4 Emissions

4.1 Radiated Emissions (Fundamental and Spurious per 15.249)

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.4:2003, and RSS 210 Issue 5. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

4.1.1 Test Methodology

4.1.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.1.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

The spurious radiated emissions were evaluated to 25GHz. The six highest (worst case) emissions were selected for inclusion into this report.

4.1.1.3 Deviations

There were no deviations from this test methodology.

4.1.2 Test Results

Section 4.1.3 contains preliminary test data as well as any engineering data used to determine any modifications or special accessories. Section 4.1.2.1 lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

4.1.2.1 Final Data

The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

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EUT Name	Zigbee Radio	**Date**	12 September 2005
EUT Model	45-1125	**Temp / Hum in**	70°F / 44%rh
EUT Serial	Not Serialized	**Temp / Hum out**	N/A
Standard	FCC 47 CFR Part 15	**Line AC / Freq**	120 VAC / 60 Hz
Deg/sweep	N/a	**RBW / VBW**	1MHz / 3MHz
Dist/Ant Used	3m / 3115_5770	**Performed by**	Eugene Moses

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	20dB Below Fundamental (dBuV/m)	Spec Margin (dB)
Fundamental CH 0: PCB on end, on table. 10% duty cycle (wake-up mode)										
2405.00	H	1.19	5	56.49	0.00	5.46	28.23	90.18	94.00	-3.82
2405.00	V	1	264	59.92	0.00	5.46	28.22	93.60	94.00	-0.4
Fundamental CH 8: PCB on end, on table. Cont. TX with modulation.										
2445.00	H	1	8	50.76	0.00	5.68	28.31	84.75	94.00	-9.25
2445.00	V	1	346	59.98	0.00	5.52	28.30	93.80	94.00	-0.2
Fundamental CH 15: PCB on end, on table. Cont. TX with modulation.										
2474.00	H	2.71	160	51.43	0.00	5.54	28.37	85.33	94.00	-8.67
2474.00	V	1	263	59.34	0.00	5.54	28.36	93.23	94.00	-0.77

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes:

Peak Measurements.

The fundamental of the EUT was tested in all three planes and the Z plane was worst case.

may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If the frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.4.1 Results

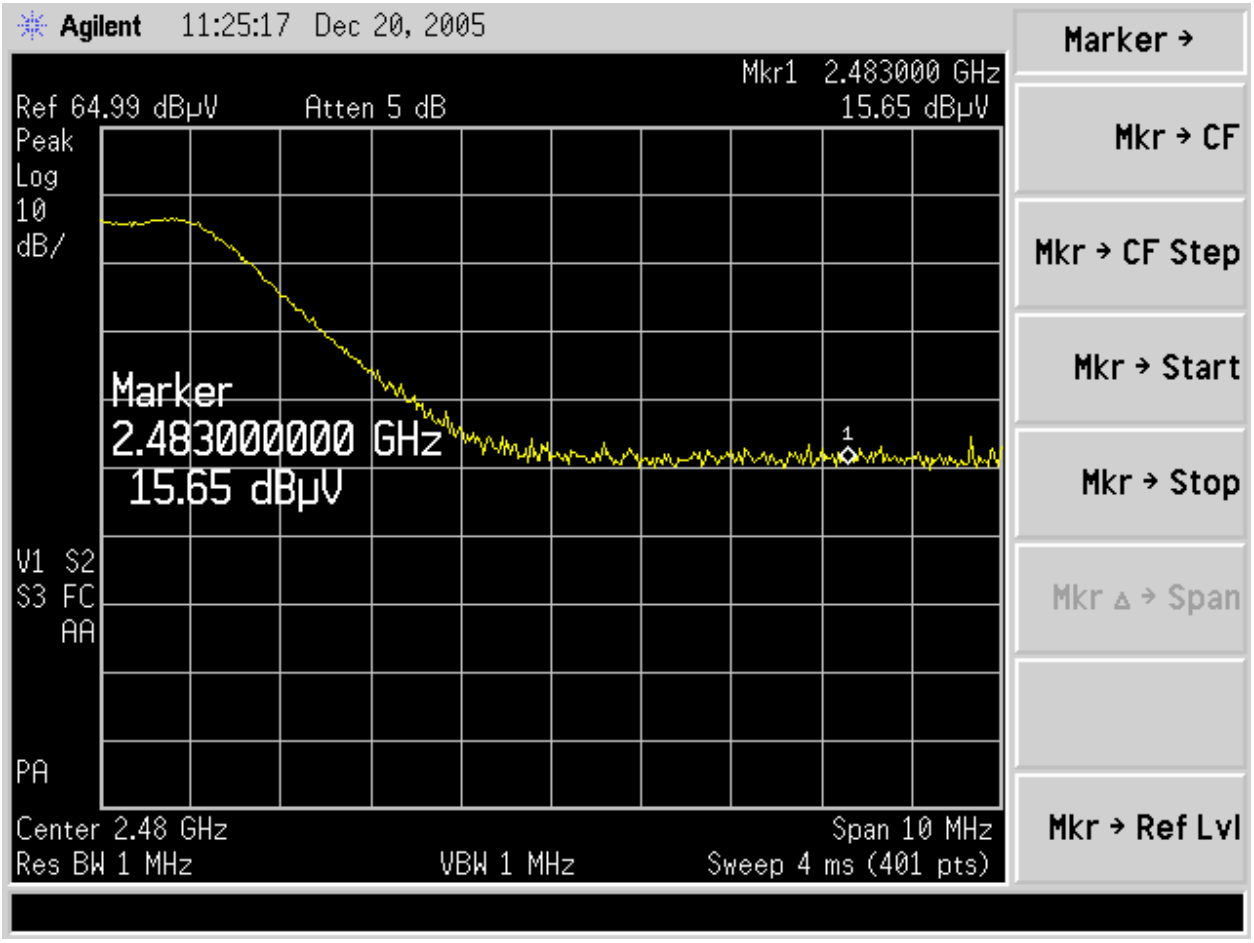

Figure 1 – Channel 15 Band edge Results

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2483.00	V	1	264	15.65	35.04	10.38	28.37	19.36	54.00	-34.64

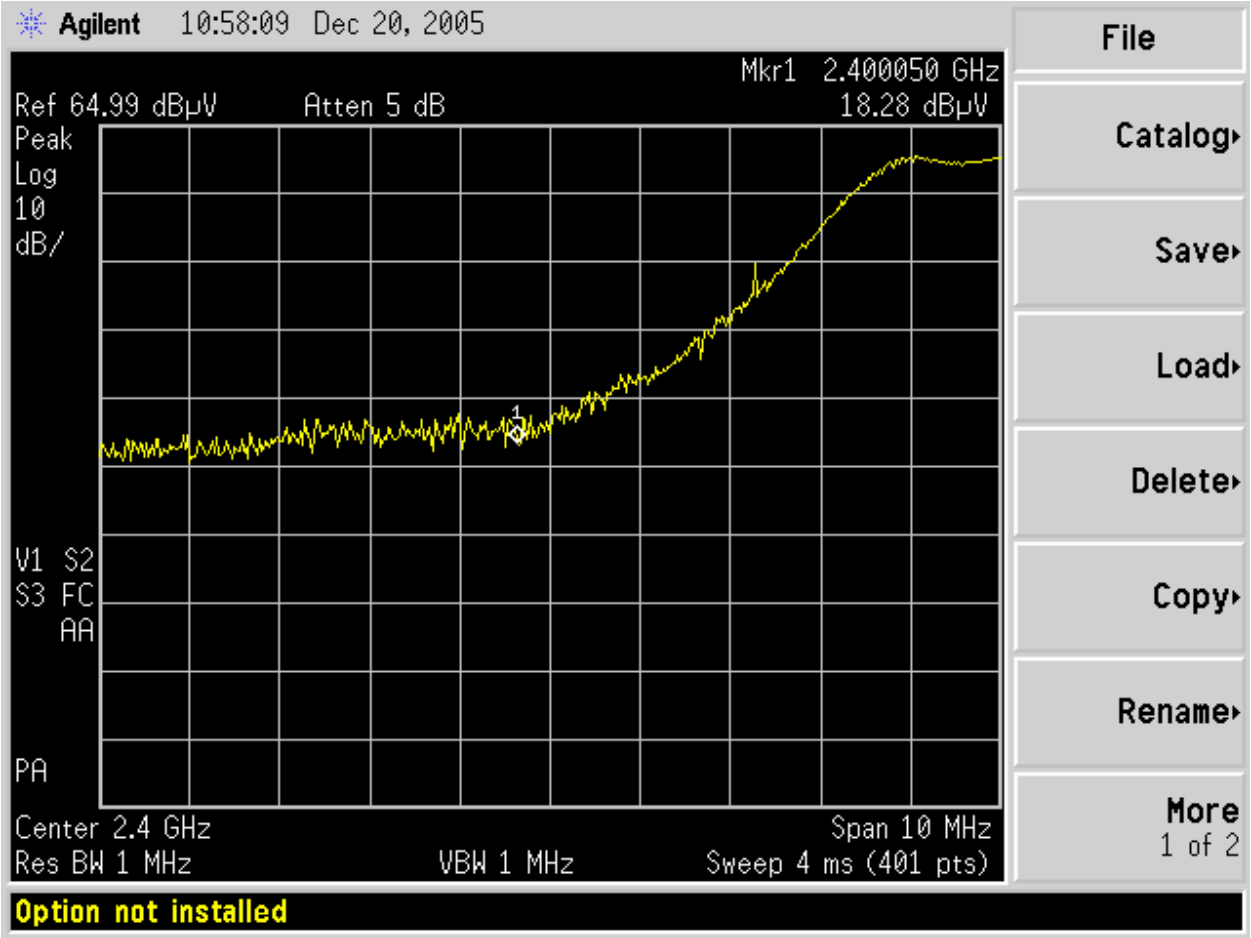

Figure 2 – Channel 0 Band edge Results

Emission Freq (MHz)	ANT Polar (H/V)	ANT Pos (m)	Table Pos (deg)	FIM Value (dBuV)	Amp Gain (dB)	Cable Loss (dB)	ANT Factor (dB/m)	E-Field Value (dBuV/m)	Spec Limit (dBuV/m)	Spec Margin (dB)
2400.00	H	1	264	18.28	35.01	10.25	28.22	21.75	54.00	-32.25

5 Test Equipment Use List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal dd/mm/yy	Next Cal dd/mm/yy
SOP 1 - Radiated Emissions, Band Edge Compliance, Variations in Voltage vs. Frequency Stability					
Ant. Biconical	EMCO	3110B	3367	24-Feb-05	24-Feb-06
Ant. Log Periodic	AH Systems	SAS-516	133	7- Feb-05	7- Feb-06
Antenna Horn 1-18GHz	EMCO	3115	5770	11-Apr-05	11-Apr-06
Antenna Horn 18-26.5GHz	AR2	MA86552	8426	8-Aug-05	8-Aug-06

Amplifier, preamp	Hewlett Packard	8447D	1937A01766	5-Aug-05	5-Aug-06
Cable, Coax	Andrew	FSJ1-50A	041	15-Jan-05	15-Jan-06
Cable, Coax	Andrew	FSJ1-50A	042	15-Jan-05	15-Jan-06
Chamber, Semi-Anechoic	Braden Shielding	5 meter	A67631	27-Jan-05	27-Jan-06
Data Table, EMCWin	TUV Rheinland	EMCWin.dll	002	6-Jan-02	6-Jan-06
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	6-Aug-05	6-Aug-06

SOP 2 - Conducted Emissions (AC/DC and Signal I/O)					
Cable, Coax	Belden	RG-213	004	18-Jan-05	18-Jan-06
LISN (1) 50mH/50Ω	Solar Electronics	8028-50-TS-24	944016	5-Aug-05	5-Aug-06
LISN (2) 50mH/50Ω	Solar Electronics	8028-50-TS-24	9212106	5-Aug-05	5-Aug-06
LISN Selection Box	TUV Rheinland	CFL-9206	1630	11-May-05	11-May-06
Spectrum Analyzer	Agilent Tec.	E7405A	US39440157	3-Aug-05	3-Aug-06

General Laboratory Equipment					
Filter, 3.0 GHz High Pass	Bonn Elektronik	BHF 3000	025155	5-Aug-05	5-Aug-06
Meter, Multi	Fluke	79-3	69200606	5-Aug-05	5-Aug-06
Meter, Temp/Humid/Barom	Fisher	02-400	01	20-Aug-05	20-Aug-06