# REPORT OF MEASUREMENTS

LINEAR CORPORATION
FCC ID: EF4 ACP00897
Model: MT-3 Remote Control Transmitter

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, 2001 and all other applicable revisions made by the Commission since that time.

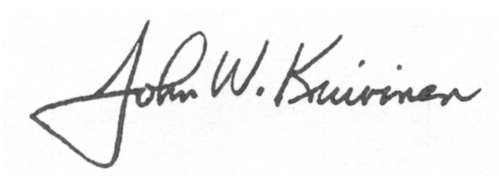
The specific rule sections for which the enclosed documents demonstrate compliance or rely upon to demonstrate compliance with the Commission's application and technical standards are as follows:

15.201-15.207, 15.231, Subpart C, Intentional Radiators.

Test Procedure C63.4-2001, Section 13, Measurement of Intentional Radiators was 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 23, 2001 (File 90767) is a portion of the Commission's records.

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




______________________________ __ September 24, 2002

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

# DURATION OF RF TRANSMISSIONS

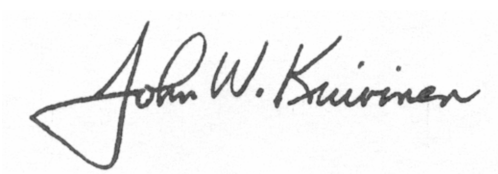
# MT-3

# REMOTE CONTROL TRANSMITTER

This transmitter is manually activated.  It is used only for remote control of a garage door operator.  As such, it may be operated continuously by the user (FCC Rules 15.231(a)(4)).  However, due to battery constraints and an accidental continuous activation causing interference to the system, the maximum manually activated transmission for a single press of a pushbutton is 30 seconds.

When the push button is released the transmitter ceases transmitting immediately.  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

# TESTING INSTRUMENTATION AND EQUIPMENT LIST

**SPECTRUM ANALYZERS**:

H.P. HP8562A 1KHz to 22GHz
S/N 2913A03742 Calibrated 12/01
Due 12/02

**ANTENNAS**:

(2) Ailtech DM105A T1 20-200 MHz Tuned Dipole
S/N 93412-105 and 93412-114 Calibrated 3/02 Due: 3/03
(2) Ailtech DM105A T2 140-400 MHz Tuned Dipole
S/N 93413-113 and 93413-117 Calibrated 3/02 Due: 3/03
(2) Ailtech DM105A T3 400-1000 MHz Tuned Dipole
S/N 93413-105 and 93414-111 Calibrated 3/02 Due 3/03
(2) AH Systems SAS-200/511 1-12.4 GHz Log Periodic
S/N 118 and 124, P/Ns 2069
(1) AH Systems SAS-200/540 20-330 MHz Biconical
S/N 367 P/N 2052

**INSTRUMENTATION**:

H.P. HP8656B RF Generator 100 KHz - 990 MHz
S/N A4229590 Calibrated 3/02
Due 3/03
Solar Electronics Line Impedance Stabilization Network, Type
8012-50-R-24-BNC Calibrated: 3/02
S/N 8379585 Due: 3/03
HP 8447D Broadband preamplifier, 0.1-1300 MHz
S/N 2443A03660 Calibrated: 3/02
Due: 3/03
Mini-Circuits ZFL-2000 broadband preamplifier, 10-3000 MHz
S/N Lin 001 Calibrated: 3/02
Due: 3/03

**ACCESSORIES**:

(2) Ailtech Rulers calibrated in MHz
4 Meter ABS Antenna Mast and Trolley
Tektronix C5C Scope Camera
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: 3/02
Due: 3/03

(2) 3' RG-55/U Low-loss Coaxial Cable, calibarated as part of the preamplifiers. Automatically taken into account when used with the above itemized range preamplifiers.

# MEASUREMENT OF RADIO FREQUENCY EMISSION OF CONTROL AND SECURITY ALARM DEVICES FCC RULES PART 15, C63.4-2001 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 Corporation, 2055 Corte del Nogal, Carlsbad, California 92009.

## 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 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 1.3 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 1.3 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

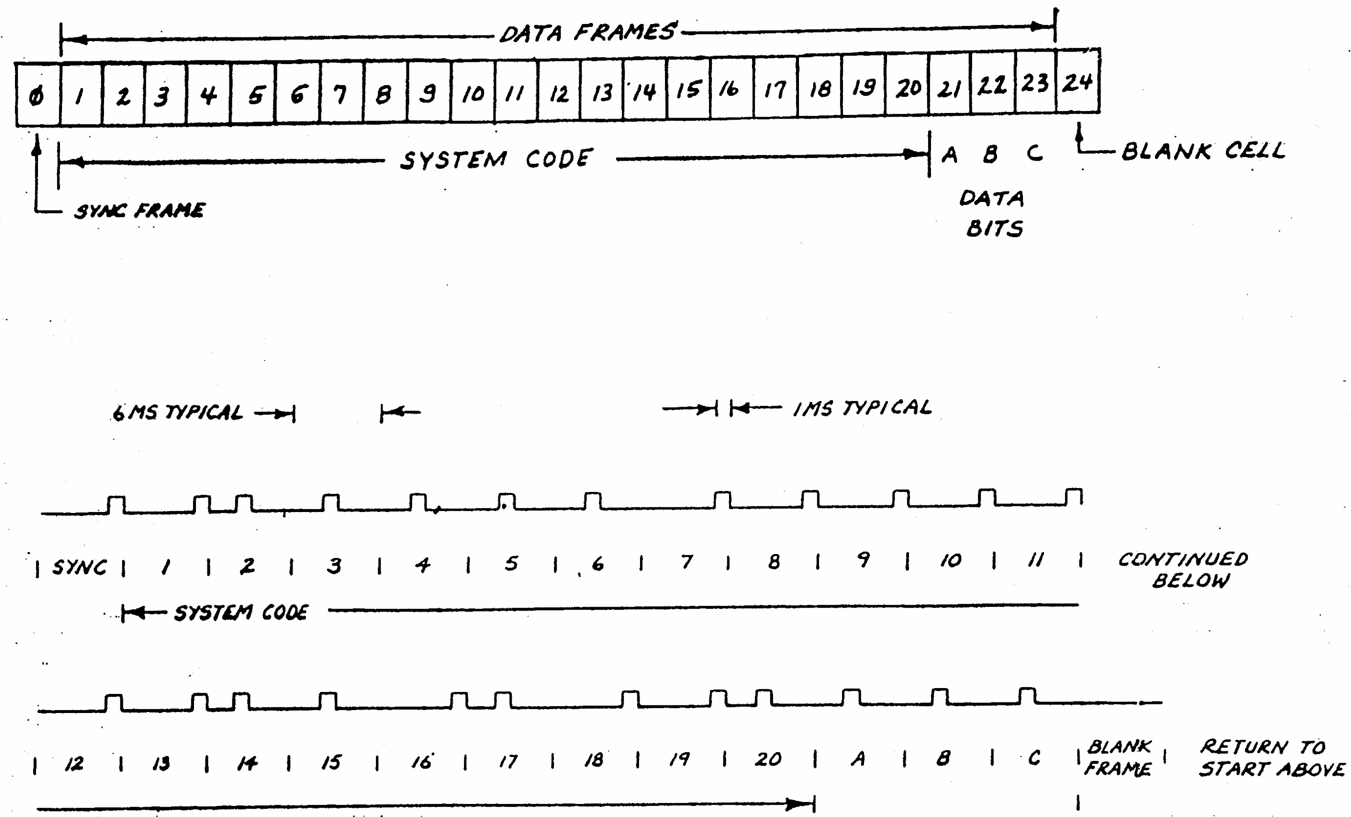
Transmitters

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 |

MEGACODE TIMING DIAGRAM



## Megacode Timing Diagram and Duty Cycle Calculations

Duty Cycle is fixed because binary-coded, pulse-position type A1D modulation is used. Modulation rate is fixed at 167 bits per second. Therefore, each bit frame occupies 6 ms.

During transmission, the transmitter sequentially emits a group of 25 pulses in the form of a pulse-keyed carrier. Each pulse (transmitter ON time) has a duration of one millisecond (ms).

REAL TIME ANALYSIS: Refer to Page 2 for timing diagram. From time zero, one synchronization pulse of 1 ms duration occurs within a 6 ms "bitframe." Elapsed time: 6 ms.

Each of the remaining 24 information pulses occupy a 1 ms duration position within a 6 ms wide "bit frame" (24 frames). Total elapsed time: 144 ms.

DUTY CYCLE FACTOR:

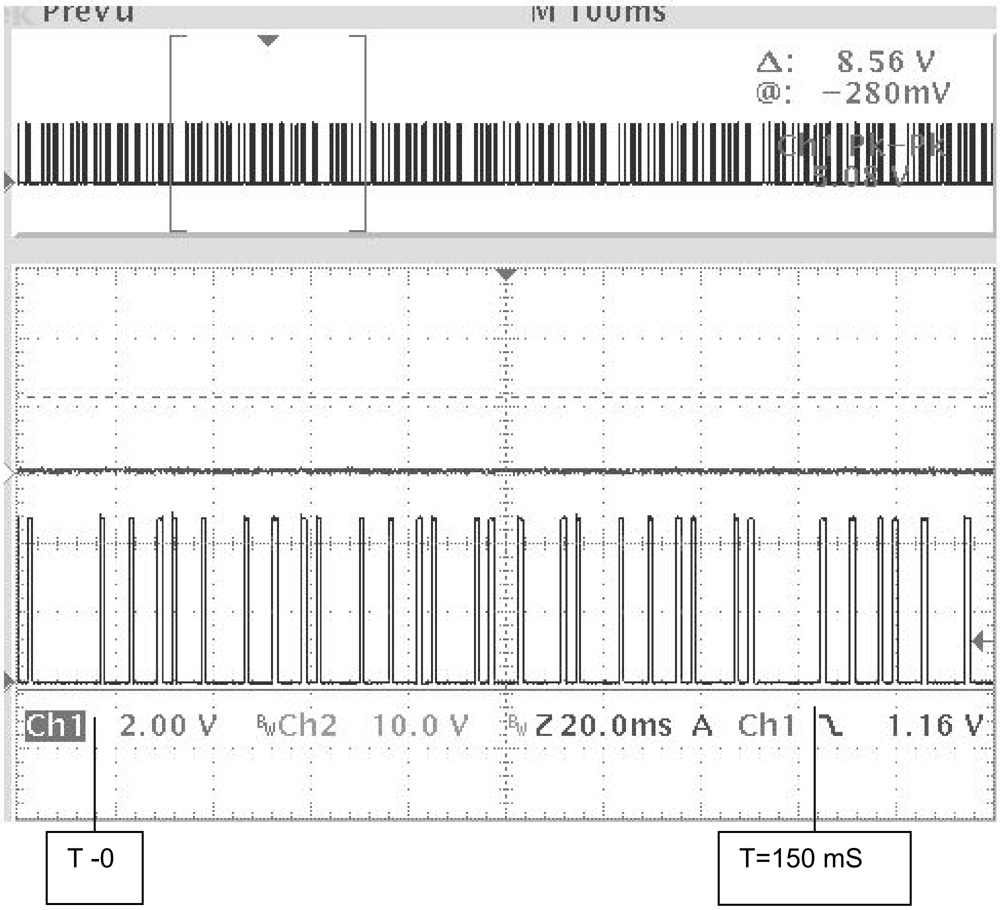
$$\frac{25 \text{ pulses (1ms)}}{150 \text{ ms}} = .1\overline{6}(20_{\log} \text{ voltage}) - -15.56\text{dB} \ (-16 \text{ practical})$$

This calculation is based on a 150 ms total cycle time which is representative of actual operation.

In compliance with Rule 15.205(b), the following duty cycle factor is used for all field strength calculations:
For a worst-case 100 ms interval occuring during the 144ms-long string of 24 bit frames:

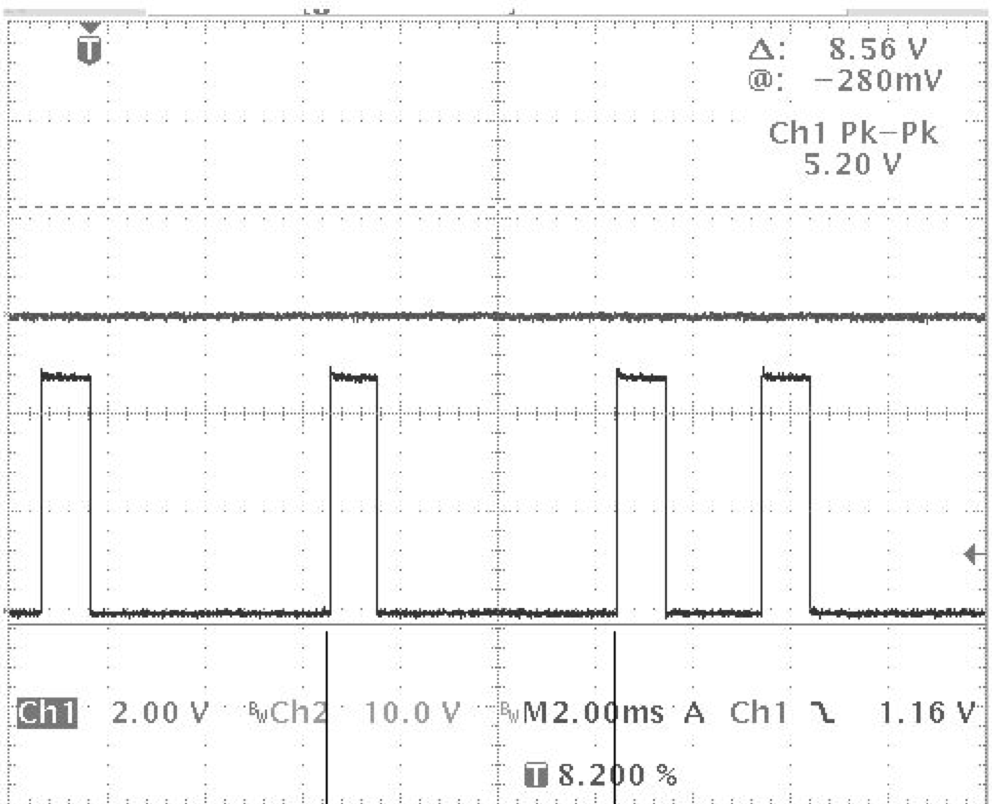
$$\frac{100 \text{ ms}}{6 \text{ ms}} \ \frac{\text{interval}}{\text{per frame}} = 16.\overline{6} \text{ frames average, 17 pulses possible.}$$

$$.17(20_{\log} \text{ voltage}) = -15.6 \text{ dB}$$




DATA WORD – TIME Zero TO END = 7.2 DIVISONS = 150 mSec.

MT-3 TRANSMITTER, OSCILLOSCOPE STORAGE ONTO FLOPPY DISK




6 mSec. data window, with 1 mSec. pulses

Single Data Pulses, 1 mSec. pulses in a 6 mSec. data window.

MT-3 Transmitter, Data Stream recorded from a storage oscilloscope onto a floppy disk.