FMSA-1
Precision Digital
FM Stereo
Modulation Monitor/Analyzer

Guide to Operations

2/99

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Thank you for purchasing the FMSA-1 Digital FM Stereo Monitor/Analyzer from Belar. Although the monitor is simple to operate, it has so many features and capabilities that a few minutes spent with this Guide will enable you to get the most out of your purchase.

We also ask that you take a moment now to fill out and return the enclosed product registration form. It will allow us to keep you informed of future product developments at Belar. In addition, if you return the registration card, you will receive one full year of FREE upgrades to the FMSA-1 (firmware) and The Wizard Software. In the event that we make a major improvement or enhancement to the FMSA-1 or The Wizard Software, we will send you FREE a new EPROM (chip) for the FMSA-1 as well as the latest Wizard Software disk.

PLEASE FILL OUT AND RETURN THE FORM TODAY!!!

(If you can't find the form, just send us a note with your name, company, address, and phone and FAX numbers.)

1 General Information

1-1 General Description

The Belar FMSA-1 Stereo Modulation Monitor and Analyzer is a DSP based precision stereo monitor designed to operate in conjunction with the Belar FMMA-1 "The Wizard" baseband modulation monitor/analyzer.

The FMSA-1 digitizes the composite and decodes the stereo multiplex signal using digital signal processing techniques. Unlike an analog design, a DSP based design is not subject to variations due to temperature, component aging, or component tolerances. The resulting circuit requires virtually no adjustments, but can achieve extremely tight tolerances. In addition, the DSP design allows the use of FIR linear phase filters which eliminate phase distortion. The elimination of phase distortion allows the FMSA-1 to measure modulation peaks on the left, Right, L+R and L-R more accurately than with traditional techniques. All of these advances are possible because a design implemented using DSP is strictly a matter of software.

The FMSA-1 also digitizes all measurements. By digitizing the measurements the user can display modulation peaks, injections, and dB readings directly. As an added benefit, all readings can be viewed remotely using the FMMA-1 or the RS-232 port and a personal computer. The ability to display measurements remotely will make a remote proof possible when the FMSA-1 is combined with a distortion analyzer such as the Audio Precision.

1-2 Specifications

Metering ..... Total, Left, Right, L + R, L - R, Pilot, Pilot Modulation, 38 kHz Suppression

Modulation Display Range ..... 0-127% in 1% increments, accuracy ±0.5%
Pilot Injection Range ..... 0-12.7% in 0.1% increments

Input ..... Composite, 100 kΩ, unbalanced, BNC Connector, 1.0 - 2.0 Vrms (2.8 V - 5.7 V P-P).

Outputs:
- Left and Right Audio (Program) ..... +10 dBm, 600 Ω balanced
- Left and Right Test ..... 2.5 Vrms, 75 Ω unbalanced
- Left and Right Scope ..... 1.3 Vrms, 75 Ω unbalanced
- Pilot ..... 2 VP-P, 499 Ω unbalanced
- Left and Right Digital ..... AES/EBU, 48 kHz

Separation:
- Left to Right ..... 80 dB, 10 Hz to 15 kHz
- Right to Left ..... 80 dB, 10 Hz to 15 kHz

Crosstalk:
- L + R to L - R, L -R to L + R (matrix) ..... 80 dB min
- L + R to L - R, L -R to L + R (direct) ..... 90 dB min
- SCA to L + R ..... 90 dB min
- SCA to L - R ..... 90 dB min
- SCA Interference ..... 90 dB min

Audio Output Specifications:

Frequency Response, Left and Right	±0.05 dB flat, 50 to 15 kHz, ±0.25 dB de-emphasized
SNR, with de-emphasis, Left and Right	90 dB
Harmonic Distortion	0.01% max, 50 to 15 kHz
Intermodulation Distortion	0.01% max (SMPTE)

Serial Interface	RS-232
Unit Interface	Wizard Standard Interface

Remote Meter Outputs:

Left Channel Analog Meter, Right Channel Analog Meter, Pilot LED, Pilot Relay (for interface to Model MP-15 Analog Meter Panel - optional)

Dimensions	1 EIA Rack Unit, 1.75"H x 14"D x 19"W
Power Requirements	25 watts, 100-240 VAC. 50-60 Hz
Shipping Weight	12 lbs

2 Unpacking

2-1 Initial Inspection

Check the shipping carton for external damage. If the carton exhibits evidence of abuse in handling (holes, broken corners, etc.) ask the carrier's agent to be present when the unit is unpacked. Carefully unpack the unit and inspect all equipment for physical damage immediately after unpacking. Bent or broken parts, dents and scratches should be noted. If damage is found, refer to Paragraph 2-2 for the recommended claim procedure. Keep all packing material for proof of claim or for possible future use.

The FMSA-1 is shipped with a Guide to Operations, 4 black rack-mount screws with cup washers, a BNC jumper, a Wizard ribbon interface cable, and a three-wire line cord.

2-2 Claims

If the unit has been damaged, notify the carrier immediately. File a claim with the carrier or transportation company and advise Belar of such action to arrange the repair or replacement of the unit without waiting for a claim to be settled with the carrier.

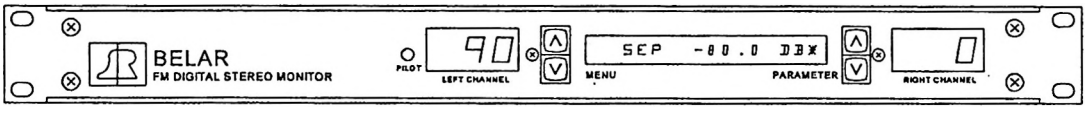
2-3 Repacking for Shipment

If the unit is to be returned to Belar, attach a tag to it showing owner and owner's address. A description of the service required should be included on the tag. The original shipping carton and packaging materials should be used for reshipment. If they are not available or reusable, Belar can provide a replacement box and packaging at a nominal cost. Alternatively, the unit should be repackaged in the following manner:

a) Use a double-walled carton with a minimum test strength of 275 pounds.
b) Use heavy paper or sheets of cardboard to protect all surfaces.

c) Use at least 4 inches of tightly packed, industry approved, shock absorbing material such as extra firm polyurethane foam or rubberized hair. **Newspaper is not sufficient for cushioning material!**
d) Use heavy duty shipping tape to secure the outside of the carton.
e) Use large **FRAGILE** labels on each surface.
f) Return the unit, freight prepaid, via air freight. Be sure to insure the unit for full value.

3 Front Panel Operation



The green **PILOT** LED is illuminated when the unit detects the 19 kHz pilot. At least 6% injection is required to illuminate this light.

The **LEFT CHANNEL** display usually displays the left channel modulation, expressed in percent modulation. When the unit is measuring crosstalk (XTALK displayed in the menu/parameter window), this display shows L+R.

The **RIGHT CHANNEL** display usually displays the right channel modulation, expressed in percent modulation. When the unit is measuring crosstalk (XTALK displayed in the menu/parameter window), this display shows L-R.

The **MENU/PARAMETER WINDOW** is a 16 character alphanumeric display that displays menu selections and associated parameters or measurements.

To the left of the Menu/Parameter Window, the **UP** and **DOWN MENU** buttons are used to scroll through the various menu selections of the FMSA-1. The menu selections are arranged in two loops, one for measurements and one for settings. Either the UP or DOWN button will get you to your menu choice -- but usually one direction will get you there quicker than the other.

To the right of the Menu/Parameter Window, the **UP** and **DOWN PARAMETER** buttons are used to scroll through the available settings for a given menu selection, where applicable. One loop, which includes the display shown in the figure above (your measured separation may be different, of course), consists of all of the measurements the FMSA-1 can make, as well as the display SET PARAMETERS. The other loop (accessed by pressing the UP PARAMETER button at the SET PARAMETERS window) consists of all the setable parameters in the unit, such as hold time, time mode, etc. These parameters are all explained in *Section 3-1 & 3-2 Menu Selections*, following.

3-1 Menu Selections: Measurements

Below is a summary of all the menu selections available on the FMSA-1.

TOTAL XXX % — Displays total peak modulation expressed in percent. The range is 0-127%.

L + R XXX % — Displays L + R peak modulation in percent. The range is 0-127%.

L - R XXX % — Displays L - R peak modulation in percent. The range is 0-127%.

PILOT INJ XX.X % — Displays the Pilot Injection in percent. The range is from 0% to 12.7% in 0.1% increments.

PILOT MOD XXX % — Displays the Pilot Modulation (AM Modulation of the pilot) in percent. The range is 0-127%. This measurement is a good indication of multipath when the unit is used for off-air monitoring. This measurement will also increase when composite clipping is used.

IMPORTANT NOTE: The following dB measurements are referenced to 0 dB = 100% modulation, and are true rms readings. DB measurements can be measured with or without de-emphasis. When the measurement is *with* de-emphasis, an asterisk (*) will appear after the DB in the menu/parameter window. Pressing the UP PARAMETER button lights the * to the right of the DB and shows the de-emphasized measurement. Pressing the down arrow turns off the * and the de-emphasis.

LEFT -XX.X DB* — Displays left channel modulation in dB.

RIGHT -XX.X DB* — Displays right channel modulation in dB.

SEP -XX.X DB* — Displays separation in dB. Note that this measurement is designed for use with test tones during a proof. It is not possible to determine separation while the unit is measuring program material.

L + R -XX.X DB* — Displays the L+R (mono) component of the stereo signal in dB.

L - R -XX.X DB* — Displays the L-R (stereo) component of the stereo signal in dB.

XTALK -XX.X DB* — Displays crosstalk in dB. Note that this measurement is designed for use with test tones during a proof. It is not possible to determine crosstalk while the unit is measuring program material. When this menu is displayed, the LEFT CHANNEL window is showing L + R, and the RIGHT CHANNEL menu is showing L - R.

TOTAL -XX.X DB* — Measures total modulation in dB (0 dB = 100%).

PILOT -XX.X DB* — Measures pilot injection in dB.

38 KHZ -XX.X DB* — Measures the 38 kHz subcarrier suppression in dB.

MODIFY SETTINGS — Press the UP PARAMETER arrow to exit the measurement section of the FMSA-1 and enter the parameter settings section of the unit. The parameter section is where you configure the unit to your preferences. The parameter settings are described below.

3-2 Menu Selections: Parameters

HOLD XX.X SEC
HOLD - EXT — Determines the interval that readings are updated on the display when in past time. Also selects the length of time that the display is held when in real time. This is user selectable in 0.5 second increments from 0.5 to 10.0 seconds, plus EXT. HOLD - EXT is an external sync and should be used when the unit is interfaced with the FMMA-1. In this case the hold time is set to that of the FMMA-1.

TIME MODE - REAL/PAST — Determines the mode in which peaks are displayed. In REAL time mode the display is updated immediately as soon as a new peak is detected. In PAST time mode the unit waits the HOLD time and displays the highest peak which occurred in that interval.

INFINITE - ON/OFF — Enables or disables infinite hold of display. If infinite hold is enabled, the display acts as a "high water mark" and will "stick" at the highest modulation (until infinite hold is turned off).

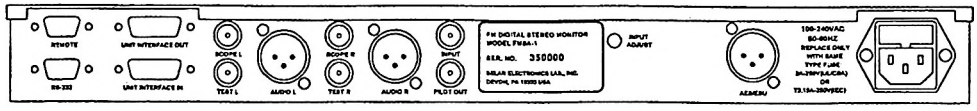
REMOTE - ON/OFF — Enables or disables the RS-232 port. This allows users to enable or block remote access to the unit. Remote cannot be turned off while the unit is in remote mode (someone is communicating remotely). Remote also cannot be turned off remotely.

SAVE CONFIG — Allows user to save all parameters to internal EEPROM so that the unit configuration is preserved when power is removed. Press the UP PARAMETER to save the configuration.

XTALK - DIRECT/MATRIX — Toggles the way crosstalk measurements are made. In the DIRECT mode, crosstalk measurements are made directly on the L+R and L-R; however, the DIRECT mode will cause the Left Audio Output to switch to L+R and the Right Audio Output to switch to L-R when measuring XTALK, L+R, and L-R. (This can be disconcerting if you are using the audio outputs to drive house monitors.) In the MATRIX mode, the measurements are derived by matrixing the left and right outputs, which does not affect the audio outputs.

EXIT ? — Press the UP PARAMETER arrow to exit the parameter setting section of the FMSA-1 and enter the measurement section of the unit. The measurement section is where the unit displays most of its measurements (pilot injection, etc.).

4 Rear Panel



Input — Composite, 100 kΩ, unbalanced, BNC Connector, 1.0 - 2.0 Vrms (2.8 V - 5.7 VP-P).

Pilot Out — Pilot output, 2 VP-P, 499 Ω source.

Audio L
Audio R — Audio outputs (left and right), 600 Ω, balanced, +10 dBm, XLR-type connector. Pin 1 is ground, pin 2 is +, pin 3 is -. These outputs have internally selectable de-emphasis, and have been set for 75 µsec de-emphasis unless 50 µsec was specified when ordered. The de-emphasis can be changed by moving jumpers P1 (Audio L) and P3 (Audio R) on the A1 board (the large board). For the locations of these jumpers see the *FMSA-1 A1 Board De-emphasis Settings* drawing in *Section 9*.

Test L
Test R — Test outputs (left and right), 2.5 Vrms, 75 Ω, unbalanced, BNC connector. These outputs are flat (no de-emphasis) as shipped from the factory but can be configured to have the same de-emphasis as the Audio outputs described above. The de-emphasis can be changed by moving jumpers P2 (Test L) and P4 (Test R) on the A1 board (the large board). For adding de-emphasis, see the *FMSA-1 A1 Board De-emphasis Settings* drawing in *Section 9*.

Scope L
Scope R — Scope outputs, 1.3 Vrms, 75 Ω, unbalanced, BNC connector. When the respective dB measurement is below -50 dB, 30 dB of gain is automatically inserted for better resolution. The de-emphasis of these outputs follows the de-emphasis of the measurement. If the DB measurement is flat (no * to the right of the DB display on the front panel), the scope outputs are flat. If the DB measurement is de-emphasized (a * to the right of the DB on the display), the outputs are de-emphasized. The de-emphasis is set for 75 µsec de-emphasis unless 50 µsec was specified when ordered. The de-emphasis can be changed by moving jumpers P5 (Scope L) and P6 (Scope R) on the A1 board. For the location of these jumpers, see the *FMSA-1 A1 Board De-emphasis Settings* drawing in *Section 9*.

These outputs depend on which measurement the FMSA-1 is displaying. A table of the dB measurements (as shown in the front panel MENU/PARAMETER window) and the respective scope outputs is shown on the next page.

Scope L
Scope R
(continued)

MENU	SCOPE L	SCOPE R
LEFT -XX.X DB	Left	Right
RIGHT -XX.X DB	Left	Right
SEP -XX.X DB	Left	Right
L+R -XX.X DB	L + R	L - R
L-R -XX.X DB	L + R	L - R
XTALK -XX.X DB	L + R	L - R
TOTAL -XX.X DB	Total	(grounded)
PILOT -XX.X DB	Pilot	38 kHz
38 KHZ -XX.X DB	Pilot	38 kHz

Unit Interface In

This interface is used to connect to The Wizard (FMMA-1) for unified remote operation. It can also connect to a jack labeled Unit Interface Out on other interface-equipped Belar equipment, such as the Belar RFA-4 Frequency Agile FM RF Amplifier.

Note that when the FMSA-1 is connected to the FMMA-1, the HOLD TIME on the FMSA-1 should be set to EXT, to synchronize the FMSA-1 to the FMMA-1.

Unit Interface Out

This interface is used to connect other Wizard-interface-equipped equipment, such as the Belar RFA-4 Frequency Agile FM RF Amplifier, to The Wizard (FMMA-1) for combined remote operation. The interface works in a daisy-chain configuration, with the FMMA-1 at the start of the chain, connected to the Unit Interface In on the FMSA-1. The Unit Interface Out of the FMSA-1 is then connected to the Unit Interface In jack of the next unit (the RFA-4, for example), and so forth.

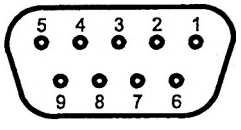
Remote Meters

This connector is used to connect the optional MP-15 Analog Meter panel to the FMSA-1. The meter panel displays Left Channel, Right Channel, and Pilot (LED). Note that the Left and Right Analog displays follow the audio output, so if the FMSA-1 is in DIRECT mode and XTALK is selected, for example, the Left meter shows L + R and the right meter shows L - R. Pins 1 and 2 are for the left meter; pins 3 and 4 are for the right meter; 5 and 6 are for the Pilot LED; and 7 and 8 are a relay closure for the pilot. Refer to the MP-15 installation instructions in *Section 5-1*. For use other than with the MP-15, contact Belar for more information.

The pinout of this connector is as follows:

Pin 1	Left Remote Meter Out
Pin 2	Left Remote Meter Gnd
Pin 3	Right Remote Meter Out
Pin 4	Right Remote Meter Gnd
Pin 5	+5 V for Pilot LED
Pin 6	Pilot LED (open collector)
Pin 7	Pilot Relay
Pin 8	Pilot Relay (when the LED is lit, Pin 7 and 8 are closed)

(Note: relay is rated at 10 W max, 0.5 A max, 200 VDC max)

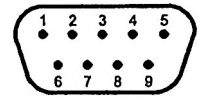


Remote Connector

RS-232

The RS-232 connector is provided for direct computer communications with the FMSA-1 for use with The Wizard Software. If you intend to write software to directly communicate with the FMSA-1 using this port, refer to the *FMSA-1 ASCII RS-232 Interface Commands* in *Section 8.*

Pin	Type		Description
1	input	CD	Carrier detect from Modem
2	input	Rx	Receive data
3	output	Tx	Transmit data
4	output	DTR	Data terminal ready
5	ground	GND	signal ground
6-9			not used



RS-232 Connector

5 Installation and Setup

The FMSA-1 is designed to be mounted in a standard 19-inch rack. The unit can be operated from an 100 to 240 VAC single phase, 50-60 Hz power source, with no user adjustments. The fuse should be a 3A-250V (UL/CSA) or T3.15A-250V (IEC) fuse only. A spare fuse is stored in the removable fuse compartment.

Connect the three wire grounded line cord provided, or, if a substitute line cord is used, be sure that the ground lead is connected to "G" on the line cord receptacle.

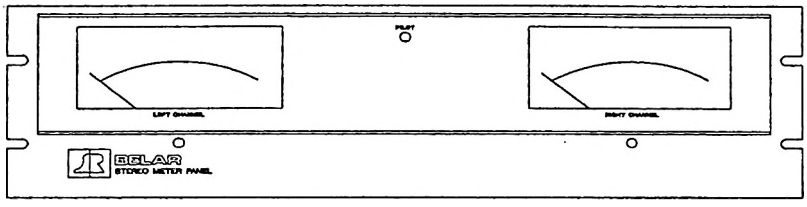
Make the rear panel connections and adjustments as follows:

COMPOSITE INPUT

While applying the appropriate calibration signal to the composite input (for example, a Belar FMM-2 or FMMA-1 with the calibrator turned on), adjust the potentiometer labeled "INPUT ADJUST" located on the back panel until the **TOTAL** display on the front panel (in the MENU/PARAMETER window) reads 100%.

5-1 Accessories

The optional MP-15 Analog Meter Panel, which consists of two large back-lit analog meters, provides continuous analog metering of Left and Right Modulation (or L+R and L-R modulation) as explained in *Section 4* under Remote Meters.



Before connecting the MP-15 to the FMSA-1, ensure that the meters are at mechanical zero.

Using the interconnect cable (provided), connect the D-connector end of the plug to the remote meter connector (J1) on the FMSA-1. The other end of the cable should be connected to the terminal strip (TB1) on the back of the MP-15 as follows:

Terminal Number	*Wire Color*
1	Brown
2	Red
3	Orange
4	White
5	Green
6	Blue

MP-15 Line Voltage Selection Procedure:
1. Unplug line cord.
2. Open fuse compartment door.
3. Move fuse pull lever to left to remove fuse. Leave fuse pull lever in the leftmost position.
4. Using needle nose pliers, pull the voltage select board straight out of the power entry module.
5. While facing the rear of the unit, orient the voltage select board so the desired line voltage is up and reads correctly ("120" for 115Vac operation, "240" for 230Vac operation).
   Note: The "100" and "220" positions on the opposite side of the board are not used.
6. Plug the voltage select board into the power entry module.
7. Install the fuse (F1).
8. Close fuse compartment door.
9. Plug line cord in.

Note: The MP-15 uses line power only to illuminate the meters. It is not required for proper operation of the meters.

MP-15 Calibration:
1.Go to "TOTAL" on the FMSA-1 main menu.
2.Feed a 1 kHz audio signal into the FMSA-1 Composite Input.
3.Adjust the level of the audio so that the Left and Right Channel displays on the FMSA-1 read 100%.
4.Adjust potentiometers R3 and R4 on the rear of the MP-15 so the remote meters also read 100%.

6 Running the Setup Program

To run the setup program, plug in the FMSA-1 and press any of the keys located on the front panel while the INITIALIZATION message is being displayed. After a few seconds the FMSA-1 will display a flashing RUNNING SETUP message as it enters the program.

6-1 Main Setup Menu Selections

RESET DEFAULTS ? Resets the FMSA-1 to default factory settings including the passwords. Pressing the UP PARAMETER button will reset the unit to default settings. The default settings are as follows:

HOLD 1.0 SEC
TIME MODE - PAST
INFINITE - OFF
REMOTE - OFF
XTALK - MATRIX

PASSWORDS

OBSERVER: BELAR1
OPERATOR: BELAR2
SUPERVISOR: BELAR3

MODIFY OPTIONS? Press the UP PARAMETER button to enter the MODIFY OPTIONS submenu section. This submenu contains the settings related to the RS-232.

MODIFY ID ? Press the UP PARAMETER button to enter the MODIFY ID submenu section. This submenu allows the user to edit the units identification string.

UNIT INFO ? Press the UP PARAMETER button to enter the UNIT INFO submenu. This submenu displays the units serial number and EPROM version.

TEST RELAY /LED ? This submenu allows the relay to be tested. Press the UP PARAMETER button to enter the TEST RELAY/LED submenu

TEST RS-232 ? This submenu allows the RS-232 port to be tested. Press the UP PARAMETER button to enter the TEST RS-232 submenu.

EXIT SETUP ? Exits the SETUP MENU and returns the unit to normal operation. Press the UP PARAMETER button to exit the setup program.

6-2 MODIFY OPTIONS SubMenu Selections

BAUD RATE - 1200/2400/4800/9600 Selects the baud rate for the RS-232 Port. This baud rate should be set to the same baud rate as the device the FMSA-1 is being interfaced with.

PASSWORDS - ON/OFF Enables/Disables password protection of the unit when it is accessed with The Wizard Software. If passwords are disabled the user will not be prompted to enter a password when establishing a connection with the unit. If the FMSA-1 is connected to a external MODEM the passwords should be enabled to protect the unit from unauthorized users, if a direct or hard wired connection is used then the password protection may not be needed.

EXT SYNC - ON/OFF Determines whether or not the unit sycnronizes its data collection to the PC's internal time of day clock. When using The Wizard Software the EXT SYNC should be enabled. This guarantees that the PC and remote unit are locked to the same time reference.

CMD TYPE: - BELAR/ASCII Determines the RS-232 Command type. For normal operation, with the Wizard Software, the command type should be set to "BELAR". For use with the *FMSA-1 ASCII RS-232 Interface Commands* in *Section 8*, set the command type to "ASCII".

EXIT ? Pressing the UP PARAMETER button exits the MODIFY OPTIONS submenu and returns the Main Setup Menu.

6-3 MODIFY ID SubMenu Selections

ID(X):XXXXXXXXXX The unit ID is a 10 character string used to uniquely identify a unit when it is accessed remotely. The string is set by default to "..FMSA-1.." when the unit is shipped. This string my be altered by using the UP PARAMETER button to scroll through the available ASCII characters at the current cursor position. The current cursor position is indicated in parentheses. The cursor position is changed by using the DOWN PARAMETER button.

EXIT ? Pressing the UP PARAMETER button exits the MODIFY ID submenu and returns to the Main Setup Menu.

6-4 UNIT INFO SubMenu Selections

VERSION X.XX Indicates the EPROM version installed in the unit.

SERIAL# 35XXXX Indicates the units factory serial number.

EXIT ? Pressing the UP PARAMTER button exits the UNIT INFO submenu and returns to the Main Setup Menu.

6-5 TEST RELAY/LED SubMenu Selections

RELAY#0 - OPEN/CLOSE	Allows the relay to be tested. The unit is configured so that when the Pilot LED is illuminated the relay is closed. The test program will continually cycle the chosen relay open and closed while it turns on and off the Pilot LED.
EXIT ?	Pressing the UP PARAMETER button exits the RELAY/LED TEST submenu and returns to the Main Setup Menu.

6-6 TEST RS-232 SubMenu Selections

TRANSMIT $XX X **RECEIVE $XX X** **RECEIVE FAILEDX**	The RS-232 test alternately transmits a $55 and $AA over the interface. The display shows the byte being transmitted followed by the byte received. If no byte is received a "RECEIVE FAILED" message is displayed. In addition to testing the Rx and Tx lines the test also toggles the DTR on the Tx and reads the CD line on the Rx. The "0" or "1" displayed after the data byte is the current logic state of the DTR or CD line.
EXIT ?	Pressing the UP PARAMETER button exits the RS-232 TEST submenu and returns to the Main Setup Menu.

7 Checkout and Verification of Operation

1. Apply the output of an ideal stereo generator to the input of the FMSA-1 and adjust the output to read 9% PILOT on the FMSA-1.

2. Apply a 400 Hertz single tone (no sweep) to the left channel of the stereo generator and adjust the level of the tone to read 90% on the LEFT CHANNEL display on the FMSA-1.
   The LEFT CHANNEL should read 90%. The RIGHT CHANNEL should read 0%.
   The rear LEFT test BNC jack should read 2.5 Vrms.
   The rear RIGHT test BNC jack should read less than 1 mVrms.

3. Scrolling up through the MENU:
   TOTAL = 96-97%
   L+R = 45%
   L-R = 45%
   PILOT INJ = 9%
   PILOT MOD = 0%
   LEFT = -ldB
   RIGHT = -80dB
   SEP = -79dB
   L+R = -7dB
   L-R = -7dB
   XTALK = 0dB
   TOTAL = -5dB
   PILOT = -2ldB
   38 kHz = -23dB

4. The above may be repeated for the single tone applied to right channel of the stereo generator and the LEFT and RIGHT readings will be interchanged.

5. Note that the outputs of the rear XLR connectors in this mode are the left and right outputs.

6. To change the XLR connectors and the L and R test jacks from left out and right out to L+R out and L-R out, do the following:
   Scroll down through the MENU to MODIFY SETTINGS.
   Depress the upper PARAMETER button.
   Scroll down the MENU to XTALK - MATRIX.
   Depress the upper PARAMETER button once to read XTALK - DIRECT.
   Scroll up the MENU to EXIT ?.
   Depress the upper PARAMETER button and the MENU displays TOTAL.

7. Scroll down through the MENU to XTALK. It will read 0 dB since the input is a left only or right only signal.

8. Apply an L+R signal to the FMSA-1 so that both the LEFT CHANNEL and RIGHT CHANNEL displays read 90%.
   The L TEST jack should read 2.5 Vrms.
   The R TEST jack should read less than 1 mVrms, indicating very little crosstalk from L+R into L-R.

9. Scroll down one position in the MENU.
   The L-R should read -80 dB or better.

10. Scroll down one more in the MENU.
    The L+R should read -1 dB. Thus steps 9 and 10 indicate very little crosstalk from L+R into L-R.

11. Scroll down one more position in the MENU to SEP, -0.0 dB indicating equal L and R and no separation. The L CHANNEL and R CHANNEL indicators both read 90%. Note that the outputs of the L and R TEST jacks will be equal and 2.5 Vrms.

12. Apply an L-R signal to the FMSA-1 so that both the L and R CHANNEL displays indicate 90%.
    The SEP still reads -0.0 dB and both the L and R CHANNELS still read 90%.
    The outputs of the L and R TEST jacks will be equal to 2.5 Vrms.

13. Scroll up one position in the MENU to L+R. It should read -80 dB or more.
    The output of the L TEST jack should be less than 1 mVrms.
    The output of the R TEST jack should be 2.5 Vrms.

14. Scroll up one more position in the MENU to L-R. It should read -1.0 dB.

15. Scroll up one more in the MENU to XTALK. It should read -80 dB or better.
    Note that when the MENU is set to SEP, the outputs of the L and R TEST jacks and XLR connectors will be set to left and right outputs, but when the MENU is scrolled to L+R, L-R or XTALK, the L Test jack and L XLR will be the L+R output and the R TEST jack and R XLR will be the L-R output. This occurs only when the XTALK in the submenu MODIFY SETTINGS is set to XTALK - DIRECT. To return to the original setting where the L and R TEST jacks and XLR connector outputs are always on left and right, go to step number 6 above - and change the XTALK - DIRECT back to XTALK - MATRIX.

    Note that the above outputs are normally de-emphasized. To change them, the top cover must be removed and the pin plugs on the A1 board must be changed - see the *FMSA-1 A1 Board De-emphasis Settings* drawing in *Section 9* of this manual. P2 and P4 will bypass the de-emphasis on only the test jacks. Turning the plugs sideways on P1 and P3 will remove the de-emphasis on both the test jacks and XLR connectors.

    Note that if a less than ideal stereo generator is used, the readings of separation and crosstalk will be somewhat poorer than the readings given above. Input levels exceeding 127% can cause overloads in the FMSA-1 and can cause faulty results.

8 FMSA-1 ASCII RS-232 Interface Commands

In order for the ASCII command set to be active, the CMD TYPE - ASCII option must be selected. This option is found in the MODIFY OPTIONS section of the SETUP PROGRAM.

'D' - Send Unit Data: Instructs FMSA-1 to send back the current value of the specified data. Use the tables below to determine the second character of the command string.

Data Available
'A' - Total Peak Max
'B' - L+R Peak Max
'C' - L-R Peak Max
'D' - Pilot Injection
'E' - Pilot Modulation
'F' - Left dB
'G' - Right dB
'H' - SEP dB
'I' - L+R dB
'J' - L-R dB
'K' - XTALK dB
'L' - Total dB
'M' - Pilot dB
'N' - SUB dB
'O' - Left Peak Max
'P' - Right Peak Max
'Q' - Pilot LED

The command syntax is:

'D' + X: (ASCII character data specifier) + CR: (carriage return)

The unit will send back four ASCII characters, representing the decimal value of the data, terminated with a carriage return.

Note: If the data requested is a dB reading the first digit returned determines the sign. A leading '1' indicates a positive value, while a leading '0' implies a negative value.

Example: Send Total Peak Modulation
Command Sent: 'D' + 'A' + CR: (carriage return)
ASCII Value: $44 $41 $0D

Data Returned (assume total peak = 100%): '0100' + CR
ASCII Value: $30 $31 $30 $30 $0D

'C' - Send Unit Configuration: Instructs FMSA-1 to send back the current setting of the specified parameter. Use the tables below to determine the second character of the command string.

Parameters Available
'A' - Hold Time
'B' - Time Mode
'C' - Infinite
'D' - XTALK Mode
'E' - De-Emphasis

The command syntax is:

'C' + X: (ASCII character parameter specifier) + CR: (carriage return)

The unit will send back four ASCII characters, representing the decimal value of the parameter, terminated with a carriage return.

Example: Send Time Mode
Command Sent: 'C' + 'B' + CR: (carriage return)
ASCII Value: $43 $42 $0D

Data Returned (assume Time Mode = Past): '0001' + CR
ASCII Value: $30 $30 $30 $31 $0D

'A' - Alter Unit Configuration: Instructs FMSA-1 to change the value of the specified parameter. Use the tables below to determine the second character of the command string.

Parameters Available
'A' - Hold Time
'B' - Time Mode
'C' - Infinite
'D' - XTALK Mode
'E' - De-Emphasis

The command syntax is:

'A' + X: (ASCII character parameter specifier)
+ XXXX: (ASCII parameter data 1st digit = thousands
2nd digit = hundreds
3rd digit = tens
4th digit = ones)
+ CR: (carriage return)

The unit will send back four ASCII characters, representing the decimal value of the updated parameter, terminated with a carriage return.

Example: Alter Time Mode

Command Sent: 'A' + 'B' + '0001' + CR: (carriage return)
ASCII Value: $41 $42 $30 $30 $30 $31 $0D

Data Returned (assume Time Mode = Past): '0001' + CR
ASCII Value: $30 $30 $30 $31 $0D

UNIT DATA DEFINITIONS

Data	High	Low	Increments
Total Peak Max	127	0	1%
L+R Peak Max	127	0	1%
L-R Peak Max	127	0	1%
Pilot Injection	12.7	0	0.1%
Pilot Modulation	127	0	1%
Left dB	+3.5	-90.0	0.5 dB
Right dB	+3.5	-90.0	0.5 dB
SEP dB	0.0	-93.5	0.5 dB
L+R dB	+3.5	-90.0	0.5 dB
L-R dB	+3.5	-90.0	0.5 dB
XTALK dB	0.0	-93.5	0.5 dB
Total dB	+3.5	-90.0	0.5 dB
Pilot dB	+3.5	-90.0	0.5 dB
SUB dB	+3.5	-90.0	0.5 dB
Left Peak Max	127	0	1%
Right Peak Max	127	0	1%
Pilot LED	1	0	toggle

UNIT PARAMETER DEFINITIONS

Parameter	High	Low	Increments
Hold Time	20	0	0-EXT; (1-20: multiples of 0.5 sec)
Time Mode	1	0	toggle (PAST=1, REAL=0)
Infinite	1	0	toggle (ON=1, OFF=0)
XTALK Mode	1	0	toggle (DIRECT=1, MATRIX=0)
De-Emphasis	1	0	toggle (ON=1, OFF=0)

9 Diagrams, Schematics and Parts Lists

Replaceable Parts. This page contains information for ordering replaceable parts for the Wizard. The tables that follow list the parts in alphanumeric order by reference designation and provide a description of the part with the Belar part number.

Ordering Information. To order a replacement part from Belar, address the order or inquiry to Belar and supply the following information:

a. Model number and serial number of unit.
b. Description of part, *including the reference designation and location.*

Orders may also be taken over the telephone. Parts orders can be put on your VISA, MasterCard, or American Express card, or we can ship them COD.

REFERENCE DESIGNATORS

A	= assembly	J	= jack	S	= switch
BR	= diode bridge	L	= inductor	T	= transformer
C	= capacitor	M	= meter	TB	= terminal block
CR	= diode or LED	P	= plug	U	= integrated circuit
DS	= display or lamp	Q	= transistor	W	= cable
F	= fuse	R	= resistor	X	= socket
FL	= filter	RL	= relay	Y	= crystal
HDR	= header connector	RN	= resistor network		

ABBREVIATIONS

ADC	= analog-to-digital converter	PIV	= peak inverse voltage
BCD	= binary coded decimal	POLY	= polystyrene
CER	= ceramic	PORC	= porcelain
COMP	= composition	POT	= potentiometer
CONN	= connector	SEMICON	= semiconductor
DAC	=digital-to-analog convertor	SI	= silicon
DPM	= digital panel meter	TANT	= tantalum
ELEC	= electrolytic	μF	= microfarads
GE	= germanium	V	= volt
IC	= integrated circuit	VAR	= variable
k	= kilo = 1,000	VDCW	= dc working volts
M	= meg = 1,000,000	W	= watts
MOD	= modulation	WW	= wirewound
MY	= Mylar		
PC	= printed circuit		
pF	= picofarads		

Appendix A: Using The Wizard Software

Getting Started

Using The Wizard Software any Belar Monitor equipped with an RS-232 Port can be operated from any IBM-compatible personal computer, either through a direct connection (on-site) or from any distance via telephone/modem connection. It can also control other Belar units connected to it using The Wizard Interface. With The Wizard Interface multiple units in a series can be accessed remotely using a single RS-232 port.

Direct Connection

Equipment Required:

- The Wizard Software.
- An IBM compatible PC with an RS-232C serial (COM) port.
- An RS-232 cable with a 9 pin female D-connector at one end (for the Belar unit) and the appropriate connector for your computer (generally either a 9 or 25 pin female D-connector). For direct connection to a PC, only a three wire connection is actually needed: Rx, TX and GND. The various cable pinouts are below; your computer manual may also offer helpful information.

Generally, the RS-232 cable for direct connection is referred to as a "null modem" cable. For your convenience, the proper pin-out follows:

Pinout for Direct Connection (if your computer has a 9-pin D connector serial port):

PC		Belar Unit
2 - Rx	<==	3 - Tx
3 - Tx	==>	2 - Rx
5 - GND	<==>	5 - GND

Pinout for Direct Connection (if your computer has a 25-pin D connector serial port):

PC		Belar Unit
3 - Rx	<==	3 - Tx
2 - Tx	==>	2 - Rx
7 - GND	<==>	5 - GND

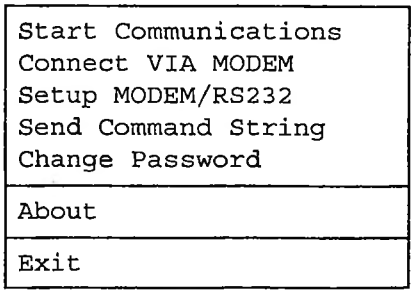
Procedure:

1. Connect one end of your RS-232 cable to the port on the back of the unit labeled "RS232", and connect the other end to the RS-232 (COM) port of your personal computer.

2. For safety's sake, if you plan to run The Wizard Software directly from the floppy disk, make a backup copy first and store the original in a safe place. Alternatively, copy The Wizard software to your hard disk, preferably in its own subdirectory (we suggest C:\WIZ).

3. From the **A>** or **C:\WIZ>** prompt, type **WIZ** and press **Enter**. Once the software has been started, pressing **F1** will bring up context-sensitive help.

4. Using the mouse, select the **Communications** menu from the top of the screen. If you do not have a mouse, press Alt-C. A drop-down menu will appear:



Select **Setup Modem/RS232** (using the arrow keys) and press **Enter**. Using the arrow and tab keys, configure your computer to the proper COM port, IRQ, and speed. Press **F1** in this screen for more information on any of these selections. Once you have made the selections, select Start Communications to establish a connection to the unit. The unit comes configured from the factory with a Supervisor password of **BELAR3**.

Connection via Modem

Equipment Required:

- The Wizard Software.
- An IBM compatible computer with at least a 1200 baud (preferably 2400 baud or greater) Hayes-compatible modem, internal or external.
- An external 1200 or 2400 baud external modem (for connection to the unit), set up as described below.
- An RS-232 cable with a 9 pin female D-connector at one end (for the unit) and the appropriate connector for your external modem (generally either a 9 or 25 pin female D-connector). For reliable external modem operation all five lines from the unit's RS-232C connector should be used. The pinout of this cable follows.
- A telephone line for connecting the two modems.

Pinout for Modem connection (25-pin D connector serial port at modem):

PC		Belar Unit
2 - Rx	<===	3 - Tx
3 - Tx	===>	2 - Rx
7 - GND	<===>	5 - GND
8 - CD	===>	1 - CD
20 - DTR	<===	4 - DTR

External Modem Setup:

Most external modems have non-volatile memory for storing configuration information. In order to configure the modem to work with the unit you must have a computer with a RS-232 port and some kind of communications software or other way of communicating with your modem. Connect the external modem to the computer using the appropriate cable and access it using your communications software. Using the appropriate AT commands set up the modem to do the following:

AT command	Description
ATS0=n	Puts modem in Auto-Answer mode, where "n" is the number of rings desired before the call will be answered. Note: "n" cannot equal 0 (we suggest n=1).

AT&C1	Carrier Detect (CD) active during connect.
AT&D3	Data Terminal Ready (DTR) disconnect and reset.
AT&W0	Writes user configuration to non-volatile memory.

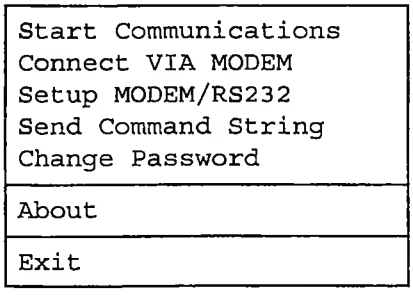
Some modems have various data compression schemes to increase the apparent speed under certain circumstances. Be sure to configure your modem to disable such compression schemes. Refer to your modem and communication software manuals if you encounter problems.

Procedure:

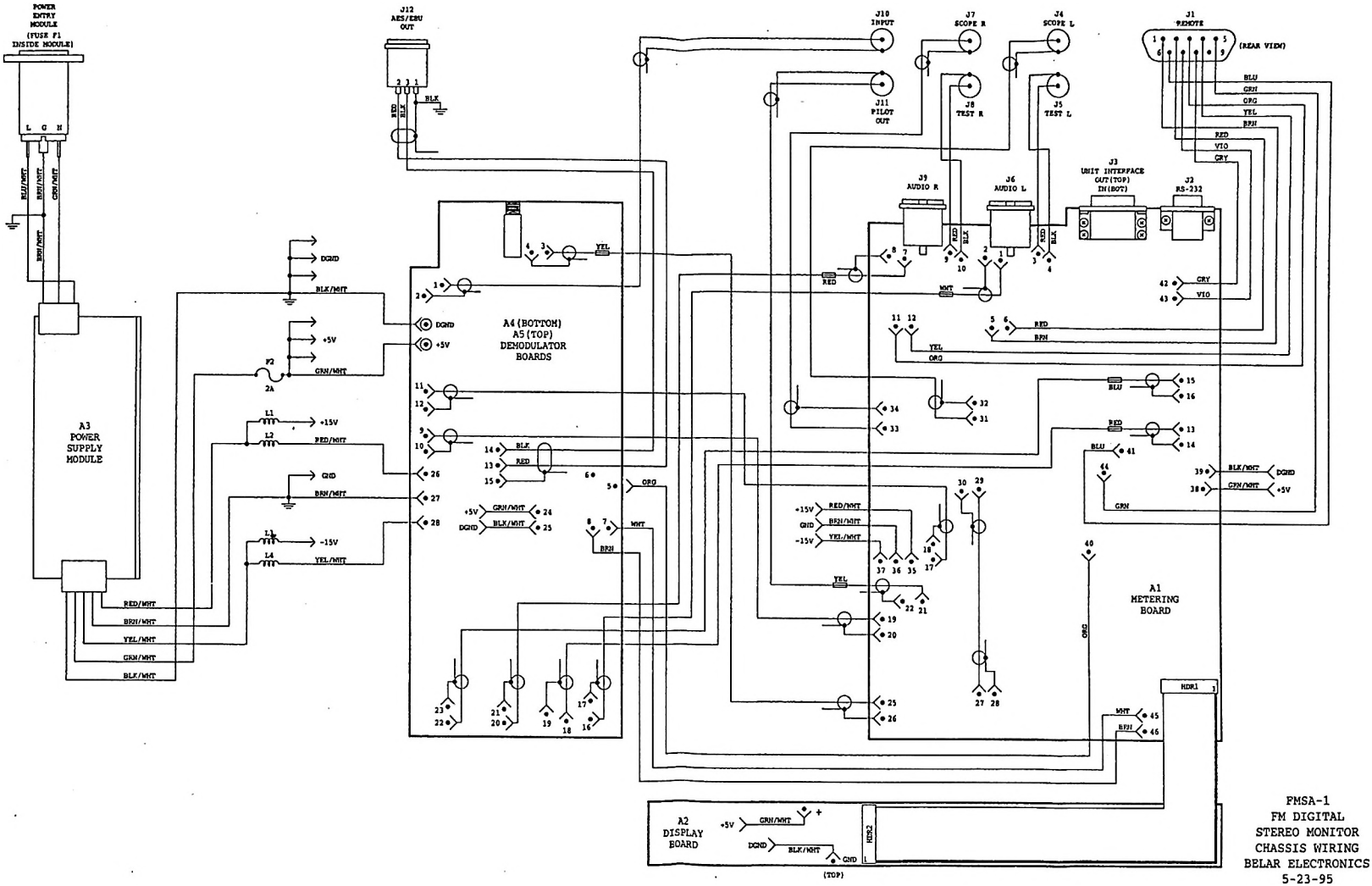
1. For safety's sake, if you plan to run The Wizard software directly from the floppy disk, make a backup copy first and store the original in a safe place. Alternatively, copy The Wizard software to your hard disk, preferably in its own subdirectory (we suggest C:\WIZ).

2. From the **A>** or **C:\WIZ>** prompt, type **WIZ** and press **Enter**. The Wizard front panel will appear in the lower half of your screen.

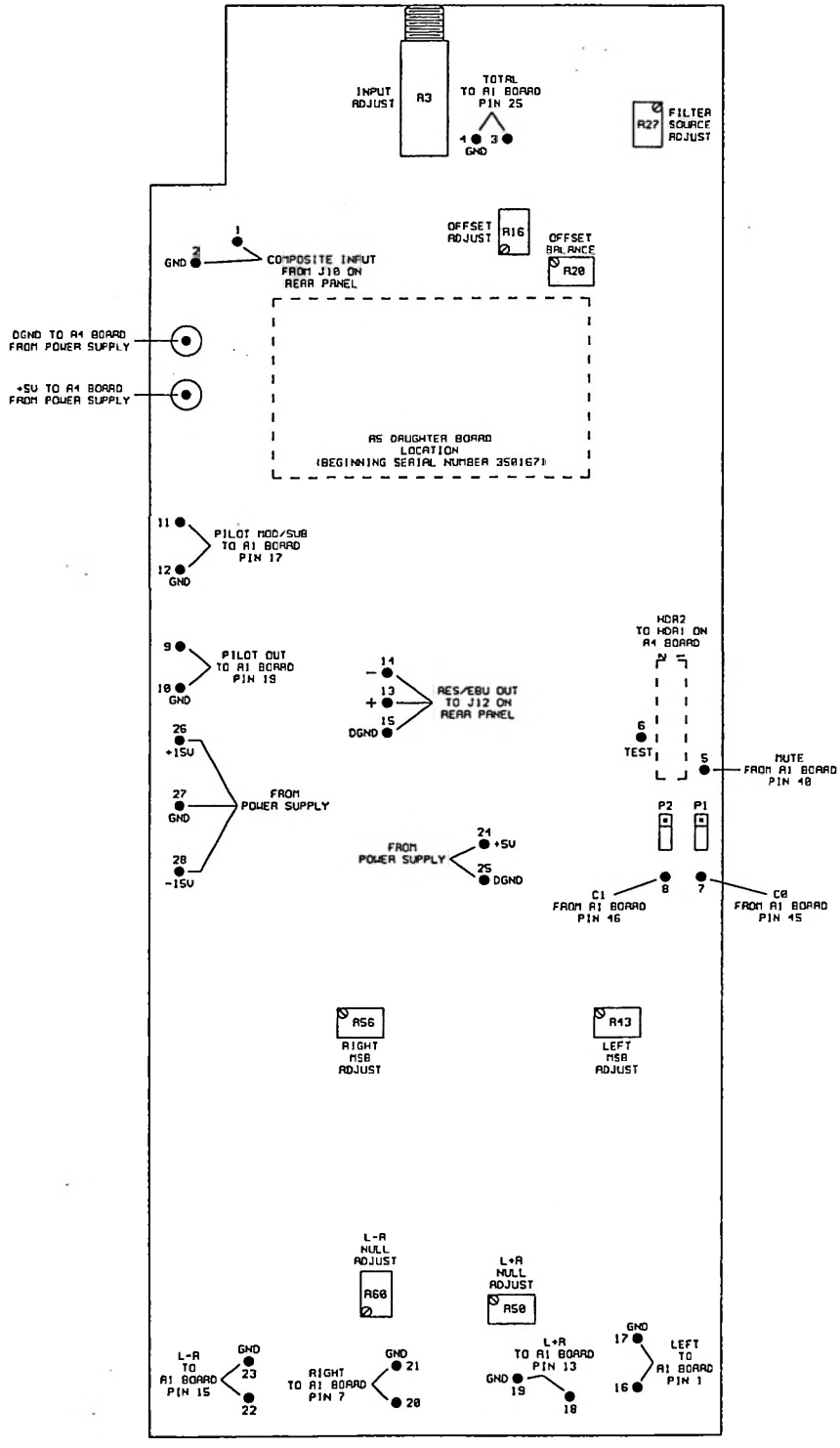
3. Using the mouse, select the **Communications** menu from the top of the screen. If you do not have a mouse, press Alt-C. A drop-down menu will appear:



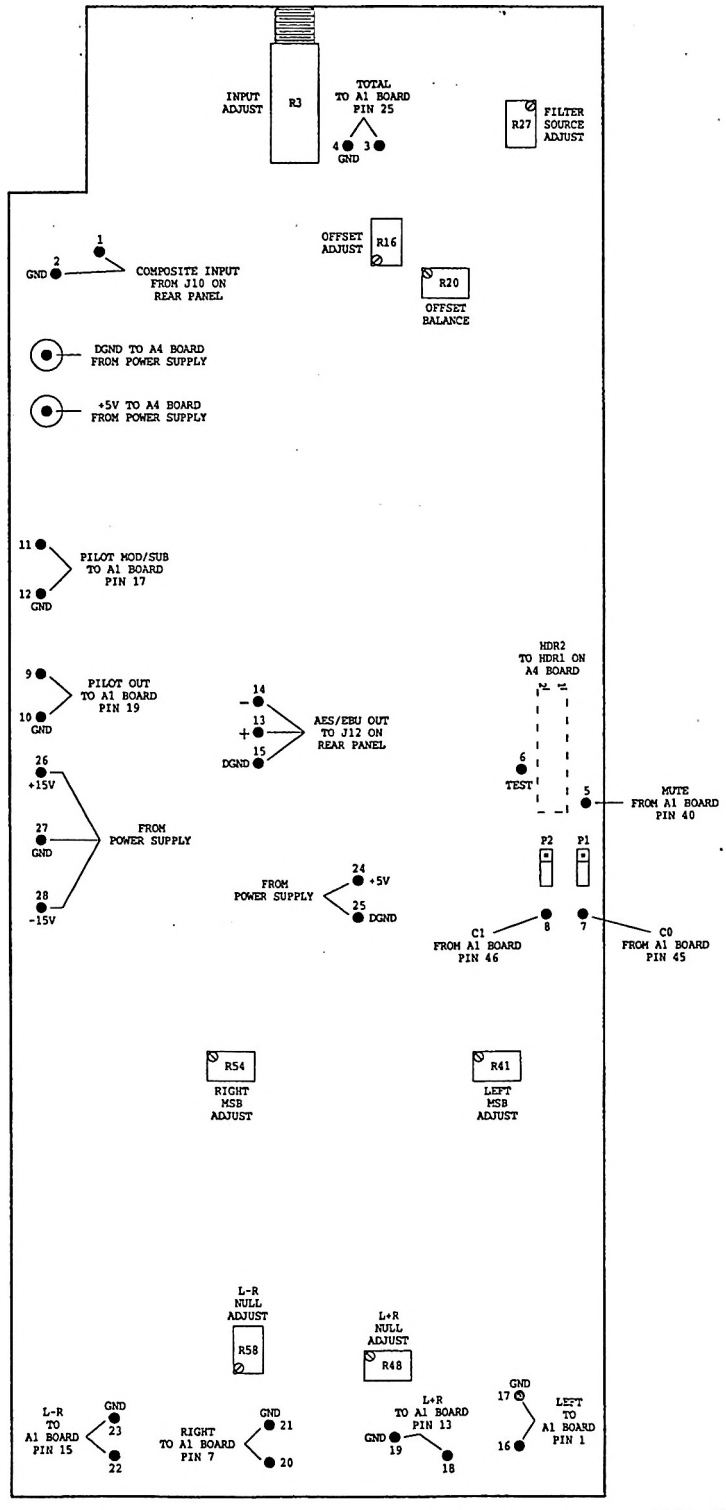
Select **Setup Modem/RS232** (using the arrow keys) and press **Enter.** Using the arrow and tab keys, configure your computer to the proper COM port, IRQ, speed, and telephone number(s). Press **F1** in this screen for more information on any of these selections. Once you have made the selections, select **Connect VIA MODEM** to instruct your modem to dial up the modem at the remote unit and established a connection. The unit comes configured from the factory with a Supervisor password of **BELAR3**.



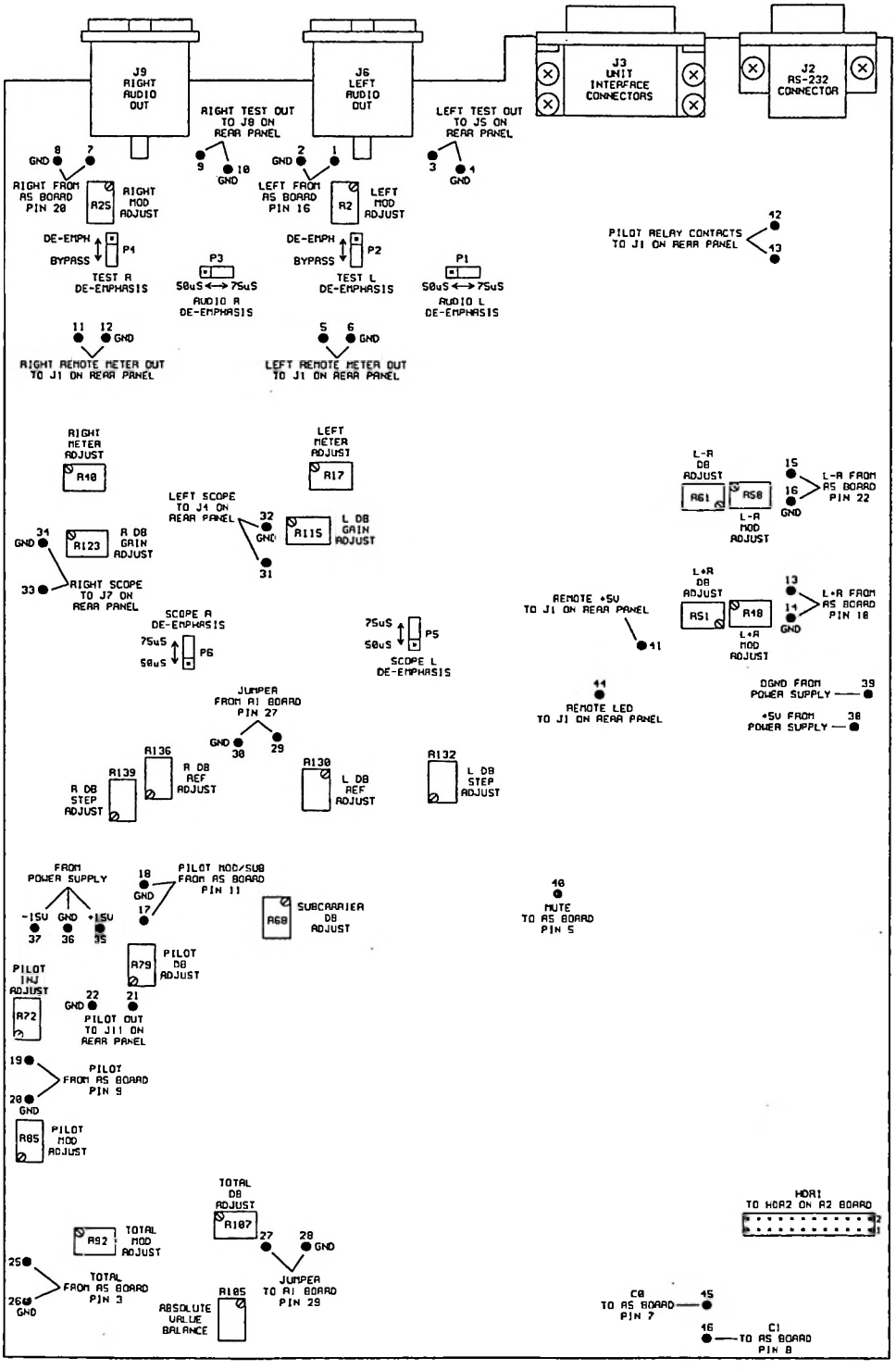
FMSA-1
FM DIGITAL
STEREO MONITOR
CHASSIS WIRING
BELAR ELECTRONICS
5-23-95



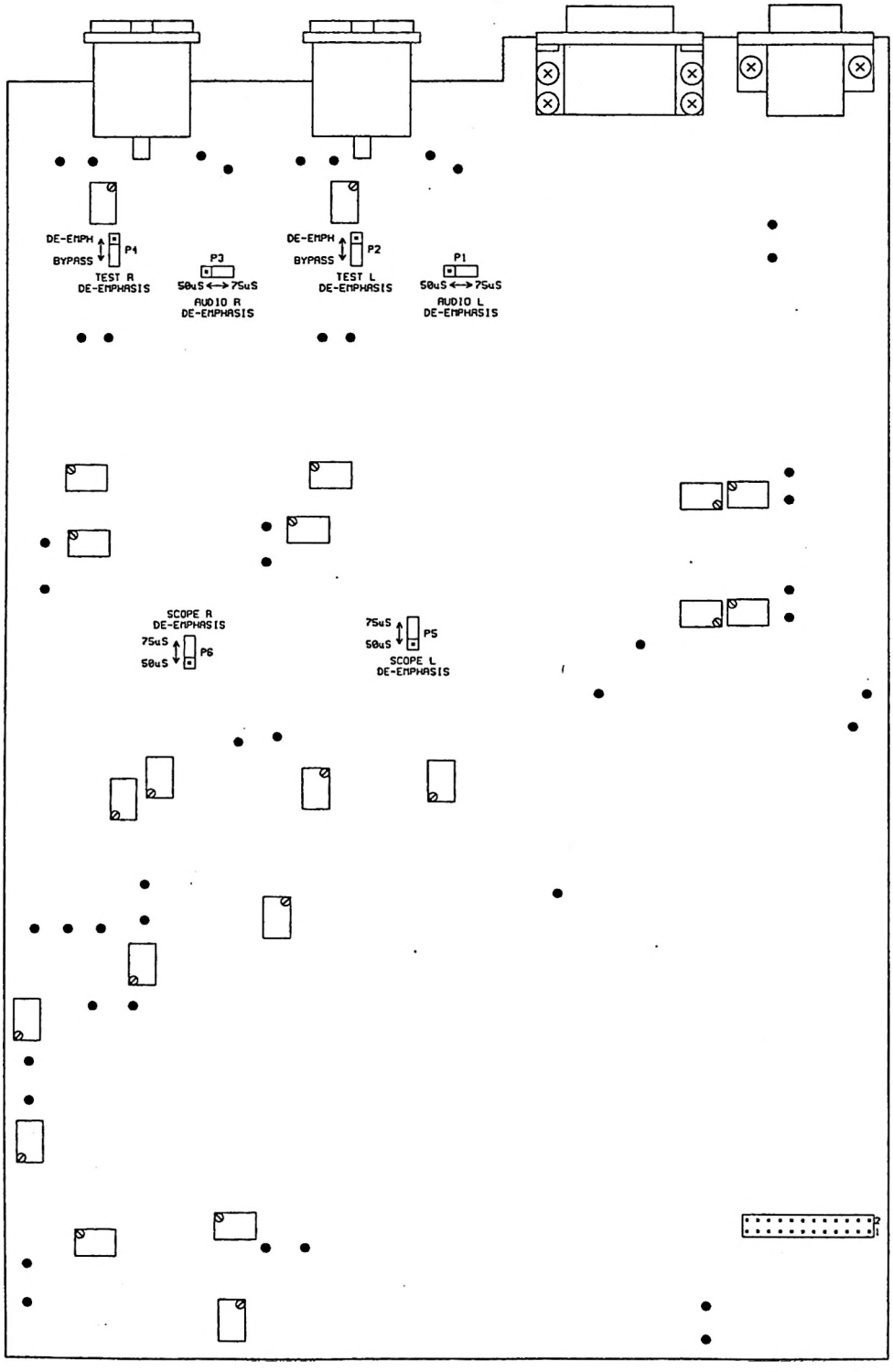
FMSA-1 A5 BOARD
REV. A
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS



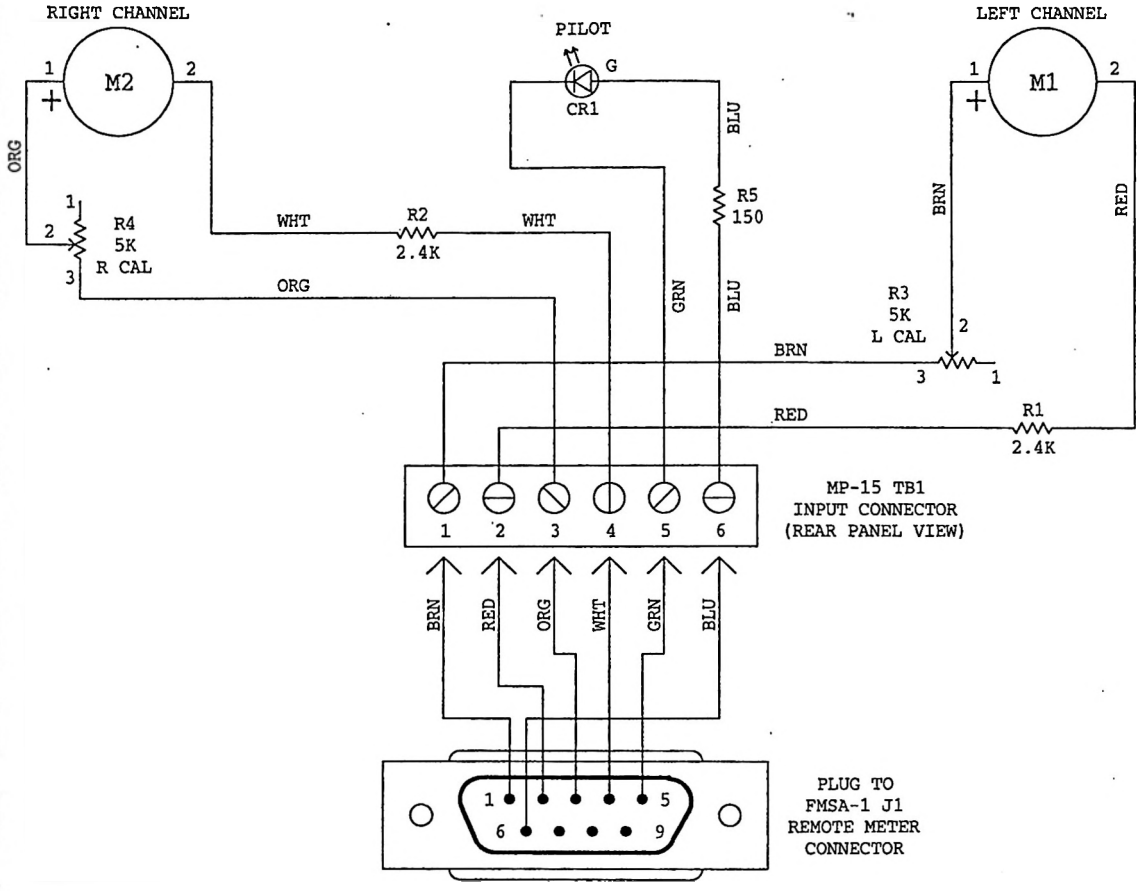
FMSA-1A A5 BOARD
REV. B
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS



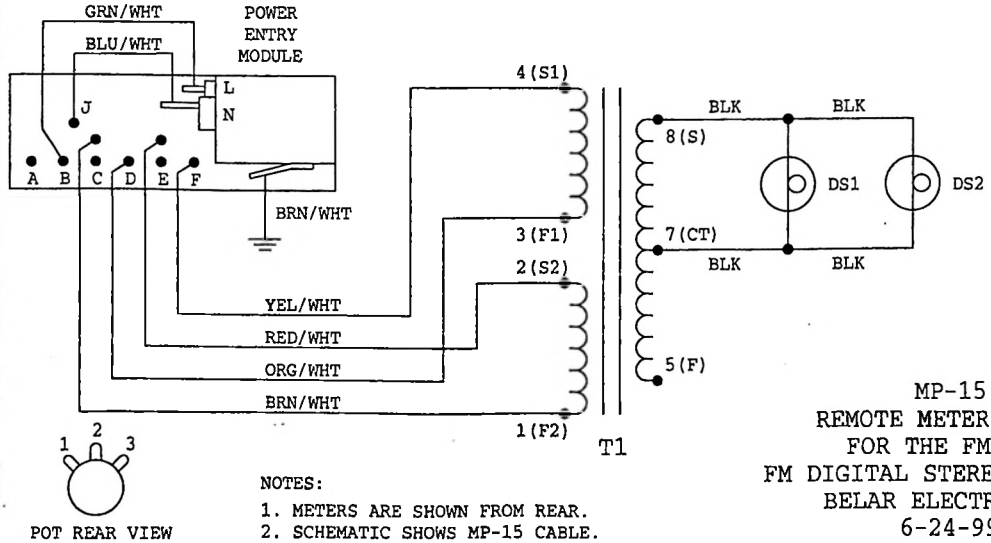
FMSA-1 A1 BOARD
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS



FMSA-1 A1 BOARD
DE-EMPHASIS SETTINGS
BELAR ELECTRONICS



MP-15 CALIBRATION: GO TO "TOTAL" ON THE FMSA-1 MAIN MENU. FEED A 1 KHZ AUDIO SIGNAL INTO THE FMSA-1 COMPOSITE INPUT. ADJUST THE LEVEL OF THE AUDIO SO THAT THE LEFT AND RIGHT CHANNEL DISPLAYS ON THE FMSA-1 READ 100%. ADJUST POTENTIOMETERS R3 AND R4 ON THE REAR OF THE MP-15 SO THE REMOTE METERS ALSO READ 100%.



NOTES:
1. METERS ARE SHOWN FROM REAR.
2. SCHEMATIC SHOWS MP-15 CABLE.

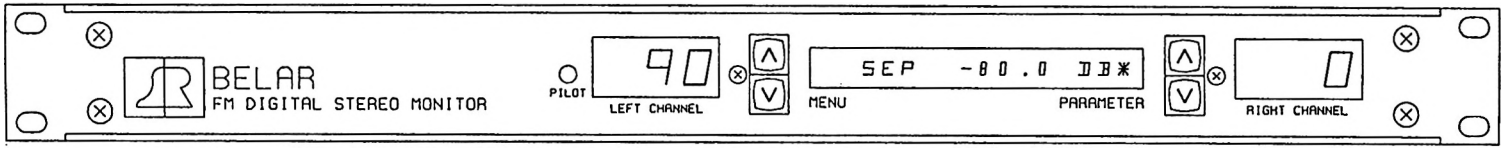
MP-15
REMOTE METER PANEL
FOR THE FMSA-1
FM DIGITAL STEREO MONITOR
BELAR ELECTRONICS
6-24-99

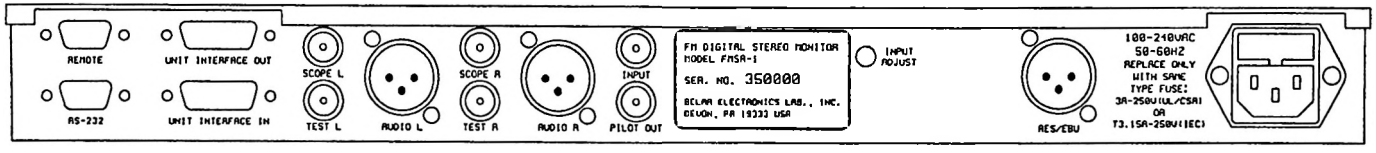
MP-15 PARTS LIST

Reference Designation	Description	Part Number
CR1	LED: GREEN CMD5453	1910-0003
DS1, DS2	LAMP: 755	2140-0005
--	SOCKET: LAMP	1450-0012
--	POWER ENTRY MODULE: 6J4	0360-0020
F1	FUSE: AGC 1/4A 250V	2110-0002
M1, M2	METER: MOD 0-133%	1120-0012
R1,R2	R: METAL FILM 2.4k 2% 1/2W	0771-2422
R3,R4	R: VAR COMP 5k	2100-0008
R5	R: METAL FILM 150 2% 1/2W	0771-1512
T1	TRANSFORMER: DP 241-4-10	9100-0024
TB1	TERMINAL BLOCK: 6 SCREW	0360-0003
--	LINE CORD (115 Vac line voltage)	8120-0002
--	LINE CORD (230 Vac line voltage)	8120-0004

MP-15 LINE VOLTAGE SELECTION PROCEDURE

1. Unplug line cord.
2. Open fuse compartment door.
3. Move fuse pull lever to left to remove fuse. Leave fuse pull lever in the leftmost position.
4. Using needle nose pliers, pull the voltage select board straight out of the power entry module.
5. While facing the rear of the unit, orient the voltage select board so the desired line voltage is up and reads correctly ("120" for 115Vac operation, "240" for 230Vac operation).
   Note: The "100" and "220" positions on the opposite side of the board are not used.
6. Plug the voltage select board into the power entry module.
7. Install the fuse (F1).
8. Close fuse compartment door.
9. Plug line cord in.





FMSA-1 FRONT & REAR VIEW
BELAR ELECTRONICS

FMSA-1 PARTS LISTS

MAIN CHASSIS

Reference Designation	Description	Part Number
A3	POWER SUPPLY MODULE: 30W	4005-0020A
--	POWER ENTRY MODULE: 6EGG1-1	0360-0021
F1	FUSE: GMA-3A 250V(UL/CSA) or T3.15A-250V(IEC)	2110-0009
--	FUSE HOLDER: CHASSIS MOUNT	2110-0010
F2	FUSE: AGC-2A 250V	2110-0006
J1	CONNECTOR: 9 PIN D, FEMALE	0360-0037
J4, J5	JACK: BNC, ISOLATED	0360-0006
J7, J8	JACK: BNC, ISOLATED	0360-0006
J10, J11	JACK: BNC, ISOLATED	0360-0006
J12	JACK: XLR MALE	0360-0047
L1 thru L4	CHOKE: RF	9140-0011
--	FLAT CABLE ASSEMBLY: 24 CONDUCTOR	8900-0017
--	LINE CORD (115 Vac line voltage)	8120-0002
--	LINE CORD (230 Vac line voltage)	8120-0004