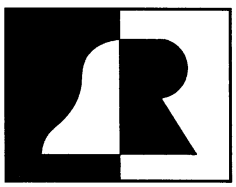
Model FMM-4A
FM AUTOMATIC
FREQUENCY MONITOR

Guide to Operations



BELAR ELECTRONICS LABORATORY, INC.
119 LANCASTER AVENUE • P.O. BOX 76 • DEVON, PA 19333-0076 USA
VOICE (610) 687-5550 • FAX (610) 687-2686
WEB: http://www.belar.com/ • E-mail: sales@belar.com • service@belar.com • parts@belar.com

WARRANTY AND ASSISTANCE

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

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

1 General Information

1-1 General Description

The Belar FMM-4A is a highly accurate FM frequency monitor designed especially for automatic broadcast transmitter monitoring. The counter will accurately monitor FM Carrier, Pilot, and SCA Frequencies. A large 3½ digit LED display provides a range of ±19.99 kHz for Carrier, ±1999 Hz for SCA, and ±10 Hz for Pilot. Front panel LED indicators are provided to warn of low level input or loss of any monitoring frequencies. To prevent false alarms, the FMM-4A inhibits the off-frequency alarms until three successive errors are detected. Two levels of alarm are provided for Carrier deviations. An alarm is also provided to indicate an invalid count, which could result from too low an input level or a malfunction with the counter. An optional alarm relay board is available.

1-2 Physical Description

The FMM-4A 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 AC power input, line voltage selector, inputs and outputs are located on the rear of the FMM-4A chassis on individual BNC connectors.

1-3 Electrical and Mechanical Specifications

Frequency Range . . . . . see below
Display . . . . . Large 3½ digit LED
Gate Time . . . . . 2 seconds
Time Base . . . . . 6 MHz
Time Base Output . . . . . 6 MHz TTL compatible level
Invalid Count Alarm . . . . . prevents false counts due to low level or problem in counter
Level Alarms . . . . . 3 LED Indicators

CARRIER
Frequency Range . . . . . 80 MHz to 120 MHz
Sensitivity . . . . . RF(LO/IF) . . (200/100)mV
Resolution . . . . . ±10 Hz
Range . . . . . ±19.99 kHz
Off-Frequency Alarms . . . . . ±1 kHz & ±2 kHz

PILOT

Frequency Range . . . . . 19 kHz ± 10 Hz
Sensitivity . . . . . 500 mV
Resolution . . . . . ±0.1 Hz
Range . . . . . ±10 Hz
Off-Frequency Alarms . . . . . ±2 Hz

SCA

Frequency Range . . . . . 67 kHz direct
or follows range of Belar SCM-2 SCA monitor
Sensitivity . . . . . 500 mV
Resolution . . . . . ±1 Hz
Range . . . . . ±1999 Hz
Frequency Alarms . . . . . ±500 Hz

Dimensions . . . . . 1.75"H x 12"D x 19"W
(EIA Rack Mount)

Power Requirements . . . . . 115/230 VAC, 50/60 Hz

1-4 Accessories

An optional alarm relay board is available for the Belar FMM-4A Automatic FM Frequency Monitor. It mounts inside the FMM-4A and provides eight normally open relays corresponding to the eight alarm conditions of the monitor. These alarms are Carrier Level, Carrier Off Frequency ±1kHz, Carrier Off Frequency 2 kHz, Pilot Level, Pilot Off Frequency, SCA Level, SCA Off Frequency, and Invalid Count.

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 FMM-4A 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 to 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 FMM-4A Modulation Monitor is designed to be mounted in a standard 19-inch rack. When mounted in a rack, a slight air space should be provided above and below the unit. When the monitor is mounted above high heat generating equipment such as vacuum-tube power supplies, consideration should be given to cooling requirements which allow a free movement of cooler air through and around the FMM-4A. In no instance should the ambient chassis temperature be allowed to rise above 50°C (122°F).

The Model FMM-4A 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 180062 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 (½A 250V for 115Vac, ¼A 250V for 230Vac). Plug the line cord back in.

Units with serial number 180063 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 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, install the proper fuse (½A 250V for 115Vac, ¼A 250V for 230Vac), close the fuse door, and plug the line cord back in.

3 Operation

3-1 Initial Operation

For use at the transmitter, connect an RF sample to the RF INPUT (J2) jack on the rear panel of the FMM-4A. Depress the switch on the rear labeled RF. The monitor will now begin measuring carrier.

For use with the Belar RFA-4 or Belar RFA-1A RF amplifier, connect the Local Oscillator output of the RF amplifier (labeled L.O.) to the RF INPUT (J2) jack. Also connect the 10.7 jack of the RF amplifier to the IF INPUT (J5). Depress both the RF and IF buttons.

3-2 Normal Operation

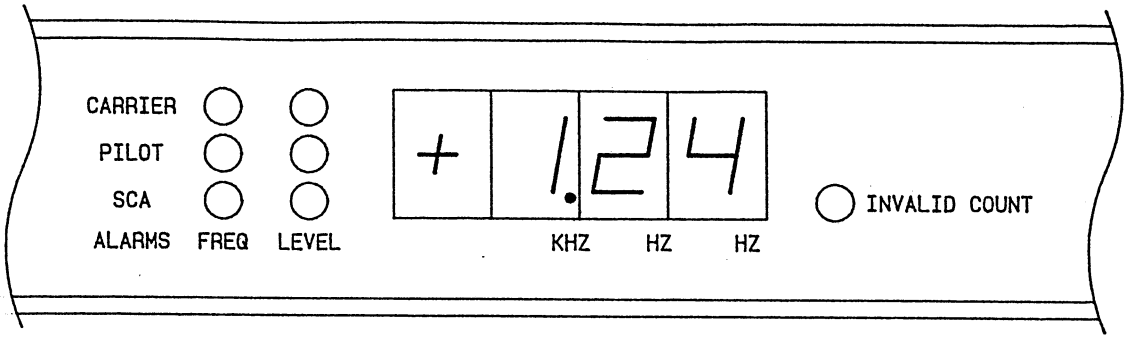
The FMM-4A will measure Carrier Frequency, Pilot Frequency, and SCA Frequency.

Typical Frequency Display readings are shown on the next page.

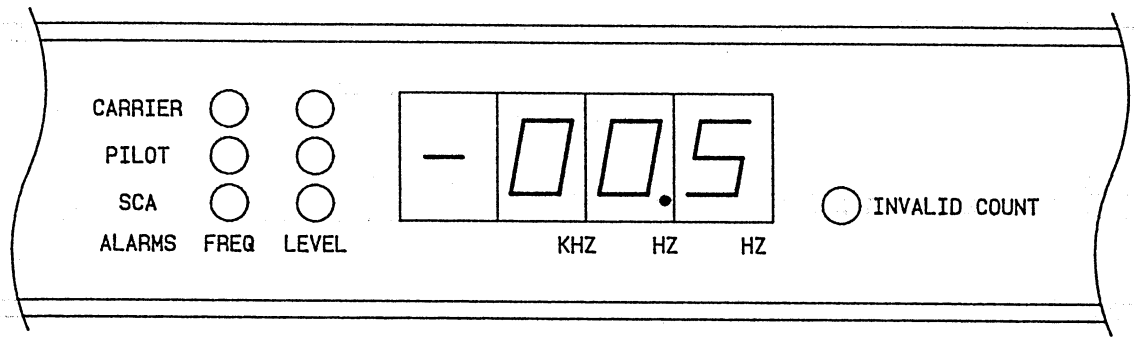
To measure Pilot Frequency, connect a source of filtered pilot (such as from the Belar FMS-2) to the Pilot Input jack (J3) and depress the Pilot enable switch.

To measure SCA Frequency, connect a source of filtered 67 kHz SCA to the SCA and depress the SCA enable switch. For measurement of an SCA other than 67 kHz, the Belar SCM-2 SCA Monitor is required.

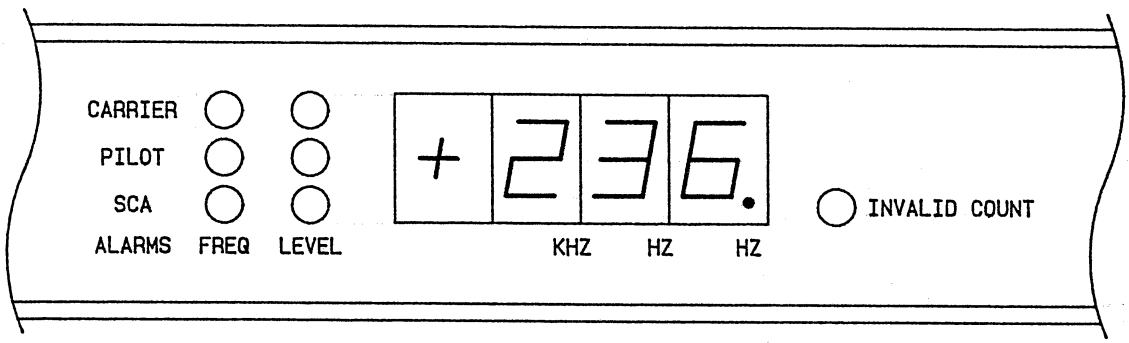
A detailed description of the front and rear panel displays, adjustments, and connectors follows. The numbers correspond the front and rear panel view of the unit as shown in the drawings section of this manual.



INDICATES A CARRIER FREQUENCY 1.24 kHz HIGH
NOTE: THE kHz DECIMAL INDICATOR IS LIGHTED TO INDICATE IT IS MEASURING CARRIER FREQUENCY.



INDICATES A PILOT FREQUENCY 0.5 Hz LOW
NOTE: THE Hz DECIMAL INDICATOR IS LIGHTED TO INDICATE IT IS MEASURING PILOT FREQUENCY.



INDICATES A SCA FREQUENCY 236 Hz HIGH
NOTE: THE Hz DECIMAL INDICATOR IS LIGHTED TO INDICATE IT IS MEASURING SCA FREQUENCY.

APPROPRIATE "FREQ" LED WILL ILLUMINATE IF CARRIER, PILOT OR SCA FREQUENCY EXCEEDS FCC LIMIT.

FMM-4A TYPICAL FREQUENCY DISPLAY READINGS

3-3 Front Panel Description

1. TIMEBASE FREQUENCY ADJUSTMENT: The 10K pot will provide necessary adjustment for the 6MHz timebase. The 6MHz test output is available on J6[24] of the back panel.

2. CARRIER FREQUENCY ALARM: This two-color LED indicates frequency deviation of the carrier. When it is amber, it indicates ±1kHz; when it is red, it indicates ±2kHz deviation. Frequency alarms will be activated only after three successive counts in this condition.

3. CARRIER LEVEL ALARM: This red LED indicates either a loss of carrier or a level too low for proper frequency measurement.

4. PILOT FREQUENCY ALARM: The alarm will be activated for frequency deviation of the pilot of ±2Hz or greater.

5. PILOT LEVEL ALARM: This red LED indicates either a loss of pilot or a level too low for proper frequency measurement.

6. SCA FREQUENCY ALARM: The alarm will be activated for frequency deviation of the SCA (67kHz) of ±500Hz or more. Frequency measurements other than 67kHz will require the Belar SCA Modulation Monitor (SCM-2).

7. SCA LEVEL ALARM: This red LED indicates either a loss of SCA level or a level too low for proper frequency measurement.

8. 3-½ DIGIT LED DISPLAY: Provides a readout of all frequency deviation measurements. When all input frequencies are selected for monitoring, the display will sequentially show each measurement for 2 seconds. The decimal point indicates the corresponding input as well as the units of measurement (see items 9, 10 & 11 below). Display will be blanked if the maximum readout is reached or if no input is selected for measurements. A self test at Power-Up will display all segments for a period of 6 seconds and the decimal point will move from right to left.

9. CARRIER DECIMAL: Activated only when displaying carrier frequency measurement.

10. PILOT DECIMAL: Activated only when displaying pilot frequency measurement.

11. SCA DECIMAL: Activated only when displaying SCA frequency measurement.

12. INVALID COUNTS: The red LED will indicate intermediate low level or malfunction in the counter. At this condition the frequency alarms are held in their OFF condition to prevent a false alarm.

13. MONITORING INDICATOR: Green LEDs light to indicate the current input selection (RF, PILOT, SCA) being measured.

3-4 Rear Panel Description

14. ALARM OUTPUTS: An optional relay card will provide all front panel LED alarm indicators for remote monitoring.

15. RF INPUT: Carrier or Local Oscillator input jack. This input can be used in direct (Carrier) mode or with the Local Oscillator of the RF amplifier. (*Note:* when in local Oscillator mode, the IF[18] input and IF[23] enable selector are also required for proper measurement.)

16. PILOT INPUT: Pilot input jack.

17. SCA INPUT: SCA input jack.

18. IF INPUT: Intermediate frequency input jack. This input is used in conjunction with the Belar RFA-4 RF amplifier for off-the-air frequency monitoring.

19. RF: Carrier input selector switch. Enables/disables frequency measurement of the carrier.

20. PIL: Pilot input selector switch. Enables/disables frequency measurement of the pilot.

21. SCA: SCA input selector switch. Enables/disables frequency measurement of the SCA.

22. AVG: Averaging selector switch. When enabled will average the carrier (Local Oscillator) readouts only.

23. IF: Local oscillator selector switch. When enabled, the monitor measures the Local Oscillator and the Intermediate Frequency of the RF Amplifier, and performs the necessary computations to display the correct carrier deviation. In this mode of operation 2 seconds is added between carrier deviation readouts.

24. 6MHz TEST: Output jack provides the 6MHz test point of the timebase necessary for correct measurements of the monitor.

3-5 Optional Alarm Relay Board Connector

Pin	Function
1	1 kHz Carrier Frequency Common
2	1 kHz Carrier Frequency Normally Open
3	1 kHz Carrier Frequency Common
4	1 kHz Carrier Frequency Normally Open
5	Carrier Level Common
6	Carrier Level Normally Open
7	Pilot Frequency Common
8	Pilot Frequency Normally Open
9	Pilot Level Common
10	Pilot Level Normally Open
L	SCA Frequency Common
K	SCA Frequency Normally Open
J	SCA Level Common
H	SCA Level Normally Open
F	Invalid Count Common
E	Invalid Count Normally Open
A-D	Not Used

4 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.*

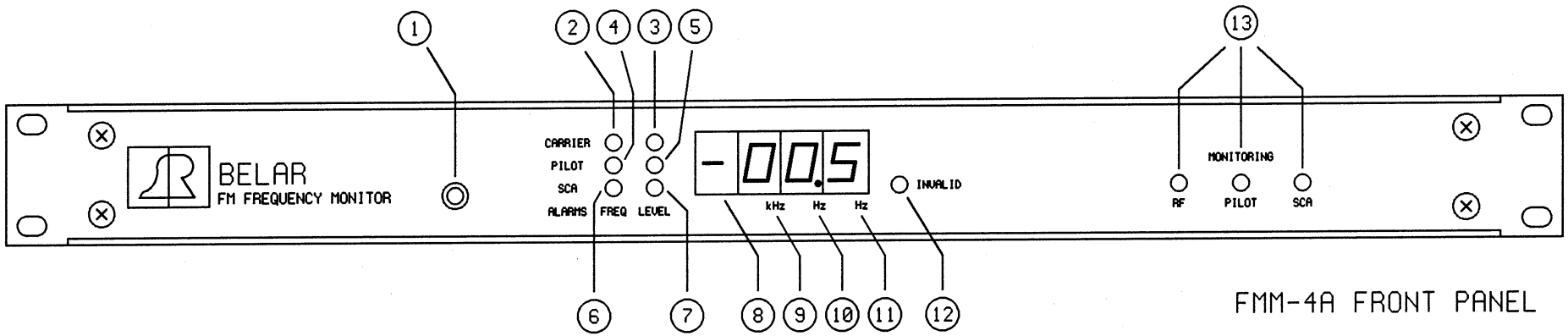
Orders may also be taken over the telephone. Parts orders can be put on your VISA, MasterCard, or American Express card, or we can ship them COD.

REFERENCE DESIGNATORS

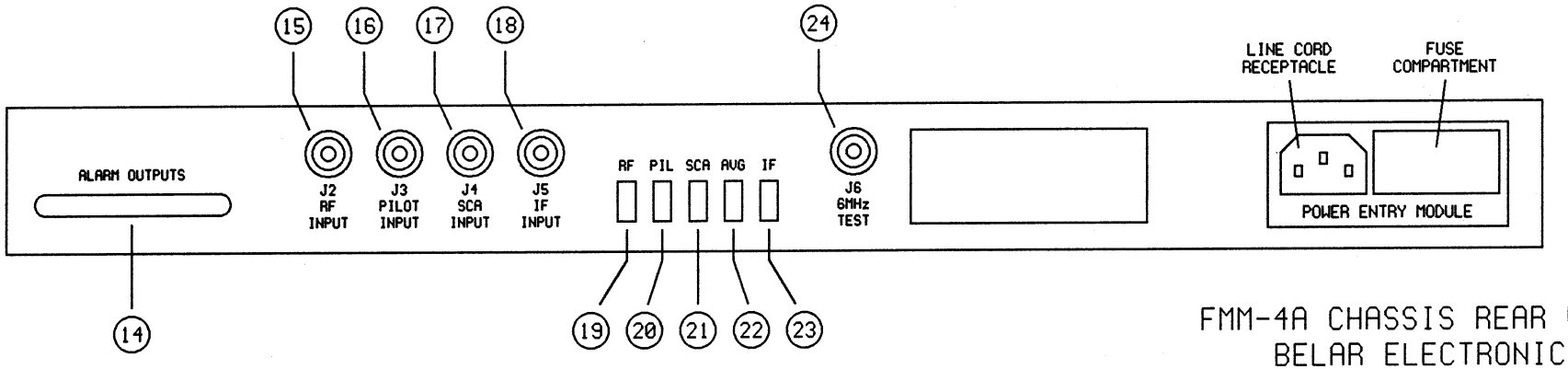
A	= assembly	J	= jack	S	= switch
BR	= diode bridge	L	= inductor	T	= transformer
C	= capacitor	M	= meter	TB	= terminal block
CR	= diode or LED	P	= plug	U	= integrated circuit
DS	= display or lamp	Q	= transistor	W	= cable
F	= fuse	R	= resistor	X	= socket
FL	= filter	RL	= relay	Y	= crystal
HDR	= header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

ABBREVIATIONS

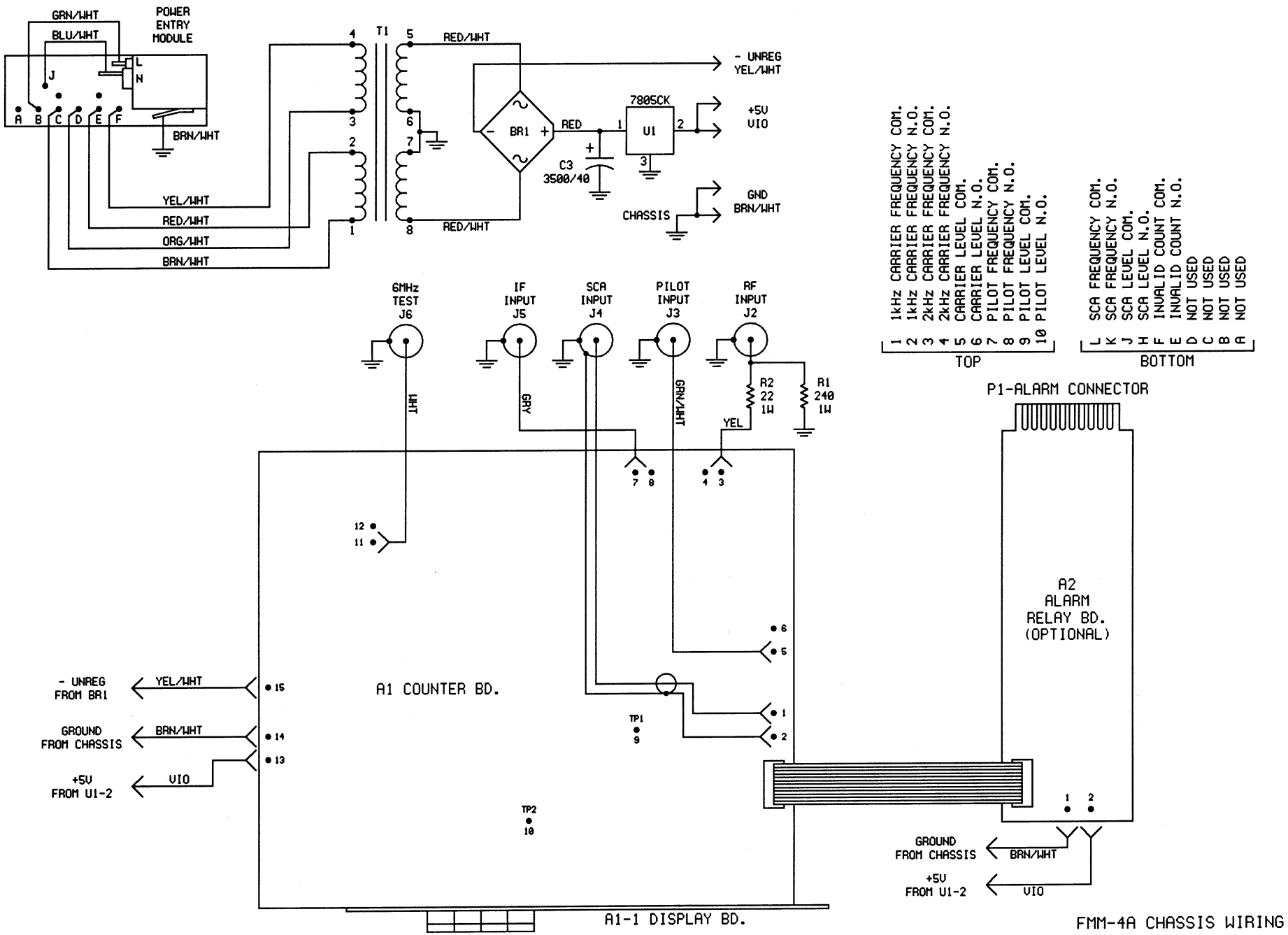
BCD	= binary coded decimal	PIV	= peak inverse voltage
CER	= ceramic	POLY	= polystyrene
COMP	= composition	PORC	= porcelain
CONN	= connector	POT	= potentiometer
DPM	= digital panel meter	SEMICON	= semiconductor
ELEC	= electrolytic	SI	= silicon
GE	= germanium	TANT	= tantalum
IC	= integrated circuit	uF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



FMM-4A FRONT PANEL



FMM-4A CHASSIS REAR VIEW
BELAR ELECTRONICS



FMM-4A CHASSIS WIRING
BELAR ELECTRONICS

MAIN CHASSIS FMM-4A

Reference Designation	Description		Part Number
BR1	DIODE: BRIDGE KBPC602 GI		1900-0025
C1,C2	C: FIXED CERAMIC 0.01uF 1.4kV	(note 1)	0151-0010
C3	C: FIXED ELEC 3500uF 40V		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 1)	2110-0003
J1	JACK: POWER	(note 1)	0360-0010
J2 thru J6	JACK: BNC		0360-0005
R1	R: FIXED CARBON 240 5% 1W		0689-2415
R2	R: FIXED CARBON 22 5% 1W		0689-2205
S1	SWITCH: SLIDE 115/230V SELECTOR	(note 1)	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
--	* CONNECTOR: CARD EDGE, 20 PIN (CINCH 50-20SN-9 or equivalent)		0365-0023
--	* JUMPER: DIP (*used with optional A2 Alarm Relay Board)		8900-0003

note 1: Beginning serial number 180063, these parts are replaced by the 6J4 power entry module (0360-0020).

NOTES:

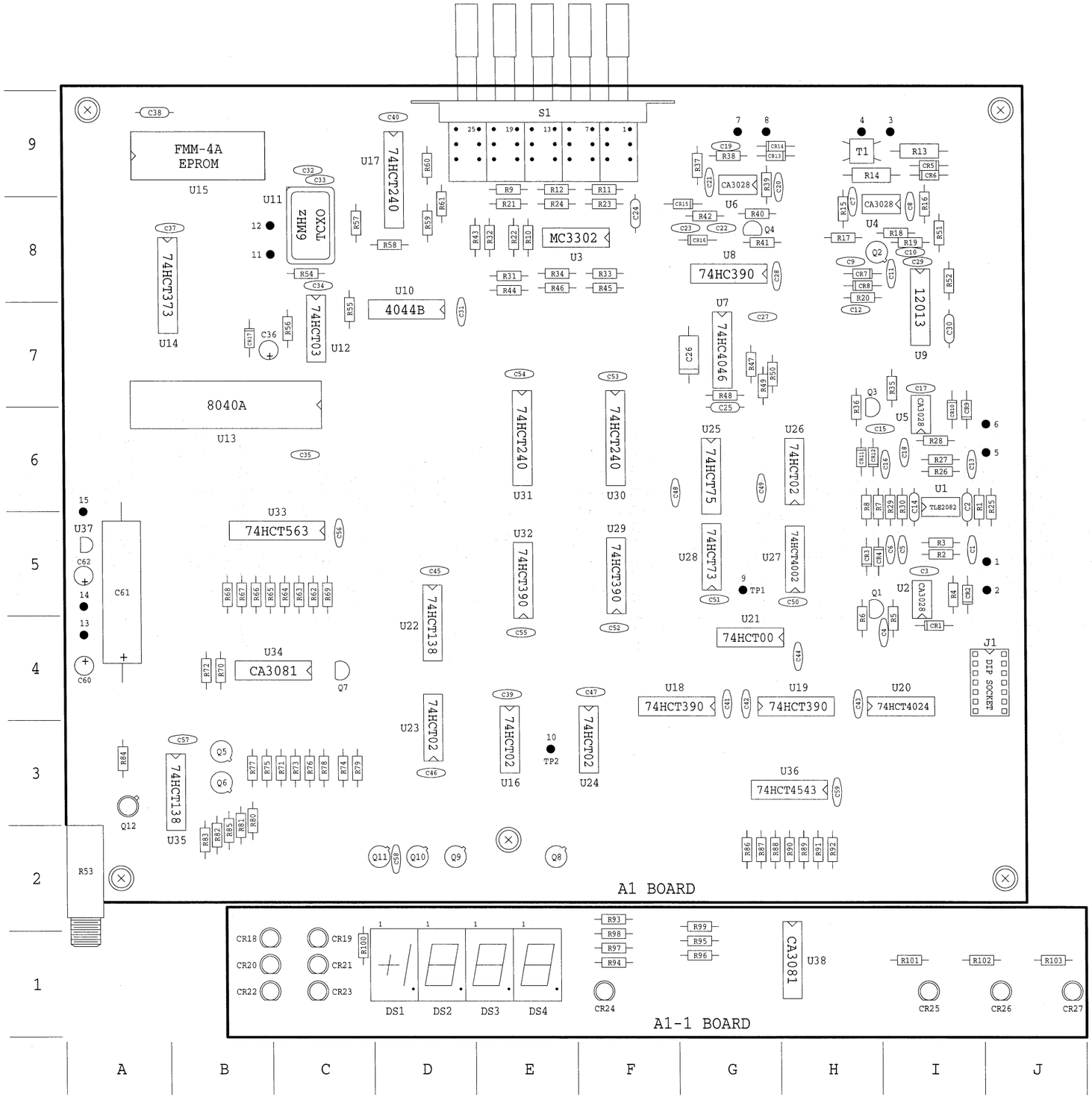
1. FOR INTERCONNECTION DETAILS REFER TO CHASSIS WIRING DIAGRAM.
2. ⊙ INDICATES CIRCUIT BOARD PIN.
3. ALL RESISTANCE VALUES ARE IN OHMS.
4. ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
5. ALL CAPACITANCE VALUES ARE IN UF, UNLESS OTHERWISE SPECIFIED.

UNUSED

TO OPTIONAL ALARM BOARD

(ON A1-1 BOARD)

FMM-4A A1 & A1-1 BOARDS
BELAR ELECTRONICS
9-2-03



FMM-4A A1 & A1-1 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS

FMM4-A A1 & A1-1 BOARD
PART LOCATIONS

Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc	Desig/Loc
C1 I5	C49 G6	J1 J4	R34 E8	R82 B2	U22 D4
C2 I6	C50 H5		R35 I7	R83 B2	U23 D3
C3 I5	C51 G5	Q1 H5	R36 H6	R84 A3	U24 F3
C4 I4	C52 F4	Q2 H8	R37 G9	R85 B2	U25 G6
C5 I5	C53 F7	Q3 H6	R38 G9	R86 G2	U26 H6
C6 I5	C54 E7	Q4 G8	R39 G9	R87 G2	U27 H5
C7 H8	C55 E4	Q5 B3	R40 G8	R88 G2	U28 G5
C8 I8	C56 C5	Q6 B3	R41 G8	R89 H2	U29 F5
C9 H8	C57 B3	Q7 C4	R42 G8	R90 H2	U30 F6
C10 I8	C58 D2	Q8 E2	R43 E8	R91 H2	U31 E6
C11 I8	C59 H3	Q9 D2	R44 E8	R92 H2	U32 E5
C12 H7	C60 A4	Q10 D2	R45 F8	R93 F2	U33 C5
C13 I6	C61 A5	Q11 D2	R46 E8	R94 F1	U34 C4
C14 I6	C62 A5	Q12 A3	R47 G7	R95 G1	U35 B3
C15 I6			R48 G7	R96 G1	U36 H3
C16 I6	CR1 I4	R1 I6	R49 G7	R97 F1	U37 A5
C17 I7	CR2 I5	R2 I5	R50 G7	R98 F1	U38 H1
C18 I6	CR3 H5	R3 I5	R51 I8	R99 G2	
C19 G9	CR4 H5	R4 I5	R52 I8	R100 C1	pins
C20 H9	CR5 I9	R5 I4	R53 A2	R101 I1	1 J5
C21 G9	CR6 I9	R6 H4	R54 C8	R102 I1	2 J5
C22 G8	CR7 H8	R7 H6	R55 C7	R103 J1	3 I9
C23 G8	CR8 H8	R8 H6	R56 C7		4 H9
C24 F8	CR9 I6	R9 E9	R57 C8	S1 E9	5 J6
C25 G6	CR10 I6	R10 E8	R58 D8		6 J6
C26 G7	CR11 H6	R11 F9	R59 D8	T1 H9	7 G9
C27 G7	CR12 H6	R12 E9	R60 D9		8 G9
C28 G8	CR13 G9	R13 I9	R61 D8	U1 I6	9 G5
C29 I8	CR14 G9	R14 H9	R62 C5	U2 I5	10 E3
C30 I7	CR15 G8	R15 H8	R63 C5	U3 F8	11 C8
C31 D7	CR16 G8	R16 I8	R64 C5	U4 I8	12 C8
C32 C9	CR17 B7	R17 H8	R65 B5	U5 I6	13 A4
C33 C9	CR18 B1	R18 I8	R66 B5	U6 G9	14 A5
C34 C8	CR19 C1	R19 I8	R67 B5	U7 G7	15 A5
C35 C6	CR20 B1	R20 H8	R68 B5	U8 G8	
C36 B7	CR21 C1	R21 E8	R69 C5	U9 I7	
C37 B8	CR22 B1	R22 E8	R70 B4	U10 D7	
C38 A9	CR23 C1	R23 F8	R71 C3	U11 C8	
C39 E4	CR24 F1	R24 E8	R72 B4	U12 C7	
C40 D9	CR25 I1	R25 J6	R73 C3	U13 B7	
C41 G4	CR26 J1	R26 I6	R74 C3	U14 B8	
C42 G4	CR27 J1	R27 I6	R75 B3	U15 B9	
C43 H4		R28 I6	R76 C3	U16 E3	
C44 H4	DS1 D1	R29 I6	R77 B3	U17 D9	
C45 D5	DS2 D1	R30 I6	R78 C3	U18 F4	
C46 D3	DS3 E1	R31 E8	R79 C3	U19 H4	
C47 F4	DS4 E1	R32 E8	R80 B3	U20 I4	
C48 F6		R33 F8	R81 B2	U21 G4	

A1 BOARD FMM-4A

Reference Designation	Description	Part Number
C1	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C2	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C3 thru C9	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C10 thru C12	C: FIXED CERAMIC 0.001uF 1kV	0151-0002
C13	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C14	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C15 thru C21	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C22,C23	C: FIXED CERAMIC 0.001uF 1kV	0151-0002
C24	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C25	C: FIXED CERAMIC 1.0uF 50V	0151-0008
C26	C: FIXED POLY 2000pF 2.5% 160V	0130-2022
C27 thru C29	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C30	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C31 thru C35	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C36	C: FIXED TANT 6.8uF 25V	0185-0002
C37	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C38	C: FIXED CERAMIC 0.1uF 50V	0151-0006
C39 thru C59	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C60	C: FIXED TANT 15uF 15V	0185-0003
C61	C: FIXED ELEC 350uF 16V	0180-0025
C62	C: FIXED TANT 15uF 15V	0185-0003
CR1,CR2	DIODE: 1N4446	1900-0002
CR3,CR4	DIODE: 1N277 GERMANIUM	1900-0001
CR5 thru CR8	DIODE: HP5082-2800	1900-0026
CR9,CR10	DIODE: 1N4446	1900-0002
CR11,CR12	DIODE: 1N277 GERMANIUM	1900-0001
CR13,CR14	DIODE: 1N4446	1900-0002
CR15,CR16	DIODE: 1N277 GERMANIUM	1900-0001
CR17	DIODE: 1N4446	1900-0002
J1	SOCKET: IC, 14 PIN DIP	1200-0011
Q1	TRANSISTOR: 2N4401	1850-0028
Q2	TRANSISTOR: 2N5179	1850-0023
Q3,Q4	TRANSISTOR: 2N4401	1850-0028
Q5,Q6	TRANSISTOR: 2N2907A	1850-0027
Q7	TRANSISTOR: 2N4401	1850-0028
Q8 thru Q11	TRANSISTOR: 2N2907A	1850-0027
Q12	TRANSISTOR: 2N2222	1850-0020
R1	R: METAL FILM 51k 2% 1/4W	0751-5132
R2	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R3	R: METAL FILM 10k 2% 1/4W	0751-1032
R4	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R5	R: METAL FILM 3k 2% 1/4W	0751-3022
R6	R: METAL FILM 1k 2% 1/4W	0751-1022
R7,R8	R: METAL FILM 330k 2% 1/4W	0751-3342
R9	R: METAL FILM 47k 2% 1/4W	0751-4732
R10	R: METAL FILM 82k 2% 1/4W	0751-8232
R11	R: METAL FILM 27k 2% 1/4W	0751-2732

A1 BOARD FMM-4A CONT.

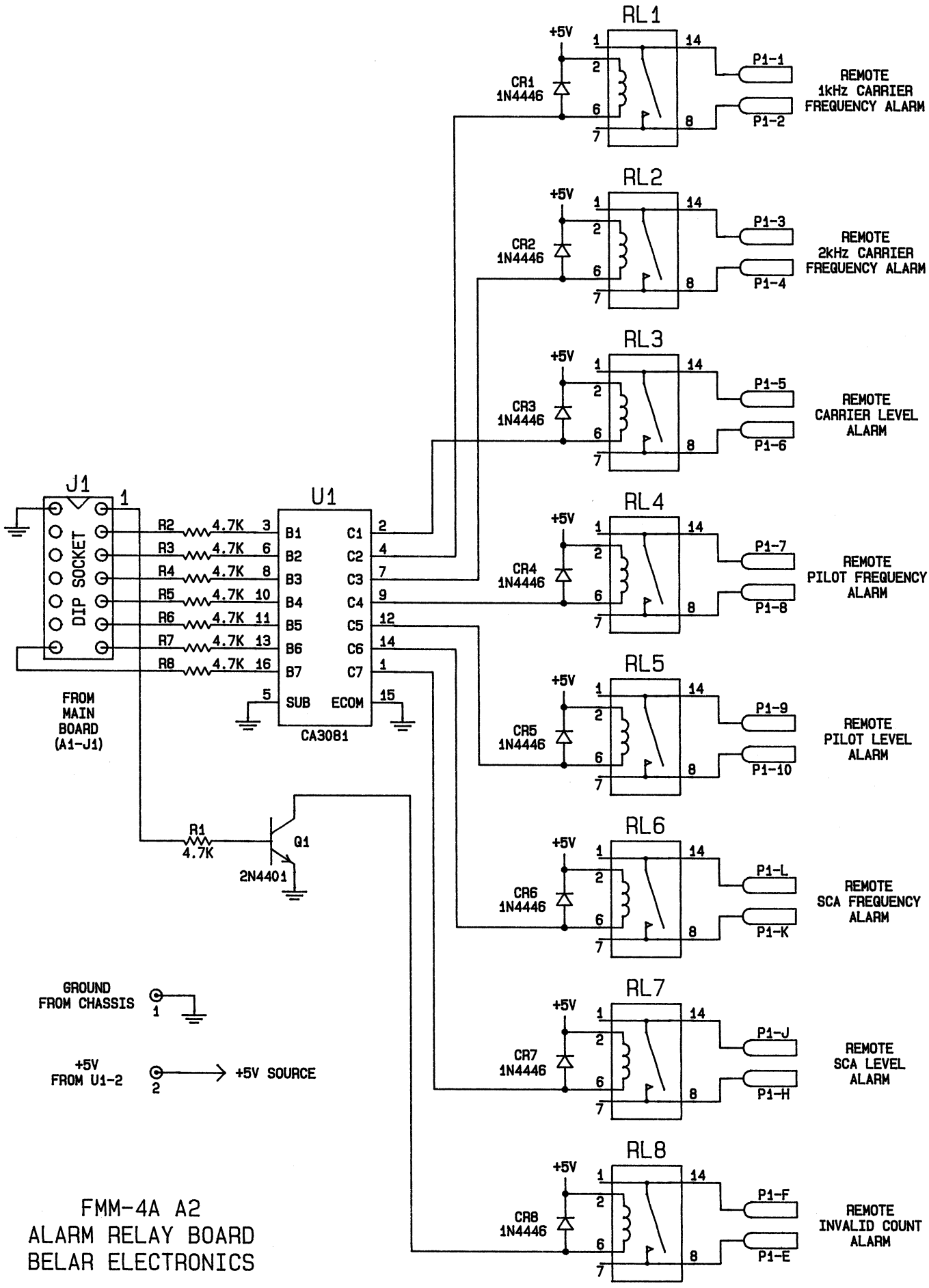
Reference Designation	Description	Part Number
R12	R: METAL FILM 820k 2% 1/4W	0751-8242
R13	R: METAL FILM 240 2% 1/2W	0771-2412
R14	R: METAL FILM 330 2% 1/2W	0771-3312
R15 thru R17	R: METAL FILM 51 2% 1/4W	0751-5102
R18	R: METAL FILM 330 2% 1/4W	0751-3312
R19	R: METAL FILM 510 2% 1/4W	0751-5112
R20	R: METAL FILM 820k 2% 1/4W	0751-8242
R21	R: METAL FILM 12k 2% 1/4W	0751-1232
R22	R: METAL FILM 330k 2% 1/4W	0751-3342
R23	R: METAL FILM 27k 2% 1/4W	0751-2732
R24	R: METAL FILM 820k 2% 1/4W	0751-8242
R25	R: METAL FILM 51k 2% 1/4W	0751-5132
R26	R: METAL FILM 5.1k 2% 1/4W	0751-5122
R27	R: METAL FILM 10k 2% 1/4W	0751-1032
R28	R: METAL FILM 1k 2% 1/4W	0751-1022
R29,R30	R: METAL FILM 330k 2% 1/4W	0751-3342
R31	R: METAL FILM 24k 2% 1/4W	0751-2432
R32	R: METAL FILM 56k 2% 1/4W	0751-5632
R33	R: METAL FILM 27k 2% 1/4W	0751-2732
R34	R: METAL FILM 820k 2% 1/4W	0751-8242
R35	R: METAL FILM 3k 2% 1/4W	0751-3022
R36	R: METAL FILM 1k 2% 1/4W	0751-1022
R37	R: METAL FILM 51 2% 1/4W	0751-5102
R38	R: METAL FILM 270 2% 1/4W	0751-2712
R39	R: METAL FILM 2.2k 2% 1/4W	0751-2222
R40,R41	R: METAL FILM 1k 2% 1/4W	0751-1022
R42	R: METAL FILM 820k 2% 1/4W	0751-8242
R43	R: METAL FILM 56k 2% 1/4W	0751-5632
R44	R: METAL FILM 62k 2% 1/4W	0751-6232
R45	R: METAL FILM 27k 2% 1/4W	0751-2732
R46,R47	R: METAL FILM 820k 2% 1/4W	0751-8242
R48	R: METAL FILM 8.2k 2% 1/4W	0751-8222
R49,R50	R: METAL FILM 7.87k 1%	0721-7871
R51	R: METAL FILM 33k 2% 1/4W	0751-3332
R52	R: METAL FILM 1k 2% 1/4W	0751-1022
R53	R: VAR COMP 10k, 10 TURN	2100-0018
R54 thru R56	R: METAL FILM 470 2% 1/4W	0751-4712
R57 thru R61	R: METAL FILM 10k 2% 1/4W	0751-1032
R62 thru R69	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R70	R: METAL FILM 2.4k 2% 1/4W	0751-2422
R71	R: METAL FILM 180 2% 1/4W	0751-1812
R72	R: METAL FILM 2.4k 2% 1/4W	0751-2422
R73 thru R79	R: METAL FILM 180 2% 1/4W	0751-1812
R80 thru R83	R: METAL FILM 2k 2% 1/4W	0751-2022
R84	R: METAL FILM 4.7k 2% 1/4W	0751-4722
R85	R: METAL FILM 180 2% 1/4W	0751-1812
R86 thru R92	R: METAL FILM 4.7k 2% 1/4W	0751-4722
S1	SWITCH: PUSHBUTTON (5 BUTTON)	3101-0027
T1	TRANSFORMER: RF	Belar

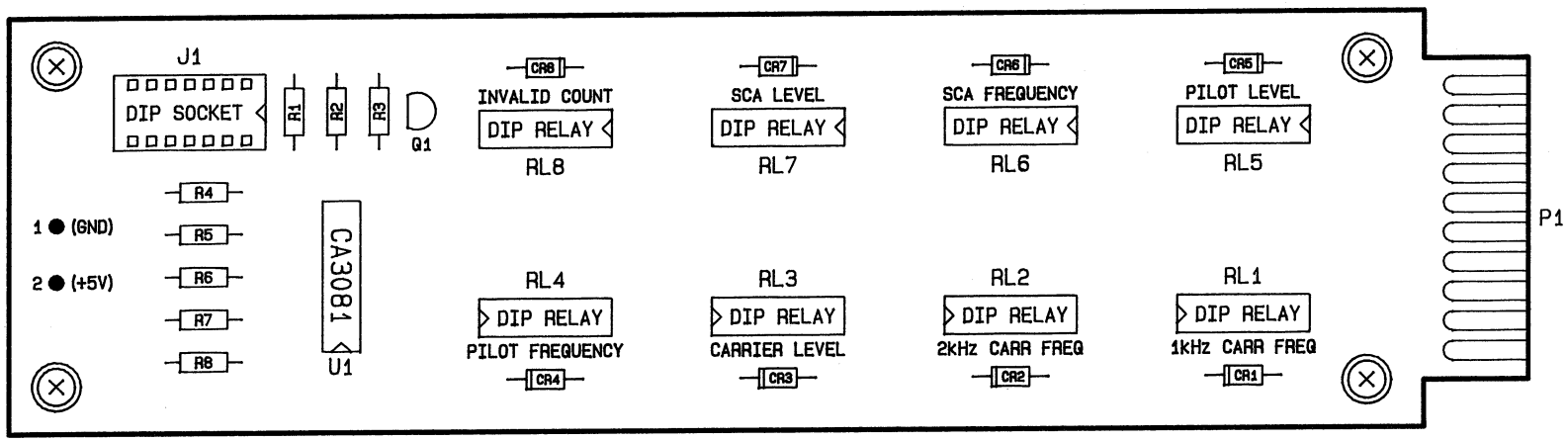
A1 BOARD FMM-4A CONT.

Reference Designation	Description	Part Number
U1	IC: TLE2082	1826-0069
U2	IC: CA3028AE	1826-0034
U3	IC: MC3302P	1826-0005
U4 thru U6	IC: CA3028AE	1826-0034
U7	IC: 74HC4046	1822-0049
U8	IC: 74HC390	1822-0056
U9	IC: MC12013	1822-0058
U10	IC: 4044B	1822-0057
U11	IC: TCXO, 6MHz	0410-0011
U12	IC: 74HCT03	1822-0028
U13	IC: 8040A	1840-0006
U14	IC: 74HCT373	1822-0033
U15	IC: FMM-4A EPROM	1840-0002A
U16	IC: 74HCT02	1822-0027
U17	IC: 74HCT240	1822-0032
U18,U19	IC: 74HCT390	1822-0034
U20	IC: 74HCT4024	1822-0037
U21	IC: 74HCT00	1822-0026
U22	IC: 74HCT138	1822-0031
U23,U24	IC: 74HCT02	1822-0027
U25	IC: 74HCT75	1822-0030
U26	IC: 74HCT02	1822-0027
U27	IC: 74HCT4002	1822-0036
U28	IC: 74HCT73	1822-0029
U29	IC: 74HCT390	1822-0034
U30,U31	IC: 74HCT240	1822-0032
U32	IC: 74HCT390	1822-0034
U33	IC: 74HCT563	1822-0035
U34	IC: CA3081	1826-0027
U35	IC: 74HCT138	1822-0031
U36	IC: 74HCT4543	1822-0038
U37	IC: 79L05CP	1826-0017

A1-1 DAUGHTER BOARD FMM-4A

Reference Designation	Description	Part Number
CR18	LED: BICOLOR, AMBER/RED	1910-0005
CR19 thru CR24	LED: RED MV5053	1910-0001
CR25 thru CR27	LED: GREEN CMD5453	1910-0003
DS1	DISPLAY: HP5082-7656	1930-0003
DS2 thru DS4	DISPLAY: HP5082-7651	1930-0007
R93 thru R99	R: METAL FILM 100 2% 1/4W	0751-1012
R100	R: METAL FILM 51 2% 1/4W	0751-5102
R101 thru R103	R: METAL FILM 180 2% 1/4W	0751-1812
U38	IC: CA3081	1826-0027


RL1
RL2
RL3
RL4
RL5
RL6
RL7
RL8
+5V
CR1 1N4446
CR2 1N4446
CR3 1N4446
CR4 1N4446
CR5 1N4446
CR6 1N4446
CR7 1N4446
CR8 1N4446
P1-1
P1-2
P1-3
P1-4
P1-5
P1-6
P1-7
P1-8
P1-9
P1-10
P1-L
P1-K
P1-J
P1-H
P1-F
P1-E
REMOTE 1kHz CARRIER FREQUENCY ALARM
REMOTE 2kHz CARRIER FREQUENCY ALARM
REMOTE CARRIER LEVEL ALARM
REMOTE PILOT FREQUENCY ALARM
REMOTE PILOT LEVEL ALARM
REMOTE SCA FREQUENCY ALARM
REMOTE SCA LEVEL ALARM
REMOTE INVALID COUNT ALARM
J1
DIP SOCKET
FROM MAIN BOARD (A1-J1)
R2 4.7K
R3 4.7K
R4 4.7K
R5 4.7K
R6 4.7K
R7 4.7K
R8 4.7K
U1
B1
B2
B3
B4
B5
B6
B7
C1
C2
C3
C4
C5
C6
C7
SUB
ECOM
CA3081
R1 4.7K
Q1
2N4401
GROUND FROM CHASSIS
+5V FROM U1-2
+5V SOURCE
FMM-4A A2
ALARM RELAY BOARD
BELAR ELECTRONICS



FMM-4A A2
ALARM RELAY BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS

A2 BOARD FMM-4A

Reference Designation	Description	Part Number
CR1 thru CR8	DIODE: 1N4446	1900-0002
J1	SOCKET: IC, 14 PIN DIP	1200-0011
Q1	TRANSISTOR: 2N4401	1850-0028
R1 thru R8	R: METAL FILM 4.7k 2% 1/4W	0751-4722
RL1 thru RL8	RELAY: JWD-107-1 (or HE721A6341)	1600-0007
U1	IC: CA3081	1826-0027