



Electromagnetic Compatibility Test Report

Tests Performed on a Digital Design, Inc.

315 MHz Transmitter, Model WM-315



FCC ID: **PQQUSAWM-315**

FCC Part 15 CFR Title 47: 1999

This report concerns: Original Grant of Certification

Equipment type: 315 MHz Low-Power, Periodic Transmitter

Radiometrics Document RP-4520D

Tests Performed For:

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Test Report Written By

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Joseph Strzelecki

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Test Date(s): (Month-Day-Year)

5/1/2001 & 5/7/2001

RP-4520D Revisions:

| Rev. | Issue Date | Affected Pages | Revised By | Authorized Signature for Revision |
|------|--------------|----------------|-------------------|--|
| 0 | May 24, 2001 | | | |
| 1 | June 8, 2001 | | Joseph Strzelecki | A handwritten signature in black ink that reads "Joseph Strzelecki". |
| | | | | |

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1 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a 315 MHz Transmitter, Model WM-315, manufactured by Digital Design, 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 | 30-3200 MHz | FCC Part 15.231 | Pass |
| Occupied Bandwidth Test | Fundamental Freq. | FCC Part 15.231 | Pass |

2 EQUIPMENT UNDER TEST (EUT) DETAILS

2.1 EUT Description

The EUT is a 315 MHz Transmitter, Model WM-315, manufactured by Digital Design, Inc. The EUT was in good working condition during the test, with no known defects.

2.1.1 Duty Cycle of Transmitter

The Code Pattern is as follows:

Number of bits per packet = 20
 Duration of one bit = 0.0009 seconds
 Duration of one packet = 0.018 seconds
 Pause between packets = 0.006 seconds
 Total duration of packet and pause = 0.024 seconds
 A one or a zero is interpreted by the duration of on-time versus off-time
 A one = 450us on and 450us off
 A zero = 100us on and 800us off

If all the bits were equal to a 1 (FFFF hex) then the maximum on-time would be 450us X 20 = 9ms and the off time would = (450us X 20) + 6ms = 15ms. If the total packet = 0.024 seconds 0.009/0.024 = 37.5% on time. There would be 4 complete packets in a 100ms period plus 4ms of another packet. (4.5 bits) Therefore (4 X 0.009) + (4.5 X 0.0045) = 0.038025 seconds ON in a 100ms period or 38% maximum. Since a packet would never = FFFFFh, then the maximum on-time is something less than 38%.

Conclusion: A 38% duty cycle is a conservative factor to use. 38% = 8.4 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.

Tested System Configuration List

| Item | Description | Type* | Manufacturer | Model Number | Serial Number |
|------|---------------------|-------|----------------------|--------------|---------------|
| 1 | 315 MHz Transmitter | E | Digital Design, Inc. | WM-315 | None |

* Type: E = EUT

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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.

2.4 EUT Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

3 GENERAL INFORMATION

Joseph Strzelecki performed the tests. The EUT was received at Radiometrics on May 1, 2001. Andrew Hottel of Dukane Corporation 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.

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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.

From 30 to 1000 MHz an Anritsu Spectrum analyzer and a MITEQ AM-1431 amplifier with a 10 dB attenuator connected to the input. The out of band emissions and the ambient emissions were below the level of input overload (80 dBuV).

For tests from 1 to 3.2 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).

7.1.1 Radiated Emission Measurement Procedures

Preliminary radiated emission tests were performed inside of a shielded anechoic enclosure. The frequency range from 30 to 3200 MHz was scanned and plotted using the peak detector function. The test antennas were positioned 1.5 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 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.

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The entire frequency range from 30 to 3200 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. All measurements may be performed using either the peak or the quasi-peak detector functions. If the peak detector data exceeds or is marginally close the limits, the measurements are repeated using a quasi-peak detector function as required by the specification for final determination of compliance.

The device was rotated through three orthogonal axis as per 13.1.4.1 of ANSI C63.4 during the prescans and during final tests on the fundamental and the 2nd to 5th Harmonics.

The field strength is calculated by adding the antenna factor, distance correction factor, 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.

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.

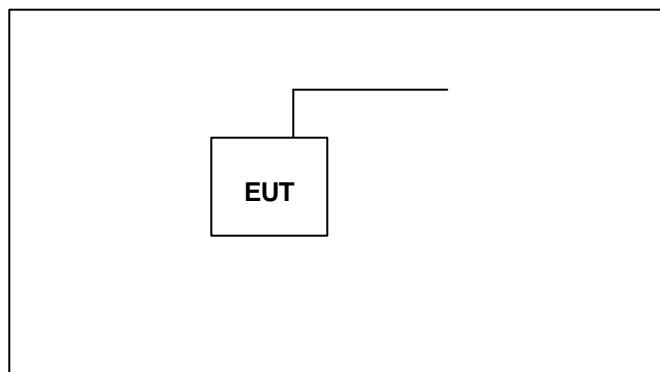
9 TEST EQUIPMENT TABLE

| RMC ID | Manufacturer | Description | Model No. | Serial No. | Frequency Range | Cal Period | Cal Date |
|--------|-----------------|-------------------|------------|---------------------------|-----------------|------------|----------|
| AMP-12 | MITEQ | Pre-amplifier | AM-1431 | 530935 | 0.01-1000MHz | 12 Mo. | 12/28/00 |
| AMP-5 | Celeretek | Pre-amplifier | MW110G | 1001 | 1.0-12GHz | 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-25 | ARA | Super Log Antenna | LPB-2520/A | 1116 | 20-2000MHz | 12 Mo. | 8/30/00 |
| ANT-13 | EMCO | Horn Antenna | 3115 | 2502 | 1.0-18GHz | 24 Mo. | 9/28/00 |
| 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. | 05/15/00 |

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

10 TEST SETUP DOCUMENTATION

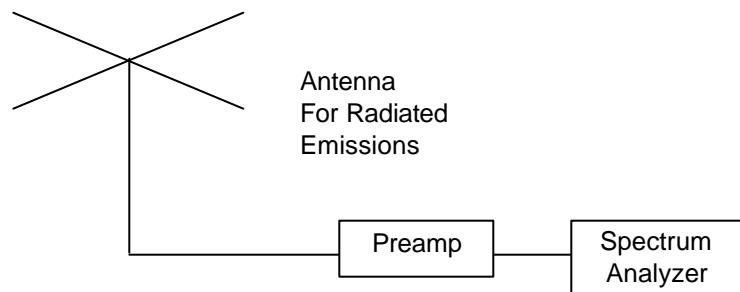
This section includes the actual test setup and drawings indicating the general test setup components. The drawing shows the test equipment setup for each test. For the detailed EUT setup see the photographs and the "equipment under test (EUT) Details" in this report.

Figure 1. Drawing of Emissions Test Setups

Rotating Platform:
1x1.5m surface above
GND plane

Notes:

- Not to Scale
- No vertical conductive wall
- Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters



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Figure 2. Photograph of Radiated Emissions Test Setup



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11 DETAILED TEST RESULTS

11.1 Radiated Emissions Test Results

| | | | |
|---------------|---|---------------|----------------------|
| Manufacturer | Digital Design, Inc. | Specification | FCC Part 15; Class B |
| Model | WM-315 | Test Date | 5/7/01 |
| Serial Number | None | Test Distance | 3 Meters |
| Notes | Corr. Factors = cable loss - preamp gain - distance factor. | | |
| 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 | Meter Reading dBuV | Antenna | | Corr. Factors dB | Field Strength dBuV/m | | Margin Under Limit dB |
|-----------|-----------------------|--------------|--------------|------------------------|--------------------------|-------|-----------------------------|
| | | Factor dB | Pol/ Type | | EUT | Limit | |
| 315.0 | 89.2 P | 15.6 | H/LP | -30.2 | 74.6 | 75.6 | 1.0 |
| 630.1 | 47.2 P | 19.7 | H/LP | -27.0 | 39.9 | 55.6 | 15.7 |
| 945.1 | 33.9 P | 24.1 | H/LP | -24.4 | 33.6 | 55.6 | 22.0 |
| 1260.1 | 50.1 P | 26.0 | H/HN | -33.5 | 42.6 | 55.6 | 13.0 |
| 1575.2 | 50.5 P | 27.2 | H/HN | -33.1 | 44.6 | 54.0 | 9.4 |
| 1890.1 | 49.3 P | 28.6 | H/HN | -33.0 | 44.9 | 55.6 | 10.7 |
| 1890.2 | 48.2 P | 28.6 | H/HN | -33.0 | 43.8 | 55.6 | 11.8 |
| 315.0 | 86.8 P | 15.6 | V/LP | -30.2 | 72.2 | 75.6 | 3.4 |
| 630.1 | 45.2 P | 19.7 | V/LP | -27.0 | 37.9 | 55.6 | 17.7 |
| 945.1 | 35.8 P | 24.1 | V/LP | -24.4 | 35.5 | 55.6 | 20.1 |
| 1260.1 | 45.9 P | 26.0 | V/HN | -33.5 | 38.4 | 55.6 | 17.2 |
| 1575.2 | 48.3 P | 27.2 | V/HN | -33.1 | 42.4 | 54.0 | 11.6 |
| 1890.2 | 49.9 P | 28.6 | V/HN | -33.0 | 45.5 | 55.6 | 10.1 |

No emissions within 15 dB of the limit were detected from 2000 to 3200 MHz

Test Personnel: Joseph Strzelecki
Senior EMC Engineer

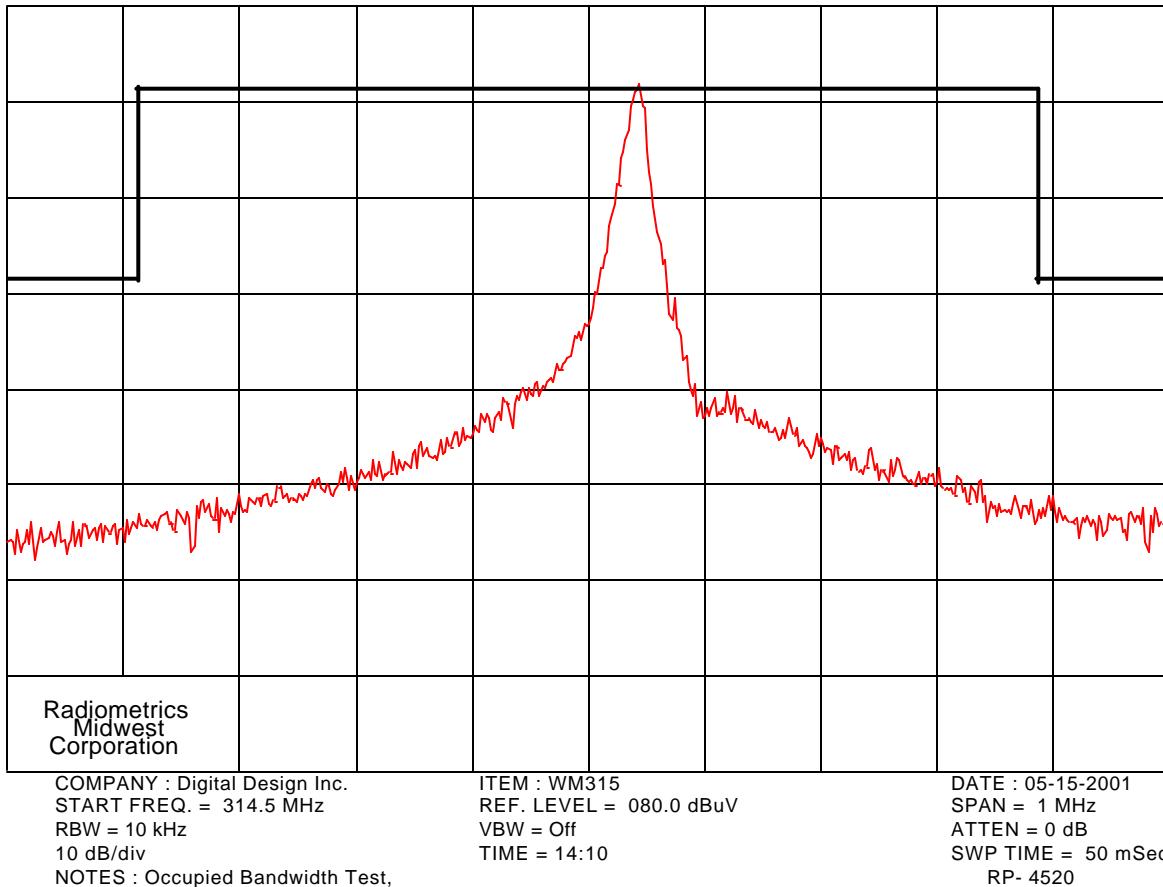
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11.2 Occupied Bandwidth Data

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 3. Occupied Bandwidth Plot



Test Result: The 20 dB Bandwidth is 60 kHz.

Test Personnel: Joseph Strzelecki
Senior EMC Engineer