



EUROFINS PRODUCT SERVICE GMBH



Testing Cert #1983.01

TEST- REPORT

Compliance Test Report

FCC PART 15 SUBPART F, 15.509

Wall penetrating radar PS38

419202

TEST REPORT NUMBER: G0M20912-2774-C-1



Eurofins Product Service GmbH
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1 General Information

1.1 Notes

The results of this test report relate exclusively to the item tested as specified in chapter "Description of test item" and are not transferable to any other test items.

Eurofins Product Service GmbH is not responsible for any generalisations and conclusions drawn from this report. Any modification of the test item can lead to invalidity of test results and this test report may therefore be not applicable to the modified test item.

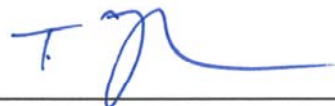
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Operator:

15.01.2010

T. Jahn



Date

Eurofins-Lab.

Name

Signature

Technical responsibility for area of testing:

15.01.2010

J. Zimmermann



Date

Eurofins

Name

Signature

Test Report No.: G0M20912-2774-C-1

EUROFINS PRODUCT SERVICE GMBH
STORKOWER STR. 38C, D-15526 REICHENWALDE B. BERLIN

1.2 Testing laboratory

EUROFINS PRODUCT SERVICE GMBH
Storkower Strasse 38c
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Germany
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Telefax : +49 33631 888 660

DAR ACCREDITED TESTING LABORATORY
DAR-REGISTRATION NUMBER: DAT-P-268/08

RECOGNIZED NOTIFIED BODY EMC
REGISTRATION NUMBER: BNetzA-bS EMV-07/61

RECOGNIZED NOTIFIED BODY R&TTE
REGISTRATION NUMBER: BNetzA-bS-02/51-53

FCC FILED TEST LABORATORY
REG.-No. 96970

A2LA ACCREDITED TESTING LABORATORY
CERTIFICATE No. 1983.01

BLUETOOTH QUALIFICATION TEST FACILITY (BQTF)
ACCREDITED BY BLUETOOTH QUALIFICATION REVIEW BOARD

INDUSTRY CANADA FILED TEST LABORATORY
REG. No. IC 3470

Test location, where different:

Name	: /.
Street	: /.
Town	: /.
Country	: /.
Telephone	: /.
Fax	: /.

1.3 Details of approval holder

Name : Hilti Corporation
Street : Feldkircherstrasse 100
Town : FL-9494 Schaan
Country : Principality of Liechtenstein
Telephone : 00423/234 3836
Fax : 00423/234 7836

Contact : Herr Wilfried Kaneider
Telephone : 00423/234 3836

1.4 Application details

Date of receipt of application : 05.01.2010
Date of receipt of test item : 05.01.2010
Date of test : 08.01.2010 – 14.01.2010

1.5 Test item

Description of test item : Wall penetrating radar PS38
Type identification : 419202
Brand Name : HILTI

Technical data

Frequency range : 1 - 6GHz
Antenna : integrated
Power supply : 4.8 VDC (Battery 4xAA)

Manufacturer:
(if applicable)

Name : Robert Bosch GmbH
Street : Postfach 10 01 56
Town : D-70745 Leinfelden-Echterdingen
Country : Germany

1.6 Test standards

Technical standard : **FCC PART 15 SUBPART F § 15.509**
FCC PART 15 SUBPART C § 15.209

1.7 Acronyms and Abbreviations

EUT : Equipment under Test
UWB : Ultra Wideband
TX : Transmission
RX : Reception
EIRP : Equivalent isotropic radiated power
 T_{nom} : Nominal Temperature
 T_{min} : Minimum Temperature
 T_{max} : Maximum Temperature
 V_{nom} : Nominal Supply Voltage
 V_{min} : Minimum Supply Voltage
 V_{max} : Maximum Supply Voltage

2 Technical test

2.1 Summary of test results

No deviations from the technical specification(s) were ascertained in the course of the tests performed.



or

The deviations as specified in 2.4 were ascertained in the course of the tests performed.



2.2 Test environment

Temperature	:	22	...	26°C
Relative humidity content	:	20	...	75%
Air pressure	:	86	...	103kPa

2.3 Test equipment utilized

Measurement Equipment List			
No.	Measurement device:	Type:	Manufacturer:
ETS 0019	Horn Antenna	BBHA 9120D	Schwarzbeck
ETS 0030	Biconical Antenna	HK 116	Rohde & Schwarz
ETS 0336	LPD Antenna	HL 223	Rohde & Schwarz
ETS 0481	Horn Antenna	22240-25	Flann Microwave
ETS 0496	Spectrum Analyzer	FSP 30	Rohde & Schwarz
ETS 0476	Measurement Receiver	ESCS 30	Rohde & Schwarz
	Amplifier Matrix		

2.4 Test results

☒ 1st test

☐ test after modification

☐ production test

Test case	Subclause	Required	Test passed	Test failed
TRANSMITTER PARAMETERS				
10dB Bandwidth	FCC § 15.503 FCC § 15.509	☒	☒	☐
Cease of operation time	FCC § 15.509	☒	☒	☐
Peak emission level	FCC § 15.509	☒	☒	☐
Radiated spurious emissions	FCC § 15.209 FCC § 15.509	☒	☒	☐

3 Transmitter parameters

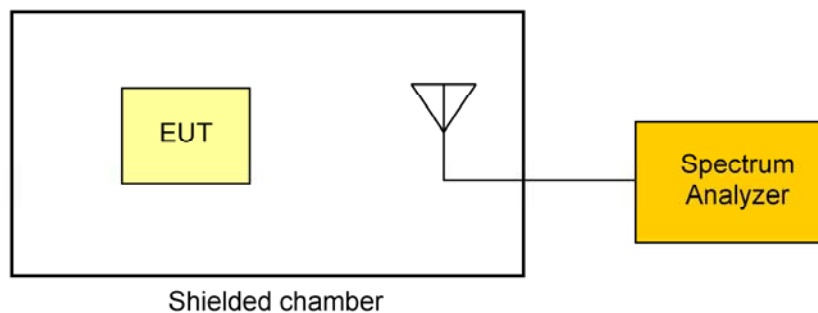
3.1 10dB Bandwidth

The UWB emission bandwidth occupied by the transmitted signal is reported as the frequency band bounded by the points that are 10dB below the highest radiated emission.

3.1.1 Limits

The intentional radiation transmitted by any UWB transmitter must have, at any point in time, a fractional bandwidth equal to or greater than 0.20 or a UWB bandwidth equal to or greater than 500MHz regardless of the fractional bandwidth. Ground penetrating radars or wall imaging systems provided after FCC § 15.509 must have a UWB bandwidth below 10.6GHz.

3.1.2 Measurement procedure



The EUT is placed in a shielded chamber and set to transmission mode under normal test conditions. A measurement antenna is connected to a spectrum analyzer. The span of the analyzer is set wide enough to capture all significant emissions of the intended transmitted spectrum. The maximum emission frequency is identified and the two edge frequencies with a power level 10dB lower than the power level of the maximum emission frequency are identified and recorded.

3.1.3 Results

Transmitter 10dB bandwidth	
Measurement Conditions	
Bandedge criteria :	-10dBc
Maximum emission frequency [MHz]	Bandwidth [MHz]
5012.2	2196.4
See attached diagram in Annex	
Verdict	PASS

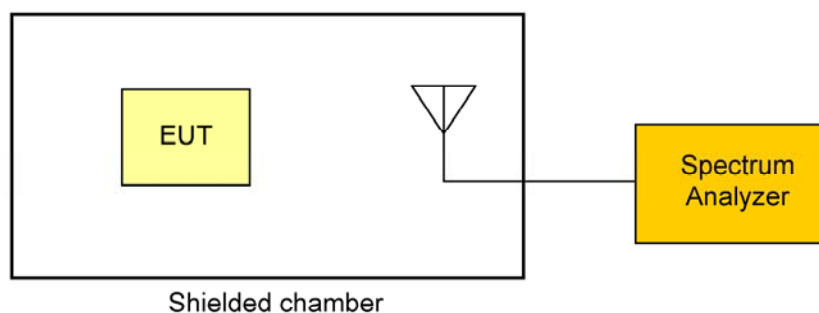
3.2 Cease of operation time

The device, if designed for manual operation, shall be equipped with a switch that causes the transmitter to cease operation within 10s.

3.2.1 Limits

The transmitter shall cease operation after 10s.

3.2.2 Measurement procedure



The EUT is placed in a shielded chamber and set to transmission mode under normal test conditions. A measurement antenna is connected to a spectrum analyzer. The EUT is switched off and the time until the transmitter ceases its operation is recorded.

3.2.3 Results

Cease of operation time	
Time for cease of operation [s]	
< 10s	
Verdict	PASS

3.3 Peak emission level

If the frequency of the highest emission frequency of the UWB transmitter is above 960MHz a limit on the peak level of the emission within a 50MHz bandwidth is defined.

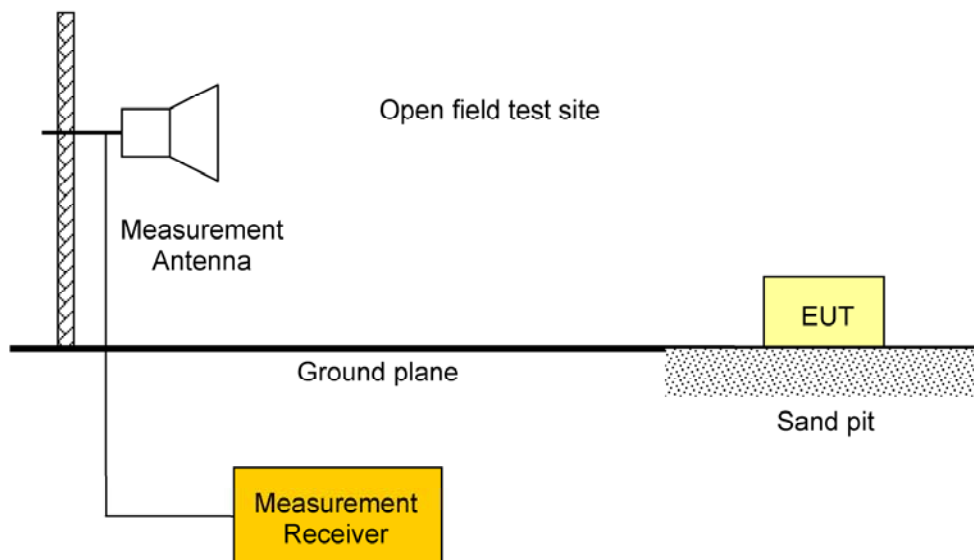
3.3.1 Limits

The peak emission level within a 50MHz bandwidth centered on the highest emission frequency f_M has to be lower or equal than 0dBm EIRP.

If a different resolution bandwidth is used the limit can be adjusted according the following equation (15.521) :

$$L[\text{dBm}] = 20 \log_{10} \left(\frac{\text{RWB}[\text{MHz}]}{50} \right)$$

3.3.2 Measurement procedure



According to FCC 02-48 the EUT is placed on a sand pit and activated in transmission mode. The measurement antenna is pointed directly to the EUT. The radiated emissions are measured in the frequency range of the intentional radiation using peak detector and resolution bandwidth of 3MHz. In order to maximize the emission the EUT is measured at 8 positions (every 45°). The measurement is performed for horizontal and vertical polarization of the measurement antenna.

3.3.3 Results

Peak emission level								
Measurement Conditions								
Resolution bandwidth:		3MHz						
Measurement Distance:		1.5m						
Emission Limit:		-24.4dBm						
Detector:		Peak						
Frequency [MHz]	Pol.	Reading [dB μ V]	AF [dB/m]	Cable Loss [dB]	Pre-Amp. Gain [dB]	Net Field Strength [dB μ V/m]	Limit [dB μ V/m]	Delta [dB]
3915.8	V	65	28	1.4	42	52.4	76.8	-24.4
3915.8	H	68	28	1.4	42	55.4	76.8	-21.4
Verdict						PASS		

Note : The field strength limits are calculated by $E[\text{dB}\mu\text{V/m}] = P[\text{dBm}] + 95.2$ for a measurement distance of 3m according 15.521 or $E[\text{dB}\mu\text{V/m}] = P[\text{dBm}] - 20 \log(D[\text{m}]) + 104.8$ for measurement distance D according NTIA 01-43 sec. 2.2.1..

3.4 Transmitter spurious emissions

The radiated emission from the device have to comply with the emission limits stated in paragraph 15.209 and 15.509 of the FCC rules.

3.4.1 Limits

Below 960MHz the radiated emissions have to comply with the limits stated in 15.209. Paragraph 15.209 defines the following emission limits in the frequency range from 9kHz to 960MHz when measured with quasi-peak detector.

Tranmitter spurious emission limits below 960MHz				
Tx-state	Frequency range [MHz]	Limit 3m [μ V/m]	Calculated Limit 3m [dB μ V/m]	Limit Distance [m]
Operational	0.009 – 0.490	2400/F[kHz]	48.5 – 13.8	300
	0.490 – 1.705	2400/F[kHz]	33.8 - 23	30
	1.705 – 30.0	30	29.5	30
	30 – 88	100	40.0	3
	88 – 216	150	43.5	3
	216 – 960	200	46.0	3
	> 960	500	54.0	3

The radiated emission limits above 960MHz are stated in 15.509. The measurements are performed with an RMS detector and a resolution bandwidth of 1MHz and the following limits shall not be exceeded.

Tranmitter spurious emission limits above 960MHz, RBW 1MHz				
Tx-state	Frequency range [MHz]	Limit [dBm EIRP]	Limit [dB μ V/m]	Limit Distance [m]
Operational	960 – 1610	-65.3	29.9	3
	1610 – 1990	-53.3	41.9	3
	1990 – 3100	-51.3	43.9	3
	3100 – 10600	-41.3	53.9	3
	> 10600	-51.3	43.9	3

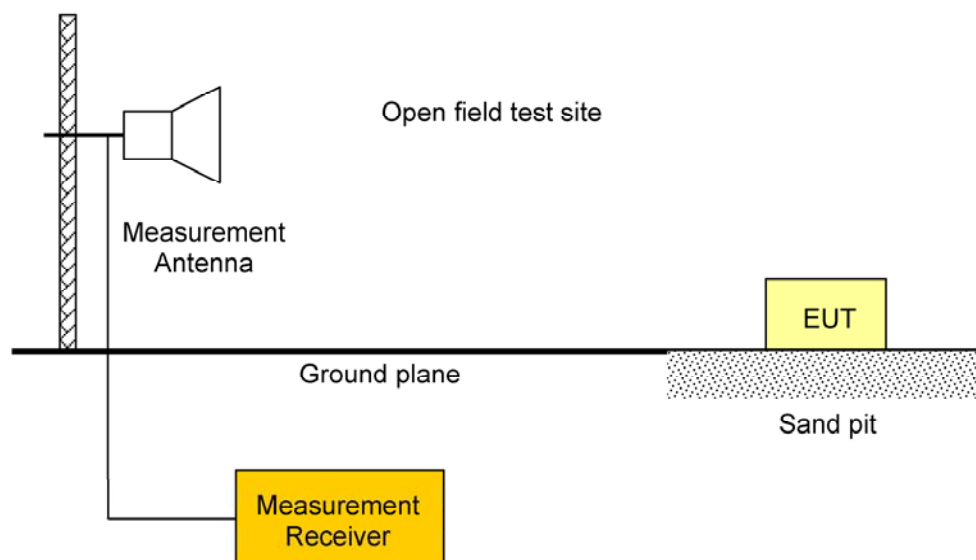
Note : The field strength limits are calculated by $E[\text{dB}\mu\text{V/m}] = P[\text{dBm}] + 95.2$ for a measurement distance of 3m according 15.521 or $E[\text{dB}\mu\text{V/m}] = P[\text{dBm}] - 20 \log(D[\text{m}]) + 104.8$ for measurement distance D according NTIA 01-43 sec. 2.2.1..

In addition the radiated emission limits have to comply with the following limits for a resolution bandwidth of 1kHz and RMS detector.

Tranmitter spurious emission limits above 960MHz, RBW 1kHz				
Tx-state	Frequency range [MHz]	Limit [dBm EIRP]	Limit [dBμV/m]	Limit Distance [m]
Operational	1164 – 1240	-75.3	19.9	3
	1559 – 1610	-75.3	19.9	3

Note : The field strength limits are calculated by $E[\mu V/m] = P[dBm] + 95.2$ for a measurement distance of 3m according 15.521 or $E[\mu V/m] = P[dBm] - 20 \log(D[m]) + 104.8$ for measurement distance D according NTIA 01-43 sec. 2.2.1..

3.4.2 Measurement procedure



According to FCC 02-48 the EUT is placed on a sand pit and activated in transmission mode. The measurement antenna is pointed directly to the EUT. The frequency range from 30MHz to 960MHz is measured using peak/quasi-peak detector and resolution bandwidths from 1 to 100kHz. Above 960MHz a RMS detector and a resolution bandwidth of 1MHz is used. In addition the frequency range 1164-1240MHz and 1559-1610MHz is measured with a resolution bandwidth of 1kHz. In order to maximize the emission the EUT is measured at 8 positions (every 45°). The measurement is performed for horizontal and vertical polarization of the measurement antenna over the frequency range from 30MHz to 40GHz.

3.4.3 Results

Transmitter spurious emissions < 960MHz								
Measurement Conditions								
Resolution bandwidth:		120kHz						
Measurement Distance:		3m						
Detector:		Quasi-Peak						
Frequency [MHz]	Pol.	Reading [dBμV]	AF [dB/m]	Cable Loss [dB]	Pre-Amp. Gain [dB]	Net Field Strength [dBμV/m]	Limit [dBμV/m]	Delta [dB]
187.74	V	17	13.5	0.2	0	30.7	43.5	-12.8
187.74	H	10	13.5	0.2	0	23.7	43.5	-19.8
200.00	V	25	9.8	0.2	0	35.0	43.5	-8.5
200.00	H	18	9.8	0.2	0	28.0	43.5	-15.5
211.22	V	10	10.0	0.2	0	20.2	43.5	-23.3
211.22	H	5	10.0	0.2	0	15.2	43.5	-28.3
236.87	V	15	11.0	0.2	0	26.2	46.0	-19.8
236.87	H	10	11.0	0.2	0	21.2	46.0	-24.8
262.53	V	13	11.4	0.2	0	24.6	46.0	-21.4
236.53	H	12	11.0	0.2	0	23.2	46.0	-22.8
336.27	V	7	13.4	0.3	0	20.7	46.0	-25.3
336.27	H	7	13.4	0.3	0	20.7	46.0	-25.3
361.92	V	25	14.4	0.3	0	39.7	46.0	-6.3
361.92	H	20	14.4	0.3	0	34.7	46.0	-11.3
387.51	V	28	16.9	0.3	0	45.2	46.0	-0.8
387.51	H	27	16.9	0.3	0	44.2	46.0	-1.8
437.27	V	28	16.9	0.4	0	45.3	46.0	-0.7
437.27	H	25	16.9	0.4	0	42.3	46.0	-3.7
474.15	V	12	17.0	0.4	0	29.4	46.0	-16.6
474.15	H	11	17.0	0.4	0	28.4	46.0	-17.6
672.95	V	5	20.6	0.5	0	26.1	46.0	-19.9
672.95	H	5	20.6	0.5	0	26.1	46.0	-19.9
749.97	V	7	20.8	0.6	0	28.4	46.0	-17.6
749.97	H	8	20.8	0.6	0	29.4	46.0	-16.6
Verdict						PASS		

Transmitter spurious emissions > 960MHz								
Measurement Conditions								
Resolution bandwidth:		1MHz						
Measurement Distance:		1.5m						
Limit Correction:		6.0dB						
Detector:		RMS						
Frequency [MHz]	Pol.	Reading [dBμV]	AF [dB/m]	Cable Loss [dB]	Pre-Amp. Gain [dB]	Net Field Strength [dBμV/m]	Limit [dBμV/m]	Delta [dB]
1295.1	V	61	25.0	1.2	44.4	42.8	35.9	6.9
1295.1	H	62	25.0	1.2	44.4	43.8	35.9	7.9
1496.1	V	58	25.8	1.2	44.5	40.5	35.9	4.6
1496.1	H	46	25.8	1.2	44.5	28.5	35.9	-7.4
2397.8	V	50	26.5	1.3	42.3	35.5	49.9	-14.4
2397.8	H	50	26.5	1.3	42.3	35.5	49.9	-14.4
2537.9	V	54	27.5	1.3	43.3	39.5	49.9	-10.4
2537.9	H	56	27.5	1.3	43.3	41.5	49.9	-8.4
2745.0	V	53	28.0	1.4	42.0	40.4	49.9	-9.5
2745.0	H	55	28.0	1.4	42.0	42.4	49.9	-7.5
2946.1	V	57	28.1	1.5	41.8	44.8	49.9	-5.1
2946.1	H	56	28.1	1.5	41.8	43.8	49.9	-6.1
3000.9	V	55	28.1	1.5	41.8	42.8	49.9	-7.1
3000.9	H	56	28.1	1.5	41.8	43.8	49.9	-6.1
3256.8	V	58	28.4	1.5	41.8	46.1	59.9	-13.8
3256.8	H	55	28.4	1.5	41.8	43.1	59.9	-16.8
3600.0	V	57	28.9	1.6	41.8	45.7	59.9	-14.2
3600.0	H	57	28.9	1.6	41.8	45.7	59.9	-14.2
3969.5	V	58	29.5	1.7	42.2	47.0	59.9	-12.9
3969.5	H	56	29.5	1.7	42.2	45.0	59.9	-14.9
4112.2	V	57	29.7	1.7	42.2	46.2	59.9	-13.7
4112.2	H	57	29.7	1.7	42.2	46.2	59.9	-13.7
4361.0	V	55	30.0	1.7	41.2	45.5	59.9	-14.4
4361.0	H	54	30.0	1.7	41.2	44.5	59.9	-15.4
Verdict						PASS		

Note : The field strength limits are calculated by $E[\mu V/m] = P[dBm] + 95.2$ for a measurement distance of 3m according 15.521 or $E[\mu V/m] = P[dBm] - 20 \log(D[m]) + 104.8$ for measurement distance D according NTIA 01-43 sec. 2.2.1..

The highlighted emissions are caused by digital circuitry, therefore acc. 15.521 the emission limit of paragraph 15.209 of 60dBμV/m applies.

Transmitter spurious emissions 1164-1240MHz & 1559-1610MHz								
Measurement Conditions								
Resolution bandwidth:		1kHz						
Measurement Distance:		1.5m						
Limit Correction:		6.0dB						
Detector:		RMS						
Frequency [MHz]	Pol.	Reading [dBμV]	AF [dB/m]	Cable Loss [dB]	Pre-Amp. Gain [dB]	Net Field Strength [dBμV/m]	Limit [dBμV/m]	Delta [dB]
1164.305	V	42	24.2	0.8	44.1	22.9	25.9	-3.0
1164.305	H	39	24.2	0.8	44.1	19.9	25.9	-6.0
1175.880	V	43	24.2	0.8	44.1	23.9	25.9	-2.0
1175.880	H	40	24.2	0.8	44.1	20.9	25.9	-5.0
1187.607	V	43	24.9	0.9	44.1	24.7	25.9	-1.2
1187.607	H	43	24.9	0.9	44.1	24.7	25.9	-1.2
1188.216	V	45	24.9	0.9	44.1	26.7	25.9	0.8
1188.216	H	42	24.9	0.9	44.1	23.7	25.9	-2.2
1199.944	V	49	24.9	0.9	44.1	30.7	25.9	4.8
1199.944	H	47	24.9	0.9	44.1	28.7	25.9	2.8
1211.671	V	45	24.9	0.9	44.1	26.7	25.9	0.8
1211.671	H	45	24.9	0.9	44.1	26.7	25.9	0.8
1212.281	V	43	24.9	0.9	44.1	24.7	25.9	-1.2
1212.281	H	45	24.9	0.9	44.1	26.7	25.9	0.8
1224.008	V	44	24.9	0.9	44.1	25.7	25.9	-0.2
1224.008	H	46	24.9	0.9	44.1	27.7	25.9	1.8
1235.735	V	44	24.9	0.9	44.1	25.7	25.9	-0.2
1235.735	H	46	24.9	0.9	44.1	27.7	25.9	1.8
1236.345	V	43	24.9	0.9	44.1	24.7	25.9	-1.2
1236.345	H	46	24.9	0.9	44.1	27.7	25.9	1.8
1571.571	V	36	25.4	1.1	44.5	18.0	25.9	-7.9
1571.571	H	36	25.4	1.1	44.5	18.0	25.9	-7.9
1575.966	V	22	24.8	1.1	44.5	3.4	25.9	-22.5
1575.966	H	25	24.8	1.1	44.5	6.4	25.9	-19.5
1572.287	V	36	24.8	1.1	44.5	17.4	25.9	-8.5
1572.287	H	36	24.8	1.1	44.5	17.4	25.9	-8.5
1599.677	V	42	24.8	1.1	44.5	23.4	25.9	-2.5
1599.677	H	40	24.8	1.1	44.5	21.4	25.9	-4.5
1600.291	V	40	24.8	1.1	44.5	21.4	25.9	-4.5
1600.291	H	39	24.8	1.1	44.5	20.4	25.9	-5.5
Verdict						PASS		

Note : The field strength limits are calculated by $E[\mu V/m] = P[dBm] + 95.2$ for a measurement distance of 3m according 15.521 or $E[\mu V/m] = P[dBm] - 20 \log(D[m]) + 104.8$ for measurement distance D according NTIA 01-43 sec. 2.2.1..

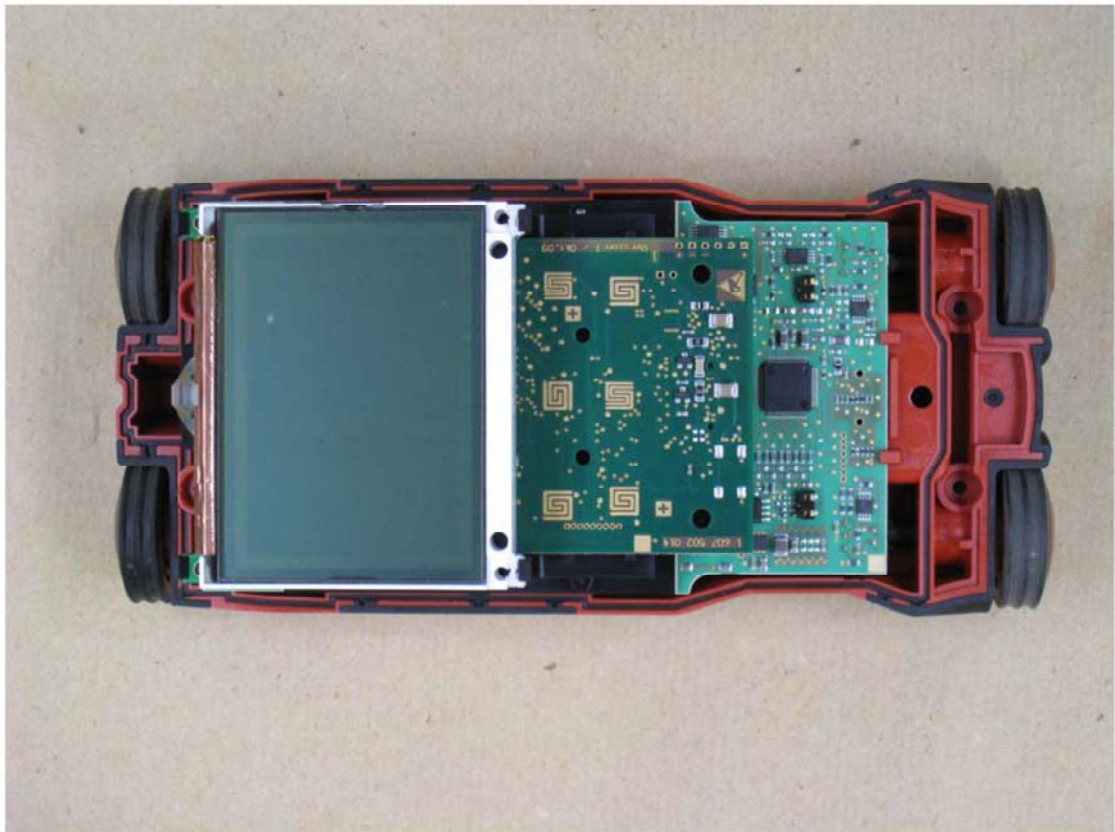
The highlighted emissions are caused by digital circuitry, therefore acc. 15.521 the emission limit of paragraph 15.209 of 60dBμV/m applies.

Annex A Photos



Test Report No.: G0M20912-2774-C-1

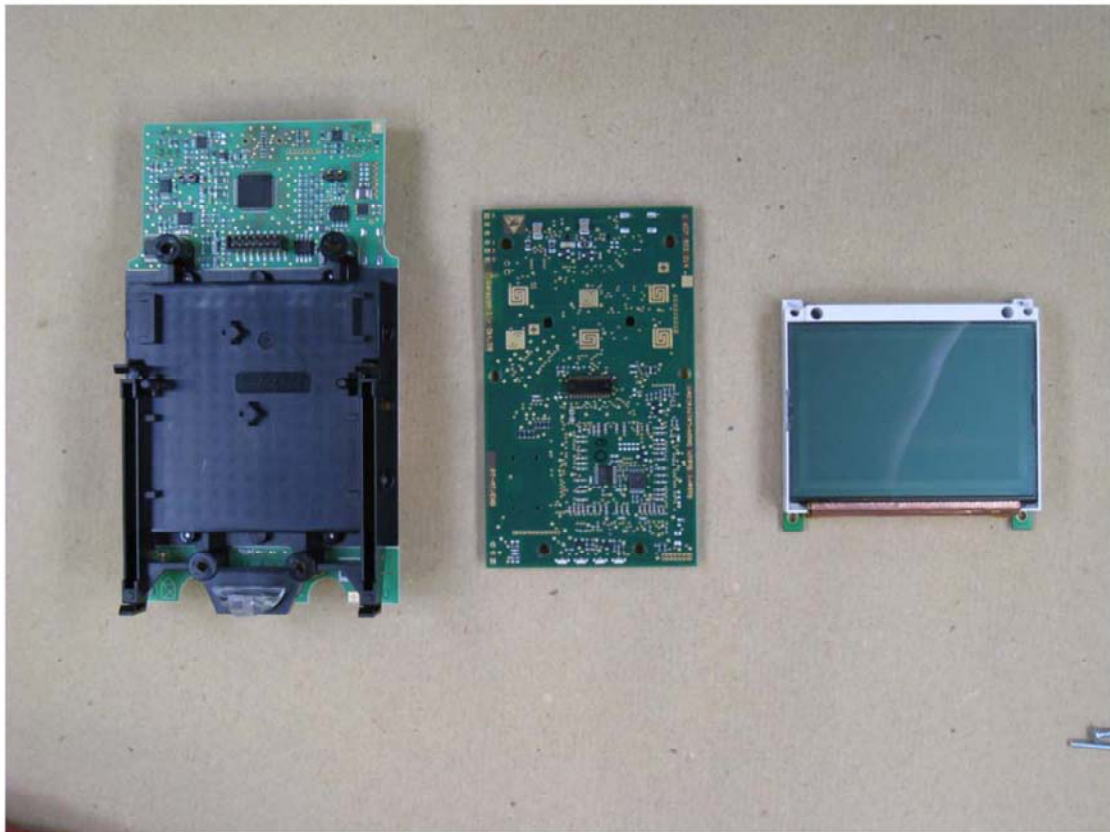
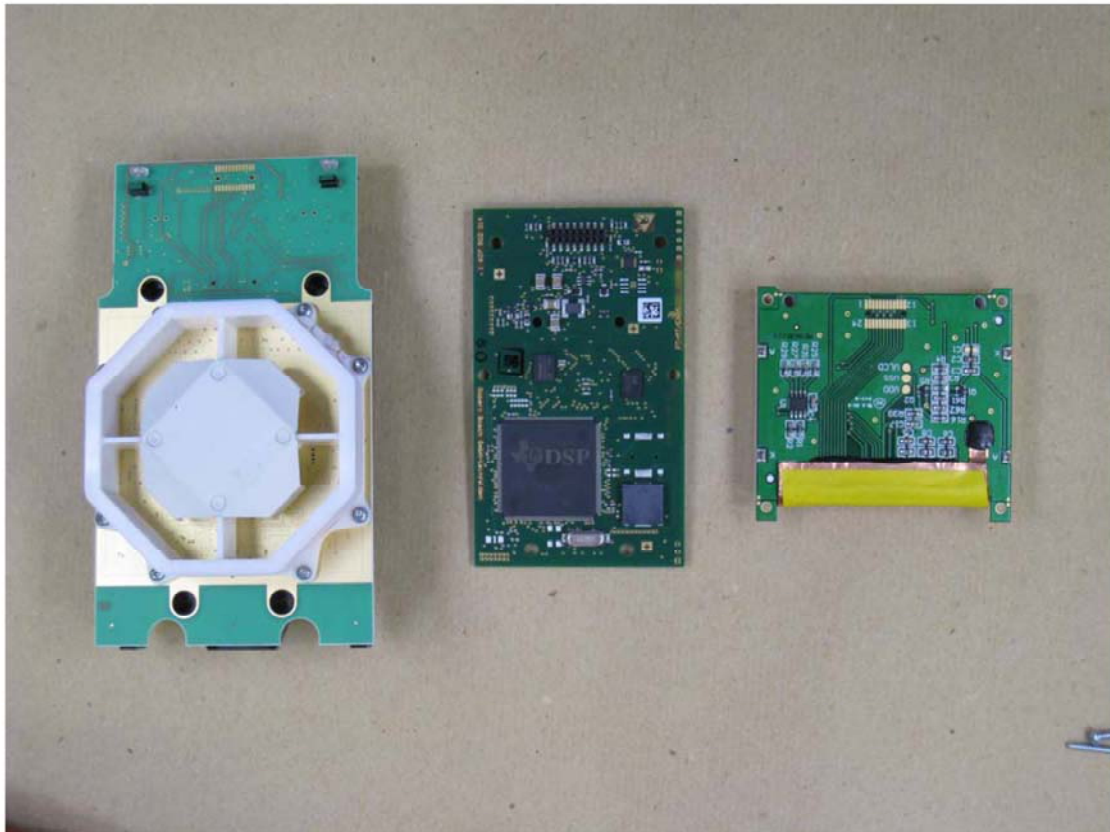
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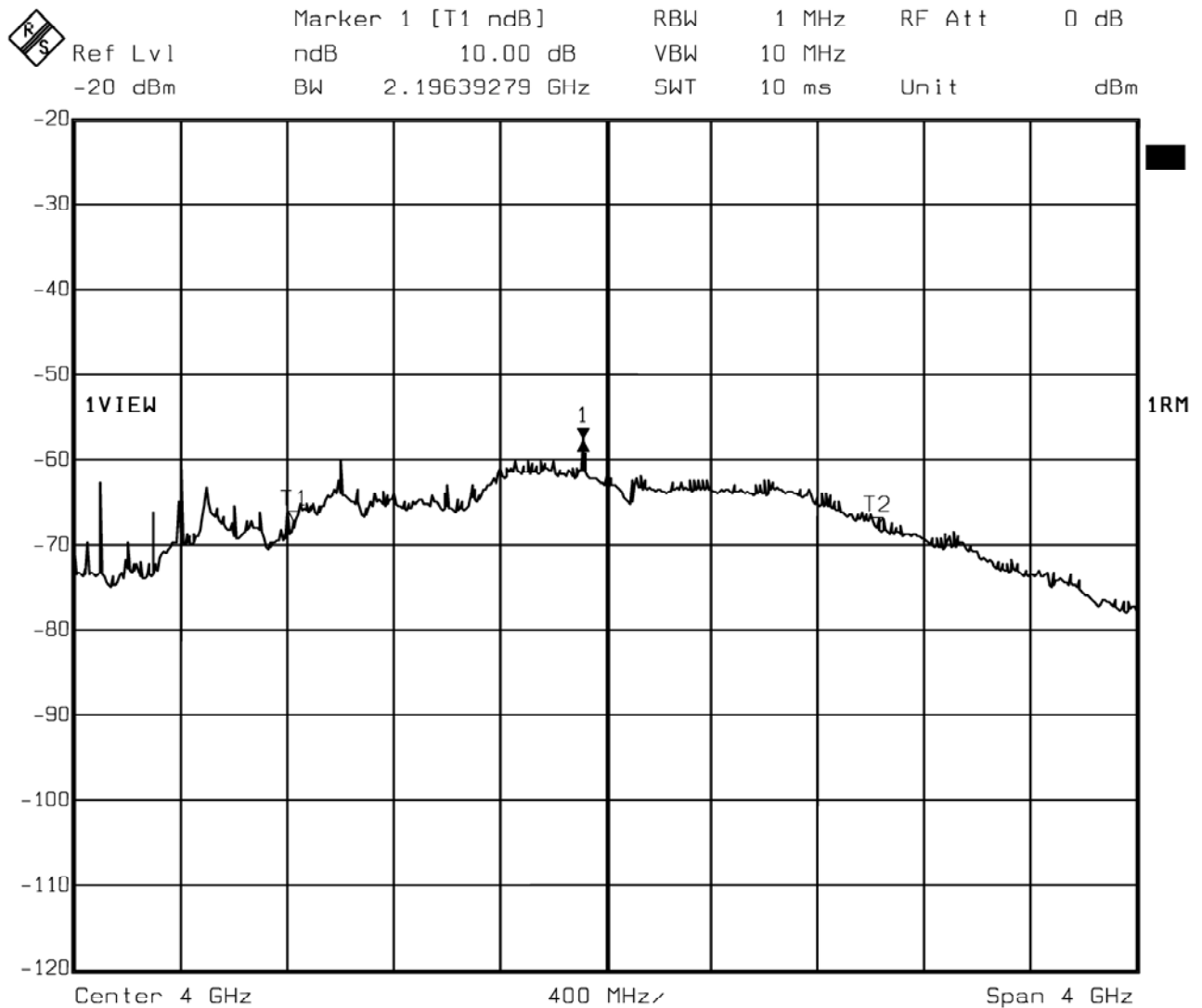
Test Setup



Annex B 10dB Bandwidth

- FCC part 15.503
- 10 dB Bandwidth

EUT Wall penetrating radar PS38
 Model 419202
 Approval Holder Hilti Corporation
 Temperature / Voltage 25°C / Voltage: 4.8 V DC
 Test Site / Operator Eurofins
 Test Specification FCC part section 503
 Comment 1 Marker 1 3.9158 GHz



Date: 13.JAN.2010 09:43:53

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