Product Service

Choose certainty.
Add value.

Report On

Limited FCC Testing of the Sharp CDMA SHI16 Dual Band CDMA (BC0 and BC6) and Tri Band GSM (900, 1800 and 1900 MHz) and Dual Band UMTS (FDD I and V) Multi Mode Cellular Phone with Bluetooth, WLAN, WiMAX, NFC (FeliCa) and GPS In accordance with FCC CFR 47 Part 15C (Bluetooth)

COMMERCIAL-IN-CONFIDENCE

FCC ID: APYHRO00172

Document 75917214 Report 11 Issue 1 June 2012

Product Service

TÜV SÜD Product Service Ltd, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuvps.co.uk

REPORT ON

Limited FCC Testing of the Sharp CDMA SHI16 Dual Band CDMA (BC0 and BC6) and Tri Band GSM (900, 1800 and 1900 MHz) and Dual Band UMTS (FDD I and V) Multi Mode Cellular Phone with Bluetooth, WLAN, WiMAX, NFC (FeliCa) and GPS In accordance with FCC CFR 47 Part 15C (Bluetooth)

Document 75917214 Report 11 Issue 1

June 2012

PREPARED FOR

Sharp Communication Compliance Ltd
Azure House
Bagshot Road
Bracknell
Berkshire
RG12 7QY

PREPARED BY

Natalie Bennett
Senior Administrator (Technical)

APPROVED BY

Mark Jenkins
Authorised Signatory

DATED

15 June 2012

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC CFR 47 Part 15C. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s).

S Bennett

G Lawler

B Airs

Product Service

CONTENTS

Section		Page No
1	**REPORT SUMMARY**	**3**
1.1	Introduction	4
1.2	Brief Summary of Results	5
1.3	Application Form	6
1.4	Product Information	6
1.5	Test Conditions	11
1.6	Deviations from the Standard	11
1.7	Modification Record	11
2	**TEST DETAILS**	**12**
2.1	AC Line Conducted Emissions	13
2.2	Frequency Hopping Systems - 20dB Bandwidth and Channel Separation	16
2.3	Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels	24
2.4	Maximum Peak Conducted Output Power	31
2.5	EIRP Peak Power	33
2.6	Spurious and Band Edge Emissions	37
3	**TEST EQUIPMENT USED**	**51**
3.1	Test Equipment Used	52
3.2	Measurement Uncertainty	55
4	**ACCREDITATION, DISCLAIMERS AND COPYRIGHT**	**56**
4.1	Accreditation, Disclaimers and Copyright	57

Product Service

SECTION 1

REPORT SUMMARY

Limited FCC Testing of the
Sharp CDMA SHI16 Dual Band CDMA (BC0 and BC6) and Tri Band GSM (900, 1800 and 1900 MHz) and Dual Band UMTS (FDD I and V) Multi Mode Cellular Phone with Bluetooth, WLAN, WiMAX, NFC (FeliCa) and GPS
In accordance with FCC CFR 47 Part 15C (Bluetooth)

Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Limited FCC Testing of the Sharp CDMA SHI16 Dual Band CDMA (BC0 and BC6) and Tri Band GSM (900, 1800 and 1900 MHz) and Dual Band UMTS (FDD I and V) Multi Mode Cellular Phone with Bluetooth, WLAN, WiMAX, NFC (FeliCa) and GPS to the requirements of FCC CFR 47 Part 15C.

Objective	To perform Limited FCC Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Sharp Corporation
Model Number(s)	CDMA SHI16
Serial Number(s)	1L400112 IMEI 004401113851519 IMEI 004401113852590
Number of Samples Tested	3
Test Specification/Issue/Date	FCC CFR 47 Part 15C (2011)
Incoming Release Date	Application Form 29 March 2012
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	9096 29 March 2012
Start of Test	15 April 2012
Finish of Test	11 June 2012
Name of Engineer(s)	S Bennett G Lawler B Airs
Related Document(s)	ANSI C63.10: 2009

Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 15C is shown below.

Section	Spec Clause	Test Description	Result	Comments/Base Standard
Bluetooth				
2.1	15.207	AC Line Conducted Emissions	Pass	
2.2	15.247 (a)(1)	Frequency Hopping Systems - 20dB Bandwidth and Channel Separation	Pass	
2.3	15.247 (a)(1)(iii)	Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels	Pass	
2.4	15.247 (b)(3)	Maximum Peak Conducted Output Power	Pass	
2.5	15.247 (b)(4)	EIRP Peak Power	Pass	
2.6	15.247 (d)	Spurious and Band Edge Emissions	Pass	

1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION	
Model Name/Number	CDMA SHI16
Part Number	
FCC ID (if applicable)	APYHRO00172
Industry Canada ID (if applicable)	
Technical Description (Please provide a brief description of the intended use of the equipment)	Dual-Band CDMA(800MHz_BC0, 1900MHz_BC6) and Tri-Band GSM (GSM900MHz, DCS1800MHz, PCS1900MHz) and Dual-band UMTS (2100MHz_FDDI, 850MHz_FDDV) Tri- Mode Cellular Phone with WIMAX, Bluetooth, W-LAN, NFC/ FeliCa and GPS receiver enabled.

EXTREME TEMPERATURE RANGE over which the equipment is to be type tested

☐ -20°C to +55°C

☒ Other (2)

☐ Not applicable (no extreme temperature testing required)

Extreme temperature range for the host(s): -20C to +60C

(2) The equipment shall be tested over the following temperature ranges :

a) 0°C to +35°C for equipment for indoor use only, or intended for used in areas where the temperature is controlled within this range.

b) Over the extremes of the temperature range(s) of the declared host equipment(s) in case of plug-in radio devices.

TYPE OF ANTENNA

☒ Integral

Temporary RF connector provided: ☒ Yes ☐ No

☐ Antenna connector

☐ Number of antenna assembly(ies) submitted

Gain of the antenna intended for normal use:

0	dBi	for assembly identified as	Bluetooth
0	dBi	for assembly identified as	WLAN
	dBi	for assembly identified as	
	dBi	for assembly identified as	
	dBi	for assembly identified as	

TRANSMITTER TECHNICAL CHARACTERISTICS

TRANSMITTER OPERATING FREQUENCY RANGE(S)

	FCC and/or Industry Canada	EU
Bluetooth	2402 to 2480 MHz	2402 to 2480 MHz
WLAN	2412 to 2462 MHz	2412 to 2472 MHz

FCC and/or Industry Canada (only)

Highest Internally Generated Frequency 1512.0 MHz

Product Service

SPREAD SPECTRUM PARAMETERS				
☒	Bluetooth			
FHSS: Channel ☒ 79 Other		EDR ☒ Yes ☐ No		
Medium Access Protocol (Customer Declaration)				
“We have implemented Bluetooth protocol which satisfies the medium access protocol requirement of EN 300 328“.				
☒	WLAN			
IEEE 802.11(b) – DSSS ☒				
IEEE 802.11(g) – OFDM ☒				
IEEE 802.11(n) – OFDM ☒				
Supported Spatial Streams			2.4 GHz	5GHz
		Transmitter (Tx)	Yes	(No: Japan only)
		Receiver (Rx)	Yes	(No: Japan only)
GI (Guard Interval)	☒ 800 ns	☐ 400 ns		
Band Width	☒ 20 MHz	☐ 40 MHz		
☐	Other Technology			
Direct Sequence ☐	Frequency Hopping ☐	Combined ☐	Other	
DSSS	Chip Sequence Length	bit		
	Spectrum Width	MHz		
FHSS	Total Number of Hops			
	Dwell Time	ms		
	Bandwidth Per Hop	MHz		
	Maximum Separation of Hops	MHz for ETSI EN 300 328		
Other				
Medium Access Protocol (Customer Declaration)				
“We have implemented IEEE 802.11 (b/g/n) protocol which satisfies the medium access protocol requirement of EN 300 328“.				

Product Service

TRANSMITTER POWER CHARACTERSITICS						
Bluetooth						
Maximum Rated Transmitter Output						
Effective radiated power (for equipment with antenna connector)		0.0025	W			
Effective radiated power (for equipment with integral antenna)		0.0025	W			
Minimum Rated Transmitter Output						
Effective radiated power (for equipment with antenna connector)		0.00025	W			
Effective radiated power (for equipment with integral antenna)		0.00025	W			
Is transmitter intended for :						
Continuous duty				☒ Yes	☐ No	
Intermittent duty				☐ Yes	☒ No	
If intermittent state DUTY CYCLE						
Transmitter ON	seconds	Transmitter OFF	minutes			
Is continuous operation possible for testing purposes?				☒ Yes	☐ No	
Is transmitter output power variable:				☐ Yes	☒ No	
State during the test:						
Transmitter duty cycle	Tx on	Seconds	Tx Off	Seconds		
Duty cycle (Tx on /(Tx on +Tx off))		%				
☐ Continuously variable		☐ Stepped				
dB per step						
WLAN						
Maximum Rated Transmitter Output						
Effective radiated power (for equipment with antenna connector)		0.046 (b/0.02(g.n)	W			
Effective radiated power (for equipment with integral antenna)		0.046 (b/0.02(g/n)	W			
Minimum Rated Transmitter Output						
Effective radiated power (for equipment with antenna connector)			W			
Effective radiated power (for equipment with integral antenna)			W			
Is transmitter intended for :						
Continuous duty				☒ Yes	☐ No	
Intermittent duty				☐ Yes	☐ No	
If intermittent state DUTY CYCLE						
Transmitter ON	seconds	Transmitter OFF	minutes			
Is continuous operation possible for testing purposes?				☒ Yes	☐ No	
Is transmitter output power variable:				☐ Yes	☒ No	
State during the test:						
Transmitter duty cycle	Tx on	Seconds	Tx Off	Seconds		
Duty cycle (Tx on /(Tx on +Tx off))		%				
☐ Continuously variable		☐ Stepped				
dB per step						

TRANSMITTER POWER SOURCE (3)				
☒ Common power source for transmitter and receiver				
☐ AC mains		State voltage		
AC supply frequency	(Hz)	VAC	Max Current	Hz
☐ Single phase		☐ Three phase		
And / Or				
☐ External DC supply				
Nominal voltage		Max Current	A	
Extreme upper voltage		Extreme lower voltage		
Battery				
☐ Nickel Cadmium				
☐ Lead acid (Vehicle regulated)				
☐ Alkaline				
☒ Lithium				
☐ Other Details :				
4.0 Volts nominal.				
End point voltage as quoted by equipment manufacturer		3.8	V	

(3) If a transmitter and receiver use the same power source, this should be declared. In such cases only the box for the transmitter power source should be filled in.

AUTOMATIC EQUIPMENT SWITCH OFF		
If the equipment is designed to automatically switch off at a predetermined voltage level which is higher or lower in value than the battery minimum and minimum calculated values this shall be clearly stated.		
☒ Applies	3.4	V cut-off voltage
☐ Does not apply		

Product Service

RECEIVER POWER SOURCE (4)				
☐ AC mains		State voltage		
AC supply frequency	(Hz)	VAC	Max Current	Hz
☐ Single phase		☐ Three phase		
And / Or				
☐ External DC supply				
Nominal voltage		Max Current	A	
Extreme upper voltage		Extreme lower voltage		
Battery				
☐ Nickel Cadmium				
☐ Lead acid (Vehicle regulated)				
☐ Alkaline				
☐ Lithium				
☐ Other Details :				
Volts nominal.				
End point voltage as quoted by equipment manufacturer		V		

(4) If a transmitter and receiver use the same power source, this should be declared. In such cases only the box for the transmitter power source should be filled in.

AUTOMATIC EQUIPMENT SWITCH OFF	
If the equipment is designed to automatically switch off at a predetermined voltage level which is higher or lower in value than the battery minimum and minimum calculated values this shall be clearly stated.	
☐ Applies	V cut-off voltage
☐ Does not apply	

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Signature: Toshiro Shiomi Name: Toshiroh Shiomi

Position held: Manager Date:

Product Service

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Sharp CDMA SHI16 Dual Band CDMA (BC0 and BC6) and Tri Band GSM (900, 1800 and 1900 MHz) and Dual Band UMTS (FDD I and V) Multi Mode Cellular Phone with Bluetooth, WLAN, WiMAX, NFC (FeliCa) and GPS. A full technical description can be found in the manufacturer's documentation.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a 4.0 V DC supply.

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standard or test plan were made during testing.

1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.

SECTION 2

TEST DETAILS

Limited FCC Testing of the
Sharp CDMA SHI16 Dual Band CDMA (BC0 and BC6) and Tri Band GSM (900, 1800 and 1900 MHz) and Dual Band UMTS (FDD I and V) Multi Mode Cellular Phone with Bluetooth, WLAN, WiMAX, NFC (FeliCa) and GPS
In accordance with FCC CFR 47 Part 15C (Bluetooth)

Product Service

2.1 AC LINE CONDUCTED EMISSIONS

2.1.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.207

2.1.2 Equipment Under Test and Modification State

CDMA SHI16 S/N: IMEI 004401113851519 - Modification State 0

2.1.3 Date of Test

11 June 2012

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Procedure

The EUT is set up on a test table 800mm above a horizontal ground plane. A vertical ground plane is also required and is placed 400mm from the EUT. Where a EUT is floor standing it will be stood on but insulated from the ground plane by up to 12mm.

The EUT is powered through a Line Impedance Stabilisation Network (LISN) which is bonded to the ground plane. The EUT is located so that the distance between the EUT and the LISN is no less than 800mm. Where possible the cable between the mains input of the EUT and the LISN is 1m. Where this is not possible the cable is non inductively bundled with the bundle not exceeding 400mm in length.

A preliminary profile of the Conducted Emissions is obtained over the frequency range 150kHz to 30MHz. Any points of interest are noted for formal measurements.

During formal measurements, the measuring receiver is tuned to the emission of interest where Quasi – Peak and Average measurements are performed in a 9kHz Video and Resolution Bandwidth.

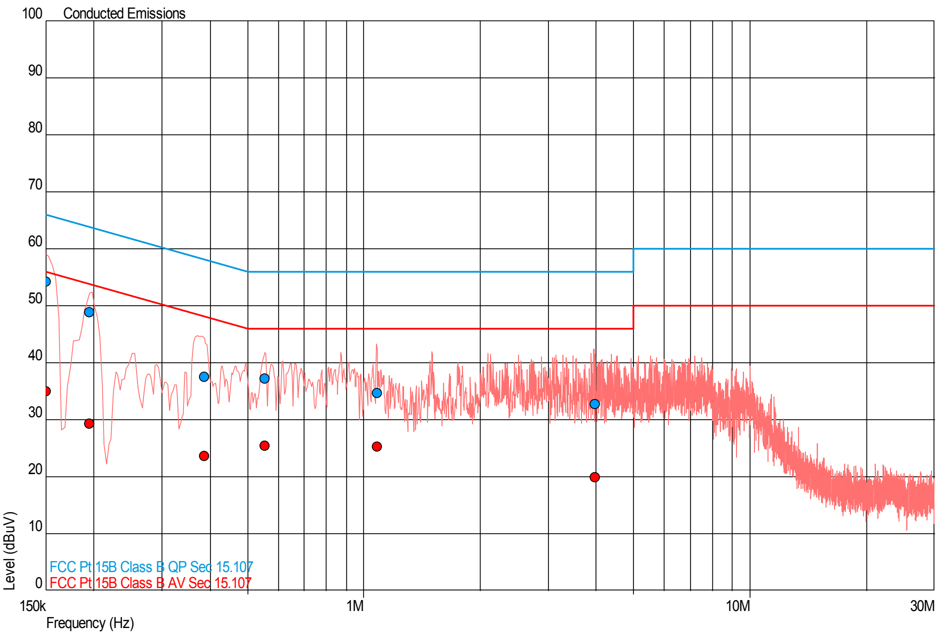
2.1.6 Environmental Conditions

Ambient Temperature	20.1°C
Relative Humidity	48.0%

Product Service

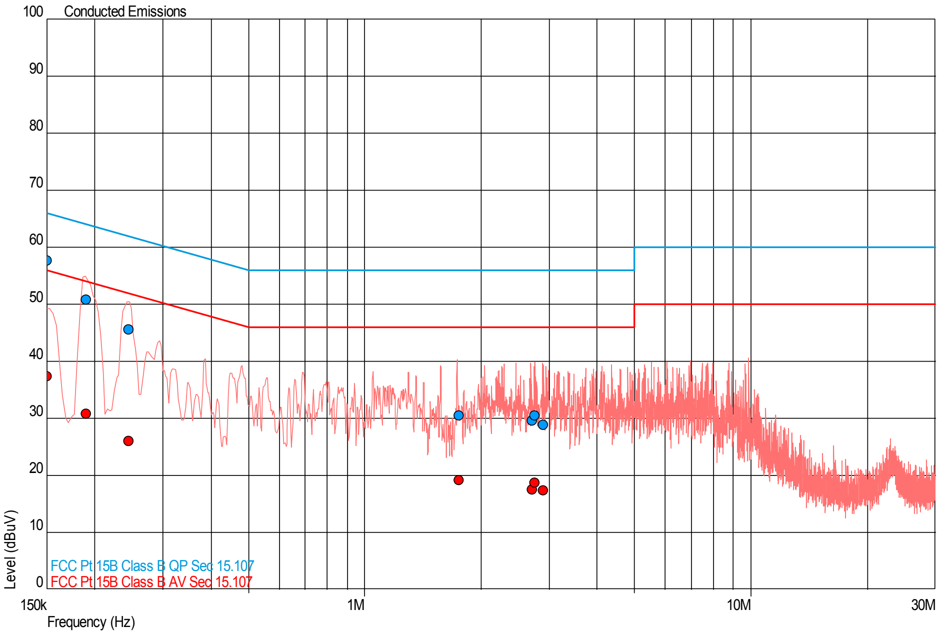
2.1.7 Test Results

Live Line



Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)	
0.150	54.2	66.0	-11.8	35.0	56.0	-21.0	
0.195	48.8	63.8	-15.0	29.4	53.8	-24.5	
0.387	37.5	58.1	-20.6	23.7	48.1	-24.4	
0.555	37.2	56.0	-18.8	25.4	46.0	-20.6	
1.082	34.7	56.0	-21.3	25.2	46.0	-20.8	
3.976	32.7	56.0	-23.3	19.9	46.0	-26.1	

Neutral Line



Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)	
0.150	57.8	66.0	-8.2	37.4	56.0	-18.6	
0.190	50.8	64.1	-13.3	30.8	54.1	-23.2	
0.245	45.6	61.9	-16.3	26.0	51.9	-25.9	
1.758	30.5	56.0	-25.5	19.2	46.0	-26.8	
2.707	29.7	56.0	-26.3	17.5	46.0	-28.5	
2.762	30.5	56.0	-25.5	18.7	46.0	-27.3	
2.903	28.9	56.0	-27.1	17.3	46.0	-28.7	

Product Service

2.2 FREQUENCY HOPPING SYSTEMS - 20dB BANDWIDTH AND CHANNEL SEPARATION

2.2.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (a)(1)

2.2.2 Equipment Under Test and Modification State

CDMA SHI16 S/N: IMEI 004401113852590 - Modification State 0

2.2.3 Date of Test

6 June 2012

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Procedure

The EUT was transmitted at maximum power via a cable to the Spectrum Analyser. The Analyser settings were adjusted to display the resultant trace on screen. The peak point of the trace was measured and the markers positioned to give the -20dBc points of the displayed spectrum.

The EUT was transmitted at maximum power into a Spectrum Analyser. The trace was set to Max Hold to store several adjacent channels on screen. Using the marker delta function, the markers were positioned to show the separation between adjacent channels.

2.2.6 Environmental Conditions

Ambient Temperature	22.6°C
Relative Humidity	43.0%

2.2.7 Test Results

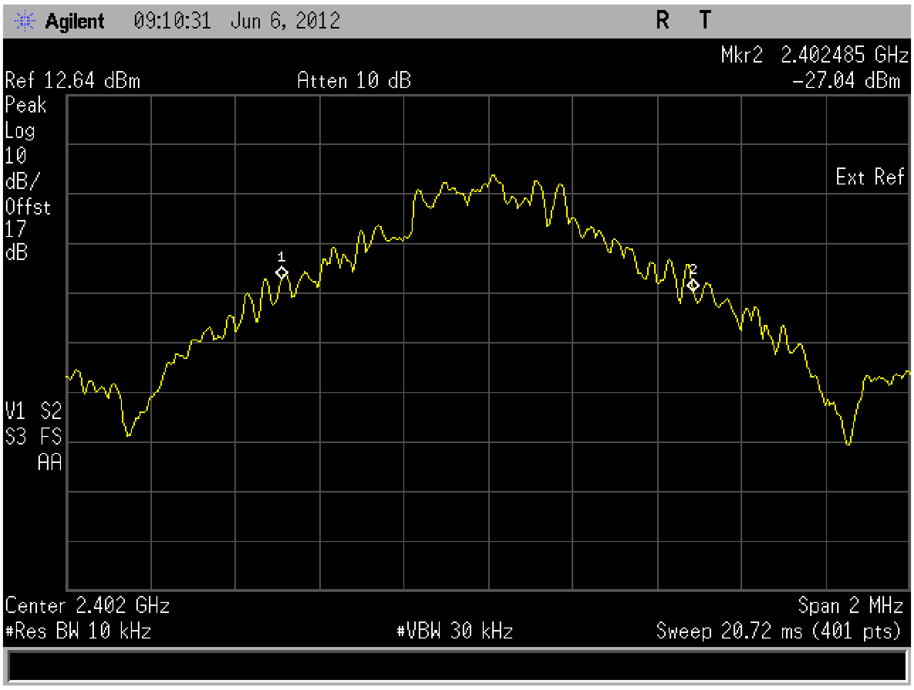
4.0 V DC Supply

20dB Bandwidth

2402 MHz

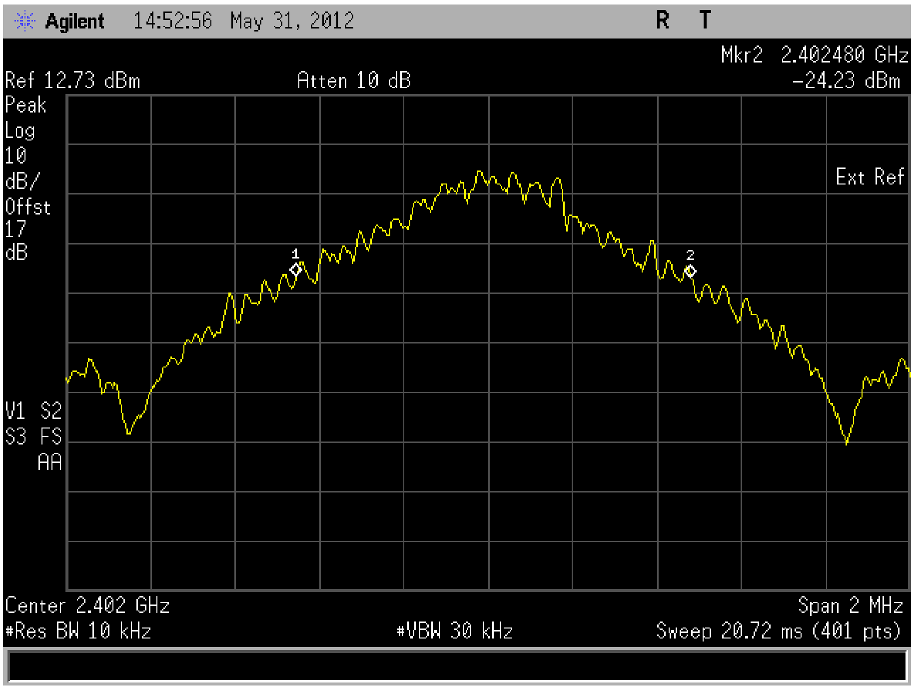
Data Rate (Mbps)	20dB Bandwidth (kHz)
DH1	975
DH3	930
DH5 (worst)	930

DH1

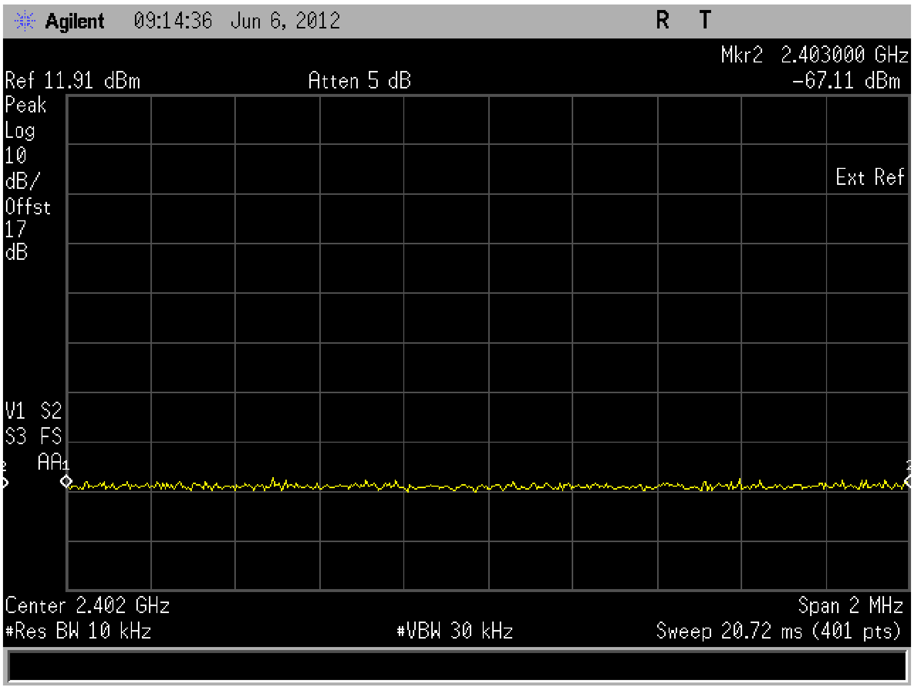


Product Service

DH3



DH5 (worst)

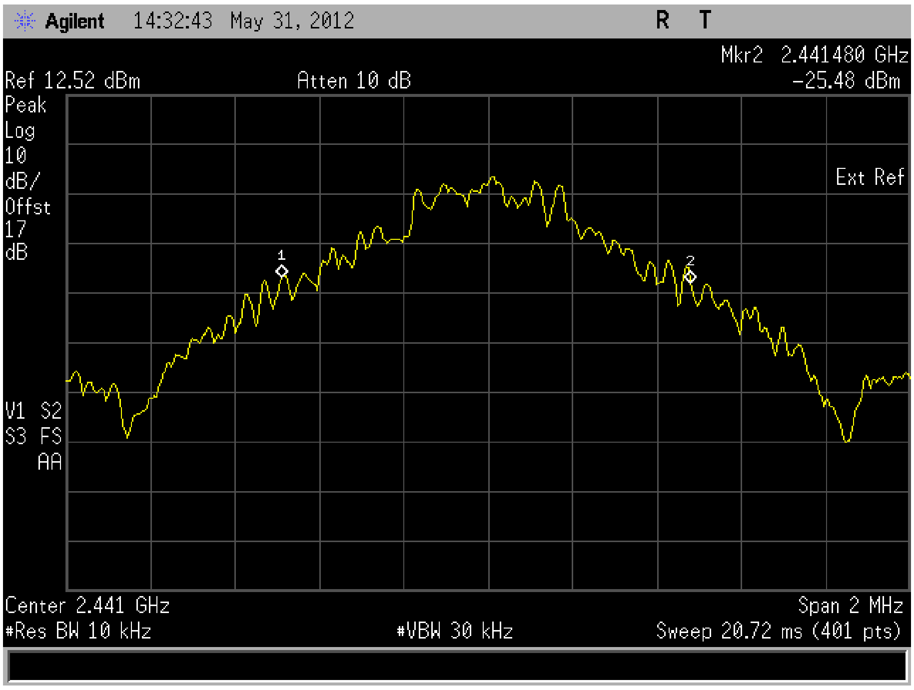


Product Service

2441 MHz

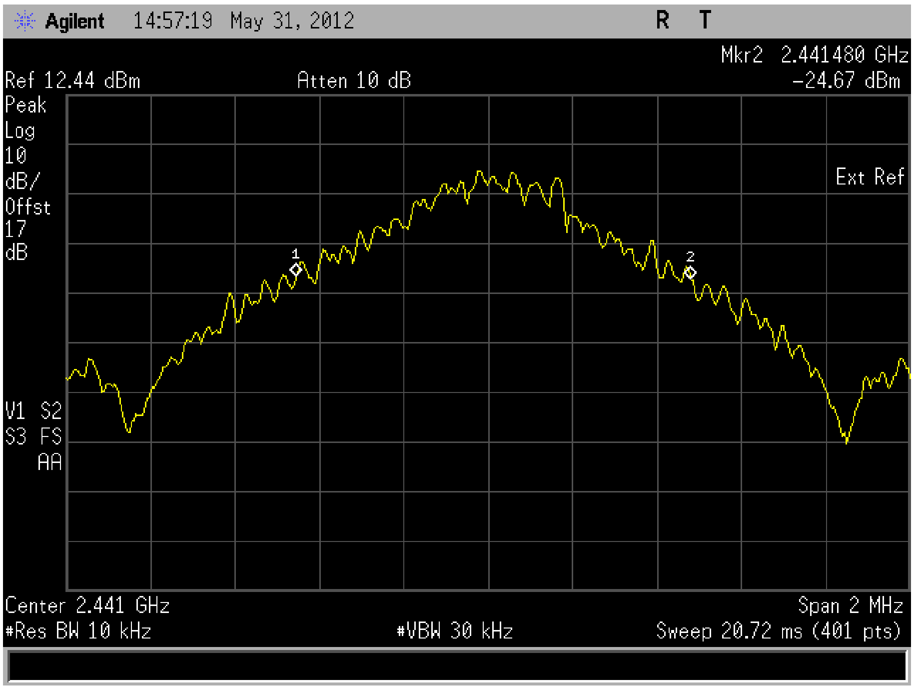
Data Rate (Mbps)	20dB Bandwidth (kHz)
DH1	970
DH3	930
DH5 (worst)	930

DH1

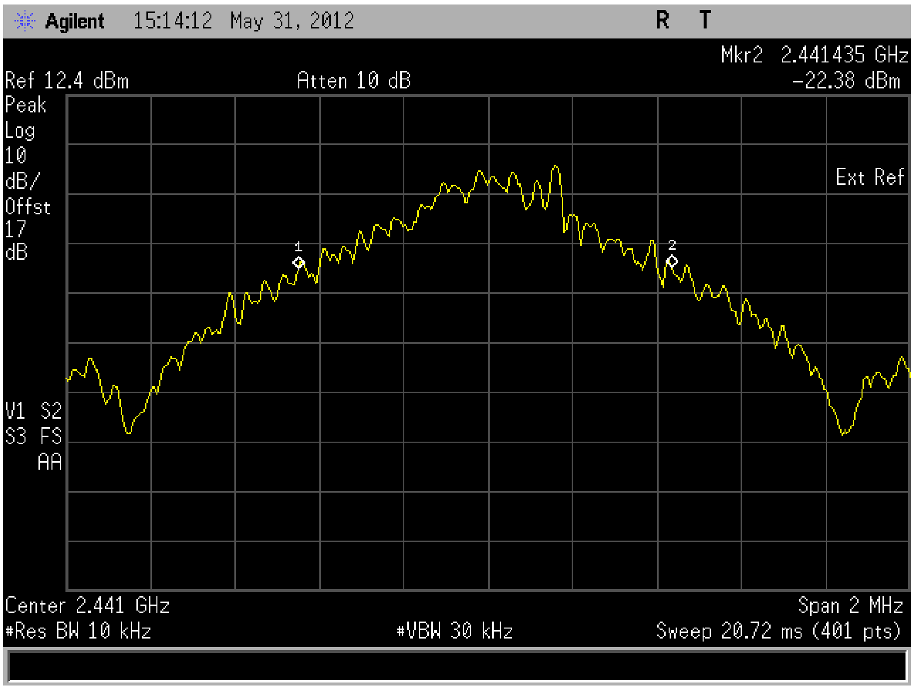


Product Service

DH3



DH5 (worst)

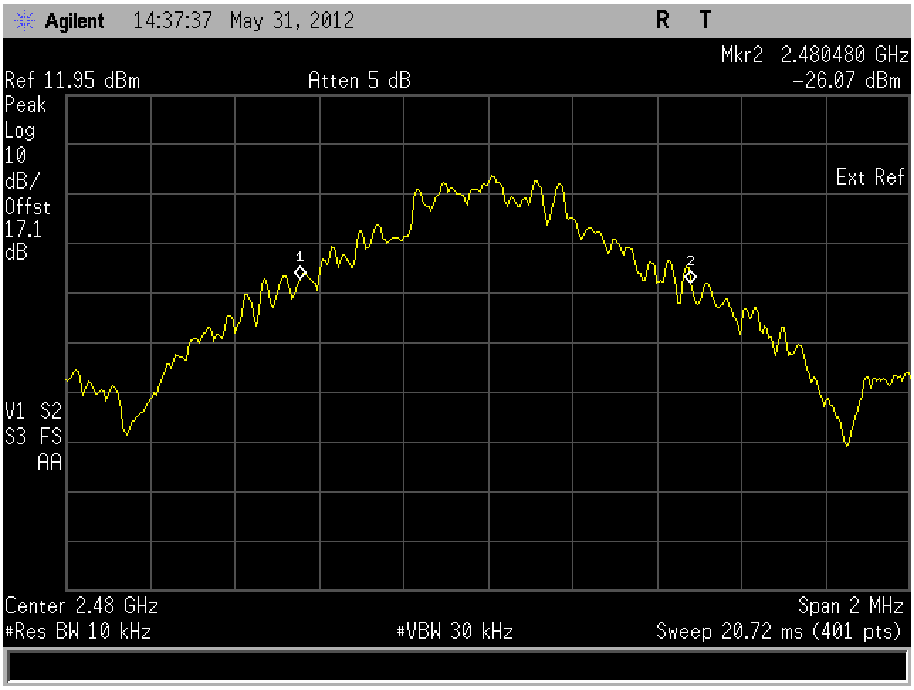


Product Service

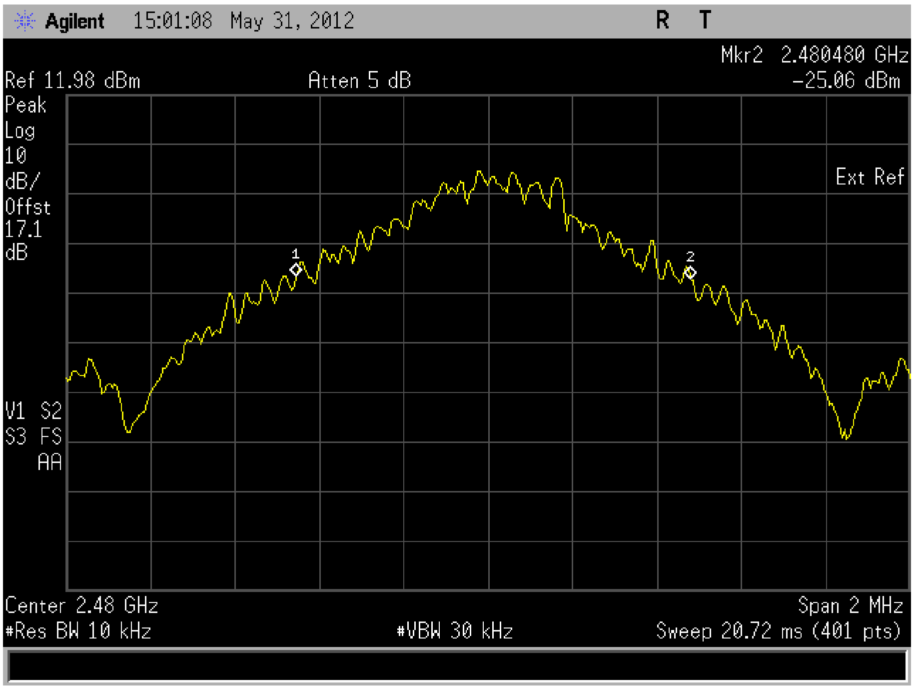
2480 MHz

Data Rate (Mbps)	20dB Bandwidth (kHz)
DH1	925
DH3	935
DH5 (worst)	935

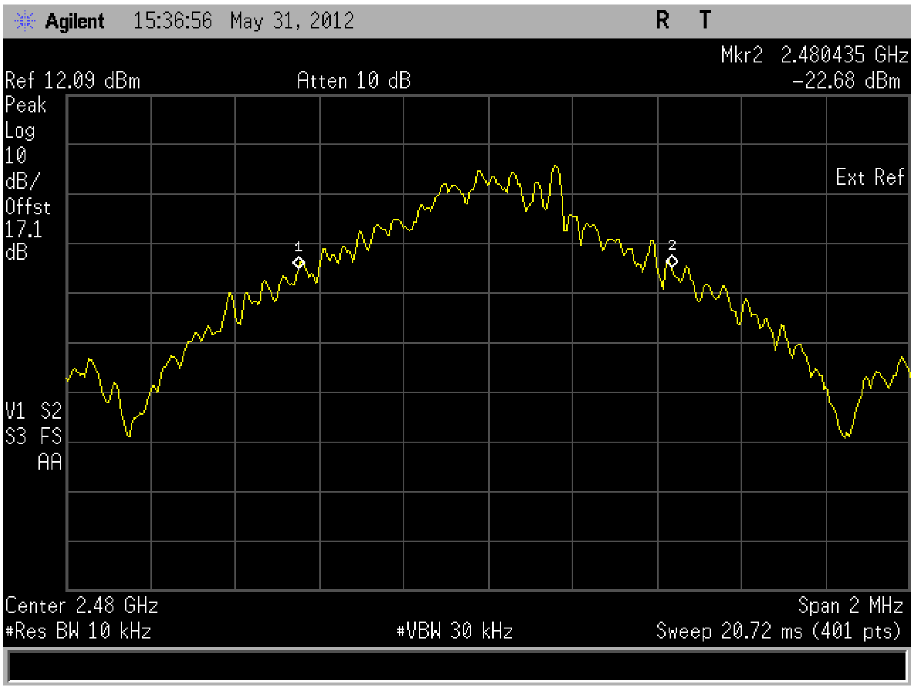
DH1



DH3



DH5 (worst)

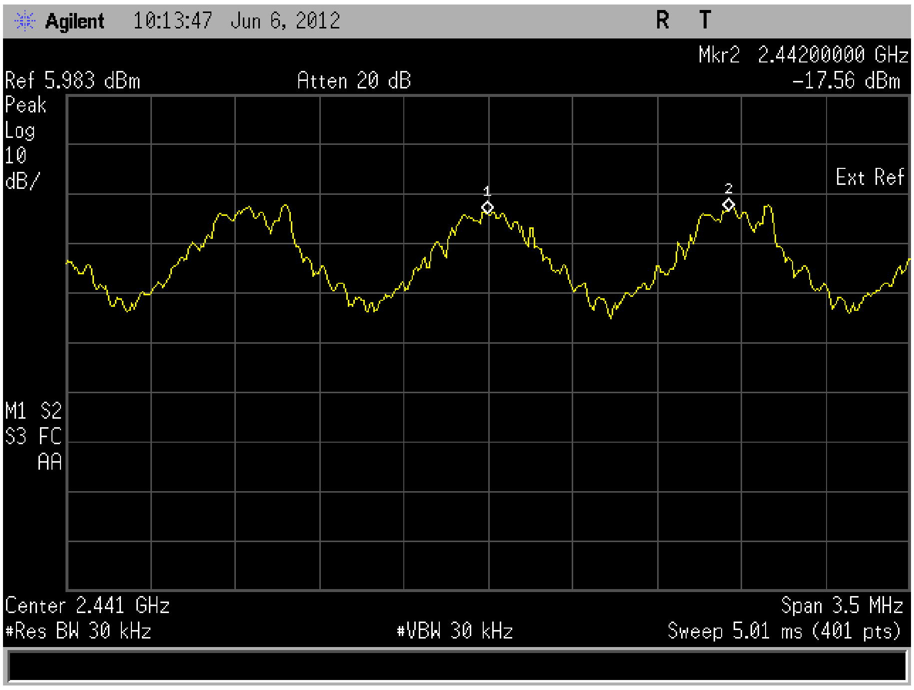


Limit Clause

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

Product Service

Channel Separation



Limit Clause

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 0.125 W.

The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

2.3 FREQUENCY HOPPING SYSTEMS - CHANNEL DWELL TIME AND NUMBER OF HOPPING CHANNELS

2.3.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (a)(1)(iii)

2.3.2 Equipment Under Test and Modification State

CDMA SHI16 S/N: IMEI 004401113852590 - Modification State 0

2.3.3 Date of Test

6 June 2012

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Procedure

DH1

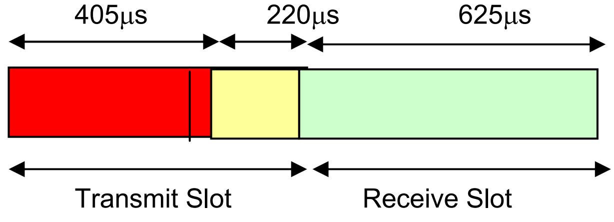
The Bluetooth system hops at a rate of 1600 times per second. Thus, this equates to 1600 timeslots in 1 second.

The DH1 data rate operates on a Transmit on 1 timeslot and Receive on 1 timeslot basis. Thus, in 1 second, there are 800 Transmit timeslots and 800 Receive timeslots.

Thus:

$$1 \text{ Timeslot} = \frac{1}{1600} = 625\mu s$$

In 1 transmit timeslot, the transmit on time is only 405µs. 220µs is reserved as off time for the synthesizer to re-tune ready for the next transmit frequency. The following timeslot is a receive slot. This process continues assuming the data rate remains the same.



DH1 Timeslot Arrangement Showing One Complete Transmit and Receive Cycle

So, with 800 Tx and 800 Rx timelsots, the transmitter is on for 800 x 405µs = 0.324 seconds.

$$\therefore \quad \frac{\text{Total Tx Time On}}{\text{No of Channels}} = \frac{0.324}{80} = 4.05\text{ms}$$

So, in 32 seconds, the transmitter dwell time per channel is:

32 x 4.05ms = 0.1296 seconds

DH3

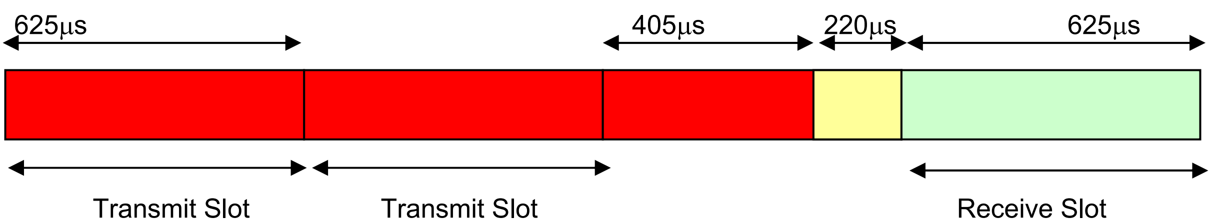
With data rate DH3, the data payload is higher and can use up to 3 timeslots. When more than one timeslot is used, the frequency does not hop and transmission is continuous on all 3 slots, (ie. no receive slot in-between the 3 transmit slots). The 220µs off time for synthesizer re-tuning at the end of a slot is only used on the final slot. Thus, for one cycle, there are 3 transmit timeslots. 2 are 625µs long and the final slot is transmitting for 405µs.

The DH3 data rate operates on a Transmit on 3 timeslots and Receives on 1 timeslot basis, (assuming maximum data payload). The frequency-hopping rate is the same. Thus, in 1 second, there are 1200 Transmit timeslots and 400 Receive timeslots.

Thus:

$$1 \text{ Timeslot} = \frac{1}{1600} = 625\mu s$$

The first 2 Transmit timeslots are transmitting for the complete 625µs. In the third transmit slot, the transmit on time is only 405µs. 220µs is reserved as off time for the synthesizer to re-tune ready for the next transmit frequency. The following timeslot is a receive slot. This process continues assuming the data rate remains the same.



DH3 Timeslot Arrangement Showing One Complete Transmit and Receive Cycle, (Maximum Payload)

Thus, the transmitter for one complete transmit and receive cycle would be on for:

Tx (2 x 625µs) + (1 x 405µs) = 1.655ms

So:

800 x 625µs = 0.5 seconds
400 x 405µs = 0.162 seconds

Thus: 0.5 + 0.162 = 0.662 seconds

$\therefore$ $\frac{\text{Total Tx Time On}}{\text{No Of Channels}} = \frac{0.662}{80} = 8.275\text{ms}$

So, in 32 seconds, the transmitter dwell time per channel is:

32 x 8.275ms = 0.2648 seconds

DH5

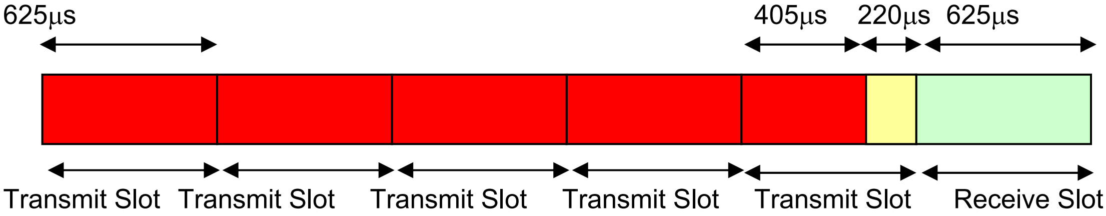
With data rate DH5, the data payload is higher and can use up to 5 timeslots. When more than one timeslot is used, the frequency does not hop and transmission is continuous on all 5 slots, (ie. no receive slot in-between the 5 transmit slots). The 220µs off time for synthesizer re-tuning at the end of a slot is only used on the final slot. Thus, for one cycle, there are 5 transmit timeslots. 4 are 625µs long and the final slot is transmitting for 405µs.

The DH5 data rate operates on a Transmit on 5 timeslots and Receives on 1 timeslot basis, (assuming maximum data payload). The frequency-hopping rate is the same. Thus, in 1 second, there are 1333.3 Transmit timeslots and 266.7 Receive timeslots.

Thus:

$$1 \text{ Timeslot} = \frac{1}{1600} = 625\mu s$$

The first 4 Transmit timeslots are transmitting for the complete 625µs. In the fifth transmit slot, the transmit on time is only 405µs. 220µs is reserved as off time for the synthesizer to re-tune ready for the next transmit frequency. The following timeslot is a receive slot. This process continues assuming the data rate remains the same.



<u>DH5 Timeslot Arrangement Showing One Complete Transmit and Receive Cycle, (Maximum Payload)</u>

Thus, the transmitter for one complete transmit and receive cycle would be on for:

Tx (2 x 625µs) + (1 x 405µs) = 2.905ms

So:

1066.7 x 625µs = 0.666 seconds
266.7 x 405µs = 0.108 seconds

Thus: 0.666 + 0.108 = 0.774 seconds

$$\therefore \quad \frac{\text{Total Tx Time On}}{\text{No Of Channels}} = \frac{0.774}{80} = 9.675\text{ms}$$

So, in 32 seconds, the transmitter dwell time per channel is:

32 x 9.675ms = 0.31 seconds

2.3.6 Environmental Conditions

Ambient Temperature	22.6°C
Relative Humidity	43.0%

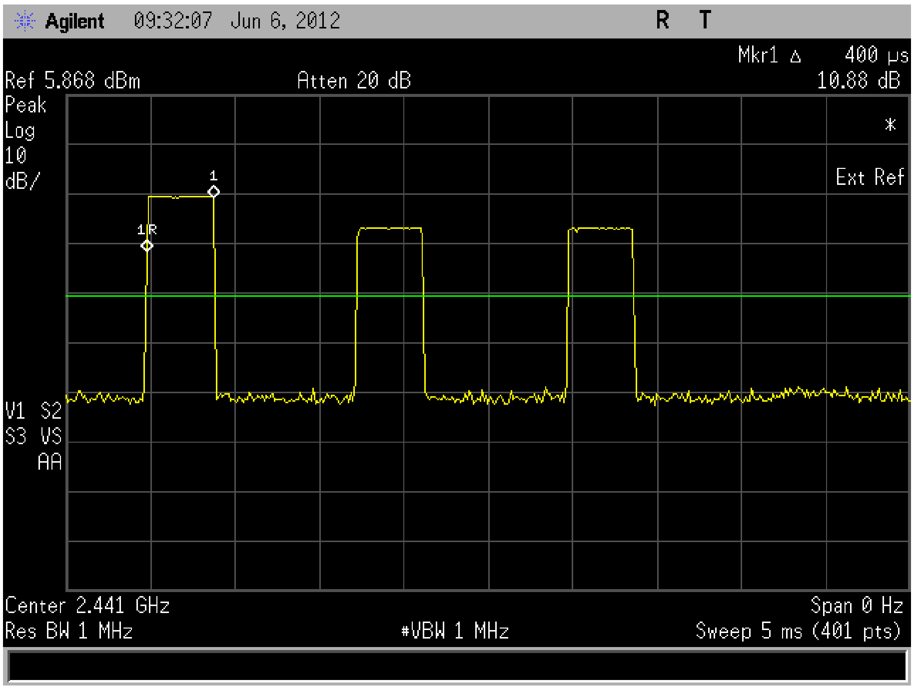
2.3.7 Test Results

4.0 V DC Supply

<u>Channel Dwell Time</u>

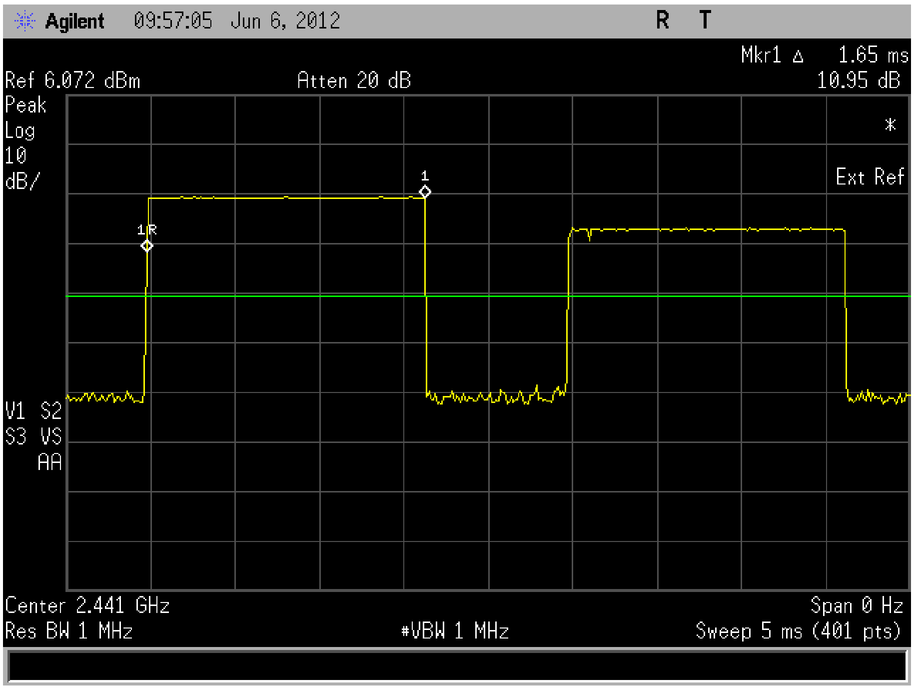
<u>DH1</u>

0.4 ms



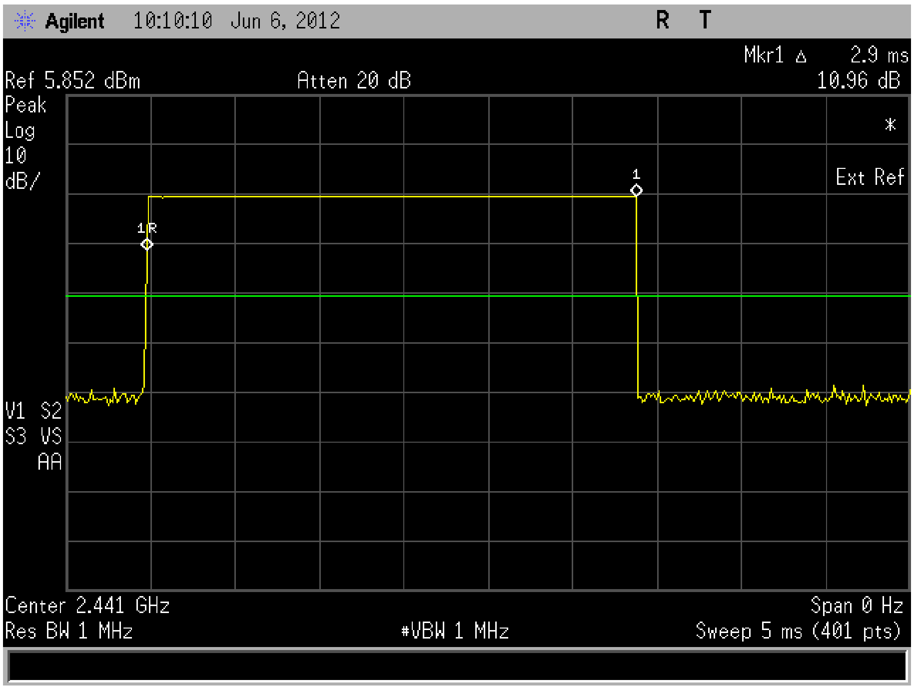
<u>DH3</u>

0.4 ms



<u>DH5</u>

2.9 ms

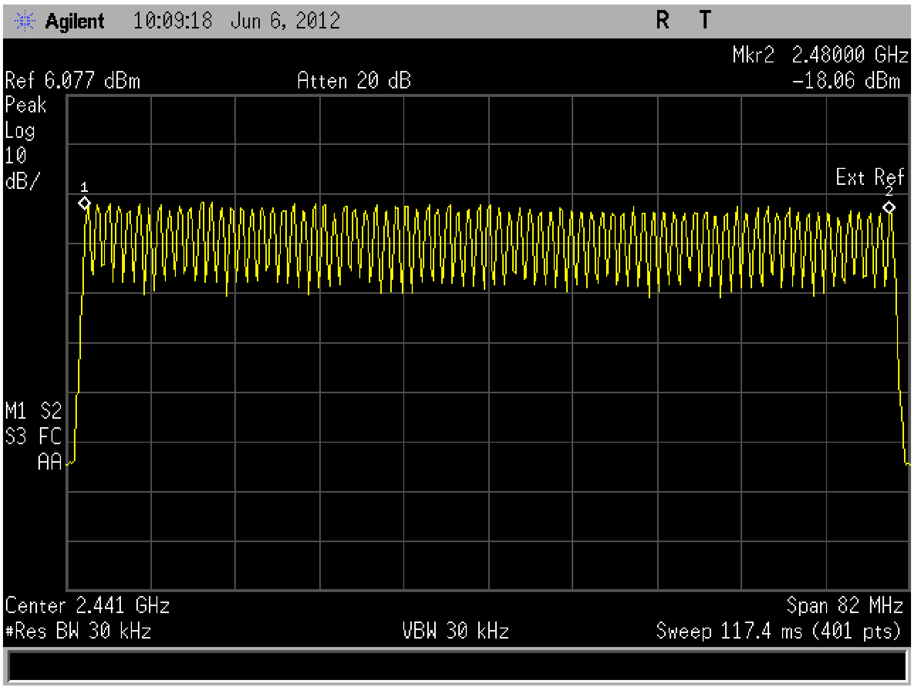


Limit

Frequency hopping systems operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

Number of Hopping Channels

79



Limit

≥ 15 channels

Product Service

2.4 MAXIMUM PEAK CONDUCTED OUTPUT POWER

2.4.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (b)(3)

2.4.2 Equipment Under Test and Modification State

CDMA SHI16 S/N: IMEI 004401113852590 - Modification State 0

2.4.3 Date of Test

6 June 2012

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Procedure

The EUT was transmitted at maximum power via a cable to the Peak Power Analyser. The Analyser settings were adjusted to display the resultant trace on screen and a reference level offset was entered to account for the measurement path loss. The measurement bandwidth was set according to the signal being measured and the peak and average levels were recorded.

2.4.6 Environmental Conditions

Ambient Temperature	22.6°C
Relative Humidity	43.0%

Product Service

2.4.7 Test Results

4.0 V DC Supply

Packet Type	Maximum Peak Conducted Output Power					
	dBm			mW		
	2402 MHz	2441 MHz	2480 MHz	2402 MHz	2441 MHz	2480 MHz
DH1	2.94	2.65	2.51	1.968	1.841	1.782
DH3	0.98	0.71	0.86	1.253	1.178	1.219
DH5 (worst)	0.94	0.67	0.61	1.242	1.167	1.151

Limit Clause

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non overlapping hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

Product Service

2.5 EIRP PEAK POWER

2.5.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (b)(4)

2.5.2 Equipment Under Test and Modification State

CDMA SHI16 S/N: IMEI 004401113851519 - Modification State 0

2.5.3 Date of Test

10 June 2012

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Procedure

The EUT was transmitted at maximum power via a cable to the Spectrum Analyser. The Analyser settings were adjusted to display the resultant trace on screen and a resolution bandwidth and video bandwidth of 1 MHz were used to perform the measurement. The level on the spectrum analyser was maximised by rotating the EUT 360° and a height search of the measuring antenna. A substitution was then performed using a substitution antenna and signal generator.

This level was maximised by adjusting the height of the measuring antenna once more. The level from the signal generator was then adjusted to achieve the same raw result as with the EUT. This level was then corrected to account for cable loss and antenna factor. If applicable, a peak power analyser was also used to obtain a correction factor for wideband signals such as WLAN.

A calculation was then performed to obtain the final figure.

2.5.6 Environmental Conditions

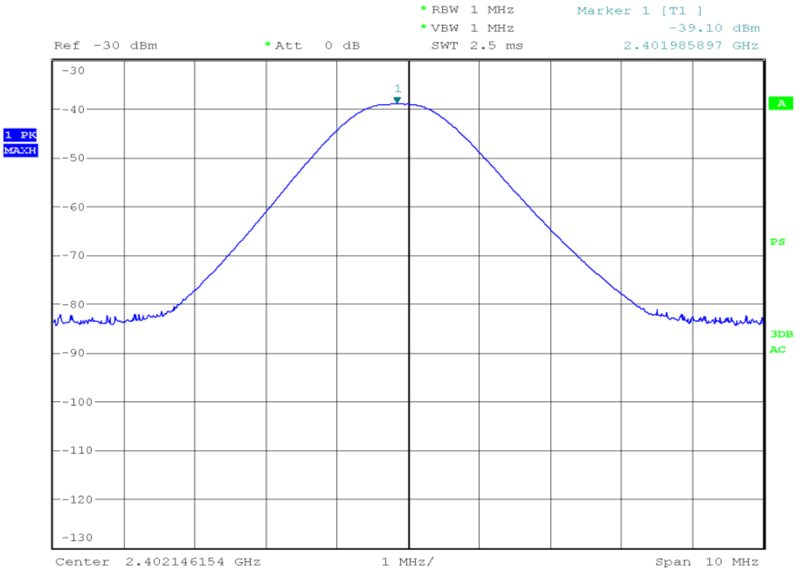
Ambient Temperature	21.5°C
Relative Humidity	43.0%

Product Service

2.5.7 Test Results

2402 MHz

EIRP (dBm)	EIRP (mW)
1.52	1.42

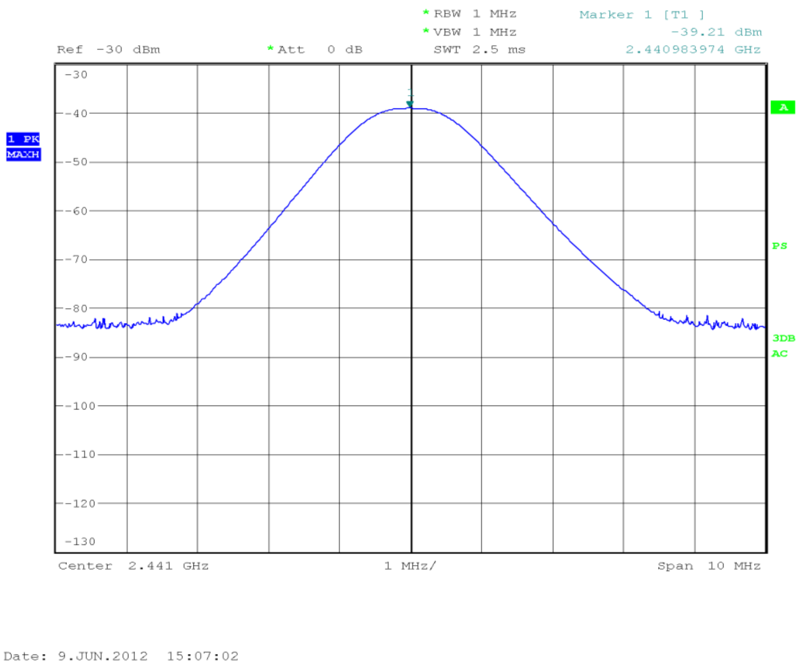


Date: 9.JUN.2012 14:26:49

Product Service

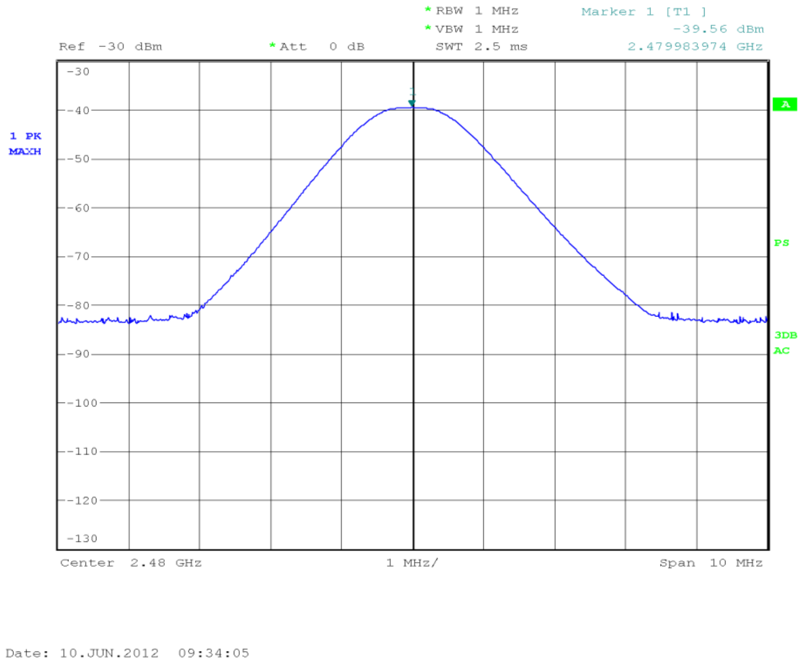
2441 MHz

EIRP (dBm)	EIRP (mW)
1.50	1.41



2480 MHz

EIRP (dBm)	EIRP (mW)
0.86	1.22



Limit

EIRP (dBm)	EIRP (mW)
36.0	4000

2.6 SPURIOUS AND BAND EDGE EMISSIONS

2.6.1 Specification Reference

FCC CFR 47 Part 15C, Clause 15.247 (d)

2.6.2 Equipment Under Test and Modification State

CDMA SHI16 S/N: IMEI 004401113851519 - Modification State 0

2.6.3 Date of Test

6 June 2012, 10 June 2012 & 11 June 2012

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Procedure

For conducted emissions, the EUT was set to operate at maximum power on the worst case data rate. The test was performed on the bottom, middle and top channels. The test was performed from 9 kHz to 25 GHz. Firstly, the power of each fundamental frequency was measured in 100 kHz bandwidth and this was used to shown a -20 dBc limit line on the trace. The measurement path loss in each relevant frequency band was measured and entered a s a reference level offset.

For radiated emissions, the test method described above was also used. However, the measurement was performed from 30 MHz to 25 GHz and the path loss is incorporated as a transducer factor and entered into the spectrum analyser.

The band edge measurements were performed in accordance with ANSI C63.10, Clause 6.9.3. The results were analysed to ensure compliance with restricted bands. The EUT was set to the lowest and highest operating frequencies.

2.6.6 Environmental Conditions

Ambient Temperature	20.1 - 22.6°C
Relative Humidity	43.0 - 48.0%

2.6.7 Test Results

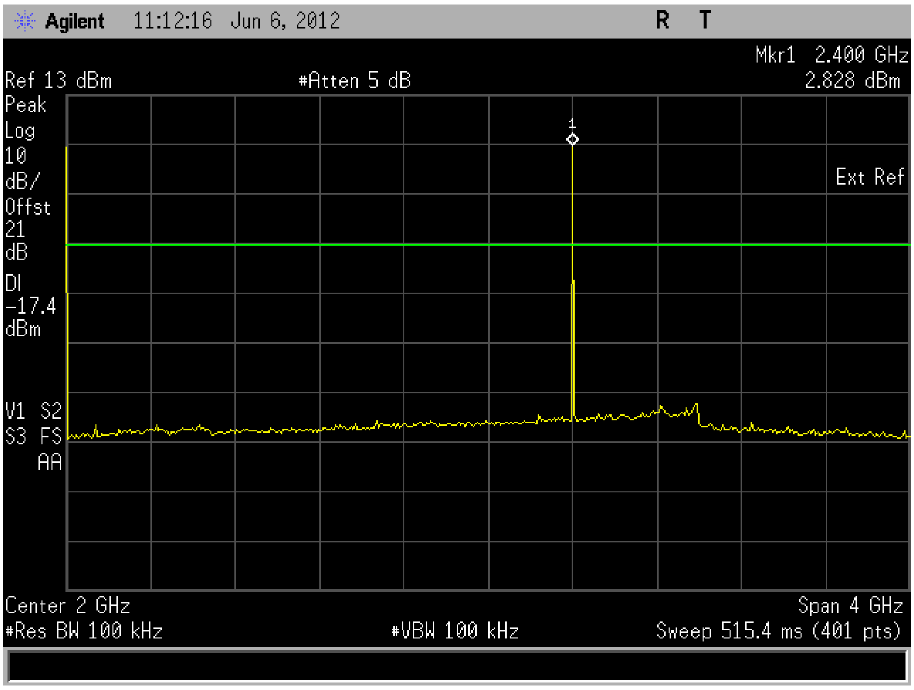
4.0 V DC Supply

Spurious Conducted Emissions

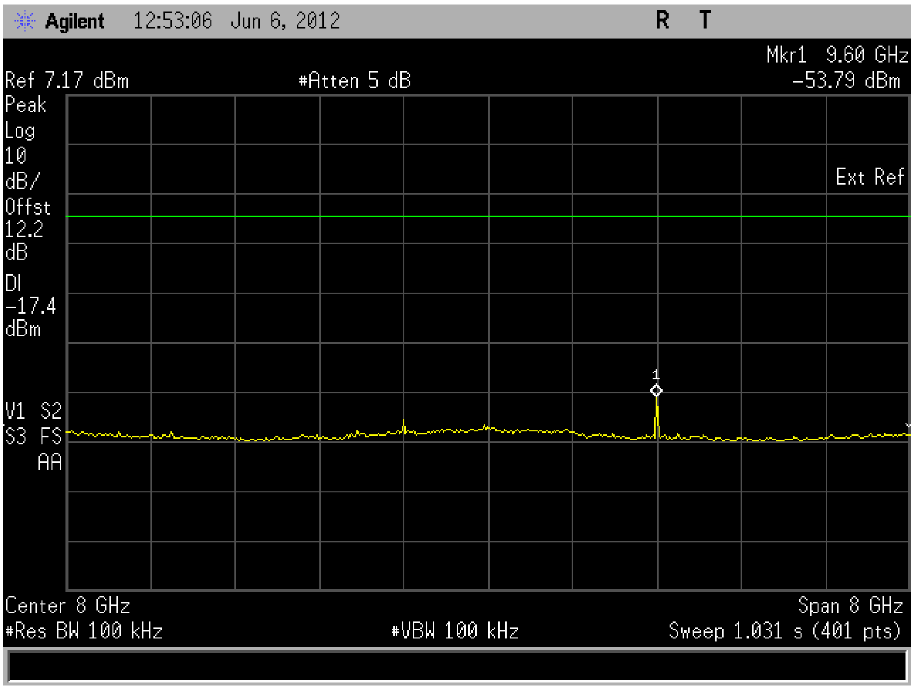
DH5

2402 MHz

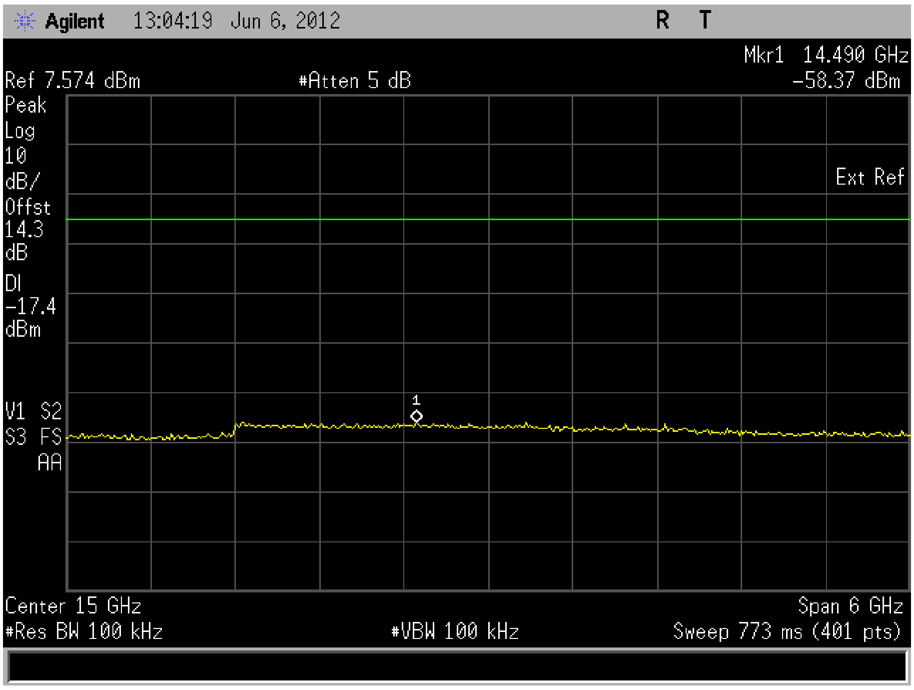
9 kHz to 4 GHz



4 GHz to 12 GHz

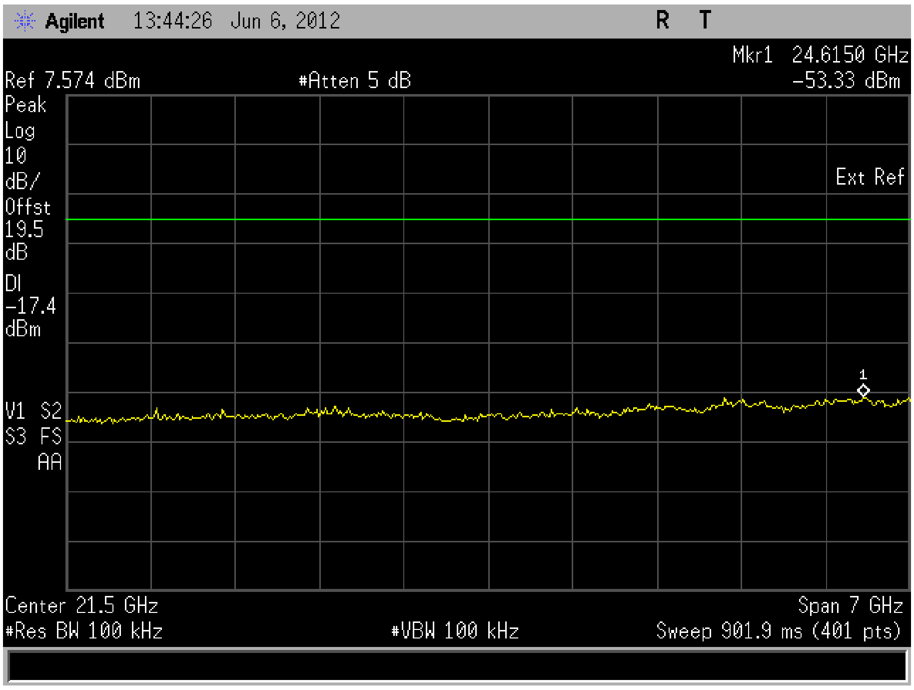


12 GHz to 18 GHz



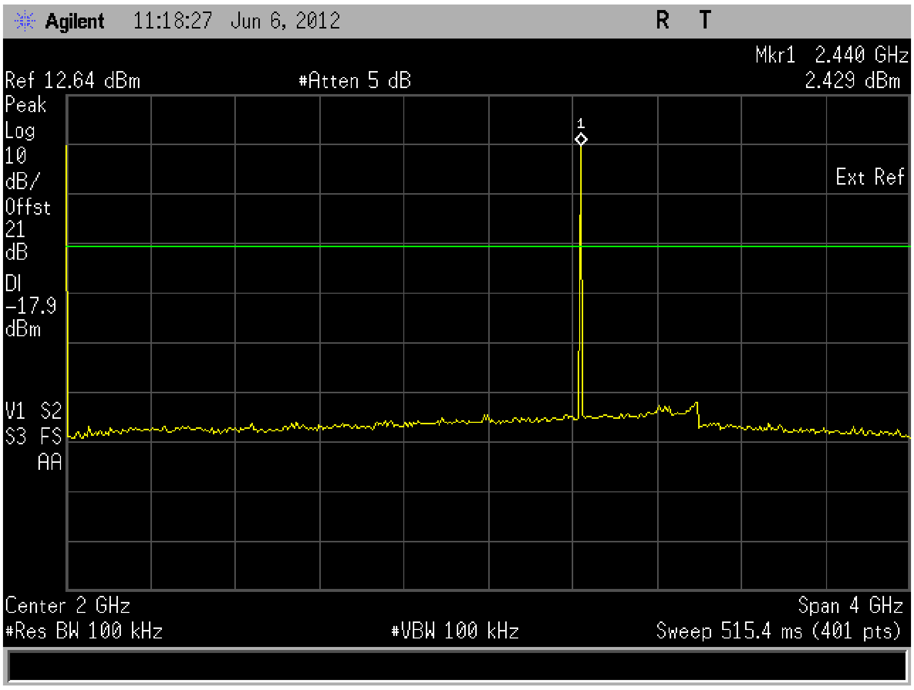
Product Service

18 GHz to 25 GHz



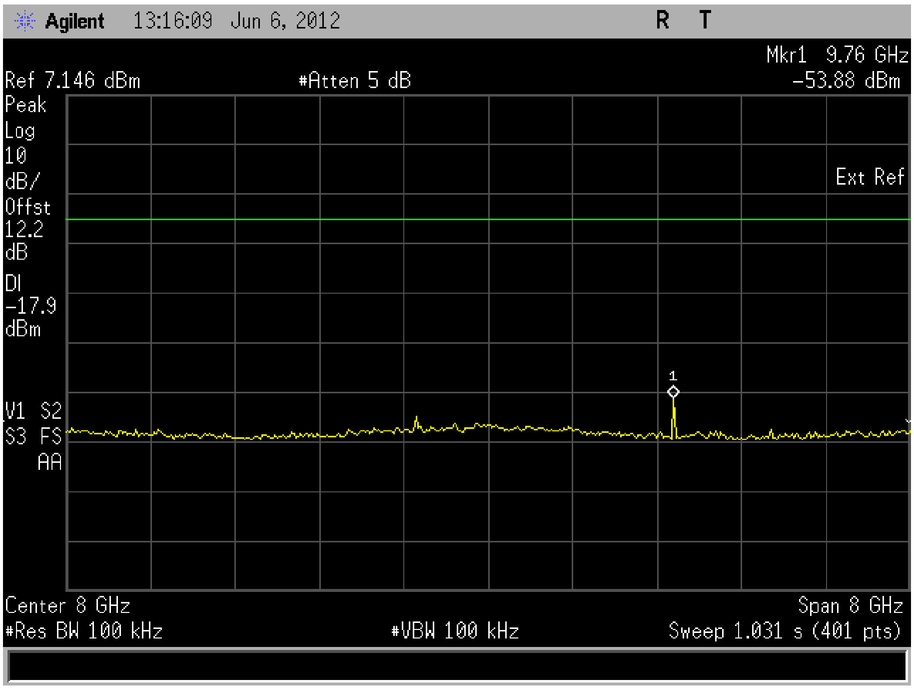
2441 MHz

9 kHz to 4 GHz

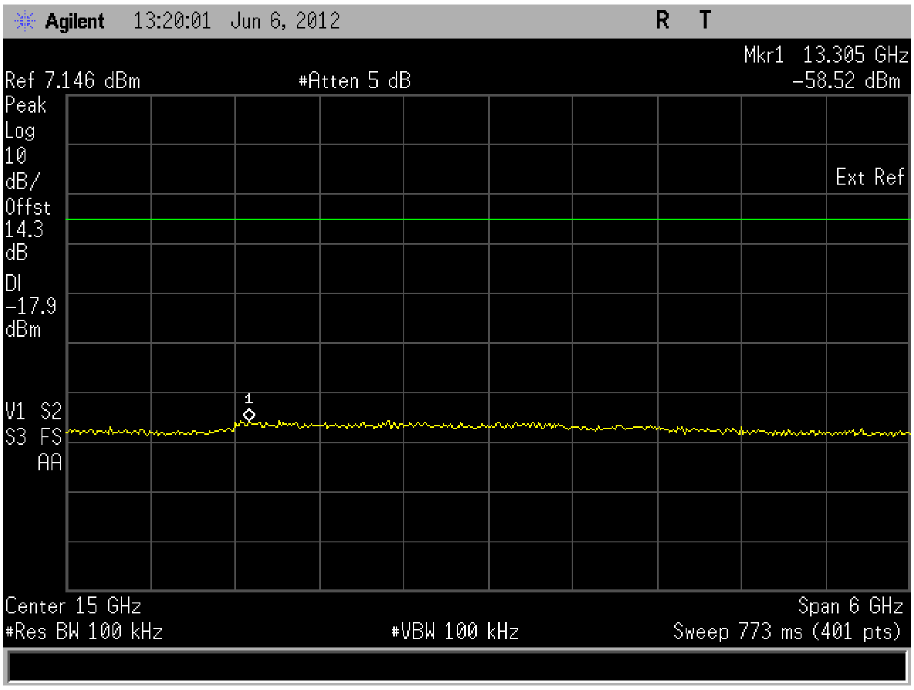


Product Service

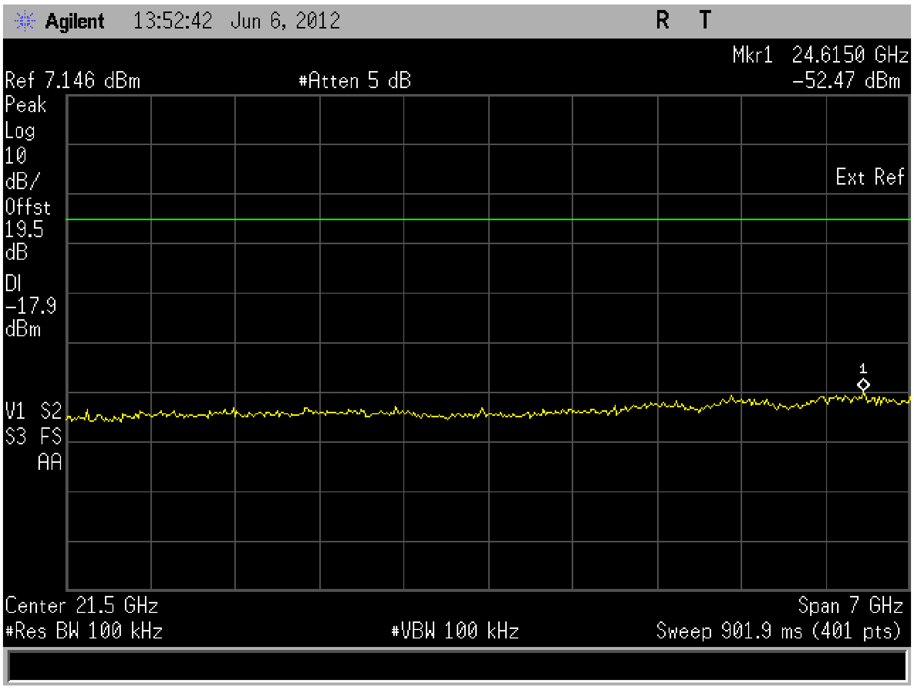
4 GHz to 12 GHz



12 GHz to 18 GHz

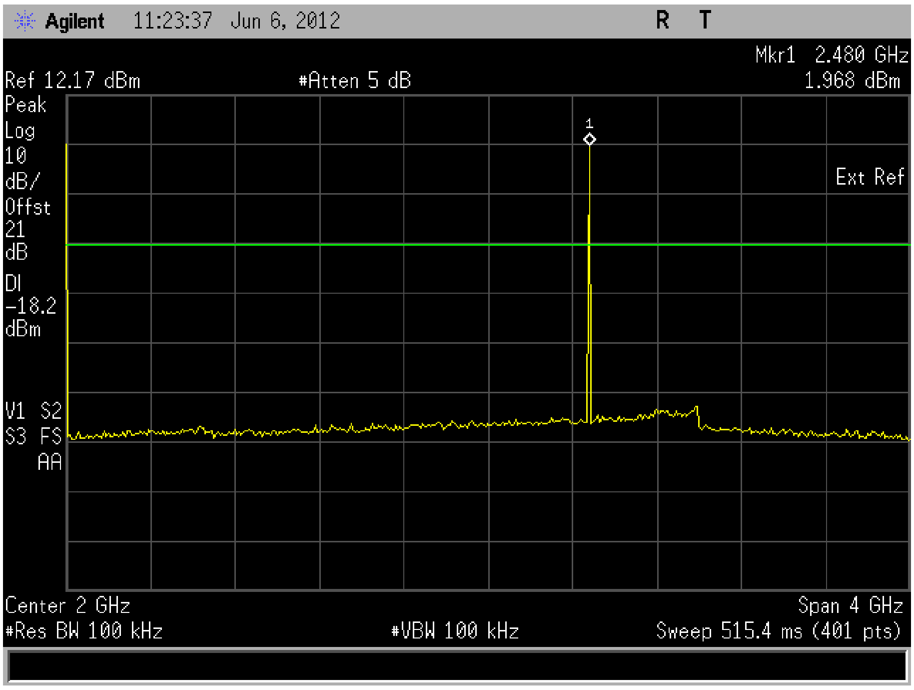


18 GHz to 25 GHz

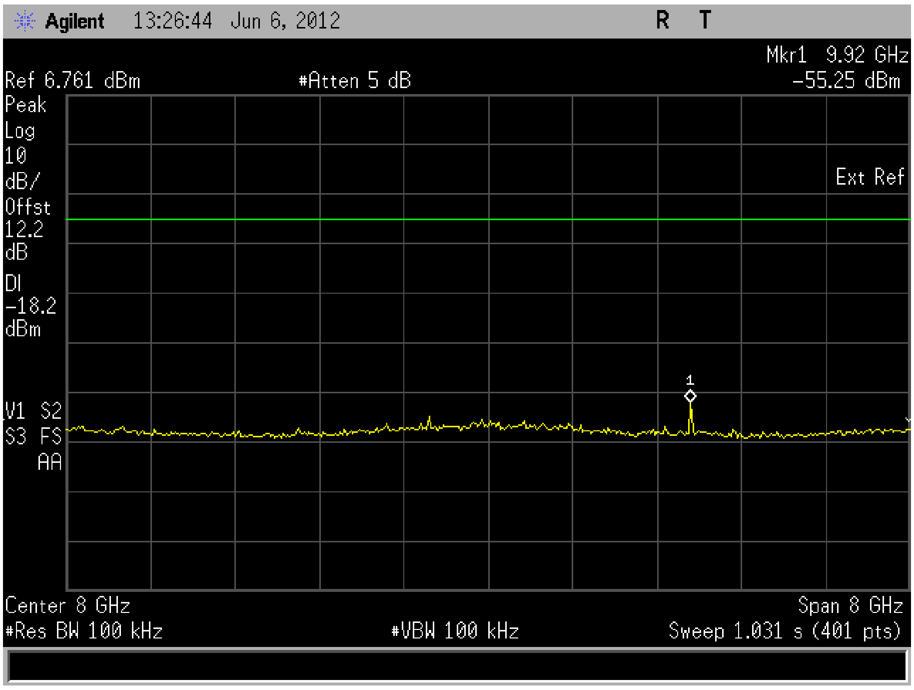


2480 MHz

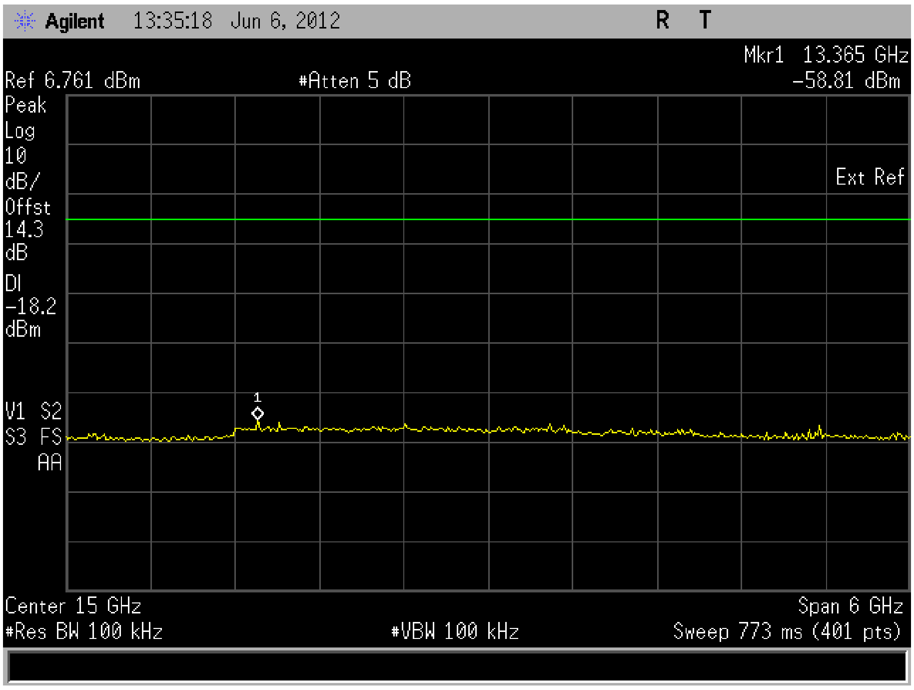
9 kHz to 4 GHz



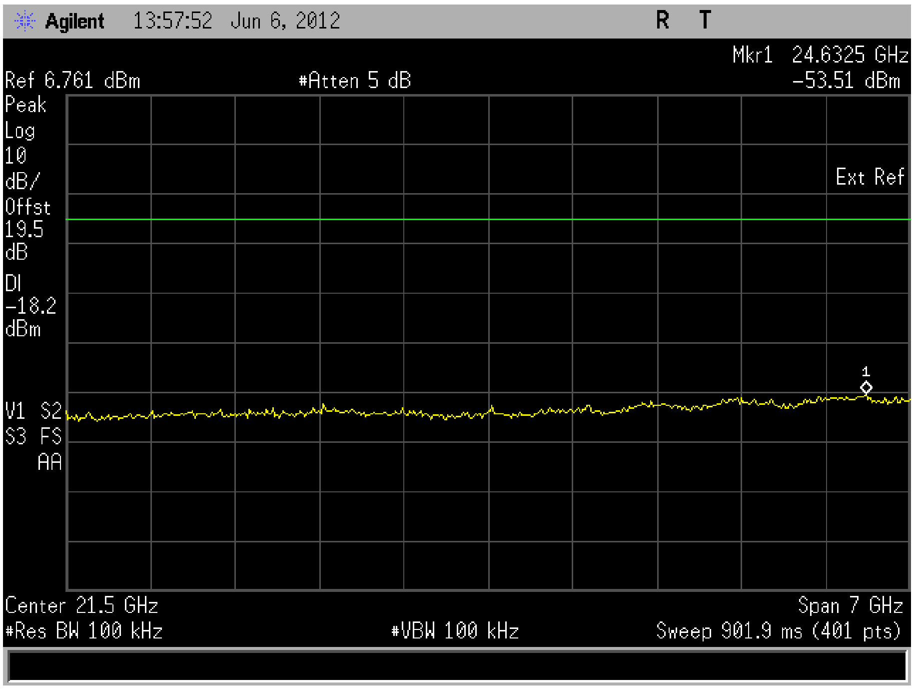
4 GHz to 12 GHz



12 GHz to 18 GHz



18 GHz to 25 GHz



Limit Clause

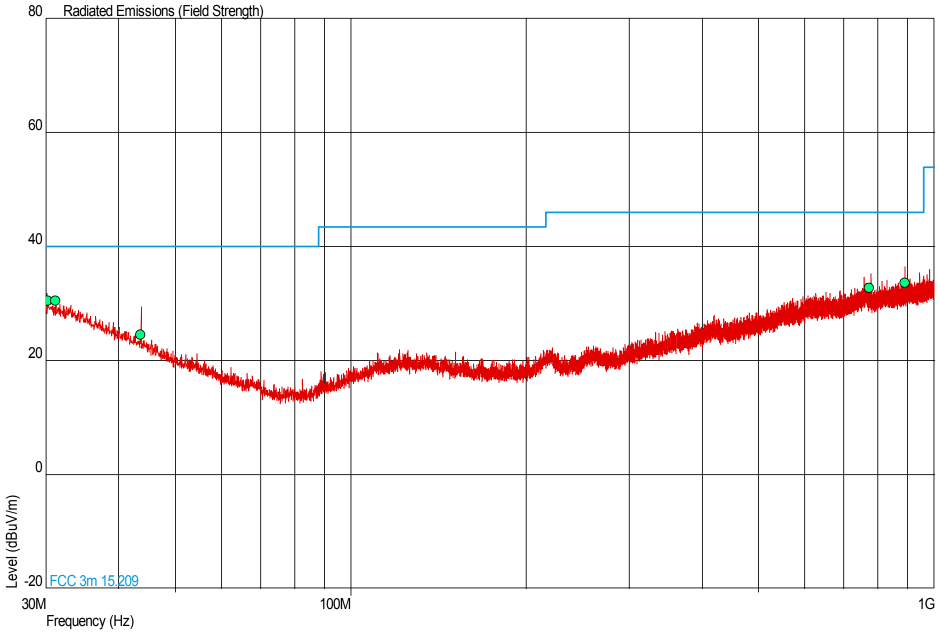
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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 the attenuation required shall be 30 dB instead of 20 dB.

Spurious Radiated Emissions

2402 MHz

30 MHz to 1 GHz



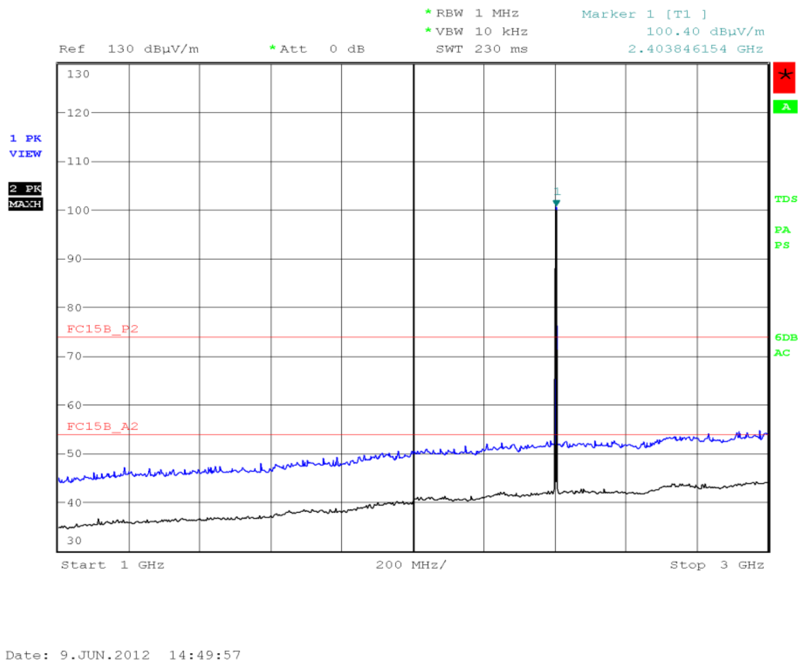
Frequency (MHz)	QP Level (dBμV/m)	QP Level (μV/m)	QP Limit (dBμV/m)	QP Limit (μV/m)	QP Margin (dBμV/m)	QP Margin (μV/m)	Angle (Deg)	Height (m)	Polarity
30.146	30.5	33.5	40.0	100	-9.5	66.5	0	1.00	Vertical
30.243	30.5	33.5	40.0	100	-9.5	66.5	90	1.00	Vertical
31.213	30.6	33.9	40.0	100	-9.4	66.1	0	1.00	Vertical
43.700	24.5	16.8	40.0	100	-15.5	83.2	0	1.00	Vertical
772.826	32.7	43.2	46.0	200	-13.3	156.8	0	1.00	Horizontal
889.517	33.6	47.9	46.0	200	-12.4	152.1	90	1.00	Horizontal

Product Service

1GHz to 25GHz

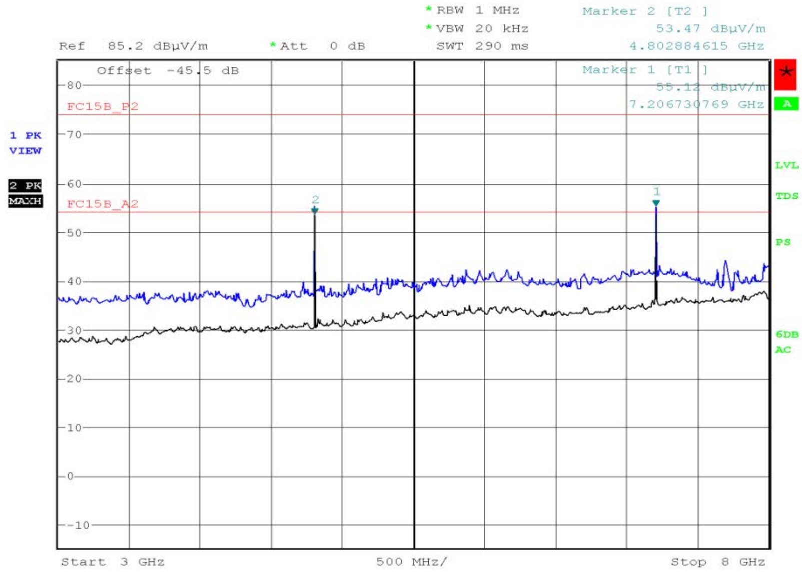
Frequency (GHz)	Antenna Polarisation	Antenna Height (cm)	EUT Arc (degrees)	Final Peak (dBµV/m)	Final Average (dBµV/m)
4.802	Vertical	122	265	58.63	53.86

1 GHz to 3 GHz



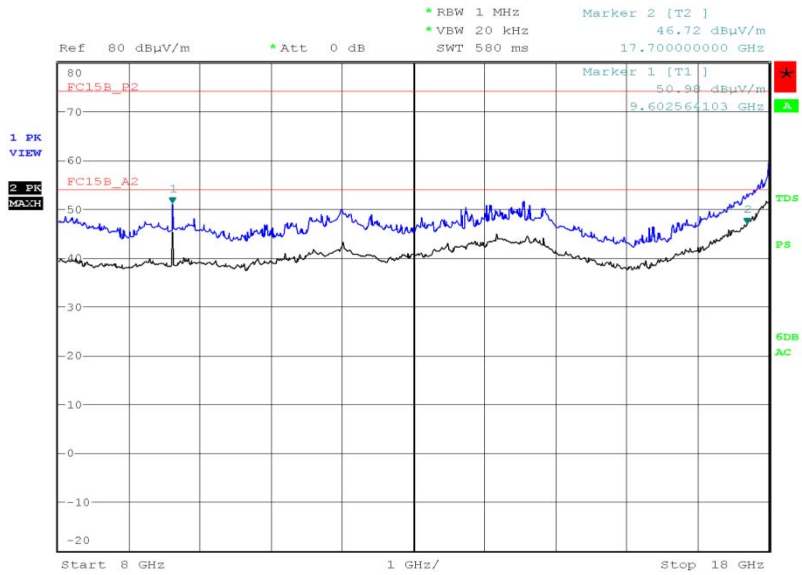
Product Service

3 GHz to 8 GHz



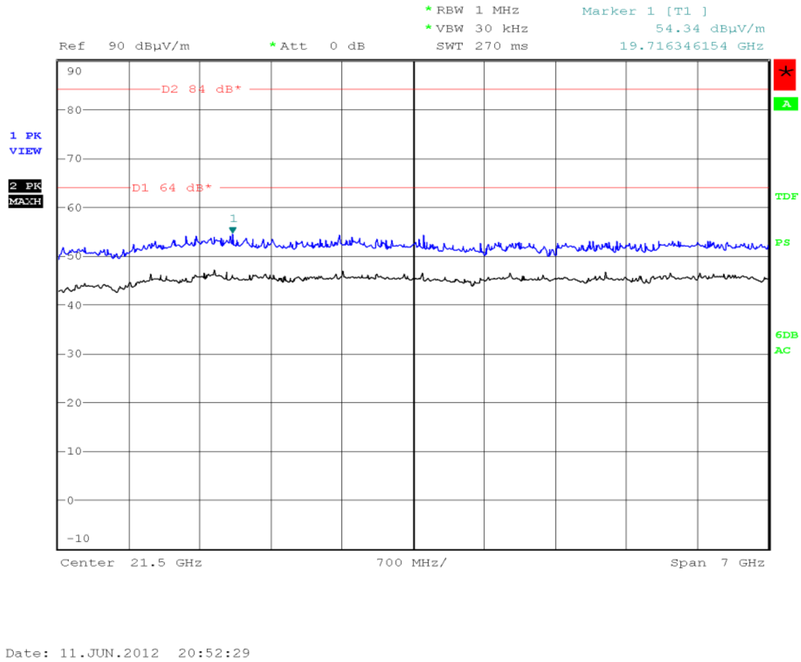
Date: 10.JUN.2012 06:55:42

8 GHz to 18 GHz



Date: 10.JUN.2012 15:29:05

18 GHz to 25 GHz



Limit

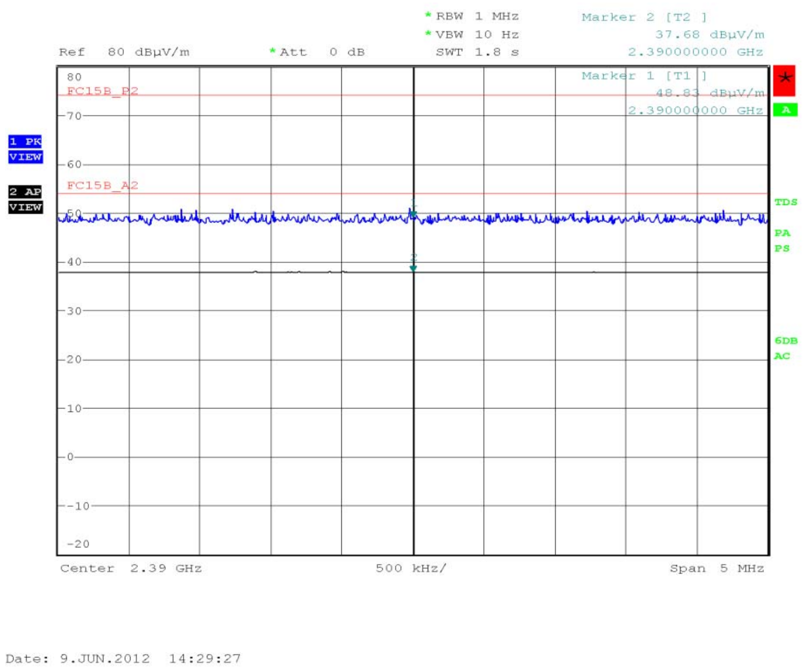
Peak (dBµV/m)	Average (dBµV/m)
74.0	54.0

Product Service

Band Edge Emissions

2402 MHz

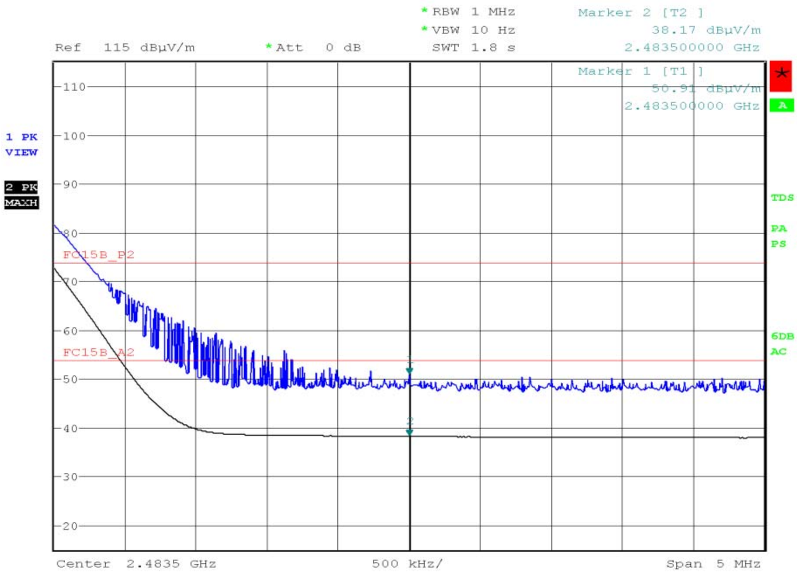
Polarisation	Final Peak (dBµV/m)	Final Average (dBµV/m)
Horizontal	48.83	37.68



Product Service

2480 MHz

Polarisation	Final Peak (dBμV/m)	Final Average (dBμV/m)
Horizontal	50.91	38.17



Date: 9.JUN.2012 15:48:21

Limit

Peak (dBμV/m)	Average (dBμV/m)
74.0	54.0

Product Service

SECTION 3

TEST EQUIPMENT USED

Product Service

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1– AC Line Conducted Emissions					
Transient Limiter	Hewlett Packard	11947A	15	12	1-Dec-2012
LISN (1 Phase)	Chase	MN 2050	336	12	23-Mar-2013
Transient Limiter	Hewlett Packard	11947A	1032	12	22-Jun-2012
Screened Room (5)	Rainford	Rainford	1545	36	3-Feb-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	29-Sep-2012
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
Section 2.2 - Frequency Hopping Systems - 20dB Bandwidth and Channel Separation					
Dual programable power supply	Thurlby	T-1000	418	-	TU
Power Divider	Weinschel	1506A	604	12	19-Mar-2013
Power Splitter	Weinschel	1506A	606	12	19-Dec-2012
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	28-Jun-2012
GPS Frequency Standard	Rapco	GPS-804/3	1312	12	13-Sep-2012
Hygromer	Rotronic	A1	2677	12	7-Feb-2013
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	18-Nov-2012
Thermocouple Thermometer	Fluke	51	3174	12	6-Sep-2012
Vector Signal Generator	Rohde & Schwarz	SMU 200A	3493	12	20-Sep-2012
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3696	12	27-Jan-2013
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	24-Jun-2012
True RMS Multimeter	Fluke	179	4007	12	16-Feb-2013
Section 2.3 - Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels					
Dual programable power supply	Thurlby	T-1000	418	-	TU
Power Splitter	Weinschel	1506A	606	12	19-Dec-2012
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	28-Jun-2012
GPS Frequency Standard	Rapco	GPS-804/3	1312	12	13-Sep-2012
Hygromer	Rotronic	A1	2677	12	7-Feb-2013
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3696	12	27-Jan-2013
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	24-Jun-2012
True RMS Multimeter	Fluke	179	4007	12	16-Feb-2013
Section 2.4 - Maximum Peak Conducted Output Power					
Dual programable power supply	Thurlby	T-1000	418	-	TU
Power Splitter	Weinschel	1506A	606	12	19-Dec-2012
GPS Frequency Standard	Rapco	GPS-804/3	1312	12	13-Sep-2012
Hygromer	Rotronic	A1	2677	12	7-Feb-2013
Power Meter	Rohde & Schwarz	NRP	3491	12	19-Apr-2013
Wideband Power Sensor, 50MHz - 18GHz	Rohde & Schwarz	NRP-Z81	3492	12	19-Apr-2013
Vector Signal Generator	Rohde & Schwarz	SMU 200A	3493	12	20-Sep-2012
'3.5mm' - '3.5mm' RF Cable (1m)	Rhophase	3PS-1803-1000-3PS	3696	12	27-Jan-2013
DC - 12.4 GHz 10 dB Attenuator	Suhner	6810.17.A	3965	12	24-Jun-2012
P-Series Power Meter	Agilent	N1911A	3981	12	12-Sep-2012
50 MHz-18 GHz Wideband Power Sensor	Agilent	N1921A	3983	12	12-Sep-2012
True RMS Multimeter	Fluke	179	4007	12	16-Feb-2013

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.5 – EIRP Peak Power					
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	9-Dec-2012
Peak Power Analyser	Hewlett Packard	8990A	107	12	10-Feb-2013
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	8-Dec-2012
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	14-Nov-2012
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	29-Jul-2012
Test Receiver	Rohde & Schwarz	ESIB40	1006	12	23-Feb-2013
Screened Room (5)	Rainford	Rainford	1545	36	3-Feb-2014
Mast Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Power Sensor	Hewlett Packard	84812A	2743	-	TU
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	24-May-2013
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	22-Aug-2012
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	20-Dec-2012
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	29-Sep-2012
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3702	12	27-Jan-2013
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3703	-	TU
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	26-Aug-2012
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Section 2.6 – Spurious and Band Edge Emissions					
Radiocommunications Tester	Rohde & Schwarz	CMU 200	39	12	9-Dec-2012
Antenna (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	13-Sep-2013
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	8-Dec-2012
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	235	12	14-Nov-2012
Attenuator 20dB 5W	Marconi	56534-904H	377	12	8-May-2013
Dual programable power supply	Thurlby	T-1000	418	-	TU
Multimeter	Iso-tech	IDM-101	466	12	5-Mar-2013
Attenuator (10dB)	Weinschel	47-10-34	481	12	27-Mar-2013
Broadband Resistive Power Divider	Weinschel	1506A	601	12	2-Dec-2012
Power Splitter	Weinschel	1506A	606	12	19-Dec-2012
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	29-Jul-2012
Spectrum Analyser	Hewlett Packard	E4407B	1154	12	28-Jun-2012
GPS Frequency Standard	Rapco	GPS-804/3	1312	12	13-Sep-2012
Antenna (Double Ridge Guide)	Q-Par Angus Ltd	QSH 180K	1511	24	2-Aug-2012
Pre-Amplifier	Phase One	PS04-0086	1533	12	20-Sep-2012
Pre-Amplifier	Phase One	PSO4-0087	1534	12	26-Sep-2012
Screened Room (5)	Rainford	Rainford	1545	36	3-Feb-2014
Mast Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	I 1000	2451	6	TU
Hygromer	Rotronic	A1	2677	12	7-Feb-2013
High Pass Filter (4GHz)	RLC Electronics	F-100-4000-5-R	2773	12	20-Sep-2012
Filter	Daden Anthony Ass	MH-1500-7SS	2778	12	21-Dec-2012
Antenna (Bilog)	Chase	CBL6143	2904	24	12-May-2013
Attenuator (20dB, 20W)	Weinschel	1	3032	12	TU
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	3171	12	22-Aug-2012

Product Service

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.6 – Spurious and Band Edge Emissions					
High Pass Filter (3GHz)	RLC Electronics	F-100-3000-5-R	3349	12	27-May-2012
Power Supply	Farnell	ET30/2	3423	-	TU
Signal Generator: 10MHz to 20GHz	Rohde & Schwarz	SMR20	3475	12	20-Dec-2012
Charge Amplifier	Endevco	133	3478	12	15-Jul-2012
Power Meter	Rohde & Schwarz	NRP	3491	12	19-Apr-2013
Wideband Power Sensor, 50MHz - 18GHz	Rohde & Schwarz	NRP-Z81	3492	12	19-Apr-2013
Vector Signal Generator	Rohde & Schwarz	SMU 200A	3493	12	20-Sep-2012
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	29-Sep-2012
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	13-Mar-2013
3 GHz High Pass Filter	K&L Microwave	11SH10-3000/X18000-O/O	3552	12	16-Apr-2013
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
DC - 8 GHz Attenuator	Lucas Weinschel	24-30-33	3963	12	24-Jun-2012
'2.92mm' - '2.92mm' RF Cable (2m)	Rhophase	KPS-1503-2000-KPS	3694	12	TU
'2.92mm' - '2.92mm' RF Cable (2m)	Rhophase	KPS-1503-2000-KPS	3695	12	TU
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	12-Jan-2013
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3701	12	12-Jan-2013
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3702	12	27-Jan-2013
'3.5mm' - '3.5mm' RF Cable (2m)	Rhophase	3PS-1803-2000-3PS	3703	-	TU
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	12	26-Aug-2012
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU
Low Noise Amplifier	Wright Technologies	APS04-0085	3969	12	8-Jul-2012
True RMS Multimeter	Fluke	179	4007	12	16-Feb-2013

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

Product Service

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	MU
Frequency Hopping Systems - Channel Dwell Time and Number of Hopping Channels	-
Frequency Hopping Systems - 20dB Bandwidth and Channel Separation	± 16.74 kHz
EIRP Peak Power	30MHz to 1GHz: ± 5.1 dB 1GHz to 40GHz: ± 6.3 dB
Maximum Peak Conducted Output Power	± 0.70 dB
Spurious and Band Edge Emissions	30MHz to 1GHz: ± 5.1 dB 1GHz to 40GHz: ± 6.3 dB
AC Line Conducted Emissions	± 3.2 dB

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

Product Service

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

UKAS
TESTING
0141

This report relates only to the actual item/items tested.

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).