

Wireless test report – 366581-3TRFWL

Applicant:

Hypertherm Inc.

Product name:

SmartSYNC™ Torch RFID Module

Model:

141463

Model variant:

141466

FCC ID:

2ASER-SMARTSYNC

ISED Registration number:

24739-SMARTSYNC

Specifications:

Low Power 0002 (LP0002) January 10, 2018

Low-power Radio-frequency Devices

Clause 3.2 Operation within the band 13.553 MHz ~ 13.567 MHz

Date of issue: **March 26, 2019**

Test engineer(s): **Yong Huang, Wireless/EMC Specialist**

Signature:



Reviewed by: **Andrey Adelberg, Senior Wireless/EMC Specialist**

Signature:



Test location(s)

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Site number	FCC: CA2040; ISED: 2040A-4 (3 m SAC)	FCC: CA2041; ISED: 2040G-5 (3 m SAC)

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Table of Contents

Section 1	Report summary	4
1.1	Applicant and manufacturer	4
1.2	Test specifications	4
1.3	Test methods	4
1.4	Statement of compliance	4
1.5	Exclusions	4
1.6	Test report revision history	4
Section 2	Summary of test results	5
2.1	LP0002, test results	5
Section 3	Equipment under test (EUT) details	6
3.1	Sample information	6
3.2	EUT information	6
3.3	Technical information	6
3.4	Product description and theory of operation	6
3.5	EUT exercise details	6
3.6	EUT setup diagram	6
Section 4	Engineering considerations	7
4.1	Modifications incorporated in the EUT	7
4.2	Technical judgment	7
4.3	Deviations from laboratory tests procedures	7
Section 5	Test conditions	8
5.1	Atmospheric conditions	8
5.2	Power supply range	8
Section 6	Measurement uncertainty	9
6.1	Uncertainty of measurement	9
Section 7	Test equipment	10
7.1	Test equipment list	10
Section 8	Testing data	11
8.1	2.3 AC power line conducted emissions limits	11
8.2	3.2.1.1 Fundamental emission	17
8.3	3.2.1.2 Unwanted emission	18
8.4	Frequency tolerance	21
Section 9	Block diagrams of test setups	22
9.1	Radiated emissions set-up for frequencies below 30 MHz	22
9.2	Radiated emissions set-up for frequencies above 30 MHz	23
9.3	Conducted emissions set-up	23

Section 1 Report summary

1.1 Applicant and manufacturer

Company name	Hypertherm Inc
Address	PO Box 5010 Hanover, NH 03755

1.2 Test specifications

LP0002 January 10, 2018, Clause 3.2	Operation within the band 13.553 MHz ~ 13.567 MHz
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1.3 Test methods

558074 D01 DTS Meas Guidance v05r01 (Feb 11, 2019)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.5 below. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	March 26, 2019	Original report issued



Section 2 Summary of test results

2.1 LP0002, test results

Part	Test description	Verdict
2.3	Conducted limits	Pass
3.2.1.1	Fundamental emission	Pass
3.2.1.2	Unwanted emission	Pass
3.2.1.3	The frequency tolerance	Pass

Note: ¹The EUT is using a permanently attached, non-detachable antenna contained within the EUT and it is not user accessible.

Section 3 Equipment under test (EUT) details

3.1 Sample information

Receipt date	January 7, 2019
Nemko sample ID number	1

3.2 EUT information

Product name	SmartSYNC™ Torch RFID Module
Model	141463, 141466
Serial number	HCT18341153, HCT18341256

3.3 Technical information

Operating band	13.553–13.567 MHz
Operating frequency	13.56 MHz
Modulation type	OOK
Power requirements	15 V _{DC} (via external 100–240 V _{AC} , 50/60 Hz power adapter)
Antenna information	Loop antenna (The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.)

3.4 Product description and theory of operation

The SmartSYNC™ RFID module (NFC 13.56 MHz RFID transceiver module) is powered by 12 to 18 V_{DC} from host equipment. The contactless reader is using low power RF transmission for proximity reading range. OOK modulation is transmitted through the coil antenna to read a tag. For further instructions, please see the user manual.

3.5 EUT exercise details

The laptop runs a script that communicates via USB to the power and control box and issues a read command. The power and control box then issue a read command via RS422 to the EUT. The data is read from the RFID tag using the NFC 13.56MHz RFID transceiver module and the data is sent back to the power and control box. The power and control box then sends the data to the laptop over USB. The script issues a read command once per second.

3.6 EUT setup diagram

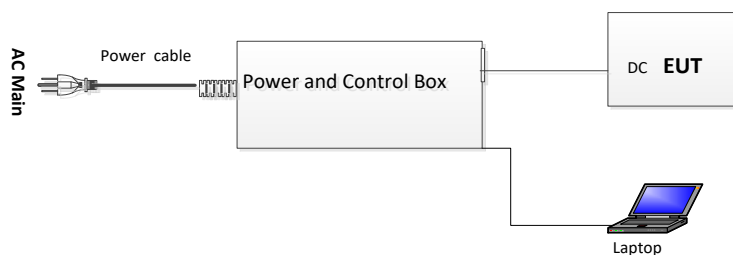


Figure 3.6-1: Setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.



Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002532	2 year	Jan. 10/20
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Dec. 6/19
Biconical antenna (30–300 MHz)	Sunol	BC2	FA002078	1 year	Oct. 5/19
Log periodic antenna (200–5000 MHz)	Sunol	LP5	FA002077	1 year	Oct. 5/19
Active loop antenna (9 kHz–30 MHz)	COM-POWER	AL-130	FA002674	1 year	Sept. 12/19
50 Ω coax cable	C.C.A.	None	FA002605	—	VOU
50 Ω coax cable	C.C.A.	None	FA002831	—	VOU
50 Ω coax cable	C.C.A.	None	FA002607	—	VOU
Environmental Chamber	ESPEC	EPX-4H	FA002736	1 year	June 6/19
Multimeter	AMPPROBE	AM-530	FA002570	1 year	May 16/19

Notes: NCR - no calibration required, VOU - verify on use

Section 8 Testing data

8.1 2.3 AC power line conducted emissions limits

8.1.1 Definitions and limits

For Low-power radio-frequency devices that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). The lower limit applies at the boundary between the frequency ranges.

Table 8.1-1: Conducted emissions limit

Frequency of emission, MHz	Conducted limit, dB μ V	
	Quasi-peak	Average**
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Note: * - The level decreases linearly with the logarithm of the frequency.

 ** - A linear average detector is required.

8.1.2 Test summary

Test date January 11, 2019

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

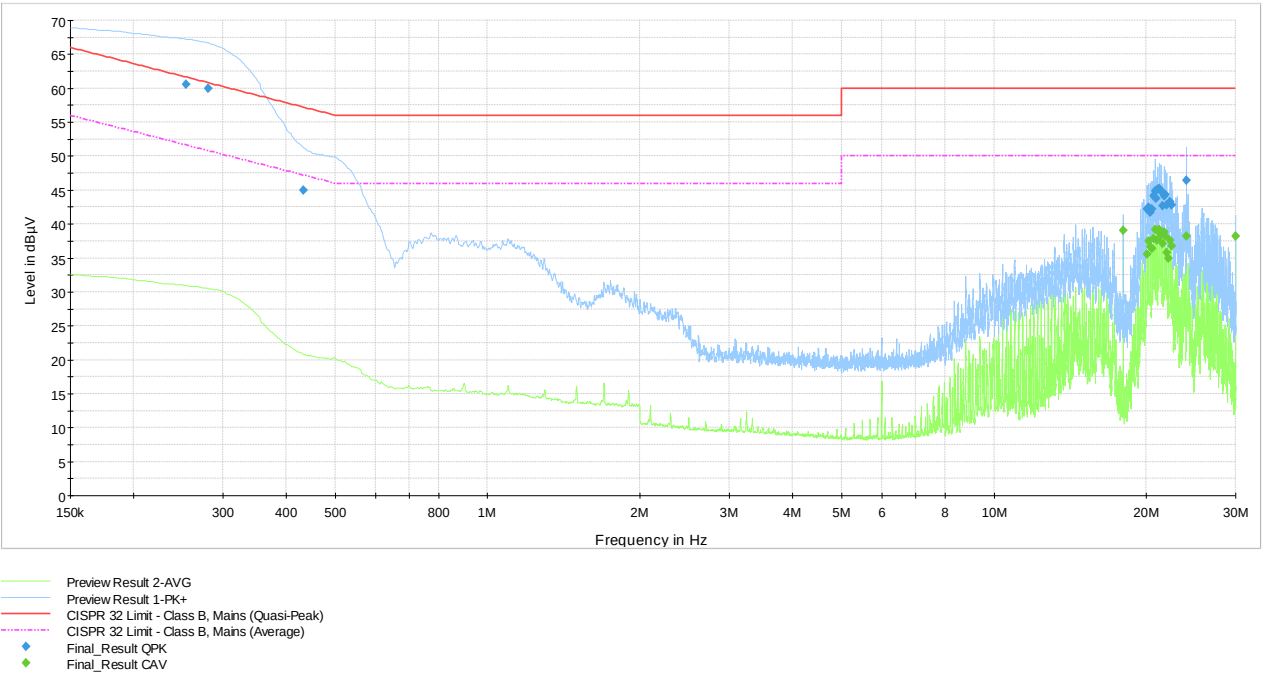
Receiver settings for preview measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average
Trace mode	Max Hold
Measurement time	1000 ms

Receiver settings for final measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Quasi-Peak and Average
Trace mode	Max Hold
Measurement time	1000 ms

8.1.4 Test data



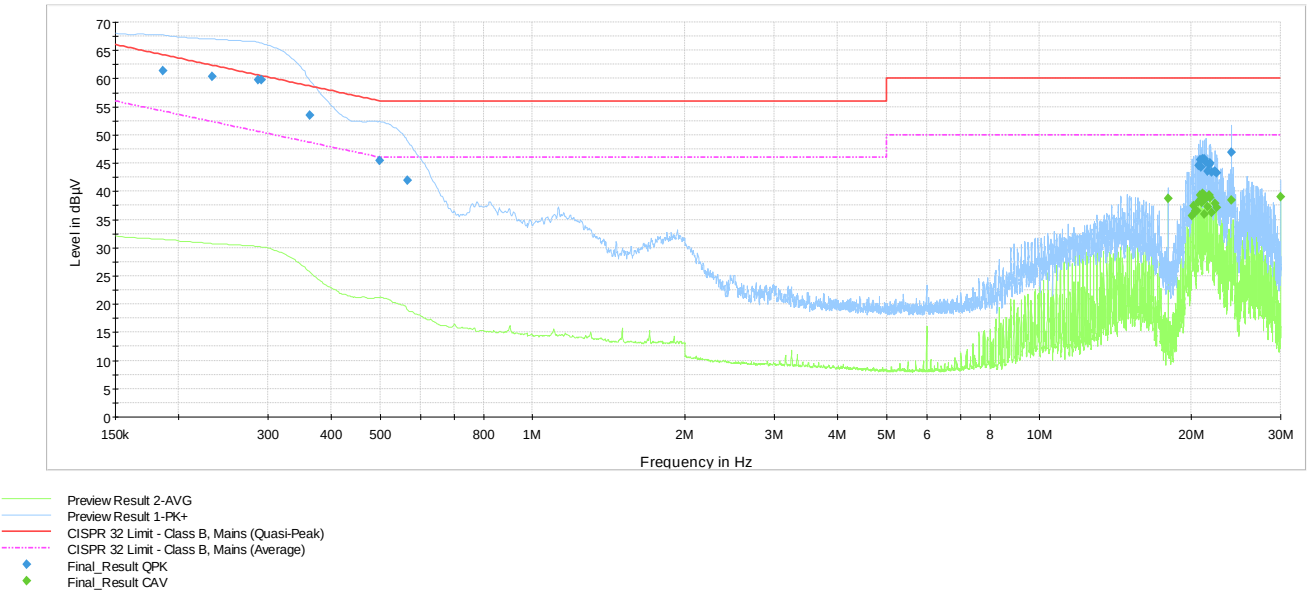
Plot 8.1-1: Conducted emissions on power line, phase

Table 8.1-2: Quasi-Peak conducted emissions results

Frequency, MHz	Q-Peak result, dBμV	Correction, dB	Limit, dBμV	Margin, dB
0.254	60.6	10.4	61.6	1.1
0.281	59.9	10.4	60.8	0.9
0.434	45.0	10.4	57.2	12.2
20.049	42.3	11.6	60.0	17.8
20.195	42.5	11.7	60.0	17.5
20.341	41.8	11.7	60.0	18.2
20.487	42.2	11.7	60.0	17.8
20.636	44.2	11.7	60.0	15.8
20.780	44.9	11.7	60.0	15.1
20.928	43.8	11.7	60.0	16.2
21.072	45.1	11.8	60.0	15.0
21.221	45.3	11.8	60.0	14.7
21.367	44.8	11.8	60.0	15.2
21.513	42.7	11.9	60.0	17.3
21.660	44.2	11.9	60.0	15.8
21.806	44.3	11.9	60.0	15.7
21.952	42.8	12.0	60.0	17.2
22.245	43.3	12.0	60.0	16.8
22.391	42.8	12.0	60.0	17.3
24.002	46.4	12.1	60.0	13.6

Table 8.1-3: Average conducted emissions results

Frequency, MHz	Average result, dBμV	Correction, dB	Limit, dBμV	Margin, dB
18.001	39.1	11.5	50.0	10.9
20.053	35.6	11.6	50.0	14.5
20.199	37.5	11.7	50.0	12.5
20.346	36.7	11.7	50.0	13.3
20.487	36.4	11.7	50.0	13.7
20.636	37.8	11.7	50.0	12.2
20.787	39.2	11.7	50.0	10.8
20.931	37.6	11.7	50.0	12.4
21.075	39.1	11.8	50.0	10.9
21.219	39.1	11.8	50.0	10.9
21.369	38.3	11.8	50.0	11.7
21.516	37.1	11.9	50.0	12.9
21.657	38.8	11.9	50.0	11.3
21.801	38.2	11.9	50.0	11.8
21.954	35.8	12.0	50.0	14.2
22.101	35.0	12.0	50.0	15.0
22.242	37.6	12.0	50.0	12.4
22.389	36.8	12.0	50.0	13.2
24.000	38.2	12.1	50.0	11.8
30.000	38.2	12.7	50.0	11.8



Plot 8.1-2: Conducted emissions on power line, neutral

Table 8.1-4: Quasi-Peak conducted emissions results

Frequency, MHz	Q-Peak result, dBμV	Correction, dB	Limit, dBμV	Margin, dB
0.186	61.3	10.1	64.2	2.9
0.233	60.4	10.1	62.3	1.9
0.287	59.8	10.1	60.6	0.8
0.292	59.7	10.1	60.5	0.8
0.364	53.5	10.1	58.6	5.1
0.499	45.5	10.1	56.0	10.5
0.566	41.9	10.1	56.0	14.1
20.634	44.6	11.6	60.0	15.4
20.782	45.6	11.6	60.0	14.4
20.928	44.3	11.6	60.0	15.7
21.072	45.7	11.6	60.0	14.3
21.221	45.8	11.7	60.0	14.2
21.365	45.2	11.7	60.0	14.8
21.513	43.6	11.7	60.0	16.5
21.660	44.7	11.7	60.0	15.3
21.806	45.0	11.7	60.0	15.0
21.952	43.4	11.7	60.0	16.6
22.245	43.6	11.7	60.0	16.4
22.391	43.3	11.7	60.0	16.7
24.002	47.0	11.9	60.0	13.0

Table 8.1-5: Average conducted emissions results

Frequency, MHz	Average result, dBμV	Correction, dB	Limit, dBμV	Margin, dB
18.001	38.8	11.4	50.0	11.2
20.051	35.6	11.5	50.0	14.4
20.199	37.4	11.5	50.0	12.6
20.343	36.6	11.5	50.0	13.4
20.487	36.6	11.6	50.0	13.4
20.636	38.1	11.6	50.0	11.9
20.787	39.4	11.6	50.0	10.7
20.931	38.0	11.6	50.0	12.0
21.072	39.6	11.6	50.0	10.4
21.169	36.0	11.6	50.0	14.1
21.219	39.3	11.7	50.0	10.7
21.369	38.8	11.7	50.0	11.3
21.516	37.3	11.7	50.0	12.7
21.657	39.4	11.7	50.0	10.6
21.801	38.8	11.7	50.0	11.2
21.954	36.3	11.7	50.0	13.7
22.242	37.8	11.7	50.0	12.2
22.389	37.1	11.7	50.0	12.9
24.000	38.5	11.9	50.0	11.5
30.000	39.1	12.5	50.0	10.9

8.2.1 Definitions and limits

3.2.1.1 Fundamental emission: The field strength of any emissions within this band shall be less than or equal 15848 microvolts/meter at 30 meters.

8.2.2 Test summary

Test date January 7, 2019

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: 6 dB bandwidth results

Fundamental Field strength @ 3 m, dBμV/m	Calculated Field strength @ 30 m, μV/m	limit, μV/m	Margin, μV/m
64.3	16.4	15848	15831.6

Note: * 30 m to 3 m distance correction factor calculation (for 13 MHz band):

$$40 \times \text{Log}_{10} (3 \text{ m}/30 \text{ m}) = 40 \times \text{Log}_{10} (0.1) = -40 \text{ dB}$$

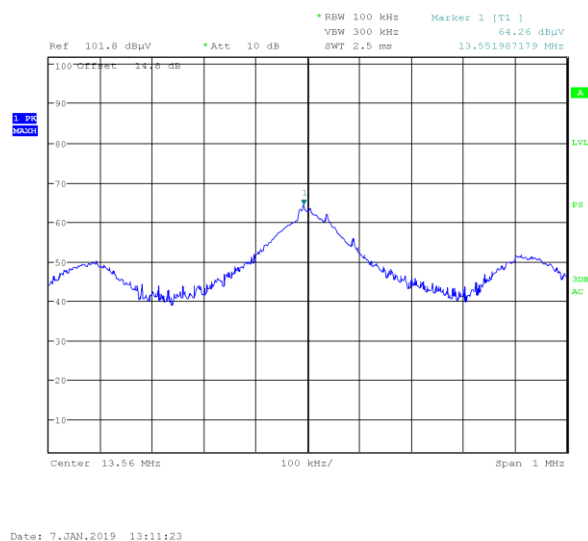


Figure 8.2-1: fundamental emission plot

8.3 3.2.1.2 Unwanted emission

8.3.1 Definitions and limits

Unwanted emission: The field strength of unwanted emissions shall not exceed the general radiated emission limits in Section 2.8. Additional regulations shall apply except for this standard, the emissions from the low-power radio-frequency devices shall be less than or equal the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges.

Table 8.3-1: Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges. For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

8.3.2 Test summary

Test date January 8, 2019

8.3.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to 1 GHz.
Radiated measurements were performed at a distance of 3 m.

Spectrum analyzer settings for frequencies below 150 kHz:

Detector mode	Quasi-Peak
Resolution bandwidth	300 Hz
Video bandwidth	9 kHz
Trace mode	Max Hold
Measurement time	100 ms

Detector mode	Quasi-Peak
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	100 ms

Spectrum analyzer settings for frequencies above 30 MHz:

Detector mode	Peak
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold
Measurement time	100 ms

8.3.4 Test data

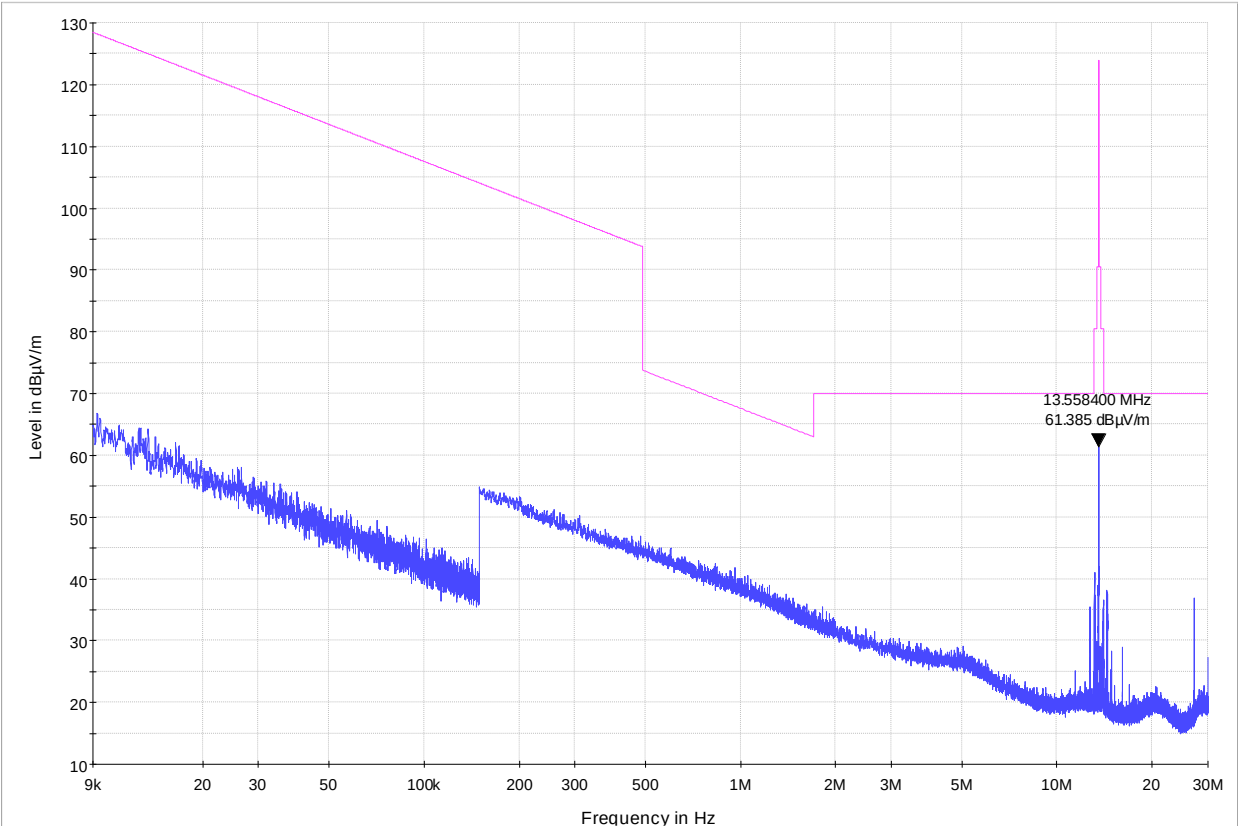


Figure 8.3-1: Field strength of spurious emissions below 30 MHz

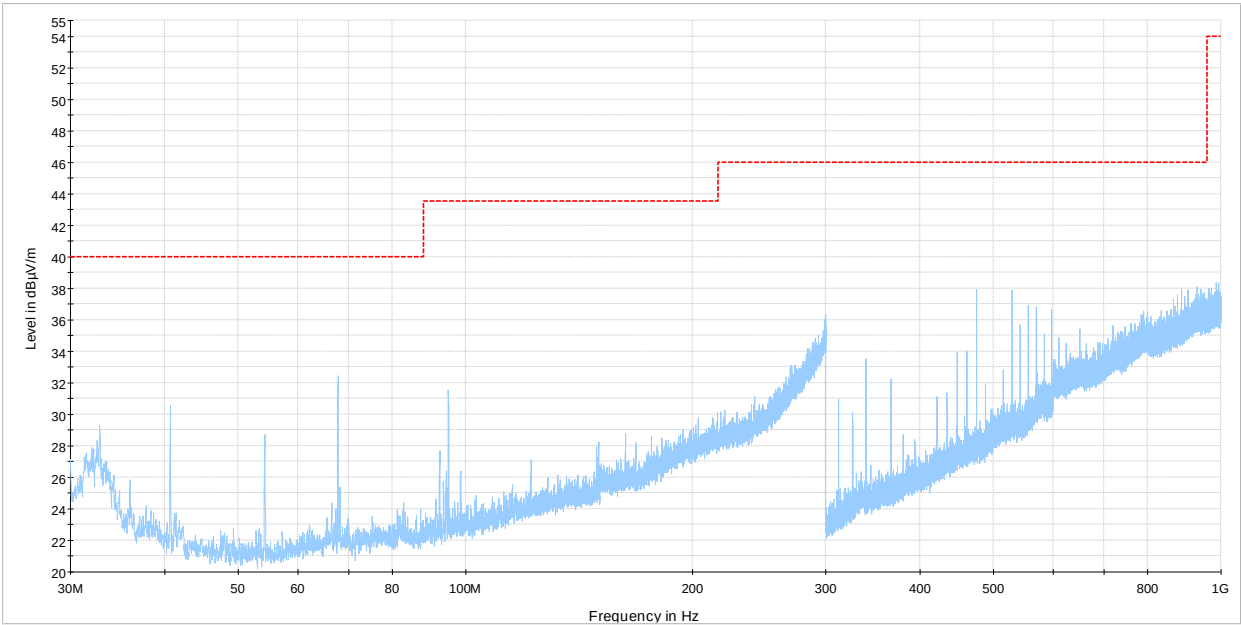


Figure 8.3-2: Field strength of spurious emissions above 30 MHz

Note: all measurement results indicated in the plot were taken with a peak detector, which is more stringent measurement, and still comply with quasi-peak limit. No spurious emissions were detected within 6 dB below the limit

8.4 Frequency tolerance

8.4.1 Definitions and limits

The frequency tolerance: The frequency tolerance of the carrier shall be $\pm 0.01\%$. This frequency tolerance shall be maintained for a temperature variation of -20 to +50°C at normal supply voltage, and for a variation in the primary supply voltage within $\pm 15\%$ of the rated supply voltage at a temperature of 20°C. For battery operated equipment, the equipment tests shall be performed using a new battery and shall conform to the requirements set forth in Section 5.18

8.4.2 Test summary

Test date January 9, 2019

8.4.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	1 Hz
Video bandwidth	RBW $\times$ 3
Trace mode	Max Hold

8.4.4 Test data

Table 8.4-1: Frequency drift measurements results

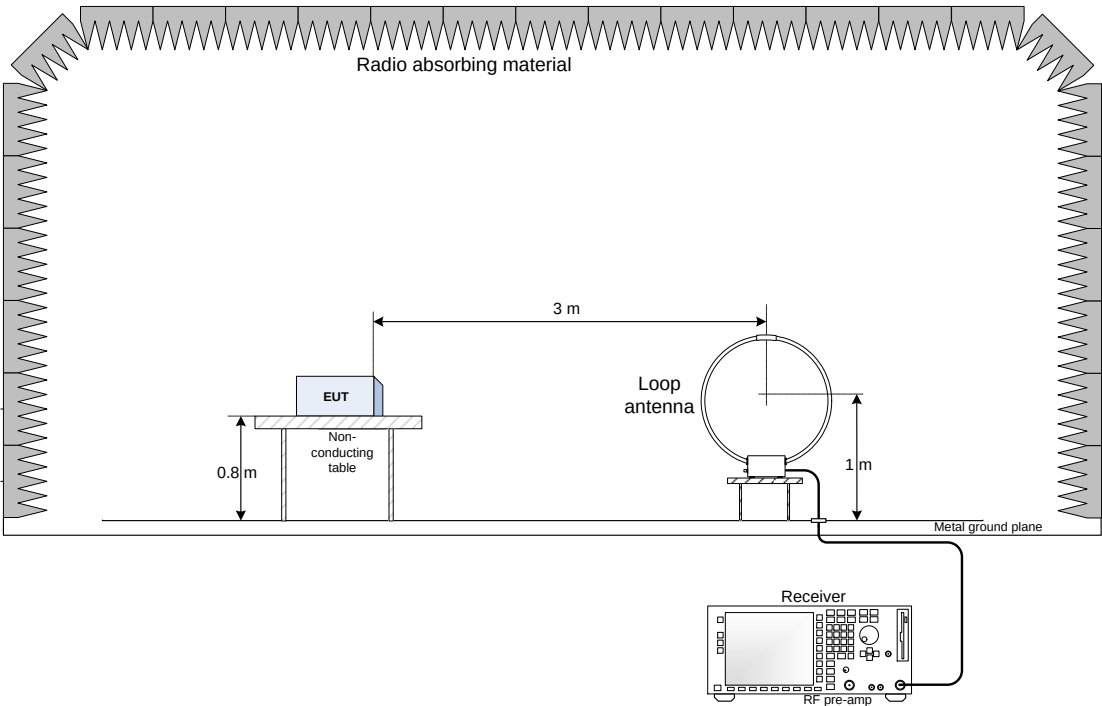
Test conditions	Frequency, MHz	Frequency drift, $\pm$ ppm	Limit, $\pm$ ppm	Margin, ppm
+50 °C, Nominal	13560024.6	1.50	100	98.50
+20 °C, +15 %	13560044.9	0	100	100
+20 °C, Nominal	13560044.9	Reference	Reference	Reference
+20 °C, -15 %	13560044.9	0	100	100
-20 °C, Nominal	13560082.5	2.77	100	97.23

Note: frequency drift was calculated as follows:

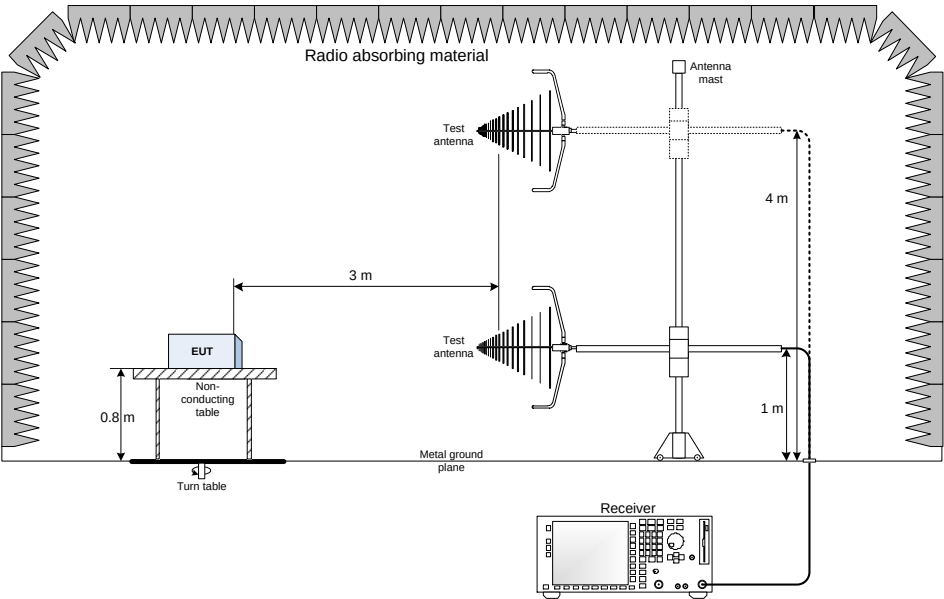
$$\text{Frequency drift (ppm)} = ((F_{\text{measured}} - F_{\text{reference}}) \div F_{\text{reference}}) \times 1 \times 10^6$$

Section 9 Block diagrams of test setups

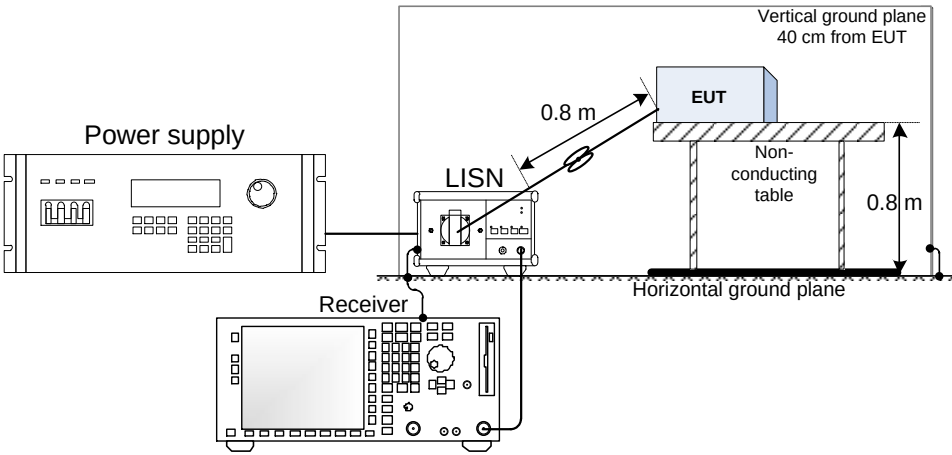
9.1 Radiated emissions set-up for frequencies below 30 MHz



9.2 Radiated emissions set-up for frequencies above 30 MHz



9.3 Conducted emissions set-up



(End of report)