

APPENDIX 2: Data of EMI test

6dB Bandwidth

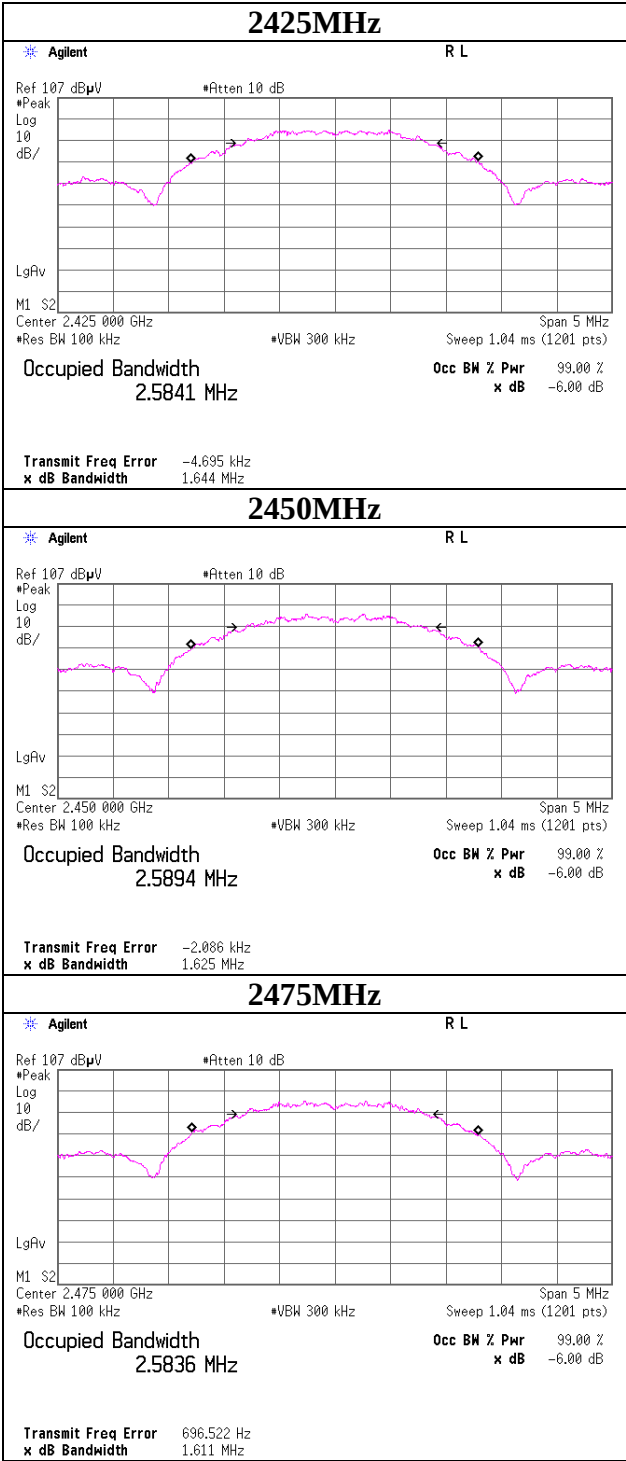
Test place	Head Office EMC Lab. No.6 Measurement Room
Report No.	30LE0087-HO-02
Date	12/08/2010
Temperature/ Humidity	23 deg. C / 30% RH
Engineer	Takeshi Choda
Mode	Tx

Zigbee

Frequency [MHz]	6dB Bandwidth [MHz]	Limit [kHz]
2425	1.644	>500
2450	1.625	>500
2475	1.611	>500

6dB Bandwidth

Zigbee



Maximum Peak Output Power

Test place Head Office EMC Lab. No.6 Measurement Room
Report No. 30LE0087-HO-02
Date 12/08/2010
Temperature/ Humidity 23 deg.C / 30% RH
Engineer Takeshi Choda
Mode Zigbee Tx

Zigbee

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result		Limit		Margin [dB]
				[dBm]	[mW]	[dBm]	[mW]	
2425	-9.31	0.30	10.00	0.99	1.26	30.00	1000	29.01
2450	-9.52	0.30	10.00	0.78	1.20	30.00	1000	29.22
2475	-9.72	0.30	10.00	0.58	1.14	30.00	1000	29.42

Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

Radiated Spurious Emission

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber		
Report No.	30LE0087-HO-02		
Date	12/24/2010	01/05/2011	01/05/2011
Temperature/ Humidity	23 deg.C / 68% RH	22 deg.C / 38% RH	22 deg.C / 38% RH
Engineer	Takeshi Choda (1-10GHz)	Takumi Shimada (10-26.5GHz)	Takumi Shimada (30-1000MHz)
Mode	Zigbee Tx 2425MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	64.000	QP	22.3	7.7	7.5	32.0	5.5	40.0	34.5	
Hori	128.000	QP	22.1	13.7	8.3	32.0	12.1	43.5	31.4	
Hori	256.000	QP	21.5	17.6	9.3	31.9	16.5	46.0	29.5	
Hori	320.000	QP	21.6	16.1	9.8	31.9	15.6	46.0	30.4	
Hori	480.000	QP	21.5	18.9	10.8	32.0	19.2	46.0	26.8	
Hori	640.000	QP	21.9	20.9	11.6	32.2	22.2	46.0	23.8	
Hori	2367.300	PK	42.4	27.2	3.0	32.1	40.5	73.9	33.4	
Hori	2373.000	PK	42.6	27.2	3.0	32.1	40.7	73.9	33.2	
Hori	2390.000	PK	43.5	27.2	3.0	32.1	41.6	73.9	32.3	
Hori	2400.000	PK	43.4	27.2	3.1	32.1	41.6	73.9	32.3	
Hori	3240.000	PK	30.1	28.7	3.5	31.8	30.5	73.9	43.4	
Hori	4850.000	PK	44.9	31.0	5.8	31.4	50.3	73.9	23.6	
Hori	7275.000	PK	41.5	35.8	6.4	32.3	51.4	73.9	22.5	
Hori	9700.000	PK	41.9	37.9	7.3	33.0	54.1	73.9	19.8	
Hori	24250.000	PK	47.2	37.9	-0.9	31.6	52.6	73.9	21.3	
Hori	2367.300	AV	30.2	27.2	3.0	32.1	28.3	53.9	25.6	
Hori	2373.000	AV	30.6	27.2	3.0	32.1	28.7	53.9	25.2	
Hori	2390.000	AV	31.3	27.2	3.0	32.1	29.4	53.9	24.5	
Hori	2400.000	AV	31.9	27.2	3.1	32.1	30.1	53.9	23.8	
Hori	3240.000	AV	42.5	28.7	3.5	31.8	42.9	53.9	11.0	
Hori	4850.000	AV	38.1	31.0	5.8	31.4	43.5	53.9	10.4	
Hori	7275.000	AV	30.0	35.8	6.4	32.3	39.9	53.9	14.0	
Hori	9700.000	AV	30.2	37.9	7.3	33.0	42.4	53.9	11.5	
Hori	24250.000	AV	33.4	37.9	-0.9	31.6	38.8	53.9	15.1	
Vert	64.000	QP	22.2	7.7	7.5	32.0	5.4	40.0	34.6	
Vert	128.000	QP	22.1	13.7	8.3	32.0	12.1	43.5	31.4	
Vert	256.000	QP	21.5	17.6	9.3	31.9	16.5	46.0	29.5	
Vert	320.000	QP	21.5	16.1	9.8	31.9	15.5	46.0	30.5	
Vert	480.000	QP	21.5	18.9	10.8	32.0	19.2	46.0	26.8	
Vert	640.000	QP	21.8	20.9	11.6	32.2	22.1	46.0	23.9	
Vert	2367.300	PK	42.2	27.2	3.0	32.1	40.3	73.9	33.6	
Vert	2373.000	PK	42.8	27.2	3.0	32.1	40.9	73.9	33.0	
Vert	2390.000	PK	43.0	27.2	3.0	32.1	41.1	73.9	32.8	
Vert	2400.000	PK	42.9	27.2	3.1	32.1	41.1	73.9	32.8	
Vert	3240.000	PK	42.3	28.7	3.5	31.8	42.7	73.9	31.2	
Vert	4850.000	PK	46.2	31.0	5.8	31.4	51.6	73.9	22.3	
Vert	7275.000	PK	42.7	35.8	6.4	32.3	52.6	73.9	21.3	
Vert	9700.000	PK	41.8	37.9	7.3	33.0	54.0	73.9	19.9	
Vert	24250.000	PK	46.7	37.9	-0.9	31.6	52.1	73.9	21.8	
Vert	2367.300	AV	30.4	27.2	3.0	32.1	28.5	53.9	25.4	
Vert	2373.000	AV	30.7	27.2	3.0	32.1	28.8	53.9	25.1	
Vert	2390.000	AV	30.7	27.2	3.0	32.1	28.8	53.9	25.1	
Vert	2400.000	AV	30.5	27.2	3.1	32.1	28.7	53.9	25.2	
Vert	3240.000	AV	30.1	28.7	3.5	31.8	30.5	53.9	23.4	
Vert	4850.000	AV	40.1	31.0	5.8	31.4	45.5	53.9	8.4	
Vert	7275.000	AV	30.1	35.8	6.4	32.3	40.0	53.9	13.9	
Vert	9700.000	AV	30.1	37.9	7.3	33.0	42.3	53.9	11.6	
Vert	24250.000	AV	33.4	37.9	-0.9	31.6	38.8	53.9	15.1	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB

26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

Radiated Spurious Emission

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber		
Report No.	30LE0087-HO-02		
Date	12/24/2010	01/05/2011	01/05/2011
Temperature/ Humidity	23 deg.C / 68% RH	22 deg.C / 38% RH	22 deg.C / 38% RH
Engineer	Takeshi Choda (1-10GHz)	Takumi Shimada (10-26.5GHz)	Takumi Shimada (30-1000MHz)
Mode	Zigbee Tx 2450MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	64.000	QP	22.1	7.7	7.5	32.0	5.3	40.0	34.7	
Hori	128.000	QP	22.1	13.7	8.3	32.0	12.1	43.5	31.4	
Hori	256.000	QP	21.5	17.6	9.3	31.9	16.5	46.0	29.5	
Hori	320.000	QP	21.5	16.1	9.8	31.9	15.5	46.0	30.5	
Hori	480.000	QP	21.5	18.9	10.8	32.0	19.2	46.0	26.8	
Hori	640.000	QP	21.8	20.9	11.6	32.2	22.1	46.0	23.9	
Hori	1007.000	PK	45.2	23.7	2.1	34.7	36.3	73.9	37.6	
Hori	3353.000	PK	41.8	29.0	3.6	31.7	42.7	73.9	31.2	
Hori	4900.000	PK	45.8	31.1	5.7	31.4	51.2	73.9	22.7	
Hori	7350.000	PK	42.8	36.0	6.4	32.4	52.8	73.9	21.1	
Hori	9800.000	PK	42.4	38.1	7.3	33.0	54.8	73.9	19.1	
Hori	24500.000	PK	47.1	37.9	-0.9	31.5	52.6	73.9	21.3	
Hori	1007.000	AV	32.6	23.7	2.1	34.7	23.7	53.9	30.2	
Hori	3353.000	AV	29.3	29.0	3.6	31.7	30.2	53.9	23.7	
Hori	4900.000	AV	39.3	31.1	5.7	31.4	44.7	53.9	9.2	
Hori	7350.000	AV	30.1	36.0	6.4	32.4	40.1	53.9	13.8	
Hori	9800.000	AV	30.5	38.1	7.3	33.0	42.9	53.9	11.0	
Hori	24500.000	AV	33.6	37.9	-0.9	31.5	39.1	53.9	14.8	
Vert	64.000	QP	22.1	7.7	7.5	32.0	5.3	40.0	34.7	
Vert	128.000	QP	22.1	13.7	8.3	32.0	12.1	43.5	31.4	
Vert	256.000	QP	21.5	17.6	9.3	31.9	16.5	46.0	29.5	
Vert	320.000	QP	21.5	16.1	9.8	31.9	15.5	46.0	30.5	
Vert	480.000	QP	21.5	18.9	10.8	32.0	19.2	46.0	26.8	
Vert	640.000	QP	21.8	20.9	11.6	32.2	22.1	46.0	23.9	
Vert	1007.000	PK	44.9	23.7	2.1	34.7	36.0	73.9	37.9	
Vert	3353.000	PK	42.1	29.0	3.6	31.7	43.0	73.9	30.9	
Vert	4900.000	PK	47.5	31.1	5.7	31.4	52.9	73.9	21.0	
Vert	7350.000	PK	42.9	36.0	6.4	32.4	52.9	73.9	21.0	
Vert	9800.000	PK	42.8	38.1	7.3	33.0	55.2	73.9	18.7	
Vert	24500.000	PK	46.8	37.9	-0.9	31.5	52.3	73.9	21.6	
Vert	1007.000	AV	32.8	23.7	2.1	34.7	23.9	53.9	30.0	
Vert	3353.000	AV	29.9	29.0	3.6	31.7	30.8	53.9	23.1	
Vert	4900.000	AV	42.2	31.1	5.7	31.4	47.6	53.9	6.3	
Vert	7350.000	AV	30.2	36.0	6.4	32.4	40.2	53.9	13.7	
Vert	9800.000	AV	30.6	38.1	7.3	33.0	43.0	53.9	10.9	
Vert	24500.000	AV	33.7	37.9	-0.9	31.5	39.2	53.9	14.7	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
 26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

Radiated Spurious Emission

Test place	Head Office EMC Lab. No.4 Semi Anechoic Chamber		
Report No.	30LE0087-HO-02		
Date	12/24/2010	01/05/2011	01/05/2011
Temperature/ Humidity	23 deg.C / 68% RH	22 deg.C / 38% RH	22 deg.C / 38% RH
Engineer	Takeshi Choda (1-10GHz)	Takumi Shimada (10-26.5GHz)	Takumi Shimada (30-1000MHz)
Mode	Zigbee Tx 2475MHz		

Polarity	Frequency [MHz]	Detector	Reading [dBuV]	Ant.Fac. [dB/m]	Loss [dB]	Gain [dB]	Result [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Remark
Hori	64.000	QP	22.2	7.7	7.5	32.0	5.4	40.0	34.6	
Hori	128.000	QP	22.1	13.7	8.3	32.0	12.1	43.5	31.4	
Hori	256.000	QP	21.5	17.6	9.3	31.9	16.5	46.0	29.5	
Hori	320.000	QP	21.5	16.1	9.8	31.9	15.5	46.0	30.5	
Hori	480.000	QP	21.6	18.9	10.8	32.0	19.3	46.0	26.7	
Hori	640.000	QP	21.9	20.9	11.6	32.2	22.2	46.0	23.8	
Hori	1023.000	PK	44.3	23.8	2.1	34.7	35.5	73.9	38.4	
Hori	2483.500	PK	46.3	27.2	3.1	32.1	44.5	73.9	29.4	
Hori	2483.670	PK	46.6	27.2	3.1	32.1	44.8	73.9	29.1	
Hori	2520.000	PK	44.3	27.2	3.1	32.1	42.5	73.9	31.4	
Hori	4950.000	PK	45.6	31.3	5.7	31.4	51.2	73.9	22.7	
Hori	7425.000	PK	43.4	36.1	6.4	32.4	53.5	73.9	20.4	
Hori	9900.000	PK	42.8	38.2	7.4	33.0	55.4	73.9	18.5	
Hori	24750.000	PK	42.7	38.0	-0.9	31.5	48.3	73.9	25.6	
Hori	1023.000	AV	32.3	23.8	2.1	34.7	23.5	53.9	30.4	
Hori	2483.500	AV	34.6	27.2	3.1	32.1	32.8	53.9	21.1	
Hori	2483.670	AV	34.8	27.2	3.1	32.1	33.0	53.9	20.9	
Hori	2520.000	AV	30.7	27.2	3.1	32.1	28.9	53.9	25.0	
Hori	4950.000	AV	38.6	31.3	5.7	31.4	44.2	53.9	9.7	
Hori	7425.000	AV	30.4	36.1	6.4	32.4	40.5	53.9	13.4	
Hori	9900.000	AV	30.4	38.2	7.4	33.0	43.0	53.9	10.9	
Hori	24750.000	AV	30.2	38.0	-0.9	31.5	35.8	53.9	18.1	
Vert	64.000	QP	22.3	7.7	7.5	32.0	5.5	40.0	34.5	
Vert	128.000	QP	22.2	13.7	8.3	32.0	12.2	43.5	31.3	
Vert	256.000	QP	21.5	17.6	9.3	31.9	16.5	46.0	29.5	
Vert	320.000	QP	21.5	16.1	9.8	31.9	15.5	46.0	30.5	
Vert	480.000	QP	21.5	18.9	10.8	32.0	19.2	46.0	26.8	
Vert	640.000	QP	21.8	20.9	11.6	32.2	22.1	46.0	23.9	
Vert	1023.000	PK	43.8	23.8	2.1	34.7	35.0	73.9	38.9	
Vert	2483.500	PK	45.5	27.2	3.1	32.1	43.7	73.9	30.2	
Vert	2483.670	PK	46.1	27.2	3.1	32.1	44.3	73.9	29.6	
Vert	2520.000	PK	42.8	27.2	3.1	32.1	41.0	73.9	32.9	
Vert	4950.000	PK	47.5	31.3	5.7	31.4	53.1	73.9	20.8	
Vert	7425.000	PK	43.0	36.1	6.4	32.4	53.1	73.9	20.8	
Vert	9900.000	PK	43.2	38.2	7.4	33.0	55.8	73.9	18.1	
Vert	24750.000	PK	42.7	38.0	-0.9	31.5	48.3	73.9	25.6	
Vert	1023.000	AV	32.1	23.8	2.1	34.7	23.3	53.9	30.6	
Vert	2483.500	AV	43.2	27.2	3.1	32.1	41.4	53.9	12.5	
Vert	2483.670	AV	43.7	27.2	3.1	32.1	41.9	53.9	12.0	
Vert	2520.000	AV	29.2	27.2	3.1	32.1	27.4	53.9	26.5	
Vert	4950.000	AV	42.0	31.3	5.7	31.4	47.6	53.9	6.3	
Vert	7425.000	AV	30.4	36.1	6.4	32.4	40.5	53.9	13.4	
Vert	9900.000	AV	30.4	38.2	7.4	33.0	43.0	53.9	10.9	
Vert	24750.000	AV	29.6	38.0	-0.9	31.5	35.2	53.9	18.7	

Result = Reading + Ant Factor + Loss (Cable+Attenuator+Filter-Distance factor(above 10GHz)) - Gain(Amplifier)

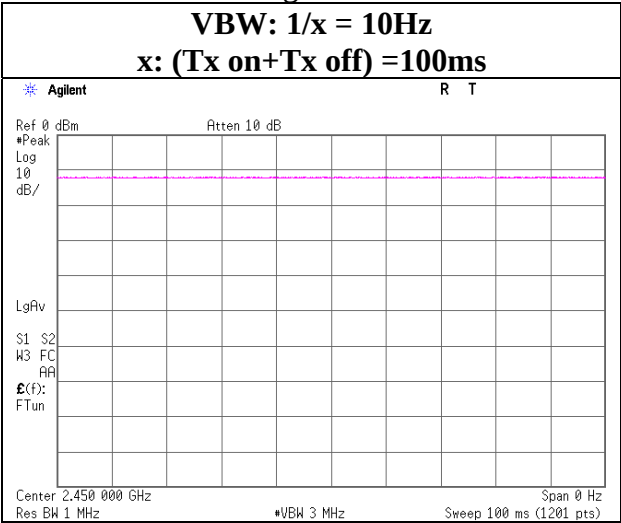
*Other frequency noises omitted in this report were not seen or had enough margin (more than 20dB).

*The 10th harmonic was not seen so the result was its base noise level.

Distance factor: 10GHz-26.5GHz 20log(3.0m/1.0m)= 9.5dB
 26.5GHz-40GHz 20log(3.0m/0.5m)=15.6dB

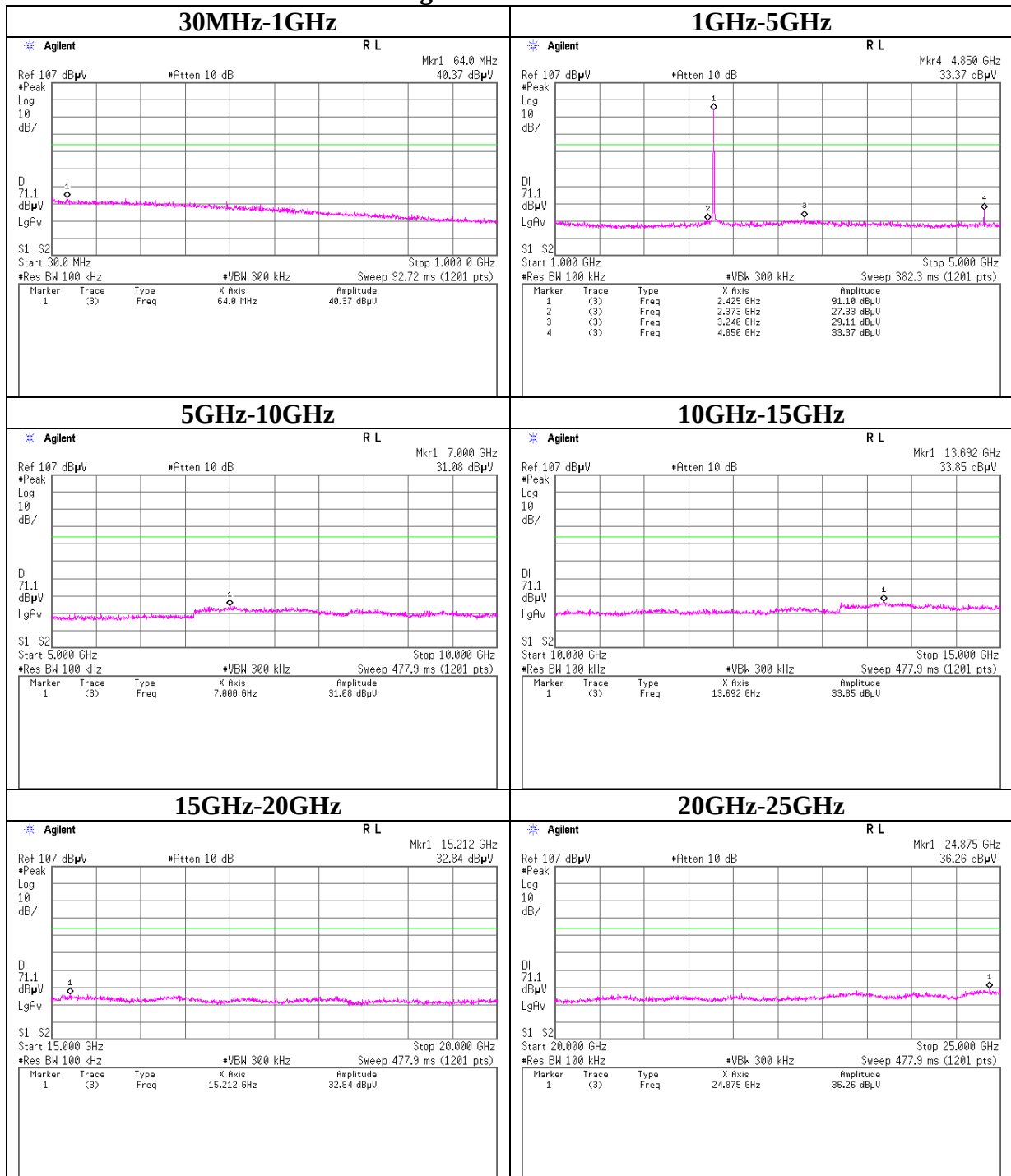
VBW (AV) Calculation

Zigbee



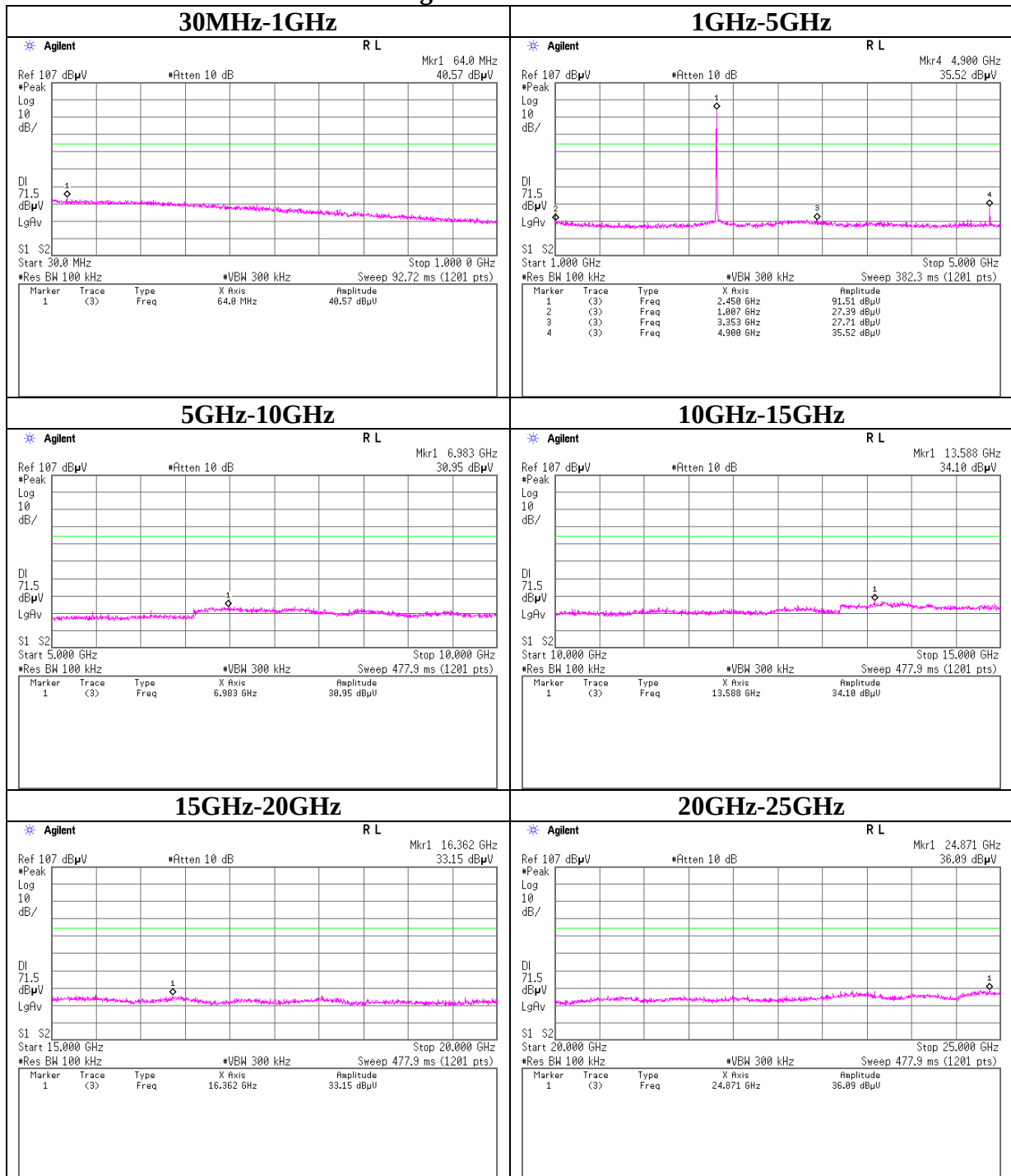
Conducted Spurious Emission

Zigbee Tx 2425MHz



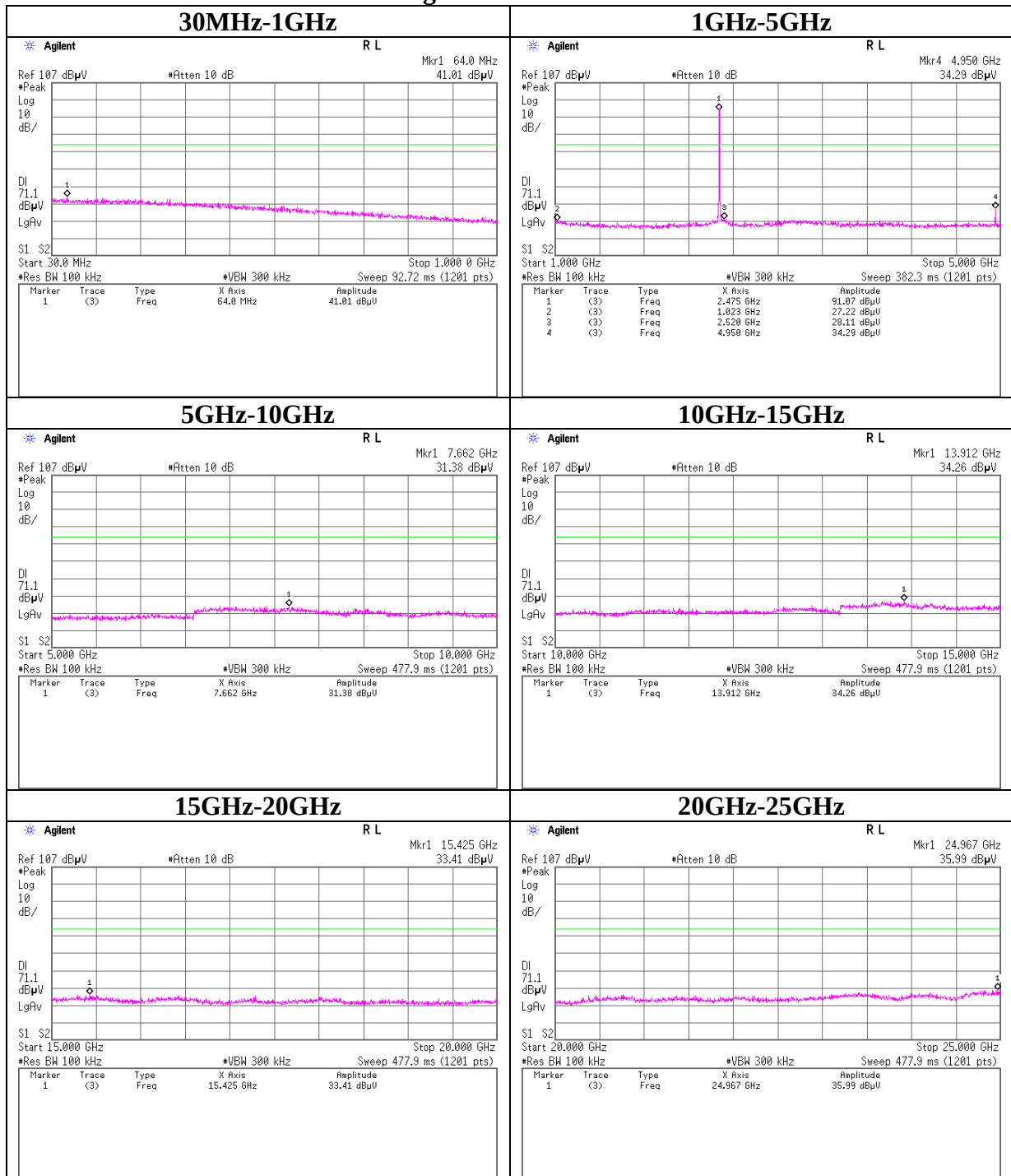
Conducted Spurious Emission

Zigbee Tx 2450MHz



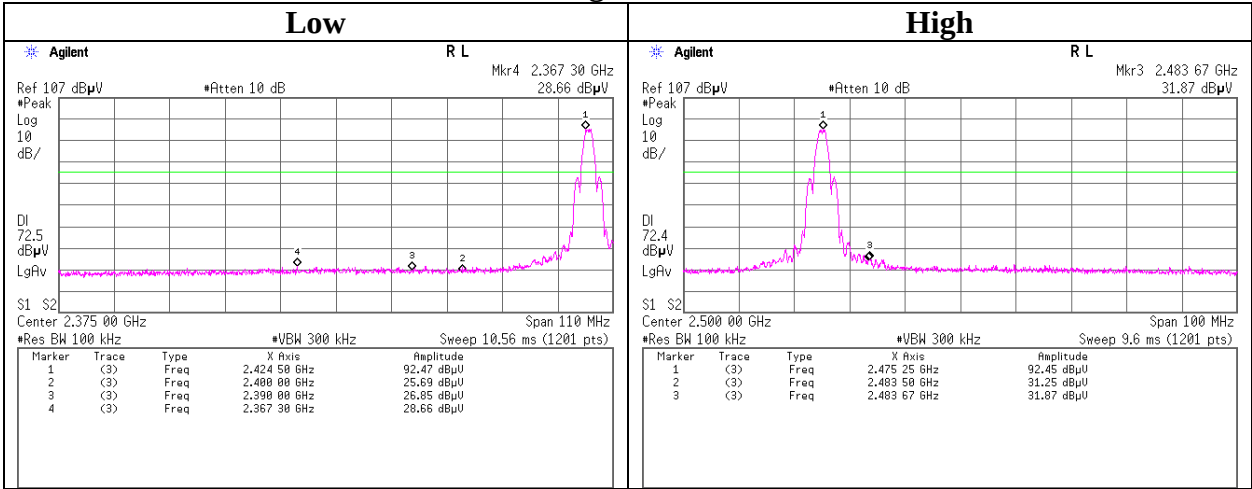
Conducted Spurious Emission

ZigbeeTx 2475MHz



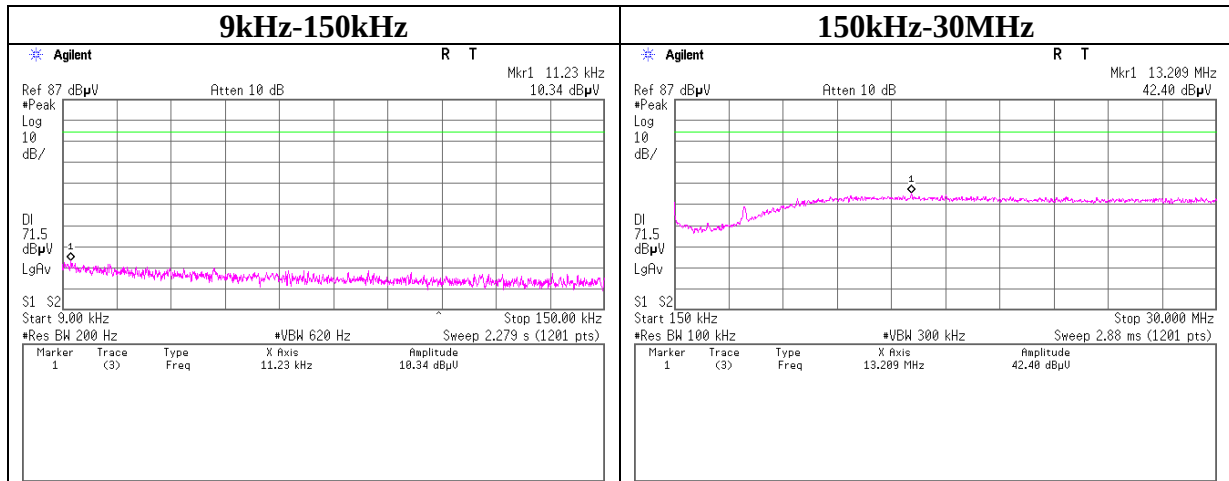
Conducted Emission Band Edge compliance

Zigbee Tx



Conducted Spurious Emission(below 30MHz)

Tx 2450MHz



*Test was performed with the representative channel (Mid channel) after it was confirmed that there was no difference in the data due to the channel.

Power Density

Test place Head Office EMC Lab. No.6 Measurement Room
Report No. 30LE0087-HO-02
Date 12/08/2010
Temperature/ Humidity 23 deg.C / 30% RH
Engineer Takeshi Choda
Mode Zigbee Tx

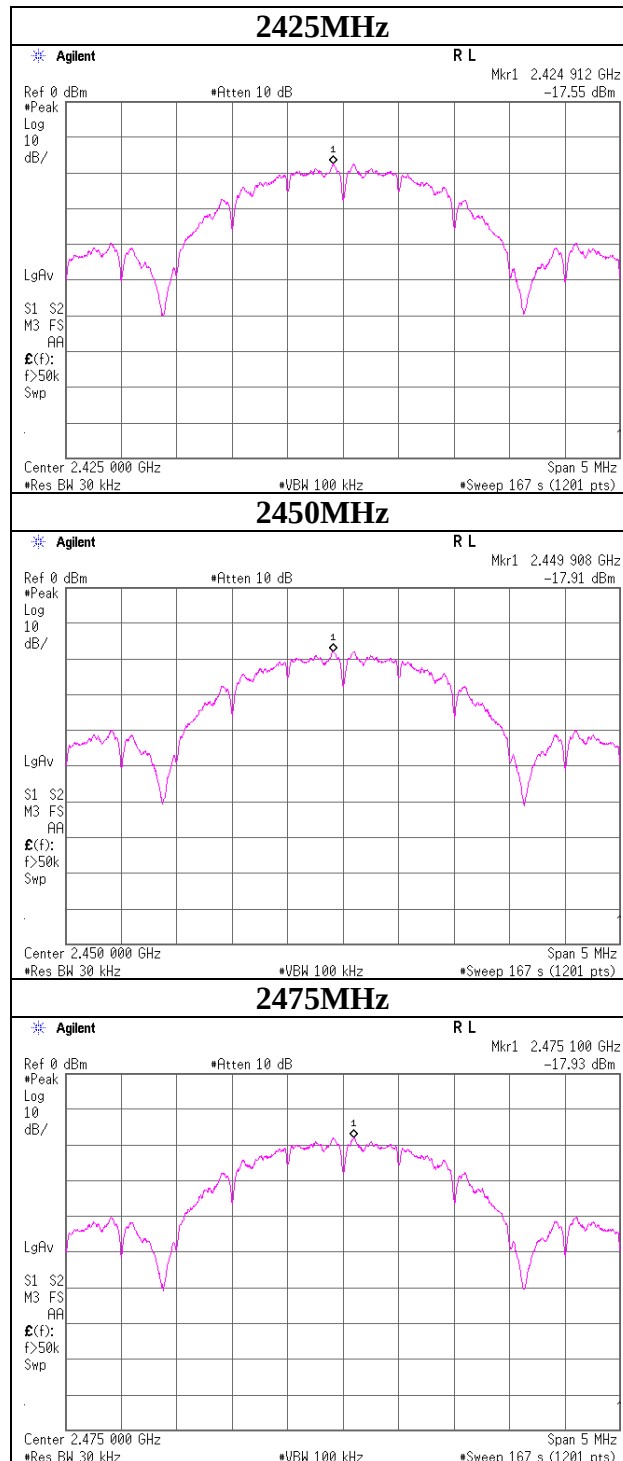
11b

Freq. [MHz]	Reading [dBm]	Cable Loss [dB]	Atten. [dB]	Result [dBm]	Limit [dBm]	Margin [dB]
2425.00	-17.55	1.27	10.00	-6.28	8.00	14.28
2450.00	-17.91	1.28	10.00	-6.63	8.00	14.63
2475.00	-17.93	1.28	10.00	-6.65	8.00	14.65

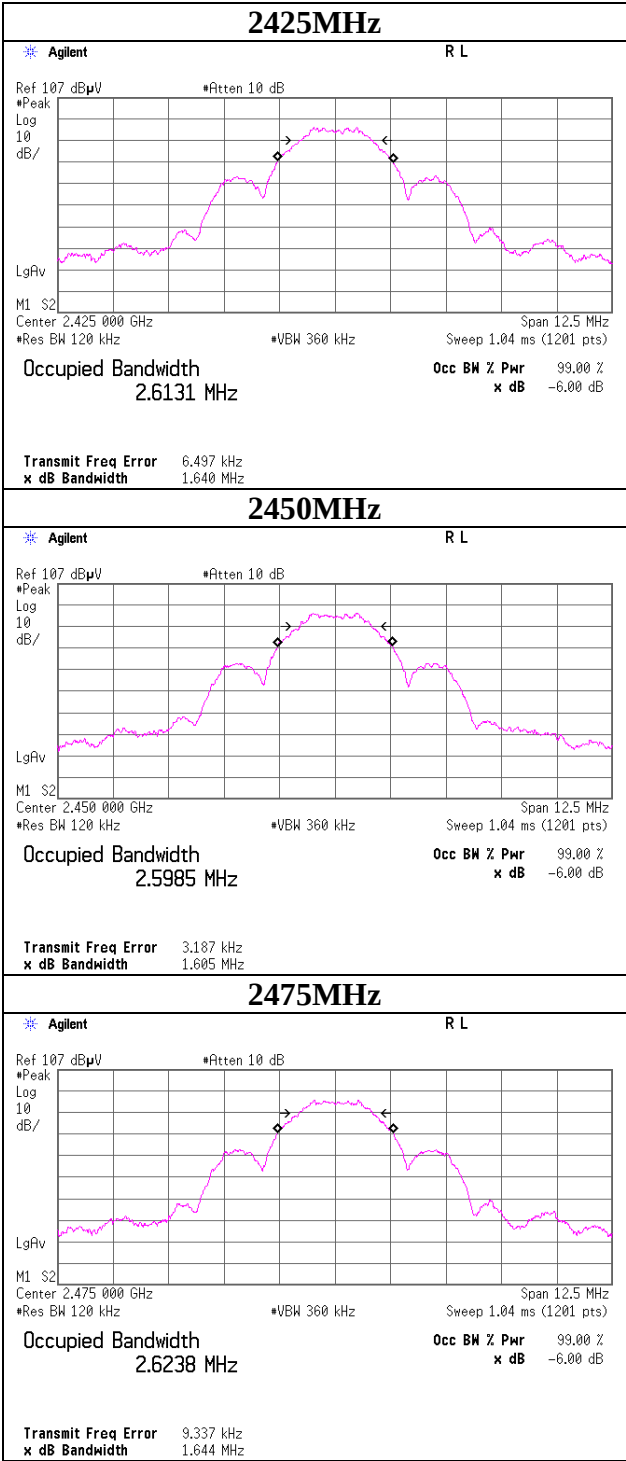
Sample Calculation:

Result = Reading + Cable Loss (including the cable(s) customer supplied) + Attenuator

Power Density



99%Occupied Bandwidth



APPENDIX 3: Test instruments

EMI test equipment

Control No.	Instrument	Manufacturer	Model No	Serial No	Test Item	Calibration Date * Interval(month)
MOS-14	Thermo-Hygrometer	Custom	CTH-201	-	AT	2010/05/19 * 12
MSA-10	Spectrum Analyzer	Agilent	E4448A	MY46180655	AT/RE	2010/02/03 * 12
MCC-114	Microwave Cable 1G-26.5GHz	Suhner	SUCOFLEX104	290212/4	AT	2010/08/05 * 12
MAT-22	Attenuator(10dB) 1-18GHz	Orient Microwave	BX10-0476-00	-	AT	2010/03/01 * 12
MPM-08	Power Meter	Anritsu	ML2495A	6K00003338	AT	2010/09/10 * 12
MPSE-11	Power sensor	Anritsu	MA2411B	011737	AT	2010/09/10 * 12
MAEC-04	Semi Anechoic Chamber(NSA)	TDK	Semi Anechoic Chamber 3m	DA-10005	RE	2010/02/02 * 12
MOS-15	Thermo-Hygrometer	Custom	CTH-180	-	RE	2010/02/09 * 12
MJM-07	Measure	PROMART	SEN1955	-	RE	-
COTS-MEMI	EMI measurement program	TSJ	TEPTO-DV	-	RE	
MSA-05	Spectrum Analyzer	Advantest	R3273	160400285	RE	2010/11/18 * 12
MHA-21	Horn Antenna 1-18GHz	Schwarzbeck	BBHA9120D	9120D-557	RE	2010/08/08 * 12
MCC-57	Microwave Cable	Suhner	SUCOFLEX104	267195/4(0.6m) / 292411(5m)	RE	2010/11/26 * 12
MPA-12	MicroWave System Amplifier	Agilent	83017A	MY39500780	RE	2010/03/16 * 12
MHF-20	High Pass Filter 3.5-18.0GHz	TOKIMEC	TF323DCC	607	RE	2010/09/21 * 12
MCC-79	Microwave Cable 1G-26.5GHz	Suhner	SUCOFLEX104	278923/4	RE	2010/12/02 * 12
MTR-07	Test Receiver	Rohde & Schwarz	ESCI	100635	RE	2010/10/27 * 12
MBA-05	Biconical Antenna	Schwarzbeck	BBA9106	1302	RE	2010/10/11 * 12
MLA-08	Logperiodic Antenna	Schwarzbeck	UKLP9140-A	N/A	RE	2010/10/11 * 12
MCC-50	Coaxial cable	UL Japan	-	-	RE	2010/03/18 * 12
MAT-51	Attenuator(6dB)	Weinschel	2	AS3557	RE	2010/01/20 * 12
MPA-14	Pre Amplifier	SONOMA INSTRUMENT	310	260833	RE	2010/03/05 * 12
MHA-17	Horn Antenna 15-40GHz	Schwarzbeck	BBHA9170	BBHA9170307	RE	2010/06/29 * 12

The expiration date of the calibration is the end of the expired month.

All equipment is calibrated with valid calibrations. Each measurement data is traceable to the national or international standards.

As for some calibrations performed after the tested dates, those test equipment have been controlled by means of an unbroken chains of calibrations.

Test Item:

RE: Radiated Emission

AT: Antenna Terminal Conducted test

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