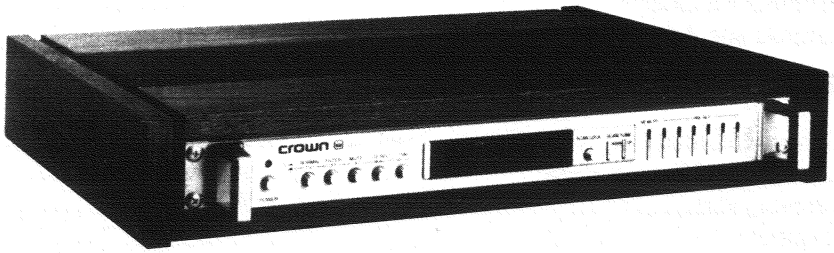
SERVICE MANUAL

FM TWO
STEREO TUNER

crown®



SERVICE MANUAL

FM TWO
STEREO TUNER

CROWN INTERNATIONAL, INC. 1718 W. MISHAWAKA RD. ELKHART, INDIANA 46517

K80146-2
8/85

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LIST OF ILLUSTRATIONS

REVIEW SECTION

I. Introduction

This manual contains complete service information on the FM TWO. It is designed to be used in conjunction with the FM TWO Instruction Manual. However, some important information is duplicated in this Service Manual in case the Instruction Manual is not readily available.

NOTE: THE INFORMATION IN THIS MANUAL IS INTENDED FOR USE BY AN EXPERIENCED TECHNICIAN ONLY!

II. Warranty

As a Crown Warranty Service Station, you should be familiar with Crown warranty policies. Each Instruction Manual contains basic policies as related to the customer. However, under questionable circumstances, please contact the Technical Service Department or Director of Customer Service at: Crown International, Inc., 1718 W. Mishawaka Road, Elkhart, IN 46517.

III. General Specifications

Conform to IEEE/IHF standards

Tuning Range: U.S. frequencies - 87.9 to 107.9MHz, European frequencies - 87.5 to 108MHz (or 104MHz).

Antenna Inputs: 75 ohms, unbalanced; 300 ohms balanced with balun (supplied).

Detector Type: Digital (Pulse Count).

Intermediate Frequency (IF): First IF 10.7MHz, second IF 1.965MHz.

Sensitivity: 9.31dBf.

Quieting: 50dB mono 11.2dBf, 50dB stereo 36dBf.

Signal to Noise Ratio: Mono 75dB, stereo 70dB.

Hum and Noise: 70dB.

Total Harmonic Distortion: Mono .05%, stereo .05%.

Capture Ratio: 1.5dB.

Alternate Channel Selectivity: 75dB.

Frequency Response: +.5dB 30Hz-15KHz.

Stereo Separation: 60dB @ 1KHz, 50dB @10KHz.

Image Response Ratio: Greater than 114dB.

IF Response Ratio: Greater than 114dB.

RF Intermodulation: 65dB.

AM Suppression Ratio: Greater than 80dB.

Subcarrier Product Ratio: 70dB.

SCA Rejection Ratio: 70dB.

Spurious Response Ratio: Greater than 114dB.

Connectors: 75 ohm unbalanced antenna input-F type, output pin jacks.

Display: A fluorescent indicator panel which consists of a signal strength indicator, stereo indicator and frequency display. Circular amber Power LED; rectangular amber Memory LED; six separate green preset LED's.

Power Requirements: 120V 50/60HZ 10 watts; 100, 220, and 240 volts also available.

Size: 1¾" H (4.4cm), 11¾" D (29.8cm), 19" W (48.3cm).

Finish: Two finishes are available: brushed and satinized aluminum front panel (shown in this manual) or a black polyester vinyl coated aluminum front panel. Zinc diecast handles.

Weight: Approximately 9.5 lbs. (4.3kg).

IV. Performance Graphs

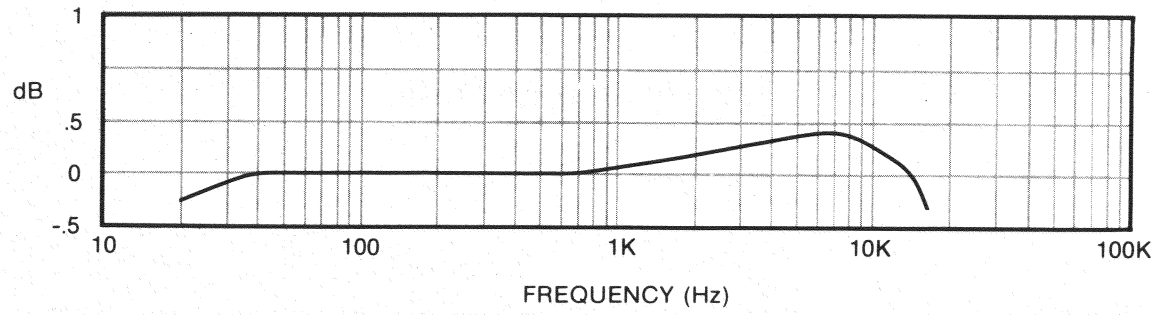

Fig. RVW.1 Frequency Response, Mono and Stereo

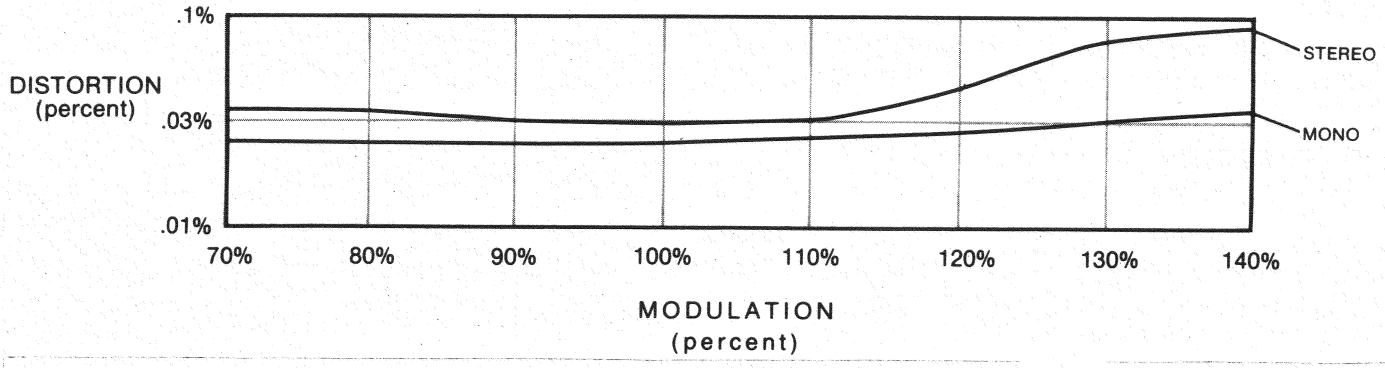

Fig. RVW.2 Distortion vs. % Modulation

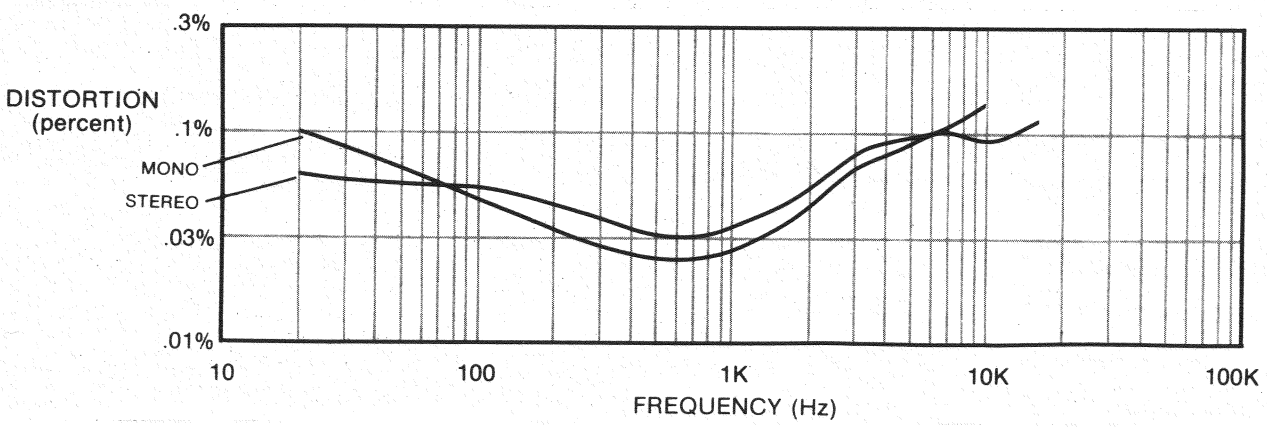

Fig. RVW.3 Mono and Stereo Distortion vs. Frequency

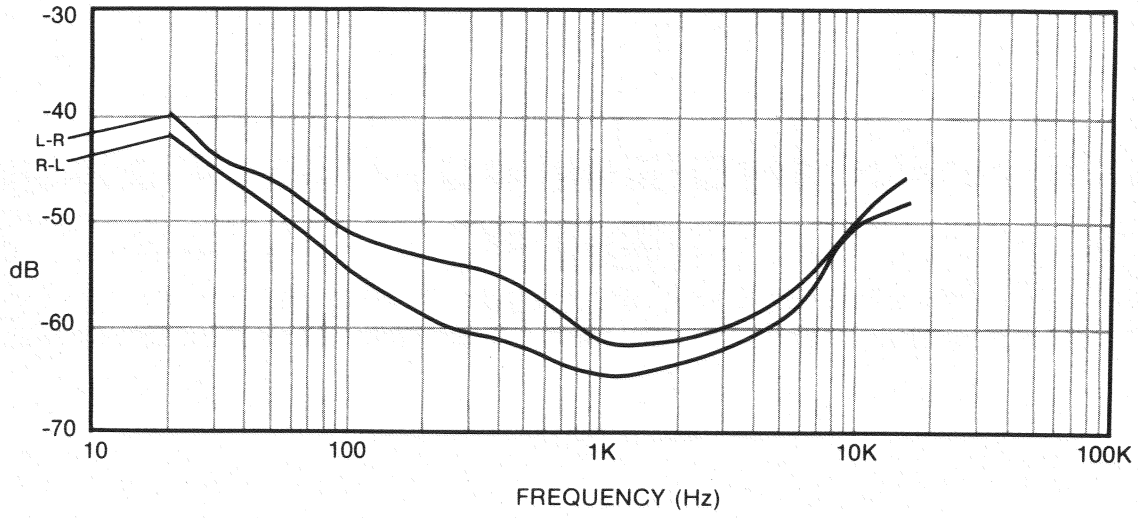

Fig. RVW.4 Stereo Separation

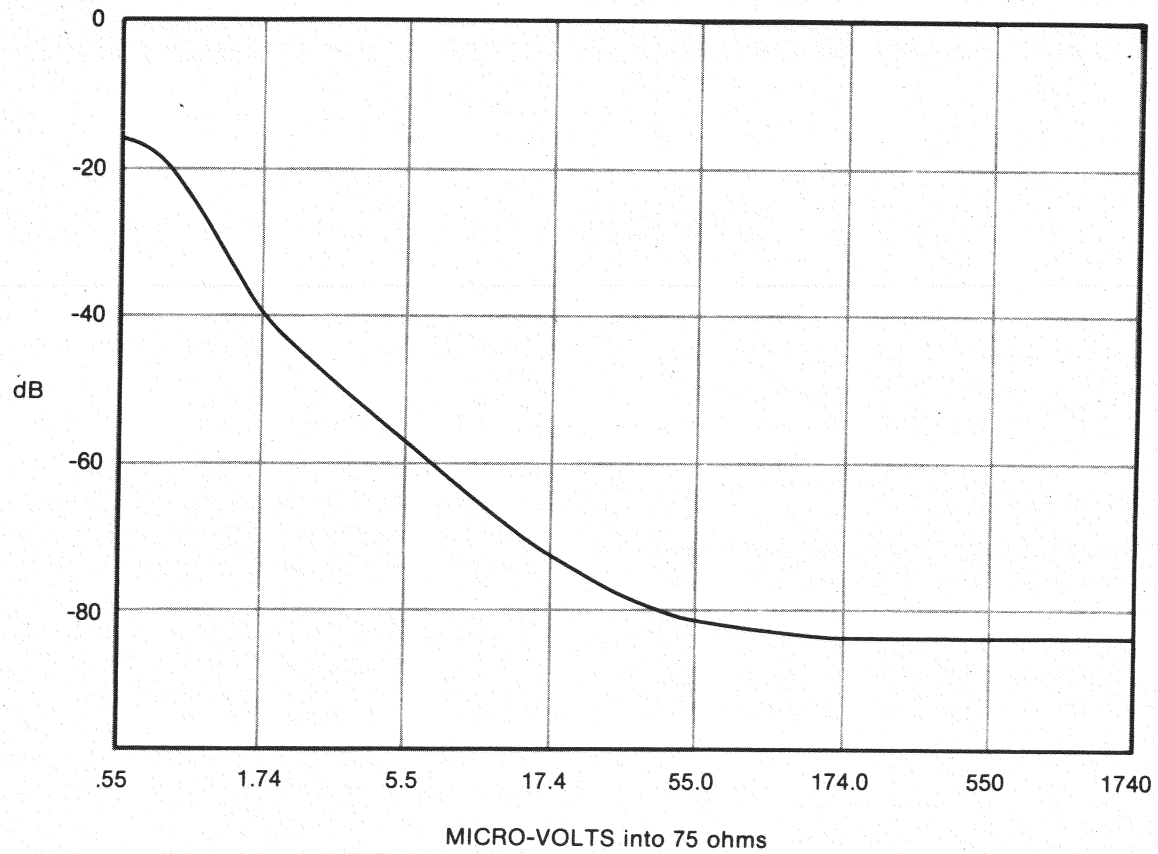

Fig. RVW.5 Input Signal vs. Quieting

V. Controls and Adjustments

The following paragraphs refer to the front and rear panel diagrams in Fig. 3.1 and 3.2.

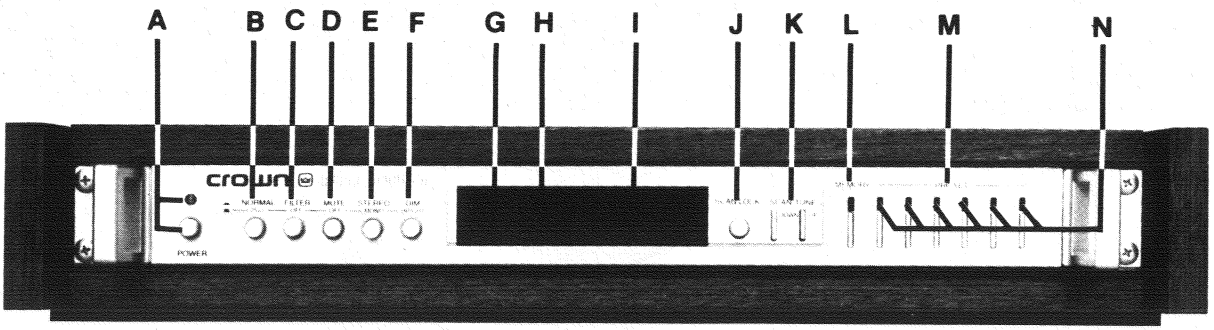

Fig. RVW.6 FM TWO Front Panel

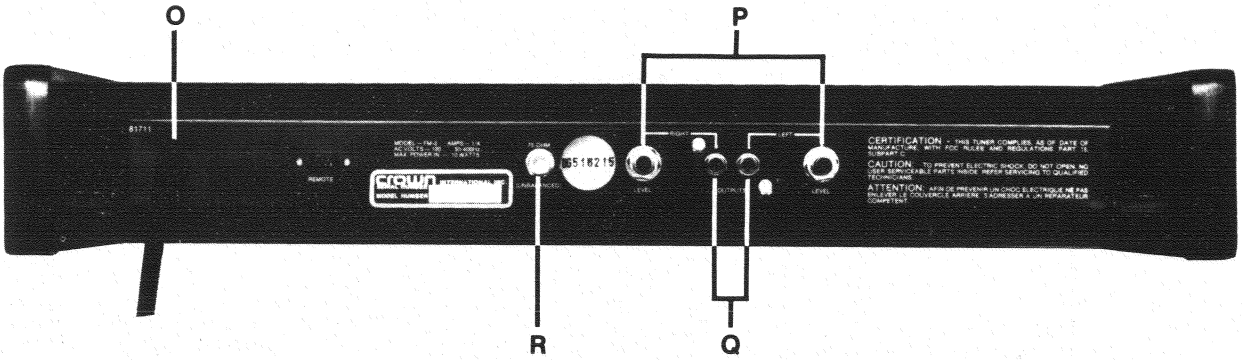

Fig. RVW.7 FM TWO Rear Panel

A. Power Switch and Indicator

This pushbutton switch activates the FM TWO and causes the amber indicator, located directly above, to glow. The station that was tuned previous to removing power, will re-appear upon turn-on.

B. Normal/25 Microsecond

During the receiving of normal broadcasts, this button should be left in the "out" position. However, certain programs may be transmitted with encoded noise reduction information and need a special "de-emphasizing" process. When this occurs, the normal/25 microsecond button should be depressed (25 microsecond position).

C. Filter

Because of the possible noise and distortion associated with weak FM stereo signals, a stereo noise Filter is incorporated. When this button is pushed "in", the higher frequencies of both the left and right channels are combined in such a manner as to eliminate or cancel most of the distortion. Use of this feature is recommended when receiving weak stereo signals.

D. Mute

The FM TWO contains a Mute feature, front panel activated, which eliminates all weak or fading signals from the audio output. It is particularly helpful when scanning the FM band because it eliminates all spurious input noise (static, weak stations, etc.) which in turn, prevents premature activation of the Scan feature. The amount of input signal voltage that is necessary to overcome the mute circuit, is predetermined internally and not adjustable. However, if the Mute function is not desired, its pushbutton should remain in the out postion.

E. Stereo/Mono

When receiving monaural broadcasts, this switch should be in the Mono postion (depressed). In addition, this feature is helpful when listening to stereo

signals that contain high levels of noise (usually from too weak of signal to receive stereo information adequately). Depressing this switch during the reception of strong stereo signals will produce a mono output and at the same time, cause the fluorescent stereo indicator light to go out.

F. Dim/Bright

In room environments where the FM TWO is housed, it is possible to encounter many different lighting situations. For this reason, the main display is capable of providing two different light intensities; Dim and Bright. In most cases, the display will probably require the Bright position (not depressed).

G. Signal Strength

A five segment fluorescent display makes up the Signal Strength indicator. The stronger the incoming signal, the farther to the right the lights will illuminate.

H. Stereo Indicator

Any time stereo program material is being received on the FM TWO, the Stereo Indicator light will glow. During the reception of weak stereo signals, the lamp may flicker. This is normal and indicates that either another, stronger station should be selected or that the Stereo/Mono switch should be placed in the Mono position for clearer reception. As mentioned previously, if the unit is placed in the Mono mode, the stereo indicator light will go out.

I. Numerical Readout Display

The frequency at which the FM TWO is tuned, is shown on the main Numerical Readout display. Upon powering up, the unit will display the station that was last tuned previous to turn-off. In most cases, the FM TWO is set up to receive and display American frequencies which are divided every 200KHz beginning at 87.9 through 107.9MHz. However, all units are capable of showing European frequencies which are divided every 50KHz from 87.5 through 108MHz (104MHz also available with minor modifications).

J. Scan Lock

Scan Lock pushbutton provides either push-by-push and rapid up/down frequency selection or, automatic scanning action. When Scan Lock is out (not depressed), touching the Up/Down switches will cause the frequency to proceed up or down at a continuous rate. Also in this position, frequency selection may be done one step at a time by "touching and releasing" the Up/Down switches. However, should the Scan Lock button be depressed (in), the same touching of the Up/Down switches will cause the unit to scan and sample each station strong enough to defeat the internal muting threshold point. When a desired station is found, releasing of the switches will allow listening of that particular selection.

K. Scan/Tune

As mentioned in paragraph J, the Up/Down pushbuttons provide direction for frequency selection, either up or down the scale. Next to each button there are labels, that indicate the respective direction that each is responsible for.

L. Memory Indicator

At any time the main Memory program switch is depressed, the Memory programing function for the six preset buttons is activated and indicated by the illuminated amber LED directly above the Memory button. It will remain lit for approximately five seconds after the Memory button is depressed.

M. Pre Set Buttons

These buttons may be pre-set or programmed to six different stations as desired by the user. To program them, first choose the desired station via the Up/Down buttons. Next depress the Memory button. At that point, the Memory function will be activated as indicated by the LED directly above the Memory button. Approximately five seconds will elapse in which it will be necessary to choose the desired Pre Set button for that specific frequency. This procedure should be followed for each of the remaining five Pre Set buttons. Now, each time a Pre set button is pressed, that particular station will be chosen and a green light above that button, will illuminate indicating that particular Pre Set is currently selected. At any time a change in Pre Set selection is desired, simply follow the original programming instructions and the previously selected station will be erased. These stations will remain in memory even if the power to the AC plug is temporarily removed (about five days) from the wall outlet or power is accidentally shut off.

Note: The FM TWO memory circuit operates on a separate power supply that remains activated even when the power switch is off. However should AC power be removed, a reserve supply "takes over" and provides adequate operating memory circuit voltage for approximately five days. This means after the five day time frame, it will be necessary to re-program all memory data. An often over-looked source of frustration is plugging the FM TWO into another stereo system component's accessory AC outlet that is switched. In other words, the power supplied to the accessory switched outlet is removed when that particular unit is shut off. If the system is not turned on during the "reserve power" time, the FM TWO will have to be re-programmed. Always try to keep AC power supplied to the unit. If this is impossible or

impractical, periodically. turn the system on to ensure successful memory storage.

N. Pre Set Indicators

Six, green LED's make-up the Pre Set indicator lights. They are located directly above each Pre Set button and illuminate whenever that particular setting is chosen. Only one light will glow at a time.

O. AC Cord

A standard two prong plug is supplied on the FM TWO.

P. Variable Output Adjustments

These variable adjustments (one for each channel) control the level of the FM TWO output signal. They are mainly useful in obtaining a uniform output level as compared to other components (turntable, tape deck, etc.) in the sound system.

Q. Output Jacks

Pin-type jacks are used on the rear panel for the output signal. The output level from these jacks is affected by the variable output adjustments as mentioned before.

R. Antenna Jack

Only one antenna connection jack is provided on the FM TWO; a 75 ohm coaxial type. This type is standard because of the low noise characteristics associated with the use of 75 ohm coaxial cable as compared to conventional twin lead. Also, most commercially available FM signals, such as those from local cable TV systems, supply 75 ohm coaxial lead-in and the connector. However, 300 ohm twin lead may be used as antenna lead-in with the FM TWO, with the use of a "balun", supplied with the unit. Fig. 3.3 shows a typical 300 ohm hook-up using a balun.

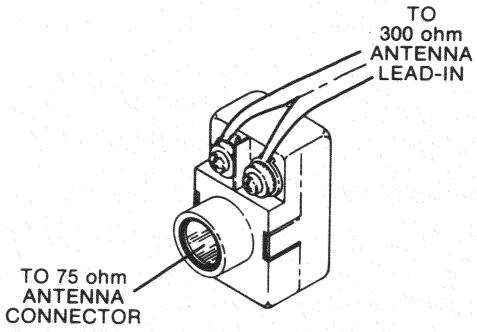

Fig. RVW.8 300 Ohm Antenna Hookup Using a Balun

SECTION 6
ILLUSTRATED PARTS LIST

6.1 General Information

Section 6 contains illustrations and parts lists for the FM TWO. This information should be used with the service, repair and adjustment procedure in Section 7.

Most of the mechanical and structural type parts are illustrated and indexed on exploded view drawings. Electrical and electronic parts on these illustrations are also identified by the circuit schematic designation next to the illustration. Both the index number and the schematic designation are included in the parts list in separate columns. The schematic designations correspond to those shown in schematic diagrams in the Review Section.

Electrical and electronic parts located on printed circuit boards are illustrated by schematic symbols on the trace side and by schematic designations on the component side.

The quantity of each part used in each location is also shown in the parts listing.

6.2 Standard and Special Parts

Many electrical and electronic parts used in the FM TWO are standard items stocked by and available from electronic supply houses. However, some electronic parts that appear to be standard, are actually special. A part ordered from Crown will assure an acceptable replacement. Structural items, covers and panels are available from Crown only.

6.3 Ordering Parts

When ordering parts, be sure to give the model and serial number and include the part description and Crown Part Number (CPN) from the parts list. Price quotes are available upon request.

6.4 Shipment

I. Shipment will be made by UPS or best method unless you specify a preferred method.
2. Shipments are made F.O.B. Elkhart, Indiana only.
3. Established Crown accounts will be freight prepaid and billed unless shipped by truck or air freight.
4. All others will be shipped freight collect.

6.5 Terms

NOTE: Part prices are subject to change without notice.

1. Normal terms are C.O.D. unless the order is prepaid.
2. Net 30 days terms apply only to those firms who have an established line of credit with Crown.
3. If prepaying please add an amount for the freight charge. $1.60 is average for an order under one pound.
4. New parts returned for credit are subject to a 10% restocking charge.
5. You must receive authorization from the Parts Dept. before returning parts for credit.
6. We are not a general parts warehouse! Parts are available for servicing Crown products only.

6.6 Schematics/Parts Lists/Exploded View Drawing

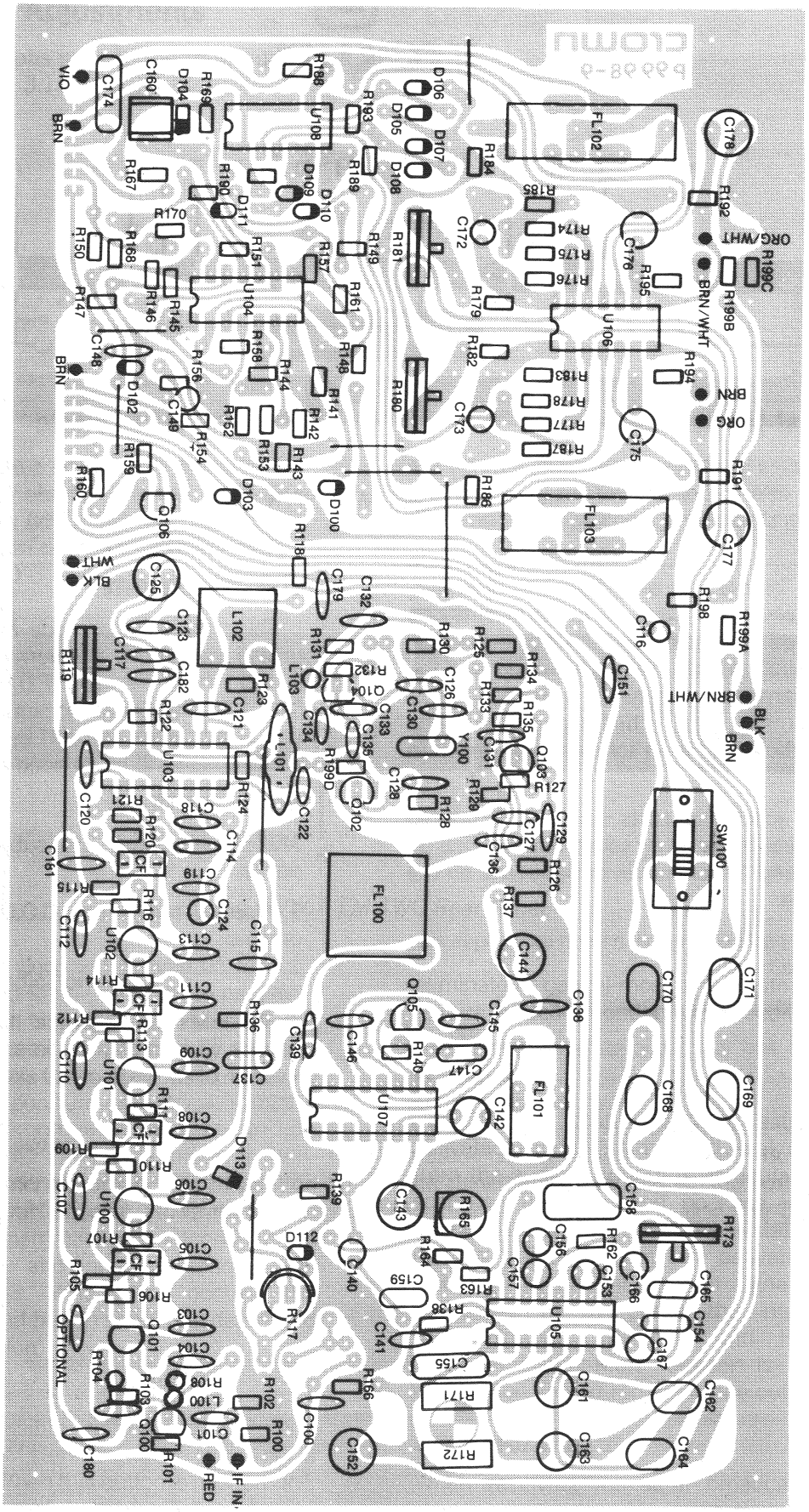

Fig. 6.1 Main Module Component Board Layout; #Q42467J2
(for serial numbers thru 3790)

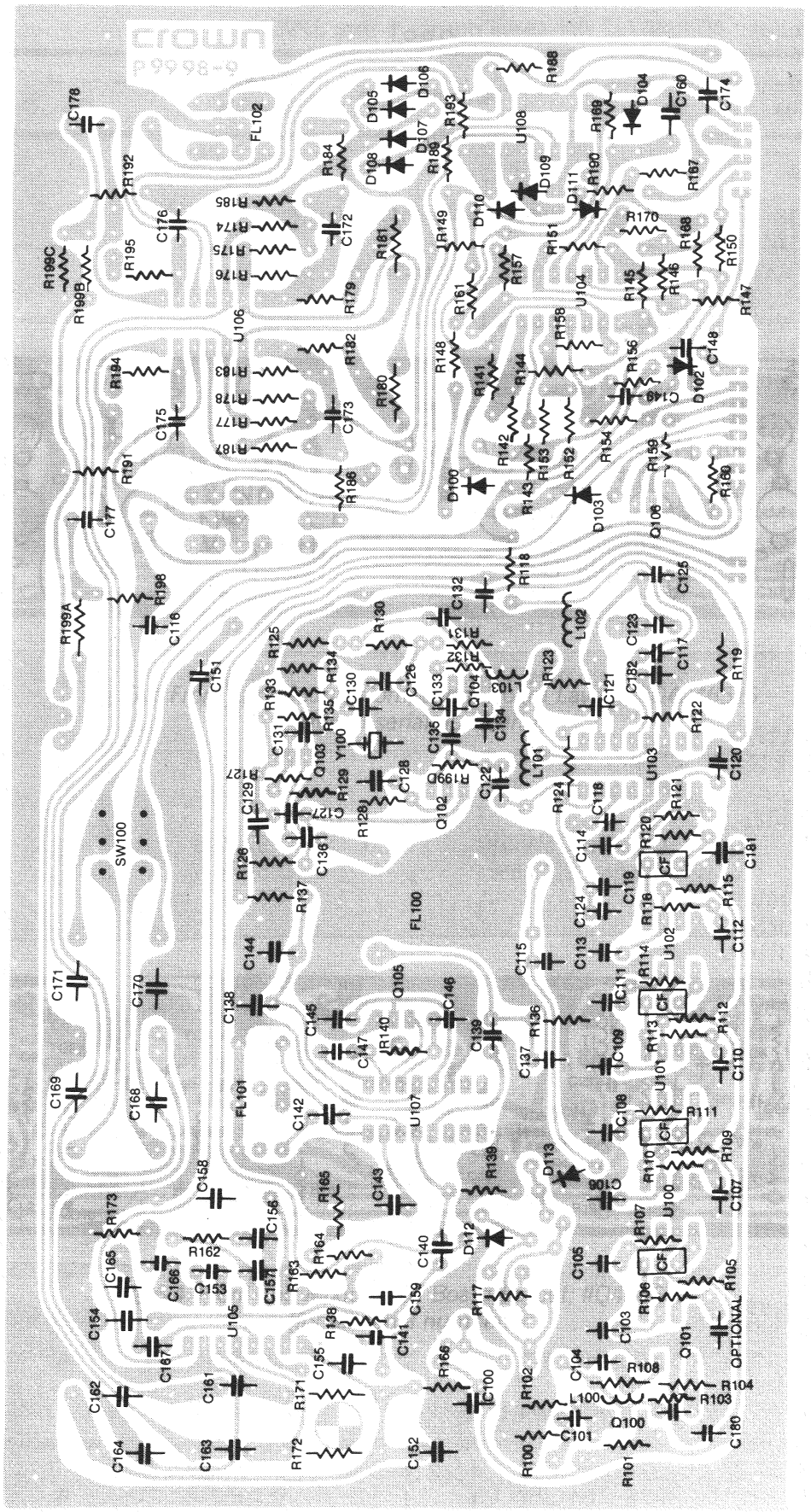

Fig. 6.2 Main Module Foil Board Layout; #Q42467J2
(for serial numbers thru 3790)

Parts List: Main Module; #Q42467J2 (for serial numbers thru 3790)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R100, R13	1.2K ohm .25W 5%	C 2875-0	2	
	R101, R102, R104, R117, R130, R131, R191, R192	100K ohm .25W 5%	C 2883-4	8	
	R105, R109, R112, R115, R134	10 ohm .25W 5%	C 3753-8	5	
	R106, R107, R110, R111, R113, R114, R116	330 ohm .25W 5%	C 5169-5	7	
	R108, R122, R125, R128, R137	100 ohm .25W 5%	C 2872-7	5	
	R117	100K ohm Cermet Trim	C 4843-6	1	
	R118, R126, R193	2.2K ohm .25W 5%	C 2628-3	3	
	R119	30K ohm Vert. Green Pot	C 2298-5	1	
	R120, R127, R129, R166	47 ohm .25W 5%	C 1011-3	4	
	R121	270 ohm .25W 5%	C 6034-0	1	
	R123, R132, R164	5.6K ohm .25W 5%	C 3220-8	3	
	R135	680 ohm .25W 5%	C 5975-5	1	
	R136, R142, R153, R160, R161, R162, R168, R190	1K ohm .25W 5%	C 2627-5	8	
	R138, R150, R185, R187, R198, R199C	4.7K ohm .25W 5%	C 3939-3	6	
	R139, R163, R175, R176, R178, R183	33K ohm .25W 5%	C 4346-0	6	
	R140, R184, R186	3.3K ohm .25W 5%	C 2629-1	3	
	R141, R146, R147, R152 R167	15K ohm .25W 5%	C 2632-5	5	
	R143, R145, R148, R154, R157, R159	10K ohm .25W 5%	C 2631-7	6	
	R144, R149, R156	1M ohm .25W 5%	C 3198-6	3	
	R151, R158, R174, R177, R179, R182	390K ohm .25W 5%	C 4660-4	6	
	R155	3.9 K ohm .25W 5%	C 2630-9	1	
	R165	5K ohm Helipot Trim	C 3670-4	1	
	R169	2.2M ohm .25W 5%	C 5170-3	1	

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	R170	10M ohm .25W 10%	C 3221-6	1	
	R171, R172	4.42K ohm .5W 1%	C 3120-0	2	
	R173	100K ohm Vert Wht Pot	C 1713-4	1	
	R180, R181	500K ohm Vert Trim Pot	C 5209-9	2	
	R199A, R199B	620 ohm .25W 5%	C 3872-6	2	
	R199D	470K ohm .25W 5%	C 4225-6	1	
	C100, C101, C102, C103, C104, C105, C106, C107, C108, C109, C110, C111, C112, C113, C114, C115, C118, C119, C120, C121, C123, C127, C128, C130, C131, C132, C136, C138, C139, C144, C145, C146, C148, C150, C151, C154, C157, C177, C179, C180, C181	.02mF 50V Disc	C 5230-5	41	
	C116	1.0mF 35V TANT	C 5638-9	1	
	C117, C217	22mF 50V NP 10%	C 5311-3	2	
	C122	39pF 10% Disc	C 5227-1	1	
	C124, C149	.47mF 25V 10% TANT	C 5181-0	2	
	C125, C143	100mF 16V	C 3729-8	2	
	C126	8.2pF 10% N220	C 5191-9	1	
	C129, C133	33pF 10% NPO	C 5980-5	2	
	C134	12pF 10% NPO	C 5979-7	1	
	C135	1pF 5% NPO	C 5982-1	1	
	C137	100pF Mica	C 3410-5	1	
	C141	220pF Z5U	C 5978-9	1	
	C142, C175, C176	4.7mF 63V Vert	C 4253-8	3	
	C147	82pF Mica	C 3627-4	1	
	C152	220mF 16V Vert	C 3796-7	1	
	C153, C156, C163	3.3mF 25V 10%	C 5180-2	3	
	C155, C174	.047mF 200V 5% Film	C 3978-1	2	
	C158	2200pF	D 6018-2	1	
	C159	1000pF	C 5636-3	1	
	C160	.47mF 100V 10% Poly	C 4119-1	1	

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	C162,C164, C168, C169, C170, C171	5640pF 63V 2.5%	D 4466-5	6	
	C165	.01mF 200V 10% Film	C 3161-4	1	
	C166, C167	.33mF 35V 10%	C 5184-4	2	
	Integrated Circuits				
	U100, U101, U102	UA703HC IF Amp	C 5077A8	3	
	U103	HA11225 IF Op Amp	C 4956-6	1	
	U104	LM339N Volt Comparator	C 4345-2	1	
	U105	HA11223 PLL St. Demod	C 4955-8	1	
	U106	TL074 Quad Op Amp	C 4696-8	1	
	U107	HA12401A Detector	C 5907-8	1	
	U108	MC14016 Quad Switch	C 4834-5	1	
	Transistors				
	Q100, Q102	2N5485	C 5123-2	2	
	Q101	J-310 JFET	C 6049-8	1	
	Q103, Q104	TI586	C 5078-8	2	
	Q105, Q106 Q107	PN4250A	C 3786-8	3	
	Miscellaneous				
		16 pin DIL IC Socket	C 4508-5	3	
		14 pin DIL IC Socket	C 3450-1	3	
	FL100	BF-56 Band Pass Filter	C 5911-0	1	
	FL101	BL-21 Low Pass Filter	C 5912-8	1	
	FL102, FL103	Multiplex Filter	C 5059-8	2	
	Y100	12.665 MHz Crystal	C 5950-8	1	
	L100, L103	15uh Choke 1500017	D 5121-5	2	
	L101	22uh Choke Shielded	D 5122-3	1	
	L102	Detector Coil	C 5948-2	1	
	SW100	DPDT PC MNT Slide Switch	C 5080-4	1	
		3 pin Socket Strip	C 5295-8	4	
		10.7MHz Ceramic Filter	C 4954-1	2	
		SFE10.7MX-A Filter	C 5933-4	2	

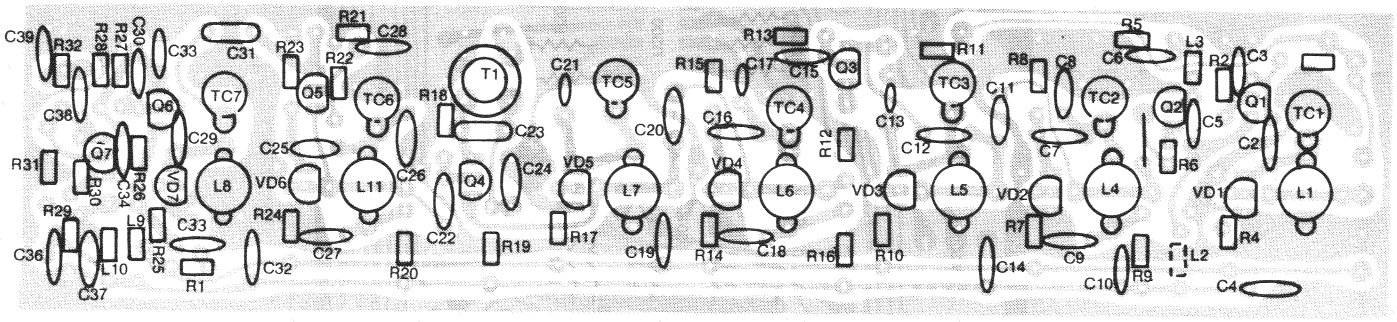

Fig. 6.3 Front End Module Component Board Layout; #Q42465J6
(for all serial numbers)

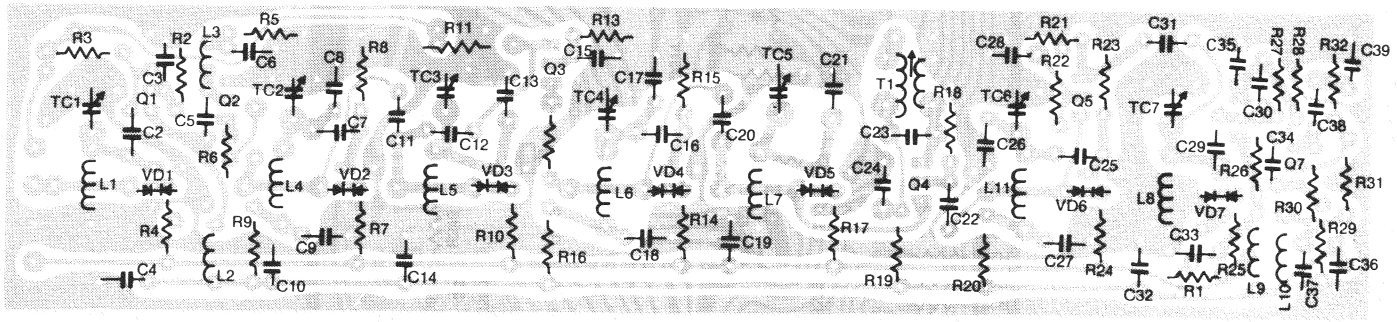

Fig. 6.4 Front End Module Foil Board Layout; #Q42465J6
(for all serial numbers)

Parts List: Front End Module; #Q42465J6 (for all serial numbers)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R1	33K ohm .25W 5%	C 4346-0	1	
	R2, R7, R10, R14, R17, R24, R25	47K ohm .25W 5%	C 2880-0	7	
	R3, R8, R11, R15	100K ohm .25W 5%	C 2883-4	4	
	R4, R30	470 ohm .25W 5%	C 2626-7	2	
	R5, R6, R13, R19, R20, R22	100 ohm .25W 5%	C 2872-7	6	
	R9, R16	130 ohm .25W 5%	C 5236-2	2	
	R12	150 ohm .25W 5%	C 3799-1	1	
	R18, R28, R29	2.2K ohm .25W 5%	C 2628-3	3	
	R21, R23	150K ohm .25W 1%	C 4870-9	2	
	R26	8.2K ohm .25W 5%	C 2877-6	1	
	R27, R31	10K ohm .25W 5%	C 2631-7	2	
	R32	6.8K ohm .25W 5%	C 5166-1	1	
	Capacitors				
	C1	.033mF 100V Film	C 5063-0	1	
	C2	240pF	C 5196-8	1	
	C3, C4, C9, C18, C19, C27, C28, C32, C33, C36	.02mF 50V	C 5230-5	10	
	C5, C6, C7, C10, C12, C14, C15, C16, C22, C24, C25, C37, C38	.001mF	C 2288-6	13	
	C8, C11, C20, C26, C34	2.2pF	C 5190-1	5	
	C13, C17, C21	3pF	C 5281-8	3	
	C23	27pF	C 2342-1	1	
	C29, C35	10pF	C 5188-5	2	
	C30	15pF	C 5272-7	1	
	C31	5pF	C 2820-6	1	
	C39	39pF	C 5227-1	1	
	Transistors				
	Q1, Q2, Q3, Q4	J-310	C 6049-8	4	
	Q5	2N5486	C 5959-9	1	
	Q6, Q7	2N5770	C 5135-0	2	

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Miscellaneous				
	VD1, VD2, VD3, VD4, VD5, VD6, VD7	BB204 Varactor Diode	C 5131-5	7	
	TC1,TC2, TC3, TC4, TC5, TC6, TC7	3-12pF Ceramic Trimmer	C 5162-0	7	
	L1	Coil, Front End (Green)	C 5760-0	1	
	L2, L3, L9, L10	15uh Choke 1500017	D 5121-5	4	
	L4	Coil, Front End (White)	D 5761-8	1	
	L5	Coil, Front End (Blue)	D 5762-6	1	
	L6, L7	Coil, Front End (Red)	D 5763-4	2	
	L11	Coil, Front End (Orange)	D 5765-9	1	
	T1	Transformer, Mixer	D 5766-7	1	

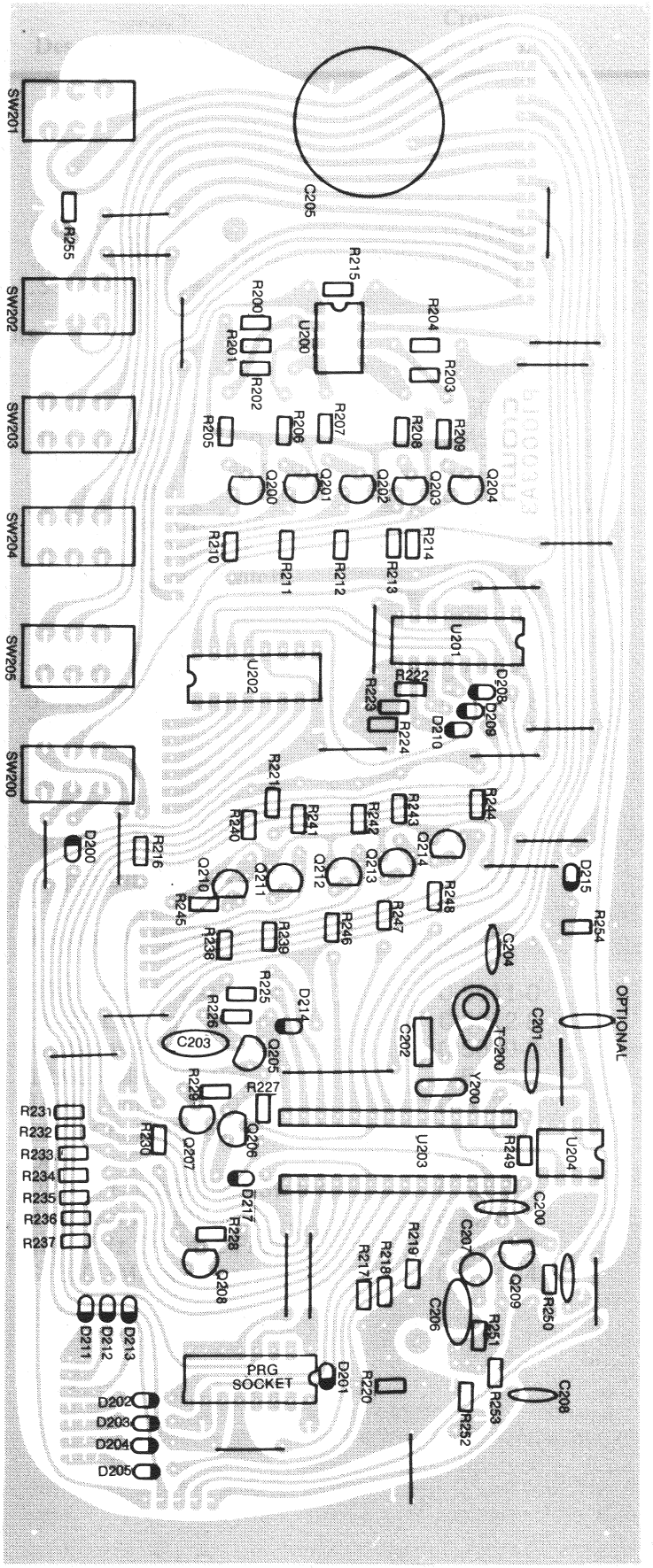

Fig. 6.5 Control Module Component Board Layout; #Q42466J4 (for serial numbers thru 3790)

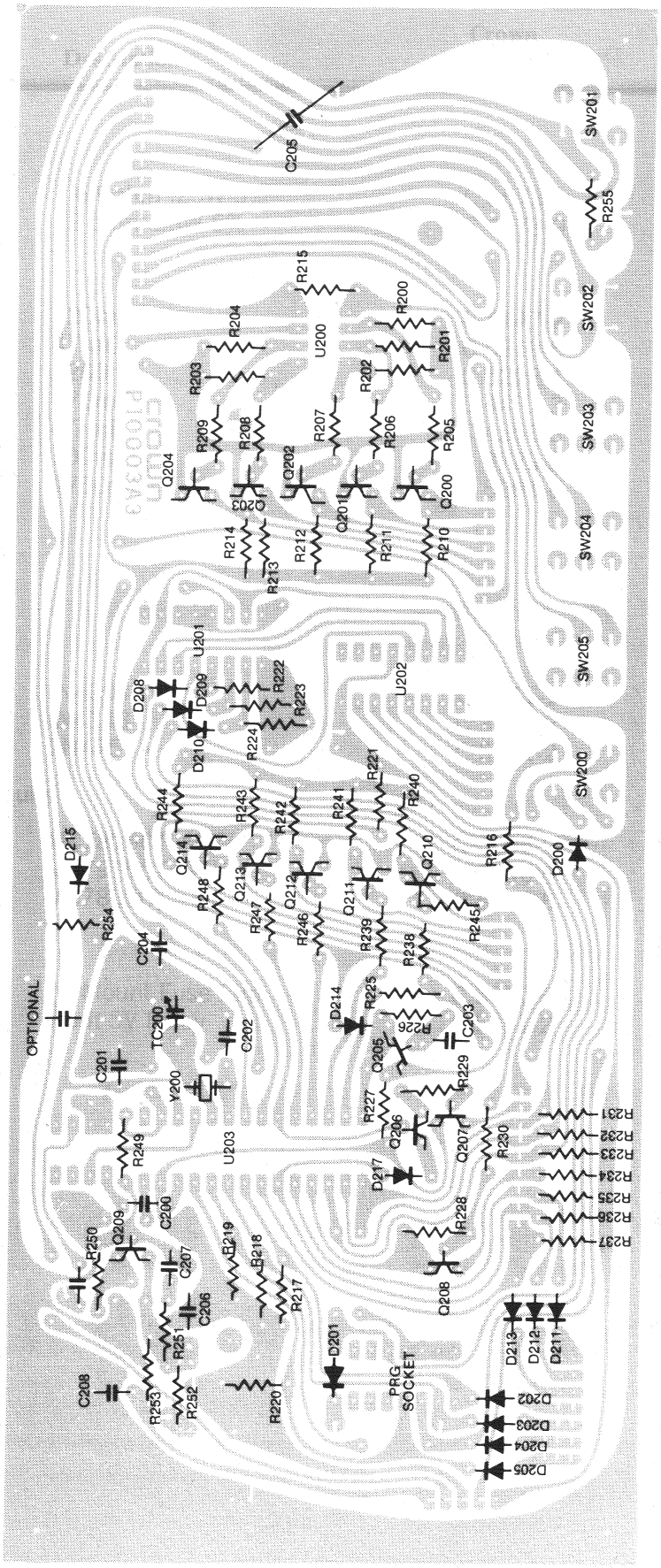

Fig. 6.6 Control Module Foil Board Layout; #Q42466J4
(for serial numbers thru 3790)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R200, R201, R202, R203, R204, R221, R222, R223, R224, R225, R226, R227, R228, R229, R238, R240, R245, R249, R252, R254	10K ohm .25W 5%	C 2631-7	20	
	R205, R206, R207, R208, R209, R239, R246, R247, R248	47K ohm .25W 5%	C 2880-0	9	
	R210, R211, R212, R213, R214, R231, R232, R233, R234, R235, R236, R237, R241, R242, R243, R244	100K ohm .25W 5%	C 2883-4	16	
	R215	8.2K ohm .25W 5%	C 2877-6	1	
	R216	150 ohm .25W 5%	C 3799-1	1	
	R217, R218, R219, R220	33K ohm .25W 5%	C 4346-0	4	
	R230	620K ohm .25W 5%	C 4227-2	1	
	R250	150K ohm .25W 5%	C 4216-5	1	
	R251	2.2K ohm .25W 5%	C 2628-3	1	
	R253	20K ohm .25W 5%	C 5046-5	1	
	R255	300 ohm .25W 5%	C 3801-5	1	
	Capacitors				
	C200, C201, C204, C208	.02mF 50V Disc	C 5230-5	4	
	C202	20pF Tubular Cer.	C 3535-9	1	
	C203	.0047mF 200V 5% Film	C 3996-3	1	
	C205	.47mF 5V	C 5952-4	1	
	C206	.022mF 200V 5% Film	C 3977-3	1	
	C207	3.3mF 25V 10% Tant	C 5180-2	1	
	C209	220mF 16V Vert	C 3796-7	1	For SN 3791 - 4860

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Diodes				
	D200, D201, D202, D203, D204, D205, D206, D207, D208, D209, D210, D211, D212, D213, D215, D216, D217, D218 D219	1N4148	C 3181-2	19	
	D214	IN4004	C 2851-1	1	
	Transistors				
	Q200, Q201, Q202, Q203, Q204, Q205, Q208, Q210, Q211, Q212, Q213, Q214	PN4250-A	C 3786-8	12	
	Q206	2N4125	C 3625-8	1	
	Q207	SEL 2N3859A	D 2961-7	1	
	Q209	2N6428A	C 4695-0	1	
	Integrated Circuits				
	U200	TL489CP SEL DIS DRVR	C 5967-2	1	
	U201	4035 4BIT SHFT RGSTR	C 5965-6	1	
	U202	74LS42 BCD-DCM Decoder	C 5966-4	1	
	U203	UPD1703C-011 DIG. CTL	C 5937-5	1	
	U204	UPB553A Prescaler	C 5936-7	1	
	Miscellaneous				
		8 pin DIL IC Socket	C 3451-9	2	Socket for U200, U204
		16 Pin DIL IC Socket	C 4508-5	2	Socket for U201, U202
		14 Pin SIP Socket	C 5981-3	2	Sockets for U203
		14 pin DIL IC Socket	C 3450-0	1	PRG Socket
	TC200	30pF PC MNT Trimmer	C 5058-0	1	
	Y200	4.5 MHz Crystal	C 5949-0	1	
	SW200, SW202, SW203, SW204, SW205	5 Station DPDT Pushbutton Switch	C 5957-3	1	
	SW201	1 Station DPDT Pushbutton 6.3 Lug	C 5958-1	1	

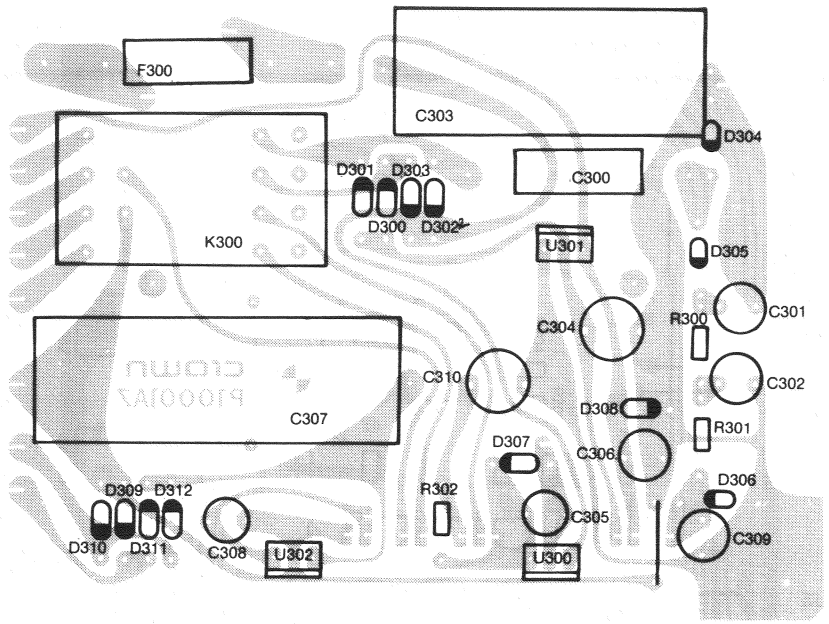

Fig. 6.7 Power Supply Component Board Layout; #Q42468J0 (for serial numbers thru 3790)

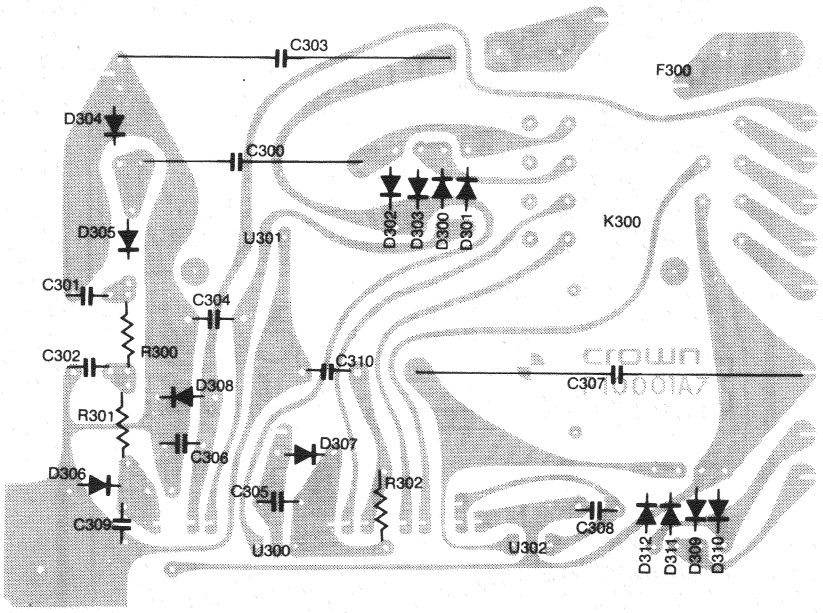

Fig. 6.8 Power Supply Foil Board Layout; #Q42468J0 (for serial numbers thru 3790)

Parts List: Power Supply Module; #Q42468J0 (for serial numbers thru 3790)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R300, R301	1.6K ohm .25W 5%	C 3873-4	2	
	R302	22 ohm .25W 5%	C 4479-9	1	
	Capacitors				
	C300	220mF	C 4147-2	1	
	C301, C302	47mF	C 5219-8	2	
	C303	2200mF	C 5202-4	1	
	C304, C310	470mF	C 4477-3	2	
	C305, C308	4.7mF	C 4253-8	2	
	C306, C309	100mF	C 3729-8	2	
	C307	4700mF	C 5201-6	1	
	Diodes				
	D300, D301, D302, D303, D307, D308, D309, D310, D311, D312	IN4004	C 2851-1	10	
	D304, D305	IN4148	C 3181-2	2	
	D306	1N4751A	C 5081-2	1	
	Integrated Circuits				
	U300	MC7815CT +15V	C 5095-2	1	
	U301	MC7915CT -15V	C 5096-0	1	
	U302	MC7805CT +5V	C 5094-5	1	
	Miscellaneous				
		PC Mount Fuse Clip	C 5060-6	2	
	K300	4 pdt 5V Relay	C 5991-2	1	

Parts List: Memory Board; #M42667-2 (for serial numbers thru 3790)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R400	150 ohm .25W 5%	C 3799-1	1	
	Diodes				
	LED 400	Amber Rectangular LED	C 5989-6	1	
	LED401, LED402, LED403 LED404 LED405, LED406	Green Rectangular LED	C 5956-5	6	
	Miscellaneous				
		TACTILE SWSPR Contact	C 5953-2	7	
		TACTILE SWBTN Contact	C 5954-0	7	
		Housing Activator, Pushbar	D 5752J6	7	

Parts List: Display Board; #M42665-6 (for serial numbers thru 3790)

Display, fluorescent	C 5939-1	1	
Tactile SWSPR Contact	C 5953-2	2	
Tactile SWBTN Contact	C 5954-0	2	
Housing, activator, Pushbar	D 5752J6	2	

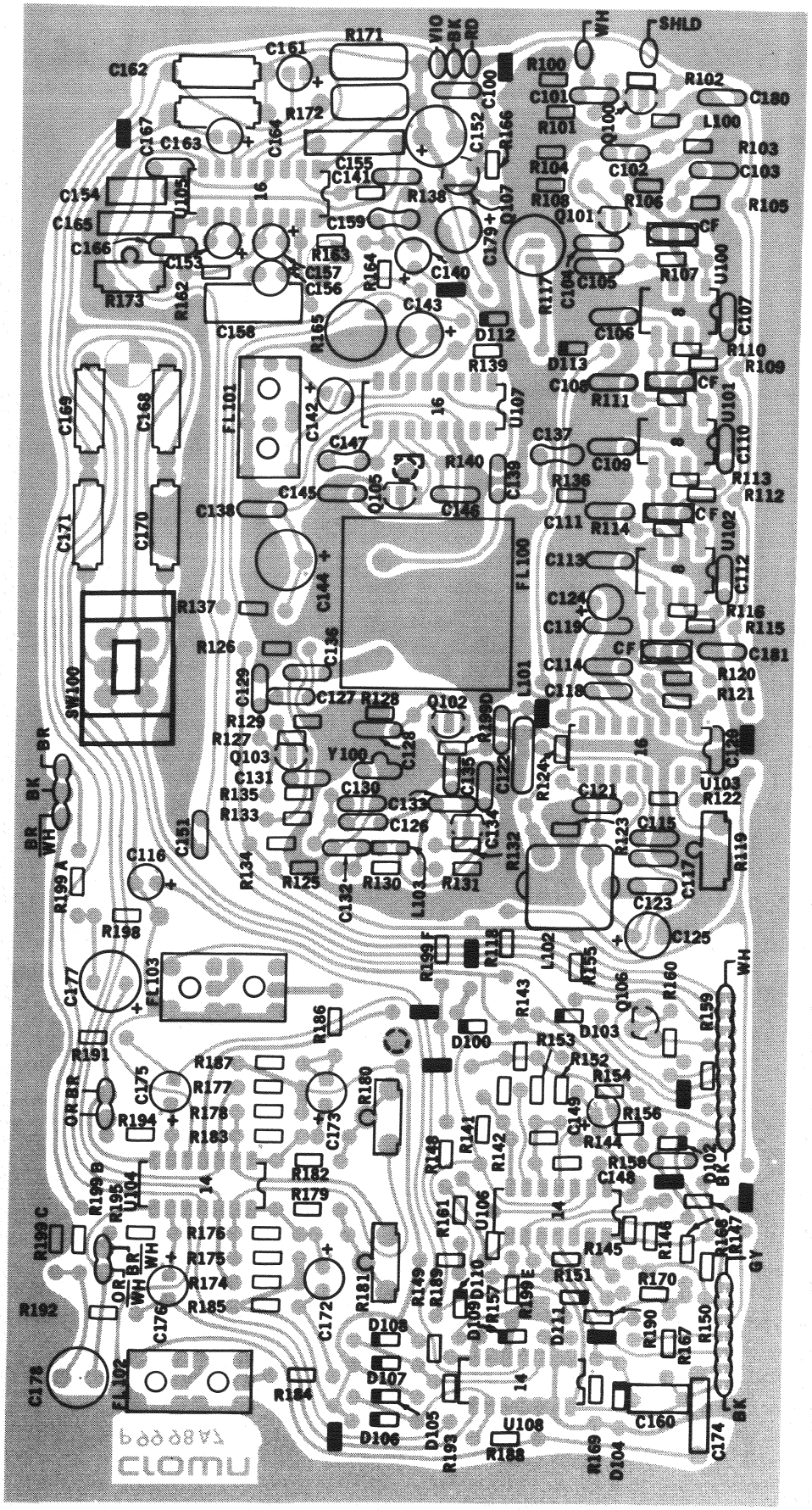

Fig. 6.9 Main Module Component Board Layout; #Q42499-6
(for serial numbers 3791 and above)

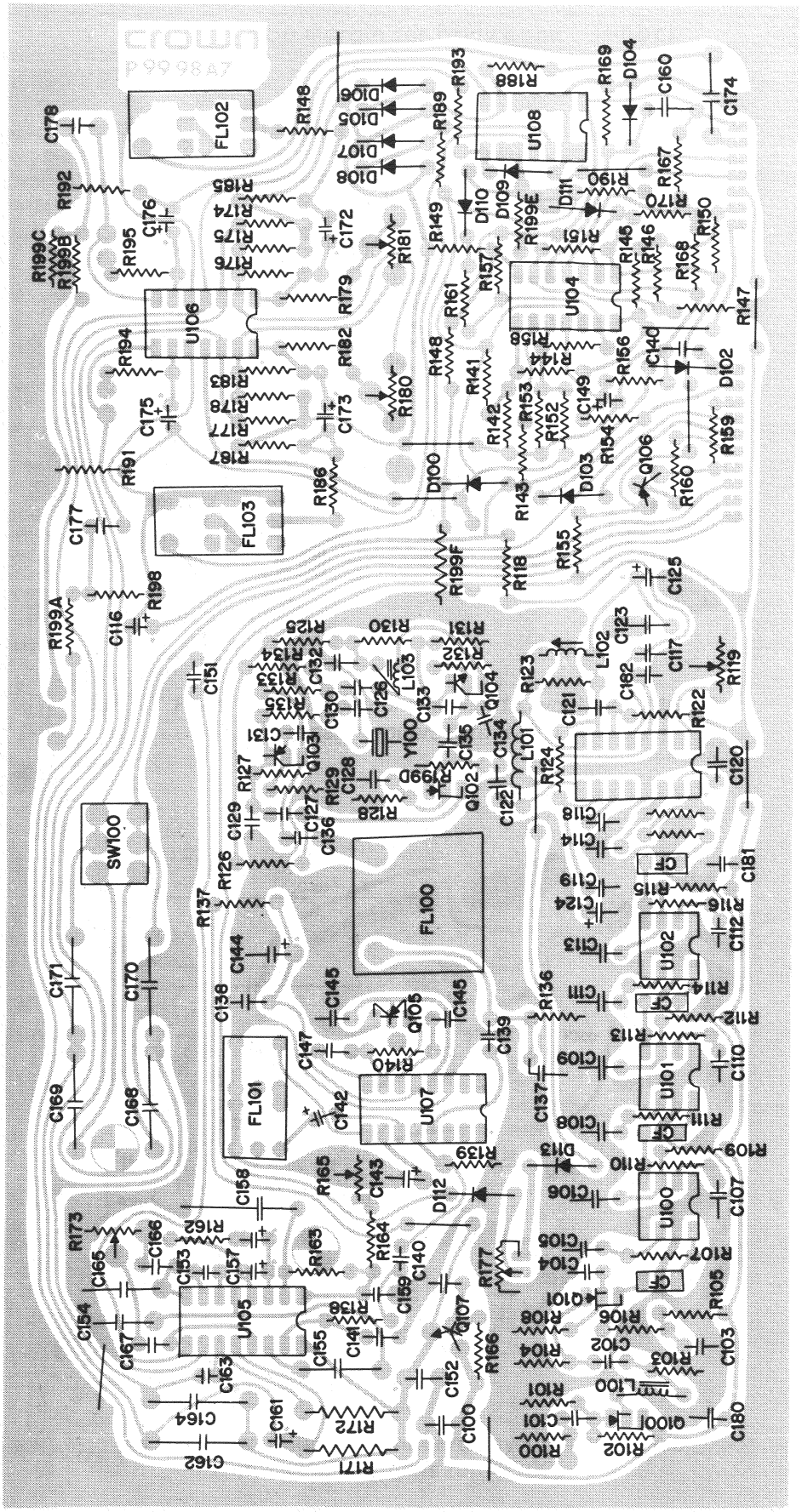

Fig. 6.10 Main Module Foil Board Layout; #Q42499-6
(for serial numbers 3791 and above)

Parts List: Main Module; #Q42499-6 (for serial numbers 3791 and above)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R100, R13	1.2K ohm .25W 5%	C 2875-0	2	
	R101, R102, R104, R117, R130, R131, R191, R192	100K ohm .25W 5%	C 2883-4	8	
	R109, R112, R115, R134	10 ohm .25W 5%	C 3753-8	4	
	R106, R107, R110, R111, R113, R114, R116	330 ohm .25W 5%	C 5169-5	7	
	R105, R108, R122, R125, R128, R137	100 ohm .25W 5%	C 2872-7	6	
	R117	100K ohm Cermet Trim	C 4843-6	1	
	R118, R126, R193	2.2K ohm .25W 5%	C 2628-3	3	
	R119	30K ohm Vert. Green Pot	C 2298-5	1	
	R120, R129	47 ohm .25W 5%	C 1011-3	2	
	R121	270 ohm .25W 5%	C 6034-0	1	
	R123, R132, R164	5.6K ohm .25W 5%	C 3220-8	3	
	R135	680 ohm .25W 5%	C 5975-5	1	
	R136, R142, R153, R160, R161, R162, R168, R190	1K ohm .25W 5%	C 2627-5	8	
	R127, R138, R150, R166, R185, R187, R198, R199C	4.7K ohm .25W 5%	C 3939-3	8	
	R139, R163, R175, R176, R178, R183	33K ohm .25W 5%	C 4346-0	6	
	R140, R184, R186	3.3K ohm .25W 5%	C 2629-1	3	
	R141, R146, R147, R152 R167	15K ohm .25W 5%	C 2632-5	5	
	R143, R145, R148, R154, R157, R159, R199F	10K ohm .25W 5%	C 2631-7	7	
	R144, R149, R156	1M ohm .25W 5%	C 3198-6	3	
	R151, R158, R174, R177, R179, R182	390K ohm .25W 5%	C 4660-4	6	
	R155	3.9 K ohm .25W 5%	C 2630-9	1	
	R165	5K ohm Helipot Trim	C 3670-4	1	
	R169	2.2M ohm .25W 5%	C 5170-3	1	

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R170	10M ohm .25W 10%	C 3221-6	1	
	R171, R172	4.42K ohm .5W 1%	C 3120-0	2	
	R173	100K ohm Vert Wht Pot	C 1713-4	1	
	R180, R181	500K ohm Vert Trim Pot	C 5209-9	2	
	R199A, R199B	620 ohm .25W 5%	C 3872-6	2	
	R199D	470K ohm .25W 5%	C 4225-6	1	
	Capacitors				
	C100, C101, C102, C103, C104, C105, C106, C107, C108, C109, C110, C111, C112, C113, C114, C115, C117, C118, C119, C120, C121, C123, C127, C128, C130, C131, C132, C136, C138, C139, C145, C146, C148, C151, C180, C181	.02mF 50V Disc	C 5230-5	36	
	C177, C178	22mF 50V NP 10%	C 5311-3	2	
	C122	39pF 10% Disc	C 5227-1	1	
	C124, C149, C157	.47mF 50V	C 6095-1	3	
	C125, C143, C179	100mF 16V	C 3729-8	3	
	C126	8.2pF 10% N220	C 5191-9	1	
	C129, C133	33pF 10% NPO	C 5980-5	2	
	C134	12pF 10% NPO	C 5979-7	1	
	C135	1pF 5% NPO	C 5982-1	1	
	C137	100pF Mica	C 3410-5	1	
	C141	220pF Z5U	C 5978-9	1	
	C142, C161, C163, C175, C176	4.7mF 63V Vert	C 6076-1	5	
	C147	82pF Mica	C 3627-4	1	
	C152, C144	220mF 16V Vert	C 3796-7	2	
	C153, C156	3.3mF 25V 10%	C 6096-9	2	
	C155, C174	.047mF 200V 5% Film	C 3978-1	2	
	C158	2200pF	D 6018-2	1	
	C159	1000pF	C 5636-3	1	
	C160	.47mF 100V 10% Poly	C 4119-1	1	
	C162,C164, C168, C169, C170, C171	5640pF 63V 2.5%	D 4466-5	6	

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Capacitors				
	C165	.01mF 200V 10% Film	C 3161-4	1	
	C166, C167	.1 mF 63V	C 5639-7	2	
	Diodes				
	D100, D102, D103, D104, D105, D106, D107, D108, D109, D110, D111, D112, D113	1N4148	C 3181-2	13	
	Integrated Circuits				
	U100, U101, U102	LM703CN IF Amp	C 5077-0	3	
	U103	HA11225 IF Op Amp	C 4956-6	1	
	U104	LM339N Volt Comparator	C 4345-2	1	
	U105	HA11223 PLL St. Demod	C 4955-8	1	
	U106	TL074 Quad Op Amp	C 4696-8	1	
	U107	HA12401A Detector	C 5907-8	1	
	U108	MC14016 Quad Switch	C 4834-5	1	
	Transistors				
	Q100, Q102	2N5485	C 5123-2	2	
	Q101	J-310 JFET	C 6049-8	1	
	Q103, Q104	2N5770	C 5135-6	2	
	Q105, Q106	PN4250A	C 3786-8	2	
	Q107	SEL TZ-81	D 2962-5	1	
	Miscellaneous				
		8 Pin DIL IC Socket	C 3451-9	3	Sockets for U100, U101, U102
		16 Pin DIL IC Socket	C 4508-5	3	Sockets for U103, U105, U107
		14 Pin DIL IC Socket	C 3450-1	3	Sockets for U104, U106, U108
	FL100	BF-56 Band Pass Filter	C 5911-0	1	
	FL101	BL-21 Low Pass Filter	C 5912-8	1	
	FL102, FL103	Multiplex Filter	C 5059-8	2	
	Y100	12.665 MHz Crystal	C 5950-8	1	
	L100, L103	15uh Choke 1500017	D 5121-5	2	
	L101	22uh Choke Shielded	D 5122-3	1	
	L102	Detector Coil	C 5948-2	1	
	SW100	DPDT PC MNT Slide Switch	C 5080-4	1	
		3 Pin Socket Strip	C 5295-8	4	Ceramic Filter Strip
		10.7MHz Ceramic Filter	C 4954-1	2	Fills 3 Pin Socket Strip
		SFE10.7MX-A Filter	C 5933-4	2	Fills 3 Pin Socket Strip
		0.0 ohm .25W Jumper	C 5868-2	13	

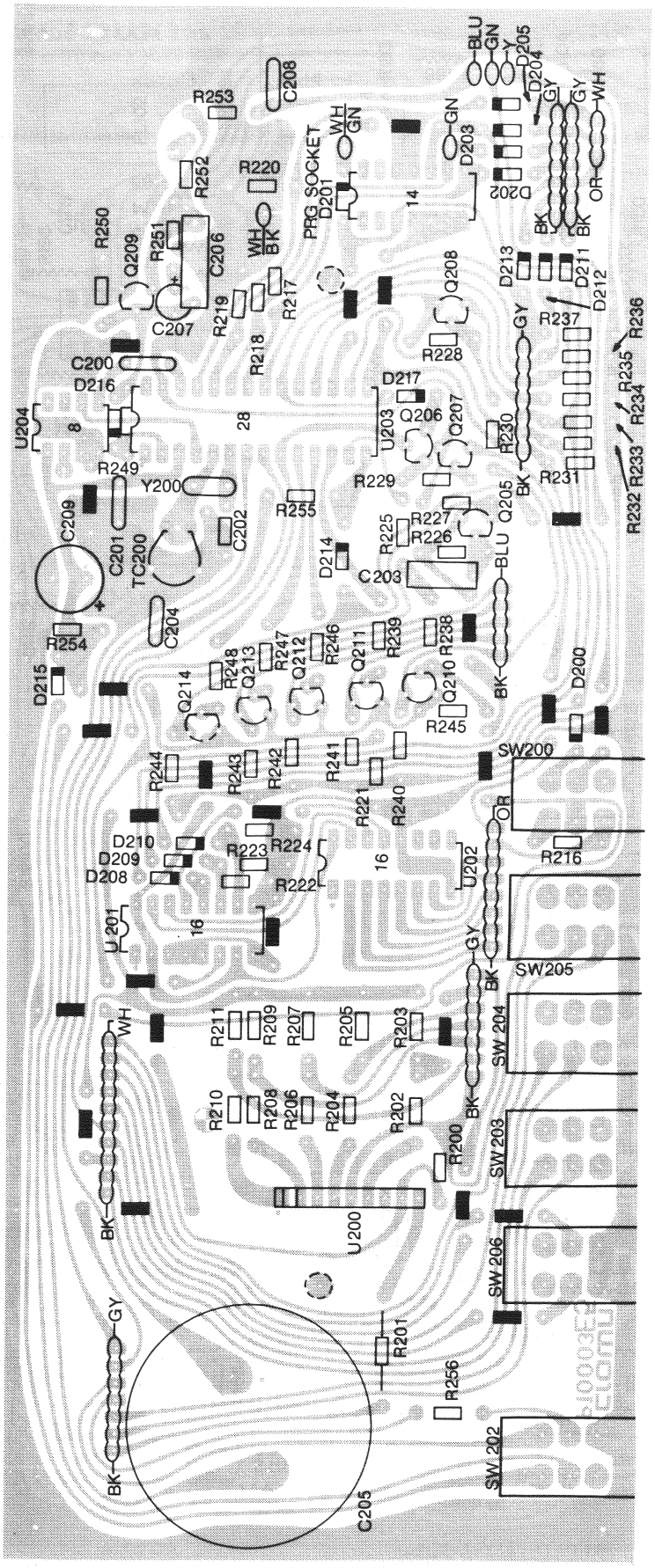

Fig. 6.11 Control Module Component Board Layout; #Q42498-8 (for serial numbers 3791 and above)

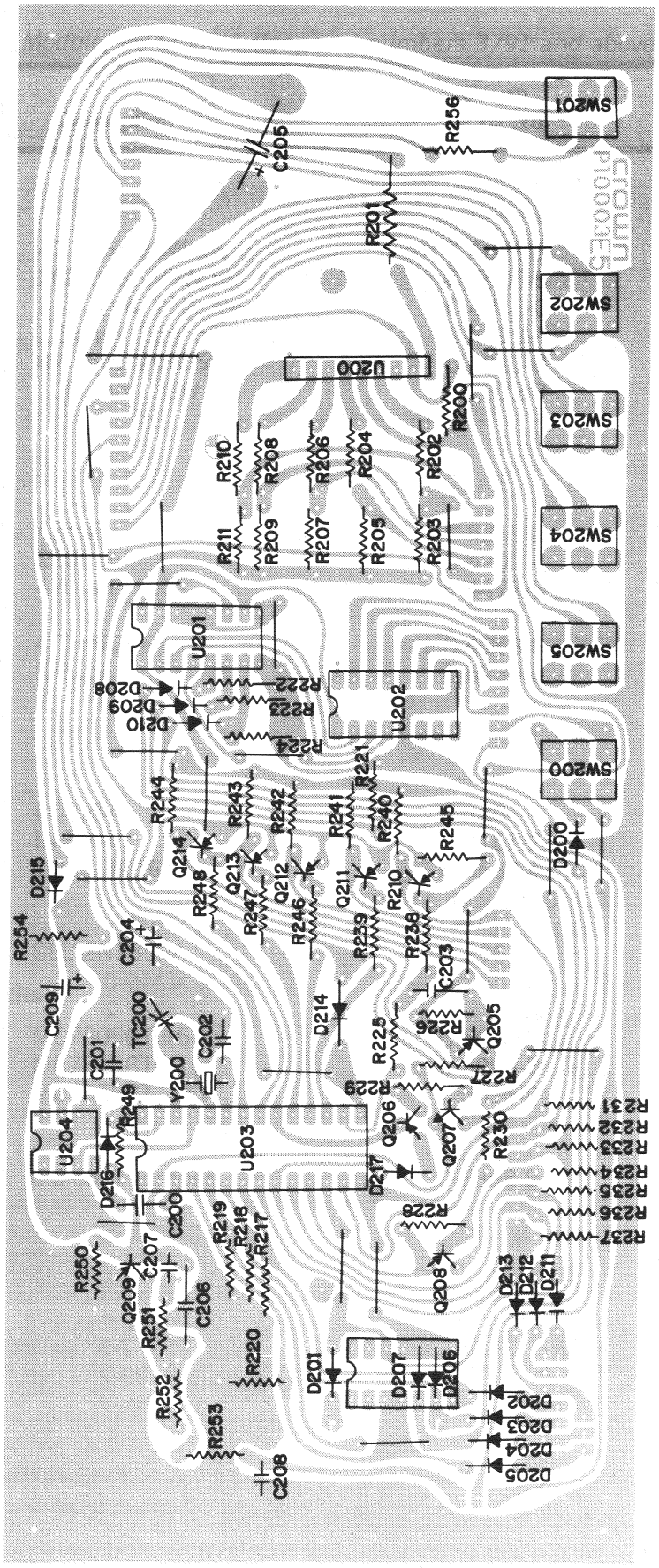

Fig. 6.12 Control Module Foil Board Layout; #Q42498-8
(for serial numbers 3791 and above)

Parts List: Control Module; #Q42498-8 (for serial numbers 3791 and above)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R200	8.2K ohm .25W 5%	C 2877-6	1	
	R201	220 ohm .25W 5%	C 5047-3	1	
	R203, R205, R207, R209, R11	200K ohm .25W 5%	C 3622-5	5	
	R221,R222, R223, R224, R225, R226, R227, R228, R229, R238, R240, R245, R249, R252, R254	10K ohm .25W 5%	C 2631-7	15	
	R239, R246, R247, R248,	47K ohm .25W 5%	C 2880-0	4	
	R202, R204, R206, R208, R231, R232, R233, R234, R235, R236, R237, R241, R242, R243, R244, R256	100K ohm .25W 5%	C 2883-4	16	
	R200	8.2K ohm .25W 5%	C 2877-6	1	
	R216	150 ohm .25W 5%	C 3799-1	1	
	R217, R218, R219, R220	33K ohm .25W 5%	C 4346-0	4	
	R230	620K ohm .25W 5%	C 4227-2	1	
	R250	150K ohm .25W 5%	C 4216-5	1	
	R251	2.2K ohm .25W 5%	C 2628-3	1	
	R253	20K ohm .25W 5%	C 5046-5	1	
	R255	300 ohm .25W 5%	C 3801-5	1	
	Capacitors				
	C200, C201, C204, C208	.02mF 50V Disc	C 5230-5	4	
	C202	20pF Tubular Cer.	C 3535-9	1	
	C203	.0047mF 200V 5% Film	C 3996-3	1	
	C205	.47mF 5V	C 5952-4	1	
	C206	.022mF 200V 5% Film	C 3977-3	1	
	C207	3.3mF 25V 10% Tant	C 5180-2	1	
	C209	220mF 16V Vert	C 3796-7	1	

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Diodes				
	D200, D201, D202, D203, D204, D205, D206, D207, D208, D209, D210, D211, D212, D213, D215, D216, D217	1N4148	C 3181-2	17	
	D214	IN4004	C 2851-1	1	
	Transistors				
	Q205, Q208, Q210, Q211, Q212, Q213, Q214	PN4250-A	C 3786-8	7	
	Q206	2N4125	C 3625-8	1	
	Q207	SEL 2N3859A	D 2961-7	1	
	Q209	2N6428A	C 4695-0	1	
	Integrated Circuits				
	U200	5 Element DIS DRVR	C 6484-7	1	
	U201	4035 4BIT SHFT RGSTR	C 5965-6	1	
	U202	74LS42 BCD-DCM Decoder	C 5966-4	1	
	U203	UPD1703C-011 DIG. CTL	C 5937-5	1	
	U204	UPB553A Prescaler	C 5936-7	1	
	Miscellaneous				
		8 Pin DIL IC Socket	C 3451-9	2	Socket for U200, U204
		16 Pin DIL IC Socket	C 4508-5	2	Socket for U201, U202
		14 Pin SIP Socket	C 5981-3	2	Sockets for U203
		14 Pin DIL IC Socket	C 3450-0	1	PRG Socket
	TC200	30pF PC MNT Trimmer	C 5058-0	1	
	Y200	4.5 MHz Crystal	C 5949-0	1	
	SW200, SW202, SW203, SW204, SW205	5 Station DPDT Pushbutton Switch	C 5957-3	1	
	SW201	1 Station DPDT Pushbutton 6.3 Lug	C 5958-1	1	
		0.0 ohm .25W Jumper	C 5868-2	26	

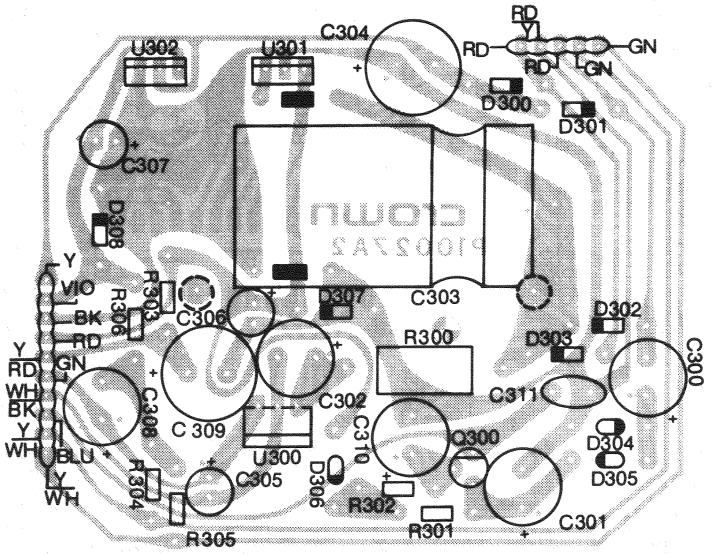

Fig. 6.13 Power Supply Component Board Layout; #Q42500-1 (for serial numbers 3791 and above)

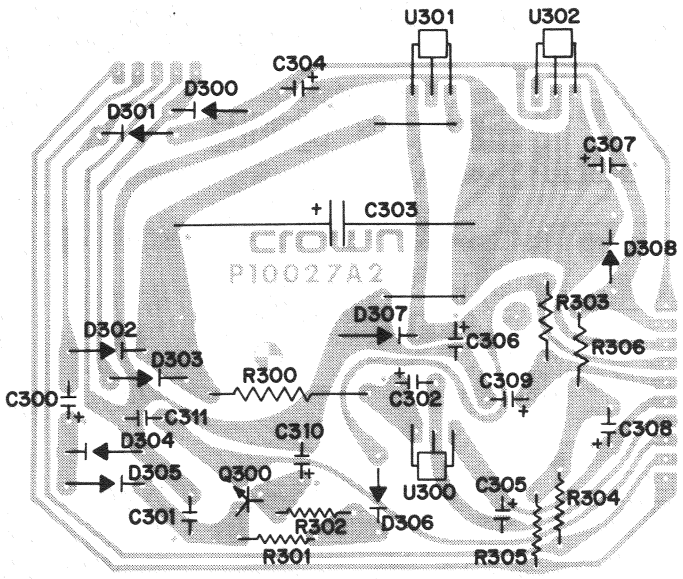

Fig. 6.14 Power Supply Foil Board Layout; #Q42500-1 (for serial numbers 3791 and above)

Parts List: Power Supply Module; #Q42500-1 (for serial numbers 3791 and above)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R300	47 ohm .25W 5%	C 1073-3	1	
	R301	20K ohm .25W 5%	C 5046-5	1	
	R302	33K ohm .25W 5%	C 4346-0	1	
	R303	22 ohm .25W 5%	C 4479-9	1	
	R304, R305	47 ohm .25W 5%	C 1011-3	2	
	R306	100 ohm .25W 5%	C 2872-7	1	
	Capacitors				
	C300, C301, C302, C308, C310	47mF	C 5219-8	5	
	C303	2200 mF	C 5202-4	1	
	C304, C309	470 mF	C 4477-3	2	
	C305, C306, C307	4.7 mF	C 4253-8	3	
	C311	.02 mF	C 5230-5	1	
	Diodes				
	D300, D301, D302, D303, D307, D308	IN4004	C 2851-1	6	
	D304, D305	IN4148	C 3181-2	2	
	D306	1N966B 16V Zener	C 3533-4	1	
	Transistors				
	Q300	SEL 2N3859A	D 2961-7	1	
	Integrated Circuits				
	U300	MC7805CT +5V	C 5094-5	1	
	U301	MC7815CT +15V	C 5095-2	1	
	U302	MC7915CT -15V	C 5096-0	1	
	Miscellaneous				
		0.0 ohm Jumper	C 5868-2	2	

Parts List: Memory/Display Board; #M42843-9 (for serial numbers 3791 and above)

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
	Resistors				
	R400	150 ohm .25W 5%	C 3799-1	1	
	Diodes				
	LED 400	Amber Rectangular LED	C 5989-6	1	
	LED401, LED402, LED403 LED404 LED405, LED406	Green Rectangular LED	C 5956-5	6	
	Miscellaneous				
		TACTILE SWSPR Contact	C 5953-2	9	
		TACTILE SWBTN Contact	C 5954-0	9	
		Housing Activator, Pushbar	D 5752J6	9	
		Display Fluorescent	C 5939-1	1	

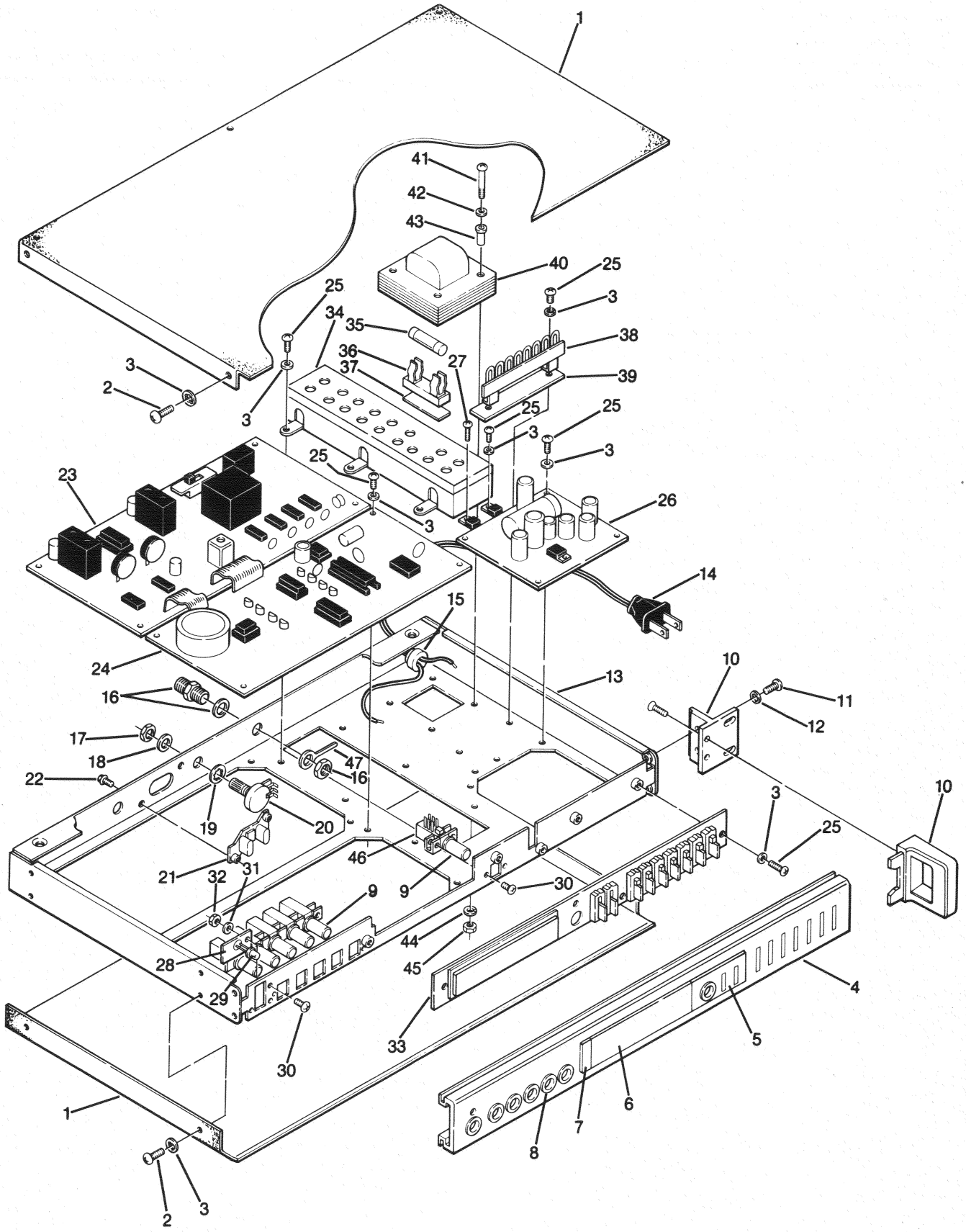

Fig. 6.15 Exploded View Drawing

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
1		Cover, Top & Bottom	F10089K1	2	
2		Screw 6-32x.25" Black	C 4758-6	14	
3		Lockwasher #6	C 1823-1	23	
4		Front Panel, Silver	F10090-3	1	
		Front Panel, Black	F10419-4	1	
5		Tuning Bezel, Silver	F10091-1	1	
		Tuning Bezel, Black	F10416-0	1	
6		Display Lens	D 5753-5	1	
7		End Bezel, Silver	D 5751J8	1	
		End Bezel, Black	D 6078J5	1	
8		Switch Collars, Silver	D 4108-3	7	
		Switch Collars, Black	F10413-7	7	
9		Pushbuttons, Silver	D 5682A4	7	
		Pushbuttons, Black	D 6013-3	7	
10		Handles, Silver	M20242J9	2	
		Handles, Black	M20250J2	2	
		End Caps, Silver	M20349J2	2	
		End Caps, Black	M20352J6	2	
11		Screw 10-32x.5" Black	C 5944-1	4	
12		Starwasher #10	C 2279-5	4	
13		Chassis	M20256J9	1	
14		AC Cord	C 5020-0	1	
15		Strain Relief	C 4896-4	1	
16		RF Input, Female	C 5207-3	1	
17		Bright Nut	C 1288-7	2	
18		Bright Washer	C 1289-6	2	
19		Lockwasher	C 2188-8	2	
20		Level Control	D 5769-1	2	
21		Output Jack	C 4933-5	1	
22		Screw, Self-Starting	C 4895-6	2	
23		Main Board *			
24		Control Board *			
25		Screw 6-32x.25"	C 1954-4	23	
26		Power Supply Board *			
27		Screw Nylon 6-32x.38"	C 2620-0	1	
28		Power LED Board	P10009-2	1	
29		Power LED	C 4342-9	1	
30		Screw 4-40x.25"	C 1827-2	1	
31		Starwasher	C 1824-9	1	
32		Nut 4-40	C 1938-7	1	
33		Display Board *			
34		Front End Module	Q42497-0	1	

* Check parts lists for correct replacement circuit boards within specified serial number groups.

Index No.	Schematic Designation	Description	Crown Part No.	Qty.	Other Information
35		Fuse 1/8 Amp	C 1758-9	1	
36		Fuse Block	C 3776-9	1	
37		1" Foam Tape	S 1152-8	1	
38		Terminal Strip	D 3503-6	1	
39		Insulator	D 3600-0	1	
40		Power Transformer	D 5901-0	1	
41		Screw 8-32x.75"	C 4330-4	4	
42		Flat Washer #8	C 2101-1	4	
43		Shoulder Washer	C 4251-2	4	
44		Lockwasher #8	C 1951-0	4	
45		Nut 8-32	C 1986-6	4	
46		Switch DPDT	C 5958-1	1	
47		Solder Lug	C 2828-8	1	

SECTION 7
MAINTENANCE

7.1 Introduction

Section 7 contains technical information required to effectively and efficiently service and repair the Crown FM TWO. Included are disassembly and reassembly procedures, required test equipment lists, checkout procedures and basic troubleshooting tips

This information is intended for use by an experienced technician only!

Use this information in conjunction with the schematic/board layout diagrams, parts lists and exploded view drawings (the latter located in Section 6 of this manual).

7.2 Required Test Equipment

Due to the complex circuitry utilized in the FM TWO, special alignment procedures and the correct test equipment are necessary to insure original factory specifications are achieved.

Note: Front end module alignment requires a full band (88.1 to 108 MHz) sweep generator with markers at 90.1, 98.1 and 106.1 MHz. Due to this requirement, along with other RF considerations, this procedure does not include Front End module alignment. Refer all servicing on the Front End module to the Crown Service Department.

The following table lists standard test bench equipment required by this procedure. The "Requirements" column provides information to allow intelligent selection of equipment model substitutes, if necessary.

EQUIPMENT	REQUIREMENTS	APPLICATIONS	MODEL
RF Generators - Two Required	88 to 108 MHz output FM mono and Stereo modulation	Used to generate various FM signals	Sound Technology 1020A or equivalent
AC Voltmeter	100 mV to 10 V range	Measure audio output levels and signal-to-noise ratios	HP 400F or equivalent
Digital Volt Meter	——	Resistance and Voltage checks	Fluke 8020 or equivalent
Frequency Counter	Capable of measurements to 108 MHz	Monitor frequency output of RF Generator	Fluke 1912 or equivalent
Antenna Impedance Matching Box	Two 50 ohm inputs with 75 ohm output	Summing of two RF generators with a single 75 ohm output	See Fig. 7.1
Oscilloscope	15 MHz	Used for monitoring signals and signal tracing	Tekequipment D54A or equivalent
THD Analyzer	1% full scale measurement	Measure total harmonic distortion of audio output	Sound Technology 1700 or equivalent
Band-pass Filter Switch selected	200 Hz to 15 kHz	Used to bandpass limit audio output	——
One kHz Notch Filter	——	Used in IHF usable sensitivity, DBQ and 30 dB quieting tests	——
Audio Generator	20 Hz to 20 kHz sine wave output	Used to modulate FM generator for frequency response tests	——

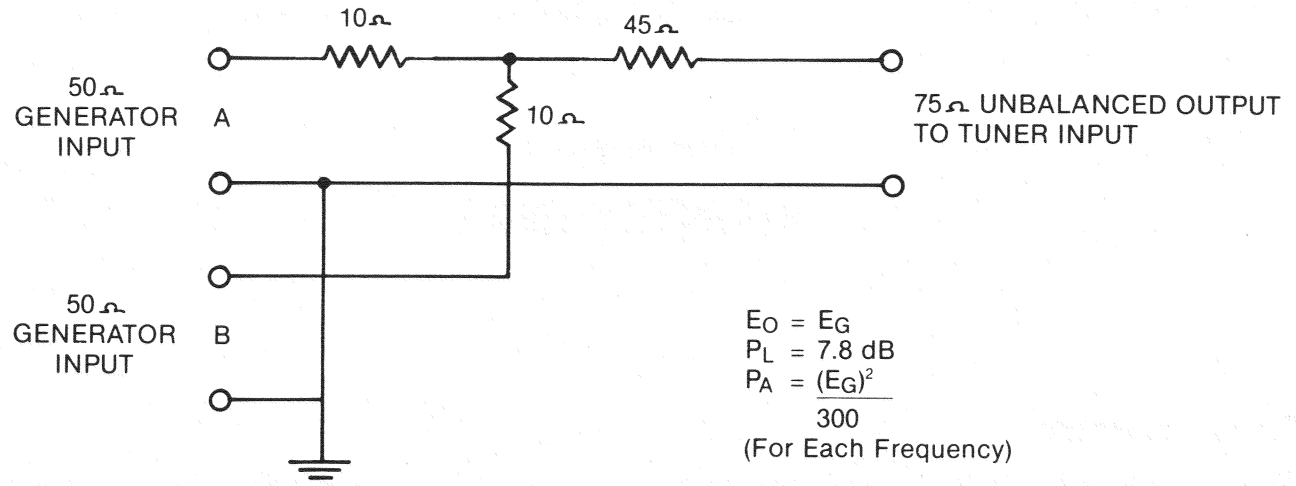

Fig. 7.1 Antenna Impedance Matching Box

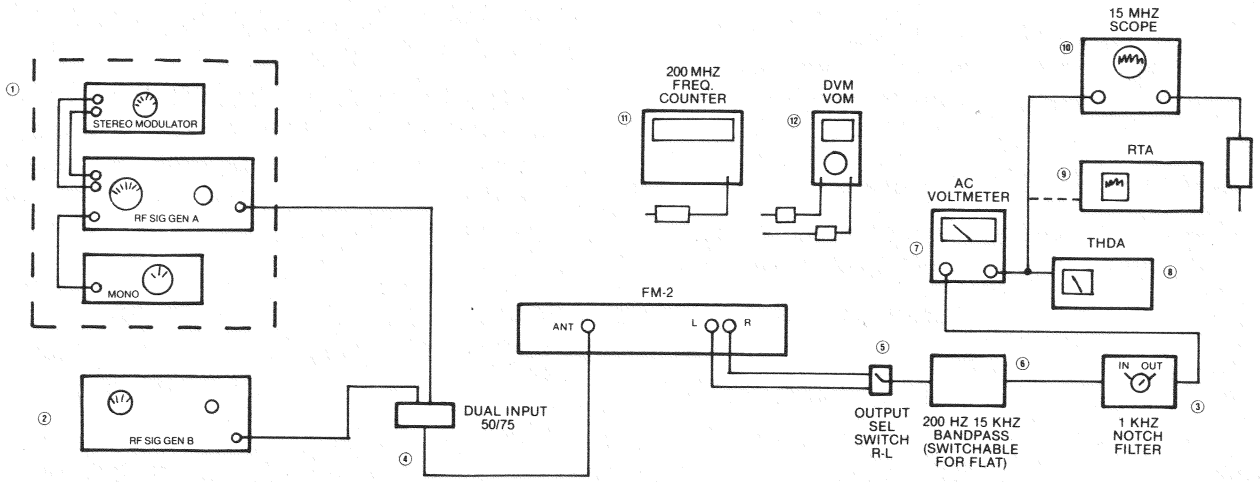

Fig. 7.2 Service Bench Setup

1. RF Signal Generator "A" 88 to 108 MHz output with stereo and mono capabilities. Output level to 1 volt. May be a single unit.
2. RF Signal Generator "B". Same as above.
3. 1 kHz Notch Filter.
4. Impedance matching box plus summation for the two RF generators.
5. Right-Left audio output selection switch.
6. 200 Hz to 15 kHz Band-pass Filter. Must be switchable for flat response.
7. AC Voltmeter.
8. Harmonic Distortion Analyzer.
9. Optional Real Time Analyzer.
10. Dual channel 15 MHz Oscilloscope.
11. Frequency Counter (200 MHz).
12. Digital Volt Meter (DVM).

7.3 Basic Troubleshooting

As is well known, time is an important factor in providing efficient service repair. Therefore, several time-saving troubleshooting steps are listed below. These hints may or may not already be implemented in your service work. If not, you may wish to experiment with them in order to help improve your efficiency. After all, time is money!

A. Establishing Problems

User complaints about defective operation may not always be clear or simple. Furthermore, the trouble the user has experienced may be due to the system and not the unit itself. If possible, talk to the user about this problem. This will usually be simpler than trying to understand written complaints. A first hand account of the problem can help in:

1) Getting the problem to re-occur on the service bench.
2) Getting an understanding of the probable cause. Some troubles will be obvious upon visual inspection. When the trouble (or its symptoms) is not so obvious ask:
   a) Exactly what was the problem; how was it noticable?
   b) How was the unit being used?
   c) Has the system as a whole been carefully examined for possible external problems?
   d) How long had the unit been operating when the problem occurred? Was it heat related?

If the user is unavailable or unable to explain the trouble the next step is a thorough visual inspection.

B. Visual Inspection

A good visual inspection may often save hours of tedious troubleshooting. Make a habit of proceeding in an orderly manner to insure that no vital part of the following procedure is omitted. The visual inspection can be performed in 10 to 15 minutes. It is recommended both as a preventive maintenance procedure and also for its value in determining cause of malfunction.

1) Check that all external screws are tight and that none are missing.
2) Check all fuses/circuit breakers.
3) Check for smooth and proper operation of switches, etc.
4) Inspect line cord for possible damage to cap, jacket and conductors.
5) Remove protective covers as outlined in disassembly instruction (Section 7.4).
6) Check that all attaching parts for internal circuits are tight and that none are missing.
7) Inspect all wiring for charred insulation, or discoloration as evidence of previous overheating.
8) Check that all electrical connections are secure. This includes wire terminals, screw and stud type terminals, and all soldered connections.
9) Check for obvious destruction of internal structural parts. Distortion in any of these parts could mean that the unit has been dropped or subjected to severe shock.

7.4 Disassembly Procedure
(for Inspection, Troubleshooting, Adjustments and Replacements)

The extent of FM TWO disassembly required will depend upon the amount of servicing required to be performed. **Do not** disassemble the unit beyond the point necessary for servicing. The FM TWO is generally easy to disassembly and service. All IC chips are located in sockets for easy replacement.

Troubleshooting for specific faulty components is recommended. Module replacement is suggested only when a problem can not be corrected by component troubleshooting.

NOTE: Because of the complex test equipment required to align and adjust the FM TWO, certain repairs/adjustments are not recommended for field servicing.

Always observe all Cautions and Warnings listed in this section pertaining to servicing "do's and don'ts."

Illustrations referred to in parenthesis are located in the illustrated parts found in Section 6 of this manual.

A. Cover Removal

Warning: Remove all AC power from the unit before removing covers!

A visual inspection can be performed by removing the top and bottom covers:

1. The FM TWO has identical top and bottom covers. Both covers are removed in the same manner.
2. Remove the seven phillips head screws (#2) securing the cover to be removed.
3. Gently lift the cover at the rear, then pull to the rear to disengage the cover front edge from the front panel flange groove. Remove the cover.

Install covers by reversing the above procedure. Guide the cover front edge flange correctly into the front panel cover flange grooves. Align cover screw holes with threaded chassis holes.

B. AC Line Fuse Replacement

The AC line fuse (F300) is mounted in a fuse block located inside the tuner. Remove the top cover to check or replace fuse (see Subsection "A"). Install the correct replacement fuse:

100/120 VAC Tuners: 1/8 Amp, slow blow type.
220/240 VAC Tuners: 1/16 Amp, slow blow type.

FM TWO tuners through serial **#3790**:
Fuse block is located on **#Q42468J0** power supply module board.

FM TWO tuners with serial **#3791** and above:
Fuse block is located adjacent to the power transformer.

C. Front Panel Removal

Access to the display/memory board (#33) and push button switches is obtained by removing the front panel assembly (#4):

1. Remove two phillips head screws (with internal lockwashers) (#11) from each end of the front panel assembly.
2. Gently work the front panel assembly forward and remove.

Caution: With the front panel removed use care not to damage pushbutton switches.

D. Power Supply Module Removal (Replacement)

Note: FM TWO tuners through serial **#3790** were manufactured with **#Q42468J0** power supply modules and **#Q42466J4** Control modules installed. Units with serial **#3791** and above have power supply module **#Q42500-1** and Control module **#Q42498-8** installed. **The modules of these two versions are not interchangeable.** If one of these modules is replaced the correct replacement module must be installed.

1. Remove the FM TWO covers as described under Subsection "A".
2. Note color coding and connecting point of wire leads soldered to component board. Using desoldering tools remove wire leads.
3. Remove the two screws (one metal; one nylon) securing the two voltage regulators to the chassis. These screws must be used with the correct regulator. The specific regulator location depends on the power supply module installed.
   a. +15VDC regulator 7815C is secured with a metal phillips head. **Insure this screw is reinstalled on the 7815C only!**
   b. The second regulator (7915 or 7805) is secured with an insulating nylon screw. **Insure this screw is reinstalled on VRX only!**

   NOTE: The mica insulator located below the insulated voltage regulator must be in good condition, positioned correctly with the correct amount of thermocompound.
4. Remove the four phillips head screws (with internal lockwashers) securing the power supply module. Remove the module.

E. Main Module Removal (Replacement)

NOTE: FM TWO tuners through serial **#3790** were manufactured with **#Q42467J2** main modules. Units with serial **#3791** and above have main module **#Q42499-6**. **These two versions are not interchangeable** due to the differences in interconnecting wire cables.

1. If the main module is to be replaced note the position of de-emphasis switch SW100:
   Open (left pos.) 50us (Europe)
   Closed (right pos.) 75us (USA)
   Place the de-emphasis switch in the required position.
2. Note the color coding of the wire leads soldered to the component board including the shielded cable from the front end module. Using desoldering tools carefully remove wire leads.
3. Remove the four phillips screws (with internal lockwashers) securing the component board. Remove the module.
4. If a replacement module is installed; perform the calibration procedure given in Section 7.5.

F. Control Module Removal (Replacement)

Note: FM TWO tuners through serial **#3790** were manufactured with **#Q42466J4** control modules which matched **#Q42468J0** power supply modules. Units with serial **#3791** and above have control module **#Q42498-8** and power supply module **#Q42500-1** installed. **The modules of these two versions are not interchangeable.** The correct replacement module must be installed.

Program socket information: The program socket with installed diodes determines the FM tuning range and 1st. I.F. frequency of the FM TWO.

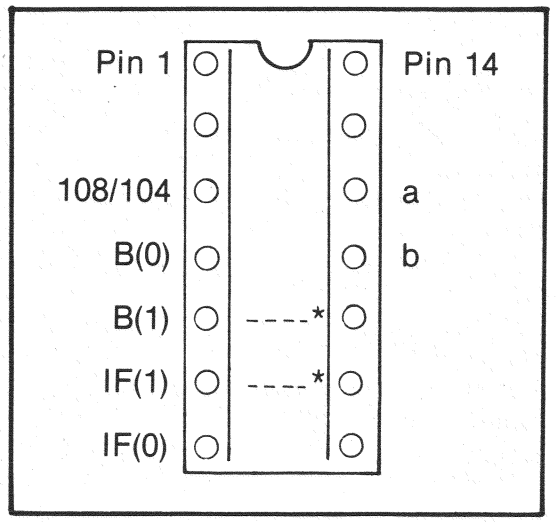

Fig. 7.3 Program Socket Layout

Notes:
1. Pins 1, 2, 13 and 14 have no operation.
2. Diode cathode end is to the right.
3. **On #Q42498-8 control modules a&b are jumped on the pc board foil pattern.

		FUNCTION	
Operation	**Diode In:**	**Receiving Frequency**	**Channel Spacing**
*U.S.A.	B(1)	87.9 to 107.9 MHz	200 kHz
Europe	B(0)	87.5 to 104/108.0 MHz	50 kHz
Stop @ 108	108/104 plus jump a&b	(BO programming only!)	
IF 10.650 MHz	IF(0)	Sets IF to 10.650 MHz	
IF 10.675 MHz	IF(0) and IF(1)	Sets IF to 10.675 MHz	
IF 10.7	None	Sets IF to 10.7 MHz	
*IF 10.725 MHz	IF(1)	Sets IF to 10.725 MHz	

* Indicates U.S.A. set up.

Procedure

1. Note color coding of the wire leads and flat cables soldered to Control module component board including shielded cable from Front End module. Using desoldering tools carefully remove all wire leads and flat cables from component board.
   Note: Tuners through serial #3790 had a remote control cable to a remote control connector on the rear panel.
2. Tuners with serial #3791 and above: Remove wire lead running from power switch to Main module at the power switch.
3. Tuners with serial #3790 and below: Remove twisted leads from power LED board.
   Tuners with serial #3791 and above: Remove wire lead and 300 ohm resistor from power LED board.
4. Remove four small phillips head screws securing the switch brackets to the chassis.
5. Remove the three phillips screws (with internal lockwashers) securing the component board to the chassis. Remove module.

G. Memory/Display Board Removal (Replacement)

Note: FM TWO tuners through serial **#3790** were manufactured with memory board **#M52667-2** and display board **M42665-6** installed. Tuners with serial **#3791** and above were manufactured with a one piece memory/display board **#M42843-9** installed. Select the following procedure depending upon unit serviced.

Caution: Use care when servicing these pc boards. Pushbutton switches or the display may easily be damaged.

For Units Through Serial #3790:

On these tuners the memory/scan switches are mounted on two pc board.

1. Access to the rear of the memory switch and display pc board can be obtained by:
   a. Making a diagram of hardware orientation.
   b. Removing the hardware securing both boards:
      - two with nuts and lockwashers.
      - one with double nut and lockwasher.
   c. Removing spacing bracket.
2. To remove either pc board:
   a. Make a wiring diagram of the flat cables and wire leads.
   b. Using desoldering tools carefully remove flat cables and wire leads from the control module board and power supply board.

For Units With Serial #3791 and Above:

On these tuners all memory/scan switches and the display are mounted on one printed circuit board.

1. Using desoldering tools remove the six memory board flat cables from the Control module component board.
2. Remove the four phillips head screws (with internal lockwashers) securing the memory board. Far right screw does not have lockwasher.
3. Carefully work the memory board with flat cables forward to clear the scan switch.
4. Remove the wire lead running to the power supply from the memory.
5. The components mounted on the memory/display board are now accessible for servicing including the display.

H. Front End Module Replacement

The Front End module **should not under any circumstances be removed or adjusted** except as described in this manual - See Section 5. Refer all other servicing to the Crown Service Department.

7.5 Field Checkout and Alignment Procedures

A. Crown Test and Check Out Procedures

Crown test and check out procedures reflect our basic design philosophy; we believe that reliability can be engineered into a product. As such, our checkout is designed to expose and correct a problem, before it happens. This testing begins when the unit is still a pile of parts; selection and grading of components is standard. The final test-inspection is the culmination of this vigorous program; but our concern doesn't stop here. Our products are backed by an extensive field service program and backed by a comprehensive warranty.

Because Crown is concerned with standard, repeatable measurements, our specification sheets are produced using standards set by IEEEE Std #185-1975 and IHF Std #IHF-T-200, 1975. These standards are published by The Institute of Electrical and Electronic's Engineers Inc.

The following discussion examines each of the test procedures. This is an attempt to help you understand, in layman's terms, what the tests mean.

1. **THD** - The total harmonic distortion is measured at the output of the FM TWO via a Crown custom built harmonic distortion Wave analyzer. At 1000Hz; second, third and fourth harmonic contributions are measured, noted and used in calculating the total harmonic distortion.
2. **IHF Usable Sensitivity** - "Sensitivity" in this usage refers to the relative strength of input signal required to produce a standard signal to noise ratio; in this case, 30dB. With the output of the unit under test referenced to 0dB, the input signal (98.1MHz) strength is the IHF usable sensitivity spec.
3. **30dB Quieting** - This test is devoted to measuring the strength of input signal that will cause the output noise to be quieted by 30dB without simultaneous modulation. Monitoring the out-put via an ACVM, the input signal strength is adjusted until a 30dB difference, referenced to the amount of output noise, is measured.
4. **50dB Stereo Quieting** - Referencing the output of the FM TWO to 0dB, the strength of the input signal is adjusted until a 50dB output reference to noise ratio is noted. The resulting figure indicates the strength of input signal required to produce an output signal whose signal to noise ratio is 50dB. This figure, stated in dBf, represents the quieting of the tuner during stereo reception.
5. **Signal To Noise** - The signal to noise test reveals, under simulated conditions, the ratio of usable signal to noise measured at the output of the FM TWO. This test indicates the quality of reception that you can expect with relatively strong input signals.
6. **Hum and Noise** - The procedure for obtaining the hum and noise specification is essentially the same procedure used in obtaining the signal to noise spec. In this procedure, however, the 200Hz high pass filter, normally connected at the output during noise measurements, is removed to allow allow for the measurement of power supply hum components.
7. **Stereo Separation** - Keeping the right channel information from leaking into the left channel and vice versa is desirable during the reception of a stereo broadcast. The quality of the isolation between channels is revealed in the stereo separation spec. While feeding left or right channel information into the FM TWO at its antenna terminals, the output of the opposite channel is measured at two frequencies to ensure consistency throughout the FM band.
8. **Frequency Response** -The frequency response of all FM tuners is limited due to the nature of FM transmitting equipment. FM TWO's are tested to ensure a deviation of no more than +.5dB from 30Hz to 15KHz.
9. **Capture Ratio** - Occasionally, there will be a situation during which two stations will be transmitting simultaneously at the same frequency. The ability of an FM tuner to discriminate against the weaker of the two signals is measured by its capture ratio. The figure obtained, represents the additional signal strength required of the stronger signal to suppress the weaker one by 30dB. Two r.f. signal generators are used to simulate a situation such as the one described above, thereby permitting the measurement of the tuner's capture ratio.
10. **Alternate Channel Selectivity** - Alternate channels are those channels that lie 400KHz at either side of a desired frequency. The alternate channel selectivity spec. tells how strong an alternate channel must be in order to interfere with the reception of a desired station. Two r.f. generators are used in determining this spec. One represents the desired station, while the other represents the alternate channel.
11. **R.F. IM.** - Several kinds of spurious signals plague FM reception. Most of these spurious signals in the FM TWO are so miniscule that they can be entirely disregarded. Intermodulation distortion or "cross mod." is the most measurable form of spurious response. It occurs whenever two or more undesired signals mix together within the

tuner in such a way that a new frequency is produced. If this internally generated spurious frequency happens to be the same as the tuned frequency, and if the spurious signal has enough strength, interference results. Cross mod. is tested for by intentionally beating two generators' signals together. The required generator signal strength is measured and compared to the IHF usable sensitivity, and noted as a ratio.

12. **Pushbuttons** - This check is to verify the correct operation of all the pushbuttons and displays.

13. **dBf-uV Conversion:** The following equations may be used to convert RF signal levels from dBf to uV and uV to dBf.
Note: uV = microvolts

For 300 ohm RF impedance:

$$dBf = 20 \text{ Log } \left(\frac{uV}{.55}\right)$$

$$uV = 10^{\left(\frac{dBf}{20}\right)} \times .55$$

For 75 ohm RF impedance:

$$dBf = 20 \text{ Log } \left(\frac{uV}{.55}\right) + 6$$

$$uV = \frac{10^{\left(\frac{dBf}{20}\right)} \times .55}{2}$$

B. Test Equipment Set Up

Fig. 7.2 illustrates the suggested test equipment set up for servicing and aligning the FM TWO. The following procedures will make reference to the equipment in this set up.

C. Preliminary Check and Adjustments

Note: Use chassis ground for the following measurements.

1. Notes:
   a. TC7 and L8 are located in the front end module - the two adjustment openings are located at the front of the module (eighth compartment).
   b. On tuners with receiving range stop at 104 MHz, reprogram tuner for stop at 108 MHz, see Subsection 7.4F, Control Module Removal.

   With no RF signal in:
   a. Set tuner at 106.1 MHz. Adjust trimmer capacitor TC7 for 18.6 VDC at the output end of R252 on the control module.
   b. Set tuner at 90.1 MHz. Adjust coil L8 for 4.0 to 4.3 volts at R252.
   c. These adjustments are interactive. Repeat this step several times to insure correct voltage level at each frequency.
2. Feed a 98.1 MHz, 1 mV (millivolt) mono FM signal modulated at 1 kHz into the 75 ohm tuner input. Adjust the 1 kHz audio output level at the output jacks for 0 dB using the two level adjusting controls on the tuner rear panel.
3. Adjusting the first IF frequency for 10.7 MHz:
   NOTE: On tuners programmed for 10.650 MHz or 10.675 MHz IF, program the IF frequency for 10.7 MHz by removing programming diode(s) from the program socket, see Subsection 7.4F, Control Module Removal.
   a. Connect an oscilloscope with a 10.7 MHz marker to resistor R120 (47 ohm) on the Main module.
   b. Adjust TC200 located on the control module for 10.7 MHz at R120.
   c. Reprogram the tuner for selected IF frequency if required.
4. Adjusting quadrature detector U103 on the Main module:
   a. Connect a DVM from pin #6 to ground and from pin #10 to ground. Record the voltage levels on these pins.
   b. Adjust L102 (next to U103) until voltage at pin #6 equals voltage at pin #10.
5. The FM TWO is now ready for specification check and alignments.

D.Tuner Specification Check and Alignment

1. Mono THD:
   a. Feed a 98.1 MHz, 1 mV (millivolt) mono FM signal modulated at 1 kHz into the 75 ohm tuner input.
   b. Adjust the 1 kHz output levels for 0 dB at the audio output.
   Note: Always make the 0 dB audio output level adjustment at the audio output jacks using the two level adjusting controls on the tuner rear panel.
   c. Check THD at each audio output for less than 0.05% distortion.
2. IHF Usable Sensitivity:
   a. Use a 1 kHz notch filter to reduce the output approximately 45 dB.
   b. Reduce generator signal level until the output equals -30 dB.

c. Signal generator level should be less than 9.13 dBf (1.6 uV).
d. **Record this reading** (in uV) for use later in the RF Intermodulation test.

3. DBQ:
   a. Switch off signal generator modulation (CW).
   b. Measure audio output levels at the output jacks. Output levels should be approximately -40 to -50 dB down.
   c. Record this reading for use later in the RF Intermodulation test.
4. 30 dB Quieting:
   a. Lower the RF signal generator signal level for a -30 dB reading at the output jacks.
   b. RF signal generator level should be less than 0.5 uV.
   c. Remove the 1 kHz notch filter.
5. Signal-To-Noise Mono:
   a. Set RF generator to 1 mV, mono FM modulated at 1 kHz (98.1 MHz). Adjust the 1 kHz audio level for 0 dB using the two level adjusting controls on the tuner rear.
   b. Insure that the 200 Hz to 15 kHz bandpass filter is in the audio output.
   c. Turn off RF generator modulation (CW) and take reading at output. The signal to noise ration should be 75 dB or greater.
6. Hum-and-Noise Mono:
   Note: Test procedure is the same as Signal-To-Noise Mono, Step 5.
   a. Remove the 200 Hz filter from the output (Bandpass equals 0 Hz to 15 kHz).
   b. Insure the 1 kHz modulation is off (CW) and take reading at output.
   c. The hum-to-noise ratio should be 70 dB or greater.
   d. Insert the 200 Hz to 15 kHz bandpass filter is in the audio output.
7. Stereo THD:
   a. Set RF signal generator to 1 mV stereo signal modulated at 1 kHz (98.1 MHz).
   b. Connect a THD analyzer to the audio output line.
   c. Adjust R165 (5 k ohm composit reference frequency adjustment pot) for maximum output signal at output jacks.
   d. Adjust the 1 kHz audio output level for 0 dB at the output jacks using the two level adjusting controls on the tuner rear.
   e. Check the THD reading. THD should be less than 0.05% distortion.
8. 50 dB Stereo Quieting:
   a. With output referenced at 0 dB, turn off stereo modulation.
   b. Decrease RF signal generator output level until a -50 dB reading is obtained.
   c. RF signal generator level should be less than 36 dBf (35 uV).
9. Signal-to-Noise Stereo:
   a. Set RF generator to 1 mV, stereo modulated at 1 kHz (98.1 MHz).
   b. Insure that the 200 Hz to 15 kHz bandpass filter is in the audio output.
   c. Adjust the 1 kHz stereo audio output levels for 0 dB at the audio output jacks using the two level adjusting controls on the tuner rear.
   d. Turn off stereo modulation and take a signal-to-noise reading. Signal-to-noise should be greater than 70 dB for both channels.
   e. Remove the 200 Hz to 15 kHz bandpass filter from the audio output.
   f. Adjust R173 (19 kHz null pot located on the main module) for lowest audio output.
   g. Install the 200 Hz to 15 kHz bandpass filter in the audio output.
10. Stereo Separation:
    a. Modulate the RF signal generator left channel only at 1 kHz. Adjust the left channel tuner audio output for 0 dB at the left channel output jack.
    b. Modulate the RF signal generator right channel only at 1 kHz. Adjust the right channel tuner audio output for 0 dB at the right channel output jack.
    c. With the right channel modulated, take a left channel audio output reading.
    d. With the left channel modulated, take a right channel audio output reading.
    The 1 kHz stereo separation in the above steps should be 60 dB or greater.
    e. Adjust cross-talk level pots R180 and R181 located on the Main module for the greatest separation between channels.
    f. Modulate the RF signal generator at 10 kHz and repeat this procedure. The 10 kHz stereo separation should be 50 dB or greater.
11. Frequency Response:
    a. Remove the 200 Hz to 15 kHz bandpass filter from the audio output.
    b. Set RF signal generator to 1 mV stereo signal modulated at 1 kHz (98.1 MHz).
    c. Adjust the 1 kHz stereo audio output levels for 0 dB at the output jacks.
    d. Modulate the RF signal generator with 30 Hz, 10 kHz and 15 kHz stereo modulation. The frequency response from 30 Hz to 15 kHz should be plus or minus 0.5 dB.
    e. Reinstall the 200 Hz to 15 kHz bandpass filter on the audio output.
12. Capture Ratio:

Two RF signal generators and an impedance matching/summation box are required for this procedure.

   a. Set RF generator #1 to 1 mV, mono signal modulated at 1 kHz (98.1 MHz). Adjust the

1 kHz audio output levels for 0 dB using the two level adjusting controls on the tuner rear.

b. Set RF generator #2, with unmodulated signal (CW) at 98.1 MHz.
c. Turn the RF level of signal generator #2 up until the output of tuner reads -1 dB.
d. Note RF level of signal generator #2 at -1 dB output level.
e. Increase the RF level of signal generator #2 until output of tuner reads -30 dB.
f. Note RF level of signal generator #2 at -30 dB output level.
g. Capture ratio calculation:

$$\text{Capture Ratio} = 10 \text{ Log } \frac{\text{Reading in Step "c"}}{\text{Reading in Step "f"}}$$

Note: Ignore minus sign.

Capture Ratio should be less than 1.5 dB.

13. Alternate Channel Selectivity:
    a. Set the RF output level of signal generator #2 to 10 uV at 98.1 MHz (CW).
    b. Set the RF frequency of signal generator #1 to 97.7 MHz with 1 kHz modulation.
    c. With the tuner at 98.1 MHz, increase the RF level of signal generator #1 until the audio output level reaches -30 dB.
    Note RF level of signal generator #1.
    d. Set the RF frequency of signal generator #1 to 98.5 MHz with 1 kHz modulation.
    e. With the tuner at 98.1 MHz, increase the RF level of signal generator #1 until the audio output level reaches -30 dB.
    Note RF level of signal generator #1.
    f. Alternate channel selectivity calculation:

$$\text{ACS} = \frac{A + B}{2}$$

A = Log (Reading in Step "c" x100) x20
B = Log (Reading in Step "e" x100) x20
Alternate channel selectivity should be greater than 75 dB.

14. RF Intermodulation:
    a. Set RF generator #1 to 98.9 MHz, unmodulated (CW) with 10 mV output.
    b. Set RF generator #2 to 98.1 MHz, unmodulated (CW) with 10 mV output.
    c. Tune the tuner to 97.3 MHz.
    d. Turn down the RF levels of both generators equally until the output signal from the tuner equals the dBQ reading obtained in Step 3-c. When this dBQ level is reached ensure that both RF generator uV output levels are equal.
    e. Note this mV RF level reading (RFI).
    f. RFIM Calculation:

$$\text{RFIM} = 20 \text{ Log } \frac{RF1}{RF2}$$

RF2 = mV reading Step 2-d
IHF Usable Sensitivity

RF Intermodulation should be 65 dB or greater.

15. Push Buttons:
    a. Disconnect RF generator #2.
    b. Set RF signal generator #1 to 98.1 MHz, 1 mV stereo signal modulated at 1 kHz.
    c. Set tuner to 98.1 MHz.
    d. Adjust the 1 kHz audio output level for 0 dB at the tuner output jacks.
    e. Ensure that the STEREO light is illuminated on the display.
    f. Press in the NORMAL de-emphasis button:
    - Tuner output should decrease 0.8 dB.
    - Release NORMAL button.
    g. Press in the FILTER button:
    - Tuner output should decrease approximately 6 dB.
    - Release FILTER button.
    h. Press in the STEREO/MONO button:
    - Stereo signal at output should be mono.
    - Stereo indicator should turn off.
    - Release STEREO/MONO button.
    i. Press in the DIM/BRIGHT button:
    - Display and illuminated memory LEDs should dim.
    - Release DIM/BRIGHT button.
16. Stereo Indicator
    Switch RF generator signal from stereo to mono signal. The tuner stereo indicator lamp should go off.
17. Mute Check and Adjustment:
    a. Press in the MUTE button.
    b. Set RF generator to 15 uV.
    c. Adjust R119 (mute level adjustment on Main module) to mute any mono signal under 15 uV.
18. Signal Meter Level Adjustment:
    a. Set RF generator to 98.1 MHz, 1 mV mono FM signal modulated at 1 kHz.
    b. Set the tuner to 98.1 MHz.
    c. Adjust pot R117 (meter level adjustment on Main module) so that signal level just lights all five signal level displays:
    - Fifth signal level should go off at approximately 25 uV.
    - Last signal level should go off at approximately 1 uV.
19. Tune/Scan Functions:
    Insure the scan up-down buttons function properly by scanning through the tuning range of the tuner.

20. Pre Set Buttons:
    a. Program stations into tuner memory using the six Pre Set buttons.
    b. Insure that the tuner programs and recalls all stations properly.
    c. Insure pushbuttons do not bind or push in excessively hard.
    d. Insure that the proper LED turns on with respective memory button.

7.6 Troubleshooting Guide

A. No frequency display
- defective display
- +5V supply to control module defective
- broken filament wire to display module
- U203 defective
- F300 defective

B. Display OK but no output
- U203 defective
- U108 defective
- +15V from power supply not present
- U103 defective
- U107 defective
- U105 defective
- U106 defective
- U104 defective

C. No signal reception (just hiss)
- defective front end module
- U203 defective
- U204 defective
- +15V to front end module defective
- U100 defective
- U101 defective
- U102 defective
- Q100 defective
- bad antenna
- broken or shorted coax at antenna connector and/or from front end module to main module

D. Up/Down & Memory buttons not operable
- switch and switch covers shorted to ground
- front panel alignment grounding switches
- switch defective
- U203 defective
- U201 defective
- U202 defective
- ribbon cable to switch board open or shorted

E. Erratic Display
- U203 defective
- Y200 defective
- TC200 defective
- defective display
- pinched or shorted ribbon cables to memory and/or display modules
- Q205 defective
- Q208 defective

F. Buzz in output
- C303 defective (loose)
- C307 defective
- U300 defective
- U301 defective
- U302 defective
- low line voltage

G. Dead, no output, no power indicator
- F300 defective
- power transformer defective
- no line voltage
- K300 defective
- +5V from supply low or zero

H. No stereo indicator
- U105 defective
- U104 defective
- Q106 defective
- L102 misaligned
- R165 misaligned
- defective display
- mono/stereo switch depressed

I. Memory loss
- C205 defective
- D214 defective
- unplugged from AC line for more than several days

J. Defective signal meter
- display defective
- weak signals to meter circuit
- R117 improperly adjusted
- defective D112, D113, D114

K. No output right channel; no output left channel
- FL102 defective
- FL103 defective
- output control shorted to chassis
- open or shorted output control
- open or shorted connecting cables
- U106 defective
- U105 defective
- U108 defective

L. Muting or scanning problems
- L102 misaligned
- mute switch defective
- U108 defective
- U104 defective
- U203 defective

7.7 Detailed Circuit Theory

The following explanation refers to the composit schematic diagram and the block diagram in Fig. 7.4.

The FM TWO requires a 75 ohm (unbalanced) input FM signal source to the rear panel connector. A coax cable couples the signal from the input connector to the Front End module.

A. Front End Module

The Front End module of the FM TWO is a precision factory aligned unit. No field service should be performed on this unit with the exception of the TC7/L8 adjustments as outlined in Section 7.5, Subsection C. Return all FM TWO units with defective Front End modules to the factory for service.

The Front End module consists of three RF amplifiers, mixer, tuned buffer, local oscillator and a final buffer. The tuned buffer aids in preventing two or more signals from intermixing with each other and appearing at the wrong place on the FM band (commonly referred to as RF Intermodulation). The local oscillator not only feeds the tuned buffer/mixer stages but also feeds a Prescaler and LSI controller located on the Control module. The LSI controller generates a dc voltage which is fed to the front end module for tuning double varicaps. The varicaps are used in all tuned RF circuits in the Front End module. This provides high Q, better selectivity and less noise. There is no AGC control required.

The output of the Front End module mixer is a 10.7 MHz IF which is tuned by transformer T1. The output of T1 is fed through a coax cable to buffer Q100 on the Main module.

B. Main Module

The Main module contains a digital IF amplifier system, dual detector stereo demultiplexer, stereo audio amplfiers and switching control.

The first IF is made up of an input buffer and four IF amplifiers with ceramic 10.7 MHz IF filters. The input impedance matching buffer consists of FETs Q100/Q101. L100 is a RF blocking inductor. Q101 amplifies and drives the first IF ceramic filter. The ceramic filters are the phase linear-type which aid in reducing total harmonic distortion. The following three IF stages (U100-U102) use uA703 operational amplifiers.

After the final ceramic filter in the first IF section, the 10.7 MHz IF signal reaches a four stages multifunction circuit U103. The main function of U103 is to act as a limiter/I.F. amplifier for the 10.7 MHz signal which will be mixed with a second local oscillator which follows. U103 also functions as a level detector and a deviation detector for the mute circuitry. The fourth section is a quadature detector which is not used.

The level detector output (Pin #13) feeds a level signal to adjustment trimpot R117. The center tap of R117 is fed through D112/D113 to a 5-step level detector U200 on the Control module, see Paragraph "B".

The deviation detector output (Pin #12) of U103 feeds the mute detector circuit consisting of quad comparator U104, the MUTE switch and the station detector/mute portion of the PPL controller U203 located on the Main module. The deviation level line drives U104B and U104C, and feeds the MUTE switch SW204.

U104C switches off stereo lamp driver Q106 between stations by taking the emitter low. This function is independant of the MUTE switch and the stereo signal control of Q106.

The deviation level from U103 is amplified by U104B and fed to the PPL controller U203 Pin #7 (station detector input) on the Control module, see Paragraph "C". The DC level on this line will be low between stations and high when on station.

The input mute control from U203 is applied directly to mute line driver U104A. This line is high between stations providing muting. Capacitor C149 provides an input time delay factor to U104B. C149 holds the input from U203 high through R156 compensating for fast controller chips.

The mute line controls bilateral switch packages U108A and U108B.

U104D provides a "turn-on" delay keeping the mute line low during this period. Capacitor C160 provides this delay keeping the voltage drop across R169 until charged. This eliminates any turn on popping from the tuner.

The mute line is also fed through power switch SW206 to minimize power off popping. On later units the line is returned through resistor R256 to either 15 VDC with power on, or ground with power off. On earlier units the mute line was directly grounded through the switch when power was turned off.

The input signal level necessary to overcome the mute circuit is set by U103 deviation adjustment R119. This adjustment is set for a 10-15 uV RF input signal level.

The mute feature, activated by front panel switch SW204, eliminates weak or fading signals and between station noise from the audio output. When the MUTE switch is pressed in muting is active. When the MUTE switch is in the normal or off position, between stations muting is defeated.

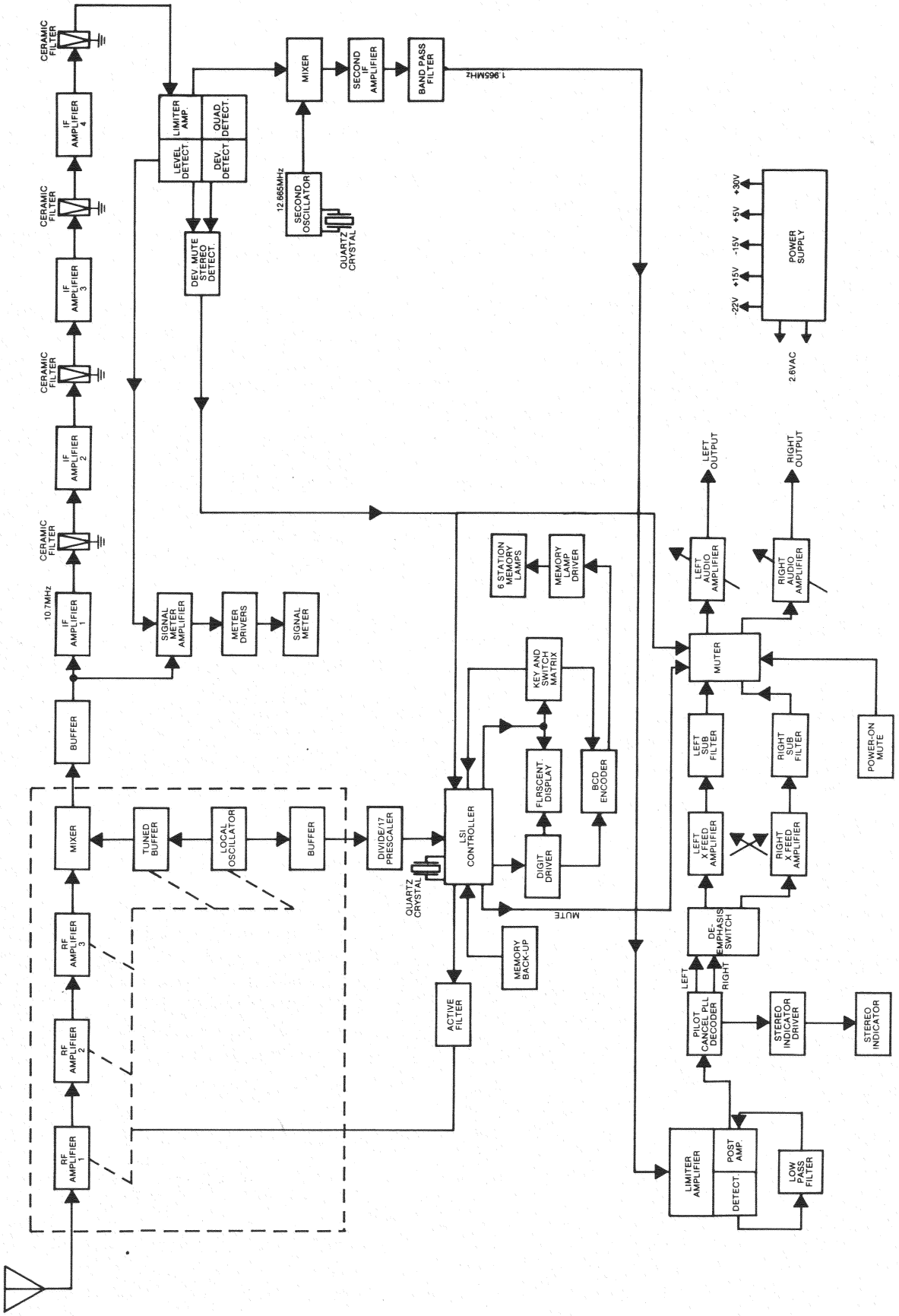

Fig. 7.4 Block Diagram

The limiter output of U103 drives second mixer Q102 through C122. A second local oscillator, crystal controlled Q104 feeds a 12.665 MHz signal to Q102. Q102 drives second IF amplifier Q103 and band-pass filter FL100. FL100 is an accurate filter which passes only the resultant 1.965 MHz signal from Q103. This second IF signal is applied to detector U107.

U107 is a pulse count digital type detector with stable characteristics, good capture ratio and AM suppression. U107 consists of a limiter amplifier, main detector and a post amplifier stage. The main detector output Pin #13 drives an external transistor amplifier Q105. Q105 amplifies the composit signal and drives an internal buffer inverter. The inverter output Pin #8 feeds low fass filter FL101. FL101 removes any 1.965 MHz signal from the composit signal. The composit signal is then fed through the internal post amplfier before it is sent to the stereo demodulator U105.

U105 is a Phase Lock Loop (PLL) MPX decoder which decodes the composit signal into left and right stereo channels. U105 also contains a stereo lamp driver circuit.

The composit input signal to Pin #2 is amplified and fed out Pin #3. The signal is coupled through C155 and fed into Pin #12 where the signal is split. One part is fed to the PLL circuit and the other to the stereo lamp driver circuit.

The 19 kHz pilot signal input to an internal stereo lamp driver is detected synchronously by the 19 kHz signal with the same phase as a pilot signal generated by the PPL. The detected signal is coupled through C153 (Pins #10 to #11) as a DC level signal proportional to the pilot signal. The DC signal is then amplified by a DC amplifier and output as a negative voltage through Pin #8 to the stereo/mono switch SW205. With SW205 switched on the negative DC signal turns signal driver Q106 on illuminating the lamp. If SW205 is open Q106 is turned off. The voltage level on the collector of Q106 controls the lamp. (-22 VDC turns lamp off; +5 VDC turns lamp on.)

Q106 is also emitter controlled by mute circuit comparator U104C.

The PPL circuit generates 76 kHz signal through the external components connected to Pin #15/#16. VCO adjust R165 sets the basic frequency for this signal The 76 kHz signal is divided down to a 19 kHz signal. The 19 kHz signal, which is 90 degrees advanced to the pilot signal input, is input to a gain control amplifier. The output (Pin #9) of the gain control amplifier is a square wave which must be properly adjusted by R173. This signal is then fed through C167 to a pilot cancel circuit which selects either a stereo or mono audio output at Pins #5/#6. A portion of the stereo output is mixed and fed back to Pin #1 for volume stabilization.

Some programs may be transmitted with Dolby encoded noise reduction information which requires de-emphasizing. A noise reduction de-emphasis circuit is placed after the demodulator stereo output (Pins #5/#6) for this purpose. A front panel 25us/NORMAL switch (SW100) selects the operation of this circuit. Depressing the switch selects de-emphasis. De-emphasis may be selected for either 50 us (USA) or 75us (Europe) by internal switch SW100.

The stereo audio signals are then fed to cross feed amplifiers of quad operational amplifier U106. These op amps help to separate the stereo information eliminating crosstalk problems. Identical signals in each channel are eliminated by impressing a portion of opposite channel signal on the reference input of the opposite channel op amp. Crosstalk signal level pots R180/R181 are designed to be adjusted for the greatest separation between channels.

From the cross-feed amplifiers the stereo signals are fed through low-pass filters to eliminate any unwanted frequencies. Signal levels through these filters are down -10 dB at 19 kHz and -45 dB at 38 kHz.

A front panel switch (SW203) controlled noise filter follows the low pass filters. This filter is designed to minimize the noise associated with weak FM stereo signals. With this switch on, the higher frequencies of both channels are combined through C174 to eliminate or cancel most distortion.

The stereo signals are next fed the mute control circuit U108. U108 is a quad bilateral switch with two sections used. The control inputs of U8 (Pins #5/#6) is controlled by the mute line. When the mute line is high the Q108 pair is switched on. If the mute line is taken low the Q108 pair is opened shutting the stereo audio output off. The mute control operation is described above under the description for deviation detector U103.

The final output amplifiers are U106B and U106C, the second pair of quad op amp package U106. The FM TWO rear panel LEVEL controls form part of the gain feedback network for these amplifiers. The level controls are used to obtain uniform output levels to match other components in the sound system.

On the two later versions of the Main module, transistor Q107 is used to regulate the Vcc voltage to U105 and U107.

C. Control Module

The heart of the Control module is U203, a LSI digital tuning system controller and Phase Locked Loop (PLL) frequency synthesizer. U203 with Prescaler U204 provides full electronic control of the vari-cap tuned Front End module.

U203 provides:
Power on clear
Reference 4.5 MHz clock generator
Indicator panel drivers
Control of front end vari-caps
Automatic up/down search (SEEK)
Manual up/down search
Preset station memory
Last station memory
Programmable IF offset

A CE (Chip Enable) input is designed to control the stand-mode of U203 (Pin #3). The Pin is tied to +5 VDC enabling the chip with power on.

Prescaler U204 receives the Front End module local oscillator on Pin #2. This RF signal is amplified and fed to a divider which is Prescaled selected (Pin #6) for divide by 16 or 17 operation from U203, Pin #4. This signal is buffered and coupled through C200 to the FM input, Pin #26 of U203.

Pin #2 of U203 is a three-state analog voltage output (E02) designed to tune the Front End module vari-caps. This level is controlled by the internal scan-select circuits of U203 to establish the receiving frequency of the tuner.

Transistors Q209 is designed to set the analog voltage to the correct values required to tune the vari-caps.

The Pin #7 SD input to U203 control the station searching operation. When this input is high the presence of a station is indicated and the operation is terminated. For a detailed description of this input signal see the mute circuit description for U104B.

The Pin #8 MUTE output of U203 mutes the tuner during station changes. This line is high with a low signal on the SD Pin #7 input. This signal is applied to mute amplifiers U104A and U104C on the Main module, see Paragraph "B".

U203 Pins #9 through #13 are outputs which enable the five digital displays of the Display module through driver transistors Q210 through Q214. The display segments for each display are turned on by the "a" to "g" output segment drivers Pins #15 through #21. segment driver Pins #15 to #17 also output the memory LED driver signals. Diodes D208 - D210 isolate U201 from the digital display. The enable outputs on Pins #9/#13 and the segment drivers are also used for the pushbutton switch frequency and IF 1 selected control. U203 Pins #22 through #25 are inputs from a seven by four input switching matrix established by the above described input/outputs. Depressing one of the scan/tune switches, one of the memory switches or setting the DIM or SCANLOCK switch completes a matrix return. Fig. 7.5 illustrates the U203 matrix network.

SCAN/TUNE Switches and SCAN/LOCK Pushbutton:
SCAN/TUNE - UP with SCAN/LOCK Pushbutton Out
Holding continuous scans upward.
Pressing and releasing scans one channel upward.
SCAN/TUNE - DOWN with SCAN/LOCK Pushbutton Out
Holding continuous scans downward.
Pressing and releasing scans one channel downward.
SCAN/TIME - UP with SCAN/LOCK Pushbutton in
Pressing scans upward until a station is found.
SCAN/TIME - DOWN with SCAN/LOCK Pushbutton in
Pressing scans downward until a station is found.

SCAN TUNE DOWN	PRESET 4	X	DIODE	108 MHZ	X	B0	PIN 25
SCAN TUNE UP	PRESET 3	X	DIODE	DIM	X	B1	PIN 24
MEMORY	PRESET 2	PRESET 6	DIODE	SCAN/LOC	X	IF 1	PIN 23
X	PRESET 1	PRESET 5	DIODE	FM	B2	IF 0	PIN 22
PIN 21	PIN 20	PIN 19	PIN 18	PIN 17	PIN 16	PIN 15	

Fig. 7.5 U203 Matrix Network

MEMORY Switch:
Six stations frequencies may be preset into tuner memory. Tuning data is stored into U203 RAM by pressing the MEMORY key then desired PRESET key within 5 seconds. Any stored station frequency will be cancelled and replaced during this time with the new frequency. The MEMORY key has an amber LED and the PRESET keys have green LEDs. The appropriate LED will be illuminated when that switch is active. Once a memory switch is Preset that frequency will be tuned when that switch is pressed.

The tuning ranges and IF frequency selections are diode selected using program socket D201. The FM TWO is manufactured with IF1 (10.725 MHz) and B1 (87.9 to 107.9 MHz).

B0	B1	Frequency
Off	Off	76.1 to 89.9 MHz
On	Off	87.5 to 108.0 MHz
Off	On	87.9 to 107.9 MHz

IF0	IF1	IF Frequency
On	Off	10.650 MHz
On	On	10.675 MHz
Off	Off	10.700 MHz
Off	On	10.725 MHz

108/104	Frequency
On	87.5 to 108.00 MHz
Off	87.5 to 104.00 MHz

On = Diode in location
Off = Open location

DIM Switch SW200:
This switch selects display brightness.
On - brightness is reduced.
Off - brightness is normal.

A power hold-up circuit is provided for the +5 VDC line which maintains U203 station selection memory. This circuit consists of capacitor C205 and diode D214. D214 isolates the U203 +5 VDC line from normal 5 VDC line. C205 will maintain charge for approximately five days with AC power to the tuner off.

Note: Two 5 VDC line versions will be seen. An earlier version VDC line at the junctions of D214 and D215. The later version ties the two lines together through power switch SW206. When the POWER switch is turned off 5 VDC is removed from the normal 5 VDC line but remains supplied to U203.

The memory displays LED400 - LED406 are driven from line decoder U202. Only one LED is illuminated at a time by U202 which is driven by a BCD input from parallel shift register U201. Only three input lines are active with Pin #12 MSB input grounded low. The high side of the LEDs is returned through R400 to the DIM SW200. Turning the DIM switch on places resistor R216 in the 5 VDC line driving the LEDs.

Switching transistors Q206 and Q207 drive the amber memory LED. These transistors are controlled from display driver output Pin #9 and mode switch matrix output Pin #20 (through D217) of controller U203.

Transistors Q208 provides the blanking drive for the first display digit. This forces the first display digit to always be "1". Q208 is driven from display driver Q210 and enabled from controller U203.

Display driver Q208 is driven from display driver Q210 and is enabled by a mode switch Pin #18 of controller U203.

Shift register U201 buffers and clocks the three data lines from the U203 display enable lines. Diodes D208 - D210 isolate U201 from the display. U201 is clocked (Pin #6) by display driver output Pin #13 of controller U203. The timing on this Pin latches the three input lines into shift register U201. Q205 buffers the clock signal and drives the clock input.

U200 is an analog signal level detector which supplies a 5-step digital output to the display 5-segment LED signal strength indicator. The five outputs of U200 drive the signal display LEDs directly.

Two versions of this circuit will be seen TL489CP or BA656.

The TL489 consists of five comparators and a reference network to detect the level of the analog input at Pin #8. The first open collector output driver Pin #2 is switched low at an input voltage of 200 mV. After each 200 mV input step the next output is switched low. The five open collector outputs are fed to driver transistors Q200 through Q204 which drive the signal display LEDs.

The BA656 consists of five 200 mV-step comparators and bar-type LED direct drivers. The input signal at Pin #8 is applied to all internal comparators. The output of each comparator will go high (from -22 VDC) in 200 mV input steps. The output resistor divider networks are selected to illuminate the signal bar LEDs in the 200 mV steps.

The POWER switch SW206 has two wiring versions:
An earlier version is wired to switch 5 VDC to the Main module with the switch on. When the switch is off 5 VDC is removed and Main module mute line is grounded.

The later version is wired to switch 15 VDC and 5 VDC to the Control module normal 5 VDC line with the switch on. When the switch is off the 15 VDC line is grounded through R256 and the 5 VDC normal line is opened.

D. Power Supply Module

The FM TWO has two Power Supply module versions. Each module version is designed to a matching Control module.

Earlier version Q42468J0
Later version Q42500-1.

The FM TWO Power Supply is designed to plug into an "unswitched" AC Power connector of the associated audio stereo preamplifier. With AC Power continuously supplied the Power Supply module will supply DC voltages as described in the following paragraphs.

If the FM TWO is plugged into a switched AC outlet, no DC voltages will be supplied when the preamplifier is turned off. Under this condition the tuner station memory may only be maintained for five days.

The Power transformer primary may be wired for either 110 VAC or 220 VAC. The Power Supply is protected by fuse F300.

The Power Supply module also has a secondary winding which supplies 6.3 VAC to the display module filament Pins for display illumination.

Power Supply module Q42468J0:
In this Power Supply version relay K300 controls all transformer secondary voltages except the +5 VDC supply. The +5 VDC supply is continuous applied to the Control module 5 VDC line. If AC power is supplied, this maintains tuner station memory and picks up relay K300 when the tuner power switch SW202 is turned on.

The Power Supply employs IC voltage regulators for +15, -15 and +5 VDC. The 30 VDC supply is regulated by zener diode D306.

Power Supply Module Q42500-1:
In this Power Supply version all supplies operate continuous with AC power supplied. The Power Supply employs IC voltage regulators for +15,-15 and +5 VDC. The 30 VDC supply is regulated by power transistor Q300 and zener diode D306.

7.8 Voltage Conversion

Often Crown products are purchased in one country and later moved to another requiring an AC mains conversion. For this reason the following chart-explanation as well as a world-wide voltage map is provided.

The FM TWO power supply may be connected for any of four voltages. Converting from one to another can be accomplished with a soldering iron and a pair of wire cutters.

1. Remove the FM TWO top cover (see Section 7.5A).
2. With the top cover off locate the AC power terminal strip near the power transformer.
3. Make the appropriate change in jumpers for the required operating voltage, see Fig. 7.6.
4. Install the correct fuse in the unit (see Section 7.5B).
5. Change the AC line cord tag to read the correct voltage.

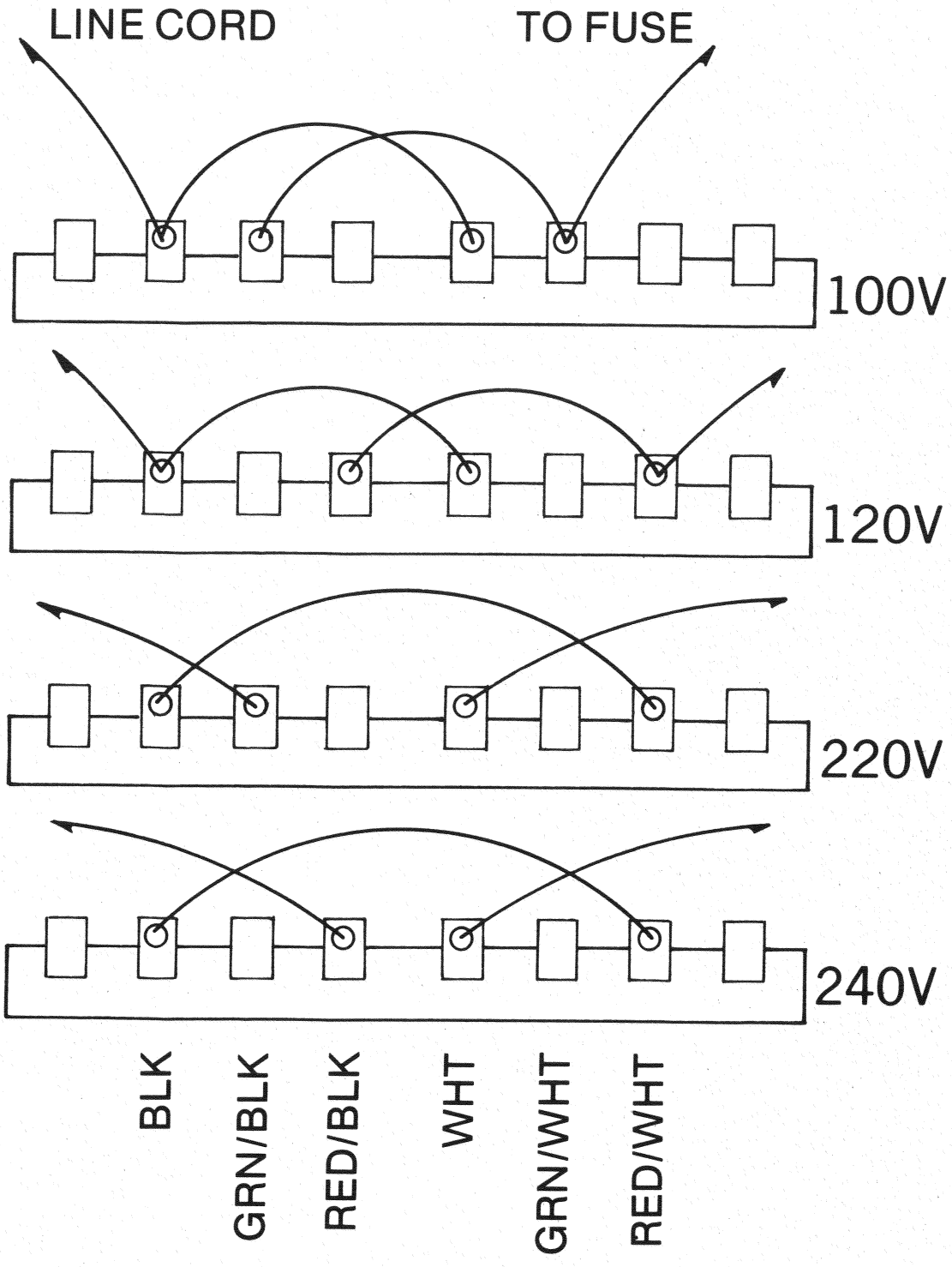

Fig. 7.6 Voltage Conversion Chart