Emissions Testing
Performed
on the
Martec
2-Button Remote Transmitter
Model: 5050

To

FCC Part 15 Subpart C, 15.231

Date of Test: February 2, 2001

Report Number: J20036277

Contact: Mr. Bernard Kasmir

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I – Introduction and Summary

TO: Mr. Bernard Kasmir
FROM: Nicholas Abbondante, Compliance Engineer
DATE: February 2, 2001
JOB #: J20036277

RE: Emissions Testing Performed on the 2-button Remote Transmitter, Model: 5050

On February 2, 2001 we tested the 2-button Remote Transmitter, Model: 5050 to determine if it was in compliance with the FCC Part 15, Subpart C, 15.231 for periodic transmitters. We found that the unit met the Part 15 requirements when tested as received.

A Prototype version of the sample was received on Wednesday, January 17th in good condition.

The following Table summarizes the results of testing.

Test	Frequency (MHz)	Measurement	Requirement	Pass/Fail	Section of FCC Rules	Section of Test Report
Fundamental Field Strength	302.866	68.7 dBµV/m	74.9 dBµV/m	Pass	15.231	Table 1
Restricted Band & Spurious Emissions	606.375	30.1 dBµV/m	54.9 dBµV/m	Pass	15.231 15.205	Table 1
Bandwidth	303	47 kHz	757 kHz	Pass	15.231	XI
Duty Cycle	N/A	31.68%	N/A	N/A	15.231	X

In summary, this report confirms that the Model: 5050 is compliant with the FCC Part 15, Subpart C, 15.231 requirements when production units conform to the initial sample. Please address all questions and comments concerning this report to Nicholas Abbondante, Compliance Engineer.

II – Technical Requirements

15.1 Scope

The 2-Button Remote Transmitter, Model: 5050, is a transmitter used to generate signals for use in garage door opener applications. It operates at 302.86 MHz.

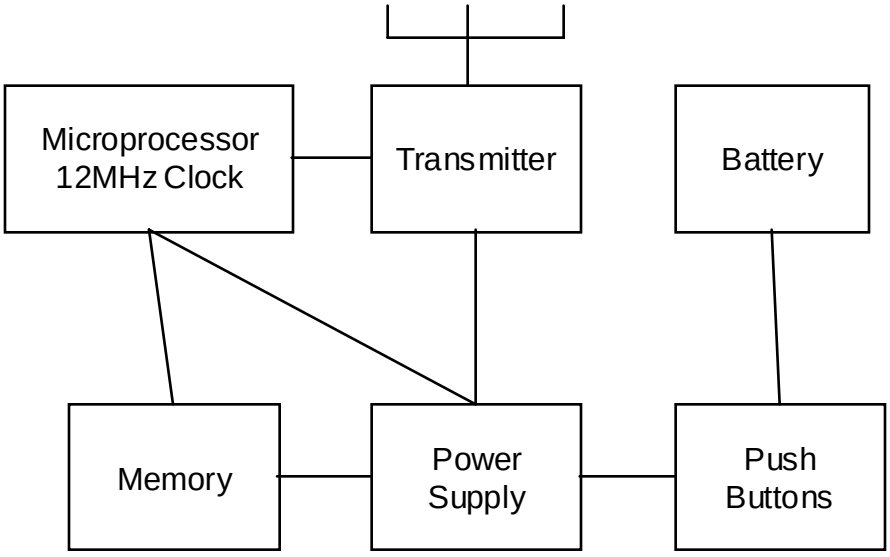
15.15 General Technical Requirements

The 5050 transmitter is a two-button transmitter used to generate signals for use in garage door opener applications. Activating each push-button generates a command code for activation of doors.

A 12-volt battery powers this device. The power supply generates operating voltage for the electronics. Activating a button turns on the power supply. The microprocessor then generates a code that activates the transmitter, which sends pulsed signals. Maximum clock for the microprocessor is 12 MHz. All of the circuitry is contained on a single printed circuit board. All timing is derived from 12 MHz oscillators.

For the purpose of FCC test requirements, the transmitter was wired to transmit continuously.

A system block diagram shows described functions and the microprocessor crystal clock frequency, which is 12 MHz.



15.27 Special Accessories

No special accessories are necessary for the Model 5050 to meet the compliance requirements.

15.31 Measurement Standards

The measurement procedures as specified by ANSI C63.4:1992 were used to test this device. See Section IV of the test report for a detailed description of the test site and the measurement equipment.

Please note that the transmitter was tested in a stand-alone configuration.

15.33 Frequency range of measurement

The device was scanned for spurious and harmonic emissions from 30 MHz to the 10th harmonic of the fundamental emission.

15.35 Measurement detector functions and bandwidth

The following table illustrates the detector functions and bandwidth used to test the device.

Frequency Range	Measurement Detector	Measurement Bandwidth
450 kHz to 30 MHz	Quasi-Peak	9 kHz
30 MHz to 1000 MHz	Quasi-Peak Peak*	120 kHz 120 kHz
1000 MHz to 10th harmonic	Peak*	1 MHz

The quasi-peak detector meets the requirements of CISPR 16.

*An averaging factor was used because the device operates with a 30.86% duty cycle. Peak measurements were performed on the transmitter fundamental and spurious emissions that did not fall within restricted bands in accordance with 15.205.

15.37 Transition Provisions

Transition provisions were not applied to the device. The device is not a receiver. The device does not operate in the band 902-905 MHz.

15.105 Information to the user.

The device is not a Class B digital device. Labeling requirements are those necessary for a Subpart C transmitter

15.107 Conducted limits.

The 5050 transmitter uses a battery as a power supply, and therefore does not need to be tested to conducted limits.

15.201 Certification

The device is required to be certified in accordance with Part 2 of the FCC rules, Subpart J.

15.203 Antenna Requirements

The antenna is part of the device circuit board, and may not be removed without destroying the integrity of the device.

15.204 External Radio Amplifier

The device is not an amplifier.

15.205 Restricted bands of operation

The maximum measured field strength allowable by 15.231 is higher than that allowed by 15.209. All unwanted emissions from the transmitter, within restricted bands, were compared to the general limits in 15.209.

See section 15.35 for explanation of how detector functions were used during testing.
All measurements outside of restricted bands were measured using a peak detector and the calculated average factor was applied to the measurements. The requirement that peak emissions not exceed average is met mathmatically.

15.207 Conducted limits

The device derives its power only from a 12 volt battery. Line conducted emissions tests were not performed.

15.209 Radiated emission limits; general requirements

All unwanted emissions from the transmitter, within restricted bands, were compared to the general requirements.

15.231 Periodic operation in the band 40.66-40.70 MHz and above 70 MHz

Paragraph A - Requirement Summary

Requirement	How the Device Meets the requirement	Deviations	Pass /Fail
Frequency Range: 40.66 – 40.7 MHz and above 70 MHz.	The device operates at one frequency 303MHz. This is within the specified band and not within a restricted band.	None	Pass
Periodic Operation?	The device is a periodic transmitter	None	Pass
Control Signal?	The control signal identifies the transmitter and the door.	None	Pass
Radio Control of a toy?	The device does not operate a toy	None	Pass
Continuous Data Transmission?	The device does not continuously transmit voice, video or data	None	Pass
Manually Operated transmitter that employs a switch to auto-shut-off before 5 seconds of being released.	The device is a manually operated transmitter. When the button on the casing is pressed. Once one of the buttons is un-pressed the transmission stops.	None	Pass
A transmitter activated automatically shall cease transmission withing 5 seconds	Not applicable, not automatic transmissions	None	Pass
Periodic transmission at regular pre-determined intervals is not permitted	Not applicable, no periodic transmission at pre-determined intervals. The device is activated manually.	None	Pass
Polling and Supervision transmission of safety and security devices to determine system integrity is one transmiision that is less than 1 second per hour.	No polling or supervisory transmissions	None	Pass
Employed for radio control during an emergency (fire, security, safety of life)	The device is not used for any emergency situations	None	Pass

(b) Field Strength Requirements
Note: The requirements of Section 15.205 are in addition to the following requirements.

Frequency Range (MHz)	Fundamental Field Strength at 3 meters* (μV/m)	Spurious Emissions At 3 meters*(***) (μV/m)
40.66 to 40.70	2,250	225
70 to 130	1,250	125
130 to 174	1,250 to 3,750 **	125 to 375 **
174 to 260	3,750	75
260 – 470	3750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

* Measured with an average detector or alternatively with Quasi-Peak detector
** linear interpolation
*** Based on the fundamental frequency

The Fundamental field strength limit is calculated as follows:
The frequency is 303MHz, therefore using the frequency range 260 to 470 MHz (Limit is 3,750 to 12,500 μV) the limit is 74.9dBuV/m. The spurious and harmonic emission limit is 20 dB lower than the fundamental.

Field Strength Measurement Summary

Requirement	Frequency	Measured Value	Required Value	Data Location	Pass/Fail
Fundamental Field Strength	302.866 MHz	68.7	74.9	p.21	Pass
Worst-case Spurious Emission	606.375 MHz	30.1	54.9	p.21	Pass

(c) Bandwidth Requirements – Shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Bandwidth Summary

Frequency (MHz)	Requirement (Bandwidth must be less than)	Measured Value	Resolution Bandwidth	Data Location	Pass/Fail
302.866	757 kHz	47 kHz	10 kHz	p.26	Pass

(d) For devices operating within the frequency band 40.66 - 40.70 MHz, the bandwidth of the emission shall be confined within the band edges and the frequency tolerance of the carrier shall be + 0.01%. This frequency tolerance shall be maintained for a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

This device does not operate between 40.66-40.70 MHz.

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) and may be employed for any type of operation, including operation prohibited in paragraph (a)

This device meets the requirements of paragraph (a).

Test Method Justifications

For maximizing emissions, the system was rotated through 360°, the antenna height was varied from 1 meter to 4 meters above the ground plane, and the antenna polarization was changed.

The EUT was mounted on a non-conductive box to allow the engineer to manipulate the EUT in the three orthogonal axes.

The unit was operated standalone and placed in the center of the turntable.

The device was powered from a new, fully charged 12V battery.

For simplicity of testing, the unit was wired to transmit continuously.

Part 2

2.201 Emission Modulation and transmission characteristics

The emission designator is determined as follows:

Bandwidth is measured to be: 47 kHz. This gives 47K0.

The transmitter is a pulse-type circuit which is pulsed at a set frequency and for a set duration. Therefore the first symbol is: L.

There is a single channel of quantized digital information without the use of a modulating sub-carrier. Therefore the second symbol is: 1.

There pulse carries data. Therefore the third symbol is: D.

The emissions designator is:

47K0L1D

2.1041 Measurement Procedures

Only the measurement procedures of Part 15 are required for this device. The device was not evaluated to the requirements of 2.1046 through 2.1057.

2.1091 Radiofrequency radiation exposure evaluation: Mobile Devices

The device does not meet the definition of a Mobile Device.

2.1093 Radiofrequency radiation exposure evaluation: Portable Devices

a portable device (That is it is not intended to operate within 20 cm of a persons body). The device does not fall under any of the categories that require routine RF exposure measurements and is therefore exempt from the requirements of this section.

III - Attestation

LABORATORY MEASUREMENTS

Pursuant To
Part 15, Subpart C
For
Intentional Radiators

Company Name:	Martec Access Products
Address:	240 Sheffield Street Mountainside NJ 07092 (908) 233-0691
Model:	2-button Transmitter Model 5050
Date of Test(s):	February 2, 2001
Test Site Location:	INTERTEK TESTING SERVICES NA INC. 70 Codman Hill Road Boxborough, MA 01719
Site:	2

I attest to the accuracy of this report:

Signature	Signature
	Michael J. Peters
Testing Performed By	Reviewer
Compliance Engineer	Senior Project Engineer
Title	Title

IV - Site Description and Measurement Equipment

The following is a description of the test procedure used by Intertek Testing Services in the measurements of transmitters operating under Part 15, Subpart C, General Requirements.

A. **Test Set-Up**: The test set-up and procedures described below are designed to meet the requirements of ANSI C63.4 (1992).

1. The test site is a Plastic/Fiberglass structure with a groundplane. The site has attenuation characteristics which meet the requirements of ANSI C63.4 (1992). Information on the site has been filed with the FCC as required by Rule 2.948. The address of the site is 70 Codman Hill Road, Boxborough, MA 01719.

2. Power to the site is nominal line voltage of 117 V_{AC} and 230 V_{AC}, 60 Hz.

3. The equipment under test (EUT) is placed on a wooden turntable which is four feet in diameter and approximately one meter in height above the groundplane. During the radiated emissions test, the turntable is rotated 360 degrees and any cables leaving the EUT are manipulated to find the configuration resulting in maximum emissions. The antenna height and polarization are also varied during the search for maximum signal levels. The height of the antenna is varied from one meter to four meters. Body-worn, hand-held and small portable devices are mounted on a non-conductive box and emissions are investigated on three orthogonal axis.

4. Detector function for radiated emissions is in peak or quasi-peak mode. Average readings, when required, are taken by measuring the duty cycle of the equipment under test and subtracting the corresponding amount in dB from the measured peak readings according to the following formula:

   Averaging Factor in dB = 20 LOG (duty cycle)

   The time period over which the duty cycle is measured is 100 msec. The worst-case (highest percentage on) duty cycle is used and described specifically in the data section. The duty cycle is measured by placing the spectrum analyzer in zero scan (receiver mode) and linear mode at maximum bandwidth (3 MHz at 3 dB down) and viewing the resulting time domain signal output from the analyzer on a Tektronix 465 Oscilloscope. The oscilloscope is used because of its superior time base and triggering facilities.

5. Antennas used below 1000 MHz were EMCO Model 3142 Biconolog Antennas and Compliance Design Inc. Model A100 tuned Dipole Antennas. For measurements between 1000 MHz and 18000 MHz above 1 GHz, an EMCO Model: 3115 Horn Antenna is used. The Antennas used are listed in the Test Equipment Summary in Section 6.
6. The field strength measuring equipment used included:

The following equipment was used to make measurements for emissions testing:

Description	Manufacturer	Model	Serial #	Cal Due
Oscilloscope	Tektronix	TDS380	B011379	10/04/2001
RECEIVER	HEWLETT PACKARD	85422E	3625A00188	11/21/2001
RF FILTER	HEWLETT PACKARD	85420E	3427A00177	11/21/2001
BICONOLOG	EMCO	3142	9711-1223	11/17/2001

7. The frequency range to be scanned is from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency, or 40 GHz, whichever is lower. For line-conducted emissions, the range scanned is 450 kHz to 30 MHz.

8. The EUT is warmed up for 15 minutes prior to the test. AC power to the unit is varied from 85% to 115% nominal and variation in the fundamental emission field strength is recorded. If battery powered, a new battery is used.

9. Conducted measurements were made as described in ANSI C63.4 (1992). An IF bandwidth of 9 kHz is used, and peak or quasi-peak detection is employed.

10. The IF bandwidth used for measurement of radiated signal strength was 100 kHz or greater below 1000 MHz. Where pulsed transmissions of short enough pulse duration warrant, a greater bandwidth is selected according to the recommendations of Hewlett Packard Application No. 150-2. A discussion of whether pulse desensitivity is applicable to this unit is included in this report. Above 1000 MHz, a bandwidth of 1 MHz is generally used.

11. Transmitter measurements are normally conducted at a measurement distance of three meters. However, to assure low enough noise floor in the forbidden bands and above 1 GHz (where no preamplifier is used), signals are acquired at a distance of one meter or less. All measurements are extrapolated to three meters using inverse scaling, but those measurements taken at a closer distance are so marked.

12. For measurements made in the 9 kHz to 30 MHz range, a distance of 30 meters was used unless a good signal-to-noise ratio could not be obtained. In that case, a closer distance was used and that distance is so marked in the data table.

V – Summary of Equipment Under Test

1	**Manufacturer**:	Martec Access Products 240 Sheffield Street Mountainside NJ 07092 (908) 233-0691 Contact: Bernard Kasmir
2	**Grantee**:	Martec Access Products 240 Sheffield Street Mountainside NJ 07092 (908) 233-0691 Contact: Bernard Kasmir
3	**Model No.**:	5050
4	**Trade Name**:	2-button Remote Transmitter
5	**Serial No.**:	2000849A (assigned by ITS for tracking purposes)
6	**Date of Test**:	2/2/01
7	**Frequencies to which device can be tuned**:	303 MHz
8	**Can customer tune device?**	No
9	**Detailed description of operation pursuant to 15.209**:	See 15.209
10	**Applicable emissions limits**:	15.205, 15.209, 15.231

VI - Configuration Information

Equipment Under Test: Transmitter

Model: 5050

Serial No.: 2000849A (assigned by ITS for tracking purposes)

FCC Identifier: Non assigned as of this report

Support Equipment:

None

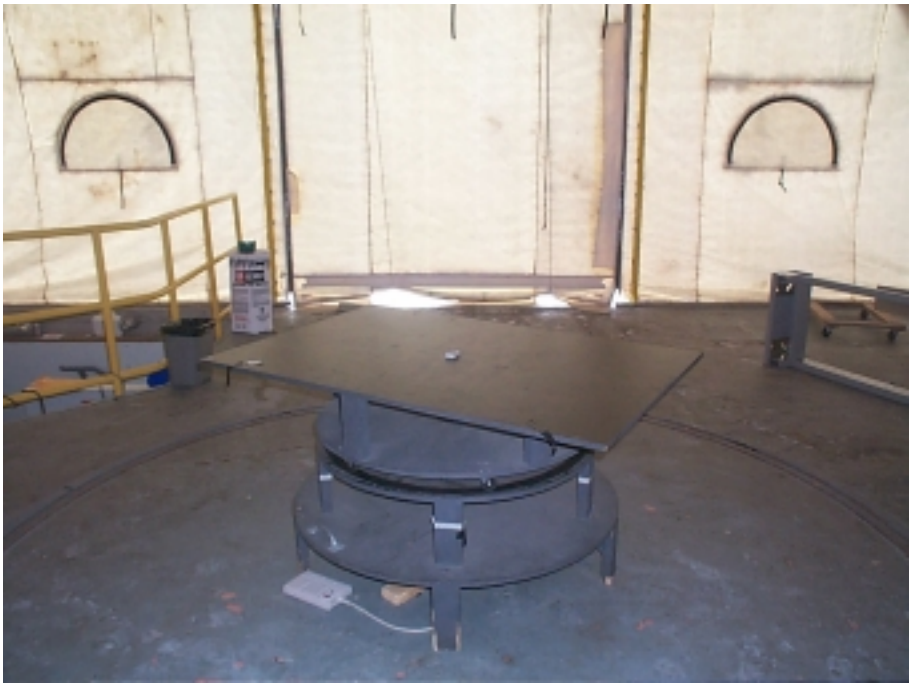
Cables:

QTY	Description	Shield Description	Hood Description	Length (m)

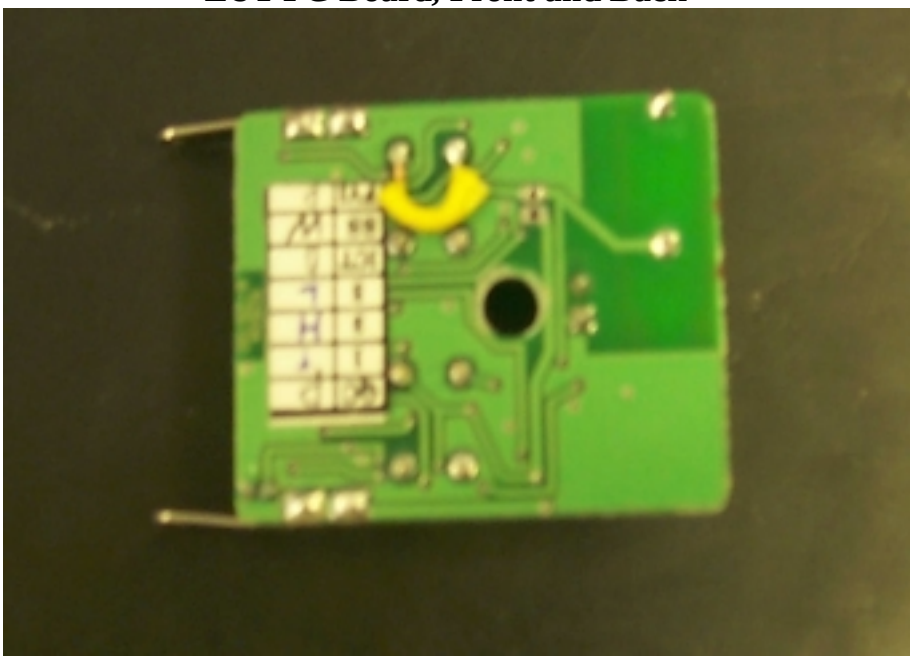
None

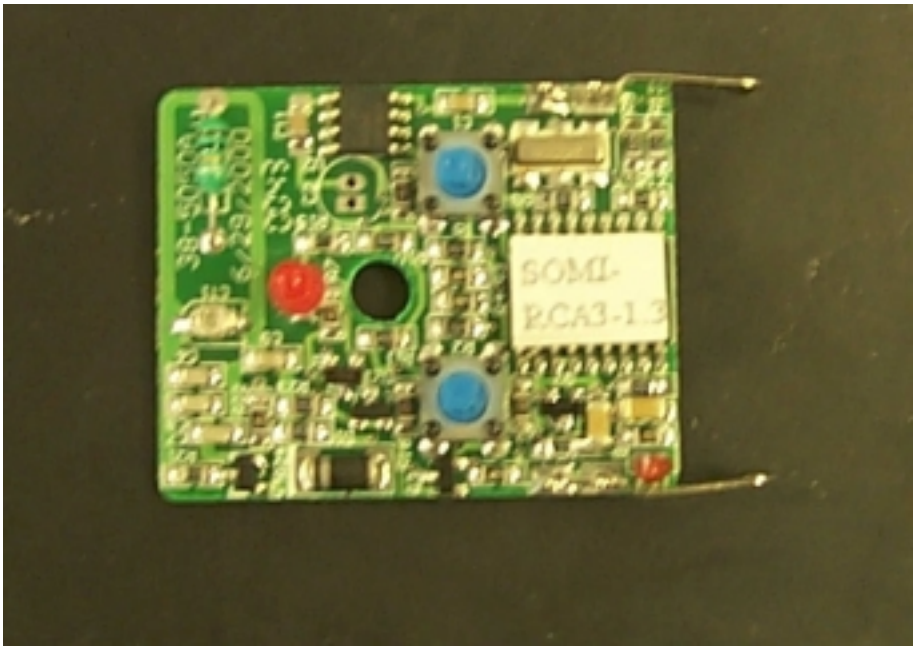
VII - Configuration Photographs

Worst-Case Radiated Emissions



EUT PC Board, Front and Back





EUT Outer Casing, Front and Back

VIII - Sample Calculation

The following is how net field strength readings were determined:

NF = RF + AF + CF + PF + DF

Where,

NF = Net Reading in dBµV/m
RF = Reading from receiver in dBµV
AF = Antenna Correction Factor in dB(1/m)
CF = Cable Correction Factor in dB
AVF = Duty Cycle Correction Factor in dB
DF = Distance Factor in dB (using 20 dB/decade), from 3 to 1 meters 10.5 dB was added for measurements performed at 1 meter

To convert from dBµV/m to µV/m or mV/m the following was used:

$UF = 10^{(NF / 20)}$

Where,

UF = Net Reading in µV/m

Example:

For the fundamental field strength measurement at 8.4 (distance = 3 meters) see table [1].

NF = NF = RF + AF + CF + AVF + DF = 62.9 + 13.7 + 2.1 + (–10.0) + 0.0 = 68.7 dBµV/m

$UF = 10^{(68.7\ dB\mu V / 20)} = 2722.7\ \mu V/m$

IX - Data Tables

Intertek Testing Services

Radiated Emissions / Interference

Table: 1

Company: **Martec**
Model: **5050-2**
Job No.: **J20036277**
Date: 02/02/01
Standard: FCC15
Class: A Group: None
Notes: Transmitting

Tested by: Candy Campbell
Location: Site 2C
Detector: HP 8542E
Antenna: LOG2 10-11-99 H10
PreAmp: None
Cable(s): 2C-3m 3-19-00
Distance: **3** meters

	Ant. Pol. (V/H)	Frequency MHz	Reading dB(uV)	Antenna Factor dB(1/m)	Cable Loss dB	Average Factor dB	Distance Factor dB	Net dB(uV/m)	Limit dB(uV/m)	Margin dB
Peak	H	302.866	62.9	13.7	2.1	-10.0	0.0	68.7	74.9	-6.2
Peak	H	606.375	16.9	20.5	2.7	-10.0	0.0	30.1	54.9	-24.8
Peak	V	606.375	11.4	20.5	2.7	-10.0	0.0	24.5	54.9	-30.4
Peak	H	909.350	9.8	23.9	4.0	-10.0	0.0	27.7	54.9	-27.2
Peak	V	909.350	5.0	23.9	4.0	-10.0	0.0	23.0	54.9	-31.9

No other emissions were detected above the measurement equipment noise floor
which is at least 6 dB below the limit
Scanned from 30 MHz to 3.030 GHz

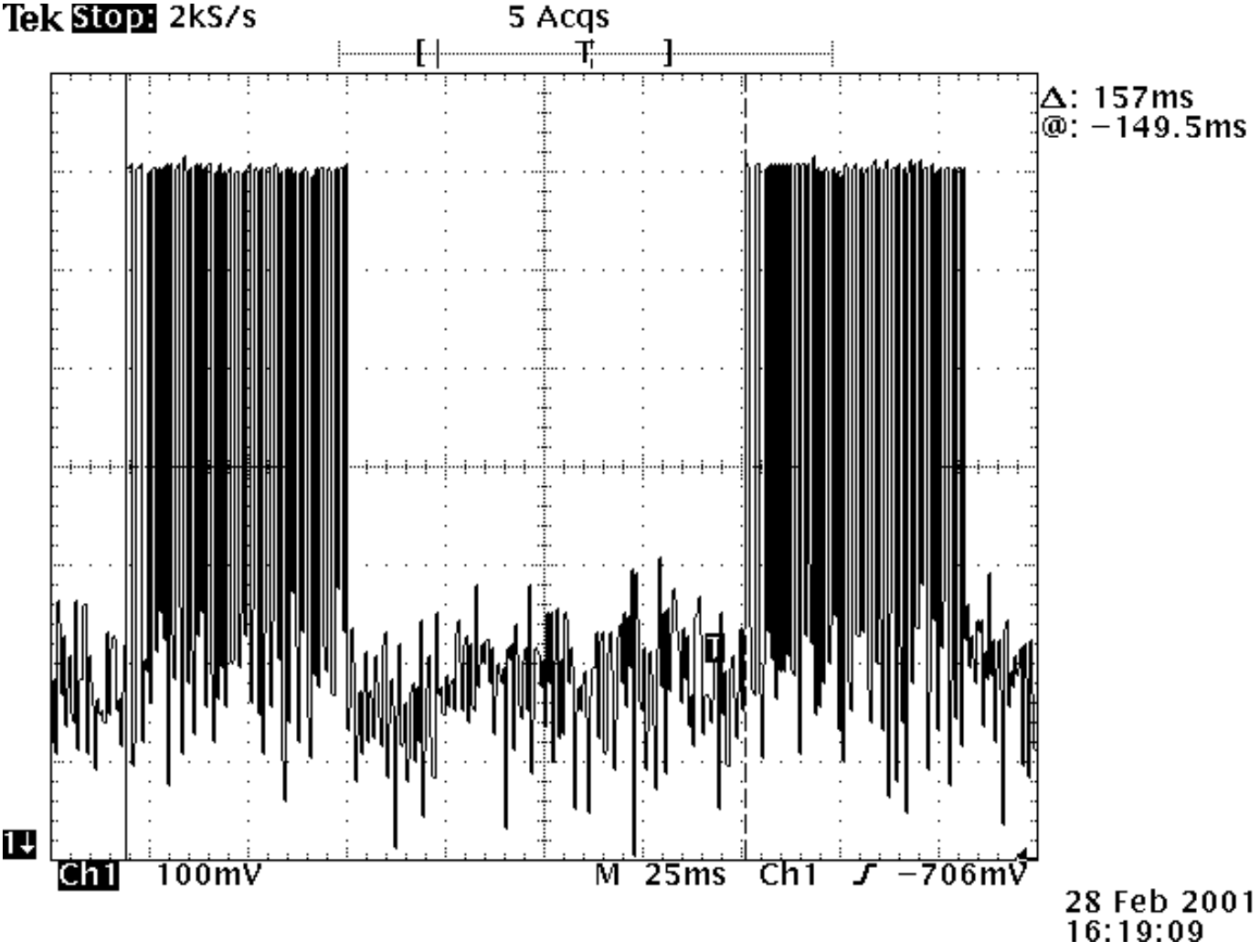
Resolution Bandwidth used is 120 kHz from 30 to 1000 MHz
is 1000 kHz over 1000 MHz

X - Duty Cycle (Average Factor)

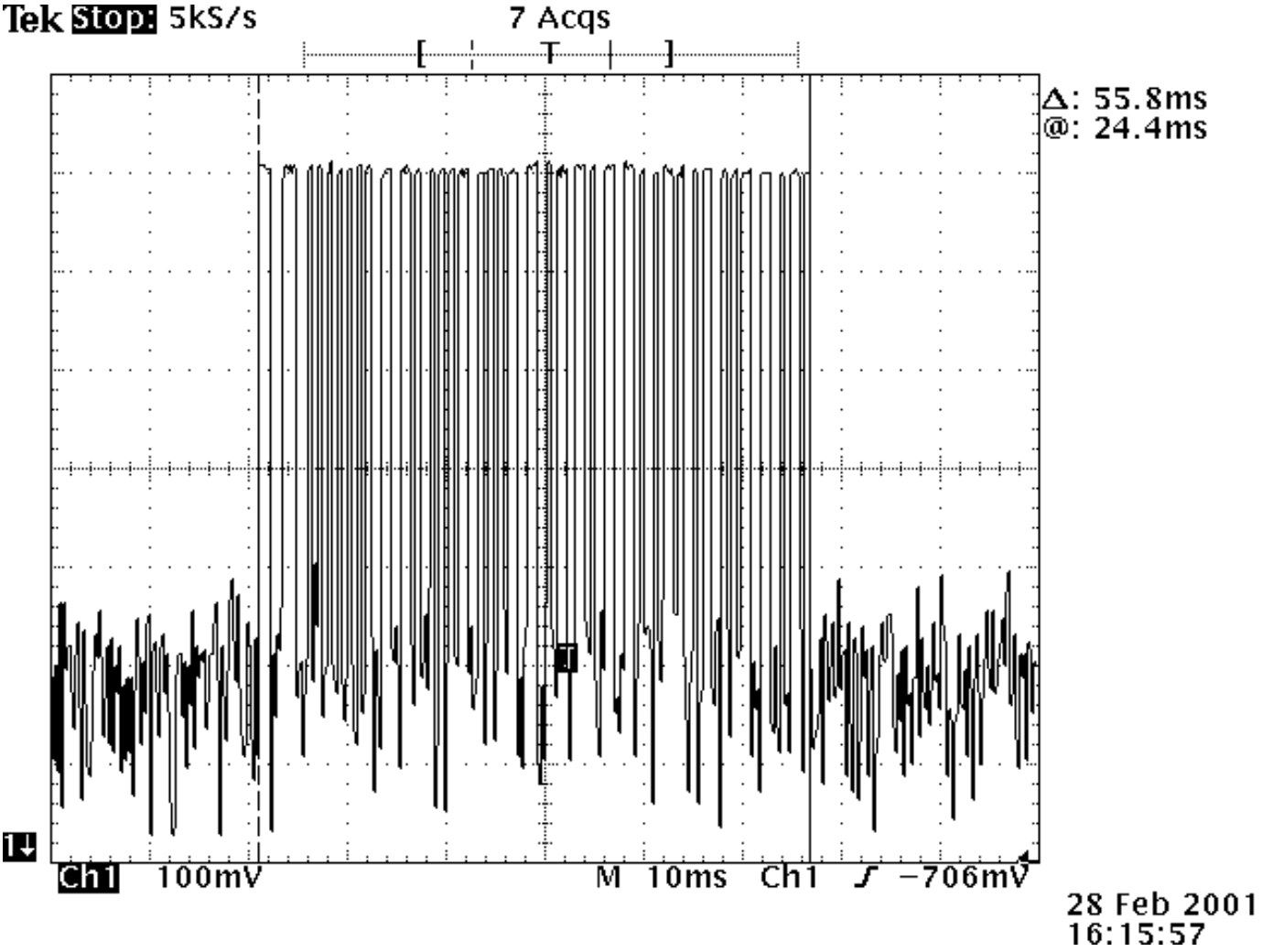
The average factor is subtracted from peak readings to compare emissions readings to average limits. The average factor is calculated from duty cycle measurements from the following plots. The average factor is 20 Log (ON-TIME/PERIOD) of the emission. If the period is longer than 100 milliseconds then 100 milliseconds is used for the period. Average factor is determined using the worst-case duty cycle.

Model 5050 Duty Cycle Derivation

The Model 5050 2-button Remote Transmitter generates a pulse of fixed duration and period. The transmit pulse waveform is shown below. The period betwen pulses is 157ms.

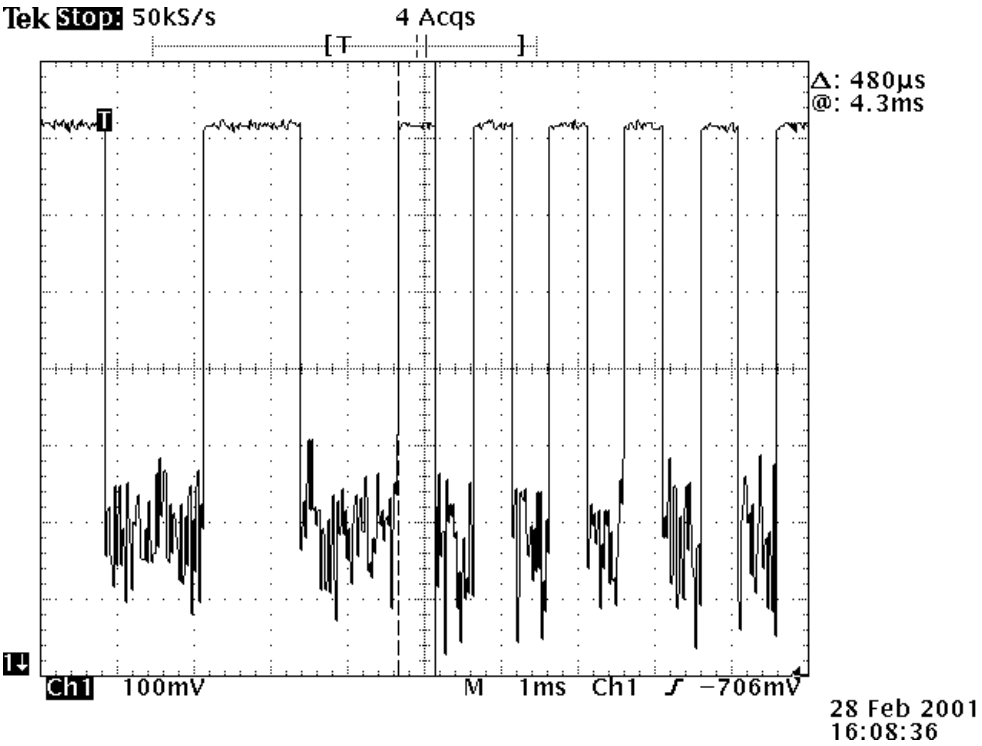


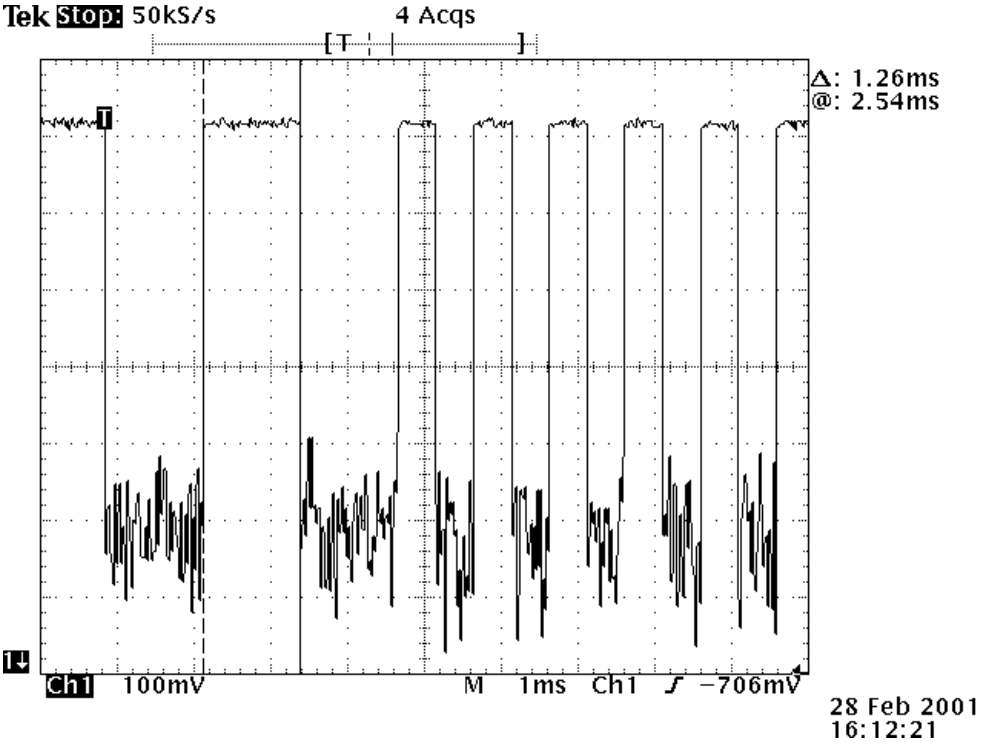
The plot below shows the pulse train. The pulse train duration is 55.8ms. There are 24 narrow peaks and 16 wide peaks.



The next two plots show the width of the narrow and wide pulses. The narrow pulses are 0.48ms, and the wide

pulses are 1.26ms.





Given 24 narrow peaks of length 0.48ms, and 16 wide peaks of 1.26ms, and a transmission length of 157ms, we

can perform the average factor calculation. The transmission length exceeds the maximum period of 100ms, so we use 100ms instead.

20 Log((0.48ms*24+1.26ms*16) /100ms) = -10 dB

Maximum duty cycle over a 100ms period is 31.68% resulting in an averaging factor of 10 dB.

XI - Bandwidth

The following plot(s) show bandwidth measurements made. The Bandwidth is measured at 20dB down from the fundamental frequency.