1. RF Exposure Requirements

1.1 General Information

Client Information

Applicant:	Sveaverken Svea Agri AB
Address of applicant:	Högmossevägen 11, SE-641 39 Katrineholm Sweden
Manufacturer:	Sveaverken Svea Agri AB
Address of manufacturer:	Högmossevägen 11, SE-641 39 Katrineholm Sweden

General Description of EUT:

Product Name:	RoboPusher Nimbo Plus
Trade Name:	Sveaverken
Model No.:	LF01
Adding Model(s):	/
Rated Voltage:	AC 120V for Adapter power DC: 58.8V
Battery Capacity:	40000mAh
Power Adapter:	Model: H82-48V10A Input: 110-245VAC 45/65Hz Battery: Ternary litium battery 14celles Output voltage : 58.8VDC
FCC ID:	2A3NS-LF01
Equipment Type:	Fixed device

Technical Characteristics of EUT:

Bluetooth AP6275S

Bluetooth Version:	V5.1 (BLE mode)
Frequency Range:	2402-2480MHz
RF Output Power:	3.74dBm (Conducted)
Data Rate:	1Mbps
Modulation:	GFSK
Quantity of Channels:	40
Channel Separation:	2MHz
Type of Antenna:	Glue stick antenna
Antenna Gain:	2.75dBi

Wi-Fi (2.4G) USB6111

Support Standards:	802.11b, 802.11g, 802.11n
Frequency Range:	2412-2462MHz for 802.11b/g/n(HT20) 2422-2452MHz for 802.11n(HT40)
RF Output Power:	15.75dBm (Conducted)
Type of Modulation:	CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM
Quantity of Channels:	11 for 802.11b/g/n(HT20); 7 for 802.11n(HT40)

Channel Separation:	5MHz
Type of Antenna:	Glue stick antenna
Antenna Gain:	2.75dBi
Wi-Fi (2.4G) AP6275S	
Support Standards:	802.11b, 802.11g, 802.11n, 802.11ax
Frequency Range:	2412-2462MHz for 802.11b/g/n/ax(HE20)
RF Output Power:	Antenna 0:16.12dBm (Conducted) Antenna 1:15.71dBm (Conducted)
Type of Modulation:	CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM, 256QAM
Quantity of Channels:	11 for 802.11b/g/n/ax(HE20)
Channel Separation:	5MHz
Type of Antenna:	Glue stick antenna
Antenna Gain:	2.75dBi
Wi-Fi (5G) USB6111	
Support Standards:	802.11a, 802.11n(HT20), 802.11n-HT40
Frequency Range:	5180-5240MHz, 5745-5825MHz
Max. RF Output Power:	5180-5240MHz:15.51dBm (Conducted) 5745-5825MHz:14.52dBm (Conducted)
Type of Modulation:	QPSK, 16QAM, 64QAM,256QAM
Type of Antenna:	Glue stick antenna
Antenna Gain:	5180-5240MHz:2.64dBi 5745-5825MHz:3.20dBi
Wi-Fi (5G) AP6275S	
Support Standards:	802.11a, 802.11n(HT20) , 802.11n-HT40, 802.11ac-VHT20/40/80, 802.11ax-HE20/40/80
Frequency Range:	5180-5240MHz, 5745-5825MHz
Max. RF Output Power:	5180-5240MHz: Antenna 0: 16.23dBm (Conducted) Antenna 1:15.65dBm (Conducted) 5745-5825MHz: Antenna 0: 14.88dBm (Conducted) Antenna 1:15.07dBm (Conducted)
Type of Modulation:	QPSK, 16QAM, 64QAM, 256QAM, 1024QAM
Type of Antenna:	Glue stick antenna
Antenna Gain:	5180-5240MHz:2.64dBi 5745-5825MHz:3.20dBi

1.2 RF Exposure Exemption

According to §1.1307(b)(3) and KDB 447498 D04 Interim General RF Exposure Guidance v01, system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Option A: FCC Rule Part 1.1307 (b)(3)(i)(A):The available maximum time-averaged power is no more than 1mW, regardless of separation distance.

Option B: FCC Rule Part 1.1307 (b)(3)(i)(B): The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. P_{th} is given by:

$$P_{th}\,(\text{mW}) = \begin{cases} ERP_{20\,cm}(d/20\,\text{cm})^{x} & d \le 20\,\text{cm} \\ ERP_{20\,cm} & 20\,\text{cm} < d \le 40\,\text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\,cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\,cm}\,(\text{mW}) = \begin{cases} 2040f & 0.3\,\text{GHz} \le f < 1.5\,\text{GHz} \\ 3060 & 1.5\,\text{GHz} \le f \le 6\,\text{GHz} \end{cases}$$

d = the separation distance (cm);

Option C: FCC Rule Part 1.1307 (b)(3)(i)(C): The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. R must be at least λ/2π, where λ is the free-space operating wavelength in meters.

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2
1.34-30	3,450 R^2/f^2
30-300	3.83 R^2
300-1,500	0.0128 R^2f
1,500-100,000	19.2R^2

For Multiple RF sources: FCC Rule Part 1.1307(b)(3)(ii):

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required).

(B) In the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following

equation.

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}}+\sum_{j=1}^{b}\frac{ERP_j}{ERP_{th,j}}+\sum_{k=1}^{c}\frac{Evaluated_k}{Exposure\ Limit_k}\leq 1$$

1.3 Calculated Result

Radio Access Technology	Prediction Frequency	Output Power	Antenna Gain	Duty Cycle	Tune-Up Time-Averaged Power	ERP
	(MHz)	(dBm)	(dBi)	(%)	(dBm)	(dBm)
Bluetooth (AP6275S-ANT 0)	2402	3.74	2.75	100	4.00	4.60
Wi-Fi (2.4G) (USB6111)	2412	15.75	2.75	100	16.00	16.60
Wi-Fi (2.4G) (AP6275S-ANT 0)	2412	16.12	2.75	100	17.00	17.60
Wi-Fi (2.4G) (AP6275S-ANT 1)	2412	15.71	2.75	100	16.00	16.60
Wi-Fi (5G) (USB6111)	5180	15.51	2.64	100	16.00	16.49
Wi-Fi (5G) (USB6111)	5745	14.52	3.20	100	15.00	16.05
Wi-Fi (5G) (AP6275S-ANT 0)	5180	16.23	2.64	100	17.00	17.49
Wi-Fi (5G) (AP6275S-ANT 0)	5745	14.88	3.20	100	15.00	16.05
Wi-Fi (5G) (AP6275S-ANT 1)	5180	15.65	2.64	100	16.00	16.49
Wi-Fi (5G) (AP6275S-ANT 1)	5745	15.07	3.20	100	16.00	17.05

Frequency	Option	Min. Distance	Max. Power		Exposure Limit	Ratio	Result
(MHz)		(cm)	(dBm)	(mW)	(mW)		Pass/Fail
2402	C	20.00	4.60	2.88	768.00	0.01	Pass
2412	C	20.00	16.60	45.71	768.00	0.06	Pass
2412	C	20.00	17.60	57.54	768.00	0.07	Pass
2412	C	20.00	16.60	45.71	768.00	0.06	Pass
5180	C	20.00	16.49	44.57	768.00	0.06	Pass
5745	C	20.00	16.05	40.27	768.00	0.05	Pass
5180	C	20.00	17.49	56.10	768.00	0.07	Pass
5745	C	20.00	16.05	40.27	768.00	0.05	Pass

5180	C	20.00	16.49	44.57	768.00	0.06	Pass
5745	C	20.00	17.05	50.70	768.00	0.07	Pass

*Note: 1. Time-Averaged Power=Output Power * Duty Cycle; ERP= Time-Averaged Power+ Antenna gain-2.15dB*

2. Option A, B and C refers as clause 1.2.

3. For option B, Max (time-averaged power, effective radiated power (ERP)) converts to Max. Power. For option C, ERP converts to Max. Power;

4. For option B, P_{th} (mW) converts to Exposure Limit (mW); For option C, ERP (W) converts to Exposure Limit (mW).

5. Ratio= Tune-Up ERP (mW)/ Exposure Limit (mW)

Mode for Simultaneous Multi-band Transmission:

Radio Access Technology	Ratio 1	Ratio 2	Ratio 3	Simultaneous Ratio	Limit	Result
						Pass/Fail
USB6111 + (AP6275S-ANT 0) + (AP6275S-ANT 1)	0.06	0.07	0.07	0.2	1	Pass

Result: Pass