

*Electromagnetic Emissions Test Report  
and  
Application for Grant of Equipment Authorization  
pursuant to  
FCC Part 15, Subpart C Specifications for an  
Intentional Radiator on the  
D2M  
Model: AccessOne Keypad*

FCC ID: NUL898

GRANTEE: D2M  
405 West Evelyn Ave.  
Mountain View, CA 94301

TEST SITE: Elliott Laboratories, Inc.  
684 W. Maude Avenue  
Sunnyvale, CA 94086

REPORT DATE: February 24, 2000

FINAL TEST DATE: February 16 and February 18, 2000

AUTHORIZED SIGNATORY:

  
\_\_\_\_\_  
Mark R. Briggs  
Manager, EMC Consulting Services

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**TABLE OF CONTENTS**

<b>COVER PAGE</b> .....	<b>1</b>
<b>TABLE OF CONTENTS</b> .....	<b>2</b>
<b>SCOPE</b> .....	<b>4</b>
<b>OBJECTIVE</b> .....	<b>4</b>
<b>STATEMENT OF COMPLIANCE</b> .....	<b>4</b>
<b>EMISSION TEST RESULTS</b> .....	<b>5</b>
LIMITS OF CONDUCTED INTERFERENCE VOLTAGE .....	5
LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH – FUNDAMENTAL FIELD STRENGTH .....	5
LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH – SPURIOUS EMISSIONS .....	5
LIMITS OF BANDWIDTH AND TRANSMIT TIME .....	5
MEASUREMENT UNCERTAINTIES .....	6
<b>EQUIPMENT UNDER TEST (EUT) DETAILS</b> .....	<b>7</b>
GENERAL .....	7
INPUT POWER .....	7
PRINTED WIRING BOARDS .....	7
SUBASSEMBLIES .....	7
ENCLOSURE .....	7
EMI SUPPRESSION DEVICES .....	8
ANTENNA SYSTEM .....	8
MODIFICATIONS .....	8
SUPPORT EQUIPMENT .....	8
EXTERNAL I/O CABLING .....	8
TEST SOFTWARE .....	8
<b>TEST SITE</b> .....	<b>9</b>
GENERAL INFORMATION .....	9
RADIATED EMISSIONS CONSIDERATIONS .....	9
<b>MEASUREMENT INSTRUMENTATION</b> .....	<b>10</b>
RECEIVER SYSTEM .....	10
INSTRUMENT CONTROL COMPUTER .....	10
FILTERS/ATTENUATORS .....	10
ANTENNAS .....	11
ANTENNA MAST AND EQUIPMENT TURNTABLE .....	11
INSTRUMENT CALIBRATION .....	11
<b>TEST PROCEDURES</b> .....	<b>12</b>
EUT AND CABLE PLACEMENT .....	12
RADIATED EMISSIONS .....	12
<b>SPECIFICATION LIMITS AND SAMPLE CALCULATIONS</b> .....	<b>13</b>
LIMIT FOR FUNDAMENTAL FIELD STRENGTH §15.231(A) .....	13
LIMITS FOR SPURIOUS EMISSIONS IN RESTRICTED BANDS §15.209 .....	13
LIMITS FOR SPURIOUS EMISSIONS OUTSIDE RESTRICTED BANDS §15.231(A) .....	13
SAMPLE CALCULATIONS - RADIATED EMISSIONS .....	14

**TABLE OF CONTENTS (Continued)**

<i>EXHIBIT 1: Test Equipment Calibration Data.....</i>	<i>1</i>
<i>EXHIBIT 2: Test Data Log Sheets .....</i>	<i>2</i>
<i>EXHIBIT 3: Radiated Emissions Test Configuration Photographs.....</i>	<i>3</i>
<i>EXHIBIT 4: Proposed FCC ID Label &amp; Label Location.....</i>	<i>5</i>
<i>EXHIBIT 5: Detailed Photographs of.....</i>	<i>6</i>
<i>D2M Model AccessOne KeypadConstruction .....</i>	<i>6</i>
<i>EXHIBIT 6: Operator's Manual for.....</i>	<i>7</i>
<i>D2M Model AccessOne Keypad .....</i>	<i>7</i>
<i>EXHIBIT 7: Block Diagram of.....</i>	<i>8</i>
<i>D2M Model AccessOne Keypad.....</i>	<i>8</i>
<i>EXHIBIT 8: Schematic Diagrams for .....</i>	<i>9</i>
<i>D2M Model AccessOne Keypad.....</i>	<i>9</i>
<i>EXHIBIT 9: Theory of Operation for .....</i>	<i>10</i>
<i>D2M Model AccessOne Keypad.....</i>	<i>10</i>

**SCOPE**

An electromagnetic emissions test has been performed on the D2M Transmitter model AccessOne Keypad pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the D2M model AccessOne Keypad and therefore apply only to the tested sample. The sample was selected and prepared by Eric Larkin of D2M

**OBJECTIVE**

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

**STATEMENT OF COMPLIANCE**

The tested sample of D2M model AccessOne Keypad complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

**EMISSION TEST RESULTS**

The following emissions tests were performed on the D2M model AccessOne Keypad. The actual test results are contained in an exhibit of this report.

**LIMITS OF CONDUCTED INTERFERENCE VOLTAGE**

This test was not performed as the EUT is battery operated.

**LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH – FUNDAMENTAL FIELD STRENGTH**

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.231(a).

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

**390 MHz**

Frequency MHz	Level dBuV/m	Pol v/h	FCC 15.231(a) Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
389.317	78.6	V	79.2	-0.6	Avg	47	1.4	120kHz Bandwidth

**LIMITS OF RADIATED INTERFERENCE FIELD STRENGTH – SPURIOUS EMISSIONS**

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.231(a) and 15.209 in the case of emissions falling within the frequency bands specified in Section 15.205.

The following measurement was extracted from the data recorded during the radiated electric field emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

**30 – 4000 MHz**

Frequency MHz	Level dBuV/m	Pol v/h	FCC 15.231(a) Limit	Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
778.635	44.3	V	59.2	-14.9	Avg	10	1.4	120kHz Bandwidth

**LIMITS OF BANDWIDTH AND TRANSMIT TIME**

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.231(a)(2) and 15.231(c).

The 20 dB bandwidth was 492 kHz. The transmit time was 3.8 seconds.

**MEASUREMENT UNCERTAINTIES**

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	$\pm 2.4$
Radiated Emissions	30 to 1000	$\pm 3.2$

**EQUIPMENT UNDER TEST (EUT) DETAILS****GENERAL**

The D2M model AccessOne Keypad is a 390 MHz transmitter that is designed to be used as part of a home security system. The sample was received on February 16, 2000 and tested on February 16 and February 18, 2000. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number
KwikSet AccessOne Keypad	None

**INPUT POWER**

The EUT power input is derived from an internal 9 V battery.

**PRINTED WIRING BOARDS**

The EUT contained the following printed wiring boards during emissions testing:

Manufacturer/Description	Assembly #	Rev.	Serial #	Crystals (MHz)
D2M/ Access One Keypad PCB/	KW04	4	Pre-production	2.2

**SUBASSEMBLIES**

The EUT did not contain subassembly modules during emissions testing.

**ENCLOSURE**

The EUT enclosure is primarily constructed of plastic.

**EMI SUPPRESSION DEVICES**

The EUT did not contain EMI suppression devices during emissions testing.

**ANTENNA SYSTEM**

The EUT antenna is part of the PCB and fully contained within the enclosure, thereby meeting the requirements of FCC 15.203 and RSS210 Section 5.5.

**MODIFICATIONS**

The EUT did not require modifications during testing in order to comply with the emission specifications.

**SUPPORT EQUIPMENT**

No support equipment was used during emissions testing.

**EXTERNAL I/O CABLING**

No interface cabling was required as the EUT does not have any external ports.

**TEST SOFTWARE**

For measuring the transmit time the EUT was configured to normal operating mode so that it would only transmit when the security code was correctly entered. The transmit time was set to the maximum time permitted by the controller.

For all other tests the EUT was configured to continuously transmit a stream of all ones. The all ones data pattern gives the highest output level.

**TEST SITE****GENERAL INFORMATION**

Final test measurements were taken on February 16 and February 18, 2000 at the Elliott Laboratories Open Area Test Site #2 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

**RADIATED EMISSIONS CONSIDERATIONS**

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

**MEASUREMENT INSTRUMENTATION****RECEIVER SYSTEM**

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

**INSTRUMENT CONTROL COMPUTER**

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

**FILTERS/ATTENUATORS**

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

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**ANTENNAS**

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

**ANTENNA MAST AND EQUIPMENT TURNTABLE**

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

**INSTRUMENT CALIBRATION**

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

**TEST PROCEDURES****EUT AND CABLE PLACEMENT**

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

**RADIATED EMISSIONS**

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

**SPECIFICATION LIMITS AND SAMPLE CALCULATIONS**

The limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

**LIMIT FOR FUNDAMENTAL FIELD STRENGTH §15.231(a)**

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
390	9120	79.2

**LIMITS FOR SPURIOUS EMISSIONS IN RESTRICTED BANDS §15.209**

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

**LIMITS FOR SPURIOUS EMISSIONS OUTSIDE RESTRICTED BANDS §15.231(a)**

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 - 3900	912.0	59.2

**SAMPLE CALCULATIONS - RADIATED EMISSIONS**

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20 \cdot \log_{10} (D_m/D_s)$$

where:

$F_d$  = Distance Factor in dB

$D_m$  = Measurement Distance in meters

$D_s$  = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

$R_r$  = Receiver Reading in dBuV/m

$F_d$  = Distance Factor in dB

$R_c$  = Corrected Reading in dBuV/m

$L_s$  = Specification Limit in dBuV/m

$M$  = Margin in dB Relative to Spec

***EXHIBIT 1:Test Equipment Calibration Data***

# Test Equipment List - SVOATS#

February 19, 2000

<u>Manufacturer/Description</u>		<u>Model</u>	<u>Asset #</u>	<u>Interval</u>	<u>Last Cal</u>	<u>Cal Due</u>
<input checked="" type="checkbox"/> EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	3/24/99	3/24/2000
<input checked="" type="checkbox"/> EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	802	12	1/20/2000	1/20/2001
<input checked="" type="checkbox"/> Filtek	High Pass Filter	HP12/1000-5B	955	12	4/17/99	4/17/2000
<input checked="" type="checkbox"/> Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/3/2000	1/3/2001
<input checked="" type="checkbox"/> Hewlett Packard	Microwave Preamplifier,	8449B	870	12	11/15/1999	11/15/2000
<input checked="" type="checkbox"/> Rohde & Schwarz	Test Receiver, 0.009-2000 MHz	ESN	775	12	6/10/99	6/10/2000

File Number: T36012/T35949

Date: 2-19-2000/2-16-00  
Engr: Mehran M Birjani /MKB

**EXHIBIT 2: Test Data Log Sheets**

**ELECTROMAGNETIC EMISSIONS**

**TEST LOG SHEETS**

**AND**

**MEASUREMENT DATA**

T 35949 5 Pages  
T 36012 4 Pages



# EMC Test Log

Client:	D2M	Date:	2/16/00	Test Eng.:	Mark Briggs
Product:	KwikSet AccessOne KeyPad	File:	T35949	Proj. Eng.:	Mark Briggs
Objective:	Final Qualification	Site:	Chamber 2	Contact:	Eric Larkin
Spec:	FCC 15.231(a)/ RSS 210	Page:	1 of 3	Approved:	
Revision	1.0				

## Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification defined above.

## Test Summary

### Run #1 - Verification of the Auto-Off time

The unit was set to operate in normal operating mode. The security password was entered and the transmit key held down. The attached plot shows that the transmission was stopped automatically after 3.8 seconds, even though the transmit key was held down for greater than 5 seconds.

FCC 15.231(a)(2) and IC RSS 210 6.1.1(a)(2) require that an automatically enabled device transmit for 5 seconds or less. The device meets this requirement.

### Run #2 - Bandwidth Measurement

The unit was set to operate in normal operating mode. The 20 dB bandwidth was measured to be 492 kHz using a resolution bandwidth of 100 kHz.

FCC 15.231(c) and IC RSS 210 6.1.1(c) require that bandwidth be less than 0.25% of the operating frequency. For a transmit frequency of 388 MHz the maximum permitted bandwidth is 970 kHz. The device meets this requirement.

## Equipment Under Test (EUT) General Description

The EUT is a 390 MHz transmitter that is designed to be used as part of a home security system. Normally, the EUT would be wall-mounted during operation. The EUT was placed against a wooden block and located on the tabletop during testing.

The EUT is designed to operate from an internal 9 V battery.



## EMC Test Log

Client:	D2M	Date:	2/16/00	Test Eng.:	Mark Briggs
Product:	KwikSet AccessOne KeyPad	File:	T35949	Proj. Eng.:	Mark Briggs
Objective:	Final Qualification	Site:	Chamber 2	Contact:	Eric Larkin
Spec:	FCC 15.231(a)/ RSS 210	Page:	2 of 3	Approved:	
Revision	1.0				

### Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
KwikSet AccessOne Keypad	None	NUL-898

### Power Supply and Line Filters

The EUT power was derived from an internal 9 V battery.

### Printed Wiring Boards in EUT

The manufacturer provided the following information:

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
D2M/ Access One Keypad PCB/	KW04	4	Pre-production	2.2

### Subassemblies in EUT

The EUT does not contain subassemblies.

### EUT Enclosure(s)

The EUT enclosure is primarily constructed of plastic.

### EUT Antenna

The EUT antenna is part of the PCB and fully contained within the enclosure, thereby meeting the requirements of FCC 15.203 and RSS210 section 5.5.

### EMI Suppression Devices (filters, gaskets, etc.)

No EMI suppression devices are used in the EUT.



## EMC Test Log

Client:	D2M	Date:	2/16/00	Test Eng.:	Mark Briggs
Product:	KwikSet AccessOne KeyPad	File:	T35949	Proj. Eng.:	Mark Briggs
Objective:	Final Qualification	Site:	Chamber 2	Contact:	Eric Larkin
Spec:	FCC 15.231(a)/ RSS 210	Page:	3 of 3	Approved:	
Revision	1.0				

### Modifications

No modification was made to the EUT during the test.

### Support Equipment

No support equipment was required to operate the EUT.

### Interface Cabling

No interface cabling was required – the EUT does not have any external ports.

### EUT Operation During Testing

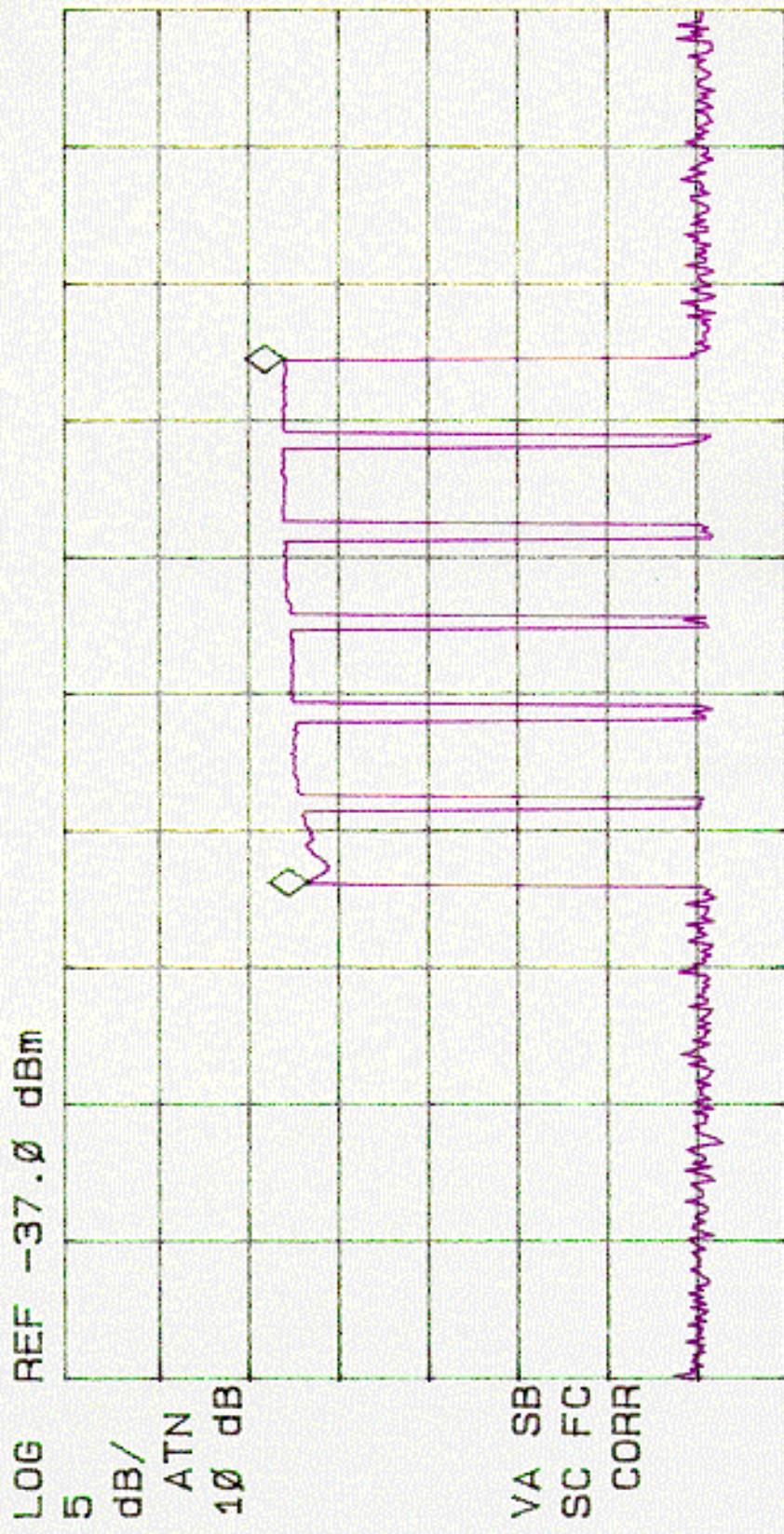
The EUT was configured to normal operating mode so that it would only transmit when the security code was correctly entered.

### General Test Conditions

During radiated testing, the EUT was powered from a fresh battery. The EUT was located on the turntable for radiated measurements.

#7 Run #1, Confirmation of time to Automatic Switch Off

ACTV DET: PEAK *mb*, 2-16-00  
MEAS DET: PEAK QP AVG  
MKR 3.8250 sec  
1.29 dB



CENTER 387.280 MHz  
#IF BW 1.0 MHz #AVG BW 1 MHz  
SPAN 0 Hz  
#SWP 10.0 sec



\*



# EMC Test Log

Client:	D2M	Date:	2/18/00	Test Eng.:	Mehran M Birgani
Product:	KwikSet AccessOne KeyPad	File:	T36012	Proj. Eng.:	Mark Briggs
Objective:	Final Qualification	Site:	OATS #2	Contact:	Eric Larkin
Spec:	FCC 15.231(a)(1)	Page:	1 of 3	Approved:	
Revision	1.0				

## Test Objective

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification defined above.

## Test Summary

Run #1 - Measurement of Fundamental Emission Field Strength.

**PASS**    Results: §15.231(a)    -0.6 dB Avg. @ 389.317 MHz    Vertical

Run #2 - Maximized Radiated Spurious Emissions Scan, 778-4000 MHz.

**PASS**    Results: §15.231(a)    -14.6 dB Avg. @ 778.635 MHz    Vertical

## Equipment Under Test (EUT) General Description

The EUT is a 390 MHz transmitter, designed to be used as part of a home security system. Normally, the EUT would be wall-mounted during operation. The EUT was placed against a wooden block and located on the tabletop during testing.

The EUT is designed to operate from an internal 9 V battery.

## Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
KwikSet AccessOne Keypad	None	NUL-898

## Power Supply and Line Filters

The EUT power was derived from an internal 9 V battery.



## EMC Test Log

Client:	D2M	Date:	2/18/00	Test Eng.:	Mehran M Birgani
Product:	KwikSet AccessOne KeyPad	File:	T36012	Proj. Eng.:	Mark Briggs
Objective:	Final Qualification	Site:	OATS #2	Contact:	Eric Larkin
Spec:	FCC 15.231(a)(1)	Page:	2 of 3	Approved:	
Revision	1.0				

### Printed Wiring Boards in EUT

The manufacturer provided the following information:

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
D2M/ Access One Keypad PCB	KW04	4	Pre-production	2.2

### Subassemblies in EUT

The EUT does not contain subassemblies.

### EUT Enclosure(s)

The EUT enclosure is primarily constructed of plastic.

### EUT Antenna

The EUT antenna is part of the PCB and fully contained within the enclosure, thereby meeting the requirements of FCC 15.203 and RSS210 Section 5.5.

### EMI Suppression Devices (filters, gaskets, etc.)

No EMI suppression devices are used in the EUT.

### Modifications

No modification was made to the EUT during the test.

### Support Equipment

No support equipment was required to operate the EUT.

### Interface Cabling

No interface cabling was required – the EUT does not have any external ports.



## EMC Test Log

Client:	D2M	Date:	2/18/00	Test Eng.:	Mehran M Birgani
Product:	KwikSet AccessOne KeyPad	File:	T36012	Proj. Eng.:	Mark Briggs
Objective:	Final Qualification	Site:	OATS #2	Contact:	Eric Larkin
Spec:	FCC 15.231(a)(1)	Page:	3 of 3	Approved:	
Revision	1.0				

### EUT Operation During Testing

The EUT was configured to normal operating mode so that it would only transmit when the security code was correctly entered.

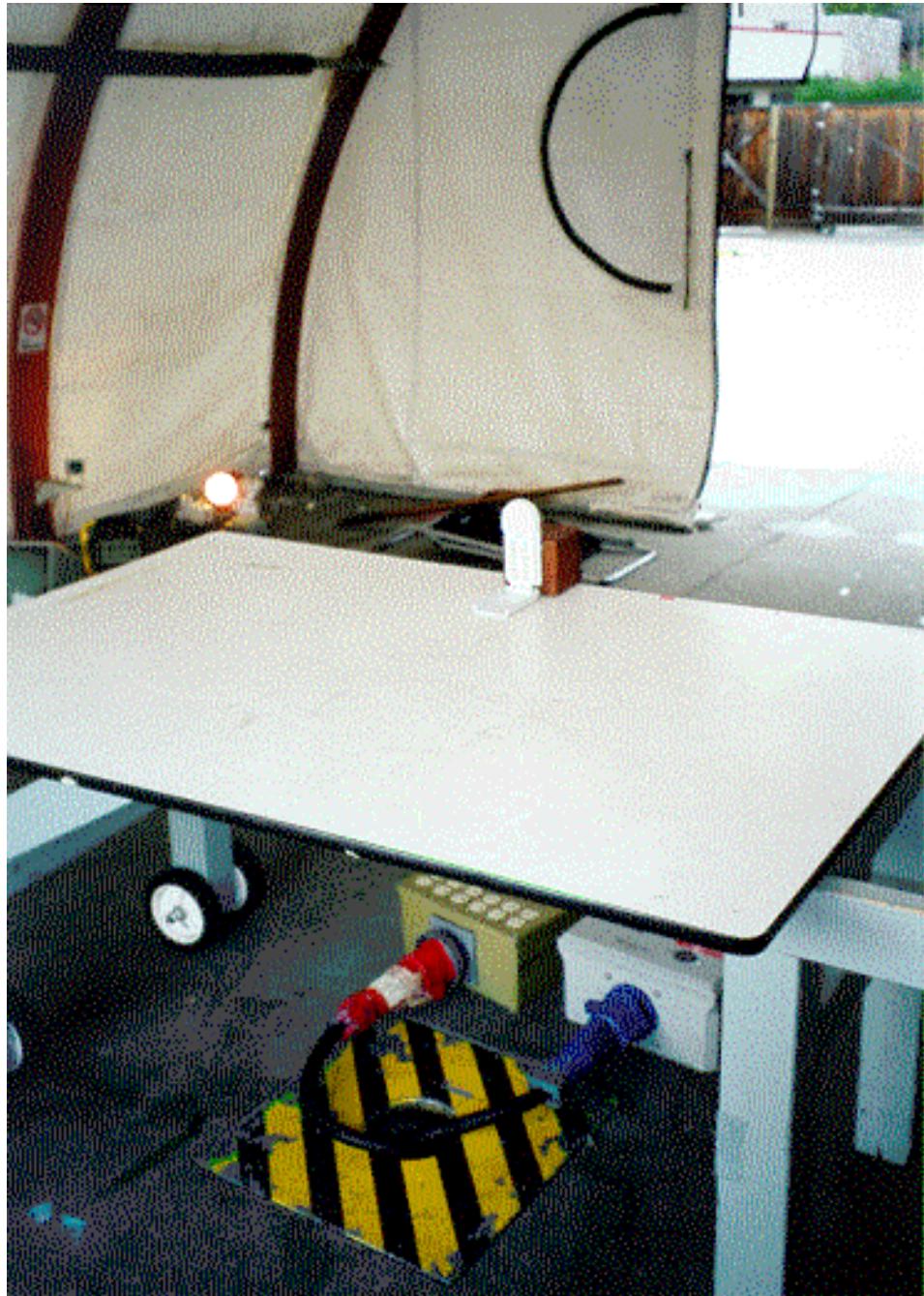
### General Test Conditions

During radiated testing, the EUT was powered from a fresh battery. The EUT was located on the turntable for radiated emissions measurements.

**EXHIBIT 3:Radiated Emissions Test Configuration Photographs**



**APPENDIX 3: Radiated Emissions Test Configuration Photographs**



***EXHIBIT 4:Proposed FCC ID Label & Label Location***

2 Pages

***EXHIBIT 5: Detailed Photographs of  
D2M Model AccessOne Keypad Construction***

6 Pages

***EXHIBIT 6: Operator's Manual for  
D2M Model AccessOne Keypad***

3 Pages

***EXHIBIT 7: Block Diagram of  
D2M Model AccessOne Keypad***

1 Pages

***EXHIBIT 8: Schematic Diagrams for  
D2M Model AccessOne Keypad***

1 Page

***EXHIBIT 9: Theory of Operation for  
D2M Model AccessOne Keypad***

29 Page