FM500
Broadcast Transmitter

User's Manual

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Important Notices

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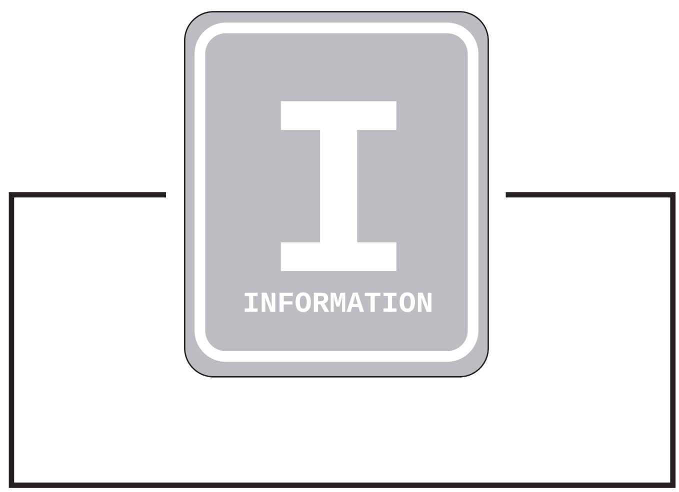
Contents

Section 5—Adjustments and Tests 5–1



Section 1—Getting Acquainted

This section provides a general description of the FM500 transmitter and introduces you to safety conventions used within this document. *Review this material before installing or operating the transmitter.*

1.1 Your Transmitter

The FM500 is a member of a family of FM stereo broadcast transmitters. Crown transmitters are known for their modularity, ease-of-use, and reliability.

The modularity is most apparent in the standard transmitter configuration which incorporates audio processing, stereo generation, and RF amplification without compromised signal quality. A single Crown transmitter can replace several pieces of equipment in a traditional system.

Ease-of-use is apparent in the user-friendly front panel interface and in the installation procedure. Simply select your operating frequency (using four rotary switches), add an audio source, attach an antenna, connect AC power, and you're ready to broadcast. Of course, the FM series of transmitters also feature more sophisticated inputs and monitoring connections if needed.

Reliability is a Crown tradition. The first Crown transmitters were designed for rigors of worldwide and potentially portable use. The modular design, quality components, engineering approach, and high production standards ensure stable performance.

Remote control and metering of the transmitter is made possible through a built-in I/O port. For more direct monitoring, the front panel includes a digital multimeter display and status indicators. Automatic control circuitry provides protection for high VSWR as well as high current, voltage, and temperature conditions.

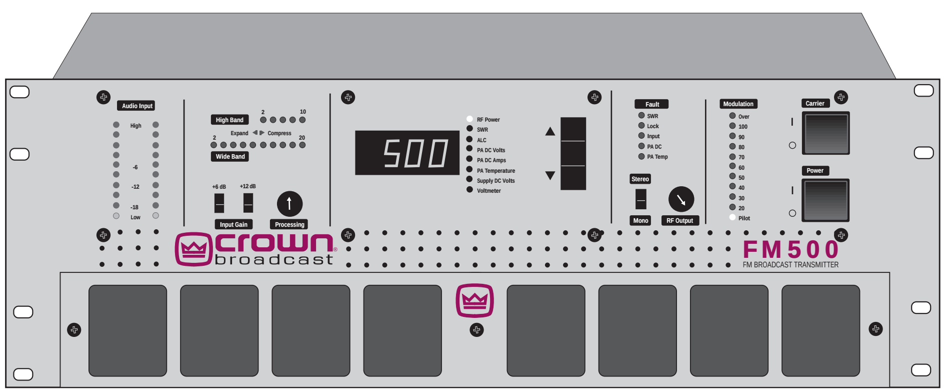


Illustration 1–1 FM500 Stereo Broadcast Transmitter

1.2 Applications and Options

Crown transmitters are designed for versatility in applications. They have been used as stand-alone and backup transmitters and in booster, translator, and satellator applications. The following discussion describes these applications further.

Model numbers describe the configuration of the product (which has to do with its intended purpose) and the RF output power which you can expect.

The number portion of each name represents the maximum RF output power. The FM500, for example, can generate up to 500 watts of RF output power.

Suffix letters describe the configuration. The FM500T, for example, designates a "transmitter" configuration. Since this is standard, it is what is described in the manual except where specified. In this configuration, the product includes the following modules (functions):

- ❑ audio processor
- ❑ stereo generator
- ❑ RF exciter
- ❑ metering
- ❑ low-pass filter

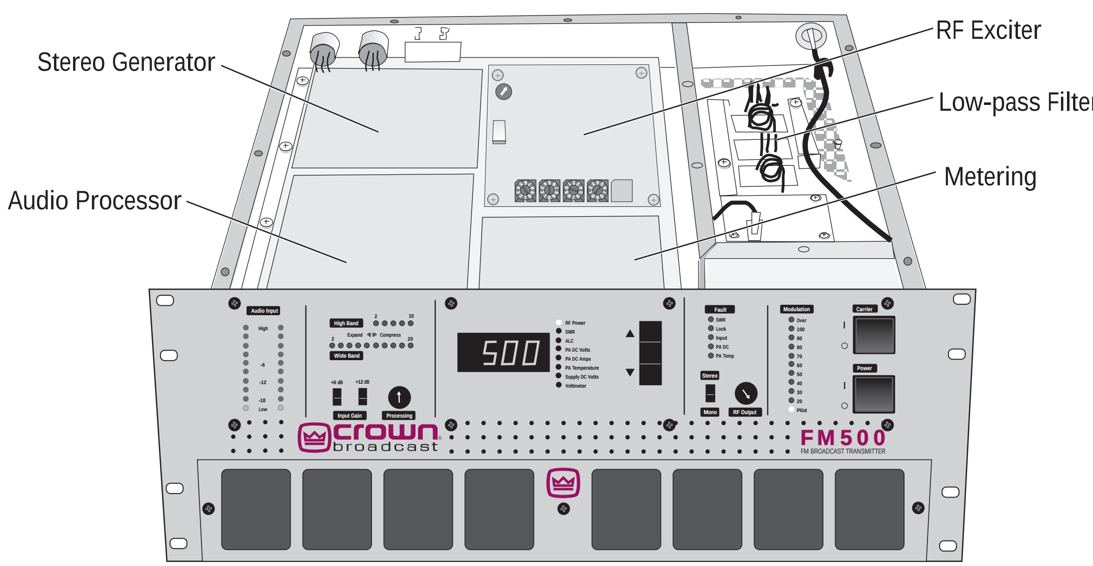


Illustration 1–2 Standard (Transmitter) Configuration

1.2.1 Stand-Alone

In the standard configuration, the FM500 is an ideal stand-alone transmitter. When you add an audio source (monaural, L/R stereo, or composite signal), an antenna, and AC power, the transmitter becomes a complete FM stereo broadcast station, capable of serving a community.

As stand-alone transmitters, Crown units often replace multiple pieces of equipment in a traditional setup (exciter, audio processor, RF amplifier).

1.2.2 Backup

In the standard configuration, Crown transmitters are also used in backup applications. Should your primary transmitter become disabled, you can continue to broadcast while repairs take place. In addition, the FM transmitters can replace disabled portions of your existing system including the exciter, audio processor, or amplifier. Transfer switches on each side of the existing and backup transmitters make the change-over possible with minimal downtime.

1.2.3 Booster

Also in the standard configuration, Crown transmitters have been used as booster transmitters. Booster applications typically involve certain geographic factors which prevent your system from broadcasting to the full coverage area allowable. For example, a mountain range might block your signal to a portion of your coverage area. Careful placement of a Crown transmitter, operating on the same frequency as your primary transmitter, can help you reach full coverage.

1.2.4 Exciter

In addition to the standard configuration, the FM500 is available in optional configurations to meet a variety of needs.

An "E" suffix, as in the FM500E, for example, represents an exciter-only configuration. In this configuration, the audio processor and stereo generator are not included. The exciter configurations are the least expensive way to get Crown-quality components into your transmission system.

You might consider the Crown exciter when other portions of your system are performing satisfactorily and you want to maximize your investment in present equipment.

1.2.5 Translator

A receiver configuration (FM500R, for example) takes an exciter configuration and adds receiver circuitry as well. This added feature makes the FM500 ideal for translator service in terrestrial-fed networks. These networks represent a popular and effective way to increase your broadcasting coverage. Translators, acting as repeater emitters, are necessary links in this chain of events.

Traditionally, network engineers have relied on multiple steps and multiple pieces of equipment to accomplish the task. Others have integrated the translator function (receiver and exciter) to feed an amplifier. Crown, on the other hand, starts with an integrated transmitter and adds a solid-state Receiver Module to form the ideal translator.

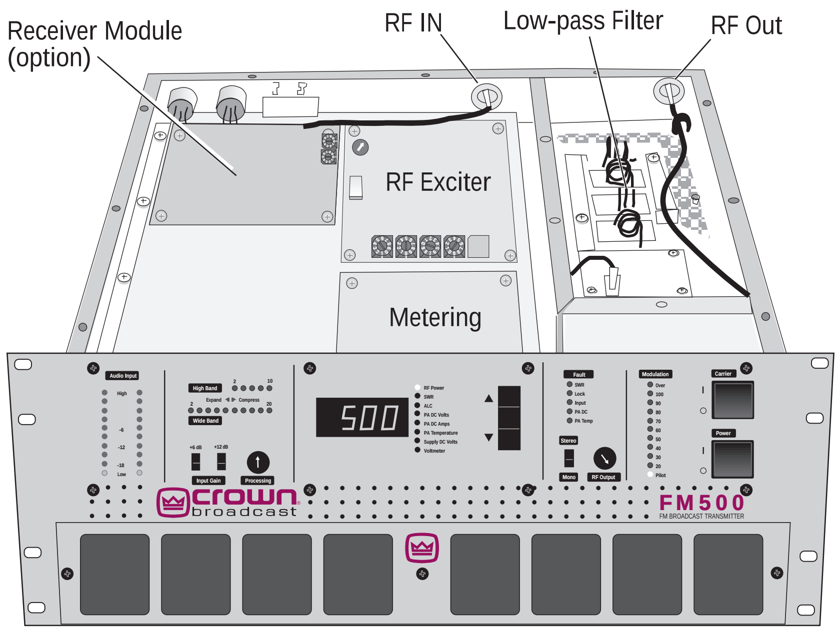


Illustration 1–3 Crown's Integrated Translator

This option enables RF in and RF out on any of Crown's FM series of transmitters. In addition, the module supplies a composite output to the RF exciter portion of the transmitter. From here, the signal is brought to full power by the built-in power amplifier for retransmission. The Receiver Module has been specifically designed to handle SCA channel output up to 100 kHz for audio and high-speed data.

FSK ID programming is built-in to ensure compliance with FCC regulations regarding the on-air identification of translators. Simply specify the call sign of the repeater station when ordering. Should you need to change the location of the translator, replacement FSK chips are available. The Receiver Module option should be ordered at the time of initial transmitter purchase. However, an option kit is available for field converting existing Crown units.

1.2.6 Satellator

Another option is available for all configurations—an FSK Identifier (FSK IDer). This added feature enables the FM500 to transmit its call sign or operating frequency in Morse Code. This option is intended for use in satellite-fed networks. Transmitters equipped in this fashion are often known as "satellators."

Connect the transmitter to your satellite receiver and the pre-programmed FSK IDer does the rest—shifting the frequency to comply with FCC requirements and in a manner that is unnoticeable to the listener. The FSK IDer module should be ordered at the time you order your transmitter but is available separately (factory programmed for your installation).

Add the FSK IDer option to the exciter configuration for the most economical satellator (a composite input signal is required).

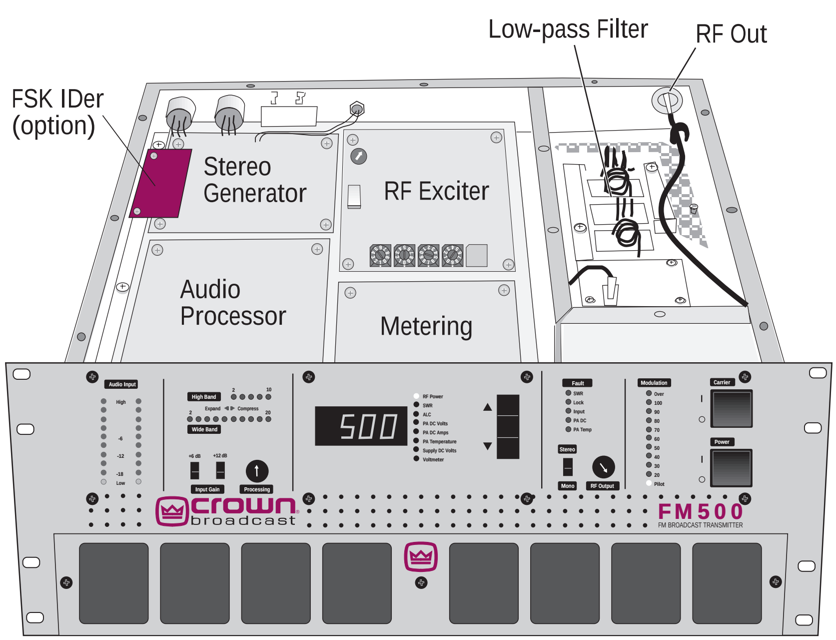


Illustration 1–4 Transmitter with FSK IDer Option

1.3 Transmitter/Exciter Specifications

Frequency Range	87 MHz–108 MHz (65 MHz–73 MHz optionally available)
RF Power Output	100–550 watts (VSWR 1.5:1 or better)
RF Output Impedance	50 Ω
Frequency Stability	Meets FCC specifications from 0-50 degrees C
Audio Input Impedance	50 kΩ bridging, balanced, or 600 Ω
Audio Input Level	Selectable for –10 dBm to +10 dBm for 75 kHz deviation at 400 Hz
Pre-emphasis	Selectable for 25, 50, or 75 µsec; or Flat
Audio Response	Conforms to 75 µsec pre-emphasis curve as follows
Complete transmitter	±0.30 dB (50 Hz–10 kHz)
	±1.0 dB (10 kHz–15 kHz)
Exciter only	±0.25 dB (50 Hz–15 kHz)
Distortion (THD + Noise)	
Complete transmitter	Less than 0.7% (at 15 kHz)
Exciter only	Less than 0.3% (50 Hz–15 kHz)
Stereo Separation	
Complete transmitter	Better than –40 dB (50 Hz–15 kHz)
Exciter only	Better than –40 dB (50 Hz–15 kHz)
Crosstalk	Main into sub, better than –40 dB
	Sub into main, better than –40 dB
Stereo Pilot	19 kHz ±2 Hz, 9% modulation
Subcarrier Suppresion	50 dB below ±75 kHz deviation
FM S/N Ratio (FM noise)	
Complete transmitter	Better than –60 dB
Exciter only	Better than –70 dB

AM S/N Ratio	Asynchronous and synchronous noise better than NAB recommendations
RF Bandwidth	±120 kHz, better than –35 dB ±240 kHz, better than –45 dB
RF Spurious Products	Better than –70 dB
Operating Environment	Temperature (0–50° C) Humidity (0–80% at 20° C) Maximum Altitude (3,000 meters; 9843 feet)
AC Power	100, 120, 220, or 240 volts (+10%/–15%); 50/60 Hz
Regulatory	Type notified for FCC parts 73 and 74; Meets FCC, DOC, and CCIR requirements
Dimensions	17.8 x 41.9 x 44.5 cm (7.0 x 16.5 x 17.5 inches)
Weight	29.5 kg (65 lbs); 31.8 kg (70 lbs) shipping weight

1.4 Receiver Specifications

Monaural Sensitivity (demodulated, de-emphasized)	
	3.5 µV for signal-to-noise > 50 dB
	12.6 µV for signal-to-noise > 60 dB
Stereo Sensitivity (19–kHz pilot frequency added)	
	2.8 µV for signal-to-noise > 40 dB
	8 µV for signal-to-noise > 50 dB
	31 µV for signal-to-noise > 60 dB
Connector	Standard type N, 50 Ω
Shipping Weight	1 lb

1.5 Safety Considerations

Crown Broadcast assumes the responsibility for providing you a safe product and safety guidelines during its use. "Safety" means protection to all individuals who install, operate, and service the transmitter as well as protection of the transmitter itself. To promote safety, we use standard hazard alert labeling on the product and in this manual. Follow the associated guidelines to avoid potential hazard.

1.5.1 Dangers

DANGER represents the most severe hazard alert. Extreme bodily harm or death <u>will</u> occur if DANGER guidelines are not followed.

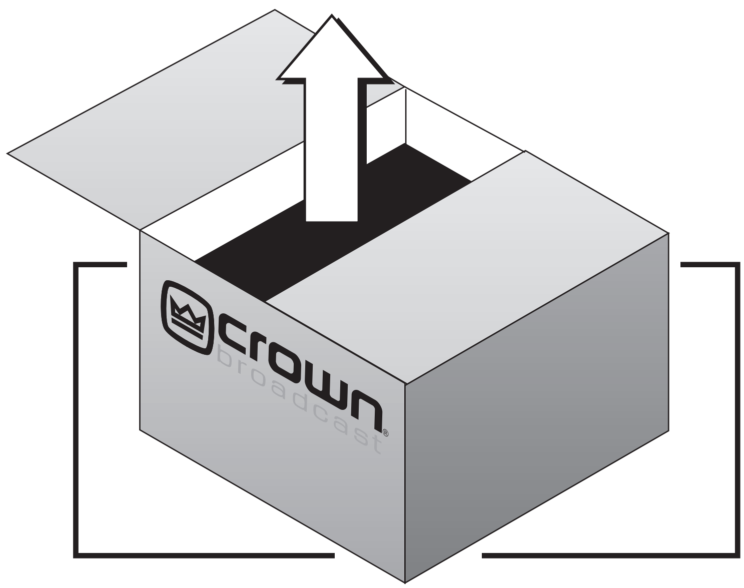
1.5.2 Warnings

WARNING represents hazards which <u>could</u> result in severe injury or death.

1.5.3 Cautions

CAUTION indicates potential personal injury or equipment or property damage if the associated guidelines are not followed. Particular cautions in this text also indicate unauthorized radio-frequency operation.

Illustration 1–5 Sample Hazard Alert



Section 2—Installation

This section provides important guidelines for installing your transmitter. Review this information carefully for proper installation.

CAUTION

Possible equipment damage!

Before operating the transmitter for the first time, check for the proper AC line voltage setting and frequency selection as described in sections 2.3 and 2.4.

2.1 Operating Environment

You can install the FM transmitter in a standard component rack or on a suitable surface such as a bench or desk. In any case, the area should be as clean and well-ventilated as possible. Always allow for at least 2 cm of clearance under the unit for ventilation. If you set the transmitter on a flat surface, install spacers on the bottom cover plate. If you install the transmitter in a rack, provide adequate clearance above and below. Do not locate the transmitter directly above a hot piece of equipment.

2.2 Remove PA Tray Spacers

The Crown FM 500 is shipped with spacers between the PA tray and the transmitter back panel. The spacers prevent damage to internal contacts during shipping. Remove and save the spacers and screws before installing the FM500.

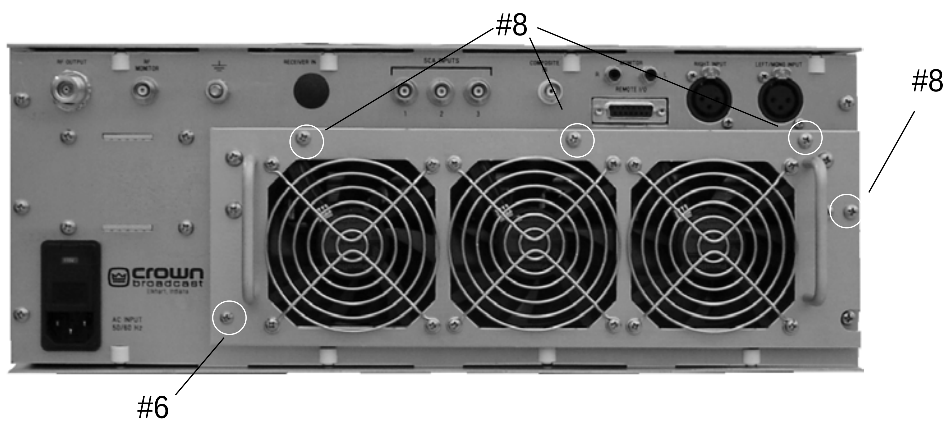


Illustration 2-1 FM 500 PA Tray Mounting Screws

1. Remove screws and spacers from five locations.
2. Firmly push the PA tray into the FM 500 until the PA tray panel touches the back panel.
3. Locate the bag labeled *500 Hardware*. Install four #8 screws and washers and one number #6 screw and washer. See photo for locations.

2.3 Power Connections

The FM500 operates on 100, 120, 220, or 240 volts AC (50 or 60 Hz; single phase). As shipped (factory default settings), the FM500 operates on 120 volts at 60 Hz.

If you are operating the transmitter at 120 volts you do not need to make any changes. To operate the FM500 at 100, 220, or 240 volts, a few changes are necessary.

To change the voltage setting, follow these steps:

1. Disconnect the power cord if it is attached.
2. To set the input voltage for 100 volts, skip to step 7.
3. Open the cover of the power connector assembly using a small, flat blade screwdriver. See Illustration 2–2.
4. Insert the screwdriver into the top slot of the voltage selection assembly (red) and pry out the assembly from the power connector.
5. If you are setting the input voltage for 220 or 240 volts, replace the installed fuses with 12 amp fuses (included in your package). See Illustration 2–3.
6. Replace the red fuse assembly so that the "230V" setting appears right side up in the window. Close the assembly window.

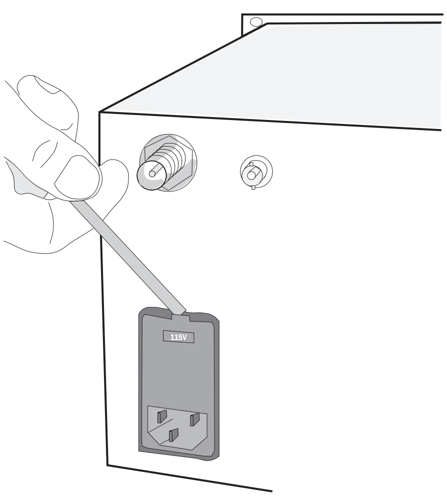


Illustration 2–2
Opening the Power Connector Cover

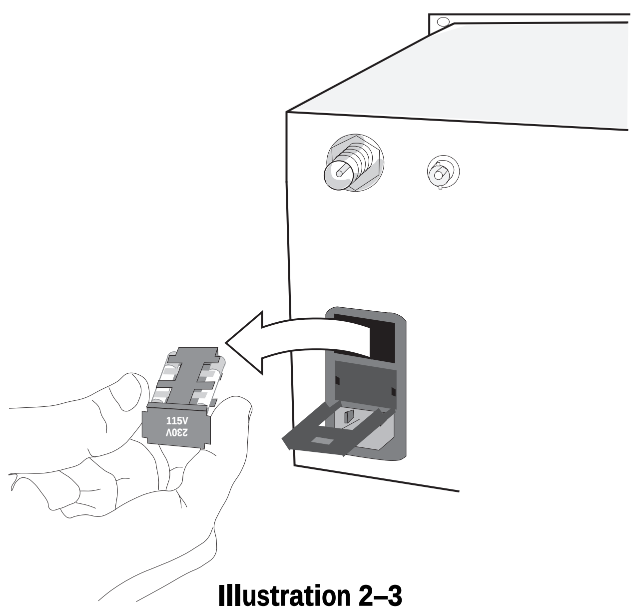


Illustration 2–3
Removing the Voltage Selection (red) Assembly

7. Turn the transmitter upside down and remove the bottom cover.

Note: *The front panel filter grill must be removed to expose all of the bottom cover screws for bottom cover removal and installation.*

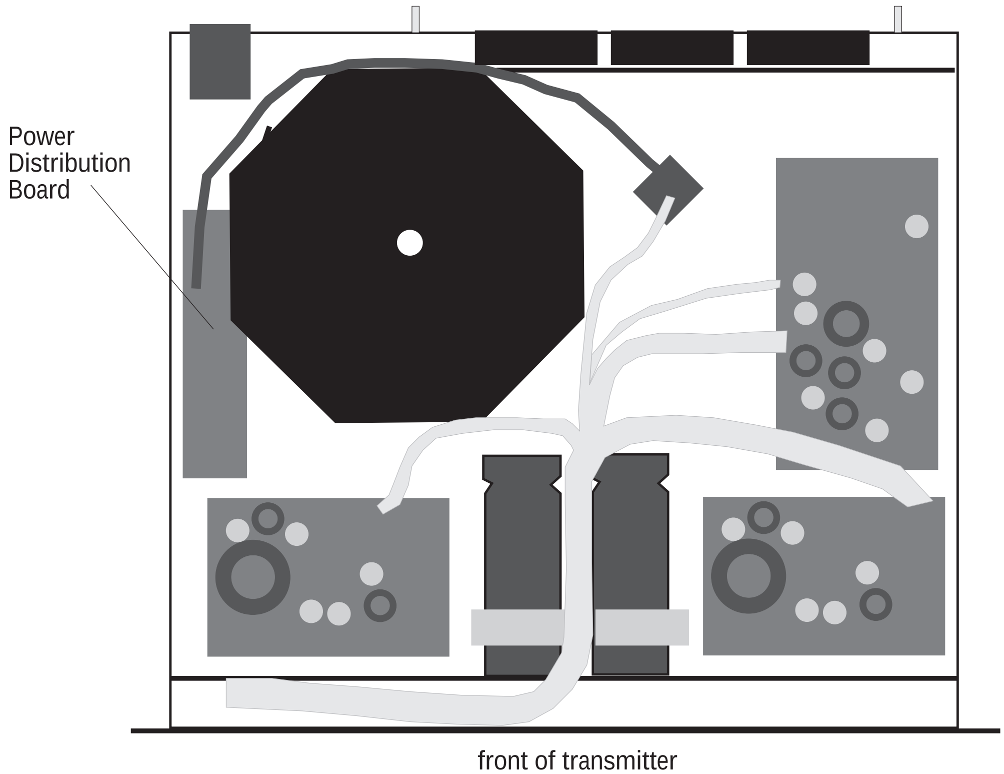


Illustration 2–4 Underside of Transmitter—Bottom Cover Removed

8. Locate the power distribution circuit board on the left side next to the large transformer cover. See Illustration 2–4.
9. For 100 or 220 volt operation, change the jumper setting of P1 to the 100/220 V setting.
10. For 220 or 240 volt operation,
    - remove the jumper connecting P6 and P7.
    - remove the jumper connecting P4 and P5.
    - use a jumper to connect P5 and P6.
11. Replace the bottom cover, and the front grill.
12. Connect the AC power cord.

For your reference, use 12 amp fuses for 220 or 240 volt operation and 20 amp fuses for 100 or 120 volt operation.

2.4 Frequency (Channel) Selection

You may select an operating frequency of 87 to 108 MHz in the FM broadcast band with 100 kHz channel spacing (10 kHz spacing is optional with the addition of a fifth rotary selector switch).

To adjust the operating frequency, follow these steps:

1. Remove the top cover by removing 15 screws.
2. Locate the RF Exciter board and identify the frequency selector switches which will be used to change the setting. See Illustrations 2–5 and 2–6.

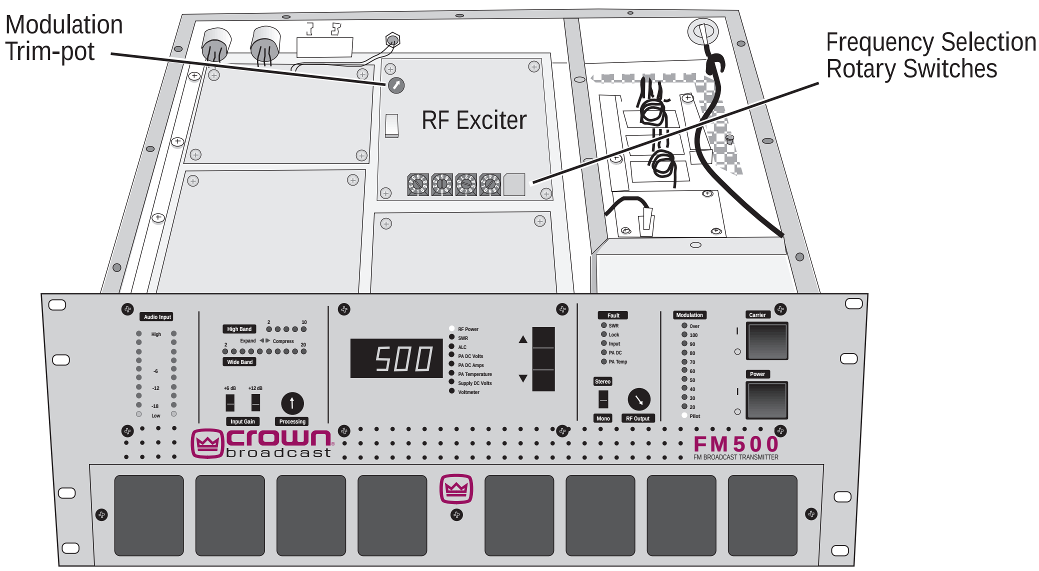


Illustration 2–5 Top Cover Removed

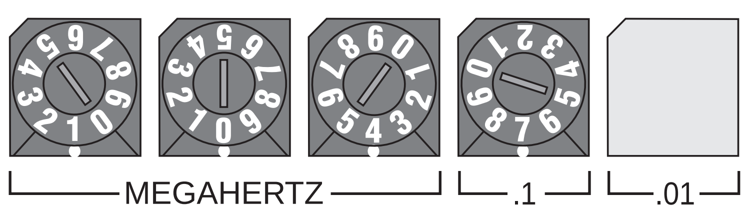


Illustration 2–6 RF Exciter Board Frequency Selector Switches

3. Use small flat blade screwdriver or another suitable device to rotate the switches to the desired setting. (The selected number will appear directly above the white indicator dot on each switch.) See examples of selected frequencies in the illustration below.

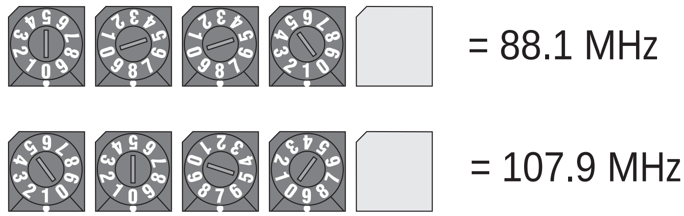


Illustration 2–7 Two Sample Frequency Selections

4. If you have the receiver option, proceed to section 2.5 to set the incoming frequency. Otherwise, replace the top cover.

2.4.1 Modulation Compensator

The Modulation trim-potentiometer (see illustration 2–8) compensates for slight variations in deviation sensitivity with frequency. Set the trim-pot dial according to the following graph:

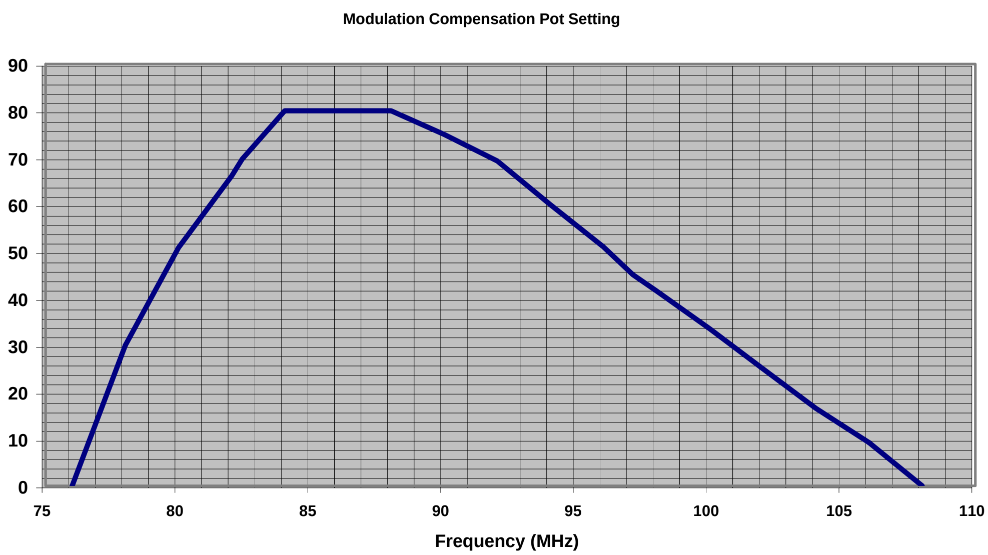


Illustration 2–8 Modulation Compensator Settings

These compensator settings are approximate. Each mark on the potentiometer represents about 1.8% modulation compensation. For more exact settings, refer to section 5.2.2.

2.4.2 RF Tuning Adjustments

All the RF stages are broadband to cover the 88 to 108 MHz broadcast band. The RF amplifier stages require no tuning.

2.5 Receiver Frequency Selection

If you have a transmitter equipped with the receiver option, you will need to set the receiving or incoming frequency.

1. With the top cover removed, locate the receiver module and the two switches (labeled SW1 and SW2).
2. Use the table on the following pages to set the switches for the desired incoming frequency.
3. After setting the frequency, return to section 2.3.1 to set the modulation compensator.

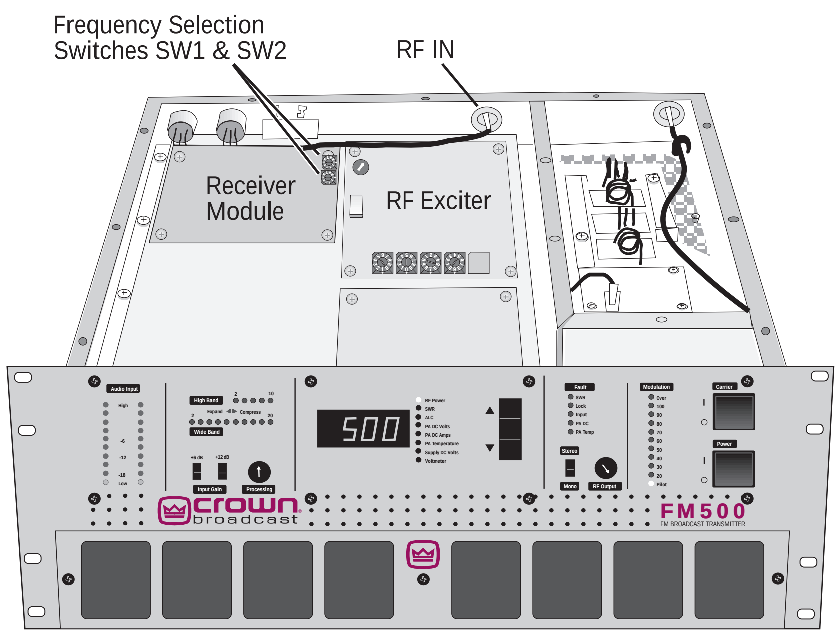


Illustration 2–8 Receiver Module Switches

Frequency	SW1	SW2	Frequency	SW1	SW2	Frequency	SW1	SW2	Frequency	SW1	SW2
87.9	0	0	**93.0**	9	9	**98.0**	B	2	**103.0**	C	B
88.0	8	0	93.1	1	A	98.1	3	3	103.1	4	C
88.1	0	1	93.2	9	A	98.2	B	3	103.2	C	C
88.2	8	1	93.3	1	B	98.3	3	4	103.3	4	D
88.3	0	2	93.4	9	B	98.4	B	4	103.4	C	D
88.4	8	2	93.5	1	C	98.5	3	5	103.5	4	E
88.5	0	3	93.6	9	C	98.6	B	5	103.6	C	E
88.6	8	3	93.7	1	D	98.7	3	6	103.7	4	F
88.7	0	4	93.8	9	D	98.8	B	6	103.8	C	F
88.8	8	4	93.9	1	E	98.9	3	7	103.9	5	0
88.9	0	5	**94.0**	9	E	**99.0**	B	7	**104.0**	D	0
89.0	8	5	94.1	1	F	99.1	3	8	104.1	5	1
89.1	0	6	94.2	9	F	99.2	B	8	104.2	D	1
89.2	8	6	94.3	2	0	99.3	3	9	104.3	5	2
89.3	0	7	94.4	A	0	99.4	B	9	104.4	D	2
89.4	8	7	94.5	2	1	99.5	3	A	104.5	5	3
89.5	0	8	94.6	A	1	99.6	B	A	104.6	D	3
89.6	8	8	94.7	2	2	99.7	3	B	104.7	5	4
89.7	0	9	94.8	A	2	99.8	B	B	104.8	D	4
89.8	8	9	94.9	2	3	99.9	3	C	104.9	5	5
89.9	0	A	**95.0**	A	3	**100.0**	B	C	**105.0**	D	5
90.0	8	A	95.1	2	4	100.1	3	D	105.1	5	6
90.1	0	B	95.2	A	4	100.2	B	D	105.2	D	6
90.2	8	B	95.3	2	5	100.3	3	E	105.3	5	7
90.3	0	C	95.4	A	5	100.4	B	E	105.4	D	7
90.4	8	C	95.5	2	6	100.5	3	F	105.5	5	8
90.5	0	D	95.6	A	6	100.6	B	F	105.6	D	8
90.6	8	D	95.7	2	7	100.7	4	0	105.7	5	9
90.7	0	E	95.8	A	7	100.8	C	0	105.8	D	9
90.8	8	E	95.9	2	8	100.9	4	1	105.9	5	A
90.9	0	F	**96.0**	A	8	**101.0**	C	1	**106.0**	D	A
91.0	8	F	96.1	2	9	101.1	4	2	106.1	5	B
91.1	1	0	96.2	A	9	101.2	C	2	106.2	D	B
91.2	9	0	96.3	2	A	101.3	4	3	106.3	5	C
91.3	1	1	96.4	A	A	101.4	C	3	106.4	D	C
91.4	9	1	96.5	2	B	101.5	4	4	106.5	5	D
91.5	1	2	96.6	A	B	101.6	C	4	106.6	D	D
91.6	9	2	96.7	2	C	101.7	4	5	106.7	5	E
91.7	1	3	96.8	A	C	101.8	C	5	106.8	D	E
91.8	9	3	96.9	2	D	101.9	4	6	106.9	5	F
91.9	1	4	**97.0**	A	D	**102.0**	C	6	**107.0**	D	F
92.0	9	4	97.1	2	E	102.1	4	7	107.1	6	0
92.1	1	5	97.2	A	E	102.2	C	7	107.2	E	0
92.2	9	5	97.3	2	F	102.3	4	8	107.3	6	1
92.3	1	6	97.4	A	F	102.4	C	8	107.4	E	1
92.4	9	6	97.5	3	0	102.5	4	9	107.5	6	2
92.5	1	7	97.6	B	0	102.6	C	9	107.6	E	2
92.6	9	7	97.7	3	1	102.7	4	A	107.7	6	3
92.7	1	8	97.8	B	1	102.8	C	A	107.8	E	3
92.8	9	8	97.9	3	2	102.9	4	B	107.9	6	4
92.9	1	9							**108.0**	E	4

Table 2–1 Receiver Frequency Selection

2.6 RF Connections

Connect the RF load, an antenna or the input of an external power amplifier, to the type-N, RF output connector on the rear panel. VSWR should be 1.5:1 or better.

The RF monitor is intended primarily for a modulation monitor connection. Information gained through this connection can supplement that which is available on the transmitter front panel displays.

If your transmitter is equipped with the receiver option, connect the incoming RF to the RF IN connector.

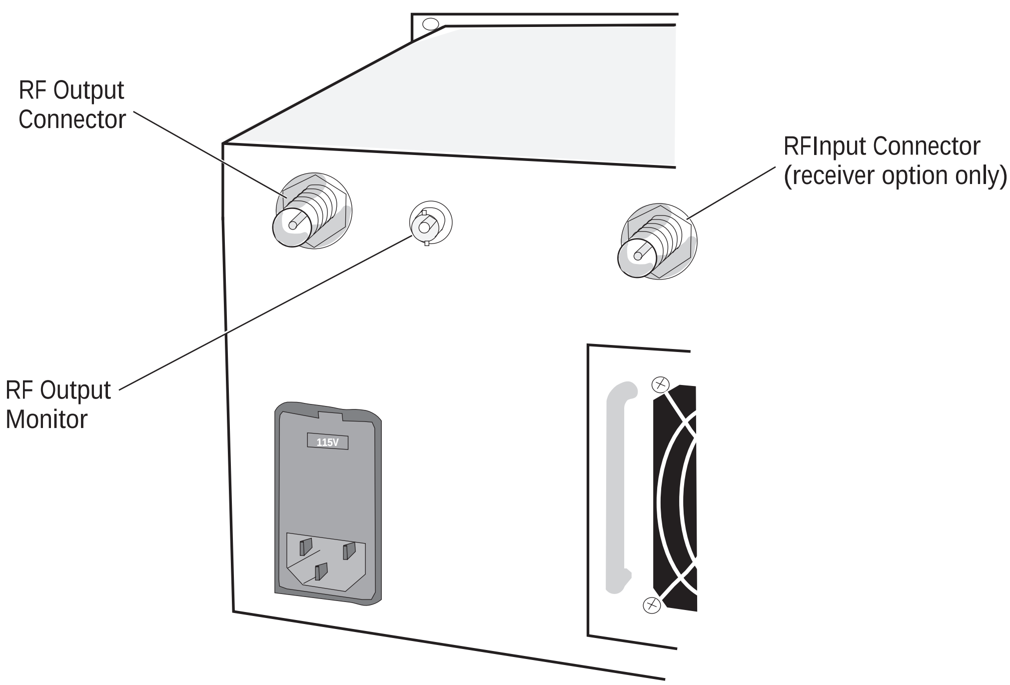


Illustration 2–10 RF Connections

2.7 Audio Input Connections

Attach audio inputs to the Left and Right XLR connectors on the rear panel. (The Left channel audio is used on Mono.) Pin 1 of the XLR connector goes to chassis ground. Pins 2 and 3 represent a balanced differential input with an impedance of about 50 kΩ. They may be connected to balanced or unbalanced left and right program sources.

The audio input cables should be shielded pairs, whether the source is balanced or unbalanced. For an unbalanced program source, one line (preferably the one connecting to pin 3) should be grounded to the shield at the source. Audio will then connect to the line going to pin 2.

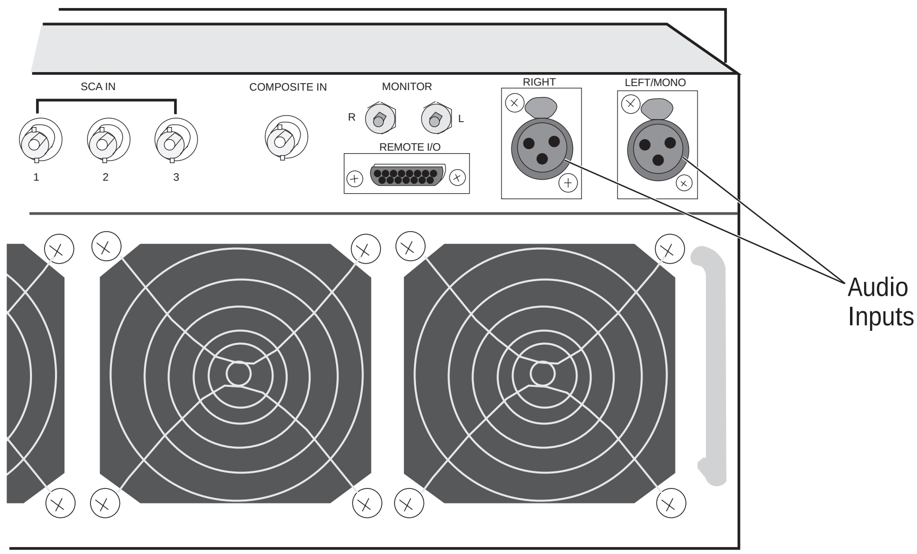


Illustration 2-10 XLR Audio Input Connectors

By bringing the audio return line back to the program source, the balanced differential input of the transmitter is used to best advantage to minimize noise. This practice is especially helpful if the program lines are fairly long but is a good practice for any distance.

If the program source requires a 600 Ω termination, install resistors on the 8–pin DIP socket on the motherboard (socket A501 located between the XLR connectors). See the motherboard schematic, on page 6–13.

2.8 SCA Input Connections

You can connect external SCA generators to the SCA In connectors (BNC-type) on the rear panel. The inputs are intended for the 60 kHz to 99 kHz range, but a lower frequency may be used if the transmitter is operated in Mono mode. (The 23 to 53 kHz band is used for stereo transmission.) For 7.5 kHz deviation (10% modulation), input of approximately 3.5–volts (peak-to-peak) is required.

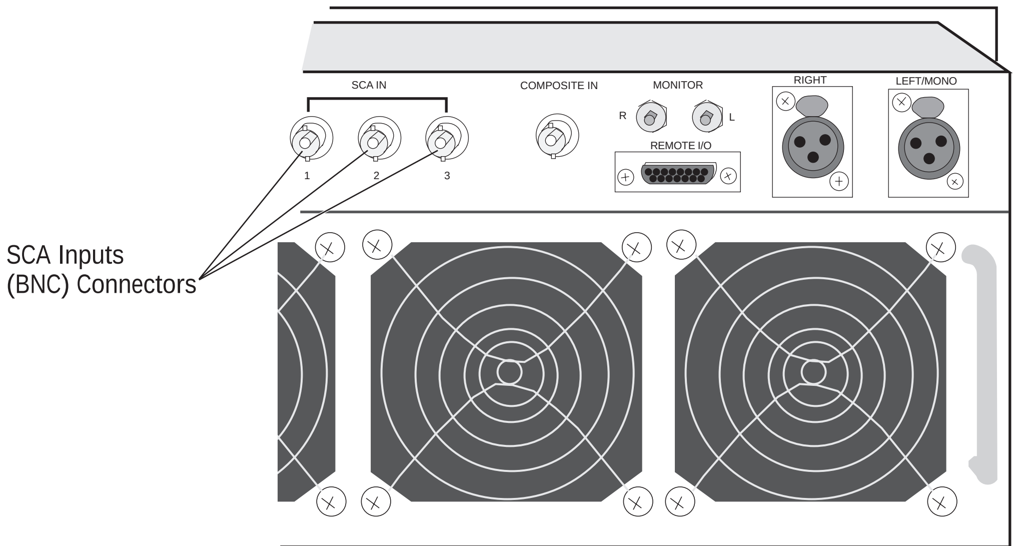


Illustration 2–12 SCA Input Connectors

2.9 Composite Input Connection

To use the Crown transmitter as an RF Exciter only ("E" version or when using the "T" version with composite input), it is necessary to use the Composite Input section of the transmitter. This will feed composite stereo (or mono audio) directly to the RF exciter. In the "T" version, this will bypass the internal audio processor and stereo generator. See Section 2.12 on the next page for caution in using the bypass option.

Input sensitivity is approximately 3.5–volt P-P for 75 kHz deviation.

1. Enable the Composite Input by grounding pin 9 of the Remote I/O connector (see Illustration 2–15).
2. Connect the composite signal using the Composite In BNC connector.

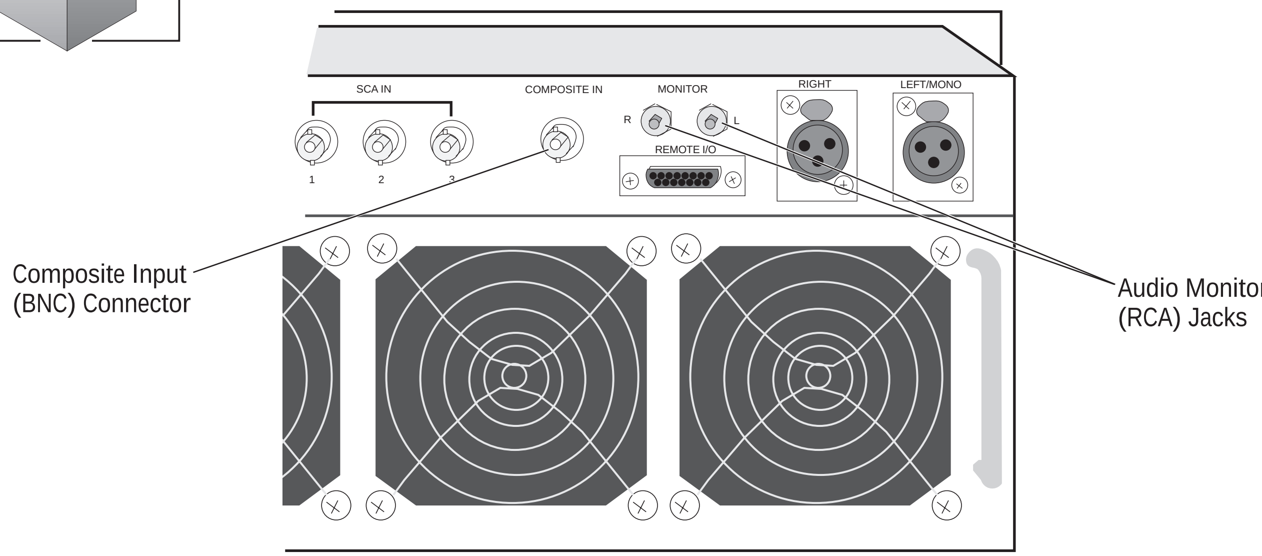


Illustration 2–13 Composite In and Audio Monitor Connections

2.10 Audio Monitor Connections

Processed, de-emphasized samples of the left and right audio inputs to the stereo generator are available at the Monitor jacks on the rear panel. The signals are suitable for feeding a studio monitor and for doing audio testing. De-emphasis is normally set for 75 µsec; set to 50 µsec by moving jumpers, JP203 and JP204, on the Stereo Generator board.

2.11 Pre-emphasis Selection

Select the pre-emphasis curve (75 µsec, 50 µsec, 25 µsec, or Flat) by jumpering the appropriate pins of header JP1 on the audio processor board. If you change the pre-emphasis, change the de-emphasis jumpers JP203 and JP204 on the Stereo Generator board to match.

2.12 Processor Bypass Option

You may bypass the audio processor in order to feed the left and right (pre-emphasized) audio directly to the stereo generator. The Normal-Bypass slide switch is near the left-rear corner of the motherboard. If the audio source is already processed and you do not desire further processing, use the Normal mode but turn the Processing control (on the front panel) to “0.” (See also section 3.5.)

CAUTION

In the BYPASS position, the pre-emphasis circuits and the filters that protect the pilot and stereo subcarrier are bypassed. As a result, the occupied bandwidth specifications of the transmitter could be compromised. The 15–Hz high-pass filters are also bypassed which may mean that modulation with frequencies below 10 Hz could cause the frequency synthesizer to unlock.

2.13 Program Input Fault Time-out

You can enable an automatic turn-off of the carrier in the event of program failure. To enable this option, see the table on the next page. The time between program failure and carrier turn-off is set by a jumper (JP701) on the voltage regulator board (see Illustration 6–4 for board location). Jumper pins 1 and 2 (the two pins closest to the edge of the board) for a delay of approximately 30 seconds; pins 3 and 4 for a 2–minute delay; pins 5 and 6 for a 4–minute delay, and pins 7 and 8 for an 8–minute delay.

2.14 Remote I/O Connector

Remote control and remote metering of the transmitter is made possible through a 15–pin, D-sub connector on the rear panel. (No connections are required for normal operation.)

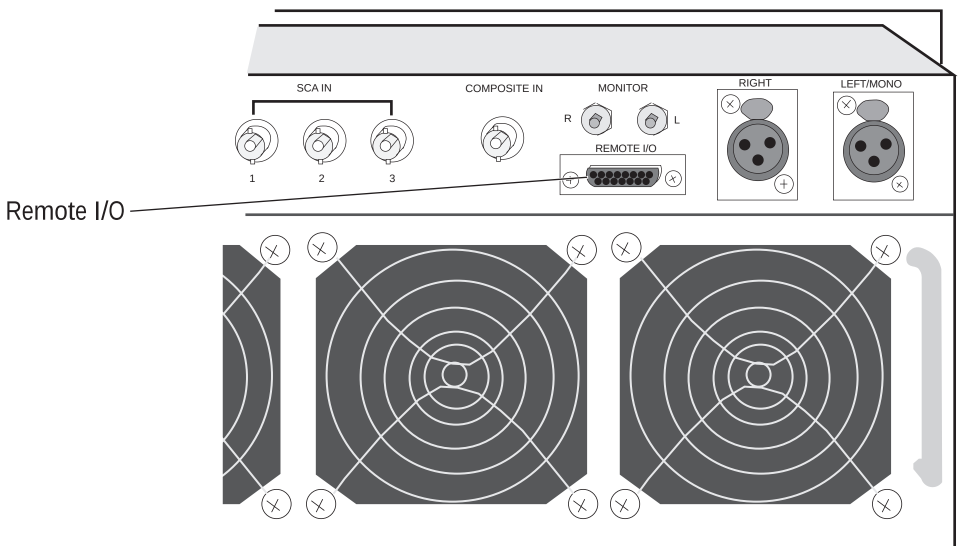


Illustration 2–14 Remote I/O Connector

The following table summarizes the Remote I/O pin connections.

Pin Number	Function
1	**Ground**
2	(no connection)
3	**Composite Out** (sample of stereo generator output)
4	**FSK In** (Normally high; pull low to shift carrier frequency approximately 7.5 kHz. Connect to open collector or relay contacts of user-supplied FSK keyer.)
5	**/Auto Carrier Off** (Pull low to enable automatic turnoff of carrier with program failure.)
6	**Meter Battery** (unregulated DC volts; 5 volts = 50 VDC)
7	**Meter RF Watts** (1 volt = 100 watts)
8	**Meter PA Volts** (5 volts = 50 VDC)
9	**/Ext. Enable** (Pull low to disable internal stereo generator and enable External Composite Input.)
10	a) **38 kHz Out** (From stereo generator for power supply synchronization.)
	b) For transmitters equipped with tuner option, this pin becomes the right audio output for an 8–ohm monitor speaker. **38kHZ Out** is disabled.
11	**ALC**
12	**/Carrier Off** (pull low to turn carrier off.)
13	**Fault Summary** (line goes high if any fault light is activated.)
14	**Meter PA Temperature** (5 volts = 100 degrees C.)
15	**Meter PA Current** (1 volt = 10 amperes DC.)

Table 2–3 Remote I/O Connections

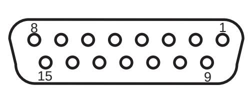
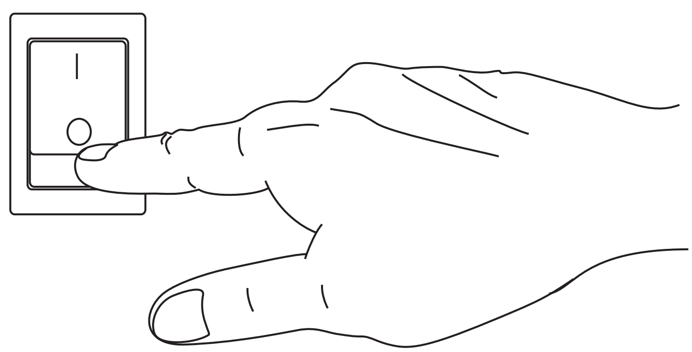
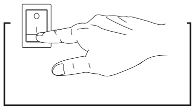


Illustration 2–15 Remote I/O Connector (outside view)



Section 3—Operation

This section provides general operating parameters of your transmitter and a detailed description of its front panel display.



3.1 Initial Power-up Procedures

These steps summarize the operating procedures you should use for the initial operation of the transmitter. More detailed information follows.

CAUTION

Possible equipment damage!

Before operating the transmitter for the first time, check for the proper AC line voltage setting and frequency selection as described in sections 2.3 and 2.4.

1. Turn on the main power switch.

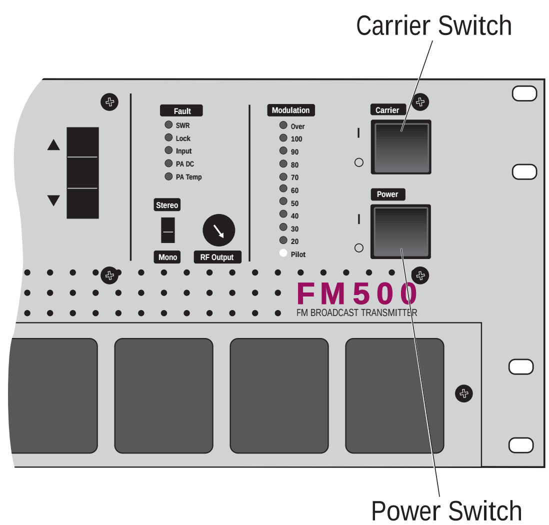


Illustration 3–1 Front Panel Power Switches

2. Verify the following:

   a. The bottom cooling fans runs continuously.

   b. The Lock Fault indicator flashes for approximately 5 seconds, then goes off.

4. Set the Input Gain switches for mid-scale wideband gain reduction on an average program level (see section 3.4).

5. Set the Processing control (see section 3.5; normal setting is “50”).

6. Set the Stereo-Mono switch to Stereo (see section 3.6).

7. Turn on the Carrier switch.

8. Check the following parameters on the front panel multimeter:

    a. RF Power should be 500–550 watts.

    b. SWR should be less than 1.25 (A reading greater than 1.25 indicates an antenna mismatch).

    c. ALC should be between 4.00 and 6.00 volts.

    d. PA DC Volts should be 46–56 volts. (Varies with antenna match, power, and frequency.)

    e. PA DC Amperes should be 12–16 amps. (Varies with antenna match, power, and frequency.)

    f. PA Temperature should initially read 20–35 degrees C (room temperature). After one hour the reading should be 35–50 degrees C.

    g. Supply DC Volts should display a typical reading of 65–70 V with the carrier on and 80–85 V with the carrier off

    h. Voltmeter should be reading 0.0.

The remainder of this section describes the functions of the front panel indicators and switches.

3.2 Power Switches

3.2.1 DC Breaker

The DC breaker, on the rear panel, must be on (up) for transmitter operation, even when using AC power. Electrically, the DC breaker is located immediately after diodes which isolate the DC and AC power supplies.

3.2.2 Power Switch

The main on/off power switch controls both the 120/240 VAC and the DC battery power input.

3.2.3 Carrier Switch

This switch controls power to the RF amplifiers and supplies a logic high to the voltage regulator board, which enables the supply for the RF driver. In addition, the Carrier Switch controls the operating voltage needed by the switching power regulator.

A "Lock Fault" or a low pin 12 (/Carrier Off) on the Remote I/O connector will hold the carrier off.   (See section 2.12.)

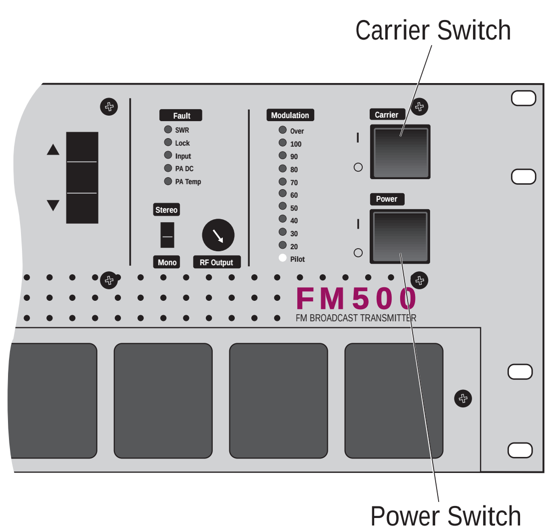


Illustration 3–2 Front Panel Power Switches

3.3 Front Panel Bar-Dot Displays

Bar-dot LEDs show audio input levels, wideband and highband audio gain control, and modulation percentage. Resolution for the gain control and modulation displays is increased over a conventional bar-graph display using dither enhancement which modulates the brightness of the LED to give the effect of a fade from dot to dot. (See section 4.7.)

3.3.1 Audio Processor Input

Two vertical, moving-dot displays for the left and right channels indicate the relative audio levels, in 3 dB steps, at the input of the audio processor. Under normal operating conditions, the left and right Audio Processor indicators will be active, indicating the relative audio input level after the Input Gain switches. During program pauses, the red Low LED will light.

With the receiver module option installed, the audio processor indicators are disabled.

3.3.2 Highband and Wideband Display

During audio processing, the moving-dot displays indicate the amount of gain control for broadband (Wide) and pre-emphasized (High) audio. These indicators are disabled if the receiver module option is installed.

As long as program material causes activity of the Wideband green indicators, determined by the program source level and Input Gain switches, the transmitter will be fully modulated. (See section 3.4.)

The Wideband indicator shows short-term "syllabic-rate" expansion and gain reduction around a long-term (several seconds) average gain set.

Program material and the setting of the Processing control determine the magnitude of the short-term expansion and compression (the rapid left and right movement of the green light).

High-frequency program content affects the activity of the Highband indicator. With 75–µsec pre-emphasis, Highband processing begins at about 2 kHz and increases as the audio frequency increases. Some programs, especially speech, may show no activity while some music programs may show a great deal of activity.

3.3.3 Modulation Display

A 10–segment, vertical peak-and-hold, bar graph displays the peak modulation percentage. A reading of "100" coincides with 75 kHz deviation. The display holds briefly (about 0.1 seconds) after the peak. The "Pilot" indicator illuminates when the transmitter is in the stereo mode.

To verify the actual (or more precise) modulation percentage, connect a certified modulation monitor to the RF monitor jack on the rear panel.

3.4 Input Gain Switches

The "+6 dB" and "+12 dB" slide switches set audio input sensitivity according to the following table.

Nominal Input Sensitivity	Switches	
	+6 dB	+12 dB
+10 dBm	Down	Down
+4 dBm	Up	Down
-2 dBm	Down	Up
-8 dBm	Up	Up

Table 3–1 Input Gain Switches

Find, experimentally, the combination of Input Gain switch settings that will bring the Wideband gain-reduction indicator to mid scale for "normal" level program material. The audio processor will accommodate a fairly wide range of input levels with no degradation of audio quality.

3.5 Processing Control

Two factors contribute to the setting of the Processing control: program material and personal taste. For most program material, a setting in the range of 40 to 70 provides good program density. For the classical music purist, who might prefer preservation of music dynamics over density, 10 to 40 is a good range. The audio will be heavily processed in the 70 to 100 range.

If the program source is already well processed, as might be the case with a satellite feed, set the Processing to "0" or "10".

3.6 Stereo-Mono Switch

The Stereo-Mono slide switch selects the transmission mode. In Mono, feed audio *only to the left channel.* Although right-channel audio will not be heard as audio modulation, it will affect the audio processing.

3.7 RF Output Control

Set this control for the desired output power level. Preferably, set the power with an external RF wattmeter connected in the coaxial line to the antenna. You may also use the RF power reading on the digital multimeter.

The control sets the RF output voltage. Actual RF output power varies as the approximate square of the relative setting of the control. For example, a setting of “50” is approximately 1/4 full power. Operation below 100 watts is not recommended as instability can occur which could damage the transmitter.

CAUTION

Possible equipment damage!

Operation below 100 watts can cause oscillations and other problems that could damage the transmitter.

3.8 Digital Multimeter

The four-digit numeric display in the center of the front panel provides information on transmitter operation. Use the “Up” and “down” push-buttons to select one of the following parameters. A green LED indicates the one selected.

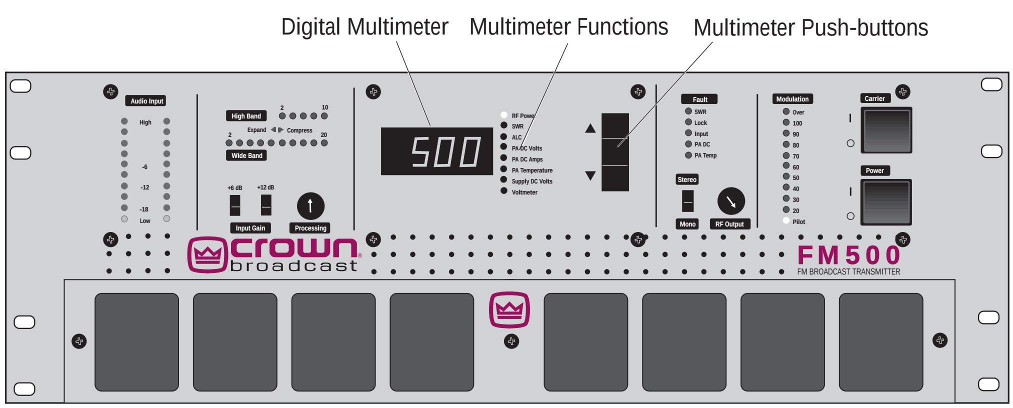


Illustration 3–3 Digital Multimeter

RF Power—Actually reads RF voltage squared, so the accuracy can be affected by VSWR (Voltage Standing-Wave Ratio). See section 5.4 for calibration. Requires calibration with the RF reflectometer being used.

SWR—Direct reading of the antenna standing-wave ratio (the ratio of the desired load impedance, 50 ohms, to actual load).

ALC—DC gain control bias used to regulate PA supply voltage. With the PA power supply at full output voltage, ALC will read about 6.0 volts. When the RF output is being regulated by the RF power control circuit, this voltage will be reduced, typically reading 4 to 5.5 volts. The ALC voltage will be reduced during PA DC overcurrent, SWR, or LOCK fault conditions.

PA DC Volts—Supply voltage of the RF power amplifier.

PA DC Amps—Transistor drain current for the RF power amplifier.

PA DC Temperature—Temperature of the RF power amplifier heatsink in degrees C.

Supply DC Volts—Unregulated DC voltage at the input of the voltage regulators. For battery operation, this reading is the battery voltage minus a diode drop.

Voltmeter—Reads the voltage at a test point located on the front edge of the motherboard. A test lead connected to this point can be used for making voltage measurements in the transmitter. The test point is intended as a servicing aid; an alternative to an external test meter. Remember that the accuracy is only as good as the reference voltage used by the metering circuit. Servicing a fault affected by the reference affects the Voltmeter reading. The metering scale is 0 to 199.9 volts.

3.9 Fault Indicators

Faults are indicated by a blinking red light as follows:

SWR—Load VSWR exceeds 1.5:1. ALC voltage is reduced to limit the reflected RF power.

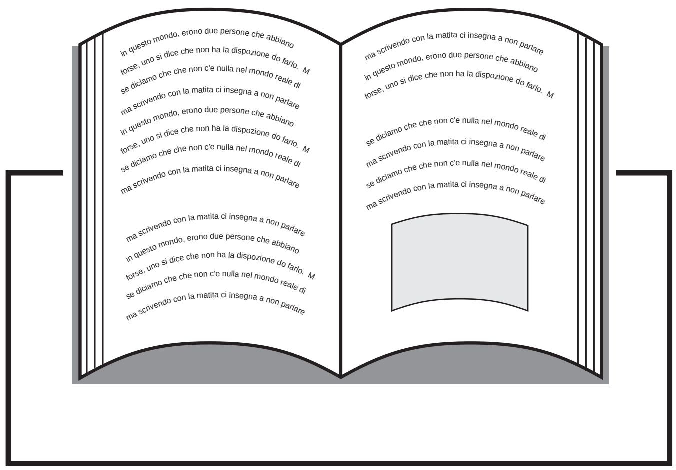
Lock—Frequency synthesizer phase-lock loop is unlocked. This indicator normally blinks for about five seconds at power turn-on. Whenever this light is blinking, supply voltages will be inhibited for the RF driver stage as well as for the RF power amplifier.

Input—The automatic carrier-off circuit is enabled (see sections 2.11 and 2.12) and the absence of a program input signal has exceeded the preset time. (The circuit treats white or pink noise as an absence of a program.)

PA DC—Power supply current for the RF power output amplifier is at the preset limit. ALC voltage has been reduced, reducing the PA supply voltage to hold supply current to the preset limit.

PA Temp—PA heatsink temperature has reached 80–85° C (178–185° F).

At about 83° C (181°F), ALC voltage begins to decrease, reducing the PA supply voltage to prevent a further increase in temperature. By 85° C (185° F), the PA will be fully cut off.



Section 4—Principles of Operation

This section discusses the circuit principles upon which the transmitter functions. This information is not needed for day-to-day operation of the transmitter but may be useful for advanced users and service personnel.

4.1 Part Numbering

As this section refers to individual components, you should be familiar with the part numbering scheme used. Although parts on the various circuit boards and circuit board drawings may be marked with identical reference numbers, each component in the transmitter has a unique part reference number.

The circuit boards and component placement drawings use designators such as "R1", "R2", and "C1." These numbers represent only a portion of the full part numbers (as shown on the schematic). To find the full number, refer to the chart below. R401, for instance, is marked "R1" on the Metering board and on its component placement drawing.

Circuit Name	Part numbers
Audio Processor	0-199
Stereo Generator	200's
RF Exciter/Synthesizer	300's
Metering/Protection	400's
Motherboard	500's
Display	600's
Voltage Regulator	700's
Power Regulator	800's
RF Predriver	900's
Chassis Wiring	1000's
RF Power Amplifier	1100's
RF Low-Pass Filter	1200's

Illustration 4–1 Component Part Numbering

4.2 Audio Processor Circuit Board

The audio processor board provides the audio control functions of a compressor, limiter, and expander. Illustration 6–5 and accompanying schematic may be useful to you during this discussion.

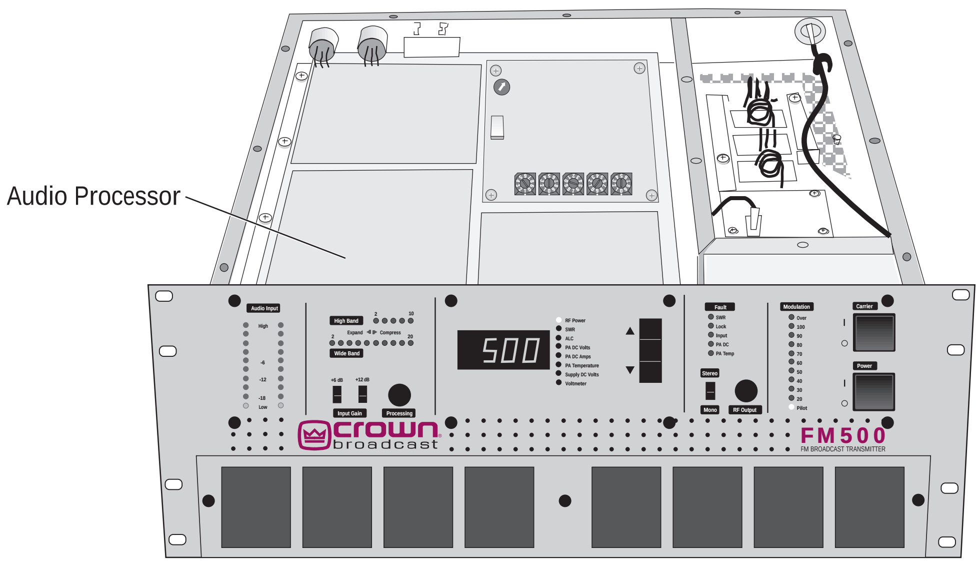


Illustration 4–2 Audio Processor Board

This board also contains the pre-emphasis networks. Reference numbers are for the left channel. Where there is a right-channel counterpart, references are in parenthesis. One processor circuit, the eighth-order elliptical filter, is located on the stereo generator board.

Audio input from the XLR connector on the rear panel of the transmitter goes to differential-input amplifier, U1A (U2A).

Binary data on the +6 dB and +12 dB control lines sets the gain of inverting amplifier U1B (U2B). Analog switch, U3, selects one of four feedback points in 6 dB steps.

The output of U1B (U2B) goes to an eighth-order, elliptical, switched-capacitor, low-pass, 15.2 kHz filter. The filter finds its home on the stereo generator board to take advantage of the ground plane and proximity to the 1.52 MHz clock.

The circuit associated with U4B (U4A), along with R22/C8 (R58/C20), form third-order, low-pass filtering, attenuating audio products below 30 Hz.

The output level of analog multiplier U5 (U6) is the product of the audio signal at pin 13 and the DC voltage difference between pins 7 and 9. At full gain (no gain reduction) this difference will be 10 volts DC.

When either the positive or negative peaks of the output of U5 (U6) exceeds the gain-reduction threshold, U13A generates DC bias, producing broadband gain reduction. Q5 is a precision-matched transistor pair. Q5 and U13B form a log converter, so that a given voltage change produces a given change in gain control dB of U5 (U6). The log conversion ensures uniform level-processing characteristics well beyond the 20 dB control range. The log conversion has an additional benefit; it allows a display of gain control on a linear scale with even distribution of dB.

Q1 (Q2) is a recover/expansion gate with a threshold about 18 dB below the normal program level. The amount of short-term expansion and gain reduction is controlled by R650, located on the front panel display board. (See section 3.5.)

Pre-emphasis, in microseconds, is the product of the capacitance of C10 (C22), multiplied by the gain of U8 (U9), times the value of R31 (R67). For a 75 µsecond pre-emphasis, the gain of U8 (U9) will be about 1.11. Select the pre-emphasis curve (75 µsec, 50 µsec, 25 µsec, or Flat) by jumpering the appropriate pins on header JP1. Use trim pot R29 (R65) to make fine adjustments to the pre-emphasis. (See section 5.1.)

For highband processing, the peak output of U10B is detected and gain-reduction bias is generated, as with the broadband processor. The highband processing, however, shifts the pre-emphasis curve rather than affecting overall gain.

Peak audio voltages are compared to a plus and minus 5 volt reference, U17 and U18. This same reference voltage is used by the stereo generator, metering, and display boards.

For an explanation of on-board adjustments see section 5.1.

4.3 Stereo Generator Circuit Board

The stereo generator board (see Illustration 4–3) generates a composite stereo signal from left and right-channel audio inputs. The component side of the board is mostly a ground plane. Once again, the eighth-order, 15.2 kHz, elliptical, low-pass filters (U201 and U202) are on this board, but belong to the audio processor.

Illustration 6–6 and accompanying schematic complement this discussion.

U207A and Y201 comprise a 7.6 MHz crystal oscillator from which the 19 kHz and 38 kHz subcarriers are digitally synthesized. U207F is a buffer. The 7.6 MHz is divided by 5 in U208A to provide 1.52 MHz at pin 6, used by filters U201 and U202. 3.8 MHz, 1.9 MHz, and 304 kHz are also derived from dividers in U208.

Exclusive-OR gates, U210A and U210B, provide a stepped approximation of a 38 kHz sine wave—a scheme described in the <u>CMOS Cookbook</u> by Don Lancaster (Howard W. Sams &. Co., Inc., Indianapolis, IN, 1978).

With the resistor ratios used, the synthesized sine wave has very little harmonic energy below the 7th harmonic. U210C and D generate the 19 kHz pilot subcarrier. U211 is a dual, switched-capacitor filter, configured as second-order, low-pass filters,

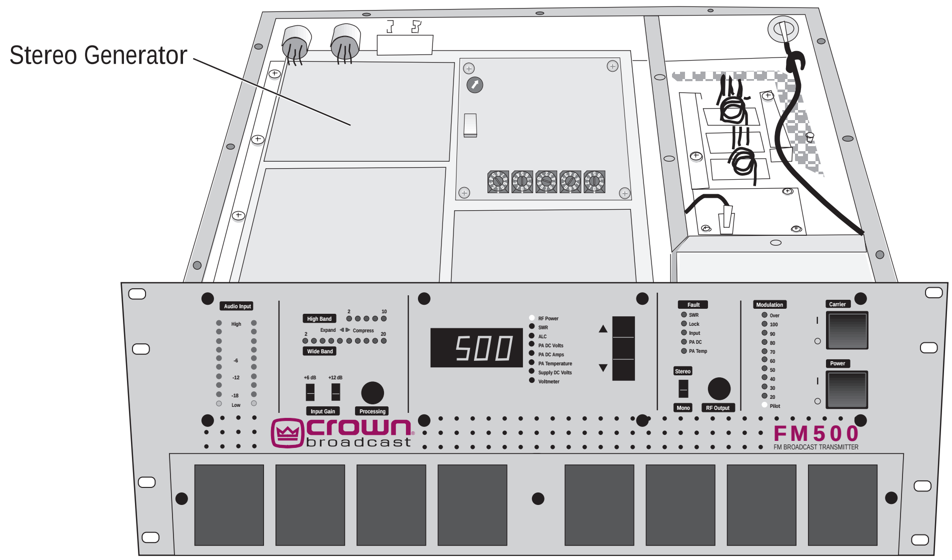


Illustration 4–3 Stereo Generator Board

each with a Q of 5. The 38 kHz and 19 kHz outputs of pins 1 and 20, respectively, are fairly pure sine waves. Harmonic distortion products are better than 66 dB down—THD of less than 0.05%.

U212 is a precision, four-quadrant, analog multiplier. The output of U212 is the product of 38 kHz applied to the “X” input and the difference of left and right audio (L-R signal) applied to the “Y” input. The resulting output is a double sideband, suppressed carrier—the L-R subcarrier.

The SCA subcarrier, the left, right, and left-minus-right subcarriers, and the 19 kHz pilot subcarrier are combined into the composite stereo signal by summing amplifier U206B.

Analog switch U205, at the input of U206B, provides switching of left and right audio for stereo and mono modes. In the mono mode, right channel audio is disabled, and the left channel audio is increased from 45% modulation to 100%.

MON L and MON R outputs go to the AF Monitor jacks on the rear panel. R208+R210 (R220+R222) and C207 (C211) comprise a 75 µsec de-emphasis network. Processed, de-emphasized (75 µsec) samples of the stereo generator input signals are used for a studio monitor and for audio testing. Option jumpers JP203 (JP204) allow you to select 50 µsec.

VR201 and VR202 supply +6 volts and –6 volts, respectively. A 5 volt reference from the audio processor board supplies the subcarrier generators.

For an explanation of on-board adjustments see section 5.2.

4.4 RF Exciter Circuit Board

This board is also known as the Frequency Synthesizer board. The entire component side of the board is a ground plane. Rotary switches along the front edge of the board establish the operating frequency. The VCO (voltage-controlled oscillator) circuitry is inside a shielded cover.

Illustration 6–7 and accompanying schematic can be used as reference in this discussion. The following theory may apply to previous versions of the exciter board, but it is typical of the operation of the current board which has the latest technological improvements.

VCO, VCO61, operates at the synthesizer output frequency of 87 MHz to 108 MHz. The frequency is controlled by voltage-variable capacitors DV71 and DV72. U7A and U7B form an active filter to supply clean DC to the drain of Q71. They also serve as a common-base RF amplifier for Q71. A71 and A1 are hybrid RF amplifiers to provide buffering and gain.

A sample of the RF from the VCO goes to the input of A2. A2 amplifies the signal and feeds it back to the synthesizer IC, U6. This signal, available at pin 4 of U6, may be used with a high frequency receiver for deviation and frequency measurements. (See sections 5.2 and 5.3.)

U6 is a phase-locked-loop frequency synthesizer IC. The 10.24 MHz from the crystal oscillator is used by U6, along with ICs U1 through U3 and the frequency selector switches, to generate the frequencies of the transmitter.

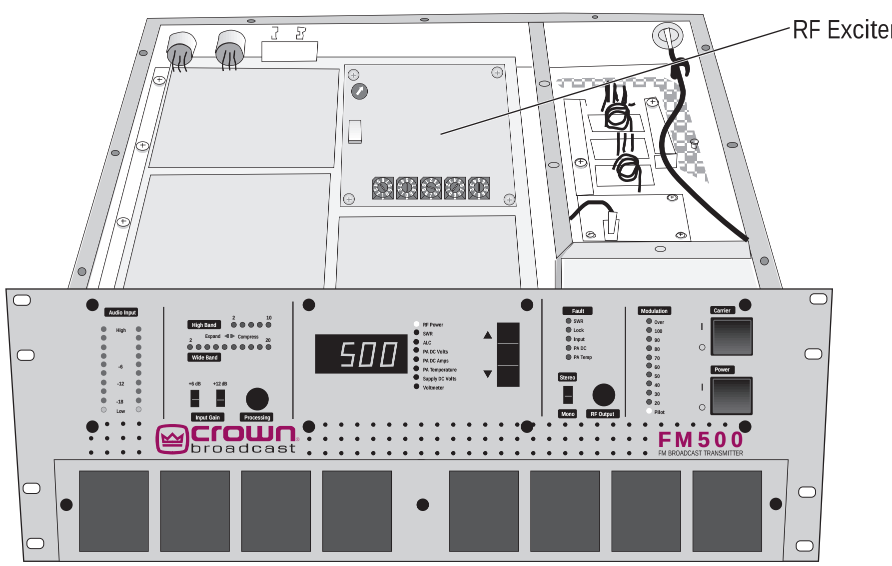


Illustration 4–4 RF Exciter Board

U6 is programmed with the four or five rotary switches. The binary output of the 0.1 MHz switch programs the “A” counter directly. BCD data from the 100’s, tens, and units rotary switches is converted to binary data by U3 to set the “N” counter. An optional fifth digit rotary switch for 10kHz spacing is available.

U5C is a differential amplifier and filter for the error signal. Audio that is out of phase with that appearing on the error voltage is introduced by U5A, allowing for greater loop bandwidth with less degradation of the low-frequency audio response. U5D is an integrator. U5B is a VCO input voltage clamp.

DV71 and DV72 are hyper-abrupt varactor tuning diodes with a square-law capacitance *vs* DC voltage curve, giving a straight-line frequency *vs* voltage curve in a LC oscillator where the varactors are the dominant source of capacitance.

Lock and unlock status signals are available at the outputs of U4E and U4F, respectively. Modulation is introduced to the VCO through R17 and R71 to R75. About 4.1 millivolts across R75 produces 75 kHz deviation.

An FSK signal (used for automatic identification of FM repeaters) shifts the frequencies of the 10.24 MHz crystal reference and the VCO. With keying, diodes D9 and D10, are reverse biased, increasing the crystal reference frequency. At the same time, current through R72 increases the VCO frequency. See section 5.3.4.

4.5 Metering Circuit Board

The ALC and metering circuitry is on the metering board (see Illustration 4–4). This board processes information for the RF and DC metering, and produces ALC (RF level-control) bias. It also provides reference and input voltages for the digital panel meter, voltages for remote metering, fan control, and drive for the front-panel fault indicators.

Illustration 6–8 and accompanying schematic complement this discussion.

PA voltage and current come from a metering shunt on the power regulator board. The PAI input is a current proportional to PA current; R405 converts the current to voltage used for metering and control. A voltage divider from the PAV line is used for DC voltage metering.

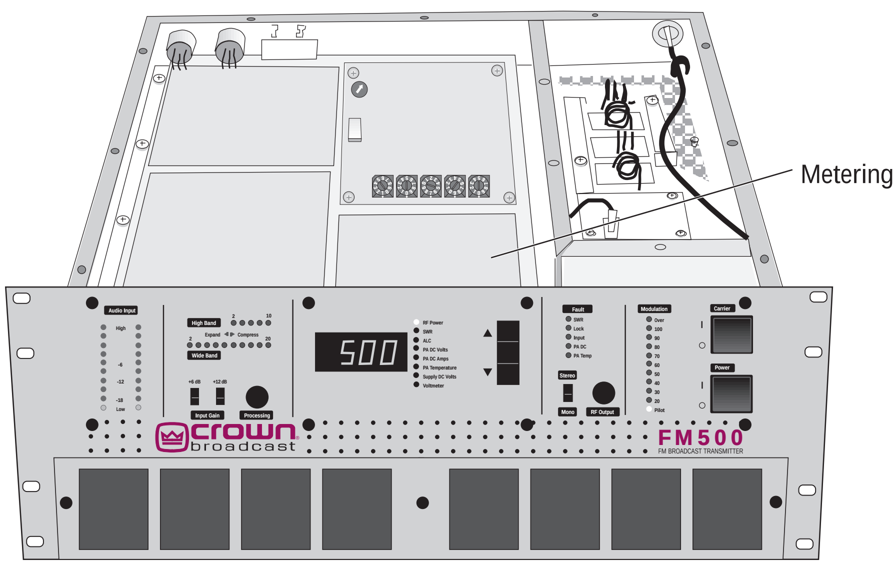


Illustration 4–5 Metering Board

U406A, U406B, and U407A, with their respective diodes, are diode linearity correction circuits. Their DC inputs come from diode detectors in the RF reflectometer in the RF low-pass filter compartment.

U407B, U407C, Q405, and Q406 are components of a DC squaring circuit. Since the DC output voltage of U407C is proportional to RF voltage squared, it is also proportional to RF power.

U404C, U404A, U403A, and U404D are level sensors for RF power, reflected RF power, PA temperature, and external PA current, respectively. When either of these parameters exceeds the limits, the output of U404B will be forced low, reducing the ALC (RF level control) voltage, which, in turn, reduces the PA supply voltage.

The DC voltage setpoint for U404A (reflected RF voltage) is one-fifth that of U404C (forward RF voltage). This ratio corresponds to an SWR of 1.5:1 [(1+.2)/(1–.2)=1.5]. The U405 inverters drive the front panel fault indicators.

To get a direct reading of SWR, the reference input of the digital panel meter is fed from a voltage proportional to the forward-minus-reflected RF voltage, while forward-plus-reflected is fed to the digital panel meter input. The panel meter provides the divide function.

U408 & U409 function as data selectors for digital panel meter input and reference voltages. Binary select data for U408 & U409 comes from the display board.

The output voltage of U403D goes positive when the temperature exceeds about 35 degrees C (set by R426) providing proportional fan control.

When the Carrier switch is off or the RF power is less than about 5 watts, the SWR automatically switches to a calibrate-check mode. U406C provides a voltage that simulates forward power, while Q403 shunts any residual DC from the reflected-power source. The result is a simulation of a 1.0 to 1 SWR. (See section 5.4.)

4.6 Motherboard

The motherboard is the large board in the upper chassis interconnecting the audio processor, stereo generator, RF exciter, and metering boards. The motherboard eliminates the need for a wiring harness, and provides input/output filtering, test points, and modular customization.

Motherboard components are passive with the exception of the fan driver transistor, power FET Q501.

With Normal-Bypass slide switch SW501, it is possible to bypass the audio processor, connecting the left and right audio inputs directly to the inputs of the stereo generator.

CAUTION

In the BYPASS position, the pre-emphasis circuits and the filters that protect the pilot and stereo subcarrier are bypassed. As a result, the occupied bandwidth specifications of the transmitter could be compromised. The 15–Hz high-pass filters are also bypassed which may mean that modulation with frequencies below 10 Hz could cause the frequency synthesizer to unlock.

If the audio source is already processed, and further processing is not desired, use the Normal mode instead of Bypass and turn the Processing control on the front panel to “0”.

If it is necessary to provide resistive terminations at the audio inputs (either line-to-line or line-to-ground), you may place resistors directly into the 8–pin DIP socket, A501, located between the XLR input connectors. See Illustration 6–9 and accompanying schematic for the socket pin-out.

4.7 Display Circuit Board

The front-panel LEDs, the numeric display, the slide switches, and the processing and RF level controls are mounted on the display circuit board. To access the component side of the board, remove the front panel by removing 12 screws. The board contains circuits for the digital panel meter, modulation peak detector, and LED display drivers, as well as indicators and switches mentioned above.

Illustration 6–10 and accompanying schematic complement this discussion.

Left and right audio from input stages of the audio processor board (just after the Input Gain attenuator) go to the L VU and R VU input on the display board. Peak rectifiers U601A and U601B drive the left and right Audio Input displays. The LED driver gives a 3 dB per step display. The lowest step of the display driver is not used; rather a red LOW indicator lights when audio is below the level of the second step. Transistors Q601 and Q602 divert current from the LOW LEDs when any other LED of the display is lit.

Resolution of the linear displays, High Band, Wide Band, and Modulation, has been improved using dither enhancement. With dither, the brightness of the LED is controlled by proximity of the input voltage relative to its voltage threshold. The effect is a smooth transition from step to step as input voltage is changed. U606A, U606B, and associated components comprise the dither generator. Dither output is a triangular wave.

Composite stereo (or mono) is full-wave detected by diodes D605 and D606. U607, U613, Q603, and Q604 are components of a peak sample-and-hold circuit.

Oscillator, U609F, supplies a low-frequency square wave to the Fault indicators, causing them to flash on and off.

Digital multimeter inputs are selected with push buttons located to the right of the multimeter menu. Signals from the push buttons are conditioned by U609A and U609B. U610 is an up/down counter. Binary input to U611 from U610 selects a green menu indicator light, and lights the appropriate decimal point on the numeric readout. The binary lines also go to analog data selectors on the ALC/ metering board.

Processing control, R650, is part of the audio processor. (See section 4.2.)

The DPM IN and DPM REF lines are analog and reference voltage inputs to digital multimeter IC U612. They originate from analog data selectors on the ALC/ metering board.

4.8 Voltage Regulator Circuit Board

The voltage regulator board is the longer of two boards mounted under the chassis toward the front of the unit. It has switch-mode voltage regulators to provide +12, –12, and 24 volts. It also contains the program detection and automatic carrier control circuits.

Illustration 6–11 and accompanying schematic complement this discussion.

U703E and U703F convert a 38 kHz sine wave from the stereo generator into a synchronization pulse. In the transmitter, synchronization is not used, thus D709 is omitted.

U704 and U705 form a 24 volt switching regulator running at about 35 kHz. U704 is used as a pulse-width modulator; U705 is a high-side driver for MOSFET switch Q701. Supply voltage for the two IC's (approximately 15.5 volts) comes from linear regulator DZ702/Q705. Bootstrap voltage, provided by D710 and C714, allows the gate voltage of Q701 to swing about 15 volts above the source when Q701 is turned on. Current through the FET is sensed by R738 and R738A. If the voltage between pin 5 and 6 of U705 exceeds 0.23 volts on a current fault, drive to Q701 is turned off. Turn-off happens cycle by cycle. The speed of the turn-off is set by C713.

U706 is a switching regulator for both +12 volts and –12 volts. It runs at about 52 kHz. Energy for –12 volts is taken from inductor L702 during the off portion of the switching cycle. The –12 volts tracks the +12 volts within a few tenths of a volt. There will be no –12 volts until current is drawn from the +12 volts.

Q702, Q703, and Q704 form an active filter and switch, supplying DC voltage to the RF driver, when the Carrier switch is on.

The program detection circuit is made up of U701 and U702. U701A and U701D and associated circuitry discriminate between normal program material and white noise (such as might be present from a studio-transmitter link during program failure) or silence. U701A and surrounding components form a band-pass filter with a Q of 3 tuned to about 5 kHz. U701D is a first-order low-pass filter. Red and green LEDs on the board indicate the presence or absence of program determined by the balance of the detected signals from the two filters. U702 and U701C form a count-down timer. The time between a program fault and shutdown is selected by jumpering pins on header JP701. For times, see section 5.7. The times are proportional to the value of R721 (that is, times can be doubled by doubling the value of R721).

4.9 Power Regulator Circuit Boards

The power regulator boards are the two boards mounted under the chassis on either side of a pair of 15,000 µf filter capacitors toward the front of the unit. Each board has the switch-mode voltage regulator for a RF power amplifier, and circuitry for PA supply current metering.

Illustration 6–12 and accompanying schematic complement this discussion.

Diode D804, in series with the battery input, together with the AC-supply diode bridge, provides diode OR-ing of the AC and DC supplies.

U801 and U802 form a switching regulator running at about 35 kHz. U801 is used as a pulse-width modulator; U802 is a high-side driver for MOSFET switch Q801. Power for the two IC's comes from the 24 volt supply voltage for the RF driver (available when the Carrier switch is on). The voltage is controlled at 16 volts by zener diode DZ801. Bootstrap voltage provided by D802 and C809 allows the gate voltage of Q801 to swing about 16 volts above the source when Q801 is turned on. Current through the FET is sensed by R812 and R812A. If the voltage from pin 5 to 6 of U802 exceeds 0.23 volts on a current fault, drive to Q801 is turned off. This happens on a cycle-by-cycle basis. The speed of the turnoff is set by C805.

In the transmitter, synchronization is not used, thus D801 is omitted.

U803 and Q802 are used in a circuit to convert the current that flows through metering shunt, R819, into a current source at the collector of Q803. Forty millivolts is developed across R819 for each amp of supply current (.04 ohms x 1 amp). Q803 is biased by U803 to produce the same voltage across R816. The collector current of Q803 is the same (minus base current) as that flowing through R822 resulting in 40 microamperes per amp of shunt current. R405 on the metering board converts Q803 collector current to 0.1 volt per amp of shunt current (.04 ma X 2.49 k). (See section 5.4.)

4.10 RF Driver

The RF Driver module is mounted next to the heat sinks on the bottom of the RF Amplifier/Combiner sub chassis. The driver amplifies the approximate 20 milliwatts from the frequency synthesizer to about 15 watts to drive the RF power amplifiers. A CA2832 hybrid, high-gain, wideband amplifier, operating at about 20 volts, provides about one watt of drive to a single MRF137 MOSFET amplifier. The MRF137 stage operates from a supply voltage of approximately 15 to 16 volts.

The circuit board has components for input and output coupling and for power supply filtering.

4.11 RF Amplifier

The two RF power amplifier modules are mounted on a combiner board, heat sink, slide rail assembly which slides into the main chassis at the rear, and is fastened to the back panel with six screws. RF power, DC power, and control voltages enter the PA assembly through a 72–pin edge connector that it slides into at the front of the chassis.

The amplifier is built around two Phillips BLF278, dual-power MOSFETs rated for 50 volts DC and a maximum power of about 300 watts. When biased for class B, the transistor has a power gain of 20 dB. (It is biased below class B in the transmitter.)

Input transformer, T1111, is made up of two printed circuit boards. The four-turn primary board is separated from the one-turn secondary by a thin dielectric film. R1112–R1117 are for damping. Trim pot R1111 sets the bias.

Output transformer, T1121, has a one-turn primary on top of the circuit board and a two-turn secondary underneath. Inductors L1121 and L1122 provide power line filtering.

The amplifiers are surrounded by a 50 Ω impedance, input/output combiner board which takes the 15 watts input and divides it equally to each power amp. Then the output from each amplifier is combined to form a single output.

4.12 Chassis

The AC power supply components, as well as the bridge rectifier and main filter capacitor are mounted on the chassis. Changing the jumpers on the AC distribution board (located beside the transformer assembly on the bottom of the transmitter), configures the power transformer for 100, 120, 220, or 240 VAC; see section 2.2 for switching and fuse information. The board also includes MOV voltage-surge suppressors and in-rush current limiters as well as a 12 volt power supply for the PA assembly cooling fans.

The main energy-storage/filter capacitors are located between the two power regulator boards. The DC voltage across each capacitor will be 65 to 70 volts when the carrier is on.

⚠ WARNING

Shock hazard!

Do not attempt to short the capacitor terminals. A bleeder resistor will discharge the capacitor in approximately one minute after shutdown.

4.13 RF Output Filter & Reflectometer

The RF low-pass filter/reflectometer are located beside the motherboard in the right-hand compartment on the top of the chassis. See Illustration 6–14 and accompanying schematic for more information.

A ninth-order, elliptic, low-pass filter attenuates harmonics generated in the power amplifier. The capacitors for the filter are circuit board pads.

The reflectometer uses printed circuit board traces for micro-strip transmission lines. Transmission line segments (with an impedance of about 82 ohms) on either side of a 50 ohm conductor provide sample voltages representative of the square root of forward and reverse power.

DC voltages, representative of forward and reflected power, go through a bulkhead filter board to the motherboard, then to the metering board, where they are processed for power control, metering, and for SWR metering and protection.

4.15 Receiver Circuit Board Option

This option allows the transmitter to be used as a translator. The receiver board receives terrestrially fed RF signal and converts it to composite audio which is then fed into the exciter board. Microprocessor controlled phase lock loop technology ensures the received frequency will not drift, and multiple IF stages ensure high adjacent channel rejection. Refer to illustrations 4–6, 6–16 and its schematic for the following discussion.

The square shaped metal can located on the left side of the receiver board is the tuner module. The incoming RF signal enters through the BNC connector (top left corner) and is tuned through the tuner module. Input attenuation is possible with jumper J1 on the top left corner of the receiver board. Very strong signals can be attenuated 20 dB automatically by placing the jumper on the left two pins (“LO” position). An additional 20 dB attenuation is also available with the jumpers in the top left corner of the board. The frequencies are tuned by setting switches SW1 and SW2 (upper right corner). These two switches are read upon power up by the microprocessor (U4). The microprocessor then tunes the synthesizer IC SA1057 (U3) to the selected frequency. The switches frequency range is 87.9 Mhz at setting “00” to 107.9 Mhz at setting “64”. Other custom ranges are available.

The synthesizer chip works on a phase lock loop system. It receives the frequency information from pin 6 of the tuner module, then goes through a FET buffer amplifier (Q2) on its way to synthesizer IC (U3). The synthesizer feeds back a DC voltage through two resistors to pin 4 of the tuner module. Different frequencies cause different tuning voltages to go to the tuner module to tune it on frequency. The frequency synthesizer locks on to the exact frequency needed and adjusts the DC voltage accordingly. The microprocessor tunes the frequencies of the synthesizer IC, but the DC tuning voltage is somewhat dependent on the tuner module.

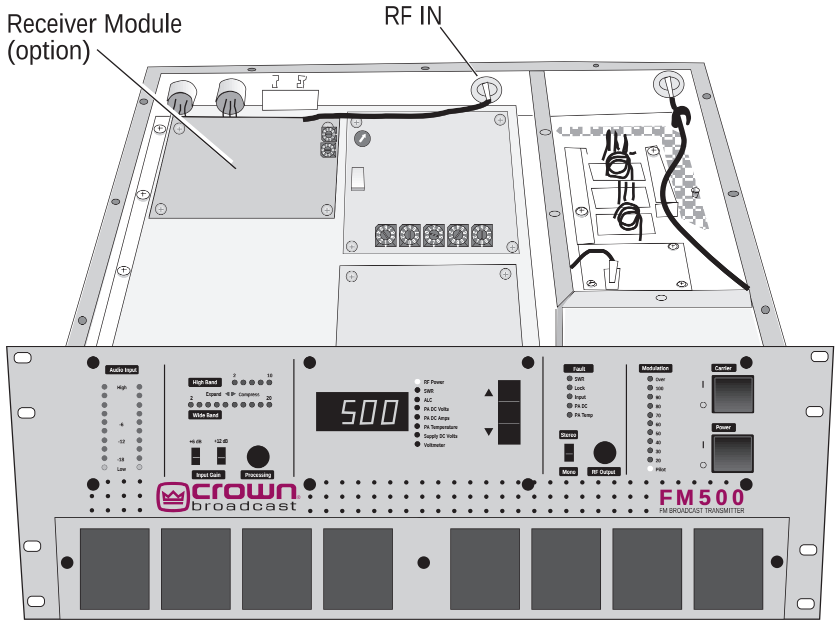


Illustration 4–6 Receiver Board (optional)

Generally, the voltage is around 0.5 volt DC for tuning 88.1 MHz, and from 5.5 to 6.5 volts DC for tuning 107.9 MHz. The 10.7 MHz IF frequency comes out of the tuner module on pin 5 and is coupled into the first filter FL1; passes through FL1 and into the IF decoder system of IC LM1865 (U1). The FL1 filter sets the bandwidth or everything outside of the bandwidth depending on the filter that is selected. It could be a bandwidth of 180 kHz where everything outside of that is filtered out depending on the filter characteristics. A second filter (F3) is available when the signal has a great amount of interference from an adjacent signal. In such a case, remove the jumper cap that is in the F3 position, then remove the ceramic filter that is in the F4 storage position and place it into the F3 position.

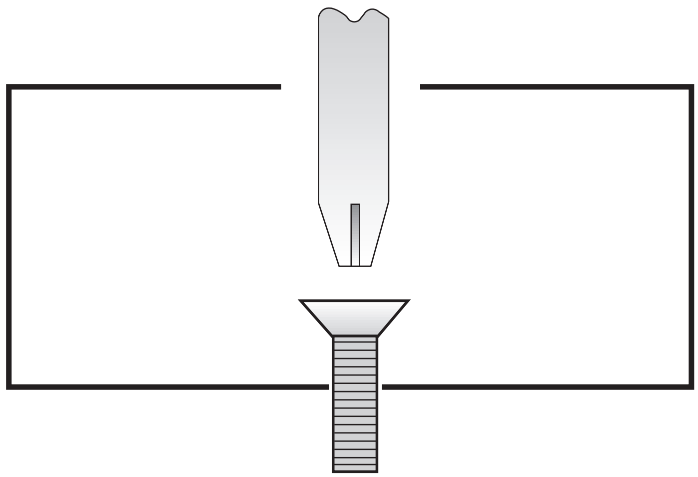
Then the signal goes to a buffer gain stage at pin 1 of LM1865 (U1). From there the signal passes through F2, which is a second filter for further removal of unwanted products, and then it goes on to the IF of that chip. The quadrature coil L4 is tuned to 10.7 MHz as per calibration procedures. This results in a low distortion of around 0.2 to 0.3% on the audio. The audio, still a composite at this point, will come out of pin 15 of that IC (U1) and go to the first buffer U9. Then it goes through a compensation network R54 and C26, and on to the stereo decoder chip at pin 2 of U5.

When a stereo signal is present, Led 1 illuminates which indicates that left and right audio is available. Then the stereo signals go to gain stages U6A and U6B and out to the RCA jacks on the back of the cabinet. These can be used for off-air monitoring of the audio signal. Incoming frequency can be monitored from the frequency monitor BNC jack on the back. The stereo buffer U9, stereo decoder U5, and gain stages U6A and U6B have no effect on the signal that goes through the transmitter. This section along with the composite signal coming out of pin 15 of LM1865 (U1) is totally separate from the transmitter section.

A muting circuit, consisting of C22, a 1N914 diode, R14, and varible resistor R15 mutes the output when a signal is too weak to be understood. The strength of the signal muted is determined by the adjustment of R15. Any signal below the setting of R15 is shorted to +VCC through C22 by the current drawn through R14 and the diode. The audio signal above this setting goes through C17 to the connector P3.

The P3 connector block allows jumpering to either internal circuitry or to external signal processing such as advertisement injection or other forms of altering the signal. If the jumper is installed for internal circuitry, the signal will go through R39 to the input of U2A. This is a buffer that drives the R20 pot located on the top left hand corner of the board. R20 sets signal gain for 100% modulation if adjusted correctly with a full incoming 75 kHz deviation signal. Then the signal goes through R21, R22, and C20 which, along with adjustable pot R24 and C21, forms a compensation network with some phase shifting. This allows the best stereo separation possible by adjusting and compensating for differences in FM exciter boards. The signal is buffered through U2B and finally reaches the output connectors P1 and P2, and on to the transmit circuitry.

The power supply is fairly straight forward. The incoming 12 volt supply goes to a 7809, 9 volt regulator (VR1) which supplies all 9–volt needs on the board. The 9 volts also supplies a 7805, 5 volt regulator (VR2) which supplies all 5–volt needs on the board. Plus and minus 12 volts from the motherboard is filtered and supplies various needs on the board. Finally there is a precision reference voltage supplied through R50 by U7 and U8. These two 2.5 volt reference shunts act very much like a very accurate zenor diode to provide precision 5 volts to the metering board.



Section 5—Adjustments and Tests

This section describes procedures for (1) advanced users who may be interested in customizing or optimizing the performance of the transmitter and (2) service personnel who want to return the transmitter to operational status following a maintenance procedure.

5.1 Audio Processor Adjustments

5.1.1 Pre-Emphasis Selection

Select the pre-emphasis curve (75 µsec, 50 µsec, 25 µsec, or Flat) by jumpering the appropriate pins of header JP1 on the audio processor board. (See section 2.9.) If you change the pre-emphasis, change the de-emphasis jumpers, JP203 and JP204 on the Stereo Generator board, to match. (See section 2.8.)

5.1.2 Pre-Emphasis Fine Adjustment

Trim potentiometers, R29 and R65, (for left and right channels, respectively) provide for fine adjustment of the pre-emphasis. Set the potentiometers to bring the de-emphasized gain at 10 kHz equal to that of 400 Hz. (At the proper setting, 15.0 kHz will be down about 0.7 dB.)

When making these adjustments, it is important that you keep signal levels below the processor gain-control threshold.

A preferred method is to use a precision de-emphasis network in front of the audio input. Then, use the non-de-emphasized (flat) output from the FM modulation monitor for measurements.

5.2 Stereo Generator Adjustments

5.2.1 Separation

Feed a 400 Hz sine wave into one channel for at least 70% modulation. Observe the classic single-channel composite stereo waveform at TP1 on the RF Exciter circuit board. Adjust the Separation control for a straight centerline.

Since proper adjustment of this control coincides with best stereo separation, use an FM monitor to make or confirm the adjustment.

5.2.2 Composite Output

Adjust the composite output with a modultion monitor following the steps below:

1. Set the Stereo-Mono switch to Mono.
2. Check that the setting of the Modulation compensation control, R17 on the RF Exciter circuit board, falls within the range specified for the frequency of operation. (See section 2.3.1.)
3. Feed a sine wave signal of about 2.5 kHz into the left channel at a level sufficient to put the wideband gain-reduction indicator somewhere in the middle of its range.
4. Set the Composite level control to produce 90% modulation as indicated on an FM monitor.
5. Apply pink noise or program material to the audio inputs and confirm, on both Mono and Stereo, that modulation peaks are between 95% and 100%.

5.2.3 19 kHz Level

Adjust the 19 kHz pilot for 9% modulation as indicated on an FM modulation monitor. (The composite output should be set first, since it follows the 19 kHz Level control.)

5.2.4 19 kHz Phase

1. Apply a 400 Hz audio signal to the left channel for at least 70% modulation.
2. Look at the composite stereo signal at TP301 on the RF Exciter circuit board with an oscilloscope, expanding the display to view the 19 kHz component on the horizontal centerline.
3. Switch the audio to the right-channel input. When the 19 kHz Phase is properly adjusted, the amplitude of the 19 kHz will remain constant when switching between left and right.
4. Recheck the separation adjustment as described in section 5.2.1.

5.3 Frequency Synthesizer Adjustments

5.3.1 Frequency (Channel) Selection

Refer to section 2.3.

5.3.2 Modulation Compensator

Refer to section 2.3.

5.3.3 Frequency Measurement and Adjustment

Next to the 10.24–MHz crystal on the RF Exciter board is a 1–11 pF piston trimmer capacitor (C3). Use C3 to set the frequency of the 10.24–MHz crystal while observing the output frequency of the synthesizer.

Use one of these methods for checking frequency:

❑ Use an FM frequency monitor.

❑ Couple a frequency counter of known accuracy to the output of the synthesizer and observe the operating frequency. (Do not connect to the 10.24–MHz clock circuit.)

5.3.4 FSK Balance Control

An FSK signal (used for automatic identification of FM repeaters) shifts the frequencies of the 10.24–MHz crystal reference oscillator and the VCO.

Use an oscilloscope to observe the cathode end of D4. With no program, the pulse will be less than 1 µsec wide. With an FSK input (a 20–Hz square wave at the FSK input will work), set trim pot R45 for minimum pulse width.

The setting will vary slightly with operating frequency.

5.4 Metering Board Adjustments

5.4.1 Power Calibrate

While looking at RF Power on the digital panel meter, set the Power Calibrate trim potentiometer to agree with an external RF power meter.

5.4.2 Power Set

With the front panel RF Output control fully clockwise, adjust the Power Set trim pot to 10% more than the rated power (33 W for FM30, 110 W for FM100, 275 W for FM250, 550 W for FM500) as indicated on an accurate external watt meter. If the authorized power is less than the maximum watts, you may use the Power Set to limit the range of the RF Output control. Operation below 100 watts is not recommended as instability can occur which could damage the transmitter.

CAUTION

Possible equipment damage!

Operation below 100 watts can cause oscillations and other problems that could damage the transmitter.

5.4.3 SWR Calibrate

When the Carrier switch is off, or the RF power is less than about 5 watts, the SWR circuit automatically switches to a calibrate-check mode. (See section 4.5 for more information.)

Set the digital panel meter to read SWR. With the Carrier switch off, set the SWR CAL trim pot to read 1.03.

5.4.4 PA Current Limit

Since it may not be practical to increase the PA current to set the PA Current Limit control, you may use this indirect method.

With the carrier turned off, look at the DC voltage at the right end of R413 on the Metering board. The current limit, in amperes, will be 0.35 amps higher than ten times this voltage. Set the current limit for 16.5 amps or 1.615 volts at R413.

5.5 Motherboard Adjustments

For Normal-Bypass switch setting, see section 2.10.

5.6 Display Modulation Calibration

The Modulation Calibrate trim pot sets the sensitivity of the front panel Modulation bar graph display.

This adjustment may be made only after the Output trim pot on the Stereo Generator board has been set. (See section 5.2.4.)

1. Set the Stereo-Mono switch to Mono.
2. Feed a sine wave source of about 2.5 kHz into the left channel at a level sufficient to put the wideband gain-reduction indicator somewhere in the middle of its range.
3. Set the Modulation Calibrate trim pot so that the “90” light on the front panel Modulation display just begins to light.

5.7 Voltage Regulator Adjustments

JP701, a 10–pin header on the Voltage Regulator board, sets the time between program failure and carrier turnoff. Pins 1 and 2 are the two pins closest to the edge of the board. The times are approximate. Sections 2.11, 2.12, and 4.8 contain further information.

1. Short pins 1 and 2 for a 30–second delay.
2. Short pins 3 and 4 for a 2–minute delay.
3. Short pins 5 and 6 for a 4–minute delay.
4. Short pins 7 and 8 for an 8–minute delay.

You may select other times by changing the value of R721. The time is proportional to the resistance.

5.8 Bias Set (RF Power Amplifier)

The Bias Set trim pot is located on the PA module on the input circuit board. Set the trim pot to its midpoint for near-optimum bias.

5.9 Performance Verification

Measure the following parameters to receive a comprehensive characterization of transmitter performance:

- ❑ Carrier frequency
- ❑ RF output power
- ❑ RF bandwidth and RF harmonics (see section 5.12)
- ❑ Pilot frequency, phase, and modulation percentage
- ❑ Audio frequency response
- ❑ Audio distortion
- ❑ Modulation percentage
- ❑ FM and AM noise
- ❑ Stereo separation between left and right
- ❑ Crosstalk between main channel and subcarrier
- ❑ 38–kHz subcarrier suppression

In addition to the above tests, which pertain to signal quality, a complete check of the unit will include items listed in section 5.21.

5.9.1 Audio Proof-of-Performance Measurements

References to “100%” modulation assume 9% pilot and 91% for the remainder of the composite stereo signal.

Because the audio processing threshold is at 90% modulation, it is not possible to make audio proof-of-performance measurements at 100% modulation through the audio processor. Instead, audio data for 100% modulation is taken from the input of the stereo generator (SW501 on Motherboard set for Bypass). Then, data, including the audio processor (SW501 set for Normal), is taken at a level below the audio processing threshold.

5.9.2 De-emphasis Input Network

A precision de-emphasis network, connected between the test oscillator and the audio input of the transmitter, can be very helpful when making the audio measurements. Note that the input impedance of the transmitter or the source impedance of the test oscillator can affect network accuracy. With the de-emphasis network, oscillator level adjustments need only accommodate gain errors, instead of the whole pre-emphasis curve.

5.10 Carrier Frequency

Carrier frequency is measured at the output frequency with a frequency monitor or suitable frequency counter.

To adjust frequency, see section 5.3.3. (FCC tolerance +/– 2000 Hz per FCC Part 73.1540 and 73.1545.)

5.11 Output Power

The output power reading on the front panel display should be 90–105% of the actual value. For a more precise measurement, use a watt meter in the RF output line. See sections 5.4.1 and 5.4.2 for setting power.

5.12 RF Bandwidth and RF Harmonics

You can observe RF bandwidth and spurious emissions with an RF spectrum analyzer.

In the Stereo mode, feed a 15.0 kHz audio signal into one channel to provide 85% modulation as indicated on a monitor. Doing so produces 38% main, 38% stereo subcarrier, and 9% pilot per FCC Part 2.989. As an alternative, use pink noise into one channel.

Using a spectrum analyzer, verify the following (per FCC 73.317):

1. Emissions more than 600 kHz from the carrier are at least 43 + 10log(power, in watts) dB down (70 dB for 500 watts). The scan should include the tenth harmonic.
2. Emissions between 240 kHz and 600 kHz from the carrier are down at least 35 dB.
3. Emissions between 120 kHz and 240 kHz from the carrier are down at least 25 dB.

5.13 Pilot Frequency

The pilot frequency should be within 2 Hz of 19 kHz. (FCC Part 73.322.) Using a frequency counter, measure 1.9 MHz at pin 1 of U209 on the Stereo Generator board. A 200-Hz error here corresponds to a 2-Hz error at 19 kHz. If the frequency is off by more than 50 Hz, you may change the value of C213. (Changing C213 from 56 pF to 68 pF lowers the 1.9 MHz by about 35 Hz.)

5.14 Audio Frequency Response

For the response tests, take the readings from an FM modulation monitor.

Make audio frequency response measurements for left and right channels at frequencies of 50 Hz, 100 Hz, 400 Hz, 1 kHz, 5 kHz, 10 kHz, and 15 kHz. See sections 5.9.1 and 5.9.2.

5.15 Audio Distortion

Make distortion measurements from the de-emphasized output of an FM modulation monitor.

Make audio distortion measurements for left and right channels at frequencies of 50 Hz, 100 Hz, 400 Hz, 1 kHz, 5 kHz, 10 kHz, and 15 kHz. See sections 5.9.1 and 5.9.2.

5.16 Modulation Percentage

While feeding an audio signal into the left channel only, confirm that the total modulation percentage remains constant when switching between Mono and Stereo.

Measure modulation percentage with an FM modulation monitor, or by using an HF receiver and Bessel nulls. See section 5.2.2.

19–kHz pilot modulation should be 9%.

5.17 FM and AM Noise

Take noise readings from a de-emphasized output of a modulation monitor.

5.18 Stereo Separation

Make left-into-right and right-into-left stereo separation measurements with an FM modulation monitor for frequencies of 50 Hz, 100 Hz, 400 Hz, 1 kHz, 5 kHz, 10 kHz, and 15 kHz.

5.19 Crosstalk

For stereo crosstalk measurements, both left and right channels are fed at the same time. For best results, there needs to be a means of correcting small imbalances in levels and phase. The balance is made at 400 Hz.

5.19.1 Main Channel Into Sub

Feed the left and right channels in phase with audio (L+R) at 50 Hz, 100 Hz, 400 Hz, 1 kHz, 5 kHz, 10 kHz, and 15 kHz at 100% modulation, while observing the stereo subcarrier (L-R) level on an FM modulation monitor.

5.19.2 Sub Channel Into Main

Feed the audio into the left and right channel as above, with the exception of reversing the polarity of the audio of one channel (L-R input). Using the frequencies of 5.19.1 above, observe the main channel (L+R) level with a modulation monitor.

5.20 38 kHz Subcarrier Suppression

With no modulation, but in the Stereo mode, the 38 kHz subcarrier, as indicated on an FM modulation monitor, should be down at least 40 dB.

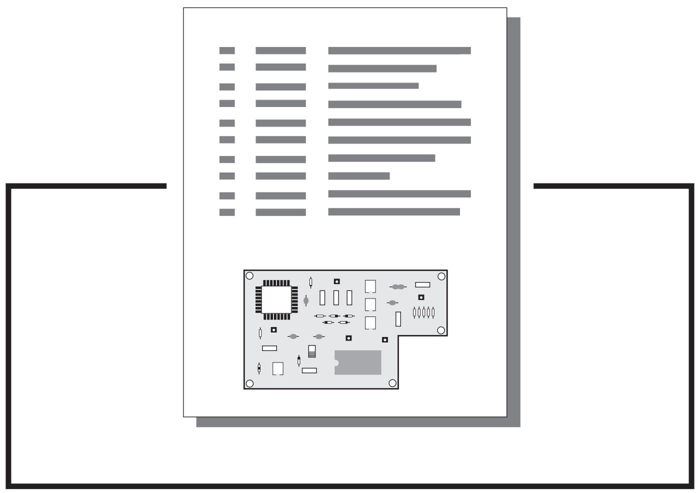
5.21 Additional Checks

In addition to the tests and adjustments mentioned in this section, the following checks ensure a complete performance appraisal of the transmitter:

1. Perform a physical inspection, looking for visible damage and checking that the chassis hardware and circuit boards are secure.
2. Check the functionality of switches and processing control.
3. Verify that all indicators function.
4. Check the frequency synthesizer lock at 80 MHz and 110 MHz.
5. Measure the AC line current with and without the carrier on.
6. Perform a functional test of the SCA input, Monitor outputs, and the monitor and control function at the 15–pin, D-sub connector.
7. Test the functionality of the FSK circuit.
8. Check the operation and timing of the automatic carrier-off circuitry associated with program failure.
9. Check all metering functions.
10. Test ALC action with PA current overload, SWR, and PLL lock.

NOTE:

FCC type acceptance procedures call for testing the carrier frequency over the temperature range of 0–50 degrees centigrade, and at line voltages from 85% to 115% of rating. (See FCC Part 2.995.)



Section 6—Reference Drawings

The illustrations in this section may be useful for making adjustments, taking measurements, troubleshooting, or understanding the circuitry of your transmitter.

6.1 Views

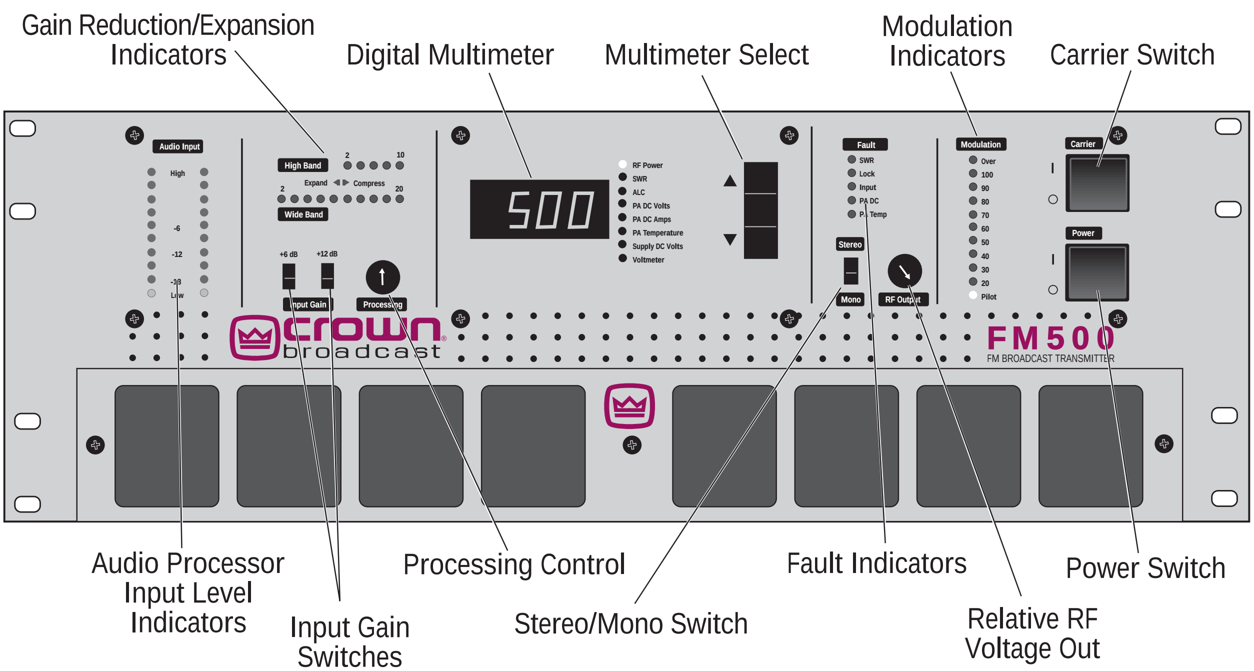


Illustration 6–1 Front View

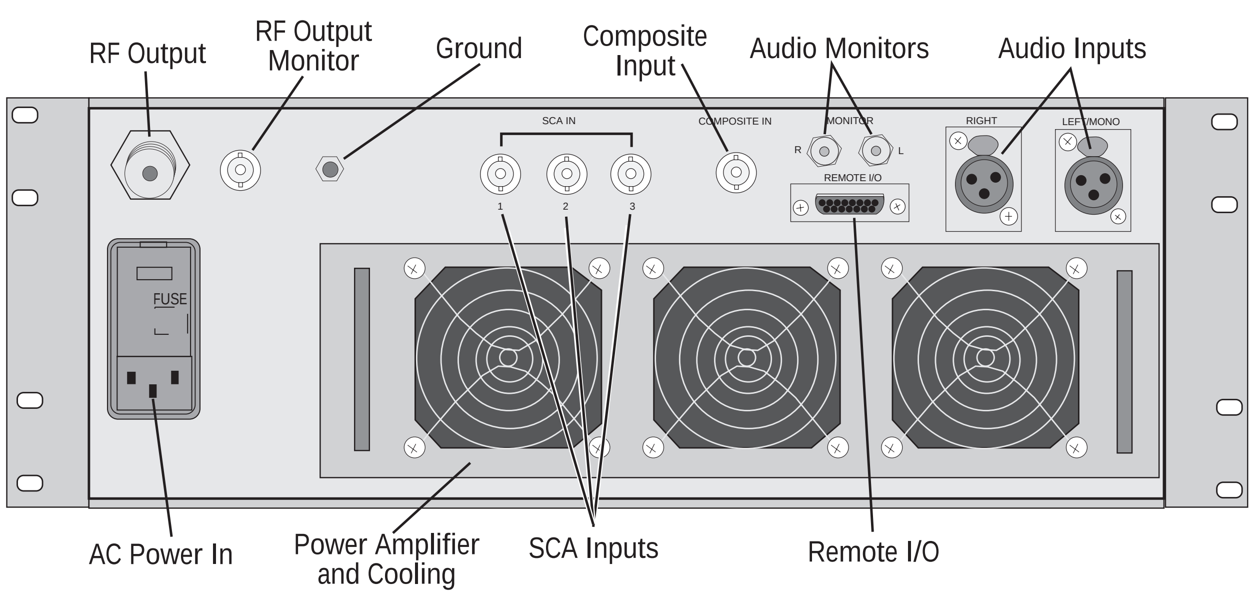


Illustration 6–2 Rear View

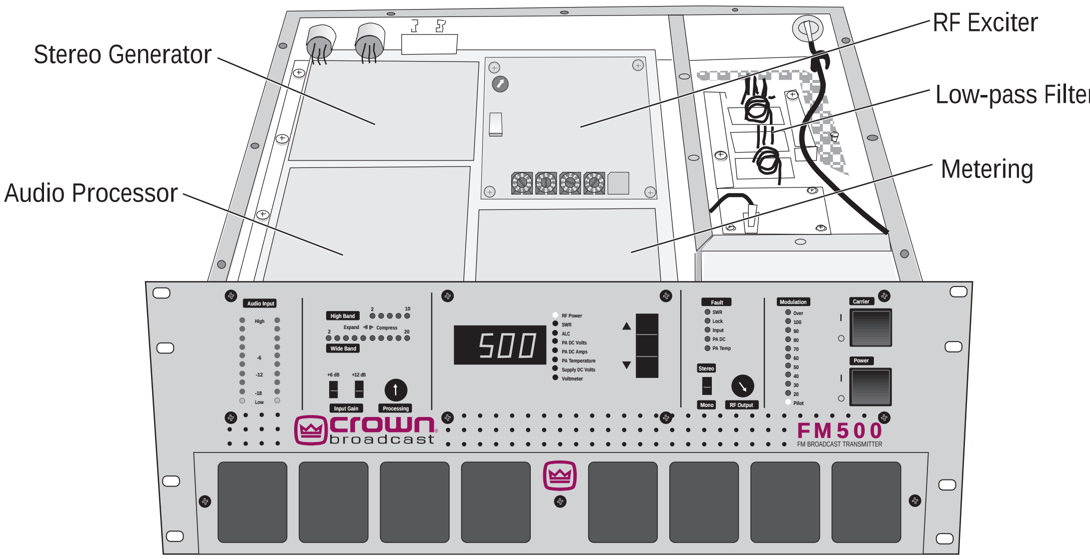


Illustration 6–3 Chassis Top View

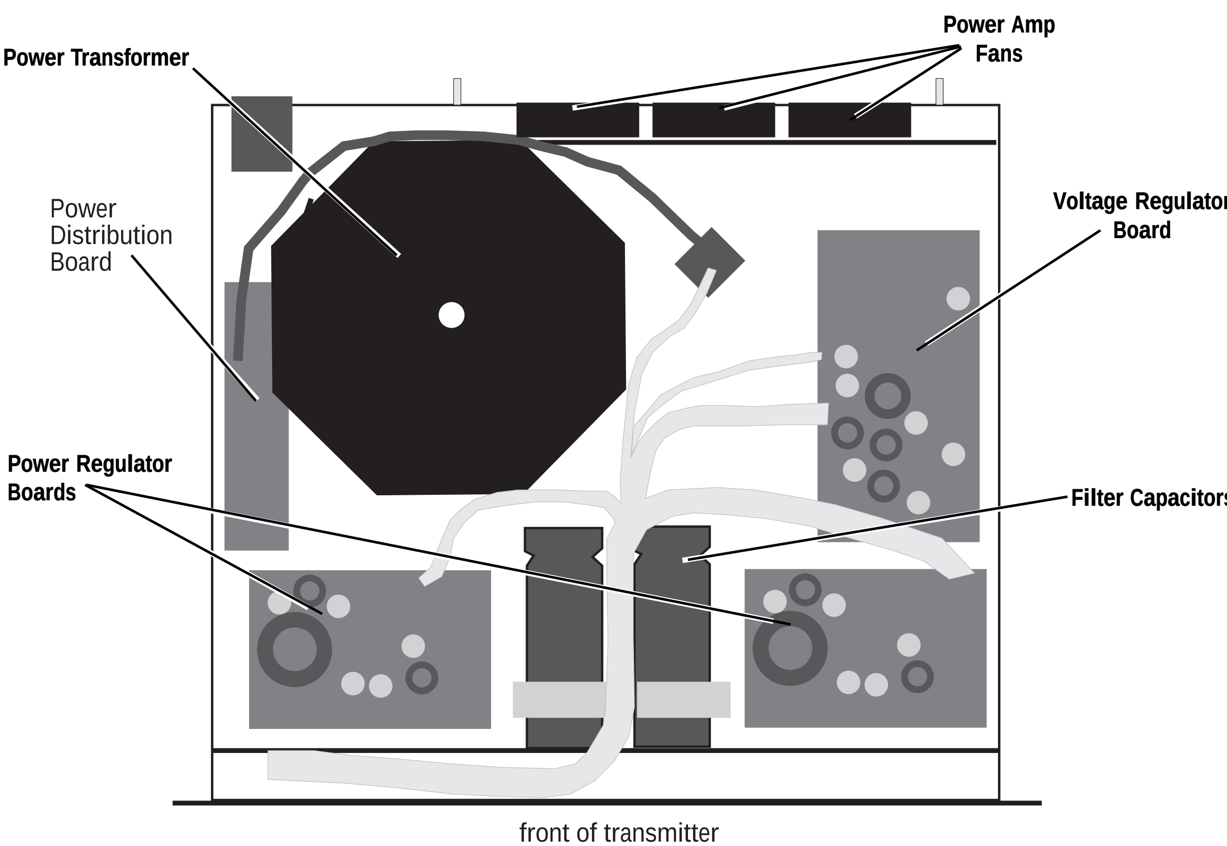


Illustration 6–4 Chassis Bottom View

6.2 Board Layouts and Schematics

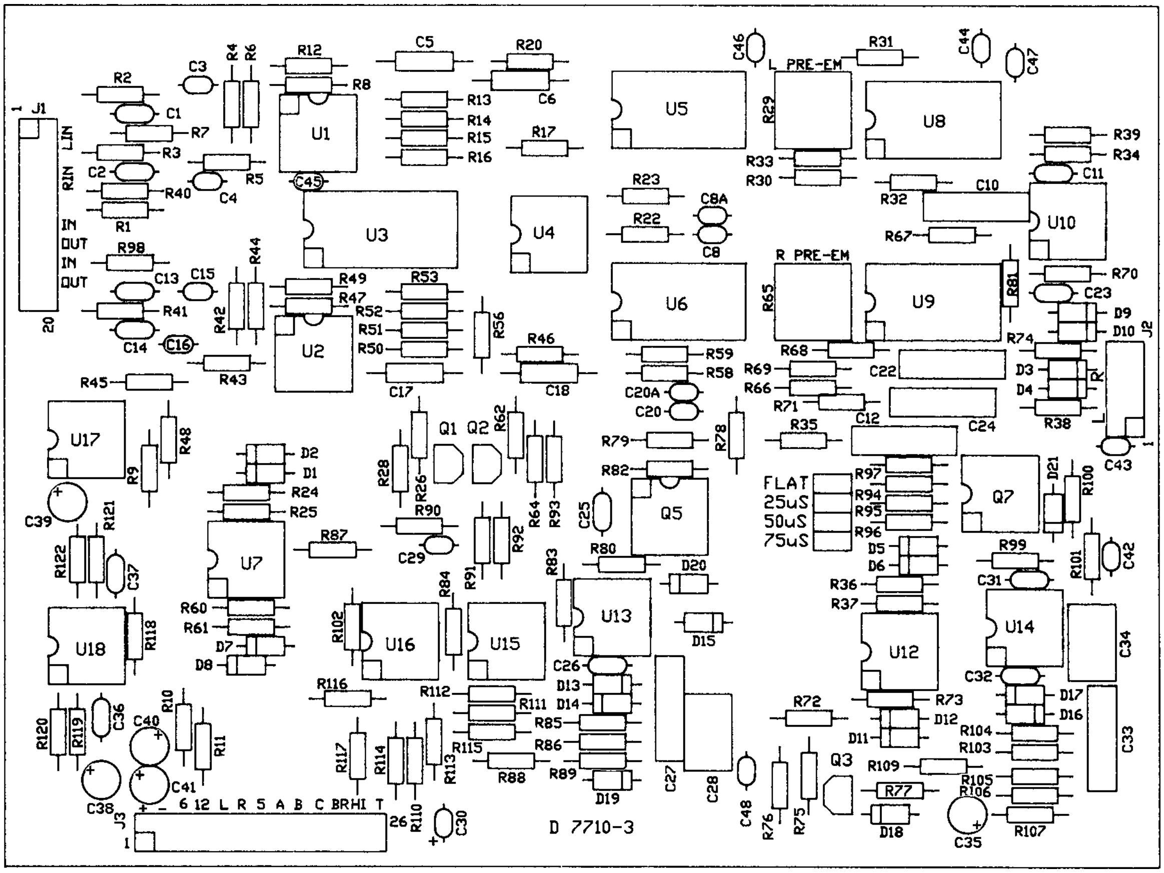
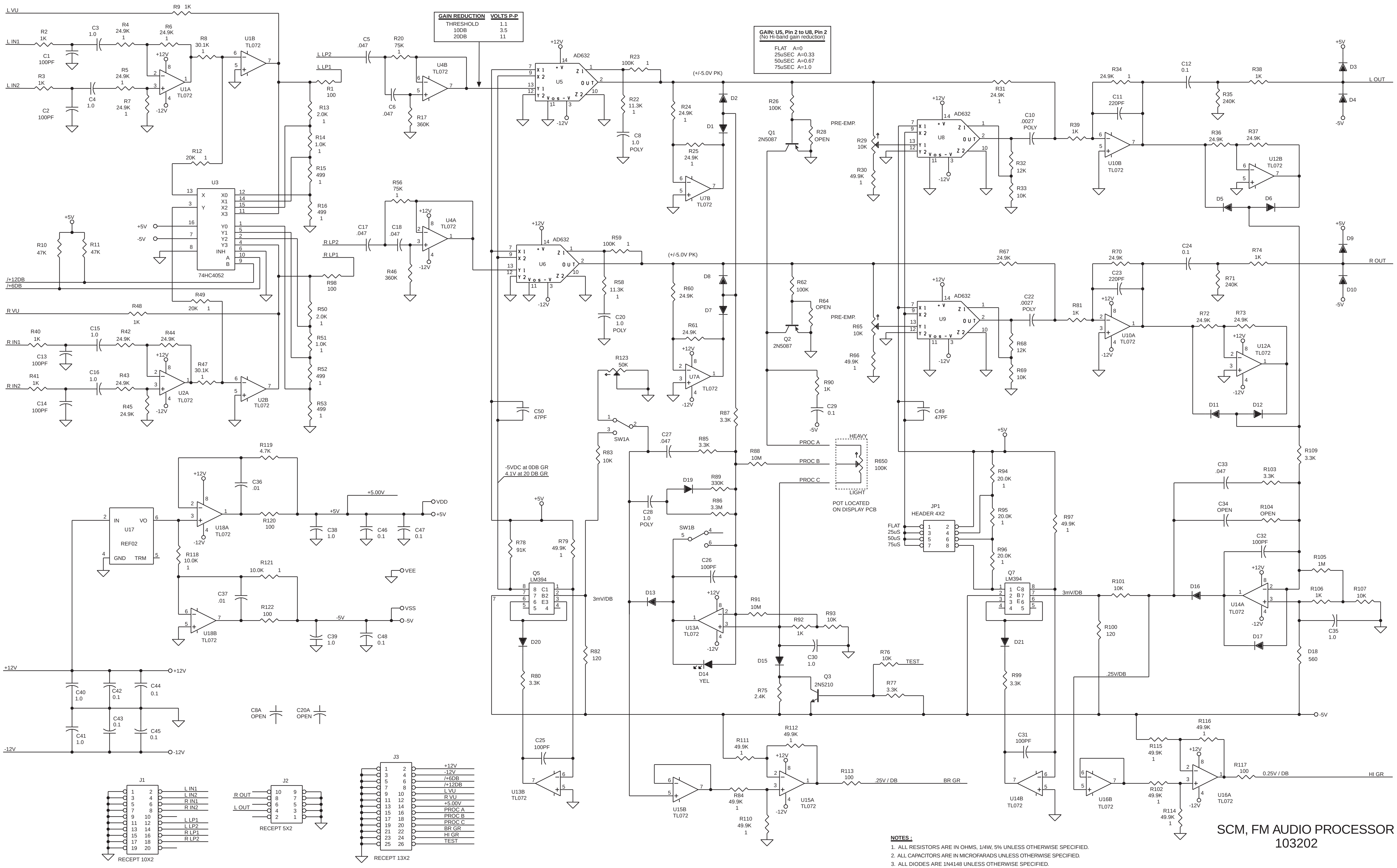


Illustration 6–5 Audio Processor Board



SCM, FM AUDIO PROCESSOR
103202

NOTES :

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. ALL DIODES ARE 1N4148 UNLESS OTHERWISE SPECIFIED.

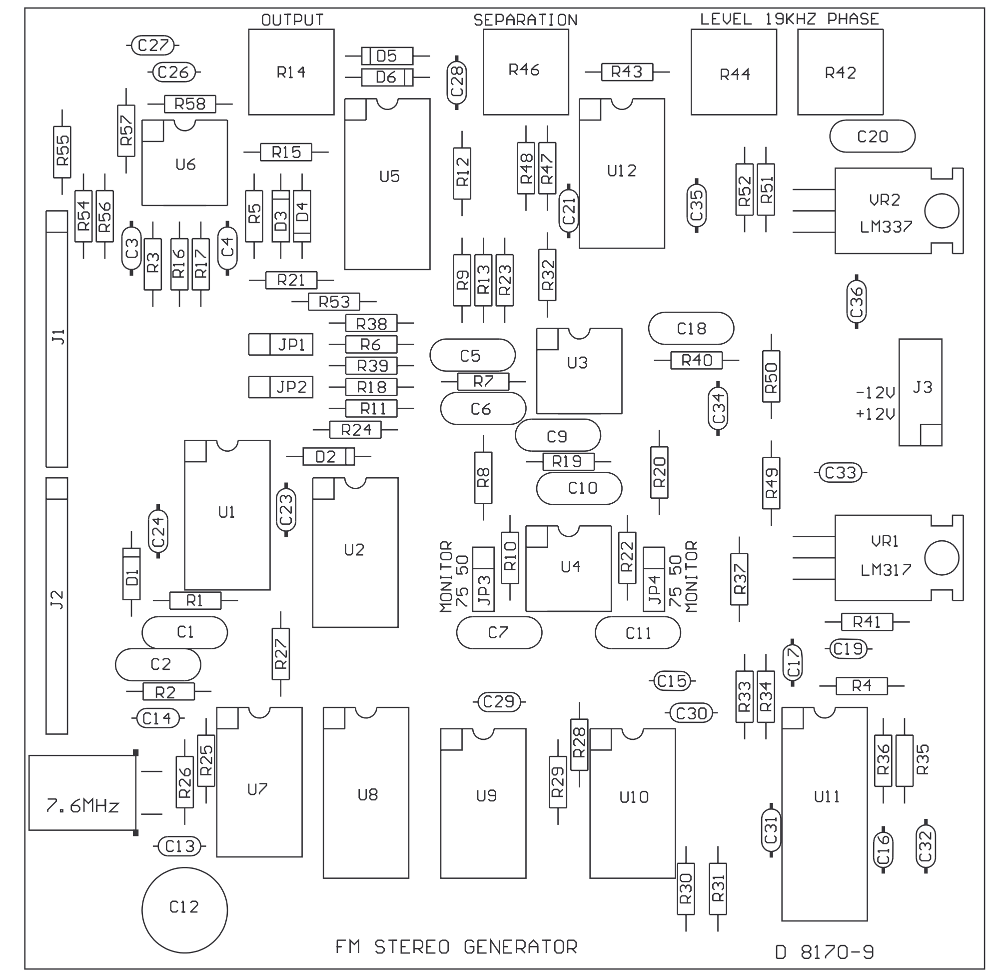
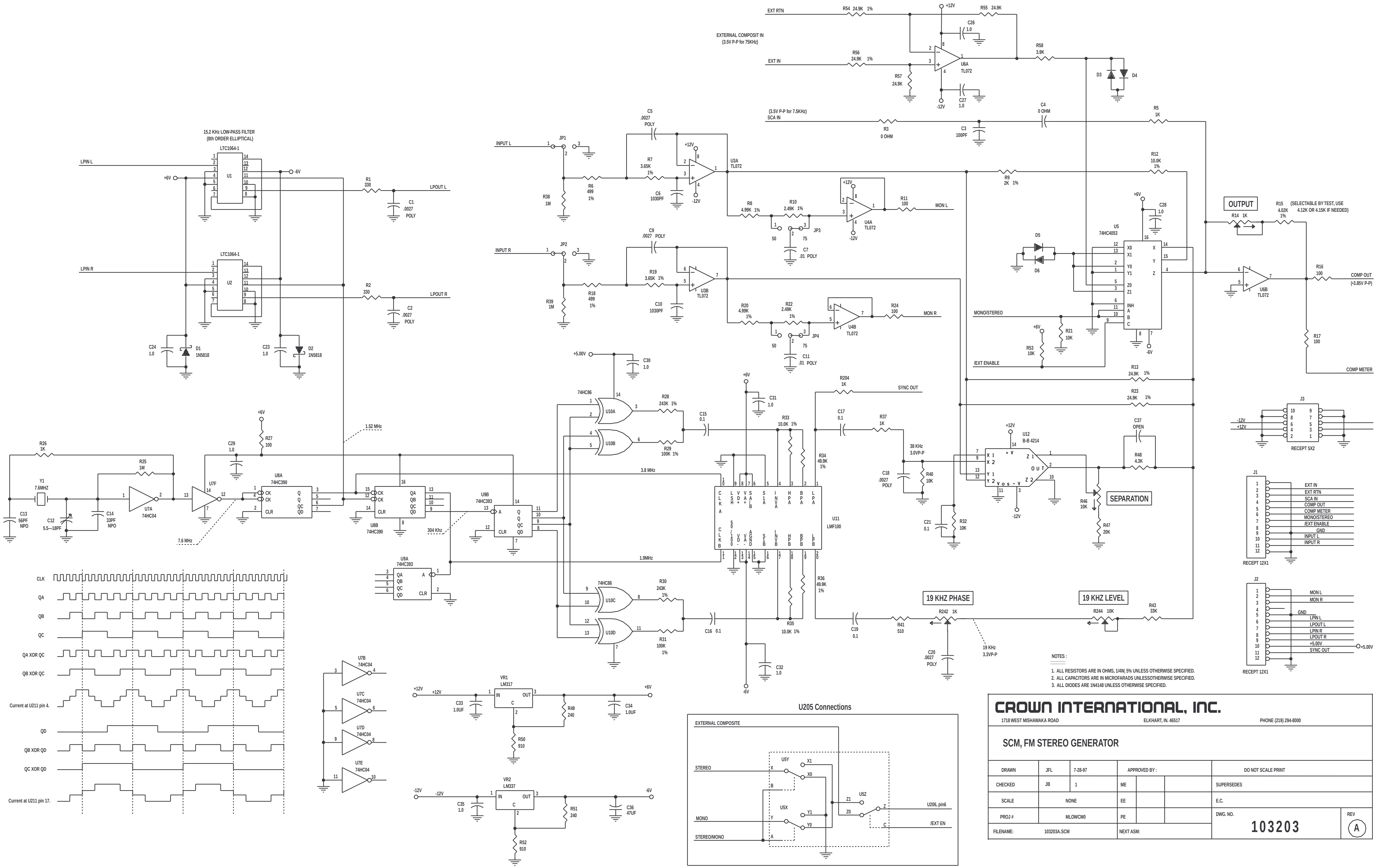
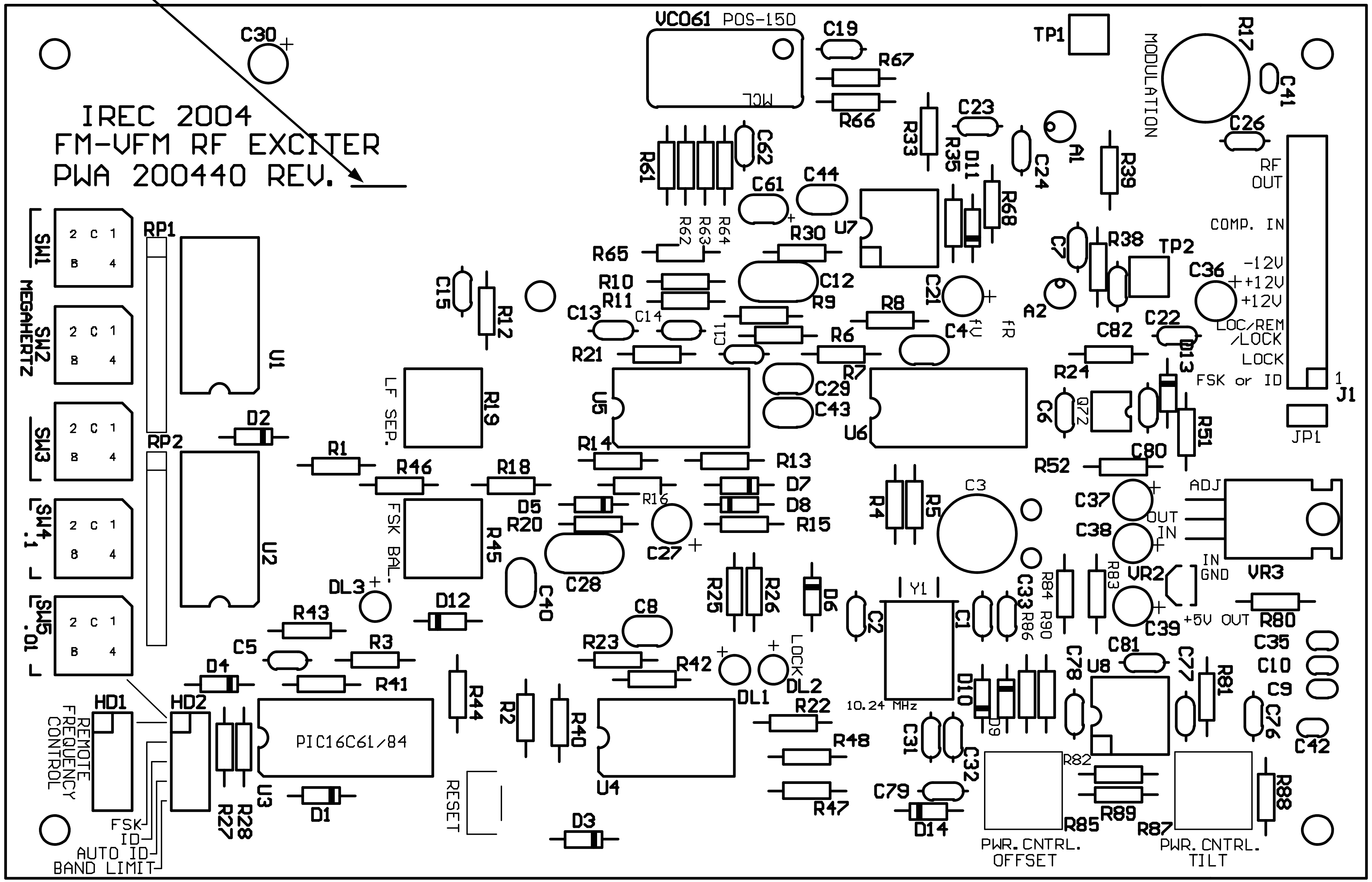


Illustration 6–6 Stereo Generator Board



STEREO GENERATOR

SEE NOTE 10



Top Overlay

TOP SIDE COMPONENT MAP, FM-VFM EXCITER

PWB: 200440-PWB-A.PCB

M200440PT-A.DOC

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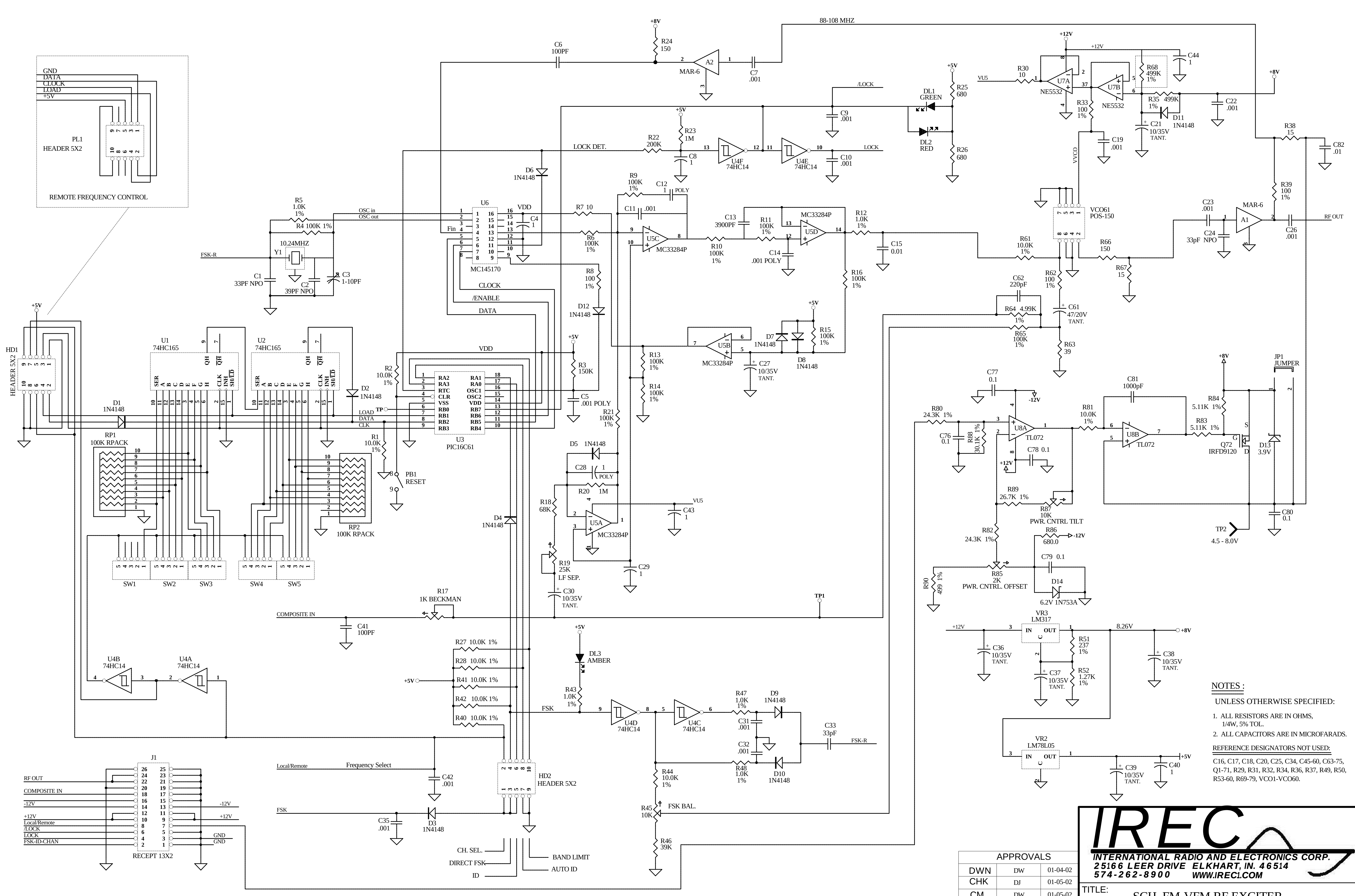
		SCALE: N/A	PROJECT #: 509	SHEET: 1 OF 1

DWG. NO. 200440-SCH REV. A

REVISION HISTORY				APPROVALS			
E . C . N.	REV	DESCRIPTION	DATE	DWN	CHK	CM	PE
	1	FOR PROTOTYPE	01-04-02	DW			
	2	MODIFIED PER MIKE SENEKI	02-06-02	DW			
	3	CHG'D R18 PER EAD MRH01. R18 WAS 91K OHM. U5 WAS C 6900-5	06-24-02	DW			
246 A-G	4	R8 WAS 1.0K OHM.	05-23-03	DW			
277	A	PRODUCTION RELEASE	01-29-04	DW		DW	DP



NOTES :

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% TOL.
2. ALL CAPACITORS ARE IN MICROFARADS.

REFERENCE DESIGNATORS NOT USED:

C16, C17, C18, C20, C25, C34, C45-60, C63-75, Q1-71, R29, R31, R32, R34, R36, R37, R49, R50, R53-60, R69-79, VCO1-VCO60.

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APPROVALS		
DWN	DW	01-04-02
CHK	DJ	01-05-02
CM	DW	01-05-02
PE	DP	01-05-02
DISTRIBUTION		
K		
FILENAME:		

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25166 LEER DRIVE ELKHART, IN. 46514
574-262-8900 WWW.IRECI.COM

TITLE: SCH, FM-VFM RF EXCITER

SIZE	DWG . NO .	REV
C	200440-SCH	A

SCALE : NONE PROJ NO. 509 SHEET 1 OF 1

C_L_SHT1_A.DOT REV. A

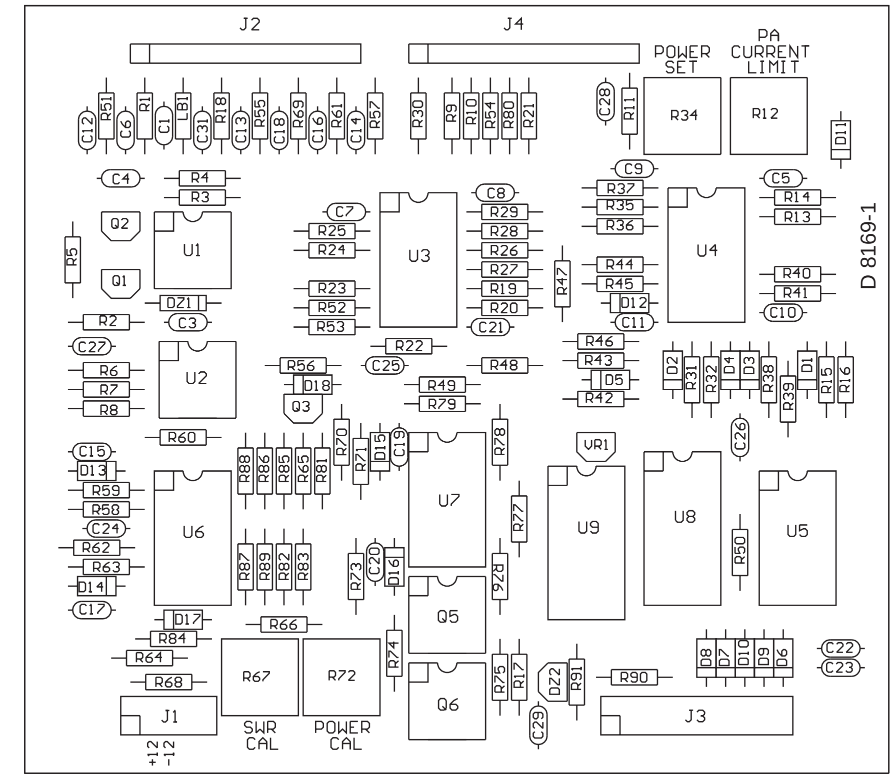
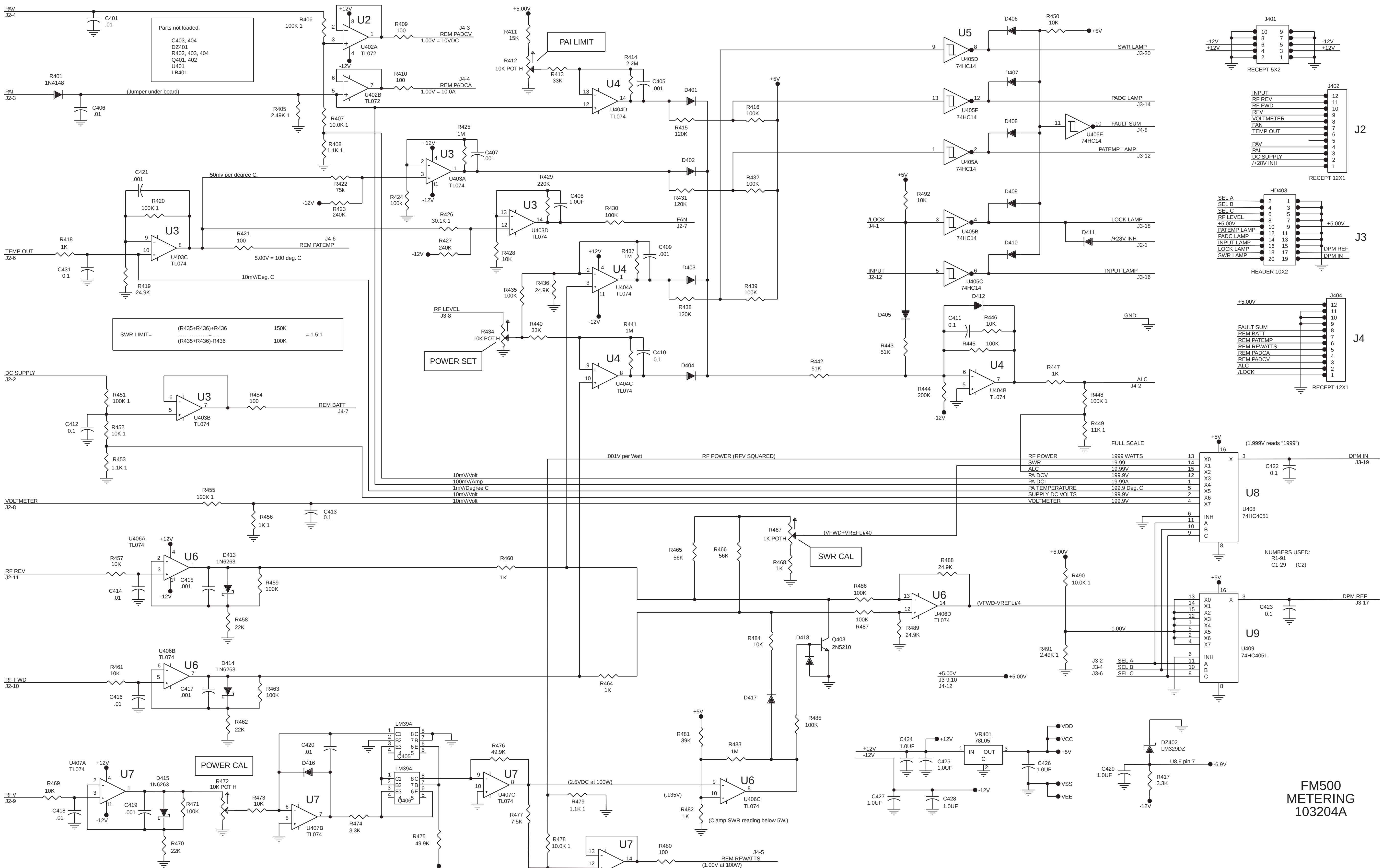
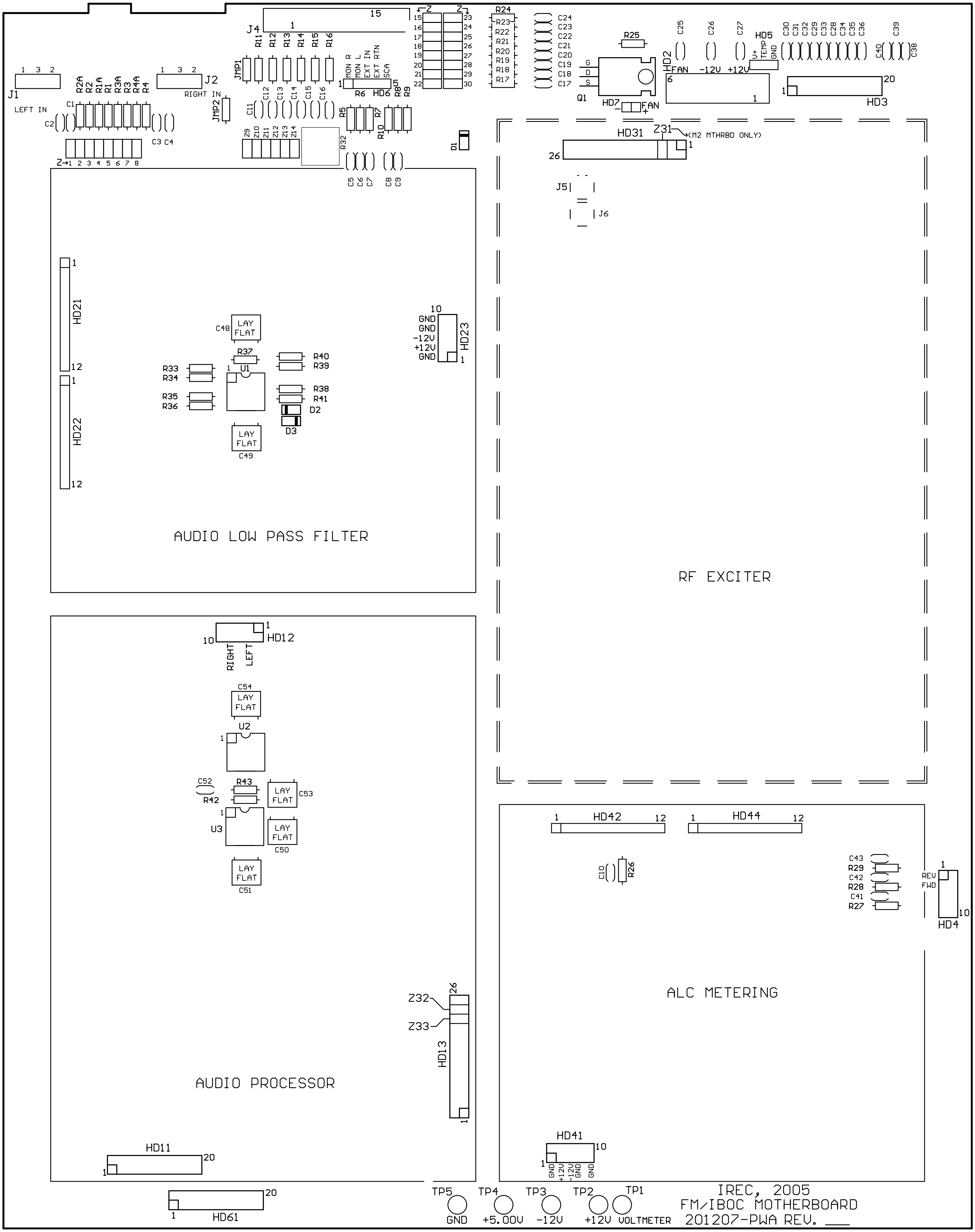
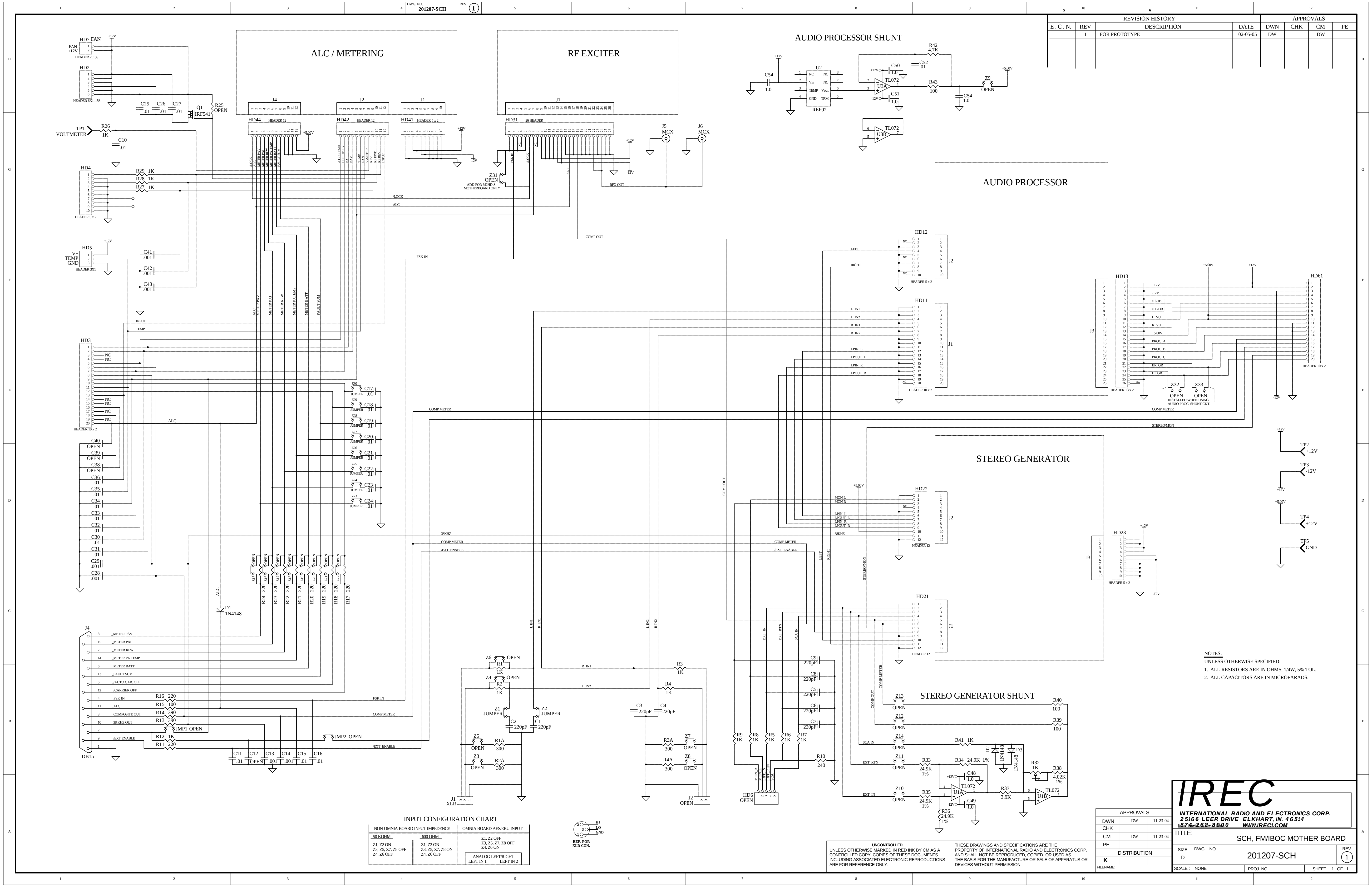


Illustration 6–8 RF Metering Board
(Add 400 to component designators for schematic reference)


Parts not loaded:
C403, 404
DZ401
R402, 403, 404
Q401, 402
U401
LB401
PAI LIMIT
POWER SET
SWR CAL
POWER CAL
SWR LIMIT= (R435+R436)+R436 / (R435+R436)-R436 150K / 100K = 1.5:1
(Jumper under board)
50mv per degree C.
5.00V = 100 deg. C
10mV/Deg. C
1.00V = 10VDC
1.00V = 10.0A
.001V per Watt
RF POWER (RFV SQUARED)
(VFWD+VREFL)/40
(VFWD-VREFL)/4
(2.5VDC at 100W)
(.135V)
(Clamp SWR reading below 5W.)
(1.00V at 100W)
FULL SCALE
(1.999V reads "1999")
NUMBERS USED:
R1-91
C1-29 (C2)
RECEPT 5X2
RECEPT 12X1
HEADER 10X2
J2
J3
J4
U8
U9
FM500
METERING
103204A



AUDIO LOW PASS FILTER
RF EXCITER
AUDIO PROCESSOR
ALC METERING
LEFT IN
RIGHT IN
(M2 MTHRBD ONLY)
FAN -12V +12V
MON R
MON L
EXT IN
EXT RTN
SCA
GND
GND
-12V
+12V
GND
RIGHT
LEFT
REV
FWD
LAY FLAT
TP5 GND
TP4 +5.00V
TP3 -12V
TP2 +12V
TP1 VOLTMETER
IREC, 2005
FM/IBOC MOTHERBOARD
201207-PWA REV. ___



201207-SCH
ALC / METERING
RF EXCITER
AUDIO PROCESSOR SHUNT
AUDIO PROCESSOR
STEREO GENERATOR
STEREO GENERATOR SHUNT
REVISION HISTORY
E. C. N. REV DESCRIPTION DATE
1 FOR PROTOTYPE 02-05-05 DW DW
APPROVALS DWN CHK CM PE
INPUT CONFIGURATION CHART
NON-OMNIA BOARD INPUT IMPEDENCE
OMNIA BOARD AES/EBU INPUT
50 KOHM
600 OHM
Z1, Z2 ON
Z3, Z5, Z7, Z8 OFF
Z4, Z6 OFF
Z1, Z2 OFF
Z3, Z5, Z7, Z8 ON
Z4, Z6 ON
ANALOG LEFT/RIGHT
LEFT IN 1
LEFT IN 2
REF. FOR XLR CON.
NOTES:
UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% TOL.
2. ALL CAPACITORS ARE IN MICROFARADS.
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25166 LEER DRIVE ELKHART, IN. 46514
574-262-8900 WWW.IRECI.COM
TITLE:
SCH, FM/IBOC MOTHER BOARD
SIZE D
DWG. NO. 201207-SCH
REV 1
SCALE: NONE
SHEET 1 OF 1

Jumper	FMA "E"	FMA "T" 50K input	FMA"T" 600 input	FMA "R"	FMA "Omnia" Analog input	FMA "Omnia" AES input	FMX "E"	FMX "T" 50K input	FMX "T" 600 input	FMX "R"	FMX "Omnia" Analog input	FMX "Omnia" AES input	FMX RMS
Z1	Short	Short	Short	Short	Short	Open	Short	Short	Short	Short	Short	Open	
Z2	Short	Short	Short	Short	Short	Open	Short	Short	Short	Short	Short	Open	
Z3	Open	Open	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	
Z4	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	Short	
Z5	Open	Open	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	
Z6	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	Short	
Z7	Open	Open	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	
Z8	Open	Open	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	
Z9	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
Z10	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
Z11	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
Z12	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
Z13	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
Z14	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
Z15	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Short
Z16	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Short
Z17	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Short
Z18	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Short
Z19	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Short
Z20	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
Z21	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
Z22	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
Z23	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Open
Z24	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Open
Z25	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Open
Z26	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Open
Z27	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Open
Z28	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short
Z29	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short
Z30	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short	Short
Z31	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	
Z32	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
Z33	Short	Open	Open	Open	Open	Open	Short	Open	Open	Open	Open	Open	
JMP1	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open
JMP2	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open	Open

Motherboard Configuration Chart

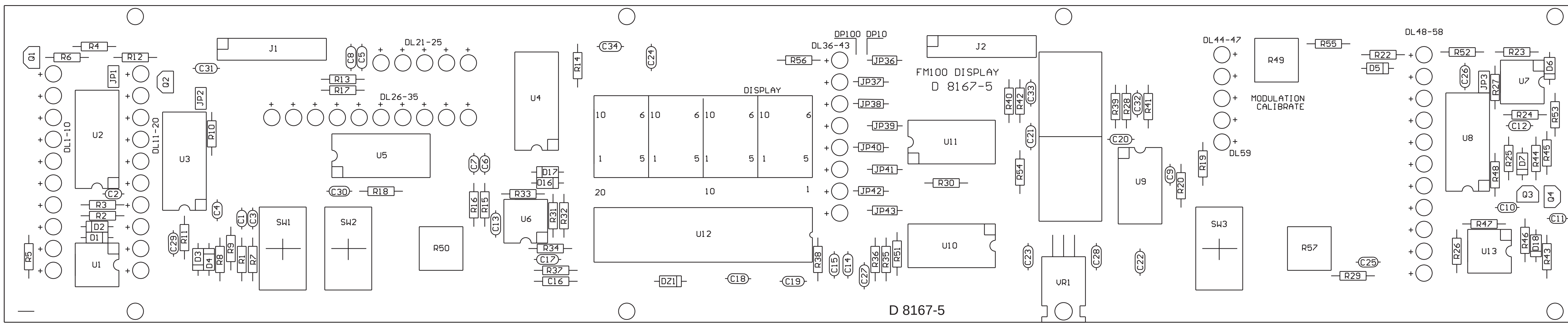
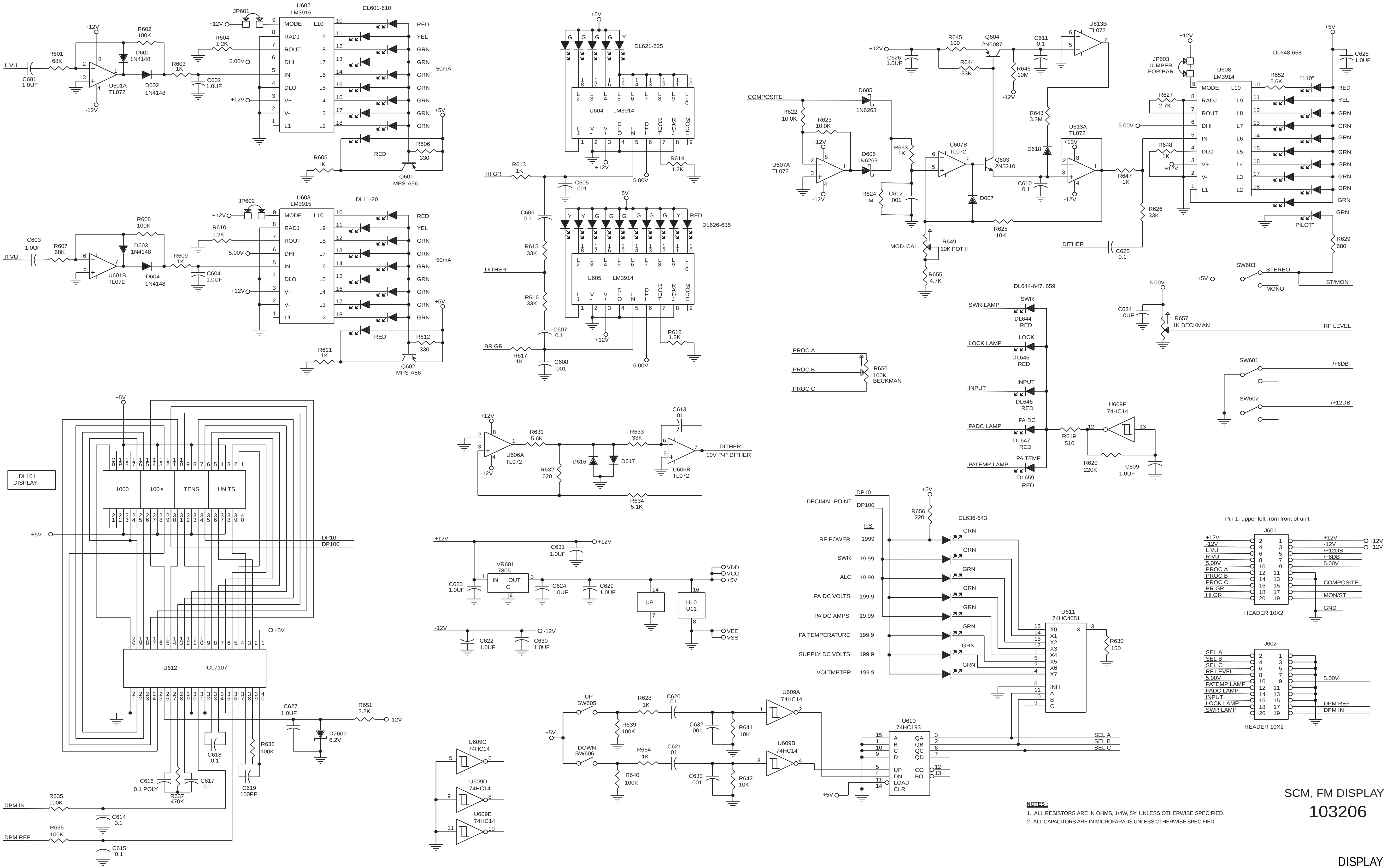


Illustration 6–10 Display Board

(Add 600 to component designators for schematic reference)



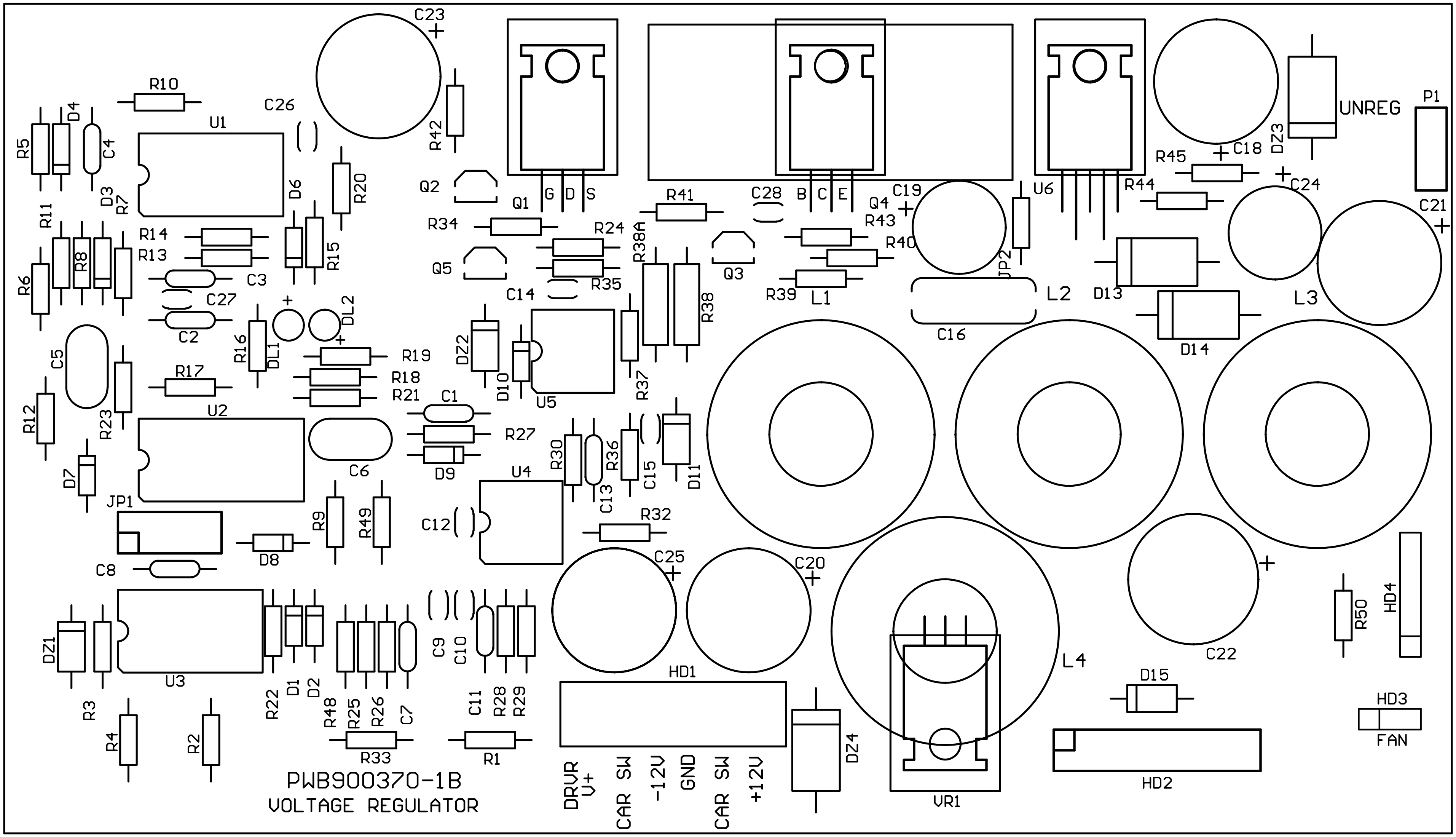
SCM, FM DISPLAY

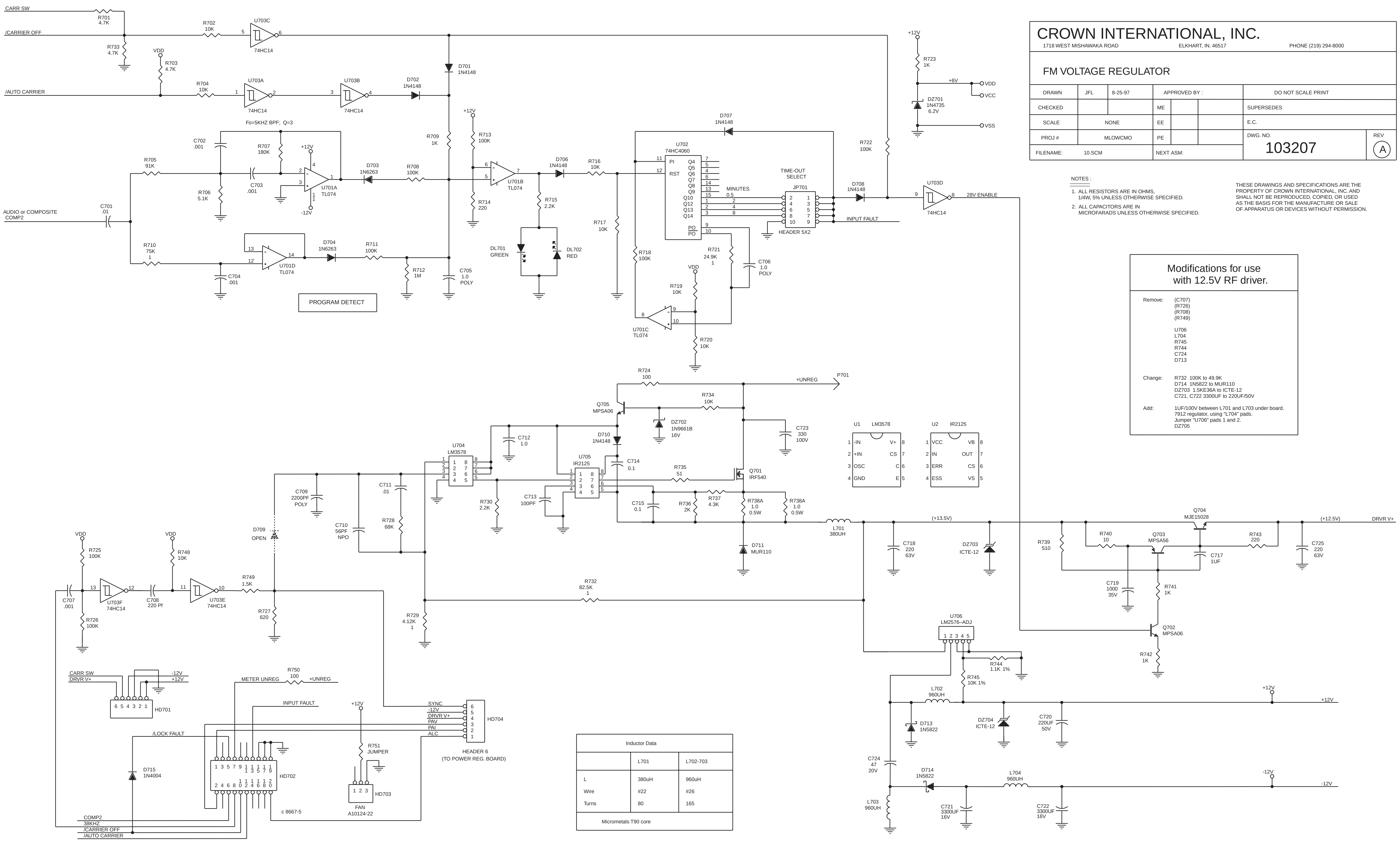
103206

NOTES :

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

DISPLAY


PWB900370-1B
VOLTAGE REGULATOR
C23
R10
C26
U1
D4
R5
C4
R42
Q2
Q1
G D S
R20
D6
D3
R7
R11
R14
R13
R15
R34
R24
Q5
C3
R8
R6
C27
C2
R16
DL1
DL2
R19
R18
R21
C5
R17
R12
R23
U2
C1
R27
C6
D9
D7
JP1
R9
R49
C12
U4
D8
C8
R41
C28
B C E
Q4
C19
R43
R40
R39
L1
R38A
R38
Q3
C14
R35
DZ2
D10
U5
R37
R30
R36
C13
C15
D11
R32
C25
C20
U6
R44
R45
C18
DZ3
UNREG
P1
C24
C21
JP2
L2
C16
D13
D14
L3
C22
L4
R50
HD4
D15
HD3
FAN
HD2
VR1
DZ4
HD1
DRVR
V+
CAR SW
-12V
GND
CAR SW
+12V
DZ1
R3
U3
R22
D1
D2
R48
R25
R26
C7
C9
C10
C11
R28
R29
R33
R1
R4
R2



CROWN INTERNATIONAL, INC.

1718 WEST MISHAWAKA ROAD ELKHART, IN. 46517 PHONE (219) 294-8000

FM VOLTAGE REGULATOR

DRAWN	JFL	8-25-97	APPROVED BY :		DO NOT SCALE PRINT
CHECKED			ME		SUPERSEDES
SCALE	NONE		EE		E.C.
PROJ #	MLOWCMO		PE		DWG. NO. 103207 — REV A
FILENAME:	10.SCM		NEXT ASM:		

NOTES :

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

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Modifications for use with 12.5V RF driver.

Remove: (C707) (R726) (R708) (R749)
U706 L704 R745 R744 C724 D713

Change: R732 100K to 49.9K
D714 1N5822 to MUR110
DZ703 1.5KE36A to ICTE-12
C721, C722 3300UF to 220UF/50V

Add: 1UF/100V between L701 and L703 under board.
7912 regulator, using "L704" pads.
Jumper "U706" pads 1 and 2.
DZ705

Inductor Data

	L701	L702-703
L	380uH	960uH
Wire	#22	#26
Turns	80	165

Micrometals T90 core

VOLTAGE REGULATOR

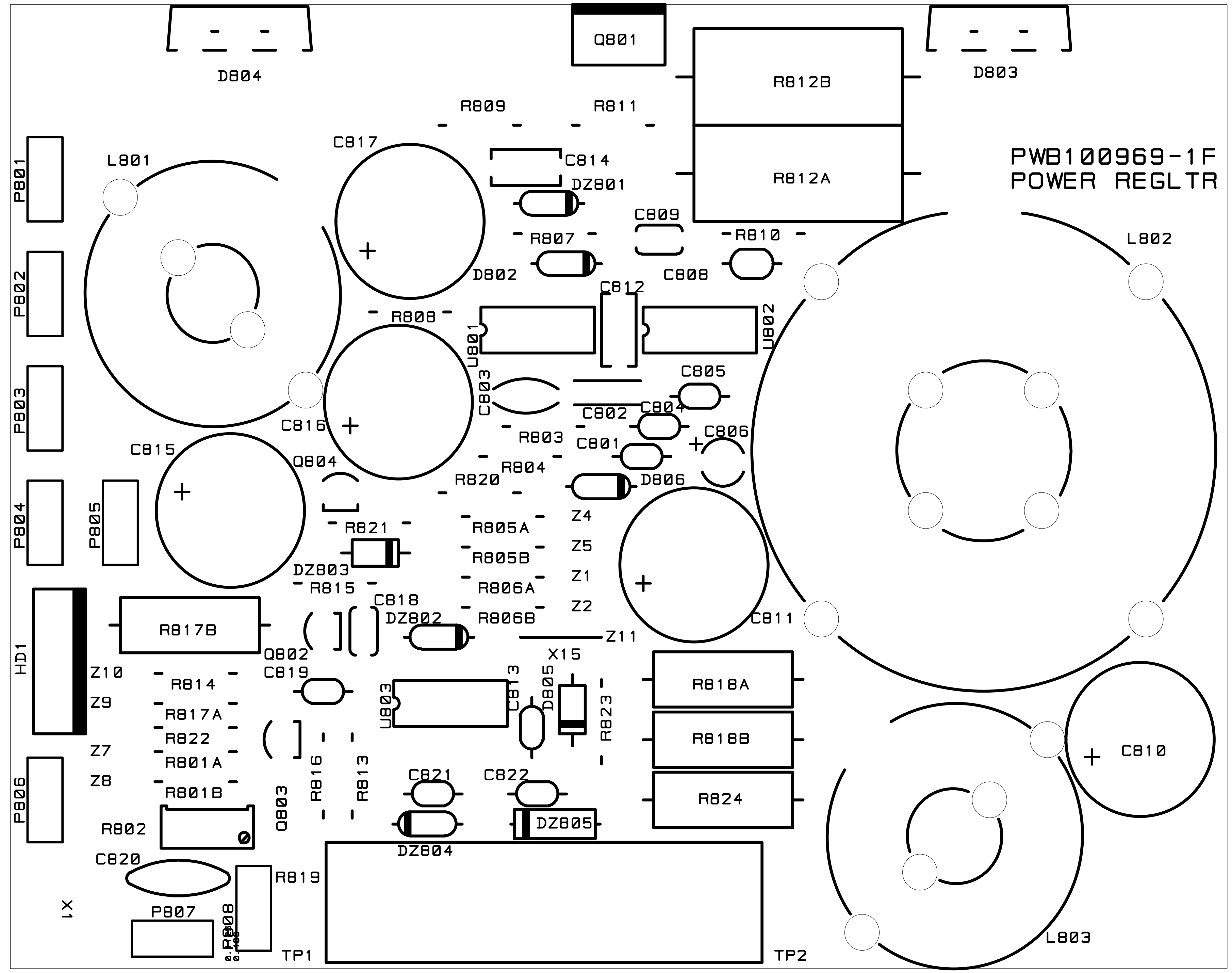
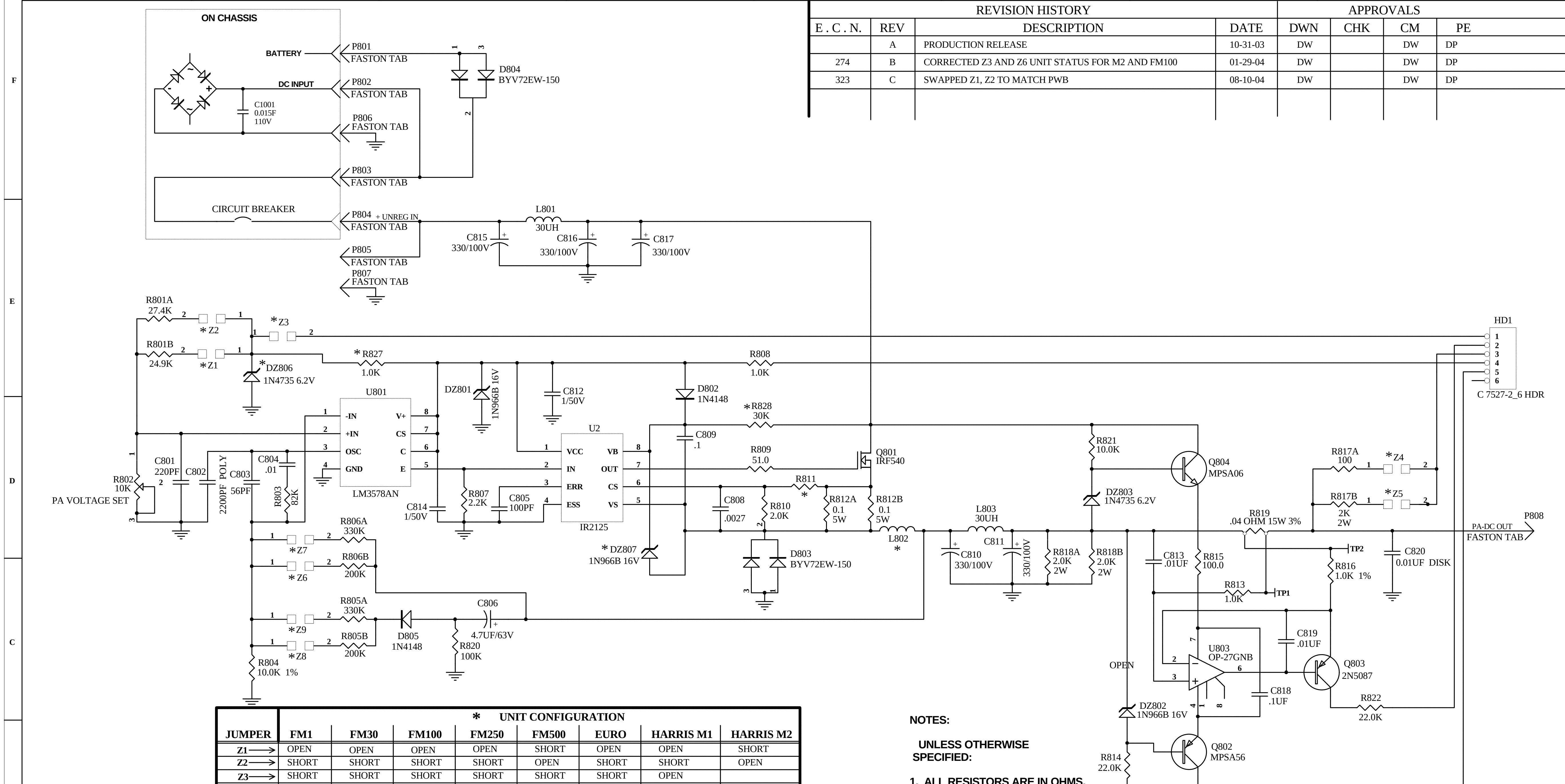


Illustration 6–12   Power Regulator Board

E . C . N.	REV	DESCRIPTION	DATE	DWN	CHK	CM	PE
		REVISION HISTORY		APPROVALS			
	A	PRODUCTION RELEASE	10-31-03	DW		DW	DP
274	B	CORRECTED Z3 AND Z6 UNIT STATUS FOR M2 AND FM100	01-29-04	DW		DW	DP
323	C	SWAPPED Z1, Z2 TO MATCH PWB	08-10-04	DW		DW	DP



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% TOL.

2. ALL CAPACITORS ARE IN MICROFARADS.

JUMPER	* UNIT CONFIGURATION FM1	FM30	FM100	FM250	FM500	EURO	HARRIS M1	HARRIS M2
Z1	OPEN	OPEN	OPEN	OPEN	SHORT	OPEN	OPEN	SHORT
Z2	SHORT	SHORT	SHORT	SHORT	OPEN	SHORT	SHORT	OPEN
Z3	SHORT	SHORT	SHORT	SHORT	SHORT	SHORT	OPEN	
Z8	SHORT	SHORT	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
Z7	OPEN	OPEN	SHORT	SHORT	SHORT	SHORT	SHORT	SHORT
Z6	SHORT	SHORT	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN
Z4	SHORT	SHORT	SHORT	SHORT	OPEN	SHORT	SHORT	OPEN
Z5	OPEN	OPEN	OPEN	OPEN	SHORT	OPEN	OPEN	SHORT
Z9	OPEN	OPEN	SHORT	SHORT	SHORT	SHORT	SHORT	SHORT
REF DES								
L802	H43608-1	H43395-5	H43533-1	H43533-1	H43533-1	H43533-1	H43533-1	H43533-1
R811	3.3K	3.3K	3.3K	3.3K	3.3K	5.11K 1%	3.3K	3.3K
R827	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	INSTALLED	INSTALLED
R828	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	INSTALLED	INSTALLED
DZ806	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	INSTALLED	INSTALLED
DZ807	OPEN	OPEN	OPEN	OPEN	OPEN	OPEN	INSTALLED	INSTALLED

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APPROVALS		
DWN	DW	09-30-03
CHK		
CM	DW	09-30-03
PE	DP	09-30-03
DISTRIBUTION		
FILENAME:	200915-SCH	

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INTERNATIONAL RADIO AND ELECTRONICS CORP.
25166 LEER DRIVE ELKHART, IN. 46514
574-262-8900 WWW.IREC1.COM

TITLE: **SCH, FM POWER REGULATOR**

SIZE B | DWG . NO . **200915-SCH** | REV. C

SCALE : NONE | PROJ NO. 533 | SHEET 1 OF 1

PWB_REV.G
C10582-2 PWB_100969-1

B_L_SHT1_A.DOT REV. A

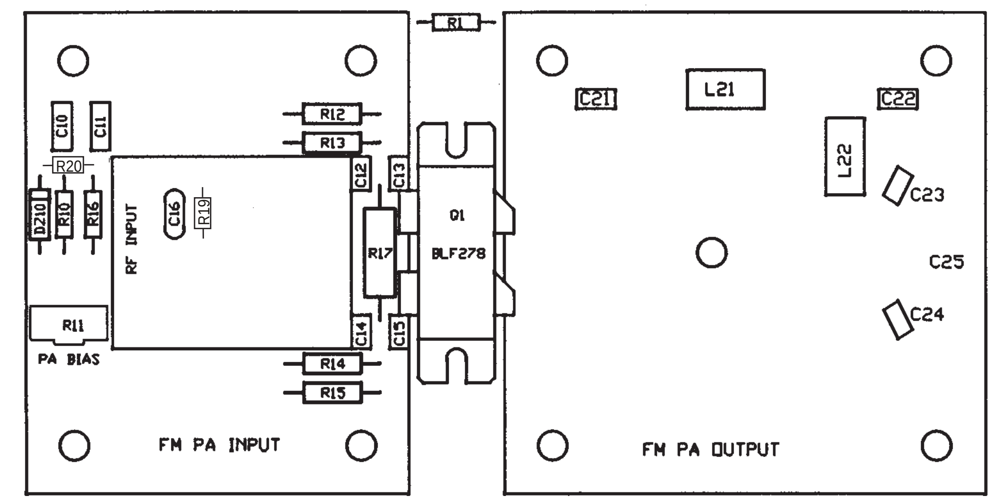
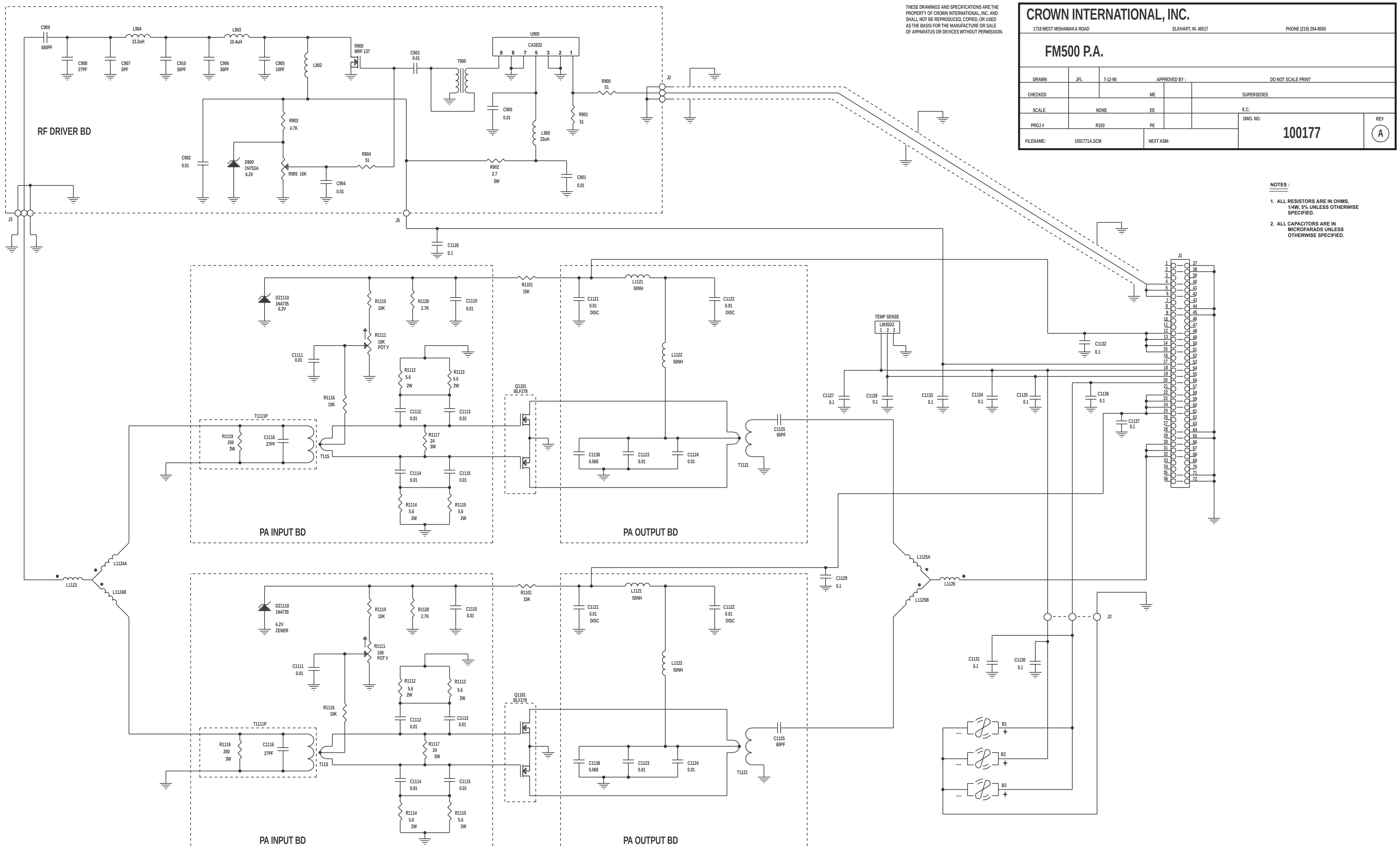


Illustration 6–13 Power Amplifier
(Add 1100 to component designators for schematic reference)



FM500 POWER AMPLIFIER

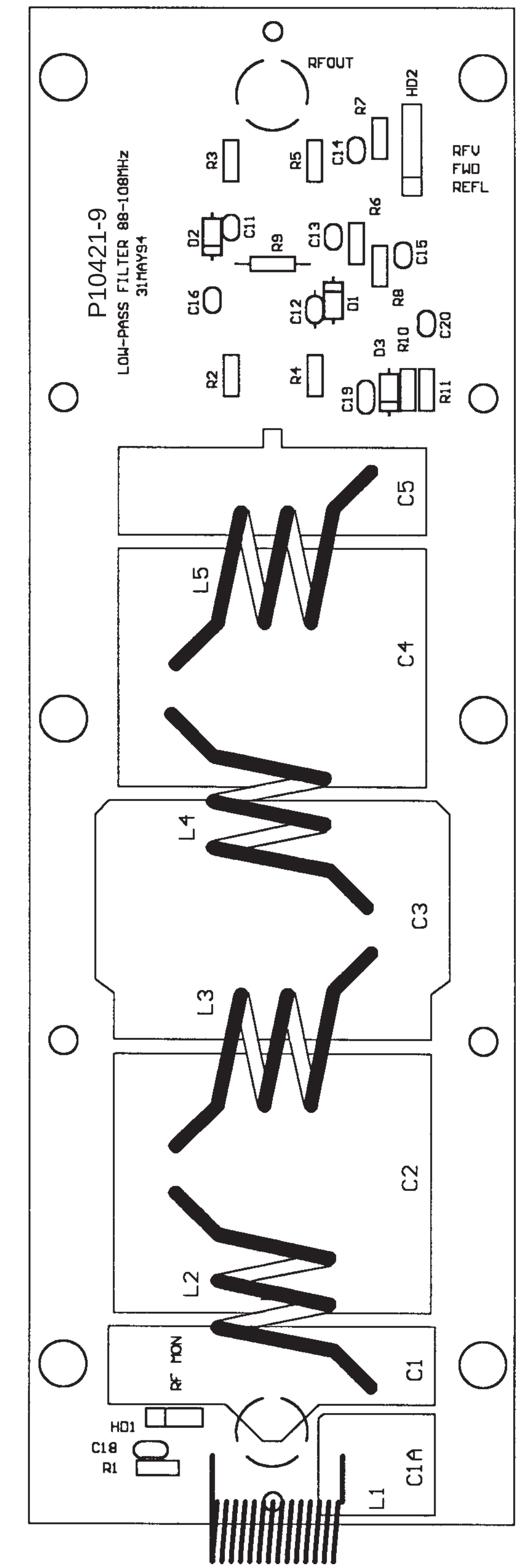
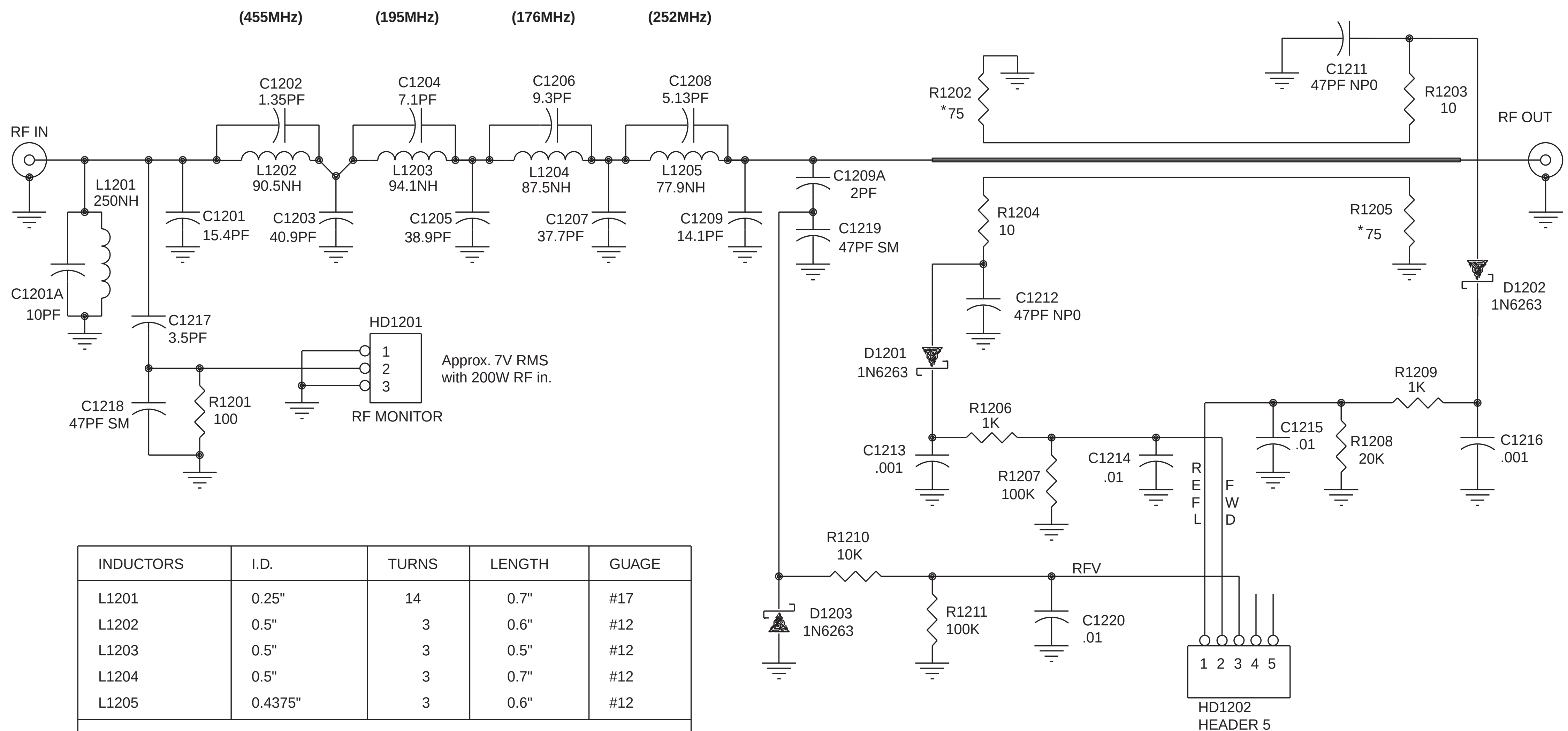


Illustration 6–14 RF Output Filter
(Add 1200 to component designators for schematic reference)



INDUCTORS	I.D.	TURNS	LENGTH	GUAGE
L1201	0.25"	14	0.7"	#17
L1202	0.5"	3	0.6"	#12
L1203	0.5"	3	0.5"	#12
L1204	0.5"	3	0.7"	#12
L1205	0.4375"	3	0.6"	#12
EXACT COIL LENGTHS ARE FACTORY-SET.				

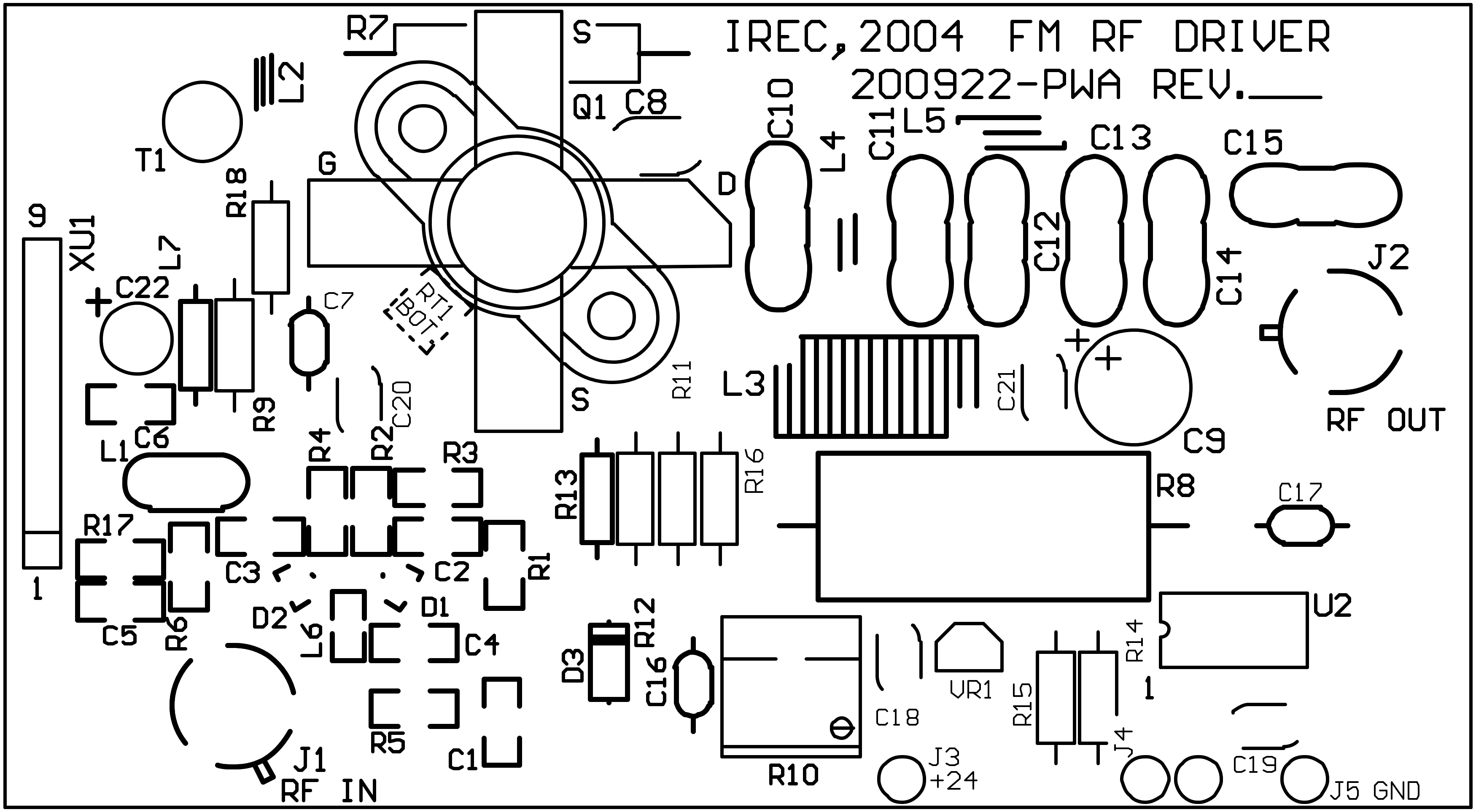
* IF NECESSARY, SELECT R1202 FOR SWR READING OF 1.1 OR BETTER WITH 50-OHM LOAD. R1205 = R1202
R1202,R1203,C1211,D1202,C1216 ON UNDERSIDE OF CIRCUIT BOARD.

NOTES :

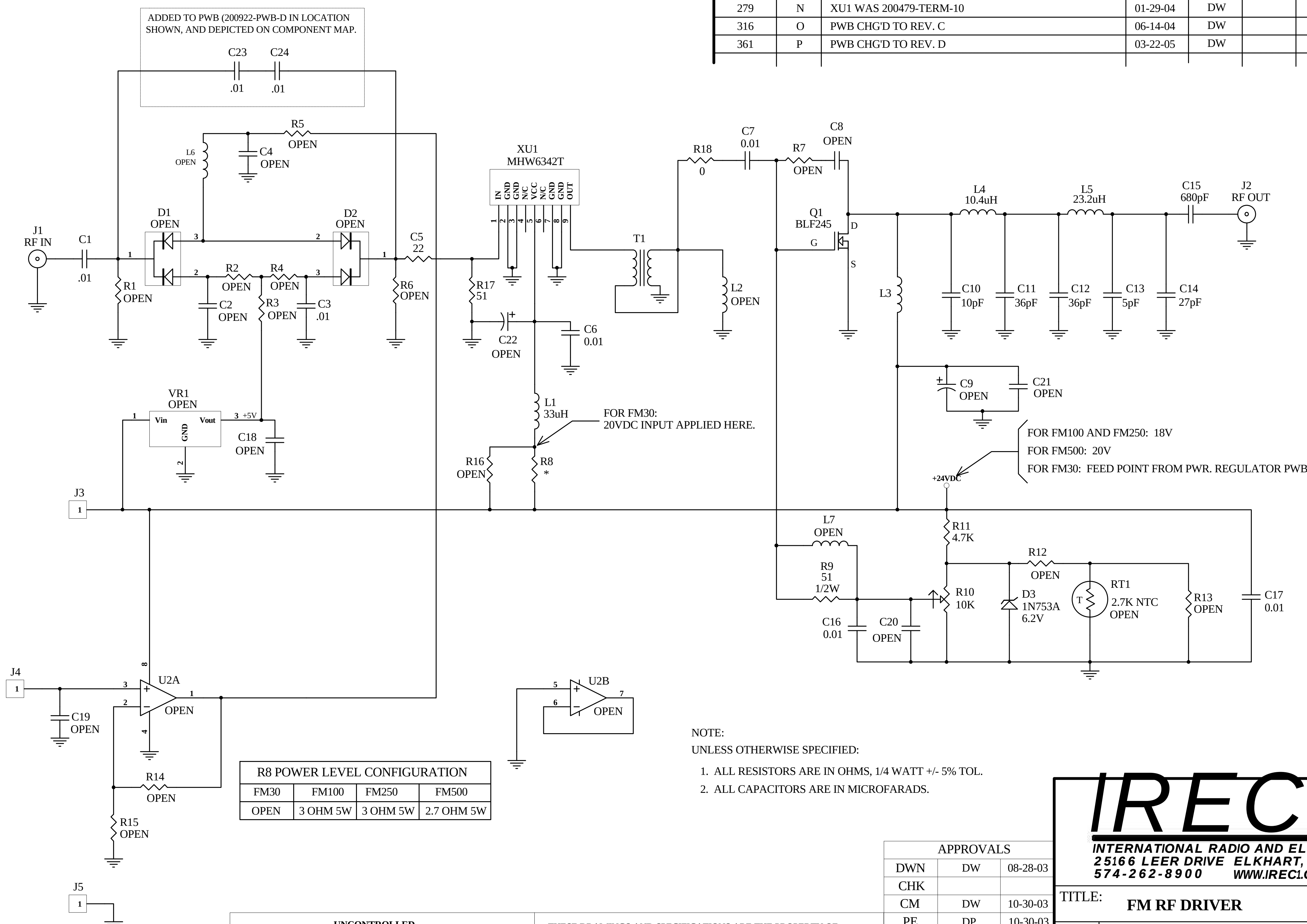
1. ALL RESISTORS ARE IN OHMS, 1/4W, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. C1201-1209A,1217 are circuit board pads.

103209

RF OUTPUT FILTER & REFLECTOMETER


IREC, 2004 FM RF DRIVER
200922-PWA REV.
R7
S
Q1
C8
G
D
S
T1
L2
R18
XU1
9
1
L7
C22
C7
RT1
BOT
C20
R9
R4
R2
R3
L1
C6
R17
C3
C2
R1
C5
R6
D2
L6
D1
C4
R5
C1
J1
RF IN
C10
L4
C11
L5
C13
C15
C12
C14
J2
RF OUT
L3
R11
C21
C9
R13
R16
R8
C17
U2
D3
R12
C16
R10
C18
VR1
R15
R14
J4
J3
+24
C19
J5 GND

REVISION HISTORY				APPROVALS			
E . C . N.	REV	DESCRIPTION	DATE	DWN	CHK	CM	PE
264	M	PRODUCTION RELEASE	12-10-03	DW		DW	DP
279	N	XU1 WAS 200479-TERM-10	01-29-04	DW		DW	MH
316	O	PWB CHG'D TO REV. C	06-14-04	DW		DW	DP
361	P	PWB CHG'D TO REV. D	03-22-05	DW		DW	DP



R8 POWER LEVEL CONFIGURATION			
FM30	FM100	FM250	FM500
OPEN	3 OHM 5W	3 OHM 5W	2.7 OHM 5W

NOTE:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE IN OHMS, 1/4 WATT +/- 5% TOL.
2. ALL CAPACITORS ARE IN MICROFARADS.

UNCONTROLLED

UNLESS OTHERWISE MARKED IN RED INK BY CM AS A CONTROLLED COPY, COPIES OF THESE DOCUMENTS INCLUDING ASSOCIATED ELECTRONIC REPRODUCTIONS ARE FOR REFERENCE ONLY.

APPROVALS		
DWN	DW	08-28-03
CHK		
CM	DW	10-30-03
PE	DP	10-30-03
DISTRIBUTION		
FILENAME:		

IREC
INTERNATIONAL RADIO AND ELECTRONICS CORP.
25166 LEER DRIVE ELKHART, IN. 46514
574-262-8900 WWW.IREC1.COM

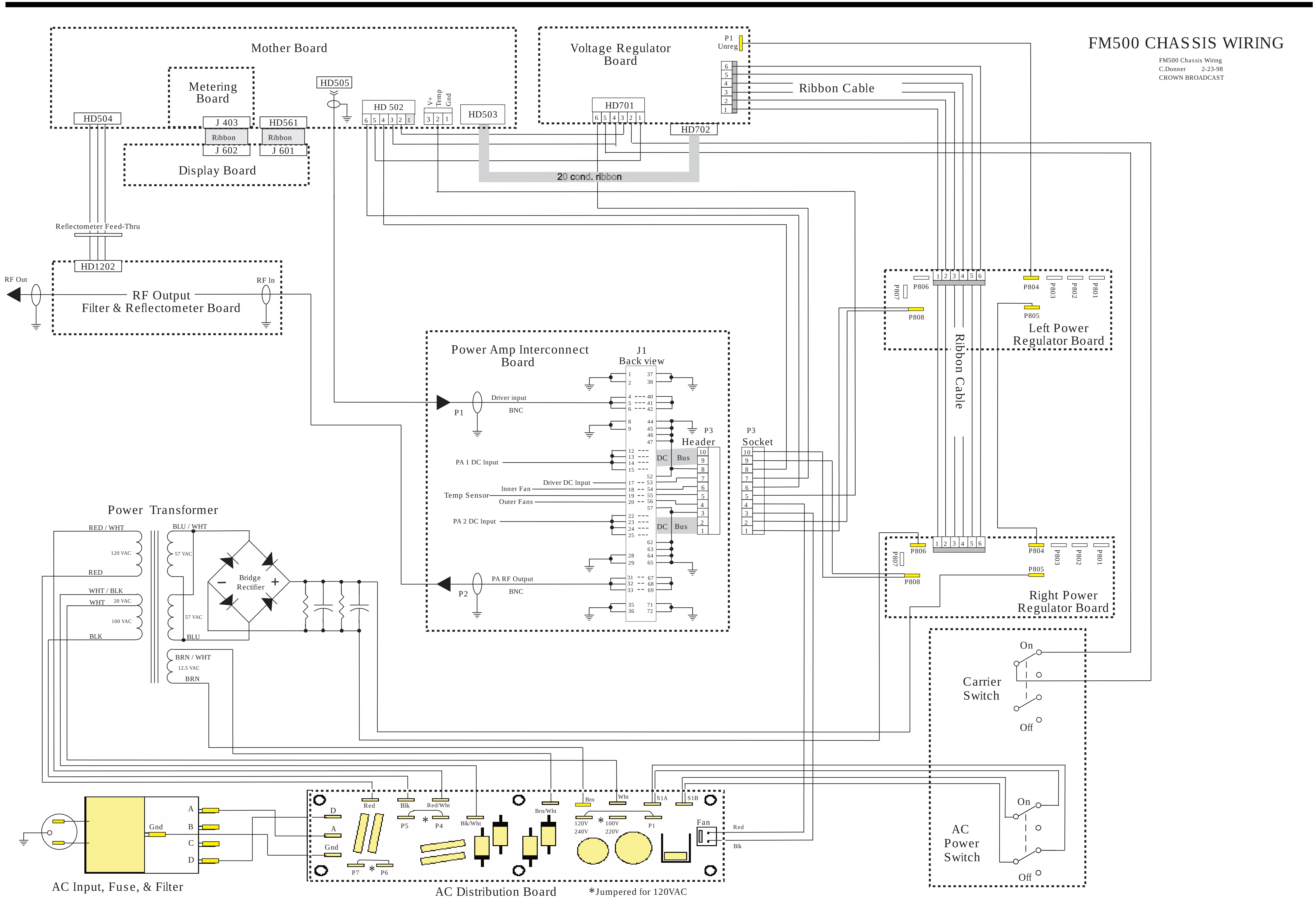
TITLE: **FM RF DRIVER**

SIZE B | DWG . NO . Q43310-4 | REV. P

SCALE : NONE | PROJ NO. 533 | SHEET 1 OF 1

REV. P DWG. NO. Q43310-4

B_L_SHT1_A.DOT REV. A


FM500 CHASSIS WIRING
FM500 Chassis Wiring
C.Donner 2-23-98
CROWN BROADCAST
Mother Board
Metering Board
HD505
HD504
J 403
HD561
HD 502
V+
Temp
Gnd
HD503
Ribbon
Ribbon
J 602
J 601
Display Board
Voltage Regulator Board
P1 Unreg
Ribbon Cable
HD701
HD702
20 cond. ribbon
Reflectometer Feed-Thru
HD1202
RF Out
RF In
RF Output
Filter & Reflectometer Board
Left Power Regulator Board
P807
P806
P804
P803
P802
P801
P808
P805
Ribbon Cable
Power Amp Interconnect Board
J1
Back view
Driver input
BNC
P1
P3
Header
P3
Socket
PA 1 DC Input
DC
Bus
Driver DC Input
Inner Fan
Temp Sensor
Outer Fans
PA 2 DC Input
DC
Bus
PA RF Output
BNC
P2
Right Power Regulator Board
Power Transformer
RED / WHT
120 VAC
RED
WHT / BLK
WHT
20 VAC
100 VAC
BLK
BLU / WHT
57 VAC
57 VAC
BLU
BRN / WHT
12.5 VAC
BRN
Bridge Rectifier
Carrier Switch
On
Off
AC Power Switch
On
Off
Gnd
A
B
C
D
AC Input, Fuse, & Filter
D
A
Gnd
Red
Blk
Red/Wht
P5
P4
Blk/Wht
P7
P6
Brn/Wht
Brn
Wht
S1A
S1B
120V
240V
100V
220V
P1
Fan
Red
Blk
AC Distribution Board
*Jumpered for 120VAC

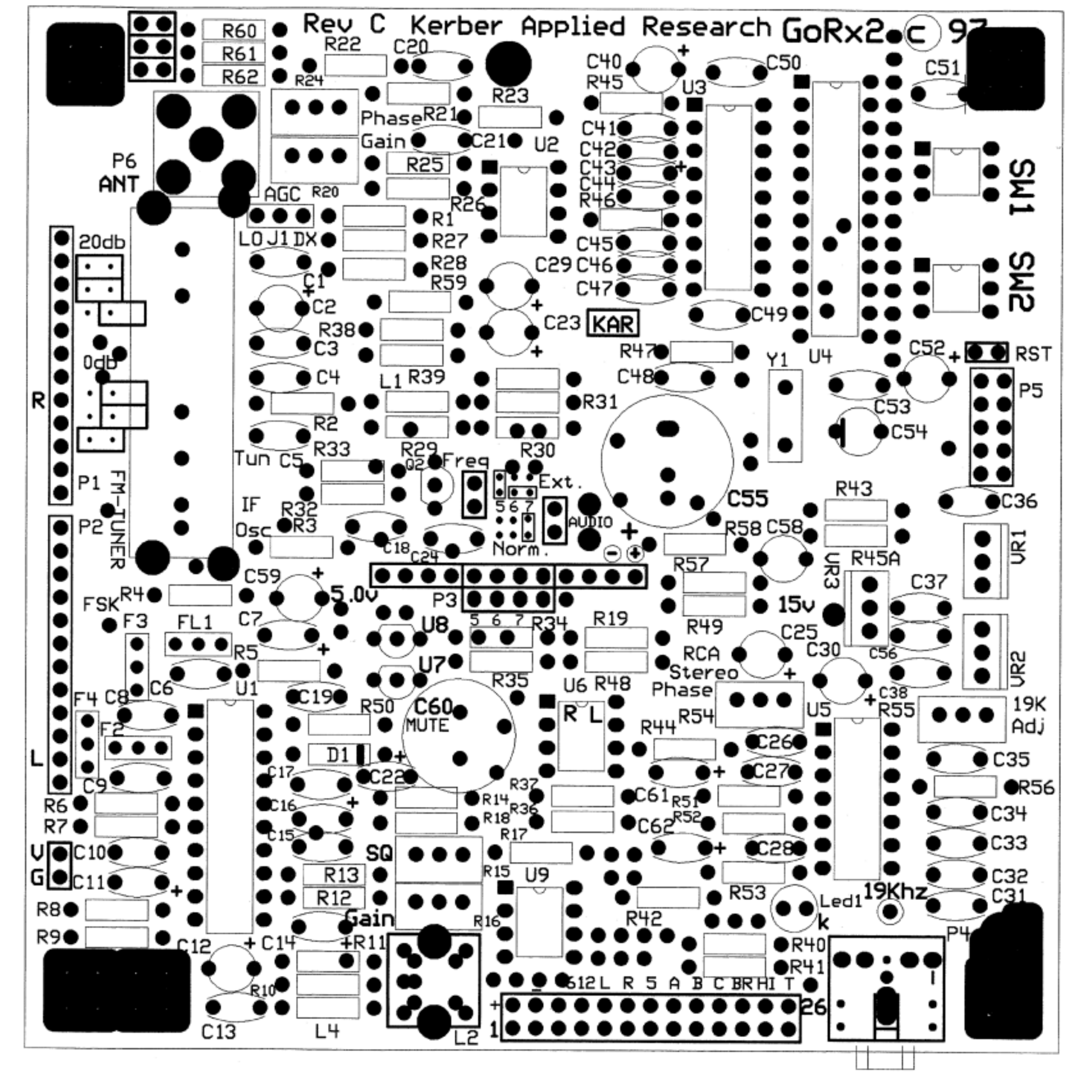
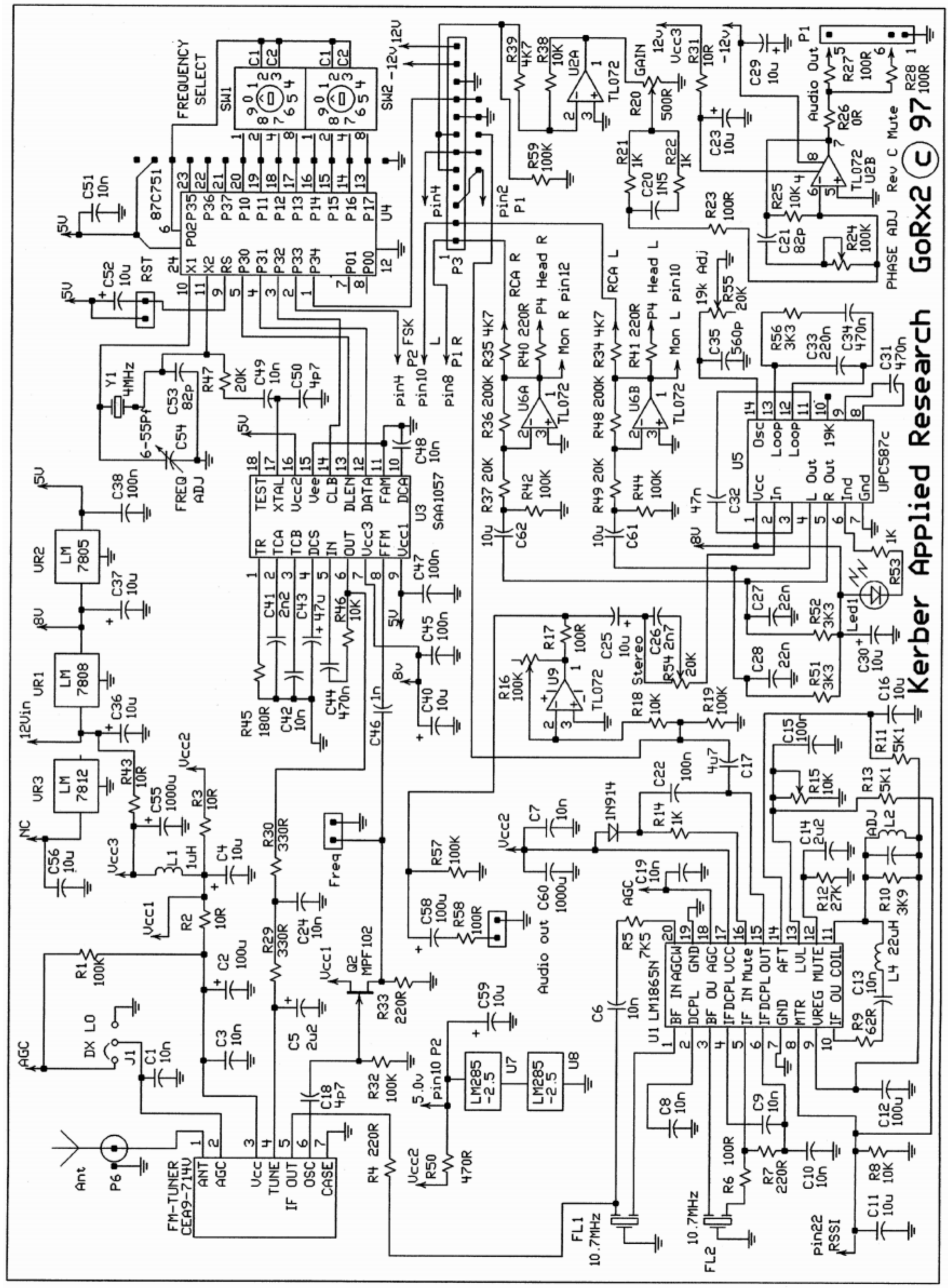


Illustration 6–16 Receiver Board



Receiver

Section 7—Service and Support

We understand that you may need various levels of support or that the product could require servicing at some point in time. This section provides information for both of these scenarios.

7.1 Service

The product warranty (see opposite page) outlines our responsibility for defective products. Before returning a product for repair or replacement (our choice), call our Customer Service department using the following telephone number:

(866) 262-8917

Our Customer Service Representative will give you further instructions regarding the return of your product. Use the original shipping carton or a new one obtained from Crown. Place shipping spacers between the slide-out power amplifier assembly and the back panel. Please fill out the Factory Service Instructions sheet (page 7–5) and include it with your returned product.

7.2 24–Hour Support

In most instances, what you need to know about your product can be found in this manual. There are times when you may need more in-depth information or even emergency-type information. We provide 24–hour technical assistance on your product via a toll telephone call. For **emergency help** or **detailed technical assistance**, call

(866) 262-8917

You may be required to leave a message at this number but your call will be returned promptly from our on-call technician.

7.3 Spare Parts

To obtain spare parts, call **Crown Broadcast Service** at the following number.
(866) 262-8917

You may also write to the following address:

International Radio & Electronics Corporation

25166 Leer Drive

Elkhart, Indiana, U.S.A. 46514-5425

Three-Year Limited Warranty

North America Only

SUMMARY OF WARRANTY

We, Crown Broadcast, a business unit of International Radio and Electronics Company, Inc., 25166 Leer Drive, Elkhart, Indiana 46515–2000 warrant to the ORIGINAL PURCHASER of a NEW Crown Broadcast product, for a period of three (3) years from the date of purchase by the original purchaser (the "warranty period") that the new Crown Broadcast product is free of defects in materials and workmanship and will meet or exceed all advertised specifications for such a product. This warranty does not extend to any subsequent purchaser or user, and automatically terminates upon sale or other disposition of our product.

ITEMS EXCLUDED FROM THIS CROWN BROADCAST

We are not responsible for product failure caused by misuse, accident, or neglect. This warranty does not extend to any product on which the serial number has been defaced, altered, or removed. It does not cover damage to loads or any other products or accessories resulting from Crown Broadcast product failure. It does not cover defects or damage caused by use of unauthorized modifications, accessories, parts, or service.

WHAT WE WILL DO

We will remedy any defect, in material or workmanship (except as excluded), in our sole discretion, by repair, replacement, or refund. If a refund is elected, then you must make the defective or malfunctioning component available to us free and clear of all liens or other encumbrances. The refund will be equal to the actual purchase price, not including interest, insurance, closing costs, and other finance charges less a reasonable depreciation on the product from the date of original purchase. Warranty work can only be performed at our authorized service centers or at our factory. Expenses in remedying the defect will be borne by Crown Broadcast, including two-way surface freight shipping costs within the United States. (Purchaser must bear the expense of shipping the product between any foreign country and the port of entry in the United States and all taxes, duties, and other custom's fee(s) for such foreign shipments.)

HOW TO OBTAIN WARRANTY SERVICE

You must notify us of your need for warranty service not later than ninety (90) days after the expiration of the warranty period. We will give you an authorization to return the product for service. All components must be shipped in a factory pack or equivalent which, if needed, may be obtained from us for a nominal charge. Corrective actions will be taken within a reasonable time of the date of receipt of the defective product by us. If the repairs made by us are not satisfactory, notify us immediately.

DISCLAIMER OF CONSEQUENTIAL AND INCIDENTAL DAMAGES

You are not entitled to recover from us any consequential or incidental damages resulting from any defect in our product. This includes any damage to another product or products resulting from such a defect.

WARRANTY ALTERATIONS

No person has the authority to enlarge, amend, or modify this warranty. The warranty is not extended by the length of time for which you are deprived of the use of the product. Repairs and replacement parts are provided under the terms of this warranty shall carry only the unexpired portion of this warranty.

DESIGN CHANGES

We reserve the right to change the design of any product from time to time without notice and with no obligation to make corresponding changes in products previously manufactured.

LEGAL REMEDIES OF PURCHASER

There is no warranty which extends beyond the terms hereof. This written warranty is given in lieu of any oral or implied warranties not contained herein. We disclaim all implied warranties, including without limitation any warranties of merchantability or fitness for a particular purpose. No action to enforce this warranty shall be commenced later than ninety (90) days after expiration of the warranty period.

Crown Broadcast, International and Radio Company, Inc.

25166 Leer Drive, P.O. Box 2000, Elkhart, Indiana 46515–2000

Revised August 2001

Notes:

Factory Service Instructions

To obtain factory service, complete the bottom half of this page, include it with the unit, and ship to:

International Radio & Electronics Corporation
25166 Leer Drive
Elkhart, Indiana, U.S.A. 46514-5425

For units in warranty (within 5 years of purchase from any authorized Crown Dealer): We pay for ground UPS shipments from anywhere in the continental U.S. and Federal Express Second Day service from Hawaii and Alaska to the factory and back to you. Expedited service/shipment is available for an additional charge. You may forward your receipt for shipping charges which we will reimburse. We do not cover any charges for shipping outside the U.S. or any of the expenses involved in clearing customs.

If you have any questions about your Crown Broadcast product, please contact Crown Broadcast Customer Service at:

Telephone: (866) 262-8917 or (866) 262-8972
Fax: (866) 262-8909

Name: Company:

Shipping Address:

Phone Number: Fax:

Model: Serial Number: Purchase Date:

Nature of the Problem
(Describe the conditions that existed when the problem occurred and what attempts were made to correct it.)

____

____

____

____

____

____

____

Other equipment in your system: ______________________________

If warranty has expired, payment will be: ☐ Cash/Check ☐ VISA ☐ Mastercard
☐ Please Quote before servicing

Card Number:____________________ Exp. Date: _______ Signature: ______________________

Return Shipment Preference if other than UPS Ground: ☐Expedite Shipment ☐Other__________

ENCLOSE WITH UNIT—DO NOT MAIL SEPARATELY

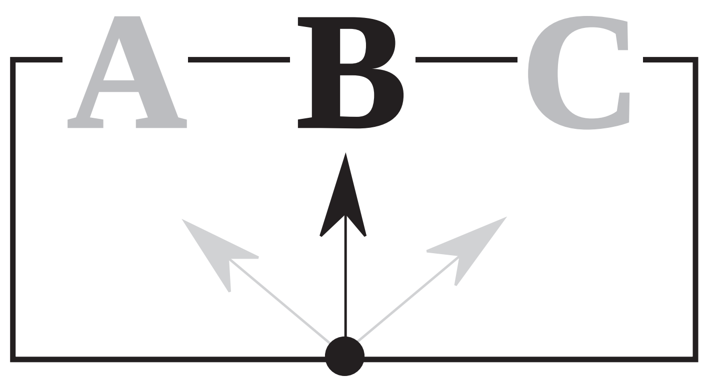
Appendix

Transmitter Output Efficiency

Transmitter efficiency output
RF Power Output Efficiency-FM500

PADC Volts	PADC Amps	RF Power	Efficiency
51.3	13.91	550	77%
48.3	13.29	500	78%
45.5	12.74	450	77%
42.7	12.14	400	77%
39.4	11.46	350	78%
36.0	10.68	300	78%
33.0	10.00	250	76%
29.6	9.25	200	73%
25.4	8.28	150	71%
21.1	7.29	100	65%

Power measurements were made at 97.1 MHz. Voltage and current measurements were taken from the unit's built-in metering. The accuracy of the internal metering is better than 2%. Return loss of the RF load was greater than -34dB at test frequency.



Glossary

The following pages define terms and abbreviations used throughout this manual.

AF	Audio Frequency; the frequencies between 20 Hz and 20 kHz in the electromagnetic spectrum.
ALC	Automatic Level Control
AM	Amplitude Modulation; the process of impressing information on a radio-frequency signal by varying its amplitude.
bandwidth	The range of frequencies available for signalling.
BCD	Binary-Coded Decimal; a digital system that uses binary codes to represent decimal digits.
BFO	Beat Frequency Oscillator
BNC	A bayonet locking connector for miniature coax; said to be short for Bayonet-Neill-Concelman.
broadband	As used in the FM transmitter, refers to the entire audio spectrum as opposed to the spectrum influenced by the pre-emphasis; also called "Wideband."
carrier	A continuous signal which is modulated with a second, information-carrying signal.
crosstalk	In FM broadcasting, this term generally refers to the interaction between the main (L+R) and the subcarrier (L–R) signals as opposed to "separation" which generally refers to leakage between left (L) and right (R) channels.
density (program)	A high average of modulation over time.
deviation	The amount by which the carrier frequency changes either side of the center frequency.
DIP	Dual In-line Pins; term used to describe a pin arrangement.
distortion	The unwanted changes in signal wave shape that occur during transmission between two points.
DPM	Digital Panel Meter
EPROM	Erasable Programmable Read Only Memory
ESD	Electrostatic Discharge; a discharge that is potentially destructive to sensitive electronic components.

exciter	(1) A circuit that supplies the initial oscillator used in the driver stage. (2) A transmitter configuration which excludes stereo generation and audio processing.
FET	Field-Effect Transistor
frequency synthesizer	A circuit that generates precise frequency signals by means of a single crystal oscillator in conjunction with frequency dividers and multipliers.
FM	Frequency Modulation; the process of impressing information on a radio signal by varying its frequency.
FSK	Frequency Shift Keying; an FM technique for shifting the frequency of the main carrier at a Morse code rate. Used in the on-air identification of frequencies.
gain reduction	The process of reducing the gain of a given amplifier.
harmonics	Undesirable energy at integral multiples of a desired, fundamental frequency.
HF	Hight Frequency; Frequencies in the 3.0 to 30.0 MHz range.
Highband	Frequencies affected by the pre-emphasis.
I/O	Input/Output
LED	Light-Emitting Diode
modulation	The process by which a carrier is varied to represent an information-carrying signal.
MOSFET	Metal Oxide Semiconductor Field Effect Transistor; a voltage-controlled device with high input impedance due to its electrically isolated gate.
nearcast	A transmission within a localized geographic area (ranging from a single room to a several kilometers).
PA	Power Amplifier

PAI	Power Amplifier Current
PAV	Power Amplifier Voltage
pilot	A 19–kHz signal used for stereo transmissions.
pre-emphasis	The deliberate accentuation of the higher audio frequencies; made possible by a high-pass filter.
processing	The procedure and/or circuits used to modify incoming audio to make it suitable for transmission.
receiver	An option which adds incoming RF capability to an existing transmitter. See also "Translator."
RF	Radio Frequency; (1) A specific portion of the electromagnetic spectrum between audio-frequency and the infrared portion. (2) A frequency useful for radio transmission (roughly 10 kHz and 100,000 MHz).
SCA	Subsidiary Communications Authorization; see "subcarrier."
S/N	Signal to Noise
spurious products	Unintended signals present on the transmission output terminal.
stability	A tolerance or measure of how well a component, circuit, or system maintains constant operating conditions over a period of time.
stereo pilot	See "pilot."
stereo separation	The amount of left-channel information that bleeds into the right channel (or vice versa).
subcarrier	A carrier signal which operates at a lower frequency than the main carrier frequency and which modulates the main carrier.
suppression	The process used to hold back or stop certain frequencies.

SWR	Standing-Wave Ratio; on a transmission line, the ratio of the maximum voltage to the minimum voltage or maximum current to the minimum current; also the ratio of load impedance to intended (50 ohms) load impedance.
THD	Total Harmonic Distortion
translator	A transmitter designed to internally change an FM signal from one frequency to another for retransmission. Used in conjunction with terrestrial-fed networks.
satellator	A transmitter equipped with an FSK ID option for rebroadcasting a satellite-fed signal.
VSWR	Voltage Standing-Wave Ratio; see "SWR."
Wideband	See "broadband."
VCO	Voltage-Controlled Oscillator

Index

R (continued)

S

T

V

W

X