



Radio Test Report

Navtech radar Ltd

HDR100 series

HDR100/CIR series, CTS350-X

47 CFR Part 95M Effective Date 1st October 2019

↳ 47CFR part 2J 2019

TNB: Licensed Non-Broadcast Station Transmitter

Test Date: 4th May 2020 to 5th May 2020

Report Number: 05-11243-1-20 Issue 01

R.N. Electronics Ltd.

Arnolds Court
Arnolds Farm Lane
Mountnessing
Essex
CM13 1UT
U.K.

www.RNelectronics.com

Telephone: +44 (0) 1277 352219
Email: sales@RNelectronics.com

This report is not to be reproduced by any means except in full and in any case not without the written approval of R.N. Electronics Ltd.



Arnolds Court, Arnolds Farm Lane, Mountnessing, Brentwood Essex, CM13 1UT

Certificate of Test 11243-1

The equipment noted below has been partially tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of FCC Part 90I. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	HDR100 series
Model Number:	HDR100/CIR series, CTS350-X (antenna types MBP535 and MBP0538-V2.0A)
Unique Serial Number:	CTS350-X-1232-18
Applicant:	Navtech Radar Ltd Home Farm Ardington Wantage Oxfordshire OX12 8PD
Proposed FCC ID	S7Y-MV1K
Full measurement results are detailed in Report Number:	05-11243-1-20 Issue 01
Test Standards:	47 CFR Part 95M Effective Date 1st October 2019 ↳ 47CFR part 2J 2018 TNB: Licensed Non-Broadcast Station Transmitter

NOTE:

Certain tests were not performed based upon manufacturer's declarations. Certain other requirements are subject to manufacturer declaration only and have not been tested / verified. For details refer to section 3 of this report.

DEVIATIONS:

The following tests have not been performed at the request of Navtech Radar Ltd:- Radiated emissions below 110GHz, , Conducted emissions, EIRP, Frequency stability, Modulation frequency response, Modulation limiting, Occupied bandwidth. Results pertaining to these tests can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

This certificate relates only to the unit tested as identified by a unique serial number and in the condition at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of unit not meeting the intentions of the standard or the requirements of the Federal Regulations, particularly under different conditions to those during testing. Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Date Of Test: 4th May 2020 to 5th May 2020

Test Engineer:

Approved By:
Radio Approvals Manager

Customer
Representative:



1 Contents

1	Contents	3
2	Equipment under test (EUT)	4
2.1	Equipment specification	4
2.2	Configurations for testing	5
2.3	Functional description	5
2.4	Modes of operation.....	5
2.5	Emissions configuration	6
3	Summary of test results	7
4	Specifications	8
4.1	Relevant standards	8
4.2	Deviations.....	8
5	Tests, methods and results	9
5.1	Radiated emissions	9
5.2	Conducted emissions	10
5.3	EIRP	10
5.4	Frequency stability	10
5.5	Occupied bandwidth.....	10
5.7	Modulation limiting.....	10
5.8	Modulation frequency response	10
6	Plots/Graphical results	11
7	Photographs.....	12
8	Test equipment calibration list	13
9	Auxiliary and peripheral equipment.....	14
9.1	Customer supplied equipment.....	14
9.2	RN Electronics supplied equipment	14
10	Condition of the equipment tested	15
10.1	Modifications before test	15
10.2	Modifications during test.....	15
11	Description of test sites	16
12	Abbreviations and units.....	17

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Navtech Radar Ltd Home Farm Ardington Wantage Oxfordshire OX12 8PD	
Manufacturer of EUT	Navtech Radar Ltd	
Full Name of EUT	HDR100 series	
Model Number of EUT	HDR100/CIR series, CTS350-X	
Serial Number of EUT	CTS350-X-1232-18	
Date Received	3rd May 2020	
Date of Test:	4th May 2020 to 5th May 2020	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	15th May 2020	
Main Function	FMCW radar.	
Information Specification	Height	400 mm
	Width	248 mm
	Depth	248 mm
	Weight	6 kg
	Voltage	22-25 V DC
	Current	1.2 A
EUT Supplied PSU	Manufacturer	Chinfa Electronics Ind. Co. Ltd
	Model number	AMR5-24
	Serial number	R191011-9601391900225
	Input voltage	100-240 V AC
	Input current	2200 mA
	Output	24 V DC 100 W

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Infrastructure mounted on a dedicated post for example by the side of a motorway or on private land such as an airfield. Alternatively can be used on autonomous vehicles
Choice of model(s) for type tests	Production sample
Antenna details	Two bespoke antennae tested. Gains of 38 dBi and 40 dBi
Antenna port	None
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	77 GHz
Lowest Signal generated in EUT	850 kHz
Hardware Version	Not declared
Software Version	Not declared
Firmware Version	Not declared
Type of Equipment	Radar
Technology Type	FMCW Radar
Geo-location (yes/no)	No
TX Parameters	
Alignment range – transmitter	76-77 GHz
EUT Declared Modulation Parameters	FMCW, 1G00F3N
EUT Declared Power level	47 dBm EIRP $\pm$ 2 dBm
EUT Declared Signal Bandwidths	1 GHz
EUT Declared Channel Spacing's	Single channel
EUT Declared Duty Cycle	Approximately 85 %
Unmodulated carrier available?	No
Declared frequency stability	Not declared
RX Parameters	
Alignment range – receiver	The system uses an integrated transceiver
EUT Declared RX Signal Bandwidth	Not declared
Receiver Signal Level (RSL)	Not declared
Method of Monitoring Receiver BER	Not declared
FCC Parameters	
FCC Transmitter Class	TNB: Licensed Non-Broadcast Station Transmitter

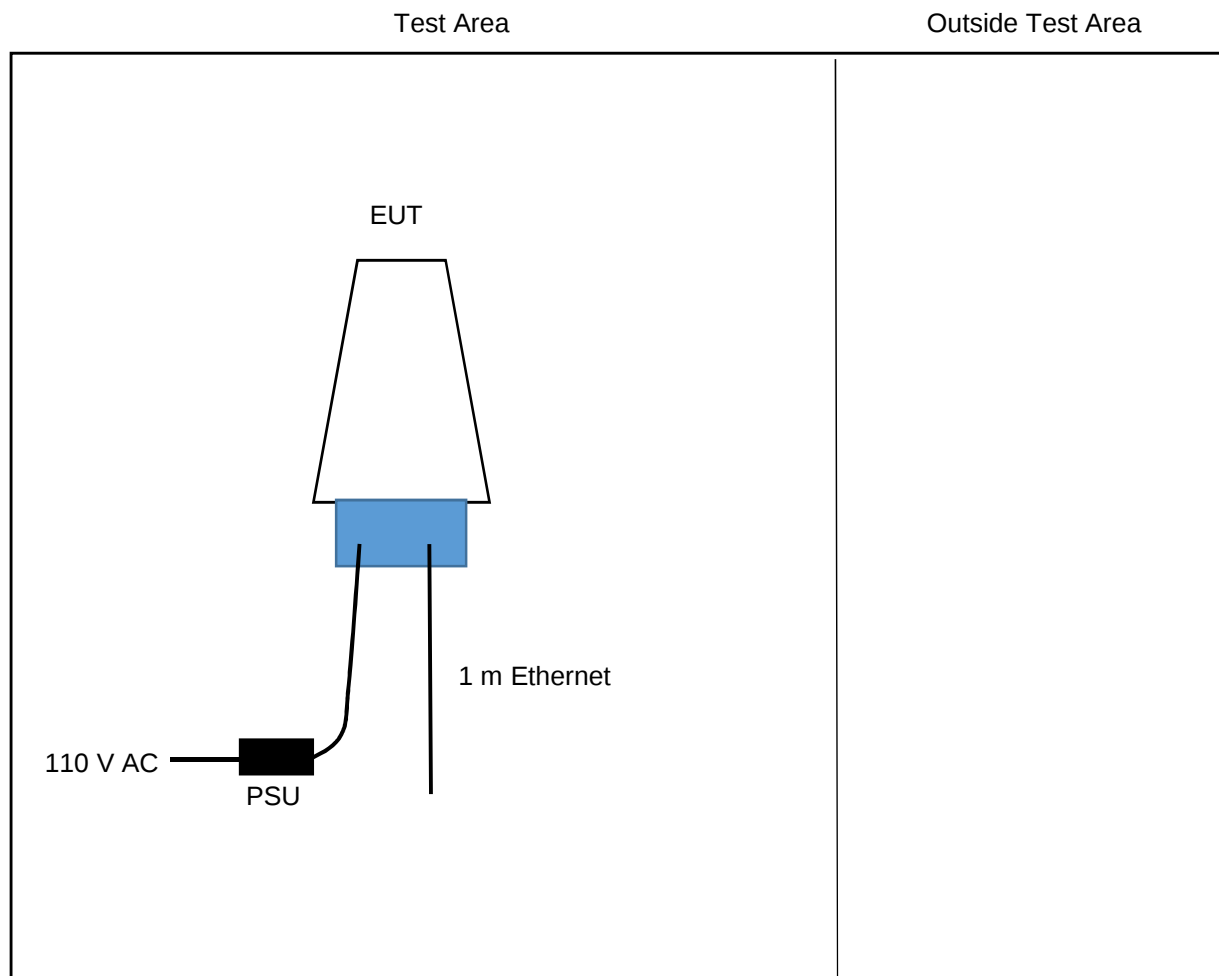
2.3 Functional description

FMCW radar operating in the 76-77GHz range. The unit has a 24V DC supply port and a gigabit Ethernet port for data communications. Ground based FMCW radar for monitoring of area local to the radar to identify both moving and stationary objects for safety applications.

2.4 Modes of operation

Mode Reference	Description	Used for testing
TX1	+47 dBm EIRP, FMCW 76-77 GHz rotating antenna MBP0538-V2.0A	Yes
TX2	+47 dBm EIRP, FMCW 76-77 GHz rotating antenna MBP535	Yes

2.5 Emissions configuration



The unit was powered from 24 V DC from the supplied AC/DC adaptor run from 110 V AC. The unit was in its operational mode from power up with FMCW (76-77 GHz) and the antenna was rotating. Two antenna types were supplied for testing. The transmit mode was approximately 85% duty cycle and the power setting was as stated below:-

Single Channel (76-77 GHz) = +47dBm EIRP

2.5.1 Signal leads

Port Name	Cable Type	Connected
DC power	Round multi pin connector, 4-core cable	Yes
Ethernet	RJ45 connector, CAT5E cable	Yes

3 Summary of test results

The KTS350-X was tested for compliance to the following standard(s) :

47 CFR Part 95M Effective Date 1st October 2019

↳ 47CFR part 2J 2019

TNB: Licensed Non-Broadcast Station Transmitter

Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard or the essential requirements of the directive, particularly under different conditions to those during testing. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Title	References	Results
Transmitter Tests		
1. Radiated emissions	FCC Part 95M Clause 95.3379(a), 47CFR part 2J Clause 2.1053	PASSED ²
2. Conducted emissions	47CFR part 2J Clause 2.1051	NOT TESTED ^{1, 3}
3. EIRP	FCC Part 95M Clause 95.3367, 47CFR part 2J Clause 2.1046	NOT TESTED ^{1, 3}
4. Frequency stability	FCC Part 95M Clause 95.3379(b), 47CFR part 2J Clause 2.1055	NOT TESTED ^{1, 3}
5. Occupied bandwidth	FCC Part 95M Clause 95.3379(b), 47CFR part 2J Clause 2.1049	NOT TESTED ^{1, 3}
6. Modulation limiting	47CFR part 2J Clause 2.1047(b)	NOT TESTED ^{1, 3}
7. Modulation frequency response	47CFR part 2J Clause 2.1047(a)	NOT TESTED ^{1, 3}

¹ Not tested at request of applicant.

² Spectrum investigated 110 GHz to 231 GHz at request of applicant.

³ Results pertaining to these tests can be found in Element Materials Technology Ltd report number TRA-044480-45-00

4 Specifications

The tests were performed and operated in accordance with R.N. Electronics Ltd procedures and the relevant standards listed below.

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	FCC Part 95M	2019	Part 95 - Personal Radio Services - Subpart M – The 76-81 GHz Band Radar Service
4.1.2	47CFR part 2J	2019	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	ANSI C63.26	2015	American National Standard for Compliance testing of transmitters used in Licensed radio services

4.2 Deviations

The following tests have not been performed at the request of Navtech Radar Ltd:-

Radiated emissions below 110GHz, , Conducted emissions, EIRP, Frequency stability, Modulation frequency response, Modulation limiting, Occupied bandwidth. Results pertaining to these tests can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

5 Tests, methods and results

5.1 Radiated emissions

5.1.1 Test methods

Test Requirements: FCC Part 95M Clause 95.3379(a) [Reference 4.1.1 of this report],
47CFR part 2J Clause 2.1053 [Reference 4.1.2 of this report]
Test Method: ANSI C63.26 Clause 5.5 [Reference 4.1.3 of this report]
Limits: FCC Part 95M Clause 95.3379(a) [Reference 4.1.1 of this report]

5.1.2 Configuration of EUT

The EUT was tested in an ALSE and ambient conditions were monitored. The EUT was examined in its declared normal use position. The EUT was operated in TX1 and TX2 modes for this test.

5.1.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Site H. Peak field strength from the EUT was maximised by rotating it 360 degrees. A peak detector was used for final measurements. Measurement distances used were 0.01 m for 110 GHz -140 GHz and 0.03 m for 140 GHz – 231 GHz.

The measuring antenna was used in both Horizontal and Vertical polarisations. Substitution method was performed using standard gain horn antennas.

5.1.4 Test equipment

E329, E562, E577, E714, E719, E720, E721, E722, E748, E755, E760, E771, E777, E781, E908, E941, E942

See Section 8 for more details

5.1.5 Test results

Temperature of test environment	17-18°C
Humidity of test environment	50-53%
Pressure of test environment	102kPa

Setup Table

Band	76-81 GHz
Power Level	47 dBm (EIRP)
Channel Spacing	Single Channel
Mod Scheme	FMCW
Single channel	76-77 GHz

Spurious Frequency (MHz)	Measured Spurious Level (pW/cm ²)	Difference to Limit (dB)	Antenna Polarisation	EUT Polarisation
No spurious emissions were detected within 6 dB of limits				

LIMITS:

Part 95.3379(a), 40-200 GHz, 600 pW/cm² @ 3 m, 200-231 GHz, 1000 pW/cm² @ 3 m

Using equation 26 from ANSI C63.10 the above limits were converted to field strengths of 93.54 dBμV/m @ 3 m and 95.76 dBμV/m @ 3 m respectively.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:

110 – 220 GHz ±5.9dB, 220 – 231 GHz ±6.6dB

5.2 Conducted emissions

NOT TESTED: Not tested at request of applicant. Results pertaining to this test can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

5.3 EIRP

NOT TESTED: Not tested at request of applicant. Results pertaining to this test can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

5.4 Frequency stability

NOT TESTED: Not tested at request of applicant. Results pertaining to this test can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

5.5 Occupied bandwidth

NOT TESTED: Not tested at request of applicant. Results pertaining to this test can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

5.7 Modulation limiting

NOT TESTED: Not tested at request of applicant. Results pertaining to this test can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

5.8 Modulation frequency response

NOT TESTED: Not tested at request of applicant. Results pertaining to this test can be found in Element Materials Technology Ltd report number TRA-044480-45-00.

6 Plots/Graphical results

No plots were required to be taken.

7 Photographs

Photos not included at applicants requests for reasons of confidentiality.

8 Test equipment calibration list

The following is a list of the test equipment used by R.N. Electronics Ltd to test the unit detailed within this report. In line with our procedures, the equipment was within calibration for the period during which testing was carried out.

RN No.	Model No.	Description	Manufacturer	Calibration date	Cal period
E329	8349B	Microwave Amplifier 2-20 GHz	Hewlett Packard	16-Dec-2019	12 months
E562	83555A	Source 33-50GHz	Agilent Technologies	25-Feb-2020	12 months
E577	2511	Attenuator 50-76GHz Rotary	Flann (FMI)	14-Apr-2020	12 months
E714	PM 140_3_1	Frequency Tripler 110-170GHz	Teratech Components Ltd	17-Feb-2020	36 months
E719	-	Horn Std Gain 90-140GHz	-	25-Jul-2019	12 months
E720	28240	Horn Std Gain 90-140GHz	Flann (FMI)	24-Jun-2019	12 months
E721	29240	Horn Std Gain 110-170GHz	Flann (FMI)	28-Apr-2020	12 months
E722	861G/387	Horn Std Gain 140-220GHz	Alpha Industries Inc	25-Jul-2019	12 months
E748	3001iM	AC Power Source 3kVA	California Instruments	17-Feb-2020	12 months
E755	N9030B	PXA 3Hz to 50GHz	Keysight Technologies	11-May-2019	12 months
E760	M05HWDX	Mixer 140-220GHz	OML Inc	25-Jun-2019	24 months
E771	861G/387	Horn Std Gain 140-220GHz WR5	Alpha	28-Apr-2020	12 months
E777	MG3695B	Signal Generator 8MHz - 50GHz	Anritsu	18-Jun-2019	12 months
E781	MX4-15-F	Multiplier 50 - 75GHz X4 WR15	MMWave Group (Quantum)	10-Sep-2019	12 months
E908	00365-60004	Isolator 50-75GHz WR15	Hewlett Packard	10-Jun-2019	12 months
E941	M08HWDX	Mixer 90-140GHz	OML Inc	08-Jul-2019	12 months
E942	-	Cable SMA - SMA ~1m Blue	OML Inc	18-Jul-2019	12 months

Note: E722 Horn, E771 Horn and E760 mixer have been used above the manufacturers recommended operating frequency range. Operation over this extended frequency range has been validated by means of an internal calibration procedure.

9 Auxiliary and peripheral equipment

9.1 Customer supplied equipment

No customer equipment was supplied.

9.2 RN Electronics supplied equipment

RN No.	Model No.	Description	Manufacturer	Serial No
P276	D30 4	PSU 30V 4A	Farnell power supply	179

10 Condition of the equipment tested

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

10.1 Modifications before test

No modifications were made before test by RN Electronics Ltd.

10.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.

11 Description of test sites

Site A	Radio Laboratory and Anechoic Chamber
Site B	Semi-Anechoic Chamber and Control Room FCC Registration No. 293246 IC Registration No. 5612A-4
Site C	Transient Laboratory
Site D	Screened Room (Conducted Immunity)
Site E	Screened Room (Control Room for Site D)
Site F	Screened Room (Conducted Emissions)
Site G	Screened Room (Control Room for Site H)
Site H	3m Semi-Anechoic Chamber (indoor OATS) FCC Registration No. 293246 IC Registration No. 5612A-2
Site J	Transient Laboratory
Site K	Screened Room (Control Room for Site M)
Site M	3m Semi-Anechoic Chamber (indoor OATS) FCC Registration No. 293246 IC Registration No. 5612A-3
Site N	Radio Laboratory
Site Q	Fully-Anechoic Chamber
Site OATS	3m and 10m Open Area Test Site FCC Registration No. 293246 IC Registration No. 5612A-1
Site R	Screened Room (Conducted Immunity)
Site S	Safety Laboratory
Site T	Transient Laboratory

RN Electronics CAB identifier as issued by Innovation, Science and Economic Development Canada is UK0002
RN Electronics CAB identifier as issued by FCC is UK0015.

12 Abbreviations and units

%	Percent	LBT	Listen Before Talk
µA/m	microAmps per metre	LO	Local Oscillator
µV	microVolts	mA	milliAmps
µW	microWatts	max	maximum
AC	Alternating Current	kPa	Kilopascal
ALSE	Absorber Lined Screened Enclosure	Mbit/s	MegaBits per second
AM	Amplitude Modulation	MHz	MegaHertz
Amb	Ambient	mic	Microphone
ATPC	Automatic Transmit Power Control	min	minimum
BER	Bit Error Rate	mm	milliMetres
°C	Degrees Celsius	ms	milliSeconds
C/I	Carrier / Interferer	mW	milliWatts
CEPT	European Conference of Postal and Telecommunications Administrations	NA	Not Applicable
COFDM	Coherent OFDM	nom	Nominal
CS	Channel Spacing	nW	nanoWatt
CW	Continuous Wave	OATS	Open Area Test Site
dB	decibel	OFDM	Orthogonal Frequency Division Multiplexing
dBµA/m	decibel relative to 1µA/m	ppm	Parts per million
dBµV	decibel relative to 1µV	PRBS	Pseudo Random Bit Sequence
dBc	decibel relative to Carrier	QAM	Quadrature Amplitude Modulation
dBm	decibel relative to 1mW	QPSK	Quadrature Phase Shift Keying
DC	Direct Current	R&TTE	Radio and Telecommunication Terminal Equipment
DTA	Digital Transmission Analyser	Ref	Reference
EIRP	Equivalent Isotropic Radiated Power	RF	Radio Frequency
ERP	Effective Radiated Power	RFC	Remote Frequency Control
EU	European Union	RSL	Received Signal Level
EUT	Equipment Under Test	RTP	Room Temperature and Pressure
FM	Frequency Modulation	RTPC	Remote Transmit Power Control
FSK	Frequency Shift Keying	Rx	Receiver
g	Grams	s	Seconds
GHz	GigaHertz	SINAD	Signal to Noise And Distortion
Hz	Hertz	Tx	Transmitter
IF	Intermediate Frequency	V	Volts
kHz	kiloHertz		