

Test report No:  
NIE: 59237RAN.001

## Assessment report

### RF EXPOSURE REPORT ACCORDING TO

IEEE Std C95.3™ -2002 (R2008)  
FCC 47 CFR Part 2.1091  
ISED RSS-102 Issue 5:2015

Identification of item tested	Cat1 Module
Trademark	Sequans Communications
Model and /or type reference	SP150Q
Other identification of the product	FCC ID: 2AAGMSP150Q
Features	Sequans SP150Q module includes Calliope Category 1 baseband, a complete triple band RF front end, memory and required circuitry to meet 3GPP E-UTRA (Long Term Evolution - LTE, Release 10 set of specifications) supporting bands 2, 5, 12, 25 and 26.
Manufacturer	Sequans Communications S.A. 15-55 Boulevard Charles de Gaulle, Colombes, 92700, France
Test method requested, standard	IEEE Std C95.3™ -2002 (R2008). IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz–300 GHz FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
Summary	See Appendix A and B
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager
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## Data provided by the client

The SP150Q is a complete LTE module including base-band, RF and memory, for the design of connected consumer electronics devices, tablet and laptop computers, machine-to-machine devices, and other devices with embedded LTE connectivity. SP150Q is based on Sequans' Calliope platform.

DEKRA declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

## Identification of the client

Sequans Communications S.A.

15-55 Boulevard Charles de Gaulle, Colombes, 92700, France

## Document history

Report number	Date	Description
59237RAN.001	2019-04-10	First release

## General description of the device under evaluation

The device under evaluation consists of a SP150Q module based on Sequans' Calliope platform and supporting LTE technology.

The equipment specifications declared by the manufacturer for each supported feature are:

Band (MHz)	Technology	Band	Maximum RF output power (dBm)	Tolerances (dB)	Maximum RF output power (incl. tune-up) (dBm)
1900	LTE	2	23.0	+/- 2.7	25.7
850	LTE	5	23.0	+/- 2.7	25.7
700	LTE	12	23.0	+/- 2.7	25.7
1900	LTE	25	23.0	+/- 2.7	25.7
850	LTE	26	23.0	+/- 2.7	25.7

**Table 1:** Equipment specifications

## Assessment summary

Radiofrequency radiation exposure limits						
FCC 47 CFR § 2.1091 & ISSED RSS-102 Issue 5 (2015-03)						
Assessment	Band (MHz)	Technology	Band	Maximum gain to meet FCC MPE limits (dBi)	Maximum gain to meet FCC EIRP limits (dBi)	Maximum gain to be in compliance with the limits (dBi)
1	1900	LTE	2	11.3	7.3	7.3
2	850	LTE	5	8.7	14.9	8.7
3	700	LTE	12	7.9	11.22	7.9
4	1900	LTE	25	11.3	7.3	7.3
5	850	LTE	26	8.6	14.9	8.6

**Table 2:** Assessment summary

## Appendix A: FCC RF Exposure

## FCC RF Exposure evaluation

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance  $\geq 20$  cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be at least 20 cm and fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile device exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When a device qualifies for the categorical exclusion provision of § 2.1091(c), the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to §1.1310 Radiofrequency radiation exposure limits, paragraph (e), the limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields are:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposure</b>				
0.3–3.0	614	1.63	* 100	6
3.0–30	1842/f	4.89/f	* 900/f <sup>2</sup>	6
30–300	61.4	0.163	1.0	6
300–1,500			f/300	6
1,500–100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3–1.34	614	1.63	* 100	30
1.34–30	824/f	2.19/f	* 180/f <sup>2</sup>	30
30–300	27.5	0.073	0.2	30
300–1,500			f/1500	30
1,500–100,000			1.0	30

f = frequency in MHz \* = Plane-wave equivalent power density

## FCC EIRP Limits

Maximum FCC EIRP limits are stated into FCC 47 CFR §22.913, FCC 47 CFR §24.232 and FCC 47 CFR §22.50 standards, these limits are frequency-dependent and are shown in the following table:

Standard	Frequency Band	Technology & Band	EIRP limit (W)	EIRP limit (dBm)
FCC 47 CFR §27.50 (c)	700	LTE 12	4.92	36.92
FCC 47 CFR §22.913	850	LTE 5/26	11.48	40.6
FCC 47 CFR §24.232	1900	LTE 2/25	2.0	33.0

## FCC MPE Evaluation Results

Each supported transmission technology will be evaluated to determine if it is in compliance with limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

In order to perform the assessment, the following equations have been used for the calculations; these equations are accurate in the far-field of an antenna and will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction:

$$\text{Power density: } S[mW/cm^2] = \frac{P_{\max}[mW]}{4\pi R[cm]^2}$$

$$\text{Minimum compliance distance: } R_{\min}[cm] = \sqrt{\frac{P_{\max}[mW]}{4\pi S[mW/cm^2]}}$$

$$\text{Maximum gain to meet the MPE limit: } G_{\max}[dBi] = (10 * \log[S[mW/cm^2] * 4\pi R[cm]^2) - P_{\max}[dBm]$$

$S$  = power density

$P_{\max}$  = power input to the antenna

$R$  = distance to the center of radiation of the antenna (evaluation distance)

$R_{\min}$  = distance to the center of radiation of the antenna

$G_{\max}$  = power gain of the antenna in the direction of interest relative to an isotropic radiator



## **Assessment 1 - LTE Band 2**

### **MPE Evaluation**

Maximum output power (dBm):	25.7
Maximum output power (mW):	371.54
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1850
General population - Power density limit (mW/cm <sup>2</sup> ):	1.0

#### **Power density at minimum use distance:**

Power density (mW/cm <sup>2</sup> ):	0.074
General population - Power density limit (mW/cm <sup>2</sup> ):	1.0

The power density level for this transmission mode is below general population exposure power density limit.

#### **Minimum compliance distance for this technology:**

Minimum compliance distance for general population (cm):	5.44
Minimum use distance (cm):	20.0

The minimum use distance is greater than general population exposure minimum compliance distance.

#### **Maximum gain to meet the §1.1310 Radiofrequency radiation exposure limits:**

Maximum antenna gain to meet reference level (dBi):	11.3
Power density using max antenna gain (mW/cm <sup>2</sup> ):	0.548

The power density level using the maximum antenna gain for this transmission mode will be below power density reference level.

### **EIRP Evaluation**

Maximum output power (dBm):	EIRP limit (dBm)	Maximum antenna gain to meet EIRP level (dBi)
25.7	33.0	7.3

#### **Maximum antenna gain to meet power density reference limit / EIRP limit**

Maximum antenna gain (dBi):	7.3
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## **Assessment 2 - LTE Band 5**

### **MPE Evaluation**

Maximum output power (dBm):	25.7
Maximum output power (mW):	371.54
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	824
General population - Power density limit (mW/cm <sup>2</sup> ):	0.549

#### **Power density at minimum use distance:**

Power density (mW/cm <sup>2</sup> ):	0.074
General population - Power density limit (mW/cm <sup>2</sup> ):	0.549

The power density level for this transmission mode is below general population exposure power density limit.

#### **Minimum compliance distance for this technology:**

Minimum compliance distance for general population (cm):	7.34
Minimum use distance (cm):	20.0

The minimum use distance is greater than general population exposure minimum compliance distance.

#### **Maximum gain to meet the §1.1310 Radiofrequency radiation exposure limits:**

Maximum antenna gain to meet reference level (dBi):	8.7
Power density using max antenna gain (mW/cm <sup>2</sup> ):	0.548

The power density level using the maximum antenna gain for this transmission mode will be below power density reference level.

### **EIRP Evaluation**

Maximum output power (dBm):	EIRP limit (dBm)	Maximum antenna gain to meet EIRP level (dBi)
25.7	40.6	14.9

#### **Maximum antenna gain to meet power density reference limit / EIRP limit**

Maximum antenna gain (dBi):	8.7
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### **Assessment 3 - LTE Band 12**

#### **MPE Evaluation**

Maximum output power (dBm):	25.7
Maximum output power (mW):	371.54
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	699
General population - Power density limit (mW/cm <sup>2</sup> ):	0.466

#### **Power density at minimum use distance:**

Power density (mW/cm <sup>2</sup> ):	0.074
General population - Power density limit (mW/cm <sup>2</sup> ):	0.466

The power density level for this transmission mode is below general population exposure power density limit.

#### **Minimum compliance distance for this technology:**

Minimum compliance distance for general population (cm):	7.97
Minimum use distance (cm):	20.0

The minimum use distance is greater than general population exposure minimum compliance distance.

#### **Maximum gain to meet the §1.1310 Radiofrequency radiation exposure limits:**

Maximum antenna gain to meet reference level (dBi):	7.9
Power density using max antenna gain (mW/cm <sup>2</sup> ):	0.997

The power density level using the maximum antenna gain for this transmission mode will be below power density reference level.

#### **EIRP Evaluation**

Maximum output power (dBm):	EIRP limit (dBm)	Maximum antenna gain to meet EIRP level (dBi)
25.7	36.92	11.22

#### **Maximum antenna gain to meet power density reference limit / EIRP limit**

Maximum antenna gain (dBi):	7.9
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## **Assessment 4 - LTE Band 25**

### **MPE Evaluation**

Maximum output power (dBm):	25.7
Maximum output power (mW):	371.54
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	1850
General population - Power density limit (mW/cm <sup>2</sup> ):	1.0

#### **Power density at minimum use distance:**

Power density (mW/cm <sup>2</sup> ):	0.074
General population - Power density limit (mW/cm <sup>2</sup> ):	1.0

The power density level for this transmission mode is below general population exposure power density limit.

#### **Minimum compliance distance for this technology:**

Minimum compliance distance for general population (cm):	5.44
Minimum use distance (cm):	20.0

The minimum use distance is greater than general population exposure minimum compliance distance.

#### **Maximum gain to meet the §1.1310 Radiofrequency radiation exposure limits:**

Maximum antenna gain to meet reference level (dBi):	11.3
Power density using max antenna gain (mW/cm <sup>2</sup> ):	0.535

The power density level using the maximum antenna gain for this transmission mode will be below power density reference level.

### **EIRP Evaluation**

Maximum output power (dBm):	EIRP limit (dBm)	Maximum antenna gain to meet EIRP level (dBi)
25.7	33.0	7.3

#### **Maximum antenna gain to meet power density reference limit / EIRP limit**

Maximum antenna gain (dBi):	7.3
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## **Assessment 5 - LTE Band 26**

### **MPE Evaluation**

Maximum output power (dBm):	25.7
Maximum output power (mW):	371.54
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	814
General population - Power density limit (mW/cm <sup>2</sup> ):	0.543

#### **Power density at minimum use distance:**

Power density (mW/cm <sup>2</sup> ):	0.074
General population - Power density limit (mW/cm <sup>2</sup> ):	0.543

The power density level for this transmission mode is below general population exposure power density limit.

#### **Minimum compliance distance for this technology:**

Minimum compliance distance for general population (cm):	7.38
Minimum use distance (cm):	20.0

The minimum use distance is greater than general population exposure minimum compliance distance.

#### **Maximum gain to meet the §1.1310 Radiofrequency radiation exposure limits:**

Maximum antenna gain to meet reference level (dBi):	8.6
Power density using max antenna gain (mW/cm <sup>2</sup> ):	0.535

The power density level using the maximum antenna gain for this transmission mode will be below power density reference level.

### **EIRP Evaluation**

Maximum output power (dBm):	EIRP limit (dBm)	Maximum antenna gain to meet EIRP level (dBi)
25.7	40.6	14.9

#### **Maximum antenna gain to meet power density reference limit / EIRP limit**

Maximum antenna gain (dBi):	8.6
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