Electromagnetic Compatibility Test Report

Tests Performed on a Distribution Control Systems, Inc.

916.5 MHz Transmitter, Model Y72140-1

FCC ID: **PN3Y72140-1**
FCC Part 15 CFR Title 47: 1999
This report concerns: Original Grant
Equipment type: 916.5 MHz Low-Power, Transmitter
Radiometrics Document RP-4550

Tests Performed For:	*Test Facility:*
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Test Date(s): (Month-Day-Year)
5/30/2001

RP-4550-FCC Revisions:

Rev.	Issue Date	Affected Pages	Revised By	Authorized Signature for Revision
0	June 12, 2001			
1	June 22, 2001	All	Joseph Strzelecki	Joseph Strzelecki
2	June 23, 2001	All	Joseph Strzelecki	Joseph Strzelecki

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1 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a 916.5 MHz Transmitter, Model Y72140-1, manufactured by Distribution Control Systems, Inc. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-9200 MHz	FCC Part 15.249	Pass

2 EQUIPMENT UNDER TEST (EUT) DETAILS

2.1 EUT Description

The EUT is a 916.5 MHz Transmitter, Model Y72140-1, manufactured by Distribution Control Systems, Inc. The EUT was in good working condition during the test, with no known defects.

In order to fully test the EUT, the device was modified by the manufacturer to provide a transmission once a second instead of once an hour, as soon as it is powered. The EUT transmission is otherwise not changed.

2.1.1 Duty Cycle of Transmitter

Frequency of Transmissions: The transmitter sends a packet of information once every hour.

Transmission Length: Each packet is approximately 0.48 seconds.

Baud Rate: Each packet is sent at 2400 bps.

Duty Cycle of Each Packet: Each packet is Manchester encoded. Which means every “1” is encoded to “10” and every “0” is encoded to “01”. Therefore, the duty cycle of each packet is 50/50.

Conclusion: A 50% duty cycle. 50% = 6 dB Peak to Average factor

2.2 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. A one meter, unterminated long field wiring was connected to the EUT during the tests. Since the EUT is wall mounted, it was placed in an upright configuration during the tests.

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	916.5 MHz Transmitter	E	Distribution Control Systems, Inc.	Y72140-1	None

* Type: E = EUT

2.3 Operating Conditions of EUT

The EUT was in a normal operating mode during the tests. All circuits were activated during the tests. Power was supplied with a new battery. The EUT does not have provisions to be connected to a battery charger.

2.4 EUT Modifications

Prior to the onset of testing, R16 was changed to 8.06 kOhms.

3 GENERAL INFORMATION

Joseph Strzelecki performed the tests. The EUT was received at Radiometrics on May 30, 2001. Karl Davlin of DCSI witnessed the tests.

4 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Test Specifications

Document	Date	Title
FCC CFR Title 47	1999	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-1992	1992	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

No sampling procedures are required by the test specifications.

5 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics has been accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC Guide 25-1990 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the "basic standards" listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la.org).

The following is a list of shielded enclosures located in Romeoville, Illinois:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles in the located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber B: Is a shielded enclosure that measures 24' L X 12' W X 8' H. Erik A. Lindgren & Associates of Chicago, Illinois manufactured the enclosure.

Chamber C: Is a shielded enclosure that measures 20' L X 10' W X 8' H. Lindgren RF Enclosures Inc. of Addison, Illinois manufactured the enclosure.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

Open Area Test Site (OATS): Is located on 8625 Helmar Road in Newark, Illinois, USA and measures 56' L X 24' W X 17' H. The entire open field test site has a metal ground screen. The FCC has accepted these sites as test site number 31040/SIT 1300F2. The FCC test site Registration Number is 90897.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

6 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

7 TEST PROCEDURES

7.1 RF Emissions Measurement Procedures

The test procedures used are in accordance with the ANSI document C63.4-1992.

The emission measurements were performed with a spectrum analyzer. The quasi-peak bandwidth of the spectrum analyzer from 150 kHz to 30 MHz is 9 kHz, and the bandwidth from 30 to 1000 MHz is 120 kHz. Above 1 GHz a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing any transmitter or if an overload condition exists.

From 30 to 1000 MHz an Anritsu Spectrum analyzer and a MITEQ AM-1431 amplifier with a 10 dB attenuator connected to the input was used. The EUT emissions and the ambient emissions were below the level of input overload (80 dBuV). The fundamental frequency was measured without a preamplifier.

For tests from 1 to 9.2 GHz, an HP8566A spectrum analyzer was used with a Celeritek uWave amplifier. The fundamental emission, out of band emissions, and the ambient emissions were below the level of input overload (72 dBuV). In addition, a high pass filter was used to reduce the fundamental emission.

7.1.1 Radiated Emission Measurement Procedures

Preliminary radiated emission tests were performed inside of an anechoic enclosure. The frequency range from 30 to 9200 MHz was scanned and plotted using the peak detector function. The test antennas were positioned 3 meters from the EUT. The results of the preliminary scans were only used to identify the frequencies being emitted from the EUT and were not used to determine compliance with the test specification. Radiated emission measurements are performed with linearly polarized broadband antennas.

Final radiated emissions measurements were performed in the open area test site at a test distance of 3 meters. Measurements were performed using the peak or quasi-peak detector function. The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground. The open area test site used to collect the radiated data is located on 8625 Helmar Road in Newark, Illinois. The open field test site has a metal ground screen. All other tests are performed at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 9200 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high in the preliminary emission scan. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded.

7.1.2 Explantion of Field Strength Calculation

The field strength is calculated by adding the antenna factor, High pass filter Loss (if used), cable loss, and subtracting the amplifier gain from the measured reading. Each antenna, cable, and amplifier has individual factors across its usable frequency range. The antenna factor converts the voltage reading in dBuV to field strength in dBuV/meter.

The peak measurements above 1 GHz were converted to Average using the peak to average factor calculated in section 2.1.1.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9 TEST EQUIPMENT TABLE

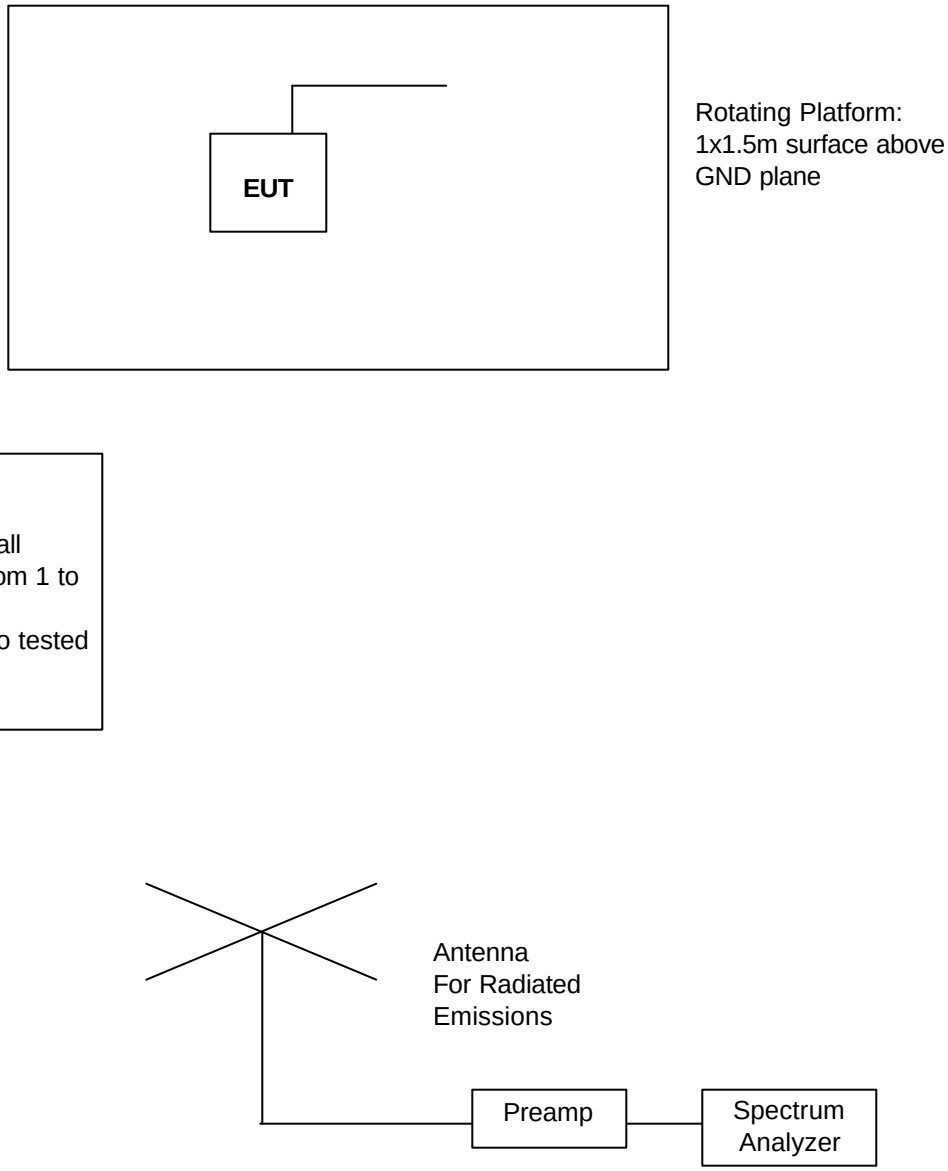
RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-5	Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	12/28/00
AMP-12	MITEQ	Pre-amplifier	AM-1431	530935	0.01-1000MHz	12 Mo.	12/28/00
ANT-3	Tensor	Biconical Antenna	4104	2231	20-200MHz	12 Mo.	8/2/00
ANT-6	EMCO	Log-Periodic Ant.	3146	1248	200-1000MHz	12 Mo.	8/3/00
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	9/28/00
HPF-2	Microwave Cir.	High Pass Filter	H2G09G02	HPF-2	1-11 GHz	18 Mo.	5/29/01
REC-3	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	08/01/00
REC-1	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	12 Mo.	05/15/01

NCR – No Calibration Required. Device monitored by calibrated equipment. N/A: Not Applicable.

10 TEST SETUP DOCUMENTATION

This section includes the actual test setup and drawings indicating the general test setup components. The drawing shows the test equipment setup for each test. For the detailed EUT setup, see the photographs and the “equipment under test (EUT) Details” in this report.

Figure 1. Drawing of Emissions Test Setups



11 DETAILED TEST RESULTS

11.1 Radiated Emissions Test Results

Manufacturer	Distribution Control Systems, Inc.	Specification	FCC Part 15.249
Model	Y72140-1	Test Date	5/30/01
Serial Number	None	Test Distance	3 Meters
Notes	Low loss cable was used above 1000 MHz.		
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; BC = Biconical (ANT-3); LP = Log-Periodic (ANT-6); HN = Horn (ANT-13) P = peak; Q = QP		
Configuration			

Freq MHz	Peak Analyzer Reading dBuV	Antenna Factor dB	Antenna Polarity/ Type	Amp Gain dB	Cable Loss dB	High Pass Filter dB	Peak to Ave factor	Field Strength of Signal dBuV/m	Limit Field Strength dBuV/m	Margin under Limit dB
916.5	58.7	23.7	V/LP	0.0	10.2	0.0	0.0	92.6	94.0	1.4
1833.0	41.1	27.6	V/HN	29.0	2.2	10.9	6.0	46.8	54.0	7.2
2749.5	34.9	30.9	V/HN	29.0	2.7	5.7	6.0	39.2	54.0	14.8
3666.0	34.0	32.8	V/HN	29.0	3.3	5.0	6.0	40.1	54.0	13.9
4582.5	28.0*	33.8	V/HN	29.0	3.9	4.2	6.0	34.9	54.0	19.1
5499.0	28.0*	35.5	V/HN	29.0	4.5	2.8	6.0	35.8	54.0	18.2
6415.5	28.0*	36.8	V/HN	29.0	4.9	2.6	6.0	37.3	54.0	16.7
7332.0	28.0*	37.8	V/HN	29.0	5.2	2.0	6.0	38.0	54.0	16.0
8248.5	28.0*	38.8	V/HN	29.0	5.4	1.9	6.0	39.1	54.0	14.9
9165.0	28.0*	40.4	V/HN	29.0	5.6	1.8	6.0	40.8	54.0	13.2
916.5	53.9	23.7	H/LP	0.0	10.2	0.0	0.0	87.8	94.0	6.2
1833.0	43.9	27.6	H/HN	29.0	2.2	10.9	6.0	49.6	54.0	4.4
2749.5	34.5	30.9	H/HN	29.0	2.7	5.7	6.0	38.8	54.0	15.2
3666.0	34.1	32.8	H/HN	29.0	3.3	5.0	6.0	40.2	54.0	13.8
4582.5	28.0*	33.8	H/HN	29.0	3.9	4.2	6.0	34.9	54.0	19.1
5499.0	28.0*	35.5	H/HN	29.0	4.5	2.8	6.0	35.8	54.0	18.2
6415.5	28.0*	36.8	H/HN	29.0	4.9	2.6	6.0	37.3	54.0	16.7
7332.0	28.0*	37.8	H/HN	29.0	5.2	2.0	6.0	38.0	54.0	16.0
8248.5	28.0*	38.8	H/HN	29.0	5.4	1.9	6.0	39.1	54.0	14.9
9165.0	28.0*	40.4	H/HN	29.0	5.6	1.8	6.0	40.8	54.0	13.2

* Ambient Level: No emissions Detected

No emissions were detected from 30 to 900 MHz. The noise floor was at least 15 dB under the limit.
All emissions outside of the band from 902 to 928 were below the limits of 15.209.
No preamp was used when measuring the fundamental emission at 916.5 MHz.

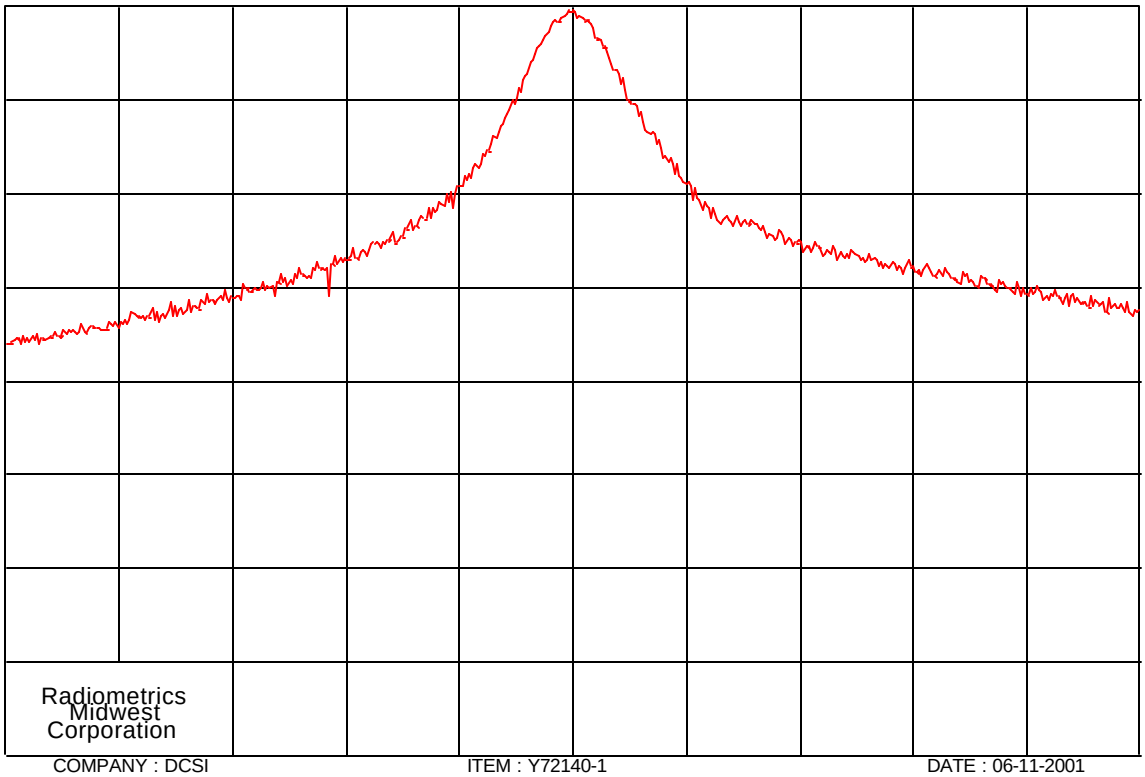
Test Personnel: Joseph Strzelecki
Senior EMC Engineer

11.2 Occupied Bandwidth Data

The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the "MAX HOLD" mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. A limit was drawn on the plot based on the level of the modulated carrier. A plot of the occupied bandwidth for the EUT is supplied as follows.

Figure 2. Occupied Bandwidth Plot



COMPANY : DCSI
START FREQ. = 916.381 MHz
RBW = 10 kHz
10 dB/div
NOTES : Occupied Bandwidth Test,

ITEM : Y72140-1
REF. LEVEL = 071.0
VBW = 100 kHz
TIME = 10:23

DATE : 06-11-2001
SPAN = .2 MHz
ATTEN = 0 dB
SWP TIME = 50 mSec
PAGE: RP- 4550

Test Result: 20 dB Bandwidth is 48 kHz.

Test Personnel: Joseph Strzelecki
Senior EMC Engineer