

Test Report

TEST PROCEDURES AND TEST SITE DESCRIPTION

MEASUREMENT ITEMS	Section No.
1. DC Voltage & Current into Final Device	2.983(d)(5)
2. RF Output Power	2.985
3. Modulation Characteristics (AF Roll-off)	2.987 & 80.213
4. Modulation Characteristics (AF Response)	2.987
5. Modulation Characteristics (Modulation Limiting)	2.987
6. Occupied Bandwidth	2.989
7. Spurious & Harmonic Emission at Antenna Terminal	2.991
8. Field Strength of Spurious & Harmonic Radiation	2.993
9. Frequency Stability (Freq. vs. Temperature)	2.995 & 80.209
10. Frequency Stability (Freq. vs. Voltage)	2.995 & 80.209
11. Receiver radiated spurious emissions	80.217(b)

NOTE: List of measurement equipment and test site description are included in this EXHIBIT.

1. DC Voltage & Current into Final Device 2.983(d)(5)

To measure the DC Voltage and Current into Final Amplifying Device, the measuring equipment was connected to the actual P.C.Board of the transmitter.

FCC limits: Not specified

Test Results: Refer to test data

2. RF Output Power 2.985

The unit was tuned-up in accordance with the alignment procedure stated in the EXHIBIT-6, and was loaded into a 50 ohm resistive termination. The unit was powered through its normally supplied power cable by a DC power supply. Power supply voltage was set to nominal voltage at the power supply terminals with the transmitter off.

The unit was operated for three consecutive test cycles of 15 minutes standby and 5 minutes in transmitting. At the end of the third 5 minutes period, the RF output power is measured. During the test, no components of the emission spectrum exceed the limit specified in the applicable rule part for occupied bandwidth or emission limitations.

FCC limits: Not specified

Test Results: Refer to test data

3. Modulation Characteristics (Audio Roll-off) 2.987 & 80.213

To measure the audio roll-off filter response, an audio frequency oscillator and AF VTVM were connected to the actual P.C.Board of the transmitter. The output of the audio filter was monitored by AF VTVM and an oscilloscope. An AF input level was maintained constant at least 10 dB below the saturation level at maximum response frequency. The measurement was made under the above conditions by varying the frequency between 1 kHz and 100 kHz.

FCC limits: 3 kHz - 15 kHz: $-40 \log_{10} (F/3)$ dB
Above 20kHz : At least -28 dB

Test Results: Refer to test data

4. Modulation Characteristics (Audio Frequency Response) 2.987

Operate the unit under the standard test conditions and monitor the output with a modulation or a calibrated test receiver. With a 1000 Hz sine wave (applied through a dummy microphone circuit) used as a 0 dB reference, vary the modulating frequency from 300 to 3000 Hz and observe the level necessary to maintain a constant 30% modulation.

FCC limits: 300 - 3000 Hz: 6dB/octave roll-off (+1/-3 dB)

Test Results: Refer to test data

5. Modulation Characteristics (Modulation Limiting) 2.987

The transmitter shall be adjusted for full rated system deviation, 1000 Hz and reference it as 0dB input. With modulation frequencies of 300, 1000 and 3000 Hz respectively, vary the audio input to a level 20dB above that required at 100 Hz to produce 60% of rated system deviation. This is required for both up to and down modulation. Record the percent of full system deviation obtained as a function of input level.

FCC limits: +/-5 kHz deviation

Test Results: Refer to test data

6. Occupied Bandwidth 2.989(c)(1) & 80.211

The spectrum of the modulated carrier was monitored by a panoramic method capable of 60dB amplitude range. The unit was modulated with a 2500 Hz audio signal at an input level 16dB above that required for 50% of maximum system deviation.

In case the 100Hz of CTCSS tone or 100 bps of digital coded data modulation is indicated for this transmitter, a representative measurement data for this operation is also presented.

Since the total deviation of the unit is designed as 4.7 kHz Div., the deviation of 2500Hz audio signal was set to 3.7 kHz Div., as the maximum deviation of tone or digital coded signal

was continuously set to 1.0 kHz Div.

At first, tone or digital signal was disabled and set the 2500 Hz audio signal to 1.85 kHz deviation (= 50% of 3.7 kHz deviation). Then, the input level of 2500Hz audio signal was increased by 16dB. In this condition, the tone or digital coded signal was then enabled and imposed with 2500Hz audio signal.

FCC limits: a) -25dB (50 - 100% of assigned frequency)
b) -35dB (100 - 250% of assigned frequency)
c) $43 + 10\log_{10}$ (RF output power in Watts) dB
or 80dB, whichever is lesser attenuation
for more than 250% of assigned frequency

Test Results: Refer to test data

7. Spurious & Harmonic Emission at Antenna Terminal 2.991

Spurious radiation are the radio frequency voltage or power generated within the equipment and appearing at the equipment's output terminals when properly loaded with its characteristic non-radiating load.

The unit was modulated with a 2500 Hz tone at an input level 16dB greater than that required 50% modulation. The spectrum was scanned from the lowest frequency generated in the equipment to the tenth harmonic of the carrier.

FCC limits: $43 + 10\log_{10}$ (RF output power in Watts) dB

Test Results: Refer to test data

8. Field Strength of Spurious & Harmonic Radiation 2.993

Measurement Procedure & Test Site Description

Field strength measurement of radiated spurious emissions were made on a 3 meter range maintained by Uniden Corporation in Japan. Complete description and measurement data of this test site have been placed on file with the Commission. The equipment was scanned for radiated emissions in a scheduled enclosure prior to open field testing.

For each spurious or harmonic frequency, the antenna was raised and lowered to obtain a maximum reading on the Spectrum Analyzer

with antenna horizontally polarized. Then the turntable, on which the equipment under test was placed, was rotated a minimum of 360 degree to further increase the reading on the Spectrum Analyzer. This procedure was repeated with the antenna vertically polarized.

FCC limits: $43 + 10\log_{10}$ (RF output power in Watts) dB

Test Results: Refer to test data

9. Frequency Stability (Temperature) 2.995 & 80.209

Frequency measurement was performed at the extremes of throughout the range -20 °C to +50 °C and at intervals of not more than 10 degrees C throughout the range. A period of time sufficient to stabilize all of the components in the equipment was allowed prior to frequency measurement.

The frequency of the unit was measured by extracting a sample of the carrier and measuring its center frequency by equipment having a degree accuracy at least 10 times that of the minimum to be measured.

FCC limits: +/-0.0005%

Test Results: Refer to test data

10. Frequency Stability (Voltage) 2.995 & 80.209

Frequency measurement was performed at the extremes of throughout the range 85% and 115% of the nominal voltage. The frequency of the unit was measured by extracting a sample of the carrier and measuring its center frequency by equipment having a degree accuracy at least 10 times that of the minimum to be measured.

FCC limits: +/-0.0005%

Test Results: Refer to test data

11. Receiver radiated spurious emissions

80.217(b)

 Regarding the electromagnetic field strength at a distance of over sea water of one nautical mile, the value of field strength in the range of visible distance, which will be emitted from $1/2 \lambda$ dipole antenna, results from the combination of the direct field component (free space field) and the ground reflected field component.

Therefore, assuming that the ground is a flat perfect conductor, the maximum value of field strength in cases of varying the antenna high at the test point should be extrapolated to indicate two as large as the value in free space field.

At the actual test site in the range of 10 feet of distance, the following formula can be considered to make up on an average, though it may include a little bit error. And, this fact is surely confirmed at our test site.

Accordingly, the value of field strength measured at the distance of 10 feet (3-meters) away shall be formulated as follows;

$$E_3 = 2 \times E_0 = 2 \times \sqrt{P} / r \text{ (V/m)} \text{ ----- (1)}$$

- where: E_3 : Field strength at the distance of 3 m (V/m)
- E_0 : Field strength in free space field (V/m)
- P : Power into $1/2 \lambda$ dipole antenna (Watts)
- r : Distance from test point to dipole antenna (m)

Also, in the surface over sea water, since it can be supposed that the sea surface rather keeps better conductor condition, the above (1).

Therefore, the value of field strength at the distance of one nautical mile (1852 m) E_{1852} shall be calculated as below;

$$\begin{aligned} E_{1852} &= E_3 \times 14 \times \sqrt{P} / 1852 \\ &= E_3 \times 3 / 1852 \\ &= E_3 / 620 \text{ ----- (2)} \end{aligned}$$

Test Results: Refer to test data

TEST DATA

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11. Receiver radiated spurious emissions	80.217(b)

1. RF Output Power & DC Voltage and Current into
Final Amplifying Device

2.983(d) (5)

FULL POWER MODE		TX FINAL TRANSISTOR	
MEASURED FREQUENCY (MHz)	OUTPUT POWER (Watts)	COLLECTOR VOLTAGE (V)	COLLECTOR CURRENT (A)
156.05	4.5	7.2	1.1
156.8	4.5	7.2	1.1
157.425	4.4	7.2	1.2

REDUCED POWER MODE		TX FINAL TRANSISTOR	
MEASURED FREQUENCY (MHz)	OUTPUT POWER (Watts)	COLLECTOR VOLTAGE (V)	COLLECTOR CURRENT (A)
156.05	0.98	7.4	0.38
156.8	0.98	7.4	0.38
157.425	0.97	7.4	0.41

2. CARRIER POWER

2.985

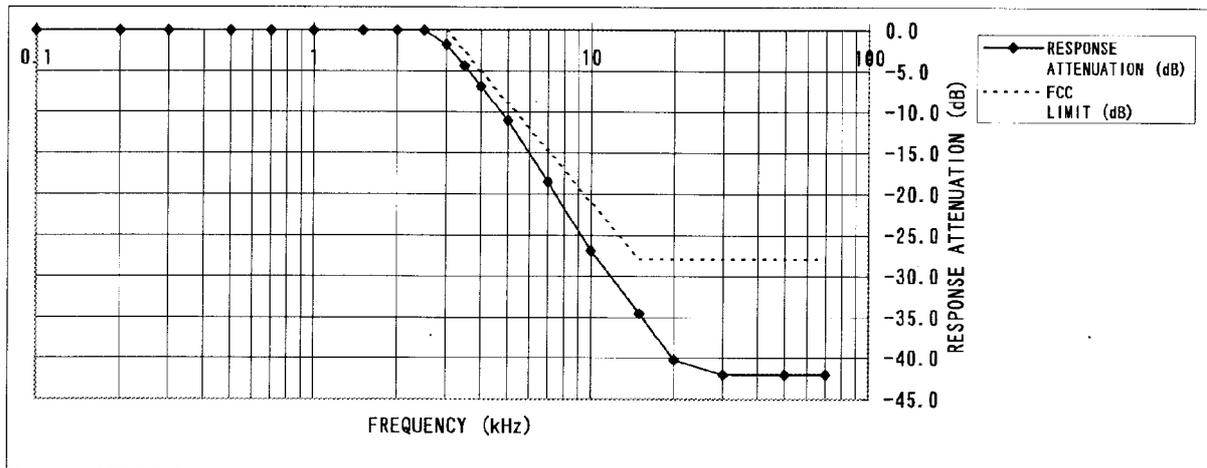
MEASURED FREQUENCY (MHz)	FULL POWER (Watts)	REDUCED POWER (Watts)
156.05	4.5	0.98
156.8	4.5	0.98
157.425	4.4	0.97

3. MODULATION CHARACTERISTICS (AUDIO ROLL-OFF RESPONSE)

2.987 & 80.213

CARRIER FREQUENCY: 156.80 MHz
 OUTPUT POWER: 0.98 WATTS

AUDIO FREQUENCY (kHz)	RESPONSE ATTENUATION (dB)	FCC LIMIT (dB)
0.1	0.0	--
0.2	0.0	--
0.3	0.0	--
0.5	0.0	--
0.7	0.0	--
1	0.0	--
1.5	0.0	--
2	0.0	--
2.5	0.0	--
3	-1.7	0.0
3.5	-4.3	-2.6
4	-6.8	-5.0
5	-11.0	-8.9
7	-18.5	-14.7
10	-26.9	-21.0
15	-34.5	-28.0
20	-40.2	-28.0
30	-42.0	-28.0
50	-42.0	-28.0
70	-42.0	-28.0

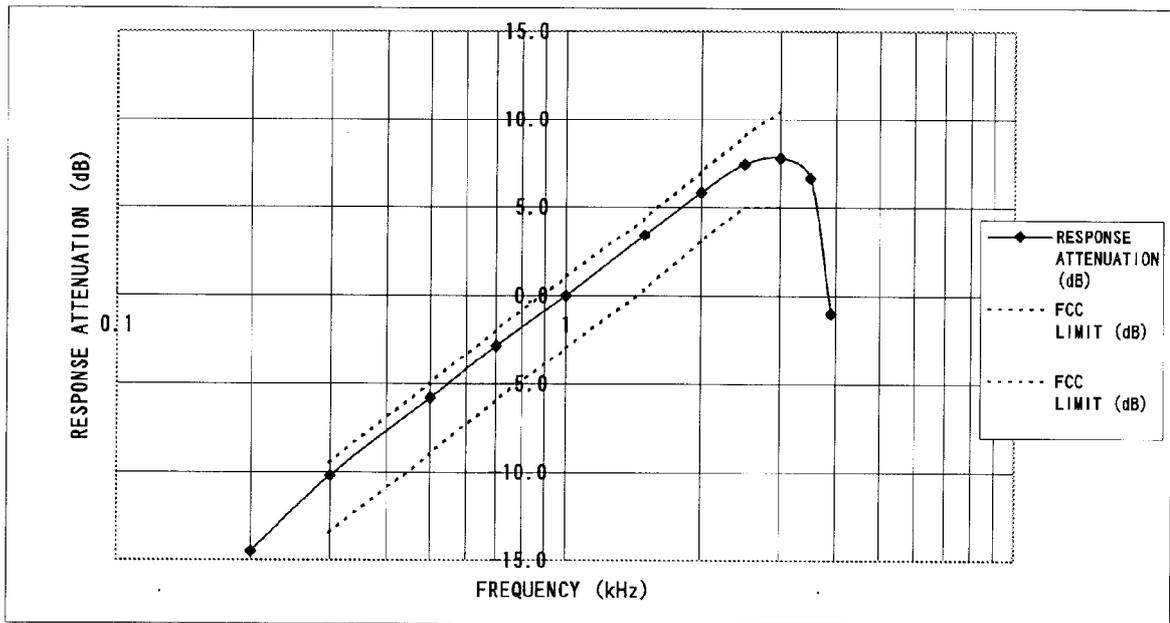


4. MODULATION CHARACTERISTICS (AUDIO FREQUENCY RESPONSE)

2.987

CARRIER FREQUENCY: 156.80 MHz
 OUTPUT POWER: 0.98 WATTS

AUDIO FREQUENCY (kHz)	RESPONSE ATTENUATION (dB)	FCC LIMIT (dB)	
0.1			
0.2	-14.5		
0.3	-10.2	-9.5	-13.5
0.5	-5.8	-5.0	-9
0.7	-2.8	-2.0	-6
1	0.0	1.0	-3
1.5	3.4	4.3	0.3
2	5.9	7.0	3
2.5	7.5	9.0	5
3	7.8	10.5	5
3.5	6.7		
3.9	-1.0		



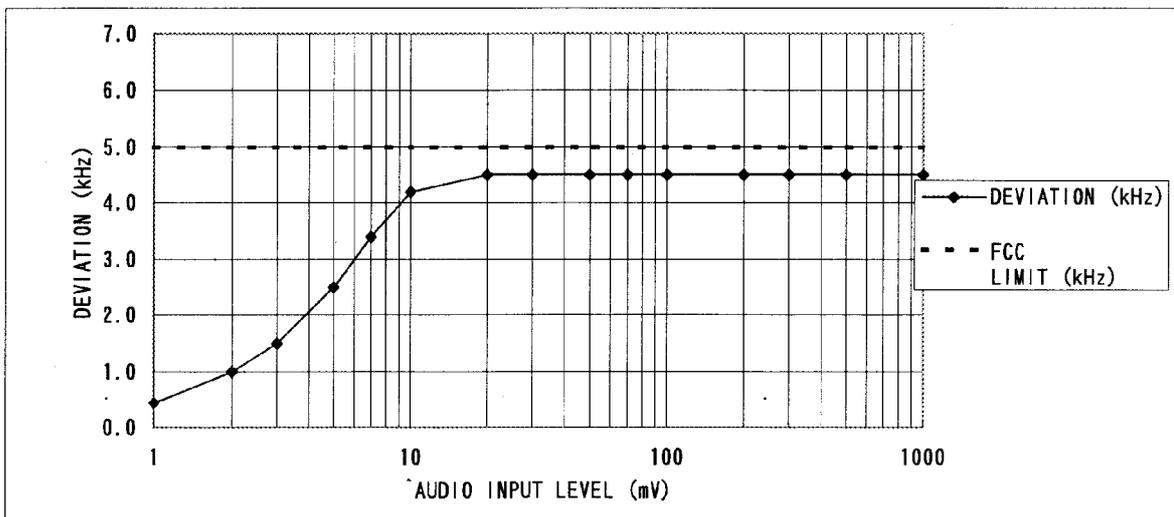
5. MODULATION CHARACTERISTICS (MODULATION LIMITING)

2.987

CARRIER FREQUENCY: 156.80 MHz

OUTPUT POWER: 0.98 WATTS

AUDIO INPUT LEVEL (mV)	DEVIATION (kHz)	FCC LIMIT (kHz)
1	0.5	5.0
2	1.0	5.0
3	1.5	5.0
5	2.5	5.0
7	3.4	5.0
10	4.2	5.0
20	4.5	5.0
30	4.5	5.0
50	4.5	5.0
70	4.5	5.0
100	4.5	5.0
200	4.5	5.0
300	4.5	5.0
500	4.5	5.0
1000	4.5	5.0



6. OCCUPIED BANDWIDTH

2.989

See attached graphs.

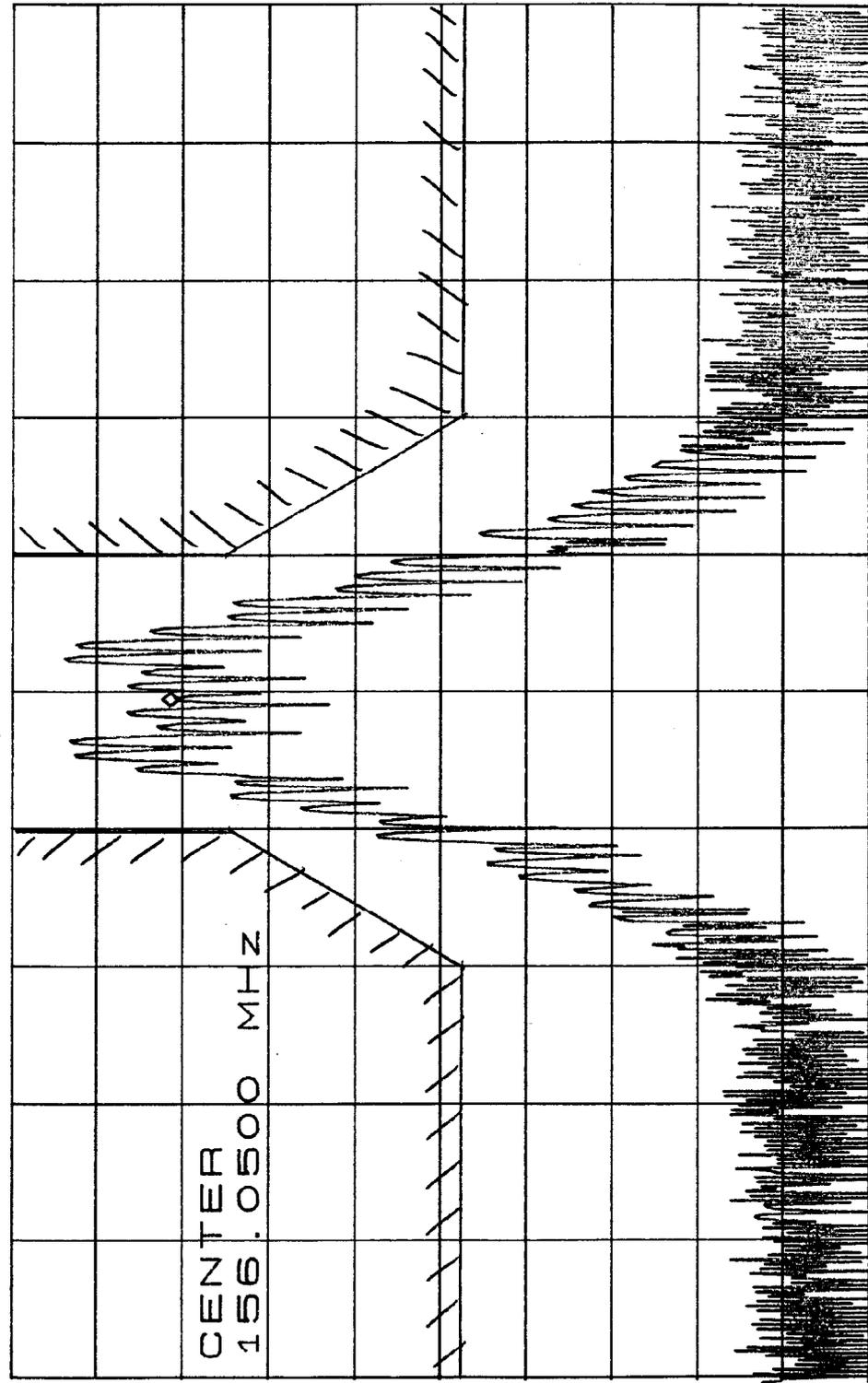
ATTEN 10dB

RL -10.9dBm

MKR -30.43dBm

156.0498MHz

10dB/



CENTER
156.0500 MHz

99.11.19

LT-871ZL

w/s No.3

CH01

[156.05MHz

TX:/W.

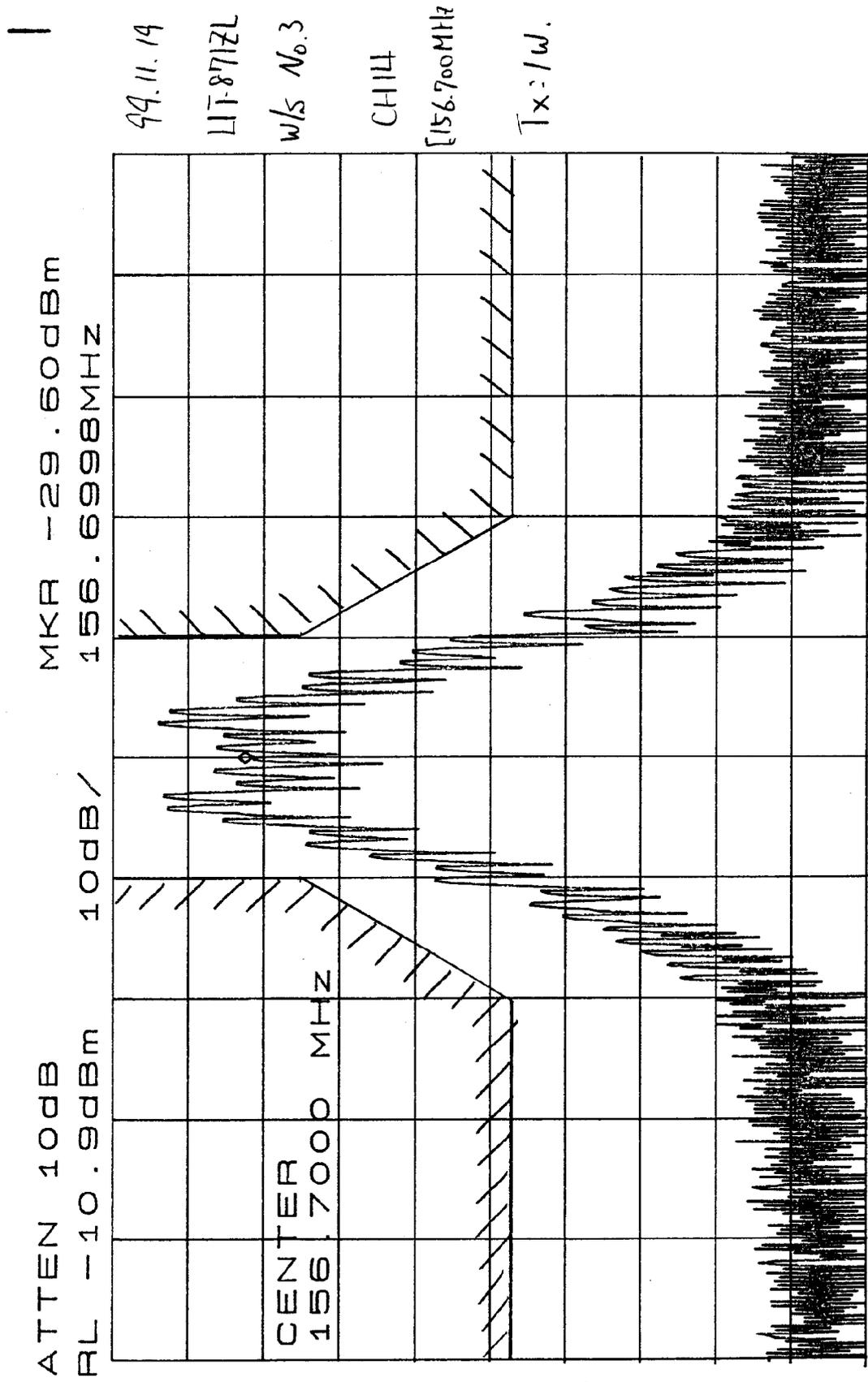
SPAN 100.0KHZ

SWP 2.8sec

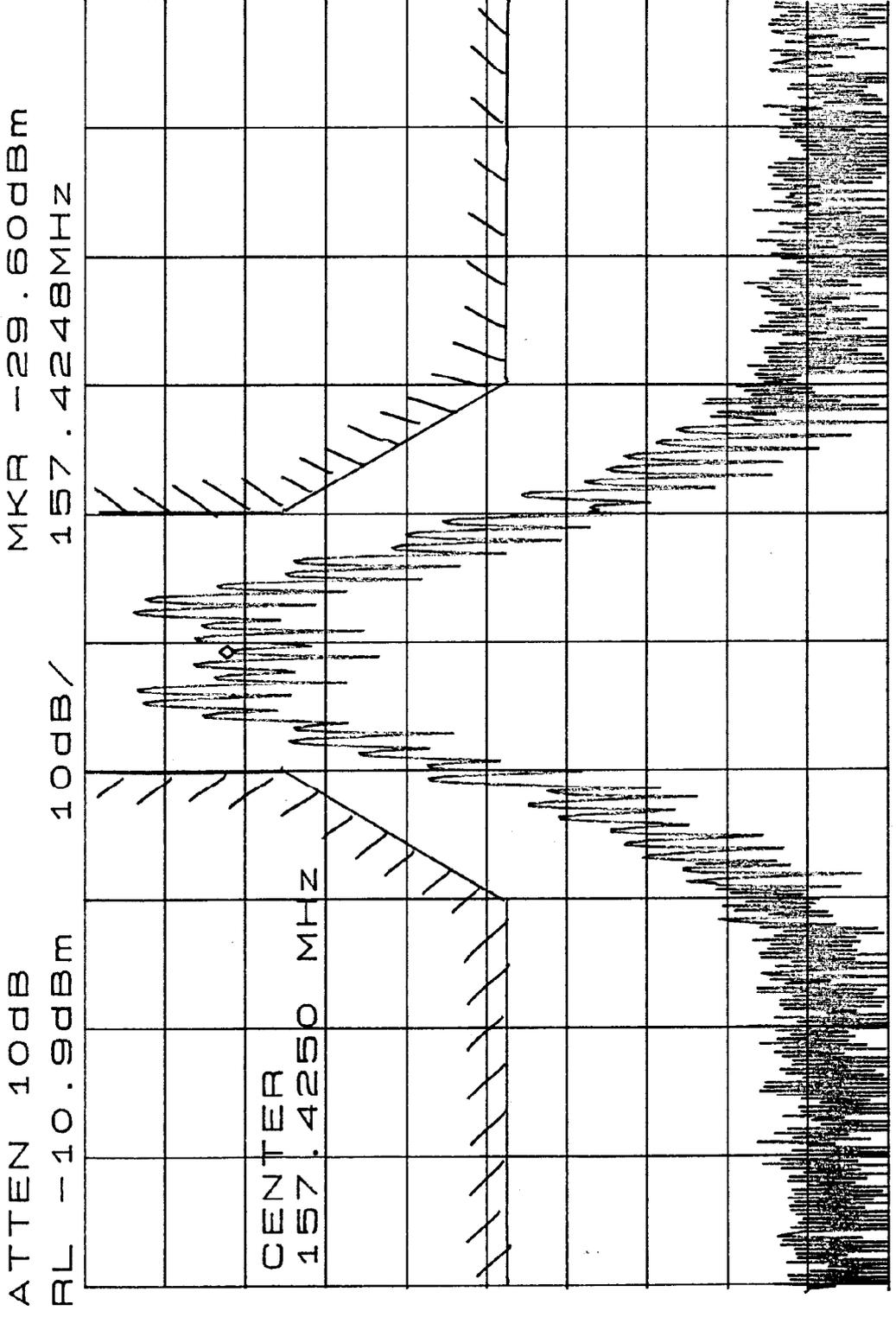
CENTER 156.0500MHz

*RBW 300Hz VBW 300Hz

*RBW 300Hz



CENTER 156.7000MHz
 *RBW 300Hz
 VBW 300Hz
 SPAN 100.0KHz
 SWP 2.8sec

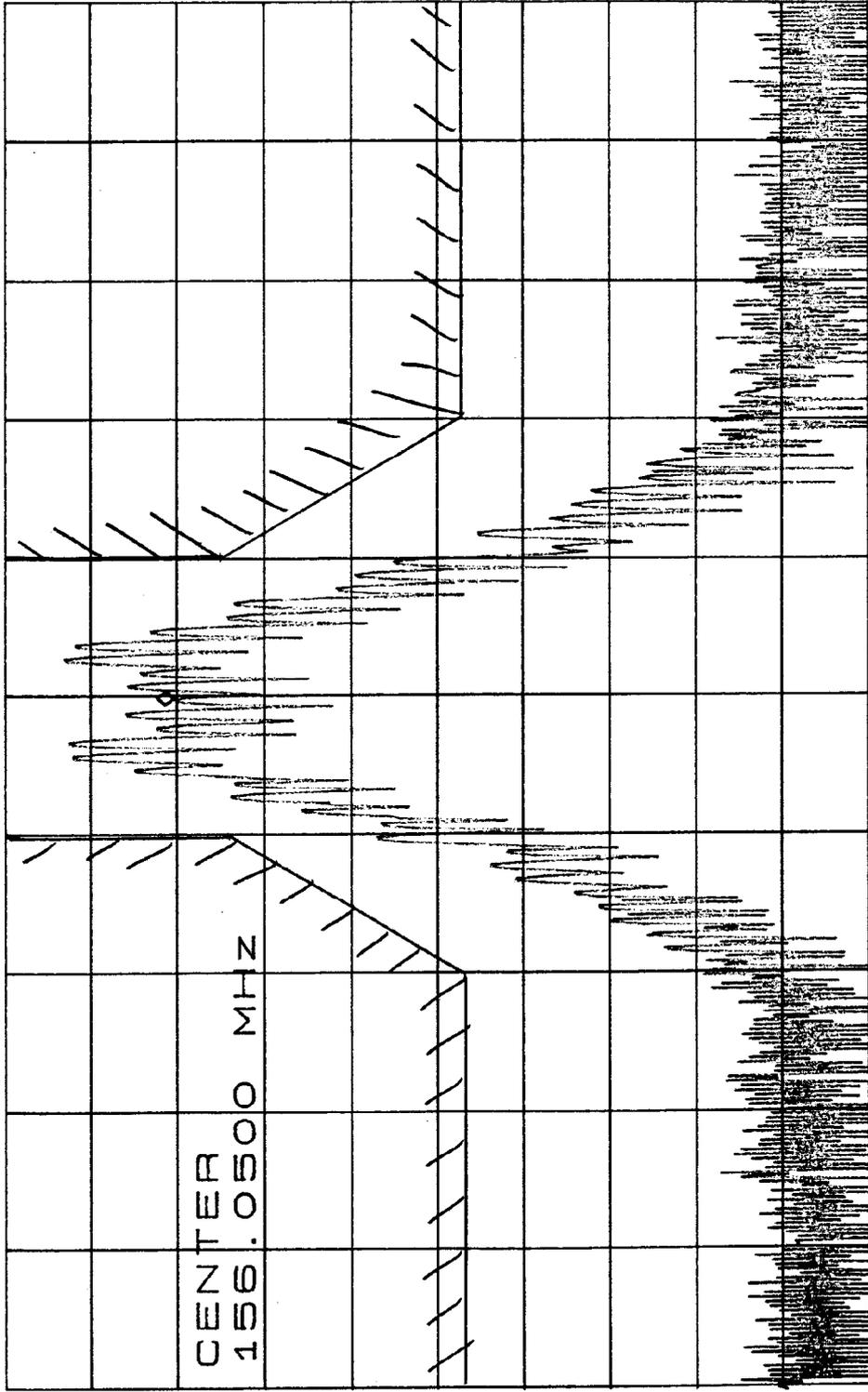


99.11.19.
 LT-871ZL
 w/s No.3
 CH88
 [157.425MHz]
 Tx: /W

CENTER 157.4250MHz
 *RBW 300Hz
 SPAN 100.0KHz
 VBW 300Hz
 SWP 2.8sec

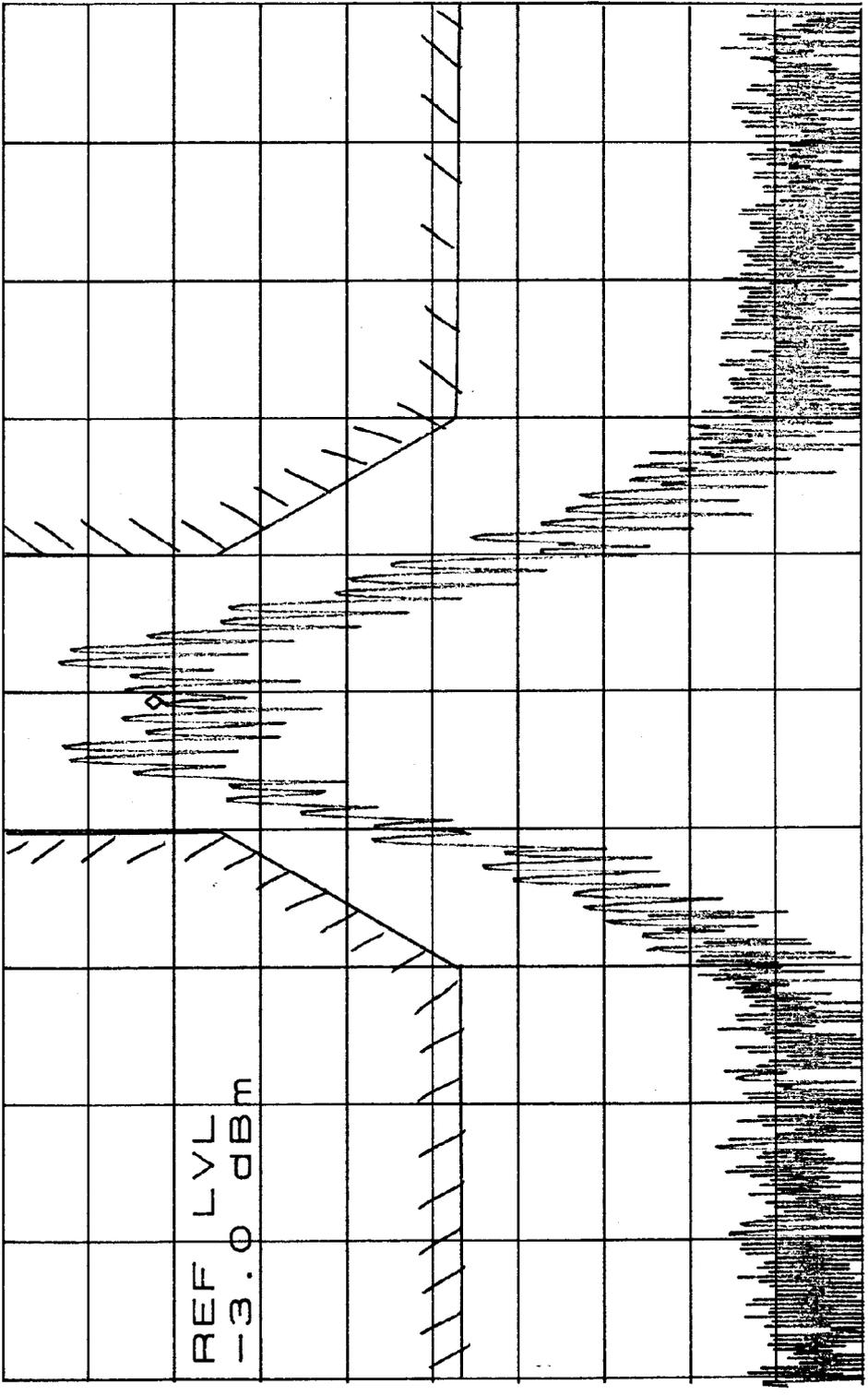
ATTEN 10dB
RL -3.0dBm

MKR -22.50dBm
156.0500MHZ



CENTER 156.0500MHZ SPAN 100.0KHZ
*RBW 300HZ VBW 300HZ SWP 2.8sec

ATTEN 10dB MKR -21.50dBm
RL -3.0dBm 157.4250MHz



99.11.19

LIT-871ZL

w/s No.3

CH 88

[157.425MHz]

TX:5W.

REF LVL
-3.0 dBm

CENTER 157.4250MHz SPAN 100.0KHz
*RBW 300Hz VBW 300Hz SWP 2.8sec

7. SPURIOUS & HARMONICS EMISSION AT ANTENNA TERMINAL

2.991

1) TX

Full Power

Harmonics of Carrier	156.05MHz [dBc]	156.8MHz [dBc]	157.425MHz [dBc]
1	-	-	-
2	-68.0	-67.0	-66.0
3	-87.0	-90.0	-89.0
4	-90.0	-90.0	-83.0
5	lesst than -90	lesst than -90	lesst than -90
6	lesst than -90	lesst than -90	lesst than -90
7	lesst than -90	lesst than -90	lesst than -90
8	lesst than -90	lesst than -90	lesst than -90
9	lesst than -90	lesst than -90	lesst than -90
10	lesst than -90	lesst than -90	lesst than -90

Reduced Power

Harmonics of Carrier	156.05MHz [dBc]	156.8MHz [dBc]	157.425MHz [dBc]
1	-	-	-
2	-55.5	-55.0	-54.6
3	-72.7	-73.0	-74.0
4	-90.0	-90.0	-90.0
5	lesst than -90	lesst than -90	lesst than -90
6	lesst than -90	lesst than -90	lesst than -90
7	lesst than -90	lesst than -90	lesst than -90
8	lesst than -90	lesst than -90	lesst than -90
9	lesst than -90	lesst than -90	lesst than -90
10	lesst than -90	lesst than -90	lesst than -90

2) RX

CONDUCTED	156.05-21.4MHz [dBm]	156.8-21.4MHz [dBm]	157.425-21.4MHz [dBm]
1	-86.5	-83.0	-71.5
2	lesst than -90	lesst than -90	lesst than -90
3	lesst than -90	lesst than -90	lesst than -90
4	lesst than -90	lesst than -90	lesst than -90
5	lesst than -90	lesst than -90	lesst than -90
6	lesst than -90	lesst than -90	lesst than -90
7	lesst than -90	lesst than -90	lesst than -90
8	lesst than -90	lesst than -90	lesst than -90
9	lesst than -90	lesst than -90	lesst than -90
10	lesst than -90	lesst than -90	lesst than -90

8. FIELD STRENGTH OF SPURIOUS & HARMONICS RADIATION

1) Frequency at which tuned: 156.05 MHz

EMISSIONS (MHz)	DUT, PLACED V/H	ANT, POLARITY V/H	ATTENUATION (dB)	FCC LIMIT (dB)	MARGIN (dB)
FULL POWER: 4.5 WATTS					
312.100	V	V	-62.0	-47	15.0
468.150	H	H	-65.0	-47	18.0
624.200	-	-	-	-47	>20
780.250	H	H	-64.0	-47	17.0
936.300	V	V	-63.0	-47	16.0
1092.350	H	H	-66.0	-47	19.0
1248.400	-	-	-	-47	>20
1404.450	-	-	-	-47	>20

EMISSIONS (MHz)	DUT, PLACED V/H	ANT, POLARITY V/H	ATTENUATION (dB)	FCC LIMIT (dB)	MARGIN (dB)
REDUCED POWER: 1 WATT					
312.100	V	V	-55.0	-43	12.0
468.150	H	H	-57.0	-43	14.0
624.200	V	V	-61.0	-43	18.0
780.250	H	H	-53.0	-43	10.0
936.300	V	V	-60.0	-43	17.0
1092.350	H	H	-61.0	-43	18.0
1248.400	-	-	-	-43	>20
1404.450	-	-	-	-43	>20

2) Frequency at which tuned: 156.80 MHz

EMISSIONS (MHz)	DUT, PLACED V/H	ANT, POLARITY V/H	ATTENUATION (dB)	FCC LIMIT (dB)	MARGIN (dB)
FULL POWER: 4.5 WATTS					
313.600	V	V	-65.0	-47	18.0
470.400	H	H	-66.0	-47	19.0
627.200	V	V	-66.0	-47	19.0
784.000	H	H	-62.0	-47	15.0
940.800	V	V	-64.0	-47	17.0
1097.600	H	H	-64.0	-47	17.0
1248.400	-	-	-	-47	>20
1404.450	-	-	-	-47	>20

EMISSIONS (MHz)	DUT, PLACED V/H	ANT, POLARITY V/H	ATTENUATION (dB)	FCC LIMIT (dB)	MARGIN (dB)
REDUCED POWER: 1 WATT					
313.600	V	V	-58.0	-43	15.0
470.400	H	H	-55.0	-43	12.0
627.200	V	V	-58.0	-43	15.0
784.000	H	H	-56.0	-43	13.0
940.800	V	V	-62.0	-43	19.0
1097.600	H	H	-62.0	-43	19.0
1248.400	-	-	-	-43	>20
1404.450	-	-	-	-43	>20

3) Frequency at which tuned: 156.05 MHz

EMISSIONS (MHz)	DUT, PLACED V/H	ANT, POLARITY V/H	ATTENUATION (dB)	FCC LIMIT (dB)	MARGIN (dB)
FULL POWER: 4.5 WATTS					
312.100	V	V	-64.0	-47	17.0
468.150	H	H	-64.0	-47	17.0
624.200	V	V	-67.0	-47	20.0
780.250	H	H	-60.0	-47	13.0
936.300	V	V	-65.0	-47	18.0
1092.350	H	H	-62.0	-47	15.0
1248.400	H	H	-67.0	-47	20.0
1404.450	-	-	-	-47	>20

EMISSIONS (MHz)	DUT, PLACED V/H	ANT, POLARITY V/H	ATTENUATION (dB)	FCC LIMIT (dB)	MARGIN (dB)
REDUCED POWER: 1 WATT					
312.100	V	V	-53.0	-43	10.0
468.150	H	H	-58.0	-43	15.0
624.200	V	V	-61.0	-43	18.0
780.250	H	H	-57.0	-43	14.0
936.300	V	V	-57.0	-43	14.0
1092.350	H	H	-62.0	-43	19.0
1248.400	-	-	-	-43	>20
1404.450	-	-	-	-43	>20

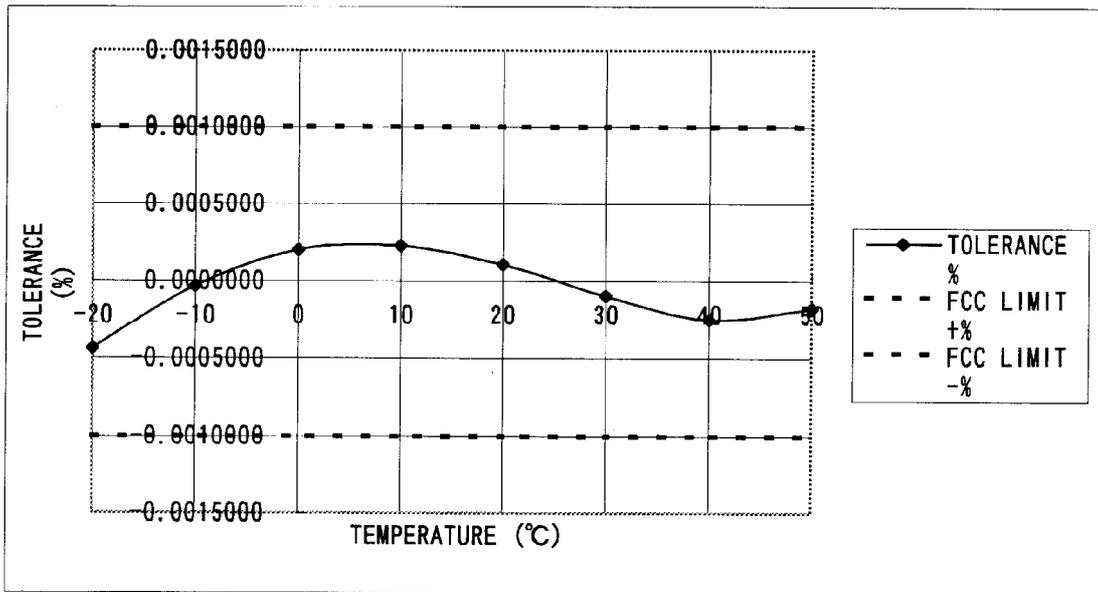
Note: All spurious emissions note reported were attenuated by at least 20 dB below the FCC limit.

9. FREQUENCY STABILITY (TEMPERATURE RANGE)

2.995 & 80.209

CENTER FREQUENCY : 156.800 MHz

TEMPERATURE °C	FREQ. MHz	TOLERANCE		FCC LIMIT	
		Hz	%	+%	-%
-20	156.799311	-689	-0.0004394	0.001	-0.001
-10	156.799944	-56	-0.0000357	0.001	-0.001
0	156.800312	312	0.0001990	0.001	-0.001
10	156.800352	352	0.0002245	0.001	-0.001
20	156.800163	163	0.0001040	0.001	-0.001
30	156.799845	-155	-0.0000989	0.001	-0.001
40	156.799602	-398	-0.0002538	0.001	-0.001
50	156.799712	-288	-0.0001837	0.001	-0.001

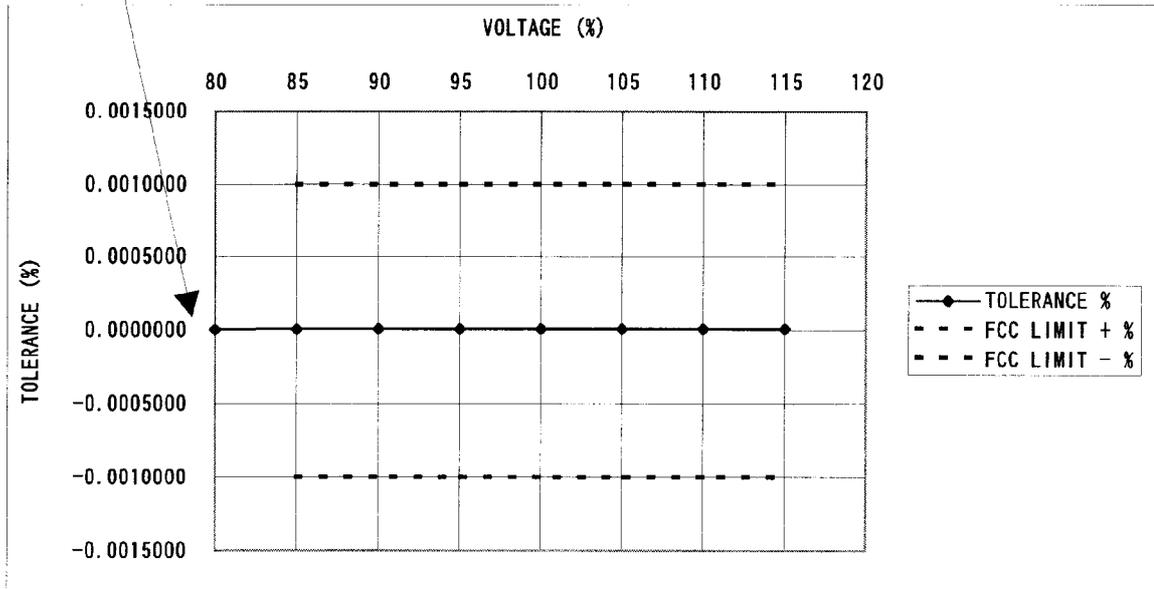


10. FREQUENCY STABILITY (VOLTAGE RANGE)

2.995 & 80.209

CENTER FREQUENCY : 156.800 MHz

	VOLTAGE		FREQ.		TOLERANCE		FCC LIMIT	
	(V)	(%)	MHz	Hz	%	+ %	- %	
BATTERY END POINT	6.00	80	156.800006	6	0.000038			
	6.38	85	156.80001	10	0.000064	0.001	-0.001	
	6.75	90	156.800012	12	0.000077	0.001	-0.001	
	7.13	95	156.800012	12	0.000077	0.001	-0.001	
	7.50	100	156.800012	12	0.000077	0.001	-0.001	
	7.88	105	156.800012	12	0.000077	0.001	-0.001	
	8.25	110	156.800012	12	0.000077	0.001	-0.001	
	8.63	115	156.800012	12	0.000077	0.001	-0.001	



RX-RADIATION

11. FIELD STRENGTH OF SPURIOUS & HARMONICS RADIATION

2.933

EMISSIONS (MHz)	ATTENUATION (dB)	FCC LIMIT (dB)	MARGIN (dB)
<p>1) Frequency at which tuned: 156.050 MHz No emissions exceed 20dB below the FCC limits.</p> <p>2) Frequency at which tuned: 156.700 MHz No emissions exceed 20dB below the FCC limits.</p> <p>3) Frequency at which tuned: 157.425 MHz No emissions exceed 20dB below the FCC limits.</p>			

Note: All spurious emissions note reported were attenuated by at least 20 dB below the FCC limit.