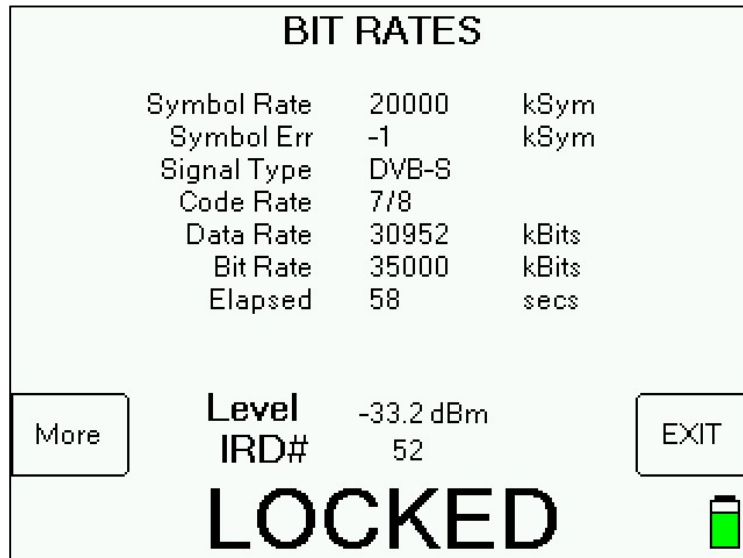
Pressing the MORE soft-key again yields more information:
4)   Symbol rate in kilo-symbols/second
5)   Symbol rate error
6)   Modulation type (i.e. DVB-S, DSS, DC2, Turbo, DVB-S2)

7)   Code rate or bit puncture rate
8)   Data rate – calculated rate of payload kilo-bits per second (post-FEC data rate)
9)   Bit rate
10)   Elapsed time counter (seconds)

Proof of Performance Testing

The Proof of Performance Test (PoP Scan) feature collects and stores signal level and quality data for later transfer to a PC for reporting. This feature may be used to document the quality of installation for later reference.

Install PC Software

The MeterMaid program is required to transfer the data from the instrument to the PC and to print reports. This software is available from the Applied Instruments website along with the FlashUpdate software used to upgrade the instrument. (See Updating section.)

Collect Test Data

Perform your satellite dish alignment as usual. When the system is fully peaked, use one of two main menu options to perform the PoP Scan and collect the data:

PoP Scan – uses the presently selected LNB port and collects data for that LNB only.
Full PoP Scan – steps through all LNB positions and collects data for all related orbital positions.

Tip: You should choose Full PoP Scan when you're connected to a multi-LNB head (LNBF assembly with built-in multi-switch) that is receiving signals from more than one satellite or when you're connected to the output port of a multi-switch that has signals from more than one satellite connected to the input ports of the multi-switch. You should choose PoP Scan when you're connected to a single LNB that is receiving signals from a single satellite.

Note:
When choosing PoP Scan, you must first power the LNB using the LNB soft key or the system may be powered externally. When using the Full PoP Scan, the meter must power the LNB so that it is able to cycle through the various LNBs by sending the required switch commands to the multi-switch or multi-LNBF head with built-in multi-switch.
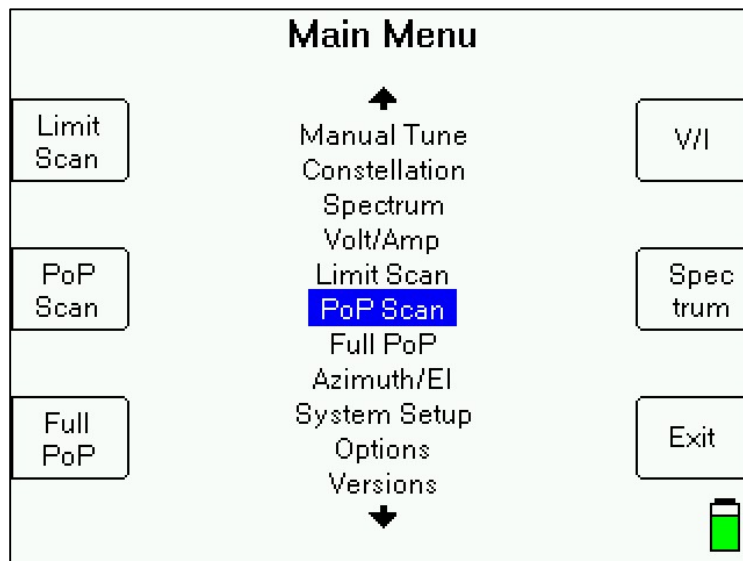
The meter will scan through all transponders on the satellite collecting the measurement data. You may press STOP to abort the scan, otherwise, wait until the scan completes.
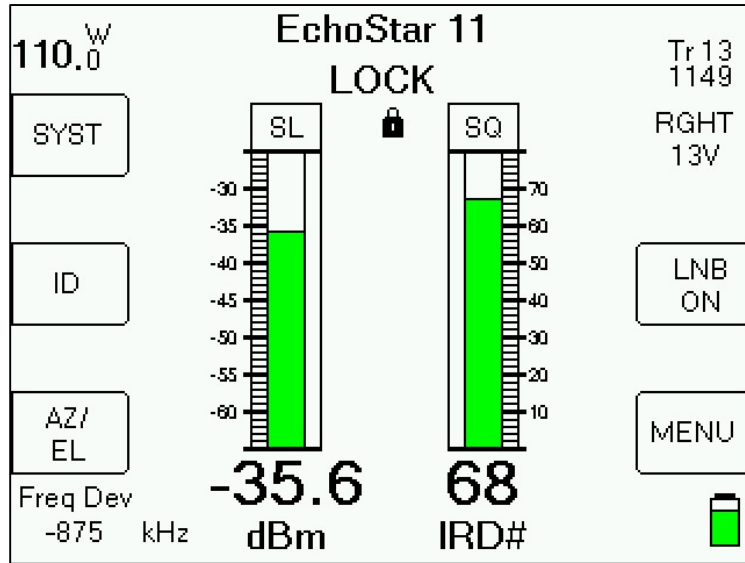
When the scan completes, the following screen displays a summary of the data:
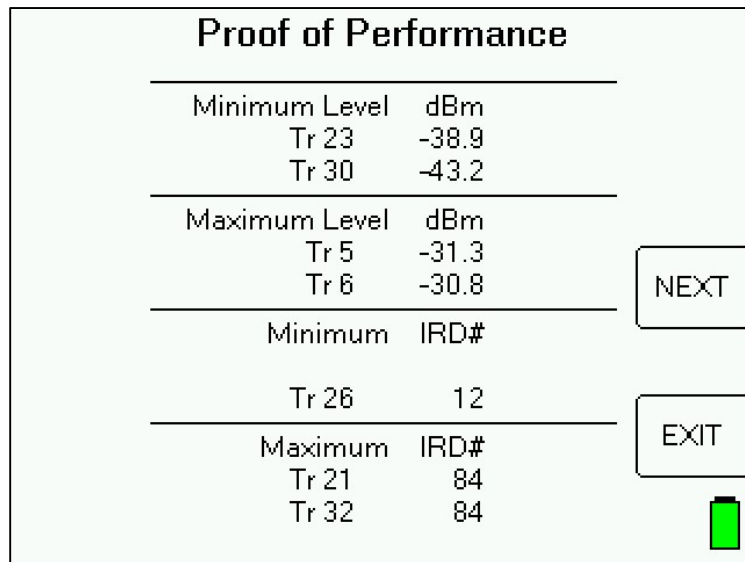
You press "EXIT" to discard the data or "NEXT" to continue.

Saving Data

If you press "NEXT" the following screen appears allowing you to enter some identification data about the test:

Note:
Alphanumeric characters can be entered in the following way:
- Press the key once to display the numeric digit.
- Press it quickly a second time to display the first alphabetic character.
- Press it quickly a third time to display the next alpha character, etc.

- A new key always moves to a new column.
- A pause will also move to a new column.
- Left/right keys move between columns.

Proof of Performance

Date: 01/09/2015

| DATE TIME |

Location: NEW YORK
Technician: JOHN SMITH

| NEXT |

Notes: _

| CLR | | EXIT |

Again, press "NEXT" to continue and the next screen lets you enter a file name:

Proof of Performance

File Name: DISH 1000.4 WEST_

| SAVE |

| CLR | | EXIT |

The file name must be unique. An error message will appear if you enter a name that has already been used. To determine which names have been used, you can run the MeterMaid program on a PC or can select 'File Utility' from the Main Menu.

There is file storage space for about 70 files. The actual limit depends on the number of transponders used.

Press "SAVE" and the system will copy the file from temporary storage to flash file storage. If an error occurs during the copy process or the flash storage area is too full, the message "Flash copy failed" will appear and the test data will be lost.

If you fill up the file storage space, you can transfer all of the stored files to a PC and then erase the meter's flash memory to create new space. You can erase the stored files by using the MeterMaid program on a PC or by pressing the 'Format' soft-key in the File Utility screen.

Transfer Data File to PC

After the data is collected you can take the meter back to your PC and transfer the files to the PC disk using the MeterMaid program, which can be downloaded from the Applied Instruments website. The MeterMaid program, MeterMaid.exe, will most likely be found in the default location of C:\FlashUpdate\

1) Connect the meter to your PC using the supplied USB data transfer cable and turn the meter on.
2) Start MeterMaid after the meter has completed its 5 second boot-up countdown. An icon that looks like the XR-3 should be installed on your desktop for this purpose.

3) The File Transfer window appears somewhat like the following example.
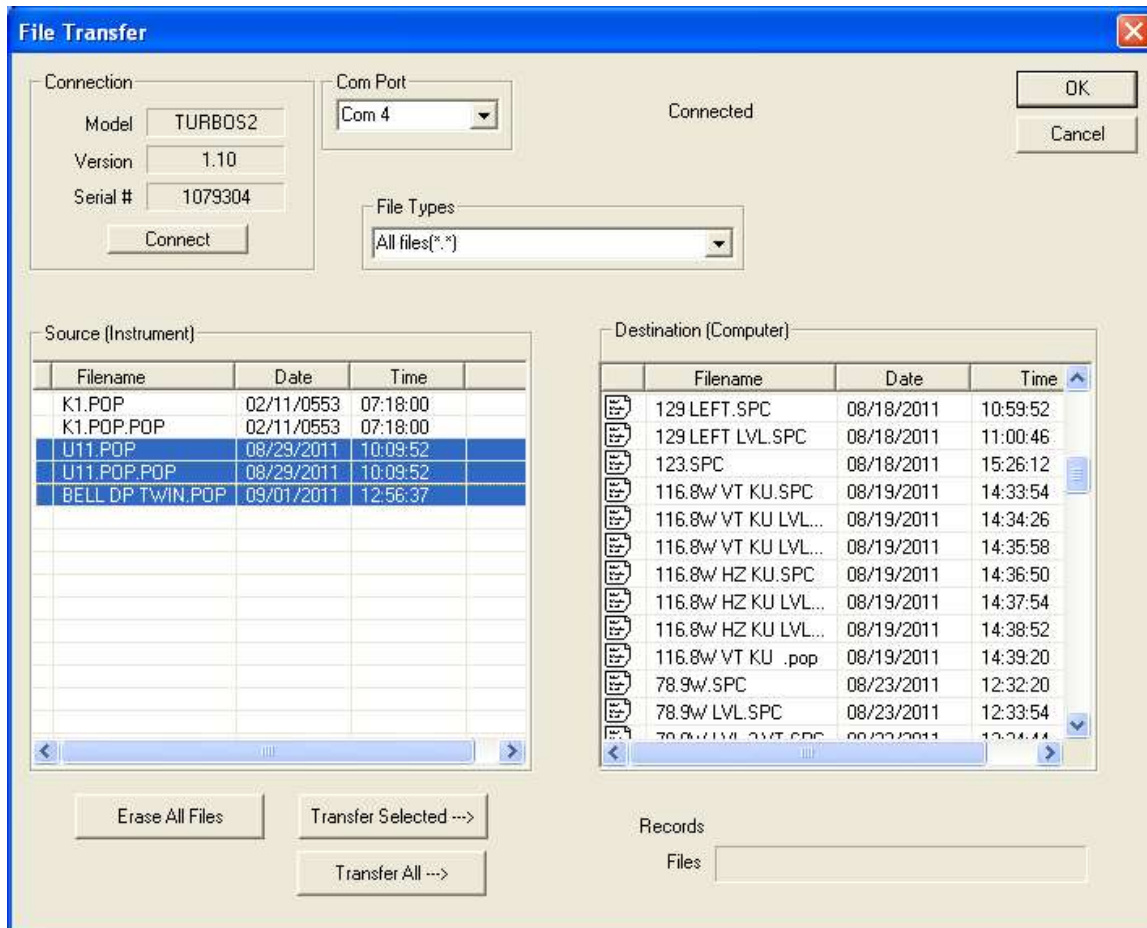
The box on the left displays the files stored on the meter. The box on the right shows the files stored on the PC. The files are stored in a text file format (.txt) so they can be easily opened in Excel or other PC applications.

By default, the text files are stored in a "Data" folder under the "Applied" folder where the MeterMaid program is installed (in the folder C:\FlashUpdate\Data). You may navigate to other

folders by double clicking on the folder icons shown in the destination file box. The [parent] folder icon takes you up one level.

Select the files on the left that you want to transfer by clicking on them. Selected files are highlighted. You may select more than one by pressing and holding Ctrl. Then click on 'Transfer Selected' to have the chosen files copied to the PC folder or you can click on 'Transfer All' button to copy all stored files from the meter to the PC. A status message near the bottom right of the MeterMaid screen will show you when the transfer is complete and the right hand box will be redrawn with the newly added files.

Erasing Files

When you have transferred all desired files, click "Erase All Files" to erase the files from the meter and free up the flash storage space. Due to the way the flash memory works, it is not possible to erase only selected files; all files must be erased to free up the memory.

Print Reports

The File Transfer window is not the only window available in the MeterMaid program. You may also open one or more report windows to display and print the data.

There are two ways to open a report window:
1) Double click the text file in the right side of the File Transfer window.
2) Use the menu bar File, Open function.

The report may be viewed on the screen or printed using the File, Print menu option.

When a report window is opened, it is usually mostly hidden behind the File Transfer window. The File Transfer window may be moved aside or closed to get it out of the way:
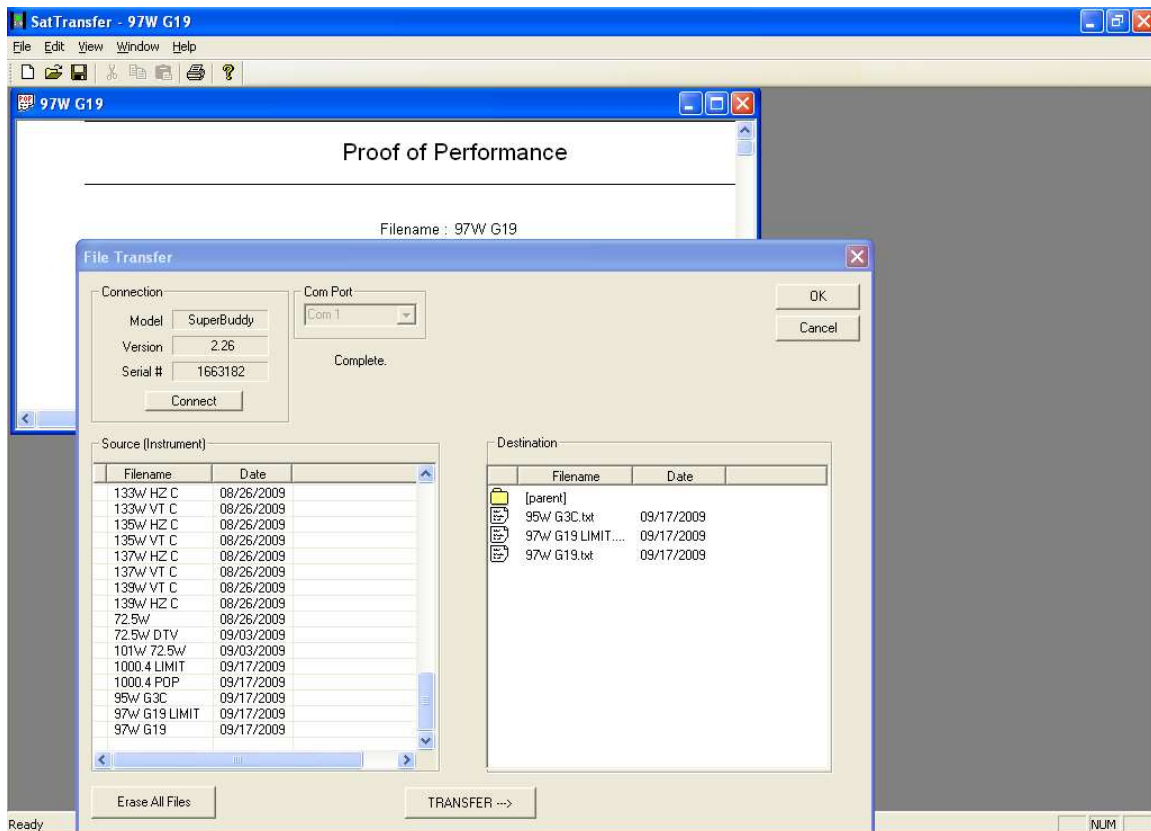
The report itself may not fit entirely on the screen but you may scroll down to see the rest.

It is recommended to right click with your mouse on the Proof of Performance Scan report and select Properties/Results Only before printing PoP Scans to reduce the number of columns printed. Most field technicians do not need to or want to see the transponder parameters (signal type, code rate, symbol rate). Screenshots of the Properties menu settings change and the subsequent trimmed down Limit Scan results are shown below.

SatTransfer - [97W G19]

File   Edit   View   Window   Help

Proof of Performance

Filename : 97W G19
Date: 09/17/2009
Location: INDIANAPOLIS
Technician: MICHAEL
Notes: 97W G19
LNB Model: Std N.Am Ku 10.75
FieldGuide: North American V1.66
Software: 2.26
Serial: 1663182

Satellite: 97.0 West

Tran	Freq MHz	Error MHz	Level dBm	IRD SiqQ	C/N db	Eb/No dB	Es/No dB	Lock Status	LNB Volts	LNB mA
1	956.000	-0.016	-41.5	43	5.6	7.4	6.9	LOCK	13.1	120
3	1039.000	-0.404	-35.0	63	7.8	8.4	9.1	LOCK	13.1	120
4	1028.000	0.349	-37.7	72	8.8	8.9	10.1	LOCK	18.0	120
5	1086.000	-0.406	-34.6	77	9.7	9.8	11.0	LOCK	13.1	120
7	1117.000	-0.408	-34.1	61	7.6	8.2	8.9	LOCK	13.1	120
8	1124.000	-0.914	-33.5	57	7.2	7.8	8.5	LOCK	13.1	120
9	1148.000	-0.412	-34.0	77	9.8	9.9	11.1	LOCK	13.1	120
11	1154.000	-0.415	-34.4	47	6.0	7.8	7.3	LOCK	18.0	120
11	1179.000	-0.410	-34.4	65	8.0	8.1	9.3	LOCK	13.1	120
12	1186.000	-0.927	-33.4	55	6.9	7.0	8.2	LOCK	18.0	120
14	1217.000	-0.925	-33.2	56	7.0	7.1	8.3	LOCK	18.0	120
15	1241.000	-0.427	-33.5	71	8.7	8.8	10.0	LOCK	13.1	120
17	1272.000	-0.430	-33.6	75	9.4	9.5	10.7	LOCK	13.1	120
19	1303.000	-0.433	-33.9	77	9.8	9.9	11.1	LOCK	13.1	120
20	1310.000	-0.936	-33.3	67	8.3	8.4	9.6	LOCK	18.0	120
21	1334.000	-0.439	-33.3	62	7.7	7.8	9.0	LOCK	13.1	120
22	1341.000	-0.941	-33.9	73	8.9	9.0	10.2	LOCK	18.0	120

Ready   NUM
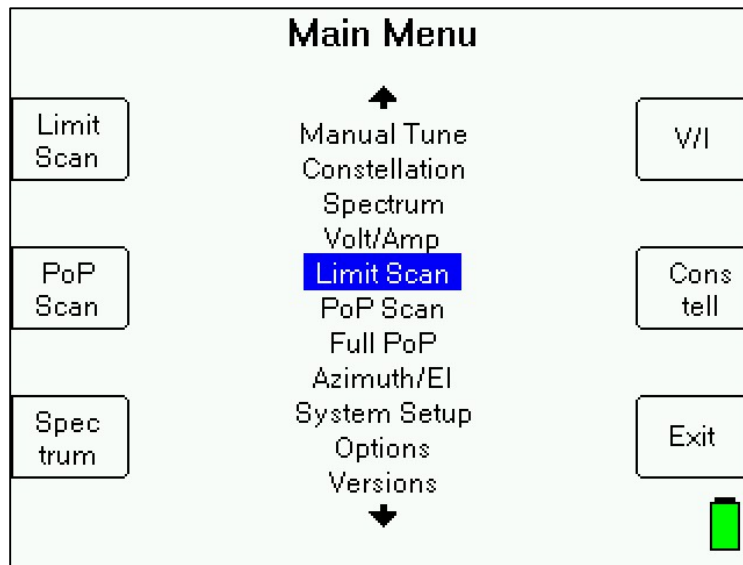
14. <u>Limit Scan</u>

The XR-3 Signal Level Meter includes a Limit Scan feature that performs a quick scan of up to four transponders on a satellite, checks the values against pre-determined limits, and provides a pass/fail indication. Use this test to quickly verify your installation against recommended level and quality values.

Specifications

1) Up to four transponders per satellite may be tested
2) Up to ten total satellites may be stored
3) Signal quality test (IRD signal quality number – i.e. 0 to 100 signal quality scale)
4) Signal level test
5) Signal quality limits defined for individual transponders
6) Signal level limit defined overall
7) Limits are changeable and are stored in the instrument

Setup

Use the normal meter setup for whatever type of system you are installing. When the installation is complete, select "Limit Scan" from the main menu:

Scanning

Upon selecting "Limit Scan" from the Main Menu, you will be prompted to enter the zip code of your present location. If the zip code shown is correct, then press 'Use Zip' to continue. If you loaded Dish Network limit values (i.e. Dish East, Dish Central, or Dish West) using the FlashUpdate program, then pressing 'Use Zip' will autopopulate the fields with minimum and average values specified by Dish Network. The soft-key labeled 'Use Zip' is usable for most Dish Network satellites (61.5, 72.7, 77, 110, 118.7, 119, and 129). When there are preset minimum and average IRD and minimum Signal Level values available for the satellite, preset limits will be automatically loaded based on the zip code entered.

If you'd like to program custom limits for non-Dish Network satellites, press 'Use Custom' and see Section 5 (Editing Limits) for more details.
.
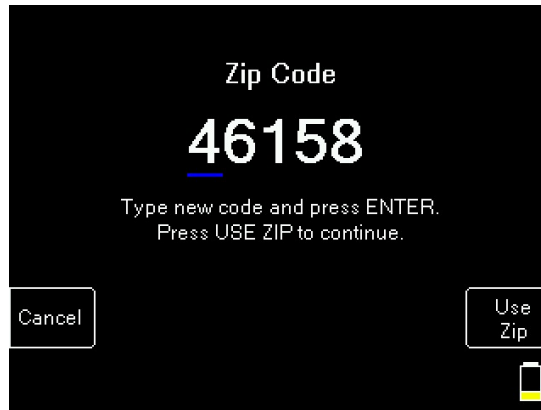
If limits have already been defined for the presently selected satellite, the scanning will start immediately. Press the LNB soft-key (located near middle right area of screen) to power the LNB. On a multi-LNBF setup, press the LNB soft-key more than once to toggle from LNB1 to LNB2 to LNB3, etc. The satellite orbital position (i.e. 119.0W) related to each selected LNB port will be displayed in the top left corner of the LCD screen.
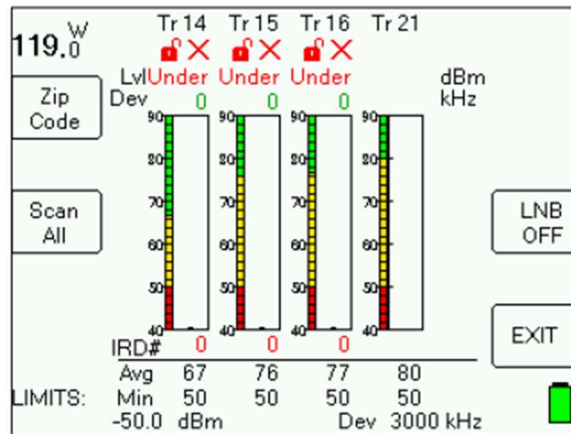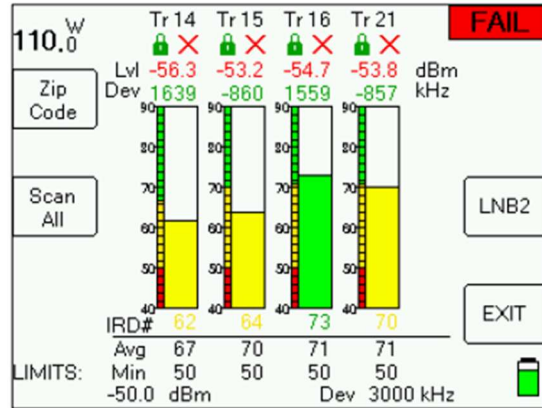
For each transponder to scan, the screen shows:
1) Tr – The transponder numbers to be scanned (transponders must be defined by user)
2) Lock – The green closed padlock symbol reflects a signal lock on the transponder. The red open padlock symbol reflects a non-locking situation on the subject transponder.
3) Lvl – The measured RF signal level value (i.e. dBm) corresponding to each specified transponder
4) Dev – The frequency deviation (estimated LNB LO drift, stated in kHz) measured for each specified transponder
5) IRD – The measured IRD signal quality value corresponding to each specified transponder
6) Avg – The average IRD signal quality limit for each specified transponder (also shown as yellow area on bar graphs)
7) Min – The minimum IRD signal quality limit for each specified transponder (also shown as red area on bar graphs)
8) The RF level limit for all specified transponders
9) The frequency deviation limit (stated in kHz) for all specified transponders
10) A grade below each individual transponder number:
    a. FAIL (Red X) - Below the minimum Signal Level limit or below the minimum IRD Signal Quality limit
    b. Low (Yellow Triangle) - At or above the minimum Signal Level limit and at or above the minimum Signal Quality limits but below the average Signal Quality limit
    c. Good (Green Check Mark) - At or above the minimum Signal Level limit and at or above the average Signal Quality limit
11) An overall grade is shown in the top right corner of the screen, which includes the grades of all specified transponders for the satellite shown:
    a. FAIL (Red) - Below the minimum Signal Level limit or below the minimum IRD Signal Quality limits
    b. Low (Yellow) - At or above the minimum Signal Level limit and at or above the minimum Signal Quality limits but below the average Signal Quality limits

   c.   Good (Green) - At or above the minimum Signal Level limit and at or above the
   average Signal Quality limits

If a lock is not obtained for a transponder, the IRD field will display "0" as the measured signal quality value and a red unlocked padlock symbol will be shown immediately below the transponder number. The table will be filled in as the transponders are measured in sequence. As each transponder is scanned, its individual transponder grade appears. When all limit scan transponders have been scanned, the overall grade will appear in the top right corner of the screen.

The Limit Scan will continue running constantly until stopped by the user. You will receive a summary (overall grade) at the top right corner of the screen after each cycle of limit scanning has been completed.

The following keys are active while scanning: Scan All – collects and stores a complete limit scan for later transfer to a PC LNB ON/OFF – also selects different LNBs in a multi-LNB system EXIT - returns to the main Run screen Left / Right Arrow keys – scroll between satellites (as in the Run Screen)
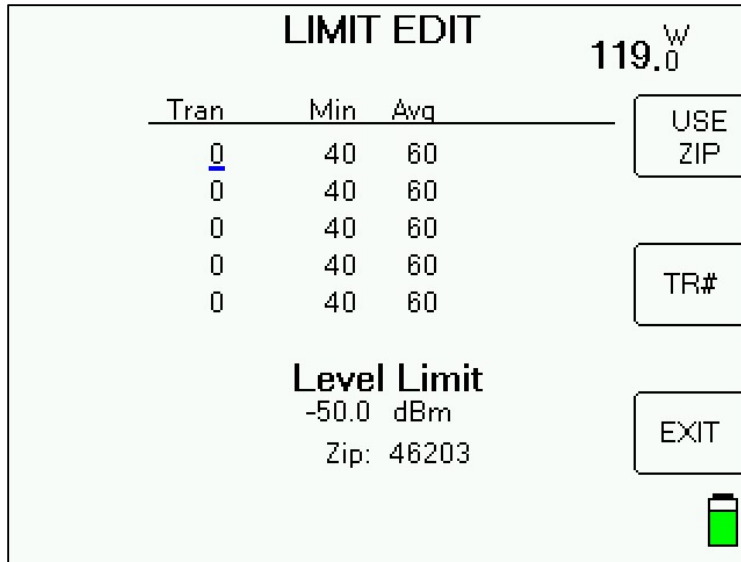
Editing Limits

If limits have not yet been defined, a message will be displayed that says "No limits for orbit".
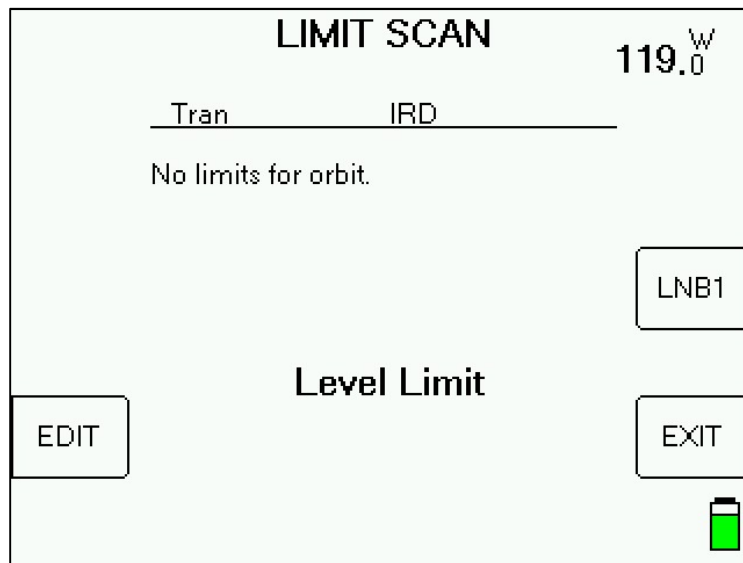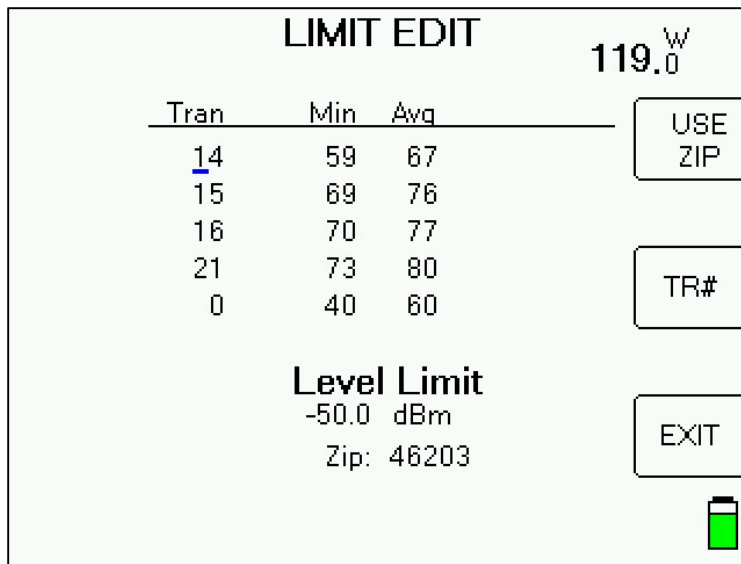

Press EDIT soft-key to define limits.

Upon entering the Limit Scan's edit screen, when a satellite with no limits is selected, the edit screen contains zeros for all transponders:

LIMIT EDIT   119.0 W

Tran	Min	Avg
0	40	60
0	40	60
0	40	60
0	40	60
0	40	60

USE ZIP

TR#

Level Limit
-50.0 dBm
Zip: 46203

EXIT

You will see a small underline cursor on the field that may be modified. Use the up/down arrow keys to move cursor to next desired field when no editing is necessary. With the cursor on a field in the Tran column, use the numeric keypad to type the number of the transponder you'd like to scan. Press the Enter key to move cursor to next field after typing in each desired value. You can edit the minimum and average required IRD signal quality values for each transponder. These IRD values apply only to the selected satellite and specific transponder. You may also edit the signal level limit, which applies to all transponders on all satellites.

LIMIT EDIT   119.0 W

Tran	Min	Avg
14	59	67
15	69	76
16	70	77
21	73	80
0	40	60

USE ZIP

TR#

Level Limit
-50.0 dBm
Zip: 46203

EXIT

To remove a transponder, enter zero for the transponder number. If all transponders have been zeroed for a satellite, that orbit will be removed from the Limit Scan table.

You may also use the "TR#" soft-key to insert a valid transponder number from the list of transponders for that satellite from the meter's database. When your cursor is in the Transponder (Tr) column field, pressing the TR# soft key several times will allow you to numerically scroll through the different transponders.

Press EXIT when you have entered the desired values to return to the Limit Scan screen to let the Limit Scan begin.

```
Tr 15              LIMIT SCAN            W
1178                                 119.0

RGHT      Tran     dBm   IRD
 18V                                        SAVE
           14     -45.3   62    LOW
           15     -34.7   78    GOOD
           16     -43.6   78    GOOD
           21     -35.0   83    GOOD
                                            LNB1

                   Level Limit
                   -50.0 dBm
 EDIT            All Above Min               EXIT
                Some Below Avg
```

Preset Limits

Use the FlashUpdate program on your PC to load a database of preset limits. In the Limit Values field of FlashUpdate, use the drop-down menu to choose either Dish Corp or Dish RSP, depending on your affiliation with Dish Network. At this time, the only available preset limits values are related to Dish Network. To be able to offer preset limits to users, the service provider must send the related files with their desired minimum IRD signal quality values and minimum Signal Level Limits (dBm) for each zip code to Applied Instruments.
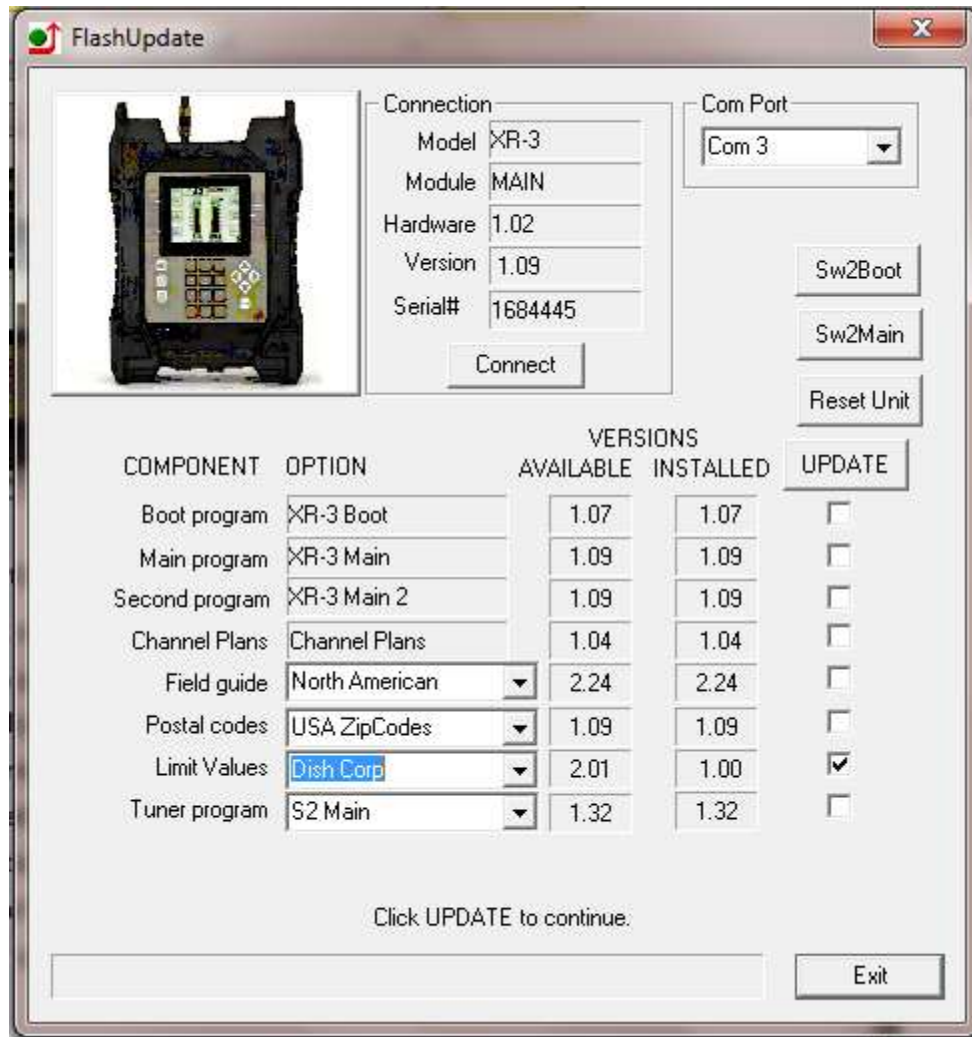
The preset limits for DISH are usable for most Dish Network satellites (61.5, 72.7, 77, 110, 118.7, 119, and 129). When there are preset minimum and average IRD and minimum Signal Level values available for the satellite, pressing the USE ZIP soft-key in the edit screen will auto-populate the fields with minimum and average values specified by Dish Network.

To auto-populate the minimum and average IRD signal quality value fields based on your geographic location (zip code) in the Limit Scan feature:

1) Press MENU soft-key
2) Using the arrow keys, highlight 'Limit Scan' from Main Menu
3) Press Enter button
4) Press EDIT soft-key
5) If the zip code shown at the bottom of the screen is the correct zip code for your present location, then press the USE ZIP soft-key.
6) If the zip code shown at the bottom of the screen is not the correct zip code for your present location, then use the up or down arrow buttons to move the cursor down to the Zip Code field, use the meter's numeric keypad to enter your local zip code, and then press Enter button.
7) Press the EXIT soft-key to return to the main Limit Scan screen to begin running a Limit Scan.

Errors

If you enter an invalid transponder number, the error will be detected after you press DONE and the system tries to scan that channel. The following error will appear and the invalid transponder will be removed from the list.
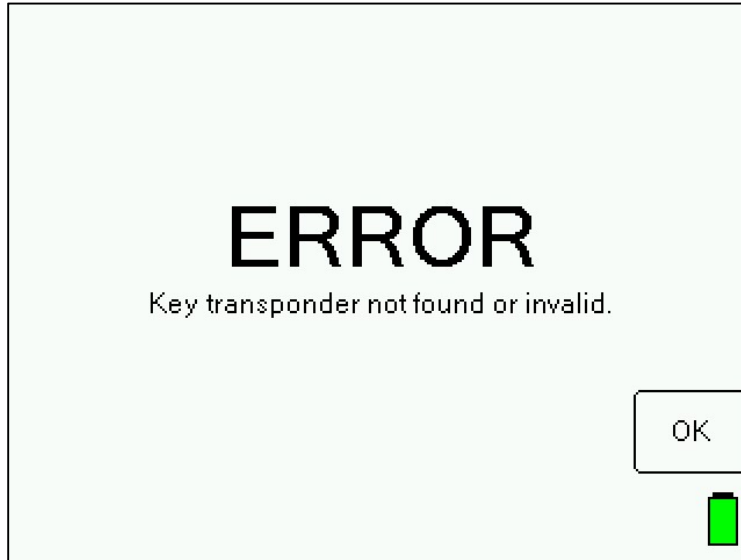
If you use all 10 orbital slots, the system will not be able to create a list for any additional satellites and the following message will appear when you scroll to or activate a satellite that does not have limits defined:
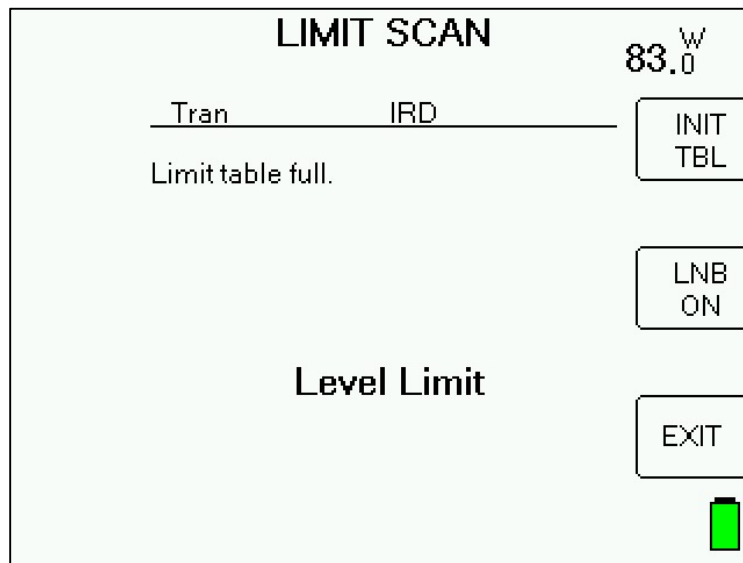
Limitations

The transponder lists are stored simply by orbital position. No distinction is made for the frequency band. Therefore, if you store limits for 101° West, DirecTV, these same transponder numbers and limits will be used for 101° West SES-1 Ku band, and again for 101° West SES-1 C-Band.

Initialization

The default preset limit values consist of the standard Dish Network set of transponders. The defaults may be restored by pressing the PRESET key in the Options screen.

Saving Limit Scans

You may find it beneficial to document the Limit Scan to prove that the signal level and quality of the key transponders are adequate before you leave the site. To accomplish this, you may save the Limit Scan to the flash memory of the XR-3 while out in the field. Then you can upload it to a PC when back at the office (or upload it onsite wirelessly if you have an XR-3 with Wi-Fi) to store the documentation on your hard drive or forward it on to upper management if required. Since the Limit Scan function only scans the key transponders (up to four per satellite), it is much less time consuming to use than the Proof of Performance Scan feature that scans all transponders on the satellite.

To save a Limit Scan, press the 'Scan All' soft-key near middle left area of LCD screen. The meter will then perform a Limit Scan on the key transponders for LNB1. Then it will automatically send the necessary commands to toggle to LNB2 and LNB3 and will scan through those key transponders if you've indicated in the System Setup that you're connected to a multi-LNB assembly.
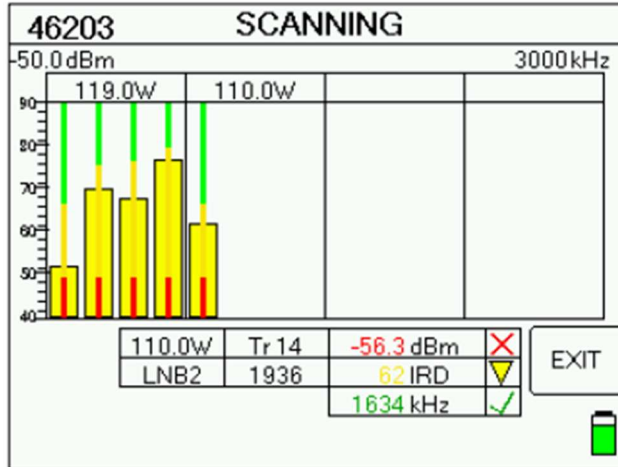
After the Limit Scan is complete, a summary is shown for all satellites and transponders scanned. An overall grade is shown in the top right corner of the screen. To see the measurements and grades for each individual transponder, press your left or right arrow button to toggle through the transponders and refer to the data below the bar graph.
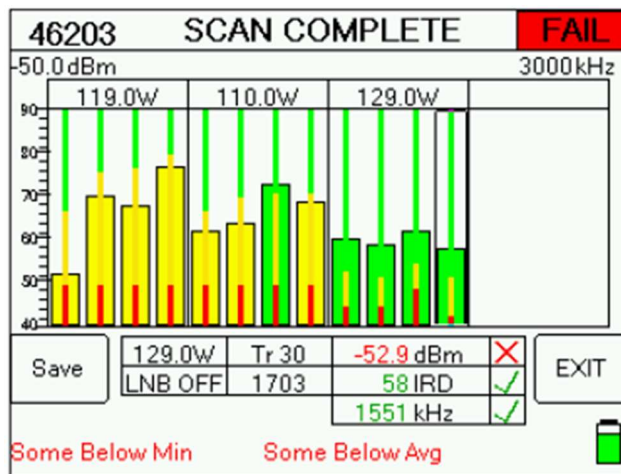
Press 'Save' soft-key to save the results. A screen will appear that allows you to type in the file name, location, technician name or ID number, and any notes. An error message will appear if you enter a name that has already been used. Use the alphanumeric keypad to fill in these fields and then press the SAVE soft-key and the system will copy the file from temporary storage to flash file storage.

If an error occurs during the copy process or if the flash storage area is too full, the message "Flash copy failed" will appear and the test data will be lost. There is file storage space for about 70 files. The actual limit depends on the number of transponders used.

Press DATE TIME soft-key to edit the meter's time and date clock. Press Clear soft-key to delete the value entered in the selected field.
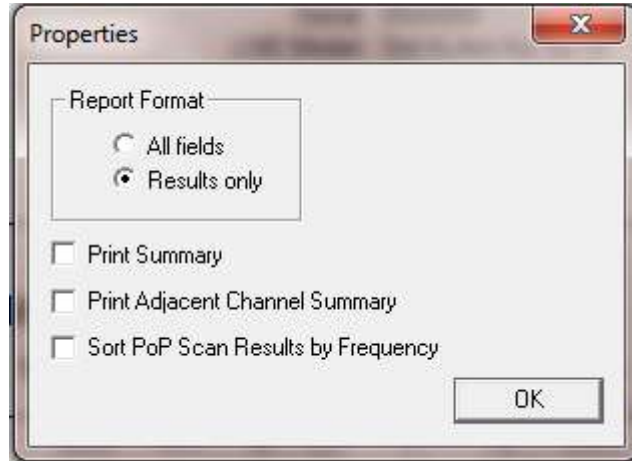
Install PC Software & Transferring Data Files to PC

The process for transferring the saved Limit Scans to your PC is identical to the process for transferring saved Proof of Performance scans. Please see the Proof of Performance Testing section of the operation manual for instructions of how to transfer the saved files to your PC using the MeterMaid application.

A screenshot from an example of a transferred Limit Scan file is shown below.

It is recommended to right click with your mouse on the Limit Scan report and select Properties/Results Only before printing Limit Scans to reduce the number of columns printed. Most field technicians do not need to or want to see the transponder parameters (signal type, code rate, symbol rate). Screenshots of the Properties menu settings change and the subsequent trimmed down Limit Scan results are shown below.

Limit Scan

Filename : G19 KU LIMSCAN	FieldGuide: North American V 2.24
Date: 01/02/2015	Software: 1.09
Time: 11:40:43	Model: XR-3
Location: NEW YORK	Serial: 0000000
Technician: JOHN SMITH	LNB Model: Std N.Am Ku 10.75
Notes:	Region: NE Continental US
Level: dBm	Switch: None
LevelLimit: -50.0	
Result: LOW	

Satellite: 97.0 West

| Tran	Freq MHz	Error MHz	Level dbm	IRD SiqQ	C/N db	Lock Status	LNB Volts	LNB mA	Req SigQ	Avg SigQ	Grade
6	1092.500	-0.125	-35.3	48	6.2	LOCK	17.5	145	40	60	Low
6	1092.500	-0.125	-35.3	48	6.2	LOCK	17.5	145	40	60	Low
6	1092.500	-0.125	-35.6	49	6.3	LOCK	17.5	145	40	60	Low
7	1117.068	-0.173	-34.9	60	7.5	LOCK	17.5	145	40	60	Good
9	1148.072	-0.176	-34.7	69	8.5	LOCK	17.5	145	40	60	Good

15. <u>Spectrum Screen</u>

The spectrum screen may be used to:

- Look for the presence of carriers
- Look at a carrier with an incompatible modulation type or encryption
- Optimize your polarity adjustment (null out the opposite polarity)
- Look for interfering signals

This feature imitates a spectrum analyzer screen although it has less resolution and a slower sweep rate than an actual spectrum analyzer. This screen has the following features:

- Adjustable frequency span
- Automated level scaling
- Frequency and level cursors
- Adjustable sweep rate

To view the spectrum display, press the MENU soft-key in bottom right hand corner of main Run screen. Then press the Spectrum soft-key or use your up/down arrow keys to highlight 'Spectrum' and press Enter.
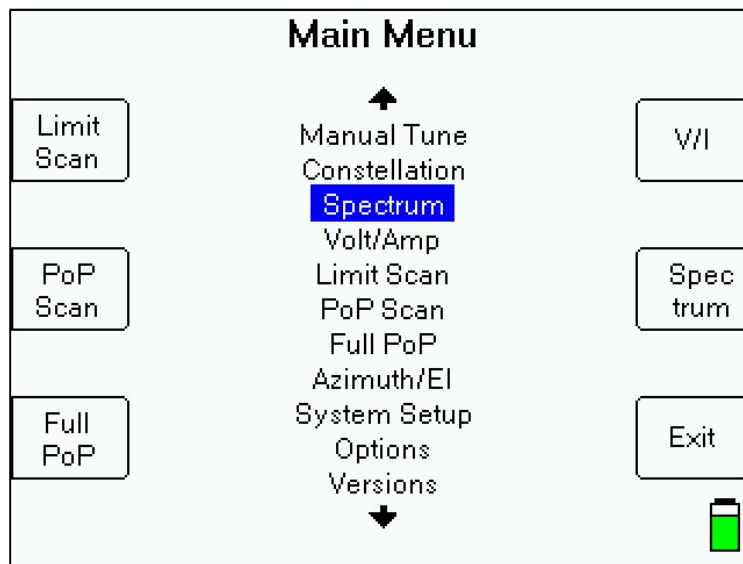
The spectrum screen will start sweeping with the maximum frequency span and amplitude range.
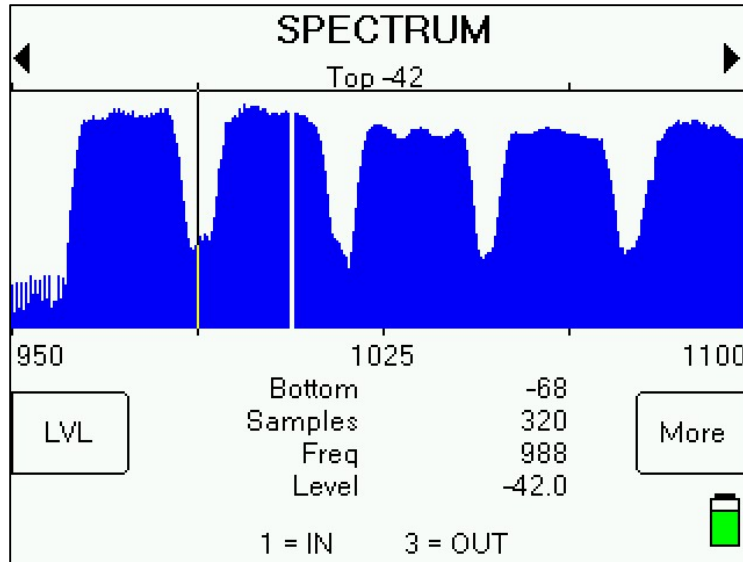
Cursor Position

Press Up/Down arrow keys to move cursor line vertically to different amplitude levels on the y-axis. The level (Level) at the cursor position is shown in the bottom center area of the screen. Note: Signal Level displayed will depend on whether you have selected dBm, dBmV, or dBμV in the Options menu.

Press Left/Right arrow keys to move cursor horizontally to different frequencies on x-axis. The frequency (Freq) of the cursor position is also shown in the bottom center area of the screen. To jump to a particular frequency, press ENTER, then use numeric keypad to type in desired frequency and then press ENTER again.

Span

Press the 1 key on the numeric keypad to zoom in (less span). This will cut the displayed span in half around the cursor's frequency position. Minimum span is 50 MHz.

Press the 3 key on the numeric keypad to zoom out (more span). This doubles the displayed span around the cursor's frequency position. Full span is 1250 MHz (i.e. 900 to 2150 MHz).

Paging

Paging allows you to change the start and stop frequencies (when not at full span) while maintaining the same span. This allows you to quickly jump through the full range of frequencies. Press the upper left soft-key to "page" to the left. Press upper right soft-key to "page" to the right.

Amplitude Range

The default amplitude range shown on the spectrum display is -75 to -15 dBm. Press the LVL soft-key near bottom left corner of the screen to perform auto level scaling. Each time you press the LVL soft-key, the instrument will rescale the amplitude range according to the min/max amplitude levels detected during the last sweep. The auto level scaling makes the measured signal levels more obvious and easier to see.

Spectrum screen before pressing LVL to perform auto level scaling:
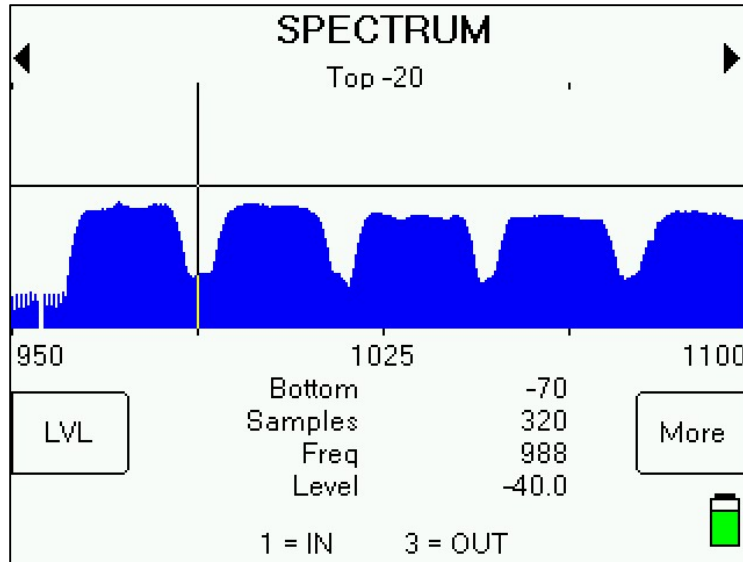
Spectrum screen after pressing LVL to perform auto level scaling:
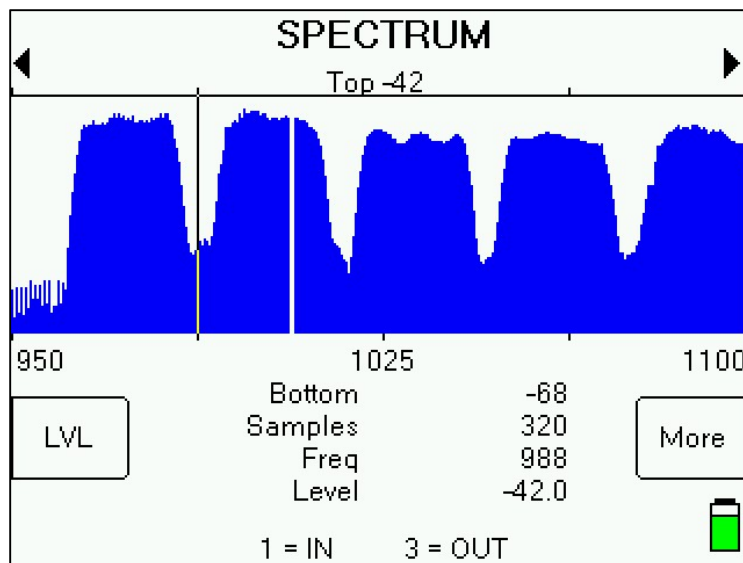
Resolution and Refresh Rate

Press +/- key on numeric keypad to change the number of samples per sweep. You can choose between 80, 160, or 320. 80 samples results in lower resolution and less detail, but a faster sweep. 320 samples results in a higher resolution and more detail, but a slower sweep. By default, the meter measures 320 samples (1 pixel per sample) to create a picture of the power spectrum.

Spectrum Menu

From within the Spectrum Screen, press MORE soft-key to enter the Spectrum Menu.

Spectrum Menu fields include:

- Save scan – allows you to save a screenshot of the screen as it appeared immediately before entering the Spectrum Menu for later recalling and viewing in the meter or on a PC
- Open scan – allows you to open and view a previously saved spectrum scan
- Add ref – allows you to add a reference to the spectrum screen, which could be a spectrum at the same site performed at an earlier time on the same carriers, or the same signal at another point in the network to show the change.
- Cable loss
- View – allows you to return to the Spectrum screen
- Exit – allows you to exit to the main Run screen
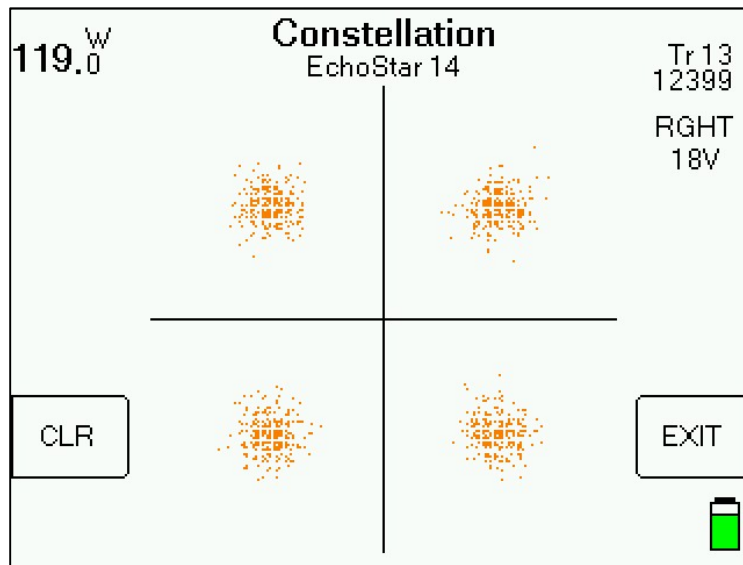
16.   <u>Constellation</u>

To view the constellation screen:
Press the MENU soft-key in bottom right hand corner of main Run screen. Then press the 'Constell' soft-key or use your up/down arrow keys to highlight 'Constellation' and press ENTER.

The constellation plotting will automatically begin if the meter is locked on a digital signal.

Sample QPSK Constellation:

Sample 8PSK Constellation:
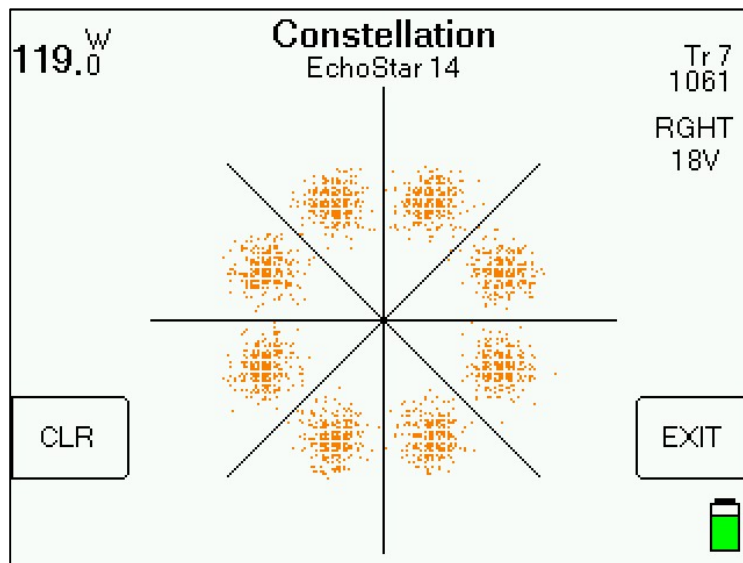
Soft-Keys:
1) Clear – clears the present constellation diagram (new diagram will begin to be plotted)
2) Exit – exits to Run screen

17.   <u>File Utility</u>

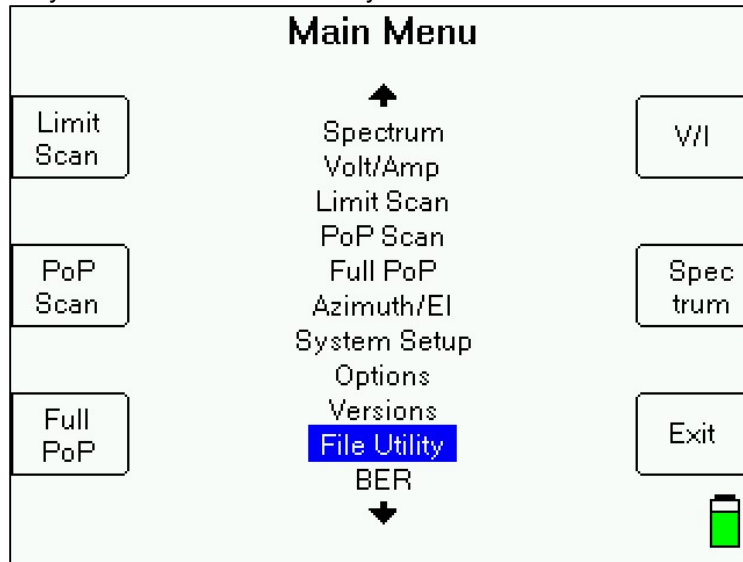The File Utility feature allows you to see the filenames that you have used for saved scans. You can also delete a single file or format the flash drive and therefore erase all saved files from the flash memory of the selected drive.

Press MENU soft-key and then select 'File Utility' from Main Menu list.

By default, the File Utility function displays the filenames of all saved files.
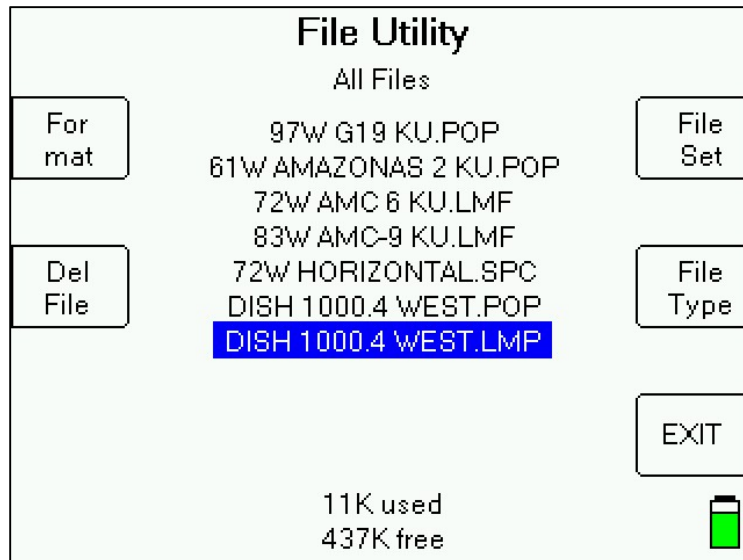
To filter the saved files, first press the File Set soft-key and then use up/down arrow keys to select "Satellite Files", then press Enter. Then press the File Type soft-key and use up/down arrow keys to select desired file type (i.e. PoP Scans, Limit Scans, Spectrum Scans), then press Enter.

Select Set of Files

Satellite Files
CATV / OTA Files

EXIT

Select Type of File

All Files
PoP Scans
Limit Scans (FAIL)
Limit Scans (PASS)
Spectrum Scans

EXIT
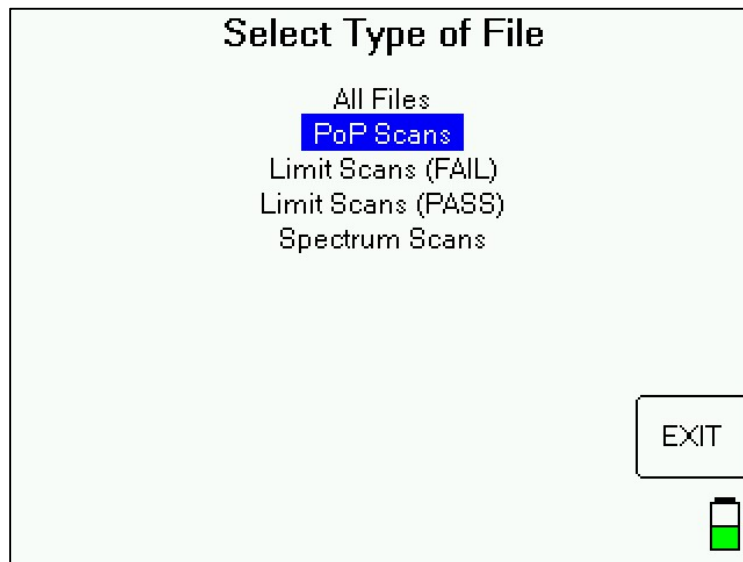
To delete a single file, highlight the file using the up/down arrow keys and then press the Delete soft-key. Note that erasing a single file does not free up flash memory. You must use the Format function to really erase the files. To format the flash memory and erase all saved files on the drive, press Format soft-key.

File Utility

All Files

| For mat | | File Set |

97W G19 KU.POP
61W AMAZONAS 2 KU.POP
72W AMC 6 KU.LMF
83W AMC-9 KU.LMF

| Del File | 72W HORIZONTAL.SPC
DISH 1000.4 WEST.POP
DISH 1000.4 WEST.LMP | File Type |

EXIT

11K used
437K free

DELETE?

F:DISH 1000.4 WEST.LMP

NO   OK

FORMAT?

NOTE: This will delete all scan files
(CATV & satellite) from the drive.

NO   OK

File Utility

All Files

For
mat

File
Set

Del
File

File
Type

EXIT

0K used
448K free
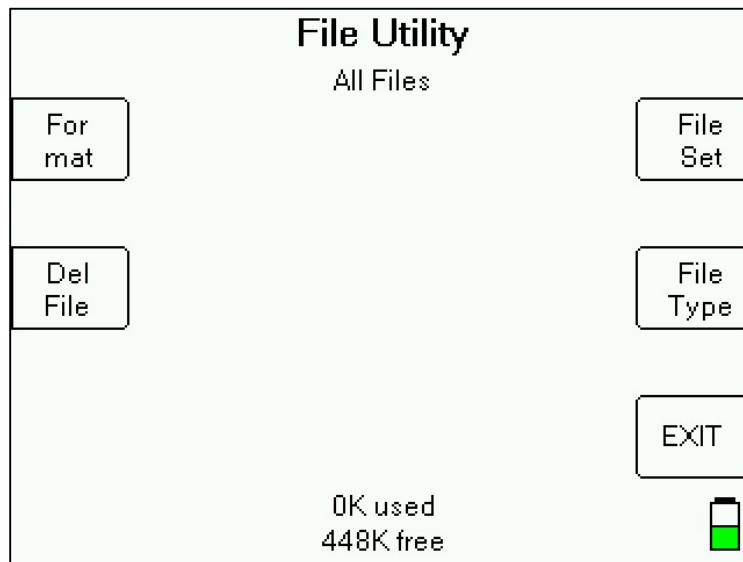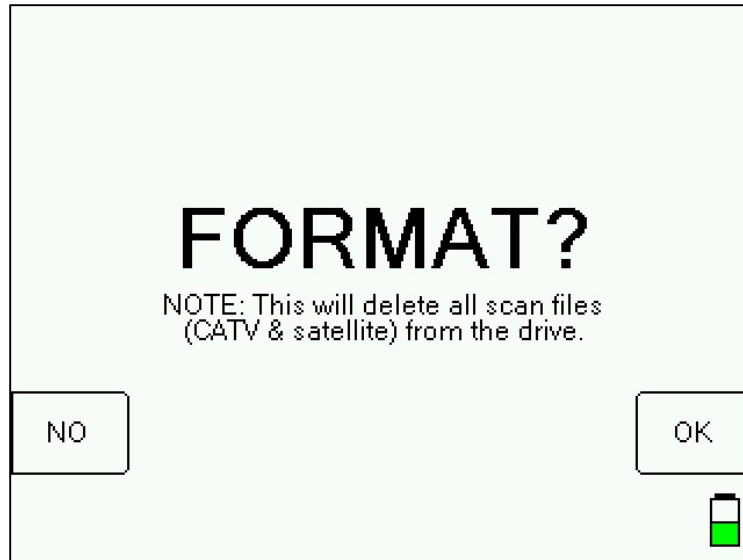
Each satellite file type is designated by a different file type extension:
Limit Scans (fail) = .LMF
Limit Scans (pass) = .LMP
PoP Scans = .POP
Spectrum Scans = .SPC

18.   Updating Your Meter

Updates to the Field Guide and to the instrument firmware are available from the Applied
Instruments website. See Software Updating section in XR-3 base operation manual for more
information.

15. Power

LNB Power

The LNB current is limited to different values under different conditions:

		Current Limit
1)	Normal battery operation:	780 mAmps
2)	Charger active (AC):	780 mAmps
3)	IRD power to LNB:	950 mAmps

Under conditions 1 and 2, an inrush current of 900 mAmps is allowed for a short period of time.

Battery Charge

1) Charging: Use either the AC to DC switching power supply or the 12VDC vehicle charger. To fully charge a dead battery, it should require approximately 3 hours. It is okay to leave the meter charging all night since the meter will go into trickle charge mode when the battery is almost fully charged. During cold weather keep the XR-3 indoors in a warm environment while charging. The battery charge temperature range is 41°F to 100°F or 5°C to 38°C.

2) Discharge / Charge: Before initial use of the meter you should fully discharge the battery and then recharge overnight. To quickly discharge the battery, disable the automatic shut-off in the Options menu, connect-to and power an LNB until the meter shuts off. To fully discharge the battery, disconnect from the LNB, power up the meter and let it die from powering itself.

3) Battery Charge Symbol: The battery symbol indicating remaining battery life in the lower right corner of the LCD display can be misleading. If not powering an LNB it may display full, even if it is not. It is more accurate when connected to an LNB load. It is normal for the battery symbol of a fully charged battery to quickly drop by ¼ when powering an LNB. The symbol should remain in the middle two segments for the longest time period, and will again drop faster when the last battery symbol segment is displayed. In summary the symbol drops by 25% quickly, remains in the middle 50% the longest, and then the last 25% drops quickly.

    The symbol's behavior is nonlinear. The battery charge indicator is based on the internal battery voltage, which changes slowly during the normal period of operation but quickly when the battery is either fully charged or nearly discharged. Therefore, the battery indicator will only appear full or empty for a short time. Most of the time, it will appear ½ or ¾ full. When the charge indicator shows ¼ charge, you will need to charge it soon. It will shut off very soon after the indicator goes to empty.

4) Automatic Shutoff: If desired you can activate the automatic shutoff feature. To activate it, press MENU → OPTIONS and then scroll to the Shutdown field with your Up/Down arrows and use the Left/Right arrows to choose the desired auto shut-down time (5 min, 10 min, 15 min, NONE). The auto shutdown feature is turned off (set to NONE) in its default state.

5) LNB Power Awareness: Only power the LNB while taking measurements. Avoid powering an LNB while not actually taking measurements.

6) Attempting to turn on a unit when the battery contains insufficient charge may result in beeps and/or a flash on the LCD but will not harm the unit.

AC Power

When 110VAC or 220VAC power is applied via the external AC to DC switching power supply, it supplies 14VDC power to charge the battery, run the meter, and power the LNB. In this case, the power available to the LNB is limited to 750 mAmps to avoid overdriving the power circuit and the battery charging circuit.

DC Power

When external 12VDC power is provided from a vehicle, it supplies enough power only to charge the battery.

16. <u>Troubleshooting / FAQs</u>

a) I receive an error message stating: "Error: LNB under voltage, over current, or short"
   i) Replace top (Signal In port) F-connector barrel. Use a 7/16" wrench to loosen existing barrel. Install new F-connector barrel and only tighten to 20 inch pounds of torque with wrench after finger-tightening. Warning: Do NOT over-tighten!
   ii) Ensure that you have the latest available version of Field Guide and Software loaded. If you don't, you must update meter's software using the FlashUpdate program.
   iii) If issue still remains, contact Applied Instruments' Tech Support department and request a RMA# to send the instrument to the factory for inspection and repair.

b) While I have the LNB connected to the ODU / LNB port of the meter with a coax cable and the LNB power is turned on, I don't even see any signal level shown on left bar graph. It just says "UNDER".
   i) Replace top (Signal In port) F-connector barrel. Use a 7/16" wrench to loosen existing barrel. Install new F-connector barrel and only tighten to 20 inch pounds of torque with wrench after finger-tightening. Warning: Do NOT over-tighten!

c) While attempting to perform a Limit Scan, I receive an Error message saying "ERROR: Key transponder not found or invalid".
   i) Turn the meter off and on. Then go to MENU/OPTIONS and press the PRESET soft-key in the lower left corner of the LCD screen. Then exit back to the MAIN MENU and try to run your Limit Scan again.

d) I believe my dish is properly aligned, but I'm not getting a LOCK on the meter for the desired satellite.
   i) Ensure that you have the latest available version of Field Guide and Software loaded. If you don't, you must update meter's software using the FlashUpdate program.
   ii) Ensure that you are using the proper LNB type and that you have specified the correct LNB type in the System Setup software menu. If in doubt, refer to the label or tag on the body of the LNB and contact Applied Instruments' Tech Support department to consult with them.
   iii) If the incoming signals are linearly polarized, you must ensure that you have properly adjusted the polarization offset of the LNBF or feed horn assembly. Even if the antenna reflector is set to the proper azimuth and elevation, it is possible to not receive adequate signal if your polarization offset is very far off.
   iv) If you're working with circularly polarized signals on a multi-LNB dish assembly, you must ensure that the skew/tilt of the dish is set correctly. You can use the ZIP postal code lookup feature to obtain approximate tilt/skew settings.

e) My XR-3 is displaying a message on the screen that says "LNB already powered by IRD input". Why is this message displayed?
  i) It means the meter is detecting power from an IRD that is connected to the IDU / IRD port of the XR-3's TS2 module. The IRD is powering the LNBF through the meter in this configuration. If your reason for pressing the LNB soft key was simply to toggle through the satellites related to the multi-LNB head, then you will have to use the left-right arrow keys instead to navigate in this configuration. If you receive this error message when there isn't an IRD or modem connected to the meter's IDU / IRD port of the XR-3's TS2 module, there may be a problem in the LNB power circuit of the meter which would require service at the factory.

f) Can I connect a coax cable from the receiver or modem's output to the IDU / IRD port of the XR-3's TS2 module to power the XR-3 if the meter has a dead battery?
  i) No. The IRD/satellite receiver isn't powerful enough to power both the meter and the LNB. When the IRD is hooked up to the IDU / IRD port of the XR-3's TS2 module, it can power the LNB through the meter (if the ODU / LNB port of the meter is connected to the LNB). If the XR-3's battery is completely dead, you will need to recharge it for at least a few minutes to allow the battery to power the meter itself. Using the IRD to power the LNB through the meter takes the LNB load off of the meter to make the satellite meter's battery last longer.

g) Can the XR-3 with the TS2 module be used to measure satellite signals outside the United States?
  i) Yes, the XR-3 with the TS2 module can be used outside the United States. Just be sure to download the appropriate global regional Field Guide into the meter using the FlashUpdate application. We have Field Guides available for North America, Europe, South America, South Pacific, NE Pacific, Asia, Middle East, and Africa. We have postal code files available for the USA and Canada. For any region outside North America, download the postal code file called "No Postal Codes" that allows you to type in and save your geographic coordinates (latitude and longitude).

h) According to my XR-3 meter, I'm getting LOCKs on all of the even transponders, but I'm not getting locks on any of the odd transponders. What is the issue and how can I fix it? There are a few possible causes for this:
  i) It's possible that you have a faulty LNBF & the internal 13V/18V switching isn't working properly
  ii) It's possible that your satellite meter isn't providing the correct voltage (most likely either 13V or 18V), as requested. You can test the voltage output of the meter with a voltmeter. If you confirm that the meter is not outputting voltage correctly, please contact Applied Instruments' Tech Support department and request a RMA# to send the instrument to the factory for inspection and repair.
  iii) You may have a stacked system and you have not specified a stacked setting in the System Setup software menu of your XR-3 meter.
  iv) There is a chance that only the even transponders are active on the satellite for your beam footprint area.

i) My serial number is missing off the back of my XR-3 meter. How can I obtain my serial number to know its history and to check if it's still under warranty?
  i) Connect your XR-3 meter to the PC, power it on, and open the FlashUpdate or MeterMaid program. The serial number of the connected unit will be displayed in FlashUpdate and MeterMaid if proper connection is established.
  ii) Turn the meter on. Then go to MENU, OPTIONS, and press the VERS soft-key in the lower left corner of the LCD screen to see the unit's serial number above the loaded software versions.

j)   While attempting to download or run the FlashUpdate application, the download just seems to stall out and not make any progress. What could be the cause of this?

i)   This issue is most likely caused by your anti-virus software or firewall blocking our program. Please temporarily disable your computer's anti-virus software and firewall so it doesn't interfere with the installation of the FlashUpdate and MeterMaid programs and the related USB drivers. If you have a hardware firewall, either stand-alone, or in a router, you must either modify the settings of the device to permit access to our program or you will have to entirely by-pass the router or other inhibiting hardware device. Also ensure that you are signed on as Administrator or have Administrator rights for Microsoft Windows.

If your company has a strict policy and the firewall blocks any executable files, then please contact your IT department and ask for assistance. Applied Instruments is more than happy to speak to the IT department about a work-around solution.

17. <u>Replacement Parts & Accessories</u>

Standard Accessories

Item Description	Part Number
Padded Cordura Flap for model XR-3	978-09390
Axle for Cordura Flap for model XR-3	976-09400
Threaded Cross Dowel Pin to secure module (qty 1)	940-89900
Thumb Screw (Tuner Lock-Down Screw) to secure module (qty 1)	940-89901
Battery door gasket for model XR-3	975-09340
Shoulder Strap	978-01843
Replacement Battery for model XR-3	742-00016
120-240VAC/15VDC AC Adapter and related line cord for model XR-3	990-08520
12VDC Vehicle Battery Charge Cord	967-20003
USB Data Transfer Cable	983-00002
Desktop kickstand for model XR-3	976-08430
Replacement Double Female F-Connector Barrel	715-01026
Signal splitter / Combiner (5-2150 MHz, single side power passing)	340-00012
Operation Manual for model XR-3 base instrument	078-00380
Operation Manual for model XR-3 Cable Air meter module	078-00400
Operation Manual for model XR-3 TS2 DBS satellite meter module	078-00390
Operation Manual for model XR-3 S2ACM VSAT sat meter module	078-00410

Optional Accessories

Item Description	Part Number
Hard Shell Protective Carrying Case	978-00008
NS-1 Handheld Broadband RF Noise Generator (5-2150 MHz)	NS-1

18. <u>Maintenance and Repairs</u>

Repair Services

In the event that a unit is damaged or otherwise not performing as specified, repair and maintenance service is available.

Warranty repair will be performed within one year from the date of purchase at no charge. Warranty repair includes defects in material and workmanship only. If unit is under warranty (standard warranty period is 12 months), charges do not apply unless instrument has been opened, abused, or exposed to moisture.

Beyond one year, TesCom offers flat rate repairs. Pricing is listed on our website at www.tescomusa.com

Shipping charges to our factory are the responsibility of the customer. Return shipping charges are included in the flat rate repair. Return shipping for warranty repairs is covered for customers located within the continental USA.

If you need to return equipment for service, please visit our website to request an RMA.

https://tescomusa.com/pages/rma-request

Version Updating

As our product lines are refined and features and performance are enhanced, we will upgrade older units at a nominal cost when possible. Shipping charges are additional. Contact us at +1 (800) 888-1978 for price and schedule if you are interested in having a unit updated.

Calibration

Periodic calibration of modules may be necessary to ensure that the unit is operating within the original factory specifications. A standard calibration charge will be incurred.

19. <u>Specifications</u>

SPECIFICATIONS
Frequency Range........250-2150 MHz
Tuning Resolution........4 kHz
Signal Level Range... ..-75 to -15 dBm (-26 to +34 dBmV)
                                        (+34 to +94 dBμV)
RF Level Accuracy.........+/- 2 dB typical, 3 dB max
Signal Lock Formats..... DVB-S (QPSK), Digicipher 2 (QPSK & OQPSK),
                                 DVB-S2 (QPSK & 8PSK CCM),
                                 DSS / DIRECTV Legacy (QPSK), Turbo (QPSK & 8PSK)
Impedance.....................75 Ohm
LNB Power....................13VDC for V/R, 18VDC for H/L,
                                 21VDC for DIRECTV SWiM LNBs, 29VDC
Switch Control.................22 kHz, DiSEqC
RF Connector ....F barrel, field replaceable
Warranty..........................12 month limited
Specifications are subject to change without notice.

WARRANTY

The Applied Instruments XR-3 is warranted against defects in materials and workmanship for a period of twelve months. Applied Instruments agrees to repair or replace any assembly or component found to be defective under normal use during this period. Our obligation under this warranty is limited solely to repairing the instrument proven to be defective within the scope of the warranty when returned to the factory. Transportation to the factory is to be prepaid by the customer. Authorization (RMA#) by Applied Instruments is required prior to shipment.

TesCom assumes no liability for secondary charges or consequential damages and, in any event, TesCom's liability for breach of warranty under any contract shall not exceed the purchase price of the instrument shipped, and against which a claim is made.

Any application recommendation made by TesCom for the use of its products is based upon tests believed to be reliable, but TesCom makes no guarantee of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for TesCom any liability in connection with the sale of our products other than that set forth herein.

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