Z Technology
R-507
USER MANUAL

Version 5a

November 2004

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In order to obtain service under this warranty, Customer must notify Z Technology Inc. of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Z Technology Inc. will provide such service at its headquarters or at one of its authorized service centers. Customer shall be responsible for all taxes, duties, packaging, shipping and insuring of the defective product to the service center designated by Z Technology Inc. with all these expenses prepaid. Z Technology Inc. shall pay for return shipping to Customer at the same location from which the product was shipped.

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Section 1: Introduction to the R-507

Congratulations on choosing the R-507 as your **FIELD/SIGNAL STRENGTH METER.** The R-507 incorporates the latest advances in test and measurement technology into one compact package. The unit is a precision measurement instrument that can be carried into the field or used in the laboratory. In either environment the operator can be assured of highly accurate measurement results.

The R-507 many features make it applicable over a wide range of applications.

Two-Way Radio Systems and Paging Systems

The instrument covers virtually all frequencies presently used by private and public radio communication networks and paging systems. For users requiring test and measurement capability at VHF or UHF (and combinations of both VHF & UHF), the R-507 provides full and continuous coverage from 5.0 MHz to 1000 MHz.

Cellular Telephone Systems:

The entire 800 - 900 MHz spectrum is well within the frequency range of the R-507. RF and IF Filters are especially tailored to address this industry. In addition, a front panel **MEMORY** function allows the operator to quickly tune to any 100 frequencies or TV channels for rapid signal level measurements.

Continuous multi-channel testing is possible using the RS-232 serial port interfaced to a standard IBM compatible PC. This allows creation of applications specific control programs such as ones for generating automated signal coverage contour plots.

Broadcast Transmission Testing:

The unit has several features required by AM, FM and television broadcasters.

A 150 kHz wideband IF filter is available for measuring systems with wide modulation formats.

Simultaneously active AM & FM detectors drive an internal speaker; and allow easy aural program confirmation of the measured signal.

A special TV channel tuning feature is also provided. Using the **FREQ/CH** button and the main front panel TUNE knob, the operator is able to step from one channel to the next with each detent of the knob.

Finally, OPTION BC provides coverage down to 350 kHz for those who work at these lower frequencies. The OPTION PCS provides coverage 1750 to 1980 MHz for those who work at PCS frequencies.

SUMMARY OF FEATURES AND SPECIFICATIONS

Major features of the R-507 are discussed in detail throughout this manual. A summary of the most critical specifications and features are listed below.

- FREQUENCY COVERAGE: 5.0 MHz TO 1000MHz

Section 1: Introduction to the R-507

- MEASUREMENT RANGE: -10 dBuV TO +90 dBuV
- ABSOLUTE MEASUREMENT ACCURACY: +/- 2 dB
- EASY TO USE INTERNAL PREAMPLIFIER
- USER SELECTABLE BANDWIDTH: Narrow = 15 kHz; Wide = 150 kHz
- FRONT PANEL SELECTABLE INTERNAL AM & FM **AUDIO** DETECTOR WITH SPEAKER
- FRONT PANEL SELECTABLE AUDIO LEVEL
- FRONT PANEL **MEMORY** CONTROL FEATURE FOR FAST STORAGE & RECALL
- FRONT PANEL **FREQ**UENCY/**CH**ANNEL MODE FOR USE WITH TELEVISION SIGNALS
- PC/PRINTER INTERFACE WITH DATA LOGGING
- BATTERY AND/OR AC LINE OPERATION
- ADDITIONAL EXTERNAL BATTERY INPUT
- EASY TO OPER ATE FRONT PANEL CONTROLS
- RUGGED, LIGHT WEIGHT AND HIGHLY PORTABLE

The R-507 provides state-of-the-art precision signal strength testing over a wide range of signal levels. It has extremely broad frequency coverage and provides a measurement accuracy of 2 dB or better. The highly portable unit combines the functions of off-air field strength metering and accurate RF signal strength measurement with data logging/storage and PC control in one convenient lightweight hand-held system.

The standard R-507 will accurately measure signal strength from -10 dBuV (0.32 uVolt) to +90 dBuV (31.6 mvolts). The full dynamic range of 100 dB is available through a combination of user selectable controls and an auto-ranging function. Auto ranging provides a continuous measurement range of 80 dB. With the **RF AMP** (preamplifier) OFF the autorange coverage is +10 dBuV to +90 dBuV. With the **RF AMP** ON, the auto-range is transposed down and becomes -10 dBuV to +70 dBuV. The R-507 remembers the **RF AMP** setting from its previous power down state.

The Preamplifier is protected from overload by a series of three user selectable internal RF Filters which allow measurement of weak signals while protecting against unwanted strong signal overload. These filters in combination with the selectable Narrowband 15 kHz and Wideband 150 kHz IF filters provide effective rejection of adjacent channel and out of band signals while precisely determining signal strength on the desired frequency.

An operator can accurately measure signals at all frequencies from 5.0 to 1000 MHz. Option BC extends low end coverage down to 350 kHz. The Option PCS extends high-end coverage into the PCS range of 1750 - 1980 MHz. The R-507 utilizes a digitally encoded front panel spin-type **TUNE** knob for coarse tuning selections. Step sizes of 100, 10, & 1 MHz as well as 100, 10, & 1 kHz are provided with the **TUNE** knob. The entire system is fully synthesized.

The unit offers internal recall of up to 100 user-defined frequencies that are programmed via the front panel and easily accessed using the spin-type **TUNE** knob.

Several television channel assignment plans are included in the instrument for user testing of television transmitters. The **FREQ**/**CH** front panel button determines if the **TUNE** knob tunes frequency in MHz, or the assigned television channel plan's channels.

The R-507 features simultaneous digital read out of signal strength and frequency being monitored on a single large LCD panel. The display can be backlit for operating in low ambient light.

AM and FM detectors are user selectable by a front panel **AUDIO** button allowing quick aural identification of signals. The instrument includes an internal water-repellent speaker and rear panel headphone jack.

Measured signal levels and associated frequency or channel readings can easily be stored inside the R-507 using the RESIDENT DATA LOGGING feature. A rear panel RS-232 port is provided to down load stored information directly to a serial printer or an IBM compatible PC.

The RS-232 port operates at baud rates of 1200, 2400 or 9600 and can be used to access the R-507 for unique user created programs and control.

The product measures 3.5" high x 8.4" wide x 9" deep (89 x 213 x 229mm) and weighs less than 10 lbs (4.5 kgs). Its compact size makes the unit ideal for one-man portable operation in all types of environments and terrain. Several options provide a choice of extra features and appropriate antennas.

The following features are standard for all R-507 models:

- Internal NICAD battery pack
- AC power supply and battery charger
- Water repellent Soft-Case
- Internal Speaker
- User Selectable AM & FM Detectors
- Backlit LCD display
- SPIN KNOB operation for tuning
- Wideband frequency coverage
- Synthesized tuning to 1kHz resolution
- 100dB dynamic measurement range
- 100 stored user defined frequency or channel settings
- Instrument set-ups accessible via Front Panel Function Controls
- Quick Basic Control Software for RS-232 PC Control

The R-507 will operate more than 5 hours on internal NiCad batteries or from an AC power supply/charger system. Battery operation along with the durable carrying case allows operation at even the most remote sites. Additional battery operation life can be achieved via an external battery plugged into the rear panel External Battery input jack. When an external battery is connected the internal battery is disconnected for both meter power, and battery charging. An external battery will be charged when both it and the AC power supply/charger are plugged into the meter.

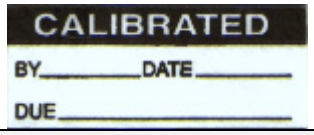
Option BC is available for measurements from 0.35 MHz to 3.0 MHz. This option provides a zero insertion loss Block Converter for measurements across this entire low-band frequency range.

Option PCS is available for measurements from 1750 to1980 MHz. Like the Option BC, this option provides a zero insertion loss Block Converter for measurements across this entire high-band frequency range.

Section 2: Specifications, Options, and Accessories

System Specifications	
Frequency Range:	5.0 MHz to 1000 MHz
Tune Mode:	Synthesized Steps as small as 1 kHz
Memory:	a) 100 user-stored frequencies or channel settings. Spinknob-retrievable in sequence. b) Several TV channel plans stored in memory.
Measurement Ranges:	-10 dBuV to +90 dBuV (-117dBm to -17 dBm) using 4 internal attenuation rangesand 1 pre amp range.
Input Filters:	Three automatically selected RF filter bands.
Measurement Resolution:	0.1dB
Measurement Accuracy: [1, 2, 3]	+/-2 dB; for CW signal, Absolute for Temp 15 to 35 Deg. C Typical for Temp 0 to 50 Deg. C
RF Signal Parameter Measurements and Storage	Power Readout Capable in the following units: dBm, dBuV or dBuV/Meter Analog Signals: Field Strength in user selected power units (as indicated above) measured and recorded to data files. Digital Signals: RF Figures of Merit signal parameters measured & recorded to data files (Bandpass settable from 1 -- 8 MHz): 1. Total Integrated Power 2. Peak Power 3. In-Band Tilt 4. In-Band Notches(Hi-Lo Diff) 5. In-Band Std Deviation
Input Impedance:	50 Ohm
IF Bandwidth:	15 kHz and 150 kHz
Type of Conversion:	Triple conversion system. 1st LO freq. 1 to 2 GHz
Ref Osc. Stability:	1st & 2nd LO typ. Stable +/-1ppm over temp.
2nd IF Rejection:	70 dB (2nd IF = 47 MHz)
Image Rejection:	60 dB typ, High Sensitivity Mode.
Audio Detection:	AM and FM with internal monitoring speaker. Rear panel connector for remote speaker or headphone. BW is 300Hz to 3KHz.
Noise Figure:	Preamplifier NF = 7 dB (when RF AMP is selected)
Sensitivity:	1 uV input, AM Detection for 12 dB S/N 1 uV input, FM Detection for 12 dB SINAD
Third Order Intercept:	Pre Amp ON typ. 0 dBm; Pre Amp OFF +20 dBm.
Operating Temperature:	-10 to +50 Deg. C.

Section 2: Specifications, Options, and Accessories

Weight:	4.5 Kg (10 lbs)
Dimensions:	89mm(3.5in) High; 229mm(9in)Deep; 213mm(8.4in) Wide
Calibration:	The R-507 Field Strength Meter is calibrated to the above specifications using factory NIST traceable equipment. Z Technology recommends re-calibration at the factory or authorized service center every two years. Refer to the Calibration sticker (shown below) located on the instrument rear panel to see the re-calibration due date. 
Application Software, Data Storage & Data Formats	
Applications Software	Windows 98/XP based Swept Spectrum Software includes the following 1. Sweep Spectrum Analysis: Displays swept frequency spans of 5MHz, 10MHz, or 20MHz spectrum. RF Figures-of-Merit Parameters are displayed for users review and analysis. 2. Data Collection: Provides for orderly collection and storage of RF Integrated Power Measurements. 3. Dot Plotting: Not provided by Software included in Windows Application. External Plotting Software available on Spectrum Display CDROM.
Data Storage	Data Stored on PC Hard Drive under open folder and file hierarchy
Data Format	Format is comma delimited nonproprietary files accessible for importing into other standard utilities. Data recorded into files include: date, time, frequency, frequency label, integrated power, integrated label, latitude, longitude, tilt, hi-low difference, standard deviation and peak power.
Computer Requirements	
Computer (Not Included)	Pentium class, 600 MHz, 64 Mb Memory, 12 G-byte Hard Drive, or better running US Windows 98/XP

[1] Some types of modulation influence measurement accuracy. For instance, with Video modulation, the R-507 measures the signal level of the Vertical Sync Peak. This adds 0.5 dB of addition uncertainty, widening the spec to +/- 2.5 dB.

[2] Each instrument is verified to be within the stated accuracy specification shown above as referenced to a CW signal. Each instrument is also calibrated over temperature to provide added accuracy through the range of 0 to 50 Deg. C.

[3] Stated accuracy numbers are referenced to an accurate signal source. The signal source itself has NIST traceable accuracy. It attributes no more than +/- 0.5dB additional error to the above specification. All inaccuracies are additive including reference signal source inaccuracy and the above measurement numbers.

Resident Data Logging Modes

The instrument provides three unique and separate Resident Data Logging methods for collecting and storing signal level & associated frequency information. Resident Data Logging is normally used when operating in a portable or field situation where connection to a PC is not possible. Data records are collected inside the R-507 and stored for later retrieval.

Contiguous Data Logging (used for most application):

Frequency channel spacing: 10 kHz to 500 kHz, front panel selectable

Frequencies stored per record: up to 360

Method of recording:	Instrument will internally store 20 records for later retrieval. Normal operation is to transfer data to a PC upon command with terminal emulator software.
Automatic Timed Records:	The time interval between Records can be set in 1 minute intervals from 5 minutes up to 24 hours.

Section 2: Specifications, Options, and Accessories

Options

BC-BCB:	0.3 MHz to 3.0 MHz External Block Converter
BC-PCS:	1750 MHz to 1980 MHz External Block Converter
BC-PCS1:	2000 MHz to 2450 MHz External Block Converter
OPT NB1:	13 kHz @ 6dB Narrowband IF Bandwidth
OPT NB3:	30 kHz @ 3dB Narrowband IF Bandwidth
OPT WB1:	120 kHz @ 3dB Wideband IF Bandwidth
OPT WB2:	200 kHz @ 3dB Wideband IF Bandwidth
OPT WB3:	300 kHz @ 3dB Wideband IF Bandwidth
BN-5:	Extra Battery Pack, NiCaD
PU-1:	Extra Power Supply/Charger, 115VAC Input
PU-2:	Extra Power Supply/Charger, 220VAC Input
R-507 SW	Spectrum Display Software
AA1-SET	Calibrated Tuned Dipole Set (30MHz -1000MHz)
AA-TV SET:	Calibrated Tuned Dipole Set (all VHF & UHF television channels)
AA1-B4:	Calibrated Tuned Dipole Antenna (325 – 1000MHz)
AA-2:	Active Monopole Antenna System
	Calibrated (100kHz-60MHz)
AA-4:	Log Periodic Antenna System
	Calibrated (290MHz-1000MHz)
AA-6:	Log Periodic Antenna System
	Calibrated (150MHz-1000MHz)
AA-7:	Bi-Log Periodic Antenna System
	Calibrated (25MHz - 1000MHz)
AA-8:	Log Periodic Antenna System
	Calibrated (800MHz - 2600MHz)
ATU-251:	Tripod; Non Conductive Design
AEH-251:	Azimuth/Elevation Head for Tripod

Section 2: Specifications, Options, and Accessories

Options

TCC-251:	Tripod Carrying Case
CAB211/301:	3 Meter RG-214U Cable; with N/N Plugs

Section 2: Specifications, Options, and Accessories

Supplied Accessories

Carrying case with shoulder strap

Rechargeable NiCAD Battery Pack (located inside instrument when shipped)

Collapsible vertical utility antenna

Type-N male to BNC female adapter

115 VAC or 220VAC Power Source & Battery Charger (dependent on shipment destination)

User manual

Quick Reference Operators Card

RS232C Comm. Port

RS-232 I/O Cable

Quick Basic Control Software on 3.5” floppy diskette, or on Spectrum Display CDROM

Antenna Calibration Tables on 3.5” floppy diskette, or on Spectrum Display CDROM

R-507 Application Notes

Section 3: First time Operation

GETTING SET UP AND PREPARING TO OPERATE

You have already unpacked the R-507 and have located the accessories. The following items should be found in every shipment of a standard instrument:

The R-507 Instrument

Battery Charger/AC Power Supply

Type-N Male to BNC Female Adapter

Collapsible Vertical Utility Antenna

Soft Carrying Case

Quick Reference Operators Card

This Manual

(NiCad Battery pack is inside the R-507 & not visible)

RS-232 cable

Option R-507 SW (if ordered) Spectrum Display Software on CDROM

Quick Basic Control Software on 3.5” floppy diskette, or on Spectrum Display CDROM

Antenna Calibration Tables on 3.5” floppy diskette, or on Spectrum Display CDROM

R-507 Application Notes

Make sure the Battery Charger/AC Power Supply received is appropriate for the AC voltage supplied by your power utility service. Each charger is plainly marked as to the Primary or Input AC voltage expected.

Every R-507 is shipped with a NiCad battery pack already installed inside the instrument. This battery pack is shipped from the factory fully charged and can operate the product for at least 5 hours between recharges. A full recharge will require 10 to 12 hours connection to the battery charger. During shipment the NiCad pack may have lost some of its charge and should be completely recharged before the instrument is put into full service.

Each Field Strength Meter is shipped inside its soft carrying case. The instrument can be operated while inside this case. (Of course, the unit will operate equally well outside the soft case). Both front and rear panels can be directly accessed through the soft case via Velcro sealed flaps covering the front and rear.

Open the rear flap and notice four connectors: From left to right looking at the rear panel (1) PORT 1 - the RS-232 serial port, (2) EXT. BATT. INPUT - the external battery input connector, (3) ACCESSORIES - the round Mini-Din accessories connector, and (4) POWER INPUT - the Batter Charger/AC Power Supply input connector. Finally notice a small hole next to PORT 1 labeled SYSTEM RESET. Inserting a pointed object into this hole while the Battery Charger/AC Power Supply is disconnected will reset the meter's internal microprocessor.

Plug the Battery Charger/AC Power Supply into the POWER INPUT connector and allow the internal battery pack to charge for 10 hours.

The Battery Charger/AC Power Supply has enough capacity to recharge the internal battery and at the same time allow full operation of the R-507.

Prepare for operating the unit by opening the Velcro front flap of the soft case and attaching a coaxial cable with the signals to be measured or if desired attach the supplied Collapsible Vertical Utility Antenna to the input connector using the N to BNC adapter.

Now you are ready to operate the Field Strength Meter and should review the next section of this manual entitled "FRONT PANEL CONTROLS AND OPERATING INSTRUCTIONS."

Section 4: Front Panel Controls and Operating Instructions

> Note: During normal operation, the meter's front Liquid Crystal Display (LCD) shows three lines of information. The Top line is called the ***SIGNAL LEVEL*** readout, the middle line is called the ***FREQUENCY/CHANNEL*** readout, and the third line is called the ***STATUS*** readout.

In this manual, words that describe front panel buttons, or knobs are written in **BOLD CAPS**. Words that callout one of the three readouts are written in ***BOLD ITALIC CAPS***. Words letters or numbers that are shown in the readouts are written in BOLD within quotes, example "**F1**".

Background Information for Basic Operation

The R-507 combines wide frequency coverage, a large dynamic range and the excellent measurement accuracy all in one instrument. It is a versatile and rugged unit while also being a precision piece of measurement equipment. As with all precision equipment, the meter must be operated correctly to obtain proper results.

When using this unit, the operator should be aware of the following background information.

Input Impedance

The R-507 has an input impedance of 50 Ohms. In order to make accurate readings, it must be operated in a 50 Ohm environment. That is, the operator should use a 50-Ohm antenna or drive the meter from a 50-Ohm signal source.

Field Strength versus Signal Strength

The R-507 Field Strength Meter is designed to accurately measure the strength of a signal which is presented to the meter at its front panel input connector. The strength of the signal is displayed in large characters in the ***SIGNAL LEVEL*** readout on the meters front panel. The units attached to this reading may be dBuV (dBuVolts), dBm, or dBuV/M (dBuV/Meter) depending on the users setup. The user may or may not be familiar with these units of power measurement. dBuV and dBm relate to Signal Strength, where as dBuV/M relates to Field Strength. A power level of 0 dBuV is equal to 1 uvolt across a 50 Ohm load. When in dBm mode, the meter internally subtracts 107 from the internal dBuV reading to display dBm on the ***SIGNAL LEVEL*** readout. (Note: A ***SIGNAL LEVEL*** reading of "**107 dBuV**" is the same as a ***SIGNAL LEVEL*** reading of "**0 dBm**"). To obtain a reading in dBuV/M the user must first ensure that the meter has an accurate Antenna Calibration Table stored internally, and that it is activated by using function 12. (see function 12 description in the FUNCTIONS FEATURES section of this manual for more information.) When the meter is used with a calibrated cable, calibrated antenna, and the meters internally stored antenna calibration table, the meter reads in dBuV/M (dbuV/Meter) units. This is a unit of Field Strength. The antenna calibration table allows the meter to account for any antenna gain (or loss) while it is acting as an impedance match between a signal propagating in open air and a signal propagating on a coaxial cable.

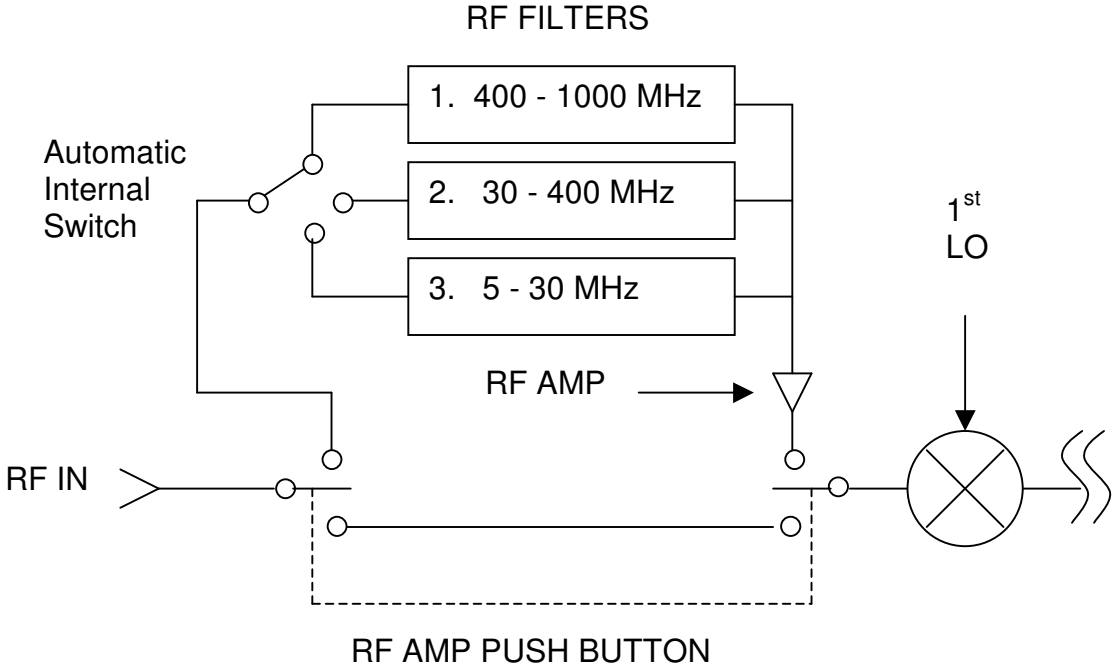
The meter can be used to obtain accurate field strength readings in microvolts per meter (uV/M) when it is used with a calibrated antenna system such as one of the optional antenna systems provided by Z Technology, Inc. See the section of this manual on "Specification, Options and Accessories". To convert from dBuV/M to uV/M use the following formula

uV/M = antilog (dBuV/M / 20)

Calibrated antenna systems are provided with Calibration Tables listing correction factor data versus frequency for each antenna. The data is taken during individual tests made on an actual antenna test site. This data, when loaded into the meters antenna calibration table and activated (see F12 description in the Function Features section later in this manual) allows the meter to read in dBuV/M. It is then possible to apply the formula above to produce uV/M. Correction factors are applied to both the meters ***SIGNAL LEVEL*** readout and to data collected and stored via a PC connected to the unit's serial port. For more information on calibrated antennas see the manuals provided with our calibrated antenna systems, AA-1, AA-2, AA-3, AA-4, AA-5, AA-6, AA-7, and AA-8. If the meter is always used to measure field strength at a single frequency, an other possibility exists, a single point calibration using the customer calibration function (see the F3 description in the Function Features section later in this manual.)

In-Band Signal Measurements and Out-of-Band Signal Rejection

It is helpful for the operator to be aware of the basic block diagram of any field strength instrument. See the "Block Diagram" section of the manual. Part of this diagram is reproduced below.



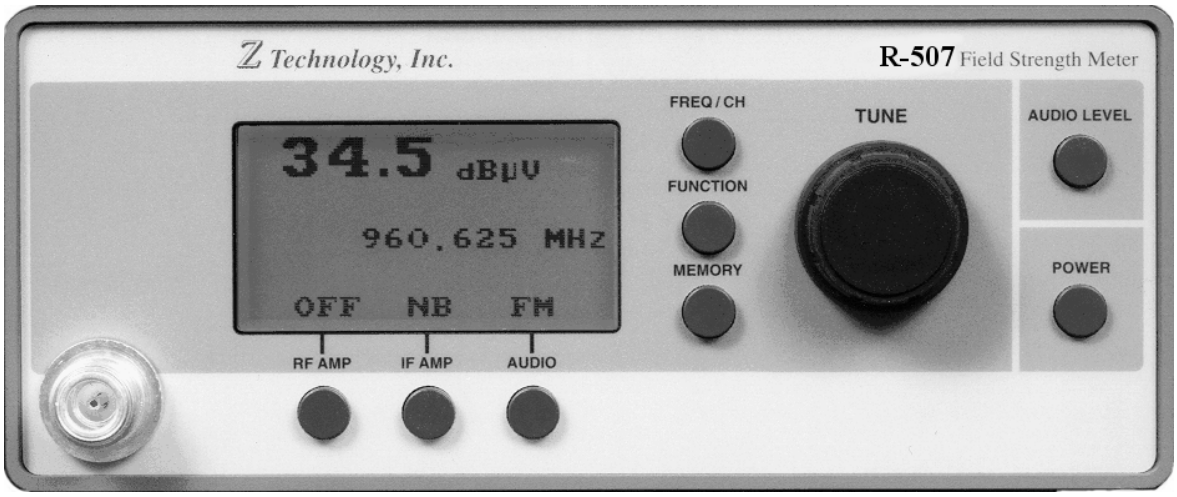
Notice that the instrument is designed with an internal Preamplifier (called the RF AMP). When in use, this amplifier gives the meter its excellent small signal measurement capability. The operator can choose when to engage the **RF AMP** through a front panel button control. As can be seen in the diagram, when the **RF AMP** is active one of three frequency dependent RF FILTERS are also active. The filters automatically switch depending on what frequency is being tuned. (When the **RF AMP** is turned off both the **RF AMP** and all RF FILTERS are bypassed and are not active in the system).

The preamplifier is designed to simultaneously handle both very weak and very strong signals. The RF FILTERS are included in the system to improve immunity to interference. See the Specifications section of this manual for frequency covered by each filter. Even with these protections, at times there may be the potential of overloading the Preamplifier (**RF AMP**). The operator can avoid this by following a few simple guidelines.

Preamplifier overload may occur when the **RF AMP** is being used and a very strong undesired signal is within the RF FILTER bandpass. It is generally a good idea to start a measurement routine with **RF AMP** turned off. If the measurement can be made without this Amplifier selected, do so. Use the **RF AMP** feature only when needed to measure weak signals that cannot be captured otherwise.

Front Panel Frequency Selection

The R-507 has a wide frequency coverage range. A single **TUNE** knob provides for frequency selection. The unit is fully synthesized and crystal controlled with minimum step size of 1 kHz. Since the narrowest bandwidth IF Filter is nominally 15 kHz and the smallest synthesized step size is 1 kHz, it requires approximately seven (15) steps to tune across a CW (clear wave) signal at any one frequency. The single **TUNE** knob operation insures it a simple process to make measurements at virtually all frequencies from 5.0 MHz to 1000 MHz.



R-507 Field Strength Meter
Front Panel

Section 4: Front Panel Controls and Operating Instructions

Front panel operation for the R-507 can be best described by referring to the accompanying product picture or by directly operating the controls of the Field Strength Meter.

First, we will describe the basic operation of the main front panel controls. Later, in-depth information concerning additional controls and useful complimentary features will be discussed.

Note: During normal operation, the meter's front Liquid Crystal Display (LCD) shows three lines of information. The Top line is called the ***SIGNAL LEVEL*** readout, the middle line is called the ***FREQUENCY/CHANNEL*** readout, and the third line is called the ***STATUS*** readout.

In this manual, words that describe front panel buttons, or knobs are written in **BOLD CAPS**. Words that callout one of the three readouts are written in ***BOLD ITALIC CAPS***. Words letters or numbers that are shown in the readouts are written in BOLD within quotes, example "**F1**".

Front Panel Description

The instrument's front panel inputs and controls include:

- 50 Ohm Type-N RF input connector
- LCD display area, becomes active when meter turned on
- 8 Grey push buttons, 3 located horizontally below the display, 3 located vertically to the right of the display, 2 located vertically at the right side. They are labeled:

  RF AMP
  BANDWIDTH
  AUDIO

  FREQ/CH
  FUNCTION
  MEMORY

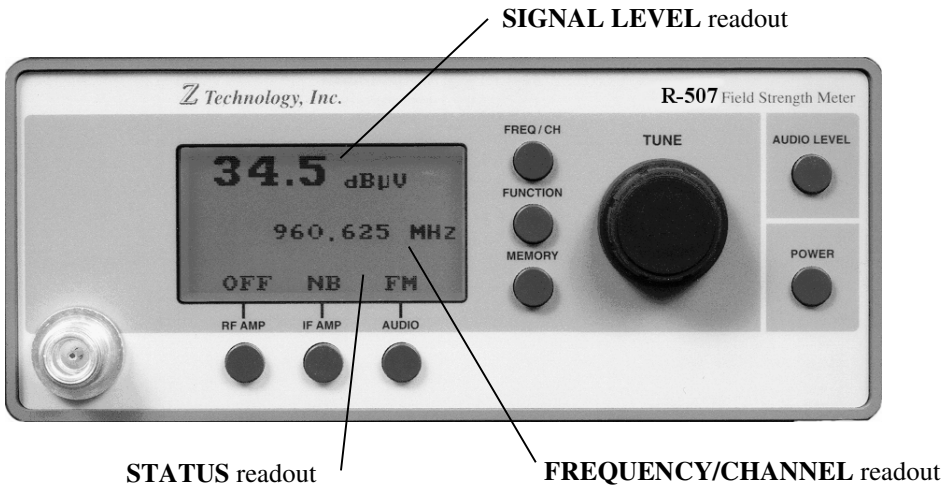
  AUDIO LEVEL
  POWER

- Frequency set up and control **TUNE** knob

The 50-ohm Type-N RF input connector is to be connected to an antenna cable directly or via the Type-N to BNC adapter supplied with the meter.

The LCD display area becomes active when the unit is powered on. It allows the user to interact with the meter. There are three distinct readout areas on LCD. The top line with the largest characters is the ***SIGNAL LEVEL*** readout, next in the middle is the ***FREQUENCY/CHANNEL*** readout, at the bottom is the ***STATUS*** readout. Information is presented in these three readout areas as shown below.

Section 4: Front Panel Controls and Operating Instructions



The **RFAMP** button turns on and off the RF amplifier. The ***STATUS*** readout above the button reads "**ON**" or "**OFF**" respectively.

The **BANDWIDTH** button switches the internal IF Filter between 15KHz Filter (Narrow Band) and 150KHz Filter (Wide Band). The ***STATUS*** readout above the button reads "**NB**" or "**WB**" respectively.

The **AUDIO** button switches between the internal AM and FM decoders. The ***STATUS*** readout reads "**AM**" or "**FM**" respectively.

The **FREQ/CH** button switches between Frequency tuning mode, and TV channel tuning mode. The above illustration shows the meter in frequency tuning mode. The ***FREQUENCY/CHANNEL*** readout shows the tuned frequency followed by "**MHz**". When in TV channel tuning mode the ***FREQUENCY/CHANNEL*** readout shows the tuned channel number followed by "**P**" for picture, or "**A**" for audio.

The **MEMORY** button toggles the meter in and out of Memory tuning mode. When in Memory tuning mode the numonic "**MEM**" is shown in the left side of the ***FREQUENCY/CHANNEL*** readout. See the Memory Feature section later in this manual for further explanation.

The **AUDIO LEVEL** button controls the audio level of the internal speaker as well as the speaker pins on the rear panel accessory connector. Pressing the Audio Level button and holding it increases the audio level to full volume in about 10 seconds. Continuing to hold the button down will decrease the audio level to minimum volume in about another 10 seconds. Releasing the button, then pushing it again reverses the direction of change.

The **POWER** button turns the meter on and off. The backlight automatically comes on and stays on if the meter is connected to its AC supply/charger. If the meter is running off battery power, the backlight will automatically turn off a few seconds after power on. Once the meter is on and the readouts have stabilized pressing the **POWER** button down and holding it until the unit beeps, (about 2 seconds) turns toggles the LCD backlight. When the meter is on, a quick press and release of the **POWER** button turns the unit off.

The **TUNE** knob is a multi-function control. It both rotates, and depresses. Rotating it generally changes the values in the ***FREQUENCY/CHANNEL*** readout. Pressing it generally activates a selected function. (See Function Features section later in this manual.)

The following procedure is the normal measurement sequence.

Turning on the Power

Push the power button (**POWER**) to turn ON the instrument. If the AC supply/charger is connected to the rear panel the unit will be powered from that supply. When the AC supply/charger is not connected the instrument automatically switches to the internal NiCad battery pack. If an external battery is connected via the rear panel EXT. BATT. INPUT the instrument uses the external battery for power, and disconnects the internal battery.

Frequency Setting

The primary frequency selection control is the **TUNE** knob. This is the large detented "Spinknob". It controls the frequency or channel number shown in the ***FREQUENCY/CHANNEL*** readout. Turn this knob and notice the detent action of the knob. Each detent will change the frequency or channel by one unit. (The **TUNE** knob has many other uses -- we will describe them throughout this manual).

Push and release this knob to change the step size of each detent position. By pushing the knob and hearing an accompanying audible beep, the step size changes to: 100 MHz, 10 MHz, 1 MHz, 100 kHz, 10 kHz or 1 kHz. An underline indicates the chosen step size.

Making a Signal Strength Reading:

In many applications the next and final step is to read the Signal Level in dBuV from the ***SIGNAL LEVEL*** readout. To read direct in dBm or dBuV/M see the F12, and F14 functions respectively in the Function Features section later in this manual.

The accompanying Signal Level Conversion Table is provided to show the relationship between signal level at the front panel connector in the units of Volts, dBuV, or dBm. Remember, this is valid for a 50 ohm system.

SIGNAL LEVEL CONVERSION TABLE

Signal Levels at RF input connector			Front Panel
Vin @ 50ohms	dBuV	DBm	Selections
0.32uV	-10 dBuV	-117 dBm	**RF AMP** "**ON**"
0.5uV	-6 dBuV	-113 dBm	**RF AMP** "**ON**"
1.0uV	0 dBuV	-107 dBm	**RF AMP** "**ON**"

SIGNAL LEVEL CONVERSION TABLE		
3.16 uV	10 dBuV	-97 dBm
100 uV	40 dBuV	-67 dBm
7.07mV	77 dBuV	-30 dBm
31.6mV	90 dBuV	-17 dBm

When the ***SIGNAL LEVEL*** readout shows either a blinking "**>**" or "**<**" sign the signal presented to the meter at the received frequency is out of measurement range. If this is the case, continue with the procedures below.

Using the RF AMP Control

> **NOTE:** Upon power on the R-507 remembers its settings from the previous power down for the **RF AMP**, **IF AMP**, **FREQ/CH**, and **MEMORY** button. It also remembers the tuned frequency or channel. The **AUDIO** button and **AUDIO LEVEL** buttons default to "**FM**" and 1/4 volume respectively with each power on. The meter is typically shipped with **RF AMP** set to "**OFF**", **BANDWIDTH** set to "**WB**", tuned to 100 MHz in frequency tuning mode (i.e. not TV channel or memory tuning mode)

With the typical factory default settings, the instrument has a continuous measurement range from 10 dBuV to 90 dBuV. The unit will always have an auto-range control span of 80 dB. As will be seen, this range can be shifted down to lower power levels.

If the signal to be measured is larger than 90 dBuV (31.6mV) the ***SIGNAL LEVEL*** readout will display "**> 90.0 dBuV**" with the "**>**" sign blinking. In this case, an external attenuator must be used for the unit to measure the level of the signal.

If the signal to be measured is smaller than 10 dBuV (3.16uV) the ***SIGNAL LEVEL*** readout will display "**< 10.0 dBuV**" and the "**<**" sign will be blinking. In this case, the operator must utilize **RFAMP** front panel amplifier control to bring the signal within the range of the meter.

When the **RF AMP** is active, the measurement range of the R-507 extends down to -10 dBuV or 0.32 uVolts. The autorange span with the **RF AMP** active is from -10 dBuV to +70 dBuV.

For all these settings, when a signal is out of range, the "**<**" Less Than or "**>**" Greater Than sign will flash. When a signal is properly within autorange levels and a stable number in the ***SIGNAL LEVEL*** readout is achieved, the user has a valid Signal Level Measurement.

At signal levels close to 0.32 uvolts where noise floors can effect reading, it is best to make measurements with the **BANDWIDTH** button set to "**NB**". See the next section for details.

WB & NB BANDWIDTH

There are two IF Filter bandwidths selectabled by the front panel **BANDWIDTH** button.

"**WB**" or Wideband filter of 150 kHz

"**NB**" or Narrowband filter of 15 kHz

The typical Factory Shipped default is "**WB**". The meter remembers whatever setting was active at the last power down and uses that at the next power up.

The wideband filter normally used when looking for a desired signal whose specific frequency is not known. It also should be used when measuring signals, which are being deviated with wideband modulation. In such cases peak deviations may disperse energy outside the bandpass of the 15 kHz narrowband filter.

> **NOTE:** The wideband "**WB**" filter is broad enough to cover more than each 100 kHz step of the **TUNE** knob. Thus by using the **TUNE** knob to step in 100 kHz steps, an operator can be confident he has continuously covered all the spectrum as he turns the **TUNE** knob to explore a specific band of frequencies. This feature is useful when attempting to locate a signal whose exact frequency is not known.

When a signal frequency is precisely known the user may select the narrowband "**NB**" filter. This will reduce out of band noise and reject adjacent signals.

Advanced Operation

FREQ/**CH** Button

(For Fast Television Channel Selection)

The R-507 will easily tune normal television channels. The unit can be incremented by channel number or in units of frequency.

The ***FREQUENCY/CHANNEL*** readout is designed to toggle between FREQUENCY and CHANNEL modes by pressing the **FREQ**/**CH** button.

When the **CH**annel mode is chosen each detent of the **TUNE** knob will move the received frequency by one channel usually 6, 7 or 8 MHz depending on the television channel plan in use. See F4 of the Function Features section later in this manual for descriptions to view factory selected channel plan.

Upon pushing the **FREQ**/**CH** button, the ***FREQUENCY/CHANNEL*** readout will display the Channel number being received. Either a "**P**" for picture "**P**" or an "**A**" for Audio will be displayed by the LCD readout. Changing between picture or audio reception is accomplished by pushing the **TUNE** knob. To see what frequency a particular TV channel Picture or Audio carrier is. Tune to that channel, select Picture or Audio, then press the **FREQ**/**CH** button. The frequency will appear followed by "**MHz**" in the ***FREQUENCY/CHANNEL*** readout.

FUNCTION Button

(For Set-up and Data Logging Access)

The **FUNCTION** button gives access to a wide range of set-up and data logging/communications functions. Set up operations and certain operating features are

accessible as FUNCTIONS. Press the **FUNCTION** button, then turn the **TUNE** knob to sequentially call control options.

Example information available through the **FUNCTION** button:

F 1: When the **FUNCTION** button is first pushed, the ***FREQUENCY/CHANNEL*** readout will display "**F1**". Now push the **TUNE** knob. The ***FREQUENCY/CHANNEL*** readout changes to show the voltage across the internal NiCad battery pack. When the **FUNCTION** button is pushed again, the R-507 will go back to normal operating Field Strength Meter (FSM) mode.

F 5: Push the **FUNCTION** button to display "**F1**". Turn the **TUNE** knob until the ***FREQUENCY/CHANNEL*** readout displays "**F5**". This function allows the user to select auto power-down mode. Push the **TUNE** knob and notice the display reads either "**AUTO**" or "**ON**". In "**AUTO**" mode the instrument will automatically turn itself OFF when operating from the internal battery pack after 5 minutes of no front panel activity. In "**ON**" mode the unit will stay ON until manually turned off or until the battery voltage reaches a low enough voltage for the meter to cycle itself off. Choose either "**AUTO**" or "**ON**" by turning the **TUNE** knob. To activate your choice, push the **FUNCTION** button and notice that the unit reverts to normal operating Field Strength Meter (FSM) mode.

See the section entitled "FUNCTION FEATURES" for a complete discussion of the wide range of useful features available through this function.

MEMORY Button:

(A Quick way to Store and Recall Often used Frequencies)

The **MEMORY** button allows storage and retrieval of up to 100 user defined frequency or channel settings in USER MEMORY. This is a very useful feature when the operator is continually monitoring a few frequencies or channels which may be spread over many megahertz. See the Section titled MEMORY OPERATIONS for programming information. When the memory is programmed, each detent of the **TUNE** knob moves the received frequency to the next memorized frequency or channel. Up to 100 different frequencies or channels can be stored in USER MEMORY. It uses a wrap-around feature where the first USER MEMORY position follows the last programmed frequency or channel i.e. 1, 2, 3,.99, 100, 1, 2

TUNE knob Features

(Addition Uses)

The **TUNE** knob, some times called a SPIN knob is used to set the R-507 to a desired frequency (or television channel); to select USER MEMORY locations for frequency or channel storage and retrieval, and to control various set up and data collection features.

The **TUNE** knob also contains a switch. This switch is operated when the **TUNE** knob is pushed toward the front panel. Some uses of this extra feature within the **TUNE** knob are detailed here while other uses are discussed in the appropriate places throughout this manual.

A summary of functions controlled by the **TUNE** knob follows:

Frequency Selection: Turn and/or push to make selections.

Television CHannel Selection: Used with **FREQ**/**CH** Button.

Recall USER MEMORY Frequency or Channel Settings: Used with **MEMORY** Button.

Program Selection Control: Used with **FUNCTION** Button.

Auto Power-Down Feature

If the R-507 is operating from the battery it will automatically power-down if there has been no operator front panel activity for at least five (5) minutes. This feature can be temporarily disabled using function F5. See the above example or the section titled FUNCTION FEATURES for more information.

The unit will also automatically power-down if the charge in the battery pack drops below a usable level. As the voltage of the battery pack (an 8 cell, series NiCad pack) approaches that level, a Low Battery indicator "**BATT**" just below the ***SIGNAL LEVEL*** readout will begin to blink slowly. As the voltage continues to drop, the "**BATT"** indicator blinks faster. When the voltage decreases below a usable level, the unit automatically powers-down. (The R-507 will display the battery voltage on command. Use F1: Battery Mode and see the FUNCTION FEATURES section for more details.)

Section 5: R-507 Spectrum Display

Spectrum Display Introduction

The R-507 Field Strength Meter is specially designed to provide standard field strength measurements plus provide the capabilities to be swept under computer control to provide spectrum analyzer functions. This section of the manual discusses the Spectrum Display features. The Spectrum Display software operates as a Windows 98/XP application and controls all the R-507 functions to provide the Spectrum Display capabilities. The PC screen is used as the display device for the Spectrum Display. The software will record many of the measurement parameters displayed on the PC screen. In addition, a GPS receiver can be connected to the PC serial port and the Spectrum Display software will tag the recorded measurement parameters with GPS longitude and latitude.

The R-507 is designed to tune to the center frequency of a terrestrially broadcast digital signal and measure the energy in a user-selected bandwidth about that center frequency. In addition the Spectrum Display software has all the measurement capability of the Z Technology R-507 Field Strength Meter, a highly accurate instrument designed to meet the needs of the analog broadcast world.

The Z Technology Spectrum Display software harnesses the power of the PC and the suburb measurement capabilities of the R-507 to produce a very low cost solution to the problem of field measurements of digitally broadcast signals by a portable system. The spectrum display software produces an image of the spectrum of a tuned frequency. This is useful in determining the strength of a signal, its flatness, amount of ripple, depth of notches and amount of tilt. The spectrum display software allows spectrum spans of 5, 10, and 20 MHz. In addition to being useful for looking at digital signals, the R-507 with the spectrum display capability is useful in looking at analog signals.

The inclusion of GPS latitude and longitude tags and signal level measurements in a simple comma delimited text file format allows the user to complete drive tests of your digital signal over your broadcast area. The included Control Software Program GP_PLOT (See the R-507 Quick Basic Control Program Application Note) allows plotting of signal strength vs location as a coded color dot plot of your driving path. Additionally the comma delimited text format log files may be imported in to spread sheets, databases, GIS systems, or other mapping systems.

The R-507 SW optional software features include the following.

- Spectral Display of Analog and Digital signals
- Digital signal strength measurement capability
- Active cursor marking frequency and power
- Five RF figures of merit - Integrated Power, Peak Sweep, High Low Difference, Tilt and Standard Deviation
- On screen Frequency sweep width/IF Bandwidth and RF Amplification controls
- 5, 10, and 20 MHz span spectrum display
- Adjustable onscreen measurement bandwidth indicators

- Text Log of five RF figures of Merit with optional GPS Latitude Longitude tags
- Peak Line
- Screen capture
- Time Plot of five RF figures of Merit

The R-507 Spectrum Display Software requires a PC of the following Specifications, you may have ordered your R-507 with a PC or may be using your own PC.

- Windows98 or WindowsXP
- 400 MHz or better Pentium Class Processor
- 64 Mbytes or more of RAM
- 10 Mbytes free Hard Disk Space

Conceptual Model

To understand the measurement concepts used in the R-507 it helps to have a conceptual model of the instrument, and the type of information that is passed between the meter and the PC. For a complete understanding of the meter internals see the Block Diagram in this R-507 User Manual.

Two types of information pass over the RS-232 link between the meter and the PC when running the R-507 Spectrum Display PC software. All though there is just one RS-232 connection, there are two communication channels that share that connection, one type of information on each channel. The first type of information is command information to the meter such as set a frequency or change a meter setting. This type of information is sent over the "Primary Channel." The second type of information is measurement data that is used to make up the spectrum display. This information is sent over the "Secondary Channel."

In R-507 measurement mode an analog signal with a carrier is measured. In this mode the meter captures a raw measurement of the signal, then applies calculated correction factors to compensate for changes that occur with frequency, signal level, signal attenuation or amplification, and internal meter temperature. The result is a highly accurate, reproducible measurement. The corrected signal level is displayed on the meters LCD Signal Level Readout or sent through the RS-232 Primary Comm channel to a connected PC.

In R-507 measurement mode a digital signal spread over several carriers, or via a spread spectrum modulation scheme is measured. In this mode the meter sweeps a user selected frequency span. As the sweep occurs raw measurement data is sent at high speed through the Secondary Comm channel to the PC. The PC then processes the raw data applying correction factors to make each measurement highly precise. Those measurements are displayed in a graphic format, called the Spectrum Display. The user can select a bandwidth centered about the center frequency for measurement. The PC then sums the measurements in the specified bandwidth. From known characteristics of the meter the PC calculates the energy received in that bandwidth and displays it as a number in dBm or dBuV and in dBuV/Meter if an antenna correction factor is included.

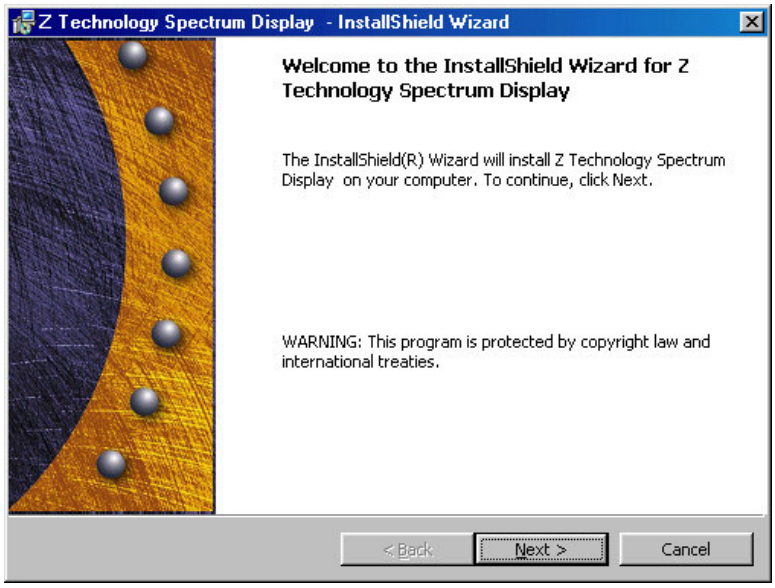
When used as an analog field strength meter the R-507 measurement range is from -10 dBuV to 90 dBuV. Internally the meters dynamic range is about 60 dB. The -10 to 90-dBuV range is

obtained by turning the RF Amplifier On or Off and the meter auto-ranging and adding a series of 20 dB attenuators to the signal path. When used to measure digital signals with the spectrum display software, the auto ranging is disabled. The user selects an RF Amplifier setting and the number of 20 dB attenuators placed in the signal path. The user may also select the IF filter bandwidth for the raw measurement. Wide Band (**WB**) employs a 150 KHz IF filter, Narrow Band (**NB**) employs a 15 KHz IF filter.

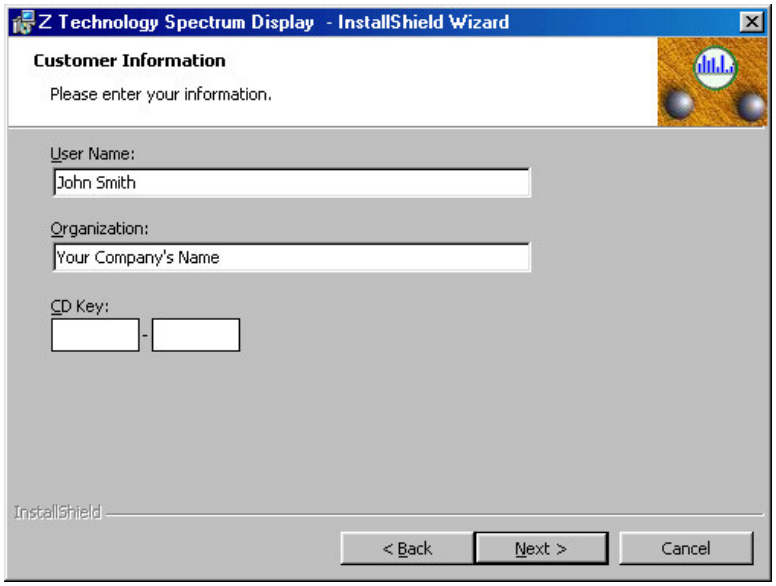
Spectrum Display software installation

Your R-507 is optionally supplied with a CDROM labeled "**Spectrum Display** " This installation requires a Windows98/XP PC with an RS232 serial port. Many PC's have a built in RS232 serial port with 9 pin connector on the back panel of the PC. If your PC does not have an RS232 Serial port you can install a PCMCIA type serial port adapter in a Laptop PC or a PCI serial port adapter board in a desktop PC. USB serial port adapters are not recommended for use with the R-507 meter. Software installation follows the normal Windows application installation procedure.

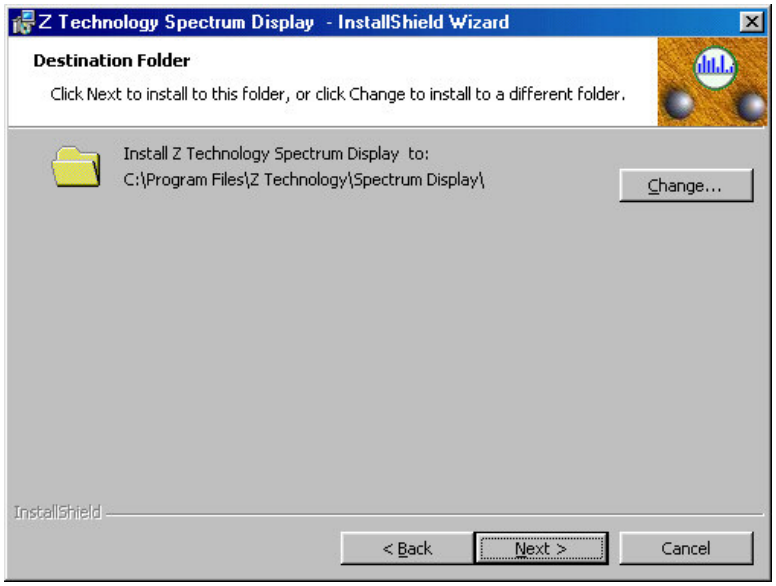
- Insert the CDROM labeled "**Spectrum Display**" into your CDROM drive.
- The CDROM will automatically begin to load the Installation program.
- If this does not occur, click the **Start** button select **Run**
- Browse to the **D:** drive (or the letter of your CDROM drive)
- Select Setup.exe
- Click **OK**
- The **R-507 Spectrum Display Installation** screen will appear



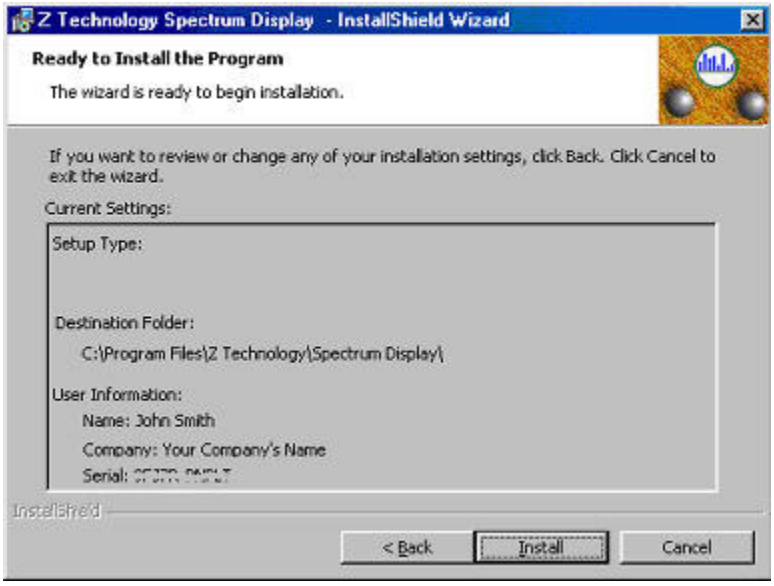
- Click on the **Next** button. This will bring up the **Customer Information** window. Fill in the requested information including the **CD Key** that can be found on the CDROM jacket.



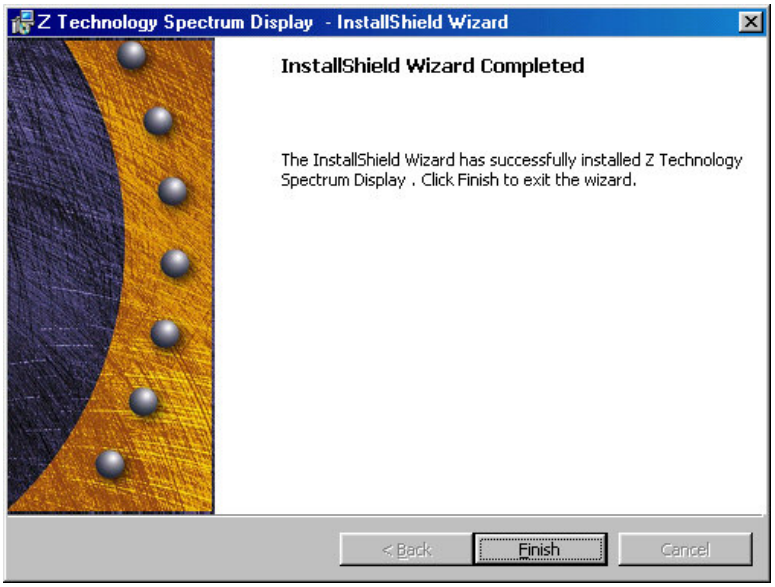
- Click **Next** to proceed with the installation. The Destination Folder screen will be displayed. The folder designated to contain the application is shown. You may change this to a different folder name if you desire.



- Click **Next** to move to the next screen. The **Ready to Install the Program** window will be displayed. Click **Install** to begin the installation of Spectrum Display.



- When the installation is complete the following screen will appear. Click **Finish** to complete the installation process.



SnagIt Third Party Screen Capture software installation

Your R-507 Spectrum Display software is designed to use a third party software called SnagIt to automate screen captures and generate .jpg graphic files. When SnagIt is installed Spectrum Display will automatically detect its presents and add a screen capture button with a camera icon to the Spectrum Display toolbar. Clicking on the camera button will allow you to capture any screen you see on the PC to a graphic image file in .jpg format. You may also adjust the SnagIt settings to do many different things such as automatically do a screen capture every 10 seconds. SnagIt also provides a Snagit Editor that allows you to edit your screen captures, add notes, highlight areas of interest.

To install SnagIt follow the procedure below.

- Insert the CDROM labeled "**SnagIt**" in to your CDROM drive. The following screen appears

If the installation program does not automatically start then:

- Click the **Start** button select **Run**
- Browse to the **D:** drive (or the letter of your CDROM drive)
- Open the folder D:\SnagIt
- Select Setup.exe
- Click **OPEN**
- Click **OK**

- Once the above screen appears, click **Next** button and follow the onscreen instructions to complete the installation.

Getting Started

To assemble an R-507 measurement system you need the following components.

- R-507 Field Strength Meter
- Z Technology R-507 Spectrum Display Software CDROM
- Snag-It 3rd party screen capture software CDROM
- 400 MHz Pentium Class PC with 64 Meg of RAM or better with built in Serial Port
- Optional USB interface GPS receiver with NMEA 0183 version 2.0 output or PCMCIA serial port adapter and RS-232 interface GPS receiver with NMEA 0183 version 2.0 output.

Once the components of the R-507 measurement system are collected, follow the steps below.

1. It is suggested that you familiarize yourself first with the R-507 front panel controls. It is suggested that you familiarize yourself with the use of the R-507 as a tool to measure analog signals. Learn how to make analog signal measurements with the meter as a stand-alone instrument by referring to the included R-507 User Manual. Install the R-507 Spectrum Display software on your PC (See the Spectrum Display software installation section earlier in this manual.)
2. Connect the PC to the meter. Connect an RS-232 cable (supplied) from the PC COM1 port to the R-507 rear panel connector PORT 1.
3. Turn on the meter.
4. Put the meter in Remote Mode.
   - Press the meter **FUNCTION** button
   - Rotate the meter **TUNE** knob counter clock wise to **F93**
   - Press the meter **TUNE** knob.
   - The meter should now be in Remote Mode. The display should show "**1 Port**".
5. (optional) Connect GPS
   - USB interface GPS
     - Install the CDROM that came with the USB interface GPS follow the onscreen instructions to install the USB interface GPS driver.
     - Connect the USB interface GPS to a USB port on the PC. The PC will create a virtual COM port. Spectrum Display software will communicate with the GPS

receiver via this virtual COM port. Open the Windows Device Manager to see which COM port Windows has mapped the virtual COM port to.

- RS-232 interface GPS using PCMCIA to serial adaptor
  - Install the CDROM that came with the PCMCIA to serial adaptor. Follow the onscreen instructions to install the PCMCIA to serial adaptor driver.
  - Insert the PCMCIA to serial adaptor. The PC will "Install new hardware" and a new COM port will show up in the Windows Device Manger. This is the COM port that Spectrum Display software will use to communicate with the GPS receiver. Connect the RS-232 interface GPS receiver to the PCMCIA serial adaptor. If you purchased an Svee Series GPS receiver from Z Technology, connect to Port 1 of the Svee Series GPS receiver.

6. Start the R-507 spectrum display application. Once the R-507 application is installed, start the application with the normal Windows98/XP procedure.
   - Click the **START** button
   - Click Programs → Z Technology → Spectrum Display
7. The first time you start Spectrum Display it will ask you what COM port the meter is connected to.

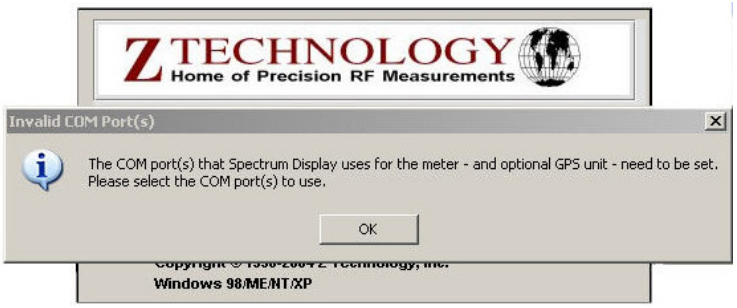


Figure 1: PC COM ports not yet selected

Click OK

On the next screen you will be able to select the COM port the meter is connected to, and optionally which COM port the GPS is connected to.

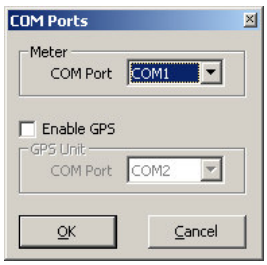


Figure 2: Select PC COM Ports

Click the down arrow in the Meter box to see what COM ports are available. Click on the COM port the meter is connected to. If you are unsure of the Mapping of your COM ports check the Windows Device Manager.

If you are using an optional GPS receiver click on the “Enable GPS” check box then select the COM port the GPS receiver is connected to.

After your COM port(s) are selected click “OK”

8. Once the COM ports are selected Spectrum Display will begin to initialize the meter.

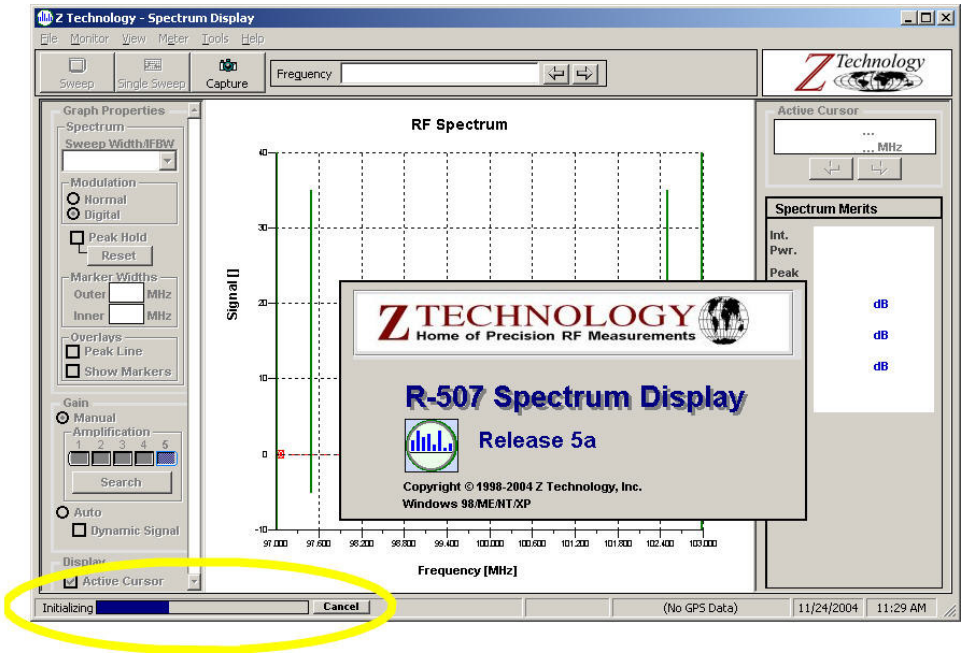


Figure 3: Initializing the Meter

A blue progress bar appears at the bottom left of the screen. If the progress bar does not expand to the right to completion there is a communication problem. Possible causes are: 1. The meter is not turned on. 2. The meter is not in Remote mode (showing “1 Port” on it’s display). 3. The meter is not connected to the COM port that has been selected above in the Spectrum Display software.

Spectrum Display will remember the last selected frequency. At first startup the selected frequency is 100 MHz. The spectrum of the FM radio band will appear.

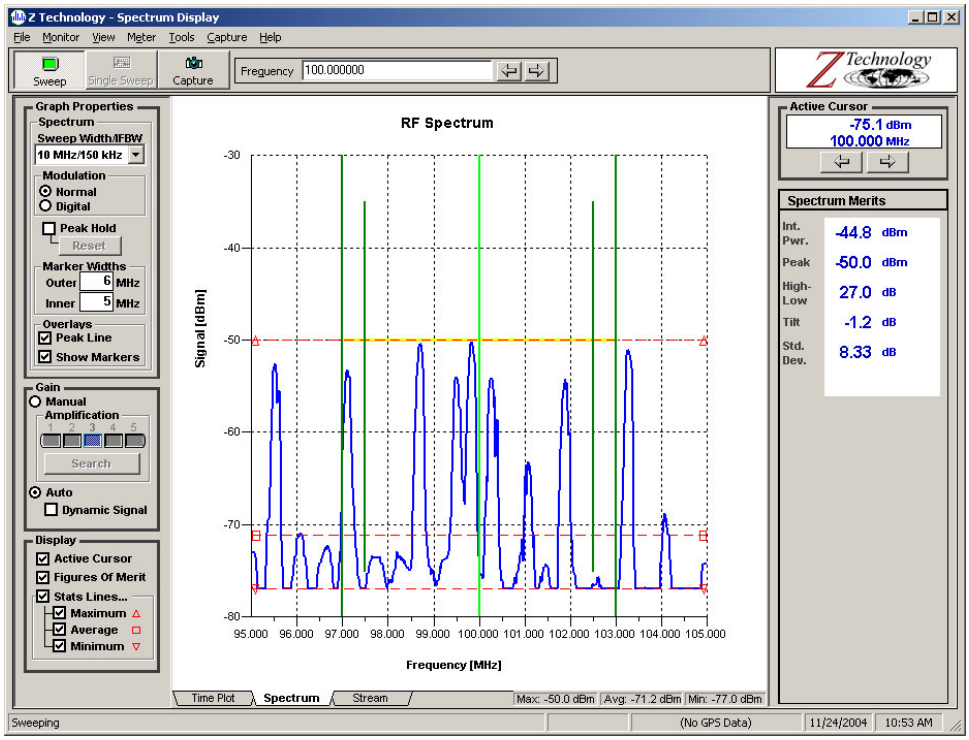


Figure 4: Spectrum of 100 MHz Center Frequency

Change Frequency

To change the center frequency of the display, type the frequency you wish to measure in the **FREQUENCY** Text Box. As you type the letters will turn red, when done press **ENTER**, the letters will then turn black again indicating that the frequency has been tuned by the meter. If the display is not updating, press the **Sweep** button in the tool bar.

A new sweep will appear about twice a second. The software will autorange the meter to put the signal in the optimum measurement range. You may manually range the signal by clicking on th “Manual” button in the “Gain” control box on the left side of the screen. Use the Amplification buttons 1 through 5 to set the displayed signal to the proper level on the screen. The signal is too large if any portion of it is displayed in the top half of the top row of the gradicule.

Record Measurements

To record measurements to a file:

1. Select the data that will be recorded. From the “Tools” menu select “Options”. In the Spectrum Display Options screen select the “Data Records” tab. In the Data Records Tab check the “Spectrum Data” check box and the “Standard Data” check box.

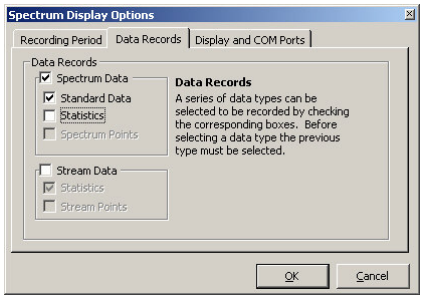


Figure 5: Selecting data to record

2. Open a new file to record data into. From the “File” menu, Select “New Data File”, The windows “Open” screen appears. Navigate to where you want the file located. Enter a file name. Give your file name a .txt extension to make it compatible with other application import requirements and to make it directly readable with Windows Note Pad. Give it a .csv (comma separated value) extension to make it directly readable with Microsoft Excel

3. Start Recording. To start recording, From the “File” menu select “Record Data”. After each sweep, a new line (or record) is written to the log file containing the date, time, frequency, frequency units, Signal Level, Signal Level units, Latitude(optional), Longitude(optional), Standard Deviation, Tilt, High Low Difference, In-band Peak.

   Each time new data is written to the file the file is automatically saved. There is no need to manually save the file.

4. Stop Recording. To stop recording, from the “File” menu select “Stop Recording”.

5. Close the file. To close the file, from the “File” menu select “Close Data File” Next time the file is opened new data will be appended to this file.

Example Spectrum of Analog Signals

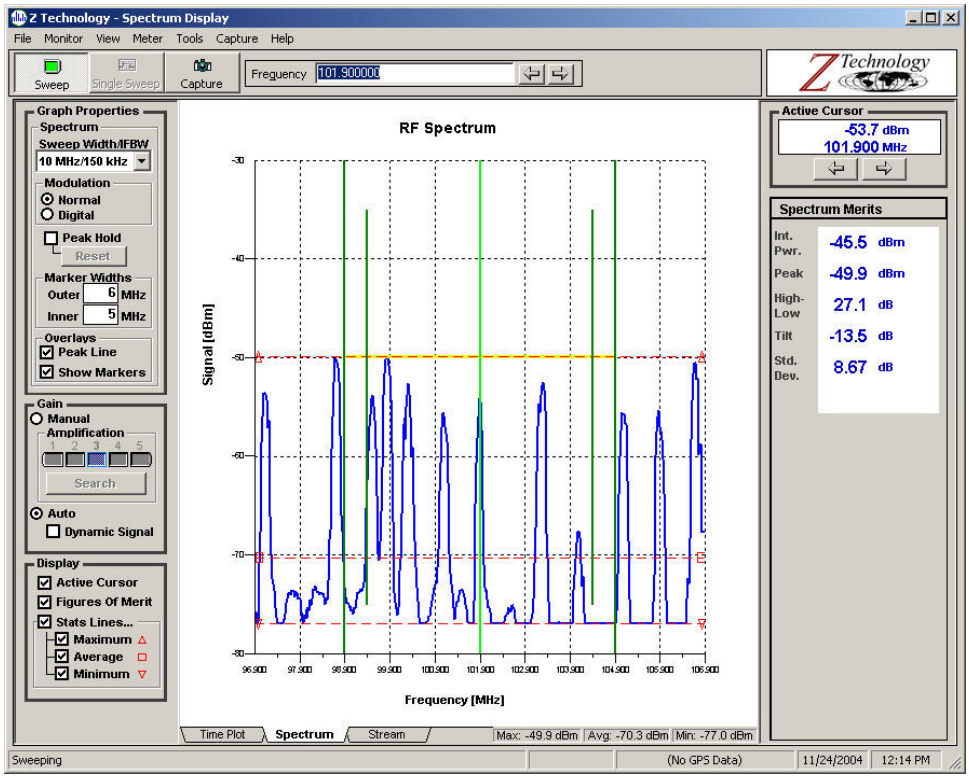


Figure 6: FM Broadcast band centered at 101.9 MHz

Standard Spectrum Display has two major functions. One is to measure signal levels while displaying their spectrum. This is done in the **Spectrum** tab. A second is to display a plot over time of the signals measured parameters. This is done in the **Time Plot** tab. Clicking on either the **Time Plot** tab or the **Spectrum** tab near the bottom of the screen brings that display to the forefront.

To enter a frequency, click in the **Frequency** box in the Spectrum Display tool bar. The frequency field highlights blue. Type in the center frequency you wish to observe. The numbers in the frequency field turn red as you type. Press ENTER on the keyboard, the numbers in the frequency field turn black and the new frequency has been set.

Optionally Spectrum Display has a third major function. Option:STR the streaming option uses the **Stream** tab to display an oscilloscope type display of signal strength vs time of a single 15kHz or 150kHz bandwidth signal. The sample rate is set by the meter as it “streams” measurement information to the PC at ~230 measurements per second. This is very useful for observing pulsed signals, or signals that change signal strength quickly. The Stream tab has the ability to trigger on a user specified signal level much like an oscilloscope can trigger on a user specified voltage level. It can trigger on the positive going swing or negative going swing through the trigger threshold. Streaming requires a time period to measure and display. The time period is user selectable from 0.1 second to 10, seconds.

In the example above the **Spectrum** tab is enabled. The user has entered 101.9 MHz into the **Frequency** box in the Spectrum Display tool bar. A signal appears in the **Spectrum** tab at 101.9 MHz. Adjacent signals appear both above and below the frequency of interest. The green vertical line is the active cursor, it can be moved by dragging it with the mouse or clicking the right/left arrows in the **Active Cursor** box at the upper right of the screen. The **Active Cursor** box shows the active cursor is positioned at 101.9 MHz and the signal strength at that frequency is –45.5 dBm.

Looking at the left side of the below the tool bar buttons, we see that the **Graph Properties** box is grayed out. This box applies to the **Time Plot** Tab of the screen which is not visible while the **Spectrum** Tab is active.

Moving down the left side of the screen we see the **Sweep Width IF/BW** box shows a setting of "10 MHz/150 kHz". These are the sweep width and IF bandwidth settings of the meter respectively. The down arrow allows one to change these settings.

Moving down again is the **Amplification** box. It shows a setting of "4". Holding the cursor over the buttons will allow a tool tip to pop up on the screen that describes the meter Attenuation level and RF Amplifier setting for each button. Unlike when making measurements with the stand alone meter where autoranging within the meter sets the proper amplification level, the Spectrum Display software requires the user to manually set the amplification level. This should be set so that the measured signal should appear in one of the three center 10 db gradicule ranges of the display. IE if the signal is in the low 10 db gradicule range more amplification is needed, a higher amplification number. If the signal is in the high 10 db gradicule range a lower amplification number is needed to properly range the signal.

Next is the **Modulation** box. It shows a setting of "Normal" This is the proper setting for CW type signals. The alternate setting is for noise like signals generally used in digital signal transmissions. 8VSB, and COFDM modulations are typical digital signals for television broadcast in USA and Europe respectively.

Last at the bottom left is the **Display** box. Here the "Active Cursor" is enabled (checked) which enables the green vertical line in the display and the **Active Cursor** box on the right side of the screen. The "Peak Line" is also enabled (checked) it is the gray horizontal line in the **Spectrum** tab. It is aligned with the highest (peak) signal in the spectrum.

Example Spectrum of Digital Signals

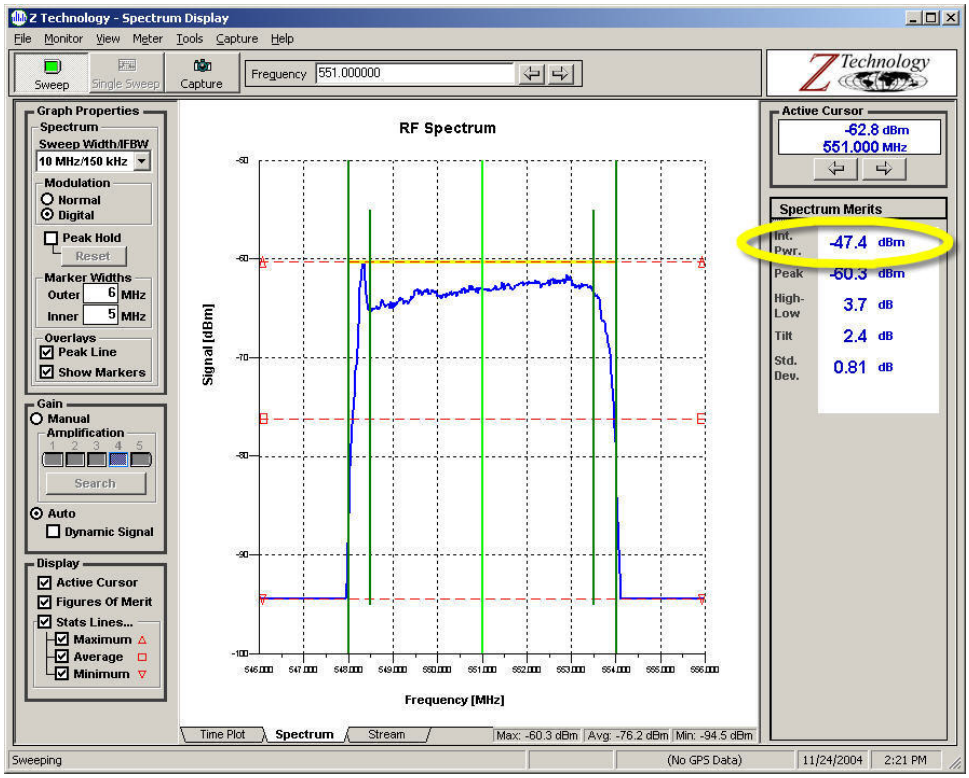


Figure 7: DTV signal at 551 MHz, Integrated Power = -47.4 dBm

The figure above shows a spectrum of an 8VSB signal with center frequency of 551 MHz. Notice that the "Digital" button in the **Modulation** box has been selected also the "Markers" selection has been enabled (checked) in the **Display** box.

When the Markers are enabled the area under the **Active Cursor** box on the screen shows the five Figures of Merit. 1: Integrated Power, the measured energy between the outer markers. 2: Peak, the peak measurement between the outer markers, 3: High Low difference, the difference in minimum and maximum signal level between the inner markers. 4: Tilt the difference in signal level at the inner markers. A plus number indicates a rising slope left to right, a minus number indicates a falling slope left to right. 5: Standard Deviation the standard deviation of the measurement samples between the inner markers.

The user may change the width of the inner markers, and outer markers in the **Display** box. The markers are useful not just for digital television measurements but for other very wide band signals that are too wide to measure with the meter's 150 KHz IF filter.

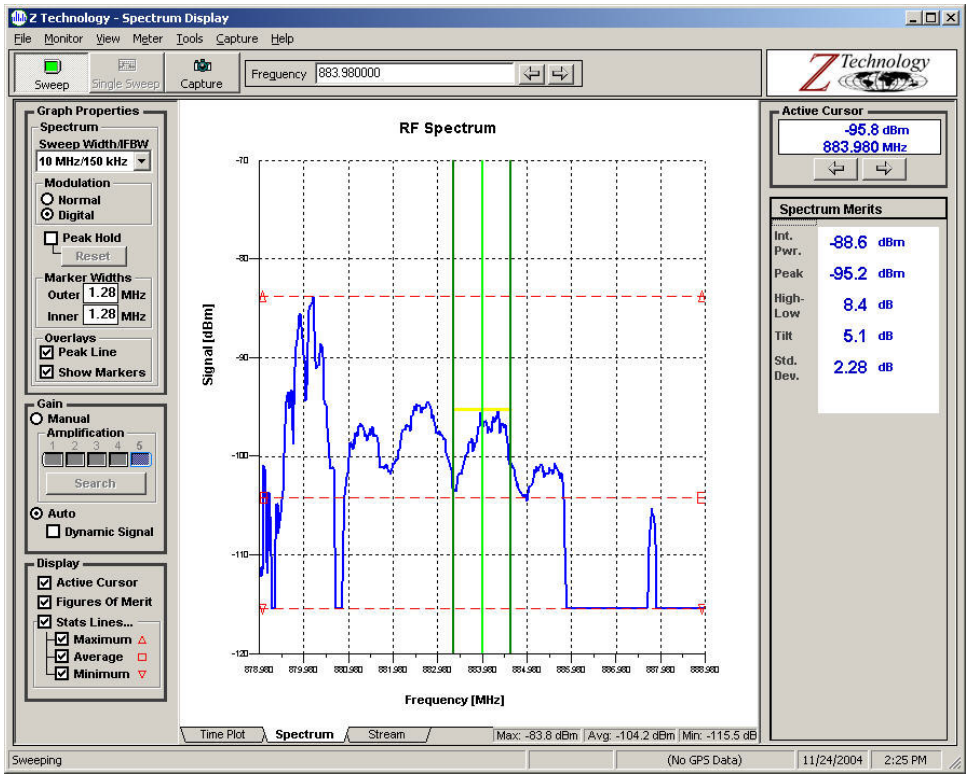


Figure 8: Spectrum of broadband cell site activity

In the example above the user has selected 1.28 MHz inner and outer marker bandwidths to observe integrated power of a cellular telephone signal.

Example of Time Plots

Clicking the **Time Plot** tab at the bottom of the PC screen allows the display of several measured parameters versus time. With the **Time Plot** enabled, the **Graph Properties** box at the upper right is enabled. The down arrow allows the selection of the measured parameter to be graphed. The **Plot** box sets the total time to be used on the horizontal axis. It can be set from 20 to 2000 seconds.

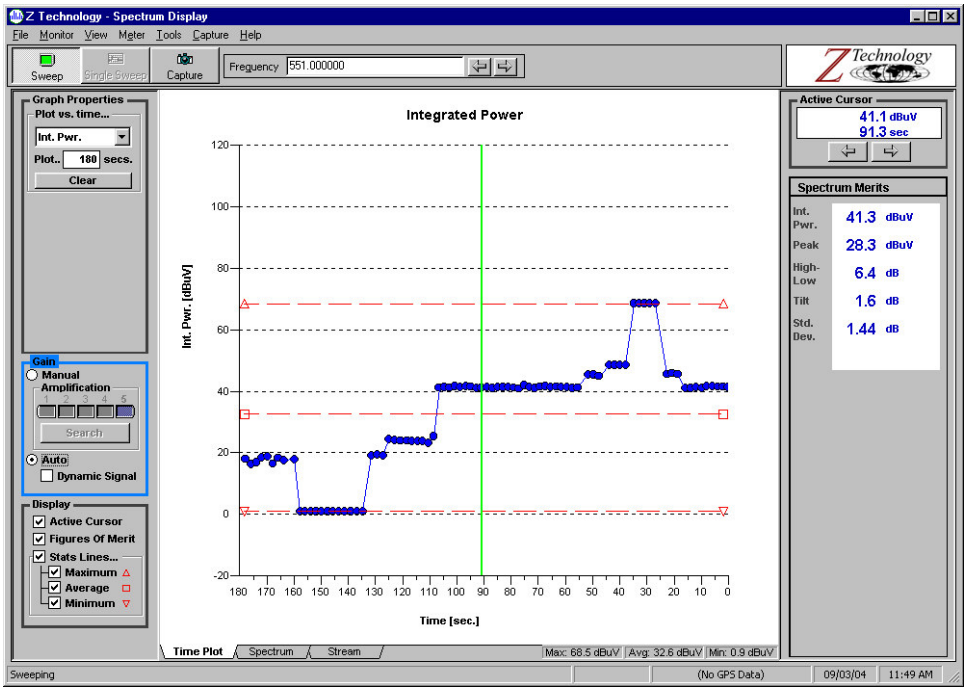


Figure 9: Time Plot of Integrated Power

The example above shows a time plot of Integrated Power of a 6 MHz wide digital signal centered at 551 MHz. In the **Graph Properties** the **Status Lines** box has been enabled (checked), additionally the **Maximum**, **Average**, **Minimum** status line boxes have been enabled (checked). In the Time Plot tab the horizontal dashed red lines mark the Maximum integrated power, the Average Integrated power and the Minimum Integrated power top to bottom respectively.

Example of Option: STR

If your R-507 Spectrum Display software includes Option: STR a third tab is visible at the bottom of the screen, the **Stream** tab.

Below is an example of a pulsed signal displayed in the **Stream** tab. The time period is 2 seconds. The capture of the signal is free running, there is no triggering occuring.

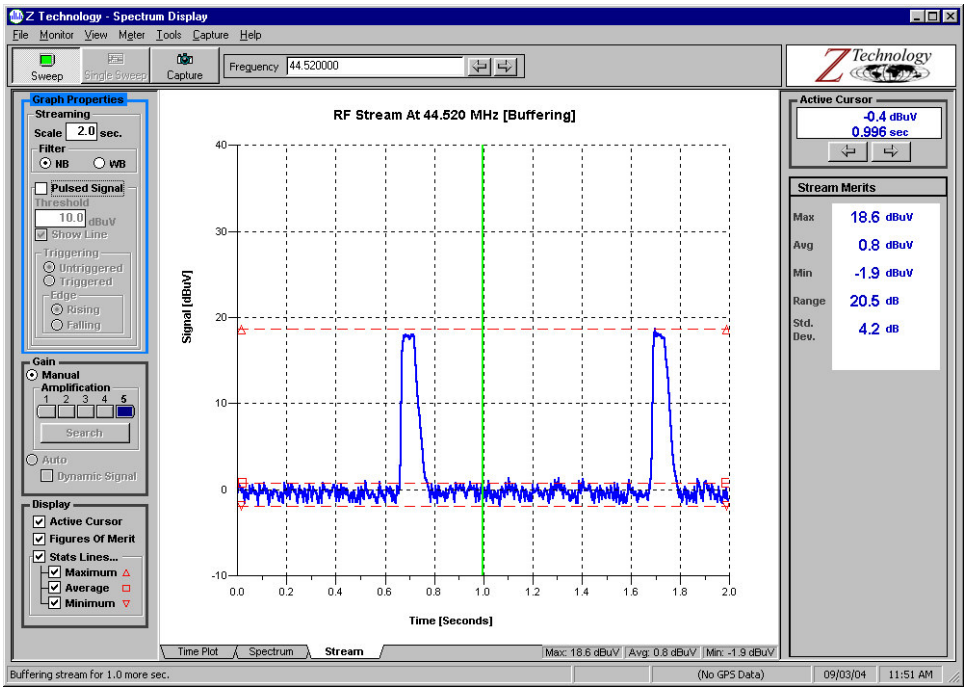


Figure 10: Capture of Pulsed signal with Stream tab

The captured signal above is a 15kHz bandwidth signal. In the **Graph Properties** box the **Filter** is set to **NB**. Unlike the **Spectrum** tab, the **Stream** tab IF bandwidth is limited to signals that fit within the IF bandwith 15kHz (**NB**) or 150 kHz (**WB**) bandwidth of the meter. While the **Stream** tab is active if tuned to a 6MHz wide or 8 MHz wide DTV signal, the meter will not be sensing the full 6 MHz or 8 MHz bandwidth of the signal. It will sense only the 15kHz (**NB**) or 150 kHz(**WB**) bandwidth about the center frequency entered in the **Frequency** box.

The figure below shows the same signal captured using triggering. This allows the user to read directly the from the time scale the pulse duration and period.

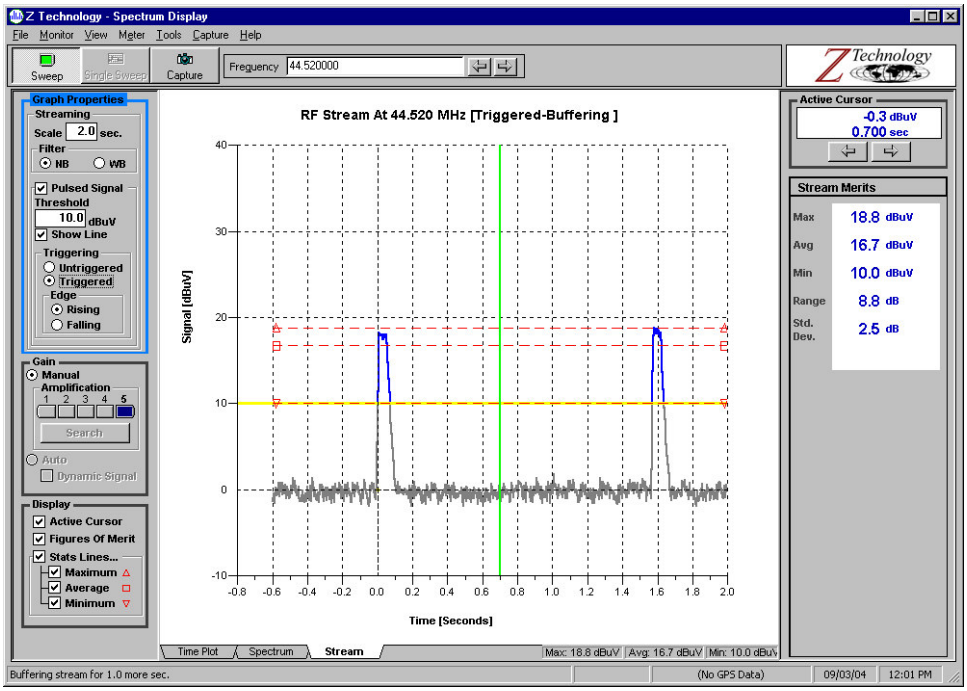
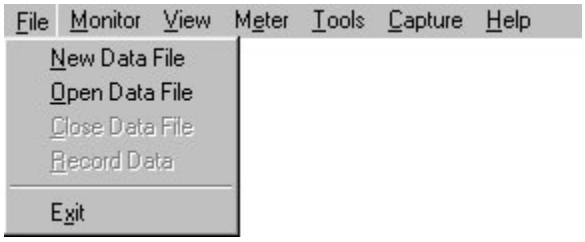
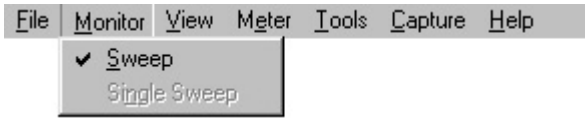


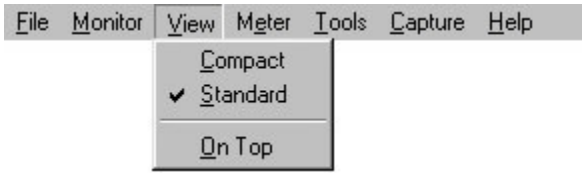
Figure 11: Pulsed signal captured with Triggering on rising edge

In the triggered example above, in the **Graph Properties** the **Pulsed Signal** box was checked to enable triggering. The **Show Line** box was checked to enable the yellow horizontal trigger threshold line. The portion of the signal above threshold is displayed in blue, the portion of the signal below threshold is displayed in gray. The **Gain** box **Display** box controls work the same as in the **Spectrum** tab.

Menu Bar

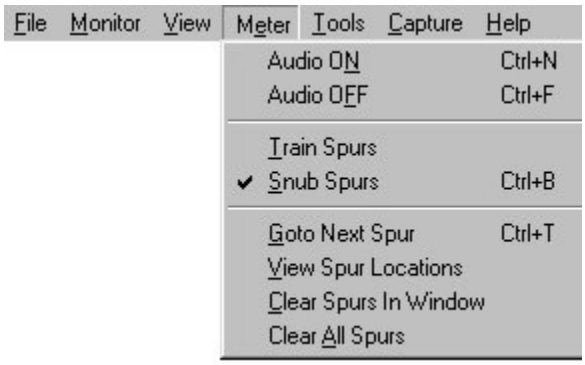
The menu bar contains 7 menu selections.

	**File Menu** ➢ Creates a **New Data File** to record data ➢ Opens an Existing Data File ➢ Closes an **Open Data File** ➢ Records data to an **Open Data File** ➢ **Exit** the program
	**Monitor Menu** ➢ Turns continuous sweeping **on** or **off** ➢ Causes a single sweep to occur



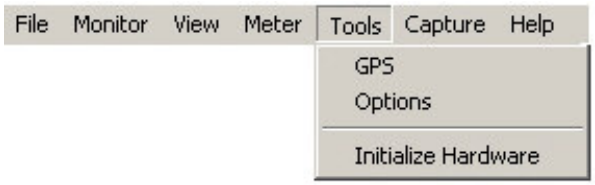
View Menu

- Displays in Compact size mode
- Displays in Standard size mode
- Displays on top of other windows



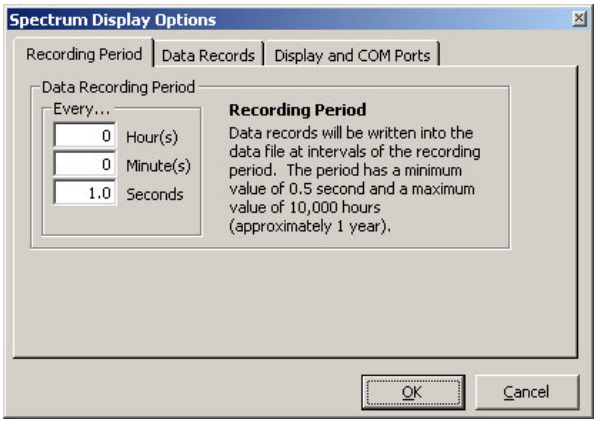
Meter Menu

- Turns audio **on**
- Turns audio **off**
- Allows the system to detect spurs
- Removes detected spurs from the active display
- Sets center frequency to next spur
- Highlights detected spur frequency window
- Clears detected spurs from active window
- Clears all detected spurs



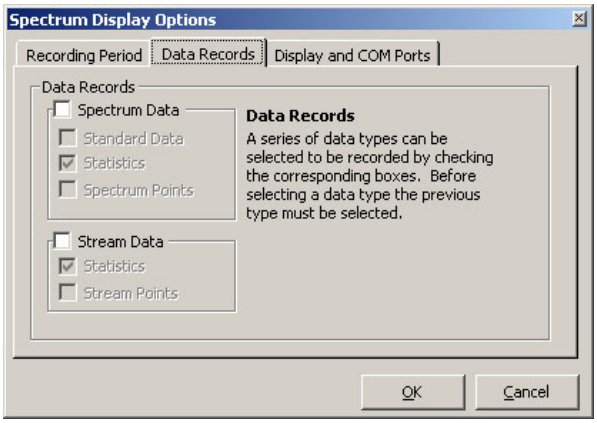
Tools Menu

- Displays GPS status
- Options:
- Recording Period tab



Use the Recording Period tab to select how long to wait between measurements.

- Data Records tab



Check the Spectrum Data check box and then check the data to be recorded.

Standard Data includes:

Date, Time, Frequency, Frequency Units, Signal Level, Signal Level Units, Latitude(optional), Longitude(optional), Standard Deviations*, Tilt*, High Low Difference*, Peak**

* between inner markers

** between outer markers

Statistics Data includes:

Standard Data plus:
Sweep Type, IF Bandwidth code, Sweep Width, Outer Marker Width, Inner Marker Width, Minimum***, Maximum***, Average***

*** across entire spectrum

Spectrum Points includes:

Standard Data plus:
Statistics Data plus:
500 or 1000 spectrum measurement points.

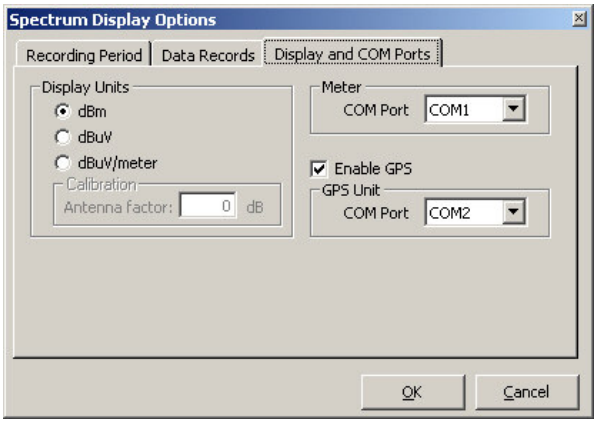
Stream Data Statistics(optional) includes:

Date, Time Frequency, Frequency Units, blank, blank, Latitude(optional), Longitude(optional), Stream Min, Stream Max, Stream Average

Stream Data Stream Points(optional) includes:

Stream Statistics plus:
Number of Stream measurements, Stream Measurements

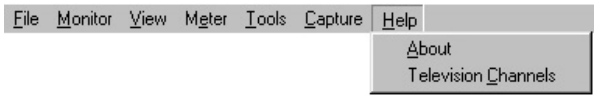
- Display and COM Ports tab



- Display Units
  may be dBm, dBuV, or dBuV/meter.
- Antenna Factor
  Note: Antenna Calibration factor only used in calculation of dBuV/meter display units.
- Meter Com Port
- Enable GPS
- GPS Com Port

Capture Menu

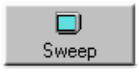
- Captures the current screen
- SnagIt configuration options



Help Menu

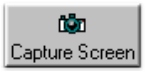
- Displays software version
- Opens a new window listing the center frequency of Television channels for North America (system M) and Great Britain (system PAL-G).

Tool Bar



When pressed, the sweep will update repetitively about twice a second. When pressed again, stops the sweep.

When presses, the sweep will update once. Single sweep is not available when the Sweep button is pressed.



When pressed, will capture the screen to a file as defined by the Capture Options menu.

Frequency Provides for entry of the center frequency of the sweep. The frequency step low (left arrow) and step hi (right arrow) will change the center

frequency by one-half the span or sweep width.

Graphic Controls

Graphic controls are shown in the left side of the screen. They control the setup of the meter, and the display of time plots and the spectrum.

	Time Plot Controls
	(Drag screen divider down to see all the Spectrum Controls.)
	(Click the "Time Plot" Tab at the bottom of the Decoder Screen)
Graph Properties	Only active when viewing Time Plots.
	(Click the "Time Plot" Tab at the bottom of the Spectrum screen to see time plots)
	Plot vs Time … box allows you to select which Figure of Merit to plot. Integrated Power, Peak Power, Tilt, High Low Difference, Standard Deviation, Stream Max, Stream Average, Stream Min, Stream Range, Stream Standard Deviation. It also allows you to select the amount of time the figure of merit is plotted. Valid range is 20 to 1800 seconds. The Clear button clears the time plot.
Gain	Same as Gain on Spectrum Tab. See Spectrum Tab Below
Display	Same as Gain on Spectrum Tab. See Spectrum Tab Below
	Spectrum Tab Controls
	(Click the "Spectrum" Tab at the bottom of the Spectrum Screen)
Graph Properties	**Spectrum** – Main Spectrum display controls
	Sweep Width/IFBW – Provides sweep width and IF bandwidth settings
	5 MHz/15kHz -- 5 MHz wide with 15kHz IF bandwidth
	10 MHz/15kHz -- 10 MHz wide with 15kHz IF bandwidth
	10 MHz/150kHz -- 10 MHz wide with 150kHz IF bandwidth
	20 MHz/150kHz -- 20 MHz wide with 150kHz IF bandwidth
	Modulation – Normal for sinusoidal modulated signals, Digital for digitally modulated signals
	Peak Hold – check to display peak at each frequency of sweep
	Reset – click to reset peak display
	Marker Widths -- Markers are Dark Green vertical lines they are always centered about the center frequency
	Outer -- Bandwidth Integrated power and Peak Power are measured in.
	Inner -- Bandwidth High Low Difference, Tilt, and Standard deviation are measured in.
	Overlays
	Stats Lines … controls the visibility of statically lines. The Maximum Average and Minimum values during the current time plot may be made visible or not visible by checking or un-checking the check box.

Gain Sets the RF gain level of the meter.

Manual In manual mode the RF Gain is set by clicking on one of the Amplification buttons 1 through 5.

Amplification The meter settings for the buttons are:

Button 1: Attenuation = 60 dB, RF Amp = Off

Button 2: Attenuation = 40 dB, RF Amp = Off

Button 3: Attenuation = 20 dB, RF Amp = Off

Button 4: Attenuation = 0 dB, RF Amp = Off

Button 5: Attenuation = 0dB, RF Amp = On

Search Click the Search button for the meter to adjust the amplification level, and lock at that level. The center frequency will be ranged to show in within the active range of the vertical scale.

Auto will set the meter gain such that the Integrated power between the outer markers will be within the active range of the vertical scale. It will auto range before every sweep. It will stay at that setting until it a sweep occurs where the Integrated Power is outside the active range of the vertical scale, then it will auto range again.

Dynamic Use this setting only if the Integrated Power of each sweep is changing level beyond 20 dB. This will set the meter gain before each sweep so that the center frequency is in the active range of the vertical scale. This will change the meter attenuation and/or RF Amp level settings each sweep via the internal relays. To avoid pre-mature wear of relay contacts, do not use this mode for extended periods of time.

Display Enables/Disables Active Cursor, Figures of Merit, and Status Lines for the spectrum display.

Active Cursor When checked, the Active Cursor, a light green vertical line in the active spectrum area is displayed. Also an Active Cursor Status box is displayed in the upper right corner of the window. Whenever the mouse cursor is inside the spectrum display area on the screen, the cursor becomes a vertical pointer ↑ and will follow mouse movement. To move the Active Cursor to a new frequency positioning the ↑ on light green vertical line, press the left mouse button, then drag the line to a new frequency. The Active Cursor status box at the upper right corner displays the new frequency and the power at that frequency. Small changes of the Active Cursor frequency can be made by clicking the right or left arrows in the Active Cursor Status box.

Figures of Merit When checked a “Spectrum Merits” status box appears on the right side of the window. The Spectrum Merits status box displays Integrated Power and Peak Power measured between the outer markers, Tilt, High Low Difference, and Standard Deviation measured between the inner markers.

Stats Lines Enables display of dotted red horizontal lines that designate Maximum, Average, and Minimum power levels of the entire sweep.

	Maximum Enables display of dotted red horizontal line with up pointing end points indicating the maximum power level of the entire sweep.
	Average Enables display of dotted red horizontal line with square end points indicating the average power level of the entire sweep.
	Minimum Enables display of dotted red horizontal line with down pointing end points indicating the minimum power level of the entire sweep.
	Stream Tab Controls (optional)
	(Click the "Stream" Tab at the bottom of the Spectrum Screen)
	Think of the Stream Tab as an RF oscilloscope, a display of signal level vs time. Stream measurements are made at the center frequency at an 15kHz IF bandwidth, (NB) or a 150 kHz IF bandwidth (WB). The measurements are made at better than 200 measurements per second, then displayed over a user specified time scale. The user may also set a trigger to capture signals that pulse infrequently, but very quickly.
Graph Properties	Sets the properties of the streaming display
	Scale -- Horizontal Time scale of stream display
	Filter -- IF Filter setting NB = 15kHz WB = 150kHz
	Pulsed Signal – check this to enable triggering
	Threshold – Enter the signal level to trigger capture and display of signal
	Show – Check to show yellow horizontal line at trigger level
	Triggering
	Untriggered – when enabled measurement are displayed independent of trigger threshold level
	Triggered – when enabled measurements are displayed only if the signal level passes through the trigger threshold.
	Edge -- enable **Rising** edge trigger or **Falling** edge trigger.

Unique Features

Display in dBm

Traditionally true power measurement is done with a Power Meter. Such a device measures the average power of a signal by measuring the heat created by that signal. The true power meter however has no way to tune out unwanted frequencies. The R-507 with it's digitally synthesized tuning allows just the frequency or frequencies of interest to be measured. The Meter is calibrated on a CW (Carrier Wave) signal. It looks at a peak voltage of a signal in a 50 ohm system and based on a sine wave relationship generates the same average Power number a Power Meter would generate if subjected to the same signal. Power can be displayed in units of dBm or dBuV, the relationship of dBuV to dBm is dBm = dBuV - 107. 0 dBuV is defined to be the power generated by a 1 Micro Volt signal across a 50-Ohm load. The default setting is Display in dBm. See the "Front Panel Operation" Section of the R-507 manual for more explanation and a table relating different values of input voltages, dBuV, and dBm levels.

Digital Modulation

In the description of Display in dBm, we learned that the meter measures voltage created by a sine wave signal and relates that to average power. This relationship is unique to sine wave signals. A digitally modulated signal has a different relationship from voltage to average power. Rather than being sine wave like, a digitally modulated signal is noise-like. It can be shown that pure noise has a voltage to average power 2.5 dB higher than that of a sine wave signal. (See Tek Appnote # 26W-7037 "Spectrum Analyzer Fundamentals") When Digital Modulation is checked, 2.5 dB is added to the inband power measurement number. The default setting is Digital Modulation Checked.

Antenna Factor

At a fixed frequency a calibrated antenna and RF feed system have a specified dB offset. This offset may be entered into the program so the inband Power measurement includes this offset. Once entered this offset is added to the inband Power measurement. When unchecked no offset is added. The default setting is unchecked. Measurements that include an antenna factor are normally displayed in units of dBm/meter.

Spur Snubber

There are known spurs in the R-507 instrument that show up on a few UHF television frequencies. You will notice these by observing a signal in the spectrum that doesn't go away, even when there is no signal on the input connector of the meter. Using the Spur Snubber can eliminate these signals. Note that if the frequency is changed the Spur Snubber should be re-trained. The spur Snubber will subtract out the spur if it is above the signal being measured.

GPS

Enables monitoring of a GPS through a user selectable PC serial COM port. When enabled the current GPS Latitude and Longitude are displayed in the status bar at the bottom of the Spectrum Display window, and added to each measurement in the log file. When not enabled, the status bar indicates NO GPS.

The Svee Series GPS receiver updates every second. Some other GPS units update every 2 seconds. These results in more than one measurement listed at a given location even when traveling at expressway speeds. When data that includes two or more measurements at a single GPS location is plotted on a map such as Microsoft MapPoint, the most recent measurement is usually the only one visible.

Import Recorded Data into Microsoft Excel

The most simple way to import data recorded with Spectrum Display into Microsoft Excel for analysis is to rename your file so that it has a .csv (comma Seperated Value) file extension. Once the file has a .csv extension simply double click on the file and Excel will open the file with all the comma separated values in columns.

Notice: Microsoft Excel has a limit of 234 columns and 65000 rows. Both Spectrum point data and Stream data exceed the column limit. In order to import Spectrum Point data or Stream data into Excel the data file must first be separated in to files of no more than 234 records,

then each file must be translated row for column. Contact the Z Technology factory if you need a program that will do this translation.

Import Recorded Data into Microsoft MapPoint

Microsoft MapPoint has a data import wizard that can easily import data recorded by Spectrum Display. The data should not include Spectrum Points data or Stream Data, but may include Standard Data, and Statistical data. Once Imported MapPoint will inquire on how the data is displayed on a map.

Note: the data must include the optional GPS Latitude and Longitude fields.

Select **Data: Import Data Wizard** from the MapPoint main menu.

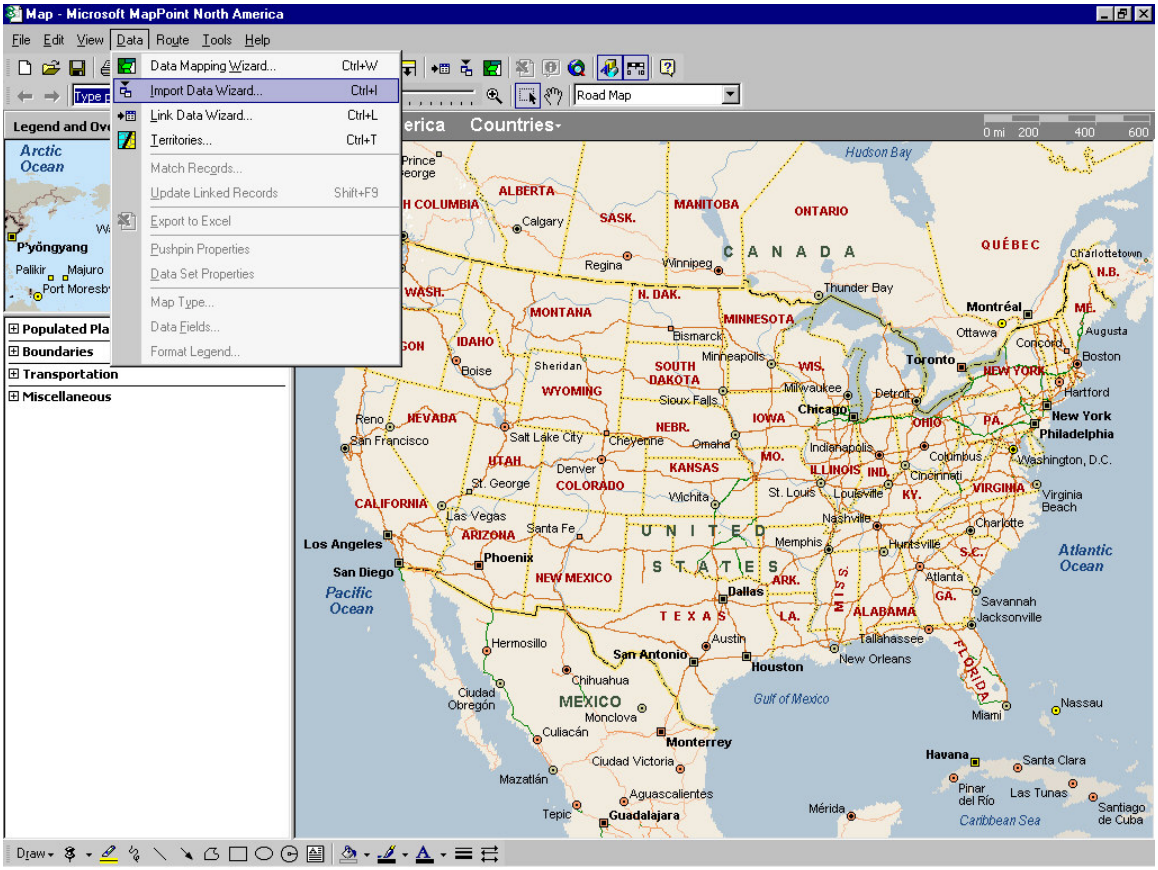


Figure 12: MapPoint – Data: Import Data Wizard Menu item

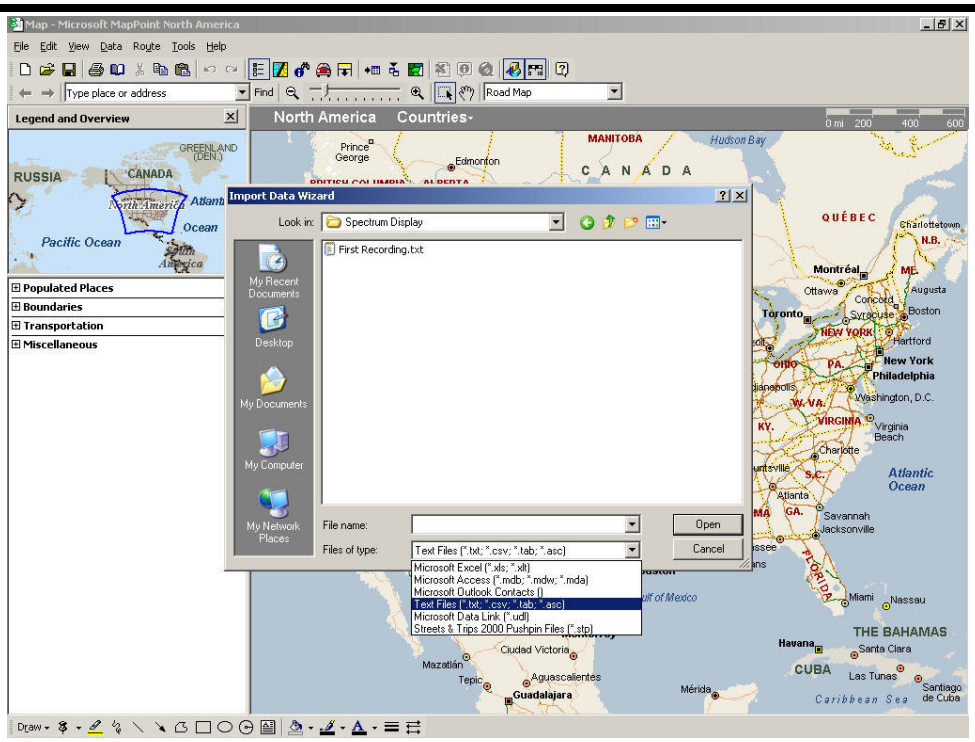


Figure 13: Import Data Wizard - .txt data file type

The MapPoint Data Import Wizard automatically displays a browse window to locate the file to be imported. Set the import file type to (.txt)

Browse to the “My Documents\Spectrum Display” folder.

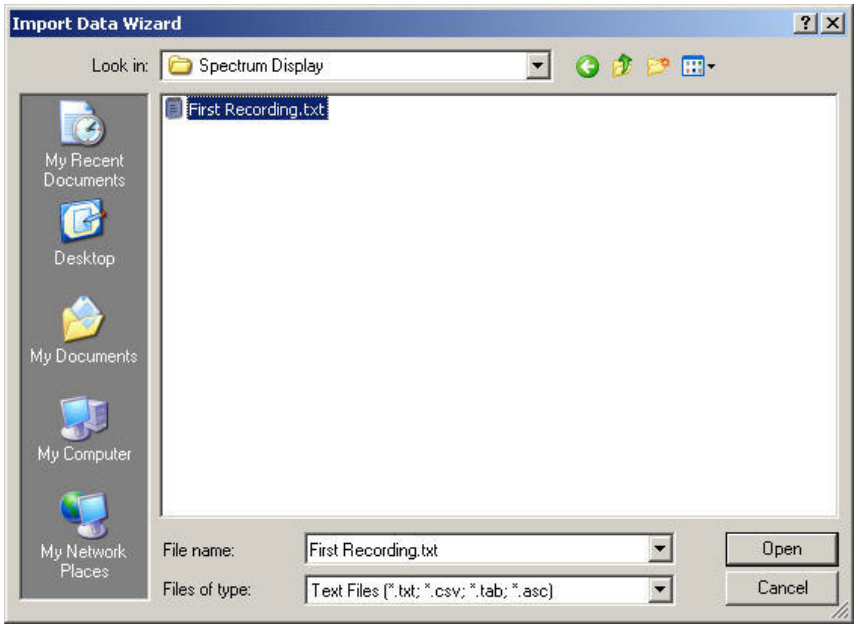


Figure 14: Import Data Wizard – Browsing to the Spectrum Display folder

Click on the file to import, in this case **First Recording.txt**. A Choose the separator character screen appears.

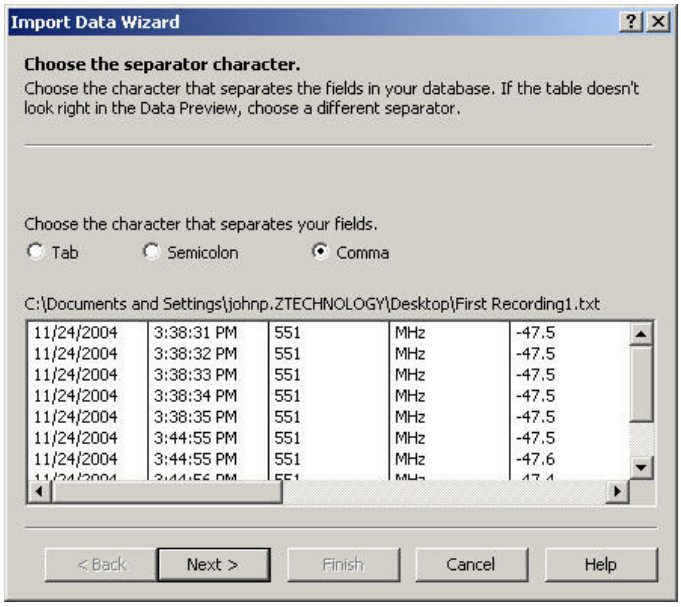


Figure 15: Import Data Wizard - choose separator character

Click the **Comma** button if not already selected, then Click **Next** to continue. Another import screen appears

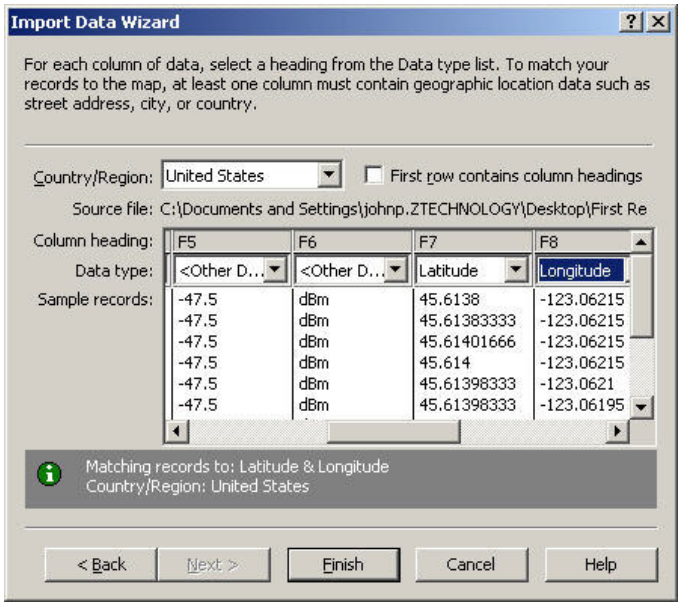


Figure 16: Import Data Wizard - Column Headings

Since there are no column headings in the recorded data file you need to identify which columns contain the Latitude and Longitude. Scroll horizontally until Columns F7 and F8 are visible. These are the Latitude and Longitude columns respectively. Click the down arrow in Column F7 and select “Latitude”. Click the down arrow in Column F8 and select “Longitude”.

Click **Finish** to complete importing the data. A completion bar indicates the data being imported into MapPoint. After the data has been Imported, a screen appears to query how you would like MapPoint to display the data.

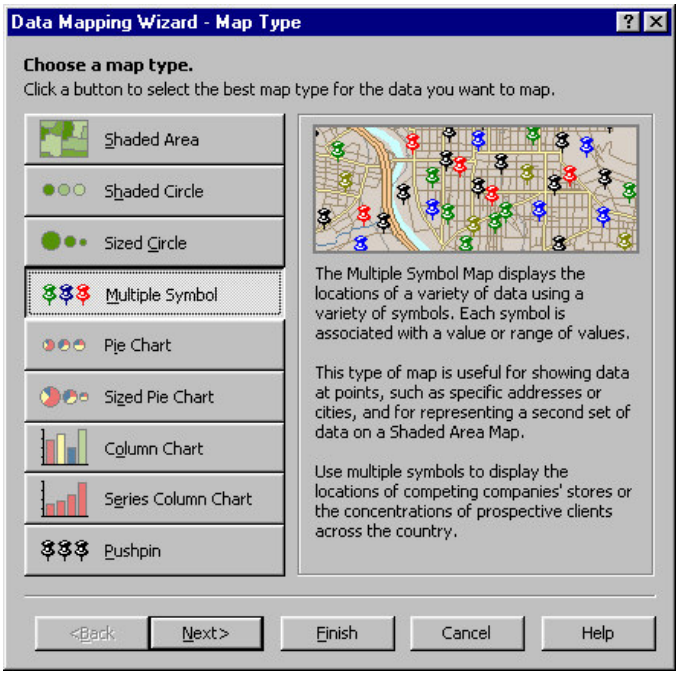


Figure 17: Data Mapping Wizard - Choosing Map Type

Select the Multiple Symbols button, then Click Next. A Data Fields screen appears next to display the fields to be imported.

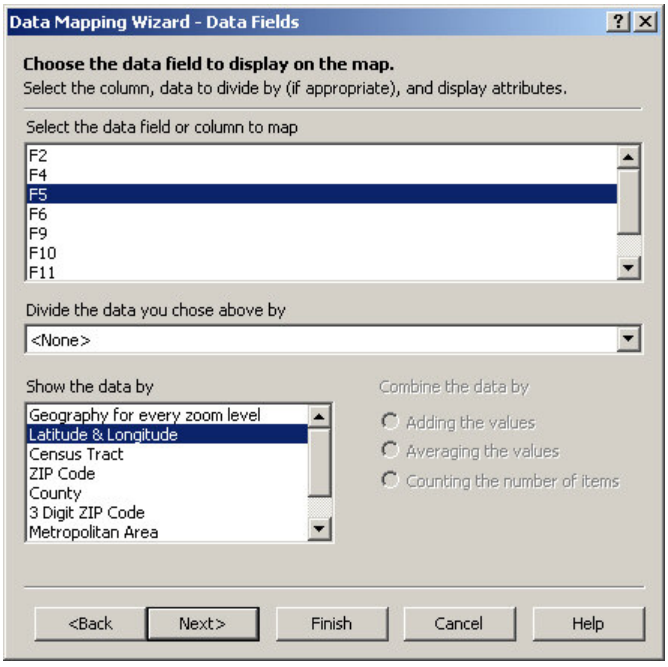


Figure 18: Data Mapping Wizard - Data Fields

Select F5, this is the Signal Level column. You may wish at some other time to select one of the other columns to plot other measured parameters. Clicks **Next** to continue. A Legend screen appears.

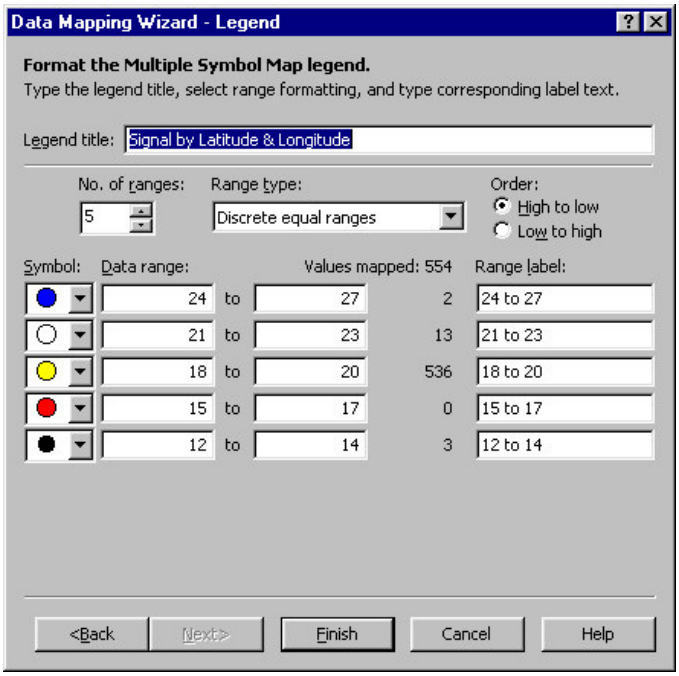


Figure 19: Data Mapping Wizard - Legend

The Legend screen allows you to change the number of ranges, the colors and how the data is plotted.

Click **Finish** to use the defaults.

Completion bars display as the data is drawn on the map.

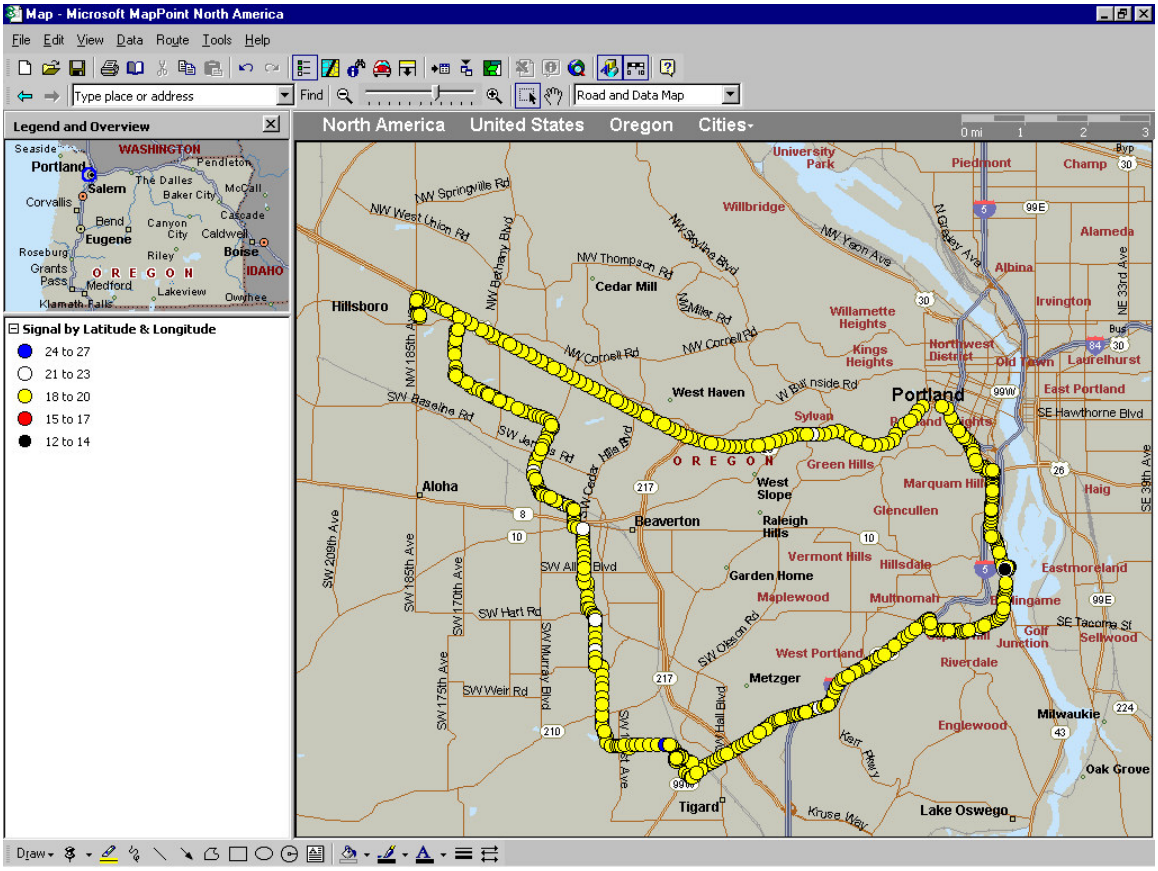


Figure 20: MapPoint displaying Imported Data

The map automatically zooms into the area of the data.

Zoom and Pan on the data, analyze as you wish using the MapPoint user interface.

When done exit the program by selecting **File: Exit** from the main menu. A Save Changes screen appears.

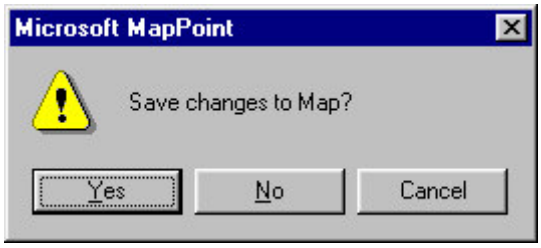


Figure 21: MapPoint – Save Changes?

If you choose **Yes**, a browse window will open to save the file, the next time MapPoint is started it uses the saved file to restore and display the imported data at its last position and zoom setting.

If you choose **No** it will start up its previous position and zoom setting.

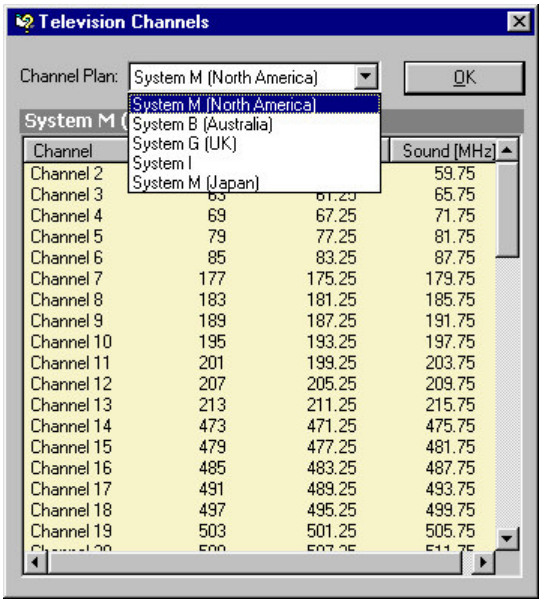


Figure 22: Television Channels from Help Menu

Five Television channel plans are available as indicated from the Help → Channels pull-down menu. Items listed for each channel plan include the channel number, center frequency of each channel, picture carrier frequency (visual), and sound carrier frequency (aural).

Section 6: Memory Feature (Memory Button Operation)

As an alternative to sequentially tuning through the frequency spectrum, or a pre-programmed Channel Plan (see F4 - View TV Channel Plan.) The operator can tune through a series of frequencies or channels stored in memory.

USER MEMORY Storage

There are one hundred (100) USER MEMORY locations available. Any of the one hundred locations (1-100) may be programmed with the current meter frequency or channel setting. The procedure for programming a memory location is as follows:

9. Tune the R-507 to the frequency or channel (including picture or audio) to be stored.

10. Enter the **FUNCTION** mode by the NORMAL operation of the **FUNCTION** button.

11. Enter the MEMORY-PROGRAMMING mode by the NORMAL operation of the **MEMORY** button. A "**P1 xxx.xxx MHz**" appears in the ***FREQUENCY/CHANNEL*** readout. The P1 indicates that the first (#1) memory location is currently selected to be programmed. xxx.xxx is the frequency of the previously recorded location.

12. Rotate the **TUNE** knob until the desired USER MEMORY location (1-100) is shown in the ***FREQUENCY/CHANNEL*** readout. If this USER MEMORY location has already been programmed, its stored setting will be displayed in the ***FREQUENCY/CHANNEL*** readout. Storing a new setting overwrites the previous setting.

    NOTE: USER MEMORY locations must be programmed in sequence. The R-507 will not allow USER MEMORY locations to be skipped, but not all USER MEMORY locations need be programmed. When retrieving frequency or channel settings, the R-507 will access only the locations that contain valid programmed settings.

13. Store the current frequency or channel setting in the selected memory location by the NORMAL operation of the **TUNE** knob. After the TUNE knob is pressed the xxx.xxx is updated to show the currently programmed frequency.

14. Exit the MEMORY-PROGRAMMING mode by the NORMAL operation of the **FUNCTION** Button.

    NOTE: All one hundred USER MEMORY locations may be erased at once by invoking the F21 function (See the "Functions" Sections for details.)

    NOTE: The **RF AMP**, **BANDWIDTH**, and **AUDIO** button states, are not stored.

    NOTE: When Memory location 100 is programmed the ***FREQUENCY/CHANNEL*** readout displays "**P00 xxx.xxx MHz**"

USER MEMORY Retrieval

The procedure to recall a frequency or channel stored in a USER MEMORY location is as follows:

Section 6: Memory Feature (Memory Button Operation)

1. Enter the MEMORY-SELECT mode by the NORMAL operation of the **MEMORY** button. Upon entering this mode, the R-507 is immediately set to the frequency or channel setting stored in the first (#1) USER MEMORY location. The setting is also shown in the ***FREQUENCY/CHANNE*** readout.

2. Each clockwise rotary click of the **TUNE** knob selects (recalls from non-volatile memory) the next sequential stored frequency or channel setting.

3. If the recalled setting specifies CHANNEL mode, the R-507 is set to that mode and tuned to the specified picture or audio carrier. If the setting specifies FREQUENCY mode, the R-507 is set to that mode and tuned to the required frequency.

4. If the data retrieved from a USER MEMORY location is invalid (for example, if corrupted by a hardware failure,) the loud speaker outputs three (3) short beeps and the R-507 returns to its previous operating mode.

5. Rotate the **TUNE** knob clockwise to increment the USER MEMORY location selected with wrap-around from high to low. Turn the **TUNE** knob counter-clockwise to decrement the USER MEMORY selection with wrap-around from low to high.

6. NOTE: Un-programmed USER MEMORY locations can not be retrieved. For example, if only four (4) USER MEMORY locations contain programmed information, the R-507 will sequence 1, 2, 3, 4, 1, This prevents the selection of an un-programmed USER MEMORY location.

7. Exit the **MEMORY-SELECT** mode by the NORMAL operation of the **MEMORY** button. This will restore the R-507 to its previous operating mode.

8. If the R-507 is powered-down while in the MEMORY-SELECT mode, the next power-up of the meter will restore the meter to this mode.

Section 7:Function Features (FUNC Button Operation)

Functions

All instrument set-up operations and certain operating features are accessible as FUNCTIONS. All internal data logging and retrieval modes are also accessed as functions.

On the next page is a summary of the functions that were available at the time this manual was shipped. Full descriptions of these functions are provided later in this chapter.

> **NOTE:** Some R-507 controls have both a NORMAL and a HOLD mode of operation. NORMAL mode is activated when these controls are pushed and released within a 2 second period of time. The HOLD mode is activated by pushing and holding the control in for at least 2 seconds.

Selecting a Function

Select any of the front panel accessible FUNCTIONs by using the following procedure.

1. Enter the FUNCTION mode by the NORMAL operation of the **FUNCTION** button. "**F1**" is always displayed upon entering the FUNCTION mode.
2. Rotate the **TUNE** knob (either clockwise or counter-clockwise) until the desired function number is displayed in the ***FREQUENCY/CHANNEL*** readout.

   > **NOTE:** Functions F40 through F48 are normally locked-out to prevent accidental changes to certain critical parameters. The user can unlock these functions by selecting F59 three times in a row. The functions are re-locked when the R-507 is switched off.

3. Select the displayed FUNCTION by the NORMAL operation of the **TUNE** knob switch. (Press the **TUNE** knob toward the front panel, briefly.)
4. The FUNCTION mode may be exited, before selecting a function, by the NORMAL operation of the **FUNCTION** button.
5. If, while executing any function the operator decides to cancel the operation, he may do so by powering-down the meter, using the NORMAL operation of the **POWER** button.

Function	Description
F1	BATTERY VOLTAGE CHECK
F3	CUSTOMER CALIBRATION (MINOR)
F4	VIEW TV CHANNEL PLAN
F5	DISABLE AUTO POWER DOWN
F7	SET SCAN STEP FREQUENCY
F8	SET SCAN START FREQUENCY (Frequently accessed functions)
F9	SET SCAN STOP FREQUENCY
F10	AUTO - CONTIGUOUS RESIDENT DATA LOGGING
F11	MANUAL - CONTIGUOUS RESIDENT DATA LOGGING
F12	SELECT ANTENNA CALIBRATION

Section 7: Function Features (FUNC Button Operation)

Function	Description
F13	SELECT BLOCK CONVERTER
F14	SELECT dBm
F 15	SELECT ATTENUATOR SETTING
F21	ERASE USER MEMORY (1 - 40)
F28	SOFTWARE VERSION #
F40	CUSTOMER CALIBRATION (MAJOR)
F41	SELECT CUSTOMER CALIBRATION
F42	SELECT FACTORY CALIBRATION
F43	SET RS-232 BAUD RATE
F44	SET RS-232 REMOTE ADDRESS (Locked out User Functions)
F45	SET 24 HOUR CLOCK {Except F44}
F46	SET MONTH/DAY
F47	SET YEAR
F48	CLONE ANOTHER R-507
F59	UNLOCK USER FUNCTIONS F40 - F48
F60	(Manufacturer only Functions) {Specially locked out}
F89	
F91	RESET DATA LOG RECORD COUNTER TO 1
F93	REMOTE MODE
F94	PRINT (RS-232) SELECTED DATA LOG RECORD
F95	PRINT (RS-232) ALL DATA LOG RECORDS
F96	AUTO - USER MEMORY RESIDENT DATA LOGGING (Data Logging Functions)
F98	MANUAL - USER MEMORY RESIDENT DATA LOGGING

Section 7: Function Features (FUNC Button Operation)

F1: BATTERY VOLTAGE CHECK

The charge level of the R-507s internal battery may be checked by selecting the F1 function (i.e. pushing the **TUNE** knob). In this function, the battery voltage is displayed in the ***FREQUENCY/CHANNEL*** readout (Example: "**9.68**" indicates 9.68 Volts). A fully charged battery pack will have a voltage of 10 volts or more.

F3: CUSTOMER CALIBRATION (MINOR)

The F3 Function enables the user to perform a single-point calibration, using a single frequency calibration source. The following procedure creates a calibration offset (maximum of +/-20.0 dBuV) that will be applied to every signal level measurement.

6. Connect the calibration signal source to the R-507s front panel jack. Set the source to the desired frequency.

7. Set the R-507 to the frequency of the calibration source, then enter the F3 function. The R-507s reading of source's signal level will be displayed in the ***SIGNAL LEVEL*** readout.

8. Rotating the **TUNE** knob will increment/decrement the reading in 0.1 dBmV steps. When the ***SIGNAL LEVEL*** readout displays the true level of the calibration signal, use the NORMAL operation of the **FUNCTION** button to store the displayed offset in non-volatile memory and exit this mode.

9. To set the single-point calibration offset to zero, enter the F3 mode and immediately exit by the NORMAL operation of the **FUNCTION** button without rotation the **TUNE** knob.

F4: VIEW TV CHANNEL PLAN

When this mode is selected, the ***FREQUENCY/CHANNEL*** readout displays the currently active factory selected channel plan. "**AIR**", "**UHF**", or "**PAL-D**" is displayed. The following table is used at the factory to determine the setting based on the unit's destination.

Shipped to	TV Standard	Setting
North America	NTSC	"**AIR**"
Europe	PAL	"**UHF**"
ASIA	PAL-D	"**PAL-D**"

NOTE: The R-507 TV CHANNEL PLAN is set at the factory. To change the TV CHANNEL PLAN call your Service Center for instructions.

F5: DISABLE AUTO-POWER-DOWN

After selecting the F5 function, rotating the **TUNE** knob will toggle the ***FREQUENCY/CHANNEL*** readout between "**AUTO**" and "**ON**". The NORMAL operation of the **FUNCTION** button while "**ON**" is displayed, disables the timed auto-power-down feature. It will not affect the auto-power-down under low battery condition.

After executing F5, the R-507 returns automatically to its previous operating mode.

NOTE: Auto-power-down is enabled each time the meter is powered up.

F7: SET SCAN STEP FREQUENCY

This function allows the operator to select the size of the step frequency to be used by functions F10 and F11.

Upon selecting this function, the ***FREQUENCY/CHANNEL*** readout will display "**000 STEP**". The rotation of the **TUNE** knob will increment/decrement the step size in 10kHz steps with wrap around from 10 to 500 and 500 to 10.

Pressing the **FUNCTION** button exits the F7 function and stores the SCAN STEP FREQUENCY in non-volatile memory to be restored each time the meter is powered up.

F8/F9: SET SCAN START FREQUENCY/SET SCAN STOP FREQUENCY

If function F8 is selected, the 6-digit SCAN START FREQUENCY (in MHz) will be displayed in the ***FREQUENCY/CHANNEL*** readout. Use the TUNE knob to select the desired SCAN START FREQUENCY.

If function F9 is selected, the 6- digit SCAN STOP FREQUENCY (in MHz) will be displayed in the ***FREQUENCY/CHANNEL*** readout. Use the TUNE knob to select the desired SCAN STOP FREQUENCY.

Pressing the **FUNCTION** button exits the F7 function and stores the SCAN STEP FREQUENCY in non-volatile memory to be restored each time the meter is powered up.

These frequency settings determine the beginning and ending points for the F10 and F11 functions. They are stored in non-volatile memory and restored each time the meter is powered up.

F10: AUTO-CONTIGUOUS RESIDENT DATA LOGGING

NOTE: To use a RESIDENT DATA LOGGING Feature, it must first be activated through the RS-232 port. This is done by using the "Quick Basic Control Software" provided with each R-507. The activation procedure is described in detail by the application note titled: R-500 Series Quick Basic Control Software. See the description concerning the program MENU.EXE and Setup Address 1888.

Initially, this function displays "**LOG :05**" in the ***FREQUENCY/CHANNEL*** readout. The "**:05**". indicates the minimum interval of 5 minutes. The rotation of the **TUNE** knob increments/decrements the interval in 1 minute steps. The maximum interval is 24 hours "**24:00**". Note the display increments from "**:59**" (59 Minutes) to "**1:00**" (1 hour, 00 minutes)

Up to twenty (20) measurement records can be initiated using this function. (see the RESIDENT DATA LOGGING section of this manual for further detail.)

After setting the scan interval, the **TUNE** knob must be pressed to start the data log. Once started, the ***FREQUENCY/CHANNEL*** readout displays the frequency under test. The ***FREQUENCY/CHANNEL*** readout will increment as the measurements are recorded. After recording all measurements, the meter will shut off until the scan interval has expired. At that time the meter will automatically power itself up and perform the next data log. After recording

all measurements, the meter will again shut itself off. If twenty records have been recorded, the meter will remain off until manually powered up by the operator.

One (1) of two (2) conditions determines at which frequency the data log record will end. If the SCAN STOP FREQUENCY (F9) is reached, the data log ends after recording the SCAN STOP FREQUENCY. If prior to reaching the SCAN STOP FREQUENCY the maximum number of readings is reached, the data log will end then, regardless of the last frequency recorded.

The maximum number of readings each data log record will hold is 360, no matter which SCAN STEP FREQUENCY (F7) is selected.

The amount of time required to record 360 entries cannot be guaranteed. The minimum time required to tune, measure and record 360 different frequencies is around 2 minutes. If the signals being measured have wide amplitude differences, the instrument must make adjustments for this by switching internal RF relays. These range changes may significantly increase the time required to completely record a long data log record.

> **NOTE:** Starting F10 resets the Record Counter to one, "**R1**" All previously stored records will be erased.

F11: MANUAL CONTIGUOUS RESIDENT DATA LOG

Initially, this function displays the record number to be logged in the ***FREQUENCY/CHANNEL*** readout, "**R 1 xx.xxx MHz**", the "**R 1**" indicates the first record, R1 if no records have been previously stored or "**R 2**", "**R 3**", up to "**R20**", if all 20 records have already been stored. The ***"xx.xxx"*** indicates the SCAN START FREQUENCY.

> The **TUNE** knob must be pressed to start the data log. Once started, the ***FREQUENCY/CHANNEL*** readout displays "**LOG xxx.xxx MHz**" where "**xxx.xxx**" is the current frequency under test. The ***FREQUENCY/CHANNEL*** readout will increment as the measurements are recorded.
>
> After recording all readings, the meter will beep twice. The ***FREQUENCY/CHANNEL*** readout will display "**END R .100**" where "**.100**" indicates end of record #1. The operator has two (2) choices at this point. If the **MEMORY** button is pressed, the record will be stored. If the **FUNCTION** button is pressed, the record will be discarded.
>
> The conditions for determining at which frequency the data log record will end are the same as for the F10 function.
>
> The maximum number of records which can be stored in the R-507 is twenty, "**R20**". If the operator has already stored 20 records, selecting function F11 again will cause the meter to beep three (3) times and exit back to normal Field Strength Meter (FSM) mode.
>
> Function F91 should be used to reset the record counter back to one (1).

F12: SELECT ANTENNA CALIBRATION

Activating the meters internal user defined Antenna Calibration Table allows the meter to display direct in dBuV/M. Typically this function is disabled when shipped from the factory unless you have specifically asked the factory to set it up with a specific antenna purchased with the meter.

If selecting this function results in no change of the ***FREQUENCY/CHANNEL*** readout, then no valid Antenna Calibration Table is loaded in the meter.

> **NOTE:** Loading a valid Antenna Calibration Table requires the use of a PC connected to the meters serial port, and Z Technology Antenna Calibration software. See the "Antenna Calibration Table" Application Note to see how to load a valid Antenna Calibration Table.

If selecting this function shows "**ANT OFF**" in the ***FREQUENCY/CHANNEL*** readout then the Antenna Calibration table is inactive. If selecting this function shows "**ON ANT**" in the ***FREQUENCY/CHANNEL*** readout then the Antenna Calibration table is active. Select "**ANT ON**" or "**ANT OFF**" by rotating the **TUNE** knob, then pressing the **FUNCTION** button.

F13: SELECT BLOCK CONVERTER

This function is used to inform the meter that the user has attached a Block Converter to the meters RF Input connector. The meter can then display the actual tuned frequency in the ***FREQUENCY/CHANNEL*** readout, relieving the user from having to add or subtract the frequency offset caused by a block converter. Entering this function shows "**STD**", "**BC**", or "**PCS**" in the ***FREQUENCY/CHANNEL*** readout. "**STD**" is the proper setting for no block converter connected. "**BC**" is the proper setting for the OPTION BC-BCB 0.3 to 3.0 MHz low frequency block converter. "**PCS**" is the proper setting for the OPTION BC-PCS 1750-1980 MHz High Frequency Block converter. Select "**STD**", "**BC**", or "**PCS**" by rotating the **TUNE** knob, then pressing the **FUNCTION** button. See Block Converter manual for further instructions

F14: SELECT dBm

This function sets the meter to display the measured signal level in the ***SIGNAL LEVEL*** readout directly in dBm units. This function overrides function 12. Entering this function shows "**DBM OFF**" in the ***FREQUENCY/CHANNEL*** readout when this function is inactive or "**DBM ON**" when the function is active. Select "**DBM OFF**", or "**DBM ON**" by rotating the **TUNE** knob, then pressing the **FUNCTION** button.

F15: SELECT ATTENUATOR SETTING

This function is used to lock the meters internal RF ATTENUATORS at a single setting or to unlock them to enable the meter to Auto-range. If a signal is known to be always within a 35 to 40 dB range locking the appropriate attenuator allows the meter to make faster measurements. Entering this function shows "**ATN UNL**" in the ***FREQUENCY/CHANNEL*** readout when the meter is Auto-ranging. Rotate the **TUNE** knob to change the setting. Possible settings are "**ATN 0**" no attenuators locked in the RF path. "**ATN 20**" a 20 dB attenuator locked in the RF path. "**ATN 40**" a 40 dB attenuator locked in the RF path. "**ATN 60**" a 60 dB attenuator locked in the RF path.

Note: Locking the attenuators may cause an error in the ***SIGNAL LEVEL*** readout reading if the signal is too large or too small for that attenuator setting. This function is for advanced users only who have special measurement needs, and know the anticipated signal level.

F21: ERASE USER MEMORY (1-100)

All USER MEMORY locations may be erased from non-volatile memory by entering the F21 function.

Select function F21. The phrase "**3 ERAS**" will be displayed in, and in the ***FREQUENCY/CHANNEL*** readout.

As a safety measure, the **MEMORY** button must be pressed three times in sequence to activate this function. Each NORMAL operation of the **MEMORY** button decrements the number shown in the ***FREQUENCY/CHANNEL*** readout. The third depression erases the USER MEMORY settings. The erase procedure may take several seconds to a minute to complete if all 100 user memory location are being erased. This feature is handy when performed immediately prior to completely changing all of the 100 USER MEMORY settings.

F28: SOFTWARE VERSION

Function 28 displays the meters software release date and version number in the ***FREQUENCY/CHANNEL*** readout. Example "**3.00 898**" Software version number 3.00, release date August, (the 8th month) of the year 1998.

F40: (Locked User Functions), CUSTOMER CALIBRATION (MAJOR)

NOTE: See function F59 to unlock functions F40 through F48.

F40 function allows the user to perform a full, multi-point calibration. The calibration procedure requires an IBM PC compatible computer running Z-Technology special R-507 Calibration software and communicating with the R-507 over the RS- 232 serial port.

The resulting user-generated calibration table is used in the place of the factory provided calibration table whenever function F41 is selected. As with the single-point calibration, the multi-point calibration table values will be used in calculating the true signal level before the level is shown on the ***SIGNAL LEVEL*** readout.

For complete information, see the instructions supplied with the R-507 Calibration Software.

F41: (Locked User Function), SELECT CUSTOMER CALIBRATION TABLE

NOTE: See function F59 to unlock functions F40 through F48.

Selecting the F41 mode causes the R-507 to substitute the User Calibration Table for the factory calibration table. This function is not executable if the User Calibration Table is empty or contains invalid data.

If the F41 mode is selected and the User Calibration Table contains invalid data, three (3) short beeps will be heard and the unit will default to the factory calibration table.

F42: (Locked User Function), SELECT FACTORY CALIBRATION TABLE

NOTE: See function F59 to Unlock functions F40 through F48.

Invoking Function F42 mode selects the Factory Calibration Table. Three (3) short beeps when the function is invoked indicates that the Factory Calibration Table contains invalid data. If this happens, contact Z Technology, or your service center to return the unit for re-calibration.

F43: (Locked User Function), SET RS-232 BAUD RATE

NOTE: See function F59 to unlock functions F40 through F48.

When function F43 is selected, the current BAUD rate (1200, 2400 or 9600) is displayed in the ***FREQUENCY/CHANNEL*** readout. Rotating the **TUNE** knob will roll through the available rates.

Use the NORMAL operation of the **FUNCTION** button to set the BAUD rate, store it in the non-volatile memory (for use at the next power-up), and exit this mode.

F44: SET RS-232 REMOTE ADDRESS

To display/set the remote address for this meter, select function F44 mode. The ***FREQUENCY/CHANNEL*** readout will show the phrase "**ADR 1**" in the case the current address 1 valid addresses are (0-255). The factory default is 1.

Rotate the **TUNE** knob to change the address setting.

The NORMAL operation of the **FUNCTION** button stores the new address in non-volatile memory and exits the F44 function.

F45: (Locked User Function), SET 24-HOUR CLOCK

NOTE: See function F59 to unlock functions F40 through F48.

To display/set the 24-hour clock, select the F45 mode. The time will be displayed in the ***FREQUENCY/CHANNEL*** readout. The first two digits are the hours (00-23) the next two digits are the minutes (00-59)

The NORMAL operation of the **TUNE** knob toggles the cursor between the hours and minutes. Rotating the **TUNE** knob changes the time setting.

The NORMAL operation of the **FUNCTION** button will set the clock and exit the F45 mode.

F46: (Locked User Function)

SET MONTH/DAY

NOTE: See function F59 to unlock functions F40 through F48.

To display/set the month and/or day, select the F46 mode. The ***FREQUENCY/CHANNEL*** readout will show a numeric month and day. For example "**09:02**". In this case September 2nd, the 9th month, the 2nd day.

The NORMAL operation of the **TUNE** knob toggles the cursor between months and days. Rotating the **TUNE** knob changes the date setting.

The NORMAL operation of the **FUNCTION** button sets the date and exits the F46 mode.

F47: (Locked User Function)

SET YEAR

NOTE: See function F59 to unlock functions F40 through F48.

To display/set the year, select the F47 mode. The ***FREQUENCY/CHANNEL*** readout will show for example "**YR 1998**".

Rotating the **TUNE** knob changes the year setting. (Note: The year may not be set less than 1992.)

The NORMAL operation of the **FUNCTION** button stores the date in non-volatile memory and exits the F47 mode.

F48: CLONE ANOTHER R-507

The "clone" mode, F48, allows an operator to copy USER MEMORY contents, CHANNEL PLANS, etc., from one R-507 to another. This function greatly reduces the time needed to set up a number of instruments.

Set both R-507's to the same address. See F44.

Connect the "Master" R-507 (an instrument already containing the desired settings) to the "Clone" R-507 using the RS-232C cloning cable.

Set the baud rate of BOTH units to 9600 baud using function F43.

Set the Clone to function F93.

Set the Master to function F48. Selecting the function (pressing the **TUNE** knob) initiates the cloning process.

F59: UNLOCKS USER FUNCTIONS F40 - F48

Function F59 when properly executed allows the user access to F40 - F48, the "Locked Out User Functions". To unlock, the user must perform F59 three (3) times in sequence. This is accomplished by the following:

Push the **FUNCTION** button, then rotate the **TUNE** knob until the ***FREQUENCY/CHANNEL*** readout displays "**F59**". Execute F59 by pressing in the **TUNE** knob. This has just performed Function F59 one (1) time. Repeat this process two (2) more times.

Functions F40 through F48 are now available to be accessed and desired changes can be made.

To again lock out F40 through F48 and prevent inadvertent changes simply cycle the instrument's power **POWER** off and back on.

F91: RESET DATA RECORD COUNTER

Selecting this function resets all data log record counters to one (1), effectively erasing all data log records of any type.

Select function F91. The phrase "**3 RSET**" will be displayed in, and in the ***FREQUENCY/CHANNEL*** readout.

As a safety measure, the **MEMORY** button must be pressed three times in sequence to activate this function. Each NORMAL operation of the **MEMORY** button decrements the number shown in the ***FREQUENCY/CHANNEL*** readout. The third depression resets the data record counter to one (1).

F93: REMOTE MODE

The F93 mode sets up R-507 to communicate with a host personal computer (PC). See the section of this manual entitled "R-507 Data Logging Application Guide".

F93 is also used to "clone" another R-507. See function F48 above.

PRINTING RECORDED DATA

At any time a scan is not taking place, recorded data may be transferred to a printer, via the RS-232 port. See function F93 for instructions for transferring data to a PC.

Two (2) functions, F94 and F95 are available for transferring records to a printer, or PC.

F94: PRINT (RS-232) SELECTED DATA LOG RECORD

Output a selected formatted record, via the RS-232 port. You can select from record 1 - 20 when collecting data through use of F10 & F11 or record 1-24 when collecting data through F96 or F98.

Select F94, the ***FREQUENCY/CHANNEL*** readout displays "**F94 R1**", (the first record number). If the ***FREQUENCY/CHANNEL*** readout simply goes back to the frequency or channel number than there are no records saved to print out.

Rotating the **TUNE** knob advances the record number. Pressing the **TUNE** knob selects the record and starts the transfer process.

NOTE: The resulting report format is determined by the RESIDENT DATA LOGGING MODE used to capture the data. Examples of report format are

shown in the RESIDENT DATA LOGGING section later in this manual. If data was captured with the meter in FREQUENCY mode, the corresponding frequency will be reported. If data was captured with the meter in **CH**ANNEL mode, the corresponding channel will be reported.

F95: PRINT (RS-232) ALL DATA LOG RECORDS

Output all formatted records, via the RS-232 port. If data was collected using F10 or F11, Records 1 - 20 will be reported. If data was collected using F96 or F98, Records 1-24 will be reported.

Select F95, the ***FREQUENCY/CHANNEL*** readout displays "**ALL Rx**," where “x” is the number of records. Pressing the **TUNE** knob starts the transfer process.

> **NOTE:** The resulting report format is determined by the RESIDENT DATA LOGGING MODE used to capture the data. Examples of report format are shown in the RESIDENT DATA LOGGING section later in this manual. If data was captured with the meter in FREQUENCY mode, the corresponding frequency will be reported. If data was captured with the meter in CHANNEL mode, the corresponding channel will be reported.

F96: AUTO - USER MEMORY RESIDENT DATA LOGGING

This function scans and records the carrier levels of the frequencies or channels stored in USER MEMORY. Up to 24 scans will occur, separated by a user-set time interval of 1 to 360 minutes, settable in 1-minute steps.

Procedure:

10. Select F96, the ***FREQUENCY/CHANNEL*** readout now displays "**001 AUTO**" where "**001**" represents the current setting for minutes-between-scans. "**AUTO**" indicates AUTO RESIDENT DATA LOGGING.

11. Rotate the **TUNE** knob to display the desired time interval.

12. Pressing the **TUNE** knob resets the record counter to the first (#1) record and starts the scanning process.

    > **NOTE:** ALL PREVIOUSLY STORED DATA, INCLUDING ANY DATA LOG MEASUREMENTS, WILL BE LOST!

13. The ***SIGNAL LEVEL*** readout will now display the message, "**LOG xxx.xxx MHz**" and ***FREQUENCY/CHANNEL*** readout where "**LOG**" indicates the meter is logging readings, **xxx.xxx** is the current frequency or channel currently being scanned. In the case of channels, only the picture **or** audio carrier level will be recorded whichever one was active when that memory location was programmed.

At the completion of each scan, the data is automatically stored in non-volatile memory and the R-507 powers down.

At a signal from its real-time clock the R-507 powers-up when it is time for the next scan.

After the last scan, the unit shuts off and remains off until manually powered up by the user.

> **NOTE:** The amount of time needed to measure and record carrier levels depends both on the number of carriers and on the signal level variation between them. When all carrier levels are within normal, usable limits, the R-507 can log up to 100 channels in less than 1 minute. However, if more than 50 frequencies or channels are present and signal levels vary more than 20 dB, the time interval should be set to 3 minutes or greater.
>
> **NOTE:** The R-507 can be manually powered up between scans. Selecting other functions or powering off during a scan will abort the AUTO - USER MEMORY RESIDENT DATA LOGGING mode. However, the data for all completed scans remains in non-volatile memory, and can be downloaded through the RS-232C port.

See the RESIDENT DATA LOGGING SECTION of this manual for further explanation.

F98: MANUAL - USER MEMORY RESIDENT DATA LOGGING

This function scans and records the carrier levels of the frequencies or channels stored in USER MEMORY. One record is filled each time this function is executed. Procedure:

14. Select F98, the ***FREQUENCY/CHANNEL*** readout now displays "**R 1n xxx.xxx MHz**" where the "**n**" is the record number to be filled, and "**xxx.xxx"** is the frequency or channel stored in the first USER MEMORY location.
15. Pressing the **TUNE** knob starts the scanning process.
16. The ***FREQUENCY/CHANNEL*** readout will now display the message, "**LOG xxx.xxx MHz**" where "**LOG**" indicates the meter is logging data, "**xxx.xxx**" is the frequency or channel currently being measured. In the case of channels, only the picture **or** audio carrier level will be recorded whichever one was active when that memory location was programmed.
17. At the completion of the scan, The ***FREQUENCY/CHANNEL*** readout displays "**END Rn**" where "n" is the record number to be filled. Press the **MEMORY** button to store the record in non-volatile memory, any other button discards the record.
18. To start another scan go back to step one.

See the RESIDENT DATA LOGGING SECTION of this manual for further explanation.

Section 8:Resident Data Logging

> **NOTE:** To use the RESIDENT DATA LOGGING Feature, it must first be activated through the RS-232 port. This is done by using the Quick Basic Control Software provided with each R-507. The activation procedure is described in detail by the application note titled: R-500 Series Quick Basic Control Software. See the description concerning the program MENU.EXE and Setup Address 1888.

What Is RESIDENT DATA LOGGING?

The user needs to clearly understand what is meant by **RESIDENT DATA LOGGING**. **RESIDENT** simply refers to measurement information being stored inside (resident to) the R-507. All **DATA LOGGING** is done in sessions.

> A **DATA LOGGING SESSION** is an automated scan of a pre-programmed set of frequencies or channels where signal level measurements are taken and recorded at each frequency or channel. Signal level measurements are stored inside the R-507**.**

An operator using the R-507 in the field may be in conditions which require the R-507 to be used stand alone, not attached to a PC via the RS232 serial port. In these situations, the operator can use front panel controls to initiate RESIDENT DATA LOGGING sessions to automatically collect extensive measurement information, and store it in the R-507's non volatile memory.

Following a RESIDENT DATA LOGGING session the R-507 can be powered down and transported to a laboratory. In the laboratory, the R-507 can be powered up and instructed via the front panel buttons to send a report of the logged data to the RS-232 serial port. A printer or a computer may be connected to the RS-232 serial port. Once printed or captured by a computer, the data may be further analyzed. (See the R-507 RESIDENT DATA LOGGING APPLICATION GUIDE later in this manual.)

> **NOTE:** The R-507 RS-232 COMMAND PROTOCAL allows a computer to interrogate the R-507 directly, whereby measurement information is sent immediately to the computer. (See the Application Note: R-500 Series Quick Basic Control Software.)
>
> The RS-232 COMMAND PROTOCAL also allows RESIDENT DATA LOGGING sessions to be initiated by a connected computer. (See Commands 25, 46, and 47 in the R-507 RS-232 COMMAND PROTOCOL section later in this manual.)

During a RESIDENT DATA LOGGING session the R-507 will scan a pre-programmed set of frequencies or channels starting at the first in the set, incrementing to the last in the set. The set may be pre-programmed by the user, or programmed to an Industry standard set. There are **TWO (2)** distinct pre-programmed sets of frequencies, each with its own features. The three pre-programmed sets are:

- **CONTIGUOUS** frequencies
- **USER MEMORY** frequencies

CONTIGUOUS frequency, RESIDENT DATA LOGGING (F10, F11.) referred to as **CONTIGUOUS DATA LOGGING**. All signal level measurements are at frequencies determined by user programmed step size (F7), start frequency (F8), and stop frequency (F9). This yields a set of contiguous frequency readings. (See Example 1, and Example 2 later in this section.)

USER MEMORY frequency, RESIDENT DATA LOGGING (F96, F98), referred to as **USER MEMORY RESIDENT DATA LOGGING**. All signal level measurements are at those frequencies stored in the USER MEMORY locations (1-100). The frequencies may represent user programmed radio broadcast frequencies, television channel picture frequencies, television channel audio frequencies, or some other important frequencies. The frequencies may be stored in USER MEMORY in any order. The scan will start at the frequency stored in the USER MEMORY location #1, step to the frequency stored in USER MEMORY location #2, and so on, until the last programmed USER MEMORY location has been used. This will yield a set of readings that could be all radio broadcast frequencies, all television frequencies, or some combination.

> **NOTE:** Television channels generally have two frequencies associated with them. One for picture carrier, one for audio carrier. When a television channel is programmed into a USER MEMORY location, (i.e. In Channel mode when programming) only the picture frequency **or** audio frequency is captured (which ever one was active when the USER MEMORY location was programmed.) When USER MEMORY RESIDENT DATA LOGGING only the captured frequency will produce a signal level reading. The report generated will show a zero level for the other television channel frequency. The report will also show what CHANNEL PLAN the channel was captured from. (See Example 3 later in this section.)

Each of the two types of data logging, **CONTIGUOUS RESIDENT DATA LOGGING**, and **USER MEMORY RESIDENT DATA LOGGING** have both a manual, and an automatic implementation. (See the Function Features section earlier in this manual.)

Common Setup Parameters

Front Panel Pre-settings

Before beginning a Resident Data Logging session, the user must prepare for the session by pre-setting some front panel controls. The controls to be pre-set are:

RF AMP ("**ON**" or "**OFF**")
BANDWIDTH ("**NB**" or "**WB**")

The Resident Data Logging process does not change these front panel controls. Thus, the operator will want to choose an **RF AMP** setting as dictated by the expected power levels to be measured. Also, depending on the type of signal to be measured, the **BANDWIDTH** control must be preset.

For all the controls mentioned in this section, see the part of this manual on FRONT PANEL OPERATION for more details on usage.

Description of CONTIGUOUS RESIDENT DATA LOGGING

This mode provides a contiguous sampling and logging of a series of equally spaced frequencies. The CONTIGUOUS RESIDENT DATA LOGGING mode is initialized by utilizing functions F7, F8, F9, F10, and F11. Signal level measurements are taken and stored for any user selected series of frequencies defined by start and stop points. It also lets the user choose the step size between measurement points. The step size can range from 10kHz to 500kHz.

The following describes in detail how to use the CONTIGUOUS RESIDENT DATA LOGGING mode to measure and store signal levels along with frequencies. Later the information is retrieved from the R-507 by downloading it into an IBM compatible PC.

Using the CONTIGUOUS RESIDENT DATA LOGGING Functions:

Functions F7, F8 and F9 must be set before attempting to log data using this method. F7 sets the Scan Frequency Step Size, which can be at any 10kHz interval from 10kHz to 500kHz. F8 and F9 set the Scan Start Frequency and Scan Stop Frequency respectively. These frequencies can be any valid R-507 measurement frequency.

This Data Logging mode has a limit of 360 data points per recorded. Twenty (20) data records can be stored in the R-507 at any one time.

As an example, assume F8 (Start Frequency) is set for 879.00MHz and F9 (Stop Frequency) is set for 889.80MHz. Let's also use F7 (Scan Step Frequency) to choose 30kHz as the step size between measured frequencies. This would create a set of exactly 360 data points (signal strength measurements) to be logged.

Functions F10 and F11 are the functions used to initiate CONTIGUOUS RESIDENT DATA LOGGING records.

F10 AUTO - CONTIGUOUS RESIDENT DATA LOGGING, allows the user to perform up to twenty (20) logging sessions. Each record separated in time by 5 minutes to 24 hours. Records are stored in the R-507 to be downloaded to a printer or PC. Starting a new Logging session resets the record counter, effectively erasing the old data.

F11 MANUAL - CONTIGUOUS RESIDENT DATA LOGGING, is similar to F10 except that it records only one data record at the time the user executes the function itself.

A summary of using functions F7 through F11 follows:

Setting Step Size, Start and Stop Frequencies.

1. Push the **FUNCTION** Button on the front panel.
2. Turn the TUNE knob until “F7” is displayed.
3. Select “F7” by pushing the TUNE knob once.
4. Increment/Decrement the number displayed to your choice of Scan Freq. Step Size --- 10 to 500 kHz.
5. Press the **FUNCTION** Button to exit and store your choice.
    1) Push the **FUNCTION** Button again.

2) Turn the **TUNE** knob until "**F8**" is displayed.
3) Select F8 by pushing the TUNE knob once.
4) Adjust the **TUNE** knob to the Start Frequency desired.
5) Press the **FUNCTION** Button to exit and store this choice.
6) Push the **FUNCTION** Button again.
7) Turn the **TUNE** knob until "**F9**" is displayed.
8) Select F9 by pushing the **TUNE** knob once.
9) Adjust the **TUNE** knob to the Scan Stop Frequency desired.
10) Press the **FUNCTION** Button to exit and store this choice.

Performing the Actual Data Logging Run(s)

Using F10-- AUTOMATIC (timed) CONTIGUOUS RESIDENT DATA LOGGING

1. Connect the signals to be measured at the Type-N connector on the R-507 front panel.
2. Push the **FUNCTION** Button on the front panel.
3. Turn the **TUNE** knob until "**F10**" is displayed.
4. Press the **TUNE** knob. "**LOG :05**" is displayed in the ***FREQUENCY/CHANNEL*** readout "**:05**" indicates 5 minute intervals between measurement sessions.
5. Rotate the **TUNE** knob to incrementing the number to select the time interval desired between Auto Log records. This time can be incremented from 5 minutes to 24 hours in 1 minute steps.
6. To initiate the scan process, press the **TUNE** knob.
7. The R-507 will immediately start its first scan.
8. When this scan is over the unit will automatically turn off. It will wait for the time interval (set above) and then automatically turn on and perform another scan. This process will repeat -- up to 20 times or until the operator terminates the cycle by manually taking the R-507 out of the AUTO CONTIGUOUS DATA LOGGING mode.
9. After the twentieth scan the unit will turn off and stay off, until manually powered up by an operator.

Using F11-- MANUAL CONTIGUOUS DATA LOGGING

1. Connect the signals to be measured at the Type-N connector on the R-507 front panel.
2. Push the **FUNCTION** Button on the front panel.
3. Turn the **TUNE** knob until "**F11**" is displayed.
4. Press the **TUNE** knob. The ***FREQUENCY/CHANNEL*** readout will display the record number to be logged "**R 1 xxx.xxx MHz**" The "**1**" indicates the record number, the number will increment as records are stored. (Indicating record R1) if no records have been stored, The "**xxx.xxx**" indicates the Start frequency.
5. Press the **TUNE** knob to start the data log. "**LOG xxx.xxx MHz**" will be displayed on the ***FREQUENCY/CHANNEL*** readout. "xxx.xxx" is the frequency currently being measured.

6. When recording is complete, the frequency in the **FREQUENCY**/**CHANNEL** readout will stop incrementing and the unit will beep two times.

7. Press the **MEMORY** Button to store this new log record. (Pressing the **FUNCTION** button will discard the new record).

8. Note: Twenty records can be stored using F11 (R1, R2, R3,.R20). If all records are already filled with stored data, selecting F11 will cause three (3) beeps to sound. To discard previous records, Function F91 must be used to reset.

To Down Load Stored Data Log use Functions F94 or F95

See information to use these functions in the previous section.

EXAMPLE 1: Report format of **CONTIGUOUS DATA LOGGING** F10 or F11. Printed using F94.

```
Z-Technology
Version: 3.00

Date: 9/02/98
Time: 14:15
Record: 1
Step: 30KHz

 Freq.  Level   Freq.  Level   Freq.  Level   Freq.  Level
-------------------------------------------------------------
 879.39 -10.0   879.42 -10.0   879.45  -4.1   879.48   5.6
 879.51  18.7   879.54   4.5   879.57  -5.7   879.60  -9.2
 879.63  -7.6   879.66  -1.3   879.69  10.9   879.72  44.0
 879.75   5.8   879.78  -2.1   879.81  -7.3   879.84  -8.4
 879.87  -4.4   879.90   3.2   879.93  14.9   879.96   7.1
 879.99  -1.4   880.02   4.1   880.05 -10.0   880.08  -7.9
 880.11    .3   880.14  11.7   880.17  40.8   880.20   4.1
 880.23  -2.9   880.26  -9.2   880.29  -8.5   880.32   1.6
 880.35  13.9   880.38  35.8   880.41   1.5   880.44  -5.3
 880.47 -10.0   880.50  -9.7   880.53  -2.9   880.56   7.9
```

EXAMPLE 2: Report format of **CONTIGUOUS DATA LOGGING** F10 or F11. Printed using F94.

Z-Technology
Version: 3.00

Date: 9/02/98
Time: 14:20
Record: 1
Step: 200KHz

Freq.	Level	Freq.	Level	Freq.	Level	Freq.	Level
88.10	27.3	88.30	29.3	88.50	29.2	88.70	27.6
88.90	29.6	89.10	28.6	89.30	27.2	89.50	27.2
89.70	27.4	89.90	29.6	90.10	26.3	90.30	26.1
90.50	29.8	90.70	43.3	90.90	26.3	91.10	25.4
91.30	34.5	91.50	53.6	91.70	25.0	91.90	34.1
92.10	34.2	92.30	43.8	92.50	25.7	92.70	27.1
92.90	27.0	93.10	25.9	93.30	25.8	93.50	44.4
93.70	51.1	93.90	25.8	94.10	24.4	94.30	26.0
94.50	26.8	94.70	26.9	94.90	27.3	95.10	27.8
95.30	28.1	95.50	32.7	95.70	25.7	95.90	25.9
96.10	24.9	96.30	25.7	96.50	27.1	96.70	28.5
96.90	37.1	97.10	45.0	97.30	25.0	97.50	24.1
97.70	23.9	97.90	29.0	98.10	26.6	98.30	28.2
98.50	35.5	98.70	25.6	98.90	24.2	99.10	24.1
99.30	31.8	99.50	42.7	99.70	22.4	99.90	27.5
100.10	44.0	100.30	57.6	100.50	48.0	100.70	15.2
100.90	21.4	101.10	57.2	101.30	49.3	101.50	14.4
101.70	19.6	101.90	67.2	102.10	54.3	102.30	19.1
102.50	29.1	102.70	33.5	102.90	16.7	103.10	18.3
103.30	62.2	103.50	52.1	103.70	14.4	103.90	10.0
104.10	13.5	104.30	14.3	104.50	22.4	104.70	31.0
104.90	20.3	105.10	34.3	105.30	28.1	105.50	20.5
105.70	22.6	105.90	20.4	106.10	23.6	106.30	20.1
106.50	23.7	106.70	35.9	106.90	27.9	107.10	17.4
107.30	22.6	107.50	52.7	107.70	44.7	107.90	16.4

Description of USER MEMORY DATA LOGGING

This mode provides measurement and logging of the frequencies or channels stored in the USER MEMORY. It is intended for those wish to log or continually monitor a few or many specific frequencies, specific cellular telephone frequencies, radio broadcast frequencies, television channels , or any combination of these categories.

F96 - AUTO USER MEMORY RESIDENT DATA LOGGING allows the user to perform up to twenty (24) logging sessions. Each record starting time separated by 1 minute to 360 minutes. Records are stored in the R-507 to be downloaded to a printer or PC. Starting a new Logging session resets the Record Counter, effectively erasing any existing data.

F98 - MANUAL USER MEMORY RESIDENT DATA LOGGING is similar to F96 except that it records only one data record at the time the user executes the function itself.

The following describes in detail how to use the USER MEMORY RESIDENT DATA LOGGING mode to measure and store signal levels along with frequencies. Later, the information can be retrieved from the R-507 by downloading it to a printer, or a PC.

Using the USER MEMORY RESIDENT DATA LOGGING Functions:

The number of entries per record in USER MEMORY RESIDENT DATA LOGGING mode is set by the number of user programmable memory locations, up to 100 entries per record. Twenty-four (24) data records can be stored in the R-507 at any one time.

A summary of using functions F96 and F98 follows:

Performing the Actual Data Logging Run(s)

Using F96-- AUTOMATIC (timed) USER MEMORY RESIDENT DATA LOGGING

1. Connect the signals to be measured at the Type-N connector on the R-507 front panel.
2. Push the **FUNCTION** Button on the front panel.
3. Turn the **TUNE** knob counter clockwise until "**F96**" is displayed.
4. Press the **TUNE** knob. "**001 AUTO**" is displayed in the ***FREQUENCY/CHANNEL*** readout.
5. Rotate the **TUNE** knob, incrementing the number, to select the time interval time desired between Auto Log records. This time can be incremented from 1 minute to 360 minutes in 1 minute steps.
6. To initiate the scan process, press the **TUNE** knob.
7. The R-507 will immediately start its first scan.
8. When this scan is over, the unit will automatically turn off. It will wait for the time interval (set above) and then automatically turn on and perform another scan. This process will repeat -- up to 24 times or until the operator terminates the cycle by manually taking the R-507 out of the AUTO - USER MEMORY RESIDENT DATA LOGGING mode.

9. After the twenty-fourth scan the unit will turn off and stay off, until manually powered up by an operator.

Using F98-- MANUAL USER MEMORY DATA LOGGING

1. Connect the signals to be measured at the Type-N connector on the R-507 front panel.
2. Push the **FUNCTION** Button on the front panel.
3. Turn the **TUNE** knob counter clockwise until F98 is displayed.
4. Press the **TUNE** knob. The ***FREQUENCY/CHANNEL*** readout will display "**R 1 xxx.xxx MHz**". "**R 1**" is the record number to be logged ("**R 1**" if no records have been stored, "**R 2**", "**R 3**", "**R 4**", etc. if previous records have been stored.) "**xxx.xxx**" is the Frequency or Channel of the #1 USER MEMORY location.
5. Press the **TUNE** knob to start the data log. "**LOG xxx.xxx MHz**" will be displayed on the ***FREQUENCY/CHANNEL*** readout. "**xxx.xxx**" is the frequency or channel currently being measured.
6. When recording is complete, "**END R 1**" will be displayed in the ***FREQUENCY/CHANNEL*** readout, and the unit will beep two times. "**R 1**" will increment as records are stored.
7. Press the **MEMORY** Button to store this new log record. (Pressing the **FUNCTION** button will discard the new record).
8. Note: Twenty-four records can be stored using F98 ("**R1**","**R2**","**R3**", "**R24**"). If all records are already filled with stored data, selecting F98 will cause three (3) beeps to sound. To discard all previous records, Function F91 must be used to reset.

To Down Load Stored Data Log use Functions F94 or F95

See information to use these functions in the previous section.

EXAMPLE 2: Report format of **USER MEMORY RESIDENT DATA LOGGING** F96 or F98. Printed using F94.

```
Z-Technology
Version: 3.00

Date: 9/02/98
Time: 14:22
Record: 1

Channel     Frequency     Picture     Audio      Level      Plan
-------------------------------------------------------------------
            101.10 MHz                             50.8       AIR
  6                       53.8          .0                    AIR
            106.70 MHz                             34.9       AIR
 10                       80.3          .0                    AIR
 10                         .0        77.2                    AIR
 12                       80.8          .0                     L1
 12                         .0        75.4                     L1
```

95	.0	23.2	HRC
96	25.1	.0	IRC
97	60.5	.0	NCTA

Section 9: R-500 Series Data Logging Application Guide

This guide is meant to help the user set up a printer or computer to accept data from an R-507.

The R-507 has several levels of intelligence incorporated. To this point in the manual, we have focused on operation the instrument directly from the front panel controls. We have only mentioned the serial port in passing. This section and the sections to follow focus on control and/or retrieval of information through the RS-232 port.

The standard R-507 can download data to a serial printer directly, or to a computer running any of the common communications software packages (i.e. Procomm, WinTerm, HyperTerminal, etc.) Once captured, PC text files can be imported into any of several commercially available spreadsheet programs for deeper analysis.

If you have trouble getting your computer or printer to operate properly, review the list of common problems and their causes at the end of this note. If you still have problems, please communicate with the factory to allow us to help. Z Technology Inc.'s telephone: 1-503-614-9800; fax 1-503-614-9898.

Please collect the following information to provide us in the fax or during the call.

1. The R-507's serial number.
2. The version of firmware in the R-507. See description of function F28 for instructions on how to determine firmware version.
3. Whether or not you are using a Z Technology Inc. Cable.
4. The specifications of the printer you are downloading to,or:
5. The configuration of the computer you are downloading to, especially whether it is equipped with a mouse or trackball.
6. Other software that might be resident in your computer, especially "terminate and stay resident" (TSR) software.
7. The version of DOS and/or Windows your computer contains.

Installation and Setup:

Connecting the R-507 to a Printer:

Using the R-507 printer interface cable, connect the R-507 to the serial input port of the printer. (See the diagrams at the end of this section to build your own cable with the proper pin to pin connections).

NOTE: The R-507 will not drive a parallel-input printer.

Set the R-507 to 1200, 2400, or 9600 baud by following the procedure outlined below.

Turn on the R-507

Unlock communications settings using F59

Press **FUNCTION** button.

Using **TUNE** knob dial to "**F59**"

Press **TUNE** knob to select, R-507 will return to previous operating mode.

Repeat steps (1) through (3) two more times.

Press **FUNCTION** button.

Using the **TUNE** knob, dial to "**F43**".

press **TUNE** knob to select. R-507 will now display the baud rate.

To change baud rate, turn **TUNE** knob.

Press **FUNCTION** button to set R-507 to whichever baud rate is currently displayed and return the R-507 to the previous function.

Set the printer communication parameters to match that of the R-507. See your printer's manual for instructions.

BAUD RATE: 1200, 2400, or 9600. (Set to match that selected above)

PARITY: no parity.

NUMBER OF DATA BITS: 8

STOP BITS: 1

If the printer can emulate several types of printers, set for "IBM".

Section 9: R-500 Series Data Logging Application Guide

Connecting the R-507 to a Computer:

> **NOTE:** The simplest way to capture R-507 Report information with your PC is to use a Terminal Emulator Communication package on your computer. Packages such as Procomm, for DOS only computers, WinTerm which is in the Accessories group in Windows 3.1, or HyperTerminal in the Accessories folder in Windows 95 or Windows 98 all allow you to capture text to a file. They also allow you to send RS-232 data directly to a printer.

Set the R-507 to 1200, 2400, or 9600 baud by following the procedure outlined below.

Turn on the R-507

Unlock communications settings using F59

Press **FUNCTION** button.

Using **TUNE** knob dial to "**F59**"

Press tune knob to select, R-507 will return to previous operating mode.

Repeat steps (1) through (3) two more times.

Press **FUNCTION** button.

Using the **TUNE** knob, dial to "**F43**".

Press **TUNE** knob to select. R-507 will now display the baud rate.

To change baud rate, turn **TUNE** knob.

Press **FUNCTION** button to set R-507 to whichever baud rate is currently displayed and return the R-507 to the previous function.

Set your Terminal Emulator communication parameters to match that of the R-507. See your Terminal Emulator manual or help pages for instructions.

BAUD RATE: 1200, 2400, or 9600. (Set to match that selected above)

PARITY: no parity.

NUMBER OF DATA BITS: 8

STOP BITS: 1

Operation:

Sending Records to a Printer:

Verify that the printer has been set up properly and that the R-507 and printer are set to the same baud rate (see section (I), "Installation and Set Up.")

Set up the R-507 to send data:

Turn on the R-507.

Press the **FUNCTION** button.

Using the tune knob, dial:

"**F94**" to send a selected record, or:

"**F95**" to print all records.

If F95 was selected, pressing the **TUNE** knob will cause the R-507 to immediately begin sequentially sending all records to the printer.

If F94 was selected, select the record to be printed:

Rotate the **TUNE** knob to the desired record number.

Press the **TUNE** knob to select record.

The R-507 will immediately begin sending the selected record to the printer.

Sending Records to a Computer:

Verify that the Terminal Emulator has been set up properly and that it and the R-507 set to the same baud rate (see section (I), "Installation and Set Up.")

Use the procedure in your Terminal Emulator's manual or help pages to set up the Emulator to receive ascii text and assign it a file name.

Transmit one or all records to the computer using the procedure below.

Turn on the R-507.

Press the **FUNCTION** button.

Using the tune knob, dial:

"**F94**" to send a selected record, or:

"**F95**" to print all records.

If F95 was selected, pressing the **TUNE** knob will cause the R-507 to immediately begin sequentially sending all records to the printer.

If F94 was selected, select the record to be printed:

Rotate the **TUNE** knob to the desired record number.

Press the **TUNE** knob to select record.

The R-507 will immediately begin sending the selected record to the printer.

Problems and Fixes:

Symptom:

The R-507 will not enter function F94 PRINT SELECED DATA LOG RECORD, or F95 PRINT ALL DATA LOG RECORDS.

POSSIBLE CAUSES:

No data stored in R-507. If no data records exist, the R-507 will not enter print mode when F94 or F95 is selected. The R-507 will emit three "beeps".

Review the procedure for CONTIGUOUS RESIDENT DATA LOGGING, or USER MEMORY RESIDENT DATA LOGGING in the DATA LOGGING section earlier in this manual. Verify that you are using the correct procedure.

Symptom:

The printer doesn't print or prints "garbage characters".

POSSIBLE CAUSES:

The printer is not on-line. Press the printer's "on line" button to connect it to the data port.

The data cable between the R-507 and printer is incompatible with the R-507. The RS-232C standard allows data cables to be internally wired in several ways. The R-507 requires a standard "straight through" pin 1 to pin 1, pin 9 to pin 9 cable with a Male DB9 connector on one side, a Female DB9 connector on the other side. Use an ohmmeter to verify your cable has the correct pin-outs.

Printer communication parameters are not set up correctly. Review “Connecting the R-507 to a printer” earlier in this section to verify that communication parameters are set correctly. If the printer has more than one emulation mode, verify that the "IBM" mode has been selected.

Printer and R-507 are set to different baud rates. The R-507 will operate at 1200, 2400, or 9600 baud, selectable from the front panel. To determine the current setting:

Turn on the R-507.

Unlock communication settings using F59:

Press **FUNCTION** button.

Using **TUNE** knob dial to “**F59**”

Press **TUNE** knob to select, R-507 will return to previous operating mode.

Repeat steps (1) through (3) two more times.

Press **FUNCTION** button.

Using the **TUNE** knob, dial to "**F43**".

Press tune knob to select. R-507 will now display the baud rate.

To change baud rate, turn **TUNE** knob.

Press **FUNCTION** button to set R-507 to whichever baud rate is currently displayed and return the R-507 to the previous function.

Symptom:

The R-507 doesn't communicate with computer.

POSSIBLE CAUSES:

The data cable between the R-507 and printer is incompatible with the R-507.

The RS-232C standard allows data cables to be internally wired in several ways. The R-507 requires a standard "straight through" pin 1 to pin 1, pin 9 to pin 9 cable with a Male DB9 connector on one side, a Female DB9 connector on the other side. Use an ohmmeter to verify your cable has the correct pin-outs.

The computer is set to the wrong Communications Port.

If you are using a Terminal Emulator program, check to see that the Emulator is using the Communications Port the R-507 is connected to.

If you are using the Quick Basic Control Software you are limited to using communications ports (1) or (2). If you are not sure which port to use, try each of them. If you still cannot verify which communication port the computer's RS-232 connector operates through, contact your computer supplier for more help.

The computer and R-507 are set to different baud rates. The R-507 will operate at 1200, 2400 or 9600 baud. Selectable from the front panel. To verify the setting:

Turn on the R-507.

Unlock communication settings using F59:

Press **FUNCTION** button.

Using **TUNE** knob dial to "F59"

Press **TUNE** knob to select, R-507 will return to previous operating mode.

Repeat steps (1) through (3) two more times.

Press **FUNCTION** button.

Using the **TUNE** knob, dial to "**F43**".

Press **TUNE** knob to select. R-507 will now display the baud rate.

To change baud rate, turn tune knob.

Press **FUNCTION** button to set R-507 to whichever baud rate is currently displayed and return the R-507 to the previous function.

Symptom:

Some or all records are scrambled during transfer.

POSSIBLE CAUSES:

Data transmission rate problem. Even though the computer's communications software may allow you to communicate at 9600 baud, the computer itself may not be able to accept data that fast. As an experiment, try communicating at 1200 baud. To set the R-507's baud rate:

Turn on the R-507.

Unlock communication settings using F59:

Press **FUNCTION** button.

Using **TUNE** knob dial to "**F59**"

Press **TUNE** knob to select, R-507 will return to previous operating mode.

Repeat steps (1) through (3) two more times.

Press **FUNCTION** button.

Using the **TUNE** knob, dial to "**F43**".

Press **TUNE** knob to select. R-507 will now display the baud rate.

To change baud rate, turn **TUNE** knob.

Press **FUNCTION** button to set R-507 to whichever baud rate is currently displayed and return the R-507 to the previous function.

Remember to reset your computer's Terminal Emulation program to 1200 baud. Consult the manual or help pages of your Terminal Emulation program for how to verify and set the baud rate.

Symptom:

Modem conflicts

POSSIBLE CAUSES:

The R-500 Series Quick Basic Control Software supports only COM1 or COM2. In DOS and Windows3.1 based systems COM1 must use the PC's hardware interrupt IRQ4, and COM2 must use hardware interrupt IRQ3. Windows 95 and Windows 98 allow COM1 and COM2 to use a number of different interrupts.

Some internal modem cards cause COM port conflicts. Obviously, the modem cannot be addressed to the same COM port as the R-507. Some modem cards have the ability to be addressed to either COM3 or COM4. In DOS and Windows3.1 based systems COM1 and COM3 share interrupt IRQ4. COM2 and COM4 share interrupt IRQ3. If a modem is using COM3, and R-507 is sending DATA LOGGING information to the computer via a Terminal Emulation program set to use COM1 a conflict will occur if both devices are used simultaneously. Similarly for the case of COM2 and COM4 used simultaneously.

RS-232 Cables and Adapters

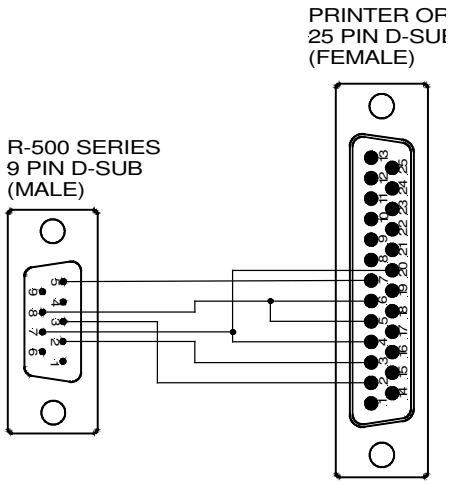
Several drawings of RS-232 I/O cables and adapters are included on the next few pages. They are for your reference and convenience as you connect your printer (and depending on the software, your PC) to the R-507 serial port. These wire configurations are unique to the R-507 and must be followed in order to correctly download stored data to a printer. In all cases, using a PC and standard straight through RS-232 cable with 9 pin connectors, will allow you to control an R-507 via the serial port.

The drawing titled **"RS-232 I/O Cable"** is used to connect the R-507's serial port to a printer serial port or a PC's 25 pin serial COM port. This drawing is the wiring diagram for the Accessory Cable (p/n 207-698-00) listed in the accessories section of this manual.

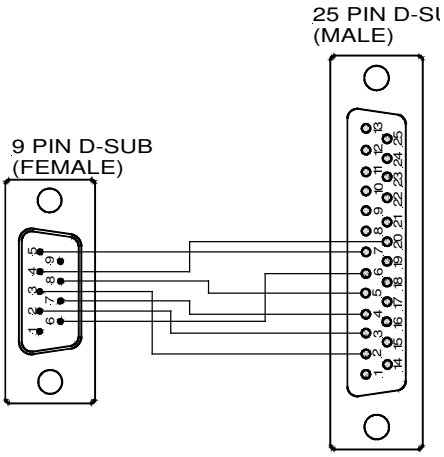
The drawing titled **"RS-232 ADAPTER"** converts from a 25 pin serial connector back to a 9 pin. This is a very common adapter and can be found at most computer stores. Along with the above cable, this adapter will allow a user to connect his R-507 serial port to either type of PC Serial COM connector found on almost all IBM compatible PCs.

The drawing titled **"RS-232 I/O CABLE, R-500 Series to PC AT"** is for use when connecting the R-500 Series Meter to a PC's 9 pin serial COM port. If the user chooses to build his own cable and will only be connecting the Field Strength Meter to a 9 pin COM port, this wire diagram can be used.

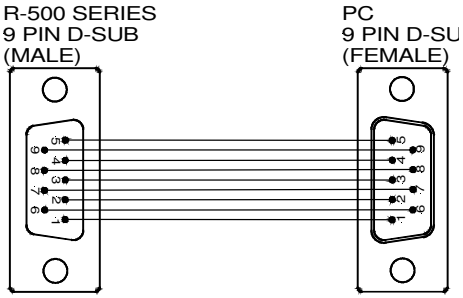
RS-232 I/O Cable



RS-232 Adaptor



RS-232 I/O Cable



Section 10: R-507 RS-232 Command Protocol

The purpose to this section is to detail the operation of the serial (RS-232) port of the R-507 Field Strength Meter. This will provide the necessary information for a customer to create his own host computer communications software and control the R-507 directly through and IBM Compatible PC.

Hardware

The female, 9-pin, D-SUB connector on the rear of the R-507 provides the connection to external devices (referred to as the HOST in this manual). Its pin assignment is shown below:

PIN 1	RS-232 LABEL	DESCRIPTION
1		
2	Tx	transmit data (to host computer)
3	Rx	receive data (from host)
4		
5	SG	signal ground
6		
7	RTS	request to send (from host)
8	CTS	clear to send (to host)
9		

Software

To communicate with the R-507, any (and all) external devices must use hardware handshaking (i.e. CTS/RTS). Data integrity cannot be guaranteed if this feature is not incorporated into the host communications software.

Each R-507 meter has its own specific address number (1-255). The operator may change this value by selecting function F44.

The R-507 's RS-232 format is 1 start bit, 8 data bits, no parity and 1 stop bit. There are three (3) BAUD rates, 1200, 2400 and 9600, selectable by function F43. A BAUD rate of 9600 is the default (as shipped from the factory).

Communications with the R-507, via the RS-232 port, is possible only while the R-507 is in the REMOTE state. The meter is placed in the REMOTE state by selecting function F93.

While in the REMOTE state, a R-507 will never initiate communications. The host must always start the communications by sending a command packet to the R-507.

Commands

The following list contains **COMMAND** numbers available to the host. These are used to obtain information from and/or set parameters of the R-507:

1. Change the REMOTE address of the unit
2. Set the serial port BAUD rate
3. Read the alarm time
4. Set the alarm time
5. Read the alarm date
6. Set the alarm date
7. Turn the alarm date ON
8. Turn the alarm date OFF
9. Turn the alarm ON
10. Turn the alarm OFF
12. Check power to clock I.C.
13. Read the time
14. Set the time
15. Read the date
16. Set the date
17. Read Data from R-507 memory
18. Erase the custom calibration table
19. Exit the REMOTE state
20. Set the R-507 frequency
24. Set & lock the attenuator range
25. Transfer log record to PC
26. Recall a USER MEMORY (0-10)
27. Store a USER MEMORY (0-10)
29. Report the state of the meter
30. Reset the R-507 (simulates power up)
31. Go to Field Strength Meter state

32. Unlock the attenuator range
33. Read the current year (offset from 1992)
34. Set the current year (offset from 1992)
35. Read the Signal Level as shown on meters LCD (calibrated)
37. Enable/Disable detector calibration
38. Enable/Disable frequency calibration
44. Write Data to R-507 memory
45. Select the channel plan for the next CHANNEL PLAN data log [1]
46. Start an CHANNEL PLAN data log (at a specific time)
47. Start a CONTIGUOUS Data Log (at a specific time)
55. Set RF amplifier, IF Bandwidth
57. Mute Audio
60. Set 4 frequencies to be used by Command #61
61. Read the signal level (dBuV) of the 4 Command #60 frequencies
62. Set a frequency and read the signal level (calibrated)

255. 255 GLOBAL command

Command Protocal

A specific protocol has been devised for exchange of data between a host computer and a R-507. Data must be sent in packets with a definite structure. The following is the packet structure for the host transmissions:

BYTE	VALUE	DESCRIPTION
1	1	1st synchronization byte
2	1	2nd synchronization byte
3	1	3rd synchronization byte
4	1-255	status flags from host (presently undefined)
5	1-255	R-507's remote address
6	8-24	packet size (in bytes)
7	1-255	command
8	0-255	1st data byte
23	0-255	16th data byte

[1] USER MEMORY data log is a special case of CHANNEL PLAN data log

24	0-255	packet checksum

The packet length is variable, depending upon the number of data bytes (if any) present in the packet. The packet size byte is a count of all bytes in the packet, including the checksum byte. Precautions should be taken by the host to insure the packet count byte is accurate and that the packet size never exceeds 24.

The checksum byte is always the last byte of the packet (not necessarily the 24th byte). The checksum is the logical compliment of an 8-bit sum of every byte in the packet (excluding the checksum byte), plus 1. The following C programming language example could be used to calculate the checksum value:

```
#define SIZE 5

unsigned char sum;

unsigned char rxbuf[24];

sum=~(rxbuf[0] + rxbuf[1] + . rxbuf[rxbuf[SIZE]]) + 1;
```

The R-507 will respond (return a data packet to the host) to most commands received from the host, except GLOBAL commands. (GLOBAL commands are to all meters on the bus, regardless of their address.) The following is the packet structure for the R-507 transmissions:

BYTE	VALUE	DESCRIPTION
1	1	1st synchronization byte
2	1	2nd synchronization byte
3	1	3rd synchronization byte
4	1-255	status flags from R-507 (defined below)
5	1-255	R-507's remote address
6	8-24	packet size (in bytes)
7	1-255	command (echoed from host packet)
8	0-255	1st data byte
23	0-255	16th data byte
24	0-255	packet checksum

The 8 bits of the STATUS FLAGS byte are updated every time the R-507 transmits a data packet to the HOST. A TRUE (bit = 1) state for any bit indicated the associated condition described below:

BIT# DESCRIPTION

7	(unused)
6	(unused)
5	ERR message is being shown on LCD display
4	data log timer has expired (timed out)

3 data log timer needs to be reprogrammed

2 unsuccessful read/write to the EEPROM

1 unable to perform last host command

0 (always zero)

The following is a description of each of the above R-507's commands:

NOTE In the following descriptions [n] signifies the packet data buffer value where **n** is the index into the data portion of the packet (Example: [1] specifies the 1st data byte but the 9th byte of the packet).

COMMAND 1

Changes the remote address of the R-507. All future commands must contain the new address The host must assume responsibility for bus conflicts with other meters with the same address.

HOST: [1] = new remote address (1-255)

R-507: [1] = new remote address

COMMAND 2

Changes the RS-232 BAUD rate The response packet will be transmitted with the new BAUD rate setting.

HOST: [1] = 4 = 1200 BAUD

5 = 2400 BAUD

7 = 9600 BAUD

R-507: [1] = 4 if BAUD rate has been set to 1200

5 if " " " " " " 2400

7 if " " " " " " 9600

COMMAND 3

Reads the hours and minutes of the alarm of the 24-hour data log timer

HOST:

R-507: [1] = hours (0-23)

[2] = minutes (0-59)

COMMAND 4

Sets the hours and minutes of the alarm of the 24-hour data log timer.

HOST: [1] = hours (0-23)

[2] = minutes (0-59)

R-507: [1] = hours (0-23)

[2] = minutes (0-59)

COMMAND 5

Reads the day and month of the alarm of the 24-hour data log timer.

HOST:

R-507: [1] = day (1-31)

[2] = minutes (0-59)

COMMAND 6

Sets the day and month of the alarm of the 24-hour data log timer.

HOST: [1] = day (1-31)

[2] = month (1-12)

R-507: [1] = day (1-31)

[2] = month (1-12)

COMMAND 7

Enables the date (day/month) feature of the 24-hour data log timer. If the alarm is enabled with this feature enabled, the alarm will only time out when the day and month match in addition to the usual hours and minutes.

HOST:

R-507:

COMMAND 8

Disables the date feature of the 24-hour log timer.

HOST:

R-507:

COMMAND 9

Enables (starts) the 24-hour data log timer.

HOST:

R-507:

COMMAND 10

Disables the 24-hour data log timer.

HOST:

R-507:

COMMAND 11

Enables the factory calibration by calculating and storing the checksums for the calibration tables in the E^2PROM.

HOST:

R-507:

COMMAND 12

Check to see if there had been a loss of power to the 24-hour data log timer. If there has, the time and date need to be reset.

HOST:

R-507: FLAG BIT #3 = 1, if timer need to be reset.

COMMAND 13

Reads the hours and minutes of the 24-hour data log timer.

HOST:

R-507: [1] = hours (0-23)

[2] = minutes (0-59)

COMMAND 14

Sets the hours and minutes of the 24-hour data log timer.

HOST: [1] = hours (0-23)

[2] = minutes (0-59)

R-507: [1] = hours (0-23)

[2] = Minutes (0-59)

COMMAND 15

Reads the day and month of the 24-hour data log timer.

HOST:

R-507: [1] = day (1-31)

[2] = month (1-12)

COMMAND 16

Sets the day and month of the 24-hour data log timer.

HOST: [1] = day (1-31)

[2] = month (1-12)

R-507: [1] = day (1-31)

[2] = month (1-12)

COMMAND 17

Read the contents of sequential memory addresses. The address is a 16-bit value. The number of memory bytes returned is always equal to the byte count.

HOST: [1] = upper 8 bits of starting address

[2] = lower 8 bits of starting address

[3] = byte count (1-16)

R-507: [1] = contents of address

[2] = contents of address+1

[16] = contents of address=15

COMMAND 18

Disables the customer calibration tables. CAUTION! Actually erases the customer calibration data in the E^2PROM. Will enable the factory calibration, if valid. The R-507 beeps three (3) times if the factory calibration is not valid.

HOST:

R-507:

COMMAND 19

Forces the R-507 to exit the RS-232 communications state, returning to Field Strength Meter state.

HOST:

R-507:

COMMAND 20

Sets the frequency for the Field Strength Meter state. Frequency data must be a multiple of 1kHz. Also, the frequency data, in Hz, must be divided by 100 before transmission. The R-507 does not perform checks for these requirements. It is the responsibility of the host software to insure these restrictions are adhered to. If a frequency setting less than 3.00MHz is received by the R-507, or if a frequency greater 1002.00MHz is received, this command will be ignored.

If in BC Block Converter mode the valid range is .3MHz to 300MHz.

HOST: [1] = upper 8 bits of (frequency/100)

[2] = middle 8 bits of (frequency/100)

[3] = lower 8 bits of (frequency/100)

R-507: FLAG BIT#1 = 1, if invalid frequency

COMMAND 23

Download Motorola ASCII S-records to the E^2PROM. The only valid S-record types are S1 and S9 (see a Motorola data manual for details on S-record definitions). The R-507 will respond to this command and then wait for S-records to be sent**.** Upon error (i.e. data overrun, invalid checksum, etc.) or reception of an S9 record, the R-507 will exit this state and resume looking for RS-232 commands.

The R-507 does not use the address of the S9 record. An S9 record simply designates the end of the S-record file transmission.

HOST:

R-507:

COMMAND 24

Forces the R-507 to set to one (1) of four (4) signal level meter attenuation ranges. Locks on the specified range, disabling the normal auto-ranging of the meter. This command will be ignored if the range is already locked. Use command # 32 to unlock a range.

HOST: [1] = range to set to (0 = 0 dB)

(1= 20 dB)

(2= 40 dB)

(3= 60 dB)

R-507:

COMMAND 25

Forces the R-507 to send one (1) data log record to the host. Normally, there is no response from the R-507 to this command other than the data log record transmission. No record data is sent and a response packet is returned with FLAG BIT # 1 set (= 1), if the record number requested is less than zero (0) or greater than the highest record number presently stored in the E^2PROM of the meter.

HOST: [1] = data log record number (0-23)

R-507: data log record, if valid record number

-or-

[1] = data log record

FLAG BIT #1 = 1, if invalid record number

COMMAND 26

Recalls one (1) of the 41 memory set-ups and forces the R-507 to that state (if recall was successful) with the following exceptions:

- the R-507 remains in remote communications state

- the R-507 remains in frequency state

Memory #0 is the power-up state of the meter. Memories 1-40 are the 40 user memories.

HOST: [1] = memory # to recall (0-10)

R-507: FLAG BIT #1 = 1, if invalid memory #

COMMAND 27

Stores the present meter state in one (1) of the 41 memory set-ups with the following exception:

- does not store the remote communications state

Memory # 0 is the power-up state of the meter. #1-40 are the 40 USER MEMORY locations.

HOST: [1] = memory # to store (0-40)

R-507: FLAG BIT # 1 = 1, if invalid memory #

COMMAND 28

Reads one (1) of the eight (8) analog-to-digital (a/d) channels. Returns the average 10-bit reading.

1. The following is the a/d channel assignment:

2. rf signal level

3. internal temperature
4. external temperature (probe must be attached)
5. leakage squelch
6. battery voltage
7. (undefined)
8. (undefined)
9. (undefined)

HOST: [1] = a/d channel # (0-7)

[2] = # of readings to average (1-63)

R-507: [1] = a/d channel # read

[2] = # of readings averaged

[3] = upper 2 bits of 10-bit a/d average

[4] = lower 8 bits of 10-bit a/d average

FLAG BIT #1 = 1, if invalid a/d channel #

or invalid # of readings

COMMAND 29

Report certain meter conditions. Bits in the 1st response byte indicate that conditions true, as shown below.

HOST:

R-507: [1] = BIT #0 - field strength meter state

#1 - leakage meter state (not used in R-507)

#2 - remote communications state

#3 - channel/video tuning state

#4 - channel/audio tuning state

#5 - frequency tuning state

#6 - user memory tuning state

if field strength meter state:

[2] = upper 8 bits of fsm frequency

[3] = middle 8 bits of fsm frequency

[4] = lower 8 bits of fsm frequency

or if leakage meter state:

[2] = upper 8 bits of leakage frequency

[3] = middle 8 bits of leakage frequency

[4] = lower 8 bits of leakage frequency

[5] = firmware version number

[6] = firmware version # month

[7] = firmware version # year

[8] = BAUD rate (4=1200)(5=2400)(7=9600)

COMMAND 30

Resets the R-507. Simulates a power-up condition.

(NOTE: The R-507 will no longer be in remote state.)

HOST:

R-507: (no response)

COMMAND 31

Forces the R-507 to go to field strength meter state while remaining in remote communications state.

HOST:

R-507:

COMMAND 32

Unlocks the attenuator range. Allows auto ranging.

HOST:

R-507:

COMMAND 33

Read the year offset from 1992 (Examples: 1992 = 0; 1993 = 1; etc.)

HOST:

R-507: [1] = year offset

COMMAND 34

Set the year offset from 1992 (Examples: 1992 = 0; 1993 = 1; etc.)

HOST: [1] = year offset

R-507: [1] = year offset

COMMAND 35

Read the signal level of the currently tuned frequency (as normally shown on the meter display). Applies calibration correction, if enabled. Units will either be dBuV, dBm or dBuV/M, depending upon the meter set up.

HOST:

R-507: [1] = upper 8 bits of reading

[2] = lower 8 bits of reading

COMMAND 36

(Factory use only. Do not use this command.)

COMMAND 37

Enables/disables the detector calibration correction. Assumes there is valid detector calibration data in the E^2PROM. If the meter is not calibrated, this command has no effect.

HOST: [1] = 0, if disable

1, if enable

R-507: [1] = 0, if disabled

1, if enabled

COMMAND 38

Enables/disables the frequency calibration correction. Assumes there is valid frequency calibration data in the E2PROM. If the meter is not calibrated, this command has no effect.

HOST: [1] = 0, if disabled

1, if enable

R-507: [1] = 0, if disabled

1, if enabled

COMMAND 39

Enables/disables the temperature calibration correction. Assumes there is valid temperature calibration data in the E2PROM. If the meter is not calibrated, this command has no effect.

HOST: [1] = 0, if disable

1, if enable

R-507: [1] = 0, if disabled

1, if enabled

COMMAND 40

(Factory use only. Do not use this command.)

COMMAND 42

Forces the R-507 into RS-485 communications state. This state does not support hardware handshaking. It is the responsibility of the host to provide sufficient intercharacter delay to allow the R-507 to process each incoming character. This state also requires the replacement of the RS-232 I.C. with an RE-485 I. C. Consult the factory for hardware requirements to utilize this state.

The command byte value must be 255 (GLOBAL).

HOST: [1] = 42 (RS-485 command)

R-507: GLOBAL command (no response)

COMMAND 43

Sets/reads all four (4) of the 6-bit digital-to-analog channels (DAC). If it is desired to leave a DAC channel's setting unchanged, a value greater than 63 should be sent from the host for the new DAC setting.

This command is not recommended for customer use. Improper usage could result in unpredictable results.

HOST: [1] = new DAC #1 setting (0-63)

[2] = new DAC #2 setting (0-63)

[3] = new DAC #3 setting (0-63)

[4] = new DAC #4 setting (0-63)

R-507: [1] = present DAC #1 setting (0-63)

[2] = present DAC #2 setting (0-63)

[3] = present DAC #3 setting (0-63)

[4] = present DAC #4 setting (0-63)

COMMAND 44

Writes up to 13 bytes of 8-bit data to sequential addresses in the RAM or E2PROM of the R-507.

This command is not recommended for customer use. Improper usage could result in unpredictable results.

HOST: [1] = number of bytes to change (1-13)

[2] = upper 8 bits of starting address

[3] = lower 8 bits of starting address

[4] = 1st 8-bit data byte

[16]= 13th 8-bit data byte

R-507: [1] = number of bytes changed

[2] = upper 8 bits of starting address

[3] = lower 8 bits of starating address

[4] = 1st 8-bit data byte

[16] = 13th 8-bit data byte

COMMAND 45

Selects a CHANNEL PLAN for command #46 to use. The meter will not allow an unlearned LEARN channel plan to be selected.

HOST: [1] = channel plan #

1 = NCTA, PAL B/G, PAL D/K, JAPAN, EI

2 = HRC, UK-1, PAL 300

4 = IRC, UK-2, PAL 470

8 = AIR, UHF

16 = L1

32 = L2

64 = USER

R-507: [1] = current channel plan # (after setting)

[2] = upper 8 bits of the tuned frequency

[3] = middle 8 bits of the tuned frequency

[4] = lower 8 bits of the tuned frequency

COMMAND 46

Starts a CHANNEL PLAN DATA LOGGING session. The maximum scan frequency is represented in 100 Hz units. For example, 325.5MHz would be represented as 3255000. The log interval is the amount of time to expire after the start of a data log record until the start of the next data log record. It must be between one (1) and 360 minutes. If a single record is desired, the 7th data byte must be zero (0). If the 7th byte is zero (0), the data log record will be taken immediately and returned to the host. If the 7th byte is non-zero, records will be taken on a continual basis, starting at the start time and date, until any command is received from the host. When all 24 records are stored, the record counter resets to the 1st record and continues to store records. This way, only the most current 24 records are retained.

The 8th through 11th data bytes (if used), must be in 4-bit BCD representation. For example, 15 hours would have a 1 in the upper 4 bits of the 8-bit byte and a 5 in the lower 4 bits. The resulting hexadecimal value for the 8th data byte would be 15.

HOST: [1] = upper 8 bits of the maximum scan frequency

[2] = middle 8 bits of the maximum scan frequency

[3] = lower 8 bits of the maximum scan frequency

[4] = upper 8 bits of log interval (minutes)

[5] = lower 8 bits of log interval (minutes)

[6] = log mode (=0 - 10 USER MEMORY log)

(!0 - channel plan log)

[7] = eternal (=0 - take 1 record only)

(!0 - loop all 24 forever)

[8] = 1st log 24-hour start time (hours)

[9] = 1st log 24-hour start time (minutes)

[10] = 1st log start date (day)

[11] = 1st log start date (month)

R-507:

COMMAND 47

Starts a CONTIGUOUS DATA LOGGING session. The beginning and ending scan frequencies are represented in 100Hz units. For example, 1.65MHz would be represented as 16500. The log interval is the amount of time to expire after the start of a data log record until the start of the next data log record. It must be between 5 and 1440 minutes (24 hours). If a single record is desired, the 9th data byte must be zero (0). If the 9th byte is zero (0), the data log record will be taken immediately and returned to the host. If the 9th byte is non-zero,

records will be taken on a continual basis, starting at the start time and date, until any command is received from the host. When 20 records are stored, the record counter resets to the 1st record and continues to store records. This way, only the most current 20 records are retained. The 11th through 14th data bytes (if used), must be in 4-bit BCD representation. For example, 17 hours would have a 1 in the upper 4 bits of the 8-bit byte and a 7 in the lower 4 bits. The resulting hexadecimal value for the 11th data byte would be 17.

HOST: [1] = upper 8 bits of the beginning scan frequency

[2] = middle 8 bits of the beginning scan frequency

[3] = lower 8 bits of the beginning scan frequency

[4] = upper 8 bits of the ending scan frequency

[5] = middle 8 bits of the ending scan frequency

[6] = lower 8 bits of the ending scan frequency

[7] = upper 8 bits of log interval (minutes)

[8] = lower 8 bits of log interval (minutes)

[9] = eternal (=0 - take 1 record only)

(!0 - loop all 20 forever)

[10] = frequency step / 10kHz

[11] = 1st log 24-hour start time (hours)

[12] = 1st log 24-hour start time (minutes)

[13] = 1st log start date (day)

[14] = 1st log start date (month)

R-507:

COMMAND 55

Sets the RF Amplifier, and IF BANDWIDTH.

HOST: [1] = 0 RF Amp off

1 RF Amp on

[2] = 0 Wideband

1 Narrowband

R-507:

COMMAND 57

Mutes the R-507 Audio.

HOST: [1] = 0 Mute Audio

1 unMute Audio

R-507:

COMMAND 60

Sets four (4) frequencies, in EEPROM, for remote command #61 to use.

Frequency data must be a multiple of 10kHz. Also, the frequency data, in Hz, must be divided by 100 before transmission. The R-507 does not perform checks for these requirements. It is the responsibility of the host software to insure these restrictions are adhered to. If a frequency setting less than 0.300MHz is received by the R-507, or if a frequency greater than 1002.00MHz is received, this command will be ignored.

HOST: [1] = upper 8 bits of (frequency_A / 100)

[2] = middle 8 bits of (frequency_A / 100)

[3] = lower 8 bits of (frequency_A / 100)

[4] = upper 8 bits of (frequency_B / 100)

[5] = middle 8 bits of (frequency_B / 100)

[6] = lower 8 bits of (frequency_B / 100)

[7] = upper 8 bits of (frequency_C / 100)

[8] = middle 8 bits of (frequency_C / 100)

[9] = lower 8 bits of (frequency_C / 100)

[10] = upper 8 bits of (frequency_D / 100)

[11] = middle 8 bits of (frequency_D / 100)

[12] = lower 8 bits of (frequency_D / 100)

R-507 [1] = upper 8 bits of (frequency_A / 100)

[2] = middle 8 bits of (frequency_A / 100)

[3] = lower 8 bits of (frequency_A / 100)

[4] = upper 8 bits of (frequency_B / 100)

[5] = middle 8 bits of (frequency_B / 100)

[6] = lower 8 bits of (frequency_B / 100)

[7] = upper 8 bits of (frequency_C / 100)

[8] = middle 8 bits of (frequency_C / 100)

[9] = lower 8 bits of (frequency_C / 100)

[10] = upper 8 bits of (frequency_D / 100)

[11] = middle 8 bits of (frequency_D / 100)

[12] = lower 8 bits of (frequency_D / 100)

- or -

FLAG BIT #1 = 1, if any frequency is invalid

COMMAND 61

Reads the signal levels of the four (4) command #60 frequencies. Applies calibration correction, if enabled. Units will either be dBuV, dBm, or dBuV/M, depending upon the meter set up.

HOST:

R-507: [1] = upper 8 bits of frequency_A reading

[2] = lower 8 bits of frequency_A reading

[3] = upper 8 bits of frequency_B reading

[4] = lower 8 bits of frequency_B reading

[5] = upper 8 bits of frequency_C reading

[6] = lower 8 bits of frequency_C reading

[7] = upper 8 bits of frequency_D reading

[8] = lower 8 bits of frequency_D reading

COMMAND 62

Sets the frequency for the field strength meter state and reads the signal level. Applies calibration correction, if enabled. Units will either be dBuV, dBm, or dBuV/M, depending upon the meter set up.

Frequency data must be a multiple of 1kHz. Also, the frequency data, in Hz, must be divided by 100 before transmission. The R-507 does not perform checks for these requirements. It is the responsibility of the host software to insure these restrictions are adhered to. If a frequency setting less than 0.300MHz is received by the R-507, or if a frequency greater than 1002.00MHz is received, this command will be ignored.

HOST: [1] = upper 8 bits of (frequency / 100)

[2] = middle 8 bits of (frequency / 100)

[3] = lower 8 bits of (frequency / 100)

R-507: [1] = upper 8 bits of reading

[2] = lower 8 bits of reading

- or -

FLAG BIT #1 = 1, if invalid frequency

Section 11: Quick Reference Card

(SHIPPED IN SOFT-CASE POUCH)

R-507 BASIC OPERATING INSTRUCTIONS
&
FUNCTION BUTTON LISTINGS

Section 11: Quick Reference Card

R-507 BASIC OPERATING INSTRUCTIONS

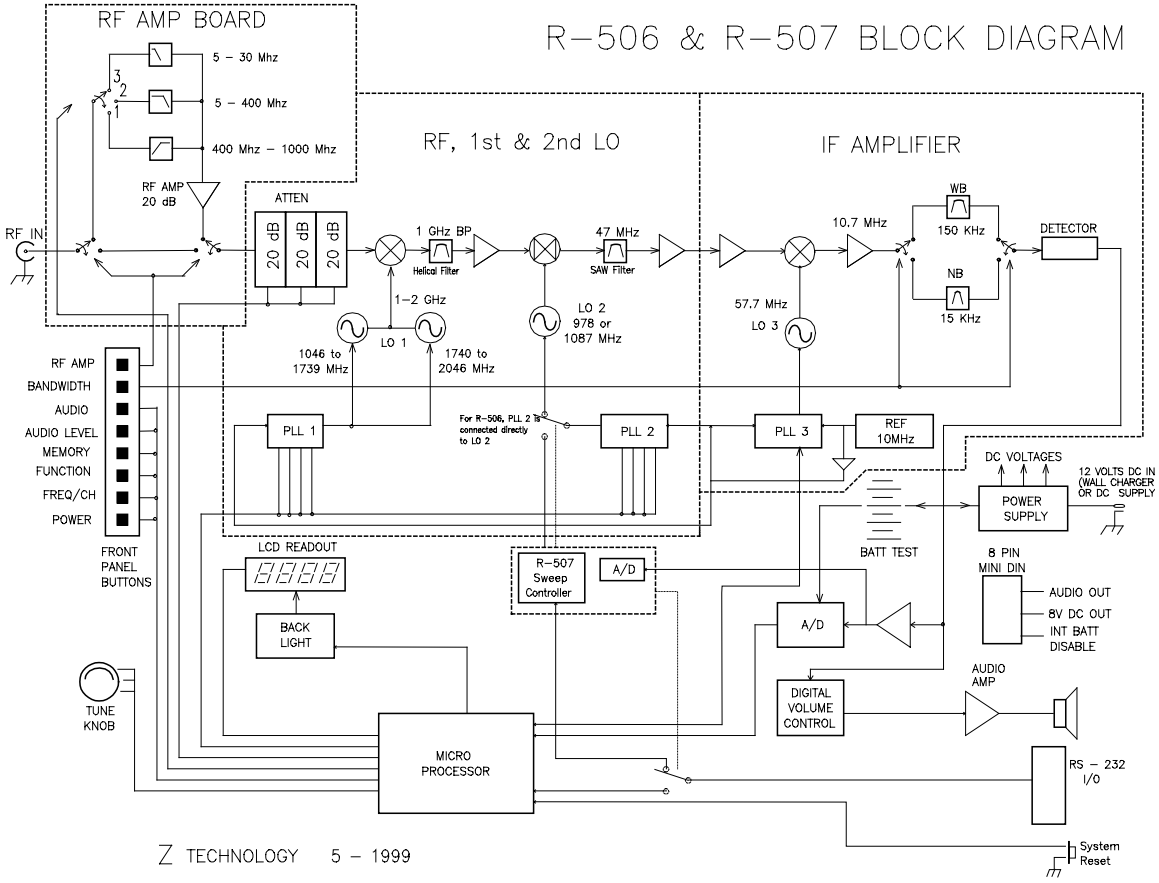
- TURN POWER ON USING **POWER** BUTTON
- TOP LINE OF LCD DISPLAY IS ***SIGNAL LEVEL*** READOUT.
- MIDDLE LINE OF LCD DISPLAY IS ***FREQUENCY/CHANNEL*** READOUT.
- BOTTOM LINE OF LCD DISPLAY IS ***STATUS*** READOUT.
- ADJUST **TUNE** KNOB FOR FREQUENCY TO BE MEASURED. PUSHING **TUNE** KNOB CHANGES DETENTS VERSUS FREQUENCY STEPS.
- WHEN THE METER IS RECEIVING A SIGNAL WITHIN ITS AUTO-RANGE CONTROL THE ***SIGNAL LEVEL*** READOUT WILL BE STABLE AND THE '<' or '>' SIGN IN THE ***SIGNAL LEVEL*** READOUT WILL NOT BLINK.
- WHEN THE '<' or '>' SIGN BLINKS, INPUT SIGNAL IS OUT OF THE AUTO-RANGE CONTROL. IF THE INPUT SIGNAL IS TOO SMALL, ADD GAIN BY PRESSING THE **RF AMP** BUTTON.
- TWO IF **BANDWIDTH** FILTERS ARE AVAILABLE SELECTABLE BY THE **BANDWIDTH** BUTTON.
- "**WB**" HAS A BANDWIDTH OF 150 kHz.
- "**NB**" HAS A BANDWIDTH OF 15 kHz.
- TO ACCURATELY MEASURE SIGNALS BELOW 0 dBuV, THE "**NB**" IF FILTER MUST BE USED.
- WHEN **FREQ/CH** BUTTON IS SELECTED, EVERY DETENT OF THE **TUNE** KNOB CHANGES THE RECEIVED FREQUENCY BY ONE CHANNEL.
- **FUNCTION** BUTTON ALLOWS USER TO ACCESS MANY HELPFUL METER FUNCTIONS. (SEE THE OTHER SIDE OF THIS CARD).
- **MEMORY** BUTTON ALLOWS USER TO STORE UP TO 100 FREQUENTLY USED FREQUENCIES OR CHANNELS. AFTER SELECTING, **MEMORY** EACH DETENT OF THE **TUNE** KNOB CHANGES THE METER TO THE NEXT STORED USER MEMORY FREQUENCY OR CHANNNEL.

- **IMPORTANT NOTE:** EVERY TIME A NEW SIGNAL IS MEASURED ALWAYS START WITH THE **RF AMP** OFF. USE THIS AMPLIFIER ONLY WHEN THE SIGNAL TO BE MEASURED IS OTHERWISE TOO SMALL.

Function Listing and Description

F1	BATTERY VOLTAGE CHECK
F3	CUSTOMER CALIBRATION (MINOR)
F4	VIEW CHANNEL PLAN
F5	DISABLE AUTO POWER DOWN
F7	SET SCAN STEP FREQUENCY
F8	SET SCAN START FREQUENCY (Frequently accessed functions)
F9	SET SCAN STOP FREQUENCY
F10	AUTO - CONTIGUOUS RESIDENT DATA LOGGING
F11	MANUAL - CONTIGUOUS RESIDENT DATA LOGGING
F12	SELECT ANTENNA CALIBRATION
F13	SELECT BLOCK CONVERTER
F14	SELECT dBm
F15	SELECT ATTENUATOR SETTING
F21	ERASE USER MEMORY (1 - 40)
F28	SOFTWARE VERSION #
F40	CUSTOMER CALIBRATION (MAJOR)
F41	SELECT CUSTOMER CALIBRATION
F42	SELECT FACTORY CALIBRATION
F43	SET RS-232 BAUD RATE
F44	SET RS-232 REMOTE ADDRESS (Locked out User Functions)
F45	SET 24 HOUR CLOCK {Except F44}
F46	SET MONTH/DAY
F47	SET YEAR
F48	CLONE ANOTHER R-507
F59	UNLOCK USER FUNCTIONS F40 - F48
F91	RESET DATA LOG RECORD COUNTER TO 1
F93	REMOTE MODE
F94	PRINT (RS-232) SELECTED DATA LOG RECORD
F95	PRINT (RS-232) ALL DATA LOG RECORDS
F96	AUTO - USER MEMORY RESIDENT DATA LOGGING (Data Logging Functions)
F98	MANUAL - USER MEMORY RESIDENT DATA LOGGING

Section 12: Block Diagram



Section 13: Rear Panel Connectors

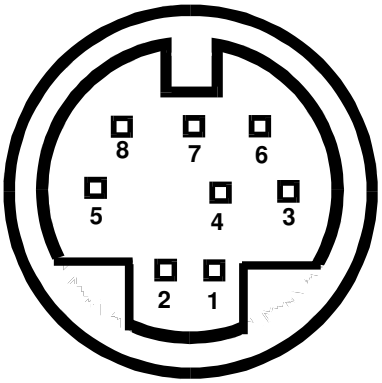
The rear panel of the R-507 has four connectors: looking at the rear panel from left to right they are: an RS-232 serial port, an External Battery Input, an accessory connector and the receptacle plug for the charger/power supply. The accessory connector an 8 pin Mini - Din Female Connector.

A small hole to the right of the RS-232 serial port is a system reset button. Should the meter fail to operate properly, disconnect any External Charger/Supply then press the reset button with the tip of a sharp pencil, or the end of a paper clip. This will reset the meter.

The accessory connector is provided for the following uses:

1. For connecting an external 8 Ohm speaker Pin 1 & Pin 2.
2. Provides external + 8.8VDC at 50 ma. accessory power Pin 3, Pin 4 is Ground.
3. To allow the instrument to power up and operate Short Pins 5 & Pin 7 only when the external power supply/charger is connected to the R-507. (With these two pins open the unit will operate normally from either the internal Battery Pack or from the External Charger/Supply).

The following Diagram shows pin numbers for the 8 Pin Mini-Din Connector.



Section 13: Rear Panel Connectors

Section 14: Appendix

Measurement Accuracy Statement:

+/- 2 dB for CW signals:	+15 to +35 Deg C
+/- 2 dB Typical:	0 to +50 Deg C

1. Modulation may influence measurement accuracy. For instance, for video modulation, the instrument measures signal strength of the Vertical Sync Peak. This adds 0.5 dB of additional uncertainty, to measurement accuracy.

2. Each instrument is verified to be within the stated accuracy specification shown above as referenced to a CW signal. Each instrument is also calibrated over temperature to provide added accuracy through the range of 0 to 50 Deg C.

3. Stated accuracy numbers are referenced to a very accurate signal source. The signal source itself has NIST Traceable accuracy to better than +/- 0.5dB. All inaccuracies are additive including reference signal source inaccuracy and the above measurement accuracy numbers.

Corrections:

1. In Narrowband IF mode, the standard instrument is specified to have a "typical" measurement accuracy of +/-2 dB from -10 dBuV to 0 dBuV over temperature.

2. In Wideband IF mode, at frequencies above 5 MHz, the standard instrument and all options are specified to have a “typical” measurement accuracy of +/- 2 dB for the lowest 10 dB of each measurement range. This is true for both the RF AMPLIFIER "ON" and "OFF" settings. This holds for the instrument's specified temperature range.

3. Some users of the R-507 may notice a few small signals (around 0dBuV) at or near the following frequencies:

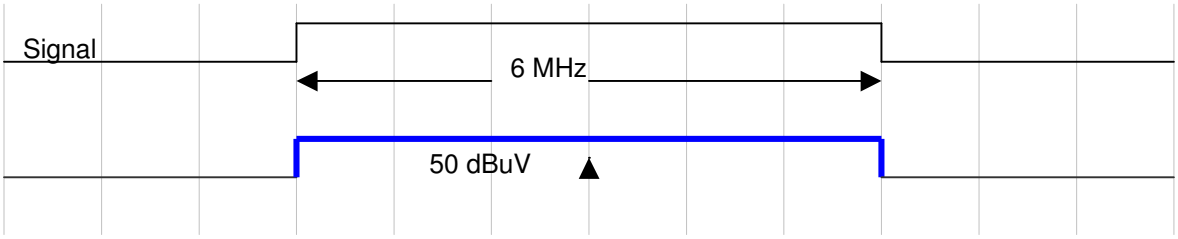
   8 MHz
   6 MHz
   30 to 80 MHz

These signals are due to internal signal sources such as reference crystals and microprocessor switching transients. They remain constant and are only found when an external antenna is attached to the Type-N input connector and held close to the instrument.

Power reading derivation from dBuV readings of swept spectrum

Consider an idealized signal with a uniformly distributed power density, an idealized measuring system with an ideal bandpass filter I.E. flat in-band, and no response out-of-band. Let the uniformly dense signal be 6 MHz wide. Let the measuring system bandpass filter also be 6 MHz wide and tuned to the center of the 6 MHz wide signal. The measurement system sees the full entirety of the signal, and gives a power reading in dBuV. Figure 1 below shows the idealized signal, the spectrum of power the measuring instrument sees (the thick line,) and the center frequency of the measurement (triangle).

Figure 1



P = E^2 / R where E = antilog (50 dBuV/20) = 316 uV

P = (316 uV)^2 / 50 $= 2000E^{-12}$ watts = 2.0 nW

Now consider the same signal being measured by a system that has just a 3 MHz bandwidth. Figure 2 below shows the signal can be measured in two parts, sum the parts to arrive at the Total power.

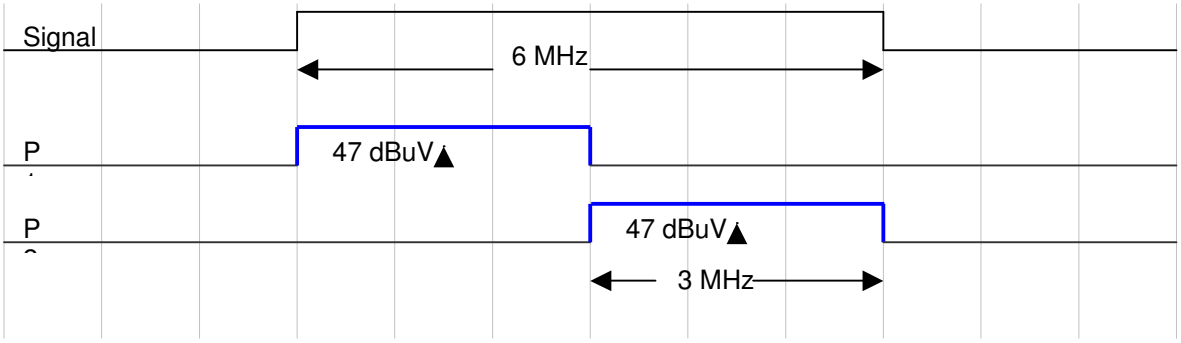


Figure 2

P_{total} = P1 + P2, P1 = P2

P1 = P 2 = E^2 / R E = antilog(47dBuV/20) = 223.8 uV

= (223.8uV)^2 / 50 = 1002E-12 watts = 1.0 nW

P_{total} = P1 + P2 = 1.0 nW + 1.0 nW = 2.0nW

Now consider the same signal being measured with the same 3 MHz bandwidth system, but this time the measurements are every 1.5 MHz such that the bandwidths overlap. Figure 3 below shows the overlapping bandwidths, and the power each measurement sees (the thicker blue lines, and the center frequency of the measurement.)

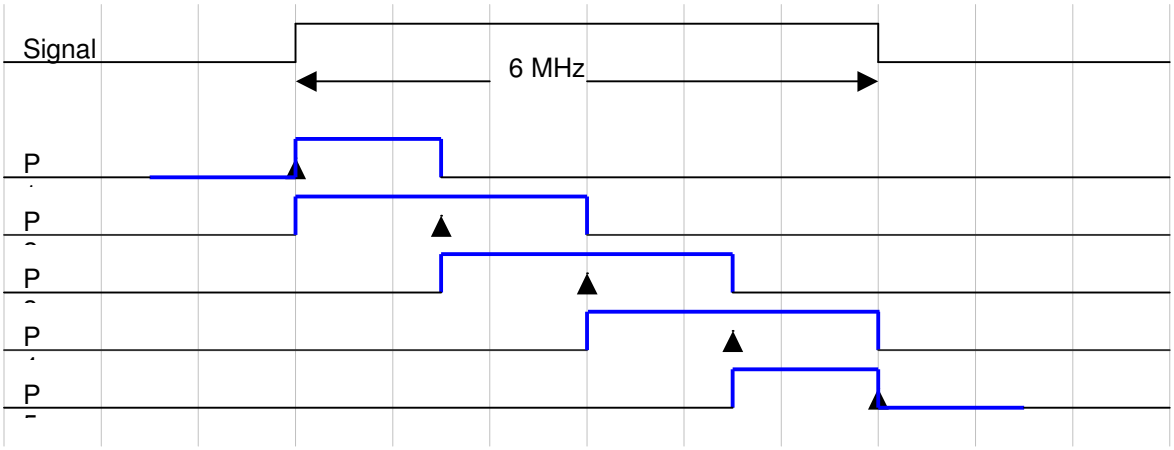


Figure 3

The sum of all the measurements now are greater than the total power because of the overlapping bandwidths. Each 1.5 MHz section of the measured signal is included twice, therefore if we divide the sum by two we arrive at the total power. Notice that the number 2 is also the ratio of the measurement bandwidth divided by the Step size, 3MHz / 1.5 MHz = 2.

Notice also the following identities

P1 + P5 = P2 = P3 = P4 = 47 dBuV

There are four 47dBuV quantities, each one is 1 nW

P_{total} = (4 * 1nW) / 2 = 2 nW

Next, take the step size down further while maintaining the bandwidth. The result is more overlapping bandwidths.

Figure 4 below shows the step size has been reduced to 1 MHz steps, while the bandwidth has remained at 3 MHz.

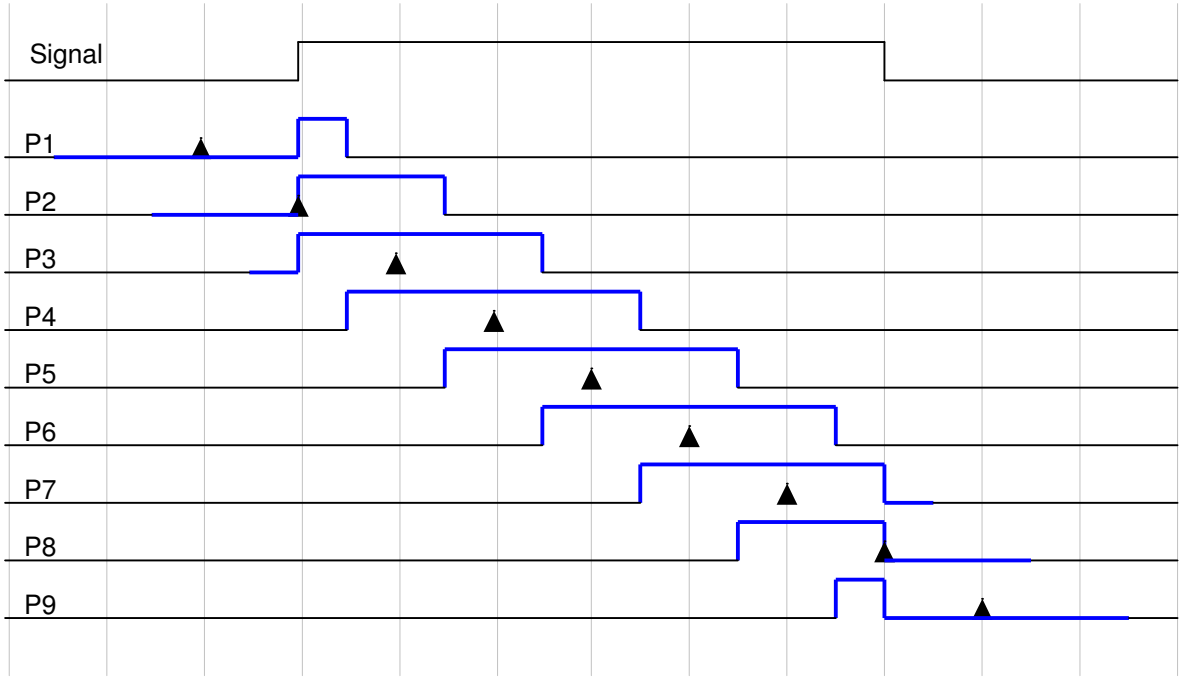


Figure 4

The sum of all the measurements are again greater than the total power because of the overlapping bandwidths. This time each 500KHz section is counted three times, therefore if we divide the sum by three we arrive at the total power. Notice that the number 3 is also the ratio of the measurement bandwidth divided by the Step size, 3MHz / 1 MHz = 3.

P_{total} = (P1 + P2 + P3 + P4 + P5 + P6 + P7 + P8 + P9) / 3

We also notice the following identities

P1 + P3 = P2 + P8 = P4 = P5 = P6 = P7 + P9 = 47 dBuV

There are six 47dBuV quantities, each one is 1 nW

P_{total} = (6 * 1nW) / 3 = 2 nW

Summarizing we notice that the when measuring the power of a signal that is wider than the bandwidth of the measuring instrument, and the power density of the signal across its bandwidth is uniform, we can make several measurements. Increment through the signal's bandwidth, then sum the power or the individual measurements to arrive at the total power.

When the measurement instrument bandwidth is greater than the step size used to increment through the signals bandwidth, we divide the sum of the power of the individual readings by the ratio of the Measurement bandwidth / step size.

For the case of the R-507, the Measurement bandwidth on Wide Band is 150 KHz, on a 10 MHz sweep the step size is 10 MHz / 500 steps = 20KHz. Therefore for the R-507 the Total

Power is equal to the sum of each power reading in the 6 MHz band being measured divided by the quantity:

Measurement bandwidth / Step size = 150Khz / 20KHz = 7.5

Or

P_{total} = (P1 + P2 + P3 + …. + Pn) / 7.5