Application for Certification

FCC ID: EF4DXS14
IC: 1078A-DXS14

DXS-14 Remote Control Transmitter

Submitted by:

Linear LLC
1950 Camino Vida Roble, Suite 150
Carlsbad, California 92008
760-438-7138
760-438-7043 (FAX)

SUMMARY OF TEST RESULTS
IN ACCORD WITH
FCC RULES PART 15, RSS-210 ISSUE 8 DECEMBER 2010 AND C63.4-2003

Equipment Model:	DXS-14
Transmitter Tested C63-4:2003 Section:	FCC Rules 15.231 (a)(b)
Field Strength at a distance of 3 meters:	6840 uV/Mtr (-4.1 dB below limit) @ 433.92 MHz
Peak to Average Ratio:	14.9 dB - Worst Case Duty Cycle
Test Conditions:	Radiated (Sections 11 & 13)
Transmitter:	
Transmitter Frequency:	433.92 MHz Nominal (Factory Tuned Only)
Bandwidth (20 dB down)	< 0.020% of Center Freq.
Frequency Tolerance:	N/A (Nominal +/- 0.045MHz)
Frequency Stability:	N/A (Nominal +/- 0.045MHz)
Transmitter Spurious at 3 meters: (Worst Harmonic)	103 uV/Mtr (-21 dB below limit)
Frequency:	868 MHz
Momentary Operation (Yes/No)	Yes
Holdover time after manual release:	0.5 seconds (maximum)
Duration of transmission after activation:	0.5 seconds on any single automatic activation

Attestation:

The radio apparatus identified in the application has been subject to all the applicable test conditions specified in FCC Rules Part 15 and all of the requirements of the Standard have been met.

Regulatory Compliance Engineer

John W. Kuivinen, P.E. _____ Date: June 14, 2012

Radio Standard Specification
Low Power Communication Devices
C63.4-2003 and FCC Rules Part 15

1.0 General:

1.2, Exclusions to TV Broadcast Freq.	Complies

2.0 Related Documents:

Reference Documents for Application:	CFR 47, FCC Rules Part 15

3.0 Test Equipment:

Supply Voltage:	Four fresh 1.5 VDC alkaline batteries configured as two 3 Volt batteries in parallel.
Test Equipment List	See Section 6
Signal Detector:	Peak with 14.9 dB, peak to average conversion.

4.0 Certification and Test Results:

Summary of Results per	See Page 1 of this Report

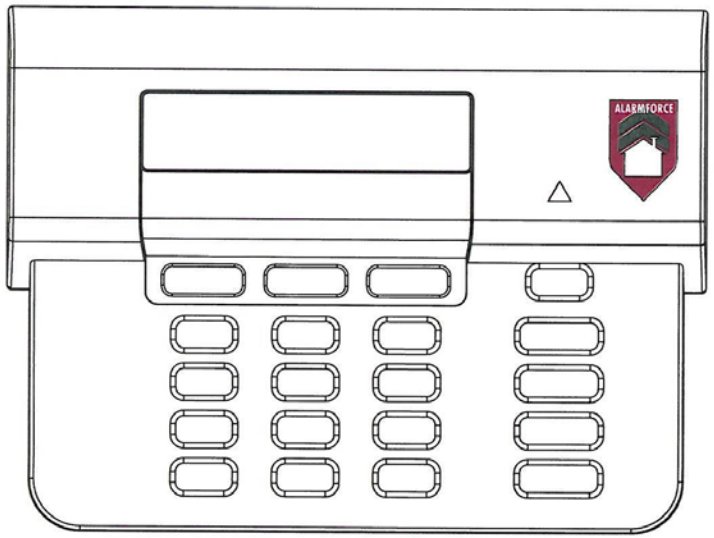
5.0 General Technical Requirements:

5.1 Testing Methods:	Peak Signal pulse width GFSK (Gaussian Frequency Shift Keyed) modulated FM signal.
5.1 Reference Standard:	C63.4-2003 (FCC Procedure)
5.2 Modulation:	Pulse Position, A1D, AM Modulation
5.3 Type of Antenna:	Integral to Transmitter PCB
5.4 External Controls:	20 button keypad controls No user serviceable parts except for replacement of batteries.
5.5 Accessories:	NONE
5.6 TX Bandwidth:	<0.020 % (See Section 8)
5.7 Equipment Labels:	See Section 2
5.8 Manual Disclaimer:	See attached draft copy of manual
5.9 Usage Restrictions:	Digital Pulse Code Only

6.0 Transmitter Characteristics and Tests:

6.1 Momentary Operated Devices:	Complies
6.1(a) Types of Signals:	Manual Push to Transmit
6.1(a) Automatic Activation:	N/A
6.1(a) Five Second Max. upon release:	Complies
6.1(b) Maximum Field Strength:	433.92 MHz = 11,000 uV/mtr at 3 meters.
6.1(c) Bandwidth (20 dB down)	<0.020 % Complies
6.1(d) Frequency Stability	N/A per regulations +/- 0.045MHz Maximum Error
6.1(e) Reduced Field Strength	N/A
6.2 Non-Momentary Operated Devices:	N/A
6.2.1 Frequency Bands:	Refer to Table 1
6.3 Restricted Bands:	Complies
6.5 Pulsed Operation:	Complies (14.9 dB Peak/Average) See Section 8
6.6 Wireline Conducted Emissions:	N/A
7.0 Receivers	Complies
8.0 Self Certification:	N/A
9.0 AC Wireline Conducted Emissions:	N/A
10.0 Terminated Measurement Method:	N/A
11.0 Radiated Measurement Method:	See Section 8
11.1 Measuring Distance:	Complies
11.2 Open Field Test Site:	Complies, C63.4-2003
11.3 Equipment Test Platform:	See Section 8
11.4 Measurement Method:	Complies, See Section 8
12.0 DC Power Consumption Methods:	N/A
13.0 Near Field Measurement for < 30 MHz:	N/A
14.0 Test Report Submission:	See Attached

CASE SHOWN FOR ALIGNMENT ONLY



ARTWORK,LOGO,DXS-14
LINEAR P/N: 232563 X1
INK: PMS 208 (RED) & BLACK
SCALE: 1-1
NOTE: CROP MARKS ALIGN WITH PART EDGE

LINEAR LLC
FCC ID: EF4DXS14
IC:1078A-DXS14

REPORT OF MEASUREMENTS

LINEAR LLC
FCC ID: EF4DXS14
IC: 1078A-DXS14
Model : DXS14 Remote Keypad Transceiver

The enclosed documents reflect the requirements contained generally within the code of Federal Regulations, Title 47, Parts 2 and 15 as most recently published October 1, 2011 and all other applicable revisions made by the Commission since that time.

The specific rule sections for which the enclosed documents demonstrate compliance or rely upon to demonstrate compliance with the Commission's application and technical standards are as follows:

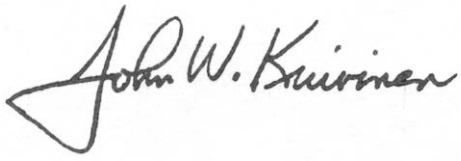
15.201-15.207, 15.231, Subpart C, Intentional Radiators.
15.35 Unintentional Radiators, Subpart B.

Test Procedure C63.4-2003, Section 13, Measurement of Intentional Radiators and Test Procedure C63.4-2003, Class B, Measurement of Un-intentional radiators were used for the testing of this device..

In accord with Section 2.948 of the Commission's Rules, a Test Site submittal is on file with the commission and a Letter of Acceptance dated March 16, 2012 (File 90767) is a portion of the Commission's records.

A test site submittal is on file with Industry Canada. The Industry Canada file number is 1078A-1. The file is dated August 4, 2010.

All of the information contained within this documentation is true, correct, and complete to the best of my knowledge.



_____
John W. Kuivinen, P.E.
Regulatory Compliance Engineer

June 14, 2012
Date

MEASUREMENT OF RADIO FREQUENCY EMISSION
OF CONTROL AND SECURITY ALARM DEVICES
FCC RULES PART 15, C63.4-2003 TEST PROCEDURE

I. INTRODUCTION

As part of a continuing series of quality control tests to ensure compliance with all applicable Rules and Regulations, this enclosure details the test procedures for certain radio control devices. Testing was performed at a test site located on the property of Linear LLC, 1950 Camino Vida Roble, Suite 150, Carlsbad, California 92008.

II. MEASUREMENT FACILITY DESCRIPTION

The test facility is a specially prepared area adequately combining the desirability of an interference free location with the convenience of nearby 120 volt power outlets, thus completely eliminating the incidence of inverter hash, so often a problem with field measurements.

III. DESCRIPTION OF SUPPORTING STRUCTURES

For Measuring Equipment - The antenna is supported on a trolley that can be raised and lowered on a mast by means of remote control to any level between 1 meter and 4 meters above the ground. For measurements at 3 meters, an antenna height (center of dipole) of about 1 meter generally yields the greatest field strength. For measurements at 1 meter, an antenna height equal to the device under test generally yields the greatest field strength. Usually, horizontal polarization yields the greatest field strength for both 1 and 3 meter measurements.

For Equipment Under Test (EUT): The equipment to be tested is supported by a wooden turntable at a height of eighty centimeters. A two axis swivel at the top of the turntable permits the unit under test to be manually oriented in the position of maximum received signal strength. The turntable can be rotated by remote control.

Test Configuration - All transmitters were located eighty centimeters above ground, at a distance of three meters from the antenna. They were each oriented for maximum radiation by rotating the turntable. The antenna was then moved vertically along the mast for optimum reception in both horizontal and vertical planes. Where no emissions were found, the antenna was also moved to one meter distance to improve system sensitivity.

All receivers were located eighty centimeters above ground, at a distance of three meters from the antenna. They were each oriented for maximum radiation by rotating the turntable. The antenna was then moved vertically along the mast for optimum reception in both horizontal and vertical planes. Generally, emissions were very close to the observed spectrum analyzer noise floor, making accurate measurement difficult because of the analyzer detector's characteristic of adding signal and noise. To better observe and measure emissions well above the noise floor, the antenna was moved in to one meter. This provides a theoretical 9.54 dB improvement in received field strength, but a possible shift from far field to near field antenna characteristics may introduce an unknown error in measurement.

All transmitters and receivers tested are typical of production units.

A Hewlett-Packard spectrum analyzer consisting of an 8562A or 8594EM mainframe is used for the field strength meter. A set of Ailtech DM-105 series dipoles are used for the receiving antennas up to 1 GHz. An A.H. Systems model SAS-200/511 log periodic antenna is used from 1 to 5 GHz. Since the published antenna factor includes the small amount of balun loss, this factor is not included in the equations for correcting measured values. The cable loss is added to the raw data. For measurements up to 1 GHz, a Hewlett-Packard 8447D broadband RF preamplifier is inserted between the antenna cable and spectrum analyzer input to ensure adequate system sensitivity while measuring.

From 1 GHz to 3 GHz, a Mini-Circuits ZFL-2000 broadband RF preamplifier is used instead of the HP 8447D. In many cases, the antenna is moved in to a distance of 1 meter to enhance test range sensitivity after the 3 meter data is observed. A theoretical 9.54dB improvement is realized. Please see Excel data spreadsheet for details. For a particular device and frequency, the EUT to antenna distance is specified in the Report of Measurements.

Correction of Measured Values - The spectrum analyzer calibration is in units of dBm absolute. Published antenna factor, measured cable loss and preamplifier gain are in units of dB. All equipment is referenced to a 50-ohm characteristic impedance; therefore, any impedance terms will factor out of any calculations. Also, balun loss is included in the antenna factor, so this term will not appear in any calculation.

To obtain field strength, the reference (50 ohm system) 1 UV = 0 dBuV = -107 dBm is used.

For a given frequency: antenna factor, cable loss, preamplifier gain (if used) and a 9.54 dB gain factor (3 meters to 1 meter field strength conversion) when required are factored into the spectrum analyzer reading, resulting in a field strength in units of dBm.

Field strength reading (dBm) + 107 dB = dBuV, using 0 dBuV = 1 uV/meter at a specified distance as reference.

All of the equipment was calibrated to NBS-traceable factory specifications prior to the date of measurement.

IV **MEASUREMENT PROCEDURE**

Transmitters

1. Set the DIP-switch rockers of the transmitter (if needed) to all ON, jam the button in the ON position, and place the transmitter on the test stand.

2. Tune the antenna (if required).

3. Tune the spectrum analyzer.

4. Adjust the antenna height and polarization for peak field strength.

5. Rotate the turntable to orient the transmitter for the highest reading.

6. Record the observed peak emission.

7. Record the screen image (if required).

Spectrum Analyzer Control Settings:

Tuning:	As required
Bandwidth	100 KHz for Field Strength,
Scan Width:	100 KHz/div (may be different when tuning or adjusting display for photographs)
Input Attenuator:	10 dB
Scan Time:	50 mSec. sweep
Reference Level:	0 dBm
Display Mode:	Log 10 dB/division
Video Filter:	OFF
Scan Mode:	Internal
Scan Trigger:	Auto

Receivers

1. Place receiver on test stand, apply power.

2. Tune the antenna to the operating frequency to be measured.

3. Tune the spectrum analyzer.

4. Cohere the Receiver (Superregenerative Receivers Only)

   Tune the RF Generator to the center frequency of the superregenerative receiver under test. Apply a signal level of -20 dBm at a distance of approximately two meters. Use an Ailtech antenna of the correct tuned frequency to radiate the cohering signal. Vary the signal frequency to insure that the maximum spurious emissions are recorded.

   While radiating a signal, monitor the output levels at the analyzer looking for the largest peak from the unintentional radiator's spurious output.

   Record the highest levels near the center frequency but be careful not to record the signal generator as an emission from the receiver.

5. Record the Emission Levels

   Retune the antenna to the exact frequency of measurement. Adjust the antenna height and polarization for peak field strength. Rotate the turntable to orient the receiver for maximum emissions and record the frequency and level on the Report of Measurements.

   Record an image of spectrum analyzer display for the Report of Measurements, if required.

Spectrum Analyzer Control Settings:

Tuning:	As required
Bandwidth:	100 KHz
Scan Width:	100 KHz/div (may be different when tuning or adjusting display for photographs)
Input Attenuator:	10 dB
Scan Time:	50 msec sweep
IF Mode:	Log 10 dB/division
Reference Level:	-10 dBm
Video Filter:	OFF
Scan Mode:	Internal
Scan Trigger:	Auto

TESTING INSTRUMENTATION AND EQUIPMENT LIST

SPECTRUM ANALYZERS:

H.P.	HP8594EM	1 KHz to 2.9GHz	
	S/N 3649A00246	Calibrated	02/22/2012
		Due	02/21/2013
H.P.	HP8562A	9 KHz to 2.9GHz	
	S/N 2913A03742	Calibrated	07/27/2011
		Due	07/27/2012

ANTENNAS:

(2)	Ailtech DM105A T1	20-200 MHz			Tuned Dipole
	S/N 93412-105 and 93412-114	Calibrated 3/12	Due:	3/13	
(2)	Ailtech DM105A T2	140-400 MHz	Tuned Dipole		
	S/N 93413-113 and 93413-117	Calibrated 3/12	Due:	3/13	
(2)	Ailtech DM105A T3	400-1000 MHz	Tuned Dipole		
	S/N 93413-105 and 93414-111	Calibrated 3/12	Due:	3/13	
(2)	AH Systems SAS-200/511	1-12.4 GHz			Log Periodic
	S/N 118 and 124, P/Ns 2069	Calibrated 3/12	Due:	3/13	
(1)	AH Systems SAS-200/540	20-330 MHz	Biconical		
	S/N 367 P/N 2052	Calibrated 3/12	Due:	3/13	

INSTRUMENTATION:

H.P.	HP8656B RF Generator	100 KHz - 990 MHz	
	S/N A4229590	Calibrated	3/12
		Due	3/13
Solar Electronics Line Impedance Stabilization Network, Type			
	8012-50-R-24-BNC	Calibrated:	3/12
	S/N 8379585	Due:	3/13
HP 8447D	Broadband preamplifier, 0.1-1300 MHz		
	S/N 2443A03660	Calibrated:	3/12
		Due:	3/13
Mini-Circuits	ZFL-2000 broadband preamplifier, 10-3000 MHz		
	S/N Lin 001	Calibrated:	3/12
		Due:	3/13

ACCESSORIES:

(2) Ailtech Rulers calibrated in MHz
4 Meter ABS Antenna Mast and Trolley
Eighty Centimeter Tall, Motorized Wooden Turntable
BNC to BNC Cables - as-required

(2)	25' RG-214/U Low-loss Coaxial Cable		
	S/N- LIN001 & LIN002	Calibrated:	3/12
		Due:	3/13

(2) 3' RG-400E Low-loss Coaxial Cable, calibarated as part of the preamplifiers. Automatically taken into account when used with the above itemized range preamplifiers.

DURATION OF RF TRANSMISSIONS

DXS14

REMOTE CONTROL TRANSMITTER

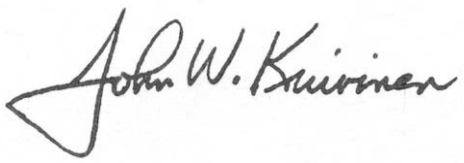
These transmitters are manually activated by pressing a button on the keypad. They are used for remote control of a home alarm system. Transmissions are encoded in AlamForce GFSK FM format and are limited to 5 data words lasting approximately 0.5 second from start of first transmission to end of last repeated word.

Automatic status transmissions are made at 1.2 hour intervals. GFSK FM format transmissions have an 18% duty cycle for each word and are repeated 5 times to insure proper reception.

Manually activated transmission may operate continuously. Due to concerns about battery life, the transmitter microprocessor has an internal clock that limits manually activated transmissions, even if the contact is held down, to no longer than 0.5 seconds Only after the switch / button is released and then pressed again may another transmission cycle begin.

On a brief momentary pressing of the test switch or door/window contacts, the microprocessor will power up and complete a minimum of 8 words in the RF data message. This transmission will take approximately 1 second. FCC Rules 15.231 (a)(1) allows no longer than 5 seconds upon the release of a manually activated transmitter.

Signed:



John W. Kuivinen, P.E.
Regulatory Compliance Engineer

DUTY CYCLE CALCULATIONS

FCC RULES 15.231(b)(2)

AlarmForce GFSK Data Format

Worst case duty cycle is computed for the FM FSK data format. Data rate is a duty cycle of 18 mSec. on during any 100 mSec. data frame window.

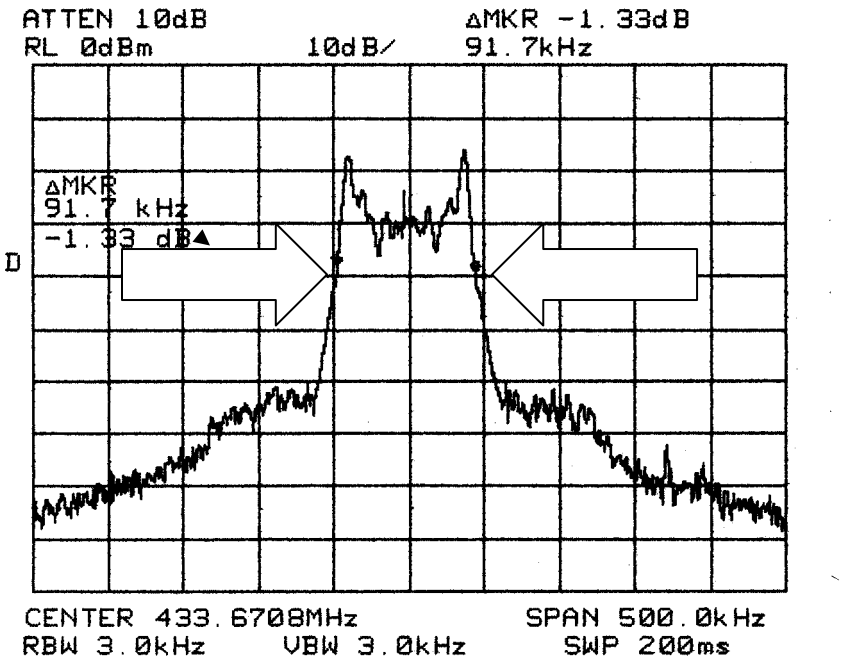
During transmission the keypad transmitter sends series of 5 bytes of data in FM FSK (frequency shift keyed) data format. During initial setup the installer may send data in a longer form but this will require a special installer code to enable this transmission format.

REAL TIME ANALYSIS, REFER TO ATTACHED SPECTRUM ANALYER PRINT OUTS.

Description	Total Time	On Time
Total Transmission	18 mSec.	18 mSec. in any 100 mSec.. Window.

FCC Rules 15.35(c)

$\frac{18\ E\text{-}3\ \text{(on time)}}{100\ E\text{-}3\ \text{(window)}}$ = 20 log (0.18) = -14.9 dB (per FCC rules)



DEVICE: DXS14 Remote Control Transmitter

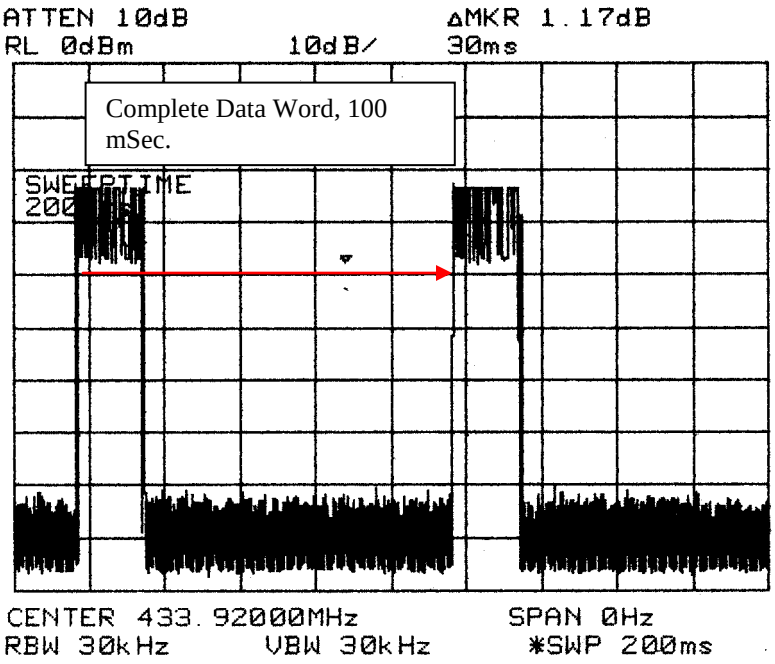
PHOTOGRAPH: Occupied Bandwidth

CONDITIONS: Transmitter Fundamental. GFSK FM Modulation - Frequency shift keyed modulation. Crystal Frequency Determining Element.

SPECTRUM ANALYZER CONTROL SETTINGS

CENTER FREQUENCY:	433.92 MHz	INPUT ATTENUATION:	-10 dB
SCAN WIDTH:	50 KHz / Div.	PREAMPLIFIER GAIN:	0 dB
SCAN TIME:	200 mSec.	LOG REF. LEVEL:	0 dBm
RF BANDWIDTH:	3 KHz		
ANTENNA:	6" Whip Ant. at Analyzer Input	TUNED TO:	N/A
ANTENNA DISTANCE:	0.01 Meters	ANTENNA HEIGHT:	N/A
SYSTEM NOISE FLOOR:	N/A		

NOTES: Per 15.231(c), Occupied Bandwidth (20 dB down) is less than +/- 100 KHz. This is less than 0.230% of the center frequency. FCC Rules, 15.231(c) devices must be less than 0.25% of center frequency (10.8 MHz). This device therefore complies with 15.231(c).



DEVICE: DXS14 Remote Control Transmitter

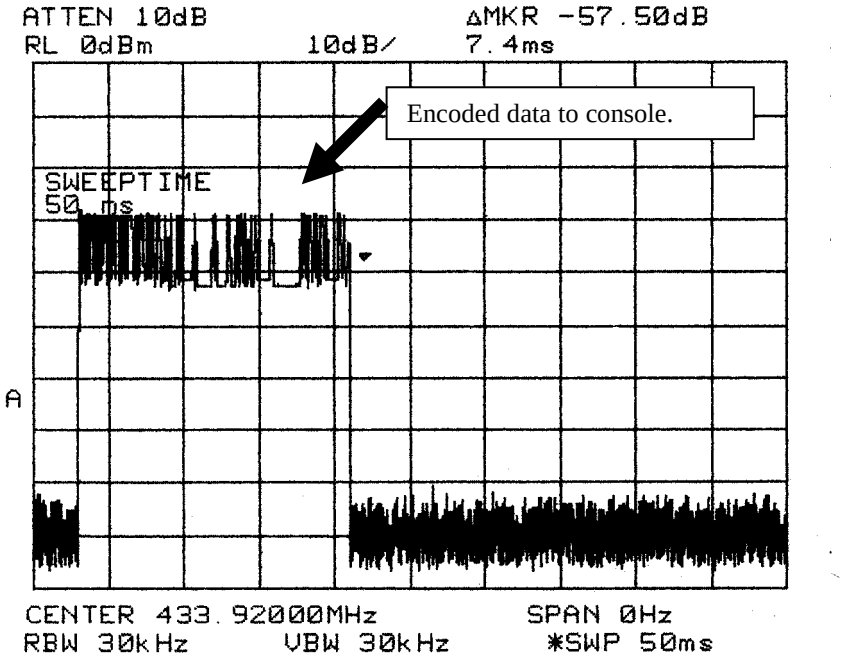
PHOTOGRAPH: Duty Cycle, Standard Keypress Transmission.

CONDITIONS: Transmitter Fundamental. GMFS FM Modulation - Frequency shift keyed Modulation. Crystal Frequency Determining Element.

SPECTRUM ANALYZER CONTROL SETTINGS

CENTER FREQUENCY:	433.92 MHz	INPUT ATTENUATION:	-10 dB
SCAN WIDTH:	Zero Hz span detector	PREAMPLIFIER GAIN:	0 dB
SCAN TIME:	200 mSec.	LOG REF. LEVEL:	0 dBm
RF BANDWIDTH:	30 KHz		
ANTENNA:	6" Whip Ant. at Analyzer Input	TUNED TO:	N/A
ANTENNA DISTANCE:	0.01 Meters	ANTENNA HEIGHT:	N/A
SYSTEM NOISE FLOOR:	N/A		

NOTES: Per 15.231(b)(2): The transmitter has a maximum keypressed signal of 18 + 12 mSec (30 mSec). in a 100 mSec. time period. The only time this limit is not applied is when setting up the transmission path during initial installation by a professional installer. The installation menu requires the use of a special password to enter the set up menu. This device therefore complies with 15.231(b)(2).



DEVICE: DXS14 Remote Control Transmitter

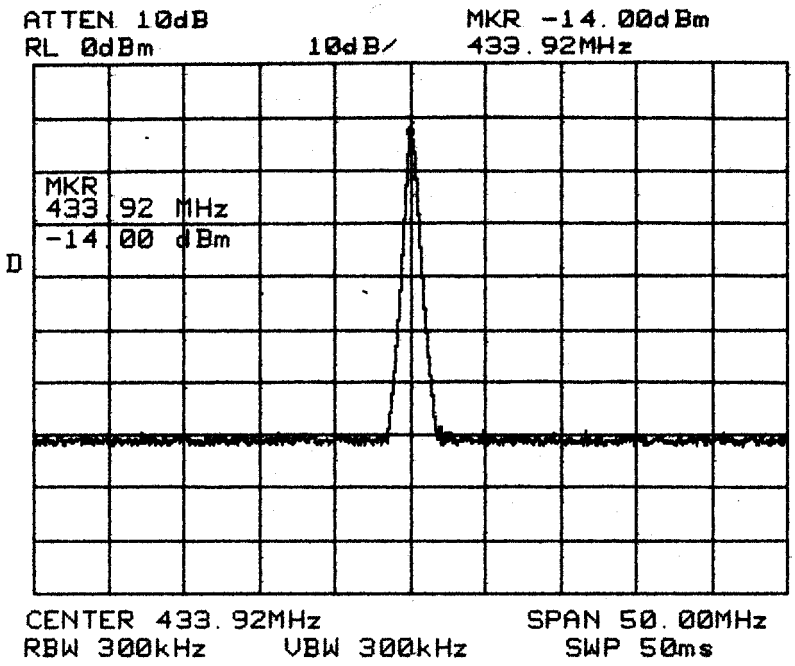
PHOTOGRAPH: Data GFSK Data Format

CONDITIONS: Transmitter Fundamental. GFSK FM Modulation - Frequency shift keyed Modulation. Crystal Frequency Determining Element.

SPECTRUM ANALYZER CONTROL SETTINGS

CENTER FREQUENCY:	433.92 MHz	INPUT ATTENUATION:	-10 dB
SCAN WIDTH:	Zero span detector	PREAMPLIFIER GAIN:	0 dB
SCAN TIME:	50 mSec.	LOG REF. LEVEL:	0 dBm
RF BANDWIDTH:	30 KHz		
ANTENNA:	6" Whip Ant. at Analyzer Input	TUNED TO:	N/A
ANTENNA DISTANCE:	0.01 Meters	ANTENNA HEIGHT:	N/A
SYSTEM NOISE FLOOR:	N/A		

NOTES: Per 15.231(b)(2), The RF format is shown with the leading in signal and following data. Additional bytes of data are added for certain special characters and/or keystrokes. Maximum time for any individual customer activated keystroke is 30 mSec. This device therefore complies with 15.231(c).



DEVICE: DXS14 Remote Control Transmitter

PHOTOGRAPH: Transmitter Spurious Emissions +/-25 MHz of the tuned center frequency.

CONDITIONS: Transmitter Fundamental. A1D Modulation, Crystal Frequency Determining Element.

SPECTRUM ANALYZER CONTROL SETTINGS

CENTER FREQUENCY:	433.92 MHz	INPUT ATTENUATION:	-10 dB
SCAN WIDTH:	50 MHz	PREAMPLIFIER GAIN:	0 dB
SCAN TIME:	50 mSec. / Div.	LOG REF. LEVEL:	0 dBm
RF BANDWIDTH:	300 KHz		
ANTENNA:	6" Whip Antenna on Analyzer Input	TUNED TO:	N/A
ANTENNA DISTANCE:	0.01 Meters	ANTENNA HEIGHT:	N/A
SYSTEM NOISE FLOOR:	N/A		

No emissions occur outside of the of the rated center freq. except for harmonic spurious signals.