



Radiated & Conducted Emissions Test Report for an Unlicensed Transmitter per 15.249

Product Tested:

Name: TX900 Transmitter

Prepared for:

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Report Number: A0133-1

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*Accredited by the National Voluntary Laboratory Accreditation Program for the specific
scope of accreditation under laboratory code 200245-0*



EMC Engineering and Testing Services

Radiated & Conducted Emissions Conformance Statement

Report Number: A0133-1

Product Name: TX900 Transmitter

We, the undersigned, hereby state that the proper standards and procedures were followed as detailed in this test record. Furthermore, we attest that the data contained within this report is accurate and concise within the bounds of the standards and our company procedures.

Daniel Wilkerson
Sr. EMC Technician

Lonnie Smoots
Sr. EMC Technician

Tom Bengel
EMC Technician

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this attached test record. The modifications made to the equipment in order to achieve compliance with these standards are listed in the Executive Summary of this report.

Furthermore, there was no deviation from, additions to or exclusions from the ANSI 63.4:1992 test methodology.

Signature:

Date: 19 April, 1999

Full Name: Michael Cantwell, PE

Location: Plano, Texas

Title: NARTE EMC Engineer (EMC-002019-NE)
Signatory for NVLAP

Note: This report may not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

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1. Executive Summary

The following report for EMC compliance of an unlicensed transmitter, per 15.249 is prepared on behalf of CVP Products in accordance with the rules of the Federal Communications Commission (47 CFR 15) and the EMC Directive (89/336/EEC as amended by 91/31/EEC) of the European Union.

This report covers testing for the TX900 Transmitter and all testing were performed on the 16th, 31st of March and the 1st and 2nd of April, 1999.

All equipment configurations and measurements contained in this report were performed in accordance with the revision of the standards listed in this report. Also, the instrumentation and facilities utilized for the measurements conform to all appropriate standards. Calibration checks are performed yearly on the instruments by a local calibration lab, with traceability to the National Institute of Standards and Technology (NIST).

All radiated and conducted emission measurements are performed manually at RheinTexas, Inc. The radiated emission measurements required by the rules were performed on a 10m open area test site (OATS) maintained by RheinTexas, Inc., 1701 East Plano Parkway, Suite 150, Plano, Texas 75074, USA. Complete site descriptions and site attenuation measurement data are maintained at the test facility and can be made available upon request. The Power Line Conducted Emission Measurements were performed in a shielded enclosure also located at the same facility. The radiated and conducted measurement sites have been listed with the Federal Communications Commission (FCC).

1.1 Modifications to EUT

The following modifications were made to the product in order to achieve compliance with these standards:

1. A Tee-pad attenuator was placed between the transmitter module and the antenna. The value of the two series resistors, R23 & R24, were 16 Ω . The value of the resistor from the center of the two series resistors and ground R25 was 143 Ω .

1.2 Special Accessories

There were no special accessories found necessary as a result of this testing.

2. Test Facility

The open area test site used to collect the radiated emissions data and the shielded room used to collect the conducted emissions data have been listed by the Federal Communications Commission (FCC, per ANSI C63.4) and approved by the Voluntary Control Council on Interference (VCCI, Japan).

3. EUT Configuration

3.1 Technical Description

The TX900 is a remote control device being marketed as a control for a model train set. It consists of several switches and a TXM-900-HP Lynx Technologies transmitter module. The antenna connection is non-standard and replacement antennas are not readily available through commercial electronic stores. The transmitting frequency is set via a DIPswitch, located on the printed circuit board, as detailed in the table below.

Table 1 - Frequency Select Chart

Frequency Select			Frequency (MHz)
C	B	A	
0	0	0	903.37
0	0	1	906.37
0	1	0	907.87
0	1	1	909.37
1	0	0	912.37
1	0	1	915.37
1	1	0	919.87
1	1	1	921.37

3.2 Test Configuration(s)

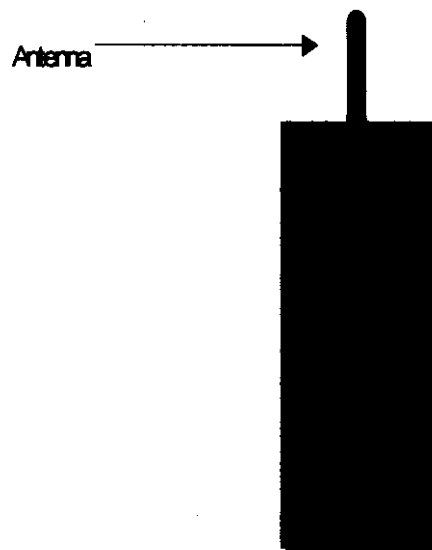


Figure 1 - Block Diagram of System Configuration

The system was configured for testing in a typical fashion (as a customer would normally use it). A list of the equipment under test (EUT) and its support equipment is found below.

Table 2 - Components in Block Diagram

Component	Manufacturer	Model	Part No.	Notes
Remote Control (EUT)	CVP Products	TX900 Transmitter	RTX#100878	None
Antenna	CVP Products	Black Antenna	RTX#100879	None

3.3 Exercise Software

The EUT exercise program used during radiated and conducted testing consists of the firmware which is normally resident in the product's microcontroller.

4. Test Results

4.1 Emissions Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4 1992 and CISPR 22:1993. Radiated testing was performed at an antenna to EUT distance of 3 meters.

RheinTexas, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the RheinTexas quality manual. RheinTexas implements these procedures to minimize errors that may occur. The highlights of the procedures are yearly as well as daily calibrations, technician training, and emphasis to employees on avoiding error.

4.1.1 Deviations from Test Methodology

There were no deviations from the test methodology during this test

4.2 Radiated Emissions Measurements

The limits utilized are from CISPR-22: 1993.

4.2.1 Test Methodology

Whenever possible, and before final measurements of radiated emissions are made on the open-field three/ten meter range, the EUT is scanned indoors at a three meter distance (or one meter distance if necessary) in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process is either repeated, or performed, during final radiated emissions measurements on the open-field range, at each frequency, in order to insure that maximum emission amplitudes are obtained. RheinTexas works diligently to ensure that worst case modes, physical arrangement of the test system and associated cabling produce maximum emission levels.

Final radiated emissions measurements were made on the 10-meter, open-field test site. The EUT was placed on a nonconductive turntable approximately 0.8 meters above the ground plane. The spectrum was examined from 30 MHz to 1000 MHz. When any clock exceeds 108 MHz but less than 500 MHz, the emissions of the EUT are also measured between 1 to 2 GHz using an average detector with the resolution bandwidth set at 1 MHz. For clocks greater than 500 MHz and less than 1 GHz, the emissions of the EUT are also measured between 1 and 5 GHz.

At each frequency, the EUT was rotated 360 degrees, and the antenna was raised and lowered from one to four meters in order to determine the maximum emission levels. Measurements were taken using both horizontal and vertical antenna polarizations. The spectrum analyzer's 6-dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

4.2.2 Test Limits

The tables below list the CISPR-22 radiated emission limits. The EUT to antenna distance used at RheinTexas is always 10m unless otherwise noted. In addition to the CISPR 22 requirements, limits have been imposed above 1 GHz for compliance with the limits found in Part 15 of the FCC rules (47CFR).

Table 3 – CISPR-22 Class A Radiated Emissions

Frequency (MHz)	Limit (dB μ V/m)		
	30m	10m	3 m
30 to 230	30	40	50
230 to 1000	37	47	57
$\geq 1000^1$	--	49.5	60

Table 4 – CISPR-22 Class B Radiated Emissions

Frequency (MHz)	Limit (dB μ V/m)	
	10m	3m
30 to 230	30	40
230 to 1000	37	47
$\geq 1000^1$	43.5	54

Table 54 This FCC Limit actually begins at 960 MHz. The lower limit is used from 960 to 1000 MHz to fully comply with the requirements of CISPR 22.

4.2.3 Radiated Emissions Data

All readings are quasi-peak unless stated otherwise. The pk notation in the receiver reading denotes that this measurement was taken using the peak detector.

There were no emissions found with regards to the digital device, which has a clock frequency of 11.0592 MHz. The transmitter was measured at three frequencies as detailed in the table below.

Code	Frequency (MHz)
A	903.37
B	909.37
C	921.37

Table 5 – Radiated Emissions Data

Emission Frequency (MHz)	Det	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dB $\square$ V)	Site Correction Factor (dB/m)	Emission Level (dB $\square$ V/m)	EN55022 / CISPR22 Limit (dB $\square$ V/m)	EN55022 / CISPR22 Margin (dB $\square$ V/m)	Pass/Fail	Comments
903.428	Qp	H	40	1.0	89.5	4.2	93.7	94.0	-0.3	Pass	A x1
903.442	Qp	V	10	1.4	82.8	4.2	87.0	94.0	-7.0	Pass	
909.428	Qp	H	90	1.3	88.6	4.3	92.9	94.0	-1.1	Pass	B x1
909.428	Qp	V	50	2.0	81.0	4.3	85.3	94.0	-8.7	Pass	
921.401	Qp	H	25	1.5	89.3	4.5	93.8	94.0	-0.2	Pass	C x1
921.436	Qp	V	140	1.2	80.6	4.5	85.1	94.0	-8.9	Pass	
1806.880	Av	H	75	1.0	39.2	13.2	52.4	54.0	-1.6	Pass	A x2
1806.880	Av	V	80	1.0	36.7	13.2	49.9	54.0	-4.1	Pass	
1818.800	Av	H	160	1.3	36.3	13.2	49.5	54.0	-4.5	Pass	
1818.800	Av	V	200	1.0	34.9	13.2	48.1	54.0	-5.9	Pass	
1842.400	Av	H	35	1.0	39.9	13.1	53.0	54.0	-1.0	Pass	
1842.700	Av	V	45	1.0	37.4	13.1	50.5	54.0	-3.5	Pass	
2710.380	Av	H	50	1.0	24.7	6.9	31.6	54.0	-22.4	Pass	A x3
2710.380	Av	V	290	1.4	34.7	6.9	41.6	54.0	-12.4	Pass	
2728.110	Av	V	34	1.2	44.9	7.2	52.1	54.0	-1.9	Pass	
2728.180	Av	H	60	1.4	42.1	7.2	49.3	54.0	-4.7	Pass	
2764.110	Av	V	140	1.0	42.6	7.2	49.8	54.0	-4.2	Pass	
2764.110	Av	H	10	3.0	39.0	7.6	46.6	54.0	-5.4	Pass	
3613.407	Av	H	40	3.0	26.7	10.8	37.5	54.0	-16.5	Pass	A x4
3613.840	Av	V	120	1.2	38.4	10.8	49.2	54.0	-4.8	Pass	
3637.740	Av	V	320	1.4	42.2	11.0	53.2	54.0	-0.8	Pass	
3638.010	Av	H	10	1.0	36.4	11.0	47.4	54.0	-6.6	Pass	
3685.700	Av	H	10	1.0	42.3	11.5	53.8	54.0	-0.2	Pass	
3685.700	Av	V	220	2.0	40.1	11.5	51.6	54.0	-2.4	Pass	
4517.230	Av	V	60	1.5	39.1	9.8	48.9	54.0	-5.1	Pass	A x5
4517.280	Av	H	205	3.0	35.2	9.8	45.0	54.0	-9.0	Pass	
4547.100	Av	H	60	1.4	36.2	9.9	46.1	54.0	-7.9	Pass	
4547.160	Av	V	320	1.0	38.9	9.9	48.8	54.0	-5.2	Pass	
4607.000	Av	V	130	1.5	37.8	10.2	48.0	54.0	-6.0	Pass	
4607.080	Av	H	355	1.0	41.6	10.2	51.8	54.0	-2.2	Pass	

Table 6 - Radiated Emissions Data (continued)

Emission Frequency (MHz)	Det	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dB $\square$ V)	Site Correction Factor (dB/m)	Emission Level (dB $\square$ V/m)	EN55022 / CISPR22 Limit (dB $\square$ V/m)	EN55022 / CISPR22 Margin (dB $\square$ V/m)	Pass/Fail	Comments
5420.800	Av	V	110	1.0	29.9	6.7	36.6	54.0	-17.4	Pass	A x6
5420.844	Av	H	90	1.4	29.9	6.7	36.6	54.0	-17.4	Pass	
5456.220	Av	V	210	1.0	20.1	6.7	26.8	54	-21.9	Pass	
5456.22	Av	H	270	1.0	16.9	6.7	23.6	54	-30.4	Pass	
5528.200	Av	V	290	1.0	25.5	6.9	32.4	54.0	-21.6	Pass	
5528.220	Av	H	235	2.0	27.7	6.9	34.6	54.0	-19.4	Pass	
6323.590	Av	H	200	1.0	22.3	9.8	32.1	54	-21.9	Pass	
6323.590	Av	V	250	1.0	26.4	9.8	36.2	54	-17.8	Pass	
6365.590	Av	H	310	1.0	20.6	9.8	30.4	54	-23.6	Pass	
6365.590	Av	V	10	1.0	28.5	9.8	38.3	54	-15.7	Pass	
6449.500	Av	V	215	3.0	32.8	9.8	42.6	54.0	-11.9	Pass	

6449.590	Av	H	260	2.5	32.0	9.8	41.8	54.0	-12.2	Pass	
6824.200	Av	H	0	1.0	39.0	8.1	47.1	54.0	-6.9	Pass	
7226.960	Av	H	180	1.0	22.2	11.8	34.0	54	-20	Pass	
7226.960	Av	V	250	1.0	26.4	11.8	38.2	54	-15	Pass	
7274.960	Av	H	145	1.3	22.2	11.9	34.1	54	-19.9	Pass	
7274.960	Av	V	60	.7	24.6	11.9	36.5	54	-17.5	Pass	
7370.900	Av	V	140	3.0	31.4	8.4	39.8	54.0	-14.2	Pass	
7370.960	Av	H	60	1.0	33.2	8.4	41.6	54.0	-12.4	Pass	
8119.700	Av	H	210	1.0	29.2	12.8	42.0	54.0	-12	Pass	
8119.700	Av	V	200	1.0	22.0	12.8	34.8	54.0	-19.2	Pass	
8130.330	Av	H	25	1.0	21.7	12.9	34.6	54	-19.4	Pass	
8130.330	Av	V	200	1.4	20.4	12.9	33.3	54	-20.7	Pass	
8184.330	Av	V	290	1.0	33.9	13.0	46.9	54.0	-7.1	Pass	
8184.330	Av	H	140	1.0	40.0	12.8	52.8	54.0	-1.2	Pass	
8292.300	Av	V	210	1.0	31.4	13.3	44.7	54.0	-9.3	Pass	
8292.330	Av	H	170	1.5	31.8	13.3	45.1	54.0	-8.9	Pass	
9014.000	Av	H	200	1.0	22.9	14.2	37.1	54.0	-16.9	Pass	
9014.000	Av	V	180	1.0	23.2	14.2	37.4	54.0	-16.6	Pass	
9033.700	Av	H	105	1.4	25.6	14.1	39.7	54	-14.3	Pass	
9033.700	Av	V	110	1.0	23.1	14.1	37.2	54	-16.8	Pass	
9093.790	Av	H	300	1.5	22.3	14.0	36.3	54	-17.7	Pass	
9093.790	Av	V	30	1.0	23.3	14.0	37.3	54	-16.7	Pass	
9213.700	Av	H	310	1.0	32.5	13.8	46.3	54.0	-7.7	Pass	
9213.700	Av	V	100	2.5	31.1	13.8	44.9	54.0	-9.1	Pass	

4.2.4 Radiated Test Configuration Photographs

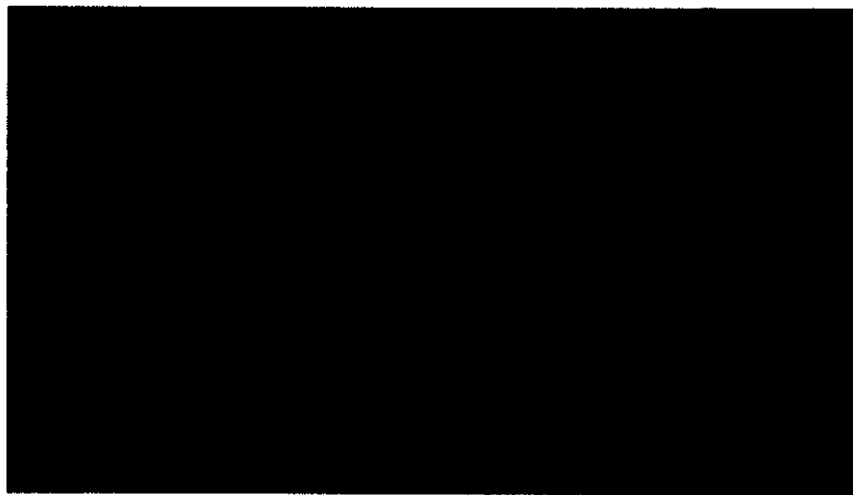


Figure 6 - Radiated Setup (Front View)

FCC ID: OKWTX900

5. Test Equipment

The following test equipment was used to perform the radiated and conducted emissions testing. All the equipment is calibrated by competent calibration laboratories traceable to NIST.

The Test column indicates which equipment was utilized to perform the radiated and conducted testing. An "R" in this column indicates that it was used for radiated emissions testing and a "C" in this column indicates that it was used for conducted emissions testing.

Table 7 - Test Equipment List

Test	Manufacturer	Model	Description	Serial Number	Last Cal	Next Cal
R	Hewlett Packard	8566B	Spectrum Analyzer	2816A16178 2747A05126	29-Dec-98	29-Dec-99
	Hewlett Packard	85650A	Quasi-Peak Adapter	3303A01859	29-Dec-98	29-Dec-99
R	Rhein Tech Labs	PR-1040	Amplifier	N/A	27-Mar-98	27-Mar-99
R	RheinTexas	Radiated Cable	Site 1NE	R002	27-Mar-98	27-Mar-99
R	Chase	CBL6112A	Bilog Antenna	2149	5-Nov-98	5-Nov-99
R	EMCO	3115	Horn Antenna	5672	25-Jan-99	25-Jan-02
R	Hewlett Packard	HP8449	Pre-Amplifier	3008A00244	25-Feb-99	25-Feb-01
	Hewlett Packard	8546A	EMI Receiver	3265A00348 3448A00288	21-Dec-98	21-Dec-99
	RheinTexas	Radiated Cable	Site 2NW	R003	27-Mar-98	27-Mar-99
	Chase	CBL6112A	Bilog Antenna	2150	7-May-98	7-May-99
	Hewlett Packard	8567A	Spectrum Analyzer	2602A00153 2542A11108	31-Jul-98	31-Jul-99
	Hewlett Packard	85650A	Quasi-Peak Adapter	3303A01832	31-Jul-98	31-Jul-99
	Solar	9252-50-R-24-BNC	LISN	961023	19-Aug-98	19-Aug-99
	RheinTexas	Conducted Cables	Coaxial Cables	C001	19-Aug-98	19-Aug-99