Z Technology
R-506 & R-507
SERVICE MANUAL

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Table of Contents

Section 1: 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. Tune knob-retrievable in sequence. b) Several TV channel plans stored in memory.
Measurement Ranges:	Standard Mode: -10 dBuV to +90 dBuV utilizing autoranging plus front panel Controlled gain setting.
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.
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
Input Filters:	Three automatically selected RF filter bands

Tuned Frequency	**RF Filter**
400.001 MHz - 1000 MHz	400 MHz High Pass
30.001 MHz - 400 MHz	400 MHz Low Pass
5.0 MHz - 30 MHz	30 MHz Low Pass

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.
Weight:	4.5 Kg (10 lbs.)
Dimensions:	89mm(3.5in)High; 229mm(9in)Deep; 213mm(8.4in) Wide

[1] Some types of modulation influence measurement accuracy. For instance, with Video modulation, the R-505C 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.

Section 2: Operating Information

Background Information for Basic Operation

The R-506/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-506/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-506/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 (dBu Volts), dBm, or dBuV/M (dBuV/Meter) depending on the user 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 function 12 has been activated. (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 the USER Manual on "Specification, Options and Accessories".

To convert from dBuV/M to uV/M use the following formula:

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

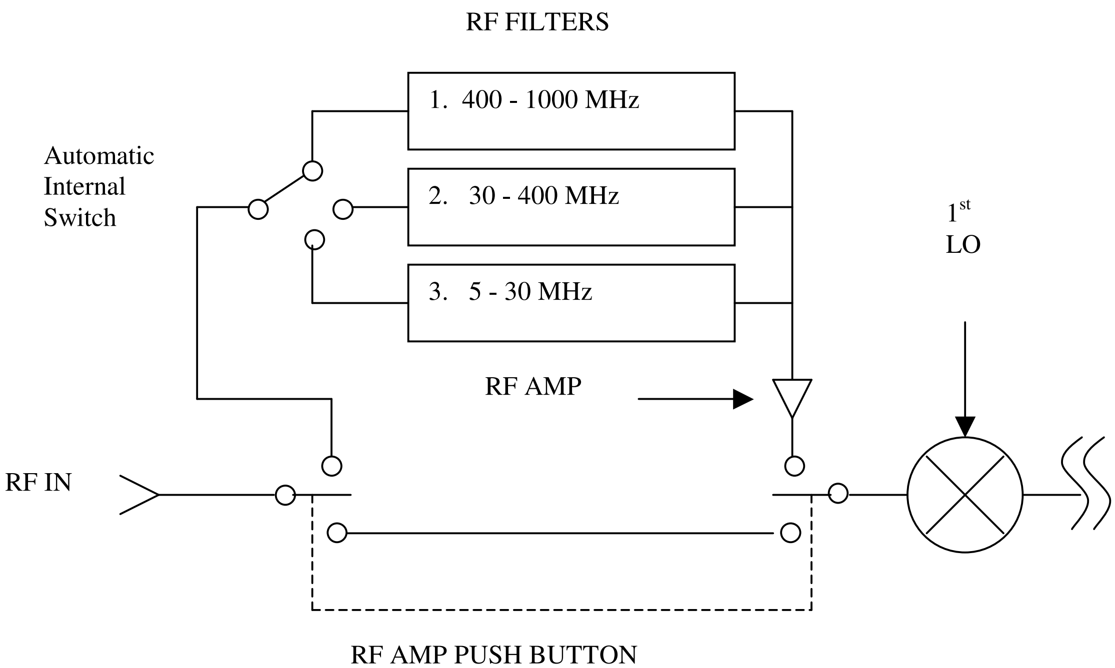
Calibrated antenna systems are provided with Calibration Tables listing correction factor data versus frequency for each antenna. The data is taken during individual tests made on an actual antenna test site. This data, when loaded into the meter’s antenna calibration table and activated (see F12 description 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 meter's ***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, other possibilities are 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 is 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 the **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-506/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-506/R-507 Field Strength Meter Front Panel

FRONT PANEL OPERATION

Front panel operation for the R-506/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*.

Front Panel Description

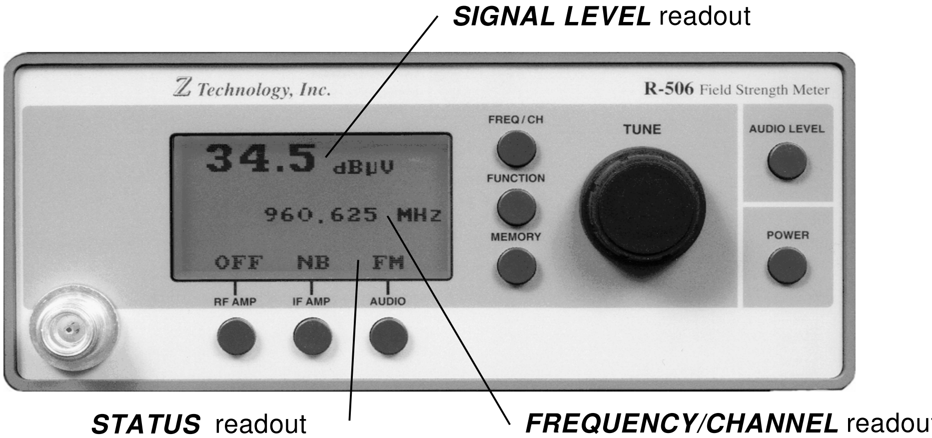
The instrument's front panel inputs and controls include:

- 50 Ohm Type-N RF input connector
- LCD display area, becomes active when meter turned on
- 1 Red and 7 Gray 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 (RED)
- 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.



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) 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 knob. 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 Vin @ 50ohms	dBuV	dBm	Front Panel Selections
0.32uV	-10 dBuV	-117 dBm	**RF AMP** "**ON**"
0.5uV	-6 dBuV	-113 dBm	**RF AMP** "**ON**"

SIGNAL LEVEL CONVERSION TABLE

1.0uV	0 dBuV	-107 dBm	**RF AMP "ON"**
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-506/R-507 remembers its settings from the previous power down for the **RF AMP**, **IF AMP**, **FREQ/CH**, and **MEMORY** buttons. 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-506/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 selectable 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-506/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-506/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

The **TUNE** knob, is used to set the R-506/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-506/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-506/R-507 will display the battery voltage on command. Use F1: Battery Mode and see the FUNCTION FEATURES section for more details.)

FUNCTION FEATURES (FUNC BUTTON OPERATION)

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-506/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. Pushing and holding the control in for at least 2 seconds activates the HOLD mode.*

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-506/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 Listing and Description Table

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	
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-506/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	

F1: BATTERY VOLTAGE CHECK

The charge level of the R-506/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.

Connect the calibration signal source to the R-506/R-507s front panel jack. Set the source to the desired frequency.

Set the R-506/R-507 to the frequency of the calibration source, then enter the F3 function. The R-506/R-507s reading of source's signal level will be displayed in the ***SIGNAL LEVEL*** readout.

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.

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-506/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-506/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**”. 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" disk provided with each R-506/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-506/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 Diskette. 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.

Section 3: Theory of Operation

Block Diagram

The R-500 SERIES is designed to give the best inherent calibration flatness possible over wide input frequencies as well as over a large dynamic range. See the block diagram in the Diagrams section near the rear of this manual as a guide for understanding the instruments operation and as the next several sections are presented.

Control & Instrument Interaction

It is important for the service engineer to understand the basic design philosophy of the R-500 series before one can be successful at evaluating the instrument's operational status and ultimately facilitating a repair.

The R-500 series utilizes the microprocessor resident on the Micro Controller Board (MCB) to control and coordinate the entire instrument's operation and to maintain the unit's strict calibration demands. The R-500 series microprocessor is at the center of the extremely accurate internal calibration monitoring procedure. The instrument is carefully calibrated at three temperatures, 0 deg., +25 deg., and +45 deg. C and calibrated every 2 MHz at 25 deg. over the entire frequency and signal level range covered by the instrument. All data is collected during the calibration process. Correction tables are generated and stored within the MCB unit. Corrections are in the form of extensive "look up" tables.

The microprocessor on periodic bases monitors instrument temperature, signal level and frequency being measured and applies the proper correction values to the signal reading displayed. It this way the R-500 SERIES can maintain extremely good accuracy without the need of day to day calibration via an internal or external standard signal source.

The microprocessor also controls all switching, automatic gain functions, and poling priorities within the unit. Interaction with an internal RS-232 interface IC to allow the instrument to communicate through the serial port. The MCB also controls the power supply switching, auto timing functions and also remembers front panel status at power turn off. A large storage capacitor (used as a backup battery) is mounted on the microprocessor board to maintain critical memory requirements even when all other power is removed.

RF AMPLIFIER Board

The RFAMP board is located in the CCSA and is at the bottom of the stack of boards in the card cage.

A received signal enters the instrument at the front panel type-N connector. The signal is routed through the RF AMP board where it can be amplified by the RF amplifier (~20 dB amplification) or bypasses this amplifier via an internal switching relay. When the RF AMP is selected on the front panel, the signal is amplified by approximately 20 dB and preconditioned through a series of RF Filters. These filters are automatically selected as the instrument is tuned through its frequency range of operation. RF conditioning filters include a 30 MHz low pass, 400 MHz low pass, or 400 -1000 MHz bandpass filter respectively. The software automatically selects when the frequency is tuned to or below 30 MHz to use the 30 MHz lowpass filter. At other frequencies the appropriate filter is selected.

The circuitry converts front panel button pushes into bi-stable switching parameters.

The RF AMP Board also contains an 8 Volt regulated supply. The 8 Volts is created from the 12volt DC supply on the RF AMP Board. The 12 volts gets to the RF AMP board from the IF AMP and the Front Panel Boards.

RF/LO Subsystem

This subsystem is contained in the next to lowest slot of the Card Cage Subassembly. The top of RF/LO Subsystem is covered with a metal shield.

After the received signal completes its path through the RF AMP Board, it is routed into the RF/LO subsystem. The signal enters at the front lower coaxial input connector for this subsystem. This is a sliding contact SMB miniature coaxial connector.

The signal travels through three (3) relay actuated 20 dB precision pads. Attenuators (or pads) are controlled via the R-500 series microprocessor and used as part of the automatic gain control system of the instrument. They are automatically activated when the unit senses a large input signal. A received signal continues through these 20 dB pads (whether they are in or out of the signal path) and enters the first mixer. This monolithic mixer has a high dynamic range and wide frequency range. It functions as a circuit element that creates an output that is the mathematical sum and difference of two input frequencies - the RF input and the first local oscillator input.

The R-500 SERIES utilizes a high-side first local oscillator (1st LO) which tunes from approximately 1040 MHz to 2040 MHz. The 1st LO is a highly stable signal generated from a phase lock loop (PLL) circuit with the instrument's 10MHz highly stable TCXO (on the IF AMP Board) as a reference oscillator. This PLL is controlled via the instrument's microprocessor. When the field strength meter (FSM) input frequency is tuned to 100 MHz, the 1st LO will be set at 1140 MHz. When the unit is receiving 1000 MHz the 1st LO will be 2040 MHz.

The first IF is at approximately 1040 MHz. The "difference" frequency is used to create the 1st IF signal and a 4-pole helical resonator filter is used to select the appropriate signal and reject other frequencies.

The filtered 1st IF is amplified by 15 dB and then presented to the second mixer (also located in the RF/LO Subsystem). The 2nd LO can be at either of two frequencies. The standard frequency for this LO is 1087 MHz, the alternate frequency is 978 MHz. The 2nd LO, like the above-discussed local oscillator, is generated by an independent PLL circuit referenced to the highly stable 10 MHz TCXO.

When the 1st IF is subtracted from the 2nd LO frequency, the 2nd IF of 47 MHz is created. The 2nd IF is filtered through a Surface Acoustic Wave Filter (SAW Filter) to allow only the desired 47 MHz signal to be presented to the rest of the signal processing sections of the R-500 SERIES.

At some received frequencies, the 2nd LO is set to be 978 MHz. This is done to eliminate spurious harmonics from falling within the 1st IF and/or 2nd IF bandwidths and interfering with the good operation. When the 2nd LO is set to 978 MHz, the 1st IF frequency is actually no longer at its normal frequency but is changed to 1025 MHz. For example, this occurs at a received frequency of 90 MHz. For this input frequency (90 MHz), the 1st LO will be set at 1115 MHz. The 1st IF is the difference of these two numbers and will be at 1025 MHz. The 4-pole helical resonator filter is wide enough to pass this frequency and it will be presented to the 2nd Mixer. Since the 2nd LO is 978 MHz, the difference frequency is still at 47 MHz, which is the desired 2nd IF.

In the above description, we have not discussed the fact that both the 1st LO and 2nd LO s are varied by up to 50 KHz from their nominal values. This occurs during fine-tuning of the R-500 series. Both local oscillators are stepped via microprocessor control to allow 10 KHz resolution steps.

IF AMPLIFIER Board

The IF AMP board is at the top of the CCSA. It slides into the top groves of the two side extrusions. The system is visible at the top of the R-500 SERIES when the outside Dust Cover is removed and the top Card Cage Shield is removed.

This board contains a 57.7 MHz local oscillator PLL circuit, 47MHz IF amplifier, wideband (WB) and narrowband (NB) IF filters, 10.7 MHz IF amplifiers, detector circuitry and baseband signal processing systems.

It also contains the 10 MHz Temperature Compensated Crystal Oscillator (TCXO) which is the frequency reference for the entire R-500 series instrument.

The 47 MHz from the output of the RF/LO Subsystem is feed via a coaxial cable and routed to J2 of the IF AMP Board. U4 is a wideband amplifier operating at 47MHz. Its operation can be verified by monitoring the IF TAP, J3. The three-resistor divider around J3 gives 20 dB isolation from the actual signal to the monitored signal at J3.

U3 is the instrument’s Third Mixer. It accepts two inputs: 1) the 47 MHz signal from U4 and a 57.7 MHz 3rd LO signal. The resulting output is the 10.7 MHz 3rd IF. The stable 57.7 MHz LO is generated by a discreet VCO (Q1, D1, L2, etc), the phase lock loop IC (U7), 10 MHz TCXO reference source (U2) and associated circuitry.

Note: The VCO uses an inductive element, L2, housed inside the smallest metal shield on the IF AMP board.

The 57.7 MHz 3rd LO is used to create step sizes smaller than 100KHz. Thus when stepping in 10KHz and 1 KHz steps the 3rd LO controls these tuning increments. For 100KHz and larger steps, the 1st and 2nd LOs located in the RF/LO Subsystem is used.

Major signal processing and decoding functions are performed at the 10.7 MHz IF frequency. A CMOS IC (U5) used as a switch to select the WB or NB IF filters. The IF frequency is then amplified by a series of 10.7 MHz amplifiers. Gains are equalized with GAAS Attenuators (U6 & U10) and then feed into a 16 pin monolithic low power IF system integrated circuit (U14). This IC incorporates two limiting IF amplifiers, a quadrature detector, muting, logarithmic received signal strength indicator (rssi) and voltage regulator sections. The output of this IC is FM audio, and rssi signal. These signals are level shifted and conditioned by a series of operational amplifiers. Audio to the speaker and rssi signal is routed off the board to the Microprocessor Board. Wideband FM audio is provided through U17 at J6-4. A wideband rssi signal is also available from U20 at J6-2.

Note: For the R-507, the rssi signal is dc offset and amplified to exactly track the primary rssi signal (the rssi signal that is routed to the Microprocessor Board.)

The AM detector is created from U11 and U12. Audio is amplified and routed to the speaker via U16.

A digital pot is used to control audio volume via IC. It is controlled from a data stream generated at the front panel.

Microprocessor Board

The Microprocessor Board (MCB) contains a Motorola microprocessor, both EEPROM and EPROM memory, A to D converters, power audio amplifier, I/O circuitry, and the instruments power supply.

The rssi voltage from the IF AMP Board is feed to the A-to-D converter on the under side of the MCB board. There it is digitized and the resulting digital signal is used by the microprocessor.

The microprocessor controls and conditions all inputs and output from the R-500 SERIES. The processor is used extensively to linearize and maintain the instrument’s rigid calibration requirements. It also communicates with the front panel micro-controller and manages serial port commands. It controls and formats all outputs including those for frequency and signal level reading, as well as all output to the RS-232 port.

The instrument’s power supply is partly contained on the MCB board (the remainder of the supply is on the Rear Panel Board.) The power supply is designed to accept a 13.5V to 20V DC input voltage from the external power supply/charger. This voltage is regulated down to 12.0V and feeds the rest of the power supply when the system is operating from the external supply/charger. A trickle current is also created off this external supply/charger through one of two 30 ohm 5 watt resistors charging the NiCad battery pack. The system can also be powered from an internal NiCAD Battery pack or a similar external 2.4AMP/Hour 8.8V NiCAD Battery Pack.

The voltage from the NiCAD pack or the 12.0 V from the external supply/charger is used to create three (3) regulated internal voltages: +5 Volts, +12 Volts and +24 Volts.

Section 4: Performance Verification

Introduction

This section of the Service Manual is designed to allow a user to verify calibration accuracy of an R-500 series. The procedure is complicated and somewhat tedious. It does, however, provide the service engineer with a step by step method to determine accuracy of the instrument for the most important signal level specifications.

Calibration Verification

This section describes how to verify that an R-500 SERIES is operating to acceptable levels and is meeting specifications. To perform the procedures listed below will require the following equipment or it equivalent.

Required Equipment Table	
Power Meter	HP 436A
Power Meter Head:	HP8482A (standard power levels)
Power Meter Head:	HP8481D (low power levels)
RF Synthesizer:	Giga-Tonics (Fluke) 6060B
Digital VOM:	Wavetek DM27XT
Frequency Counter:	Tektronix DC503M
Attenuators:	3 each, HP8491A

Verify Measurement Accuracy

Signal levels will be measured at the frequency and power levels shown in the Table below. Levels are chosen in 10 dB increments and frequencies are generally at 100 MHz spacing.

Verification Table

FREQ	**MEASURED SIGNAL LEVEL READINGS (in dBuV) Specification requires reading within +/- 2.0dB or better**											
	100	90	80	70	60	50	40	30	20	10	0	-10
5												
10												
50												
100												
200												
300												
400												
500												
600												
700												
800												
900												
1000												

Before actually verifying an R-500 series for measurement accuracy, a detailed process must be used to assure the accuracy of the test equipment being used.

The power meter is calibrated for highly accurate power readings and is traceable to NIST. Therefore, the power meter is used throughout this section of the manual as the reference piece of test equipment. It is the standard the R-500 SERIES will be measured against and for which all the other pieces of test equipment must be checked before they are useful in this verification process.

Unfortunately the power meter has a limited dynamic range. Most sensitive meters, with associate power heads, are only capable of reading down to -60dBm (+47dBuV). This situation calls for a boot strapping process to be used to “self-calibrate” several RF Attenuators and the RF Synthesizer which are used in the test procedure. (It is obvious these steps are necessary when one reviews power level accuracy specification for essentially all RF synthesizers and tolerance specs on insertion loss of RF Attenuators.)

Self Calibrating the RF Synthesizer and RF Attenuators:

By using the power meter, RF synthesizer and RF attenuators, all levels at all frequencies on the above chart can be measured and followed back to the power meter’s NIST tractability.

The RF synthesizer output power level accuracy (or inaccuracy) must be determined at each of the frequencies in the table. First recall the relationship between dBuV (the R-500 SERIES displays signal levels in these units) and dBm, which is displayed by the power meter.

Normalization Table

dBm	DBuV
- 7 dBm	+100 dBuV
- 17	+ 90
- 27	+ 80
- 37	+ 70
- 47	+ 60
- 57	+ 50
- 67	+ 40
- 77	+ 30
- 87	+ 20
- 97	+ 10
-107	+ 0
-117 dBm	-10 dBuV

The power meter (with the standard power level Head) will be used to directly read power levels down to -27 dBm (+80 on the LCD display). Connect the power meter head directly to the RF synthesizer at the exact coaxial cable output connector which will be used to screw onto the R-500 SERIES front panel Type -N connector. (This should require a Type-N to Type-N female barrel adapter.) Determine and record in a correction table, the synthesizer’s power output settings which produce exact power levels of -7, -17, and -27 dBm (+100, +90 and +80 dBuV). Do this for all frequencies in the above Table. When finished with this process, the engineer will have generated a “Correction Table” which will look something like this.

Correction Table #1

	100	90	80	70	60	50	40	30	20	10	0	-10
5 MHz	-7.0	-17.1	-27.0									
10	-6.9	-16.9	26.8									

Correction Table #1

50	-7.0	-17.0	-27.0									
100	-7.1	-17.2	-27.1									
200	-7.0	-17.1	-27.0									
300	-6.8	-16.7	-26.8									
400	-6.9	-16.8	-27.0									
500	-7.0	-17.1	-27.1									
600	-6.7	-16.8	-26.7									
700	-6.7	-16.6	-26.7									
800	-6.8	-16.7	-26.8									
900	-6.6	-16.7	-26.5									
1000MHz	-6.6	-16.5	-26.5									

Next remove the standard power level Head from the power meter and connect the low power level Head. This will change the measurement range of the power meter to -20 to -60 dBm. (Note: Each time the Head is changed from standard to low Head or visa versa, the power meter must be recalibrated. See the power meter's manual for instructions.) We will use the power meter in this configuration to directly read power levels from -37 dBm (+70 on the LCD display) down to -57dBm (+50 on the LCD display). Connect the power meter head directly to the RF synthesizer at the exact coaxial cable output connector which will be used to screw onto the R-500 SERIES front panel Type -N connector. (This should require a Type-N to Type-N female barrel adapter.) Determine and record in a correction table, the synthesizer's power output settings to produce exact power levels of -37, -47, and -57 dBm (+ 70, +60 and +50 dBuV). Do this for all frequencies in the above Table. When finished with this process, the engineer will have generated a "Correction Table" which will look something like this.

Correction Table #2

	100	**90**	**80**	**70**	**60**	**50**	**40**	**30**	**20**	**10**	**0**	**-10**
5 MHz	-7.0	-17.1	-27.0	-37.0	-47.0	-56.9						
10	-6.9	-16.9	-26.8	-37.1	-47.0	-57.1						
50	-7.0	-17.0	-27.0	-37.0	-47.2	-57.0						
100	-7.1	-17.2	-27.1	-37.0	-47.1	-57.0						
200	-7.0	-17.1	-27.0	-37.0	-47.0	-57.1						
300	-6.8	-16.7	-26.8	-37.0	-47.0	-57.0						
400	-6.9	-16.8	-27.0	-37.0	-47.0	-57.1						
500	-7.0	-17.1	-27.1	-36.9	-47.0	-57.1						
600	-6.7	-16.8	-26.7	-37.0	-47.0	-57.2						
700	-6.7	-16.6	-26.7	-37.2	-47.0	-57.1						
800	-6.8	-16.7	-26.8	-37.3	-47.2	56.9						
900	-6.6	-16.7	-26.5	-37.5	-47.1	-57.0						
1000MHz	-6.6	-16.5	-26.5	-37.4	-47.3	-57.3						

Next use the RF synthesizer and the power meter (with low level Head) to determine exact insertion losses for each 20dB pad at each of the above frequencies. This process must be done at levels high enough for the power meter to accurately measure a signal after it has passed through one 20 dB attenuator. Set the synthesizer to -25 dBm. For each frequency, measure the synthesizer power output level with the power meter. Next, for each frequency, determine the meter power reading when the 20 dB pad is inserted between the synthesizer's output and the power meters input. Generate a unique Insertion Table for each of the three (3) 20 dB RF Attenuators used. See example below.

20 dB Pad Insertion Table

Freq.	Reading	Correction #
5 MHz	-20.0	0 dB

20 dB Pad Insertion Table		
10	-20.0	0
50	-20.0	0
100	-20.0	0
200	-20.0	0
300	-20.1	-0.1
400	-20.0	0
500	-20.0	0
600	-19.9	+0.1
700	-19.9	+0.1
800	-19.8	+0.2
900	-19,8	+0.2
1000MHz	-19.8	DB

Accurate signal levels can now be generated at +40dBuV, and +30 dBuV. This is done by attaching one (1) 20dB pad to the output of the synthesizer. Set the RF synthesizer to one frequency in the table and use the precise level settings recorded in the "Correction Table" (at that frequency) for power meter readings of +60 and +50 dBuV. Use the same cables and connectors for the output of the combined synthesizer + attenuator as was used previously.

the signal levels generated by this set up must be as accurate as possible. Thus, the RF synthesizer signal output level must be modified by the inaccuracy of the 20 dB pad used, as shown in the Insertion Table. For example at 1000 MHz, the RF Synthesizer output level must be set to -46.7 dBm to create a +60 dBuV signal. With the 20dB Attenuator of the above Insertion Table, the synthesizer output level must be reset to -46.9 dBm (-46.7 + 0.2) to generate the required accurate +60 dBuV signal needed to test the R-500 series at the +70dBuV level at 1000MHz.

Using this specific 20dB pad and the process just described, the engineer can fill in values at all frequencies in the Correction Table, that the RF synthesizer power output must be set to in order to generate accurate signal levels for +40 and +30 dBuV signals.

By using this procedure and employing up to three (3) 20 dB Attenuators in series, accurate and traceable signal levels at all frequencies and at all power levels can be determined and entered into the Calibration Table, completing the table. (Note: The -10dBuV level has a typical specification and can be measured without the rigor used in this process.)

This process is cumbersome but, given the equipment called out, it is the only way to guarantee signals being used, at all power levels, are NIST traceable and accurate enough for checking the R-500 series to its specifications.

Collecting Calibration Data

It is now a simple matter to verify calibration of the R-500 series under test. The technician utilizes the Correction Table set up values as a guide for setting the RF Synthesizer power levels and for attaching various RF 20 dB Attenuators, as needed, to generate all the signal levels required for the R-500 SERIES. The signal source is attached to the Type -N connector input of the R-500 SERIES - the same coaxial cable and connectors are used as before. The instrument is tuned to the appropriate frequency and measures are recorded in the Measured Signal Level Table shown above. A Chart can be generated for the R-500 SERIES with the BANDWIDTH in the WB (wideband) mode and a second chart generated for the NB (narrowband) mode. For each filter the specification is +/- 2.0dB or better.

For signal levels down to +10 dBuV be sure the front panel controlled RF AMP is turned OFF. For measurements at +10 and 0dBuV the RF AMP is to be turned ON.

When this process is complete, the engineer has verified signal level measurement accuracy for the R-500 SERIES at 25 degrees C. If desired, the ambient temperature may be lower to +15 degrees C and the above procedures repeated. Likewise the high end temperature specification of +35 degree C can be tested in similar manner.

Fine Step Resolution Verification

Use the RF synthesizer to generate a signal at 100 MHz and a power level of -7dBm. While monitoring the power level with the power meter (standard level Head), reduce the signal level in 1.0 dB increments down to -27dBm. Verify that the 1.0 dB steps are actually correct and accurate to within 0.1 dB.

Next, connect the RF synthesizer directly to the input of the R-500 SERIES. Tune the instrument's frequency to 100.00 MHz. Again vary the RF synthesizer power level from -7 dBm to -27 dBm in 1.0 dB steps and verify that the R-500 SERIES steps in uniform and accurate steps from +100 to +80 dBuV. The specification is requires accuracy to within +/- 2dB.

When the above procedures are followed and acceptable accuracy is verified, the R-500 SERIES under test is meeting the specifications for signal level measurement accuracy called out in the manual.

Section 5: Trouble Shooting

Introduction

The following discussion is designed to allow a repair engineer to determine if an instrument is working properly. If there is a problem, the procedure helps to identify what subsystem or board is not working. In some cases, this manual details repair procedures for use in the field by the engineer. In other cases, it helps the engineer to quickly determine which part within an R-500 SERIES has failed. This part (i.e. subsystem, board, and component) can then be returned to a service facility for rapid repair and return.

Interrelationships

It is important to remember that each R-500 SERIES has a unique set of calibration data stored on the MCU Board. The calibration data is in the form of a “look up” table (discussed above) and stored in EEPROM. A specific correction table is valid for one and only one set of three boards. These critical boards include the: MCU Board, RF/LO Subsystem and IF Board. These boards & subsystems must be operated together to maintain valid calibration. During any recalibration process, the same three boards must stay together for a successful recal. The boards are all located within the same internal Card Cage subassembly (CCSA). This CCSA is mounted via 6 screws onto the instrument chassis. If it becomes necessary to send any of these boards back to the factory, all boards must be sent back together. A fourth board is located in the CCSA. It is the RF Amplifier. It is the board located at the very bottom of the card cage. This board may be replaced separately.

Equipment

The following laboratory test equipment may be needed when doing R-500 SERIES troubleshooting and repair.

Required Equipment Table	
RF Synthesizer:	Giga Tronics 6060B
Digital Multimeter:	
Frequency Counter:	Upper frequency limit at least 100 MHz
External Power Supply:	+5V, +12V and -5 Vdc
Spectrum Analyzer:	Range up to 2.2 GHz
Various SMB to BNC adapters	
Various Tweaking tools, soldering irons, pliers, cutter, etc.	
IBM type PC with Serial Comm port and DOS	

Checking Power Supply/Charger

Insert the R-500 SERIES wall power supply/charger into 120Vac for supply PU-1 or 230 Vac for supply PU-2. The output voltage of the secondary side of the supply should be approximately +20 Vdc when measured with no load. Note: The inner contact of this plug is the positive voltage and the outer (exposed) contact is negative. Under a full load of 900 ma., the voltage will reduce, but should not sag below +14 Vdc. Test the supply voltage at full load by connecting a 15 ohm 20 Watt resistor across the secondary side of the supply.

Checking DC Voltage in the R-500 SERIES

Be sure the Power Supply/Charger is plugged into the "Power Input" plug on the back of the instrument. Turn the R-500 SERIES ON, wait 2 seconds or until the power up process is complete. Push the FUNC button. The front panel LCD's will display “FI”. When the Tune knob is pushed, the display now indicates internal DC voltage within the R-500 SERIES. This voltage reading is across the internal Battery Pack. It will not be the same readings as was registered directly across the external supply/charger secondary. This voltage should be approximately 11.0 with the external supply is connected.

Remove the external supply. The voltage reading will drop to approximately 9 Vdc. Typical voltages are from 8.8 to 9.8 V.

If the unit does not have these readings, the supply or battery pack may be defective.

The R-500 SERIES has been designed with an optional battery disconnect feature. In this mode, the unit will power up and operate as usual only with an external power supply connected but will not respond (i.e. will not turn ON or remain ON) when the external supply is removed. This feature allows users to operate an R-500 SERIES from the wall power supply only. Thus an operator using this mode can removal ac power to the external supply and deactivate the R-500 SERIES.

This optional battery disconnect feature is active when the rear panel Accessory Socket has pin 5 directly connected to pin 7. See a later section of this manual for a pin location diagram.

A “System Reset” feature is also provided to allow the user to temporarily disconnect the internal DC power source from powering the instrument. To Reset the instrument, use a pointed object (such as a ballpoint pen) and activate the System Reset button through the small whole provided in the rear panel.

Verifying Front Panel Operation

Turn the R-500 SERIES power OFF using the PWR Button. Wait three seconds and again turn the instrument ON. If three rapid beeps are heard through the speaker, the instrument is no longer calibrated. The internal microprocessor has detected an error during the power UP process. The processor performs a Checksum calculation to verify stored data in memory is not corrupted. When the Checksum process reveals an unauthorized change in stored data, the instrument beeps three times and defaults into an uncalibrated state.

Usually this occurs when one or more of the stored calibration tables within memory has been corrupted. In some cases this can be remedied in the field. At other times, the instrument must be returned to a service center or the factory for recalibration. See the section below for more details.

Check LCD Backlighting

Be sure the Power Supply/Charger is plugged into the "Power Input" plug on the back of the instrument. With the power turned on, some of the LCD segments should show alphanumerical readings. The LCD back light will be on. Push the PWR Button and hold it for at least 2 seconds. This will cause the LCD display back light to toggle OFF. The backlight can be turned on again by pushing and holding the PWR Button for two seconds. When batteries are powering the instrument, the Instrument will turn on with the backlight in the off state. Pushing and holding the PWR Button will toggle the backlight ON.

Check the TUNE Knob for its multipurpose uses. The primary use is as a detent rotational tuning device.

The TUNE Knob also has an integrated push button. Each push of the knob will create a beep and cause the active LCD digit under control to change. The active digit will be underlined with a dash.

When the above feature/functions are working properly, the instrument can be tested further as outlined in this section.

Checking Signal Level Readings

This procedure should be used when the operator finds the R-500 SERIES is not responding to a known strong signal at a known frequency. The process outlined uses a stable RF synthesizer to generator a specific, known signal level at a frequency within the measurement range of the R-500 SERIES.

1. Connect a signal generator to the R-500 SERIES Type-N input connector on the front panel. Set the frequency of both the RF synthesizer and the R-500 SERIES to the same frequency. Select 100.000 MHz and set the power level of the generator to -57dBm. Set the R-500 SERIES front panel for RF AMP: OFF and BANDWIDTH: WB. A signal reading on the front panel LCD displays should read +50dBuV.
2. Push the front panel RF AMP button to ON. In this mode the LCD display should continue to read +50dBuV.
3. Select narrowband (BANDWIDTH: NB) from the front panel. The LCD display should read +50dBuV. Push the TUNE knob until the 1KHz digit of the LCD frequency display is underlined. Rotate the TUNE knob to adjust the frequency up by +10 KHz (100.010 MHz) and then down by -10 KHz (99.990 KHz), the LCD power display should peak at 100.000 MHz and be reduced as the read out approaches +10 KHz and - 10 KHz offsets. The amount of actual signal level drop off will depend on the Narrowband IF filter option within your R-500 SERIES.

Note: When checking the narrowband response, be sure the RF synthesizer is set for exactly the same frequency as is the R-500 SERIES. Check that the frequency of the field strength meter is set correctly.

If during any of these tests, the R-500 SERIES does not operate correctly, then proceed through the next sections of this manual.

Tracing the Signal Path

Remove the dust covers of the instruments. Removing six (6) screws on the bottom of the instrument does this. Set the RF AMP front panel button for RF AMP OFF.

With the TUNE knob, set the received frequency to 100.000 MHz. Connect the RF synthesizer to the instruments Front Panel RF input. Set the generator's output frequency to 100.000 MHz and the power level to -27dBm (this is +80dBuV as displayed in the large LCD display area).

Conversion Table		
dBm	dBuV	UVolts @ 50ohms
- 7 dBm	+100 dBuV	100 mVolts
- 27	+ 80	10 mVolts
- 47	+ 60	1 mVolt
- 67	+ 40	100 uVolts
- 87	+ 20	10 uVolts
-107	+ 0	1 uVolt
-117 dBm	- 10 dBuV	0.32 uVolts

Within the instrument just behind the front panel, break the RF signal path just after the RF AMP Board. This is done by unplugging the SMB coaxial cable (use a pair of needle nose pliers to carefully slide apart the mini-coaxial connector) which is behind the front panel and that plugs into the lower-front-left-side of the U shaped extrusion module. Using adapters and/or cables as needed, connect the loose cable to the spectrum analyzer. Look for a 100.000 MHz signal of approximately -27dBm. From the front panel, turn the RF AMP ON. Note: the signal should increase by approximately 20 dB.

Move the RF synthesizer frequency to various different frequencies in the 5 MHz to 1000 MHz band. Follow these frequency changes with the R-500 SERIES TUNE Knob. Continue to monitor the same point within the instrument. Check to see that with the RF AMP OFF there is approximately 0 dB of Gain through this part of the instrument. Turn the RF AMP ON and look for 20 dB of gain across the entire frequency range.

If the RF signals are not as indicated above the RF AMP Board is in need of repair (see instructions later in this manual).

Set the RF synthesizer to a frequency of 110.000 MHz and a power level of -27dBm. Reconnect the SMB coaxial cable back to its mating connector on the U shaped black extrusion.

Check to be sure the TUNE Knob is set to the received frequency of 110.000 MHz. The U shaped extrusion has a protective cover over that unsnaps from both sides of the extrusion itself. Remove this protective cover. The top board now most visible in the instrument is the IF AMP Board. Locate the coaxial cable coming from the back of the R-500 SERIES, up over the IF AMP Board and plugging into J2 on this board. J2 is at the mid-way along one side of the board half-way between the front and rear panels. This cable connects to a receptacle next to a small metal shielding box on this top board. Disconnect this cable (it slides apart) at the metal box and look at the signal on the coaxial cable with a spectrum analyzer. The 2nd IF frequency which is 47.00 MHz should be present at this point. Its should be stable and have approximately 0 to 10 dB more power level than the RF input power to the front panel (this assumes the RF AMP is turned OFF).

On this same coaxial cable at reduced levels, look for the 1st LO signal at 1150 MHz and the 2nd LO signal at 1087 MHz. These signals should be present and stable.

Change the TUNE frequency to be 100.000 MHz. Set the signal generator frequency to 100.000 MHz. Again the 2nd IF frequency will be found at 47.00 MHz and should be stable.

On this same coaxial cable at reduced levels look for the 1st LO signal at 1125 MHz and the 2nd LO signal at 978 MHz. This signal must be present and stable.

If these signals are not as indicated above the RF/LO Subsystem is defective and must be repaired (see instructions concerning the CCSA module).

Reconnect the coaxial cable to the IF AMP. Below is a Table showing typical power levels that should be found as a signal is traced through the instrument and onto the IF AMP Board.

Conditions of the test are as follow: Connect the input generator to the instrument Front Panel at the RF Input Type-N connector. Set the synthesizer for a -57dBm output level with at a frequency of 100.000 MHz. Push the front panel FUNCTION Button once placing the instrument in the Function Mode. The LCD display will then read "F1". Rotate the TUNE Knob so "F15" shows on the LCD's. Push the TUNE Knob once and rotate the knob until the LCD reads "ATN 0". Finally push the FUNCTION Button.

This process sets up the instrument with the internal RF 20 dB attenuators "locked" in the attenuators out position -- the most sensitive set up condition for the instrument. Set the frequency of the R-500 SERIES instrument to 100.000 MHz. Be sure the R-500 SERIES is set in WB mode and the RF AMP in turned off.

Using the spectrum analyzer and the following Table an engineer can trace the signal and measure typical IF levels and DC voltage levels normally found in the instrument.

Signal Level Table #1

Point under Test	Conditions	Normal Level/Reading	Comments
Coax connected to J2 on the IF AMP Board. (See above)	Signal at 47 MHz	-52 dBm +/- 10 dB	
J3 on IF AMP Board	Signal at 47MHz	-44dBm	J3 may not have a connector mounted
J1 on IF AMP Board	Signal at 10.7MHz	-20dBm	
TP3 on IF AMP Board	Signal at 10.7MHz	-20dBm	use a 10X scope probe with a spectrum analyzer
The following Measurements are made with the input RF signal to -77dBm			
U15 Pin 8&9 on IF Bd.	Measure DC Volts	~ 2.5 Volts	Use a Volt meter
U15 Pin 1 on IF Bd.	Measure DC Volts	~ 3.5 Volts	Use a Volt meter
The following Measurements are Made with the input RF signal turned off			
U15 Pin 8&9 on IF Bd.	Measure DC Volts	~ 1.5 Volts	Use a Volt meter
U15 Pin 1 on IF Bd.	Measure DC Volts	~ 1.3 Volts	Use a Volt meter

With the signal path reconnected for normal operation (RF AMP off & in WB mode), the LCD displays should read power levels as described above and repeated here:

Signal Level Table #2

RF Input Power	Expected LCD Reading
-57 dBm	+50 dBuV
-77 dBm	+30 dBuV
No input	+10 dBuV

If these signal readings are not as described above, the IF AMP Board is defective and must be repaired.

The 3rd LO can be tested by making a short pick up “antenna” out of a 4 inch piece of insulated wire soldered to the center pin of a BNC female panel receptacle. Use this as a probe to lightly couple into the 57.7 MHz 3rd LO.

This signal can be seen on a spectrum analyzer placed in high sensitivity mode. Hold the probe close to the top board in the instrument. The 57.7 MHz is generated here and can be picked up near C26 or L4 on the IF Amp Board. It should be present and stable when viewed in this manner. (The signal strength is not of importance).

Check the voltage at C22 (TP9) which is next to the small metal shield box on the board. This test point measures the control voltage of the 57.7 MHz voltage controlled oscillator (VCO). The voltage can vary from 0.1 to 5.0 volts and the PLL oscillator will remain locked. A typical setting for this voltage is between 1.5 to 3.5 Volts. The voltage will vary approximately 500 mvolts when the TUNE Knob is adjusting in 10KHz steps across any frequency range ending in 10KHz to 90KHz (such as, 100.010 to 100.090MHz). This indicates the VCO is locked and responding to the phase lock loop control.

If these signals or the voltages are not as described above, the IF AMP Board is defective and must be repaired.

Section 6: Adjustment Procedure

IF Amplifier

VCO Voltage Adjustment

If it is determined that the 3rd LO (57.7 MHz LO) of the R-500 SERIES is not locked properly at all times, use this procedure.

This procedure centers the VCO voltage which controls the 3rd LO of 57.7 MHz. Using a Digital Multimeter, monitor test point TP9 (at C22). This test point may not be on some boards. In this case, measure the voltage on C22. (One side of C22 is ground.)

This voltage can be adjusted by tweaking variable capacitor C27 which is close to metal can on the IF AMP Board. Carefully adjust C27 with a non-conductive tweaking tool. Set this voltage to approximately 2.5 volts. The voltage reading will vary during power transients but should stabilize quickly.

Continue to monitor TP9 (C22) while turning the front panel TUNE Knob to make the LCD frequency readout cover any range from 10 KHz to 90 KHz (such as: 100.010 MHz to 100.090MHz). The monitored voltage will move up and down over a range of approximately 500mvolts while exercising this knob.

This completes the Procedure. The instrument will now have FREQ OFFSET steps of 1 KHz with a total offset of at least +10 KHz and -10 KHz.

LCD Display

Contrast Adjustment

The Front panel LCD display contrast adjustment is located on the LCD Display controller circuit board. The adjustment is R7, the only adjustment on this board. To access this board, remove the dust cover from the R-500 series instrument. The LCD Display Controller board is located and accessable just behind the front panel. The adjustment is made by with the instrument turned on and adjusted for best contrast while observing the front panel LCD display.

Section 7: Maintenance

Skills and Training

The R-500 series instruments are complex pieces of test equipment. Advanced electronic engineering or technician skills and training are highly recommended for personnel attempting to understand and use this manual to repair and verify calibration of a R-506 or R-507.

Safety and Handling

Proper safety procedures and extreme care must be taken while using the products and the laboratory test equipment described in this manual. Hazardous electric shock can be received from improper use of the equipment. Shock or injury is also possible when using tools, soldering irons, etc. required in working on the R-500 series of products.

Special work place set up and handling procedures are required to prevent static electricity from damaging sensitive components such as ICs, Transistors, etc. Be sure all people, tools and work areas are properly grounded using static grounding methods.

Repair Strategy

Service and repair strategy for the R-500 series is based on a combination of component level repair of some circuitry while other sections are serviced by identifying defective subsystems and sending these subsystems back to a service center or the factory for rapid repair and return.

In either case, on-site repair and service center return, the service engineer will be taken through the following steps.

1. Verify that the instrument is actually in need of repair. This involves testing for instrument calibration. This is a step by step procedures outlined in this manual. If a problem is found, it is quantified and verified using equipment such as laboratory RF synthesizers, spectrum analyzers, power meters, and Digital Multimeters.
2. Trouble shooting to the subsystem level. This can be done by the customer's service technician or at a near-by-authorized service center.
3. Follow detailed removal procedures of any component, subsystem or module that is defective. This may include any item(s) on the Return and Repair list (shown below). The defective item is shipped to the factory or a service center for repair.
4. When the component or subsystem is repaired, it is returned to the customer. The customer carefully follows "installation" procedures by reversing the removal steps in this manual.

Note: The R-500 series front panel FUNCtion control is also used to verify certain problems and in some cases, the FUNC control is used to reinitialize the instrument effectively eliminating some specific malfunctions. Adjusting firmware data stored in the instrument's EEPROM does this. A section of the manual covers this procedure.

The repair and service strategy for the R-500 series has been carefully designed. All points are important and should be reviewed:

a) A qualified and capable electronic technician or engineer must do the service and repair procedures. Such a technician will be able to perform all tasks required in the Service Manual.

b) In some cases, a subsystem must be repaired as a complete item. That is, parts within a subsystem cannot be exchanged without destroying the instrument's calibration. When the repairs are done according to the Service Manual, the R-500 series will continue to be within calibrated performance level assuming it was calibrated before the instrument breakdown.

c) Some customers prefer to stock service-level subsystems and components. Z Technology provides for this possibility by allowing an owner of an instrument to purchased subsystems and components. Z Technology publishes such a list.

Replacement Instructions

This section, addresses each board and subsystem separately. When field repairs are possible, this section describes the process. If it is necessary to return a subsystem to the factory, a procedure is detailed for removal of the part.

Card Cage Sub-Assembly (CCSA)

The U Shaped extrusion enclosure (CCSA) contains four boards. These three (3) boards or subsystems must be kept together when calibrated.

They include:

The RF/LO Subsystem
The Microprocessor Board
The IF AMP Board

The IF AMP Board is described in the section on the IF AMP Board. Even with this description, in order to assure absolute calibration, the IF AMP Board must be replaced as part of the 3-board set within the CCSA.

If it is determined that the CCSA is in need of repair, it can be removed from the instrument and returned to the factory for repair and/or calibration.

Removal and Repair

If it has been determined that the CCSA is not working properly use this procedure to remove the system.

Removing the instrument dust cover by unscrewing the 6 screws on the bottom of the instrument. The Front Panel Assembly is removed by removal of 5 screws These are located as follows: three (3) screws on the bottom of the instrument and one (1) screw from either side of the front panel. Carefully pull the F. Panel Assembly away from the rest of the instrument. Disconnect the coaxial cable to the backside of the RF Input connector. Unplug the three (3) cable assemblies also connected to the Front. Panel Assembly while carefully observing the orientation of these cables. They must be orientated the same way when replaced.

Now disconnect the front supporting plate of the CCSA from the chassis. Three (3) screws hold this plate to the instrument chassis. Remove these 3 screws.

If the CCSA is to be sent back for repair with the RF AMP Board included, disregard this paragraph and move to the next paragraph. To remove or replace the RF AMP Board, remove the front metal cover on the CCSA. Next remove the four (4) screws holding this plate to the CCSA itself. As this plate is removed a rubber bumper, may be found glued to the inside of this plate. Remove the bottom board within the extrusion enclosure. It is the RF AMP Board. It is removed by pulling it forward and out. It has two coaxial cables and one 10-pin cable assembly attached. Note the location and orientation for each cable and connector. The board can be replaced or returned for repair and then reinstalled. When reinstalling the board, reverse the above steps and carefully replace the board back into the instrument.

If the CCSA is to be returned as a unit for repair, it must have the front metal plate on the assembly. If you have removed this plate (as described above), replace it with the appropriate 4 screws. Do no reattach the CCSA to the chassis.

To completely remove the CCSA from the chassis, remove the 3 remaining screws. They connect to the rear metal extrusion assembly plate to the chassis.

The CCSA will be loosely sitting within the instrument. It has several cables which must be removed before is can be withdrawn. From the rear of the module and front panel assembly unplug all these cables while keeping track of how they should be replaced during assembly.

The CCSA is now totally disconnected from the rest of the instrument and can be slid back and out of the unit.

Service of the CCSA

There are several areas on the various systems and boards within the CCSA that may be checked and/or repaired in the field. These include:

Cable and connector continuity
Frequency accuracy of the 1st LO and 2nd LO oscillators
Mechanical integrity

To expose any of the systems or boards inside the CCSA, remove the front metal cover by removing the appropriate four (4) screws. The three (3) board/system set can now be slid out of the CCSA. As this is done, take care to notice which slots the various board edges mate into. These same slots must be used when re-assembling the CCSA. The entire set of boards is now completely separated from the CCSA and the instrument.

Disconnect the two coaxial cables from the IF AMP Board (the top most board) and remember where they originally connect so as to correctly attached them during assembly. Locate the 6-wire black connector that plugs through a slot in the side of the IF AMP Board and onto the board just below this one. This black plug has a latching mechanism on one side that must be released before it can be unplugged. Unplug this black connector. Disconnect the 15 pin FFC (Flat Flexible Cable) from and the 10 pin Molex type cables from the back of the IF AMP Board. Note the 15 pin FFC inserts into a white zero insertion force connector. To remove the FFC, first slide back the outer shell of the white connector. The IF AMP Board can now be remove from and handled separately. See an above description of trouble shooting and testing procedures for the IF AMP Board.

The lower two boards in the CCSA are the Microprocessor Board and the 1st & 2nd LO Subsystem. These two systems are connected together through two separate 15 pin FFCs. Each of these cables attaches to boards through zero insertion force connectors. These connectors must be snapped open in order to release the FFC and allow it to be removed (or reinserted). During assembly, be sure these cables are fully seated in the connectors and that each connector housing is snapped shut.

When reassembling the CCSA, reverse the above steps. Especially be careful in the following areas. The 15 pin FFC attaches to the white is a zero insertion force connector. During assembly, this cable must be completely pushed into the zero insertion force sockets and the external latch section slide back into place. If this is not done correctly, intermittent operation of the R-500 SERIES will occur.

During the final steps of assembly, be careful when sliding the boards back into the CCSA that these FFCs are not jarred, pinched or disconnected.

Replacement of the CCSA

The CCSA module can be replaced or returned for repair and then reinstalled. When reinstalling the module reverse the above steps. Note, the service manual does not provide details on field repairs for this module nor on all the boards inside the module. This is due to the fact that, repairing the module in many cases will create the need to recalibrate the entire module or the entire instrument. Recalibration is beyond the scope of this manual and should not be attempted by the customer in the field.

Rear Panel Assembly

The Rear Panel Assembly contains the Rear Panel Board and Chassis (The instrument rear panel is part of the Chassis).

Rear Panel Board

The rear panel board is separated from the rest of the instrument by removing three (3)-mounting- screws and the DB-9 connector(s). (Note: the *R-506* has only one DB-9 connector while the R-507 utilizes two such connectors.) Two of the mounting screws are on the rear panel and the third is on the instrument's side panel.

Accessory Connector

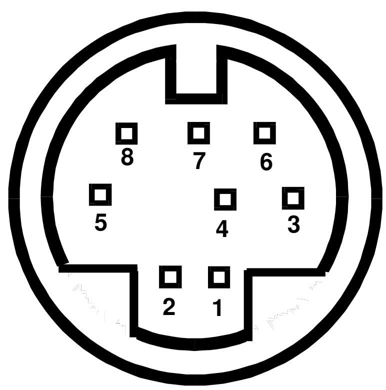
There are several connectors on the rear panel board. The largest connector protruding through the rear panel is the Accessory Connector. This connector is round in shape with 8 pins provided for in the connector. The pin assignments are as follows:

Accessory Pin-Out Table	
External 8 Ohm speaker	Pin 1 & Pin 2
External + 8.8VDC at <50 ma. Accessory power	Pin 3

Accessory Pin-Out Table	
Ground	Pin 4
Pins 5 and 7	When connected together, causes the instrument to power up and operate only when the external power supply/charger is connected to the R-500 SERIES
Pins 6 and 8	Not connected

With pins 5 and 7 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. **Note**: In some



unusual situations, the Battery Pack may become discharged beyond its normal lower limit. This may happen if the Auto Power Down Function (F5) is disabled.

In this case, during the period before the battery pack is entirely discharged, the R-500 SERIES may continue to show numerical readings on the LCD displays but become unresponsive to any front panel command. In this case, place a jumper between pins 5 and 7. This action internally disconnects the battery from the internal circuitry. When the two pins are jumpered together, the instrument will come out of it unresponsive state and power down.

Plug in the external supply/charger and the R-500 SERIES will automatically power up. The unit may be operated in this mode and the battery will be trickled charged while the unit is ON. The other option is to turn the power OFF and leave the charger in place for 12 hours. The battery will be fully recharged over the 12-hour period. (Remember removing the jumper will allow the unit to operate from the recharged Battery Pack.)

System Reset

A System Reset recessed button is located on the instrument's rear panel. It provides an alternate method of resetting the instrument other than shorting pins 5 & 7 on the Accessory

Connector. When the System Reset button is pushed by using a thin pointed object to push this button, the instrument is reset. It is ready for use immediately upon release of this button.

Power Input

This is a coaxial plug used to connect an external 15VDC at 900mamp power supply/charger to the instrument. The center pin of this connector is positive (+) while the outside connector ring is negative (-).

Ext. Batt. Input

This is a coaxial plug used to connect an external NiCAD battery pack to the instrument. The center pin of this connector is positive (+) while the outside connector ring is negative (-). The user can purchase separately from Z Technology additional battery packs for use. With the Power Supply/ Charger (described above) connected, both the internal and the External Battery can be recharged. in 12 hours.

DB-9 Connectors

The lower DB-9 connector is labeled Port 1. It is the RS-232 serial control port for the instrument. See the schematics for connection details.

The other DB-9 connector (is installed) is not used during operation. It may be installed for use in future applications.

Front Panel

Remove the instrument dust cover by unscrewing the 6 screws on the bottom of the instrument. The Front Panel Assembly is removed by removal of 5 screws These are located as follows: three (3) screws on the bottom of the instrument and one (1) screw from either side of the front panel. Carefully pull the F. Panel Assembly away from the rest of the instrument. Disconnect the coaxial cable to the backside of the RF Input connector. Unplug the five (5) cable assemblies also connected to the Front. Panel Assembly while carefully observing the orientation of these cables. They must be orientated the same way when replaced. Details of these five cables are as follows:

1. A coaxial cable connects to the backside of the front panel Type-N input connector via a MCX coax plug. This coax cable feeds signal from the RF front panel input to the input of the RF AMP board.
2. A five (5) pin wire cable attaches to a small board on the front panel containing the shaft encoder used as the TUNE Knob. This cable connects onto the Microprocessor board and black housings used to plug onto the shaft encoder board.
3. A 10 pin flat Molex type cable connects the front panel LCD Display Controller Board to the RF AMP Board. This cable provides +12V and +5V power to the RF AMP Board. It also carries control signals to the bandpass switching circuitry on the RF AMP Board.
4. A 15-conductor FFC cable connects between the front panel LCD Display Controller Board to the Microprocessor board. This cable carries all the signals between the microprocessor the LCD driver system.

5. A 10 pin Molex type wire cable plugs into the LCD Display Controller Board and connects to the rear on the IF AMP Board to provide control signals to the 2nd LO phase lock loop and also provide power supply connections.

The front panel assembly is composed of four (4) separate boards: The LCD Display, LCD Display Controller, the Front Panel Switch Board and the Shaft Encoder Support Board.

The longest board containing the front panel buttons is the Front Panel Switch Board. This board is held to the front panel with spacers and six #2 nuts.

A second board, the LCD Display Controller Board is attached to the Front Panel Switch Board with plastic stand-offs. These stand-offs snap into relief holes when properly aligned.

The final front panel board is the Shaft Encoder Board. This board is mounted onto the digital shaft encoder that is used for the front panel TUNE KNOB. This knob and board assembly is removed by first removing the larger knob from the units 1/8 inch shaft. Next remove the nut which frees the Shaft Encoder Board and the entire Assembly.

Battery Pack

The battery pack is attached to the chassis. It is held in a metal container with spring tension tab holding on the top of this container. It is removed and replaced by releasing the tension on both ends and pulling up the metal battery cover.

Carefully disconnect the two (2) wire power connector which attaches the Battery Pack to the rear panel board. When reinstalling the Battery Pack or a new battery, be careful to reconnect the white power connector correctly. It may be possible to invert the plug and cause damage to the R-500 SERIES.

IF Amplifier Board

The IF System consists of the top board as seen from above the instrument looking down. The IF AMP Board cannot be replaced separately. It must be replaced along with the IF AMP Board, RF/LO Subsystem and Microprocessor Board as one set. See the discussion about the Card Cage Sub-Assembly (CCSA) module below.

Location of the IF AMP Board

Remove the outside dust cover of the R-500 Series instrument (6 screws on the bottom of the instrument secure the dust cover). Remove the shield or cover that is snapped onto the top of the CCSA module. Locate IF AMP Board at the very top of this subsystem.

Removal of the IF AMP Board

If it has been determined that the IF AMP Board is not working properly and that the PLL board within this system is at fault, use this procedure to remove the board.

The IF AMP Board is located at the top of the R-500 SERIES and is visible when the dust cover and CCSA cover are removed. Parts of this system may be repaired in the field without effecting overall instrument calibration.

For access to this board, remove the Front Panel Assembly and the front supporting plate of the CCSA.

The Front Panel Assembly is removed by removal of 5 screws These are located as follows: three (3) screws on the bottom of the instrument and one (1) screw from either side of the front panel. Carefully pull F. Panel Assembly away from the rest of the instrument. Disconnect the coaxial cable to the backside of the RF Input connector. Unplug the three (3) cable assemblies also connected to the F. Panel Assembly while carefully observing the orientation of these cables. They must be orientated the same way when replaced.

Now remove the front supporting plate of the CCSA. Three (3) screws hold this plate to the instrument chassis. Remove these 3 screws. Next remove the four (4) screws holding this plate to the CCSA itself. As the CCSA is removed a rubber bumper, may be found glued to the inside of this plate.

To remove or replace the IF AMP Board, disconnect from J2 the coaxial cable from the lower board in the CCSA. Remove the 15 pin flat flexible cable (15 pin FFC) from P1 on the backside of the board (the white flat connector is a zero insertion force connector). Remove the 10-conductor cable from J11 also at the backside of the board. Now the IF AMP Board will slide forward and out of the CCSA enclosure.

The board can be replaced or returned for repair and then reinstalled. When reinstalling the board, reverse the above steps and carefully replace the PLL Board back into the instrument.

[Note: The instrument's white flat connectors must have the 15pin FFC inserted in it correctly. The correct way is with the bare connector side of the flat cable facing up or away from the board as the cable is inserted into the flat connector. If the 15 pin FFC is inverted in the white connector, no actual connections are made even when the slide section is pushed back into place. When this process is reversed during re-installation, remember to slide the outside part of each connector back into place to firmly make the cable contacts.]

RF AMP Board

The RF AMP Board is located at the bottom of CCSA and can be seen when after removing the Front Panel Assembly and front support plate as described above.

This section describes actual replacement of the board for service and or return for repair.

RF AMP Board Removal and Replacement

By using an earlier procedure in this manual, if it has been determine the RF AMP Board must be repaired or replaced, follow these directions.

For access to this board, remove the Front Panel Assembly and the front supporting plate of the CCSA.

The Front Panel Assembly is removed by removal of 5 screws These are located as follows: three (3) screws on the bottom of the instrument and one (1) screw from either side of the front panel. Carefully pull F. Panel Assembly away from the rest of the instrument. Disconnect the coaxial cable to the backside of the RF Input connector. Unplug the three (3) cable assemblies also connected to the Front. Panel Assembly while carefully observing the orientation of these cables. They must be orientated the same way when replaced.

Now remove the front supporting plate of the CCSA. Three (3) screws hold this plate to the instrument chassis. Remove these 3 screws. Next remove the four (4) screws holding this plate to the CCSA itself. As this plate is removed a rubber bumper, may be found glued to the inside of this plate.

From the front of the instrument looking into the CCSA area, four (4) Boards can be seen inside the enclosure.

In order from top to bottom:

IF AMP Board
Microprocessor Board
RF/LO Subsystem
RF AMP Board

The RF AMP Board is the only board of these four that can be slide forward and removed without interference from connecting cables to other board in the four (4) board set. Pull the RF AMP Board forward and out from the extrusion enclosure. It will have two coaxial cables and one 10-pin cable assembly attached. Note the location and orientation for each cable and connector.

The board can be replaced or returned for repair and then reinstalled. When reinstalling the board, reverse the above steps and carefully replace the board back into the instrument.

This service manual provides detailed information on how to perform the trouble shooting analysis and isolate a service problem down to the subsystem or component level.

Section 8: Replaceable Parts

The following list details replacement subsystems and components for use in the service and repair of the R-500 series Field Strength Meter.

Front Panel Assembly

Including LCD Displays/with its Circuit Board, Buttons and Button Board, the TUNE Knob and Input Connector.

Battery Pack

Includes eight (8) C cell NiCAD Batteries with 2-wire cable and connector. The battery pack is rated for 2.4 amp/hours at 8.8 Vdc.

Rear Board

Includes the Rear Panel Board with associated cables.

Card Cage Subassembly (CCSA)

Includes the RF AMP Board, RF/LO Subsystem, IF Subsystem, Microprocessor Board, the Metal Card Cage itself and associated cables.

Metal Cabinet Components

Slide-on Dust Cover, Metal Battery Holder Box with Top Plate, Chassis with Back Panel and Speaker with Mounting Bracket.

Battery Charger/Supply

PU-1 Battery Charger/Supply operates on 120 VAC 60 Hz.

PU-2 Battery Charger/Supply operates on 230 VAC 50 Hz. The primary side uses a Euro plug connector.

Both units' output is at least +14Vdc at 900ma. (Under load). The secondary connector is a 2.1mm coaxial type DC power plug with **Center Pin Positive**.

SoftCase

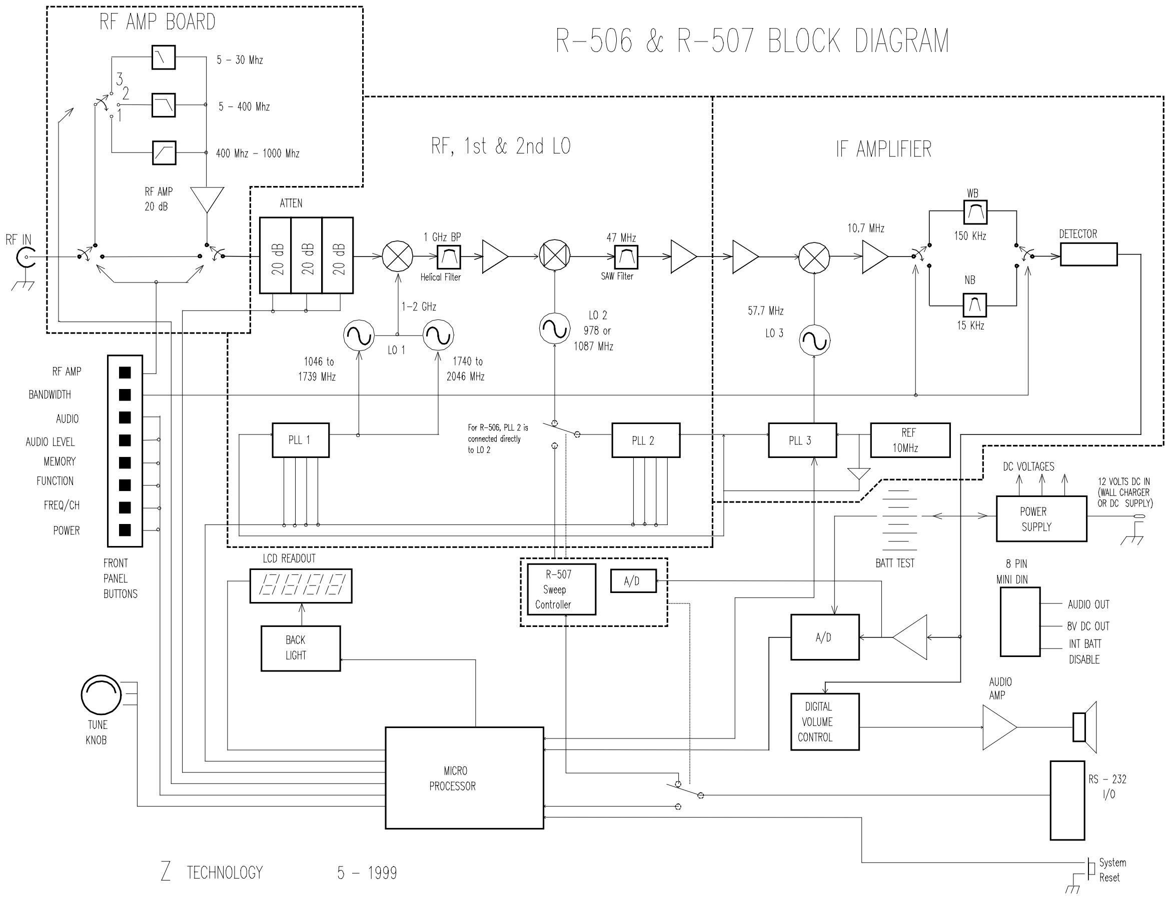
A heavy protective material bags with front and rear Velcro flaps and zipper pouch. The contens of the pouch are:

Utility Antenna (uncalibrated)
Type-N to BNC adapter
Plastic Instruction Card.

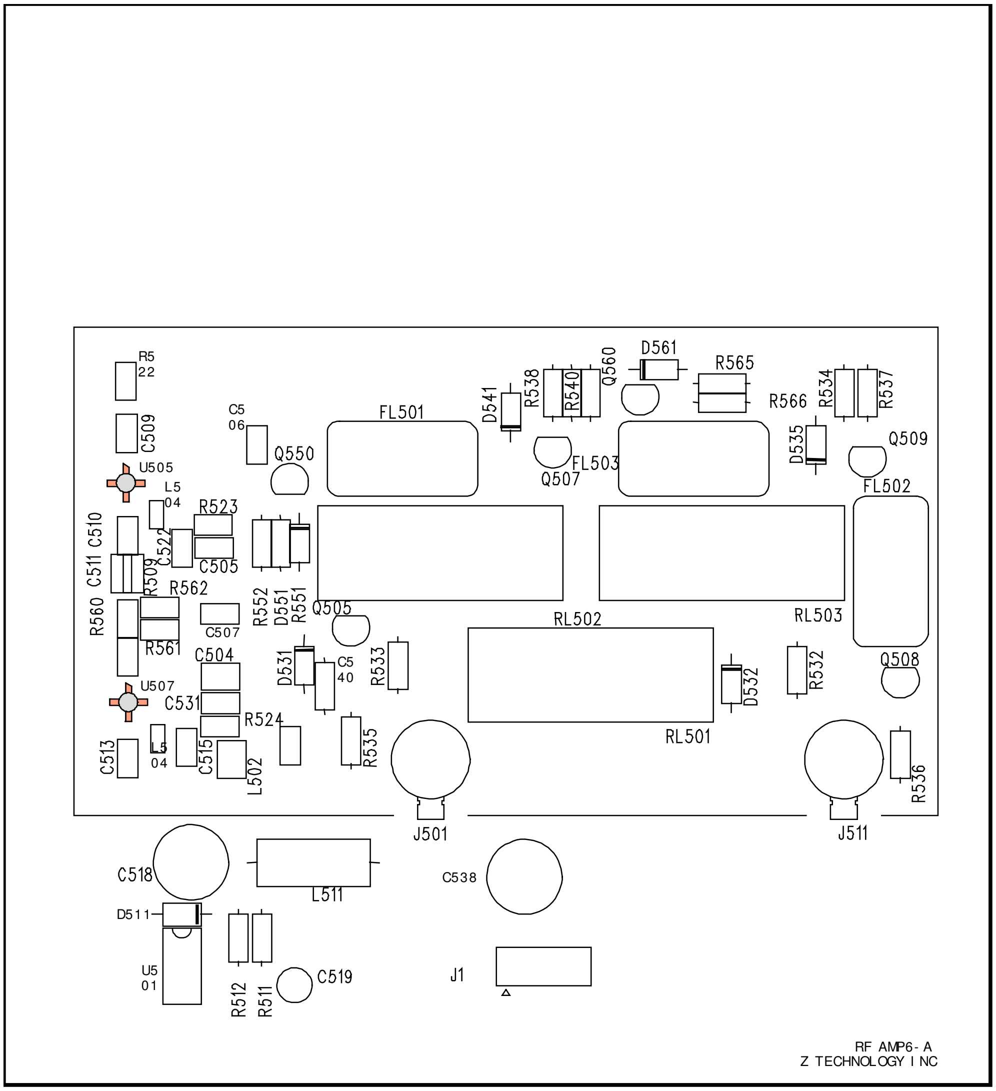
Section 9: Diagrams

Schematics and board illustrations

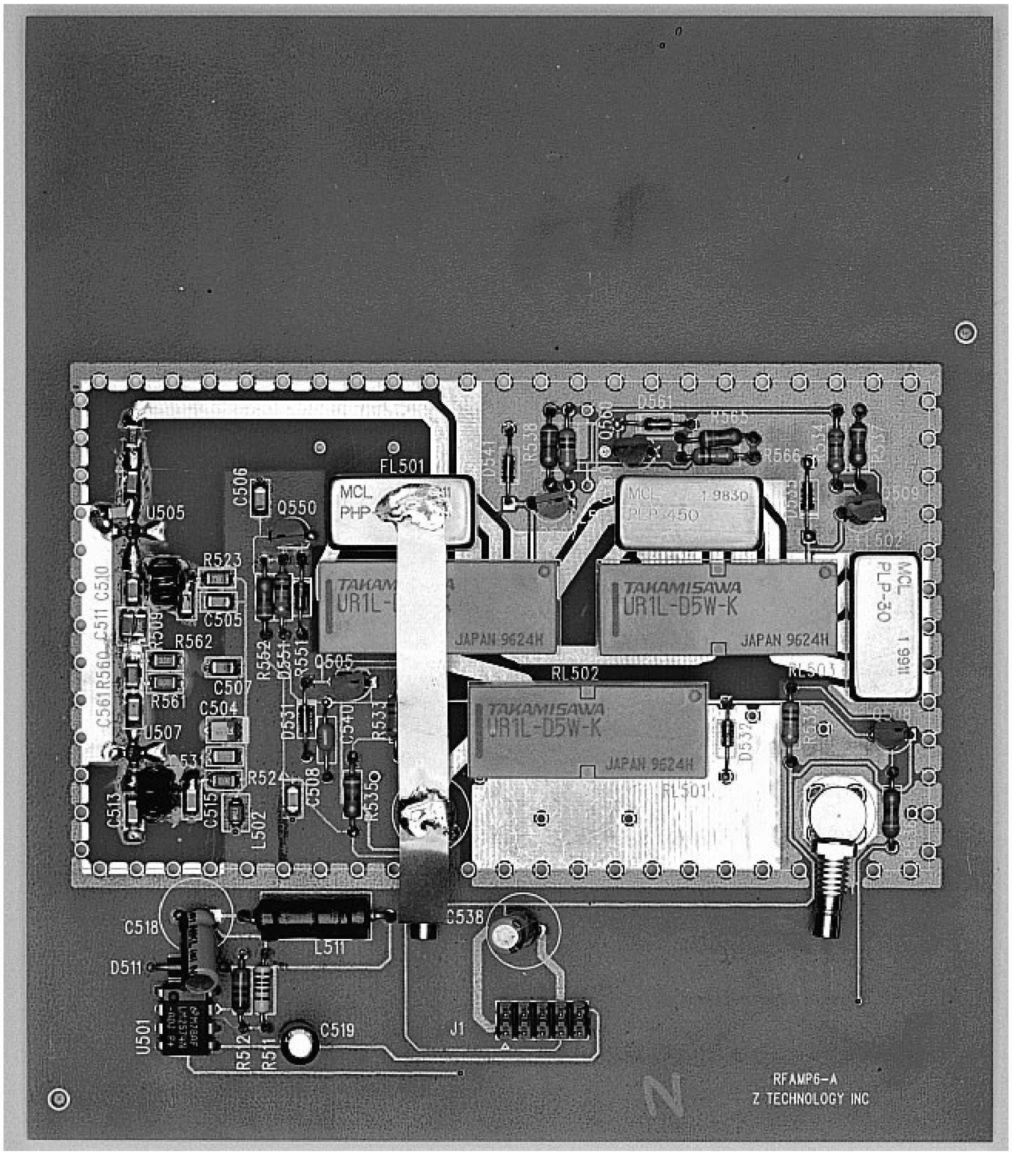
- R-506 and R-507 Block Diagram
- RF Amplifier <1>
- 1^{st} and 2^{nd} LO <2>
- IF Amplifier <3> <4>
- MPU Board <5> <6>
- LCD Display Controller <7>
- Front Panel and Switch Board <8>, Schematic only
- Rear Panel <9>
- A to D Converter Board <10>



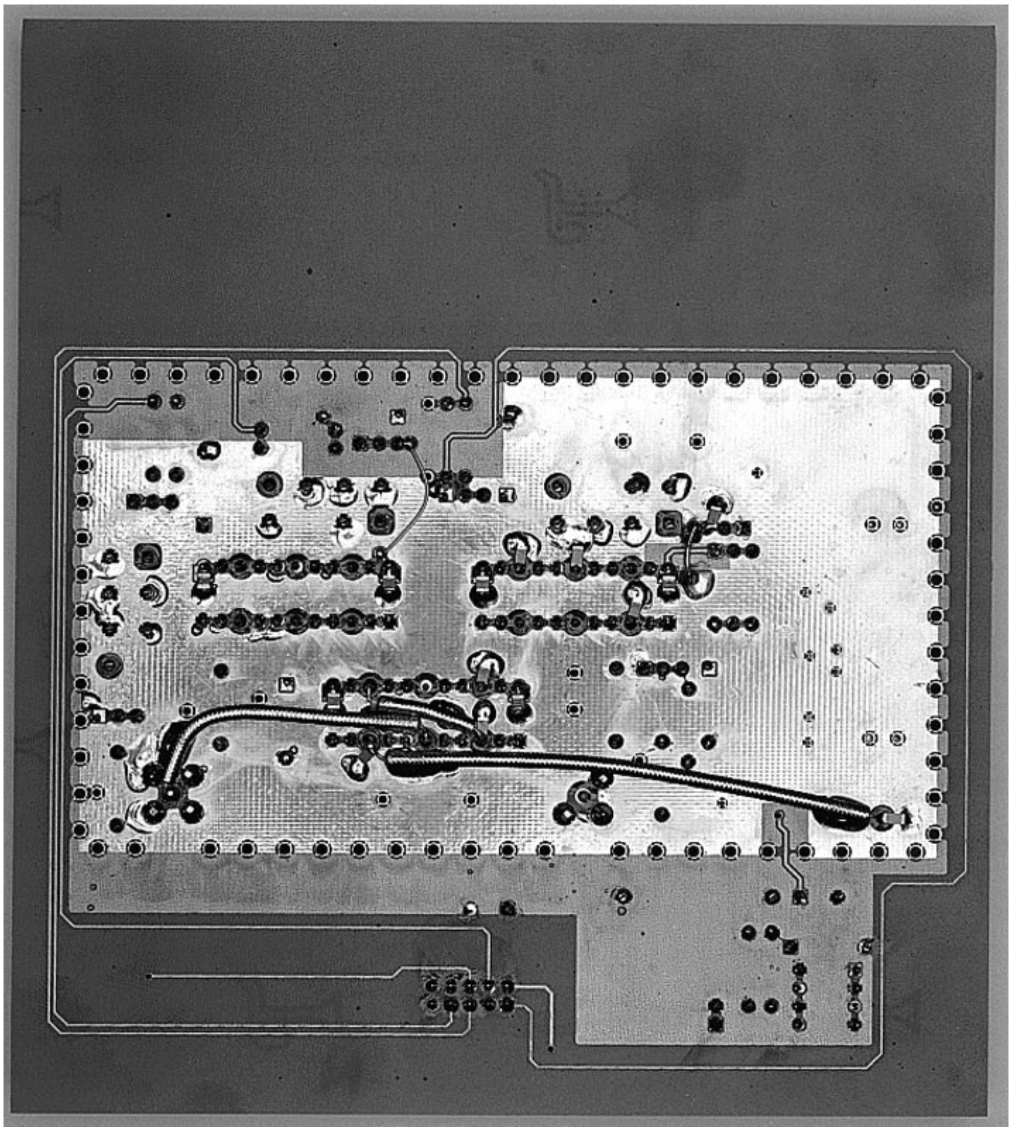
R-506 & R-507 Block Diagram



RF Amplifier, front side

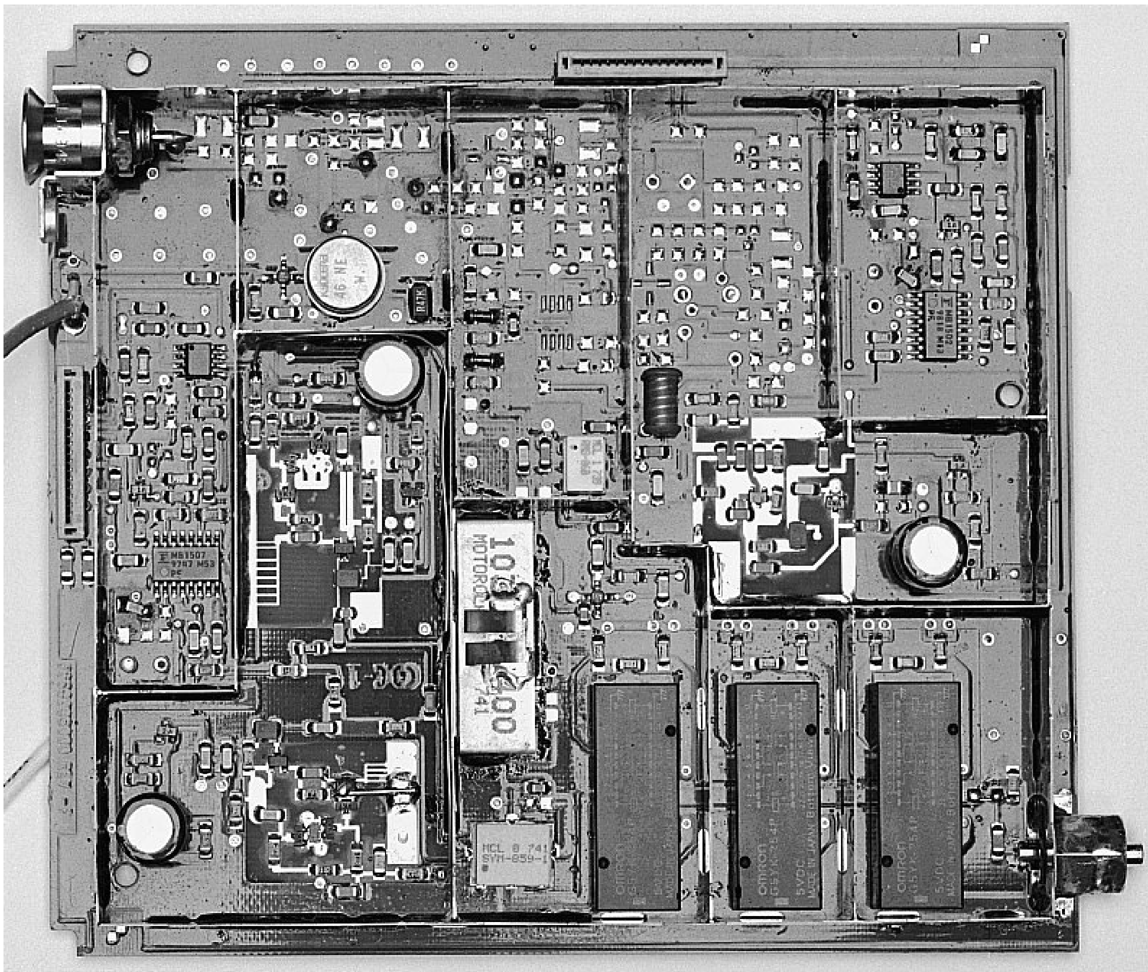


RF Amplifier, front side



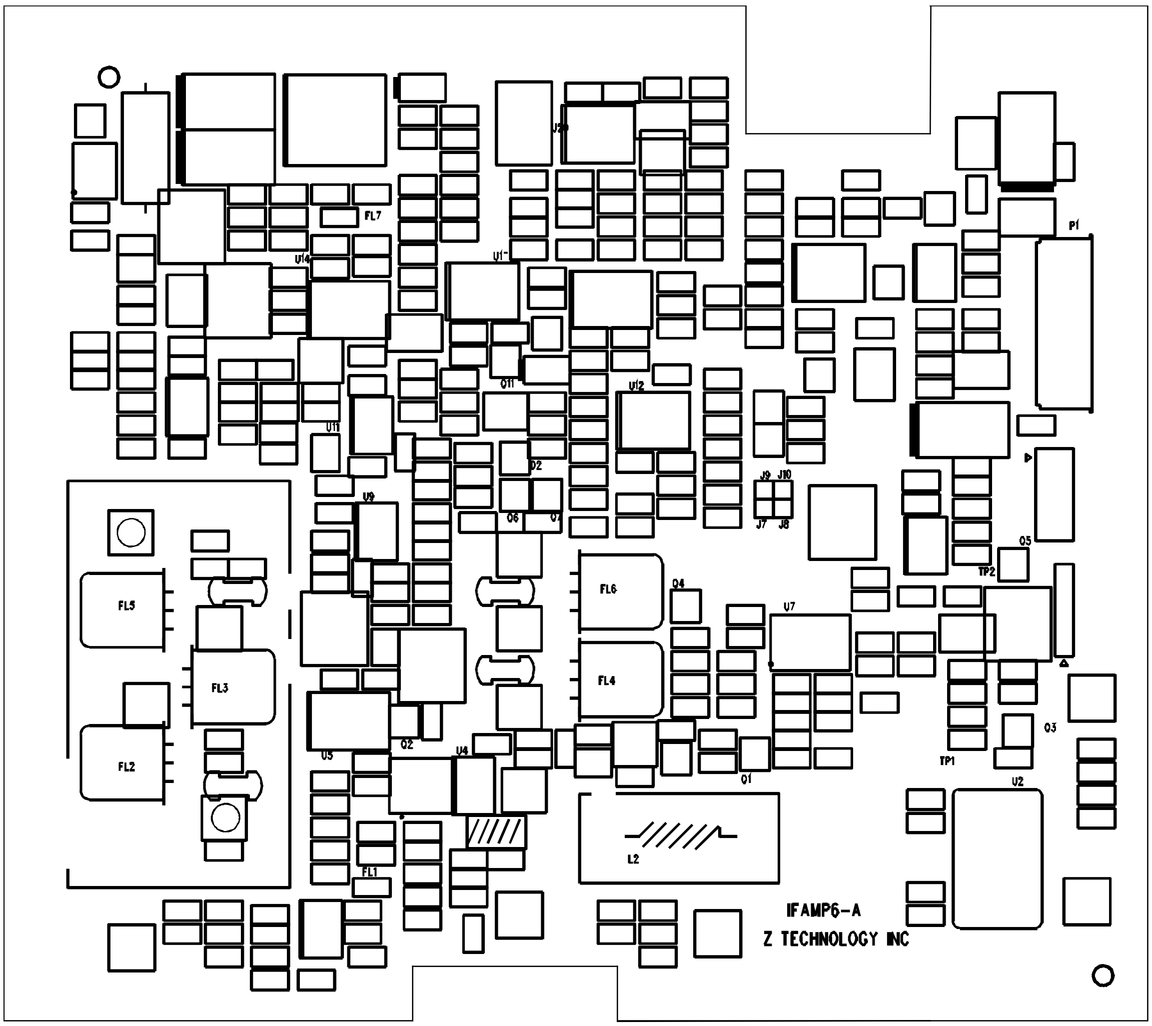
RF Amplifier, back side

RF Amplifier <1>

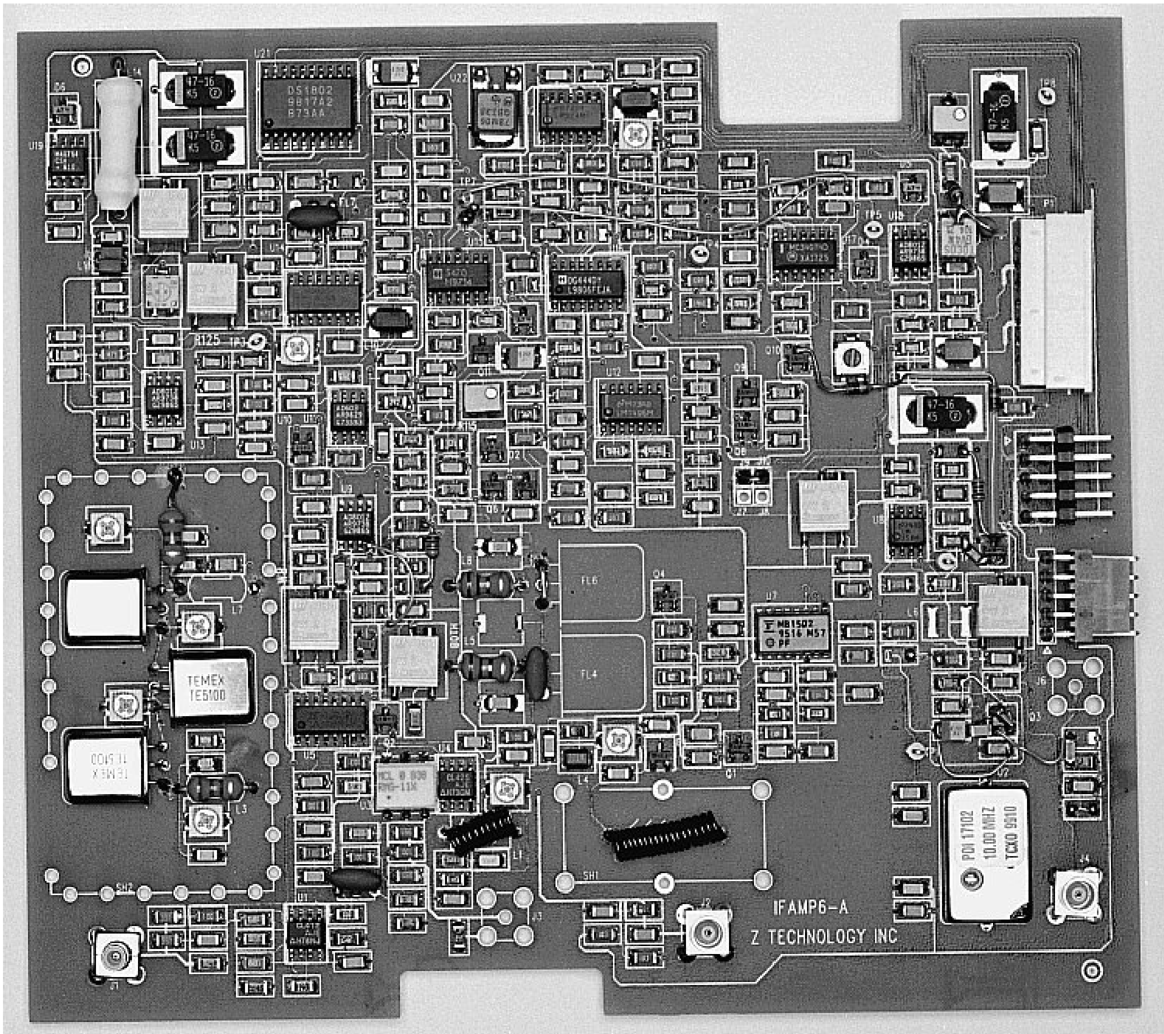


1st & 2nd LO Board, front view

1st and 2nd LO board <2>



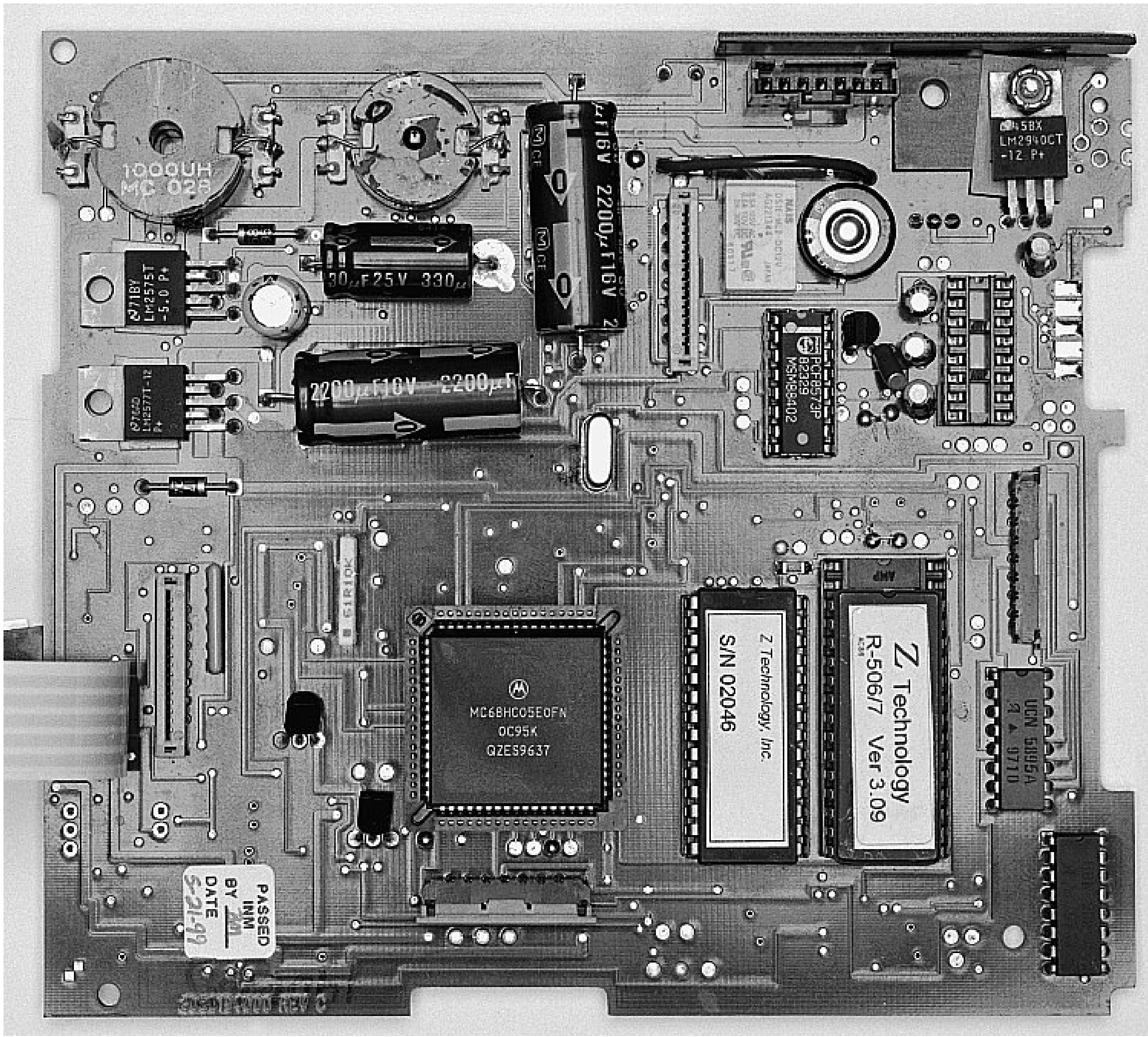
IF Amplifier Board



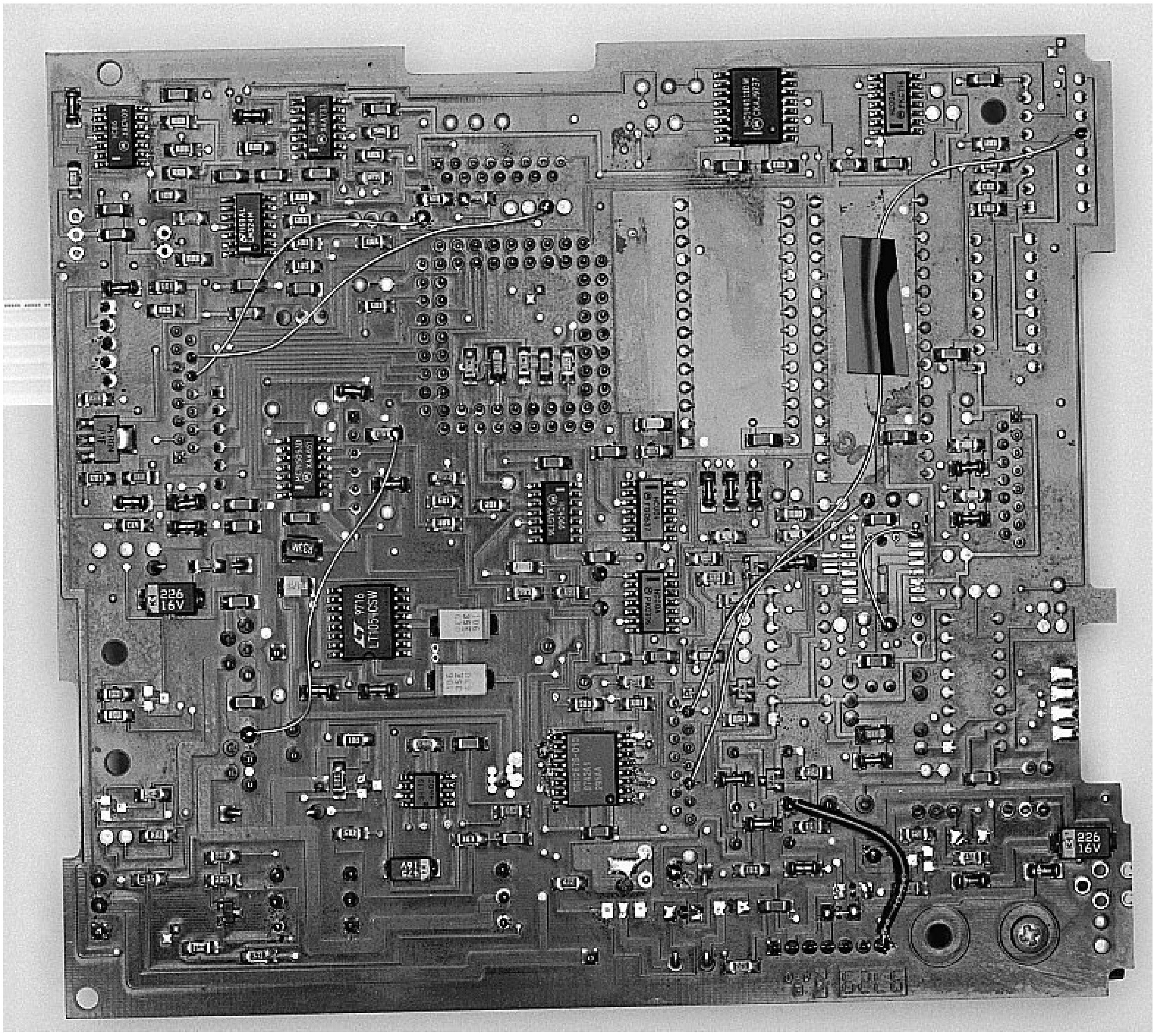
IF Amplifier board

IF Amplifier <3 & 4>

IF Amplifier <4>



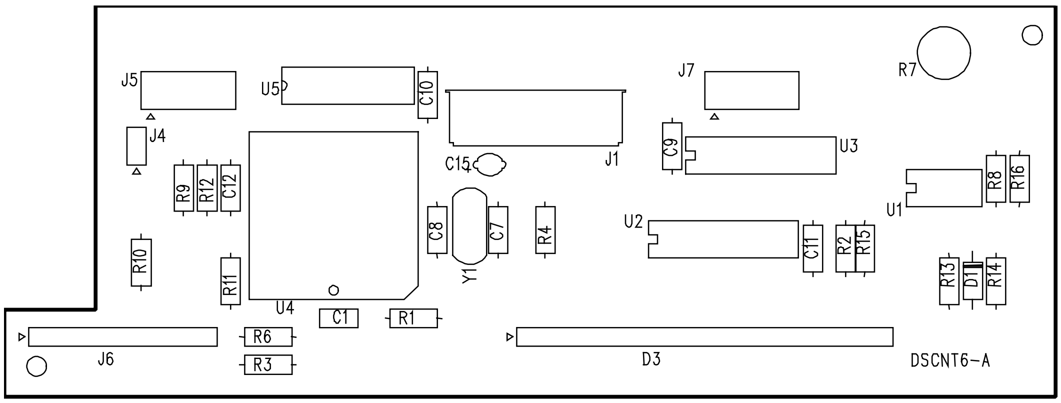
MPU Board, front view



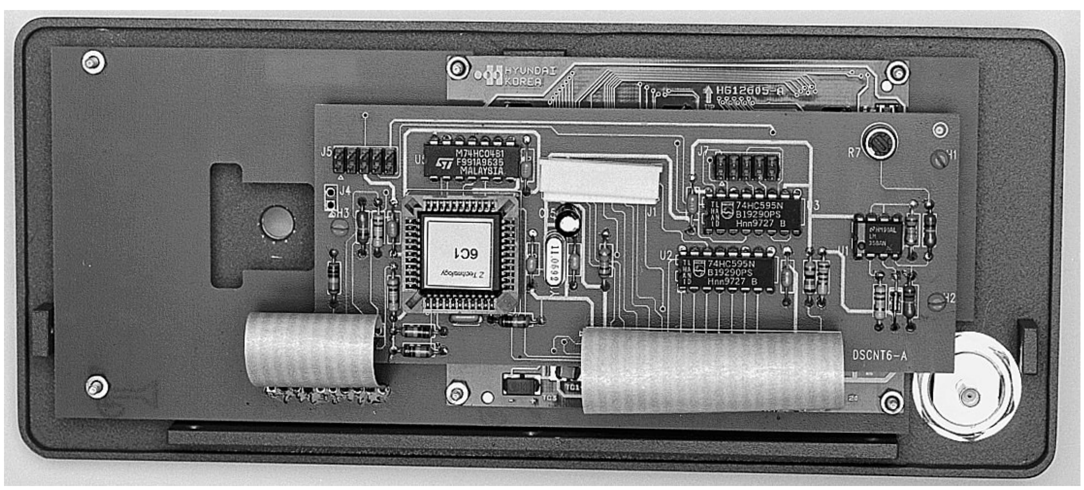
MPU Board, back side

MPU board <5>

MPU board <6>



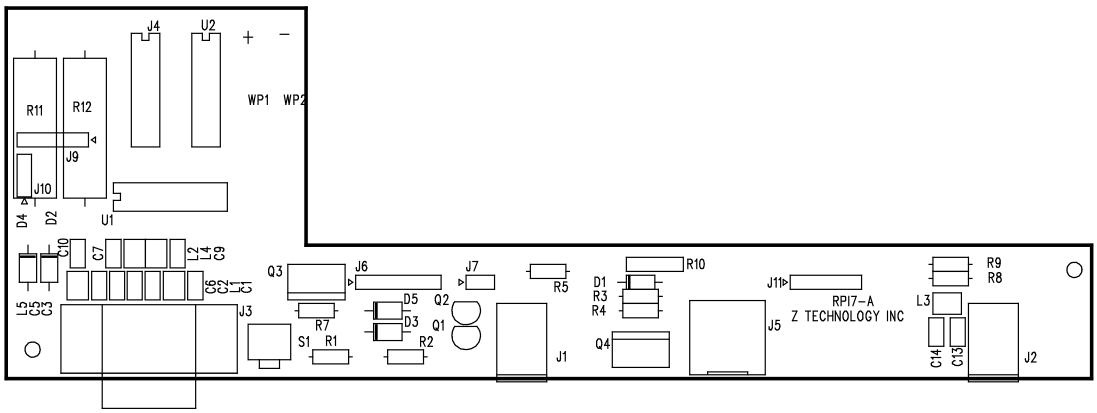
LCD Display Controller



LCD Display Controller

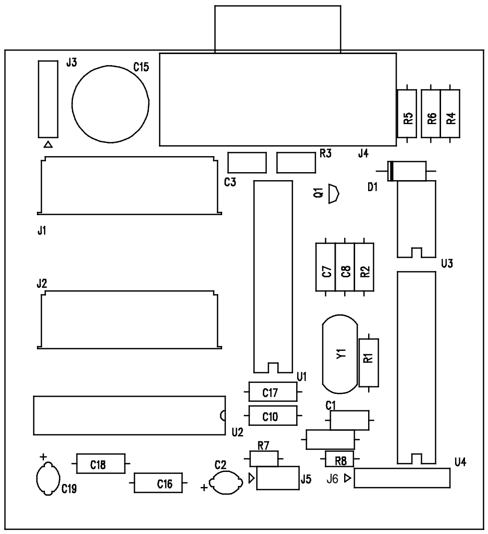
LCD Display Controller <7>

Front Panel Switch board <8>

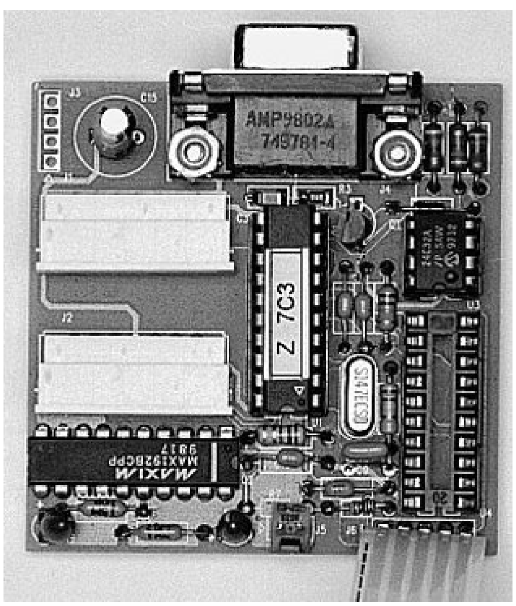


Rear Panel Board

Rear Panel <9>



R-507 A to D Converter Board



R-507 A to D Converter Board

A to D Converter <10>

Section 10: Appendix A

Instrument Reset

In some unusual situations, the R-500 SERIES may need to be reset. This may happen because of an internal battery pack with extremely low voltage. It may also occur due to such things as very high power supply transients, or in some cases excessive shock or vibration.

In these cases, the R-500 SERIES may continue to show numerical readings on the LCD displays but will become unresponsive to any front panel command. If this happens, place a jumper between pins 5 and 7 on the rear panel Accessory board. This action internally disconnects the battery from the internal circuitry. When the two pins are jumpered together, the instrument will come out of it unresponsive state and power down.

Plug in the external supply/charger and the R-500 SERIES should automatically power up. The unit may be operated in this mode and the battery will be trickled charged while the unit is ON. The other option is to turn the power OFF and leave the charger in place for 12 hours. The battery should be fully recharged over the 12 hour period. If the unit repeatedly locks up after using the battery as the source of power, the battery pack may need replacing.

System Reset:

In addition to the above jumper method, a System Reset recessed button is located on the instrument's rear panel. It provides an alternate method of resetting the instrument other than shorting pins 5 & 7 on the Accessory Connector. When the System Reset button is pushed by using a thin pointed object to push this button, the instrument is Reset. It is ready for use immediately upon release of this button.

Software and Firmware

There are several software and firmware features, which are helpful for the service engineer to understand. The serial communication port provides an excellent way to diagnose and/or make modifications to the R-500 SERIES performance. This section describes communication parameters, baud rate settings and some very helpful engineering-only Functions available to the engineer. Measured signal samples, delays, wait times and timing parameters are also described.

Serial Port Tests

For proper communications between instrument and computer, the communications parameters between the R-500 SERIES and your PC must match. The R-500 SERIES parameters are set as follows:

- Baud rate: as adjusted (see below)
- Data bits: 8
- Parity type: None
- Stop bits: 1
- Remote Address as adjusted (see below)

Setting the computer's communications parameters: The computer's baud rate, number of data bits, type of parity, number of stop bits and remote address must match those of the R-500 SERIES (Baud rate, 8,N,1 and remote address).

Since certain R-500 SERIES parameters cannot be changed, the computer's data bits, stop bit and parity must be set to match those of the instrument. The baud rate and remote address parameters must be set to the same value for both instrument and PC.

Setting the R-500 SERIES baud rate and remote address: The R-500 SERIES can be set to operate at 1200, 2400, or 9600 baud. Usually, you will want to use the highest baud rate to minimize communications time between the R-500 SERIES and the computer. The remote address can be set to any number between 0 and 255.

The R-500 SERIES is factory set to the following settings:

The Baud Rate is set to **9600**

The Remote Address is set to **01**

It is possible to change both of these values. The control to set baud rate and to set remote address functions are "locked out" to prevent accidental changes. To access and change them:

To unlock the control functions:

1. Press the FUNC button on the front panel, then use the TUNE-Knob to select "F59".
2. Press the TUNE-Knob -- the R-500 SERIES will immediately return to its previous operating mode.
3. Repeat steps 1 and 2 two more times. Function "F59" has now been consecutively selected three times; therefore, the baud rate and remote address functions are unlocked.

To change the baud rate or remote address:

Use the FUNC button and TUNE-Knob to select function "F43" to change the baud rate or select function "F44" to change the remote address. When you press the TUNE-Knob the present value will be displayed on the large right LCD. To change it, rotate the TUNE-Knob until the desired value is displayed and press the TUNE-Knob to store the new setting. Press the FUNC button to exit the setup function.

Engineering Only Functions

There are several R-500 SERIES set up parameters that normally do not need adjustment. Under some unusually circumstances one or more of these parameters may require changing. The engineering only functions discussed here are:

Front Panel	Serial Port	Descriptions.
F89	not needed	Unlocks access to engineering only memory locations
F60	11	**Calculate Checksum** for calibration data In EEPROM
F69	17	Displays stored data in a memory location
F69	44	Allows changes in data at these Hex address locations

Access to the engineering functions is gained by selecting F89 three times in succession.

Set up parameters are controlled by data stored in several Hex address locations. There are two ways to gain access and then change set up parameters: One way is through using the serial port and the MENU.EXE program provided on a free software control disk for the R-500 SERIES. The second way to unlock the ENGINEERING ONLY FUNCTIONS is to access them via the front panel FUNC button. Using either method, the operator must know which HEX address is to be used to change a parameter.

Changing EEPROM Memory via RS-232

If the serial port is to be used to access memory locations, run the QBASIC Demo Software Program named MENU.EXE. After reaching the list of possible commands the program displays, call up item number 17. This command allows reading stored data in up to 16 memory locations at one time. When you are sure of the specific Hex Address in which you wish to change data call up command 44. This command must be used with extreme care. Double check the address, then change the data at that address to the new value. When completely finished with your changes, the final step must be to recalculate the Checksum for the newly altered data record and store the Checksum in memory, Com 11.

Performing the Checksum process is important in that the R-500 SERIES will reject the entire EEPROM instrument calibration correction and set up tables if the Checksum is wrong. The Checksum is referenced to each time the instrument is turned ON. If this step is not performed but data is changed in the memory, on the next power up process the instrument will assume corrupted data has occurred and will default to an uncalibrated state. When this happens, the speaker will rapidly beep three (3) times at power up.

Changing EEPROM Memory Using the Front Panel

A second way to change data in memory is by using the front panel. Select the FUNC button by pushing it one time. F1 will show on the LCD displays. Rotate the TUNE Knob to a reading of F89 and push the TUNE Knob. Repeat this process until you have performed F89 three (3) times. Once again push the FUNC button but this time go to F69 and push the TUNE Knob. The small LCD displays now show a Hex address (initially 0000) and the large LCD display will show the Data that is stored in that memory location. Turning the TUNE Knob will change the address viewed. Push the TUNE Knob and notice the blinking digit increments. The TUNE Knob always adjusts the blinking digit. This digit will change when rotating the knob. When you have reached the Hex address to be modified, push-and-hold the TUNE Knob for at least 2 seconds or until you hear a beep. Now, the TUNE Knob will change the data stored at the active address. When the new value has been entered, push the MEM button on the front panel. This action stores the new data in the Hex address and causes the TUNE Knob to revert back to controlling the Hex address readout.

In this manner, it is possible to change data in several addresses sequentially. You may push the FUNC button at any time and return to active operation of the R-500 SERIES. In some cases the results of new stored data will be active immediately, but in most cases the instrument’s power must be cycles before the new data is active. Important: When finished with all data changes a Checksum must be performed. This is done by coming out of the FUNC mode (i.e. push the FUNC button). Next return back into the FUNC mode and rotate the TUNE Knob for an LCD display of F60. Now push the TUNE Knob one time. Power down the instrument. Power the instrument back up and make sure the Checksum comparison performed by the microprocessor is valid. If no beeps are heard, the instrument has accepted the new data and is operating correctly. If the operator hears three (3) rapid beeps, this means the R-500 SERIES has failed the auto-power up Checksum test and has reverted to an uncalibrated operating state. If this happens, do a F60 again. (Since, the power was turned OFF in the above steps, it will be necessary to perform three (3) F89s in order to access the engineering only Checksum enable command -F60).

Useful EEPROM Address Locations:

What follows is a description of several important addresses with EEPROM memory that effect R-500 SERIES operational speed, number of readings taken per measurement recorded, Data Logging enable/disable commands, World wide TV Channel presets, etc.

Address 1888

When "B", 1888, is set to 01 Data Logging is enabled. With data set to 01, the RS-232 port communication has approximately 500 msec added to every serial port command or exchange. When 1888 is set to 00 Data Logging is not possible; however, in this mode serial communication speed is increased dramatically since the above mentioned 500msec is eliminated. It is our experience that most users are concerned with RS-232 port speed. Since this is the case, the standard R-500 SERIES is shipped with Data Logging disabled. That is, at the factory, 1888 is loaded with 00. (The following timing values assume 1888 is set to 00).

Note: Certain highlighted main-menu functions set features that can be used only in the Data Logging Mode. The functions in this category are 3, 4, 5, 6, 13, 14, 15 and 16. These items are active, only when address 1888 it set to 01.

Address 18AB

"D", 18AB, sets the number of "readings" which are averaged before a "measurement" is sent to the serial port or the front panel. In order to increase R-500 SERIES measurement accuracy, multiple readings are recommended. The instrument is normally calibrated with this Data set to 04. In that case, a "measurement" is the averaged of four (4) "readings".

All Data (for all addresses) must be entered in Hex. For instance, to have a measurement be the average of 15 readings, enter the Hex value "0F".

Addresses 1880 & 18AA

"A", 1880, and "C", 18AA, are used to set delays between signal readings (A) or between groups of measurements (C).

An example will help to understand the sequence of these values. When 1880, 18AA and 18AB are set at the above Default Data values, four (4) signal readings will be taken, with 10msec of delay between each reading, and a delay of 24.6 msec is added between each group of four signal readings. In addition to these delays, a normal system delay of approximately 150msec is inherent in the instrument.

system delay	24.6msec	10ms	10ms	10ms	system delay
	Sample ^	Sample ^	Sample ^	Sample ^	

When the delay and number of signal readings are set as shown, the total time between serial port measurements will be approximately 205 msec.

Setting Hex Addresses

Hex Add.	Setting 1	Setting 2	Description
1880	04	04	Delay before each group of signal readings (8.2msec/)
1881	05	04	No. of RSSI ADC Readings
1883	05	00	Delay after each Serial Port Comm (100msec per)
1888	01	01/00	Data Logging Enabled =01 Must be 00 - disabled for fast RS-232)
1889	00	00-05	00= NTSC
			(Australia) 01=PALG,PAL 02=PALI, E1 03=JPN 04=PALG (PRC, Singapore) 05=PALD,PALG
188A	01	01	Serial Port Enabled
1895	16	00	Adds Delay to Data Logging (8.2msec per)
189A	01	01	Allows Tuning below 5MHz
18AA	28	0F	Delay between each of the individual signal readings (1msec per)
18AB	OF	04	Number of readings that are averaged before responding to COMM 35 or to LCDs
18B3/4	0032	0000	Delay before transmitting response to RS-232 COMM (8.2msec per)
18B5	00	01	Lowest Freq. = 3.0MHz 00 = 0.3MHz for low freq.
18A6	14	Sel	IF AMP Gain Setting(1db/)
18A7	14	Sel	RFAMP Gain Setting(1dB/)
18B8	0A	02	#Sec. before "ERR" Clears
18B9	0A	03	# Clears before ERR stays

Notes:
Setting 1, are max. settings the factory recommends for these timing addresses.
Setting 2, are suggested settings & are typical for R-506/7 as they leave the factory.
Addresses 18A6 and 18A7 indicate “SEL” These settings are chosen at the factory and must remain as set in order to meet specs.
Data at address 1889 have the following attributes: (P/A is Picture/Audio carrier frequency)

Data:	00	P/A =	4.5 MHz	F4 = NTSC
Data:	01	P/A =	5.5 MHz	F4 = PALG/PAL
Data:	02	P/A =	6.0 MHz	F4 = PALI/EI
Data:	03	P/A =	4.5 MHz	F4 = JPN
Data:	04	P/A =	5.5 MHz	F4 = PALG
Data:	05	P/A =	6.5/5.5MHz	F4 = PALD/PALG

Complete Listing of Hex Addresses

REFERENCE MEMORY MAP ADDRESSES & STARTUP ADDRESSES		
ADDRESS	DATA	COMMENTS
0204	5A	0dB Attenuator Offset
0205	5A	20dB Attenuator Offset
0206	5A	40dB Attenuator Offset
0207	5A	60dB Attenuator Offset
1880	**04**	**Delay before each group of signal readings (8.2msec/)**
1881	**04**	**Number of RSSI ADC Readings**
1883	**00**	**Delay after each Serial Port Comm (100msec/)**
1887	01	Display set for dBuV (00 = dBmV)
1888	**00**	**Data Logging OFF. Must be 00 for fast port (01=Data Logging ON)**
1889	**00 – 05**	**00=NTSC; 01=PALB/G UK; 02=E1,UK1…;03=Japan;04=PALB/G 05=PALD/K PRC, Singapore.**
188A	**01**	**Serial Port Enabled**
188E	20	Sets threshold to trip delays when power supply is unstable 0 – 1023
188F	00	Sets wait time when above (188E) threshold is crossed
1895	**00**	**Adds Delay to Data Logging (8.2msec/)**
189A	**01**	**Allows Tuning below 5MHz**
18A6	14	IF AMP Gain Setting (1dB/)
18A7	C8	RF AMP Gain Setting (0.1dB/)
18AA	**0F**	**Delay between each of the individual signal readings (1msec/)**
18AB	**04**	**Number of readings averaged before responding to COMM35 or to LCD**
18AD	F1	Subtracts X.X from reading from –7 to –10 dBuV
18AE	F6	Subtracts X.X from reading from –6 to –6.9 dBuV
18AF	F9	Subtracts X.X from reading from –5.5 to –5.9 dBuV
18B0	FB	Subtracts X.X from reading from –5.0 to – 5.4 dBuV
18B1	FC	Subtracts X.X from reading from –4.5 to –4.9 dBuV
18B2	FE	Subtracts X.X from reading from –3.5 to –4.4 dBuV
18B3/B4	**0000**	**Delay before transmitting response to RS-232 COMM (8.2mse/)**
18B5	**00**	**00=Std; 01=BC; 02= PCS Tuning Modes**
18B6/B7	0001	X10msec Delay when switching to or from BC Block Converter
18B8	**02**	**No. Seconds before “ERR” Clears from LCD**
18B9	**03**	**No. of Clears before “ERR” Stays on LCD. TUNE knob must be turned**
18BA	04	Second set of power-up initialization flags
1AA8	00	01 = forces meter to dBuV/M mode (same as F12 being set ON)
1AA9	00	01=forces meter to dBm mode (same as F14 set ON) (will override F12)
1AAA/AB/AC	0493E0	Setting the 30 MHz Filter Switch Point
1AAD/AE/AF	3D0900	Setting the 400MHz Filter Switch Point (425MHz = 40D990)
1AB0	01	Enables all RF Filter Control
1AB1	00/01	00=10 MHz PLL References; 01= 8 MHz PLL References(1st &2nd LOs)
1AB2/3/4	00C350	Low-end Frequency Stop (Resolution is 100Hz)
1B2D/E	0370	Low Battery Switch Voltage Point (0370 = ~10.5V)
1AB5/6 –1B2A/B	8005 - FFFF	2nd LO Switch Point Frequency Callouts (Set up with R506.cfg Program)

Note: Bold faced addresses are described in detail above.