



Test Report No. 7212319860

Applicant: E.N.G.S Systems LTD

Equipment Under Test:

RF transceiver

Model: Radio repeater (V2.00)

FCC ID: XBL-TRANSCEIVER

***The Standards Institution of Israel
Industry Division
Electrical & Electronics Laboratory
EMC Branch***



Certificate Number:AT-1359

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Applicant:	E.N.G.S Systems LTD
Address:	ZAHAR industrial park, POB 666, Rosh-Pina , Israel
Sample for test selected by:	The customer
The date of tests:	29 September 2022 - 3 November 2022

Description of Equipment Under Test (EUT):	Radio repeater (Transceiver)
Model:	Radio repeater (V2.00)
Software version of radio unit:	V-3.2.3
Hardware version of radio unit:	V2.00
Manufactured by:	E.N.G.S Systems LTD

Reference Documents:

❖ CFR 47 FCC:	Rules and Regulations; Part 15. "Radio frequency devices"; <u>Subpart C</u> : "Intentional radiators" Section 15.205. "Restricted bands of operations", Section 15.207. "Conducted limits" Section 15.209. "Radiated emission limits, general requirements". "Radiated Emission Limits, Additional Provisions"; Section 15.231. "Periodic operation in the bands 40.66 – 40.70 MHz, and above 70 MHz".
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This Test Report contains 25 pages and may be used only in full.

This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.

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1. EUT Description and operation

1.1. General description:

* Note: the customer supplied all information in clause below.

The Equipment Under Test (hereinafter: EUT) is a Radio repeater Model Radio repeater (V2.00) intended to be used for receiving and transmitting the cow tag signal.

Radio repeater works in the transmitting at 433.9MHz.

Radio repeater works with the 24 Volt AC.

The tag is attached to a belt and worn around the neck or leg of a cow. The main future of the Transceiver is to receive and transmit the cow tag data.

A Cow tags used for Cow monitoring. The tag is counting steps and monitor cow behavior.

Type of modulation:	FSK
Antenna type:	Omni. Antenna gain 2.15 dBi. Manufacturer: HYS Model number: 433-RH771-BNC

The EUT external view is presented in photo 1.



Photo 1. Transceiver view and block diagram.

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2. Test summary

Parameter	FCC Part 15 Reference paragraph	Verdict
Radiated emission from intentional radiators in restricted bands	Subpart C Section 15.205	Comply
AC line conducted emission test	Subpart C Section 15.207	Comply
Test of field strength emission from intentional radiators	“Radiated Emission Limits, Additional Provisions”; Section 15.231.	Comply
Occupied bandwidth	Subpart C section 15.231(c)	Comply


 Electrical & Electronics
Laboratory

17 July 2023


 Name: Eng. Yuri Rozenberg
Position: Head of Branch

 Name: Alexander Konkov
Position: Test Engineer

Measurement uncertainty.

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.

The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

In the following table the uncertainty calculation is given.

Type of disturbance Test description	Calculated uncertainty U_{LAB}
Radiated disturbance electric field strength in a SAR at 3 m distance 30 MHz – 1.0 GHz	±4.32 dB
electric field strength in a FAR at 3 m distance 1.0 – 18 GHz. 18 – 40 GHz.	±4.47 dB ±2.78 dB

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FCC 47 CFR Part 15, Subpart C	Radio Frequency Devices Subpart C – Intentional Radiators
ANSI C63.4: 2009	American National Standard for Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

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2.1. EUT setup and operation:

Test was performed in continuous transmission mode.

The transmitter operated in test mode and transmitted a modulated FSK signal with a random transmission of zero or one.

3. Measurements and derived results

3.1. Location of the Test Site:

Radiated test measurements were conducted in the Anechoic chamber at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv.

3.2. Test condition:

Temperature: 24 °C. Humidity: 53 %. Atmospheric pressure: 1010 mbar.

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3.3. Radiated emission test.

3.3.1. General:

Per FCC Part 15 Subpart C Sections 15.209, 15.231.

- * Initial scans were made using a peak detector but still using the appropriate ANSI IF bandwidth.

3.3.2. Radiated emission measurements:

Preliminary investigation was performed from the lowest radio frequency signal generated in the equipment up to ten harmonic of a carrier frequency.

The final radiated emission measurements were performed in the semi Anechoic chamber at the 3 m test distances. Test was performed with a connected battery.

The EUT was operated in continue transmission mode. The transmitter was installed on a turn - table. Biconilog and Double Ridged Guide antennas were used.

The measurements were performed at frequencies at which the signal level was 10 dB below the limit or less. The levels were maximized by rotating turntable through 360° and changing antenna-to-EUT polarization from vertical to horizontal. The worst case result was noted in tables.

3.3.3. Radiated emission test results:

Final measurements result are presented in tables and plots ## 1 - 5 in section 3.5.

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3.4. Common conditions for operation in the band above 70 MHz.

3.4.1. General:

Per FCC Part 15 Subpart C clause 15.231 (a).

3.4.2. Requirements:

15.231(a) – Transmitter is defined as a part of security system.

15.231(a)(1) – Not applicable. Transmitter is not activated manually.

15.231(a)(2) - Transmission duration is limited by program and after activation is less than 5 second. This transmitter worked as a repeater, received from Tag and advanced further.

15.231(a)(3) - Duration of transmission used for the Transmitter is to transmit the cow tag data is 0.663 second per hour that is less than limited 2 seconds per hour. This transmitter worked as a repeater, received from Tag and advanced further and otherwise - the transfer time is less.

15.231(a)(4) – Transmitter is not designed to use during the emergencies.

15.231(a)(5) – Transmitter doesn't exceed the limits of this section.

3.4.3. Summary:

The verification tests according to 15.231(a) have been done and the EUT was found complies with the requirements of clause 15.231(a).



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3.5. Test of field strength emission from intentional radiator.

3.5.1. General:

Per FCC Part 15 Subpart C clause 15.231(b).

3.5.2. Requirements:

The field strength emissions from intentional radiators operated on this frequency shall comply with the limit based on the average value.

Fundamental Frequency MHz	Calculated Field Strength limit of Fundamental dB μ V/m	Calculated Field Strength limit of Harmonics dB μ V/m
433.92	80.8	60.8

Note: Peak field strength shall not exceed the maximum permitted specified limit by more than 20 dB.

Field strength limits are specified at a distance of 3 meters.

3.5.3. Test procedure:

The test was conducted according to clause 15.231.

3.5.4. Test summary:

The tested unit meets the standard requirement.

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3.5.5. Test results:
Radiated emission result at carrier frequencies.

Freq.	Ant. Pol.	Emission level dBuV/m		Limit 3m dBuV/m		Marging	Verdict
MHz	H/V	Pk	AV	Pk	AV	dB	-
433.919	V	71.75	71.75	100.82	80.82	-9.07	Pass
867.838	V	43.38	43.38	81.9	61.9	-18.52	Pass

* Test was performed in continuous transmission mode in test mode!

For recorded Fundamental frequency result, see plot #1.

For second harmonic frequency result, see plot #2

All received spurious emissions were found below the specified limit.

Founded spurious emissions results presented in tables below.

Unwanted emissions test result.

Freq. kHz	Antenna Height (m)	Turn table Angle (°)	QP. Emission Level (dB μ V/m)	Limit @ 3 m (dB μ V/m)	Margin (dB)	Reference to plot #
514.46	1.0	21	52.378	73.3	>20	3
16.812	1.0	351	33.374	69.5	>20	3

Spurious emission result.

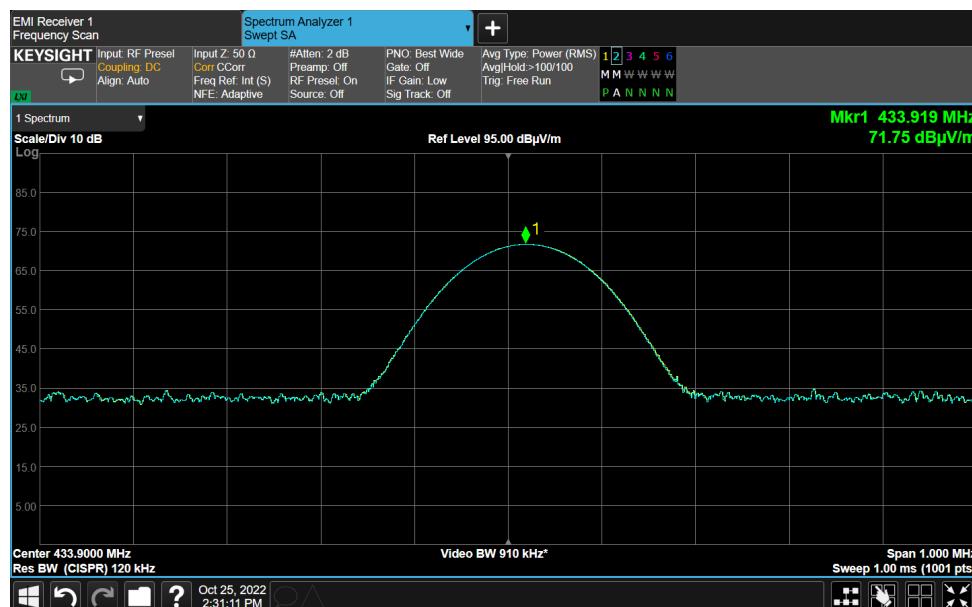
Freq. GHz	Antenna pol. V/H	Peak Ampl dB μ V/m	Peak Ampl limit, dB μ V/m	Margin dB	Avg Ampl. dB μ V/m	Specified @3m limit, dB μ V/m	Margin dB	Ref. to plot #
1.3019	H	45.325	*74.0	>20	37.998	*54.0	16.00	5
1.7704	H	45.220	-	-		60.8	15.58	5
2.1695	H	50.234	-	-	-	60.8	10.56	5
3.3075	H	52.065	-	-	-	60.8	8.73	5
3.4715	H	53.797	-	-		60.8	7.00	5

*Limit 15.205 restricted bands.

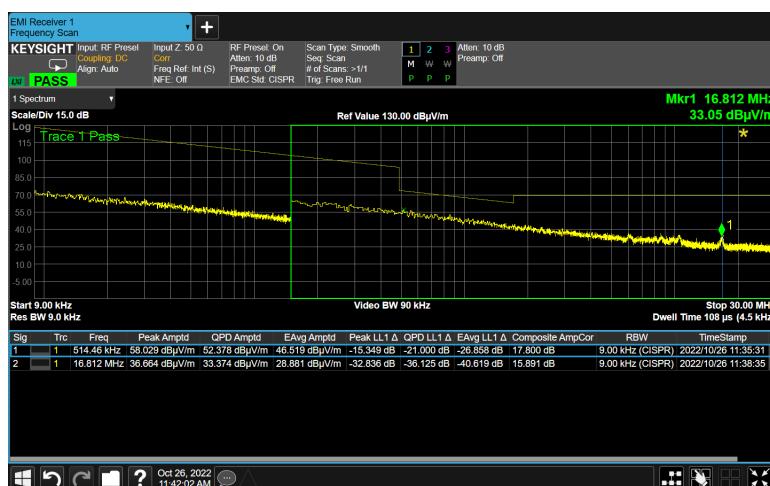
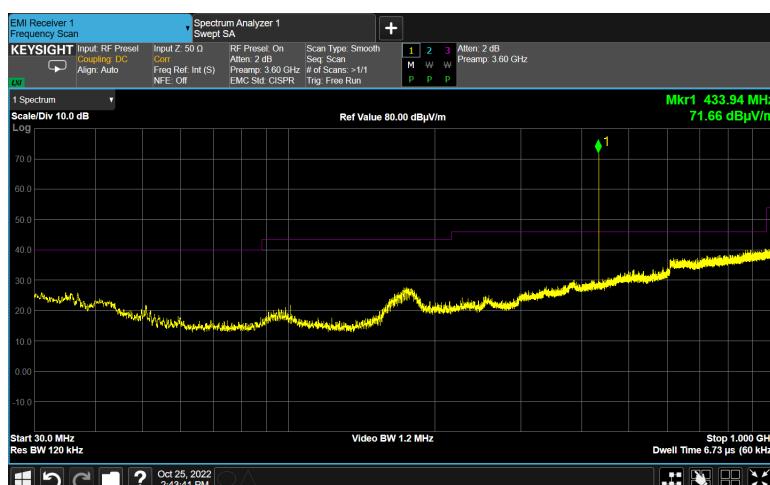
*Frequency range 30-1000MHz not found disturbance emission, see plot #4.

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Fundamental frequency test.


Plot # 1. Carrier frequency 433.92 MHz.

Plot # 2. Second harmonic frequency 867.838 MHz.

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Plot # 3. Emissions scan 9kHz – 30 MHz.

Plot # 4. Emissions scan– 30-1000 MHz.

Plot # 5. Emissions scan 1.0 – 4.5 GHz.

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3.6. Transmission activation.

3.6.1. Requirements:

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

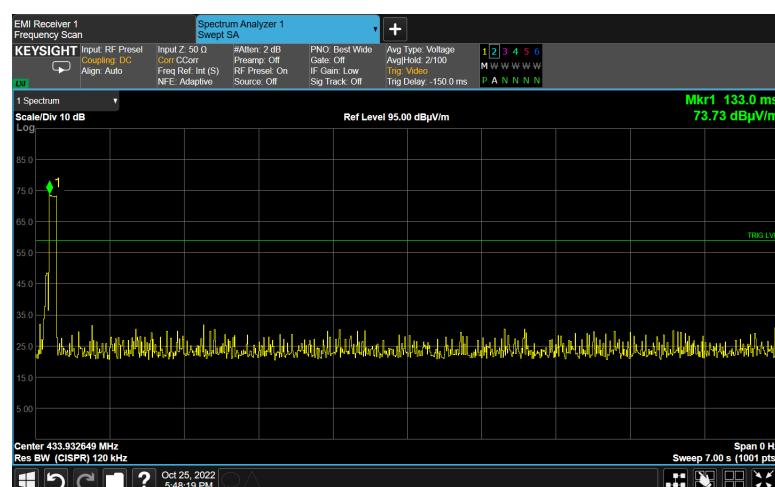
A transmitter activated automatically shall cease transmission within 5 seconds after activation.

3.6.2. Test results:

Test was performed in typical installation transmission mode.

This transmitter worked as a repeater, received from Tag and advanced further. The transmitter transmitted a modulated FSK signal.

Test result presented in plots below.



Plot # 6. Transmission time duration.



Plot # 7

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3.7. Test of occupied bandwidth per 15.231(c)

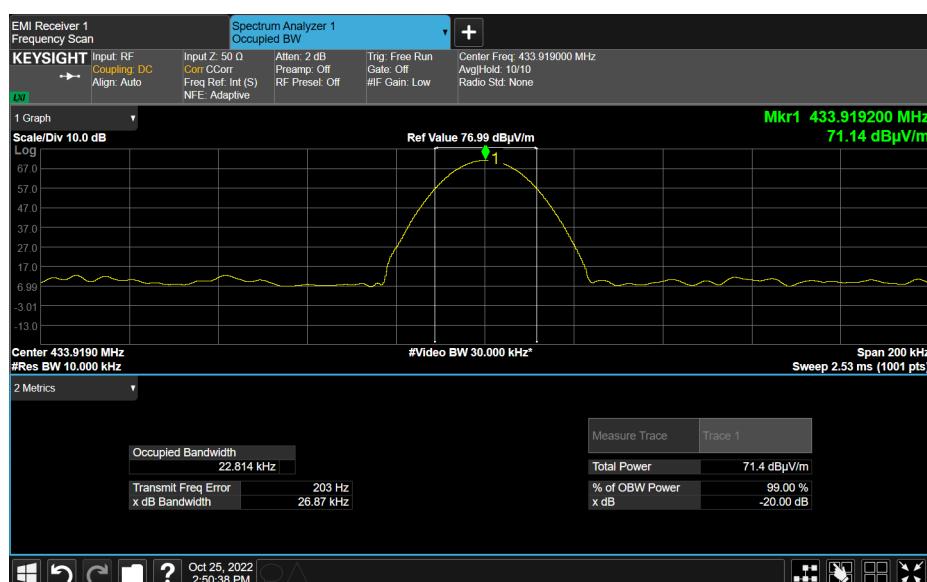
3.7.1. Requirements:

The bandwidth of the emissions shall be no wide than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

For 433.919 MHz center frequency allowed emission bandwidth shall be less than $(433.919/100) 0.25\% = 1.084 \text{ MHz}$.

3.7.2. Test results:

Test result presented in plot below.



3.7.3. Test summary:

Freq. MHz	Meas. Bandwidth kHz	Limit kHz	Verdict
433.9	26.87	Max 1084.8	Pass

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3.8. Conducted emissions test per 15.207(a)

3.8.1. Requirements:

Frequency, MHz	Conducted limit, dB μ V	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5	56	46
5 - 30	60	50

* Decreases linearly with the logarithm of the frequency.

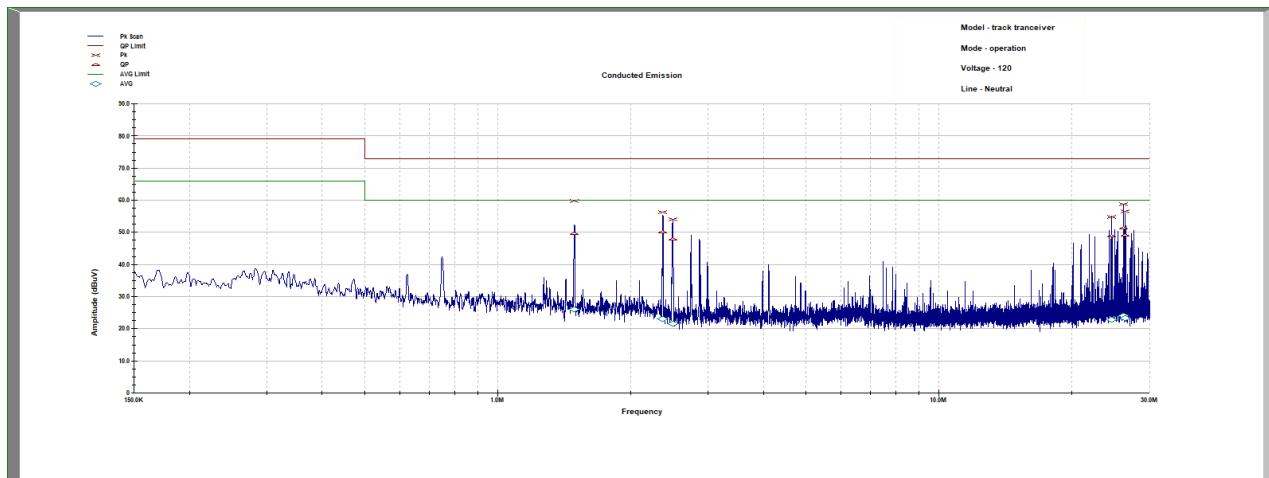
EUT was placed on a wooden table in a shielded chamber at a height of 80 cm from the floor and 40 cm from the vertical reference plane. The measurements were performed at mains terminals by means of LISN, connected to spectrum analyzer in the frequency range as referred to in the table above. The measurements were made with quasi-peak (CISPR) and average detectors. The position of the EUT cables was varied to determine maximum emission level.

3.8.2. Test results:

Test results present in plots # 12 for line Phase and # 13 for line Neutral.

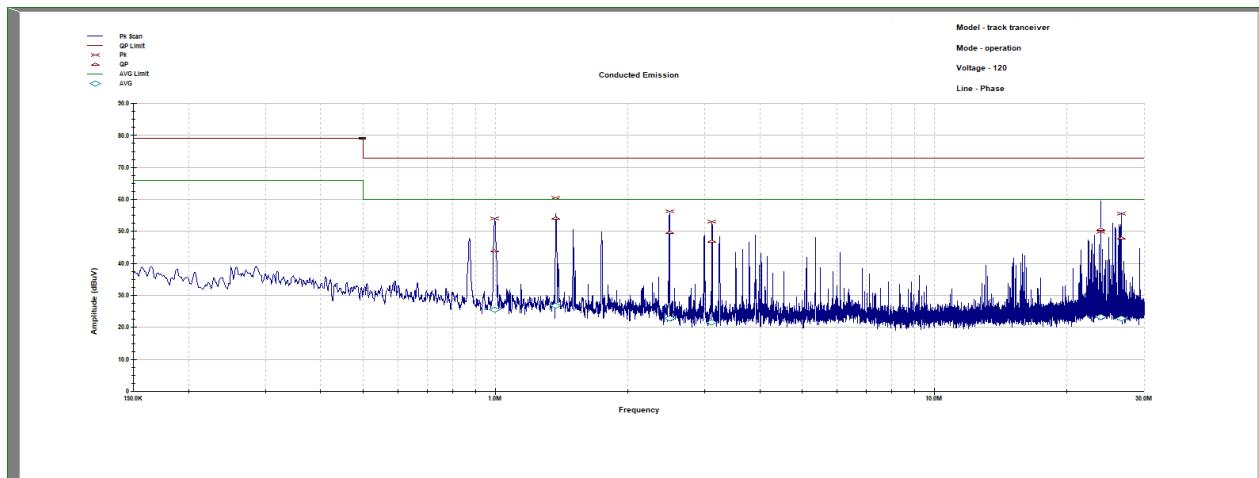
3.8.3. Test summary:

The tested unit meets the standard requirement.

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Plot # 9. 120VAC conducted emissions test. Line PH.

Test results 120VAC conducted emissions test. Line PH.

Frequency (MHz)	Peak (dBuV)	QP (dBuV)	Limit QP (dBuV)	Avg (dBuV)	Limit Avg (dBuV)	Delta QP (dB)	Delta Avg (dB)	Verdict (P/F)
1.493	59.8	49.6	73.0	26.1	60.0	-23.4	-33.9	PASS
2.367	56.2	50.1	73.0	23.0	60.0	-22.9	-37.0	PASS
2.492	54.1	47.9	73.0	21.7	60.0	-25.1	-38.3	PASS
24.666	54.7	48.8	73.0	22.7	60.0	-24.2	-37.3	PASS
26.164	58.8	51.4	73.0	24.0	60.0	-21.6	-36.0	PASS
26.413	56.5	49.1	73.0	23.4	60.0	-23.9	-36.6	PASS

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Plot # 10. 120VAC conducted emissions test Line N.

Test results 120VAC conducted emissions test Line N.

Frequency (MHz)	Peak (dBuV)	QP (dBuV)	Limit QP (dBuV)	Avg (dBuV)	Limit Avg (dBuV)	Delta QP (dB)	Delta Avg (dB)	Verdict (P/F)
0.997	54.1	43.8	73.0	25.5	60.0	-29.2	-34.5	PASS
1.373	60.4	54.1	73.0	26.8	60.0	-18.9	-33.2	PASS
2.491	56.3	49.7	73.0	22.7	60.0	-23.3	-37.3	PASS
3.115	52.9	46.9	73.0	21.5	60.0	-26.1	-38.5	PASS
23.919	49.8	50.5	73.0	23.2	60.0	-22.5	-36.8	PASS
26.664	55.4	47.7	73.0	22.8	60.0	-25.3	-37.2	PASS

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3.9. Antenna requirement

3.9.1. Requirements:

Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section".

3.9.2. Test summary:

This equipment belongs to intentional radiators that must be professionally installed.

* Note: the customer supplied all information.

Conclusion: The unit complies with the requirement of §15.203.

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433MHz Flexible Shaft Antenna TCQ-X-2.15-433-RH771-TNC


Model No. : 433-RH771-TNC

Brand Name : HYS

Country of Origin : China


Product Description

Antenna Electrical Specifications	
FrequencyRange	433MHz
Impedance	50 Ω
VSWR	<1.5
Gain	2.15dBi
Radiation	Omni
Polarization	Vertical
Maximum Power Input-watts	20W
Antenna Mechanical Specifications	
Height	38cm +/- 2cm
Termination	TNC MALE
Radome Material	ABS/Heat Shrink Tube
Radome Color	Black

Photo 2. Antenna

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4. Appendix 1: Test equipment used

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

Instrument	Manufacturer	Model	SII No.	Last calibration date	Next calibration date
EMI RECEIVER-MXE 3Hz-44GHz	Agilent	N9038B	6505208	09/22	09/23
LISN 9 kHz – 30 MHz	Schwarbeck Mess Elektronik	NSLK 8128	6505753	08/22	08/23
Active Receiving Loop Antenna	ETS-Lindgren	6507	00144641	11/20	11/22
Bigonilog Antenna 20 MHz - 6000 MHz	ETS-Lindgren	3142D	146490	10/21	10/23
Double Ridged Waveguide Antenna 1-18 GHz	EMCO	3115	0143138	07/21	07/23
Antenna Broad-Band Horn, 14 GHz - 40 GHz	SCHWARBECK MESS-ELEKTRONIK	BBHA 9170	5854	07/21	07/23
Data +Power splitter	-	-	-	N/A	N/A
Semi Anechoic Chamber	ETS-Lindgren	RFSD-F/A-100	5002	N/A	N/A
Multi-Device Positioning Controller	ETS-Lindgren	2090	5002	N/A	N/A
Antenna Tower	ETS-Lindgren	2175	5002	N/A	N/A
Boresight Antenna Tower	ETS-Lindgren	2171B	5002	N/A	N/A
Turntable	ETS-Lindgren	2188	5002	N/A	N/A
Cable RF 1 m	SUCOFLEX	104PE	21325	04/22	04/23
Cable RF 3 m	VPO 2930	K30K30-5003-300cm5VI	005	04/22	04/23
Cable RF 3 m	VPO 2930	K30K30-5003-300cm6VI	006	04/22	04/23
Cable RF 3 m	VPO 2930	K30K30-5003-300cm7VI	007	04/22	04/23
Cable RF 3 m	VPO 2930	K30K30-5003-300cm8VI	008	04/22	04/23
Attenuator 10dB 5W	-	5W	6502986	04/22	04/23
Attenuator 20dB 5W	-	5W	6502992	04/22	04/23
USB preamplifier 2 GHz – 50 GHz	Keysight	U7227F	MY 55380004	11/20	11/22
Cable	EIM	RG 214/U	8 & 10	01/22	01/23



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5. Appendix 2: Antenna Factor and Cable Loss

Cable Loss (SAC, frequency range: 30 MHz-1.0 GHz)

No.	Frequency (MHz)	Attenuation (dB)	Frequency (MHz)	Attenuation (dB)	Frequency (MHz)	Attenuation (dB)
1	28.71	0.4	97.21	1.0	329.17	1.7
2	30.14	0.4	102.07	1.0	345.63	1.8
3	31.65	0.5	107.17	1.0	362.91	1.8
4	33.23	0.5	112.53	1.0	381.06	1.8
5	34.89	0.5	118.15	1.0	400.11	1.9
6	36.64	0.5	124.06	1.1	420.12	2.0
7	38.47	0.5	130.27	1.1	441.12	2.0
8	40.39	0.6	136.78	1.1	463.18	2.1
9	42.41	0.6	143.62	1.1	486.34	2.1
10	44.53	0.6	150.80	1.1	510.66	2.2
11	46.76	0.6	158.34	1.1	536.19	2.2
12	49.10	0.6	166.26	1.1	563.00	2.4
13	51.55	0.6	174.57	1.2	591.15	2.4
14	54.13	0.7	183.30	1.2	620.70	2.5
15	56.83	0.7	192.46	1.3	651.74	2.6
16	59.68	0.7	202.08	1.3	684.33	2.6
17	62.66	0.7	212.19	1.3	718.54	2.8
18	65.79	0.8	222.80	1.4	754.47	2.9
19	69.08	0.8	233.94	1.4	792.19	2.9
20	72.54	0.8	245.63	1.4	831.80	3.0
21	76.16	0.8	257.92	1.5	873.39	3.2
22	79.97	0.9	270.81	1.5	917.06	3.2
23	83.97	0.9	284.35	1.5	962.92	3.3
24	88.17	0.9	298.57	1.6	1011.06	3.4
25	92.58	0.9	313.50	1.6	--	--



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No.	Frequency (MHz)	Attenuation (dB)	Frequency (MHz)	Attenuation (dB)	Frequency (MHz)	Attenuation (dB)
1	962.92	3.3	1815.72	5.0	3423.81	7.2
2	1011.06	3.4	1906.51	5.1	3595.00	6.8
3	1061.61	3.4	2001.83	5.2	3774.75	7.0
4	1114.70	3.5	2101.92	5.3	3963.49	7.1
5	1170.43	3.7	2207.02	5.4	4161.67	7.6
6	1228.95	3.9	2317.37	5.5	4369.75	7.7
7	1290.4	3.9	2433.24	5.6	4588.24	7.7
8	1354.92	4.0	2554.90	5.9	4817.65	7.8
9	1422.67	4.2	2682.65	5.8	5058.53	8.1
10	1493.80	4.6	2816.78	5.8	5311.46	8.4
11	1568.49	4.7	2957.62	6.3	5577.03	8.6
12	1646.91	4.8	3105.50	6.2	5855.88	9.1
13	1729.26	4.9	3260.77	6.7	6000.00	9.3

Antenna Magnetic Factor
For Antenna Loop ETS LINDGREN Model 6507, SII S/N 00144641,
0.009 MHz to 30 MHz

No.	f / MHz	AF/ dBuA/m	f / MHz	AF/ dBuA/m
1	0.009	-21.2	1.00	-33.7
2	0.01	-22.1	2.00	-33.6
3	0.02	-27.7	3.00	-33.7
4	0.05	-32.1	4.00	-34.0
5	0.075	-33.0	5.00	-34.3
6	0.10	-33.3	10.00	-35.2
7	0.15	-33.5	15.00	-35.8
8	0.25	-33.7	20.00	-36.1
9	0.50	-33.8	25.00	-36.6
10	0.75	-33.8	30.00	-37.0

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Title: RF transceiver
Model: Radio repeater (V2.00)
FCC ID: XBL-TRANSCEIVER
Double Ridged Waveguide Antenna Model Number: 3115 S/N 0143138
Frequency range: 1.0 GHz – 18.0 GHz
3m distance

No.	f / MHz	AF / dB/m	f / MHz	AF / dB/m	f / MHz	AF / dB/m
1	1000	23.6	7000	36.7	13000	39.7
2	1500	25.6	7500	37.3	13500	40.3
3	2000	28.2	8000	37.0	14000	41.0
4	2500	27.8	8500	37.6	14500	41.0
5	3000	29.3	9000	37.8	15000	39.6
6	3500	30.7	9500	38.0	15500	38.8
7	4000	31.8	10000	38.3	16000	39.1
8	4500	32.1	10500	38.6	16500	40.0
9	5000	32.9	11000	38.6	17000	40.9
10	5500	32.9	11500	38.9	17500	42.3
11	6000	34.0	12000	38.8	18000	42.5
12	6500	35.3	12500	38.9	--	--

Antenna Factor

Biconilog Antenna, Model Number: 3142D S/N: 00146488 SII No. 6503046
Frequency range: 30 MHz – 2.0 GHz
3 m distance

No.	f / MHz	ACF / dB/m	f / MHz	AF / dB/m
1	30	22.7	200	16.7
2	35	20.4	250	18.0
3	40	17.8	300	19.8
4	45	15.7	400	22.7
5	50	14.2	500	25.8
6	60	13.0	600	27.4
7	70	13.0	700	28.4
8	80	12.4	800	30.0
9	90	13.3	900	31.3
10	100	14.2	1000	32.8
11	120	13.3	1250	35.8
12	140	13.3	1500	42.9
13	160	14.6	1750	36.1
14	180	16.3	2000	34.6



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Title: RF transceiver

Model: Radio repeater (V2.00)

FCC ID: XBL-TRANSCEIVER

6. Appendix 3: Test setups photo.



Photo 3.



Photo 4.



Photo 5.



Photo 6

End of the document.