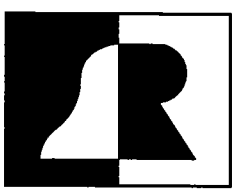
Model RFA-3
TV RF AMPLIFIER

Guide to Operations

9/01



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 RFA-3 TV RF Amplifier is a sensitive, high-gain amplifier designed to meet the requirements of the broadcaster for off-air monitoring of both Aural and Visual TV transmitters in the VHF and UHF band.

The RFA-3 utilizes separate IFs for Aural and Visual channels to reduce cross-talk, improve selectivity and reduce selective fading of either the Aural or Visual signals.

1-2 Physical Description

The RFA-3 is constructed on a standard 3.5 x 19 inch rack mount. The RELATIVE OUTPUT meter is located on the front panel. The AC power input, RF input, and all interconnections for Aural, Visual and L.0. are located on the rear of the unit.

The RFA-3 is completely solid state, utilizing all-silicon transistors and integrated circuits for long, trouble-free life. The individual circuits are constructed on military grade, glass-epoxy, plated printed circuit boards. High reliability industrial and military-grade components are used throughout.

1-3 Electrical Description

The RFA-3 is a sensitive, high-gain superheterodyne receiver consisting of an RF preamp, a mixer, a crystal oscillator, and two IF strips. The dynamic range of the amplifier is such that no adjustments are necessary over an input range of 100 uv to over 0.5V (approximately 70 db). The front panel meter indicates the relative RF output level.

The amplifier is designed to drive both the Belar TVM-1 TV aural modulation monitor, the Belar TVM-2 VHF TV frequency monitor, and the TVM-3 UHF TV frequency monitor.

1-4 Electrical and Mechanical Specifications

RF Input Sensitivity	1 mV (aural carrier) for full IF output 10 mV (aural carrier, visual carrier) for modulation and frequency monitoring
Antenna Impedance	50-75 Ω
Adjacent Channel Rejection (6 MHz removed)	70 dB
Dynamic Range	100 μV to 0.5 V (70 dB)
I.F. Rejection	Greater than 90 dB
L.O. Radiation	meets applicable FCC specifications
RF Power Output	0 dBm
Output Impedance	50 Ω
Power Requirements	115/230 Vac, 50/60 Hz
Power Consumption	5 Watts

Dimensions	3.5"H x 7"D x 19"W (EIA Rack Mount) (89 x 178 x 483mm)
Net Weight	5 lbs. (2.3 kg)
Shipping Weight	9 lbs. (4 kg)

1-5 Instrument Identification

The instrument is identified by the model number and a six-digit serial number. The model number and serial number appear on a plate located on the rear chassis. All correspondence to your Belar representative or to the Belar factory in regard to the instrument should reference the model number and complete serial number.

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 RFA-3 is shipped with an instruction book, three wire line cord and four beige rack mount screws.

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 RFA-3 is designed to be mounted in a standard 19 inch rack. The unit should be mounted either immediately below or above the modulation monitor. This is so the RF output cables may be kept as short as possible and dressed away from the RF input cable.

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 RFA-3. In no instance should the ambient chassis temperature be allowed to rise above 50°C (122°F). Mount the RFA-2 in the rack using the four non-marring rack mount screws provided.

3-2 Power Connection

The RFA-3 can be operated from either a 105 to 125 Vac or 210 to 250 Vac single phase, 50-60 Hz power source. Make sure the unit is set for the proper voltage as follows: Unplug the line cord. Slide the line voltage selector switch (S1) to the 115 V or 230 V position.

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 Initial Operation

The following procedures should be followed for placing the RFA-3 into initial operation.

1. OPERATION WITH TVM-1:

A. Connect a 50 Ω coaxial cable from the AURAL MOD output connector located on the rear of the RFA-3 to the RFA IN connector on the TVM-1. Place the DIR-RFA switch on the TVM-1 in the RFA position.

B. Connect the antenna cable to the RF IN connector located on the rear of the RFA-3 chassis.

C. If the Relative Output meter (M1) is reading more than half scale, adjust the Sensitivity control (R1) on the rear panel so the meter reading is approximately half scale.

2. OPERATION WITH TVM-2 (or TVM-3):

A. Connect a 50 Ω coaxial cable between the AURAL FREQ output of the RFA-3 and the AURAL (A) input of the TVM-2/3.

B. Connect a 50 Ω coaxial cable between the VISUAL FREQ output of the RFA-3 and the VISUAL (V) input of the TVM-2/3.

C. Connect a 50 Ω coaxial cable between the L.0. output of the RFA-3 and the L.0. input of the TVM-2/3.

D. Place the DIR-RFA switch located on the rear of the TVM-2/3 to the RFA position.

4 Principles of Operation

4-1 Principles of Operation - VHF

The incoming signal is applied to the pre-select filter FLI, which is tuned to the individual station's frequency. It is then applied to the RF preamp, where it is amplified and applied to the mixer.

Here the signal is mixed with the crystal oscillator, which is 44 MHz above the signal frequency. The 44 MHz center frequency signal which results is then applied to the aural/visual splitter, which separates the Aural and Visual signals and applies it to their respective IF strips.

The outputs of the Aural and Visual IF strips are then applied to line driver amplifier A2QI and A2Q2, whose outputs are used to drive the TVM-2.

The output of the aural line driver amplifier A2Q2 is then split and applied to the base of a second mixer A2Q4.

The second crystal oscillator A2Q3, whose frequency is 216 kHz above the aural IF frequency, is applied to the emitter of mixer A2Q4. The IF output of the mixer (216 kHz) is then filtered and amplified by A2Q5. The output of A2Q5 is then applied to the buffer amplifier A2Q6.

The 216 kHz aural IF output of A2Q6 is then used to drive the TVM-1 aural modulation monitor at the monitor IF frequency of 216 kHz. The Relative Output meter indicates the relative output of the 216 kHz aural IF amplifier A2Q6.

5 Diagrams, Schematics and Parts Lists

Replaceable Parts. This page contains information for ordering replaceable parts for the unit. 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.*

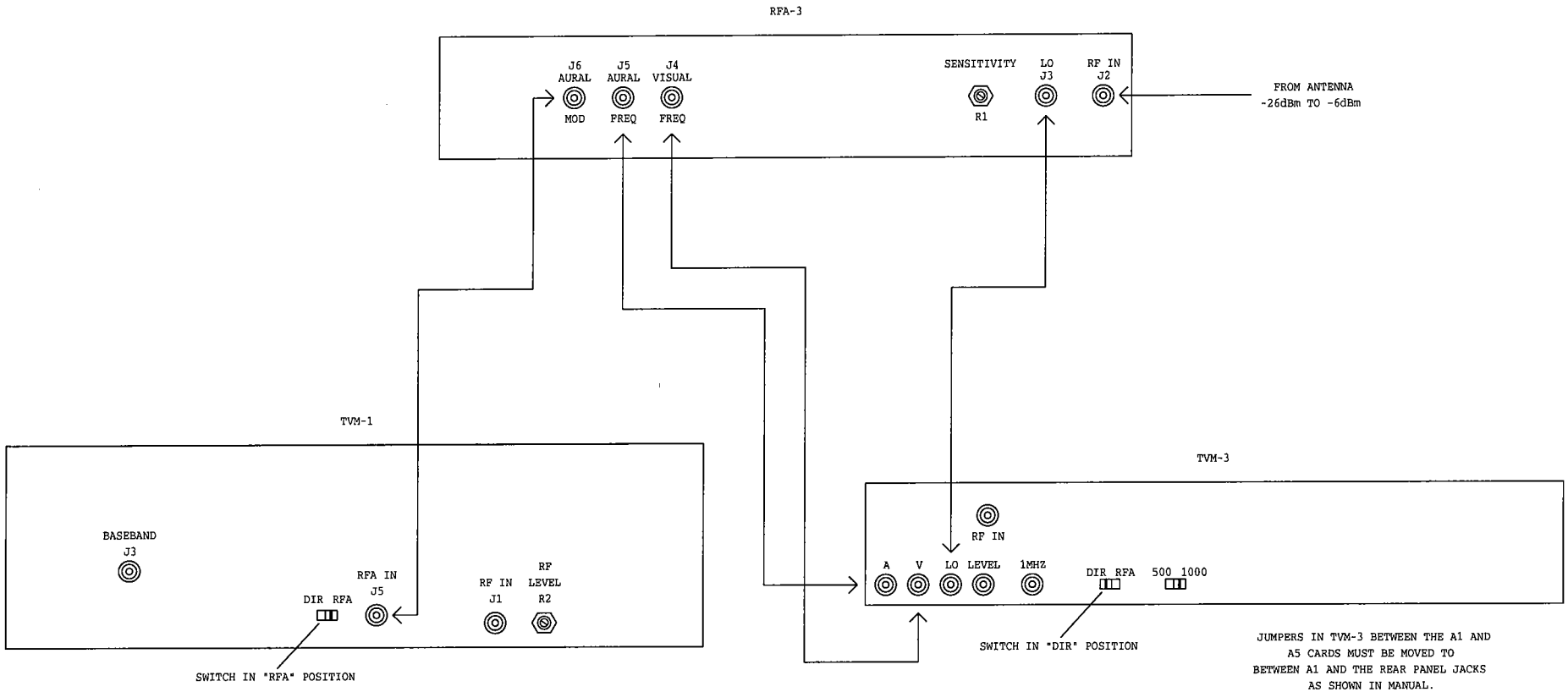
Orders may also be taken over the telephone. Parts orders can be put on your VISA, MasterCard, or American Express card, or we can ship them COD.

REFERENCE DESIGNATORS

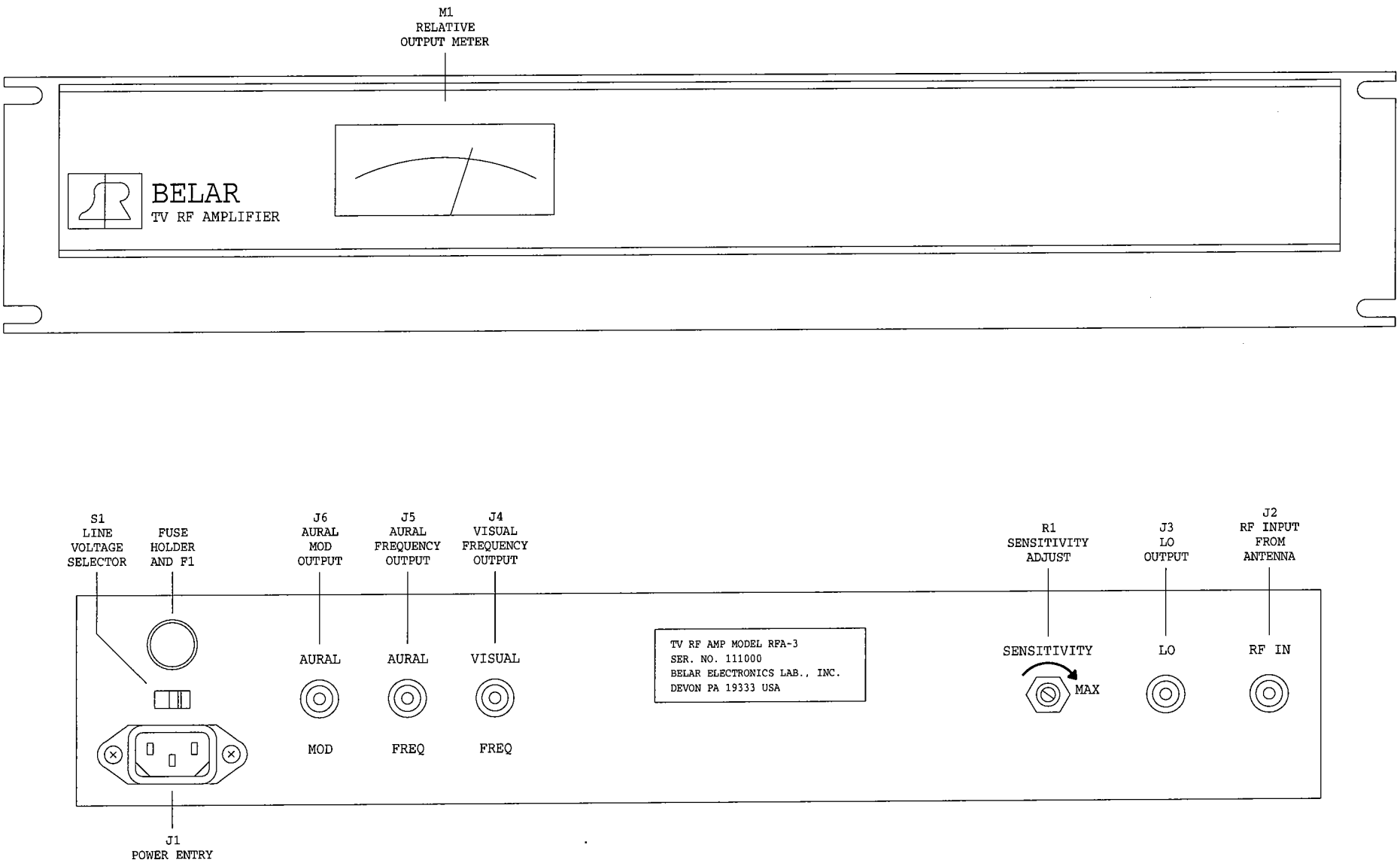
A	= assembly	J	= jack	S	= switch
BR	= diode bridge	L	= inductor	T	= transformer
C	= capacitor	M	= meter	TB	= terminal block
CR	= diode or LED	P	=plug	U	= integrated circuit
DS	= display or lamp	Q	= transistor	VR	= voltage regulator
F	= fuse	R	= resistor	W	= cable
FL	= filter	RL	= relay	X	= socket
HDR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

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		



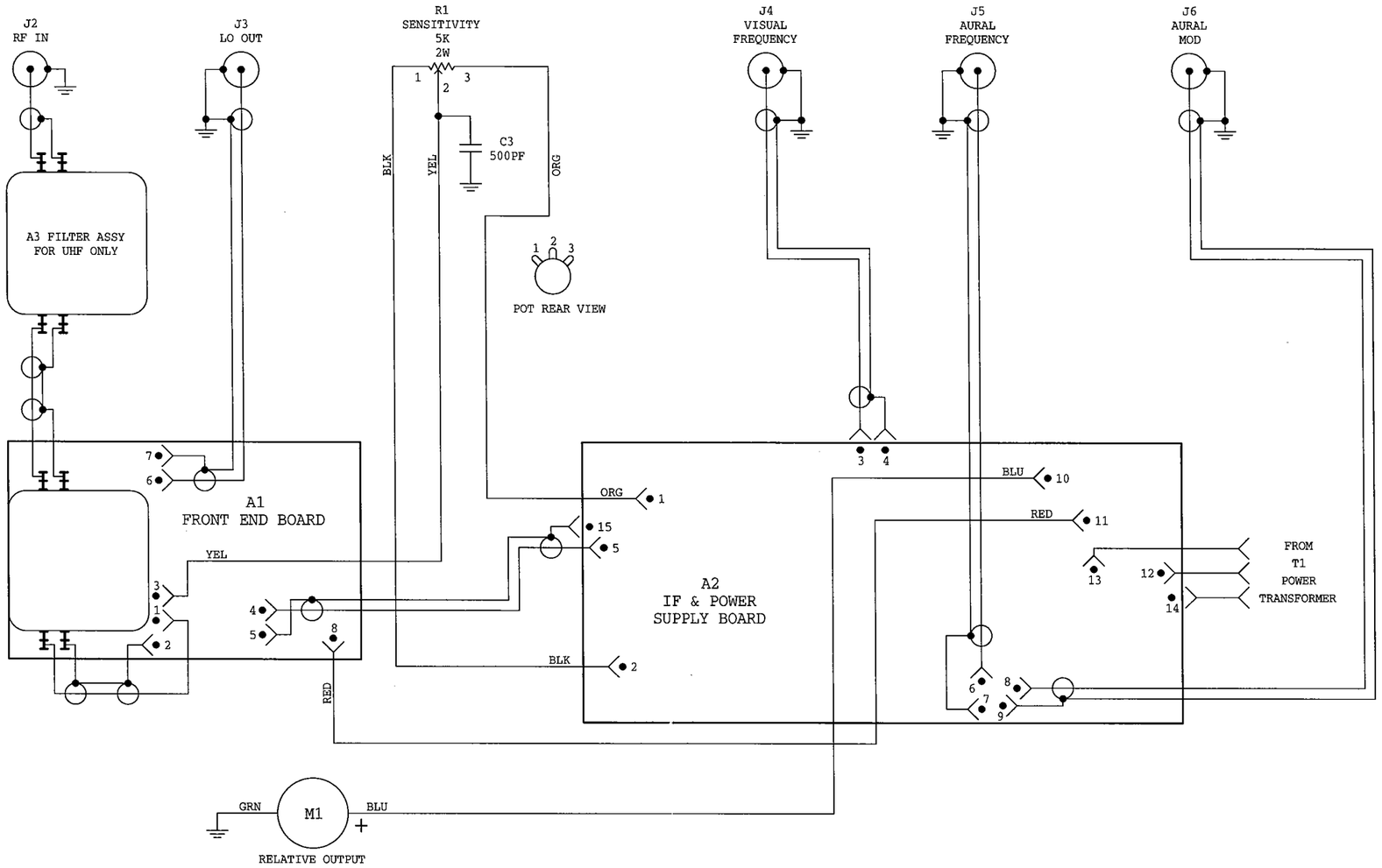
RFA-3 INTERCONNECTIONS
BELAR ELECTRONICS

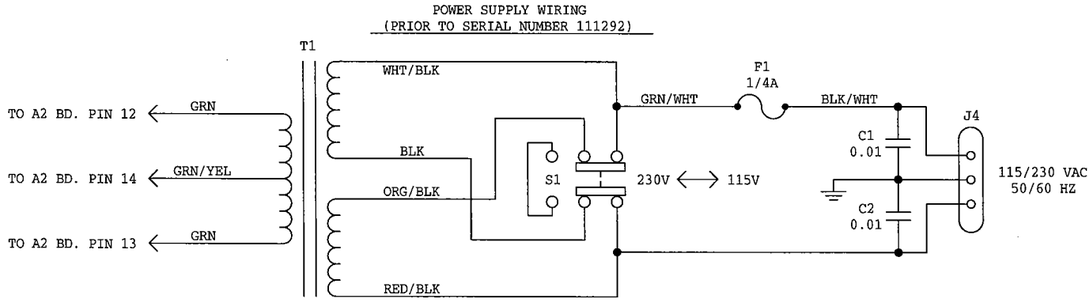


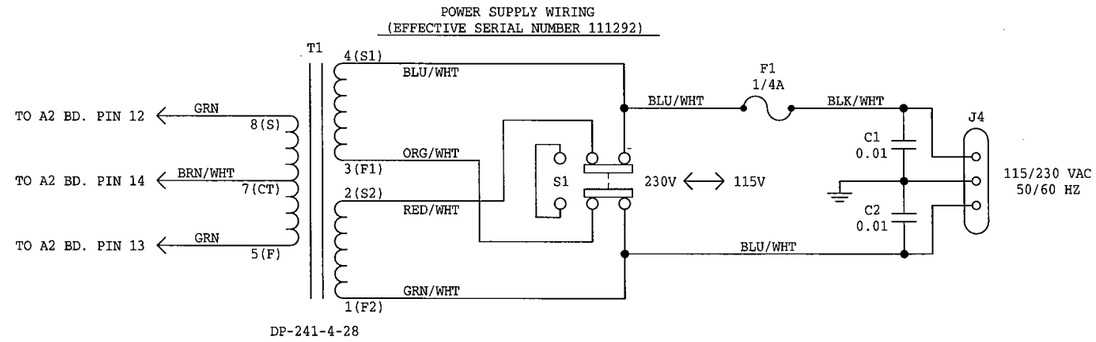
RFA-3 FRONT & REAR VIEW
BELAR ELECTRONICS

RFA-3 MAIN CHASSIS

Reference Designation	Description	Part Number
A1	ASSEMBLY: FRONT END BOARD	Belar
A2	ASSEMBLY: IF & POWER SUPPLY BOARD	Belar
A3	FILTER ASSEMBLY (UHF ONLY)	Belar
C1,C2	C: FIXED CERAMIC 0.01uF 1.4kV	0151-0010
F1	FUSE: AGC 1/4	2110-0002
J1	JACK: POWER	0360-0010
J2 thru J6	JACK: BNC	0360-0005
M1	METER: RELATIVE OUTPUT	1120-0011
R1	R: VAR COMP 5k, 2W	2100-0008
S1	SWITCH: SLIDE 115/230V SELECTOR	3102-0002
T1	TRANSFORMER: POWER	9100-0004
XF1	FUSEHOLDER:	2110-0003
--	LINE CORD (115 Vac line voltage)	8120-0002
--	LINE CORD (230 Vac line voltage)	8120-0004

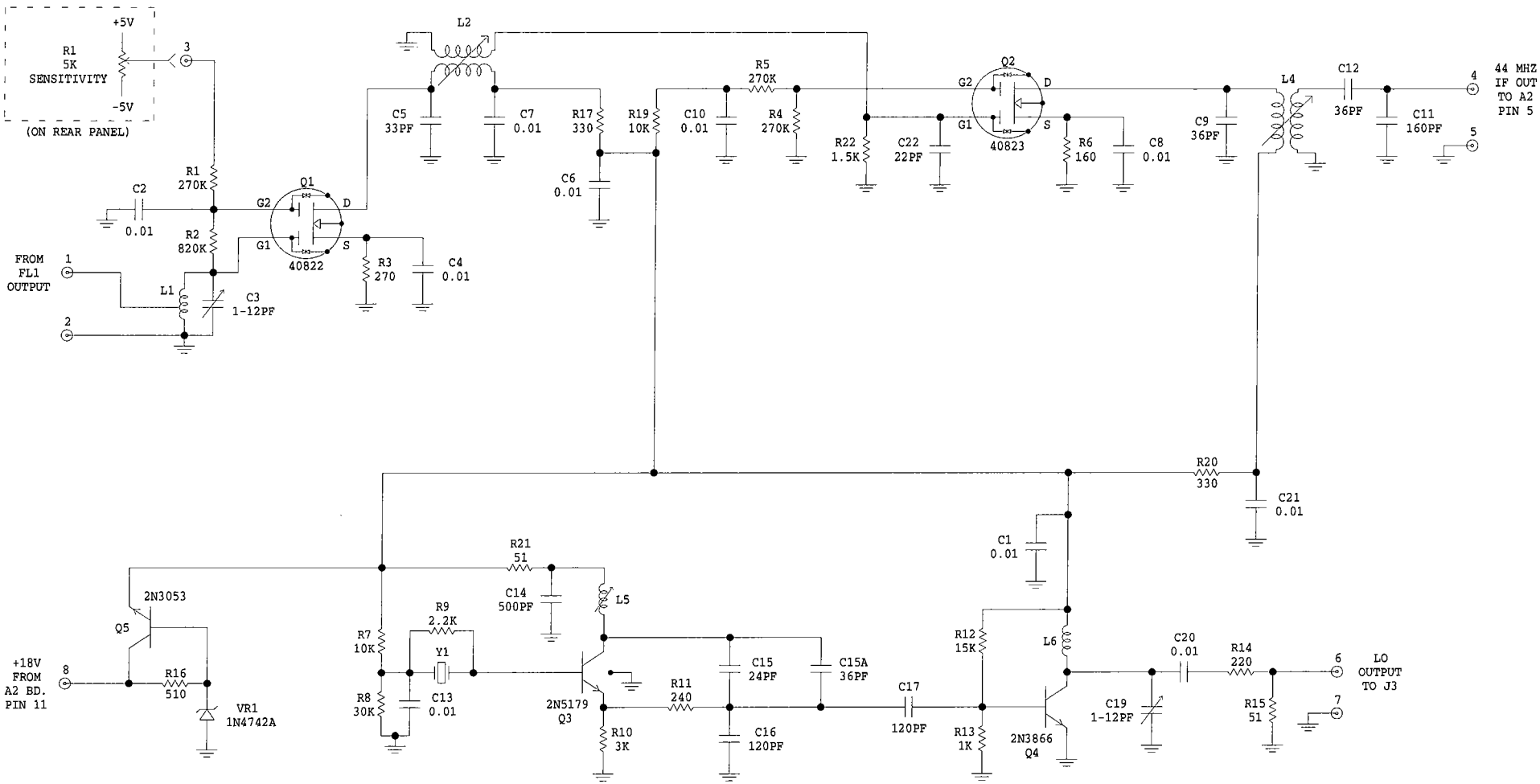






DP-241-4-28

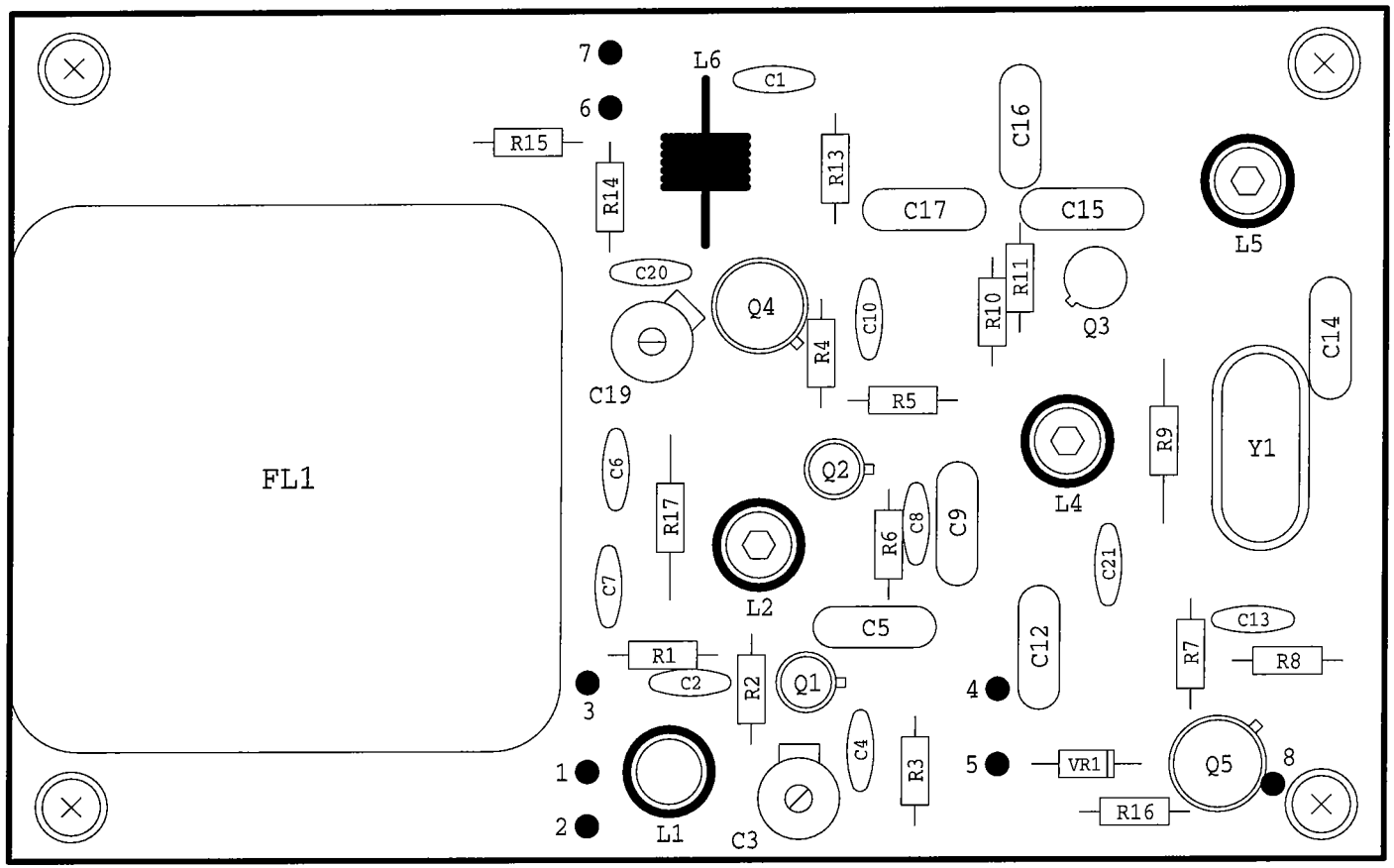
RFA-3 TV RF AMP
CHASSIS WIRING
9-21-01



NOTES:

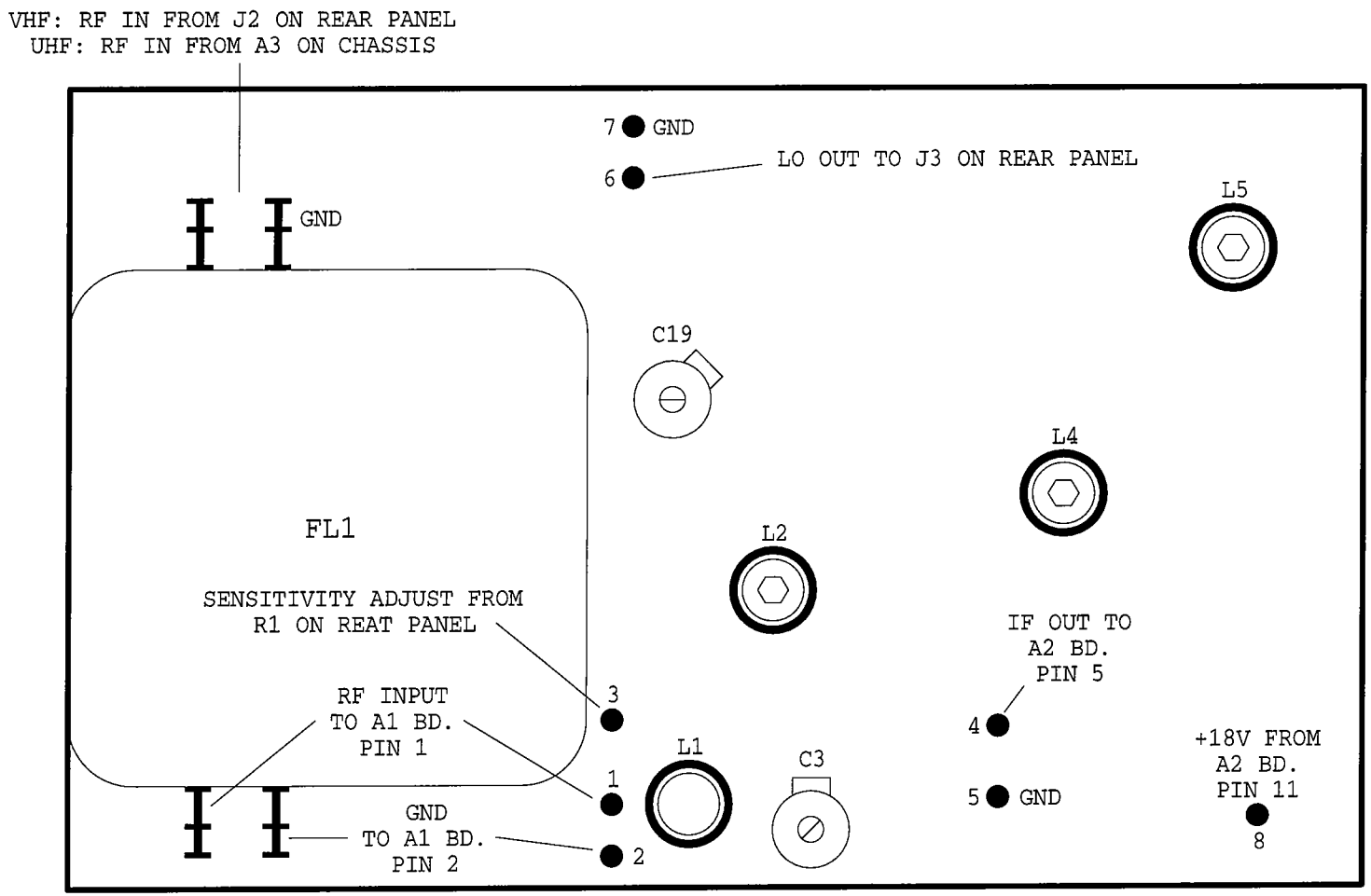
1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/4 WATT.
3. ALL CAPACITANCE VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED.

RFA-3 A1
FRONT END BOARD
UHF
BELAR ELECTRONICS
9-21-01



NOTE: C11, C15A, C22, R12 AND R19 THRU R22 ARE ON PCB BOTTOM.

RFA-3 A1 UHF BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS



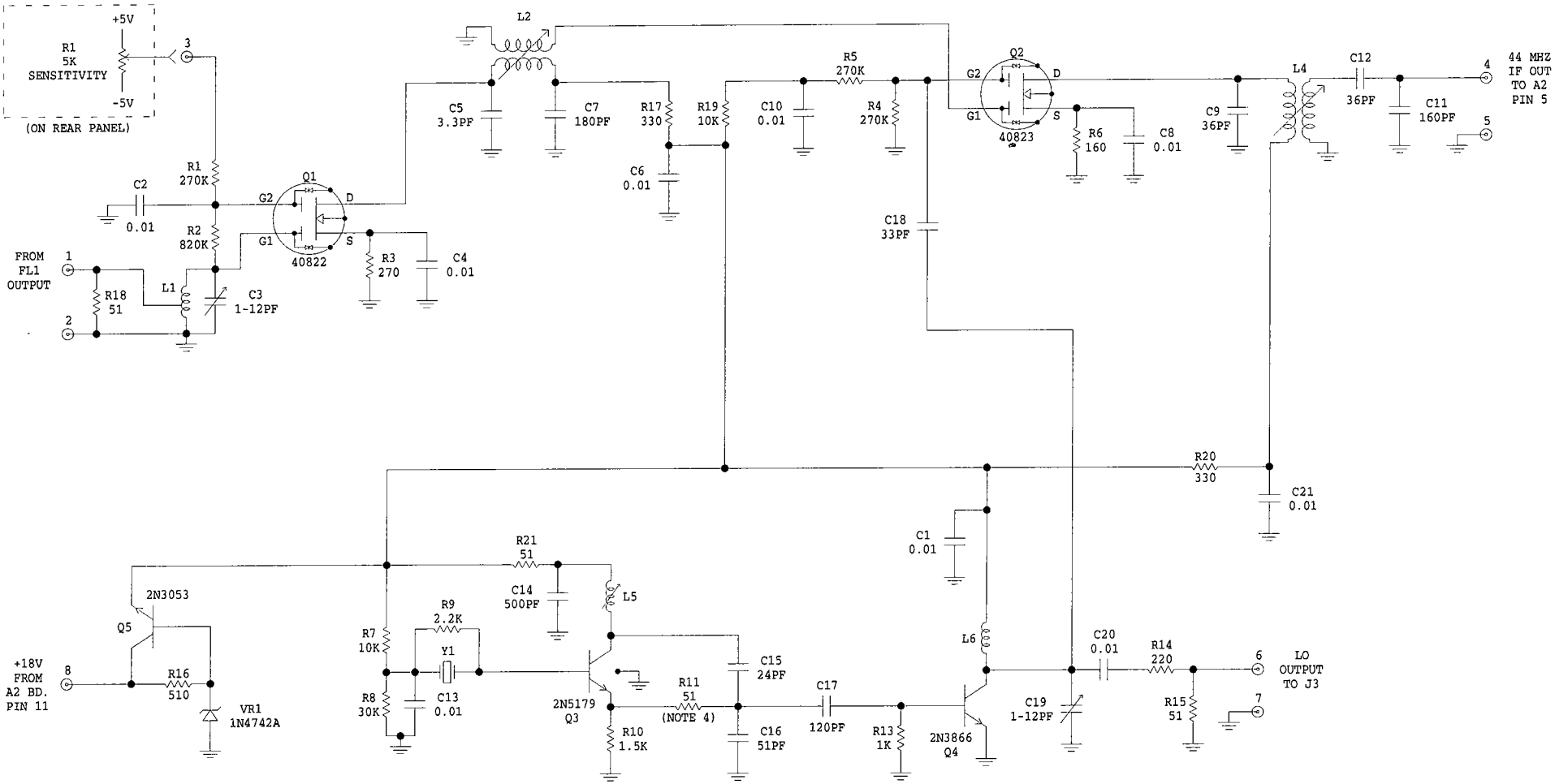
RFA-3 A1 BOARD
VHF AND UHF
CONNECTIONS AND ADJUSTMENTS
BELAR ELECTRONICS

A1 BOARD RFA-3 (UHF VERSION)

Reference Designation	Description	Part Number
C1,C2	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C3	C: VAR MICA 1-12pF	0121-0005
C4	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C5	C: FIXED MICA 33pF 5%	0140-3305
C6 thru C8	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C9	C: FIXED MICA 36pF 5%	0140-3605
C10	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C11	C: FIXED MICA 160pF 5%	0140-1615
C12	C: FIXED MICA 36pF 5%	0140-3605
C13	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C14	C: FIXED MICA 500pF 5%	0140-5015
C15	C: FIXED MICA 24pF 5%	0140-2405
C15A	C: FIXED MICA 36pF 5%	0140-3605
C16,C17	C: FIXED MICA 120pF 5%	0140-1215
C18	not used	
C19	C: VAR MICA 1-12pF	0121-0005
C20,C21	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C22	C: FIXED MICA 22pF 5%	0140-2205
FL1	FILTER ASSEMBLY	Belar
L1	INDUCTOR:	Belar
L2	INDUCTOR:	Belar
L3	not used	
L4	INDUCTOR:	Belar
L5	INDUCTOR:	Belar
L6	INDUCTOR:	Belar
Q1	TRANSISTOR: 40822	1850-0024
Q2	TRANSISTOR: 40823	1850-0025
Q3	TRANSISTOR: 2N5179	1850-0023
Q4	TRANSISTOR: 2N3866	1850-0014
Q5	TRANSISTOR: 2N3053	1850-0008
R1	R: METAL FILM 270k 2% 1/4W	0751-2742
R2	R: METAL FILM 820k 2% 1/4W	0751-8242
R3	R: METAL FILM 270 2% 1/4W	0751-2712
R4,R5	R: METAL FILM 270k 2% 1/4W	0751-2742
R6	R: METAL FILM 160 2% 1/4W	0751-1612
R7	R: METAL FILM 10k 2% 1/4W	0751-1032
R8	R: METAL FILM 30k 2% 1/4W	0751-3032
R9	R: METAL FILM 2.2k 2% 1/4W	0751-2222
R10	R: METAL FILM 3k 2% 1/4W	0751-3022
R11	R: METAL FILM 240 2% 1/4W	0751-2412
R12	R: METAL FILM 15k 2% 1/4W	0751-1532
R13	R: METAL FILM 1k 2% 1/4W	0751-1022
R14	R: METAL FILM 220 2% 1/4W	0751-2212
R15	R: METAL FILM 51 2% 1/4W	0751-5102
R16	R: METAL FILM 510 2% 1/4W	0751-5112
R17	R: METAL FILM 330 2% 1/4W	0751-3312

A1 BOARD RFA-3 (UHF VERSION) cont.

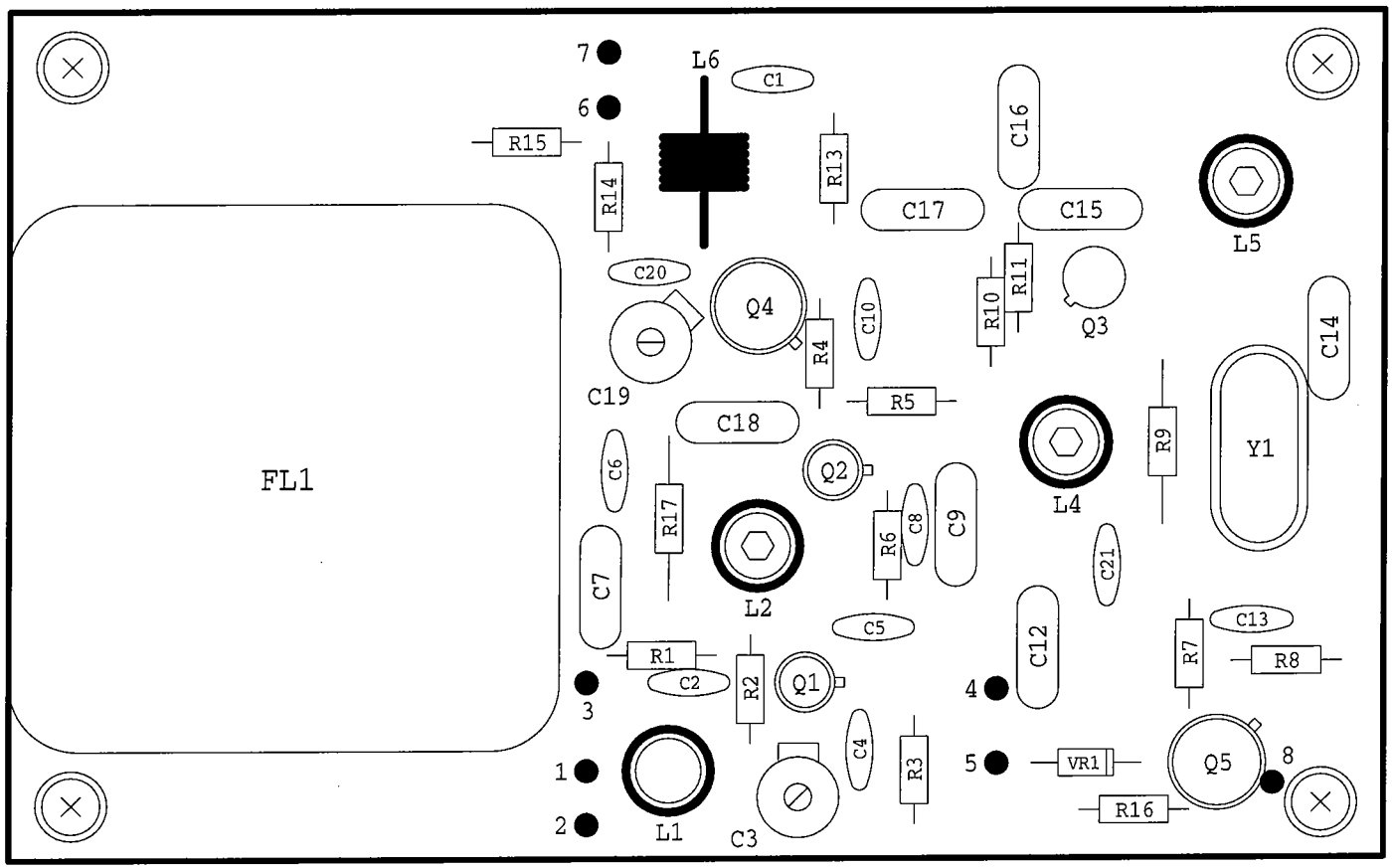
Reference Designation	Description	Part Number
R18	not used	
R19	R: METAL FILM 10k 2% 1/4W	0751-1032
R20	R: METAL FILM 330 2% 1/4W	0751-3312
R21	R: METAL FILM 51 2% 1/4W	0751-5102
R22	R: METAL FILM 1.5k 2% 1/4W	0751-1522
VR1	DIODE: ZENER 1N4742A	1900-0008
Y1	CRYSTAL: ORDER PER FREQUENCY	Belar
XY1	SOCKET: CRYSTAL	1200-0006



NOTES:

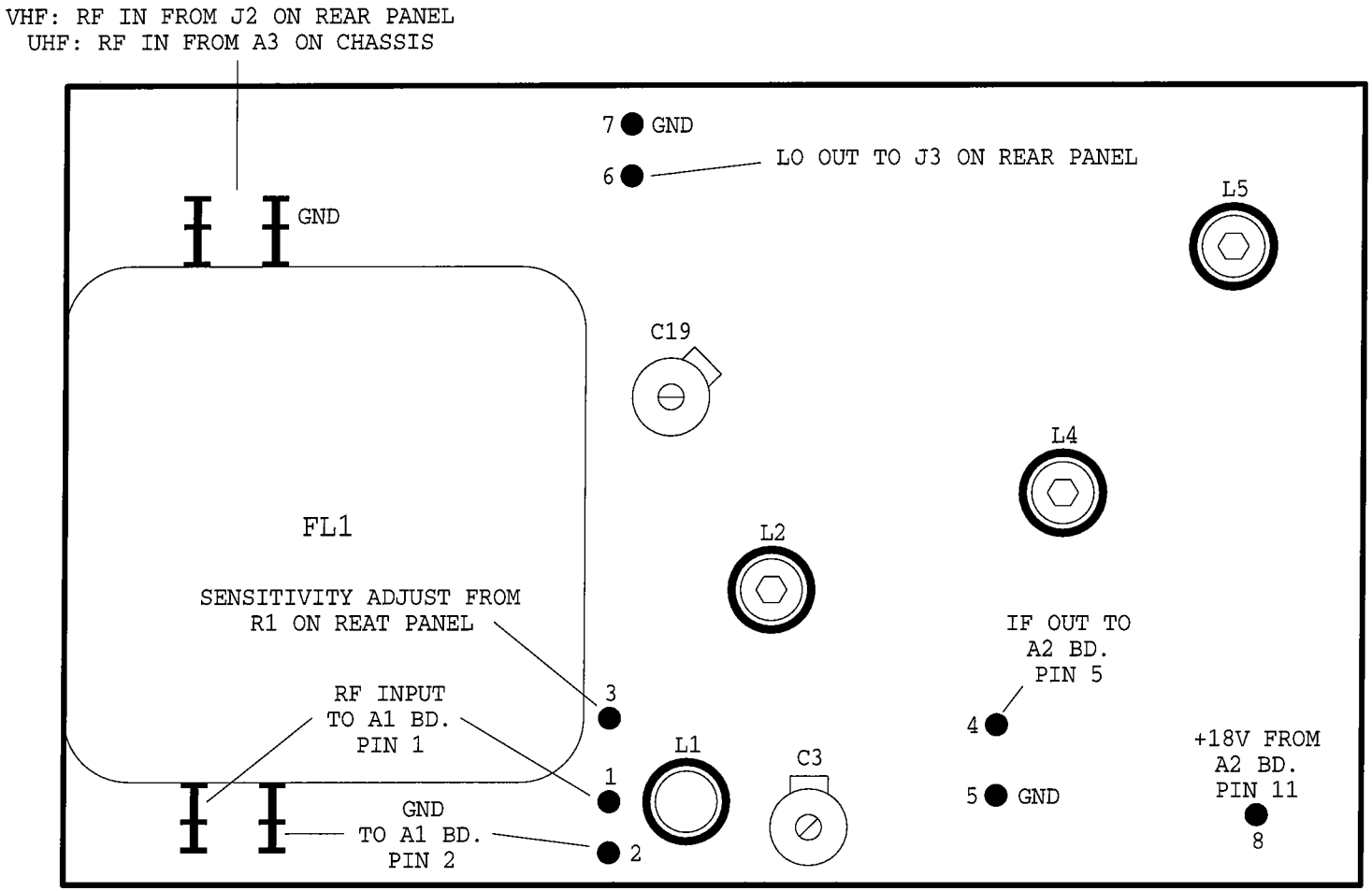
1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/4 WATT.
3. ALL CAPACITANCE VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED.
4. R11 IS 100 OHM FOR CHANNELS 10 THRU 13.

RFA-3 A1
FRONT END BOARD
VHF
BELAR ELECTRONICS
9-21-01



NOTE: C11 AND R18 THRU R21 ARE ON PCB BOTTOM.

RFA-3 A1 VHF BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS



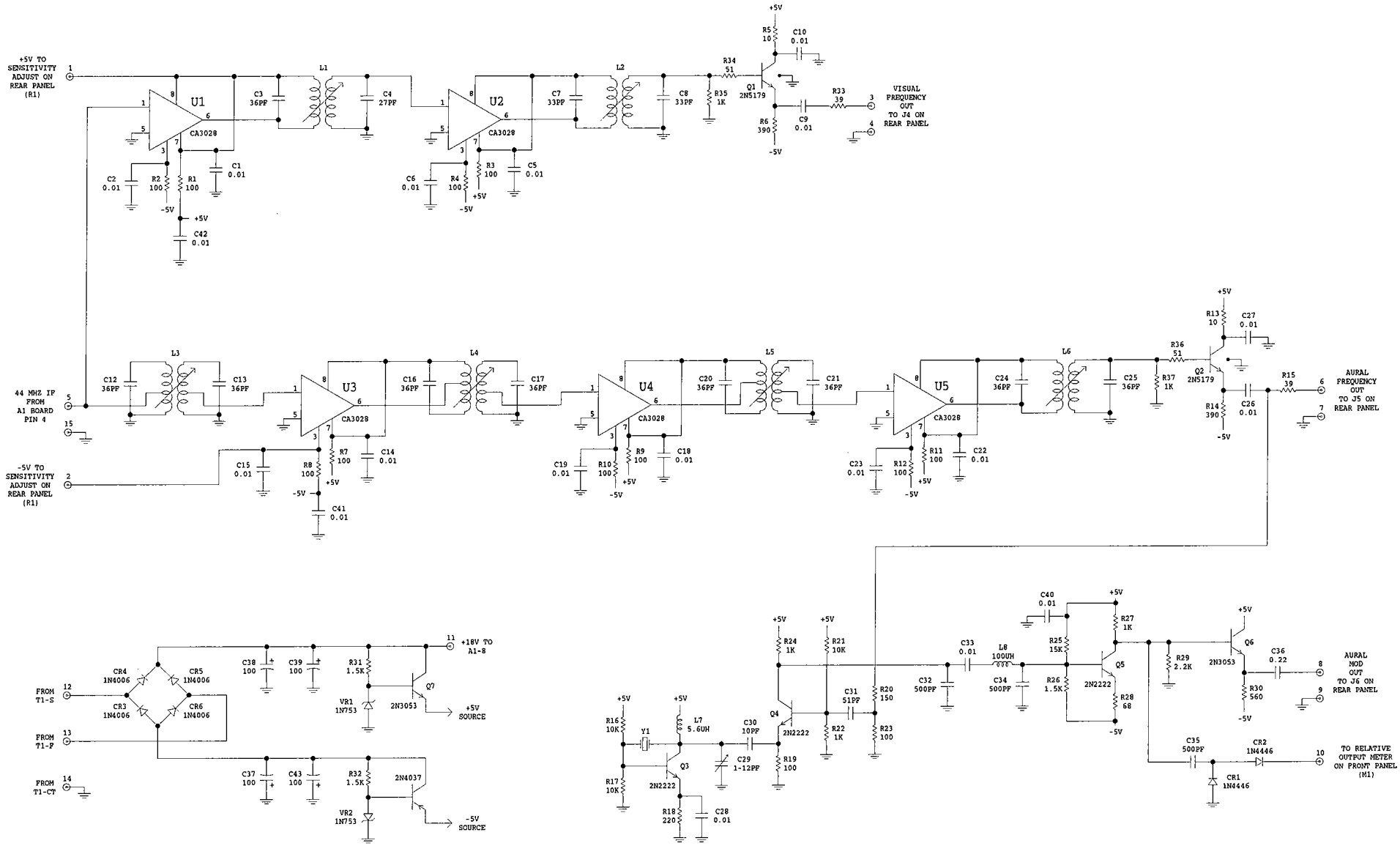
RFA-3 A1 BOARD
VHF AND UHF
CONNECTIONS AND ADJUSTMENTS
BELAR ELECTRONICS

A1 BOARD RFA-3 (VHF VERSION)

Reference Designation	Description	Part Number
C1,C2	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C3	C: VAR MICA 1-12pF	0121-0005
C4	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C5	C: FIXED CERAMIC 3.3pF 1kV	0151-0001
C6	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C7	C: FIXED MICA 180pF 5%	0140-1815
C8	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C9	C: FIXED MICA 36pF 5%	0140-3605
C10	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C11	C: FIXED MICA 160pF 5%	0140-1615
C12	C: FIXED MICA 36pF 5%	0140-3605
C13	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C14	C: FIXED MICA 500pF 5%	0140-5015
C15	C: FIXED MICA 24pF 5%	0140-2405
C16	C: FIXED MICA 51pF 5%	0140-5105
C17	C: FIXED MICA 120pF 5%	0140-1215
C18	C: FIXED MICA 33pF 5%	0140-3305
C19	C: VAR MICA 1-12pF	0121-0005
C20,C21	C: FIXED CERAMIC 0.01uF 100V	0151-0003
FL1	FILTER ASSEMBLY	Belar
L1	INDUCTOR:	Belar
L2	INDUCTOR:	Belar
L3	not used	
L4	INDUCTOR:	Belar
L5	INDUCTOR:	Belar
L6	INDUCTOR:	Belar
Q1	TRANSISTOR: 40822	1850-0024
Q2	TRANSISTOR: 40823	1850-0025
Q3	TRANSISTOR: 2N5179	1850-0023
Q4	TRANSISTOR: 2N3866	1850-0014
Q5	TRANSISTOR: 2N3053	1850-0008
R1	R: METAL FILM 270k 2% 1/4W	0751-2742
R2	R: METAL FILM 820k 2% 1/4W	0751-8242
R3	R: METAL FILM 270 2% 1/4W	0751-2712
R4,R5	R: METAL FILM 270k 2% 1/4W	0751-2742
R6	R: METAL FILM 160 2% 1/4W	0751-1612
R7	R: METAL FILM 10k 2% 1/4W	0751-1032
R8	R: METAL FILM 30k 2% 1/4W	0751-3032
R9	R: METAL FILM 2.2k 2% 1/4W	0751-2222
R10	R: METAL FILM 1.5k 2% 1/4W	0751-1522
R11	R: METAL FILM 51* 2% 1/4W (R11 is 100 ohm for channels 10 thru 13)	0751-5102
R12	not used	
R13	R: METAL FILM 1k 2% 1/4W	0751-1022
R14	R: METAL FILM 220 2% 1/4W	0751-2212
R15	R: METAL FILM 51 2% 1/4W	0751-5102

A1 BOARD RFA-3 (VHF VERSION) cont.

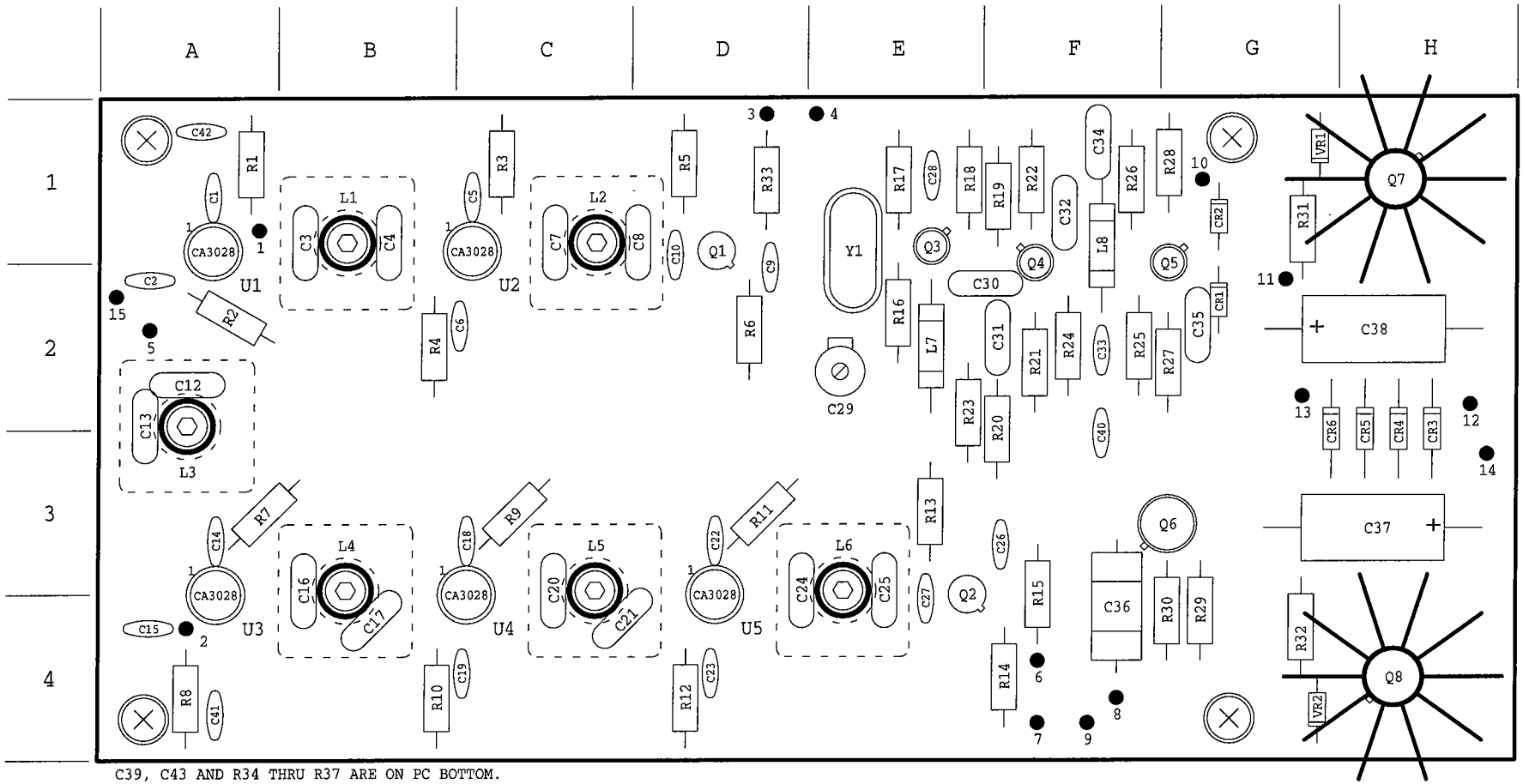
Reference Designation	Description	Part Number
R16	R: METAL FILM 510 2% 1/4W	0751-5112
R17	R: METAL FILM 330 2% 1/4W	0751-3312
R18	R: METAL FILM 51 2% 1/4W	0751-5102
R19	R: METAL FILM 10k 2% 1/4W	0751-1032
R20	R: METAL FILM 330 2% 1/4W	0751-3312
R21	R: METAL FILM 51 2% 1/4W	0751-5102
VR1	DIODE: ZENER 1N4742A	1900-0008
Y1	CRYSTAL: ORDER PER FREQUENCY	Belar
XY1	SOCKET: CRYSTAL	1200-0006



NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS.
2. ALL RESISTORS ARE 1/2 WATT.
3. ALL CAPACITANCE VALUES ARE IN UF UNLESS OTHERWISE SPECIFIED.

RFA-3 A2
IF & POWER SUPPLY BOARD
BELAR ELECTRONICS
9-21-01



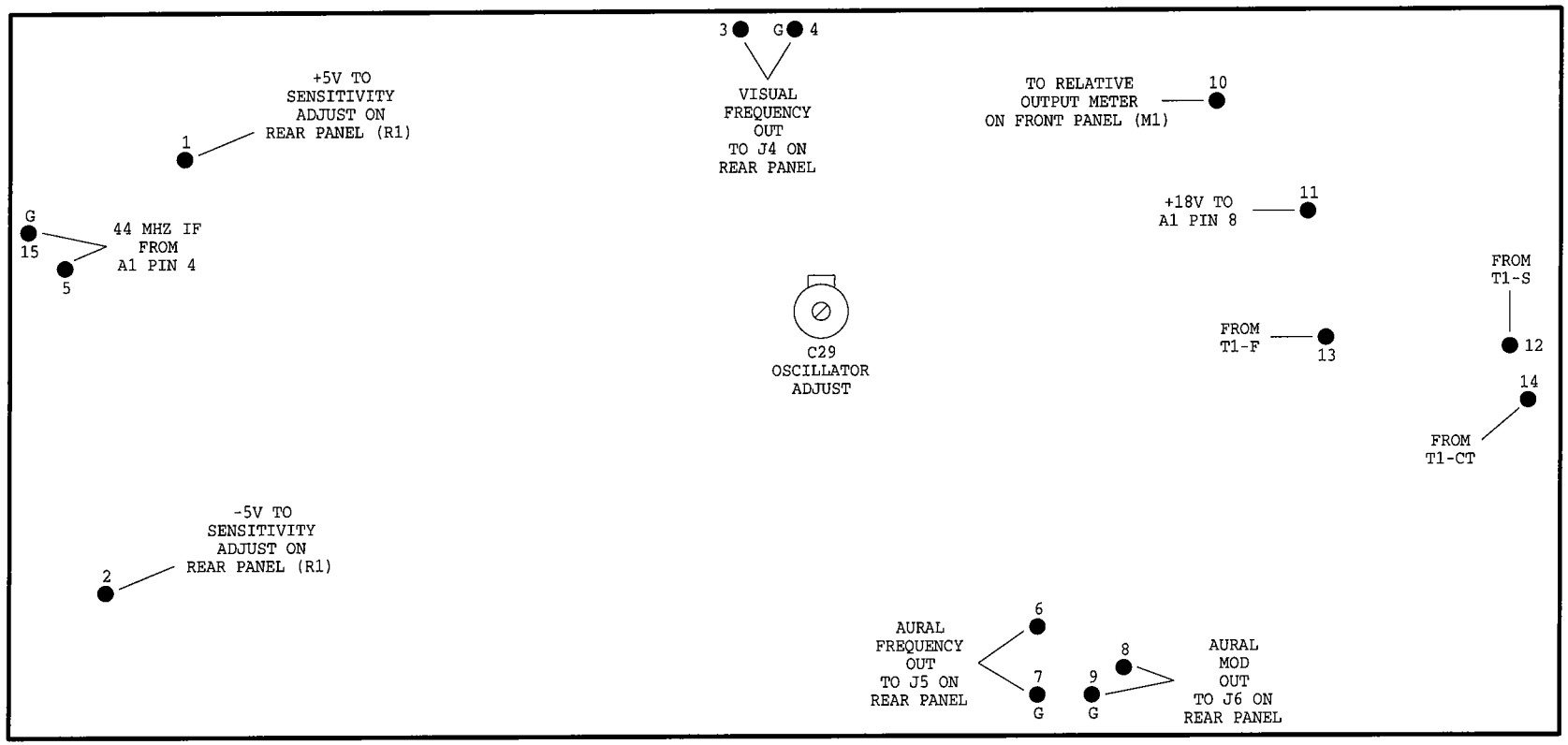
C39, C43 AND R34 THRU R37 ARE ON PC BOTTOM.

RFA-3 A2 BOARD
COMPONENT LAYOUT
BELAR ELECTRONICS

RFA-3 A2 BOARD
PART LOCATIONS

Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc		Desig/Loc	
C1	A1	C29	E2	L6	E3	R16	E2	VR1	G1
C2	A2	C30	F2	L7	E2	R17	E1	VR2	G4
C3	B1	C31	F2	L8	F1	R18	E1		
C4	B1	C32	F1			R19	F1	Y1	E1
C5	C1	C33	F2	Q1	D1	R20	F2		
C6	C2	C34	F1	Q2	E3	R21	F2	XY1	E1
C7	C1	C35	G2	Q3	E1	R22	F1		
C8	D1	C36	F4	Q4	F1	R23	E2	pins	
C9	D2	C37	H3	Q5	G1	R24	F2	1	A1
C10	D1	C38	H2	Q6	G3	R25	F2	2	A4
C11	--	C39	H2*	Q7	H1	R26	F1	3	D1
C12	A2	C40	F3	Q8	H4	R27	G2	4	E1
C13	A2	C41	A4			R28	G1	5	A2
C14	A3	C42	A1	R1	A1	R29	G4	6	F4
C15	A4	C43	H3*	R2	A2	R30	G4	7	F4
C16	B3			R3	C1	R31	G1	8	F4
C17	B4	CR1	G2	R4	B2	R32	G4	9	F4
C18	C3	CR2	G1	R5	D1	R33	D1	10	G1
C19	C4	CR3	H2	R6	D2	R34	D1*	11	G2
C20	C3	CR4	H2	R7	A3	R35	D1*	12	H2
C21	C4	CR5	H2	R8	A4	R36	E3*	13	G2
C22	D3	CR6	G2	R9	C3	R37	E3*	14	H3
C23	D4			R10	B4			15	A2
C24	D3	L1	B1	R11	D3	U1	A1		
C25	E3	L2	C1	R12	D4	U2	C1		
C26	F3	L3	A2	R13	E3	U3	A3		
C27	E4	L4	B3	R14	F4	U4	C3		
C28	E1	L5	C3	R15	F3	U5	D3		

*ON BOTTOM OF PCB



RFA-3 A2 BOARD
CONNECTIONS & ADJUSTMENTS
BELAR ELECTRONICS

A2 BOARD RFA-3

Reference Designation	Description	Part Number
C1,C2	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C3	C: FIXED MICA 36pF 5%	0140-3605
C4	C: FIXED MICA 27pF 5%	0140-2705
C5,C6	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C7,C8	C: FIXED MICA 33pF 5%	0140-3305
C9,C10	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C11	not used	
C12,C13	C: FIXED MICA 36pF 5%	0140-3605
C14,C15	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C16,C17	C: FIXED MICA 36pF 5%	0140-3605
C18,C19	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C20,C21	C: FIXED MICA 36pF 5%	0140-3605
C22,C23	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C24,C25	C: FIXED MICA 36pF 5%	0140-3605
C26 thru C28	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C29	C: VAR MICA 1-12pF	0121-0005
C30	C: FIXED MICA 10pF 5%	0140-1005
C31	C: FIXED MICA 51pF 5%	0140-5105
C32	C: FIXED MICA 500pF 5%	0140-5015
C33	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C34,C35	C: FIXED MICA 500pF 5%	0140-5015
C36	C: FIXED FILM 0.22uF 10% 80V	0120-2241
C37 thru C39*	C: FIXED ELEC 100uF 25V (* C39 is on pc bottom)	0180-0003
C40 thru C42	C: FIXED CERAMIC 0.01uF 100V	0151-0003
C43*	C: FIXED ELEC 100uF 25V (* C43 is on pc bottom)	0180-0003
CR1,CR2	DIODE: 1N4446	1900-0002
CR3 thru CR6	DIODE: 1N4006	1900-0016
L1 thru L6	INDUCTOR:	Belar
L7	INDUCTOR: RF 5.6uH	9140-0004
L8	INDUCTOR: RF 100uH	9140-0005
Q1,Q2	TRANSISTOR: 2N5179	1850-0023
Q3 thru Q5	TRANSISTOR: 2N2222	1850-0020
Q6,Q7	TRANSISTOR: 2N3053	1850-0008
Q8	TRANSISTOR: 2N4037	1850-0011
R1 thru R4	R: METAL FILM 100 2% 1/2W	0771-1012
R5	R: METAL FILM 10 2% 1/2W	0771-1002
R6	R: METAL FILM 390 2% 1/2W	0771-3912
R7 thru R12	R: METAL FILM 100 2% 1/2W	0771-1012
R13	R: METAL FILM 10 2% 1/2W	0771-1002
R14	R: METAL FILM 390 2% 1/2W	0771-3912
R15	R: METAL FILM 39 2% 1/2W	0771-3902
R16,R17	R: METAL FILM 10k 2% 1/2W	0771-1032
R18	R: METAL FILM 220 2% 1/2W	0771-2212

A2 BOARD RFA-3 CONT.

Reference Designation	Description	Part Number
R19	R: METAL FILM 100 2% 1/2W	0771-1012
R20	R: METAL FILM 150 2% 1/2W	0771-1512
R21	R: METAL FILM 10k 2% 1/2W	0771-1032
R22	R: METAL FILM 1k 2% 1/2W	0771-1022
R23	R: METAL FILM 100 2% 1/2W	0771-1012
R24	R: METAL FILM 1k 2% 1/2W	0771-1022
R25	R: METAL FILM 15k 2% 1/2W	0771-1532
R26	R: METAL FILM 1.5k 2% 1/2W	0771-1522
R27	R: METAL FILM 1k 2% 1/2W	0771-1022
R28	R: METAL FILM 68 2% 1/2W	0771-6802
R29	R: METAL FILM 2.2k 2% 1/2W	0771-2222
R30	R: METAL FILM 560 2% 1/2W	0771-5612
R31,R32	R: METAL FILM 1.5k 2% 1/2W	0771-1522
R33	R: METAL FILM 39 2% 1/2W	0771-3902
R34*	R: METAL FILM 51 2% 1/2W	0771-5102
R35*	R: METAL FILM 1k 2% 1/2W	0771-1022
R36*	R: METAL FILM 51 2% 1/2W	0771-5102
R37*	R: METAL FILM 1k 2% 1/2W (* on pc bottom)	0771-1022
U1 thru U5	IC: CA3028A	1820-0009
VR1,VR2	DIODE: ZENER 1N753A	1900-0006
Y1	CRYSTAL: ORDER PER FREQUENCY	Belar
XY1	SOCKET: CRYSTAL	1200-0006