

TEST REPORT

ACCORDING TO: FCC CFR 47 Part 15 subpart C, section 15.231

FOR:

Phytech Ltd.

**Communication Control unit (CCU),
part number CBRD1000V2-CCU**

FCC ID: 2ALN6GWA

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1 Applicant information

Client name: Phytech Ltd.
Address: Atir Yeda 1, Building 2, 6th floor, Kfar Saba, Postal code 4464301, Israel
Telephone: +972 3947 8050
Fax: +972 3947 8010
E-mail: eitanp@phytech.com
Contact name: Mr. Eitan Peleg

2 Equipment under test attributes

Product name: Communication Control unit (CCU)
Product type: Transceiver
Part number: CBRD1000V2-CCU
Hardware version: REV-A
Software release: Z.11.23.2
Receipt date: 28-Dec-23

3 Manufacturer information

Manufacturer name: Phytech Ltd.
Address: Atir Yeda 1, Building 2, 6th floor, Kfar Saba, Postal code 4464301, Israel
Telephone: +972 3947 8050
Fax: +972 3947 8010
E-Mail: eitanp@phytech.com
Contact name: Mr. Eitan Peleg

4 Test details

Project ID: 51928
Location: Hermon Laboratories Ltd. 66 HaTachana str., P.O. Box 23, Binyamina 3055001, Israel
Test started: 14-Nov-23
Test completed: 19-Dec-23
Test specification(s): FCC CFR 47 Part 15 subpart C, section 15.231

5 Tests summary

Test	Status
Transmitter characteristics	
FCC Part 15, Section 231(a) / RSS-210, Section A1.1, Periodic operation requirements	Pass
FCC Part 15, Section 231(a) / RSS-210, Section A1.2, Field strength of emissions	Pass
FCC Part 15, Section 231(c) / RSS-210, Section A1.3, Occupied bandwidth	Pass
FCC Part 15, Section 207 / RSS-Gen, Section 8.8, Conducted emission	Not required
FCC Part 15, Section 203 / RSS-Gen, Section 8.3, Antenna requirements	Pass

Testing was completed against all relevant requirements of the test standard. However, results obtained indicate that the product under test complies in full with the requirements tested.

The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mrs. E. Pitt, test engineer, EMC & Radio	14-Nov-23 – 19-Dec-23	
Reviewed by:	Mrs. S. Peysahov Sheynin, certification specialist, EMC & Radio	30-Feb-24	
Approved by:	Mr. M. Nikishin, group leader, EMC & Radio	24-Apr-24	

6 EUT description

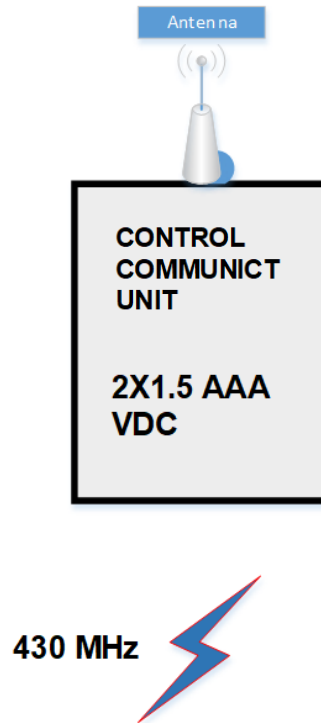
Note: The following data in this clause is provided by the customer and represents his sole responsibility

6.1 General information

The EUT is a Communication control unit (CCU):

- Dimension – 193mmX 129.3mmX50.6mm (HxWxD)
- Weight – 1Kg
- RF EFR Silicon Lab (EFR32FG23A020F512GM48-C) –
 - Frequency – 433.92 ± 0.1 MHz
 - 800 bit/second
- Atmel processor – Similar to current logger
- Modem – Quectel LTE EG21-G
- Power – 6 Volt power from the CBU with a backup 18650 Li-ion battery
- RS485 connection to CBU. 19200 baudrate.

6.2 Test configuration



6.3 Changes made in EUT

No changes were implemented in the EUT during testing.



6.4 Transmitter characteristics

Type of equipment					
X	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
Operating frequency		433.92 MHz			
Maximum rated output power		At transmitter 50 Ω RF output connector			
		Field strength at 3 m distance		79.21 dB(μ V/m)	
Is transmitter output power variable?		X	No		
		Yes		continuous variable	
				stepped variable with stepsize	dB
			minimum RF power		dBm
			maximum RF power		dBm
Antenna connection					
X	unique coupling	standard connector	X	integral	
			X		with temporary RF connector
			X		without temporary RF connector
Antenna/s technical characteristics					
Type		Manufacturer	Model number		Gain
Integrated on board		Phytech	CBRD1000		0-3 dBi
Transmitter aggregate data rate/s		4.5 kHz			
Type of modulation		FSK			
Modulating test signal (baseband)		800 kbps			
Transmitter power source					
X	Battery	Nominal rated voltage	3.0 VDC	Battery type	LI-ion 18650
	DC	Nominal rated voltage	VDC		
	AC mains	Nominal rated voltage	VAC	Frequency	
Common power source for transmitter and receiver			X	yes	no



Test specification: Section 15.231(a), Periodic operation requirements			
Test procedure: Supplier declaration		Verdict: PASS	
Test mode: Compliance			
Date(s): 04-Dec-23			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1012 hPa	Power: 3.7 VDC
Remarks: CCU			

7 Transmitter tests according to 47CFR part 15 subpart C requirements

7.1 Periodic operation requirements

7.1.1 General

The EUT was verified for compliance with periodic operation requirements listed below:

- Continuous transmissions such as voice, video and the radio control of toys are not permitted;
- A manually operated transmitter shall employ switch that will automatically deactivate the transmitter within not more than 5 seconds of being released;
- A transmitter activated automatically shall cease transmission within 5 seconds after activation;
- Periodic transmissions, excluding polling or supervision transmissions, at regular predetermined intervals are not permitted;
- Total duration of polling or supervision transmissions, including data, to determine system integrity in security or safety applications shall not exceed 2 seconds per hour;
- Transmission of set-up information for security systems may exceed the transmission duration limits of 5 seconds, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

The rationale for compliance with the above requirements was either test results or supplier declaration. The summary of results is provided in Table 7.1.1.

7.1.2 Test procedure for transmitter shut down test

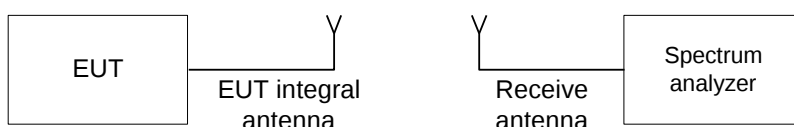
7.1.2.1 The EUT was set up as shown in Figure 7.1.1.

7.1.2.2 The spectrum analyzer center frequency was adjusted to the EUT carrier, span set to zero and video triggered for transmission.

7.1.2.3 The transmitter was activated either manually or automatically. Once manually operated transmitter was activated, the switch was immediately released.

7.1.2.4 The transmission time was captured and shown in Plot 7.1.1.

Figure 7.1.1 Setup for transmitter shut down test





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Test specification: Section 15.231(a), Periodic operation requirements			
Test procedure: Supplier declaration			
Test mode: Compliance	Verdict: PASS		
Date(s): 04-Dec-23			
Temperature: 23 °C	Relative Humidity: 45 %	Air Pressure: 1012 hPa	Power: 3.7 VDC
Remarks: CCU			

Table 7.1.1 Periodic operation requirements

Requirement	Rationale	Verdict
Continuous transmissions are not permitted	Supplier declaration*	Comply
A manually operated transmitter shall be deactivated within not more than 5 seconds of switch being released	NA	NA
Transmitter activated automatically shall cease transmission within 5 seconds	Plot 7.1.1	Pass
Periodic transmissions at regular predetermined intervals are not permitted	Supplier declaration*	Comply
Total duration of polling or supervision transmissions shall not exceed 2 seconds per hour	NA	Pass
Transmission of set-up information for security systems may exceed the transmission duration limits of 5 seconds, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.	NA	NA

* Provided in Appendix G.

Plot 7.1.1 Transmitter shut down test result



Reference numbers of test equipment used

HL7585	HL 5288	HL 5902	HL 3903				
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Full description is given in Appendix A.



Test specification: Section 15.231(b), Field strength of emissions			
Test procedure: ANSI C63.4, Section 13.1.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

7.2 Field strength of emissions

7.2.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.2.1 and Table 7.2.2.

Table 7.2.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
434.02	100.8	80.8

Table 7.2.2 Radiated spurious emissions limits

Frequency, MHz	Field strength at 3 m, dB(μV/m)				
	Within restricted bands			Outside restricted bands	
	Peak	Quasi Peak	Average	Peak	Average
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	80.8	60.8
0.090 – 0.110	NA	108.5 – 106.8**	NA		
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**		
0.490 – 1.705	NA	73.8 – 63.0**	NA		
1.705 – 30.0*		69.5			
30 – 88		40.0			
88 – 216		43.5			
216 – 960		46.0			
960 - 1000		54.0			
Above 1000	74.0	NA	54.0		

*- The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$\text{Lim}_{S2} = \text{Lim}_{S1} + 40 \log (S_1/S_2),$$

where S_1 and S_2 – standard defined and test distance respectively in meters.

** - The limit decreases linearly with the logarithm of frequency.

Note 1: The fundamental emission limit in dB(μV/m) was calculated as follows:

$$\text{Lim}_{AVR} = 20 \times \log (56.81818 \times F - 6136.3636) \text{ - within } 130 - 174 \text{ MHz band;}$$

$$\text{Lim}_{AVR} = 20 \times \log (41.6667 \times F - 7083.3333) \text{ - within } 260 - 470 \text{ MHz band,}$$

where F is the carrier frequency in MHz.

The limit for spurious emissions was 20 dB lower than fundamental emission limit.

The above limits provided in terms of average values, peak limit was 20 dB above the average limit.

Note 2: The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency.



Test specification: Section 15.231(b), Field strength of emissions			
Test procedure: ANSI C63.4, Section 13.1.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

7.2.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.2.2.3 The worst test results (the lowest margins), recorded in Table 7.2.3 and shown in the associated plots.

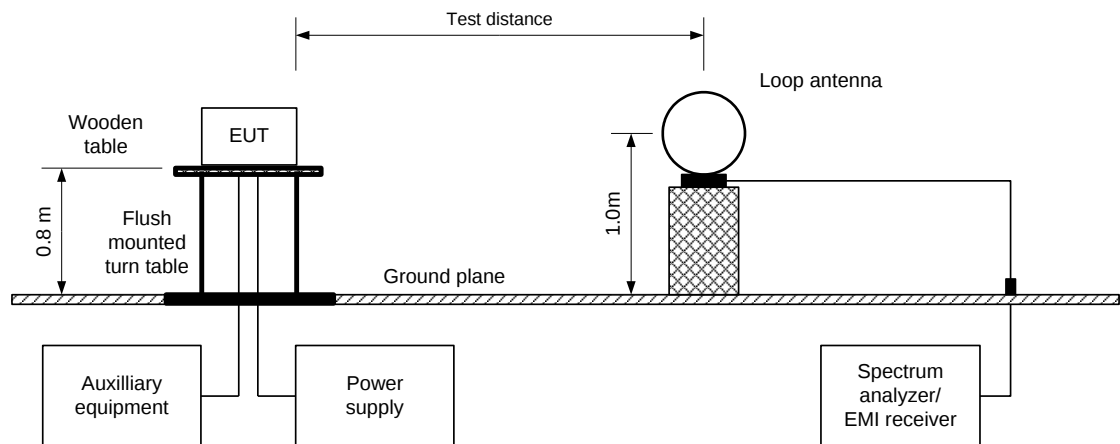
7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in, Figure 7.2.3, Figure 7.2.2, energized and the performance check was conducted.

7.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.2.3.3 The worst test results (the lowest margins), recorded in Table 7.2.4 and shown in the associated plots.

Figure 7.2.1 Setup for spurious emission field strength measurements below 30 MHz





Test specification: Section 15.231(b), Field strength of emissions			
Test procedure: ANSI C63.4, Section 13.1.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Figure 7.2.2 Setup for spurious emission field strength measurements in 30 -1000 MHz

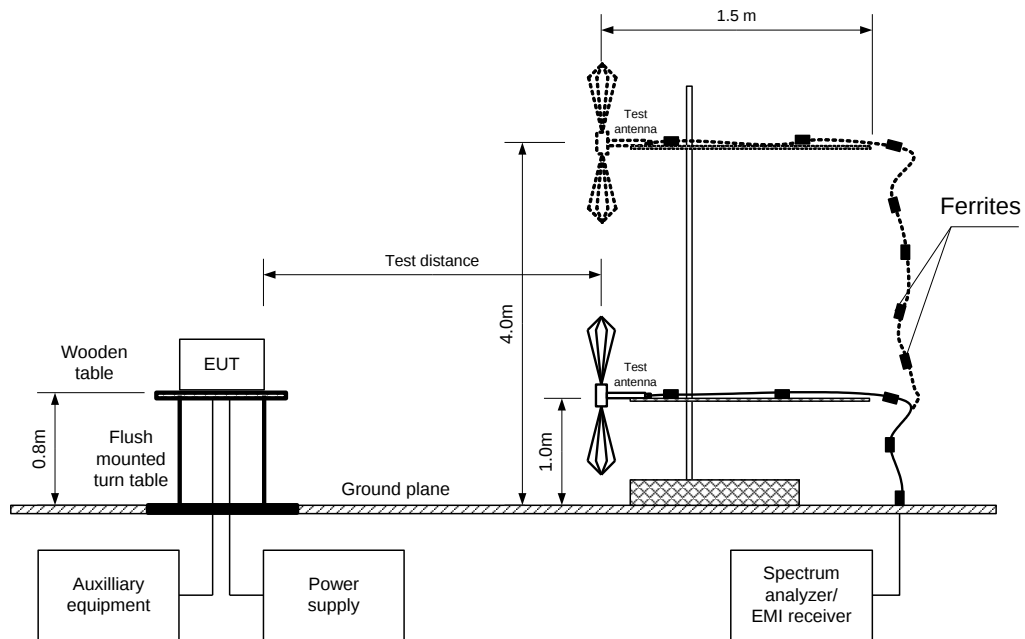
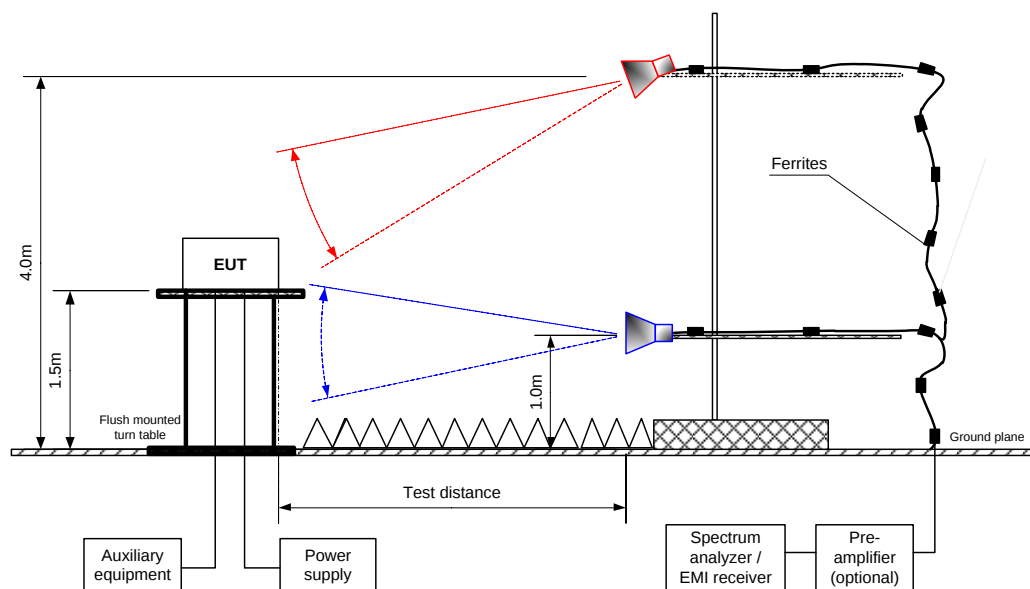


Figure 7.2.3 Setup for spurious emission field strength measurements above 1000 MHz





Test specification:		Section 15.231(b), Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Verdict: PASS	
Date(s):			
17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Table 7.2.3 Field strength of fundamental emission, spurious emissions below 1 GHz

TEST DISTANCE: 3 m
 EUT POSITION: Typical
 MODULATION: FSK
 BIT RATE: 800 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 - 4500 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 0.2 kHz (9 kHz – 150 kHz)
 9.0 kHz (150 kHz – 30 MHz)
 120 kHz (30 MHz – 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconilog (30 MHz – 1000 MHz)

F, MHz	Antenna		Azimuth, degrees*	Peak field strength			Average field strength				Verdict
	Pol.	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	
Fundamental emission***											
434.02	H	1.0	95	79.21	100.80	-21.59	79.21	79.21	80.80	-1.59	Pass
Spurious emissions											
No emissions were found											Pass

*- EUT front panel refers to 0 degrees position of turntable.

**- Margin, dB = Measured (calculated) value, dB(μV/m) - Limit, dB(μV/m)

Table 7.2.4 Field strength spurious emissions outside and within restricted bands at frequencies above 1 GHz

TEST DISTANCE: 3 m
 EUT POSITION: Typical
 MODULATION: FSK
 BIT RATE: 800 kbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 INVESTIGATED FREQUENCY RANGE: 0.009 - 4500 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 1.0 MHz (above 1000 MHz)
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 TEST ANTENNA TYPE: Double ridged guide (above 1000 MHz)

Frequency, MHz	Peak			Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	Measured emission, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*				
2227.850	35.10	74.00	-38.90	23.37	54.00	-30.63	Horizontal	1.89	0	Pass
3037.780	36.59	80.80	-44.21	24.64	60.80	-36.16	Horizontal	3.93	1	
3469.280	37.21	80.80	-43.59	25.04	60.80	-35.76	Vertical	1.46	-57	
4308.000	38.50	74.00	-35.50	26.90	54.00	-27.10	Horizontal	1.67	-63	
4390.800	38.97	74.00	-35.03	27.31	54.00	-26.69	Vertical	2.54	177	
4391.200	39.16	74.00	-34.84	27.15	54.00	-26.85	Vertical	1.24	-87	



Test specification:		Section 15.231(b), Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Verdict: PASS	
Date(s):			
17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Table 7.2.5 Average factor calculation

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
NA	NA	NA	NA	NA	NA

*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{Burst duration}}{\text{Train duration}} \times \text{Number of bursts within pulse train} \right)$$

for pulse train longer than 100 ms:

$$\text{Average factor} = 20 \times \log_{10} \left(\frac{\text{Pulse duration}}{\text{Pulse period}} \times \frac{\text{Burst duration}}{100 \text{ ms}} \times \text{Number of bursts within 100 ms} \right)$$

Reference numbers of test equipment used

HL 7585	HL3903	HL 5902	HL 0446	HL 4933	HL 5288	HL5311	
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Full description is given in Appendix A.



Test specification:		Section 15.231(b), Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Verdict: PASS	
Date(s):			
17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Table 7.2.6 Restricted bands

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.42 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

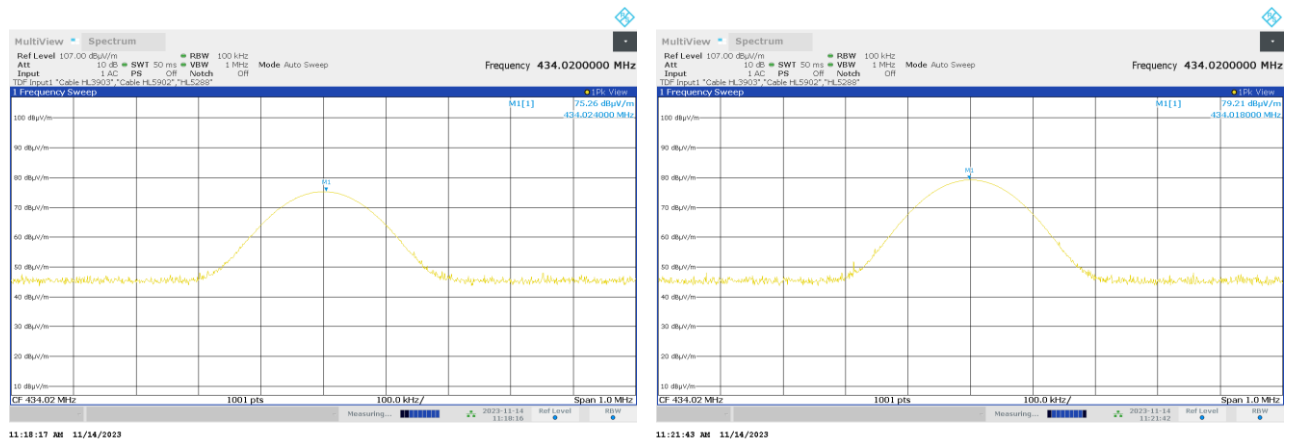


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Test specification:		Section 15.231(b), Field strength of emissions	
Test procedure:		ANSI C63.4, Section 13.1.4	
Test mode:		Verdict: PASS	
Date(s):			
17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

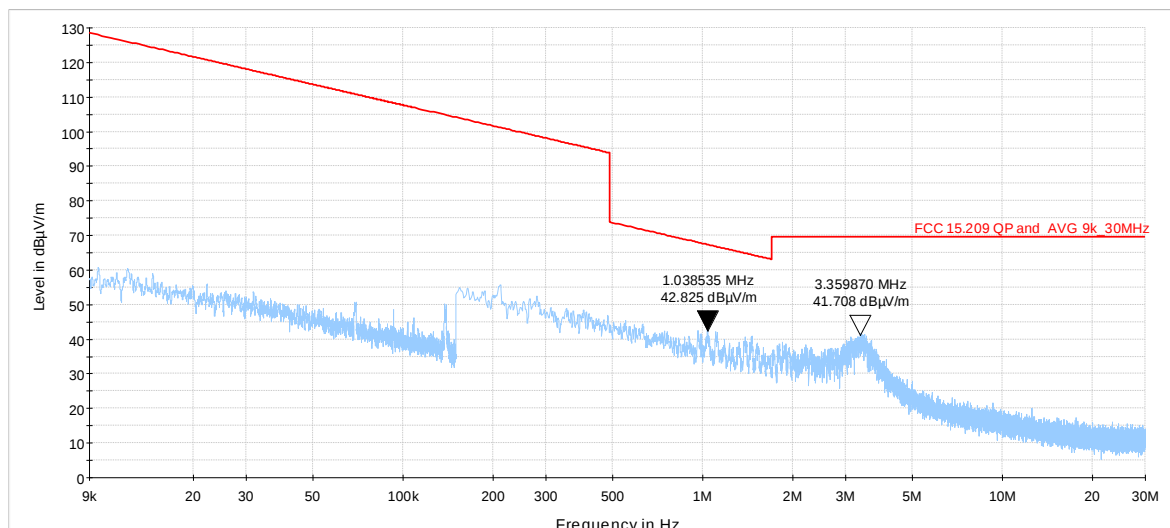
Plot 7.2.1 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



Plot 7.2.2 Radiated emission measurements from 0.009 to 30 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical
EUT POSITION: Typical



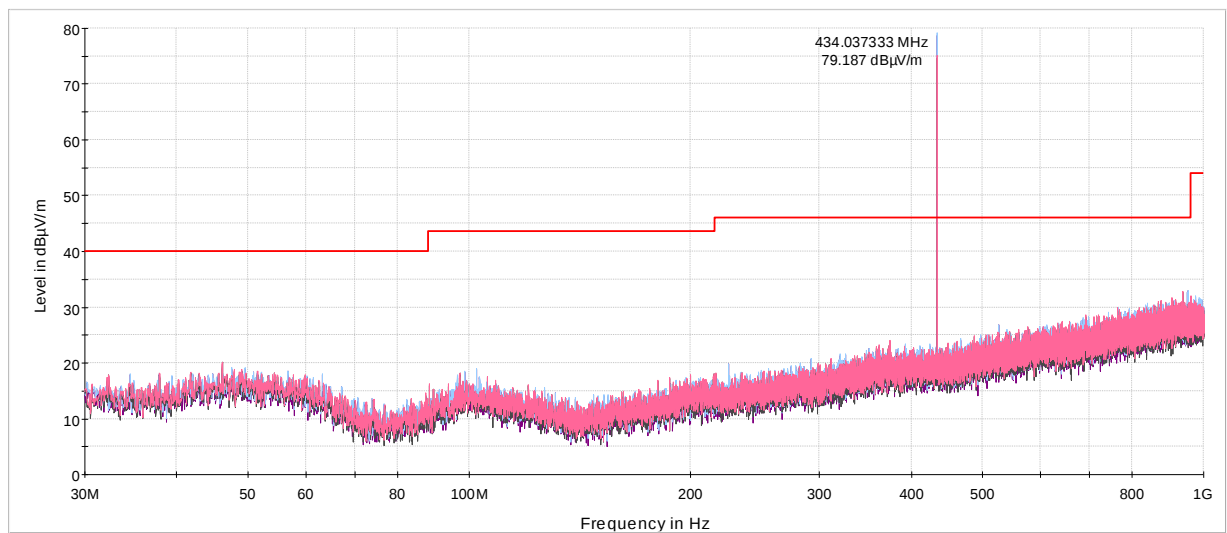


HERMON LABORATORIES

Test specification: Section 15.231(b), Field strength of emissions			
Test procedure: ANSI C63.4, Section 13.1.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Plot 7.2.3 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical



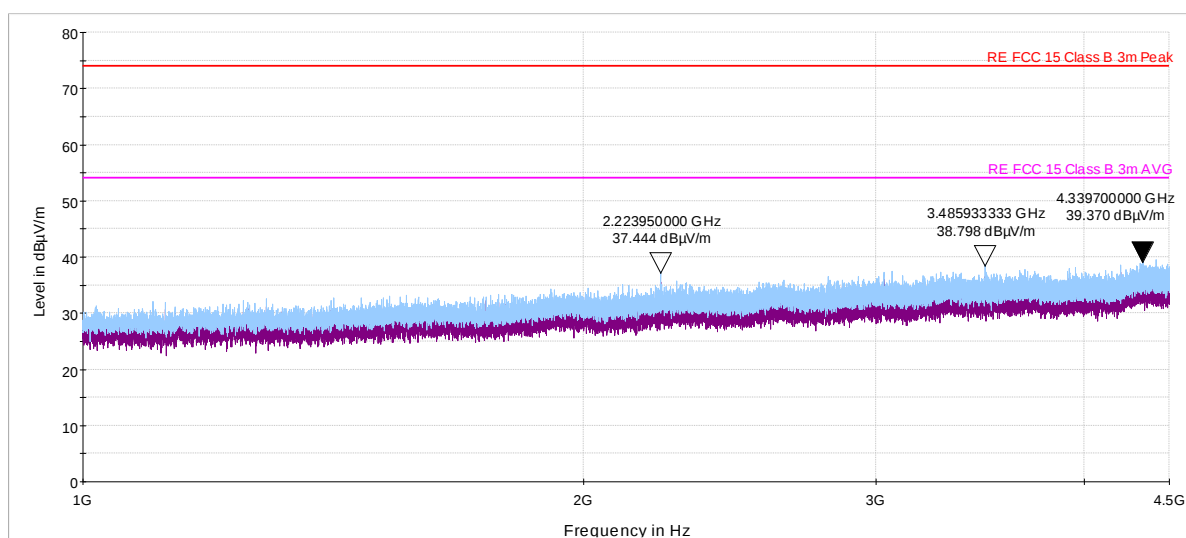


HERMON LABORATORIES

Test specification: Section 15.231(b), Field strength of emissions			
Test procedure: ANSI C63.4, Section 13.1.4			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Plot 7.2.4 Radiated emission measurements from 1000 to 4500 MHz

TEST SITE: Semi anechoic chamber
TEST DISTANCE: 3 m
ANTENNA POLARIZATION: Vertical and Horizontal
EUT POSITION: Typical





Test specification: FCC Part 15, Section 231(c), Occupied bandwidth			
Test procedure: ANSI C63.10 section 6.9.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

7.3 Occupied bandwidth test

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1. The test results are provided in Table 7.3.2 and associated plots.

Table 7.3.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, % of the carrier frequency
70 - 900	20.0	0.25
Above 900		0.50

*- Modulation envelope reference points provided in terms of attenuation below modulated carrier.

7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The EUT was set to transmit modulated carrier.

7.3.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.3.2 and associated plot.

Figure 7.3.1 Occupied bandwidth test setup





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Report ID: PHYRAD_FCC.51928_CCU.docx

Date of Issue: 25-Apr-24

Test specification: FCC Part 15, Section 231(c), Occupied bandwidth			
Test procedure: ANSI C63.10 section 6.9.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak hold
RESOLUTION BANDWIDTH: 200 Hz
VIDEO BANDWIDTH: 1 kHz
MODULATION ENVELOPE REFERENCE POINTS: 20 dBc
MODULATION: FSK
BIT RATE: 800 kbps

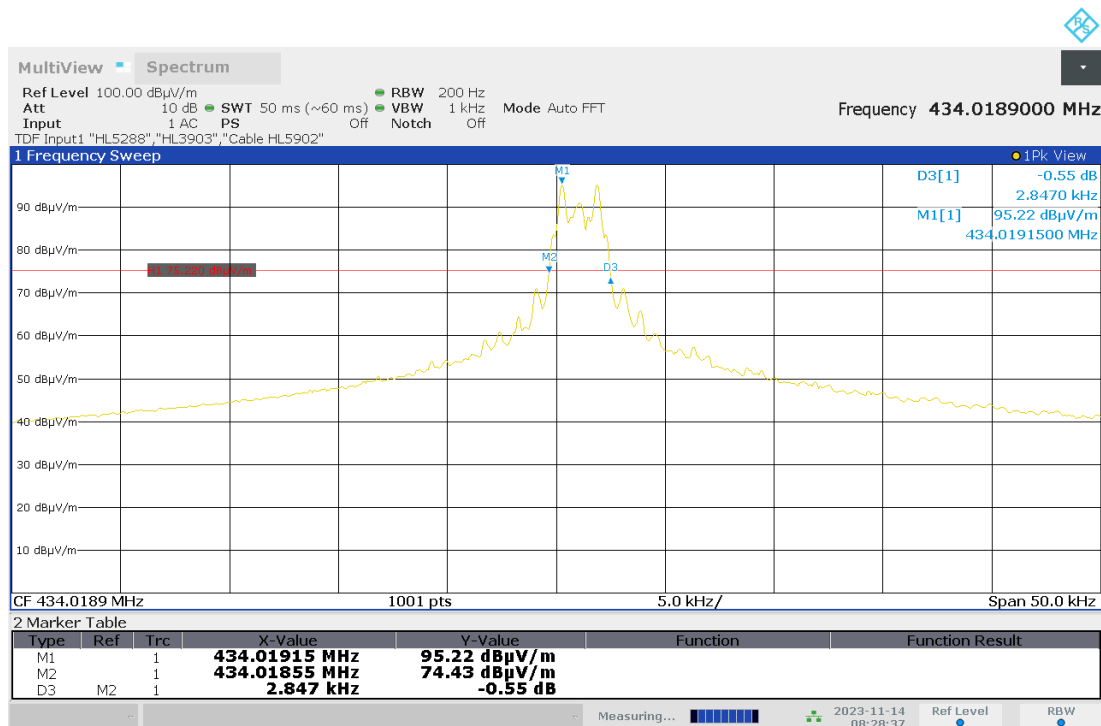
Carrier frequency, MHz	Occupied bandwidth, kHz	Limit		Margin, kHz	Verdict
		% of the carrier frequency	kHz		
434.02	2.847	0.25	1085.05	-1082.203	Pass

Reference numbers of test equipment used

HL 7585	HL 5288	HL 3903	HL 5902					
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Full description is given in Appendix A.

Plot 7.3.1 Occupied bandwidth test result



08:28:37 AM 11/14/2023

Test specification: Section 15.203, Antenna requirement			
Test procedure: Visual inspection / supplier declaration			
Test mode: Compliance		Verdict: PASS	
Date(s): 17-Dec-23			
Temperature: 24 °C	Relative Humidity: 44 %	Air Pressure: 1008 hPa	Power: 6 VDC
Remarks:			

7.4 Antenna requirements

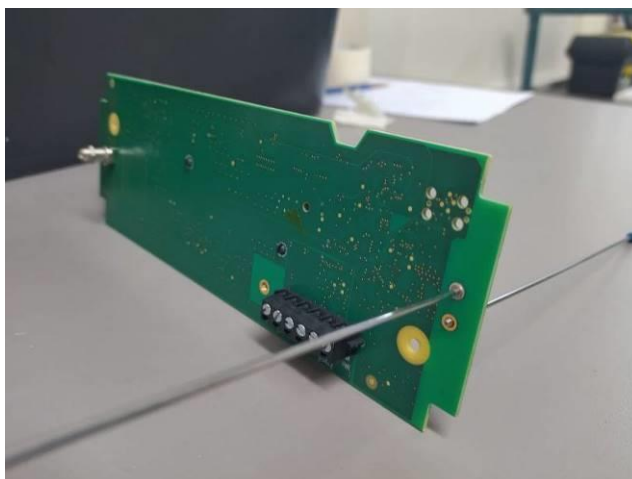
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters.

The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.4.1.

Table 7.4.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	NA	Comply
The transmitter employs a unique antenna connector	Visual inspection	
The transmitter requires professional installation	NA	

Photograph 7.4.1 Antenna assembly



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 (9) kHz - 30 MHz	EMCO	6502	2857	07-Mar-23	07-Mar-24
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	23-Apr-23	23-Apr-24
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFL EX 102A	1226/2A	16-Apr-23	16-Apr-24
4135	Shield Box	TESCOM CO., LTD	TC-5916A	5916A000 136	03-May-23	03-May-24
4136	Shield Box	TESCOM CO., LTD	TC-5916A	5916A000 137	03-May-23	03-May-24
4355	Signal and Spectrum Analyzer, 9 kHz to 7 GHz	Rohde & Schwarz	FSV 7	101630	24-Oct-23	24-Oct-24
4933	Active Horn Antenna, 1 GHz to 18 GHz	COM-POWER CORPORATION	AHA-118	701046	19-Jan-23	19-Jan-24
5288	Trilog Antenna, 25 MHz - 8 GHz, 100W	Frankonia	ALX-8000E	00809	24-Mar-22	24-Mar-25
5376	EXA Signal Analyzer, 10 Hz - 32 GHz	Keysight Technologies	N9010B	MY574704 04	27-Dec-22	27-Dec-23
5612	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini Circuits	BW-S10W5+	NA	10-Aug-23	10-Aug-24
5644	Cable, 50 Ohm, DC to 18 GHz, 1.8 m, SMA/SMA	Mini Circuits	CBL-6FT-SMSM+	NA	29-Nov-22	29-Nov-23
5902	RF cable, 18 GHz, 6.0m, N-type	Huber-Suhner	SF126EA/ 11N/11N/ 6000	NA	08-Dec-22	08-Dec-23
6105	Field Probe Set, 5 un	NA	NA	NA	05-Sep-23	05-Sep-24
7585	EMI Test Receiver, 1 Hz to 44 GHz	Rohde & Schwarz	ESW44	103130	21-Sep-23	21-Sep-24

9 APPENDIX B Test equipment correction factors

Antenna factor
Trilog antenna
Model ALX-8000E, Frankonia, S/N 00809, HL 5288, 30-1000 MHz

Frequency, MHz	Antenna factor, dB/m		
	Vert Up	Vert Down	Delta
30	-51.19	-51.28	0.09
35	-44.03	-44.12	0.09
40	-43.07	-43.12	0.05
45	-39.61	-39.79	0.18
50	-37.84	-38.14	0.3
60	-34.93	-34.9	0.03
70	-29.76	-29.66	0.1
80	-27.69	-27.82	0.13
90	-29.05	-29.07	0.02
100	-31.19	-31.19	0
120	-31.61	-31.6	0.01
140	-28.13	-28.06	0.07
160	-27.71	-27.75	0.04
180	-26.19	-26.15	0.04
200	-28.2	-28.15	0.05
250	-27.45	-27.47	0.02
300	-29.61	-29.63	0.02
400	-31.77	-31.78	0.01
500	-32.81	-32.81	0
600	-33.64	-33.61	0.03
700	-34.21	-34.21	0
800	-35.66	-35.66	0
900	-36.99	-36.91	0.08
1000	-38	-37.91	0.09

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μ V) to convert it into field intensity in dB(μ V/m).

Antenna factor
Active Horn Antenna,
Com-Power Corporation, model: AHA-118, s/n 701046, HL 4933

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
1000	-16.1
1500	-15.1
2000	-10.9
2500	-11.9
3000	-11.1
3500	-10.6
4000	-8.6
4500	-8.3
5000	-5.9
5500	-5.7
6000	-3.3
6500	-4.0
7000	-2.2
7500	-1.7
8000	1.1
8500	-0.8
9000	-1.5
9500	-0.2

Frequency, MHz	Measured antenna factor (with preamplifier), dB/m
10000	1.8
10500	1.0
11000	0.3
11500	-0.5
12000	3.1
12500	1.4
13000	-0.3
13500	-0.4
14000	2.5
14500	2.2
15000	1.9
15500	0.5
16000	2.1
16500	1.2
17000	0.6
17500	3.1
18000	4.2

The antenna factor shall be added to receiver reading in dB μ V to obtain field strength in dB μ V/m.

Cable loss
RF cable, 18 GHz, 6.0m, N-type, Huber-Suhner, S/N 511435/126EA,
SF126EA/11N/11N/6000, HL 5902

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.00	4800	3.24	10000	4.82	15200	6.08
1	0.01	4900	3.30	10100	4.85	15300	6.11
10	0.07	5000	3.32	10200	4.87	15400	6.12
30	0.18	5100	3.37	10300	4.91	15500	6.14
50	0.25	5200	3.40	10400	4.93	15600	6.15
100	0.41	5300	3.42	10500	4.95	15700	6.18
200	0.56	5400	3.46	10600	4.99	15800	6.20
300	0.68	5500	3.50	10700	5.01	15900	6.23
400	0.76	5600	3.53	10800	5.03	16000	6.22
500	0.87	5700	3.56	10900	5.06	16100	6.26
600	1.03	5800	3.58	11000	5.08	16200	6.29
700	1.14	5900	3.63	11100	5.12	16300	6.30
800	1.23	6000	3.67	11200	5.13	16400	6.33
900	1.34	6100	3.69	11300	5.16	16500	6.35
1000	1.43	6200	3.73	11400	5.18	16600	6.37
1100	1.51	6300	3.76	11500	5.22	16700	6.40
1200	1.59	6400	3.80	11600	5.24	16800	6.43
1300	1.66	6500	3.81	11700	5.25	16900	6.46
1400	1.73	6600	3.83	11800	5.28	17000	6.47
1500	1.78	6700	3.87	11900	5.32	17100	6.49
1600	1.82	6800	3.91	12000	5.33	17200	6.51
1700	1.87	6900	3.91	12100	5.35	17300	6.53
1800	1.89	7000	3.93	12200	5.38	17400	6.56
1900	1.95	7100	3.95	12300	5.39	17500	6.60
2000	1.99	7200	3.98	12400	5.43	17600	6.62
2100	2.02	7300	4.02	12500	5.46	17700	6.60
2200	2.06	7400	4.04	12600	5.48	17800	6.63
2300	2.11	7500	4.07	12700	5.50	17900	6.64
2400	2.16	7600	4.11	12800	5.52	18000	6.66
2500	2.21	7700	4.15	12900	5.57		
2600	2.29	7800	4.17	13000	5.57		
2700	2.32	7900	4.20	13100	5.60		
2800	2.38	8000	4.22	13200	5.61		
2900	2.44	8100	4.26	13300	5.64		
3000	2.47	8200	4.30	13400	5.67		
3100	2.53	8300	4.32	13500	5.70		
3200	2.57	8400	4.35	13600	5.71		
3300	2.61	8500	4.39	13700	5.73		
3400	2.67	8600	4.43	13800	5.74		
3500	2.71	8700	4.45	13900	5.80		
3600	2.76	8800	4.47	14000	5.82		
3700	2.80	8900	4.49	14100	5.85		
3800	2.85	9000	4.53	14200	5.86		
3900	2.89	9100	4.55	14300	5.87		
4000	2.93	9200	4.57	14400	5.92		
4100	2.98	9300	4.61	14500	5.93		
4200	3.01	9400	4.64	14600	5.95		
4300	3.05	9500	4.68	14700	5.97		
4400	3.10	9600	4.70	14800	6.01		
4500	3.12	9700	4.73	14900	6.04		
4600	3.18	9800	4.78	15000	6.04		
4700	3.21	9900	4.80	15100	6.08		

10 APPENDIX C Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 10 m measuring distance Horizontal polarization Vertical polarization	Biconilog antenna: ± 5.0 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.1 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 5.5 dB Biconical antenna: ± 5.5 dB Log periodic antenna: ± 5.6 dB Double ridged horn antenna: ± 5.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization Vertical polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 6.0 dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
Occupied bandwidth	± 8.0 %

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

11 APPENDIX D Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for relevant parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; Recognized by Innovation, Science and Economic Development Canada for wireless and terminal testing (ISED), ISED #2186A, CAB identifier is IL1001; Certified by VCCI, Japan (the registration numbers for OATS are R-10808 for RE measurements below 1 GHz, G-20112 for RE measurements above 1 GHz, R-11082 for anechoic chamber for RE measurements below 1 GHz, G-10869 for RE measurements above 1 GHz, C-10845 for conducted emissions site and T-11606 for conducted emissions at telecommunication ports).

The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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Person for contact: Mr. Michael Nikishin, EMC&Radio group manager

12 APPENDIX E Specification references

FCC 47CFR part 15: 2022	Radio Frequency Devices
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
ANSI C63.4: 2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	Ohm
PM	pulse modulation
PS	power supply
ppm	part per million (10^{-6})
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband

14 APPENDIX G Manufacturer's declaration about periodic operation

April 11, 2024

To: Hermon Laboratories

Manufacturer's Declaration

We, Phytech Ltd. located in Kfar Saba, Israel, declare under our sole responsibility that the product Communication Control unit (CCU) is operate on **433.92** MHz and designed to comply and satisfy periodic operational requirements.

Eitan Peleg
Managing Director



END OF DOCUMENT