1. CONTENTS

2. SPECIFICATIONS

Following table summarizes AM 15000 SS specifications:

1. Frequency Range:	530 kHz to 1700 kHz
2. Nominal R.F. output power:	11 kW with 150% modulation capability.
3. Maximum output power @100% continuous tone modulation:	12 kW
4. Efficiency:	> 82%
5. Power reduction:	2 levels standard. Quasi continuous adjustment: +/- 15%.
6. Configuration:	Modular, with 14 independent and interchangeable amplifiers
7. A.C input voltage:	220 V 50/60 Hz three phase standard. 380 V 50/60 Hz three phase available. Other voltages upon request.
8. Output impedance:	50 ohms unbalanced
9. Maximum S.W.R.:	1.5:1
10. Output connector:	Type E.I.A. 1-5/8" female. Other connectors upon request.
11. Harmonics and spurious :	> 80 dB.
12. Output spectrum:	Complies with CCIR recommendations and a mask defined by the following frequency and attenuation points: 0 to 10 kHz: 0 dB. 10 kHz to 13.5 kHz: atten. > than delimited by a line from point (10 kHz, -25 dB) to (13.5 kHz, -35 dB). 13.5 kHz to 54.5 kHz: atten. > than delimited by a line from point (13.5 kHz, -35 dB) to (54.5 kHz, -65 dB). 54.5 kHz to 75 kHz: atten. > than delimited

	by a line from point (54.5 kHz, -65 dB) to (75 kHz, -80 dB). Over 75 kHz: atten. > than 80 dB.
13. Frequency Stability	Better than +/- 5 Hz between 0°C and +50°C (32°F and 122°F).
14. Audio Response:	Better than +/- 1 dB, 30 Hz to 10 kHz.
15. Harmonic Distortion:	Less than 1% @ 90% modulation, between 30 Hz and 10 kHz.
16. Signal to Noise Ratio:	Better than –65 dB on a 20 Hz to 22 kHz bandwidth.
17. Carrier Shift:	Less than 1% between 0 and 95% modulation at 400 HZ.
18. Audio Input	Nominal +10 dBm balanced. Adjustable between 0 dBm and +13 dBm.
19. Operating temperature:	Storage: -15°C to +75°C (5°F to 167°F). Operation: -10°C to +50°C (14°F to 122°F).
20. Altitude:	0 to 10000 feet (3000 meters) above sea level.
21. Humidity:	0 a 95% non condensing.
22. Dimensions and weight:	Width: 31-1/2” (80 cm) Depth: 71-1/4” (181 cm) Height: 31-3/4” (81 cm) Gross weight: 1102 lb (500 kg)

Note: Specifications may change without notice.

3. FACTORY TEST DATA

1) Transmitter Data

Model: .... AM 15000 SS   Date: ....

Frequency: ....kHz   Ambient temp: ....ºC

Mains voltage: V   Responsible: ....

Serial Number: ....

Customer: ....

2) A2M1 Multimeter Readings

Position	PB1	PB2	PB3	PB4	PB5	PB6	PB7
B mod.							
IPB.							
Tº RF							
Tº PWM							

Position	PB8	PB9	PB10	PB11	PB12	PB13	PB14
B mod.							
IPB.							
Tº RF							
Tº PWM							

Meter	
V.	
I.	
VDR.	
IDR.	
PLL.	
9 V.	
-15 V.	

Distortion and Frequency Response (Pn=10 kW)

Frequency (Hz)	dB @ 90% M (dBr)	d @ Pn 90% M (%)	d @ Pn 25% M (%)
30			
50			
100			
400			
1000			
5000			
7500			
10000			

Input level for M=100%: ....dBm.

Carrier shift between 0% and 95% mod @ 400 Hz: ....%

Signal to noise ratio referred to 100% mod: ....dBr.

IMD 60 Hz / 7 KHz 4:1 @ 80% mod: ....%

3) Power Levels

Level 1: ....W   Level 2: ....W

4) Checklist

Power level selection: ....

Local/Remote operation: ....

Multimeter: ....

Directional wattmeter: ....

S.W.R. protection: ....

Amplifier protections: ....

Over voltage protection: ....

Overcurrent protection: ....

Over temperature protection: ....

Amplifier 1 extraction: ....

Amplifier 2 extraction: ....

Amplifier 3 extraction: ....

Amplifier 4 extraction: ....

Amplifier 5 extraction: ....

Amplifier 6 extraction: ....

Amplifier 7 extraction: ....

Frequency: ....

Harmonics and spurious: ....

Temperatures: ....

5) Keys

Upper Left key number: ....

Upper Right key number: ....

Middle key number: ....

Bottom key number: ....

1011......	1111......	1211......	1311......	1511......
1811......	1911......	3111.....	3211.....	3411......
3911......	4111......	4611......	4711......	4811......
4911......	6411......	7711......	8711......	

Signature:.....................................

4. TRANSMITTER DESCRIPTION

4.1. GENERAL INFORMATION

The AM 15000 SS transmitter is designed to operate in any channel of the A.M. band from 530 kHz to 1700 kHz. The equipment uses a synthesizer as a frequency reference that can be easily adjusted for any frequency channel.

This transmitter is intended for 10 kW AM stations, and the nominal carrier power is 11 kW with 150% of positive peak modulation capability.

The standard AC supply is three phase 380V 50/60 Hz. A 220V 50/60 Hz three phase option is also available. Please check the transmitter characteristic plate if unsure about which supply requires your unit.

The output impedance is 50 ohm unbalanced, and the standard output connector is E.I.A. 1-5/8 flange.

The transmitter is equipped with two preset power levels that can be selected either locally or by remote control. Each power level may be set according to user needs in a range from 10% to 110% i.e. from 1 to 11 kW.

The transmitter is equipped with an external interface unit that allows monitoring of the most important parameters, and allows commanding remotely the main functions.

4.2. PHYSICAL DESCRIPTION

The transmitter is contained in a compact cabinet whose dimensions are shown in the Specifications section of this manual.

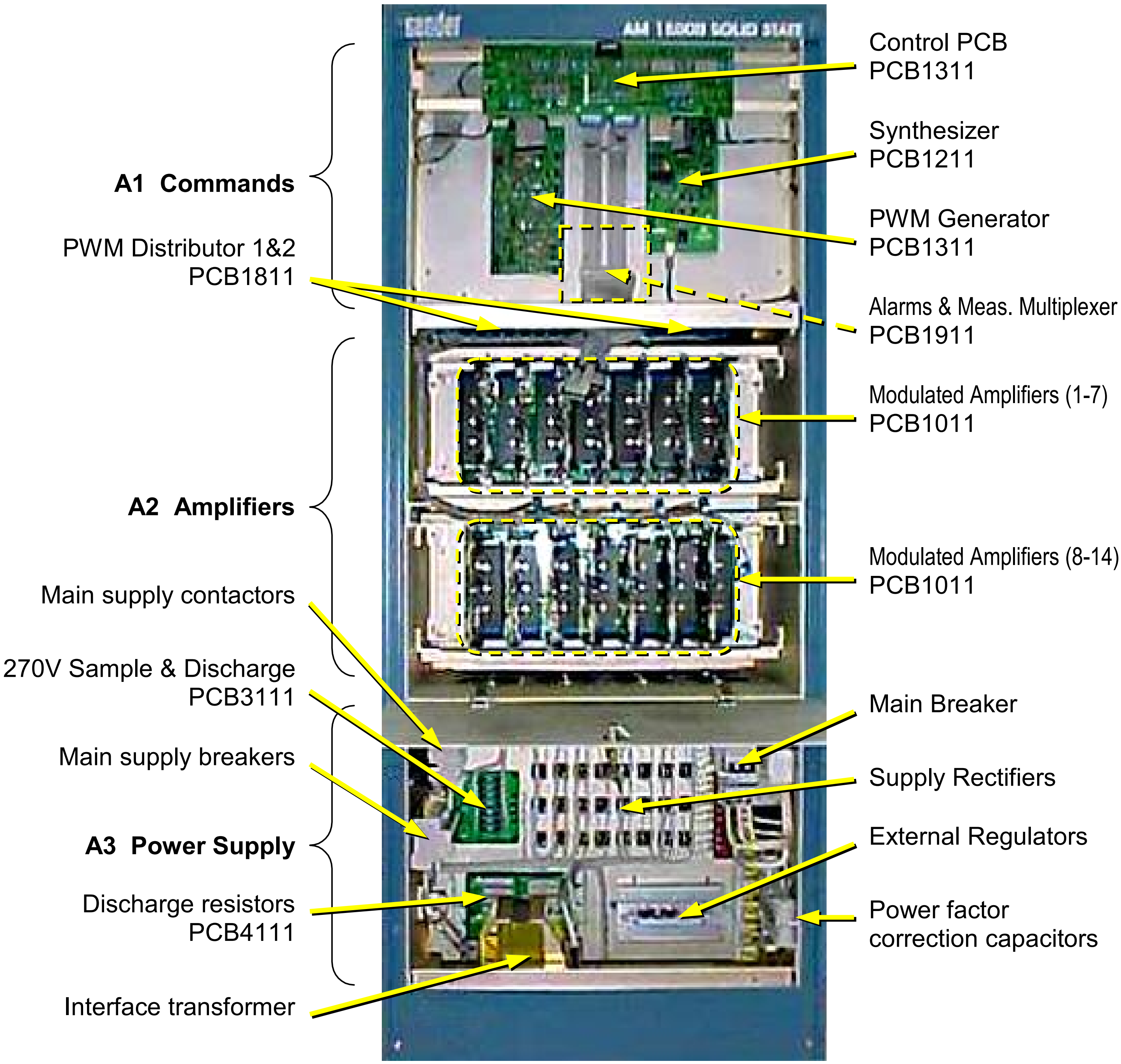
Transmitter components are organized hierarchically in assemblies and subassemblies. Refer the Tree Diagram BLK1711 for a visual representation of the transmitter assemblies and subassemblies.

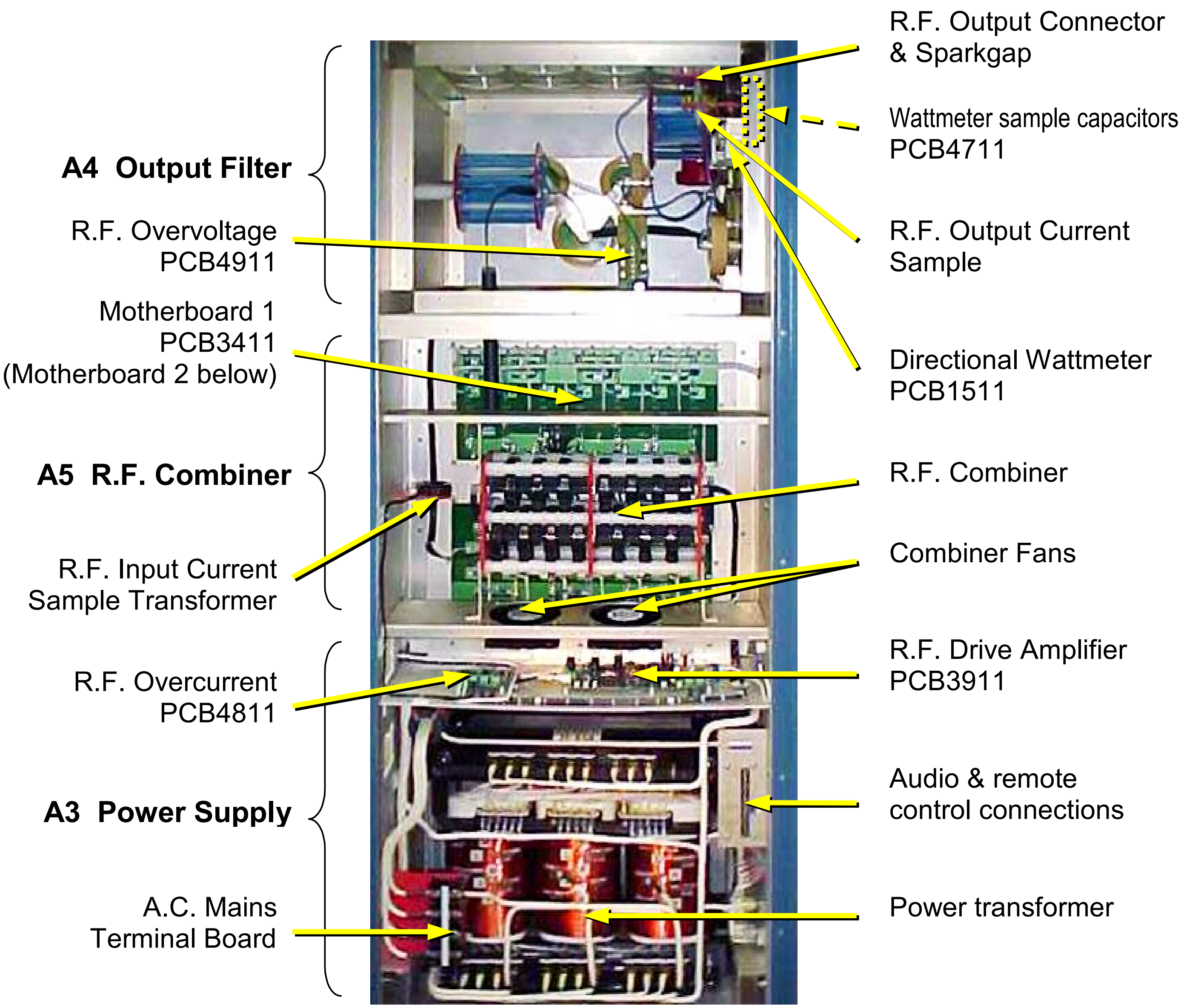
Transmitter is composed of five assemblies related to functionality and physical components distribution:

6) A1 Commands
7) A2 Amplifiers
8) A3 Power Supply
9) A4 Output Filter

10) A5 R.F. Combiner

Following images show location of most transmitters components.





Next paragraphs describe transmitter assemblies and subassemblies.

4.3. A1: Commands Assembly

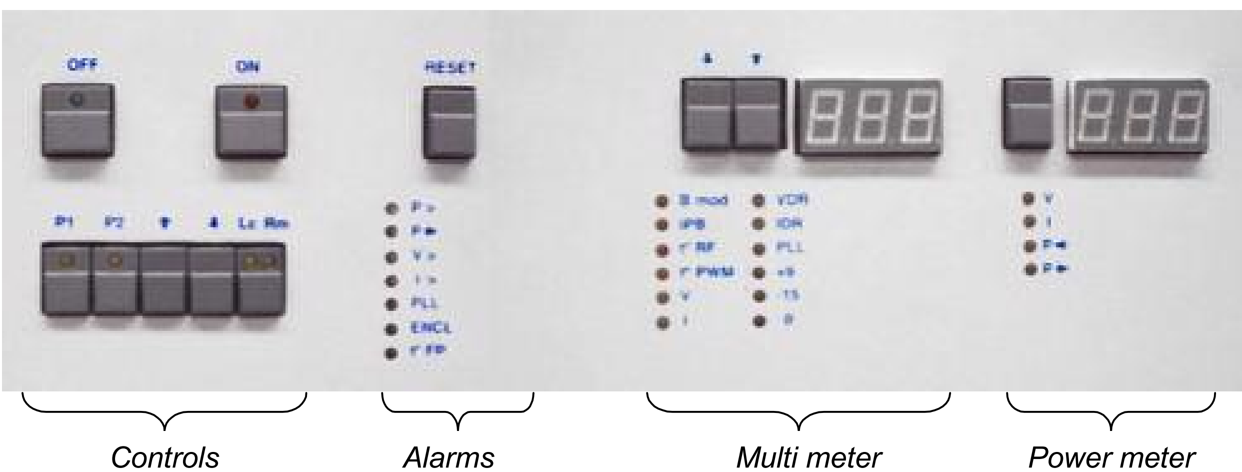
The Commands Assembly consists of a main subassembly (A1A1) including command, signaling, measuring and protective circuits; and an auxiliary subassembly () for the power amplifiers alarm and measurements selection.

The Commands Assembly is composed of the following subassemblies:

1) A1A1A1 Control PCB (PCB1311)
2) A1A1A2 Control Annex (PCB7711)
3) A1A2 PWM Generator (PCB1111)
4) A1A3 Synthesizer (PCB1211)
5) A1A4 Alarms and measurement multiplexer (PCB1911)
6) A1A5 Modulation Monitor (PCB4211) optional

4.3.1. A1A1A1: Control PCB

Control PCB performs tasks related to transmitter control, alarms and protections, and operational parameter metering. Following picture illustrates the control interface.



a) Controls section

The Control PCB includes the following command buttons:

LABEL	FUNCTION	SIGNALING
OFF	Transmitter OFF (stand-by)	Green LED
ON	Transmitter ON (on-air)	Red LED
P1	Power level 1 selection	Yellow LED
P2	Power level 2 selection	Yellow LED
⇧	Fine power increase	
⇩	Fine power reduction	
Lc Rm	Local or remote control operation	2 Yellow LEDs

b) Alarms section

The Control PCB includes the following alarm indications:

LABEL	MEANING	SIGNALING
P >	Over power	Clear red LED
P⇦	Reflected power (SWR)	Clear red LED
V >	Main supply overvoltage	Clear red LED
I >	Main supply overcurrent	Clear red LED
PLL	Synthesizer PLL out of lock	Clear red LED
ENCL	Interlock	Clear red LED
tº FP	Main supply overtemperature	Clear red LED

Alarms remain lit until the RESET button is pressed.

c) Multi Meter section

Multimeter reading is selected by buttons ⇧ and ⇩. It is possible to read the following parameters:

LABEL	MEASUREMENT	SIGNALING
Bmod	+B modulated voltage (*)	Orange LED
IPB	Power block modulated current (*)	Orange LED
Tº RF	R.F. stage temperature (*)	Orange LED
Tº PWM	PWM stage temperature (*)	Orange LED
V	Main supply voltage	Yellow LED
I	Main supply current	Yellow LED
VDR	R.F. drive peak voltage	Yellow LED
IDR	R.F. drive effective current	Yellow LED
PLL	Synthesizer PLL voltage	Yellow LED
+9	+9V auxiliary supply voltage	Yellow LED
-15	-15V auxiliary supply voltage	Yellow LED
0	0V reference reading	Yellow LED

Measurements marked with (*) correspond to the amplifier selected on the Alarms Multiplexer (PCB1911).

d) Power Meter section

Following measurements may be read on the Power Meter:

LABEL	MEASUREMENT	SIGNALING
V	Main supply voltage	Yellow LED
I	Main supply current	Yellow LED
P⇨	Direct Power	Yellow LED
P⇦	Reverse Power	Yellow LED

Reading is selected by pressing the button located on top of the indicating LEDs (no label).

4.3.2. A1A1A2: Status Interface

Connected in the rear of Control PCB, there is the status interface PCB that allows the external monitoring of alarms and main operational parameters.

4.3.3. A1A2: PWM Generator

The PWM Generator (PCB1111) performs the following functions:

1) Soft start
2) Automatic power control
3) Output power adjustment (fixed and quasi continuous)
4) Balanced to unbalanced audio signal conversion
5) Adjustable positive and negative clippers
6) Hum and noise reduction
7) Fast acting protection by PWM pilot kill

The PWM generator utilizes an instrumentation type balanced input stage as a front end for program audio.

Power level selection is commanded from the Control PCB. Two power levels P1 and P2 may be selected. The coarse power levels may be further adjusted by means of the fine power adjustments controls.

Two crystal-controlled PWM pilot signals, which are 180º out of phase, are sent from the PWM board to the modulated amplifiers. This dual phase PWM modulation scheme drastically reduces the artifacts associated with standard PWM modulators.

4.3.4. A1A3: Synthesizer

The following table defines dip-switch settings for the different frequency channels:

The following table defines dip switch settings for the different frequency channels spaced at 10 kHz (XC1 crystal frequency is 10.240 MHz):

Frec (kHz.)	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	JP-1	JP-2
530	1	0	1	0	1	0	0	1	0	1
540	1	1	0	0	1	0	0	1	0	1
550	1	0	0	0	1	0	0	1	0	1
560	1	1	1	1	0	0	0	1	0	1
570	1	0	1	1	0	0	0	1	0	1
580	1	1	0	1	0	0	0	1	0	1
590	1	0	0	1	0	0	0	1	0	1
600	1	1	1	0	0	0	0	1	0	1
610	1	0	1	0	0	0	0	1	0	1
620	1	1	0	0	0	0	0	1	0	1
630	1	0	0	0	0	0	0	1	0	1
640	1	1	1	1	1	1	1	0	0	1
650	1	0	1	1	1	1	1	0	0	1
660	1	1	0	1	1	1	1	0	0	1
670	1	0	0	1	1	1	1	0	0	1
680	1	1	1	0	1	1	1	0	0	1
690	1	0	1	0	1	1	1	0	0	1
700	1	1	0	0	1	1	1	0	0	1
710	1	0	0	0	1	1	1	0	0	1
720	1	1	1	1	0	1	1	0	0	1
730	1	0	1	1	0	1	1	0	0	1
740	1	1	0	1	0	1	1	0	0	1
750	1	0	0	1	0	1	1	0	0	1
760	1	1	1	0	0	1	1	0	0	1
770	1	0	1	0	0	1	1	0	0	1
780	1	1	0	0	0	1	1	0	0	1
790	1	0	0	0	0	1	1	0	0	1
800	1	1	1	1	1	0	1	0	0	1
810	1	0	1	1	1	0	1	0	0	1
820	1	1	0	1	1	0	1	0	0	1
830	1	0	0	1	1	0	1	0	0	1
840	1	1	1	0	1	0	1	0	0	1
850	1	0	1	0	1	0	1	0	0	1
860	1	1	0	0	1	0	1	0	0	1
870	1	0	0	0	1	0	1	0	0	1
880	1	1	1	1	0	0	1	0	0	1
890	1	0	1	1	0	0	1	0	0	1
900	1	1	0	1	0	0	1	0	0	1
910	1	0	0	1	0	0	1	0	0	1
920	1	1	1	0	0	0	1	0	0	1
930	1	0	1	0	0	0	1	0	0	1
940	1	1	0	0	0	0	1	0	0	1
950	1	0	0	0	0	0	1	0	0	1
960	1	1	1	1	1	1	0	0	0	1

Frec (kHz.)	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	JP-1	JP-2
970	1	0	1	1	1	1	0	0	0	1
980	1	1	0	1	1	1	0	0	0	1
990	1	0	0	1	1	1	0	0	0	1
1000	1	1	0	1	1	0	0	1	1	0
1010	0	1	0	1	1	0	0	1	1	0
1020	1	0	0	1	1	0	0	1	1	0
1030	0	0	0	1	1	0	0	1	1	0
1040	1	1	1	0	1	0	0	1	1	0
1050	0	1	1	0	1	0	0	1	1	0
1060	1	0	1	0	1	0	0	1	1	0
1070	0	0	1	0	1	0	0	1	1	0
1080	1	1	0	0	1	0	0	1	1	0
1090	0	1	0	0	1	0	0	1	1	0
1100	1	0	0	0	1	0	0	1	1	0
1110	0	0	0	0	1	0	0	1	1	0
1120	1	1	1	1	0	0	0	1	1	0
1130	0	1	1	1	0	0	0	1	1	0
1140	1	0	1	1	0	0	0	1	1	0
1150	0	0	1	1	0	0	0	1	1	0
1160	1	1	0	1	0	0	0	1	1	0
1170	0	1	0	1	0	0	0	1	1	0
1180	1	0	0	1	0	0	0	1	1	0
1190	0	0	0	1	0	0	0	1	1	0
1200	1	1	1	0	0	0	0	1	1	0
1210	0	1	1	0	0	0	0	1	1	0
1220	1	0	1	0	0	0	0	1	1	0
1230	0	0	1	0	0	0	0	1	1	0
1240	1	1	0	0	0	0	0	1	1	0
1250	0	1	0	0	0	0	0	1	1	0
1260	1	0	0	0	0	0	0	1	1	0
1270	0	0	0	0	0	0	0	1	1	0
1280	1	1	1	1	1	1	1	0	1	0
1290	0	1	1	1	1	1	1	0	1	0
1300	1	0	1	1	1	1	1	0	1	0
1310	0	0	1	1	1	1	1	0	1	0
1320	1	1	0	1	1	1	1	0	1	0
1330	0	1	0	1	1	1	1	0	1	0
1340	1	0	0	1	1	1	1	0	1	0
1350	0	0	0	1	1	1	1	0	1	0
1360	1	1	1	0	1	1	1	0	1	0
1370	0	1	1	0	1	1	1	0	1	0
1380	1	0	1	0	1	1	1	0	1	0
1390	0	0	1	0	1	1	1	0	1	0
1400	1	1	0	0	1	1	1	0	1	0
1410	0	1	0	0	1	1	1	0	1	0
1420	1	0	0	0	1	1	1	0	1	0
1430	0	0	0	0	1	1	1	0	1	0
1440	1	1	1	1	0	1	1	0	1	0

Frec (kHz.)	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	JP-1	JP-2
1450	0	1	1	1	0	1	1	0	1	0
1460	1	0	1	1	0	1	1	0	1	0
1470	0	0	1	1	0	1	1	0	1	0
1480	1	1	0	1	0	1	1	0	1	0
1490	0	1	0	1	0	1	1	0	1	0
1500	1	0	0	1	0	1	1	0	1	0
1510	0	0	0	1	0	1	1	0	1	0
1520	1	1	1	0	0	1	1	0	1	0
1530	0	1	1	0	0	1	1	0	1	0
1540	1	0	1	0	0	1	1	0	1	0
1550	0	0	1	0	0	1	1	0	1	0
1560	1	1	0	0	0	1	1	0	1	0
1570	0	1	0	0	0	1	1	0	1	0
1580	1	0	0	0	0	1	1	0	1	0
1590	0	0	0	0	0	1	1	0	1	0
1600	1	1	1	1	1	0	1	0	1	0
1610	0	1	1	1	1	0	1	0	1	0
1620	1	0	1	1	1	0	1	0	1	0
1630	0	0	1	1	1	0	1	0	1	0
1640	1	1	0	1	1	0	1	0	1	0
1650	0	1	0	1	1	0	1	0	1	0
1660	1	0	0	1	1	0	1	0	1	0
1670	0	0	0	1	1	0	1	0	1	0
1680	1	1	1	0	1	0	1	0	1	0
1690	0	1	1	0	1	0	1	0	1	0
1700	1	0	1	0	1	0	1	0	1	0

The following table defines dip switch settings for the different frequency channels spaced at 9 kHz (XC1 crystal frequency is 9.216 MHz):

Frec (kHz)	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	JP-1	JP-2
531	1	0	0	1	0	0	0	11	0	1
540	1	1	1	0	0	0	0	1	0	1
549	1	0	1	0	0	0	0	1	0	1
558	1	1	0	0	0	0	0	1	0	1
567	1	0	0	0	0	0	0	1	0	1
576	1	1	1	1	1	1	1	0	0	1
585	1	0	1	1	1	1	1	0	0	1
594	1	1	0	1	1	1	1	0	0	1
603	1	0	0	1	1	1	1	0	0	1
612	1	1	1	0	1	1	1	0	0	1
621	1	0	1	0	1	1	1	0	0	1
630	1	1	0	0	1	1	1	0	0	1
639	1	0	0	0	1	1	1	0	0	1
648	1	1	1	1	0	1	1	0	0	1

Frec (kHz)	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	JP-1	JP-2
657	1	0	1	1	0	1	1	0	0	1
666	1	1	0	1	0	1	1	0	0	1
675	1	0	0	1	0	1	1	0	0	1
684	1	1	1	0	0	1	1	0	0	1
693	1	0	1	0	0	1	1	0	0	1
702	1	1	0	0	0	1	1	0	0	1
711	1	0	0	0	0	1	1	0	0	1
720	1	1	1	1	1	0	1	0	0	1
729	1	0	1	1	1	0	1	0	0	1
738	1	1	0	1	1	0	1	0	0	1
747	1	0	0	1	1	0	1	0	0	1
756	1	1	1	0	1	0	1	0	0	1
765	1	0	1	0	1	0	1	0	0	1
774	1	1	0	0	1	0	1	0	0	1
783	1	0	0	0	1	0	1	0	0	1
792	1	1	1	1	0	0	1	0	0	1
801	1	0	1	1	0	0	1	0	0	1
810	1	1	0	1	0	0	1	0	0	1
819	1	0	0	1	0	0	1	0	0	1
828	1	1	1	0	0	0	1	0	0	1
837	1	0	1	0	0	0	1	0	0	1
846	1	1	0	0	0	0	1	0	0	1
855	1	0	0	0	0	0	1	0	0	1
864	1	1	1	1	1	0	0	1	1	0
873	1	0	1	1	1	1	0	0	0	1
882	1	0	1	1	1	0	0	1	1	0
891	0	0	1	1	1	0	0	1	1	0
900	1	1	0	1	1	0	0	1	1	0
909	0	1	0	1	1	0	0	1	1	0
918	1	0	0	1	1	0	0	1	1	0
927	0	0	0	1	1	0	0	1	1	0
936	1	1	1	0	1	0	0	1	1	0
945	0	1	1	0	1	0	0	1	1	0
954	1	0	1	0	1	0	0	1	1	0
963	0	0	1	0	1	0	0	1	1	0
972	1	1	0	0	1	0	0	1	1	0
981	0	1	0	0	1	0	0	1	1	0
990	1	0	0	0	1	0	0	1	1	0
999	0	0	0	0	1	0	0	1	1	0
1008	1	1	1	1	0	0	0	1	1	0
1017	0	1	1	1	0	0	0	1	1	0
1026	1	0	1	1	0	0	0	1	1	0
1035	0	0	1	1	0	0	0	1	1	0
1044	1	1	0	1	0	0	0	1	1	0
1053	0	1	0	1	0	0	0	1	1	0
1062	1	0	0	1	0	0	0	1	1	0

Frec (kHz)	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	JP-1	JP-2
1071	0	0	1	0	0	0	0	1	1	0
1080	1	1	1	0	0	0	0	1	1	0
1089	0	1	1	0	0	0	0	1	1	0
1098	1	0	1	0	0	0	0	1	1	0
1107	0	0	1	0	0	0	0	1	1	0
1116	1	1	0	0	0	0	0	1	1	0
1125	0	1	0	0	0	0	0	1	1	0
1134	1	0	0	0	0	0	0	1	1	0
1143	0	0	0	0	0	0	0	1	1	0
1152	1	1	1	1	1	1	1	0	1	0
1161	0	1	1	1	1	1	1	0	1	0
1170	1	0	1	1	1	1	1	0	1	0
1179	0	0	1	1	1	1	1	0	1	0
1188	1	1	0	1	1	1	1	0	1	0
1197	0	1	0	1	1	1	1	0	1	0
1206	1	0	0	1	1	1	1	0	1	0
1215	0	0	0	1	1	1	1	0	1	0
1224	1	1	1	0	1	1	1	0	1	0
1233	0	1	1	0	1	1	1	0	1	0
1242	1	0	1	0	1	1	1	0	1	0
1251	0	0	1	0	1	1	1	0	1	0
1260	1	1	0	0	1	1	1	0	1	0
1269	0	1	0	0	1	1	1	0	1	0
1278	1	0	0	0	1	1	1	0	1	0
1287	0	0	0	0	1	1	1	0	1	0
1296	1	1	1	1	0	1	1	0	1	0
1305	0	1	1	1	0	1	1	0	1	0
1314	1	0	1	1	0	1	1	0	1	0
1323	0	0	1	1	0	1	1	0	1	0
1332	1	1	0	1	0	1	1	0	1	0
1341	0	1	0	1	0	1	1	0	1	0
1350	1	0	0	1	0	1	1	0	1	0
1359	0	0	0	1	0	1	1	0	1	0
1368	1	1	1	0	0	1	1	0	1	0
1377	0	1	1	0	0	1	1	0	1	0
1386	1	0	1	0	0	1	1	0	1	0
1395	0	0	1	0	0	1	1	0	1	0
1404	1	1	0	0	0	1	1	0	1	0
1413	0	1	0	0	0	1	1	0	1	0
1422	1	0	0	0	0	1	1	0	1	0
1431	0	0	0	0	0	1	1	0	1	0
1440	1	1	1	1	1	0	1	0	1	0
1449	0	1	1	1	1	0	1	0	1	0
1458	1	0	1	1	1	0	1	0	1	0
1467	0	0	1	1	1	0	1	0	1	0
1476	1	1	0	1	1	0	1	0	1	0

Frec (kHz)	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	JP-1	JP-2
1485	0	1	0	1	1	0	1	0	1	0
1494	1	0	0	1	1	0	1	0	1	0
1503	0	0	0	1	1	0	1	0	1	0
1512	1	1	1	0	1	0	1	0	1	0
1521	0	1	1	0	1	0	1	0	1	0
1530	1	0	1	0	1	0	1	0	1	0
1539	0	0	1	0	1	0	1	0	1	0
1548	1	1	0	0	1	0	1	0	1	0
1557	0	1	0	0	1	0	1	0	1	0
1566	1	0	0	0	1	0	1	0	1	0
1575	0	0	0	0	1	0	1	0	1	0
1584	1	1	1	1	0	0	1	0	1	0
1593	0	1	1	1	0	0	1	0	1	0
1602	1	0	1	1	0	0	1	0	1	0
1611	0	0	1	1	0	0	1	0	1	0
1620	1	1	1	1	0	0	1	0	1	0
1629	0	1	0	1	0	0	1	0	1	0

Previous tables have been provided for reference only. It transmitter frequency needs to be changed, a complete transmitter setup procedure is required. This includes: RF drive adjustment, frequency dependent component replacement in the RF output stage, output filter tuning, and wattmeter recalibration.

By changing some straps it is possible to operate with an external frequency reference or with an external C-QUAM stereo ®.

Note: C-QUAM is a Motorola Inc. registered trademark.

4.3.5. A1A4: Alarms and Measurements Multiplexer

This subassembly consists in an LED panel that shows the following alarms for each of the 14 Modulated Amplifiers:

- R.F. Alarm, indicated as "RF" (caused by low R.F. drive voltage or by a bad R.F. transistor)
- Supply Alarm, indicated as "V" (caused by a faulty fuse or bad voltage regulator on the Modulated Amplifier)
- PWM or Temperature Alarm, indicated as "PWM Tº" (caused either by a failure or by overtemperature on a PWM transistor)

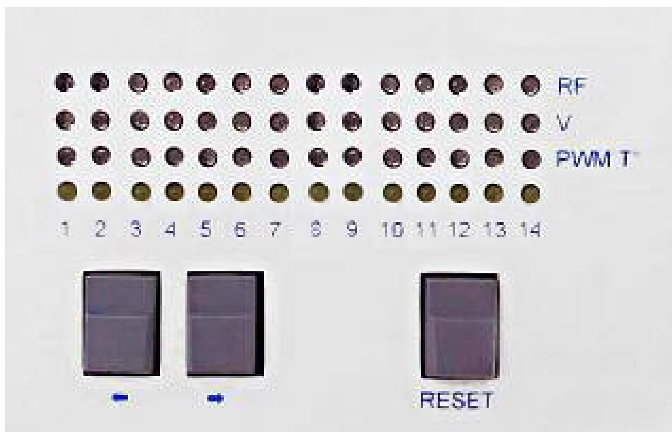
The alarms are indicated by means of clear red LED's that remain lit until reset. A reset button (labeled RESET) allows clearing the alarm panel. In addition, the alarms are automatically reset when transmitter is turned ON.

Two selection buttons (labeled ⇦ and ⇨) allow selection of one of the 14 modulated amplifiers. The following parameters are displayed on the Control PCB on the Multi Meter for the selected amplifier:

- Bmod: +B modulated voltage
- IPB: Power block modulated current
- tº RF: RF amplifier temperature
- tº PWM: PWM amplifier temperature

The selected amplifier is indicated with a yellow LED. Amplifiers are numbered from left to right as 1 to 7 for the upper group and 8 to 14 for the lower group.

The following picture shows the alarm panel:



4.3.6. A1A5: Modulation Monitor

The optional Modulation Monitor (PCB4211) was specially designed to operate integrated with SENDER transmitters. As such, supply voltages and RF sample are taken directly from the transmitter's power supply and RF output connector, respectively. All required cabling is done internally.

4.4. A2: AMPLIFIERS ASSEMBLY

The amplifiers assembly is composed of the following functional units:

1) Amplifier Fans
2) PWM Distributors (two)
3) Modulated Amplifier Blocks (two)
4) Audio processor (optional)

The above assemblies are described in the following lines:

4.4.1. A2A1 Amplifier fans

These fans provide a constant low-velocity airflow for cooling the modulated amplifiers.

4.4.2. A2A2A1 & A2A2A2: PWM Distributor 1 & 2

Each PWM Distributor (PCB1811) receives the PWM pilot signals and distributes them to a group a 7 power amplifiers each. One group receives the PWM phase 0º and the other group is driven with the PWM phase 180º.

4.4.3. A2A3 & A2A4: Modulated Amplifier Block 1 & 2

The transmitter contains 14 Modulated Amplifiers (PCB1011), arranged in two blocks of seven. Each block is plugged into a Motherboard (PCB3411) that performs the main supply, R.F. drive and R.F. output connections.

The plug-in modulated amplifiers contain in a single PCB a switching-type high-efficiency PWM amplifier and a class-D RF amplifier.

The R.F. amplifier and the PWM amplifier use the same type of power MOSFET transistor (IRFP350).

The modulated amplifiers are plugged in a motherboard where 31 pin sockets carrying main D.C. voltage, R.F. drive and R.F. output, are installed.

A DB-25 plug, carrying PWM pilot, auxiliary D.C. voltages and command signaling and control signals, is installed in the front of the amplifier's boards. A flat cable interconnects mentioned DB25 plug with the control board.

Internally, the power amplifiers include over temperature protection, low R.F. drive and drive unbalance protection, overload protection and PWM duty cycle protection.

A safety switch discharges the amplifier filter capacitors when the board is unplugged.

4.4.4. A2A5: Audio Processor (optional)

The optional onboard Audio Processor has been specially adapted to operate fully integrated with SENDER transmitters. Thus, transmitter audio input is directly routed to the processor and its output is internally fed into the transmitter's modulation input.

The audio processor is composed of two subassemblies:

- A2A5A1 is the main audio processor PCB
- A2A5A2 is the audio processor interface PCB

For a detailed description and operating instructions on the Audio Processor, refer to its operating manual.

4.5. A3: POWER SUPPLY ASSEMBLY

It is located in the floor panel and is composed of the following subassemblies:

1) Power supply fans
2) 270V sample and discharge diodes
3) Main supply discharge resistors
4) External regulators
5) AC mains conditioning
6) Auxiliary supplies
7) Starting resistors
8) Remote commands

The above subassemblies are described in the following lines:

4.5.1. A3A1: Power Supply Fans

These fans contribute to the low-velocity airflow that cools the transmitter.

4.5.2. A3A2: 270V Sample and Discharge Diodes

The 270V sample is a representative sample of voltage applied to all the power amplifiers. It is used for monitoring purposes and for correcting the duty cycle of the PWM pilots.

The PWM Generator PCB uses this sample in a way that cancels out distortion introduced by noise and ripple components on the main supply, as well as carrier variations that would otherwise occur due to line voltage variations.

Refer to schematic SCH3111 for additional information.

4.5.3. A3A3: Discharge Resistors

The discharge resistors drain the main supply capacitors when transmitter is turned OFF.

Refer to schematic SCH4111 for additional information.

4.5.4. A3A4: External Regulators

The external regulators subassembly contains three high-power voltage regulators that condition the auxiliary supply voltages.

Refer to schematic SCH6411 for additional information.

4.5.5. A3A5: AC Mains Conditioning

AC mains conditioning subassembly is composed of the following functional blocks:

1) A3A5A1: AC Mains Monitor. It verifies that the three phases exist and that are balanced within 5% to allow proper transmitter operation.
2) A3A5A2: Transient Suppressors. These solid-state devices (varistors) provide basic protection to the transmitter against overvoltage conditions that may occur on the AC power lines. An external transient voltage suppressor is still required on sites with probability of lightning strikes on the AC power lines.
3) A3A5A3: Power Factor Capacitors: These capacitors correct power factor of the transmitter when operating in stand-by or OFF mode.

4.5.6. A3A6: Auxiliary Supplies

The auxiliary supplies provide the regulated +20, +15, +9 and -15 volts used by the low power circuits of the transmitter.

The +15 and -15 volts are locally converted to +12 and -12 volts, respectively, on each PCB. The +9 volts auxiliary supply is used to feed the +5 volt regulators used to supply logic circuitry.

Refer to SCH3211 for additional information.

4.5.7. A3A7: Start Resistors

Starting resistors are connected in series with the main transformer primary to limit high currents that may occur when the main breaker is energized (transformer inrush), and when the transmitter is turned ON (charging of the main supply capacitors).

These resistors are bypassed automatically one second after transmitter is turned ON. A3A8: Remote Commands

4.5.8. A3A8: Remote Commands

This subassembly contains the remote control inputs and the audio input required for transmitter operation. It is located at the transmitter rear on the right side.

Refer to schematic SCH4611 for additional information.

4.6. A4: OUTPUT FILTER

The Output Filter assembly contains the RF output filter network to perform the following functions:

- Output power addition of modulated amplifiers.
- Impedance matching between external load and modulated amplifiers.
- Harmonics and spurious attenuation.
- Protection against discharges and over voltages in the load.

The Output Filter assembly is composed of the following functional blocks:

1) Output sparkgap and RF connector
2) Output current sample
3) Wattmeter sample capacitors
4) Directional wattmeter
5) RF overvoltage protection
6) Input sparkgap

These elements are described in the following paragraphs:

4.6.1. A4A1: Output Sparkgap and RF Connector

This subassembly contains the RF output connector and an adjustable sparkgap. The sparkgap is factory preset for the operating power of the transmitter.

4.6.2. A4A2: Output Current Sample

A toroidal current transformer takes a current sample from the RF output for the directional wattmeter.

An additional RF current sample transformer is included on equipment that include the optional modulation monitor.

4.6.3. A4A3: Wattmeter Sample Capacitors

A voltage sample is taken from the RF output for the directional wattmeter.

4.6.4. A4A4: Directional Wattmeter

Direct and reflected power is measured by the directional wattmeter. These measurements are used both for indication and for protection purposes on the Control PCB.

Refer to schematic SCH1511 for additional information.

4.6.5. A4A5: RF Overvoltage Protection

This subassembly contains a group a calibrated gas discharge elements that are fired when voltage at an internal node in the output filter exceeds a preset limit.

When the gas discharge elements conduct, this node is shorted to ground and a safe inductive load is presented to the modulated amplifiers. At the same time, a current sensing transformer detects conduction of these devices and transmitter is shut down shortly to restore normal operation.

Refer to schematic SCH4911 for additional information.

4.6.6. A4A6: Input Sparkgap

A stainless steel sparkgap is installed in parallel with the RF Overvoltage Protection devices. Main purpose of this element is to protect against high levels of energy coming from the outside of the transmitter (typically a direct lightning strike on the antenna).

4.7. A5: RF COMBINER

The RF combiner assembly is composed of the following functional units:

1) RF Input Current Sample
2) RF Combiner
3) Combiner Fans
4) RF Overcurrent
5) RF Drive Amplifier
6) RF Drive Load Resistors
7) RC Circuits

The above subassemblies are described in the following lines:

4.7.1. A5A1: RF Input Current Transformer

The current at the Combiner output (i.e. at the input of the Output Filter) is measured using a ferrite current transformer. The transformer has a single-turn primary and a balanced secondary winding.

This RF transformer detects conduction of the sparkgap at the input of the Output Filter as well as other overload conditions.

4.7.2. A5A2: RF Combiner

The balanced output voltages of the 14 modulated amplifiers are added using a series Combiner, consisting of 14 ferrite transformers with independent primaries and a common secondary winding. Each primary is connected to the output of its associated modulated amplifier. The common secondary is grounded at one side while the other side is connected to the output filter.

4.7.3. A5A3: Combiner Fans

Two moderate flow fans provide cooling to the RF Combiner transformers and avoid air ionization.

4.7.4. A5A4: RF Overcurrent

The output of the RF Input Current Transformer is rectified and processed in this PCB to inhibit the modulated amplifiers when an overcurrent condition is detected.

In addition, this PCB receives a control signal from the RF Overvoltage subassembly to inhibit the modulated amplifiers when the gas arresters on mentioned PCB are fired.

Refer to schematic SCH 4811 for additional information.

4.7.5. A5A5: RF Drive Amplifier

This subassembly includes input and output series tuning circuits, a bridge R.F. amplifier and a +45V regulator. Drive voltage and current measuring circuits are incorporated.

Refer to schematic SCH3911 for additional information.

4.7.6. A5A6: Drive Loading Resistors

A group of drive loading resistors is mounted in parallel with the drive output to damp oscillations.

4.7.7. A5A7 & A5A8: RC Circuit 1 & 2

To avoid oscillations in the modulated voltage, the R-C damping circuits connect the +Bmod voltages of the modulated amplifiers to a single point.

5. INSTALLATION AND START-UP

5.1. UNPACKING AND INITIAL INSPECTION

Transmitter is packed in a plywood box. As the total weight is around 1100 lb (500 kg) it should be handled by trained personnel using a fork lift or similar equipment.

It is recommended to position the transmitter in its crating, close to the final operating location. While moving and handling the transmitter, observe the positions indicated by the arrows in the box.

To remove the box cover, remove the screws accessible from the outer side of the crating.

After the crating is removed, open the front doors and the lower front and back panels to check for damage or loose components. To open the front doors, (corresponding to the power amplifier) it is necessary to turn the keys ¼ turn. To remove the other panels its fixing screws should be removed .If any damage is detected please inform the factory immediately

5.2. MOUNTING

The following matters should be considered for a correct installation:

5.2.1. Power Source

AM 15000 SS transmitter requires a three phase source, protected by a circuit breaker of at least 63A (or 40A) for the 220V (or 380V) nominal voltage units.

In addition, installation must comply with local regulations.

It is highly recommended to include a device designed to protect electrical lines against lightning strikes.

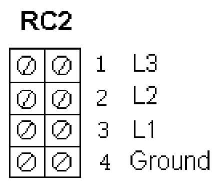
If the normal voltage variation of the power source is more than +/-5%, use an automatic voltage regulator is strongly recommended.

The AC mains connection is in RC2, located in the back of the transmitter floor. Cable entrance is provided close to RC2 from the floor.

Cable types and sections shall be according to local regulations. A neutral conductor is not required. Only a protective ground conductor should be routed together with the power lines.

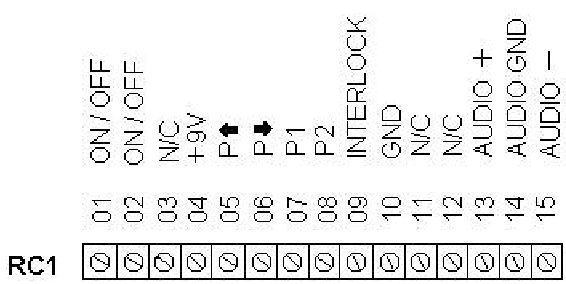
Connect primary power to terminal board RC2, located in the back side of the transmitter. Prior to that, the plastic protective cover of the terminal board needs to be removed.

Terminal board RC2 contacts are:



5.2.2. Audio and Remote Control

Audio and remote control cables should be previously routed close to transmitter final position, with enough length to allow its connection at RC1 in the transmitter rear panel.



The balanced shielded cable with the program signal should be connected in RC1 terminals 13, 14 and 15.

The use of a good quality cable such as BELDEN 8451 is recommended.

Regarding the signal, verify that the level is between 0 dBm and +10 dBm, that the signal is balanced with respect to ground and that no D.C. component is present.

For remote operation the local/remote switch A2A1S12 in the front panel should be in the remote position “Rm”.

Remote operation operates according to the following protocol:

a) Remote On:

Terminals 1 & 2 of RC1 need to be connected by the remote control system in order to start the transmitter. (For instance with the STL squelch relay).

b) Remote Off:

Opening the connection between RC1 terminals 1 & 2 stops transmitter operation.

c) Power increase:

A gradual power increase is generated by the pulsed connection of terminals 4 & 5 of RC1.

d) Power reduction:

A gradual power reduction is generated by the pulsed connection of terminals 4 & 6 of RC1.

e) Power level 1 selection:

Power level 1 is selected by the momentary connection of terminals 4 & 7 of RC1. Actual output power is adjusted by means of A3P13

f) Power level 2 selection:

Power level 1 is selected by the momentary connection of terminals 4 & 8 of RC1. Actual output power is adjusted by means of A3P15

5.2.3. External Modulation Monitor

The R.F. sample for an external modulation monitor is present at the BNC connector A8A1X5. Recommended cable for the R.F. sample is RG58 or similar.

The sample level can be adjusted by A8A1P3, accessible through a small hole in located immediately above the connector A8A1X5 at the left rear side of the transmitter.

5.2.4. R.F. Output Connection

The R.F. output is available at the E.I.A. 1-5/8" type connector located at the top of the transmitter.

Recommended transmission lines should comply with the following requirements:

1) Characteristic impedance should be 50 ohm.

2) At the end of the transmission line close to the transmitter, one or more ferrite toroids, covering the complete coaxial cable, should be installed.

   Each toroid should exhibit a single turn inductance equal or higher than 2 uH.

3) The transmission line shield should be grounded near its entry into the transmitter building by means of a short and wide copper strap. A ferrite toroid should be installed after this ground connection, i.e. close to the transmitter.

Detailed information on the grounding system and ferrite usage can be found in the Grounding Systems for AM Transmitters section of this manual.

5.2.5. Ventilation

The transmitter must be installed in a clean and properly ventilated room.

Please carefully consider

1) The room should have low restriction clean air intakes, and low restriction hot air exhausts.

2) An air extraction system to remove hot air is very desirable. The system should remove about 1000 C.F.M.

3) Transmitter heat load under normal operating conditions is 12000 to 16000 BTU, depending on the power level and modulation density employed.

4) Avoid hot air accumulation between the transmitter exhaust and intake.

5.3. START-UP

When operating the transmitter for the first time the following recommendations should be observed:

1) Main transmitter breaker CB1 should be initially OFF.

2) Check the AC mains lies within normal operating limits (220V or 380V +/- 10% depending on voltage option ordered).

3) Adjust the primary tap on the main transformer for a voltage as close as possible to the actual measured mains voltage.

4) Check that the load impedance seen by the transmitter is within (50 +/- 3) ohms +/- J5 ohm at most.

5) Verify power connections, RF output, grounds and audio.

6) Initially, make sure there is no audio signal into the transmitter.

7) Turn ON breaker CB1.

8) Use "LcRm" button to select for local operation (Lc position).

9) Check that the Multi Meter readings correspond to VDR, IDR, PLL, +9 y -15 are very close to the values indicated on the test data sheet.

10) Use button “P2” to set power level 2.

11) If any alarm indication is on press button labeled "RESET".

12) Select direct power reading on the Power Meter (labeled P⇨).

13) Press "ON" button and check that the multimeter shows a power reading close to 5 kW, or to the lower preset power level.

14) Select the reflected power reading on the Power Meter (labeled P⇦). Check it is zero or smaller than 10 units.

15) Use button “P1” to set power level 1. The direct power reading on the Power Meter should be close to 10 kW.

16) Factory preset power levels may be adjusted to desired values by means of potentiometers P13 and P15 on the PWM Generator PCB (subassembly A1A3). Refer to schematic SCH1111.

17) This test requires use of an external modulation monitor. Initially, symmetrically processed audio should be used. Gradually increase the audio input until the positive modulation peak reaches 70%. Negative peak should not differ more than 3%.

18) If an audio processor with asymmetrical processing is available, it is important to check the correct polarity of the audio. Slowly turn the asymmetry control and check that the positive peak modulation increases while the negative peak remains unchanged. If the negative peak increases and the positive peak remains unaffected, then the audio input polarity is reversed.

19) Adjust the audio processor for the desired positive peak modulation (usually between 100% and 125%).

20) Check that when the transmitter is operated at 10 kW carrier and with program material, the main supply voltage reading "V" (available either on the Multi Meter or on the Power Meter) lies between 260V and 275V. If this is not so, the power transformer tap should be changed accordingly.

21) Operate the transmitter normally, and check during the first hours of operation that both the PWM and RF temperatures are normal. These temperatures may be 10ºC to 20ºC (18ºF to 36ºF) above ambient temperature. It is normal that the temperature on the upper amplifiers appears around 5ºC (8ºF) higher than the lower amplifiers.

22) If the transmitter is equipped with remote control measurement capability, measurement connections should be done on connector RC3.

6. GROUNDING SYSTEMS FOR AM TRANSMITTERS

6.1. ANTENNA & ANTENNA TUNING UNIT (ATU)

- Ideally, 120 radials of 1/4 wavelength should lie buried between 1 and 2 feet deep. The radials should be made of #8 or #10 AWG bare copper wire.
- Radials should be soldered with silver or bronze to the radial collector ring.
- Radial collector ring should be connected to three or four copper weld bars buried at least eight feet deep.
- Several ferrite toroids should be installed on the RF coax near its entrance into the ATU. Ferrite must cover both the central conductor and the shield.
- The ATU output should be connected to the antenna via a copper pipe forming one or two loops two to four feet in diameter.

6.1.1. Isolated Antenna

- Collector ring must be connected to the tower base (tower ground) by means of four 2" wide copper straps.
- The antenna must have a robust spark gap, and it must be properly adjusted (ball separation according to the impedance and power level used) and it must make excellent electrical contact both with the tower and the ground (balls and contact points must be free of paint and rust).
- ATU ground must be connected to the tower base ground or radial collector ring by means of a 2" wide copper strap.

6.1.2. Monopole

- The tower must be connected to the radial collector ring by means of four 2" wide copper straps.
- ATU ground must be connected to the tower base ground by means of a 2" wide copper strap.

6.2. TRANSMITTER BUILDING

6.2.1. Reference Ground

- A perimetral ground system made of #1/0 AWG bare copper wire connected to four copper weld bars is required around the building. Copper weld bars must be buried at least 8 feet deep.
- A reference ground bar (a robust copper bar) is required close to the electric switch box. This bar must be connected to the building ground in a single point using a 2" wide copper strap.
- The reference ground bar must be connected independently (using copper strap) to the following elements:
  - RF coax shield.
  - Auxiliary equipment chassis.
  - AC mains input transient protector.
  - Transmitter AC mains ground (passing through ferrite as described in section 8.2.4).
- If a ground copper strap exists between the building and the antenna, it must be connected to the reference ground bar.
- No ground interconnections should exist between different equipment. All ground connections shall be independent and routed to a single point in the reference ground bar.

6.2.2. RF Coaxial Cable

- The RF coax shield must be connected to the reference ground bar using 2" wide copper strap. The connection shall be made close to where the coax enters into the building.
- If the coax doesn't enter through the same wall where the reference ground and electrical switch board are located, then the coax should be routed so as to make it pass close to the reference ground bar before it goes into the transmitter. This allows for a short and straight connection between the coax shield and the reference ground bar.
- Several toroid ferrite shall be placed in the RF coax (covering both the shield and the central conductor) close to its connection with the transmitter. *(NOTE: If the coax diameter doesn't allow installation of ferrite, then two loops of at least six feet in diameter should be formed with the coax between the transmitter and its connection to ground near the reference ground bar.)*

6.2.3. Low Level Signals (audio, remote control, RF sample)

- All weak signal cables connected to the transmitter must have several ferrite toroids installed covering every conductor and shield.

6.2.4. Mains Supply

- A transient protector must be installed close to the electric panel board. (NOTE: The transient protector must be of good quality and shall be installed according to the manufacturer's specifications.)
- Several ferrite toroids must be installed in the power cable that feeds the transmitter. The ferrite must cover all the phases, the neutral if exists, and the power ground cable.

Notes:

- It is very important to make sure all ground connections, specially those that are underground, are making solid electrical contact (ideally they should be silver or bronze soldered). This is specially important in existing installations where this may be easily overlooked. An inspection before installing a new transmitter is highly recommended.
- It is necessary verify that ground connections, power connections, and weak signal connections do not make loops where RF currents may be induced, specially when the transmitter is installed close to the antenna.
- All ground connections shall be made using 2" or wider copper strap. If necessary, copper strap may be replaced by a bare copper conductor #1/0 AWG or better.
- All ferrites used in the installation must have a minimum initial permeability of 1000, and should be adequate for frequencies up to 2 MHz or more.
- It is important to verify if any of the ferrites get hot. If this happens, additional ferrites shall be added close to the ones that are hot. Also, presence of ground loops and proper grounding connections should be verified. Eventually, ferrites located at the ATU entry could be removed.

7. ADJUSTMENTS

7.1. IMPORTANT NOTES

1) **Dangerous voltages present inside the equipment may be accessible during the adjustment procedures. Adjustments must be performed by qualified personnel only, using extreme care and following all the applicable safety precautions.**
2) Components are designated with a prefix that identifies the assembly and sub-assembly, followed by the name of the particular unit where it is located.

   For example, resistor R1 in the PWM Modulator Unit is designated A3R1. Capacitor C1 from sub-assembly A1 of the power supply assembly is designated as A1A1C1.
3) In certain cases prefixes may be omitted if the mentioned components belong to the same unit.
4) These procedures are intended for checking and adjustment of assemblies and sub-assemblies. When working on a particular procedure, it is assumed that the rest of the assemblies and sub-assemblies have been already set.

7.2. ADJUSTMENT PROCEDURES

7.2.1. Control PCB (A1A1A1)

Reference schematics: SCH1312 and SCH1322.

1) Remove the front panel that covers the control board by loosening two countersunk screws located on top of the unit, and two screws that are located below the front panel.
2) Turn on main transmitter breaker but DO NOT press "ON".
3) Locate adjustment pots P5 and P6 on PCB1311.
4) Adjust pot P5 for 1.00VDC at U16:36. There is a small pad (test point) for this purpose located under the legend "P5 ADJ MULTIM 1" on the Control PCB.
5) Adjust pot P6 for 1.00VDC at U15:36. There is a small pad (test point) for this purpose located under the legend "P6 ADJ MULTIM 2" on the Control PCB.
6) Selct the "+9V" reading on the Multi Meter.

7) Adjust “P9 ADJ +9V” for a reading at M1 equal to the voltage at X6 pin 13. This voltage should be read with a digital multimeter with an accuracy of 1% or better.

8) Select "-15V" reading on the Multi Meter.

9) Adjust pot P10 for a reading on the Multi Meter equal to the voltage at X6 pin 26.

10) Select "VDR" (R.F. drive voltage) on the Multi Meter.

11) Remove the upper-left modulated amplifier . Connect an oscilloscope with at least 20MHz of bandwidth to Q4-Gate. Oscilloscope ground should be connected to Q4-Source. Use adhesive tape to fix the oscilloscope probe and reinsert the amplifier in the transmitter. NOTE: the oscilloscope must not be grounded and the transmitter must be OFF while the oscilloscope probe is connected, otherwise high voltage will be applied to the oscilloscope ground lead.

12) Adjust pot P16 “P16 ADJ VOLT RF” for a reading on the Multi Meter equal to the peak-to-peak voltage divided by two, as seen on the oscilloscope. (The oscilloscope probe and scale must be properly calibrated).

13) Select "IRF" (R.F. drive current) reading on the Multi Meter.

14) Connect the oscilloscope probe to resistor R49 on the Synthesizer PCB 1211. Oscilloscope ground goes to the right lead of R46.

15) Adjust pot P18 “P18 ADJ I DRIVE RF” for a reading on the Multi Meter equal to the peak-to-peak reading on the oscilloscope divided by 2.83. It is advisable to use the oscilloscope with the 20MHz bandwidth limit ON.

16) Remove the test probe from the modulated amplifier. Take care to disconnect the flat cable before removing the amplifier and reconnecting it after replacing it.

17) Select the "PLL" reading on the Multi Meter.

18) Use a digital multimeter to measure voltage at TP1 on the Synthesizer PCB1211 and adjust pot P19 “P19 ADJ VOLT PLL” on the Control PCB1311 for the same reading on the Multi Meter.

19) Disconnect the coaxial cable from socket X5 on the Syntheziser PCB1211 (RF synthesizer output).

20) Select "tºRf" on the Multi Meter. Select the Modulated Amplifier 1 (upper-left) on the Alarms Multiplexer PCB1911.

21) Use a contact thermometer (calibrated in Celsius degrees) to measure temperature on the second heatsink of Modulated Amplifier 1 (this heatsink cools MOSFETs Q4, Q5 and Q6).

22) Adjust pot P15 “P15 ADJ TEMP RF” for a reading on the Multi Meter equal to that of the contact thermometer.

23) Select "tºPWM" on the Multi Meter. Repeat procedure described in the above paragraphs, but now measure temperature on the first heatsink (contains MOSFETs Q2, Q3 and dual diode D13). Adjust pot P12 "P12 ADJ TEMP PWM" for a reading on the Multi Meter equal to that of the contact thermometer.

24) Reconnect the coaxial cable in X5 on Synthesizer PCB.

Note: Measurements described on the above paragraphs should be done with the transmitter in the "OFF" position. Under these conditions, temperature readings should be close to room temperature. If desired, the transmitter may be left ON for some minutes, then turned OFF and the temperatures promptly checked before it cools down. It is not recommended to check temperatures while the transmitter is ON, since dangerous voltages will be present and the readings may be interfered by RF.

25) Connect the transmitter RF output to a resistive dummy load rated for at least 20kW. A directional wattmeter or an R.F. ammeter should be connected between the transmitter and the load. This instrument should be rated for the transmitter power and should be adequate for the operating frequency.

26) Press P2 button to select Power Level 2.

27) Select "V" reading on the Multi Meter.

28) Turn the transmitter ON.

29) The transmitter should apply power to the load and no reflected power should be present.

30) With extreme care, use a digital multimeter to measure the main supply voltage at any fuse terminal of any modulated amplifier. Reference ground is chassis.

31) Adjust pot P3 "P 3 ADJ 270VDC" for a Multi Meter reading equal to the main supply voltage.

32) Adjust pot P2 "P2 ADJ VDC PWM" to obtain a voltage equal to the main supply voltage divided by 45 at TP1 on PCB 1311. (In other words, when the main supply voltage is exactly 270V the voltage at TP1 is exactly 6V).

7.2.2. PWM Generator (A1A3)

Reference schematic: SCH1111.

1) Energize breaker CB1, but leave the transmitter OFF.

2) Select local operation and power level 1.

3) Pulse power increase button 15 times to make sure the fine power control is at maximum.

4) Turn pots P13 and P15 fully clockwise.

5) Remove U19 and place jumper JP3 (it is not installed during normal operation).
6) Adjust P8 for 5.00V at TP5. If this is not possible, adjust also P10.
7) Connect an oscilloscope at TP6 and adjust P11 so as to make the square wave exactly 50% duty cycle.
8) Connect an oscilloscope on TP3 and adjust P3 and P4 for a triangular signal with limits exactly between 0 V and 5 V. (the oscilloscope probe and scale must be properly calibrated).
9) Connect an oscilloscope on TP4 and adjust P5 and P6 for a triangular signal with limits exactly between 0 V and 5 V.
10) Adjust P7 for 2V DC at TP2 when no audio is present. Move jumper JP1 to the left position.
11) Connect a balanced audio signal of +10dBm / 1 kHz. Adjust P2 for a clean sinusoid at TP2 with peak limits exactly between 0V and +4V.
12) Turn CB1 down and reinstall U19.
13) Turn CB1 on and adjust P9 for 200mV clipping on the lower half of the audio signal at TP2.
14) Increase audio signal level to +20 dBm and adjust P12 so the upper half of the audio signal at TP2 is clipped at +4.75V.
15) Adjust P8 for +4.75V at TP5.
16) Adjust P10 for +6.5V at TP7.
17) Replace JP1 on the right position and remove JP3.

7.2.3. Synthesizer (A1A4)

Reference schematic: SCH1211.

1) Configure Dip switches S1-1 to S1-8 and jumpers JP1 and JP2 according to the frequency selection table on Section 2.
2) Connect a spectrum analyzer between DZ5-cathode and ground. Adjust pot-core L2 to minimize the operating frequency component. Alternatively, the adjustment may be done using an oscilloscope connected at the same mentioned points. Pot-core L2 is adjusted so as to reduce the amplitude of the pulses that appear (with a period corresponding to the period of the operating frequency) on top of the DC component.
3) Connect at TP2 a calibrated frequency meter with a precision at least 1 ppm.

   Carefully adjust CV1 until the frequency reading on the instrument matches the nominal transmitter frequency.

NOTE: Main breaker on the transmitter must be energized at least half an hour before performing the frequency adjustment. Also, the frequency meter must be on at least for a similar period of time.

7.2.4. Modulated Amplifiers (A2A3An and A2A4An)

Reference schematic: SCH1011.

The amplifiers are wide bandwidth and cover the full AM range, thus no adjustments are necessary.

Note: For normal operation jumpers JP1 and JP3 on the amplifier boards must be set on the positions opposed to the white dot on the silkscreen. JP4 must be placed near the white dot position.

7.2.5. Directional Wattmeter (A4A4)

Reference schematic: SCH1511.

The directional wattmeter includes a variable capacitor and three potentiometers which are accessible from the rear part of the transmitter through a set of small holes located above the R.F. sample output (BNC female connector).

The adjustments from top to bottom are:

- CV1 Wattmeter balance
- P1 Reverse power adjustment
- P2 Direct power adjustment
- P3 RF sample amplitude adjustment

Following procedure is required for proper calibration:

1) Operate the transmitter over a dummy load with 10 kW of carrier power. Select the reflected power reading on the Power Meter.
2) Adjusted CV1 for a minimum reading of reflected power on the Power Meter.
3) Connect an auxiliary capacitor in parallel with the dummy load. Capacitor must have an impedance of –J100 ohm at the transmitter operating frequency. Use a suitable R.F. capacitor rated for at least 15KV / 15A at the operating frequency. Adjust P1 on the wattmeter for a reading of 100 units.
4) Turn off the transmitter and remove the capacitor connected in parallel with the load.
5) Select Direct Power reading on the Power Meter.
6) Set output power for 10 kW.

7) Adjust A7A3P3 to obtain an R.F. sample signal adequate for driving the modulation monitor in use.

8. TROUBLESHOOTING

ATTENTION

In order to avoid failures it is important to follow these guidelines:

- *Mains supply voltage should be reasonably stable, within normal limits and protected against surge conditions.*
- *Ideally load connected to the transmitter should be within 50+J0 +/- 2 ohms, and it should be stable.*
- *Installation must comply with INSTALLATION AND START-UP and GROUNDING SYSTEMS FOR AM TRANSMITTERS sections of this manual.*
- *The room where the transmitter operates should have proper ventilation.*

8.1. NORMAL OPERATING CONDITIONS

Typical readings on the integrated multimeter are given in the next lines. These values should serve as a reference in order to determine if the transmitter is working properly.

Next readings are to be obtained with the transmitter powered (breaker CB1 up), but not necessarily transmitting (transmitter can be either "ON" or "OFF"). Left multimeter should have the following readings:

- "VDR" between 13.5 and 15 V.
- "IDR" between 0.7 and 1.8 A, depending on frequency.
- "PLL" between 2.5 and 10.0 V.
- "+9V" between 8.8 and 9.2 V.
- "-15V" between 14.8 and 15.2 V.
- "0V" at 000 or 001.

When the transmitter is powered "ON" close to nominal power (between 9.8 and 10.2 kW) and without modulation, over a 50+J0 +/- 2 ohms load, the following readings and conditions should be observed on the front panel:

- Alarms remain OFF after "RESET" button is pushed.

- Readings on the left meter corresponding to each power amplifier should be very similar to each other (for each parameter). Readings should lie in the following ranges:
  - "Bmod" between 160 and 200.
  - "IPB" between 2.0 and 3.0 A.
  - "tº RF" between 0 and 60 ºC.
  - "tº PWM" between 0 and 60 ºC.

  If one power amplifier shows different readings with respect to the rest, then that amplifier should be further investigated.

- Right multimeter should show:
  - Main supply voltage "V" between 260 and 275 volts.
  - Main supply current "I" between 36 and 44 A.
  - Direct power "P ⇒" between 9.8 and 10.2 kW.
  - Reflected power "P ⇐" lower than 10 W.

Note: "Bmod" corresponds to the difference between the main supply voltage (around 270 V) and the modulated R.F. voltage. (In other words, at very low power "Bmod" is close to 270 V, meanwhile at high power levels this value may go as low as 130 V.) "IPB" corresponds to the modulated R.F. current.

8.2. ALARMS

The meaning of the alarms on the front panel is as follows:

- P ⇒ Excessive direct power.
- P ⇐ Excessive reflected power.
- V > Main supply over voltage.
- I > Main supply overcurrent.
- PLL Synthesizer PLL out of lock.
- ENCL Interlock is open.
- t° FP Starter resistors are overheated.

8.3. FAILURE DETECTION

Failure detection requires full understanding of the transmitter's essential operating principles. A complete reading of this manual and some study of the schematics and electrical diagrams are recommended.

In simple terms, transmitter operation can be summarized as:

- The transmitter has 14 identical modulated amplifiers, whose R.F. outputs are combined in series.
- Each amplifier includes a PWM modulator, an "H" bridge R.F. amplifier and protection and monitoring circuits.
- In order to operate, each amplifier requires:
  - Supply voltages (+270 V, +15 V and +9 V).
  - R.F. drive signal.
  - PWM pilot signal.

8.4. FAILURES

On the following paragraphs most common failures are treated.

8.4.1. Breakers and Fuses

One of the most common causes for a transmitter not working at all or delivering reduced power are burnt fuses and down breakers.

First, remove front lower cover using a Phillips #2 screw driver to access the power supply section of the transmitter and check the following steps:

- Four breakers on the left side should be on. Cycle them down and up to make sure they are OK. It is common for this breakers to trip if excessive positive modulation is being applied or when operating at power levels above nominal power for long periods of time.

- Check three fuses on the right side of the transmitter power supply section. These fuses protect the Phase Asymmetry detection device.

- The Phase Protector device located on the right side should have its red LED lit for normal operation. If this is not the case, then phase asymmetry protection is preventing the transmitter from working. Adjust phase imbalance sensitivity to about 5% in case the 2% setting is causing the sensor to trip. If this device acts often then installation of a phase independent voltage regulator should be considered.

- Check six fuses located above the power transformer, corresponding to the A.C. supply for the Auxiliary Supplies
- Check two fuses located on the left side corresponding to the blowers.
- Check each fuse of PCB 3211 (Auxiliary Supplies) located on the floor.
- Remove the rear-lower transmitter cover and check the R.F. Drive fuse on PCB 3911, located below the R.F. combiner.

8.4.2. Power Amplifier Failure

If the transmitter output power is zero or it is lower than the nominal power, there is a chance of a faulty amplifier only after the following points have been verified:

- Fuses.
- Auxiliary supplies.
- After pressing "RESET" (with the transmitter running) none of the following alarms are asserted: "P >", "P ⇐", "V >", "I >", "PLL", "ENCL", "tº FP".

Most common problems in power amplifiers are:

- Amplifier fuse burnt (corresponding “V” alarm indicator lit after powering up the transmitter and pressing "ON"). Refer to paragraph 4.1.
- R.F. Mosfet burnt (corresponding "RF alarm indicator lit). Refer to paragraph 4.3.
- Missing PWM. Refer to paragraph 4.7.
- One or more Amplifiers not properly installed ("DESC" alarm lit). Turn off the transmitter and check each amplifier is properly inserted.
- Amplifier auxiliary supply fail. Refer to schematic diagram SCH 1011 and check voltage regulators U13 (LM7805) and U15 (LM7812).

The following test verifies that each amplifier is working properly in case the transmitter is not able to deliver nominal power:

Note: A simple way of determining if an amplifier is delivering power consists in inhibiting its PWM signal. With the unit transmitting, select "P ⇒" on the right hand multimeter. Install a jumper in JP2 on one of the amplifiers (see SCH 1011 sector E5). Jumper JP2 is located nearby the DB25 connector on the amplifier. Instead of using a jumper, it is possible to momentarily short JP2 pins using a screwdriver. Possible results are interpreted as follows:

- If power remains the same, the amplifier was not working at all.
- If power is reduced, the amplifier is likely to be OK.

If there are one or more faulty amplifiers, it is advised to keep them plugged until serviced. This is because when an amplifier is removed the R.F. drive is detuned, producing a large increase in the drive current.

ATTENTION

Never remove more than two amplifiers per motherboard with the transmitter powered on, since this could damage the R.F. drive transistors. Before removing more amplifiers, transmitter must be OFF and main breaker must be off.

If a spare amplifier is available, it is possible to replace a faulty amplifier. Before proceeding it is necessary to check that all pins in the two rear connectors are straight. Also, the guide pin should be installed and identical in size to that in the amplifier that is being replaced (this pin actions a bypass switch for the corresponding output transformer).

ATTENTION

In order to replace an amplifier with the transmitter "ON" it is necessary to disconnect the flat cable that goes into the DB-25 connector in the amplifier. Then, remove the amplifier and replace it with another amplifier, pushing firmly until is fully inserted. Finally, reconnect the flat cable into the new amplifier.

8.4.3. Faulty R.F. Mosfet

A faulty R.F. Mosfet in one amplifier is detected because output power drops down to about 90% of original power and the corresponding "R.F." alarm lits . In the unlikely event that more than one amplifier has his Mosfets defective the power output will decrease more than 10% per each amplifier defective.. and the "RF" alarm will be lit.

Detection of damaged MOSFETs require turning power off and removing the faulty amplifier. Then, it is necessary to measure each of the four branches of the "H" bridge of the R.F. amplifier (see schematic SCH 1011). Each branch is composed of three paralleled transistors mounted on a common heatsink, being: Q4-Q5-Q6, Q7-Q8-Q9, Q10-Q11-Q12 and Q13-Q14-Q15.

These are the pins of Mosfet IRFP350 (as seen from left to right when looking the transistor from its front):

- Gate (G)
- Drain (D)
- Source (S)

ATTENTION

It is highly recommended to replace Mosfets with IRFP 350 from International Rectifier (IRF). Devices made by different manufacturers have different capacitance and switching times, so when different devices are paralleled they will not be driven equally and will not share the load evenly.

In order to measure each branch and "free" Mosfets, a digital multimeter in "DIODE" position (such as Fluke 73 or similar) is required. In this position, the multimeter outputs a constant test current (typically between 0.5 and 1 mA) and voltage developed across the leads is read.

NOTE: Measurement of an installed Mosfet differs from a "free" Mosfet in the following aspects:

- Gate and Source are connected by the secondary winding of the corresponding drive transformer (very low impedance).
- Measuring between Drain (+) and Source (-) produces a voltage equivalent to two diode drops and not an open circuit, due to the presence of other components in the amplifier.

Measurements should be done on the bottom side of the amplifier's PCB in order to have reasonable access to all Mosfet pins. The multimeter is always connected across the central pin of the Mosfet (Drain) and any of the exterior pins (Gate or Source). Following instructions allow checking if a branch contains faulty Mosfets (only one Mosfet per branch needs to be checked for this purpose).

- Put the (-) test lead on the Drain and the (+) lead on the Gate or Source:
  - A reading of about 450 mV is normal (intrinsic diodes in forward conduction).
  - A reading between 300 and 400 mV indicates a faulty Mosfet on other branch.
  - A lower or close to 0 V reading indicates one or more faulty Mosfets on this branch.
- Reverse polarity and put (+) test lead on the Drain and the (-) lead on the Gate or Source:
  - A reading from 900 mV to 1 V is normal (approximately two forward conducting diodes).
  - A reading of about 500 mV indicates one or more faulty Mosfets on other branch.
  - A lower or close to 0 V reading indicates one or more faulty Mosfets on this branch.

Once faulty branches have been located, it is necessary to determine which Mosfets need replacement. In order to proceed the following tools and materials are required:

- 1/4" wrench.
- Soldering iron (80 watts or more).
- 63/37 (or 60/40) soldering wire.
- Solder extractor.

Detection and replacement of a faulty Mosfet requires loosening its bolt, unsoldering the pins, extracting the Mosfet and measuring if it is OK. The following procedure is optimized so as to remove as few Mosfets as possible on a faulty branch:

- Unsolder and remove any Mosfet on the faulty branch (for instance, the leftmost). Use the multimeter in "DIODE" position to check this Mosfet and discard it if damaged.
- Measure again the faulty branch (now with only two Mosfets). If readings are wrong, go to the next step. If readings are OK, only the removed Mosfet needs replacement (END).
- Unsolder and remove another Mosfet from the faulty branch. Use the multimeter in "DIODE" position to check this Mosfet and discard it if damaged.
- Measure again the faulty branch (now with only one Mosfet). If readings are wrong, the remaining Mosfet is damaged and needs replacement. If readings are OK, the remaining Mosfet is fine.
- Install good Mosfets in place of removed Mosfets.

NOTE: In order to check an uninstalled Mosfet, use a digital multimeter in "DIODE" position and follow these steps:

- First, Gate and Source pins must be shorted briefly (to ensure the Gate-Source capacitance is fully discharged).
- Put the (-) lead on Drain and (+) on Source and check for a reading of 450 mV (intrinsic diode forward conducting).
- Now put the (+) lead on Drain and (-) lead on Source, an open circuit should be observed (the same voltage observed when the test leads are open, typically between 2.5 and 3.5 V).
- Put the (+) lead on the Gate and (-) on Source so as to charge the Gate-Source capacitor and turn the Mosfet into conduction.
- Finally, put the (+) lead on the Drain and the (-) on the Source and check the Mosfet is conducting (multimeter voltage may be too low to turn Mosfet into full conduction, so instead of 0 V a somewhat higher voltage may be observed).

Once all damaged Mosfets have been replaced, readings on all branches in both amplifiers should be very similar.

8.4.4. Problems in the Radiating System

The radiating system corresponds to the following elements:

- Coaxial cable from the transmitter to the antenna.
- Antenna tuning unit (ATU).
- Illumination and static discharge coils.
- Duplexes and Phasors / Power Splitting Networks (if any).
- Antenna or antenna array.
- Antennas from nearby stations located at distances closer than 3 miles and/or operating at a frequency closer than +/-100 kHz or harmonically related.

Any radiating system problem that produces and inadequate load for the transmitter it is likely to trigger the reflected power alarm "P ⇐" (VSWR condition).

Reflected power readings can be observed selecting position "P ⇐" on the right hand meter on the front panel. Under normal operating conditions (10 kW carrier and radiating system in good conditions) a reading lower than 10 watts should be observed.

In case there is an excessive reflected power reading, it is necessary to check that the impedance loading the transmitter is 50+J0 ohms +/- 2 ohms. If not, all elements in the radiating system should be checked and the antenna tuning unit should be readjusted. If neighbor stations are interfering, proper filters should be designed and installed.

8.4.5. Output Gas Discharge Protector

In the event of an atmospheric discharge on the radiating system, it is possible that the gas discharge protector located at the transmitter's output results damaged (usually becomes a short circuit). In this case the transmitter self protects and the "P ⇐" alarm lights, even though the radiating system is OK.

A good gas discharge device has a very high impedance across its terminals. If it is damaged, a short circuit or low impedance is observed.

When replacing a gas discharge device, it is advised to check also that the spark gap is OK and has a 3 mm (120 mils) separation.

8.4.6. Directional Wattmeter Problems

If the transmitter has suffered a strong atmospheric discharge, it is possible that the wattmeter readings are zero or wrong in value.

If the wattmeter is not functioning properly there are three things to check:

- One or more diodes in the wattmeter are damaged. Turn off the transmitter, remove the wattmeter PCB and check diodes D1 y D2 (1N5711 or 1N4148) and zener diodes D3 y D4 (1N4744) using a multimeter. (Refer to schematic SCH 1511.)
- Check both connectors of the wattmeter signal cable are well plugged. One end goes into the Wattmeter PCB and the other goes to the Control PCB (refer to SCH 1312).

8.4.7. PWM and Bmod Generation

If proceeding problems have been discarded and the transmitter still runs at low power or with no power at all, it is recommended to check both amplifiers are receiving a PWM signal. The PWM signal is required in order to generate the "Bmod" voltage (the modulated voltage).

NOTE: PWM signal frequency is 72 kHz (13.9 μsec period). With 10 kW carrier and no audio modulation, duty cycle must be close to 36% or 5 μsec pulse width. The transmitter uses a bi-phase PWM, thus, each amplifier is fed with a PWM signal shifted 180º with respect to the other.

In order to check proper generation and distribution of the PWM signals, the following steps should be performed:

- Shut down transmitter opening breaker CB1. Install a jumper on JP4 on the PWM Modulator PCB (refer to SCH 1111). (This enables the PWM signals without having to turn transmission "ON".)
- Remove each power amplifier and change jumpers JP1 and JP3 to the "dot" position. Locate test points TP1, TP2 and TP3 (for further use) and reinstall the amplifiers. Make sure flat ribbon cable is properly connected to each power amplifier.
- Turn on CB1 and set a 10 kW power level, but keep transmission "OFF".
- Use an oscilloscope and check the PWM signals on resistors R5 and R7 on the PWM Modulator PCB (measure between any pin on the resistors and ground/chassis). PWM signals should be observed as a square wave from 0 to 5 V, and with timing characteristics as described above. If these signals are not OK, then there is a problem on the PWM Modulator PCB (refer to SCH 1111).
- Now use an oscilloscope or multimeter to check voltage on test points TP1, TP2 and TP3 on each amplifier (measure with respect to ground/chassis). If the internal alarm systems are normal, readings on TP1 and TP2 should be

close to +5 V. If not, maybe there is a problem in the amplifier protection circuits (refer to SCH 1011).

- Use an oscilloscope and check each amplifier is receiving and conditioning the PWM pilot signal. First measure between Gate pins of Mosfets Q2 and Q3 and ground. PWM signals should be present with an amplitude from 0 to 12V approximately. (Mosfets pins are G-D-S, from left to right, when looking at their front side.)
- Then put the oscilloscope on pins 6 and 7 of U14 and check for a PWM signal with an amplitude from 0 to 12 V. If this point lacks PWM, or if the signal looks weak or distorted, probably U14 and/or Mosfets Q2 and Q3 are damaged. Remove U14 and check Mosfets Q2 and Q3 to see if they are damaged and replace if necessary.
- In case there is a faulty Mosfet, it is advised to check the following components on the amplifier:
  - U1 (74HC10)
  - U2 (74HC11)
  - U6 (74HC86)
  - D13 (double ultra fast rectifier U30D40A)
- Check the PWM signal is present on pin 2 of IC U14 (TC4420) with an amplitude from 0 to 5 V (see SCH 1011 sector B3).
- Remove power from the transmitter and remove jumper JP4 on the PWM Modulator PCB. On each amplifier, replace jumpers JP1 and JP3 in the position opposed to the dot. Reinsert each amplifiers and connect their respective cables.

8.4.8. R.F. Synthesizer

Next test performs an exhaustive R.F. drive tuning check.

- Turn on breaker CB1 but keep transmission "OFF". Read "VDR" and "IDR" on the left multimeter and write down these values. "VDR" should be between 12.5 y 15 V. "IDR" depends on frequency and varies typically between 0.9 and 1.8 A.
- Remove <u>one amplifier at a time</u> and check "VDR" reading remains constant (within +/-0.10 V at most).
- Remove <u>one amplifier at a time</u> and check "IDR" reading doesn’t exceed 3 Amp with one amplifier removed. Reinsert the amplifier and proceed to remove the next. In each case IDR current variation should be very similar (within +/- 0.20 A at most). Removing an amplifier that produces a noticeable different current change indicates that said amplifier may have bad Mosfets.

- If strange VDR or IDR variations occur when removing one amplifier at a time, and every amplifier has been checked for bad Mosfets, then each amplifier have been checked for bad Mosfets, then drive retuning may be necessary.

8.4.9. Main and Auxiliary Supplies

Energize breaker CB1 but keep transmission "OFF". Check +9 V and –15 V supplies on the left hand meter. If these readings are OK probably all the auxiliary supplies are OK.

In order to perform a full check, auxiliary supplies can be measured on connector X6 on the Control PBC (refer to SCH 1312). This is a 40-pin socket placed horizontally on the left side of the Control PCB when looking the transmitter from its front.

Test all auxiliary supplies at connector X6 as follows:

- Pins 1 to 6: +20 V
- Pins 7 to 12: +15 V
- Pins 13 to 18: +9 V
- Pins 19 to 24: GND
- Pins 25 to 30: -15 V

Main supply checking (one +270 V supply for each amplifier) is done as directed in the next lines. Turn off breaker CB1 and unplug BNC connector named X5 on the Synthesizer PCB (refer to SCH 1211) so as to leave the amplifiers without drive signal. Then, energize CB1 and press "ON". Select position "V" on the right hand meter on the front panel. Reading should lie between 280 and 320 V.

Next measurement requires Maximum Caution. Use a multimeter in voltage scale of at least 400 VDC. For every power amplifier, measure voltage between each fuse side and ground (this ensures detection of a burnt or open fuse also). If fuses are OK, readings should be the same on each side. Additionally, all readings should coincide with the VDC value on the right multimeter. Finally, turn off breaker CB1 and reconnect the drive coaxial cable into X5 on the Synthesizer PCB.