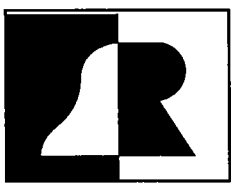
Model AMM-4
AM FREQUENCY MONITOR

Guide to Operations

10/03



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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 AMM-4 is a digital AM frequency monitor designed especially for automatic broadcast transmitter monitoring. The counter will accurately monitor any frequency from 10 kHz to 50 MHz. A large 3½ digit LED readout provides a range of ±1999 Hz deviation from the assigned channel. A front panel LED indicator warns of low RF level or loss of carrier; and optional relay contacts can be provided. The monitor also provides two off-frequency alarms which are inhibited so that three successive errors are required to signal an alarm. This prevents false off-frequency conditions. For example, if the carrier frequency exceeds ±10 Hz, a front panel LED indicator is immediately activated into a flashing state. This warns of an impending off-frequency condition. After three successive counts in this condition, the monitor changes the front panel indicator to a continuous ON state and activates the optional 10 Hz alarm relay contacts, if present. If the frequency exceeds ±20 Hz for three successive counts, then the second front panel indicator is activated as well as optional relay contacts.

Another feature of the AMM-4 is the invalid count alarm. If this condition arises due to low RF level or a malfunction in the counter, the frequency alarms are held in their OFF condition; however, a front panel LED indicator and optional relay contacts are provided to warn of an invalid count.

If the counter is driven by a modulated source, a count inhibit input is provided. This input is controlled by the 100% negative output of a modulation monitor; thus if the modulation level exceeds 99% negative, then the display and alarms would be held at the state they were in prior to the overmodulation fault.

Relay contact outputs (described above) are available as options. A switchable 1 MHz input/output connector is provided for frequency comparison.

1-2 Features

- Inhibited off-frequency alarms
- 10 Hz off-frequency alarm
- 20 Hz off-frequency alarm
- RF level alarm
- Invalid count alarm
- Count inhibit input
- External time base input
- 1 MHz output
- 3½ digit LED display
- Low profile design
- Designed for ATS operation

1-3 Physical Description

The AMM-4 is constructed on a standard 1.75 x 19 inch EIA rack mount panel. Factory adjustments are located within the shielded compartment of the monitor. The frequency deviation readout, alarm and gate LEDs and the frequency adjust access are located on the unit front panel. The AC power input, line voltage select, RF input, count inhibit input, time base input/output and optional alarm outputs are located on the rear of the chassis.

1-4 Electrical and Mechanical Specifications

Frequency Range ..... 10 kHz to 50 MHz
Display ..... Large 3½ digit LED
Display Range ..... ±1999 Hz standard
±500 Hz when unit is modified for 1 kHz counting intervals
RF Input Impedance ..... 1 kΩ
Sensitivity ..... 100 mV, unmodulated
2 Vrms, 99% modulation
Gate Time ..... 2 seconds
Resolution ..... 0.5 Hz
Time Base (Internal) ..... 6 MHz
Time Base Output ..... 1 MHz TTL compatible level
Stability ..... ±1 x 10^{-6} per year
Time Base (External) ..... Requires 1 MHz TTL compatible level
10 Hz Alarm ..... Front panel LED warns of potential frequency fault, inhibited for three successive errors
20 Hz Alarm ..... Front panel LED, inhibited for three successive errors
RF Level Alarm ..... Front panel LED, warns of low RF level or carrier fail condition
Invalid Count Alarm .. Prevents false counts due to low RF level or problem in counter
Count Inhibit Input ..... External contact required capable of sinking 2 mA
Dimensions ..... 1.75"H x 10.5"D x 19"W (EIA Rack Mount)
Power Requirements ..... 115/230 Vac, 50/60 Hz

1-5 Accessories

An optional alarm relay board is available for the Belar AMM-4 Automatic AM Frequency Monitor. It mounts inside the AMM-4 and provides three relays which activate during the alarm conditions of the monitor. These alarms are the 10 Hz Alarm, 20 Hz Alarm and the combined Invalid Count/ RF Level Alarm. Two sets of SPDT relay contacts are provided for each of the three alarm conditions.

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 damage claim or for possible future use.

The AMM-4 is shipped with an instruction book, three wire line cord, four black rack mount screws, and a BNC interface cable.

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.

3 Installation and Setup

3-1 General

The AMM-4 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 AMM-4. In no instance should the ambient chassis temperature be allowed to rise above 45°C (113°F).

3-2 Power Connection

The AMM-4 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:

Units with serial number 151258 and lower:
Unplug the line cord. Slide the switch (S1) to 115V or 230V position. Ensure that the fuse (F1) is the proper current rating for selected voltage (½ A 250 V for 115 Vac, ¼ A 250 V for 230 Vac).

Units with serial number 151259 and higher:
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 (½ A 250 V for 115 Vac, ¼ A 250 V for 230 Vac), and close the fuse door.

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

3-3 RF Input Connection

When installing at the transmitter:
Connect an RF sample from your transmitter to the RF Input connector of the AMM-4, using the short coaxial cable supplied with your unit. The ideal RF input level for reliable operation of the AMM-4 is 5 V rms. The display on the unit will still accurately indicate frequency deviation down to an input level of 100 mV unmodulated and 2 V rms modulated but below about 1 V rms the RF level alarm activates which holds the 10 and 20 Hz alarms in their OFF state.

Do not apply more than 10 V rms of RF to the AMM-4 input or unit damage could result. This type of damage is not covered under the warranty.

When installing at the studio:

When using an RFA-2 AM RF Amplifier to monitor an off-air signal at the studio, connect the "FREQ RF OUT" (J3) on the rear of the RFA-2 to the RF Input connector of the AMM-4, using the short coaxial cable supplied with your unit. This is an unmodulated RF signal which is on the original station frequency for frequency monitoring purposes*.

> *note: When using the RFA-2 FREQ RF OUT with an AMM-4 in this manner, R65 (2k) on the A2 Board in the AMM-4 has to be *paralleled* with another 2k resistor so that the AMM-4 is sensitive enough to operate accurately with the RFA-2 FREQ RF OUT signal.

When using the AMM-4 with another type of AM RF amplifier, remember that the ideal RF input level for the AMM-4 is about 5 V rms. Do not apply more than 10 V rms of RF to the AMM-4 input or unit damage could result.

3-4 Count Inhibit Connection

If the AMM-4 is being driven by a modulated source, it is important that the Count Inhibit input be used to avoid erroneous readings and alarms if the modulation level exceeds 99% negative.

The AMM-2 and AMM-3 series modulation monitors all have open-collector outputs which go low when the modulation level exceeds 100% negative. These outputs are labeled "-100% mod indicator". When this output is connected to the Count Inhibit input on the AMM-4, it holds the AMM-4 display and alarms in the state they were in prior to the overmodulation fault.

3-5 Remote Alarm Connections

When the optional Alarm Relay Card is installed, it provides two sets of SPDT relay contacts which activate when the corresponding AMM-4 front panel alarm LED lights. These alarms are the 10 Hz alarm, the 20 Hz alarm and the combined Invalid Count/ RF Level alarm.

The relay contacts are rated at 0.25 Amps at 100 Volts dc maximum (4VA) or 0.5 Amps continuous carry current. *Under no circumstances should 120 Vac be run through these contacts.* This could damage the relays and under some circumstances, possibly even the AMM-4. This type of damage is not covered by the warranty.

These relay contacts would normally control circuits which activate a visual or audible alarm in a remote location.

Connection to the relays is made through the gold contacts on the rear of the AMM-4 with the 36 pin card-edge connector supplied with the option. See the Alarm Relay Board schematic at the rear of this manual for the relay connection information.

Note: Prior to the Revision A, A3 Alarm Relay Board, the relays provided four sets of SPDT relay contacts for each alarm function. These contacts were rated at 0.1 to 2 Amps at 28 Vdc or 3 Amps continuous carry current.

4 Operation

4-1 Normal Operation

Once the AMM-4 is properly installed, it will automatically monitor your transmitter frequency, give you direct frequency deviation readings and activate off-frequency and level alarms without any user intervention being necessary.

4-2 Front Panel Description

1. TIME BASE FREQUENCY ADJUSTMENT: This pot which is accessible through a hole in the front panel provides adjustment for the 6 MHz time base should it become necessary. See *Section 5-1 Time Base Frequency Adjustment* later in this manual.

2. 3½ DIGIT LED DISPLAY: Provides a readout of the frequency deviation measurement of the transmitter up to ±1999 Hz. The display will be blanked if the maximum readout is reached or if no input is present.

3. GATE LED: The AMM-4 gate time is 2 seconds. This red LED blinks each time the unit gates. When the count inhibit is enabled, the LED stays on, showing that the AMM-4 is not counting.

4. 10 Hz ALARM: If the carrier frequency exceeds ±10 Hz, this yellow front panel LED indicator is immediately activated into a flashing state. This warns of an impending off-frequency condition. After three successive counts in this condition, the monitor changes the front panel indicator to a continuous ON state and activates the optional 10 Hz alarm relay contacts, if present.

5. 20 Hz ALARM: If the carrier frequency exceeds ±20 Hz, this red front panel LED indicator is immediately activated into a flashing state. This warns of an impending off-frequency condition. After three successive counts in this condition, the monitor changes the front panel indicator to a continuous ON state and activates the optional 20 Hz alarm relay contacts, if present.

6. INVALID COUNT ALARM: This red LED will indicate low RF level or a malfunction in the counter. At this condition the frequency alarms are held in their OFF condition to prevent a false alarm and the monitor activates the optional Invalid Count/ RF Level alarm relay contacts, if present.

7. RF LEVEL ALARM: This red LED will indicate a loss of carrier or a level too low for proper measurement. At this condition the frequency alarms are held in their OFF condition to prevent a false alarm and the monitor activates the optional Invalid Count/ RF Level alarm relay contacts, if present.

5 Maintenance and Modifications

5-1 Time Base Frequency Adjustment

(note: This adjustment can only be made on AMM-4s S/N 151206 and higher.)

Normally the internal time base in the AMM-4 is very stable and should not require readjustment. In the event that it drifts off-frequency, the time base can be adjusted one of two ways;

1. Connect an accurate frequency counter to the "1 MHz" output (J3) and set the Frequency Adjust pot (R69, accessible through the AMM-4 front panel) for exactly 1 MHz at J3. (note: The 1 MHz signal at J3 is TTL level.)

2. If the station frequency is being measured by a professional frequency measurement service, set the Frequency Adjust pot so the AMM-4's frequency deviation reading agrees with the service's frequency measurement *while it is being made.*

5-2 Use of an External Time Base

If the internal time base in the AMM-4 fails or becomes unstable, it is recommended that the unit be returned to Belar for repair, but the AMM-4 could be operated temporarily using an external, accurate, 1 MHz, TTL compatible time base.

1. Disconnect the AMM-4 and remove it from the rack. Remove the unit top cover.

2. Move one end of the internal reference jumper from pin 5 to pin 4 (see the *AMM-4 A2 Board Connections and Adjustments* drawing at the rear of this manual). Leave the other end of the jumper connected to pin 7.

3. Move the wire coming from the 1 MHz jack (J3) from pin 3 to pin 6.

4. Reinstall the top cover, replace the unit in the rack and reconnect it.

5. Connect the external time base to the 1 MHz jack on the rear of the AMM-4. The AMM-4 should now function normally.

5-3 Conversion of the AMM-4 to 1 kHz Counting Intervals

The AMM-4 can be converted from its standard 10 kHz counting intervals to 1 kHz counting intervals for use in parts of the world where the FM broadcast band is based on 9 kHz multiples instead of 10 kHz intervals.

The modification requires taking the main board out of the unit and cutting several traces and installing several jumper wires. When the modification is complete, the display range decreases from ±1999 Hz to ±500 Hz.

The AMM-4 can be returned to Belar to have the modification performed at our standard repair prices or if the AMM-4 owner desires to perform the modification themselves, a procedure can be sent from the factory.

6 Circuit Description

6-1 Timing Circuits

The purpose of the timing generator circuits is threefold:

1. To provide a very accurate and constant enabling pulse for the signal gate.
2. To provide a short pulse which transfers the resultant count into the display latches.
3. To reset the counters after the display has been latched.

All internal timing functions for the AMM-4 are derived from U1, a temperature compensated crystal oscillator (TCXO) operating at exactly 6 MHz. The output from U1 is divided down to 3 MHz by U47A, and then down to 1 MHz by U2A and U2B, and is applied to the time base selection gates, U3. (note: Before S/N 151206 U1 operated at 3 MHz and U47 was not used.)

If terminal pins 5 and 7 are jumpered together, the internally generated 1 MHz signal will be enabled as the clock source for U4. If an external 1 MHz clock source is applied to pin 6, and pin 4 is grounded, then the external signal will serve as the clock source for U4.

U4A is a binary-coded-decimal (BCD) counter with BCD outputs on pins 3,5,6 and 7. Each trailing edge of the input clock signal increments the count at the BCD outputs, until a count of 0 through 9 has been reached, at which point the counter starts over from 0. The output of U4A is thus 100 kHz, and is applied to U4B, another divide by 10 circuit. The output of U4B, at 10 kHz, is applied to U5 and U6 which form a divide by 10,000 circuit. The output of U6 is thus a square wave which goes high once each second.

The timing sequence is as follows:

A trailing edge of the 10 kHz output at pin 9 of U4B causes pin 11 of U9C to go high and pin 5 of U12B to go low. This negative-going transition at pin 5 of U12B causes the U12B flip-flop to latch a "1" into pin 9 and a "0" into pin 8. The "0" on pin 8 of U12B is fed back to the other input of U9C, blocking any further 10 kHz pulses from clocking U12B, and also enables U5 and U6 to start counting.

The "1" on pin 9 of U12B enables U11 and U12A, and opens the signal gate, U8B. U8B will now pass input signals from pin 13 to the counter circuits until one of its inputs is

driven low. 2 seconds after U5 and U6 are enabled, U11A will have divided the 1 Hz output of U6 by 2, and pin 5 of U11B will be driven low, which, in turn, causes U11B to present a logic "1" to pin 14 of J-K flip-flop U12A and a logic "0" to the signal gate U8B .

The signal at pin 13 of U8B has thus been gated to the counters for exactly 2 seconds. 10 μsec. after pin 14 of U12A goes high, a negative-going edge from counter U4A drives pin 1 of U12A low, clocking the logic "1" from pin 14 of U12A to pin 12, and causing pin 13 to go low.

This low, which will last for 100 μsec. (when another 10 kHz trailing edge triggers U12B through U9C) resets U12B. Pin 8 of U12B goes high, disabling U5 and U6, and pin 9 of U12B goes low, resetting U11 and U12A. 10 μsec. after U12A has been triggered, another 100 kHz trailing edge will reset it. Thus, pin 12 will have been high, and pin 13 will have been low for a 10 μsec. "window" after the counting period has ended. The low from pin 13 of U12A is inverted by U10A to drive pin 5 of U8A and pin 2 of U9A high during the 10 μsec. "window". 4 μsec. after this signal has been delivered to U9A, U4A will have counted up to 4, and pin 1 of U9A will be driven high, causing pin 10 of U13A to go high, and triggering the gate LED one-shot U15A and U15B. After another 3 μsec. , U4A will have counted up to 7, and pin 12 of U13B will go high, causing the display to be transferred from the counters into the latches.

After 1 more μsec. U4A will have counted up to 8, and pin 8 of U7B will go high to reset the counters. In another 82 μsec. (82+18=100 μsec.), this whole timing cycle will repeat for another count. Thus, the unit counts for 2 seconds, pauses for 100 μsec. during which the necessary housekeeping pulses are generated, and repeats.

Should a negative modulation peak in excess of 99% occur during counting, the -100% peak indicator from the modulation monitor will drive terminal pin 11 low, setting the U10 flip-flop. The logic "1" thus generated at pin 13 of U10 will keep the current count from being transferred to the display. At the beginning of the next count, the U10 flip-flop will be reset, and normal display will resume.

6-2 Signal Conditioner and Level Detector

The RF input signal, applied at terminal pin 18, drives a zero-axis amplitude limiter consisting of CR7, CR8 and U33. The output from this stage drives another identical limiter consisting of CR5, CR6 and U17. These limiters remove almost all of the AM modulation from the input signal. The limited signal is level shifted and buffered by Q1, and is applied to 'the signal gate at pin 13 of U8B.

The RF input from terminal pin 18 is also routed to CR9, which rectifies the RF signal current and C13 filters the rectified signal into a DC voltage which is proportional to the input carrier voltage. This signal is applied to one input of a voltage comparator, U45, and is compared to a preset DC voltage. If the input carrier voltage falls below this preset level, the output of U45 will go low, turning on the "RF LEVEL" indicator through U22F. An indication of insufficient input level is also routed to the alarm circuits through U15C and U14C.

6-3 Counter

During the 2 second "count" interval, signals from the signal conditioning circuitry will pass through U8B, and will toggle U18A, a flip-flop which divides the input frequency by a factor of 2. The pre-scaled output of U18A, at pin 12, is applied to decode up-counters U19A through U20B.

The total counting range of this array (U19A through U20B) is 10,000 (10x10x10x10), and the counter chain will overflow and restart counting from zero every 10,000 cycles of the input signal. Thus, if the input frequency to U19A is any integer multiple of 10 kHz, the BCD outputs of the counters will indicate zeros at the end of the counting period. If the input frequency to U19A is not an exact multiple of 10 kHz, the BCD outputs of the counters will contain a "residue" which indicates the difference between the input frequency and the nearest exact multiple of 10 kHz. For example, if, after counting has stopped, the residue on U20B through U19A is BCD "0001" , then the input frequency error is +1 count with respect to a multiple of 10 kHz. Similarly, if the residue on U20B through U19A is 9,999, the input frequency error is considered to be -1 count with respect to the nearest multiple of 10 kHz. (It should be noted that, although U20B has a total counting range of 10, it is actually configured as a divide by 5 driving a divide by 2. Only the BCD outputs of the divide by 5 are examined by the following circuitry, giving the instrument a total counting range of ±4999 Hz from any 10 kHz multiple.)

6-4 Arithmetic Circuits

The purpose of the arithmetic circuits is to examine the "residue" from counters U19A through U20B, and perform the necessary calculations to convert it to a true BCD frequency error indication. U23 through U26 are BCD "9's complement" generators and U27 through U30 are BCD adders.

If, at the end of the counting period, the residue on U20B through U19A is less than 5000, then pin 13 of U20B will be low, causing U23 through U26 to pass the BCD counter residue directly to the BCD adders. Since pin 13 of U20B will be low, pins 4 and 14 of U30 will also be driven low, and the counter residue will be added to BCD "0000". If the counter residue is 5000 or greater, pin 13 of U20B will be high, and U23 through U26 will generate the BCD 9's complement of the counter residue.

The complemented residue is applied to BCD adders, U27 through U30, and since the high on pin 13 of U20B drives pins 4 and 14 of U30 high, the complemented residue will be added to BCD "5000". This process of adding the BCD complement is arithmetically identical to subtraction, and the state of pin 13 of U20B indicates whether the BCD number generated by the arithmetic circuits indicates a negative or a positive frequency error.

Pin 13 of U20B also drives the clock input of latch U18B. If the total number of pulses counted by the counter is less than 5000, (at least one overflow) U18B will not be set, and the following circuitry will interpret the whole count as invalid.

7 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.*

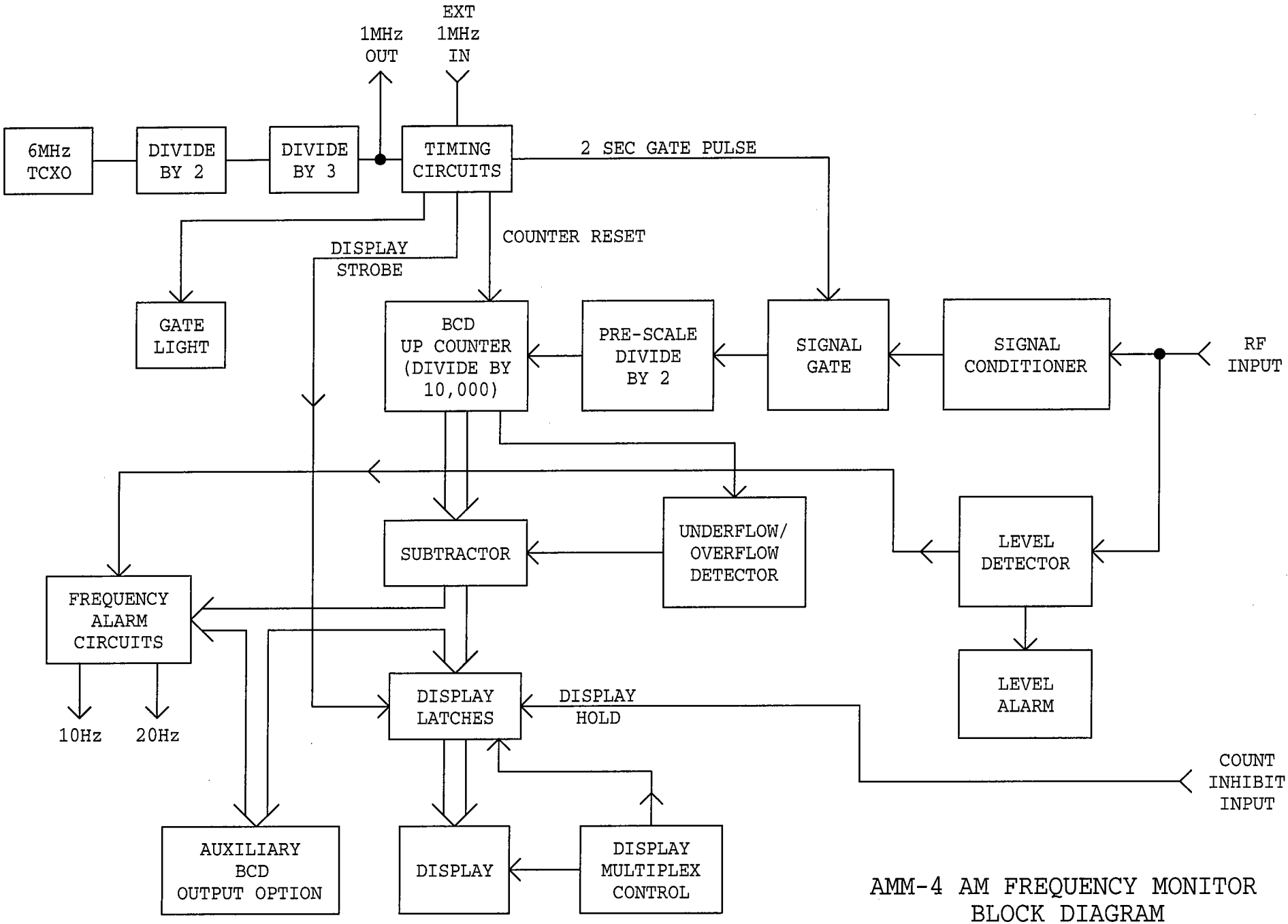
Orders may also be taken over the telephone. Parts orders can be put on your VISA, MasterCard, or American Express card, or we can ship them COD.

REFERENCE DESIGNATORS

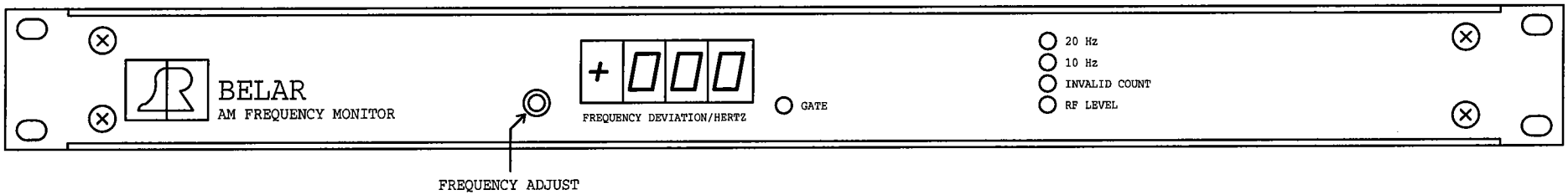
A	= assembly	J	= jack	S	= switch
BR	= diode bridge	L	= inductor	T	= transformer
C	= capacitor	M	= meter	TB	= terminal block
CR	= diode or LED	P	=plug	U	= integrated circuit
DS	= display or lamp	Q	= transistor	W	= cable
F	= fuse	R	= resistor	X	= socket
FL	= filter	RL	= relay	Y	= crystal
HDR	= header connector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

ABBREVIATIONS

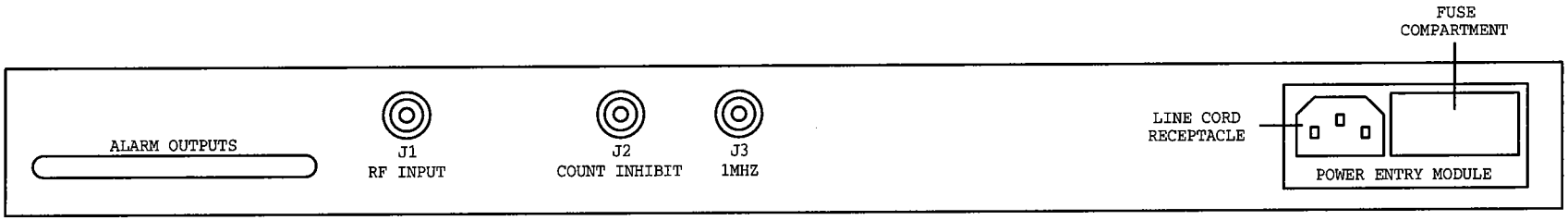
ADC	= analog-to-digital converter	PIV	= peak inverse voltage
BCD	= binary coded decimal	POLY	= polystyrene
CER	= ceramic	PORC	= porcelain
COMP	= composition	POT	= potentiometer
CONN	= connector	SEMICON	= semiconductor
DPM	= digital panel meter	SI	= silicon
ELEC	= electrolytic	TANT	= tantalum
GE	= germanium	μF	= 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		
pF	= picofarads		



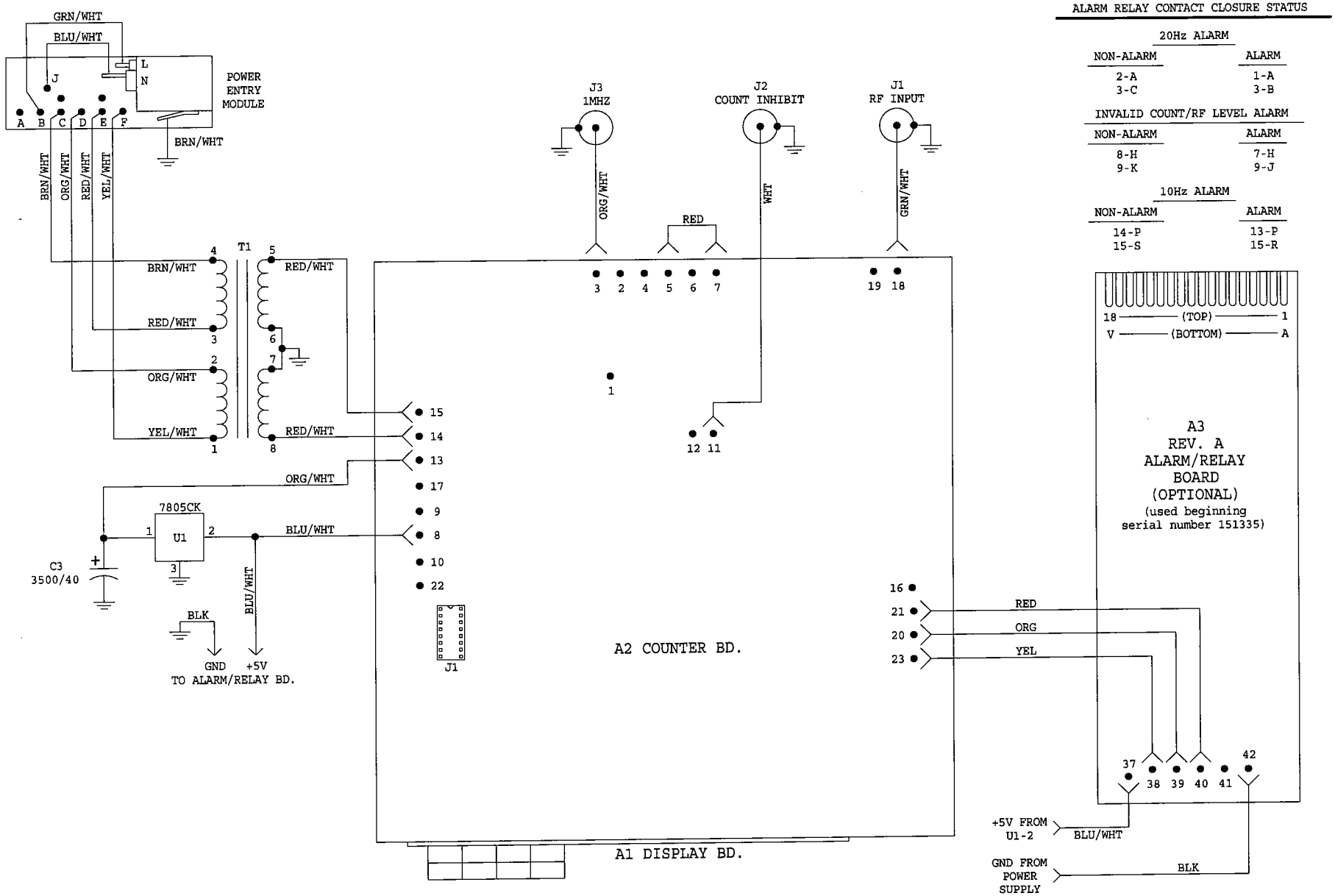
AMM-4 AM FREQUENCY MONITOR
BLOCK DIAGRAM



AMM-4 FRONT PANEL



AMM-4 CHASSIS REAR VIEW
BELAR ELECTRONICS



ALARM RELAY CONTACT CLOSURE STATUS

20Hz ALARM

NON-ALARM	ALARM
2-A	1-A
3-C	3-B

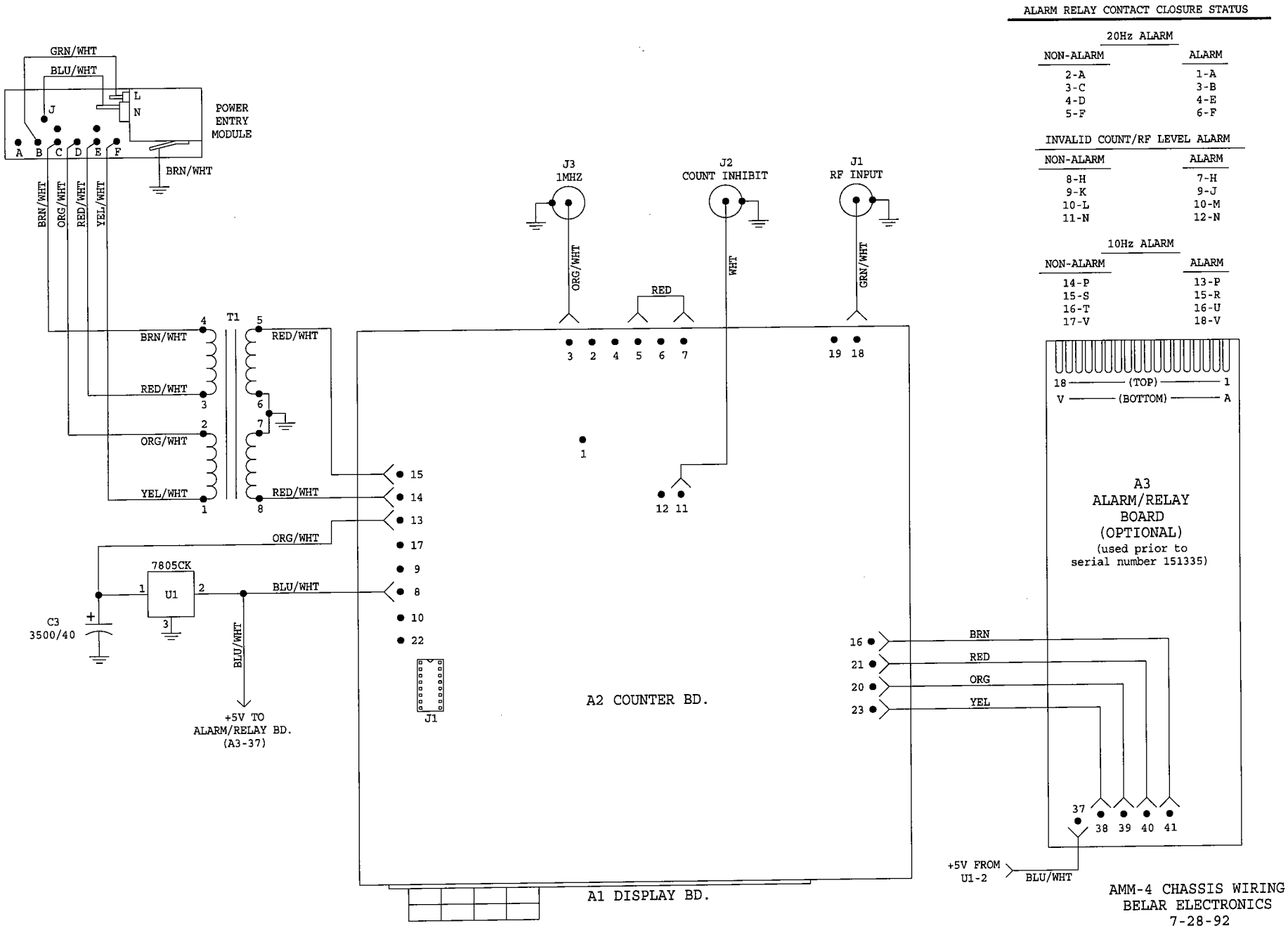
INVALID COUNT/RF LEVEL ALARM

NON-ALARM	ALARM
8-H	7-H
9-K	9-J

10Hz ALARM

NON-ALARM	ALARM
14-P	13-P
15-S	15-R

AMM-4 CHASSIS WIRING
BELAR ELECTRONICS
10-6-03


ALARM RELAY CONTACT CLOSURE STATUS
20Hz ALARM
NON-ALARM ALARM
2-A 1-A
3-C 3-B
4-D 4-E
5-F 6-F
INVALID COUNT/RF LEVEL ALARM
NON-ALARM ALARM
8-H 7-H
9-K 9-J
10-L 10-M
11-N 12-N
10Hz ALARM
NON-ALARM ALARM
14-P 13-P
15-S 15-R
16-T 16-U
17-V 18-V
GRN/WHT
BLU/WHT
POWER ENTRY MODULE
BRN/WHT
ORG/WHT
RED/WHT
YEL/WHT
T1
J3 1MHZ
J2 COUNT INHIBIT
J1 RF INPUT
A3 ALARM/RELAY BOARD (OPTIONAL)
(used prior to serial number 151335)
7805CK
U1
C3 3500/40
+5V TO ALARM/RELAY BD. (A3-37)
A2 COUNTER BD.
A1 DISPLAY BD.
+5V FROM U1-2
AMM-4 CHASSIS WIRING
BELAR ELECTRONICS
7-28-92

MAIN CHASSIS AMM-4

Reference Designation	Description		Part Number
C1,C2	C: FIXED CERAMIC 0.01uF 1.4kV	(NOTE 2)	0151-0010
C3	C: FIXED ELEC 3500uF 40V	(NOTE 1)	0180-0026
F1	FUSE: AGC 1/2A 250V (115 Vac line)		2110-0001
	FUSE: AGC 1/4A 250V (230 Vac line)		2110-0002
--	FUSEHOLDER:	(NOTE 2)	2110-0003
J1 thru J3	JACK: BNC		0360-0005
J4	JACK: POWER	(NOTE 2)	0360-0010
S1	SWITCH: SLIDE 115/230V SELECTOR	(NOTE 2)	3102-0002
T1	TRANSFORMER: POWER		9100-0011
U1	IC: 7805CK		1826-0013
--	LINE CORD (115 Vac line voltage)		8120-0002
--	LINE CORD (230 Vac line voltage)		8120-0004

NOTE 1: Prior to serial number 151219 - C3 was 1000uF 50V (0180-0002).

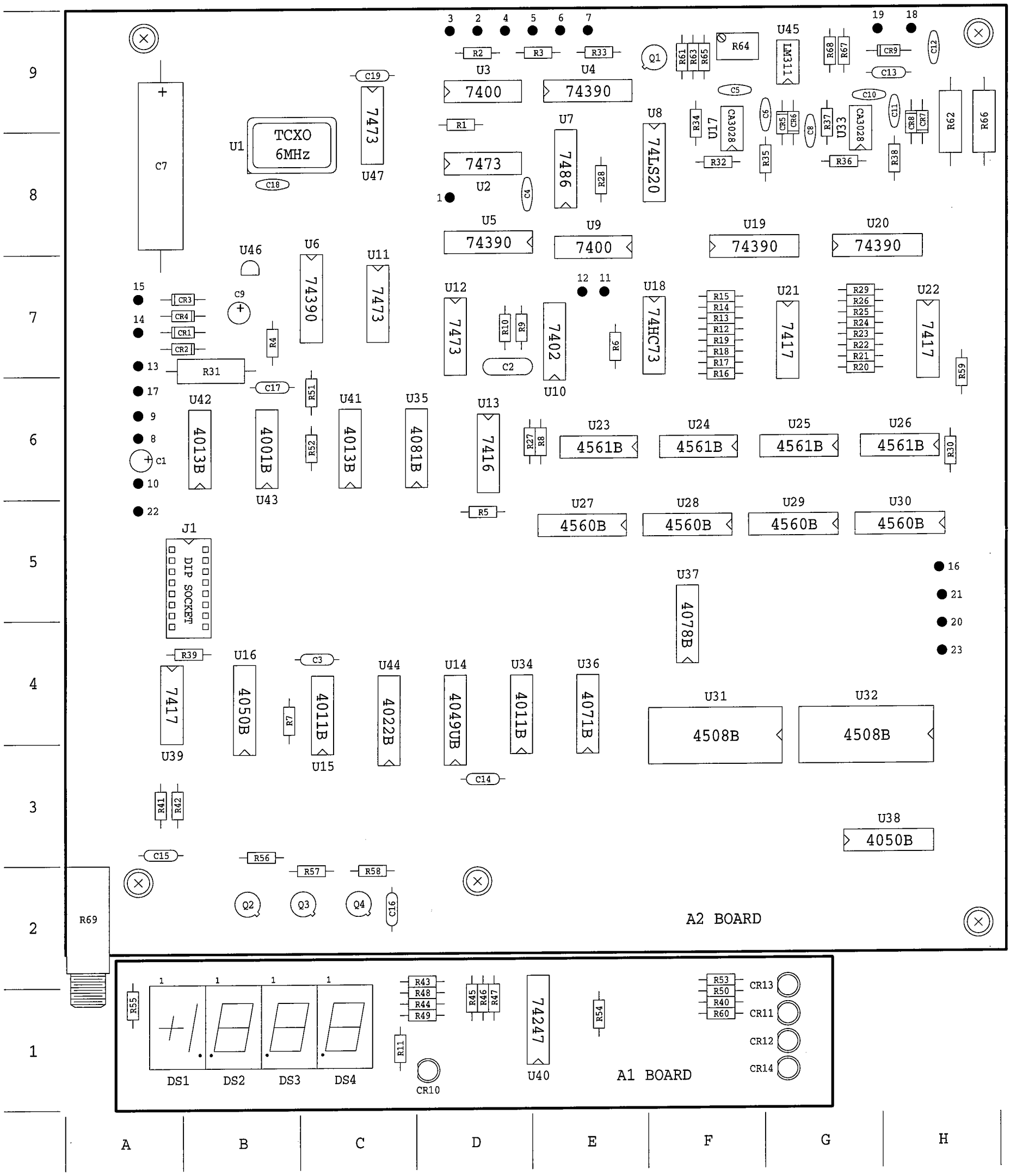
NOTE 2: Beginning serial number 151259, these parts are replaced by the 6J4 power entry module (0360-0020).

U7D 7406
U13E 7416
U13F 7416
U39E 7417
U39F 7417
U47B 7473
UNUSED
U1 TCXO 10MHz
(SEE NOTE 6)
FREQ ADJUST R61 10K
C18 0.01
C19 0.1
U47A 7473
U2A 7473
U2B 7473
TO 1MHz JACK-J3 (ON REAR PANEL)
INTERNAL REFERENCE JUMPER
U3A 7400
U3B 7400
U3C 7400
U3D 7400
R1 1K
R2 10K
R3 10K
U4A 74390
U4B 74390
U5A 74390
U5B 74390
U6A 74390
U6B 74390
U11A 7473
U11B 7473
U12A 7473
U12B 7473
R4 1K
+5V SOURCE
C1 15
+5V FROM U1-2 (ON CHASSIS)
U13C 7416
U16A 4050B
U15B 4011B
U15A 4011B
U14A 4049UB
U13A 7416
R5 2K
C3 0.1
R7 10M
U9A 7400
U9B 7400
U7A 7486
U7B 7486
U13B 7416
R8 2K
U8A 74LS20
U10B 7402
U10D 7402
U10C 7402
U10A 7402
R10 10K
FROM COUNT INHIBIT JACK-J2 (ON REAR PANEL)
C2 1200PF
R9 680
U8B 74LS20
U9C 7400
U9D 7400
R31 0.15
CR1 1N4006
CR2 1N4006
CR3 1N4006
CR4 1N4006
9VAC FROM T1-5 (ON CHASSIS)
9VAC FROM T1-8 (ON CHASSIS)
-11.5V INPUT TO OPTIONAL ALARM/RELAY BOARD (A3-A1)
U46 79L05
C9 15
C7 350
U39D 7417
U16C 4050B
U35C 4081B
U43C 4001B
U43B 4001B
U35D 4081B
C17 1.0
R51 120K
R52 270K
U15D 4011B
U43A 4001B
10HZ ALARM (TO A3-38)
U16B 4050B
U43D 4001B
U13D 7416
U16D 4050B
20HZ ALARM (TO A3-40)
U42A 4013B
U42B 4013B
U41A 4013B
U41B 4013B
U18A 74HC73
U19A 74390
U19B 74390
U20A 74390
U20B 74390
U7C 7486
C4 0.01
R28 2K
U18B 74HC73
R6 1K
R27 2K
R30 2K
U22C 7417
R24 1K
R35 1K
U21A 7417
U21B 7417
U21C 7417
U21D 7417
U21E 7417
U21F 7417
U22A 7417
U22B 7417
U23 4561B
U24 4561B
U25 4561B
U26 4561B
R12 2K
R13 2K
R14 2K
R15 2K
R16 2K
R17 2K
R18 2K
R19 2K
R20 2K
R21 2K
R22 2K
R23 2K
R25 2K
R29 2K
U27 4560B
U28 4560B
U29 4560B
U30 4560B
BCD OUTPUT J1
DIP SOCKET
U34A 4011B
U34B 4011B
U35A 4081B
U34C 4011B
U35B 4081B
U36A 4071B
U36B 4071B
U37 4078B
U14B 4049UB
U36C 4071B
R32 51
R35 51
R34 1K
U17 CA3028
Q1 2N5179
R33 510
C6 0.01
C5 0.01
C8 0.01
CR5 1N4446
CR6 1N4446
R36 51
R38 51
C11 0.01
R37 1K
U33 CA3028
C10 0.01
R62 1K 1W
CR8 1N4446
CR7 1N4446
ALARM LEVEL ADJUST
R41 15K
R63 3K
R64 5K
R65 2K
U45 LM311
R68 75K
R67 27K
C13 1.0
CR9 AA119
C12 0.01
R44 1K 1W
RF IN FROM J1 (ON REAR PANEL)
U22F 7417
INVALID COUNT/ RF LEVEL ALARM (TO A3-39)
U16E 4050B
U14C 4049UB
U15C 4011B
U22D 7417
U38E 4050B
CR10 GATE
CR13 20HZ
CR11 10HZ
CR12 INVALID COUNT
CR14 RF LEVEL
R53 160
R50 160
R49 160
R60 160
U40 74247
R43 100
R44 100
R45 100
R46 100
R47 100
R48 100
R49 100
R54 1K
U38A 4050B
U38B 4050B
U38C 4050B
U38D 4050B
U31A 4508B
U31B 4508B
U32A 4508B
U32B 4508B
R55 910
DS1
DS2
DS3
DS4
(SEE NOTE 7)
(ON A1 BOARD)
C15 0.1
C16 0.1
2N2907A Q4
2N2907A Q3
2N2907A Q2
R58 2K
R57 2K
R56 2K
U14D 4049UB
U14E 4049UB
U14F 4049UB
U44 4022B
R59 2K
U22E 7417
U39C 7417
U39B 7417
R42 1.1K
R41 1.1K
U38F 4050B
U36D 4071B
U39A 7417
U16F 4050B
U4D 4011B
R39 820
C14 0.1

NOTES:

1. FOR INTERCONNECTION DETAILS REFER TO CHASSIS WIRING DIAGRAM.
2. ⊖ INDICATES CIRCUIT BOARD PIN.
3. ALL RESISTANCE VALUES ARE IN OHMS.
4. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
5. ALL CAPACITANCE VALUES ARE IN UF, UNLESS OTHERWISE SPECIFIED.
6. UNITS SHIPPED BEFORE S/N 151206 HAVE A 1MHZ TCXO FOR U1. C18,C19, R69, AND U47 WERE NOT USED.
7. UNITS SHIPPED BEFORE S/N 151199 HAVE A MP5082-7652 DISPLAY FOR DS1 AND R39,41,42 & 55 WERE DIFFERENT VALUES. (SEE PARTS LIST)

AMM-4 A1,A2
REV. B
DISPLAY & COUNTER BD.
BELAR ELECTRONICS
9-18-91

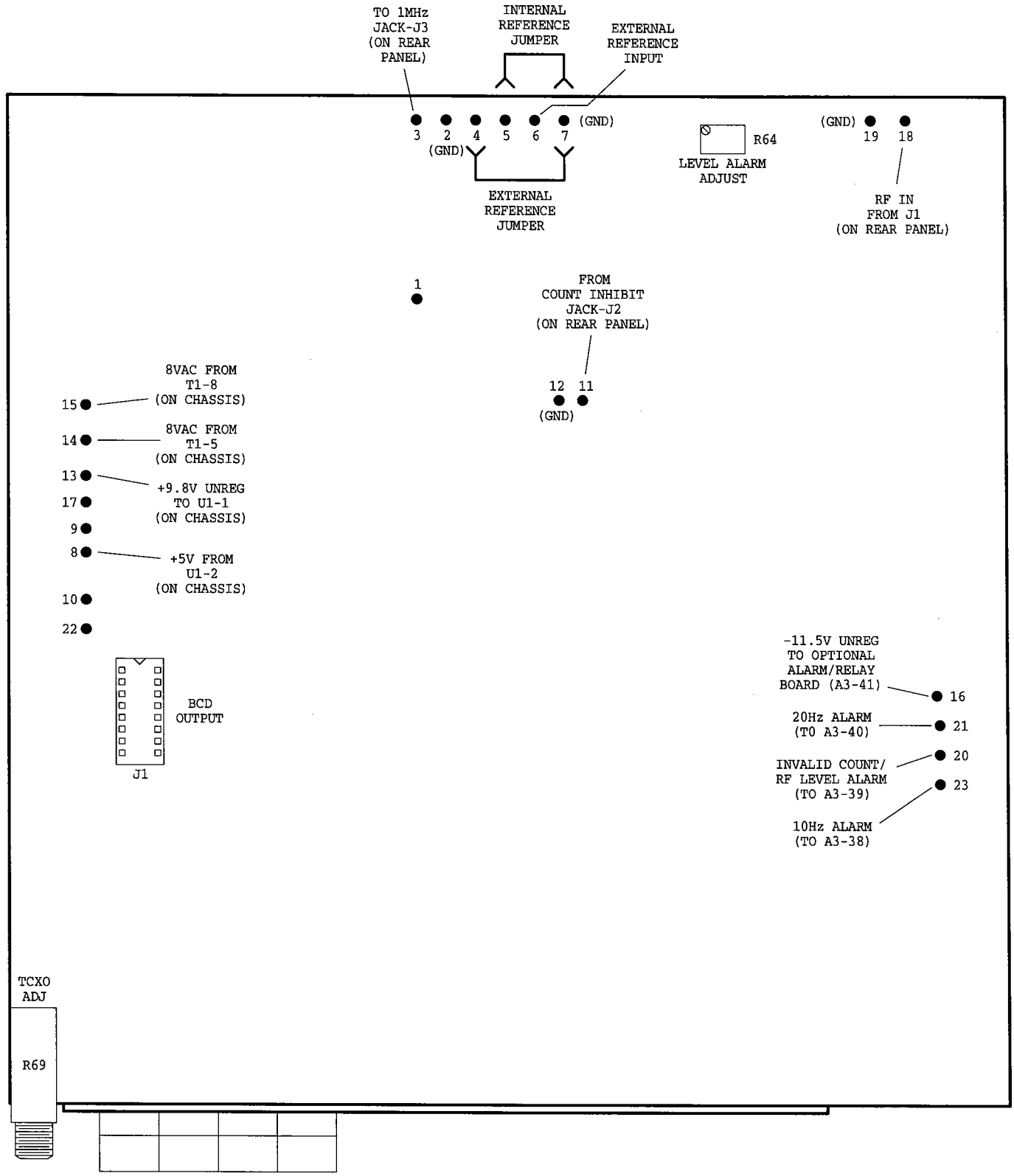


AMM-4 A1 & A2 BOARDS
REVISION B
COMPONENT LAYOUT
BELAR ELECTRONICS

AMM-4 A1 & A2 BOARD
PART LOCATIONS

Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc
C1 A6	CR13 G1	R18 F7	R50 F1	U12 D7	U44 C4
C2 D7	CR14 G1	R19 F7	R51 C6	U13 D6	U45 G9
C3 C4		R20 G7	R52 C6	U14 D4	U46 B7
C4 D8	DS1 A1	R21 G7	R53 F2	U15 C4	U47* C9
C5 F9	DS2 B1	R22 G7	R54 E1	U16 B4	
C6 F9	DS3 B1	R23 G7	R55 A1	U17 F9	pins
C7 A8	DS4 C1	R24 G7	R56 B3	U18 F7	----
C8 G8		R25 G7	R57 C2	U19 F8	1 D8
C9 B7	J1 B5	R26 G7	R58 C2	U20 G8	2 D9
C10 G9		R27 D6	R59 H7	U21 G7	3 D9
C11 H9	Q1 F9	R28 E8	R60 F1	U22 H7	4 D9
C12 H9	Q2 B2	R29 G7	R61 F9	U23 E6	5 D9
C13 H9	Q3 C2	R30 H6	R62 H9	U24 F6	6 E9
C14 D3	Q4 C2	R31 B7	R63 F9	U25 G6	7 E9
C15 A3		R32 F8	R64 F9	U26 H6	8 A6
C16 C2	R1 D9	R33 E9	R65 F9	U27 E5	9 A6
C17 B6	R2 D9	R34 F9	R66 H9	U28 F5	10 A6
C18* B8	R3 E9	R35 F8	R67 G9	U29 G5	11 E7
C19* C9	R4 B7	R36 G8	R68 G9	U30 H5	12 E7
	R5 D5	R37 G9	R69* A2	U31 F4	13 A7
CR1 A7	R6 E7	R38 H8		U32 G4	14 A7
CR2 A7	R7 B4	R39 B4	U1 B8	U33 G9	15 A7
CR3 A7	R8 E6	R40 F1	U2 D8	U34 D4	16 H5
CR4 A7	R9 D7	R41 A3	U3 D9	U35 C6	17 A6
CR5 G9	R10 D7	R42 A3	U4 E9	U36 E4	18 H9
CR6 G9	R11 C1	R43 D2	U5 D8	U37 F4	19 G9
CR7 H9	R12 F7	R44 D1	U6 C7	U38 H3	20 H4
CR8 H9	R13 F7	R45 D1	U7 E8	U39 A4	21 H5
CR9 H9	R14 F7	R46 D1	U8 F8	U40 E1	22 A5
CR10 D1	R15 F7	R47 D1	U9 E8	U41 C6	23 H4
CR11 G1	R16 F7	R48 D1	U10 E7	U42 B6	
CR12 G1	R17 F7	R49 D1	U11 C7	U43 B6	

*NOT USED BEFORE S/N 151206



AMM-4 A2 BOARD
REVISION B
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A1 DISPLAY BOARD - AMM-4

Reference Designation	Description	Part Number
CR10	LED: RED MV5053	1910-0001
CR11	LED: YEL MV5353	1910-0002
CR12 thru CR14	LED: RED MV5053	1910-0001
DS1*	DISPLAY: HP5082-7656	1930-0003
*NOTE: UNITS BEFORE S/N 151119 HAVE A HP5082-7652 DISPLAY FOR DS1. CONSULT THE FACTORY IF A REPLACEMENT IS REQUIRED.		
DS2 thru DS4	DISPLAY: HP5082-7650	1930-0002
R11	R: METAL FILM 160 2% 1/4W	0751-1615
R40	R: METAL FILM 160 2% 1/4W	0751-1615
R43 thru R49	R: METAL FILM 100 2% 1/4W	0751-1015
R50	R: METAL FILM 160 2% 1/4W	0751-1615
R53	R: METAL FILM 160 2% 1/4W	0751-1615
R54	R: METAL FILM 1k 2% 1/4W	0751-1025
R55*	R: METAL FILM 910 2% 1/4W	0751-9115
*BEFORE S/N 151119 R55 WAS 200 5% 1/4W		
R60	R: METAL FILM 160 2% 1/4W	0751-1615
U40	IC: 74247	1821-0027

A2 COUNTER BOARD - AMM-4

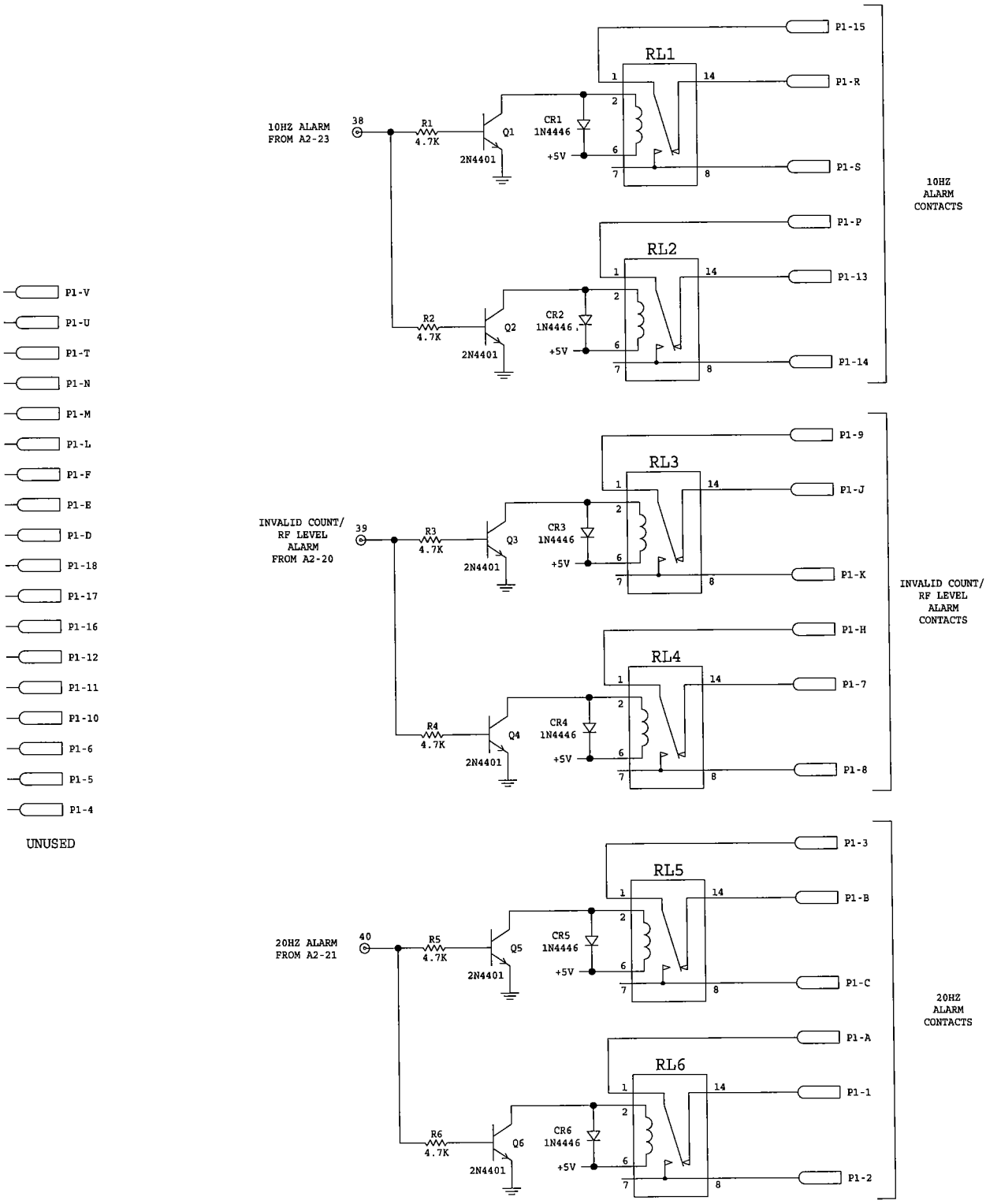
Reference Designation	Description	Part Number
C1	C: FIXED TANT 15uF 15V	0185-0003
C2	C: FIXED MICA 120pF 5%	0140-1215
C3	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C4 thru C6	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C7	C: FIXED ELEC 350uF 16V	0180-0025
C8	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C9	C: FIXED TANT 15uF 15V	0185-0003
C10 thru C12	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C13	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C14 thru C16	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C17	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C18*	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C19*	C: FIXED CERAMIC 0.1uF 50V	0151-0006
*C18 & C19 NOT USED BEFORE S/N 151206		
CR1 thru CR4	DIODE: 1N4006	1900-0016
CR5 thru CR8	DIODE: 1N4446	1900-0002
CR9	DIODE: 1N277 GERMANIUM	1900-0001
J1	SOCKET: IC 16 PIN DIP	1200-0012

Reference Designation	Description	Part Number
Q1*	TRANSISTOR: 2N5179	1850-0023
	*ALTERNATE TYPE: 2N914, P/N 1850-0006	
Q2 thru Q4	TRANSISTOR: 2N2907A	1850-0027
R1	R: METAL FILM 1k 2% 1/4W	0751-1022
R2,R3	R: METAL FILM 10k 2% 1/4W	0751-1032
R4	R: METAL FILM 1k 2% 1/4W	0751-1022
R5	R: METAL FILM 2k 2% 1/4W	0751-2022
R6	R: METAL FILM 1k 2% 1/4W	0751-1022
R7	R: FIXED CARBON 10M 5% 1/4W	0683-1065
R8	R: METAL FILM 2k 2% 1/4W	0751-2022
R9	R: METAL FILM 680 2% 1/4W	0751-6812
R10	R: METAL FILM 10k 2% 1/4W	0751-1032
R12 thru R30	R: METAL FILM 2k 2% 1/4W	0751-2022
R31	R: WIRE WOUND 0.15 5% 2W	0811-0017
R32	R: METAL FILM 51 2% 1/4W	0751-5102
R33	R: METAL FILM 510 2% 1/4W	0751-5112
R34	R: METAL FILM 1k 2% 1/4W	0751-1022
R35,R36	R: METAL FILM 51 2% 1/4W	0751-5102
R37	R: METAL FILM 1k 2% 1/4W	0751-1022
R38	R: METAL FILM 51 2% 1/4W	0751-5102
R39*	R: METAL FILM 820 2% 1/4W	0751-8212
	*BEFORE S/N 151119 R39 WAS 160 5% 1/4W	
R41,R42*	R: METAL FILM 1.1k 2% 1/4W	0751-1122
	*BEFORE S/N 151119 R41 & R42 WERE 330 5% 1/4W	
R51	R: METAL FILM 120k 2% 1/4W	0751-1242
R52	R: METAL FILM 270k 2% 1/4W	0751-2742
R56 thru R59	R: METAL FILM 2k 2% 1/4W	0751-2022
R61	R: METAL FILM 15k 2% 1/4W	0751-1532
R62	R: FIXED CARBON 1k 10% 1W	0690-1021
R63	R: METAL FILM 3k 2% 1/4W	0751-3022
R64	R: VAR COMP 5k, 10 TURN	2100-0020
R65	R: METAL FILM 2k 2% 1/4W	0751-2022
R66	R: FIXED CARBON 1k 10% 1W	0690-1021
R67	R: METAL FILM 27k 2% 1/4W	0751-2732
R68	R: METAL FILM 75k 2% 1/4W	0751-7532
R69*	R: VAR COMP 10k, 10 TURN	2100-0018
	*BEFORE S/N 151206 R69 WAS NOT USED	
U1*	IC: TCXO 6MHz	0410-0011
	*BEFORE S/N 151206 U1 WAS A 3MHz CRYSTAL OSCILLATOR	
U2	IC: 7473	1821-0010
U3	IC: 7400	1821-0001
U4 thru U6	IC: 74390	1821-0022
U7	IC: 7486	1821-0013
U8	IC: 74LS20	1821-0024
U9	IC: 7400	1821-0001
U10	IC: 7402	1821-0002
U11,U12	IC: 7473	1821-0010
U13	IC: 7416	1821-0004
U14	IC: 4049UB	1822-0005

A2 COUNTER BOARD - AMM-4 CONT.

Reference Designation	Description	Part Number
U15	IC: 4011B	1822-0002
U16	IC: 4050B	1822-0006
U17	IC: CA3028AE	1826-0034
U18	IC: 74HC73	1822-0044
U19,U20	IC: 74390	1821-0022
U21,U22	IC: 7417	1821-0005
U23 thru U26	IC: 4561B	1822-0014
U27 thru U30	IC: 4560B	1822-0013
U31,U32	IC: 4508B	1822-0011
U33	IC: CA3028AE	1826-0034
U34	IC: 4011B	1822-0002
U35	IC: 4081B	1822-0010
U36	IC: 4071B	1822-0008
U37	IC: 4078B	1822-0009
U38	IC: 4050B	1822-0006
U39	IC: 7417B	1821-0005
U41,U42	IC: 4013B	1822-0003
U43	IC: 4001B	1822-0015
U44	IC: 4022B	1822-0004
U45	IC: LM311	1826-0009
U46	IC: 79L05CP	1826-0017
U47*	IC: 7473	1821-0010

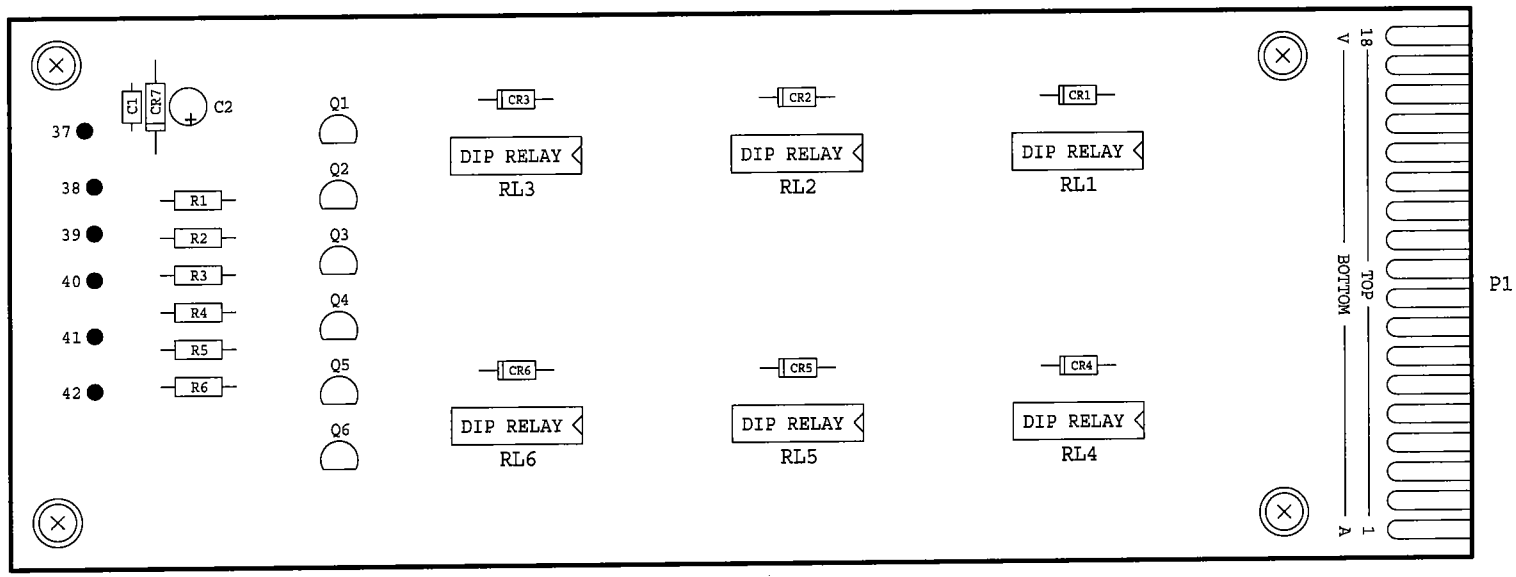
*BEFORE S/N 151206 U47 WAS NOT USED



NOTES:

1. FOR INTERCONNECTION DETAILS REFER TO CHASSIS WIRING DIAGRAM.
2. ⊙— INDICATES CIRCUIT BOARD PIN.
3. ▭— DENOTES CARD EDGE FINGER.
4. ALL RESISTANCE VALUES ARE IN OHMS.
5. ALL RESISTORS ARE 1/4 WATT.
6. ALL CAPACITANCE VALUES ARE IN UF.
7. RELAYS SHOWN IN ALARM CONDITION WHICH IS DE-ENERGIZED.

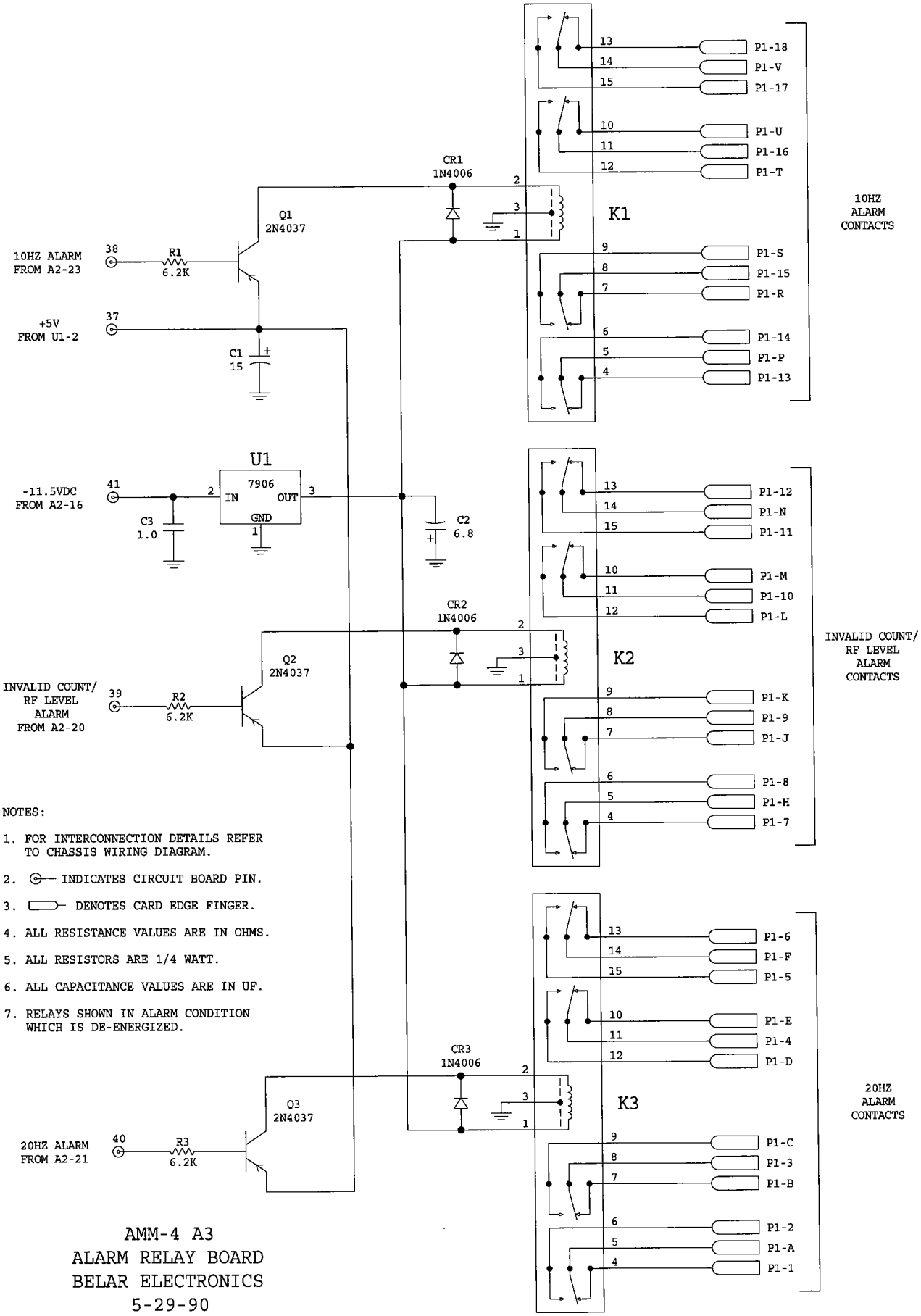
AMM-4 A3
REV. A
ALARM RELAY BOARD
BELAR ELECTRONICS
10-6-03
(used beginning serial number 151335)



AMM-4 A3 BOARD
REV. A
COMPONENT LAYOUT
BELAR ELECTRONICS
(used beginning serial number 151335)

AMM-4 A3 ALARM RELAY BOARD, REV. A
(used beginning serial number 151335)

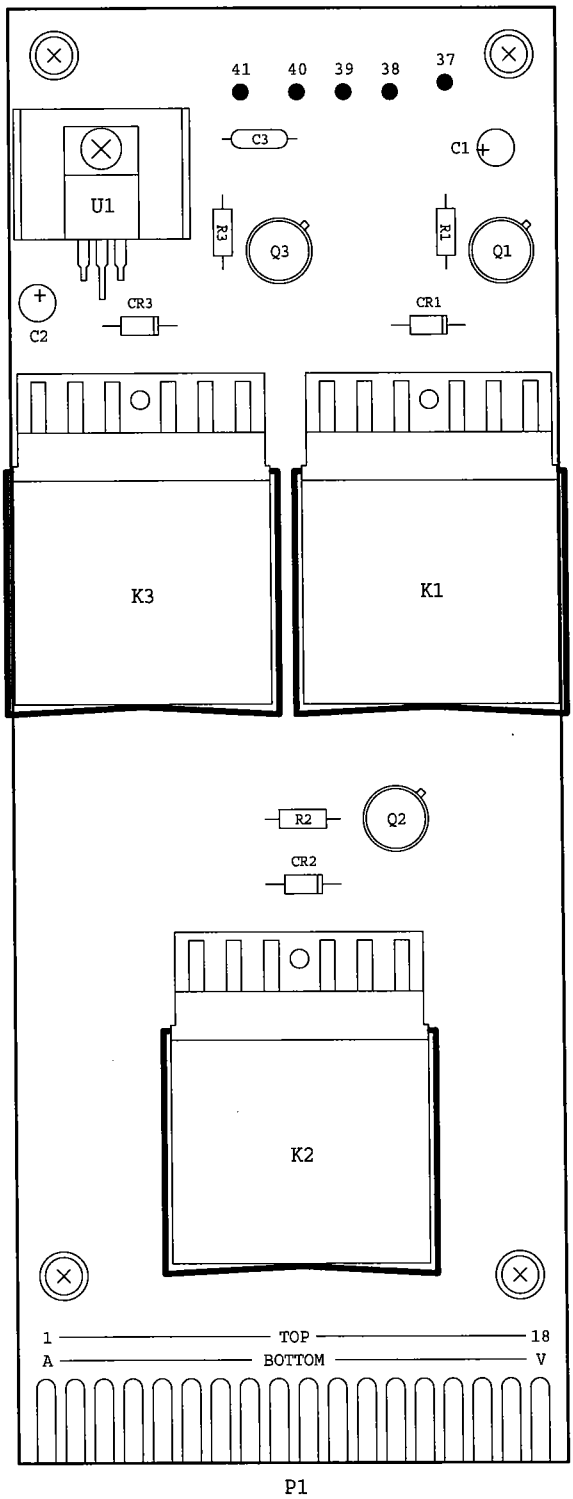
Reference Designation	Description	Part Number
C1	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C2	C: FIXED TANT 15uF 16V	0185-0003
CR1 thru CR6	DIODE: 1N4446	1900-0002
CR7	DIODE: 1N4006	1900-0016
Q1 thru Q6	TRANSISTOR: 2N4401	1850-0028
R1 thru R6	R: METAL FILM 4.7k 2% 1/4W	0751-4722
RL1 thru RL6	RELAY: 5V 0.5A SPDT, W172DIP-1	1600-0006



NOTES:

1. FOR INTERCONNECTION DETAILS REFER TO CHASSIS WIRING DIAGRAM.
2. ⊙— INDICATES CIRCUIT BOARD PIN.
3. ▭— DENOTES CARD EDGE FINGER.
4. ALL RESISTANCE VALUES ARE IN OHMS.
5. ALL RESISTORS ARE 1/4 WATT.
6. ALL CAPACITANCE VALUES ARE IN UF.
7. RELAYS SHOWN IN ALARM CONDITION WHICH IS DE-ENERGIZED.

AMM-4 A3
ALARM RELAY BOARD
BELAR ELECTRONICS
5-29-90
(used prior to serial number 151335)



AMM-4 A3 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS
(used prior to serial number 151335)

AMM-4 A3 ALARM RELAY BOARD
(used prior to serial number 151335)

Reference Designation	Description	Part Number
C1	C: FIXED TANT 15uF 15V	0185-0003
C2	C: FIXED TANT 6.8uF 25V	0185-0002
C3	C: FIXED CERAMIC 1.0uF 50V	0151-0008
CR1 thru CR3	DIODE: 1N4006	1900-0016
K1 thru K3	RELAY: 12V 2A 4PDT, R40-E1-Y4-V200	1600-0001
Q1 thru Q3	TRANSISTOR: 2N4037	1850-0011
R1 thru R3	R: METAL FILM 6.2k 2% 1/4W	0751-6222
U1	IC: 7906CT	1826-0018
XK1 thru XK3	SOCKET: RELAY	1200-0040