Test Report Electromagnetic Compatibility

Product	IoT gateway for cellular connection and data communication from and to different type of devices	
Name and address of the applicant	Telenor Connexion AB Box 3081, SE-169 03 Solna, Sweden	
Name and address of the manufacturer	Telenor Connexion AB Box 3081, SE-169 03 Solna, Sweden	
Model	ECB02_A	
Rating	12 – 56VDC, max 6W	
Trademark	Telenor	
Additional information	/	
Tested according to	FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7	
Project number	467274	
Tested in period	2022-11-29 to 2023-03-09	
Issue date	2024-05-21	
Name and address of the testing laboratory	Nemko Scandinavia AS Philip Pedersens vei 11, 1366 Lysaker, Norway	
	An accredited technical test executed under the Norwegian accreditation scheme	
	Tore Johien Rog llagerul Prepared by [Tore LøvlienDRAFT] Approved by [Roy Uggerud]	



TEST REPORT Report No. REP006529-1

REPORT REVISIONS

Report Edition	Date	Project	Description	
REP006529	2023-06-21	467274 First issued		
REP006529-1	2024-05-21	467274 Correction of model names		
REP006529-1	2024-08-06	467274	467274 Deleted 4V DC due voltage limitation (12-56Vdc)	
REP006529-1	2024-08-16	467274	Removed Annex	



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.

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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 "Test Report Summary".

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DESCRIPTION OF TESTED ITEM(S)

Product description:	The EUT is a multipurpose communication boards with cellular, WiFi, BLE/BT and GNSS technology. The EUT also har connection for RS232, RS485, Digital I/O, USB and CANbus. The EUT also has several onboard LEDs and sensors.
	During all testing, except Surge and ESD, the device has been connected to a laptop which has been used to energize and supervise all interfaces via a proprietary LabVIEW program. For ESD and Surge, the EUT has been reprogrammed with a special FW, and been supervised via the onboard LEDs. The software allows for having either cellular or GNSS running, not both.

Model/type:	ECB02_A	
Serial number:	Prototypes	
Operating voltage:	12 – 56 VDC	
Maximum power/current:	max 6W	
Insulation class:	III	
Highest clock frequency:	582MHz	
Hardware version:	ECB02_A V2	
Software version:	BIST_EBC02_A_0.3.6	
FCC id	2BAKCECB02A	
Contains FCC id	XMR202005BG95M5 (BG95) XPYMAYAW166 (WiFi) XMR201909EG95NAX (EG95NAX)	
Mounting position:	 Tabletop equipment Wall/ceiling mounted equipment Floor standing equipment Handheld equipment Rack mounted equipment Console equipment 	

RF CHARACTERISTICS OF THE TRANSMITTER

See the following Nemko reports for full details on RF transmitters:

□ Other:

2.4GHz WiFi + BT and BLE	REP004400	According to EN 300 328
5GHz WiFi	REP004401	According to EN 301 893
LTE	REP004402	According to EN 301 908
GNSS	REP004403	According to EN 303 413



CRITICAL MODULES/PARTS

Description	Manufacturer	Туре
MCU	NXP	MIMXRT1061CVL5B
Modem	Quectel	BG95 M5
Modem	Quectel	EG95 EX
Modem	Quectel	EG95 NAX
MM Connector	Wurth	690367292676
WiFi Module	Ublox	MAYA-W166-00B-00
RJ45	Molex	955406888
Power Socket	Weidmuller	1874690000 alt. 1870500000
PCB	NCAB	/

ACCESSORIES USED DURING TEST

Description	Manufacturer	Туре
Laptop computer	Lenovo	Legion
CAN to USB adapter	Kvaser	U100
2x UART-USB adapters	-	-
POE Injector	Trendnet	TPE-115GI /EU
POE Switch	Zyxel	GS1900-10HP

MODEL VARIANTS

The following model variants have been inspected and are confirmed to be identical or believed to be less disposed with regard to electromagnetic compatibility.

Model/type	Comment	Tested
ECB02A	Full test	\boxtimes

INPUT/OUTPUT PORTS

Port name and description	Cable		
	Longer than 3m	Attached during test	Shielded
DC	\boxtimes	\boxtimes	
Ethernet	\boxtimes	\boxtimes	
RS232	\boxtimes	\boxtimes	
RS485	\boxtimes	\boxtimes	
USB	\boxtimes	\boxtimes	\boxtimes
CANBUS	\boxtimes	\boxtimes	
Digital IO	\boxtimes	\boxtimes	
Sensor Feed	\boxtimes	\boxtimes	
Power via Minimodule Connector	\boxtimes	\boxtimes	
Power via Power Terminal	\boxtimes	\boxtimes	

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



OPERATING MODES

OP no.	Description		Applied for testing	
		Emissions	Immunity	
OP1	Active and communicating, wireless disabled			
OP2	Active and communicating, wireless enabled			

POWER SUPPLY CONDITIONS

The following nominal power supply conditions have been tested:

PC no.	Voltage	Frequency	Туре	Ground terminal
PC1	24 V	🗆 AC 50Hz / 🗆 AC 60Hz / 🖂 DC	🗆 3AC / 🗆 3ACN / 🗆 PoE	\Box PE / \boxtimes GND / \Box None
PC3	54 V	🗆 AC 50Hz / 🗆 AC 60Hz / 🖂 DC	\Box 3AC / \Box 3ACN / \boxtimes PoE	\Box PE / \boxtimes GND / \Box None

All DC sources where supplied with 120V/60Hz AC.

PHOTOS AND DRAWINGS

Copy of marking label:	1
Photo of the test item:	See Photos

OTHER INFORMATION

Modifications:	/
Additional information:	Power source was supplied with 120V 60Hz.



TEST ENVIRONMENT

Test laboratory:	🖾 KJELLER	(Instituttveien 6, N-2007 Kjeller, Norway)
	□ LYSAKER	(Philip Pedersens vei 11, N-1366 Lysaker, Norway)
Laboratory accreditation :	NO ACCF TI	Norsk Akkreditering – TEST 033 P06 – Electromagnetic Compatibility ENDEDITATION EST 033
Environmental conditions: :	The climatic co operation of th The climatic co	nditions during the tests are within limits specified by the manufacturer for the e product and the test equipment. nditions during tests are within the following limits:
	Ambient te Relative hu Atmospher	emperature: 15 - 35 °C unidity: 25 - 75 %RH ric pressure: 86 - 106 kPa uired by the test standard, or the requirements are tighter than the above; the
Calibration:	climatic conditi All instruments international st basis by interm calibrated level The instrument	ions are recorded and documented separately in this test report. Is used in the tests of this test report are calibrated and traceable to national or tandards. Between calibrations test set-ups are controlled and verified on a regular nediate checks to ensure, with 95% confidence that the instruments remain within their s. tation accuracy is within limits agreed by the IECEE/CTL and defined by Nemko.
Measurement uncertainties:	Uncertainty in measurement of with CISPR 16-4 Uncertainties for emission uncer For Harmonics same principles Uncertainties for standard. Further informed	EMC emission measurements stated in this report are calculated from the standard uncertainties multiplied by the coverage factor k=2. It was determined in accordance 4-2. The true value is in the corresponding interval with a probability of 95%. or continuous immunity tests are calculated based on the same principles as for EMC tainties. and Flicker measurements the measurement uncertainty is calculated based on the sa for EMC emission uncertainties. or transient immunity are kept within the requirements of the relevant basic ation about measurement uncertainties is provided on request.
Decision rules :	As specified by compliance is of indicated, and limits hence "F. For continuous levels. Tests are are based on b For transient in the requirement the test standa For Harmonics measurements been considere <i>Further informa</i>	CISPR 16-4-2; if our measurement uncertainty U _{LAB} is less than or equal to U _{CISPR} , deemed to occur if no measured disturbance level exceeds the limit hence "PASS" is non-compliance is deemed to occur if any measured disturbance level exceeds the AIL" is indicated. immunity tests, uncertainties are not considered when applying the calibrated test e performed at the test levels specified by the test standard. PASS and FAIL decisions ehaviour observations of the specimen. nmunity tests, uncertainties are not considered if the test equipment is kept within nts of the relevant basic standard. Tests are performed at the test levels specified by rd. PASS and FAIL decisions are based on behaviour observations of the specimen. and Flicker measurements the measurement uncertainty is considered, and are marked if necessary. In doing so, the associated uncertainty of measurement has ed. ation about decision rules is provided on request.



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APPLIED STANDARDS

Standards	Titles
FCC CFR 47 Subpart 15B	Digital devices - Unintentinal radiators, Class B Digital Device
ISED Canada ICES-003, Issue 7	Spectrum Management and Telecommunications Policy. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus - Limits and Methods of Measurement (Issue 7, June 2020)

TEST SUMMARY

Requirements – Tests	Reference standards	Verdict
Conducted Emissions	FCC CFR 47 Subpart 15B:0 ISED Canada ICES-003, Issue 7:0 FCC Part 12.107 per ANSI C63.4-2014	PASS
Radiated Emissions (Below 1GHz)	FCC CFR 47 Subpart 15B:0 ISED Canada ICES-003, Issue 7:0 FCC Part 12.109 per ANSI C63.4-2014	PASS
Radiated Emissions (Above 1GHz)	FCC CFR 47 Subpart 15B:0 ISED Canada ICES-003, Issue 7:0 FCC Part 12.109 per ANSI C63.4-2014	PASS

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
#		A grid (#) placed after the verdict in the Result column indicates test

* 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

ABOUT REFERENCE STANDARDS AND TEST LEVELS

Product standards with dated references to basic standards may have been performed 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 if 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.

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.

NOTES

None



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Test Results



TEST DESCRIPTION

Method

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

Set-up

The measurement was performed at the power supply terminal of the specimen. Nominal supply voltage was provided. The specimen was energized and in normal operating mode during the measurement.

 \Box The specimen and its cables were elevated 10 cm above a ground plane.

 \Box The specimen and its cables were elevated 40 cm above a ground plane.

🗵 The specimen and its cables were placed 40 cm from a vertical ground plane, 80 cm over ground plane.

 \Box The specimen was mounted directly on, and bonded to a ground plane. Cables and auxiliary equipment were elevated by 1 cm

☑ The specimen was connected to an Artificial Mains Network (AMN) by its power supply cable, which was adjusted to 100cm length by folding.

□ The specimen was connected to an Artificial Mains Network (AMN) by a 0.8 m shielded power supply cable directly connected to the AMN

Conditions

□ Frequency range was 9kHz – 30MHz.
 □ Frequency range was 10kHz – 30MHz.
 ⊠ Frequency range was 150kHz – 30MHz.

The measuring bandwidth is 200Hz in the frequency range 9 kHz – 150 kHz. Measurement was made with a 100 Hz step size and 100 ms dwell time.

The measuring bandwidth is 9 kHz in the frequency range 150 kHz – 30 MHz. Measurement was made with a 4.5 kHz step size and 20 ms dwell time.

Measurement uncertainty: ± 3.7 dB (9 kHz - 150 kHz); ± 3.3 dB (150 kHz - 30 MHz)

Instruments used during measurement

 Instrument list:
 AMN: R&S / ENV216 (LR-1665) (11/2023)

 EMI Receiver: R&S / ESCI 3 (N-4259) (12/2023)

 AC Power Source: Agilent Technoligies / 6812B (LR-1515) (N/A)

Conformity Verdict: Test engineer:

PASS GNS



EMISSION SPECTRUM



Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment



ECB02A - PC3 - OP2

EMISSION SPECTRUM



Full Spectrum

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment



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 CDMS was explicible to the ground plane applied to cables leaving the test volume.

 \Box 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°.

□ Band-stop filter(s) was used to suppress the wanted RF transmission band to protect the measurement equipment.

Frequency range:	Measurement distance:
🗆 30-300MHz	🗵 3m
🗵 30-1000MHz	🗆 5m
🗆 Other:	🗆 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, Hybrid: Schwarzbeck / VULB 9163 (LR-1616) (05/2023) EMI Receiver: R&S / ESU40 (LR-1639) (01/2024) Preamplifier: Sonoma / 310N (LR-1686) (08/2023)

Preamplifier: Sonoma / 310N (LR-1686) (08/2023) AC Power Source: Agilent Technoligies / 6812B (LR-1515) (N/A)

Conformity

Verdict:

Test engineer:

PASS DGW



Full Spectrum



Frequency	QuasiPeak	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(ms)	(kHz)	(cm)		(deg)	(dB/m)
32.225852	20.73	40.00	19.27	15000.0	120.000	150.0	V	236.0	-15.4
33.448820	25.07	40.00	14.93	15000.0	120.000	106.0	V	244.0	-15.1
59.250332	25.32	40.00	14.68	15000.0	120.000	127.0	V	268.0	-13.5
98.392650	25.29	43.50	18.21	15000.0	120.000	102.0	V	250.0	-14.4
101.873166	23.34	43.50	20.16	15000.0	120.000	104.0	V	241.0	-14.2
104.742092	27.60	43.50	15.90	15000.0	120.000	115.0	V	104.0	-14.5
120.012220	30.64	43.50	12.86	15000.0	120.000	365.0	Н	222.0	-15.8
240.024134	35.39	46.00	10.61	15000.0	120.000	100.0	V	154.0	-12.3
720.021262	37.55	46.00	8.45	15000.0	120.000	104.0	Н	31.0	-2.3



Full Spectrum



Frequency	QuasiPeak	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(ms)	(kHz)	(cm)		(deg)	(dB/m)
34.577414	34.10	40.00	5.90	15000.0	120.000	104.0	V	128.0	-14.8
55.280300	33.31	40.00	6.69	15000.0	120.000	112.0	V	322.0	-13.5
58.791290	31.44	40.00	8.56	15000.0	120.000	109.0	V	12.0	-13.5
60.225518	35.42	40.00	4.58	15000.0	120.000	104.0	V	24.0	-13.6



RADIATED EMISSIONS (ABOVE 1GHZ)

TEST DESCRIPTION

Method

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

Set-up

Nominal supply voltage was provided. The specimen was energized and in normal operating mode during the measurement.

 \Box The specimen and its cables were elevated 10 cm above the floor and placed in the centre of the turntable. \boxtimes The specimen and its cables were placed on a table 80 cm above the floor and placed in the centre of the turntable.

Facility:

 \Box 3m semi-anechoic chamber (SAC3) with extra floor absorbers* (calibrated volume: D=2.0m / H=2.0m).

☑ 10m semi-anechoic chamber (SAC10) with extra floor absorbers* (calibrated volume: D=1.5m / H=2.0m).

 \Box 3m fully anechoic room (FAR3) (calibrated volume: D=1.2m / H=2.0m).

* The reference ground plane was covered with ferrite absorbers in the reflecting area between the specimen and the measuring antenna.

Measurement distance = \boxtimes 3m. Antenna elevation = fixed at centre of specimen height. Specimen rotation = 0-360°. Measurements were performed with a double-ridged guide horn antenna.

□ Band-stop filter(s) was used to suppress the wanted RF transmission band to protect the measurement equipment.

Frequency range:	Highest internal frequency of specimen:
🗆 1-2GHz	🗌 Below 108MHz
🗆 1-5GHz	Between 108MHz and 500MHz
🗵 1-6GHz	Between 500MHz and 1000MHz
🗵 1-12GHz	🗆 Above 1000MHz

The measuring bandwidth is 1 MHz in the above frequency range. Frequency sweeps with RBW = 1 MHz and VBW = 1 MHz was applied with a sweep time of 100 ms (proper segmentation of the frequency range was applied to obtain step size resolution < 500 kHz).

Measurement uncertainty: ± 5.1 dB

Instruments used during measurement

 Instrument list:
 Antenna, Horn: ETS / 3117 (LR-1717) (12/2027)

 EMI Receiver: R&S / ESU40 (LR-1639) (01/2024)

 Preamplifier: ETS / 3117-PA (LR-1757) (08/2023)

 AC Power Source: Agilent Technoligies / 6812B (LR-1515) (N/A)

 Conformity

 Verdict:
 PASS

 Test engineer:
 DGW



ECB02A – PC1 – OP1 EMISSION SPECTRUM (HORIZONTAL POLARIZATION)

Full Spectrum



Frequency	MaxPeak	CAverage	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(ms)	(kHz)	(cm)		(deg)	(dB/m)
						-				







Frequency	MaxPeak	CAverage	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(ms)	(kHz)	(cm)		(deg)	(dB/m)



ECB02A – PC3 – OP1 EMISSION SPECTRUM (HORIZONTAL POLARIZATION)

Full Spectrum



Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)



Full Spectrum



Frequency	MaxPeak	CAverage	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Corr.
(MHz)	(dBµV/m)	(dBµV/m)	(dBµV/m)	(dB)	(ms)	(kHz)	(cm)		(deg)	(dB/m)