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TEST REPORT

Report No.: 23030658HKG-001

Application For Original Grant of 47 CFR Part 15 Certification

PTS Technologies Private Limited

902-928MHz Transceiver

FCC ID: 2BBP2SNPLUS-PL

Prepared and Checked by:	**Approved by:**
Signed on File Leung Chun Ning, Peter Assistant Engineer	Digitally signed by Herbert Wong DN: cn=Herbert Wong, o=Intertek, ou=Intertek Testing Services HK Ltd., email=herbert.wong@intertek.com, c=HK Date: 2023.07.18 15:14:46 +08'00' Wong Cheuk Ho, Herbert Assistant Supervisor Date: June 12, 2023

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TEST REPORT

GENERAL INFORMATION

Grantee:	PTS Technologies Private Limited
Grantee Address:	2 KAKI BUKIT AVENUE 1, #04-05 SINGAPORE (S) 417938
Manufacturer Name:	PTS Technologies Private Limited
Manufacturer Address:	2 KAKI BUKIT AVENUE 1, #04-05 SINGAPORE (S) 417938
FCC Specification Standard:	FCC Part 15, October 1, 2021 Edition
FCC ID:	2BBP2SNPLUS-PL
FCC Model(s):	SNPLUS-PL
Type of EUT:	DTS/Hybrid System
Description of EUT:	Environmental Multi-sensing Device (902-928MHz Transceiver)
Sample Receipt Date:	May 12, 2023
Date of Test:	May 12, 2023 to June 12, 2023
Report Date:	June 12, 2023
Environmental Conditions:	Temperature: +10 to 40°C Humidity: 10 to 90%
Conclusion:	Test was conducted by client submitted sample. The submitted sample as received complied with the 47 CFR Part 15 Certification.

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TEST REPORT

EXHIBIT 1 TEST RESULTS SUMMARY & STATEMENT OF COMPLIANCE

1.1 Summary of Test Results

Test Items	FCC Part 15 Section	RSS-210/ RSS-Gen#	Results	Details See Section
Antenna Requirement	15.203	7.1.2#	Pass	2.1
Maximum Conducted Output Power at Antenna Terminals	15.247(b)(3)&(4)	5.4(4)	Pass	4.1
Minimum 6dB RF Bandwidth	15.247(a)(2)	5.2(1)	Pass	4.2
99% Occupied Bandwidth	--	4.6.1#	Pass	4.2
Maximum Power Spectral Density Reading	15.247(e)	5.2(2)	Pass	4.3
Minimum Number of Hopping Frequencies	15.247(a)(1)(iii)	5.1(4)	Pass	4.3
Minimum Hopping Channel Carrier Frequency Separation	15.247(a)(1)	5.1(2)	Pass	4.4
Average Channel Occupancy Time	15.247(a)(1)(iii)	5.1(4)	Pass	4.5
Out of Band Conducted Emission	15.247(d)	5.5	Pass	4.4
Radiated Emission in Restricted Bands and Spurious Emissions	15.247(d), 15.209 & 15.109	5.5	Pass	4.7

Note: Pursuant to FCC Part 15 Section 15.215(c), the 20dB bandwidth of the emission was contained within the frequency band designated (mentioned as above) which the EUT operated. The effects, if any, from frequency sweeping, frequency hopping, other modulation techniques and frequency stability over expected variations in temperature and supply voltage were considered.

1.2 Statement of Compliance

The equipment under test is found to be complying with the following standards:

FCC Part 15, October 1, 2021 Edition
RSS-247 Issue 2, February 2017
RSS-Gen Issue 5 Amendment 2, February 2021

EXHIBIT 2 GENERAL DESCRIPTION

2.1 Product Description

The Environmental Multi-sensing Device (Model: SNPLUS-PL) is a 902-928MHz Transceiver.

The Equipment Under Test (EUT) operates at frequency range of 902.9MHz to 927.5MHz in DTS mode, and 902.3MHz to 914.9MHz in Hybrid mode.

The EUT is powered by 3.3VDC rechargeable battery.

Antenna type: Internal, integral Antenna
Maximum Antenna Gain: 1.6 dBi

2.2 Test Methodology

Radiated emission measurements were performed according to the procedures in ANSI C63.10 (2013). Preliminary radiated scans and all radiated measurements were performed in radiated emission test sites. All Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application. Antenna port conducted measurements were performed according to ANSI C63.10 (2013) and KDB Publication No. 558074 D01 v05r02 (April 02, 2019) All other measurements were made in accordance with the procedures in 47 CFR Part 2 and RSS-Gen Issue 5 Amendment 2, February 2021.

2.3 Test Facility

The radiated emission test site and antenna port conducted measurement facility used to collect the radiated data and conductive data are at Workshop No. 3, G/F., World-Wide Industrial Centre, 43-47 Shan Mei Street, Fo Tan, Sha Tin, N.T., Hong Kong SAR, China. This test facility and site measurement data have been fully placed on file with the FCC and Industry Canada No.: 2042H, CABID is “HKAP01”.

2.4 Related Submittal(s) Grants

This is a single application for certification of a transeiver.

EXHIBIT 3 SYSTEM TEST CONFIGURATION

3.1 Justification

For radiated emissions testing, the equipment under test (EUT) was setup to transmit / receive continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, all cables (if any) were manipulated to produce worst case emissions.

The EUT was powered by a fully charged 3.3VDC rechargeable battery during test.

For the measurements, the EUT was attached to a plastic stand if necessary and placed on the wooden turntable. If the base unit attached to peripherals, they were connected and operational (as typical as possible).

The signal was maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization were varied during the search for maximum signal level. The antenna height was varied from 1 to 4 meters. Radiated emissions were taken at three meters unless the signal level was too low for measurement at that distance. If necessary, a pre-amplifier was used and/or the test was conducted at a closer distance.

Radiated emission measurement for transmitter were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Emission that are directly caused by digital circuits in the transmit path and transmitter portion were measured, and the limit are according to FCC Part 15 Section 15.209 / RSS-247 2.5. Digital circuitries used to control additional functions other than the operation of the transmitter are subject to FCC Part 15 Section 15.109 / RSS-247 Section 5.5 Limits.

Detector function for radiated emissions was in peak mode. Average readings, when required, were taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings. A detailed description for the calculation of the average factor can be found in section 4.8.3.

Determination of pulse desensitization was made according to *Hewlett Packard Application Note 150-2, Spectrum Analysis... Pulsed RF.* The effective period (Teff) was referred to Exhibit 4.8.3. With the resolution bandwidth 1MHz and spectrum analyzer IF bandwidth 3dB, the pulse desensitization factor was 0dB.

All relevant operation modes have been tested, and the worst-case data is included in this report.

All data rates were tested under normal mode. Only the worst-case data is shown in the report.

For simultaneous transmission, both 900MHz DTS/Hybrid and Bluetooth portions are also switched on when taking radiated emission for determining worst-case spurious emission.

3.2 EUT Exercising Software

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

3.3 Details of EUT and Description of Accessories

Details of EUT:

The EUT is powered by 3.3VDC rechargeable battery

Description of Accessories:

N/A

There are no accessories for compliance of this product.

3.4 Measurement Uncertainty

Decision Rule for compliance: For FCC/IC standard, the measured value must be within the limits of applicable standard without accounting for the measurement uncertainty. For EN/IEC/HKTA/HKTC standard, conformity rules will be used as per standard directly excepted EN/IEC 61000-3-2, EN/IEC 61000-3-3, HKTA1004, HKCA1008, HKTA1019, HKTA1020, HKTA1041 and HKTA1044. For these excepted or not mentioned standards, Cl 4.2.2 of ILAC-G8:09/2019 decision rules will be reference and guard band will be equal to our measurement uncertainty with 95% confidence level (k=2). In case, the measured value is within guard band region, undetermined decision will be used. The values of the Measurement uncertainty for radiated emission test, AC line conducted emission test and RF conducted test, frequency stability and timing jitter are ± 5.3dB, ± 4.2dB, ±1dB, ±23Hz, 0.1µs respectively.

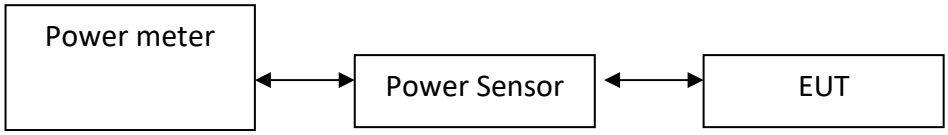
Uncertainty and Compliance - Unless the standard specifically states that measured values are to be extended by the measurement uncertainty in determining compliance, all compliance determinations are based on the actual measured value.

EXHIBIT 4 TEST RESULTS

4.1 Maximum Conducted Output Power at Antenna Terminals

RF Conduct Measurement Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



The antenna port of the EUT was connected to the input of a spectrum analyzer.

☒ External attenuation and cable loss were compensated for using the OFFSET function of the analyser. The measurement procedure PK1 was used.

☐ The EUT should be configured to transmit continuously (at a minimum duty cycle of 98%) at full power over the measurement duration. The measurement procedure AVG1 was used.

DTS mode (500kHz) / Peak Antenna Gain = 1.6 dBi

Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	902.9	11.88	15.4
Middle Channel:	914.9	11.82	15.2
High Channel:	927.5	11.67	14.7

Hybrid mode (125kHz) / Peak Antenna Gain = 1.6 dBi

Frequency (MHz)		Output in dBm	Output in mWatt
Low Channel:	902.3	11.94	15.6
Middle Channel:	908.5	11.88	15.4
High Channel:	914.9	11.82	15.2

Cable loss: 0.5dB External Attenuation: 0 dB

Cable loss, external attenuation: ☒ included in OFFSET function
☐ added to SA raw reading

EUT dBm Max. Output Level = 11.94 dBm

Limits:

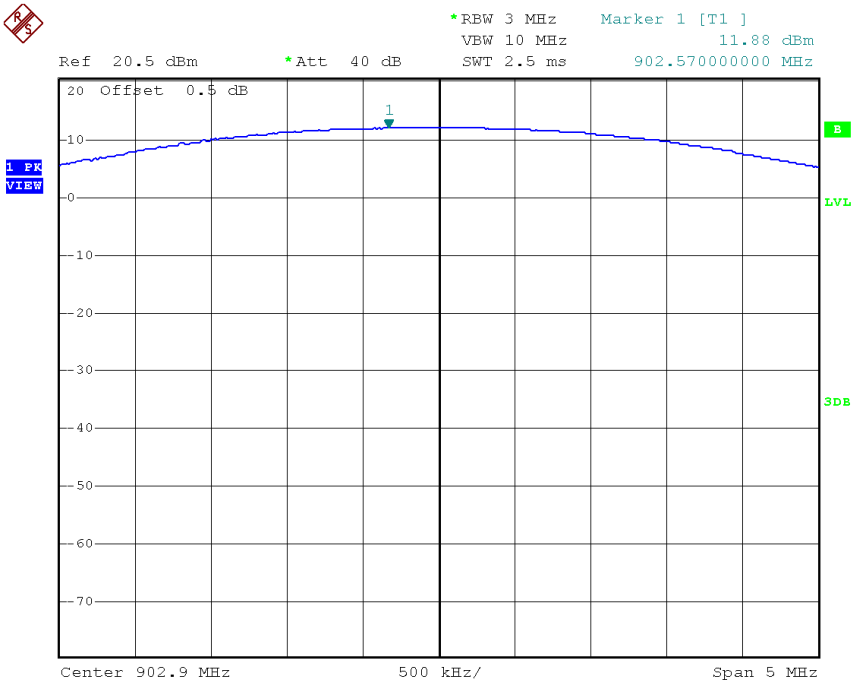
☐ 1W (30dBm) for antennas with gains of 6dBi or less.

☒ 0.912W (29.6dBm) for antennas with gains more than 6dBi.

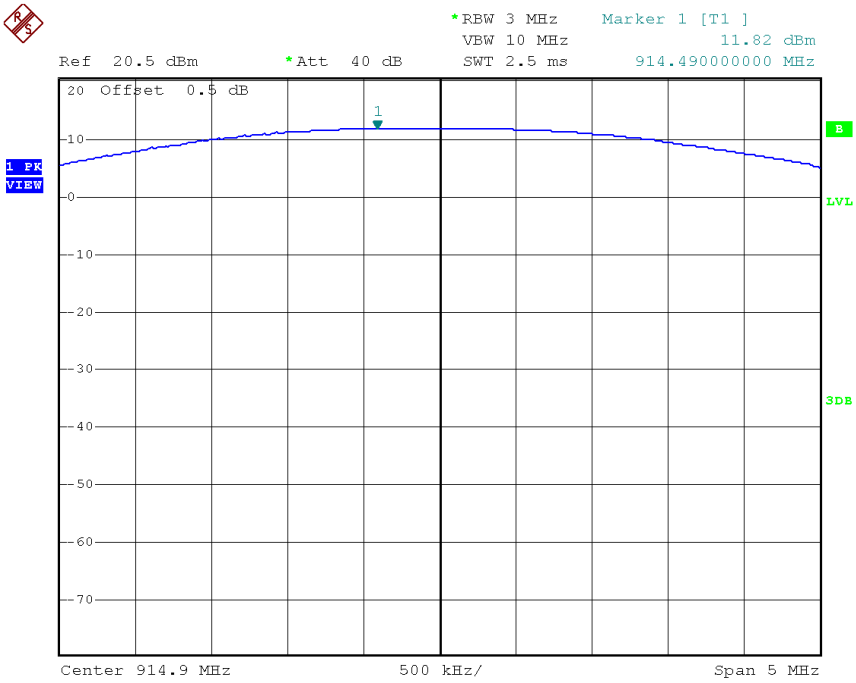
TEST REPORT

PLOTS OF MAXIMUM CONDUCTED OUTPUT POWER AT ANTENNA TERMINALS

Lowest Channel DTS mode (500kHz)



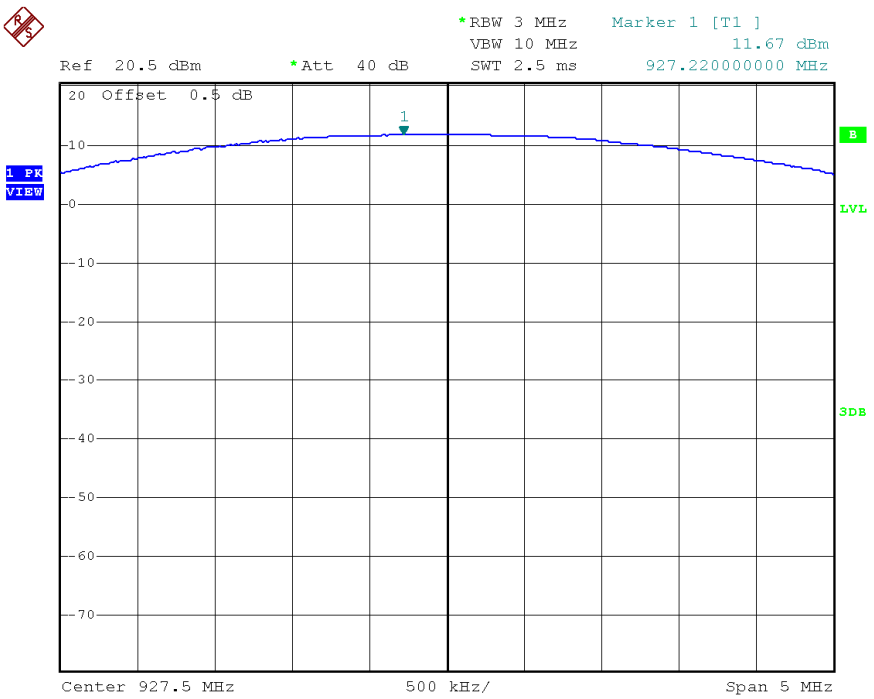
Middle Channel DTS mode (500kHz)



TEST REPORT

PLOTS OF MAXIMUM CONDUCTED OUTPUT POWER AT ANTENNA TERMINALS

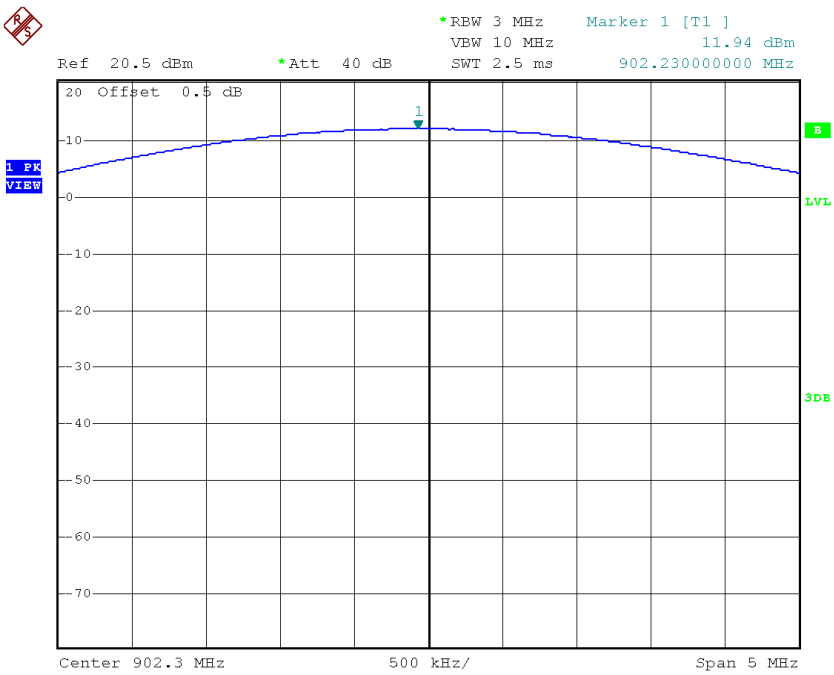
Highest Channel DTS mode (500kHz)



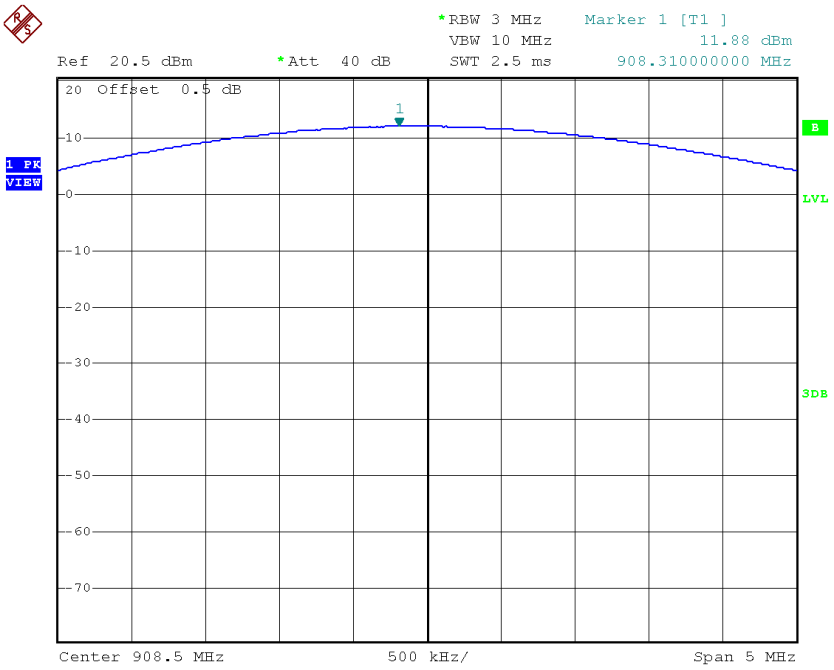
TEST REPORT

PLOTS OF MAXIMUM CONDUCTED OUTPUT POWER AT ANTENNA TERMINALS

Lowest Channel Hybrid mode (125kHz)



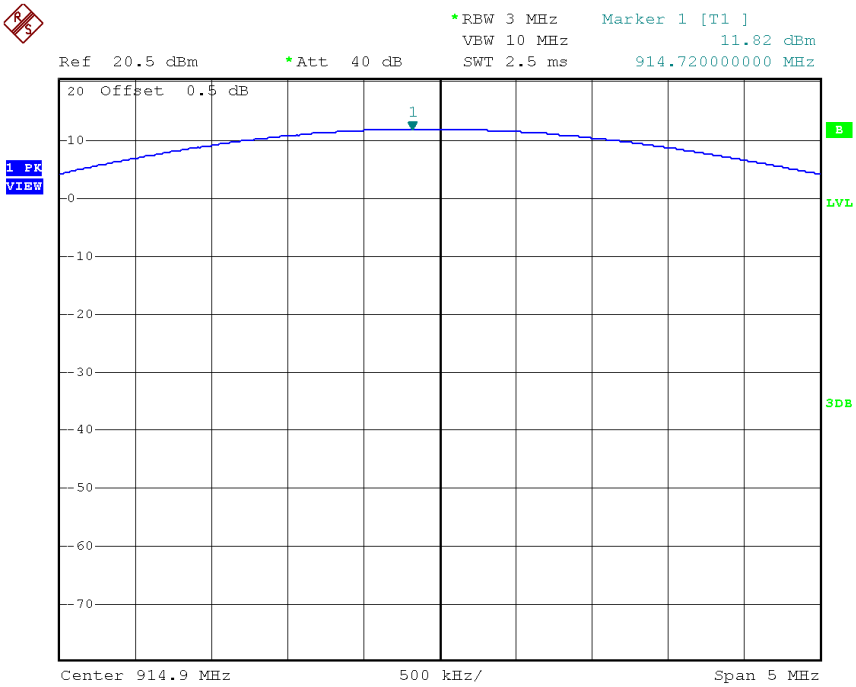
Middle Channel Hybrid mode (125kHz)



TEST REPORT

PLOTS OF MAXIMUM CONDUCTED OUTPUT POWER AT ANTENNA TERMINALS

Highest Channel Hybrid mode (125kHz)



4.2 Minimum 6dB RF Bandwidth and Occupied Bandwidth

The antenna port of the EUT was connected to the input of a spectrum analyzer. The EBW measurement procedure was used. A PEAK output reading was taken, a DISPLAY line was drawn 6dB lower than PEAK level. The 6dB bandwidth was determined from where the channel output spectrum intersected the display line.

For Industry Canada, the 99% occupied bandwidth was measured, and the procedure under the section 4.6.1 of RSS-GEN was used.

DTS mode (500kHz)

Frequency (MHz)		6dB Bandwidth (MHz)
Low Channel:	902.9	0.774
Middle Channel:	914.9	0.774
High Channel:	927.5	0.774

Limits: 6dB bandwidth shall be at least 500kHz.

Hybrid mode (125kHz)

Frequency (MHz)		6dB Bandwidth (MHz)
Low Channel:	902.3	0.270
Middle Channel:	908.5	0.270
High Channel:	914.9	0.270

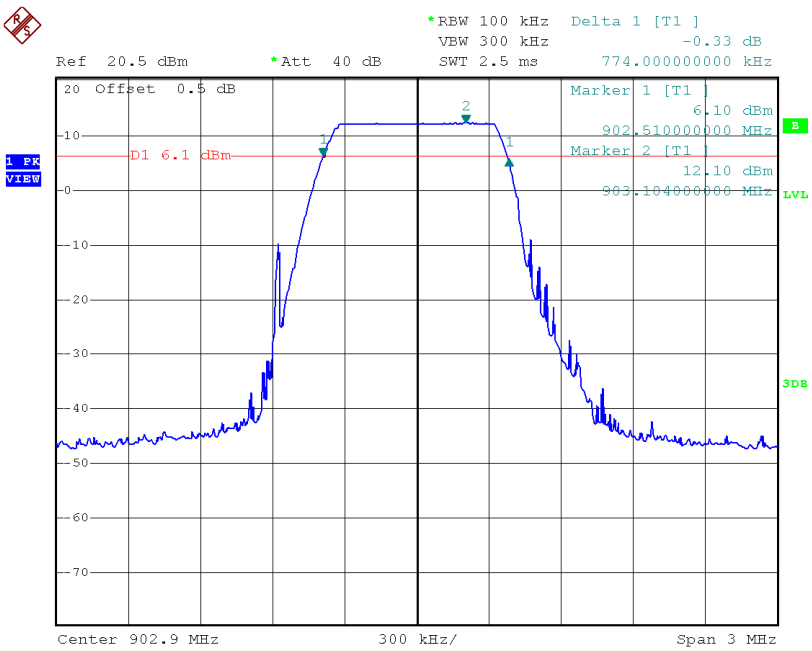
Limits: N/A

The plots of 6dB RF bandwidth and occupied bandwidth are saved as below.

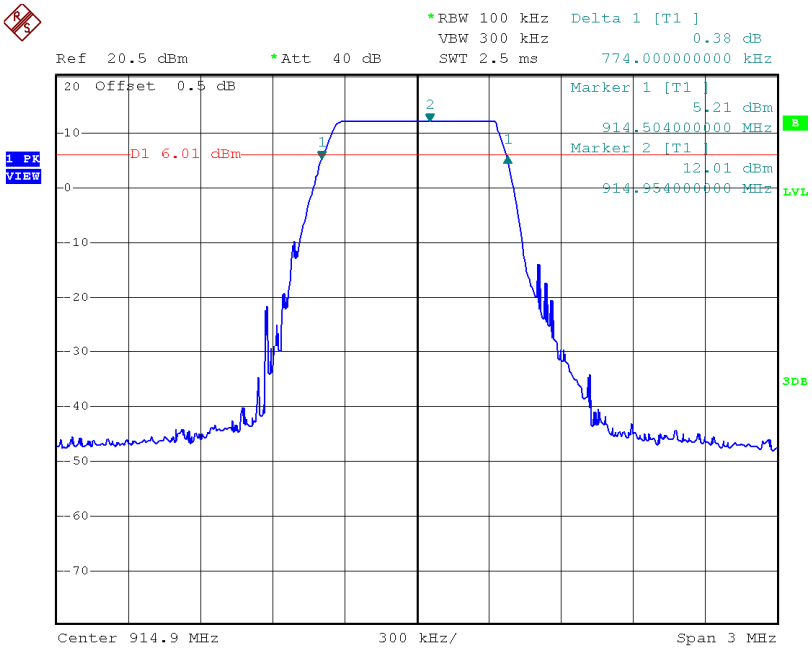
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH (500kHz) DTS mode

Lowest Channel



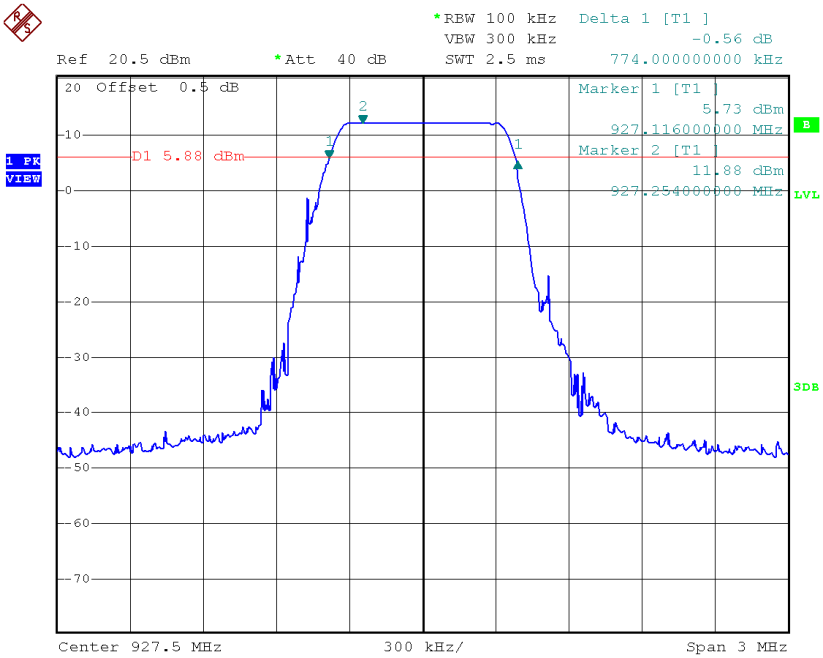
Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH (500kHz) DTS mode

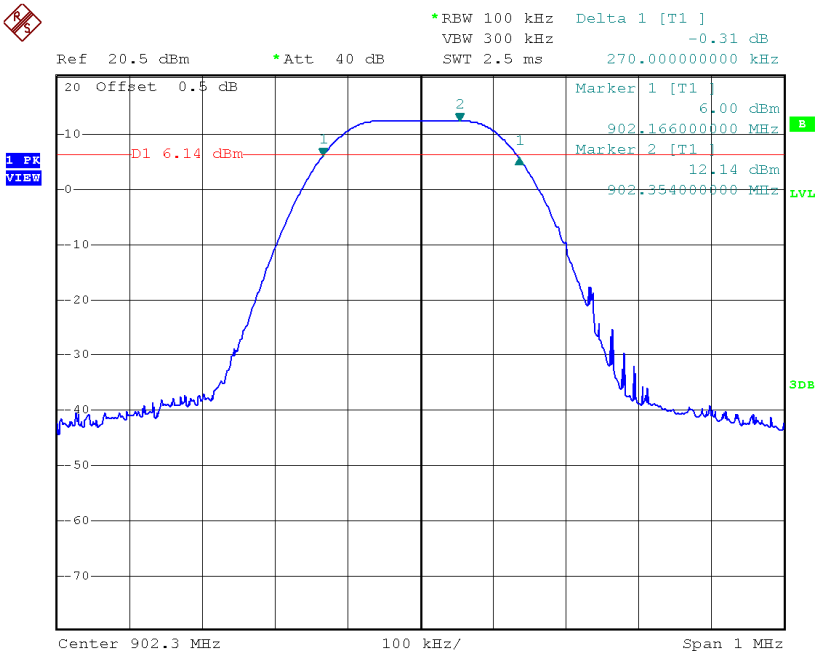
Highest Channel



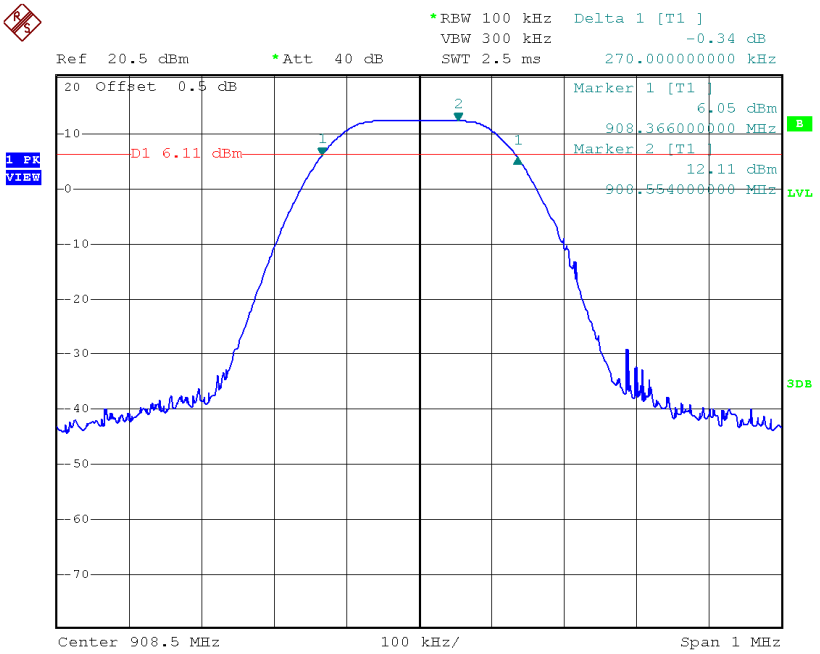
TEST REPORT

PLOTS OF 6dB RF BANDWIDTH (125kHz) Hybrid mode

Lowest Channel



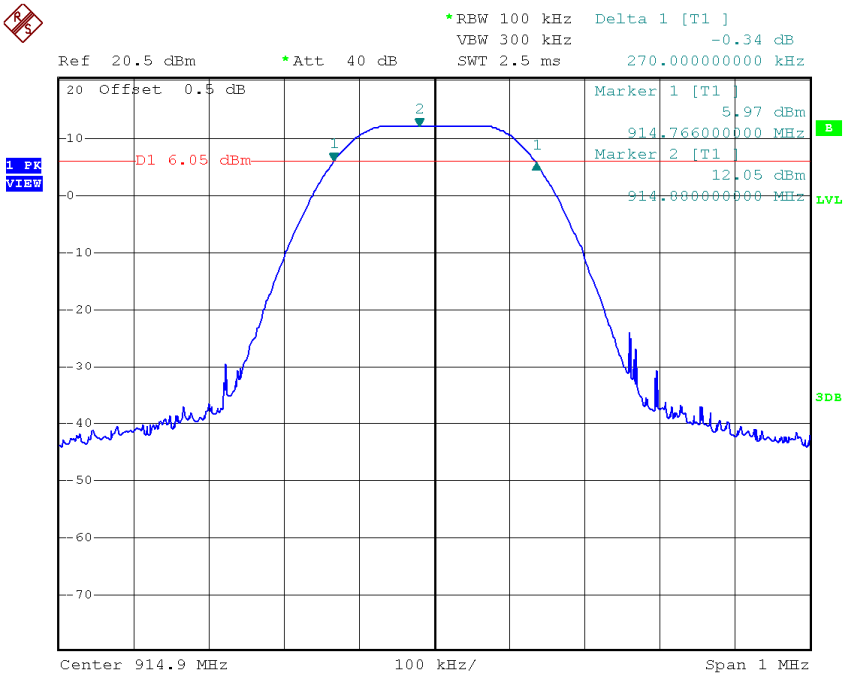
Middle Channel



TEST REPORT

PLOTS OF 6dB RF BANDWIDTH (125kHz) Hybrid mode

Highest Channel

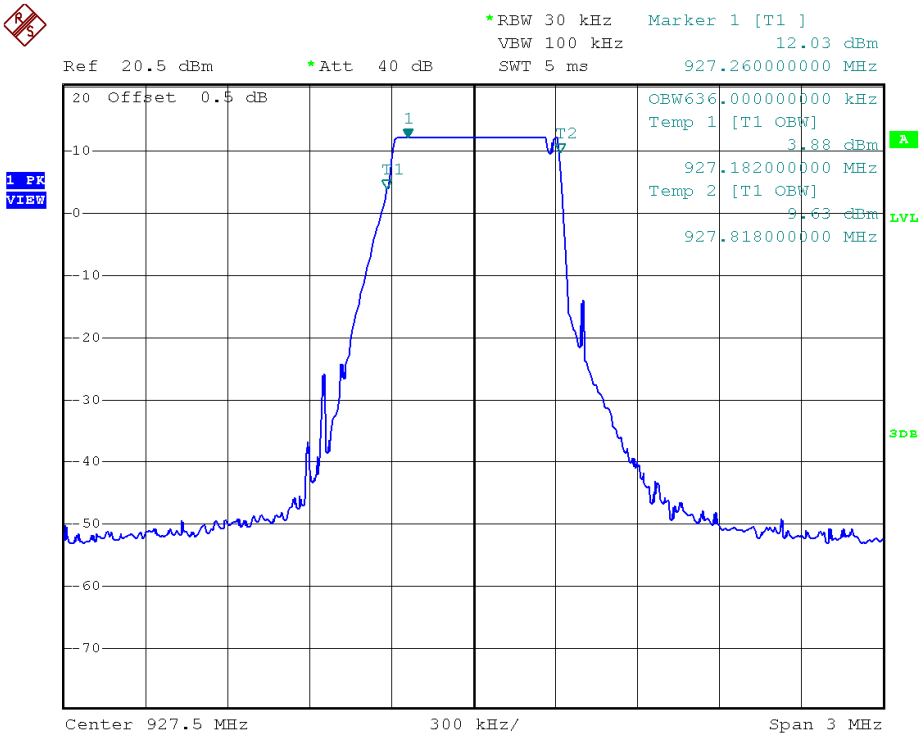


TEST REPORT

Occupied Bandwidth Results: DTS mode (500kHz)

		Occupied Bandwidth (MHz)
Low Channel:	902.9	0.636
Middle Channel:	914.9	0.636
High Channel:	927.5	0.636

The worst case is shown as below:

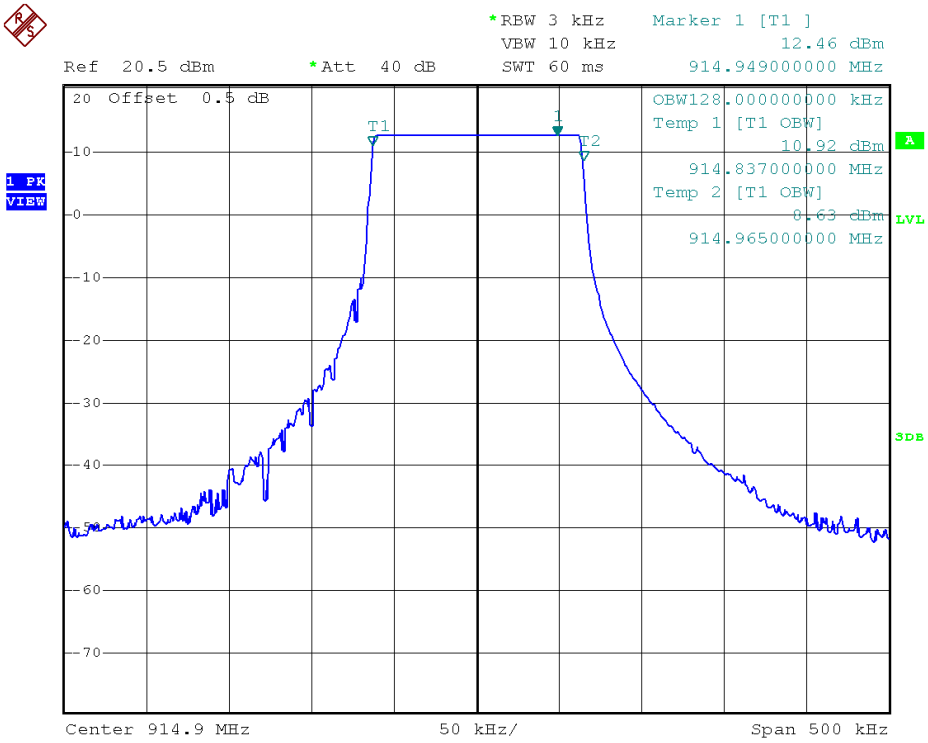


TEST REPORT

Occupied Bandwidth Results: Hybrid mode (125kHz)

		Occupied Bandwidth (MHz)
Low Channel:	902.3	0.128
Middle Channel:	908.5	0.128
High Channel:	914.9	0.128

The worst case is shown as below:



4.3 Minimum Power Spectral Density

Antenna output of the EUT was coupled directly to spectrum analyzer. The measurement procedure 10.2 PKPSD was used. If an external attenuator and/or cable was used, these losses are compensated for using the OFFSET function of the analyser.

DTS mode (500kHz)

Frequency (MHz)		PSD in 100kHz (dBm)	PSD in 3kHz (dBm)
Low Channel:	902.9	10.13	-2.01
Middle Channel:	914.9	10.03	-1.92
High Channel:	927.5	9.90	-2.11

Hybrid mode (125kHz)

Frequency (MHz)		PSD in 100kHz (dBm)	PSD in 3kHz (dBm)
Low Channel:	902.3	11.15	6.57
Middle Channel:	908.5	11.12	6.54
High Channel:	914.9	11.06	6.47

Cable Loss: 0.5dB

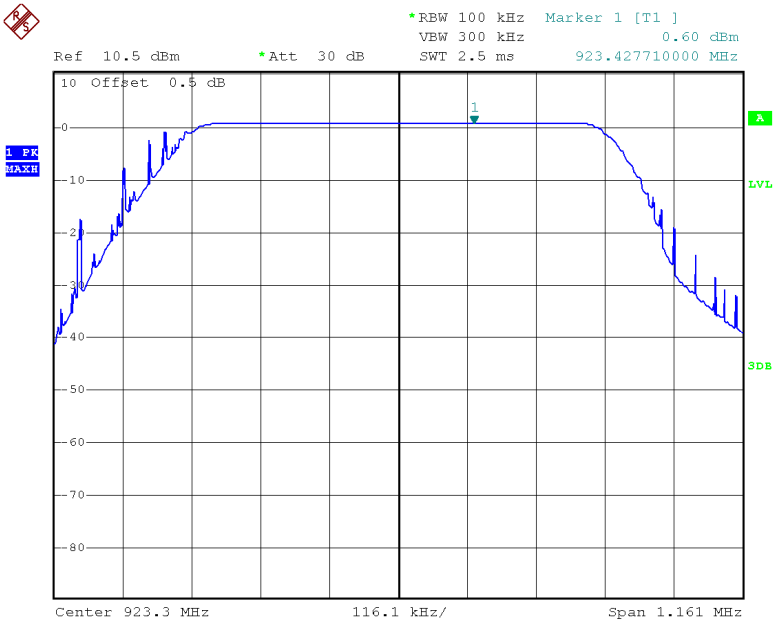
Limit: 8dBm in 3kHz

The plots of power spectral density are as below.

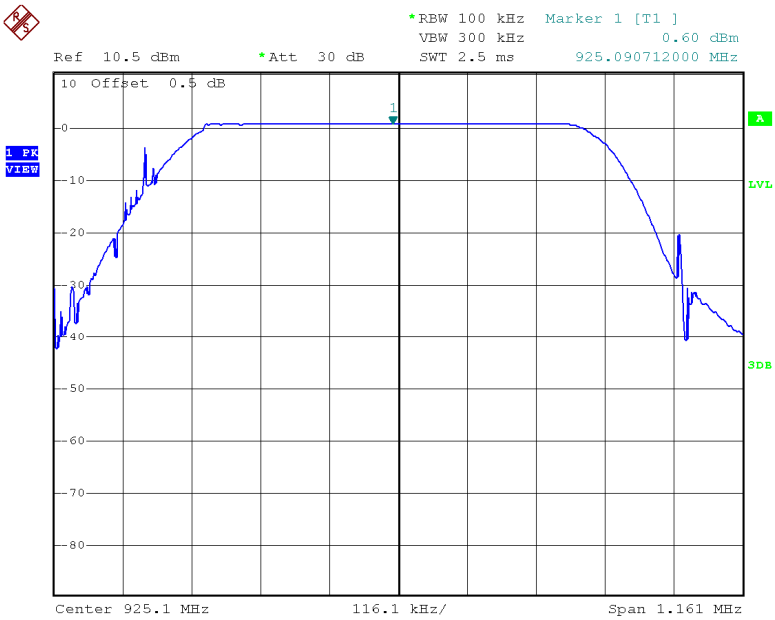
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 100kHz RBW (500kHz – DTS mode)

Lowest Channel



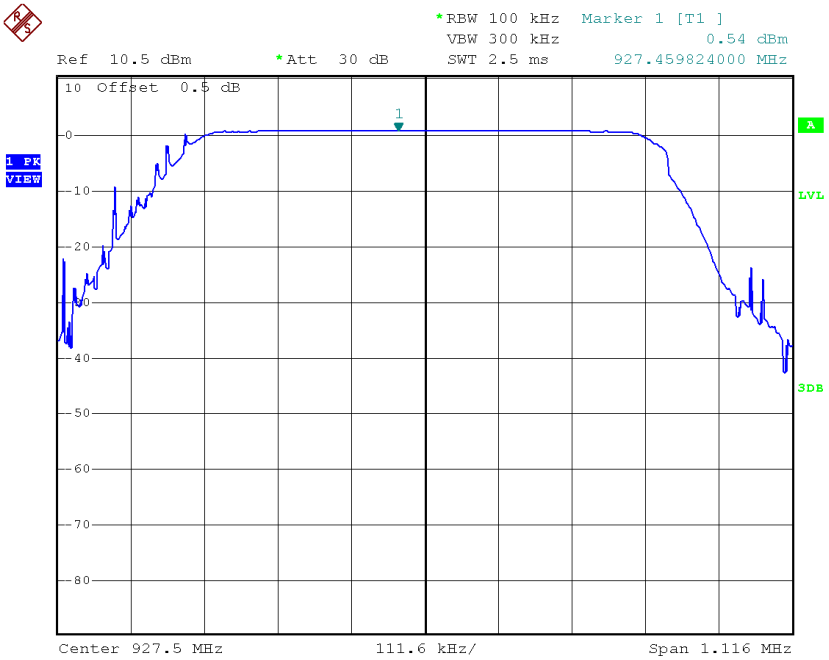
Middle Channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 100kHz RBW (500kHz – DTS mode)

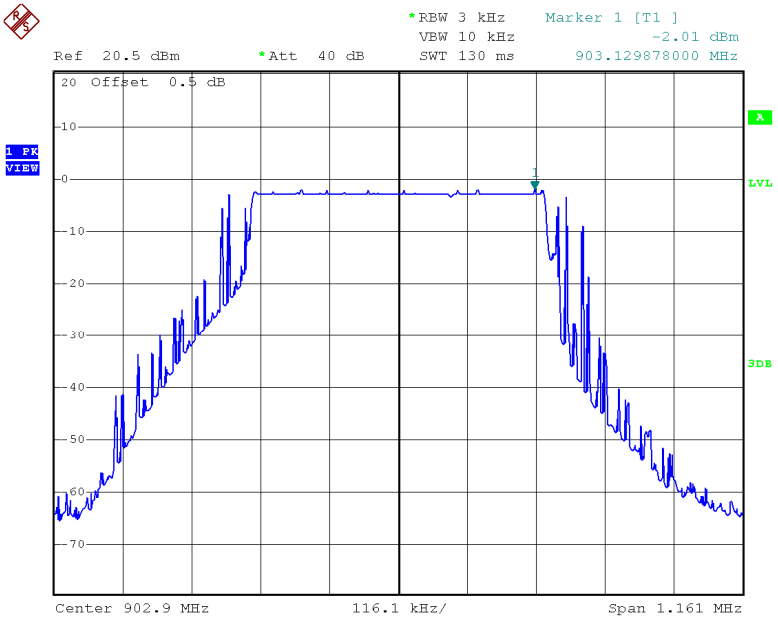
Highest Channel



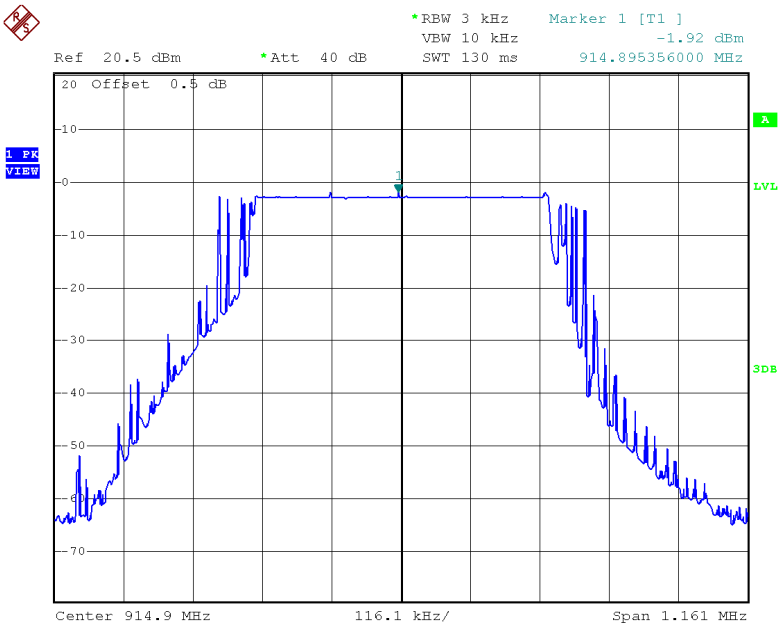
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 3kHz RBW (500kHz – DTS mode)

Lowest Channel



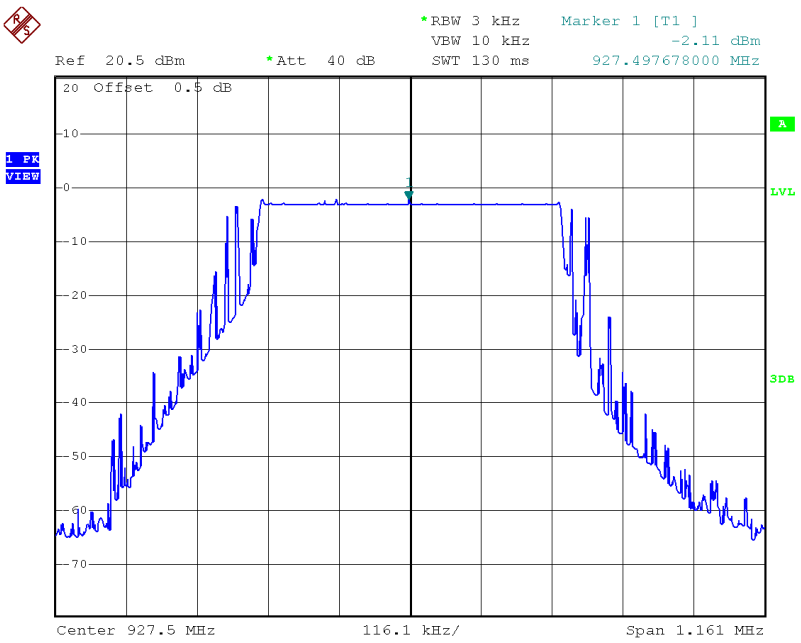
Middle Channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 3kHz RBW (500kHz – DTS mode)

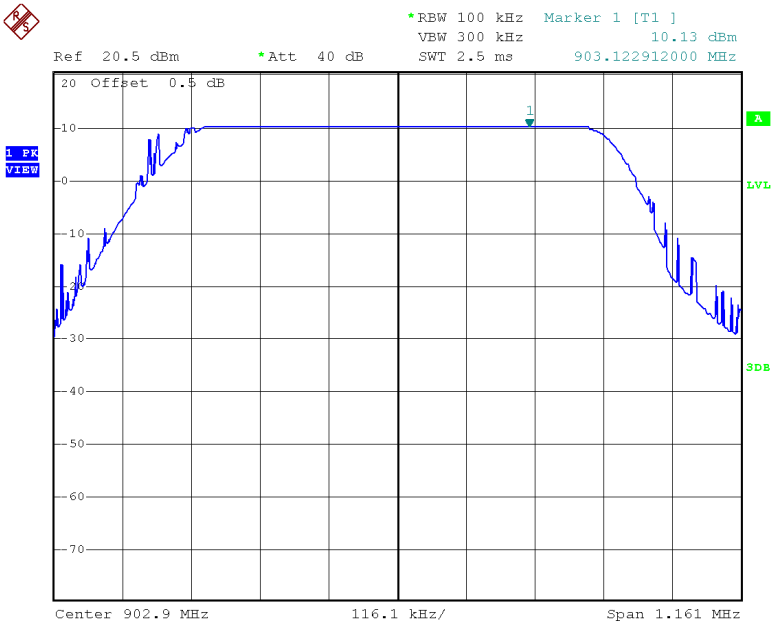
Highest Channel



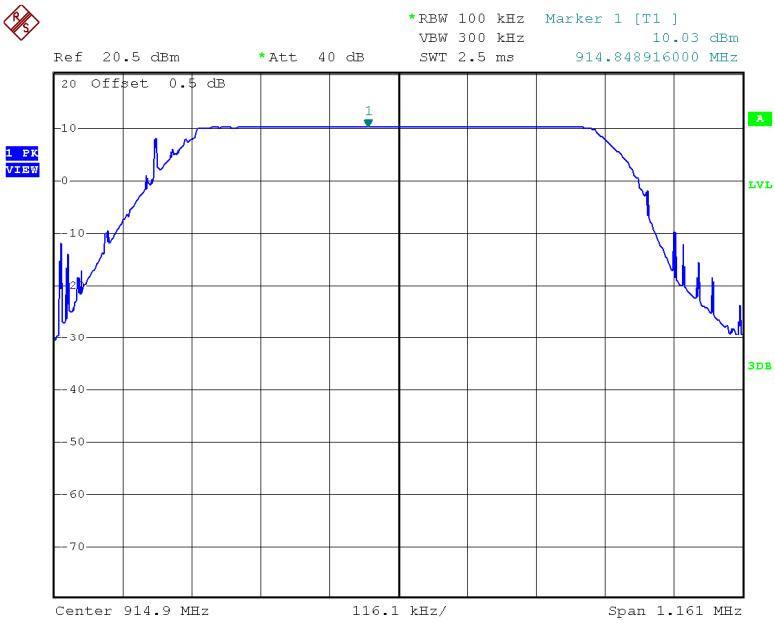
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 100kHz RBW (125kHz – Hybrid mode)

Lowest Channel



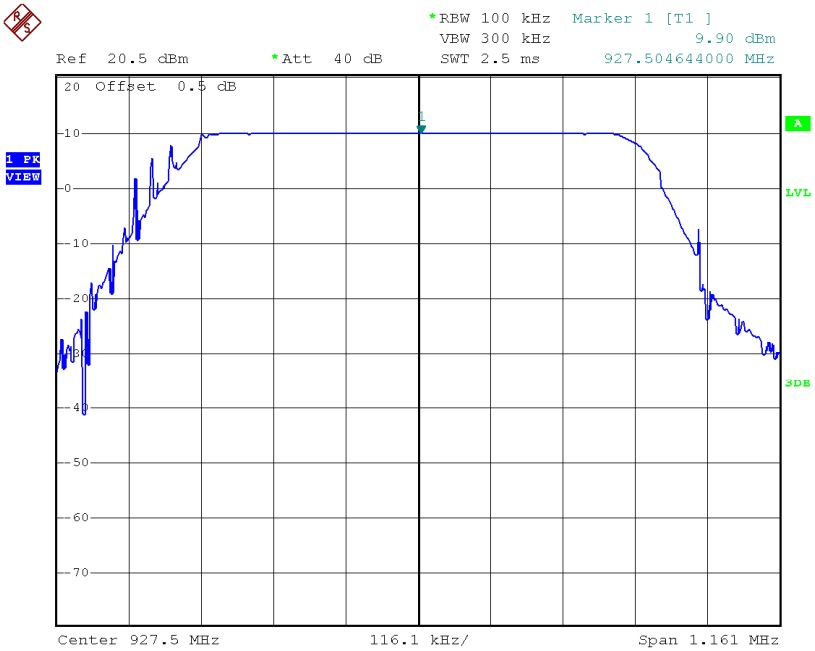
Middle Channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 100kHz RBW (125kHz – Hybrid mode)

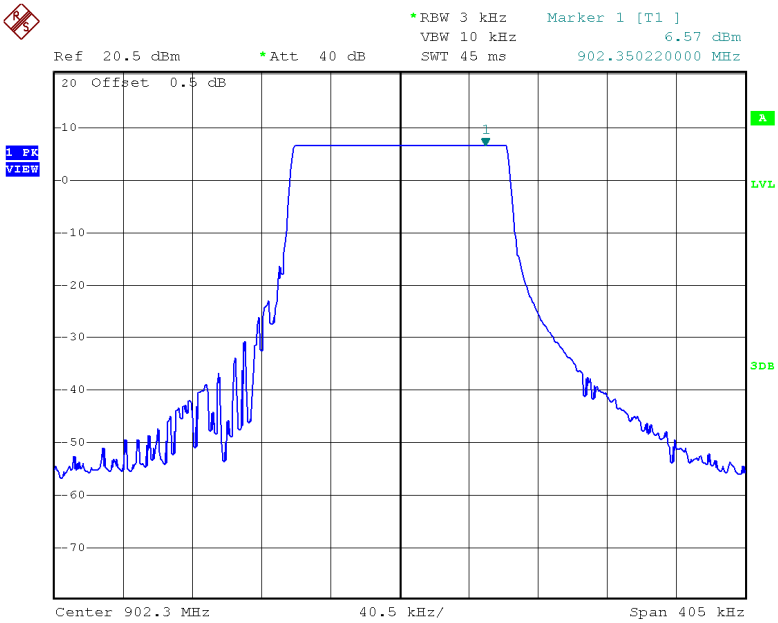
Highest Channel



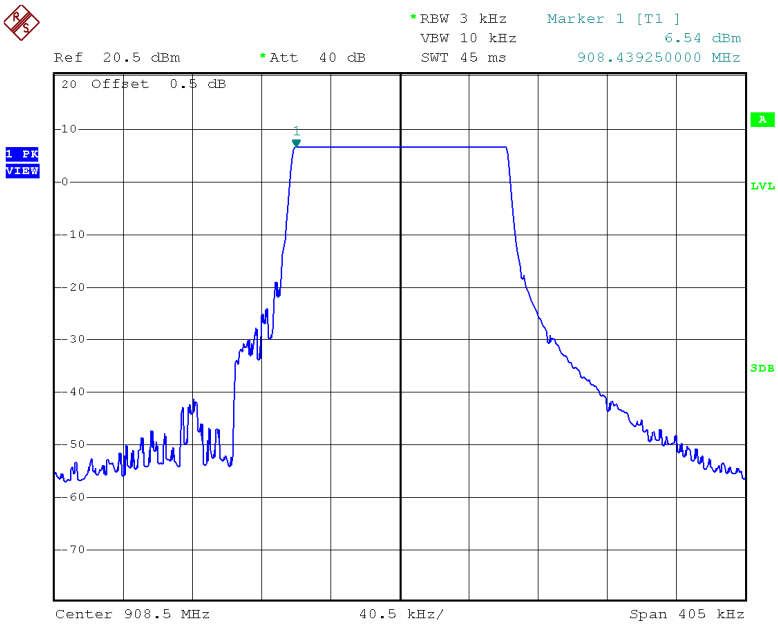
TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 3kHz RBW (125kHz – Hybrid mode)

Lowest Channel



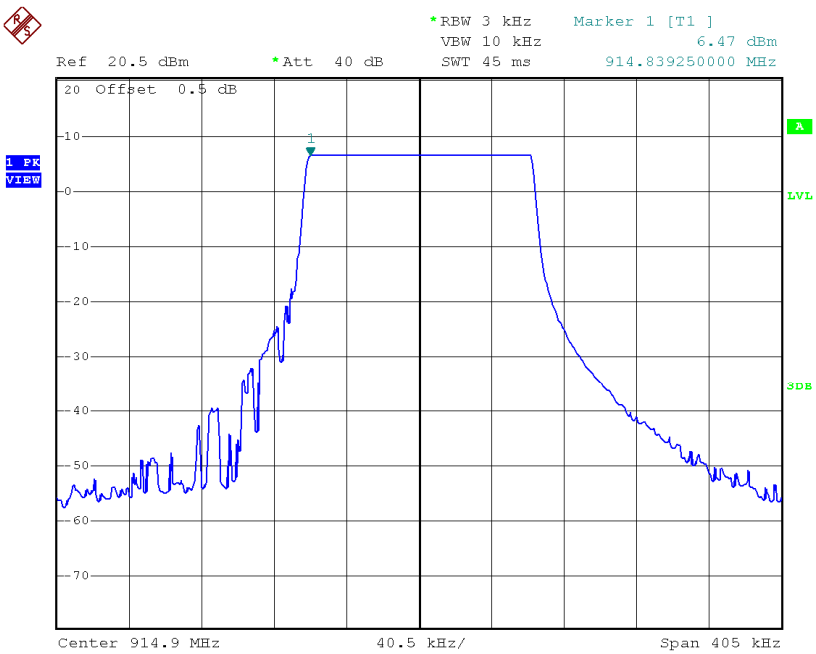
Middle Channel



TEST REPORT

PLOTS OF POWER SPECTRAL DENSITY – 3kHz RBW (125kHz – Hybrid mode)

Highest Channel



4.4 Hopping Channel 20dB RF Bandwidth

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was chosen so that the display was a result of the hopping channel modulation. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 20dB lower than PEAK level. The 20dB bandwidth was determined from where the channel output spectrum intersected the display line.

(125kHz – Hybrid mode)

Frequency (MHz)		20dB Bandwidth (kHz)
Low Channel:	902.3	140
Middle Channel:	908.5	140
High Channel:	914.9	140

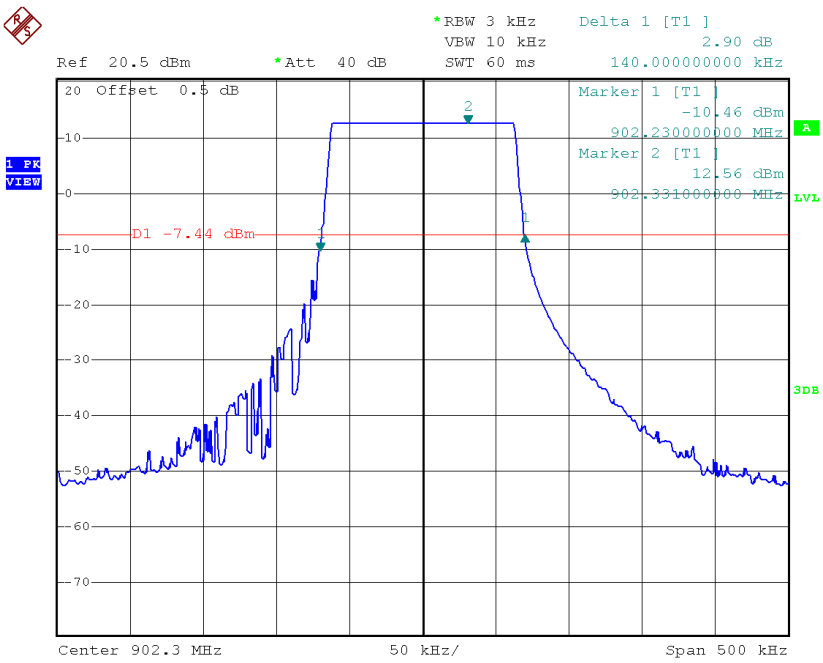
Limits: ≤500kHz for 902-928MHz

The plots of hopping channel 20dB RF bandwidth are saved as below.

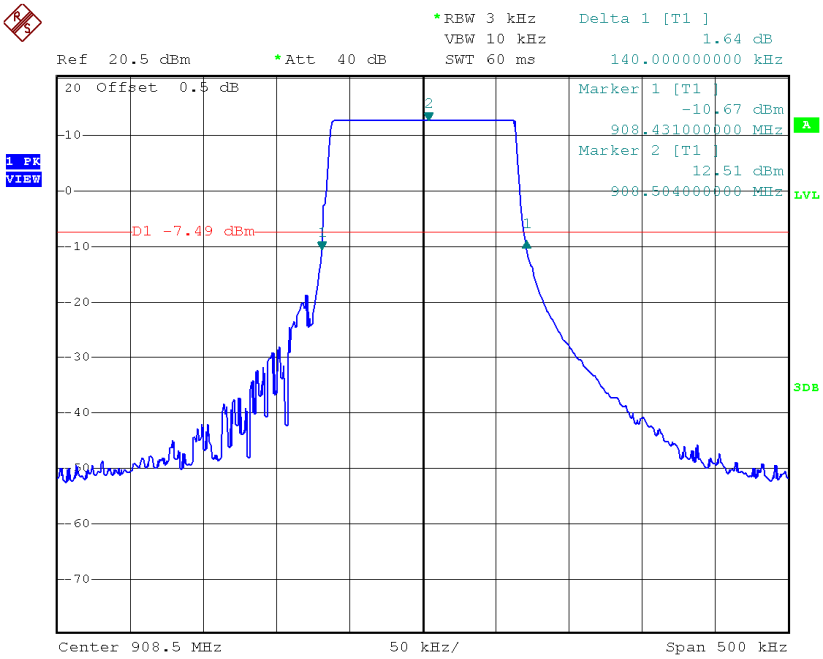
TEST REPORT

PLOTS OF HOPPING CHANNEL 20dB RF BANDWIDTH (125kHz – Hybrid mode)

Lowest Channel



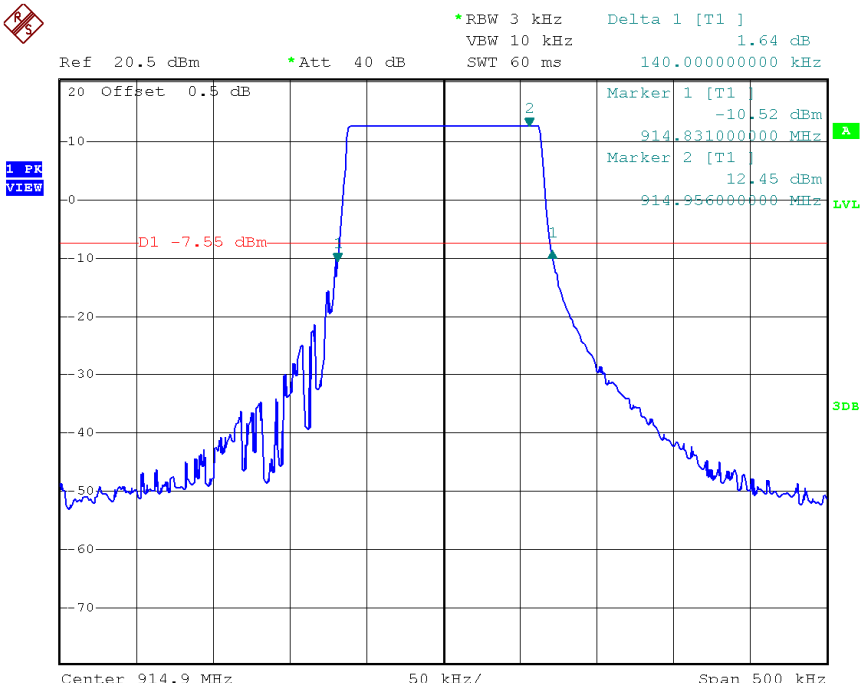
Middle Channel



TEST REPORT

PLOTS OF HOPPING CHANNEL 20dB RF BANDWIDTH (125kHz – Hybrid mode)

Highest Channel



4.5 Minimum Number of Hopping Frequencies

With the analyzer set to MAX HOLD readings were taken for 2-3 minutes in each band. The channel peaks so recorded were added together, and the total number compared to the minimum number of channels required in the regulation.

No. of Hopping Channels: 64

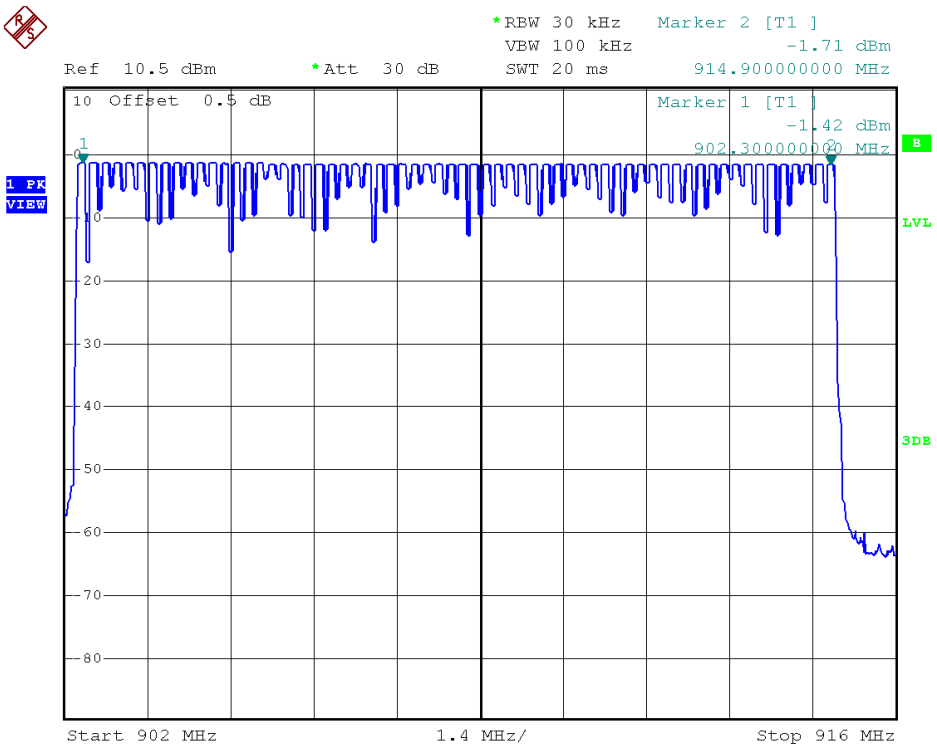
Limits:

At least 50 hopping channels for 902MHz-928MHz (20dB bandwidth of hopping channel < 250kHz)

The plots of number of hopping frequencies are saved as below.

TEST REPORT

PLOTS OF MINIMUM NUMBER OF HOPPING FREQUENCIES (125kHz – Hybrid mode)



4.6 Minimum Hopping Channel Carrier Frequency Separation

Using the DELTA MARKER function of the analyzer, the frequency separation between two adjacent channels was measured and met the requirement.

The two adjacent channels being measured	Channel Separation (kHz)
Channel Separation (Channel 1 and Channel 2)	200

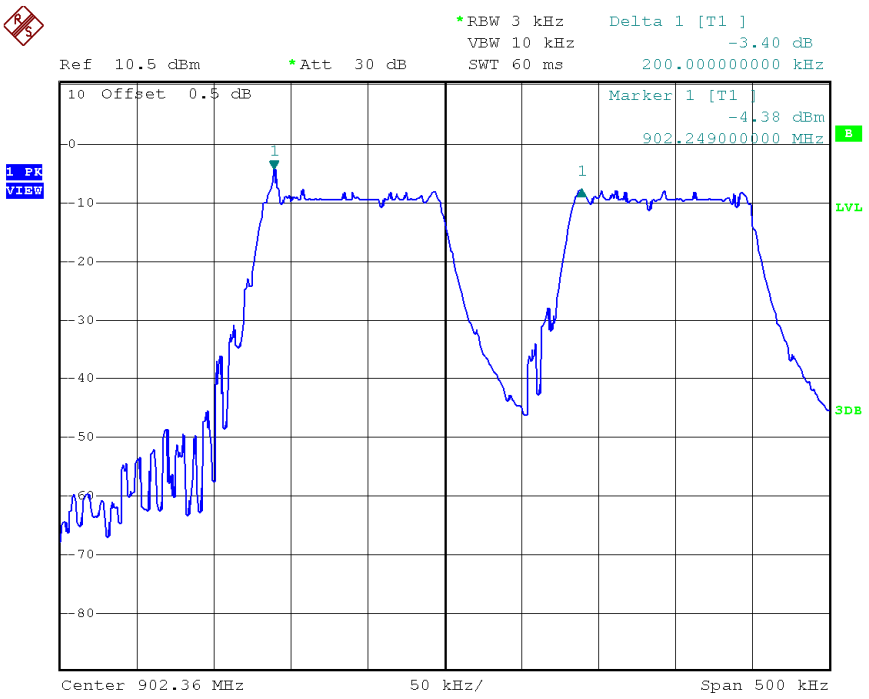
Limits:

The channel separation must be larger than:
20dB bandwidth of hopping channel: 140kHz

The plot(s) of hopping channel carrier frequency separation is saved as below.

TEST REPORT

PLOTS OF MINIMUM HOPPING CHANNEL CARRIER FREQUENCY SEPARATION



4.7 Average Channel Occupancy Time

The spectrum analyzer center frequency was set to one of the known hopping channels. The SWEEP was set to 1ms, the SPAN was set to ZERO SPAN, and the TRIGGER was set to VIDEO. The time duration of the transmission so captured was measured with the MARKER DELTA function.

The SWEEP was then set to the time required by the regulation (20 seconds for 902-928 MHz devices, if the 20dB bandwidth is less than 250kHz, 10 seconds for 902-928 MHz if the 20dB bandwidth is or greater than 250kHz, "0.4 seconds x Number of hopping channels employed" seconds for 2400-2483.5 MHz, 30 seconds for 5725-5850 MHz). The analyzer was set to SINGLE SWEEP, the total ON time was added and compared against the limit (0.4 seconds).

Transmitter	
Average Occupancy Time (Traffic – in a clear RF environment) =	358.4 ms

Limits:

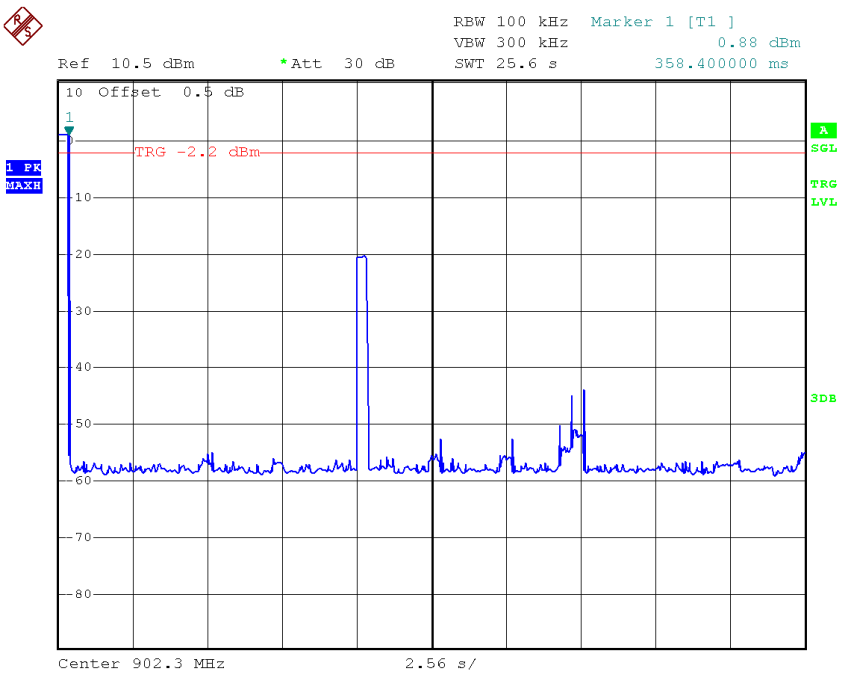
Average 0.4 seconds maximum occupancy in:
25.6 seconds for Hybrid mode (64 channels X 0.4 seconds)

The plots of average channel occupancy time are saved as below.

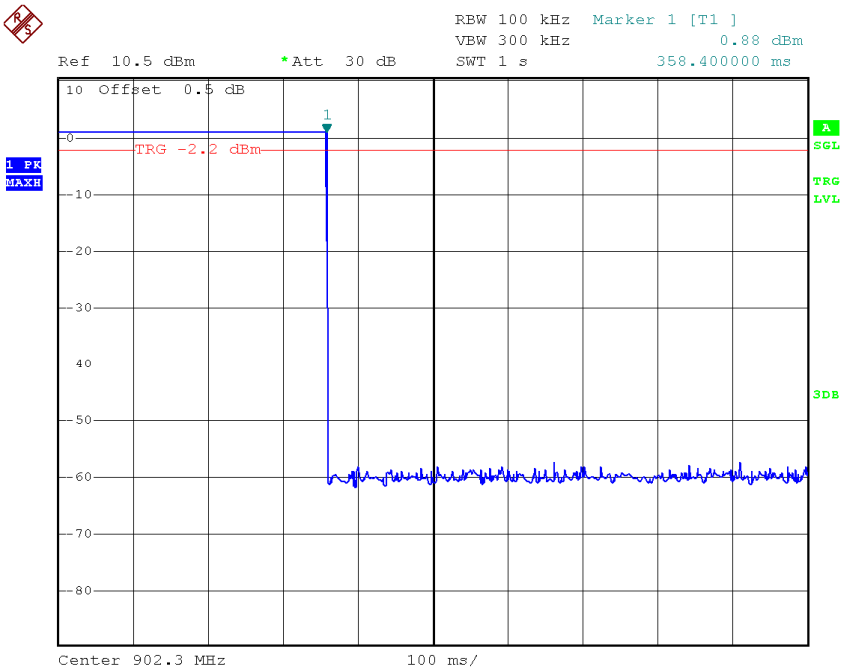
TEST REPORT

PLOTS OF AVERAGE CHANNEL OCCUPANCY TIME (125kHz – Hybrid mode)

Plot A



Plot B



4.8 Out of Band Conducted Emissions

In any 100 kHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission.

The measurement procedures under sections 5.4.1.1 and 5.4.1.2 of KDB558074 were used.

Limits:

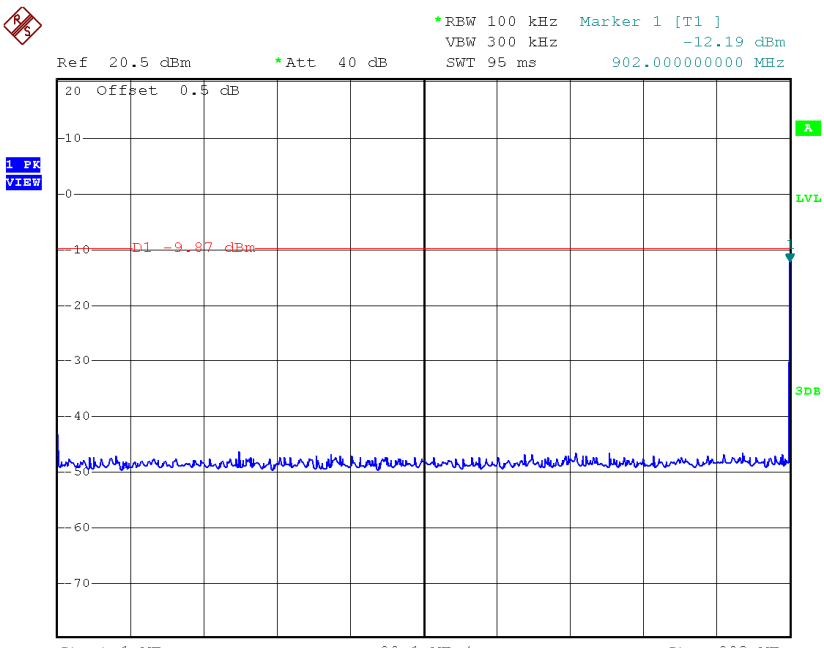
All spurious emission and up to the tenth harmonic was measured and they were found to be at least 20 dB below the maximum measured in-band peak PSD level.

The plots of out of band conducted emissions and bandedge are as below.

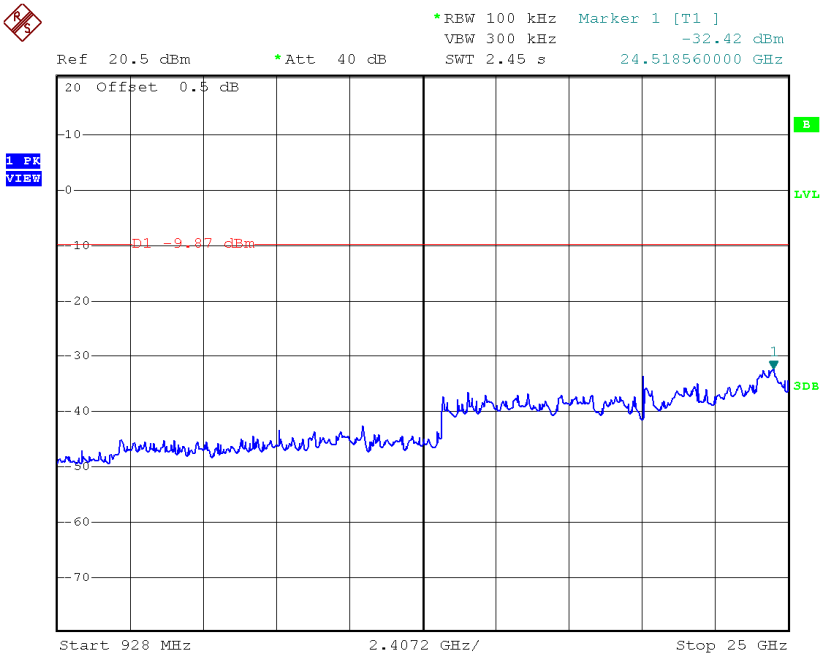
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS (500kHz – DTS mode)

Lowest Channel, Plot A



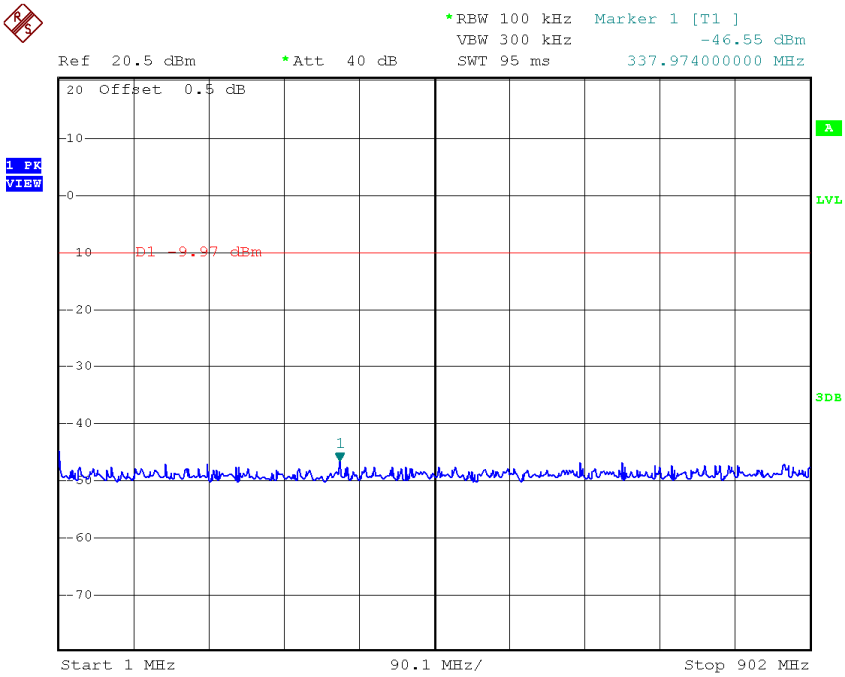
Lowest Channel, Plot B



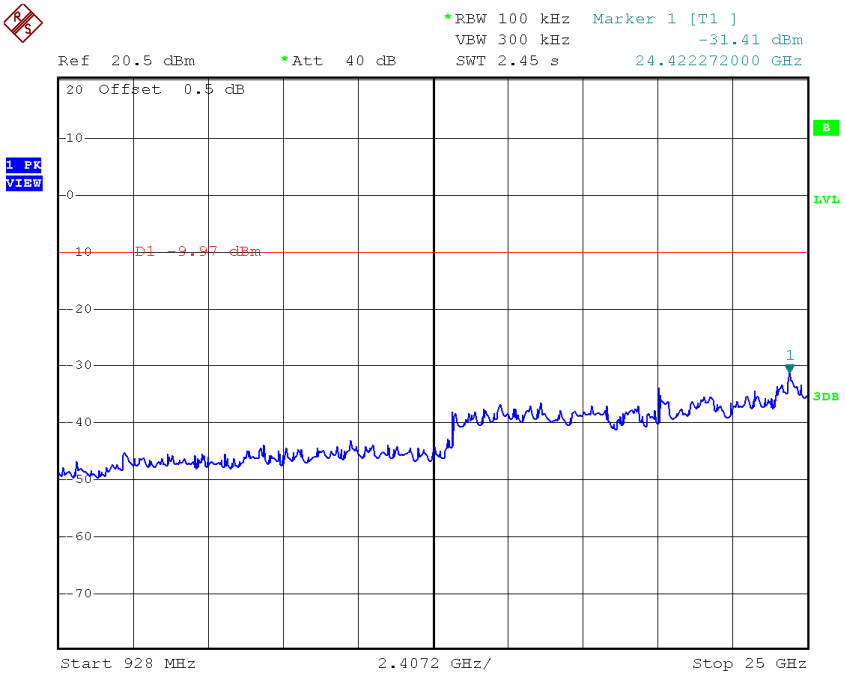
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS (500kHz – DTS mode)

Middle Channel, Plot A



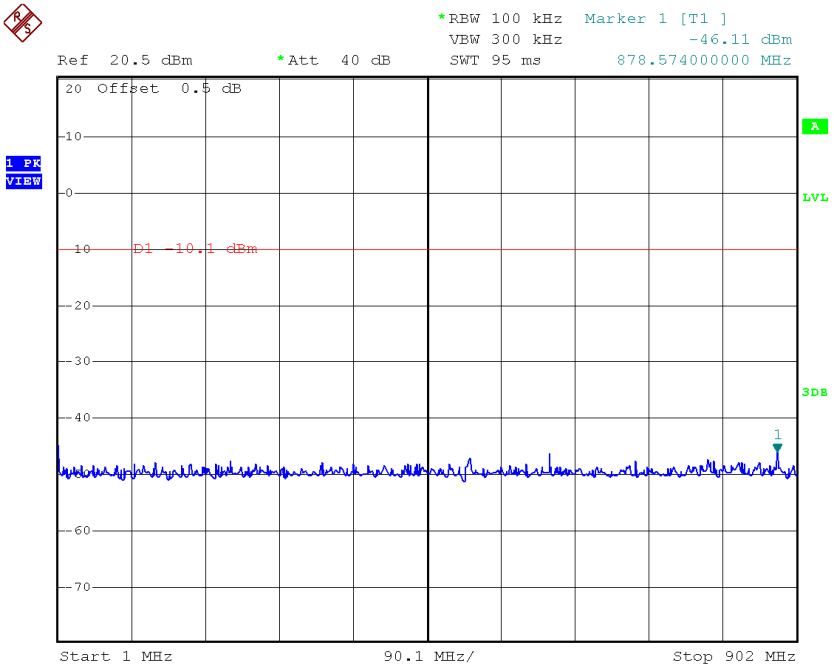
Middle Channel, Plot B



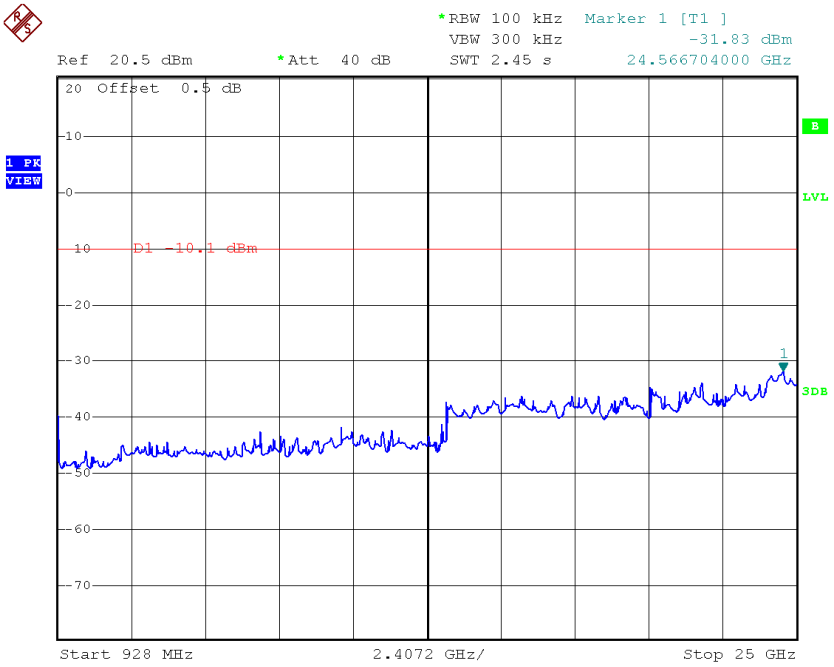
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS (500kHz – DTS mode)

Highest Channel, Plot A



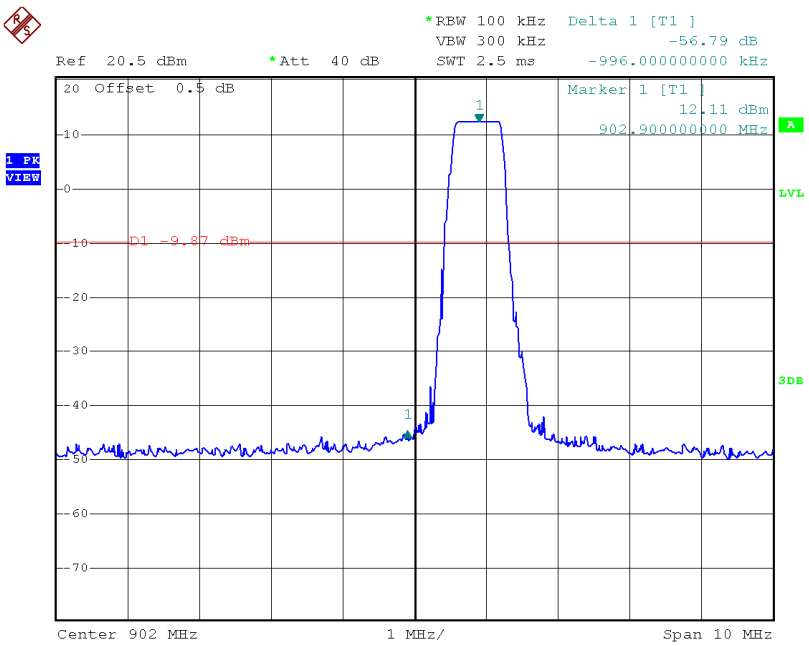
Highest Channel, Plot B



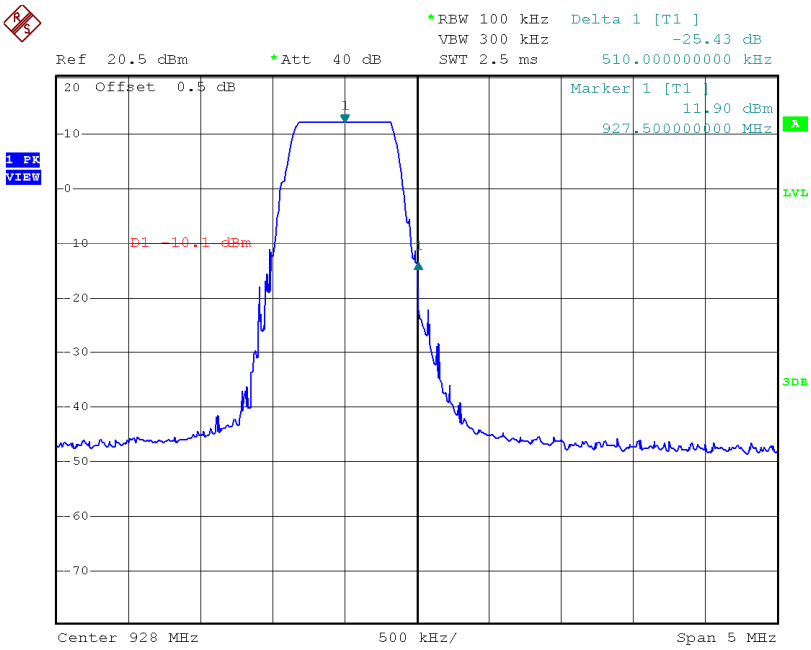
TEST REPORT

PLOTS OF BANDEDGE (500kHz – DTS mode)

Lowest Channel, Bandedge



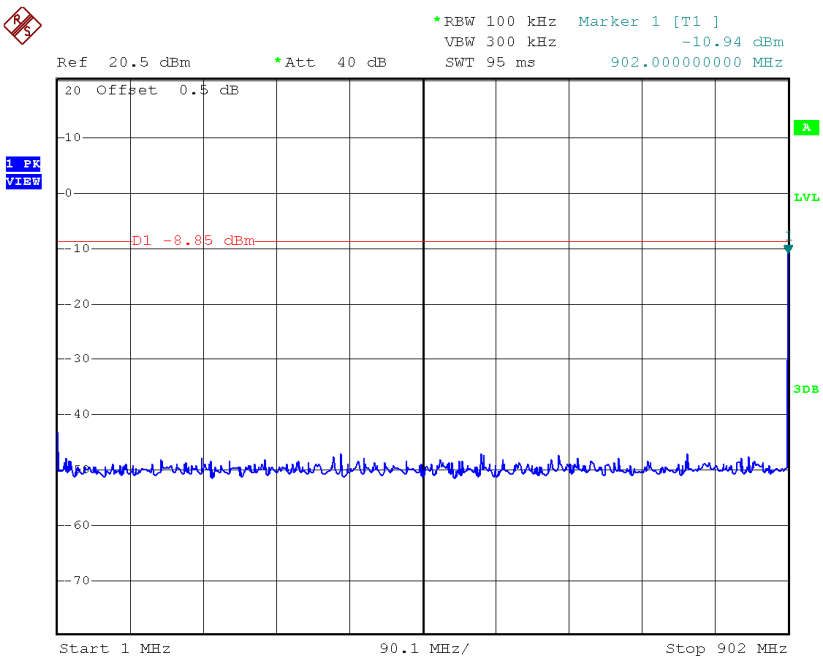
Highest Channel, Bandedge



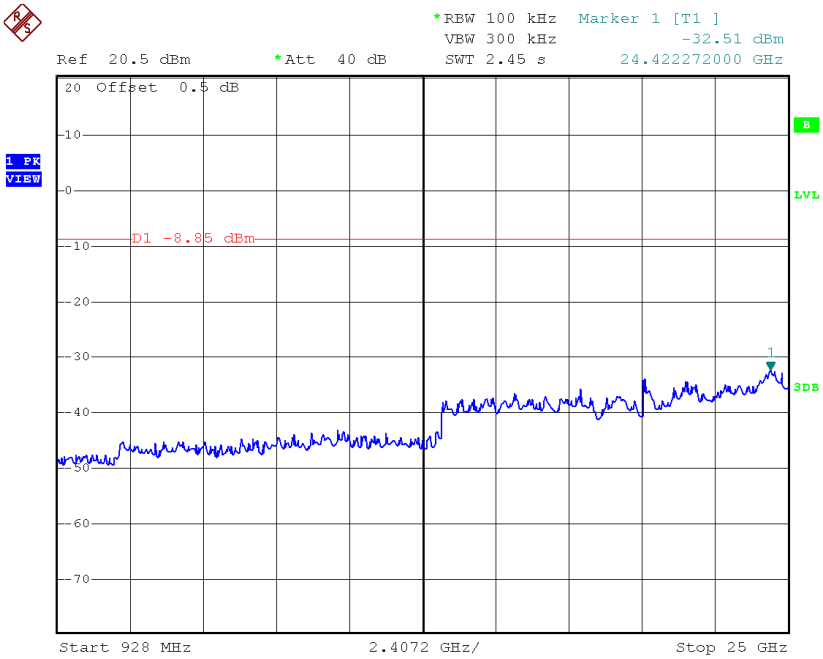
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS (125kHz – Hybrid mode)

Lowest Channel, Plot A



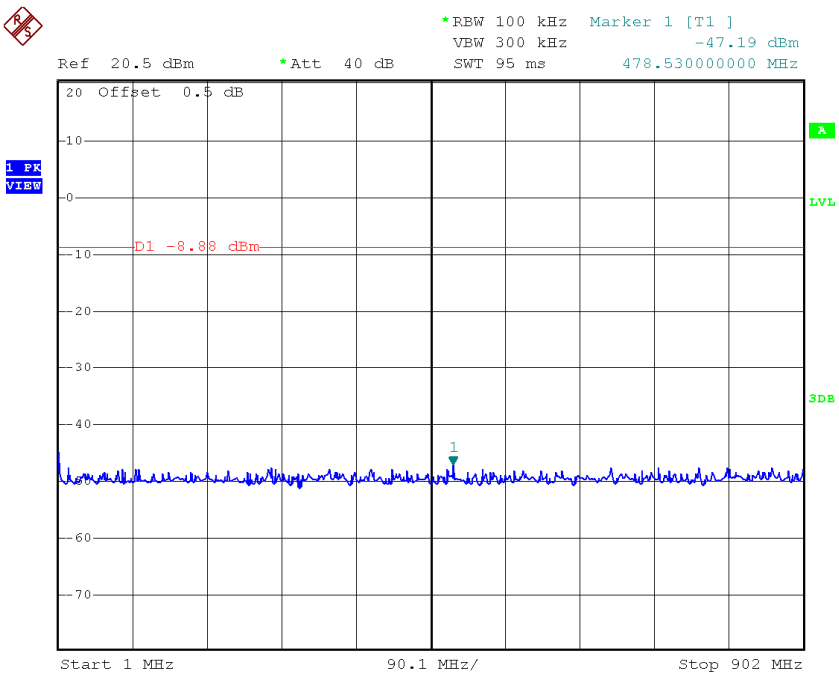
Lowest Channel, Plot B



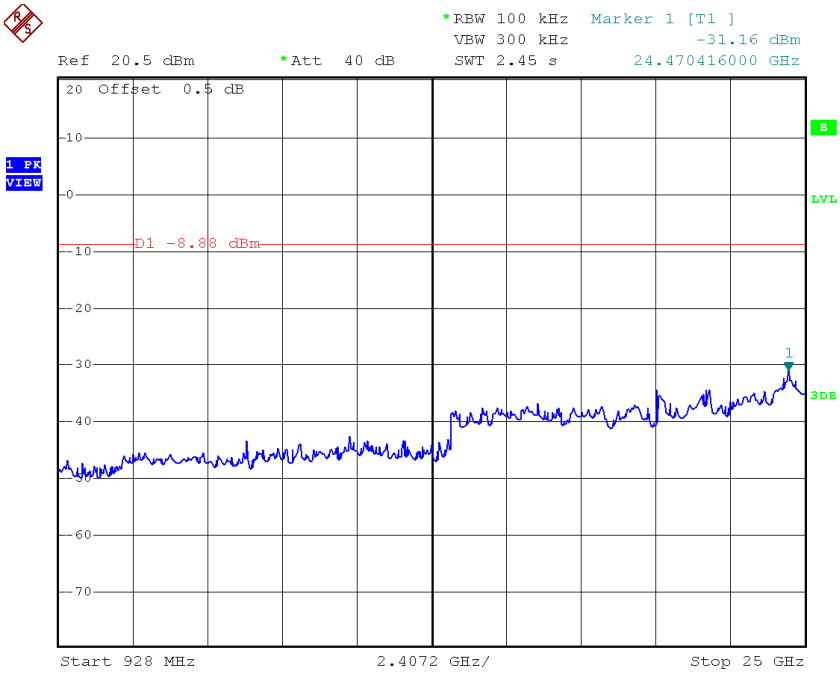
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS (125kHz – Hybrid mode)

Middle Channel, Plot A



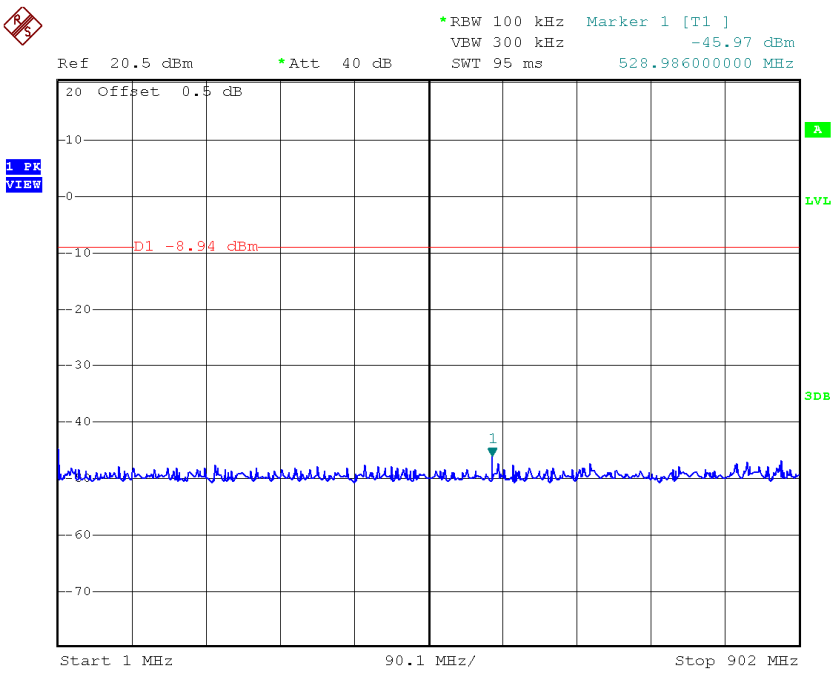
Middle Channel, Plot B



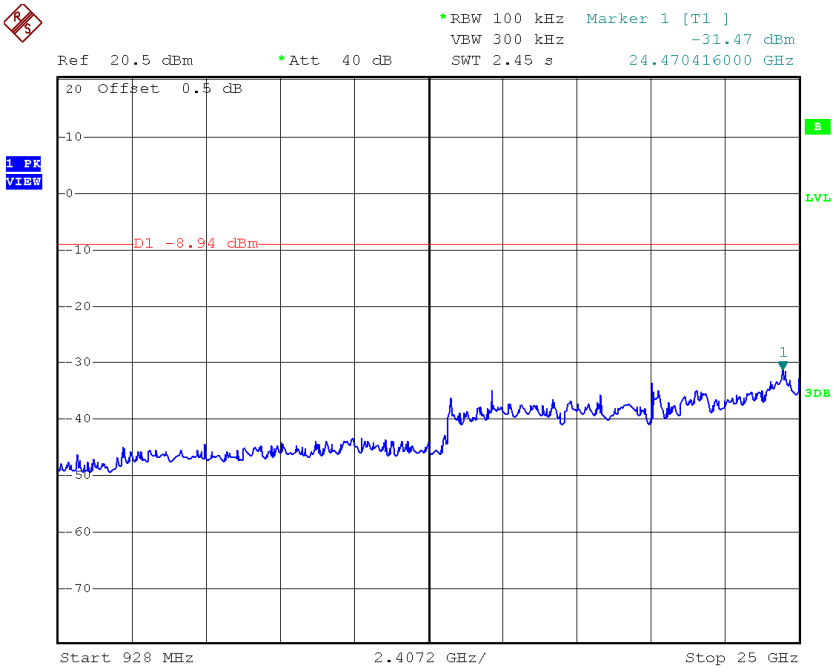
TEST REPORT

PLOTS OF OUT OF BAND CONDUCTED EMISSIONS (125kHz – Hybrid mode)

Highest Channel, Plot A



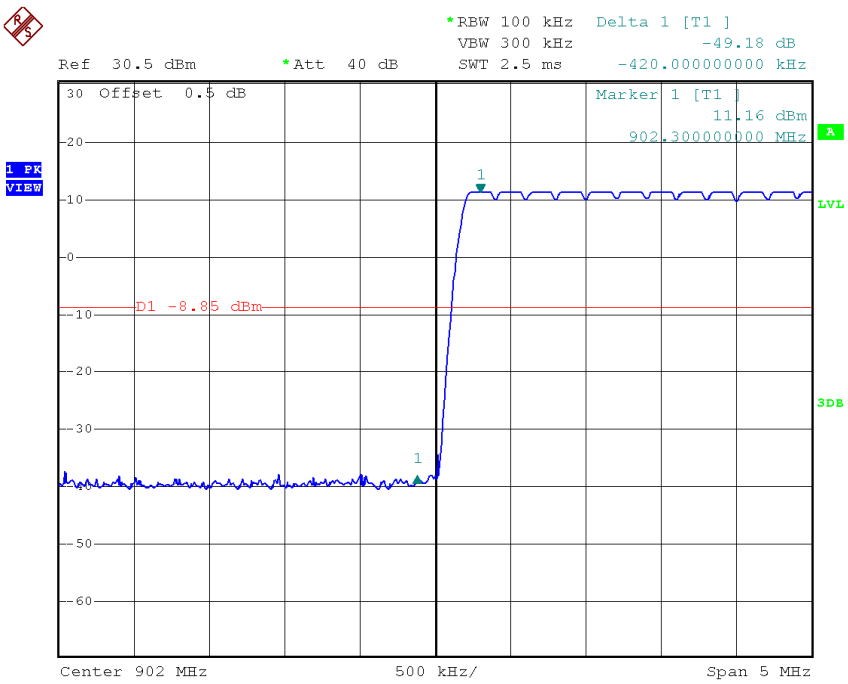
Highest Channel, Plot B



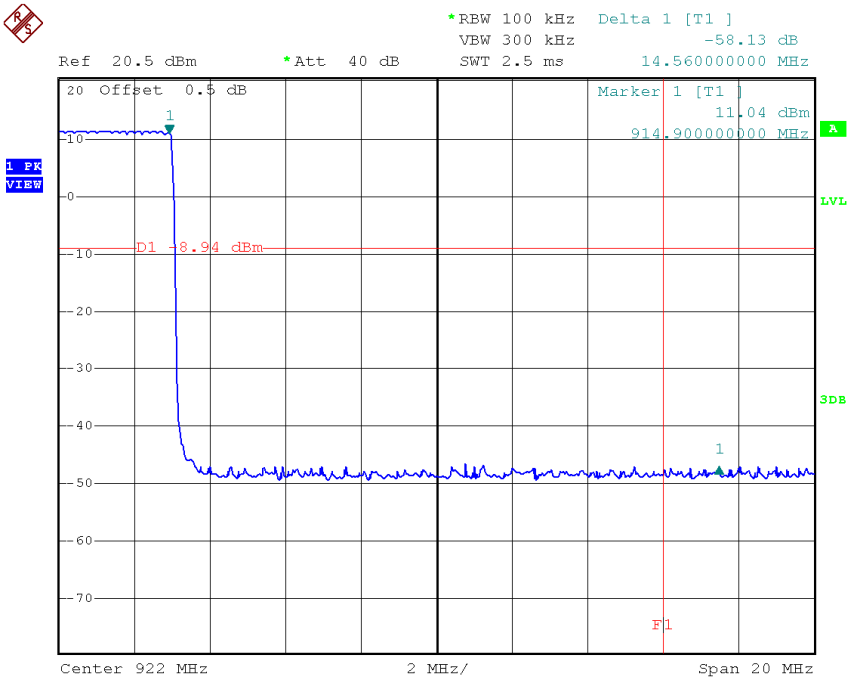
TEST REPORT

PLOTS OF BANDEDGE (HOPPING) (125kHz – Hybrid mode)

Lowest Channel



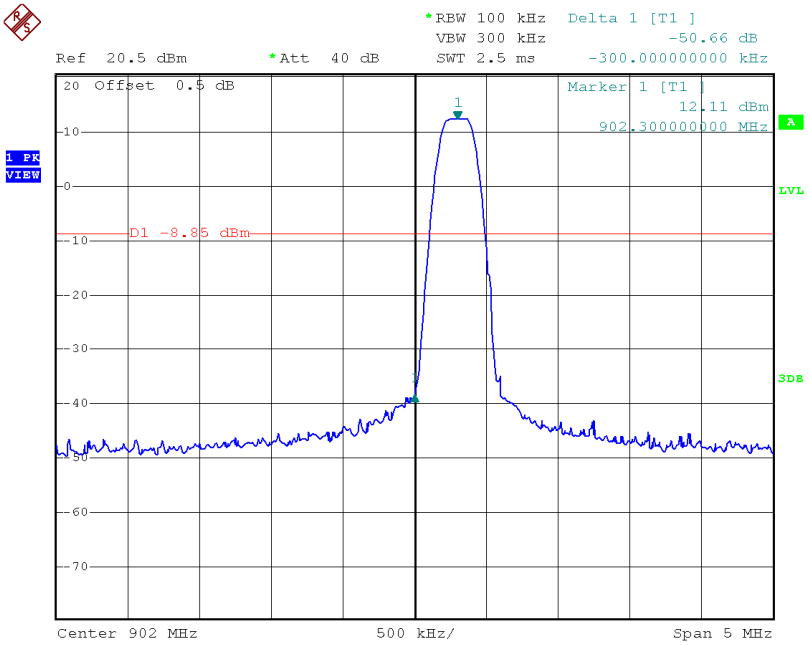
Highest Channel



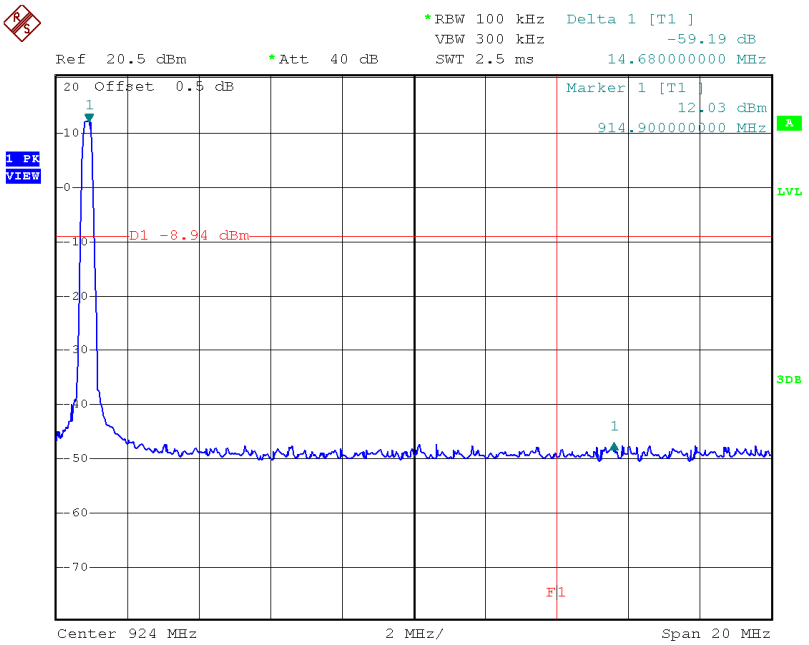
TEST REPORT

PLOTS OF BANDEDGE (HOPPING TURN-OFF) (125kHz – Hybrid mode)

Lowest Channel, Bandedge



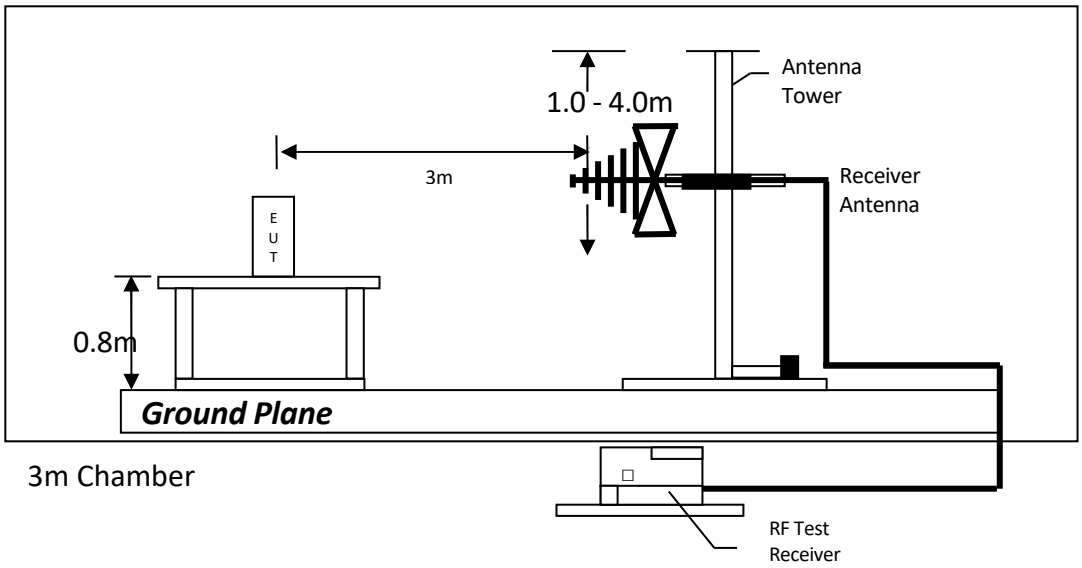
Highest Channel, Bandedge



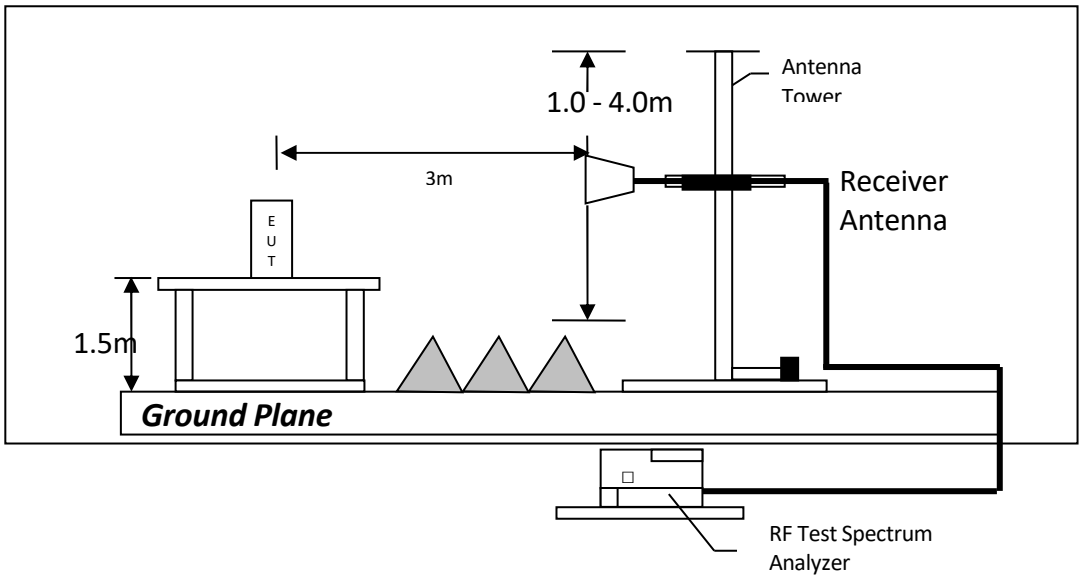
TEST REPORT

4.9 Radiated Emission Test Setup

The figure below shows the test setup, which is utilized to make these measurements.



Test setup of radiated emissions up to 1GHz



Test setup of radiated emissions above 1GHz

4.10 Field Strength Calculation

The field strength is calculated by adding the reading on the Spectrum Analyzer to the factors associated with preamplifiers (if any), antennas, cables, pulse desensitization and average factors (when specified limit is in average and measurements are made with peak detectors). A sample calculation is included below.

FS = RA + AF + CF - AG + PD + AV

where	FS	=	Field Strength in dBµV/m
	RA	=	Receiver Amplitude (including preamplifier) in dBµV
	CF	=	Cable Attenuation Factor in dB
	AF	=	Antenna Factor in dB
	AG	=	Amplifier Gain in dB
	PD	=	Pulse Desensitization in dB
	AV	=	Average Factor in -dB

In the radiated emission table which follows, the reading shown on the data table may reflects the preamplifier gain. An example of the calculations, where the reading does not reflect the preamplifier gain, follows:

FS = RA + AF + CF - AG + PD + AV

Example:

Assume a receiver reading of 62.0 dBµV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29.0 dB is subtracted. The pulse desensitization factor of the spectrum analyzer is 0.0 dB, and the resultant average factor is -10.0 dB. The net field strength for comparison to the appropriate emission limit is 32.0 dBµV/m. This value in dBµV/m is converted to its corresponding level in µV/m.

RA	=	62.0 dBµV
AF	=	7.4 dB
CF	=	1.6 dB
AG	=	29 dB
PD	=	0.0 dB
AV	=	-10 dB
FS	=	62.0 + 7.4 + 1.6 – 29.0 + 0.0 + (-10.0) = 32.0 dBµV/m

Level in µV/m = Common Antilogarithm [(32.0 dBµV/m)/20] = 39.8 µV/m

4.11 Transmitter Radiated Emissions in Restricted Bands and Spurious Emissions

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

4.11.1 Radiated Emission Configuration Photograph

Worst Case Restricted Band Radiated Emission

at 7319.200 MHz

The worst case radiated emission configuration photographs are saved with filename: config photos.pdf

4.11.2 Radiated Emission Data

The data in tables 1-7 list the significant emission frequencies, the limit and the margin of compliance.

Judgement –

Passed by 0.2 dB margin

TEST REPORT

RADIATED EMISSION DATA

Mode: TX - Digital Transmission System (500kHz mode)

Table 1 Lowest Channel

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	1805.800	48.0	33	27.2	42.2	54.0	-11.8
V	2708.700	34.4	33	30.4	31.8	54.0	-22.2
H	3611.600	27.2	33	33.3	27.5	54.0	-26.5
V	4514.500	26.7	33	34.9	28.6	54.0	-25.4
V	5417.400	25.7	33	35.7	28.4	54.0	-25.6
V	6320.300	24.3	33	36.9	28.2	54.0	-25.8
V	7223.200	48.8	33	37.9	53.7	54.0	-0.3
V	8126.100	47.6	33	39.0	53.6	54.0	-0.4

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	1805.800	53.0	33	27.2	47.2	74.0	-26.8
V	2708.700	51.8	33	30.4	49.2	74.0	-24.8
H	3611.600	40.6	33	33.3	40.9	74.0	-33.1
V	4514.500	39.9	33	34.9	41.8	74.0	-32.2
V	5417.400	37.5	33	35.7	40.2	74.0	-33.8
V	6320.300	36.2	33	36.9	40.1	74.0	-33.9
V	7223.200	57.3	33	37.9	62.2	74.0	-11.8
V	8126.100	55.6	33	39.0	61.6	74.0	-12.4

NOTES:
1. Peak detector is used for the emission measurement. Average detector is used for the average data of emission measurement
2. All measurements were made at 3 meters.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz
5. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: TX - Digital Transmission System (500kHz mode)

Table 2 Middle Channel

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	1829.800	48.1	33	27.2	42.3	54.0	-11.7
V	2744.700	34.8	33	30.4	32.2	54.0	-21.8
H	3659.600	27.9	33	33.3	28.2	54.0	-25.8
V	4574.500	26.8	33	34.9	28.7	54.0	-25.3
V	5489.400	26.8	33	35.7	29.5	54.0	-24.5
V	6404.300	24.6	33	36.9	28.5	54.0	-25.5
V	7319.200	48.8	33	37.9	53.7	54.0	-0.3
V	8234.100	47.5	33	39.0	53.5	54.0	-0.5

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	1829.800	53.3	33	27.2	47.5	74.0	-26.5
V	2744.700	52.8	33	30.4	50.2	74.0	-23.8
H	3659.600	40.5	33	33.3	40.8	74.0	-33.2
V	4574.500	40.9	33	34.9	42.8	74.0	-31.2
V	5489.400	37.7	33	35.7	40.4	74.0	-33.6
V	6404.300	36.3	33	36.9	40.2	74.0	-33.8
V	7319.200	57.5	33	37.9	62.4	74.0	-11.6
V	8234.100	55.5	33	39.0	61.5	74.0	-12.5

NOTES:
1. Peak detector is used for the emission measurement. Average detector is used for the average data of emission measurement
2. All measurements were made at 3 meters.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz
5. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: TX - Digital Transmission System (500kHz mode)

Table 3 Highest Channel

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	1855.000	47.3	33	27.2	41.5	54.0	-12.5
V	2782.500	38.4	33	30.4	35.8	54.0	-18.2
H	3710.000	27.8	33	33.3	28.1	54.0	-25.9
V	4637.500	26.8	33	34.9	28.7	54.0	-25.3
V	5565.000	25.2	33	36.6	28.8	54.0	-25.2
V	6492.500	36.9	33	36.9	40.8	54.0	-13.2
V	7420.000	48.6	33	37.9	53.5	54.0	-0.5
V	8347.500	46.2	33	39.0	52.2	54.0	-1.8

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	1855.000	52.6	33	27.2	46.8	74.0	-27.2
V	2782.500	50.8	33	30.4	48.2	74.0	-25.8
H	3710.000	40.0	33	33.3	40.3	74.0	-33.7
V	4637.500	39.4	33	34.9	41.3	74.0	-32.7
V	5565.000	38.6	33	36.6	42.2	74.0	-31.8
V	6492.500	48.9	33	36.9	52.8	74.0	-21.2
V	7420.000	66.3	33	37.9	71.2	74.0	-2.8
V	8347.500	54.4	33	39.0	60.4	74.0	-13.6

NOTES:
1. Peak detector is used for the emission measurement. Average detector is used for the average data of emission measurement
2. All measurements were made at 3 meters.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz
5. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: TX-Hybrid (125kHz mode)

Table 4, Transmitter Lowest Channel

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	1804.600	45.3	33	27.2	39.5	54.0	-14.5
V	2706.900	31.8	33	30.4	29.2	54.0	-24.8
H	3609.200	29.1	33	33.3	29.4	54.0	-24.6
V	4511.500	26.5	33	34.9	28.4	54.0	-25.6
V	5413.800	28.4	33	35.7	31.1	54.0	-22.9
V	6316.100	28.9	33	36.9	32.8	54.0	-21.2
V	7218.400	48.7	33	37.9	53.6	54.0	-0.4
V	8120.700	44.8	33	39.0	50.8	54.0	-3.2

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	1804.600	50.0	33	27.2	44.2	74.0	-29.8
V	2706.900	45.0	33	30.4	42.4	74.0	-31.6
H	3609.200	42.2	33	33.3	42.5	74.0	-31.5
V	4511.500	40.0	33	34.9	41.9	74.0	-32.1
V	5413.800	39.6	33	35.7	42.3	74.0	-31.7
V	6316.100	38.5	33	36.9	42.4	74.0	-31.6
V	7218.400	57.7	33	37.9	62.6	74.0	-11.4
V	8120.700	53.4	33	39.0	59.4	74.0	-14.6

NOTES:
1. Peak detector is used for the emission measurement. Average detector is used for the average data of emission measurement
2. All measurements were made at 3 meters.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz
5. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: TX-Hybrid (125kHz mode)

Table 5, Transmitter Middle Channel

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	1817.000	48.0	33	27.2	42.2	54.0	-11.8
V	2725.500	29.2	33	30.4	26.6	54.0	-27.4
H	3634.000	26.0	33	33.3	26.3	54.0	-27.7
V	4542.500	26.9	33	34.9	28.8	54.0	-25.2
V	5451.000	37.2	33	35.7	39.9	54.0	-14.1
V	6359.500	26.6	33	36.9	30.5	54.0	-23.5
V	7268.000	48.8	33	37.9	53.7	54.0	-0.3
V	8176.500	39.4	33	39.0	45.4	54.0	-8.6

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	1817.000	52.4	33	27.2	46.6	74.0	-27.4
V	2725.500	41.4	33	30.4	38.8	74.0	-35.2
H	3634.000	39.8	33	33.3	40.1	74.0	-33.9
V	4542.500	40.5	33	34.9	42.4	74.0	-31.6
V	5451.000	42.8	33	35.7	45.5	74.0	-28.5
V	6359.500	46.2	33	36.9	50.1	74.0	-23.9
V	7268.000	56.3	33	37.9	61.2	74.0	-12.8
V	8176.500	48.4	33	39.0	54.4	74.0	-19.6

NOTES:
1. Peak detector is used unless otherwise stated. Average detector is used for the average data of emission measurement
2. All measurements were made at 3 meters.
3. Negative value in the margin column shows emission below limit.
4. Horn antenna is used for the emission over 1000MHz
5. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10
6. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: TX-Hybrid (125kHz mode)

Table 6, Transmitter Highest Channel

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m Average (dBµV/m)	Average Limit at 3m (dBµV/m)	Margin (dB)
H	1829.800	48.2	33	27.2	42.4	54.0	-11.6
V	2744.700	27.8	33	30.4	25.2	54.0	-28.8
H	3659.600	26.6	33	33.3	26.9	54.0	-27.1
V	4574.500	27.0	33	34.9	28.9	54.0	-25.1
V	5489.400	27.5	33	35.7	30.2	54.0	-23.8
V	6404.330	27.6	33	36.9	31.5	54.0	-22.5
V	7319.200	48.9	33	37.9	53.8	54.0	-0.2
V	8234.100	29.8	33	39.0	35.8	54.0	-18.2

Polari-zation	Frequency (MHz)	Reading (dBµV)	Pre-Amp Gain (dB)	Antenna Factor (dB)	Net at 3m - Peak (dBµV/m)	Peak Limit at 3m (dBµV/m)	Margin (dB)
H	1829.800	51.2	33	27.2	45.4	74.0	-28.6
V	2744.700	41.2	33	30.4	38.6	74.0	-35.4
H	3659.600	40.1	33	33.3	40.4	74.0	-33.6
V	4574.500	40.0	33	34.9	41.9	74.0	-32.1
V	5489.400	42.5	33	35.7	45.2	74.0	-28.8
V	6404.330	41.9	33	36.9	45.8	74.0	-28.2
V	7319.200	58.9	33	37.9	63.8	74.0	-10.2
V	8234.100	47.2	33	39.0	53.2	74.0	-20.8

NOTES:
1. Peak detector is used unless otherwise stated. Average detector is used for the average data of emission measurement
2. Average detector is used for the average data of emission measurement.
3. All measurements were made at 3 meters.
4. Negative value in the margin column shows emission below limit.
5. Horn antenna is used for the emission over 1000MHz
6. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10
7. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

TEST REPORT

RADIATED EMISSION DATA

Mode: Normal Operation with charging

Table 7

Polarization	Frequency (MHz)	Reading (dBµV)	Pre-amp (dB)	Antenna Factor (dB)	Net at 3m (dBµV/m)	Limit at 3m (dBµV/m)	Margin (dB)
H	31.334	25.5	16	10.0	19.5	40.0	-20.5
H	54.372	18.4	16	11.0	13.4	40.0	-26.6
H	250.918	16.2	16	20.0	20.2	46.0	-25.8
H	405.875	17.2	16	24.0	25.2	46.0	-20.8
V	696.026	17.8	16	30.0	31.8	46.0	-14.2
H	902.000	29.6	16	32.0	45.6	46.0	-0.4
H	928.000	28.7	16	33.0	45.7	46.0	-0.3

NOTES:
1. Quasi-Peak detector is used unless otherwise stated.
2. All measurements were made at 3 meters.
3. Negative value in the margin column shows emission below limit.
4. Emissions within the restricted band meets the requirement of FCC Part 15 Section 15.205 / RSS-Gen Section 8.10
5. Measurement Uncertainty is ±5.3dB at a level of confidence of 95%.

4.12 AC Power Line Conducted Emission

☐ Not Applicable – EUT is only powered by battery for operation.

☒ EUT connects to AC power line. Emission Data is listed in following pages.

☐ Base Unit connects to AC power line and has transmission. Handset connects to AC power line but has no transmission. Emission Data of Base Unit is listed in following pages.

4.12.1 AC Power Line Conducted Emission Configuration Photograph

Worst Case Line-Conducted Configuration
at

0.186 MHz

The worst-case line conducted configuration photographs are attached in the Appendix and saved with filename: config photos.pdf.

4.12.2 AC Power Line Conducted Emission Data

The plot(s) and data in the following pages list the significant emission frequencies, the limit and the margin of compliance.

Passed by 9.5 dB margin

TEST REPORT

AC POWER LINE CONDUCTED EMISSION

Worst Case: Normal Operation with charging

EDIT PEAK LIST (Final Measurement Results)

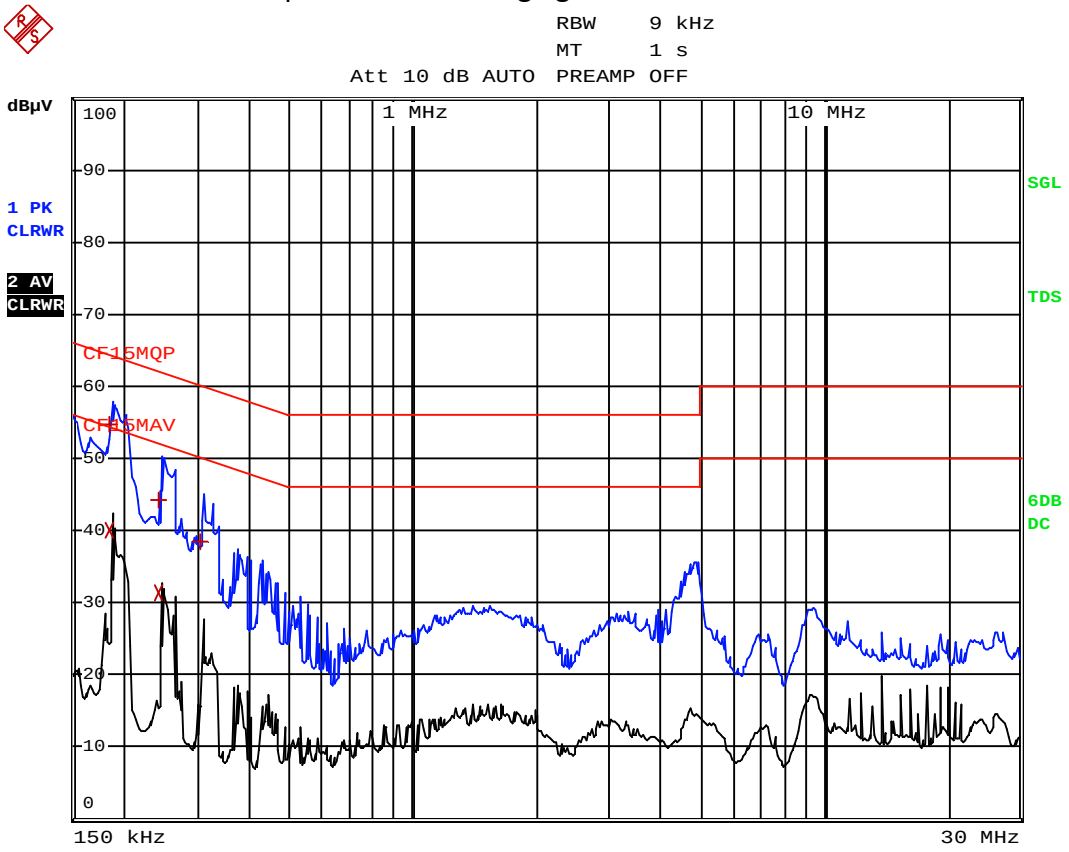
Trace1: CF15MQP
Trace2: CF15MAV
Trace3: ---

	TRACE	FREQUENCY	LEVEL dBµV		DELTA LIMIT dB
1	Quasi Peak	186 kHz	54.70	N	-9.50
2	CISPR Average	186 kHz	39.91	N	-14.29
1	Quasi Peak	244.5 kHz	44.25	L1	-17.68
2	CISPR Average	244.5 kHz	31.35	N	-20.58
1	Quasi Peak	307.5 kHz	38.49	L1	-21.54

Date: 24.MAY.2023 13:40:18

TEST REPORT

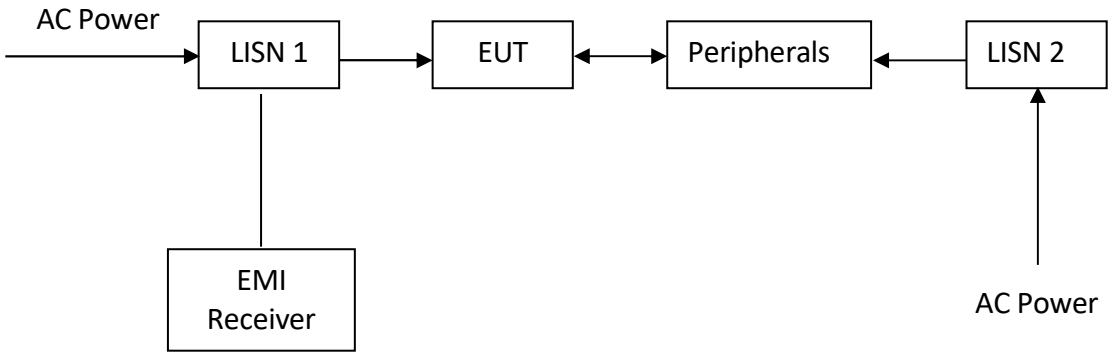
Worst Case: Normal Operation with charging



Date: 24.MAY.2023 13:40:43

TEST REPORT

4.12.3 Conducted Emission Test Setup



The EUT along with its peripherals were placed on a 1.0m(W)×1.5m(L) and 0.8m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane. The EUT was connected to power mains through a line impedance stabilization network (LISN), which provided 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled.

All connecting cables of EUT and peripherals were moved to find the maximum emission.

EXHIBIT 5 EQUIPMENT LIST

1) Radiated Emissions Test

Equipment	Signal and Spectrum Analyzer (10Hz to 40GHz)	Biconical Antenna (30MHz to 300MHz)	EMI Test Receiver 7GHz
Registration No.	EW-3016	EW-3242	EW-3481
Manufacturer	ROHDESCHWARZ	EMCO	ROHDESCHWARZ
Model No.	FSV40	3110C	ESR7
Calibration Date	January 29, 2022	May 26, 2021	December 21, 2021
Calibration Due Date	July 29, 2023	August 26, 2023	June 21, 2023

Equipment	Log Periodic Antenna	Double Ridged Guide Antenna	Active Loop H-field (9kHz to 30MHz)
Registration No.	EW-3243	EW-1133	EW-3302
Manufacturer	EMCO	EMCO	EMCO
Model No.	3148B	3115	6502
Calibration Date	June 03, 2021	May 26, 2021	September 08, 2022
Calibration Due Date	June 30, 2023	August 26, 2023	September 08, 2023

Equipment	RF Preamplifier (9kHz to 6000MHz)	Pyramidal Horn Antenna	14m Double Shield RF Cable (9kHz - 6GHz)
Registration No.	EW-3006b	EW-0905	EW-2376
Manufacturer	SCHWARZBECK	EMCO	RADIALL
Model No.	BBV9718	3160-09	n m/br56/bnc m 14m
Calibration Date	February 15, 2022	July 20, 2021	January 26, 2022
Calibration Due Date	August 15, 2023	August 20, 2023	July 26, 2023

Equipment	RF Cable 14m (1GHz to 26.5GHz)	14m Double Shield RF Cable (20MHz to 6GHz)	Pyramidal Horn Antenna
Registration No.	EW-2781	EW-2074	EW-0905
Manufacturer	GREATBILLION	RADIALL	EMCO
Model No.	SMA m/SHF5MPU /SMA m ra14m,26G	N(m)-RG142-BNC(m) L=14M	3160-09
Calibration Date	November 24, 2021	December 10, 2021	July 20, 2021
Calibration Due Date	July 24, 2023	September 10, 2023	August 20, 2023

5.0 EQUIPMENT LIST (CONT'D)

2) Bandedge Measurement

Equipment	Signal and Spectrum Analyzer (10Hz to 40GHz)	5m RF Cable (40GHz)
Registration No.	EW-3016	EW-2701
Manufacturer	ROHDESCHWARZ	RADIALL
Model No.	FSV40	Sma m-m 5m 40G
Calibration Date	January 29, 2022	November 24, 2021
Calibration Due Date	July 29, 2023	August 24, 2023

3) OBW Measurement

Equipment	EMI Test Receiver 7GHz	5m RF Cable (40GHz)
Registration No.	EW-3481	EW-2701
Manufacturer	ROHDESCHWARZ	RADIALL
Model No.	ESR7	Sma m-m 5m 40G
Calibration Date	December 21, 2021	November 24, 2021
Calibration Due Date	June 21, 2023	August 24, 2023

4) Conducted Emissions Test

Equipment	RF Cable 240cm (RG142) (9kHz to 30MHz)	Artificial Mains Network	EMI Test Receiver 7GHz
Registration No.	EW-2454	EW-2501	EW-3481
Manufacturer	RADIALL	ROHDESCHWARZ	ROHDESCHWARZ
Model No.	Bnc m st / 142 / bnc mra 240cm	ENV-216	ESR7
Calibration Date	January 26, 2022	September 11, 2021	December 21, 2021
Calibration Due Date	July 26, 2023	September 11, 2023	June 21, 2023

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5) Control Software for Radiated Emission

Software Information	
Software Name	EMC32
Manufacturer	ROHDESCHWARZ
Software version	10.50.40

END OF TEST REPORT