Technical brief FCC SAR Exemption

FCC ID	2ATYF-DS02	Project nr	N02-09
Model Number	DS02	Date	June 27, 2022
Manufacturer	TWTG R&D B.V.		

Revision History

Revision	Date	Author(s)	Description
A1	17-06-2022	D.Moeliker	Initial version

1 Declaration of RF exposure compliance for exemption from routine evaluation limits

This device has a single RF source. During normal operation this device is mounted with multiple screws, therefore the device can not be easily moved and is classified as ”Fixed”. The antenna of the product, under normal use condition is at least 20cm away from the body of the user.

The calculations in the section(s) below will be based on theoretical maximum power output. The actual power output has been given in appendix A. Using that setup, an output power of around 107 dBμV/m is measured at a distance of 3 m. That measurement can be converted to an EIRP of 11.77 dBm and an ERP of 9.62 dBm These measured values are lower than the values which are used for the calculations below and should therefore hold true.

1.1 Exemption based on §1.1307(b)(3)(i)(A)

§1.1307(b)(3)(i)(A) specifies that a device can be exempted from SAR testing if the maximum time-averaged power is no more than 1mW, regardless of the seperation distance.

The TX time limit for LoRaWan is set by the LoRaWan alliance and is different in different regions. For the US915 region, it is allowed to have a dwell time of 400 milliseconds every 20 seconds. This results in a 2% allowed transmit time.

The radio chip used in this device can transmit up to +15dBm. The peak gain of the antenna is 1.8 dBi. In the worst case scenario, there would be no losses in the filtering and matching circuit which would mean that the EIRP would be:

$$EIRP[dBm] = TXpower[dBm] + antennagain[dBi] - cableloss[dBm]$$
$$= 15 + 1.8 - 0 = 16.8\,\text{dBm}$$

Converted to the power in mW, this will be 47.86 mW. Because the LoRaWan protocol limits the transmit time, the maximum time-averaged power will be 2% of this number:

$$time - averagedPower[mW] = EIRP[mW] * TXtime$$
$$= 47.86 * 0.02 = 0.9572\,\text{mW}$$

If there are no losses in the device itself and with peak antenna gain, the time-averaged output power is still lower than the limit set forth in §1.1307(b)(3)(i)(A). Therefore the product should be exempted from SAR testing.

1.2 Exemption based on §1.1307(b)(3)(i)(C)

§1.1307(b)(3)(i)(C) specifies that a device can be exempted from SAR testing if the ERP is under a certain power given by table 1 in §1.1307(b)(3)(i)(C) based on RF source frequency and the seperation distance is larger than $\lambda/2\pi$. where λ is the free-space operating wavelength in meters

As the device will transmit data in the US915 band as per the LoRaWan specifications, the frequency will range from 902 MHz to 928 MHz. All calculations in this section will thus be performed for both the upper- and lower bound.

The threshold ERP must be calculated using the following formula:

$$ThresholdERP = 0.0128 * R^2 * f$$

Where R is the seperation distance in meters and f is the frequency in MHz. The calculated ERP is given in Watts. This results in:

$$ThresholdERP_{902mHz} = 0.0128 * 0.2^2 * 902 = 0.4751\,\text{W}$$
$$ThresholdERP_{928mHz} = 0.0128 * 0.2^2 * 928 = 0.4751\,\text{W}$$

The maximum ERP radiated by this device can be determined using the relation between EIRP and ERP:

$$EIRP[dBm] = ERP[dBm] + 2.15$$

By using the EIRP calculated in subsection 1.2, the resulting ERP will be 14.65 dBm or 29.174 mW, which is far below the threshold.

The free-space operating wavelength can be obtained by dividing the speed of light by the frequency of the signal. This results in:

$$\lambda = \frac{c}{f}$$

$$\lambda_{902mHz} = \frac{c}{f} = \frac{299792458}{902000000} = 0.3324\,\text{m}$$

$$\lambda_{928mHz} = \frac{c}{f} = \frac{299792458}{928000000} = 0.3231\,\text{m}$$

The separation distance must be larger than $\lambda/2\pi$:

$$\frac{\lambda_{902mHz}}{2\pi} = 0.052\,89\,\text{m}$$

$$\frac{\lambda_{928mHz}}{2\pi} = 0.051\,42\,\text{m}$$

Based on the above calculations, the separation distance is large enough and the ERP is lower than set by the standard set in §1.1307(b)(3)(i)(C). Therefore the product should be exempted from SAR testing.

2 Attestation

ATTESTATION: I attest that the testing and calculations were performed or supervised by me; that the test measurements were made in accordance with the above-mentioned departmental standard(s), and that the radio equipment identified in this application has been subject to all applicable test conditions specified in the departmental standards and all of the requirements of the standards have been met.

Signature:	
Date:	27-06-2022
Name:	W. Kerstens
Function:	Hardware Lead

Appendix A Test report

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telefication

FCC and IC Pre-compliance test results

Product name : TWTG Ditto-Promax

Table of Contents

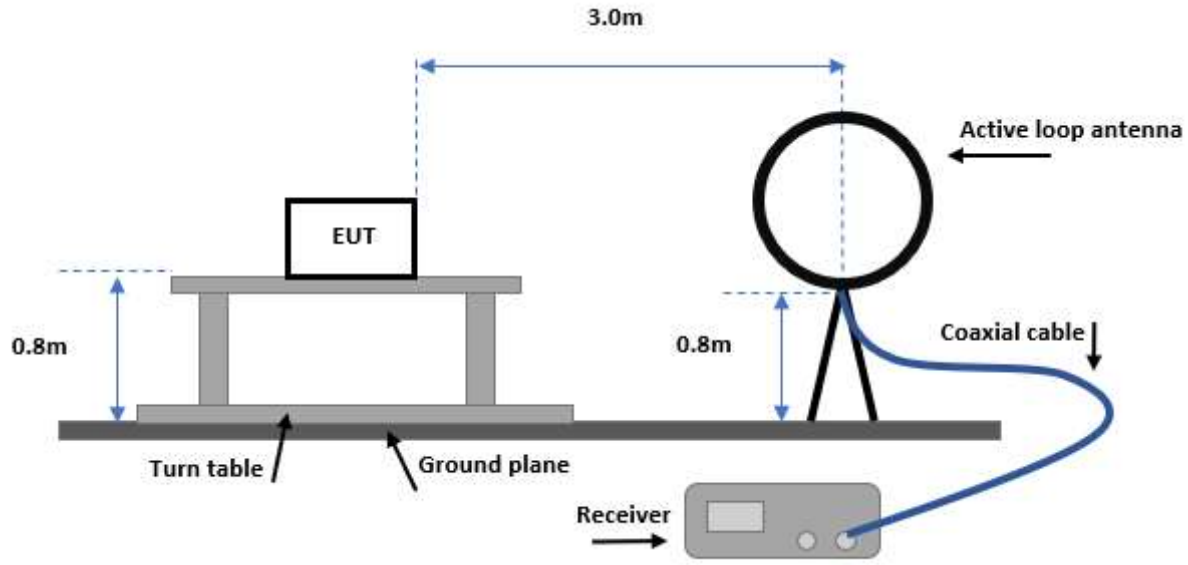
Summary of Test results

FCC	ISED	Description	Section in report
15.247(d) 15.225(d) 15.209 (a)	RSS-Gen 8.9	Radiated spurious emissions	2.1
15.205 (a)	RSS Gen 8.10	Spurious emissions in the restricted bands	2.1

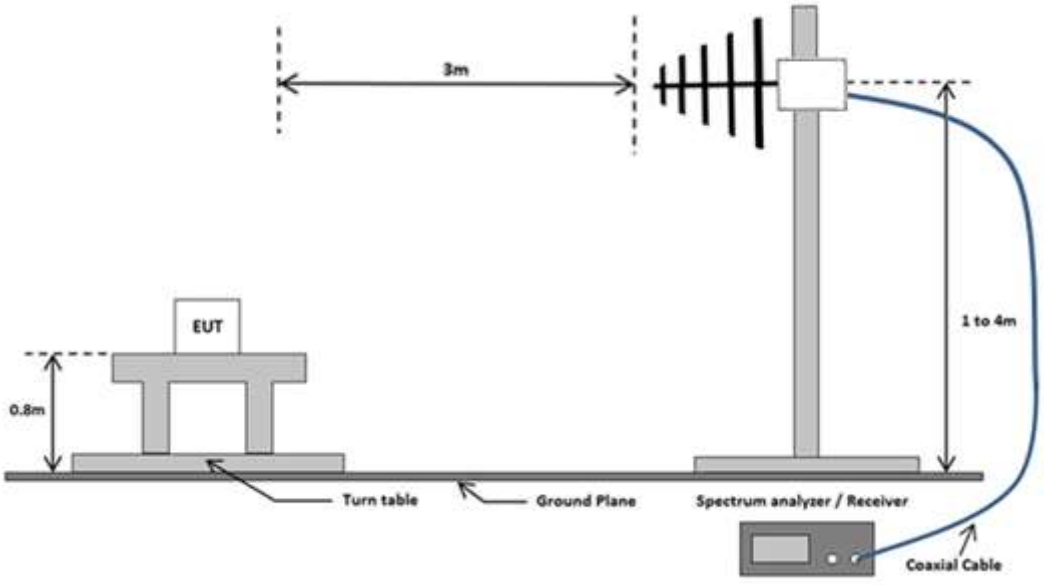
1 Test configuration of the Equipment Under Test

1.1 Test setups

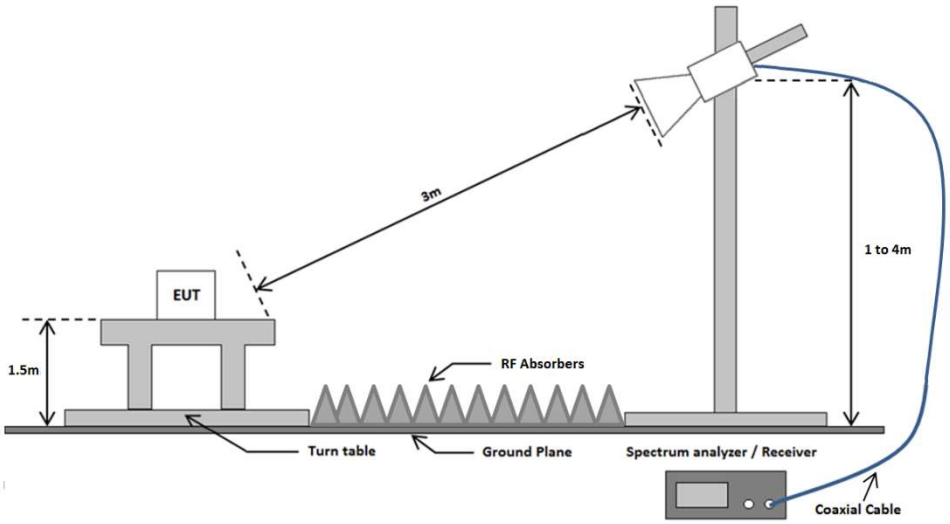
Radiated emissions test setup 9 kHz – 30 MHz



Radiated emissions test setup 30 MHz - 1 GHz



Radiated emissions test setup above 1 GHz



2 Test results

2.1 Radiated spurious emissions

2.1.1 Limit

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance(m)
0.009 – 0.490	2400/F(kHz)	20*{log[2400]-log[F(kHz)]}	300*
0.490 – 1.705	24000/F(kHz)	20*{log[24000]-log[F(kHz)]}	30*
1.705 – 13.11 14.01 – 30.0	30	29.5	30*
30 -88	100	40	3
88 - 216	150	43,5	3
216-960	200	46	3
Above 960	500	54	3

*Note: Measured values in the plots 9 kHz to 30 MHz corrected to 3m measurement distance according to the method described in ANSI C63.10-2013, clause 6.4

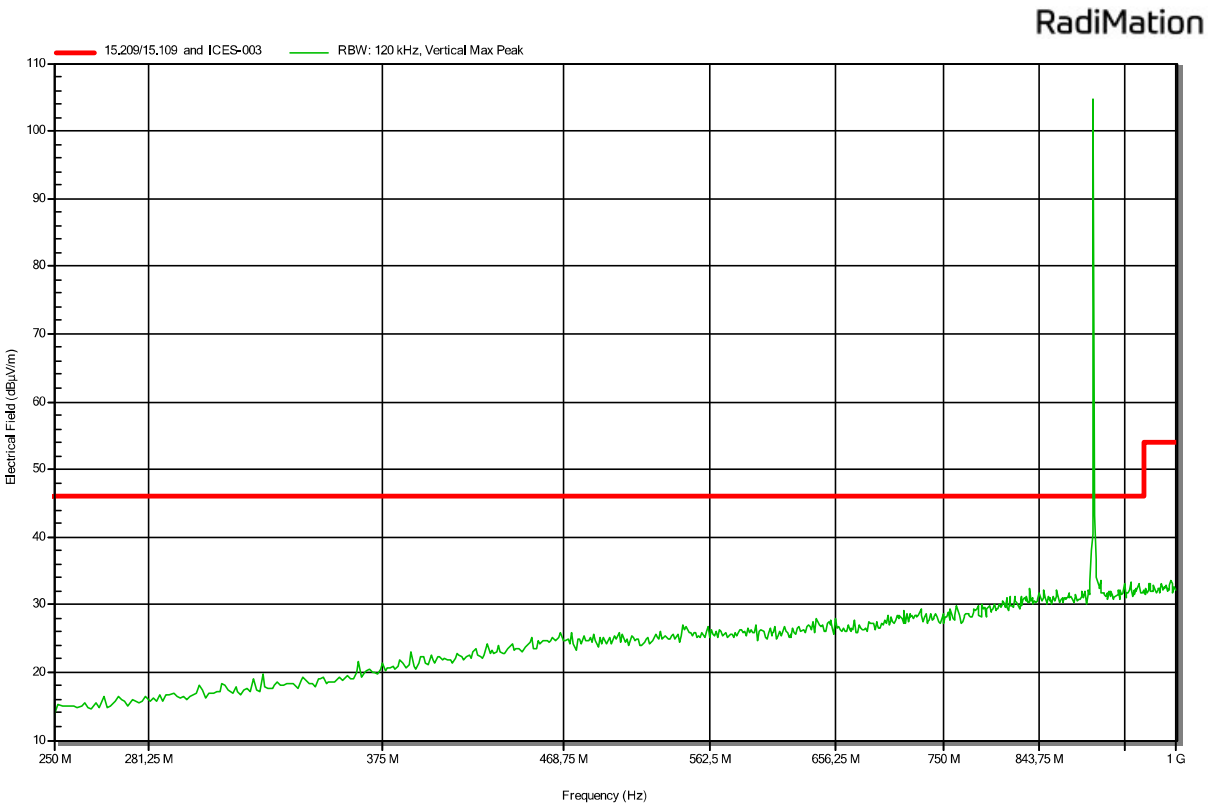
2.1.2 Test setup

The test setup is as shown in chapter 1.2 of this report.

2.1.3 Measurement Uncertainty

Frequency range	Polarization	Uncertainty
9 kHz – 30 MHz	--	±1.6 dB
30 – 200 MHz	Horizontal	±4.5 dB
	Vertical	±5.4 dB
200 -1000 MHz	Horizontal	±3.6 dB
	Vertical	±4.6 dB
1 – 18 GHz	Horizontal	±5.7 dB
	Vertical	±5.7 dB
18 – 26.5 GHz	Horizontal	±4.9 dB
	Vertical	±4.9 dB

250 - 1000 MHz


RadiMation
15.209/15.109 and ICES-003
RBW: 120 kHz, Vertical Max Peak
Electrical Field (dBµV/m)
110
100
90
80
70
60
50
40
30
20
10
250 M
281,25 M
375 M
468,75 M
562,5 M
656,25 M
750 M
843,75 M
1 G
Frequency (Hz)