

## TEST REPORT

Test Report No.: 1-2403-01-09/10



### Testing Laboratory

**CETECOM ICT Services GmbH**

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**Accredited Test Laboratory:**

The test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025  
DAR registration number: DGA-PL-176/94-D1

Area of Testing: Radio Satellite Communications

### Applicant

**Sagem Wireless**

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95801 Cergy Pontoise Cedex/France  
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Phone: +86 574 27960929

**Manufacturer**

**Sagem Wireless**  
2 rue du Petit Albi  
95801 Cergy Pontoise Cedex/France

### Test Standard/s

47 CFR Part 15

Title 47 of the Code of Federal Regulations; Chapter I-Federal Communications Commission  
subchapter A - general, Part 15-Radio frequency devices

For further applied test standards please refer to section 3 of this test report.

### Test Item

Kind of test item: GSM Mobile Phone  
Model name: Cosy 2G  
FCC ID: M9HCOSY2G  
IC: -/-  
Frequency [MHz]: 2402 MHz to 2480 MHz (2.4 GHz ISM Band)  
Power supply: 3.9V DC from power supply / battery + charger  
Temperature range: -20 °C to +55 °C



**Test performed:**

**Test Report authorised:**

2010-07-29 Daniel Muyunga

2010-07-29 Michael Berg

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## 2 General Information

### 2.1 Notes

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM ICT Services GmbH.

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### 2.2 Application details

Date of receipt of order:	2010-06-24
Date of receipt of test item:	2010-06-24
Start of test:	2010-07-05
End of test:	2010-07-28
Person(s) present during the test:	-/-

## 3 Test standard/s

Test Standard	Version	Test Standard Description
47 CFR Part 15	2009-10	Title 47 of the Code of Federal Regulations; Chapter I-Federal Communications Commission subchapter A - general, Part 15-Radio frequency devices

## 4 Test Environment

Temperature:	$T_{nom}$	+20 °C during room temperature tests
	$T_{max}$	+55 °C during high temperature test
	$T_{min}$	-20 °C during low temperature test
Relative humidity content:		49 %
Air pressure:		not relevant for this kind of testing
Power supply:	$V_{nom}$	3.9 V DC from power supply / battery + charger
	$V_{max}$	4.2 V DC from power supply
	$V_{min}$	3.5 V DC from power supply

**5 Test item**

Kind of test item	:	GSM Mobile Phone
Type identification	:	Cosy 2G
S/N serial number	:	Rad. IMEI: 352330040008174 Cond. IMEI: 352330040008257
HW hardware status	:	V0x
SW software status	:	EA, R07
Frequency Band [MHz]	:	2402 MHz to 2480 MHz
Type of Modulation	:	GFSK, Pi/4 DQPSK and 8 DPSK
Number of channels	:	79
Antenna	:	Internal antenna
Power Supply	:	3.9 V DC from power supply / battery + charger
Temperature Range	:	-20°C to +55 °C

**6 Test Laboratories sub-contracted**

None

## 7 Summary of measurement results



No deviations from the technical specifications were ascertained



There were deviations from the technical specifications ascertained

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	CFR Part 15	Passed	2010-07-29	-/-

Test Specification Clause	Test Case	Temperature Conditions	Power Source Voltages	Mode	Pass	Fail	NA	NP	Results (max.)
§15.247(b)(4)	Antenna Gain	Nominal	Nominal	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(e)	Power spectral density	Nominal	Nominal	GFSK Pi/4 DQPSK 8 DPSK	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
§15.247(a)(1)	Carrier frequency separation	Nominal	Nominal	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(a)(1)	Number of hopping channels	Nominal	Nominal	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(a)(1) (iii)	Time of occupancy (dwell time)	Nominal	Nominal	GFSK Pi/4 DQPSK 8 DPSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.247(a)(1)	Spectrum bandwidth of a FHSS system 20dB bandwidth	Nominal	Nominal	GFSK Pi/4 DQPSK 8 DPSK	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
§15.247(b)(1)	Maximum output power	Nominal	Nominal	GFSK Pi/4 DQPSK 8 DPSK	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
§15.247(d)	Band edge compliance conducted	Nominal	Nominal	GFSK Pi/4 DQPSK 8 DPSK	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	complies
§15.205	Band edge compliance radiated	Nominal	Nominal	GFSK Pi/4 DQPSK 8 DPSK	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	complies
§15.247(d)	TX spurious emissions conducted	Nominal	Nominal	GFSK Pi/4 DQPSK 8 DPSK	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	complies
§15.247(d)	TX spurious emissions radiated	Nominal	Nominal	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.109	RX spurious emissions radiated	Nominal	Nominal	-/-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.209(a)	TX spurious emissions radiated < 30 MHz	Nominal	Nominal	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies
§15.107(a)	Conducted emissions < 30 MHz	Nominal	Nominal	GFSK	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	complies

**Note:** NA = Not Applicable; NP = Not Performed

## 8 RF measurement testing

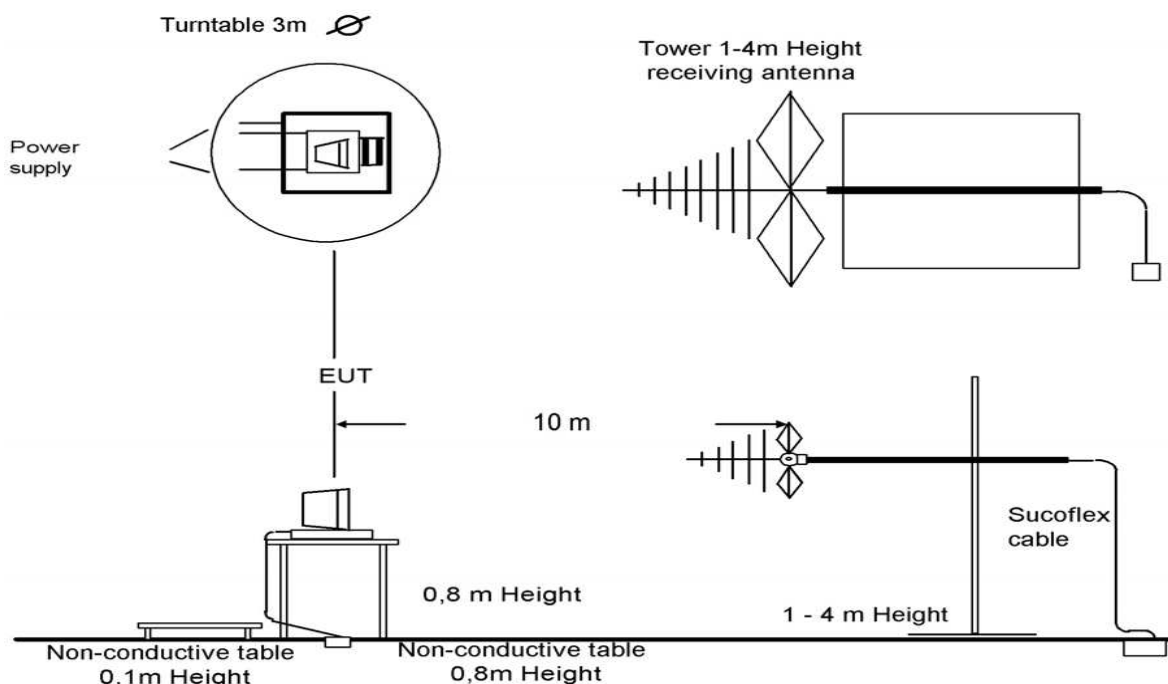
### 8.1 Description of test setup

#### 8.1.1 Radiated measurements

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 25 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63-4-2003 clause 4.2.

Antennas are confirmed with ANSI C63.2-1996 item 15.

Semi anechoic chamber



Picture 1: Diagram radiated measurements

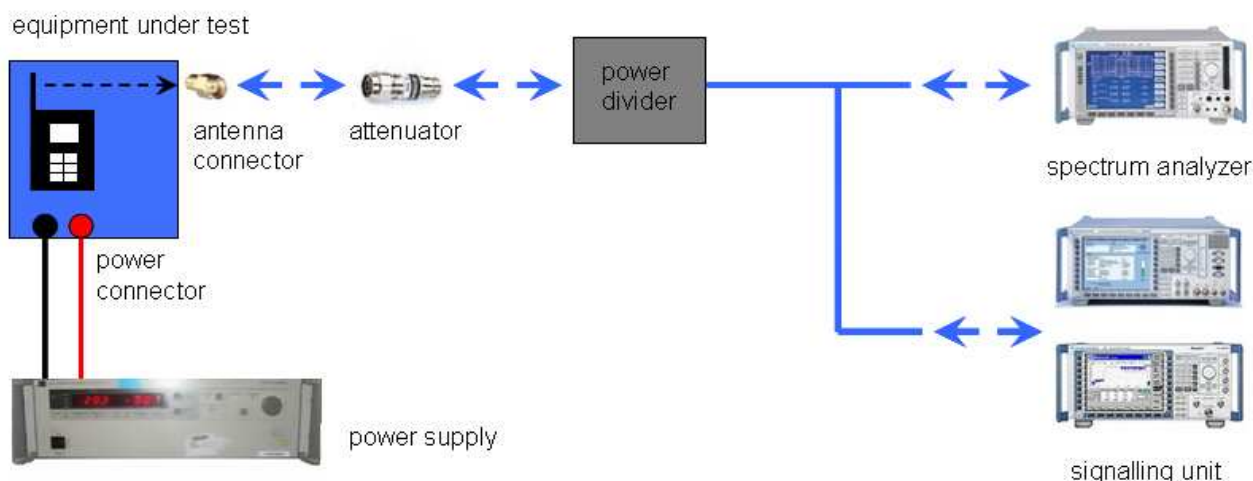
9 kHz - 30 MHz:	active loop antenna
30 MHz – 1 GHz:	tri-log antenna
> 1 GHz:	horn antenna

All measurements are done in accordance with the Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems DA 00-705 and Appendix A "BLUETOOTH® APPROVALS"

The EUT is powered by an external power supply with nominal voltage. The signalling is performed from outside the chamber with a signalling unit (CMU200 or other) by air link using signalling antenna.

### 8.1.2 Conducted measurements

The EUT's RF signal is coupled out by the antenna connector which is supplied by the manufacturer. The signal is first 10dB attenuated before it is power divided (~6dB loss per branch). One of the signal paths is connected to the communication base Station (CMU200 or other), the other one is connected to the spectrum analyzer. The specific losses for both signal paths are first checked within a calibration. The measurement readings on the signalling unit/spectrum analyzer are corrected by the specific test set-up loss. The attenuator, power divider, signalling unit and the spectrum analyzer are impedance matched on 50 Ohm.



Picture 2: Diagram conducted measurements

## 8.2 Additional comments

The Bluetooth® word mark and logos are owned by the Bluetooth SIG Inc. and any use of such marks by Cetecom ICT Services GmbH is under license.

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

Test mode:

- ☒ Bluetooth Test mode loop back enabled (EUT is controlled over CBT/CMU)
- ☐ Special software is used. EUT is transmitting pseudo random data by itself

## 9 Measurement Results

### 9.1 Antenna Gain

#### Measurement:

The antenna gain of the complete system is calculated by the difference of radiated power in EIRP and the conducted power of the module. For normal Bluetooth® devices, the GFSK modulation is used.

#### Measurement parameters:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	3 MHz
Resolution bandwidth:	3 MHz
Span:	5 MHz
Trace-Mode:	Max hold

#### Limits:

FCC
CFR Part 15.247 (b)(4)
Antenna Gain
6 dBi

#### Results:

T <sub>nom</sub>	V <sub>nom</sub>	lowest channel 2402 MHz	middle channel 2441 MHz	highest channel 2480 MHz
Conducted power [dBm] Measured with GFSK modulation		5.63	6.09	5.37
Radiated power [dBm] Measured with GFSK modulation		6.07	5.65	5.15
Gain [dBi] Calculated		0.44	-0.44	-0.22

Result: The result of the measurement is passed.



## 9.2 Power Spectral Density

### Description:

Measurement of the power spectral density of a digital modulated system. This requirement is only valid for digitally modulated systems without hopping functionality.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	500 s
Video bandwidth:	3 kHz
Resolution bandwidth:	3 kHz
Span:	150 kHz
Trace-Mode:	Max Hold

### Limits:

FCC
CFR Part 15.247 (e)
Power Spectral Density
For digitally modulated systems the transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration.

### Result:

Modulation	Power Spectral density [dBm/3kHz]		
Frequency	2412 MHz	2437 MHz	2462 MHz
GFSK	Not required for hopping systems!		
Pi/4 DQPSK			
8DPSK			
Measurement uncertainty	± 0.5 dB		

### 9.3 Carrier Frequency Separation

#### Description:

Measurement of the carrier frequency separation of a hopping system. The carrier frequency separation is constant for all modulation-modes. We use GFSK-modulation to show compliance. EUT in hopping mode.

#### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	100 kHz
Resolution bandwidth:	100 kHz
Span:	4 MHz
Trace-Mode:	Max Hold

#### Limits:

FCC
CFR Part 15.247 (a)(1)
Carrier Frequency Separation
Minimum 25 kHz or two-thirds of the 20 dB bandwidth of the hopping system whichever is greater.

#### Result:

Carrier Frequency Separation	~ 1 MHz
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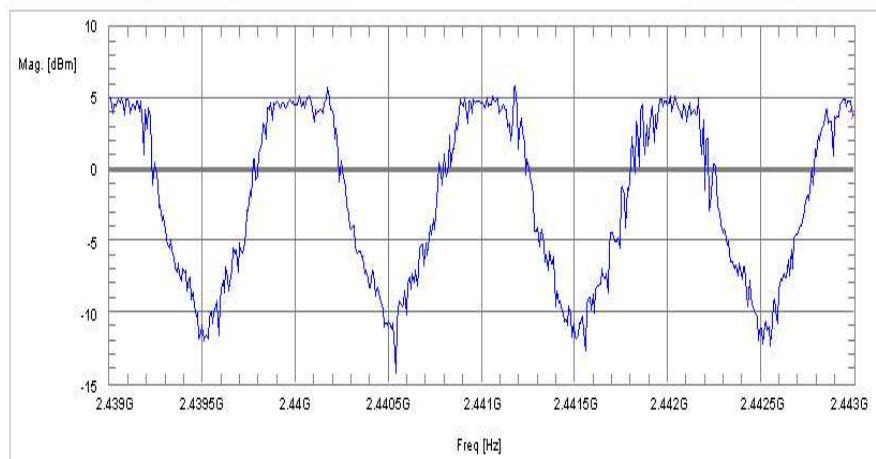
**Result:** The result of the measurement is passed.

**Plot 1: Carrier Frequency Separation (GFSK)**

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Ref. Level Offset [dB]	Detector	SweepTime [s]
12.5	POS	5m

Video BW [Hz]	RBW [Hz]
100k	100000



Start Freq [Hz]	Stop Freq [Hz]	TraceM.	Found Peak [dBm]	Found Peak [Hz]
2.439G	2.443G	MAXH	3.823829651	2.443G

## 9.4 Number of Hopping Channels

### Description:

Measurement of the total number of used hopping channels. The number of hopping channels is constant for all modulation-modes. We use GFSK-modulation to show compliance. EUT in hopping mode.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	500 kHz
Resolution bandwidth:	500 kHz
Span:	Plot 1: 2400 – 2445 MHz Plot 2: 2445 – 2485 MHz
Trace-Mode:	Max Hold

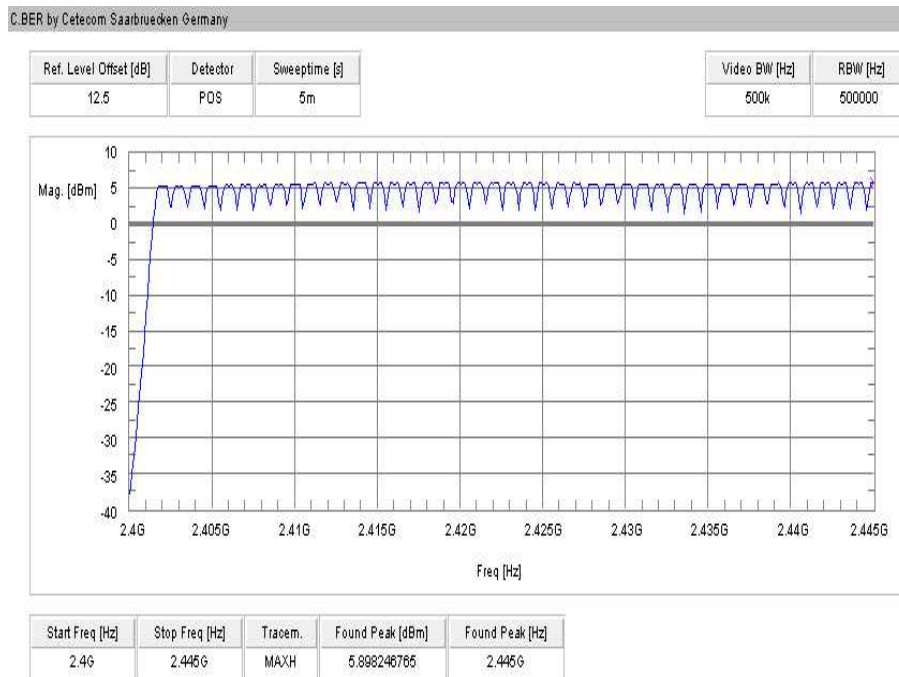
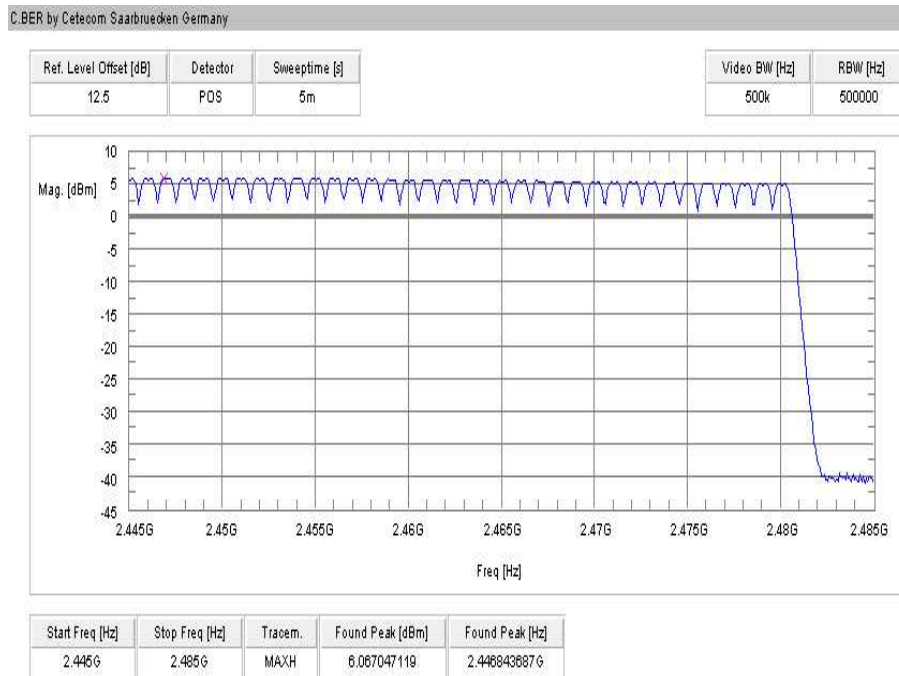
### Limits:

FCC
CFR Part 15.247 (a)(1)
Number of Hopping Channels
At least 15 non overlapping hopping channels

### Result:

Number of Hopping Channels	79
----------------------------	----

**Result:** The result of the measurement is passed.

**Plot 1: Number of Hopping Channels (GFSK)****Plot 2: Number of Hopping Channels (GFSK)**

## 9.5 Time of Occupancy (Dwell Time)

### Measurement:

For Bluetooth® devices no measurements mandatory depending on the fixed requirements according to the Bluetooth® Core Specifications!

### For Bluetooth® devices:

The dwell time of 0.4 s within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is as follows:

Dwell time = time slot length \* hop rate / number of hopping channels \* 31.6 s

Example for a DH1 packet (with a maximum length of one time slot)  
Dwell time =  $625 \mu\text{s} * 1600 \text{ 1/s} / 79 * 31.6 \text{ s} = 0.4 \text{ s}$  (in a 31.6 s period)

For multi-slot packet the hopping is reduced according to the length of the packet.  
Example for a DH5 packet (with a maximum length of five time slots)  
Dwell time =  $5 * 625 \mu\text{s} * 1600 * 1/5 * 1/\text{s} / 79 * 31.6 \text{ s} = 0.4 \text{ s}$  (in a 31.6 s period)

This is according to the Bluetooth® Core Specification V 2.0 & V 2.1 & V 3.0 & V4.0 (+ critical errata) for all Bluetooth® devices.

Therefore, all Bluetooth® devices comply with the FCC dwell time requirements in the data mode.

This was checked during the Bluetooth® Qualification tests.

The Dwell time in hybrid mode is approximately 2.6 ms (in a 12.8s period)

### Limits:

FCC
CFR Part 15.247 (a)(1)(iii)
Time of Occupancy (Dwell Time)
The frequency hopping operation shall have an average time of occupancy on any frequency not exceeding 0.4 seconds within a duration in seconds equal to the number of hopping frequencies multiplied by 0.4.

**Result:** The result of the measurement is passed.

## 9.6 Spectrum Bandwidth of a FHSS System – 20 dB Bandwidth

### Description:

Measurement of the 20dB bandwidth of the modulated signal. The measurement is performed according to the "Measurement Guidelines" (DA 00-705, March 30, 2000). EUT in single channel mode.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	2 s
Video bandwidth:	30 kHz
Resolution bandwidth:	10 kHz
Span:	3 MHz
Trace-Mode:	Max Hold

### Limits:

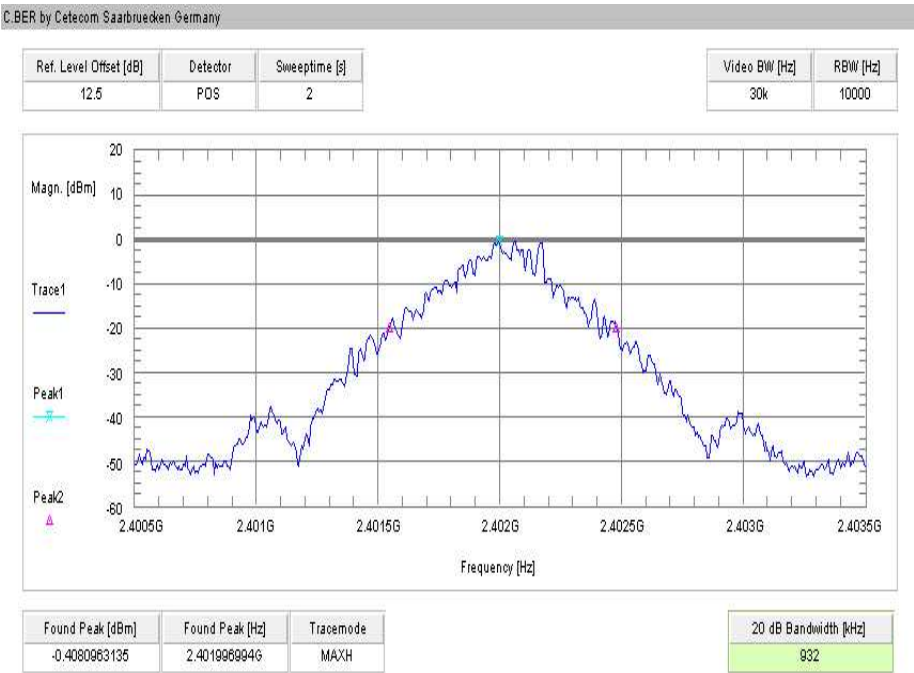
FCC
CFR Part 15.247 (a)(1)
Spectrum Bandwidth of a FHSS System – 20 dB Bandwidth
GFSK < 1000 kHz Pi/4 DQPSK < 1500 kHz 8DPSK < 1500 kHz

### Result:

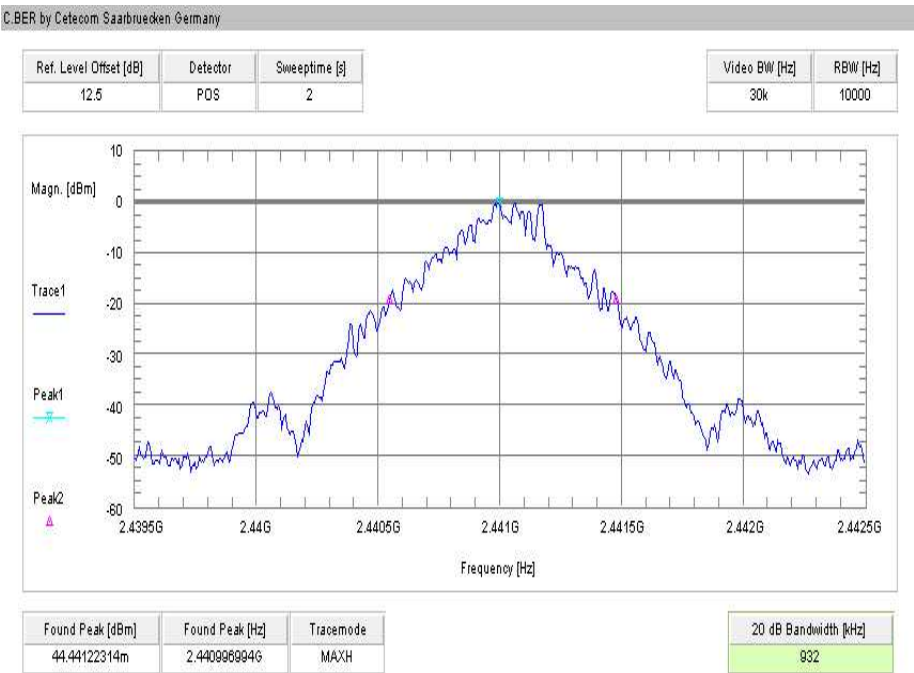
Modulation Frequency	20 dB BANDWIDTH [kHz]		
	2402 MHz	2441 MHz	2480 MHz
GFSK	932	932	926
Pi/4 DQPSK	1311	1311	1311
8DPSK	1263	1263	1263
Measurement uncertainty	± 10 kHz		

**Result:** The result of the measurement is passed.

**Plot 1: Channel 00 / GFSK**



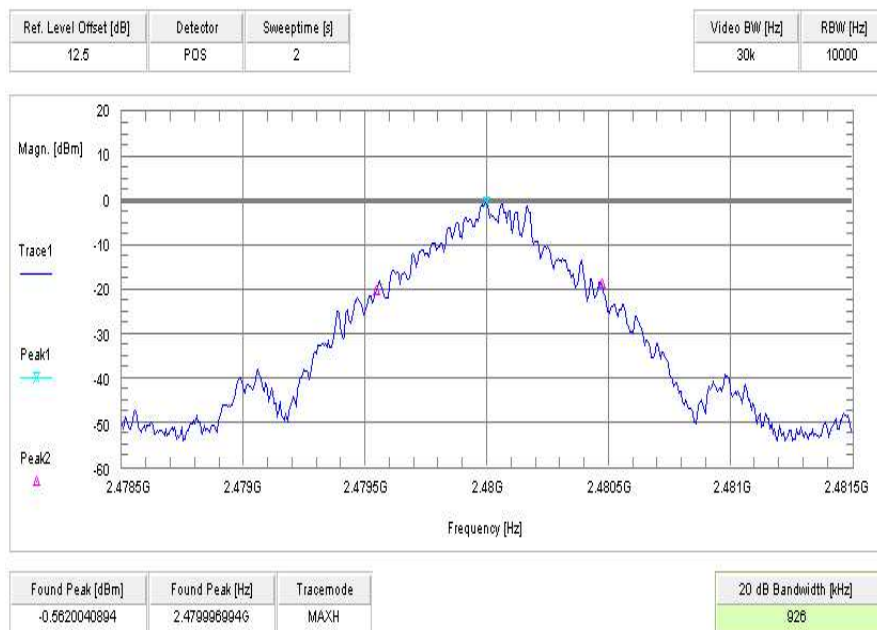
**Plot 2: Channel 39 / GFSK**



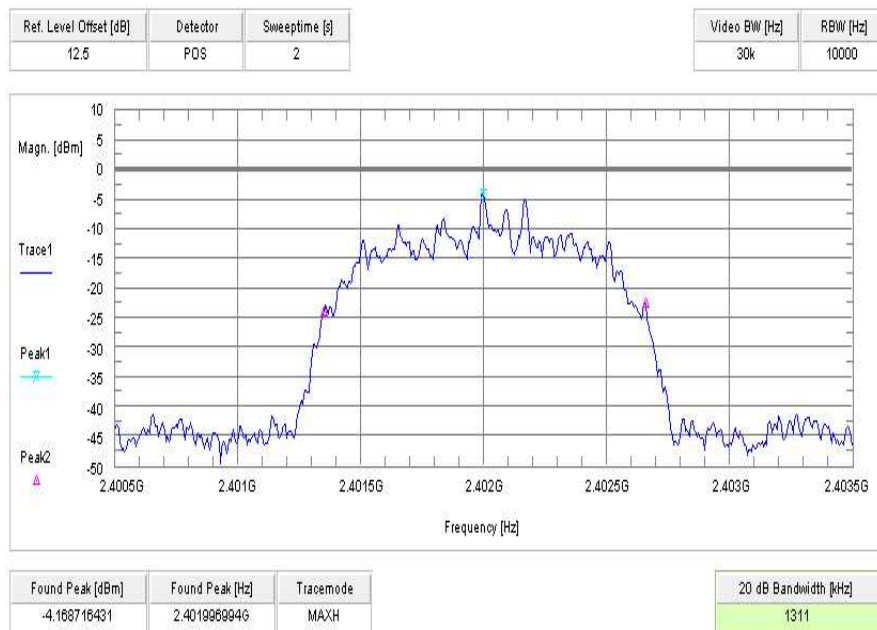


**Plot 3: Channel 78 / GFSK**

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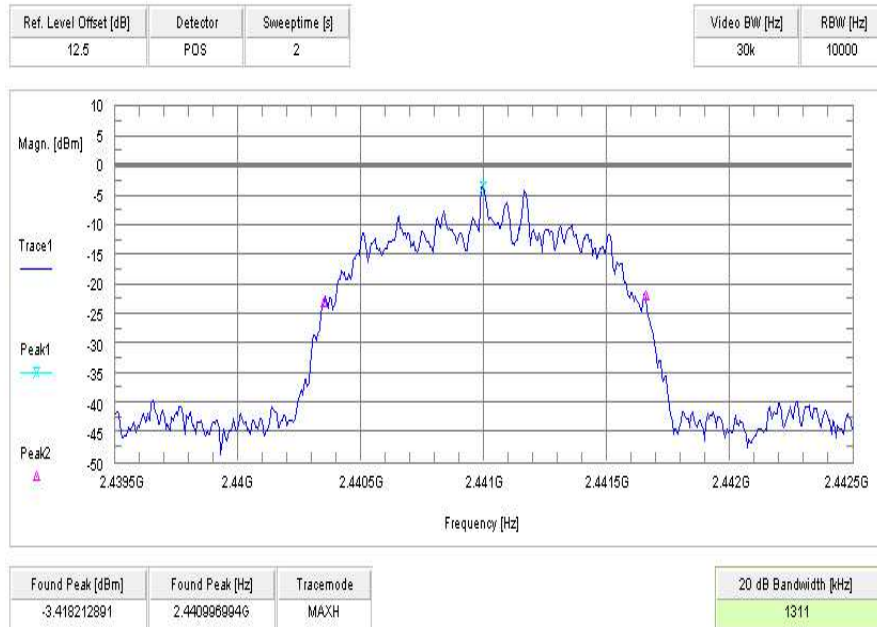
**Plot 4: Channel 00 / Pi/4 DQPSK**

C.BER by Cetecom Saarbruecken Germany

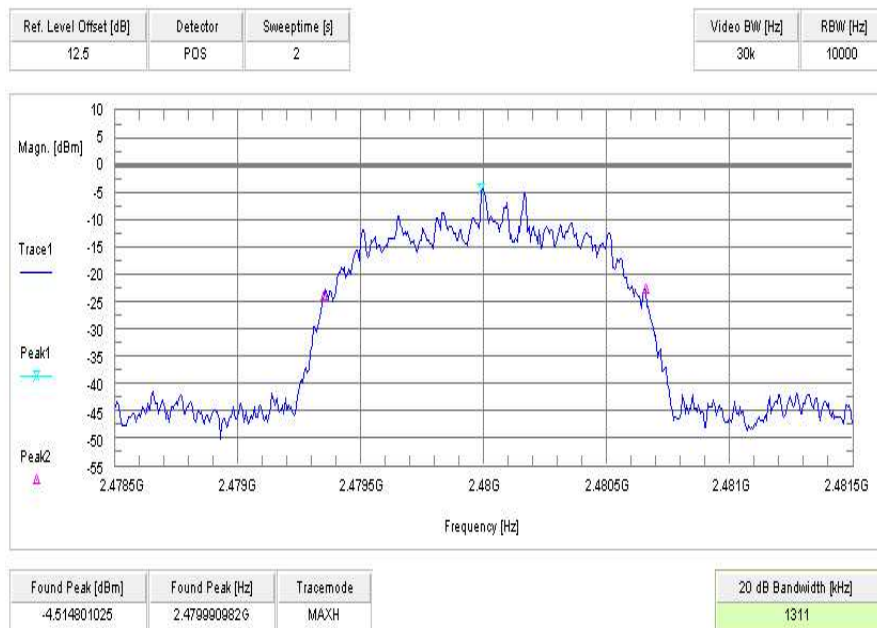


**Plot 5: Channel 39 / Pi/4 DQPSK**

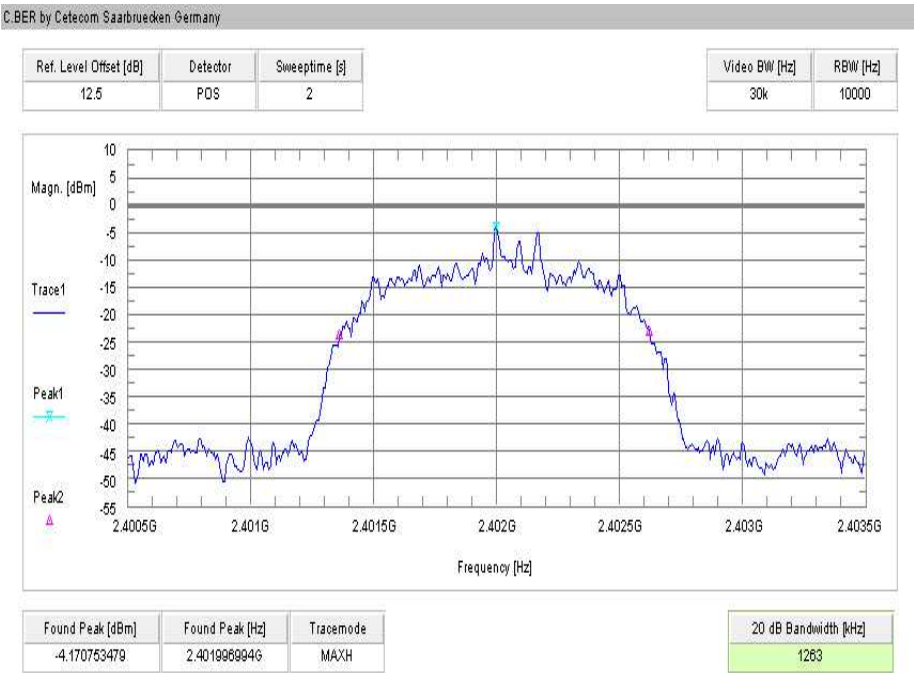
C.BER by Cetecom Saarbruecken Germany

**Plot 6: Channel 78 / Pi/4 DQPSK**

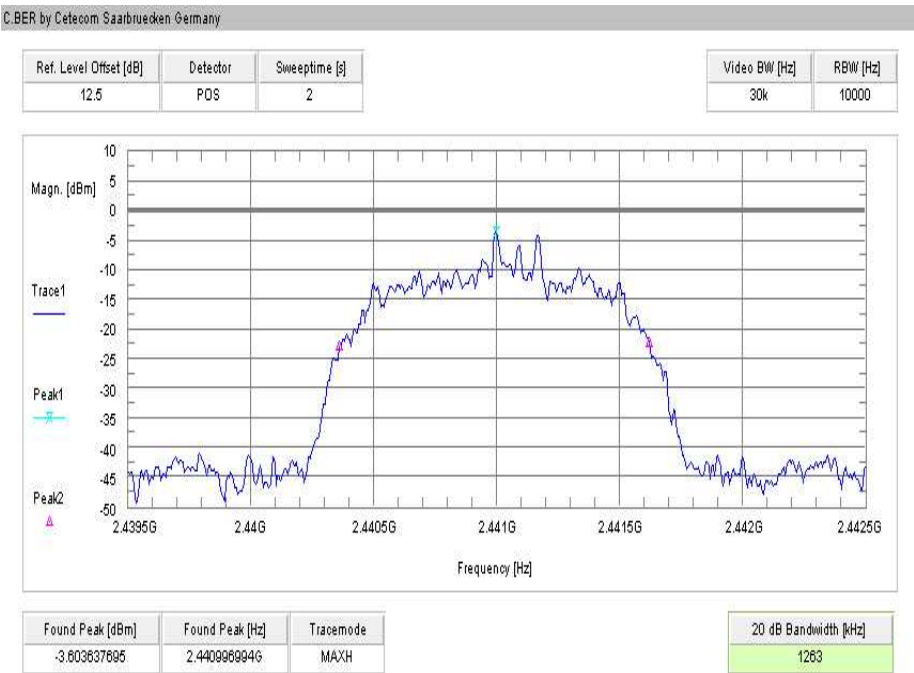
C.BER by Cetecom Saarbruecken Germany



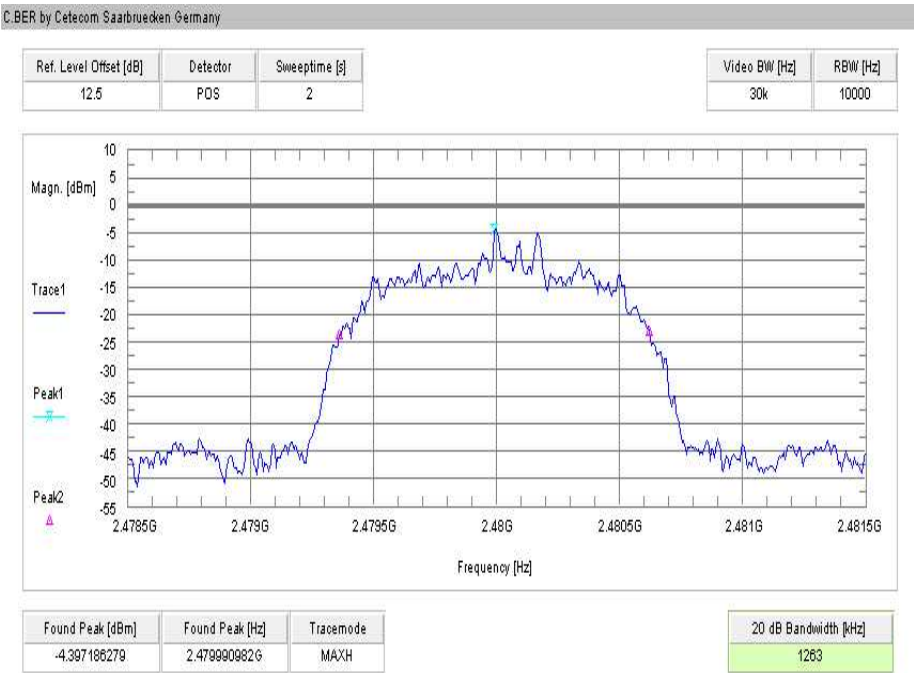
**Plot 7: Channel 00 / 8DPSK**



**Plot 8: Channel 39 / 8DPSK**



**Plot 9: Channel 78 / 8DPSK**



## 9.7 Maximum Output Power

### Description:

Measurement of the maximum output power conducted and radiated. EUT in single channel mode.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	3 MHz
Resolution bandwidth:	3 MHz
Span:	3 MHz
Trace-Mode:	Max Hold

### Limits:

FCC
CFR Part 15.247 (b)(1)
Maximum Output Power
[Conducted: 0.125 W – Antenna Gain max. 6 dBi] Systems using more than 75 hopping channels: Conducted: 1.0 W – Antenna Gain max. 6 dBi

**Result:**

Modulation Frequency	Maximum Output Power Conducted [dBm]		
	2402 MHz	2441 MHz	2480 MHz
GFSK	5.63	6.09	5.37
Pi/4 DQPSK	3.34	3.72	3.02
8DPSK	3.37	3.85	3.20
Measurement uncertainty	$\pm 0.5$ dB		

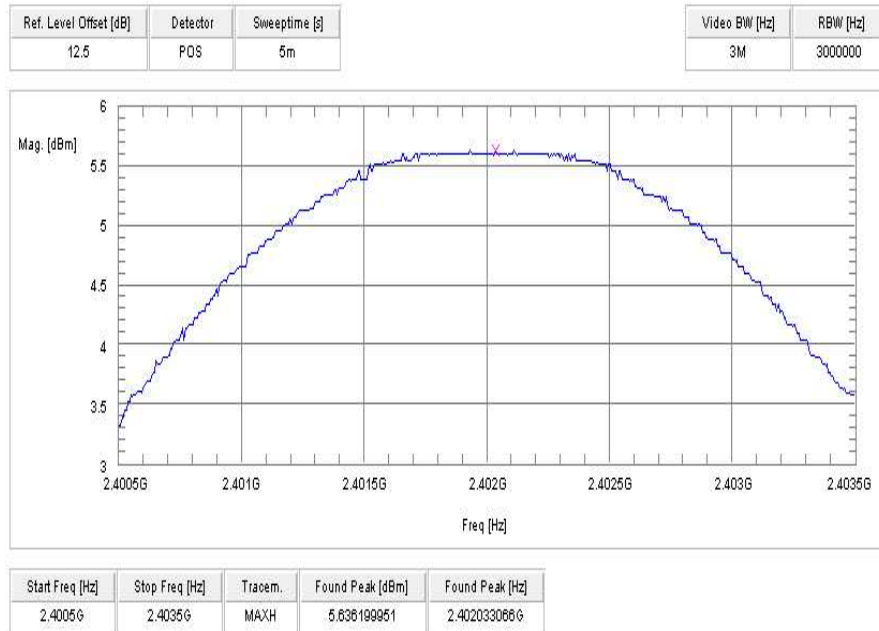
Modulation Frequency	Maximum Output Power Radiated - EIRP [dBm]		
	2402 MHz	2441 MHz	2480 MHz
GFSK	6.07	5.65	5.15
Pi/4 DQPSK *)	3.78	3.28	2..80
8DPSK *)	3.81	3.41	2.98
Measurement uncertainty	$\pm 2.0$ dB		

\*) - Values calculated with antenna gain

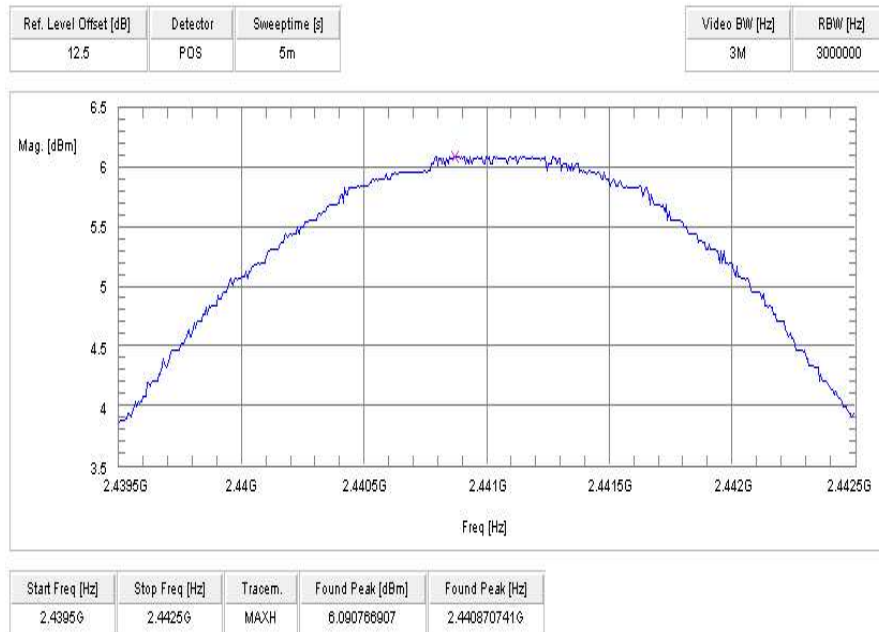
**Result:** The result of the measurement is passed.

**Plot 1: Channel 00 / GFSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

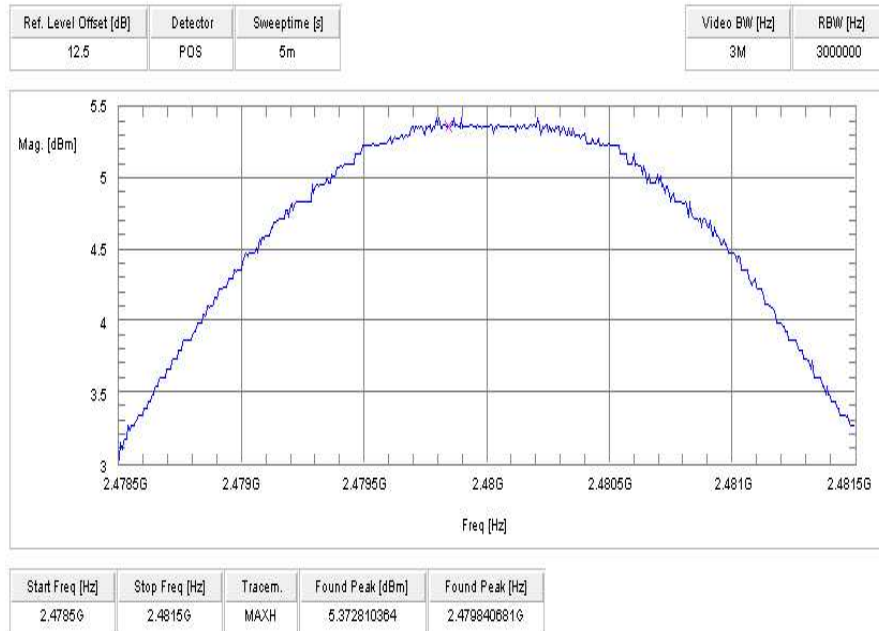
**Plot 2: Channel 39 / GFSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

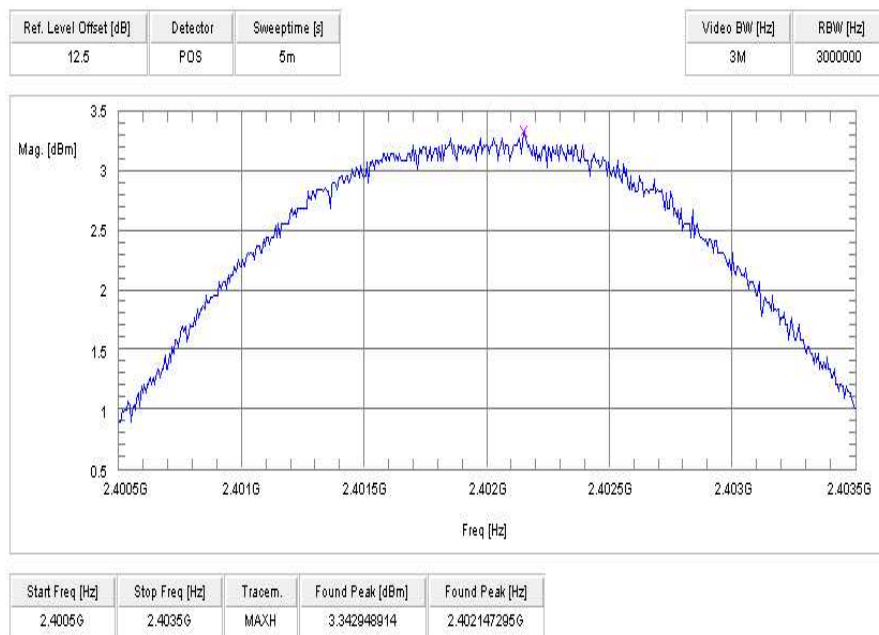


**Plot 3: Channel 78 / GFSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

**Plot 4: Channel 00 / Pi/4 DQPSK (conducted)**

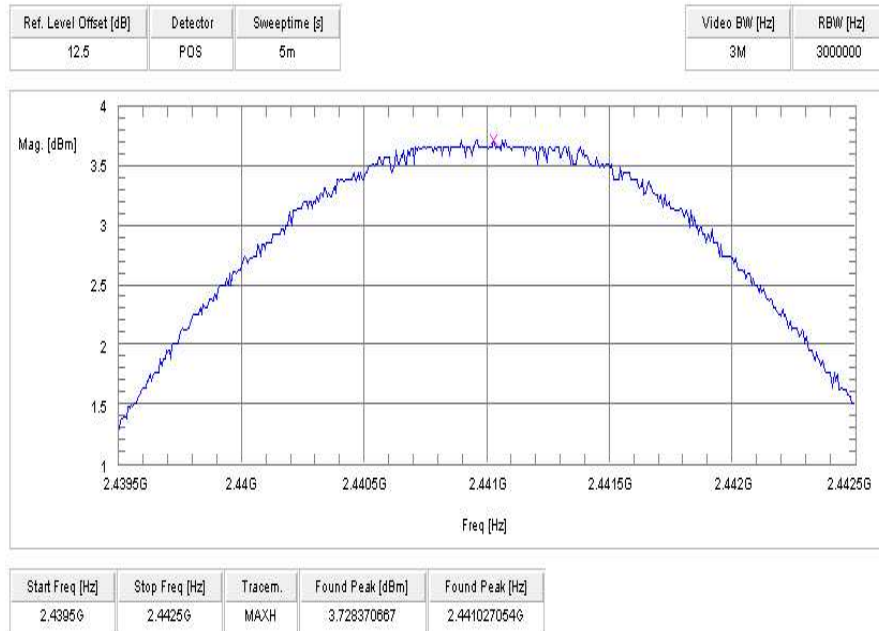
C.BER by Cetecom Saarbruecken Germany



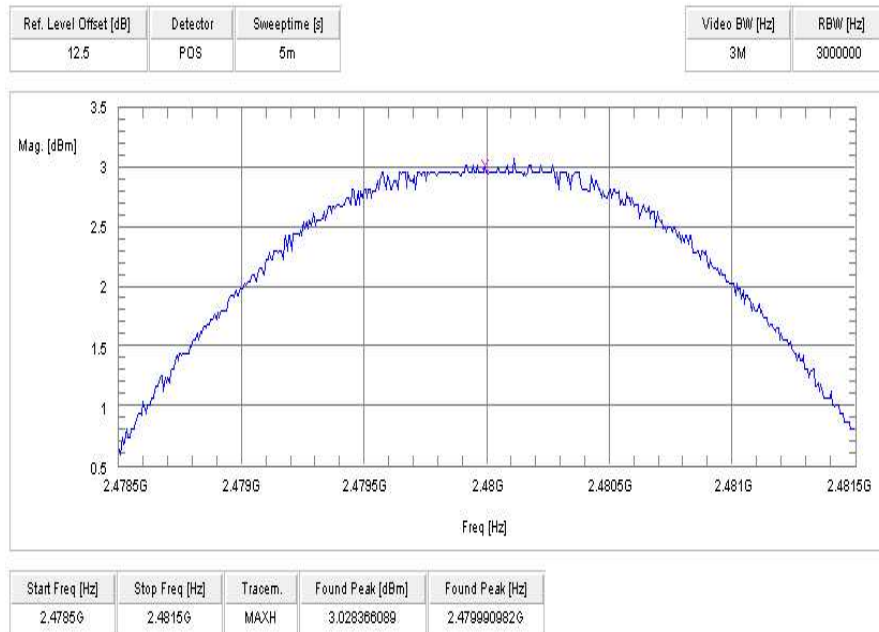


**Plot 5: Channel 39 / Pi/4 DQPSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

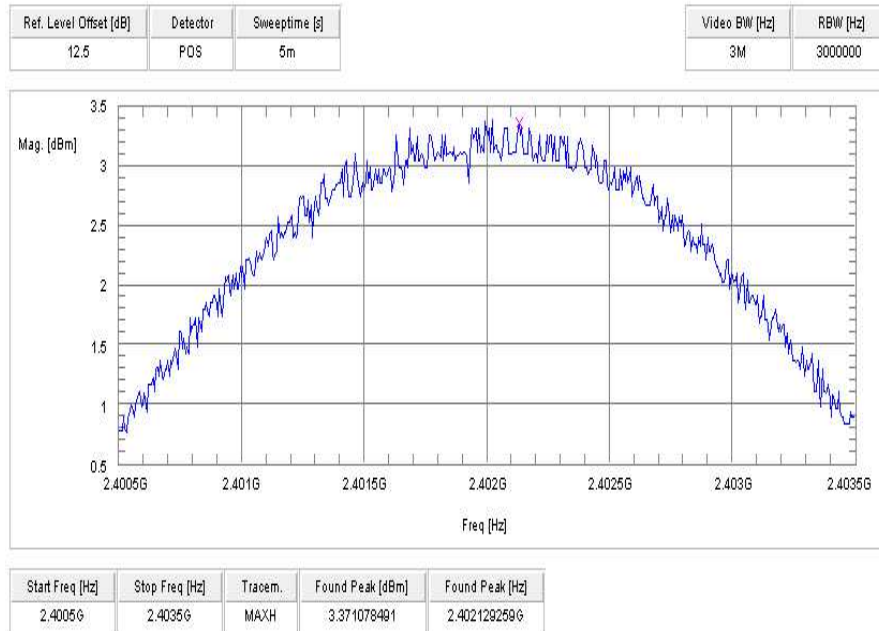
**Plot 6: Channel 78 / Pi/4 DQPSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

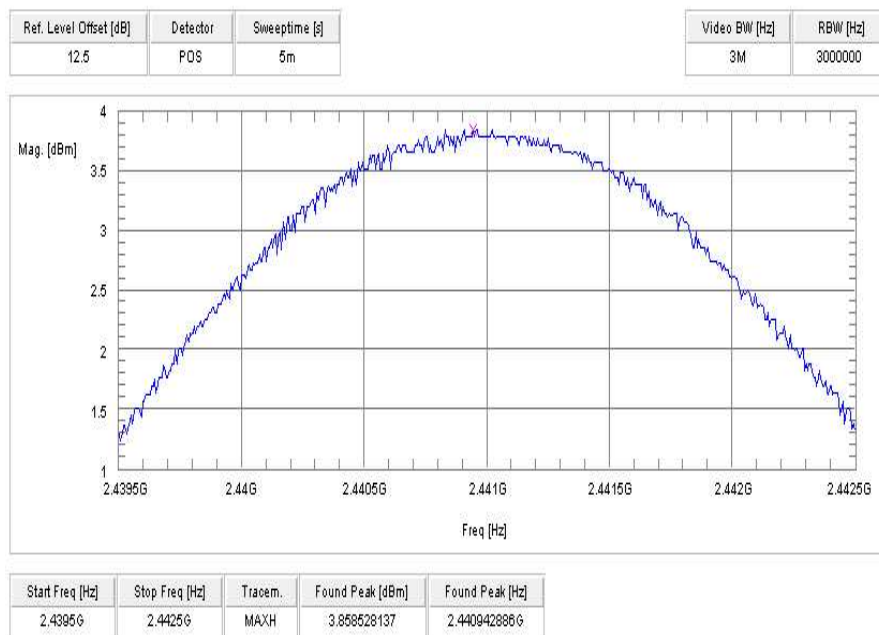


**Plot 7: Channel 00 / 8DPSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

**Plot 8: Channel 39 / 8DPSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

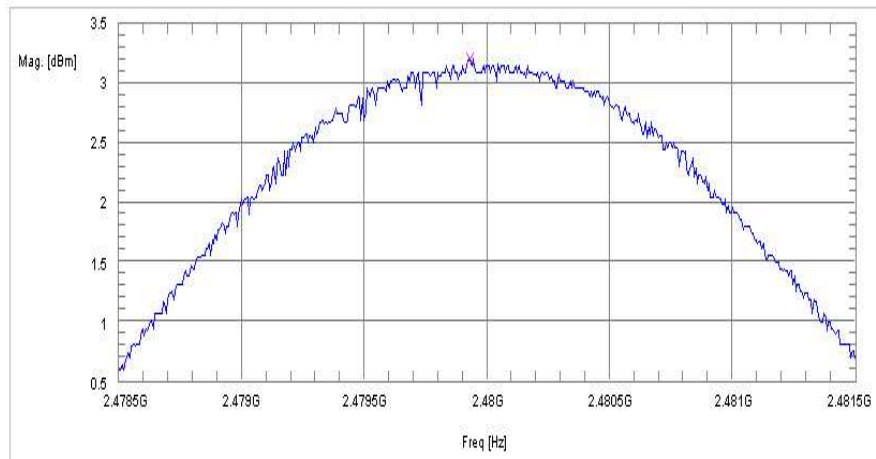


**Plot 9: Channel 78 / 8DPSK (conducted)**

C.BER by Cetecom Saarbruecken Germany

Ref. Level Offset [dB]	Detector	SweepTime [s]
12.5	POS	5m

Video BW [Hz]	RBW [Hz]
3M	3000000



Start Freq [Hz]	Stop Freq [Hz]	TraceM.	Found Peak [dBm]	Found Peak [Hz]
2.4785 G	2.4815 G	MAXH	3.207336426	2.479930862 G

## 9.8 Band Edge Compliance Conducted

### Description:

Measurement of the conducted band edge compliance. EUT is measured at the lower and upper band edge in single channel and hopping mode. The measurement is repeated for all modulations.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	100 kHz
Resolution bandwidth:	100 kHz
Span:	Lower Band Edge: 2395 – 2405 MHz higher Band Edge: 2478 – 2489 MHz
Trace-Mode:	Max Hold

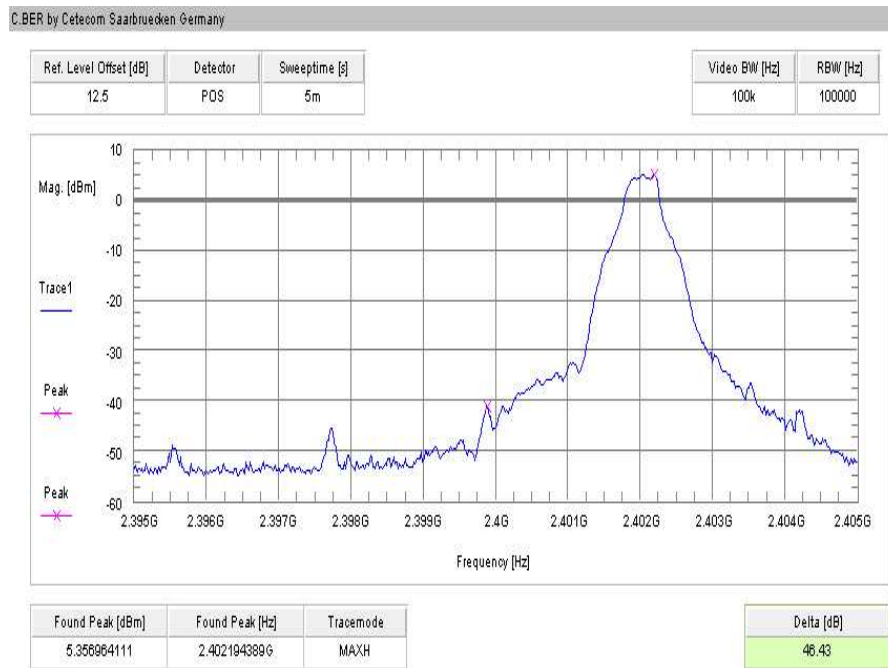
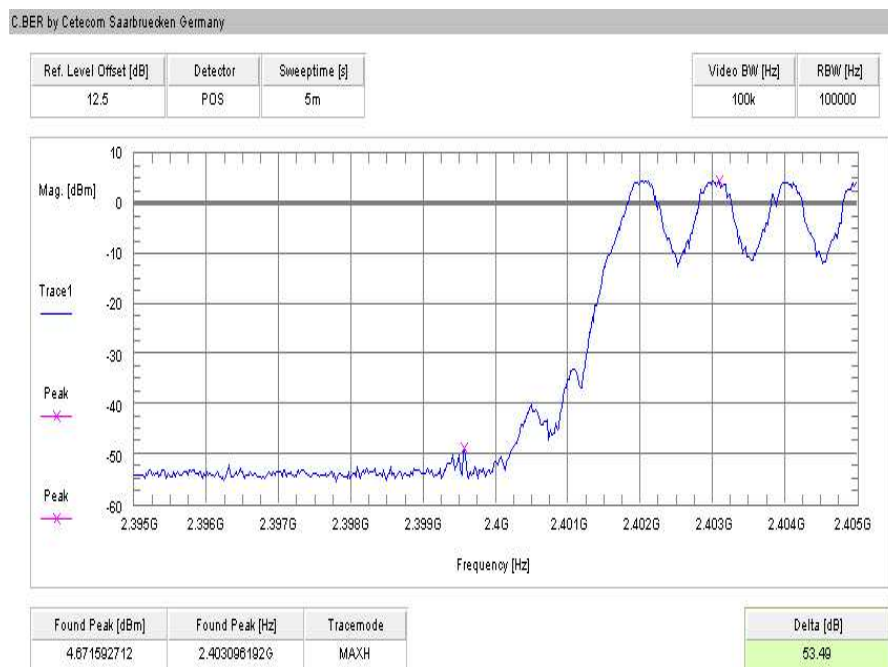
### Limits:

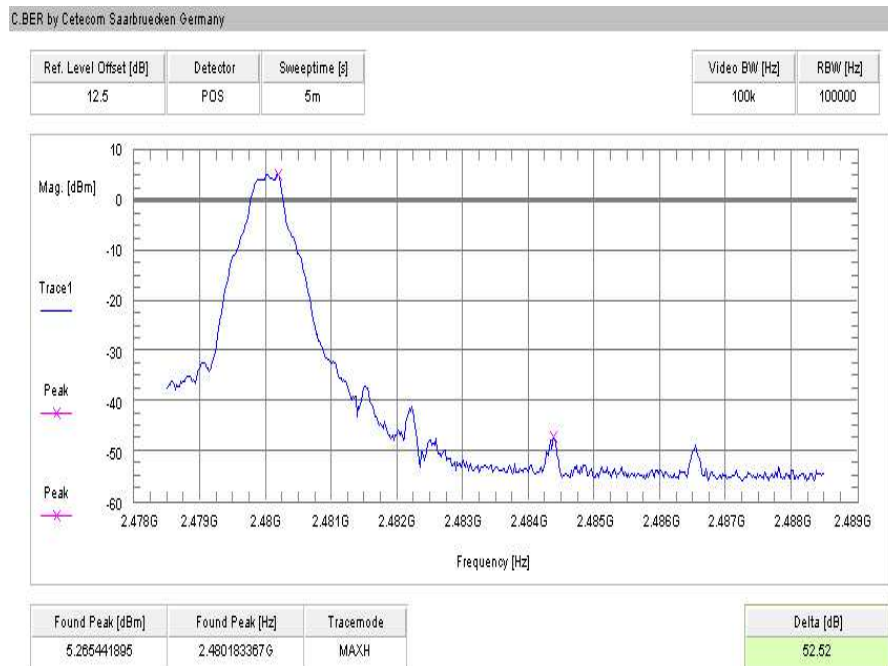
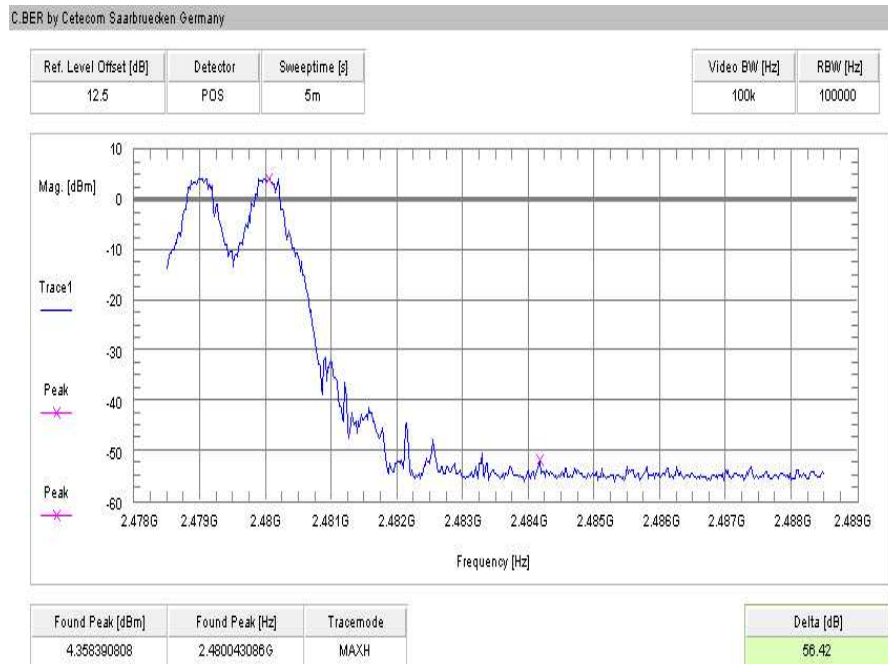
FCC
CFR Part 15.247 (d)
Band Edge Compliance Conducted
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in 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. Attenuation below the general limits specified in Section 15.209(a) is not required.

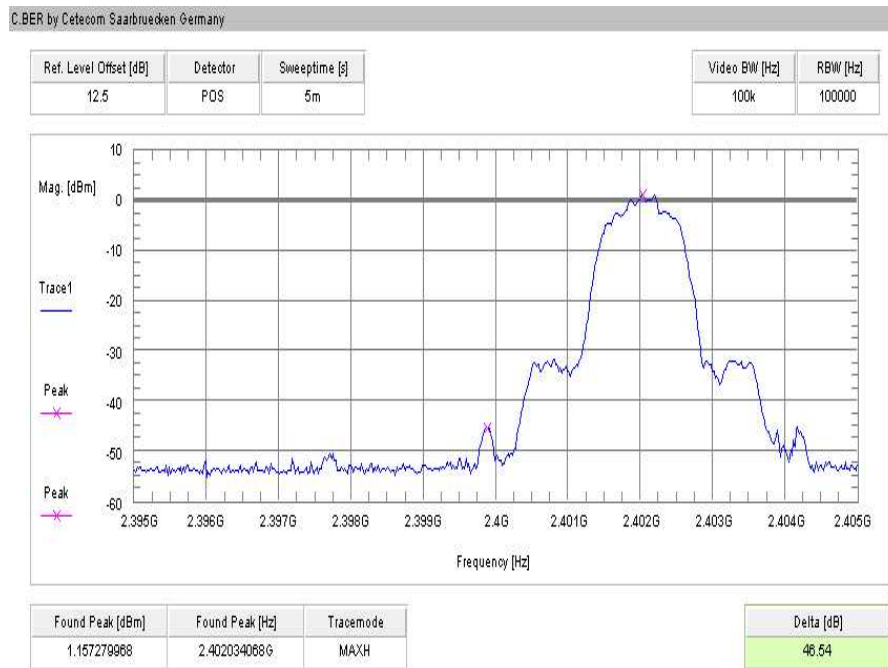
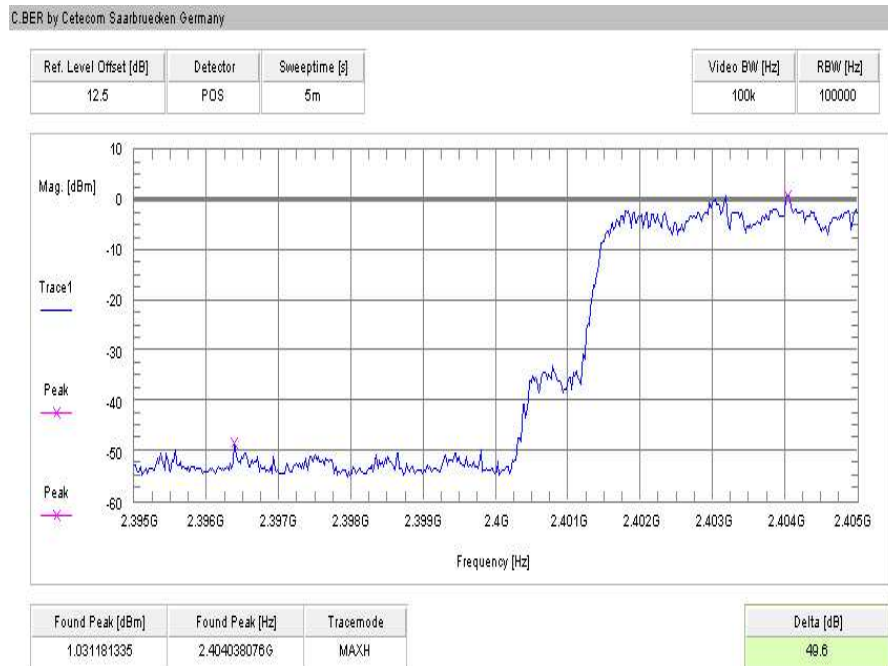
**Result:** Also see plots

Szenario Modulation	Band Edge Compliance Conducted [dB]		
	GFSK	Pi/4 DQPSK	8DPSK
Lower Band Edge – Hopping Off	> 20 dB	> 20 dB	> 20 dB
Lower Band Edge – Hopping On	> 20 dB	> 20 dB	> 20 dB
Upper Band Edge – Hopping Off	> 20 dB	> 20 dB	> 20 dB
Upper Band Edge – Hopping On	> 20 dB	> 20 dB	> 20 dB
Measurement uncertainty	± 1.5 dB		

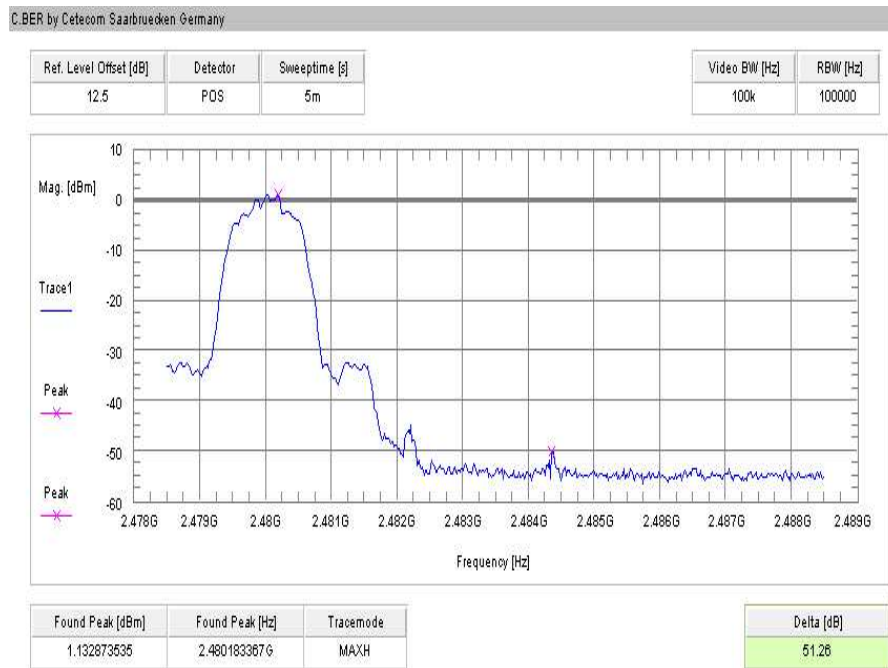
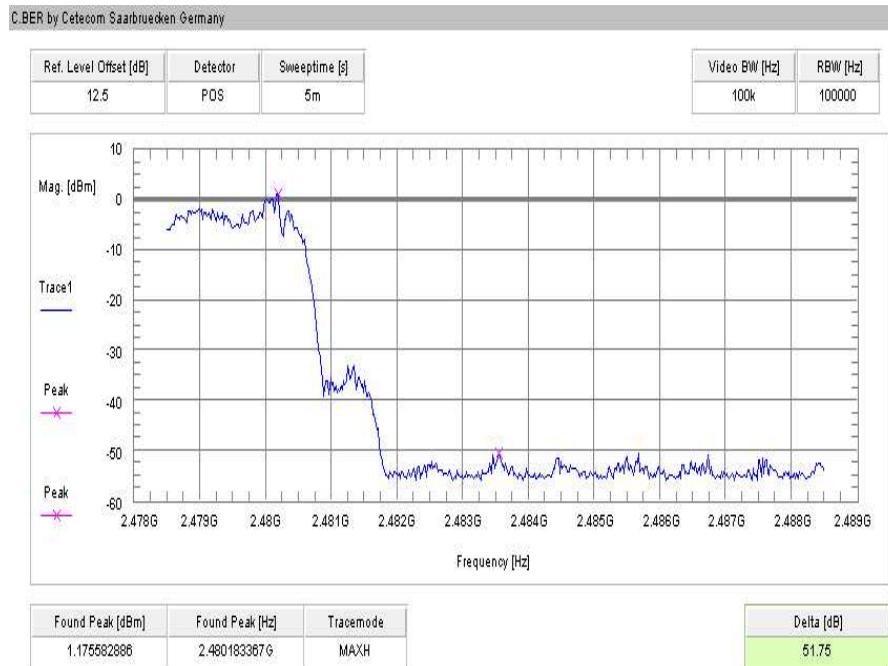
**Result:** The result of the measurement is passed.

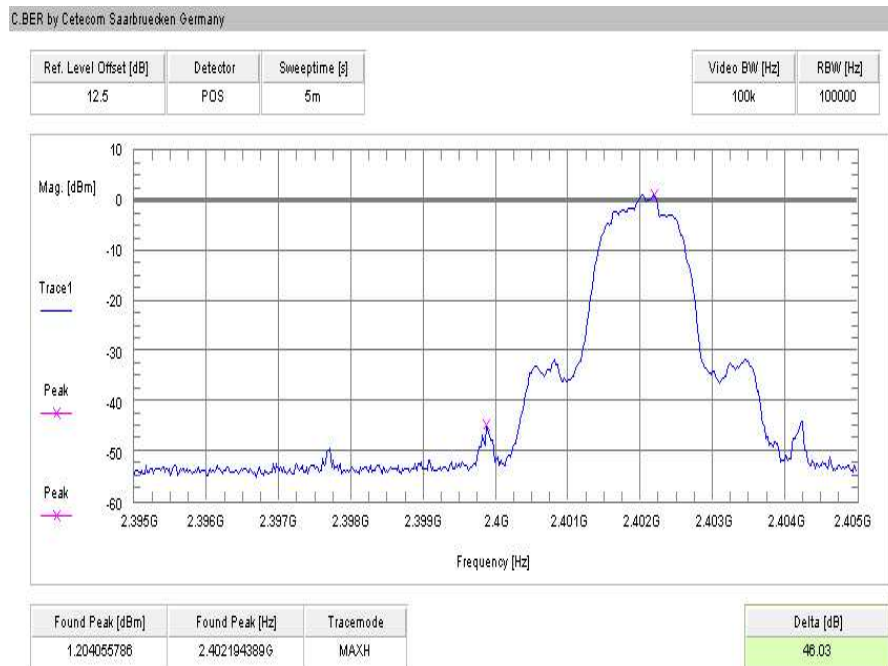
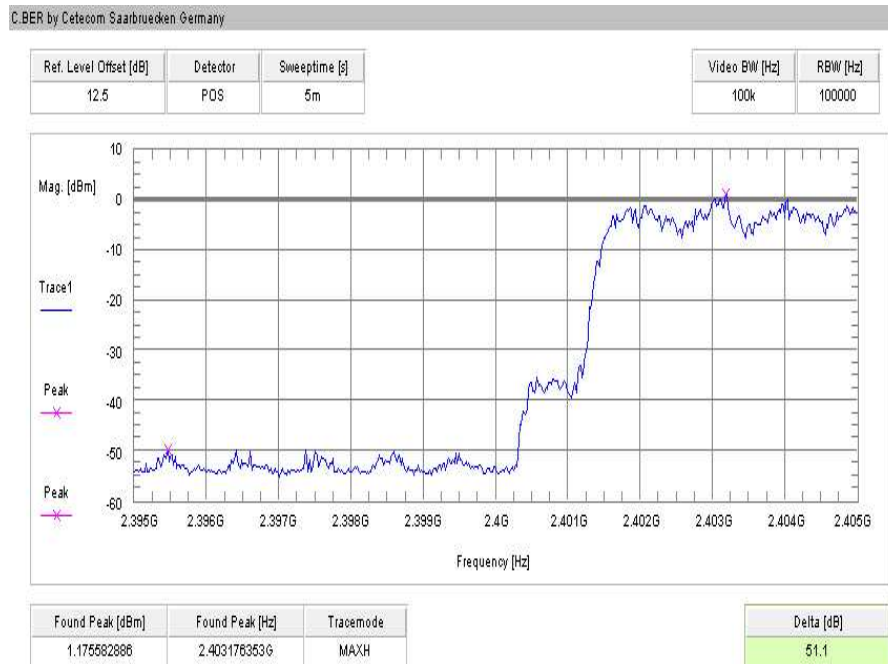
**Plot 1: Lower Band Edge – Hopping Off / GFSK (conducted)****Plot 2: Lower Band Edge – Hopping On / GFSK (conducted)**

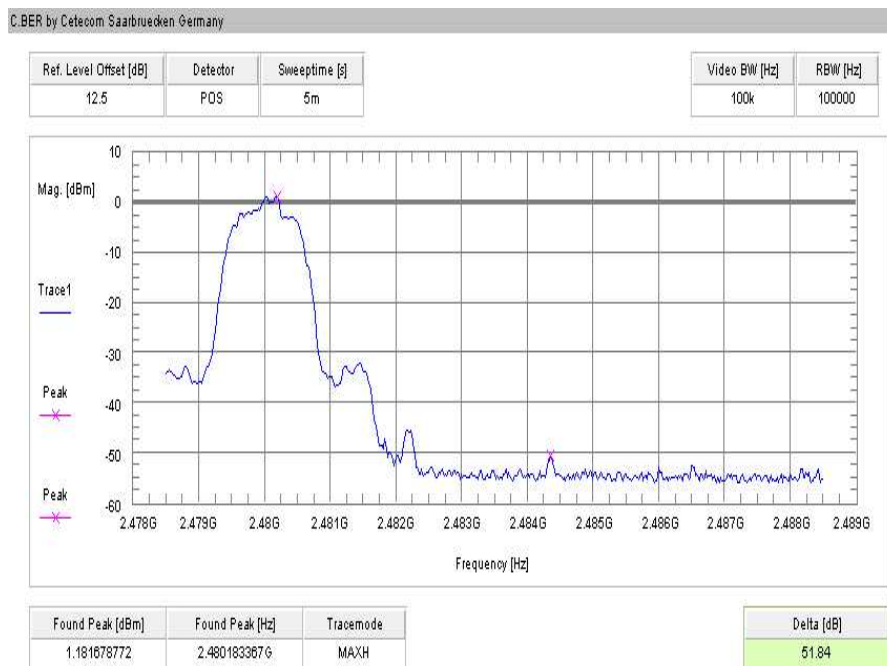
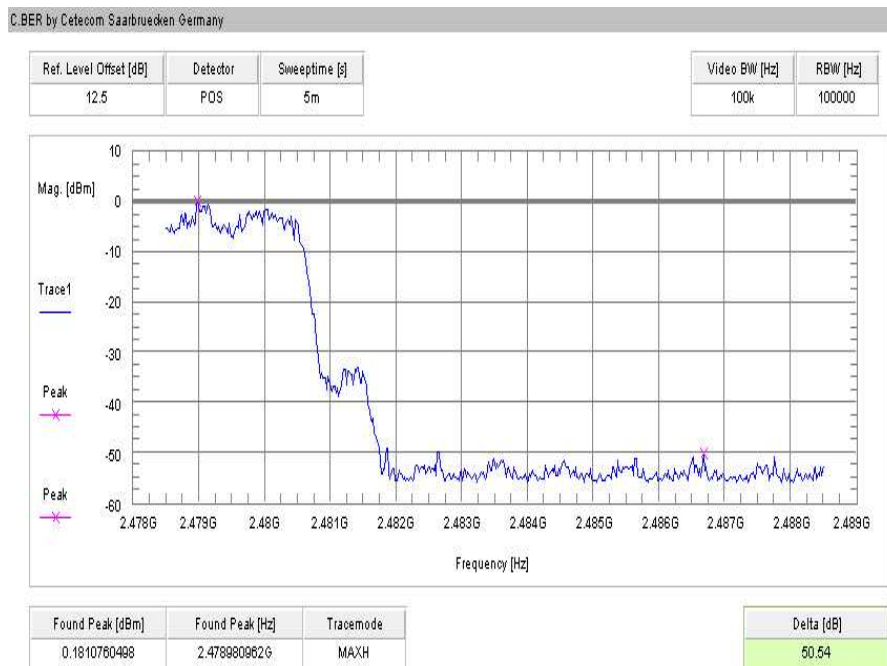
**Plot 3: Upper Band Edge – Hopping Off / GFSK (conducted)****Plot 4: Upper Band Edge – Hopping On / GFSK (conducted)**

**Plot 5: Lower Band Edge – Hopping Off / Pi/4 DQPSK (conducted)****Plot 6: Lower Band Edge – Hopping On / Pi/4 DQPSK (conducted)**



**Plot 7: Upper Band Edge – Hopping Off / Pi/4 DQPSK (conducted)****Plot 8: Upper Band Edge – Hopping On / Pi/4 DQPSK (conducted)**

**Plot 9: Lower Band Edge – Hopping Off / 8DPSK (conducted)****Plot 10: Lower Band Edge – Hopping On / 8DPSK (conducted)**

**Plot 11: Upper Band Edge – Hopping Off / 8DPSK (conducted)****Plot 12: Upper Band Edge – Hopping On / 8DPSK (conducted)**

## 9.9 Band Edge Compliance Radiated

### Description:

Measurement of the radiated band edge compliance. The EUT is turned in the position that results in the maximum level at the band edge. Then a sweep over the corresponding restricted band is performed. The EUT is set to single channel mode and the transmit channel is channel 00 for the lower restricted band and channel 78 for the upper restricted band. The measurement is repeated for all modulations. Measurement distance is 3m.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	10 Hz
Resolution bandwidth:	1 MHz
Span:	Lower Band: 2300 – 2400 MHz higher Band: 2480 – 2500 MHz
Trace-Mode:	Max Hold

### Limits:

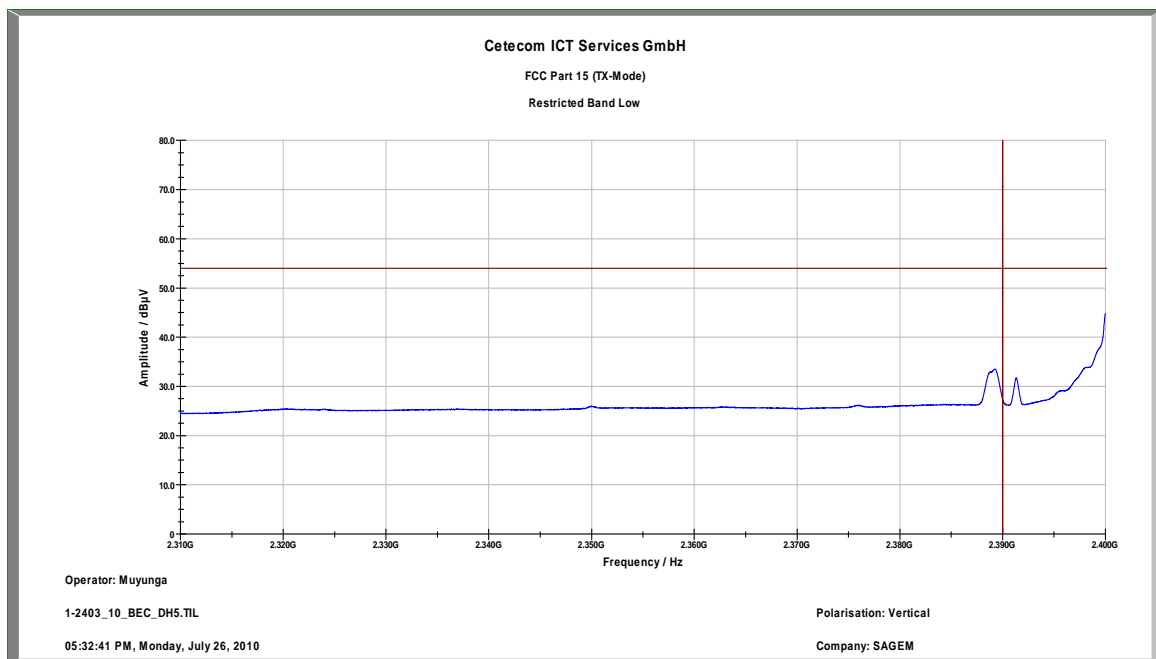
FCC
CFR Part 15.205
Band Edge Compliance Radiated
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 5.205(c)).
54 dBμV/m AVG

**Result:** Also see plots

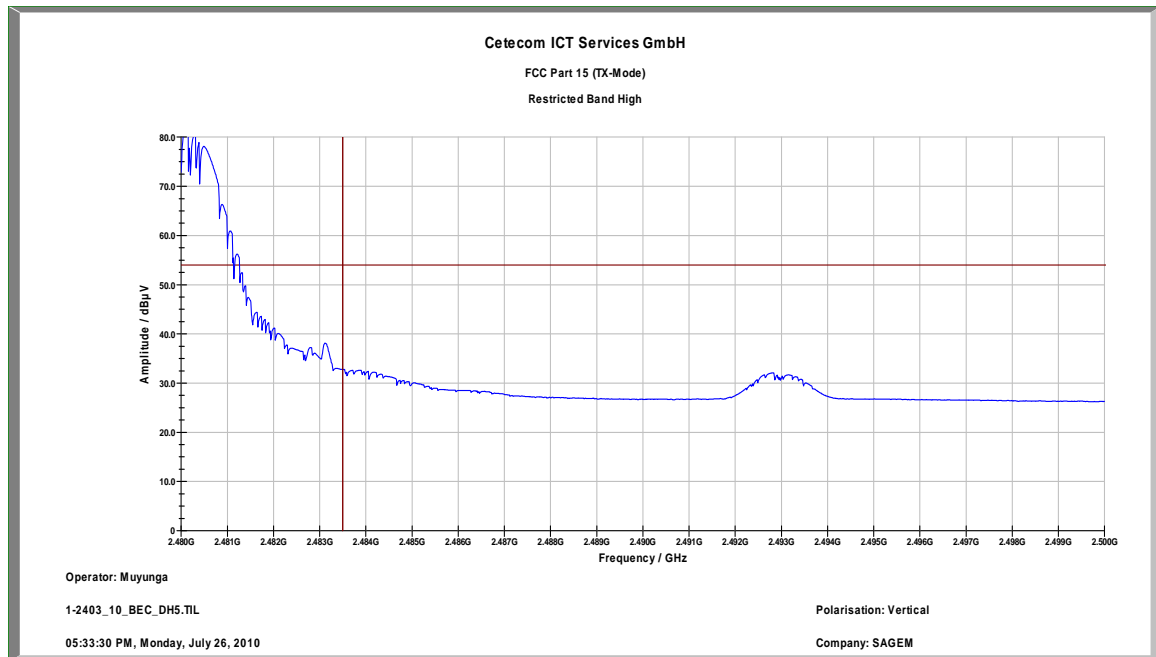
Szenario Modulation	Band Edge Compliance Radiated [dBµV/m]		
	GFSK	Pi/4 DQPSK	8DPSK
Lower Restricted Band	< 54 (see plot 1)	< 54 (see plot 3)	< 54 (see plot 5)
Upper Restricted Band	< 54 (see plot 2)	< 54 (see plot 4)	< 54 (see plot 6)
Measurement uncertainty	± 2 dB		

**Result:** The result of the measurement is passed.

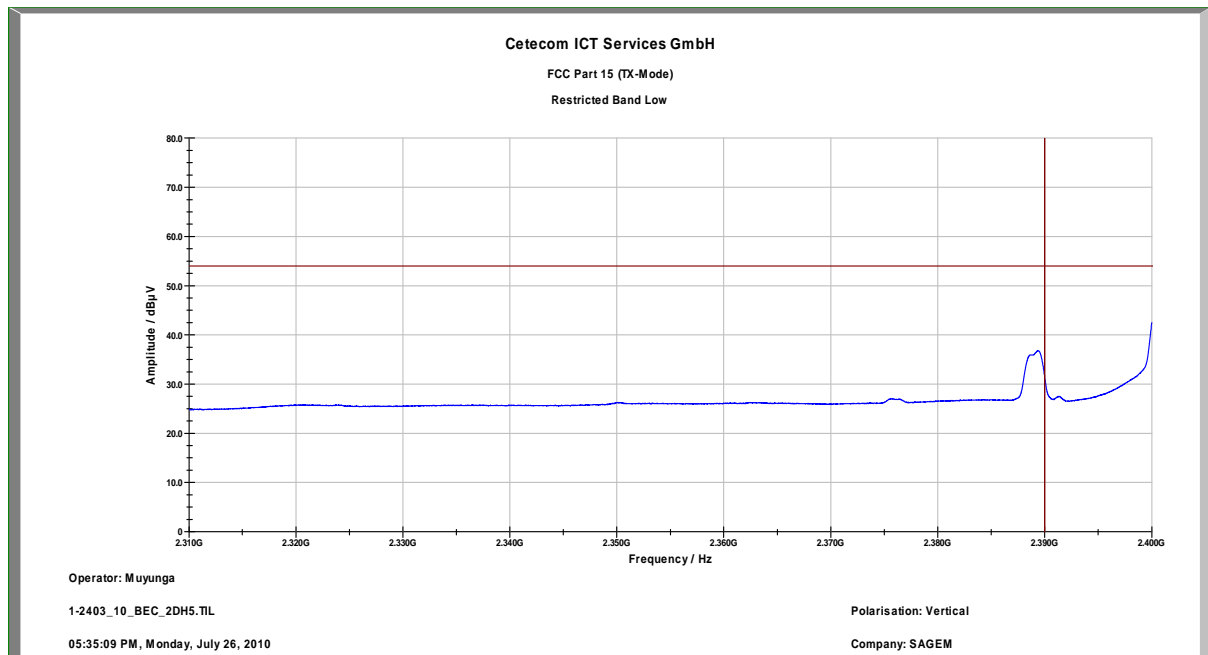
**Plot 1: Lower Restricted Band / GFSK (radiated)**

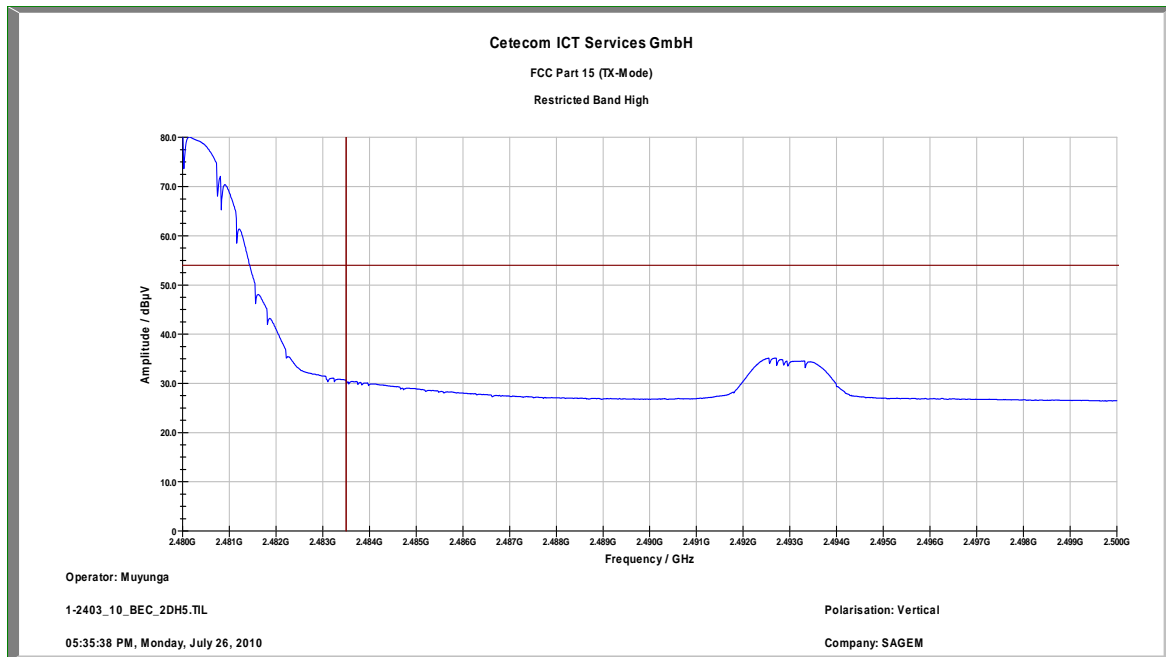
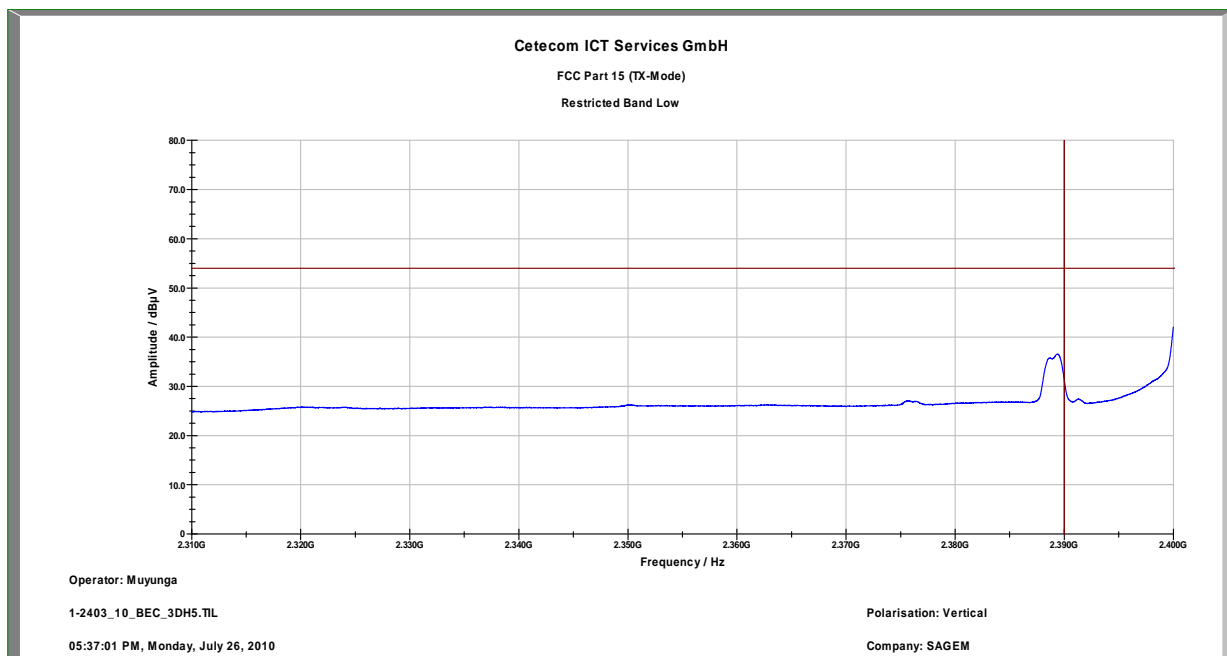


**Plot 2: Upper Restricted Band / GFSK (radiated)**

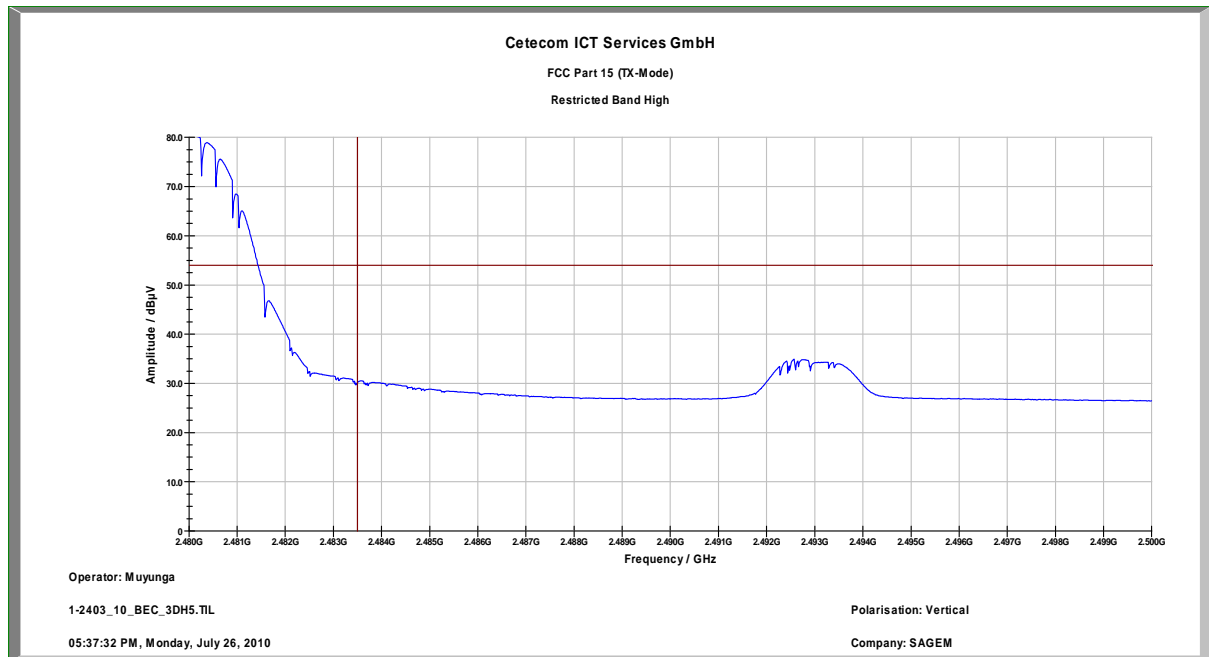


**Plot 3: Lower Restricted Band / Pi/4 DQPSK (radiated)**



**Plot 4: Upper Restricted Band / Pi/4 DQPSK (radiated)****Plot 5: Lower Restricted Band / 8DPSK (radiated)**

**Plot 6: Upper Restricted Band / 8DPSK (radiated)**





## 9.10 TX Spurious Emissions Conducted

### Description:

Measurement of the conducted spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 39 and channel 78. The measurement is repeated for all modulations.

### Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Span:	9 kHz to 25 GHz
Trace-Mode:	Max Hold

### Limits:

FCC
CFR Part 15.247(d)
TX Spurious Emissions Conducted
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. Attenuation below the general limits specified in Section 15.209(a) is not required

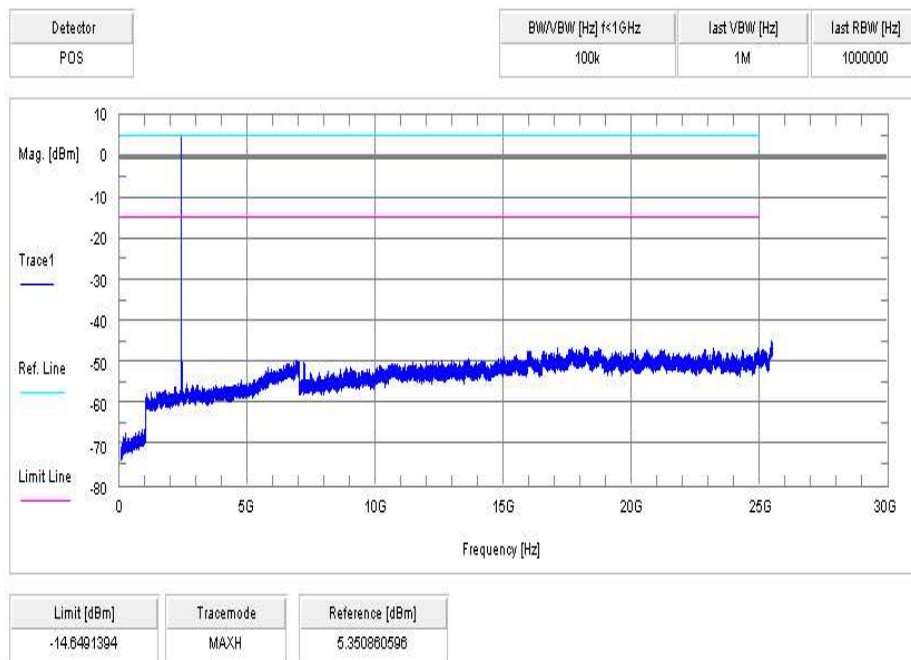
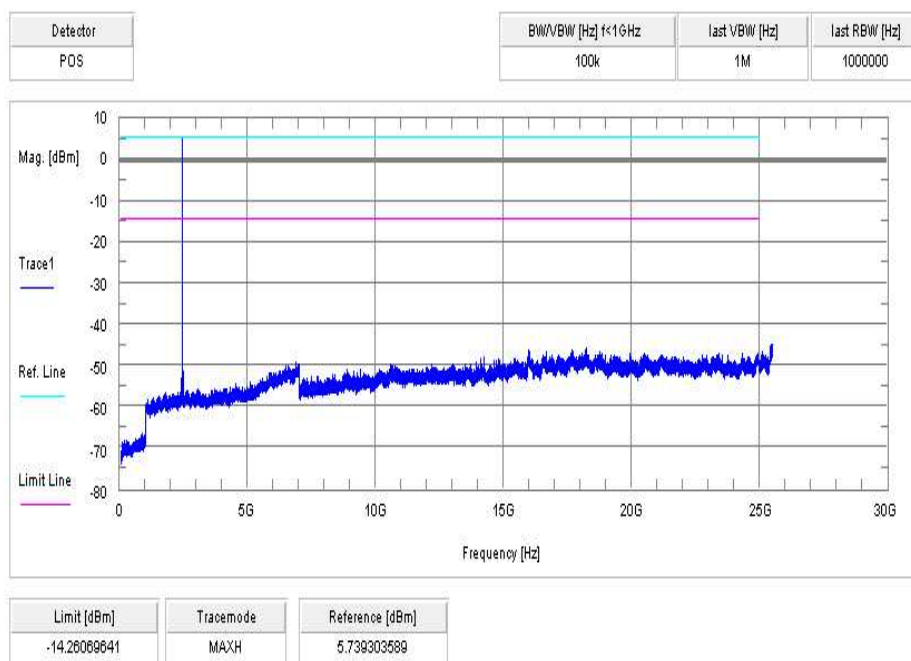
**Result:** Also see plots

TX Spurious Emissions Conducted					
GFSK - mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2402			30 dBm		Operating frequency
<i>No critical peaks found</i>			-20 dBc		complies
2441			30 dBm		Operating frequency
<i>No critical peaks found</i>			-20 dBc		complies
2480			30 dBm		Operating frequency
<i>No critical peaks found</i>			-20 dBc		complies
Measurement uncertainty			± 3 dB		

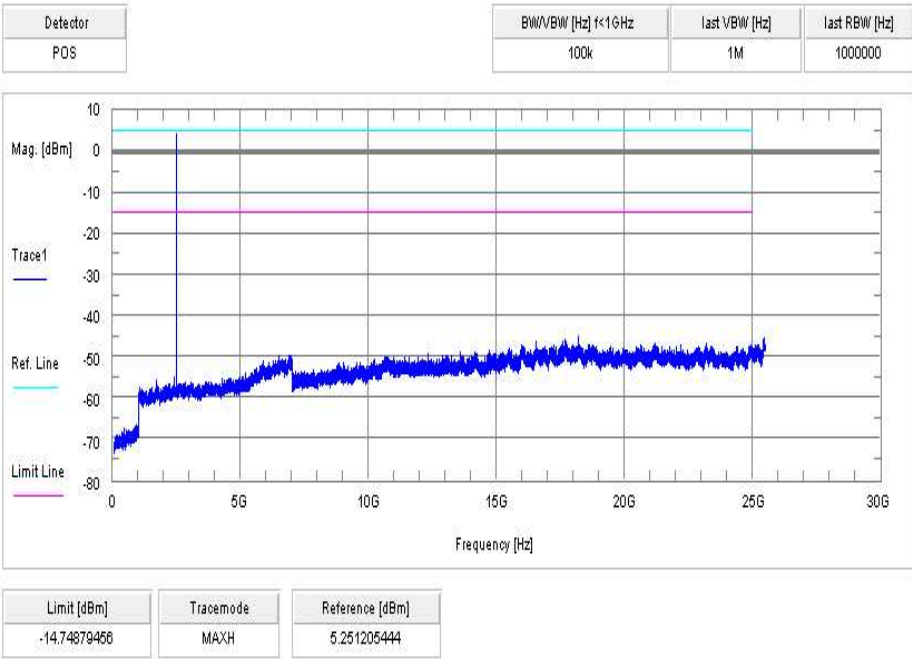
TX Spurious Emissions Conducted					
Pi/4-DQPSK - mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2402			30 dBm		Operating frequency
<i>No critical peaks found</i>			-20 dBc		complies
2441			30 dBm		Operating frequency
<i>No critical peaks found</i>			-20 dBc		complies
2480			30 dBm		Operating frequency
<i>No critical peaks found</i>			-20 dBc		complies
Measurement uncertainty			± 3dB		

TX Spurious Emissions Conducted					
8DPSK - mode					
f [MHz]		amplitude of emission [dBm]	limit max. allowed emission power	actual attenuation below frequency of operation [dB]	results
2402			30 dBm		Operating frequency
No critical peaks found			-20 dBc		complies
2441			30 dBm		Operating frequency
No critical peaks found			-20 dBc		complies
2480			30 dBm		Operating frequency
No critical peaks found			-20 dBc		complies
Measurement uncertainty		± 3dB			

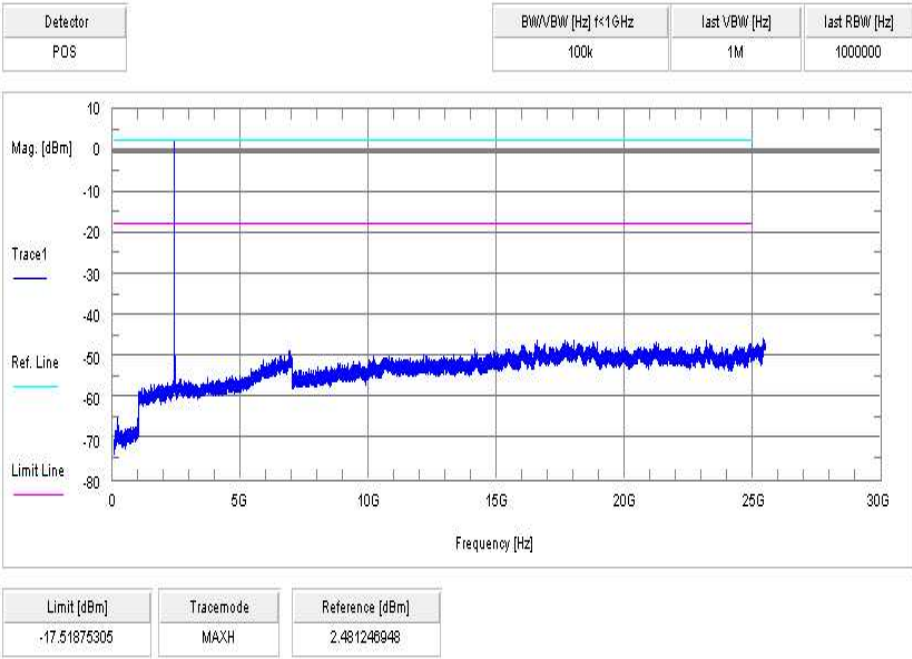
**Result:** The result of the measurement is passed.

**Plot 1: Channel 00 / GFSK****Plot 2: Channel 39 / GFSK**

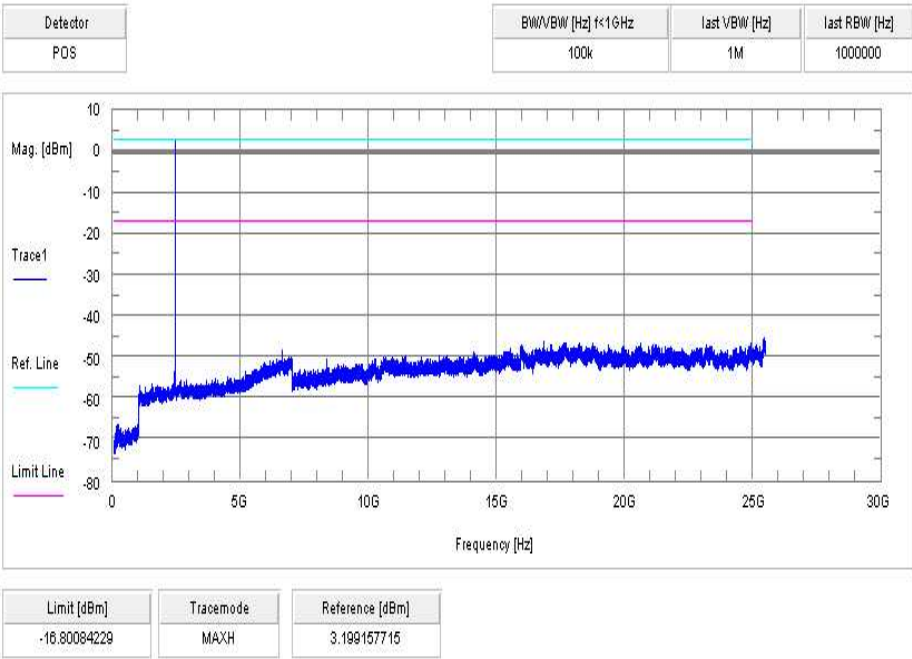
Plot 3: Channel 78 / GFSK



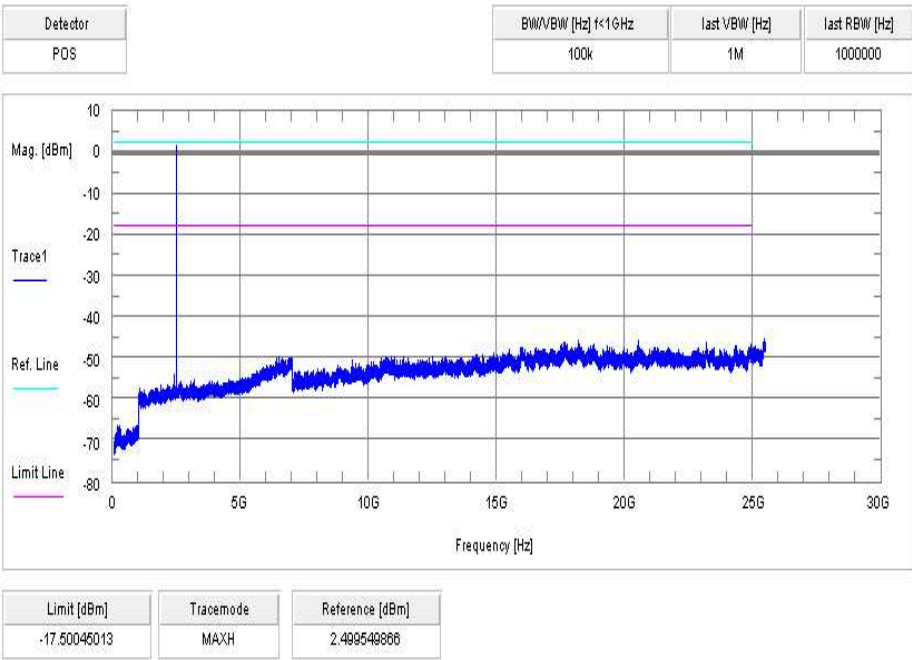
Plot 4: Channel 00 / Pi/4 DQPSK

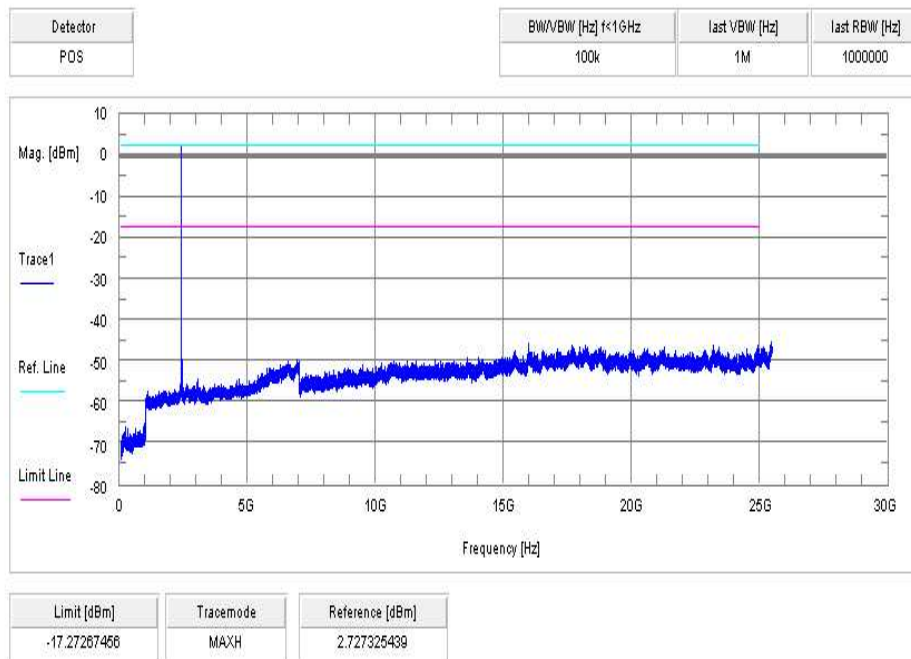
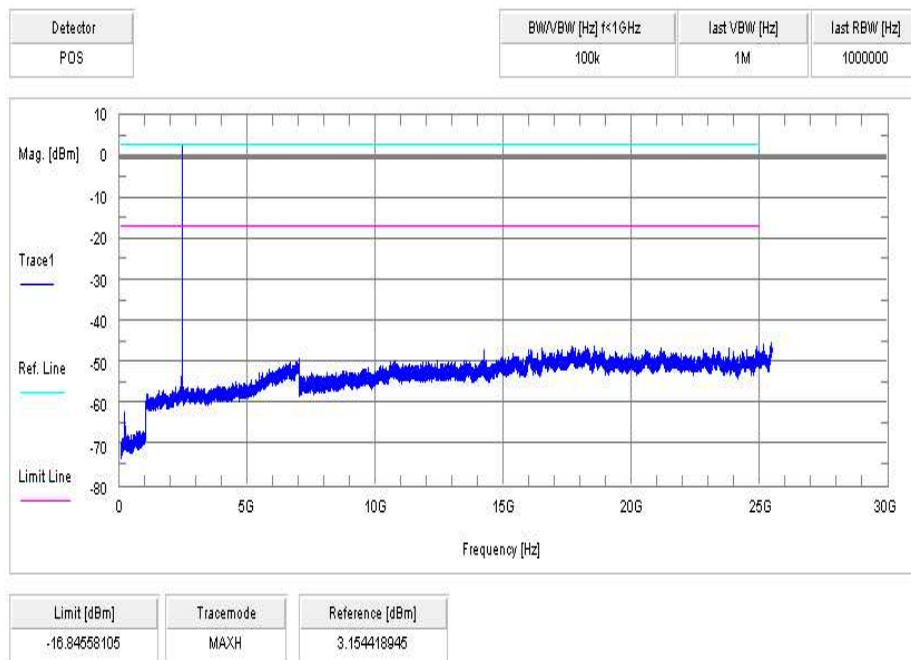


Plot 5: Channel 39 / Pi/4 DQPSK

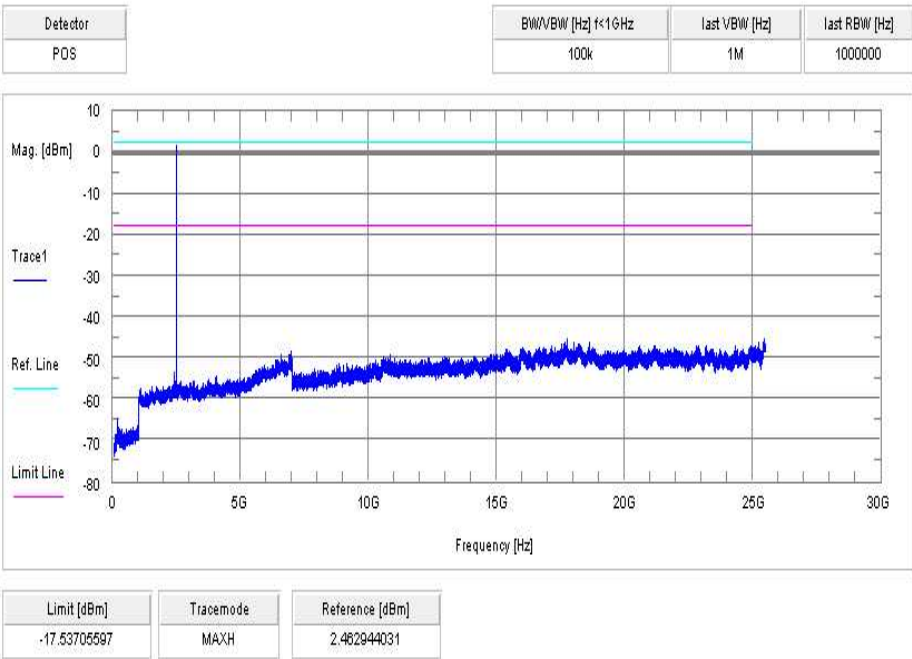


Plot 6: Channel 78 / Pi/4 DQPSK



**Plot 7: Channel 00 / 8DPSK****Plot 8: Channel 00 / 8DPSK**

**Plot 9: Channel 00 / 8DPSK**





## 9.11 TX Spurious Emissions Radiated

### Description:

Measurement of the radiated spurious emissions in transmit mode. The EUT is set to single channel mode and the transmit channel is channel 00, channel 39 and channel 78. The measurement is performed in the mode with the highest output power.

### Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	Sweep: 100 kHz Remeasurement: 10 Hz
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Span:	30 MHz to 25 GHz
Trace-Mode:	Max Hold
Measured Modulation:	<input checked="" type="checkbox"/> GFSK <input type="checkbox"/> Pi/4 DQPSK <input type="checkbox"/> 8DPSK

The modulation with the highest output power was used to perform the transmitter spurious emissions. If spurious were detected a re-measurement was performed on the detected frequency with each modulation.

### Limits:

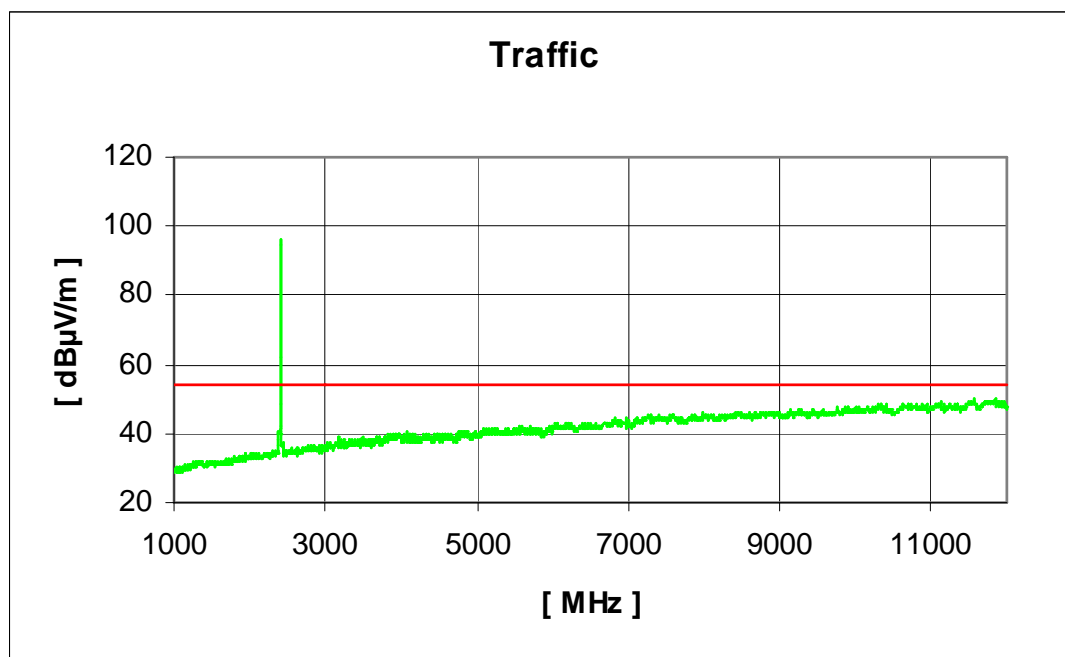
FCC		
CFR Part 15.247(d)		
TX Spurious Emissions Radiated		
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).		
§15.209		
Frequency (MHz)	Field Strength (dBμV/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

**Result:** Also see plots

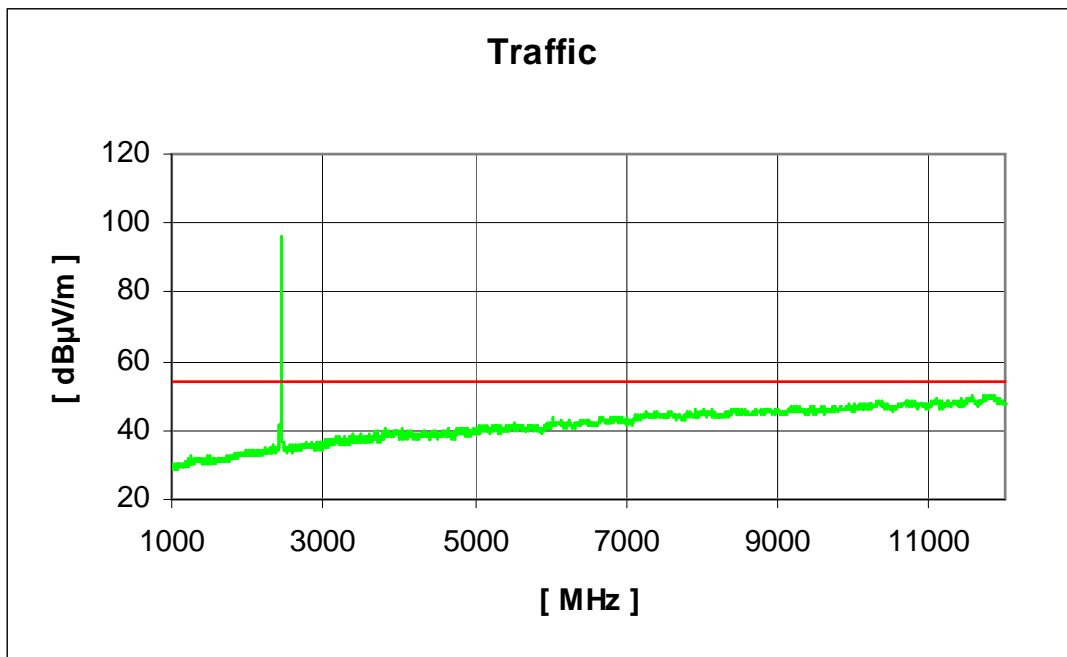
TX Spurious Emissions Radiated [dB $\mu$ V/m]								
2402 MHz			2441 MHz			2480 MHz		
F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]	F [MHz]	Detector	Level [dB $\mu$ V/m]
No critical peaks found			No critical peaks found			No critical peaks found		
Measurement uncertainty			$\pm 3$ dB					

**Result:** The result of the measurement is passed.

**Plot 1: 30 MHz to 12.75 GHz / Channel 00 (horizontal/vertical polarisation)**



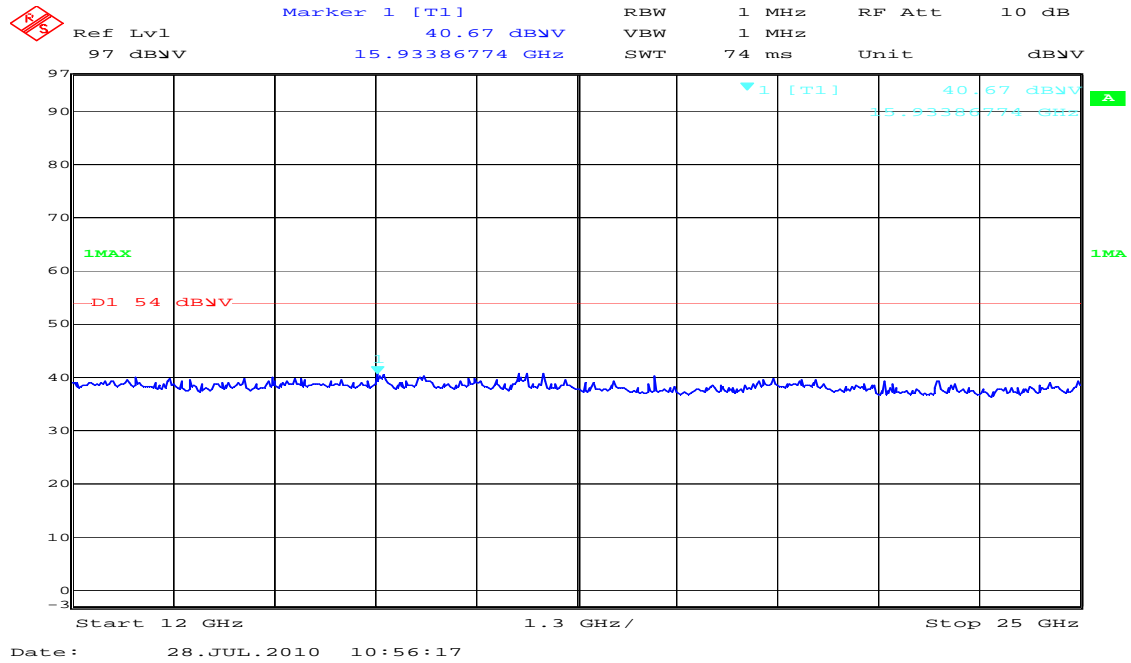
Plot 2: 30 MHz to 12.75 GHz / Channel 39 (horizontal/vertical polarisation)



Plot 3: 30 MHz to 12.75 GHz / Channel 78 (horizontal/vertical polarisation)



**Plot 4: 12 GHz to 25 GHz / Channel 00 (horizontal/vertical polarisation)**  
 (Valid for all modulations and channels)



## 9.12 RX Spurious Emissions Radiated

### Description:

Measurement of the radiated spurious emissions in idle/receive mode. The EUT is detached so all oscillators are active.

### Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	Sweep: 100 kHz Remeasurement: 10 Hz
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz
Span:	30 MHz to 25 GHz
Trace-Mode:	Max Hold

### Limits:

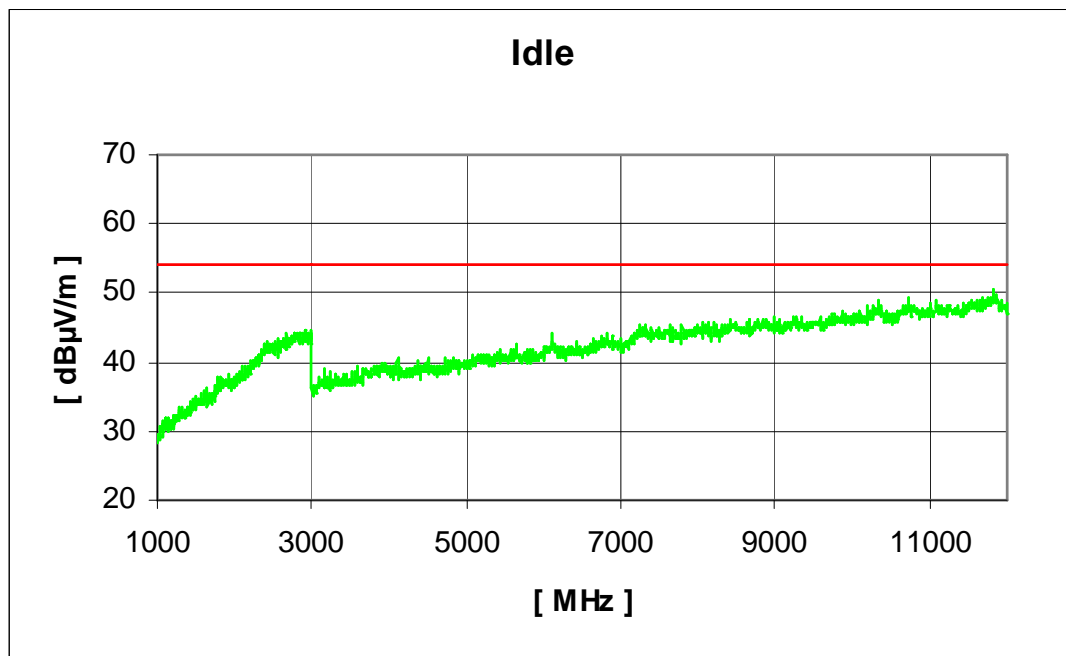
FCC		
CFR Part 15.109		
RX Spurious Emissions Radiated		
Frequency (MHz)	Field Strength (dB $\mu$ V/m)	Measurement distance
30 - 88	30.0	10
88 – 216	33.5	10
216 – 960	36.0	10
Above 960	54.0	3

### Result: Also see plots

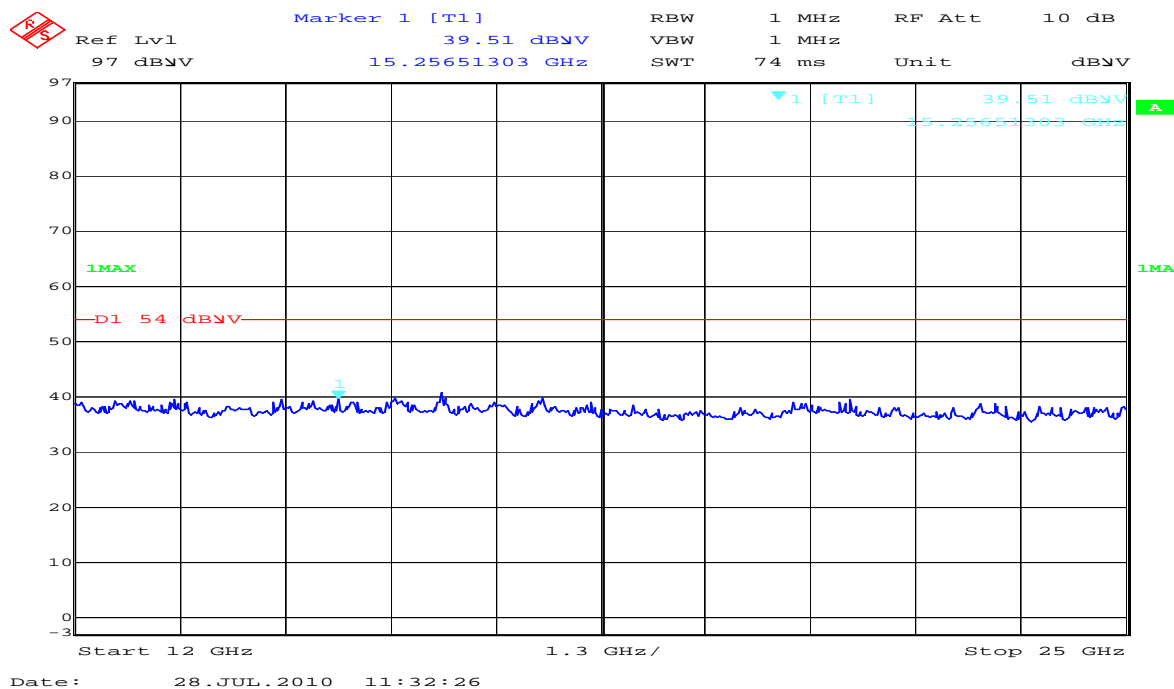
RX Spurious Emissions Radiated [dB $\mu$ V/m]		
F [MHz]	Detector	Level [dB $\mu$ V/m]
No critical peaks found		
Measurement uncertainty	$\pm 3$ dB	

**Result:** The result of the measurement is passed.

Plot 1: 30 MHz to 12.75 GHz / Idle-mode (horizontal/vertical polarisation)



Plot 2: 12 GHz to 25 GHz / Idle-mode (horizontal/vertical polarisation)



### 9.13 TX Spurious Emissions Radiated < 30 MHz

#### Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channel is channel 39. This measurement is representative for all channels and modes. If critical peaks are found channel 00 and channel 78 will be measured too. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

#### Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold

#### Limits:

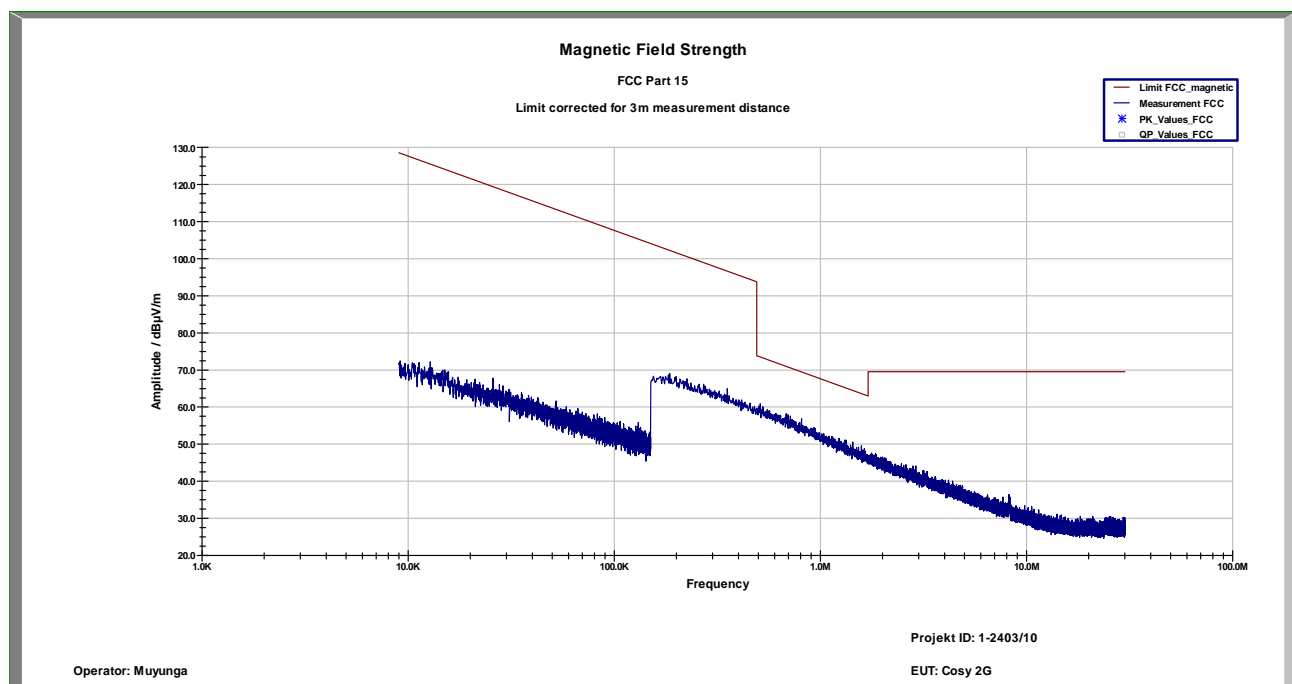
FCC		
CFR Part 15.209(a)		
TX Spurious Emissions Radiated < 30 MHz		
Frequency (MHz)	Field Strength (dBμV/m)	Measurement distance
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30

**Result:** Also see plot

TX Spurious Emissions Radiated < 30 MHz [dBμV/m]		
F [MHz]	Detector	Level [dBμV/m]
No critical peaks found		
Measurement uncertainty	± 3 dB	

**Result:** The result of the measurement is passed.

**Plot 1: 9 kHz to 30 MHz / Channel 39 (valid for all channels and modulations)**





## 9.14 TX Spurious Emissions Conducted < 30 MHz

### Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channel is channel 39. This measurement is representative for all channels and modes. If critical peaks are found channel 00 and channel 78 will be measured too. The measurement is performed in the mode with the highest output power. Both power lines, phase and neutral line, are measured. Found peaks are remeasured with average and quasi peak detection to show compliance to the limits.

### Measurement:

Measurement parameter	
Detector:	Peak - Quasi Peak / Average
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold

### Limits:

FCC		IC	
CFR Part 15.107(a)		ICES-003, Issue 4	
TX Spurious Emissions Conducted < 30 MHz			
Frequency (MHz)	Quasi-Peak (dBμV/m)	Average (dBμV/m)	
0.15 – 0.5	66 to 56*	56 to 46*	
0.5 – 5	56	46	
5 – 30.0	60	50	

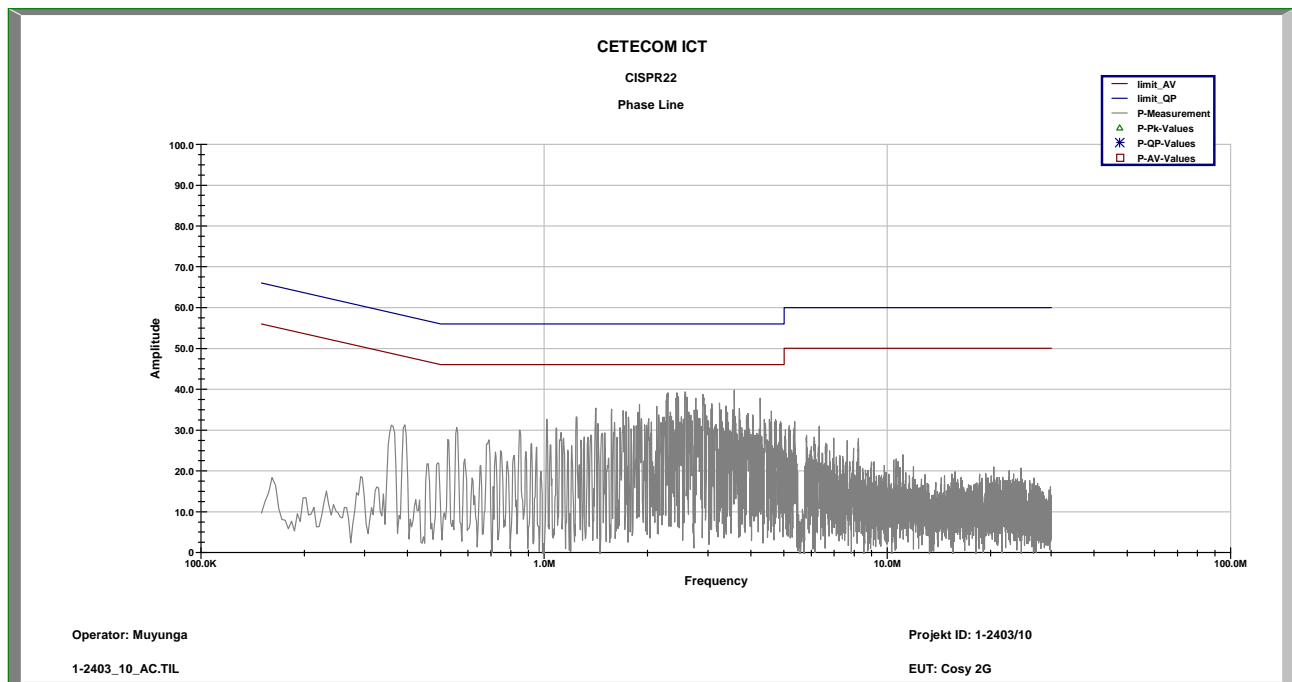
\*Decreases with the logarithm of the frequency

**Result:** Also see plots

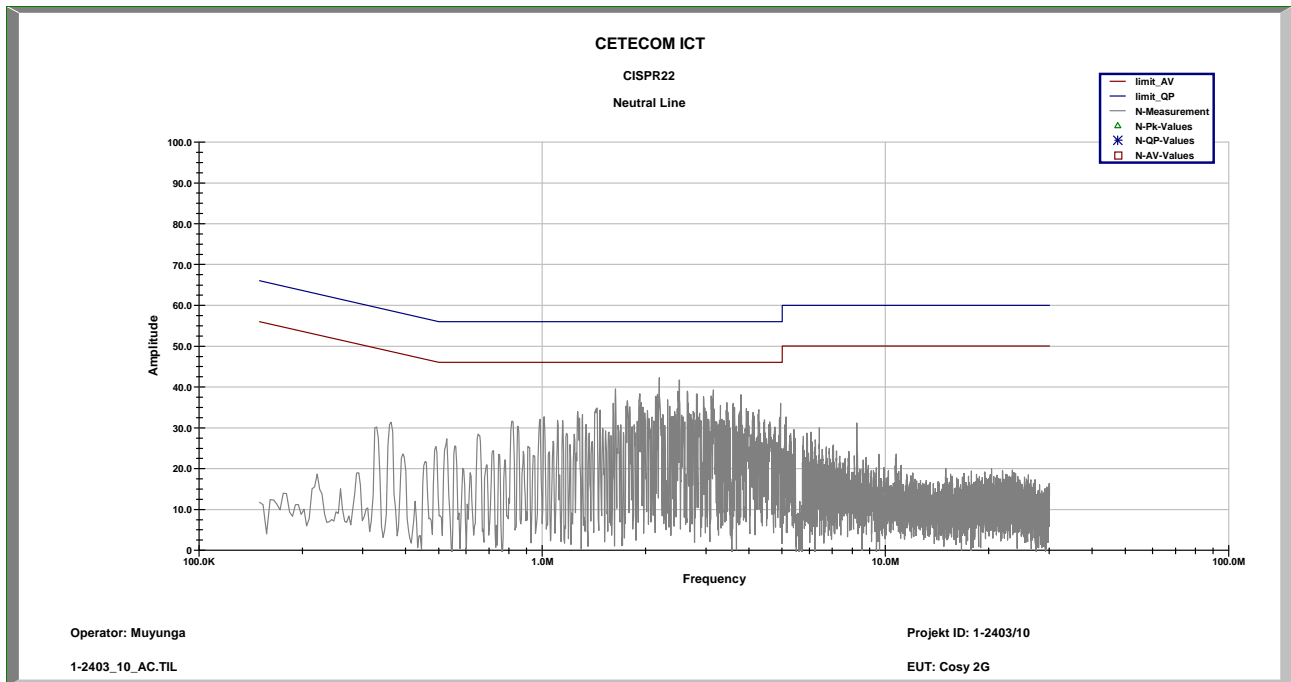
TX Spurious Emissions Conducted < 30 MHz [dBμV/m]		
F [MHz]	Detector	Level [dBμV/m]
No critical peaks found		
Measurement uncertainty	± 3 dB	

**Result:** The result of the measurement is passed.

**Plot 1: 9 kHz to 30 MHz / Phase Line**



**Plot 2: 9 kHz to 30 MHz / Neutral Line**



## 10 Test equipment and ancillaries used for tests

In order to simplify the identification of the equipment used at each specific test, each item of test equipment and ancillaries are provided with an identifier or number in the equipment list below.

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, rf-generating and signalling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

No.	Equipment	Type	Manufact.	Serial No.	INV. No Cetecom	Last Calibration	Next Calibration
1	Switch-Unit	3488A	HP Meßtechnik	2719A14505	300000368		
2	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2920A04466	300000580	06.01.2009	06.01.2011
3	software	SPS_PHE 1.4f	Spitzberger & Spieß	B5981; 5D1081;B5979	300000210		
4	EMI Test Receiver	ESCI 1166.5950.03	R&S	100083	300003312	08.01.2010	08.01.2012
5	Analyzer-Reference-System (Harmonics and Flicker)	ARS 16/1	SPS	A3509 07/0 0205	300003314	01.06.2009	01.06.2011
6	Amplifier	JS42-00502650-28-5A	MITEQ	1084532	300003379		
7	Antenna Tower	Model 2175	ETS-LINDGREN	64762	300003745		
8	Positioning Controller	Model 2090	ETS-LINDGREN	64672	300003746		
9	Turntable Interface-Box	Model 105637	ETS-LINDGREN	44583	300003747		
10	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	295	300003787	01.04.2010	01.04.2012
11	Spectrum-Analyzer	FSU26	R&S	200809	300003874	08.01.2010	08.01.2012
12	Horn Antenne 1-26.5GHz	3115	EMCO	9005-3440	300002190		
14	Horn Antenne 1-26.5GHz	3115	EMCO Elektronik	9709-5290	300000212		
15	Universal Communication Tester	CMU200	R&S	106826	300003346	12.01.2010	12.01.2011
16	Software Option für CMU 200	CMU-Kxx	R&S		300003345	12.01.2010	12.01.2011
17	Ultra Stable Notch Filter	WRCD1887.82/1889.55-5EE		1	300000115		
18	Funkstörmessempfänger 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	08.01.2010	08.01.2011
19	HF-Schaltmatrixgrundgerät	TS-RSP 1144.1500K03	R&S	100300	300003556		
22	Signalgenerator 1-20 GHz	SMR20	R&S	101697/020	300003593	08.01.2010	08.01.2012
23	Turnable Band Reject	WRCT1850/2170-5/40-10EEK	Wainwright	7	300003386		
24	Software Option für CMU 200	CMU-K62	R&S	103288	300003600	12.01.2010	12.01.2011
25	Software Option für CMU 200	CMU-K61	R&S	103354	300003612	12.01.2010	12.01.2011
26	Software Option für CMU 200	CMU-K64	R&S	102017	300003613	12.01.2010	12.01.2011
27	Software Option für CMU 200	CMU-K56	R&S	100251	300003614	12.01.2010	12.01.2011
29	Tunable Band Reject	WRCT1850/2170-5/40-10EEK	Wainwright	40	300003872		
30	Tunable Band Reject	WRCT824/894-5/40-8EEK	Wainwright	27	300003873		
31	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP Meßtechnik	2818A03450	300001040	08.01.2009	08.01.2012
32	PowerAttenuator	8325	Byrd	1530	300001595		
33	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	05.03.2009	05.03.2011
34	Active Loop Antenna	6502	EMCO	2210	300001015		
35	Anechoic chamber		MWB	87400/02	300000996		
36	System rack for EMI measurement solution	85900	HP I.V.	*	300000222		
37	Artificial Mains 9 kHz to 30 MHz, 4 x 25 Ampere	ESH3-Z5	R&S	828576/020	300001210	06.01.2010	06.01.2012
38	Relais Matrix	3488A	HP Meßtechnik	2719A15013	300001156		
39	Relais Matrix	PSU	R&S	890167/024	300001168		
40	Isolating Transformer	RT5A	Grundig	9242	300001263		

41	Three-Way Power Splitter, 50 Ohm	11850C	HP Meßtechnik		300000997		
42	Switch / Control Unit	3488A	HP	2605e08770	300001443		
43	Band Reject filter	WRCG1855/1910-1835/1925-40/8SS	Wainwright	7	300003350		
44	Band Reject filter	WRCG2400/2483-2375/2505-50/10SS	Wainwright	11	300003351		
45	TILE-Software Emission	Quantum Change, Modell TILE-ICS/FULL	EMCO	none	300003451		
46	Highpass Filter	WHKX2.9/18G-12SS	Wainwright	1	300003492		
47	Highpass Filter	WHK1.1/15G-10SS	Wainwright	3	300003255		
48	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789		
49	PSA Spectrum Analyzer 3 Hz - 26.5 GHz	E4440A	Agilent Technologies	MY48250080	300003812	05.08.2008	05.08.2010
50	MXG Microwave Analog Signal Generator	N5183A	Agilent Technologies	MY47420220	300003813	06.08.2008	06.08.2010
51	RF Filter Section 9kHz - 1GHz	N9039A	Agilent Technologies	MY48260003	300003825	19.08.2008	19.08.2010
52	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck	371	300003854	17.12.2008	17.12.2010

## Annex A Photographs of the Test Set-up

Photo documentation:

Photo 1:

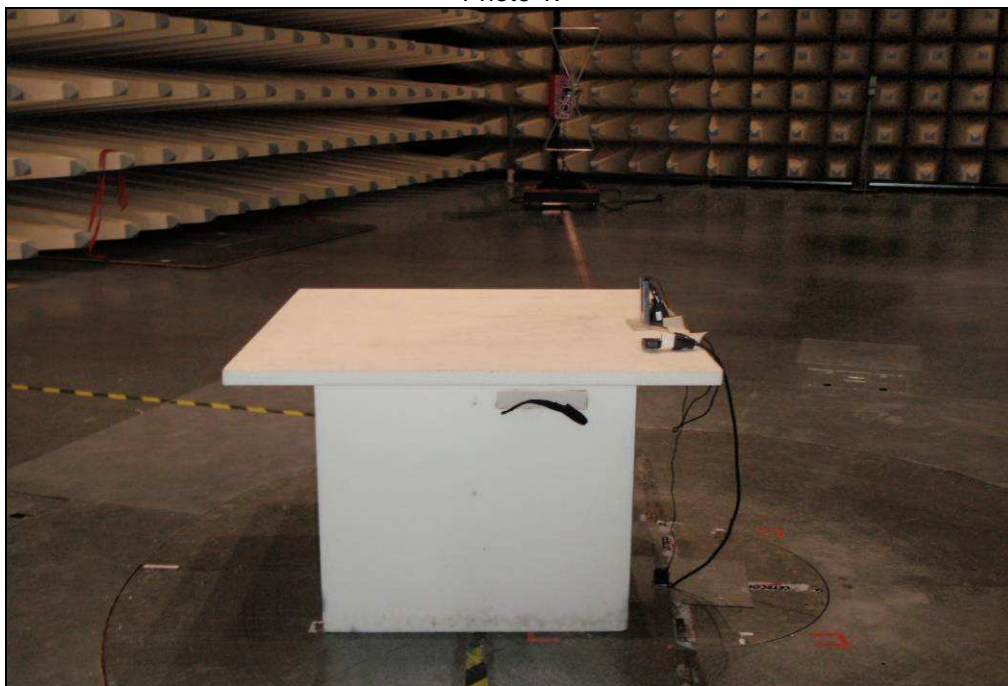


Photo 2:



Photo 3:





## Annex B External Photographs of the EUT

Photo documentation

Photo 1:





Photo 2:



Photo 3:



Photo 4:



Photo 5:



Photo 6:





## Annex C Internal Photographs of the EUT

Photo documentation

Photo 7:



Photo 8:



Photo 9:



Photo 10:

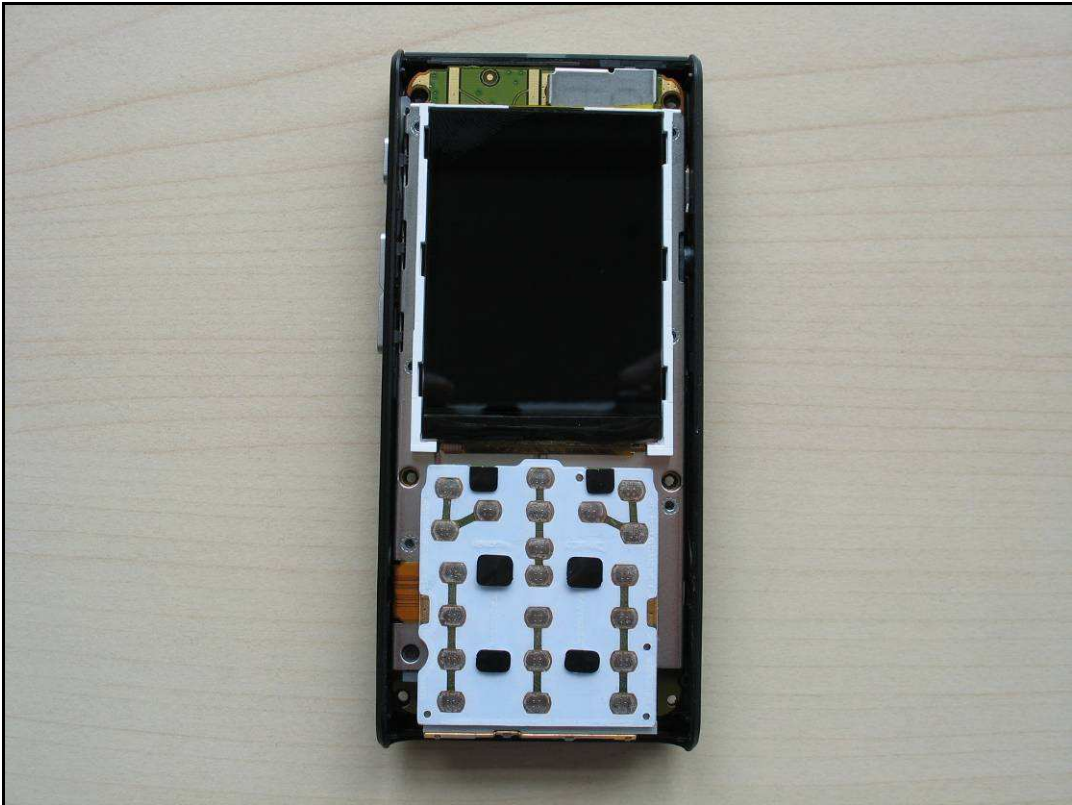


Photo 11:

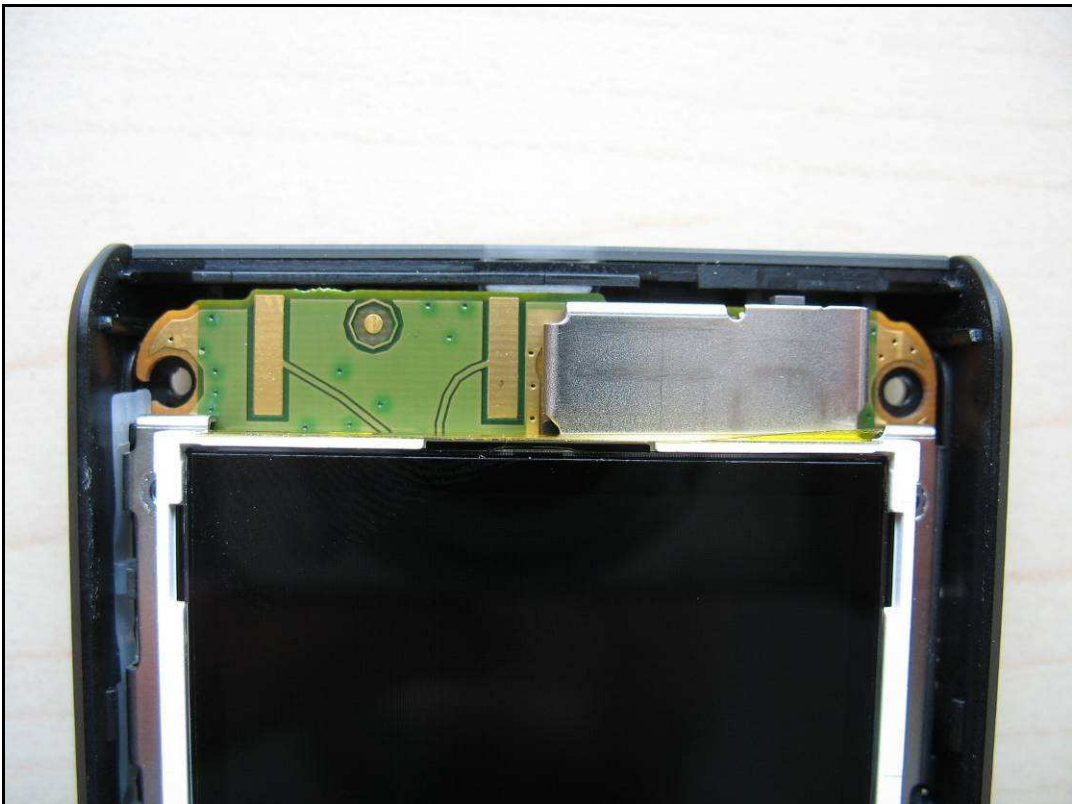




Photo 12:

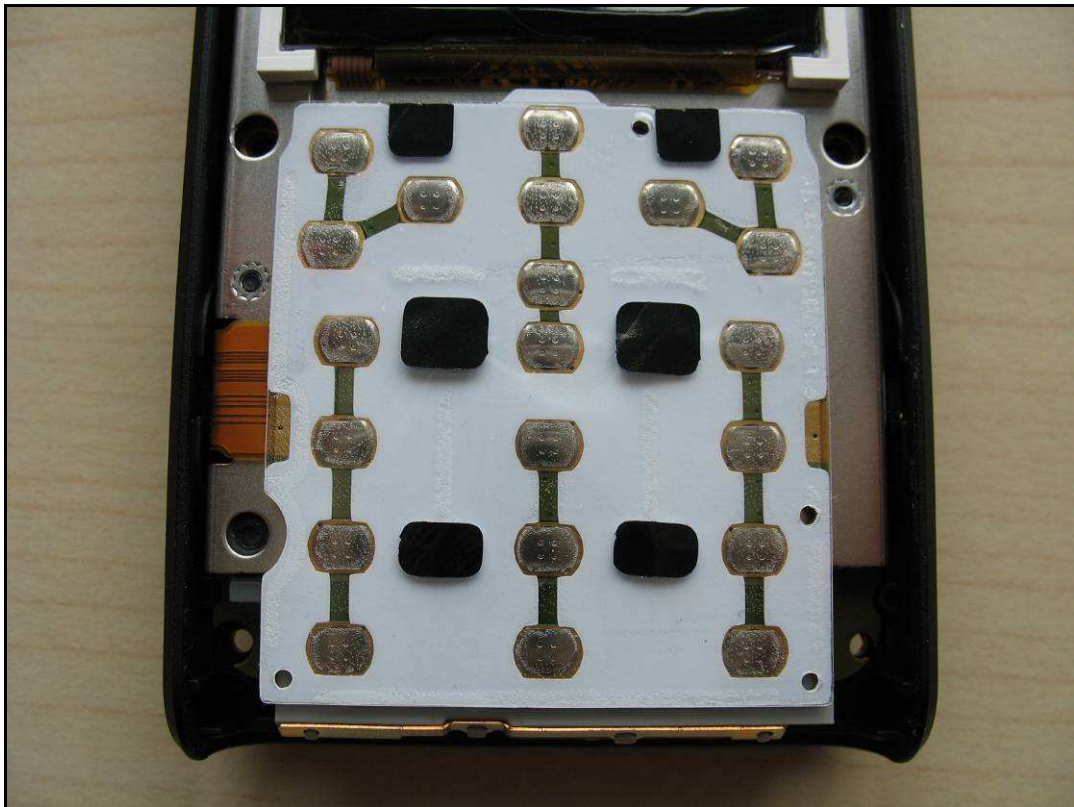


Photo 13:



Photo 14:

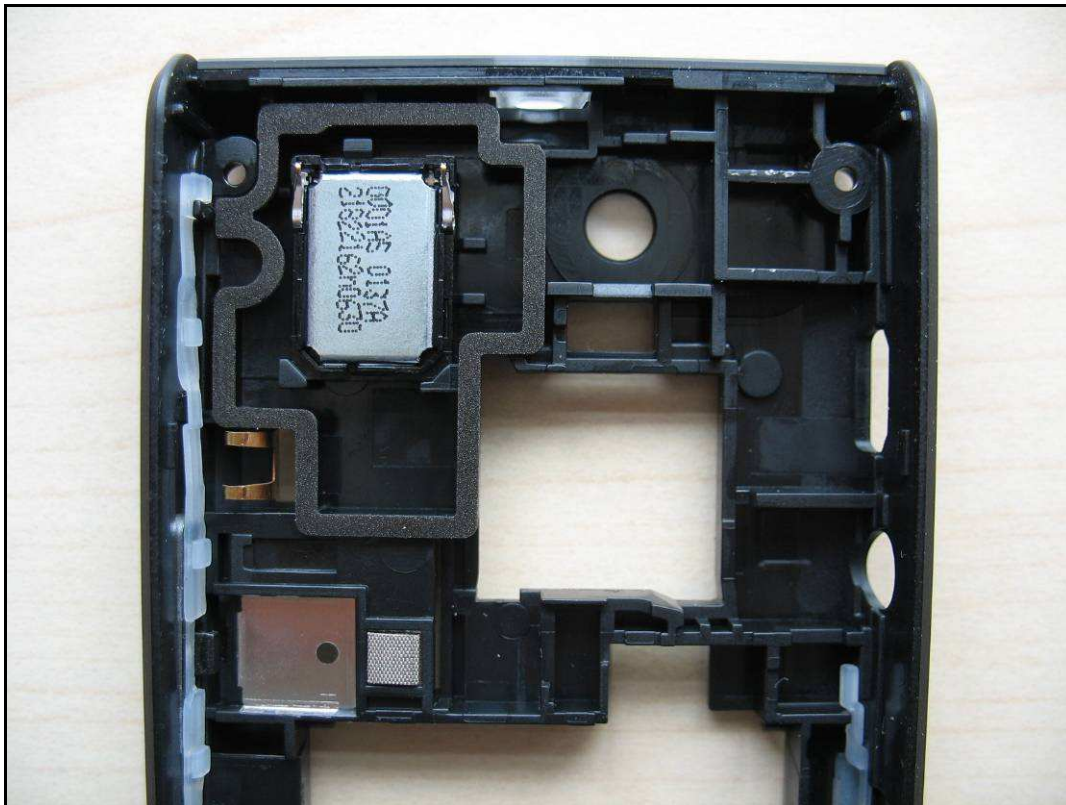


Photo 15:





Photo 16:

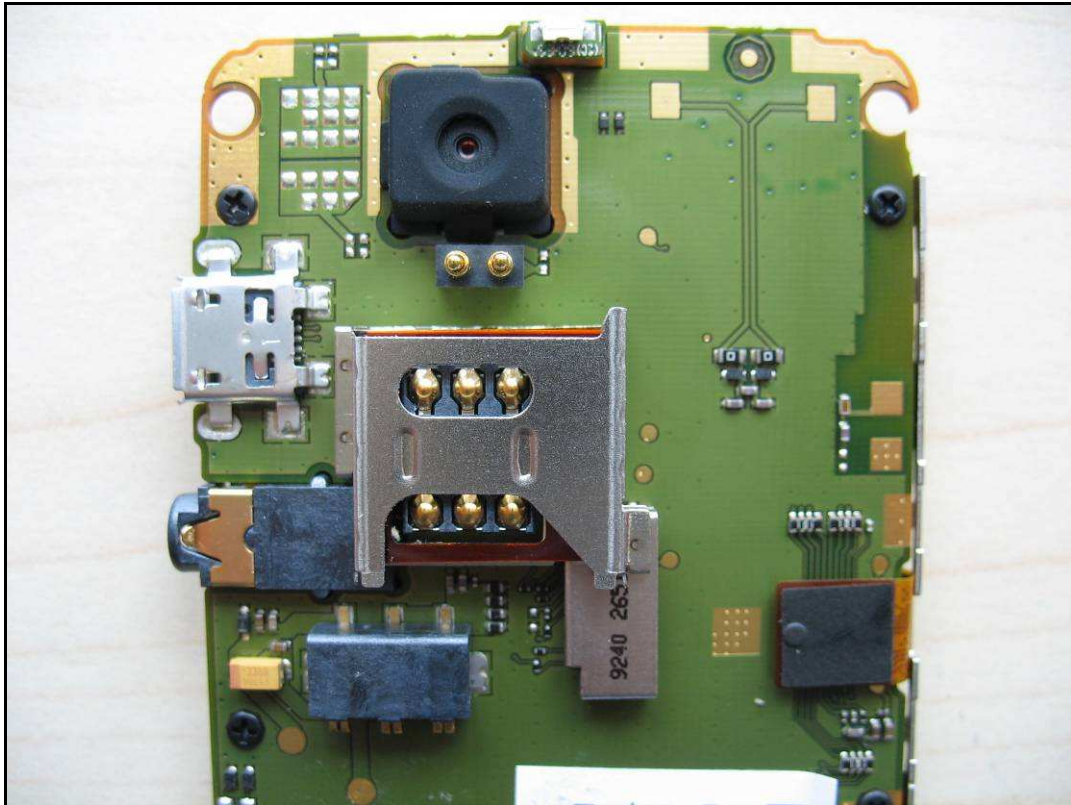


Photo 17:

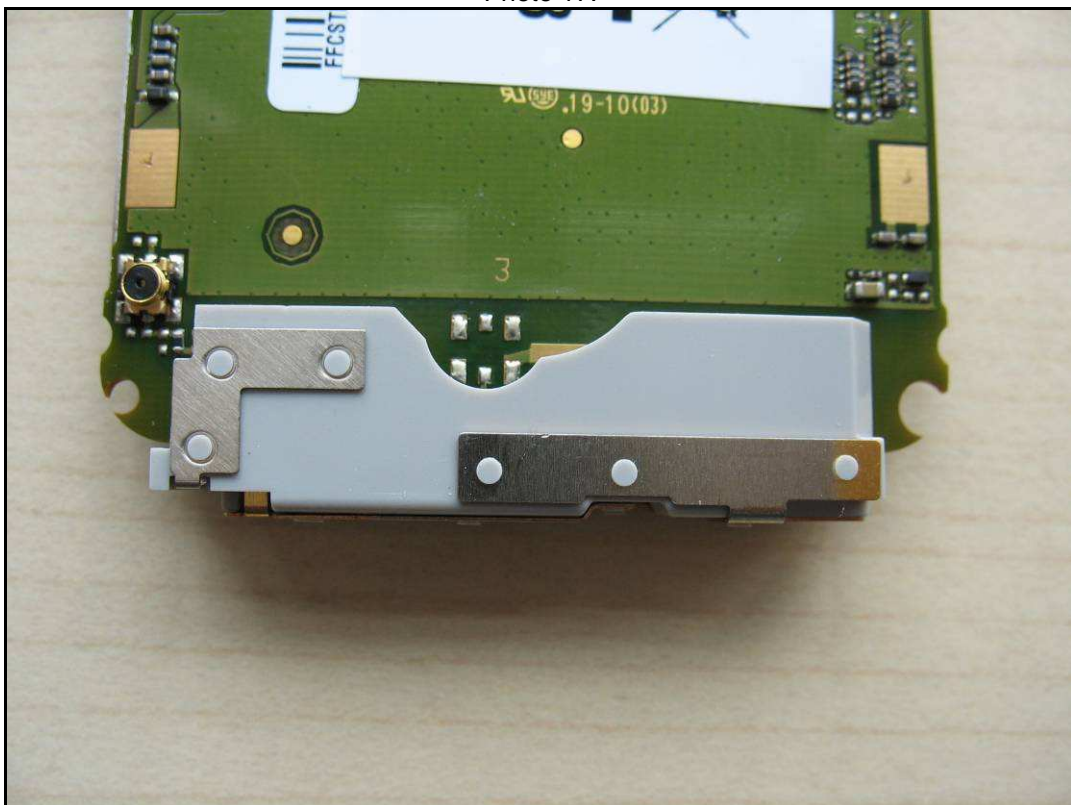


Photo 18:



Photo 19:





Photo 20:

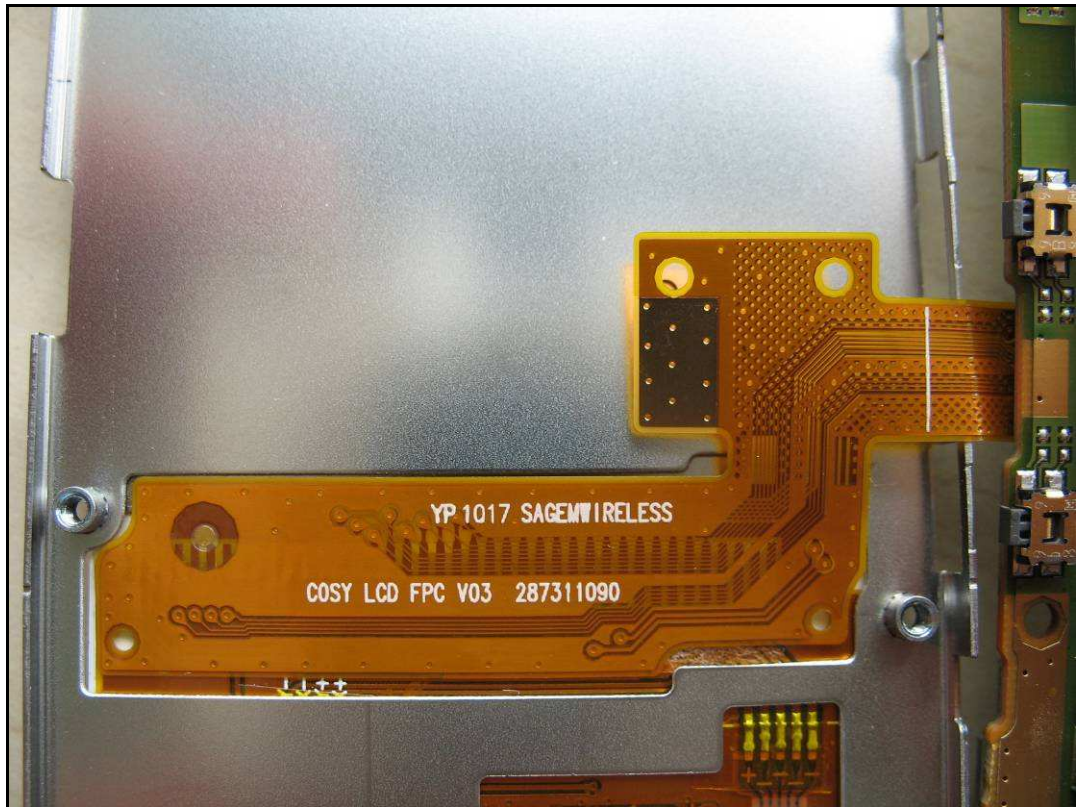


Photo 21:

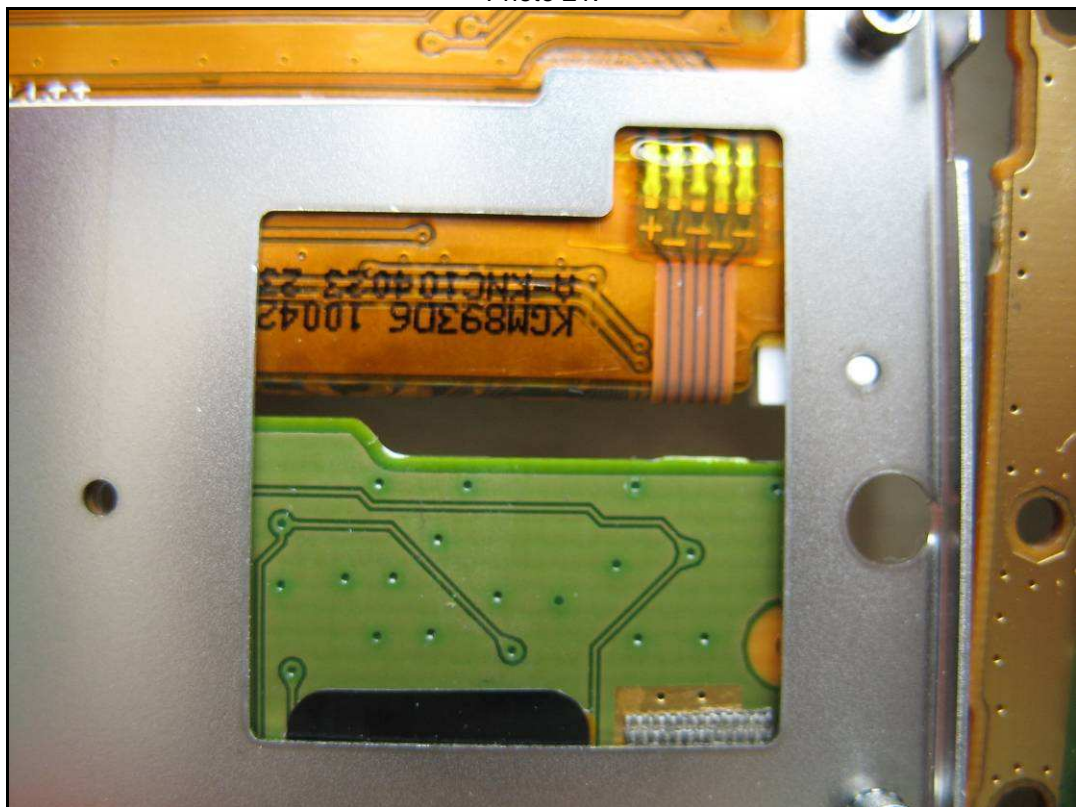


Photo 22:

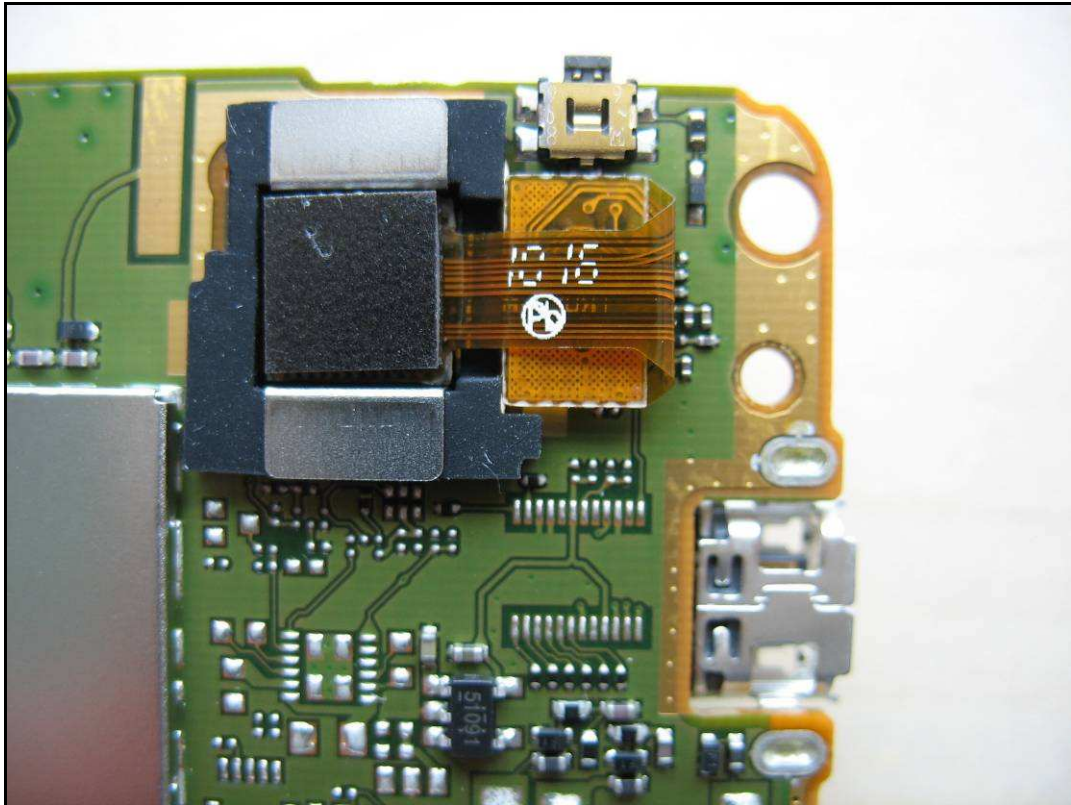


Photo 23:

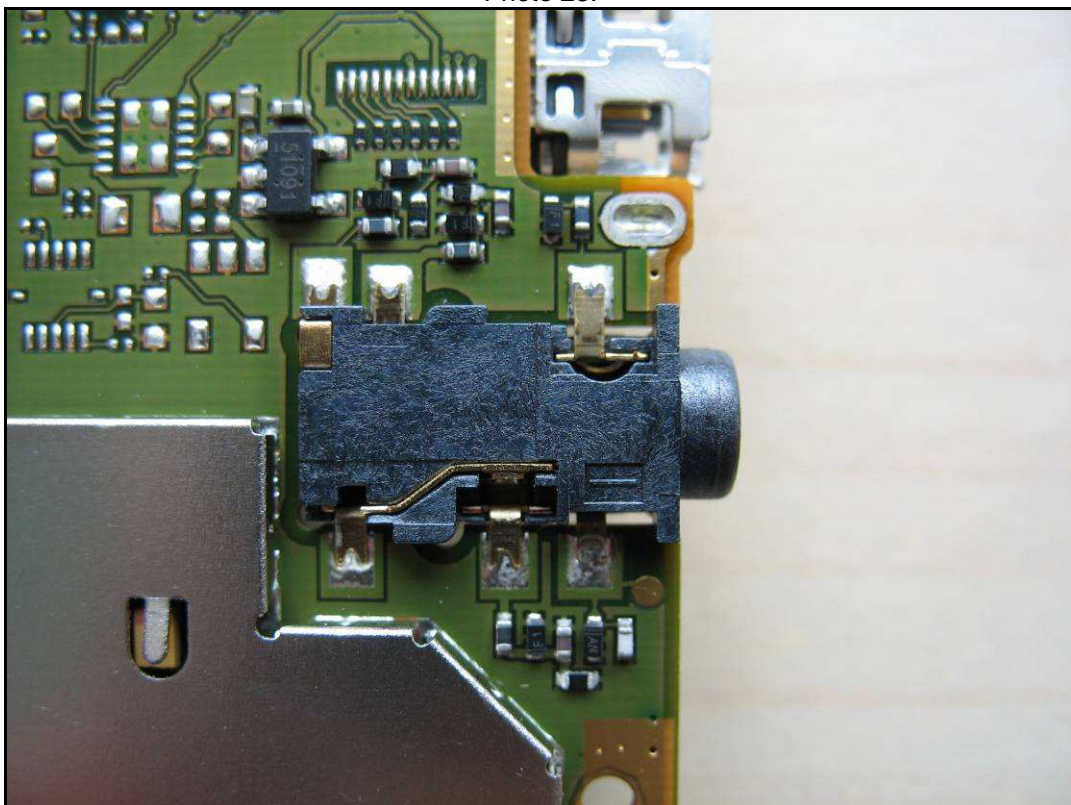




Photo 24:



Photo 25:

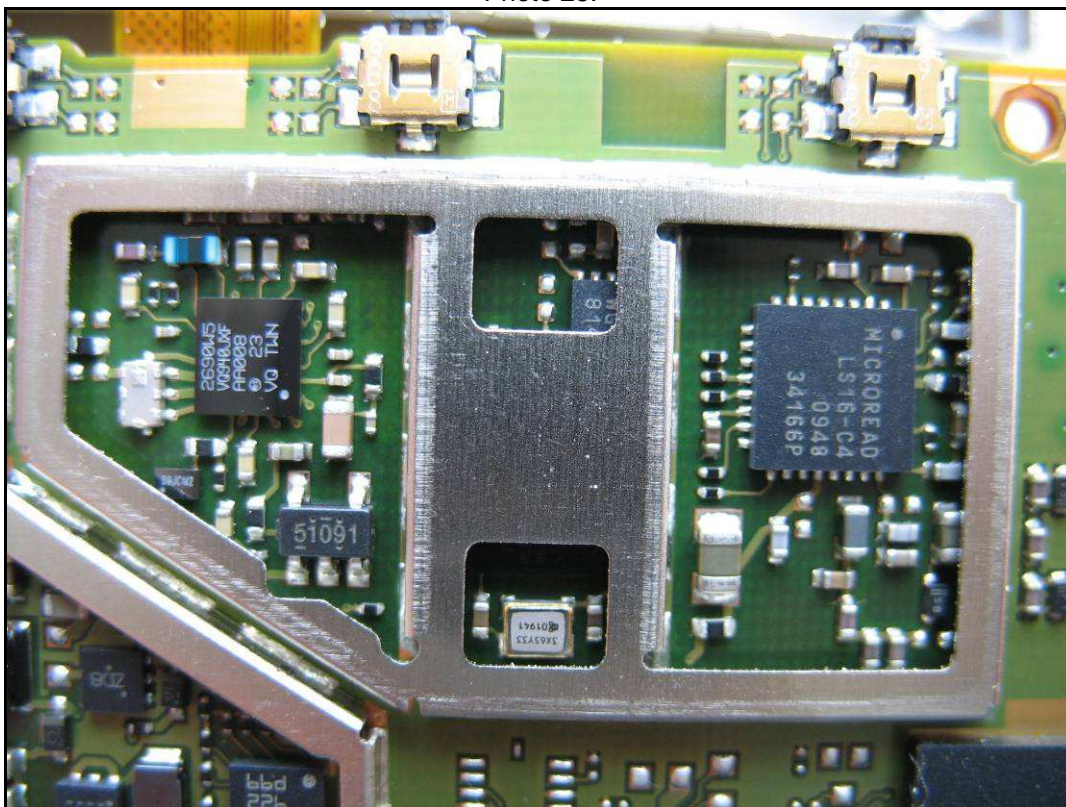




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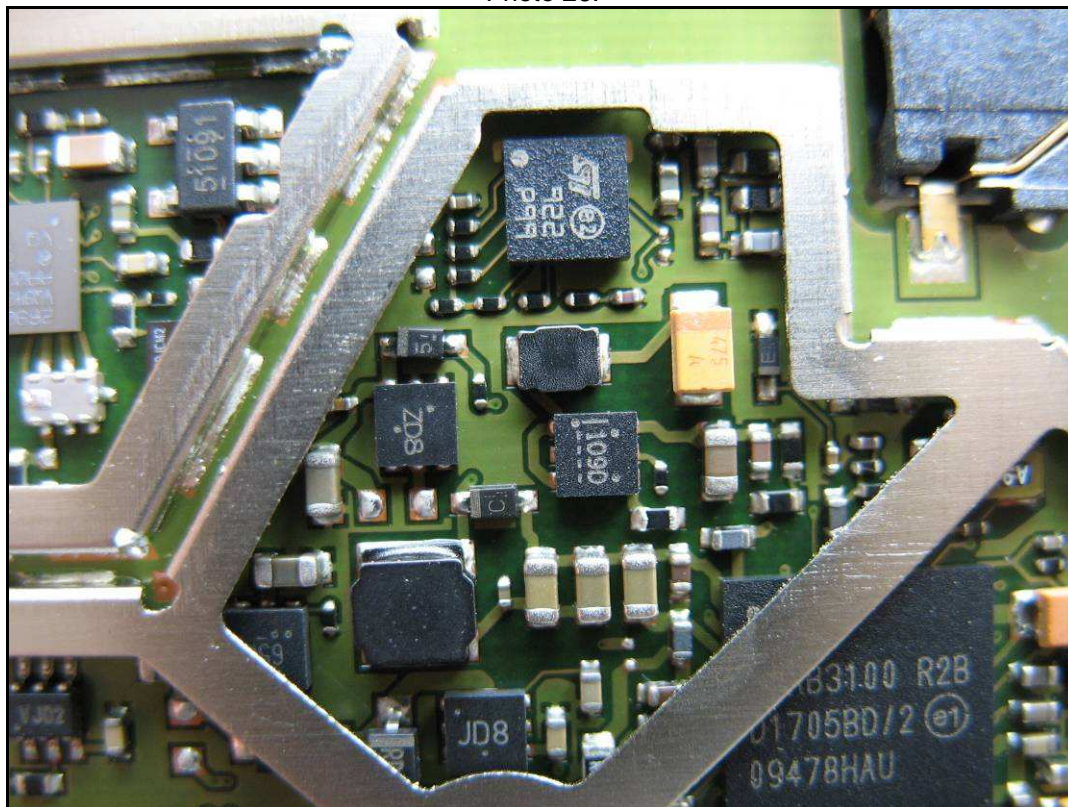


Photo 27:

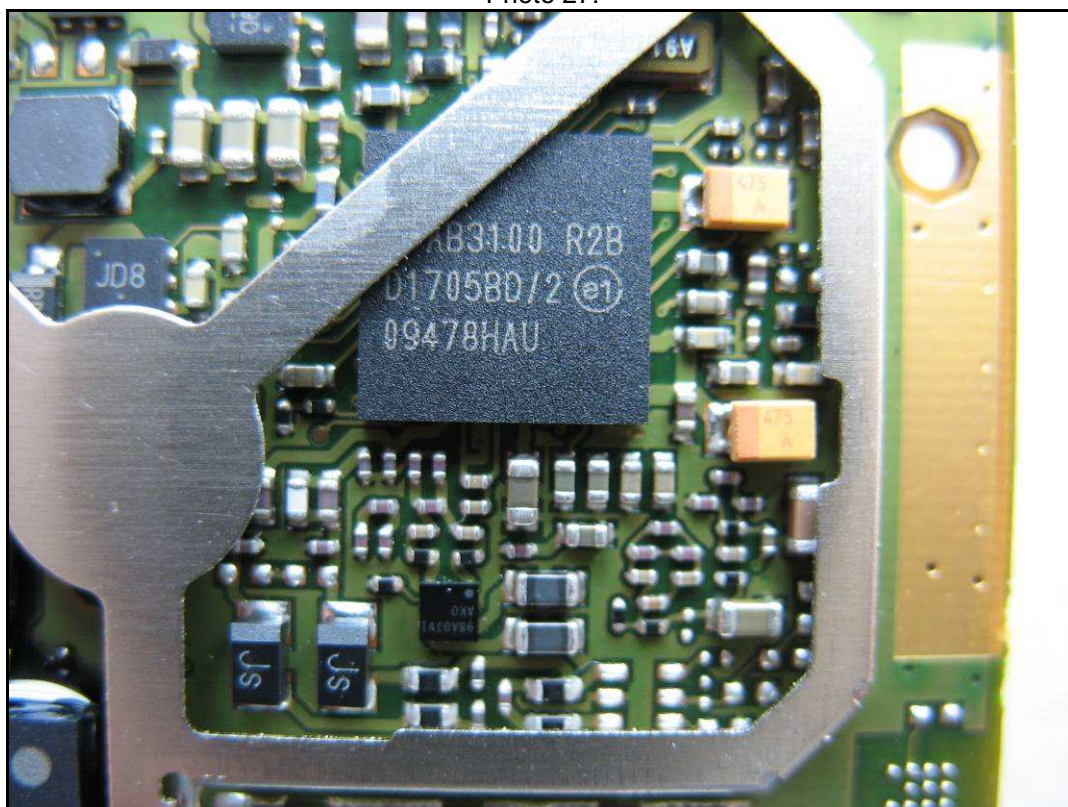




Photo 28:

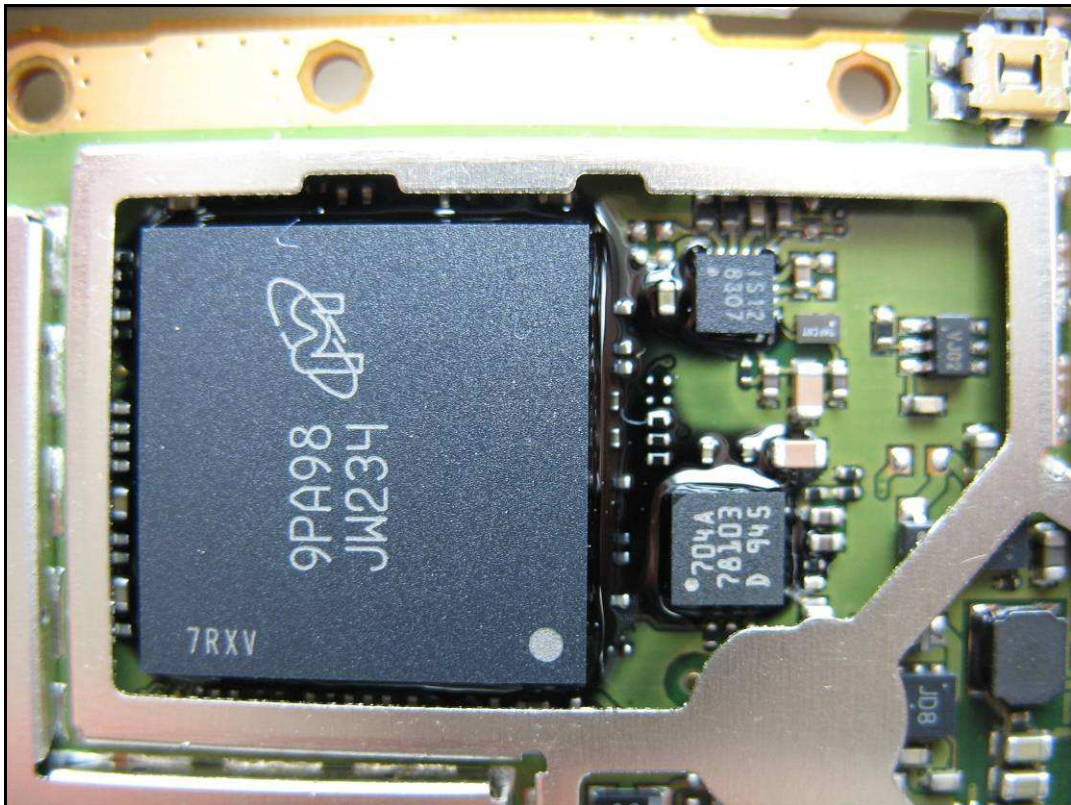


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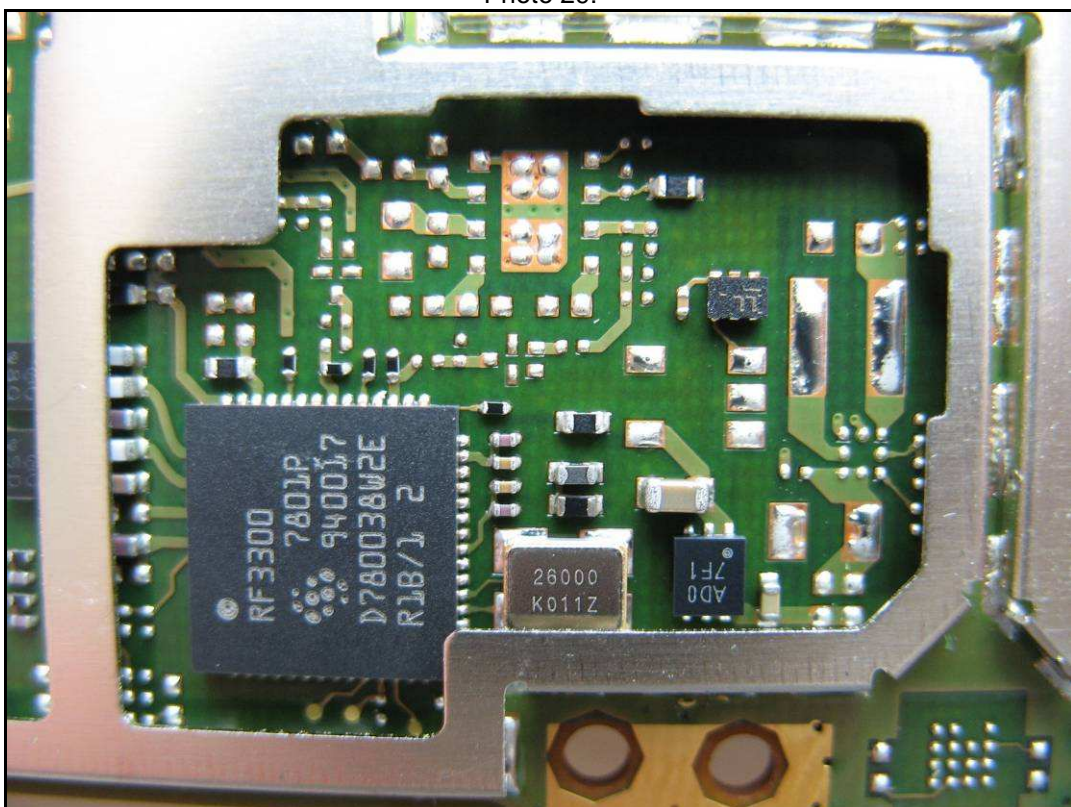




Photo 30:

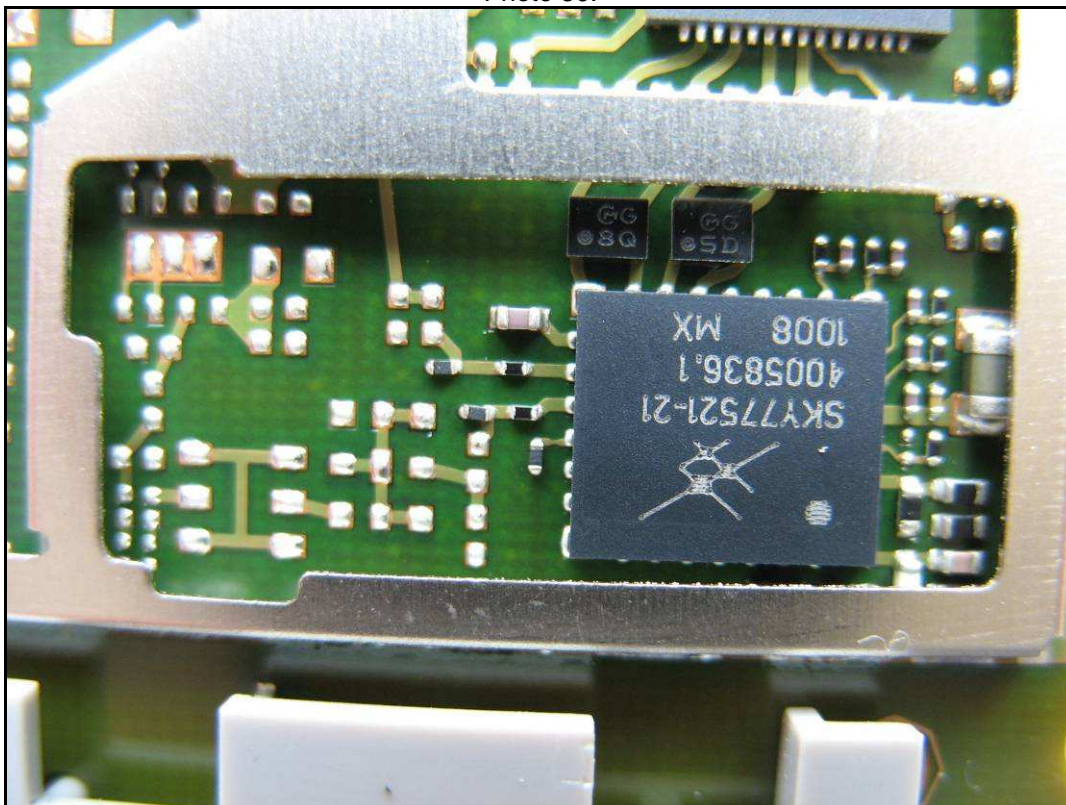


Photo 31:

