



Radio Test Report

Zinwave Ltd

UNlremote

302-1107

47 CFR Part 74H Effective Date 1st October 2014

↳ 47CFR part 2J

Test Date: 28th January 2016

Report Number: 11-8405-4-15 Issue 01

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Certificate of Test 8405-4

The equipment noted below has been partially tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of 47CFR part 74H. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	UNlremote
Model Number:	302-1107
Unique Serial Number:	310400000021
Manufacturer:	Zinwave Ltd Harston Mill, Royston Road Harston, Cambridge CB22 7GG
Full measurement results are detailed in Report Number:	11-8405-4-15 Issue 01
Test Standards:	47 CFR Part 74H Effective Date 1st October 2014 ↳ 47CFR part 2J

NOTE:

The above list is incomplete as only partial tests conducted at request of the manufacturer. For details refer to section 3 of this report.

DEVIATIONS:

The following tests have not been performed at the request of Zinwave Ltd:- Antenna power conducted emissions, Maximum Average conducted output power, Frequency stability, Audio frequency response, Modulation limiting, Occupied bandwidth

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: 28th January 2016

Test Engineer:

Approved By:
Technical Director

Customer
Representative:

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2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Zinwave Ltd Harston Mill Royston Road Harston Cambridge CB22 7GG	
Manufacturer of EUT	Zinwave	
Full Name of EUT	UNlremote	
Model Number of EUT	302-1107	
Serial Number of EUT	310400000021	
Date Received	27th January 2016	
Date of Test:	28th January 2016	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Created	10th February 2016	
Visual Description	Metal enclosure with a fibre port and DC jack port on one end and two N-type antenna ports on the other.	
Main Function	Distributed Antenna system	
Information Specification	Height	268 mm
	Width	220 mm
	Depth	50 mm
	Weight	1 kg
	Voltage	100-240 Vac 50/60 Hz
	Current	1A
EUT Supplied PSU	Manufacturer	XP Power
	Model number	AEB36US12
	Serial number	36120-0018687
	Input voltage	100-240 Vac
	Input current	1 A
	Output	12 Vdc @ 2.5 A

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Fixed - wall mounted
Choice of model(s) for type tests	Production unit
Antenna details	8dBi
Antenna port	External N-type Transmit port and External N-type receive port
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	2180MHz (highest supported radio service)
Lowest Signal generated in EUT	150MHz (lowest supported radio service)
TX Parameters	
Alignment range – transmitter	150 - 2700 MHz
EUT Declared Modulation Parameters	Any, EUT reproduces signal including modulation that is applied to its fibre optic port from the host system it is connected to
EUT Declared Power level	+20dBm max
EUT Declared Signal Bandwidths	CW to 10MHz, EUT reproduces signal including bandwidth that is applied to its fibre optic port from the host system it is connected to
EUT Declared Channel Spacing's	Any, EUT reproduces signal including modulation that is applied to its fibre optic port from the host system it is connected to
EUT Declared Duty Cycle	Any, EUT reproduces signal including Duty cycle that is applied to its fibre optic port from the host system it is connected to
Unmodulated carrier available?	Yes, If a CW signal is applied via the host system
Declared frequency stability	No Frequency translation declared by applicant, EUT is reliant on Host system
RX Parameters	
Alignment range – receiver	150 - 2700 MHz
EUT Declared RX Signal Bandwidth	CW to 10MHz, EUT receives signal including bandwidth that is applied to its Receive port and translates it to a fibre optic signal to pass to the host system it is connected to

2.3 Functional description

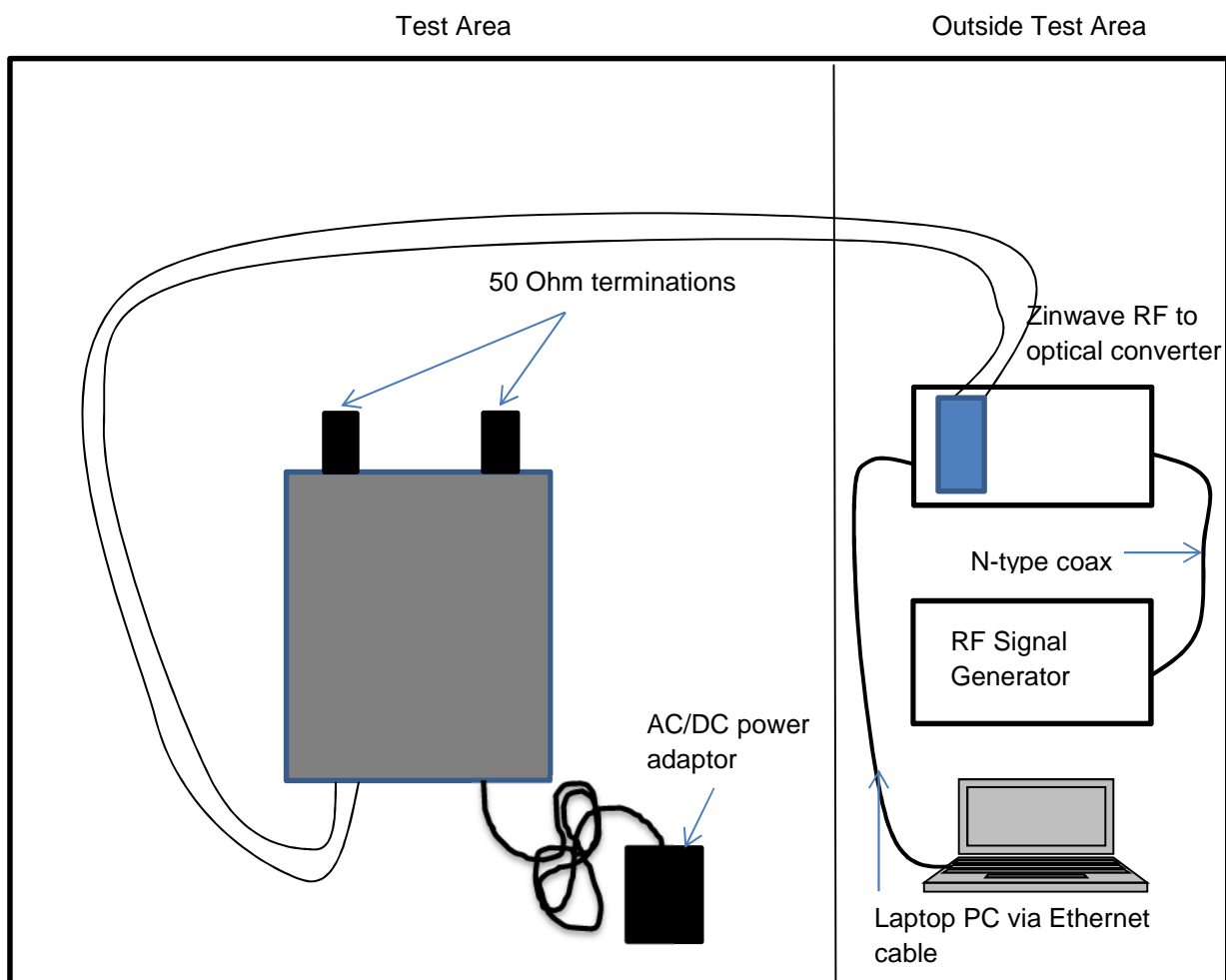
The UNIREMOTE is used with the Zinwave UNIHUB to provide cellular and private radio services within buildings, sports arenas and similar areas. The system is wideband in nature and can support a wide range of radio services depending upon the system that is connected to the service module of the UNIHUB.

2.4 Modes of operation

Mode Reference	Description	Used for testing
Mode 1	EUT repeating constant signal at 470.0125MHz with C4FM (QPSK) modulation	Yes
Mode 2	EUT repeating constant signal at 566MHz with C4FM (QPSK) modulation	Yes
Mode 3	EUT repeating constant signal at 607.9875MHz with C4FM (QPSK) modulation	Yes
Mode 4	EUT repeating constant signal at 614.0125MHz with C4FM (QPSK) modulation	Yes
Mode 5	EUT repeating constant signal at 654MHz with C4FM (QPSK) modulation	Yes
Mode 6	EUT repeating constant signal at 697.9875MHz with C4FM (QPSK) modulation	Yes
Mode 7	EUT repeating constant signal at 566 & 566.025 MHz with C4FM (QPSK) modulation	Yes
Mode 8	EUT repeating constant signal at 654 & 654.025 MHz with C4FM (QPSK) modulation	Yes

Note: This report only pertains to the operation of the equipment to 47CFR part 74H, for details of testing to other rule parts please see RN reports: 11-8405-1-15 Issue 01 (Parts 22E, 22H, 24E)
11-8405-2-15 Issue 01 (Part 27)
11-8405-3-15 Issue 01 (Part 90)

2.5 Emissions configuration



The unit was powered from the dedicated AC/DC adapter supplied with the unit. No conducted tests were required by the client. For radiated emissions testing both the TX and RX ports were populated with 50 ohm loads. The fibre port was connected back to a Zinwave Unihub which in turn was connected to one or two (combined) signal generator outputs when required. The signal generators were set as required to produce signals on the channels under test with the required bandwidths and modulation schemes. The unit was configured at +20dBm maximum output power using the provided laptop and software which was used for all tests. Please refer to section 2.4 of this report for a list of test modes used. All transmit modes were 100% continuous. As the EUT can operate as a single channel enhancer and a multi-channel enhancer tests have been performed for both requirements.

Please refer to Zinwave test plan: SC_ZIN_TP10_A, for further information on test set-up, Channels/frequencies used for test and EUT bandwidths and modulation schemes.

2.5.1 Signal leads

Port Name	Cable Type	Connected
Fibre	Fibre optic	Yes
DC Jack	2 core DC from AC/DC supply brick	Yes
TX port	N-Type, terminated into 50ohms	Yes
RX port	N-Type, terminated into 50ohms	Yes
Ethernet	RJ45 connector to cat 5 cable	No

3 Summary of test results

The UNlremote, 302-1107 was tested for compliance to the following standard(s) :

47 CFR Part 74H Effective Date 1st October 2014

↳ 47CFR part 2J

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. Antenna power conducted emissions	47CFR part 2J Part 2.1051	NOT TESTED ¹
2. Maximum Average conducted output power	47CFR part 2J Part 2.1046	NOT TESTED ¹
3. Frequency stability	47CFR part 2J Part 2.1055	NOT TESTED ¹
4. Occupied bandwidth	47CFR part 2J Part 2.1049	NOT TESTED ¹
5. Radiated emissions	47CFR part 74H Clause 74.861 (e) (6) (iii) 47CFR part 2J Part 2.1053	PASSED ²
6. Audio frequency response	47CFR part 2J Clause 2.1047	NOT TESTED ¹
7. Modulation limiting	47CFR part 2J Clause 2.1047	NOT TESTED ¹

¹ Not tested at request of applicant.

² Spectrum investigated started at a frequency of 30MHz up to a frequency of 7GHz based on 10 times the highest channel of 697.9875MHz.

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	47CFR part 74H	2014	PART 74—EXPERIMENTAL RADIO, AUXILIARY, SPECIAL BROADCAST AND OTHER PROGRAM DISTRIBUTIONAL SERVICES Subpart H - Low Power Auxiliary Stations
4.1.2	47CFR part 2J	2014	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	KDB 971168 D01 v02r02	2014	Measurement Guidance for Certification of Licensed Digital Transmitters
4.1.4	ITU-R SM.329-12	2012	Unwanted emissions in the spurious domain
4.1.5	TIA-603-D	2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards, Telecommunications Industry Association, June, 2010.

4.2 Deviations

Deviations have been applied on the following :

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

Antenna power conducted emissions : Not tested at request of applicant,

Maximum Average conducted output power : Not tested at request of applicant,

Frequency stability : Not tested at request of applicant,

Audio frequency response : Not tested at request of applicant,

Modulation limiting : Not tested at request of applicant,

Occupied bandwidth : Not tested at request of applicant

5 Tests, methods and results

5.1 Antenna power conducted emissions

NOT TESTED: Not tested at request of applicant.

5.2 Maximum Average conducted output power

NOT TESTED: Not tested at request of applicant.

5.3 Frequency stability

NOT TESTED: Not tested at request of applicant.

5.4 Occupied bandwidth

NOT TESTED: Not tested at request of applicant.

5.5 Radiated emissions

5.5.1 Test methods

Test Requirements:	47CFR part 2J Clause 2.1053 [Reference 4.1.2 of this report] 47CFR part 74H Clause 74.861 (e)(6)(iii) [Reference 4.1.1 of this report]
Test Method:	KDB 971168 D01 v02r02 [Reference 4.1.3 of this report], TIA-603-D [Reference 4.1.5 of this report]
Limits:	47CFR part 74H Clause 74.861 (e)(6)(iii) [Reference 4.1.1 of this report]

5.5.2 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. All test modes specified in section 2.4 were tested. As the EUT can operate as a single channel amplifier and a multi-channel amplifier, tests have been performed to satisfy both requirements.

5.5.3 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.

30MHz - 1GHz.

The measuring antenna was scanned 1 - 4m in both Horizontal and Vertical polarisations. Substitution method was performed using tuned dipoles / a calibrated bi-conical antenna. Measurement distance of 3metres was used.

1GHz – 7GHz.

The measuring antenna was used in both Horizontal and Vertical polarisations. Substitution method was performed using standard gain horn antennas. Measurement distances used were: 1 – 6 GHz at 3metres, 6 – 7 GHz at 1.2metres.

The EUT was tested in Site H

5.5.4 Test equipment

E268, E534, E535, LPE261, LPE333, LPE364, E420

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	15°C
Humidity of test environment	48%
Pressure of test environment	102.5kPa

Setup Table

Band	470-608 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	C4FM QPSK
Low channel	470.0125 MHz
Mid channel	566 MHz
high channel	607.9875 MHz

No signals observed within 20dB of emissions limits

Setup Table

Band	614-698 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	C4FM QPSK
Low channel	614.0125 MHz
Mid channel	654 MHz
high channel	697.9875 MHz

No signals observed within 20dB of emissions limits

Setup Table

Band	470-608 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	C4FM QPSK
Channels	566 & 566.025 MHz

No signals observed within 20dB of emissions limits

Setup Table

Band	614-698 MHz
Power Level	20 dBm
Channel Spacing	25 kHz
Mod Scheme	C4FM QPSK
Channels	654 & 654.025 MHz

No signals observed within 20dB of emissions limits

LIMITS:

74.861(e)(iii) On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least $43+10\log_{10}$ (mean output power in watts) dB. -13dBm.

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:
30MHz - 1GHz ± 3.9 dB, 1 – 18 GHz ± 3.5 dB,

5.6 Audio frequency response

NOT TESTED: Not tested at request of applicant.

5.7 Modulation limiting

NOT TESTED: Not tested at request of applicant.

6 Plots/Graphical results

As substitution method is employed for radiated emissions, no plots are required.

7 Photographs

7.1 EUT Front View



7.2 EUT Reverse Angle



7.3 EUT Antenna Ports



7.4 EUT Display & Controls

None.

7.5 EUT Internal photos

No photos taken.

7.6 EUT ID Label

No EUT label supplied.

7.7 30-1000MHz Spurious emissions test set-up



7.8 Above 1GHz Spurious emissions test set-up



7.9 Radiated emission diagram

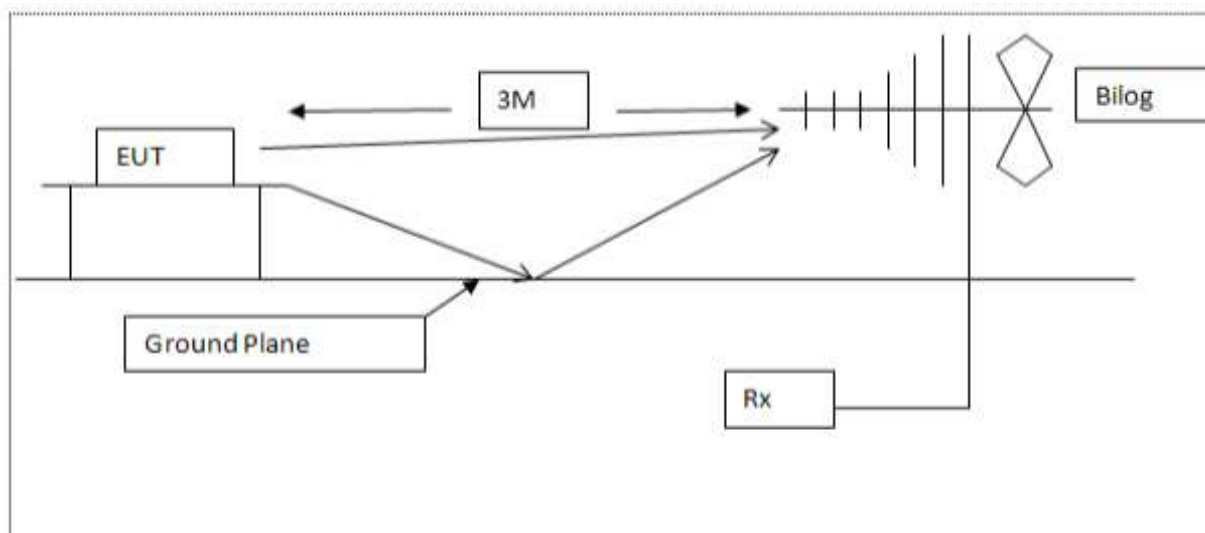


Diagram of the radiated emissions test setup 30 - 1000 MHz

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
E268	BHA 9118	1-18 GHz Horn Antenna	Schaffner	08-Apr-2015	24 months
E420	E4438C	Signal Generator 250 KHz - 3.0 GHz	Agilent	11-Aug-2015	24 months
E534	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	26-Feb-2015	24 months
E535	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	26-Jan-2015	14 months
LPE261	3115	1-18GHz Horn	EMCO	18-Feb-2014	24 months
LPE333	8449B	Pre-amplifier 1GHz - 26.5GHz	Hewlett Packard	29-Jan-2015	24 months
LPE364	CBL6112A	30MHz - 2GHz Bilog Antenna	Chase Electronics Ltd	22-Jan-2016	24 months

9 Auxiliary and peripheral equipment

9.1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
2	302-1001	UNIhub	Zinwave	3.703E+11
3	E4433B	250 kHz-4 GHz signal generator	HP	GB38450326

9.2 RN Electronics supplied equipment

No RN Electronics Ltd supplied equipment was used.

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 / Calibration Laboratory and anechoic chamber

Site B Semi-anechoic chamber

Site B1 Control Room for Site B

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)
VCCI Registration No. C-2823

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 Screened Room

Site K Screened Room (Control Room for Site M)

Site M 3m Semi-anechoic chamber (indoor OATS)
FCC Registration No. 293246

Site Q Fully-anechoic chamber

Site OATS 3m and 10m Open Area Test Site
FCC Registration No. 293246
IC Registration No. 5612A-1
VCCI Registration No. R-2580

Site R Screened Room (Conducted Immunity)

Site S Safety Laboratory

Site T Transient Laboratory

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	decibels	OFDM	Orthogonal Frequency Division Multiplexing
dBµA/m	decibels relative to 1µA/m	ppm	Parts per million
dBµV	decibels relative to 1µV	PRBS	Pseudo Random Bit Sequence
dBc	decibels relative to Carrier	QAM	Quadrature Amplitude Modulation
dBm	decibels 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		