PRELIMINARY OPERATING INSTRUCTIONS
FOR
AVCOM'S
PSA-37D SPECTRUM ANALYZER

BEFORE OPERATING PSA-37D SPECTRUM ANALYZER, READ THESE SECTIONS:

GENERAL SAFETY, PAGE 2
IMPORTANT CAUTIONS, PAGE 3

IMPORTANT
READ CAREFULLY BEFORE USING INSTRUMENT

GENERAL SAFETY

ONE OR MORE COMPONENTS OF YOUR EARTH STATION IS CONNECTED TO 120 VOLT AC LINE CURRENT. IT IS IMPORTANT THAT YOU GROUND ALL COMPONENTS OF YOUR SYSTEM, PARTICULARLY THE ANTENNA, TO REDUCE THE POSSIBILITY OF DANGEROUS ELECTRICAL SHOCK.

WHEN USING INSTRUMENTS SUCH AS THE PSA-37D, POWER HAND TOOLS, AND ANY OTHER APPLIANCE CONNECTED TO AN ELECTRICAL OUTLET, EXERCISE GREAT CARE TO ENSURE THAT THE DEVICE IS GROUNDED EFFECTIVELY TO AVOID ELECTRICAL SHOCK. DO NOT USE WHILE STANDING IN WATER, ON DAMP EARTH, OR WHILE IN PERSONAL CONTACT WITH A CONDUCTING SURFACE SUCH AS A METAL LADDER OR CHAIR.

ALSO,

- USE PROPERLY GROUNDED ELECTRICAL OUTLET OR EXTENSION CORD
- DO NOT CUT GROUNDING PIN FROM LINE CORD PLUG
- USE FUSES OF CORRECT AMPERAGE
- DISCONNECT LINE CORDS WHEN WORKING INSIDE RECEIVER OR ON ANTENNA
- ENSURE THE ANTENNA AND OTHER COMPONENTS OF YOUR EARTH STATION ARE PROPERLY GROUNDED
- DO NOT SERVICE EQUIPMENT ALONE-WORK WITH SOMEONE WHO CAN ADMINISTER HELP AND FIRST AID
- PERSONS WORKING WITH LINE VOLTAGES SHOULD BE TRAINED IN AND CAPABLE OF PERFORMING FIRST AID AND RESUSCITATION TECHNIQUES

IMPORTANT CAUTIONS

1. THE PSA-37D supplies +12/+18 VDC on the RF connectors to power most LNA's and BDC's. It is the customers' responsibility to ensure that the components being powered by the PSA-37D are compatible with +12/+18 VDC. If in doubt, consult the manufacturer of the component.

2. Do not couple the input of the PSA-37D to high power RF sources such as walkie-talkies, CB radios, transmitters, etc. Signal levels in excess of +15 dBm can damage the sensitive mixers in the instrument resulting in otherwise unnecessary expense and repairs. External DC voltage not to exceed 50 VDC.

3. HANDLE WITH CARE- The PSA-37D Spectrum Analyzer is a precision instrument designed for normal operating and handling conditions. It should be protected from abuse such as dropping, throwing, and other rough handling. When being transported in a vehicle, or shipped, the PSA-37D must be cushioned and protected against shock and vibration.

4. Follow safety practices on preceding page.

WHAT IS THE PSA-37D SPECTRUM ANALYZER AND WHY DO I NEED ONE?

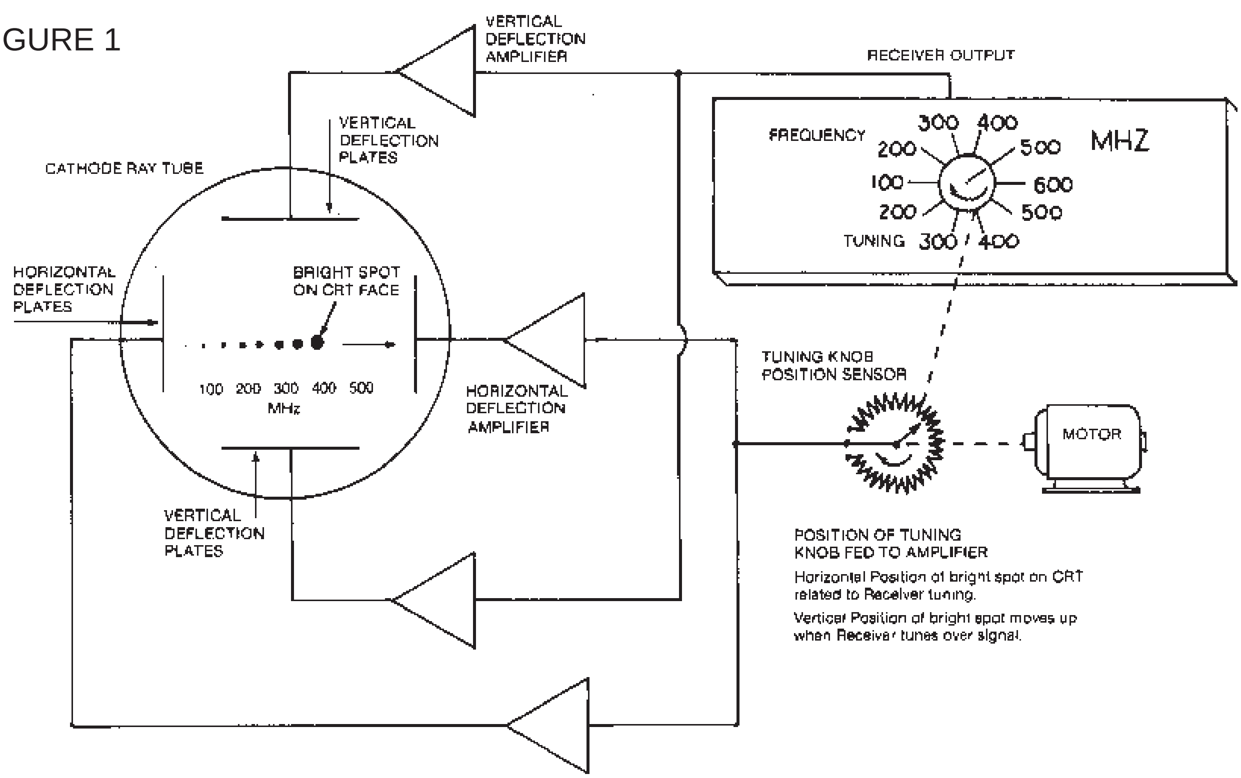
ANSWER:

Traditionally, when the words, "spectrum analyzer" are mentioned, most people think of a highly complex, bulky and heavy instrument that few people with less than an engineering degree could use, let alone understand. Until now there was some truth to this statement. But not anymore.

Avcom's PSA-37D Spectrum Analyzer has been designed to be the most versatile and useful single piece of test equipment ever available to the satellite communications industry. In short, there is not another spectrum analyzer in existence that combines the portability, ease of operation, and analytical power of the PSA-37D.

The history of the spectrum analyzer dated back to pre-World War II when radar and microwave communications were just beginning to evolve. There was a need to see on some type of display all the signals that might be present in a specific band of frequencies. A basic spectrum analyzer was built in the following way. The tuning knob of a receiver was electrically connected to a cathode ray tube so that as the receiver was tuned from the start to the end of a frequency band, the scope trace would move from the left to the right of the display. The position of the dot on the horizontal axis of the display was directly related to the frequency the receiver was tuned to at any instant. (See figure 1) The receiver was tuned over the frequency band rapidly by a motor* so that the spot would move back and forth rapidly and appear as a bright line on the face of the CRT. This is the first basic concept to understanding a spectrum a

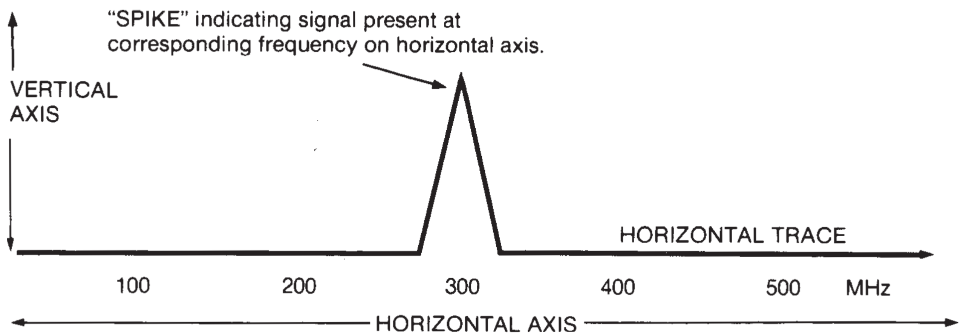
FIGURE 1



*A motor was used in this spectrum analyzer example because in the early stages of technology there was no way to sweep wide frequency ranges with purely electronic means. A motor could be attached to rotating capacitor plates and wide frequency tuning could be obtained.

We have devised a method of tracing a line on a display screen so that at any point along the line a specific frequency is defined. All that is needed now is to deflect the trace vertically when a signal is received. Where the line is deflected vertically, a "spike" will appear (See Figure 2) indicating that a signal is present at that horizontal position or frequency.

FIGURE 2



To deflect the beam vertically when the receiver is tuned across a signal, the output of the receiver was connected to the vertical deflection plates. If the receiver detected a signal, it would be amplified and cause the CRT deflection plates to bend the beam upward. If the signal were strong the reflection would be great, and much less if the signal were weak. At whatever point the beam was deflected along the horizontal axis, it would represent a signal being received at a frequency corresponding to that horizontal position. The amount of deflection or height of the spike indicated signal strength. That's all there is to a basic spectrum analyzer.

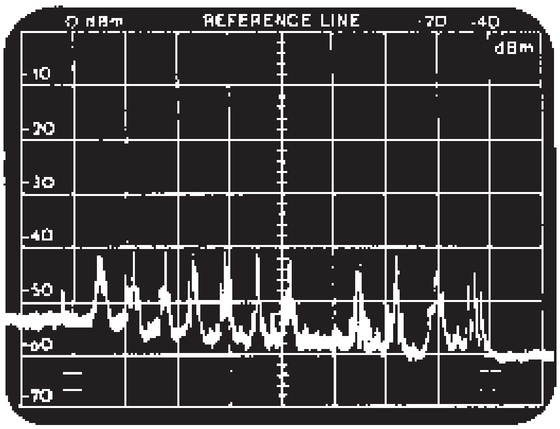
The PSA-37D Spectrum Analyzer is no different in its display. Frequency is represented by the position of the trace along the bottom horizontal scale and signal strength (amplitude) is read out by the height of the trace on the vertical scale. A few more controls and readouts are provided so that wide frequency ranges can be covered, center frequency is accurately measured and displayed, signals can be "zoomed" in on for close inspection, and very accurate amplitude measurements can be made.

Here's good news. The controls on the PSA-37D can be mastered and basic operating procedures learned in a few minutes. Basic trouble shooting applications can be learned in a few more. Even more important is that the PSA-37D has been designed with such versatility and accuracy that it will satisfy the beginner as well as the most demanding engineer.

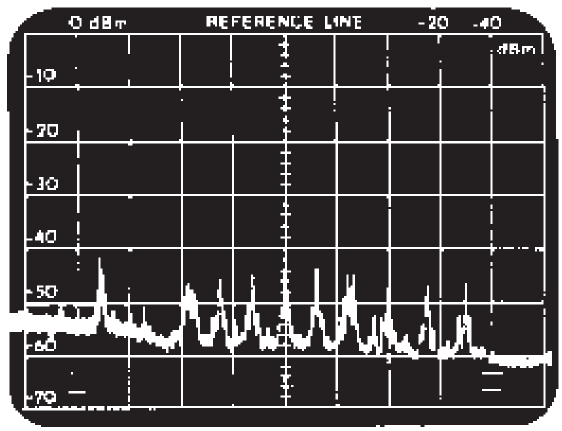
How can the PSA-37D Spectrum Analyzer be used in the satellite communications industry? Having a PSA-37D to look at and identify all the different RF signals on the outputs of LNA's, BDC's, downconverters, modulators, feedlines, and being able to make meaningful measurements and comparisons enable the user to quickly see and identify weak signals, signal frequency, line "tilt", missing or spurious signals, cross polarization, and terrestrial interference. Acquiring a PSA-37D is like being given a flashlight on a dark night in a field full of potholes.

Probably the most common application for the PSA-37D is during an installation. After the dish is assembled and the LNA and/or BDC mounted, connect it to the PSA-37D. Select internal battery power and switch on the internal LNA/BDC +18 VDC. In a few seconds you will see a trace on the display. Move the antenna in the direction of the satellites and almost immediately transponders will be seen (before they would appear on a receiver-monitor). Adjust the dish for strongest displayed signals and then adjust polarization. After the first use or two you will be able to identify various satellites from the pattern of the transponders on the display. (See figure 3) Then move the dish across the arc, watching all the transponders from each satellite as you go. You will adjust the tracking faster than ever before. When your alignment is done you can connect the receiver coax and be confident of receiving perfect pictures in your customer's house. And having a spectrum analyzer will impress and fascinate the customer. If Terrestrial Interference is present, you can show and explain it to him/her and use the PSA-37D to align the IF filters for minimum TI and best picture.

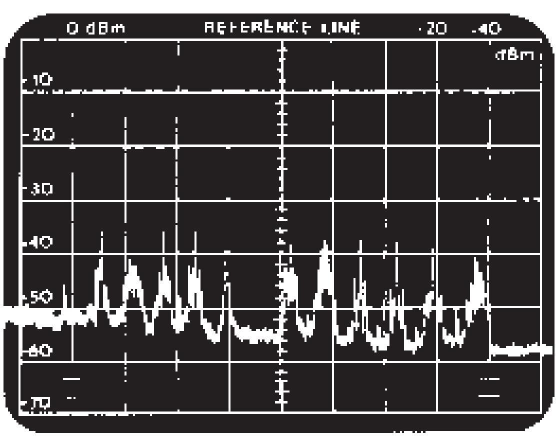
You need an AVCOM PSA-37D to enhance your ability to install and service satellite systems, to reduce time spent on elusive trouble calls, to increase customer confidence and respect, and to aid in diagnosing and resolving Terrestrial Interference problems. The time, effort, and money saved will pay for it quickly. But, maybe the best reason to own an AVCOM PSA-37D is the personal satisfaction and enthusiasm that will come from developing your technical skills and expertise as you and your business grow.



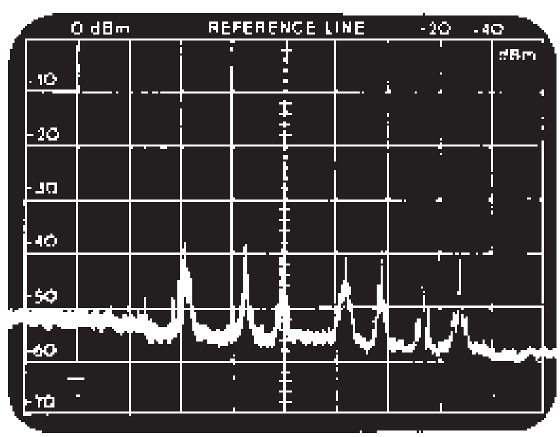
GALAXY 1
VERTICAL



SATCOM 3
VERTICAL



ANIK B
VERTICAL



SATCOM 4
VERTICAL

FIGURE 3

INTRODUCTION

The PSA-37D Spectrum Analyzer is a high performance, reliable instrument for making accurate signal strength measurements of wideband signals over the frequency range commonly used in the satellite communications industry. The unit is small and lightweight, battery-operated, or can be operated from 115 VAC, and includes its own battery recharger. Two to three hours of battery operation (depending on duty cycle) are possible.

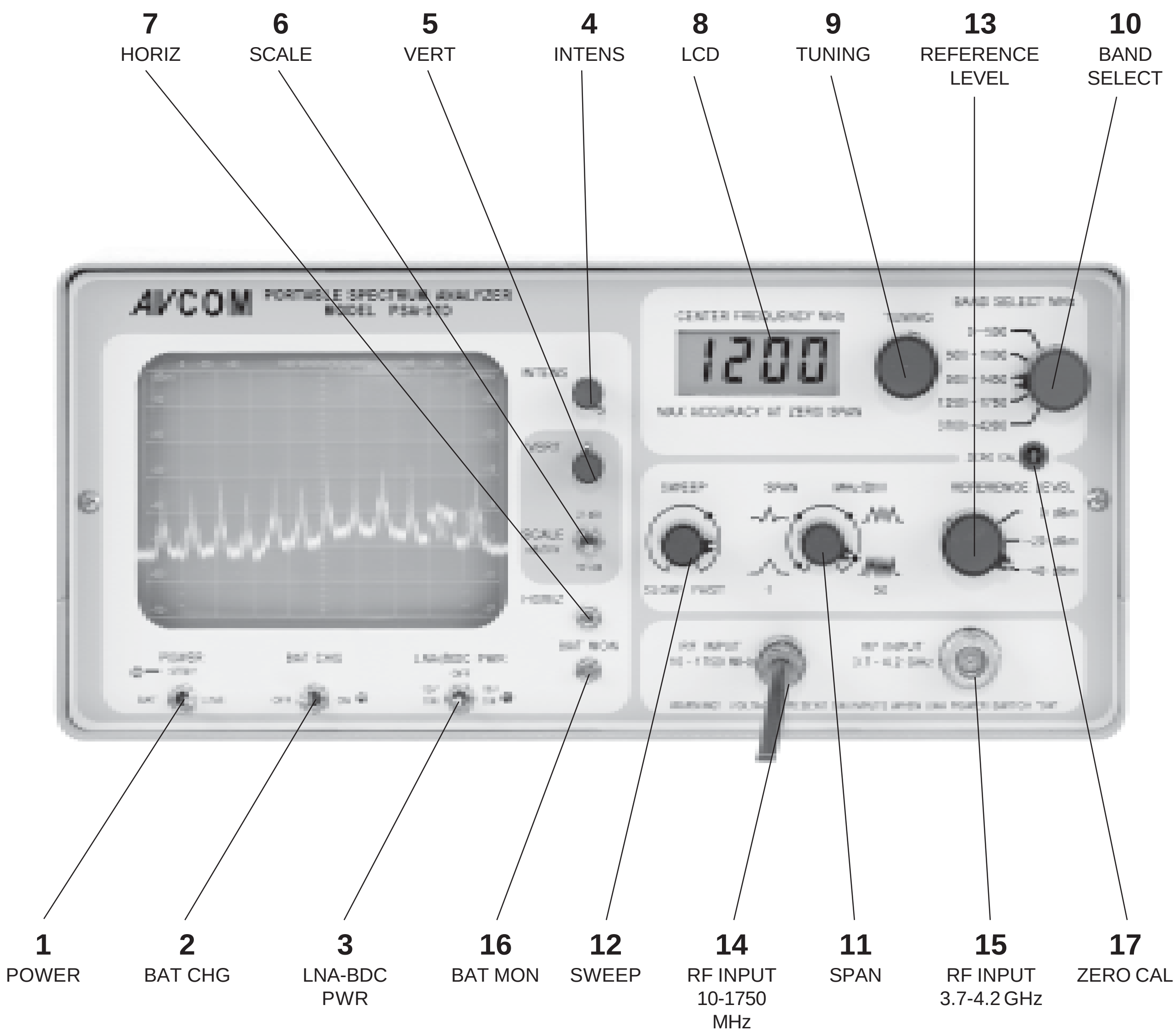
LNA's and BDC's can be powered up the feedline via the front panel coax connectors by setting the LNA/BDC PWR switch to ON. Maximum current 1/2 amp.

The PSA-37D can be used to acquire a satellite signal initially on a dish antenna and then to optimize the tracking adjustments much faster than conventional methods. Low Noise Amplifier and Block Downconverter performance can be determined instantly from the spectrum analyzer display. In fact, PSA-37D is able to clearly show the difference in the output noise levels of an LNA when it is pointed at the ground and when pointed at clear sky (a very good indication of LNA operation).

Amplitude accuracy is typically within ±2 dB on each band so that meaningful and reproducible signal measurements can be taken. On-screen dynamic range is better than 60 dB.

Frequency coverage is from less than 10 MHz to over 1750 MHz and less than 3.7 GHz to over 4.2 GHz in 5 bands. Each band is designed to cover a specific group of frequencies of interest to the satellite communications industry. The PSA-37D can be tuned through the selected band and signals of interest can be centered on the display while their frequency is shown on the center frequency display. The 4 digit LCD center frequency readout allows you to quickly and correctly identify the frequency in MHz of a signal centered on the PSA-37D display.

AVCOM's PSA-37D



LOCATION AND FUNCTION OF FRONT PANEL CONTROLS

(Refer to diagram on opposite page)

1 POWER

BAT - turns instrument on and instrument is powered by internal rechargeable battery or external 12V source depending on rear panel switch position.

STBY - Amber LED is illuminated if line cord connected to source of 115 VAC. Instrument is functionally off although power is present inside chassis.

LINE - turns instrument on and power is from 115 VAC line source.

2 BAT CHG

Battery is connected to internal charging circuit when switch is on the ON position. Amber LED is illuminated while battery is recharging. Best results while in STBY with rear panel switch on internal battery position. External DC input (rear panel 2.5mm connector) should not exceed +14.8 VDC when charging from car adapter, rear panel switch should be in external 12V source position.

3 LNA-BDC PWR

When in the ON position, power is applied to the input connectors so that LNA's and/or BDC's can be powered via the feedline. The red LED is illuminated when voltage is present on the connectors. Three position switch allows +12 VDC, OFF, or +18 VDC. Dual voltage allows for special operation on specific LNB. Check manufacturers specifications.

4 INTENS

Controls the brightness of the CRT display.

5 VERT

Controls the vertical position of the trace.

TO SET: With no signal input and "Reference Level" control set of 0 dBm, the trace should be adjusted to be between the 2 small "tic" marks between -60 and -70 dBm at the bottom of the display.

6 SCALE

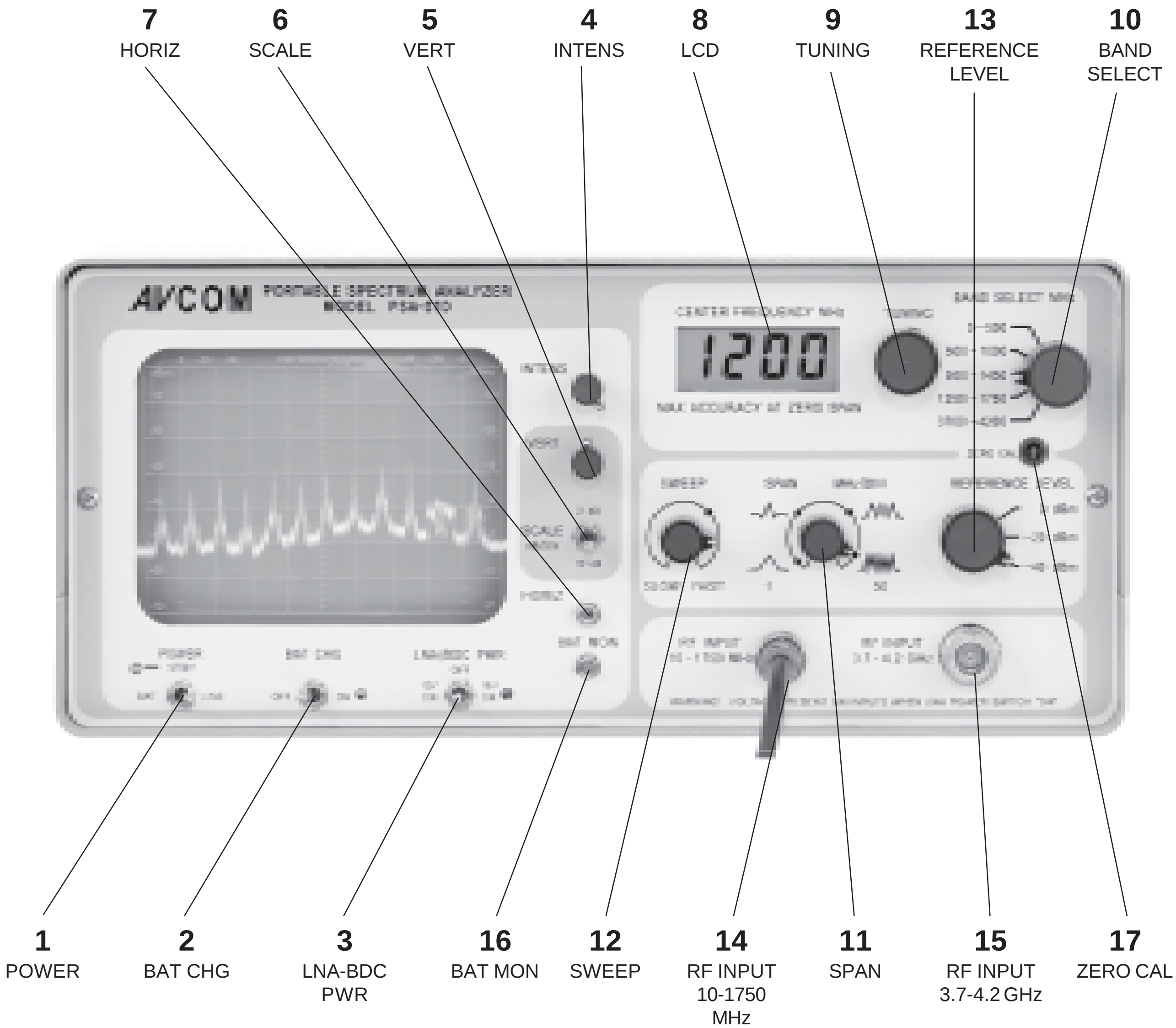
Used to select amplitude sensitivity of either 10 dB/DIV or 2 dB/DIV. The 2 dB position is particularly helpful for peaking the antenna and feedhorn.

7 HORIZ

The HORIZontal position control is a recessed pot that is factory set but is accessible to the operator with the use of a plastic tuning tool. In general, the HORIZ should not need to be adjusted in the field. HORIZ positions the trace horizontally on the screen so that if a signal is placed at the center of the display and the span control turned counterclockwise for a closer look at the signal, the signal remains at the center of the display and the CENTER FREQUENCY should remain the same.

TO SET (if the situation warrants): Using SPAN and TUNING controls, expand on a signal turning SPAN counterclockwise while keeping signal on screen with the TUNING control. Then turn SPAN clockwise while observing the signal. Adjust HORIZ to position the signal on the centerline of the display. Repeat one time.

AVCOM's PSA-37D



8 LIQUID CRYSTAL DISPLAY

The 4 digit LCD currently has 2 functions but additional features may be added in the future. The LCD allows you to read the frequency of a signal centered on the PSA-37D graticule. When the BAT MON button is depressed, the DC voltage of the internal battery pack is displayed.

9 TUNING

Tunes the PSA-37D through the selected band and centers signals of interest on the display while their frequency is shown on the CENTER FREQUENCY LCD display.

10 BAND SELECT

Selects the frequency range of interest to be displayed on the Spectrum Analyzer. Frequencies from less than 10 MHz to more than 1750 MHz and 3.7 to 4.2 GHz can be displayed.

11 SPAN

Controls the sweep width of the Spectrum Analyzer. When fully clockwise, signals in the entire bandwidth of the selected band are displayed. Then, if a smaller area of that spectrum is to be examined, the area is centered over the vertical centerline with the CENTER FREQUENCY control and the SPAN control turned counterclockwise to see the signal more closely.

12 SWEEP

Controls the rate the trace moves over the display. For general observation, a sweep rate just fast enough that "trace flicker" almost disappears should be used. For the accurate amplitude and signal measurements the PSA-37D is capable of, the sweep rate should be slowed down until the signal is at maximum display amplitude. Generally, the sweep should be set at the mark or below (approximately 1 o'clock position).

13 REFERENCE LEVEL dBm/dBmv

The Reference Level control establishes the amplitude calibration for the display. When set at the 0 dBm position, with the scale switch in the 10 dB/DIV position, signals peaking at the 2nd line from the top, the -10 dBm / + 49 dBmv line, would have a strength or amplitude of -10 dBm / +49 dBmv, signals peaking at the -20 dBm / +29 dBmv line would have a signal strength of -20 / +29 dBmv, dBm and so on.

When the Reference Level control is set to -20 dBm the very top line represents an amplitude of -20 dBm / +29 dBmv and the second line down would be -20 dBm minus 10 or -30 dBm (+29 dBmv minus 10 equals +19 dBmv) subtract 10 for each line down to get the signal level represented by that line.

The same is true for the -40 dBm position except that -40 dBm / +9 dBmv signals would be at the top line. This is the most sensitive position and signals as weak as -90 dBm can be seen.

14 RF INPUT 10-1750 MHz

The BNC connector accepts signals to be displayed from less than 10 MHz to over 1750 MHz.

15 RF INPUT 3.7-4.2 GHz

The type N connector accepts signals from 3.7-4.2 GHz for display on the CRT.

16 BAT MON

When the BAT MON button is depressed, (reading available with unit ON only) the voltage internal battery pack is displayed on the LCD, +12 volt nominal, +14.5 volts during equalize charge, 13.8 volts float charge (Equalize and float levels are electronically controlled internally). Turn unit off when operating on internal batteries at a reading of 10 volts or greater.

WARNING-DO NOT APPLY SIGNAL STRENGTHS GREATER THAN +15dBm OR INPUT MIXER MAY BE DAMAGED! ALSO, NOT MORE THAN 50 VDC.

17 ZERO CAL (Recessed Pot)

Allows for adjustment of the signal tuning to match the LCD readout. It adjusts the tuning of all five bands by +/- 10 MHz to compensate for temperature drift.

OPERATION

Preliminary Checkout and User Familiarization

IMPORTANT: The batteries in your AVCOM Portable Spectrum Analyzer are gel cell lead acid type - NOT NICAD. They are similar to the battery in your car which means that “deep cycling” or total depletion may cause irreparable damage. AVCOM recommends that anytime the PSA-37D is operated on battery (regardless of duration) it should be fully recharged. There is not any memory problems associated with the use of these gel cell batteries. Since the life of the batteries is greatly dependent on operator’s care, they are excluded from the Limited Warranty.

1. Place POWER switch into STBY position.
2. Plug PSA-37D into line socket (115 VAC).
3. Note that amber STBY LED is illuminated.
4. Turn BAT CHG to ON and note that amber LED is illuminated.
5. Turn POWER switch to ON. Turn INTENS control 80% of full clockwise position. Center VERT. After 30 seconds a trace should appear on CRT.
6. NOTE: In this step +18 VDC will be applied to input connectors. Make certain that nothing is connected to them.
   Place LNA/BDC PWR switch in +18 VDC ON position. Note red LED lights indicating that +18 VDC is available on RF connectors (or 12 VDC ON if preferred).
7. Turn LNA/BDC PWR switch off, red LED should extinguish.
8. Set up instrument as follows:
   BAND SELECT: 0-500 MHz Band (first position)
   CENTER FREQUENCY: Use TUNING to set frequency at 100 MHz
   SWEEP: set at 1 o'clock
   SPAN: fully clockwise
   REFERENCE LEVEL: 0 dBm
   SCALE: 10 dB/DIV(down position)
9. Adjust VERT control to position trace between the two short "tic" marks in the bottom left graticule square (between -60 and -70).
10. Note that a large signal is visible on left of display. This is normal for all spectrum analyzers and is called ZERO FREQUENCY. Small spurious signals are present around it.
11. Using the TUNING Control, place the Zero Frequency signal in the center of the display.

12. Turn the SPAN control slowly counterclockwise to expand the signal, while keeping it centered with the TUNING control. Expand the large peak significantly and center it.
13. The HORIZ position control is not normally used in the field however if the PSA-37D seems to be out of calibration, the following procedures may be helpful. Turn the span control full clockwise and do not touch the TUNING control. If the HORIZ control is not calibrated the peak will shift to the right or left of the vertical centerline. Use the HORIZ control to move it back to the center line.
14. Repeat steps 12 and 13 to verify adjustment is correct.
15. To check that the sensitivity of the instrument can be changed with the REFERENCE Level control, observe the ZERO FREQUENCY peak and turn REFERENCE LEVEL to -20 dBm. The peak should become larger. Then turn REFERENCE LEVEL to -40 dBm. The little peaks to the sides of the main peak should become higher and the main trace should become noticeably noisy.
16. Note position of VERT and INTENS knobs so PSA-37D can be put into service rapidly the next time it's used.
17. This completes the User Familiarization and Preliminary Checkout procedure.

SPECIFICATIONS

Frequency Coverage

Low Bands: a) less than 10 to 500 MHz (70 MHz and other receiver IF frequencies)
b) 500 to 1000 MHz (3.7 to 4.2 GHz and 12 GHz block downconverter frequencies - pertains to frequencies b-e)
c) 950 to 1450 MHz
d) 1250 to 1750 MHz

High Band: a) 3.7 to 4.2 GHz

Input Connectors

Low Band: BNC (type F to BNC adapter included)
High Band: type N

Input Connector DC Block Capability -- Both input connectors are DC blocked and provision is made for insertion of +12 or +18 VDC into connector by front panel switch.

Frequency Display Accuracy - 4 digit LCD frequency readout - Accuracy ±6 MHz nominal, at zero span.

Display - 10 horizontal graticule divisions (frequency) x 7 vertical graticule divisions (amplitude). Each vertical division equals either 2 dB or 10 dB.

Reference Levels - 0, -20, and -40 dBm/+49, +29, and +9 dBmv

Dynamic Range - 60 dB

Display Sensitivity - 2 dB/DIV or 10 dB/DIV

Amplitude Accuracy - ±2 dB, typical per band

Resolution Bandwidth - 250 KHz

Calibration - internal calibration, factory set

Span - Over 500 MHz (50 MHz/DIV) to less than 1 MHz/DIV

Weight - 17 lbs. / 7.72 Kg

Dimensions - 14.5"W x 5.5"H x 13.5"D, 37 cmW x 14 cmH x 34 cmD.

Circuitry - Most circuitry on pluggable PC boards for rapid and easy service.

Construction - Attractive and durable epoxy painted heavy gauge aluminum chassis and cover, with carrying handle, and line cord storage brackets which double as feet to stand the PSA-37D on end for easy viewing and operation in the field.

Power Requirements - 115 VAC, 60 Hz, 15 watts or internal rechargeable batteries for portable operation. 100/220/240 volt model available.

BATTERY OPERATION NOTE

The batteries in your AVCOM Portable Spectrum Analyzer are gel cell lead acid type - NOT NICAD. They are similar to the battery in your car which means that “deep cycling” or total depletion may cause irreparable damage.

AVCOM recommends that anytime the PSA-37D is operated on battery (regardless of duration) it should be fully recharged. There is not any memory problems associated with the use of these gel cell batteries. Recharge often but not longer than 20 hours.

Since the life of the batteries is greatly dependent on operator’s care, they are excluded from the Limited Warranty.

Design and specifications subject to change without notice

SASAR INTRODUCTION

Spectrum Analyzer System Analysis Report

The SASAR is an invaluable tool to assist the installer and service personnel and to establish their credibility and reinforce customers' confidence. The SASAR contains a record of all signal strength readings taken with a PSA-37D Spectrum Analyzer that are available from LNA to the receiver. If a problem should arise in the future involving video quality or other system performance problems, and the solution isn't obvious, the SASAR should be consulted and the measurements taken again. The installing dealer should give a copy to the customer and keep a copy on file.

Many problems will fall quickly to the serviceman equipped with a PSA-37D. Some that could take many hours will be obvious at a glance of the display.

INTRODUCTION TO APPLICATION SECTION

The following Application Section presents a series of checks and tests to familiarize and teach the principles and usage of the PSA-37D Spectrum Analyzer. The section should be read by everyone who will use the PSA-37D since may subtle points are made and by practicing the examples, many questions will be answered.

AVCOM solicits your own applications and suggestions. Use the form and envelope at the last page of this manual and mail to: AVCOM, 500 Southlake Blvd., Richmond, VA 23236.

Application Example #1

Observing Output of LNA at Dish for Testing and Dish Alignment

One of the most useful and easiest applications of the PSA-37D Spectrum Analyzer is to use it to look at the signal spectrum coming from the LNA on a satellite dish. By observing the output of the LNA, satellites can be found more quickly than with a receiver (signals show up on a spectrum analyzer before they can be seen on a receiver), the feedhorn polarization can be optimized, the dish can be adjusted to track the satellite belt and any spurious or interfering signals such as Terrestrial Interference can be seen.

As an exercise, connect the PSA-37D to a dish and LNA and become familiar with what satellite signals look like and how the controls of the PSA-37D are used.

Equipment Required:

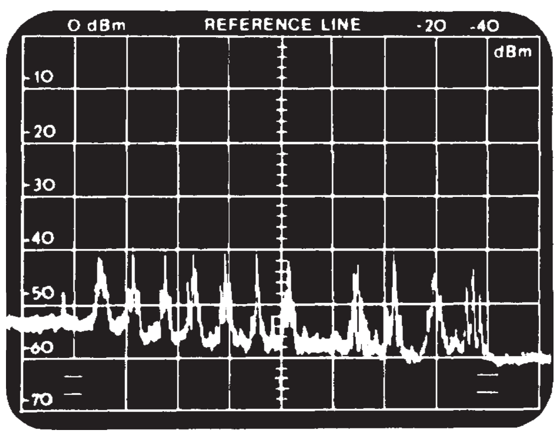
- TVRO Dish
- LNA and Feedhorn
- PSA-37D Spectrum Analyzer
- Feedline with type N connectors about 12" long

Connect LNA to PSA-37D Spectrum Analyzer with the feedline pigtail. (CAUTION: Make sure type N connectors on feedline are in good condition so PSA-37D connector is not damaged.)

Set up PSA-37D as follows:
INTENS and HORIZ - as in checkout section
CENTER FREQUENCY - 3950 MHz
BAND SELECT - 3700-4200 MHz
SWEEP - 1 o'clock position
SPAN - fully clockwise
REFERENCE LEVEL - -20 dBm
POWER - ON (either BAT or LINE)
BAT CHG - N/A
LNA-BDC PWR - ON (+12 or +18 VDC as required.
RF INPUT - 3.7-4.2 GHz, connect to LNA

After 15 seconds or so, the display trace should appear and if the dish was pointed at a satellite, transponders should be seen as in the figure at the bottom of this page.

1. Take a moment to vary each control to see its effect on the display.
2. Choose a transponder, place it in the center of the display and expand it to fill the entire display. Return controls to normal.
3. Move the dish and watch the amplitude of the transponders increase and decrease.
4. Rotate the polarization of the feedhorn and note opposite polarization transponders coming up between the others. This is a great way to see if a feedhorn is working properly.
5. Set the REFERENCE LEVEL control to -40 dBm and note height of display. Leave it on the setting that is most comfortable for you.
6. Measure the output of the LNA for future reference and draw the way the transponders appear for that satellite and polarization. Note the REF setting. Slow down the SWEEP rate for accurate amplitude measurement and note signal levels of a low, middle, and high end transponder. Rotate feedhorn and make measurements for the opposite polarization.
7. If time permits, sketch the transponder pattern for Galaxy, Satcom F3, and Satcom 4. These sketches will be useful later when you wish to identify which satellite the dish is pointed at without having to connect a receiver for visual identification.



GALAXY 1
VERTICAL

Application Example #2

Feedhorn Cross-Polarization Performance and Evaluation
(Additional practice and familiarization with the PSA-37D)

When you performed Application #1, you noticed how the transponders appear as the feedhorn is rotated. As the feedhorn or its polarizer is rotated, one set of transponders will increase to maximum as the other set gets weaker, then as the feed is rotated further, the stronger set becomes weaker and the weaker ones get stronger. The position of the polarizer where each set of transponders is most weak is the null point. It is easier to peak the feed by looking at the nulled transponders (or the absence of them, as they disappear into noise, then it is to peak on the strongest signals). We also know that by rotating the feed 90 , the transponders that were weakest now become strongest and vice versa.

While working with the PSA-37D Spectrum Analyzer, it has been noticed that some brands of feedhorns may not be tuned or constructed properly to give adequate rejection of the opposite polarity to which they are positioned. This gave the idea for a good practice and learning application for the PSA-37D. Many manufacturers claim 30 dB or more cross-polarization rejection or isolation. This is probably much more than is needed for any earth station application that we might encounter. If you can still see the opposite polarization after you have nulled it out as much as possible; that's bad! Such poor performance can result in noticeable picture quality degradation and chances are you or the customer will attribute the problem to some other factor such as the dish or receiver threshold performance.

How to test for poor feedhorn cross-polarization isolation
(Use same test setup as in Application #1)

CAUTION-When performing this test we must be sure to avoid closely spaced satellites to test on because if the dish is picking up two satellites at one time (one weak and the other strong) it could be easily confused with poor feedhorn isolation.

A pretty good satellite to test on is ANIK B. Westar 3 is fairly far away and not much is coming off the old ANIK bird. Whatever satellite you use, verify that adjacent satellites aren't too close and that the one you've picked is strong. (Use the PSA-37D to do this.)

The test is easy. Rotate the feed while watching the weak transponders begin to null out. Null them as much as possible. If they disappear, the feedhorn should give good performance as far as cross-polarization goes. If you can't get them to null out, well, you better get in touch with the manufacturer. Check first that it isn't interference from another satellite. Move the dish a little up and down to see if its being caused by another bird. If the answer is no, make this check. Note which transponders are nulled the best. Then rotate the feed very slightly and see if the null improves for the ones that were the worst and gets worse for the ones that were best. If so, it indicates that the polarizer is frequency sensitive, i.e., the skew will be different for lower numbered transponders than higher ones.

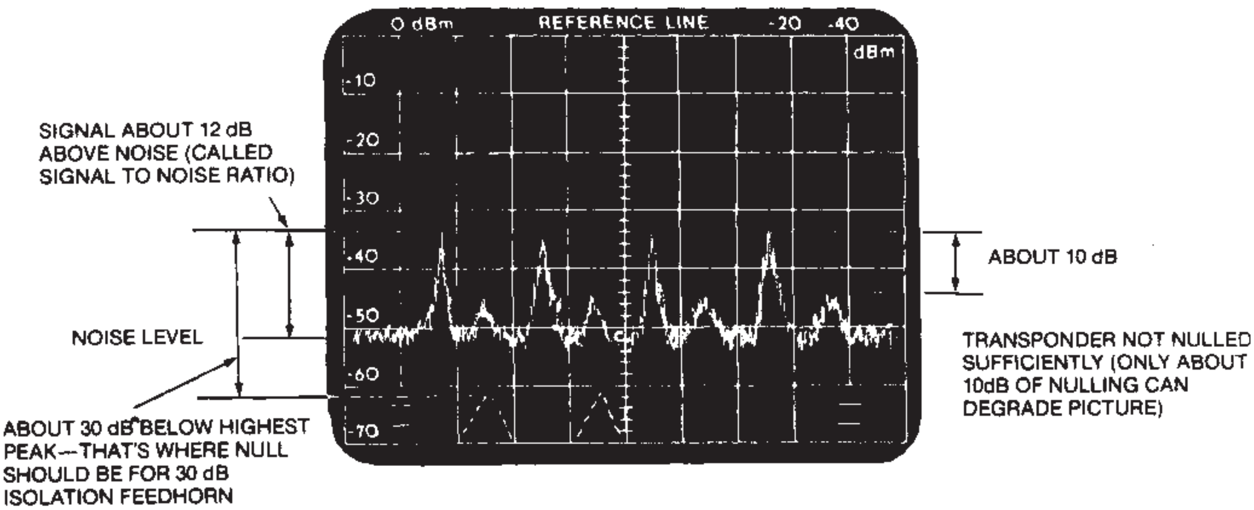
Be sure and use the SPAN and TUNING controls to expand the display to look at just a few transponders at a time and more carefully. Slow the sweep down for accurate amplitude measurements.

If you have a questionable feed, swap in another one and maybe try a different brand for comparison.

Note that this test can't resolve feedhorn isolation greater than the signal to noise ratio* of the satellite transponder. But as long as the transponder can be nulled into the noise far enough that we can't see it, we're O.K. (see Figure 1)

This application should have given considerable insight and practice with the PSA-37D.

FIGURE 1



IN THIS FIGURE, A FEEDHORN WITH 30 dB OF ISOLATION WOULD NULL
THE SIGNAL OF OPPOSITE POLARIZATION DOWN TO THE DOTTED LINES.

*Signal to noise ratio means the difference between signal power and the noise level usually expressed in dB. A spectrum analyzer does not average the signal power in a given bandwidth so it can't be used for absolute measurements. A laboratory grade power meter such as the HP436A would be used. With experience though, a spectrum analyzer can give an excellent "feel" from which comparisons can be made.

Application Example #3

Block Downconverter Flatness Check and
Testing for Proper BDC Signal Distribution Levels

When using block downconverter receivers there are two important considerations for good system performance.

1. That the output of the block downconverter is fairly flat (see front cover of this manual a display from an AVCOM BDC-60 after passing through 200 feet of RG-59. With control settings as in picture, reference line = 0 dBm, the signal output is a healthy -40 dBm).

2. That the cable used and splitters etc., don't introduce so much loss in parts of the band, that compensating amplifiers amplify too strongly one part of the band and overdrive the receiver while starving the receiver in another portion of the band.

The PSA-37D enables the feed into the receiver to be evaluated at a glance. Above problems will stick out like a sore thumb.

ACTIVITY A

Look at the output of the BDC before signal is distributed to receivers.
Equipment Required:
TVRO Dish
LNA and BDC or LNC
PSA-37D Spectrum Analyzer
Connect a LNA to the BDC. Then, connect the BDC to the PSA-37D.

CAUTION: The LNA/BDC power switch causes +18 VDC to be applied to front panel connectors. Be certain that this power is compatible with your LNA and BDC.

Use the BNC to F adapter supplied with the instrument and use 6-10 foot jumper of RG-59 to connect the BDC and PSA-37D.

Flip on LNA/BDC power and make sure red LED is glowing (if not check for shorted RG-59 cable).

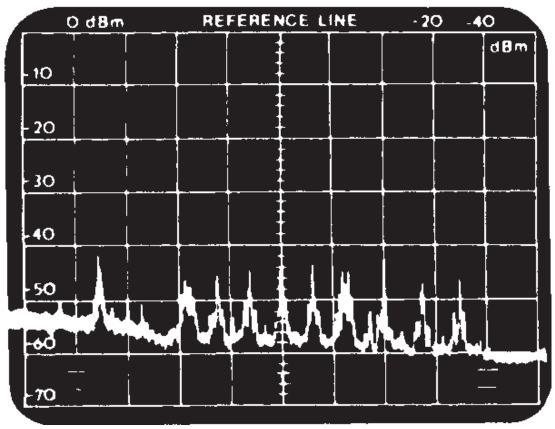
Adjust BAND SELECT switch to be compatible with output frequency of BDC. For example, if you are using an AVCOM BDC-60, Scientific Atlanta or Microdyne BDC, use the 500-1000 MHz position. DX BDC's operate from 950 to 1450 MHz. Select the correct range. If you're wrong it will be apparent since the transponders won't fill the display nicely with the CENTER FREQUENCY display centered.

IMPORTANT NOTE: Some imported and other BDC's have their local oscillator injection above 3.7-4.2 GHz. This causes the output frequency to be inverted. On a spectrum display transponder 1 will be on the right hand side of the display, transponder 24 on the left. Check manufacturer's data sheet to determine if the BDC you're using has frequency inversion. (If its LO frequency is greater than 4.2 GHz, it does.) Compare the output of a LNA for a given satellite to the output of the BDC on the same satellite. If the presentation is reversed (missing transponders, etc.) you know the answer.

Set SWEEP RATE just above the "flicker rate" and set SPAN for the whole band, fully clockwise.

Set the REFERENCE LEVEL to put transponders near center of display (as far as vertical positioning is concerned; and you should have calibrated the instrument per Operation section of this manual before starting Application).

Look at the display. It should be similar to the photo.



SATCOM 3
VERTICAL

You can see that the transponders are all fairly equal in height and that the noise line is also fairly constant in amplitude across the band. That's the output of a good (flat) BDC. If the BDC is poorly designed or defective, you will see gross variations in signal and noise line amplitudes.

Here's an important point. Both the amplitude of the transponder and the amplitude of the noise level give us important information. Be sure to pay attention to both as you learn to use the PSA-37D. Also pay attention to the height of the transponder above the noise level. Generally there should be not more than a few dB difference. Too little to be terribly significant when looking at a rapidly changing transponder signal. If there's a very noticeable difference from one end of the band to the other, there's probably something wrong with feedhorn, LNA or BDC. Remember to slow the sweep down and expand the display when recording the actual signal output level from the BDC. (And don't use the Sweep Rate set at full clockwise position. That's too fast. Should never be used that way!)

It's a good idea to record the output level from the BDC. Note setting of REFERENCE LEVEL switch.

ACTIVITY B
Testing the BDC signal after passing through all the distribution components.

Take the PSA-37D to the receiver location and connect it to the BDC feed. Look at the way the signal differs from the way it looks at the BDC. (Power the BDC via PSA-3D of if by another receiver, be sure +18 VDC is turned OFF.) You should see some signal tilt if the coax run is very long and probably some high frequency roll-off if many signal splitters are used.
If you suspect that a component isn't functioning correctly, connect it directly to the BDC with a short jumper and to the PSA-37D. Problems and bad components can be quickly isolated in this manner.

Record the level going into the receiver. Slow down the sweep for accuracy when reading the level.

Application Example #4

Sweep Office or Home for Hidden Transmitter

1. Take phone off hook and/or play radio to activate sound activated type device.
2. Set the PSA-37D Spectrum Analyzer to the 10-500 MHz range. Connect a portable whip antenna to the BNC input.
3. Walk to a different room and observe the display on the PSA-37D. Signals will be seen. Note their position and amplitude. These will be FM and TV stations, two way radios, etc....
4. Walk toward the area suspected of having a hidden transmitter while watching the PSA-37D display for a signal that starts very small and grows larger as you as you move. Home in on the signal source by moving in directions that tend to make the signal spike grow larger.
5. Verify that the signal is not a legitimate one by walking away from the area. If the signal fades when walking away from target room in different directions and grows as you return, the room is probably "bugged". You can also hang up the phone and/or silence the room to see if the signal "spike" disappears, indicating transmitting stopped.
6. Continue to home in on signal reducing the sensitivity of the PSA-37D as you get closer to the suspected transmitter.
7. After homing in on the transmitter as much as possible, begin physical search. You should be able to localize the suspected transmitter to within a few feet, the physical search should be fruitful in moments.

Application Example #5

Detect a Breach of Radio Silence in a Remote Area

1. Set the PSA-37D Spectrum Analyzer band select switch to the 10-500 MHz band.
2. Connect a wide band antenna to the 10-1500 MHz input. Observe display and note signals present.
3. If a transmitter is activated nearby, a large "spike" will be seen on the PSA-37D display.
4. Standard procedures can then be followed to intercept the signal on a communication receiver.

Application Example #6

Viewing DSS DBS Satellite Signals on the PSA-37D Spectrum Analyzer

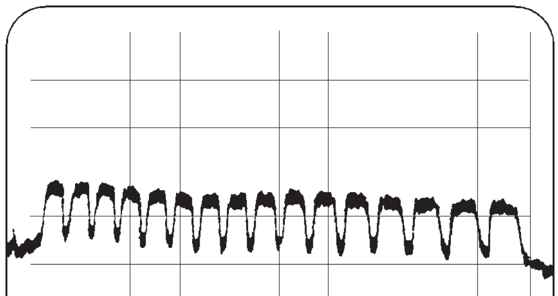
DSS signals from the DIRECTV-HC5 spacecraft can be seen with AVCOM's PSA-37D Portable Spectrum Analyzer. The HC5 satellite has 16 transponders transmitting at 12.2-12.7 GHz. These transponders are centered 500 MHz above the "standard" Ku satellite band (11.7-12.2 GHz) and normal "USA" Ku LNBs will not convert the DBS transponders to the 950-1450 MHz block. However, most of the transponders can be seen with a standard LNB by setting the PSA-37D to the 1250-1750 MHz band and tuning to a center frequency of about 1650 MHz.

The output of the DSS LNB is in the 950-1450 MHz band because its internal local oscillator is tuned to 11.250 GHz, 500 MHz above the "normal" LNB. AVCOM can furnish Ku LNBs modified for 12.2-12.7 GHz operation for $235.00 (circular polarized feed extra for $125.00).

The figure below shows the DIRECTV-HC5 satellite's 16 Ku transponders with 24 MHz channel bandwidths. The transponders are *circularly* polarized.

DSS Signals shown on a PSA-37D

This pattern (as of 7/27/94) may change with the launch of another satellite in early August '94 which is to be co-located in orbit with the existing spacecraft.



PSA-37D display of DIRECTV-HC5 using 18" RCA offset feed antenna and DSS LNB, 50' of RG-59 coax, and with the following PSA-37D settings: BAND SELECT - 950-1450 MHz, CENTER FREQUENCY - 1200 MHz, REFERENCE LEVEL - -40 dBm

WARNING: Before you connect the PSA-37D to any LNB, it is your responsibility to make sure the LNB is rated for +18 VDC. One way to check might be to measure the voltage provided by the receiver for the LNB.

The HC5 spacecraft transponders are very powerful having an EIRP of 53 dBw. Our experiments show that the 18" offset dish can be more than 50% covered with black conductive foam and the DSS receiver will still lock on and function. Also we have received video through a single pane of glass but if the need arises to put the dish indoors behind heavy or thermopane windows, it may be necessary to use a larger dish, about 24" to 30". The original LNB could be used and mounted at the focal point of a larger offset feed type antenna. For a round parabolic antenna, AVCOM can supply an LNB and feed modified for circular polarization.

In our experiments, it seems that with S/N ratios below about 25, as indicated in the setup program of the DSS receiver, the picture will drop out of lock for fractions of a second as observed on the C-SPAN and Weather channels (channels we were using for test). This was while receiving the signal through a single pane glass window with a 30" dish and a linearly polarized LNB and may not be true in other situations. (The dish was partially masked by the windowframe). When we switched to a circularly polarized feed, the signal improved dramatically from about 25 to 35. There was a tree branch in the path of the signal about 75' away so we moved to an adjacent window and the signal jumped to about 60. There seems to be some effect on signal strength with the distance of the dish to the glass surface but we do not fully understand it.

Those attempting more creative DSS dish installations (inside buildings, looking through sparse foliage, using smaller antennas than the 18" offset supplied, or concealed installations) where the signal obtained is not optimum or there is uncertainty where to point the dish, may find it difficult to use the receiver's built-in alignment program because it may not have been intended for such applications. If the installer has an AVCOM PSA-37D spectrum analyzer the signal can be very quickly located and measured even though it is below the receiver's signal strength requirement and steps can be taken to improve the signal by larger antenna or relocation. For the experiments we just did we would have been unable to acquire the satellite through the windows and trees without the spectrum analyzer and from time to time when the tripod was bumped the only way that we could reacquire the signal was to go back to the spectrum analyzer which then took a few seconds.

In the short time that we have had the DSS system we are very impressed with its performance and consider it to be one of the most exciting things to happen in the history of the satellite industry. C-Band systems are still desirable and have a solid position in the marketplace because of the vast programing available (both free and subscription). The DSS system can't be beat for portability, ease of use and opportunity for creative installations.

Some of you installers have said that you don't need a spectrum analyzer anymore but wait until you go to a customer whose house or apartment is in the middle of trees or whose covenants prohibit a dish to be visible.

What appears to be an impossible installation may become doable, and hours can be turned into seconds with the use of an AVCOM PSA-37D Portable Spectrum Analyzer and site survey horn. Optimum dish location through holes in trees can be quickly found using AVCOM's PSA-37D and Ku survey horn (PKSA-12).

This technology gives you a whole new opportunity to generate income and you may want to ally yourself with a tree trimmer to snip just the right opening in the trees (and you probably won't be able to find the spot without an AVCOM spectrum analyzer).

LATE NOTES:

It seems that our DSS LNB requires at least +18 VDC for operation. When the battery of the PSA-37D gets a little weak (below +18 VDC), our DSS LNB stopped operating. Its noise level stayed high but the transponder signals went away which fooled us into thinking that it was still operating and the dish was off of the satellite. We switched the PSA-37D to line power and the signal reappeared.

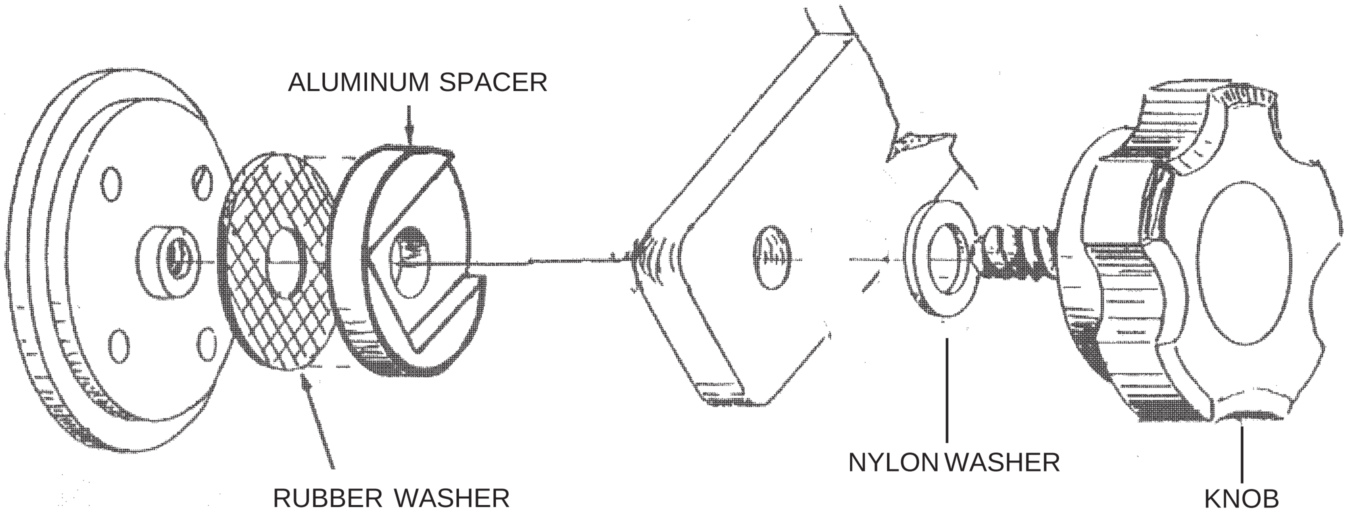
We placed a single pane storm window in parallel with existing window and signal dropped off from about 60 to 25. System would lock up but Weather channel was out of lock 10% of the time. At this point no effort was made to optimize other than realign the dish.

There may be some phase cancellation between the panes of glass and there may be an optimum spacing of the parallel panes of glass based on a multiple of the Ku band wavelength. (By holding the piece of glass in front of the feed and moving it closer and farther, signal strength varies based on some wavelength relationship).

BAIL HANDLE ASSEMBLY SEQUENCE

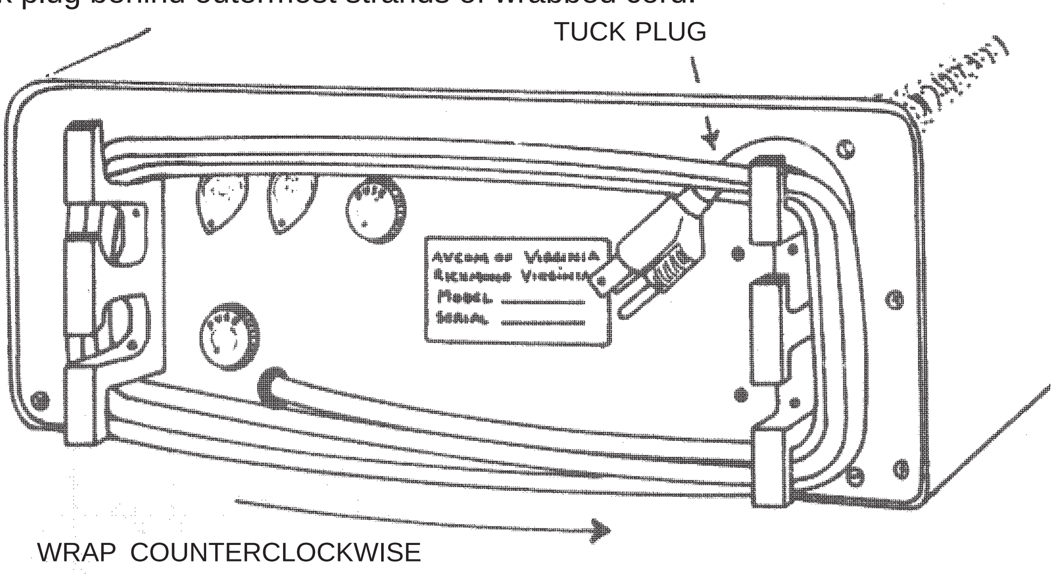
The bail handle friction knob must be assembled in the order shown below. The order of parts are (1) knob, (2) nylon washer, (3) bail handle, (4) aluminum spacer and (5) rubber washer.

There are two of these assemblies mounted to either side of the chassis. If they are not attached in this way, the handle may not function properly as a prop stand.



CORD WRAP PROCEDURE

1. Wrap power cord in a counterclockwise direction around cord guides. Only top and bottom hooks of cord guides are to be used.
2. Tuck plug behind outermost strands of wrapped cord.



PSA-37D - REAR PANEL VIEW

LIMITED WARRANTY

AVCOM OF VIRGINIA, INC. (hereafter referred to as AVCOM) warrants to the original purchaser that this product shall be free from defects in workmanship for one hundred eighty days from the date of original purchase. During this warranty period AVCOM will provide free of charge the parts and labor necessary to correct defects in workmanship and materials.

AVCOM additionally warrants to the original purchaser that this product shall be free from defects in material until one year after the date of original purchase. During this additional warranty period, AVCOM will provide free of charge the parts necessary to correct defects in material. Labor charges are not included and will be based on current rates if product diagnosis, repair, alignment or inspection is required.

THIS WARRANTY DOES NOT INCLUDE batteries or cathode ray tubes. AVCOM cannot control the environment or usage of these components and therefore the customer is solely responsible for any cost of labor or material in conjunction with their maintenance and/or replacement.

To obtain this warranty service, the original purchaser must:

(1) Notify AVCOM if a possible defect is discovered, with the following information:
   (a) The model number and serial number.
   (b) A detailed description of the problem, including details of electrical connections to any associated equipment and a description of such equipment.
(2) Obtain authorization from AVCOM to return the spectrum analyzer for warranty repair.
(3) Deliver the spectrum analyzer to AVCOM or ship the same in its original shipping container or equivalent, fully insured and shipping charges prepaid.

Correct maintenance, repair, and use are important to obtain proper performance from this product. Therefore, carefully read instructions provided. This warranty does not apply to any defect that AVCOM determines is due to:

(1) Improper maintenance or repair by unauthorized personnel, including the removal of factory seals or rivets, or the installation of parts or accessories that do not conform to the quality and specifications of the original parts.
(2) Misuse, abuse, lightning damage, alteration, neglect or improper installation.

All implied warranties, if any, terminate one hundred eighty days from the date of the original purchase.

AVCOM makes no warranty, representation or guarantee regarding the suitability and/or fitness of its products for any particular purpose, nor does AVCOM assume any liability arising out of the application or use of this product or circuit, and specifically disclaims any and all liability including, without limitation, consequential or incidental damages.

AVCOM products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the AVCOM product could create a situation where personal injury or death may occur. Should purchaser buy or use AVCOM products for any such intended and/or unauthorized application, purchaser shall indemnify and hold AVCOM and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that AVCOM was negligent regarding the design or manufacture of the product.

The above constitutes AVCOM's entire obligation with respect to this product, and the original purchaser and any user or owner shall have no other remedy and no claim for incidental or consequential damages. Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion or limitation of incidental or consequential damages, so the above limitations and exclusions may not apply to you.

This warranty gives specific legal rights and you may also have other rights which vary from state to state.

Manufacturer reserves the right to change specifications or design of this product without notice.