FCC TEST REPORT

Test report No:	EMC- FCC- R0130
FCC ID:	O6ZHR44
Type of Equipment:	SATELLITE RECEIVER
Model Name:	HR44-500
Applicant:	HUMAX Co., Ltd
Max.RF Output Power:	4.47 dBm
FCC Rule Part(s):	FCC Part 15 Subpart C Section 15.203, Section 15.209 Section 15.207, Section 15.247
Frequency Range:	2 400 MHz ~ 2 483.5 MHz
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: 2014. 01. 03 ~ 07

Issued date: 2014. 01. 08

Tested by: AHN, BYUNG WOO

Approved by: YU, SANG HOON

[Contents]

1. Client information

Applicant:	HUMAX Co., Ltd
Address:	HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-825, Korea
Telephone number:	+82-31-776-6400
Facsimile number:	+82-31-776-6149
Contact person:	Seo, In Seok / isseo@humaxdigital.com

Manufacturer:	HUMAX Co., Ltd
Address :	212-1, Yubang-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea

2. Laboratory information

Address

EMC compliance Ltd.
65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 443-390, Korea
Telephone Number: 82-31-336-9919 Facsimile Number: 82-505-299-8311

Certificate

CBTL Testing Laboratory, KOLAS NO.: 231
FCC Filing No.: 508785
VCCI Registration No.: R-3327, G-198, C-3706, T-1849
IC Recognition No.:8035A-2

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant	HUMAX Co., Ltd
Address of Applicant	HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-825, Korea
Manufacturer	HUMAX Co., Ltd
Address of Manufacturer	212-1, Yubang-dong, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea
Type of equipment	SATELLITE RECEIVER
Basic Model	HR44-500
Serial number	Proto Type

3.2 General description

Model Name	HR44-500
Communication	2.4 GHz: 802.15.4(RF4CE) 2.4 GHz: 802.11b/g/n(HT20, HT40), 5.0 GHz: 802.11a/n(HT20, HT40)
Frequency Range	2.4 GHz: 2 400.0 ~ 2 483.5 MHz 5.0 GHz: 5 150 ~ 5 350 MHz, 5 470 ~ 5 725 MHz, 5 725 ~ 5 850 MHz
Type of Modulation	O-QPSK, CCK, OFDM
Channel capacity	**2.4 GHz**: 3 ch(RF4CE) **2.4 GHz:** 11 ch(802.11b/g/n_HT20) 7 ch(802.11n_HT40) **5.0 GHz:** 5 150 ~ 5 350 MHz: 8 ch(802.11a/n_HT20), 4 ch(802.11n_HT40) 5 470 ~ 5 725 MHz: 11 ch(802.11a/n_HT20), 5 ch(802.11n_HT40) 5 725 ~ 5 850 MHz: 5 ch(802.11a/n_HT20), 2 ch(802.11n_HT40)
Antenna Gain	2.4 GHz : 4.1 dBi (RF4CE) 2.4 GHz : 3.1 dBi (802.11b/g/n) 5.0 GHz : 3.2 dBi (802.11a/n)
Type of Antenna	PCB Antenna
Firmware version	Wi-Fi Driver Ver: 5.90.188.59, RF4CE Driver Ver:1.5.3.1
Power supply	AC 120 V
Operating temperature	0 ~ 50 °C
Dimension	33 mm x 25 mm x 4 mm (W x D x H)

3.3 Test frequency

For all teset items, the low, middle and high channels of the modes were tested with above worst case data rate.

2400 ~ 2483.5 (MHz) : 802.15.4(RF4CE)

	CH	Frequency
Low frequency	15	2 425 MHz
Middle frequency	20	2 450 MHz
High frequency	25	2 475 MHz

2400 ~ 2483.5 (MHz) :802.11b/g/n(HT20, HT40)

	Frequency	Frequency
Band Width	20 MHz	40 MHz
Low frequency	2 412 MHz	2 422 MHz
Middle frequency	2 437 MHz	2 437 MHz
High frequency	2 462 MHz	2 452 MHz

5150~5250 (MHz) : 802.11a/n(HT20, HT40)

	Frequency	Frequency
Band Width	20 MHz	40 MHz
Low frequency	5 180 MHz	5 190 MHz
Middle frequency	5 200 MHz	-
High frequency	5 240 MHz	5 230 MHz

5250~5350 (MHz) : 802.11a/n(HT20, HT40)

	Frequency	Frequency
Band Width	20 MHz	40 MHz
Low frequency	5 260 MHz	5 270 MHz
Middle frequency	5 300 MHz	-
High frequency	5 320 MHz	5 310 MHz

5470~5350 (MHz) : 802.11a/n(HT20, HT40)

	Frequency	Frequency
Band Width	20 MHz	40 MHz
Low frequency	5 500 MHz	5 510 MHz
Middle frequency	5 600 MHz	5 590 MHz
High frequency	5 700 MHz	5 670 MHz

5250~5350 (MHz) : 802.11a/n(HT20, HT40)

	Frequency	Frequency
Band Width	20 MHz	40 MHz
Low frequency	5 745 MHz	5 755 MHz
Middle frequency	5 785 MHz	-
High frequency	5 825 MHz	5 795 MHz

3.4 Test Voltage

mode	Voltage
Norminal voltage	AC 120V

4. Summary of test results

4.1 Standards & results

Rule Reference	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	Antenna Requirement	5.1	C
15.247(b)(3)	Maximum Peak Output Power	5.2	NA
15.247(e)	Peak Power Spectral Density	5.3	NA
15.247(a)(2)	6 dB Channel Bandwidth	5.4	NA
15.247(d), 15.205(a), 15.209(a)	Spurious Emission, Band Edge, and Restricted bands	5.5	C
15.207(a)	Conducted Emissions	5.6	NA
15.247(i), 1.1307(b)(1)	RF Exposure	5.7	C
RSS-Gen, Issue 3,6	Receiver Spurious Emission (Radiated)	5.8	NA

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

4.2 Uncertainty

Measurement Item	Combined Standard Uncertainty Uc	Expanded Uncertainty U = KUc (K = 2)
Radiated disturbance	30 MHz ~ 300 MHz : + 2.43 dB, - 2.44 dB 300 MHz~1 000 MHz : + 2.49dB, - 2.50 dB 1 GHz ~ 6 GHz : + 3.10 dB, - 3.10 dB 6 GHz ~ 18 GHz : + 3.21 dB, - 3.27 dB	30 MHz ~ 300 MHz : + 4.86 dB, - 4.88 dB 300 MHz ~ 1 000 MHz + 4.98dB, - 4.99 dB 1 GHz ~ 6 GHz : + 6.19 dB, - 6.20 dB 6 GHz ~ 18 GHz : + 6.41 dB, - 6.53 dB

5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2 Result

-Complied

The transmitter has an integral PCB antenna. The directional peak gain of the antenna is 4.1 dBi.

5.2 SPURIOUS EMISSION, BAND EDGE, AND RESTRICTED BANDS

5.2.1 Regulation

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

5.2.2 Measurement Procedure

1) Band-edge Compliance of RF Conducted Emissions

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
3. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

3) Spurious Radiated Emissions:

1. The preliminary and final rdiated measurements were performed to determine the frequency producing the maximum emissions in at a 3m anechoic chamber. The EUT was tested at a distance 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360˚.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1 000 MHz to 40 000 MHz using the horn antenna.
4. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

- Sample calculation

The field strength is calculated adding the antenna Factor, cable loss and, Antenna pad adding, subtracting the amplifier gain from the measured reading.

The sample calculation is as follow:

Result = M.R + C.F(A.F + C.L +3 dB Att – A.G) + D.F
M.R = Meter Reading
C.F = Correction Factor
A.F = Antenna Factor
C.L = Cable Loss
A.G = Amplifier Gain
3 dB Att = 3 dB Attenuator

If M.R is 30 dB, A.F 12 dB, C.L 5 dB, 3 dB, A.G 35 dB
The result is : 30 + 12 + 5 + 3 – 35 = 15 dB(μV/m)

5.2.3 Test Result

-Complied

1. Band edge compliance of RF Radiated Emissions was shown in figure 5.
2. Measured value of the Field strength of spurious Emissions (Radiated)

Low channel (2 425 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)							
below 30 MHz	Not Detected	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1GHz							
405.026	120	H	50.1	-9.3	40.8	46.0	5.2
533.188	120	V	45.7	-6.3	39.4	46.0	6.6
833.039	120	H	42.7	-1.0	41.7	46.0	4.3
Peak DATA. Emissions above 1GHz							
1 493.32	1 000	V	65.2	-11.8	53.4	74.0	20.6
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1GHz							
1 493.32	1 000	V	46.4	-11.8	34.6	54.0	19.4
Above 3 000.00	Not Detected	-	-	-	-	-	-

Middle channel (2 450 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)							
below 30 MHz	Not Detected	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1GHz							
405.026	120	H	50.1	-9.3	40.8	40.0	5.2
533.188	120	V	45.7	-6.3	39.4	46.0	6.6
833.039	120	H	42.7	-1.0	41.7	46.0	4.3
Peak DATA. Emissions above 1GHz							
1 492.68	1 000	V	63.6	-11.8	51.8	74.0	22.2
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1GHz							
1 492.68	1 000	V	48.5	-11.8	36.7	54.0	17.3
Above 3 000.00	Not Detected	-	-	-	-	-	-

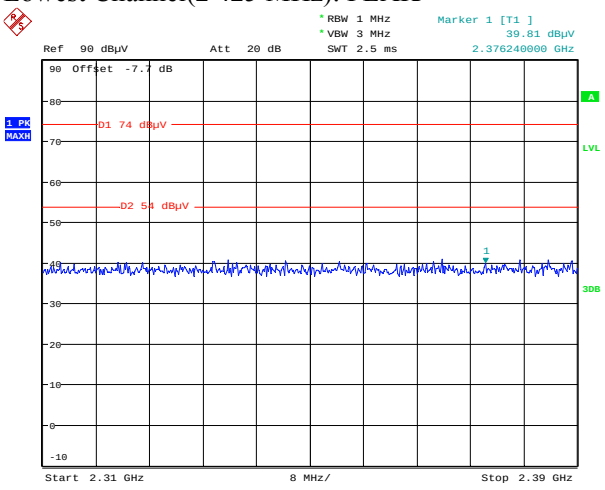
High channel (2 475 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)							
below 30 MHz	Not Detected	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1GHz							
404.991	120	H	50.0	-9.3	40.7	46.0	5.3
533.075	120	V	44.3	-6.3	38.0	46.0	8.0
797.721	120	V	32.6	-1.6	31.0	46.0	15.0
833.039	120	H	41.0	-1.0	40.0	46.0	6.0
Peak DATA. Emissions above 1GHz							
1 492.68	1 000	V	63.6	-11.8	51.8	74.0	22.2
Above 3 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1GHz							
1 492.68	1 000	V	48.5	-11.8	36.7	54.0	17.3
Above 3 000.00	Not Detected	-	-	-	-	-	-

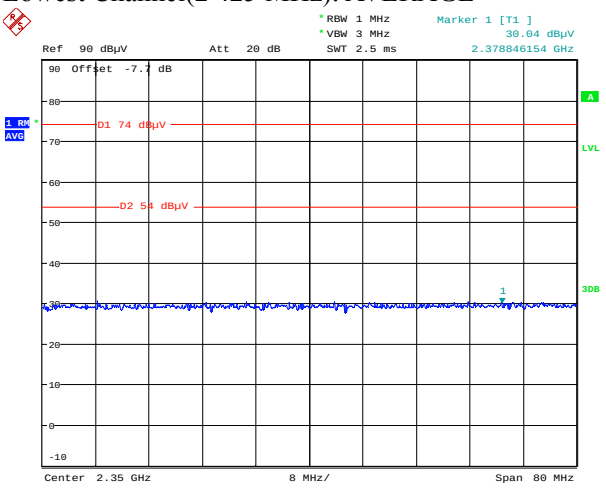
5.2.4 Test Plot (Continue)

Figure 5. Plot of the Band Edge (Radiated)

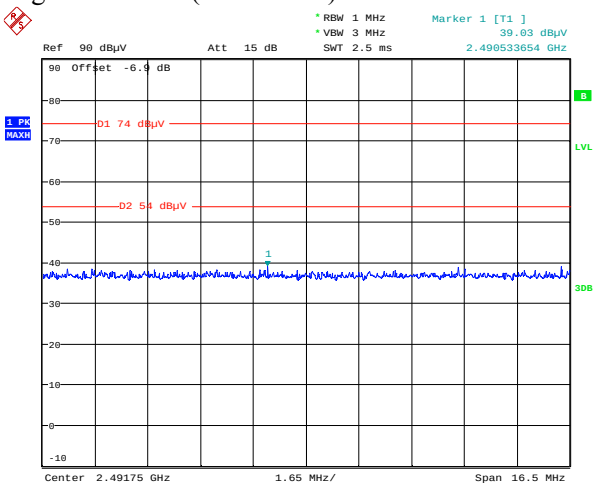
Lowest Channel(2 425 MHz): PEAK



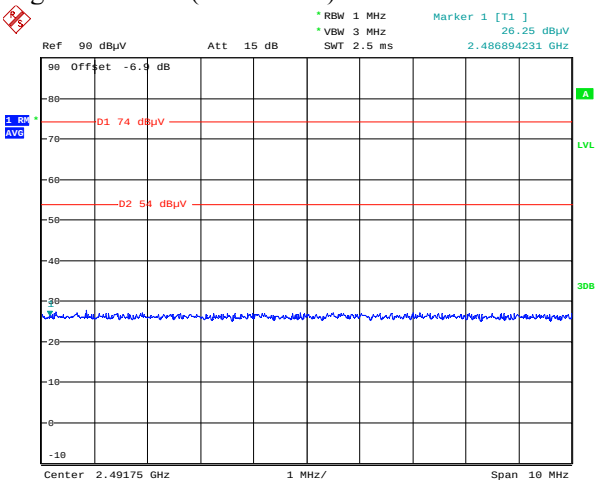
Lowest Channel(2 425 MHz): AVERAGE



Highest Channel(2 475 MHz): PEAK



Highest Channel(2 475 MHz): AVERAGE



*** offset = Factor (ANT Factor+ Amp Gain + Cable Loss) [dB]**
= -7.7 dB (2 425 MHz)
= -6.9 dB (2 475 MHz)

5.3 RF Exposure

5.3.1 Regulation

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Limits for Maximum Permissive Exposure: RF exposure is calculated.

Frequency Range	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [mW/cm^2]	Averaging Time [minute]
Limits for General Population / Uncontrolled Exposure				
0.3 ~ 1.34	614	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 ~ 15000	/	/	1.0	30

*f=frequency in MHz, *= plane-wave equivalent power density*

MPE (Maximum Permissive Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$S = PG/4\pi R^2 \quad \left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$

S=power density [mW/cm^2]
P=Power input to antenna [mW]
G=Power gain of the antenna in the direction of interest relative to an isotropic radiator
R= distance to the center of radiation of the antenna [cm]

EUT: Maximum peak output power = 2.80 [mW] (4.47 dBm) Antenna gain = 2.57 (4.1 [dBi])	
100 mW, at 20 cm from an antenna 6 [dBi]	S = PG/4πR² = 100 × 3.98 / (4 × π × 400) = 0.079 2 [mW/cm^2] < 1.0 [mW/cm^2]
2.57 mW, at 20 cm from an antenna 4.1 [dBi]	S = PG/4πR² = 0.001 43 [mW/cm^2] < 1.0 [mW/cm^2]
2.57 mW, at 2.5 cm from an antenna 4.1 [dBi]	S = PG/4πR² = 0.091 60 [mW/cm^2] < 1.0 [mW/cm^2]

5.3.2 RF Exposure Compliance Issue

The information should be included in the user's manual:
This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter. A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

5.3.3 Calculation Result of RF Exposure

- 2 400 ~ 2 483.5 MHz (RF4CE)

Channel	Channel Frequency [MHz]	Ant Gain [mW]	power [dBm]	power [mW]	Power Density at 20 cm [mW/Cm2]
Lowest	2 425	2.57	4.47	2.80	0.001 43
Middle	2 450	2.57	4.18	2.62	0.001 34
Highest	2 475	2.57	3.83	2.42	0.001 24

6. Test equipment used for test

	Description	Manufacture	Model No.	Serial No.	Next Cal Date.
■	Test Receiver	R&S	ESCI7	100732	14.02.18
■	Spectrum Analyzer	R&S	FSP40	100209	14.10.21
■	Loop Antenna	R&S	HFH2-Z2	100355	15.06.19
■	Bi-Log Antenna	Schwarzbeck	VULB9163	552	14.07.18
■	Amplifier	Sonoma	310N	186280	14.02.15
■	Attenuator	HP	8491A	16861	14.07.08
■	Amplifier	Agilent	8449B	3008A02343	14.10.31
■	Horn Antenna	ETS-Lindgren	3115	86706	14.08.20
■	Antenna Mast	Innco Systems	MA4000-EP	303	-
■	Turn Table	Innco Systems	DT2000S-1t	079	-