

RF Emissions Test Report

To Determine Compliance With:

FCC, Part 15

Rules and Regulations

Model number: MSP 430

August 25, 2003

Manufacturer: Goggin Research & Engineering, PC
4510-D Northchase Parkway NE
Wilmington, North Carolina 28405

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Section 1

General Information

Manufacturer: Goggin Research & Engineering
4510-D Northchase Parkway NE
Wilmington, North Carolina 28405

Manufacturer representative: **Mr. Chris Goggin**

Equipment covered by this report: Model no.: MSP 430

Options covered by this report: None

Equipment serial no. Prototype

Test specifications: To determine compliance with:
FCC, Part 15.231, Subpart C
Rules and Regulations, Class B

Test report number: 03-173A

Test commenced: August 19, 2003

Test completed: August 22, 2003

Test engineer: **Edward Barnes**

Test Facility: The test facility used to perform these tests is on file with
the FCC under registration number 637500 and located at:

EMC Testing Laboratories, Inc.
2210 Justin Trail
Alpharetta, GA 30004

Section 2

Test report summary sheet 1 of 2

Summary:

Tests	Results
FCC, Part 15, Class B, Radiated emissions:	Pass
FCC, Part 15, Class B, Conducted emissions:	N/A

- 1- The product(s) covered by this report was found to comply with the limits indicated in paragraphs 15.109 Subpart B and 15.231, Part 15, Subpart C of the FCC Rules and Regulations.

Note: The conducted emissions test was not performed since the EUT is battery operated with no means for connection to public mains.

Product description:

The product(s) covered by this report consisted of a battery-operated transmitter, intended for use with an associated receiver to tag and find articles.

The transmitter is an intentional radiator operating at 418MHz and transmits when a manual switch is depressed. The transmitter stops transmission within 5 seconds of operation. The transmitter was set to its maximum duty cycle of 8.5%

The enclosure is constructed of plastic with overall dimensions measuring 15.5cm long by 5.5cm wide by 1.7cm high and encloses the following components judged as critical:

1. A transmitter board, part no. MSP430TX.
2. Two new, fully charged 3V lithium Ion batteries.

Test report summary sheet 2 of 2

Test configuration:

The equipment under test was set-up and configured as specified by the manufacturer.

1- The EUT was connected to the following support peripherals.

A) None

2- The EUT was connected to the following cables.

A) None

Test operation:

For all measurements, the equipment under test was caused to function in a continuous mode of operation for maximum electrical activity as specified by the manufacturer. Specifically, the EUT was caused to continually transmit, utilizing its maximum 8.5% duty cycle while being powered from fresh batteries.

Modifications:

The following modifications were required to comply with the indicated limits:

1- The value of resistor R5 was changed from 47 ohm to 100 ohm to reduce the output power of the fundamental and second harmonic.

Conclusion:

With the above indicated modifications, the product(s) covered by this report has been tested and found to comply with the limits indicated in paragraph 15.231 table (b) of the FCC, Part 15, Subpart C Rules and Regulations and all subsequent limits indicated therein for a class B device.

Tested by:

Edward Barnes
RF Engineer
EMC Testing Laboratories, Inc.
August 25, 2003

Reviewed by:

Gene J. Bailey
Engineering Manager
EMC Testing Laboratories, Inc.
August 25, 2003

Section 2 cont...

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Section 3

STANDARD REFERENCE

The following primary standards were used for this test:

- 1) **ANSI C63.4-2001:** Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 KHz to 40 Ghz.
- 2) **US Code of Federal Regulations (CFR) 1998:** Title 47, Part 15, Radio Frequency Devices, Subpart C, Intentional Radiators.

Section 4

TEST METHOD

INTRODUCTION:

The product(s) covered by this report were subjected to electromagnetic interference emissions measurements to determine compliance with the FCC, Part 15 requirements.

Radiated emissions were measured in accordance with Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 Ghz, C63.4.

MEASUREMENT CALCULATIONS:

Radiated Emissions:

For radiated emissions measurements, the signal attenuation due to impedance losses in the antenna and signal cable was significant and was added to the spectrum analyzer reading to give corrected signal strength reading. Additionally, a 6dB attenuator was utilized at the antenna to prevent over driving the front end of the preamplifier and was added to the spectrum analyzer reading. If a preamplifier was used, the signal gain was subtracted from the signal strength reading. Radiated emissions data was specified as microvolt per meter (dB μ V/m) of radiated field strength.

Radiated emissions (dB μ V/m) = Analyzer reading (dB μ V) plus
antenna factor (dB) plus cable factor (dB) plus attenuator (dB)
minus Amplifier gain (dB)

RADIATED EMISSIONS MEASUREMENT:

Radiated emissions measurements were performed at an open field test site. The receiving antenna was positioned 3 meters from the equipment under test as indicated below, along the center axis of the test site. Measurements were made with broadband antennas and if necessary, detected emissions were verified with dipole antennas. The dipole antenna was manually tuned to the signal frequency by adjusting the length of the antenna elements. The radiated emissions were measured for both the horizontal and vertical signal planes by rotating the antennas. Additionally, the EUT was rotated by the turntable and the antenna height was raised and lowered 1 to 4 meters to locate the maximum emission strength at each frequency. Radiated emission measurements of the product were measured from 30MHz to 4200MHz.

Section 4 cont...

The following antennas were used to measure the radiated emissions within the specified frequency spans.

<u>Antenna</u>	<u>Frequency Span</u>
Biconical	20 - 200 Mhz
Log Periodic	200 - 1000 Mhz
Dipoles	20 - 1000 Mhz
Horn	1-18 Ghz

INSTRUMENTATION:

Radiated strength measurements were taken with a spectrum analyzer. Radiated emissions are measured with broadband and tuned dipole antennas. The test equipment consists of the following:

<u>Test Equipment</u>	<u>Model No.</u>	<u>Serial No.</u>	<u>Cal. Due</u>
Spectrum Analyzer	HP 8591A	3144A02506	01-06-04
Spectrum Analyzer	8592L	3649A00744	01-10-04
LISN	94641-1	0145/0146	06-05-04
LISN	3825/2	9305-2088	08-15-04
LISN	LI-210	25145	08-15-04
Biconical Antenna	3110B	1708	10-01-03
Biconical Antenna	BIA-25	2451	09-18-03
Log Periodic	LPA25	1112	10-01-03
Dipole Antenna	DM-105A-T1	31402-110	06-05-04
Dipole Antenna	DM-105A-T2	31402-105	06-05-04
Dipole Antenna	DM-105A-T3	31402-109	06-05-04
Horn Antenna	3115	9405-4264	10-01-03
R.F. Amplifier	QB-820	11602	01-11-04
Preamplifier	8449B	3008A00914	01-07-04

DETECTOR FUNCTION FOR OUT OF BAND EMISSIONS:

The out of band emissions measurements were taken using a peak hold signal detector function. In this mode, the spectrum analyzer makes continuous scans across the frequency band and stores the highest emission value detected at each frequency for all scans. The peak hold integration will detect transient or low duty cycle emissions peak which might be missed on single scan measurement. The emission value at each frequency was a true value.

SPECTRUM ANALYZER SETTING FOR OUT OF BAND EMISSIONS:

For all out of band emissions measurements, the spectrum analyzer was set for a 10 dB input attenuation, 10 dB/Division vertical scale and 90 or 100 dB μ V reference level. The resolution bandwidth is set at 9 Khz for the 0.15 - 30 Mhz span and at 120 Khz for 30 - 1000 Mhz span. The video bandwidth and sweep rates were automatically coupled by the analyzer.

Section 5

RADIATED OUT OF BAND EMISSIONS MEASUREMENTS

Radiated Out of Band Emissions - Section 15.209 Limits**Model number:** MSP430TX**Test date:** 8/22/03

Frequency Mhz	Measurement Reading dB μ V	Corrected Reading dB μ V	FCC Limit dB μ V	Minimum Margin dB μ V
There were no measurable emissions within 20 dB μ V of the limits with the antenna in the vertical or horizontal polarizations.				

Section 6

Fundamental Frequency Radiated Emissions Measurements

EMISSION MEASUREMENTS FOR EQUIPMENT WITH PERIODIC OPERATION IN THE BAND 40.66 – 40.70 MHz AND ABOVE 70 MHz:

As per Section 15.231 of the 47 CFR and in accordance with the measurement provisions in Section 15.35, the peak and average emissions field strength of the fundamental frequency were measured and recorded. For all harmonics emissions peak and average measurements were recorded unless the peak reading did not exceed the average limits. After measurement data was recorded the data was then corrected, as indicated in the Measurement Calculations section above.

With the spectrum analyzer in the Linear mode and the resolution bandwidth set to 10Khz, the duty cycle was measured as indicated in section 15.35, (see duty cycle calculation below). The average measurement was then calculated using the below Average measurement calculation.

$$\text{Pulse width / 100mS} = \text{Duty Cycle}$$

$$\text{Peak Value (uV/m)} \times \text{Duty Cycle} = \text{Average measurement (uV/m)}$$

During the emission measurements of the fundamental frequency and harmonics the antenna was positioned 3 meters from the EUT and with the spectrum analyzer in the Linear mode and the resolution bandwidth set to 100Khz minimum resolution bandwidth the fundamental frequency was measured. The measurements were performed with the antenna in the horizontal and vertical polarization.

During the emission measurements above 1000MHz of the harmonic emissions of the fundamental frequency, the antenna was positioned 3 meters from the EUT and with the spectrum analyzer in the Linear mode and the resolution bandwidth set to 1 MHz minimum, the harmonic emissions were measured. The measurements were performed with the antenna in the horizontal and vertical polarization.

During the emissions testing, the EUT emissions were maximized by manipulating the position of the EUT antenna and axis of the EUT in relation to the antenna. The highest emissions were recorded and maximum orientation test setup was photographed.

Additionally the following table shows that the maximum field strength for the fundamental frequency was in compliance with the peak limits as indicated in Section 15.231.

The limits indicated in the tables below have been calculated for the measurement distances as indicated above.

Section 6 cont...

Model: MSP430TX**Date:** August 22, 2003

Frequency Mhz	Detection Method	Total Level dB μ V/m	FCC Limit (Avg.) dB μ V/m	Margin dB μ V
Horizontal				
418.0	Peak	100.1	100.3 (Peak Limit)	-0.2
418.0	Average	78.7	80.3	-1.6
835.8	Peak	74.8	80.3(Peak Limit)	-5.5
835.8	Average	53.4	60.3	-6.9
1253.8	Peak	54.0	60.3	-6.3
1671.7	Peak	58.4	60.3	-1.9
2090	Peak	48.9	60.3	-10.5
2507.6	Peak	51.5	60.3	-8.8
2926	Peak	48.4	60.3	-11.9
3344	Peak	50.0	60.3	-10.3
3762	Peak	48.6	60.3	-11.7
4179	Peak	48.1	60.3	-12.2
Vertical				
418.0	Peak	90.1	100.3 (Peak Limit)	-10.2
418.0	Average	68.7	80.3	-11.6
836	Peak	69.1	80.3(Peak Limit)	-11.2
836	Average	47.7	60.3	-12.6
1253.9	Peak	60.5	80.3(Peak Limit)	-19.8
1253.9	Average	39.1	60.3	-21.2
1672	Peak	54.6	60.3	-5.7
2090	Peak	56.9	60.3	-3.4
2508	Peak	53.1	60.3	-7.2
2926	Peak	51.6	60.3	-8.7
3344	Peak	54.2	60.3	-6.1
3762	Peak	48.2	60.3	-12.1
4072	Peak	46.4	60.3	-13.9

Section 7

Occupied Bandwidth Measurements

OCCUPIED BANDWIDTH MEASUREMENTS:

As per Section 15.231 (c), the minimum 20dB bandwidth is less than 0.25% of the center frequency. The bandwidth was measured with the spectrum analyzer's resolution bandwidth set to 10 kHz and the span set to 1 MHz. The measurement was taken 20dB down on each side of the center frequency and the total occupied bandwidth was recorded.

Center Frequency Mhz	Allowed Occupied Bandwidth	Total Occupied Bandwidth
418	1 Mhz	52 kHz

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