



INSTRUCTION MANUAL

DEMODULATOR

MODEL EM-8500

INSTRUCTION MANUAL

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DEMODULATOR

ELECTRO-METRICS

MODEL EM-8500

SERIAL NO: N/A

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MANUAL REV. NO: EM8500-0194

ISSUE DATE: JANUARY 01 1994

WARRANTY

This Model EM-8500 Demodulator is warranted for a period of 12 months (USA only) from date of shipment against defective materials and workmanship. This warranty is limited to the repair or replacement of defective parts and is void if unauthorized repair or modification is attempted. Repairs for damage due to misuse or abnormal operating conditions will be performed at the factory and will be billed at our commercial hourly rates. Our estimate will be provided before the work is started.

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SECTION 0.1 SAFETY INFORMATION

0.1.1 Introduction

The following section should be read before operating the EM-8100 Communications Adapter to prevent damage to the unit or spectrum analyzer/signal source and possible personal injury.

0.1.2 Demodulator Markings

The following markings are located interally and externally on the unit.

CAUTION Indicates a hazard not immediately apparent when read.

DANGER Indicates an immediate hazardous situation when read.



Symbol means CAUTION.

0.1.3 AC Power Source

CAUTION

To prevent damage to the EM-8500 Communications Adapter, operate only from a 90-250 VAC, 48-63 Hz power source. 60 Watts *MAXIMUM*.

0.1.4 Grounding

CAUTION

To avoid electrical shock, the EM-8500 must be plugged into a grounded outlet.

The EM-8500 is grounded through the ground lead of the AC power cord. Without a proper ground connection, all accessible parts of the unit could be at a high enough voltage level to cause potentially dangerous electrical shock. In addition, lack of a proper ground can cause ground loop problems.

0.1.5 Fuse Protection

CAUTION

For continuous fire protection, replace only with 250 VAC 2 A fuse.

0.1.6 Input Signal Voltage Levels

CAUTION

Damage to the internal circuitry of the EM-8500 may result if signals larger than +15 dBm are applied.

0.1.7 General Operating Precautions

- a. To prevent electric shock or equipment damage, *do not use the EM-8100 in:*

••• RAIN •••

••• WET--DAMP CONDITIONS •••

- b. When operating the EM-8500, allow at least 50 mm (2") clearance around the sides and rear of the unit to permit cooling to occur.
- c. Operate the EM-8500 within the stated environmental, RF input voltages, and AC power range stated in Section I, Para. 1.2.
- d. **NEVER** operate the EM-8500 with panels or covers removed.

- e. All servicing and repair of the EM-8500 should be performed only by qualified service personnel.
- f. **NEVER** operate the EM-8500 in an explosive atmosphere unless it has been **specifically certified for such operation.**
- g. **NEVER** immerse the EM-8500 in any liquids (e.g., for cleaning purposes).

SECTION I EM-8500 DEMODULATOR INTRODUCTION AND SPECIFICATIONS

1.1 Introduction

The Electro-Metrics Model EM-8500 Demodulator is designed to convert and demodulate the IF Output of a conventional spectrum analyzer.

The EM-8500 is available with a maximum total of 12 IF bandwidths between 50 MHz (upper limit) and 200 Hz (lower limit), with matched FM and AM demodulators. In addition, the unit has tunable subcarrier demodulation capability for bandwidths of 300 kHz or 150 kHz with FM, AM, SSB, and CW demodulators.

The unit has three video outputs: AM, FM, plus a switch selectable AM or FM. The video outputs are useable over the specified 50 MHz to 200 Hz IF bandwidth range.

All input and output connectors for the EM-8500 are located on the rear panel and consist of the following:

- a. IF INPUT, either 310.7 MHz or 160 MHz standard (other IF frequency options available),
- b. EXTERNAL SUBCARRIER VIDEO INPUT,
- c. AM VIDEO OUTPUT,
- d. FM VIDEO OUTPUT,
- e. SWITCHED VIDEO OUTPUT, switch selectable AM or FM.
- f. 10 MHz REFERENCE IN/OUTPUT.

The EM-8500 uses a built-in microprocessor to control the operation of the unit from information keyed in from its front panel controls. The unit can also be controlled using an external computer via the rear panel IEEE-488 Interface Bus Connector.

1.2 Instrument Specifications

The electrical and general specifications for the EM-8500 Demodulator are given in Sections 1.2.1, 1.2.2, and 1.2.3.

1.2.1 Electrical

IF Input Frequency:	310.7 MHz or 160 MHz standard. Front panel switch selectable. (Other IF Input Frequency options available.)
---------------------	---

Input Level: -5 dBm for 1 dB compression.

Input Noise Figure: 16 dB.

IF Bandwidths (3 dB): Standard:

30 MHz, 20 MHz, 10 MHz, 4 MHz, 1 MHz, 300 kHz, 150 kHz, 20 kHz, 10 kHz, 3.2 kHz, 1 kHz, 200 Hz.

Optional:

Limited to a total of 12 IF bandwidths between 50 MHz (upper limit) and 200 Hz (lower limit).

NOTE: The IF Bandwidth selections must follow this order:

2 Wideband: 50 MHz >10 MHz.

5 Narrowband: 10 MHz >75 kHz

5 Extra Narrowband: 20 kHz-200 Hz.

IF Shape Factors
(6-60 dB):

IF Bandwidths Shape Factor

50 MHz to 1 MHz: <2:1

300 kHz to 200 Hz: <3:1

Phase Linearity: <5° over 80% of Bandpass.

Reference Input: 10 MHz @ -2 to +10 dBm.

Optional Internal Reference: Accuracy 1×10^{-6} /year

Residual FM: <2 Hzpp in 20 msec.

Noise Sidebands:	<-100 dBc/Hz @ 10 kHz Offset.
Video Outputs:	1 V _{pp} , nominal, into 50Ω. FM deviation 50% of bandwidth or 50% AM modulation.
Video Frequency Response:	½ the IF bandwidth, -3 dB.
Gain Control Modes:	Manual, Automatic.
Gain Range:	120 dB minimum.
AM Stability:	10 dB maximum change from AGC threshold.
Audio Output:	10 mW into 8Ω.
Subcarrier Tuning:	10 Hz minimum resolution 300 kHz, and 150 kHz carrier bandwidths available on both AM and FM video.
Subcarrier Bandwidths:	Standard: 20 kHz, 10 kHz, 3.2 kHz, 1 kHz, 200 Hz.
Subcarrier Demodulation:	AM, FM, USB, LSB, CW.
Subcarrier External Video Input:	Freq. Response: 500 Hz-300 kHz Input Level: -7 dBm to -47 dBm
GPIB Interface:	IEEE Std. 488.2-1987
GPIB Interface Supports:	AH1, L4, SH1, T6, SR1, PP1, DC1, DTO, RL1, C0, E1, TEO, LE0.
AC Line Voltage:	90/250 VAC, 48-63 Hz
AC Power Requirement:	60 Watts maximum

1.2.2 Mechanical

Dimensions:

Height: 191 mm (7.5")

Width: 362 mm (14.25")

Length: 406 mm (16")

Weight: 15.4 kg (33.75 lbs).

1.2.3 Environmental

Temperature:

Operating: 0°C to 50°C

Spec. Compliance: 20°C to 30°C

Storage: -40°C to 75°C

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

**SECTION II
EM-8500
OPERATING INSTRUCTIONS**

CAUTION

READ THIS SECTION BEFORE OPERATING THE EM-8500. IMPROPER OPERATION MAY DAMAGE THE DEMODULATOR OR THE SPECTRUM ANALYZER.

☞ READ THIS FIRST ☞

2.1 Operational Precautions

2.1.1 Signal Input Voltage Levels

Damage to the internal circuitry may result if signals larger than +15 dBm are applied.

2.2 Power Supply

2.2.1 Power Requirements

- a. 90 VAC to 250 VAC, 48 Hz-63 Hz.

NOTE: Internal power supplies can operate directly over the stated voltage and frequency ranges without the need to change either transformer taps or fuses.

CAUTION

To avoid electrical shock, the protective grounding conductor must be connected to earth ground.

2.2.2 Fuse Specifications

The EM-8500 uses the following fuse:

- a. 250 VAC 2.0 AMP 3AG SLO-BLO.

CAUTION

For continued fire protection, replace only with 250 VAC 2A fuse.

2.3 Description Front/Rear Panel

2.3.1 Front Panel

2.3.1.1 Input Selection Switches

Selects one of three inputs to the EM-8500 Demodulator: IF "A", IF "B", or VIDEO.

- a. **IF "A" Input Switch**

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Selects IF Input "A".

Standard IF Input "A" frequency is 310.7 MHz.

b. IF "B" Input Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Selects IF Input "B".

Standard IF Input "B" frequency is 160 MHz.

NOTE: Both IF "A" and IF "B" are applied via the rear panel IF INPUT Connector.

c. VIDEO Input Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Selects VIDEO Input.

The Video Input is only for sub-carrier demodulation. When selected, it forces the EM-8500 into the Sub-Carrier mode of operation. The IF Bandwidth Select, SC Source Select, Mode Select, and Gain switches are disabled. The remaining front panel switches function normally.

2.3.1.2 Audio Selection Switches

Selects one of five audio sources for the audio output applied to the front panel phone jack of the EM-8500 Demodulator: AM, FM, CW, SSB, LSB.

a. AM Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Selects the AM video as the source for the audio amplifier. The source depends on the Operating Mode selected: DIRECT OR SUB-CARRIER.

Direct Mode: Audio source is obtained from the main IF AM detector for the IF Bandwidth chosen.

Sub-Carrier Mode: Audio source is obtained from the Sub-Carrier IF AM detector chosen.

b. FM Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Selects the FM video as the source for the audio amplifier. The source depends on the Operating Mode selected: DIRECT OR SUB-CARRIER.

Direct Mode: Audio source is obtained from the main IF FM detector for the IF Bandwidth chosen.

Sub-Carrier Mode: Audio source is obtained from the Sub-Carrier IF FM detector chosen.

c. CW Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Turns on the BFO and selects the CW/SSB detector as the source for the audio amplifier.

CW is selectable in either the Sub-Carrier or Direct Modes of operation except for the following:

1) Direct Mode: The main IF Bandwidth must be ≤ 20 kHz, otherwise the CW function is disabled.

The frequency offset (from 455 kHz) of the BFO DDS (Direct Digital Synthesizer) is set using the EM-8500 front panel Tuning Control. The BFO offset selected is indicated on the front panel Frequency Display whenever BFO is selected using the Display Select Mode Switch. The BFO may be offset a maximum of 10.0 kHz. The offset selected will remain in effect for CW until changed by the operator. The offset setting is unaffected by the normal power on/off cycle of the unit.

d. USB Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Turns on the BFO and selects the CW/SSB detector as the source for the audio amplifier.

USB (Upper Side Band) is selectable in either the Sub-Carrier or Direct Modes of operation except for the following:

1) **Direct Mode:** The main IF Bandwidth must be ≤ 20 kHz, otherwise the USB function is disabled.

The frequency offset (from 455 kHz) of the BFO DDS (Direct Digital Synthesizer) is set using the EM-8500 front panel Tuning Control. The BFO offset selected is indicated on the front panel Frequency Display whenever BFO is selected using the Display Select Switch. The BFO may be offset a maximum of 10.0 kHz. The offset selected for USB is independent of the settings for CW or LSB. The offset selected will remain in effect for USB until changed by the operator. The offset setting is unaffected by the normal power on/off cycle of the unit.

e. LSB Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Turns on the BFO and selects the CW/SSB detector as the source for the audio amplifier.

LSB (Lower Side Band) is selectable and operates in the same manner as USB (2.3.1.2-d). Again the BFO offset is independent of the settings for CW and USB.

2.3.1.3 Audio Volume/Squelch Controls

The front panel Volume and Squelch Controls are used in conjunction with the Audio Selections Switches and the audio source selected.

a. Audio Volume Control

Type: Cermet single turn, 280° rotation, 10 kΩ.

Function: Used to adjust the audio output level to the front panel PHONE JACK.

b. Squelch Control

Type: Cermet single turn, 280° rotation, 10 kΩ.

Function: Used to adjust the level of audio noise present at the front panel Phone Jack.

2.3.1.3.1 Phone Jack

Type: Standard.

Function: Self-explanatory.

2.3.1.4 IF Bandwidth Select Switches

Type: Momentary pushbutton switch.

Number: 2.

Indicator: LED, integrated into switch.

Color: Red.

Function: Two (2) selection switches (DOWN/UP $\downarrow\uparrow$), used to select the IF Bandwidths (3 dB) for the EM-8500 in conjunction with the Mode Switch (DIRECT/SUB-CARRIER).

a. Direct Mode: The DN/UP ($\downarrow\uparrow$) switches are used to sequentially select one (1) of twelve (12) IF Bandwidths.

The IF Bandwidth selections follow this order:

2 Wideband: 50 MHz \geq 10 MHz.

5 Narrowband: 10 MHz \geq 75 kHz.

5 Extra Narrowband: 20 kHz-200 Hz.

The standard IF Bandwidths (3 dB) are:

Wideband: 30 MHz, 20 MHz,

Narrowband: 10 MHz, 4 MHz, 1 MHz, 300 kHz, 150 kHz,

Extra Narrowband: 20 kHz, 10 kHz, 3.2 kHz, 1 kHz, 200 Hz.

NOTE: The EM-8500 can have any optional arrangement of IF Bandwidths up to a total of 12. However, the bandwidths options must follow the sequence stated above.

The LED indicators in the DN/UP ($\downarrow\uparrow$) switches are independent of the switch function and denote whether the IF Bandwidth Display resolution is in MHz or kHz.

The EM-8500 allows only a sequential selection of the IF Bandwidths (i.e. only selectable in ascending/descending order).

NOTE: Whenever the EM-8500 is turned-on, the microprocessor scans and verifies the IF Bandwidths available.

b. Sub-Carrier Mode: The DN/UP switches can only select between IF Bandwidths of 300 kHz or 150 kHz.

When switching from the Direct mode to the Sub-Carrier mode, the mode switch change will force the IF Bandwidth to the widest available bandwidth (in Sub-Carrier, standard: 300 kHz) while the Sub-Carrier Bandwidth will be the bandwidth previously selected.

If the Video Input is selected, the IF Bandwidth Select Switches are disabled and the EM-8500 forced into the Sub-Carrier mode of operation.

2.3.1.4.1 IF Bandwidth Display

Type: Liquid Crystal Display, backlighted.

Function: Indicates the IF Bandwidth selected. The LED indicators in the DN/UP switches denote whether the IF BANDWIDTH DISPLAY resolution is in MHz or kHz.

2.3.1.5 Mode Switch

Type: Momentary pushbutton switch.

Indicator: LED (x2), integrated into switch.

Color: Red.

Function: To select either the Direct or Sub-Carrier Mode of operation for the EM-8500.

Whenever the Video Input is selected, the Mode Switch is disabled and the EM-8500 forced into the Sub-Carrier mode of operation.

2.3.1.6 Gain Mode Select Switch

Type: Momentary pushbutton switch.

Indicator: LED (x2), integrated into switch.

Color: Red.

Function: To select either the Manual or Auto Mode of gain control for the IF Bandwidth chosen. Active in both Direct and Sub-Carrier modes of operation.

If the Video Input is selected, the Gain Mode Select Switch and associated Gain Control (2.3.1.6.1) is disabled and the EM-8500 forced into the Sub-Carrier mode of operation.

2.3.1.6.1 Gain Control

Type: Wirewound 10-turn, 10 k Ω .

Function: Used to manually adjust the gain for the IF Bandwidth chosen. Maximum range: 120 dB.

Active in both Direct and Sub-Carrier modes of operation.

2.3.1.7 Sub-Carrier Bandwidth Select Switches

Type: Momentary pushbutton switch.

Number: 2.

Indicator: None.

Function: Two (2) selection switches (DOWN/UP ↓↑), used to select the Sub-Carrier Demodulator Bandwidths (3 dB) for the EM-8500.

The DN/UP switches are used to sequentially select one (1) of five (5) Sub-Carrier Bandwidths.

The standard Sub-Carrier Bandwidths (3 dB) are:

20 kHz, 10 kHz, 3.2 kHz, 1 kHz, 200 Hz.

NOTE: The EM-8500 can have any optional arrangement of Sub-Carrier Bandwidths up to a total of 5. However, the bandwidth options must follow the sequence stated above.

The EM-8500 microprocessor allows only a sequential selection of the Sub-Carrier Bandwidths (i.e. only selectable in ascending/descending order).

NOTE: Whenever the EM-8500 is turned-on, the microprocessor scans and verifies the Sub-Carrier Bandwidths available.

When switching from the Direct mode to the Sub-Carrier mode, the Sub-Carrier Bandwidth will be the bandwidth previously selected.

The Sub-Carrier Bandwidth Select Switches are always active in the Sub-Carrier mode of operation, whether selected by Mode Select Switch or Video Input.

2.3.1.7.1 Sub-Carrier Bandwidth Display

Type: Liquid Crystal Display, backlighted.

Function: Indicates the Sub-Carrier Demodulator Bandwidth selected. The Sub-Carrier Bandwidth Display resolution is in kHz.

2.3.1.8 Sub-Carrier Source Select Switch

Type: Momentary pushbutton switch.

Indicator: LED (x2), integrated into switch.

Color: Red.

Function: To select either the AM or FM IF detector for the Sub-Carrier demodulator bandwidth chosen.

If the Video Input is selected, the Sub-Carrier Source Select Switch is disabled and the EM-8500 forced into the Sub-Carrier mode of operation.

2.3.1.9 Sub-Carrier Gain Mode Select Switch

Type: Momentary pushbutton switch.

Indicator: LED (x2), integrated into switch.

Color: Red.

Function: To select either the Manual or Auto Mode of gain control for the Sub-Carrier Demodulator Bandwidth chosen. Active in the Sub-Carrier mode of operation, whether selected by Mode Select Switch or Video Input.

This is a separate and independent function from the IF Bandwidth Gain Control Selection Switch.

2.3.1.9.1 SC Gain Control

Type: Wirewound 10-turn, 10 k Ω .

Function: Used to manually adjust the gain for the Sub-Carrier Demodulator Bandwidth chosen. Maximum range: 120 dB.

Active in both Sub-Carrier modes of operation, Sub-Carrier mode select or Video Input select.

2.3.1.10 Tuning Control Section

This section includes the Tuning Control, Step Size Selection Switches, Frequency Display, Display Select Mode Switch, and Lock Switch.

The Tuning Section functions are active in both Sub-Carrier modes of operation (Sub-Carrier mode select or Video Input select) and when CW, USB, or LSB are selected using the Audio Selection Switches.

2.3.1.10.1 Tuning Control

Type: Digital Pulse Generator.

Function: Two (2) assigned functions.

a. Function 1

Conditions: Mode Switch: Sub-Carrier
Display Select Switch: SC

The Tuning Control tunes the selected sub-carrier video signal over a tuning range equal to the IF Sub-Carrier Bandwidth displayed (standard: 300 kHz/150 kHz). The bandwidth of the tuned video signal is set by the Sub-Carrier Bandwidth.

b. Function 2

Conditions: Audio Selection Switch: CW, USB, or LSB

Display Select Switch: BFO

The Tuning Control is used to individually set the BFO frequency offset for CW, USB, or LSB.

2.3.1.10.2 Tuning DN/UP Switches

Performs the same functions as the Tuning Control described in 2.3.1.10.1.

Type: Momentary pushbutton switch.

Number: 2.

Indicator: None.

Function: Two (2) assigned functions, same as the Tune Control.

a. Function 1

Conditions: Mode Switch: Sub-Carrier

Display Select Switch: SC

Two (2) selection switches (↓↑), used to tune the selected sub-carrier video signal over a tuning range equal to the IF Sub-Carrier Bandwidth displayed (standard: 300 kHz/150 kHz). The bandwidth of the tuned video signal is set by the Sub-Carrier Bandwidth.

b. Function 2

Conditions: Audio Selection Switch: CW, USB, or LSB

Display Select Switch: BFO

Two (2) selection switches (↓↑), used to individually set the BFO frequency offset for CW, USB, or LSB.

2.3.1.10.3 Step Size Selection Switches

Type: Momentary pushbutton switch.

Number: 3.

Indicator: LED, integrated into switch.

Color: Red.

Function: Sets the tuning resolution of the Tuning Control at step sizes of 10 Hz, 100 Hz, or 1 kHz. Valid for either Sub-Carrier Tuning or BFO offset selection.

2.3.1.10.4 Frequency Display

Type: Liquid Crystal Display, backlighted.

Function: Indicates either the frequency of the sub-carrier tuned selected video signal or the BFO offset selected for CW, USB, or LSB. The Frequency Display resolution is in kHz.

2.3.1.10.5 Display Select Mode Switch

Type: Momentary pushbutton switch.

Indicator: LED (x2), integrated into switch.

Color: Red.

Function: To select either the SC (Sub-Carrier) or BFO mode of operation for the Tuning Control and Frequency Display.

2.3.1.10.6 Lock Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: To disable (lock) the front panel Tuning Section. The Lock LED Indicator is activated whenever this condition is selected.

2.3.1.11 Switched Video Out Select Switch

Type: Momentary pushbutton switch.

Indicator: LED (x2), integrated into switch.

Color: Red.

Function: Selects AM or FM Video source for the rear panel Switched AM/FM Video Output Connector.

2.3.1.12 Signal Strength Indicator

Type: LED Bargraph Display.

Color: Red.

Function: Indicates the relative amplitude of the modulation signal for the IF or Sub-Carrier Bandwidth plus Audio Function chosen. In AM, it indicates the modulation on the AM Video. In FM, the modulation on the FM Video, etc. The scale is linear with video level.

2.3.1.13 Local/Remote Switch

Type: Momentary pushbutton switch.

Indicator: LED, integrated into switch.

Color: Red.

Function: Two assigned functions.

a. Function 1

Conditions: EM-8500 in the remote of operation, no Local Lockout command in effect.

If the Remote Switch is pushed, returns control of the EM-8500 to the local (manual) mode of operation from the remote (computer) mode of operation.

The Remote LED indicator is activated whenever the remote mode of operation is selected (via computer command only, IEEE Bus).

b. Function 2

Conditions: EM-8500 in the local mode of operation, Remote LED off.

If the Remote Switch is pushed, the EM-8500 GPIB Bus Address will be displayed on the front panel SC Bandwidth Display. The Remote LED Indicator will flash whenever this condition is selected.

In this mode of operation, the SC Bandwidth Switches can be used to change the Bus Address as follows:

- 1) Push the UP (↑) SC Bandwidth Switch to increase the Bus Address number,
- 2) Push the DOWN (↓) SC Bandwidth Switch to decrease the Bus Address number,

In addition:

The EM-8500 Firmware Version number will be displayed on the front panel IF Bandwidth Display.

The IF Inputs available within the EM-8500 will be displayed on the front panel Frequency Display. Pushing the front panel Input Selection Switches "A" or "B" will indicate the IF INPUT frequency assigned to each input. The firmware will automatically update the IF INPUT assignment whenever the internal modules are changed.

NOTE: The IF "B" INPUT is always assigned the 160 MHz IF input.

Pushing the Remote Switch a second time, restores the displays and switches to a normal mode of operation.

2.3.1.14 ON/OFF (Power) Switch

Type: Two cycle rocker switch

Function: Self-explanatory.

2.3.2 Rear Panel

2.3.2.1 AC Power Connector

Type: Integrated AC power connector with RFI power line filter.

Current Rating: 1 Amp.

Operating Frequency: 48-63 Hz.

Voltage Range: 90-250 VAC.

Function: Self explanatory.

2.3.2.2 AC Fuse Holder

Type: Panel mount.

Current Rating: 20 Amp.

Voltage Rating: 250 VAC.

Function: Self explanatory.

2.3.2.3 GPIB Connector

Type: IEEE Std 488.2-1987 General Purpose Interface Bus Connector (24-pin).

Function: Interfacing a computer with the EM-8500.

2.3.2.4 Input/Output Connectors

a. IF Input Connector

Type: BNC, male.

Function: Standard 310.7 MHz/160 MHz or optional IF input to unit.

b. Video Input Connector

Type: BNC, male.

Function: External Sub-Carrier video input to unit.

c. AM Video Output Connector

Type: BNC, male.

Function: AM Video from AM detector (IF bandwidth source mode dependent).

d. FM Video Output Connector

Type: BNC, male.

Function: FM Video from FM detector (IF bandwidth source mode dependent).

e. AM/FM Output Connector

Type: BNC, male.

Function: Front panel, switch selectable AM or FM Video.

f. Reference Input/Output Connector

Type: BNC, male.

Function: Either external 10 MHz reference input or internal 10 MHz reference output, -2.0 to +10 dBm level.

2.4 Operating Procedure

2.4.1 Initial Power-Up Procedure

- a. Connect the AC power cord to the selected AC power source.

CAUTION

To avoid electrical shock, the EM-8500 must be plugged into a grounded outlet.

- b. The unit is turned on by pushing the power switch to the "ON" (3) position.
- c. A self-test procedure is initiated at power turn-on, sequencing as follows:
- 1) All front panel LEDs' activated,
 - 2) LCD Displays activated showing 8888 across the displays.
 - 3) At end of self-test sequence, the front panels control settings will revert to the control settings at the moment the unit was turned off.

If the above self-test sequence does not occur, or all LEDs' do not activate, or the front panel controls do not revert to the identical settings at the moment of unit turn off, it may indicate problems with the microprocessor or front panel PC board. Contact Electro-Metrics (518) 762-2600 or your nearest Electro-Metrics representative for any assistance required.

- d. The unit is now ready for manual operation, Section 2.5.

NOTE: The front panel Local Switch can only switch the unit to Local from the Remote mode of operation.

2.5 Manual Operation

To operate the EM-8500 manually:

- a. Follow the Initial Power-Up procedure in Section 2.4.1 a thru d.
- b. Use the front panel Input Selection Switches to select the input selection desired (IF A, IF B, or VIDEO). The Input selected will be indicated by the activated LED integrated into the switch.
- c. Connect the selected IF Output from the spectrum analyzer to the EM-8500 rear panel IF Input Connector or the selected Video Output to the EM-8500 rear panel Video Input. The EM-8500 Demodulator is now ready for operational use.

2.6 Remote Operation

The EM-8500 Preselector is operated remotely using a computer supplying control information through the IEEE Std 488.2-1987 General Purpose Interface Bus (GPIB).

Section 2.6.1 provides a typical equipment setup for operation using the GPIB interface.

Sections 2.6.2 thru 2.6.9 are intended to provide the user with a *brief explanation* of the GPIB IEEE codes and command information plus the overall Preselector/computer operating command structure. For more complete and detailed information, refer to the ANSI/IEEE Std 488.2-1987 Standards handbook on Standard Codes, Formats, Protocols, and Common Commands.

The commands listed in Section 2.6 are all EM-8500 device dependent commands issued as ASCII commands over the GPIB. The syntax of each command is given in Section 2.6.9.1. EM-8500 Device Dependent Commands are listed in Section 2.6.9.2. In each case listed, the EM-8500 is a listener as defined in the IEEE Std 488.2-1987.

2.6.1 Equipment Setup

NOTE: The following setup assumes a test system consisting of an EM-8500 Preselector, spectrum analyzer, and computer.

To operate the EM-8500 remotely:

- a. Connect the GPIB Cable (24 pin) to the EM-8500 rear panel IEEE STD 488 PORT Connector.
- b. Connect the selected IF Output from the spectrum analyzer to the EM-8500 rear panel IF Input Connector or the selected Video Output to the EM-8500 rear panel Video Input.
- c. Verify that no other device is assigned the Bus Address for the EM-8500. If assigned to another device, use the procedure in 2.3.1.13-b to select a new bus address for the unit. The new bus address is implemented immediately upon being entered.

NOTE: Always verify that each device on the GPIB network is assigned its own unique bus address before activating the network.

- d. Follow the Initial Power-Up procedure in Section 2.4.1 a thru d.
- e. Turn on the spectrum analyzer.
- f. Turn on the computer and initiate the software being used.
- g. Connect the selected RF source to the spectrum analyzer RF Input Connector. The EM-8500 and associated equipment is now ready for remote operation.

2.6.2 Interface Function Codes

The EM-8500 GPIB operates as both a talker and a listener. The GPIB is compatible with the IEEE STD 488 interface function codes listed in Table 2.1.

TABLE 2.1
IEEE STD 488 INTERFACE FUNCTION CODES

CODE	DESCRIPTION
AH1	Acceptor Handshake Capability
L4	Listener (Basic Listener, Unaddressed to Listen on TAG)
SH1	Source Handshake Capability
T6	Talker (Basic Talker, Serial Poll, Unaddressed to Talk On LAG)
SR1	Service Request Capability
PP1	Parallel Poll Capability (Remote Configuration)
DC1	Device Clear Capability
DT0	No Device Clear Capability
RL1	Remote/Local Capability
C0	No Controller Capability
E1	Open Collector Bus Drivers
TE0	No Extended Talker Capabilities
LE0	No Extended Listener Capabilities

NOTE: The codes listed in Table 2.1 are also marked above the rear panel GPIB Connector.

2.6.3 Bus Address

The bus address can be changed at any time, refer to the procedure in Paragraph 2.3.1.13-b. The new bus address is implemented immediately upon being entered.

2.6.4 Remote Operation

To put the device into the remote mode, the remote command must be used to toggle the REN line. If the remote command is sent as an addressed command group (UAGC), the EM-8500 will go into the remote mode immediately. The format of the commands are shown below for the HP-9836 Computer.

REMOTE 710 <EXECUTE>

Where 710 corresponds to device 10 on the bus.

If a universal command is used, i.e. REMOTE 7 on a HP9836, the device will not go into remote until addressed as a listener or talker.

The front panel REMOTE LED is activated whenever the unit is in the remote mode of operation.

The EM-8500 can be controlled via the computer without going into the remote mode of operation. This is accomplished by not toggling the REN line. The EM-8500 will now accept commands from the computer but is still in the local mode of operation.

2.6.5 Local/Local Lockout Commands

The EM-8500 may be commanded to lockout all the front panel pushbutton switches using a GPIB command. The local lockout command can only be cancelled with a GPIB "GO TO LOCAL" command. The format of the commands are shown below for the HP-9836 Computer.

LOCAL LOCKOUT:

LOCAL LOCKOUT 7

LOCAL:

LOCAL 7

NOTE: This command should not be implemented unless the REN line has been asserted by using the Remote command. Otherwise, the user will not be able to control the EM-8500 manually or remotely.

If a Local Lockout has not been commanded, the EM-8500 may be brought into the Local mode by pushing the front panel Local Switch.

2.6.6 Polling

The computer may periodically check devices on the bus to determine if a particular device needs service, or in response to SRQ to determine which device requested service. Two types of polling may be performed, serial or parallel.

2.6.6.1 Serial Poll

When performing a serial poll, the computer can access each device on the bus individually to read an eight-bit status byte. The computer is then informed of the nature of service required by the polled device. The EM-8500 returns a status byte as shown in Table 2.2.

**TABLE 2.2
STATUS BYTE INFORMATION**

LINES	(8)	(7)	(6)	(5)	(4)	(3)	(2)	(1)
BITS	7	6	5	4	3	2	1	0
VALUE	128	64	32	16	8	4	2	1

MEANING: BIT 0: 1 = hardware error
 BIT 4: 1 = MAV: Message Available
 BIT 5: 1 = ESB
 BIT 6: 1 = requested service

If the status byte read back is equal to 65, then this indicates that **BIT 6 = 1 (64)** and **BIT 0 = 1 (1)**. In this case, the EM-8500 has requested service for a hardware error.

2.6.6.2 Parallel Poll

Parallel polling provides the computer a quick way to check if any devices require service or to determine which device requested service. The computer can configure the EM-8500 to respond on any one of eight data lines with up to two devices per data line. When performing a parallel poll the device needing service will assert the particular line assigned to it. This allows the computer to see all devices on the bus at once and attend to only those requiring service. When two devices are assigned to one line, a serial poll of each device will be necessary to determine which of the two require service.

Please refer to your computer software manual for complete details of parallel poll configure and parallel poll unconfigure.

2.6.7 SRQ (Service Request)

The service request is a signal that the EM-8500 can send to the computer to let it know that the unit requires some kind of attention. When the SRQ is enabled, using the Service Request Enable Register (*SRE) common command, the unit will assert the SRQ line of the GPIB. This can occur whenever a hardware error has occurred in the unit dependent upon the SRQ Mask settings.

The unit will assert SRQ until the computer performs a serial poll, or the fault condition is corrected.

To enable the EM-8500 to SRQ the computer the *SRE function must be used in the following form:

*SRExxx where xxx is equal to the value of the bits corresponding to the condition that will SRQ the computer.

If an SRQ is desired for a hardware error condition then the value of xxx will be 1 (**BIT 0 = 1**).

An example is shown below for an HP-9836 Computer:

Type: OUTPUT 701;"*SRE1" (hit Execute)

With xxx = 0, the EM-8500 will never request service (default condition).

Please refer to previous section on Serial Poll for bit assignments.

NOTE: The SRE function will not put the EM-8500 into the remote mode. Only numeric values in the range of 0 to 255 should be used with the *SRE function, otherwise unexpected results may occur.

2.6.8 Device Clear

The DCL command may be used to clear the output/input buffers, event status register, and reset the command parser of the unit.

An example is shown below for an HP-9836 Computer:

Type: CLEAR 7 (hit Execute)

The SDC command performs the same function as DCL except that only the addressed device responds.

An example is shown below for an HP-9836 Computer:

Type: CLEAR 701 (hit Execute)

2.6.9 Control Commands

2.6.9.1 Common Commands Available

The common commands used to operate the EM-8500 via the GPIB interface are listed in Table 2.3.

**TABLE 2.3
IEEE COMMON COMMANDS**

MNEMONIC	COMMAND NAME
*CLS	Clear Status Command
*ESE	Standard Event Status Enable Com- mand
*ESE?	Standard Event Status Enable Query
*ESR?	Standard Event Status Register Query
*IDN?	Identification Query
*IST?	Individual Status Query
*OPC¹	Operation Complete Command
*OPC?¹	Operation Complete Query
*PRE²	Parallel Poll Register Enable Command
*PRE?	Parallel Poll Register Enable Query
*RST	Reset Command
*SRE	Service Request Enable Command
*SRE?	Service Request Enable Query
*STB?	Read Status Byte Query
*TST?	Self Test Query
*WAI¹	Wait-To-Continue Command

- NOTE:**
- 1) *OPC, *OPC?, *WAI are commands used for device synchronization. Since the EM-8500 processes all commands in sequence, the *WAI command always continues immediately. *OPC sets the operation complete bit in the event status register as soon as it is parsed. Similarly, the *OPC? query puts an ASCII "1" in the output buffer and sets the MAV status bit in the status byte register when it is parsed.
 - 2) *PRE command is limited to a value of 0-255 ASCII encoded data byte since the status byte register is only 8-bits in length.

2.6.9.2 EM-8500 Device Dependent Commands

EM-8500 Device Dependent Commands are listed in Table 2.4.

**TABLE 2.4
DEVICE DEPENDENT COMMAND SUMMARY**

FUNCTION	COMMAND	DESCRIPTION
IF BANDWIDTH	IFB UP	Steps Bandwidth up one setting.
	IFB DN	Steps Bandwidth down one setting.
	IFB xxxxxxMHZ IFB xxxxxxKHZ IFB xxxxxxHZ	Sets Bandwidth to specific value, xxxxxx is numeric.
SUB CARRIER BANDWIDTH	SCB UP	Steps Bandwidth up one setting.
	SCB DN	Steps Bandwidth down one setting.
	IFB xxxxxKHZ IFB xxxxxxHZ	Sets Bandwidth to specific value, xxxxxx is numeric.
DETECTION	DM AM DM FM DM CW DM LSB DM USB	Sets selected detection mode.
MODE	MO S MO D	Sets Sub Carrier. Sets Direct.
INPUT	INP A INP B INP V	Sets selected input.
VIDEO OUT	VO AM VO FM	Sets selected Video Out.
GAIN	GN A GN M	Sets direct gain auto Sets manual.
SUB CARRIER GAIN	SCG A SCG M	Sets selects Subcarrier Gain. A = auto, M = manual.
SUB CARRIER SOURCE	SCS AM SCS FM	Sets select Subcarrier Source.
DISPLAY	BFO SC	Sets selected Frequency Display.

**TABLE 2.4
DEVICE DEPENDENT COMMAND SUMMARY**

FUNCTION	COMMAND	DESCRIPTION
FREQUENCY	FT xxxxxxMHZ FT xxxxxxKHZ FT xxxxxxHZ	Sets Sub Carrier Frequency. xxxxxx is numeric.
BFO FREQUENCY	BFB xxxxxxKHZ BFB xxxxxxHZ	Sets BFO Frequency. xxxxxx is numeric.
LOCK	LK ON LK OFF	Sets knob lock on. Sets knob lock off.
FREQUENCY STEP SIZE	FSS xxxxxxKHZ FSS xxxxxxHZ	Sets selected Frequency step size. xxxxxx is numeric.
FREQUENCY STEP	TN UP TN DN	Tune display frequency up one step size. Tune display frequency down one step size.
QUERY FREQUENCY	FSC?	Query command puts subcarrier frequency in output buffer, readback by computer will return frequency.
QUERY BANDWIDTHS	BWS?	Query command puts list of available bandwidths in output buffer, readback by computer will return array of 12 bandwidth values.

**SECTION III
EM-8500
IF INPUT OPTIONS SELECTION/INSTALLATION**

3.1 Introduction

Section III contains the information and data for gaining access to the interior of the EM-8500 plus locating/ installing the frequency options available for the unit.

3.2 Internal Access

NOTE: **The following procedures are performed with AC power removed from the EM-8500.**

3.2.1 Case Removal

To remove the case from the EM-8500:

UNIT ORIENTATION: Rear EM-8500 looking towards front.

- a. Remove the six (6) Phillips head screws (6-32 x 1/4) which secure the case to the unit. The six (6) screws are located as follows:
 - 1) **Rear Bottom:**
 - Right of Fuse Holder,
 - Above GPIB Connector,
 - Right of REF IN/OUT BNC Connector.
 - 2) **Rear Top:**
 - Above right hand power cord holder.
 - Above left hand power cord holder.
 - Center, above similar screw GPIB Connector.
- b. Tip the unit onto its front panel. Use a piece of foam rubber or similar material to prevent damage to the front panel.
- c. Pull the case up and off the internal chassis.
- d. To install the external case, reverse the above procedure.

3.2.2 Top Cover Removal

To remove the top cover from the EM-8500 internal chassis:

UNIT ORIENTATION: Front EM-8500 looking towards rear.

- a. Remove the eight (8) Phillips flat-head screws (4-40 x 3/8) from the top of the cover (four each front/rear).
- b. Remove the eight (8) Phillips flat-head screws (4-40 x 3/8) from the sides of the chassis (four each side).
- c. Remove the top cover by lifting up the rear edge and pulling the cover up and off.
- d. To replace the top cover, reverse the above procedure.

NOTE: 1) The flanges of the cover fits inside the chassis box with the cutout on the right hand side (orientation front to rear).

2) Top screws secure into pems located on the chassis while the side screws secure into pems inserted into the cover flange.

3.3 IF Frequency Options Available

The EM-8500 can utilize the following IF frequencies:

310.7 MHz (standard)
 160.0 MHz (standard)
 110.0 MHz (Opt.01)
 10.7 MHz (Opt.02)

In addition to the above listed frequencies, other IF frequencies options are available. Contact Electro-Metrics for availability and price.

The EM-8500 has the capability within the unit to operate with three (3) different IF frequencies. The 160 MHz IF capability is always available as the standard IF frequency. The two remaining options are available as follows:

- a. One installed--active, nominally 310.7 MHz,
- b. The other installed--stored inactive.

The options being varied are the phase lock oscillators used for the LO Input to several mixers within the unit. These are assigned as follows:

IF INPUT

310.7 MHz
 110.0 MHz
 10.7 MHz

PHASE LOCK OSCILLATOR

470.7 MHz
 270.0 MHz
 80.7 MHz

The active phase lock oscillator is installed in Slot J8 and given the Designation A1A8. The inactive phase lock oscillator is installed in Storage Slot J11 and given the Designation A1A11.

The 160 MHz IF input is designated the standard input for the EM-8500 and is always selected using the **IF "B" INPUT Select Switch**.

The 310.7 MHz, 110.0 MHz, and 10.7 MHz IF inputs (plus any other optional IF inputs) are always selected using the **IF "A" INPUT Select Switch**. The 310.7 MHz IF Input is nominally designated as the 2nd standard input for the EM-8500.

3.4 Installation--Phase Lock Oscillator Options

In the following procedure, a 470.7 MHz Phase Lock Oscillator (310.7 MHz IF Input) is being replaced by a 80.7 MHz Phase Lock Oscillator (10.7 MHz IF Input). **Procedure is performed with AC power removed from the EM-8500.**

- a. Remove the external case from the EM-8500 following the procedure in 3.2.1.
- b. Remove the Top Cover from the internal chassis following the procedure in 3.2.2.
- c. Locate the A1A8 Module (470.7 ϕ Lock Osc.). Remove the following cables:
 - 1) Cable J075-8 from A1A8-J2.
 - 2) Cable J075-11 from A1A8-J3.
- d. Remove the A1A8 Module (470.7 MHz ϕ Lock Osc.) and exchange it with the A1A11 Module (80.7 ϕ Lock Osc.). At this point, the modules exchange designations, i.e. A1A8 becomes A1A11 and vice versa.
- e. Reconnect the following cables:
 - 1) Cable J075-8 to "new" A1A8-J2.
 - 2) "New" Cable J075-16 to "new" A1A8-J3 and A1A12-J2.
- f. Re-install Top Cover onto the internal chassis and the external case onto the EM-8500.
- g. Reconnect the external AC power source and turn on the unit. The internal micro-processor will automatically recognize the phase lock oscillator (80.7 MHz) installed in A1A8 and reconfigure the unit accordingly. Thus, the IF "A" INPUT IF frequency is 10.7 MHz.

Other phase lock oscillator options are installed in a similar manner. Use the information in Table 3-1 to determine the cabling connections required.

**TABLE 3.1
PHASE LOCK OSCILLATOR OPTIONS
CABLES/CONNECTORS/DESTINATIONS**

470.7 MHz ϕ LOCK OSC. ASSY J053 IF INPUT = 310.7 MHz

CONNECTOR	CABLE ASSEMBLY	DESTINATION
J2	J075-8	A1A1-J4 10 MHz REF ASSY J062
J3	J075-11	A1A2-J3 1st CONVERTER ASSY J025

270.0 MHz ϕ LOCK OSC. ASSY J068 IF INPUT = 110.0 MHz

CONNECTOR	CABLE ASSEMBLY	DESTINATION
J2	J075-36	A1A1-J5 10 MHz REF ASSY J062
J3	J075-11	A1A2-J3 1st CONVERTER ASSY J025

80.7 MHz ϕ LOCK OSC. ASSY J059 IF INPUT = 10.7 MHz

CONNECTOR	CABLE ASSEMBLY	DESTINATION
J2	J075-8	A1A1-J4 10 MHz REF ASSY J062
J3	J075-16	A1A2-J2 1st CONVERTER ASSY J034

FIGURE 3-1
EM-8500 LOCATION GUIDE