# The Wizard™

# FMMA-1
# Precision Digital FM
# Modulation Monitor/Analyzer

PATENTED
U.S. Pat. No. 5,230,087

# Guide to Operations
1/01

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**BELAR** ELECTRONICS LABORATORY, INC.

# The Wizard

**BELAR ELECTRONICS LABORATORY, INC.**

Thank you for purchasing the FMMA-1 Precision Digital FM Modulation Monitor/Analyzer from Belar. Although the unit 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 FMMA-1 (firmware) and The Wizard Software. In the event that we make a major improvement or enhancement to the FMMA-1 or The Wizard Software, we will send you FREE a new EPROM (chip) for the FMMA-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 Wizard FM Digital Modulation Monitor/Analyzer represents the next generation of FM modulation monitors. Controlled by a sophisticated microprocessor, The Wizard can tell you just about everything you ever wanted to know about your FM signal -- using parameters that you configure, either from the front panel or remotely. When used with the FMSA-1, SCMA-1, and RDS-1, full remote monitoring of baseband, stereo, five subcarriers and RDS is possible.

Just a few of the features:

- Digital reading of Peak Modulation (in both percent and kHz deviation), with variable hold time from instant to 10 seconds. In addition, The Wizard can display the highest peak since last reset, or blank the display under non-peak conditions.
- Adjustable Peak Modulation indicator -- you decide what you want to call a peak, from 0% to 200% modulation, in 0.5% increments.
- Adjustable Peak-per-Minute (PPM) alarm - you decide at what PPM level you want the alarm triggered, from 1 PPM to 100 PPM, in 1 PPM increments.
- Adjustable PPM duration window, from 10ms all the way up to 500 ms, depending on your preference for peak duration. The longer the window, the fewer peaks The Wizard will display.
- Eight different peak weighting time constants, from 3 Cycles to 45 Cycles, plus a weighting-off setting. At a setting of 10, for example, the monitor will ignore peaks of 9 Cycles or less (at 10 kHz).
- Actual PPM Count, averaged over a sliding 1 minute window.
- Peak/Average and Average/Peak ratios
- Built-in configureable "Audio-Sentry" loss-of-program alarm. Simply set a minimum acceptable modulation (0-100%) and a maximum time (1-60 seconds). When modulation falls below the set threshold for the set time, the alarm will be triggered.
- Built-in alarms for AM Noise, Synchronous AM Noise, and RF Level (with FMMA-1 Option 02 Down Convertor/AM Noise Detector).

The Wizard may be used with the Belar FMM-2, FMS-2, and SCM-2 series of monitors, displaying Pilot Injection, Pilot Modulation, SCA Injection, and more. To ensure the highest quality measurements, The Wizard can accept the composite signal from the FMM-2 or can be ordered with an optional internally-mounted precision demodulator. The Wizard with the internal demod will even recalibrate itself at the push of a button! The internal demod has the same low distortion (typically < 0.003%), high Signal-to-Noise ratio (typically > 95 dB), and the same separation capability (typically > 70 dB) as our FMM-2 Monitor. The internal de-mod also has 2 wideband, buffered, 75 Ω composite outputs.

With The Wizard Software, every function of The Wizard (even recalibration) can be accessed from anywhere at anytime. Just connect a modem to The Wizard and to your IBM-compatible personal computer, and dial it up! (Direct RS-232 connection is also possible). Three levels of password protection ensure security. Besides giving you a picture of The Wizard's front panel on your computer screen, the software enables your personal computer to log and display in graphical format (even if your computer has no graphics capability) the last 24 hours of peak modulation, which can be saved to disk or even printed for future reference. The software also calculates and displays a modulation histogram, allowing you to examine the modulation density on a real-time basis. Numerous *real-time* bar graphs allow you to monitor the parameters of your choosing. Now you can know more about the characteristics and quality of your FM signal than ever before!

## 1-2    Specifications

Accuracy: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 0.1%
Display . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . large 4 digit LED for Total Modulation, 16 segment
alphanumeric LED display for menus and parameters
Input:
    Standard: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . composite
    with FMMA-1 Option 01: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 650 kHz IF
    with FMMA-1 Option 02: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 88 to 108 MHZ
Serial Interface: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . RS-232
Remote Alarms: . . . . . . . . . . . . . . . . . . . . . . . . relays for Peak Modulation, Peaks-Per-Minute, Remote, General
Dimensions: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1 EIA Rack Unit 1.75" H x 14" D x 19" W
Power Requirements: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 15 Watts, 100-240 Vac, 50-60 Hz
Shipping Weight: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 12 lbs


FMMA-1 Option 01: Precision FM Demodulator with Calibrator
Input: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . (From RFA-4, RFA-1A, DC-4, or FMMA-1 Option 02)
Wideband Output: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . two 75 Ω buffered, composite
Wideband Output Frequency Response: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ±0.1 dB, dc to 100 kHz
Wideband Output Separation Capability: . . . . . . . . . . . . . . . . . . . . . . . . . . . greater than 70 dB, 10 Hz to 15 kHz
Audio Outputs (mono): . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 600 Ω balanced @ 2.5 Vrms and
high impedance unbalanced @ 5 Vrms, 9-pin D-connector
Mono Frequency Response: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . ±0.25 dB, 50 Hz to 15 kHz
flat, 50 $\mu$-sec, or 75 $\mu$-sec
Signal/Noise: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . greater than 95 dB
Distortion (IM): . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . less than 0.003%
Distortion (THD): . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . unmeasurable (less than 0.01%)


FMMA-1 Option 02: Down Converter and Synchronous AM Noise Detector
Frequency Range: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 88 to 108 MHZ Standard (Specify Frequency)
Input: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1-10 Volts rms, 50 Ω, BNC connector
Outputs: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9-pin D connector and BNC, to Wizard
Signal/Noise: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . greater than 95 dB
AM Noise Range: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . -17 to -80 dB
Synchronous AM Noise Range: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . -17 to -80 dB


DC-4: Down Converter
Frequency Range: . . . . . . . . . . . . . . . . . . . . . . . . . . frequency agile from 87.5 to 108 MHz in 50 kHz increments
Input: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1-10 Volts rms, 50 Ω, BNC connector
Output: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 650 kHz IF
Signal/Noise: . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . greater than 90 dB
AM Noise Range (with DC-4 Option 01): . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . -17 to -80 dB
Synchronous AM Noise Range (with DC-4 Option 01): . . . . . . . . . . . . . . . . . . . . . . . . . . . -17 to -80 dB

## 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 to avoid damaging the equipment through use of careless procedures. 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 Wizard is shipped with a Guide to Operations, The Wizard Software, 4 black rack-mount screws, a BNC jumper, 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    Rear Panel Connections
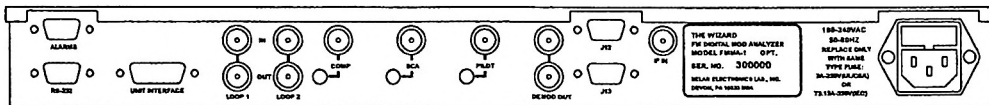


Composite Input . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 220 kΩ, unbalanced, BNC Connector
0.5 - > 2.5 Vrms @ 100%
0.1% resolution
0.0 - > 175.0% range

Pilot Input . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 220 kΩ, unbalanced, BNC Connector
0.5 - > 1.5 Vrms @ 9.0%
0.1% resolution
0.0 - > 25.5% range

SCA Input  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 220 kΩ, unbalanced, BNC Connector
0.5 - > 1.5 Vrms @ 10.0%
0.1% resolution
0.0 - > 25.5% range

Loop Throughs . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 220 kΩ, unbalanced, BNC Connector
0.5 - > 2.5 Vrms @ 100.0%
0.5% resolution
0.0 - > 127.5% range

Remote Alarm Connector  . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . female 9-pin D connector
Normally Open relay contacts rated at 10W max, 0.5A max, 200 Vdc max

| Pin # | Alarm |
|-------|-------|
| 1,2 | PEAK MOD |
| 3,4 | PPM |
| 5,6 | GENERAL (Audio Failure, etc.) |
| 7,8 | REMOTE |
| 9 | not used |
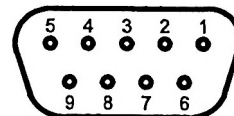
Remote Alarm
Connector

RS-232 connector

The male 9-pin D type RS-232 connector is provided for direct communication between the FMMA-1 and an IBM-compatible computer using the Wizard Software. If you intend to write software to directly communicate with the FMMA-1 using this port, please refer to *Section 8*.

| Pin | Type | | Description |
|-----|------|------|-------------|
| 1 | input | CD | Carrier detect from Modem |
| 2 | input | Rx | The Wizard receive data |
| 3 | output | Tx | The Wizard transmit data |
| 4 | output | DTR | The Wizard data terminal ready |
| 5 | ground | GND | signal ground |
| 6-9 | | | not used |
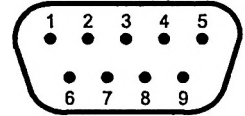
RS-232 Connector

Unit Interface

This female 15-pin D type interface connector is used to connect to other Belar equipment equipped with an interface so that combined remote operation is possible. For example, when the Belar RFA-4 Frequency Agile RF Amplifier is ordered with the optional unit interface, the RFA-4 can be controlled with The Wizard Software, so that the user can call up The Wizard and change stations on the RFA-4 to monitor the competition.

## 3-1   Options, Accessories and Other Equipment

### 3-1-1   FMMA-1 Option 01 - Precision Demodulator with Calibrator

**Rear Panel Connections:**
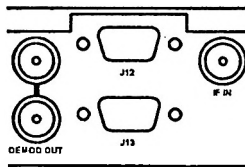
IF IN (650 kHz) . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . BNC Connector
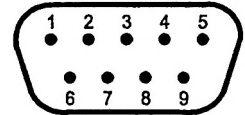For use with the RFA-1A FM RF Amplifier, the Belar RFA-4 Frequency Agile RF Amplifier, the FMMA-1 Option 02 Down Converter and AM Noise Detector, or the Belar DC-4 Frequency Agile Down Converter and AM Noise Detector.

DEMOD OUT (2 jacks) . . . . . . . . . . . . . . 75 $\Omega$ buffered composite, BNC Connector
Note that a BNC jumper cable must be connected between one of the DEMOD OUT jacks and the COMP jack. No other connection should be made to the DEMOD OUT to COMP jack.

J12 - Audio Output . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . male 9-pin D connector

| Pin | Function |
|-----|----------|
| 1 | Audio Out, 10 k$\Omega$, unbalanced (selectable de-emphasis) |
| 2 | Ground for unbalanced output |
| 3 | Audio Out, 600 $\Omega$, balanced, (+), (selectable de-emphasis) |
| 4 | Ground for balanced output |
| 5 | Audio Out, 600 $\Omega$, balanced, (-), (selectable de-emphasis) |
| 6-9 | not used |

Audio Connector

J13 - Down Converter/AM Noise Detector Interface . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . female 9-pin D connector
for use with the FMMA-1 Option 02 Down Converter/AM Noise Detector or the Belar DC-4 Frequency Agile Down Converter and AM Noise Detector with the DC-4 Option 01

**De-Emphasis**

The de-emphasis is set at the factory at $75\mu$-seconds unless $50\mu$-seconds was specified with the order. The de-emphasis is easily changed with jumper P2 on the FMMA-1 Option 01 Internal Demod (see the *A4 Board Connections & Adjustments* drawing in *Section 9*). Removing the jumper completely removes the de-emphasis and the output is flat.

**Using the Demod with the RFA-1A or RFA-4**

If the FMMA-1 Option 02 Down Converter/AM Noise Detector or the DC-4 Frequency Agile Down Converter/AM Noise Detector is being used, jumper P1 on the A4 (demod) board must be positioned towards the back of the unit for maximum flatness of the frequency response.

If The Wizard with Demod is being used with the Belar RFA-1A or RFA-4 RF Amplifier, the jumper P1 may be moved toward the front of the unit for better stereo separation at high frequencies. This provides compensation for the amplitude response of the IF filter in the RF amplifier.

If you own both an RFA-4 and the Down Converter (so you can use The Wizard off-air or at the studio), and don't want to move the jumper each time, we recommend leaving the jumper towards the back of the unit (in the "Down Converter" position). The Wizard is normally shipped with the P1 jumper in the "Down Convertor" position. See the *A4 Board Connections & Adjustments* drawing in *Section 9*.

**3-1-2    FMMA-1 Option 02 - Down Converter/AM Noise Detector**

The Down Converter/AM Noise detector converts the the transmitter RF sample to the 650 kHz IF required by the optional FMMA-1 demodulator, and contains the logarithmic amplifiers for the AM and Synchronous AM Noise measurements.

See *Section 4-3* for installation and setup instructions for the FMMA-1 Option 02 Down Converter/AM Noise Detector

**Down Converter/AM Noise Detector Operation**

Once the Down Convertor is in operation, the RF Level and AM Noise measurements can be viewed by selecting the desired display in the Menu/Parameter window (see *Section 5-1 Menu Selections: Measurements*). The RF Level measurement is a relative measurement that allows you to keep an eye on transmitter power changes. The Down Convertor/AM Noise detector will also measure AM Noise and Synchronous AM Noise through the relevant windows. AM Noise and Synchronous AM Noise measurements are expressed in dB, and may be made with modulation present.

**3-1-3    DC-4 Frequency Agile Down Converter and AM Noise Detector**

The DC-4 is a one-rack-unit high frequency agile version of the FMMA-1 Option 02. It converts RF (from the transmitter tap) to the 650 kHz IF required by the demodulator. It also gives The Wizard the ability to display both AM and AM Synchronous Noise when equipped with the DC-4 Option 01.

See *Section 4-3* for installation and setup instructions when using the Wizard with the DC-4 Down Converter.

## 4    Installation and Setup

### 4-1    General

The Wizard is designed to be mounted in a standard 19-inch rack. When the amplifier is mounted above high heat generation equipment such as power amplifiers, consideration should be given to cooling requirements which allow a free movement of cooler air around The Wizard. In no instance should the ambient chassis temperature be allowed to rise above 45°C (113°F).

### 4-2    Power Connection

**Units beginning with serial number 300188:** These units can be operated from a 100 to 240 Vac, single phase, 50 to 60 Hz power source with no user adjustments. The fuse should be a 5mm x 20mm type GMA-3, 3 AMP-250 V (UL/CSA) or T3.15A-250 V (IEC) fuse only. A spare fuse is stored in the removable fuse compartment.

**Units prior to serial number 300188:** These units can be operated from either a 105 to 125 Vac or 210 to 250 Vac single phase, 50 to 60 Hz power source.  To set the unit for the proper line voltage: Unplug the line cord. Slide open the fuse compartment door and pull lever to remove fuse. Using needle nose pliers, pull the voltage select board straight out of the power entry module. While facing the rear of the unit, orient the voltage select board so the desired line voltage is face up and reads correctly ("120" for 115 Vac operation, "240" for 230 Vac operation. The "100" and "220" positions on the bottom of the board are not used.) Reinsert the board into the power entry module, install the proper fuse (½A 250 V for 115 Vac, ¼A 250 V for 230 Vac), and slide the fuse door closed.

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

### 4-3    FMMA-1 Input Signal Connection

**Installation at the transmitter with the FMMA-1 Option 02 as a source of IF signal:** (See the *Interconnections for Transmitter Operation* drawing in *Section 9* at the rear of this manual. This installation method also requires that Option 01, the Precision FM Demodulator, be installed in the FMMA-1.)

The RF input connection to the Option 02, Down Converter/AM Noise detector should be as short as possible.

Turn the RF level pot on the Down Converter full counterclockwise. Connect the RF sample of your transmitter to the RF Input connector of the Down Converter, using a short coaxial cable. (If your sample points downward, a male BNC to BNC connector will allow the Down Converter to hang directly below the sample point, with no cable length.)

If the sample port is taken from the transmission line, an RF directional coupler should be used to prevent VSWR problems from causing erroneous readings.

Connect the long (6 foot or 25 foot) BNC coaxial cable (supplied) from the 650 kHz output of the Down Converter to the IF INput jack on The Wizard rear panel. Also connect the long (6 foot or 25 foot) multi-conductor D-connector interface cable between the D-connector on the Down Converter and jack J13 (Down Converter Interface Connector) of The Wizard. Be sure to tighten the jack screws on the cable.

Use the BNC patch cable included in your cord pack to connect the FMMA-1 composite output (labeled DEMOD OUT -- there are two, just pick one) to the FMMA-1 COMPosite input jack.

Power up The Wizard. Change the Menu on The Wizard until the RF Level selection is visible. If you cannot find the RF Level selection, see *Section 6-2 MODIFY OPTIONS SubMenu Selections* for information on how to tell The Wizard you are using a Down Converter.

Slowly turn the RF Level pot on the Down Converter clockwise until the LOW LED on the Down Convertor goes out. The RF Level measurement on The Wizard should read close to 100. (You can fine-tune the pot until the RF Level reads exactly 100 if you desire).

The FMMA-1 Composite Input level adjustment should not be necessary, but the calibration can be checked by turning on the calibrator (see *SELF CALIBRATION* and *CALIBRATOR* in *Section 5-2*).

**Installation at the transmitter with a DC-4 as a source of IF signal:** (This installation method also requires that Option 01, the Precision FM Demodulator, be installed in the FMMA-1.) Turn the RF LEVEL adjust potentiometer on the back of the DC-4 all the way down (full counterclockwise) and connect the unit line cord.

Connect the transmitter sample to the RF INput jack on the back of the DC-4 using a BNC coaxial cable. If the sample port is taken from the transmission line, an RF directional coupler should be used to prevent VSWR problems from causing erroneous readings.

Connect the DC-4 IF OUTput jack to the FMMA-1 IF INput jack using the short BNC patch cable from the DC-4 cord pack. If the DC-4 is equipped with the DC-4 Option 01, Wizard Interface Kit, connect the multi-conductor D-connector-terminated cable to the AM Noise D-connector of the DC-4 and J14 (Down Convertor Interface Connector) on the FMMA-1.

Use the BNC patch cable included in your FMMA-1 cord pack to connect the FMMA-1 composite output (labeled DEMOD OUT -- there are two, just pick one) to the FMMA-1 COMPosite input jack.

Apply power to the FMMA-1 and the DC-4. Slowly raise the DC-4 RF input level by turning the DC-4 RF LEVEL adjust pot clockwise until 5 bars are lit on the DC-4 front panel RF level indicator. The level indicator is linear, and 10 bars lit means the input level is too high by at least a factor of 2. If the DC-4 has the AM Noise option installed, adjust the input level so that both the level LEDs on the back panel are extinguished.

The FMMA-1 Composite Input level adjustment should not be necessary, but the calibration can be checked by turning on the calibrator (see *SELF CALIBRATION* and *CALIBRATOR* in *Section 5-2*).

**Installation at the transmitter with an FMM-2 as a source of composite signal:** Connect the BNC patch cable included in your cord packet between the STEREO OUTPUT on the rear of the FMM-2 and the COMPosite input on the rear of the FMMA-1. Depress the FMM-2 CAL pushbutton, then adjust the COMPosite Input Level Adjust potentiometer located on the FMMA-1 back panel until the seven segment display reads 100.0 %. Once this coarse adjustment is made, all further signal calibration may be done from the FMMA-1 front panel. After setting the FMMA-1 input level, depress the OPER pushbutton on the FMM-2.

**Installation at the studio with an RFA-1A or RFA-4 RF Amplifier as a source of IF signal:** (See the *Interconnections for Studio Operation* drawing in *Section 9* at the rear of this manual. This installation method also requires that Option 01, the Precision FM Demodulator, be installed in the FMMA-1.)

After connecting the receiving antenna cable to the RF input jack on the RF amplifier and setting the input attenuators for the proper RF level, connect the RFA-1A or RFA-4 IF OUTput jack to the FMMA-1 IF INput jack using a BNC patch cable.

Use the BNC patch cable included in your FMMA-1 cord pack to connect the FMMA-1 composite output (labeled DEMOD OUT -- there are two, just pick one) to the FMMA-1 COMPosite input jack.

No FMMA-1 Composite Input level adjustment should be necessary, but the calibration can be checked by turning on the calibrator (see *SELF CALIBRATION* and *CALIBRATOR* in *Section 5-2*).

## 4-4    Pilot Input Connection

If it is desired to have the FMMA-1 read pilot injection and pilot modulation, connect a BNC patch cord from the PILOT output of an FMS-2 or similar source of pilot to the PILOT input on the rear of the FMMA-1.

Find the PILOT INJ selection in The Wizard menu and adjust the Pilot Input Level Adjust pot on the rear panel (R31) until it reads the same as the source of pilot. If the PILOT INJ selection is not present in The Wizard menu the setup program must be run to tell The Wizard that an external source of pilot is present. (See *Section 6-2 MODIFY OPTIONS SubMenu Selections*).

## 4-5    SCA Input Connection

If it is desired to have the FMMA-1 read SCA injection, connect a BNC patch cord from the FREQ (IF Output) of an SCM-2 or similar source of subcarrier injection level to the SCA input on the rear of the FMMA-1.

Find the SCA INJ selection in The Wizard menu and adjust the SCA Input Level Adjust pot on the rear panel (R57) until it reads the same injection as the source of SCA. If the SCA INJ selection is not present in The Wizard menu the setup program must be run to tell The Wizard that an external source of SCA is present. (See *Section 6-2 MODIFY OPTIONS SubMenu Selections*).

## 4-6     Loop-Thru #1 & Loop-Thru #2 Connection

Two composite loop-thru's permit the user to adjust modulation levels remotely through the RS-232 port. For example, you could run the output of the stereo generator through loop-thru #1, then through a composite clipper, then through loop-thru #2. The modulation going to the clipper input and coming from the clipper output could then be independentley raised or lowered to "touch up" the modulation level.

Before calibrating the loop-thru modulation displays, two internal jumpers for each loop-thru should be set to their desired position. The MOD ADJ range is selectable -either ±10% in 0.5% increments, or ±20% in 1% increments -- determined by the position of jumper P1 (loop-thru #1) or jumper P3 (loop-thru #2). The factory-preset range is ±10% in 0.5% increments.

The Wizard loop-thru modulation display is determined by the position of jumper P2 (loop-thru #1) or jumper P4 (loop-thru #2). The factory preset displays the modulation of the loop-thru input; if monitoring of the loop-thru output is desired, move the jumper to the other position.

To calibrate a loop-thru, apply the appropriate calibration signal to the input and set the internal Modulation Gain Adjust potentiometer (R72 for loop-thru #1, R100 for loop-thru #2) until the loop modulation display reads 100%. Note that if you have changed the modulation display to read the loop-thru output, set the MOD ADJ to 0.0%.

Jumpers and potentiometers can be located by referring to the *A1 Board Connections & Adjustments* drawing in *Section 9*. For more information, refer to LOOP #1, LOOP #2, MOD ADJ #1 and MOD ADJ #2 in *Sections 5-1 & 5-2 Menu Selections*.

## 4-7     J12 - Demodulator Audio Output Connection

If the Option 01 Precision Demodulator is installed in the FMMA-1, de-emphasized monaural audio is available on the rear of the unit at J12. This male 9-pin D-connector will supply 2.5 Vrms into a 600 Ω balanced load or 5 Vrms into a high impedance load. See *Section 3-1-1* for J12 pin-out information and for de-emphasis selection information.

## 4-8     Unit Interface Connection

This female 15-pin D type interface connector is used to connect the FMMA-1 to other Belar equipment having a Wizard interface so that unified remote operation is possible. In unified remote operation, the FMMA-1 is always the master unit. Each unit that is capable of being used as a slave unit in this type of operation is shipped with a Wizard ribbon interface cable.

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 next unit. The Unit Interface Out of that unit is then connected to the Unit Interface In of the next unit, and so forth.

Note that when a slave unit is connected to the FMMA-1, the HOLD TIME on the slave unit should be set to EXT, to synchronize the slave unit to the FMMA-1. Also, if the slave unit has an INTERFACE: MASTER/SLAVE option in its submenu, it should be set to SLAVE.

## 4-9     RS-232 Connection

This male 9-pin D type RS-232 connector is provided for direct communication between the FMMA-1 and an IBM-compatible computer using the Wizard Software or user written ASCII RS-232 commands.

Both of these methods of FMMA-1 to computer communication may be accomplished with a direct connection (on-site) or from any distance via a telephone/modem connection.

The FMMA-1 can also control other Belar units connected to it using The Wizard Interface and Wizard Software. With The Wizard Interface multiple units in a series can be accessed remotely using a single RS-232 computer port.

Refer to *Appendix A: Using The Wizard Software* at the rear of this manual for information on the FMMA-1 to computer connections and information on the use of a modem. The connection instructions apply to both communication methods mentioned.

Once connection is complete, if The Wizard Software is being used, refer to the Appendix for instructions on starting the software. If you intend to write software to directly communicate with the FMMA-1, please refer to *Section 8, FMMA-1 ASCII RS-232 Interface Commands*.

**4-10    Remote Alarm Connections**

This female 9-pin D-connector provides dry, normally-open relay contacts which close when the corresponding FMMA-1 front panel alarm LED lights. These contacts are rated at 10 Watts, 0.5 Amps, and 200 Vdc maximum. *Under no circumstances should 110 Vac be run through these contacts.* This could damage the relays and under some circumstances, possibly even the FMMA-1. This type of damage is not covered by the warranty.

These relay contacts would normally control circuits which would activate a visual or audible alarm in a remote location. See *Section 3, Rear Panel Connections* for a list of the connector pin-outs.


Once the physical installation of the FMMA-1 is complete, go to *Section 6, Running the Setup Program* to insure that the adjustable unit parameters, options configuration, unit ID, etc. are properly set.

## 5    Front Panel Operation
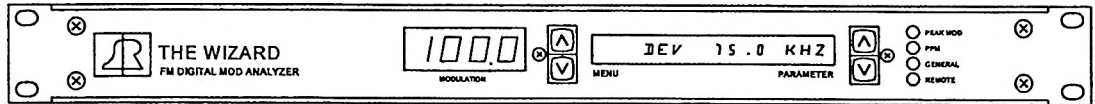


The **MODULATION** display displays the total modulation, expressed in percent modulation.

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 FMMA-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, consists of all of the measurements the FMMA-1 can make, as well as the display MODIFY SETTINGS. The other loop (accessed by pressing the UP PARAMETER button at the MODIFY SETTINGS window) consists of all the adjustable parameters in the unit, such as hold time, time mode, etc. (These parameters are all explained in *Section 5-2 Menu Selections: Parameters,* which follows.)

On the far right of the front panel are three **ALARM LEDS** and the **REMOTE LED**. Each alarm LED has a corresponding relay closure, available through a rear panel connection (described later). The PEAK MOD LED lights when the modulation reaches or exceeds the PEAK MOD parameter setting. The PPM LED lights when the number of peaks per minute reaches or exceeds the PPM parameter setting. The GENERAL LED lights when one or more general alarms are active. The alarm conditions pending are displayed in the alphanumeric display, alternating with the current menu setting. The yellow REMOTE LED lights when The Wizard is actively connected to a remote computer through the RS-232 port on the rear panel.

**5-1    Menu Selections: Measurements**

| | |
|---|---|
| **DEV XXX.X KHZ** | Displays peak modulation expressed in kilohertz deviation. |
| **PEAK AVE XXX.X%** | Displays the average of all peaks measured during the measurement window (hold time). |
| **AVE/PEAK X.XX** | Displays the Average/Peak ratio. |
| **PEAK MIN XXX.X%** | Displays the minimum peak measured during the measurement window (hold time). |
| **PPM COUNT XXXX** | Displays the current count of peaks which have exceeded the PEAK MOD threshold in a sliding one minute window. |
| **LOOP#1 XXX.X %** | Displays the peak modulation from either the input or output (depending on the internal jumper position) of loop-thru #1, with 0.5 percent resolution. |
| **LOOP#2 XXX.X %** | Displays the peak modulation from either the input or output (depending on the internal jumper position) of loop-thru #2, with 0.5 percent resolution. |
| **RF LEVEL XXX.X %** | Displays relative RF level.[1] When the FMMA-1 Option 02 is first set up, it is adjusted so that this display reads 100.0%, so that changes in RF level can be monitored. |
| **AM NOISE -XX.X DB** | Displays AM noise, expressed in dB relative to the RF level.[1] |
| **SYNC AM  -XX.X DB** | Displays synchronous AM noise, expressed in dB relative to the RF level.[1] |
| **PILOT INJ XX.X %** | Displays pilot injection in 0.1% increments.[2] |
| **PILOT MOD XXX.X%** | Displays pilot modulation in 0.5% increments.[2] This is a measurement of AM modulation of the pilot. |
| **SCA INJ XX.X %** | Displays SCA injection in 0.1% increments.[3] |
| **MODIFY SETTINGS** | Press the UP PARAMETER arrow to exit the measurement section of the FMMA-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 in the following section. |

Notes
1. Requires FMMA-1 Option 02 - Down Converter and AM Noise Detector, or the DC-4 with DC-4 Option 01.
2. If using the FMS-2 or a similar source of filtered pilot amplitude is available.
3. If using the SCM-2 or a similar source of filtered SCA amplitude is available.

## 5-2      Menu Selections: Parameters

| | |
|---|---|
| **HOLD XX.X SEC** | Determines the time at which readings will be updated or held on the display. This is user selectable in 0.5 second increments from 0.5 to 10.0 seconds. |
| **PEAK MOD XXX.X%** | Determines the threshold for both the PEAK MOD light and the Peaks Per Minute (PPM) count. This is user selectable in 0.5 percent increments from 0.5 to 200.0 percent. |
| **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). |
| **BLANK - ON/OFF** | Enables or disables blanking mode. When blanking mode is enabled the display is blanked for all readings below the PEAK MOD threshold. |
| **RESOLUTION - 0.1/1.0 %** | Allows the user to select either 0.1 or 1.0 percent displayed resolution. |
| **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 that occurred in that interval. |
| **PK WEIGHT - OFF/XX CYC** | Enables or disables peak weighting mode. When peak weighting mode is enabled the user may select one of eight time constants, from 3 Cycles to 45 Cycles, expressed in cycles of a 10 kHz waveform, plus a weighting-off setting. At a setting of 10, for example, the monitor will ignore peaks of 9 Cycles or less (at 10 kHz). |
| **PPM DURA - XXX MS/TRACK** | Determines the duration of what will be counted as one peak. No matter how many peaks exceed the threshold in the PPM DURATION time, only one will be counted. This is user selectable from 10ms to 500ms, plus TRACK. In the TRACK mode the PPM COUNT tracks the PEAK MOD light, counting each flash as one peak. |
| **PPM THRESH XXXX** | Threshold for Peaks Per Minute counting which, when exceeded, activates the PPM light. This is user selectable from 1 to 100 Peaks Per Minute. |
| **SENTRY XX.X SEC** | The amount of time that modulation must stay below the modulation threshold (described below) in order to activate the AUDIO FAILURE alarm. This is user selectable in 1.0 second increments from 0.0 to 60.0 seconds. |
| **SENTRY XXX.X %** | The threshold in percent modulation below which the AUDIO FAILURE alarm is activated after the selected SENTRY time (set above) has been reached. This is user selectable in 0.5 percent increments from 0.0 to 100.0 percent. A setting of 0.0 disables the SENTRY. |
| **MOD ADJ#1 - XX.X %** | Determines the percent gain between input and output jacks of loop-thru #1. This is user selectable in 0.5% increments from -10.0% to +10.0% gain or in 1% increments from -20% to +20% gain (depending on the internal jumper position). |
| **MOD ADJ#2 - XX.X %** | Determines the percent gain between input and output jacks of loop-thru #2. This is user selectable in 0.5% increments from -10.0% to +10.0% gain or in 1% increments from -20% to +20% gain (depending on the internal jumper position). |

**REMOTE - ON/OFF**

Enables or disables 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 PARAM to save the configuration.

**SELF CALIBRATION**

Calibrates the unit to either an external signal, or if the internal demod is present, to its calibrator. The SELF CALIBRATION function has a range of ±5.0 percent; therefore, coarse adjustment must first be made with the Composite Input Level Adjust potentiometer located on the back panel (R1).

**CALIBRATOR - ON/OFF**

Turns the internal calibrator on and off. The calibrator is used to normalize other units, such as the FMS-2 FM Stereo Monitor or the FMSA-1 FM Digital Stereo Monitor/Analyzer. When using the self-calibrator as described above, there is no need to turn on the calibrator manually -- The Wizard will automatically turn on the calibrator, recalibrate itself, and turn the calibrator off again.[1]

**RF THRES XXX.X %**

Sets the threshold in % below which the LOW CARRIER alarm is activated. The threshold is user selectable in 0.5 % increments from 0.0% to 127.5%.[2]

**AM THRES -XX.X DB**

Sets the threshold in DB above which the HIGH AM NOISE alarm is activated. The threshold is user selectable in 0.5 dB increments from -80.5 dB to -17.0 dB.[2]

**SY THRES -XX.X DB**

Sets the threshold in DB above which the HIGH SYNC AM (high synchronous AM noise) alarm is activated. The threshold is user selectable in 0.5 dB increments from -80.5 dB to -17.0 dB.[2]

**EXIT ?**

Press the UP PARAMETER arrow to exit the parameter setting section of the FMMA-1 and enter the measurement section of the unit. The measurement section, as described earlier, is where the unit displays most of its measurements (kHz deviation, PPM count, etc.).

Notes
1. Requires the FMMA-1 Option 01 - Precision FM Demodulator with Calibrator.
2. Requires the FMMA-1 Option 02 - Down Convertor/AM Noise Detector, or the DC-4 with DC-4 Option 01.

## 6 Running the Setup Program

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

### 6-1 Main Setup Menu Selections

**RESET DEFAULTS ?** Resets the FMMA-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
> PEAK MOD - 100 %
> TIME MODE - PAST
> INFINITE - OFF
> BLANK - OFF
> RESOLUTION 0.1%
> PK WEIGHT - OFF
> PPM DURA 250 MS
> PPM THRESH 10
> SENTRY 30.0 SEC
> SENTRY 0.0 %
> MOD ADJ#1 + 0.0 %
> MOD ADJ#2 + 0.0 %
> REMOTE - OFF
> CALIBRATOR - OFF
> AM THRES -17.0 DB
> SY THRES -17.0 DB
> RF THRES -17.0 DB
>
> 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 and Installed Options.

**MODIFY ID ?** Press the UP PARAMETER button to enter the MODIFY ID submenu section. This submenu allows the user to edit the unit's identification string.

**MODIFY OFFSETS ?** Press the UP PARAMETER button to enter the MODIFY OFFSETS submenu section. This submenu is used during setup and calibration at the factory to remove A/D offset voltages.

**UNIT INFO ?** Press the UP PARAMETER button to enter the UNIT INFO submenu. This submenu displays the unit's serial number and EPROM version.

**TEST RELAY /LED ?** This submenu allows the relays and LEDS 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

**OPTION 01>Y/N**

Specifies if The Wizard has the *Option 01 Precision FM Demodulator with Calibrator* installed.

**OPTION 02>Y/N**

Specifies if The Wizard is being used with the *Option 02 Down Converter and AM Noise Detector*.

**EXTERNAL PILOT>Y/N**

Specifies if The Wizard is being used with the Belar FMS-2 FM Stereo Monitor or similar external source of pilot. Note: if you are using The Wizard with the FMSA-1 FM Digital Stereo Monitor/Analyzer, select "N" -- the pilot measurements are available from the FMSA-1 directly, and do not need to be obtained from The Wizard.

**EXTERNAL SCA>Y/N**

Specifies if The Wizard is being used with the Belar SCM-2 SCA Monitor or similar external source of SCA. Note: if you are using The Wizard with the SCMA-1 FM Digital SCA Modulation Analyzer, select "N" -- the SCA measurements are available from the SCMA-1 directly, and do not need to be obtained from The Wizard.

**GAIN STEPS - 0.5/1.0 %**

Determines the gain steps displayed in the MOD ADJ menu selections. The step size should be chosen to correspond with the jumper position in on the A1 board. See the *A1 Board Connections and Adjustments* drawing in *Section 9* of this manual for the location of the jumpers.

**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 FMMA-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 FMMA-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 STR - ON/OFF**

Enables/Disables RS-232 command string transmission. If command strings are enabled, whenever the unit is powered up or a MODEM connection is terminated a user defined ASCII command string is transmitted.

**CMD(XX):** The 32 character command string is used to configure an external MODEM connected to the FMMA-1's RS-232 Port. In order for the string to be transmitted it must be enabled by setting CMD STR - ON. The default string is blank. To enter a string use the UP PARAMETER button to scroll through the available ASCII characters, and the DOWN PARAMETER button to advance the cursor. The current cursor position is the number displayed in brackets.

**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 *FMMA-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 "..FMMA-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    MODIFY OFFSETS SubMenu Selections

**COMP#1 PW XX**
**COMP#2 PW XX**
**COMP#1 NPW XX**
**COMP#2 NPW XX** Allows the four composite A/D offsets to be displayed and set. Pressing the DOWN PARAMETER button cycles through the four possible offsets and displays their current value. Pressing the UP PARAMETER button starts an offset calibration cycle and displays the updated value. The composite input must be grounded before setting an offset value.

**LOOP#1 XX**
**LOOP#2 XX**
**PILOT INJ XX**
**PILOT MOD XX**
**SCA INJ XX**
**AM NOISE XX**
**SYNC AM XX**
**RF LEVEL XX** Allows the designated A/D offsets to be displayed and set. Pressing the UP PARAMETER button will start an offset calibration cycle on the indicated channel. Before initiating an offset calibration, the input of the selected channel must be grounded. The offsets are set at the factory and generally do not need to be readjusted in the field. For more information contact BELAR.

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

**6-5     UNIT INFO SubMenu Selections**

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

**SERIAL# 30XXXX**          Indicates the unit's factory serial number.

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

**6-6     TEST RELAY/LED SubMenu Selections**

**RELAY#X -**               Allows the relays and their associated LEDs to be tested. The relay number being tested is
**OPEN/CLOSE**              displayed along with the its state , either open or closed. The unit is configured so that when a 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 corresponding LED. To change the relay/LED being tested press the UP PARAMETER button.

**EXIT ?**                  Pressing the UP PARAMETER button exits the RELAY/LED TEST SubMenu and returns to the Main Setup Menu.

**6-7     TEST RS-232 SubMenu Selections**

**TRANSMIT $XX  X**         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
**RECEIVE $XX X**           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
**RECEIVE FAILED X**        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.

# The Wizard

## 7 Menu/Parameter Interaction

This chart shows what parameter settings affect which displays.

| Parameter → / Display ↓ | Hold | Peak Mod | Infinite | Blank | Resolution | Time Mode | Peak Weight | PPM Duration | PPM Threshold | Sentry Sec | Sentry % | Remote | RF Threshold | AM Threshold | SY Threshold |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Modulation | X | | X | X | X | X | X | | | | | | | | |
| DEV xxx.x kHz | X | | | | X | X | X | | | | | | | | |
| PEAK AVE | X | | | | | X | X | | | | | | | | |
| AVE/PEAK | X | | | | | X | X | | | | | | | | |
| PEAK MIN | X | | | | | X | X | | | | | | | | |
| PPM Count | X[1] | X | | | | | X | X | X | | | | | | |
| Loop #1 | X | | | | | | | | | | | | | | |
| Loop #2 | X | | | | | | | | | | | | | | |
| Peak Mod LED | X | X | X | | X | X | X | | | | | | | | |
| PPM LED | X[1] | X | | | | | X | X | X | | | | | | |
| General LED | | | | | | | | | | X | X | | X | X | X |
| Remote LED | | | | | | | | | | | | X | | | |

[1] Only when PPM Duration = TRACK

## 8    FMMA-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 FMMA-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' - Total Deviation
'C' - Total Peak Ave
'D' - Total Ave/Peak
'E' - Total Min
'F' - PPM Count
'G' - LOOP #1 Peak Max
'H' - LOOP #2 Peak Max
'I' - RF Level
'J' - AM Noise
'K' - Sync AM Noise
'L' - Pilot Injection
'M' - Pilot Modulation
'N' - SCA Injection
'O' - Peak Mod LED
'P' - PPM LED
'Q' - General LED
'R' - Remote 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 = 100.0%): '1000' + CR
        ASCII Value: $31 $30 $30 $30 $0D

'C' - Send Unit Configuration : Instructs FMMA-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' - Peak Mod
> 'C' - Infinite
> 'D' - Blank
> 'E' - Resolution
> 'F' - Time Mode
> 'G' - Peak Weight
> 'H' - PPM Duration
> 'I' - PPM Thresh
> 'J' - Sentry Time
> 'K' - Sentry Thresh
> 'L' - Mod Adj #1
> 'M' - Mod Adj #2
> 'N' - Remote
> 'O' - Save Configuration
> 'P' - Self Calibration
> 'Q' - Calibrator
> 'R' - RF Thresh
> 'S' - AM Thresh
> 'T' - ***Reserved***
> 'U' - SYNC AM Thresh

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' + 'F' + CR: (carriage return)
>> ASCII Value : $43 $46 $0D
>>
>> Data Returned (assume Time Mode = Past): '0001' + CR
>> ASCII Value: $30 $30 $30 $31 $0D

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

<u>Parameters Available</u>
'A' - Hold Time
'B' - Peak Mod
'C' - Infinite
'D' - Blank
'E' - Resolution
'F' - Time Mode
'G' - Peak Weight
'H' - PPM Duration
'I' - PPM Thresh
'J' - Sentry Time
'K' - Sentry Thresh
'L' - Mod Adj #1
'M' - Mod Adj #2
'N' - Remote
'O' - Save Configuration
'P' - Self Calibration
'Q' - Calibrator
'R' - RF Thresh
'S' - AM Thresh
'T' - ***Reserved***
'U' - SYNC AM Thresh

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' + 'F' + '0001' + CR: (carriage return)
        ASCII Value : $41 $46 $30 $30 $30 $31 $0D

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

'P' - Select RFA-4 Frequency Preset : Instructs FMMA-1 to send a preset select command to the RFA-4 over the unit interface. The second character of the command string indicates the preset number.

> Parameters Available
> '0' → '9' - Preset Number
>
> The command syntax is:
>
> 'P' + X: (ASCII character preset number)
>    + CR: (carriage return)
>
> Example: Select RFA-4 preset #5
>        Command Sent: 'P' + '5' + CR: (carriage return)
>        ASCII Value : $50 $35 $0D

## UNIT DATA DEFINITIONS

| Data | High | Low | Increments |
|---|---|---|---|
| Total Peak Max | 2000 | 0 | 0.1% |
| Total Deviation | 150 | 0 | 0.1 kHz |
| Total Peak Ave | 2000 | 0 | 0.1% |
| Total Ave/Peak | 1.00 | 0 | 0.01 |
| Total Peak Min | 2000 | 0 | 0.1% |
| PPM Count | 9999 | 0 | 1 |
| LOOP #1 Peak Max | 127.5 | 0 | 0.5% |
| LOOP #2 Peak Max | 127.5 | 0 | 0.5% |
| RF Level | 127.5 | 0 | 0.5% |
| AM Noise | 17.0 | 80.0 | 0.5 dB |
| Sync AM Noise | 17.0 | 80.0 | 0.5 dB |
| Pilot Injection | 25.5 | 0 | 0.1% |
| Pilot Modulation | 127.5 | 0 | 0.5% |
| SCA Injection | 25.5 | 0 | 0.1% |
| Peak Mod LED | 1 | 0 | toggle |
| PPM LED | 1 | 0 | toggle |
| General LED | 1 | 0 | toggle |
| Remote LED | 1 | 0 | toggle |

UNIT PARAMETER DEFINITIONS

| PARAMETER | High | Low | Increments |
|-----------|------|-----|------------|
| Hold Time | 20 | 0 | 0-EXT; (1-20: multiples of 0.5 sec) |
| Peak Mod | 2000 | 0 | multiples of 0.1%, (0.5% smallest step) |
| Infinite | 1 | 0 | toggle (ON=1, OFF=0) |
| Blank | 1 | 0 | toggle (ON=1, OFF=0) |
| Resolution | 1 | 0 | toggle (1.0%=1, 0.1%=0) |
| Time Mode | 1 | 0 | toggle (PAST=1, REAL=0) |
| Peak Weighting Index | 8 | 0 | (0=OFF, 1-8=Time Constants) |
| PPM Duration Index | 6 | 0 | (0-5=Durations, 6=Track) |
| PPM Threshold | 100 | 1 | 1 |
| Sentry Time | 60 | 1 | 1 sec |
| Sentry Threshold | 1000 | 0 | multiples of 0.1%, (1.0% smallest step) |
| Mod Adjust #1 | 40 | 0 | (0= − max, 20=flat, 40= + max) |
| Mod Adjust #2 | 40 | 0 | (0= − max, 20=flat, 40= + max) |
| Remote | 1 | 0 | toggle (ON=1, OFF=0) |
| Save Config | 1 | 0 | Save=1 |
| Self Calibrate | 1 | 0 | Calibrate=1 |
| Calibrator | 1 | 0 | toggle (ON=1, OFF=0) |
| RF Threshold | 255 | 0 | multiples of 0.5 % |
| AM Threshold | 254 | 0 | multiples of 0.25 dB, (0.5 dB smallest step) |
| Sync AM Threshold | 254 | 0 | multiples of 0.25 dB, (0.5 dB smallest step) |

## 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 converter | SI | = silicon |
| DPM | = digital panel meter | TANT | = tantalum |
| ELEC | = electrolytic | $\mu$F | = 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):
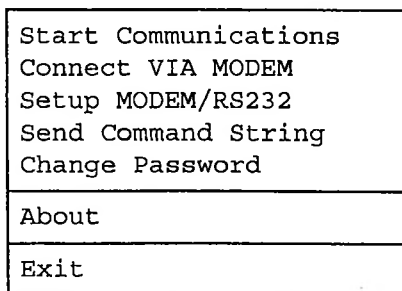
| __PC__ | <===> | __Belar Unit__ |
|------|-------|-------------|
| 2 - Rx | <=== | 3 - Tx |
| 3 - Tx | ===> | 2 - Rx |
| 5 - GND | <===> | 5 - GND |

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:

```
Start Communications
Connect VIA MODEM
Setup MODEM/RS232
Send Command String
Change Password

About

Exit
```

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:

```
┌─────────────────────────────┐
│ Start Communications        │
│ Connect VIA MODEM           │
│ Setup MODEM/RS232           │
│ Send Command String         │
│ Change Password             │
├─────────────────────────────┤
│ About                       │
├─────────────────────────────┤
│ Exit                        │
└─────────────────────────────┘
```

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**.

# INTERCONNECTIONS FOR TRANSMITTER OPERATION
## FMMA-1 (WITH DOWN CONVERTER) / FMSA-1 / SCMA-1



FROM TRANSMITTER SAMPLE POINT

DOWN CONVERTER

**FMMA-1**

ALARMS
RS-232
UNIT INTERFACE
IN
OUT
LOOP 1   LOOP 2
COMP
SCA
PILOT
DEMOD OUT
J12
J13
IF IN

THE WIZARD
FM DIGITAL MOD ANALYZER
MODEL FMMA-1    OPT. 01
SER. NO.  300000
BELAR ELECTRONICS LAB., INC.
DEVON, PA 19333 USA

100-240VAC
50-60HZ
REPLACE ONLY
WITH SAME
TYPE FUSE:
3A-250V(UL/CSA)
OR
T3.15A-250V(IEC)

USE "T" CONNECTOR

**FMSA-1**

REMOTE
RS-232
UNIT INTERFACE OUT
UNIT INTERFACE IN
SCOPE L
TEST L
AUDIO L
SCOPE R
TEST R
AUDIO R
INPUT
PILOT OUT
INPUT ADJUST

STEREO MONITOR
MODEL FMSA-1
SER. NO. 300000
BELAR ELECTRONICS LAB., INC.
DEVON, PA 19333 USA

AES/EBU

100-240VAC
50-60HZ
REPLACE ONLY
WITH SAME
TYPE FUSE:
3A-250V(UL/CSA)
OR
T3.15A-250V(IEC)

**SCMA-1**

REMOTE
RS-232
UNIT INTERFACE OUT
UNIT INTERFACE IN
SCA BPF
SCA TEST
SCA OUT
SCOPE
MAIN TEST
MAIN OUT
COMP IN
ADJ

FM DIGITAL SCA MONITOR
MODEL SCMA-1    OPT.
SER. NO.  290000
BELAR ELECTRONICS LAB., INC.
DEVON, PA 19333 USA

100-240VAC
50-60HZ
REPLACE ONLY
WITH SAME
TYPE FUSE:
3A-250V(UL/CSA)
OR
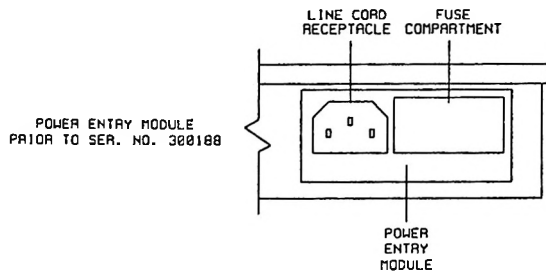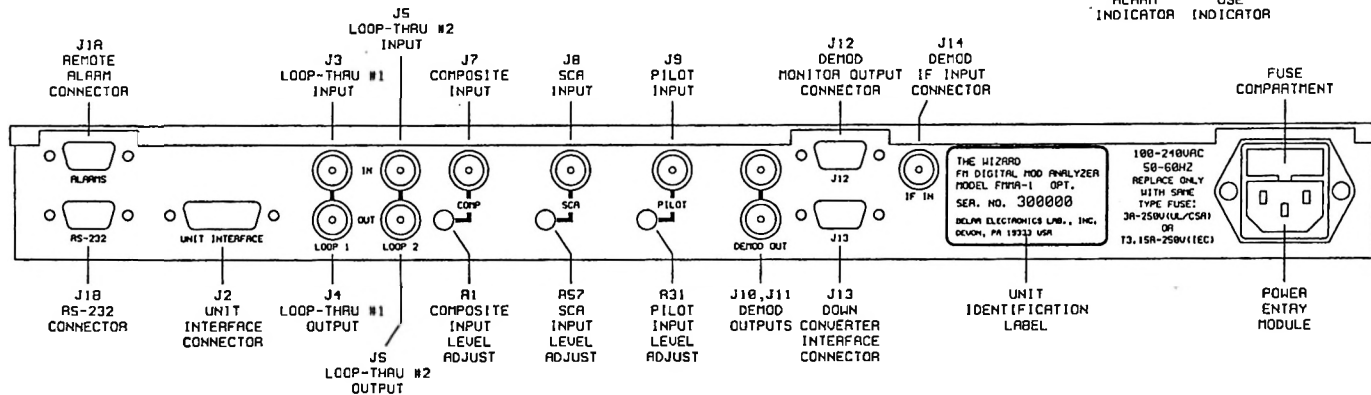T3.15A-250V(IEC)

## BELAR ELECTRONICS LABORATORY, DEVON PA (610)687-5550

# INTERCONNECTIONS FOR OFF-AIR OPERATION
## RFA-4 / FMMA-1 / FMSA-1 / SCMA-1
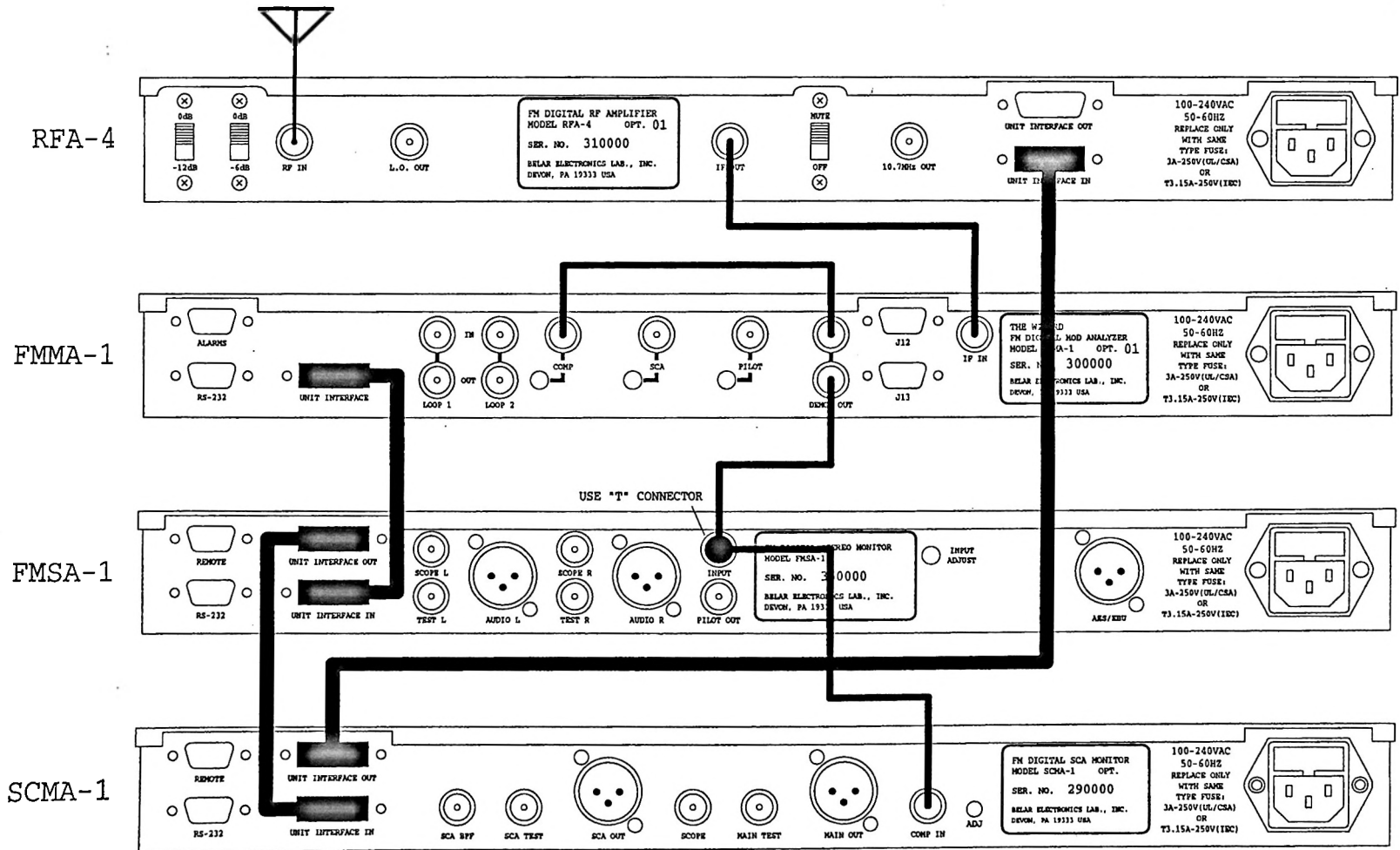


BELAR ELECTRONICS LABORATORY, DEVON PA (610)687-5550
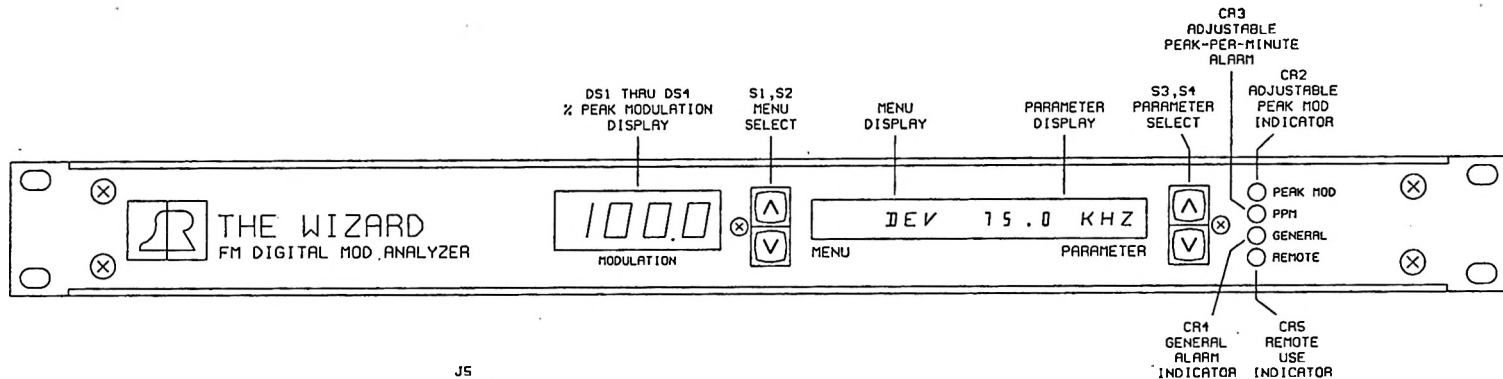
FMMA-1 FRONT & REAR VIEW
BELAR ELECTRONICS
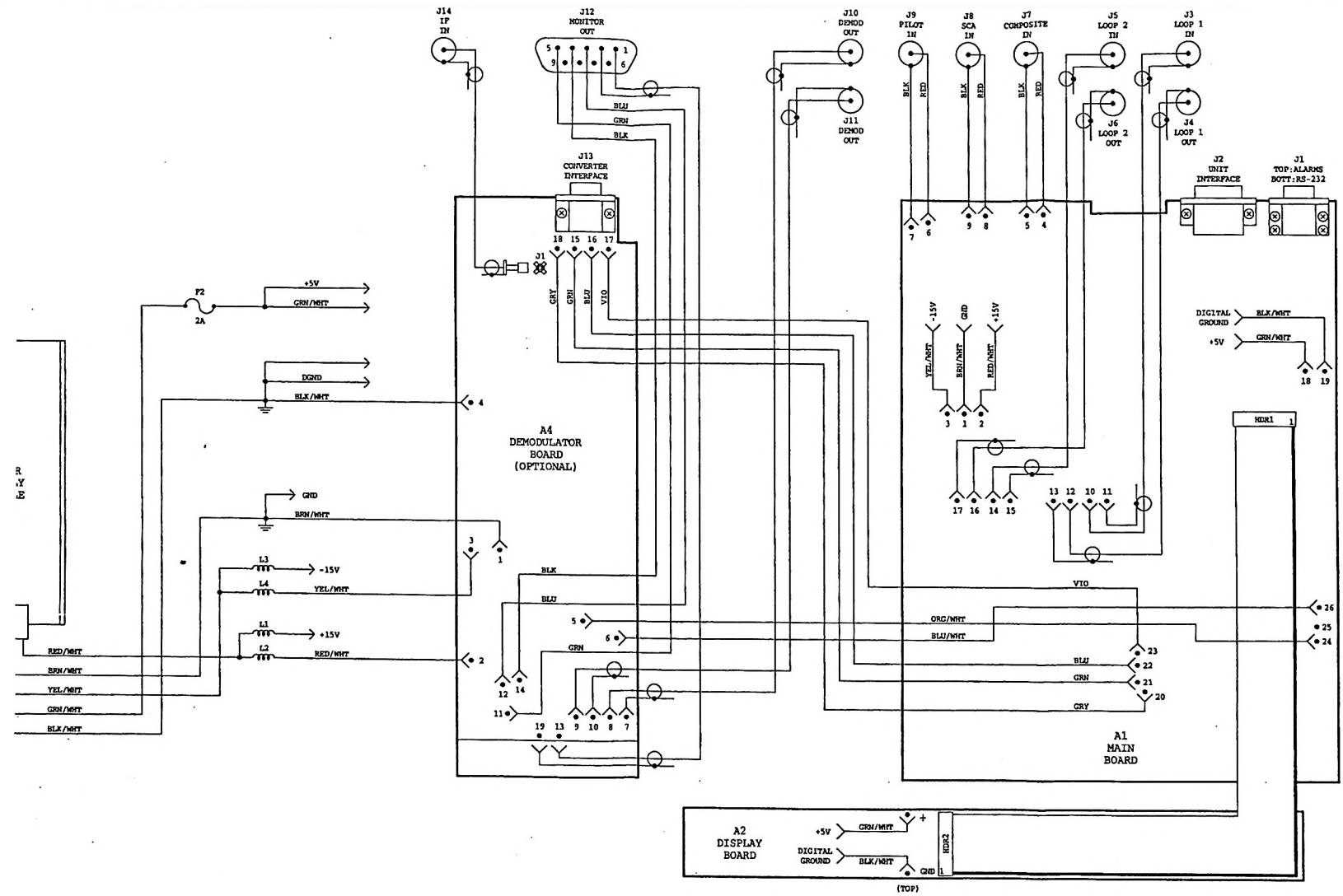
FMMA-1 CHASSIS WIRING
BELAR ELECTRONICS
2-27-97
(EFFECTIVE S/N 300188)
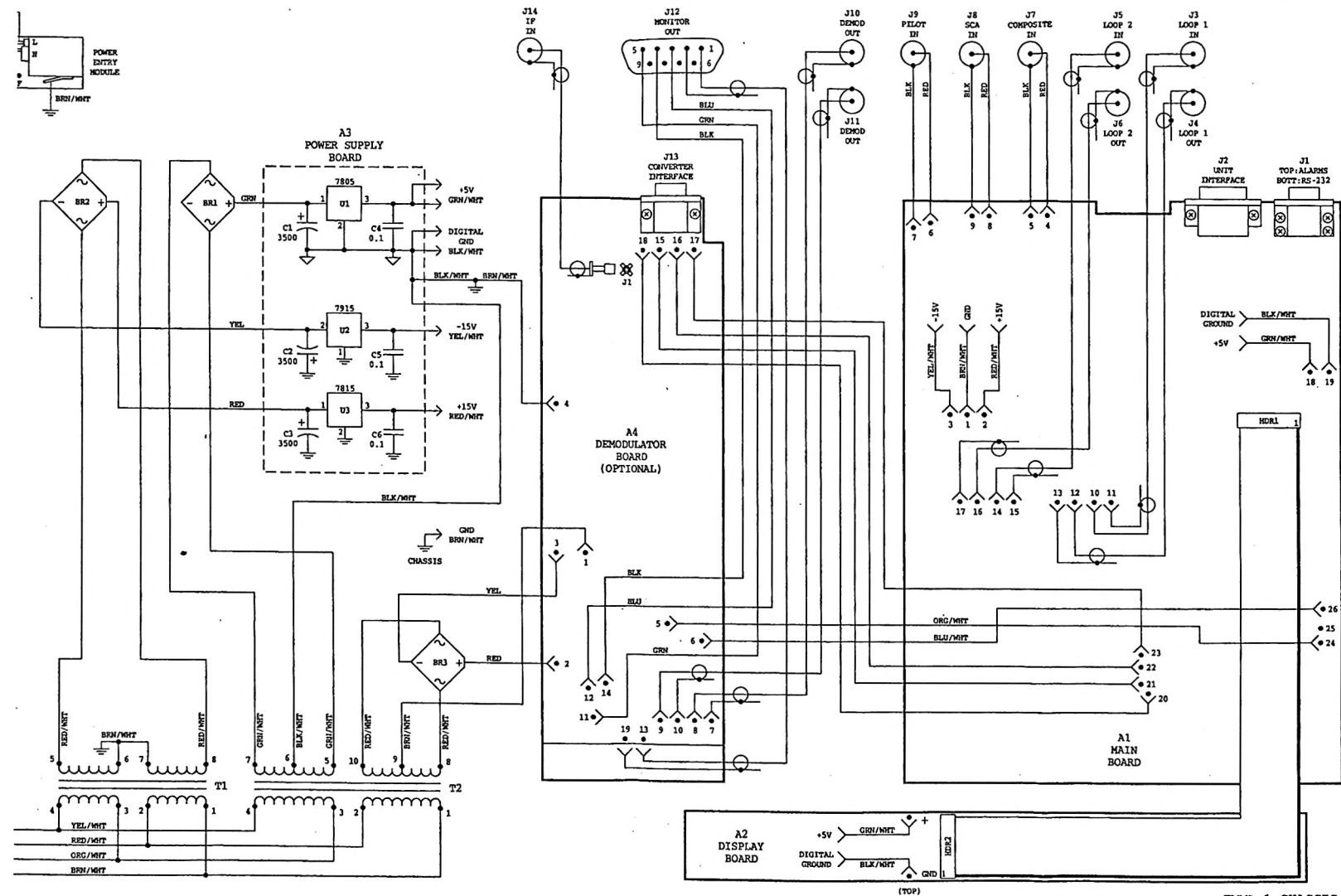
FMMA-1 CHASSIS WIRING
BELAR ELECTRONICS
5-4-92
(USED PRIOR TO S/N 300188)

J13 CONVERTER INTERFACE

17 FROM A1 PIN 23
16 FROM A1 PIN 22
15 FROM A1 PIN 21
18 FROM A1 PIN 20

J1 FROM J14 IF INPUT

R13
PULSE WIDTH ADJUST

R26
OFFSET ADJUST

CAL
R33

DOWN CONVERTER ⟷ RPA-4
P1

FROM CHASSIS GROUND  1

6 MUTE FROM A1 BD. PIN 26

5 CALIBRATE FROM A1 BD. PIN 24

DE-EMPHASIS SELECT
75uS
50uS
P2

7 GND  DEMOD OUT TO J10 ON REAR PANEL
8

10 GND  DEMOD OUT TO J11 ON REAR PANEL
9

13  UNBAL MON OUT TO J12 ON REAR PANEL
19 GND

BALANCED MON OUT TO J12 ON REAR PANEL
14 GND
12    11

FROM CHASSIS GROUND  4
-15V FROM POWER SUPPLY  3
+15V FROM POWER SUPPLY  2

FMMA-1 A4 BOARD
REV. A
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

FECTIVE SERIAL NUMBER 300188

7
GND
FROM
J9

6
PILOT
INPUT
FROM J9

9
GND
FROM
J8

8
SCA
INPUT
FROM J8

5
GND
FROM
J7

4
COMPOSITE
INPUT
FROM J7

R31

R57

R1

PILOT
INPUT LEVEL
ADJUST

SCA
INPUT LEVEL
ADJUST

COMPOSITE
INPUT LEVEL
ADJUST

J2

UNIT INTERFACE CONNECTOR

J1

TOP:REMOTE ALARM CONNECTOR
BOTTOM:RS-232 CONNECTOR

R45  PILOT MODULATION
ABSOLUTE VALUE
BALANCE

R16  COMPOSITE
ABSOLUTE VALUE
BALANCE

+5V FROM
POWER SUPPLY

18   19

DGND FROM
POWER
SUPPLY

PILOT MODULATION
GAIN ADJUST

R51

HDR1

2

(TO HDR2 ON A2 BOARD)

-15V FROM
POWER
SUPPLY

3    1    2

GND
FROM
CHASSIS

+15V FROM
POWER
SUPPLY

TO J6   FROM J5

GND OUT   IN GND
17  16    14  15
LOOP-THRU #2

TO J4   FROM J3

GND OUT   IN GND
13  12    10  11
LOOP-THRU #1

LOOP #2
UNITY GAIN
ADJUST

R95

LOOP #1
UNITY GAIN
ADJUST

R67

+/-10%
+/-20%

MOD ADJ #2
RANGE SELECT

+/-10%
+/-20%

MOD ADJ #1
RANGE SELECT

P2

IN   OUT

LOOP #2
MODULATION
SELECT

P2

IN   OUT

LOOP #1
MODULATION
SELECT

MUTE TO A4 BOARD, PIN 6   26

GND   25

CAL TO A4 BOARD, PIN 5   24

R100

LOOP #2
MODULATION
GAIN ADJUST

R72

LOOP #1
MODULATION
GAIN ADJUST

23  FROM A4 BOARD, PIN 17
22  FROM A4 BOARD, PIN 16
21  FROM A4 BOARD, PIN 15
20  FROM A4 BOARD, PIN 18
GND

R116

LOOP #2
ABSOLUTE VALUE
BALANCE

R88

LOOP #1
ABSOLUTE VALUE
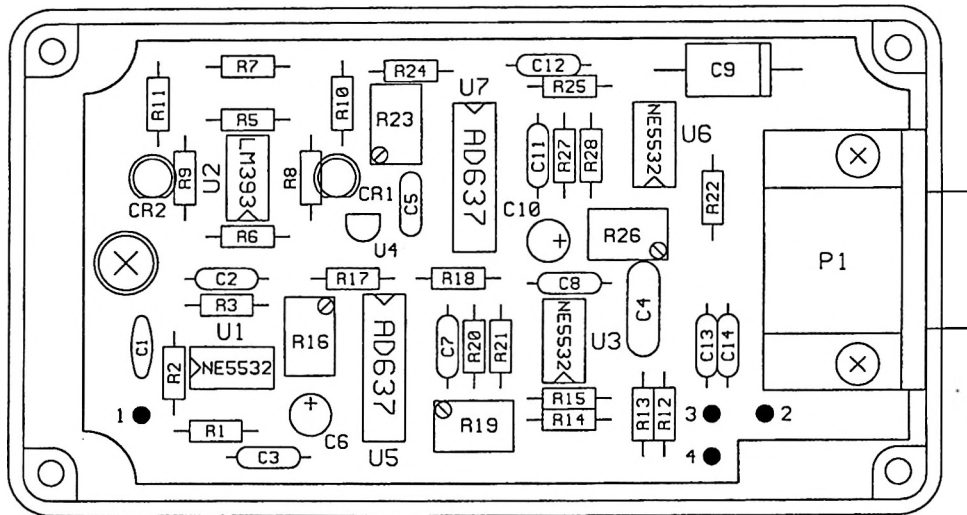BALANCE

FMMA-1 A1 BOARD
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A2 BOARD FM DOWN CONVERTER

| Reference Designation | Description | Part Number |
|---|---|---|
| C1 | C: FIXED CERAMIC 0.001uF 1kV | 0151-0002 |
| C2,C3 | C: FIXED CERAMIC 1.0uF 50V | 0151-0008 |
| C4 | C: FIXED MICA 250pF 5% | 0140-2515 |
| C5 | C: FIXED CERAMIC 0.1uF 50V | 0151-0015 |
| C6 | C: FIXED TANT 1.0uF 35V | 0185-0006 |
| C7,C8 | C: FIXED CERAMIC 1.0uF 50V | 0151-0008 |
| C9 | C: FIXED POLY 7500pF 2.5% 160V | 0130-7522 |
| C10 | C: FIXED TANT 1.0uF 35V | 0185-0006 |
| C11 thru C14 | C: FIXED CERAMIC 1.0uF 50V | 0151-0008 |
| CR1,CR2 | LED: RED MV5053 | 1910-0001 |
| P1 | CONNECTOR: "D" SINGLE 9 PIN MALE | 0360-0036 |
| R1 | R: METAL FILM 866 1% | 0721-8660 |
| R2 | R: METAL FILM 5.11k 1% | 0721-5111 |
| R3 | R: METAL FILM 10k 2% 1/4W | 0751-1032 |
| R4 | R: METAL FILM 866 1% | 0721-8660 |
| R5 | R: METAL FILM 649 1% | 0721-6490 |
| R6 | R: METAL FILM 10k 2% 1/4W | 0751-1032 |
| R7 | R: METAL FILM 4.32k 1% | 0721-4321 |
| R8 | R: FIXED CARBON 1.5M 5% 1/4W | 0683-1555 |
| R9 | R: FIXED CARBON 2.2M 5% 1/4W | 0683-2255 |
| R10,R11 | R: METAL FILM 2.2k 2% 1/4W | 0751-2222 |
| R12 | R: METAL FILM 160k 2% 1/4W | 0751-1642 |
| R13 | R: METAL FILM 9.09k 1% | 0721-9091 |
| R14 | R: METAL FILM 1.00k 1% | 0721-1001 |
| R15 | R: METAL FILM 10.0k 1% | 0721-1002 |
| R16 | R: VAR COMP 100k, 10 TURN | 2100-0030 |
| R17 | R: METAL FILM 24.9k 1% | 0721-2492 |
| R18 | R: METAL FILM 100k 2% 1/4W | 0751-1042 |
| R19 | R: VAR COMP 500, 10 TURN | 2100-0027 |
| R20 | R: METAL FILM 1.24k 1% | 0721-1241 |
| R21 | R: METAL FILM 38.3k 1% | 0721-3832 |
| R22 | R: METAL FILM 10.0k 1% | 0721-1002 |
| R23 | R: VAR COMP 100k, 10 TURN | 2100-0030 |
| R24 | R: METAL FILM 24.9k 1% | 0721-2492 |
| R25 | R: METAL FILM 100k 2% 1/4W | 0751-1042 |
| R26 | R: VAR COMP 500, 10 TURN | 2100-0027 |
| R27 | R: METAL FILM 1.24k 1% | 0721-1241 |
| R28 | R: METAL FILM 38.3k 1% | 0721-3832 |
| U1 | IC: NE5532 | 1826-0037 |
| U2 | IC: LM393 | 1826-0011 |
| U3 | IC: NE5532 | 1826-0037 |
| U4 | IC: 78L05CP | 1826-0012 |
| U5 | IC: AD637 | 1827-0003 |
| U6 | IC: NE5532 | 1826-0037 |
| U7 | IC: AD637 | 1827-0003 |

CR2

CR1

LOW LIMIT
LED

HIGH LIMIT
LED

P1

TO J13
ON FMMA-1

+12V
TO
A1-6

GND
TO
A1-7

1
RF
LEVEL
FROM
A1-3

3

2

-12V
TO
A1-8

4
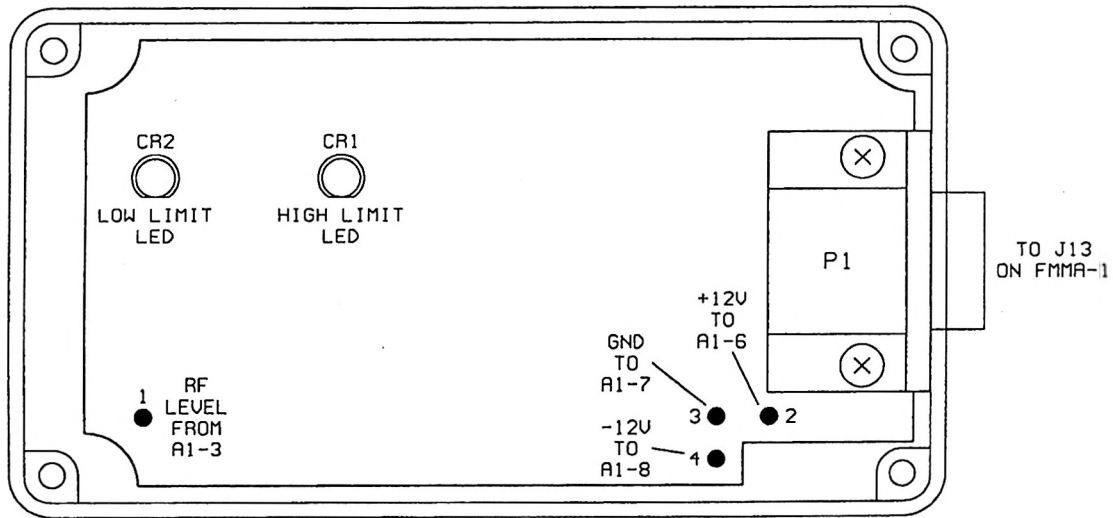
FM DOWN CONVERTER
A2 BOARD
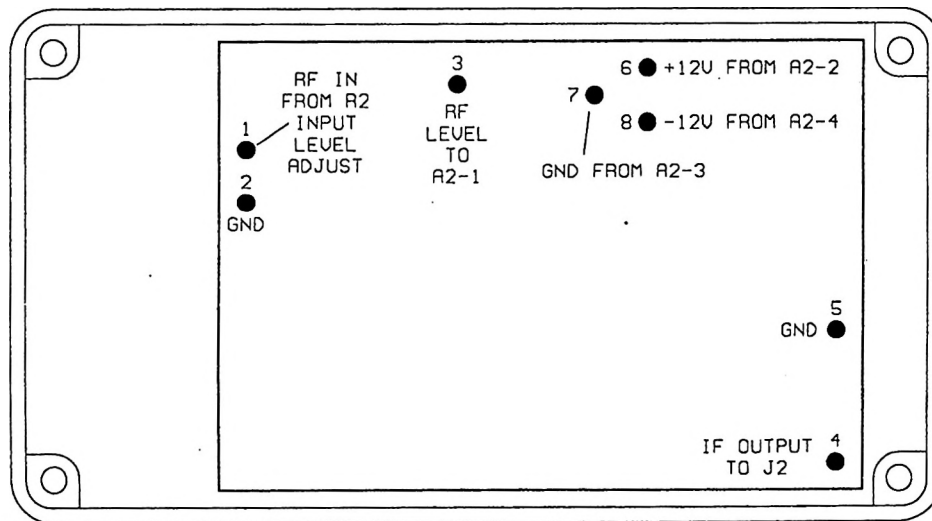CONNECTIONS & INDICATORS
BELAR ELECTRONICS
(EFFECTIVE SERIAL NUMBER 300188)

NOTE: R4 IS MOUNTED UNDER PC BOARD.

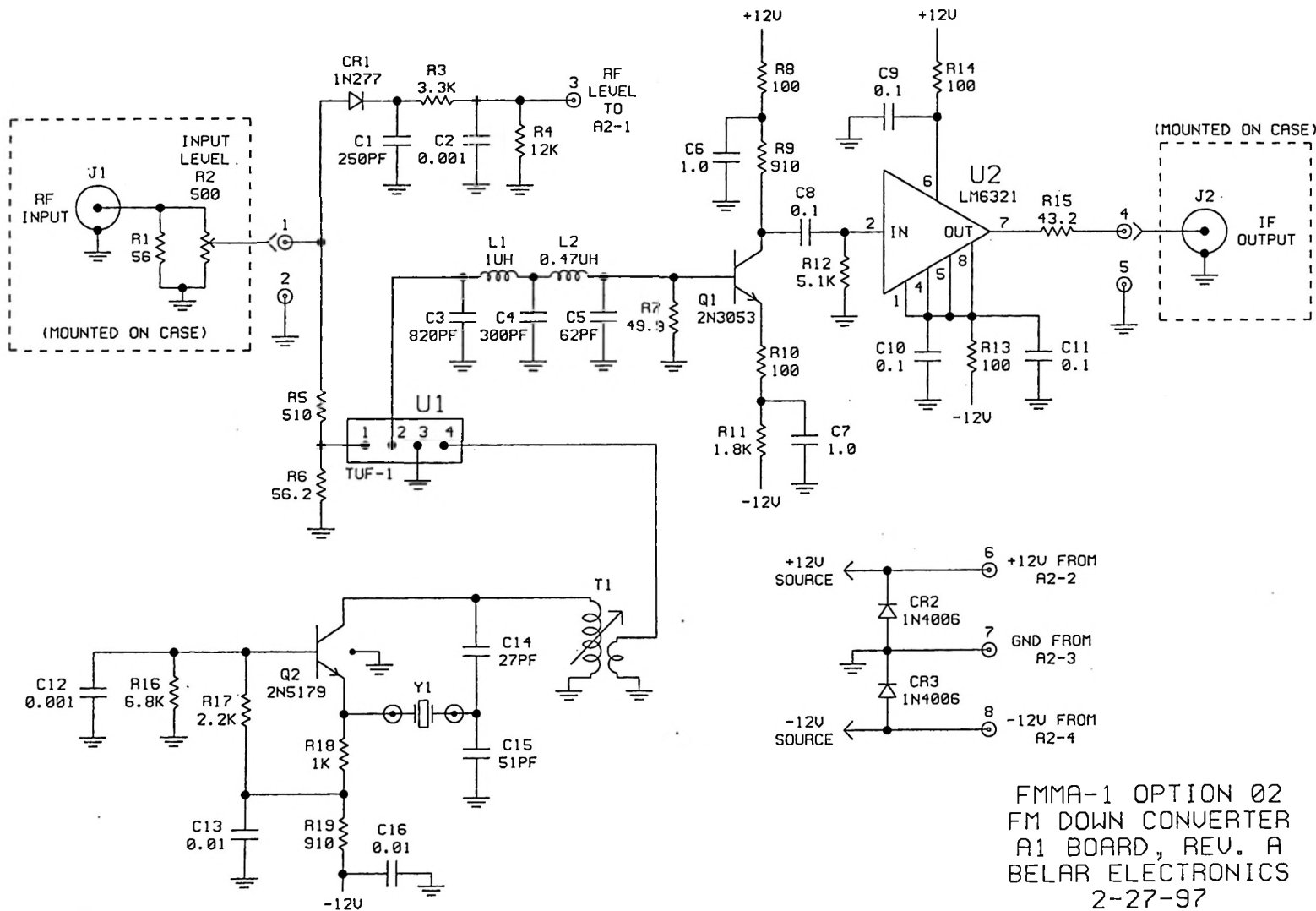FM DOWN CONVERTER
A2 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS
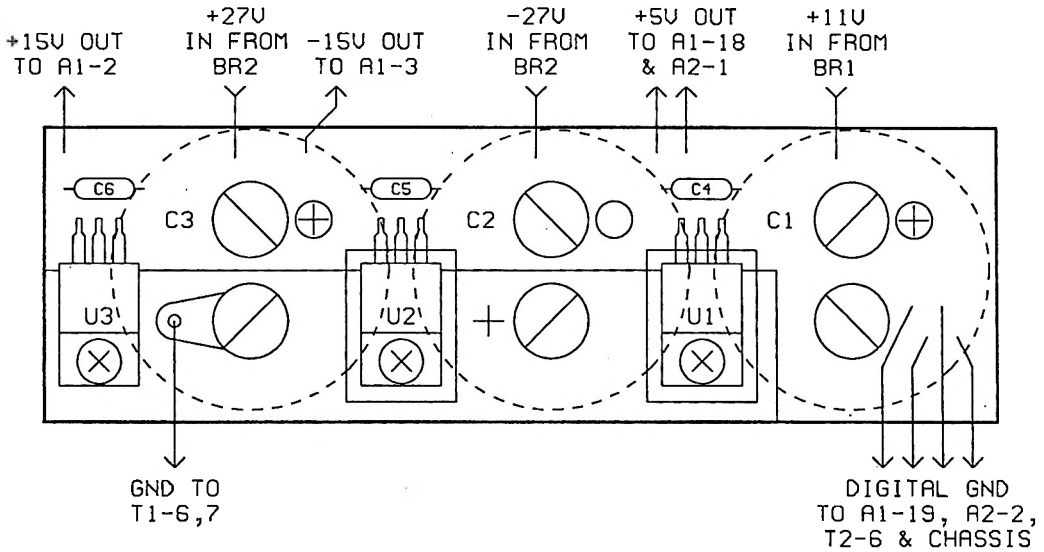(EFFECTIVE SERIAL NUMBER 300188)

FMMA-1 OPTION 02
FM DOWN CONVERTOR
A2 BOARD
BELAR ELECTRONICS
2-27-97
(EFFECTIVE SERIAL NUMBER 300100)

## A1 BOARD FM DOWN CONVERTER Rev. A

| Reference Designation | Description | Part Number |
|---|---|---|
| C1 | C: FIXED MICA 250pF 5% | 0140-2515 |
| C2 | C: FIXED CERAMIC 0.001uF 1kV | 0151-0002 |
| C3 | C: FIXED MICA 820pF 5% | 0140-8215 |
| C4 | C: FIXED MICA 300pF 5% | 0140-3015 |
| C5 | C: FIXED MICA 62pF 5% | 0140-6205 |
| C6,C7 | C: FIXED CERAMIC 1.0uF 50V | 0151-0016 |
| C8 thru C11 | C: FIXED CERAMIC 0.1uF 50V | 0151-0015 |
| C12 | C: FIXED CERAMIC 0.001uF 1kV | 0151-0002 |
| C13 | C: FIXED CERAMIC 0.01uF 100V | 0151-0003 |
| C14 | C: FIXED MICA 27pF 5% | 0140-2705 |
| C15 | C: FIXED MICA 51pF 5% | 0140-5105 |
| C16 | C: FIXED CERAMIC 0.01uF 100V | 0151-0003 |
| CR1 | DIODE: 1N277 GERMANIUM | 1900-0001 |
| CR2,CR3 | DIODE: 1N4006 | 1900-0016 |
| J1,J2 | JACK: BNC                      (on chassis) | 0360-0005 |
| L1 | CHOKE: 1uH | 9141-0002 |
| L2 | CHOKE: 0.47uH | 9141-0006 |
| Q1 | TRANSISTOR: 2N3053 | 1850-0008 |
| Q2 | TRANSISTOR: 2N5179 | 1850-0023 |
| R1 | R: VAR COMP 500 2W          (on chassis) | 2100-0015 |
| R2 | R: FIXED NON-IND 56 20W   (on chassis) | 0811-0021 |
| R3 | R: METAL FILM 3.3k 2% 1/4W | 0751-3322 |
| R4 | R: METAL FILM 12k 2% 1/4W | 0751-1232 |
| R5 | R: METAL FILM 510 2% 1/4W | 0751-5112 |
| R6 | R: METAL FILM 56.2 1% | 0721-56R2 |
| R7 | R: METAL FILM 49.9 1% | 0721-49R9 |
| R8 | R: METAL FILM 100 2% 1/4W | 0751-1012 |
| R9 | R: METAL FILM 910 2% 1/4W | 0751-9112 |
| R10 | R: METAL FILM 100 2% 1/4W | 0751-1012 |
| R11 | R: METAL FILM 1.8k 2% 1/4W | 0751-1822 |
| R12 | R: METAL FILM 5.1k 2% 1/4W | 0751-5122 |
| R13,R14 | R: METAL FILM 100 2% 1/4W | 0751-1012 |
| R15 | R: METAL FILM 43.2 1% | 0721-43R2 |
| R16 | R: METAL FILM 6.8k 2% 1/4W | 0751-6822 |
| R17 | R: METAL FILM 2.2k 2% 1/4W | 0751-2222 |
| R18 | R: METAL FILM 1k 2% 1/4W | 0751-1022 |
| R19 | R: METAL FILM 910 2% 1/4W | 0751-9112 |
| T1 | TRANSFORMER: VARIABLE | Belar |
| U1 | IC: TUF-1 | 1845-0011 |
| U2 | IC: LM6321 | 1826-0050 |
| Y1 | XTAL: 650kHz above carrier | |

RF IN
FROM R2
1  INPUT
   LEVEL
2  ADJUST

GND

3
RF
LEVEL
TO
A2-1

6  +12V FROM A2-2
7
8  -12V FROM A2-4

GND FROM A2-3

5
GND

4
IF OUTPUT
TO J2

FM DOWN CONVERTER
A1 BOARD Rev. A
CONNECTIONS
BELAR ELECTRONICS
(EFFECTIVE SERIAL NUMBER 300188)

FM DOWN CONVERTER
A1 BOARD Rev. A
COMPONENT LAYOUT
BELAR ELECTRONICS

FMMA-1 OPTION 02
FM DOWN CONVERTER
A1 BOARD, REV. A
BELAR ELECTRONICS
2-27-97
(EFFECTIVE SERIAL NUMBER 300188)

```
+15V OUT        +27V         -15V OUT        -27V      +5V OUT      +11V
TO A1-2      IN FROM       TO A1-3       IN FROM    TO A1-18     IN FROM
               BR2                         BR2       & A2-1         BR1
```

GND TO
T1-6,7

DIGITAL GND
TO A1-19, A2-2,
T2-6 & CHASSIS

FMMA-1
A3 POWER SUPPLY BOARD
COMPONENT LAYOUT
(ONLY USED PRIOR TO SERIAL NUMBER 300188)

A3 BOARD FMMA-1

| Reference Designation | Description | Part Number |
|---|---|---|
| C1 thru C3 | C: FIXED ELEC 3500uF 40V | 0180-0026 |
| C4 thru C6 | C: FIXED CERAMIC 0.1uF 50V | 0151-0006 |
| U1 | IC: 7805C | 1826-0014 |
| U2 | IC: 7915C | 1826-0033 |
| U3 | IC: 7815C | 1826-0031 |

(SEE CHASSIS WIRING DIAGRAM FOR A3 BOARD SCHEMATIC)

MAIN CHASSIS

| Reference Designation | Description | | Part Number |
|---|---|---|---|
| A3 | POWER SUPPLY MODULE: 15W | (note 2) | 4005-0019A |
| BR1 thru BR3 | DIODE: BRIDGE KBPC602 GI | (note 1) | 1900-0025 |
| -- | POWER ENTRY MODULE: 6EGG1-1 | (note 2) | 0360-0021 |
| F1 | FUSE: GMA-3A 250V(UL/CSA) or T3.15A-250V(IEC) | (note 2) | 2110-0009 |
| -- | FUSE HOLDER: CHASSIS MOUNT | (note 2) | 2110-0010 |
| F2 | FUSE: AGC-2A 250V | (note 2) | 2110-0006 |
| -- | POWER ENTRY MODULE: 6J4 | (note 1) | 0360-0020 |
| | FUSE: AGC 1/2A 250V | (note 1) | 2110-0001 |
| J3 thru J9 | JACK: BNC, ISOLATED | | 0360-0006 |
| J10,J11 | JACK: BNC, ISOLATED | (note 3) | 0360-0006 |
| J12 | CONNECTOR: 9 PIN D ,MALE | (note 3) | 0360-0030 |
| J14 | JACK: BNC, ISOLATED | (note 3) | 0360-0006 |
| -- | PLUG: SMB | (note 3) | 0360-0042 |
| L1 thru L4 | CHOKE: RF | (note 2) | 9140-0011 |
| T1 | TRANSFORMER: POWER, DPC 28-800 | (note 1) | 9100-0021 |
| T2 | TRANSFORMER: POWER, DMPC-Y-12 | (note 1) | 9100-0020 |
| -- | FLAT CABLE ASSEMBLY: 24 CONDUCTOR | | 8900-0002 |
| -- | LINE CORD (115 Vac line voltage) | | 8120-0002 |
| -- | LINE CORD (230 Vac line voltage) | | 8120-0004 |

note 1: USED PRIOR TO SERIAL NUMBER 300188.

note 2: USED BEGINNING SERIAL NUMBER 300188.

note 3: USED WITH OPTIONAL A4 DEMODULATOR BOARD.