AMMA-1
Precision Digital
AM Modulation Monitor/Analyzer

The Wizard™ System

Guide to Operations

11/99

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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.

1 General Description

The Wizard AM Digital Modulation Analyzer represents the next generation of AM modulation monitors. Controlled by a sophisticated microprocessor, The Wizard can tell you just about everything you ever wanted to know about your AM signal -- using parameters that you configure, either from the front panel or remotely. Some of the features include:

- Digital reading of Negative Peak Modulation, in percent, with variable hold time from ½-second to 10 seconds. In addition, The Wizard can display the highest negative peak since last reset.
- Adjustable Negative Peak Modulation Indicator.
- Adjustable Negative Peak-per-Minute (PPM) alarm.
- Adjustable Negative PPM duration window, from 10ms to 500 ms, plus track. One or more negative peaks in the window is counted as one peak.
- Negative PPM Count, averaged over a sliding 1 minute window.
- Digital reading of Positive Peak Modulation, in percent, with variable hold time from ½-second to 10 seconds. The Wizard can also display the highest positive peak since last reset.
- Adjustable Positive Peak Modulation Indicator.
- Adjustable Positive Peak-per-Minute (PPM) alarm.
- Adjustable Positive PPM duration window, from 10ms to 500 ms, plus track. One or more positive peaks in the window is counted as one peak.
- Positive PPM Count, averaged over a sliding 1 minute window.
- Average/Peak ratios to see what your compression is doing to your modulation.
- Eight peak weighting time constants on Positive Modulation, from 3 Cycles to 45 Cycles, plus a weighting-off setting. At a setting of 9, for example, the monitor will ignore positive peaks of less than 9 Cycles (at 10kHz).
- Low Carrier Alarm
- Settable Loss of Modulation (Audio Failure) and Carrier Failure alarms.
- Automatic carrier level adjustment over a ±50% range ensures accurate measurements.
- Automatic carrier leveling can be disabled for use with controlled carrier transmitter operation.
- Includes precision demodulator with calibrator.
- Carrier Shift Alarm detects shifts in carrier past a preset level.
- Normal modulation indicator confirms modulation is within normal limits.
- Audio Loop-thru with XLR connectors allows remote adjustment of audio levels.
- Relay closures for alarms and indicators.

With The Wizard Software, every function of The Wizard, including checking calibration, can be accessed remotely, with modems and your IBM-compatible personal computer. (Direct RS-232/RS-422 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. Now you can know more about the characteristics and quality of your AM signal than ever before!

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.

2-2 Claims

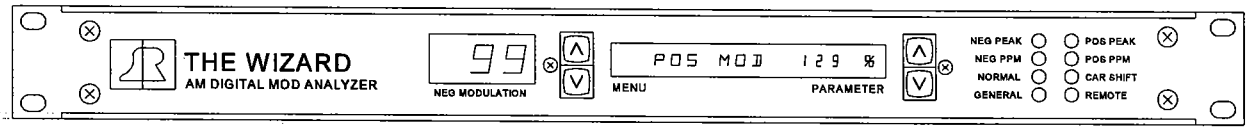
If the unit has been damaged, notify the carrier immediately. File a claim with the carrier or transportation company and advise Belar of such action to arrange the repair or replacement of the unit without waiting for a claim to be settled with the carrier.

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.

3 Front Panel Operation



The **NEG MODULATION** display displays the total negative peak 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 Wizard. The menu selections are arranged in five loops, one for measurements and four 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. The main loop, which includes the display shown in the figure above, consists of all of the measurements The Wizard can make, as well as the four displays UNIT SETTINGS, CAR SETTINGS, NEG SETTINGS and POS SETTINGS. These other four loops (individually accessed by pressing the UP PARAMETER button at one of these "---- SETTINGS" windows) consist of all the settable parameters in the unit, such as hold time, time mode, etc. These parameters are all explained in *Section 3-1 through 3-5 Menu Selections*, following.

On the far right of the front panel are eight **ALARM LEDS**. All but the Neg Peak, Pos Peak, and Car Shift alarm LEDs have corresponding relays, available through a rear panel connection.

The **NEG PEAK** LED lights when the negative modulation equals or exceeds the - PEAK MOD parameter setting. Similarly, the **POS PEAK** LED lights when the positive modulation equals or exceeds the + PEAK MOD parameter setting.

The **NEG PPM** LED lights when the number of negative peaks per minute equals or exceeds the - PPM THRESH parameter setting. Similarly, the **POS PPM** LED lights when the number of positive peaks per minute equals or exceeds the +PPM THRESH parameter setting.

The **NORMAL** Modulation indicator lights when the number of positive peaks per minute within a selectable minimum and maximum exceeds a selectable threshold setting. When this LED is green and no modulation alarms are present, modulation is normal.

The **CAR SHIFT** LED lights when the preset carrier shift threshold is exceeded.

The **GENERAL** LED lights when one or more general alarms is active. The alarm conditions pending are displayed in the alphanumeric display, alternating with the current menu setting. The alarm conditions currently implemented are the AUDIO FAILURE alarm, CARRIER FAILURE alarm, and LOW CARRIER alarm.

The yellow **REMOTE** LED lights when The Wizard is actively connected to a remote computer through the RS-232/422 port on the rear panel.

3-1 Main Menu Selections

The following Main Menu Selections are shown in the order that they appear beginning with initialization and then the use of the UP MENU push-button.

POS MOD xxx % — This display shows the current positive peak modulation.

CAR LEVEL xxx % — Displays the carrier level.

CAR SHIFT xxx % — Displays the percent of carrier shift. The carrier shift is calculated every two seconds according to the formula *(High - Low) / High*. For example, if the carrier varies from 100 to 90 during the two second window, this menu will display 10 percent.

+PPM COUNT xxxx — Displays the current number of positive peaks that have reached or exceeded the +PEAK MOD threshold in a sliding one minute window.

-PPM COUNT xxxx — Displays the current number of negative peaks that have reached or exceeded the -PEAK MOD threshold in a sliding one minute window.

NORM COUNT xxxx — Displays the current count of peaks that fall at or within the NORM LOW and NORM HIGH window. When this count is equal to or higher than the NORM THRESH setting, the NORMAL LED will be lit.

+ PEAK AVG xxx % — Displays the average of all positive peaks measured during the measurement window (hold time).

+ AVE/PEAK x.xx — Displays +PEAK AVE/POS MOD. This measurement is a good indication of compression.

+ PEAK MIN xxx %

Displays the minimum positive peak measured during the measurement window (hold time).

- PEAK AVE xxx %

Displays the average of all negative peaks measured during the measurement window (hold time).

- AVE/PEAK x.xx

Displays -PEAK AVE/NEG MODULATION. This measurement is a good indication of compression.

- PEAK MIN xxx %

Displays the minimum negative peak measured during the measurement window (hold time)

POS SETTINGS

Press the UP PARAMETER button to enter the positive modulation settings submenu. This submenu provides access to all parameters which affect readings generated from positive modulation data.

NEG SETTINGS

Press the UP PARAMETER button to enter the negative modulation settings submenu. This submenu provides access to all parameters which affect readings generated from negative modulation data.

CAR SETTINGS

Press the UP PARAMETER button to enter the carrier level settings submenu. This submenu provides access to all parameters which affect readings generated from carrier level data.

UNIT SETTINGS

Press the UP PARAMETER button to enter the unit settings submenu. This submenu allows access to all parameters which affect the unit's operation.

3-2 POS SETTINGS Menu Selections

+ PEAK MOD xxx %

Presets the peak threshold for the POS PEAK light and the Positive Peaks Per Minute (PPM) counting. The positive peak threshold is user selectable in 1 percent increments from 0 to 150 percent.

+PPM THRESH xxx

Number of Peaks threshold for Pos PPM counting that, when exceeded, activates the POS PPM light. This is user selectable from 1 to 100 Peaks Per Minute.

+PPM DUR xxxx MS **+PPM DUR - TRACK**	Presets the duration window for the positive peak counting. One or more positive peaks in the window is counted as one peak. This is user selectable from 10ms to 500ms, plus TRACK. In the TRACK mode the +PPM COUNT tracks the POS PEAK light, counting each flash as one peak.
NORM HIGH xxx %	Sets the upper limit for the normal modulation PPM counts. The range of this setting is from the NORM LOW setting to 150%, in 1% increments.
NORM LOW xxx %	Sets the lower limit for the normal modulation PPM counts. The range of this setting is from 0% to the NORM HIGH setting, in 1% increments.
NORM THRESH xxx	Presets the threshold for Normal PPM counting, that, when exceeded, activates the NORMAL LED. This is user selectable from 1 to 100 PPM.
NORM DUR xxxx MS	Presets the duration window for the normal modulation peak counting. One or more positive peaks in the window is counted as one peak. This is user selectable from 10ms to 500ms.
SENTRY xxx %	Threshold in percent positive modulation that will activate the AUDIO FAILURE (loss of modulation) alarm. This is user selectable in 1 percent increments from 0 to 100 percent.
SENTRY xx SEC	Sets the length of time that positive modulation must fall below the SENTRY threshold to activate the AUDIO FAILURE alarm. This is user selectable in 1 second increments from 0 to 60 seconds. The AUDIO FAILURE alarm is automatically reset when positive modulation is restored.
PK WEIGHT - OFF/xx CYC	Enables or disables peak weighting mode. When peak weighting mode is enabled the user may select from 8 time constants expressed in cycles of a 10 khz waveform. At a setting of 9, for example, the monitor will ignore positive peaks of less than 9 cycles (at 10 kHz). Peak weighting can only be enabled on positive modulation readings.
EXIT ?	Press the UP PARAMETER button to exit this submenu and return to the main menu.

3-3 NEG SETTINGS Menu Selections

- PEAK MOD xxx %	Presets the peak threshold for the NEG PEAK light and the Negative Peaks Per Minute (PPM) counting. The negative peak threshold is user selectable in 1 percent increments from 0 to 100 percent.
-PPM THRESH xxx	Number of Peaks threshold for Neg PPM counting that, when reached or exceeded, activates the NEG PPM light. This is user selectable from 1 to 100 Peaks Per Minute.
-PPM DUR xxxx MS **-PPM DUR - TRACK**	Presets the duration window for the negative peak counting. One or more peaks in the window is counted as one peak. This is user selectable from 10ms to 500ms, plus TRACK. In the TRACK mode the -PPM COUNT tracks the NEG PEAK light, counting each flash as one peak.
EXIT ?	Press the UP PARAMETER button to exit this submenu and return to the main menu.

3-4 CAR SETTINGS Menu Selections

MOD MODE- NORM/FIXED	NORM enables the Automatic Carrier Leveling and FIXED disables the Automatic Carrier Leveling.
CAR THRESH xxx %	Presets the threshold (in percent carrier level) that will activate the carrier alarm. This is user selectable in 1 percent increments from 0 to 100 percent.
CAR TIME xx SEC	Presets the time allowed after the carrier falls below the CAR THRESHOLD before the carrier alarm is activated. This is user selectable in 1 second increments from 1 to 60 seconds.
SHIFT THRES xxx%	Presets the carrier shift threshold for the carrier shift alarm/LED. This setting is adjustable, with a range of 0% to 100%, in 1% increments.
EXIT ?	Press the UP PARAMETER button to exit this submenu and return to the main menu.

3-5 UNIT SETTINGS Menu Selections

HOLD xx.x SEC

Presets 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.

TIME MODE - REAL/PAST

Presets the mode in which peaks are displayed. In REAL time mode the display is updated the instant a new peak is detected. In PAST time mode the unit waits the HOLD time and displays the highest peak that occurred during that interval.

INFINITE - ON/OFF

Enables or disables infinite hold of display. If infinite hold is enabled, the display acts as a "high water mark" and will "stick" at the highest negative and positive modulation (until infinite hold is turned off).

REMOTE - ON/OFF

Enables or disables the computer communications 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 when someone is communicating remotely. Remote also cannot be turned off remotely.

SAVE CONFIG

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

MOD ADJ ± xx.x%

Presets the percent gain between the audio input and audio output jacks of the loop-thru. This is user selectable in 0.5 percent increments from -10.0% to +10.0% gain. This can be changed to be user selectable in 1.0 percent increments from -20.0% to +20.0% gain -- see *Section 6 Running the Setup Program.*

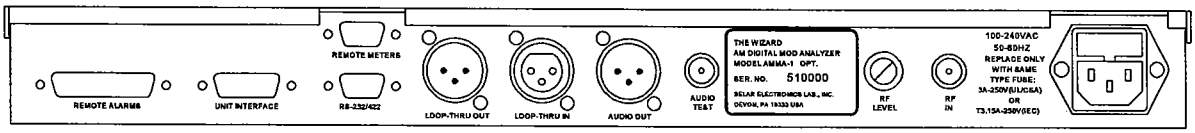
CALIBRATOR - ON/OFF

Turns the internal calibrator on and off. When the calibrator is on, the negative modulation, positive modulation, and carrier level will all indicate 100%.

EXIT ?

Press the UP PARAMETER button to exit this submenu and return to the main menu.

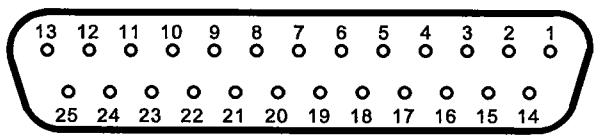
4 Rear Panel



RF Input ..... 260 kHz to 50 MHZ
5 to 10 volts RMS

Remote Alarm Connector ..... female 25 pin D connector
Relay contacts rated at 10W max, 0.5A max, 200 VDC max

Relay #	Pin	Description
0	1,2	LOSS OF MODULATION ALARM
1	3,4	NEG PPM ALARM
2	5,6	NORMAL
3	7,8	GENERAL ALARM
4	9,10	RESERVED
5	11,12	POS PPM ALARM
6	13,14	LOSS OF CARRIER ALARM
7	15,16	REMOTE



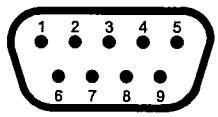
Rear Panel Alarm Connector

RS-232/422 connector ..... male 9 pin D connector

An internal DIP shunt determines which electrical specification is chosen. The shunt, which is located inside the unit near the connector, should be inserted in the appropriate socket. The sockets are clearly labeled on the printed circuit board and are also shown on the *A1 Board Connections and Adjustments* drawing at the rear of this manual.

When Configured as RS-232:

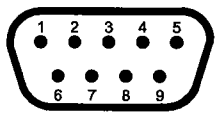
Pin	Type	Description	
1	input	CD	Carrier detect from Modem
2	input	Rx	The Wizard receive data
3	output	Tx	The Wizard transmit data
4	output	DTR	The Wizard data terminal ready
5	ground	GND	signal ground
6-9			not used



RS-232 Connector

When Configured as RS-422:

Pin	Type	Description	
1	input	Rx +	The Wizard receive data (+)
2	input	Rx -	The Wizard receive data (-)
3	output	Tx +	The Wizard transmit data (+)
4	output	Tx -	The Wizard transmit data (-)
5	ground	GND	signal ground
6-9			not used



RS-422 Connector

Unit Interface . . . . . female 15 pin D connector

This interface is used to connect other Belar equipment equipped with an interface so that unified remote operation is possible.

4-1 Accessories

MP-14 Meter Panel

With its two backlit analog meters, the MP-14 Remote Meter Panel provides continuous display of both positive and negative modulation. See *Section 7 Use of the MP-14 Analog Meter Panel* for connection and calibration information.

5 Installation and Setup

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).

The procedure shown below should be followed for placing the AMMA-1 into operation.

1. Before applying RF to the AMMA-1, turn the RF LEVEL control R1 on the rear panel maximum clockwise and perform the following steps to power up.

2. Units beginning with serial number 510113:
   These units can be operated from a 100 to 240 Vac, single phase, 50-60 Hz power source with no user adjustments. The fuse should be a 5mm x 20mm type GMA-3, 3AMP-250V (UL/CSA) or T3.15A-250V (IEC) fuse only. A spare fuse is stored in the removable fuse compartment.

   Units prior to serial number 510113:
   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. Make sure the unit is set for the proper voltage as follows: Unplug the line cord. Open the fuse compartment door and pull lever to remove fuse. Using needlenose 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 250V for 115 Vac, ¼A 250V for 230 Vac), close the fuse door, and plug the line cord back in.

3. Connect the three wire grounded power cord to the AC receptacle and the voltage source. The AMMA-1 will immediately turn on since there is no power switch. The 7-segment NEG MODULATION display will show "8.8.8." and the alphanumeric menu display will indicate "INITIALIZATION" while the AMMA-1 is going through its factory settings.

4. After initialization, the NEG MODULATION display will indicate "0" and the menu display will show "POS MOD 0 %". Since RF carrier is not yet present, the menu display will cycle continuously from "***LOW CARRIER**" and back to "POS MOD" indicating no audio and no carrier.

5. Change the menu to "CAR SETTINGS" and enter this loop using the UP PARAMETER push-button. Go to "MOD MODE" and set to "NORM". This will turn on the automatic carrier leveling.

NOTE: IF THE "MOD MODE" IS "FIXED", THAT IS, IF THE AUTOMATIC CARRIER LEVELING IS TURNED OFF, THE MODULATION READINGS WILL CHANGE WITH CHANGES IN RF CARRIER LEVEL AND THE MODULATION READINGS WILL BE IN ERROR. WHEN THE AUTO CAR LEVEL IS OFF, THE MODULATION READING IS REFERENCED TO A FIXED CARRIER LEVEL.

6. Change the menu to "UNIT SETTINGS" and enter this loop. Go to "CALIBRATOR - OFF" and set to "ON". The NEG MODULATION display should read "100" and the NEG PEAK, NEG PPM and NORMAL LEDs should light. The NORMAL LED should go out after a short time. The "100" reading and the LED activity indicate that the negative modulation function is correctly calibrated.

7. Leaving the calibrator turned on, exit this loop and go to the "POS MOD" menu display. The POS MOD reading should be 100%. The 100% reading indicates the positive modulation function is correctly calibrated.

8. Change the menu to "CAR LEVEL". The CAR LEVEL reading should be 100%. The 100% reading indicates the carrier level function is correctly calibrated.

9. Go back to the "UNIT SETTINGS" loop and turn the calibrator off. The menu should read "CALIBRATOR - OFF".

The calibration of the AMMA-1 has now been checked and it is now ready to accept RF power.

CAUTION: DO NOT APPLY MORE THAN 10 VOLTS RMS OF RF TO THE MONITOR OR THE RF INPUT CIRCUIT MAY BE DAMAGED! BEFORE APPLYING ANY RF INPUT, TURN THE RF LEVEL CONTROL (R1) MAXIMUM COUNTERCLOCKWISE! DAMAGE AS A RESULT OF EXCESSIVE RF INPUT IS NOT COVERED UNDER THE WARRANTY.

10. Change the menu to read "CAR LEVEL". This function will assist in setting the correct carrier level. Note that the "***LOW CARRIER**" error message is still cycling.

11. Verify by some independent means (such as a wideband oscilloscope or RF voltmeter) that the voltage of the RF sample falls in the range between 5 and 10 Vrms (between 14 V peak-to-peak and 28 V p-p for an *unmodulated* AM carrier). If necessary, adjust the RF sample voltage to fall within this range.
Apply RF to the RF INPUT jack J9 on the rear panel. Adjust the RF LEVEL control R1 fully clockwise. Observe the carrier level on the "CAR LEVEL" display. If the reading exceeds 160%, the RF input level may be too high and the error message "CAR LEV TOO HI" will appear. Continued use at this level may damage the input potentiometer R1. Note that 160% is the maximum carrier level reading the AMMA-1 will attain because the circuits may

saturate and the modulation readings could be in serious error.
Adjust R1 counterclockwise until the CAR LEVEL reads 100%. NOTE: if the CAR LEVEL indication comes up to 100% when the RF LEVEL potentiometer is at *¼ or less* of its full rotation, immediately remove the coaxial cable carrying the RF sample to the RF INPUT jack (J9) and reduce the voltage of the RF sample at its source. Otherwise, damage to the AMMA-1 may result. Once the proper level of the RF sample is confirmed, adjust the CARRIER SET potentiometer to obtain a CARRIER indication of 100%. Approximately 4 volts RMS RF carrier will indicate 100% carrier level with R1 maximum clockwise.

12. Change the menu to read "POS MOD". The AMMA-1 is now ready to read and monitor both negative and positive modulations simultaneously. With the automatic carrier leveling turned on, the accuracy of the modulation readings will be maintained over the range of 50 to 150% carrier levels.

SETTING THE PEAK LIGHTS AND DISPLAY TIMES

13. To set the NEG PEAK indicator, change the menu to "NEG SETTINGS" and enter this loop. Go to "- PEAK MOD xxx %". Depress the right up or down (PARAMETER) button until the desired preset is reached for the NEG PEAK indicator, i.e., "- PEAK MOD 97 %". In this example the NEG PEAK indicator will light when the negative peak modulation equals or exceeds the preset 97%. Note that the maximum negative setting is 100% since negative modulations can never exceed 100%.

14. To set the POS PEAK indicator, change the menu to "POS SETTINGS" and enter this loop. Go to "- PEAK MOD xxx %". Depress the up or down PARAMETER button until the desired preset is reached for the POS PEAK indicator, i.e., "+ PEAK MOD 102 %". In this example the POS PEAK indicator will light when the positive peak modulation equals or exceeds the preset 102%. The maximum that this can be set to is 150%.

15. To set the HOLD time, that is, the time at which the readings will be updated or held on the displays, change the menu to "UNIT SETTINGS" and enter this loop. Go to "HOLD xx.x SEC". Depress the up or down PARAMETER button until the desired HOLD time is reached. For example "HOLD 1.0 SEC" will then set the time to hold the displays for one second and the value displayed is the highest peak reached in that one second. The HOLD time is the same for both the negative and positive modulation displays. The recommended hold time for initial AMMA-1 use is 1.0 seconds.

16. Enabling the INFINITE hold function will hold the highest peak value displayed until a new higher peak value updates it or until it is turned off. To set the INFINITE hold, go to "INFINITE - XXX" in the "UNIT SETTINGS" loop. Depress the up or down PARAMETER button to turn the INFINITE hold ON or OFF. Normally this function is used only to measure the highest value of peak modulation in a small portion of audio or when adjusting audio processing equipment. Note that the INFINITE hold is the same for both negative and positive modulation displays.

17. To set the TIME MODE function, change the menu to "UNIT SETTINGS" and enter this loop. Go to "TIME MODE - REAL (*or* PAST)". Depress the up PARAMETER button for PAST time or the down PARAMETER button for REAL time. The PAST time mode updates every HOLD time cycle and displays the highest peak modulation value during that HOLD time. Both negative and positive modulation displays are updated at the same time. The REAL time mode instantaneously updates the display every time the peak modulation exceeds the displayed value and then holds that reading for the preset HOLD time. If a new, higher peak is detected during that time, the display is instantly updated and the HOLD time starts from that instant. Note that the negative and positive modulation displays are independent of each other in the REAL time mode.

ADDITIONAL MEASUREMENTS AND DISPLAYS

18. PEAK WEIGHTING Peak weighting is only used for processing the positive peak readings. Peak weighting cannot be used for processing the negative peaks since it could fail to indicate 100% negative peaks which cause carrier shutoff. To enable the peak weighting, change the menu to "POS SETTINGS" and enter this loop. Go to "PK WEIGHT - XXX". Depress the up PARAMETER button to select peak weighting time constants from 3 cycles to 45 cycles. To disable the peak weighting, depress the down PARAMETER button until the menu reads "PK WEIGHT - OFF". The peak weighting function can be used as an analysis tool for determining modulation characteristics and for removing noise spikes on "off air" monitoring applications.

19. PEAK AVERAGE When "+ PEAK AVE" or "- PEAK AVE" is selected in the menu, the numerical value displayed is the average of all positive peaks or negative peaks during the HOLD time window. For example, the display "+ PEAK AVE 89 %" indicates that the average of all positive peaks is 89% in the past one second window if the HOLD time was set to 1.0 second. Note that the positive and negative peak averages are independent of each other.

20. AVERAGE TO PEAK RATIO When "+ AVE/PEAK" or "- AVE/PEAK" is selected in the menu, the numerical value displayed is the ratio of the positive or negative peak average to the highest positive or negative peak during the HOLD time window. For example, the display "- AVE/PEAK .78" indicates that the ratio of all negative peaks to the highest negative peak in the past one second window if the HOLD time was set to 1.0 second. A higher ratio is an indication of higher audio compression, thus if the calibrator is turned on, the value will be "1.00". Note that the positive and negative average to peak ratios are independent of each other.

21. PEAK MINIMUM When "+ PEAK MIN" or "- PEAK MIN" is selected in the menu, the numerical value displayed is the minimum positive or negative peak during the HOLD time window. For example, the display "+ PEAK MIN 23 %" indicates that the minimum positive peak in the past one second window if the HOLD time was set to 1.0 second. Note that the positive and negative peak minimums are independent of each other.

6 Running the Setup Program

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

6-1 Main Setup Menu Selections

RESET DEFAULTS ? Resets The Wizard to default factory settings including the passwords. Pressing the UP PARAMETER key when this message is displayed will reset the unit to default settings. The default settings are as follows:

+ PEAK MOD 125%
+PPM THRESH 10
+PPM DUR 10 MS
NORM HIGH 99 %
NORM LOW 90 %
NORM THRESH 10
NORM DUR 10 MS
SENTRY 0 %
SENTRY 30 SEC
PK WEIGHT - OFF
- PEAK MOD 99 %
-PPM THRESH 10
-PPM DUR 10 MS
MOD MODE- NORM
CAR THRESH 0 %
CAR TIME 1 SEC
SHIFT THRESH 10%
HOLD 1.0 SEC
TIME MODE - PAST
INFINITE - OFF
REMOTE - ON
MOD ADJ + 0.0%

PASSWORDS

OBSERVER: BELAR1
OPERATOR: BELAR2
SUPERVISOR: BELAR3

Pressing one of the MENU keys will advance to the next selection.

MODIFY OPTIONS ? Press the UP PARAMETER button to enter the MODIFY OPTIONS submenu section. This submenu informs The Wizard what options are present and how to configure itself.

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 ? The function is used during setup and calibration at the factory to remove A/D offset voltages. Pressing the UP PARAMETER key will allow the offsets to be set.

UNIT INFO ? Displays information about the unit. Pressing the UP PARAMETER key will display information about the unit.

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

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

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

6-2 MODIFY OPTIONS Submenu Selections

For the following prompts the front panel keys responses are:

UP MENU, DN MENU	Advances to the next prompt without altering the current setting.
UP PARAMETER	Indicates a YES/ON response or changes a parameter.
DN PARAMETER	Indicates a NO/OFF response or changes a parameter.

GAIN STEPS - 1.0/0.5 % Determines the gain steps displayed in the MOD ADJ menu selections. When the gain steps are set to 0.5%, the range of the gain adjustment is ±10%. When the gain steps are set to 1.0%, the range of the gain adjustment is ±20%.

BAUD RATE - 1200/2400/4800/9600 Determines the communications speed of the RS-232/422 port, in bps. *Note:* setting the speed to 1200 bps will restrict the hold time to a minimum of 1.0 seconds, even when the unit is not being accessed remotely.

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 *AMMA-1 ASCII RS-232 Interface Commands* in *Section 8*, set the command type to "ASCII".

PASSWORDS - ON/OFF Enables/Disables password protection of The Wizard when it is accessed remotely.

EXT SYNC - ON/OFF Enables/Disables external sync signal present when The Wizard is being accessed remotely. Generally, the external sync should be enabled, so that when the AMMA-1 is accessed remotely, the computer displays will be synchronized with the unit. Note that if the external sync is enabled, an external sync *must* be provided when the unit is accessed through the RS-232/422 port, or the unit will not function. If no sync will be provided (as will be the case with certain polling operations), then this setting *must* be OFF.

INTERFACE: MASTER/SLAVE Specifies if a second Wizard is present. Pressing the UP PARAMETER key will select this Wizard as the MASTER; pressing the DN PARAMETER key will select it as the SLAVE.

For the following prompts the front panel keys responses are:

UP MENU, DN MENU	Advances to the next prompt without altering the current setting.
UP PARAMETER	Selects the next relay to be set.
DN PARAMETER	Toggles between NO and NC for the selected relay.

RELAY #0 - NO/NC Selects the normal and alarm states of alarm relay #0 (LOSS OF MODULATION). If NC is selected, the relay will be Normally Closed (alarm pins 1 & 2 will be connected to each other) and will open (the connection will be broken) under the alarm condition.

RELAY #1 - NO/NC Selects the normal and alarm states of the NEG PPM relay.

RELAY #2 - NO/NC Selects the normal and alarm states of the NORMAL relay.

RELAY #3 - NO/NC Selects the normal and alarm states of the GENERAL relay.

RELAY #4 - NO/NC This relay is reserved for future use.

RELAY #5 - NO/NC Selects the normal and alarm states of the POS PPM relay.

RELAY #6 - NO/NC Selects the normal and alarm states of the CARRIER FAILURE relay.

RELAY #7 - NO/NC Selects the normal and alarm states of the REMOTE relay.

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 "..AMMA-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

+XXXX -XXXX XXXX Displays the positive, negative, and carrier A/D offsets. This menu selection is used during setup at the factory. For more information on its use, contact Belar.

CAR XXXX OFF XX
NEG XXXX OFF XX
POS XXXX OFF XX
WPOS XXXX OFF XX

The offset prompts display the specified reading with its current offset subtracted out, and the current offset value. To set an offset, press the UP PARAMETER key. After about a second, the new offset will be displayed. Offsets are set at the factory during initial setup and in general, do not need to be modified in the field. For more information on setting the offsets, contact Belar.

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

6-5 UNIT INFO Submenu Selections

VERSION x.xx Indicates the EPROM version installed in the unit.

SERIAL #510xxx Indicates the units factory serial number.

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

6-6 TEST RELAY/LED Submenu Selections

RELAY#X - OPEN/CLOSE Allows the relays to be tested. Entering the TEST RELAY/LED submenu will begin the test of Relay #0. The unit is configured so that when the LED is illuminated the relay is closed. The relay test will continually cycle the relay open and closed. The state of the relay will be indicated in the Menu/Parameter window. Each press of the UP PARAMETER key will test the next relay. When finished testing the relays, press the UP MENU button. EXIT ? Will show in the MENU/PARAMETER window.

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

6-7 TEST RS-232 Submenu Selections

TRANSMIT $XX X

RECEIVE $XX X
RECEIVE FAILEDX

The RS-232 test alternately transmits a $55 and $AA over the interface. The display shows the byte being transmitted followed by the byte received. If no byte is received a "RECEIVE FAILED" message is displayed. In addition to testing the Rx and Tx lines the test also toggles the DTR on the Tx and reads the CD line on the Rx. The "0" or "1" displayed after the data byte is the current logic state of the DTR or CD line.

EXIT ? Pressing the UP PARAMETER button exits the TEST RS-232 submenu and returns the Main Setup Menu.

7 Use of the MP-14 Analog Meter Panel

The MP-14 Analog Meter Panel (optional) provides continuous indication of both positive and negative modulation.

7-1 MP-14 Connections

Note: Before connecting the MP-14 to the AMMA-1, ensure that the meters are at mechanical zero.

Using the interconnect cable (provided), connect the D-connector end of the plug to the remote meter connector (J3) on the AMMA-1. The other end of the cable should be connected to the terminal strip (TB1) on the back of the MP-14 as follows:

Terminal Number	*Wire Color*
1	Red
2	Black
3	Green
4	White

See the MP-14 parts list at the rear of this manual for the MP-14 line voltage selection procedure.

Note: The MP-14 uses line power only to illuminate the meters. It is not required for proper operation of the meters.

7-2 MP-14 Calibration

Turn on the calibrator of the AMMA-1. Once the AMMA-1 display has settled, adjust R1 and R2 on the rear of the meter panel as necessary until both meters read 100%.

8 AMMA-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 AMMA-1 to send back the current value of the specified data. Use the tables below to determine the second character of the command string.

Positive Modulaton Data Available
'A' - Pos Peak Max
'B' - Pos Peak Ave
'C' - Pos Ave/Max
'D' - Pos Peak Min
'E' - Pos PPM Count
'F' - Normal PPM Count

Negative Modulation Data Available
'G' - Neg Peak Max
'H' - Neg Peak Ave
'I' - Neg Ave/Peak
'J' - Neg Peak Min
'K' - Neg PPM Count

Carrier Level Data Available
'L' - Carrier Level
'M' - Carrier Shift

Alarm/Relay Data Available
'N' - Alarms LED
'O' - Alarms Relay
'P' - Display Alarms

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.

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

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

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

Positive Modulation Parameters Available
'A' - Pos Peak Mod
'B' - Pos PPM Threshold
'C' - Pos PPM Duration Index
'D' - Normal High
'E' - Normal Low
'F' - Normal PPM Threshold
'G' - Normal PPM Duration Index
'H' - Sentry Threshold
'I' - Sentry Time
'J' - Peak Weighting Index

Negative Modulation Parameters Available
'K' - Neg Peak Mod
'L' - Neg PPM Threshold
'M' - Neg PPM Duration Index

Carrier Level Parameters Available
'N' - Mod Mode
'O' - Carrier Threshold
'P' - Carrier Time
'Q' - Carrier Shift Threshold

Unit Parameters Available
'R' - Peak Hold Time
'S' - Menu Switch
'T' - Loop-Thru Gain Pointer

The command syntax is:

'C' + X:(ASCII character data 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 Positive Peak Flasher value
Command Sent: 'C' + 'A' + CR:(carriage return)
ASCII Value : $43 $41 $0D

Data Returned(assume flasher set at 100%): '0100' + CR
ASCII Value: $30 $31 $30 $30 $0D

'+' or '-' - Increment/Decrement Configuration Data: Changes the specified parameter value by one. The data is range checked in the AMMA-1 with any data out of range being ignored. Use the tables below to determine the second character of the command string.

Positive Modulation Parameters Available
'A' - Pos Peak Mod
'B' - Pos PPM Threshold
'C' - Pos PPM Duration Index
'D' - Normal High
'E' - Normal Low
'F' - Normal PPM Threshold
'G' - Normal PPM Duration Index
'H' - Sentry Threshold
'I' - Sentry Time
'J' - Peak Weighting Index

Negative Modulation Parameters Available
'K' - Neg Peak Mod
'L' - Neg PPM Threshold
'M' - Neg PPM Duration Index

Carrier Level Parameters Available
'N' - Mod Mode
'O' - Carrier Threshold
'P' - Carrier Time
'Q' - Carrier Shift Threshold

Unit Parameters Available
'R' - Peak Hold Time
'S' - Time Mode
'T' - Infinite Hold
'U' - Save Config
'V' - Loop-Thru Gain Pointer
'W' - Calibrator

The command syntax is:

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

Example: Increment Positive Peak Flasher value
Command Sent: '+' + 'A' + CR:(carriage return)
ASCII Value : $28 $41 $0D

Decrement Positive Peak Flasher value
Command Sent: '-' + 'A' + CR:(carriage return)
ASCII Value : $2D $41 $0D

UNIT DATA DEFINITIONS

Data	High	Low	Increments
Pos Peak Max	200	0	1%
Pos Peak Ave	200	0	1%
Pos Ave/Max	100	0	0.01
Pos Peak Min	200	0	1%
Pos PPM Count	6000	0	1
Normal PPM Count	6000	0	1
Neg Peak Max	100	0	1%
Neg Peak Ave	100	0	1%
Neg Ave/Peak	100	0	0.01
Neg Peak Min	100	0	1%
Neg PPM Count	6000	0	1
Carrier Level	200	0	1%
Carrier Shift	200	0	1%

Alarms LED

bit #0 = REMOTE
bit #1 = CAR SHIFT
bit #2 = POS PPM
bit #3 = POS PEAK
bit #4 = GENERAL
bit #5 = NORMAL
bit #6 = NEG PPM
bit #7 = NEG PEAK

Alarms RELAY

bit #0 = REMOTE
bit #1 = LOSS OF CARRIER
bit #2 = POS PPM
bit #3 = RESERVED
bit #4 = GENERAL

bit #5 = NORMAL
bit #6 = NEG PPM
bit #7 = LOSS OF MODULATION

Display Alarms

bit #0 = AUDIO FAILURE
bit #1 = CARRIER FAILURE
bit #2 = LOW CARRIER
bit #3 = HIGH CARRIER
bit #4 = RESERVED
bit #5 = RESERVED
bit #6 = RESERVED
bit #7 = RESERVED

UNIT PARAMETER DEFINITIONS

PARAMETER	High	Low	Increments
Pos Peak Mod	150	0	1%
Pos PPM Threshold	100	1	1
Pos PPM Duration Index	6	0	1
Normal High	200	0	1%
Normal Low	200	0	1%
Normal PPM Threshold	100	1	1
Normal PPM Duration Index	5	0	1
Sentry Threshold	100	0	1%
Sentry Time	60	1	1 sec
Peak Weighting Index	8	0	1
Neg Peak Mod	100	0	1%
Neg PPM Threshold	100	1	1
Neg PPM Duration Index	6	0	1
Mod Mode	1	0	1

Carrier Threshold	100	0	1%
Carrier Time	60	1	1 sec
Carrier Shift Threshold	200	0	1%
Peak Hold Time	20	1	0.5 sec
Time Mode	1	0	1
Infinite Hold	1	0	1
Save Config	1	0	1
Loop-Thru Gain Pointer	40	1	0.5% or 1.0%
Calibrator	1	0	1

Menu Switch

bit #0 = INFINITE
bit #1 = CALIBRATOR
bit #2 = TIME MODE
bit #3 = REMOTE
bit #4 = RESERVED
bit #5 = RESERVED
bit #6 = RESERVED
bit #7 = RESERVED

9 Theory of Operation

9-1 AMMA-1 A4 Demodulator Board Theory of Operation

Summary

The A4 Demodulator Board detects the AM input signal applied to the AMMA-1 Wizard, and provides carrier and calibration reference signals for the A1 AM Modulation Analyzer Board. A control signal from the A1 board determines the mode of operation.

Input Connections

The RF input sample is applied to BNC jack J9 on the rear panel of the unit chassis. Inputs taken from transmitter RF sample points are terminated with 50 ohms by the parallel combination of R2 and potentiometer R1, which are mounted on the inside of the rear panel. R1 is adjusted during installation to place the RF level seen by the detector within a prescribed range to insure proper operation of the modulation scaling and conditioning circuitry. (See "Installation".) The values of R1 and R2 vary depending on whether the unit was shipped for use with standard broadcast or high-frequency transmitters. Note that when the AMMA-1 is used in conjunction with RF amplifiers with high output impedance, such as the Belar RFA-2, the termination resistor R2 must be disconnected to avoid damaging the RF amplifier. The RF input to the board from potentiometer R1 is brought to pins 6 and 7 (7 for ground) of the A4 card.

Carrier and Modulation Detection Circuitry

The AM detector is a half-wave rectifier and consists of a biased-diode, a linear-phase low-pass filter, and a protection circuit. CR4 is the shunt detector diode, biased near turn-on by the current through R2 from the positive 15V supply. The RF input is coupled to the diode through capacitors C3 and C4, which also form part of the detector's low-pass filter. The detector diode is afforded some protection from excessive reverse voltages, such as might be caused by lightning, by a second shunt diode CR3. This diode is normally biased off through the combined action of its own rectification of the signal envelope, capacitors C3 and C4, and the unregulated negative -15V supply voltage applied to its anode. Any rapid negative excursion in the input which exceeds the maximum peak-to-peak envelope will be shunted through CR3 and C5 to ground. R1 and C6 isolate the power supply from these impulses.

The values for C3, C4, C7, C8, C9, L1, L2, and L3 are selected to provide a Bessel low-pass frequency response characteristic which greatly attenuates the carrier frequency and passes the envelope of the signal with minimum overshoot. Resistors R31 and R3 terminate the filter and provide the required attenuation of the detector output. Operational amplifier U1 is a unity-gain follower, providing isolation required by the following differential amplifier. Diode CR5 is biased by R6 to provide a DC voltage identical to the turn-on voltage of the detection diode CR4. Resistors

R4, R5, R7, and R8, along with amplifier U2A, form a differential amplifier which effectively subtracts the DC offset due to the turn-on voltage of CR4 from the detector output at pin 6 of U1.

The detector output at pin 6 of U1 is the negative going portion of the applied RF signal, consisting of the lower portion of the carrier envelope superimposed on a DC voltage equal to the average value of the negative going carrier. After inversion in the differential amplifier U2A, the detected envelope of the carrier (plus carrier DC) is applied to the A1 board through normally-closed relay RL1 and board connection pins 10 and 11. At this point, positive voltage excursions correspond to positive modulation, and negative voltages to negative modulation. Increasing DC voltages correspond to higher carrier levels. The combined modulation and carrier signal is low-pass filtered by the active filter consisting of R9-R12, C14 and C15, and amplifier U2B. This removes modulation, leaving a DC voltage proportional to the detected carrier level. The cutoff frequency is approximately 1 Hz. (Carrier fluctuations of less than 1 Hz are passed with little attenuation.) The DC output is passed to the A1 board through normally-closed relay RL2 and board connection pins 12 and 13.

Calibrator Circuitry

Integrated circuits U3, U4, U5A, U6A, and U6B form a calibration system for the AMMA-1. A clocked square wave is generated, high-pass filtered and low-pass filtered, and then supplied to the modulation and carrier inputs of the A1 card, respectively, through relays RL1 and RL2. The levels of the two signals are adjusted during factory calibration to permit a precise check of the accuracy of the A1 card's metering circuitry.

U3 is an three-terminal regulator which supplies +5V DC to comparator U4 and dual flip-flop U5 from the A4 card's +15V DC bus during all modes of monitor operation. The calibrator is activated by a calibration control signal from the A1 board that is applied to pin 9 of the A4 card. For normal modulation monitoring, the control signal is at a logic low, near ground. A low at pin 9 biases comparator U4 into a saturated state (output either high or low) and turns off both Q1 and Q2, the relay driver transistors. This allows the detected modulation and carrier signals to pass to the A1 board through the normally closed relay contacts. When the control line goes high, approximately 5 volts, U4 becomes active and the relay drivers turn on, allowing the outputs of calibrator amplifiers U6A and U6B to pass to the modulation and carrier inputs of the A1 board.

When active, U4 acts as an RC relaxation oscillator. U4 is a 311-type comparator with an open-collector output at pin 7. Output swing is developed across load resistor R18. The positive feedback required for oscillation is provided by resistive divider R15-R16, with the bias point set at +2.5V DC by R13 and R14. When the output of U4 changes state from 0V DC to +5V DC, C17 is charged through R17. When the voltage on the capacitor and pin 3 reaches the reference voltage at pin 2 of U4 set by the divider (approximately +2.7V DC), the comparator output goes low. C17 is then discharged through R17 until pin 3 reaches the new reference voltage at pin 2 (approximately +2.2V DC). The comparator output goes high and the cycle repeats. C17 and R17 give an oscillation frequency of about 2000 Hz. R19 limits the current out of the bias circuitry of the

comparator, and C18 prevents fluctuation of the bias point of the IC during operation.

The oscillator output is applied to the clock input of J-K flip-flop U5A. The R (RESET) and J and K inputs of U5A are held high, disabling the reset line and setting the flip-flop to toggle (or to alternate output states) at each negative-going edge of the input signal from the oscillator. The Q output of U5A is thus a square wave of exactly one half the oscillator input frequency. One symmetric signal is then available for checking the sensitivity and balance between the modulation and carrier inputs to the conditioning circuitry on the A1 card.

The calibration square wave from pin 12 of U5 is high-pass filtered by C19 and R20 to remove the DC portion of the flip-flop output and amplified by non-inverting amplifier U6A. Gain is adjusted for calibration by potentiometer R21. R24 and C20 form a smoothing network with a time constant such that the tilt in the waveform resulting from C19 and R20 is removed and the peaks of the resulting AC waveform occurs about midway between waveform's transitions. The AC signal is passed to the modulation input of the A1 board through active relay RL1.

R25 and C21 act as a low-pass filter to remove the AC content of the flip-flop square wave. The resultant DC is amplified by U6B, with gain adjustment provided by potentiometer R26. This DC signal is passed to carrier input of the A1 card through active relay RL2. Note that since the calibration signals are derived from one source, variations in the relative values of the modulation and carrier signals would be expected to be very small.

Regulated power is applied to the A4 card at board connection pins 1, 2, and 3. CR1 and CR2 provide reverse-polarity protection for components on the board, while C1 and C2 provide local bypassing. CR6 and CR7 suppress back-EMF transients when relays RL1 and RL2 are deactivated.

9-2 AMMA-1 A1 Modulation Processor Board Theory of Operation -- Analog Section

(Schematic Sheet 1)

Summary

The functions of the analog section of the A1 processor board are to provide leveled audio modulation output and analog remote metering outputs, handle sampling and multiplexing of the modulation and carrier signals for processing by the microprocessor, and provide an audio loop through to permit automatic modulation control by adjustment of the transmitter input signal.

Leveled Audio Output and Analog Remote Metering

Processing of the modulation signal from the A4 board will be discussed first. Modulation indications for both the remote meters and the AMMA-1's front panel readout are referenced to the carrier level. For the remote meters, this is achieved by scaling the analog signal in a multiplying digital-to-analog (DAC) converter controlled by the microprocessor.

The modulation signal from the A4 detector card is applied to pins 6 and 7 of the A1 card and enters non-inverting operational amplifier U1 through a high-pass filter formed by C6 and R1. This filter serves to guarantee no DC reaches the metering circuitry, which would result in a constant offset in the readings. "OUTPUT LEVEL ADJUST" potentiometer R2 serves to set the gain of U1 and adjusts the audio output level of the monitor. (This adjustment also affects sensitivity of the remote metering.) The output of U1 passes through U2, a 12-bit CMOS multiplying DAC. Under control of the system microprocessor, 12 bits of scaling data are clocked into U2, pin 6, on the rising edge of clock signals at pin 7. (These control signals are passed through opto-couplers U27 and U28 to isolate the system analog ground from the digital ground.) When the load line at pin 5 goes low, the current output from pin 3 reflects the product of the modulation signal input at pin 1 and a computed scale factor. Operational amplifier U3A converts the output current to a leveled and inverted output voltage for further processing. C8 is chosen for stable operation of amplifier U3A. Three-terminal regulator U29 provides +5V DC for use by the DAC's in U2 and U23, as well as the optical isolators in U27 and U28.

The leveled and inverted audio modulation signal at the output of U3A is passed through relay RL1, which mutes the audio signal when the monitor is operated in the calibration mode. During calibration, Q1 is driven into saturation by the Q0 output (pin 19) of processor output latch U47 via R5. This activates the coil of RL1 and breaks the audio connection. CR3 protects Q1 from voltage transients when the relay is deactivated. Inverting amplifier U3B provides gain for the audio signal and an optional de-emphasis network for stations that pre-emphasize their audio. (This second inversion re-establishes natural polarity in the output signal.) Board-mounted blue jumper P1, when placed in the shorting position, parallels R8 with R7 and C11 in the feedback path of the amplifier, giving the audio the standard NRSC 75 microsecond de-emphasis characteristic. The 2122 Hz break frequency is set by the product of C11 and the sum of R7 and R8. The values of R7 and C11 set the upper break frequency to approximately 8800 Hz, where the audio rolloff begins to slow. U3B's output appears as the high-impedance "AUDIO TEST" modulation test output on rear panel BNC jack J8 via C14 and current limiting resistor R9.

U4, a dual-amplifier IC also driven by U3B, provides a balanced output signal of nominally +10 dBm into 600 ohms at 80% modulation. Sense lines in U4 provide a differential output that mimics the operation of a floating secondary of an audio transformer. The balanced output appears at J7, the "AUDIO OUT" XLR plug on the rear panel. The connector is soldered to the A1 board. Positive polarity is assigned to pin 2 of the connector, negative to pin 3, and ground to pin 1.

The leveled audio modulation signal from U3A feeds non-inverting remote metering amplifier U5A. Gain for the remote metering is set by R12, R14, and "METER GAIN" potentiometer R13. R10 and R11 attenuate the input signal to U5A to permit reasonable linearity in the gain adjustment. The signal is then applied to precision half-wave rectifiers of both polarities.

Analog Remote Metering Rectifiers

Operational amplifiers U7A and U7B and associated parts form the half-wave rectifier that senses negative modulation. (Operation of this rectifier is the same as the one formed by amplifiers U6A and U6B, but only the negative rectifier will be described.) The principal diode in this rectifier is CR7. When a positive voltage is applied to pin 3 of U7A (in this case representing negative modulation swings), the amplifier's output at pin 1 quickly rises until the signal fed back to pin 2 of U7A from unity-gain follower U7B equals the voltage input at pin 3. R23 and R24 limit input currents in the amplifiers. C17 holds charge long enough to allow the meter movement to respond to brief peaks. The combination of R25 and C17 provide the time constant for appropriate meter decay when modulation is reduced. Diode CR6 serves to close the feedback loop around C7A for voltages at pin 3 that go below ground, preventing the amplifier output from slewing to negative saturation. (The presence of this diode does not affect circuit operation for positive input voltages, because the voltage at the anode of CR6 is always at least one diode drop below its anode for this situation.) The output of U7B at pin 7 drives the remote meters through R26, C18, and R27. The resistors serve to limit amplifier current. Capacitor C18 suppresses transients that may be picked up by the wires connecting the remote meter to the AMMA-1.

Amplifier U5B inverts the leveled audio modulation signal from U5A. The rectifier formed by U6A and U6B then detects the positive modulation swings. The gain of U5B is near unity and is set by R16, R17, and "METER BALANCE" potentiometer R15. This allows the relative sensitivity between the positive and negative meters to be adjusted. Operation of the positive modulation rectifier is identical to that of the negative rectifier described above. Positive and negative remote meter outputs appear at A1 board connection pins 10 and 12, respectively, with grounds at pins 11 and 13. They appear at J3, the "REMOTE METERS" Cinch connector mounted on the rear panel.

Digital Modulation Peak Measurement and Sampling

The detected modulation signal from the A4 card is high-pass filtered by C19 and R28 before being amplified by non-inverting amplifier U8A. Gain is set by R30, R31, and "MODULATION ADJUST" potentiometer R29. The audio modulation signal is half-wave rectified by amplifiers U9 and U15 and associated components to obtain the positive and negative modulation, respectively. The operation of the two rectifiers is identical, but that for U15 will be described.

High-Speed Rectifiers and Peak Detection

U15 is a high-speed operational amplifier (LM318) connected as an inverting half-wave rectifier with unity gain. R54 and C34 provide feed-forward compensation to improve its slew rate. R53 and R55 set the gain. With a negative voltage applied to input resistor R53, pin 6 of U15 swings upward with open-loop gain until diode CR13 turns on and the feedback path through R55 is closed. Since the feedback causes the amplifier to keep the voltages at pins 2 and 3 as close as possible, the amplifier output voltage increases just enough to keep the cathode of CR13 at a positive voltage equal to the magnitude of the negative input signal. The amplifier maintains this relationship as long as the input signal is a negative voltage.

When the input voltage from U8A is positive, the output of U15 can only swing low. This means that CR13 will always be reversed biased and the feedback loop cannot be closed through it. As soon as the output of U15 swings below one diode drop below ground, CR12 turns on. The amplifier now has much reduced gain, but pin 2 is still maintained at ground by the feedback through CR12. Since pin 2 is held at ground and CR13 is open, R55 holds the input of the voltage divider formed by R56 and R57 at ground. The R56-57 voltage divider lowers the rectifier output level for compatibility with the negative peak detector in U16.

The half-wave rectifier for the positive modulation peaks formed by U9 and associated components works in the same way as U15. Inverting amplifier U8B is required to reverse the polarity of the modulation audio so the rectifier U9 yields the positive modulation waveform. Gain is set by R32, R34, and "POSitive PEAK GAIN" potentiometer R33. As for rectifier U15, R38 and R39 pad the rectifier output signal for further processing.

Positive and negative modulation peaks are detected in integrated circuit peak detectors U14 and U16, respectively. These IC's continuously track the input waveforms, increasing the voltage on storage capacitors C29 and C35 to match rising input voltages. Every 10 milliseconds, after their outputs are held in the sample-and-hold circuit in U17, they are reset by the system processor with a brief logic true on their DET/RST lines (pins 1 and 14). The positive peak rectifier output is handled in a special way to permit peak-weighted measurements of positive peaks.

Positive Peaks and Peak Weighting

The output of positive peak rectifier is buffered by unity-gain follower U12 and fed to analog switch IC U13. Under control of the system processor, U13 selects the conventional, unweighted positive peak waveform from the output of U12, or a weighted peak waveform from the half-wave rectifier and weighting selection circuit formed by IC's U10A, U10B and U11. When the control line from U47 to pins 6 and 15 of U13 is high, U12 is fed directly to the input of positive peak detector U14 through section A of U13. Simultaneously pin 11 of switch U13, normally held at +5V DC by R50, is grounded through switch section C. This turns off section B of the switch, disconnecting the output of the weighting rectifier U10B from the peak detector.

Positive Peak Weighting Circuit

The half-wave rectifier formed by amplifiers U10A and U10B is configured in much the same way as the rectifier formed by U7A and U7B described above under "Leveled Audio Output and Analog Remote Metering". The two major differences are the series resistance inserted between rectifying diode CR11 and holding capacitor C26 (one of the resistors R42 through R49), and the discharging resistor R40, which here is connected to the negative supply instead of ground. The series resistance greatly slows the charging of C26--and the rise of the peak output level of the rectifier. This provides a means of weighting positive peak indications so as to minimize modulation indications for peaks with the least energy--those of the shortest duration.

Analog multiplexer U11 receives a 3-bit binary code from processor latch U47, which selects one of the eight resistors R42 through R49 to be placed between CR11 and C26. When the voltage at pin 3 of U10A exceeds the voltage stored on C26, the output of U10A saturates positive until C26 charges through the selected resistor to the input voltage. When the output of U10B reaches the input at pin 2 of U10A, the feedback through R41 and C25 brings the output of U10A to one diode drop above the voltage on C26. R40 mimics a current source, discharging C26 during the portions of the modulation cycle when the input to U10A falls below the voltage on C26. The front-panel selection of the charging resistor determines the time constant selected for positive peak indications. C25 shapes the frequency response of the weighting rectifier.

When peak-weighted indications are selected on the front panel of the AMMA-1, the control line from pin 15 of latch U47 goes low, pins 6 and 15 of U13 go low, and the connection between U12 and U14 through switch A of U13 is opened. Switch C of U13 also opens, allowing pin 11 to be pulled high by R50, which in turns on closes section B of U13. This connects the output of U10B to the positive peak detector in U14.

Sample and Hold Circuitry

The instantaneous positive and negative peaks and carrier level are held for interrogation by the system processor in the sample-and-hold IC, U17. Every 10 milliseconds, the output of inverter U40D drives the S/H lines at pins 6, 7, 9, and 10 of U17 low momentarily, causing U17 to track its three inputs. When U40D goes high, the sampled carrier and negative and positive modulation voltages appear at output pins 2, 1, and 15 respectively. The carrier signal from the A4 demodulator board is applied to pins 14 and 15 of the A1 board and attenuated by R51 and R52. C38 lowers the dynamic resistance seen by the multiplexer input.

Analog multiplexer U18 passes one of these three DC signals to non-inverting buffer amplifier U20, and then on to the analog-to-digital converter (ADC) U30. The binary number represented on the control lines at pins 10 and 11 of U18 from latch U47 and the processor determine which of the signals is selected by the multiplexer. Amplifier U20 provides a means of adjusting the DC offset of the analog data acquisition system to zero. Resistors R59, R60, and R61 form a voltage divider to provide an input offset voltage to U20 to cancel any residual offset in the preceding circuitry. The

"A/D OFFSET ADJUSTment" potentiometer R60 sets the precise offset required, which is then summed with the non-inverted signal through R62 and the inverting input of U20. R58 provides a load for the multiplexer and prevents transients associated with switching from becoming excessive.

Three-terminal regulator U19 provides -5V DC for multiplexers U13 and U18, which require split supplies.

Transmitter Audio Loop-Through

This subsystem on the A1 board provides a means for the AMMA-1 to automatically adjust gain in the audio program line to maintain transmitter modulation at the maximum practical value. The circuitry provides for balanced input and output audio, and a fail-safe system to pass the signal straight through in the event of a failure of line power to the AMMA-1.

Balanced transmitter audio is input to the loop-through via "LOOP-THRU IN" jack J6, an XLR connector on the rear panel. The balanced output to the transmitter is taken from rear-panel "LOOP-THRU OUT" XLR plug J5. When the AMMA-1 is not receiving line power, or when the automatic leveling is disabled under front-panel control, the base of Q2 is grounded through R73, de-energizing the coil of RL2. As a result, the balanced audio input signal at J6 is passed through the normally closed contacts of RL2 directly to the corresponding output connections on J5.

When the loop-through is activated, pin 19 of latch U48 goes high, supplying base current to Q2 through R7. The collector of saturated Q2 is pulled near ground, drawing current through the coil of RL2. Relay contacts then place the leveling circuit in the path between J6 and J5. Diode CR14 protects Q2 from back-EMF when RL2 is deactivated.

The balanced input signal from J6 is bridged and converted to a single-ended signal by a differential amplifier in U21. A high-pass filter formed by C46 and R64 blocks any differential DC in the program circuit from being passed into the gain-control circuitry. The signal is then buffered by unity-gain amplifier U22.

At this point the program signal is applied to both unity-gain inverting amplifier U24A and the inverting, multiplying digital-to-analog converter (DAC) formed by the combination of U23 and U24B. This circuit, with gain adjustment in only one of the two parallel inverters, provides a redundant path for program audio in the event of a DAC failure, and allows two ranges of gain adjustment with a change in the position of just one jumper. The U23-U24B combination works like the converter U2-U3A described above under "Leveled Audio Output and Analog Remote Metering". The gain control data and control signals arrive from the system processor via opto-isolators U27 and U28. Feedback capacitors C48 and C49 provide increased stability and match the responses of U24A and U24B.

The outputs of the fixed and adjustable-gain inverters are summed in the resistor network formed by R67 through R72, summing amplifier U25, and summing resistor R72. The multiplying DAC gain is normally centered at its mid-range (-0.5) by the processor. With R68, the "LOOP UNITY GAIN ADJUST" potentiometer properly set, the network of summing resistors forms a binary-weighting network which provides unity gain between the output of U22 and U25 for both settings of the "MODulation ADJUSTment RANGE SELECT" jumper P2. For both positions of the jumper, the fixed and gain-controlled inputs to U25 pass through R71 and the R67-R68 combination respectively. The jumper position determines the effective binary weight used for changing the system gain--and the maximum control range. When R69, the largest of the binary resistors, is selected the control range is the smallest. The polarity inversion occurring in summing amplifier U25 serves to re-establish proper polarity in the program signal. Capacitor C52 provides compensation for summing amplifier U25.

Summer U25 feeds integrated circuit U26, a differential line-driver capable of driving 600 ohm loads. Sense lines in U26 enable it to mimic the operation of a floating secondary of an audio output transformer. Its two outputs are connected through contacts in relay RL2 to contacts on loop-through output jack J5 (positive to contact 2, negative to contact 3). When the relay is de-energized, the loop-through input signal passes directly to J5 through normally-closed contacts in the relay.

10 Diagrams, Schematics and Parts Lists

Replaceable Parts. This page contains information for ordering replaceable parts for the monitor. The tables that follow list the parts in alphanumeric order by reference designation and provides 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.*

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

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

Appendix A: Using The Wizard Software

Getting Started

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

Direct Connection

Equipment Required:

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

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

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

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

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

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

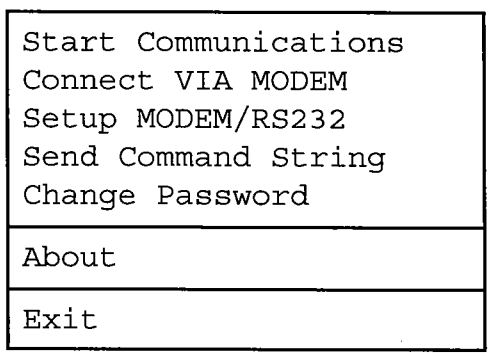
Procedure:

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

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

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

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



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

Connection via Modem

Equipment Required:

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

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

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

External Modem Setup:

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

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

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

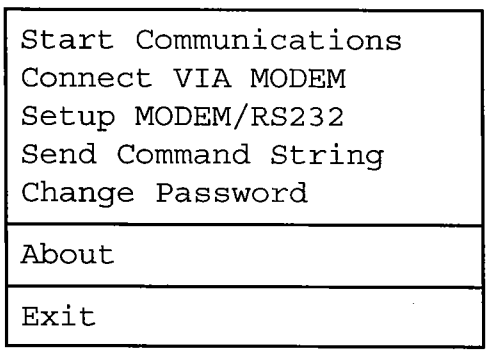
Some modems have various data compression schemes to increase the apparent speed under certain circumstances. Be sure to configure your modem to disable such compression schemes. Refer to your modem and communication software manuals if you encounter problems.

Procedure:

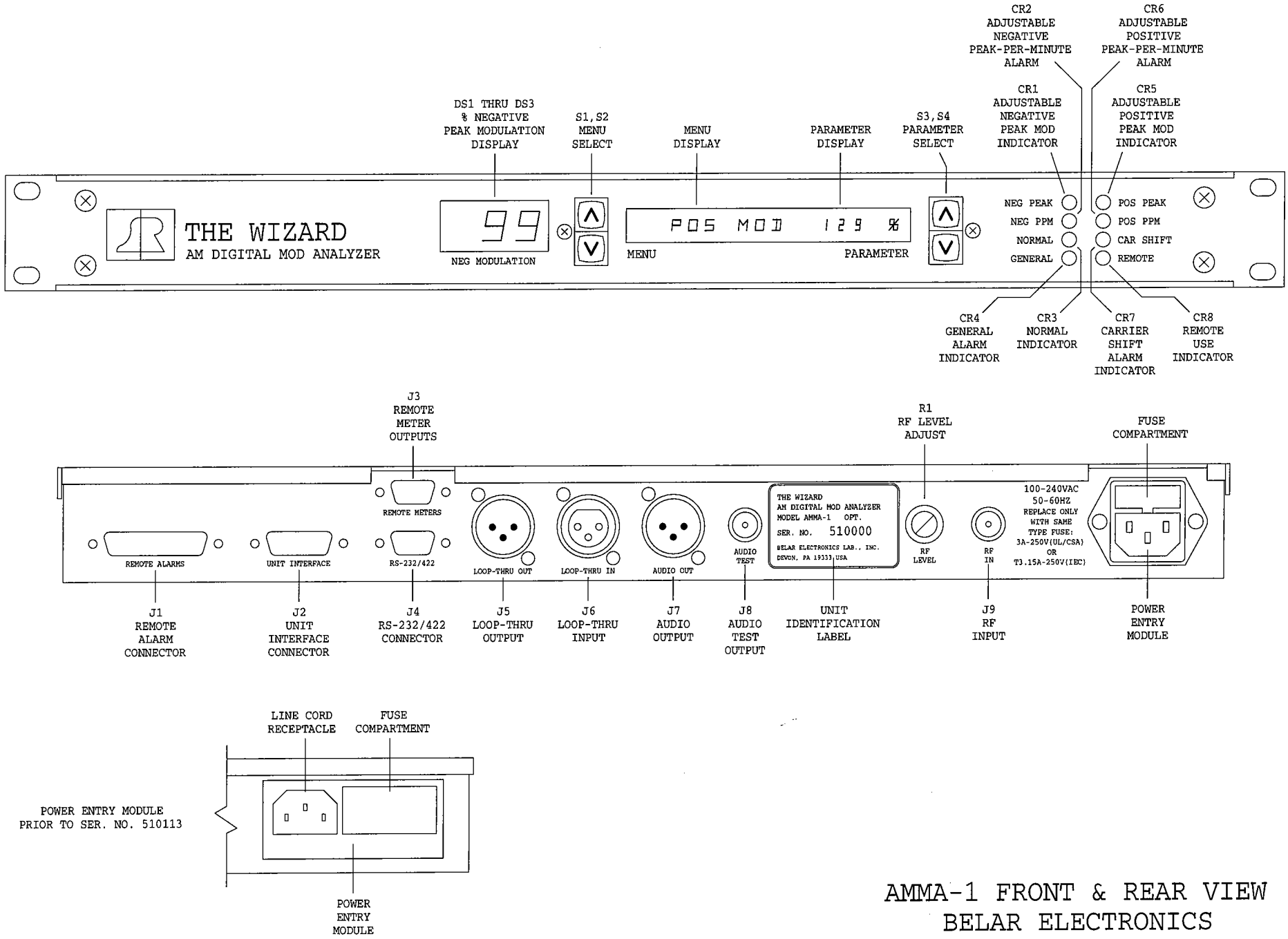
1. For safety's sake, if you plan to run The Wizard software directly from the floppy disk, make a backup copy first and store the original in a safe place. Alternatively, copy The Wizard software to your hard disk, preferably in its own subdirectory (we suggest C:\WIZ).

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

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



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



AMMA-1 FRONT & REAR VIEW
BELAR ELECTRONICS

AMMA-1 PARTS LISTS

MAIN CHASSIS

Reference Designation	Description		Part Number
A3	POWER SUPPLY MODULE: 15W	(note 1)	4005-0019A
BR1,BR2	DIODE: BRIDGE KBPC602 GI	(note 2)	1900-0025
--	POWER ENTRY MODULE: 6EGG1-1	(note 1)	0360-0021
F1	FUSE: GMA-3A 250V(UL/CSA) or T3.15A-250V(IEC)	(note 1)	2110-0009
--	FUSE HOLDER: CHASSIS MOUNT	(note 1)	2110-0010
F2	FUSE: AGC-2A 250V	(note 1)	2110-0006
--	POWER ENTRY MODULE: 6J4	(note 2)	0360-0020
	FUSE: AGC 1/2A 250V	(note 2)	2110-0001
J3	CONNECTOR: 9 PIN D ,FEMALE		0360-0037
J8,J9	JACK: BNC		0360-0005
L1 thru L4	CHOKE: RF	(note 1)	9140-0011
R1	R: VAR COMP 500 2W	(note 3)	2100-0015
R2	R: FIXED NON-IND 56 20W	(note 3)	0811-0021
T1	TRANSFORMER: POWER, DPC 34-700	(note 2)	9100-0022
T2	TRANSFORMER: POWER, DPC 10-2400	(note 2)	9100-0023
--	FLAT CABLE ASSEMBLY: 24 CONDUCTOR		8900-0005
--	LINE CORD (115 Vac line voltage)		8120-0002
--	LINE CORD (230 Vac line voltage)		8120-0004

note 1: Used beginning serial number 510113.

note 2: Used prior to serial number 510113.

note 3: Optional HF input:

R1	R: VAR COMP 100 2W	2100-0010
R2	R: FIXED COMP 100 5% 2W	0692-1015

POWER ENTRY MODULE
(FUSE F1 INSIDE MODULE)

L G N

BLU/WHT
BRN/WHT
GRN/WHT
BRN/WHT

A3 POWER SUPPLY MODULE

J9 RF IN

R1 RF LEVEL 100,2W

R2 100 2W

3 2 1

GRN
BRN

OPTIONAL HF INPUT

J9 RF IN

R1 RF LEVEL 500,2W

R2 56 20W

3 2 1

GRN
BRN

NOTE: DISCONNECT R2 FOR RFA USE.

BROADCAST BAND INPUT

1 2 3

POT REAR VIEW (R1)

BLK/WHT
BLK/WHT
BLK/WHT
BLK/WHT
DGND

GRN/WHT
GRN/WHT
GRN/WHT
+5V

F2
2A

L1 RED/WHT
L2 RED/WHT
+15V

BRN/WHT
BRN/WHT
GND

RED/WHT
BRN/WHT
YEL/WHT
GRN/WHT
BLK/WHT

L3 YEL/WHT
L4 YEL/WHT
-15V
YEL

7 6 8

-15V YEL

-15V YEL/WHT 3
GND BRN/WHT 2
+15V RED/WHT 1

11 10 13 12

DGND BLK/WHT 5
+5V GRN/WHT 4

9

A4 DEMODULATOR BOARD

J8 AUDIO TEST

J3 REMOTE METERS

1 5
6 9

BLU
BRN
ORG
BLK

J7 AUDIO OUT
J6 LOOP-THRU IN
J5 LOOP-THRU OUT
J4 RS-232/422 CONNECTOR
J2 UNIT INTERFACE
J1 REMOTE ALARMS

12
13

5 4

GRN/WHT +5V
BLK/WHT DGND

+5V GRN/WHT 17
DGND BLK/WHT 18

GRY
BRN

9 8
11
10

6 7

14
15

3 YEL/WHT -15V
2 BRN/WHT GND
1 RED/WHT +15V

HDR1 1

BLU/WHT

16

A1 MAIN BOARD

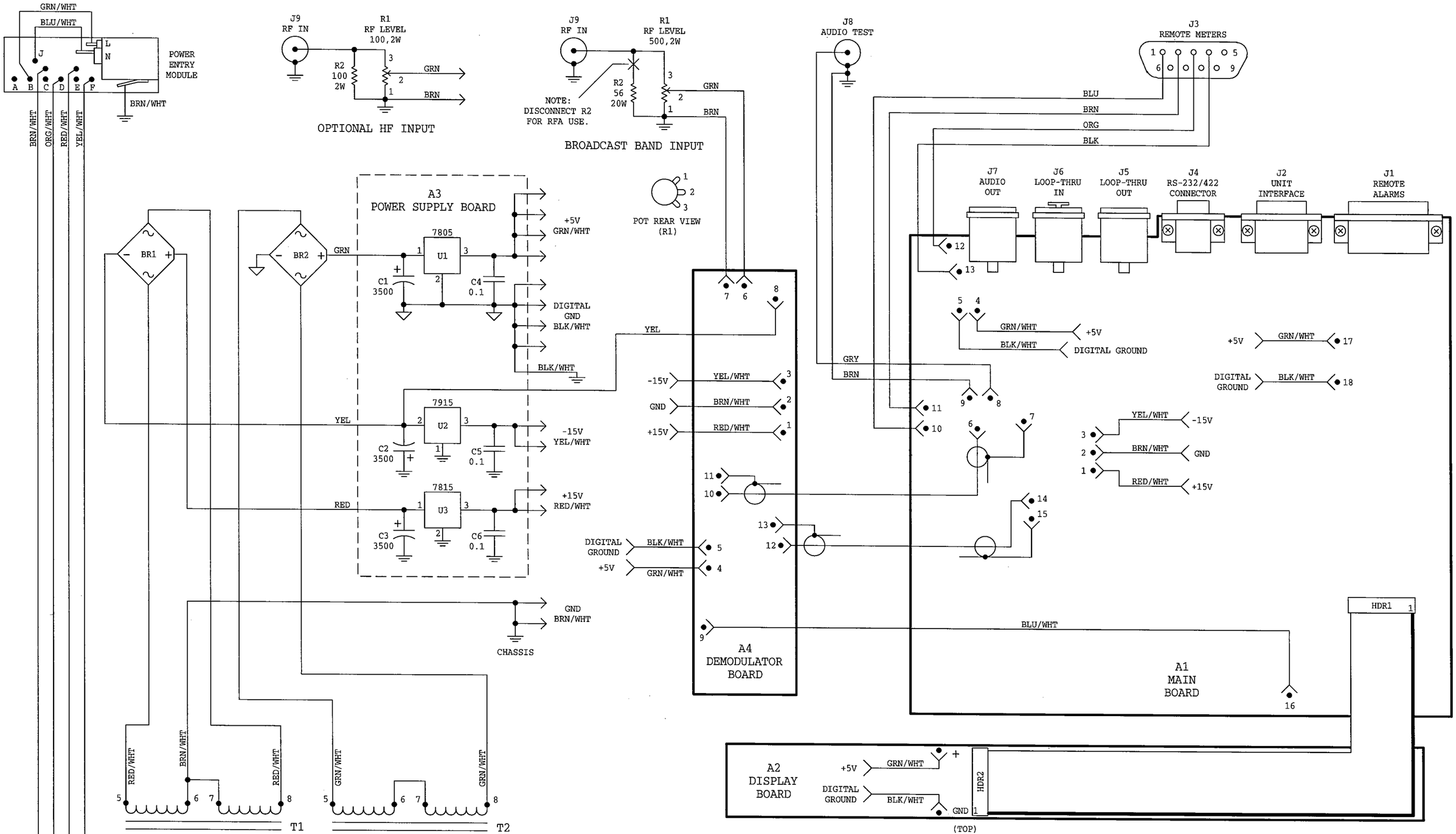
A2 DISPLAY BOARD

+5V GRN/WHT +
DGND BLK/WHT GND

HDR2 1

(TOP)

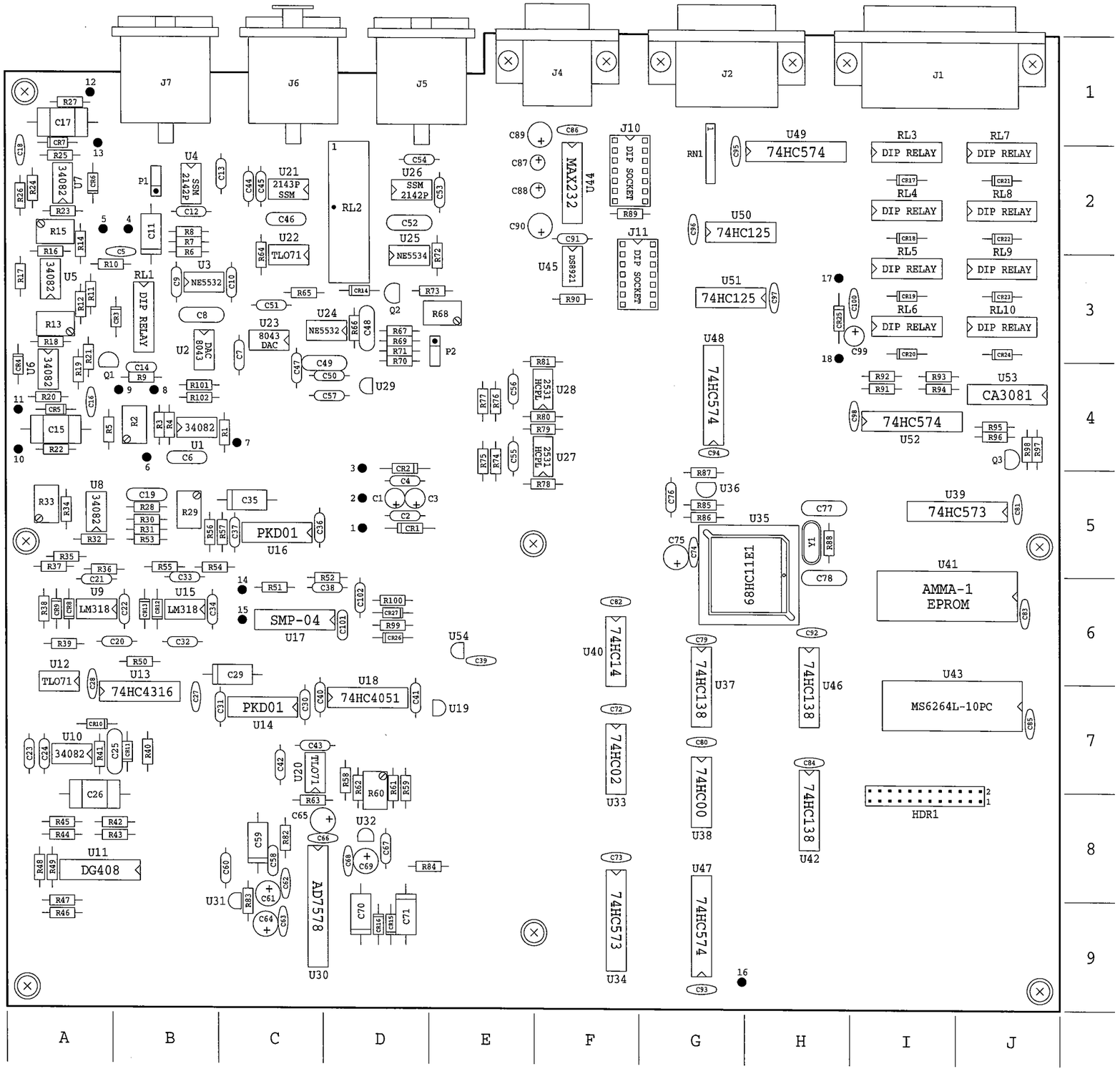
AMMA-1 CHASSIS WIRING
BELAR ELECTRONICS
2-27-97
(USED BEGINNING SERIAL NUMBER 510113)



AMMA-1 CHASSIS WIRING
BELAR ELECTRONICS
9-16-95
(USED PRIOR TO SERIAL NUMBER 510113)

THE WIZARD
AMMA-1
AM MODULATION ANALYZER
A1 BOARD REV. A
SHEET 1
7-22-98

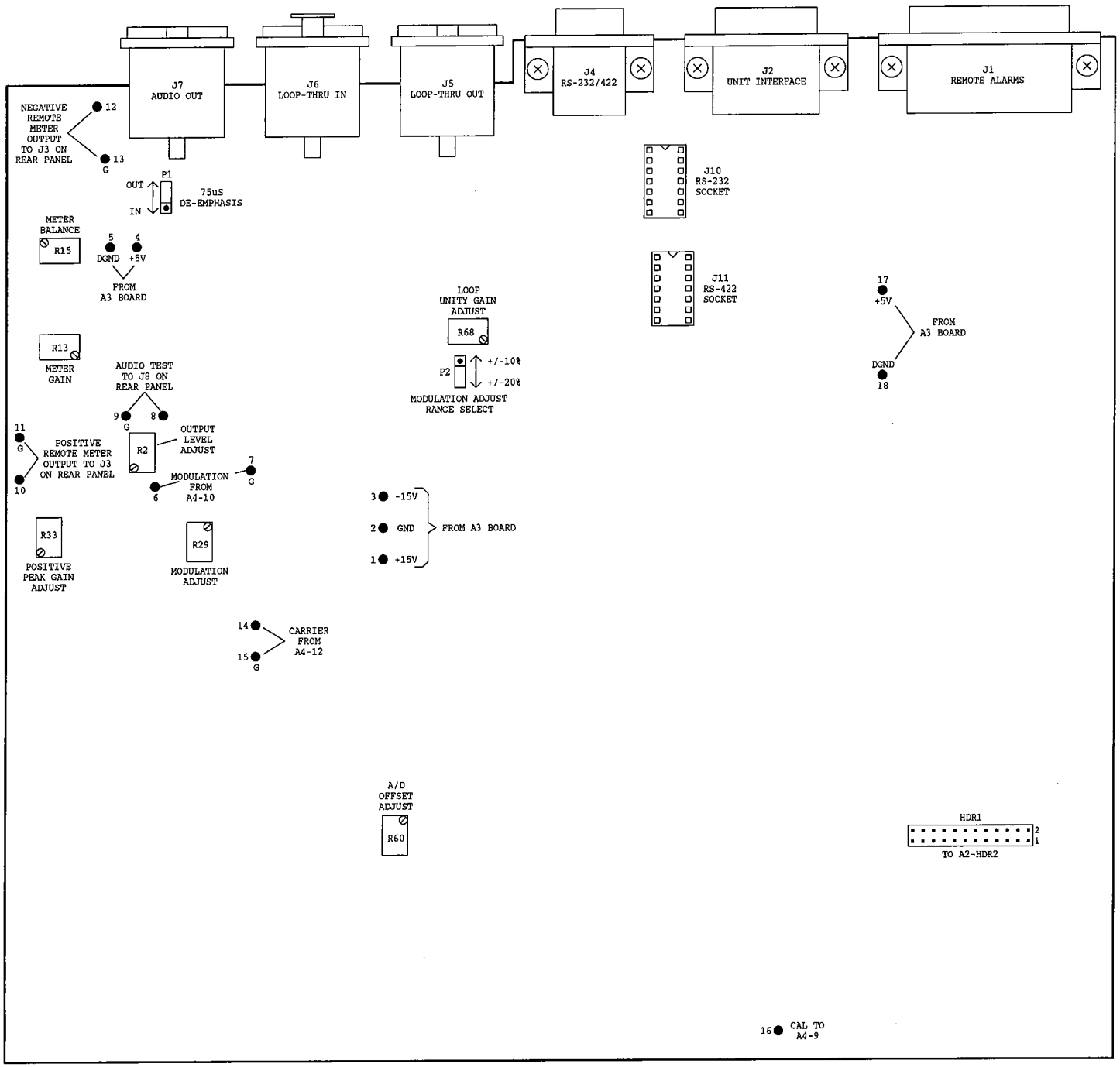
THE WIZARD
AMMA-1
AM MODULATION ANALYZER
A1 BOARD REV. A
SHEET 2
1-23-95



AMMA-1 A1 BOARD
REV. A
COMPONENT LAYOUT
BELAR ELECTRONICS

AMMA-1 A1 BOARD, REV. A
PART LOCATIONS

Des/Loc	Des/Loc	Des/Loc	Des/Loc	Des/Loc	Des/Loc	Des/Loc
C1 D5	C52 D2	CR1 D5	R6 B3	R57 C5	RL5 I3	U43 I7
C2 D5	C53 E2	CR2 D5	R7 B2	R58 D7	RL6 I3	U44 F2
C3 D5	C54 D2	CR3 B3	R8 B2	R59 D7	RL7 J2	U45 F3
C4 D5	C55 E4	CR4 A4	R9 B4	R60 D7	RL8 J2	U46 H7
C5 B3	C56 E4	CR5 A4	R10 A3	R61 D7	RL9 J3	U47 G9
C6 B4	C57 D4	CR6 A2	R11 A3	R62 D7	RL10 J3	U48 G4
C7 C3	C58 C8	CR7 A2	R12 A3	R63 C8		U49 H2
C8 B3	C59 C8	CR8 A6	R13 A3	R64 C3	RN1 G2	U50 G2
C9 B3	C60 C8	CR9 A6	R14 A2	R65 C3		U51 G3
C10 C3	C61 C8	CR10 A7	R15 A2	R66 D3	U1 B4	U52 I4
C11 B2	C62 C8	CR11 B7	R16 A3	R67 D3	U2 B3	U53 J4
C12 B2	C63 C9	CR12 B6	R17 A3	R68 E3	U3 B3	U54 E6
C13 C2	C64 C9	CR13 B6	R18 A3	R69 D3	U4 B2	
C14 B4	C65 C8	CR14 D3	R19 A4	R70 D4	U5 A3	Y1 H5
C15 A4	C66 C8	CR15 D9	R20 A4	R71 D3	U6 A4	
C16 A4	C67 D8	CR16 D9	R21 A3	R72 E3	U7 A2	pins
C17 A1	C68 D8	CR17 I2	R22 A4	R73 E3	U8 A5	1 D5
C18 A2	C69 D8	CR18 I2	R23 A2	R74 E4	U9 A6	2 D5
C19 B5	C70 D9	CR19 I3	R24 A2	R75 E4	U10 A7	3 D5
C20 B6	C71 D9	CR20 I3	R25 A2	R76 E4	U11 A8	4 B2
C21 A6	C72 F7	CR21 J2	R26 A2	R77 E4	U12 A6	5 A2
C22 B6	C73 F8	CR22 J2	R27 A1	R78 F5	U13 B7	6 B4
C23 A7	C74 G5	CR23 J3	R28 B5	R79 F4	U14 C7	7 C4
C24 A7	C75 G5	CR24 J3	R29 B5	R80 F4	U15 B6	8 B4
C25 B7	C76 G5	CR25 H3	R30 B5	R81 F4	U16 C5	9 B4
C26 A8	C77 H5	CR26 D6	R31 B5	R82 C8	U17 C6	10 A4
C27 B7	C78 H6	CR27 D6	R32 A5	R83 C9	U18 D7	11 A4
C28 A7	C79 G6		R33 A5	R84 D8	U19 E7	12 A1
C29 C6	C80 G7	HDR1 I8	R34 A5	R85 G5	U20 C7	13 A2
C30 C7	C81 J5		R35 A5	R86 G5	U21 C2	14 C6
C31 C7	C82 F6	J1 I1	R36 A5	R87 G5	U22 C3	15 C6
C32 B6	C83 J6	J2 G1	R37 A5	R88 H5	U23 C3	16 G9
C33 B6	C84 H7	J4 F1	R38 A6	R89 F2	U24 D3	17 H3
C34 B6	C85 J7	J5 D1	R39 A6	R90 F3	U25 D3	18 H3
C35 C5	C86 F1	J6 C1	R40 B7	R91 I4	U26 D2	
C36 C5	C87 F2	J7 B1	R41 A7	R92 I4	U27 F4	
C37 C5	C88 F2	J10 F2	R42 B8	R93 I4	U28 F4	
C38 D6	C89 F1	J11 F3	R43 B8	R94 I4	U29 D4	
C39 E6	C90 F2		R44 A8	R95 J4	U30 C9	
C40 C7	C91 F2	P1 B2	R45 A8	R96 J4	U31 C9	
C41 D7	C92 H6	P2 E3	R46 A9	R97 J4	U32 D8	
C42 C7	C93 G9		R47 A9	R98 J4	U33 F7	
C43 C7	C94 G4	Q1 A4	R48 A8	R99 D6	U34 F9	
C44 C2	C95 G2	Q2 D3	R49 A8	R100 D6	U35 H5	
C45 C2	C96 G2	Q3 J4	R50 B6	R101 B4	U36 G5	
C46 C2	C97 H3		R51 C6	R102 B4	U37 G7	
C47 C4	C98 I4	R1 C4	R52 D6		U38 G8	
C48 D3	C99 I3	R2 B4	R53 B5	RL1 B3	U39 I5	
C49 D4	C100 I3	R3 B4	R54 B5	RL2 D2	U40 F6	
C50 D4	C101 D6	R4 B4	R55 B5	RL3 I2	U41 I6	
C51 C3	C102 D6	R5 A4	R56 B5	RL4 I2	U42 H8	



AMMA-1 A1 BOARD, REV. A
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A1 BOARD AMMA-1, rev. A

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 0.01uF 100V	0151-0003
C6	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C7	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C8	C: FIXED MICA 15pF 5%	0140-1505
C9,C10	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C11	C: FIXED POLY 1500pF 2.5% 160V	0130-1522
C12,C13	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C14	C: FIXED CERAMIC 1.0uF 50V	0151-0016
C15	C: FIXED FILM 0.047uF 10% 200V	0120-4731
C16	C: FIXED CERAMIC 0.001uF 1kV	0151-0002
C17	C: FIXED FILM 0.047uF 10% 200V	0120-4731
C18	C: FIXED CERAMIC 0.001uF 1kV	0151-0002
C19	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C20 thru C24	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C25	C: FIXED MICA 75pF 5%	0140-7505
C26	C: FIXED FILM 0.047uF 10% 200V	0120-4731
C27,C28	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C29	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C30 thru C34	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C35	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C36 thru C38	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C39	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C40 thru C45	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C46	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C47	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C48,C49	C: FIXED MICA 15pF 5%	0140-1505
C50,C51	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C52	C: FIXED MICA 27pF 5%	0140-2705
C53 thru C57	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C58	C: FIXED CERAMIC 0.1uF 50V	0151-0015
C59	C: FIXED POLY 2200pF 2.5% 160V	0130-2222
C60	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C61	C: FIXED TANT 10uF 16V	0185-0007
C62,C63	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C64,C65	C: FIXED TANT 10uF 16V	0185-0007
C66	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C67	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C68	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C69	C: FIXED TANT 10uF 16V	0185-0007
C70	C: FIXED POLY 3900pF 2.5% 160V	0130-3922
C71	C: FIXED POLY 560pF 2.5% 160V	0130-5612
C72 thru C74	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C75	C: FIXED TANT 10uF 16V	0185-0007
C76	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C77,C78	C: FIXED MICA 24pF 5%	0140-2405
C79 thru C86	C: FIXED CERAMIC 0.01uF 100V	0151-0003

A1 BOARD AMMA-1, rev. A, cont.

Reference Designation	Description	Part Number
C87,C88	C: FIXED TANT 4.7uF 10V	0185-0001
C89,C90	C: FIXED TANT 10uF 16V	0185-0007
C91	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C92 thru C98	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C99	C: FIXED TANT 6.8uF 25V	0185-0002
C100	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C101	C: FIXED CERAMIC 0.1uF 50V	0151-0015
C102	C: FIXED CERAMIC 0.1uF 50V	0151-0006
CR1,CR2	DIODE: 1N4006	1900-0016
CR3	DIODE: 1N4446	1900-0002
CR4	DIODE: 1N277 GERMANIUM	1900-0001
CR5	DIODE: 1N4446	1900-0002
CR6	DIODE: 1N277 GERMANIUM	1900-0001
CR7 thru CR24	DIODE: 1N4446	1900-0002
CR25	DIODE: 1N4006	1900-0016
CR26,CR27	DIODE: 1N755A	1900-0023
HDR1	HEADER: 24 PIN	0361-0024
J1	CONNECTOR: "D" SINGLE 25 PIN FEMALE	0360-0035
J2	CONNECTOR: "D" SINGLE 15 PIN FEMALE	0360-0032
J4	CONNECTOR: "D" SINGLE 9 PIN MALE	0360-0036
J5	CONNECTOR: "XLR" MALE	0360-0046
J6	CONNECTOR: "XLR" FEMALE	0360-0045
J7	CONNECTOR: "XLR" MALE	0360-0046
J10,J11	SOCKET: IC 14 PIN	1200-0011
P1,P2	PLUG: 3 PIN, PC MOUNT	0365-0030
--	JUMPER: 2 PIN (USED WITH P1 & P2)	0365-0028
Q1 thru Q3	TRANSISTOR: 2N4401	1850-0028
R1	R: METAL FILM 220k 2% 1/4W	0751-2242
R2	R: VAR COMP 5k, 10 TURN	2100-0020
R3,R4	R: METAL FILM 9.09k 1%	0721-9091
R5	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R6	R: METAL FILM 29.4k 1%	0721-2942
R7	R: METAL FILM 12.1k 1%	0721-1212
R8	R: METAL FILM 38.3k 1%	0721-3832
R9	R: METAL FILM 10k 2% 1/4W	0751-1032
R10,R11	R: METAL FILM 10.0k 1%	0721-1002
R12	R: METAL FILM 15.0k 1%	0721-1502
R13	R: VAR COMP 10k, 10 TURN	2100-0024
R14	R: METAL FILM 29.4k 1%	0721-2942
R15	R: VAR COMP 1k, 10 TURN	2100-0021
R16	R: METAL FILM 9.53k 1%	0721-9531
R17	R: METAL FILM 10.0k 1%	0721-1002
R18	R: METAL FILM 5.1k 2% 1/4W	0751-5122

A1 BOARD AMMA-1, rev. A, cont.

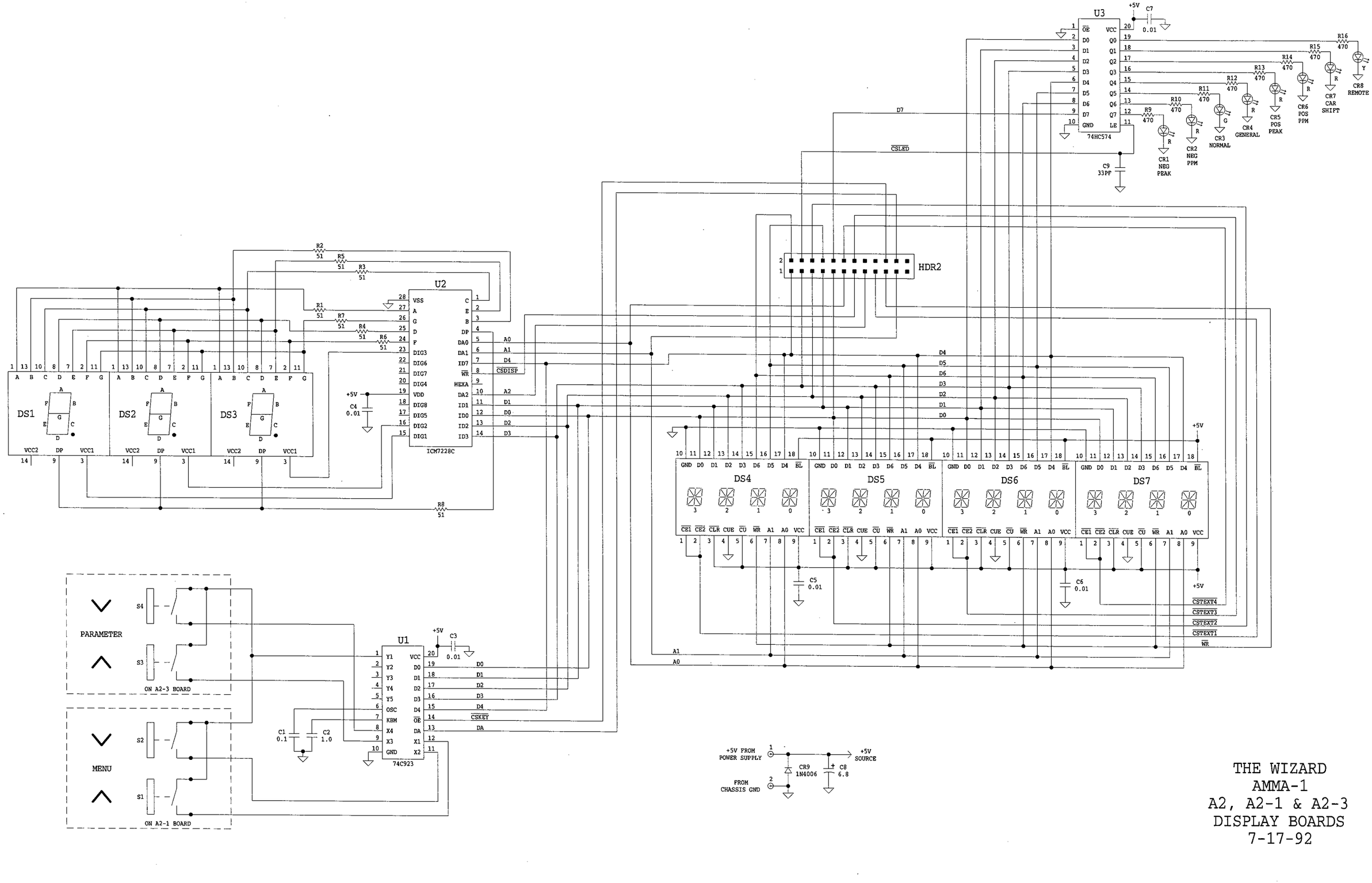
Reference Designation	Description	Part Number
R19	R: METAL FILM 3.9k 2% 1/4W	0751-3922
R20	R: FIXED CARBON 5.6M 5% 1/4W	0683-5655
R21,R22	R: METAL FILM 100 2% 1/4W	0751-1012
R23	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R24	R: METAL FILM 3.9k 2% 1/4W	0751-3922
R25	R: FIXED CARBON 5.6M 5% 1/4W	0683-5655
R26,R27	R: METAL FILM 100 2% 1/4W	0751-1012
R28	R: METAL FILM 220k 2% 1/4W	0751-2245
R29	R: VAR COMP 10k, 10 TURN	2100-0024
R30	R: METAL FILM 6.19k 1%	0721-6191
R31	R: METAL FILM 4.99k 1%	0721-4991
R32	R: METAL FILM 9.53k 1%	0721-9531
R33	R: VAR COMP 1k, 10 TURN	2100-0021
R34,R35	R: METAL FILM 10.0k 1%	0721-1002
R36	R: METAL FILM 3k 2% 1/4W	0751-3022
R37	R: METAL FILM 10.0k 1%	0721-1002
R38	R: METAL FILM 19.1k 1%	0721-1912
R39	R: METAL FILM 12.1k 1%	0721-1212
R40	R: FIXED CARBON 22M 5% 1/4W	0683-2265
R41	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R42	R: METAL FILM 15.0k 1%	0721-1502
R43	R: METAL FILM 27k 2% 1/4W	0751-2732
R44	R: METAL FILM 38.3k 1%	0721-3832
R45	R: METAL FILM 43k 2% 1/4W	0751-4332
R46	R: METAL FILM 90.9k 1%	0721-9092
R47	R: METAL FILM 120k 2% 1/4W	0751-1242
R48	R: METAL FILM 180k 2% 1/4W	0751-1842
R49	R: METAL FILM 270k 2% 1/4W	0751-2742
R50	R: METAL FILM 47k 2% 1/4W	0751-4732
R51	R: METAL FILM 10.0k 1%	0721-1002
R52	R: METAL FILM 9.53k 1%	0721-9531
R53	R: METAL FILM 10.0k 1%	0721-1002
R54	R: METAL FILM 3k 2% 1/4W	0751-3022
R55	R: METAL FILM 10.0k 1%	0721-1002
R56	R: METAL FILM 19.1k 1%	0721-1912
R57	R: METAL FILM 12.1k 1%	0721-1212
R58	R: METAL FILM 49.9k 1%	0721-4992
R59	R: METAL FILM 7.50k 1%	0721-7501
R60	R: VAR COMP 1k, 10 TURN	2100-0021
R61	R: METAL FILM 7.50k 1%	0721-7501
R62	R: METAL FILM 100k 1%	0721-1003
R63	R: METAL FILM 7.50k 1%	0721-7501
R64	R: METAL FILM 220k 2% 1/4W	0751-2242
R65,R66	R: METAL FILM 10.0k 1%	0721-1002
R67	R: METAL FILM 12.1k 1%	0721-1212
R68	R: VAR COMP 1k, 10 TURN	2100-0021
R69	R: METAL FILM 100k 1%	0721-1003
R70,R71	R: METAL FILM 49.9k 1%	0721-4992

A1 BOARD AMMA-1, rev. A, cont.

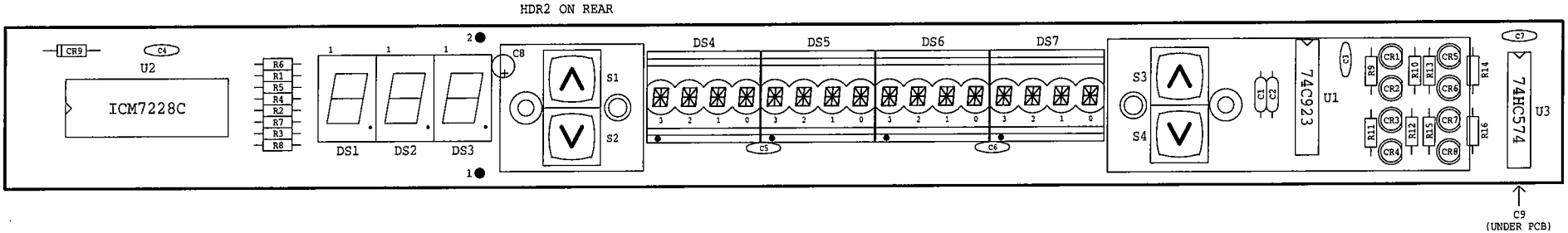
Reference Designation	Description	Part Number
R72	R: METAL FILM 10.0k 1%	0721-1002
R73	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R74 thru R77	R: METAL FILM 3k 2% 1/4W	0751-3022
R78 thru R81	R: METAL FILM 200 2% 1/4W	0751-2012
R82	R: METAL FILM 1k 2% 1/4W	0751-1022
R83	R: METAL FILM 10 2% 1/4W	0751-1002
R84	R: METAL FILM 56k 2% 1/4W	0751-5632
R85 thru R87	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R88	R: FIXED CARBON 10M 5% 1/4W	0683-1065
R89,R90	R: METAL FILM 10k 2% 1/4W	0751-1032
R91 thru R98	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R99,R100	R: METAL FILM 910 2% 1/4W	0751-9112
R101	R: METAL FILM 15.0k 1%	0721-1502
R102	R: METAL FILM 38.3k 1%	0721-3832
RL1	RELAY: JWD-171-12	1600-0009
RL2	RELAY: T84S17D214-05	1600-0008
RL3 thru RL10	RELAY: JWD-107-1	1600-0007
RN1	R: NETWORK 6 PIN 10k	0906-1032
U1	IC: MC34082	1826-0042
U2	IC: DAC8043	1830-0001
U3	IC: NE5532	1826-0037
U4	IC: SSM2142P	1827-0005
U5 thru U8	IC: MC34082	1826-0042
U9	IC: LM318	1826-0010
U10	IC: MC34082	1826-0042
U11	IC: DG408 (was IH6108)	1827-0002
U12	IC: TLO71CP	1826-0004
U13	IC: 74HC4316	1822-0051
U14	IC: PKD01	1827-0001
U15	IC: LM318	1826-0010
U16	IC: PKD01	1827-0001
U17	IC: SMP-04	1827-0004
U18	IC: 74HC4051	1822-0063
U19	IC: 79L05CP	1826-0017
U20	IC: TLO71CP	1826-0004
U21	IC: SSM2143P	1827-0006
U22	IC: TLO71CP	1826-0004
U23	IC: DAC8043	1830-0001
U24	IC: NE5532	1826-0037
U25	IC: NE5534	1826-0025
U26	IC: SSM2142P	1827-0005
U27,U28	IC: HCPL2531	1823-0005
U29	IC: 78L05CP	1826-0012
U30	IC: AD7578	1830-0002

A1 BOARD AMMA-1, rev. A, cont.

Reference Designation	Description	Part Number
U31	IC: 78L05CP	1826-0012
U32	IC: 79L05CP	1826-0017
U33	IC: 74HC02A	1822-0040
U34	IC: 74HC573	1822-0052
U35	IC: MC68HC11E1	1840-0010
U36	IC: MC34064	1826-0048
U37	IC: 74HC138	1822-0047
U38	IC: 74HC00	1822-0039
U39	IC: 74HC573	1822-0052
U40	IC: 74HC14A	1822-0042
U41	IC: AMMA-1 EPROM	1840-0003D
U42	IC: 74HC138	1822-0047
U43	IC: MOSEL MS6264L-10CP(or equivalent)	1840-0005
U44	IC: MAX232	1823-0001
U45	IC: DS8921	1823-0007
U46	IC: 74HC138	1822-0047
U47 thru U49	IC: 74HC574	1822-0053
U50,U51	IC: 74HC125	1822-0045
U52	IC: 74HC574	1822-0053
U53	IC: CA3081	1826-0027
U54	IC: 78L05CP	1826-0012
Y1	XTAL: 8 MHz	0411-0005
--	SHUNT PLUG: RS-232/422	0365-0043



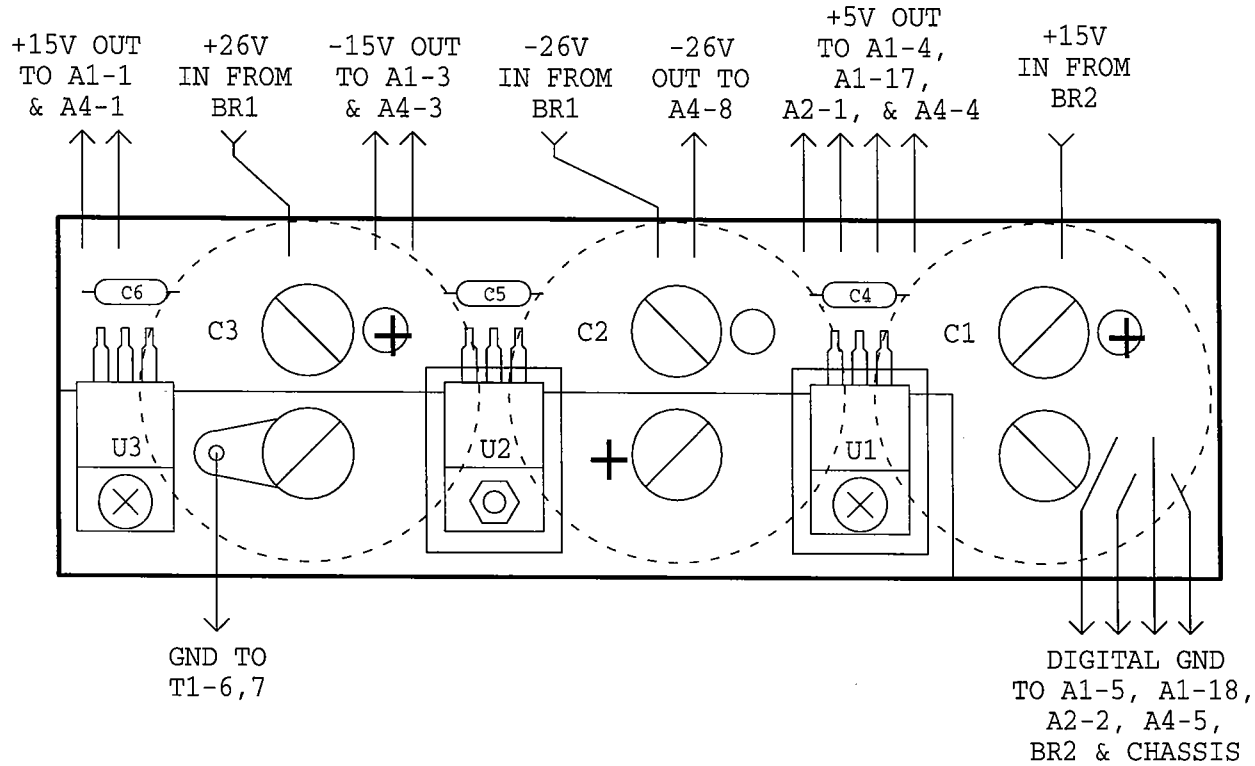
THE WIZARD
AMMA-1
A2, A2-1 & A2-3
DISPLAY BOARDS
7-17-92



THE WIZARD
AMMA-1 A2 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS

A2 BOARD AMMA-1

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 C7	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C8	C: FIXED TANT 6.8uF 25V	0185-0002
C9	C: FIXED MICA 33pF 5%	0142-3305
CR1,CR2	LED: RED MV5053	1910-0001
CR3	LED: GREEN CMD5453	1910-0003
CR4 thru CR7	LED: RED MV5053	1910-0001
CR8	LED: YELLOW MV5353	1910-0002
CR9	DIODE: 1N4006	1900-0016
DS1 thru DS3	DISPLAY: HP5082-7651	1930-0007
DS4 thru DS7	DISPLAY: HPDL2416	1930-0005
HDR2	HEADER: 24 PIN	0361-0024
R1 thru R8	R: METAL FILM 51 2% 1/4W	0751-5102
R9 thru R16	R: METAL FILM 470 2% 1/4W	0751-4712
S1 thru S4	SWITCH: PUSHBUTTON, MOMENTARY (ON A2-1 & A2-3 BOARDS)	3105-0001
U1	IC: 74C923	1823-0006
U2	IC: ICM7228C	1823-0002
U3	IC: 74HC574	1822-0053



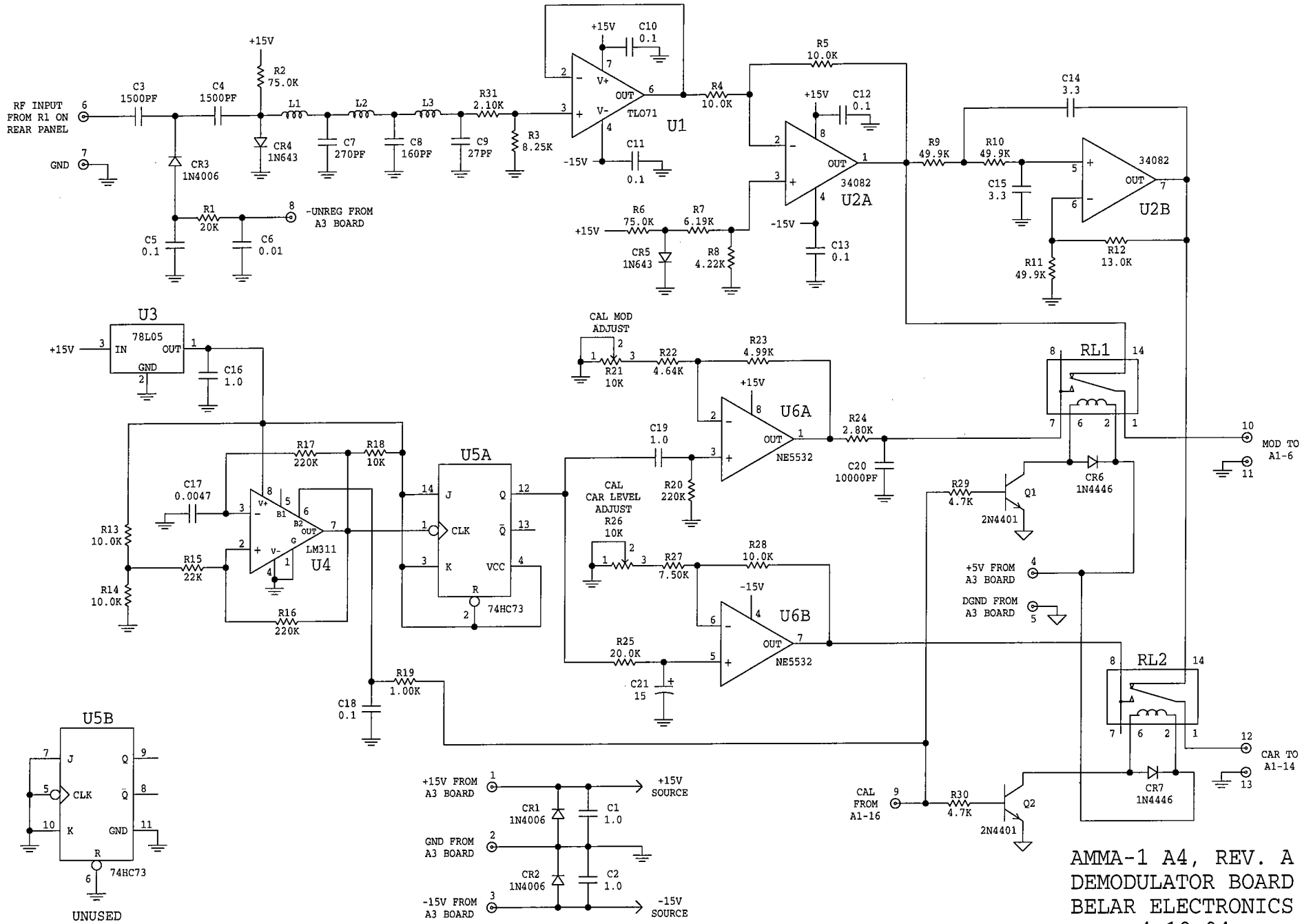
AMMA-1
A3 POWER SUPPLY BOARD
COMPONENT LAYOUT

(ONLY USED PRIOR TO SERIAL NUMBER 510113)

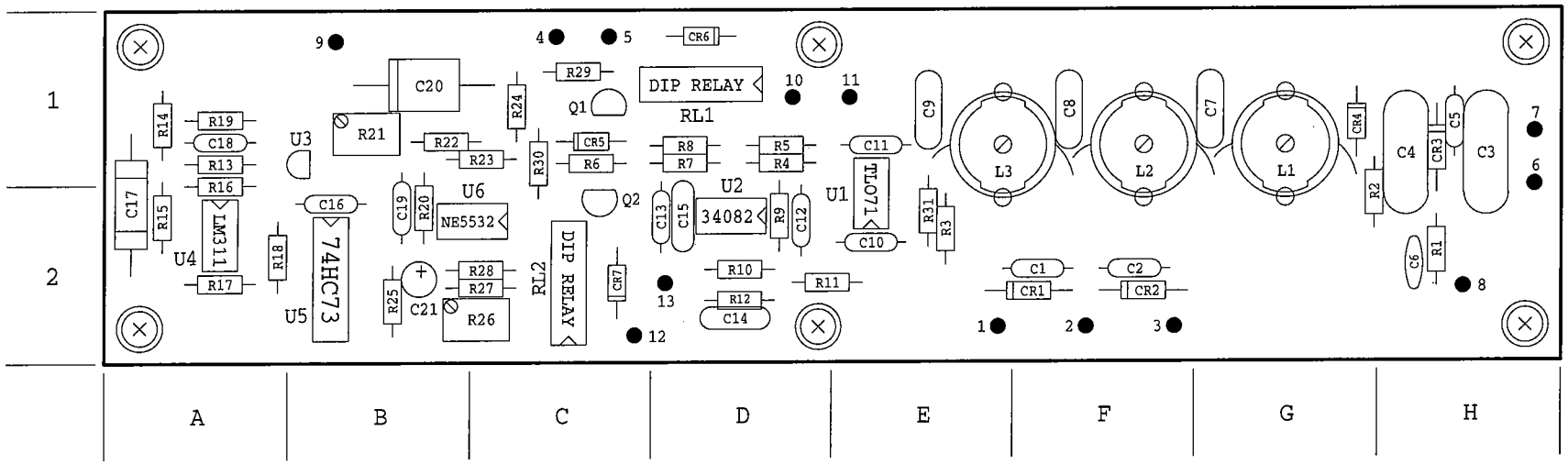
A3 BOARD AMMA-1

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)



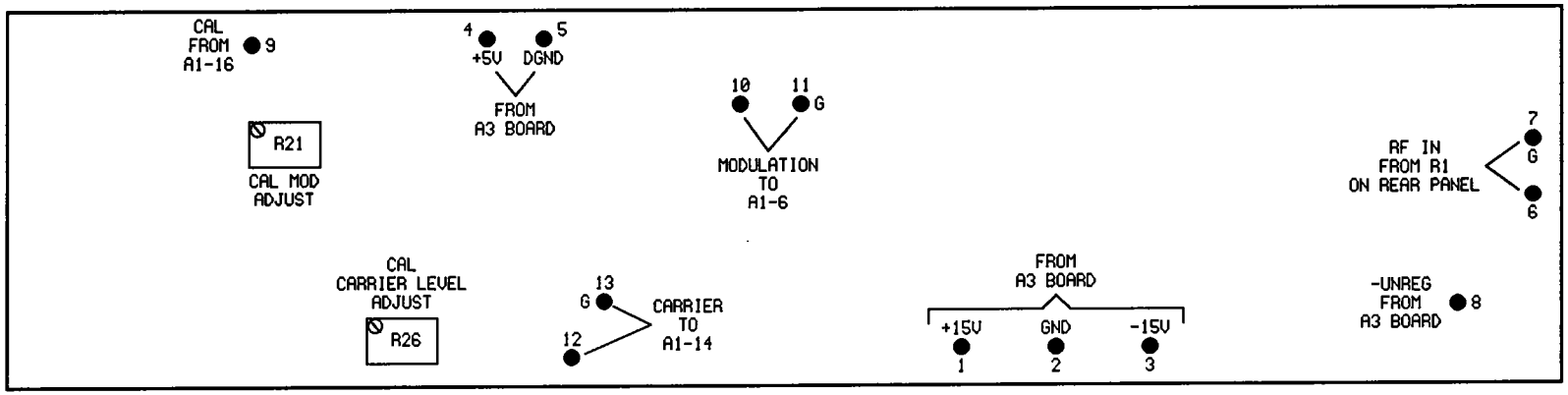
AMMA-1 A4, REV. A
DEMODULATOR BOARD
BELAR ELECTRONICS
4-18-94



AMMA-1 A4 BOARD
REV. A
COMPONENT LAYOUT
BELAR ELECTRONICS

AMMA-1 A4 BOARD REV A
PART LOCATIONS

Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc	
C1	F2	C19	B2	R1	H2	R19	A1	U1	E2	11	E1
C2	F2	C20	B1	R2	G2	R20	B2	U2	D2	12	C2
C3	H1	C21	B2	R3	E2	R21	B1	U3	B1	13	D2
C4	H1			R4	D1	R22	B1	U4	A2		
C5	H1	CR1	F2	R5	D1	R23	C1	U5	B2		
C6	H2	CR2	F2	R6	C1	R24	C1	U6	B2		
C7	G1	CR3	H1	R7	D1	R25	B2				
C8	F1	CR4	G1	R8	D1	R26	C2	pins			
C9	E1	CR5	C1	R9	D2	R27	C2	1	E2		
C10	E2	CR6	D1	R10	D2	R28	C2	2	F2		
C11	E1	CR7	C2	R11	D2	R29	C1	3	F2		
C12	D2			R12	D2	R30	C1	4	C1		
C13	D2	L1	G1	R13	A1	R31	E2	5	C1		
C14	D2	L2	F1	R14	A1			6	H1		
C15	D2	L3	E1	R15	A2	RL1	D1	7	H1		
C16	B2			R16	A1	RL2	C2	8	H2		
C17	A2	Q1	C1	R17	A2			9	B1		
C18	A1	Q2	C2	R18	A2			10	D1		



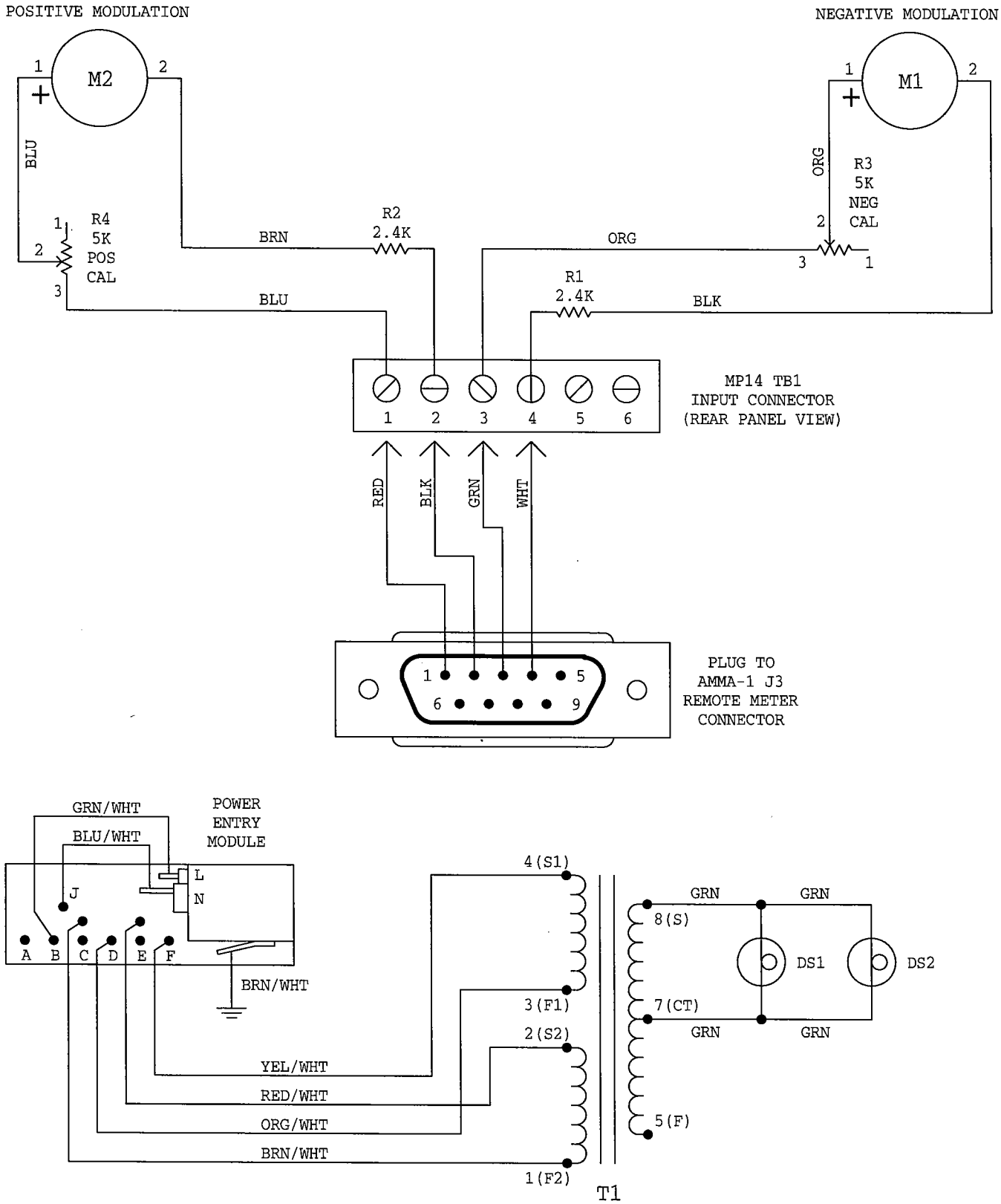
AMMA-1 A4 BOARD
REV. A
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A4 BOARD AMMA-1, Rev. A

Reference Designation	Description	Part Number
C1,C2	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C3,C4	C: FIXED MICA 1500pF 5%	0141-1525
C5	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C6	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C7	C: FIXED MICA 270pF 5%	0140-2715
C8	C: FIXED MICA 160pF 5%	0140-1615
C9	C: FIXED MICA 27pF 5%	0140-2705
C10 thru C13	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C14,C15	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C16	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C17	C: FIXED FILM 0.0047uF 10% 200V	0120-4721
C18	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C19	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C20	C: FIXED POLY 10,000pF 2.5% 160V	0130-1032
C21	C: FIXED TANT 15uF 15V	0185-0003
CR1 thru CR3	DIODE: 1N4006	1900-0016
CR4,CR5	DIODE: 1N643	1900-0017
CR6,CR7	DIODE: 1N4446	1900-0002
L1	INDUCTOR:	Belar
L2	INDUCTOR:	Belar
L3	INDUCTOR:	Belar
Q1,Q2	TRANSISTOR: 2N4401	1850-0028
R1	R: METAL FILM 20k 2% 1/4W	0751-2032
R2	R: METAL FILM 75.0k 1%	0721-7502
R3	R: METAL FILM 8.25k 1%	0721-8251
R4,R5	R: METAL FILM 10.0k 1%	0721-1002
R6	R: METAL FILM 75.0k 1%	0721-7502
R7	R: METAL FILM 6.19k 1%	0721-6191
R8	R: METAL FILM 4.22k 1%	0721-4221
R9 thru R11	R: METAL FILM 49.9k 1%	0721-4992
R12	R: METAL FILM 13.0k 1%	0721-1302
R13,R14	R: METAL FILM 10.0k 1%	0721-1002
R15	R: METAL FILM 22k 2% 1/4W	0751-2232
R16,R17	R: METAL FILM 220k 2% 1/4W	0751-2242
R18	R: METAL FILM 10k 2% 1/4W	0751-1032
R19	R: METAL FILM 1.00k 1%	0721-1001
R20	R: METAL FILM 220k 2% 1/4W	0751-2242
R21	R: VAR COMP 10k, 10 TURN	2100-0024
R22	R: METAL FILM 4.64k 1%	0721-4641
R23	R: METAL FILM 4.99k 1%	0721-4991
R24	R: METAL FILM 2.80k 1%	0721-2801
R25	R: METAL FILM 20.0k 1%	0721-2002

A4 BOARD AMMA-1, Rev. A, CONT.

Reference Designation	Description	Part Number
R26	R: VAR COMP 10k, 10 TURN	2100-0024
R27	R: METAL FILM 7.50k 1%	0721-7501
R28	R: METAL FILM 10.0k 1%	0721-1002
R29,R30	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R31	R: METAL FILM 2.10k 1%	0721-2101
RL1,RL2	RELAY: JWD-172-1	1600-0006
U1	IC: TLO71	1826-0004
U2	IC: MC34082	1826-0042
U3	IC: 78L05CP	1826-0012
U4	IC: LM311	1826-0009
U5	IC: 74HC73	1822-0044
U6	IC: NE5532	1826-0037



NOTES:

1. METERS ARE SHOWN FROM REAR.
2. SCHEMATIC SHOWS MP-14 CABLE.

MP-14 CALIBRATION:

1. TURN ON THE AMMA-1 CALIBRATOR.
2. ONCE THE AMMA-1 DISPLAY HAS SETTLED, ADJUST R1 AND R2 ON THE REAR OF THE METER PANEL UNTIL BOTH METERS READ 100%.

MP-14
AMMA-1 AM WIZARD
REMOTE METER PANEL
BELAR ELECTRONICS
6-24-99

MP-14 PARTS LIST

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

MP-14 LINE VOLTAGE SELECTION PROCEDURE

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