RF TEST REPORT

Test report No.:	**EMC- FCC- R0001**
FCC ID:	**VTB-TR450H**
Type of equipment:	**UHF FM Portable Tranceiver**
Brand Name:	**Tekmax**
Model Name:	**TR-450H**
Applicant:	**Tekmax Telecom Co.,Ltd**
Device Category:	**UHF FM Portable Tranceiver**
FCC Rule Part(s):	**§2 , §22 , §74 , §90**
Frequency Range:	**440.0125 MHz ~ 469.9875 MHz**
RF Output Power:	**4W / 1W**
Channel Separation:	**12.5 kHz/ 25kHz**
Emission Designators:	**8K50F3E / 16K0F3E**
Test result:	**Complied**

The above equipment was tested by EMC compliance Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.
The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Date of test: October 16, 2007 ~ October 23 , 2007
Issued date: December 12, 2007

Tested by: KIM, CHANG MIN

Approved by: YOO, SUNG YOUNG .

82-1 Jeil-ri, Yangji-myun, Churingu, Yongin-city, Kyungki-do,Korea 449-825,
82 31 336 9919 (Main) 82 31 336 4767 (Fax)

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1. Client information

Applicant:	Tekmax Telecom Co.,Ltd
Address:	#606 Ilsan Techno Town, 1141-1 Baekseok-dong, Ilsan-gu, Koyang-city, Kyungki-Do, Korea
Telephone number:	+8231-812-3321
Facsimile number :	+8231-812-2646
Contact person:	Hoin Kim / Marketing director

Manufacturer:	Tekmax Telecom Co.,Ltd
Address:	#606 Ilsan Techno Town, 1141-1 Baekseok-dong, Ilsan-gu, Koyang-city, Kyungki-Do, Korea
Telephone number:	+8231-812-3321
Facsimile number :	+8231-812-2646
Contact person:	Hoin Kim / Marketing director

2. Laboratory information

Address
EMC Compliance Ltd.
82-1, JEIL-RI, YANGJI-MYUN, CHURINGU, YONGIN-CITY, KYUNGGI-DO,
KOREA 449-825
Telephone Number: 82 31 336 9919 Facsimile Number: 82 31 336 4767

Certificate
CBTL Testing Laboratory, KOLAS NO.: 231
FCC Filing No.: 793334
VCCI Registration No.: C-1713, R-1606, T-258

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant :	Tekmax Telecom Co., Ltd
Address of Applicant:	#606 Ilsan Techno Town, 1141-1 Baekseok-dong, Ilsan-gu, Koyang-city, Kyungki-Do, Korea
Manufacturer:	Tekmax Telecom Co., Ltd
Address of Manufacturer:	#606 Ilsan Techno Town, 1141-1 Baekseok-dong, Ilsan-gu, Koyang-city, Kyungki-Do, Korea
Type of equipment:	UHF FM Portable Tranceiver
Basic Model:	TR-450H
Brand name:	Tekmax
Serial number:	Proto Type

3.2 General description

Frequency Range	440.0125 MHz ~ 469.9875 MHz
Type of Modulation	8K50F3E (12.5kHz) / 16K0F3E (25kHz)
Channel spacing	12.5 kHz / 25 kHz
Channel capacity	128ch
Type of Antenna	λ/4 Whip Antenna
Intermediate Frequencies	1^{st} : 21.7 MHz 2^{nd}: 450 kHz
Power supply	DC 7.4 V , (LI-ION Rechageable battery 1800mA)
Battery life	8 hrs
Operating temperature	-30 °C ~ 60 °C
Dimension	59 x 102 x 32 mm
Weight	250g (with 1800mAh Li-Ion battery)

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3.3 Transmitter

RF Output Power	4W(high), 1W(low) selectable
Frequency stability	±0.0002%
Spurious Emission	< -45dB
Audio distortion	< 5% at 1kHz 60% deviation
Audio response @ 6dB/oct	+1 to -3 dB
Max deviation	±2.5kHz (12.5kHz) / ±5.0kHz (25kHz)

3.4 Receiver

Modulation acceptance	±3.75 kHz (12.5kHz) / ±7.5kHz (25kHz)
Sensitivity	< 0.25 μW (at 12dB SINAD)
Intermodulation rejection	< -65 dB
Squelch sensitivity	< 0.2 μW (at 6dB SINAD)
Spurious and image rejection	65dB
Audio distortion	< 5% at 1kHz 60% deviation
Audio output power(16Ω)	< 500mW

3.5 Test frequency

Frequency	**TX**	**RX**
Low frequency	**440.0125**	**440.0125**
Middle frequency	**455.0125**	**455.0125**
High frequency	**469.9875**	**469.9875**

3.6 Test conditions

Test condition	**Temperature (°C)**
Low	**-30**
High	**+60**

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4. Summary of test results

4.1 Standards & results

Rule Reference	Parameter	Status
2.1046 (a)	Carrier output Power (conducted)	C
2.1051	Unwanted Emission (transmitter conducted)	C
2.1053 (a)	Field Strength of spurious Radiation	C
2.1049 (c)(1)	Emission Mask (Occupied bandwidth)	C
90.214	Transient frequency Behavior	C
2.1047 (a)	Audio Low pass Filter (Voice Input)	C
2.1047 (a)	Audio Frequency response	C
2.1047 (b)	Modulation Limiting	C
2.1055	Frequency Stability	C
2.202(g)	Necessary Bandwidth and Emission Bandwidth	C

Note: C=complies
NC= Not complies
NT=Not tested
NA=Not Applicable

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5. Test results (Transmitter parameters)

5.1 Carrier Output Power

5.1.1 Definition

The carrier power output for a transmitter for this service is the power available at the output terminals of the transmitter when the output terminals are connected to the standard transmitter load.

FCC ID : VTB-TR450H

Specification: 47CFR 2.1046 (a)

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.1

5.1.2 Measurement procedure

The EUT was connected to a resistive coaxial attenuator of normal load impedance, and The unmodulated output power was measured by means of RF Power Meter.

5.1.3 Test Result

Test Conditions		Power Rating (dBm)	Carrier Power (dBm)		
Power level (W)	Channel Spacing (kHz)		440.0125 MHz	455.0125 MHz	469.9875 MHz
4	12.5	36	35.74	35.83	35.48
1	12.5	30	30.90	29.88	29.54
4	25	36	35.73	35.75	35.25
1	25	30	29.94	29.93	29.61
Uncertainty		± 0.603 dB			

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5.2 Unwanted Emission (Transmitter Conducted)

5.2.1 Definition

Conducted spurious emissions are emission at the antenna terminals on a frequency or frequencies which art outside a band sufficient to ensure transmission of required quality for the class of communication desired.

FCC ID : VTB-TR450H

Specification: 47CFR 2.1051

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.13

5.2.2 Measurement Procedure

The emissions were measured for the worst case as follows:
(1) Within a band of frequency plus and minus one channel.
(2) From the lowest frequency generated in the EUT and to at least the 10^{th} harmonics of the frequency, or 40GHz, whichever is lower.
The magnitude of spurious emissions that are attenuated more than 20dB below the permissible value need not be specified.

5.2.3 Limit

12.5kHz Channel Spacing

$=50 + 10 \log_{10} (P)$ dBc

25kHz Channel Spacing

$=43 + 10 \log_{10} (P)$ dBc

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5.2.4 Test Result

- **Attached for Worst Case**

Operating frequency: 440.0125 MHz / Narrow Band
Power: 4W
Measured output power: 35.74 dBm = 3.75 W
Modulation signal: FM
Limit: $50+10\log_{10}(W)$= 55.74 dBc

Frequency (MHz)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dB)
880.025	-38.24	73.98	55.74	18.24
1320.038	-39.46	75.20	55.74	19.46

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Operating frequency: 440.0125 MHz / Narrow Band
Power: 1W
Measured output power: 30.90 dBm = 1.23 W
Modulation signal: FM
Limit: $50+10\log_{10}(W)$= 50.90 dBc

Frequency (MHz)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dB)
880.025	-32.9	63.80	50.90	12.90
1320.038	-39.84	70.74	50.90	19.84

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Mask D Limit =50 + 10 log10 (P) dBc
Correct Level(dBm) = Substitute SG Level (dBm)
Emission Level= Correct Level- 10Log(P*1000)
P=Carrier Level(W)

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Operating frequency: 455.0125 MHz / Narrow Band
Power: 4W
Measured output power: 35.83 dBm = 3.83 W
Modulation signal: FM
Limit: 50+10log$_{10}$(W)= 55.83 dBc

Frequency (MHz)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dB)
910.025	-36.04	71.87	55.83	16.04
1365.038	-40.16	75.99	55.83	20.16

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Operating frequency: 455.0125 MHz / Narrow Band
Power: 1W
Measured output power: 29.88 dBm = 0.97 W
Modulation signal: FM
Limit: 50+10log$_{10}$(W)= 49.88 dBc

Frequency (MHz)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dB)
910.025	-38.9	63.78	49.88	18.90
1365.038	-44	73.88	49.88	24.00

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Mask D Limit =50 + 10 log10 (P) dBc
Correct Level(dBm) = Substitute SG Level (dBm)
Emission Level= Correct Level- 10Log(P*1000)
P=Carrier Level(W)

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Operating frequency: 469.9875 MHz / Narrow Band
Power: 4W
Measured output power: 35.48 dBm = 3.53 W
Modulation signal: FM
Limit: $50+10\log_{10}(W)=$ 55.48 dBc

Frequency (MHz)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dB)
939.975	-39.04	74.52	55.48	19.04
1409.963	-44.12	79.60	55.48	24.12

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Operating frequency: 469.9875 MHz / Narrow Band
Power: 1W
Measured output power: 29.54 dBm = 0.89 W
Modulation signal: FM
Limit: $50+10\log_{10}(W)=$ 49.54 dBc

Frequency (MHz)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dB)
939.975	-34.6	64.14	49.54	14.60
1409.963	-48.88	78.42	49.54	28.88

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Mask D Limit =50 + 10 log10 (P) dBc
Correct Level(dBm) = Substitute SG Level (dBm)
Emission Level= Correct Level- 10Log(P*1000)
P=Carrier Level(W)

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5.3 Field Strength of spurious radiation

5.3.1 Definition

Radiated spurious emission are emissions from the equipment when transmitting into a non-radiating load on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired.

FCC ID : VTB-TR450H

Specification: 47CFR 2.1053(a)

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.12

5.3.2 Measurement Procedure

- The test sample was set up at a distance of three meters from the test instrument . Valid spurious signals were determined by switching the power on and off.
- In the field ,the test sample was placed on a wooden turntable above ground at three meters away from the search antenna.
- The cables were oriented in order to obtain the maximum response. At each emission frequency, the turntable was rotated and the search antennas were raised and lowered vertically.
- The emission was observed with both a vertically polarized and a horizontally polarized search antenna ant the worst case was used.
- The field strength if each emission within 20dB of the limit was recorded ant corrected with the appropriated cable and transducer factor.
- From the lowest frequency generated, in the EUT and to at least the 10^{th} harmonics of the carrier frequency, or 40GHz, whichever is lower.
- The worst case for all channels is shown.

5.3.3 Limit

$=43 + 10 \log_{10} (P)$ dBc	: 25kHz
$=50 + 10 \log_{10} (P)$ dBc	: 12.5kHz

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5.3.4 Test Result

- **Attached for Worst Case**

Operating frequency: 469.9875 MHz(Narrow Band)
Power: 4W
Measured output power: 36.12 dBm = 4.09 W
Modulation signal: FM
Limit: $50+10\log_{10}(W)= 56.12$ (dBc)

Freq.(MHz)	Pol	SG Out Level (dBm)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dBc)
939.975	H	-40.02	-41.75	77.87	56.12	21.74
939.975	V	-23.00	-24.73	60.84	56.12	4.72
1409.963	H	-35.60	-40.26	76.38	56.12	20.26
1409.963	V	-36.80	-41.46	77.58	56.12	21.46
1879.950	H	-40.20	-46.09	82.21	56.12	26.09
1879.950	V	-36.12	-42.01	78.13	56.12	22.01
2349.938	H	-38.86	-45.53	81.65	56.12	25.53
2349.938	V	-44.88	-51.55	87.67	56.12	31.55
2819.925	H	-36.08	-44.44	80.56	56.12	24.44
2819.925	V	-35.04	-43.40	79.52	56.12	23.40

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Mask D limit (dBc) = -(50+10Log(P))
Correct Level(dBm)= Substitute SG Level (dBm)+Ant gain(dBi) – Cable Loss(dB)
Emission Level (dBc)= Correct Level- 10log(P*1000)
P=Carrier Level(w)

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- **Attached for Worst Case**

Operating frequency: 469.9875 MHz (Narrow Band)
Power: 1W
Measured output power: 30.01 dBm = 1.00 W
Modulation signal: FM
Limit: $50+10\log_{10}(W)= 50.01$ (dBc)

Freq.(MHz)	Pol	SG Out Level (dBm)	Correct Level (dBm)	Emission Level (dBc)	Limit (dBc)	Margin (dBc)
939.975	H	-42.56	-44.29	74.30	50.01	24.29
939.975	V	-31.22	-32.95	62.96	50.01	12.95
1409.963	H	-43.00	-47.66	77.67	50.01	27.66
1409.963	V	-42.88	-47.54	77.55	50.01	27.54
1879.950	H	-47.34	-53.23	83.24	50.01	33.23
1879.950	V	-39.62	-45.51	75.52	50.01	25.51
2349.938	H	-41.32	-47.99	78.00	50.01	27.99
2349.938	V	-45.16	-51.83	81.84	50.01	31.83
2819.925	H	-36.22	-44.58	74.59	50.01	24.58
2819.925	V	-30.98	-39.34	69.35	50.01	19.34

Remarks
No other emissions were detected at a level greater than 20 dB below limit.

Mask D limit (dBc) = -(50+10Log(P))
Correct Level(dBm)= Substitute SG Level (dBm)+Ant gain(dBi) – Cable Loss(dB)
Emission Level (dBc)= Correct Level- 10log(P*1000)
P=Carrier Level(w)

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5.4 Emission Mask (occupied bandwidth)

5.4.1 Definition

The term transmitter sideband spectrum denotes the sideband energy produced at a discrete frequency separation from the carrier up to the test bandwidth due to all sources of unwanted noise within the transmitter in a modulated condition.

FCC ID : VTB-TR450H

Specification: 47CFR 2.1049(C)(1)

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.11

5.4.2 Measurement Procedure

- The EUT and test equipment were setup as shown on the following page, with the spectrum analyzer connected.
- For EUT's supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for ±2.5 / ±1.25kHz deviation(or 50% modulation).With level constant, the signal level was increased 16dB.
- For EUT's supporting digital modulation, the digital modulation mode was operated to its maximum extant.
- The occupied bandwidth was measured with the spectrum analyzer controls set as shown on the test result.

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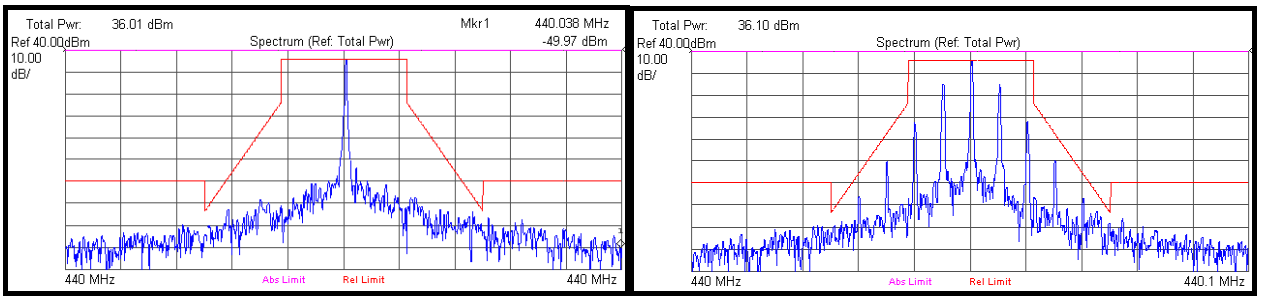
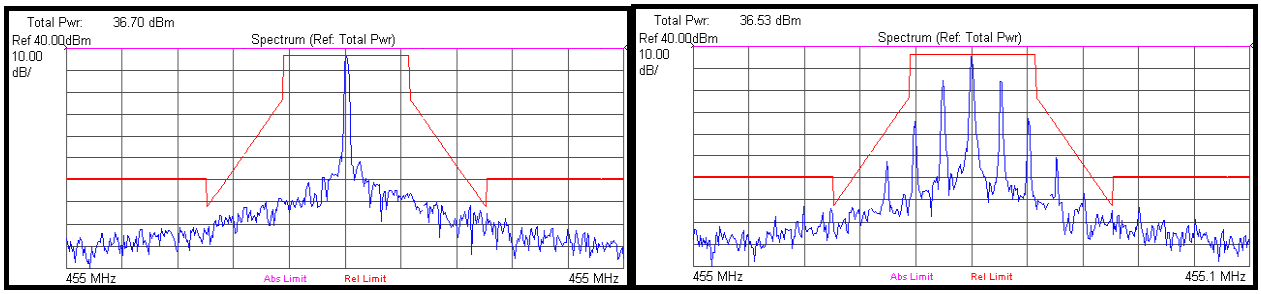
5.4.3 Test Result

1. 12.5 kHz channel spacing

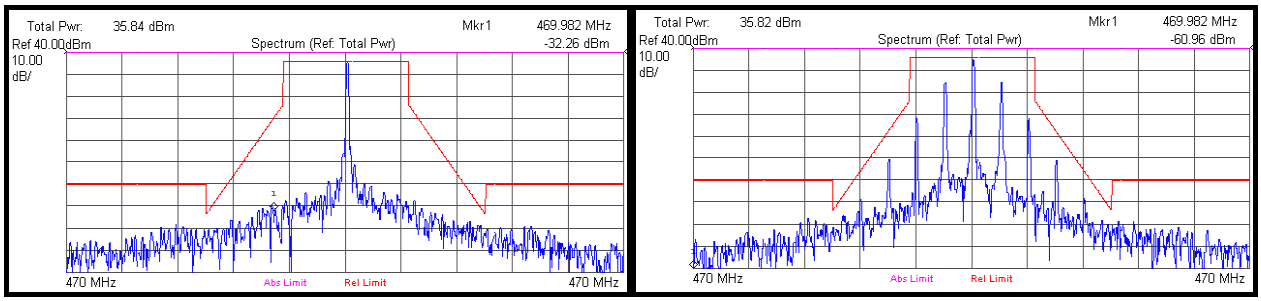
- **440.0125MHz 4W**



- **455.0125 MHz 4W**



- **469.9875 MHz 4W**



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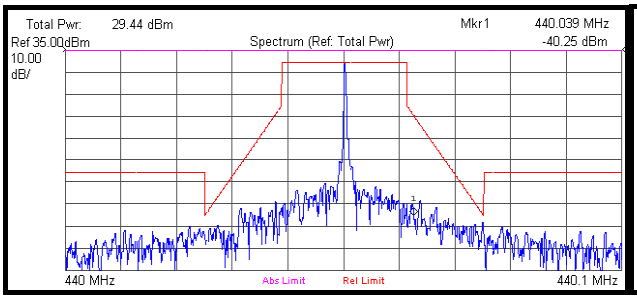
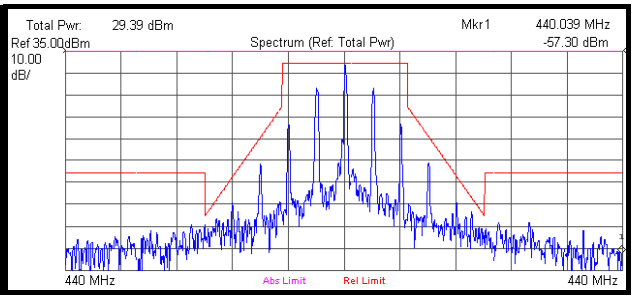
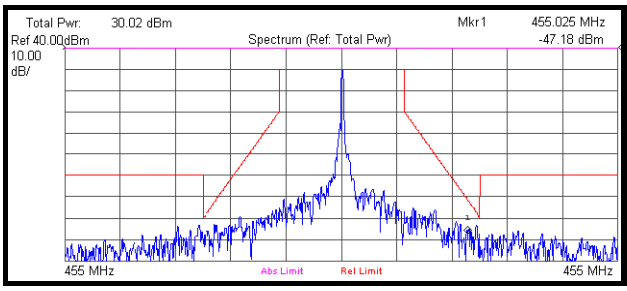
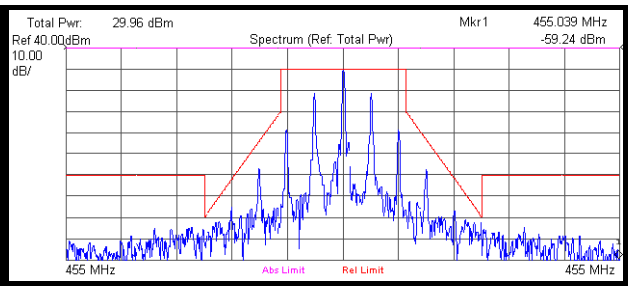
- **440.0125 MHz 1W**



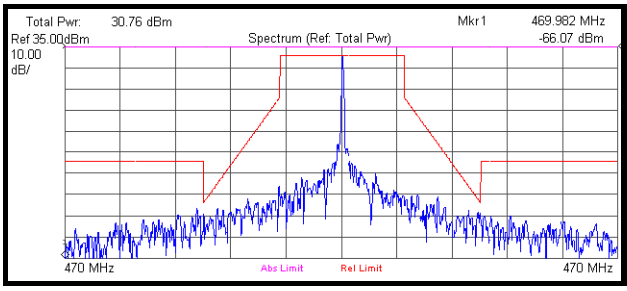


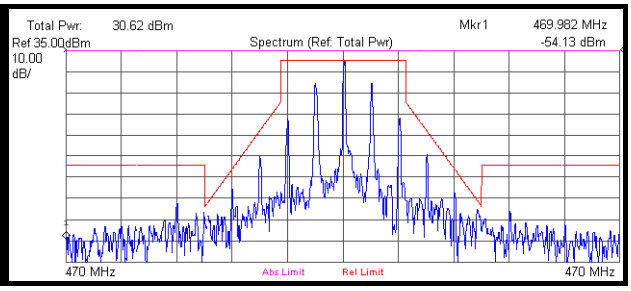
- **455.0125 MHz 1W**





- **469.9875 MHz 1W**





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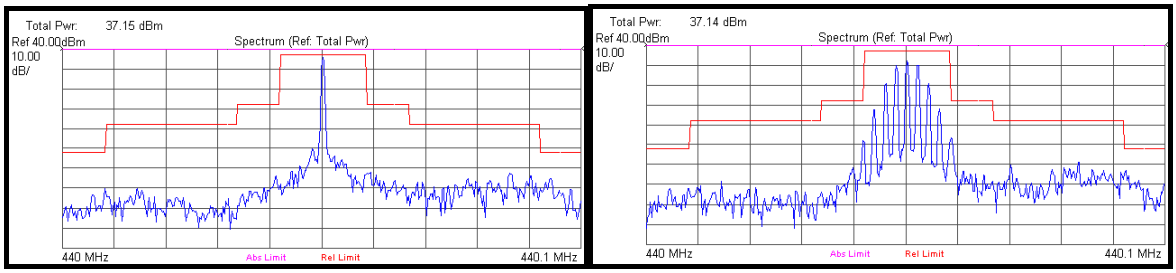
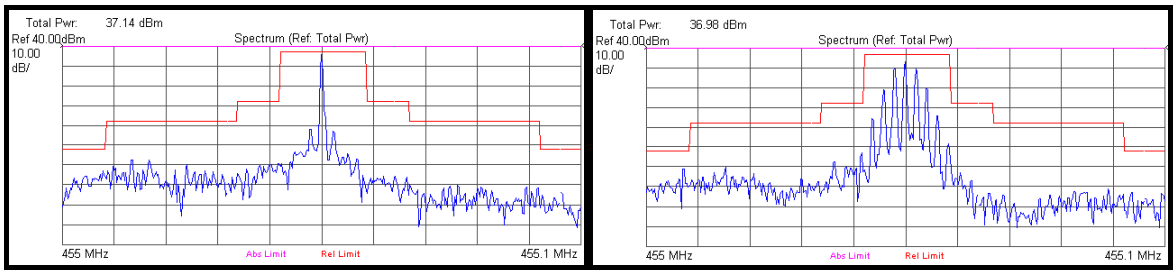
2. 25 kHz channel spacing

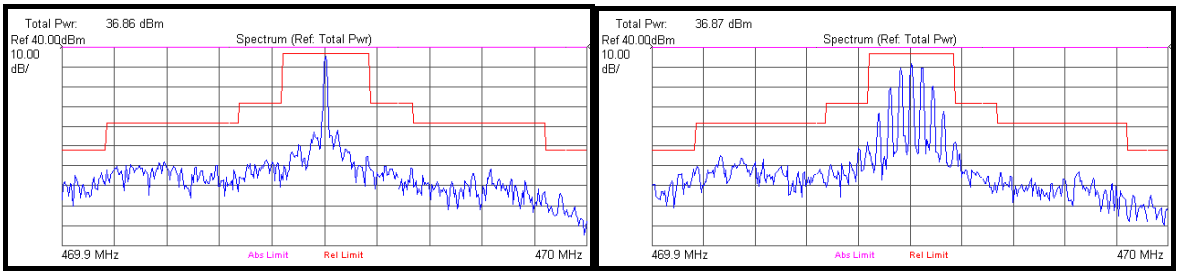
- **440.0125MHz 4W**



- **455.0125 MHz 4W**



- **469.9875 MHz 4W**



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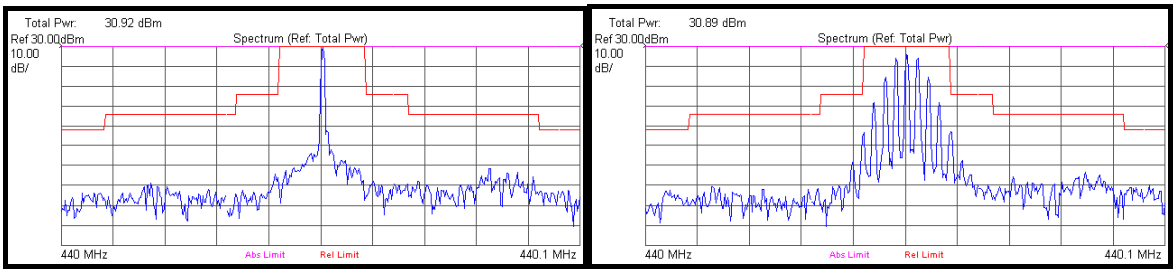
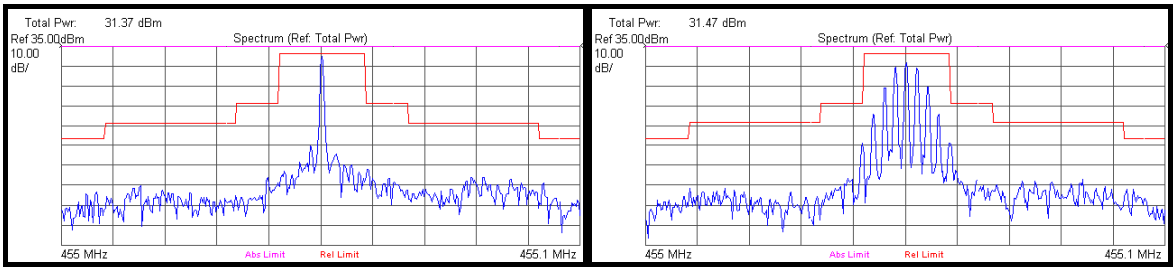
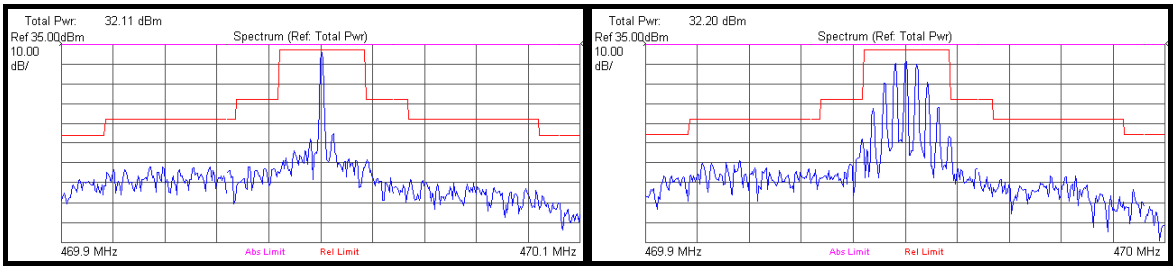
- **440.0125MHz 1W**



- **455.0125 MHz 1W**



- **469.9875 MHz 1W**



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5.5 Transient Frequency Behavior

5.5.1 Definition

The transient frequency behavior is measured the difference, as a function in time. Of the actual transmitter frequency to the assigned transmitter frequency when the transmitted RF output power is switched on or off.

FCC ID : VTB-TR450H

Specification: 47CFR 90.214

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.19

5.5.2 Measurement Procedure

- The EUT was set up as shown in the attached page, following TIA/EIA-603 steps a,b, and c as a guide.
- Sufficient attenuation was provided so that the transmitter carrier level measured at the output of the combiner was 40dB below the maximum input level of the test receiver. This level was recorded as step f.
- The transmitter turned off.
- An RF signal generator (1) modulated with a 1kHz tone at either 25,12.5kHz or 6.5kHz deviation, and set to the same frequency as the assigned transmitter frequency,(2) was adjusted to a level -20 dB below the level recorded for step f,as measured at the output of the combiner. This level was then fixed for the remainder of the test and is recorded at step h.
- The oscilloscope was set up using TIA/EIA-603 steps j and k as a guide, and to either 10ms/div (UHF) if 5ms/div (VHF).
- The 30dB attenuator was removed, the transmitter was turn on, and the level of the carrier at the output of the combiner was recorded as step l.
- The carrier on-time as referenced in TIA/EIA-603 steps m, n and o was captured and plotted . The carrier –off time as referenced in TIA/EIA-603 steps p, q, r, and s was captured and plotted.
- For EUTs supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for ±2.5kHz / ±1.25kHz deviation (or 50% modulation). When level constant, the signal level was increased 16dB.
- For EUTs supporting digital modulation, the digital modulation mode was operated to its maximum extent.
- The occupied bandwidth was measured with the spectrum Analyzer controls set as shown on the test results.

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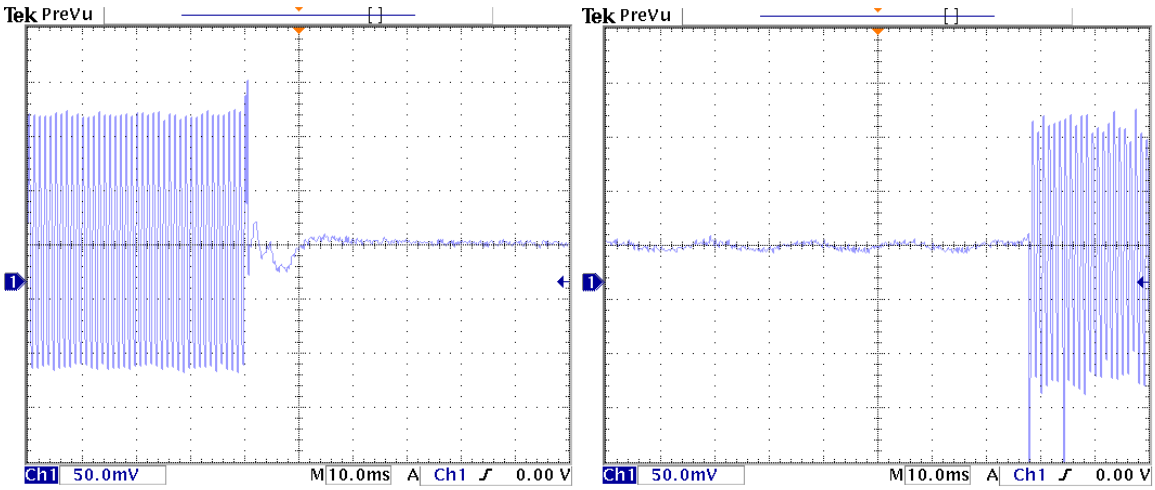
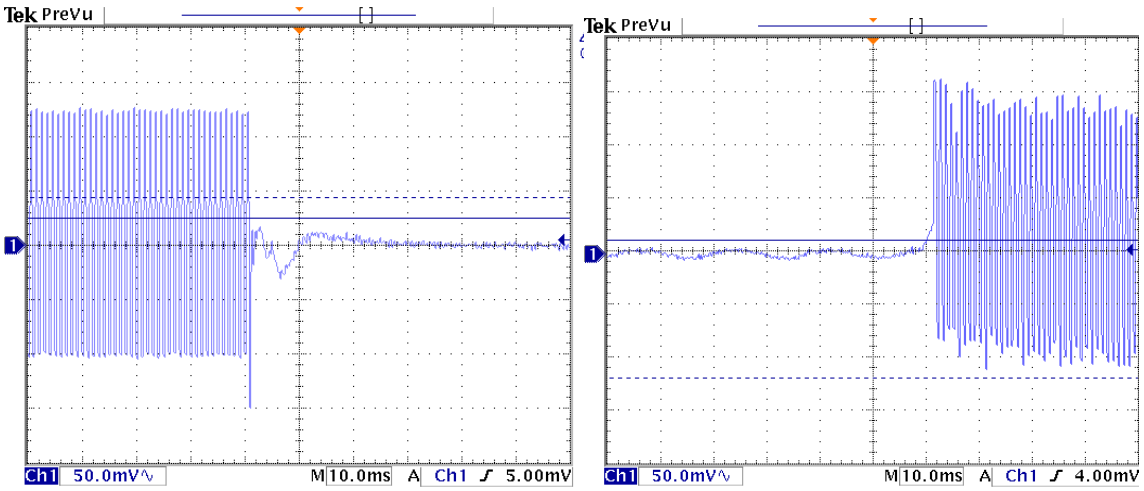
5.4.4 Plot

1. 12.5 kHz channel spacing
(440.0125MHz 4W)



(440.0125MHz 1W)



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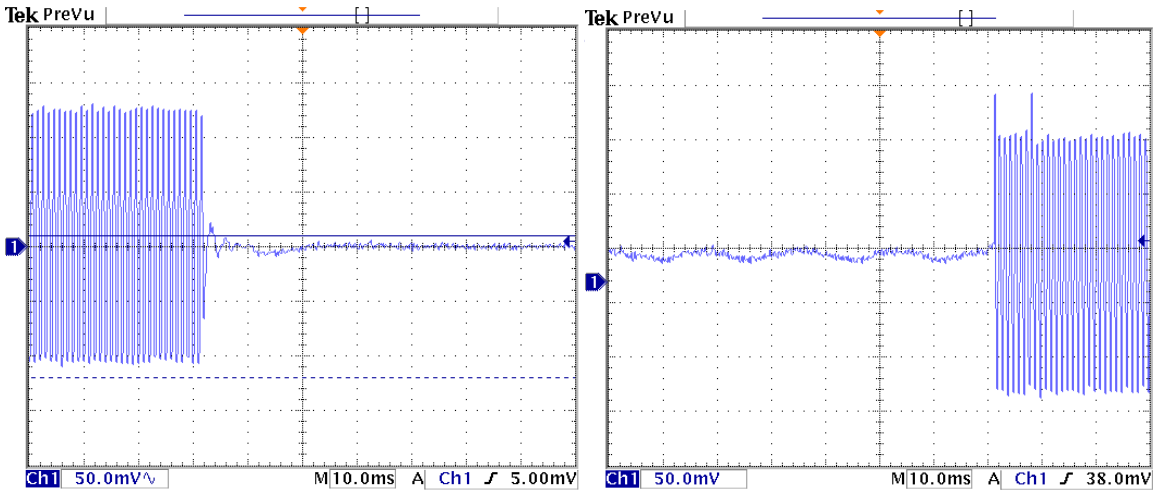
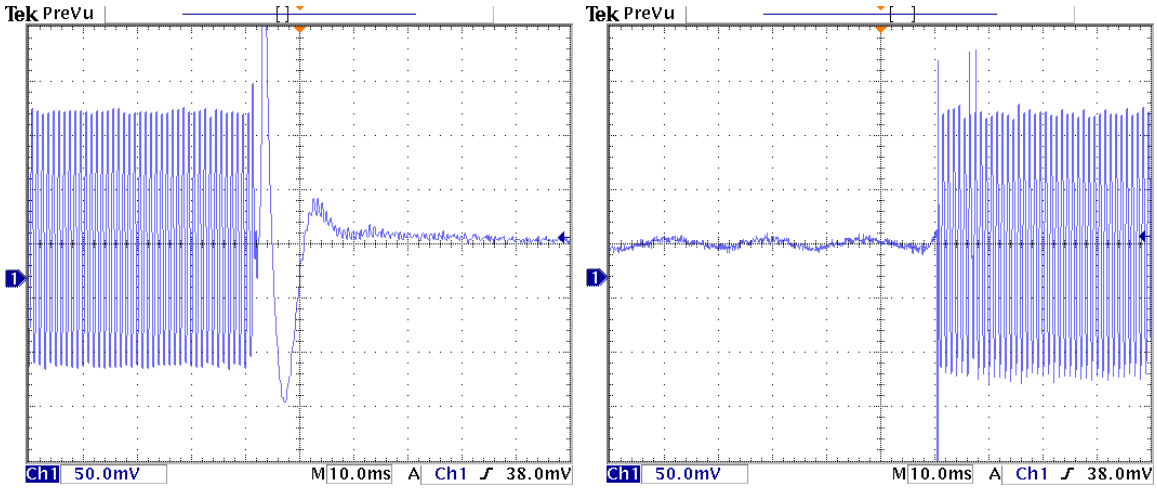
(455.0125MHz 4W)



(455.0125MHz 1W)



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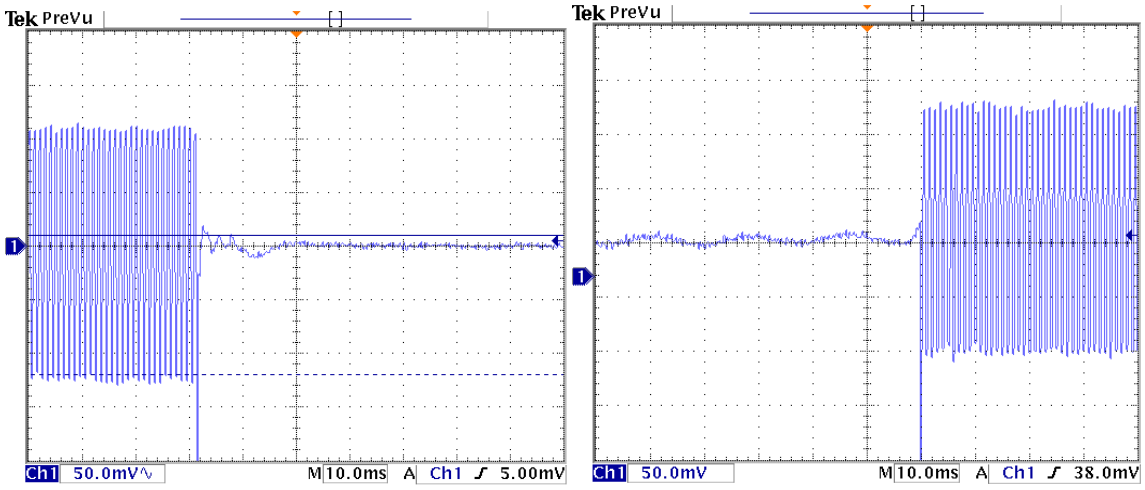
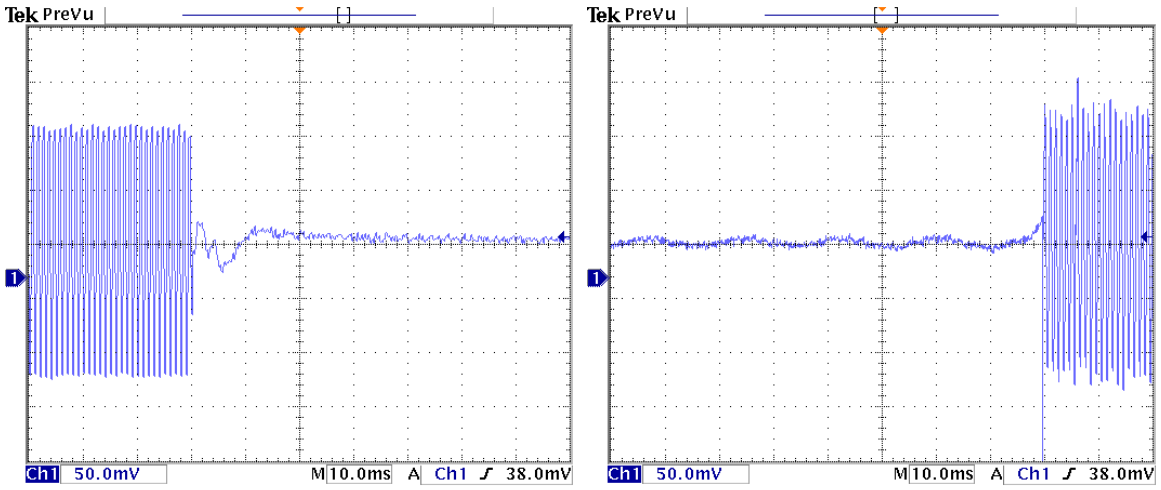
(469.9875MHz 4W)



(469.9875MHz 1W)



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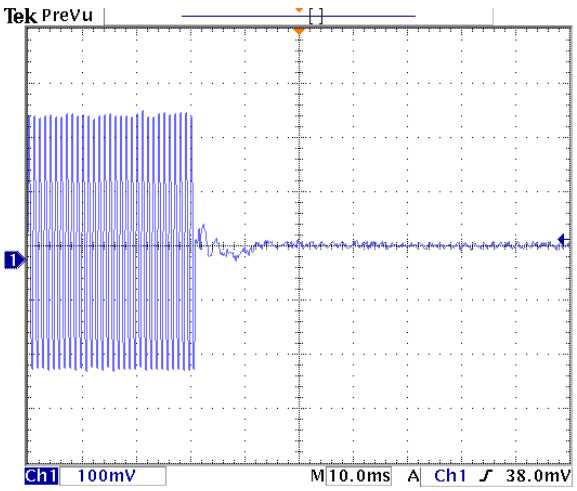
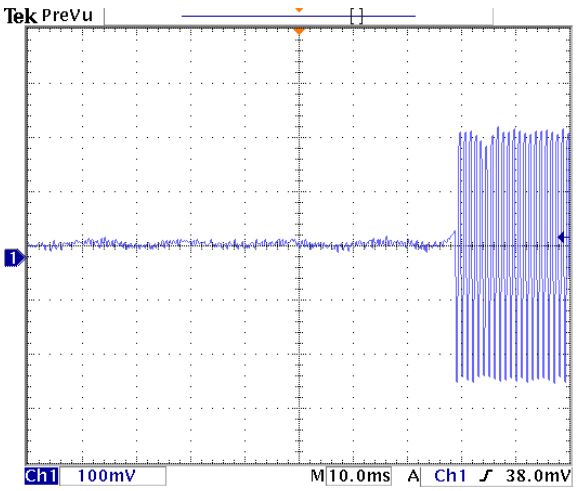
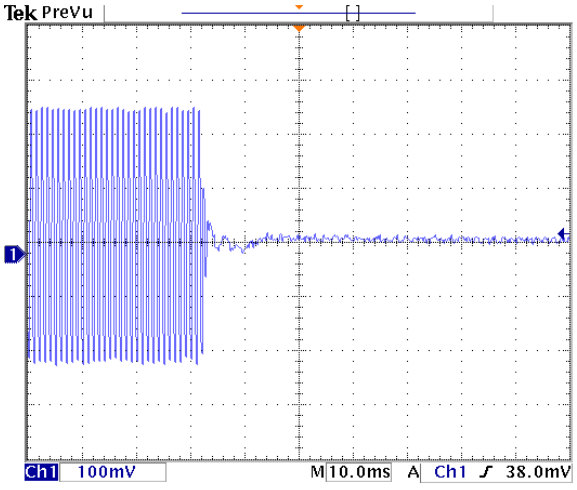
2. 25 kHz channel spacing

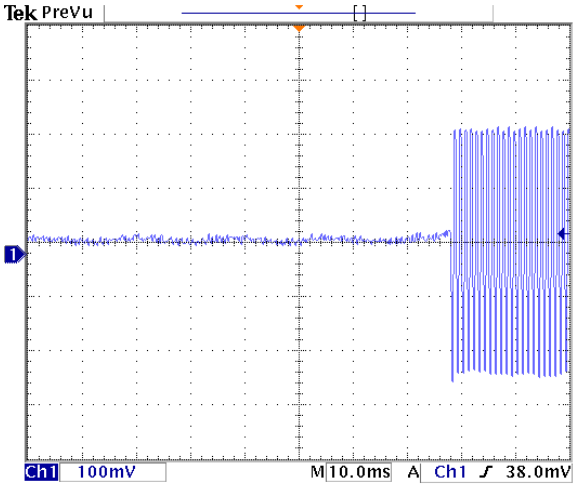
(440.0125MHz 4W)





(440.0125MHz 1W)





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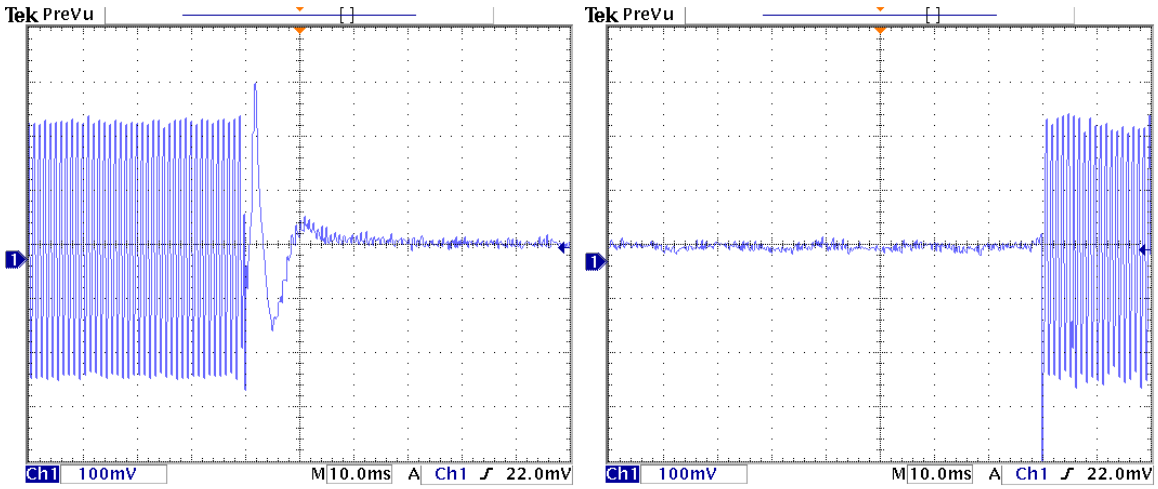
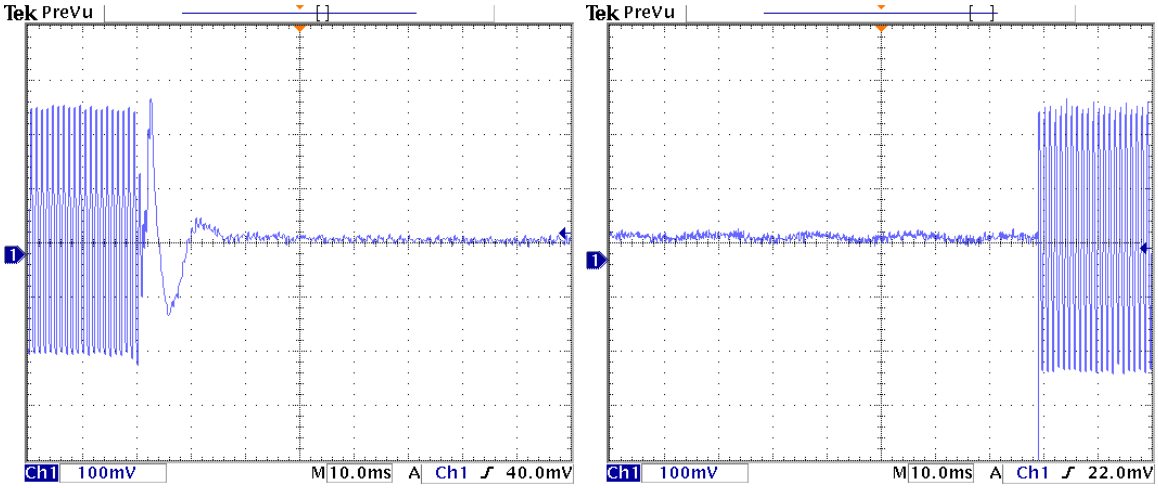
(455.0125MHz 4W)



(455.0125MHz 1W)



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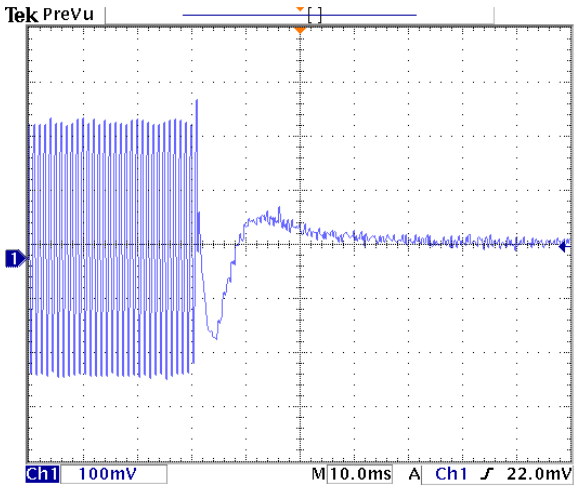
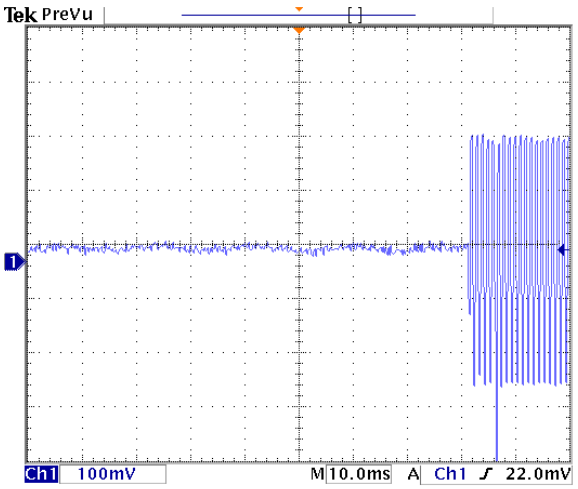
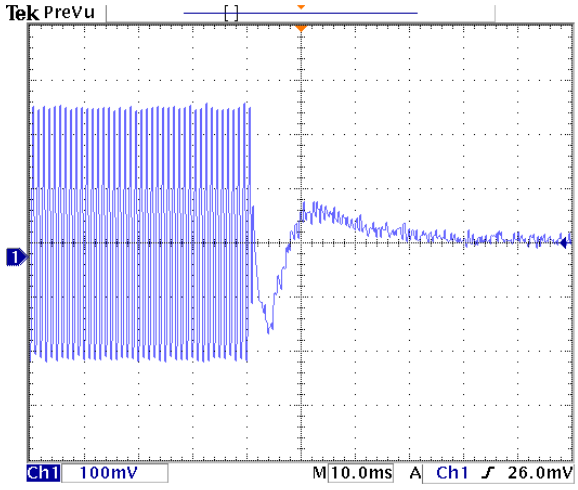
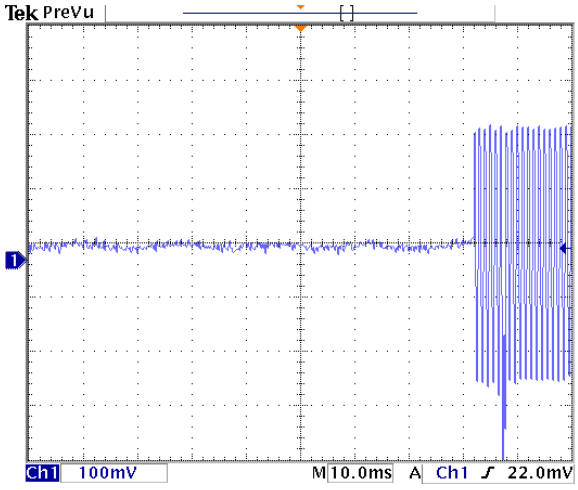
(469.9875MHz 4W)





(469.9875MHz 1W)





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5.6 Audio Low Pass Filter (Voice input)

5.5.1Definition

The audio low pass filter response is the frequency response of the post limiter low pass filter circuit above 3000Hz.

FCC ID : VTB-TR450H

Specification: 47CFR 2.1047(a)

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.15

5.5.2 Measurement Procedure

- The EUT and test equipment were set up such that the audio input was connected at the input to the modulation limiter, and the modulated stage.
- The audio output was connected at the output to the modulated stage.

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5.7 Audio Frequency Response

5.7.1 Definition

Audio frequency response is the degree of closeness to which the frequency deviation of the transmitter follows a prescribed characteristic.

FCC ID : VTB-TR450H

Specification: 47CFR 2.1047(a)

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.6

5.7.2 Measurement Procedure

- The audio signal input was adjusted to obtain 20% modulation at 1 kHz , and this point was taken as the 0 dB reference level.
- With input levels held constant and below limiting at all frequencies , the audio signal generator was varied from 300 Hz to 30 kHz.
- The response in dB relative to 1 kHz was then measured, using the HP8901A modulation analyzer .

Frequency range	9 kHz to 1GHz	Above 1GHz to 4GHz,or above 1GHz to 12.75GHz, see clause 8.6.2
Tx operating	0,25uW(-36,0 dBm)	1,00 uW(-30,0 dBm)
Tx standby	2,0nW(-57,0 dBm)	20,0 nW (-47,0 dBm)

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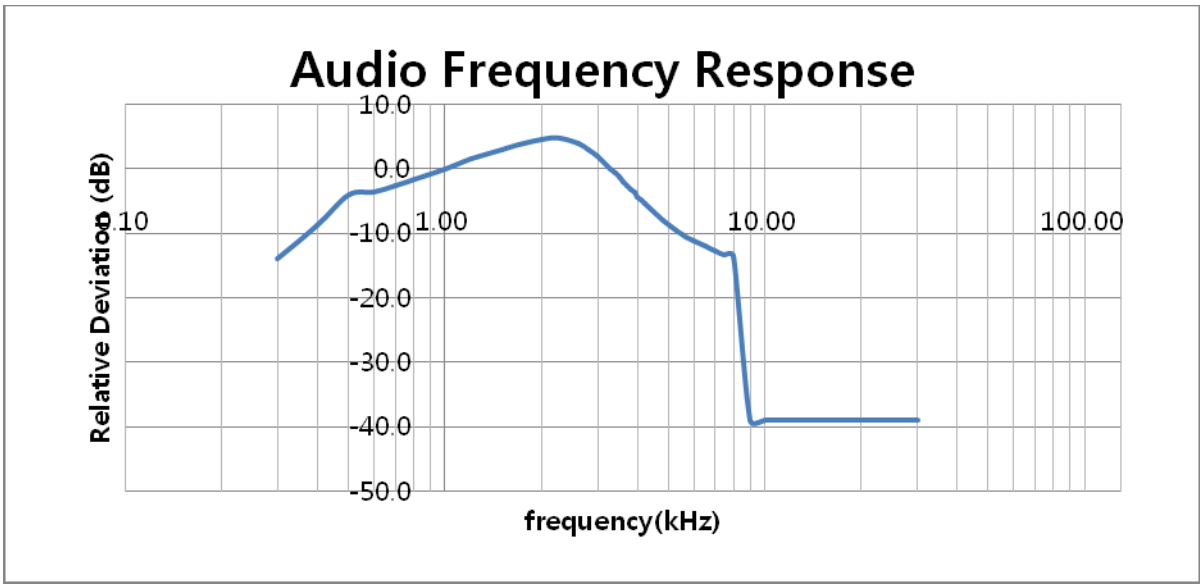
5.7.3 Test Result

Operating Frequency : 455.0125MHz

Reference Level: 0 dB @ 1kHz

Audio Frequency Response					
Freq (kHz)	Level (dB)	Freq (kHz)	Level (dB)	Freq (kHz)	Level (dB)
0.3	-14.0	2.8	3.0	5.5	-10.3
0.4	-8.8	3.0	1.8	6.0	-11.1
0.5	-4.1	3.3	-0.1	6.5	-12.0
0.6	-3.7	3.4	-0.8	7.0	-12.8
0.7	-2.6	3.5	-1.4	7.5	-13.3
0.8	-1.7	3.6	-2.0	8.0	-13.5
1.0	0.0	3.7	-2.6	9.0	-39.1
1.2	1.4	3.8	-3.2	10.0	-39.1
1.5	3.0	3.9	-3.7	15.0	-39.1
1.7	3.7	4.0	-4.4	20.0	-39.1
2.0	4.6	4.1	-4.9	30.0	-39.1
2.3	4.7	4.2	-5.4		
2.6	3.9	4.8	-8.0		



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5.8 Modulating Limiting

5.7.1 Definition

Modulating limiting refers to the transmitter circuits' ability to limit the transmitter from producing deviation due to modulation in excess of a rated system deviation.

FCC ID : VTB-TR450H

Specification: 47CFR 2.1047(b)

Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.3

5.7.2 Measurement Procedure

- The signal generator was connected to the input of the EUT as for " Frequency Response of the Modulating Circuit."
- The modulation response was measured for each of three frequencies (one of which was the frequency of maximum response), and the input voltage was varied and was observed on an HP8901A modulation Analyzer.
- The input level was varied from the 30% modulation (±1.5kHz deviation) to at least 20dB higher than the saturation point.

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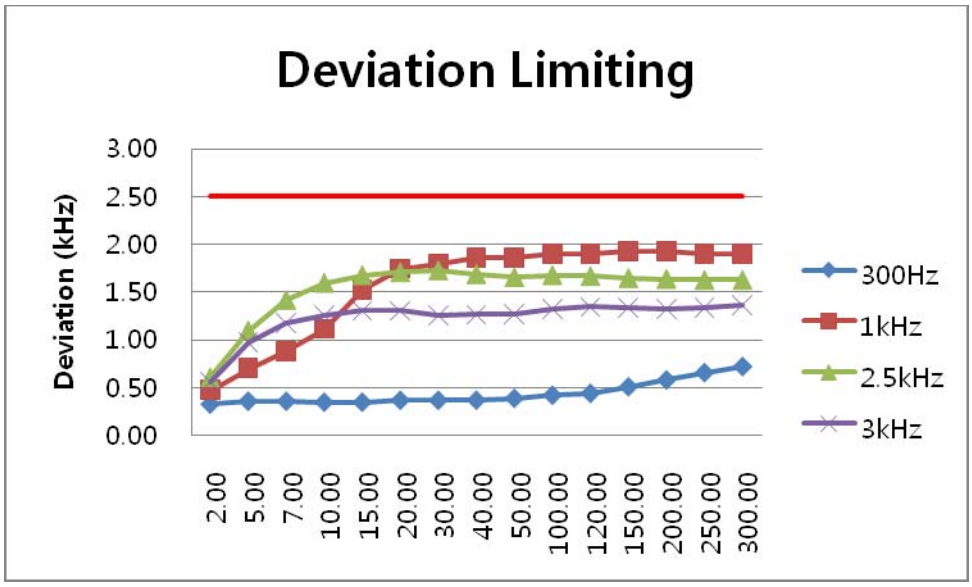
5.7.3 Test Result

Operating Frequency :455.0125 MHz

Channel spacing : 12.5 kHz

Input Level(mV)	FM deviation in kHz at indicated Modulating Frequency			
	300 Hz	1 kHz	2.5 kHz	3 kHz
2	0.33	0.47	0.61	0.56
5	0.36	0.70	1.10	0.97
7	0.36	0.88	1.42	1.17
10	0.35	1.11	1.60	1.25
15	0.35	1.52	1.68	1.30
20	0.37	1.74	1.71	1.30
30	0.37	1.80	1.73	1.25
40	0.37	1.86	1.69	1.26
50	0.39	1.86	1.66	1.27
100	0.42	1.90	1.68	1.32
120	0.44	1.90	1.67	1.34
150	0.51	1.93	1.65	1.33
200	0.58	1.93	1.64	1.32
250	0.66	1.90	1.63	1.33
300	0.72	1.90	1.63	1.36

Graph



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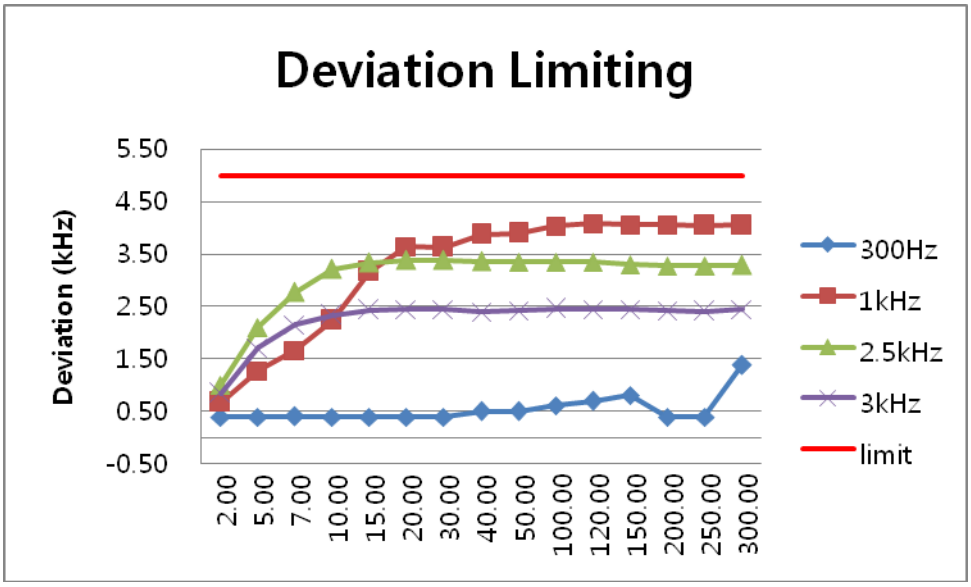
Operating Frequency :455.0125 MHz

Channel spacing : 25 kHz

Input Level(mV)	FM deviation in kHz at indicated Modulating Frequency			
	300 Hz	1 kHz	2.5 kHz	3 kHz
2	0.40	0.68	1.01	0.85
5	0.40	1.27	2.10	1.71
7	0.41	1.66	2.77	2.15
10	0.40	2.24	3.21	2.33
15	0.40	3.17	3.33	2.43
20	0.40	3.64	3.38	2.45
30	0.40	3.63	3.38	2.45
40	0.50	3.87	3.36	2.40
50	0.50	3.90	3.35	2.42
100	0.62	4.03	3.35	2.46
120	0.70	4.08	3.35	2.45
150	0.81	4.06	3.30	2.45
200	0.40	4.06	3.27	2.42
250	0.40	4.04	3.27	2.41
300	1.39	4.05	3.28	2.45

Graph



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5.9 Frequency stability

5.9.1 Definition

Modulation limiting refers to the transmitter circuits' ability to limit the transmitter from producing deviations due to modulation in excess of a rated system deviation.

FCC ID : VTB-TR450H
Specification: 47CFR 2.1055
Test method: ANSI/TIA/EIA-603-B-2002, Paragraph 2.2.2

5.9.2 Measurement Procedure

The frequency stability of the transmitter is measured by:

a) Temperature: the temperature is varied from -30°C to +60°C using an environmental chamber.
b) Primary Supply Voltage: the primary supply terminals if cables are not normally supplied.

Specification- the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ±0.00025(±2.5ppm) of the center frequency.

Time period and Procedure:

1. The carrier frequency of the transmitter and the individual oscillator is measured at room temperature (25°C to 27°C to provide a reference)
2. The equipment is subject to an overnight "soak" at -30°C without power applied.
3. After the overnight "soak" at 30°C(usually 14-16 hours), the equipment is turn on in a "standby" condition for an minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter and the individual oscillator is made within a three minute interval after applying power to the transmitter.
4. Frequency measurements are made at 10°C interval up to room temperature. At least a period one and one half-hour is provided to allow stabilization of the equipment at each temperature level.
5. Again the transmitter carrier frequency and the individual oscillators are measured at room temperature to begin measurement of the upper temperature levels.
6. Frequency measurement are at 10 intervals starting at -30°C up to 60°C allowing at least two hours at each temperature for stabilization. In all measurements the frequency is measured within three minutes after reapplying power to the transmitter.
7. The artificial load is mounted external to the temperature chamber.
   NOTE: the EUT is tested down to the battery endpoint.

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5.9.3 Test Result

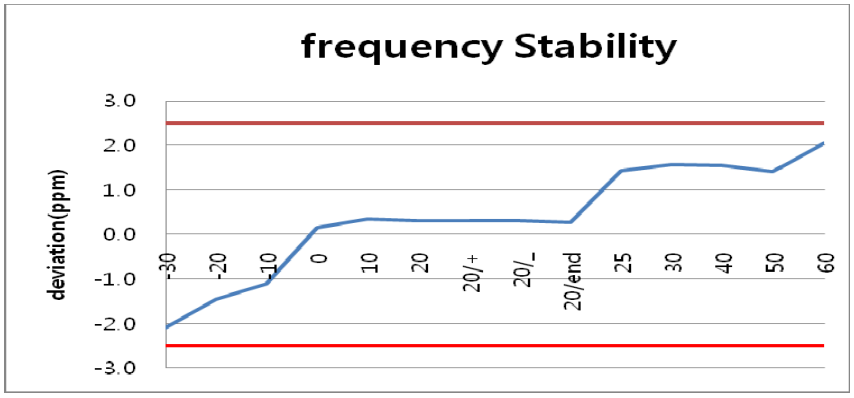
Operating frequency: 455.0125MHz

Reference voltage: 7.4 V DC

Channel spacing: 12.5kHz

Deviation limit: ±0.00025% or 2.5ppm

Voltage (%)	Power (V DC)	Temp (dB)	Frequency(Hz)	Deviation(%)
100%	7.4	+20(ref)	455012638	0.000030
100%		-30	455011548	-0.000209
100%		-20	455011841	-0.000145
100%		-10	455011993	-0.000111
100%		0	455012567	0.000015
100%		+10	455012653	0.000034
100%		+20	455012638	0.000030
100%		+25	455013148	0.000142
100%		+30	455013212	0.000156
100%		+40	455013200	0.000154
100%		+50	455013140	0.000141
100%		+60	455013430	0.000204
85%	6.29	+20	455012635	0.000030
115%	8.51	+20	455012640	0.000031
Batt.Endpoint	5.80	+20	455012624	0.000027



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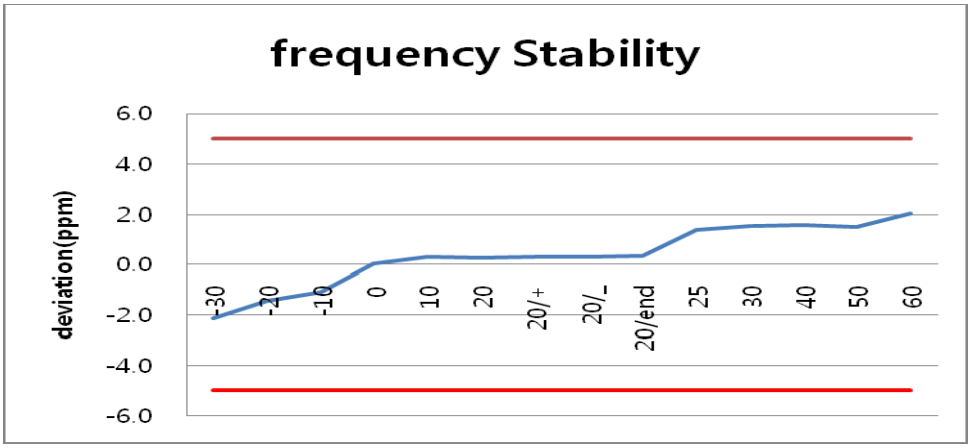
Operating frequency: 455.0125MHz

Reference voltage: 7.4 V DC

Channel spacing: 25kHz

Deviation limit: ±0.00050% or 5 ppm

Voltage (%)	Power (VDC)	Temp (dB)	Frequency(Hz)	Deviation(%)
100%	7.4	+20(ref)	455012622	0.000027
100%		-30	455011532	-0.000213
100%		-20	455011846	-0.000144
100%		-10	455011998	-0.000110
100%		0	455012520	0.000004
100%		+10	455012644	0.000032
100%		+20	455012622	0.000027
100%		+25	455013132	0.000139
100%		+30	455013200	0.000154
100%		+40	455013212	0.000156
100%		+50	455013190	0.000152
100%		+60	455013428	0.000204
85%	6.29	+20	455012640	0.000031
115%	8.51	+20	455012642	0.000031
Batt.Endpoint	5.80	+20	455012649	0.000033



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5.10 Necessary Bandwidth and Emission bandwidth

FCC ID: VTB-TR450H
Specification: 47 CFR 2.202(g)

Modulation= 16K0F3E

Necessary bandwidth calculation:

Maximum modulation (M), kHz	**= 3**
Maximum deviation (D),kHz	**= 5**
Constant Factor (K)	**= 1**
Necessary bandwidth (BN),kHz	**= (2 x M) + (2 x D x k)**
	= 16.0

Modulation= 8K50F3E

Necessary bandwidth calculation:

Maximum modulation (M), kHz	**= 1.75**
Maximum deviation (D),kHz	**= 2.5**
Constant Factor (K)	**= 1**
Necessary bandwidth (BN),kHz	**= (2 x M) + (2 x D x k)**
	= 8.5

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6. Test equipment used for test

	Description	Manufacture	Model No.	Serial No.	Next Cal Date.
■	Temp & humidity chamber	taekwang	TK-04	TK001	07.12.19
□	Temp & humidity chamber	taekwang	TK-500	TK002	08.09.06
■	Power Meter	Agilent	E4416A	GB41292365	08.11.02
■	Frequency Counter	HP	5351B	3049A01295	08.11.02
■	Spectrum Analyzer	Agilent	E4407B	US39010142	08.11.02
■	Spectrum Analyzer	R & S	FSP40	100209	08.11.19
■	Signal Generator	HP	E4432B	GB39340611	08.11.02
■	Modulation Analyzer	HP	8901B	3538A05527	08.11.08
■	Function Generator	Agilent	33120A	US36018826	08.11.02
■	Audio Analyzer	HP	8903B	3011A10372	08.11.02
□	Audio Analyzer	HP	8903B	3729A18248	08.11.02
□	AC Power Supply	KIKUSUI	PCR2000W	GB001619	08.11.02
□	DC Power Supply	HP	6032A	2920A-04499	07.11.15
■	DC Power Supply	Tektronix	PS2520G	TW50517	08.02.12
□	DC Power Supply	Tektronix	PS2521G	TW53135	08.11.02
□	Dummy Load	BIRD	8141	7560	-
□	Dummy Load	BIRD	8401-025	799	-
■	EMI Test Receiver	R&S	ESCI	100001	08.11.16
■	Attenuator	HP	8494A	2631A09825	08.11.06
■	Attenuator	HP	8496A	3308A16640	08.11.06
■	Attenuator	R&S	RBS1000	D67079	08.11.05
□	Attenuator	BIRD	50-A-MFN-20	0403002	08.11.02
■	Attenuator	HP	11581A	29738	08.01.10
■	Power sensor	Agilent	E9321A	US40390422	08.11.03
□	Power sensor	Agilent	E9325A		08.11.03
□	LOOP Antenna	EMCO	EMCO6502	9205-2745	07.10.31
■	BILOG Antenna	Schwarzbeck	VULB 9160	3138	08.02.12
■	HORN Antenna	ETS	3115	00062589	08.03.25
■	Power Divider	HP	11636A	05441	08.11.07
■	Signal Generator	HP	E4421B	GB40052295	08.11.02
■	Signal Generator	IFR	IFR2023A	202304/278	08.05.03
■	Power Divider	Weinschel	1580-1	NX375	08.11.07
□	Power Divider	Weinschel	1580-1	NX379	07.10.31
□	Power Divider	Weinschel	1580-1	NX380	08.11.16
■	Power Divider	Weinschel	1594	671	08.06.15

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