

Prüfbericht - Nr.: Test Report No.	14012658 002		Seite 1 von 29 Page 1 of 29	
Auftraggeber: Applicant	Convergence Systems Limited 12/F., Chung Nam Building 1 Lockhart Road Wan Chai Hong Kong			
Gegenstand der Prüfung: Test item	4 Port EPC Class 1 Gen 2 UHF RFID Fixed Reader			
Bezeichnung: Identification	CS-461	Serien-Nr.: Serial No.	V01063ES00051	
Wareneingangs-Nr.: Receipt No.	060512001	Eingangsdatum: Date of receipt	12.05.2006	
Prüfört: Testing location	TÜV Rheinland Hong Kong Ltd. Unit 8, 25 th Floor, Skyline Tower, 39 Wang Kwong Road, Kowloon Bay Kowloon, Hong Kong Hong Kong Productivity Council HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong			
Prüfgrundlage: Test specification	FCC Part 15, Subpart C			
Prüfergebnis: Test Result	Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben genannter Prüfgrundlage. The above mentioned product was tested and passed.			
geprüft / tested by:		kontrolliert / reviewed by:		
08.06.2006	Derek Leung Project Manager	08.06.2006	Thomas Berns Manager	
Datum Date	Name Name	Unterschrift Signature	Datum Date	Name Name
Sonstiges: FCC ID:UB4CS461C1GEN2				
Other Aspects				
Abkürzungen:	OK, Pass, P = entspricht Prüfgrundlage	Abbreviations:	OK, Pass, P = passed	
Fail, F	= entspricht nicht Prüfgrundlage	Fail, F	= failed	
N/A	= nicht anwendbar	N/A	= not applicable	
N/T	= nicht getestet	N/T	= not tested	
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicate in extracts. This test report does not entitle to carry any safety mark on this or similar products.				

Test Summary

Voltage Variations

Result: Pass

Conducted Peak Output Power

Result: Pass

Spurious Conducted RF power

Result: Pass

Conducted Emission on a.c. mains

Result: Pass

Spurious Radiated Emissions

Result: Pass

20dB Bandwidth Occupancy

Result: Pass

Number of Hopping Channels

Result: Pass

Carrier Frequency Separation

Result: Pass

Time of Occupancy

Result: Pass

Band-edge compliance

Result: Pass

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List of Test and Measurement Instruments

Kind of Equipment	Manufacturer	Type	S/N
Test Receiver	Rohde & Schwarz	ESVS30	842807/009
Biconical Antenna	Rohde & Schwarz	HK116	841489/015
Log-Periodic Antenna	Rohde & Schwarz	HL223	841516/017
Horn Antenna	EMCO	3115	9002-3347
Active Loop Antenna	EMCO	6502	9107-2651
Spectrum Analyzer	Rohde & Schwarz	FSP30	1093.4495K30

General Product Information

Product Function and Intended Use

The equipment under test (EUT) CS-461 RFID reader is an EPCglobal Class 1 Gen 2 certified fixed reader providing real-time tag processing for Class 1 (Read / Write) EPC- compliant tag. The system output power is selectable from 15dBm to 30dBm and operates in the 902 to 928MHz frequency band. Detail specifications of the EUT refer to appendix 6.

Ratings and System Details

FCC ID	:	UB4CS461C1GEN2
Operating Frequency	:	902.75MHz to 927.25MHz
No. of RF channel	:	50 channels
Channel Spacing	:	500kHz
Antenna	:	CS-771 Mono-static antenna (Detail antenna specification refer to appendix 6)
Power supply	:	AC/DC adapter: Brand: CUI Inc Model: DSA-60W-DB Input: 100-240Vac, 50-60Hz, 1.5A Output: +24V, 2.5A
Port(s)	:	(i) Ethernet port (ii) TNC Reverse Jack (Female) RF port x 4 (iii) DC input port (iv) RS232 serial port (v) DB 25

Operation Descriptions

The RFID reader hops among 50 channels from 902.75MHz to 927.25MHz in 500kHz steps in operating mode according to a generated pseudo-random sequence. The time of occupancy on each frequency is 0.2 seconds maximum within a 10 second period.

Each CS-461 reader hops among its 50 available channels according to an independently generated pseudo-random sequence. The reader maintains no capability to coordinate RF channel occupancy among separate units. Within each hop, the RFID reader may be sending command to the tag or receiving backscatter from the tag, alternating between them as required by the EPC Gen 2 protocol. When the reader is sending command to the tag, the reader is sending out modulated signal. When the reader is receiving backscatter from the tag, the reader is sending out continuous wave signal.

There are four bi-directional antenna ports (ANT1 – ANT4) that are multiplexed via 4-way RF switch circuit to the internal TX and RX path. The system will time multiplex among the selected ports if more than one port are selected. The power measured at the port can be adjusted from 15dBm to maximum 30dBm.

The system supports four preset profiles of operational configurations that are high throughput mode, medium throughput mode, and two dense reader modes. The details of the settings of each profile are shown in table:

Profile	Tari	PIE	Forward Link	Pulse Width	Link Frequency	Reverse Modulation	Mode
0	7.14	1.5:1	PR-ASK	Long	640 kbps	FM0	High Throughput
1	12.5	1.5:1	PR-ASK	Short	160 kbps	FM0	Medium Throughput
2	25	2:1	PR-ASK	Long	256 kbps	Miller, M=4	Dense Reader 1
3	25	2:1	PR-ASK	Long	256 kbps	Miller, M=8	Dense Reader 2

Glossary:

Tari: time interval of symbol 0

PIE: pulse interval encoding ratio of time span of Symbol 1 to Symbol 0 signal

Forward Link: modulation method of reader to tag link

Pulse Width: time width of RF pulse at power below average power level

Link Frequency: data rate of tag to reader link

Reverse Modulation: Encoding method of the tag to reader link (either FM0 or Miller subcarrier)

Submitted Documents

The submitted documents are listed as follow:

- Schematic diagram
- Block diagram
- User manual
- FCC ID label and location diagram
- Specification of EUT
- Specification of antenna
- Bill of material
-

Related Submittal(s) Grants

This is a single application for certification of the EUT.

Test Set-up and Operation Mode

Principle of Configuration Selection

Emission: The test was performed under test mode to obtain the maximum emissions.

Test Operation and Test Software

Testing software was used to enable the continuous transmission on the EUT for the tests in this report.

Special Accessories and Auxiliary Equipment

The EUT was tested together with the following additional accessory:

- Notebook computer

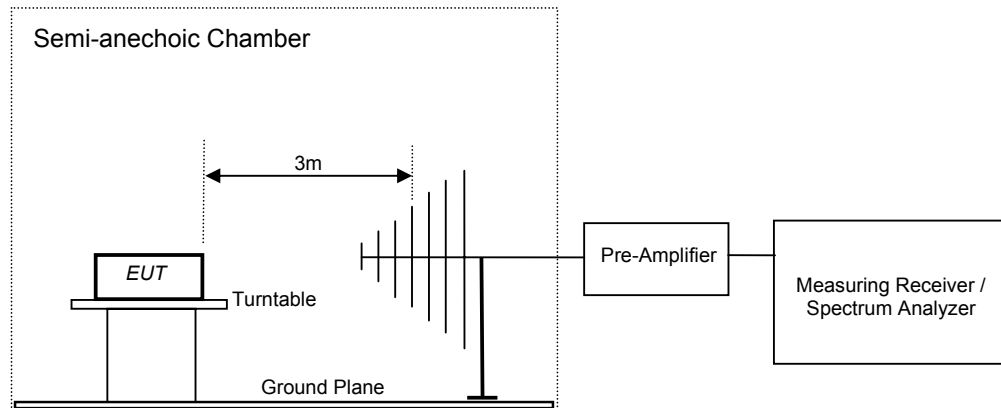
Countermeasures to achieve EMC Compliance

- none

Test Methodology

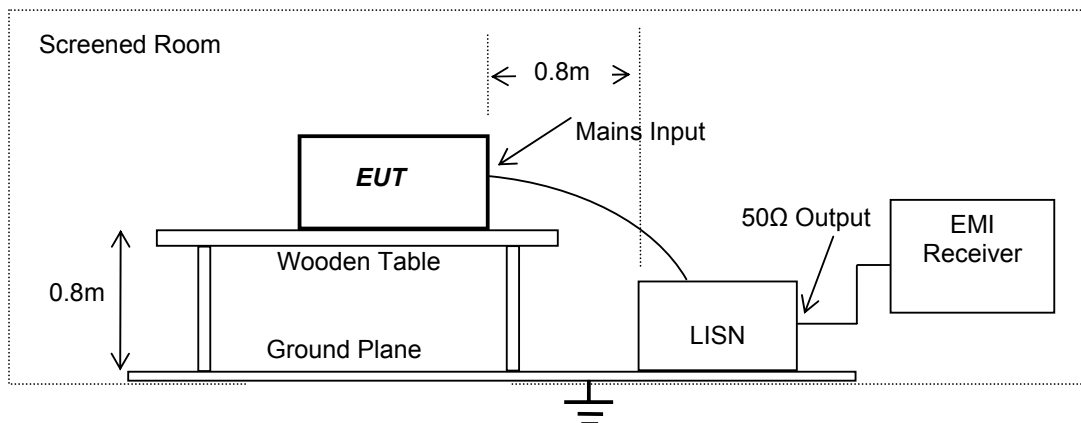
Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.4-2003. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable and all four antenna ports were connected with the dedicated antennas (model:CS-771), and the EUT is 3 meters far from the measuring antenna. The turntable was rotated 360° for obtaining the maximum emission. The height of the measuring antennas was scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurement above 1000MHz was performed by horn antenna. The measurement below 30MHz was performed by loop antenna, maximum emission was obtained by two antenna polarizations of loop faced and sided to the EUT. maximum emission was obtained by two antenna polarizations of loop faced and sided to the EUT.



Conducted Emission Test on a.c. mains line

The equipment under test (EUT) was placed on a wooden table 80cm above the ground plane, the LISN was placed 80cm away from the EUT. The test was performed in accordance with ANSI C63.4: 2003, with the following: an initial measurement was performed in peak and average detection mode on the live and neutral lines. The pre-scan was performed by peak detection on both live and neutral conductors. Any emissions recorded within 20dB of the relevant limit line were re-measured using quasi-peak and average detections, the 6 worst cases were recorded in the table of results.



Test Results

Voltage Variations

Section 15.31(e)

RESULT:

Pass

Test Specification : FCC Part 15 Section 15.31(e) & 15.247(b) (2)
 Test Method : ANSI C63.4-2003
 Measurement Bandwidth : 100kHz
 Detector : Peak
 Limit : 15.247(b) (2)
 Nominal voltage : 100Va.c.
 Port of testing : Antenna port 1
 Transmit profile type : 0

Frequency (MHz)	RF Conducted Peak Power (dBm) 85% of Nom. Volt	RF Conducted Peak Power (dBm) 100% of Nom. Volt	RF Conducted Peak Power (dBm) 115% of Nom. Volt	Limit (dBm)
Ch1- 902.75	29.7	29.7	29.7	30.0
Ch26 - 915.25	29.8	29.8	29.8	30.0
Ch50 - 927.25	29.6	29.6	29.6	30.0

Conducted Peak Output Power**Section 15.247(b)****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.31
 Test Method : ANSI C63.4-2003
 Measurement BW : 100kHz
 Detector : Peak
 Supply voltage : 100V.a.c.
 Requirement : <1 watt (30dBm) for system employing at least 50 hopping channels

Antenna port	Channel	Frequency (MHz)	Profile	Output power	Limit (dBm)	Margin (dB)
1	1	902.75	0	29.5	30.0	-0.5
		902.75	1	29.4	30.0	-0.6
		902.75	2	29.3	30.0	-0.7
		902.75	3	29.3	30.0	-0.7
	26	915.25	0	29.6	30.0	-0.4
		915.25	1	29.5	30.0	-0.5
		915.25	2	29.5	30.0	-0.5
		915.25	3	29.5	30.0	-0.5
	50	927.25	0	29.3	30.0	-0.7
		927.25	1	29.3	30.0	-0.7
		927.25	2	29.3	30.0	-0.7
		927.25	3	29.3	30.0	-0.7
2	26	915.25	0	29.7	30.0	-0.3
		915.25	1	29.8	30.0	-0.2
		915.25	2	29.8	30.0	-0.2
		915.25	3	29.8	30.0	-0.2
3	26	915.25	0	29.7	30.0	-0.3
		915.25	1	29.8	30.0	-0.2
		915.25	2	29.7	30.0	-0.3
		915.25	3	29.6	30.0	-0.4
4	26	915.25	0	29.5	30.0	-0.5
		915.25	1	29.4	30.0	-0.6
		915.25	2	29.4	30.0	-0.6
		915.25	3	29.4	30.0	-0.6

Spurious Conducted RF Power**Section 15.247(d)****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.31
 Test Method : ANSI C63.4-2003
 Detector Function : Peak
 Supply Voltage : 100Va.c.
 Measuring Frequency Range : 30MHz – 10GHz(Up to 10th harmonic of the highest fundamental frequency)
 Measurement bandwidth : Below 1GHz: 100kHz, above 1GHz: 1MHz
 Requirement : At least 20dB below that in the 100kHz 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 limit.

Antenna port	Transmit Profile	Channel	Fundamental Carrier Signal (MHz)	Spurious Emission (MHz)	Emission Level (dBm)
1	0	1	902.75	1805.5	-50.1
				2708.3	-50.8
		26	915.25	1830.5	-46.8
				1854.5	-46.1
				3709.0	-49.2
	1	1	902.75	1805.6	-51.1
				1830.56	-47.3
		26	915.25	1854.5	-46.3
				3708.94	-49.2
	2	1	902.75	1805.52	-50.6
				2708.32	-51.2
		26	915.25	1830.58	-47.4
				1854.46	-46.5
				3709.02	-48.3
	3	1	902.75	1805.6	-51.2
				2713.26	-52.4
		26	915.25	1830.56	-47.6
				1854.46	-46.9
2	0	26	915.25	1830.36	-48.4
				2746.36	-53.0
3	0	26	915.25	1830.54	-44.9
				2745.82	-46.1
4	0	26	915.25	1830.62	-47.7
				2745.74	-49.8

Conducted Emission Test on a.c. mains**Section 15.207****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.207
 Test Method : ANSI C63.4-2003
 Testing Location : Screened room
 Measurement Bandwidth : 9kHz
 Frequency Range : 150kHz – 30MHz
 Supply Voltage : 100V a.c.

Conductor	Transmit Profile	Frequency of Emission	Emission Level (QP)	Emission Level (AV)
		(MHz)	(dBµV)	(dBµV)
L	0	0.186	41.9	36.3
		0.246	32.6	29.0
		0.438	31.9	30.3
		0.564	30.9	29.4
		2.76	13.3	0.8
		16.56	30.7	9.5
	1	0.816	44.4	37.7
		0.252	41.8	37.1
		0.378	35.8	32.1
		0.444	32.5	29.6
		2.904	21.8	13.6
		15.066	28.7	12.8
	2	0.816	42.6	36.5
		0.252	40.6	36.6
		0.378	35.1	32.3
		2.832	23.7	15.0
		15.06	28.7	11.4
		16.566	27.3	7.3
	3	0.186	42.0	36.2
		0.252	40.4	37.0
		0.378	34.6	32.2
		2.64	24.0	15.9
		15.066	28.5	12.7
		16.566	27.3	12.0

Conductor	Transmit Profile	Frequency of Emission	Emission Level (QP)	Emission Level (AV)
		(MHz)	(dBµV)	(dBµV)
N	0	0.186	40.4	36.1
		0.252	37.7	34.9
		0.378	33.0	30.7
		0.564	29.3	28.1
		2.832	22.3	4.2
		16.566	30.7	10.5
	1	0.186	42.1	36.7
		0.252	38.4	35.0
		0.378	33.3	30.7
		2.898	23.8	5.3
		15.06	28.6	14.5
		16.566	27.5	16.2
	2	0.192	40.3	35.1
		0.252	37.5	34.6
		0.378	32.7	30.4
		2.832	23.9	5.1
		15.072	28.4	12.2
		16.554	26.9	12.3
	3	0.156	29.6	7.8
		0.186	40.5	35.9
		0.252	37.3	34.7
		0.378	32.8	30.6
		2.766	24.0	4.3
		15.066	28.4	12.7

Limit of section 15.207:

Frequency of emission (MHz)	QP Limit (dBµV)	AV Limit (dBµV/m)
0.15 – 0.5	66 – 56*	56 – 46*
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

Spurious Radiated Emissions**Section 15.209****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.205, 15.209 & 15.247(d)
 Test Method : ANSI C63.4-2003
 Measurement Location : Semi Anechoic Chamber
 Supply Voltage : 100Va.c.
 Measuring Frequency Range : 30kHz (Lowest internal oscillator frequency of 32.768kHz) – 10GHz(Up to 10th harmonic of the highest fundamental frequency)
 Measuring Distance : 3m
 Antennas connected on EUT : All four antennas were connected to port 1- 4 during the test
 Detection : QP for frequency below 1GHz, Peak for frequency above 1GHz
 Transmit profile type : 0
 Requirement : 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. Attenuation below the general limits specified in Sections 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).

Channel	Fundamental Carrier Signal (MHz)	Antenna Polarization	Spurious Emission (MHz)	Field Strength at 3m (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	902.75	H	1805.42	43.66	*	-
		V	1805.52	49.15	*	-
		H	3611.0	46.51	54	-7.49
		V	3611.0	44.68	54	-9.32
26	915.25	H	1830.6	36.87	*	-
		V	1830.64	41.73	*	-
		H	3661.0	40.09	54	-13.91
		V	3661.02	36.36	54	-17.64
50	927.25	H	1854.52	38.54	*	-
		V	1854.52	41.74	*	-
		H	3709.06	44.87	54	-9.13
		V	3708.88	42.43	54	-11.57

*Spurious emissions that do not fall into the restricted band of Section 15.205.

Remark: Transmit profile 0 (highest link frequency) was chosen for the test.

Limit for Radiated Emission of Section 15.209:

Frequency (MHz)	Field strength (dB μ V) at 3m range	Field strength (dB μ V/m) at 3m range
1.705-30	30 (30m range)*	29.5(30m range)*
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

Remark: * the limit shows in the table above of frequency range 1.705-30MHz are at 30 meter range, which is correspond to 49.5dB μ V/m at 3m range by extrapolation calculation and the measurement of loop antenna.

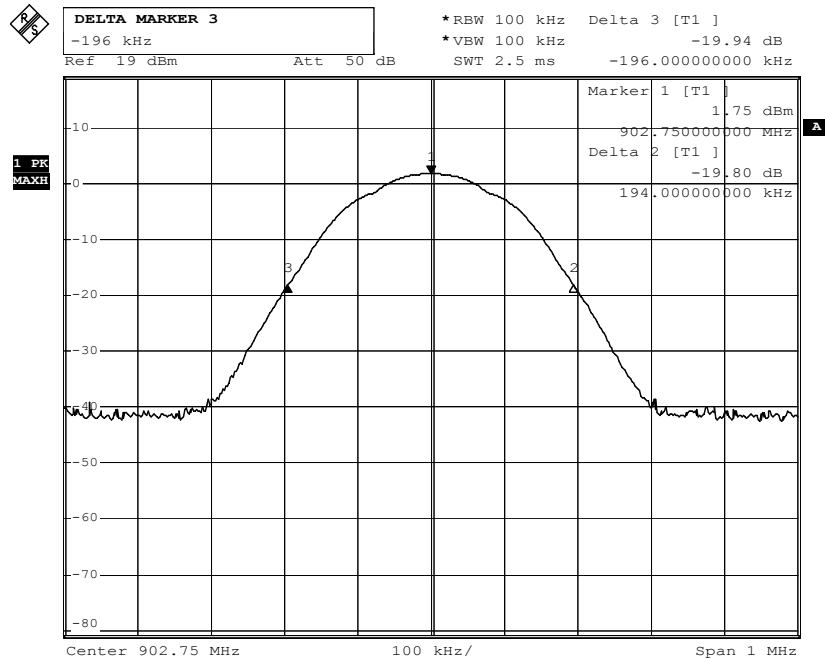
The emission limits shows in the above table are based on measurements employing a CISPR quasi-peak detector and above 1000 MHz are based on the measurements employing an average detector.

20dB Bandwidth Occupancy**Section 15.247(a)(1)(i)****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.31
 Detector Function : Peak
 Supply Voltage : 100V a.c.
 Port of testing : Antenna port 1
 Transmit profile type : 0 [Transmit profile 0 (highest link frequency) was chosen for the test.]
 Requirement : If the 20dB bandwidth of the hopping channel is 250kHz or greater, the system shall use at least 25 hopping frequency and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 sec period. The maximum allowed 20dB bandwidth of the hopping channel is 500kHz.

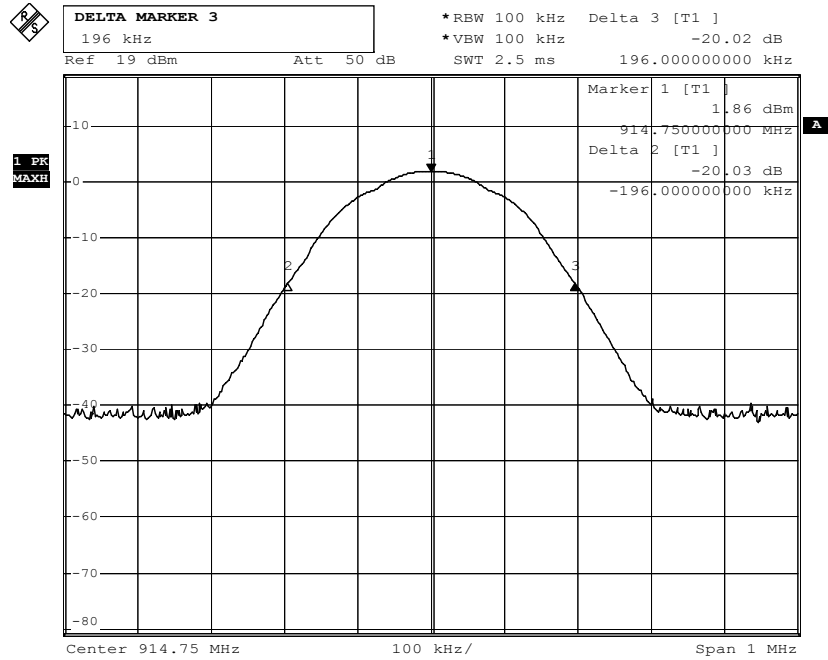
Results:

Frequency (MHz)	20 dB at lower cut of f (Δ kHz)	20 dB at upper cut of f (Δ kHz)	20dB bandwidth (kHz)
Ch1- 902.75	-196.0	+194.0	390
Ch25 - 914.75	-196.0	+196.0	392
Ch50 - 927.25	-196.0	+196.0	392

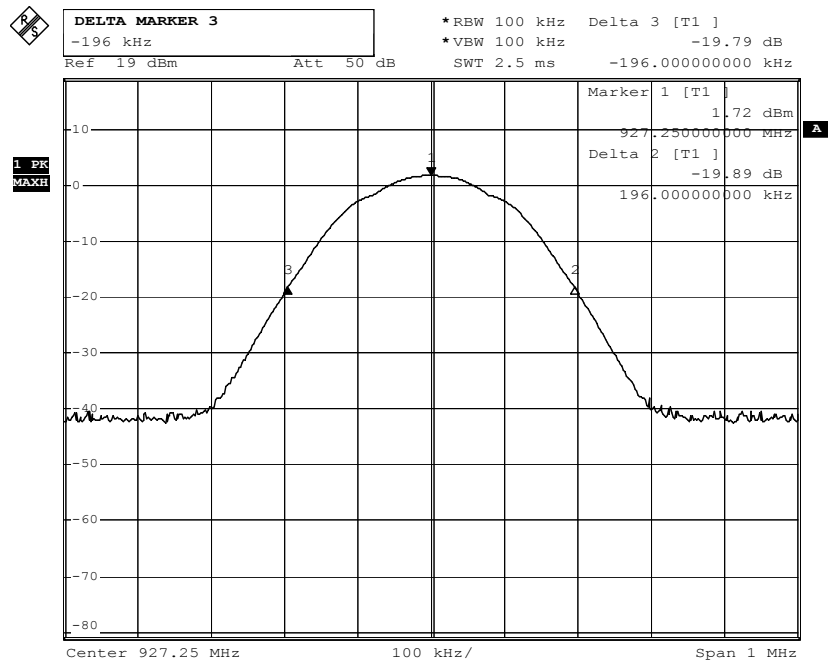


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Channel 1 - 20dB Bandwidth Measurement



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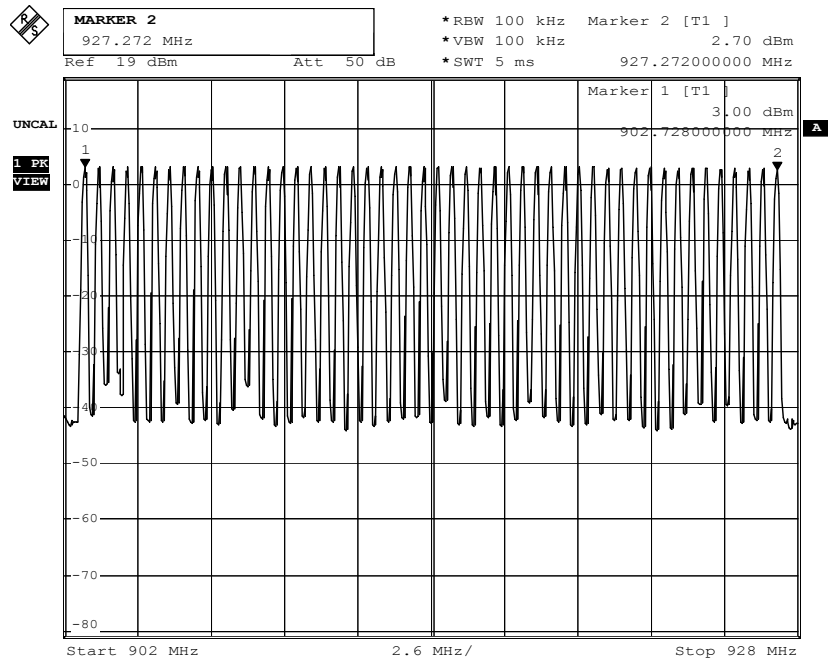
Channel 25 - 20dB Bandwidth Measurement

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Channel 50 - 20dB Bandwidth Measurement

Number of Hopping Channels**Section 15.247(a)(1)(i)****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.247(a)(1)(i)
 Detector Function : Peak
 Supply Voltage : 100Va.c.
 Port of testing : Antenna port 1
 Transmit profile type checked : 0, 1, 2 & 3
 Requirement : If the 20dB bandwidth of the hopping channel is 250kHz or greater, the system shall use at least 25 hopping frequency.

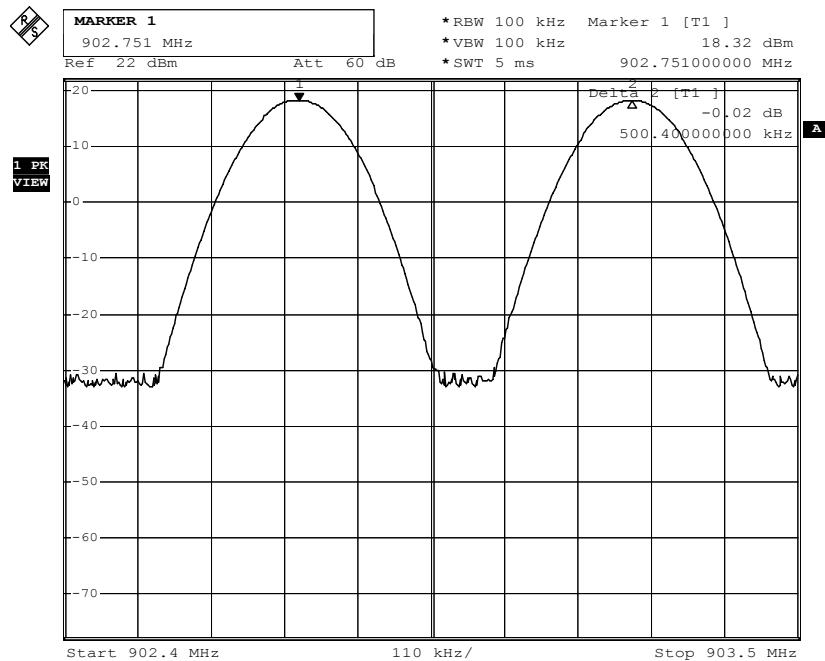


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Number of Hopping Channels – 50 channels

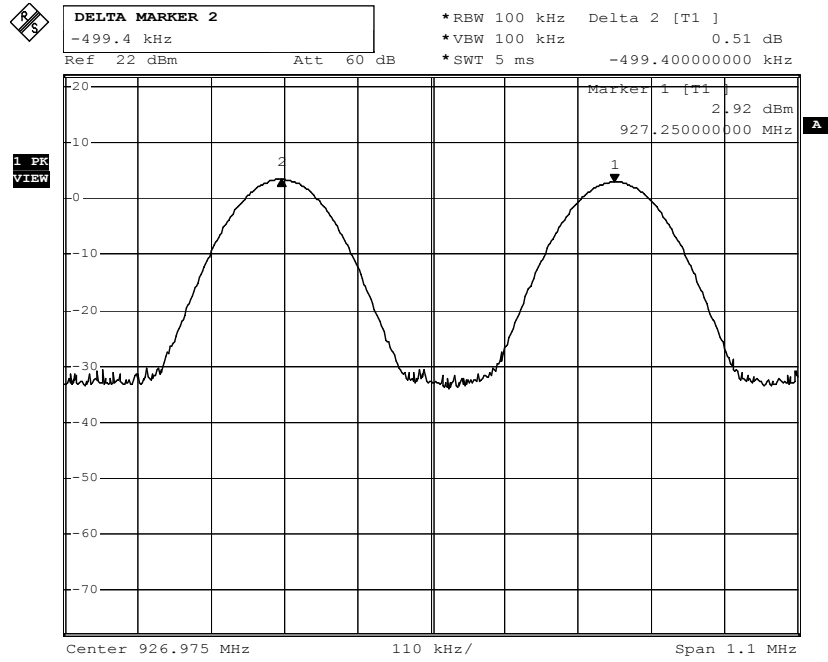
Carrier Frequency Separation**Section 15.247(a)(1)****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.247(a)(1)
 Detector Function : Peak
 Supply Voltage : 100V a.c.
 Port of testing : Antenna port 1
 Transmit profile type checked : 0, 1, 2 & 3
 Requirement : Frequency hopping systems shall have hopping channel carrier frequency separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. The 20dB bandwidth of the EUT is 392kHz, and the carrier frequency separation is 500kHz, so it complies with the requirement.



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Channel 1 – Channel Separation

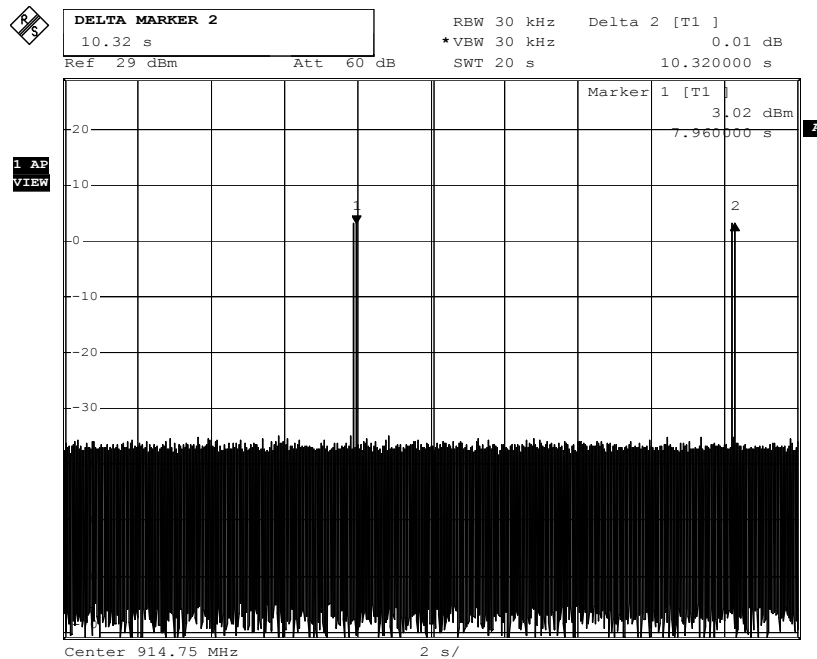


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Channel 50 – Channel Separation

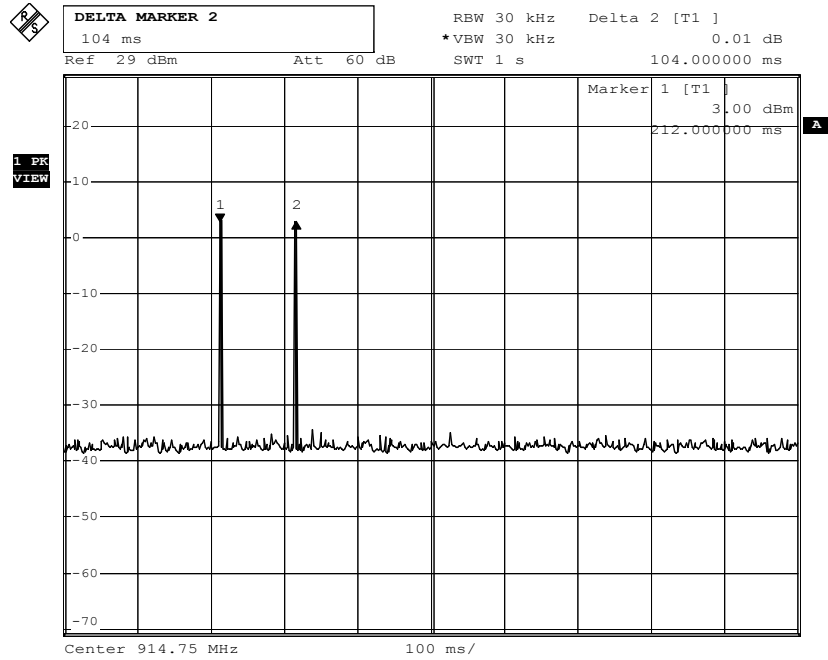
Time of Occupancy (Dwell Time)**Section 15.247(a)(1)****RESULT:****Pass**

Test Specification : FCC Part 15 Section 15.247 (a) (1) (i)
 Detector Function : Peak
 Supply Voltage : 100Va.c.
 Port of testing : Antenna port 1
 Requirement : If the 20dB bandwidth of the hopping channel is 250kHz or greater, the system shall use at least 25 hopping frequency and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

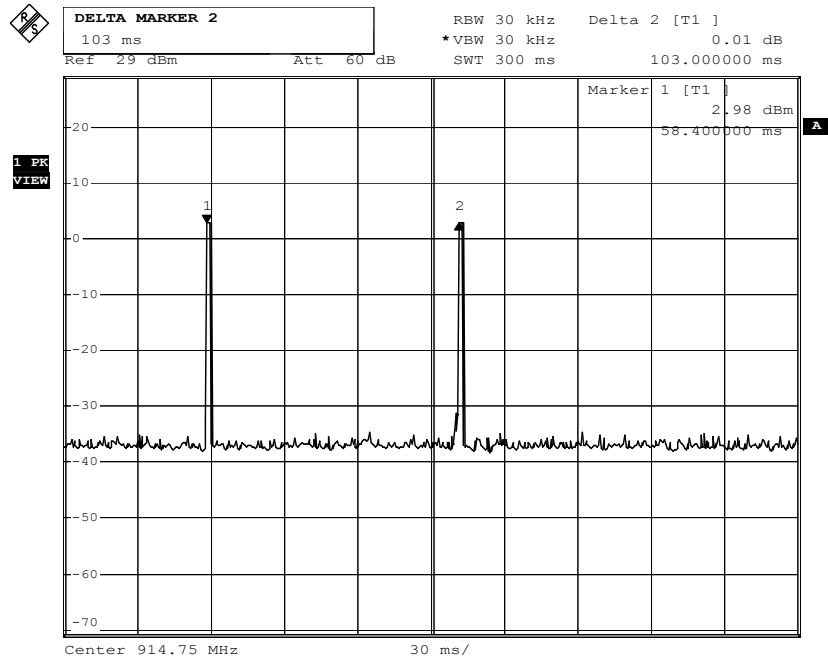


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Profile 0-Scan time: 20 sec.

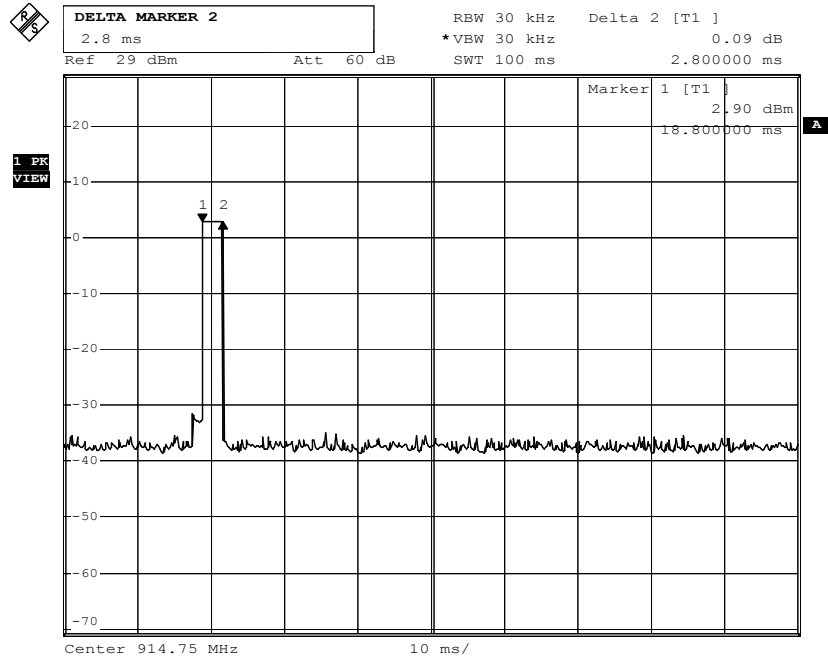


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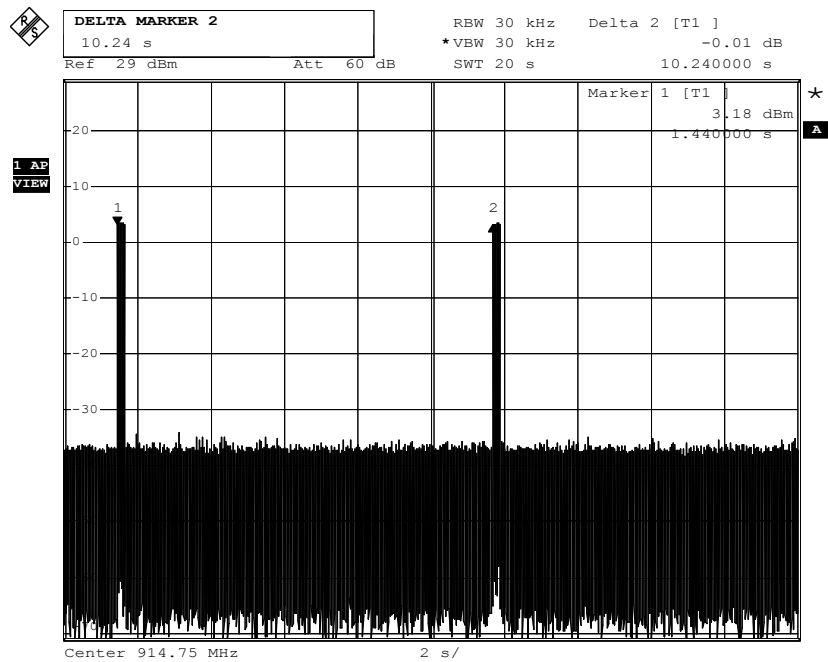
Profile 0-Scan time: 1 sec.

Date: 7.MAY.2006 16:14:33

Profile 0-Scan time: 300 msec.

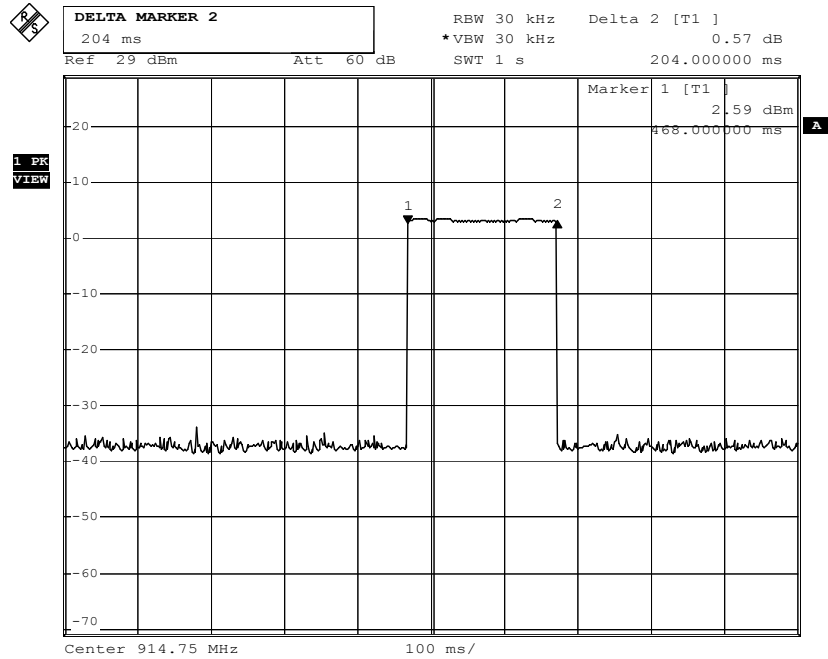


Date: 7.MAY.2006 16:21:52

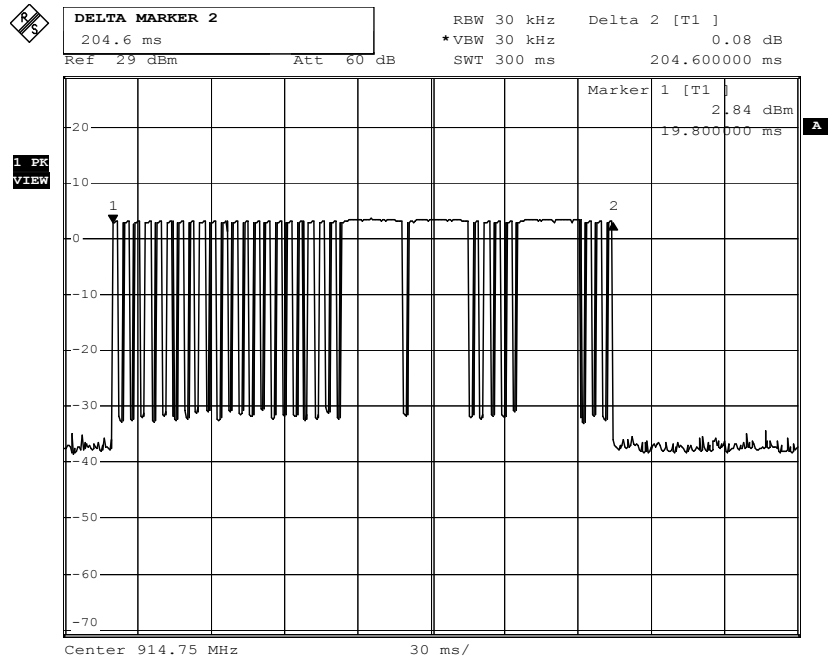
Profile 0-Scan time: 100 msec.

Date: 7.MAY.2006 16:48:32

Profile 1-Scan time: 20sec.

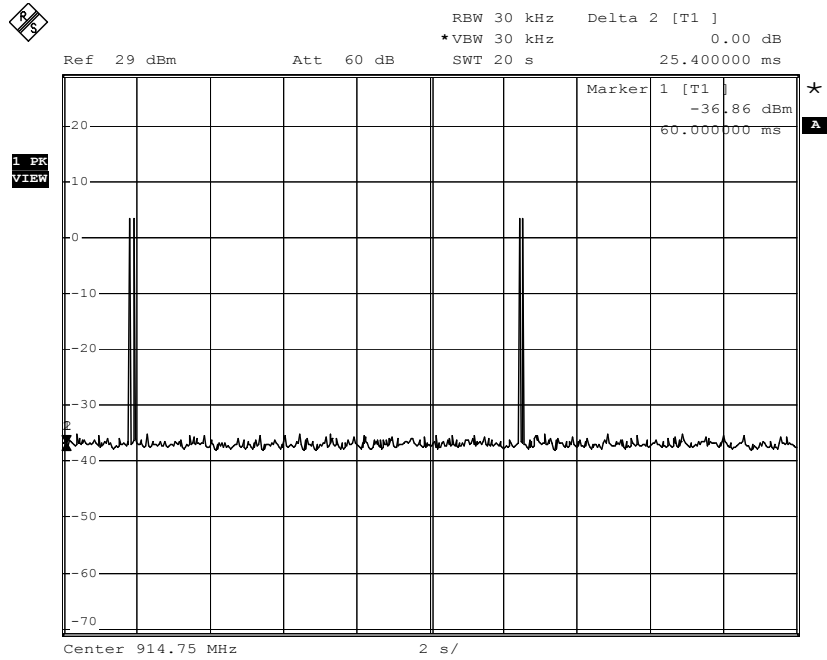


Date: 7.MAY.2006 16:50:09

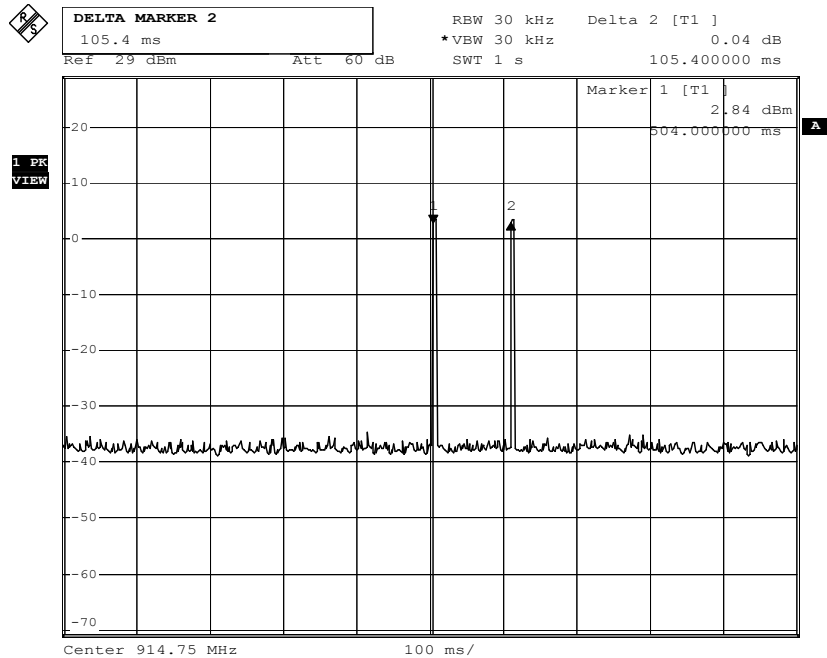
Profile 1-Scan time: 1sec.

Date: 7.MAY.2006 16:52:18

Profile 1-Scan time: 300msec.

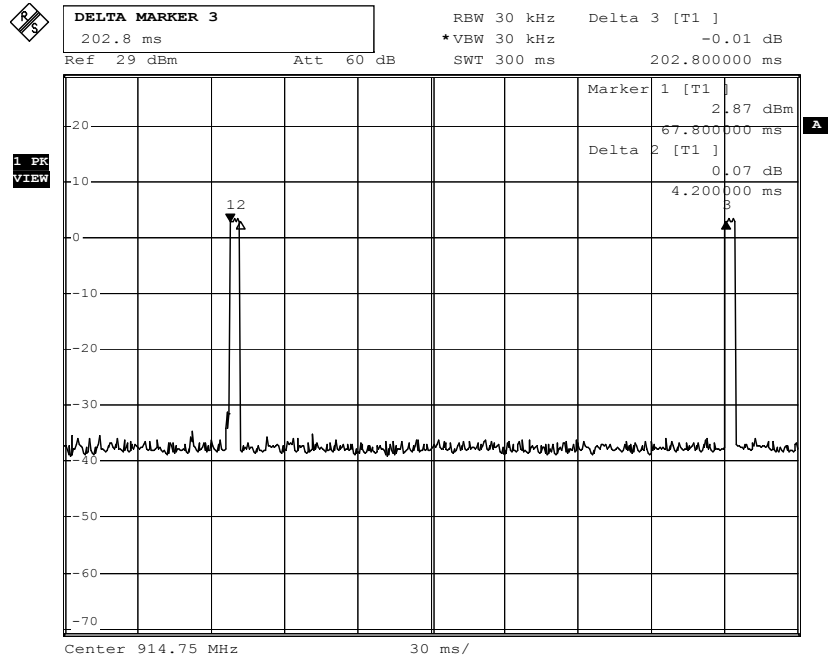


Date: 7.MAY.2006 17:02:50

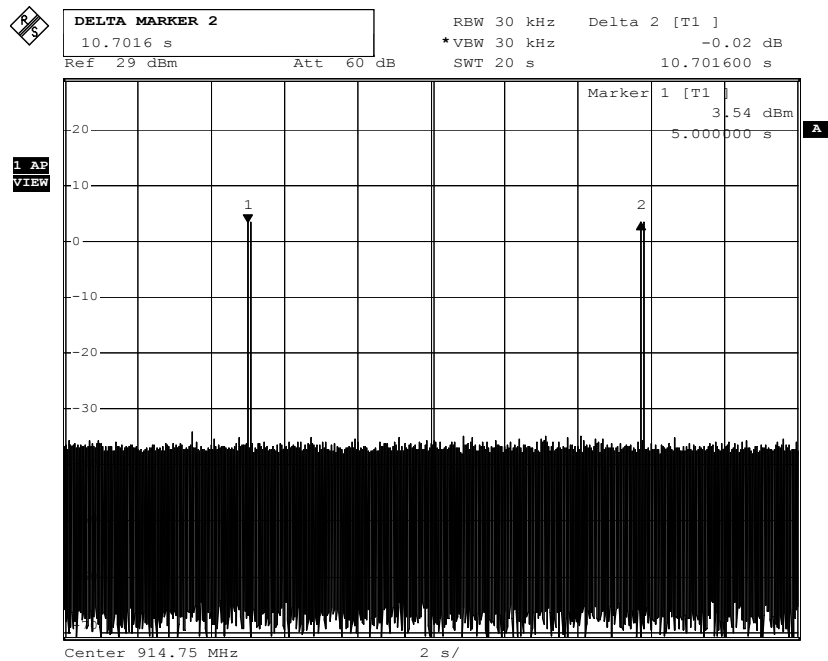
Profile 2-Scan time: 20sec.

Date: 7.MAY.2006 17:04:07

Profile 2-Scan time: 1sec.

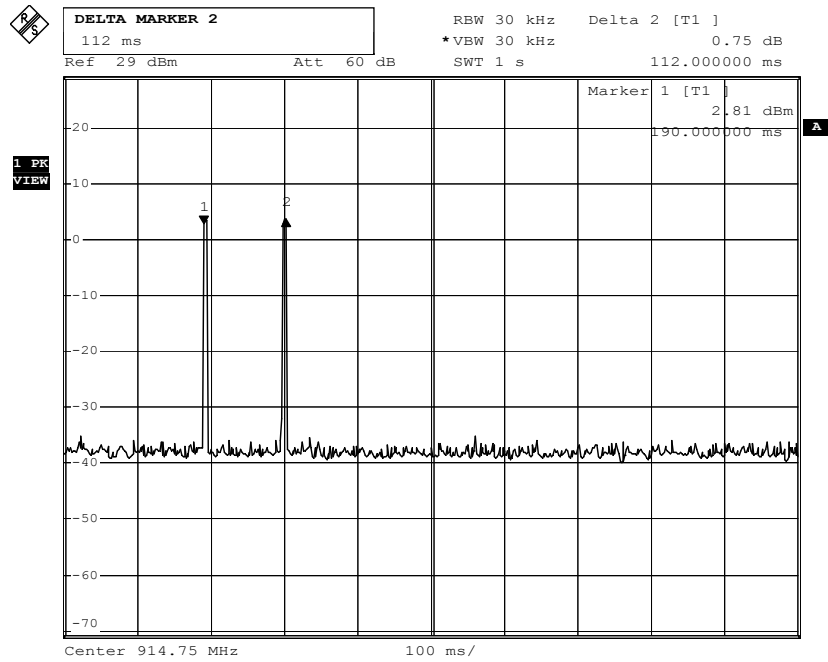


Date: 7.MAY.2006 17:06:04

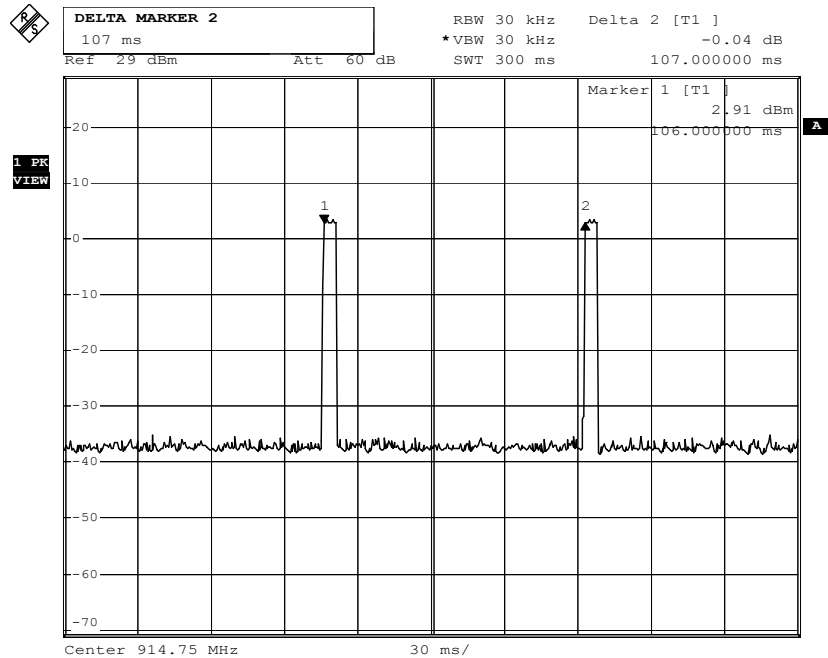
Profile 2-Scan time: 300msec.

Date: 7.MAY.2006 16:27:54

Profile 3-Scan time: 20sec.



Date: 7.MAY.2006 16:30:22

Profile 3-Scan time: 1sec.

Date: 7.MAY.2006 16:31:52

Profile 3-Scan time: 300msec

Band-edge Compliance**Section 15.247(b)****RESULT:****Pass**

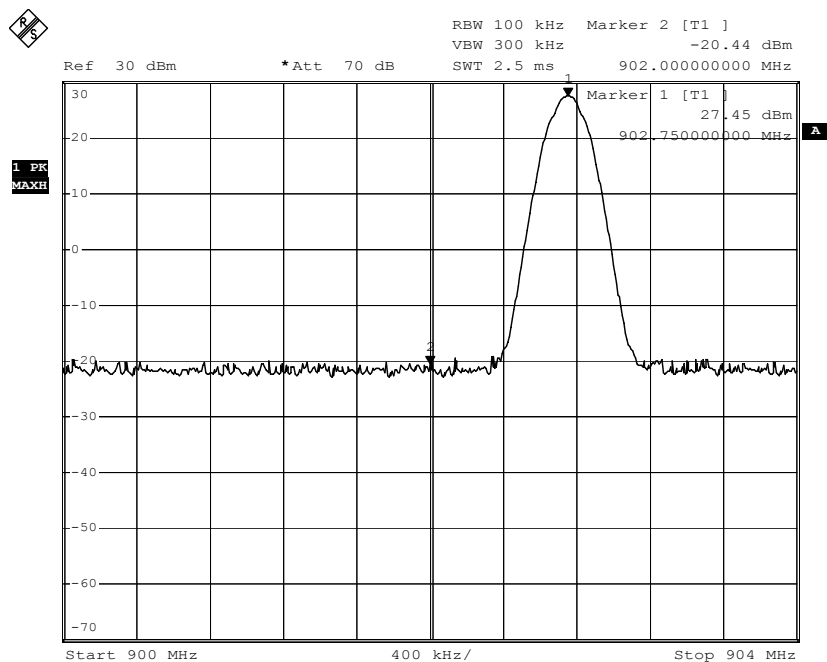
Test Specification : FCC Part 15 Section 15.247(d)

Detector Function : Peak

Supply Voltage : 100Va.c.

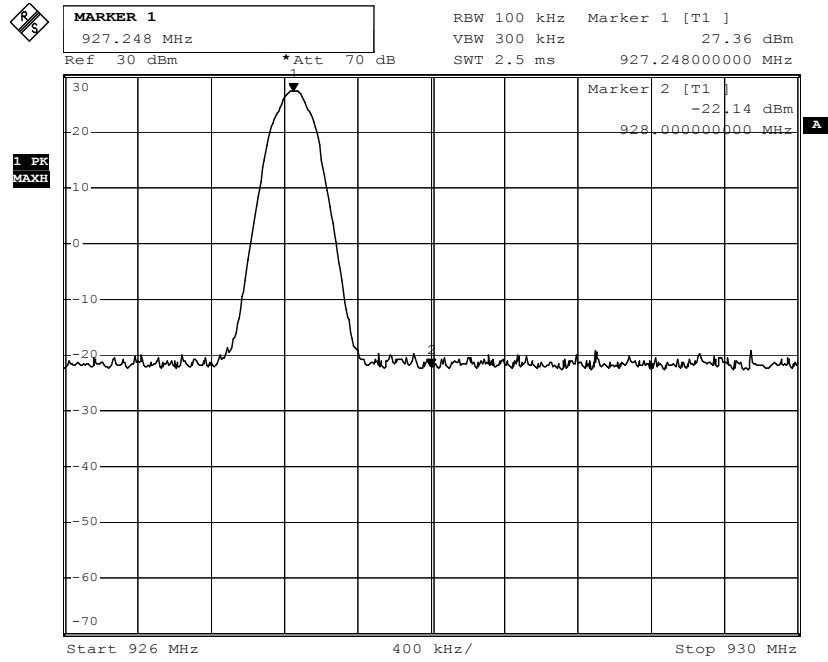
Port of testing : Antenna port

Requirement : In any 100kHz 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 20dB below that in the 100kHz 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.



Date: 11.MAY.2006 11:48:40

Band-edge Measurement - Channel 1



Date: 11.MAY.2006 11:51:28

Band-edge Measurement - Channel 50