

COMMUNICATION CERTIFICATION LABORATORY

1940 West Alexander Street
Salt Lake City, UT 84119
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Test Report

Certification

Test Of:

TC-PhotoGate A

FCC ID: XVABTS

Test Specification:

FCC PART 15, Subpart C

Test Report Serial No: 2424

Applicant:

Brower Timing
12660 South Fort Street #102
Draper, UT 84020

Date of Test: October 27, 2009

Issue Date: November 2, 2009

Accredited Testing Laboratory By:



NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory to determine compliance of the device described below with the certification requirements of FCC Part 15, Subpart C. This report may be reproduced in full, partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: Brower Timing
- Manufacturer: Brower Timing
- Brand Name: Brower Timing
- Model Number: TC-PhotoGate A
- FCC ID Number: XVABTS

On this 2nd day of November 2009, I, individually, and for Communication Certification Laboratory, certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has accredited the Communication Certification Laboratory EMC testing facilities, this report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

COMMUNICATION CERTIFICATION LABORATORY



Tested by: Norman P. Hansen
EMC Technician

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SECTION 1.0 CLIENT INFORMATION

1.1 Client Information:

Company Name: Brower Timing
12660 South Fort Street #102
Draper, UT 84020

Contact Name: Mark Brower
Title: Manager

1.2 Manufacturer:

Company Name: Brower Timing
12660 South Fort Street #102
Draper, UT 84020

Contact Name: Mark Brower
Title: Manager

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)**2.1 Identification of EUT:**

Brand Name:	Brower Timing
Model Number:	TC-PhotoGate A
Serial Number:	None

2.2 Description of EUT:

The TC-PhotoGate A, when used with the TC-PhotoGate B, create an event timing system. The TC-PhotoGate B is an IR emitter. The TC-PhotoGate A is an IR receiver and 432.8 MHz transmitter using OOK modulation. Breaking the IR beam between the units causes the TC-PhotoGate A to transmit a pulse train that is received by a Brower Timing receiver. The TC-PhotoGate A is powered by 3 AAA batteries. There is no provision for connecting the EUT to the AC mains or a device connected to the AC mains. The antenna is mounted to the PCB of the EUT by a screw and nut.

This report covers the transmitter circuitry of the device subject to FCC Part 15, Subpart C. The digital circuitry of the TC-PhotoGate A, subject to FCC Part 15, Subpart B, is to be covered in separate testing and report.

2.3 Modification Incorporated/Special Accessories on EUT:

The following modification was made to the TC-PhotoGate A by the Client during testing to comply with the specification. These modifications will be implemented during manufacturing.

1. The output power setting was lowered to 7.8 dB from 9 dB.

Signature: _____

Typed Name: Mark Brower

Title: Manager

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES**3.1 Test Specification:**

Title: FCC PART 15, Subpart C (47 CFR 15)
Section 15.203
Section 15.231

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

Purpose of Test: The tests were performed to demonstrate Initial compliance.

3.2 Methods & Procedures:**3.2.1 §15.203**

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

3.2.2 §15.231

(a) The provision of this section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as Shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Radio control of toys is not permitted. Continuous transmissions, such as voice or video, and data transmissions are not permitted. The prohibition against data transmissions does not preclude the use of recognition codes. Those codes are used to identify the sensor that is activated or

to identify the particular component as being part of the system. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmission to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(b) In addition to the provisions of §15.205, the field strength of emission from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 -130	1,250	125
130 - 174	1,250 to 3,750 **	125 to 375 **
174 - 260	3,750	375
260 - 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** Linear interpolations

[Where F is the frequency in MHZ, the formula for calculating the maximum permitted field strengths are as follows: for the band 130 - 174 MHz, $\mu\text{V/m}$ at 3 meters = $56.81818(F) - 6136.3636$; for the band 260 - 470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

(1) the above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provision in §15.35 for averaging pulsed emission and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emission in the above table are based on the fundamental frequency of the intentional radiator. Spurious emission shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

(c) The bandwidth of the emission 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.

(d) For devices operation 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 $\pm 0.01\%$. 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 on 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.

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided that intentional radiator complies with the provisions of paragraphs (b) through (d) of this section except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66 - 40.70	1,000	100
70 -130	500	50
130 - 174	500 to 1,500 **	50 to 150 **
174 - 260	1,500	150
260 - 470	1,500 to 5,000 **	150 to 500 **
Above 470	5,000	500

** Linear interpolations

[Where F is the frequency in MHZ, the formula for calculating the maximum permitted field strengths are as follows: for the band 130 - 174 MHz, $\mu\text{V/m}$ at 3 meters = $22.72727(F) - 2454.545$; for the band 260 - 470 MHz, $\mu\text{V/m}$ at 3 meters = $16.6667(F) - 2833.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent periods between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

3.3 Test Procedure

The testing was performed according to the procedures in ANSI C63.4 (2003). Testing was performed at CCL's Wanship open area test site #2, located at 29145 Old Lincoln Highway, Wanship, UT. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated March 11, 2009 (90504).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accredited under NVLAP Lab Code: 100272-0, which is effective until September 30, 2010.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: The TC-PhotoGate A is powered by 3 AAA batteries.

4.2 Operating Modes:

The EUT was tested on 3 orthogonal axes while constantly transmitting. Photograph 1 of Appendix 2 shows the worst-case emission configuration.

4.3 EUT Exercise Software:

No software was required.

SECTION 5.0 SUMMARY OF TEST RESULTS**5.1 FCC PART 15, Subpart C****5.1.1 Summary of Tests:**

Section	Test Performed	Frequency Range (MHz)	Result
15.203	Antenna Requirement	N/A	Complied
15.231 (a)	Periodic Operation	432.8	Complied
15.231 (b)	Radiated Emissions	30 to 4328	Complied
15.231 (c)	Bandwidth	432.8	Complied
15.231 (d)	Frequency Stability	40.66 to 40.70	Not Applicable
15.231 (e)	Radiated Emissions	30 to 4328	Not Applicable

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS**6.1 General Comments:**

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

6.2 Test Results:**6.2.1 15.203****Demonstration of Compliance:**

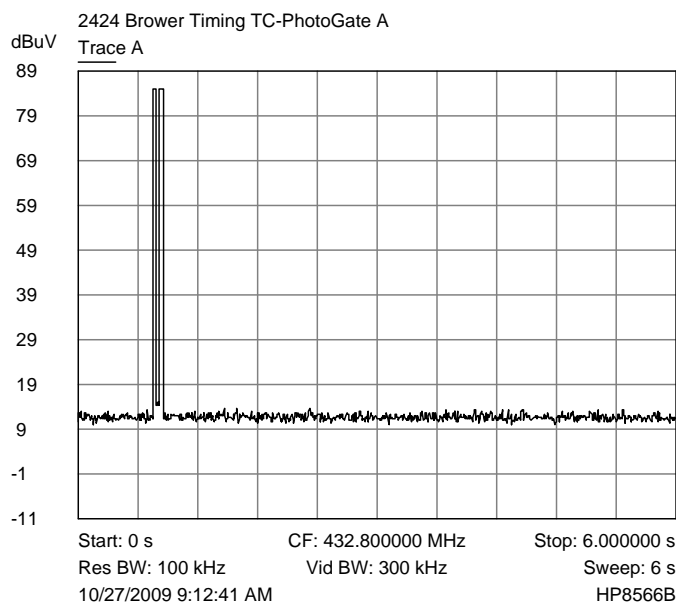
The antenna is mounted to the PCB using a bolt and nut. The antenna is not designed to be replaced by the user and can not be replaced without disassembling the EUT.

RESULT

The EUT complied with the requirements of this section.

6.2.2 §15.231 (a)**Demonstration of Compliance:**

1. The transmitter is activated when the IR signal between the TC-PhotoGate A and B is interrupted. Transmission is less than 5 seconds. See the plot below:



Trace A on to off in less than 5 seconds

2. The TC-PhotoGate A does not transmit at regular predetermined intervals. The TC-PhotoGate A only transmits if activated by an interruption of the IR signal.

RESULT

In the configuration tested, the EUT complied with the requirements of this section.

6.2.3 §15.231 (b) Radiated Emissions

Demonstration of Compliance:

The TC-PhotoGate A operates at 432.8 MHz, therefore; the field strength of the fundamental must be less than 10950 $\mu\text{V/m}$ (80.8 dB $\mu\text{V/m}$) at 3 meters. The maximum permitted field strength of any unwanted emission must be 20 dB below the maximum allowable fundamental field strength (60.8 dB $\mu\text{V/m}$).

Emissions in the restricted bands of §15.205 must meet the limits specified in §15.209.

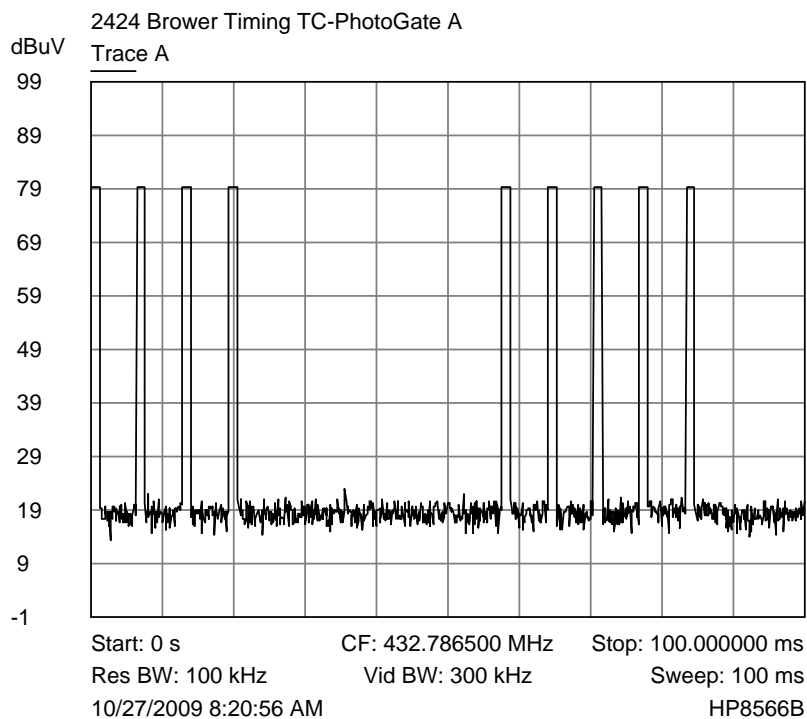
Measurement Data Fundamental and Harmonic Emissions:

The frequency range from 30 MHz to the tenth harmonic of the highest fundamental frequency was investigated to measure any radiated emissions.

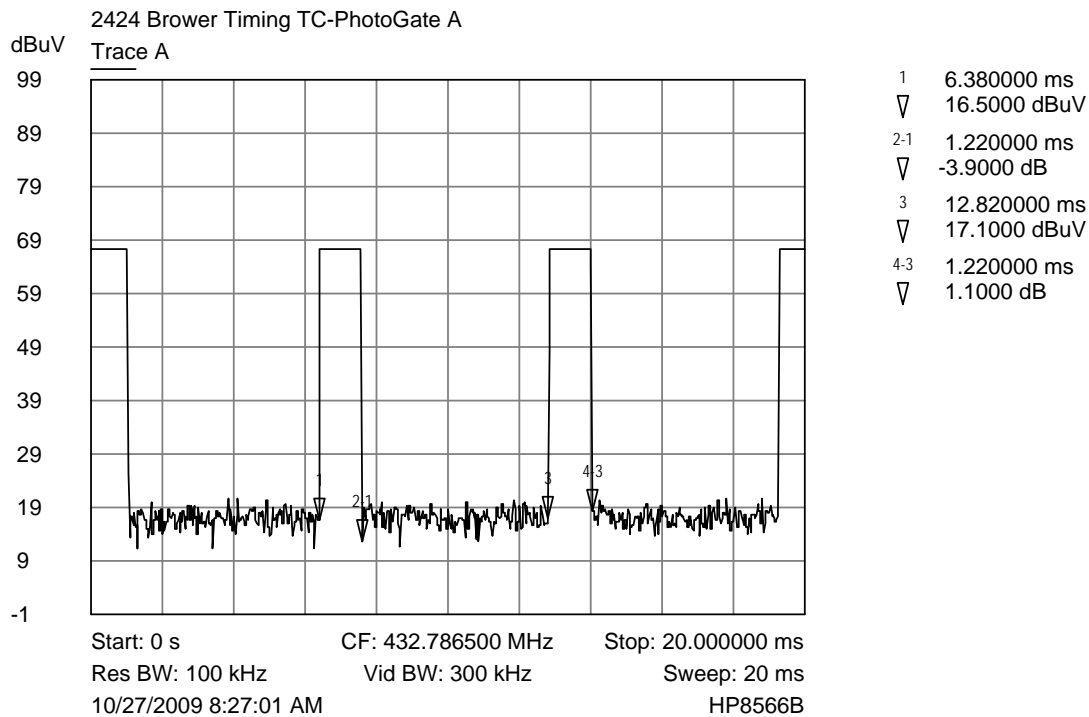
A diagram of the test configuration and test equipment used is enclosed in Appendix 1.

Pulsed Emission Averaging Factor

The TC-PhotoGate A transmitter is a pulsed emission device; therefore, the method of §15.35 for averaging a pulsed emission may be used. Plots of the pulse train and the average factor calculations are shown below:



Trace A 100 ms pulse train plot for average factor calculation



Trace A 20 ms pulse duration plot for average factor calculation

Average factor calculation

From the plots, the pulse train consists of 9 pulses with a maximum pulse width of 1.22 ms over a time of 100 ms.

The Average Factor is calculated by the equation:

Average Factor = $20 \log (\text{on time/pulse train time})$
 = $20 \log (9 \times 1.22 \text{ ms})/100 \text{ ms})$
 = -19.1879 dB

§15.35(b) specifies a 20 dB maximum between the peak and average measurements; therefore, a -19.2 dB averaging factor is allowed by the FCC specification and applied to the peak measurement.

Radiated Interference Level Data - (Vertical Polarity)

[illegible]

Radiated Interference Level Data - (Horizontal Polarity)

Frequency MHz	Detector	Receiver Reading dBμV	Average Factor dB	Correction Factor dB	Field Strength dBμV/m	Limit dBμV/m	Delta dB
432.8	Peak	79.3	-19.2	19.7	79.8	80.8	-1.0
865.6	Peak	40.5	-19.2	27.5	48.8	60.8	-12.0
1298.4	Peak	28.5	-19.2	26.7	36.0	60.8	-24.8
1731.2	Peak	28.2	-19.2	28.8	37.8	60.8	-23.0
2164.0	Peak	26.2	-19.2	30.7	37.7	60.8	-23.1
2596.8	Peak	2.8	-19.2	32.0	15.6	60.8	-45.2
3029.6	Peak	9.1	-19.2	33.7	23.6	60.8	-37.2
3462.4	Peak	2.6	-19.2	34.9	18.3	60.8	-42.5
3895.2*	Peak	5.5	-19.2	36.2	22.5	54.0	-31.5
4328.0*	Peak	5.2	-19.2	36.7	22.7	54.0	-31.3
* Emissions within restricted bands							

Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor) and the Average Factor to the measured level of the receiver. The receiver amplitude reading is compensated for any amplifier gain.

The basic equation with a sample calculation is shown below:

$$FS = RA + CF + AV \quad \text{Where}$$

FS = Field Strength

RA = Receiver Amplitude Reading

CF = Correction Factor (Antenna Factor + Cable Factor)

AV = Averaging Factor

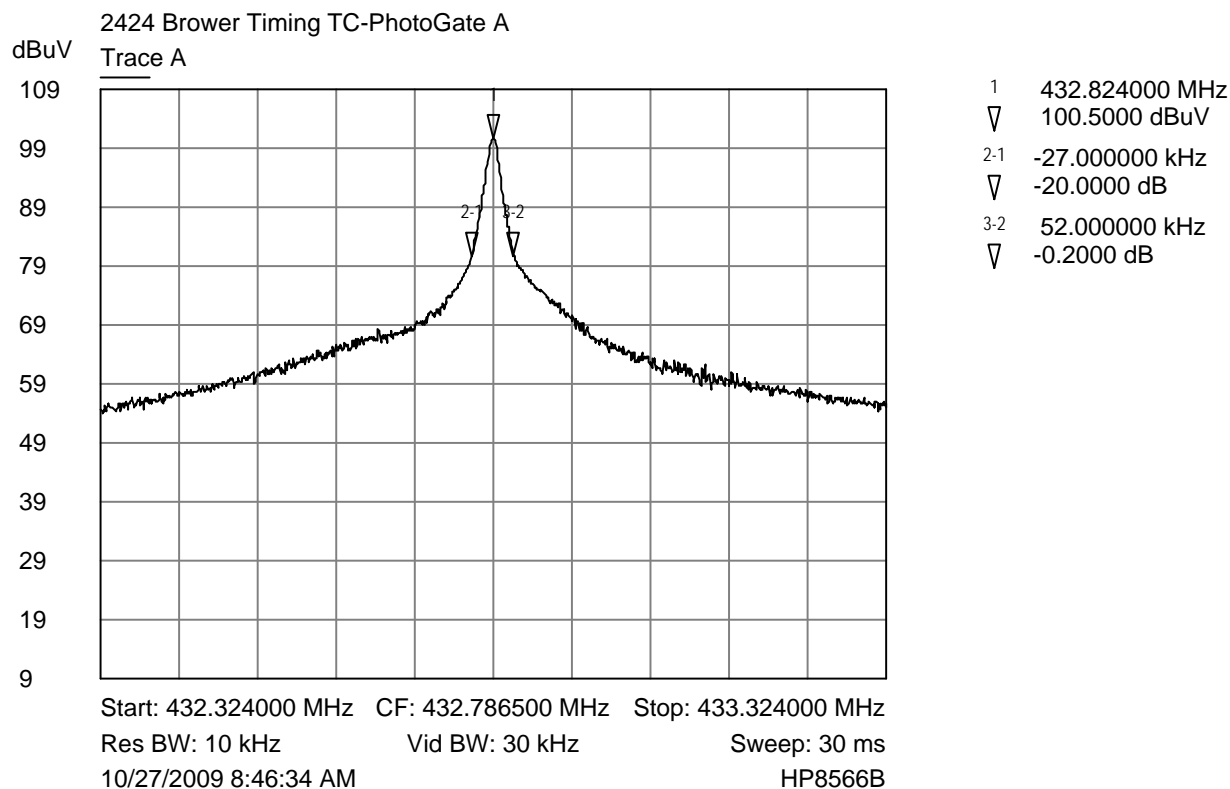
Assume a receiver reading of 44.2 dBμV is obtained from the receiver, with an average factor of -8.6 dB and a correction factor of 17.5 dB. The field strength is calculated by adding the correction factor and the average factor, giving a field strength of 53.1 dBμV/m, $FS = 44.2 + 17.5 + (-8.6) = 53.1 \text{ dBμV/m}$

RESULT

In the configuration tested, the EUT complied with the requirements of this section.

6.2.4 §15.231 (c) Bandwidth**Demonstration of Compliance:**

The bandwidth of the emission must not be wider than 0.25% of the center frequency. The center frequency is 432.8 MHz, therefore the bandwidth must not be wider than 1082 kHz. The TC-PhotoGate A 20 dB bandwidth was 52.0 kHz. See spectrum analyzer plot below.

TC-PhotoGate A Bandwidth Plot

Trace A band width plot

RESULT

In the configuration tested, the EUT complied with the requirements of this section.

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT**Radiated Emissions:**

The radiated emissions from the intentional radiator were measured using a spectrum analyzer. The resolution bandwidth was set at 100 kHz and the video bandwidth was set at 300 kHz. For peak emissions above 1000 MHz the spectrum analyzer's resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz.

A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequencies above 1 GHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the intentional radiator was varied to find the maximum radiated emission. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

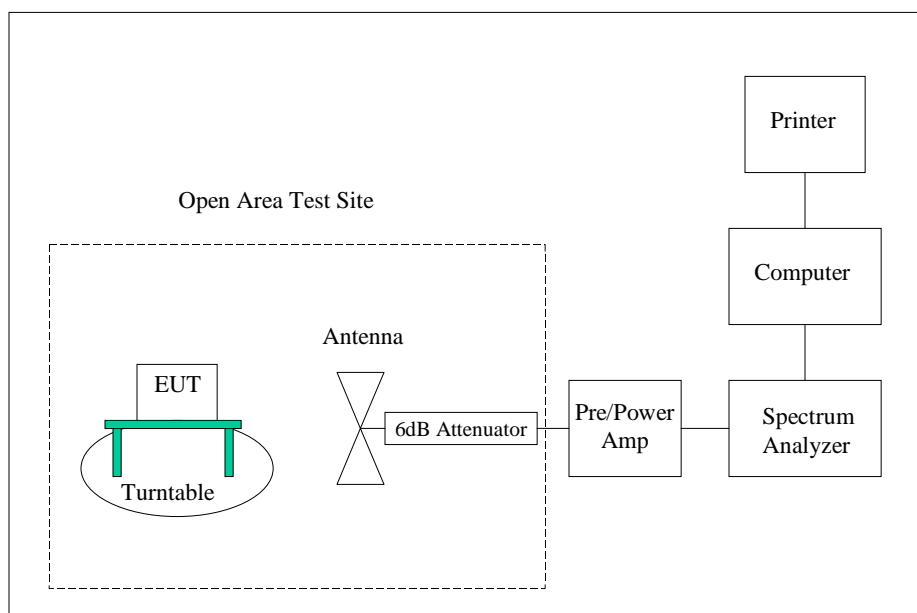
Desktop intentional radiator is measured on a non-conducting table 0.8 meter above the ground plane. The table is placed on a turntable which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/08/2009
Test Software	CCL	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer/Receiver	Rohde & Schwarz	1302.6005.40	100064	07/08/2009
Spectrum Analyzer	Hewlett Packard	8566B	2332A02726	1/15/2009
Quasi-Peak Detector	Hewlett Packard	85650A	2043A00287	3/18/2009
Biconilog Antenna	EMCO	3142	9601-1008	9/26/2008
Double Ridged Guide Antenna	EMCO	3115	9409-4355	03/11/2009

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
High Frequency Amplifier	Miteq	AFS4-01001800-43-10P-4	1096455	06/04/2009
20' High Frequency Cable	Utiflex	UFA210A-1-2400-30050U	1175	03/05/2009
3 Meter Radiated Emissions Cable Wanship Site #2	CCL	Cable K	N/A	12/31/2008
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	08/24/2009
6 dB Attenuator	Hewlett Packard	8491A	32835	12/31/2008

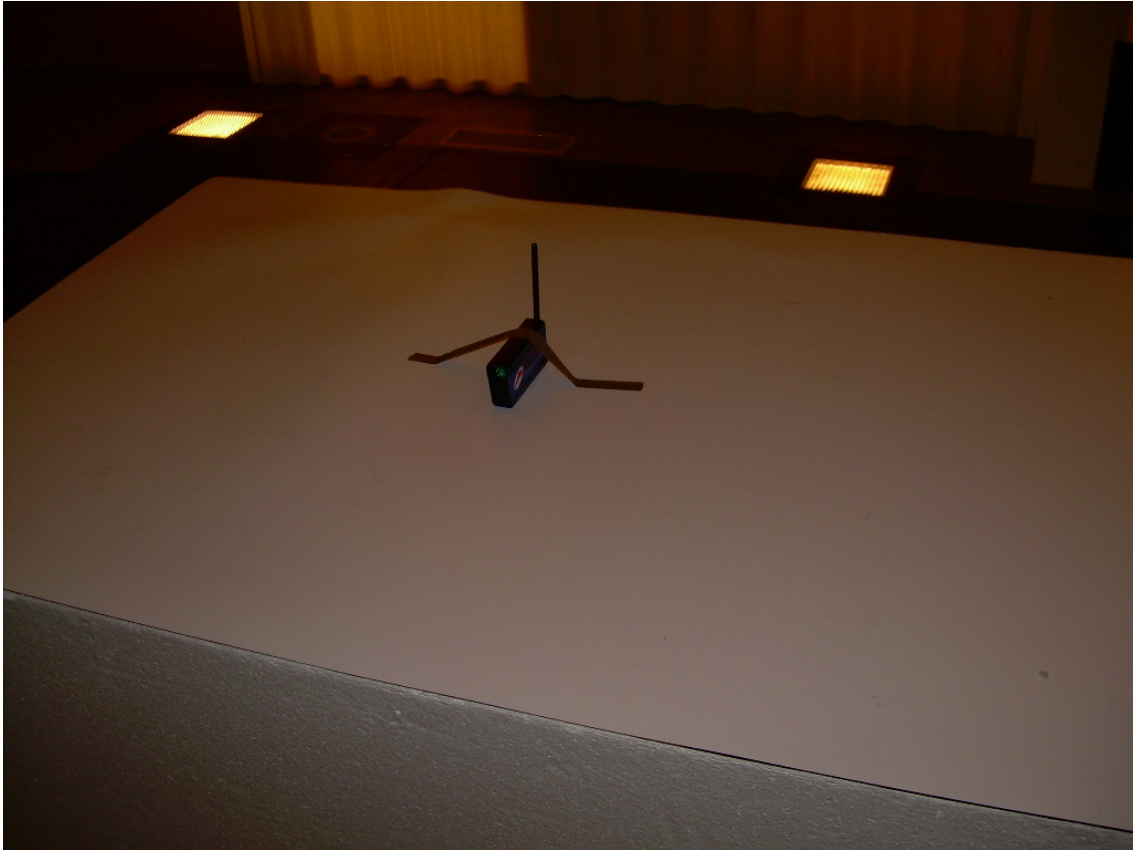
An independent calibration laboratory or CCL personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Radiated Emissions Test Setup

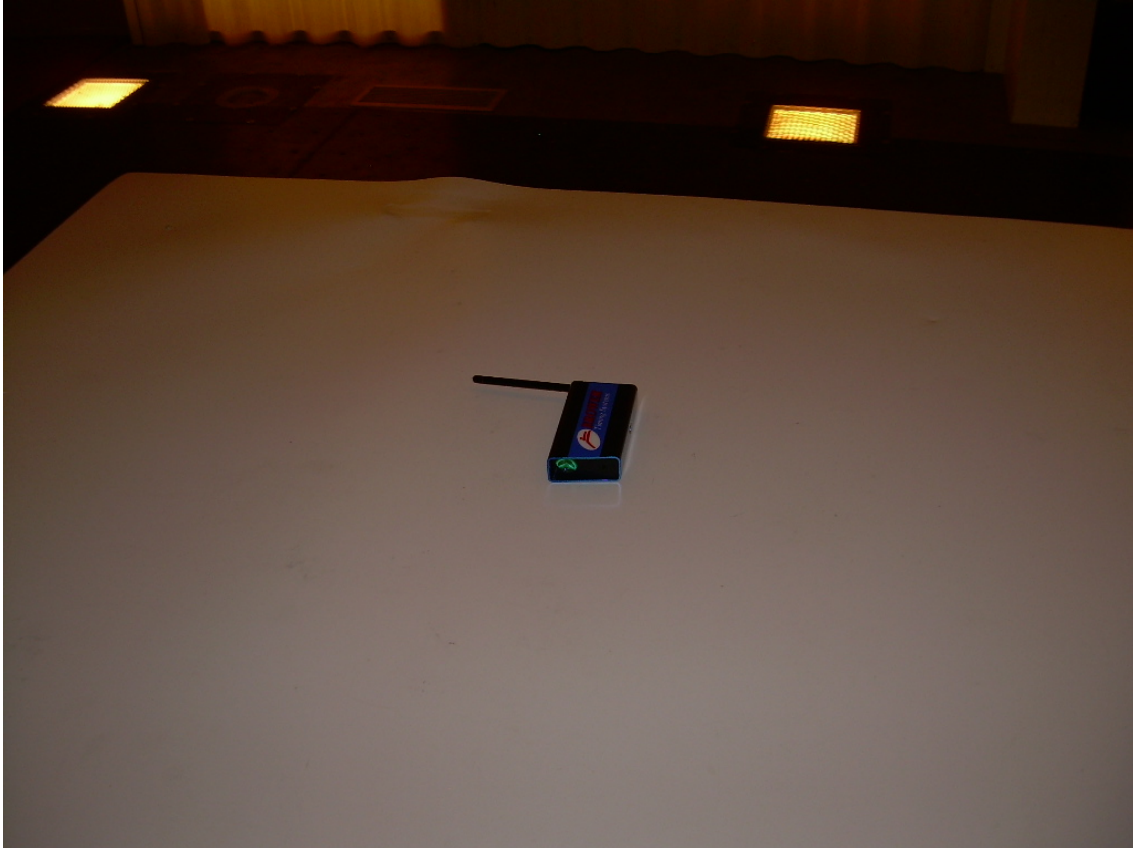


APPENDIX 2 PHOTOGRAPHS

Photograph 1 - View of the Worst-Case Radiated Emission Test Setup (Vertical Alignment)



Photograph 2 - View of the Radiated Emission Test Setup
(Horizontal Alignment)



Photograph 3 - View of the Radiated Emission Test Setup
(On-Edge Alignment)



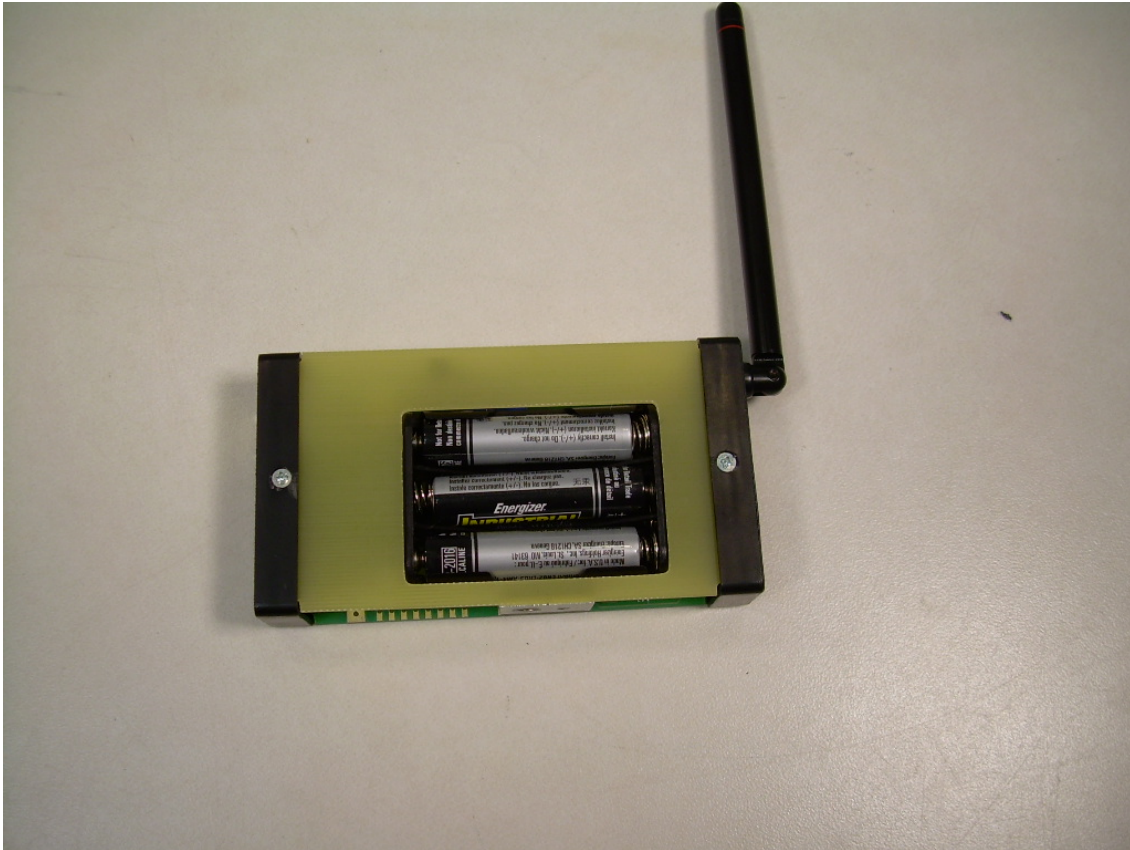
Photograph 3 - Back and Side View of the TC-PhotoGate A



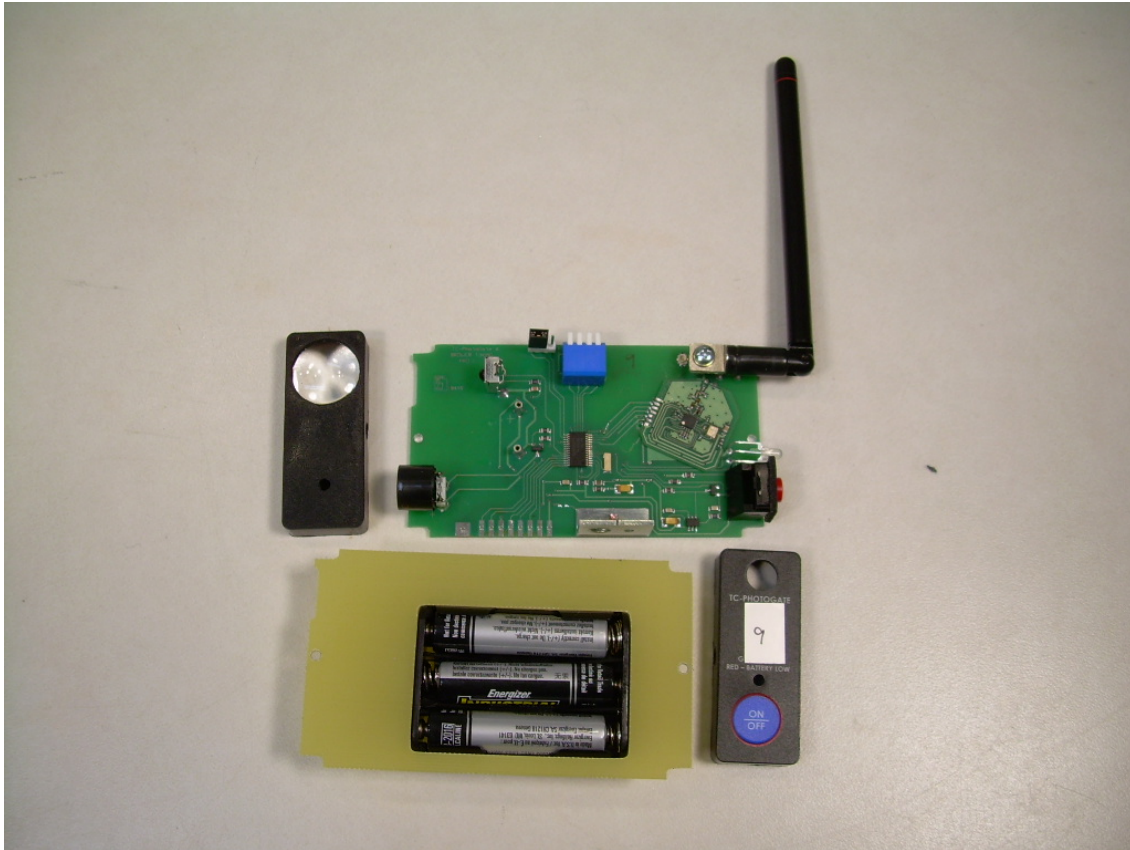
Photograph 4 - Front and Side View of the TC-PhotoGate A



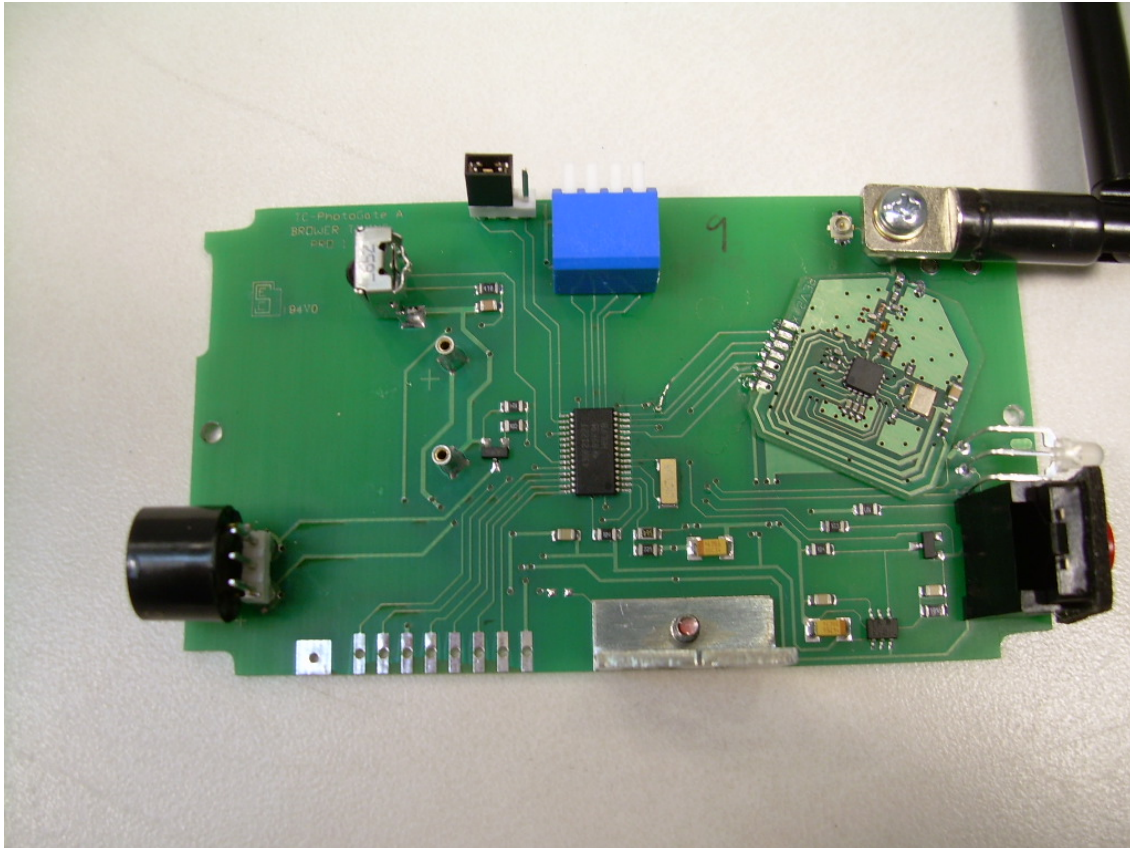
Photograph 5 - View of the TC-PhotoGate A with Housing Removed



Photograph 6 - View of the Components of the TC-PhotoGate A



Photograph 7 - View of the Component Side of the TC-PhotoGate A
PCB



Photograph 8 - View of the Trace Side of the TC-PhotoGate A PCB

