SAT 9520™

OPERATION MANUAL

Satellite Signal Level Meter

950-2150 MHz

APPLIED INSTRUMENTS, INC.

TELECOMMUNICATIONS INSTRUMENTATION

SAT 9520
OPERATION MANUAL

VERSION 1.1

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Applied Instruments, Inc.
5230 Elmwood Avenue
Indianapolis, IN 46203 USA
http://www.appliedin.com

Voice: (317) 782-4331
Fax: (317) 786-9665
Toll free USA: (800) 244-2976

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WARRANTY

The Applied Instruments SAT 9520 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 proved 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 by Applied Instruments is required prior to shipment.

Applied Instruments assumes no liability for secondary charges or consequential damages and, in any event, Applied Instruments' 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 recommendations made by Applied Instruments for the use of its products are based upon tests believed to be reliable, but Applied Instruments makes no warranty 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 Applied Instruments any liability in connection with the sale of our products other than that set forth herein.

FEATURES

The SAT 9520™ Satellite Signal Level Meter facilitates installation and troubleshooting of residential and commercial satellite systems. Its features include:

- Measuring the strength and quality of digital satellite signals
- Powering single and multiple LNB (low noise block amplifier) antennas
- Identifying most satellites
- Controlling multi-switches
- Tuning to individual transponder frequencies
- Storing field selectable channel plans

By obtaining a signal decoding lock, the SAT 9520 positively identifies many DBS, Ku, and C-band satellites. Installation of two-way broadband, VSAT and DBS installations is much quicker when the correct satellite is easily located and identified.

The SAT 9520 simultaneously displays signal strength and IRD signal quality bar graphs for signal peaking, carrier-to-noise for optimizing cross polarization, and bit-error-rate for obtaining maximum rain-fade margin.

Finally, the SAT 9520's scan feature automatically measures, collects, and summarizes the proof of performance data requested by system providers.

STANDARD ACCESSORIES

- Padded carrying case with shoulder strap
- Data cable and Load9520 software
- Operation Manual
- Transformer for battery charging
- One spare F-connector (usually in the box with the transformer)

MEASUREMENTS

- SIGNAL LEVEL
  In dBm, dBmV or dBuV
  Present and peak levels
  Numeric and bar graph display

- SIGNAL QUALITY
  IRD signal meter equivalent
  Present and peak levels
  Numeric and bar graph display

- CARRIER-TO-NOISE RATIO
  C/N, Eb/N0 or Es/N0

- BIT ERROR RATE (BER)
  Pre-FEC BER
  Post-FEC BER

- FREQUENCY ACCURACY
  Estimated LNB frequency deviation

SCAN MODE

The Scan Mode measures each transponder in the channel plan and displays summary data to verify proper operation at all frequencies.

- **Min/Max Measurements**
  Left and right hand polarity separately
  Signal level
  Eb/N0, Es/N0 or C/N
  Pre-FEC BER

- **Adjacent Channel Difference**
  Co-polar left hand
  Co-polar right hand
  Cross-polar

EXTRAS

- LNB POWER
  13 or 18 volt polarity selection
  22 kHz tone for multiple LNB or frequency range selection
  Control of most multi-switch types including DiSEqC™

- AUDIBLE PEAKING TONE
  Signal strength indicator or
  C/N signal quality indicator

- CHANNEL PLANS
  Standard plans for major system providers
  Multiple satellite plans for identification within frequency band
  Plan lists for different location or purposes
  Custom channel plans available

- BACK LIGHT

- FAST CHARGE BATTERY

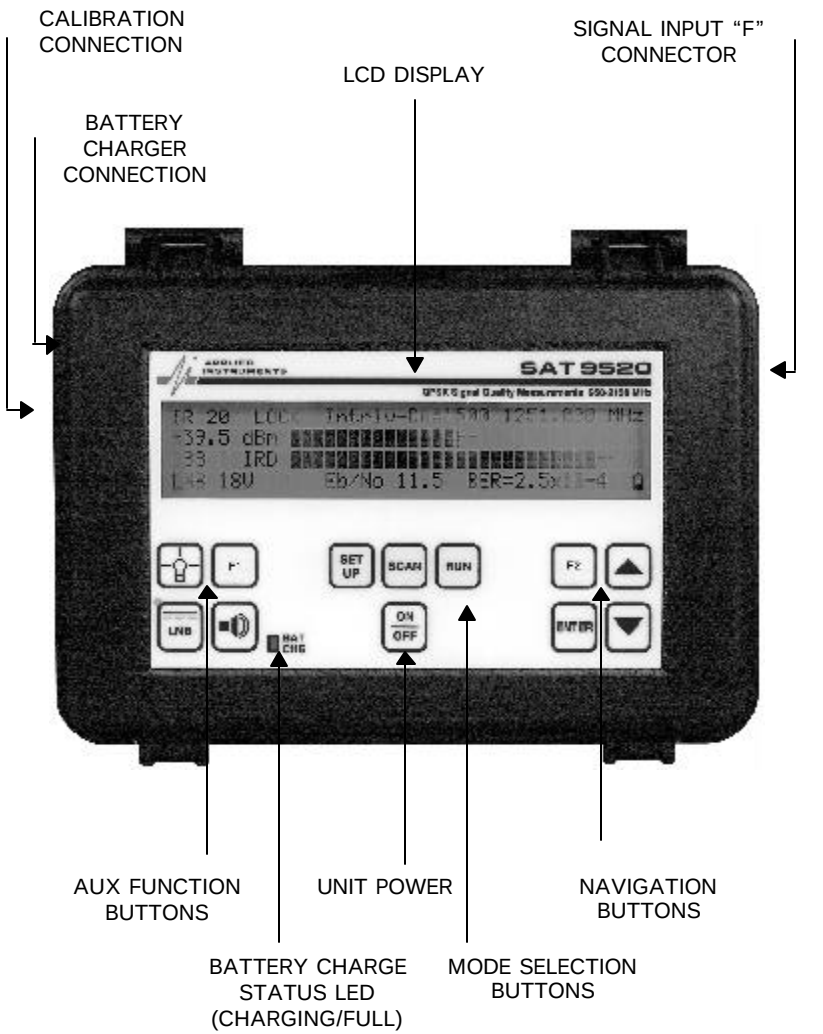
- SERIAL PORT AND CABLE
  Channel plans and tables upgraded from internet or disk via PC

SPECIFICATIONS

Frequency Range	950 to 2150 MHz
Tuning Resolution	Individual transponders
Receiver Bandwidth	25 MHz
Signal Level Range	-68 to –8 dBm (–20 to + 40 dBmV) (+ 40 to + 100 dBµV)
Impedance	75 Ohm
LNB Power	13/18 VDC current limited to 750 mA (22 kHz tone and DiSEqC™ capable for controlling multi-switches)
Battery Life/Charge	3.5 hours LNB power (depending on LNB current draw)
Battery Charge Time	Fast charges in 2 hours, trickle thereafter
Pre-FEC BER Range	2.0 E-2 (1 in 50) to 4.0 E-7 (1 in 2,500,000)
Size / Weight	8.5”W x 6.5”H x 3.3”D / 4.5 lbs.
Temperature Range	0°F to 130°F (-17°C to 55°C)
Connector	Type F female (field replaceable)

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

CONTROLS & CONNECTIONS



MODE SELECTION BUTTONS

SAT 9520 on/off

Run Mode

Setup Mode

Scan Mode

AUX FUNCTION BUTTONS

LNB power on/off and multiple LNB selection

Audio on/off

Backlight on/off

Bit Error Test (Pre and Post FEC) of selected transponder

Frequency deviation estimate (replaces BER on Run mode screen)

NAVIGATION BUTTONS

Up arrow

Down arrow

Enter

RF INPUT CONNECTOR

This is a high quality 2 GHz "F" type connector to connect the coaxial cable from the antenna or distribution system. This connector may be replaced using a 7/16 inch wrench. The F-connector should be replaced periodically, especially if you suspect the meter's performance has degraded.

THE NUT ON THE 2 GHZ CONNECTOR DOES NOT SEAT FLUSH AGAINST THE CASE. SOME THREADS WILL BE VISIBLE BETWEEN THE CASE AND THE NUT; THIS IS NORMAL.

BATTERY CHARGER CONNECTION

Only the AC wall transformer provided should be plugged into this connector. Any other device may damage the instrument.

COMPUTER CONNECTION

This is a serial port for connecting to a computer with the data cable provided. By using the LOAD9520 software, this interface allows upgrading with new or modified channel plans and internal tuner settings.

THIS IS NOT A HEADPHONE JACK!

QUICK START

The following sections of this manual contain detailed instructions on using the SAT 9520, but because the unit was designed to be user-friendly, the guidelines in this section should be sufficient to get you up and running quickly.

This section assumes you are installing a standard, single LNB, DIRECTV™ antenna. If not, read the section on Setup Mode before performing the procedures in this section.

ALIGNING THE DISH

Complete the following steps to ensure proper alignment of the dish antenna.

Step 1 Mount the antenna according to the manufacturer's instructions and perform approximate alignment using the azimuth and elevation tables provided with the antenna.

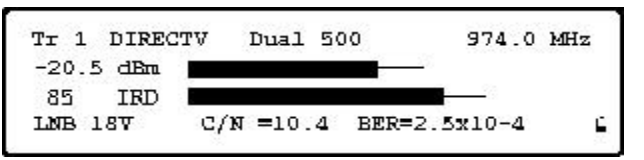
Step 2 Connect the antenna cable to the SAT 9520 and press ON/OFF to turn the unit on.

Step 3 Use the ▲ and ▼ arrows to select a DIRECTV™ transponder on the desired satellite. DIRECTV™ has several satellites and not all transponders are used on every satellite. A list of the transponders used on different satellites should be available in the system's installation manual or from DIRECTV™.

Step 4 Turn on the antenna's LNB by pressing the 

button.

Step 5 Observe the signal level and lock status on the SAT 9520 display. If the dish is pointed at the satellite, the level should be fairly high and the display should indicate a lock status. The "Search" indicator should be replaced by "DIRECTV."



More than likely, your dish will not be pointed at the satellite; the level will be lower and the lock status will show "Search."

Step 6 Turn on the audible peaking tone by pressing the 
button. You should hear a slow beeping tone.

Step 7 Slowly turn the dish slightly to the left and right. When the dish is pointed at the satellite, the signal will be stronger and the audible peaking tone from the SAT 9520 will beep faster. Move the dish back and forth slowly until you find the spot where the tone beeps solid.

While looking at the display, pay careful attention to the signal level (DBM) and the IRD signal quality bar graphs. Try to obtain the highest signal strength and the highest signal quality.

Step 8 Fine tune the elevation by adjusting the dish up and down until the maximum signal position is found.

Step 9 Observe the locking status on the display. If "DIRECTV" is shown, you are locked onto a DIRECTV™ transponder. Check the other transponders to be sure you are locked onto the correct DIRECTV™ satellite.

If "DVB-S" is shown, you are locked onto a non-DIRECTV™ transponder. Some of the orbital positions are shared between DIRECTV™ and other systems, so check other transponders to determine which satellite you are receiving.

If "Search" is shown, you may have found the wrong satellite or the signal may be too low to obtain a lock. Check the approximate alignment and elevation settings again. Make sure the line of sight to the satellite is clear of obstructions; you may need to relocate the dish.

Step 10 Check the peak indicator on the signal level bar graph. If the narrow line extends more than one full block beyond the thick line, the dish is not presently at the peak position. Try adjusting it again.

Step 11 Check the peak indicator on the IRD bar graph. It also should not extend more than one full block beyond the thick line or you should readjust the dish to maximize the signal quality.

NOTE: ACCEPTABLE SIGNAL LEVELS ARE DIFFERENT FOR DIFFERENT LOCATIONS AND WILL DEPEND ON THE WEATHER.

VERIFYING THE SYSTEM

When the dish has been aligned, complete the following steps to check the complete system. This should be done at the dish to be sure the dish and LNB are operating correctly and again at the IRD connection to be sure there are no problems with the cabling.

Step 1 Check a few channels by using the ▲ and ▼ buttons to change channels. Check the lock status, the signal level, and the IRD reading.

Step 2 Use the Scan Mode to check all transponders. Press SCAN and wait while the SAT 9520 measures all channels. This takes about 1 minute.

Step 3 Check the Transponder List to verify that all valid DIRECTV™ transponders for the desired satellite are listed. Note: Some transponders are spot-beamed to certain locations and may not be visible from your location.

Step 4 Press ▼ to view the Power Summary screen, check for reasonable values:

- Are all max and min power levels reasonable?
- Are they within the system provider's specifications?

Step 5 Press ▼ to view the Bit Error Rate summary screen:

- Are all BER values reasonable and consistent?
- An unusually high BER may indicate a problem with a particular frequency. You may want to check that transponder using Run Mode.

Step 6 Press [▼] to view the signal quality summary screen:

- Are these values consistent and reasonable?

Step 7 Press [▼] to view the Adjacent Channel Power summary screen.

- Are these values reasonable and within the system provider's specifications?

ASSESSING SYSTEM MARGIN

At this point, you should be confident that the system is working correctly. Next, you should verify that the system is good enough to tolerate some degradation in the signal (e.g. bad weather).

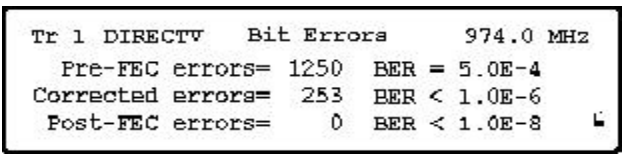
Step 1 Press [RUN] to return to Run Mode and review the IRD signal quality measurements:

- Are these well within the acceptable limits or are they marginal?

Step 2 Review the signal level measurements:

- Is the signal strong enough?

Step 3 Press [F1] to start the Post-FEC BER test. This test provides a better indication of the available system margin.



Check the Pre-FEC BER rate; this will typically be around 1.0E-3 to 1.0E-4. A larger negative exponent indicates a lower bit error rate. 1.0E-4 is 1 error in 10,000 bits, while 1.0E-3 is 1 error in 1,000 bits. The lower the rate, the better the system margin.

Step 4 Let the system run for a few minutes and watch the Corrected BER. The Corrected BER rate provides a good estimate of the system margin. The so-called "cliff effect" occurs when this rate is exceeds 1.0E-4. However, this rate takes a little while to become established, so let this test run for a minute or two.

Step 5 Check the Post-FEC BER. This is the rate of errors visible to the customer. If this error count is not zero, there is a problem.

FINDING CABLE PROBLEMS

If the system is verified at the dish but shows a problem at the IRD connection, there must be a problem somewhere in the cabling system. Multi-dwelling unit installations that contain amplifiers, splitters and a lot of cable are especially susceptible to cable problems.

The source of these problems can be located by simply testing the system at various points along the path from the dish to the IRD. If a problem is found at some point in the cable, the problem source is located between the point tested and the dish. If the systems results are good at the point tested, the problem source is located closer to the IRD. Keep testing until the source is isolated.

Many intermittent cable faults are caused by bad crimps or broken center-conductors. The audible tone can help locate these faults. Turn the tone on and then shake or bend the cable. If the tone changes significantly, a fault is indicated.

SETUP MODE

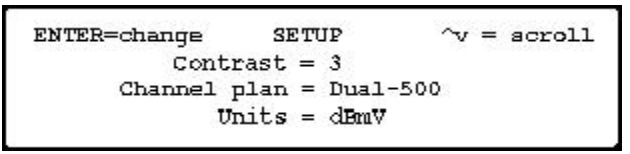
Before using the SAT 9520, you may need to change some setup parameters to tailor its operation to your system and specific needs. Setup Mode presents these parameters in a scrolling list that makes it easy to select different options.

THE SETUP PARAMETERS ARE:

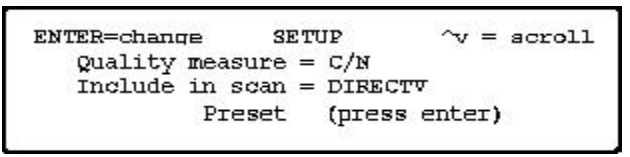
Contrast	Adjusts the contrast of the display screen.
Channel plan	Selects the frequency plan appropriate for your system.
Switch Type	Selects the type of multi-switch control.
Units	Specifies the display units for the signal level measurement.
Quality measure	Selects from three nearly equivalent measures of signal quality.
Include in scan	Selects the system types to include in Setup Mode.
Preset	Resets the instrument to factory defaults.
Level offset	Allows signal level calibration to be tied to another signal source.
C/N offset	Allows C/N calibration to be to tied to another signal source.
IRD offset	Allows IRD Signal Quality to be tied to another known source.
C/N compensation	Allows the C/N compensation to be turned on or off.

GENERAL INSTRUCTIONS

Press [SET UP] to start Setup Mode.



To change any of the parameters, use the arrow keys to position the blinking cursor on the item to be modified and press [ENTER]. The prompts on the top line will then indicate that a parameter has been selected and can now be modified. Next, use the arrow keys to select a value for that parameter and press [ENTER] again.



There are more setup parameters than the screen can display at one time. Press [UP] from the top line or [DOWN] from the bottom line to scroll the parameters in a circular fashion.

CONTRAST

It may be necessary to adjust the display contrast to make the screen easier to read. In fact, if the contrast is too low, the screen may not be visible at all. In that case, you may need to perform this adjustment without being able to read the screen! Don't worry, it's easy.

TO CHANGE DISPLAY CONTRAST:

- Press [SETUP] to start Setup Mode. The cursor will appear on the “Contrast” line.
- Press [ENTER] to edit the contrast level.
- Use the [UP] and [DOWN] until the desired contrast is displayed.
- Press [ENTER] to accept the contrast.
- Press [RUN] to resume measurements.

CHANNEL PLANS

The channel plan defines the frequencies and settings associated with each channel or transponder to be measured. The SAT 9520 includes several standard plans for the most common system configurations, which are listed in the back of this guide. Custom plans may also be provided, please contact the manufacturer.

NOTE: “CHANNEL” AND “TRANSPONDER” ARE USED INTERCHANGEABLY THROUGHOUT THIS GUIDE.

TO CHANGE THE CHANNEL PLAN:

- Press [SETUP] to start Setup Mode. The cursor will appear on the “Contrast” line.
- Press [DOWN] to position cursor on the “Channel plan” line.
- Press [ENTER] to edit the channel plan.
- Use the [UP] and [DOWN] until the desired plan is displayed.
- Press [ENTER] to accept the shown plan.
- Press [RUN] to resume measurements.

SWITCH TYPE

To control a multi-switch, the type of switch must be specified. Select the switch type that corresponds to your system.

None For systems with one LNB (such as a typical DIRECTV™ single LNB) or when the LNB is connected directly to the SAT 9520.

22 kHz For DIRECTV™ and similar systems that use a twin LNB. In the case of DIRECTV™,
SAT A is the 101° satellite.
SAT B is the 119° satellite.

SW21 For Dish Network™ model SW21.

SW42 For Dish Network™ model SW42.

SW64 For Dish Network™ model SW64.

Twin For Dish Network™ Twin LNB (Dish 500 systems).
LNB 1 is the 119° satellite.
LNB 2 is the 110° satellite.

Quad For Dish Network™ Quad LNB switch.

DiSEqC For Eutelsat DiSEqC™ standard compatible switches.
Dish 1 = switch input 1 or A.
Dish 2 = switch input 2 or B.
Dish 3 = switch input 3 or C.
Dish 4 = switch input 4 or D.

DpTwin For the DishPro™ twin head LNB.
LNB 1 is the 110° satellite.
LNB 2 is the 119° satellite.

NOTE: WHEN YOU SELECT THE "DISH 500" CHANNEL PLAN, THE SWITCH TYPE WILL AUTOMATICALLY CHANGE TO "TWIN." SIMILARLY, WHEN YOU SELECT "DISHPRO," THE SWITCH TYPE CHANGES TO "DISEQC." IF YOU ARE USING A DIFFERENT TYPE OF SWITCH, YOU CAN OVERRIDE THESE DEFAULT SETTINGS WHILE IN SETUP MODE.

SEE THE LNB POLARITY AND MULTIPLE LNBS SECTION FOR MORE DETAILS.

SIGNAL LEVEL UNITS

The SAT 9520 can display signal level readings in dBmV, dBm, or dBuV. Select whichever units you are most comfortable with.

To change signal level units:

- Press [SETUP] to start Setup Mode. The cursor will appear on the "Contrast" line.
- Press [DOWN] until the cursor is positioned at the "Units" line.
- Press [ENTER] to edit the units.
- Use the [UP] and [DOWN] until the desired unit is displayed.
- You may select from dBm, dBmV or dBuV.
  Note: dBmV = dBm + 48.75
  dBuV = dBmV + 60.0
- Press [ENTER] to accept the displayed unit.
- Press [RUN] to resume measurements.

SIGNAL QUALITY MEASUREMENT

Signal quality may be measured as a carrier-to-noise ratio (C/N), as energy-per-bit over noise-per-hertz (Eb/N0), or as energy-per-symbol over noise-per-hertz (Es/N0). For a given type of

signal, these measurements are equivalent, and the SAT 9520 will display the measurement in whichever term you prefer.

TO CHANGE SIGNAL QUALITY MEASUREMENT:

- Press [SETUP] to start Setup Mode. The cursor will appear on the "Contrast" line.
- Press [DOWN] until the cursor is positioned on the "Quality measure" line.
- Press [ENTER] to edit the signal quality measurement.
- Use the [UP] and [DOWN] until the desired measurement is shown.
- You may select from:
  C/N (carrier-to-noise)
  Eb/N0 (energy-per-bit / noise-per-Hz)
  Es/N0 (energy-per-symbol / noise-per-Hz)
- Press [ENTER] to accept the displayed measurement.
- Press [RUN] to resume measurements.

SEE THE DIGITAL SIGNAL MEASUREMENTS SECTION FOR MORE DETAILS ABOUT THESE MEASUREMENTS.

INCLUDE IN SCAN

This parameter selects the system types to include in the Scan Mode summary screens.

THE OPTIONS ARE:

DIRECTV Includes only DIRECTV™ transponders.

DVB-S Includes only DVB-S compatible transponders.

ALL Includes DIRECTV™ and DVB-S (default).

TO CHANGE THE SYSTEM TYPE TO INCLUDE IN SCAN:

- Press [SETUP] to start Setup Mode. The cursor will appear on the “Contrast” line.
- Press [DOWN] until the cursor is positioned on the “Include in scan” line.
- Press [ENTER] to edit the system type.
- Use the [UP] and [DOWN] until the desired selection is shown.
- Press [ENTER] to accept the displayed type.
- Press [RUN] to resume measurements.

DEFAULT CONFIGURATION

The “Preset” option may be used to restore the factory defaults for all settings.

TO RETURN TO DEFAULT SETTINGS:

- Press [SETUP] to start Setup Mode. The cursor will appear on the “Contrast” line.
- Press [DOWN] until the cursor is positioned on the “Preset” line.
- Press [ENTER] to restore the defaults.

OFFSET AND COMPENSATION FEATURES

LEVEL OFFSET

This feature allows user to tie the SAT 9520’s signal strength calibration to another known signal source. Most individuals will not use this feature since the unit leaves the factory calibrated. Certain laboratory situations may require slight adjustment to the level to fit their applications.

C/N OFFSET

This feature allows user to tie the SAT 9520's carrier-to-noise calibration to another known signal source. Most individuals will not use this feature since the unit leaves the factory calibrated. Certain laboratory situations may require slight adjustment to the level to fit their applications.

IRD OFFSET

This feature allows user to tie the SAT 9520's IRD Signal Quality reading to another known signal source. Most individuals will not use this feature since the unit leaves the factory calibrated. Certain laboratory situations may require slight adjustment to the level to fit their applications.

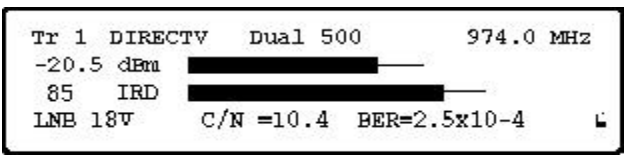
C/N COMPENSATION ON/OFF

This feature allows the C/N compensation to be turned on or off. Normally, this should be left ON. The OFF setting was added to allow disabling the compensation in certain experimental situations. Disabling this feature for the standard DBS systems (DirecTV™, Dish Network™, Bell ExpressVu™) will result in a C/N reading that is higher than the correct value.

RUN MODE

Normally, you will use the Run Mode to measure the performance of one transponder at a time. This is the default mode of the SAT 9520, and you can return to it from either the Setup Mode or the Scan Mode at any time by pressing the [RUN] button.

To measure a signal, connect the antenna cable to the F-connector on the side of the SAT 9520 and turn the unit on. After a short start up period, a screen similar to the following will appear:



THIS SCREEN SHOWS THE FOLLOWING INFORMATION:

Top row:

- Transponder (Tr 1)
- Signal lock status (DIRECTV)
- Channel plan name (Dual 500)
- Transponder frequency (974.00 MHz)

Second row:

- Signal level (-20.5 dBm)
- Signal level bar graph

Third row:

- Estimated IRD reading (85 IRD)
- IRD reading bar graph

Fourth row:

- LNB power status (LNB 18V)
- Selected C/N measurement: (C/N=10.4 dB)
- Pre-FEC BER (BER=2.5x10-4)
- A battery charge indication

This screen shows the measurements for one transponder at a time. The following keys are used in this mode:

Turns LNB power on or off and selects different multi-switch positions.

Turns on audible peaking tone.

Selects the next higher transponders.

Selects the next lower transponder.

Starts Post-FEC BER test.

Toggles between the BER reading and the frequency deviation estimate.

LNB POWER

The LNB (low noise block amplifier) is the part of the satellite antenna dish that amplifies the received signal and converts it to the L-band frequency range for transmission through coaxial cable. The LNB is powered by 13 or 18 volts DC on the center conductor of the cable. Normally, this power is provided by the set-top IRD.

When using the SAT 9520, the set-top box may not be connected, so the SAT 9520 supplies this power. The SAT 9520's LNB power can be turned on or off with the [LNB] button. The status of the LNB power is noted on the lower left of the display screen. The LNB must be powered, either by the SAT 9520 or some other device, before a signal will be available.

TO TURN LNB POWER ON, OFF, OR TO SELECT ANOTHER LNB:

- Press [LNB] to toggle the LNB power. If a switch type other than "none" is selected, press it again until the desired setting appears. Refer to SWITCH TYPE section.

THE LNB POWER IS A SIGNIFICANT DRAIN ON THE BATTERY. TURN IT OFF WHEN IT IS NOT ACTUALLY BEING USED!

LNB POWER INDICATOR LED

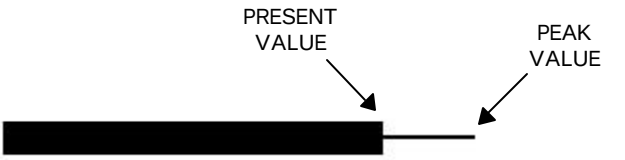
The LNB power LED on the front panel will indicate when a voltage is present on the center conductor of the cable. This LED operates independently from the SAT 9520's LNB power supply circuit.

THIS LED CAN BE USED TO IDENTIFY SEVERAL CONDITIONS:

	SAT 9520 LNB OFF	ANY OTHER INDICATION
LNB LED OFF	The LNB is not powered by the SAT 9520 or any other device.	The SAT 9520 is trying to power the LNB but a short may exist in the cable.
LNB LED ON	The LNB is being powered by some other device.	The SAT 9520 is powering the LNB successfully.
LNB LED FLASHING		The SAT 9520 is unable to provide enough current, or there is a short.

BAR GRAPHS

The Run Mode display contains two bar graphs: the top one indicates the signal level and the bottom one indicates the IRD signal quality. These two bar graphs represent the present value with a thick bar and the peak value with a thin bar. If the present value is the same as the peak value, no thin bar will be shown.



THE BAR GRAPHS ARE SCALED TO COVER THE ENTIRE RANGE OF MEASUREMENTS:

- –68.75 to –8.75 dBm (or -20 to +40 dBmV, or +40 to +100 dBuV)
- 0 to 100, or 0 to 125 IRD counts, depending on the system

The peak value is reset whenever the channel is changed or Run Mode is restarted. If you want to reset the peak indicator, press [RUN].

IRD SIGNAL QUALITY INDICATOR

This measurement, labeled “IRD” on the display and indicated by the lower bar graph, is the estimated signal quality measurement as shown on a standard set-top box in its dish-pointing screen.

The IRD reading is based on the carrier-to-noise ratio measurement. It provides an easy- to-use quality measurement. You are probably already familiar with this reading if you have used the set-top box to align dishes. The SAT 9520 IRD value will not match all IRD set-tops, but should be fairly close (±10) and can be counted on as a "relative signal quality" measurement; higher is better.

BIT ERROR RATE

The Bit Error Rate (BER) shown on the Run Mode screen is the rate of bit errors encountered in the first stage of the forward error correction process. This is NOT the error rate delivered to the monitor. Rather, it indicates the errors present in the raw received signal and, thus, provides an assessment of the signal degradation from all sources of impairments.

SIGNAL LOCK

A signal lock indicator is shown on the top line of the Run Mode screen, just after the channel designator. The lock indicator shows whether the SAT 9520 is searching for a data channel or if it has locked onto the signal. While searching for the signal, "Search" will be displayed. When the SAT 9520 has fully locked onto the signal, it will usually say either "DIRECTV" or "DVB-S" depending on whether the locked signal is a DIRECTV™ signal or a DVB-S compatible signal.

SEE THE SIGNAL LOCKING SECTION FOR MORE DETAILS.

CHANNEL SELECTION

TO SELECT ANOTHER CHANNEL:

- Press [UP] or [DOWN] until the desired channel is displayed.

- If you hold the button down, the channels will scroll until you release the button.
- Actual measurements will not be made until you stop on a channel.

AUDIBLE PEAKING

Peaking is the process of adjusting the antenna or system to obtain the maximum signal strength. The SAT 9520 provides an audible tone that lets you easily peak the antenna without having to hold or look at the SAT 9520 during the process, which allows you to use both hands to adjust the antenna. Press [AUDIO] to turn the audio peaking tone on.

DISH PEAKING TONE

The audible peaking tone uses a single pitched tone, with two pulse rates for aligning the dish.

- No tone = Audible tone function turned off.
- Slow beep = Less than 3 dB above minimum signal level.
- Fast beep = Greater than 3 dB above minimum level but not more than 5 dB above minimum or not within 1 dB of peak.
- Solid tone = More than 5 dB above minimum and within 1 dB of peak.

The SAT 9520 remembers the minimum and maximum levels it has measured since being reset (pressing [RUN] will reset the minimum and maximum levels). Changing the channels will reset the maximum, but not the minimum. The default minimum is set to -45 dBm.

TO PEAK THE DISH, FOLLOW THIS PROCEDURE:

1. Grossly align the dish per the instructions of the service provider. Press the SAT 9520's power button and the LNB power button.

2. Press the audio button. You should hear a slow beeping tone.

3. Adjust the dish in one direction. As the signal strength increases, the audible tone should start beeping faster.

4. Continue adjusting the dish until a solid tone is heard. This is the "peak range" of the dish.

5. Continue adjusting the dish in the same direction until the tone starts beeping fast. You have now passed the peak and the peak has been identified.

6. Adjust the dish in the opposite direction until the tone is solid. This is the peak of the signal.

7. You could continue to move the dish in both directions to center it in the middle of the solid tone.

It may be necessary to learn the minimum level for the system you are working with. For example, if you start with the dish already pointed at the satellite, the default minimum of –45 dB will probably be used. If the signal level of the service you are looking for is fairly low (i.e. –45 to –42 dB range), then the slow beep will sound even though the dish may be peaked. If you move the dish away from the satellite, the SAT 9520 will learn the true minimum so that when you move the dish back into its original position, the fast beep and solid tone will sound.

If you start with the dish already peaked and have good signal (i.e. –40 to –32 dBm range), then when you turn on the SAT 9520's audible peaking tone, you will hear the solid tone immediately. You can use the procedure above to verify that the dish is indeed peaked the best it can be.

AUDIBLE C/N PEAKING FEATURE

The Audible C/N Peaking feature enables the user to make polarity adjustments to horizontal/vertical polarity LNBs and uses the same tone-beeping pattern as the level peaking function.

TO USE THE AUDIBLE C/N PEAKING FEATURE:

1. Peak the level first by adjusting the azimuth and elevation to obtain the best signal strength.
2. Press the speaker button to activate the audible peaking tone. A speaker icon will flash next to the signal level reading to indicate that the Level Peaking mode is active.
3. Press the F1 button to switch to the C/N mode. The flashing speaker icon will appear next to the C/N reading to indicate the measurement being peaked.
4. Adjust the polarity of the LNB to obtain the solid peaking tone and maximize the C/N.

NOTE: YOU WILL HEAR THE SLOW BEEP UNTIL MORE THAN 4 DB OF C/N IS OBTAINED. THE SOLID TONE WILL SOUND WHEN THE C/N IS WITHIN 0.4 DB OF THE HIGHEST PEAK DETECTED SINCE THE RUN BUTTON WAS PRESSED OR SINCE A LOCK WAS OBTAINED.

FREQUENCY DEVIATION ESTIMATE

This measurement checks the frequency error in the LNB or in stacking up-converters. Because the accuracy of this estimate is not specified, it should be used as an indicator only. This measurement is not meaningful unless a signal lock has been obtained.

The Frequency Deviation Estimate will be displayed in place of the BER on the lower right part of the display. Press F2 from

the Run Mode to toggle between the BER and the Frequency Deviation Estimate. This number indicates the frequency offset (in kHz) between the observed signal and the frequency defined in the channel plan.

EXAMPLE:

If you are tuned to transponder 1 at 974 MHz, and the deviation reported is –1500 kHz, the signal frequency from the LNB is 972.5 MHz (974 MHz – 1500 kHz = 972.5 MHz). This might indicate a 1.5 MHz error in the LNB's local oscillator. This magnitude would probably not be noticeable on a clear day, but would reduce the rain fade margin substantially.

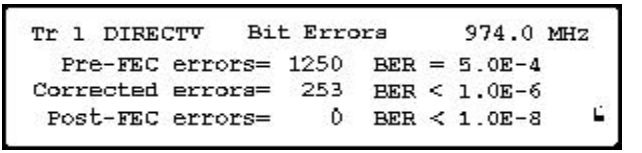
NOTE: THE SAT 9520 IS CONFIGURED TO LOCK ON TO SIGNALS WITH UP TO A 3.5 MHZ OFFSET AND THE SET-TOP IRD MAY LOCK AT EVEN GREATER OFFSETS DURING STRONG SIGNAL CONDITIONS.

POST-FEC BIT ERROR RATE

The Post-FEC BER test measures the bit error rate (BER) after forward error correction (FEC) is applied. This is a final measurement of the quality of the delivered picture and the only measurement that is relevant to the viewer. If there are no errors in the decoded signal, the picture is perfect regardless of the quality of the signal before decoding.

The SAT 9520 also provides a BER figure before error correction and an intermediate BER between the two FEC stages. These measurements indicate the quality of the received signal and let you assess how close your system comes to having problems that will be noticeable to the viewer.

To perform a Post-FEC BER on the selected channel, press [F1]. The following screen is then displayed:



This test will continue to count errors and update the rate as long as the transponder remains locked.

The Pre-FEC error count shows the errors found in the previous block of 2.5 Mbits. The Pre-FEC BER is the same rate as displayed on the normal run screen.

The corrected error count shows the number of errors that survived the Viterbi decoding but were caught by the Reed-Solomon decode. If this BER exceeds 1.0E-4, the RS decode will begin to fail, causing the signal quality "cliff effect".

The Post-FEC BER is the rate of errors that the RS decode was unable to correct over the duration of the test. Normally, this count will be zero and the Post-FEC BER will decrease as the length of time increases. A BER of 1.0E-12 or less is considered perfect, while a BER of 1.0E-6 or more is considered noticeable.

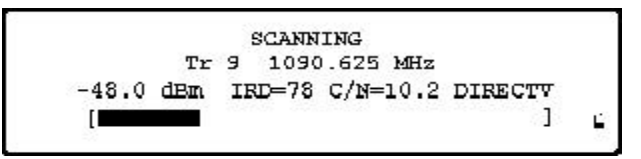
SCAN MODE

Scan Mode searches through all transponders, collecting critical parameter information. When finished, summary information is displayed in several screens. Use Scan Mode to verify that your system operates correctly at all frequencies.

TO START A SCAN

First, be sure that the correct channel plan is selected for your system and that the LNB power is turned on if needed. If you are using a multi-switch, press the LNB button until the desired switch setting is obtained. Then, press the [SCAN] button.

While scanning, the following screen is displayed:

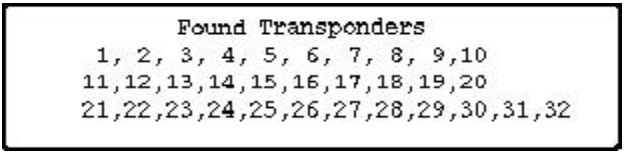


The bar graph shows the progress through the channels and readings for each transponder are shown briefly.

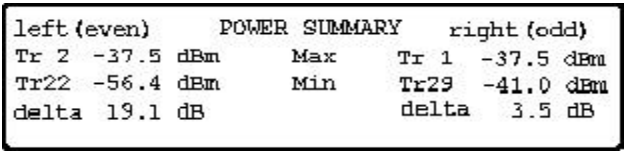
SUMMARY SCREENS

When the scan is completed, the following screens display the summary information, with left and right hand polarity transponders summarized separately. Press the [UP] and [DOWN] buttons to scroll between these screens.

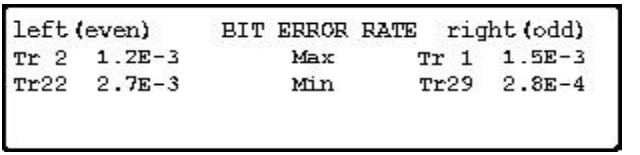
The Found Transponders screen shows the transponders used in the scan summary that matched the desired system type (DIRECTV or DVB-S).



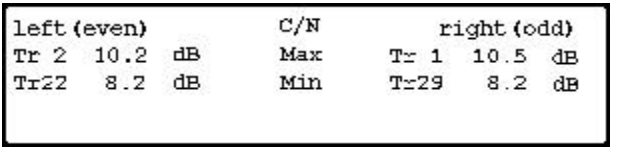
The Power Summary screen shows the maximum and minimum power levels for both left hand and right hand polarity transponders. It also shows the difference between the maximum and minimum, which indicates the tilt across the entire frequency range.



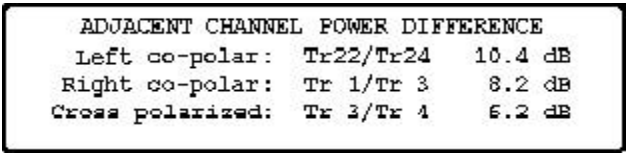
The Bit Error Rate summary screen shows the maximum and minimum BER for left and right polarity transponders. This is the PRE-FEC BER and does not include channels for which a lock could not be obtained.



The C/N summary screen will be titled with whichever quality measurement you have selected in Setup Mode: C/N, Eb/N0 or Es/N0. It also shows the maximum and minimum of the measurements for left and right polarity channels.



The Adjacent Channel Power Difference screen shows the worst case comparisons of adjacent channel power readings. It does this for the left and right polarity channels separately and also compares adjacent channels across polarity, unless a stacked channel plan is selected. The display shows the two channels with the worst case difference in power and indicates what that difference is.



NOISE SCAN CHANNEL PLAN

The "Noise Scan" channel plan may be used with an RF noise source to sweep a cable system and check for suck-outs or high frequency roll-off. A broadband noise generator such as the Applied Instruments NS-1 is convenient for this use.

The “Noise Scan” channel plan uses the same frequencies as the “Single 1000” to allow a scan over the entire 950 to 2150 MHz range. All channels are defined as “(DC-2)” or Digicipher II channels, which simply tells the SAT 9520 that a code lock is not needed.

When using the scan function with this channel plan and a noise source, the only summary screen that contains meaningful data is the Power Summary screen. This screen will show the maximum and minimum power levels for the odd numbered channels (950-1500 MHz) and for the even numbered channels (1500-2150 MHz). This provides an easy check of the cable system across the frequency ranges.

POLARITY AND MULTIPLE LNBS

POLARITY

The satellites transmit polarized signals that overlap in frequency. There are two types: circular and planar. Circular polarization has left-hand or right-hand circular polarized signals, while planar polarization has vertical or horizontal polarized signals. This scheme allows opposite polarity channels to overlap in frequency without interfering.

On most satellites, the odd numbered transponders use right-hand or vertical polarity and the even numbered transponders use left-hand or horizontal polarity. However, there are exceptions to this rule.

DUAL POLARITY LNBS

"Interleaved" systems leave the transponders in the same relative frequency positions as transmitted from the satellite. Because the opposite polarity transponders overlap in frequency, only one set can be selected at a time for transmission on the cable from the antenna. In dual polarity LNBs, this selection is made using 18 or 13 volts DC on the cable center conductor. Most channel plans are set up for dual polarity LNBs and the recommended voltage is part of the channel plan definition. Therefore, the SAT 9520 automatically sets the proper voltage when the LNB power is on and a channel is selected.

In a "stacked" system, the left-hand or horizontal polarity transponders are shifted in frequency and "stacked" on top of the right-hand or vertical polarity frequencies. The unshifted

transponders are at the same frequency as those in interleaved systems, but the shifted transponders are moved to frequencies between 1450 and 2150 MHz. Both can be present on the distribution cable at the same time. This is useful in multiple dwelling unit applications.

SINGLE POLARITY LNBS

Some systems use an LNB that supports only a single polarity and must be mechanically positioned to configure the system for horizontal or vertical transponders. To simplify operation with this type of LNB, several channel plans are provided that contain only transponders from one polarity or the other. For example, “C-Band H” contains only horizontal transponders while “C-Band V” contains only vertical transponders. When installing one of these systems, you should select a plan that matches the polarity your system will use.

MULTIPLE LNB ANTENNAS

Oval antenna dishes that can receive signals from satellites at two or more orbital positions are also available. These antennas have one LNB for each orbital slot and either an internal or an external switch to select a satellite. The LNB button can be pressed repeatedly to rotate through the available switch positions, provided the switch type is set up as described below. Some channel plans have an associated switch type.

MULTI SWITCHES

When using a switch, you can toggle between LNBs (switch settings) by pressing the LNB button on the SAT 9520.

EXAMPLE:

You are using a DiSEqC™ switch with a Dual 500 service on input 1, a Single 1000 service on input 2, and a Dish 500 service on input 3. You would like the SAT 9520 to measure the Single 1000 service through the DiSEqC™ switch. Connect all of the dishes to the switch according to the instructions provided with the switch. Connect the SAT 9520 to one of the output ports on the switch. Turn on the SAT 9520 and select the channel plan for Single 1000. Then, under SWITCH TYPE select "DiSEqC." Press [RUN] on the SAT 9520. Press the LNB button until the lower left part of the display reads "Dish 2" (press LNB button twice). You can now use the SAT 9520 on the Single 1000 feed.

ANOTHER EXAMPLE:

You are using a DishPro™ system with the twin LNB head that has an internal switch. Select the "DishPro" channel plan, the switch type changes to "DiSEqC." While this switch type would work with the external DishPro™ switch, it will not work with the twin head. So, change the switch type to "DpTwin." Now, when you press the LNB button once, the LNB 1 for the 110° satellite will be selected. Press the LNB button a second time to select LNB 2 for the 119° satellite.

SIGNAL LOCKING

The signal locking capability enables the SAT 9520 to identify which satellite a signal is coming from and to obtain BER measurements. There are three standard formats for digital signals in use: DVB-S, DIRECTV™ and DigicipherII™ (DC2). The SAT 9520 can lock onto DVB-S and DIRECTV™, but not DC2.

For DVB-S and DIRECTV™ signals, the SAT 9520 will display "Search" in the lock indicator position while searching for a lock and "DVB-S," "DIRECTV," or a system specific label when a lock is obtained. Examples of system specific labels are "DIRECWY" (for Hughes DIRECWAY™ signals), "STARBAND" and "TACHYON."

The SAT 9520 cannot lock onto DC2 signals so "(DC2)" is displayed instead of "Search." Because it cannot lock onto DC2 signals, it cannot provide a BER measurement for these channels. However, it can measure signal level and provide an estimated C/N.

The signal MUST be locked in order to obtain a BER reading. Also, if the signal is not locked, the C/N will be less stable and accurate. This will, in turn, compromise the Eb/N0, Es/N0, and IRD readings. Until the signal is locked, the demodulator scans for a frequency and clock rate that will produce a valid signal. The frequency deviation estimate will vary substantially due to the frequency scan.

SATELLITE IDENTIFICATION CARD

The SAT 9520 is shipped with a laminated card attached via a ball-chain. One side of this card is for identifying DBS satellites and the other is for non-DBS Ku Band satellites.

THE DBS SATELLITE SIDE INDICATES:

- The orbital-slot of the DBS satellites
- The transponder (Tr) numbers to use for that specific satellite
- The lock indicator that will replace "Search" when you are correctly aligned and tuned to that transponder

EXAMPLE: YOU ARE TRYING TO ALIGN THE ANTENNA TO THE 119° DBS SATELLITE FOR DIRECTV™.

As indicated on the laminated card:

- Tune to Tr 21 and adjust the dish until the lock-status shows "DVB-S."
- Tune to Tr 22 and verify that the lock-status shows "DIRECTV."
- With these two lock status indicators on Tr 21 and Tr 22, you can be confident that you are aimed at 119°.

The other side of the laminated card is for identifying the non-DBS Ku satellites. It lists the orbital position, the abbreviated name of the satellite, and the lock status indication (if a lock can be obtained) for those satellites.

SATELLITE IDENTIFICATION PLANS

Some of the channel plans contain one channel for each satellite in a certain band and/or reception area. Examples include the "Low Ku Band" plan for Ku Band satellites visible from North

America and the “C-Band H” plan for C Band satellites using the horizontal polarity setting on the LNB.

With this type of plan, the channel label in the upper left corner of the screen indicates the orbital position and satellite designation that the channel is set up to receive. If you receive a lock-status other than “Search” or “(DC2)” for one of these channels, you are locked onto the indicated satellite.

For more information, refer to the application note “Lower Ku Satellite Identification.”

BATTERY CHARGING

The standard Nickel-Cadmium battery pack will last for 300 to 1000 charge-discharge cycles, if properly cared for. Charging Ni-Cad batteries more often than necessary will shorten their life, so it is best to wait until the battery status indicator reads empty before recharging the battery.

The SAT 9520 has a fast battery charge circuit that charges the battery to 85 percent capacity in approximately 2 hours. An overnight charge (6 to 8 hours) will continue charging until the battery is completely full.

LEAVING THE CHARGER ON AFTER THE BATTERY IS COMPLETELY CHARGED WILL NOT HARM THE UNIT, BUT REMOVING THE CHARGER AFTER 6 TO 8 HOURS IS RECOMMENDED.

BATTERY STATUS INDICATOR

The battery indicator symbol on the LCD display shows the relative battery charge status:

When the “Empty” symbol is shown, the unit should be re-charged. If the charge falls too far below the empty mark, the unit will automatically shut off to avoid damage to the battery.

BATTERY CHARGE LED

The battery charge LED shows the status of the battery charging circuit:

Off	Charger is not connected
Yellow	Fast charging
Green	Battery nearly full and in a trickle-charge mode

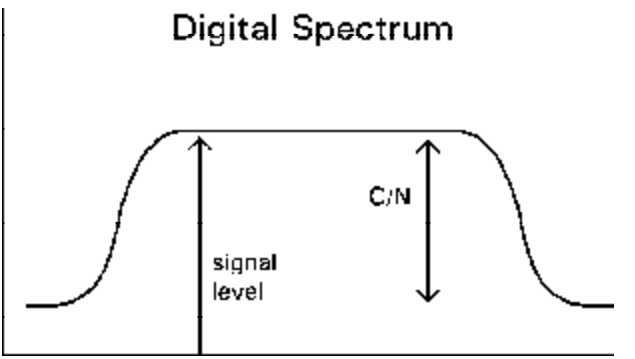
WALL TRANSFORMER

The wall transformer is rated at 120 VAC, 50-60Hz input and 24 VAC at 1.5 Amperes output with 2.1 mm plug. Using a transformer with a lesser or greater rating may damage the transformer and the SAT 9520.

ANY ATTEMPTS TO CHARGE THE BATTERY WITH AN EXTERNAL POWER SOURCE OTHER THAN THE PROVIDED AC WALL TRANSFORMER MAY RESULT IN POOR OPERATION OR DAMAGE TO THE UNIT.

DIGITAL SIGNAL MEASUREMENTS

Digital signals are significantly different from the traditional analog signals. The following diagram illustrates what a digital signal looks like on a spectrum analyzer and shows the two most basic measurements: the signal power level and the carrier-to-noise ratio (C/N).



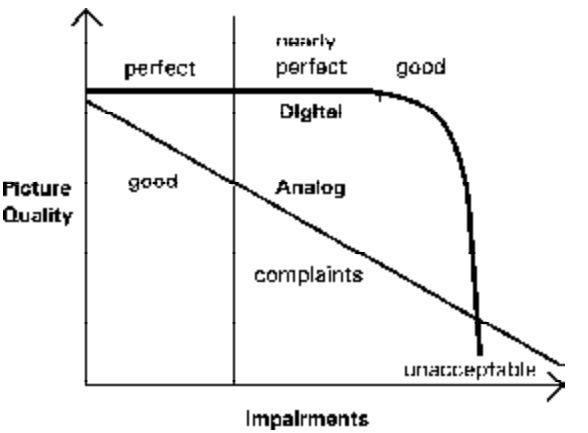
Measuring the signal level is useful when aligning the antenna and adjusting amplifiers. In general, a stronger signal is better unless it overdrives the amplifiers or receivers. The C/N ratio provides a measurement of the signal quality. The larger this difference, the fewer errors received.

Unfortunately, some types of signal impairments that affect performance can remain hidden within the digital "haystack." These impairments will not show up in the C/N ratio; however, they will show up in a Bit Error Rate (BER) measurement.

The classic BER measurement is performed either by transmitting a known bit pattern and comparing it to the received bit pattern, or by comparing transmitted and received bit patterns directly. The former requires a disruption of service, and the latter is not possible except at a satellite uplink facility.

Furthermore, because DBS systems use forward error correction (FEC), the BER measurement will remain very good until the impairments become so insurmountable that the FEC is unable to make the corrections. This is known as the "cliff effect."

The diagram below illustrates how the digital channels maintain nearly perfect picture quality with increasing level of impairment until the "cliff" has been reached. At that point, the signal will quickly degrade to no picture at all. Although analog channels will maintain some picture even after digital channels quit all together, customers become unhappy with analog fuzz and snow long before digital channels fail to provide a picture.



BIT ERROR RATE

The SAT 9520 utilizes data from the FEC process to provide more useful BER measurements without requiring a disruption of service. There are two types: a Pre-FEC BER and a Post-FEC BER.

The Pre-FEC BER test is based on the number of errors detected by the first stage of the FEC process, the Viterbi decoder. This BER is measured quickly and provides an estimation of available margin. Because it measures errors found in the raw received signal, not the corrected signal, it indicates the damage caused by interference and noise, thereby showing the effect of the impairments hidden within the digital "haystack" and letting you assess how close to the "cliff" you are.

A Post-FEC BER measurement is also available in the SAT 9520. This uses data from the second stage of the FEC process, the Reed-Solomon decoder, to measure the errors that survived the first stage and the errors that remain in the final signal that is delivered to the customer. An intermediate stage error rate is also displayed as part of the Post-FEC BER test.

A Post-FEC BER of 1E-6 is considered a threshold for visible degradation[1] and a "perfect" signal has been defined as one that has a BER of 1E-12 or less. A BER of 1E-12 is less than one bit wrong out of 1 trillion bits. Unfortunately, it takes about 9 hours to receive 1 trillion bits, so it would take 9 hours to test for a BER of 1E-12. To obtain any statistical level of confidence, you would need to allow even more time! This level of testing is probably not something you want to do in the field, but the SAT 9520's Post-FEC BER test will run as long as you wish and will display the number and BER of corrected and uncorrected errors for the duration of its running time.

[1]THOMAS & EDGINGTON,* DIGITAL BASICS FOR TELEVISION, *PRENTICE HALL, 1999.

EB/N0

DEFINITION: EB/N0 = ENERGY-PER-BIT / NOISE-PER-HZ

Eb/N0 can be thought of as the average carrier-to-noise ratio per bit. It can be used to compare the performance of different modulation systems without having to correct for different bit rates.

The carrier-to-noise ratio (C/N) and Eb/N0 are related by the following formula:

$$\frac{Eb}{N0} = \frac{C}{N} + 10\log(noiseBandwidth) - 10\log(bitrate)$$

where bit rate is in bits per second
noiseBandwidth is in Hertz (24 MHz for DBS signals)

The bit rate refers to the bits received after the bits added for the FEC process have been removed. The standard DBS signals use a 20 MHz symbol rate, with 2 bits per symbol. The FEC process adds bits for Reed Solomon and Viterbi encoding. A 130/147 Reed Solomon code rate and a 6/7 Viterbi code rate produce an overall code rate factor of 0.758. The bit rate is thus:

bit rate = 40 MBps * 0.758 = 30.3 MBps

$$\frac{Eb}{N0} = \frac{C}{N} + 10\log(24MHz) - 10\log(30.3MHz)$$

$$\frac{Eb}{N0} = \frac{C}{N} - 1.01$$

ES/N0

DEFINITION: ES/N0 = ENERGY PER SYMBOL / NOISE PER HZ

The Carrier to Noise ratio (C/N) can be converted to Es/N0 with the following formula:

$$\frac{Es}{N0} = \frac{C}{N} + 10\log(noiseBandwidth) - 10\log(symbolRate)$$

In this case, the symbol rate for DBS signals is always 20 MHz, so:

$$\frac{Es}{N0} = \frac{C}{N} + 10\log(24) - 10\log(20)$$

$$\frac{Es}{N0} = \frac{C}{N} + 0.79$$

These formulas are dependent upon the symbol rate and the noise bandwidth. The noise bandwidth depends on the symbol rate and the filtering coefficient. These numbers are part of the tuner setup parameters associated with each channel. The SAT 9520 will automatically use the correct values for the channel when a signal lock has been obtained. The bit rate is also dependent on the Viterbi code rate. The SAT 9520 scans the available code rates in the process of obtaining signal lock and the matching code rate is used in the bit rate computation.

CHANNEL PLANS

The following list shows the “Standard” North American plans available at the time of this printing. For the latest list of available channel plans see www.appliedin.com.

DBS PLANS:

These plans are for use with the DBS systems.

Dual 500 For standard DIRECTV™ “interleaved” systems, tunable to 32 transponder frequencies from 950 to 1450 MHz (101°, 110°, 119°).

Single 1000 For DIRECTV™ stacked LNB systems that move the even transponders to 1500 thru 2025 MHz, 32 transponder frequencies.

Bell Express For “interleaved” Bell ExpressVu™ systems (32 frequencies from 950 to 1450 MHz).

Bell Stacked For Bell ExpressVu™ systems using the NAS stacking up-converter (32 frequencies from 950 to 2150 MHz).

Dish 500 For Echostar/Dish Network™ single or twin systems (950 to 1450 MHz).

DishPro For Echostar/Dish Network™ stacked systems that look at multiple satellites (61°, 110°, 119°).

KU BAND SATELLITES:

These plans are each configured for a particular satellite and contain the digital transponders which the SAT 9520 can lock onto or measure.

Galaxy 4R For use with WSNet™, "HITS", and Hughes.

G4R Stacked Galaxy 4R with a stacked LNB system.

GE4 @101W For AMC4 (formerly GE4) transponders including STARBAND™ Internet signals.

SatMex 5 SM5 individual transponder frequencies.

Telstar 5 T5 individual transponder frequencies.

Telstar 6 T6 individual transponder frequencies for WSNet™ program signals using an "interleaved" LNB (950 to 1450 MHz).

Telstar 6 Stacked T6 individual transponder frequencies for WSNet™ program signals using a stacked LNB (950 to 2150 MHz).

Telstar 7 T7 individual transponder frequencies.

SATELLITE ID PLANS:

These plans are configured with one channel per satellite and cover a range of satellites for a particular band or LNB configuration.

Low Ku Band For identifying Ku satellites using an "interleaved" dual polarity LNB. (LO = 10.750 GHz).

Low Ku Stacked Same as above but using a stacked LNB (950 to 2150 MHz).

Starband H Primarily for installing STARBAND™ satellite Internet systems that have a horizontal polarity transmitter (vertical receive).

Starband V Primarily for installing STARBAND™ satellite Internet systems that have a vertical polarity transmitter (horizontal receive).

C-Band H/V For identifying C-Band satellites on systems that utilize dual polarity LNBs down converted to 950-1450 MHz.

C-Band H For locating C-Band satellites on systems set for horizontal polarity.

C-Band V For locating C-Band satellites on systems set for vertical polarity.

SPECIAL PURPOSE PLANS:

Noise Scan For use with a noise source for cable sweeping. See additional information labeled "NOISE SCAN CHANNEL PLAN" in the SCAN MODE section.

WSNet Dual For use with the WSNet™ dual LNB system with interleaved LNBs. (950 to 1450 MHz). Contains G4R and T6 channels.

WSNet Stack Same as above but for stacked LNBs (950 to 2150 MHz).

FREQUENCY CHART