

The WizardTM

FMMA-1 Precision Digital FM Modulation Monitor/Analyzer

PATENTED

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

Guide to Operations 1/01

©1991-2001



BELAR ELECTRONICS LABORATORY, INC.

119 LANCASTER AVENUE • P.O. BOX 76 • DEVON, PA 19333-0076 USA

VOICE (610) 687-5550 • FAX (610) 687-2686

WEB: <http://www.belar.com/> • E-mail: sales@belar.com • service@belar.com • parts@belar.com

WARRANTY AND ASSISTANCE

All Belar products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, FOB factory or, in the case of certain major components listed in the instruction manual, for the specified period. Belar will repair or replace products which prove to be defective during the warranty period provided that they are returned to Belar prepaid. No other warranty is expressed or implied. Belar is not liable for consequential damages.

For any assistance, contact your Belar Sales Representative or Customer Engineering Service at the Belar factory.

The Wizard

1	General Information	1
1-1	General Description	1
1-2	Specifications	2
2	Unpacking	3
2-1	Initial Inspection	3
2-2	Claims	3
2-3	Repacking for Shipment	3
3	Rear Panel Connections	4
3-1	Options, Accessories and Other Equipment	5
3-1-1	FMMA-1 Option 01 - Precision Demodulator with Calibrator	5
3-1-2	FMMA-1 Option 02 - Down Converter/AM Noise Detector	6
3-1-3	DC-4 Frequency Agile Down Converter and AM Noise Detector	6
4	Installation and Setup	7
4-1	General	7
4-2	Power Connection	7
4-3	FMMA-1 Input Signal Connection	7
4-4	Pilot Input Connection	8
4-5	SCA Input Connection	8
4-6	Loop-Thru #1 & Loop-Thru #2 Connection	9
4-7	J12 - Demodulator Audio Output Connection	9
4-8	Unit Interface Connection	9
4-9	RS-232 Connection	9
4-10	Remote Alarm Connections	10
5	Front Panel Operation	11
5-1	Menu Selections: Measurements	12
5-2	Menu Selections: Parameters	13
6	Running the Setup Program	15
6-1	Main Setup Menu Selections	15
6-2	MODIFY OPTIONS SubMenu Selections	16
6-3	MODIFY ID SubMenu Selections	17
6-4	MODIFY OFFSETS SubMenu Selections	17
6-5	UNIT INFO SubMenu Selections	18
6-6	TEST RELAY/LED SubMenu Selections	18
6-7	TEST RS-232 SubMenu Selections	18
7	Menu/Parameter Interaction	19
8	FMMA-1 ASCII RS-232 Interface Commands	20
9	Diagrams, Schematics and Parts Lists	25
	Appendix A: Using The Wizard Software	

The Wizard

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 configurable "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 Converter/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 μ -sec, or 75 μ -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

The Wizard

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.

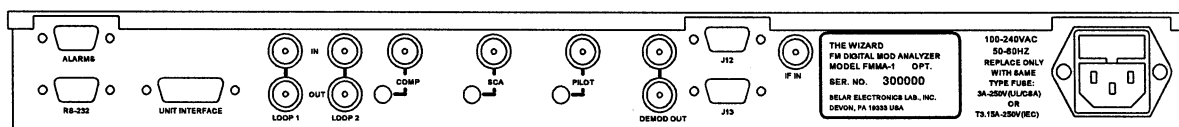
2-3 Repacking for Shipment

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. Be sure to insure the unit for full value.

The Wizard

3 Rear Panel Connections



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

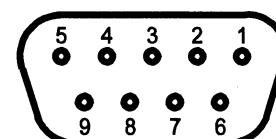
Pilot Input 220 k Ω , unbalanced, BNC Connector
 0.5 -> 1.5 Vrms @ 9.0%
 0.1% resolution
 0.0 -> 25.5% range

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

Loop Throughs 220 k Ω , 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



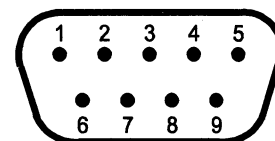
Remote Alarm
Connector

The Wizard

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

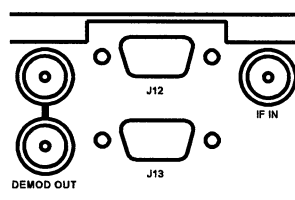
Unit Interface

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

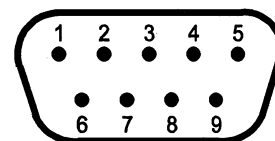
For use with the RFA-1A FM RF Amplifier, the Belar RFA-4 Frequency Agile RF Amplifier, the FMMA-1 Option 02 Down Converter and AM Noise Detector, or the Belar DC-4 Frequency Agile Down Converter and AM Noise Detector.

DEMOM OUT (2 jacks) 75 Ω 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 Ω , unbalanced (selectable de-emphasis)
2	Ground for unbalanced output
3	Audio Out, 600 Ω , balanced, (+), (selectable de-emphasis)
4	Ground for balanced output
5	Audio Out, 600 Ω , 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

The Wizard

De-Emphasis

The de-emphasis is set at the factory at 75 μ -seconds unless 50 μ -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 Converter" 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 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 Converter 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 Converter/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.

The Wizard

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 Converter 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).

The Wizard

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 Converter 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.

The Wizard

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 independently 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 $\pm 10\%$ in 0.5% increments, or $\pm 20\%$ in 1% increments -- determined by the position of jumper P1 (loop-thru #1) or jumper P3 (loop-thru #2). The factory-preset range is $\pm 10\%$ 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.

The Wizard

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

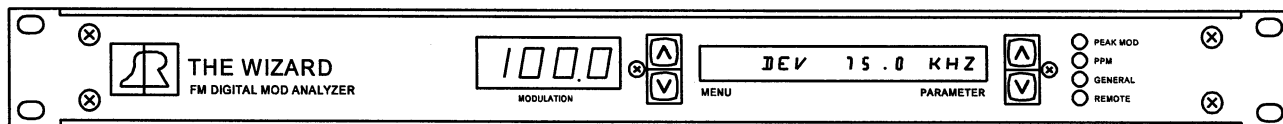
This female 9-pin D-connector provides dry, normally-open relay contacts which close when the corresponding FMMA-1 front panel alarm LED lights. These contacts are rated at 10 Watts, 0.5 Amps, and 200 Vdc maximum. *Under no circumstances should 110 Vac be run through these contacts.* This could damage 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.

The Wizard

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.

The Wizard

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.

The Wizard

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).

The Wizard

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 FMMA-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.

The Wizard

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

The Wizard

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 FMMA-1 FM Digital Stereo Monitor/Analyzer, select "N" -- the pilot measurements are available from the FMMA-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 synchronizes 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.

The Wizard

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 may 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.

The Wizard

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 -
OPEN/CLOSE** Allows the relays and their associated LEDs to be tested. The relay number being tested is displayed along with 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 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.
- RECEIVE \$XX X**
- RECEIVE FAILED X**
- 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 ↓	H o l d	P e a k M o d	I n f i n i t e	B l a n k	R e s o l u t i o n	T i m e M o d e	P e a k W e i g h t	P P M D u r a t i o n	P P M T h r e s h o l d	S e n t r y S e c	S e n t r y %	R e m o t e	R F T h r e s h o l d	A M T h r e s h o l d	S Y T h r e s h o l d
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

The Wizard

'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

The Wizard

'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.

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:

'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

The Wizard

'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

The Wizard

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)

The Wizard

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	μ 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):

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

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

<u>PC</u>	<u><==></u>	<u>Belar Unit</u>
3 - Rx	<u><==</u>	3 - Tx
2 - Tx	<u>==></u>	2 - Rx
7 - GND	<u><==></u>	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):

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

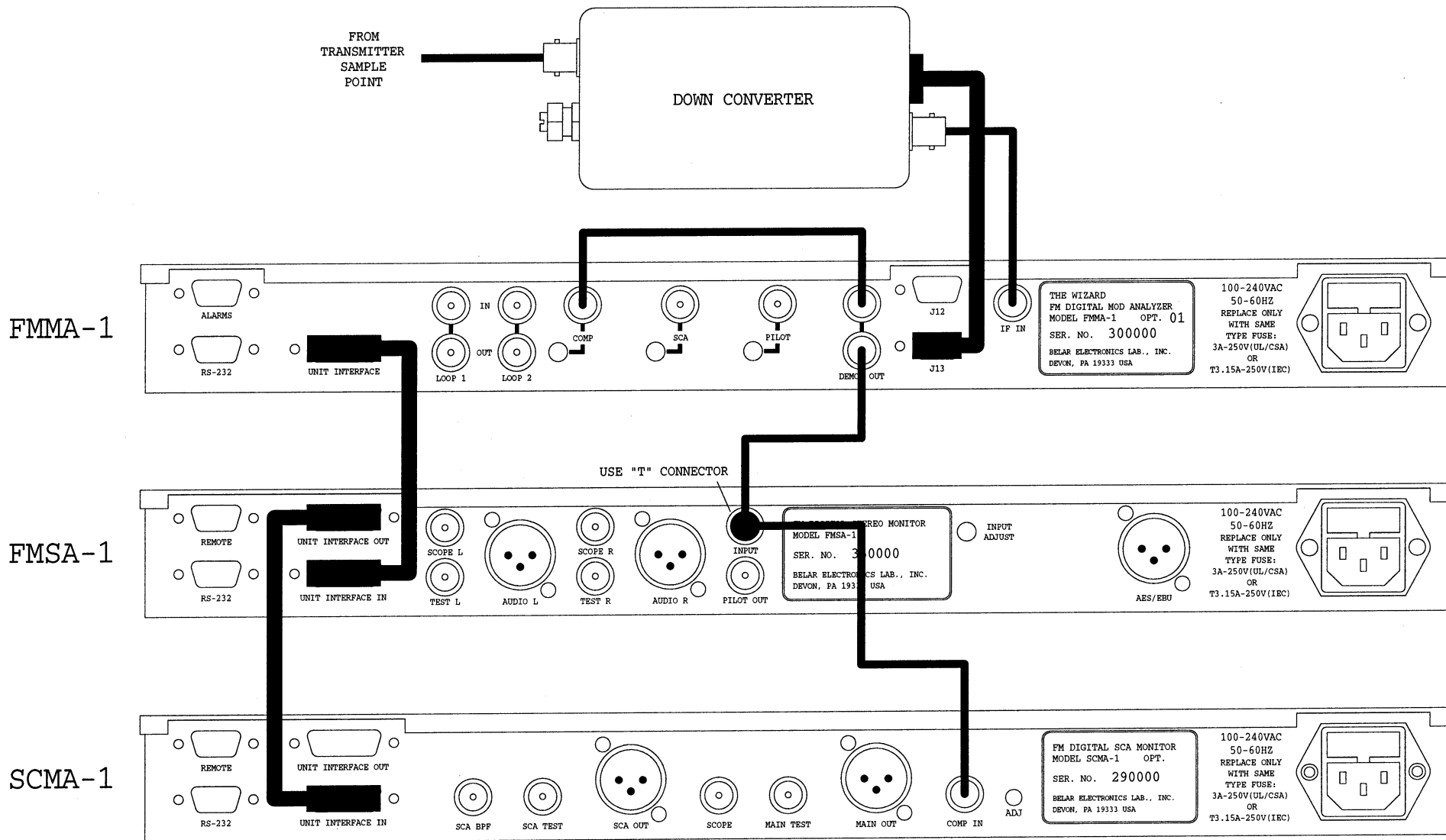
Procedure:

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**.

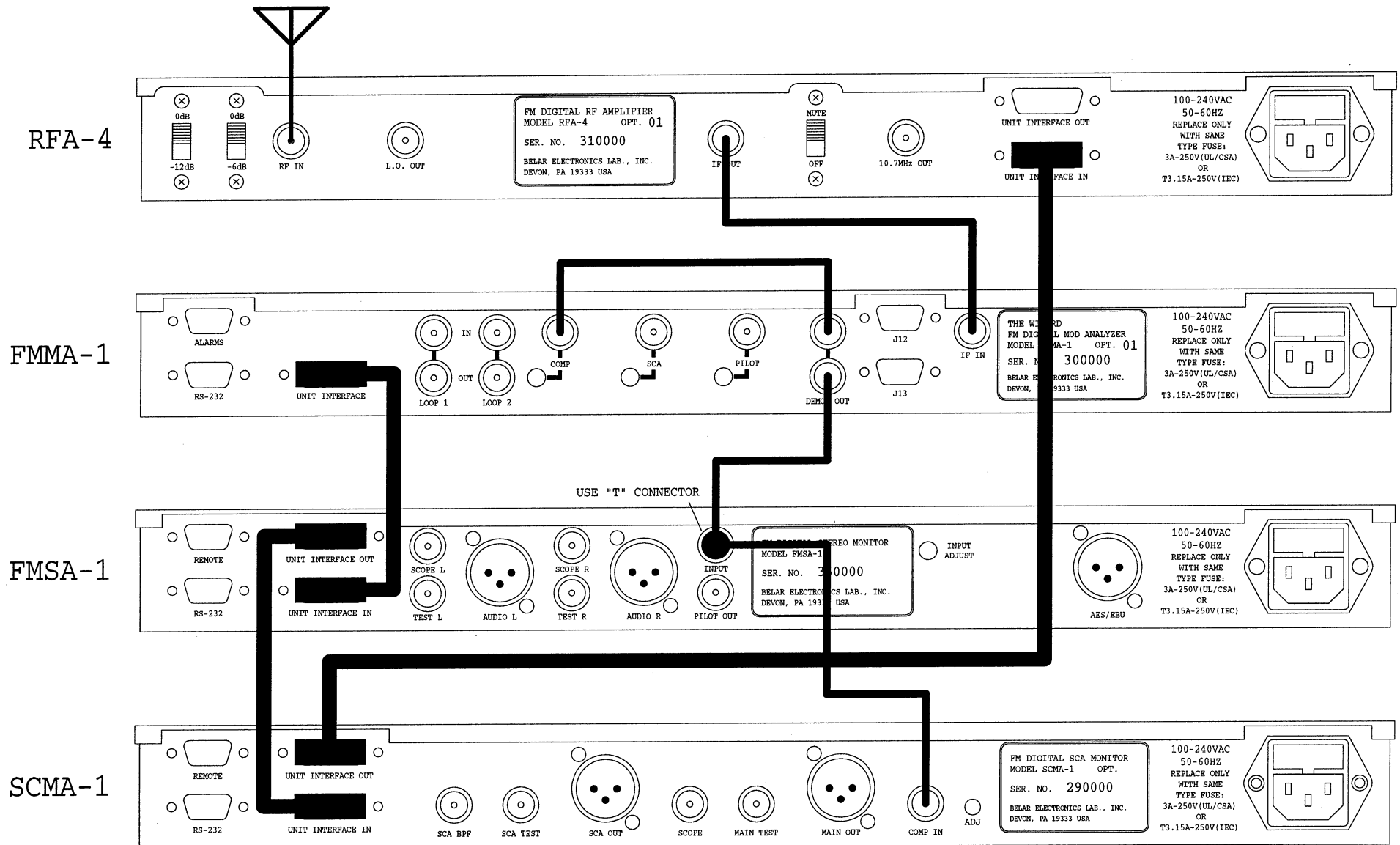
INTERCONNECTIONS FOR TRANSMITTER OPERATION
FMMA-1 (WITH DOWN CONVERTER) / FMSA-1 / SCMA-1



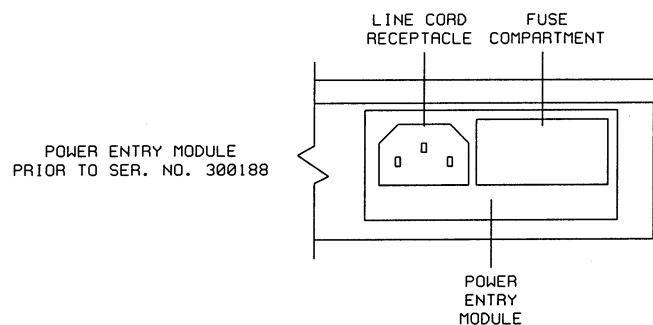
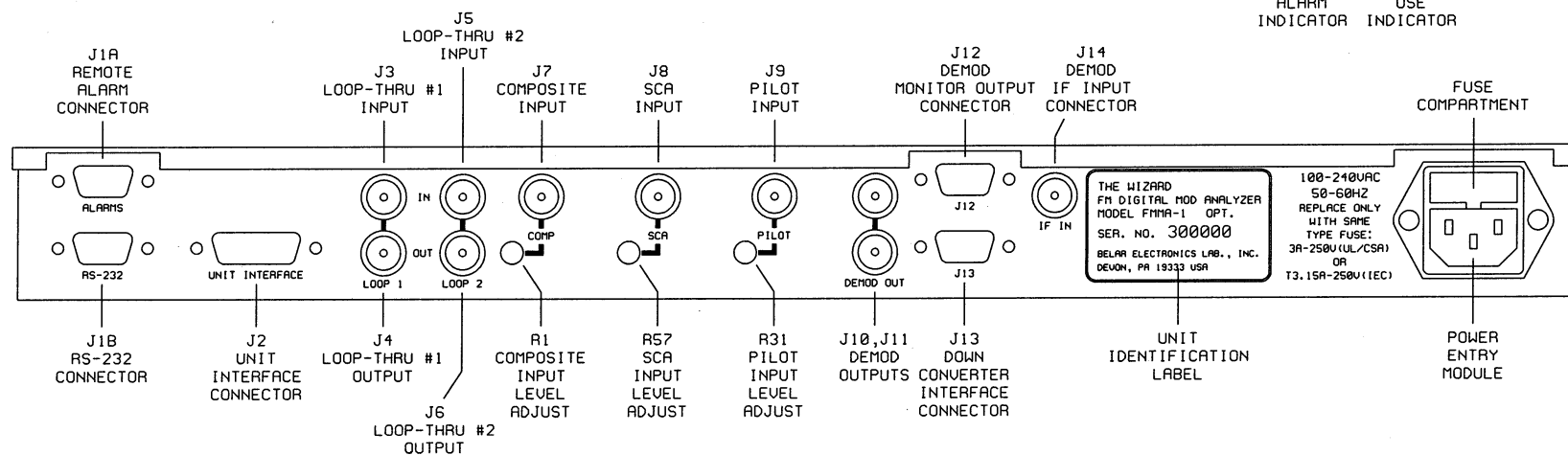
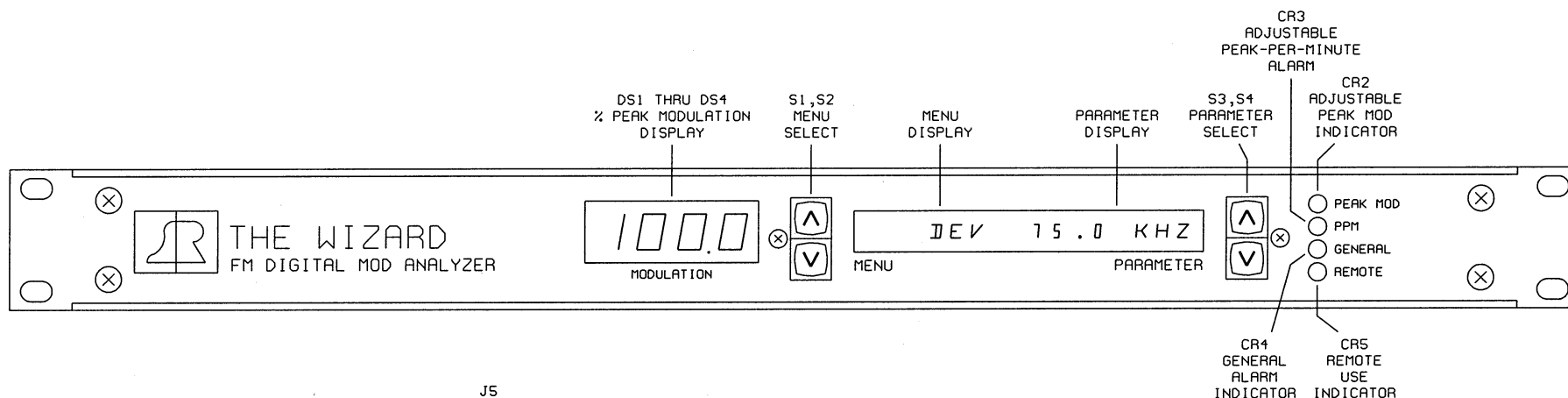
BELAR ELECTRONICS LABORATORY, DEVON PA (610) 687-5550

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 PARTS LISTS

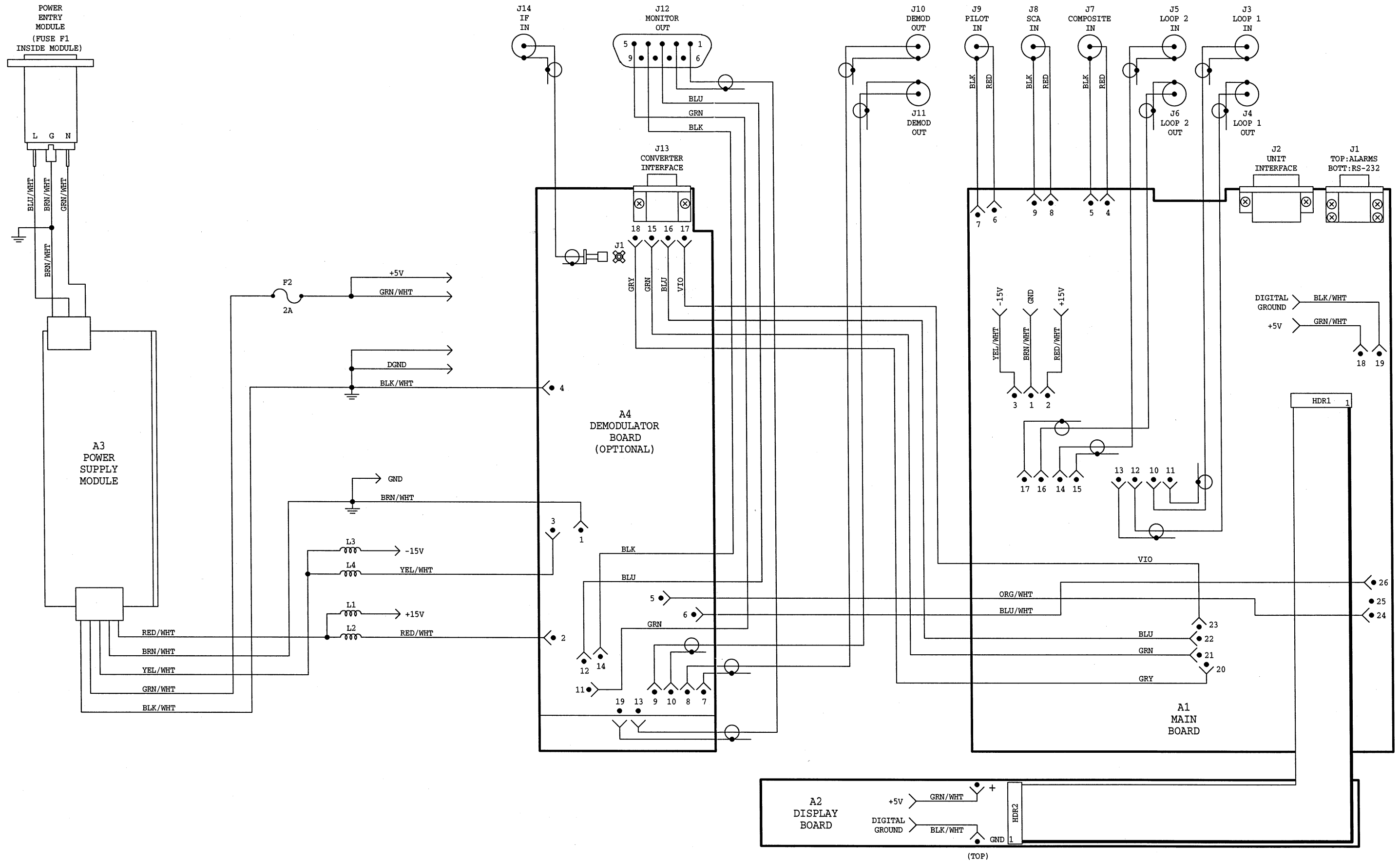
MAIN CHASSIS

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

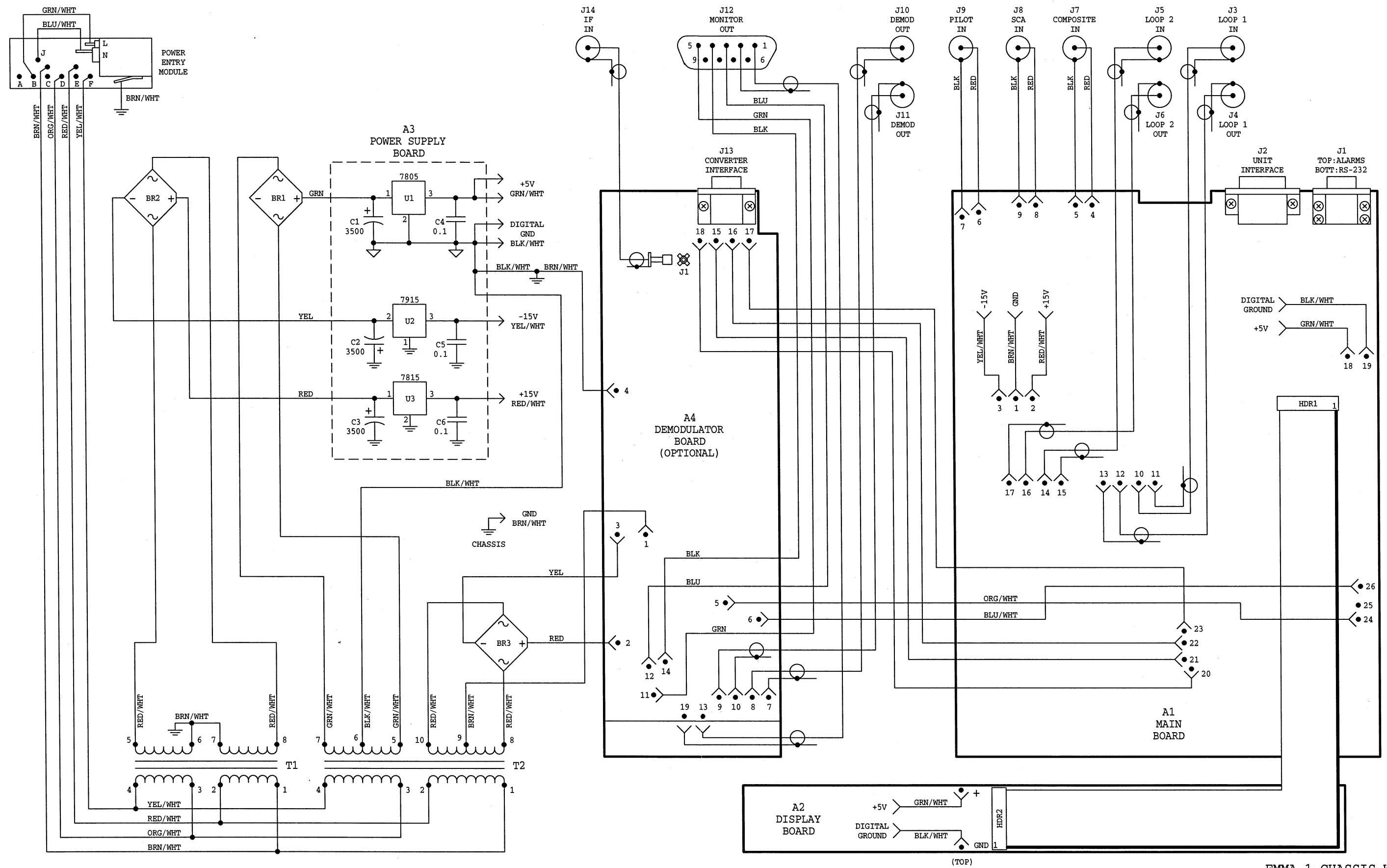
note 1: USED PRIOR TO SERIAL NUMBER 300188.

note 2: USED BEGINNING SERIAL NUMBER 300188.

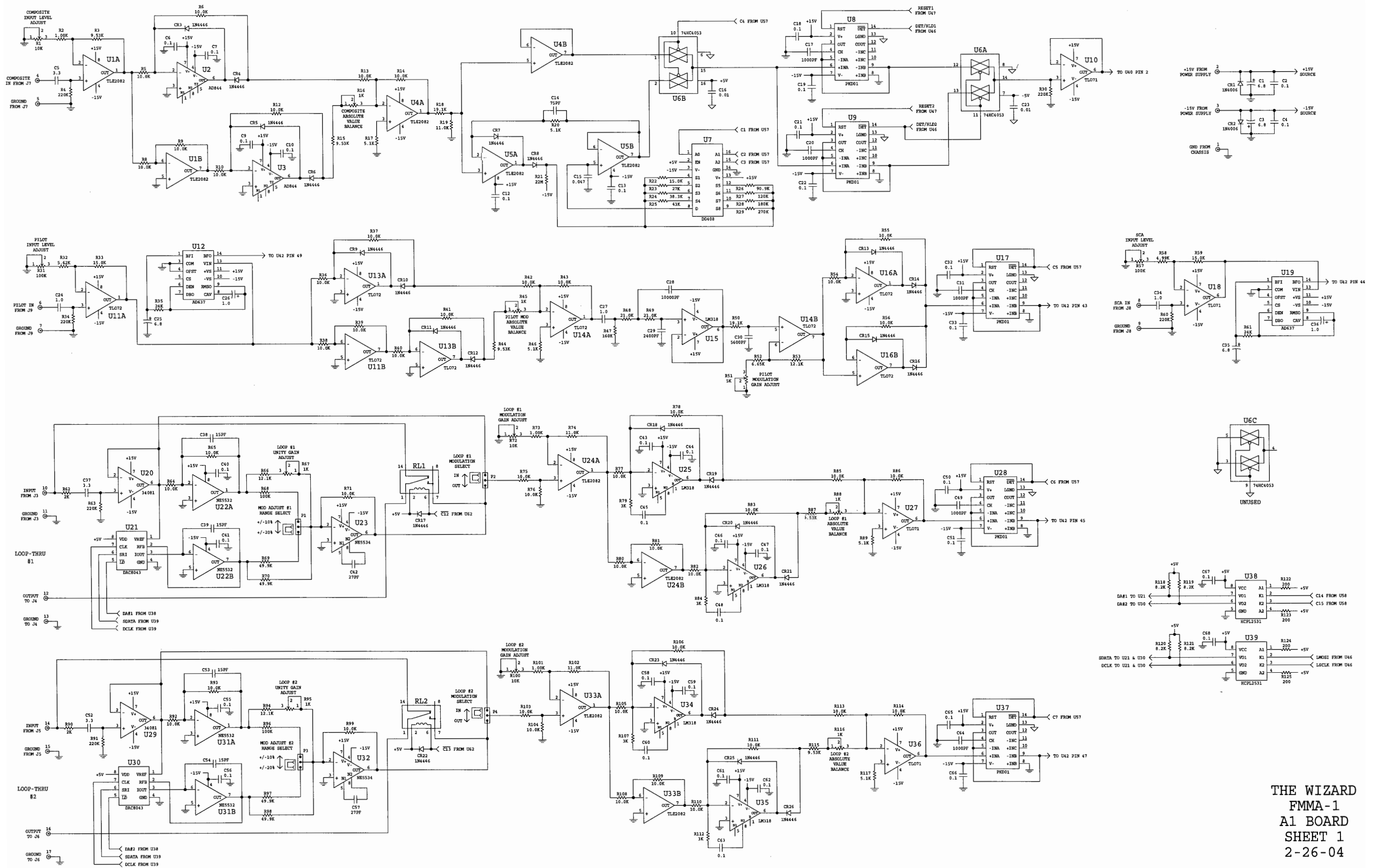
note 3: USED WITH OPTIONAL A4 DEMODULATOR BOARD.

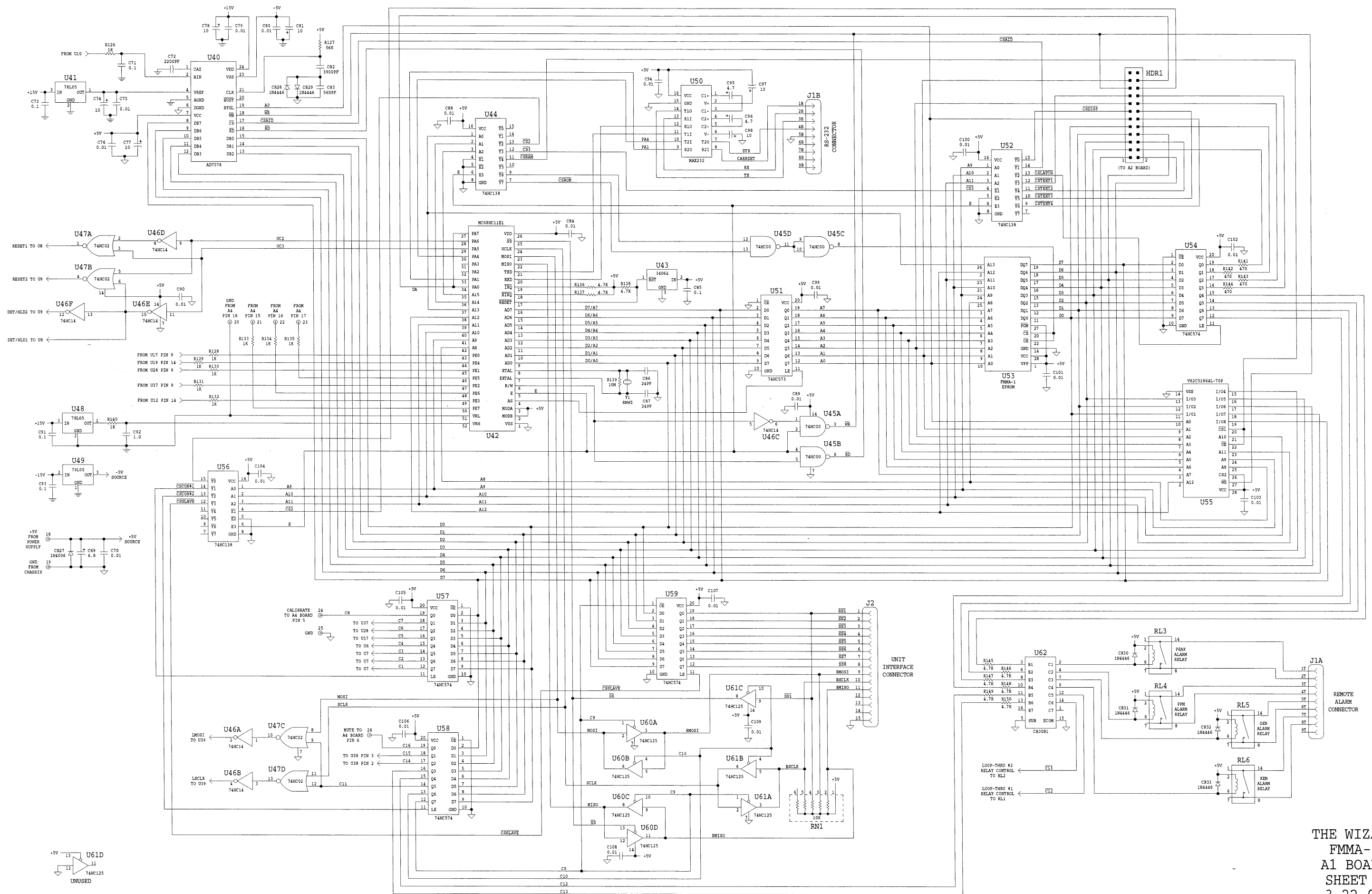


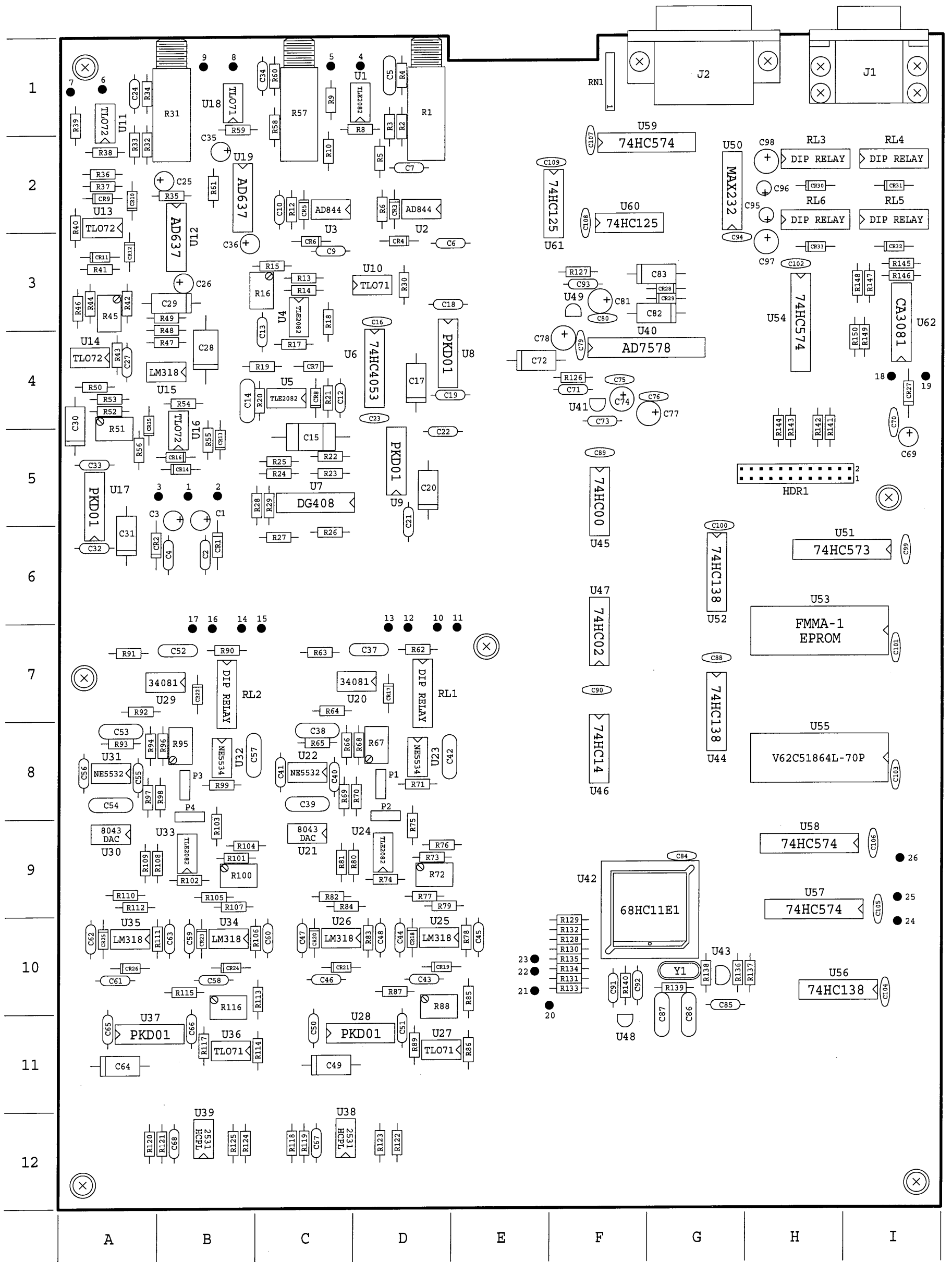
(TOP)



FMMA-1 CHASSIS WIRING
 BELAR ELECTRONICS
 5-4-92
 (USED PRIOR TO S/N 300188)





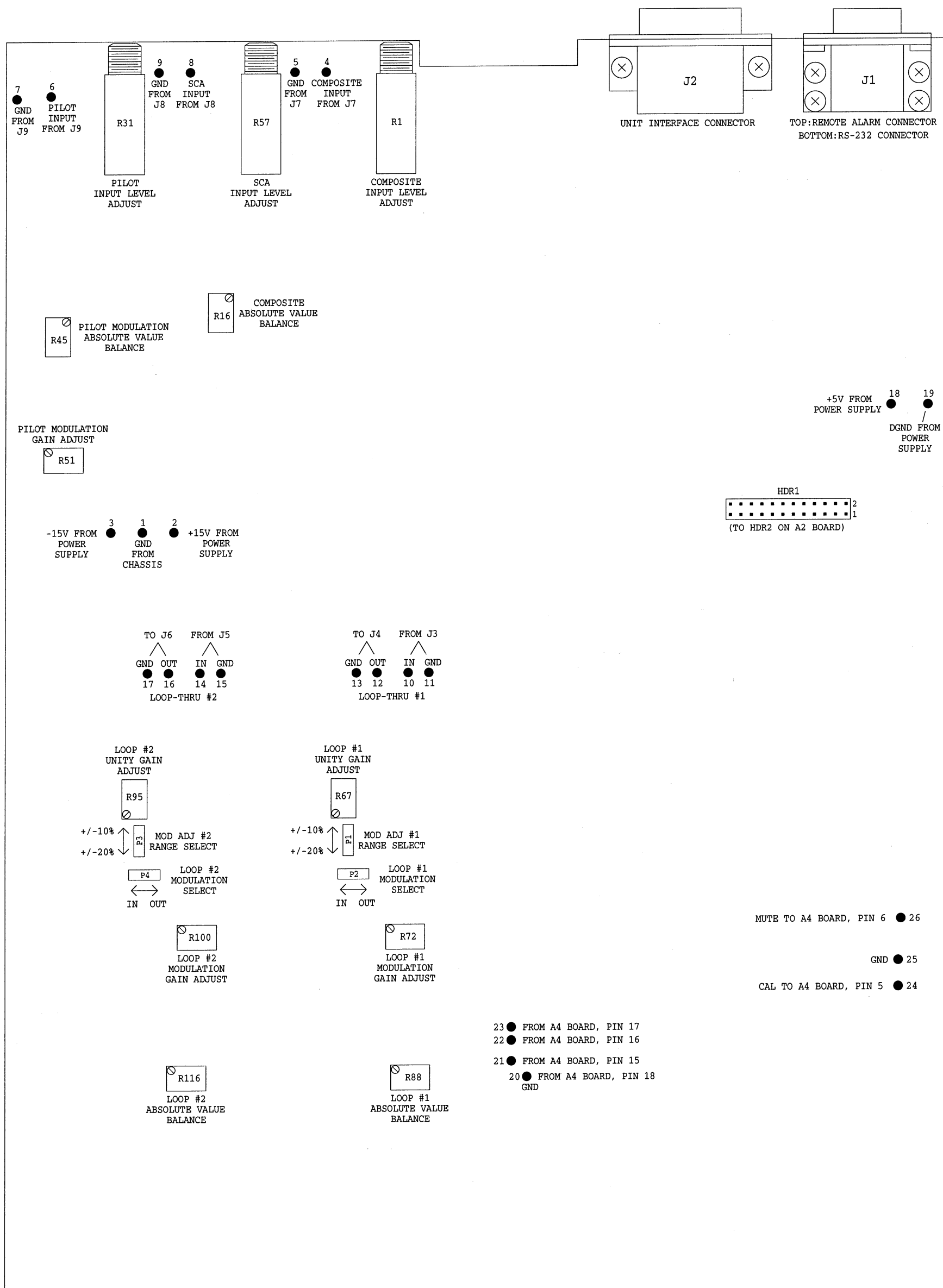


FMMA-1 A1 BOARD
PART LOCATIONS

<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>
C1	B5	C50	C11	C99	I6	J1	I1	R42	A3	R91	A7
C2	B6	C51	D11	C100	G6	J2	G1	R43	A4	R92	A7
C3	B5	C52	B7	C101	I7			R44	A3	R93	A8
C4	B6	C53	A8	C102	H3	P1	D8	R45	A3	R94	A8
C5	D1	C54	A8	C103	I8	P2	D8	R46	A3	R95	B8
C6	D3	C55	A8	C104	I10	P3	B8	R47	B4	R96	B8
C7	D2	C56	A8	C105	I9	P4	B8	R48	B3	R97	A8
C8	D2	C57	B8	C106	I9			R49	B3	R98	B8
C9	C3	C58	B10	C107	F2	R1	D1	R50	A4	R99	B8
C10	C2	C59	B10	C108	F2	R2	D1	R51	A4	R100	B9
C11	D2	C60	C10	C109	E2	R3	D1	R52	A4	R101	B9
C12	C4	C61	A10			R4	D1	R53	A4	R102	B9
C13	C4	C62	A10	CR1	B6	R5	D2	R54	B4	R103	B9
C14	B4	C63	B10	CR2	A6	R6	D2	R55	B5	R104	B9
C15	C5	C64	A11	CR3	D2	R7	D2	R56	A5	R105	B9
C16	D3	C65	A11	CR4	D3	R8	D1	R57	C1	R106	B10
C17	D4	C66	B11	CR5	C2	R9	C1	R58	C1	R107	B9
C18	D3	C67	C12	CR6	C3	R10	C2	R59	B1	R108	A9
C19	D4	C68	B12	CR7	C4	R11	C2	R60	C1	R109	A9
C20	D5	C69	I5	CR8	C4	R12	C2	R61	B2	R110	A9
C21	D5	C70	I4	CR9	A2	R13	C3	R62	D7	R111	A10
C22	D5	C71	F4	CR10	A2	R14	C3	R63	C7	R112	A9
C23	D4	C72	E4	CR11	A3	R15	C3	R64	C7	R113	C10
C24	A1	C73	F4	CR12	A3	R16	C3	R65	C8	R114	C11
C25	B2	C74	F4	CR13	B5	R17	C4	R66	C8	R115	B10
C26	B3	C75	F4	CR14	B5	R18	C3	R67	D8	R116	B10
C27	A4	C76	G4	CR15	A4	R19	C4	R68	D8	R117	B11
C28	B4	C77	F4	CR16	B5	R20	C4	R69	C8	R118	C12
C29	B3	C78	F4	CR17	D7	R21	C4	R70	D8	R119	C12
C30	A4	C79	F4	CR18	D10	R22	C5	R71	D8	R120	A12
C31	A6	C80	F3	CR19	D10	R23	C5	R72	D9	R121	B12
C32	A6	C81	F3	CR20	C10	R24	C5	R73	D9	R122	D12
C33	A5	C82	G3	CR21	C10	R25	C5	R74	D9	R123	D12
C34	C1	C83	G3	CR22	B7	R26	C6	R75	D9	R124	B12
C35	B2	C84	G9	CR23	B10	R27	C6	R76	D9	R125	B12
C36	B3	C85	G10	CR24	B10	R28	B5	R77	D9	R126	F4
C37	D7	C86	G11	CR25	A10	R29	C5	R78	E10	R127	F3
C38	C8	C87	G11	CR26	A10	R30	D3	R79	D9	R128	F10
C39	C8	C88	G7	CR27	I4	R31	B1	R80	C9	R129	F10
C40	C8	C89	F5	CR28	G3	R32	A2	R81	C9	R130	F10
C41	C8	C90	F7	CR29	G3	R33	A2	R82	C9	R131	F10
C42	D8	C91	F10	CR30	H2	R34	A1	R83	D10	R132	F10
C43	D10	C92	F10	CR31	I2	R35	B2	R84	C9	R133	F10
C44	D10	C93	F3	CR32	I3	R36	A2	R85	E10	R134	F10
C45	E10	C94	G3	CR33	H3	R37	A2	R86	E11	R135	F10
C46	C10	C95	H2			R38	A2	R87	D10	R136	G10
C47	C10	C96	H2	HDR1	H5	R39	A1	R88	D10	R137	H10
C48	D10	C97	H3			R40	A2	R89	D11	R138	G10
C49	C11	C98	H2			R41	A3	R90	B7	R139	G10

FMMA-1 A1 BOARD
PART LOCATIONS
CONT.

<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>
R140	F10	U28 D11 10 D7
R141	H5	U29 B7 11 E7
R142	H5	U30 A9 12 D7
R143	H5	U31 A8 13 D7
R144	H5	U32 B8 14 B7
R145	I3	U33 B9 15 C7
R146	I3	U34 B10 16 B7
R147	I3	U35 A10 17 B7
R148	I3	U36 B11 18 I4
R149	I4	U37 A11 19 I4
R150	I4	U38 C12 20 E10
		U39 B12 21 E10
RL1	D7	U40 F4 22 E10
RL2	B7	U41 F4 23 E10
RL3	H2	U42 F9 24 I10
RL4	I2	U43 G10 25 I9
RL5	I2	U44 G7 26 I9
RL6	H2	U45 F5
		U46 F8
RN1	F1	U47 F7
		U48 F11
U1	D1	U49 F3
U2	D2	U50 G2
U3	C2	U51 H6
U4	C3	U52 G6
U5	C4	U53 H7
U6	D4	U54 H3
U7	C5	U55 H8
U8	D4	U56 H10
U9	D5	U57 H9
U10	D3	U58 H9
U11	A1	U59 F2
U12	B3	U60 F2
U13	A2	U61 F2
U14	A4	U62 I3
U15	B4	
U16	B5	Y1 G10
U17	A5	
U18	B1	<u>pins</u>
U19	B2	1 B5
U20	D7	2 B5
U21	C9	3 A5
U22	C8	4 D1
U23	D8	5 C1
U24	D9	6 A1
U25	D10	7 A1
U26	C10	8 B1
U27	D11	9 B1



FMMA-1 A1 BOARD
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A1 BOARD FMMA-1

Reference Designation	Description	Part Number
C1	C: FIXED TANT 6.8uF 25V	0185-0002
C2	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C3	C: FIXED TANT 6.8uF 25V	0185-0002
C4	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C5	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C6 thru C13*	C: FIXED CERAMIC 0.1uF 50V	0151-0006
*C8 and C11 are not used when U2 and U3 are a AD844 IC.		
C14	C: FIXED MICA 75pF 5%	0140-7505
C15	C: FIXED FILM 0.047uF 10% 200V	0120-4731
C16	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C17	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C18,C19	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C20	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C21,C22	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C23	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C24	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C25	C: FIXED TANT 6.8uF 25V	0185-0002
C26	C: FIXED TANT 1.0uF 35V	0185-0006
C27	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C28	C: FIXED POLY 10,000pF 2.5% 160V	0130-1032
C29	C: FIXED POLY 2400pF 2.5% 160V	0130-2422
C30	C: FIXED POLY 5600pF 2.5% 160V	0130-5622
C31	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C32,C33	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C34	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C35	C: FIXED TANT 6.8uF 25V	0185-0002
C36	C: FIXED TANT 1.0uF 35V	0185-0006
C37	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C38,C39	C: FIXED MICA 15pF 5%	0140-1505
C40,C41	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C42	C: FIXED MICA 27pF 5%	0140-2705
C43 thru C48	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C49	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C50,C51	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C52	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C53,C54	C: FIXED MICA 15pF 5%	0140-1505
C55,C56	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C57	C: FIXED MICA 27pF 5%	0140-2705
C58 thru C63	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C64	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C65 thru C68	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C69	C: FIXED TANT 6.8uF 25V	0185-0002
C70	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C71	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C72	C: FIXED POLY 2200pF 2.5% 160V	0130-2222
C73	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C74	C: FIXED TANT 10uF 16V	0185-0007
C75,C76	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C77,C78	C: FIXED TANT 10uF 16V	0185-0007
C79,C80	C: FIXED CERAMIC 0.01uF 100V	0151-0003

A1 BOARD FMMA-1 CONT.

Reference Designation	Description	Part Number
C81	C: FIXED TANT 10uF 16V	0185-0007
C82	C: FIXED POLY 3900pF 2.5% 160V	0130-3922
C83	C: FIXED POLY 560pF 2.5% 160V	0130-5612
C84	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C85	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C86,C87	C: FIXED MICA 24pF 5%	0140-2405
C88 thru C90	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C91	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C92	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C93	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C94	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C95,C96	C: FIXED TANT 4.7uF 10V	0185-0001
C97,C98	C: FIXED TANT 10uF 16V	0185-0007
C99 thru C109	C: FIXED CERAMIC 0.01uF 100V	0151-0003
CR1,CR2	DIODE: 1N4006	1900-0016
CR3 thru CR26	DIODE: 1N4446	1900-0002
CR27	DIODE: 1N4006	1900-0016
CR28 thru CR33	DIODE: 1N4446	1900-0002
HDR1	HEADER: 24 PIN	0361-0024
J1	CONNECTOR: "D" DUAL 9 PIN	0360-0034
J2	CONNECTOR: "D" SINGLE 15 PIN	0360-0032
P1 thru P4	PLUG: 3 PIN, PC MOUNT	0365-0030
--	JUMPER: 2 PIN (USED WITH P1 THRU P4)	0365-0028
R1	R: VAR COMP 10k, 10 TURN	2100-0018
R2	R: METAL FILM 1.00k 1%	0721-1001
R3	R: METAL FILM 9.53k 1%	0721-9531
R4	R: METAL FILM 220k 2% 1/4W	0751-2242
R5,R6	R: METAL FILM 10.0k 1%	0721-1002
R7*	R: METAL FILM 3k 2% 1/4W	0751-3022
*R7 is not used when U2 is an AD844 IC.		
R8 thru R10	R: METAL FILM 10.0k 1%	0721-1002
R11**	R: METAL FILM 3k 2% 1/4W	0751-3022
*R11 is not used when U3 is an AD844 IC.		
R12 thru R14	R: METAL FILM 10.0k 1%	0721-1002
R15	R: METAL FILM 9.53k 1%	0721-9531
R16	R: VAR COMP 1k, 10 TURN	2100-0021
R17	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R18	R: METAL FILM 19.1k 1%	0721-1912
R19	R: METAL FILM 11.0k 1%	0721-1102
R20	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R21	R: FIXED CARBON 22M 5% 1/4W	0683-2265
R22	R: METAL FILM 15.0k 1%	0721-1502
R23	R: METAL FILM 27k 2% 1/4W	0751-2732
R24	R: METAL FILM 38.3k 1%	0721-3832
R25	R: METAL FILM 43k 2% 1/4W	0751-4332

A1 BOARD FMMA-1 CONT.

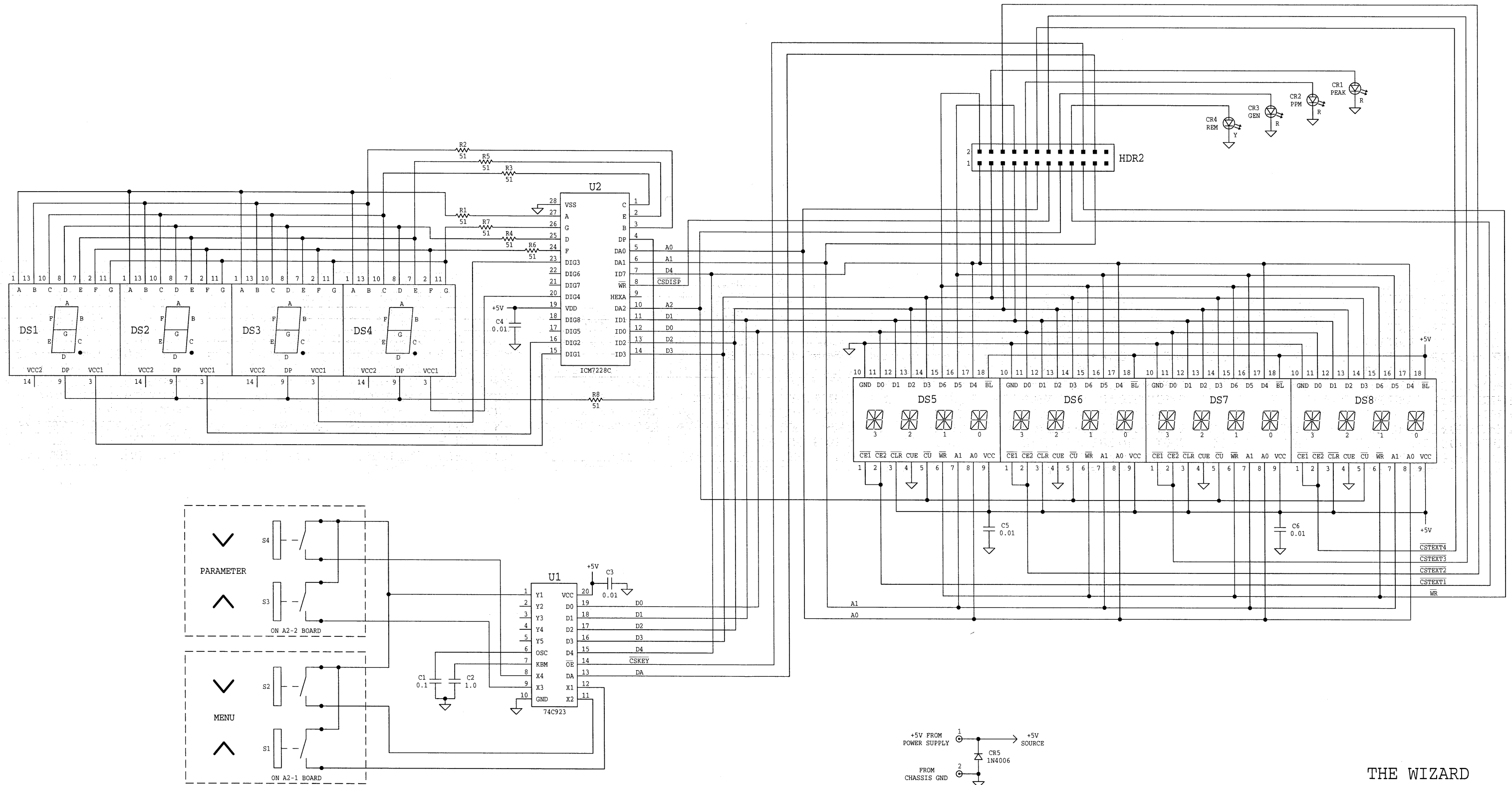
Reference Designation	Description	Part Number
R26	R: METAL FILM 90.9k 1%	0721-9092
R27	R: METAL FILM 120k 2% 1/4W	0751-1242
R28	R: METAL FILM 180k 2% 1/4W	0751-1842
R29	R: METAL FILM 270k 2% 1/4W	0751-2742
R30	R: METAL FILM 220k 2% 1/4W	0751-2242
R31	R: VAR COMP 100k, 10 TURN	2100-0029
R32	R: METAL FILM 5.62k 1%	0721-5621
R33	R: METAL FILM 15.0k 1%	0721-1502
R34	R: METAL FILM 220k 2% 1/4W	0751-2242
R35	R: METAL FILM 24k 2% 1/4W	0751-2432
R36 thru R43	R: METAL FILM 10.0k 1%	0721-1002
R44	R: METAL FILM 9.53k 1%	0721-9531
R45	R: VAR COMP 1k, 10 TURN	2100-0021
R46	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R47	R: METAL FILM 160k 2% 1/4W	0751-1642
R48,R49	R: METAL FILM 21.0k 1%	0721-2102
R50	R: METAL FILM 19.1k 1%	0721-1912
R51	R: VAR COMP 5k, 10 TURN	2100-0020
R52	R: METAL FILM 6.65k 1%	0721-6651
R53	R: METAL FILM 12.1k 1%	0721-1212
R54 thru R56	R: METAL FILM 10.0k 1%	0721-1002
R57	R: VAR COMP 100k, 10 TURN	2100-0029
R58	R: METAL FILM 4.99k 1%	0721-4991
R59	R: METAL FILM 15.0k 1%	0721-1502
R60	R: METAL FILM 220k 2% 1/4W	0751-2242
R61	R: METAL FILM 24k 2% 1/4W	0751-2432
R62	R: METAL FILM 2k 2% 1/4W	0751-2022
R63	R: METAL FILM 220k 2% 1/4W	0751-2242
R64,R65	R: METAL FILM 10.0k 1%	0721-1002
R66	R: METAL FILM 12.1k 1%	0721-1212
R67	R: VAR COMP 1k, 10 TURN	2100-0021
R68	R: METAL FILM 100k 1%	0721-1003
R69,R70	R: METAL FILM 49.9k 1%	0721-4992
R71	R: METAL FILM 10.0k 1%	0721-1002
R72	R: VAR COMP 10k, 10 TURN	2100-0024
R73	R: METAL FILM 1.00k 1%	0721-1001
R74	R: METAL FILM 11.0k 1%	0721-1102
R75 thru R78	R: METAL FILM 10.0k 1%	0721-1002
R79	R: METAL FILM 3k 2% 1/4W	0751-3022
R80 thru R83	R: METAL FILM 10.0k 1%	0721-1002
R84	R: METAL FILM 3k 2% 1/4W	0751-3022
R85,R86	R: METAL FILM 10.0k 1%	0721-1002
R87	R: METAL FILM 9.53k 1%	0721-9531
R88	R: VAR COMP 1k, 10 TURN	2100-0021
R89	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R90	R: METAL FILM 2k 2% 1/4W	0751-2022
R91	R: METAL FILM 220k 2% 1/4W	0751-2242
R92,R93	R: METAL FILM 10.0k 1%	0721-1002
R94	R: METAL FILM 12.1k 1%	0721-1212
R95	R: VAR COMP 1k, 10 TURN	2100-0021

A1 BOARD FMMA-1 CONT.

Reference Designation	Description	Part Number
R96	R: METAL FILM 100k 1%	0721-1003
R97,R98	R: METAL FILM 49.9k 1%	0721-4992
R99	R: METAL FILM 10.0k 1%	0721-1002
R100	R: VAR COMP 10k, 10 TURN	2100-0024
R101	R: METAL FILM 1.00k 1%	0721-1001
R102	R: METAL FILM 11.0k 1%	0721-1102
R103 thru R106	R: METAL FILM 10.0k 1%	0721-1002
R107	R: METAL FILM 3k 2% 1/4W	0751-3022
R108 thru R111	R: METAL FILM 10.0k 1%	0721-1002
R112	R: METAL FILM 3k 2% 1/4W	0751-3022
R113,R114	R: METAL FILM 10.0k 1%	0721-1002
R115	R: METAL FILM 9.53k 1%	0721-9531
R116	R: VAR COMP 1k, 10 TURN	2100-0021
R117	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R118 thru R121	R: METAL FILM 8.2k 2% 1/4W	0751-8222
R122 thru R125	R: METAL FILM 200 2% 1/4W	0751-2012
R126	R: METAL FILM 1k 2% 1/4W	0751-1022
R127	R: METAL FILM 56k 2% 1/4W	0751-5632
R128 thru R135	R: METAL FILM 1k 2% 1/4W	0751-1022
R136 thru R138	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R139	R: FIXED CARBON 10M 5% 1/4W	0683-1065
R140	R: METAL FILM 1k 2% 1/4W	0751-1022
R141 thru R144	R: METAL FILM 470 2% 1/4W	0751-4712
R145 thru R150	R: METAL FILM 4.7k 2% 1/4W	0751-4722
RL1,RL2	RELAY: JWD-172-1	1600-0006
RL3 thru RL6	RELAY: JWD-107-1 (or HE721A6341)	1600-0007
RN1	R: NETWORK 6 PIN 10k	0906-1032
U1	IC: TLE2082	1826-0069
U2,U3*	IC: AD844	1826-0052
	*prior to Feb, 2004 U2 & U3 were the LM318 IC.	
U4,U5	IC: TLE2082	1826-0069
U6	IC: 74HC4053	1822-0050
U7	IC: DG408 (was IH6108)	1827-0002
U8,U9	IC: PKD01	1827-0001
U10	IC: TLO71	1826-0004
U11	IC: TLO72	1826-0038
U12	IC: AD637	1827-0003
U13,U14	IC: TLO72	1826-0038
U15	IC: LM318	1826-0010
U16	IC: TLO72	1826-0038
U17	IC: PKD01	1827-0001
U18	IC: TLO71	1826-0004
U19	IC: AD637	1827-0003
U20	IC: MC34081	1826-0041
U21	IC: DAC8043	1830-0001
U22	IC: NE5532	1826-0037
U23	IC: NE5534	1826-0025

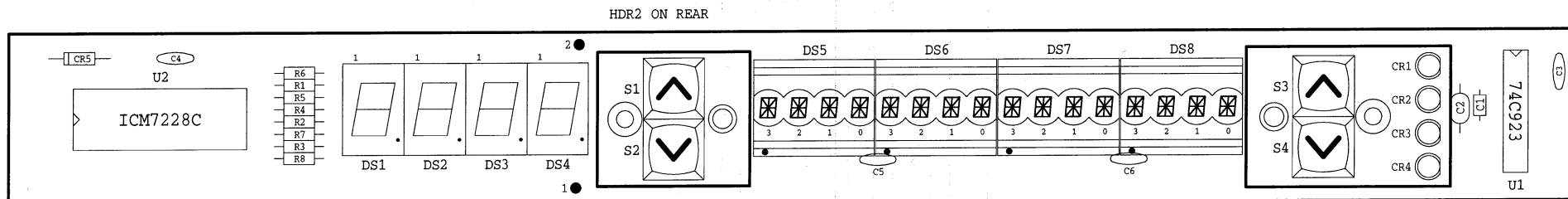
A1 BOARD FMMA-1 CONT.

Reference Designation	Description	Part Number
U24	IC: TLE2082	1826-0069
U25,U26	IC: LM318	1826-0010
U27	IC: TLO71	1826-0004
U28	IC: PKD01	1827-0001
U29	IC: MC34081	1826-0041
U30	IC: DAC8043	1830-0001
U31	IC: NE5532	1826-0037
U32	IC: NE5534	1826-0025
U33	IC: TLE2082	1826-0069
U34,U35	IC: LM318	1826-0010
U36	IC: TLO71	1826-0004
U37	IC: PKD01	1827-0001
U38,U39	IC: HP 2531	1823-0005
U40	IC: AD7578	1830-0002
U41	IC: 78L05CP	1826-0012
U42	IC: MC68HC11E1	1840-0010
U43	IC: MC34064	1826-0048
U44	IC: 74HC138	1822-0047
U45	IC: 74HC00	1822-0039
U46	IC: 74HC14A	1822-0042
U47	IC: 74HC02A	1822-0040
U48	IC: 78L05CP	1826-0012
U49	IC: 79L05CP	1826-0017
U50	IC: MAX232	1823-0001
U51	IC: 74HC573	1822-0052
U52	IC: 74HC138	1822-0047
U53	IC: FMMA-1 EPROM	1840-0003A
U54	IC: 74HC574	1822-0053
U55	IC: V62C51864L-70P	1840-0005
U56	IC: 74HC138	1822-0047
U57 thru U59	IC: 74HC574	1822-0053
U60,U61	IC: 74HC125	1822-0045
U62	IC: CA3081	1826-0027
Y1	XTAL: 8 MHz	0411-0005



PRIOR TO REV. B OF THE A2 BOARD, PIN 5 OF DS5 THRU DS8 WAS CONNECTED TO +5V.

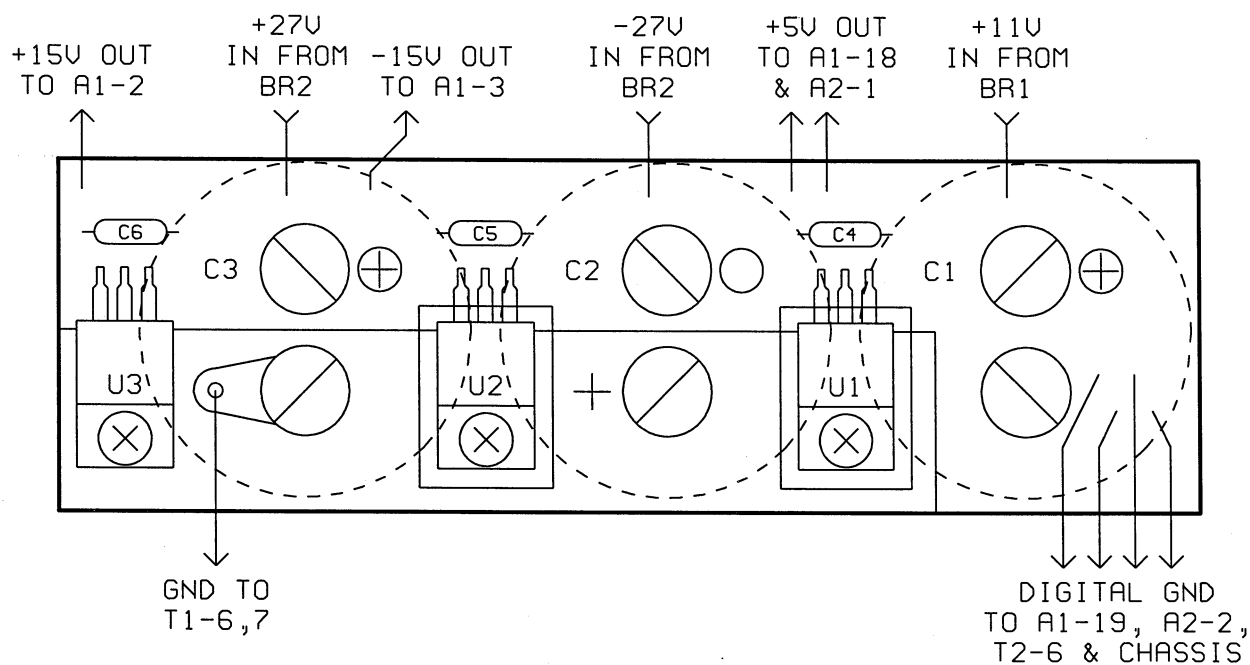
THE WIZARD
FMMA-1
A2, A2-1 & A2-2
REV. B
DISPLAY BOARDS
6-2-03



FMMA-1 A2 BOARD
REV. B
COMPONENT LAYOUT
BELAR ELECTRONICS

A2 BOARD FMMA-1, REV. B

Reference Designation	Description	Part Number
C1	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C2	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C3 thru C6	C: FIXED CERAMIC 0.01uF 100V	0151-0003
CR1 thru CR3	LED: RED MV5053	1910-0001
CR4	LED: YELLOW MV5353	1910-0002
CR5	DIODE: 1N4006	1900-0016
DS1 thru DS4	DISPLAY: HP5082-7651	1930-0007
DS5 thru DS8*	DISPLAY: HDLO-2416	1930-0008
(prior to rev. B, DS5 thru DS8 were the HPDL2416 display, Belar P/N 1930-0005. These parts are not interchangeable.)		
HDR2	HEADER: 24 PIN	0361-0024
R1 thru R8	R: METAL FILM 51 2% 1/4W	0751-5102
S1 thru S4	SWITCH: PUSHBUTTON, MOMENTARY (ON A2-1 & A2-2 BOARDS)	3105-0001
U1	IC: 74C923	1823-0006
U2	IC: ICM7228C	1823-0002

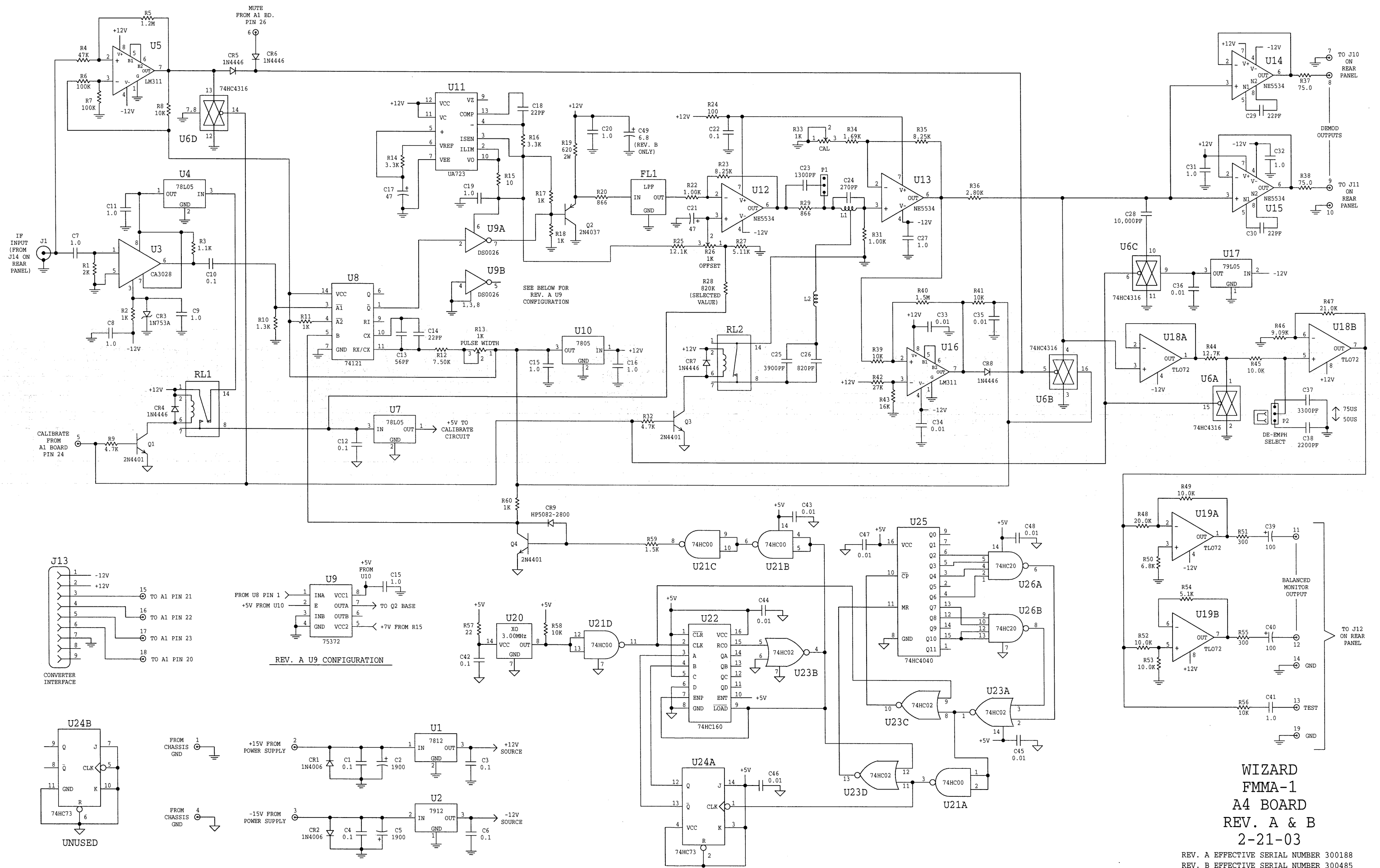


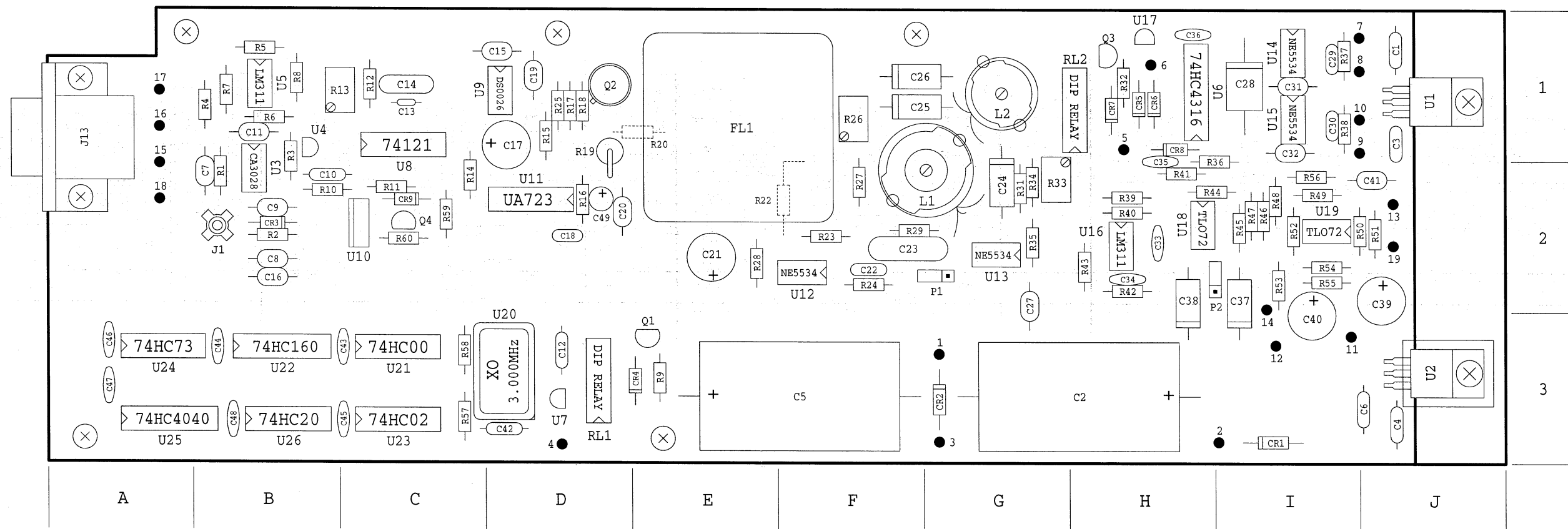
FMMA-1
A3 POWER SUPPLY BOARD
COMPONENT LAYOUT
(ONLY USED PRIOR TO SERIAL NUMBER 300188)

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)

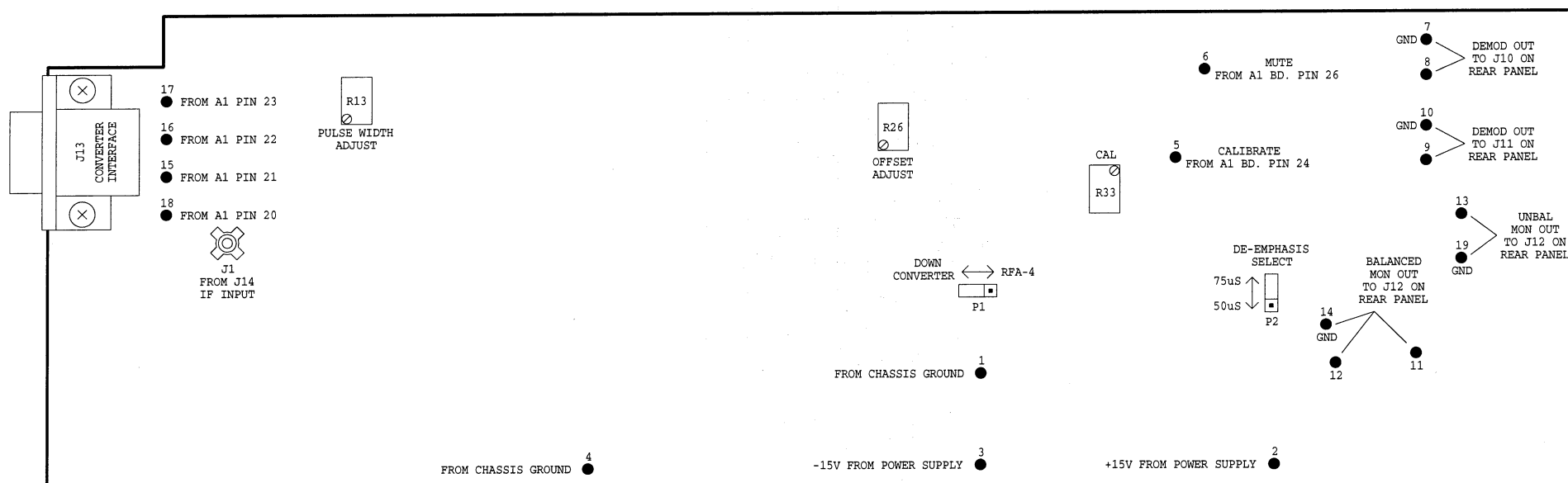




FMMA-1 A4 Rev A BOARD
PART LOCATIONS

<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>	<u>Desig/Loc</u>
C1 J1	C32 I1	J13 A1	R19 D1	R50 I2	U17 H1
C2 H3	C33 H2		R20 E1*	R51 J2	U18 H2
C3 J1	C34 H2	L1 G2	R21 --	R52 I2	U19 I2
C4 J3	C35 H1	L2 G1	R22 F2*	R53 I2	U20 D3
C5 F3	C36 H1		R23 F2	R54 I2	U21 C3
C6 J3	C37 I2	P1 G2	R24 F2	R55 I2	U22 B3
C7 B2	C38 H2	P2 H2	R25 D1	R56 I2	U23 C3
C8 B2	C39 J2		R26 F1	R57 C3	U24 A3
C9 B2	C40 I3	Q1 E3	R27 F2	R58 C3	U25 A3
C10 B2	C41 J2	Q2 D1	R28 E2	R59 C2	U26 B3
C11 B1	C42 D3	Q3 H1	R29 F2	R60 C2	
C12 D3	C43 C3	Q4 C2	R30 --		<u>pins</u>
C13 C1	C44 B3		R31 G2	RL1 D3	1 G3
C14 C1	C45 C3	R1 B2	R32 H1	RL2 H1	2 I3
C15 D1	C46 A3	R2 B2	R33 G2		3 G3
C16 B2	C47 A3	R3 B1	R34 G2	U1 J1	4 D3
C17 D1	C48 B3	R4 B1	R35 G2	U2 J3	5 H1
C18 D2		R5 B1	R36 H1	U3 B2	6 H1
C19 D1	CR1 I3	R6 B1	R37 I1	U4 B1	7 J1
C20 D2	CR2 G3	R7 B1	R38 I1	U5 B1	8 J1
C21 E2	CR3 B2	R8 B1	R39 H2	U6 H1	9 J1
C22 F2	CR4 E3	R9 E3	R40 H2	U7 D3	10 J1
C23 F2	CR5 H1	R10 B2	R41 H2	U8 C1	11 I3
C24 G2	CR6 H1	R11 C2	R42 H2	U9 D1	12 I3
C25 F1	CR7 H1	R12 C1	R43 H2	U10 C2	13 J2
C26 F1	CR8 H1	R13 B1	R44 H2	U11 D2	14 I2
C27 G2	CR9 C2	R14 C2	R45 I2	U12 F2	15 A2
C28 I1		R15 D1	R46 I2	U13 G2	16 A1
C29 I1	FL1 E1	R16 D2	R47 I2	U14 I1	17 A1
C30 I1		R17 D1	R48 I2	U15 I1	18 A2
C31 I1	J1 B2	R18 D1	R49 I2	U16 H2	19 J2

*under pc board
R21 & R30 not used



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

A4 BOARD FMMA-1 Rev. A & B

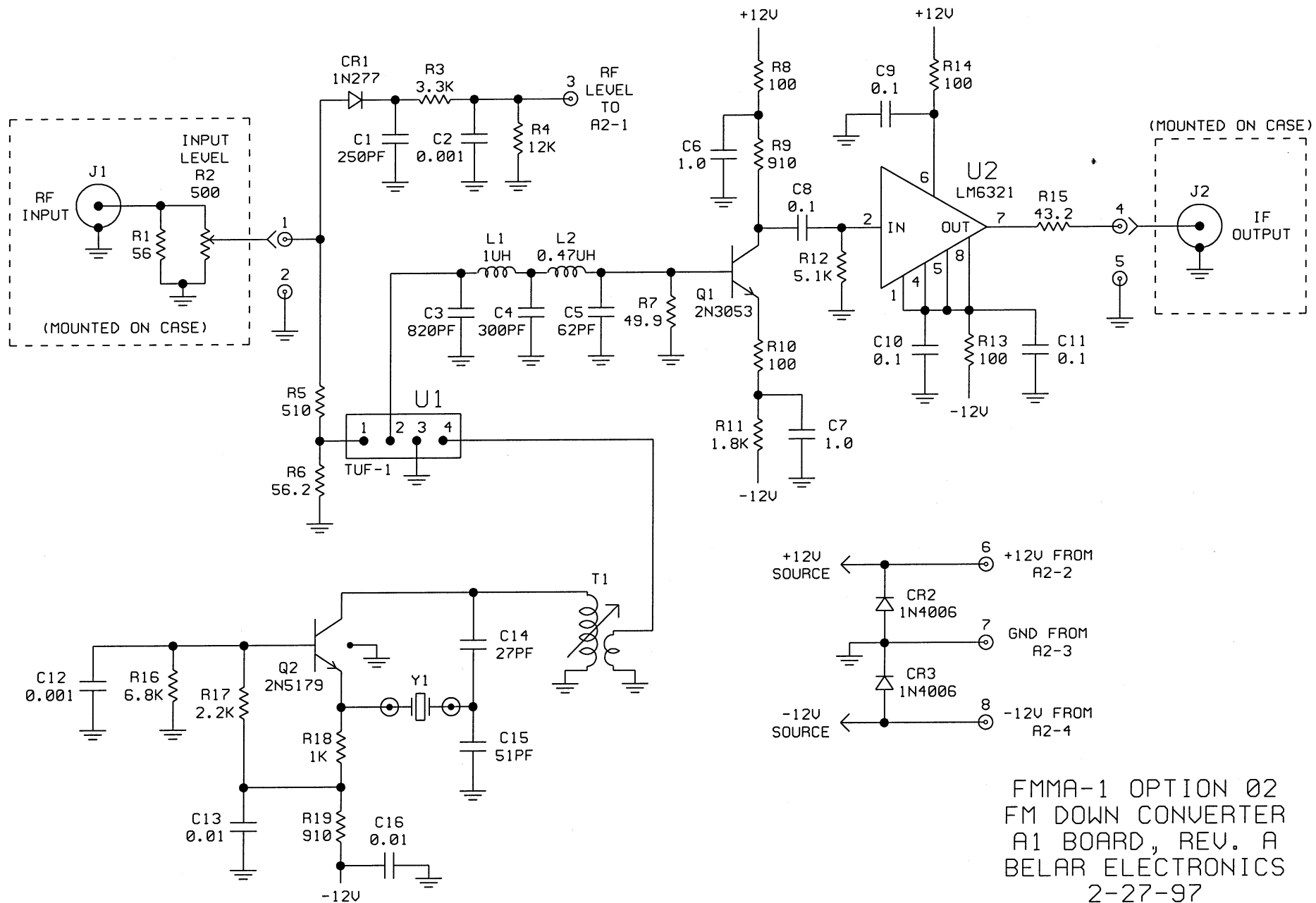
Reference Designation	Description	Part Number
C1	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C2	C: FIXED ELEC 1900uF 50V	0180-0027
C3, C4	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C5	C: FIXED ELEC 1900uF 50V	0180-0027
C6	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C7 thru C9	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C10	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C11	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C12	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C13	C: FIXED CERAMIC 56pF 100V N750	0155-0005
C14	C: FIXED MICA 22pF 5%	0140-2205
C15, C16	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C17	C: FIXED ELEC 47uF 50V	0180-0017
C18	C: FIXED MICA 22pF 5%	0142-2205
C19, C20	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C21	C: FIXED ELEC 47uF 50V	0180-0017
C22	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C23	C: FIXED MICA 1300pF 1%	0141-1321
C24	C: FIXED POLY 270pF 2.5% 160V	0130-2712
C25	C: FIXED POLY 3900pF 2.5% 160V	0130-3922
C26	C: FIXED POLY 820pF* 2.5% 160V	0130-8212
	*C26 IS SELECTED BY TEST.	
C27	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C28	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C29, C30	C: FIXED MICA 22pF 5%	0142-2205
C31, C32	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C33 thru C36	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C37	C: FIXED POLY 3300pF 2.5% 160V	0130-3322
C38	C: FIXED POLY 2200pF 2.5% 160V	0130-2222
C39, C40	C: FIXED ELEC 100uF 35V	0180-0018
C41	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C42	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C43 thru C48	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C49*	C: FIXED TANT 6.8uF 25V	0185-0002
(*Note: C49 is not used on Rev. A boards.)		
CR1, CR2	DIODE: 1N4006	1900-0016
CR3	DIODE: 1N753A	1900-0006
CR4 thru CR8	DIODE: 1N4446	1900-0002
CR9	DIODE: HP5082-2800	1900-0026
FL1	FILTER: BELAR, LOW PASS	9120-0014
J1	JACK: SMB, PC MOUNT	0360-0040
J13	CONNECTOR: "D" SINGLE 9 PIN	0360-0031
L1	INDUCTOR: BELAR	9140-0039
L2	INDUCTOR: BELAR	9140-0038

A4 BOARD FMMA-1 Rev. A & B cont.

Reference Designation	Description	Part Number
P1,P2	PLUG: 3 PIN, PC MOUNT	0365-0030
--	JUMPER: 2 PIN (USED WITH P1 & P2)	0365-0028
Q1	TRANSISTOR: 2N4401	1850-0028
Q2	TRANSISTOR: 2N4037	1850-0011
Q3,Q4	TRANSISTOR: 2N4401	1850-0028
R1	R: METAL FILM 2k 2% 1/4W	0751-2022
R2	R: METAL FILM 1k 2% 1/4W	0751-1022
R3	R: METAL FILM 1.1k 2% 1/4W	0751-1122
R4	R: METAL FILM 47k 2% 1/4W	0751-4732
R5	R: FIXED CARBON 1.2M 5% 1/4W	0683-1255
R6,R7	R: METAL FILM 100k 2% 1/4W	0751-1042
R8	R: METAL FILM 10k 2% 1/4W	0751-1032
R9	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R10	R: METAL FILM 1.3k 2% 1/4W	0751-1322
R11	R: METAL FILM 1k 2% 1/4W	0751-1022
R12	R: METAL FILM 7.50k 1%	0721-7501
R13	R: VAR COMP 1k, 10 TURN	2100-0021
R14	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R15	R: METAL FILM 10 2% 1/4W	0751-1002
R16	R: METAL FILM 3.3k 2% 1/4W	0751-3322
R17,R18	R: METAL FILM 1k 2% 1/4W	0751-1022
R19	R: WIRE WOUND 620 5% 2W	0811-0012
R20*	R: METAL FILM 866 1%	0721-8660
R21	not used	
R22*	R: METAL FILM 1.00k 1%	0721-1001
	(*R20 & R22 are on pc bottom)	
R23	R: METAL FILM 8.25k 1%	0721-8251
R24	R: METAL FILM 100 2% 1/4W	0751-1012
R25	R: METAL FILM 12.4k 1% (Rev. A)	0721-1242
	R: METAL FILM 12.1k 1% (Rev. B)	0721-1212
R26	R: VAR COMP 1k, 10 TURN	2100-0021
R27	R: METAL FILM 4.32k 1% (Rev. A)	0721-4321
	R: METAL FILM 5.11k 1% (Rev. B)	0721-5111
R28	R: METAL FILM 820k 2% 1/4W	0751-8242
R29	R: METAL FILM 866 1%	0721-8660
R30	not used	
R31	R: METAL FILM 1.00k 1%	0721-1001
R32	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R33	R: VAR COMP 1k, 10 TURN	2100-0021
R34	R: METAL FILM 1.69k 1%	0721-1691
R35	R: METAL FILM 8.25k 1%	0721-8251
R36	R: METAL FILM 2.80k 1%	0721-2801
R37,R38	R: METAL FILM 75.0k 1%	0721-75R0
R39	R: METAL FILM 10k 2% 1/4W	0751-1032
R40	R: FIXED CARBON 1.5M 5% 1/4W	0683-1555

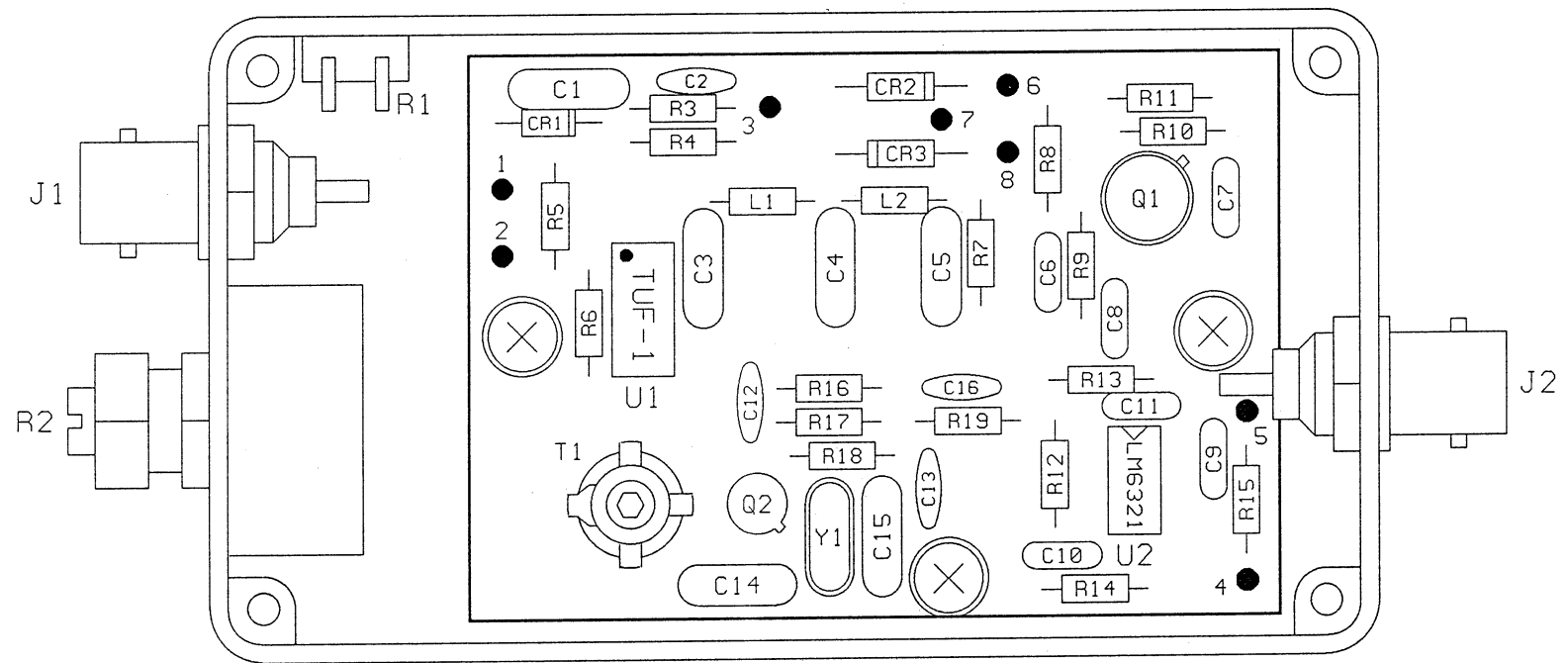
A4 BOARD FMMA-1 Rev. A & B cont.

Reference Designation	Description	Part Number
R41	R: METAL FILM 10k 2% 1/4W	0751-1032
R42	R: METAL FILM 27k 2% 1/4W	0751-2732
R43	R: METAL FILM 16k 2% 1/4W	0751-1632
R44	R: METAL FILM 12.7k 1%	0721-1272
R45	R: METAL FILM 10.0k 1%	0721-1002
R46	R: METAL FILM 9.09k 1%	0721-9091
R47	R: METAL FILM 21.0k 1%	0721-2102
R48	R: METAL FILM 20.0k 1%	0721-2002
R49	R: METAL FILM 10.0k 1%	0721-1002
R50	R: METAL FILM 6.8k 2% 1/4W	0751-6822
R51	R: METAL FILM 300 2% 1/4W	0751-3012
R52, R53	R: METAL FILM 10.0k 1%	0721-1002
R54	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R55	R: METAL FILM 300 2% 1/4W	0751-3012
R56	R: METAL FILM 10k 2% 1/4W	0751-1032
R57	R: METAL FILM 22 2% 1/4W	0751-2202
R58	R: METAL FILM 10k 2% 1/4W	0751-1032
R59	R: METAL FILM 1.5k 2% 1/4W	0751-1522
R60	R: METAL FILM 1k 2% 1/4W	0751-1022
RL1	RELAY: JWD-172-3	1600-0005
RL2	RELAY: JWD-171-14	1600-0004
U1	IC: 7812CT	1826-0060
U2	IC: 7912CT	1826-0061
U3	IC: CA3028	1826-0034
U4	IC: 78L05CP	1826-0012
U5	IC: LM311	1826-0009
U6	IC: 74HC4316	1822-0051
U7	IC: 78L05CP	1826-0012
U8	IC: 74121	1821-0014
U9*	IC: DS0026	1826-0021
(*Note: On Rev. A boards, U9 is a 75372 IC, p/n 1823-0004)		
U10	IC: 7805CT	1826-0014
U11	IC: UA723	1820-0012
U12 thru U15	IC: NE5534	1826-0025
U16	IC: LM311	1826-0009
U17	IC: 79L05CP	1826-0017
U18, U19	IC: TLO72	1826-0038
U20	IC: XO, 3.000MHZ	0415-0300
U21	IC: 74HC00	1822-0039
U22	IC: 74HC160	1822-0061
U23	IC: 74HC02A	1822-0040
U24	IC: 74HC73	1822-0044
U25	IC: 74HC4040A	1822-0062
U26	IC: 74HC20	1822-0060

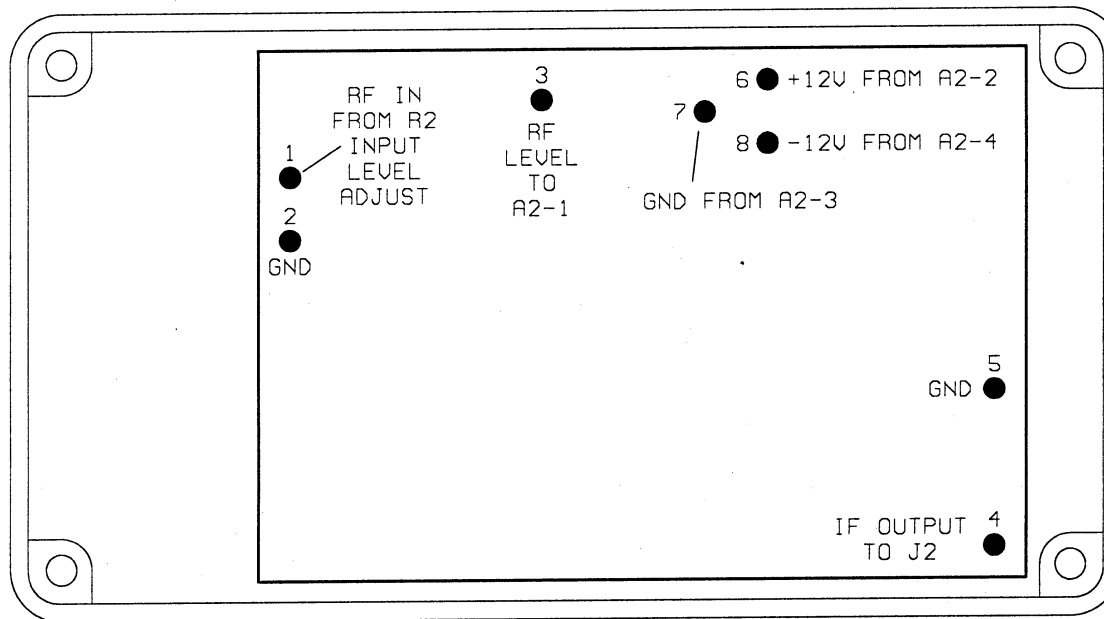


FMMA-1 OPTION 02
FM DOWN CONVERTER
A1 BOARD, REV. A
BELAR ELECTRONICS
2-27-97

(EFFECTIVE SERIAL NUMBER 300188)



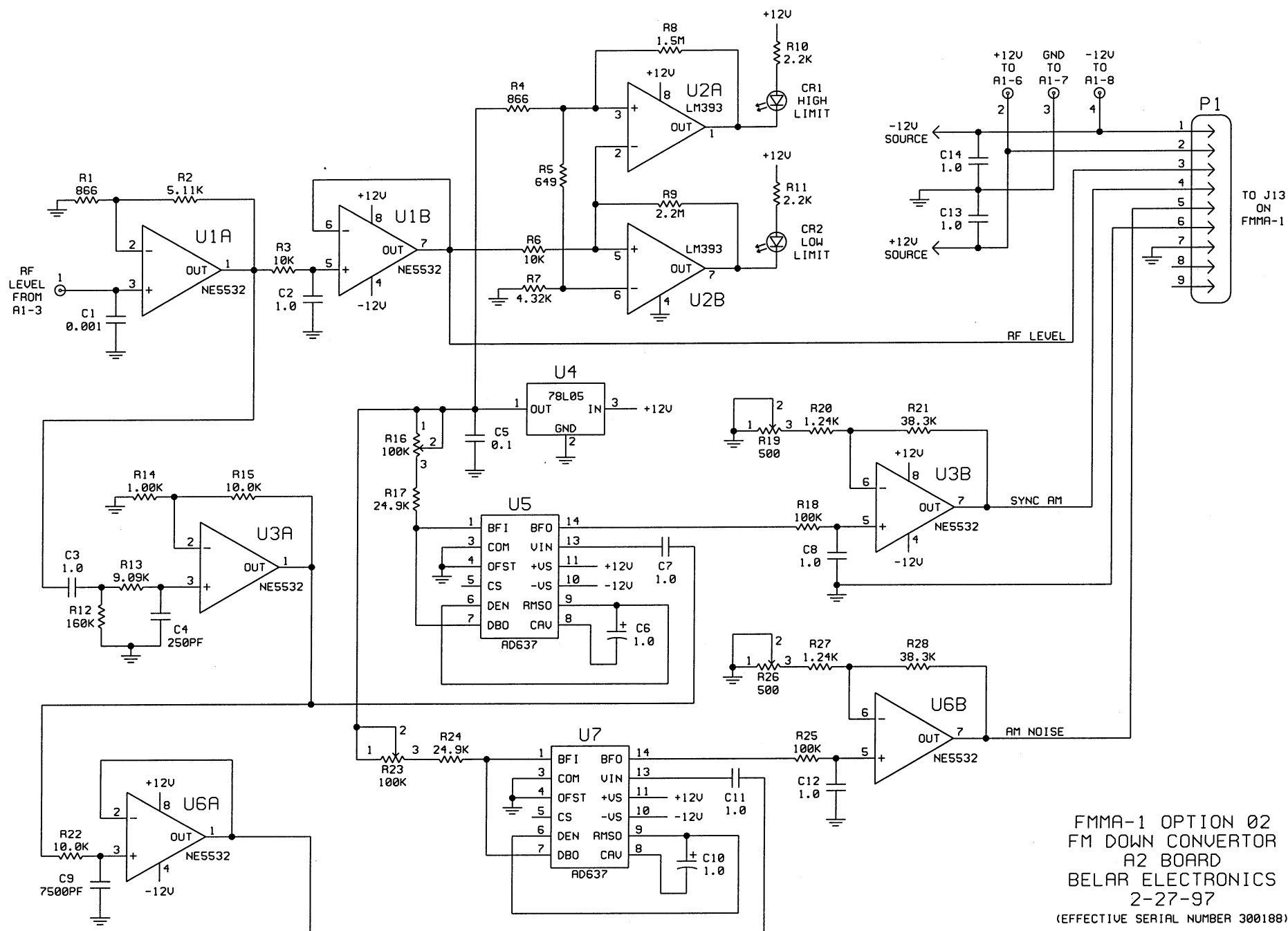
FM DOWN CONVERTER
A1 BOARD Rev. A
COMPONENT LAYOUT
BELAR ELECTRONICS



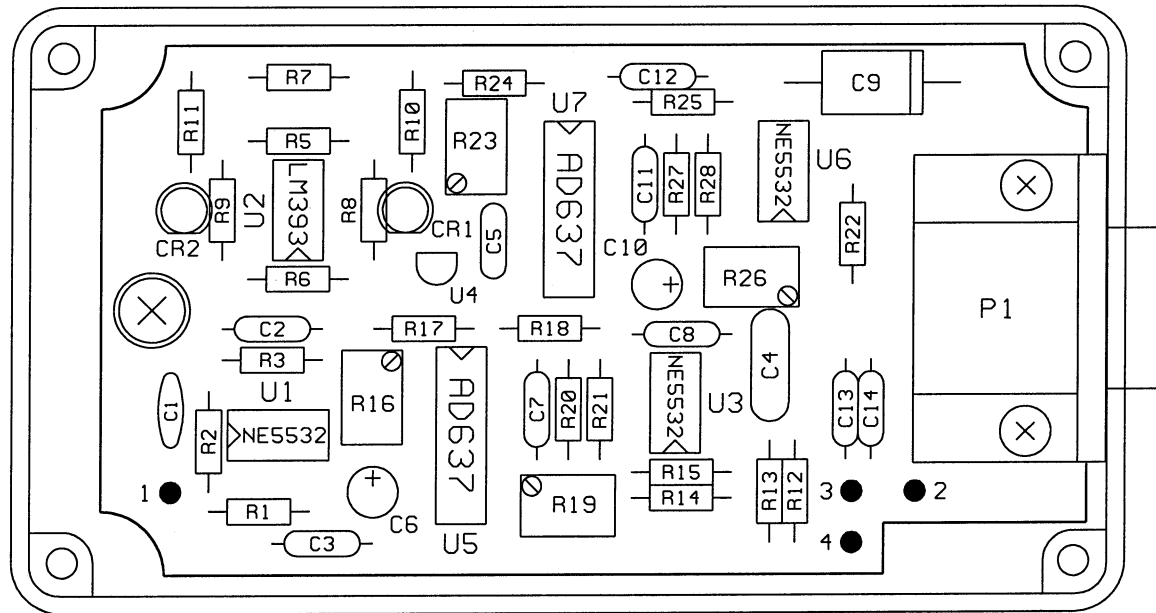
FM DOWN CONVERTER
A1 BOARD Rev. A
CONNECTIONS
BELAR ELECTRONICS
(EFFECTIVE SERIAL NUMBER 300188)

A1 BOARD FM DOWN CONVERTER Rev. A

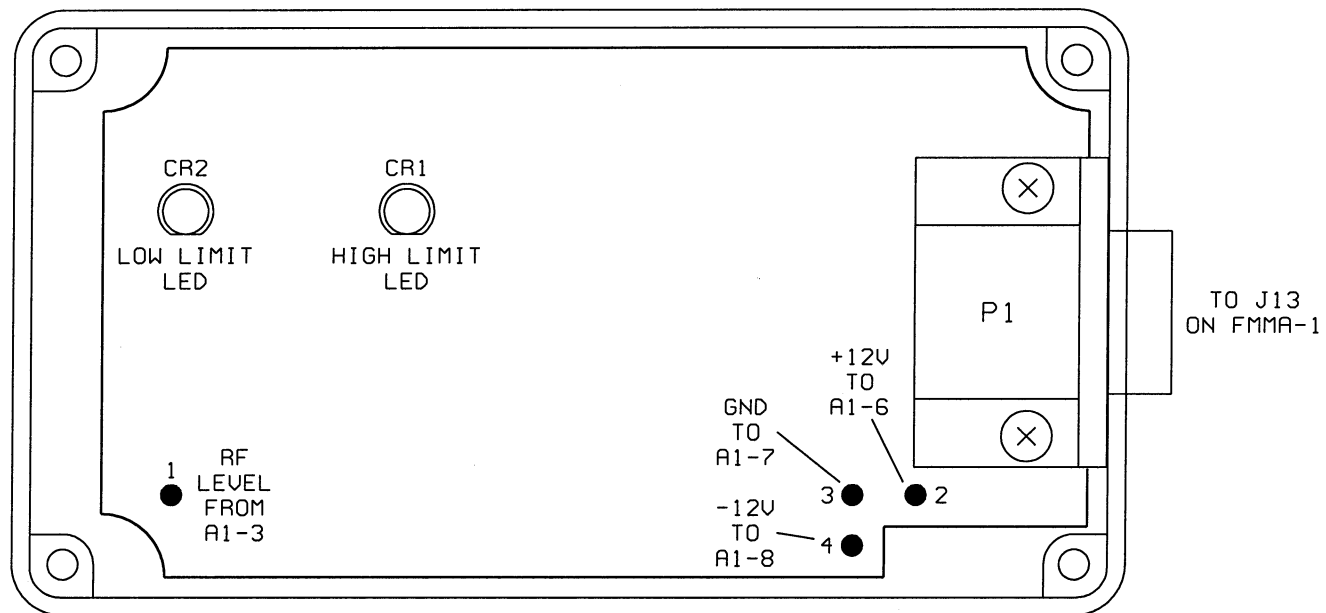
Reference Designation	Description	Part Number
C1	C: FIXED MICA 250pF 5%	0140-2515
C2	C: FIXED CERAMIC 0.001uF 1kV	0151-0002
C3	C: FIXED MICA 820pF 5%	0140-8215
C4	C: FIXED MICA 300pF 5%	0140-3015
C5	C: FIXED MICA 62pF 5%	0140-6205
C6, C7	C: FIXED CERAMIC 1.0uF 50V	0151-0016
C8 thru C11	C: FIXED CERAMIC 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	



FMMA-1 OPTION 02
 FM DOWN CONVERTOR
 A2 BOARD
 BELAR ELECTRONICS
 2-27-97
 (EFFECTIVE SERIAL NUMBER 300188)



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



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

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