

**COMPLIANCE TESTING REPORT FOR
REMOTE CONTROL THERMOSTAT TRANSMITTER
MODEL NO: SEELEY FREEDOM**

CLIENT:	SEELEY INTERNATIONAL PTY. LTD.
ADDRESS:	1-11 ROTHESAY AVENUE, ST. MARYS, SA 5042
REPORT NUMBER:	05-991-1SA
FILE NUMBER:	05-991SA
DATE OF ISSUE:	22 ND MARCH 2006
TEST STANDARD:	FCC PART 15.231 (E)
RESULT:	COMPLIES
TESTED AND COMPILED BY:	PAUL KAY
	
APPROVED BY:	P. KAY EMC MANAGER
CHECKED BY:	E. NOWAK
Results appearing herein relate only to the sample(s) tested. This report may not be reproduced in any form unless done so in full. Original copies of reports are printed on Austest Laboratories official Test Report letterhead, printed in reflex blue. This report is issued errors and omissions exempt and is subject to withdrawal at Austest Laboratories discretion. This document is copyright by Austest Laboratories with a limited grant of reproduction issued to Austest Laboratories customers subject to the above conditions.	

CONTENTS:

1. Client Information.....	3
2. Equipment Under Test (EUT)	3
2.1 Identification of the EUT	3
2.2 Additional Information about the EUT	3
2.3 Peripheral equipment	3
3. Test Specifications.....	4
3.1 Standard selection and justification	4
3.2 Test Facility.....	4
3.3 Additions to, deviations and exclusions from standards and accreditation	4
3.4 Test equipment.....	5
3.5 References.....	6
4. Labelling Requirements	6
4.1 Equipment and documentation labels	6
4.2 Information to the user	7
5. Test summary	7
6. Modifications.....	7
7. Test results	8
7.1 15.231(a) Transmitter auto-off.....	8
7.1.1 Test Conditions	8
7.1.2 Operation Modes.....	8
7.1.3 Transmitter on-time Test Data	8
7.1.4 Summary	9
7.2 15.231 (b) Radiated Spurious Emissions	10
7.2.1 Test Conditions	10
7.2.2 Operation Modes.....	10
7.2.3 Emissions Data.....	10
7.2.4 Summary	11
7.3 15.231 (c) Occupied Bandwidth	12
7.3.1 Test Conditions	12
7.3.2 Operation Modes.....	12
7.3.3 Bandwidth Data	12
7.3.4 Summary	13
7.4 15.231(e) Transmitter Fundamental Field Strength (automatic operation limits)	14
7.4.1 Test Conditions	14
7.4.2 Operation Modes.....	14
7.4.3 Emissions Data.....	14
7.4.4 Summary	14
7.5 15.209 Receiver Spurious emissions	15
7.5.1 Test Conditions	15
7.5.2 Operation Modes.....	15
7.5.3 Emissions Data.....	15
7.5.4 Summary	15
8. Measurement Uncertainty:	16
9. Photographs.....	17

1. CLIENT INFORMATION

COMPANY: SEELEY INTERNATIONAL PTY. LTD.
1-11 ROTHESAY AVE. ST. MARYS, SA 5042

NAME OF CONTACT: TRIET CHAU

2. EQUIPMENT UNDER TEST (EUT)

2.1 IDENTIFICATION OF THE EUT

EQUIPMENT: 433 MHZ WIRELESS RF REMOTE CONTROL
TYPE/MODEL: REMOTE CONTROL THERMOSTAT FOR EVAPORATIVE COOLER
BRAND NAME: SEELEY
SERIAL NUMBER: NOT MARKED
MANUFACTURER: SEELEY INTERNATIONAL PTY. LTD.

RATING: 3 X 1.5V AAA ALKALINE BATTERIES

2.2 ADDITIONAL INFORMATION ABOUT THE EUT

The transmitter is designed to operate in a hand-held or wall mounted application. The receiver is mounted with the cooling plant, typically located in or on the ceiling of a building.

The system operates by the transmitter sending a data packet to the receiver once every ten minutes in automatic operation, or by edge triggered manual push-button operation (only when the control is adjusted).

The maximum repetition rate in automatic mode is once every two minutes, but this only occurs if the temperature changes during that period. The normal automatic repetition rate is once every 10 minutes.

2.3 PERIPHERAL EQUIPMENT

Defined as equipment needed for correct operation of the EUT, but not included as part of the testing and evaluation of the EUT.

A laboratory DC supply, Trio PR-630 was used to supply power to the receiver during receive spurious emissions tests. No other supporting equipment was required.

3. TEST SPECIFICATIONS

3.1 STANDARD SELECTION AND JUSTIFICATION

FCC Part 15.231 was chosen to demonstrate compliance with the RF requirements of 47CFR Part 15 (FCC), because the Breezair Freedom 433 MHz is a periodic operation transmitter for remote control applications, in accordance with 15.231(e).

3.2 TEST FACILITY

Results reported in this document were performed by Austest Laboratories' South Australian EMC facilities, at the following locations:

Main Laboratory: Unit 3, No. 4 Aristotle Close, Golden Grove, SA 5125
(2.4 x 2.4 x 7.2m screened room, equipped with power and telecommunications line filters.)

Open Area Test Site: Cnr. Fox Creek Road and Lobethal Road, Cudlee Creek
SA 5232
10m OATS, equipped with 360 degree remote control turntable and 6m remote control antenna mast.

Radiated emissions tests are performed at a class C OATS, where some ambients may exceed the limit. The possibility of missing an emission is avoided by performing a pre-scan of the test item in a screened enclosure prior to final OATS measurements.

The EMC laboratory and OATS are listed with the FCC for tests against FCC parts 15 or 18. The registration number is 97015 and the last update was completed on 10th October 2003.

3.3 ADDITIONS TO, DEVIATIONS AND EXCLUSIONS FROM STANDARDS AND ACCREDITATION

No deviations from the prescribed test methods were required.

3.4 TEST EQUIPMENT

item	model no.	cal due
Bi Log Antenna	Schaffner CBL 6141A	Jun-06
coaxial cable (4m)	Suhner RG223/U	Jun-06
coaxial cable (13m)	Suhner RG223/U	Jun-06
coaxial cable (6m)	Suhner RG223/U	Jun-06
RF pre-amp	HP8447E	Jun-06
h/d coax (25m)	Suhner FSJ4-50B	Sep-06
h/d coax (18m)	Suhner FSJ4-50B	Sep-06
OATS	Cudlee Creek 10m range	Nov-06
Attenuator 3dB DC-4GHz	Suhner 6803.17.AC	Jun-06
Digital multimeter	Fluke 111	Oct-06
Spectrum Analyser (9 kHz – 2.9 GHz)	HP8594EM	Dec-05
Spectrum Analyser (2.9-18GHz)	SD 763	Verified on use
EMI Receiver	Schaffner SCR3102	Jan-06
16 A LISN	Electro-Metrics EM7823	Mar-06
Horn antenna	AH Systems SAS571	Feb-06
Horn antenna	AH Systems SAS571	Dec-06
RF amplifier	ZHL-1042J	Sep-06
RF pre-amplifier 28dB (2-28GHz)	RE218	Verified on use

3.5 REFERENCES

DOCUMENT	NAME	ISSUE/AMENDMENTS
Test standard(s)	47CFR Part 15	April 2005
Frequency allocations and radio treaty matters; general rules and regulations	47CFR Part 2	2005
Quality Manual	Austest Laboratory Quality & Operations Manual	Quman11
Equipment and methods of measurement	CISPR 16-1-1 CISPR 16-1-2 CISPR 16-1-3 CISPR 16-1-4 CISPR 16-1-5 CISPR 16-2-1 CISPR 16-2-2 CISPR 16-2-3 CISPR 16-2-4 CISPR 16-3 CISPR 16-4 ANSI C63.4	AS/NZS CISPR 16-1-1:2004 AS/NZS CISPR 16-1-2:2004 AS/NZS CISPR 16-1-3:2004 AS/NZS CISPR 16-1-4:2004 AS/NZS CISPR 16-1-5:2004 AS/NZS CISPR 16-2-1 :2004 AS/NZS CISPR 16-2-2:2004 AS/NZS CISPR 16-2-3:2004 AS/NZS CISPR 16-2-4:2004 AS/NZS CISPR16-3:2004 AS/NZS CISPR16-4:2004 2001
Procedures and Work Instructions	RAD-WI-01	1.2
	SCR-WI-01	1.7

4. LABELLING REQUIREMENTS

4.1 EQUIPMENT AND DOCUMENTATION LABELS

Part 15.19 requires the following label on the device or, if space does not permit on the device, in a prominent location in the instruction manual or on the packaging.

“This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.”

The FCC identifier must be displayed on the device.

Section 2.925 and 2.926 require a label of the following form on the transmitter.
TX FCC ID XXX123.

XXX is the Grantee Code and 123 is the equipment product code.
The receiver label format is RX FCC ID XXX123.

The proposed label is RX FCCID R2E SIA06.

4.2 INFORMATION TO THE USER

The user manual shall include a cautionary note to the user that changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

5. TEST SUMMARY

Austest makes no claim regarding the consistency of production versions of the product.

The results in this report apply only to the sample tested.

RF Tests	Result	Note
Conducted emissions (mains port)	n/a	EUT has no mains port
Transmitter auto-off function 15.231a(1), a(2)	Complies	For manual operation
Radiated spurious emissions 15.231 (b)	Complies	15.205 refers to 15.209 for limits of spurious emissions in restricted bands.
Occupied Bandwidth 15.231 (c)	Complies	-
Occupied Bandwidth 15.231 (d)	n/a	EUT does not operate in the band 40.66-40.7 MHz.
Transmitter EIRP 15.231(e) automatic operation	Complies	For automatic operation only.
Transmitter automatic ON time limit 15.231 (e)	Complies	-
Receiver spurious emissions 15.209	Complies	-

The equipment complies with the relevant requirements of 47CFR Part 15 (April 2005 issue).

6. MODIFICATIONS

No modifications were necessary for the equipment to comply with the requirements of the standard. The equipment was fitted with a 6k2Ω transmitter drive resistor, component designation R109 when submitted for final testing.

7. TEST RESULTS

7.1 15.231(A) TRANSMITTER AUTO-OFF

7.1.1 TEST CONDITIONS

Date of test	16 th Jan 2006
Temperature	26°C
Humidity	33%
Supply Voltage	4.5V dc (battery)
Location	Golden Grove screened room
Test Officer	Paul Kay

Tests were performed with the equipment connected to the spectrum analyser by a coupling antenna. The spectrum analyser was tuned to the centre frequency of the transmitter's emission and set to zero span mode with a sweep time of 10 seconds. The trace was captured and the analyser's marker function was used to determine the duration of transmission.

7.1.2 OPERATION MODES

Exploratory tests were performed with the equipment operating in the following modes:

- (i) Cool/vent
- (ii) Speed down
- (iii) Speed up
- (iv) Drain
- (v) Power on/off
- (vi) Mode
- (vii) Economy
- (viii) Program
- (ix) Auto

The on-air time for the transmitter was the same in each test case.

7.1.3 TRANSMITTER ON-TIME TEST DATA

Parameter	Results	Notes
Periodic transmission frequency	Once every two minutes, maximum	Only when remote control is on
Transmission duration	802.5 msec	For periodic transmissions only
Maximum manual transmission duration	5.575 sec. (6 pulses is the maximum number of pulses that can be produced by the transmitter)	Worst case manual operation (adjusting fan from minimum to maximum speed) Tx automatically turns off even if button is held down

Parameter	Results	Notes
Manual on time	802.5 msec	With DIP code switches set for max duty cycle
Duty cycle (worst case manual operation)	80%	
Pulse repetition frequency (worst case manual operation)	1.000Hz (1000msec total period)	Applicable for manual operation only, relates to a train of 5 pulses
Periodic on time (automatic operation)	802.5 msec	Automatic operation (i.e. normal thermostatic control, when operator is not adjusting controls)
Periodic off time (automatic operation)	120seconds (2 minutes), minimum	
Duty cycle (automatic operation)	0.669%	

7.1.4 SUMMARY

The equipment complies with the requirements of 15.231 (a), when operated in manual mode.

When operated in automatic (normal) mode, the equipment transmits a 802.5 msec pulse (maximum) to the receiver once every two minutes, at most. This operation is not allowed under 15.231(a) but is allowed under 15.231(e) if tighter field strength limits are met. Section 7.4 demonstrates that these limits are met.

In particular,

- (1) manual de-activation of the transmitter occurs within 5 seconds of releasing any switch on the remote control. (Actual on-air time is less than 802.5msec, depending on when the switch is released.)
- (2) Automatic transmissions are limited to 802.5msec, once every 2 minutes, at most.
- (3) Automatic operation in a stable temperature environment is limited to 802.5msec, once every ten minutes. Transmissions are only made more frequently if the temperature is changing rapidly.

7.2 15.231 (B) RADIATED SPURIOUS EMISSIONS

7.2.1 TEST CONDITIONS

Date of test	10 th Jan 2006
Temperature	24°C
Humidity	58%
Supply Voltage	4.7V dc (battery)
Location	Cudlee Creek OATS (10m)
Test Officer	Paul Kay

Radiated emissions tests were performed in accordance with ANSI C63.4, on a 10m reflective-ground plane OATS (below 2000 MHz). When necessary, closer ranges were used to ensure the measurement system had sufficient sensitivity to determine compliance. A spectrum analyser with peak detection and a 1MHz bandwidth was used to capture spurious emissions in the range above 2000MHz and calibration was achieved using RF substitution.

7.2.2 OPERATION MODES

Exploratory tests were performed with the equipment operating in the following modes:

- (i) tabletop orientation
- (ii) wall mount orientation
- (iii) edge-on hand-held operation

Final tests were performed with the equipment operating in mode (ii). Internal modulation was used and peak readings were recorded. The high duty cycle of the transmitter during each 802.5msec packet causes the CISPR QP detector to produce the same result as the peak detector.

7.2.3 EMISSIONS DATA

Table 3: Radiated spurious emissions (transmitter) (3m range)

Frequency (MHz)	Polarisation	Measured Field Strength dBµV/m at 10m	Equivalent (µV/m at 3m)	FCC 15.231 (e) Limit (µV/m at 3m) (average)	Pass Margin (µV/m)
876	V	31.02 (pk)	115 (pk)	440	325
1301.63	H	<37.8 (pk)	< 245 (pk)	500	> 255
1735.506	V	<34.0 (av)	< 159 (av)	500	> 341

Table 4: Radiated spurious emissions (transmitter) (1.0m range)

Frequency (MHz)	Polarisation	Measured Field Strength dB μ V/m at 1.0m (average)	Equivalent (μ V/m at 3m) (peak)	FCC 15.231 (e) Limit (μ V/m at 3m) (average)	Pass Margin (μ V/m)
2169.6	V/H	< 41.5	< 37.6	500	> 462.4
2603.52	V/H	< 41.5	< 37.6		> 462.4
3037.44	V/H	< 42.5	< 42.2		> 457.8
3471.36	V/H	< 43.5	< 47.3		> 452.7
3905.28	V/H	< 45.5	< 59.6		> 440.4
4339.2	V/H	< 45.5	< 59.6		> 440.4

7.2.4 SUMMARY

The equipment complies with the radiated spurious limits of 15.231 (b), substituted by the tighter limits of 15.231 (e), or the general radiated spurious limits of 15.209 as referenced by 15.231(b) (2) via 15.205, for all frequencies in the range 30-5000MHz.

7.3 15.231 (C) OCCUPIED BANDWIDTH

7.3.1 TEST CONDITIONS

Date of test	16 th Jan 2006
Temperature	26°C
Humidity	33%
Supply Voltage	4.5V dc (battery)
Location	Golden Grove Laboratory
Test Officer	Paul Kay

Occupied bandwidth emissions tests were performed in accordance with ANSIC63.4, clause 13.1.7. The spectrum analyser resolution bandwidth was 100 kHz (3dB bandwidth), which exceeds the C63.4 requirement. The trace was set to maximum hold and allowed to build up over several manual transmission actions. The transmitter was manually activated and coupled to the spectrum analyser via a coupling antenna for this test.

7.3.2 OPERATION MODES

Final tests were performed with the equipment operating in manual transmit mode using internal modulation with code switches set to all ones. A series of manual transmissions was made by reducing the fan speed setting from maximum to minimum.

7.3.3 BANDWIDTH DATA

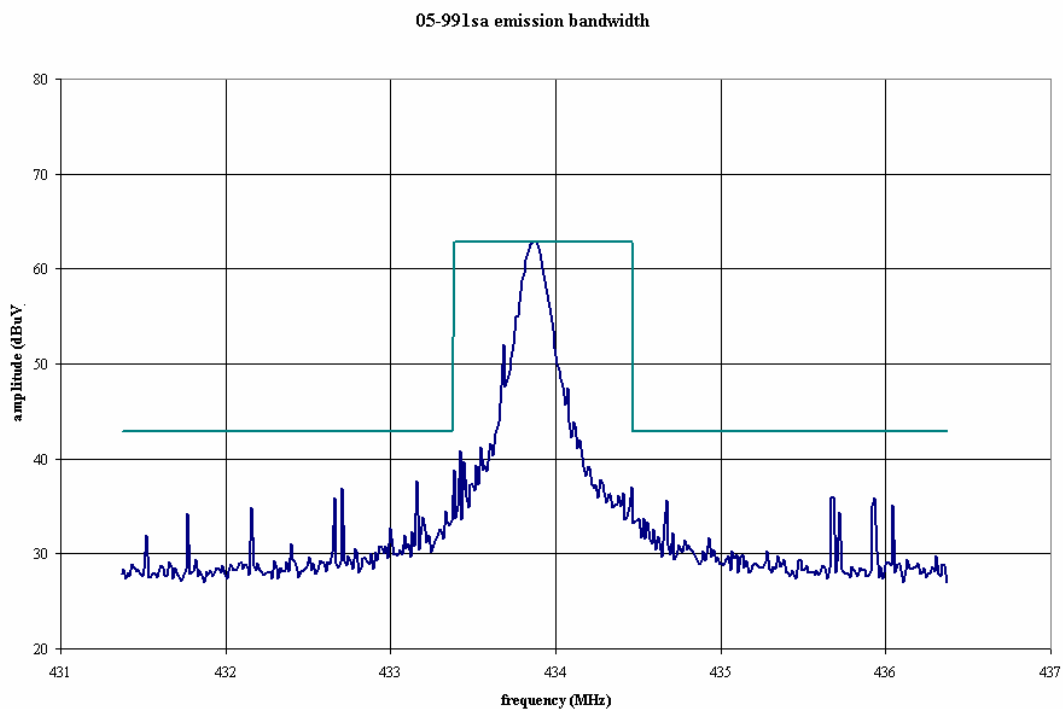
The allowed bandwidth under 15.231(c) is $\leq 0.25\%$ of the centre frequency, f_o .

$$f_o = 433.92 \text{ MHz (central peak of emitted spectrum)}$$

$$0.25\% f_o = 1.0848 \text{ MHz}$$

The measured -20dBc frequencies were 433.645 MHz and 434.1325MHz; the bandwidth was calculated as 0.4875 MHz.

Figure 1: Breezair Remote emitted spectrum (max hold) – $0.25\%f_0$ –20dBc mask shown.



7.3.4 SUMMARY

The equipment complies with the occupied bandwidth requirement of the standard.

7.4 15.231(E) TRANSMITTER FUNDAMENTAL FIELD STRENGTH (AUTOMATIC OPERATION LIMITS)

7.4.1 TEST CONDITIONS

Date of test	10 th Jan 2006
Temperature	21-26°C
Humidity	33-41%
Supply Voltage	4.6V dc (fresh batteries)
Location	Cudlee Creek OATS 10m
Test Officer	Paul Kay

Radiated emissions tests for EIRP and spurious emissions were performed in accordance with ANSI C63.4 clause 13.1, on a 10m reflective-ground plane OATS (below 1000 MHz). At frequencies above 1000 MHz, closer ranges were used to ensure the measurement system had sufficient sensitivity to determine compliance.

The limits are expressed in terms of average values. Unless otherwise stated, peak detector measurements were performed and reported. This was done to detect the worst case ASK modulation, with the code dip-switches set to all ones. Exploratory tests confirmed that the CISPR QP detector produced the same results as the peak detector during a 802.5msec transmission under these conditions.

7.4.2 OPERATION MODES

Tests were performed by repeatedly transmitting cool on/cool off commands. No significant change in field strength was observed in the measurement result when other commands were used to initiate transmission.

7.4.3 EMISSIONS DATA

Table 5: Fundamental maximum field strength (10m range).

Frequency (MHz)	Polarisation	Measured Field Strength dBµV/m at 10m (peak)	Equivalent (µV/m at 3m) (peak)	FCC 15.231 (e) Limit (µV/m at 3m) (average)	Pass Margin (µV/m)
433.8760	V	62.8	4370	4394.3	24.3
433.8760	H	54.0	1580	4394.3	2814.3

7.4.4 SUMMARY

The EUT complies with the maximum power requirements for part 15 transmitters described in 15.231 (e). Refer to section 7.2 for Tx spurious data.

7.5 15.209 RECEIVER SPURIOUS EMISSIONS

7.5.1 TEST CONDITIONS

Date of test	3 rd Feb 2006
Temperature	21-26 deg C
Humidity	30-50%
Supply Voltage	4.8V dc supply
Location	Golden Grove Laboratory
Test Officer	Paul Kay

As discussed in section 3.2, OATS measurements, where applicable, were performed after an initial scan in a screened room at close range. Radiated emissions tests for EIRP and spurious emissions are performed in accordance with ANSI C63.4 clause 13.1, on a 10m reflective-ground plane OATS (below 1000 MHz). At frequencies above 1000 MHz, closer ranges were used to ensure the measurement system had sufficient sensitivity to determine compliance.

7.5.2 OPERATION MODES

Exploratory tests were performed with the equipment operating in the following modes:

- (i) Receive ON, awaiting incoming signal
- (ii) Receive ON, in presence of signal from Tx

Final tests were performed with the equipment operating in mode (i) because tests in mode (ii) showed no spurious emissions that could not be attributed to the transmitter. It was deduced that the receiver (local oscillator in particular) was not producing spurious emissions whilst receiving a signal.

7.5.3 EMISSIONS DATA

The receiver did not produce any emissions within 10 dB of the applicable limits. Preliminary measurements at 0.5m in a shielded enclosure detected no emissions above the measurement system noise floor.

7.5.4 SUMMARY

The EUT complies with the spurious emissions requirements of part 15.

8. MEASUREMENT UNCERTAINTY:

Measurement uncertainties for emission tests have been calculated in accordance with CISPR16-4.

Uncertainties quoted in this report are 95% confidence intervals, calculated with coverage factor $k=2$ and 30 degrees of freedom.

Radiated emission measurement uncertainty in the range 30 –1000 MHz is estimated as better than ± 5.2 dB.

Transmitter on-time resolution was 25msec.

Occupied bandwidth frequency resolution was 12.5 kHz.

9. PHOTOGRAPHS

Photo 1: EUT identification (front)

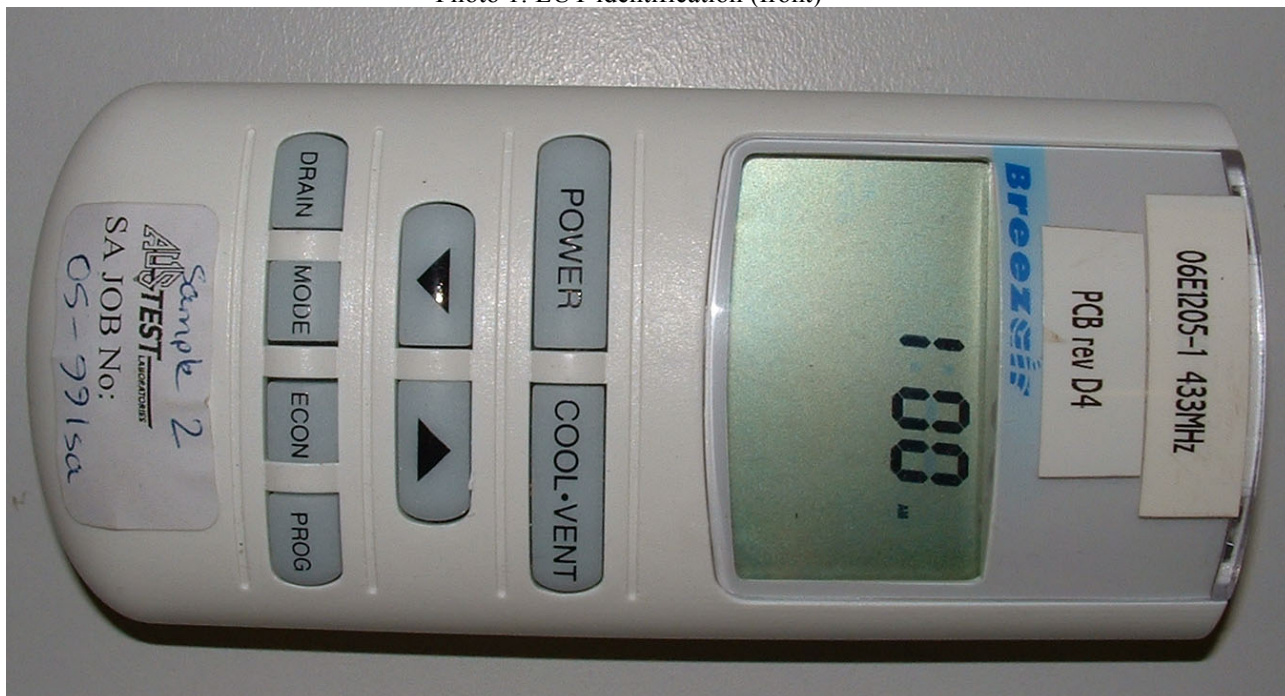


Photo 2: EUT identification (rear)



photo 3: PCB component side

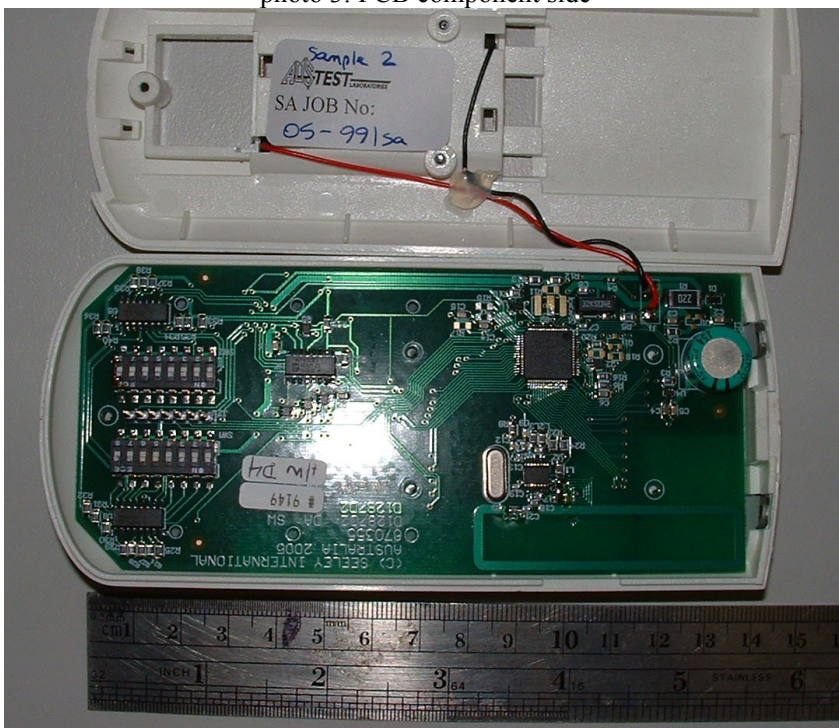


photo 4:pcb reverse side

