Certification Test Report

For a

8 Channel Bi- Directional Booster Amplifier

Manufacturer:

AeroComm, Inc.
19516 Amaranth Drive
Germantown, MD 20874

Testing Facility:

F-Squared Laboratories
10880 Moxley Road
Damascus, MD 20872

The 8 Channel Bi- Directional Booster Amplifier, model 504830203, has been tested and was found to comply with the requirements of the Federal Communications Commission outlined in the Federal Register CFR 47, Part 2 and Part 90 for a Class B Private Land Mobile Radio Service Signal Booster. The product was received on September 1, 1999 and the testing was completed on November 25, 1999.

Evaluation Conducted By:

Dale Royston
EMC Technical Manager

Report Reviewed By:

Wendy Fuster
President

F-Squared Laboratories
success thru compliance

F-Squared Laboratories
9890 Main Street
Damascus, MD 20872
(301) 253-4500
Fax (301) 253-5179

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Exhibit I

Engineering Statements

This report has been prepared on behalf of AeroComm, Inc. to certify a Private Land Mobile Radio Service Bi-directional Signal Booster. The test was performed for above said device under Parts 2 and Part 90 of the FCC Rules and Regulations. The test results found in this test report relate only to the items tested.

EQUIPMENT UNDER TEST:	8 Channel Programmable Bi-Directional Signal Booster Model: 504830203
FCC ID:	KJA504830203
APPLICABLE RULES:	CFR 47 Part 2.1033 (c); 2.1046, 90.209, 90.219
EQUIPMENT CATEGORY:	Non- Broadcast amplifier
MEASUREMENT LOCATION:	F-Squared Laboratories in Damascus, MD. Site description and attenuation data are on file with the FCC's Sampling and Measurement Branch at the FCC Laboratory in Columbia, MD.
MEASUREMENT PROCEDURE:	All measurements were performed according to the 1992 version of ANSI C63.4. A list of the measurement equipment can be found in Exhibit II.

UNCERTAINTY BUDGET:

- Radiated Emission
  Combined Uncertainty (+ or -) 2.24 dB
  Expanded Uncertainty (+ or -) 4.48 dB

- Conducted Emission
  Combined Uncertainty (+ or -) 1.13 dB
  Expanded Uncertainty (+ or -) 2.26 dB

ENGINEERING STATEMENT #1: I hereby state that: The measurements shown in this application were made in accordance with the procedures indicated and the energy emitted by this equipment was found to be within the limits. I assume full responsibility for the accuracy and completeness of these measurements.

I further state that: On the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 90 of the FCC Rules under normal use and maintenance.

ENGINEERING STATEMENT #2: RADIO FREQUENCY RADIATION EXPOSURE DECLARATION

The FCC Rules as noted in Part 2.1091 is not applicable for this fixed station device.

Certified by: _____
Dale Royston, EMC Technical Manager

Exhibit II

List of Measurement Instrumentation

Equipment Type	Manufacturer	Model #	Serial #	Cal. Due Date
Receiver Systems	Rohde & Schwarz	ESMI	DE23119	Feb. 2000
LISN #1	Solar	8012-50-R-24-BNC	910488	Jan. 2000
LISN #2	Solar	8012-50-R-24-BNC	933201	Jan. 2000
Biconical Antenna	Compliance Design Inc.	B100	383	Jan. 2000
Biconical Antenna	Compliance Design Inc.	B200	292	Jan. 2000
Biconical Antenna	Compliance Design Inc.	B300	318	Jan. 2000
Horn Antenna	Antenna Research Associates	DRG-118/A	1105	Feb. 2000
Antenna Mast	Compliance Design Inc.	M100	NA	NA
Turntable	F^2 Laboratories	Site 1	NA	NA
Isolator #1*	UTE Microwave Inc.	CT-1059-OT	U6049	**
Isolator #2*	UTE Microwave Inc.	CT-1059-OT	U6050	**
Combiner*	Mini-Circuits	ZESC-2-11	15542	**
RF Signal Generator#1	Giga-Tronics	6061A	9637902	Jan. 2000
RF Signal Generator#2	HP	E4420B-1E5	US38220249	July 2000
RF Signal Generator#3	Marconi	2024	1151131019	April 2001
Amplifier	HP	8447f	3113A04704	July 2000
Data Logger	Honeywell	DRS-4505	88137287001	Jan 2000
Spectrum Analyzer	HP	8391A	3149A07546	Feb. 2000
DMM	Wavetek	10XL	981103749	Jan 2000

*** Note 1: Customer Provided Equipment**
****Note2: Calibrated with the Rohde & Schwarz receiver and the HP and Gigatronics Signal Generators**

Note: All Equipment was in calibration at the time of test.

Exhibit III

Equipment Under Test Information and Data

TEST ITEM CONDITION:

The equipment to be tested was received in good condition.

TESTING ALGORITHM:

The EUT was driven with a –60 to –50 dBm input signal level. The worst case emissions are recorded in the data tables.

CONDUCTED EMISSION TESTING:

The EUT was placed on a 0.1 meter high, non-conductive pallet. Power was provided to the EUT through a LISN bonded to a 3 X 2 meter ground plane. The LISN and peripherals were supplied power through a filtered AC power source. The output of the LISN was connected to the input of the receiver and emissions in the range 450kHz to 30 MHz were measured. The measurements were recorded using the quasi-peak values, and the resolution bandwidth during testing was 9kHz. All data for conducted emissions is found in Exhibit VI.

RADIATED EMISSIONS: SPURIOUS EMISSIONS TESTING

The EUT was tested at a distance of 3 meters. The emissions were maximized by rotating the table and raising/lowering the antenna mounted on a 4 meter mast. Cable and peripheral positions were also varied to produce maximum emissions. Both horizontal and vertical field components were measured. The output of the antenna was connected to the input of the receiver and emissions were measured in the range 30MHz to 8.5 GHz. The measured values up to 1GHz with a resolution bandwidth of 120KHz are quasi-peak readings made at 3 meters. Emissions from 1 GHz to 8.6 GHz were measured with a resolution bandwidth of 1 MHz and placed in the average detector mode. All data for radiated spurious emissions is found in Exhibit VII.

RADIATED SPURIOUS EMISSION ANTENNA PORT TESTING:

The EUT was tested near the spectrum analyzer and source signal generators with the shortest available length cables to insure correct data collection. The output of the EUT was connected to the EMI receiver input port and the emissions were measured as shown in Exhibit VII.

INTERMODULATION DISTORTION AND EMISSIONS MASK TESTING:

The EUT was tested by the use of 3 signal generators, 2 combiners, and 3 isolators in line with each signal generator. The output of the EUT was connected to the receiver and the emissions were measured as shown in Exhibit VIII.

CALCULATION OF DATA #1:

RADIATED EMISSIONS - The antenna factors (including cable losses) of the biconical antennas were used along with the pre-amplifier gain, which were entered into the memory of the receiver. The receiver uses these values to correct the reading for amplitude automatically. The field strength reading taken directly from the receiver and compared to the FCC limits in dBuV/m. The following equation is used to convert to uV/m:

$$E_{uV/m} = \text{antilog}(E_{dBuV/m}/20)$$

SAMPLE OF FIELD STRENGTH CALCULATION:

$$Ea = Va + AF + Ae + (-AG)$$

Where Ea = Field Strength(dBuV/m)
Va= 20 x log10 (Measure RF voltage, uV)
Ae= Cable Loss Factor, dB
AG= Amplifier Gain, dB
AF= Antenna Factor dB(m-1)

i.e. if the reading is 57.0 dBuV, the antenna factor 8.0 dB, cable loss factor 1.0 dB and Amplifier gain is 25.0 dB, so the field strength will be:

$$Ea(dBuV/m) = 57 + 8 + 1 + (-25)$$
$$= 41 \text{ dBuV/m}$$

or

$$Ea(uV/m) = 10^{(41/20)}$$
$$= 112.20 \text{ uV/m}$$

CALCULATION OF DATA#2:

Emission Mask Limits – All of the calculations were based on the measured unmodulated output power level of the EUT and Emissions Mask B of section 90.210 (B). The EUT does have an audio low-pass filter and the limits specified in sub sections 1 to 3 were applied. The limits are based on the following Mask (B) criteria's:

KHz offset from Center Frequency	DB of attenuation down from Center Frequency
12.5 KHz to 25 KHz	25 dB
25 KHz to 62.5 KHz	35 dB
> 62.5 KHz	43 + Log (P) dB

The spreadsheet on the next page reveals all of the limit data points used for the test as shown in Exhibit VIII.

EMISSION Mask dBmW Limit Levels

Frequency (MHz)	Output Power (dBmW)
30	-18.36
867.950	-18.36
867.950	-7.66
867.9875	-7.66
867.9875	2.34
868.005	2.34
868.005	27.34
868.0125	27.34
868.025	27.34
868.025	2.34
868.0375	2.34
868.0375	-7.66
868.075	-7.66
868.075	-18.36
8680.00	-18.36

Exhibit IV

Block Diagram

Please see Block.pdf

Exhibit V

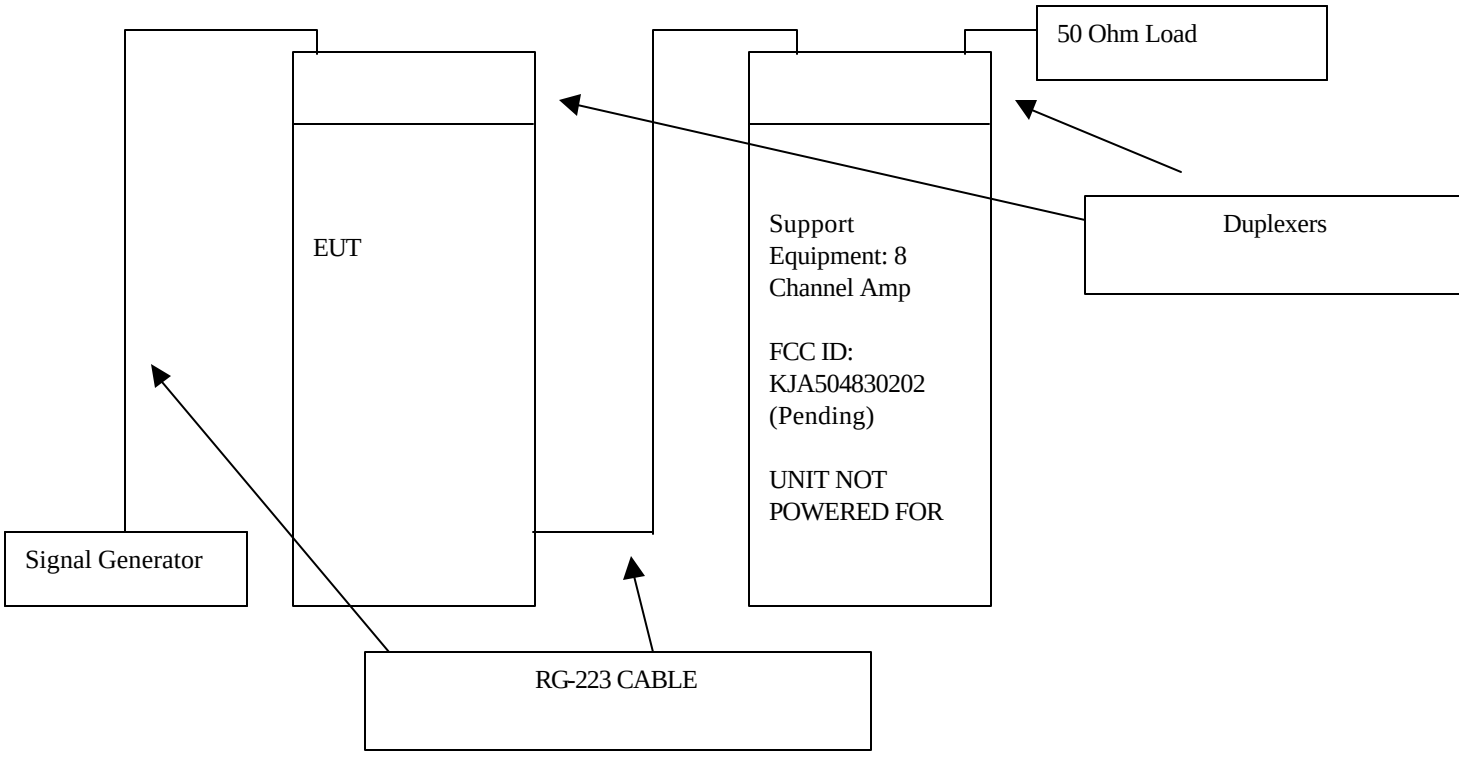
EUT Configuration and Cables

EUT:

Device	Manufacturer	Model #	FCC ID
Signal Booster	AeroComm, Inc.	504830203	KJA504830203

Cable: All one meter or greater in length – bundled according to ANSI C63.4 – 1992

EUT: Power - unshielded

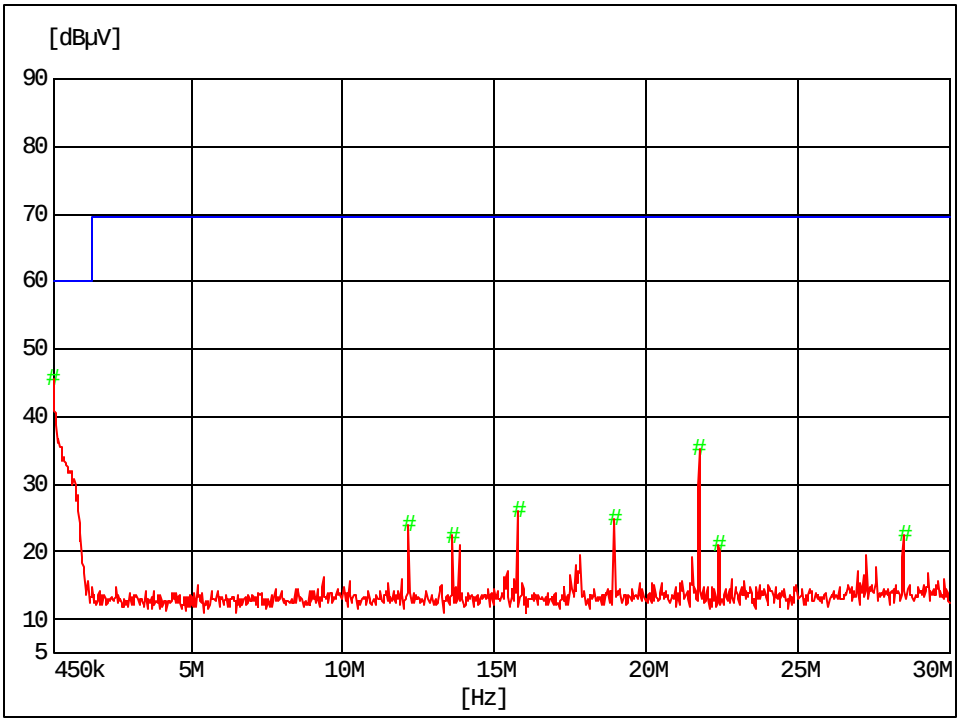


Note : Support Equipment not powered to protect signal generator from overload

Exhibit VI

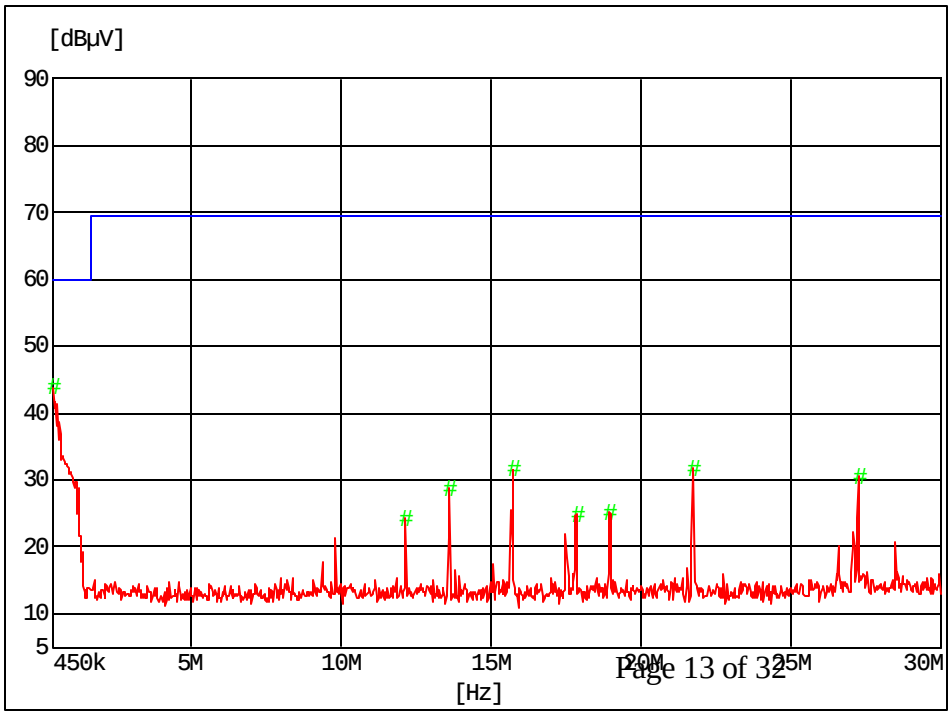
Conducted Test Line: Phase (Case "B")

After Modified (Cap=0.22uF X2) LCR Electronics, Inc. P/N KNB153224K0270602706B



Frequency MHz	Level dBµV
0.450000	45.58
12.171500	24.01
13.616167	22.38
15.750333	26.10
18.968000	24.98
21.758833	35.24
22.382667	21.10
28.489667	22.58

Conducted Test Line: Neutral



Frequency MHz	Level dBµV
0.450000	43.88
12.171500	24.25
13.649000	28.70
15.750333	31.59
17.884500	24.83
18.968000	25.06
21.791667	31.71
27.274833	30.52

Exhibit VII

RADIATED DATA

Temperature: **22** °C
Humidity: **39** % RH
Pressure: **100.5** Mb

Frequency (MHz)	Reading (dBuV)/m		Emission(uV)/m		FCC Limits @ 3 meters	
	Horizontal	Vertical	Horizontal	Vertical	(dBuV/m)	(uV/m)
55.98	38.36	35.71	82.79	61.02	84.71	17198.87
63.98	36.91	33.42	70.06	46.88	84.71	17198.87
71.99	39.55	34.38	94.95	52.36	84.71	17198.87
119.98	35.27	33.11	58.01	45.24	84.71	17198.87
135.98	37.92	36.40	78.70	66.07	84.71	17198.87
159.98	37.64	35.93	76.21	62.59	84.71	17198.87
207.98	49.73	47.34	306.55	232.81	84.71	17198.87
227.80	46.06	44.21	200.91	162.37	84.71	17198.87
247.98	48.21	46.09	257.34	201.60	84.71	17198.87
279.90	54.45	51.67	527.84	383.27	84.71	17198.87
263.98	49.20	46.53	288.40	212.08	84.71	17198.87
*866.2125	74.91	69.25	5565.45	2900.68	124.71	1719887.34

Note * = Carrier Frequency

Signal Generator Frequency 866.21250 MHz
Input Level –60 dBm

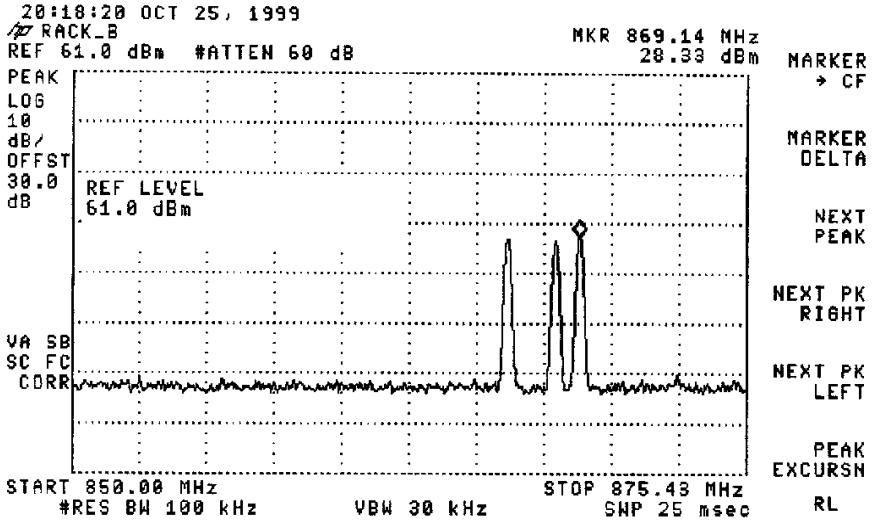
Field Strength Calculation = F v/m = $(49.2 \times P(w))^{1/2} / D$
P(w) = 27.34 dBmW= .542 Watts
D= 3 meters

F= 1.72 V/m = $(49.2 * .542)^{1/2}/3$
1.72 V/m = 124.71 dBuV/m
Lowest Limit For Mask B = 43+ Log (P) = -40dBc
124.71 – 40dBc = 84.71 dBuV/m

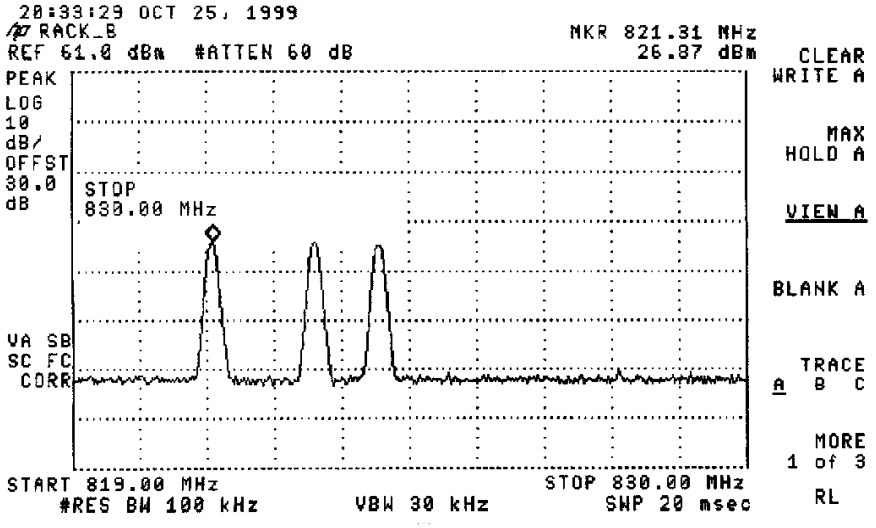
Exhibit VIII

Data for CFR 47 Part 2.1041

Section 2.1046 –RF Power Output
Section 2.1047 –Modulation Characteristics
Sections 2.1049 (i) and 90.219 (b & c) - Emissions Mask
Section 2.1051 – Spurious Emissions at Antenna Terminal

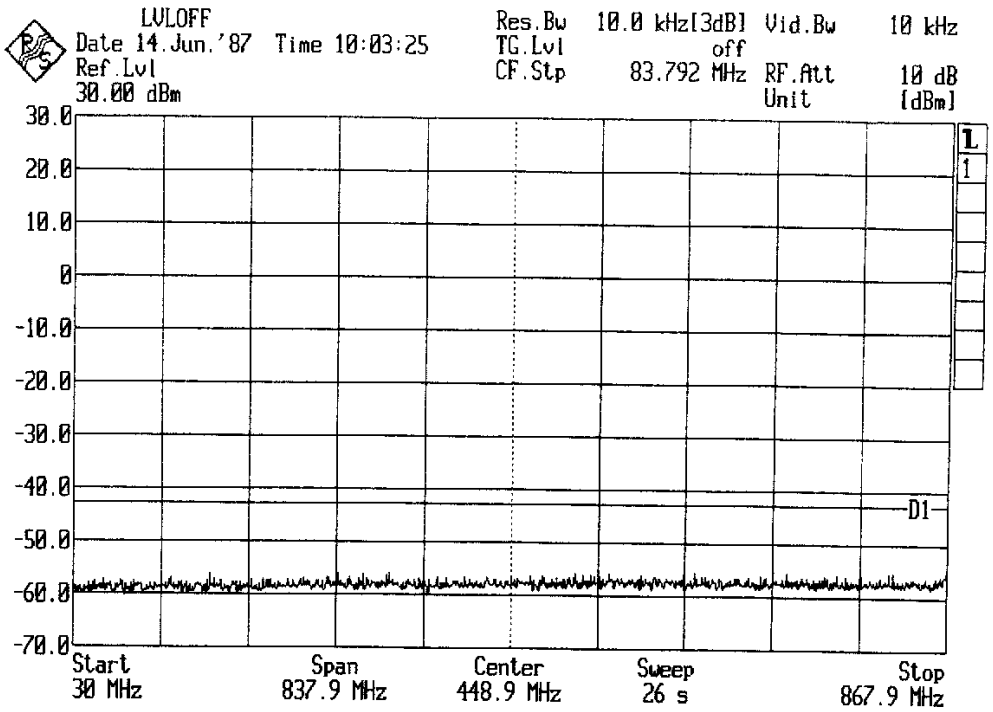


OUTPUT POWER PLOT - **HIGH BAND UNMODULATED INPUT @ -60dBm**
866.2125 MHz 27.90 dBm, 868.0125 Mhz 27.34 dBm, 868.9125 28.33 dBm

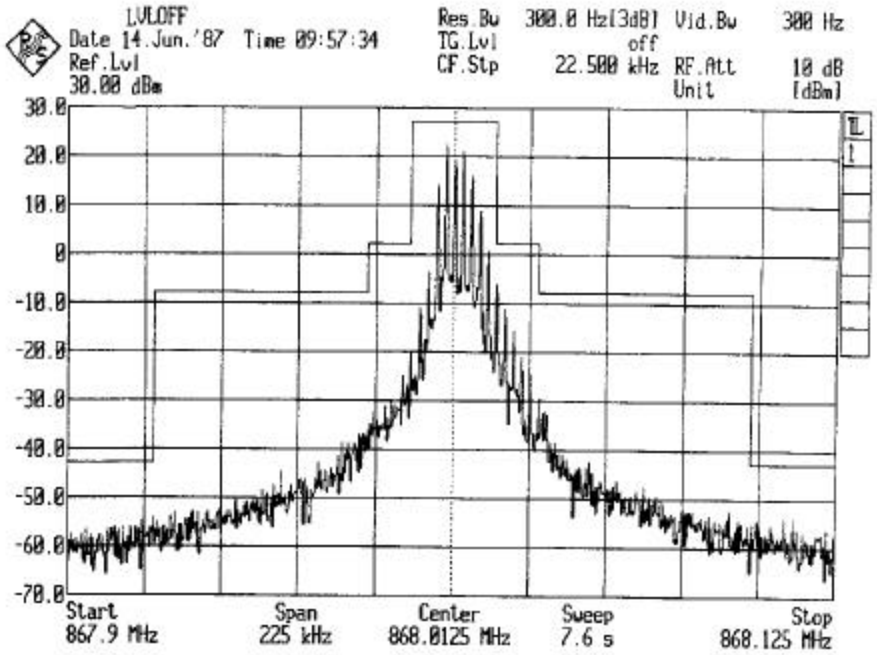


OUTPUT POWER PLOT - **LOWBAND- UNMODULATED INPUT @60dBm**
821.2150 MHz 26.87 dBm, 822.8750 Mhz 26.81 dBm, 823.9125 Mhz 26.33 dBm

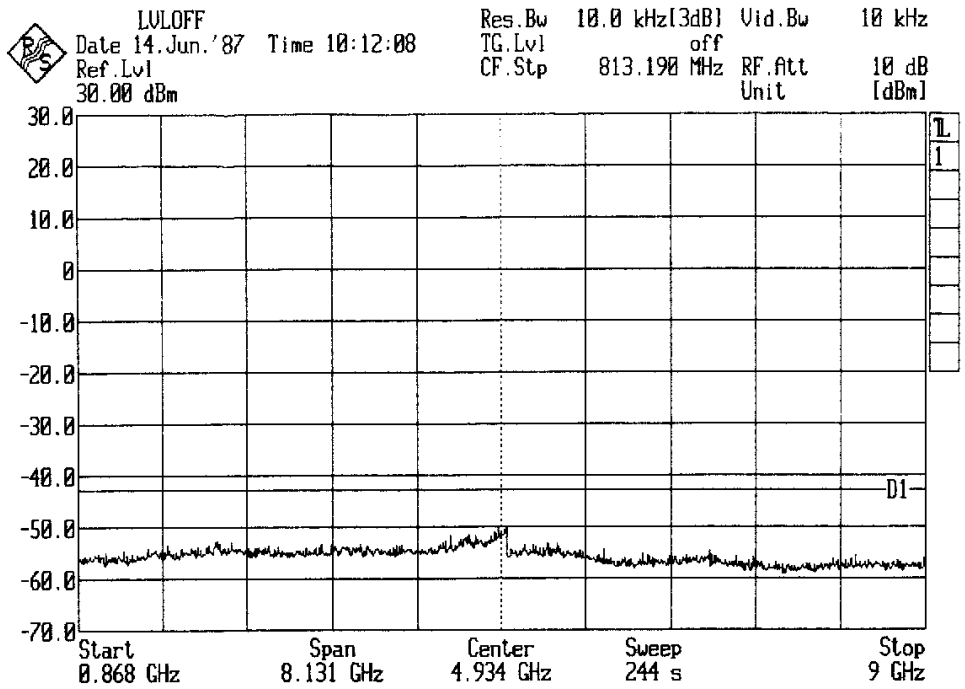
Note: Above plot is for Pending Application FCC ID: KJA504830202



Occupied Bandwidth/ Antenna Conducted Spurs
Plot 1 of 3



Occupied Bandwidth/ Antenna Conducted Spurs
Plot 2 of 3



Occupied Bandwidth/ Antenna Conducted Spurs
Plot 3 of 3

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Occupied Bandwidth, Antenna Conducted Spurious and Intermodulation Test Setup

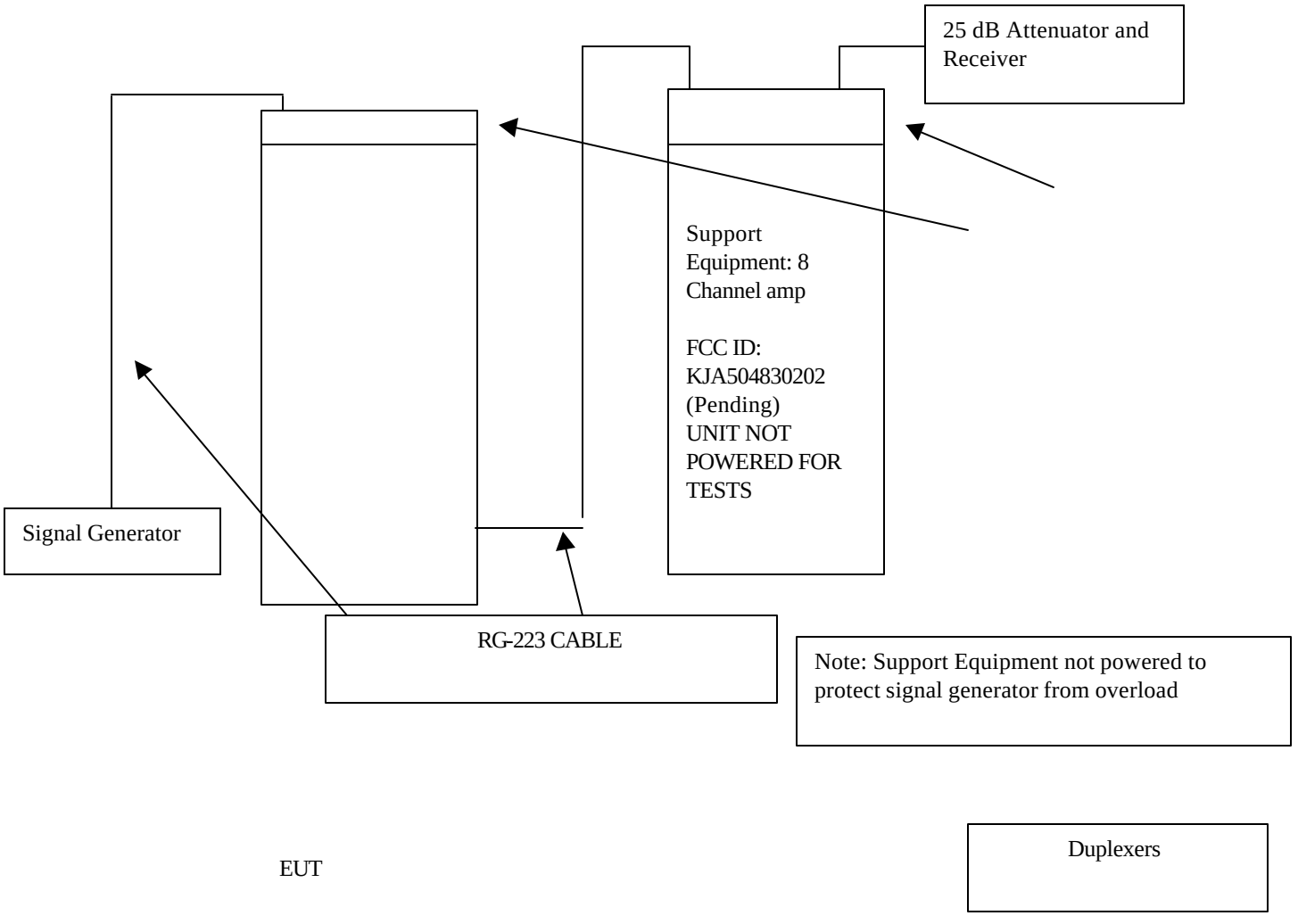
Equipment Settings

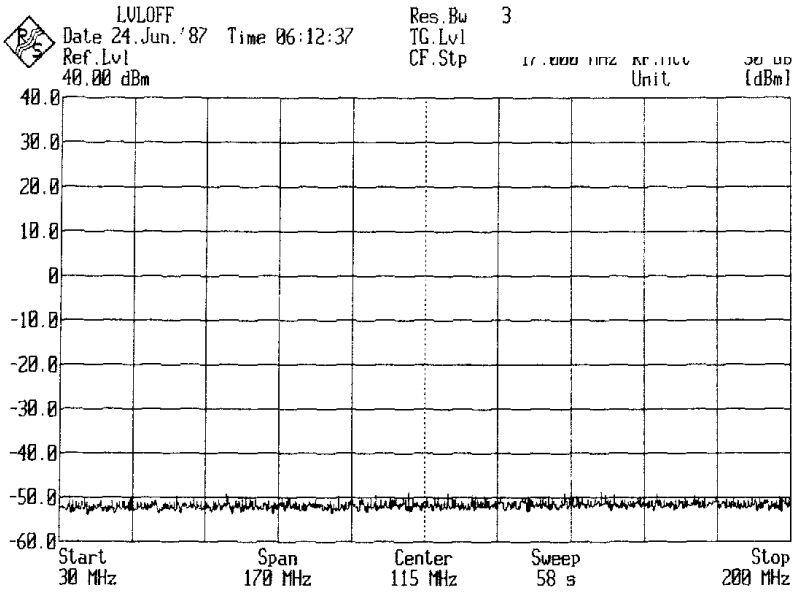
Occupied Bandwidth:

Input Level –50dBm to –60dBm
Modulation: FM
Deviation: 4.2KHz
Modulation Frequency : 2.5 KHz

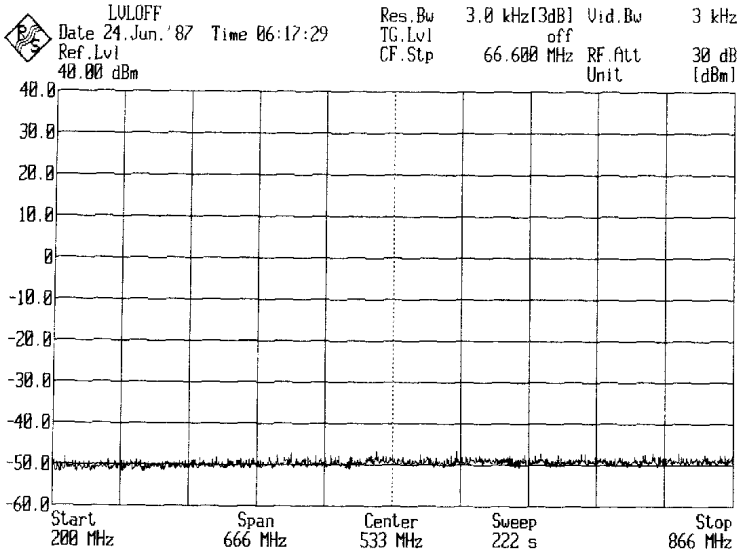
Intermodulation and Antenna Conducted Spurious Emissions:

Input Level: -50 dBm per frequency
Modulation: Off

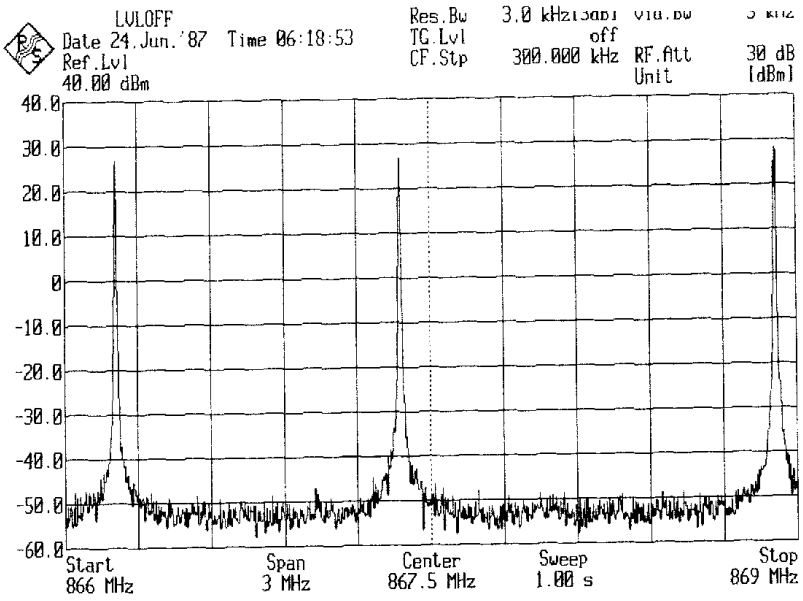




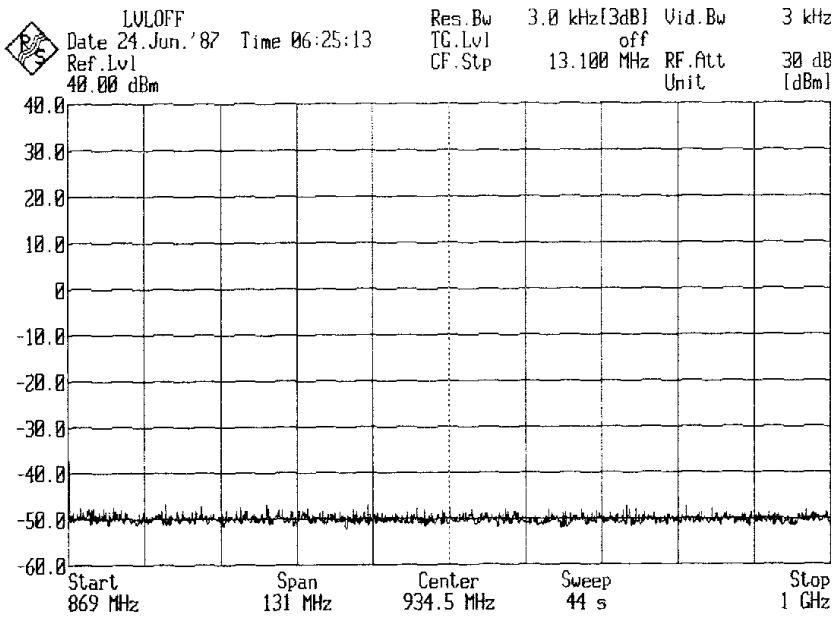
Intermodulation
Plot 1 of 8



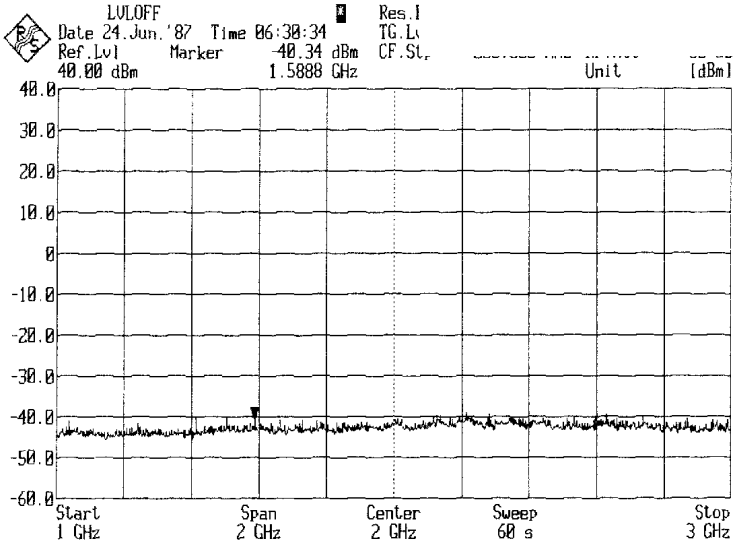
Intermodulation
Plot 2 of 8



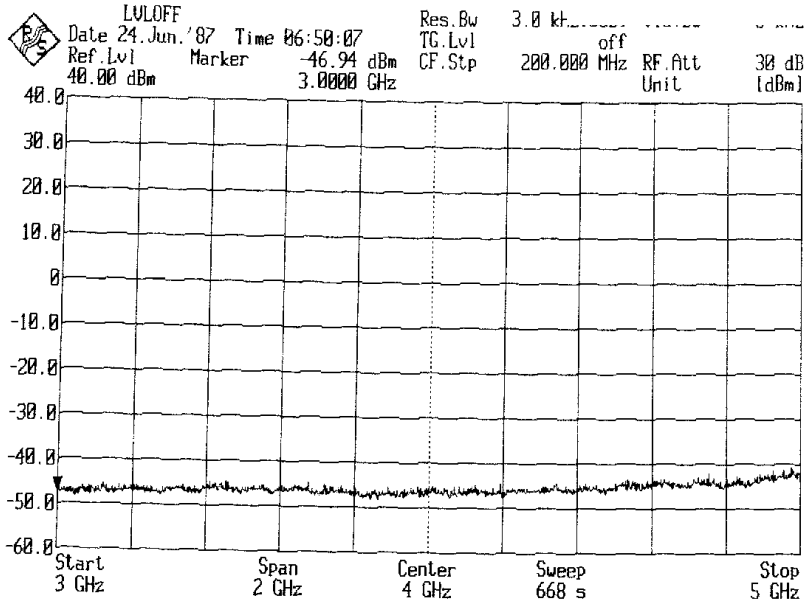
Intermodulation
Plot 3 of 8



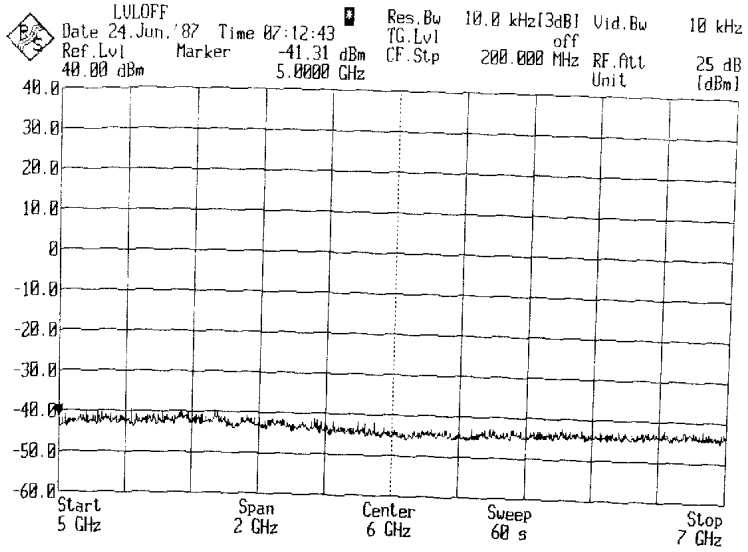
Intermodulation
Plot 4 of 8



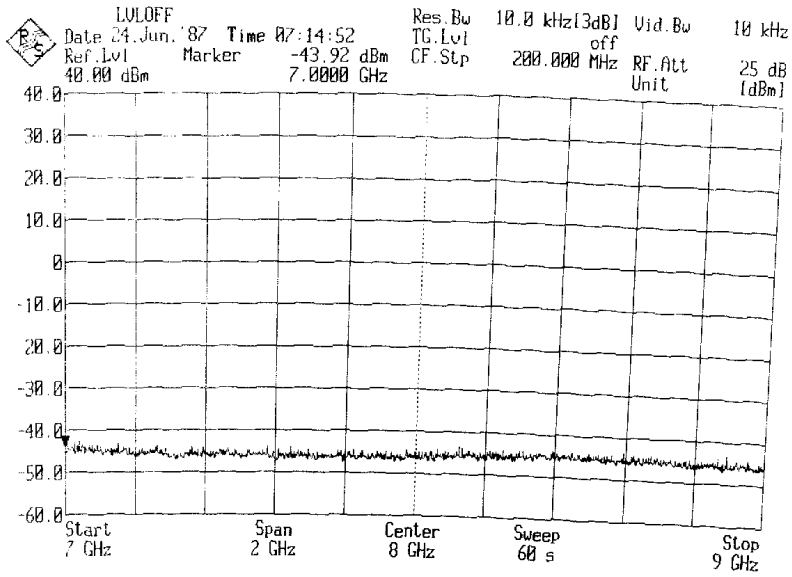
Intermodulation
Plot 5 of 8



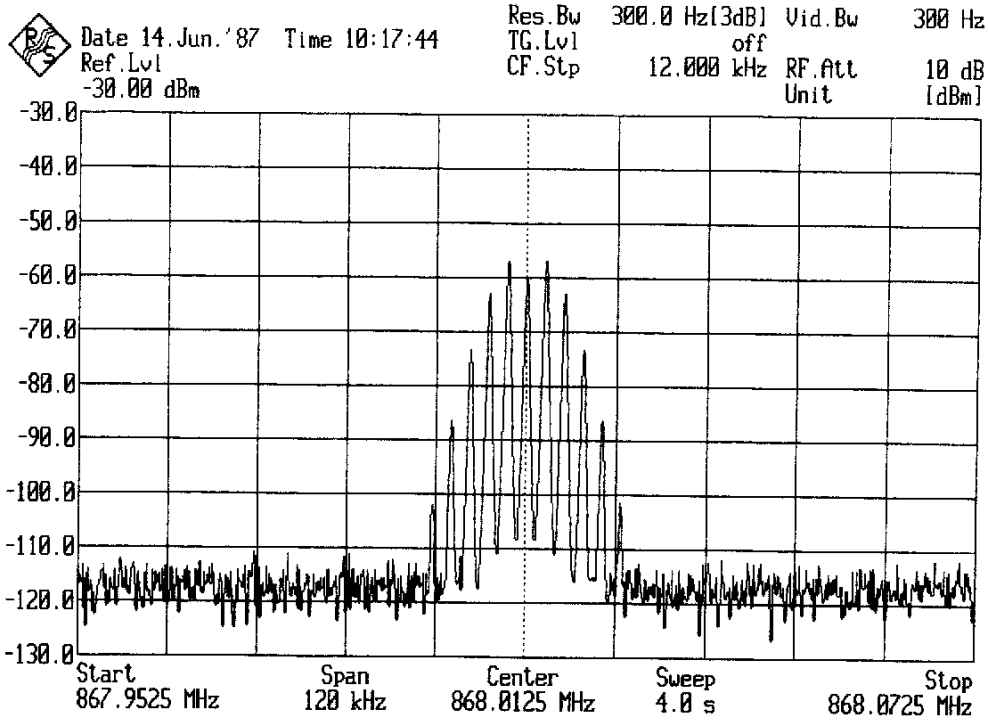
Intermodulation
Plot 6 of 8



Intermodulation Plot 7 of 8



Intermodulation Plot 8 of 8



Occupied bandwidth Input signal plot

plot 11

Voltage and Temperature Stability

Voltage Stability

Frequency =821.2125	**Tolerance = +/-.00015%**	**Limits (KHz)= +/- 1.23KHz**
Nominal Voltage = +12 Vdc		
Input Voltage	**Measured Freq.**	**Deviation**
10.2Vdc	821.21270	+30Hz
12Vdc	821.21267	0
13.8Vdc	821.21270	+30Hz
Frequency =823.55	**Tolerance = +/-.00015%**	**Limits (KHz)= +/- 1.24KHz**
Nominal Voltage = +12 Vdc		
Input Voltage	**Measured Freq.**	**Deviation**
10.2Vdc	823.55017	0
12Vdc	823.55017	0
13.8Vdc	823.55025	+80Hz
Frequency =823.9125	**Tolerance = +/-.00015%**	**Limits (KHz)= +/- 1.24KHz**
Nominal Voltage = +12 Vdc		
Input Voltage	**Measured Freq.**	**Deviation**
10.2Vdc	823.91272	**-80Hz**
12Vdc	823.9180	**0**
13.8Vdc	823.91278	**-80Hz**

Note: All Output Frequencies are directly dependant on the input Frequencies. See Block diagram for Oscillator and mixer information.

THIS TEST WAS DONE ON THE FREQUENCY RANGE FOR THE PENDING APPLICATION KJA504830202. THE BASE OSSICLATOR AND ALL CIRCUITY IS THE SAME FOR THE APPLIED RANGE OF 866-869 MHz. PLEASE SEE THE OWNERS MANUAL 800MHZ.PDF FOR FURTHER CLARIFICATION

Temperature Stability

Frequency = 821.21250 MHz		
Temperature in Celsius	**Measured Frequency (MHz)**	**Deviation (Hz)**
-30	821.212512	+12
-20	821.212512	+12
-10	821.212475	-25
0	821.212438	-62
10	821.212575	+75
20	821.212575	+75
30	821.212562	+62
40	821.212575	+75
50	821.212662	+162

THIS TEST WAS DONE ON THE FREQUENCY RANGE FOR THE PENDING APPLICATION KJA504830202. THE BASE OSSICLATOR AND ALL CIRCUITY IS THE SAME FOR THE APPLIED RANGE OF 866-869 MHz. PLEASE SEE THE OWNERS MANUAL 800MHZ.PDF FOR FURTHER CLARIFICATION

Exhibit XI

Compliance Information

The following statement, or equivalent, is required to be in the user's manual:

FCC COMPLIANCE STATEMENT

The equipment described in this manual generates and uses radio frequency energy. If it is not installed and used properly, that is, in strict accordance with the manufacturer's instructions, it may cause interference to radio and television reception.

This equipment has been tested and found to comply with the limits for a Class B Private Land Mobile Radio Service Bi-directional Signal Booster device pursuant to CFR 47 Part 2.1041 and Part 90 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference at the end use installation intended for this product. This device can only be operated with a station license issued by the FCC.

Warning to User:
Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.