FCC CERTIFICATION REPORT

FOR THE

SBM-1000A, 1000 WATT ANALOG TRANSMITTER SYSTEM

THOMCAST COMMUNICATIONS,
COMWAVE DIVISION
P.O. Box 69
Oakhill Road
Mountaintop, PA 18707
570-474-6751

TABLE OF CONTENTS

1.0 INTRODUCTION

This report contains all the required data for certification of Thomcast's model SBM-1000A analog transmitter system. The data presented was taken from tests performed on a production transmitter system designed to transmit up to 31 ITFS/MMDS television channels, in the MDS and ITFS bands. Other information required for Certification, such as circuit diagrams and descriptions, photographs, and tune-up and maintenance procedures may be found in the technical manual, which is attached.

2.0 CERTIFICATION OF DATA

FCC Section 2.909 (d)

Having personally conducted the tests contained in this report, I certify that the statements and data submitted are true and correct to the best of my knowledge.

Paulo Correa

Paulo Correa
Director of Engineering
Thomcast Communications, Comwave Division

3.0 TEST EQUIPMENT

FCC Section 2.947 (d)

The following is a list of major test equipment, which was used in testing the SBM-1000A transmitter for this report:

1) Spectrum Analyzer	HP Model 8564E & 8593E
2) Power Meter	HP Model 436A
3) Frequency Counter	HP Model 5350B
4) Digital Multimeter	Fluke Model 87
5) TV Demodulator	TEK Model 1450-1
6) Audio Analyzer	TEK Model VM700
7) NTSC Test Set	TEK Model VM700
8) NTSC Video Generator	TEK Model 1910
9) Oscilloscope	TEK Model 2215
10) Test Oscillator	HP 651B
11) Scaler Network Analyzer	HP8713B

4.0 DESCRIPTION OF EQUIPMENT

FCC Section 2.1033

1) Instruction Books: (c)(3)	Technical manual attached
2) Type of Emission: (c)(4)	
Visual	5M75C3F
Aural	250KF3E
3) Frequency Range: (c)(5)	2000-2700 MHz in select bands
4) Operating Range: (c)(6)	+50.5 to +34.5 dBm
5) Power Rating: (c)(7)	1-2 Channels @ 50.5 dBm 3-4 Channels @ 45.5 dBm 5-8 Channels @ 41.5 dBm 9-16 Channels @ 38.0 dBm 17-31 Channels @ 34.5 dBm
6) Variation of output power (c)(6)	See calibration section, document # DOC16-0005 of technical manual
7) E & I on Final: (c)(8)	
Drain voltage	10V
Drain current	7A each
8) Tune-up Procedures: (c)(9)	See calibration section, document # DOC16-0005 of technical manual

9) Function of Active Devices: (c)(10)

The following is a list of active devices in the RF chains of the SBM-1000A transmitter. The relative position of each device may be found by referring to the block diagrams and schematics found in the technical manual.

- Frequency Stability Devices: See technical manual, document # DOC13-0060 & DOC13-0059
- Spurious Suppression Circuits: Not applicable
- Describe Limiters:
  - Modulation: Not applicable
  - Power: See technical manual, document # DOC13-0062

VHF/UHF UPCONVERTER DRIVER

Final Amplifier — ***Module 04-308-02***

Board 40-229-02

U1, U2 .... RF Amplifiers

Power Amplifier #1 — ***Module 04-306-02***

Board 40-225-02

Q1-Q5 .... RF Amplifiers

Power Amplifier #2 — ***Module 04-307-02***

Board 40-225-02

U2-U5 .... RF Amplifiers

RF Precorrector — ***Module 04-299-02***

Board 40-226-02

U1-U3 .... RF Amplifiers
D1, D2 .... Diodes

Board 40-227-02

U1, U2 .... RF Amplifiers
U3........ Regulator
U4........ OP Amplifiers
Q1 – Q4........ Transistors
D1 – D8........ Diodes

LO AGC — ***Module 04-314-02***

Board 40-228-02

U1 .... RF Amplifier
U2........ RF Amplifier
U3A, U3B, U3C, U3D .... Operational Amplifier
U4........ Voltage Regulator
Q1........ Current Driver
D1, D2........ Attenuator Diode
D3........ Detector Diode
D4, D5........ Small Signal Diodes

LO Multiplier — ***Module 08-013-02***

Board 08-010-02

IC1, IC2, IC3, IC4 .... RF Amplifier
D1........ Step Recovery Diode
D2........ Rectifier

VCXO PLL — ***Module 09-060-02***

Board 33-300-02

U1........ Synthesizer
U2........ Phase Detector
U3, U4........ RF Amplifier
U5........ Dual modulus pre-scaler
U6........ Voltage Regulator
Y1........ Crystal
IC1 .... Frequency Divider
D1, D2, D3, D6........ Small Signal Diodes
D4, D5 .... Varactor Diodes
Q1........ Oscillator
Q2........ RF Amplifier

Board 33-301-02

U1A........ Operational Amplifier
Q1, Q2........ DC Switch
DS1 .... Light Emitting Diode

IF ALC — ***Module 04-129-02***

Board 33-117-02

U1A, U1B .... Operational Amplifier
U2 .... RF Amplifier
D1, D2 .... Attenuator Diodes

IF Detector — ***Module 12-025-02***

Board 33-324-02

U1-U3........ IF Amplifiers
U4 .... DC Amplifier
D1, D2 .... Detector Diodes
Q1 .... DC Amplifier
Z1 .... Zener Diode

Envelop Detector — ***Module 12-017-02***

Board 33-094-02

D1,D2 .... Detector Diodes

POWER AMPLIFIER SEGMENTS

Power Amplifier Segments — ***Module 04-294-02***

IC1 .... SPDT Switch
D1 .... Diode Common Cathode
D2........ Diode Dual Cathode
Q1 – Q5 .... GaAs FET

POWER SUPPLY

Power Supply — ***OEM***

The transmitter's % power meter was found to be within 2% of the indications provided by the external average power meter with output variations of 80% to 110% of the transmitter's rated output.

Output Power Calibration	See technical manual, document # DOC16-0005

- MODULATION CHARACTERISTICS

FCC Section 2.1047

- OVERALL ATTENUATION

FCC Section 2.1047 (d)

Visual Output Power:	50.5 dBm peak sync per channel
% Video Modulation:	87.5%
Type Video Modulation:	Per FCC 73.687 (a) (4)
Aural Output Power:	Not applicable
Method of Measurement:	Per FCC 73.687 (a) (2 & 4)
Overall Modulation:	Measure at channel

Modulation Frequency (MHz)	Detected Output (dB)
0.2 (reference)	0.0
0.5	0.0
0.75	0.0
1.25	-6.12
2.1	-6.14
3.0	-5.95
3.58	-6.0
4.18	-6.2

- ENVELOPE DELAY

FCC Section 73.687 (a) (3)

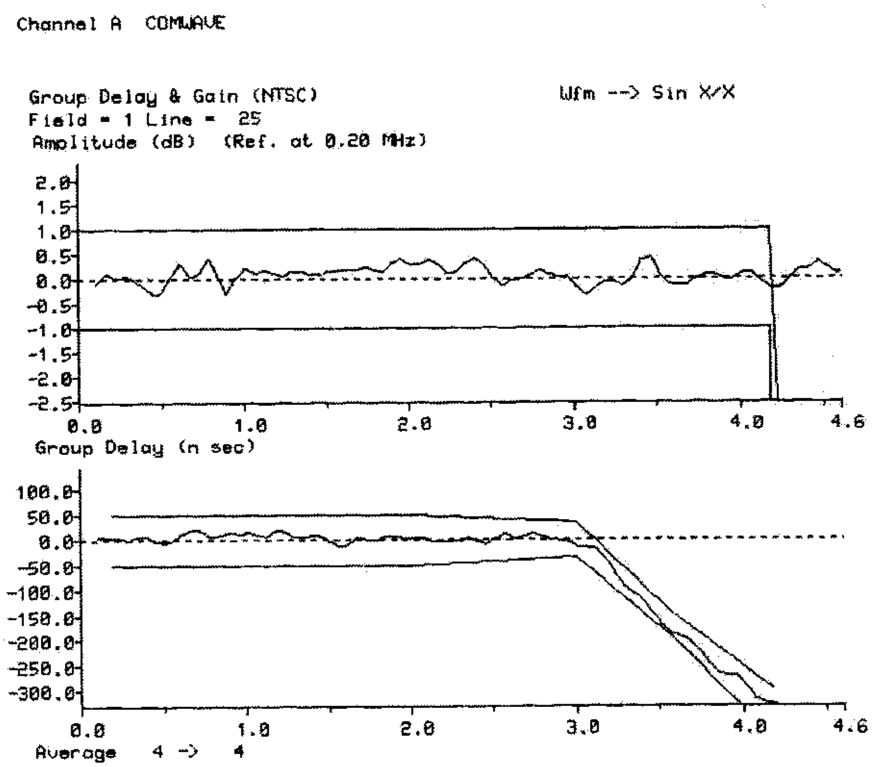
Visual Output Power:	50.5 dBm peak sync per channel
% Video Modulation:	87.5%

Type Video Modulation:	Per FCC 73.687 (a) (4)
Aural Output Power:	Not applicable
Method of Measurement:	Per EIA RS-240, Section B (12c)

Delay vs. Frequency:

Frequency (MHz)	Delay (ns)
0.2 (reference)	0
0.5	-5
1.0	+20
1.5	-10
2.1	0
2.5	0
3.0	-20
3.2	-30
3.4	-100
3.58	-150
4.0	-300
4.18	>-300

TEST DATA



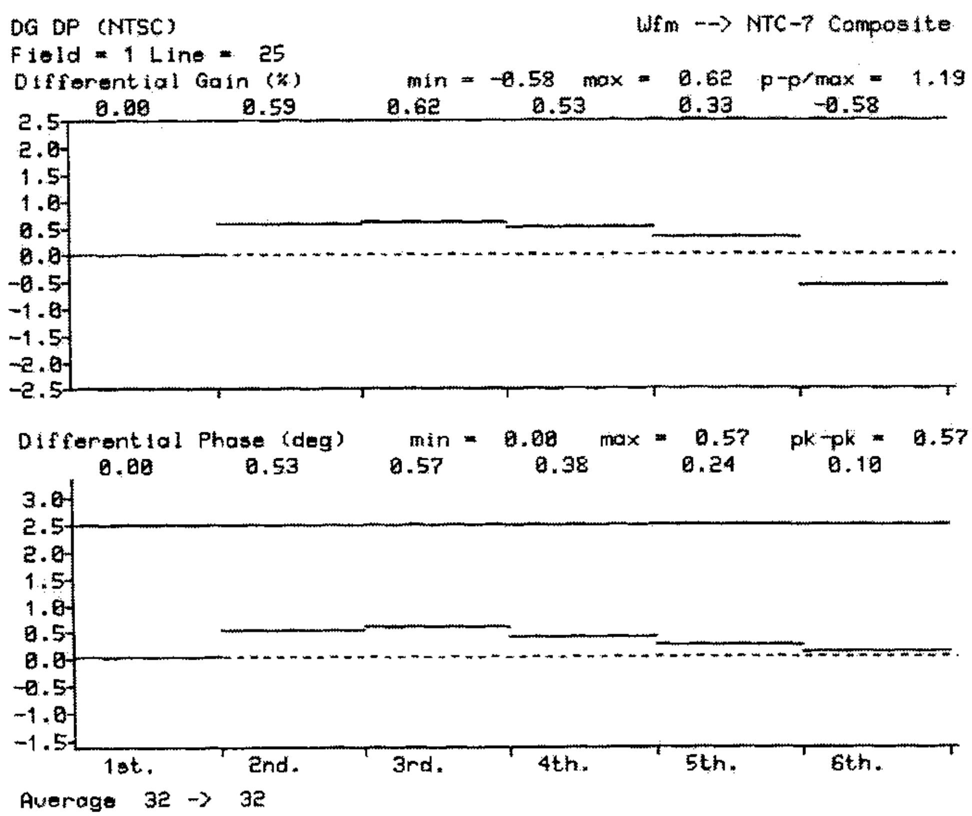
➢ DIFFERENTIAL PHASE AND GAIN

FCC Section 73.682 (a) (20) (vii)

Visual Output Power:	50.5 dBm peak sync per channel
% Video Modulation:	87.5%
Type Video Modulation:	Per EIA RS-240, Section B (10c) & (11c)
Aural Output Power:	35.5 dBm average
Method of Measurement:	Per EIA RS-240, Section B (10c) & (11c)
Differential Phase:	<2°
Differential Gain:	<1.5%

TEST DATA

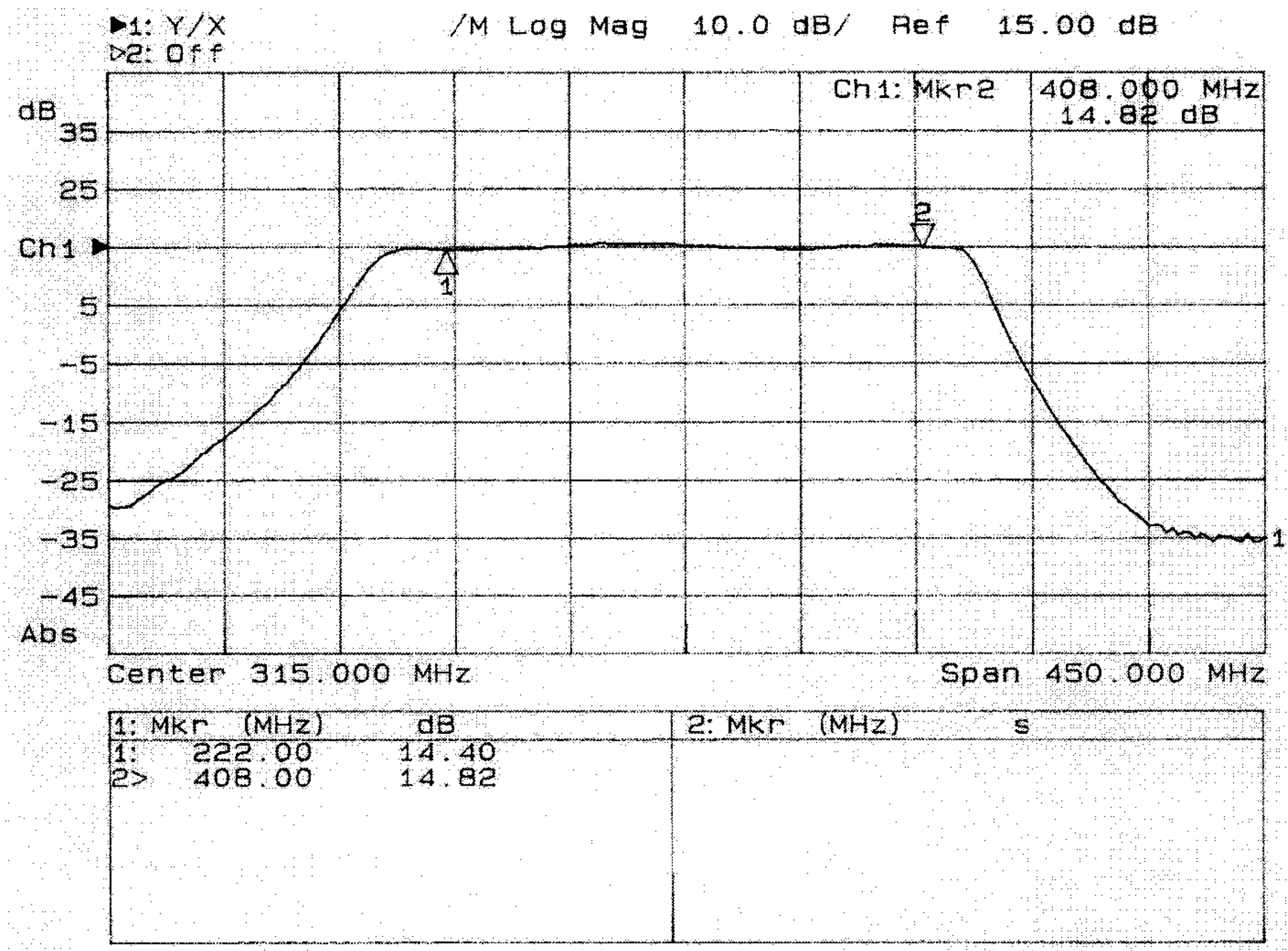
Channel A COMWAVE



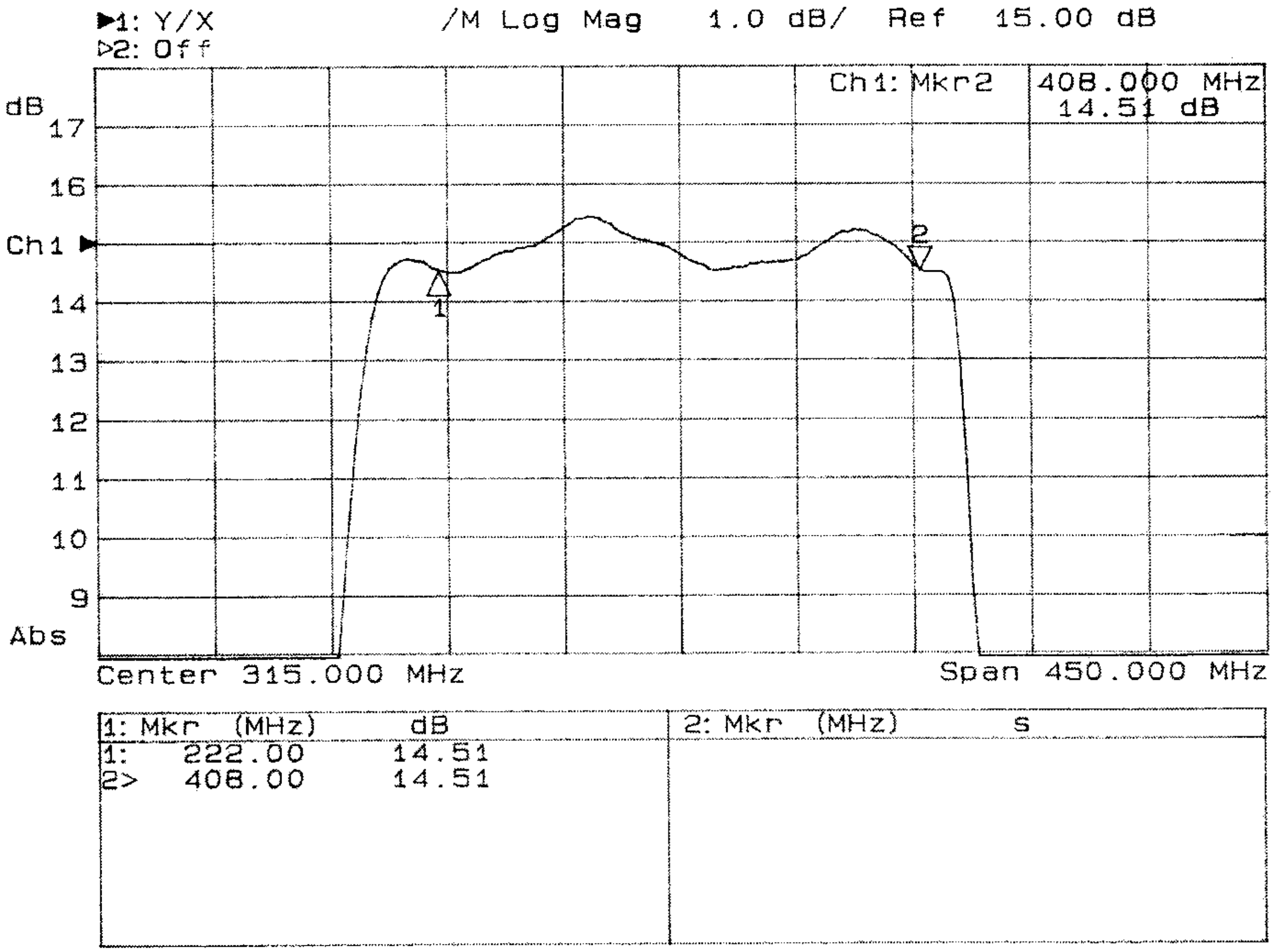
❖ OCCUPIED BANDWIDTH & FREQUENCY RESPONSE

FCC Section 2.1049 (e) (6) (i)

The frequency response of the SBM-1000A is very flat and provides near perfect transmission of carriers without linear distortion. The frequency response was measured by injecting a CW signal into the transmitter front end at a nominal input level of –15 dBm. The signal was swept from 90 MHz to 540 MHz and the output, at microwave 2368 – 2818 MHz, was captured on an HP8713B Scaler Network Analyzer. Marker one and two correspond to the passband. See plots one and two below:



PLOT 1: Frequency Response on 10 dB/div Scale



PLOT 2: Frequency Response on 1 dB/div Scale

- VISUAL OCCUPIED BANDWIDTH

FCC Section 2.1047/2.1049/73.687 (a) (2)/74.936

Visual Output Power:	50.5 dBm peak sync per channel
% Video Modulation:	87.5%
Type Video Modulation:	Per FCC 73.687 (a) (4)
Aural Output Power:	Not Applicable
Method of Measurement:	Per FCC 73.687 (a) (2) & (4)

Frequency Response:

Output Frequency (MHz)	Sidebands (MHz)	Relative to +200 KHz (dB)	Relative to Visual Carrier (dBc)
2550.50	-4.75	-52.50	-68.00
2551.07	-4.18	-52.60	-68.10
2551.67	-3.58	-49.84	-65.34
2552.25	-3.00	-46.35	-61.85
2553.00	-2.25	-45.76	-61.26
2554.00	-1.25	-22.80	-38.30
2554.50	-0.75	-0.78	-16.28
2554.75	-0.50	-0.49	-15.99
2555.25	Visual Carrier	------------------	Reference
2555.75	+0.50	0.00	-15.5
2556.50	+1.25	+0.15	-15.35
2557.25	+2.00	+0.20	-15.30
2558.25	+3.00	+0.17	-15.33
2558.83	+3.58	+0.33	-15.17
2559.43	+4.18	-0.17	-15.67
2560.00	+4.75	-46.20	-61.70
2560.50	+5.25	-47.55	-63.05
2561.25	+6.00	-50.20	-65.70
2562.00	+6.75	-48.33	-63.83

<u>Spectrum Analyzer Settings:</u>

Center Frequency:	2557 MHz
Span:	13.00 MHz
Log/Div:	10 dB
Resolution BW:	30 KHz
VBW:	3 MHz
Sweep:	43.3 msec

- AURAL FREQUENCY RESPONSE

FCC Section 2.1047

Visual Output Power:	50.5 dBm peak sync per channel
% Video Modulation:	87.5%
Type Video Modulation:	Standard 10 riser stairstep
Aural Output Power:	35.5 dBm average
% Aural Modulation:	100%, 50% and 25%

Aural Modulation Signal: 50 Hz to 15 Hz

Aural Frequency Response:

Frequency (Hz)	Output Relative to 1 KHz (dB) 100% Mod
50	-0.53
100	-0.53
400	-0.44
1000	0.0
3000	+4.08
5000	+7.60
7000	+9.54
12000	+13.62
15000	+16.12

➢ AURAL OCCUPIED BANDWIDTH

FCC Section 2.202

Visual Output Power: 50.5 dBm peak sync per channel

% Video Modulation: 87.5%

Type Video Modulation: Standard 10 riser stairstep

Aural Output Power: 35.5 dBm average

% Aural Modulation: 85% (21.25 KHz)

Aural Modulation Signal: 15 KHz

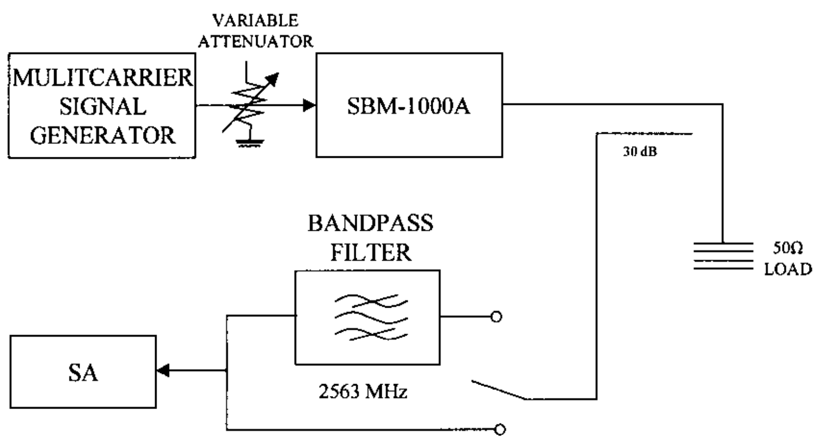
Method of Measurement (Bn = 2M + 2DK): Bandwidth was read at 0.5% (-23 dB) of mean power on a spectrum analyzer

Aural Occupied Bandwidth: 80 KHz

➢ SPECTRAL OCCUPANCY

The following plots demonstrate the occupied bandwidth of the composite signal(s) at the output of the transmitter system power amplifier at the maximum rated peak power. The occupied bandwidth complies with the out of band emissions for analog systems. The signal(s) meets the requirements of out of band emissions less than -38 dB at the channel edge decreasing to less than -60 dB at ≤1 MHz and ≥ .5MHz from the channel edge relative to the peak of sync of the analog channel. Also, see page 15 of this report.

Due to the multi-carrier nature of the input/output signal(s), some additional measurements are necessary to accurately represent the spectral occupancy. This is due to the dynamic range of in-band signal power versus out-of-band power. In addition, we are concerned not only with the intermodulation products of a single carrier, but also those intercarrier products (sometimes referred to as CTB in the cable industry) that may appear out-of-band. For that reason, some explanation of the measurement technique is in order.

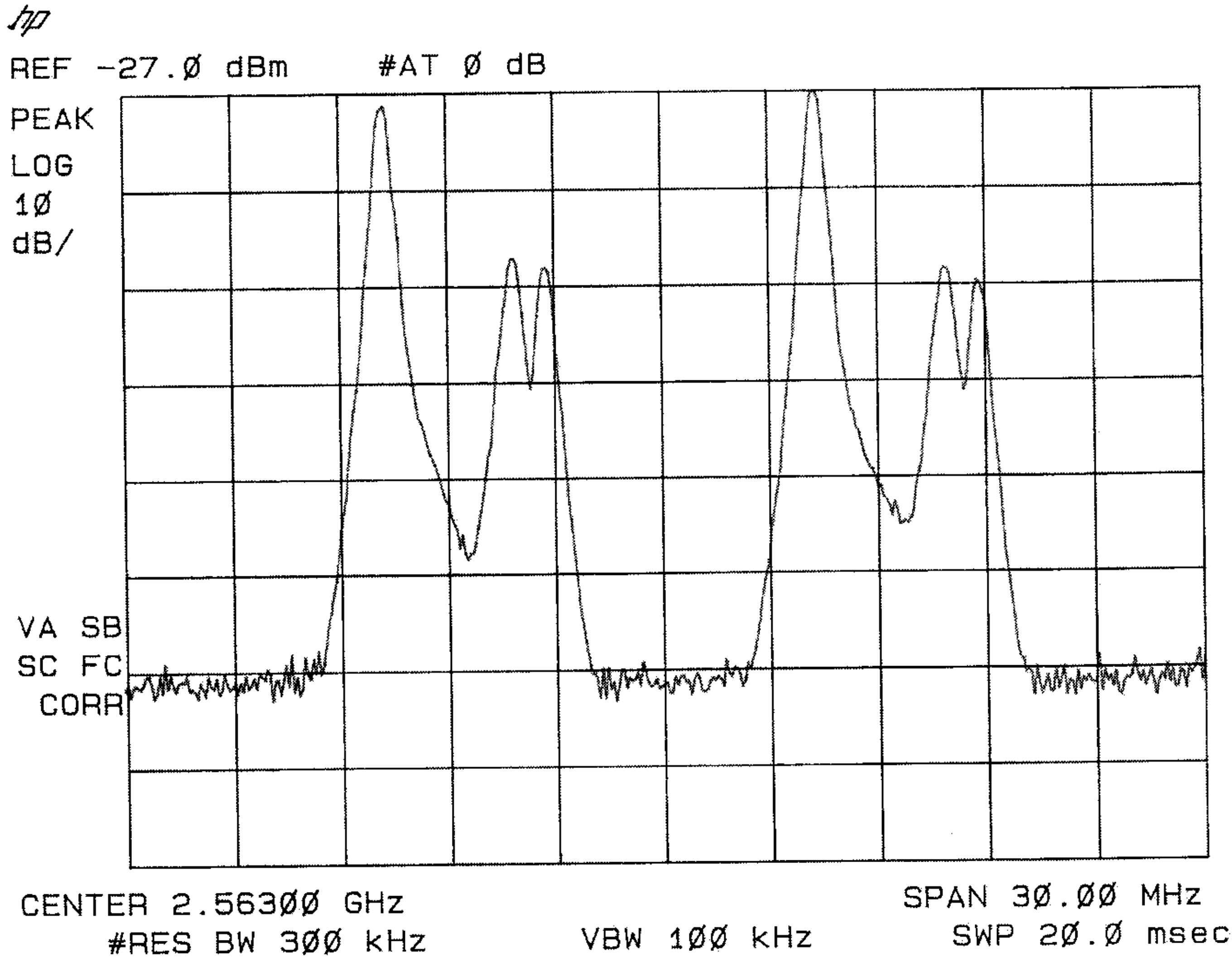


Measurement Technique

Accurately measuring out-of-band power requires sufficient dynamic range to measure both signal power and intermodulation products without undue influence from the instrumentation noise floor. Since the ultimate requirement for out-of-band signal power is –60 dB relative to in-band peak of sync power, we require at least 70 dB dynamic range to prevent noise floor interference from corrupting the measurement. To accomplish this, we have measured out-of-band power after filtering out the majority of in-band signal power since this allows us to reduce the noise floor of the spectrum analyzer. A block diagram of the test set-up is shown above.

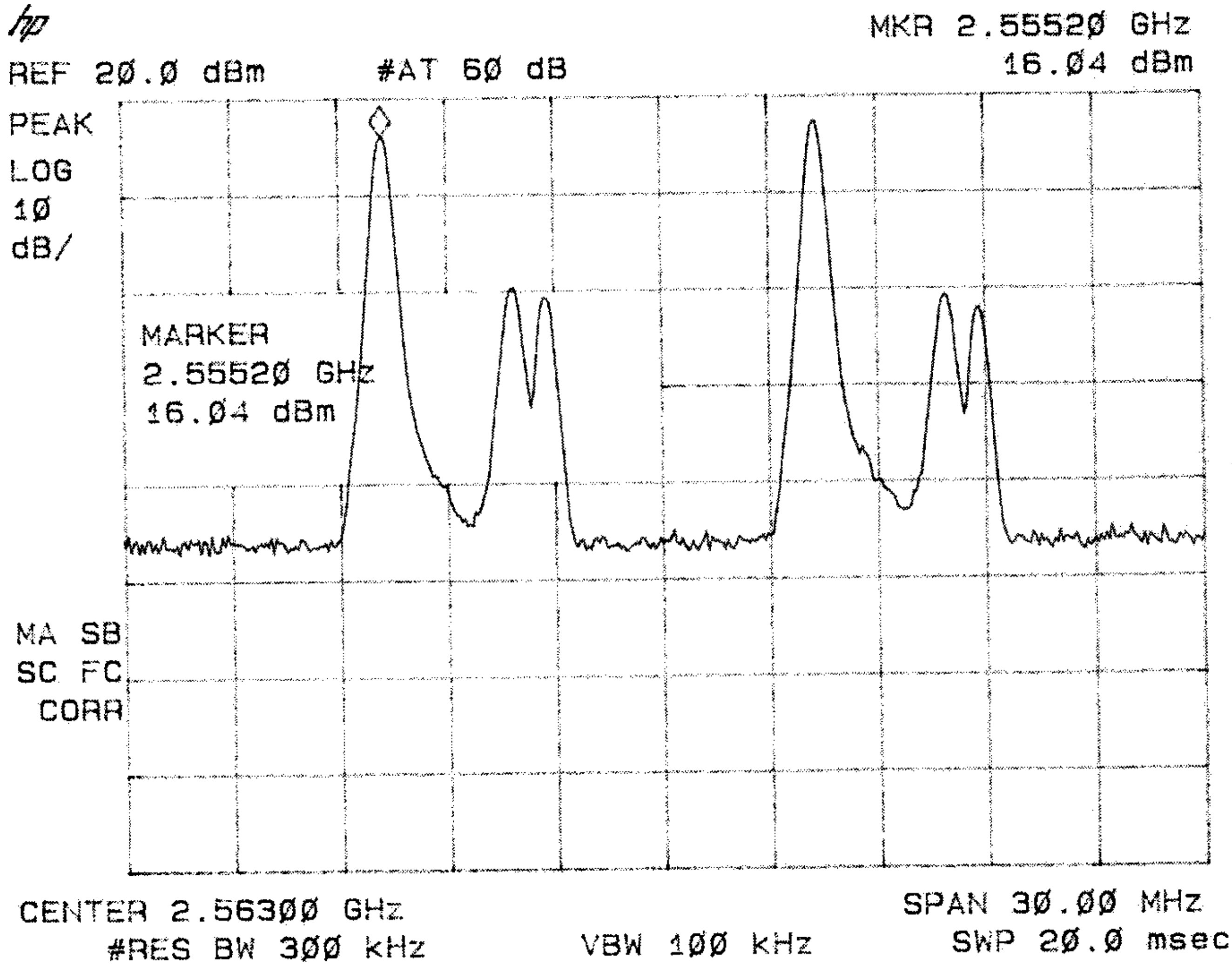
Narrative Description of Occupied Bandwidth Plots

Plot 3 shows the transmitter-input signal for two carriers. Each carrier is modulated with 75% color bars. All plots were taken with a resolution bandwidth of 300 kHz for peak measurement and 30 kHz resolution bandwidth for intermodulation measurement.



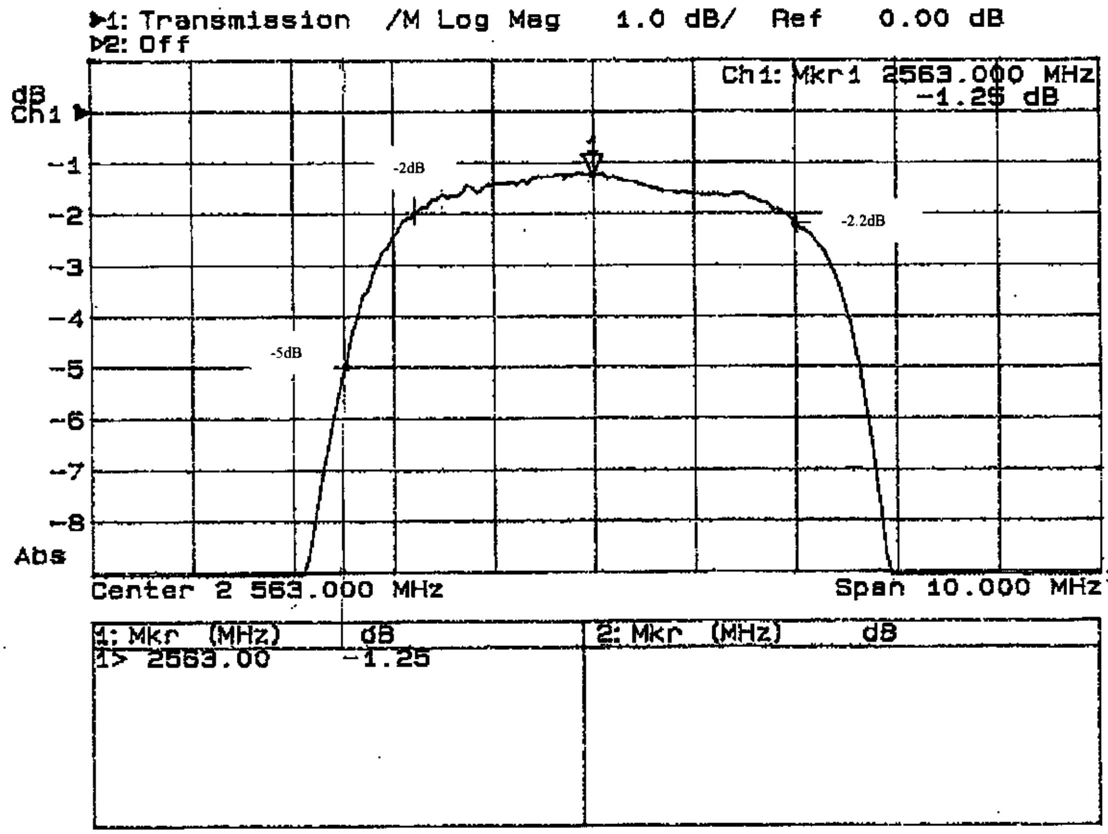
PLOT 3: Two Carrier Composite Transmitter System Input Signal

Plot 4 shows the transmitter system output signal for two composite carriers with 75% color bars modulation at an SCL of 46.5 dBm as measured by an average power meter which corresponds to 50.5 dBm peak of sync. The Spectrum Analyzer is set to display the in-band signal power (after 34.5-dB attenuation) of approximately 16.04 dBm. From these plots we can see that the out-of-band requirement to be better than –38 dB relative to peak of sync is met.



PLOT 4: Two Carrier Composite Transmitter System Output Signal

The bandpass filter is used to eliminate signal energy and allow us to reduce the spectrum analyzer input attenuator, thus lowering the noise floor to a level where we can accurately measure the out-of-band power. The bandpass filter has the following passband characteristics:

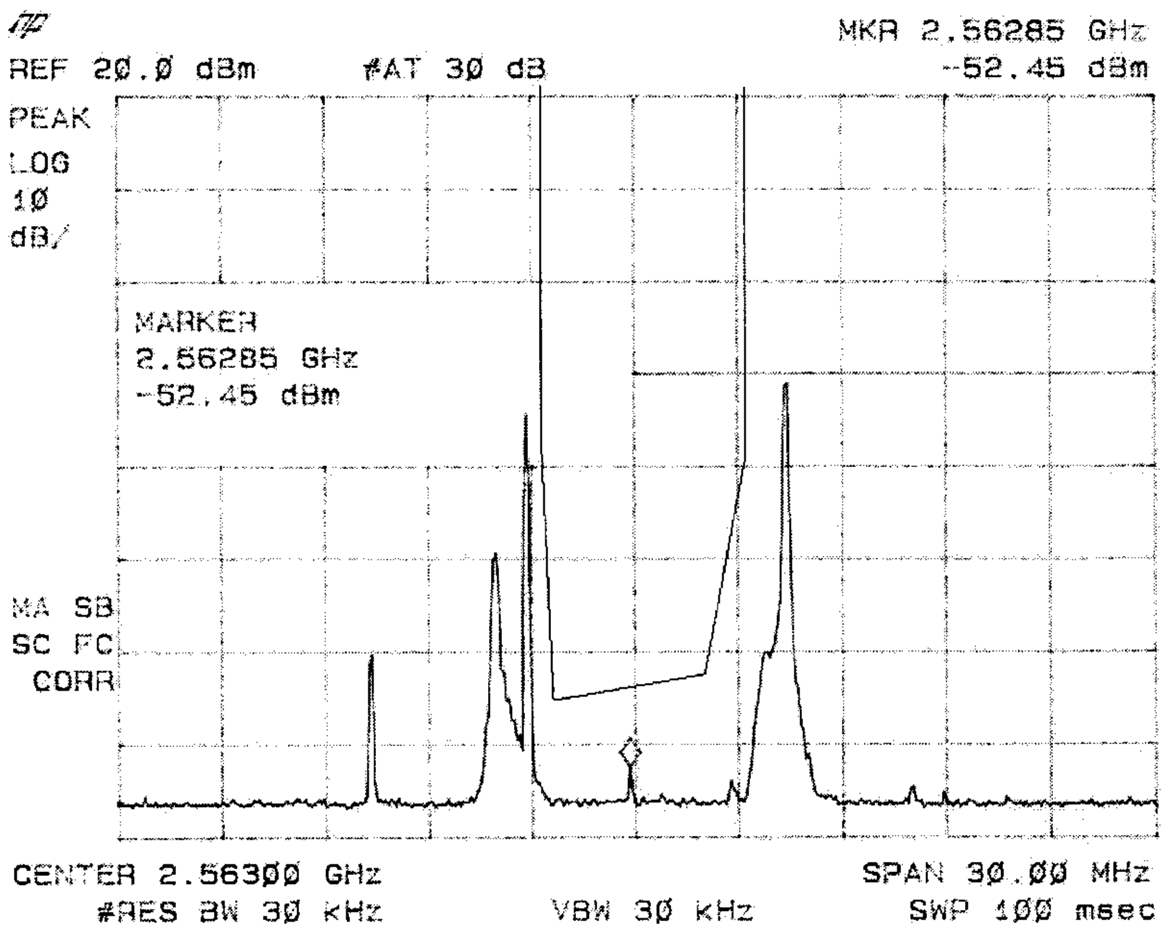


The mark with –5 dB indicates attenuation of the filter at a frequency .5 MHz higher than the band edge of the lower adjacent channel. The mark with –2.2 dB, otherwise, indicates a frequency 1 MHz lower than the edge of the higher adjacent channel. The mark of –2 dB corresponds to the visual carrier.

In plot 5, the measured out-of-band power within the limits of the unoccupied channel is –52.45 dBm. Accounting for the filter insertion loss and two adjacent channels, we conclude that a single-carrier has relative out-of-band signal power given by:

-52.45 + 2.2 – 16.04 = -66.29 dB between +.5 MHz and –1 MHz of the band edges

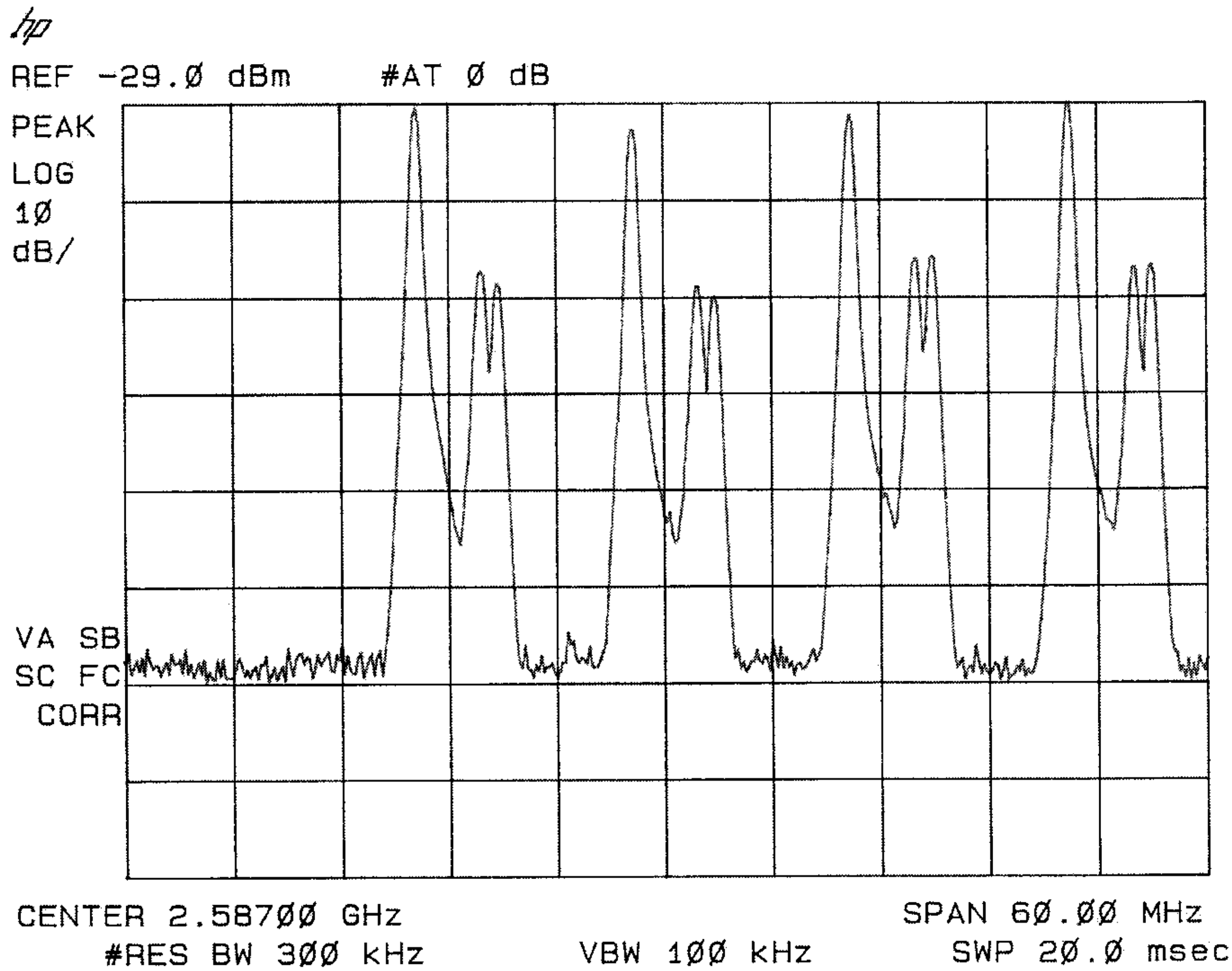
Moreover, the total measured power in the adjacent channel is more than 60 dB below the channel peak power. This shows that the system complies with the spectral occupancy mask established in FCC 74.936.



PLOT 5 – Two Carrier Out-of-band Power

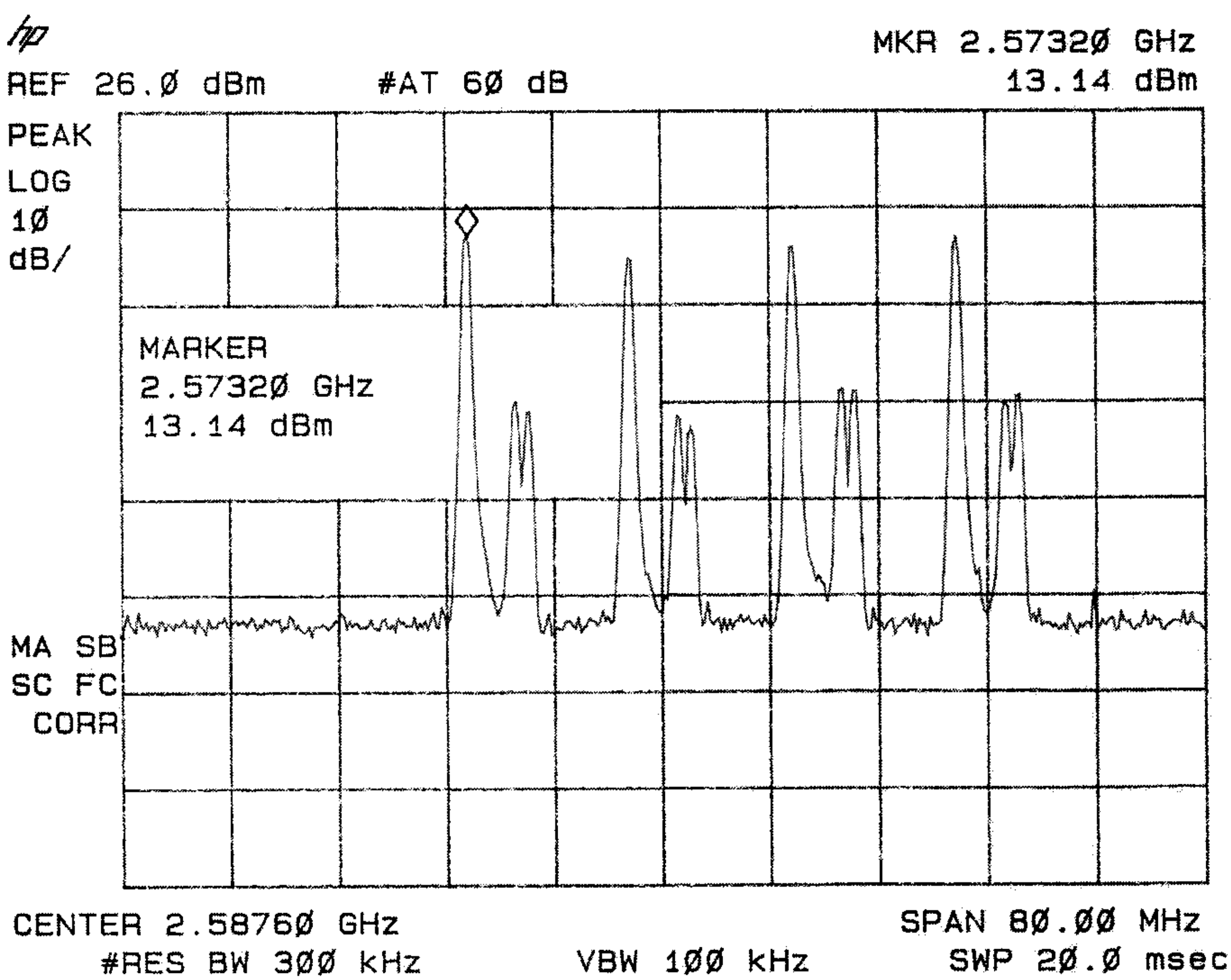
❖ MULTI-CARRIER INTERMODULATION PRODUCTS

This system is a multi-carrier transmitter, therefore, intercarrier intermodulation products are of concern. These are the third order intermodulation products that occur at $2F_1$-F_2 and $2F_2$-F_1. In plot 6, the analog carriers are positioned so that the $2F_1$- F_2 product falls into the passband of the Bandpass Filter.



PLOT 6: Four Carrier Composite Transmitter System Output Signal

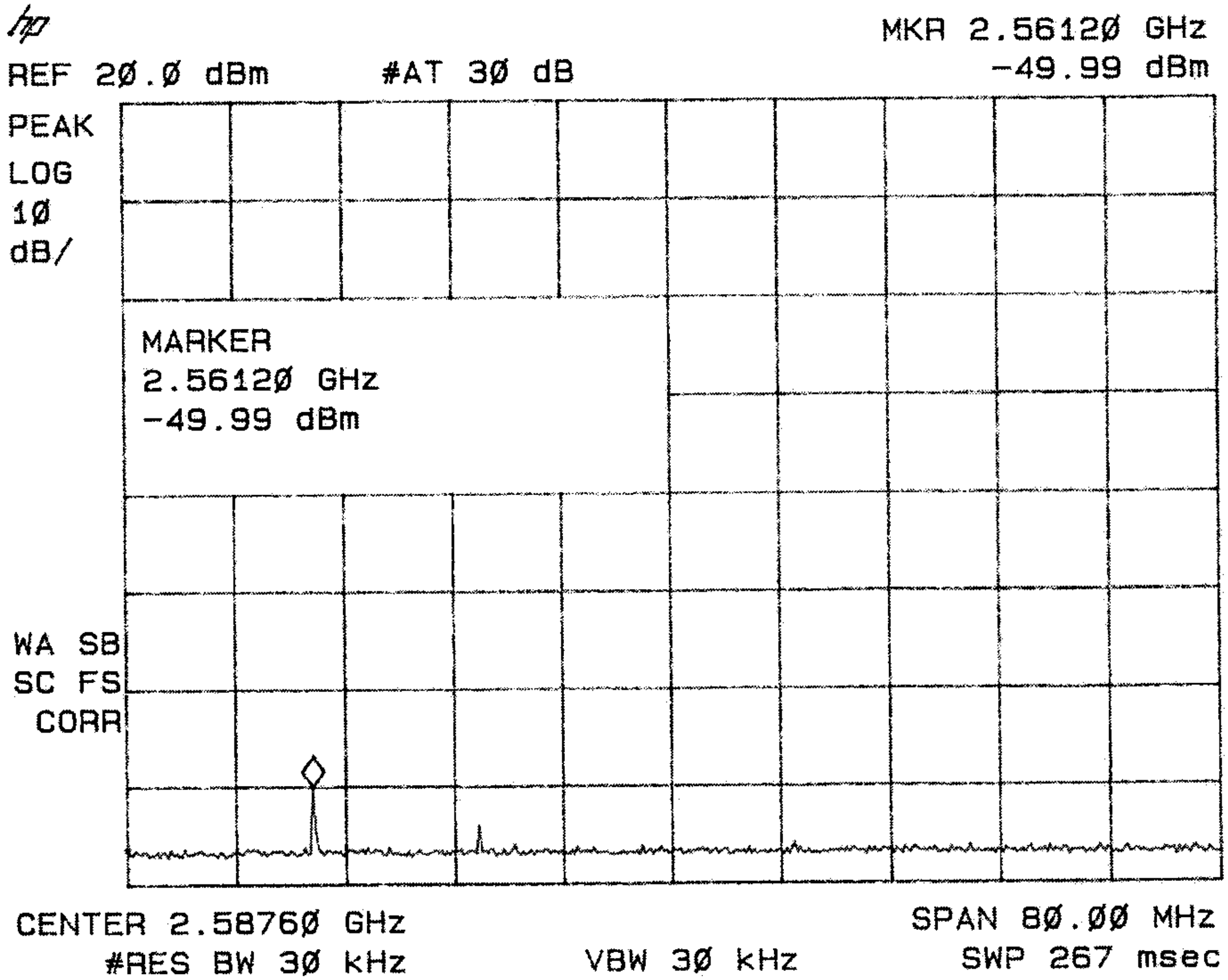
Plot 7 shows the output of the transmitter with four analog carriers. The reference is moved to 13.14 dBm since the power per carrier is 3 dB lower and the attenuator was set to 32.5 dB attenuation. Plot 8 shows the IM3 measurement with four carriers. In this case, an additional 2 dB back-off in output power was required to maintain the same level of out-of-band power as shown in plot 8.



PLOT 7: Four Carrier Composite Transmitter System Output Signal, Measurement Shown

The additional back-off shown in plot 8 follows the well known requirement for multi-carrier systems. Specifically, Leffel [1] cites results showing the back-off requirement for constant IM product power as being asymptotic to 4 dB as the number of carriers approach infinity. Our laboratory test results reflect the back-off requirement predicted by Leffel. That requirement is incorporated in the rated output power per carrier as the number of carriers is increased. $IM_3 = -(13.14\text{ dBm} - 2\text{ dB}_{\text{filter loss}} - (-49.99\text{ dBm})) = -61.13$ dBc

[1] Leffel, Michael, "Intermodulation Distortion in a Multi-Signal Environment", RF Design, June '95.



PLOT 8: Four Carrier Out-of-band Power

SPURIOUS EMISSIONS AT ANTENNA TERMINALS

FCC Section 2.1051/2.1057/21.908 (b)/74.936

Visual Output Power:	**1-2 Channels 50.5 dBm/ch (112.2 W)/ch** **3-4 Channels 45.50 dBm/ch (35.5 W)/ch** **5-8 Channels 41.5 dBm/ch (14.1 W)/ch** **9-16 Channels 38.0 dBm/ch (6.3 W)/ch** **17-31 Channels 34.5 dBm/ch (2.8 W)/ch**
% Video Modulation:	87.5%
Type Video Modulation:	Per EIA RS-240, Section A (6c)
Aural Output Power:	35.5 dBm average
% Aural Modulation:	0%
Spectrum Analyzer Setting:	The Spectrum Analyzer setting used in conducting the spurious emissions test at the equipment output terminals was as follows
Frequency Span:	2 MHz per Division
Center Frequency:	Adjusted continuously for 10 MHz to 27 GHz
Resolution Bandwidth:	100 KHz
Video Filter:	Out
Input Attenuator Setting:	Input level was set for a full-scale calibration of the visual carrier. All other frequencies were referenced to this point.
Spurious Emissions:	See chart on next page

Spurious Emissions:

Frequency (MHz)	Amplitude (dBc)		Relative to Peak Visual (MHz)
2555.25	0	Visual Carrier	(reference)
2546.25	-62	Visual Carrier	-9
2550.75	-63	Visual Carrier	-4.5
2551.67	-62	Visual Carrier	-3.58
2562.41	-66	Visual Carrier	7.16
2559.75	-65	Aural Carrier	4.50
2278.00	-69	Local Oscillator	277.25
5110.50	-69	Harmonic	x 2
7665.75	-62	Harmonic	x 3
10221.00	>-70	Harmonic	x 4
12776.25	>-70	Harmonic	x 5
15331.50	>-70	Harmonic	x 6
17886.75	>-70	Harmonic	x 7
20442.00	>-70	Harmonic	x 8
22997.25	>-70	Harmonic	x 9
25552.50	>-70	Harmonic	x 10

- FIELD STRENGTH OF SPURIOUS RADIATION

FCC Section 2.1053, 2.1057

Visual Output Power: **2 Channels @ 50.5 dBm**
8 Channels @ 41.5 dBm
31 Channels @ 34.5 dBm

Modulation: Composite Television Signals

Spectrum Analyzer Settings: A spectrum analyzer used to measure the spurious emissions at a distance of 10 meters from the television transmitter was set as follows:

Frequency Span: 1 MHz per division
Center Frequency: Adjusted continuously from 10 MHz to 27 GHz
Resolution Bandwidth: 100 KHz
Video Bandwidth: 100 KHz
Analyzer Noise Threshold: <-89 dBm

Method of Measurement:

Absolute power of the spurious radiation was measured on a spectrum analyzer at a distance of 10 meters from the transmitter. The radiation was received with a half-wave dipole antenna (gain = 2.15 dB) and measured as an absolute power level; therefore, all measurements include the dipole gain. The relative levels of the received spurious signals were calculated with respect to the absolute power level of the transmitter's visual output received with a dipole at 10 meters. The visual received power level was calculated using:

Received @ 10 meters (dBm) = EIRP (dBm) - Path Loss (dB) + 2.15 dB

Path Loss (dB) = 20 log distance(Km) + 20 log frequency (visual carrier)(GHz) + 92.4 dB
= 20 log (.010 Km) + 20 log (2.55525) +92.4 dB
= 60.55 dB

EIRP (dBm) = 50.5 dBm (tx output) + 2.15dB (transmit dipole gain)
= 52.65 dBm

Received Level = **EIRP** dBm - **Path Loss** dB + 2.15 dB
= -5.75 dBm

The Electric Field Intensity E(v/m) incident on a receive dipole antenna was found using:

$$\mathbf{E}\ (v/m) = \text{Antilog}\left[\frac{(\text{Received Level} - 2.15\ dB) - 20\log \text{wavelength}(m) + 6.75}{20}\right]$$

$$= \text{Antilog}\left[\frac{-5.75dBm - 2.15\ dB - 20\log[0.117405342m] + 6.75}{20}\right]$$

= Antilog 0.8729

E = 7.462 v/m

Spurious Radiation:

Due to the total shielded component design needed for the high system gain enclosure, no radiated signals were detected to the threshold of the analyzer.

* Analyzer threshold = -89 dBm

The range of examination in these tests was from 10 MHz to 27 GHz.

- FREQUENCY STABILITY

FCC Section 2.1055 (a) (1) / 73.687 / 21.101 (a)

Method of Measurement: The upconverter was Channel tested per FCC Part 73, Subpart E, Section IV (c)

Microwave L.O. (Synthesized)	2278.00 MHz
IF Frequency (Modulator*)	- 277.25 MHz
On Channel Frequency	2555.25 MHz

**Modulator is certified separately.*

Frequency Stability over Temperature: **Microwave Upconverter PLL Local Oscillator**

Temp. (C)	LO (MHz)	Error (Hz)
50	2278.000073	-73.00
40	2278.000045	-45.00
30	2278.000032	-32.00
20	2278.000015	-15.00
10	2278.000007	-7.00
0	2278.000002	-2.00
-10	2277.999982	18.00
-20	2277.999918	82.00
-30	2277.999978	22.00

The worst case of the oscillator frequency shift results in an 82.00 Hz channel error. This represents accuracy, which is well within the required channel ± 1,000 Hz tolerance requirement set on November 1, 1991, for ITFS/MMDS transmitters.

Frequency Stability over AC Input Voltage: **Microwave Upconverter PLL Local Oscillator**

AC Line (V)	LO Frequency (MHz)	Error (Hz)
95	2277.999987	13.00
100	2278.000009	-9.00
110	2278.000009	-9.00
115	2278.000007	-7.00
120	2278.000008	-8.00
125	2278.000007	-7.00
130	2278.000009	-9.00
135	2278.000008	-8.00

NOTE:
Frequency stability of the microwave LO was totally dependent on the accuracy and stability of the 10 MHz reference oscillator. This is a purchased item with 1×10^{-7} minimum stability specification.

8.0 SUMMARY

This report demonstrates that the SBM-1000A television transmitter meets or exceeds the FCC certification criteria. Peak output power was verified with direct measurement of power at microwave. Measurement of spurious emissions at the RF output revealed no emissions above -60 dBc. Field strength measurements of spurious emissions revealed no detectable emissions down to the analyzer noise threshold of < - 89 dBm.

SBM-1000 TOP LEVEL DESCRIPTION

The SBM series of transmitters is available in both redundant and non-redundant models. The SBM-1000 is a non-upgradeable high power and high gain multi-channel transmitter. The redundant SBM-1000 consists of three power supplies, sixteen power amplifier segments, one backup system controller (switch and control drawer), two VHF/UHF to microwave drawers (VHF/UHF block upconverter) or (drivers), one primary, one secondary, and two or four[1], IF to VHF/UHF drawers, one or two[1] primary, one or two[1] secondary, which are contained within a rack and sub-rack. The backup system controller indicates output power and enables the secondary driver should a failure occur in the primary driver. The non-redundant SBM-1000 consists of two power supplies, sixteen power amplifier segments, one VHF/UHF to microwave drawer (VHF/UHF block upconverter) or (driver), and one or two IF to VHF/UHF drawers. In both the redundant and non-redundant system the power supplies and power amplifier segments allow hot replacement. Identical drivers are provided for both MDS and ITFS frequencies.

A new front panel label is needed to accommodate each FCC ID. For the redundant system the labels are located on the backup system controller, as shown in document # DOC22-0014, and will be replaced with each upgrade as needed. For the non-redundant system, a blanking panel will be used in place of the backup system controller, the labels will be found on this panel, again, they will be replaced with each upgrade as needed.

In order to maximize power density, both the rack and sub-rack are integral subsystems of the transmitter design. The rack provides phase to phase AC power to the drivers, DC power to the sub-rack, and the cooling for the power amplifier segments. Similarly, the sub-rack provides an interface between the power amplifier segments and the entire system.

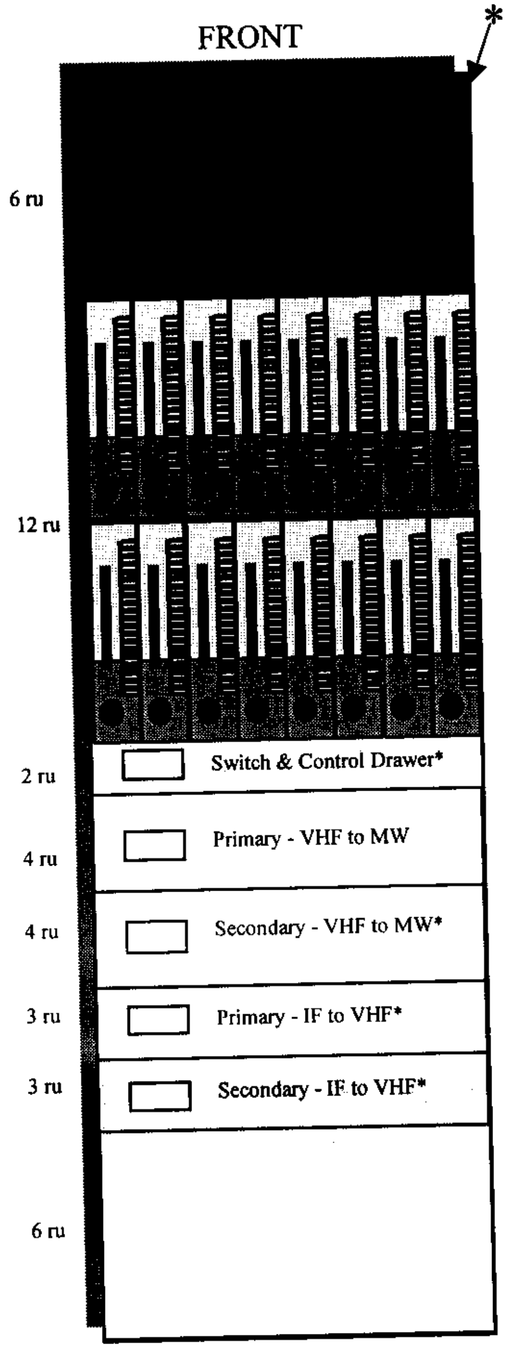
NOTE: 1. Depending on the number of channels.

Created by: Kimberly Simeone 6/98	Checked by: [signature] 10/23/98	Released by: [signature] 10/23/98

SBM-1000 RACK ASSEMBLY

Up to 16 Channels, Redundant System

NOTE: 1ru = 1.75"

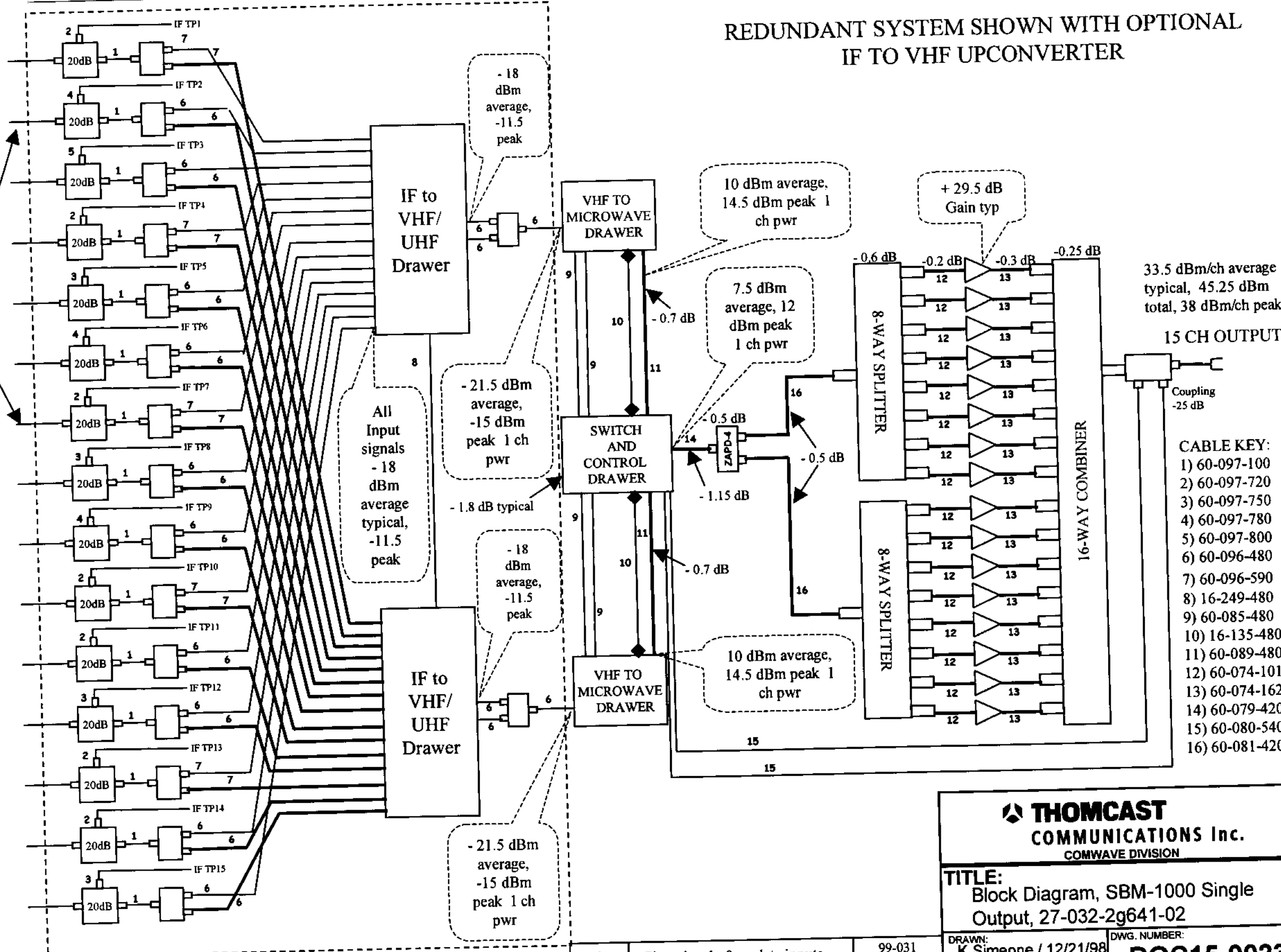


DRAWING NOT TO SCALE

***These components are optional**

Created by: Kimberly Simeone *12/9/98 ECO #: 98-164*	*Checked by: Kevin Harding* *12/10/98*	*Released by: Donald Wike* *12/10/98*

REDUNDANT SYSTEM SHOWN WITH OPTIONAL IF TO VHF UPCONVERTER



CABLE KEY:

1) 60-097-100
2) 60-097-720
3) 60-097-750
4) 60-097-780
5) 60-097-800
6) 60-096-480
7) 60-096-590
8) 16-249-480
9) 60-085-480
10) 16-135-480
11) 60-089-480
12) 60-074-101
13) 60-074-162
14) 60-079-420
15) 60-080-540
16) 60-081-420

NOTE: This block is used for both Analog and Digital systems. Average power measurements are Digital. Peak power measurements are Analog.

REV	Description	ECO# NAME/DATE
C	Show levels & update inputs	99-031 K.Simeone/3/9/99
B	Showed IF to VHF dwr as optional	98-164 K.Simeone/12/8/98

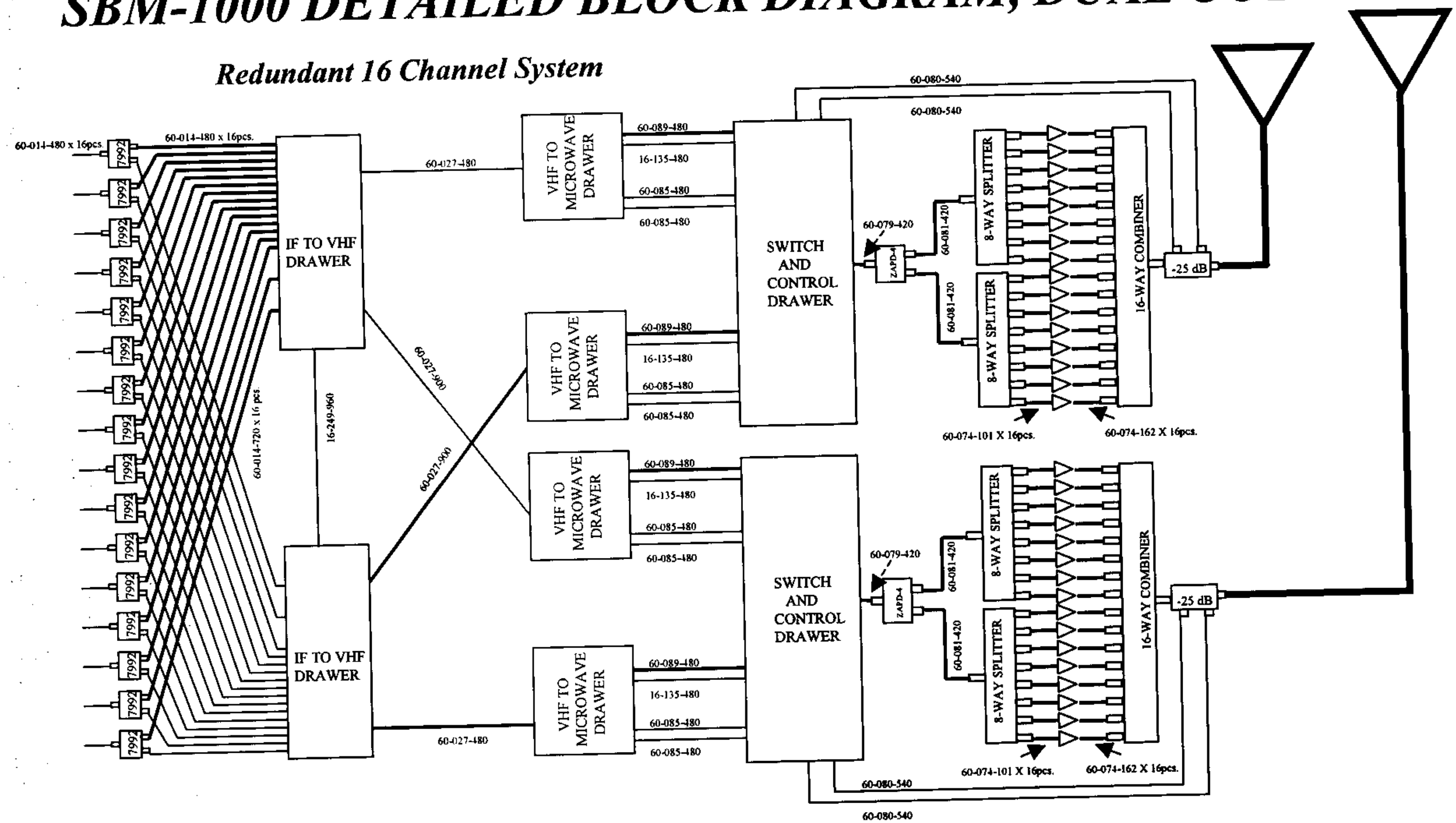
THOMCAST COMMUNICATIONS Inc.
COMWAVE DIVISION

TITLE: Block Diagram, SBM-1000 Single Output, 27-032-2g641-02

DRAWN: K.Simeone / 12/21/98	DWG. NUMBER: DOC15-0023		
CHECKED: D.Wike / 12/21/98	Scale: none	Sheet 1of 1	REV: C
RELEASED: P.Correa / 2/21/98			

SBM-1000 DETAILED BLOCK DIAGRAM, DUAL OUTPUT

Redundant 16 Channel System



Created by: Peter J. Przekop	6/25/98	Checked by: *[signature]* 10/20/98	Released by: *[signature]* 10/21/98

Document #: DOC15-0019

REV: A

SBM SERIES MULTICARRIER TRANSMITTER SPECIFICATIONS

DIGITAL SPECIFICATIONS				
Parameter	**Specifications**			**Notes/Test Conditions**
	OUTPUT SPECIFICATIONS[3]			
	SBM-250[4]	**SBM-500[4]**	**SBM-1000**	
Peak Envelope Output Power	250 Watts	500 Watts	1000 Watts	
Digital Average Output Power 17 – 31 channels 9-16 channels 5-8 channels 3-4 channels 1-2 channels	 24.0 dBm 27.5 dBm 31.0 dBm 35.0 dBm 40.0 dBm	 27.0 dBm 30.5 dBm 34.0 dBm 38.0 dBm 43.0 dBm	 30.0 dBm 33.5 dBm 37.0 dBm 41.0 dBm 46.0 dBm	Non-Coherent QAM Modulated Carriers 2^{23}-1 PN data sequence (at transmitter output)
Broadband Frequency Response[5]	≤ ± 1.0 dB			2000 - 2700 MHz in select bands
Frequency Response (single channel)[5]	≤ ± 0.25dB			2000 - 2700 MHz in select bands
Output Frequency	2000 - 2700 MHz			In select bands
Output Connector / Impedance	N-female / 50 Ω			
Spurious Products[2]	≤ -60 dBc			Relative to unmodulated carrier power measured @ 100 KHz RBW at the transmitter output
Carrier to Noise (C/N)[5]	≥ -52 dB			
Harmonics[1]	≤ -60 dBc			Relative to unmodulated carrier power measured @ 100 KHz RBW at the transmitter output
In-band Intermodulation Distortion[5] (CTB)	≤ -60 dBc			
Out–of-band Intermodulation Distortion[5]	≤ -60 dBc			
RF Output Regulation	≤ ± .2 dB			Measured at transmitter output
Hum and Noise	≤ -60 dBc			
Frequency Stability	≤ ±500 Hz ≤ ±3 Hz (Optional LORAN C) ≤ ±1 Hz (Optional GPS)			

Created by: Kimberly Simeone 12/14/98 *ECO #: 99-008, 1/21/99*	*Checked by: Donald Wike 12/14/98*	*Released by: Paulo Correa 12/14/98*

**Specifications subject to change without notice*

Document #: DOC19-0019
REV: D

Parameter	Specifications			Notes/Test Conditions
	SBM-250[4]	SBM-500[4]	SBM-1000	
SSB Phase Noise Direct measurement of microwave LO	≤-80 dBc/Hz @ 10 KHz offset ≤-110 dBc/Hz @ 10 KHz offset			Optional Standard (recommended for digital transmission)
Group Delay[5]	≤ ±5 ns per channel			F_c ±2.6 MHz Measured at transmitter output
Digital Modulation Error Vector Magnitude[5,8] (EVM)	≤ 2.0% per channel			64-QAM/8-VSB @ 5.06 Msps RMS average over 12,500 symbols Measured at transmitter output using Comstream modulator and a Thomcast IF to VHF/UHF drawer
Digital Modulation Signal to Noise Ratio[5,8] (SNR)	≥30 dB per channel			64-QAM/8-VSB @ 5.06 Msps RMS average over 12,500 symbols Measured at transmitter output using Comstream modulator and a Thomcast IF to VHF/UHF drawer
Magnitude Linearity[5] (AM-AM conversion)	≤ ±0.125 dB per channel			Measured at transmitter output
Phase Linearity[5] (AM-PM conversion)	≤ ±0.75° per channel			Measured at transmitter output
UHF INPUT SPECIFICATIONS				
Input Frequency	222 - 408 MHz			Other frequency options available
Input Connector / Impedance	BNC-female / 75 Ω			
Input Signal Level per Carrier	Redundant -21.5 dBm ± 3dB	Non-Redundant -24.5 dBm ± 3dB		Measured at input of microwave upconverter 2^{23}-1 PN data sequence (at transmitter output)
Input Return Loss	≥ 15 dB			Measured at input of microwave upconverter

Digital Specification Notes:

1. *Undesired signal power 2 dB higher than the nominal PSD of the adjacent spectral regions that is harmonically related to unmodulated carrier.*
2. *Undesired signal power 2 dB higher than the nominal PSD of the adjacent spectral regions that is harmonically related to internal system signals such as clock, LOs, etc.*
3. *All factory test measurements made at approximately 23°C.*
4. *The SBM-250 and SBM-500 includes space for upgrade to SBM-1000.*
5. *In dual systems, broadcast and trunking, the trunking system is the one specificied.*
6. *Weight doesn't include shipping materials.*
7. *Frequency bands up to 200 MHz bandwidth available from 2.0 to 2.7 GHz.*
8. *Or equivalent threshold BER measurement*

ANALOG SPECIFICATIONS[3]

Parameter	Specifications			Notes/Test Conditions
	OUTPUT SPECIFICATIONS[5]			
	SBM-250A[4]	**SBM-500A**[4]	**SBM-1000A**	
Peak Envelope Output Power	250 Watts	500 Watts	1000 Watts	
Analog Peak Output Power 17 – 31 channels 9-16 channels 5-8 channels 3-4 channels 1-2 channels	 28.5 dBm 32.0 dBm 35.5 dBm 39.5 dBm 44.5 dBm	 31.5 dBm 35.0 dBm 38.5 dBm 42.5 dBm 47.5 dBm	 34.5 dBm 38.0 dBm 41.5 dBm 45.5 dBm 50.5 dBm	
Input Frequency[6]	222 – 408 MHz			Other frequency options available
Input Signal Level per Carrier	Redundant -15 dBm ± 3dB	Non-Redundant -18 dBm ± 3dB		Measured at input of microwave upconverter
Frequency Response	≤ ±1.0 dB			2000 – 2700 MHz in select bands
Output Frequency[6]	2000 – 2700 MHz			In select bands
Impedance / Connector Input Ouput	 75Ω / BNC 50Ω / EIA 7/8 or N female			
Harmonics	≤-60 dBc			Measured in 30 KHz RBW at transmitter output relative to visual carrier (unmodulated carriers)
In-band Intermodulation Distortion[2] (CTB)	≤-60 dBc			Measured in 30 KHz RBW at transmitter output relative to in-band peak power per channel
Out-of-band Intermodulation Distortion	≤-60 dBc			Measured in 30 KHz RBW at transmitter output relative to visual carrier (unmodulated carriers)
RF Output Regulation	≤ ±0.2 dB			
Spurious Products[1]	≤ -60 dBc			Measured in 30 KHz RBW at transmitter output relative to visual carrier using 75% color bars video pattern
	VISUAL PERFORMANCE			
Emission	5M75C3F or per CCIR			
Frequency Response[1,7]	≤ ± 1 dB			FCC Multiburst video pattern

**Specifications subject to change without notice*

Document #: DOC19-0019
REV: D

Parameter	Specifications			Notes/Test Conditions
	SBM-250A[4]	SBM-500A[4]	SBM-1000A	
Group Delay[1,7]	FCC 73.687 (a) (3) or per CCIR			Sin(x)/x video pattern
Differential Gain[1,7]	≤3%			NTC7 composite video pattern
Differential Phase[1,7]	≤2°			NTC7 composite video pattern
Sync Pulse Amplitude[1,7]	±5%			NTC7 composite video pattern
Luminance Non-linearity[1,7]	≤3%			NTC7 composite video pattern
Weighted SNR[1,7]	≥55 dB			Quiet Line - Line 12
Hum and Noise[1,7]	≤-60 dB			
K Factor 2T[1,7]	≤2%			NTC7 composite video pattern
Incidental Carrier Phase[1,7] Modulation (I.C.P.M.)	≤3°			NTC7 composite video pattern
Frequency Stability	≤ ±500 Hz ≤ ±3 Hz (Optional LORAN C) ≤ ±1 Hz (Optional GPS)			
SSB Phase Noise Direct measurement of microwave LO	≤ -80 dBc/Hz @ 10 KHz offset ≤ -110 dBc/Hz @ 10 KHz offset			Standard Optional (recommended for digital transmission)
Carrier to Noise (C/N)	≥52 dB			Measured at transmitter output
AURAL PERFORMANCE				
Output Power[2]	15 dB visual/aural ratio +0.5 dB to -2 dB			Measured at transmitter output Other ratios available upon request
Emission	250KF3E or per CCIR			
Intercarrier Frequency Accuracy	≤±50 Hz relative to visual carrier			
Frequency Response[1,7] Mono Stereo	 ≤±1 dB 30 Hz to 15 KHz ≤±1 dB 50 Hz to 105 KHz w/o pre-emphasis			
Deviation	±25 KHz (System M/N) (±50 KHz Stereo) ±50 KHz (System B/G/D/K/I) NICAM and IRT Stereo compatible			
Harmonic Distortion[1,7]	≤1%			
FM Noise[1,7]	≤-60 dB			

**Specifications subject to change without notice*

Parameter	Specifications			Notes/Test Conditions
	SBM-250A[4]	SBM-500A[4]	SBM-1000A	
Audio Input Level[1]				
Mono @ ±25 KHz deviation	-10 to +10 dBm into 600Ω			
Mono @ ±50 KHz deviation	-10 to +10 dBm into 600Ω			
Stereo @ ±50 KHz deviation	-10 to +10 dBm			

Analog Specification Notes:

1. *Using TVM-102 modulator and VHF/UHF drawer.*
2. *In band intermodulation specification is based on 15 dB visual to aural ratio. Contact factory for specification change due to other ratios.*
3. *All factory test measurements made at approximately 23 ℃.*
4. *The SBM-250A and SBM-500A includes space for upgrade to SBM-1000A.*
5. *In dual systems, broadcast and trunking, the trunking system is the one specified.*
6. *Frequency bands up to 200 MHz bandwidth available from 2.0 to 2.7 GHz.*
7. *Factory video/audio performance test limits may include up to 50% of the test demodulator measurement uncertainty.*

Parameter	Specifications			Notes/Test Conditions
GENERAL				
	SBM-250(A)[1]	SBM-500(A)[1]	SBM-1000(A)	
Operating Temperature Range	0° to + 50° C			Frequency stability and equipment functionality guaranteed.
Specified Temperature Range	13° to + 33° C			All Specified parameters guaranteed
Relative Humidity	95 % non-condensing			
Power Requirement	230 V_{AC} ±10% single phase; 208 V_{AC} ±10% three phase; 50/60 Hz			
Power Consumption per component (VA) Operating AC Power (Max) 230 V_{AC}, 50/60 Hz	≤ 1420	≤ 2560	≤ 5100	Final Amplifier Line PF ≥ 0.95
	≤ 200			Microwave Upconverter Line PF ≥ 0.7
	≤ 45			Switch and Control Drawer Line PF ≥ 0.7
	≤ 70			Fan
Vertical Rack Requirements	6 RU = 10.5"			Power Supply Shelf
	12 RU = 21"			Sub-Rack
	3 RU = 5.25"			Switch and Control Drawer
	4 RU = 7"			Microwave Upconverter
Mechanical Dimensions	80"H x 22"W x 35" D (rack) 203.2 cm H x 55.88 cm W x 88.9 cm D			40 Rack Units (RU) 1 RU = 1.75" or 4.45 cm
Approximate Weight[2]	295 lb	295 lb	310 lb	Rack/Sub-Rack
	21.5 lb			Power Supply
	10 lb			Amplifier Segment
	18.5 lb			Switch and Control Drawer
	37 lb			Microwave Upconverter

GENERAL NOTES:

1. ***The SBM-250A and SBM-500A includes space for upgrade to SBM-1000A.***
2. ***Weight doesn't include shipping materials.***

SECTION 2

This section is designed to assist you in setting up and turning on your system.

You will find installation instructions including unpacking, physical installation, environmental and safety considerations. Also included in this section is cabling instruction, as well as a basic turn-on procedure.

INSTALLATION

Unpacking

The racks should remain in their original packing containers until they are placed in the equipment shelter. Place all racks outside of the shelter sequentially so they can be installed in their proper position. Packing materials should be removed from the racks inside the equipment shelter as they are being installed.

The drivers and power amplifier segments should be removed from their boxes, as they are ready to be installed. Any unused equipment should remain in the original packing box until needed. As each piece of equipment is being unpacked, compare the packing list with the contents of the box and check for in-transit damage. Should any damage be noted, notify the freight carrier immediately to file a freight claim. Also, notify Comwave of any damages or of materials missing from the shipment. Refer to the customer service document # DOC20-0001 for information about contacting Comwave.

Please do not discard original packaging material. It should be returned to Comwave to be recycled. Be sure to retain several boxes for each type of equipment at the transmitting site. This is to be used in the event the equipment is shipped back to the factory for repairs, upgrades, or modifications to ensure adequate protection.

Physical Installation

Installation of the Rear Door

Install the rear door of each transmitter as it is unpacked. Place the hinged portion of the door over the corresponding holes in the fan shroud assembly. Insert the screws provided into the existing rack clips. After adjusting the door position, close and lock the door to ensure proper mechanical operation.

AC Power Connections to the Exhaust Fans

The exhaust fans located on the rear door of the rack have attached wiring harnesses. The harnesses must be routed into the transmitter chassis through a hole in the fan shroud and connected to the AC terminal strip. The terminal strip must be accessed before the racks are bolted together. Verify that the circuit breaker is in the OFF position. Connect the fan harness to the terminal strip following the AC interconnect diagram, 66-310-01, located in section 3, of this manual.

Installation of the Driver Chassis

The rack is equipped with slide rails for convenient installation of the driver chassis. Slide rails also enable easy access to internal adjustable controls and other maintenance/adjustments. To install the driver chassis in the rack, pull the slide rails outward until they lock into place. Carefully align the drawer with the slide rails and mate. Unlock the slide rails by depressing the lock button on each rail while pushing the chassis inward. The chassis should slide easily into rack. If binding occurs, the rail-mounting brackets are in need of adjustment, loosen the brackets and manipulate the drawer to seat rails to match the transmitter drawer. Re-tighten the brackets once free sliding motion has been achieved. Once the driver chassis has been installed in the rack and the rack slides are adjusted, cabling can begin. Refer to document # DOC23-0045, located in section 2 of this manual, to assist in cabling.

Installation of the Power Amplifier Segments

The power amplifier segments slide into the sub-rack on nylon slides and connect to the motherboard via a floating connector. The key-lock switch, located on the segment's front panel, must be in the OFF position in order to plug the segment into the sub-rack. This is to ensure that there is no arcing between connections before the segment is fully engaged. Once the segment is slid into place, thumbscrews on the segment's front panel are provided to fasten the segment to the sub-rack and to provide additional ground connection. The key-lock switch may now be turned to the ON position to apply power to the segment. Once the key-lock switch is turned on, the segment will automatically set the gain and currents of the amplifier.

SYSTEM GROUNDING

For proper system operation, it is imperative that the system be adequately grounded. Each individual equipment rack requires grounding to the main building ground. When bolting ground wires to racks, sand finish to remove paint ensuring a good bond.

ENVIRONMENTAL AND SAFETY CONSIDERATIONS

Environmental Considerations

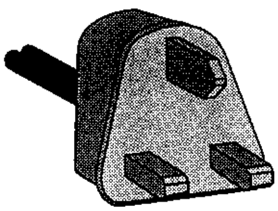
The equipment can be safely operated in ambient temperatures of -30 to +50 degrees Celsius (-22 to +122 degrees Fahrenheit). However, moderate temperatures generally extend equipment life. Although the equipment may be operated with relative humidity of up to 95%, the equipment must be protected from conditions that cause condensation within the equipment.

A rear door is used to force proper ventilation through the cabinet (600 cfm fans per transmitter are used). If failure of a fan occurs, replacement should be made as soon as possible. An air or temperature interlock should be incorporated for protection against interruption of ventilation. The area should be kept dry and clean.

There should be sufficient space in front of the transmitter cabinet for the serviceman and test equipment plus the full extension of the racked 27" deep chassis. A minimum of 36" behind the cabinet should be free for rear cabinet access and air movement. Also, ample room must be available at the cabinet rear for cable placement.

Safety Considerations

This equipment utilizes a grounding plug on all power cords. For personal safety, do not defeat this safety feature. As with all similar types of equipment, high voltage can be accessed when the driver chassis cover is removed. Special care should be given in areas of fuses, line switches, and power supplies.

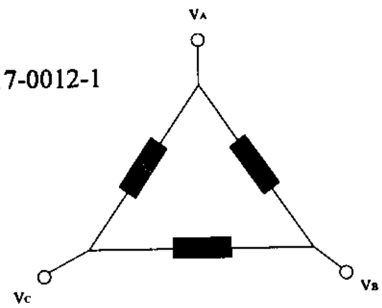


Modern high power solid state equipment contains low output voltage power supplies with very high current capability. To prevent severe burns, avoid contact of rings, watch bands, etc., with these circuits. When servicing the transmission line and antenna, care must be taken to avoid exposure to high-energy microwave.

AC LOADING IN AN HPB/SBM SYSTEM

The AC loading in a three-phase arrangement must be considered when configuring the transmitter/booster. Since each component will be distributed across two phases (i.e. AB AC & BC) of the DELTA connected system the load should be divided equally among the phases.

FIGURE 17-0012-1



The line current is calculated by: $I_L = 1.73 I_P$
I_L is the line current & I_P is the phase current

Power is calculated by: $P_{total} = 1.73(V_L I_L)(\cos\theta)$
$\cos\theta$ = power factor

Figure 17-0012-1 depicts a DELTA system. The DELTA system uses no neutral the voltage between any two phases (the line voltage) is equal to that of a single phase. The line current however, is 120° out of phase with the current in any of the phases.

Balancing the load is accomplished by following document #DOC24-0006, the AC loading chart, also refer to the AC interconnection diagrams included in section 3 of the manual. The outlet strip within the rack is configured as shown in figure 17-0012-2.

The system components can be plugged into the outlet in an arrangement which best distributes the load.

The N+1 redundant power supply is connected to the three-phase power in the same manner, refer to figure 17-0012-3.

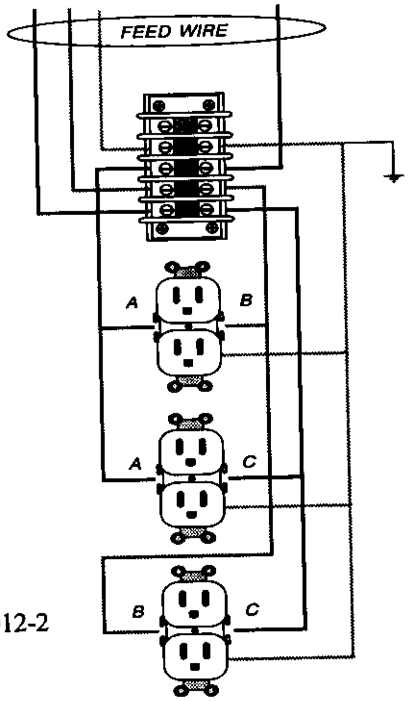


FIGURE 17-0012-2

MTS-3 POWER SHELF
HC POWER
AC DIAGRAM FOR 3-PHASE HOOK-UP

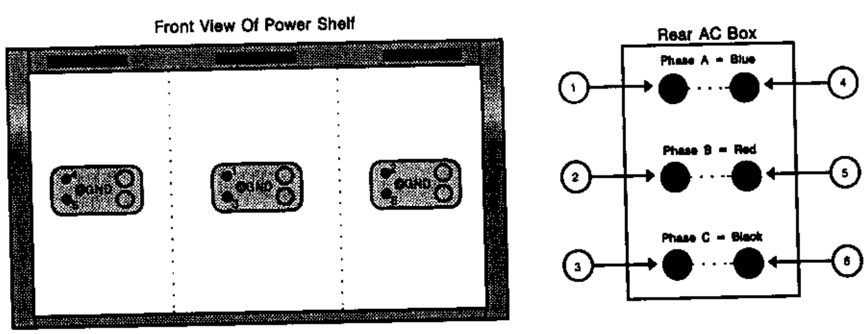


FIGURE 17-0012-3

Drawn By: Don Wike 03/16/98

In the case of the HPB/SBM-1000 all three power bays are occupied, phases between AB, AC, & BC are balanced. However, in cases where all three power supplies are not needed to provide redundancy one of the pairs is left unloaded. An example of this is the HPB/SBM-250, which requires only two power supply modules to power the final amplifier. In case of failure the single power segment will run the entire load. The empty bay of the power shelf is compensated by distributing the other system components to the phase pair which is unloaded by the N+1 power supply.

The fans are also strapped in accordance to load distribution, again consult the chart for proper connection. Figure 17-0012-4 gives a general overview of the AC system and the typical system components that are included.

AC DISTRIBUTION - 3 PHASE HOOK UP

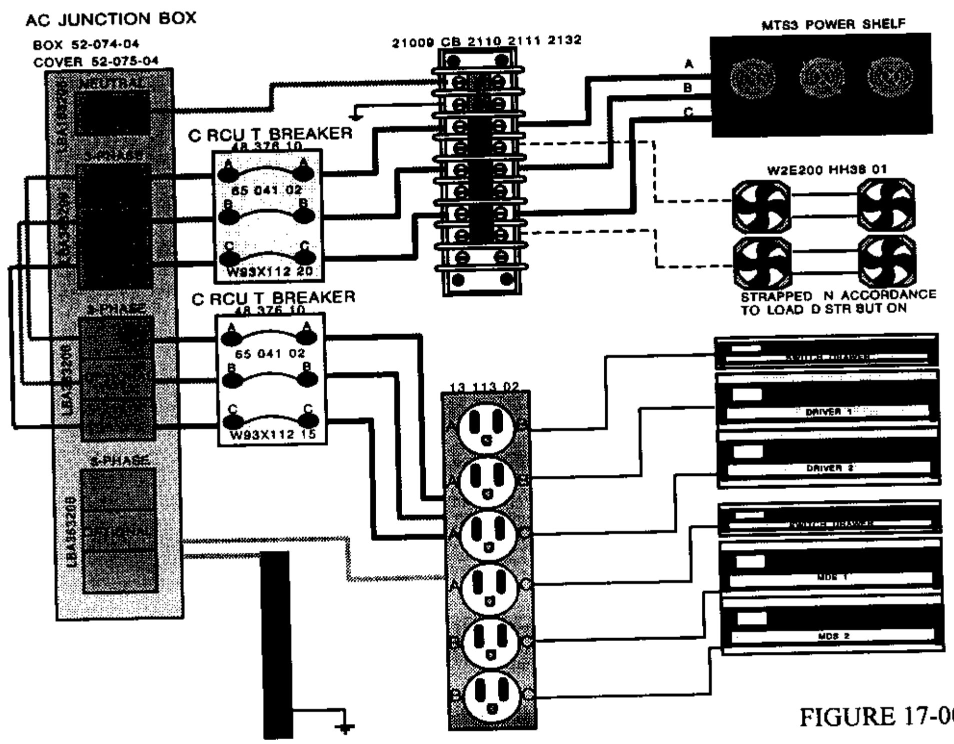


FIGURE 17-0012-4

In order to be flexible in system architecture the AC wiring is kept consistent; the load is then distributed via the use of the outlet strip and terminal block within the rack. In doing so the rack will support many variations in system components. The chart provided in this manual shows configuration for a few standard arrangements, if the configuration of your system is not shown consult the factory.

HPB/SBM THREE PHASE AC LOADING DELTA CONFIGURATION

SBM-250	A & B	A & C	B & C
Power supply	X	X	
VHF/UHF Block Upconverter #1 191VA			X
VHF/UHF Block Upconverter #2 191VA			X
IF to VHF Upconverter #1 169VA	X		
IF to VHF Upconverter #2 169VA		X	
Switch & Control Drawer 39VA	X		
(2) Fans			X
SBM-500	**A & B**	**A & C**	**B & C**
Power supply	X	X	
VHF/UHF Block Upconverter #1 191VA			X
VHF/UHF Block Upconverter #2 191VA			X
IF to VHF Upconverter #1 169VA	X		
IF to VHF Upconverter #2 169VA		X	
Switch & Control Drawer 39VA	X		
(2) Fans			X
SBM-1000	**A & B**	**A & C**	**B & C**
Power supply	X	X	X
VHF/UHF Block Upconverter #1 191VA	X		
VHF/UHF Block Upconverter #2 191VA		X	
IF to VHF Upconverter #1 169VA			X
IF to VHF Upconverter #2 169VA		X	
Switch & Control Drawer 39VA	X		
(4) Fans			X

Note: A, B, & C denote phase names see below: A=R=L1, B=S=L2, C=T=L3

Created by: Kimberly Simeone 10/30/98	Checked by: Donald Wike 10/30/98	Released by: Paulo Correa 10/30/98

CABLING OF THE SBM SERIES TRANSMITTER

DRIVER

Pull the driver out of the rack until the rack slides lock, to provide access to the rear panel of the driver chassis. Wrap-around labels are located on each cable to denote proper destination. See document # DOC23-0045 for assistance with cabling.

REFERENCE DISTRIBUTION

The reference drawer distributes a signal through the rack (refer to the system interconnect diagram, document # DOC15-0026, for more detail). The RG-59 coaxial cable enters the rack. The level should equal 15 dBm +5 dB/-10 dB at the input of each rack (point 2 on DOC15-0026). This level should be measured to determine if attenuation is needed. Place the appropriate size attenuator in-line with the frequency reference input to the rack.

IF DISTRIBUTION

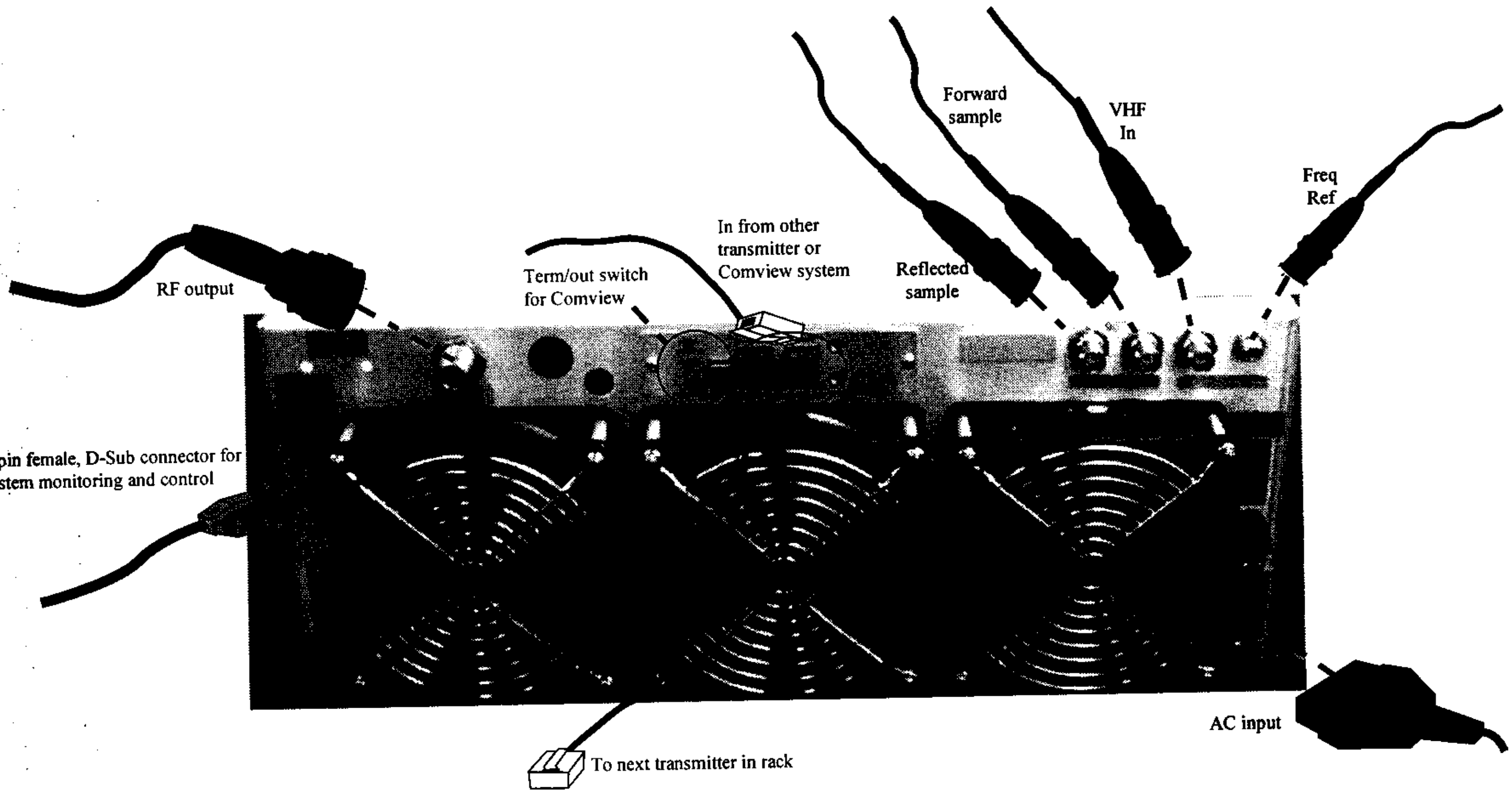
The modulators that provide the input signal are typically located in a separate rack. Cabling is accomplished by distributing the modulator outputs to each rack. (Refer to DOC15-0026 for more detail). The modulator levels should be set to equal -15 dB at the entrance of the rack.

NOTE: If splitters are used within the system, the modulator should be set to overcome the splitter's loss, i.e., 2 way splitter has 3 dB loss.

COMVIEW INTERCONNECTIONS

Comview interconnections are achieved through six-conductor phone cables with RJ-11 connectors at each end. The first cabling harness exits the PC and enters the Net Input on the RS-485 Board of the first transmitter (refer to the rear panel of the driver chassis, document # DOC23-0039, in section 4 of this manual, for input and output locations). Another harness is cabled from the Net Output of the first transmitter to the Net Input of the second transmitter. This daisy chain effect continues to the last transmitter in the rack. At the last transmitter in the rack the connection is terminated. If there are several systems to be cabled together, the harness would be cabled from the Net Output of the last transmitter in the rack to the Net Input of the first transmitter in the next rack. (refer to DOC15-0026 for cabling).

VHF/UHF BLOCK UPCONVERTER (DRIVER) CABLING



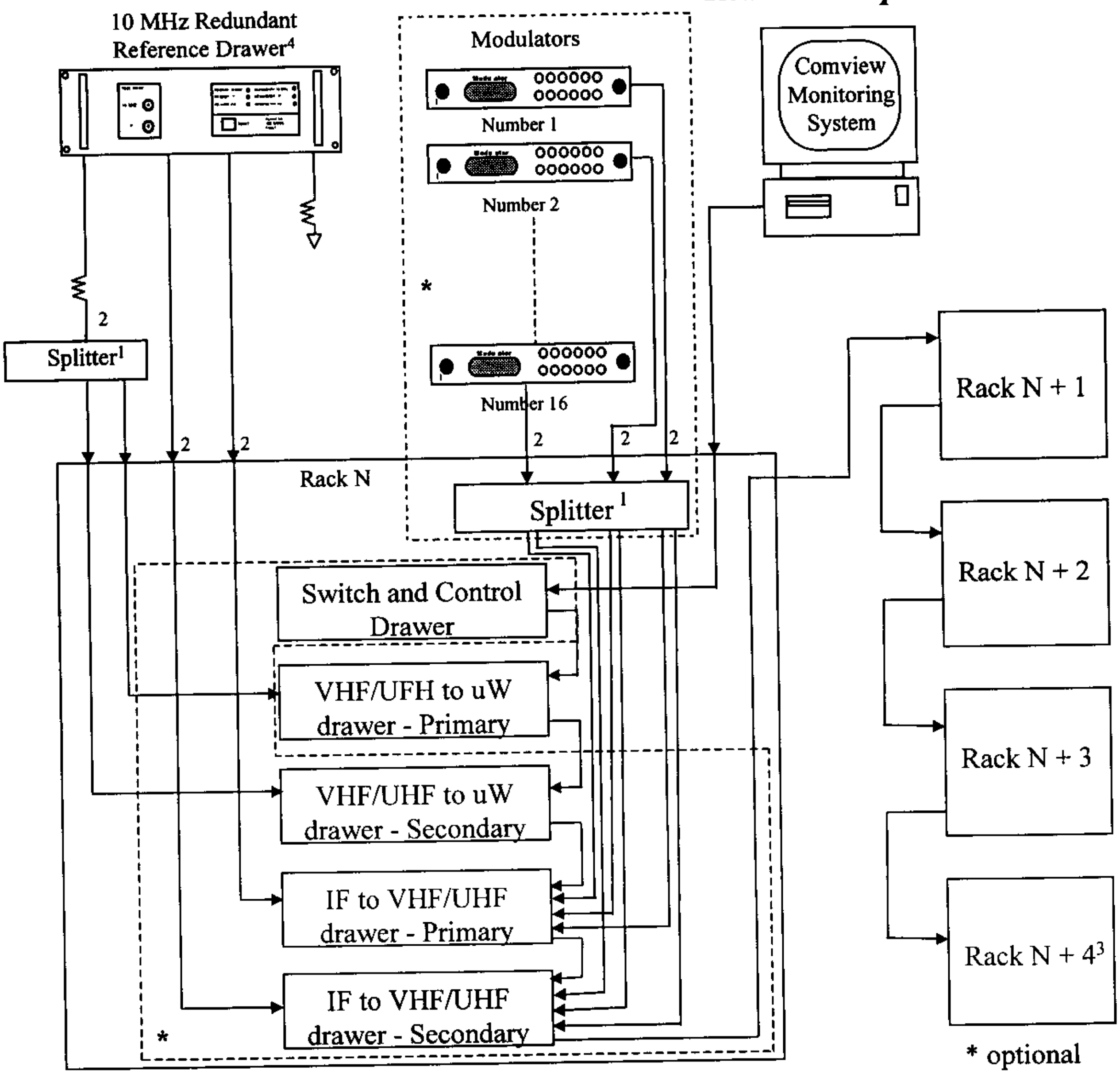
Created by: Kimberly Simeone 12/8/98 *ECO#: 98-164*	*Checked by: Kevin Harding 12/10/98*	*Released by: Donald Wike 12/10/98*

Document #: DOC23-0045

REV:B

SBM SYSTEM INTERCONNECTION

Redundant up to 16 Channels



1. *The type of splitter used is dependent upon the configuration of the transmitter.*
2. *A certain level must be obtained at this input (refer to cabling, Document # DOC18-0013, section 2 of this manual)*
3. *The network end termination switch located on the rear panel of the driver must be set to TERM on the last transmitter in the system (all other are set to OUT).*
4. *The cables and splitter for cabling the 10 MHz Redundant Reference Drawer are sold as option kit 99-006-02.*

Created by: Kimberly Simeone 12/21/98 ECO #: 98-164	Checked by: Donald Wike 12/21/98	Released by: Paulo Correa 12/21/98

TURN-ON PROCEDURE FOR THE HPB/SBM SERIES OF BOOSTERS/TRANSMITTERS

Prior to any initial equipment turn-on, verify that all appropriate wiring interconnections have been accomplished and the installation procedures have been followed precisely. Ensure proper AC power distribution to the exhaust fans and cabling of the driver chassis and the ultra low phase noise drawer (Agile applications only).

INITIAL OPERATION PROCEDURE

Driver Initial Operation

1. Position the front panel rotary function switch to "STANDBY."
2. Place the circuit breaker on the rear of the rack in the "ON" position.
3. The following GREEN LED's continuously illuminate verifying successful initial operation:
   - IN SIGNAL ***(Modulator operation is required if an input signal is applied)***
   - INTERLOCK ***(occurs in normal operation or by the signal distribution board video presence switch, SW1, in by-pass)***

Power Amplifier Segment Initial Operation

No initial operation procedure is needed for the power amplifier segments. Proceed to the normal operation procedures.

NORMAL OPERATION PROCEDURE

Driver Normal Operation

Rotating the function switch from "STANDBY" to any other position, besides "RESET", enables driver operation. Once the function switch is rotated, the following GREEN LED's continuously illuminate confirming normal operation:

- IN SIGNAL
- INTERLOCK
- TRANSMIT

Absence of a green LED indicates a missing signal or parameter. Continuous illumination of any red status LED indicates a failure has been detected by the diagnostic circuitry. Refer to section 3 of this manual for troubleshooting failures.

To verify other transmitter parameters using the front panel meter, rotate the function switch. +11 V^{PS}, AGC and FWD PWR should have meter readings of 100%. REFL

PWR is a function of combiners, the transmission line and antenna. Reflected power readings less than 10% are typical.

Power Amplifier Segment Normal Operation

Power Amplifier Segment operation is accomplished by turning the key-lock switch to the "ON/LOCKED" position. ***Note: The locks are an added safety feature; however, the keys are interchangeable.***

The POWER/FAULT LED should continuously illuminate GREEN. If the LED flashes RED, the power amplifier segment has faulted. After three faults, a failure will occur and the segment will shut down. Turning the key-lock switch to the "OFF/UNLOCKED" position and then back to the "ON/LOCKED" position will reset it. Should failure occur again, hot replacement is necessary. Turn the key-lock switch to the "OFF/UNLOCKED" position and pull the failed segment out of the rack by the handle. Slide a new power amplifier segment into the vacant space, set the correct node address, see document # DOC22-0019 in section 3, and turn the key-lock switch to the "ON/LOCKED" position. Refer to Document # DOC17-0007, in section 2 of this manual, for power amplifier segment installation if needed.

TROUBLESHOOTING OF THE SBM SERIES

DRIVER

The driver is equipped with comprehensive diagnostic circuitry that monitors the status of power amplifier modules and critical circuits so failures can be readily detected. Observing the front panel LED diagnostic display, analog panel meter and diagnostic interface will inform you of the complete operational status. This section explains various failure mode displays that may be encountered and possible solutions.

NOTE: Due to internal transmitter design, there are no user serviceable modules, parts, or components. Repair of these modules is not recommended or advised. Contact COMWAVE customer support should a failure occur.

The following LED's continuously illuminate GREEN during normal operation. Absence of a green LED indicates a missing signal or parameter that results in a controlled automatic shutdown.

IN SIGNAL ***(Missing IF input signal):***

CAUSES:

- Defective cabling to modulator baseband IF INPUT
- Defective modulator
- Missing IF source signal

REMEDY:

- Check Cabling
- Verify IF source signal
- Replace modulator
- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

INTERLOCK ***(Missing system Interlock signal):***

CAUSES:

- RF module unplugged or shorted
- Defective module

REMEDY:

- Check driver for disconnected module(s)
- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

TRANSMIT ***(No transmit):***

CAUSES:

- Missing IN SIGNAL
- Missing INTERLOCK signal
- Defective/disconnected harness
- See other diagnostic LED's

REMEDY:

- Check cabling
- Check harness between modulator and transmitter
- Troubleshoot per highlighted LED's
- Measure voltages at 25 pin diagnostic Interface J2
- Contact Comwave customer support

The following LED's continuously illuminate RED when a failure is detected. Controlled automatic transmitter shut down is a function of the failure and severity. Presence of a RED status LED with normal meter readings and/or normal transmitter operation indicates an out of tolerance condition with that circuit.

LO LEVEL ***(Local Oscillator failure):***

CAUSES:

- Oscillator failure
- 10 MHz reference missing or low level
- Defective module

REMEDY:

- Check external cabling
- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

LO AGC ***(LO AGC failure):***

CAUSES:

- Local oscillator failure
- 10 MHz reference missing or low level
- Defective module

REMEDY:

- Check external cabling
- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

IPA 1 ***(Defective internal power amp 1):***

CAUSES:
- Internal power amplifier 1 current
- Power supply failure
- Defective module

REMEDY:
- Measure voltages at 25 pin diagnostic interface, J2
- Contact Comwave customer support

IPA 2 ***(Defective internal power amp 2):***

CAUSES:
- Internal power amplifier 2 current
- Power supply failure
- Defective module

REMEDY:
- Measure voltages at 25 pin diagnostic interface, J2
- Contact Comwave customer support

TEMPERATURE ***(Internal chassis temperature exceeded +140° Fahrenheit (+60° Celsius.):***

CAUSES:
- Fans inoperative
- Heavy accumulation of debris on fans or heatsinks
- Module(s) overheating
- Site air conditioning

REMEDY:
- Check fan operation
- Check site air conditioning
- Allow transmitter to cool, check latched failure logic by rotating function switch momentarily to "STANDBY"
- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

R.F. POWER: ***(Meter does not indicate 100% R.F. power):***

CAUSES:

- Driver Module
- Final Module(s)
- Switching Power Supply
- Forward metering out of adjustment

REMEDY:

- Confirm input/output power
- Troubleshoot per front panel LED diagnostic display
- Check for defective module
- Calibrate forward power and AGC metering per document # DOC16-0005, in section 3 of this manual
- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

POWER SUPPLY ***(Voltage has deviated beyond a set operating window {high or low}):***

CAUSES:

- Defective main input line fuse
- Open switching power supply fuse, F1
- Shorted amplifier module
- Open motherboard fuse, F1
- Defective module

REMEDY:

- Check switching power
- supply output voltage
- Check for defective fuses(s)
- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

FINAL ***(Power Amplifier) (Defective final module):***

CAUSES:

- Final module current
- Power supply failure
- Defective module

REMEDY:

- Measure voltages at 25-pin diagnostic interface, J2
- Contact Comwave customer support

To assist in troubleshooting, Comwave products employ a 25-pin computer type diagnostic interface connector, labeled J2, located on the rear of the chassis. Critical power supply, module and motherboard voltage test points can be accessed/monitored at this location. Should a failure occur, the combination of meter readings, diagnostic LED status lights, and the diagnostic interface voltage test points help identify the failure.

ANALOG METERING

The front panel analog meter provides a visual indication of the +11 V switching power supply, AGC, reflected or forward power. The +11 V switching power supply and forward power should indicate 100%. Reflected power meter readings less than 10% are typical. By observing the meter readings, transmitter performance can be interpreted. Analog meter readings in conjunction with the front panel diagnostic status LED's help to identify/isolate failures. The following information will assist in troubleshooting analog meter anomalies.

+11 V_{PS} ***(Meter does not indicate 100%):***

CAUSES:

- Defective switching power supply
- Shorted module
- Open switching power supply fuse F2
- Open main AC input fuse
- Switching power supply out of adjustment
- Metering out of adjustment

REMEDY:

- Replace defective fuse(s)
- Check switching power supply output voltage
- Troubleshoot per front panel LED diagnostic display
- Adjust switching power supply output voltage per document # DOC16-0005, in section 3 of this manual
- Calibrate meter per document # DOC16-0005, in section 3 of this manual
- Measure voltages at 25 pin diagnostic interface J2
- Contact Comwave customer support

AGC ***(Meter does not indicate 100%):***

CAUSES:

- Exceeding ALC input limits
- Defective module

REMEDY:

- Correct input level
- Check cable
- Calibrate per document # DOC16-0005, in section 3 of this manual
- Contact Comwave customer support

REFL PWR ***(Reflected power is greater than 10%):***

CAUSES:

- Loose RF cable connection(s)
- RF cable kinked
- Wave guide leak/depressurized
- Reflected metering out of adjustment
- Defective module

REMEDY:

- Check integrity of all RF cable connections
- Check cabling for kinks or severe bends
- Check wave guide pressure
- Calibrate reflected metering per document # DOC 16-0005, in section 3 of this manual
- Measure voltages at 25 pin diagnostic interface J2
- Contact Comwave customer support

FWD PWR ***(Meter does not indicate 100%):***

CAUSES:

- Driver module
- Final module(s)
- Switching power supply
- Visual metering out of adjustment

REMEDY:

- Confirm output power
- Troubleshoot per front panel LED diagnostic display
- Replace defective module
- Calibrate fwd power metering per document # DOC16-0005 in section 3 of this manual
- Measure voltages at 25 pin diagnostic interface J2
- Contact Comwave customer support

POWER AMPLIFIER SEGMENT
Hot replacement of the power amplifier segment may be required if a failure occurs. To remove a segment, turn the key-lock switch to the OFF position, loosen the thumbscrews on the segment's front panel and slide the failed segment out of the sub-rack. Before the replacement segment can be installed, the node address must be set. A set of DIP switches is accessible through the cover of each segment directly behind the key-lock switch. Set the DIP switches of the replacement segment to the same positions as the failed segment's DIP switches. Install the replacement segment as described in document # DOC17-0007 in section 2 of this manual.

TROUBLESHOOTING WORKSHEET

This troubleshooting worksheet identifies each interface pin, the associated internal test point, nominal value, and the expected voltage range. Please fill in all blank spaces completely.

[illegible] Rear Panel Diagnostic Pin	Function Checked	Low Limit "V_{DC}"	Nominal Voltage "V_{DC}"	High Limit "V_{DC}"	Measured Voltage
1	Ground	0.00	0.00	0.00	
2	+12 V_{DC} PS	+11.75	+12.00	+12.25	
3	-12 V_{DC} PS	-11.80	-12.00	-12.20	
4	+11 V_{DC} PS	+10.70	+10.80	+10.90	
5	+5 V_{DC} PS	+4.80	+5.00	+5.20	
6	N/A	N/A	N/A	N/A	
7	N/A	N/A	N/A	N/A	
8	IPA1	-	3.00-4.00	-	
9	IPA2	-	3.00-4.00	-	
10	N/A	N/A	N/A	N/A	
11	N/A	N/A	N/A	N/A	
12	N/A	N/A	N/A	N/A	
13	Final	-	1.29-1.58	-	
14	N/A	N/A	N/A	N/A	
15	N/A	N/A	N/A	N/A	
16	N/A	N/A	N/A	N/A	
17	N/A	N/A	N/A	N/A	
18	N/A	N/A	N/A	N/A	
19	Remote Turnoff	<0.40	>4.00	5.10	
20	In-Signal (IF Detect)	-	5.00	-	
21	LO Level	-	>0.70	-	
22	Remote Fault	0.00	0.00	5.10	
23	FWD Power	1.00	1.35-1.45	-	
24	AGC	N/A	1.35-1.45	-	
25	REFL Power	0.00	0.10	0.30	

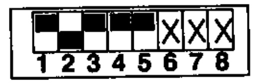
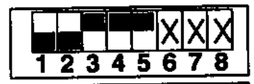
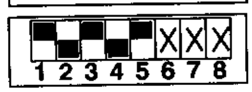
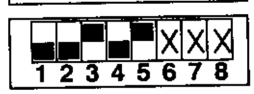
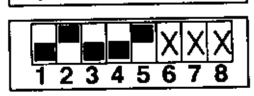
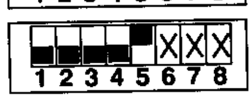
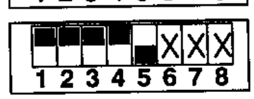
Company Name: ____________________ **Customer's Name:** ____________________
Phone #: ____________________ **Fax #:** ____________________
Model: ________________ **Channel:** _______ **Serial #** ***(Rear Panel)*****:** ________________

Send Results to:
COMWAVE- Attention Technical Support
PO Box 69, 395 Oakhill Road, Mountaintop, PA 18707 USA
Toll Free (USA & Canada only): 1-800-266-9283
Domestic and International 1-570-474-6751
Fax #: 1-570-474-5469

Created by: Kimberly Simeone 12/10/98 ECO #: 98-164	*Checked by: Donald Wike 12/21/98*	*Released by: Paulo Correa 12/21/98*

NODE ADDRESSES

1 to 16 Channels

MODULE POSITION	*NODE ADDRESS*	*NODE SWITCH SETTING*
1	2	
2	3	
3	4	
4	5	
5	6	
6	7	
7	8	
8	9	
9	10	
10	11	
11	12	
12	13	
13	14	
14	15	
15	16	
16	17	

NOTE: Do not change node switch Settings 6, 7, and 8. They should remain as set by the factory.

Created by: Kimberly Simeone 9/16/98 ECO #: 98-116	*Checked by: Donald Wike 10/20/98*	*Released by: Paulo Correa 10/20/98*

EQUIPMENT FUSING AND PROTECTION

DRIVER FUSING
The Driver Chassis is equipped with six replaceable fuses. The locations and values of each fuse are as follows:

Location	Fuse	Value
Motherboard	F1	4 Amperes
Motherboard	F2	25 Amperes
Motherboard	F3	25 Amperes
Motherboard	F4	4 Amperes
Rear Panel	Input	12 Amperes @ 117 VAC 7 Amperes @ 230 VAC (slow blow)
Power Supply	F1	15 Amperes @ 117 VAC 8 Amperes @ 230 VAC

FIGURE 18-0015-1

The AC line input is supplied with voltage suppressers to protect the equipment from moderate power surges. Thermal protection is accomplished using a thermostat that closes when internal temperature exceeds +140 degrees Fahrenheit (+60 degrees Celsius). When thermal shut down occurs, logic control removes power from the finals until the unit is sufficiently cooled.

Interlocks are designed for transistor bias protection for both the FET gate and drain power supply voltages.

Three-phase: 20 Amp
Phase-to-phase: 30 Amp

Three-phase: 15 Amp
Phase-to-phase: 20 Amp

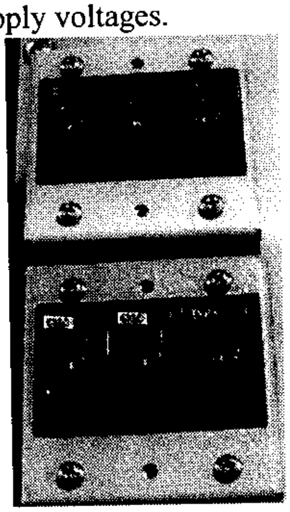


FIGURE 18-0015-2

CIRCUIT BREAKER
A three-phase 15 and 20-Ampere circuit breaker, figure 18-0015-02, is provided with each transmitter for system protection. They are located on the rear of the rack above the fans. When the lesser Ampere circuit breaker trips the driver, switch and control drawer, and IF to VHF drawer will shut down. When the larger Ampere circuit breaker trips the AC to DC front-end converter and the power amplifier segments will shut down. In a phase-to-phase system the circuit breakers are 20-Ampere and 30-Ampere and when they are tripped it produces the same results. If either circuit trips the transmitter will be inoperable. A plastic cover is provided to protect the circuit breaker from accidental shut down (not shown in figure 18-0015-02).

**NOTE: THIS IS A PHOTO OF A THREE-PHASE SYSTEM IN A PHASE-TO-PHASE SYSTEM THERE WILL ONLY BE 2 SWITCHES ON EACH BREAKER.*

Created by: Kimberly Simeone 9/30/98	Checked by: [signature] 10/20/98	Released by: [signature] 10/20/98

AC POWER INTERCONNECTIONS

The AC power interconnections, see figure 13-0029-1, include an AC power distribution box, 15-Ampere/30-Ampere circuit breaker, terminal strip, AC to DC front end converter, drawers and fans. The AC power interconnections provide phase-to-phase 208 V_{AC} and/or three-phase 208 V_{AC}* to each part of the transmitter or to each transmitter in the rack. Figure 13-0029-1 shows an example of an agile transmitter.

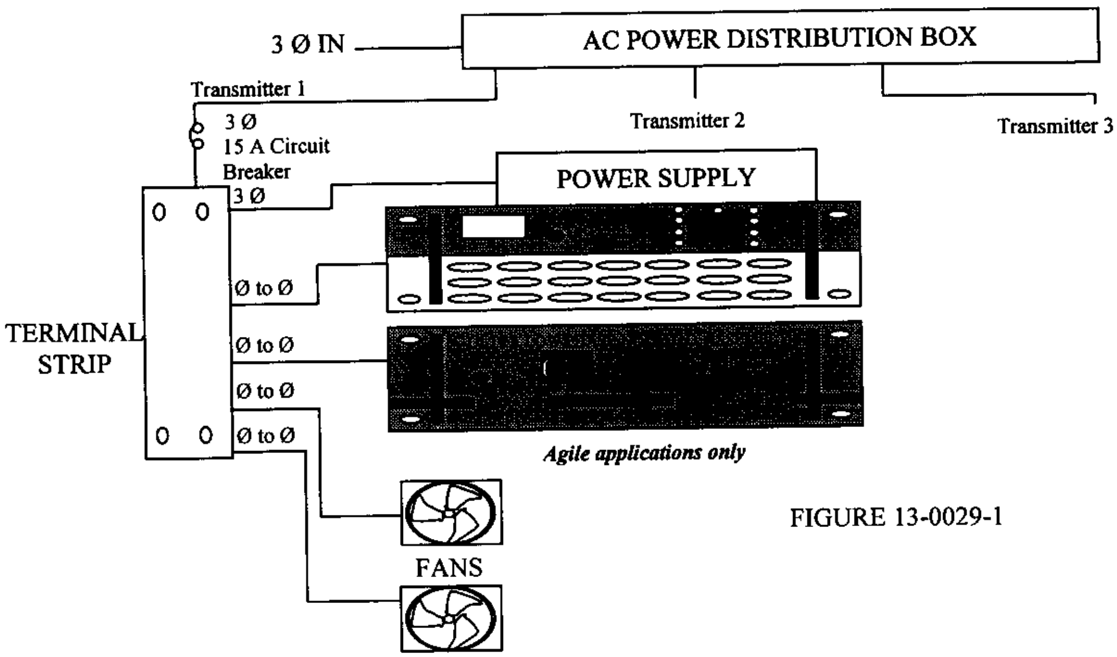
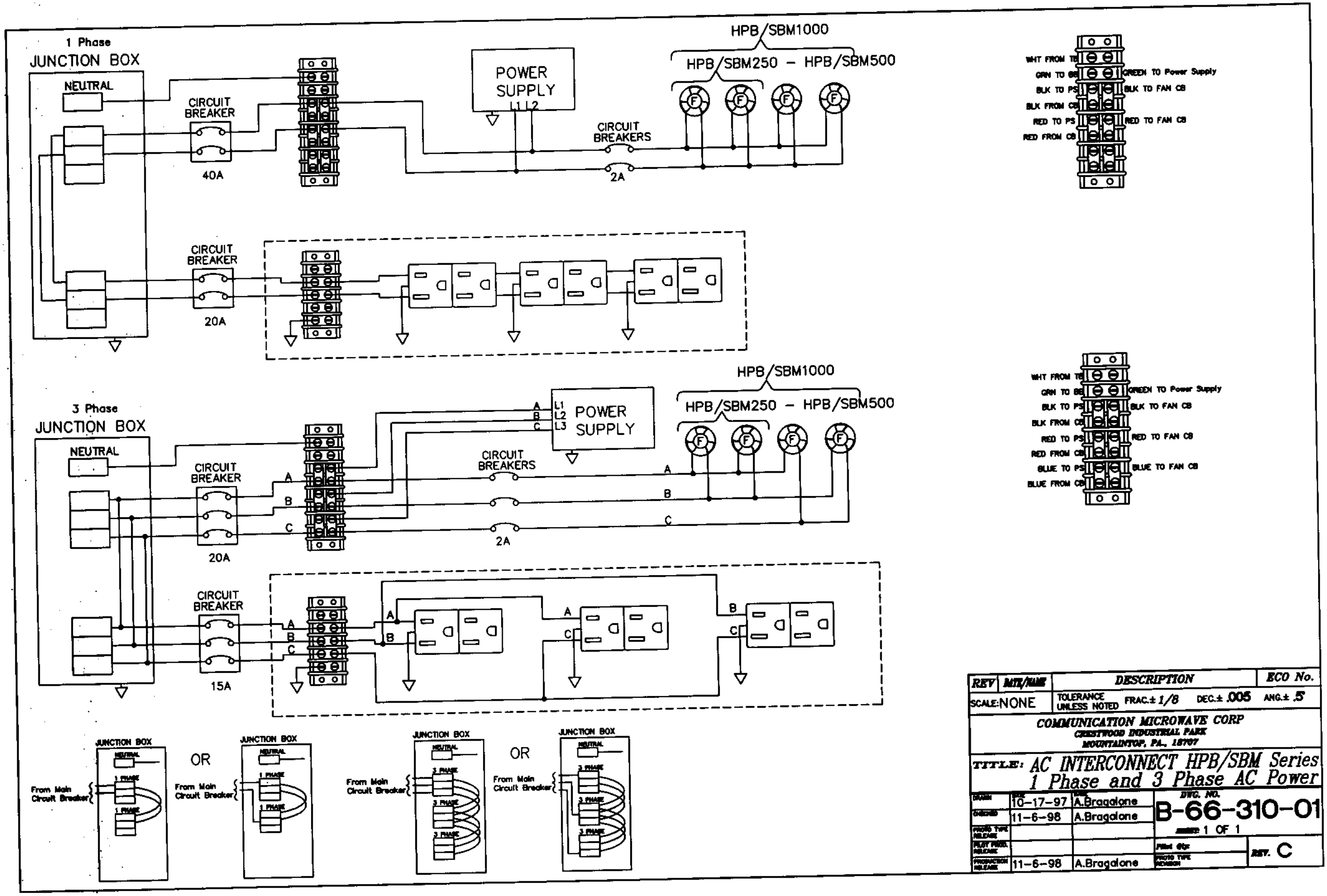


FIGURE 13-0029-1

The AC power is connected to the rack through the AC power distribution box, which is located on the top of the rack. The AC power distribution box distributes the AC power via two or three 350 Ampere, 600 V_{AC}, three pole terminal blocks. The number of terminal blocks depends upon the number of transmitters in each rack. Each transmitter has its own circuit breaker. The circuit breaker is connected to the AC power distribution box via 6 AWG, 3000 Volt, and stranded-tinned-copper wire with polyvinylchloride insulation. The circuit breaker is located on the rear of the rack, a brief description of it can be found on the equipment fusing and protection document located in section 3 of this manual, a plastic cover protects the breaker to prevent accidental shut down of the transmitter

The terminal strip is connected to the circuit breaker via 12 AWG polyolefin-insulated wire, rated at 600 Volts with a breakdown voltage of 6000 Volts. The terminal strip is constructed of phenolic-insulated material with a breakdown voltage of 9000 Volts. The zinc-plated steel terminals are rated at 30-Amperes of current. The terminal strip distributes the three phase power or phase-to-phase power to the AC to DC front end converter and phase-to- phase 208 V_{AC} to the remaining equipment. All the low power and support equipment require phase-to-phase 208 V_{AC}, which is delivered by a 14 AWG-three conductor line cord. The terminal strip also supplies phase-to-phase power to the 208 V_{AC}, 80-Watt, 600-CFM fans, which are mounted on the rear door of the rack. The number of fans per transmitter is dependent upon the transmitter model. The fan power harness is constructed of eight 14 AWG wires. Two wires are required for each fan; the unused wires are fastened in place and terminated to allow for future upgrades.

Other power options available upon request.


1 Phase
JUNCTION BOX
NEUTRAL
CIRCUIT BREAKER
40A
20A
POWER SUPPLY
L1 L2
CIRCUIT BREAKERS
2A
HPB/SBM1000
HPB/SBM250 - HPB/SBM500
WHT FROM TB
GRN TO BB
BLK TO PS
BLK FROM CB
RED TO PS
RED FROM CB
GREEN TO Power Supply
BLK TO FAN CB
RED TO FAN CB
3 Phase
JUNCTION BOX
NEUTRAL
CIRCUIT BREAKER
20A
15A
A
B
C
L1
L2
L3
POWER SUPPLY
CIRCUIT BREAKERS
2A
BLUE TO PS
BLUE FROM CB
BLUE TO FAN CB
JUNCTION BOX
NEUTRAL
1 PHASE
3 PHASE
From Main Circuit Breaker
OR
REV
MTE/NAME
DESCRIPTION
ECO No.
SCALE:NONE
TOLERANCE UNLESS NOTED
FRAC.± 1/8
DEC.± .005
ANG.± .5
COMMUNICATION MICROWAVE CORP
CRESTWOOD INDUSTRIAL PARK
MOUNTAINTOP, PA., 18707
TITLE: AC INTERCONNECT HPB/SBM Series
1 Phase and 3 Phase AC Power
10-17-97
A.Bragalone
11-6-98
A.Bragalone
11-6-98
A.Bragalone
DWG. NO.
B-66-310-01
1 OF 1
REV. C

DC POWER INTERCONNECTIONS

The DC power interconnection, figure 13-0030-1, for each transmitter includes an AC to DC front end converter (power supply), a DC power harness, a DC to DC converter, and a motherboard.

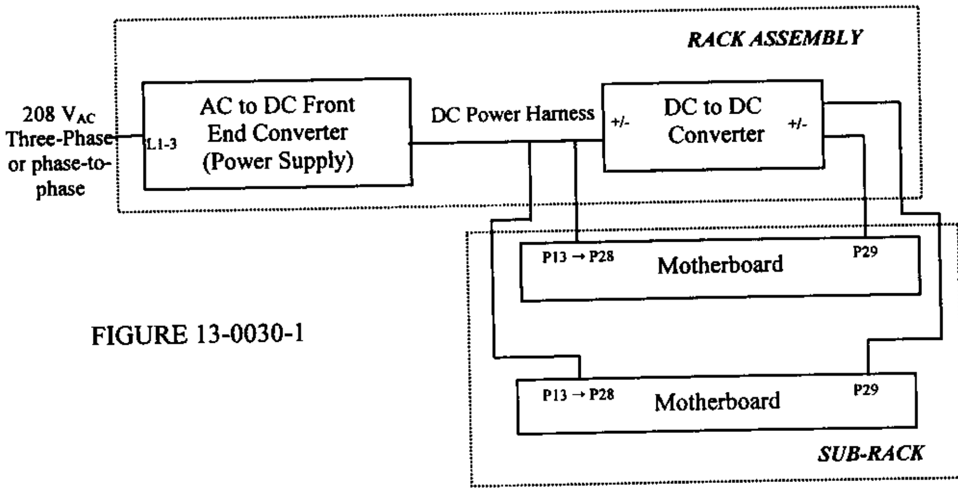
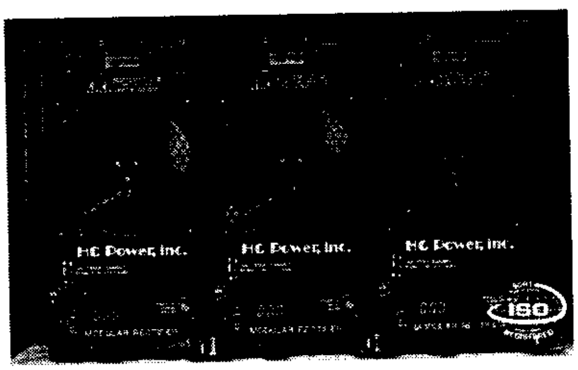


FIGURE 13-0030-1



REDUNDANT

FIGURE 13-0030-2

The power supply for the rack, figure 13-0030-2, consists of two 24-volt modules for the HPB/SBM-250 and HPB/SBM-500, and three for the HPB/SBM-1000 booster/transmitter, in a rectifier shelf designed to minimize installation and maintenance time. Hotswap insertion technology (hot replacement) allows easy system power upgrades. The power supply is equipped with logic and visual status indications, automatic load sharing and complete front access.

Front panel features include PWR IN and DC OK LED indicators, output voltage and current limit adjustments, voltage and current monitor test points, and digital display indication of current or voltage output of the power supply.

The modules are housed in a three bay rectifier shelf to provide easy-guide module insertion and extraction. Forced air cools the power supply by drawing ambient air through the intake on the front of the power supply and exhausting out the rear of the shelf.

Protection is provided against overvoltage, overcurrent, and overtemperature. The power supply will shut off if the voltage exceeds the nominal voltage by 20%. The AC input or the remote on/off must be recycled to restart the rectifier. The power supply will also shut down if the internal temperature reaches an unsafe level. Restart is automatic when the power supply returns to normal operating range.

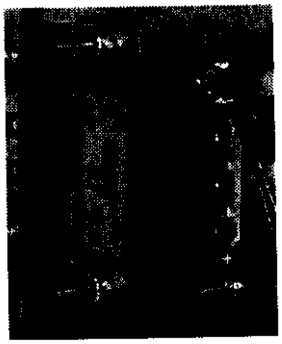


FIGURE 13-0030-3

The DC power harness provides a path for 48 V_{DC} to the motherboard and the DC to DC converter. The DC power harness consists of standard tinned 14 AWG copper conductors with .032 thick polyolefin insulation rated at 600 volts.

The DC to DC converter, figure 13-0030-3, is a 75-Watt, 15 Amp, 48 V_{DC} to 10 V_{DC}, single output converter. It supplies 10 V_{DC} to the power amplifier segments through the motherboard on the sub-rack. In systems where there are more than eight power amplifier segments in the sub-rack two DC to DC converters are supplied, one for each motherboard.

The motherboard, figure 13-0030-4, supplies 10 V_{DC} and 48 V_{DC} to the power amplifier segments through connections located on eight 14-pin connectors. Control and diagnostic signals are also routed through the motherboard to the microcontroller board within each segment.

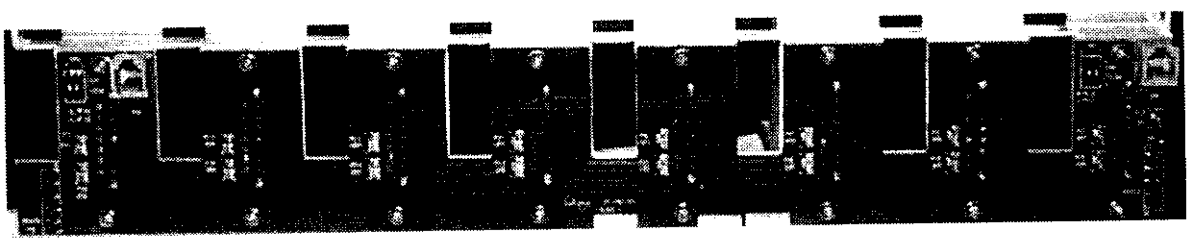
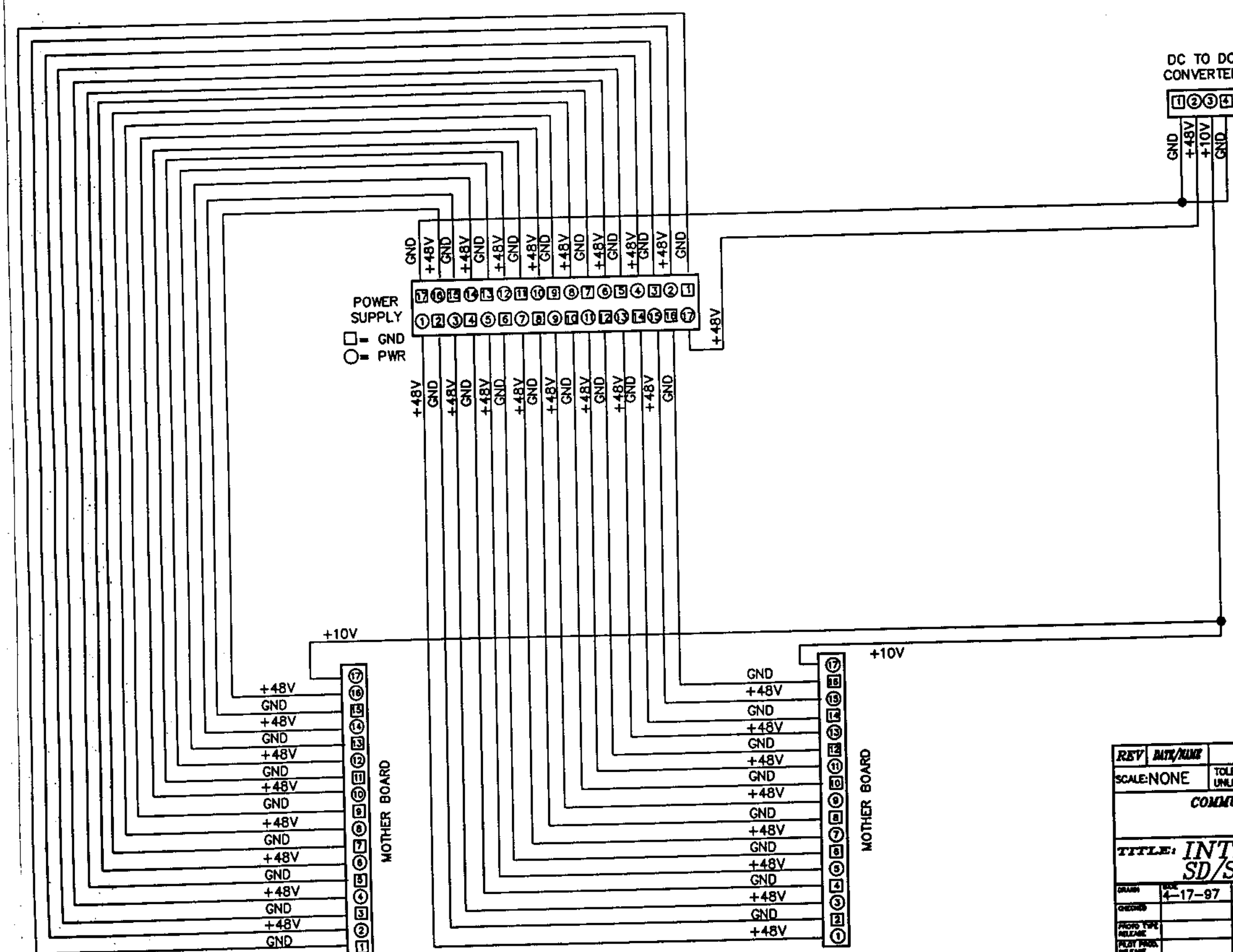


FIGURE 13-0030-4

Note:
1. ***Each amplifier module receives 48 V_{DC} at 5 Amps.***
2. ***Each amplifier module receives 10 V_{DC} at .35 Amps.***



REV	DATE/NAME	DESCRIPTION	ECO No.
SCALE: NONE	TOLERANCE UNLESS NOTED	FRAC.± – DEC.± –	ANG.± –

COMMUNICATION MICROWAVE CORP
CRESTWOOD INDUSTRIAL PARK
MOUNTAINTOP, PA., 18707

TITLE: INTERCONNECT, DC SD/SDA SERIES (HIGH POWER)

DRAWN	DATE 4-17-97	C.SPARKES	DWG. NO. B-66-304-01
CHECKED			SHEET 1 OF 1
PROTO TYPE RELEASE			
PILOT PROD. RELEASE			Final Qty. / REV.
PRODUCTION RELEASE			PROTO TYPE REVISION

RF POWER INTERCONNECTIONS

The input signals interface directly to the IF to VHF/UHF drawer or to a splitter, where they are divided between redundant IF to VHF/UHF drawers. The VHF/UHF signal is heterodyned to RF and amplified in the driver chassis. The 10 MHz reference signal enters the rack, cabling varies depending how the system is racked. These signals are connected to the IF to VHF/UHF drawers through a splitter, and the VHF/UHF to microwave drawers using male F and BNC bulkhead connectors. In a non-redundant system the IF to VHF/UHF drawers cable directly to a single VHF/UHF to microwave drawer using male F and BNC bulkhead connectors.

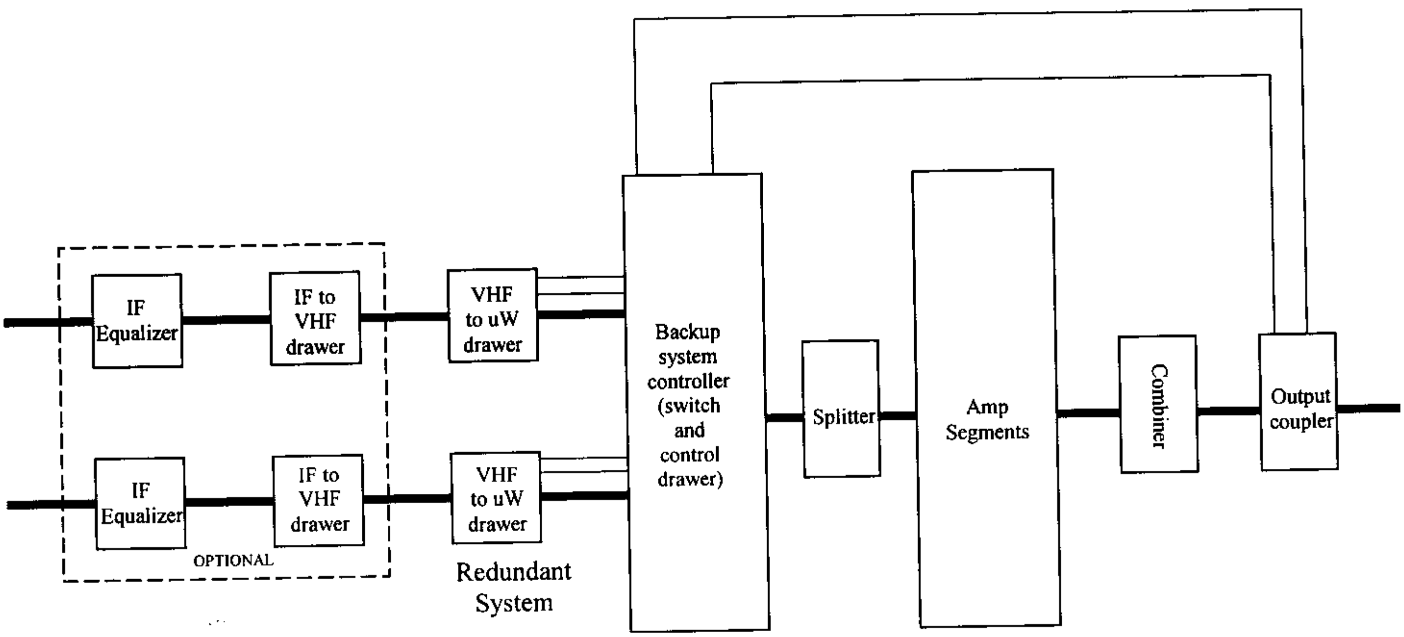


FIGURE 13-0054-1

The RF signal exits the driver chassis via an N-type connector on the rear panel. In a redundant system the output of the driver is connected to a switch and control drawer. In a non-redundant system it is connected directly to the amplifier cage. The number of splitter outputs is dependent upon the output power of the transmitter. The output of the splitter is connected to the power amplifier using an SMA to OSP floating bulkhead cable.

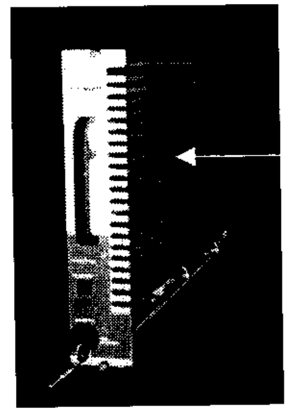
Each power amplifier segment increases the RF signal by 29.5 dB. The number of power amplifier segments in each transmitter is dependent upon the output power required by the transmitter. Connected to the output of each power amplifier segment, is an OSP floating bulkhead to SMA cable, which is connected to the combining network.

The combining network is a proprietary circuit that allows for hot replacement without serious degradation in power or performance. Connected to the combining network is a directional coupler, which samples the forward power and reflected power. The forward and reflected power samples are connected to the RF detector located in the switch and control drawer. The output connector of the directional coupler fits through a hole in the rear door to allow the N connector super-flex cable to be connected.

MAINTENANCE

COMWAVE products have been carefully designed to be maintenance free. Only periodic inspection and cleaning is necessary.

INSPECTIONS



Heatsink

FIGURE 18-0005-1

1. Periodically inspect cooling fans on the rear door of the rack and the heatsinks of the Power Amplifier Segments for heavy accumulations of dirt and/or insects. Heavy accumulation of foreign debris impedes cooling effectiveness and could lead to premature failure. Should any debris be detected, shut down the transmitter and follow the cleaning instructions to remove debris from transmitter. ***NOTE: The Agile Transmitter will automatically recover the channel of the transmitter, which is being cleaned.***

2. Record analog meter readings of each transmitter on a monthly basis. This establishes a performance historical database. These entries can identify degraded performance before it becomes a hard failure.

3. After performing routine maintenance, be sure to check the tightness of all cable connections and especially the integrity of crimp type connectors.

CLEANING

Clean faceplate and outside cover using a damp non-abrasive cloth with a mixture of a mild detergent and water.

MONTHLY MAINTENANCE RECORD

Date	Channel	Analog Metering				Failure LED's	Comments
		FWD	REF	+11VPS	AGC		

Created by: Kimberly Simeone 9/29/98	Checked by: [illegible] 10/08/98	Released by: Paulo Correia 10/12/98.

METERING CALIBRATION

COMWAVE service technicians prior to shipping complete calibration of the system; however, re-calibration of the driver may become necessary when the input or output power levels are changed. Due to the equal gain of the power amplifiers, re-calibration of the segments is not necessary.

STOP

WARNING

STOP

NOTE: This procedure is applicable for only making MINOR adjustments to output power and analog metering. Do NOT adjust power more than ±.5 dB. Adjustments more than ±.5 dB may result in increased intermodulation distortion products. For larger adjustments to output power re-calibration of the IF Precorrector is necessary. Contact Comwave customer service for further assistance, see Document # DOC20-0001 for contact information.

For proper calibration, adjustments are performed in a specific sequence. Before beginning, place the Driver into "STANDBY.

REFER TO DOCUMENT # DOC23-0042 FOR NUMBER REFERENCES.

DIGITAL METERING

DIGITAL INPUT AGC CALIBRATION

- Break the circuit[3] between the –10dB coupler and the precorrector and connect an HP435B power meter, or equivalent, to the coupler output.
- Apply a digital VHF/UHF input signal, having –18 dBm ± 3 dB minimum per carrier at the driver input[1].
- Turn the switch[2] on the VHF/UHF AGC module to "MANUAL".
- Set, with the manual control potentiometer[4] on the VHF/UHF module, to a reading of 0 dBm at the power meter.
- Rotate the function switch on the front panel to AGC.
- Set AGC metering control[5] to read 100% on the front panel meter.
- Turn the switch[2] on the AGC module from "MANUAL" to "AUTO" and set the auto control potentiometer[6] to read 100% on the front panel meter.
- Disconnect the power meter and reconnect the cable[3] between the –10 dB coupler and the precorrector.

DIGITAL FWD POWER (OUTPUT ALC CALIBRATION)

- Apply microwave digital signal, having 0 dBm total power to the precorrector input (J1)[3], be sure to turn the switch[7] on the precorrector to the on position.
- Connect an external coupler to the system output, see document # DOC22-0018, and a power meter to its forward power port. Make sure power meter is set to a scale proper to read the expected levels.

Created by: Kimberly Simeone 1/7/99 ECO #: 99-004	*Checked by: Paulo Correa 1/7/99*	*Released by: Donald Wike 1/7/99*

- Turn the switch(8) on the precorrector to "MANUAL".
- Adjust, by means of a manual control potentiometer(9), the output power of the system to be the power required, see figure 16-0005-1 below.
- Place front panel switch to forward power position and adjust the metering control(10) to set the reading to 100%.
- Turn the precorrector switch(8) back to "AUTO" and adjust the auto control potentiometer(11) to set the front panel reading back to 100%.

ANALOG METERING

NOTE: Analog Power output is dependent upon Modulation Depth. Obtain proper Modulation Depth prior to setting Output Power levels. Use a video generator capable of Black No Burst (O IRE = 2.2 dB correction factor) or Black Burst with setup (2.6 dB correction factor) for proper power level adjustments.

Example:

Transmitter Output @ 100 Watts	=	+50.00 dBm
-30 dB Coupler	=	-30.00 dB
Correction Factor (black burst)	=	- 2.60 dB
Expected Power Meter Reading	=	+17.40 dBm

ANALOG INPUT AGC CALIBRATION

- Break the circuit(3) between the –10dB coupler and the precorrector and connect an HP435B power meter, or equivalent, to the coupler output.
- Apply a analog VHF/UHF input signal, having –18 dBm ± 3 dB minimum per carrier at the driver input(1).
- Turn the switch(2) on the VHF/UHF AGC module to "MANUAL".
- Set, with the manual control potentiometer(4) on the VHF/UHF module, to a reading of 0 dBm at the power meter.
- Rotate the function switch on the front panel to AGC.
- Set AGC metering control(5) to read 100% on the front panel meter.
- Turn the switch(2) on the AGC module from "MANUAL" to "AUTO" and set the auto control potentiometer(6) to read 100% on the front panel meter.
- Disconnect the power meter and reconnect the cable(3) between the –10 dB coupler and the precorrector.

ANALOG FWD POWER (OUTPUT ALC CALIBRATION)

- Apply microwave analog signal, having 0 dBm total power to the precorrector input (J1)(3), be sure to turn the switch(7) on the precorrector to the on position.
- Connect an external coupler to the system output, see document # DOC22-0018, and a power meter to its forward power port. Make sure power meter is set to a scale proper to read the expected levels.
- Turn the switch(8) on the precorrector to "MANUAL".
- Adjust, by means of a manual control potentiometer(9), the output power of the system to be the power required, see figure 16-0005-1 below.
- Place front panel switch to forward power position and adjust the metering control(10) to set the reading to 100%.
- Turn the precorrector switch(8) back to "AUTO" and adjust the auto control potentiometer(11) to set the front panel reading back to 100%.

Calculate power meter reading necessary for 100% output, accounting for the coupler loss and correction factor.

POWER SPECIFICATION CHART – dBm PER CHANNEL					
	CH 1-2	*CH 3-4*	*CH 5-8*	*CH 9-16*	*CH 17-31*
SBM-250	40.0	35.0	31.0	27.5	24.0
SBM-500	43.0	38.0	34.0	30.5	27.0
SBM-1000	46.0	41.0	37.0	33.5	30.0

FIGURE 16-0005-1

REFLECTED OUTPUT POWER METERING

- Rotate the function switch to "STANDBY" and turn the RF precorrector switch(8) to "MANUAL."
- For a redundant system: Momentarily interchange the coax cables at the switch and control drawer rear panel, figure 16-0005-2, AMP FWD & AMP REF. For a non-redundant system: Switch the cables at the driver input.

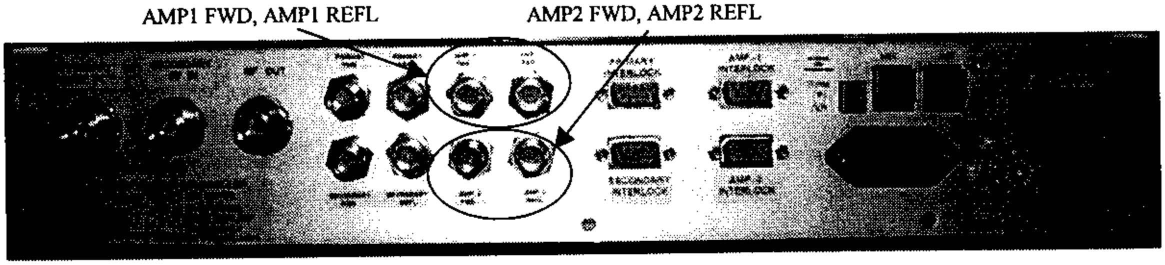


FIGURE 16-0005-2

- Rotate the function knob from "STANDBY" to "REF" to enable transmitting.
- Adjust the motherboard reflected metering potentiometer(12) so that the driver front panel meter indicates 100% reflected power. Refer document # DOC23-0042, for potentiometer locations.
- Rotate the function knob to "STANDBY."
- Return the coax cables to the original configuration.
- Turn the RF precorrector switch(8) to "AUTO."
- Rotate the function knob to "REF." The meter should indicate less than 7% residual reflected power reading into a resistive termination.

+11V SWITCHING POWER SUPPLY METERING

- Using a digital voltmeter, measure the switching power supply output.
- Confirm that the switching power supply voltage output is +10.80 V_{DC}.
- Rotate the function switch to +11 VPS.
- Adjust the motherboard +11 VPS potentiometer, VR3, so that the driver front panel meter indicates 100% +11 VPS metering. Refer to figure 16-0005-3 below, for potentiometer locations.

Potentiometer locations

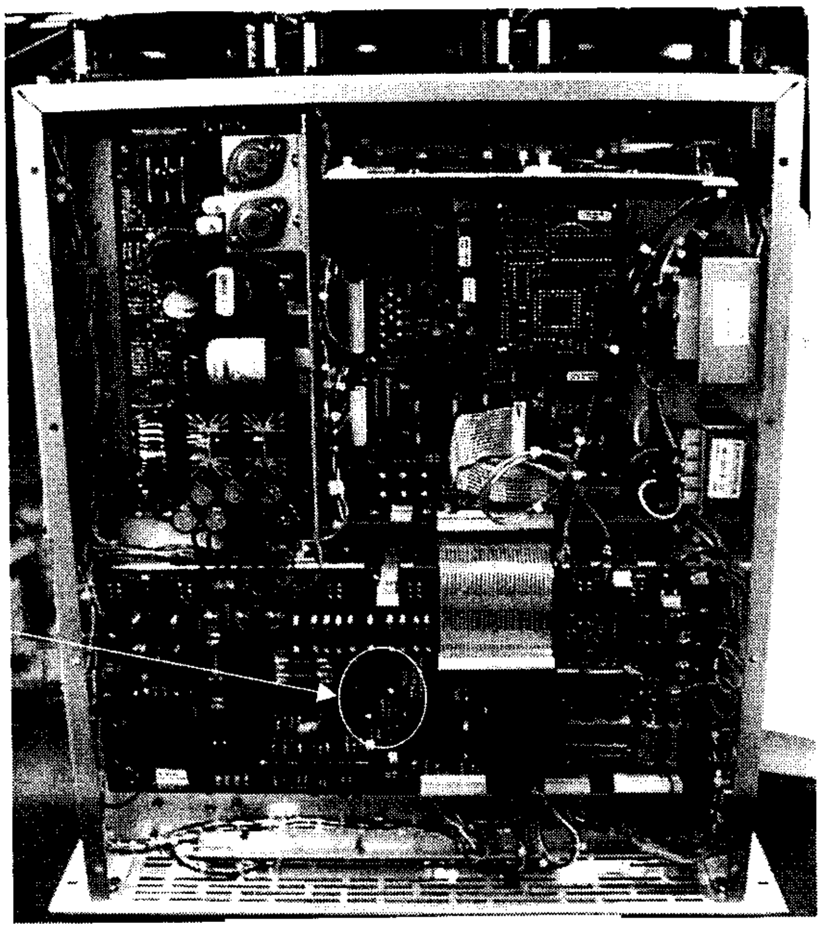
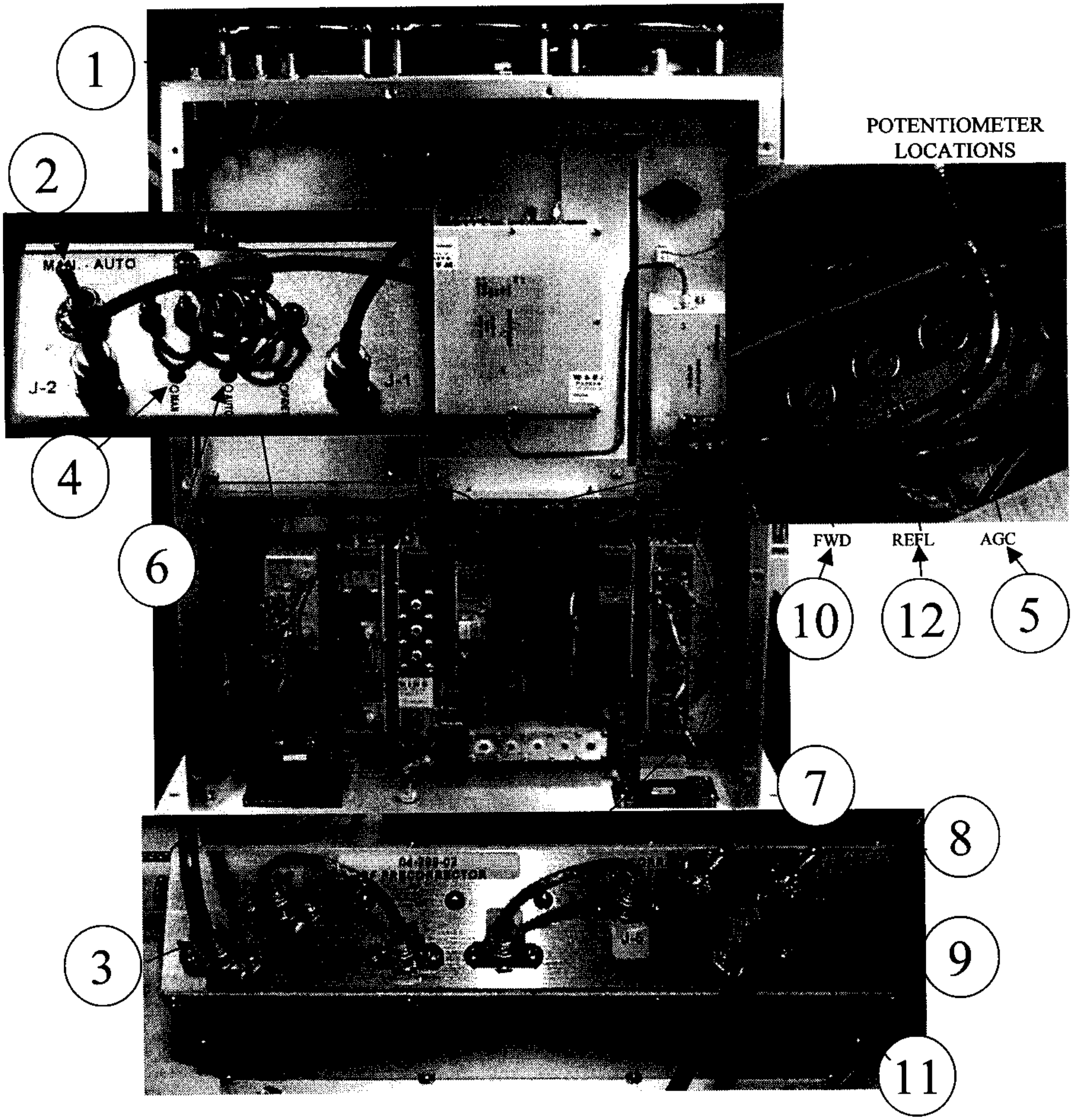


FIGURE 16-0005-3

SBM SERIES CALIBRATIONS



Created by: Kimberly Simeone *9/25/98*	*Checked by:* 10/08/98	*Released by:* 10/12/98