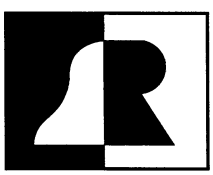
Model FMS-2
FM STEREO MODULATION MONITOR

Guide to Operations

Rev 10-8-02



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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 Information

1-1 General Description

The Belar FMS-2 Stereo Modulation Monitor (FCC ID: C4J9W1FMS-2) is an all solid state stereo demodulator designed to operate in conjunction with the Belar FMM-2 FM Modulation Monitor to provide all of the stereo monitoring requirements outlined in part 73 of the Federal Communications Commission's Rules and Regulations for FM radio stations engaged in multiplex stereo transmission. In addition, the FMS-2 may be used as a low distortion, low noise FM stereo demodulator for driving audio monitors and associated test equipment. The FMS-2 used in conjunction with the FMM-2, provides complete monitoring and test functions to meet the daily requirements for stereo monitoring and provides additional facilities for proof-of-performance measurements to insure maximum performance from FM stereo transmission systems.

1-2 Physical Description

The FMS-2 is constructed on a standard EIA 5¼ x 19 inch rack mount panel. Operational controls are front panel mounted. Factory adjustments are located within the unit. The composite baseband input, power connection, monitor outputs and remote outputs are located at the rear of the FMS-2 on individual connectors and a card edge connector.

1-3 Electrical Description

The FMS-2 is a solid state stereo demodulator designed to accurately demodulate a stereo composite baseband signal. Various metering and testing provisions are contained within the monitor to measure the stereo signal characteristics. These provisions include two selectable semi-peak or average reading meters; function switches to measure total modulation, L+R modulation, L - R modulation, pilot carrier level, regenerated pilot phase null , 38 kHz rejection, left channel modulation, right channel modulation, auto-ranging meter controls and a de-emphasis switch. Displays include two meter range indicators and a pilot indicator. Outputs obtained from the monitor include individual left and right channel test jacks, scope jacks, balanced and unbalanced audio outputs, composite output (less pilot) jack, and a pilot frequency test jack. Remote outputs include a +5Vdc source, a pilot indicator along with left and right meters.

As a test instrument, the FMS-2 permits the following measurements:

1. Crosstalk into the L+R channel
2. Crosstalk into the L - R channel
3. Suppression of the 38 kHz carrier
4. Separation - right into left channel
5. Separation - left into right channel
6. Left channel noise
7. Right channel noise
8. Left channel response
9. Right channel response
10. Left and right channel distortion (with appropriate analyzer)

1-4 Electrical and Mechanical Specifications

Input Level . . . . . 4.2 V pk-pk (3.5 V pk-pk Opt) composite
Input Impedance . . . . . 220kΩ, unbalanced, BNC connector

Metering:

Left Meter . . . . . selectable: total modulation, L+R, pilot or left channel modulation
Right Meter . . . . . selectable: pilot phase, L - R, 38 kHz suppression or right channel modulation

Auto Range Attenuator . . . . . 0-60 dB in 10 dB steps, calibrated full range readings: +3 to -80 dB

Modulation Meter Range . . . . . 0 to 133%

Modulation Meter Accuracy . . . . . better than 2% over entire range

Pilot Meter Accuracy . . . . . 0.5% (6% to 13% pilot modulation)

Separation:

Left to Right . . . . . 70 dB, 10 Hz to 15 kHz
Right to Left . . . . . 70 dB, 10 Hz to 15 kHz

Crosstalk:

L+R to L - R	85 dB min
L - R to L+R	85 dB min
SCA to L+R	Greater than 90 dB
SCA to L - R	Greater than 90 dB
SCA Interference	Greater than 90 dB

Outputs:

Left and Right Channel Program Audio	+10 dBm, 600Ω, balanced
Left and Right Channel Program Test	5 Vrms, 10kΩ, unbalanced
Left and Right Channel Scope Outputs	2.5 Vrms (nominal), 10kΩ, unbalanced
Pilot	3 V pk-pk, 27kΩ source
Composite (less pilot)	4 V pk-pk, 2kΩ source

Audio Output Specifications:

Frequency Response, Left and Right	±0.25 dB, 50-15,000 Hz
Signal to Noise Ratio, Left and Right	90 dB min
Harmonic Distortion	0.01% max, 50-15,000 Hz
Intermodulation Distortion	0.01% max (SMPTE)

Remote Outputs:

Left Meter, Right Meter, Pilot Indicator	for interface to model MP-8 remote meter panel (opt)

Dimensions	5¼" H X 10½" D X 19" W (EIA Rack Mount)
Power Consumption	15 watts, 115/230 Vac 50/60 Hz
Shipping Weight	17 lbs

1-5 Accessories

The Belar FMS-2 Stereo Modulation Monitor may be used for the remote monitoring of a stereo FM transmitter with the Belar MP-8 meter panel, which also provides remote monitoring of the FMM-2 FM Modulation Monitor. The MP-8 provides a left and right remote meter, along with a pilot indicator LED.

2 Installation

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 damage claim or for possible future use.

The FMS-2 is shipped with an instruction book, three wire line cord, four beige rack mount screws, coaxial cable patch cord, and a 10 position dual readout remote connector.

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, 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.

2-4 Preparation for Use

The FMS-2 Stereo Modulation Monitor is designed to be mounted in a standard 19-inch rack. The monitor may be mounted above or below the companion Model FMM-2 FM Modulation Monitor. When the monitor 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 FMS-2. In no instance should the ambient chassis temperature be allowed to rise above 50°C (122°F).

Units beginning with serial number 173181:
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 5 mm x 20 mm type GMA-3, 3 AMP-250 V (UL/CSA) or T3.15 A-250 V (IEC) fuse only. A spare fuse is stored in the removable fuse compartment.

Units with serial number 171692 to 173180:
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 115Vac operation, "240" for 230Vac operation. The "100" and "220" positions on the bottom of the board are not used.) Reinsert the board into the power entry module, reinstall the fuse , close the fuse door, and plug the line cord back in.

Units with serial number 171691 and lower:
Unplug the line cord. Slide the switch (S1) to the 115V or 230V position. Plug the line cord back in.

The Model FMS-2 accepts a composite baseband signal from the FMM-2 FM Modulation Monitor. Interconnect the FMM-2 to the FMS-2 with the cable supplied (an 18 inch 50Ω coaxial cable) between the FMM-2 stereo output jack (J5) and the FMS-2 input jack (J2). When using the Belar FMM-1 FM Frequency and Modulation Monitor, connect this cable to the FMM-1 stereo composite output jack (J1).

If desired, connect an external stereo aural monitoring amplifier to remote connector pins 2 and 3 (right) and pins 5 and 6 (left). These are balanced 600Ω outputs. Pins 1 (right) and 4 (left) may also be used, but note that these outputs are 10kΩ unbalanced, with pins A and D serving as the ground connection.

Remote meters may be connected to pins 7 (right meter) and 8 (left meter), with pins H and J serving as ground connections. The remote meter circuits should have a total loop resistance of 3750Ω. To remotely connect the pilot indicator, a current limiting resistor, typically 160Ω, should be connected in series with the remote LED connected to pin 9. A +5 Vdc source is provided on pin 10.

The Model MP-8 Remote Meter Panel contains illuminated left and right remote meters and a pilot LED along with the necessary meter calibration and LED current limiting resistors.

2-5 Interconnections and Controls

Model FMS-2 Rear Panel Jacks

JACK	Function
J2	Composite input, 4.2V pk-pk, 220kΩ
J3	Pilot output, 3V pk-pk, 27kΩ source
J4	Composite output, less pilot; 4V pk-pk, 2kΩ source
J5	Right channel test audio output, de-emphasized, 5 Vrms, 10kΩ source
J6	Left channel test audio output, de-emphasized, 5 Vrms, 10kΩ source
J7	Right channel scope output: follows right meter function switch, 2.5 Vrms (nominal), 10kΩ source
J8	Left channel scope output: follows left meter function switch, 2.5 Vrms (nominal), 10kΩ source

NOTE: WE RECOMMEND COAXIAL CABLES 36" OR SHORTER WHEN CONNECTING THE FMS-2 TO THE FMM-2 MONITOR AND/OR SCA MONITOR.

Model FMS-2 Remote Connector

PIN	Function
1	Right channel audio output, 5 Vrms, 10kΩ, unbalanced (de-emphasized)
2	Right channel audio output, +10 dBm, 600Ω, balanced (de-emphasized) (-)
3	Right channel audio output, +10 dBm, 600Ω, balanced (de-emphasized) (+)
4	Left channel audio output, 5 Vrms, 10kΩ, unbalanced (de-emphasized)
5	Left channel audio output, +10 dBm, 600Ω, balanced (de-emphasized) (-)
6	Left channel audio output, +10 dBm, 600Ω, balanced (de-emphasized) (+)
7	Right channel remote meter
8	Left channel remote meter
9	Remote pilot indicator LED
10	+5 Vdc
A - L	Ground

3 Operation

3-1 Initial Operation

1. Place the FMM-2 modulation monitor into normal operation as outlined in the FMM-2 instruction book.

2. Depress the FMS-2 left meter function switch to TOTAL, the right meter function switch to PHASE, the meter selector switch to PEAK, and allow a 15 minute warm-up period.

3. Depress the CAL and SEMI pushbuttons on the FMM-2. The FMM-2 meter and the FMS-2 left meter should read the same (100%). If not, adjust the FMS-2 input level pot (R1 on the A2 board, which is accessible from the chassis rear) until both meters read the same. This adjustment normalizes the FMS-2 with the FMM-2, and will only be necessary during the initial set-up or installation.

4. Depress the OPERate button on the FMM-2, the LEFT and RIGHT meter pushbuttons on the FMS-2 and the monitors are ready for normal operation.

3-2 Normal Operation

To monitor normal stereo programming, it is recommended that the LEFT and RIGHT function switches be depressed to indicate left and right channel levels, with the meter switch PEAK pushbutton depressed.

3-3 Monitor Functions

PILOT INDICATOR - Indicates when the 19 kHz pilot carrier is present on the composite input signal.

LEFT METER - Measures TOTAL, L+R, PILOT or LEFT channel levels, depending on the setting of the **LEFT METER FUNCTION SWITCH:**

TOTAL - When depressed, the LEFT meter indicates the total, composite modulation level.

L+R - When depressed, the LEFT meter indicates the L+R modulation level that is filtered by a 15 kHz low-pass filter.

PILOT - When depressed, the LEFT meter indicates 19 kHz pilot carrier level. With the meter switch in AUTO, the meter circuit will increase in sensitivity to the -20 dB range (X10). Thus with a 9% pilot, the meter will indicate 90% and the range will indicate -20 dB, i.e., 90% divided by 10 (20 dB).

LEFT - When depressed, the LEFT meter indicates the LEFT CHANNEL modulation level.

RIGHT METER - Measures pilot PHASE null, L - R level, 38 kHz suppression or RIGHT channel level, depending on the setting of the **RIGHT METER FUNCTION SWITCH:**

PHASE - When depressed, the RIGHT meter indicates the depth of the 19 kHz null produced by the pilot cancellation circuits. This null is optimized by the front panel PHASE ADJUST control.

L - R - When depressed, the RIGHT meter indicates the L - R modulation level that is filtered by a 23 to 53 kHz band-pass filter.

38 KHZ - When depressed, the RIGHT meter indicates the 38 kHz subcarrier suppression that is filtered by a 37 to 39 kHz bandpass filter.

RIGHT - When depressed, the RIGHT meter indicates the RIGHT CHANNEL modulation level.

METER SWITCH - Selects the mode of operation of the LEFT and RIGHT meters:

PEAK - When the meter switch is depressed to PEAK, both LEFT and RIGHT meters are in the semi-peak reading mode.

AUTO - When the meter switch is depressed to AUTO, both LEFT and RIGHT meters are in the auto-ranging mode. In this mode, the meter sensitivities are individually and automatically adjusted in 10 dB steps to obtain meter readings between -10 dB and +0.5 dB on each range. The algebraic sum of the meter reading and the range indication is the reading. For example, -1 dB indication on the meter with a range indication of -60 dB yields a reading of -61 dB. Note that in the AUTO and HOLD modes, the meter is average reading.

HOLD - When the meter switch is depressed to HOLD, both meter *ranges* are held to their indicated settings.

DE-EMP - When the meter switch is depressed to DE-EMP, both meter readings are de-emphasized in the AUTO or HOLD settings. The PEAK position is not de-emphasized.

LEFT METER RANGE INDICATOR - Indicates the operating range, in -dB, of the LEFT meter. (0 in PEAK AND 0 to -60 dB in AUTO and HOLD).

RIGHT METER RANGE INDICATOR - Indicates the operating range, in -dB, of the RIGHT meter. (0 in PEAK and 0 to -60 dB in AUTO and HOLD).

PHASE ADJUST - Adjusts the depth of the 19 kHz null produced by the pilot cancellation circuits.

NOTE: When making separation measurements, the LEFT and RIGHT functions may be depressed and the meter switch may be depressed to AUTO. Thus a 90% left channel signal may indicate 90% or -1 dB on the LEFT meter, range 0 dB, with a -10 dB indication on the RIGHT meter, range -60 dB. This would yield a left into right separation of 69 dB, i.e., -1 dB minus (-10 dB plus -60 dB).

3-4 Stereo Measurements

TOTAL MODULATION - Depress the LEFT METER FUNCTION switch TOTAL pushbutton and the meter switch PEAK pushbutton. The left meter will measure TOTAL composite modulation.

LEFT CHANNEL MODULATION - Depress the LEFT METER FUNCTION switch to LEFT and the meter switch to PEAK. A fully modulated left channel signal will indicate 90% on the LEFT meter.

RIGHT CHANNEL MODULATION - Depress the RIGHT METER FUNCTION switch to RIGHT and the meter switch to PEAK. A fully modulated right channel signal will indicate 90% on the RIGHT meter.

L+R MODULATION - Depress the LEFT METER FUNCTION switch to L+R and the meter switch to PEAK. A fully modulated left channel only signal will indicate 45% on the LEFT meter. A fully modulated L=R signal will indicate 90% and a fully modulated L - R signal will indicate 0.

L - R MODULATION - Depress the RIGHT METER FUNCTION switch to L - R and the meter switch to PEAK. A fully modulated left channel only signal will indicate 45% on the right meter. A fully modulated L= - R signal will indicate 90% and a fully modulated L = R signal will indicate 0.

PILOT CARRIER MODULATION LEVEL - Depress the LEFT METER FUNCTION switch to PILOT and the meter switch to AUTO. The LEFT meter indicates pilot modulation level automatically normalized with the 100% reading representing 10%

pilot carrier injection. A normal pilot carrier level is 9% (90% on scale) - halfway between the FCC specified 8 to 10%.

38 KHZ SUBCARRIER SUPPRESSION - Apply a 5 to 15 kHz modulating signal to either the left or right channel of the stereo transmitter and adjust the level to 90%. Depress the RIGHT METER FUNCTION switch to 38 KHZ and the meter switch to AUTO. The algebraic sum of the meter reading and the range indicator is the 38 kHz subcarrier suppression normalized to 100% total modulation. For example, a meter reading of -8 dB and a range indicator display of -40 dB yields a 38 kHz suppression of -48 dB below 100% modulation.

STEREO SEPARATION - Apply a 50 to 15 kHz modulating signal to the left channel of the stereo transmitter and adjust the level to 90% as read on the LEFT meter with the LEFT METER FUNCTION switch depressed to LEFT. Depress the RIGHT METER FUNCTION switch to RIGHT and the meter switch to AUTO. The algebraic sum of the meter reading and the range indicator is the separation from left channel into right channel, subtracting 1 dB from the reading since the left channel was set to 90% (-1 dB). For example, a meter reading of -6 dB and a range indicator display at -30 dB yields -36 dB, and subtracting the 1 dB (90% left channel level) provides a separation reading of -35 dB.

CROSSTALK (MAIN TO SUB) - To measure crosstalk from main channel (L+R) into subchannel (L - R), apply an L=R modulating signal to the stereo transmitter and adjust the level for 90% L+R reading with the LEFT METER FUNCTION switch set to L+R and the meter switch to AUTO. Now depress the RIGHT METER FUNCTION switch to L - R. The algebraic sum of the meter reading and the range indicator display is the crosstalk, subtracting 1 dB from the reading since the L+R was set at 90% (-1 dB). Note that since this reading is a function of L being exactly equal to R, the amplitude of one or the other may be adjusted to minimize the reading in the L - R channel. Also note that any harmonic distortion in the L+R channel may appear as a reading in the L - R channel. For example, the second and third harmonics of 15 kHz are 30 and 45 kHz and may appear as a crosstalk reading (2% distortion is only 34 dB down.)

CROSSTALK (SUB TO MAIN) - To measure crosstalk from subchannel (L - R) into main channel (L+R), apply an L= - R modulating signal to the stereo transmitter and adjust the level for 90% L - R reading with the RIGHT METER FUNCTION switch set to L - R and the meter switch to AUTO. Now set the LEFT METER FUNCTION switch to L+R. The algebraic sum of the meter reading and the range indicator is the crosstalk, subtracting 1 dB from the reading since the L - R was set to 90% (-1 dB). Note that since this reading is a function of L being exactly equal to R in amplitude but opposite in phase, the amplitude of one or the other may be adjusted to minimize the reading in the L+R channel. Also note that any distortion in the transmitter's stereo modulator may appear as a reading in the L+R channel.

FREQUENCY RESPONSE - Frequency response may be measured by applying the modulating signal to the transmitter and measuring the input signal level from the audio oscillator with an ac audio voltmeter, such as one contained in a distortion analyzer. For monaural, adjust the level at 400 Hz to indicate the desired modulation as read on the FMM-2, usually 100%, 50% or 25% modulation. Change the frequency of the audio oscillator to all the frequencies to be measured, adjusting the audio oscillator output to keep the total modulation constant. The ac voltmeter indication of the oscillator output should follow the standard FCC 75 μsec de-emphasis curve. Standard modulating frequencies used are 50, 100, 400, 1000, 5000, 7500, 10,000 and 15,000 Hz.

To measure frequency response of the left and right channels, repeat the above steps, but apply the modulating signal to the left and right channels respectively. Standard levels are 99% (90% signal plus 9% pilot), 59% (50% signal plus 9% pilot), and 34% (25% signal plus 9% pilot). Note that 90% signal plus 9% pilot will not add in total modulation to yield exactly 99%. This is because the peaks of the 19 kHz pilot do not occur simultaneously with the peaks of the 38 kHz double sideband L - R signal. The reading is about 1½% lower.

DISTORTION MEASUREMENTS - Distortion measurements may be made by connecting an external distortion analyzer to the L or R TEST audio output on the rear panel and applying a modulating signal to the respective channel of the transmitter. These outputs are de-emphasized. Monaural distortion measurements may be made using the AUDIO TEST jack on the FMM-2 monitor in the same manner.

LEFT CHANNEL NOISE MEASUREMENT - Left channel noise can be measured by applying a 400 Hz modulating signal to the left channel of the transmitter. Adjust the level for 100% modulation with the LEFT METER FUNCTION switch depressed to LEFT and the meter switch depressed to AUTO. Remove the modulation, and the resultant will be the left channel noise figure as measured on the left meter and the meter range indicator.

Left channel noise may also be measured using the L TEST audio output jack on the rear panel. This output is de-emphasized. Apply a 400 Hz modulating signal to the left channel of the transmitter and adjust the level for 100% modulation as before. Normalize the voltmeter in the distortion analyzer, remove the modulation, and take the noise reading in the conventional manner.

RIGHT CHANNEL NOISE MEASUREMENT - Right channel noise may be measured as above by substituting right for left.

INTERMODULATION - Intermodulation may be measured with FMS-2 by using the internal L - R and 38 kHz bandpass filters. The principle of the measurement is that

when two tones are used to modulate a transmitter whose stereo modulator is non-linear, difference frequencies will be produced that are equal in frequency to the difference between the two modulating frequencies. These difference frequencies appear in the L+R channel in addition to appearing as sidebands around 38 kHz.

The ratio of the desired sidebands (due to modulation) to the unwanted sidebands (due to the difference frequencies) is the intermodulation. The amplitudes of the desired sidebands are measured with the L - R filter and the amplitudes of the unwanted sidebands are measured with the 38 kHz filter. The frequencies of the two modulating signals must be greater than 5 kHz so that the 38 kHz filter will reject the desired sidebands. The difference between the two modulating signals must be less than 1200 Hz so that the 38 kHz filter will pass the unwanted sidebands.

For example, apply a 10 kHz modulating signal to the left channel, adjusting its level for 90% left channel modulation. Apply an 11 kHz modulating signal to the right channel, adjusting its level for 90% right channel modulation. Depress the RIGHT METER FUNCTION switch to L - R and the meter switch to AUTO and note the reading on the RIGHT meter. Depress the RIGHT METER FUNCTION switch to 38 KHZ and the algebraic sum of the meter reading and the range indicator is the measurement of the unwanted sidebands. The difference between the L - R and 38 kHz readings is the ratio between the desired sidebands and unwanted sidebands and is the intermodulation between the left and right channels.

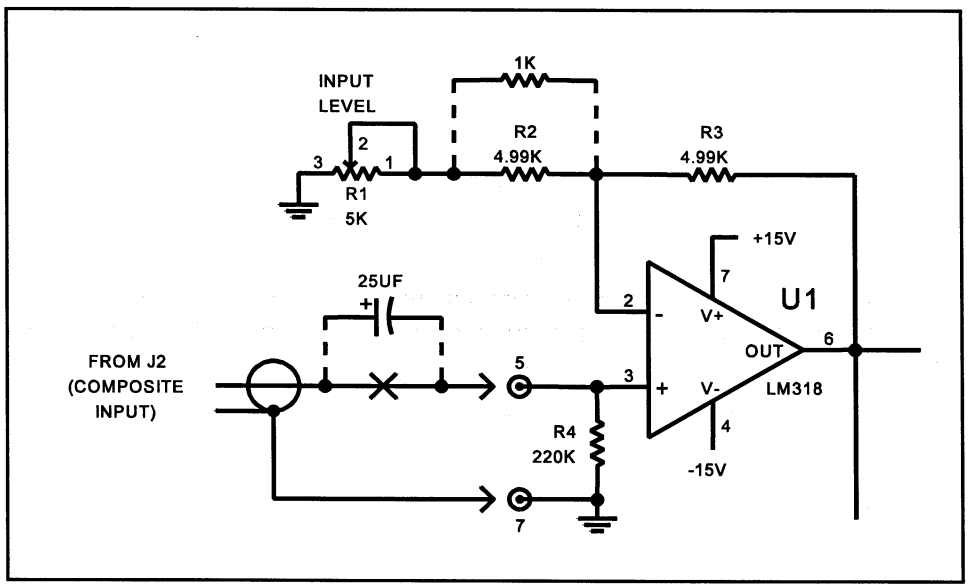
The dB difference can easily be converted to an IMD percentage, i.e., -40 dB is 1%, -60 dB is 0.1%, etc. There are no standards for this measurement, but it is a useful test since harmonic distortion of a stereo signal above 5 kHz is filtered out by the 15 kHz filters, rendering a harmonic distortion test invalid.

3-5 Field Changes and Modifications

1. When the FMS-2 is to be used with an FMM-1 Frequency and Modulation Monitor, and this was not specified when ordered, the FMS-2 input gain must be changed to accept the lower composite output level of the FMM-1, and allow for proper normalization of the FMS-2. (If specified when ordered, this modification will be done at the factory.)

   The modification is accomplished by paralleling a 1kΩ ¼ watt or ½ watt resistor across R2 on the A2 board, and inserting a 25 μF, 10 volt capacitor between pin 5 on the A2 board and the lead from J2 on the rear panel as shown (see schematic below).

   The normalization adjustment would then be performed as described in section 3-1, steps 3 and 4, substituting FMM-1 for FMM-2 in the instructions. Note that the FMM-1 has no SEMI button.



Schematic for modifying FMS-2 to be used with the Belar FMM-1

2. The FMS-2 standard audio de-emphasis curve (75 μsec) may be changed to a 50 μsec de-emphasis curve by replacing C20 and C27 (3900 pF) on the A2 circuit board with 2600 pF, 2.5% polystyrene capacitors, and by moving jumpers P1 and P2 on the A1 board, as shown in the Connections and Adjustment diagram in *Section 6.*

4 Maintenance

4-1 Auto-ranging Voltmeter Set-Up Procedure, A1 Board

1. Place monitor in the PEAK mode. Remove the green/white wire from the left channel input to the auto-ranging voltmeter (pin 5). With an audio oscillator, apply a 1 kHz signal at 0.55 Vrms to the left channel input (pin 5). Adjust the *Left Channel Gain* trimmer (R49) for a 100% indication on the left channel meter. Similarly, remove the orange/white wire from the right channel input (pin 13) and apply the 0.55 Vrms 1 kHz signal. Adjust the *Right Channel Gain* trimmer (R117) for a 100% indication on the right meter.

2. With DE-EMPhasis switched off (button out), apply a 1 kHz audio signal to the left channel input (pin 5). Adjust the *Left Channel Average Gain* trimmer (R47) so that there is no change in meter indication when switching between PEAK and AUTO (average metering) modes.

3. With the unit in the AUTO mode, apply 1 kHz of sufficient level to the *Left Channel Input* to put the left meter in the "0" dB range. Slowly decrease the level of the audio input just until the unit switches to the -10 dB range. Note the meter reading on the -10 dB range. The desired trip point is 103%, as read on the -10 dB range. Adjust *Left Channel Lower Limit* control (R9) until the meter range change for decreasing audio levels occurs at 103% (as indicated on the lower range).

4. With the unit still in the AUTO mode, apply 1 kHz of sufficient level to the *Left Channel Input* to put the left meter in the -10 dB range. While watching the left meter, slowly increase the audio input level until the range changes from the "-10 dB" range to the "0 dB" range. Note the highest reading reached by the meter in the "-10 dB" range. Adjust the *Left Channel Upper Limit* trimmer (R4) until this highest reading reached for increasing input levels is 113% (as indicated on the lower range).

5. Repeat steps 2 through 5 for the right channel section of the voltmeter card, making appropriate adjustments to the right channel trimmers. The right channel controls and test points are as follows:

   Right Channel Gain Trimmer (R117)
   Right Channel Average Gain Trimmer (R115)
   Right Channel Lower Limit (R77)
   Right Channel Upper Limit (R72)
   Right Channel Input (pin 13)

6. Return the green/white wire to pin 4 and the orange/white wire to pin 13.

4-2 Stereo Demodulator Set-Up Instructions, A2 Board

The following adjustments should be made using a stereo signal generator whose output with a fully modulated FCC composite waveform is 4.24 volts peak-to-peak. All meter readings should be made with the DE-EMPhasis off (button out).

1. Connect the stereo generator to the INPUT jack on the rear panel. Remove modulation on the generator so only pilot is present. Place the metering in AUTO and select PHASE for the right-hand meter. Set the front-panel PHASE adjustment potentiometer to the center of its adjustment range. Adjust both the slug in the fifth inductor (L5, nearest the front panel) of the *Pilot Cancellation Filter* and the *Pilot Null* trimmer (R25) on the stereo demodulator board for a minimum reading on the right-hand meter.

2. With a clip lead, short the junction (pin 8) between the *Pilot Null* trimmer (R25) and the *19 kHz Summing Resistor* (R27) to ground. Apply pilot only to the monitor. Place the metering in the AUTO mode and the right meter into the PHASE position. Remove the *Composite Output* end of the wire (pin 24) connecting the *Composite Output*to the *19 kHz Test Filter Input*. Connect the loose end of this wire alternately to the two *Switch Buffer Output* pins (pins 12 & 13). Adjust the *19 kHz Phase* trimmer (R96) until the meter reading in the PHASE position is the same for both of the *Switch Buffer Outputs*. Return the wire to connect the *19 kHz Test Filter* to the *Composite Output* and remove the ground jumper from the *19 kHz Summing Resistor*.

3. Turn pilot on and apply a 67 kHz sine wave at 10% injection through the SCA input jack on the stereo generator. While monitoring LEFT and RIGHT channels (meter switch in AUTO), adjust *SCA crosstalk* trimmer (C41) for equal readings on the left and right meters.

4. This step should be performed using a stereo generator known to have good stereo separation characteristics (stereo separation of at least 60 dB). Place the meters in the LEFT and RIGHT modes respectively and the metering in the AUTO mode. Apply a left-channel only stereo signal to the monitor and adjust the *Right Channel Separation Null* trimmer (R70) on the stereo demodulator board for minimum indication on the right meter. Apply a right-channel-only signal to the monitor and adjust the *Left Channel Separation Null* trimmer (R47) for a minimum reading on the left meter.

5. Place the meters in the LEFT and RIGHT modes and the metering into the PEAK mode. Apply a 100% modulated L=R composite stereo signal (90% L=R, 9% pilot) and adjust the generator level to obtain 90% readings on both the left and right

meters. Switch the left meter into the TOTAL mode and adjust the *Total* trimmer (R6) on the stereo demodulator board for a reading of 99% on the left meter.

6. Remove the pilot so that the monitor is receiving only an L=R signal. In the PEAK mode, adjust the *L+R gain control* (R2) on the filter frame (chassis assembly) so that the reading in the L+R mode is the same as the reading in the TOTAL mode.

7. Place the monitor in the TOTAL mode and the metering in AUTO. Remove audio modulation so that only pilot is being applied to the monitor. Note the left meter reading in the TOTAL position. Switch the meter to the PILOT mode and adjust the *Pilot* trimmer (R18) on the stereo demodulator board so that the readings in the TOTAL mode and the PILOT mode are the same.

8. Place the left meter in TOTAL, the right meter in 38 KHZ and the metering in PEAK mode. With an oscillator, apply a 38 kHz input signal so that the left meter reads 100%. Adjust the *38 kHz potentiometer* (R5) on the filter frame (chassis assembly) so that the right meter reads 100%.

9. With the left meter in TOTAL, the right meter in L - R, and the metering in PEAK, apply a 38 kHz input signal so that the left meter reads 100%. Adjust the frequency of the oscillator upwards until the indication of the right meter reaches a peak (about 39.3 kHz). At this frequency, adjust *L - R potentiometer* (R4) on the filter frame (chassis assembly) so that the right meter reads 103%.

10. Connect the STEREO output of the companion FMM-2 FM monitor to the INPUT of the FMS-2 stereo monitor. Apply the output of an FM signal generator at carrier frequency to the input of the FMM-2. Modulate the FM generator with a 1 kHz sine wave so that the FMM-2 indicates 100% modulation in the OPERate and SEMI-peak modes. Place the FMS-2 stereo monitor in the TOTAL and PEAK modes. Adjust the *Input Level* trimmer (R1) on the FMS-2 stereo demodulator board so that the left channel meter reads 100%.

5 Theory of Operation

FMS-2 A2 Board

STEREO DEMODULATION CIRCUITS

The composite signal is applied to the A2 Stereo Demodulator board through non-inverting operational amplifier U1. Gain is adjustable to compensate for variations in input signal level and normal circuit tolerances. The output of U1 drives the pilot cancellation amplifier U4 and the pilot cancellation filter. In addition, U1 drives an adjustable voltage divider that supplies signal to the A1 metering board for the TOTAL position. The pilot cancellation filter has a bandwidth of about 1 kHz and passes only the pilot with a phase shift of zero degrees. The output of the filter is amplified by non-inverting amplifier U2 and inverting amplifier U3. So, at the output of U3 the pilot signal is 180 degrees out of phase with the incoming pilot. This pilot signal is summed with the composite signal in U4 with the proper amplitude so that the pilot signal is canceled from the composite signal appearing at the output of U4. It is this pilot-less signal which is chopped by the demodulating analog switch in U12 to recover the left and right channels. This composite signal is also buffered by U5 and applied to the L+R, the L - R, the 38 kHz, and the 19 kHz test filters and to the rear-panel COMPOSITE jack.

The L+R filter is a low-pass filter with a cutoff frequency of 15 kHz. It permits measurement of the L+R component of a stereo signal. The L - R filter is a bandpass filter with a passband extending from 23 kHz to 53 kHz to recover the L - R signal. The 38 kHz filter is a bandpass filter with a center frequency of 38 kHz and a bandwidth of 1 kHz to measure the suppression of the 38 kHz component of the stereo waveform. The outputs of these filters are metered when the appropriate pushbutton on the front panel is depressed. The output of the 19 kHz test filter is metered when the PHASE button is depressed. This filter passes only those frequencies in the immediate vicinity of 19 kHz and minimizes the effects of extraneous noise when measuring the depth of the 19 kHz null produced in the pilot cancellation circuit. This same filter can also be used in the PHASE position to check the phase of the regenerated 38 kHz signal. This is done, with the 19 kHz cancellation circuit disabled, by comparing the amplitudes of the demodulated 19 kHz signals at the outputs of U13 & U14. (Input connection to the filter is made by a wire jumper.)

A shunt varicap diode in the pilot cancellation filter, along with an associated front panel potentiometer network, provide a means for adjusting the phase of the pilot signal in the monitor. An adjustable divider at the output of U2 is the source of pilot for the PILOT metering position. The PILOT signal available at the rear panel is taken from the output of U3.

The isolated pilot available at U3 also supplies the pilot comparator U7 and limiter U6. The pilot signal is rectified by a diode and applied to the non-inverting input of comparator U7. The reference voltage is derived from a voltage divider connected to the positive supply. When the pilot signal exceeds approximately four percent, the output of U7 goes high. The comparator output controls logic associated with the operation of the demodulator. U6 is a zero-axis limiter which serves to square the 19 kHz pilot signal and remove the effects of any minor amplitude fluctuations. The adjustable voltage divider on the reference input of U6 compensates for any time delay occurring between the pilot cancellation and the stereo demodulation circuitry by shifting the zero-crossing point of the pilot signal. U6's output is applied to one input of the phase comparator of a phase-locked loop.

U8 and U9, operating in conjunction, generate a 38 kHz square wave which is phase locked with the incoming 19 kHz pilot signal. U8 contains a voltage-controlled oscillator, an edge triggered phase comparator and control circuitry. U9 contains two D flip-flops, each of which is wired to divide by two.

When not inhibited by the pilot comparator, the VCO in U8 generates a 76 kHz wave which is applied to the first divide-by-two flip-flop. The 38 kHz output of this divide-by-two is fed to the demodulating switches through the control logic and also to the second divide-by-two.

The 19 kHz output of the second divide-by-two is connected to the second input of the phase comparator in the phase-locked loop. This phase comparator in U8 keeps the transitions of the 19 kHz square wave from the second divide-by-two in phase synchronism with the transitions of the incoming, limited pilot signal. Thus the 38 kHz signal fed to the demodulating switches is phase-locked with the 19 kHz pilot signal.

The four stereo demodulating analog switches are in U12. They are arranged in two pairs. When the series pass switch in each pair is on, the shunt switch is off, and vice versa. Thus, during stereo demodulation, the input to the switch buffer amplifiers either consists of the composite signal (minus pilot) or is shorted to ground. Logic in NOR gates in U10 and EXCLUSIVE-OR gates in U11 pass the 38 kHz from U8 and U9 to the analog switches in U12. The EXCLUSIVE-OR's guarantee that conduction of the composite signal occurs only on the one appropriate side at any given time.

The NOR gates in U10 perform several functions. First, one gate passes the 38 kHz signal to the demodulating switches through U11 when the pilot comparator output is high, indicating the presence of pilot.

A second gate, operating in conjunction with the first, ensures that the EXCLUSIVE-OR gates in U11 turn on the series demodulating switches and turn off the shunt switches in U12 so the composite signal is conducted by U12 when the stereo pilot is not present during monaural transmissions. This second gate also drives two

transistors, one controlling the PILOT indication LED, the other controlling the mono-stereo relay. When pilot is present, the presence transistor (Q1) is on, providing a current path to light the PILOT LED. In the absence of pilot, the mono-stereo relay (RL1) is energized through Q2. When energized, the lower leg of the 2:1 voltage divider at the input to the stereo demodulator is grounded. This normalizes the levels between operation in the monaural and stereo modes.

The third gate in U10 inverts the pilot comparator output from U7 so the VCO in the phase-locked loop is on when pilot is present and off during monaural transmissions.

The fourth gate in U10 also inverts the pilot comparator output for proper operation of the logic gates driving the analog switches. This fourth gate also has an R-C network on its input (R104,C43) which provides a delay between the time pilot is sensed (and the VCO is activated) and the time the demodulator is activated. In this time interval, the VCO can achieve phase lock. Thus mono/stereo switching noises are minimized. A series diode associated with the R-C delay network (CR11) insures that the stereo demodulator is rapidly shut off when the pilot is removed.

CROSS-COUPLING AND OUTPUT CIRCUITS

The following discussion covers the operation of the cross-coupling and output stages of the left channel and refers to integrated circuits U13, U15, U17, U19 and U21. The discussion is directly applicable to right channel operation with the appropriate substitution of integrated circuit numbers U14, U16, U18, U20 and U22.

Inverting amplifier U13 serves to buffer the left-channel output of the demodulating switch. The buffered signal is then applied to the inverting input of differential amplifier U15. A small portion of the signal from the alternate channel buffer amplifier is applied to the non-inverting input of U15. This cross-coupling serves to remove the excess L - R generated by the demodulating switch and leaves a left-only signal. The amount of cross-coupling, or subtraction, that occurs is adjustable to compensate for normal component variations.

The output of differential amplifier U15 is applied to a 15 kHz low pass filter to remove undesired demodulation products. The filter output is available for metering the LEFT signal level. The filter output is amplified by non-inverting amplifier U17, which has a 75 μsec characteristic. Its output feeds the high impedance rear panel L TEST jack, as well as U19 and U21. Non-inverting amplifier U19 and inverting amplifier U21 provide a +10 dBm, 600Ω, balanced, and de-emphasized output which is available on the board edge connector.

6 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.*

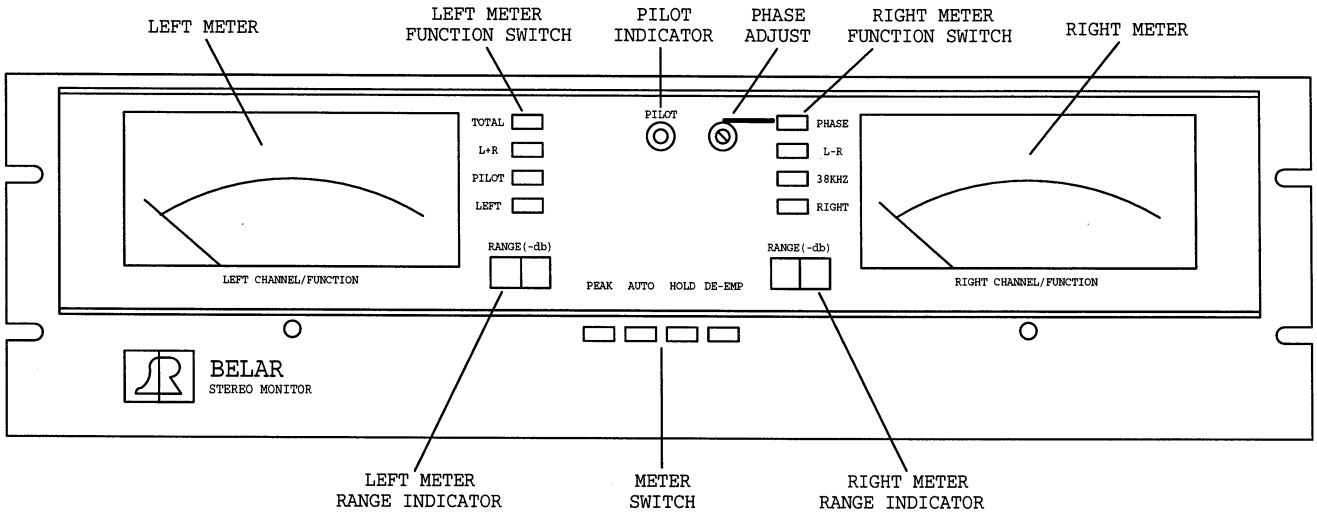
Orders may also be taken over the telephone. Parts orders can be put on your VISA, MasterCard, or American Express card, or we can ship them COD.

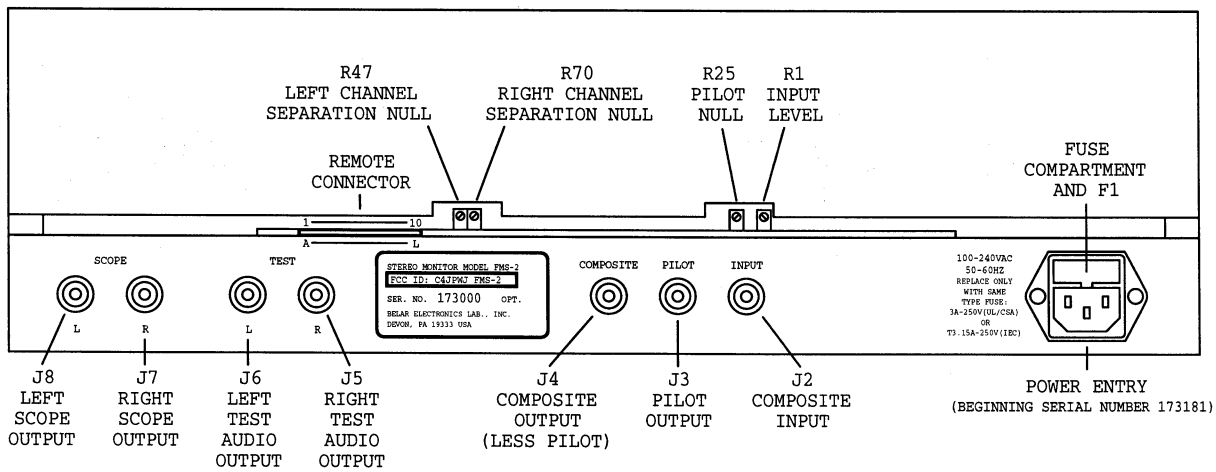
REFERENCE DESIGNATORS

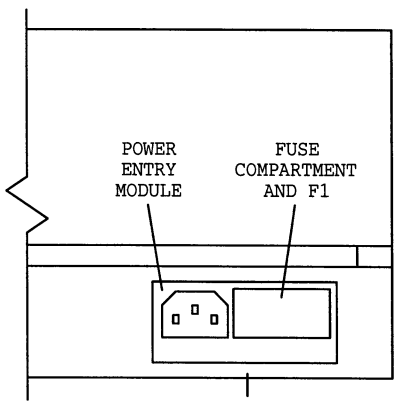
A	= assembly	J	= jack	S	= switch
BR	= diode bridge	L	= inductor	T	= transformer
C	= capacitor	M	= meter	TB	= terminal block
CR	= diode or LED	P	= plug	U	= integrated circuit
DS	= display or lamp	Q	= transistor	W	= cable
F	= fuse	R	= resistor	X	= socket
FL	= filter	RL	= relay	Y	= crystal
HDR	= header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

ABBREVIATIONS

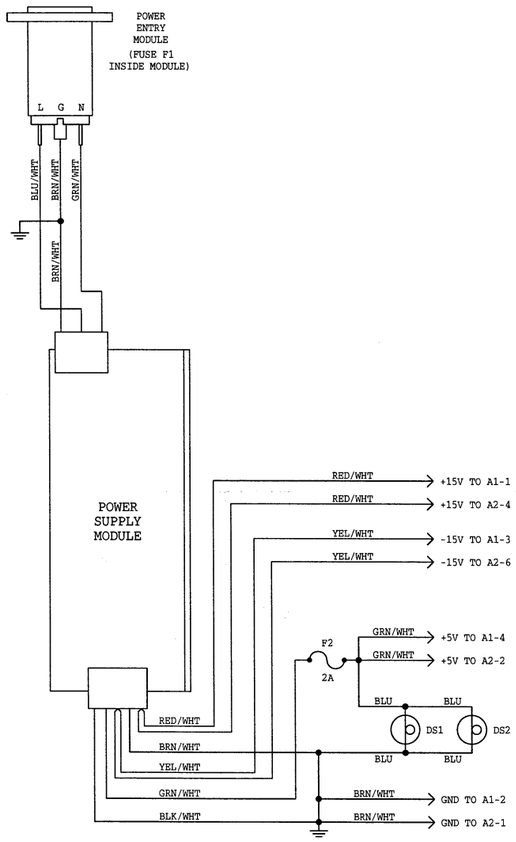
ADC	= analog-to-digital converter	pF	= picofarads
BCD	= binary coded decimal	PIV	= peak inverse voltage
CER	= ceramic	POLY	= polystyrene
COMP	= composition	PORC	= porcelain
CONN	= connector	POT	= potentiometer
DAC	= digital-to-analog convertor	SEMICON	= semiconductor
DPM	= digital panel meter	SI	= silicon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



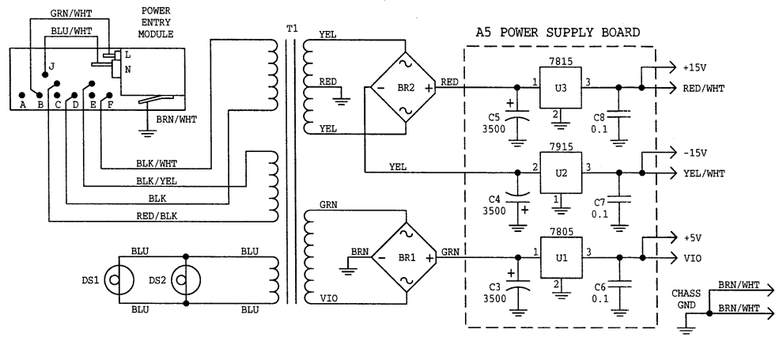




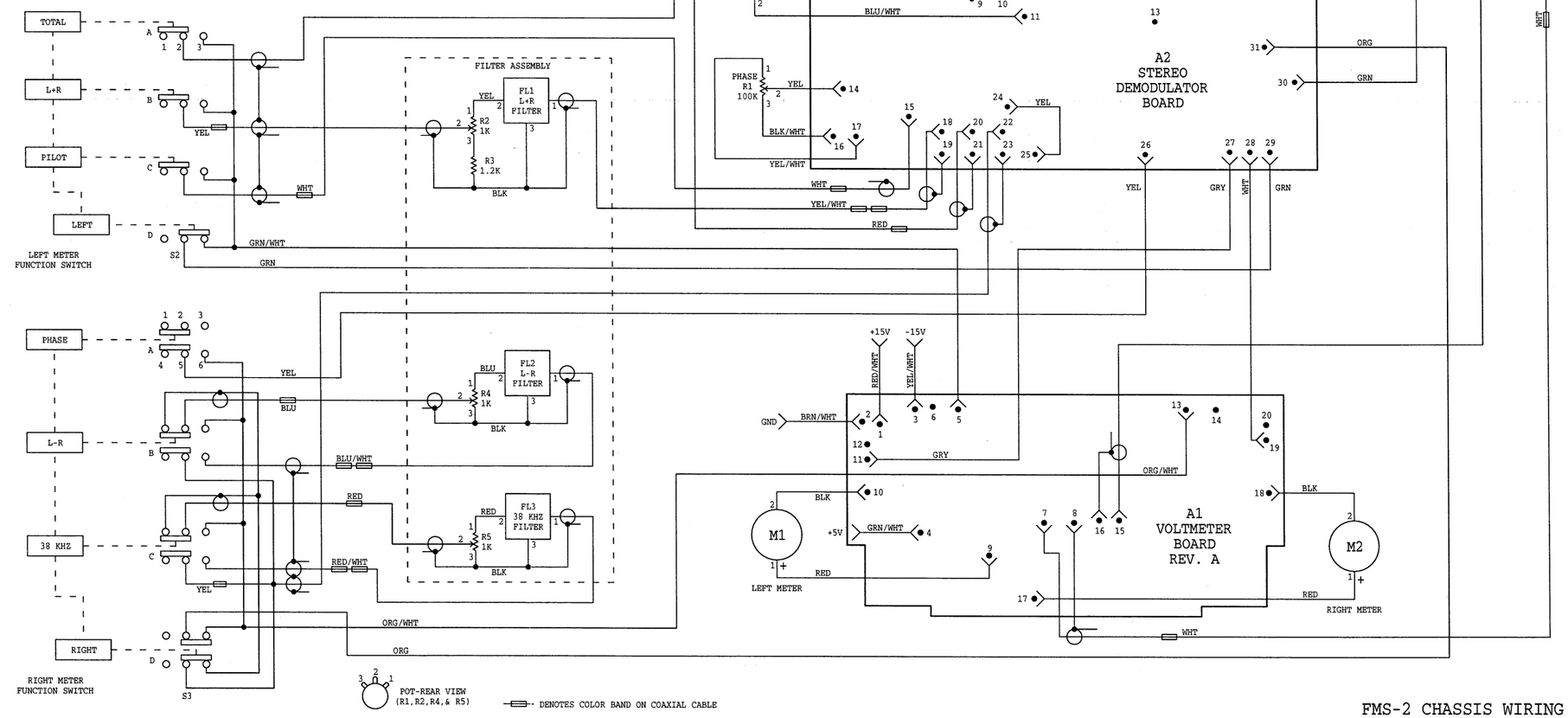
FMS-2 FRONT AND REAR VIEW
BELAR ELECTRONICS
10-8-02



POWER SUPPLY CONFIGURATION-BEGINNING SERIAL NUMBER 173181



POWER SUPPLY CONFIGURATION-SERIAL NUMBERS 171692 TO 173180



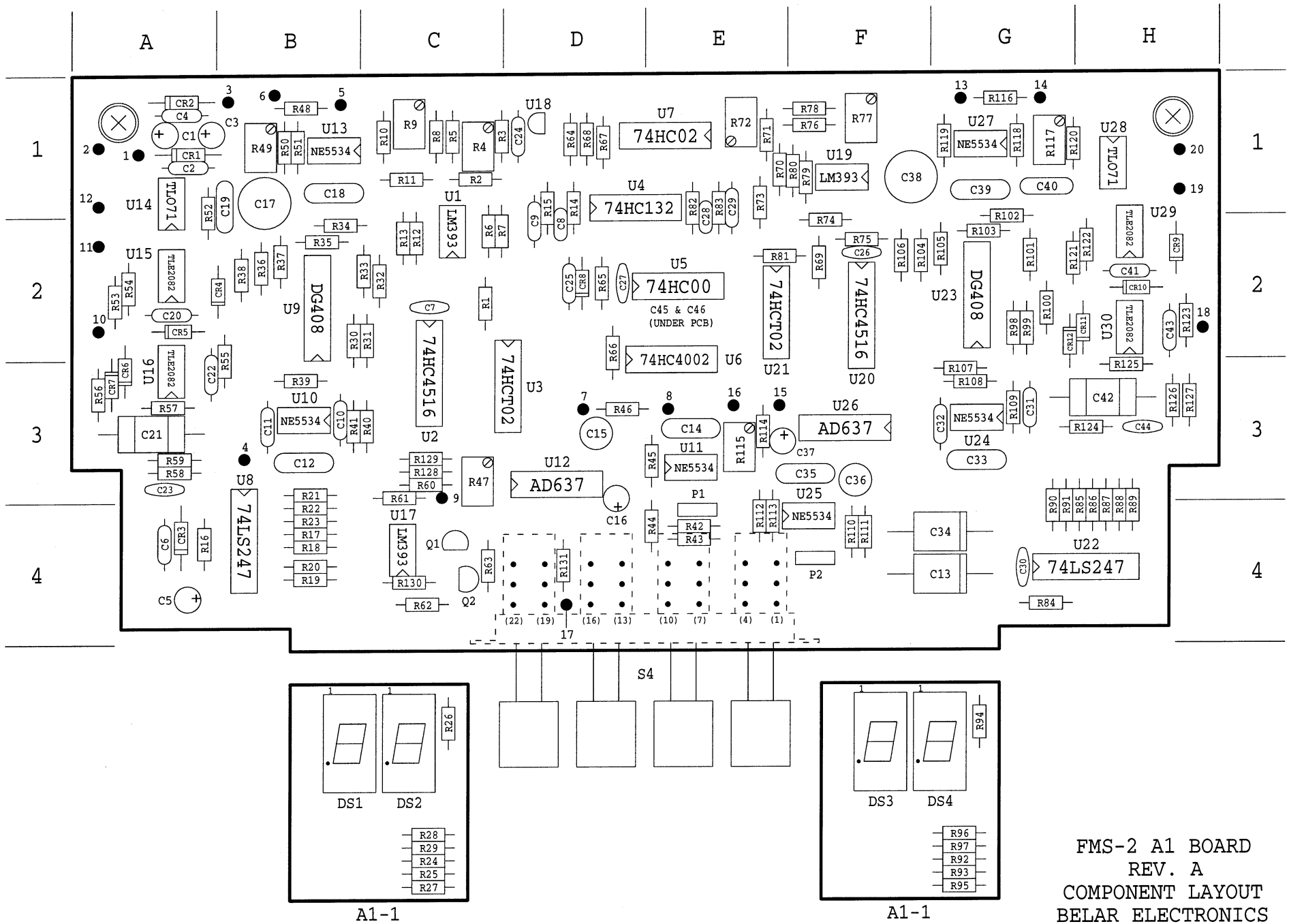
FMS-2 CHASSIS WIRING
BELAR ELECTRONICS
10-8-02

FMS-2 PARTS LISTS

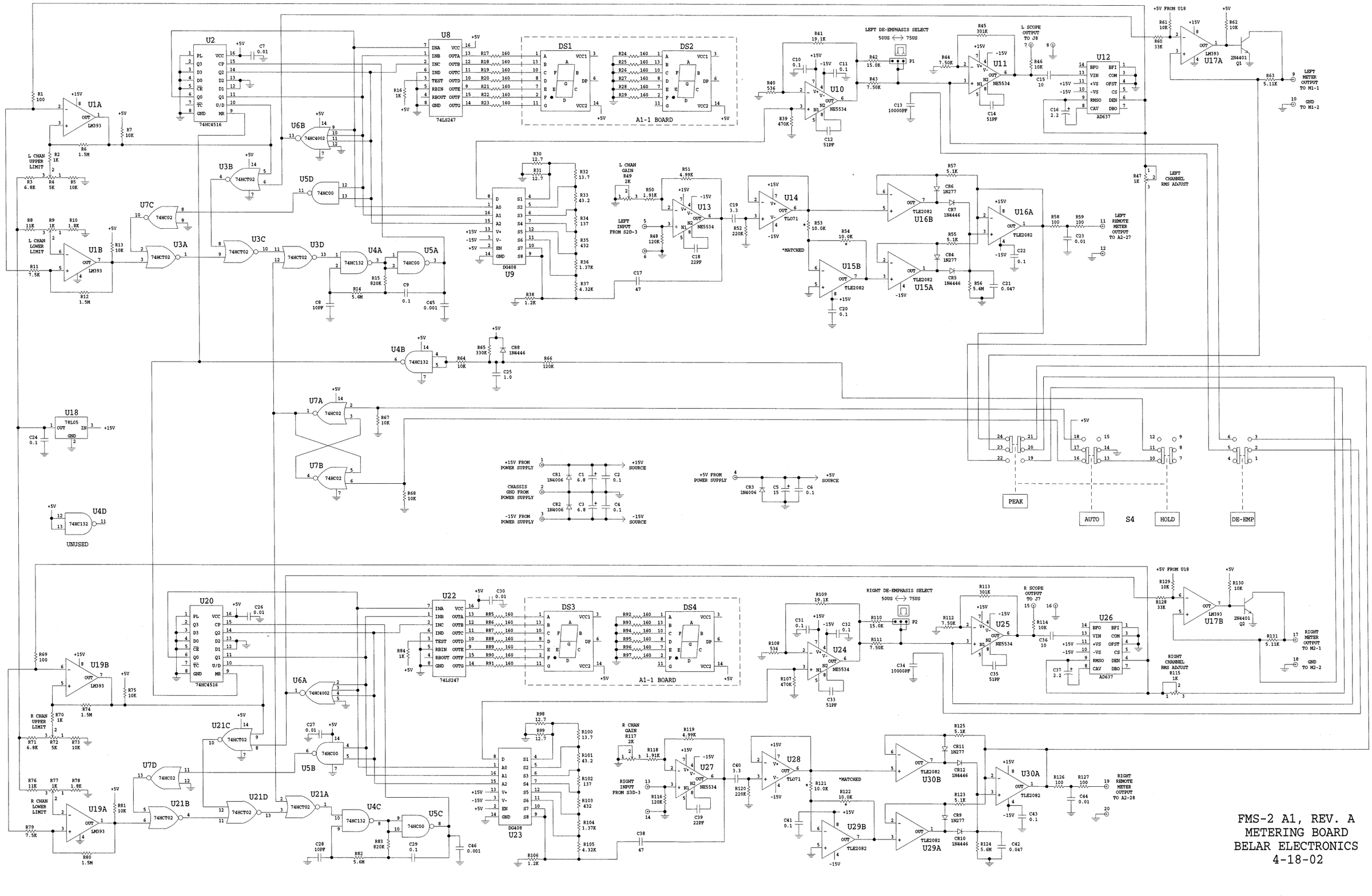
MAIN CHASSIS

Reference Designation	Description		Part Number
A3	POWER SUPPLY MODULE: 15W	(Note 6)	4005-0019A
BR1,BR2	DIODE: BRIDGE KBPC602 GI	(Note 3)	1900-0025
C1,C2	C: FIXED CERAMIC 0.01uF 1.4kV	(Note 2)	0151-0010
C3 thru C5	C: FIXED ELECT 1000uF 50V	(Note 1)	0180-0002
C3 thru C5	C: FIXED ELECT 3500uF 40V	(Note 4)	0180-0026
C6 thru C8	C: FIXED CERAMIC 0.1uF 50V	(Note 4)	0151-0006
CR1	LED: GREEN MV5253		1910-0003
DS1,DS2	LAMP: 755		2140-0005
--	SOCKET: LAMP		1450-0012
F1	FUSE: AGC 1/2A 250V	(Note 2)	2110-0001
--	FUSEHOLDER: REAR PANEL MOUNT	(Note 2)	2110-0003
F1	FUSE: GMA-3A 250V(UL/CSA) or T3.15A-250V(IEC)	(Note 5)	2110-0009
F2	FUSE: AGC-2A 250V	(Note 6)	2110-0006
--	FUSE HOLDER: CHASSIS MOUNT	(Note 6)	2110-0010
FL1	FILTER: LOW-PASS L+R, BELAR		9120-0010
FL2	FILTER: BANDPASS L-R, BELAR		9120-0012
FL3	FILTER: BANDPASS 38 kHz, BELAR		9120-0011
J1	JACK: POWER	(Note 2)	0360-0010
J1	JACK: POWER 6J4	(Note 5)	0360-0020
J1	POWER ENTRY MODULE: 6EGG1-1	(Note 6)	0360-0021
J2 thru J8	JACK: BNC		0360-0005
M1,M2	METER: MOD 0-133%		1120-0012
R1	R: VAR COMP 100k 2W		2100-0011
R2	R: VAR COMP 1k 2W		2100-0007
R3	R: METAL FILM 1.2k 2% 1/2W		0771-1222
R4,R5	R: VAR COMP 1k 2W		2100-0007
S1	SWITCH: SLIDE 115/230V SELECTOR	(Note 2)	3102-0002
S2,S3	SWITCH: PUSHBUTTON (Meter, 4 button)		3101-0017
T1	TRANSFORMER: POWER	(Note 3)	9100-0010
U1	IC: 7805C	(Note 3)	1826-0014
U2	IC: 7915C	(Note 3)	1826-0033
U3	IC: 7815C	(Note 3)	1826-0031
--	LINE CORD (115 Vac line voltage)		8120-0002
--	LINE CORD (230 Vac line voltage)		8120-0004
--	CONNECTOR: CARD EDGE, 20 PIN (CINCH 50-20SN-9 or equivalent)		0365-0023

Note 1: Used serial numbers 171001 to 171219.
Note 2: Used serial numbers 171001 to 171691.
Note 3: Used serial numbers 171001 to 173180.
Note 4: Used serial numbers 171220 to 173180.
Note 5: Used serial numbers 171692 to 173180.
Note 6: Used beginning serial number 173181.



FMS-2 A1 BOARD
REV. A
COMPONENT LAYOUT
BELAR ELECTRONICS

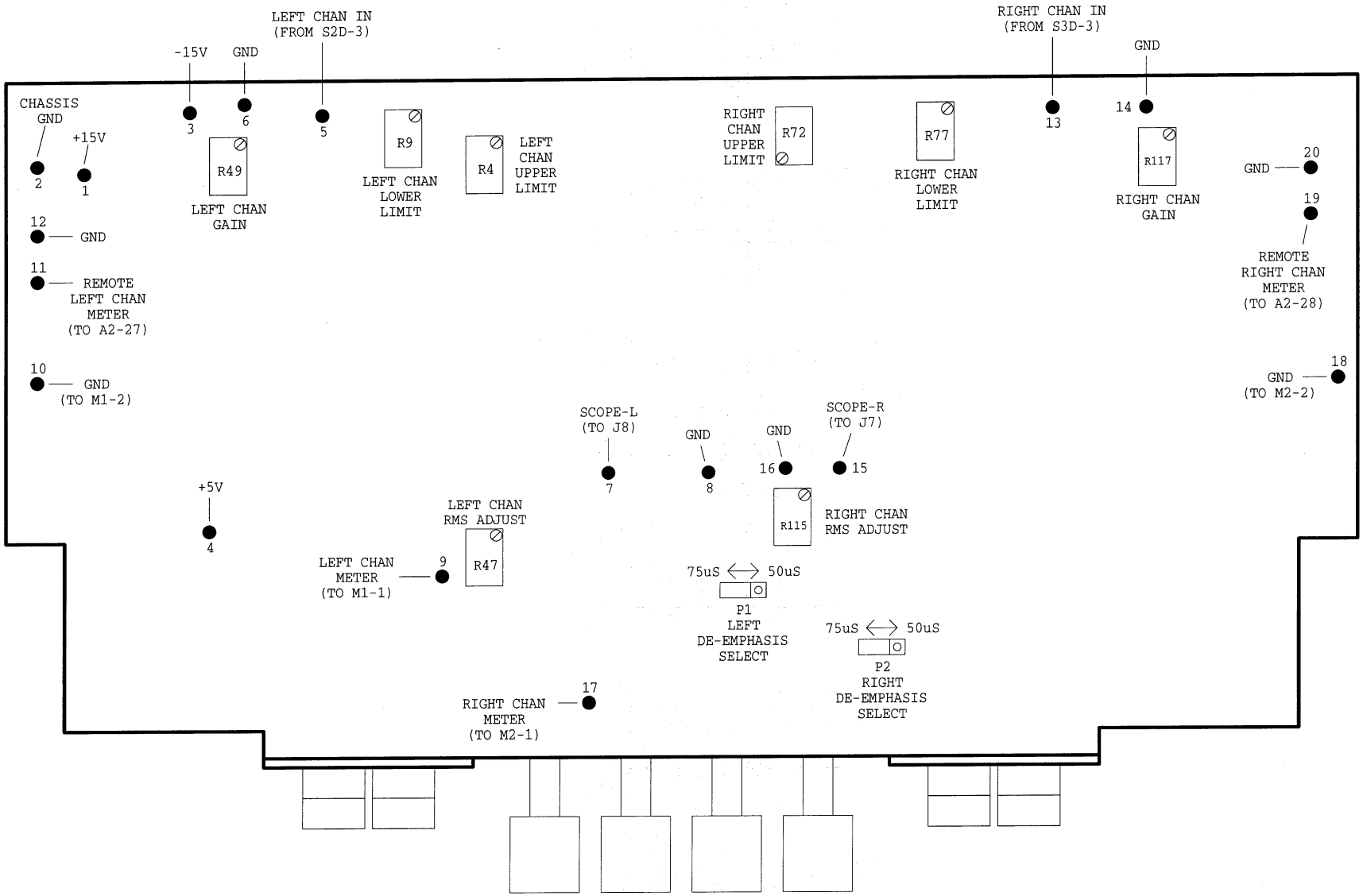


FMS-2 A1, REV. A
METERING BOARD
BELAR ELECTRONICS
4-18-02

FMS-2 A1 BOARD Rev. A
PART LOCATIONS

Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc
C1 A1	C45 E2*	R18 B4	R62 C4	R106 F2	U16 A3
C2 A1	C46 E2*	R19 B4	R63 C4	R107 G3	U17 C4
C3 A1		R20 B4	R64 D1	R108 G3	U18 D1
C4 A1	CR1 A1	R21 B3	R65 D2	R109 G3	U19 F1
C5 A4	CR2 A1	R22 B4	R66 D2	R110 F4	U20 F2
C6 A4	CR3 A4	R23 B4	R67 D1	R111 F4	U21 E2
C7 C2	CR4 B2	R24 A1-1	R68 D1	R112 E4	U22 H4
C8 D2	CR5 A2	R25 A1-1	R69 F2	R113 E4	U23 G2
C9 D2	CR6 A3	R26 A1-1	R70 E1	R114 E3	U24 G3
C10 B3	CR7 A3	R27 A1-1	R71 E1	R115 E3	U25 F4
C11 B3	CR8 D2	R28 A1-1	R72 E1	R116 G1	U26 F3
C12 B3	CR9 H2	R29 A1-1	R73 E1	R117 G1	U27 G1
C13 G4	CR10 H2	R30 B2	R74 F2	R118 G1	U28 H1
C14 E3	CR11 H2	R31 C2	R75 F2	R119 G1	U29 H2
C15 D3	CR12 G2	R32 C2	R76 F1	R120 G1	U30 H2
C16 D3		R33 C2	R77 F1	R121 G2	
C17 B1	DS1 A1-1	R34 B2	R78 F1	R122 H2	pins
C18 B1	DS2 A1-1	R35 B2	R79 F1	R123 H2	1 A1
C19 B1	DS3 A1-1	R36 B2	R80 F1	R124 H3	2 A1
C20 A2	DS4 A1-1	R37 B2	R81 E2	R125 H3	3 B1
C21 A3		R38 B2	R82 E1	R126 H3	4 B3
C22 A3	P1 E4	R39 B3	R83 E1	R127 H3	5 B1
C23 A3	P2 F4	R40 C3	R84 G4	R128 C3	6 B1
C24 D1		R41 B3	R85 H4	R129 C3	7 D3
C25 D2	Q1 C4	R42 E4	R86 H4	R130 C4	8 E3
C26 F2	Q2 C4	R43 E4	R87 H4	R131 D4	9 C3
C27 D2		R44 E4	R88 H4		10 A2
C28 E2	R1 C2	R45 E3	R89 H4	S4 D4	11 A2
C29 E1	R2 C1	R46 D3	R90 G4		12 A1
C30 G4	R3 C1	R47 C3	R91 G4	U1 C2	13 G1
C31 G3	R4 C1	R48 B1	R92 A1-1	U2 C3	14 G1
C32 G3	R5 C1	R49 B1	R93 A1-1	U3 D3	15 E3
C33 G3	R6 C2	R50 B1	R94 A1-1	U4 D1	16 E3
C34 G4	R7 C2	R51 B1	R95 A1-1	U5 E2	17 D4
C35 F3	R8 C1	R52 A1	R96 A1-1	U6 E2	18 H2
C36 F3	R9 C1	R53 A2	R97 A1-1	U7 E1	19 H1
C37 E3	R10 C1	R54 A2	R98 G2	U8 B4	20 H1
C38 F1	R11 C1	R55 B2	R99 G2	U9 B2	
C39 G1	R12 C2	R56 A3	R100 G2	U10 B3	
C40 G1	R13 C2	R57 A3	R101 G2	U11 E3	
C41 H2	R14 D1	R58 A3	R102 G2	U12 D3	
C42 H3	R15 D1	R59 A3	R103 G2	U13 B1	
C43 H2	R16 A4	R60 C3	R104 F2	U14 A1	
C44 H3	R17 B4	R61 C3	R105 G2	U15 A2	

* C45 & C46 ARE UNDER PC BOARD



FMS-2 A1 BOARD
REV. A
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A1 BOARD FMS-2 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 TANT 15uF 15V	0185-0003
C6	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C7	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C8	C: FIXED MICA 10pF 5%	0142-1005
C9 thru C11	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C12	C: FIXED MICA 51pF 5%	0140-5105
C13	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C14	C: FIXED MICA 51pF 5%	0140-5105
C15	C: FIXED ELEC 10uF 35V NON-POLAR	0180-0029
C16	C: FIXED TANT 2.2uF 35V	0185-0009
C17	C: FIXED ELEC 47uF 35V NON-POLAR	0180-0036
C18	C: FIXED MICA 22pF 5%	0140-2205
C19	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C20	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C21	C: FIXED FILM 0.047uF 10% 200V	0120-4731
C22	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C23	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C24	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C25	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C26,C27	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C28	C: FIXED MICA 10pF 5%	0142-1005
C29	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C30	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C31,C32	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C33	C: FIXED MICA 51pF 5%	0140-5105
C34	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C35	C: FIXED MICA 51pF 5%	0140-5105
C36	C: FIXED ELEC 10uF 35V NON-POLAR	0180-0029
C37	C: FIXED TANT 2.2uF 35V	0185-0009
C38	C: FIXED ELEC 47uF 35V NON-POLAR	0180-0036
C39	C: FIXED MICA 22pF 5%	0140-2205
C40	C: FIXED CERAMIC 3.3uF 50V	0151-0011
C41	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C42	C: FIXED FILM 0.047uF 10% 200V	0120-4731
C43	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C44	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C45,C46	C: FIXED CERAMIC 0.001uF 1kV	0151-0002
CR1 thru CR3	DIODE: 1N4006	1900-0016
CR4	DIODE: 1N277 GERMANIUM	1900-0001
CR5	DIODE: 1N4446	1900-0002
CR6	DIODE: 1N277 GERMANIUM	1900-0001
CR7,CR8	DIODE: 1N4446	1900-0002
CR9	DIODE: 1N277 GERMANIUM	1900-0001
CR10	DIODE: 1N4446	1900-0002
CR11	DIODE: 1N277 GERMANIUM	1900-0001
CR12	DIODE: 1N4446	1900-0002

A1 BOARD FMS-2 Rev. A cont.

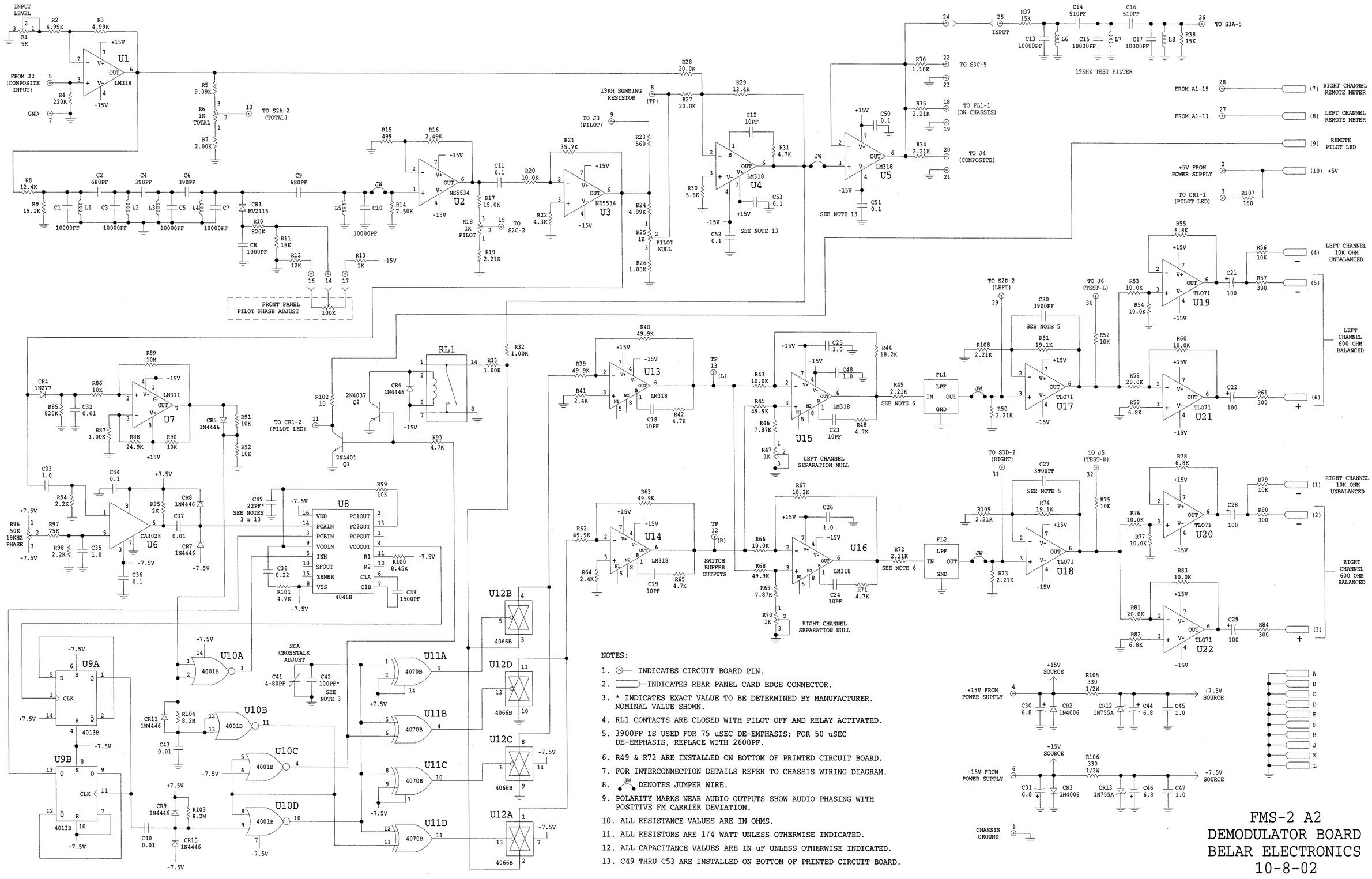
Reference Designation	Description	Part Number
DS1 thru DS4	DISPLAY: MAN3820A	1930-0004
P1,P2	PLUG: 3 PIN, PC MOUNT	0365-0030
--	JUMPER: 2 POSITION (USED WITH P1 & P2)	0365-0028
Q1,Q2	TRANSISTOR: 2N4401	1850-0028
R1	R: METAL FILM 100 2% 1/4W	0751-1012
R2	R: METAL FILM 1k 2% 1/4W	0751-1022
R3	R: METAL FILM 6.8k 2% 1/4W	0751-6822
R4	R: VAR COMP 5k, 10 TURN	2100-0020
R5	R: METAL FILM 10k 2% 1/4W	0751-1032
R6	R: FIXED CARBON 1.5M 5% 1/4W	0683-1555
R7	R: METAL FILM 10k 2% 1/4W	0751-1032
R8	R: METAL FILM 11k 2% 1/4W	0751-1132
R9	R: VAR COMP 1k, 10 TURN	2100-0021
R10	R: METAL FILM 1.8k 2% 1/4W	0751-1822
R11	R: METAL FILM 7.5k 2% 1/4W	0751-7522
R12	R: FIXED CARBON 1.5M 5% 1/4W	0683-1555
R13	R: METAL FILM 10k 2% 1/4W	0751-1032
R14	R: FIXED CARBON 5.6M 5% 1/4W	0683-5655
R15	R: METAL FILM 820k 2% 1/4W	0751-8242
R16	R: METAL FILM 1k 2% 1/4W	0751-1022
R17 thru R29	R: METAL FILM 160 2% 1/4W	0751-1612
R30,R31	R: METAL FILM 12.7 1%	0721-12R7
R32	R: METAL FILM 13.7 1%	0721-13R7
R33	R: METAL FILM 43.2 1%	0721-43R2
R34	R: METAL FILM 137 1%	0721-1370
R35	R: METAL FILM 432 1%	0721-4320
R36	R: METAL FILM 1.37k 1%	0721-1371
R37	R: METAL FILM 4.32k 1%	0721-4321
R38	R: METAL FILM 1.2k 2% 1/4W	0751-1222
R39	R: METAL FILM 470k 2% 1/4W	0751-4742
R40	R: METAL FILM 536 1%	0721-5360
R41	R: METAL FILM 19.1k 1%	0721-1912
R42	R: METAL FILM 15.0k 1%	0721-1502
R43,R44	R: METAL FILM 7.50k 1%	0721-7501
R45	R: METAL FILM 301k 1%	0721-3013
R46	R: METAL FILM 10k 2% 1/4W	0751-1032
R47	R: VAR COMP 1k, 10 TURN	2100-0021
R48	R: METAL FILM 120k 2% 1/4W	0751-1242
R49	R: VAR COMP 2k, 10 TURN	2100-0031
R50	R: METAL FILM 1.91k 1%	0721-1911
R51	R: METAL FILM 4.99k 1%	0721-4991
R52	R: METAL FILM 220k 2% 1/4W	0751-2242
R53,R54*	R: METAL FILM 10.0k 1%	0721-1002
	*R53 & R54 ARE A MATCHED PAIR	
R55	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R56	R: FIXED CARBON 5.6M 5% 1/4W	0683-5655
R57	R: METAL FILM 5.1k 2% 1/4W	0751-5122

A1 BOARD FMS-2 Rev. A cont.

Reference Designation	Description	Part Number
R58,R59	R: METAL FILM 100 2% 1/4W	0751-1012
R60	R: METAL FILM 33k 2% 1/4W	0751-3332
R61,R62	R: METAL FILM 10k 2% 1/4W	0751-1032
R63	R: METAL FILM 5.11k 1%	0721-5111
R64	R: METAL FILM 10k 2% 1/4W	0751-1032
R65	R: METAL FILM 330k 2% 1/4W	0751-3342
R66	R: METAL FILM 120k 2% 1/4W	0751-1242
R67,R68	R: METAL FILM 10k 2% 1/4W	0751-1032
R69	R: METAL FILM 100 2% 1/4W	0751-1012
R70	R: METAL FILM 1k 2% 1/4W	0751-1022
R71	R: METAL FILM 6.8k 2% 1/4W	0751-6822
R72	R: VAR COMP 5k, 10 TURN	2100-0020
R73	R: METAL FILM 10k 2% 1/4W	0751-1032
R74	R: FIXED CARBON 1.5M 5% 1/4W	0683-1555
R75	R: METAL FILM 10k 2% 1/4W	0751-1032
R76	R: METAL FILM 11k 2% 1/4W	0751-1132
R77	R: VAR COMP 1k, 10 TURN	2100-0021
R78	R: METAL FILM 1.8k 2% 1/4W	0751-1822
R79	R: METAL FILM 7.5k 2% 1/4W	0751-7522
R80	R: FIXED CARBON 1.5M 5% 1/4W	0683-1555
R81	R: METAL FILM 10k 2% 1/4W	0751-1032
R82	R: FIXED CARBON 5.6M 5% 1/4W	0683-5655
R83	R: METAL FILM 820k 2% 1/4W	0751-8242
R84	R: METAL FILM 1k 2% 1/4W	0751-1022
R85 thru R97	R: METAL FILM 160 2% 1/4W	0751-1612
R98,R99	R: METAL FILM 12.7 1%	0721-12R7
R100	R: METAL FILM 13.7 1%	0721-13R7
R101	R: METAL FILM 43.2 1%	0721-43R2
R102	R: METAL FILM 137 1%	0721-1370
R103	R: METAL FILM 432 1%	0721-4320
R104	R: METAL FILM 1.37k 1%	0721-1371
R105	R: METAL FILM 4.32k 1%	0721-4321
R106	R: METAL FILM 1.2k 2% 1/4W	0751-1222
R107	R: METAL FILM 470k 2% 1/4W	0751-4742
R108	R: METAL FILM 536 1%	0721-5360
R109	R: METAL FILM 19.1k 1%	0721-1912
R110	R: METAL FILM 15.0k 1%	0721-1502
R111,R112	R: METAL FILM 7.50k 1%	0721-7501
R113	R: METAL FILM 301k 1%	0721-3013
R114	R: METAL FILM 10k 2% 1/4W	0751-1032
R115	R: VAR COMP 1k, 10 TURN	2100-0021
R116	R: METAL FILM 120k 2% 1/4W	0751-1242
R117	R: VAR COMP 2k, 10 TURN	2100-0031
R118	R: METAL FILM 1.91k 1%	0721-1911
R119	R: METAL FILM 4.99k 1%	0721-4991
R120	R: METAL FILM 220k 2% 1/4W	0751-2242
R121,R122*	R: METAL FILM 10.0k 1%	0721-1002
	*R121 & R122 ARE A MATCHED PAIR	
R123	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R124	R: FIXED CARBON 5.6M 5% 1/4W	0683-5655

A1 BOARD FMS-2 Rev. A cont.

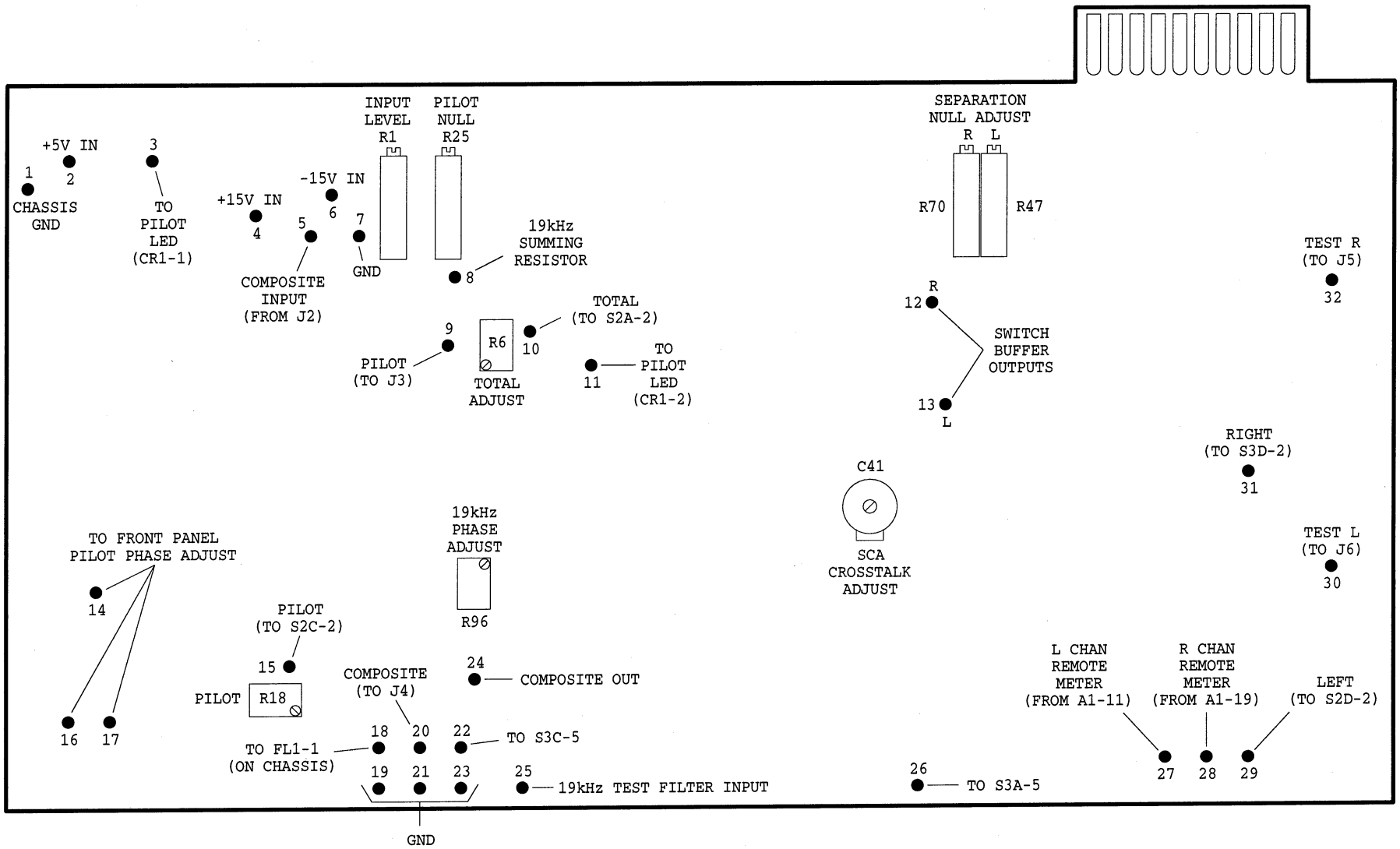
Reference Designation	Description	Part Number
R125	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R126,R127	R: METAL FILM 100 2% 1/4W	0751-1012
R128	R: METAL FILM 33k 2% 1/4W	0751-3332
R129,R130	R: METAL FILM 10k 2% 1/4W	0751-1032
R131	R: METAL FILM 5.11k 1%	0721-5111
S4	SWITCH:PUSHBUTTON (DISPLAY,4 BUTTON)	3101-0016
U1	IC: LM393	1826-0011
U2	IC: 74HC4516	1822-0064
U3	IC: 74HCT02	1822-0027
U4	IC: 74HC132	1822-0065
U5	IC: 74HC00	1822-0039
U6	IC: 74HC4002	1822-0066
U7	IC: 74HC02A	1822-0040
U8	IC: 74LS247	1826-0026
U9	IC: DG408 (was IH6108)	1827-0002
U10,U11	IC: NE5534	1826-0025
U12	IC: AD637	1827-0003
U13	IC: NE5534	1826-0025
U14	IC: TLO71	1826-0004
U15,U16	IC: TLE2082	1826-0069
U17	IC: LM393	1826-0011
U18	IC: 78L05CP	1826-0012
U19	IC: LM393	1826-0011
U20	IC: 74HC4516	1822-0064
U21	IC: 74HCT02	1822-0027
U22	IC: 74LS247	1826-0026
U23	IC: DG408 (was IH6108)	1827-0002
U24,U25	IC: NE5534	1826-0025
U26	IC: AD637	1827-0003
U27	IC: NE5534	1826-0025
U28	IC: TLO71	1826-0004
U29,U30	IC: TLE2082	1826-0069



NOTES:

1. ○ INDICATES CIRCUIT BOARD PIN.
2. ▭ INDICATES REAR PANEL CARD EDGE CONNECTOR.
3. * INDICATES EXACT VALUE TO BE DETERMINED BY MANUFACTURER. NOMINAL VALUE SHOWN.
4. RL1 CONTACTS ARE CLOSED WITH PILOT OFF AND RELAY ACTIVATED.
5. 3900PF IS USED FOR 75 uSEC DE-EMPHASIS; FOR 50 uSEC DE-EMPHASIS, REPLACE WITH 2600PF.
6. R49 & R72 ARE INSTALLED ON BOTTOM OF PRINTED CIRCUIT BOARD.
7. FOR INTERCONNECTION DETAILS REFER TO CHASSIS WIRING DIAGRAM.
8. JW DENOTES JUMPER WIRE.
9. POLARITY MARKS NEAR AUDIO OUTPUTS SHOW AUDIO PHASING WITH POSITIVE FM CARRIER DEVIATION.
10. ALL RESISTANCE VALUES ARE IN OHMS.
11. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE INDICATED.
12. ALL CAPACITANCE VALUES ARE IN uF UNLESS OTHERWISE INDICATED.
13. C49 THRU C53 ARE INSTALLED ON BOTTOM OF PRINTED CIRCUIT BOARD.

FMS-2 A2
DEMODULATOR BOARD
BELAR ELECTRONICS
10-8-02

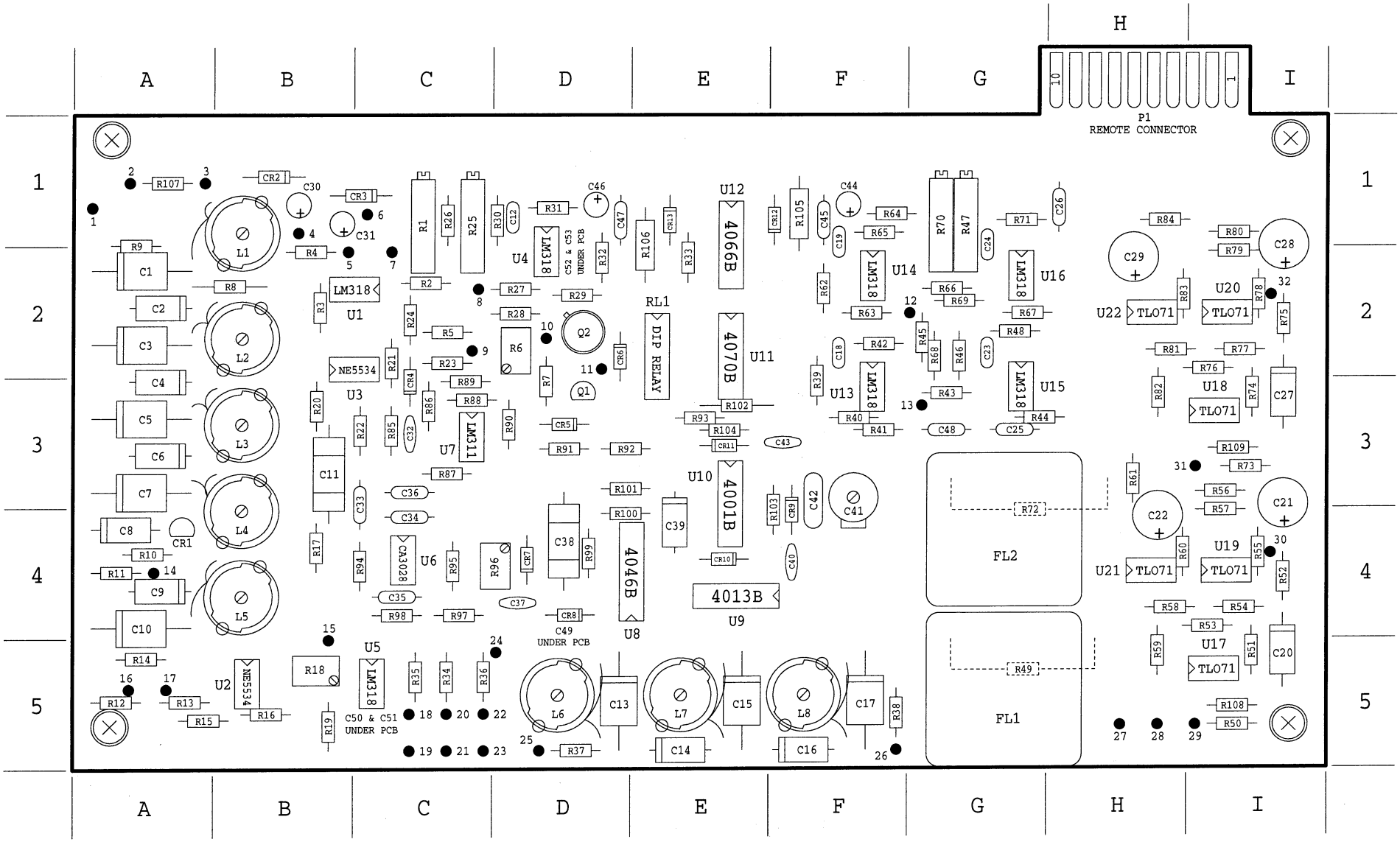


FMS-2 A2 BOARD
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

FMS-2 A2 BOARD
PART LOCATIONS

Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc	
C1	A2	C52	D2*	R20	B3	R71	G1	U10	E3
C2	A2	C53	D2*	R21	C2	R72	G4*	U11	E2
C3	A2			R22	C3	R73	I3	U12	E1
C4	A3	CR1	A4	R23	C2	R74	I3	U13	F3
C5	A3	CR2	B1	R24	C2	R75	I2	U14	F2
C6	A3	CR3	C1	R25	C1	R76	I2	U15	G3
C7	A3	CR4	C3	R26	C1	R77	I2	U16	G2
C8	A4	CR5	D3	R27	D2	R78	I2	U17	I5
C9	A4	CR6	D2	R28	D2	R79	I2	U18	I3
C10	A4	CR7	D4	R29	D2	R80	I1	U19	I4
C11	B3	CR8	D4	R30	D1	R81	H2	U20	I2
C12	D1	CR9	F4	R31	D1	R82	H3	U21	H4
C13	D5	CR10	E4	R32	D2	R83	H2	U22	H2
C14	E5	CR11	E3	R33	E2	R84	H1		
C15	E5	CR12	F1	R34	C5	R85	C3	pins	
C16	F5	CR13	E1	R35	C5	R86	C3	1	A1
C17	F5			R36	C5	R87	C3	2	A1
C18	F2	FL1	G5	R37	D5	R88	C3	3	A1
C19	F1	FL2	G4	R38	F5	R89	C3	4	B1
C20	I5			R39	F3	R90	D3	5	B2
C21	I3	L1	B1	R40	F3	R91	D3	6	C1
C22	H4	L2	B2	R41	F3	R92	D3	7	C2
C23	G2	L3	B3	R42	F2	R93	E3	8	C2
C24	G1	L4	B4	R43	G3	R94	C4	9	C2
C25	G3	L5	B4	R44	G3	R95	C4	10	D2
C26	H1	L6	D5	R45	G2	R96	D4	11	D2
C27	I3	L7	E5	R46	G2	R97	C4	12	F2
C28	I1	L8	F5	R47	G1	R98	C4	13	G3
C29	H2			R48	G2	R99	D4	14	A4
C30	B1	Q1	D3	R49	G5*	R100	D4	15	B5
C31	B1	Q2	D2	R50	I5	R101	D3	16	A5
C32	C3			R51	I5	R102	E3	17	A5
C33	C3	R1	C1	R52	I4	R103	F4	18	C5
C34	C4	R2	C2	R53	I4	R104	E3	19	C5
C35	C4	R3	B2	R54	I4	R105	F1	20	C5
C36	C3	R4	B2	R55	I4	R106	E1	21	C5
C37	D4	R5	C2	R56	I3	R107	A1	22	C5
C38	D4	R6	D2	R57	I4	R108	I5	23	C5
C39	E4	R7	D3	R58	H4	R109	I3	24	D5
C40	F4	R8	B2	R59	H5			25	D5
C41	F3	R9	A1	R60	H4	RL1	E2	26	F5
C42	F3	R10	A4	R61	H3			27	H5
C43	F3	R11	A4	R62	F2	U1	B2	28	H5
C44	F1	R12	A5	R63	F2	U2	B5	29	I5
C45	F1	R13	A5	R64	F1	U3	B2	30	I4
C46	D1	R14	A5	R65	F1	U4	D2	31	H3
C47	D1	R15	A5	R66	G2	U5	C5	32	I2
C48	G3	R16	B5	R67	G2	U6	C4		
C49	D4*	R17	B4	R68	G2	U7	C3		
C50	C5*	R18	B5	R69	G2	U8	D4		
C51	C5*	R19	B5	R70	G1	U9	E4		

*C49 THRU C53, R49 & R72 ARE ON BOTTOM OF PCB



FMS-2 A2 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS

A2 BOARD FMS-2

Reference Designation	Description	Part Number
C1	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C2	C: FIXED POLY 680pF 2.5% 160V	0130-6812
C3	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C4	C: FIXED POLY 390pF 2.5% 160V	0130-3912
C5	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C6	C: FIXED POLY 390pF 2.5% 160V	0130-3912
C7	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C8	C: FIXED POLY 1000pF 2.5% 160V	0130-1022
C9	C: FIXED POLY 680pF 2.5% 160V	0130-6812
C10	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C11	C: FIXED FILM 0.1 uF 10% 80V	0120-1041
C12	C: FIXED MICA 10pF 5%	0142-1005
C13	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C14	C: FIXED POLY 510pF 2.5% 160V	0130-5112
C15	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C16	C: FIXED POLY 510pF 2.5% 160V	0130-5112
C17	C: FIXED POLY 10000pF 2.5% 160V	0130-1032
C18,C19	C: FIXED MICA 10pF 5%	0142-1005
C20	C: FIXED POLY 3900pF 2.5% 160V	0130-3922
C21,C22	C: FIXED ELEC 100uF 35V	0180-0018
C23,C24	C: FIXED MICA 10pF 5%	0142-1005
C25,C26	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C27	C: FIXED POLY 3900pF 2.5% 160V	0130-3922
C28,C29	C: FIXED ELEC 100uF 35V	0180-0018
C30,C31	C: FIXED TANT 6.8uF 25V	0185-0002
C32	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C33	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C34	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C35	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C36	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C37	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C38	C: FIXED FILM 0.22uF 10% 80V	0120-2241
C39	C: FIXED POLY 1500pF 2.5% 160V	0130-1522
C40	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C41	C: VARIABLE MICA 4-80pF	0121-0004
C42	C: FIXED MICA-VALUE SELECTED BY MFR.	
C43	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C44	C: FIXED TANT 6.8uF 25V	0185-0002
C45	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C46	C: FIXED TANT 6.8uF 25V	0185-0002
C47,C48	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C49	C: FIXED MICA-VALUE SELECTED BY MFR.	
C50 thru C53	C: FIXED CERAMIC 0.1uF 50V	0151-0006
CR1	DIODE: MV2115	1900-0024
CR2,CR3	DIODE: 1N4006	1900-0016
CR4	DIODE: 1N277 GERMANIUM DIODE	1900-0001
CR5 thru CR11	DIODE: 1N4446	1900-0002
CR12,CR13	DIODE: 1N755A	1900-0023
FL1,FL2	FILTER: BELAR	9120-0010

A2 BOARD FMS-2 CONT.

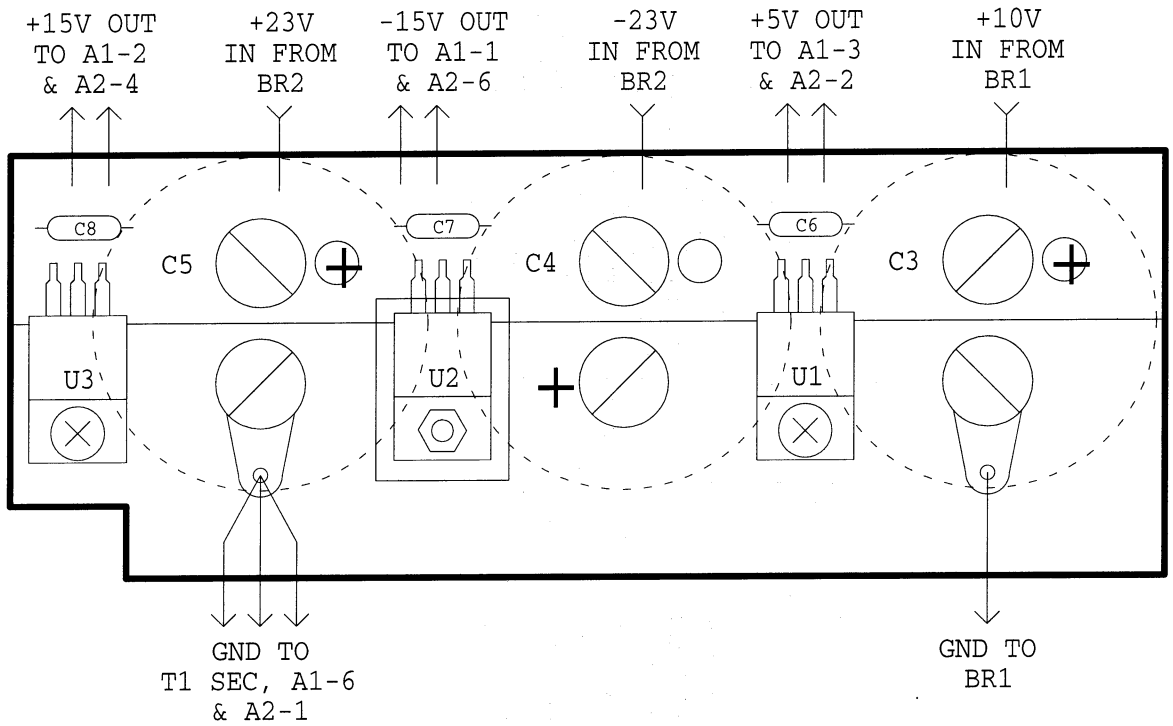
Reference Designation	Description	Part Number
L1 thru L8	COIL:	Belar
Q1	TRANSISTOR: 2N4401	1850-0028
Q2	TRANSISTOR: 2N4037	1850-0011
R1	R: VAR COMP 5k, 10 TURN	2100-0026
R2,R3	R: METAL FILM 4.99k 1%	0721-4991
R4	R: METAL FILM 220k 2% 1/4W	0751-2242
R5	R: METAL FILM 9.09k 1%	0721-9091
R6	R: VAR COMP 1k, 10 TURN	2100-0021
R7	R: METAL FILM 2.00k 1%	0721-2001
R8	R: METAL FILM 12.4k 1%	0721-1242
R9	R: METAL FILM 19.1k 1%	0721-1912
R10	R: METAL FILM 820k 2% 1/4W	0751-8242
R11	R: METAL FILM 18k 2% 1/4W	0751-1832
R12	R: METAL FILM 12k 2% 1/4W	0751-1232
R13	R: METAL FILM 1k 2% 1/4W	0751-1022
R14	R: METAL FILM 7.50k 1%	0721-7501
R15	R: METAL FILM 499 1%	0721-4990
R16	R: METAL FILM 2.49k 1%	0721-2491
R17	R: METAL FILM 15.0k 1%	0721-1502
R18	R: VAR COMP 1k 10 TURN	2100-0021
R19	R: METAL FILM 2.21k 1%	0721-2211
R20	R: METAL FILM 10.0k 1%	0721-1002
R21	R: METAL FILM 35.7k 1%	0721-3572
R22	R: METAL FILM 4.3k 2% 1/4W	0751-4322
R23	R: METAL FILM 560 2% 1/4W	0751-5612
R24	R: METAL FILM 4.99k 1%	0721-4991
R25	R: VAR COMP 1k, 10 TURN	2100-0023
R26	R: METAL FILM 1.00k 1%	0721-1001
R27,R28	R: METAL FILM 20.0k 1%	0721-2002
R29	R: METAL FILM 12.4k 1%	0721-1242
R30	R: METAL FILM 5.6k 2% 1/4W	0751-5622
R31	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R32,R33	R: METAL FILM 1.00k 1%	0721-1001
R34,R35	R: METAL FILM 2.21k 1%	0721-2211
R36	R: METAL FILM 1.10k 1%	0721-1101
R37,R38	R: METAL FILM 15k 2% 1/4W	0751-1532
R39,R40	R: METAL FILM 49.9k 1%	0721-4992
R41	R: METAL FILM 2.4k 2% 1/4W	0751-2422
R42	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R43	R: METAL FILM 10.0k 1%	0721-1002
R44	R: METAL FILM 18.2k 1%	0721-1822
R45	R: METAL FILM 49.9k 1%	0721-4992
R46	R: METAL FILM 7.87k 1%	0721-7871
R47	R: VAR COMP 1k, 10 TURN	2100-0023
R48	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R49,R50	R: METAL FILM 2.21k 1%	0721-2211
R51	R: METAL FILM 19.1k 1%	0721-1912
R52	R: METAL FILM 10k 2% 1/4W	0751-1032

A2 BOARD FMS-2 CONT.

Reference Designation	Description	Part Number
R53,R54	R: METAL FILM 10.0k 1%	0721-1002
R55	R: METAL FILM 6.8k 2% 1/4W	0751-6822
R56	R: METAL FILM 10k 2% 1/4W	0751-1032
R57	R: METAL FILM 300 2% 1/4W	0751-3012
R58	R: METAL FILM 20.0k 1%	0721-2002
R59	R: METAL FILM 6.8k 2% 1/4W	0751-6822
R60	R: METAL FILM 10.0k 1%	0721-1002
R61	R: METAL FILM 300 2% 1/4W	0751-3012
R62,R63	R: METAL FILM 49.9k 1%	0721-4992
R64	R: METAL FILM 2.4k 2% 1/4W	0751-2422
R65	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R66	R: METAL FILM 10.0k 1%	0721-1002
R67	R: METAL FILM 18.2k 1%	0721-1822
R68	R: METAL FILM 49.9k 1%	0721-4992
R69	R: METAL FILM 7.87k 1%	0721-7871
R70	R: VAR COMP 1k, 10 TURN	2100-0023
R71	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R72,R73	R: METAL FILM 2.21k 1%	0721-2211
R74	R: METAL FILM 19.1k 1%	0721-1912
R75	R: METAL FILM 10k 2% 1/4W	0751-1032
R76,R77	R: METAL FILM 10.0k 1%	0721-1002
R78	R: METAL FILM 6.8k 2% 1/4W	0751-6822
R79	R: METAL FILM 10k 2% 1/4W	0751-1032
R80	R: METAL FILM 300 2% 1/4W	0751-3012
R81	R: METAL FILM 20.0k 1%	0721-2002
R82	R: METAL FILM 6.8k 2% 1/4W	0751-6822
R83	R: METAL FILM 10.0k 1%	0721-1002
R84	R: METAL FILM 300 2% 1/4W	0751-3012
R85	R: METAL FILM 820k 2% 1/4W	0751-8242
R86	R: METAL FILM 10k 2% 1/4W	0751-1032
R87	R: METAL FILM 1.00k 1%	0721-1001
R88	R: METAL FILM 24.9k 1%	0721-2492
R89	R: FIXED CARBON 10M 5% 1/4W	0683-1065
R90 thru R92	R: METAL FILM 10k 2% 1/4W	0751-1032
R93	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R94	R: METAL FILM 2.2k 2% 1/4W	0751-2222
R95	R: METAL FILM 2k 2% 1/4W	0751-2022
R96	R: VAR COMP 50k, 10 TURN	2100-0025
R97	R: METAL FILM 75k 2% 1/4W	0751-7532
R98	R: METAL FILM 2.2k 2% 1/4W	0751-2222
R99	R: METAL FILM 10k 2% 1/4W	0751-1032
R100	R: METAL FILM 8.45k 1%	0721-8451
R101	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R102	R: METAL FILM 10 2% 1/4W	0751-1002
R103,R104	R: FIXED CARBON 8.2M 5% 1/4W	0683-8255
R105,R106	R: METAL FILM 330 2% 1/2W	0771-3312
R107	R: METAL FILM 160 2% 1/4W	0751-1612
R108,R109	R: METAL FILM 2.21k 1%	0721-2211

A2 BOARD FMS-2 CONT.

Reference Designation	Description	Part Number
RL1	RELAY: JWD-107-3	1600-0003
U1	IC: LM318N	1826-0010
U2,U3	IC: NE5534	1826-0025
U4,U5	IC: LM318N	1826-0010
U6	IC: CA3028	1826-0034
U7	IC: LM311	1826-0009
U8	IC: 4046B	1822-0016
U9	IC: 4013B	1822-0003
U10	IC: 4001B	1822-0015
U11	IC: 4070B	1822-0019
U12	IC: 4066B	1822-0018
U13 thru U16	IC: LM318N	1826-0010
U17 thru U22	IC: TLO71	1826-0004



FMS-2
A5 POWER SUPPLY BOARD
COMPONENT LAYOUT

(USED BEGINNING SERIAL NUMBER 171220)