

TEST REPORT NO: RU1250/7053
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FCC ID: T5V01EXEMIC

**REPORT ON THE CERTIFICATION TESTING OF A
REVOLABS INC.
SOLO MICROPHONE UNIT
WITH RESPECT TO
THE FCC RULES CFR 47, PART 15.323(c) & 15.323(e) February 2006
INTENTIONAL RADIATOR SPECIFICATION**

TEST DATE: 12th – 19th June 2006

TESTED BY: _____ D WINSTANLEY

APPROVED BY: _____ P GREEN
EMC PRODUCT
MANAGER

DATE: 19th June 2006

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Notes:	
1. Component failure during test	YES [] NO [X]
2. If Yes, details of failure:	
3. The facilities used for the testing of the product contain in this report are FCC Listed.	
4. The contents of the attached applicants declarations and other supplied information are not covered by the scope of this laboratory's UKAS or FCC accreditations' and is provided in good faith.	

CERTIFICATE OF CONFORMITY & COMPLIANCE

FCC IDENTITY: T5V01EXEMIC

PURPOSE OF TEST: Certification

TEST SPECIFICATION: FCC RULES CFR 47, Part 15.323(c) & 15.323(e) February 2006

TEST RESULT: Compliant to Specification

EQUIPMENT UNDER TEST: Solo Microphone Unit

EQUIPMENT SERIAL No: 279

EQUIPMENT TYPE: UPCS Transceiver

PRODUCT USE: Personal communications

CARRIER POWER: 14.5mW (see TUV Test report DI602355 for measurement)

ANTENNA TYPE: Integral

ALTERNATIVE ANTENNA: Not Applicable

BAND OF OPERATION: 1920 MHz – 1930 MHz

CHANNEL SPACING: Not Applicable

NUMBER OF CHANNELS: 5 frequencies, 6 double time slots per frequency giving 30 channels

FREQUENCY GENERATION: SAW Resonator ☐ Crystal ☐ Synthesiser ☒

MODULATION METHOD: Amplitude ☐ Digital ☒ Angle ☐

POWER SOURCE(s): +110Vac

TEST DATE(s): 12th – 19th June 2006

ORDER No(s): Pro Forma Invoice

APPLICANT: REVOLABS INC.

ADDRESS: 63 Great Rd
Maynard
MA 01754
United States

TESTED BY: _____ D WINSTANLEY

APPROVED BY: _____ P GREEN
EMC PRODUCT
MANAGER

APPLICANT'S SUMMARY

EQUIPMENT UNDER TEST (EUT):	Solo Microphone Unit		
EQUIPMENT TYPE:	UPCS Transceiver		
SERIAL NUMBER OF EUT:	279		
PURPOSE OF TEST:	Certification		
TEST SPECIFICATION(s):	FCC RULES CFR 47, Part 15.323(c) & 15.323(e) February 2006		
TEST RESULT:	COMPLIANT	Yes	[X]
		No	[]
APPLICANT'S CATEGORY:	MANUFACTURER		[X]
	IMPORTER		[]
	DISTRIBUTOR		[]
	TEST HOUSE		[]
	AGENT		[]
APPLICANT'S ORDER No(s):	Pro Forma Invoice		
APPLICANT'S CONTACT PERSON(s):	Mr M Bodley		
E-mail address:	MBodley@maestrolabs.com		
APPLICANT:	REVOLABS INC.		
ADDRESS:	63 Great Rd Maynard MA 01754 United States		
TEL:	+1 (0) 978 897 5655		
FAX:	+1 (0) 978 897 5616		
TEST LABORATORY:	TRL Compliance Ltd		
UKAS ACCREDITATION No:	0728		
TEST DATE(s):	12 th – 19 th June 2006		
TEST REPORT No:	RU1250/7053		

EQUIPMENT TEST / EXAMINATIONS REQUIRED

1.

TEST/EXAMINATION	RULE PART	APPLICABILITY
Monitoring Thresholds	15.323 (c)(2) 15.323 (c)(9)	Yes
Monitoring of Intended Transmit Window and Maximum Reaction Time	15.323 (c)(1)	Yes
Monitoring Bandwidth	15.323 (c)(7)	Yes
Access Criteria Test Interval	15.323 (c)(6)	No note 1
Duration of Transmission	15.323 (c)(3)	Yes
Connection Acknowledgement	15.323 (c)(4)	Yes
Lower threshold Selected Channel, Power Accuracy, Segment Occupancy	15.323 (c)(5)	Yes
Monitoring Antenna	15.323 (c)(8)	Yes
Duplex Connections	15.323 (c)(10)	Yes
Alternative Monitoring Interval for Co-located Devices	15.323 (c)(11)	No note 2
Fair Access to Spectrum Related to (c)(10) & (c)(11)	15.323 (c)(12)	Yes
Frame Period	15.323 (e)	Yes
Note:	1. The solo microphone unit does not transmit control and signalling information. 2. The manufacturer declares that the provisions of CFR47 part 15.323(c)(11) are not used.	

This test report only covers CFR47 part 15.323(c) and CFR47 part 15.323(e). Please refer to TUV test report DI602355 for all other measurement information.

2.	Product Use:	Personal Communications
3.	Duty Cycle:	8.33%
4.	Transmitter bit or pulse rate and level:	2Mbps
5.	Temperatures:	Ambient (Tnom) 22°C
6.	Supply Voltages:	Vnom +110Vac

Note: Vnom voltages are as stated above unless otherwise shown on the test report page

7.	Equipment Category:	Single channel	☐
		Two channel	☐
		Multi-channel	☒
8.	Channel spacing:	Narrowband	☐
		Wideband	☒

9. System Description:

The system is made up of two parts, a fixed part and a portable part. The portable part is a tie mounted microphone about the body. The portable part is powered by an internal rechargeable 3.7Vdc battery. The system is supplied with a charging station for the microphones. The microphones have a jack socket to enable connection of an ear piece. The fixed part constitutes two pairs Radio Fixed Parts (RFPs) and each pair of RFPs having a pair of diversity antennae. The base unit is rack mounted and is powered from 110Vac. The base unit has audio inputs and outputs on the rear and

The system operates in the 1920MHz -1930MHz band. The system use 5 different frequency channels 1.728MHz apart using MC/TDMA/TDD (Multi Carrier / Time Division Multiple Access / Time Division Duplex) using QPSK modulation.

The system employs a 10ms frame, divided into 24 equal timeslots, numbered 0-23. The system uses double-slots only, where a double-slot always begins on an even-numbered slot. The Base station always transmits in the first half of the frame, and the Portable always transmits on the duplex mate in the second half. A physical bearer is composed of a transmit double-slot and a receive double-slot. The two halves of a given bearer are always exactly half a frame (5ms, 12 slots) apart.

During the testing the Solo Microphone Unit was frequency administered to allow operation on only certain channels during the test. The frequency administration was performed using software. The EUT was fitted with a temporary antenna connector to allow measurements to be performed conducted.

MONITORING THRESHOLDS – PART 15.323 (c)(2); (c)(9)

The monitoring threshold calculations are carried out in accordance with ANSI C63.17 sub-clause 7.2.1 using the calculations laid out in ANSI C63.17 sub-clauses 4.3.3 and 4.3.4

Calculation of monitoring threshold limits for isochronous devices:

$$\text{Lower threshold: } T_L = -174 + 10\log_{10}B + M_U + P_{MAX} - P_{EUT} \text{ (dBm)}$$

$$\text{Upper threshold: } T_U = -174 + 10\log_{10}B + M_U + P_{MAX} - P_{EUT} \text{ (dBm)}$$

Where:

B = Emission bandwidth (Hz)

M_U = dBs the threshold may exceed thermal noise (30 for T_L & 50 for T_U)

P_{MAX} = Output Power Limit (dBm)

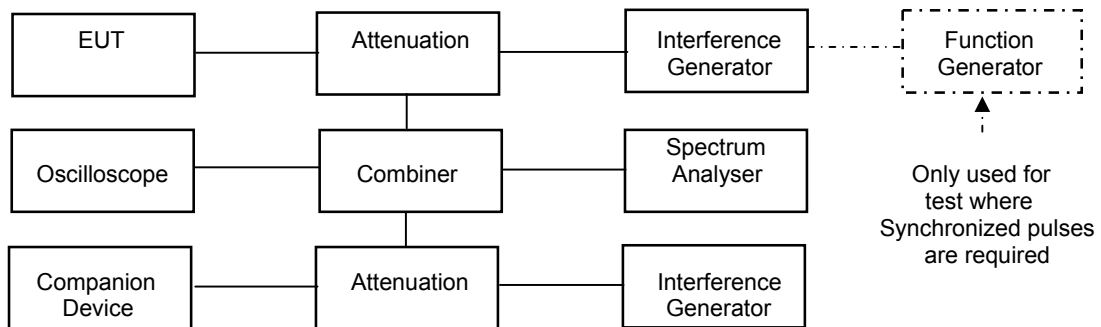
P_{EUT} = Transmitted power (dBm)

Monitor Threshold	B (MHz)	M_U (dB)	P_{MAX} (dBm)	P_{EUT} (dBm)	Threshold (dBm)
T_L	1.46	30	20.8	11.61	-73.2
T_U	1.46	50	20.8	11.61	-53.2

Note: 1. The upper threshold (T_U) is only applicable for systems with a minimum of 40 channels

The monitoring threshold tests are carried out in accordance with ANSI C63.17 sub-clause 7.3 using the test setup 2. The lower threshold level was determined following the procedure as laid out in ANSI C63.17 sub-clause 7.3.1 (a) Frequency administration was used to allow operation on the carrier closest to the centre of the band.

Test Setup 1:



Limits

The EUT must not transmit until the interference level is less than or equal to:

$$\text{Measured Threshold Level} \leq T_L + U_M$$

Where:

T_L = Lower threshold level

U_M = Margin of uncertainty in threshold measurements (6dB)

Results

Monitor threshold	Measured Threshold Level	Limit	Pass/Fail
Lower Threshold (dBm)	-72.2 dBm	-67.2 dBm	Pass
Upper threshold (dBm)	N/A	N/A	Pass

- Notes:
1. The threshold level for the Solo Microphone Unit is set using the 'thr' command as detailed in the document C7490-TM-002.
 2. The value of 'thr' for the purpose of this test was 28 (decimal), it then remained at this level for the rest of the testing

MONITORING OF INTENDED TRANSMIT WINDOW AND MAXIMUM REACTION TIME – PART 15.323 (c)(1)

The monitoring of intended transmit window was carried out in accordance with ANSI C63.17 sub-clause 7.5 using test setup 1. (page 7)

The EUT was frequency administered to only one operating frequency channel and only one of the interference generators in the test setup was utilized. The interference generator was fed pulses from the function generator to produce a pulsed carrier of the specified time length and the output of the interference generator was set to the required level. The pulse generator and companion device were synchronized so the position of the pulses corresponded to the time-slot pattern in the frame of the EUT. The test is performed with the unit frequency administered to operate only on bottom, middle or top frequency.

For each of the required tests the pulse width and interference level are as below:

Test c)

With the interference generator output set at the calculated threshold level (lower) and the width of the pulse interference exceeds the largest of $50\mu\text{s}$ and $50\sqrt{1.25/B}$ μs verify that the EUT does not establish a connection.

Test d)

With the interference generator output set at 6dB above the calculated threshold level (lower) and the width of the pulse interference exceeds the largest of $35\mu\text{s}$ and $35\sqrt{1.25/B}$ μs verify that the EUT does not establish a connection.

Test e)

With the interference generator output set at 10dB above the calculated threshold level (lower) and the width of the pulse interference exceeds the largest of $75\mu\text{s}$ and $75\sqrt{1.25/B}$ μs verify that the EUT does not establish a connection.

Where B = Emission bandwidth of the EUT in MHz

Results

Test Equation (μs)	Pulse Width (μs)	Interferer Level (dBm)	Connection			Pass/Fail
			F _L	F _M	F _H	
$50\sqrt{1.25/B}$	50	Calculated	No	No	No	Pass
$35\sqrt{1.25/B}$	35	Calculated + 6	No	No	No	Pass
$75\sqrt{1.25/B}$	75	Calculated + 10	No	No	No	Pass

MONITORING BANDWIDTH – PART 15.323 (c)(7)

The monitoring bandwidth test was carried out in accordance with ANSI C63.17 sub-clause 7.4 using test setup 1 (page 7).

ANSI C63.17 sub-clause 7.4 states that if the monitoring is made through the radio receiver used by the EUT for communication the intended monitoring bandwidth requirements met.

As declared by the manufacturer the EUT uses the radio receiver used for communication for monitoring the intended monitoring bandwidth therefore requirements of ANSI C63.17 sub-clause 7.4 are met.

DURATION OF TRANSMISSION – PART 15.323 (c)(3)

The duration of transmission test was carried out in accordance with ANSI C63.17 sub-clause 8.2.2 using test setup 1.(page 7) (No interference generators were active during this test).

The time/spectrum window occupied by the connection was monitored using a spectrum analyzer for the spectrum window and an oscilloscope for the time slot. The connection was watched over a period of over 6 hours during this time the access criteria was repeated several times.

Result

Repetition of Access Criteria	Maximum Transmission Time	Maximum Transmission Time Limit	Pass/Fail
First	2 Hours	<8 Hours	Pass
Second	2 Hours	<8 Hours	Pass

CONNECTION ACKNOWLEDGEMENT – PART 15.323 (c)(4)

The connection acknowledgement test was carried out in accordance with ANSI C63.17 sub-clause 8.2.1 using test setup 1. (Page 7)(No interference generators were active during this test).

The test was carried out in two parts. The first was to verify that with the no acknowledgements received from the companion device the EUT does not transmit for more than the limit. The second was to verify that after a connection is broken the EUT terminates its transmission on the current communication channel within 30 seconds or less.

Result

Test	Time Taken (seconds)	Limit (seconds)	Pass/Fail
Transmission on communication channel no acknowledgement received (note 1)	0.206	1	Pass
Established communication channel termination, acknowledgements blocked during communication (note 1)	5.20	30	Pass

- Note:
1. The companion device transmits a beacon signal when acknowledgements are blocked.
 2. The EUT does not transmit a control channel.
 3. See Annex B for Transmission on comms channel no ACK received.
 4. See Annex C for Established communication channel termination plot.

**UPPER THRESHOLD SELECTED CHANNEL, POWER ACCURACY, SEGMENT OCCUPANCY – PART 15.323
(c)(5)**

Least interfered Channel

As this system has less than 40 channels the least interfered channel relating to the lower monitoring threshold shall be assessed. This test was carried out in accordance with ANSI C63.17 sub-clause 7.3.3 using test setup 1.(page 7)

The EUT was frequency administered to operating on two frequencies only, f1 and f2.

f1 = 1924.992 MHz

f2 = 1923.264 MHz

Test b)

Interference on f1 was set at $T_L + U_M + 7\text{dB}$ and at $T_L + U_M$ on f2. Initiate communication. The EUT should transmit on f2. Repeat 5 times. If the EUT transmits on f1 the test is failed.

Test c)

Interference on f1 was set at $T_L + U_M$ and at $T_L + U_M + 7\text{dB}$ on f2. Initiate communication. The EUT should transmit on f1. Repeat 5 times. If the EUT transmits on f2 the test is failed.

Test d)

Interference on f1 was set at $T_L + U_M + 1\text{dB}$ and at $T_L + U_M - 6\text{dB}$ on f2. Initiate communication. The EUT should transmit on f2. Repeat 5 times. If the EUT transmits on f1 the test is failed.

Test e)

Interference on f1 was set at $T_L + U_M - 6\text{dB}$ and at $T_L + U_M + 7\text{dB}$ on f2. Initiate communication. The EUT should transmit on f1. Repeat 5 times. If the EUT transmits on f2 the test is failed.

Result

Test	Transmit on f1	Transmit on f2	Wanted Transmit Channel	Pass/Fail
b	No	No	f2	Pass
c	No	No	f1	Pass
d	No	Yes	f2	Pass
e	Yes	No	f1	Pass

- Note:
1. All tests were repeated 5 times.
 2. Tests b and c are deemed to comply as no transmissions occurred.

Selected Channel Confirmation

This test was carried out in accordance with ANSI C63.17 sub-clause 7.3.4 using test setup 1 (page 7). The test is to ensure the EUT monitors the time/spectrum window immediately prior to transmission.

The EUT was frequency administered to operating on two frequencies only, f1 and f2.

f1 = 1924.992 MHz
f2 = 1921.536 MHz

Test a)

Interference is applied on f1 at a level of $T_L + U_M$. Verify a connection is established on f2.

Any connection is terminated.

Test b)

Interference is applied on f2 at a level of $T_L + U_M$ and immediately removed from f1 and the EUT is immediately caused to attempt transmission. In this case the EUT should transmit on f1

Result

Test	Transmit on f1	Transmit on f2	Wanted Transmit Channel	Pass/Fail
a	No	Yes	f2	Pass
b	Yes	No	f1	Pass

Power Accuracy

The power measurement resolution for the previous comparison must be accurate to within 6dB. The monitoring threshold test covered in Part 15.323 (c)(2) automatically proves that this requirement is met.

Segment Occupancy

This section is not applicable as no units will be located within 1 metre of each other.

MONITORING ANTENNA – PART 15.323 (c)(8)

The antenna of the EUT used for transmitting is the same antenna that is used for monitoring.

DUPLEX CONNECTIONS – PART 15.323 (c)(10)

The tests laid out in this section verify that the access criteria are met by two devices communicating over a duplex connection. The EUT is the initiating device and the companion is the responding device.

These tests are carried out in accordance with ANSI C63.17 sub-clause 8.3.1 using test setup 1 (page7)

Before all tests are carried out any connection is terminated.

Test b)

The system is restricted to operation on one frequency (1923.264 MHz) using administration. Verify that a connection between the EUT and its companion device can be made.

Test c) & d)

Apply interference at a level $T_L + U_M$ to all transmit time slots and to all but one receive time slots.

The EUT should not establish a connection.

Test e) & f)

Apply interference at a level $T_L + U_M$ to all receive time slots and to all but one transmit time slots.

The EUT should not establish a connection.

Result

Test	Connection Made	Correct Time Slot	Required Slot	Pass/Fail
b	Yes	N/A	Any	Pass
c & d	No	N/A	N/A	Pass
e & f	No	N/A	N/A	Pass

ALTERNATIVE MONITORING INTERVAL FOR CO-LOCATED DEVICES – PART 15.323 (c)(11)

This test is carried out in accordance with ANSI C63.17 sub-clause 8.4.

The manufacturer declares that this provision is not utilized by the EUT.

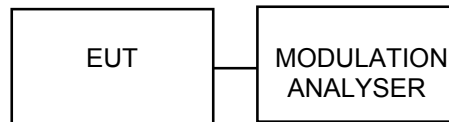
FAIR ACCESS TO SPECTRUM RELATED TO (c)(10) & (c)(11) – PART 15.323 (c)(12)

The provisions of (c)(10) & (c)(11) shall not be used to extend the range of spectrum occupied over space or time for the purposes of denying fair access to the spectrum to other devices.

The manufacturer declares that this device does not work in mode which denies fair access to the spectrum to others.

FRAME PERIOD 15.323 (e)

Frame repetition stability is tested according with ANSI C63.17 sub-clause 6.2.2. Frame period and jitter are tested in accordance with ANSI C63.17 sub-clause 6.2.3. The test setup below is used for the above measurements.



Test Setup 3:

Frame Repetition Stability

This is the mean value of the frame repetition rate recorded over 1000 samples. For devices that divide access in time the repetition rate shall not exceed 10ppm.

Result

Frame Repetition Stability (ppm)	Limit (ppm)	Pass/Fail
0.0	±10	Pass

Frame Period and Jitter

Jitter is the difference in time between the rising edges of consecutive pulses.

Result

Maximum Jitter (µs)	3xSD Jitter (µs)	Frame period (ms)	Limit (µs)		Pass/Fail
			Frame Period (ms)	Jitter (µs)	
0.01	0.03	10.00003	2 or 10/X	±25	Pass

ANNEX A
PHOTOGRAPHS

PHOTOGRAPH No. 1

TEST SETUP



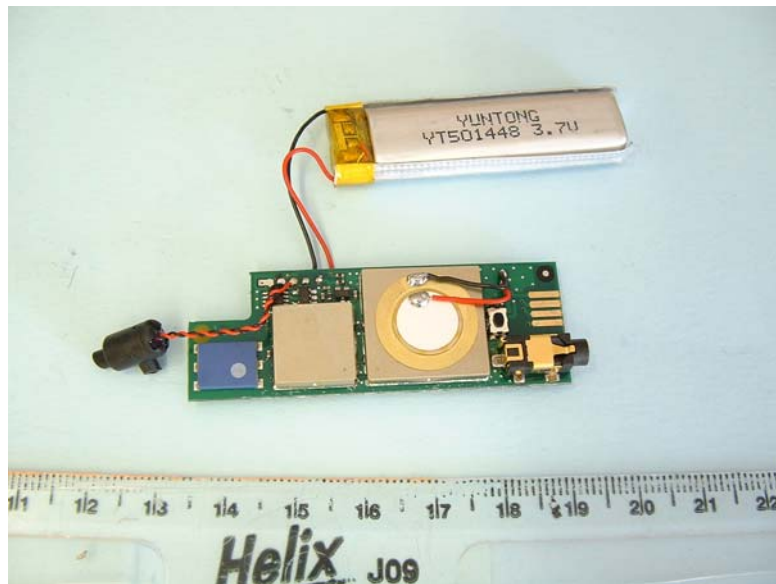


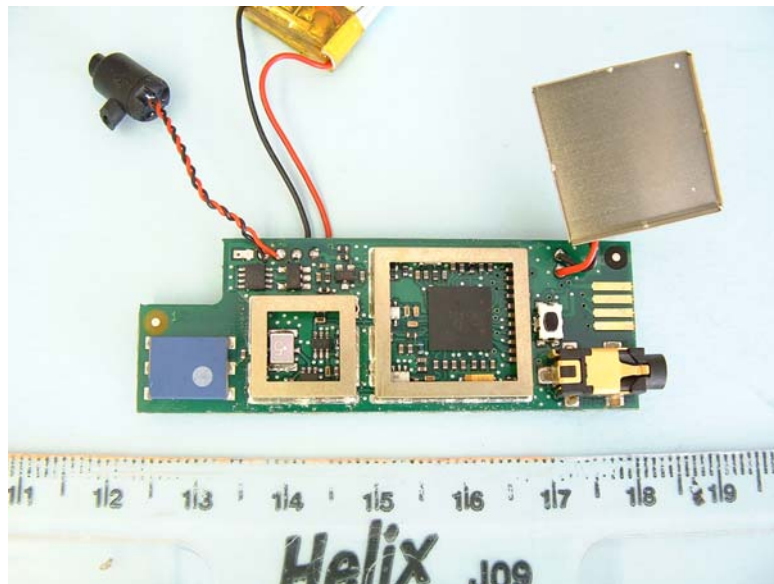
PHOTOGRAPH No. 3 **TRANSMITTER OVERVIEW BACK REMOVED**



PHOTOGRAPH No. 4

MAIN PCB RF SIDE





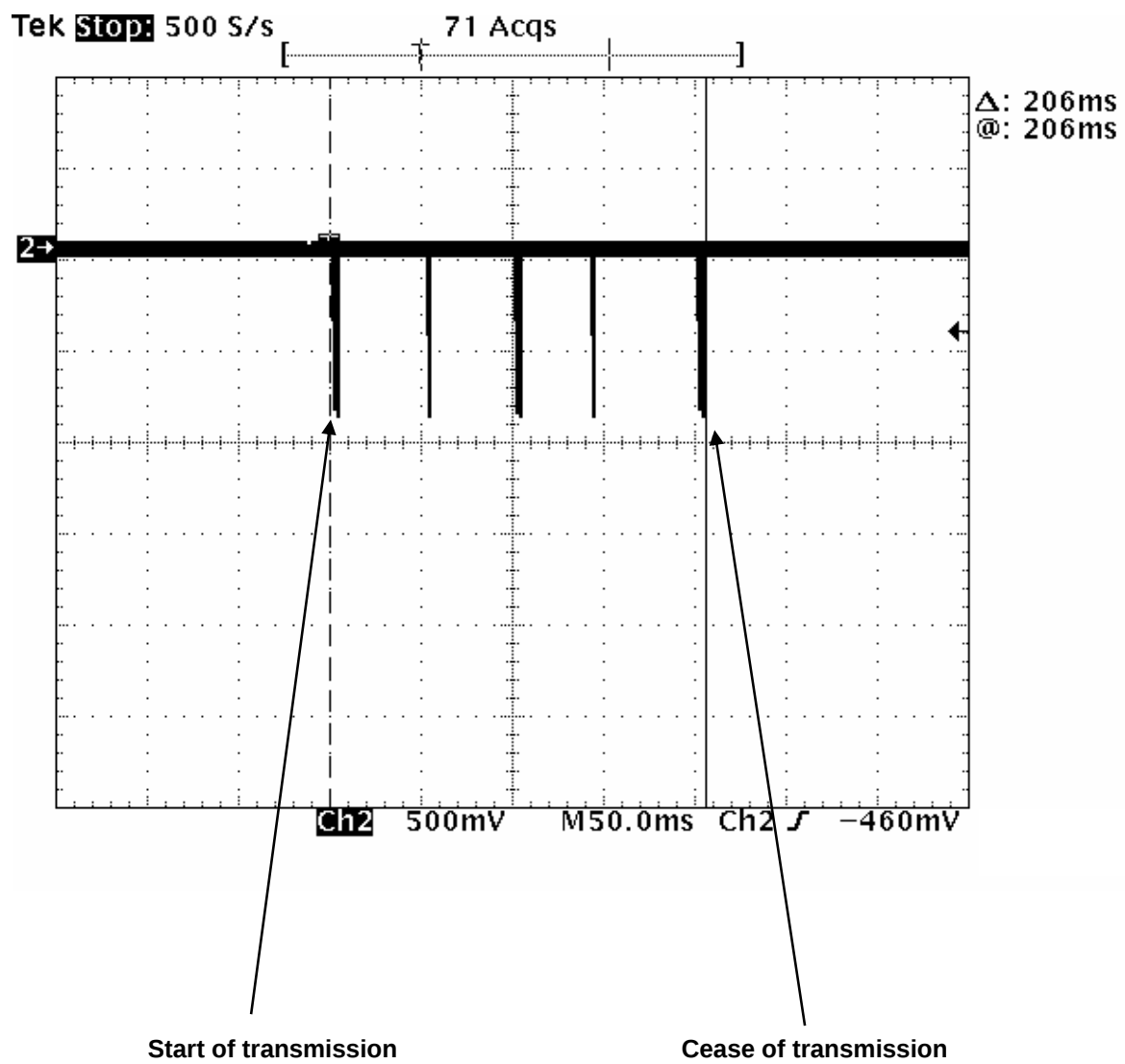
PHOTOGRAPH No. 6

MAIN PCB CONTROL SIDE

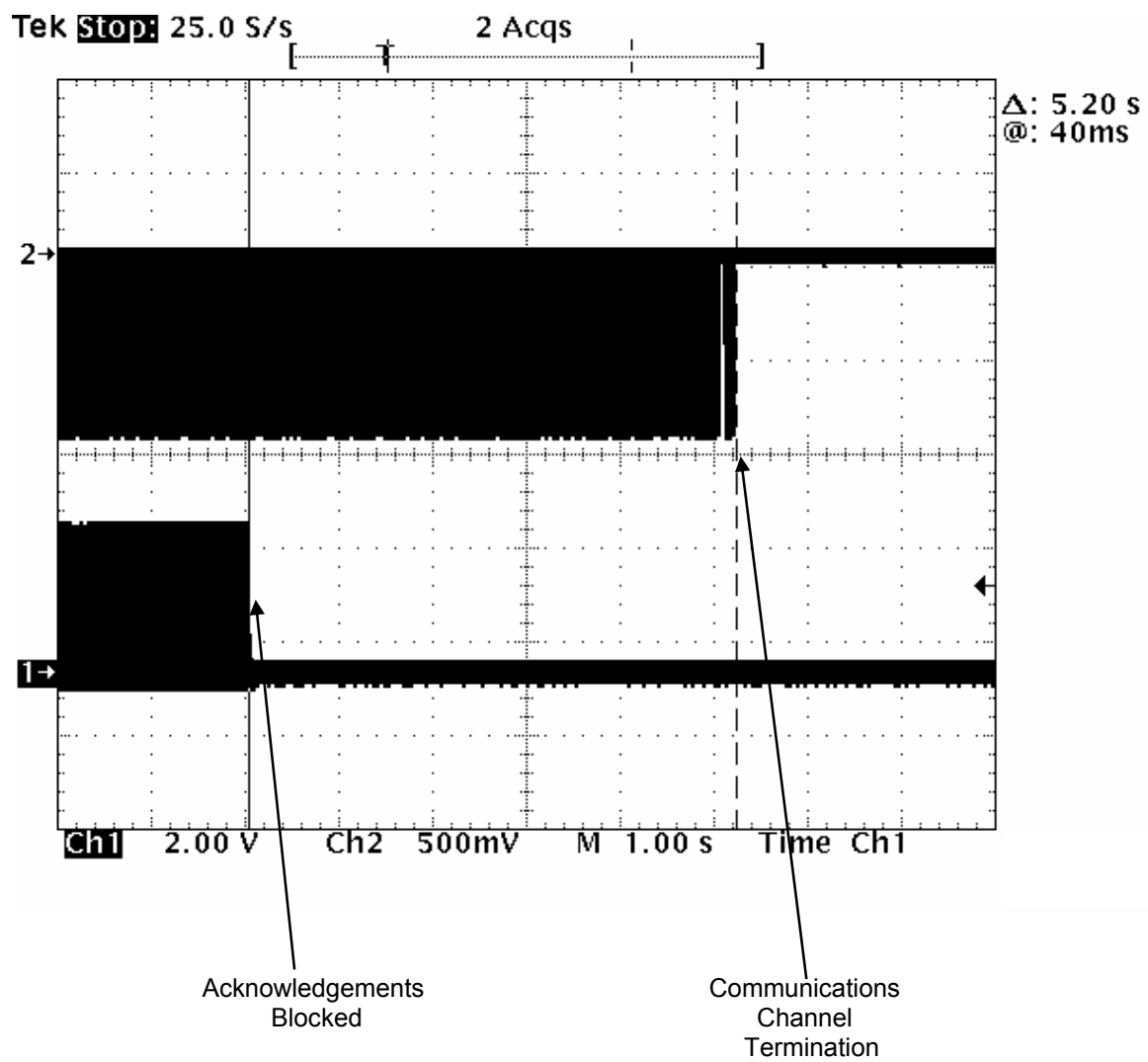


ANNEX B

**TRANSMISSION ON COMMUNICATIONS CHANNEL
NO ACKNOWLEDGMENTS RECEIVED**

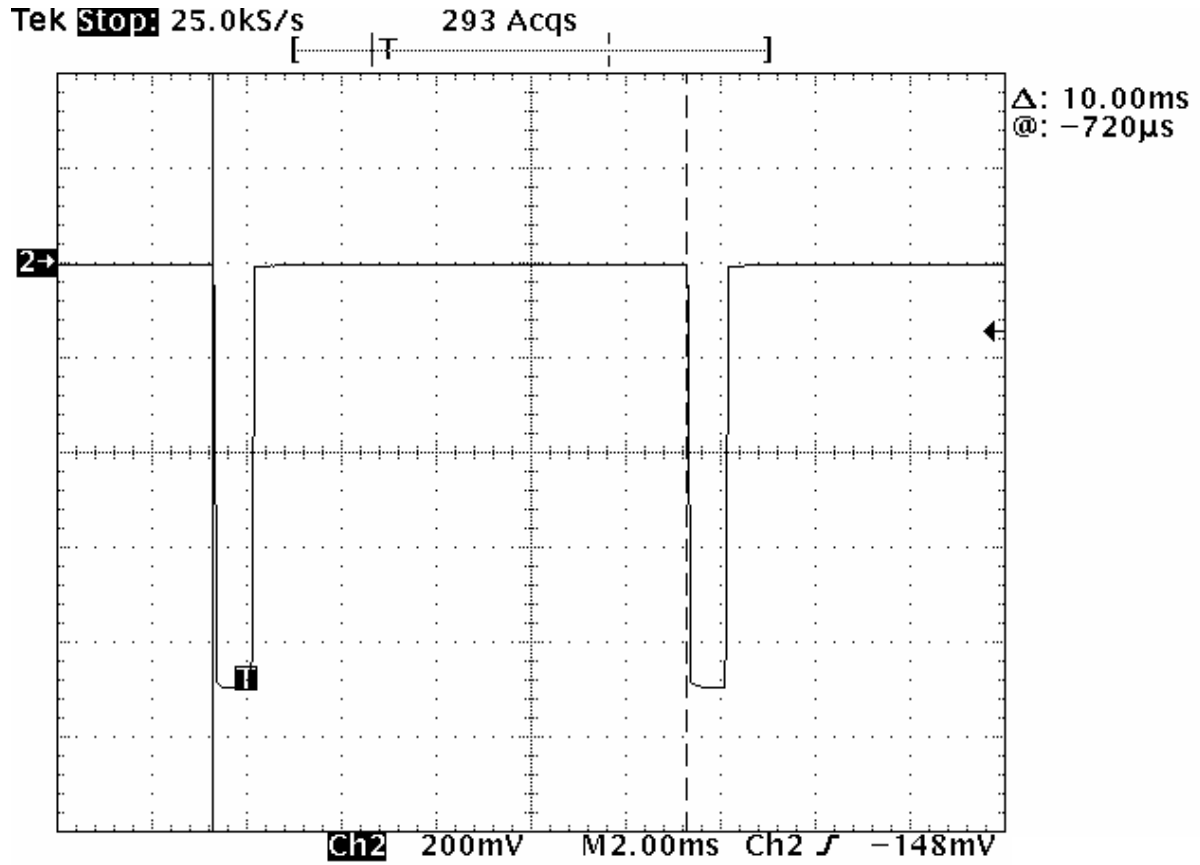


ANNEX C
COMMUNICATION CHANNEL TERMINATION
ACKNOWLEDGMENTS BLOCKED



ANNEX D
FRAME PERIOD

FRAME PERIOD COMMUNICATIONS CHANNEL ACTIVE



ANNEX E
EQUIPMENT CALIBRATION

TRL Number	Equipment Type	Manufacturer	Last Cal Calibration	Calibration Period	Due For Calibration
UH003	Receiver	R&S	22/06/2005	12	22/06/2006
UH005	LISN/AMN	R&S	21/03/2005	12	21/03/2006
UH006	3m Range ERP CAL	TRL	06/01/2006	12	06/01/2007
UH028	Log Periodic Ant	Schwarbeck	28/04/2005	24	28/04/2007
UH029	Bicone Antenna	Schwarbeck	27/04/2005	24	27/04/2007
UH041	Multimeter	AVOmeter	20/12/2005	12	20/12/2006
UH093	Bilog Antenna	Chase	19/08/2005	12	19/08/2006
UH122	Oscilloscope	Tektronix	07/06/2005	24	07/06/2007
UH132	Power meter	Marconi	03/01/2006	12	03/01/2007
UH162	ERP Cable Cal	TRL	06/01/2006	12	06/01/2007
UH177	Power supply	Manson	Use Calibrated Multimeter		
UH186	Receiver	R&S	01/02/2006	12	01/02/2007
UH221	Function Generator	Wavetek	Use Calibrated oscilloscope		
UH228	Power Sensor	Marconi	03/01/2006	12	03/01/2007
UH253	1m Cable N type	TRL	23/02/2006	12	23/02/2007
UH254	1m Cable N type	TRL	05/01/2006	12	05/01/2007
UH271	1m Cable N type	TRL	23/02/2006	12	23/02/2007
UH273	1m Cable N type	TRL	23/02/2006	12	23/02/2007
UH297	Signal Generator	R&S	21/04/2006	12	20/04/2007
L005	CMTA	R&S	05/12/2005	12	05/12/2006
L007	Loop Antenna	R&S	29/03/2005	24	29/03/2007
L011	Temperature chamber	Shartree	Use Calibrated Temperature Indicator		
L119	Combiner	Elcom	Calibrate in use		
L138	1-18GHz Horn	EMCO	15/04/2005	24	15/04/2007
L139	1-18GHz Horn	EMCO	03/05/2005	24	03/05/2007
L170	Combiner	Elcom	Calibrate in use		
L176	Signal Generator	Marconi	15/02/2006	12	15/02/2007
L193	Bicone Antenna	Chase	12/10/2003	24	12/10/2005
L203	Log Periodic Ant	Chase	21/10/2003	24	21/10/2005
L254	Signal Generator	Marconi	04/01/2006	12	04/01/2007
L280	18GHz Cable	Rosenberger	05/01/2006	12	05/01/2007
L343	CCIR Noise Filter	TRL	07/06/2005	12	07/06/2006
L426	Temperature Indicator	Fluke	04/01/2006	12	04/01/2007
L479	Analyser	Anritsu	18/11/2005	12	18/11/2006
L552	Signal Generator	Agilent	25/04/2005	12	25/04/2006
N/A	High Pass Filter	AFL	23/02/2006	12	23/02/2007
N/A	CMD60	R&S			
N/A	Cables	TRL	Calibrate in use		
N/A	Attenuators	TRL	Calibrate in use		
N/A	RF Diode		For information only		

ANNEX F

MEASUREMENT UNCERTAINTY

Radio Testing – General Uncertainty Schedule

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 1.96 to give a 95% confidence where no required test level exists.

[1] Adjacent Channel Power

Uncertainty in test result = **1.86dB**

[2] Carrier Power

Uncertainty in test result (Equipment - TRLUH120) = **2.18dB**

Uncertainty in test result (Equipment – TRL05) = **1.08dB**

Uncertainty in test result (Equipment – TRL479) = **2.48dB**

[3] Effective Radiated Power

Uncertainty in test result = **4.71dB**

[4] Spurious Emissions

Uncertainty in test result = **4.75dB**

[5] Maximum frequency error

Uncertainty in test result (Equipment - TRLUH120) = **119ppm**

Uncertainty in test result (Equipment – TRL05) = **0.113ppm**

Uncertainty in test result (Equipment – TRL479) = **0.265ppm**

[6] Radiated Emissions, field strength OATS 14kHz-18GHz Electric Field

Uncertainty in test result (14kHz – 30MHz) = **4.8dB**, Uncertainty in test result (30MHz – 1GHz) = **4.6dB**, Uncertainty in test result (1GHz-18GHz) = **4.7dB**

[7] Frequency deviation

Uncertainty in test result = **3.2%**

[8] Magnetic Field Emissions

Uncertainty in test result = **2.3dB**

[9] Conducted Spurious

Uncertainty in test result (Equipment TRL479) Up to 8.1GHz = **3.31dB**

Uncertainty in test result (Equipment TRL479) 8.1GHz – 15.3GHz = **4.43dB**

Uncertainty in test result (Equipment TRL479) 15.3GHz – 21GHz = **5.34dB**

Uncertainty in test result (Equipment TRLUH120) Up to 26GHz = **3.14dB**

[10] Channel Bandwidth

Uncertainty in test result = **15.5%**

[11] Amplitude and Time Measurement – Oscilloscope

Uncertainty in overall test level = **2.1dB**, Uncertainty in time measurement = **0.59%**, Uncertainty in Amplitude measurement = **0.82%**

[11] Power Line Conduction

Uncertainty in test result = **3.4dB**