



FM600 Broadcast Transmitter

User's Manual

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International Radio & Electronics Corporation
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Revision Control

Revision	Print Date
Initial Release	March 2007
Revision A	January 2008
Revision B	February 2021

Changes include High Power Power Supply, Receiver PWA, & SMT Motherboard

Important Notices

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Crown Broadcast attempts to provide information that is accurate, complete, and useful. Should you find inadequacies in the text, please send your comments to the following email address: fmsales@irec1.com.

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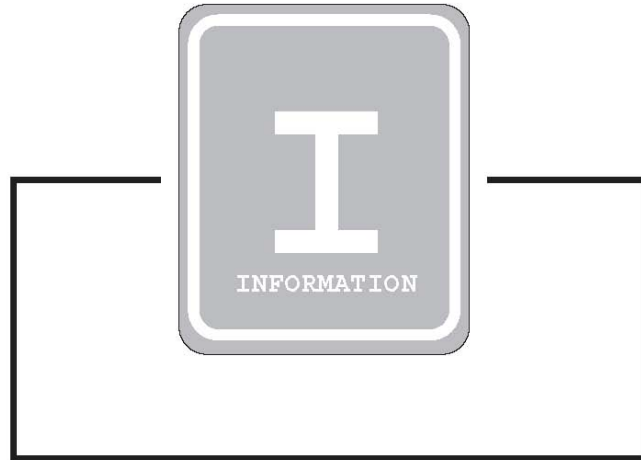
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Section 1—Getting Acquainted

This section provides a general description of the FM600 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 FM600 is a member of a family of FM stereo broadcast transmitters. Crown transmitters are known for their integration, ease-of-use, and reliability.

The integration 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 5 external switches), add an audio source, attach an antenna, and 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 are made possible through a built-in I/O connector. Crown offers an internal remote option, the IReC-1. See page 1-9. Crown also offers a stand-alone unit, The Companion. See our website www.crownbroadcast.com for more information.

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 FM600 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, satellator, and nearcast 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 FM600, for example, can generate up to 600 watts of RF output power.

Suffix letters describe the configuration. The FM600T, for example, is the standard or transmitter configuration. Except where specified, this document describes the transmitter configuration. In this configuration, the product includes the following components (functions):

- Audio Processor/Stereo Generator
- RF Exciter
- Metering
- Low-Pass filter

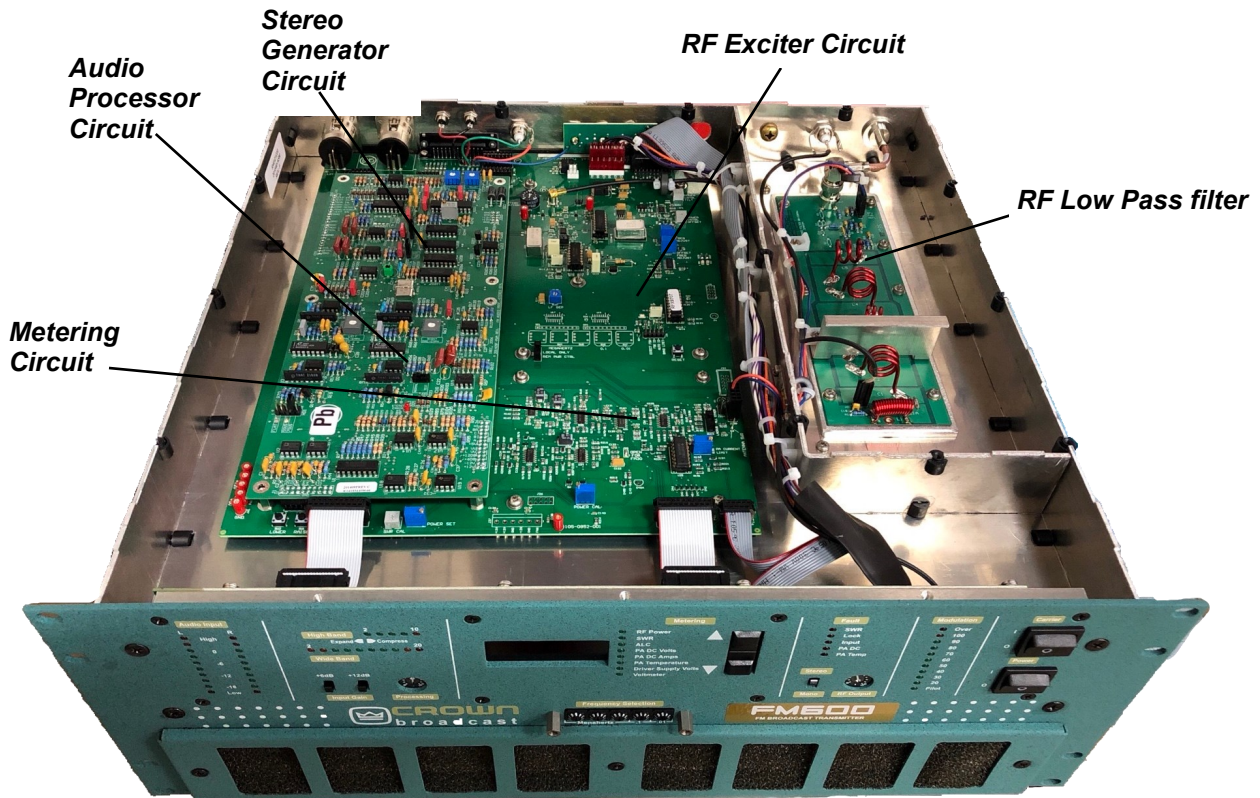


Illustration 1-2 Standard (Transmitter) Configuration

1.2.1 Stand-Alone

In the standard configuration, the FM600 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 Exciter

In addition to the standard configuration, the FM600 is available in optional configurations to meet a variety of needs.

An "E" suffix, as in the FM600E, for example, represents an exciter-only configuration. In this configuration, the audio processor and stereo generator boards are replaced with circuitry to bypass their function. 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.

1.2.4 Translator

A receiver configuration (FM600R, for example) replaces the audio processor/stereo generator board with a receiver module. This added feature makes the FM600 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.

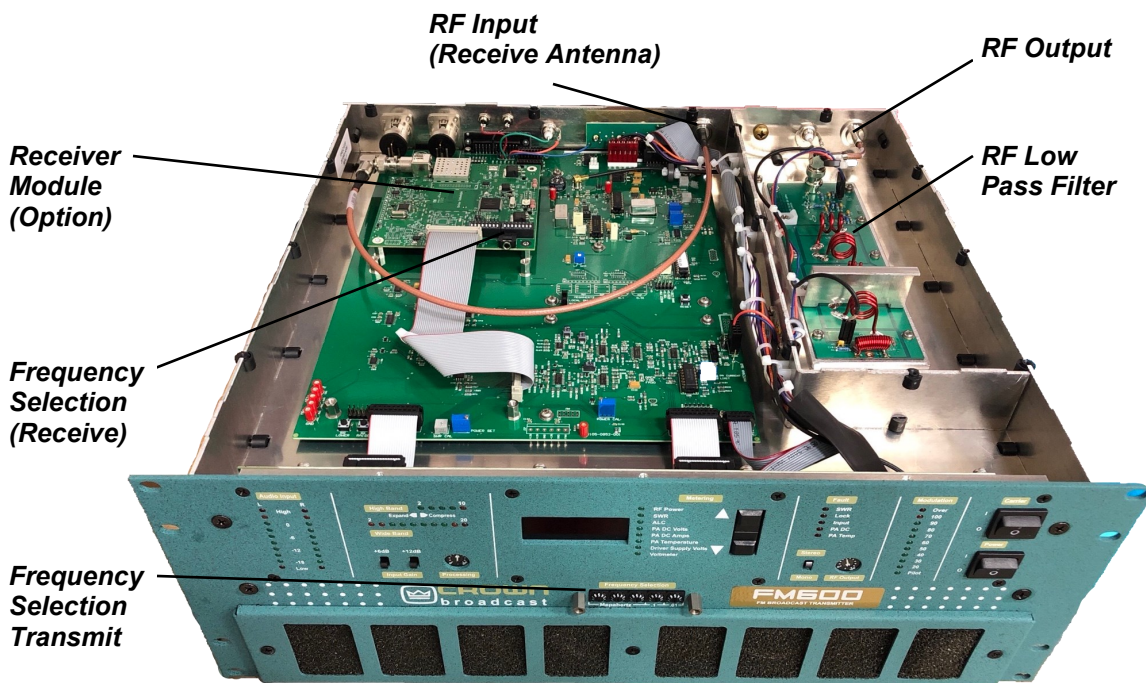


Illustration 1-3 Crown's Integrated Translator

This option enables RF input and RF output on any of Crown's Classic FM series of transmitters. The CT-1 Receiver Module does not allow feedthrough to the composite output. The CT-1 however, is designed to handle SCA channel output up to 100 kHz for audio and high-speed data. The CT-1 will also receive both AM & FM frequencies.

FSK (Frequency Shift Keying) 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.

In the translator configuration, there are differences in the function of the front panel. See Section 3 for a description.

1.2.5 Satellator

One additional option is available for all configurations—an FSK Identifier (FSK IDer). This added feature enables the FM600 to transmit its call sign or operating frequency in a Morse code style. 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).



Illustration 1–4 Transmitter with FSK IDer Option

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

1.3 Transmitter/Exciter Specifications

Frequency Range	87.9 MHz–107.9 MHz (76 MHz–90 MHz optionally available)
RF Power Output	(VSWR 1.7:1 or better)
FM600	Up to 660 watts output
RF Output Impedance	50 Ohms
Frequency Stability	Meets FCC specifications from 0-50 degrees C
Audio Input Impedance	50k Ω 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 μ S; or flat
Audio Response	Conforms to 75 μ S pre-emphasis curve as follows:
Complete Transmitter	\pm 0.30 dB (50 Hz–10 kHz) \pm 1.0 dB (10 kHz–15 kHz)
Exciter only	\pm 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 –40dB (50 Hz-15 kHz)
Exciter only	Better than –40dB (50 Hz-15 kHz)
Crosstalk	Main into Sub, better than –40dB Sub into Main, better than –40dB
Stereo Pilot	19 kHz \pm 2 Hz, 9% modulation

Subcarrier Suppression	50dB 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 FCC requirements
RF Bandwidth	± 120 kHz, better than -35 dB
	± 240 kHz, better than -45 dB
RF Spurious Products	Better than -71 dB
Operating Environment	Temperature (0°C to 50°C)
	Humidity (0 to 80% at 20°C)
	Maximum Altitude (3,000 Meters; 9834 Feet)
AC Power	240 volts* $\pm 10\%$ 50/60 Hz

Note: We set voltage and ampere requirements to assist you in designing your system. Depending on your operating frequency, actual requirements for maximum voltage and current readings are 10–15% lower than stated.

Regulatory	FCC Supplier Declaration of Conformity or Type Notified part 74 Meets FCC, SDoC
Dimensions	32.38 x 59.69 x 62.23 centimeters 12.75 x 23.5 x 24.5 Inches
Weight	38 lbs 17.237 Kg

1.4 Receiver Specifications

Monaural Sensitivity (demodulated, de-emphasized)

2 μ V for signal-to-noise > 40 dB

Stereo Sensitivity (19-kHz pilot frequency added)

35 μ V for signal-to-noise > 50 dB

Connector

Standard type N-Female, 50 Ω

Shipping Weight

1 lb

1.5 IReC-1 Internet Remote Access Option

If ordered with the transmitter, the IReC-1 will come preinstalled. It may also be added to existing Crown Classic transmitters as a factory upgrade or an upgrade kit can be ordered and installed by a station engineer. (The Companion is the stand-alone option just Plug & Play.)

Features include...

- Programmable alarm parameters for email alerts
- 3 levels of password control
- Low power consumption for ultimate reliability
- Extreme long-term logging
- No mechanical relays—Better reliability with opto-couplers
- Upgrades can be done through the Internet after revision 1.5.6 has been installed. If you have an older unit with a black SD Card, you can request a new SD card by emailing service@irec1.com and the factory will send it free of charge. Please note, you must provide the serial # of the IReC-1 for this free upgrade.

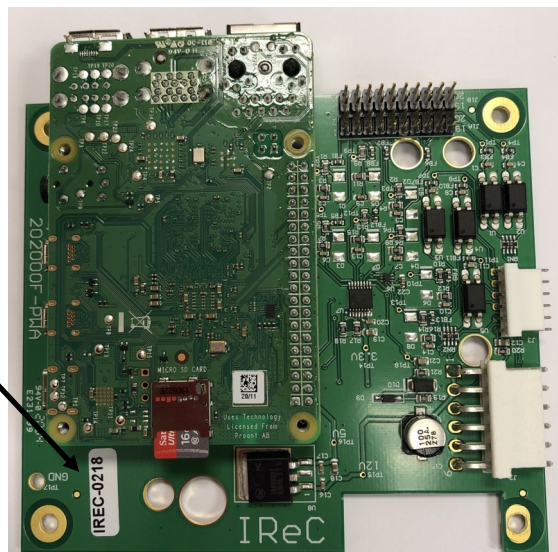


Illustration 1–5 IReC-1

1.6 Safety Considerations

Crown Broadcast assumes the responsibility for providing you with 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.

1.6.1 Dangers

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

1.6.2 Warnings

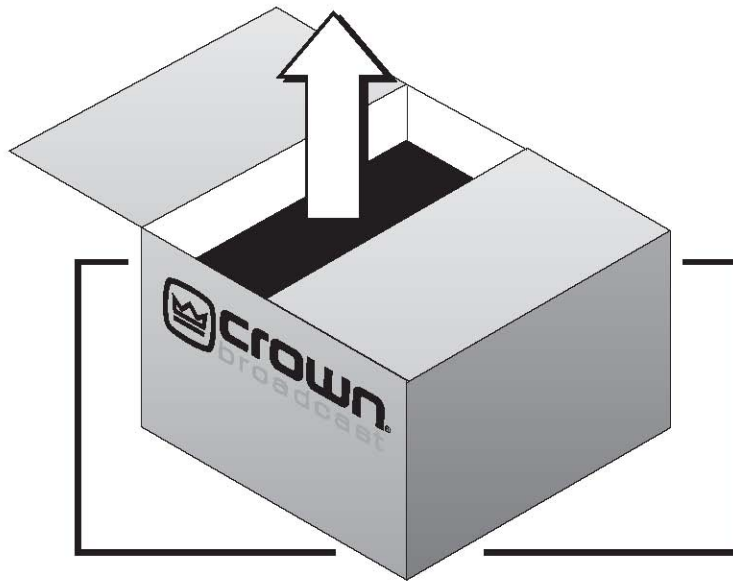
WARNING represents hazards which could result in severe injury or death.

1.6.3 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 1–6 Sample Hazard Alert



Section 2—Installation

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

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 Power Connections

The FM600 operates best on 240 volts AC (50 or 60 Hz; single phase). The power cord that is included has a supply end that can only be plugged into 240 volts.

If the FM600 is run at 500 watts or below, it can be plugged into 110 volts.

2.2.1 AC Line Voltage Setting

Voltage selection is automatic; configuration is not necessary.

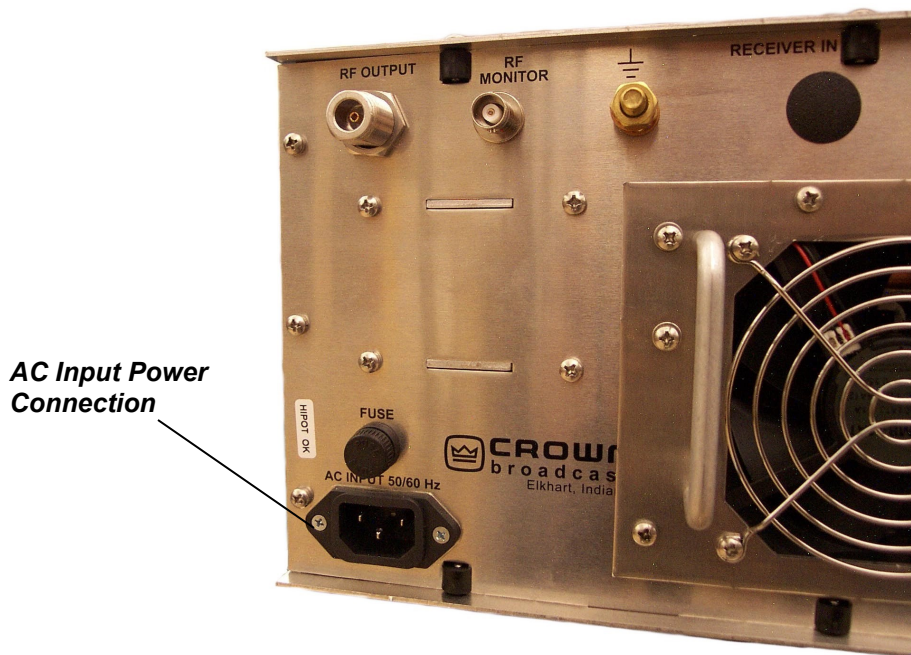


Illustration 2-2 AC Input Power Connection

2.2.2 Fuses

The fuse holder is located on the back panel just above the power connection.

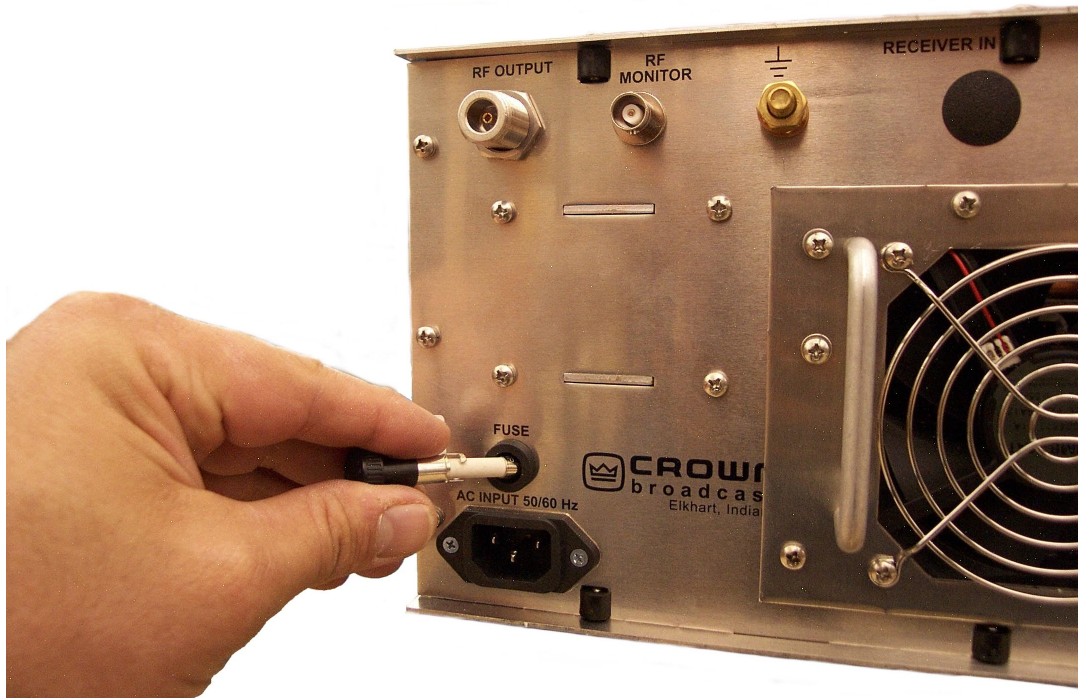


Illustration 2-3 Fuse Holder

For the recommended 200 to 240 VAC operation, use the fuse installed at the factory. For 120 to 200 consult the following table:

AC Input Voltage	Fuse Rating
200-240 VAC	6 Ampere
120-200 VAC	12 Ampere

Illustration 2-4 Fuse Reference Table

2.3 Frequency (Channel) Selection

Your transmitter is capable of operating between 87.9 and 107.9 MHz in the FM band. The transmitter can also operate between 76 and 90 MHz by shorting pins 9 and 10 of J20 on the motherboard. See Illustration 2-6.

To adjust the operating frequency, follow these steps:

1. Locate the frequency selector switches on the front panel which will be used to change the setting. See Illustrations 2-6 and 2-7.
2. Use a 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.
3. To change the operating band from 87.9-107.9MHz to 76-90MHz or vice versa, or to adjust the modulation compensation pot, remove the top cover to gain access to these features. See Illustrations 2-6 and 2-10.

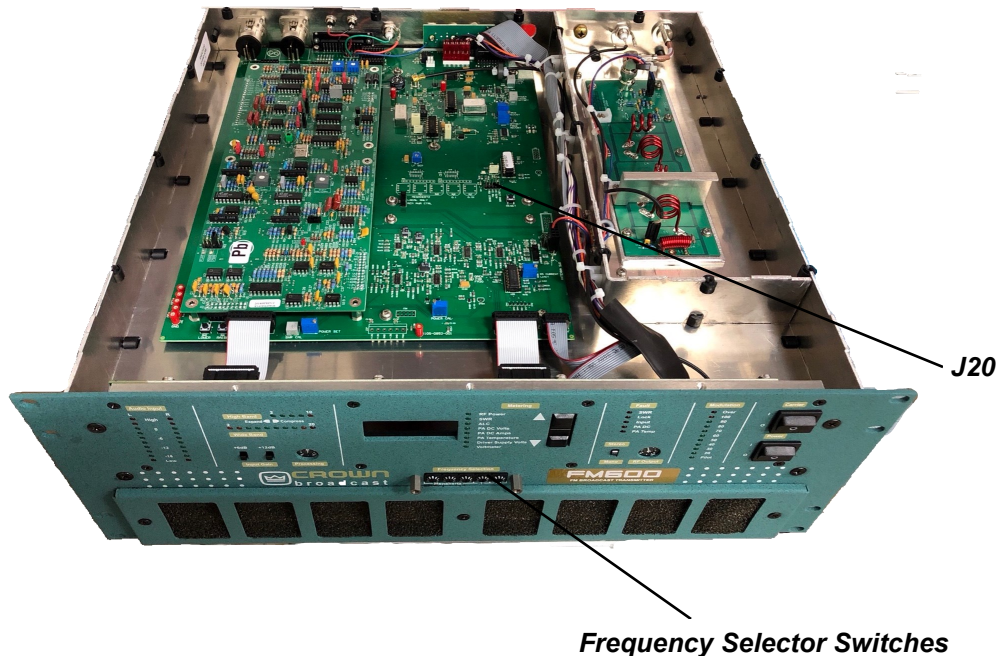


Illustration 2-6 Top Cover Removed

2.3 Frequency (Channel) Selection, continued

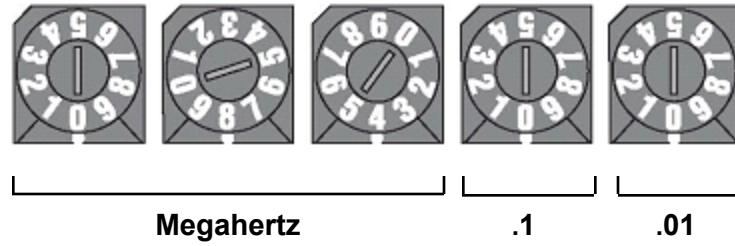


Illustration 2-7 Transmitter Front Panel (Frequency Selector Switches)

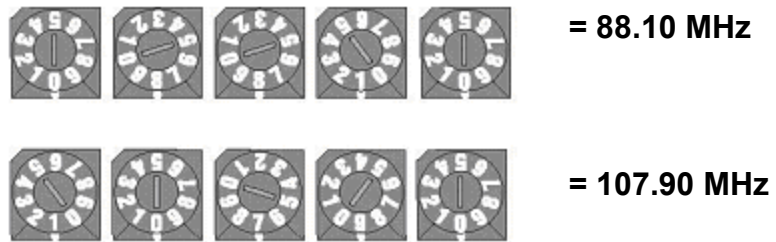


Illustration 2-8 Two Sample Frequency Selections

2.3.1 Modulation Compensator

The Modulation trim-potentiometer (see Illustration 2–10) compensates for slight variations in deviation sensitivity with frequency. Set the trim-pot dial according to the following graph:

Frequency of Operation (MHz)	Modulation Compensation Pot Setting
108	0
106	10
104	15
102	25
100	35
98	40
97.1	45
96	55
94	60
92	70
90	75
88	80
86	80
84	80
82.4	70
82	65
80	55
78	30
76	0

Illustration 2–9 Modulation Compensator Settings

These compensator settings are approximate. Each mark on the potentiometer represents about 1.8% modulation compensation.

*Modulation
Compensa-
tor*

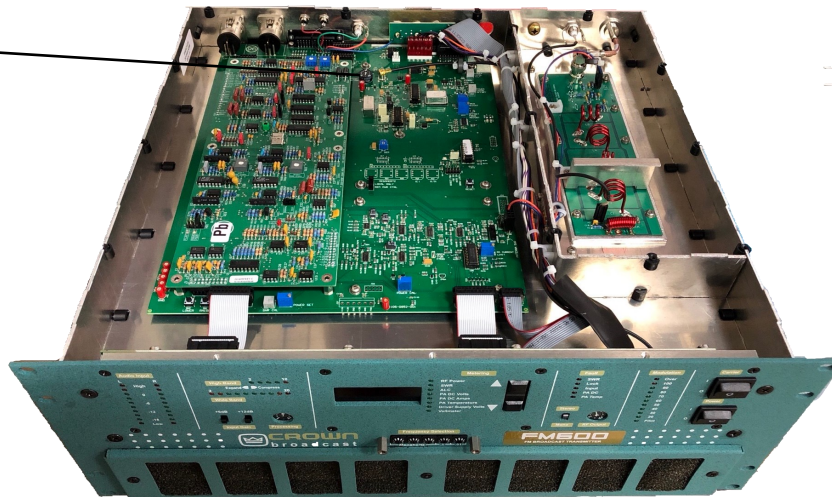


Illustration 2–10 Modulation Compensator Pot

2.4 Receiver Frequency Selection

If you have a transmitter equipped with the receiver option, you will need to set the receiving or incoming frequency. Use the adjacent chart to set the DIP switches for the desired incoming frequency.

- 1) With the top cover removed, locate the receiver module and the two DIP switches (labeled DIP0 and DIP1), and identify pins 1:8 of each DIP switch. Note that “On” or “1” is indicated by a DIP pin being in the “Up” position, and “Off” or “0” is indicated by a DIP pin being in the “Down” position.
- 2) Use the following tables to set DIP0 Pins 1:8 and DIP1 Pins 1:2 for the desired incoming frequency:
 - a. For FM Reception, use Illustration 2-14 and 2-15 on page 2-8. The frequency chosen by setting DIP0’s pins and the offset chosen by setting DIP1’s pins 1:2 must sum to your desired frequency. (e.g. $98.00 + 0.10 = 98.10$)
 - b. For AM Reception, use Illustration 2-16 on page 2-9.
- 3) Set the reserved pins, DIP1’s pins 3:8, to “Off”.
- 4) Press the Reset button to force the receiver to use the new configuration settings. Be careful when pressing the Reset button, as the resistor next to the button may be very hot; this is normal.
- 5) After setting the frequency, replace the top cover and screws.



Illustration 2-11 CHT-1 Receiver Module Frequency DIP Switches

The translator's receiver can tune FM frequencies from 76.00 – 108.00 MHz in steps of 0.05 MHz (50kHz); this allows for tuning of all typical FM broadcast frequencies in the US, European, and Japanese Bands. To tune:

- 1) Use Illustration 2-14 on page 2-9, to correctly set DIP0's pins 1:8 values to match the closest frequency less than or equal to your desired frequency.
- 2) Use Illustration 2-15 on page 2-9, to add the additional frequency offset needed to obtain your desired frequency.
- 3) Press the Reset button to force the receiver to tune using the new configuration settings. Be careful when pressing the Reset button, as the resistor next to the button may be very hot; this is normal.

For example: If 98.10 MHz is desired, set DIP0 to the value corresponding to 98.00 MHz (01101110), and set DIP1 pins 1:2 to the value corresponding to 0.10 MHz (10). 98.00 MHz + 0.10 MHz = 98.10 MHz, the desired frequency. See Figure 2, below, for a picture of the correct DIP positions for tuning 98.10 MHz.

DIP1's pins 3:8 are reserved for future use. All of these pins should be in the "Off" position as to not interfere with the intended operation of this translator board version. Unintended results could occur if any of these pins are in the "On" position.

No configuration of De/Pre-Emphasis is necessary for the CHT-1. The Pre-Emphasis of the translator will be the same as the Pre-Emphasis of the source station.

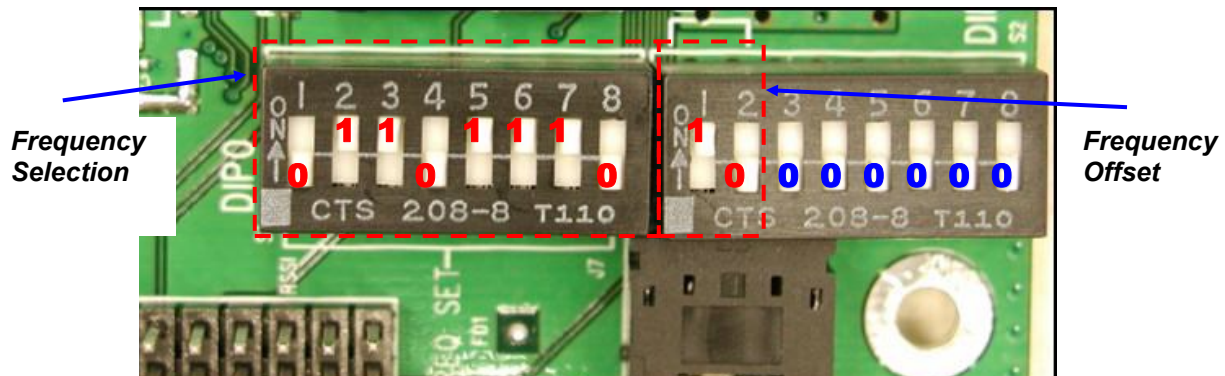


Illustration 2-12 CHT-1 Receiver Module DIP Switches

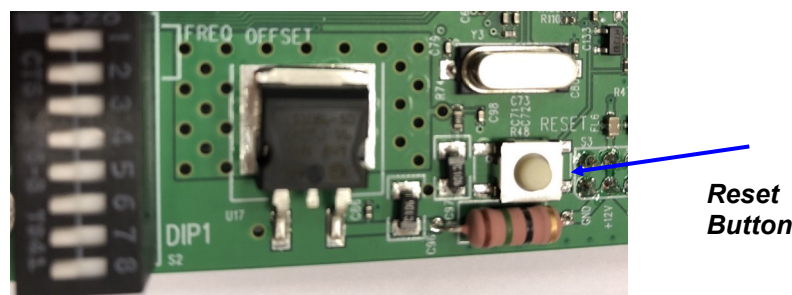


Illustration 2-13 CHT-1 Receiver Module Reset Button

Frequency (MHz)	DIP0		Frequency (MHz)	DIP0		Frequency (MHz)	DIP0		Frequency (MHz)	DIP0	
	1:4	5:8		1:4	5:8		1:4	5:8		1:4	5:8
76.00	0000	0000	84.00	0010	1000	92.00	0101	0000	100.00	0111	1000
76.20	0000	0001	84.20	0010	1001	92.20	0101	0001	100.20	0111	1001
76.40	0000	0010	84.40	0010	1010	92.40	0101	0010	100.40	0111	1010
76.60	0000	0011	84.60	0010	1011	92.60	0101	0011	100.60	0111	1011
76.80	0000	0100	84.80	0010	1100	92.80	0101	0100	100.80	0111	1100
77.00	0000	0101	85.00	0010	1101	93.00	0101	0101	101.00	0111	1101
77.20	0000	0110	85.20	0010	1110	93.20	0101	0110	101.20	0111	1110
77.40	0000	0111	85.40	0010	1111	93.40	0101	0111	101.40	0111	1111
77.60	0000	1000	85.60	0011	0000	93.60	0101	1000	101.60	1000	0000
77.80	0000	1001	85.80	0011	0001	93.80	0101	1001	101.80	1000	0001
78.00	0000	1010	86.00	0011	0010	94.00	0101	1010	102.00	1000	0010
78.20	0000	1011	86.20	0011	0011	94.20	0101	1011	102.20	1000	0011
78.40	0000	1100	86.40	0011	0100	94.40	0101	1100	102.40	1000	0100
78.60	0000	1101	86.60	0011	0101	94.60	0101	1101	102.60	1000	0101
78.80	0000	1110	86.80	0011	0110	94.80	0101	1110	102.80	1000	0110
79.00	0000	1111	87.00	0011	0111	95.00	0101	1111	103.00	1000	0111
79.20	0001	0000	87.20	0011	1000	95.20	0110	0000	103.20	1000	1000
79.40	0001	0001	87.40	0011	1001	95.40	0110	0001	103.40	1000	1001
79.60	0001	0010	87.60	0011	1010	95.60	0110	0010	103.60	1000	1010
79.80	0001	0011	87.80	0011	1011	95.80	0110	0011	103.80	1000	1011
80.00	0001	0100	88.00	0011	1100	96.00	0110	0100	104.00	1000	1100
80.20	0001	0101	88.20	0011	1101	96.20	0110	0101	104.20	1000	1101
80.40	0001	0110	88.40	0011	1110	96.40	0110	0110	104.40	1000	1110
80.60	0001	0111	88.60	0011	1111	96.60	0110	0111	104.60	1000	1111
80.80	0001	1000	88.80	0100	0000	96.80	0110	1000	104.80	1001	0000
81.00	0001	1001	89.00	0100	0001	97.00	0110	1001	105.00	1001	0001
81.20	0001	1010	89.20	0100	0010	97.20	0110	1010	105.20	1001	0010
81.40	0001	1011	89.40	0100	0011	97.40	0110	1011	105.40	1001	0011
81.60	0001	1100	89.60	0100	0100	97.60	0110	1100	105.60	1001	0100
81.80	0001	1101	89.80	0100	0101	97.80	0110	1101	105.80	1001	0101
82.00	0001	1110	90.00	0100	0110	98.00	0110	1110	106.00	1001	0110
82.20	0001	1111	90.20	0100	0111	98.20	0110	1111	106.20	1001	0111
82.40	0010	0000	90.40	0100	1000	98.40	0111	0000	106.40	1001	1000
82.60	0010	0001	90.60	0100	1001	98.60	0111	0001	106.60	1001	1001
82.80	0010	0010	90.80	0100	1010	98.80	0111	0010	106.80	1001	1010
83.00	0010	0011	91.00	0100	1011	99.00	0111	0011	107.00	1001	1011
83.20	0010	0100	91.20	0100	1100	99.20	0111	0100	107.20	1001	1100
83.40	0010	0101	91.40	0100	1101	99.40	0111	0101	107.40	1001	1101
83.60	0010	0110	91.60	0100	1110	99.60	0111	0110	107.60	1001	1110
83.80	0010	0111	91.80	0100	1111	99.80	0111	0111	107.80	1001	1111
									108.00	1010	0000

Illustration 2–14 CHT-1 Receiver FM Frequency Selection DIP0 1:8

Offset	(MHz)	0.00	0.05	0.10	0.15
DIP1	1:2	00	01	10	11

Illustration 2–15 CHT-1 Receiver FM Frequency Offsets DIP1 1:2

US AM Band				US AM Band				US AM Band			
Frequency	DIP0		DIP1	Frequency	DIP0		DIP1	Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2	(kHz)	1:4	5:8	1:2	(kHz)	1:4	5:8	1:2
520	1100	0000	00	920	1100	1010	00	1320	1101	0100	00
530	1100	0000	01	930	1100	1010	01	1330	1101	0100	01
540	1100	0000	10	940	1100	1010	10	1340	1101	0100	10
550	1100	0000	11	950	1100	1010	11	1350	1101	0100	11
560	1100	0001	00	960	1100	1011	00	1360	1101	0101	00
570	1100	0001	01	970	1100	1011	01	1370	1101	0101	01
580	1100	0001	10	980	1100	1011	10	1380	1101	0101	10
590	1100	0001	11	990	1100	1011	11	1390	1101	0101	11
600	1100	0010	00	1000	1100	1100	00	1400	1101	0110	00
610	1100	0010	01	1010	1100	1100	01	1410	1101	0110	01
620	1100	0010	10	1020	1100	1100	10	1420	1101	0110	10
630	1100	0010	11	1030	1100	1100	11	1430	1101	0110	11
640	1100	0011	00	1040	1100	1101	00	1440	1101	0111	00
650	1100	0011	01	1050	1100	1101	01	1450	1101	0111	01
660	1100	0011	10	1060	1100	1101	10	1460	1101	0111	10
670	1100	0011	11	1070	1100	1101	11	1470	1101	0111	11
680	1100	0100	00	1080	1100	1110	00	1480	1101	1000	00
690	1100	0100	01	1090	1100	1110	01	1490	1101	1000	01
700	1100	0100	10	1100	1100	1110	10	1500	1101	1000	10
710	1100	0100	11	1110	1100	1110	11	1510	1101	1000	11
720	1100	0101	00	1120	1100	1111	00	1520	1101	1001	00
730	1100	0101	01	1130	1100	1111	01	1530	1101	1001	01
740	1100	0101	10	1140	1100	1111	10	1540	1101	1001	10
750	1100	0101	11	1150	1100	1111	11	1550	1101	1001	11
760	1100	0110	00	1160	1101	0000	00	1560	1101	1010	00
770	1100	0110	01	1170	1101	0000	01	1570	1101	1010	01
780	1100	0110	10	1180	1101	0000	10	1580	1101	1010	10
790	1100	0110	11	1190	1101	0000	11	1590	1101	1010	11
800	1100	0111	00	1200	1101	0001	00	1600	1101	1011	00
810	1100	0111	01	1210	1101	0001	01	1610	1101	1011	01
820	1100	0111	10	1220	1101	0001	10	1620	1101	1011	10
830	1100	0111	11	1230	1101	0001	11	1630	1101	1011	11
840	1100	1000	00	1240	1101	0010	00	1640	1101	1100	00
850	1100	1000	01	1250	1101	0010	01	1650	1101	1100	01
860	1100	1000	10	1260	1101	0010	10	1660	1101	1100	10
870	1100	1000	11	1270	1101	0010	11	1670	1101	1100	11
880	1100	1001	00	1280	1101	0011	00	1680	1101	1101	00
890	1100	1001	01	1290	1101	0011	01	1690	1101	1101	01
900	1100	1001	10	1300	1101	0011	10	1700	1101	1101	10
910	1100	1001	11	1310	1101	0011	11	1710	1101	1101	11

Illustration 2–16 CHT-1 Receiver US AM Band Frequency Selection

Europe/Japan AM Band				Europe/Japan AM Band				Europe/Japan AM Band			
Frequency	DIP0		DIP1	Frequency	DIP0		DIP1	Frequency	DIP0		DIP1
(kHz)	1:4	5:8	1:2	(kHz)	1:4	5:8	1:2	(kHz)	1:4	5:8	1:2
531	1110	0000	00	900	1110	1010	01	1269	1111	0100	10
540	1110	0000	01	909	1110	1010	10	1278	1111	0100	11
549	1110	0000	10	918	1110	1010	11	1287	1111	0101	00
558	1110	0000	11	927	1110	1011	00	1296	1111	0101	01
567	1110	0001	00	936	1110	1011	01	1305	1111	0101	10
576	1110	0001	01	945	1110	1011	10	1314	1111	0101	11
585	1110	0001	10	954	1110	1011	11	1323	1111	0110	00
594	1110	0001	11	963	1110	1100	00	1332	1111	0110	01
603	1110	0010	00	972	1110	1100	01	1341	1111	0110	10
612	1110	0010	01	981	1110	1100	10	1350	1111	0110	11
621	1110	0010	10	990	1110	1100	11	1359	1111	0111	00
630	1110	0010	11	999	1110	1101	00	1368	1111	0111	01
639	1110	0011	00	1008	1110	1101	01	1377	1111	0111	10
648	1110	0011	01	1017	1110	1101	10	1386	1111	0111	11
657	1110	0011	10	1026	1110	1101	11	1395	1111	1000	00
666	1110	0011	11	1035	1110	1110	00	1404	1111	1000	01
675	1110	0100	00	1044	1110	1110	01	1413	1111	1000	10
684	1110	0100	01	1053	1110	1110	10	1422	1111	1000	11
693	1110	0100	10	1062	1110	1110	11	1431	1111	1001	00
702	1110	0100	11	1071	1110	1111	00	1440	1111	1001	01
711	1110	0101	00	1080	1110	1111	01	1449	1111	1001	10
720	1110	0101	01	1089	1110	1111	10	1458	1111	1001	11
729	1110	0101	10	1098	1110	1111	11	1467	1111	1010	00
738	1110	0101	11	1107	1111	0000	00	1476	1111	1010	01
747	1110	0110	00	1116	1111	0000	01	1485	1111	1010	10
756	1110	0110	01	1125	1111	0000	10	1494	1111	1010	11
765	1110	0110	10	1134	1111	0000	11	1503	1111	1011	00
774	1110	0110	11	1143	1111	0001	00	1512	1111	1011	01
783	1110	0111	00	1152	1111	0001	01	1521	1111	1011	10
792	1110	0111	01	1161	1111	0001	10	1530	1111	1011	11
801	1110	0111	10	1170	1111	0001	11	1539	1111	1100	00
810	1110	0111	11	1179	1111	0010	00	1548	1111	1100	01
819	1110	1000	00	1188	1111	0010	01	1557	1111	1100	10
828	1110	1000	01	1197	1111	0010	10	1566	1111	1100	11
837	1110	1000	10	1206	1111	0010	11	1575	1111	1101	00
846	1110	1000	11	1215	1111	0011	00	1584	1111	1101	01
855	1110	1001	00	1224	1111	0011	01	1593	1111	1101	10
864	1110	1001	01	1233	1111	0011	10	1602	1111	1101	11
873	1110	1001	10	1242	1111	0011	11	1611	1111	1110	00
882	1110	1001	11	1251	1111	0100	00	1620	1111	1110	01
891	1110	1010	00	1260	1111	0100	01	1629	1111	1110	10

Illustration 2–17 CHT-1 Receiver Europe/Japan AM Band Frequency Selection

2.5 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 Receiver IN connector.

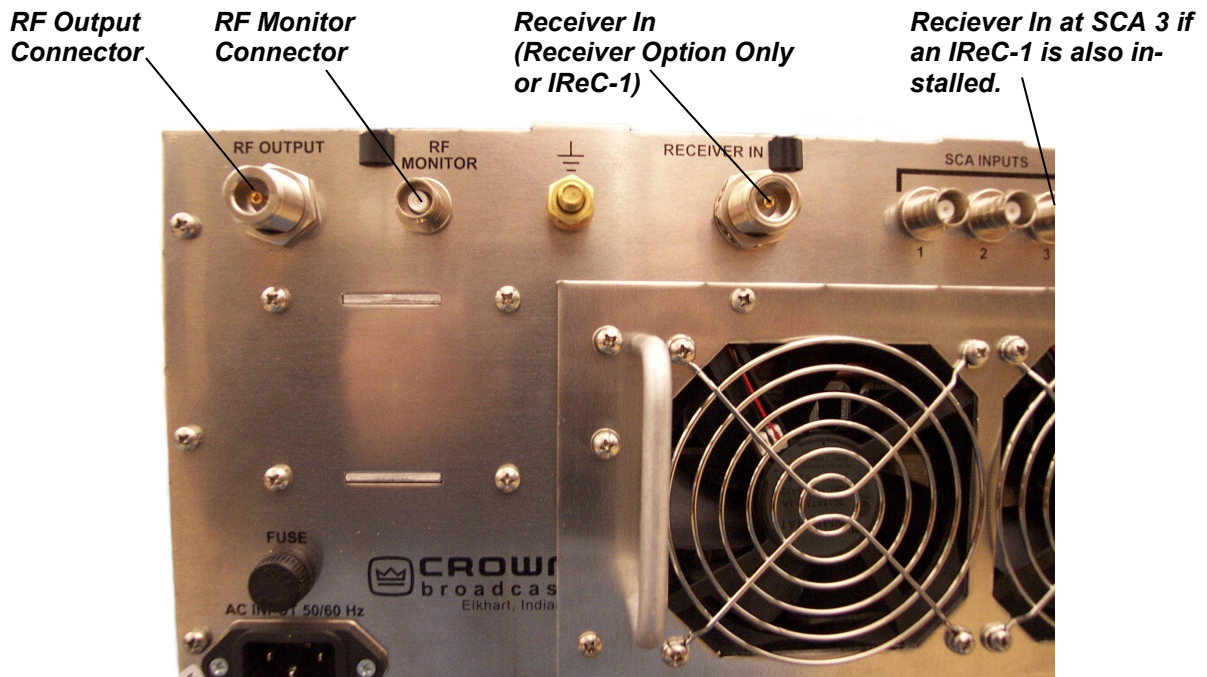


Illustration 2-18 RF Connections

2.6 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 (+ or High) and 3 (- or Low) represent a balanced differential input with an impedance of about 50 k Ω . 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.

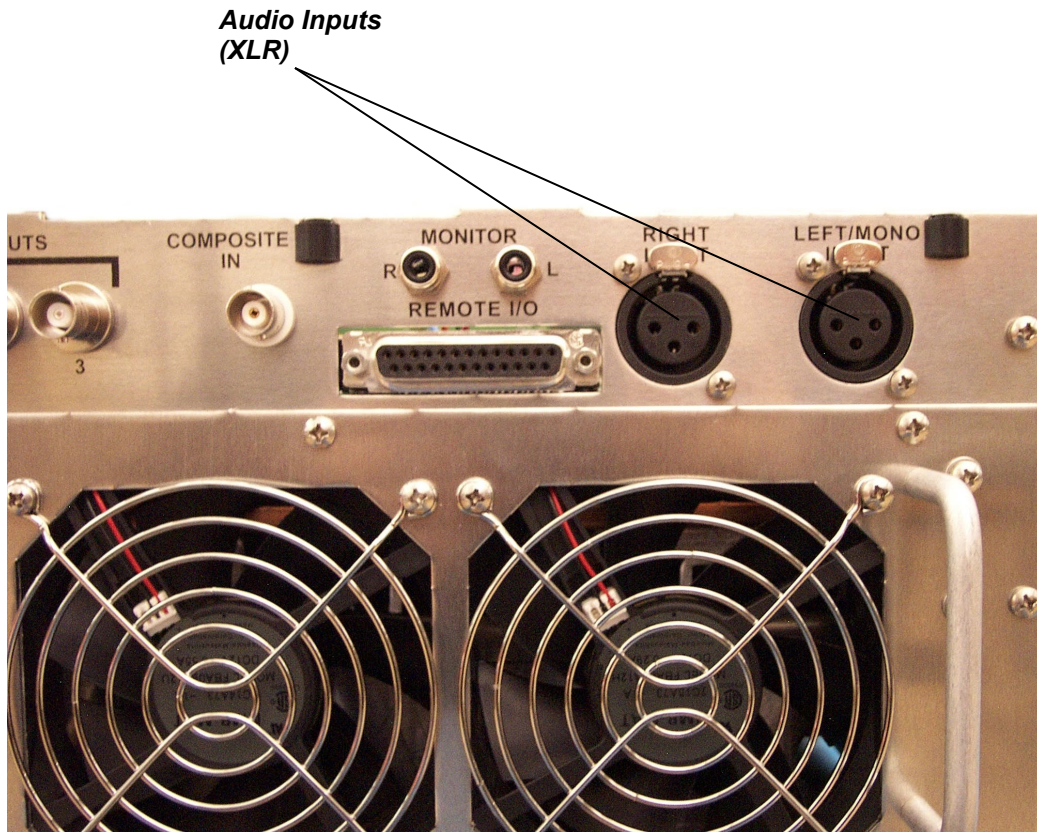


Illustration 2–19 XLR Audio Input Connectors

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, see the motherboard configuration chart on page 4-9 for the proper configuration of the jumpers.

2.7 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.

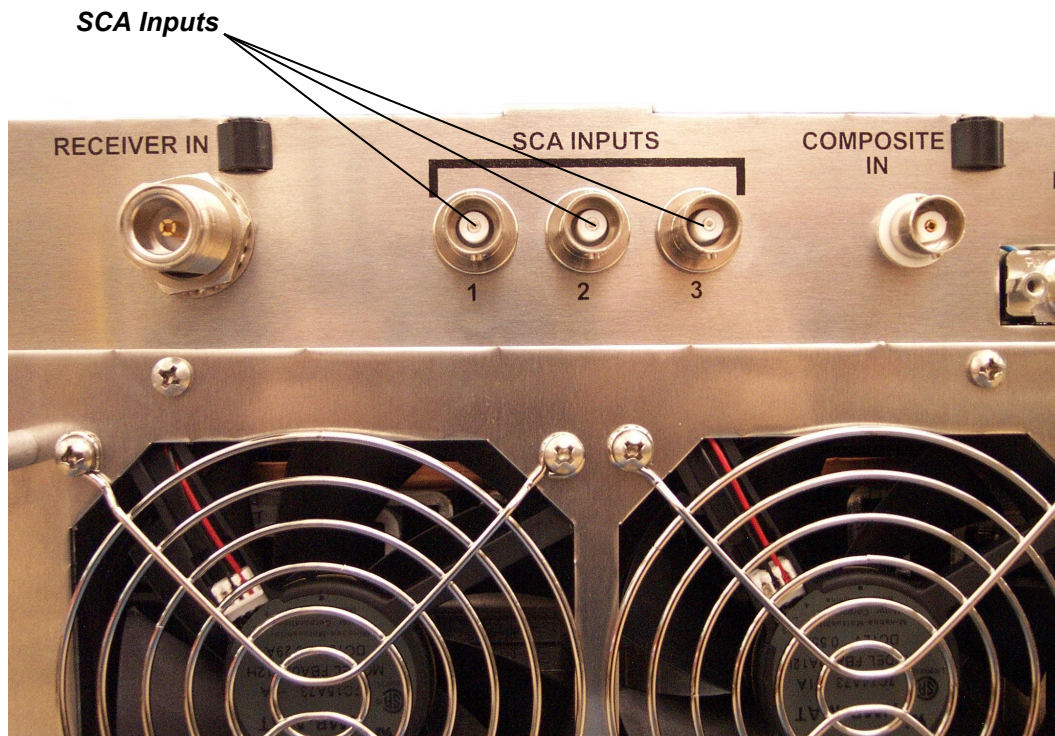


Illustration 2–20 SCA Input Connectors

2.8 Composite Input Connection

You may feed composite stereo (or mono audio) directly to the RF exciter bypassing the internal audio processor and stereo generator. 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.

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

1. Enable the Composite Input by grounding pin 14 of the Remote I/O connector (see Illustration 2–23).
2. Connect the composite signal using the Composite In BNC connector.

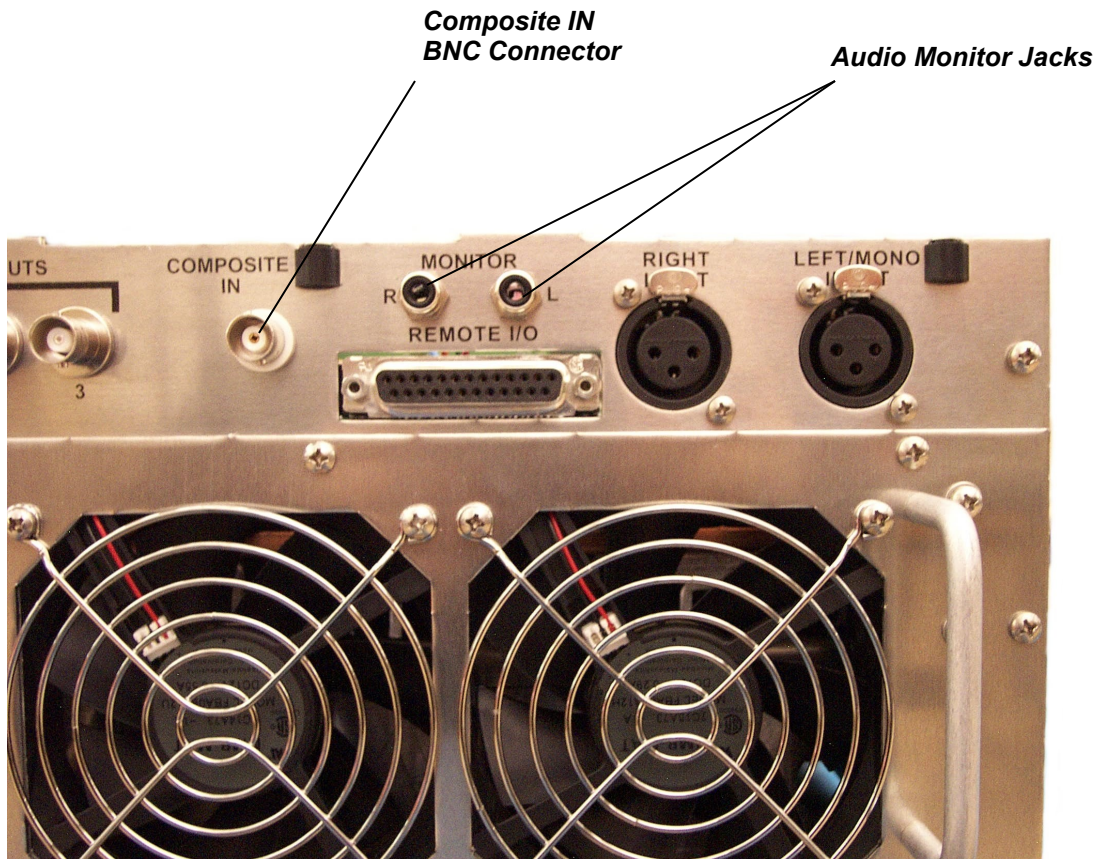


Illustration 2–21 Composite In and Audio Monitor Connections

2.9 Audio Monitor Connections

Processed, de-emphasized samples of the left and right audio inputs to the stereo generator are available at the Audio 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 μ S; set to 50 μ S by moving jumpers, HD201 and HD202, on the Audio Processor/Stereo Generator board.

2.10 Pre-emphasis Selection

Select the pre-emphasis curve (75 μ S, 50 μ S, 25 μ S, or Flat) by jumpering the appropriate pins of header HD1 on the Audio Processor/Stereo Generator board. If you change the pre-emphasis, change the de-emphasis jumpers HD201 and HD202 on the Audio Processor/Stereo Generator board to match.

2.11 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 remote I/O connector pin out chart on page 2-16. The time between program failure and carrier turn-off is set by a jumper (JP1) on the Driver Switch Logic board. (See page 6-3 for board location.) Place jumper on 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. Placing a jumper on pins 9 and 10 will disable the time-out timer.

2.12 Remote I/O Connector

Remote control and remote metering of the transmitter is made possible through a 25 pin, D-sub connector on the rear panel. (No connections are required for normal operation.)

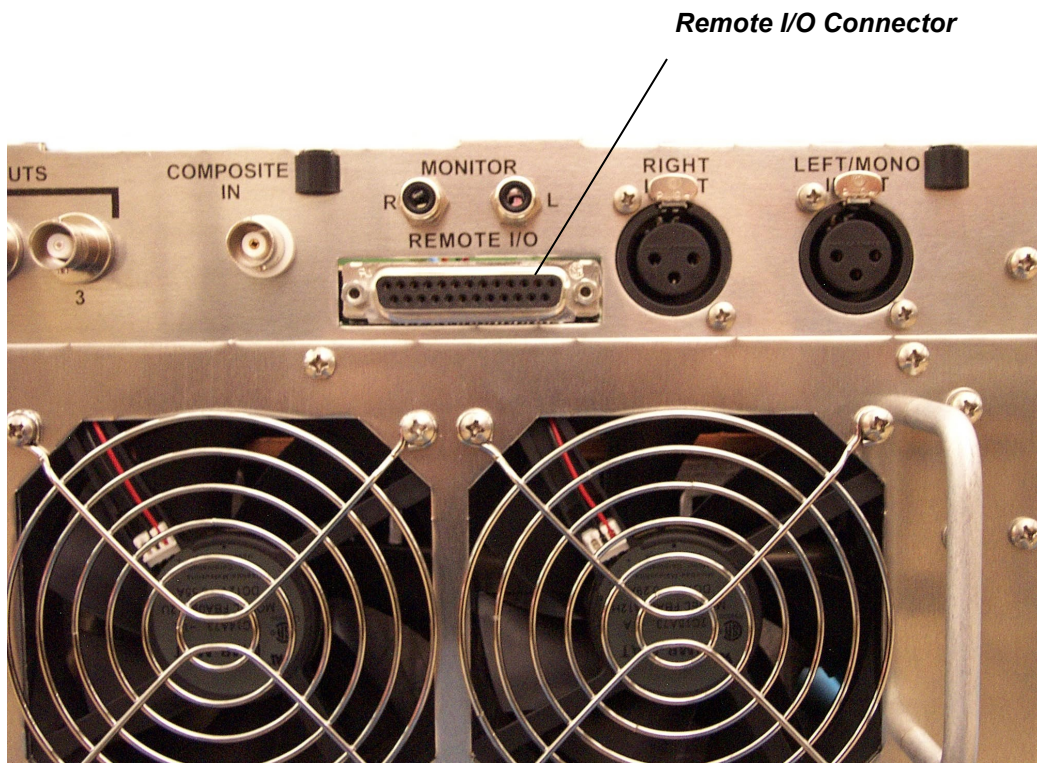


Illustration 2-22 Remote I/O Connector

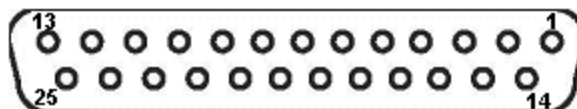
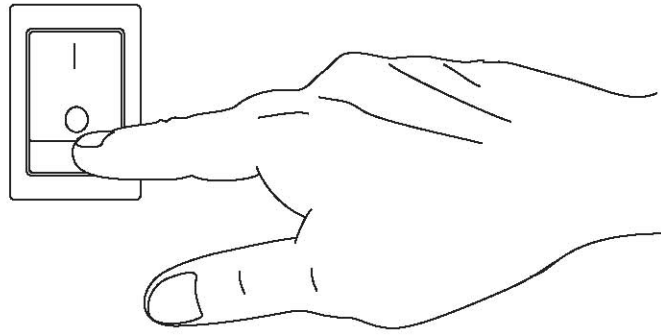


Illustration 2-23 Remote I/O Connector (DB-25 Female)

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 voltage; 5 VDC=50 VDC)
7.	Meter RF Watts (1 VDC = 100 Watts)
8.	Meter PA Volts (5 VDC = 50VDC)
9.	Remote Raise (A momentary switch, holding this pin low will slowly raise the RF output)
10.	Remote Lower (A momentary switch, holding this pin low will slowly lower the RF output)
11.	Remote SWR (A buffered metering output with a calculated reading of standing wave ratio in VDC.)
12.	External ALC Control
13.	No Connection
14.	/Ext. Enable (Pull low to disable the internal stereo generator and enable External Composite Input.)
15.	38 KHz Out (From stereo generator for power supply synchronization. For transmitter equipped with receiver option, this pin becomes the right audio output for an 8-ohm monitor speaker. 38 KHz is disabled.)
16.	ALC
17.	/Carrier Off (Pull low to turn carrier off)
18.	Fault Summary (Line goes high if any fault light is activated.)
19.	Meter PA Temperature (5 VDC=100 degrees C.)
20.	Meter PA Current (1VDC=10 DC Amperes.)
21.	Front Panel Voltmeter Input.
22.	No Connection.
23.	RDS RX
24.	RDS TX
25.	Ground

Notes



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 2.2 and 2.3.

1. Turn on the main power switch.

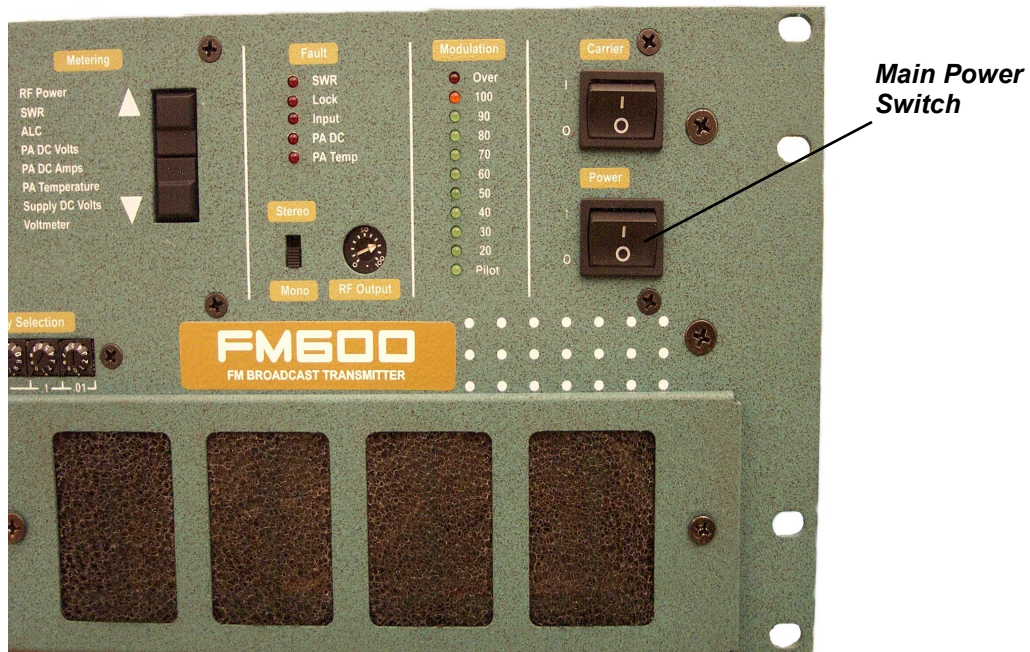


Illustration 3-2 Front Panel Power Switch

-
2. Verify the following:
 - A. All three power amplifier cooling fans run continuously.
 - B. The Lock Fault indicator flashes for approximately 5 seconds, then goes off.
 3. Set the Input Gain switches for mid-scale wideband gain reduction on an average program level (see section 3.4).
 4. Set the Processing control (see section 3.5; normal setting is "50").
 5. Set the Stereo-Mono switch to Stereo (see section 3.6).
 6. Turn on the carrier switch.
 7. Check the following parameters on the front panel multimeter:
 - A. RF Output power should be set for 600 watts.
 - B. SWR should be less than 1.1. (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 to 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 40-60 degrees C.
 - G. Driver Supply voltage should be about 24 volts.
 - 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 Power Switch

The main on/off power switch controls both the high voltage and low voltage internal power supplies.

3.2.2 Carrier Switch

This switch controls power to the RF amplifiers and supplies a logic high to the Driver Switch Logic board, which enables the power supply for the RF driver.

A "Lock Fault" or a low pin 17 (/Carrier Off) on the Remote I/O connector will hold the carrier off. (See section 2.12.)

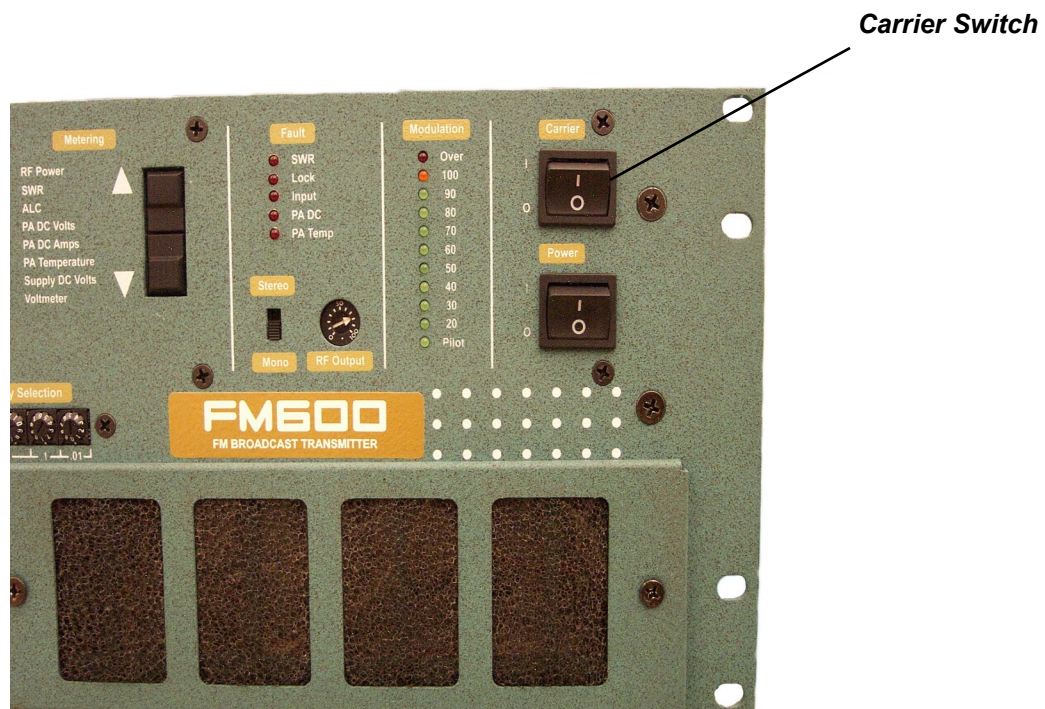


Illustration 3-3 Front Panel Carrier Switch

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.

The translator configuration shows relative audio levels from the included receiver.

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.

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. In the translator configuration, the Wideband indicator also shows relative RF signal strength.

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 μ S 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.

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

Illustration 3–4 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.

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.

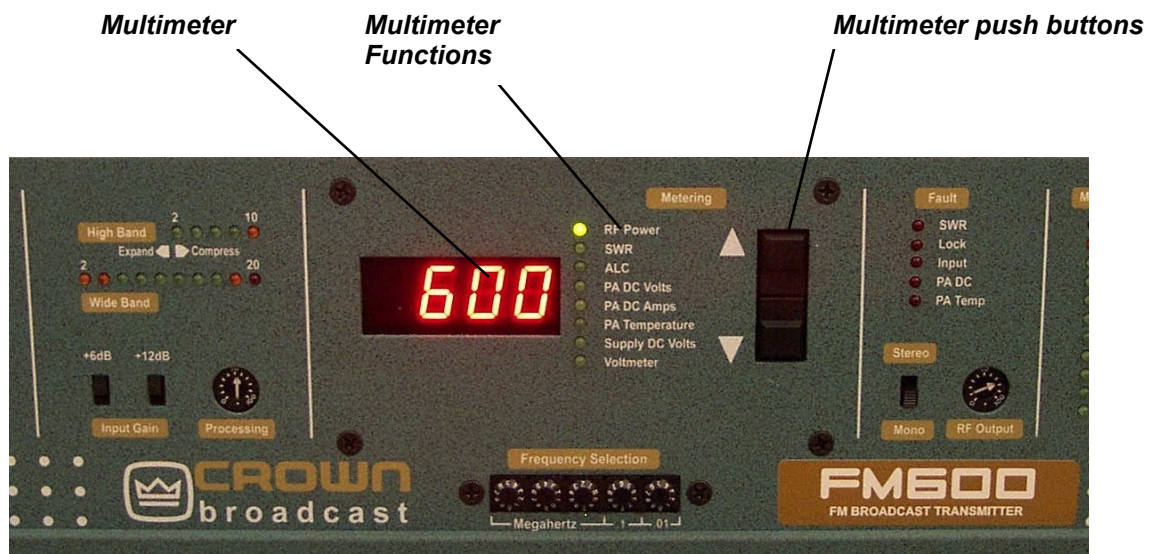


Illustration 3–5 Digital Multimeter

RF Power—Actually reads RF voltage squared, so the accuracy can be affected by VSWR (RF voltage-to-current 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 Temperature—Temperature of the RF power amplifier heatsink in degrees C.

Driver Supply Volts—Regulated 24 volt DC supply for the RF driver amplifier.

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.

In the translator configuration, you can read a relative indication of RF signal strength numerically in the Voltmeter setting.

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.

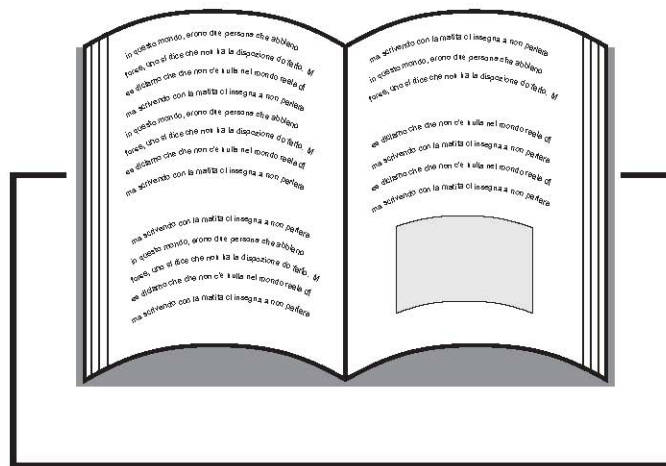
Lock—Frequency synthesizer phase-lock loop is unlocked. This indicator normally blinks for about five seconds at power turn-on. Whenever this light is blinking, supply voltages will be inhibited for the RF driver stage as well as for the RF power amplifier.

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 93° C (199° F).

At about 97°C (207° F), ALC voltage begins to decrease, reducing the PA supply voltage to prevent a further increase in temperature. By 105° C (221° F) the PA will be at the minimum output level, of approximately 190 Watts.



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.

The circuit boards and component placement drawings use designators such as “R1”, “R2”, and “C1.” These same designators are used throughout the transmitter on several different circuit boards and component placement drawings. When referencing a particular component it is necessary to also reference the circuit board that it is associated with.

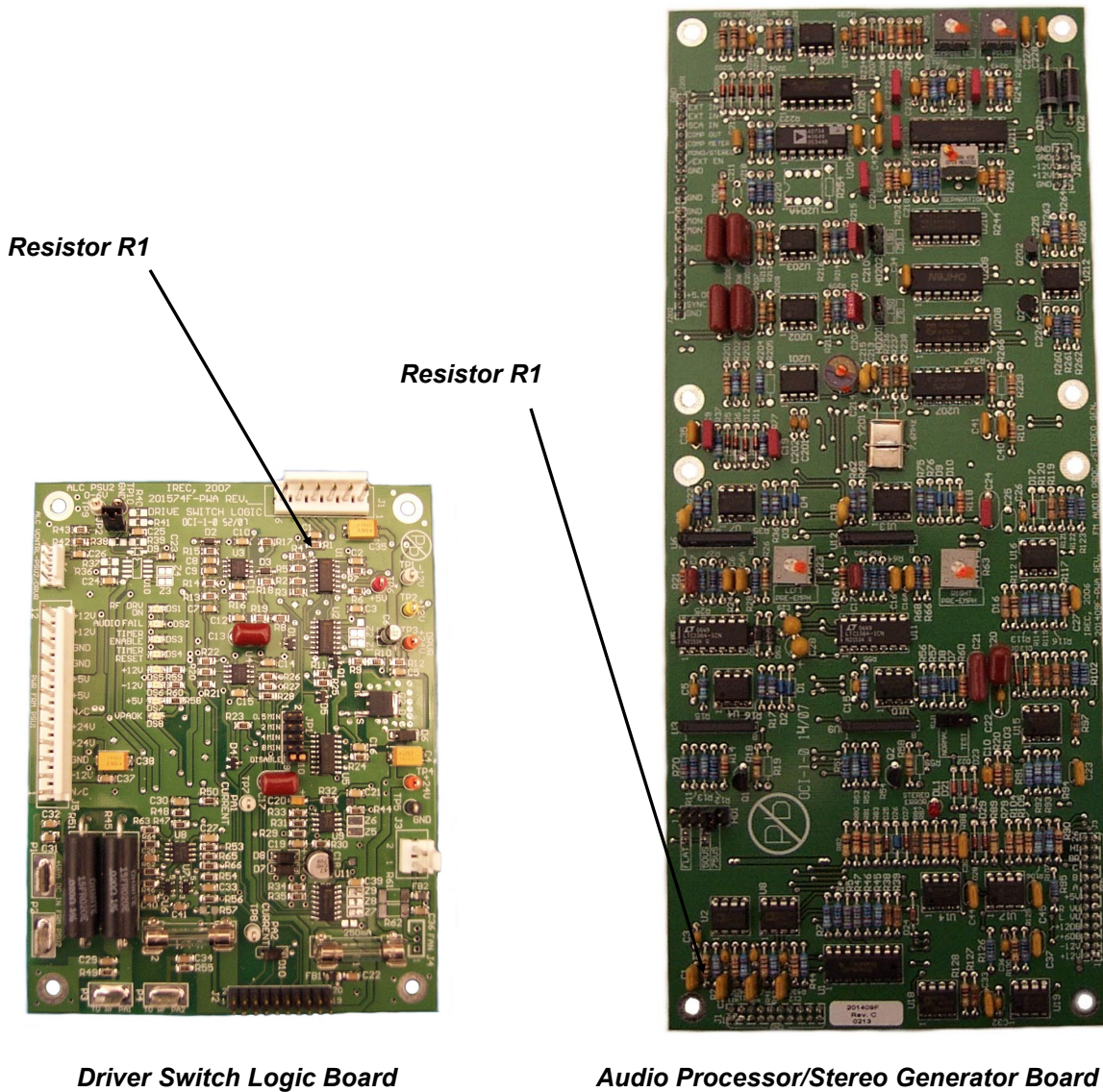


Illustration 4-1 Resistor R1 On Different Circuit Boards

4.2 Audio Processor/Stereo Generator Circuit Board

The audio board provides the control functions of audio processing-compression, limiting, and expansion, as well as stereo phase-error detection, pre-emphasis and generation of the composite stereo signal.

Illustration 6-4 and accompanying schematic may be useful to you during this discussion. The overall schematic for the audio board is divided into two sheets; one each for the processor and the stereo generator sections of the board.

Reference numbers are for the left channel. Where there is a right-channel counterpart, reference number are in parenthesis.

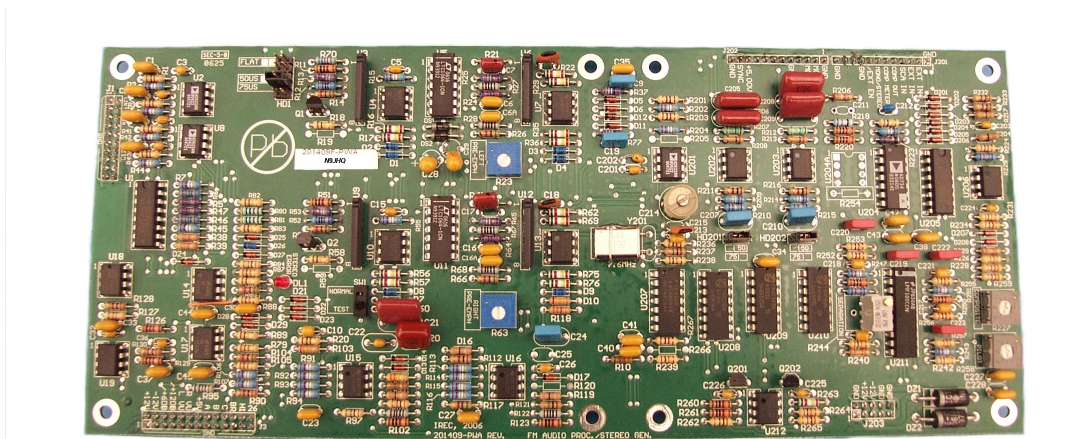


Illustration 4–2 Audio Processor/Stereo Generator Board

4.2.1 Audio Processor Section

Audio input from the XLR connector on the rear panel of the transmitter goes to instrument amplifier, U2 (U8). Two-bit binary data on the +6 dB and +12 dB control lines sets the gain of U2 (U8) to one of four levels in 6-dB steps. Gain of U2 is determined by R5, R6, or R7 (R45, R46, or R47) as selected by analog switch U1.

U3 (U9) is a THAT2180 voltage-controlled amplifier with a control-voltage-to-gain constant of 6.1 mV/dB. The 2180 is a current-in/current-out device, so signal *voltages* at the input and output will be zero. R11 converts the audio voltage at the output of U2 (U8) to current at the input of U3 (U9). U3 (U9) output current is converted to audio voltage by U4A (U10A).

U4B (U10B) is a unity-gain inverter. When the positive peaks at the output of U4A (U10A) or U4B (U10B) exceeds the gain-reduction threshold, U15 generates a 0.25 Volts-per-dB DC control bias, producing wide-band gain reduction for U3 (U9). The dB-linear allows a front-panel 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 time for gain recovery is controlled by the PROCESSING control, located on the front panel display board. (See section 3.5.)

Audio components above 15,200 Hz are greatly attenuated by eighth-order switched-capacitor elliptical filter, U5 (U11). The filter cut-off frequency is determined by a 1.52 MHz clock (100 x 15,200 Hz) signal from the stereo generator section of the board. The broadband signal level at the output of U5 (U11) is about 5 dB below that required for full modulation. (With normal program material, the 5 dB of headroom will be filled with pre-emphasized audio.)

Pre-emphasis in microseconds is the product of the capacitance of C7 (C17), multiplied by the current-gain of U6 (U12), times the value of R22 (R62). (For description of the device used for U6 (12), see explanation for U3 (U9) above.) For a 75 micro-seconds pre-emphasis, the gain of U6 (U12) will be about 1.11.

Selection of the pre-emphasis curve (75 μ S, 50 μ S, or Flat) is made by moving the jumper on HD1 to the pins designated on the board. Fine adjustment of the pre-emphasis is made with R23 (R63). (See section 5.1.)

For high-band processing, the peak output of U7A (U13A) and U7B (U13B) is detected and gain-reduction bias is generated, as with the broadband processor. The high-band processing, however, shifts the pre-emphasis curve rather than affecting overall gain. Peak audio voltages are compared to plus and minus 5-volt reference voltages at the outputs of U19A and U19B. This same reference voltage is used in the stereo generator section.

A stereo phasing error occurs when left and right inputs are of equal amplitude but opposite polarity. The most common cause is incorrect wiring of a left or right balanced audio line somewhere in the program chain sometimes at the source of a recording. When this happens, all the audio is in the left-minus-right stereo subcarrier none in the left-plus-right baseband. The error can go unnoticed by one listening on a stereo receiver, but the audio may disappear on a mono receiver. In normal programming there may be short-term polarity reversals of left versus right, either incidental or for effect intentional. A phase error of several seconds duration is processed by U14A and U14B and interpreted as a real error. During a phasing error, the right -channel level is gradually reduced by 6 dB. For a listener to a stereo radio, the right-channel volume will be lower, while on a mono receiver there will be a reduction of volume.

NORMAL/TEST switch. In the TEST position, the stage gains are set to a fixed level. See section 6.2

4.2.2 Stereo Generator Section

Composite stereo signal is generated from left and right-channel audio inputs. This section also has the amplifier (U201) for an optional external composite input and provision for insertion of SCA signal(s).

Processed, pre-emphasized left and right audio is passed through third-order low-pass filters comprised of U202A (203A) and associated circuitry. The filters decrease the level of audio products below 30 Hz. This low-frequency roll off is necessary to prevent disturbance to the phase lock loop in the RF frequency synthesizer by extremely low-frequency audio components. (See caution at section 2.8.)

U204 is a precision, four-quadrant, analog multiplier. The output of U204 is the product of 38 kHz applied to the Y input and the difference of left and right audio (L-R signal) applied to the X input. The resulting output is a double sideband, suppressed carrier/the L-R subcarrier.

Spectral purity of the stereo subcarrier is dependent on a pure 38 kHz sine wave at the multiplier input.

U207A and Y201 comprise a 7.6 MHz crystal oscillator from which the 19 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, used by switched-capacitor filters U5 and U11 in the audio section. 3.8 MHz, 1.9 MHz, and 304 kHz are also derived from dividers in U208. Exclusive OR gates, U210C and U210D, provide a stepped approximation of a 38 kHz sine wave. With the resistor ratios used, the synthesized sine wave has very little harmonic energy below the 7th harmonic. U210A and B generate the 19 kHz pilot subcarrier. U211 is a dual switched capacitor filter, configured as second order, low-pass filters, each one with a Q of 5. The 38 and 19 kHz outputs of pins 1 and 20, respectively, are fairly pure sine waves. Harmonic distortion products are better than 66 dB down with a THD of less than 0.05%. SEPARATION control R244 sets the 38 kHz level at the Y input of U204.

Resistor matrix R219, R220, R221, and R223 sum the L+R audio with the L-R subcarrier to produce a current at the junction of R221 and R223 that will be converted to composite stereo (less pilot) at the output of summing amplifier U206A. SCA signal is also injected at the input of U206A. 19 kHz pilot is combined with composite stereo in summing amplifier U206B.

Analog switch U205, at the input of U206A, 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. R209+R210 (R214+R215) and C207 (C210) is a de-emphasis network. Processed, de-emphasized samples of the left and right audio are used for a studio monitor and for audio testing. Jumpers at HD201 (HD202) allow selection of 50- μ S or 75- μ S de-emphasis.

VR212A and B supply +7 volts and -7 volts, respectively. A 5-volt reference from the audio processor section supplies the subcarrier generators.

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

4.3 RF Exciter Circuit

This circuit is also known as the Frequency Synthesizer. The Frequency Synthesizer part of the motherboard is no longer a separate module as was the case on older transmitters. The entire component side of the motherboard is a ground plane. Frequency selector switches located on the front panel of the transmitter establish the operating frequency. The VCO (voltage-controlled oscillator) circuitry is inside an aluminum case.

Illustration 6-6 and accompanying schematics can be used as reference in this discussion.

VCO1 operates at the synthesizer output frequency of 87 MHz to 108 MHz. The frequency is controlled by a voltage applied to pin 8 of the VCO. A sample of the RF comes from A2 and is fed to the PLL chip U13. U13 is a phase-locked-loop frequency synthesizer IC. The 10.24 MHz from the crystal oscillator is divided to 10 kHz. Internal programmable dividers divide the 87 - 108 MHz RF to 10 kHz. Differences between the two signals produce error signals at pins 7 and 8 of U14.

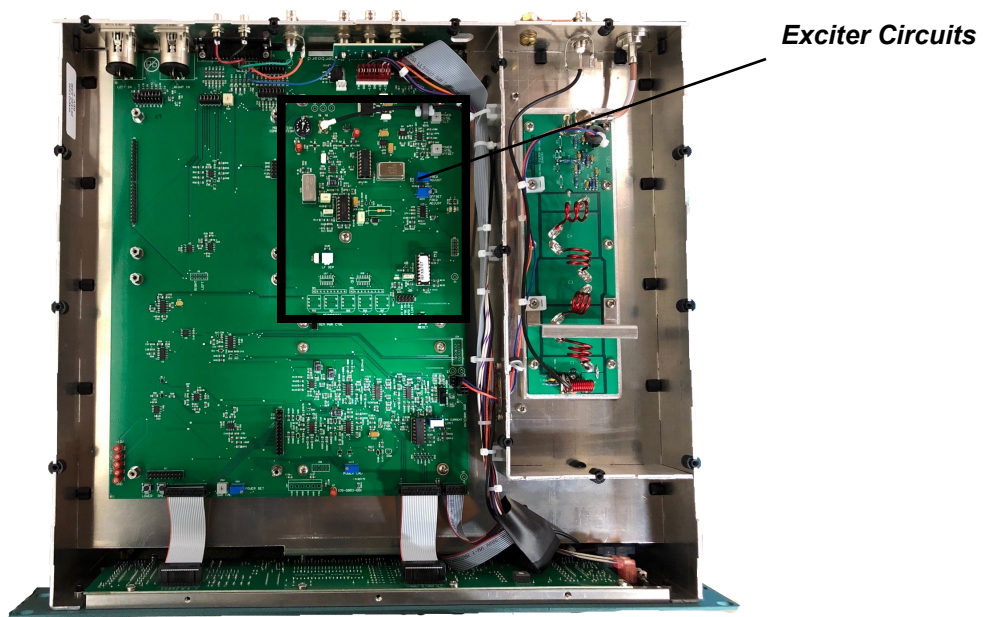


Illustration 4-3 Motherboard (Exciter Circuits)

Frequency selector switches are read by shift registers U17 and U18. Data from the shift registers is read by U16 which then programs the PLL (Phase Lock Loop) IC U13.

U14B 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 U14A, allowing for greater loop bandwidth with less degradation of the low frequency audio response.

Lock and unlock status signals are available at the outputs of U15E and U15F, respectively.

Modulation is introduced to the VCO through R72 and R122.

4.4 Metering Circuit

The ALC and metering circuitry is on the motherboard (see Illustration 6–6). This circuit 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, and drive for the front-panel fault indicators.

Illustration 6–6 and accompanying schematics complement this discussion.

PA voltage and current come from a metering shunt on the Driver Switch Logic board. The PAI input is a current proportional to PA current; R153 converts the current to voltage used for metering and control. A voltage divider from the PAV line is used for DC voltage metering.

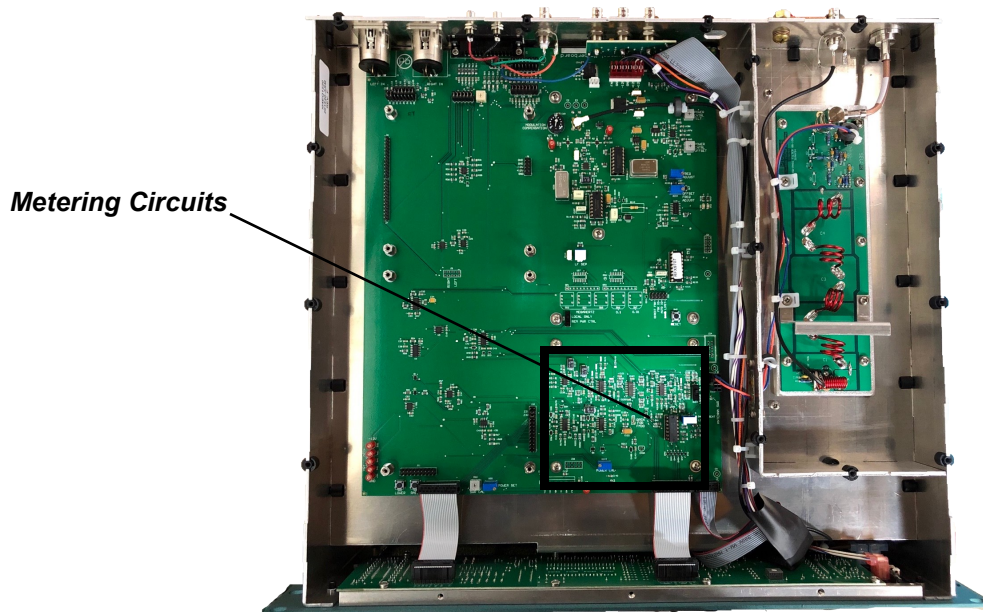


Illustration 4–4 Motherboard (Metering Circuits)

U23A, U23B, and U24A, 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.

U24B, U24C, are components of a DC squaring circuit. Since the DC output voltage of U24C is proportional to RF voltage squared, it is also proportional to RF power.

U22C, U22A, U20A, and U22D 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 U22B will be forced low, reducing the ALC (RF level control) voltage, which, in turn, reduces the PA supply voltage.

The DC voltage set point for U22A (reflected RF voltage) is one-fifth that of U22C (forward RF voltage). This ratio corresponds to an SWR of 1.5:1 $[(1+.2)/(1-.2)=1.5]$. The U25 inverters drive the front panel fault indicators.

4.5 Motherboard

The motherboard is the large board in the upper chassis interconnecting the audio processor/ stereo generator board or the optional receiver module to the RF exciter and metering circuits. The motherboard provides the interconnections for these boards, eliminating the need for a wiring harness, and provides input/output filtering. The RF exciter and metering circuits are an integral part of the motherboard and are no longer separate boards as in past transmitter designs.

Also contained on the motherboard is the +5.00 volt reference and the composite drive Op amp and its associated circuitry.

The motherboard has configuration jumpers associated with different options that can be added at the time of order or at a later time as an upgrade. The motherboard configuration chart for these jumpers can be found on the following page.

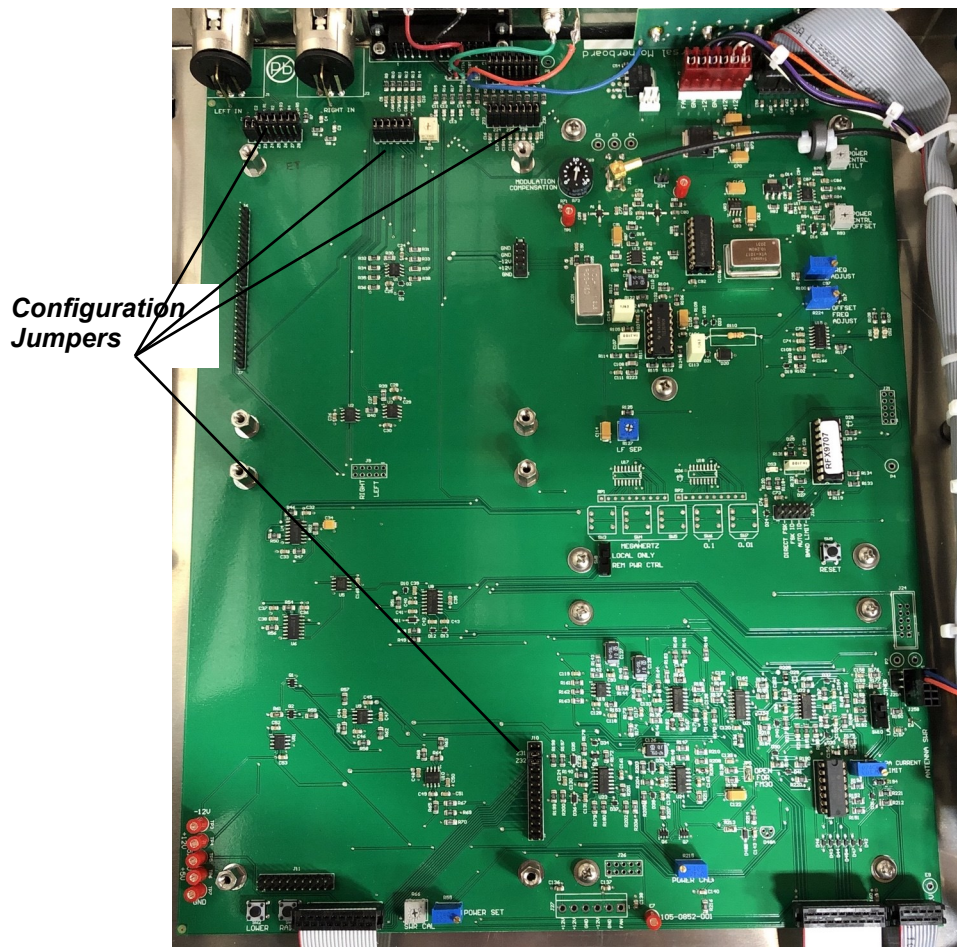


Illustration 4–5 Motherboard Configuration Jumpers

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

Motherboard Jumper Configuration Chart 4.6.1

4.6 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 6–9 and the 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 U1A and U1B 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 Q1 and Q2 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. U6A, U6B, and associated components comprise the dither generator. Dither output is a triangular wave.

Composite stereo (or mono) is full-wave detected by diodes D5 and D6, U7, U13, Q3, and Q4 and are components of a peak sample-and-hold circuit.

Oscillator, U9F, 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 U9A and U9B. U10 is an up/down counter. Binary input to U11 from U10 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, R50, 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 U12. They originate from analog data selectors on the ALC/ metering board.

4.7 Driver Switch Logic Circuit Board

The Driver Switch Logic board is mounted on the bottom side of the transmitter chassis with the two power supplies. The Driver Switch Logic board performs the following five different functions, program audio detection, audio fail timer, PA current monitor, PSU2 voltage monitor, and driver switch.

The program audio detection circuit and the audio fail timer is made up of U3,U4, and U5. U3A and U3B 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. U3A and surrounding components form a band-pass filter with a Q of 3 tuned to about 5kHz. U3B is a first-order low pass filter. Red (DS3) and green (DS4) LEDs on the board indicate the presence or absence of program determined by the balance of the detected signals from the two filters. U5 and U4B form a count-down timer. The time between a program fault and shutdown is selected by jumpering pins on header JP1. For times, see section 5.7. The times are proportional to the value of R28 (that is, times can be doubled by doubling the value of R28). When the timer circuit times out, a red LED (DS2) will illuminate giving a visual indication of the audio fail timers status.

The PA current monitor circuit consists of R45(R51) U6(U7), U8 and associated circuitry. Note that components listed in parentheses () are used in the PA current monitor for PA2. Current passing through R45(R51) creates a voltage drop that is measured by the current monitor U6(U7). U6(U7) has a gain of 5. The output voltage from U6(U7) is delivered to op-amp U8A (U8B) which has a gain of 4. The outputs of U8A and U8B are summed together through R47 and R53. The summed output equals the total currents drawn by both RF power amplifiers PA1 and PA2. This total current draw is displayed on the front panel as PA DC Amps.

The PSU2 voltage monitor is used to monitor the status of the high voltage power supply and determines if it is stable and operational. The PSU2 voltage monitor circuit is made up of R29, R30, U9A ,U11 and associated circuitry. R29 and R30 create a voltage divider circuit that scales down the voltage from the high voltage power supply. The scaled down power supply voltage is fed to comparator U9A. When the high voltage power supply has an output voltage above 21 volts, the output of comparator U9A goes high. The output of U9A is fed to inverter U11B which inverts the signal creating a logic low output. This output is fed to NOR gate U2C in the driver switch circuit. The logic high signal from U9A is also fed to U11A which enables the green LED (DS8) indicating that the voltage from the high voltage power supply is OK.

The driver switch circuit is the last circuit on the driver switch logic board that determines if the driver amplifier should be enabled based on the status of the above mentioned circuits. The driver switch circuit consists of U2C, Q1, Q2 and associated circuitry. Logic gate U2C is a NOR gate. The inputs to U2C are the outputs of the PSU2 voltage monitor and the audio fail timer circuits. If the outputs from the PSU2 voltage monitor circuit and the audio fail timer circuit are at a logic low, the resulting output of U2C will be a logic high, enabling transistor Q1 and turning on green LED (DS1) indicating that the driver amplifier should be enabled. When Q1 is turned on, this will place about -8.8 volts (w/respect to the source of Q2) on the gate of the P-channel MOSFET Q2. This will cause MOSFET Q2 to conduct, delivering +24 volts to the driver amplifier, thus enabling the RF output.

4.7 Driver Switch Logic Circuit Board, continued

Also present on the Driver Switch Logic board are power supply diagnostic LEDs and various circuit test points.

Several green LEDs give a visual indication that the power supplies are functioning. The LEDs do not indicate that the voltage is correct for its given power supply; they are just merely an indication that voltage is present. LED DS7 is the indicator for the +5 volt power supply, DS5 is the indicator for the +12 volt power supply and DS6 is for the -12 volt power supply.

Test points that are present on the board can be used to measure various power supply and circuit voltages. See illustration 4-6 for test point descriptions and typical voltages.

Test Point	Description	Voltage
TP1	-12V DC supply	-11.76v to -12.24v
TP2	+12V DC supply	11.76v to 12.24v
TP3	+24V Driver supply (switched)	23.52v to 24.48v
TP4	+24V DC supply	23.52v to 24.48v
TP5	Ground	0v
TP6	+5V DC supply	4.9v to 5.1v
TP7	PA1 Drain current/10	.100v = 10 amps
TP8	PA2 Drain current/10	.100v = 10 amps
TP9	ALC Control voltage	0v to 6v
TP10	Ground	0v
TP11	Audio filter output	**See text below

Illustration 4-6 Driver Switch Logic Board Test Points

The voltages listed in the chart are approximate values. The colors in the left hand column indicate the color of the test point on the circuit board.

The audio filter output test point voltage should be 0 volts during an audio fault such as during silence or a loss of program audio. This voltage will be constantly changing while program audio is present. This circuit is only active if the /Auto Carrier line has been pulled low by grounding pin 5 on the Remote I/O connector on the back of the transmitter.

See illustration 4-7 for diagnostic LED and test point positions on the Driver Switch Logic

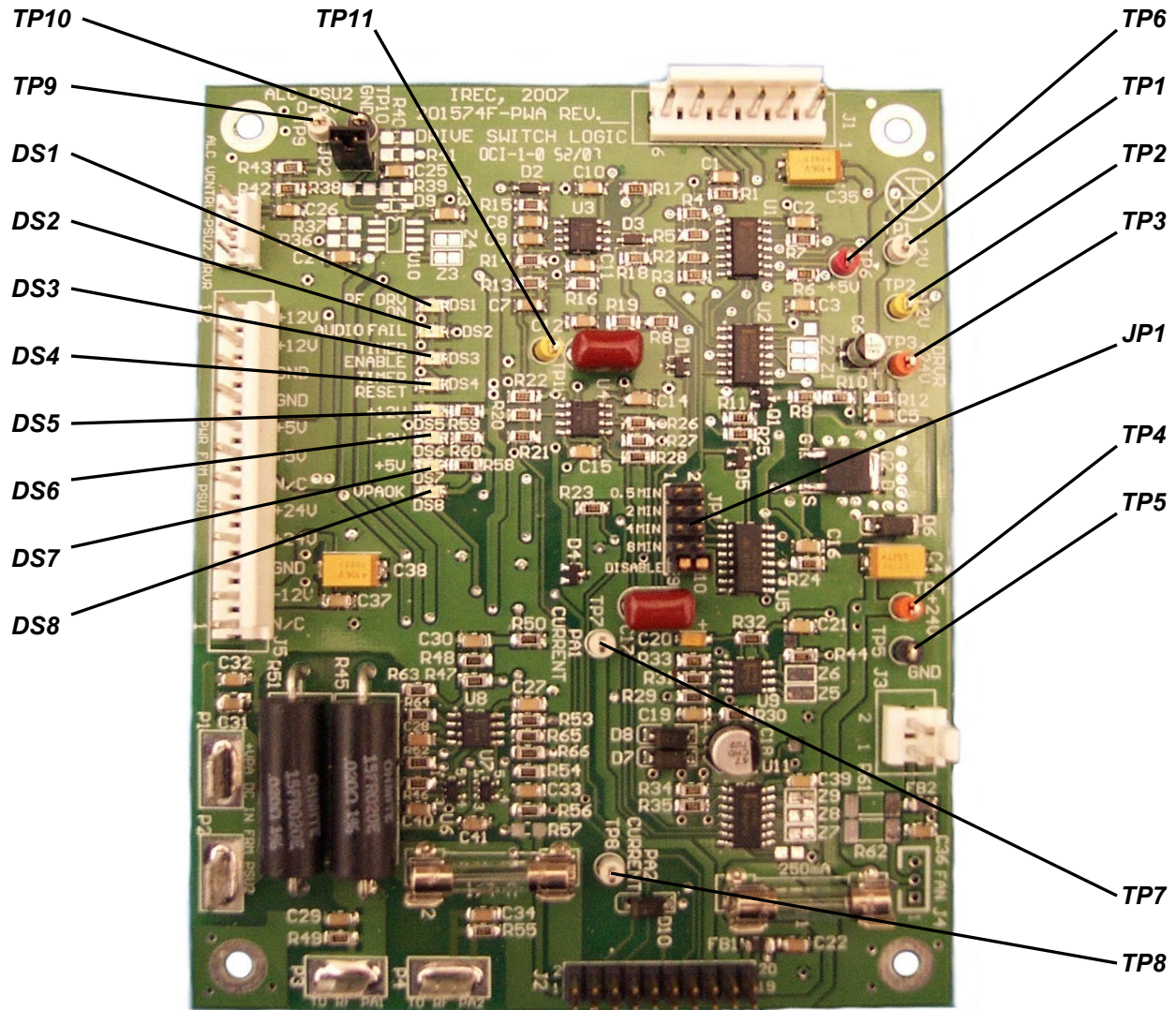


Illustration 4-7 Driver Switch Logic Board

4.8 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 20 watts to drive the RF power amplifiers. A BGY588N hybrid, high-gain, wideband amplifier, operating at about 20 volts, provides about one watt of drive to a single SA702 MOSFET amplifier. The SA702 stage operates from a supply voltage of approximately 24 volts.

The circuit board provides for input/output coupling and for power supply filtering.

4.9 RF Amplifier

The 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 slides into at the front of the chassis.

The amplifier is built around two SD2942, dual power MOSFET's rated for 50 volts DC and a maximum power of about 350 watts. When biased for class B, the transistor has a power gain of 20dB. The RF power amplifier 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 Ohm impedance, input/output combiner board which takes 15 watts input and divides it equally to each power amp. Then the output from each amplifier is combined to for a single output.

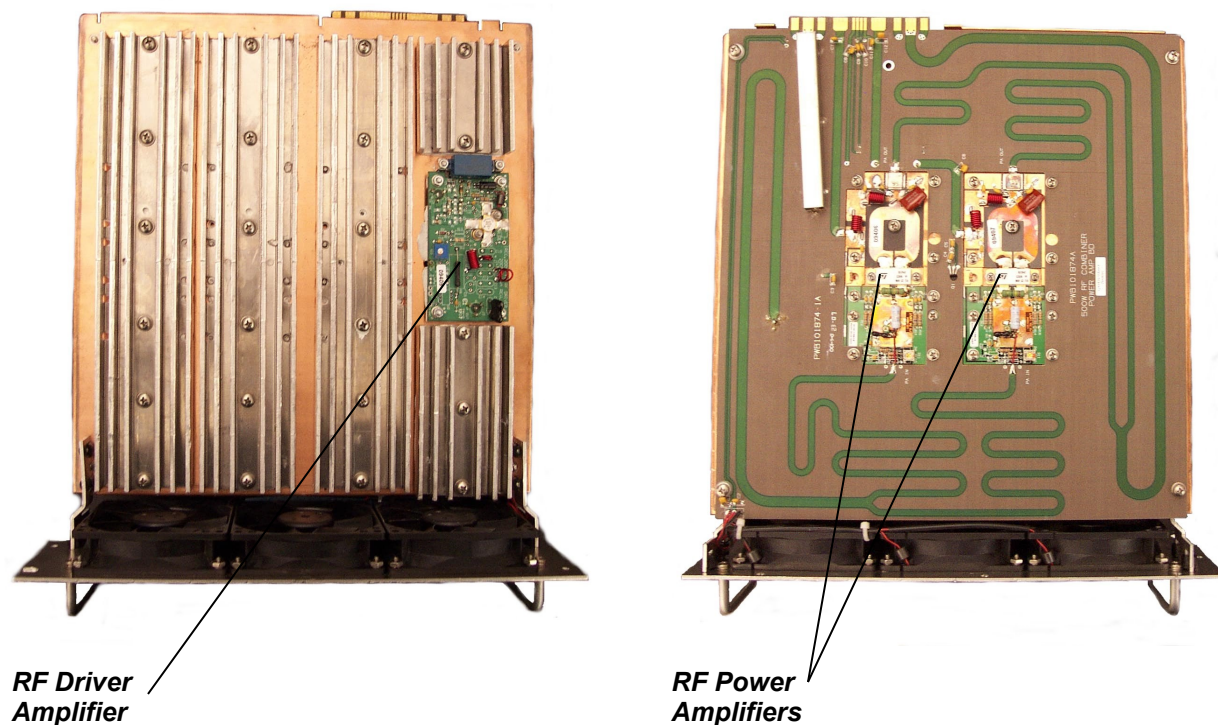


Illustration 4-7 RF Power Amplifier Module

4.10 Chassis

The high voltage and low voltage power supplies, as well as the driver switch logic board are mounted on the bottom side of the chassis.

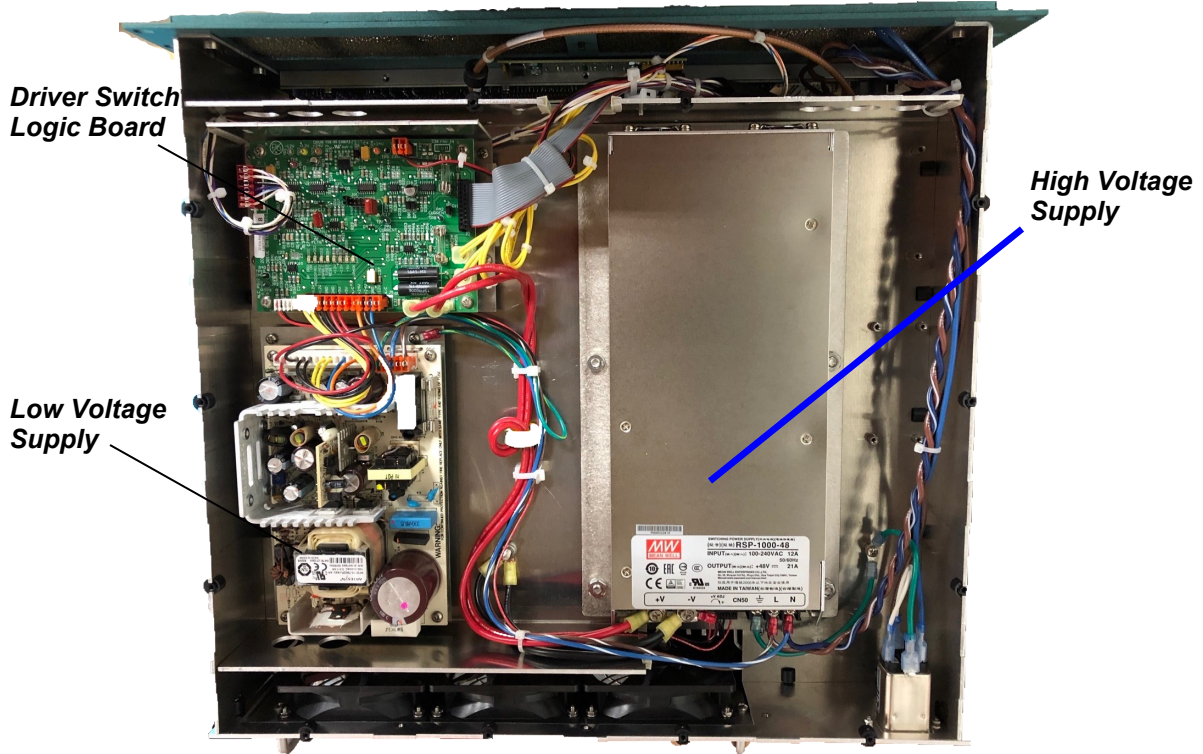


Illustration 4-8 Chassis Bottom View

4.11 RF Output Filter & Reflectometer

The RF low-pass filter/reflectometer is located in the right-hand compartment on the top of the chassis. See Illustration 6-13 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 and metering and for SWR metering and protection.

4.12 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.

The FM Translator Module is designed to work within Crown Broadcast's FM Broadcast Transmitters. It receives FM or AM signals from an external antenna input and generates an FM composite multiplex (MPX) signal output to be used by the transmitter's internal FM modulator. The translator module interfaces directly with Crown's mainboard to provide user interface feedback via the transmitter's front panel display. Band and frequency selection is performed via circuit board mounted DIP switches on the translator module itself.

The onboard AM/FM receiver utilizes a Digital Signal Processor (DSP) that incorporates advanced algorithms to provide world-class receiver performance. Tuner parameters have been optimized by experts in AM/FM reception to provide the best overall performance for this specific product, eliminating the need for broadcasters to make adjustments. The receiver is capable of tuning:

- 1) FM frequencies from 76.00 – 108.00 MHz in steps of 0.05 MHz (50 kHz).
- 2) AM frequencies from 520 – 1710 kHz in 10 kHz increments.
- 3) AM frequencies from 531 – 1629 kHz in 9 kHz increments.

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. The microprocessor tunes the tuner module to the selected frequency.

Located in the lower right-hand corner of the Receiver Module is a 3.5mm headphone jack. Demodulated Left and Right audio is present at this jack. A regular pair of 32 ohm stereo headphones, such as the types used with portable audio devices, can be used to monitor the audio on the receiver module.

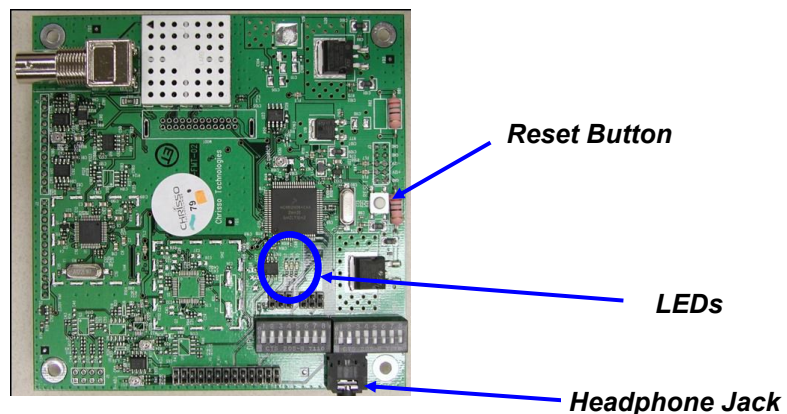


Illustration 4–9 CHT-1 Receiver Module

4.12 Receiver Circuit Board Option (Continued)

PILOT LED

When the front-panel Stereo-Mono Switch is set to “Stereo” and the receiver board is set to receive an FM signal, the translator PILOT LED indicates the presence of a stereo pilot in the received signal. When the Stereo-Mono Switch is set to “Mono” or the receiver board is set to receive an AM signal, the PILOT LED will be off. If the PILOT LED is not consistently lit, it is recommended to force the receiver to mono reception by moving the front-panel Stereo-Mono Switch to the “Mono” position.

I2C_ACTIVE LED

The “I2C_ACTIVE” LED indicates digital bus communications between various digital components of the translator. This LED will light frequently and for various lengths of time. If this LED is lighted solid, it may indicate an I²C communication error. This error will trigger the translator’s auto-recovery feature, and the translator will self reboot.

ERROR_CODES LED

The “ERROR_CODES” LED indicates that an error has occurred within the translator. If this LED lights, the translator will reboot itself within 30 seconds. If this LED lights or flashes for more than 30 seconds, power cycle the translator by pressing the Reset button. If resetting the translator does not solve the issue, this indicates an unrecoverable hardware error, and will require the translator module to be serviced. This LED flashes at different rates depending upon the error. The following are for diagnostics purposes only, and are not to be treated as an exhaustive error-code list.

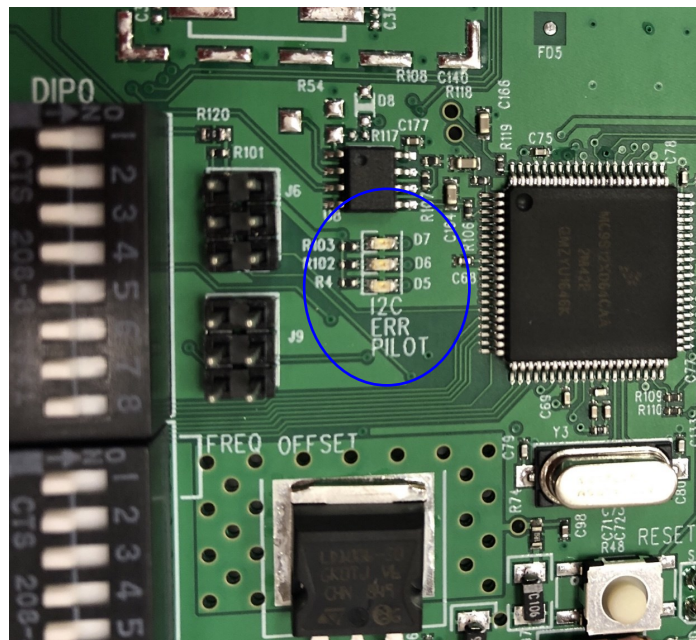
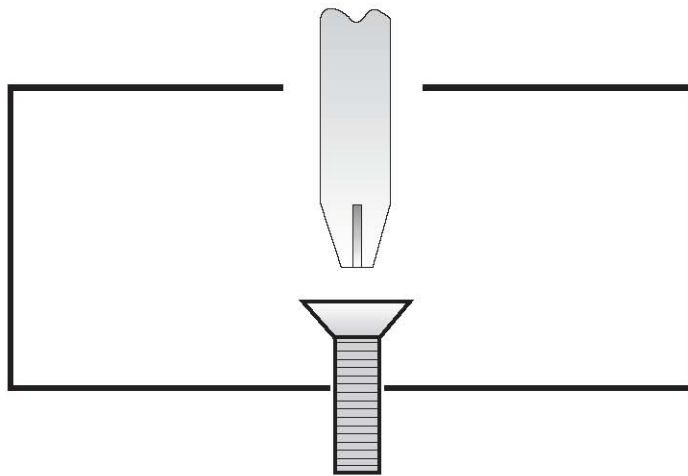


Illustration 4–10 CT-1 Receiver Module LEDs

Notes



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 μ S, 50 μ S, 25 μ S, or Flat) by jumpering the appropriate pins of header HD1 on the audio processor/stereo generator board. (See section 2.10.) If you change the pre-emphasis, change the de-emphasis jumpers, HD201 and HD202 on the audio processor/stereo generator board, to match. (See section 2.10.)

5.1.2 Pre-Emphasis Fine Adjustment

Trim potentiometers, R23 and R63, (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 in the RF Exciter circuit of the Motherboard. Adjust the Separation control R244 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

You can make adjustments to the composite output in the following manner:

Using a Modulation Monitor

1. Set the Stereo-Mono switch to Mono.
2. Check that the setting of the Modulation compensation control (see Illustration 2–9) on the RF Exciter circuit 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 2.3.1

5.3.3 Frequency Measurement and Adjustment

Next to the 10.24 MHz VCXO in the RF Exciter circuit on the motherboard is a 50K potentiometer (R101). Use R101 to set the frequency of the 10.24 MHz VCXO while observing the output frequency of the synthesizer.

Use one of two methods for checking frequency:

1. Use an FM frequency monitor.
2. Couple a frequency counter of known accuracy to the output of the synthesizer and observe the operating frequency.

5.3.4 FSK Frequency Offset Control

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

Ground pin 4 on the DB25 connector located on the back panel of the transmitter. This will shift the operating frequency. Adjust R224 for an offset of the operating frequency of about 6 kHz. Un-grounding pin 4 will cause the operating frequency to return to normal.

Use one of two methods for checking frequency:

1. Use an FM frequency monitor.
2. Couple a frequency counter of known accuracy to the output of the synthesizer and observe the operating frequency.

5.4 Metering Adjustments

5.4.1 Power Calibrate

While looking at RF Power on the digital panel meter, set the Power Calibrate trim potentiometer (R215) 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 (660 watt for FM600) 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 RF output control. Operation below 200 watts is not possible due to the switching power supply not being able to reach zero volts.

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 (R66) 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 bottom of R195 in the Metering circuit on the motherboard. The current limit, in amperes, will be 0.35 amps higher than ten times this voltage. Set the current limit for 19.00 amps or 1.90 volts at R195.

5.5 Motherboard Configuration

See section 4.6.1 for motherboard jumper configuration.

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 Audio Processor/Stereo Generator board has been set. (See section 5.2.2.)

Set the Stereo-Mono switch to Mono.

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.

Set the Modulation Calibrate trim pot so that the "90" light on the front panel Modulation display just begins to light.

5.7 Driver Switch Logic Adjustments

JP1, a 10 pin header on the Driver Switch Logic board, sets the time between program failure and carrier disable (automatic turnoff). The times are approximate. Sections 2.11, 2.12, and 4.7 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.
5. Short pins 9 and 10 to disable the circuit.

You may select other times by changing the value of R28. The time is proportional to the resistance.

5.8 Bias Set (RF Power Amplifier)

The Bias Set trim pot is located inside the PA module on the input circuit board. Set the trim pot R11 to 10 ohms at right side of R16.

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, data is taken at a level below the audio processing threshold at 80% modulation.

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 2.1049. 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 $43 + 10\log(\text{power, in watts})$ dB down (71 dB for 600 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 13 of U208 on the Audio Processor/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. 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.

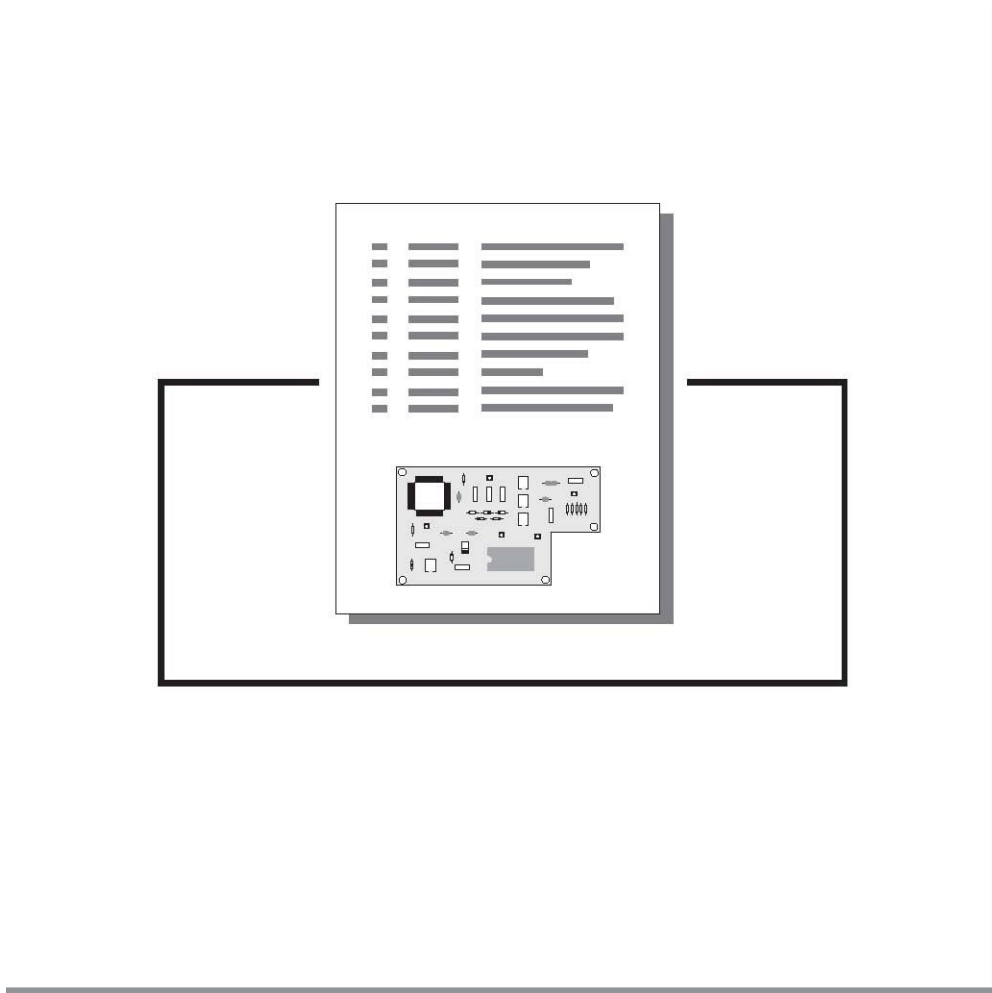
5.21 Additional Checks

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 2.1055.)



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

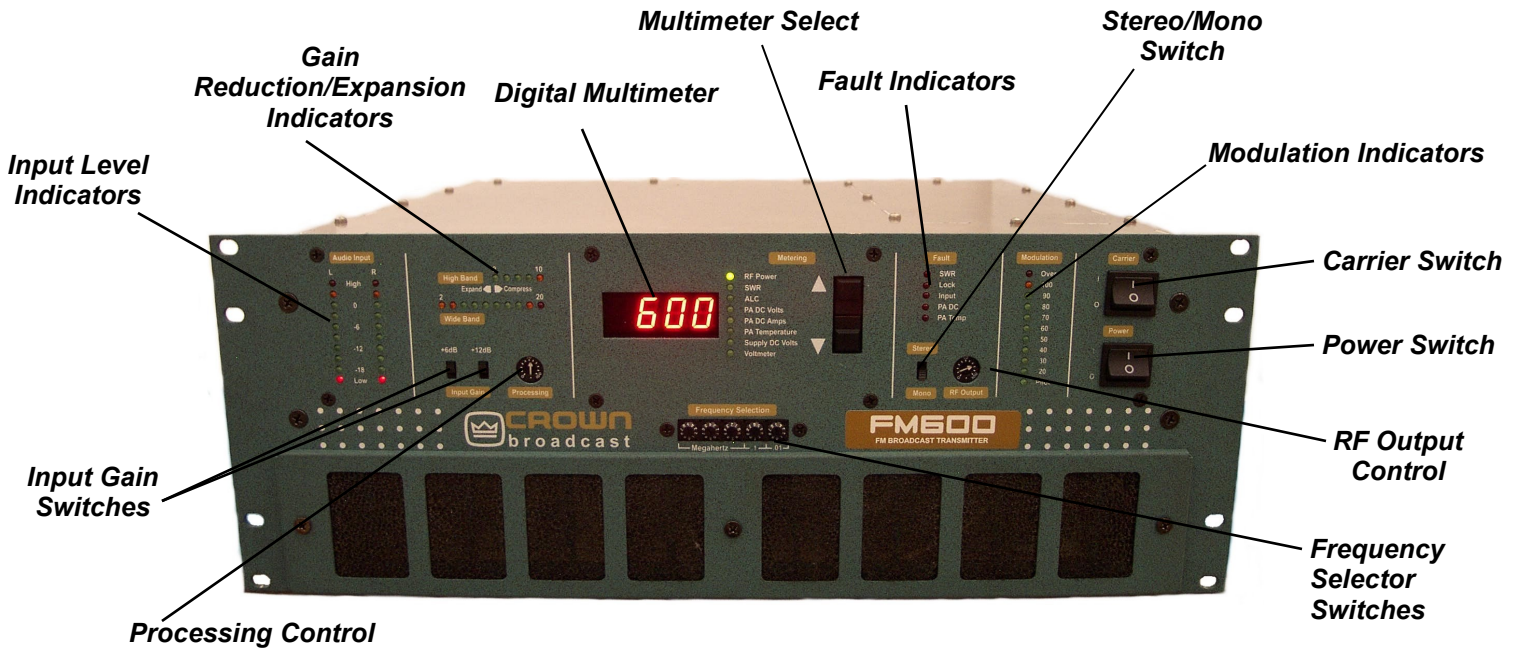


Illustration 6-1 Front View

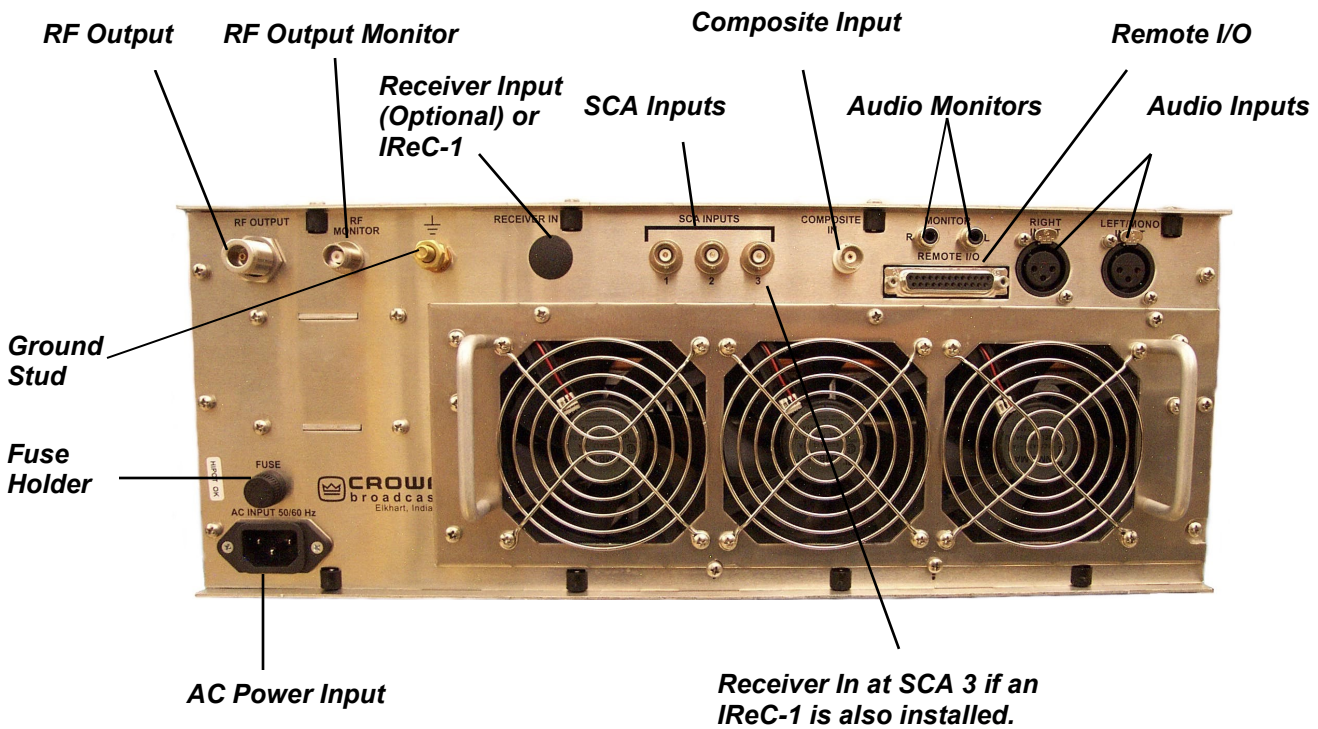


Illustration 6-2 Rear View

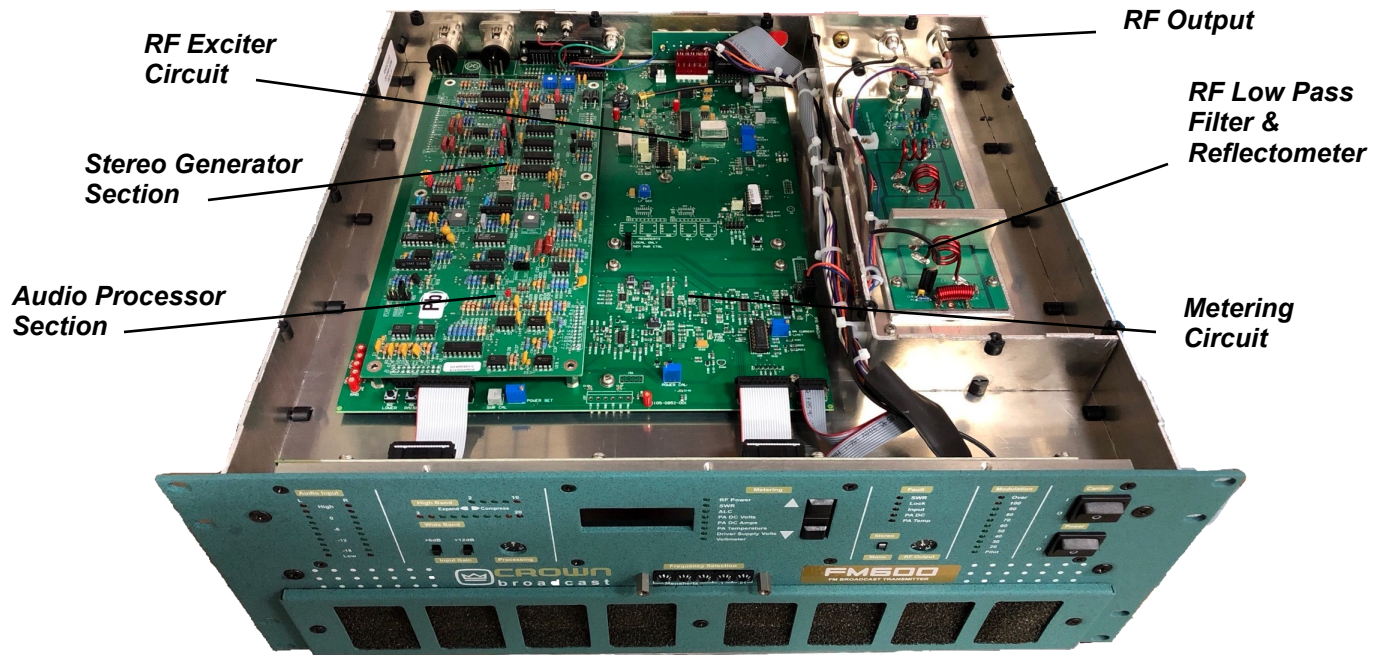


Illustration 6-3 Chassis Top View

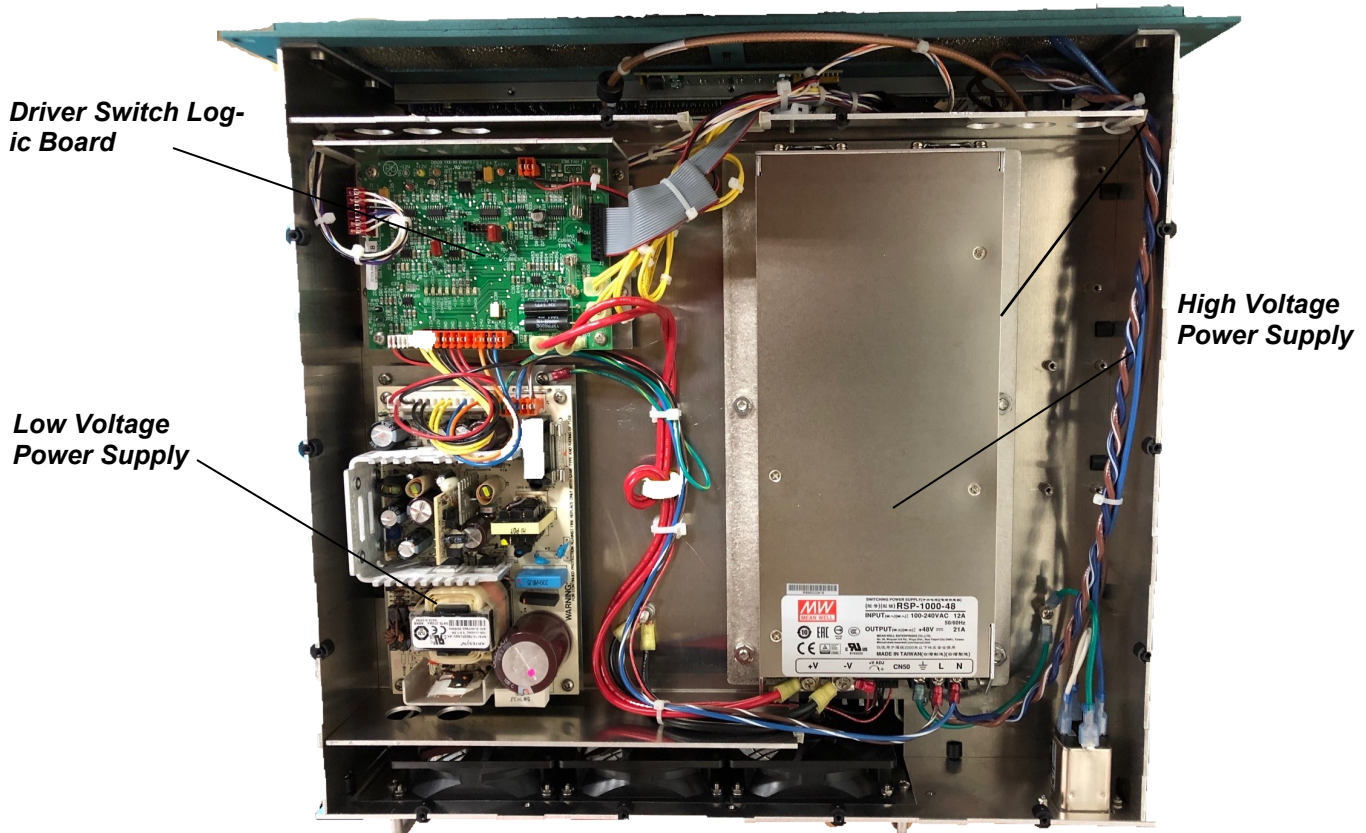


Illustration 6-4 Chassis Bottom View

Notes:



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:

(574) 218-6547

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 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 technical assistance on your product during normal business hours via the telephone. For **emergency help** outside normal business hours, please leave a message and a return phone number. We do listen to the messages regularly, even on week-ends and if it is an emergency, we will do our best to return the call as promptly as possible.

(574) 218-6547

Even during normal business hours, we may be on another call so please leave a message so our technician can return your call.

7.3 Spare Parts

To obtain spare parts, call **Crown Broadcast Service** at the following number.

(574) 218-6547

You may also email us at: service@irec1.com

Crown Broadcast Five Year Limited Product Warranty

Summary Of Warranty

Crown Broadcast /IREC warrants its broadcast products of a NEW Crown Broadcast manufactured product for a period of five (5) years after shipment from Crown Broadcast. All products are warranted to be free of defects in materials and workmanship and meet or exceed all specifications published by Crown Broadcast. Product nameplate with serial number must be intact and not altered in any way.

Exclusions

Crown Broadcast will not warranty the product due to misuse, accident, neglect and improper installation or operation. Proper installation includes A/C line surge suppression, lightning protection and proper grounding of the entire transmitter, and any other recommendations designated in the Instruction manual. This warranty does not extend to any other products other than those designed and manufactured by Crown Broadcast. This warranty does not cover any damage to any accessory such as loads, transmission line or antennas resulting from the use or failure of a Crown Broadcast transmitter. Warranty does not cover any loss of revenue resulting from any failure of a Crown Broadcast product, act of God, or natural disaster.

Procedure for Obtaining Warranty Service

Crown Broadcast will repair or service, at our discretion, any product failure as a result of normal intended use. Warranty repair can only be performed at our plant facility in Elkhart, Indiana USA or at a factory authorized service depot. Expenses in remedying the defect will be borne by Crown Broadcast, including two-way ground transportation cost within the continental United States. Prior to returning any product or component to Crown Broadcast for warranty work or repair, a Return Authorization (RMA) number must be obtained from the Crown Broadcast Customer Service Department. Product must be returned in the original factory pack or equivalent. Original factory pack materials may be obtained at a nominal charge by contacting Crown Broadcast Customer Service. Resolution of the defective product will be made within a reasonable time from the date of receipt of the defective product.

Warranty Alterations

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

Product Design Changes

Crown Broadcast reserves the right to change the design and manufacture of any product at any time without notice and without obligation to make corresponding changes in products previously manufactured.

Legal Remedies of Purchaser

This written warranty is given in lieu of any oral or implied warranties not covered herein. Crown Broadcast disclaims all implied warranties including any warranties of merchantability or fitness for a particular purpose.

Crown Broadcast

2524 Toledo Road, Elkhart, Indiana 46516-5768, Phone: (574) 262-8900, Fax: (574) 970-8909
www.crownbroadcast.com

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
2524 Toledo Road
Elkhart, Indiana, U.S.A. 46516-5768

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 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: (574) 218-6547
service@irec1.com

RMA Number:

Name:

Company:

Shipping Address:

Billing Address:

Phone Number:

Contact Name:

Email:

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: _____

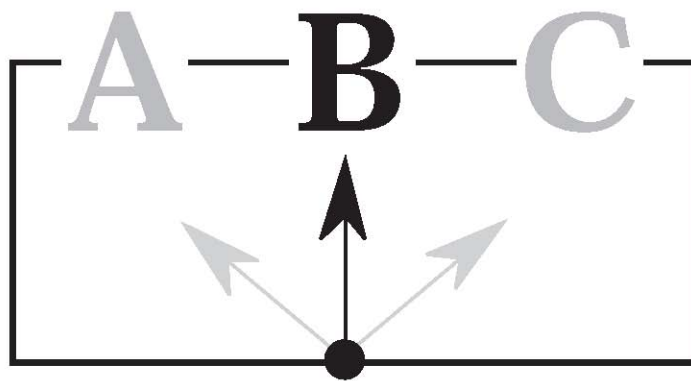
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Appendix

Transmitter Output Efficiency

Frequency	RF Power	PA DC Volts	PA DC Current	Power Input	Efficiency
89.7	660	47.3	17.2	813.6	81.1
	600	45.1	15.9	717.1	83.7
	450	39.4	13.68	539	83.5
	300	32.2	11.42	367.7	81.6
	150	22.9	8.87	203.1	73.8
	60	14.5	6.95	100.8	59.5
	97.9	660	49.7	14.86	738.5
600		47.1	14.12	665.1	90.2
450		40.3	12.55	505.8	89
300		32.4	11.11	360	83.3
150		23	9.22	212.1	70.7
60		14.8	8.26	22.2	49.1
107.9		660	51.1	16.24	829.9
	600	48.8	15.8	771	77.8
	450	42	14.56	611.5	73.6
	300	34.6	12.83	443.9	67.6
	150	26.4	10.91	288	52.1
	60	16.2	7.09	129.4	46.4

Notes:



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 signaling
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, the 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
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 a radio signal by varying its frequency
FSK	Frequency Shift Keying; an F 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
High Frequency	Frequencies in the 3.0 to 30.0 MHz range
Highband	Frequencies affected by the pre-emphasis
I/O	Input/Output
IReC-1	Internet Remote Control
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 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 Networks.
Satellator	A transmitter equipped with an FSK ID option for re-broadcasting a satellite-fed signal
VSWR	Voltage Standing Wave Ratio; see “SWR”
Wideband	See “Broadband”
VCO	Voltage Controlled Oscillator

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6.2 Board Layout and Schematics

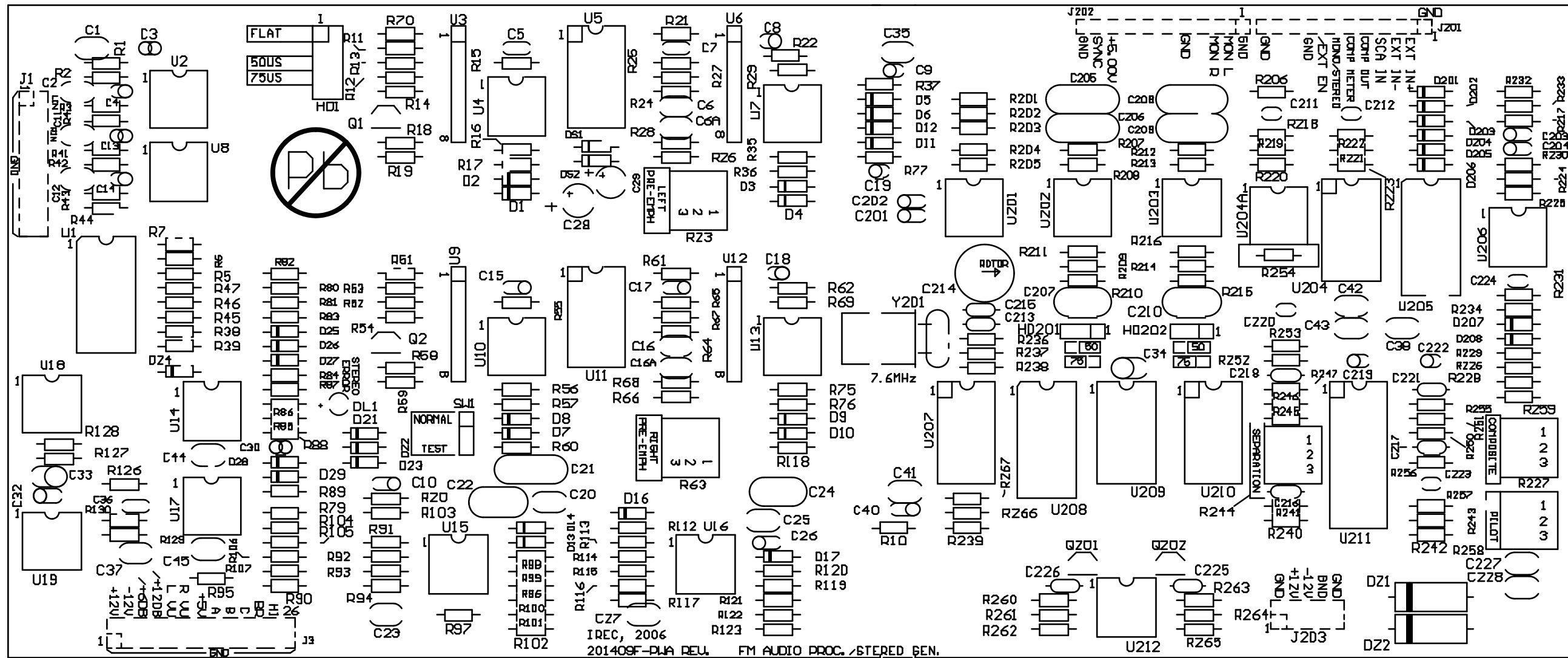
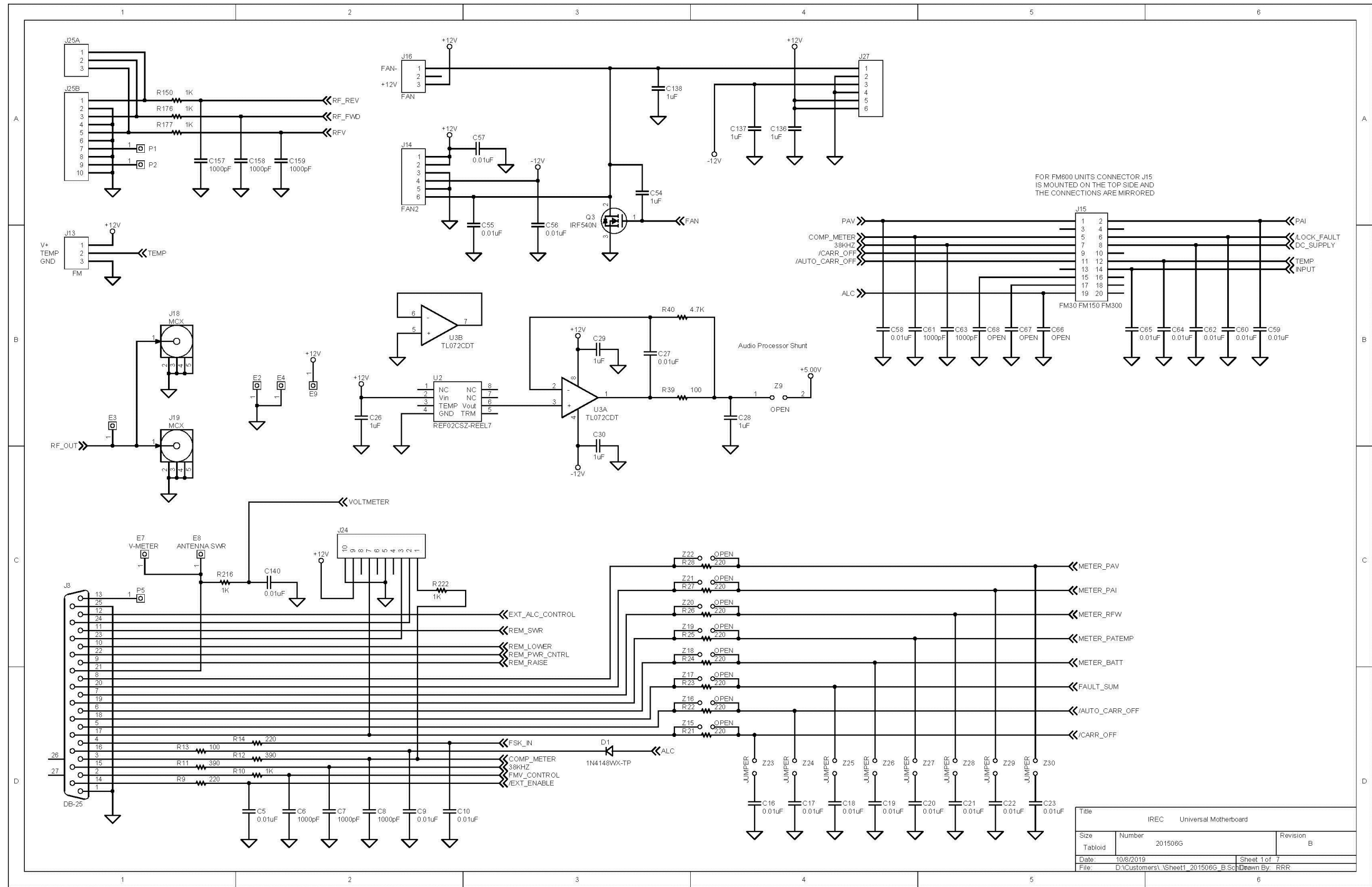
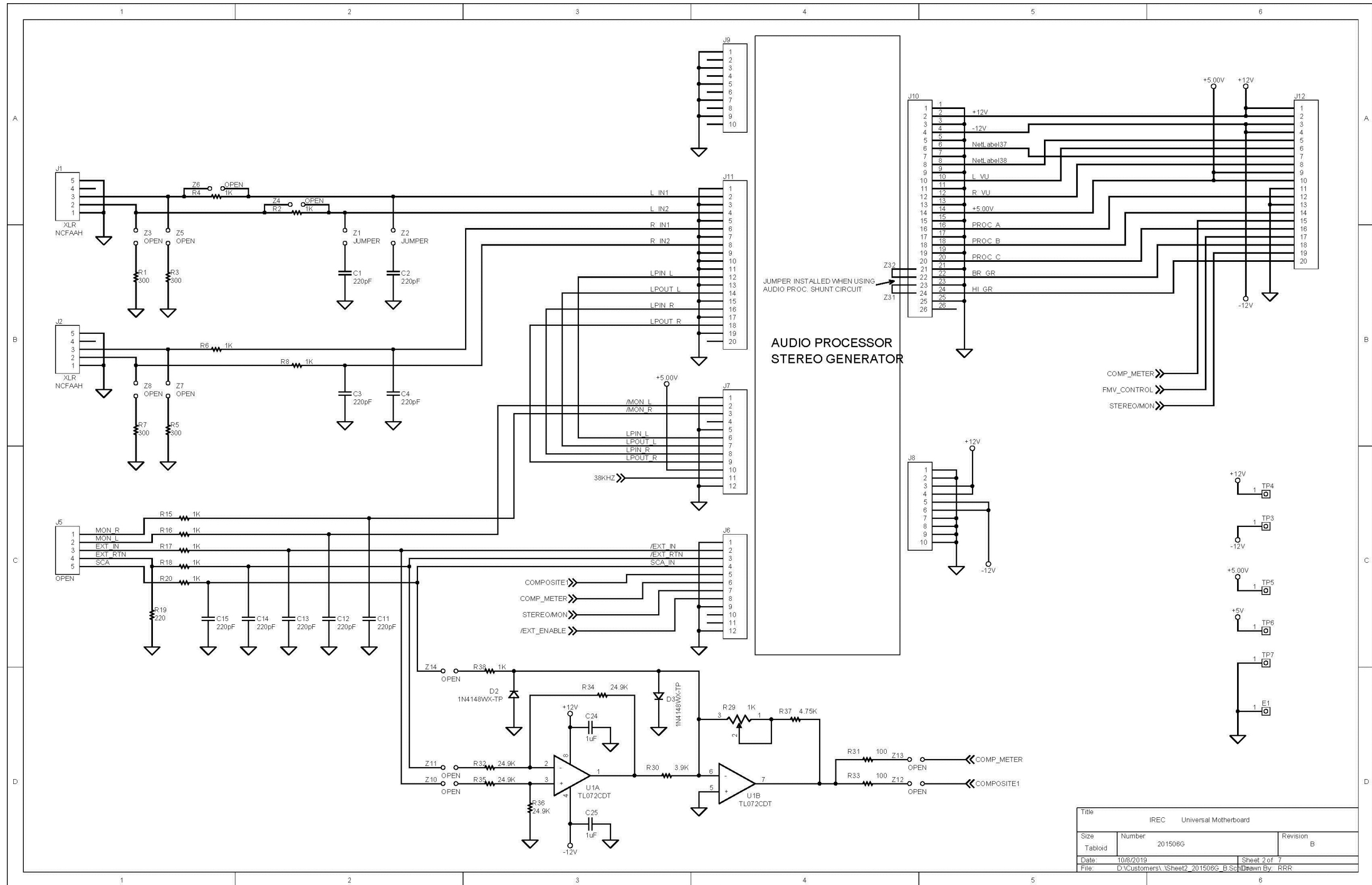


Illustration 6-5 Audio Processor/Stereo Generator Board

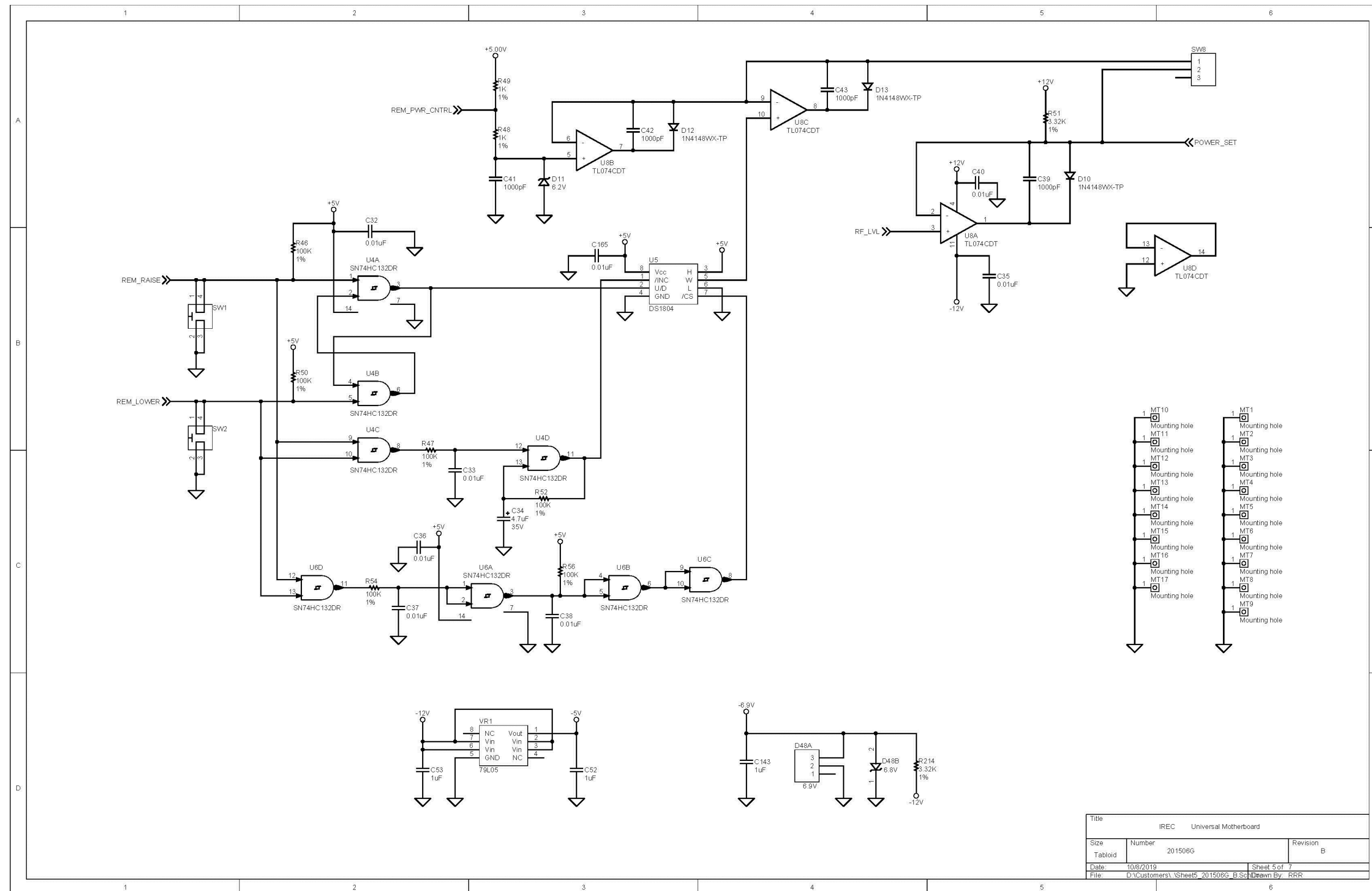


Schematic Diagram: Motherboard (Sheet 1 of 7)

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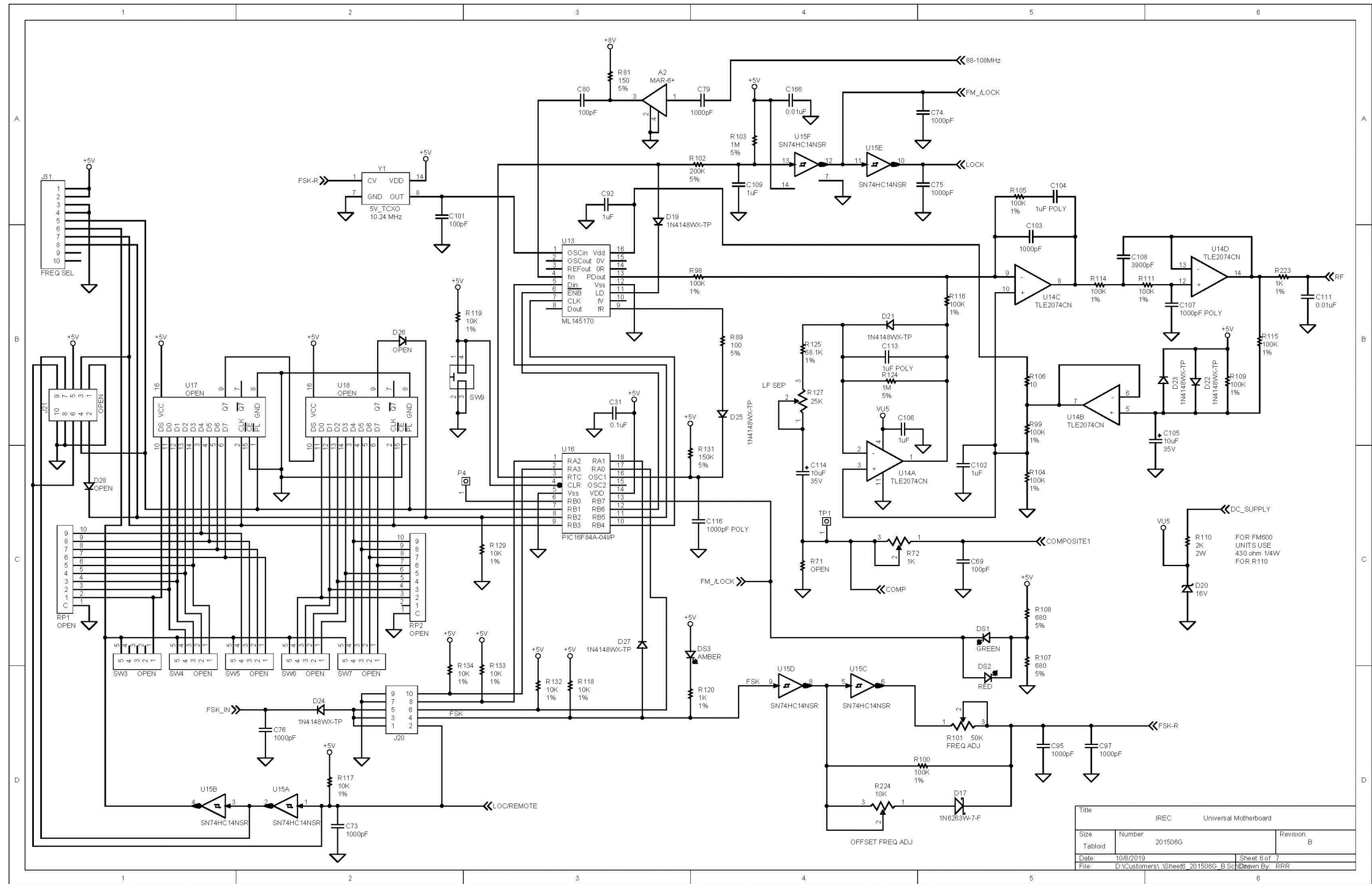


Schematic Diagram: Motherboard (Sheet 2 of 7)

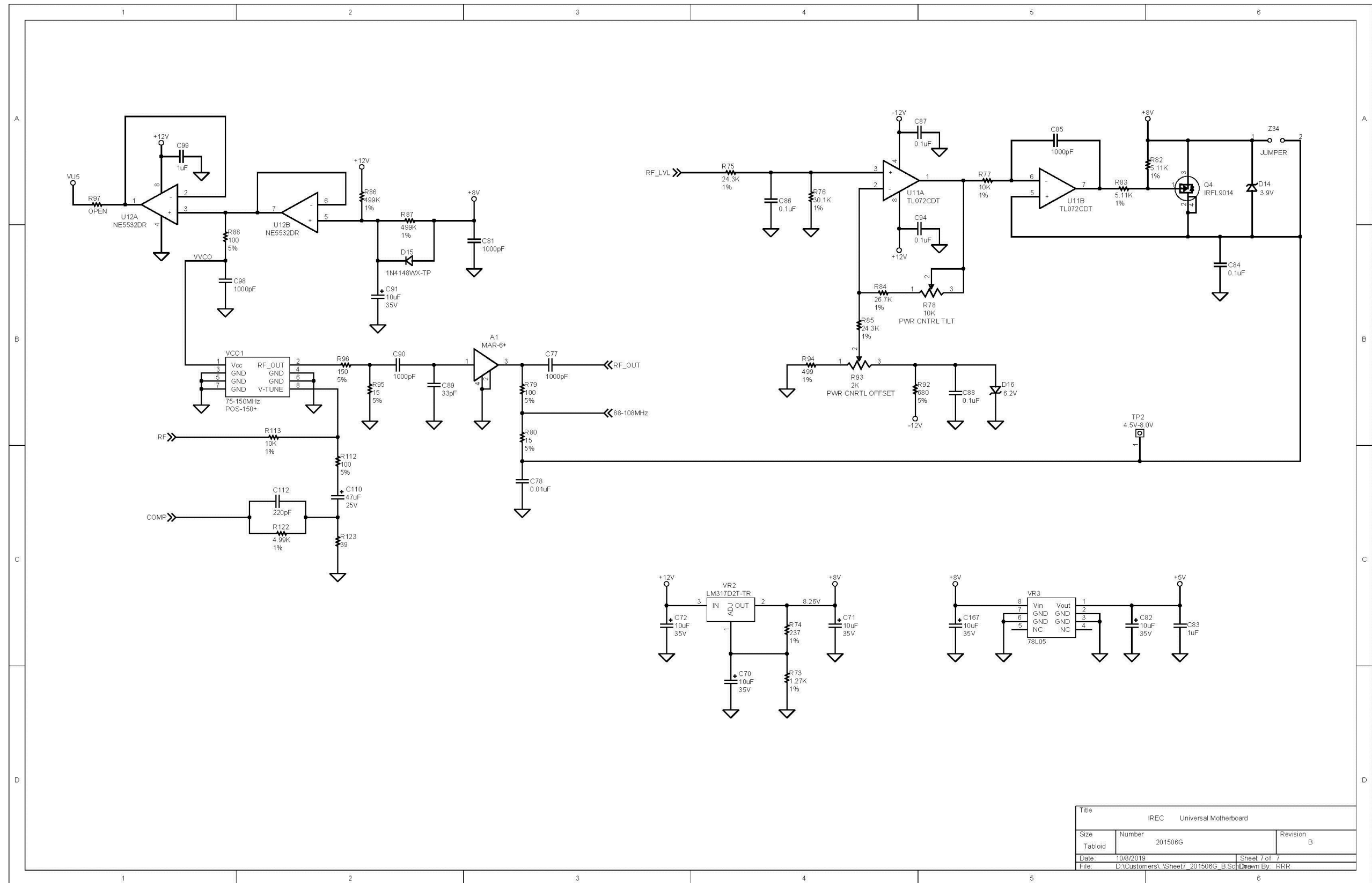


Schematic Diagram: Motherboard (Sheet 5 of 7)

Board Layouts and Schematics



Schematic Diagram: Motherboard (Sheet 6 of 7)



Title		
IREC Universal Motherboard		
Size	Number	Revision
Tabloid	201506G	B
Date:	10/8/2019	Sheet 7 of 7
File:	D:\Customers\Sheet7_201506G_B.Sch Drawn By: RRR	

Schematic Diagram: Motherboard (Sheet 7 of 7)

Illustration 6-7 FM Frequency Selection Board (Top-Side)

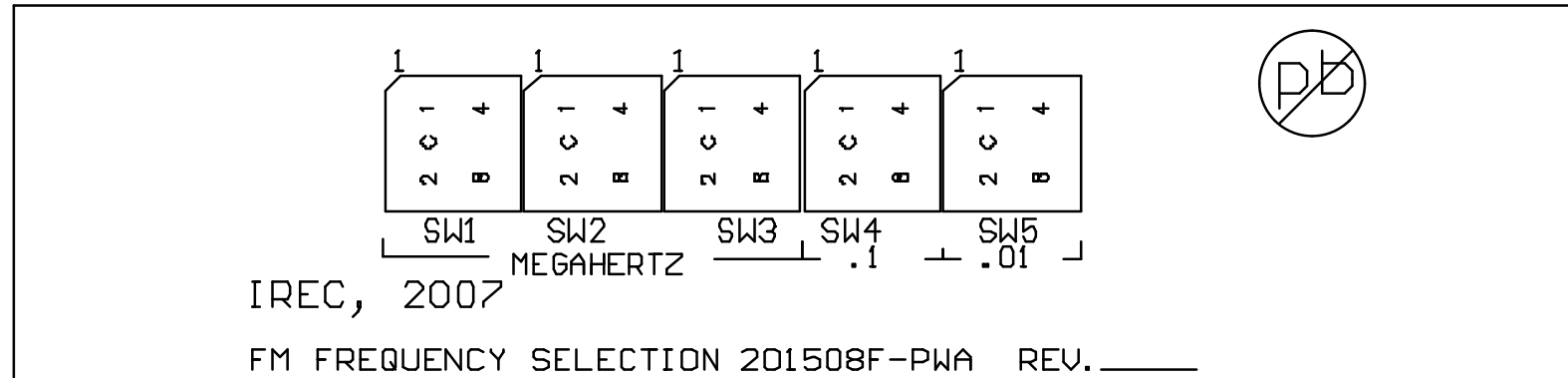
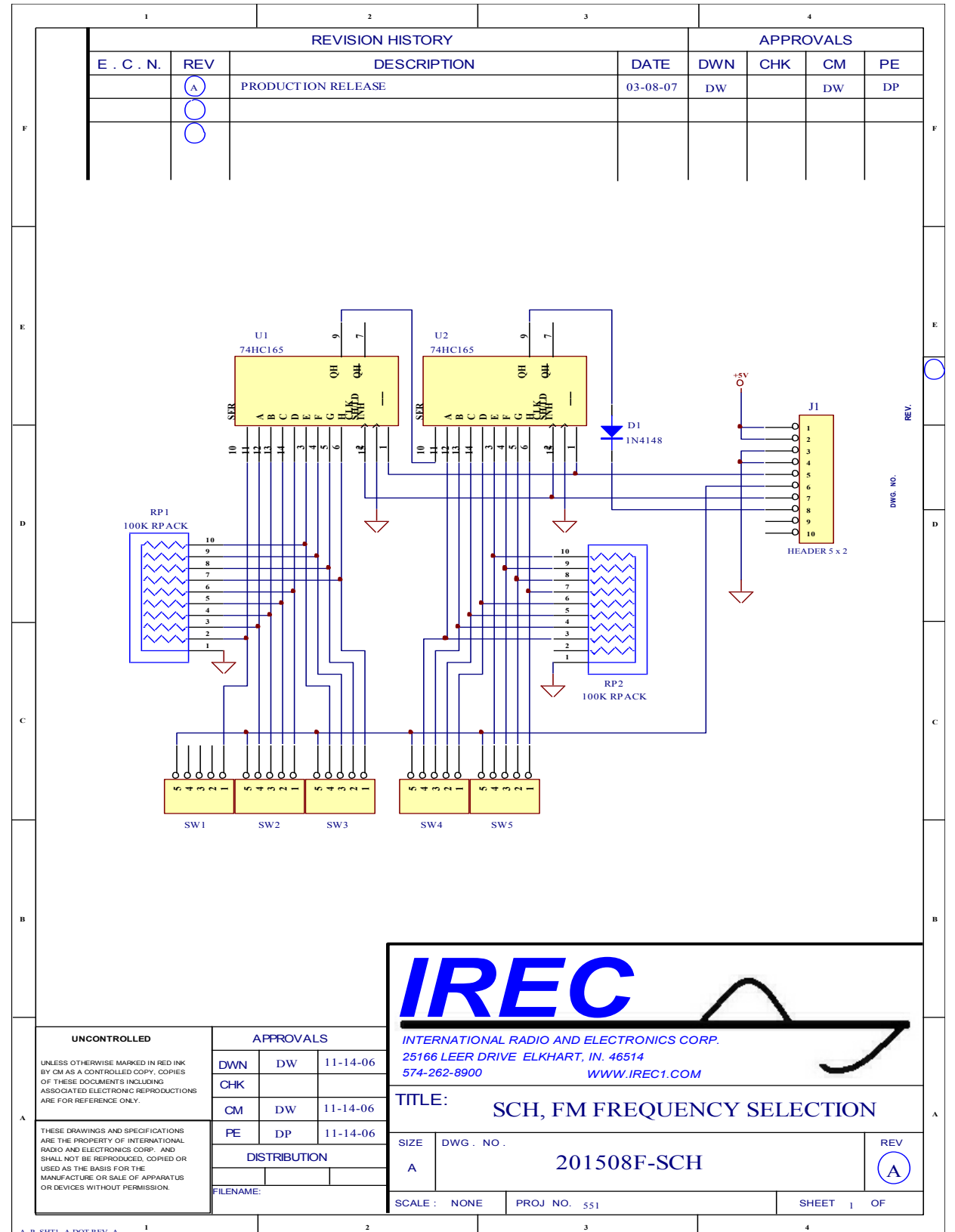


Illustration 6-8 FM Frequency Selection Board (Bottom-Side)



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<small>THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF INTERNATIONAL RADIO AND ELECTRONICS CORP. AND SHALL NOT BE REPRODUCED, COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS OR DEVICES WITHOUT PERMISSION.</small>			DISTRIBUTION		
			FILENAME:		

TITLE: SCH, FM FREQUENCY SELECTION		REV: A
SIZE: A	DWG. NO.: 201508F-SCH	REV: A
SCALE: NONE	PROJ. NO.: 551	SHEET 1 OF

Schematic Diagram: FM Frequency Selection

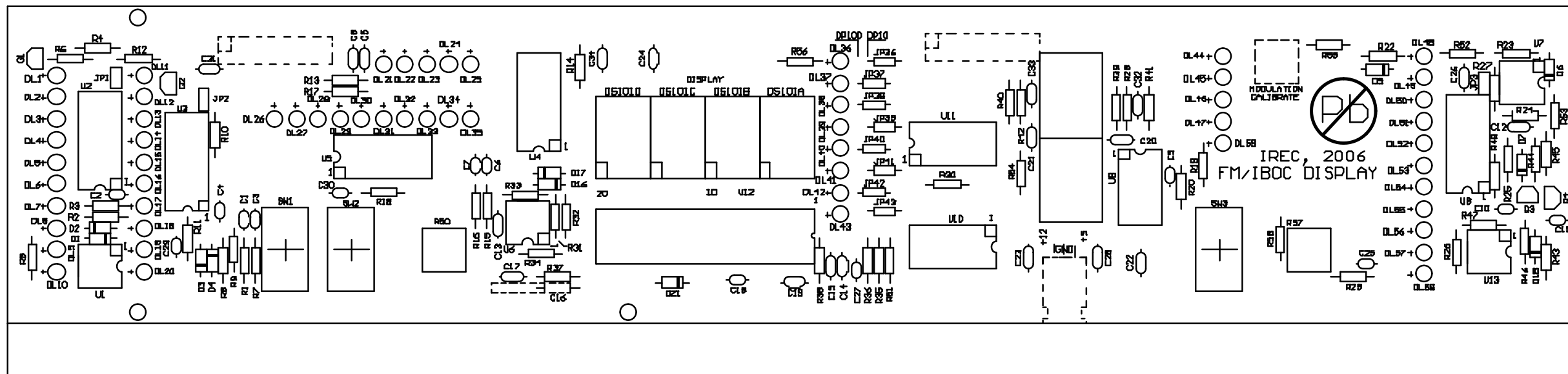
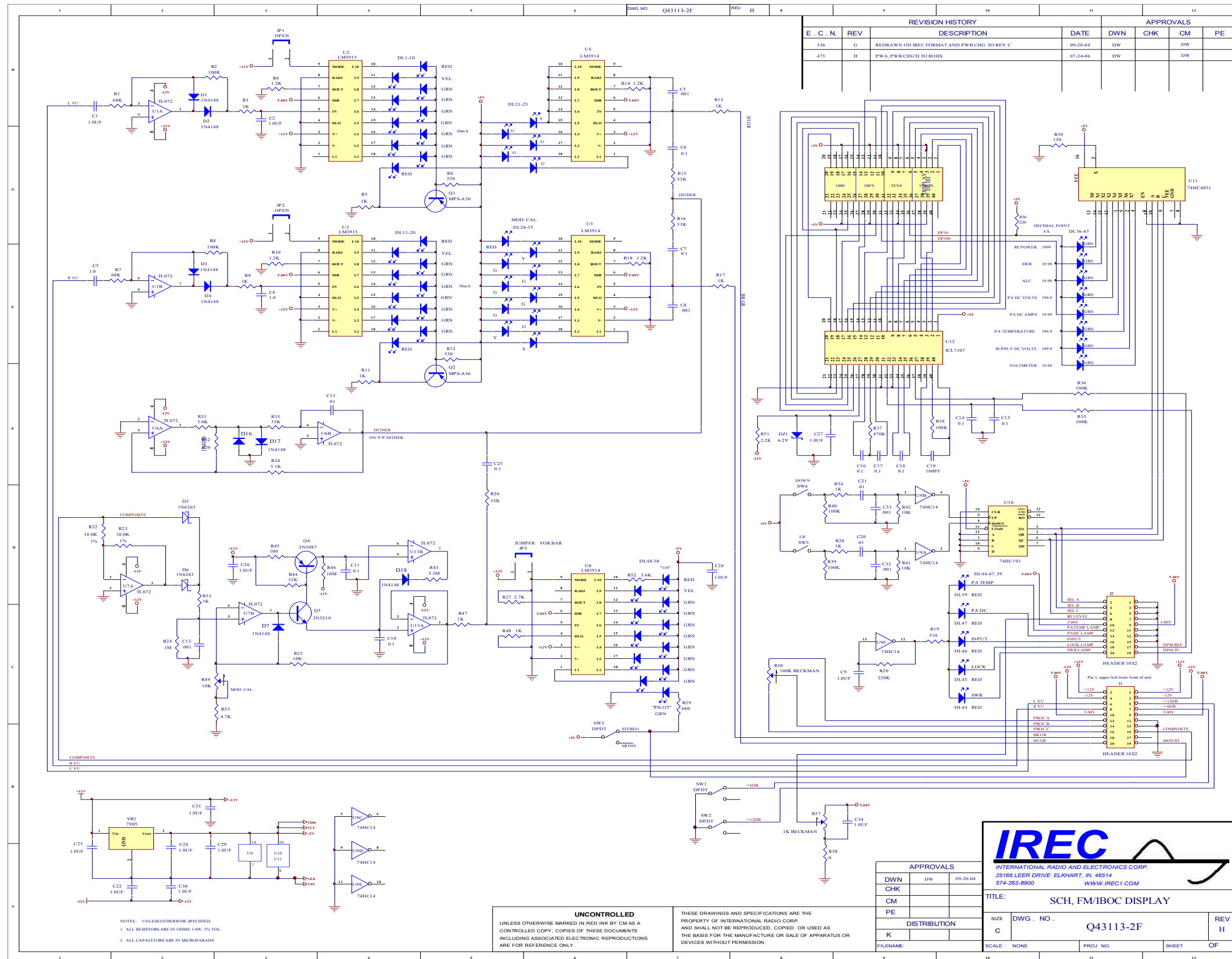


Illustration 6-9 FM Display Board

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Schematic Diagram: FM Display

Top Overlay

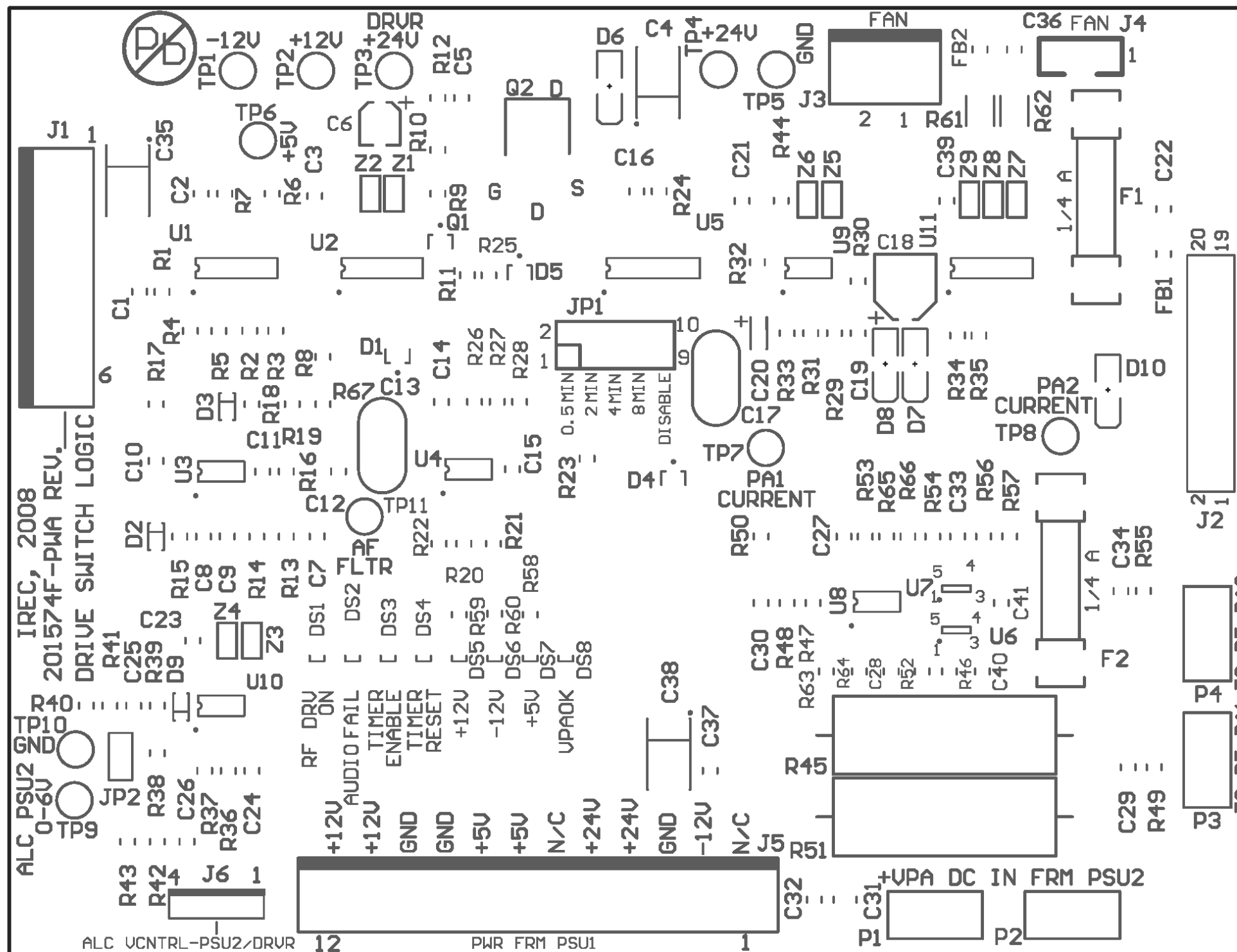
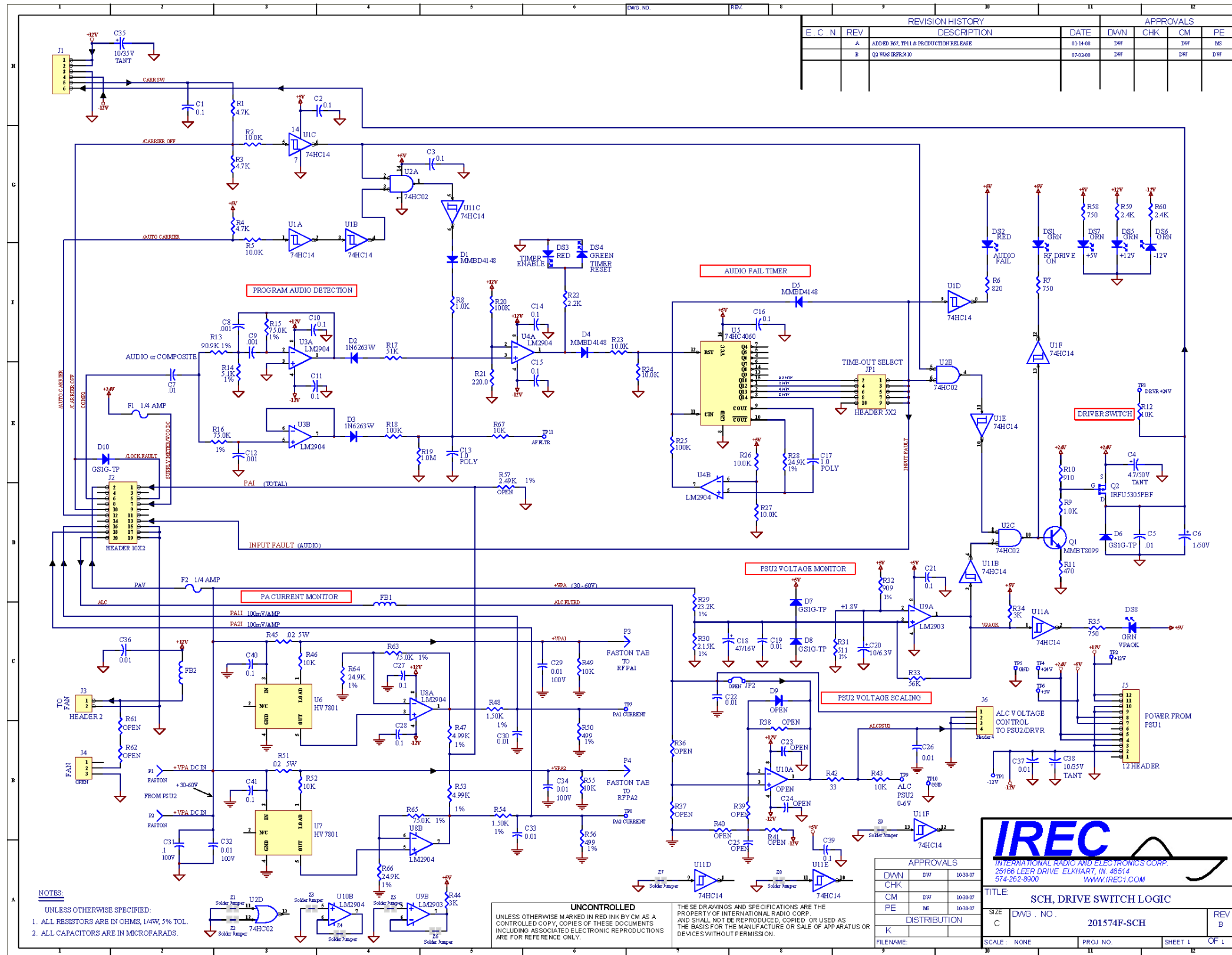


Illustration 6-10 Driver Switch Logic Board

Board Layouts and Schematics



REVISION HISTORY		DATE	DWN	CHK	CM	PE
A	ADDED REV. TP11 & PRODUCTION RELEASE	01-14-08	DW		DW	ME
B	Q2 WAS SURFACED	07-03-08	DW		DW	DW



APPROVALS		DISTRIBUTION	
DWN	DW	10-30-07	
CHK	DW		
CM	DW	10-30-07	
PE	ME	10-30-07	
FILENAME:		K	

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

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TITLE		SCH, DRIVER SWITCH LOGIC	
SIZE	DWG. NO.	201574F-SCH	
SCALE	PROJ. NO.	SHEET 1 OF 1	

Schematic Diagram: Driver Switch Logic Board

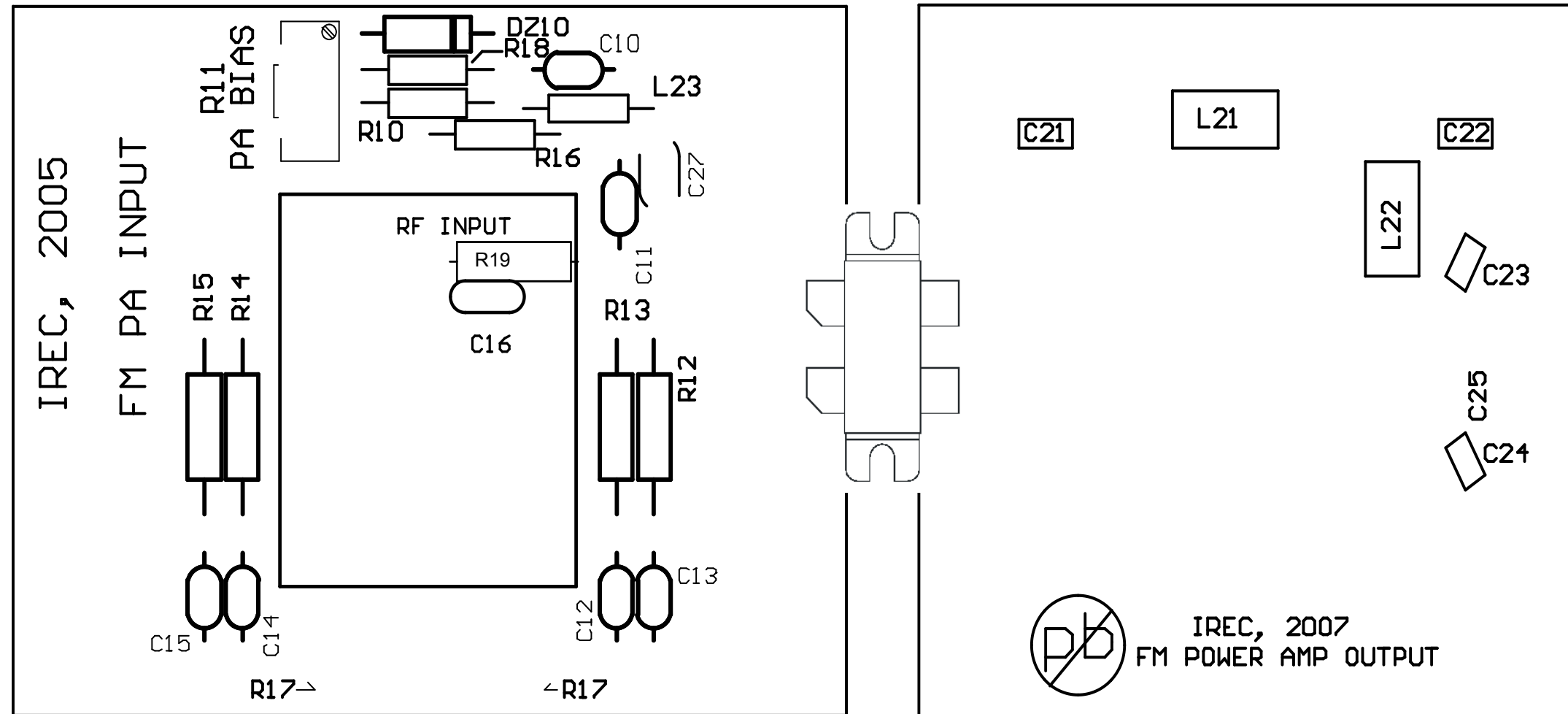


Illustration 6-12 FM600 Power Amplifier Module

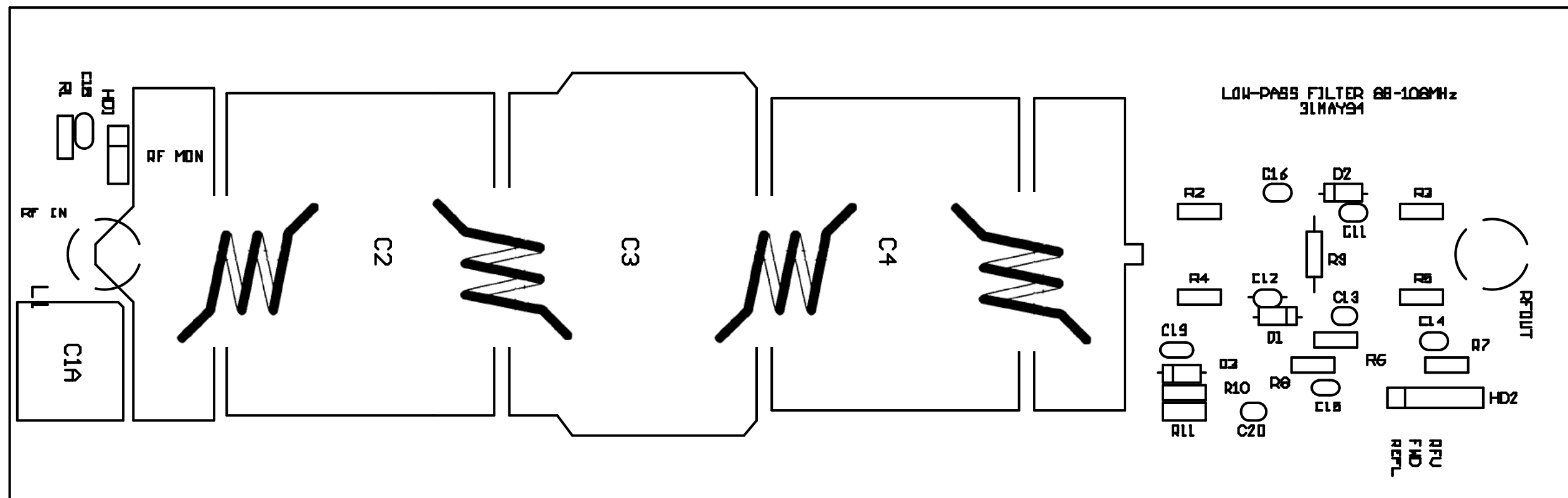
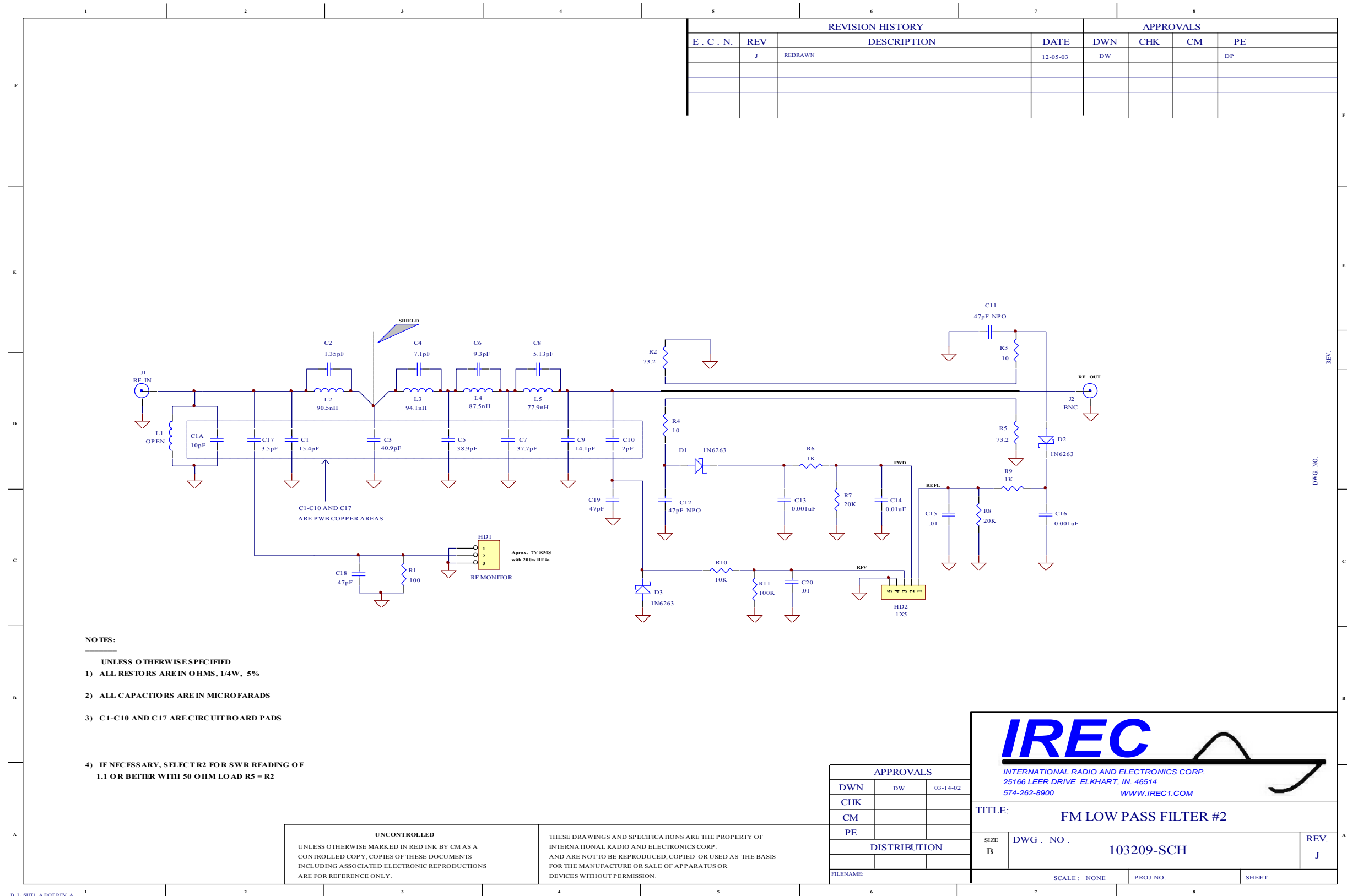


Illustration 6-13 FM Low Pass Filter #2

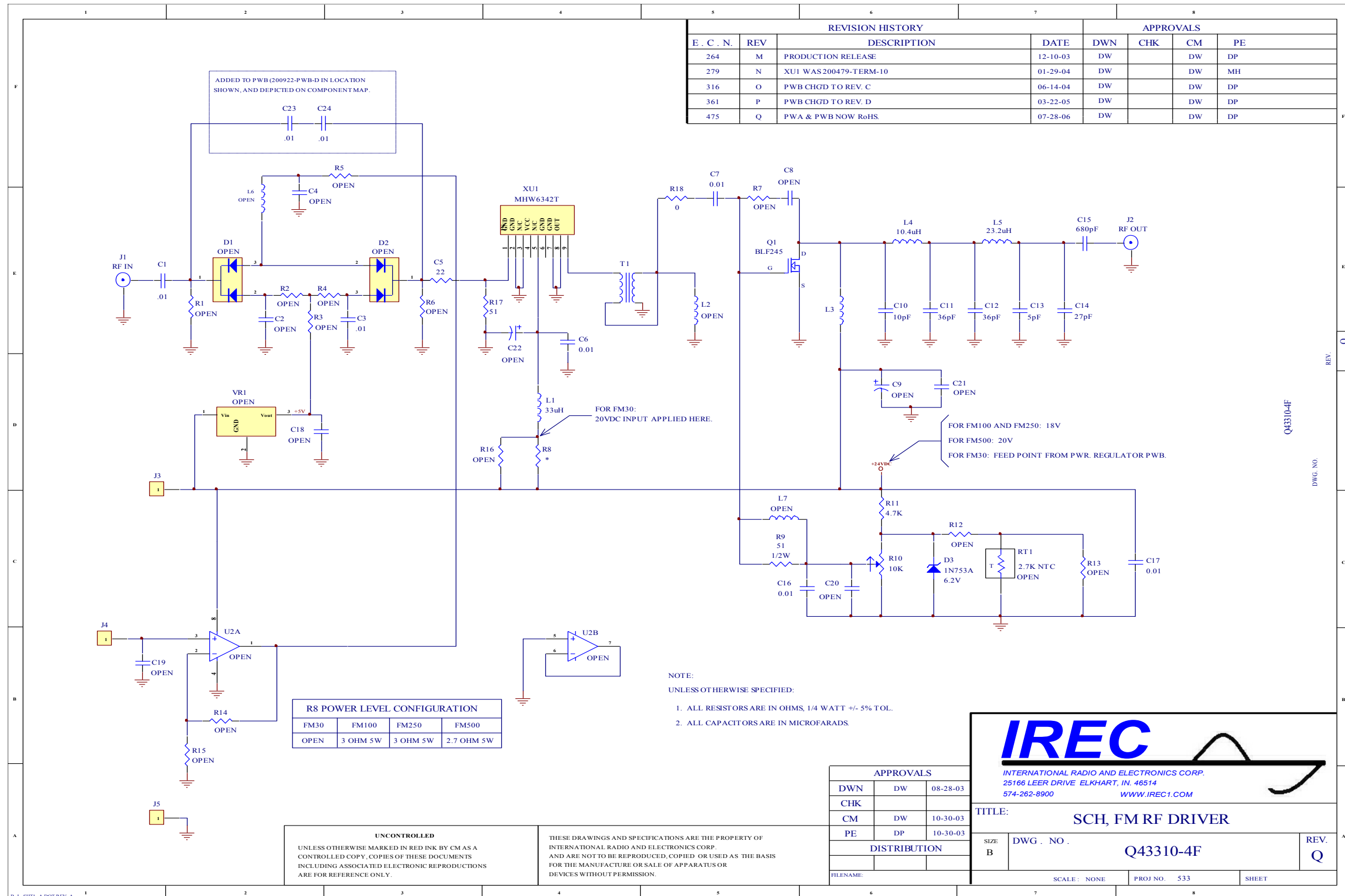
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EP

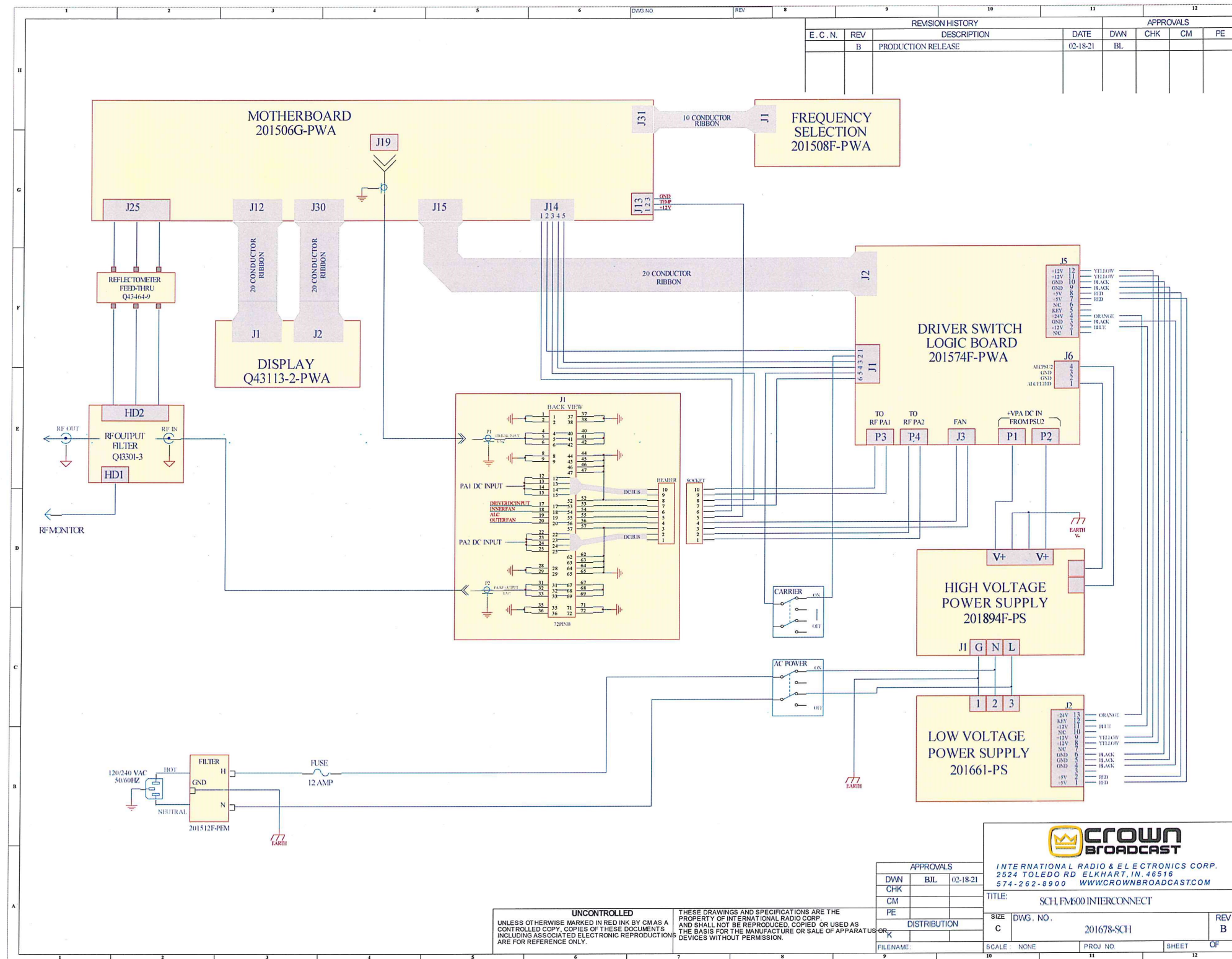


Schematic Diagram: FM Low Pass Filter #2

Board Layouts and Schematics



Schematic Diagram: FM RF Driver



Schematic Diagram: FM600 Chassis Interconnect

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NOTES