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Aquana RF EXPOSURE REPORT

SCOPE OF WORK

RF EXPOSURE CALCULATION
ON THE AQUANA SV-2 SMART VALVE

REPORT NUMBER

105620787LEX-001b

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RF EXPOSURE TEST REPORT

Report Number: 105620787LEX-001b

Project Number: G105620787

Report Issue Date: 5/2/2024

Product Name: Aquana SV-2 Smart Valve

Product Model: SV-2-LORA

Standards: FCC Title 47 CFR Part 1.1310(e)(1) Limits for
Maximum Permissible Exposure (MPE)

RSS-102 Issue 6 RF Field Strength Limits for
Devices Used by the General Public

Tested by:
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Client:
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Table of Contents

1	<i>Introduction and Conclusion.....</i>	4
2	<i>Test Summary</i>	4
3	<i>Client Information</i>	5
4	<i>Description of Equipment under Test and Variant Models.....</i>	6
5	<i>Output Power.....</i>	7
6	<i>Antenna Gain</i>	8
7	<i>FCC RF Exposure Limits</i>	9
8	<i>RSS-102 Issue 6 RF Exposure Limits.....</i>	10
9	<i>Test Procedure</i>	11
10	<i>Results:.....</i>	12
11	<i>Revision History.....</i>	13



1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 4. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
10	FCC Title 47 CFR Part 1.1310(e)(1) Limits for Maximum Permissible Exposure (MPE) (Limits for General Population / Uncontrolled Exposure)	Pass
	RSS-102 Issue 6 RF Field Strength Limits (For Devices Used by the General Public)	Pass



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Aquana
Address:	7007 Pinemont Drive Houston, TX 77040 USA
Contact:	Jeff Askew
Telephone:	+1 (888) 404-2782
Email:	jeff.askew@aquana.com
Manufacturer Information	
Manufacturer Name:	Aquana
Manufacturer Address:	7007 Pinemont Drive Houston, TX 77040 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Aquana SV-2 Smart Valve
Model Number	SV-2-LORA
Hardware Version	Rev E
Software Version	3.0.6
Supported Transmit Bands	2402 – 2480MHz
FCCID	2AQSE-AQSV1
ICID	24363-AQSV1
Embedded Module	Multitech MTXDOT-NA1
Embedded Module Supported Transmit Bands	902.3 – 914.9MHz
Embedded Module FCCID	AU792U13A16858
Embedded Module ICID	125A-0055
Description of Equipment Under Test (provided by client)	
The Aquana Smart Valve is a remotely controllable water valve that works over RF networks to provide monitoring and control via cloud-based software applications.	

4.1 Variant Models:

There were no variant models covered by this evaluation.



5 Output Power

The LoRa output power was taken from report MLT10058.1 provided by the client and may affect compliance. Intertek does not make any claim of compliance for values other than those shown below.

125 kHz BW Data Rate						
Low Channel, 902.3 MHz	17.143	1.4	18.5	30	Pass	
Mid Channel, 908.7 MHz	17.261	1.4	18.6	30	Pass	
High Channel, 914.9 MHz	17.065	1.4	18.4	30	Pass	
500 kHz BW Data Rate						
Low Channel, 903.0 MHz	11.406	7.9	19.3	30	Pass	
Mid Channel, 909.4 MHz	11.508	7.9	19.4	30	Pass	
High Channel, 914.2 MHz	11.11	7.9	19	30	Pass	

The BLE output power was taken from report 103553976LEX-003 provided by the client and may affect compliance. Intertek does not make any claim of compliance for values other than those shown below.

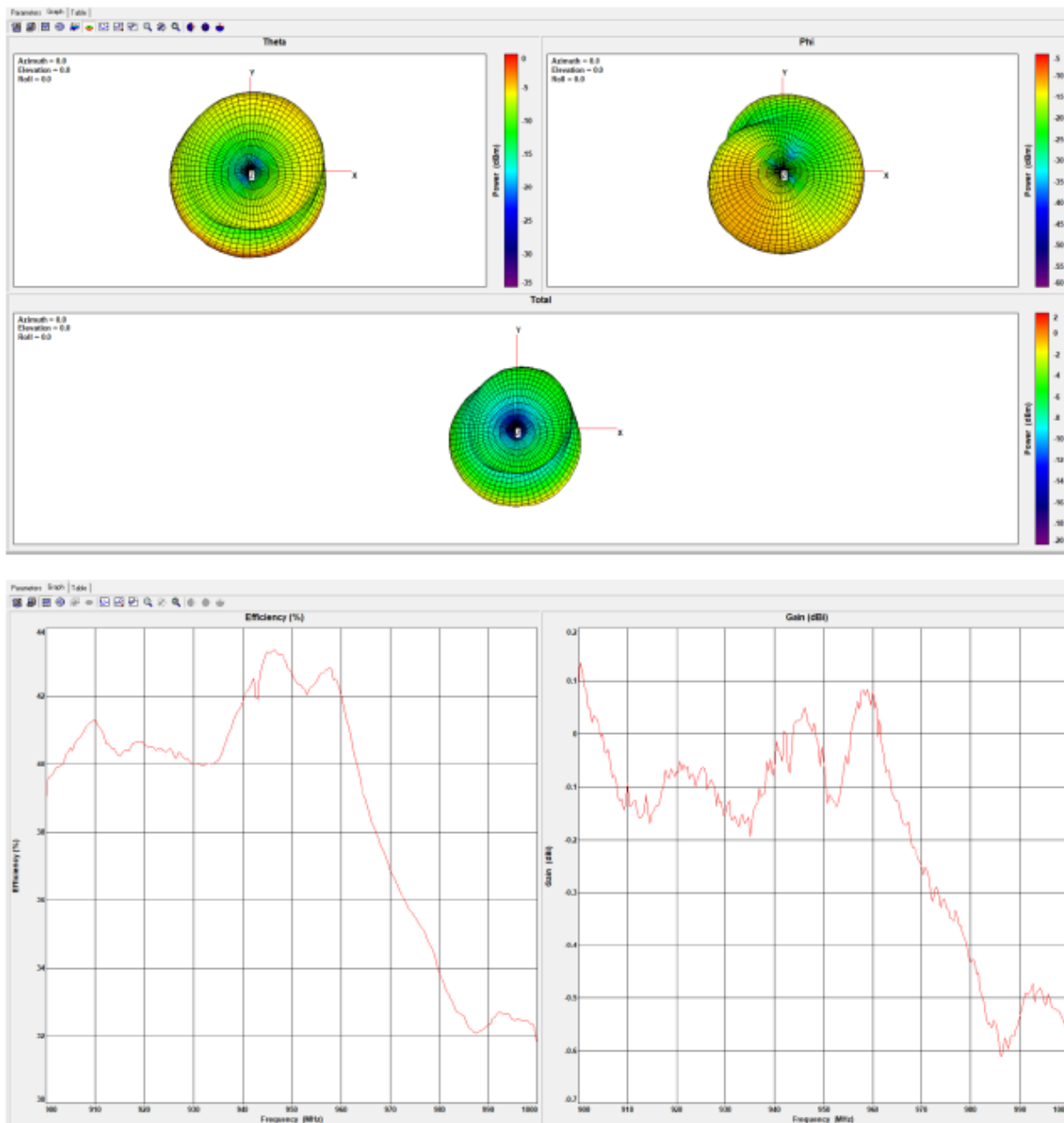
Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)	Result
2.402 GHz	2.188	30	27.812	Pass
2.440 GHz	2.660	30	27.340	Pass
2.480 GHz	3.242	30	26.758	Pass



6 Antenna Gain

The antenna gain was taken from the antenna measurement report provided by the client and may affect compliance. Intertek does not make any claim of compliance for values other than those shown below.

2.3 900 – 1000 MHz



Peak efficiency is 43.36 %, and peak gain is 0.13 dBi



7 FCC RF Exposure Limits

Title 47 CFR Part 1.1310(d)(2):

For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 in paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b) of this part, except for portable devices as defined in § 2.1093 of this chapter as these evaluations shall be performed according to the SAR provisions in § 2.1093.

Table 1 to § 1.1310(e)(1)—Limits for Maximum Permissible Exposure (MPE)

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



8 RSS-102 Issue 6 RF Exposure Limits

RSS-102 Issue 6 § 6.6:

Field reference level (FRL) exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm (i.e. mobile devices), except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 1 W (adjusted for tune-up tolerance)
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance)
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz
- at or above 6 GHz and the source-based, time-averaged maximum EIRP of the device is equal to or less than 5 W (adjusted for tune-up tolerance)

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the EIRP was derived.

RSS-102 Issue 6 § 5.3.2:

The electric and magnetic field strength reference levels, power density reference levels, and associated reference period for devices employed by the general public (uncontrolled environment) and controlled-use devices (controlled environment) are specified in table 7 and table 8. Note that the power density limits specified in these tables apply to whole body exposure conditions.

Table 7: RF field strength and power density limits for devices used by the general public (uncontrolled environment)

Frequency range (MHz)	Electric field (V _{RMS} /m)	Magnetic field (A _{RMS} /m)	Power density (W/m ²)	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000 / f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000 / f^{1.2}$

Note: f is frequency in MHz.



9 Test Procedure

An RF exposure calculation was performed to show that the device was compliant with the general population exposure limits from FCC Title 47 CFR Part 1.1310(e)(1) and RSS-102 Issue 6. The maximum power density was calculated for each transmitter at a separation distance of 20cm using the maximum conducted output power (including tune up tolerance) plus antenna gain, or measured EIRP.

For each transmitter the maximum power density at a 20cm distance using the formula:

$$EIRP(dBm) = Conducted\ Power(dBm) + Antenna\ Gain(dBi)$$

$$EIRP(mW) = 10^{EIRP(dBm)/10}$$

$$Power\ Density\left(mW/cm^2\right) = \frac{EIRP(mW)}{4\pi \cdot (20cm)^2}$$

$$Power\ Density\left(W/m^2\right) = \left(\frac{100cm}{1m}\right)^2 \left(\frac{1W}{1000mW}\right) Power\ Density\left(mW/cm^2\right)$$



10 Results:

The calculated maximum power density at 20cm was less than or equal to the limits for general population exposure in FCC Title 47 CFR Part 1.1310(e)(1) and RSS-102 Issue 6.

10.1 FCC RF Exposure Data

Radio	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle (%)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value @ 20cm (mW/cm ²)	MPE Limit (mW/cm ²)	MPE / Limit Ratio (for Co-Location)
LoRa	903.0	19.3	100%	19.3	0.13	0.01745	0.6020	0.0290
	908.7	19.4	100%	19.4	0.13	0.01785	0.6058	0.0295
	914.2	19.0	100%	19.0	0.13	0.01628	0.6095	0.0267
BLE	2402	2.19	100%	2.19	3.18	0.0007	1.0000	0.0007
	2440	2.66	100%	2.66	3.18	0.0008	1.0000	0.0008
	2480	3.24	100%	3.24	3.18	0.0009	1.0000	0.0009

$0.0295 + 0.0009 = 0.0304 < 1$, so the device is deemed to comply with simultaneous exposure requirements.

10.2 RSS-102 Issue 6 RF Exposure Data

Radio	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle (%)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value @ 20cm (W/m ²)	MPE Limit (W/m ²)	MPE / Limit Ratio (for Co-Location)
LoRa	903.0	19.3	100%	19.3	0.13	0.1745	2.7419	0.0636
	908.7	19.4	100%	19.4	0.13	0.1785	2.7537	0.0648
	914.2	19.0	100%	19.0	0.13	0.1628	2.7651	0.0589
BLE	2402	2.19	100%	2.19	3.18	0.0069	5.3508	0.0013
	2440	2.66	100%	2.66	3.18	0.0076	5.4085	0.0014
	2480	3.24	100%	3.24	3.18	0.0087	5.4689	0.0016

$0.0648 + 0.0016 = 0.0664 < 1$, so the device is deemed to comply with simultaneous exposure requirements.

**11 Revision History**

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	5/2/2024	105620787LEX-001b	BZ	MC	Original Issue