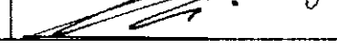
FCC Part 95(B) Test Report
for
Telson Information and Communication Co., Ltd.
on the
Family Radio
Model: RANGER-FORCE-10

Test Report: J99017686
Date of Report: July 29, 1999

Accreditation logos in this area, if any apply to testing reported. Note that limitations on scope of accreditation must be stated. For example, NIST Handbook 150, section 285.8, requires: "Use of the NVLAP logo...should be accompanied by the following: "Accredited by the National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code 200201-0."

Tested by:	Xi-Ming Yang	
Reviewer:	C. K. Li	

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1 JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of

Company: Telson Information and Communications Co., Ltd.
356_5GA, San-Dong, Kum Cheun-Ku
Seoul, Korea

Name of contact: Y. Won
Telephone: (02) 851-2780
Fax: (02) 857-9583

1.2 Equipment under test (EUT)

Equipment type: Family Radio Face-Held Transceiver

Model number(s): RANGER

Part or serial number: FCC ID: OBARANGER-FORCE-10

Manufacturer: SAME as above.

Use of Product : Voice communications

Production is planned: [X] Yes, [ ] No

Technical Specifications:

Type of Emission	11KOF3E
Max. Allowed modulation (M)	3.0 kHz
Max. Allowed deviation (D)	2.5 kHz
Range of RF Output	0.5 W (ERP)
Means for variation of operating power	None
The dc voltage applied to and current into the several elements of the final RF amplifying device	*Collector Voltage:* 6 Vdc *Collector Current:* 300 mA
Frequency Range	462 to 468 MHz
Max. number of Channels	14
Antenna	Monopole
Detachable antenna ?	No
External input	Audio

EUT receive date: 06/23/1999

EUT received condition: Good condition prototype

Test start date: 06/30/1999
Test end date: 07/16/1999

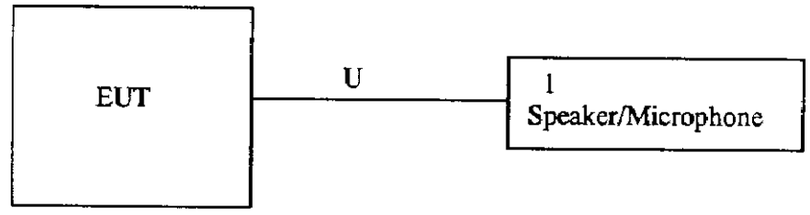
1.3 Test plan reference

FCC Part 2.1033, FCC Part 95 (B)

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details the placement of the equipment under test on the turntable. Please note that the equipment on the rear of the table was centered along the back edge. Equipment on the front of the turntable was centered along the front edge. All peripherals were separated by 10 cm.



S: Shielded	U: Unshield	F: With Ferrite Core

Support equipment					
Equp. #	**Equipment**	**Manufacturer**	**Model #**	**S/N #**	**FCC ID**
1	Speaker/Microphone	Radio Shack	19-315	Not labelled	N/A
--	--	--	--	--	--

1.4.2 Justification

The system was configured for testing in a typical manner in accordance with ANSI C63.4 standard. During testing, the peripheral locations were varied with respect to the EUT.

1.4.3 Mode(s) of operation

The EUT was powered and fully operational with option speaker/microphone connected. The unit was powered from 4 fully charged AAA batteries.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

2 TEST SUMMARY

FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
Transmitter Section			
2.1046 95.639(d)	Effective Radiated Power	0.49 W	8
2.1047 95.631(d) 95.637(a)	Modulation Characteristics F3E analogy voice Peak frequency deviation Audio frequency response	 2.5 kHz 3.0 kHz	9
2.1049 95.633(c)	Occupied Bandwidth	11 kHz	12
2.1053 15.109(a)	Field Strength of Spurious Radiation	Worst case Freq.: 2806.3MHz Margin: -9.0dB	14
15.107	Line Conducted Emissions	N/A	N/A
2.1055	Frequency Stability Vs. Temperature Vs. Voltage	 1.75 ppm -1.44ppm	20
Receiver Section			
15.109(a)	Radiated Emissions	Worst case Freq.: 849.6 MHz Margin: -8.5 dB	16

3 EFFECTIVE RADIATED POWER

3.1 Test Description

Parameter:	FCC § 2.1046
Requirement:	FCC § 95.639
Effective Radiated Power (ERP):	< 0.5 watts

3.2 Test Procedure

The EUT was positioned on a non-conductive turntable, 0.8m above the ground plane on an open test site.

The radiated emission at the fundamental frequency was measured at 3m distance with a test antenna and spectrum analyzer. During the measurement, the resolution and video bandwidth of the spectrum analyzer were set to 100 kHz. To maximize emissions, the system was rotated through 360°, the antenna height was varied from 1m to 4m, and the antenna polarization was changed.

The ERP was calculated using equation:

$$E = \frac{\sqrt{30 \cdot P \cdot G}}{D}$$

Where E = Field Strength (V/m), P = ERP (W)
G = Antenna Gain (1.64 for a half-wave dipole), D = Distance (m)

3.3 Test Results

Test Conditions:		*Antenna Gain, G =*		*1.64*	*Distance, D =*	*3*
Frequency MHz	Reading dB(μV)	Antenna Factor dB(1/m)	Preamp Gain dB	Cable Loss DB	Field Strength dB(μV/m)	ERP W
462.56	106.2	16.6	0	1.5	124.3	0.489
467.72	105.9	16.9	0	1.5	124.3	0.489

Note: Field Strength = Reading + Antenna Factor – preamp + Cable loss

3.4 Modifications made during testing

None

3.5 Test Instrumentation

[x] Hewlett Packard HP8566B Spectrum Analyzer (S.A.)
[x] EMCO Bi-Log Antenna
[ ] HP Pre-amp

4 MODULATION CHARACTERISTICS

4.1 Test Description

Parameter:	FCC § 2.1047
Requirement:	FCC § 95.637
Peak Frequency Deviation: Audio Frequency Response:	Less than ± 2.5 kHz ≤ 3.125 kHz

4.2 Test Procedure

4.2.1 Audio Frequency Response

The RF output of the transceiver was connected to the input of a FM deviation meter through sufficient attenuation so as not to overload the meter or distort the readings. An audio signal generator was coupled into the external microphone jack of the transceiver, or alternatively, the microphone element was removed and the generator output was connected to the microphone connectors.

The audio signal input level was adjusted to obtain 20% of the maximum rated system deviation at 1 kHz, and recorded as DEV_{REF}. With the audio signal generator level unchanged, set the generator frequency between 300 Hz to 5000 Hz. The transmitter deviations (DEV_{FREQ}) were measured and the audio frequency response was calculated as

$$20\log_{10}\left[\frac{DEV_{FREQ}}{DEV_{REF}}\right]$$

4.2.2 Audio Low-Pass Filter Response

An audio signal generator and an audio spectrum analyzer were connected to the input and output of the post limiter low pass filter respectively. The audio signal generator frequency was set between 1000 Hz and the upper low pass filter limit. The audio frequency response at test frequency was calculated as

$LEV_{FREQ} - LEV_{REF}$

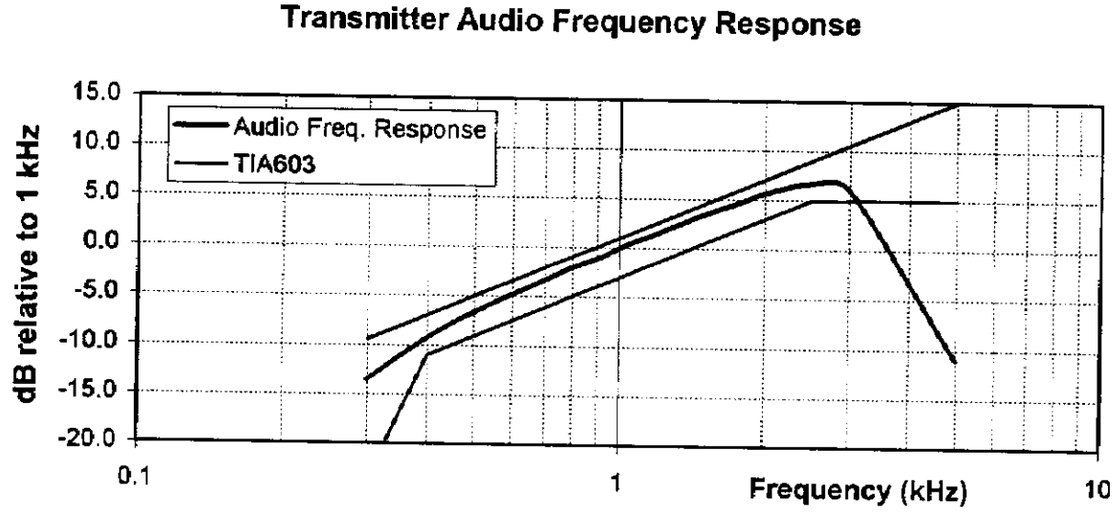
4.2.3 Modulation Limiting

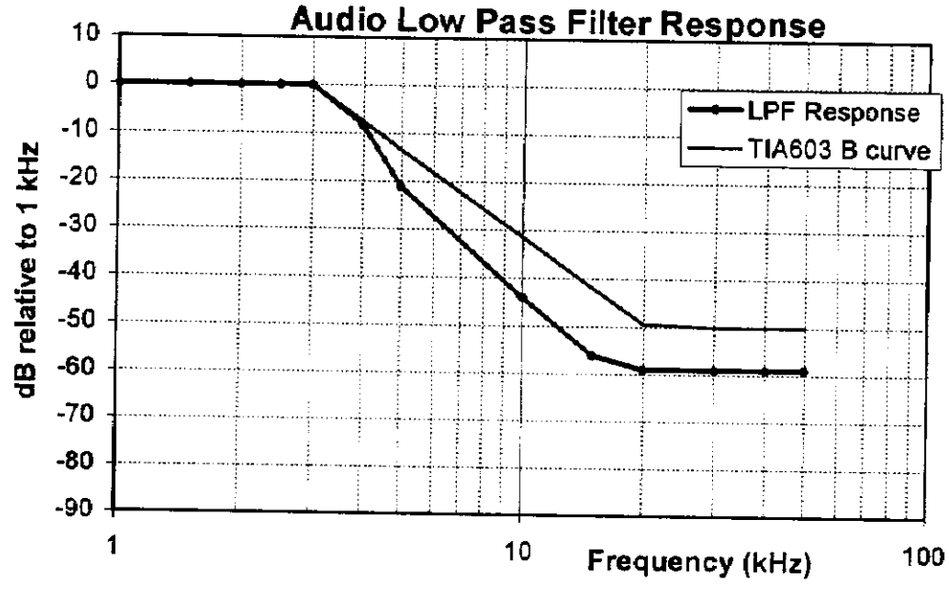
With the same setup as section 4.2.1 above, at three different modulating frequencies, the output level of the audio generator was varied and the FM deviation level was recorded.

4.3 Test Results

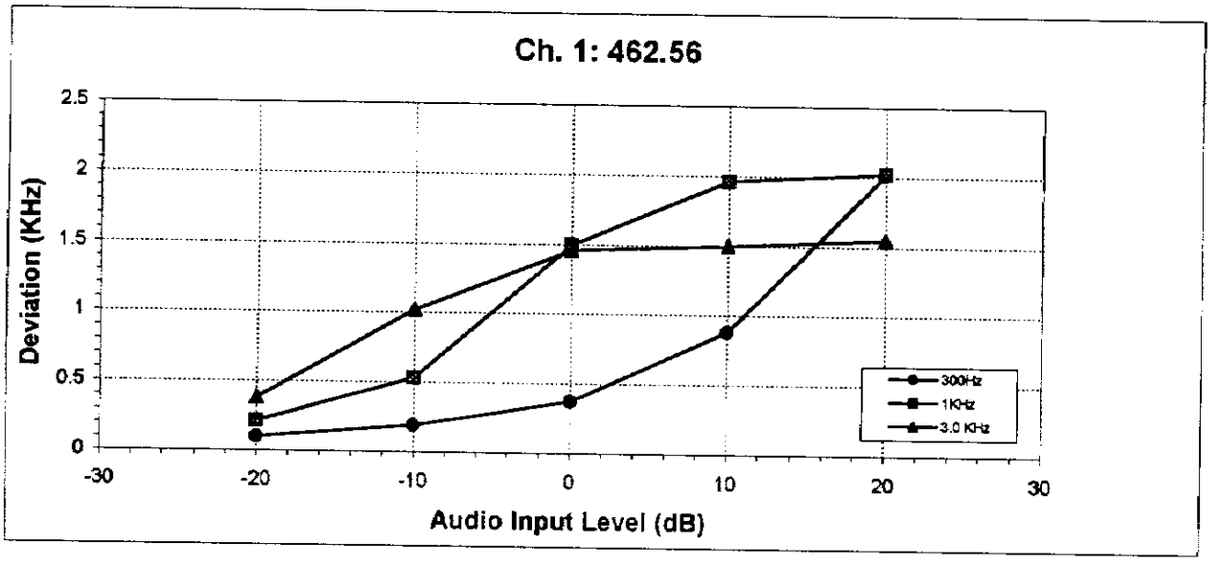
X	See below.
	There were no changes in the schematics and PCB layout of the already granted unit.

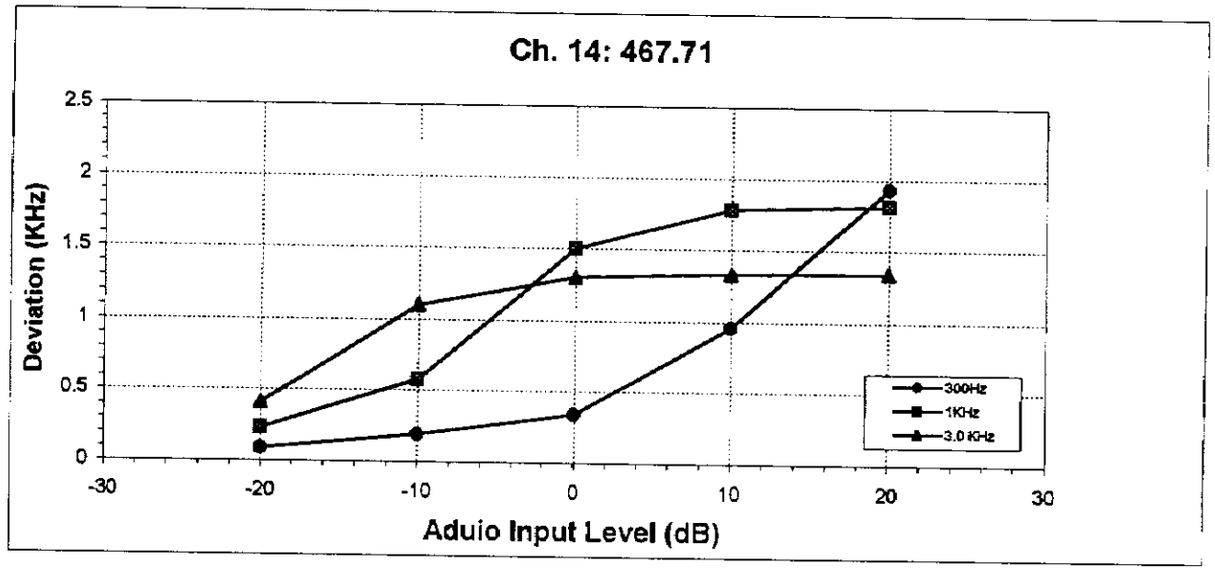
Test Condition	
Frequency (MHz)	mid channel





Modulation Limiting Test Condition	
Frequency (MHz)	462.56 and 467.7125
V_{inp} (mV)	15 mV
Reference Deviation	1.5 kHz at 1 kHz modulating frequency





4.4 Modifications made during testing

None

4.5 Test instrumentation

[X] Marconi 2955A Radio Communication Test Set
[X] Leader LFG-1300S Function Generator
[X] LMV-182 AC Millivoltmeter

5 OCCUPIED BANDWIDTH

5.1 Test description

Parameter:	FCC §2.1049
Requirement:	FCC § 95.633(c)
Emission Bandwidth:	12.5 kHz

5.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output.

The RF output was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set up at least 10 times higher then the authorized bandwidth of the transmitter. With the transmitter keyed, the level of the unmodulated carrier was set to the full scale reference line of the spectrum analyzer. This is used as a 0dB reference for emission mask measurements.

The transmitter was then modulated with a 2500 Hz tone at an input level 16 dB greater than the necessary to produce 50% of rated system deviation. The resolution bandwidth of the spectrum analyzer was set up to 100 Hz and the spectrum of the transmitting signal was recorded. This spectrum was compared to the required emission mask.

5.3 Test Results

Please see Exhibit 10 for the occupied bandwidth plots:

Plot Number	Description
10-1	Full Power, reference level
10-2	Occupied bandwidth, scan 62.5 kHz

5.4 Modifications made during testing

None

5.5 Test instrumentation

[X] Leader LFG-1300S Function Generator
[X] HP 8566B Spectrum Analyzer
[X] HP 7470A Plotter

6 RADIATED SPURIOUS EMISSIONS

6.1 Test description

Parameter:	FCC §2.1053
Requirement:	FCC § 15.109
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6.2 Test Procedure

The transmitter was placed on a wooden turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3 orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

The spurious harmonic attenuation was calculated as the difference between E in dB(uV/m) at the fundamental frequency and at the spurious emission frequency.

Spurious attenuation in dB = 43 +10Log_{10}(power out in Watts)

6.3 Test Results

Please see the following pages for

[X] Spurious harmonic attenuation
[X] FCC Part 15.109 Radiated Emission

SPURIOUS HARMONIC ATTENUATION

Company: Telson Information & Communication
Project #: J99017686
Model: RANGER-FORCE-10
Engineer: Xi-Ming Y
Date of test: June 30, 1999

Test Condition: Continue Transmitting

Frequency MHz	Pol H/V	Antenna Factor dB(uV)	Reading dB(1/m)	Antenna dB	Pre-amp dB	Cable Loss dB	Field Strength dB(uV/m)	Spurious Attenuation dB	Margin dB
Channel 1									
925.15	V	41.5	22.8	0.0	2.2	66.0	58.3	-18.3	
1387.68	V	45.8	24.7	0.0	2.7	73.2	51.1	-11.1	
1850.26	V	36.5	27.2	0.0	3.2	66.9	57.4	-17.4	
2312.82	V	33.8	39.6	0.0	2.3	65.7	58.6	-18.6	
2775.36	V	41.1	30.6	0.0	2.3	74.0	50.3	-10.3	
3237.94	V	32.5	31.8	0.0	2.5	66.8	57.5	-17.5	
3700.50	V	35.5	33.1	0.0	2.7	71.3	53.0	-13.0	
4163.06	V	31.9	34.2	0.0	2.9	69.0	55.3	-15.3	
4625.60	H	32.0	34.0	0.0	3.2	69.2	55.1	-15.1	
Channel 14									
935.43	V	42.5	22.6	0.0	2.2	67.3	57.0	-17.0	
1403.14	V	45.7	24.7	0.0	2.7	73.1	51.2	-11.2	
1870.25	V	32.2	27.2	0.0	3.2	62.6	61.7	-21.7	
2338.56	V	33.0	29.6	0.0	2.3	64.9	59.5	-19.4	
2806.28	V	42.4	30.6	0.0	2.3	75.3	49.0	-9.0	
3273.99	V	30.1	31.8	0.0	2.5	64.4	59.9	-19.9	
3741.70	V	34.6	33.1	0.0	2.7	70.4	53.9	-13.9	
4209.42	V	30.0	34.2	0.0	2.9	67.1	57.4	-17.2	
4677.12	H	33.0	34.0	0.0	3.2	70.2	54.1	-14.1	

Note: 1. All measurement were made at 3 meters
2. Field Strength at the fundamental frequency equals 124.3 dBuV/m (ch.1) and 124.3 dBuV/m (ch.14)
3. Negative signs (-) in the margin column signify levels below the limit.

FCC PART 15.109 RADIATED EMISSION

Test Condition: Receiving mode
Frequency range investigated: 30 to 1000 MHz.

Frequency	Reading	Det.	Ant. Pol.	Ant. Factor	Pre-Amp	Cable Loss	Net	Limit @3m	Margin
MHz	DB(uV)	P/A/Q	H/V	dB(1/m)	DB	dB	dB(uV/m)	dB(uV/m)	dB
63.75	27.2	Peak	H	6.0	18.9	0.3	14.6	40.0	-25.4
127.50	26.7	Peak	H	7.4	19.1	0.1	15.1	43.5	-28.4
233.88	28.8	Peak	H	11.4	18.4	0.3	22.1	46.0	-23.9
255.05	26.7	Peak	H	12.8	18.2	0.1	21.4	46.0	-24.6
318.00	25.6	Peak	H	14.4	17.9	1.1	23.2	46.0	-22.8
382.48	27.4	Peak	H	15.6	17.4	1.8	27.4	46.0	-18.6
446.50	28.6	Peak	H	16.9	16.9	1.2	29.8	46.0	-16.2
637.03	28.1	Peak	H	20.3	15.7	1.4	34.1	46.0	-11.9
849.58	26.7	Peak	H	23.1	14.6	2.3	37.5	46.0	-8.5

Note: 1. All measurement were made at 3 meters
2. Negative signs (-) in the margin column signify levels below the limit.

6.4 Modifications made during testing

None

6.5 Test instrumentation

[X] CDI B100/200/300 Biconical Antennas
[X] EMCO Bi-logcon Antenna
[X] EMCO 3115 Horn Antenna
[X] HP 8566B Spectrum Analyzer
[X] Preamplifiers

7 AC LINE CONDUCTED EMISSIONS

7.1 Test description

Parameter:	ANSI C63.4
Requirement:	FCC § 15.107

7.2 Test Procedure

The EUT was connected to the DC power supply, that was connected to the AC line through the LISNs.

Both HOT and NEUTRAL leads were tested.

7.3 Test Results

[X] Not applicable, the EUT is battery powered only.

7.4 Modifications made during testing

None

7.5 Test instrumentation

[ ] HP 8566B Spectrum Analyzer
[ ] LISN

8 FREQUENCY STABILITY

8.1 Test description

Parameter:	FCC §2.1055
Requirement:	FCC § 95.627
Frequency Tolerance:	Within 0.00025% (25ppm)

8.2 Test Procedure

The ppm frequency error of the transmitter was calculated by:

$$ppm\ error = \left(\frac{MCF}{ACF} - 1\right) \cdot 10^6$$

Where MCF is the Measured Carrier Frequency in MHz
ACF is the Assigned Carrier Frequency in MHz

8.2.1 Frequency Stability vs. Temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feedthrough attenuators. The EUT was placed inside the temperature chamber.
After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

9.2.2 Frequency Stability vs. Voltage

At room temperature (25 ±5 °C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

9.3 Test Results

ACF (MHz):	462.5625	Limit: 2.5ppm
Temperature, C	MCF (MHz)	PPM Error
50	462.563189	1.489528442
40	462.563309	1.748952844
30	462.562652	0.328604243
20	462.561881	-1.338197541
10	462.561881	-1.338197541
0	462.561689	-1.753276584
-10	462.56207	-0.929604108
-20	462.561973	-1.139305499

Frequency Stability vs Voltage			
ACF (MHz): 462.5625			Limit: 2.5 ppm
%	Voltage	MCF (MHz)	PPM Error
115	6.90	462.561938	-1.22
100	6.00	462.561953	-1.18
85	5.10	462.561984	-1.11
Battery Endpoint	4.00	462.561821	-1.47

9.4 Modifications made during testing

None

9.5 Test instrumentation

[X] Temperature Chamber, -50C to +100C
[X] Hewlett Packard 5383A Frequency Counter
[X] Tektronix 2784 Spectrum Analyzer
[X] Goldstar DC Power Supply, GR303

10 LIST OF EXHIBITS

The following exhibits are listed as reference only and are submitted as separate attachments:

Exhibit 1 **ID Label Format**

Exhibit 2 **ID Label Location**

Exhibit 3 **Equipment Photographs**

Exhibit 4 **Block Diagram**

Exhibit 5 **Circuit Diagram**

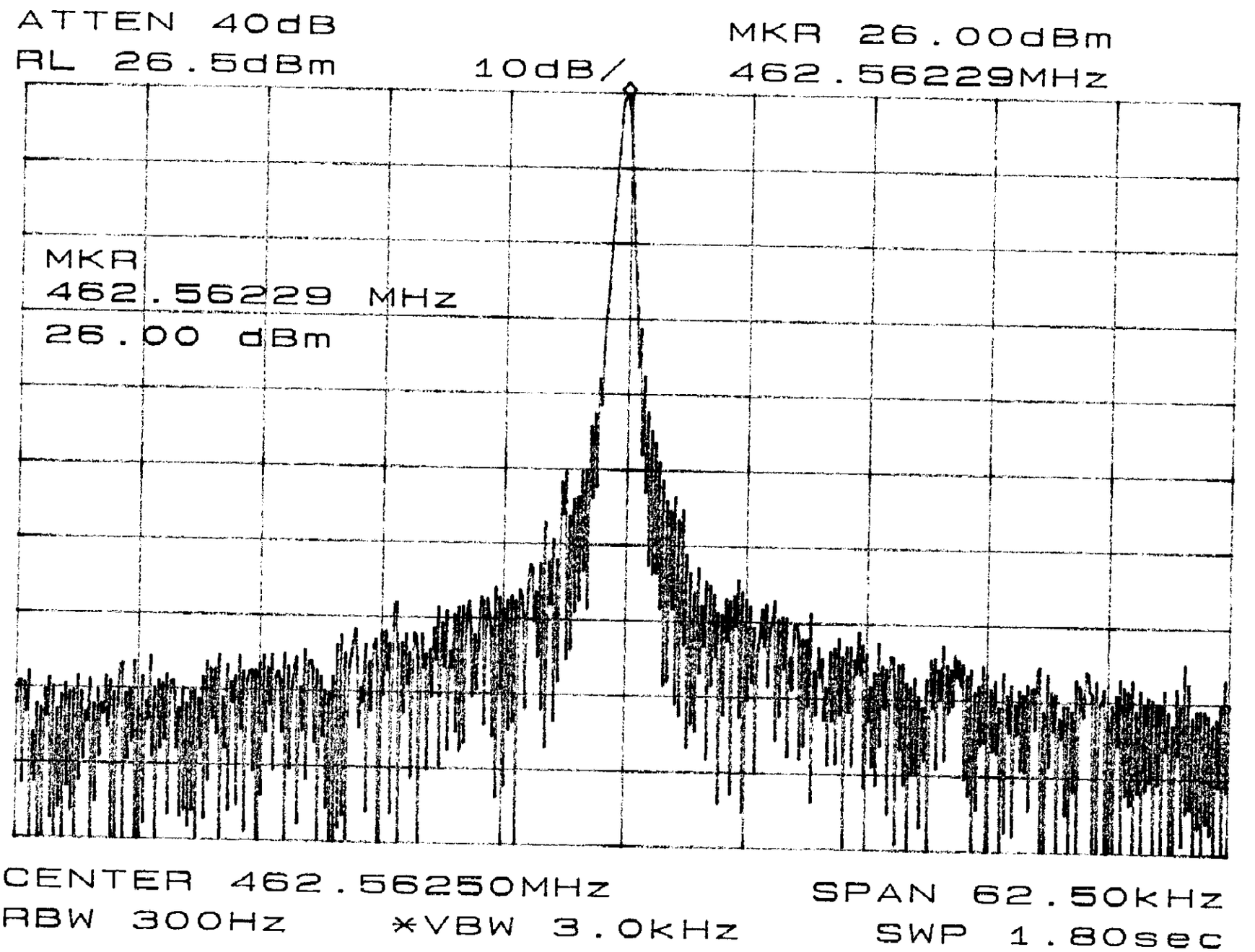
Exhibit 6 **Theory of Operation:**
Description of all circuitry and devices provided for determining and stabilizing Frequency, for suppression of spurious radiation, for limiting modulation, and for Limiting power.

Exhibit 7 **Tune-Up Procedure over the power range**

Exhibit 8 **Test Setup Photos**

Exhibit 9 **Instruction Manual**

Exhibit 10 **Plots** - See attached
10-1: **Full Power**, reference level
10-2: Occupied bandwidth, scan 62.50kHz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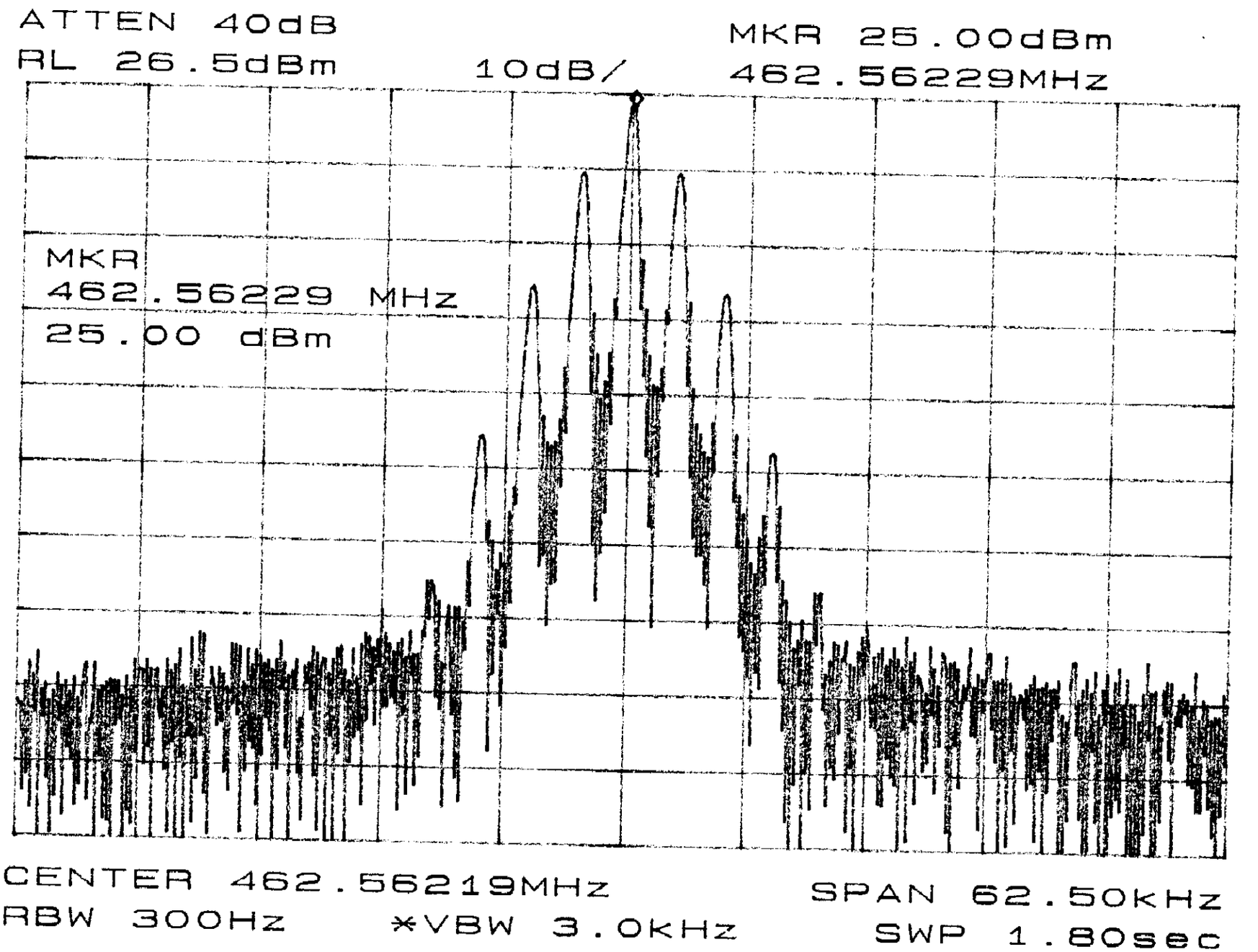
RL 26.5dBm
10dB/
MKR 26.00dBm
462.56229MHz
MKR
462.56229 MHz
26.00 dBm
CENTER 462.56250MHz
SPAN 62.50kHz
*RBW 300Hz
*VBW 3.0kHz
SWP 1.80sec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10dB/
MKR 25.00dBm
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MKR
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25.00 dBm
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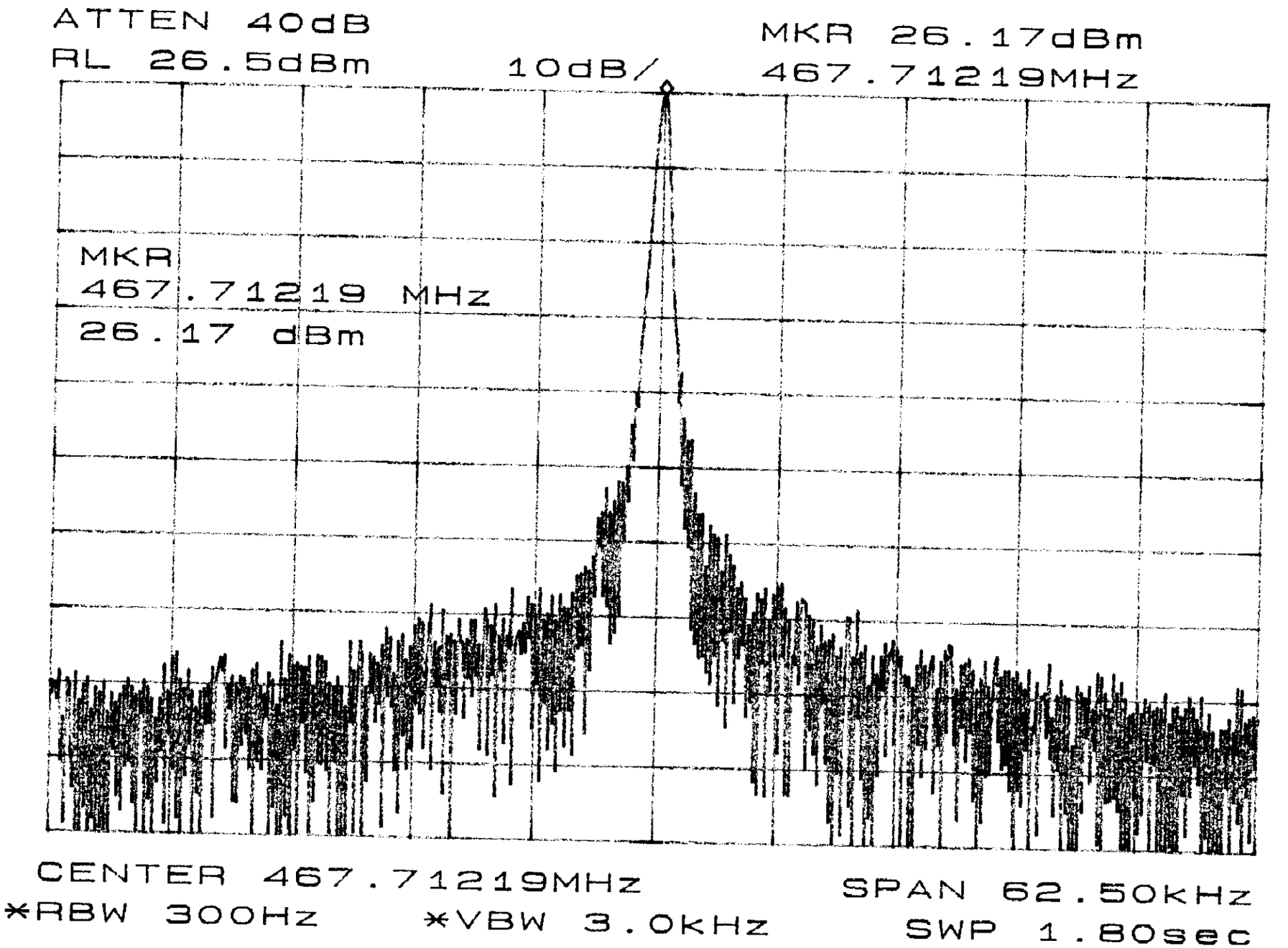
SPAN 62.50kHz
*RBW 300Hz
*VBW 3.0kHz
SWP 1.80sec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MKR
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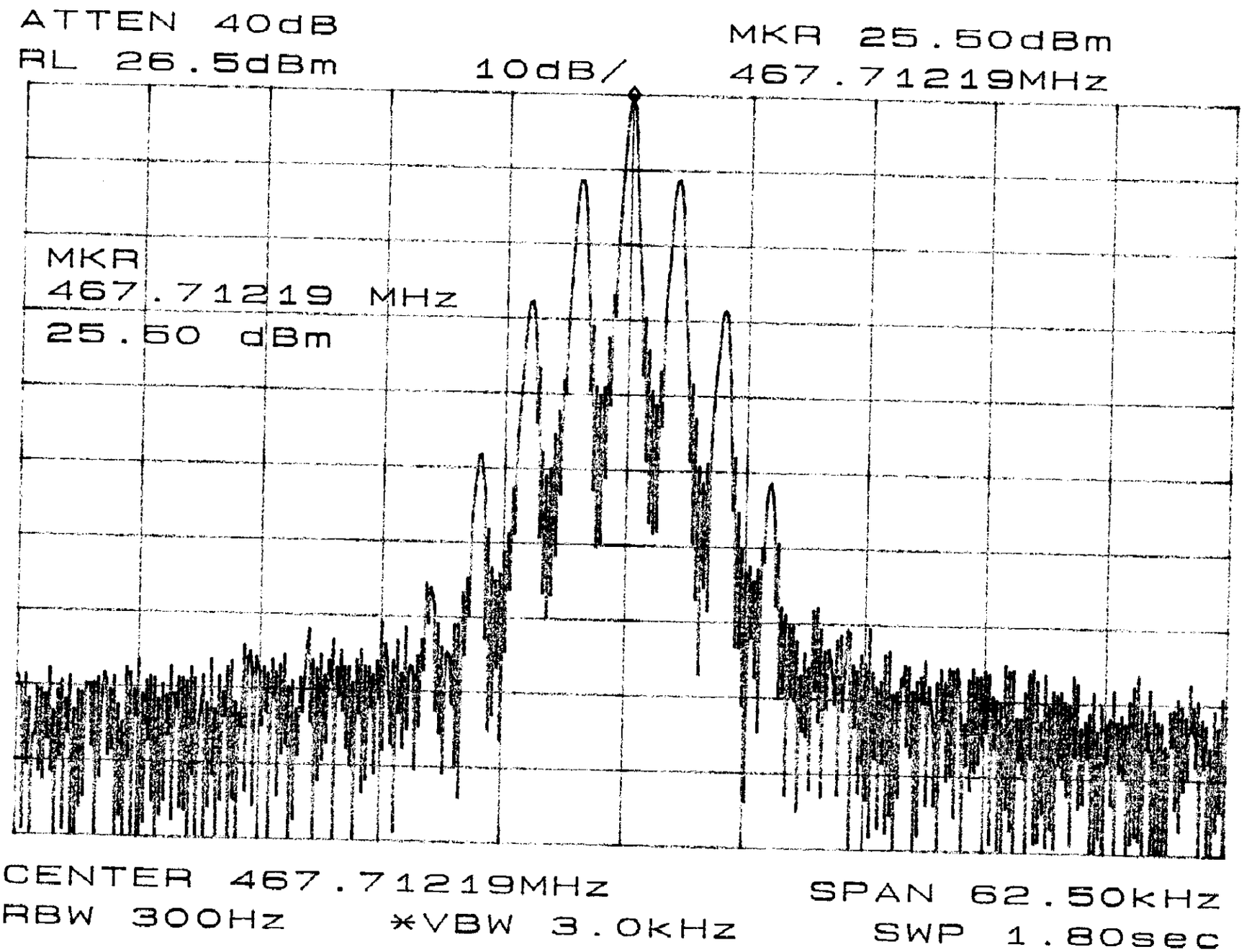
*RBW 300Hz
*VBW 3.0kHz
SWP 1.80sec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SPAN 62.50kHz
*RBW 300Hz
*VBW 3.0kHz
SWP 1.80sec