TEST REPORT

For

GNSS RECEIVER

In conformity with

FCC 47 CFR Part 90 subpart I / October 1, 2009
IC RSS-119 ISSUE 9

Model: SOKKIA MODEL: GRX1/S / TOPCON MODEL: HiPer Ⅱ/S

FCC ID: LCB-090531

IC ID: 6050B-090531

Test Item: GNSS RECEIVER

Report No: RY1006H02R1

Issue Date: June 2, 2010

Prepared for

FCC Applicant:
Topcon America Corporation
37 West Century Road, Paramus, New Jersey 07625 U.S.A

IC Applicant:
Topcon Positioning Systems, Inc.
7400 National Drive, Livermore, CA94551, U.S.A.

Prepared by

RF Technologies Ltd.
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History

Report No	Date	Revisions	Isseud by
RY1006H02R1	June 2, 2010	Initial Issue	**T. Hori**

1 General information

1.1 Product description

Test item	: GNSS RECEIVER
Manufacturer	: TOPCON POSITIONING SYSTEMS, INC.
Address	: 7400 NATIONAL DRIVE LIVERMORE, CA 94511,U.S.A.
Model	: SOKKIA MODEL : GRX1/S / TOPCON MODEL : HiPer II /S
Serial numbers	: Proto Type No.20
FCC ID	: LCB-090531
IC ID	: 6050B-090531
Type of modulation	: 4FSK
Transmitter Power	: 1.000 W
Transmitting Frequency	: 461 MHz – 465 MHz
Clock Frequency	: 12.5 MHz, 14.7 MHz, 20 MHz
Antenna Gain	: 2.4dBi (Manufacture's declared)
Receipt date of EUT	: February 26, 2010
Nominal power source voltages	: DC 12.0V

This EUT is equipped with GPS, UHF transceivers. The UHF transceiver operates at the frequency of 461 MHz – 465 MHz.

1.2 Test(s) performed/ Summary of test result

Test specification(s)	: FCC 47 CFR Part 90 Subpart I / October 1, 2009 IC RSS-119 ISSUE 9
Test method(s)	: ANSI C63.4: 2003, TIA 603-C: 2004
Test(s) started	: March 1, 2010
Test(s) completed	: June 2, 2010
Purpose of test(s)	: Certification of FCC
Test condition	: Continuous transmission mode
Test Temperature	: -20 degree to +60 degree (Manufacture's declared)
Summary of test result	: Complied

Note: The above judgment is only based on the measurement data and it does not include the measurement uncertainty. Accordingly, the statement below is applied to the test result.
The EUT complies with the limit required in the standard in case that the margin is not less than the measurement uncertainty in the Laboratory.
Compliance of the EUT is more probable than non-compliance is case that the margin is less than the measurement uncertainty in the Laboratory.

Test engineer : T. Hori
T. Hori (EMC Testing Department)

Reviewer : T. Ikegami
T. Ikegami (Manager, EMC Testing Department)

1.3 Test facility

The Federal Communications Commission has reviewed the technical characteristics of the test facilities at **RF Technologies Ltd.**, located in 472, Nippa-cho, Kohoku-ku, Yokohama, 223-0057, Japan, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948, per October 1, 2009. The description of the test facilities has been filed under registration number 319924 at the Office of the Federal Communications Commission. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.
The list of all public test facilities is available on the Internet at http://www.fcc.gov.

Registered by Voluntary Control Council for Interference by Information Technology Equipment (VCCI)
Each registered facility number is as follows;
Test site (Semi Anechoic chamber 3m) R-2393
Test site (Shielded room) C-2617

Registered by Industry Canada (IC) Each registered facility number is as follows;
Test site No.1 (Semi Anechoic chamber 3m): 6974A-1

Accredited by **National Voluntary Laboratory Accreditation Program** (NVLAP) for the emission tests stated in the scope of the certificate under Certificate Number 200780-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

1.4 Measurement uncertainty

The treatment of uncertainty is based on the general matters on the definition of uncertainty in “Guide to the expression of uncertainty in measurement (GUM)” published by ISO. The Lab’s uncertainty is determined by referring UKAS Publication LAB34: 2002 “The Expression of Uncertainty in EMC Testing” and CISPR16-4-2: 2003 “Uncertainty in EMC Measurements”.
The uncertainty of the measurement result in the level of confidence of approximately 95% (k=2) is as follows;

RF frequency: ± 1 x 10^{-7}
Conducted emission of Receivers: ± 1.9 dB
Radiated emission (9 kHz - 30MHz): ± 2.8 dB
Radiated emission (30MHz - 1000MHz): ± 5.7 dB
Radiated emission (1000 MHz – 50000 MHz): +/- 5.8 dB
Temperature: ± 1 degree
Humidity: ± 10%
DC voltage: +/- 1 %

1.5 Summary of test results

Requirement of;	Section in FCC90, RSS-119	Result	Section in this report
1.5.1 RF Power output	FCC 90.205 RSS-119 Clause 5.4	Complied	2.1
1.5.2 Occupied Bandwidth	FCC 90.209 RSS-119 Clause5.5	Complied	2.2
1.5.3 Emission Mask	FCC 90.210 RSS-119 Clause 3.2.11	Complied	2.3
1.5.4 Field Strength of Spurious Radiation	FCC 90.210 RSS-119 Clause 3.2.11	Complied	2.4
1.5.5 RECEIVER Spurious Emissions	RSS-119 Clause 5.11	Complied	2.5
1.5.6 Frequency Stability	FCC 90.213 RSS-119 Clause 5.3	Complied	2.6
1.5.7 Transient Frequency Behavior	FCC 90.214 RSS-199 Clause 5.9	Complied	2.7
1.5.8 Maximum Permissible Exposure	FCC § 1.1310	Complied	2.8

1.6 Setup of equipment under test (EUT)

Equipment(s) under test:

	Item	Manufacturer	Model No.	Serial No.	Remark
1	GNSS RECEIVER	TOPCON	HiPer Ⅱ/S, GRX1/S	Proto Type No.20	EUT

Support Equipment(s):

	Item	Manufacturer	Model No.	Serial No.	Remark
2	PC	TOSHIBA	PS265J-CCKL6	40033432J	-
3	AC Adaptor	TOSHIBA	PA2450U	4589388	-
4	Mouse	ELECOM	M-N1P2LG	21000728	-
5	Ferrite core	TKK	9FT36SN-	-	-

Connected cable(s)

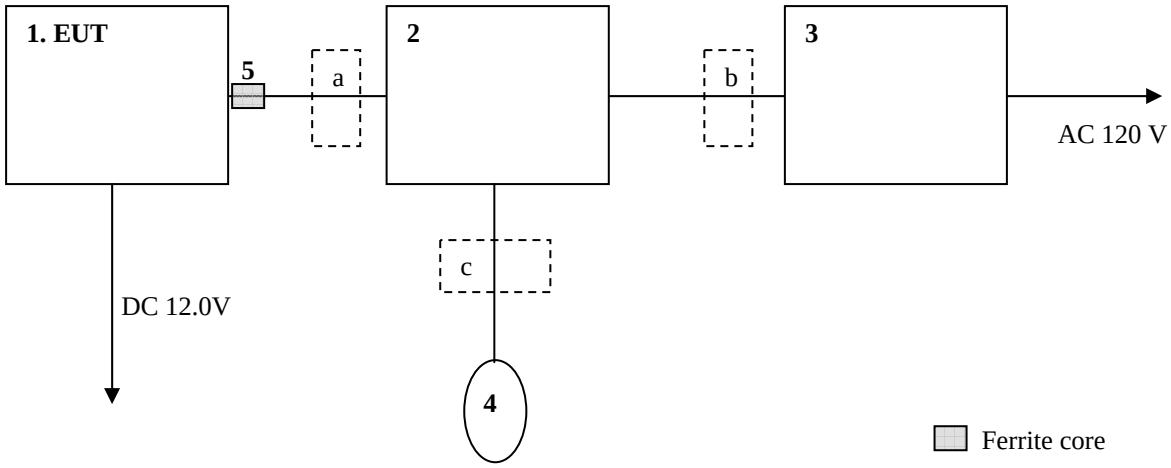
No.	Item	Identification (Manu.e.t.c)	Shielded Yes / No	Ferrite Core Yes / No	Connector Type Shielded Yes / No	Length (m)
a	RS 232C Cable	-	Yes	Yes	Yes	2.0
b	DC Cable	-	No	No	No	1.8
c	Mouse Cable	ELECOM	No	No	No	0.8

1.6.1 Operating condition:

Operating mode:

Continuous transmission mode (461 MHz, 463 MHz, 465 MHz)
Cannel Spacing: 12.5 KHz
All tests were conducted with operation mode provided by the manufacturer.

1.6.2 Setup diagram of tested system:



1.7 Equipment modifications

No modifications have been made to the equipment in order to achieve compliance with the applicable standards described in clause 1.2.

1.8 Deviation from the standard

No deviations from the standards described in clause 1.2.

2 Limit and Result

2.1 RF Power Output

Limit

FCC Part 90.205 (h): The Maximum ERP transmitter power will be considered and authorized on a case-by base bases. Please also refer to the limitations on power and antenna heights are specified as Table2 below.

Table2: 461-465MHz－Maximum ERP / Reference HAAT for a Specific Service Area Radius

	Service area radius (km)									
	3	8	13	16	24	32	40[4]	48[4]	64[4]	80[4]
Maximum ERP (W)[1]	2	100	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500	[2]500
Up to reference HAAT (m)[3]	15	15	15	27	63	125	250	410	950	2700

1 Maximum ERP indicated provides for a 39 dBu signal strength at the edge of the service area per FCC Report R–6602, Fig.29 (See § 73.699, Fig. 10 b).
2 Maximum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.
3 When the actual antenna HAAT is greater than the reference HAAT, the allowable ERP will be reduced in accordance with the following equation: ERP allow =ERP max × (HAATref / HAATactual)^2.
4 Applications for this service area radius may be granted upon specific request with justification and must include a technical demonstration that the signal strength at the edge of the service area does not exceed 39 dBu.

RSS-119 5.4 Transmitter Output Power Limit:
The output power shall be within +/- 1.0 dB of the manufacturer's rated power.
This EUT’s rated power: 30dBm

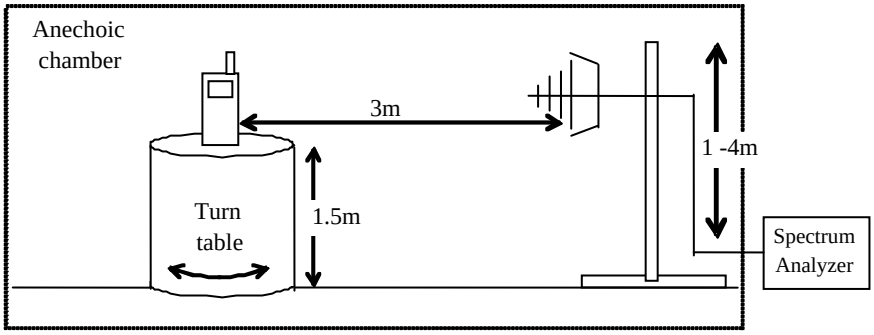
Test Procedure

RSS119 & ANSI / TIA / EIA 603 Clause 2.2.17

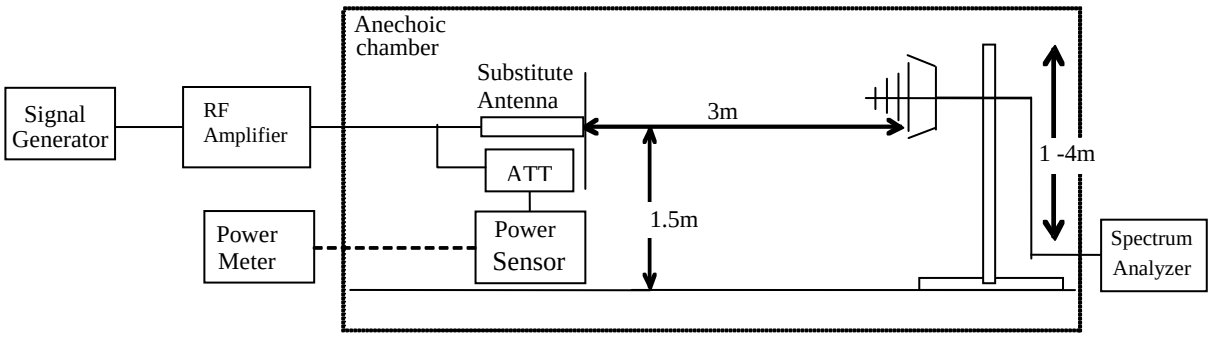
Test equipment used (refer to List of utilized test equipment)

CL26	PU03	PM03	AC01(EM)	BA04	CL11	SA06	SG05
LA02	RP04						

Test setup



[Substitution]



Tested Date: May 28, 2010

Temperature: 23 ˚C
Humidity: 42 %
Atmos. Press: 1009 hPa

Test results

IC

Conducted Output Power

Channel	Frequency [MHz]	Conducted Output Power [dBm]	Rated Power [dBm]	IC Limit [dB]
Channel Spacing: 12.5 kHz				
Low	461.0	29.7	30.0	+/- 1.0
Mid	463.0	29.5	30.0	+/- 1.0
High	465.0	29.8	30.0	+/- 1.0

FCC

Effective Radiated Power

Channel	Frequency	Reading	PM Level	ANT Gain	Result (ERP)	FCC Limit	Margin	Polarization
	[MHz]	[dBuV]	[dBm]	[dBd]	[dBm]	[dBm]	[dB]	
Low	461.0	98.5	24.0	2.8	26.8	33.0	6.2	V
Mid	463.0	98.5	24.0	2.9	26.9	33.0	6.1	V
High	465.0	98.2	23.8	2.9	26.7	33.0	6.3	V

2.2 Occupied Bandwidth

Limit

§ FCC90.209 & RSS-119 § 5.5 Bandwidth limitations.
(5) Unless specified elsewhere、channel spacing and bandwidth that will be authorized in the following frequency bands are given in the following table.

STANDARD CHANNEL SPACING/BANDWIDTH

Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
Below 25[2]		
25-50	20	20
72-76	20	20
150-174	[1]7.5	[1,3]20/11.25/6
216-220[5]	6.25	20/11.25/6
220-222	5	4
406-512[2]	[1]6.25	[1,3]20/11.25/6
806-809 / 851-854	12.5	20
809-824 / 854-869	25	20
896-901 / 935-940	12.5	13.6
902-928[4]		
929-930	25	20
1427-1432[5]	12.5	12.5
[3]2450-2483.5[2]		
Above 2500[2]		

[1] For stations authorized on or after August 18, 1995.

[2] Bandwidths for radiolocation stations in the 420–450 MHz band and for stations operating in bands subject to this footnote will be reviewed and authorized on a case-by-case basis.

[3] Operations using equipment designed to operate with a 25 kHz channel bandwidth will be authorized a 20 kHz bandwidth. Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth. Operations using equipment designed to operate with a 6.25 kHz channel bandwidth will be authorized a 6 kHz bandwidth. All stations must operate on channels with a bandwidth of 12.5 kHz or less beginning January 1, 2013, unless the operations meet the efficiency standard of § 90.203(j)(3).

[4] The maximum authorized bandwidth shall be 12 MHz for non-multilateration LMS operations in the band 909.75–921.75 MHz and 2 MHz in the band 902.00–904.00 MHz. The maximum authorized bandwidth for multilateration LMS operations shall be 5.75 MHz in the 904.00–909.75 MHz band; 2 MHz in the 919.75–921.75 MHz band; 5.75 MHz in the 921.75–927.25 MHz band and its associated 927.25–927.50 MHz narrowband forward link; and 8.00 MHz if the 919.75– 921.75 MHz and 921.75–927.25 MHz bands and their associated 927.25–927.50 MHz and 927.50–927.75 MHz narrowband forward links are aggregated.

[5] See § 90.259.

Test procedure

The transmitter output is connected to the spectrum analyzer. The RBW is set to l%to 3%of the 99%bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99%bandwidth function is utilized.

Test equipment used (refer to List of utilized test equipment)

TR04	PL06	LN06	CL18

Test results - Complied with requirement.

99% Bandwidth

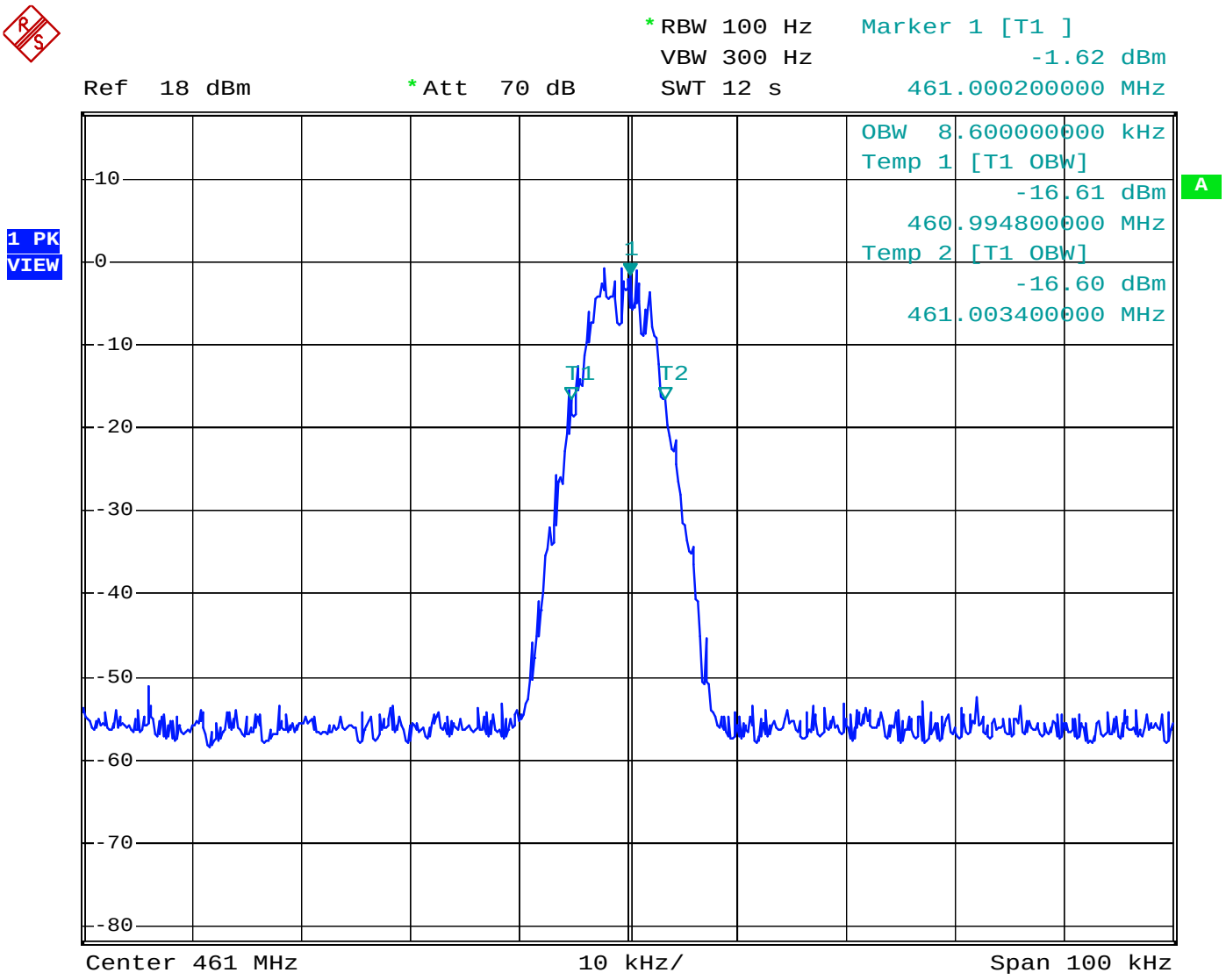
Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)
Channel Spacing: 12.5 kHz			
Low	461.0	8.60	11.25
Mid	463.0	8.40	11.25
High	465.0	8.60	11.25

Test Data

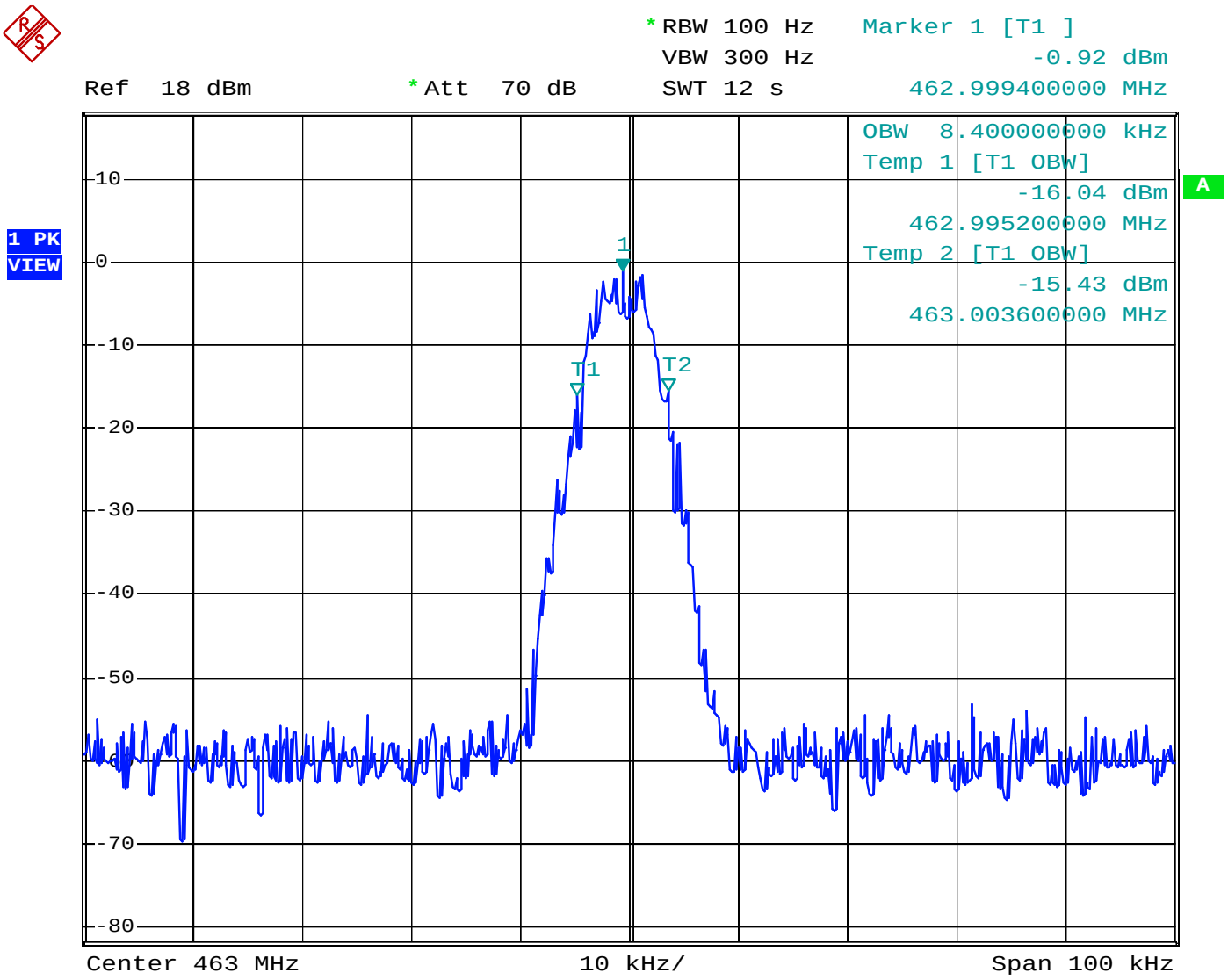
Tested Date: March 9, 2010

Temperature: 20 ˚C
Humidity: 40 %
Atmos. Press: 1017 hPa

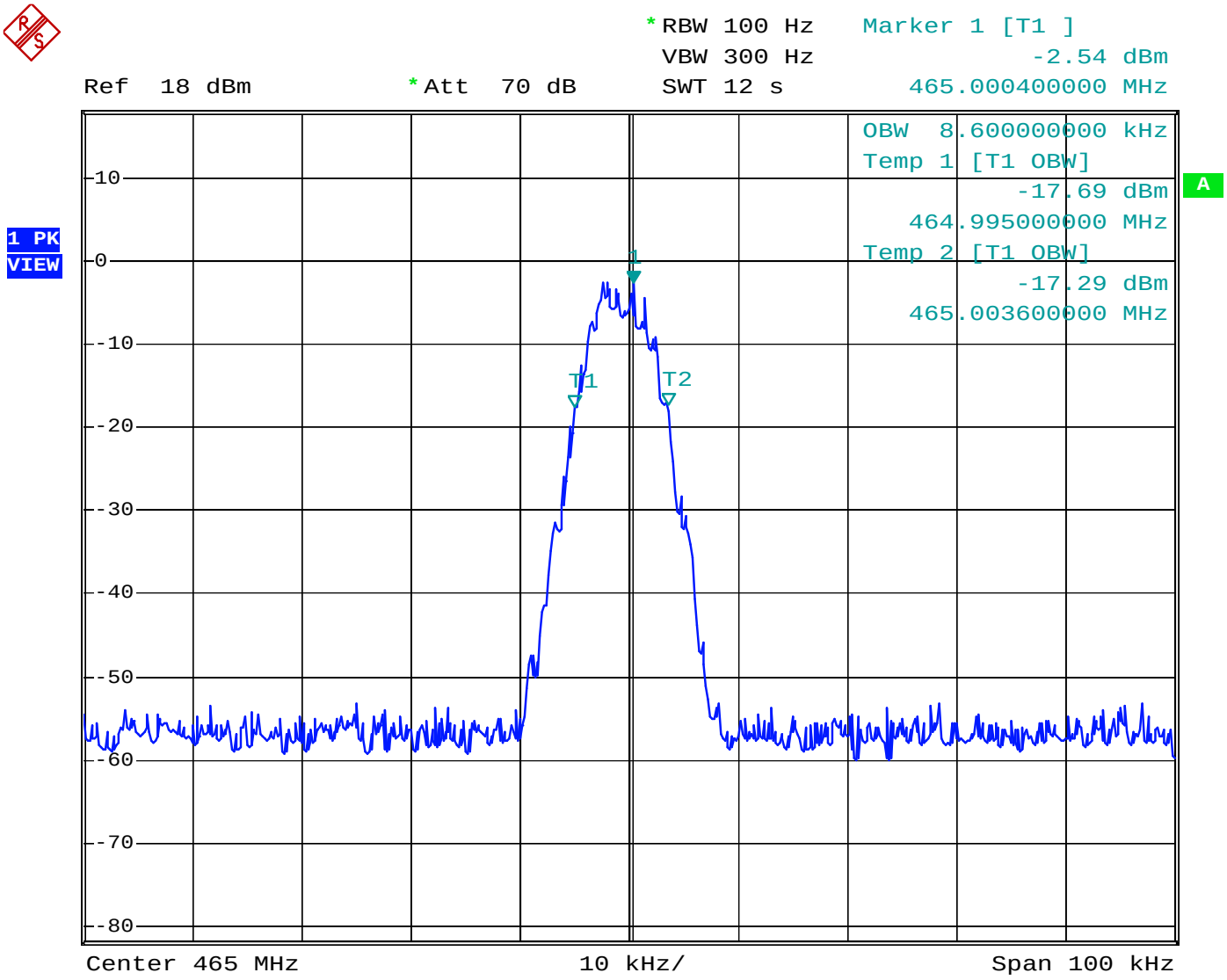
(1) Operating mode: 461 MHz Continuous transmission Channel Spacing 12.5 kHz



(2) Operating mode: 463 MHz Continuous transmission Channel Spacing 12.5 kHz



(3) Operating mode: 465 MHz Continuous transmission Channel Spacing 12.5 kHz



2.3 Emission Mask

Limit

§ FCC 90.210 & RSS-119 § 5.5 Emission masks
(c) Emission Mask C. For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd\2\/11) dB or 50 dB, whichever is the lesser attenuation;
(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.
(d) Emission Mask D.12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd-2.88 kHz) dB.
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

Test procedure

RSS-119 Clause 3.2.11, ANSI / TIA / EIA 603 Clause 3.2.13, & FCC 90.210

Test equipment used (refer to List of utilized test equipment)

TR04	CL26		

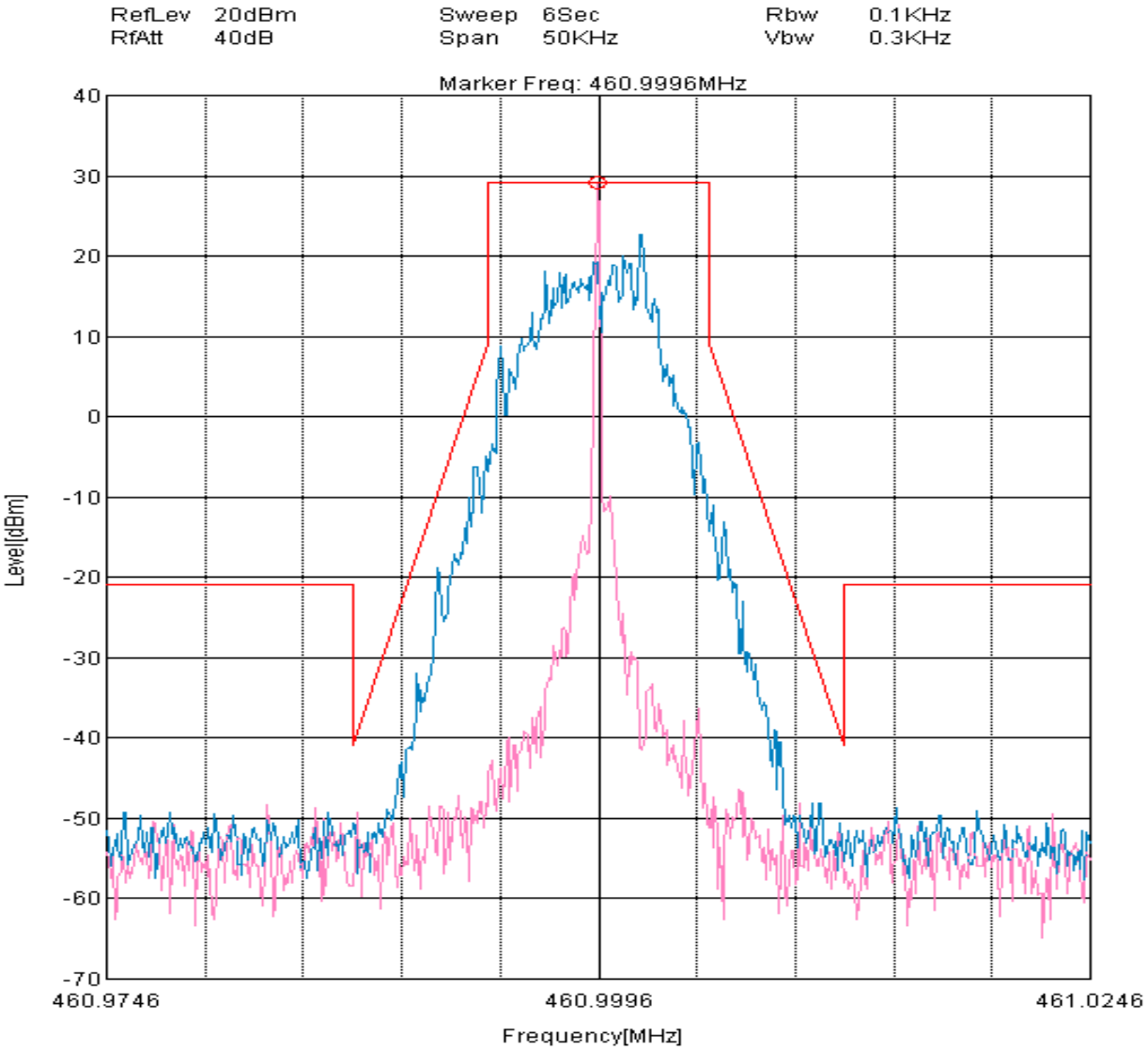
Test results - Complied with requirement.

Test Data

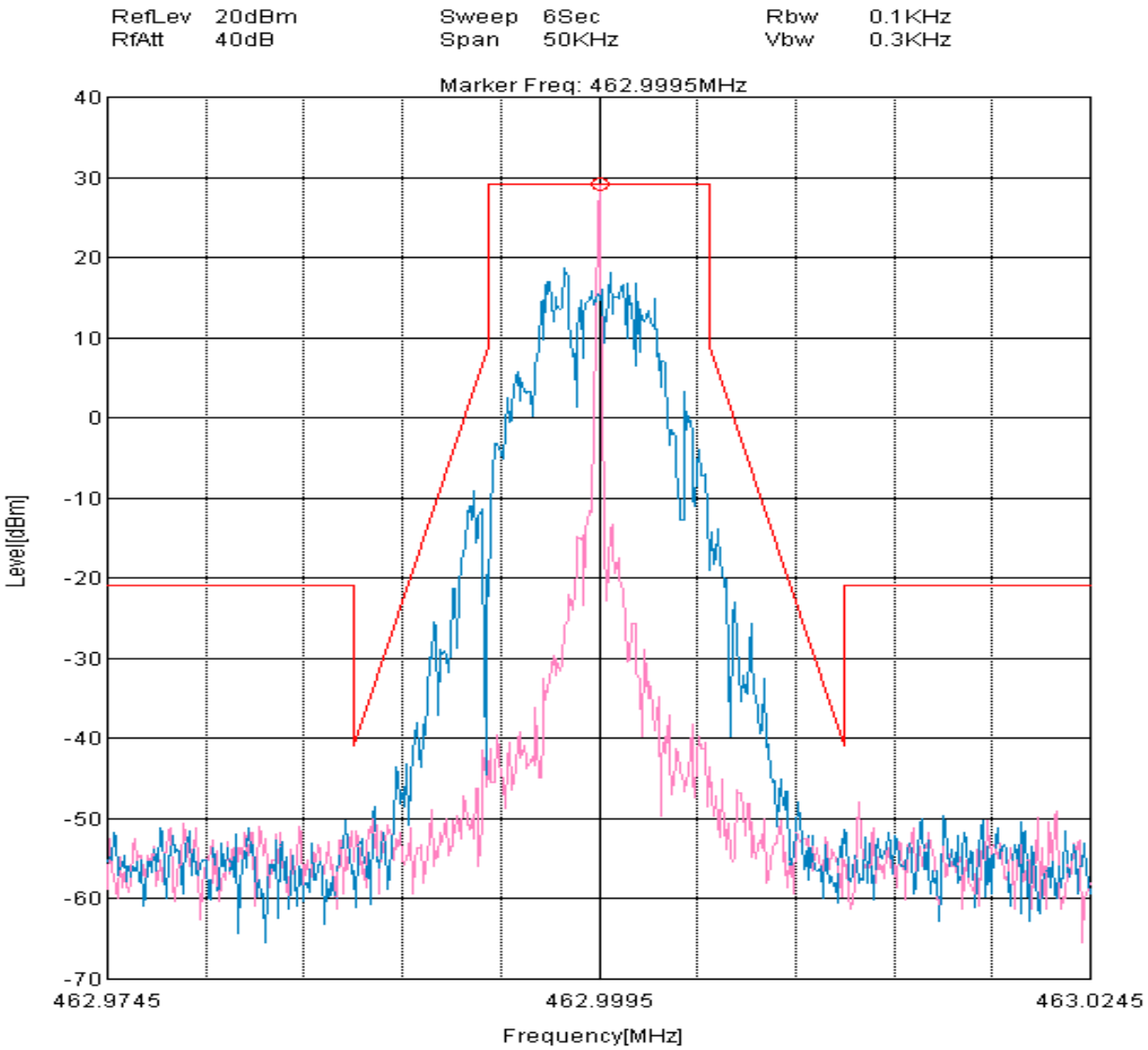
Tested Date: March 9, 2010

Temperature: 20 ˚C
Humidity: 40 %
Atmos. Press: 1017 hPa

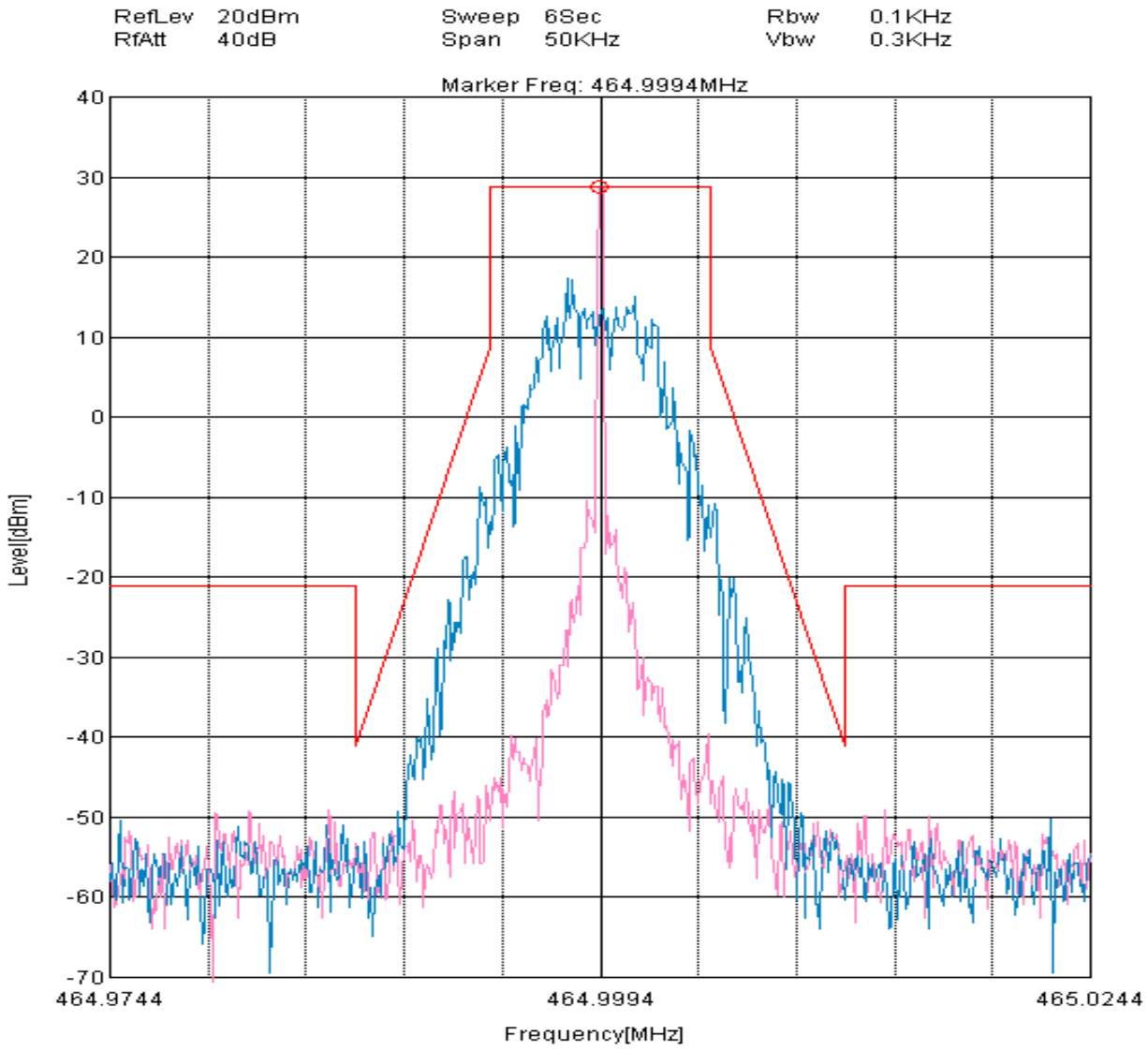
(1) Operating mode: 461 MHz Continuous transmission Channel Spacing 12.5 kHz (Mask D)



(2) Operating mode: 463 MHz Continuous transmission Channel Spacing 12.5 kHz (Mask D)



(3) Operating mode: 465 MHz Continuous transmission Channel Spacing 12.5 kHz (Mask D)



2.4 Conducted spurious emissions

Limit

§ FCC 90.210 & RSS-119 § 5.5 Emission masks:

Channel Spacing: 12.5 kHz

Frequency Range (MHz)	Limit (dBm)	Limit (dBuV)
10 - 5000	-20.0	87.0

Test procedure

RSS-119 Clause 3.2.11, ANSI / TIA / EIA 603 Clause 3.2.13, & FCC 90.210

Test equipment used (refer to List of utilized test equipment)

TR06	CL26			

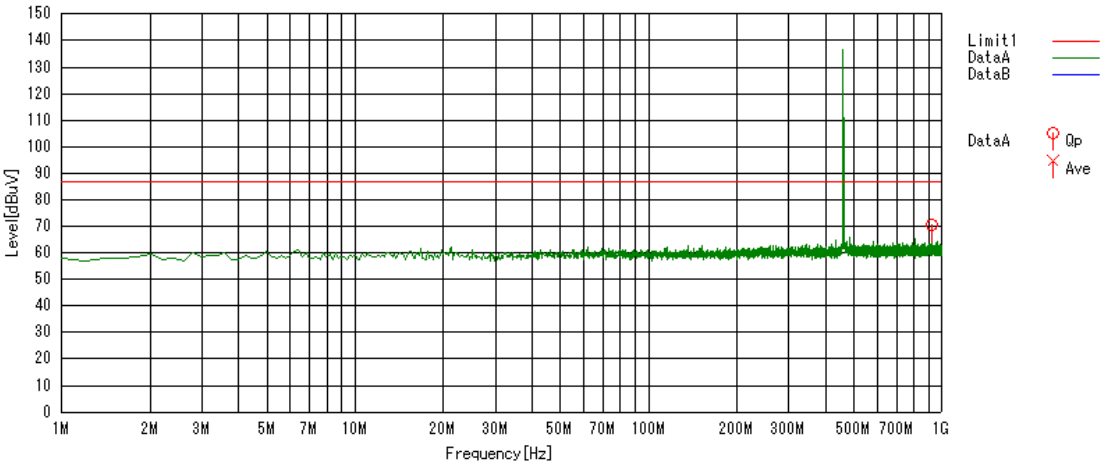
Test results - Complied with requirement.

Test Data: 10 MHz – 1000 MHz

Tested Date: March 1, 2010

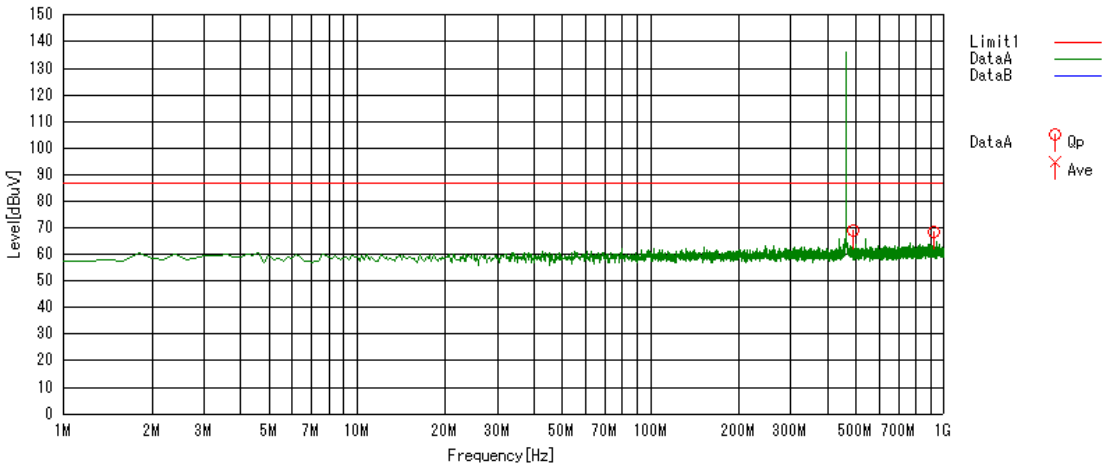
Temperature: 20 ˚C
Humidity: 38 %
Atmos. Press: 1017 hPa

(1) Operating mode: 461 MHz Continuous transmission Channel Spacing 12.5 kHz



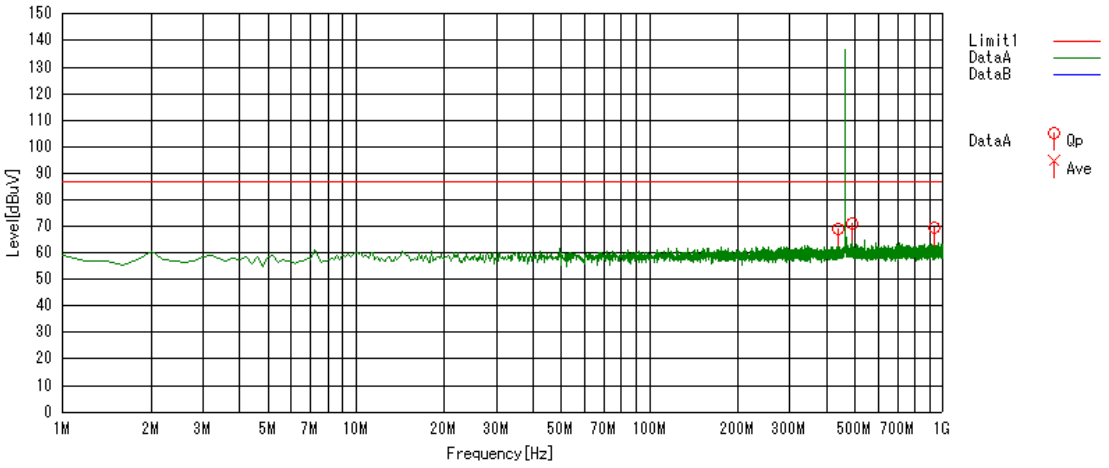
No	Frequency (MHz)	Reading (dB)	C.Fac (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	922.0050	50.3	20.5	70.8	87.0	26.2

(2) Operating mode: 463 MHz Continuous transmission Channel Spacing 12.5 kHz



No	Frequency (MHz)	Reading (dB)	C.Fac (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	488.8141	48.4	20.4	68.8	87.0	18.2
2	926.0000	47.9	20.5	68.4	87.0	18.6

(3) Operating mode: 465 MHz Continuous transmission Channel Spacing 12.5 kHz



No	Frequency (MHz)	Reading (dB)	C.Fac (dB)	Result (dBuV)	Limit (dBuV)	Margin (dB)
1	439.0738	48.7	20.4	69.1	87.0	17.9
2	490.8116	50.9	20.4	71.3	87.0	15.7
3	930.0000	48.8	20.5	69.3	87.0	17.7

Test Data: 1000 MHz – 5000 MHz

Tested Date: March 1, 2010

Temperature: 20 ˚C
Humidity: 38 %
Atmos. Press: 1017 hPa

Note: No emissions were found within above 1 GHz of 20 dB below the system noise floor.

Operation mode:

461 MHz Continuous transmission Channel Spacing 12.5 kHz
463 MHz Continuous transmission Channel Spacing 12.5 kHz
465 MHz Continuous transmission Channel Spacing 12.5 kHz

2.5 Field Strength of Spurious Radiation

Limit

Channel Spacing: 12.5 kHz

Frequency Range (MHz)	Limit (dBm)
30 - 5000	-20.0

Test procedure

RSS-119、ANSI / TIA / EIA 603 Clause3.2.13、& FCC 90.210

Test equipment used (refer to List of utilized test equipment)

AC01(EM)	AC01(EG)	PD03	BA04	DH02	CL11	CL23	CL24
RP10	PU03	PM03	SG05	PD04	TR06	PR10	

Test results - Complied with requirement.

Test Data: 30 MHz – 1000 MHz

Tested Date: March 2, 2010

Temperature: 23 ˚C
Humidity: 38 %
Atmos. Press: 1012 hPa

Result:

(1) Operating mode: 461 MHz Continuous transmission Channel Spacing 12.5 kHz

No.	Frequency MHz	Reading dBuV	Result (ERP) dBm	Limit dBm	Margin dB	Polarization
1	435.133	24.6	-43.1	-20.0	23.1	Vert.
2	486.848	26.0	-39.4	-20.0	39.4	Vert.
3	922.001	21.8	-40.5	-20.0	20.5	Vert.

(2) Operating mode: 463 MHz Continuous transmission Channel Spacing 12.5 kHz

No.	Frequency MHz	Reading dBuV	Result (ERP) dBm	Limit dBm	Margin dB	Polarization
1	435.149	24.2	-43.5	-20.0	23.5	Vert.
2	486.849	25.9	-39.5	-20.0	19.5	Vert.
3	926.000	20.5	-41.8	-20.0	21.8	Vert.

(3) Operating mode: 463 MHz Continuous transmission Channel Spacing 12.5 kHz

No.	Frequency MHz	Reading dBuV	Result (ERP) dBm	Limit dBm	Margin dB	Polarization
1	439.148	25.5	-42.0	-20.0	42.0	Hori.
2	439.149	30.8	-36.7	-20.0	16.7	Vert.
3	490.848	27.0	-38.2	-20.0	18.2	Hori.
4	490.848	33.0	-32.2	-20.0	12.2	Vert.
5	930.000	21.2	-40.9	-20.0	20.9	Vert.

Test Data: 1 GHz – 5 GHz

Tested Date: March 2, 2010

Temperature: 23 ˚C
Humidity: 38 %
Atmos. Press: 1012 hPa

Note: No emissions were found within above 1 GHz of 20 dB below the system noise floor.

Operation mode:
461 MHz Continuous transmission Channel Spacing 12.5 kHz
463 MHz Continuous transmission Channel Spacing 12.5 kHz
465 MHz Continuous transmission Channel Spacing 12.5 kHz

2.6 Receiver Spurious Emissions

Limit

RSS-119 § 5.11
Spurious Emission Limits for Receivers

Spurious Frequency (MHz)	Field Strength (micro volts / m at 3 meters)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Test procedure

The search for spurious emissions shall be from the lowest frequency internally generated or used in the RECEIVER (local oscillator frequency, intermediate frequency or carrier frequency), or 30 MHz whichever is the higher, to at least 3 times the highest tunable and local oscillator frequencies.

Test equipment used (refer to List of utilized test equipment)

AC01(EM)	AC01(EG)	RP03	BA04	DH02	CL11	CL23	CL24
RP10							

Test results – Complied with requirement.

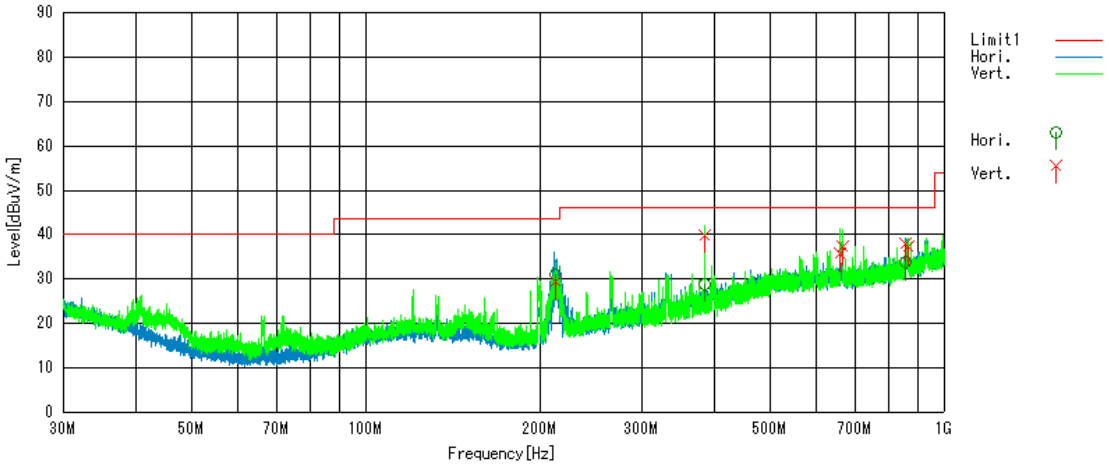
Test Data

Tested Date: March 4, 2010

Temperature: 19 ˚C
Humidity: 40 %
Atmos. Press: 1013 hpa

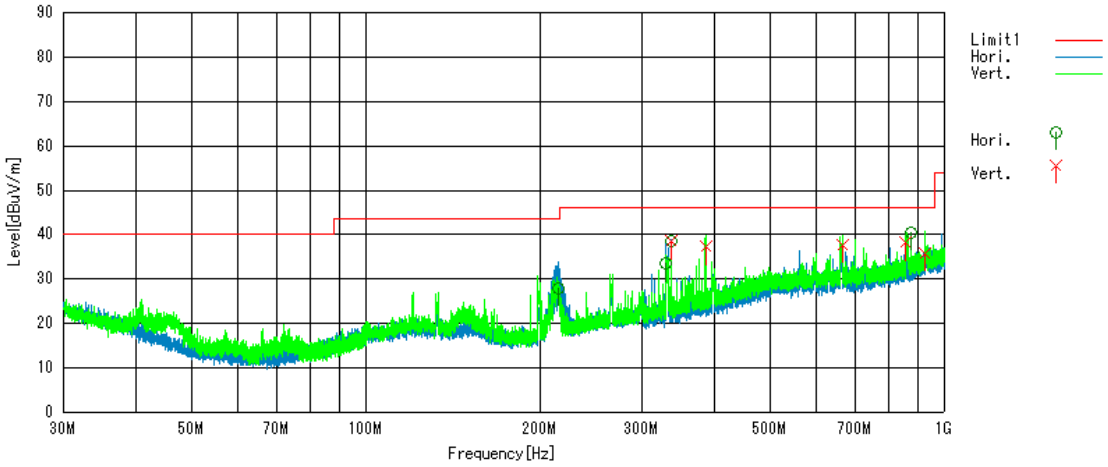
Receiver Spurious Emissions (30 MHz – 1000 MHz)

(1) Operating mode: 461 MHz Receiving



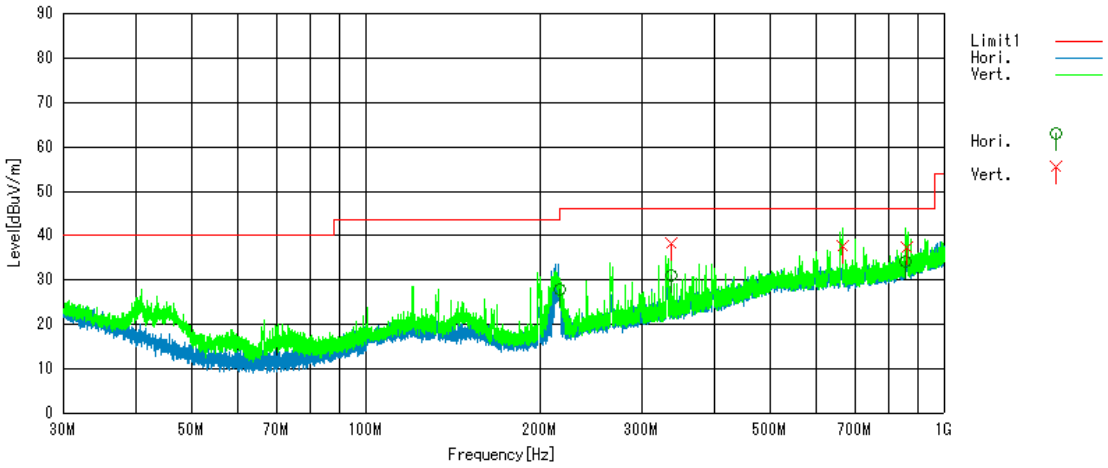
No	Frequency MHz	Reading[QP] dB	Ant dB/m	Los dB	Gain dB	Result dBuV/m	Limit dBuV/m	Margin dB	Antenna
1	211.866	40.9	10.0	9.6	29.5	31.0	43.5	12.5	Hori.
2	212.281	39.2	10.0	9.6	29.5	29.3	43.5	14.2	Vert.
3	383.450	42.2	15.5	11.9	29.7	39.9	46.0	6.1	Vert.
4	384.059	31.1	15.5	11.9	29.7	28.8	46.0	17.2	Hori.
5	658.789	32.7	19.2	13.3	29.6	35.6	46.0	10.4	Vert.
6	665.484	34.2	19.3	13.3	29.6	37.2	46.0	8.8	Vert.
7	856.329	32.7	20.4	13.9	29.1	37.9	46.0	8.1	Vert.
8	856.378	28.5	20.4	13.9	29.1	33.7	46.0	12.3	Hori.
9	865.106	31.9	20.5	13.9	29.1	37.2	46.0	8.8	Vert.

(2) Operating mode: 463 MHz Receiving



No	Frequency MHz	Reading[QP] dB	Ant dB/m	Los dB	Gain dB	Result dBuV/m	Limit dBuV/m	Margin dB	Antenna
1	214.617	37.7	10.2	9.6	29.5	28.0	43.5	15.5	Hori.
2	329.554	37.7	14.3	11.0	29.6	33.4	46.0	12.6	Hori.
3	336.050	42.8	14.4	11.1	29.7	38.6	46.0	7.4	Hori.
4	336.053	42.7	14.4	11.1	29.7	38.5	46.0	7.5	Vert.
5	385.450	39.5	15.5	11.9	29.7	37.2	46.0	8.8	Vert.
6	665.423	34.7	19.3	13.3	29.6	37.7	46.0	8.3	Vert.
7	856.658	32.9	20.4	13.9	29.1	38.1	46.0	7.9	Vert.
8	875.774	34.9	20.6	14.0	29.1	40.4	46.0	5.6	Hori.
9	922.072	29.4	20.9	14.2	28.8	35.7	46.0	10.3	Vert.

(3) Operating mode: 465 MHz Receiving



No	Frequency MHz	Reading[QP] dB	Ant dB/m	Los dB	Gain dB	Result dBuV/m	Limit dBuV/m	Margin dB	Antenna
1	216.031	37.5	10.3	9.6	29.5	27.9	46.0	18.1	Hori.
2	336.050	35.3	14.4	11.1	29.7	31.1	46.0	14.9	Hori.
3	336.052	42.5	14.4	11.1	29.7	38.3	46.0	7.7	Vert.
4	665.595	34.6	19.3	13.3	29.6	37.6	46.0	8.4	Vert.
5	856.529	29.0	20.4	13.9	29.1	34.2	46.0	11.8	Hori.
6	856.929	32.1	20.4	13.9	29.1	37.3	46.0	8.7	Vert.

Receiver Spurious Emissions (Above 1 GHz)

Note: No emissions were found within above 1 GHz of 20 dB below the system noise floor.

Operation mode:

461 MHz Continuous transmission Channel Spacing 12.5 kHz
463 MHz Continuous transmission Channel Spacing 12.5 kHz
465 MHz Continuous transmission Channel Spacing 12.5 kHz

2.7 Frequency Stability

Limit

§ FCC 90.213 Frequency Stability

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Minimum Frequency Stability
[Parts per million (ppm)]

Frequency range (MHz)	Fixed and base stations	Over 2 Watts output power	2 Watts or less output power
Below 25	[1,2,3]100	100	200
25-50	20	20	50
72-76	5		50
150-174	[5.11]5	[6]5	[4,6]50
216-220	1.0		1.0
220-222[12]	0.1	1.5	1.5
406-512	[7,11,14]2.5	[8]5	[8]5
806-809	[14]1.0	1.5	1.5
809-824	[14]1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	[14]0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928[13]	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1432	[9]300	300	300
Above 2500[10]			

1 Fixed and base stations with over 200 watts transmitter power must have a frequency stability of 50 ppm except for equipment used in the Public Safety Pool where the frequency stability is 100 ppm.
2 For single sideband operations below 25 MHz, the carrier frequency must be maintained within 50 Hz of the authorized carrier frequency.
3 Travelers information station transmitters operating from 530-1700 kHz and transmitters exceeding 200 watts peak envelope power used for disaster communications and long distance circuit operations pursuant to Sec. Sec. 90.242 and 90.264 must maintain the carrier frequency to within 20 Hz of the authorized frequency.
4 Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
5 In the 150-174 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
6 In the 150-174 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth or designed to operate on a frequency specifically designated for itinerant use or designed for low-power operation of two watts or less, must have a frequency stability of 5.0 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 2.0 ppm.
7 In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.
8 In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.
9 Fixed stations with output powers above 120 watts and necessary bandwidth less than 3 kHz must operate with a frequency stability of 100 ppm. Fixed stations with output powers less than 120 watts and using time-division multiplex, must operate with a frequency stability of 500 ppm.
10 Except for DSRCS equipment in the 5850-5925 MHz band, frequency stability is to be specified in the station authorization. Frequency stability for DSRCS equipment in the 5850-5925 MHz band is specified in subpart M of this part.
11 Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

12 Mobile units may utilize synchronizing signals from associated base stations to achieve the specified carrier stability.
13 Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge, intermittently operated hand-held readers, and mobile transponders are not subject to frequency tolerance restrictions.
14 Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

RSS-119 § 5.3 Frequency stability Table 1 below

Table 1: Transmitter Frequency Stability

Frequency range (MHz)	Authorized Bandwidth (kHz)	Base / Fixed	Mobile station	
			> 2 Watts	≦ 2 Watts
406.1－430 and 450 – 470 (Note 5)	20	2.5	5	5
	11.25	1.5	2.5	2.5
	6.25	0.5	1	1

Note 5: Control stations may operate with the frequency tolerance specified for associated mobile frequencies.

Test procedure

RSS-119, ANSI / TIA / EIA 603 Clause 2.2.2, Clause 2.3.1 and 2.3.2

Test equipment used (refer to List of utilized test equipment)

TC01	FC02R	CL26	

Test results - Complied with requirement.

Test Condition:
Environment Temperature (deg C): 60, 50, 40, 30, 20, 10, 0, -10, -20

Test voltage:
Normal voltage: DC 12.0V, Low voltage: DC 7.0V, High voltage: DC 13.8V

Results:

Reference Frequency: MID Channel 463.0 MHz Cannel Spacing 12.5 kHz Limit: ±2.5 ppm				
Power Supply (Vdc)	**Environment Temperature (deg C)**	**Frequency Deviation Measured with Time Alapse**		
		(MHz)	**Delta (PPM)**	**Limit (ppm)**
12.0	60	462.99934	-1.425	±2.5
12.0	50	462.99910	-1.944	±2.5
12.0	40	462.99918	-1.771	±2.5
12.0	30	462.99940	-1.296	±2.5
12.0	20	462.99920	-1.728	±2.5
12.0	10	463.00000	+/-0.000	±2.5
12.0	0	463.00012	+0.259	±2.5
12.0	-10	463.00012	+0.259	±2.5
12.0	-20	463.00040	+0.864	±2.5
7.0	20	462.99956	-0.950	±2.5
13.8	20	462.99952	-1.037	±2.5

2.8 Transient Frequency Behavior

Limit

FCC 90.214 & RSS-119 § 5.9 Transmitters designed to operate in the 150 - 174 MHz and 421—512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Table 16 – Transient Frequency Behaviour

Channel Spacing (kHz)	Time Intervals[1,2]	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138 - 174 MHz	406.1 - 512 MHz
25	t_1	±25	5	10
	t_2	±12.5	20	25
	t_3	±25	5	10
12.5	t_1	±12.5	5	10
	t_2	±6.5	20	25
	t_3	±12.5	5	10
6.25	t_1	±6.25	5	10
	t_2	±3.125	20	25
	t_3	±6.25	5	10

[1] t_{on}: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1: the time period immediately following ton.
t_2: the time period immediately following t_1.
t_3: the time period from the instant when the transmitter is turned off until $t_{off.}$
t_{off}: the instant when the 1 kHz test signal starts to rise.

[2] If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t_1 and t_3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t_1 and t_3 shall be recorded in the test report.

Test procedure

RSS 119, ANSI /TIS / EIA 603 Clause 2.2.19

Method of measurement (Using a Modulation Domain Analyzer)

Test equipment used (refer to List of utilized test equipment)

MD01	CL26		

Test results - Complied with requirement.

Test Data

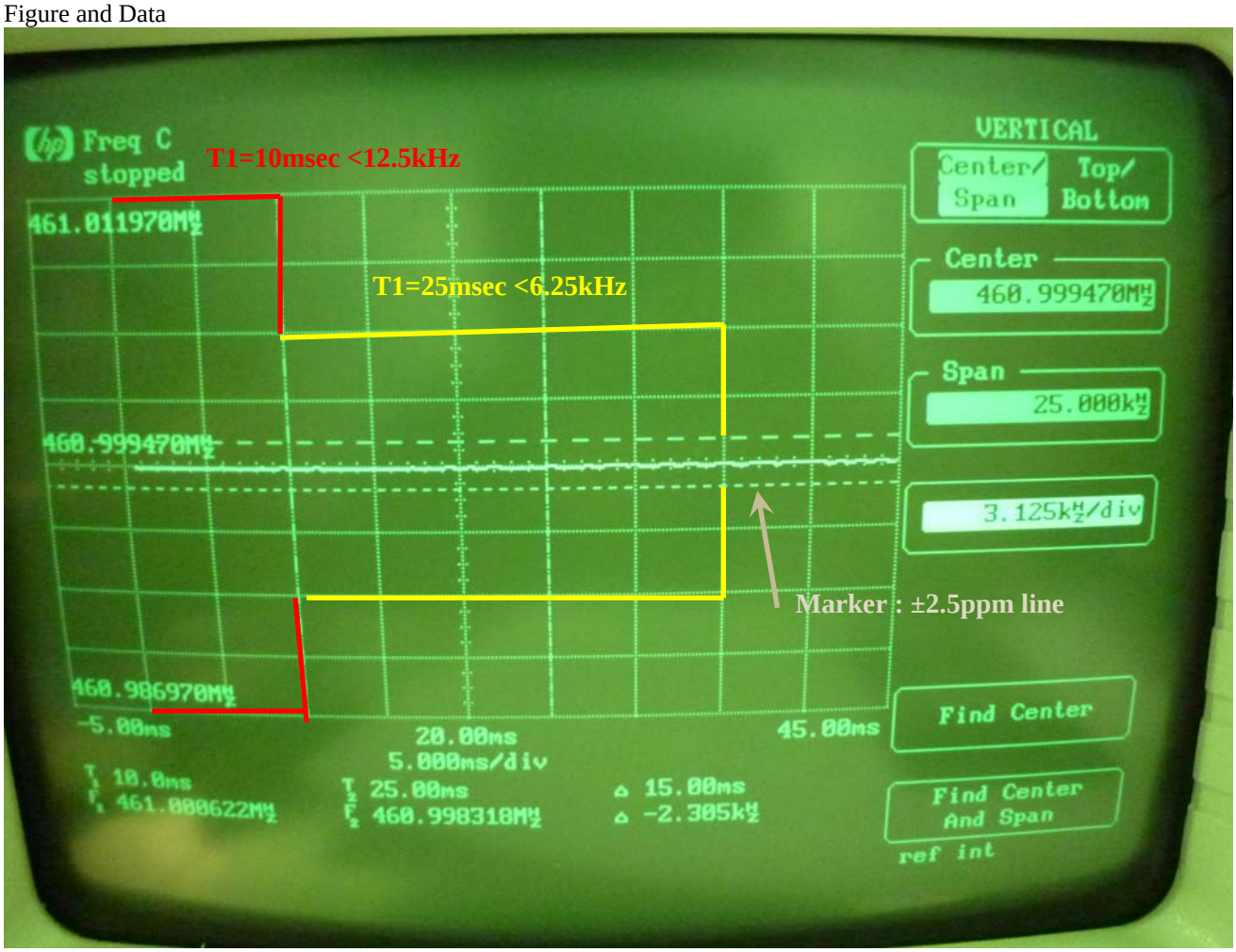
Tested Date: June 2, 2010

Temperature: 23 ˚C
Humidity: 48 %
Atmos. Press: 1014 hpa

Result:

(1) Operation mode:
461 MHz Tx ON Channel Spacing 12.5 kHz
Condition
X axis: 5 msec / DIV, Span: 50 msec
Y axis: 3.125 kHz / DIV, Span: 25 kHz

Figure and Data



Transmit Frequency: 460.999470 MHz (-1.15ppm)

(2) Operation mode:

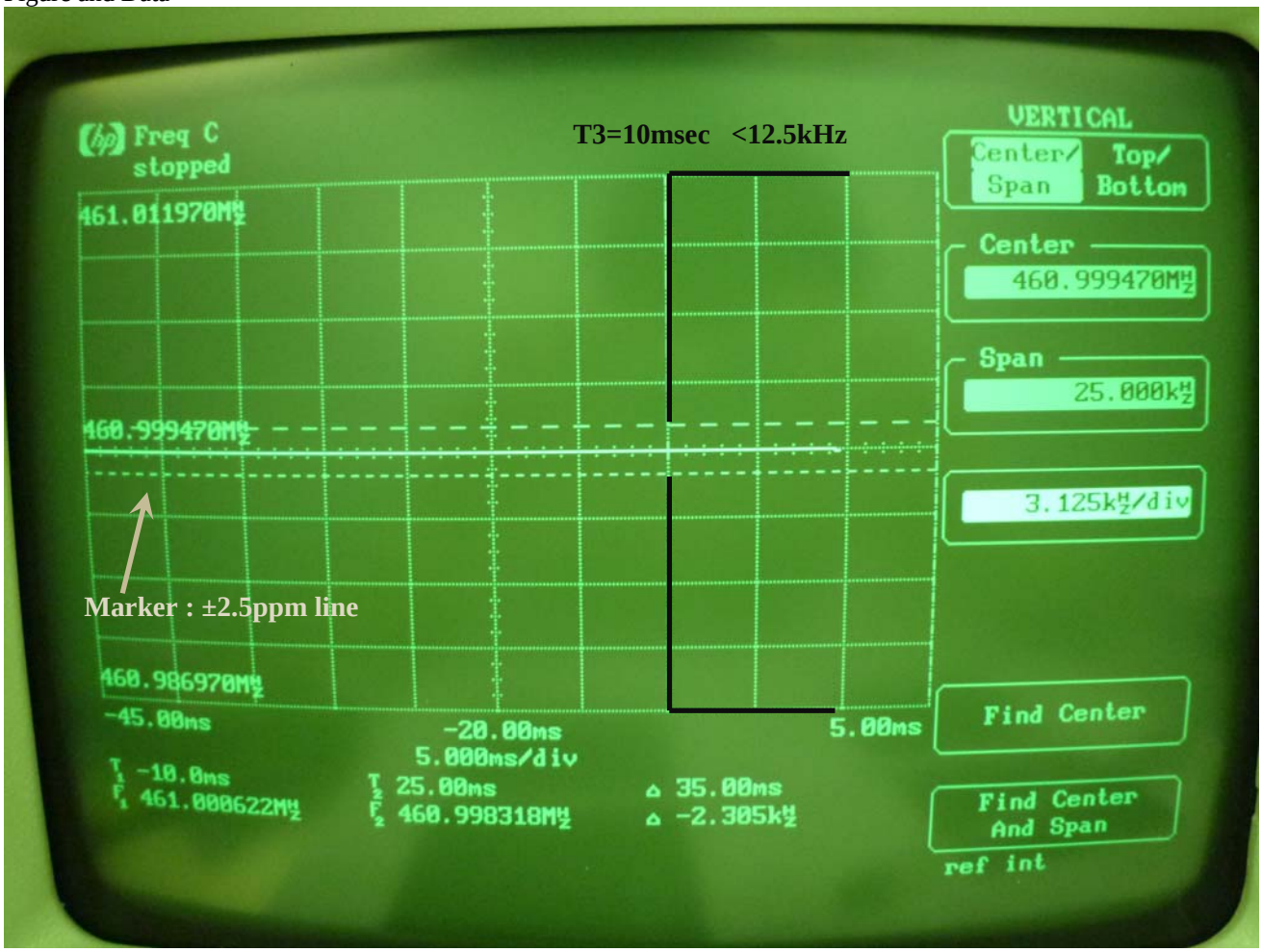
461 MHz Tx OFF Channel Spacing 12.5 kHz

Condition

X axis: 5 msec / DIV, Span: 50 msec

Y axis: 3.125 kHz / DIV, Span: 25 kHz

Figure and Data



Transmit Frequency: 460.999470 MHz (-1.15ppm)

(3) Operation mode:

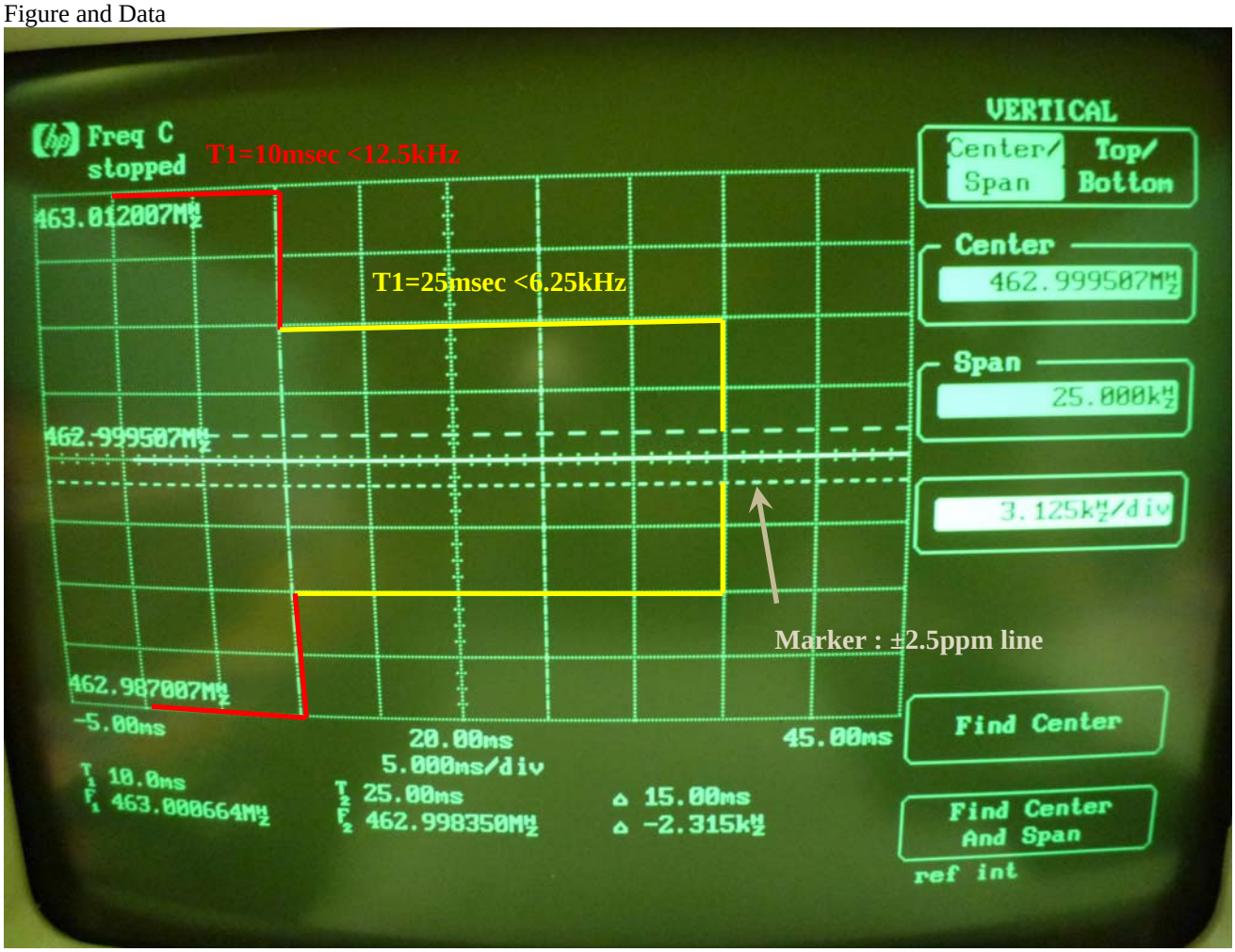
463 MHz Tx ON Channel Spacing 12.5 kHz

Condition

X axis: 5 msec / DIV, Span: 50 msec

Y axis: 3.125 kHz / DIV, Span: 25 kHz

Figure and Data



Transmit Frequency: 462.999507 MHz (-1.06ppm)

(4) Operation mode:

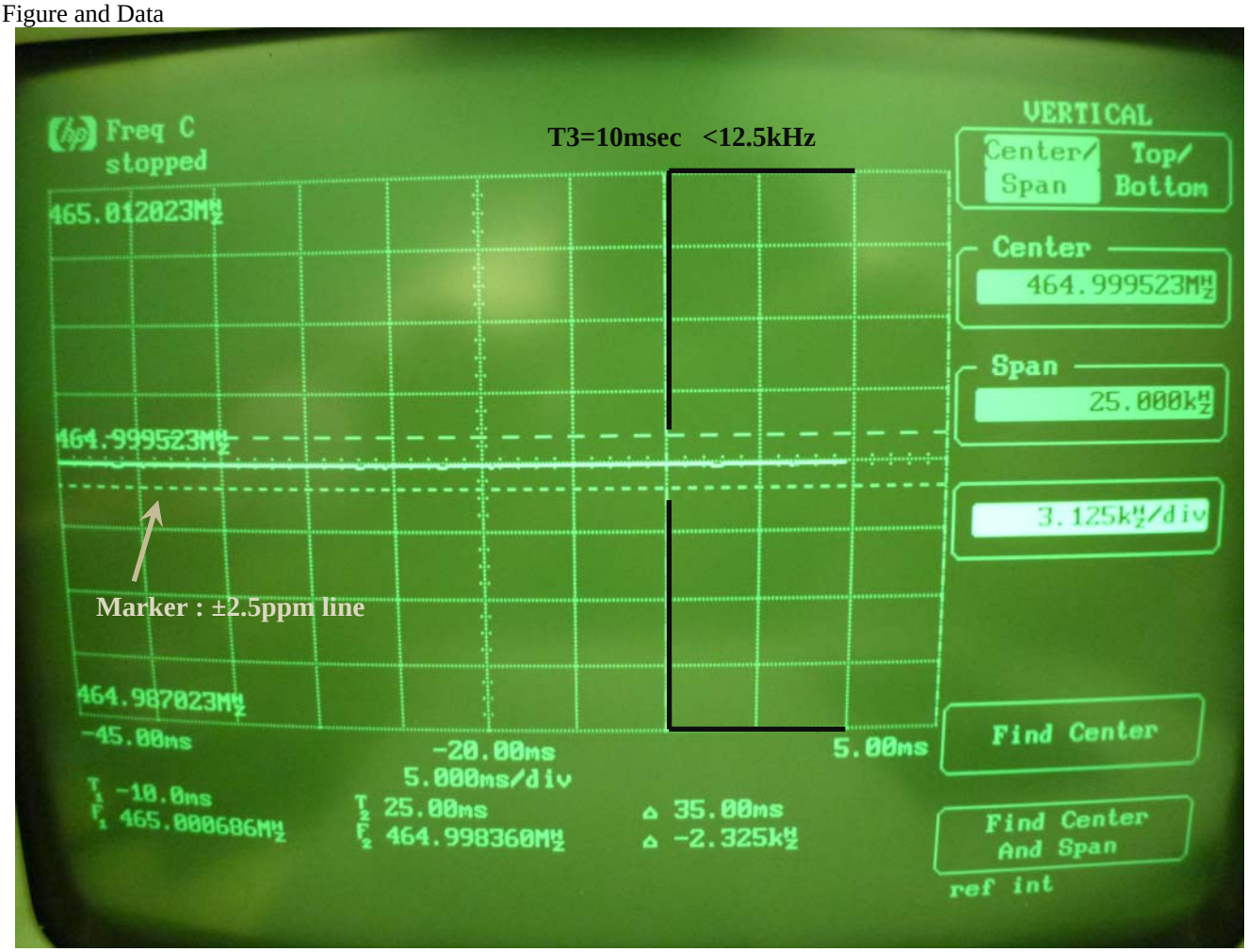
461 MHz Tx OFF Channel Spacing 12.5 kHz

Condition

X axis: 5 msec / DIV, Span: 50 msec

Y axis: 3.125 kHz / DIV, Span: 25 kHz

Figure and Data



Transmit Frequency: 462.999507 MHz (-1.06ppm)

(5) Operation mode:

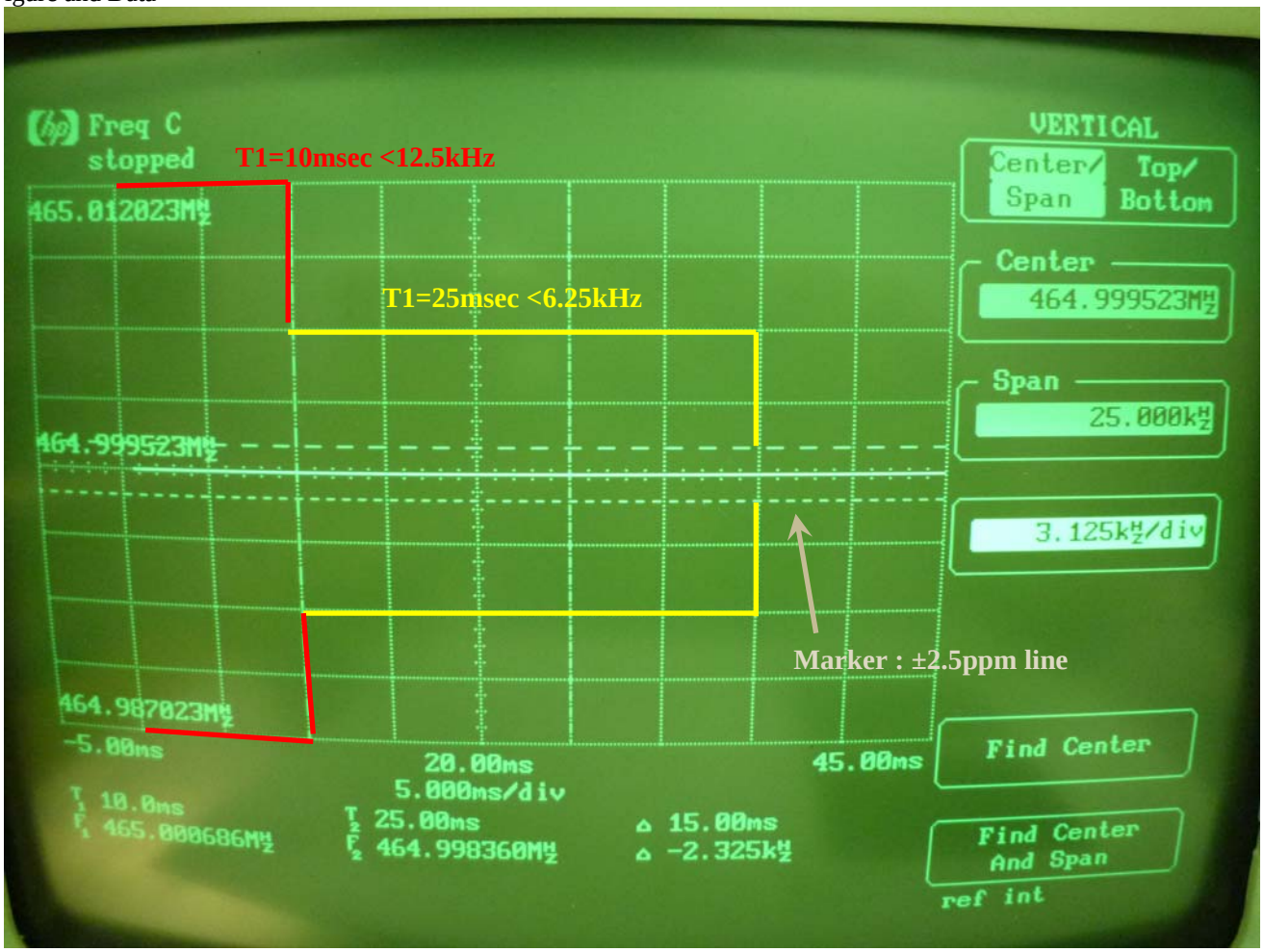
465 MHz Tx ON Channel Spacing 12.5 kHz

Condition

X axis: 5 msec / DIV, Span: 50 msec

Y axis: 3.125 kHz / DIV, Span: 25 kHz

Figure and Data



Transmit Frequency: 464.999523 MHz (-1.03ppm)

(6) Operation mode:

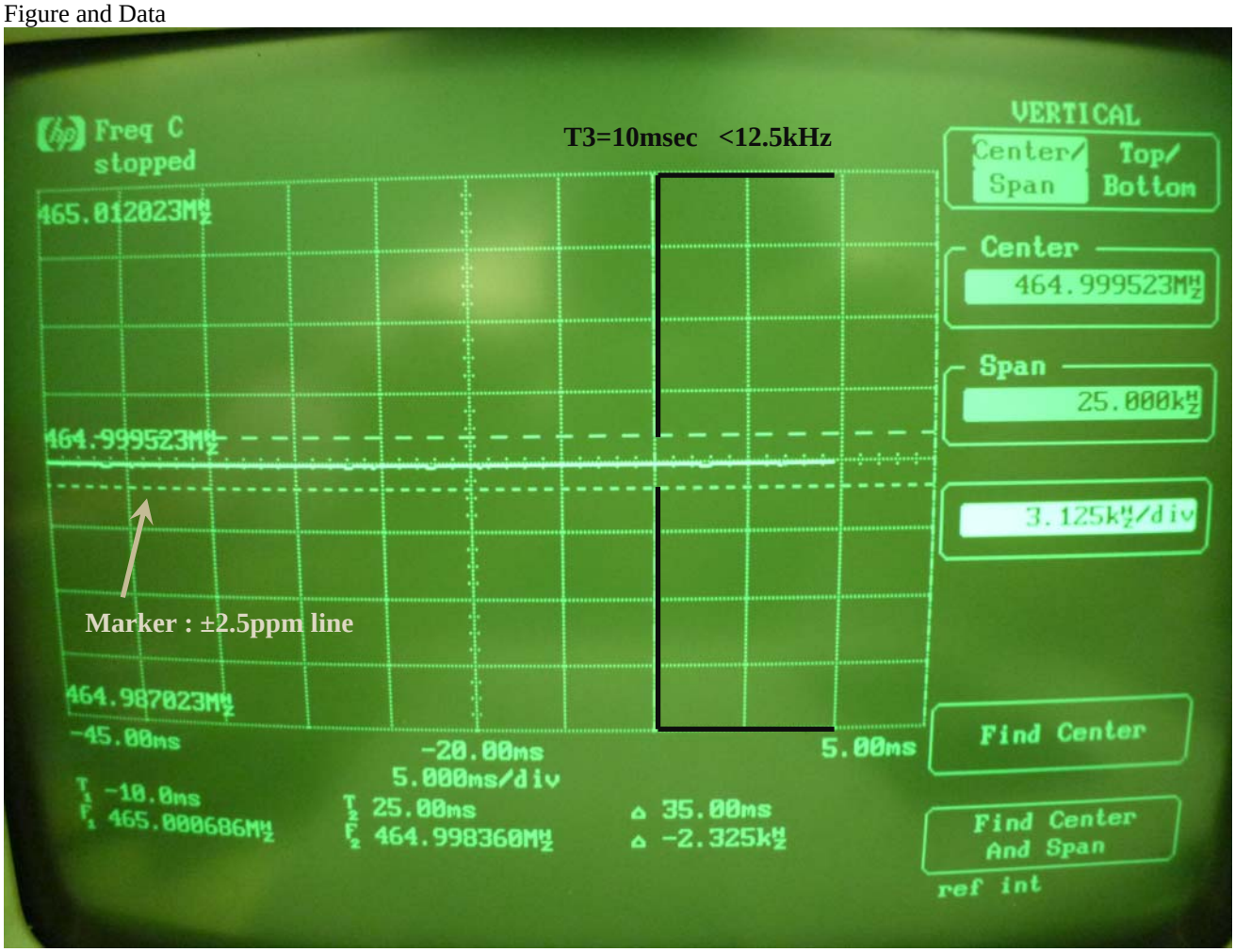
465 MHz Tx OFF Channel Spacing 12.5 kHz

Condition

X axis: 5 msec / DIV, Span: 50 msec

Y axis: 3.125 kHz / DIV, Span: 25 kHz

Figure and Data



Transmit Frequency: 464.999523 MHz (-1.03ppm)

2.9 Maximum Permissible Exposure

FCC Rules

§ 1.1310 Radiofrequency radiation exposure limits.
The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of § 2.1093 of this chapter.

Table 1--Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3 – 3.0	614	1.63	*(100)	6
3.0 – 30	1842/f	4.89/f	*($900/f^2$)	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	-	-	f/300	6
1500 – 100,000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3 -1.34	61.4	1.63	*(100)	30
1.34 – 30	824/f	2.19/f	*($180/f^2$)	30
30 – 300	27.5	0.073	0.2	30
300 – 1500		-	f/1500	30
1500 – 100,000		-	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
Note 1 to Table 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
Note 2 to Table 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC Rules

IC Safety Code 6, Section2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column l of Table5, if the field strength exceeds the value given in Column 2 or3 of Table 5, when averaged spatially and overtime、or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5: Exposure Limits for Persons Not Classed As RF and Microwave Exposed Works (Including the General Public)

1	2	3	4	5
Frequency (MHz)	Electric Field Strength: rms (V/m)	Magnetic Field Strength: rms (A/m)	Power Density (W/m^2)	Averaging Time (min)
0.003-1	280	2.19		6
1-10	280/f	2.19/f		6
10-30	28	2.19/f		6
30-300	28	0.073	2*	6
300-1500	$1.585f^{0.5}$	$0.0042f^{0.5}$	f/150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$1.585f^{0.5}$	$4.21x\ 10^{-4}f^{0.5}$	$6.67x\ 10^{-5}f$	$616000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Note: 1. Frequency, f, is in MHz.
2. A Power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 micro tesla (uT) or 12.57 mill gauss (mG).

Calculations

Given

E = √(30 x P x G) / d

And

S = E^ 2 / 3770

Where

E = Field strength in Volts / Meter
P = Power in Watts
G = Numeric antenna Gain
d = Distance in meters
S = Power Density in mill Watts / square meter

Combining equations, rearranging the terms to express the distance as a function of the remaining variable changing to unit oh Power to mW and Distance to cm, and substituting the logarithmic of power and gain yields:

d = 0.282 x 10^ ((P + G) / 20) /√S

Where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW / cm^ 2

Rearranging terms to calculate the power density at a specific distance yields

S = 0.0795 x 10^ ((P + G) / 10) / (d^2)

The power density in units of mW/cm^2 is converted to units of W/m^2 by multiplying by a factor of 10.

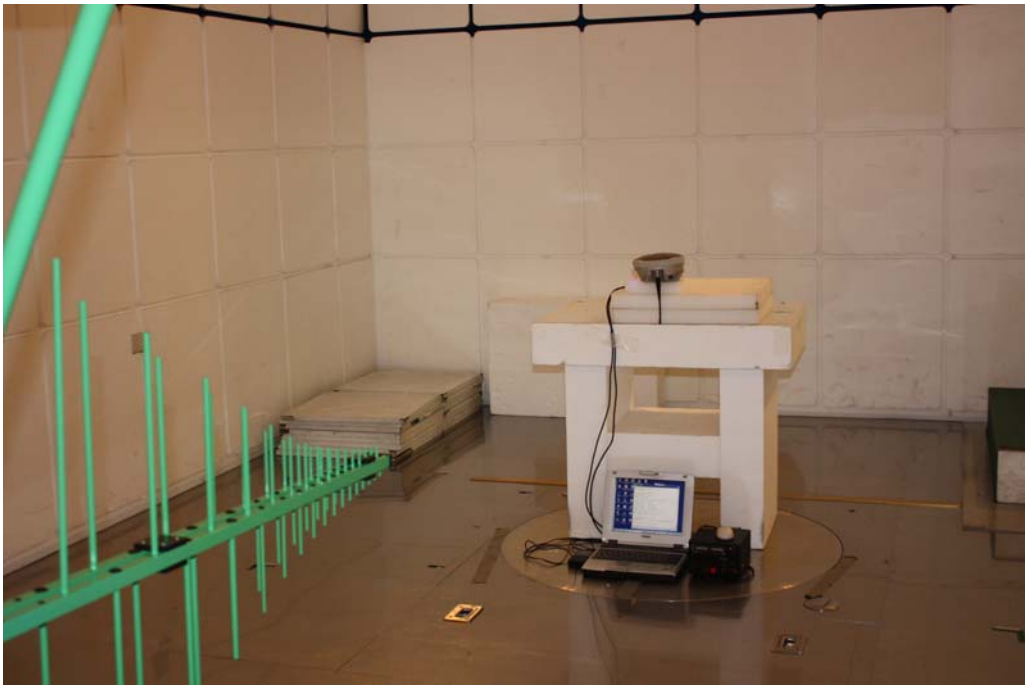
Results

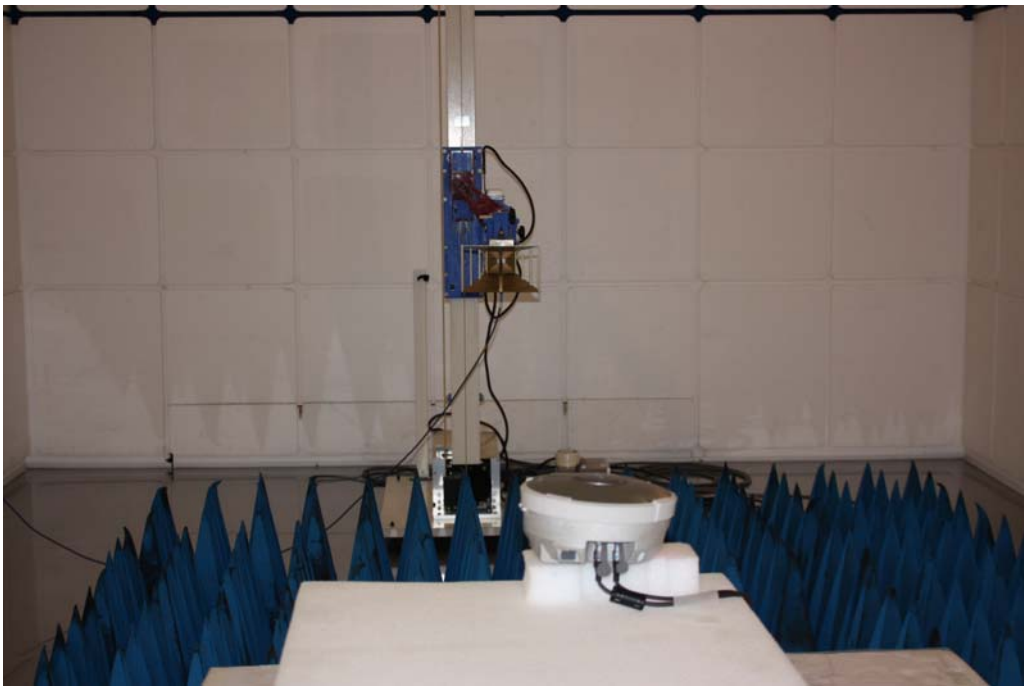
Frequency Range	MPE Distanse (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
461 – 465 MHz	20.0	29.8	2.4	0.033	0.33

FCC Limit: 0.308 mW/cm^2
IC Limit: 3.08 W/m^2

3 Test setup photographs

3.1 Receiver spurious emissions





4 List of utilized test equipment/ calibration

RFT ID No.	Kind of Equipment and Precision	Manufacturer	Model No.	Serial Number	Calibration Date	Calibrated until
AC01(EM)	Anechoic Chamber (1st test room)	JSE	203397C	-	2010/4/10	2011/4/30
AC01(EG)	Anechoic Chamber (1st test room)	JSE	203397C	-	2009/11/14	2010/11/30
BA04	Bilogical Antenna	SCHAFFNER	CA2855	2903	2010/1/19	2011/1/31
CL11	Antenna Cable for RE	RFT	-	-	2010/4/21	2011/4/30
CL26	RF Cable 2.0m	SUCOFLEX	SF104	274754/4	2009/6/25	2010/6/30
CL23	RF Cable 0.5m	SUCOFLEX	SF104PE	48773/4PE	2009/6/25	2010/6/30
CL24	RF Cable 5.0m	SUCOFLEX	SF104PE	48775/4PE	2009/6/25	2010/6/30
PR12	Pre. Amplifier (1-26G)	Agilent Technologies	8449B	3008A02513	2010/1/25	2011/1/31
PR03	Pre. Amplifier	Anritsu	MH648A	M41984	2009/5/26	2010/5/31
PM03	Power Meter	Anritsu	ML2438A	99070001	2009/7/21	2010/7/31
PU03	Power Sensor	Anritsu	MA2472A	990103	2009/7/21	2010/7/31
SG05	Signal Generator	Rohde & Schwarz	SMR20	100905	2009/6/18	2010/6/30
RP04	RF Power Amplifier	PRANA	AP32DT120	0509-688	2009/5/25	2010/5/31
MD01	Modulation Domain Analyzer	HP	53310A	3121A02790	2010 3/2	2011/3/31
TR06	Test RECEIVER (F/W : 3.93 SP2)	Rohde & Schwarz	ESU26	100002	2009/9/16	2010/9/30
PD03	Dipole Antenna (VHF)	SCHWARZBECK	VHAP	1122	2009/11/5	2010/11/30
PD04	Dipole Antenna (UHF)	SCHWARZBECK	UHAP	1103	2009/11/4	2010/11/30
TC01	Temperature Chamber	ESPEC	SH-641	92000964	2009/11/13	2010/11/30
FC02R	Frequency counter	Anritsu	MF2412B	620089917	2009/09/19	2010/09/30
LA01	Logperiodic Antenna	SCHWARZBECK	USLP 9143	338	2009/7/22	2010/7/31

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.