

# Test Report

## Electromagnetic Compatibility

<b>Product</b>	Ultrasonic corrosion/erosion sensor
<b>Name and address of the applicant</b>	Sensorlink Swarm AS Mellomlia 56 7018 Trondheim
<b>Name and address of the manufacturer</b>	Sensorlink Swarm AS Mellomlia 56 7018 Trondheim
<b>Model</b>	S2
<b>Rating</b>	7.2V DC
<b>Trademark</b>	Swarm Link
<b>Serial number</b>	Logger: 6421-00034 + Sensors: 6421-00060/61/62/63
<b>Additional information</b>	Contains the following certified modules: ZigBee FCC-ID: SGJ-WFC011, IC: 8999A-WIC010 BlueTooth FCC-ID: T7VPAN10, IC: 216Q-PAN10
<b>Tested according to</b>	FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 6
<b>Order number</b>	413692
<b>Tested in period</b>	2021-01-10 – 2021-04-30
<b>Issue date</b>	2022-07-08
<b>Name and address of the testing laboratory</b>	Nemko Group Nemko AS Philip Pedersens vei 11, 1366 Lysaker, Norway TEL: +47 22 96 03 30 FAX: +47 22 96 05 50
  An accredited technical test executed under the Norwegian accreditation scheme	
  Prepared by [Jan G Eriksen]      Approved by [G.Suhanthakumar]	
This report shall not be reproduced except in full without the written approval of Nemko. Opinions and interpretations expressed within this report are not part of the current accreditation. This report was originally distributed electronically with digital signatures. For more information contact Nemko.	

## REPORT REVISIONS

Revision #	Date	Order #	Description
00	2021-06-07	413692	First issued
01	2021-10-12	413692	Correction on Applicant and manufacture name
02	2022-03-21	413692	Editorials and clarification of FCC/ICED precertified modules
03	2022-06-21	413692	Adding new FCC ID to report
04	2022-06-23	413692	Adding measurement setup photos to report
05	2022-07-08	413692	Putting setup photos in separate document



**THIS REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATION(S) TESTED.**

It is the manufacturer's responsibility to assure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is responsible to the authorities for any modifications made to the product, which result in non-compliance to the relevant regulations.

Nemko authorizes the named Customer (Applicant) to reproduce this report provided it is reproduced in its entirety.  
Any reproduction of parts of this report requires approval in writing from Nemko.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko accepts no responsibility for damages suffered by any third party as a result of decisions made or actions based on this report.

Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither is opinions expressed regarding model variants covered by the testing performed in this report.

Deviations from, additions to, or exclusions from the test specifications are described in "Testing Report Summary".

## DESCRIPTION OF TESTED ITEM(S)

Product description.....:	<p>The equipment is a device which measures corrosion in metall pipes. It contains one logger and a number of (4 in this case) sensors. The sensors transmit an acoustic pulse which is used to measure the thickness of the tube wall, and then calculate possible corrosion.</p> <p>The device uses 802.15.4 "ZigBee" radio for communication with a central hub for transmission of measurement data to the end user.</p> <p>It also contains a BLE (Blue Tooth Low Energy ) module for service purposes. The BLE module will not be used during normal operation.</p> <p>The ZigBee module is pre-certified by FCC/ICED (see page 1).        The BLE module is pre-certified by FCC/ICED (see page 1).</p>
---------------------------	--

Model/type .....	Logger: SWARM S2 LT Sensors: SWARM S2 LT Sensor
Serial number .....	Logger: 6421-00034 Sensors: 6421-00060/61/62/63
Operating voltage.....:	7.2 V DC replacable batteries
Maximum power/current.....:	-
Insulation class .....	-
Highest clock frequency .....	60MHz
Hardware version .....	2
Software version .....	1.5.0

Mounting position.....:	<input type="checkbox"/> Table top equipment <input type="checkbox"/> Wall/ceiling mounted equipment <input type="checkbox"/> Floor standing equipment <input type="checkbox"/> Handheld equipment <input type="checkbox"/> Rack mounted equipment <input type="checkbox"/> Console equipment <input checked="" type="checkbox"/> Other: To be mounted along and on metal pipes
-------------------------	---

## INPUT/OUTPUT PORTS

Port name and description	Cable		
	Longer than 3m	Attached during test	Shielded
Signal Port between Logger and Sensors – 5 m four wire cable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

## OPERATING MODES

No.	Description	Applied for testing	
		Emissions	Immunity
1	Pre-progammed normal operation mode with transmission of data over 2.4 GHz in "ZigBee"-mode	<input checked="" type="checkbox"/>	<input type="checkbox"/>
2	BLE communication in "Service"-mode	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	Ultra Sound measurement mode	<input checked="" type="checkbox"/>	<input type="checkbox"/>

## ACCESSORIES USED DURING TEST

Description	Manufacturer	Type
Computer	Any	Laptop

**PHOTOS AND DRAWINGS**

Copy of marking label.....:	 S/N: <b>6421-00034</b> Contains FCC ID: <b>T7VPAN10</b> Contains IC: <b>216Q-PAN10</b>	 <b>WARNING</b> POTENTIAL ELECTROSTATIC CHARGING HAZARD READ IM 01W03C01-01 FCC ID: SGJ-WFC011 IC : 8999A-WIC010
-----------------------------	--	--

Photo of the test item .....	 Logger	 Sensors
------------------------------	--	--

**OTHER INFORMATION**

Modifications .....	None
Additional information .....	None

Note: This equipment has been tested with certain cable types and cable configurations. Any changes to these parameters when installed may influence on the EMC properties of this equipment.

## TEST ENVIRONMENT

Test laboratory .....	<input type="checkbox"/> KJELLER (Instituttveien 6, N-2007 Kjeller, Norway) <input type="checkbox"/> LYSAKER (Philip Pedersens vei 11, N-1366 Lysaker, Norway)						
Laboratory accreditation .....	 <p><b>Norsk Akkreditering – TEST 033</b> P06 – Electromagnetic Compatibility</p>						
Environmental conditions .....	<p>The climatic conditions during the tests are within limits specified by the manufacturer for the operation of the product and the test equipment.</p> <p>The climatic conditions during tests are within the following limits:</p> <table> <tr> <td><b>Ambient temperature:</b></td> <td>15 – 35 °C</td> </tr> <tr> <td><b>Relative humidity:</b></td> <td>25 – 75 %RH</td> </tr> <tr> <td><b>Atmospheric pressure:</b></td> <td>86 – 106 kPa</td> </tr> </table> <p>If explicitly required by the test standard, or the requirements are tighter than the above; the climatic conditions are recorded and documented separately in this test report.</p>	<b>Ambient temperature:</b>	15 – 35 °C	<b>Relative humidity:</b>	25 – 75 %RH	<b>Atmospheric pressure:</b>	86 – 106 kPa
<b>Ambient temperature:</b>	15 – 35 °C						
<b>Relative humidity:</b>	25 – 75 %RH						
<b>Atmospheric pressure:</b>	86 – 106 kPa						
Calibration .....	<p>All instruments used in the tests of this test report are calibrated and traceable to national or international standards. Between calibrations test set-ups are controlled and verified on a regular basis by intermediate checks to ensure, with 95% confidence that the instruments remain within their calibrated levels.</p> <p>The instrumentation accuracy is within limits agreed by the IEC/CE/CTL and defined by Nemko.</p>						
Measurement uncertainties.....	<p>Uncertainty in EMC emission measurements stated in this report are calculated from the standard measurement uncertainties multiplied by the coverage factor <math>k=2</math>. It was determined in accordance with CISPR 16-4-2. The true value is in the corresponding interval with a probability of 95%.</p> <p>Uncertainties for continuous immunity tests are calculated based on the same principles as for EMC emission uncertainties.</p> <p>For Harmonics and Flicker measurements the measurement uncertainty is calculated based on the same principles as for EMC emission uncertainties.</p> <p>Uncertainties for transient immunity are kept within the requirements of the relevant basic standard.</p> <p><i>Further information about measurement uncertainties is provided on request.</i></p>						
Decision rules .....	<p>As specified by CISPR 16-4-2; if our measurement uncertainty <math>U_{LAB}</math> is less than or equal to <math>U_{CISPR}</math>, compliance is deemed to occur if no measured disturbance level exceeds the limit hence "PASS" is indicated, and non-compliance is deemed to occur if any measured disturbance level exceeds the limits hence "FAIL" is indicated.</p> <p>For continuous immunity tests, uncertainties are not considered when applying the calibrated test levels. Tests are performed at the test levels specified by the test standard. PASS and FAIL decisions are based on behaviour observations of the specimen.</p> <p>For transient immunity tests, uncertainties are not considered if the test equipment is kept within the requirements of the relevant basic standard. Tests are performed at the test levels specified by the test standard. PASS and FAIL decisions are based on behaviour observations of the specimen.</p> <p>For Harmonics and Flicker measurements the measurement uncertainty is considered, and measurements are marked if necessary. In doing so, the associated uncertainty of measurement has been considered.</p> <p><i>Further information about decision rules is provided on request.</i></p>						

## POWER SUPPLY CONDITIONS

The following nominal power supply conditions have been tested:

The EUT is powered by internal battery only.

## TEST REPORT SUMMARY

### APPLIED STANDARDS

Standards	Titles
FCC CFR 47 Subpart 15B	<i>Digital devices - Unintentional radiators, Class B Digital Device</i>
ISED Canada ICES-003, Issue 6	<i>Spectrum Management and Telecommunications Policy. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus - Limits and Methods of Measurement (Issue 6, June 2016)</i>

### TEST SUMMARY

Requirements – Tests	Reference standards	Verdict
Conducted Emissions	FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 6 FCC Part 12.107 per ANSI C63.4-2014	N/A
Radiated Emissions (Below 1GHz)	FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 6 FCC Part 12.109 per ANSI C63.4-2014	PASS
Radiated Emissions (Above 1GHz)	FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 6 FCC Part 12.109 per ANSI C63.4-2014	N/A

PASS : Tested and complied with the requirements  
 FAIL : Tested and failed the requirements  
 N/A : Test not relevant to this specimen (evaluated by the test laboratory)  
 – : Test not performed (instructed by the applicant)  
 \* : An asterisk (\*) placed after the verdict in the Result column indicates test items that are not within Nemko's scope of accreditation  
 # : A grid (#) placed after the verdict in the Result column indicates test items that are only partly covered by Nemko's scope of accreditation. Further information is detailed in the test section

### NOTES

Note 1: Product standards with dated references to basic standards may have been performed by Nemko AS according to the newest edition of the basic standard. This may impact the compliance criteria or technical performance of the test, still this is adequate as long as the test is expected to confirm compliance to the intention of the product standard. The table above lists the actual editions of the basic standards which have been used during testing.

Note 2: The choice of immunity test levels could be higher than those specified by the reference standards when we consider the nature of the specimen and its intended use or based on customer requests.

## Test Results

## RADIATED EMISSIONS (BELOW 1GHZ)

### TEST DESCRIPTION

#### Method

The reference method for this test is listed in the table under clause TEST SUMMARY.

#### Set-up

The measurements were performed in a semi-anechoic chamber (SAC). Nominal supply voltage was provided. The specimen was energized and in normal operating mode during the measurement.

- The specimen and its cables were elevated 10 cm above the site ground plane and placed in the centre of the turntable.
- The specimen and its cables were placed on a table 80 cm above the site ground plane and placed in the centre of the turntable.
- Ferrite clamps type CMAD were applied to cables leaving the test volume.
- A CDNE was applied to the power supply cable.

Antenna type = Hybrid bilog antenna

Antenna elevation = 100-400 cm above the ground reference plane.

Specimen rotation = 0-360°.

Frequency range:

- 30-300MHz
- 30-1000MHz
- Other:

Measurement distance:

- 3m
- 5m
- 10m

#### Conditions

The measuring bandwidth is 120 kHz in the frequency range 30 MHz – 1000 MHz. Frequency sweeps with RBW = 120 kHz and VBW = 1 MHz was applied with a sweep time of 20 ms (step size resolution < 60 kHz ).

Measurement uncertainty: ± 4.9 dB (3m distance in SAC10); ± 4.6 dB (3m distance in SAC3); ± 4.6 dB (10m distance in SAC10)

#### Instruments used during measurement

Instrument list:

- Antenna, bilog: Sunol / JB3 (N-4525) (02/2022)
- Antenna, bilog: Schwarzbeck / VULB 9163 (LR-1616) (02/2022)
- EMI Receiver: R&S / ESU40 (LR-1639) (02/2022)
- Preamplifier: Sonoma / 310N (LR-1686) (07/2021)
- Preamplifier: Sonoma / 317 (LR-1687) (07/2021)

#### Conformity

Verdict:

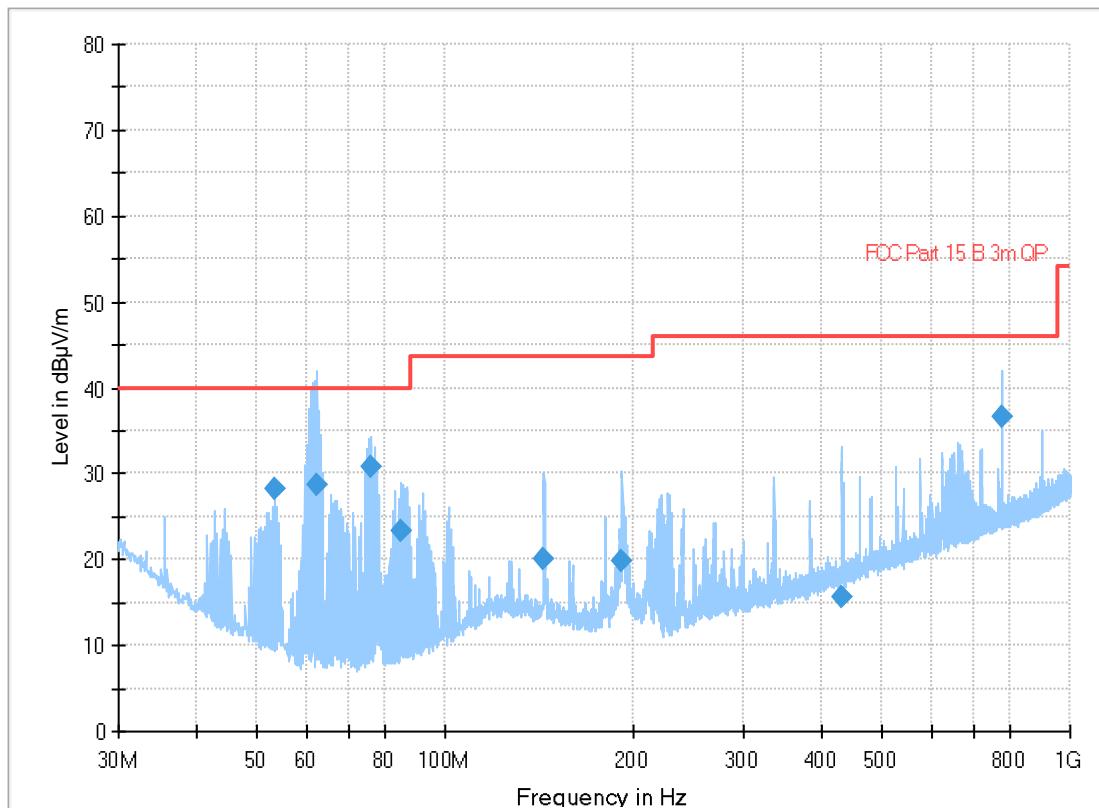
PASS

Test engineer:

Jan G Eriksen

## EMISSION SPECTRUM IN NORMAL OPERATIONAL MODE WITH "ZIGBEE" COMMUNICATION

Full Spectrum

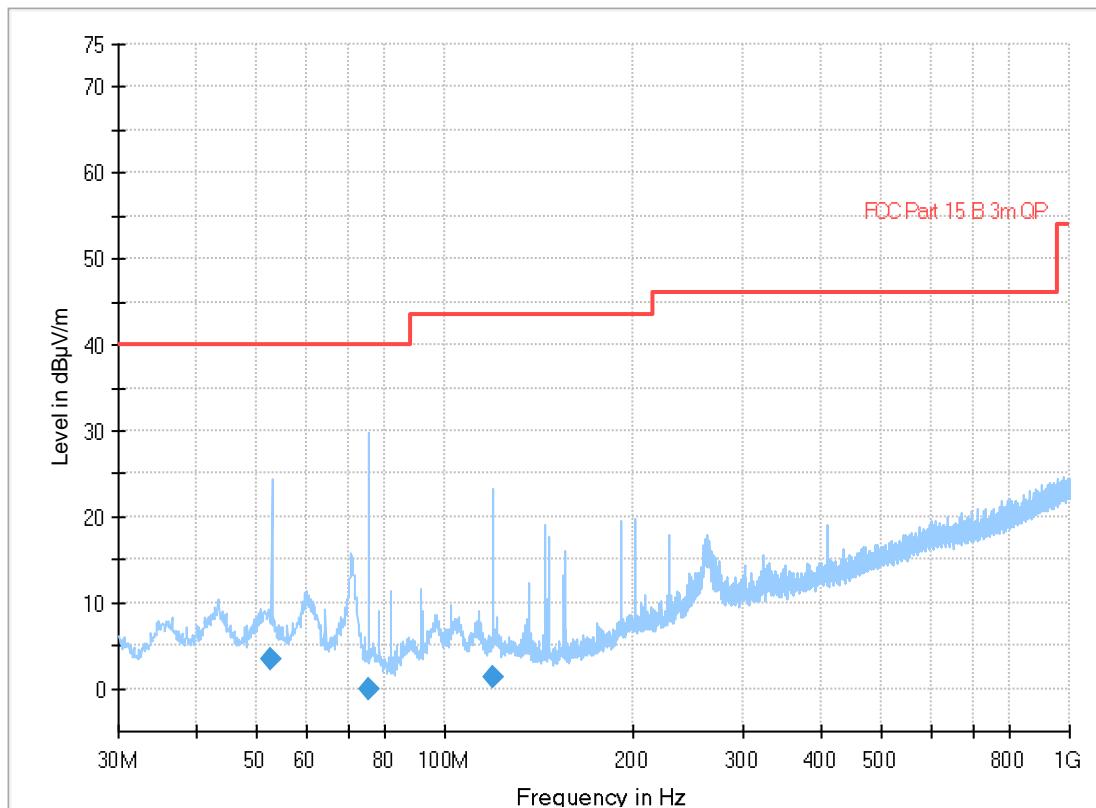


## MEASUREMENTS DATA

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
53.425750	28.3	40.00	11.7	1000.0	120.000	250.0	H	45.0
62.268350	28.7	40.00	11.3	1000.0	120.000	250.0	H	21.0
76.144250	30.9	40.00	9.1	1000.0	120.000	250.0	H	13.0
85.076650	23.4	40.00	16.6	1000.0	120.000	250.0	H	45.0
144.000550	20.0	40.00	20.0	1000.0	120.000	333.0	V	208.0
191.995300	19.7	40.00	20.3	1000.0	120.000	213.0	H	269.0
430.962050	15.7	47.00	31.3	1000.0	120.000	265.0	H	247.0
780.002300	36.7	47.00	10.3	1000.0	120.000	100.0	H	18.0

**EMISSION SPECTRUM IN "SERVICE MODE" WITH "BLE" COMMUNICATION**

Full Spectrum

**MEASUREMENTS DATA**

Frequency (MHz)	QuasiPeak (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
52.572400	3.36	40.00	36.64	1000.0	120.000	103.0	V	158.0
75.374150	-0.10	40.00	40.10	1000.0	120.000	316.0	V	147.0
119.505400	1.18	43.50	42.32	1000.0	120.000	350.0	H	37.0