Space Hub (Hub Cellular) 2820 (9F)

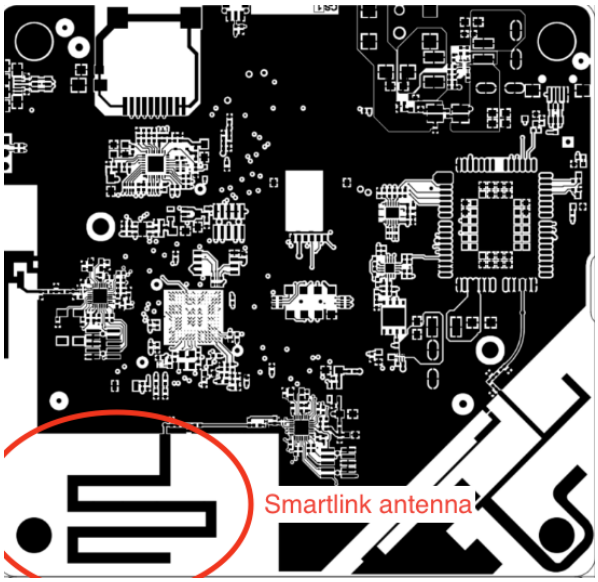
Antenna Specification

SmartLink operating in 902-928MHz band
(Proprietary sub-GHz protocol, SRD multi-band radio)

Type of antenna: shared fixed internal antenna;	**Antenna gain**: 2.77 dBi

DUT	Space Hub (Hub Cellular) 2820 (9F)
Test Site Information	TI Norway, Validation Lab, Hoffsveien 70C, 0377 Oslo
Completed Test Dates	8th March 2023
Test Personnel	Diego Pelaez Martinez
Hardware	R&S®TS8991 OTA (Over The Air) performance test system. Additional RSE (Radiated Spurious Emission) test capability with additional filter/LNA support for spurious emissions measurements.
Software	R&S®EMC32 measurement software for Automation for EMC compliance and pre-compliance.
Table of Calibrated Instruments	SA12 - R&S FSL - Due 25th July 2023

Figure 1. DUT board and Smartlink antenna



Antenna Gain Measurement Set-up

One device Space Hub 9F with SAW filter is tested in 3m RF anechoic chamber for pre-compliance testing in Oslo, Norway. Device is rotated 360 degrees in 45 degrees steps in both horizontal and vertical direction. Radiated Power in dBm is reported as max hold across all angle steps and orientations (see Figure 3 and 4).

Figure 2. Placement of DUT on turning arm in the anechoic chamber.

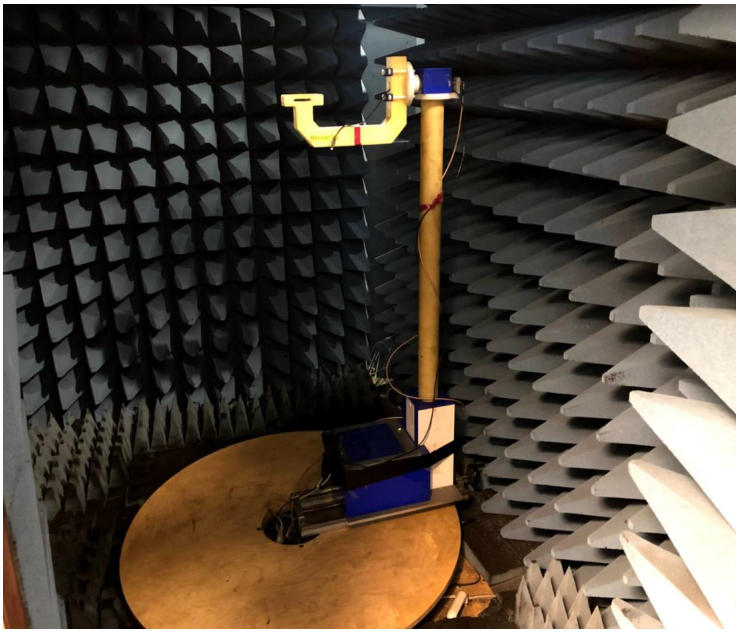
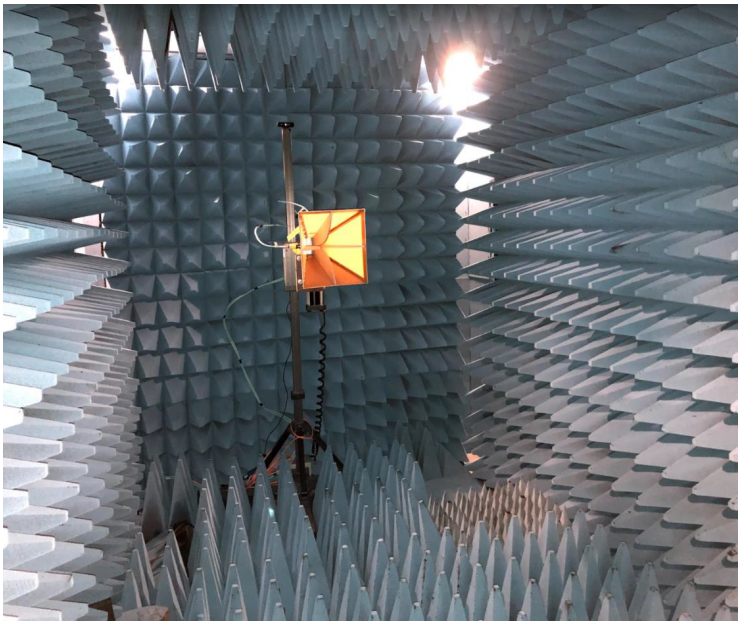
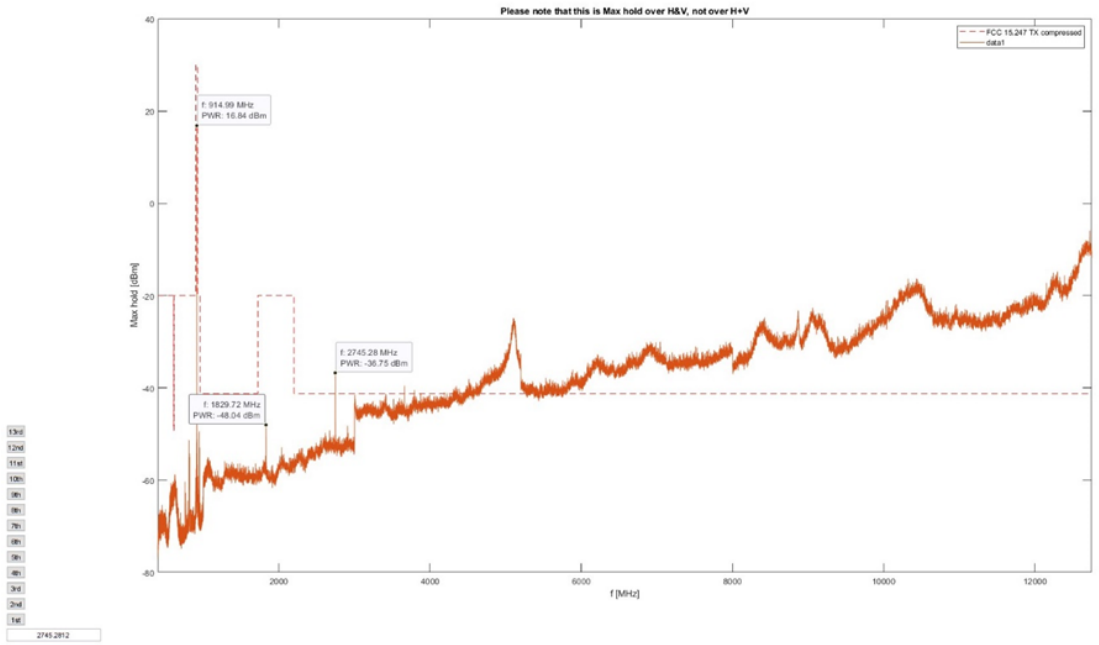


Figure 4. Receiving antenna in the anechoic chamber.



Measurement



The 3rd harmonic at 2745.28MHz is in compliance when duty cycling is taken into account with a correction factor of -23.25dB as calculated below.

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
6.8	2500	NA	NA	NA	-23.35

The transmission duration of 6.8ms is the longest "Ack" message from the hub.
The period was calculated from the maximum of 30 devices connected to the hub, each transmitting sensor data every 2.5 minutes (150 seconds), with the need for two "Ack" messages on average for each sensor data transmission.

According to the regulations, the average factor shall be calculated as follows:

For pulse train shorter than 100 ms:

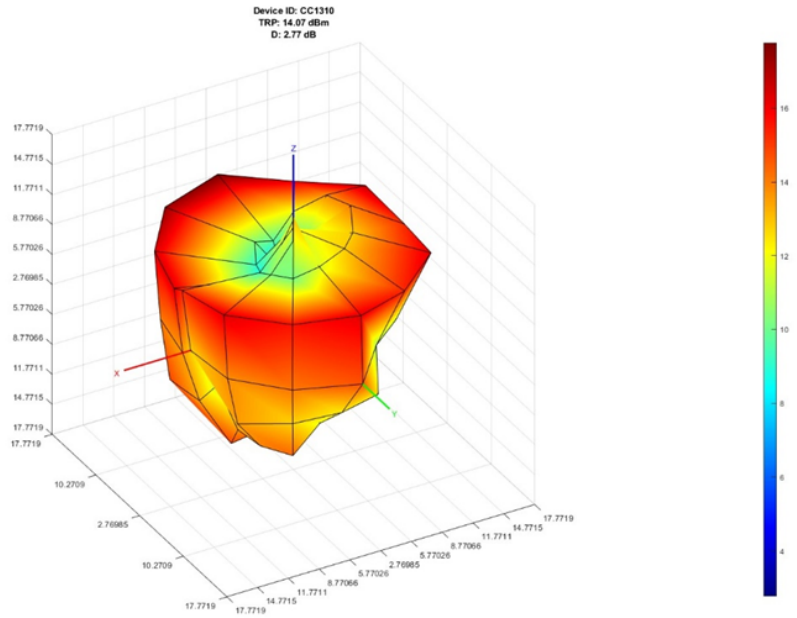
$$Average\ factor\ =\ 20\ \times log_{10}\left(\frac{Pulse\ duration}{Pulse\ period}\ \times \frac{Burst\ duration}{Train\ duration}\ \times\ Number\ of\ bursts\ within\ pulse\ train\right)$$

For pulse train longer than 100 ms:

$$Average\ factor\ =\ 20\ \times log_{10}\left(\frac{Pulse\ duration}{Pulse\ period}\ \times \frac{Burst\ duration}{100\ ms}\ \times\ Number\ of\ bursts\ within\ 100ms\right)$$

The transmission period is used as the "pulse train" length, which is longer than 100ms. Since the transmission period also equals the "burst duration" and the "pulse period", the average factor is:

$$Average\ factor\ =\ 20\ \times log_{10}\left(\frac{6.8\ ms}{2500\ ms}\ \times \frac{2500\ ms}{100\ ms}\ \times\ 1\right) =\ \ -\ 23.35\ dB$$



The matlab script calculates the antenna gain with the total radiated power (14.07 dBm) and the max power detected (16.84 dBm). 16.84 – 14.07 = 2.77 dBi.

Space Hub 9F is in pre-compliance with FCC Part 15.247 for SRD 905.6-926MHz and ISED RSS-247 for SRD 905.6-926MHz based on FCC.

Antenna gain is established to be 2.77 dBi.