

# EMC EMISSION - TEST REPORT

Test Report No. **B952601a** Issue Date 23 March, 2000

Model / Serial No. FA-202 / 1

Product Type Transmitter Module

Client Inovonics Corporation

Manufacturer Inovonics Corporation

License holder Inovonics Corporation

Address 2100 Central Avenue  
Boulder, CO 80301

Test Criteria Applied FCC Part 15 15.247C

Test Start Date: 23 December, 1999

Test End Date: 23 December, 1999

Test Result  **PASS**  **FAIL**

Test Report Project No. **BC1G952601**

Total Pages including Appendices 32

*Shawn Singh*

*Jeffrey V. Doolittle*

Reviewed By : Shawn Singh

Reviewed By : Jeffrey V. Doolittle

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**EMISSIONS TEST REGULATIONS :**

The tests were performed according to following regulations :

- - Federal Communication Commission part 15
- - Federal Communication Commission part 15, Subpart C
- - Class A
- - 15.209
- - Class B
- - 15.247

All tests performed according to ANSI C63.4.

**Emission Test Results:**

**Conducted emissions 450 kHz - 30 MHz**

Test Result  - PASS  - FAIL  - Not Applicable  
 Passing Margin \_\_\_\_\_ dB at \_\_\_\_\_ MHz  
 Remarks: EUT is battery operated.

**Radiated emissions (electric field) 30 MHz - 1000 MHz (Unintentional Radiator)**

Test Result  - PASS  - FAIL  - Not Applicable  
 Passing Margin \_\_\_\_\_ 25.9 dB at \_\_\_\_\_ 35 MHz  
 Remarks: \_\_\_\_\_

**Radiated emissions (electric field) 906.11 MHz - 9193.7 MHz (Intentional Radiator)**

Test Result  - PASS  - FAIL  - Not Applicable  
 Passing Margin \_\_\_\_\_ 6.1 dB at \_\_\_\_\_ 4530.7 MHz  
 Remarks: \_\_\_\_\_

**GENERAL REMARKS:**

Modifications required to pass: None

Test Specification Deviations: Additions to or Exclusions from: None

Test-setup photo(s)  
Radiated Emissions



Test-setup photo(s):  
Conducted Emissions



Test Not Applicable

Test Equipment Used



# Equipment Report

23-Dec-1999

Project Number: B9526

Project Date: 23-Dec-1999

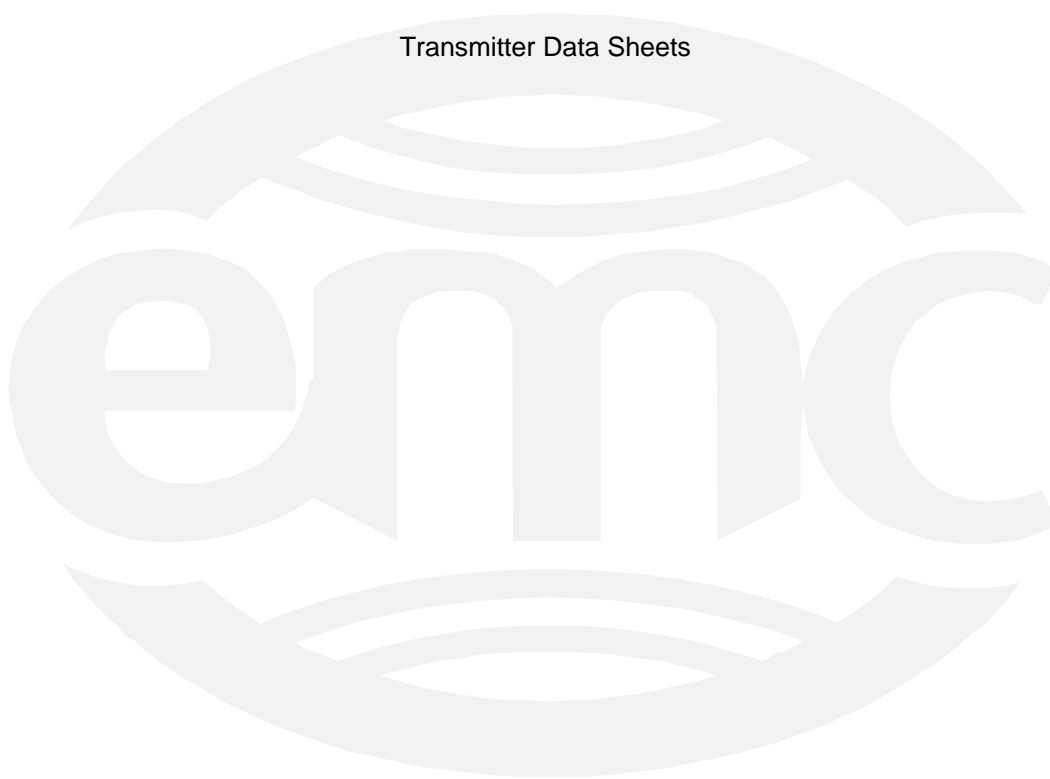
Company Name: Inovonics Corporation

Equip ID	Manufacturer	Model Number	Serial Number	Description	Date	Calibration Interval	Due	Cal Code
<u>Test Performed R</u>		<u>Radiated Emissions</u>						
2679	HEWLETT-PACKARD	85650A	2430A00550	Quasi Peak Adapter	07-Jun-1999	12	06-Jun-2000	G
7514	A.H.SYSTEMS	SAS-200/512	104	Log Periodic Antenna (200-1500 MHz)	28-Jul-1999	12	27-Jul-2000	G
8179	EMCO	3108	2149	Biconical Dipole Antenna (30-300 MHz)	28-Jun-1999	12	27-Jun-2000	G
8207	AVANTEK	AWT-18037	1002	RF Pre-Amplifier (8-18 GHz)	02-Dec-1999	12	01-Dec-2000	G
8208	AVANTEK	AFT-8434-10F	1007	RF Pre-Amplifier (4-8 GHz)	02-Dec-1999	12	01-Dec-2000	G
8212	MINI CIRCUITS	ZHL-1042J-SMA	D020499-5	RF Pre-Amplifier(.01-4.2 GHz)	12-Feb-1999	12	12-Feb-2000	Y
8213	HEWLETT PACKARD	8566B	2410A00154	Spectrum Analyzer (dc-22 GHz)	15-Apr-1999	12	14-Apr-2000	G
8214	HEWLETT PACKARD	85662A	2403A08749	Display Section	15-Apr-1999	12	14-Apr-2000	G
8219	HEWLETT PACKARD	8445B	2034A03223	Pre-Selector	24-Jun-1999	12	23-Jun-2000	G
8264	EMCO	3115	9205-38866	Horn Antenna	05-Apr-1999	12	04-Apr-2000	G

Cal Code Legend: G=Out Source, Y=No Cal required, R=Out of Service, B=In-House Verification Required

## Appendix A

Transmitter Data Sheets





**15.247 SPREAD SPECTRUM INTENTIONAL RADIATOR DATA**

**Date:** 23-Dec-99  
**EUT:** FA-202  
**Customer:** Donald J. Hume

**Measured @**  
 Low Freq.: 906.11 MHz  
 Mid Freq: 912.4 MHz  
 High Freq: 919.37 MHz

**Miscellaneous Measurements:** FCC Specification =>25 Measurement  
 1) Number of hopping channels 25

**Tx Mode: Radiated Measurements**

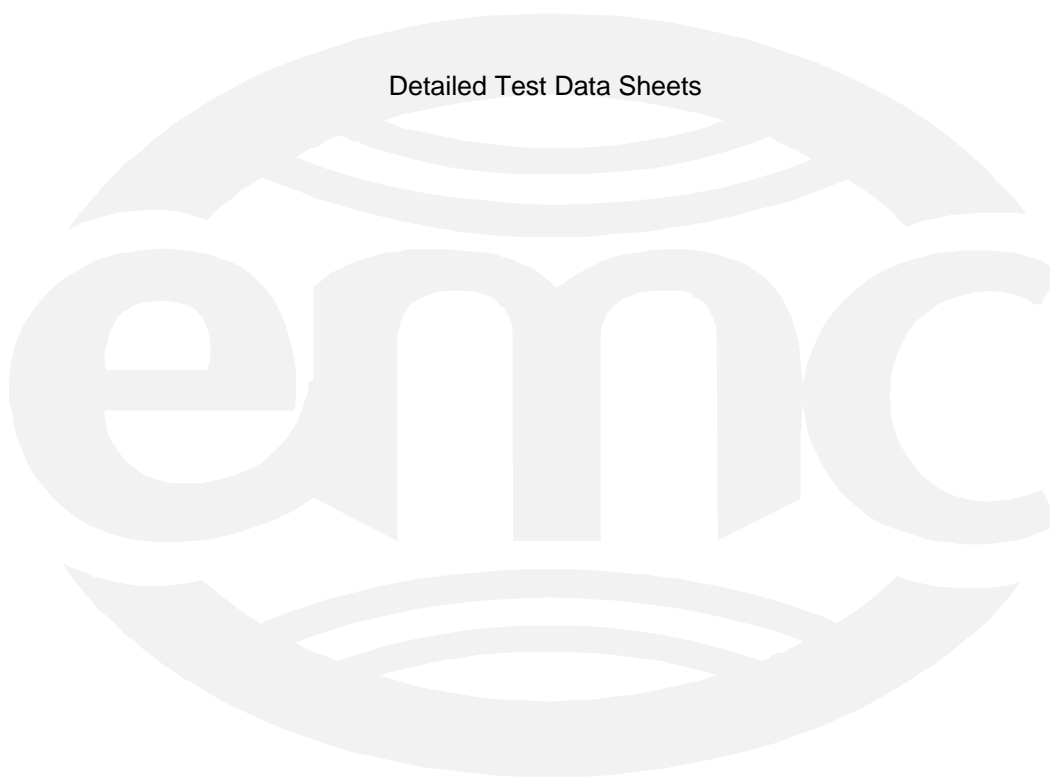
**Calculated Averaging Factor:** -33 dB (20\*Log(duty cycle))  
**Max Averaging Factor Allowed:** -20 dB  
**Averaging Factor Applied:** -20 dB  
**Fundamental Field Strength:** 95.2 dBuV/m

Range	Specification	Peak Measurement dBuV/m @ MHz	Average Measurement dBuV/m @ MHz	Delta dB
2nd harmonic (1812-1839 MHz)	20 dB down	68.9	48.9	-6.3
3rd harmonic (2718-2759 MHz)	54 dBuV/m	63.3	43.3	-10.7
4th harmonic (3624-3678 MHz)	54 dBuV/m	60.6	40.6	-13.4
5th harmonic (4530-4597 MHz)	54 dBuV/m	67.9	47.9	-6.1
6th harmonic (5436-5517 MHz)	54 dBuV/m	62.2	42.2	-11.8
7th harmonic (6342-6436 MHz)	20 dB down	62.7	42.7	-12.5
8th harmonic (7248-7355 MHz)	54 dBuV/m	50.8	30.8	-23.2
9th harmonic (8154-8275 MHz)	54 dBuV/m	57.6	37.6	-16.4
10th harmonic (9061-9194 MHz)	54 dBuV/m	66.2	46.2	-7.8

**Minimum Passing Margin:** -6.1 dB

## Appendix B

Detailed Test Data Sheets



# Radiated Electromagnetic Emissions



Test Report #:	B9526 Run 1	Test Area:	Pinewood Site 1 (3m)
Test Method:	15.247C	Test Date:	12-23-1999
EUT Model #:	FA-202	EUT Power:	3 VDC Battery Powered
EUT Serial #:	1	Temperature:	22 °C
Manufacturer:	Inovonics Corporation	Relative Humidity:	<18 %
EUT Description:	Transmitter Module	Air Pressure:	81 kPa
Notes:	Frequency Hopping		Page: 1 of 5

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 None	DELTA2 None
Prescan performed to find worst case position of EUT.						
All readings Peak.						
All readings maximized.						
Log/vertical						
906.11	69.2Pk	1.8 / 22.7 / 0.0	93.8	V / 1.2 / 213.0	N/A	N/A
912.40	69.0Pk	1.8 / 22.9 / 0.0	93.8	V / 1.2 / 220.0	N/A	N/A
919.37	70.2Pk	1.9 / 23.2 / 0.0	95.2	V / 1.3 / 215.0	N/A	N/A
Log/Horizontal						
906.15	66.5Pk	1.8 / 22.7 / 0.0	91.0	V / 1.5 / 12.0	N/A	N/A
912.46	65.9Pk	1.8 / 22.9 / 0.0	90.6	H / 1.4 / 7.0	N/A	N/A
919.40	65.0Pk	1.9 / 23.2 / 0.0	90.1	H / 1.4 / 7.0	N/A	N/A
Horn/vertical						
1812.29	68.1Pk	2.8 / 28.0 / 30.0	68.9	V / 1.0 / 279.0	N/A	N/A
1824.92	65.7Pk	2.8 / 28.1 / 30.0	66.5	V / 1.0 / 280.0	N/A	N/A
1838.64	62.0Pk	2.8 / 28.1 / 30.0	62.9	V / 1.0 / 278.0	N/A	N/A
Horn/Horizontal						
2718.45	52.4Pk	3.5 / 31.4 / 30.0	57.2	V / 1.0 / 23.0	N/A	N/A
2737.50	49.3Pk	3.5 / 31.5 / 30.0	54.2	V / 1.0 / 21.0	N/A	N/A
2758.03	48.3Pk	3.5 / 31.5 / 30.0	53.3	V / 1.0 / 21.0	N/A	N/A
Horn/Horizontal						
3624.63	52.6Pk	4.2 / 33.3 / 30.0	60.1	V / 1.8 / 231.0	N/A	N/A
3649.96	50.9Pk	4.2 / 33.3 / 30.0	58.4	V / 1.8 / 241.0	N/A	N/A
3677.44	49.4Pk	4.3 / 33.3 / 30.0	56.9	V / 1.8 / 236.0	N/A	N/A
Horn/Horizontal						
3624.61	53.1Pk	4.2 / 33.3 / 30.0	60.6	H / 1.4 / 185.0	N/A	N/A

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# Radiated Electromagnetic Emissions



Test Report #: B9526 Run 1 Test Area: Pinewood Site 1 (3m)  
 Test Method: 15.247C Test Date: 12-23-1999  
 EUT Model #: FA-202 EUT Power: 3 VDC Battery Powered  
 EUT Serial #: 1 Temperature: 22 °C  
 Manufacturer: Inovonics Corporation Relative Humidity: <18 %  
 EUT Description: Transmitter Module Air Pressure: 81 kPa  
 Notes: Frequency Hopping Page: 2 of 5

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 None	DELTA2 None
3649.96	50.5Pk	4.2 / 33.3 / 30.0	58.0	H / 1.4 / 190.0	N/A	N/A
3677.51	51.1Pk	4.3 / 33.3 / 30.0	58.7	H / 1.4 / 195.0	N/A	N/A
2718.40	58.5Pk	3.5 / 31.4 / 30.0	63.3	H / 2.0 / 202.0	N/A	N/A
2737.59	55.6Pk	3.5 / 31.5 / 30.0	60.6	H / 2.0 / 198.0	N/A	N/A
2758.05	53.0Pk	3.5 / 31.5 / 30.0	58.0	H / 1.9 / 198.0	N/A	N/A
1812.32	63.2Pk	2.8 / 28.0 / 30.0	64.0	H / 1.4 / 311.0	N/A	N/A
1824.99	61.6Pk	2.8 / 28.1 / 30.0	62.4	H / 1.3 / 311.0	N/A	N/A
1838.73	61.9Pk	2.8 / 28.1 / 30.0	62.8	H / 1.3 / 312.0	N/A	N/A
4530.74	60.0Pk	4.5 / 33.3 / 40.0	57.7	H / 1.3 / 28.0	N/A	N/A
4562.47	60.4Pk	4.5 / 33.4 / 40.0	58.3	H / 1.4 / 32.0	N/A	N/A
4597.01	55.2Pk	4.5 / 33.6 / 40.0	53.3	H / 1.3 / 37.0	N/A	N/A
5436.97	60.0Pk	5.0 / 36.5 / 40.0	61.5	H / 1.2 / 262.0	N/A	N/A
5475.06	57.6Pk	5.0 / 36.6 / 40.0	59.2	H / 1.4 / 265.0	N/A	N/A
5516.35	57.4Pk	5.0 / 36.9 / 40.0	59.2	H / 1.3 / 266.0	N/A	N/A
6343.16	60.8Pk	5.0 / 36.9 / 40.0	62.7	H / 1.3 / 305.0	N/A	N/A
6387.40	58.9Pk	5.0 / 36.9 / 40.0	60.8	H / 1.3 / 305.0	N/A	N/A
6435.60	57.4Pk	5.0 / 36.8 / 40.0	59.2	H / 1.3 / 305.0	N/A	N/A
7249.20	45.2Pk	5.0 / 36.4 / 40.0	46.6	H / 1.3 / 305.0	N/A	N/A
7299.98	46.2Pk	5.0 / 36.4 / 40.0	47.7	H / 1.3 / 305.0	N/A	N/A
7355.23	49.4Pk	5.0 / 36.5 / 40.0	50.8	H / 1.3 / 305.0	N/A	N/A
4530.74	70.2Pk	4.5 / 33.3 / 40.0	67.9	V / 1.0 / 218.0	N/A	N/A
4562.47	69.3Pk	4.5 / 33.4 / 40.0	67.2	V / 1.0 / 215.0	N/A	N/A

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# Radiated Electromagnetic Emissions



Test Report #: B9526 Run 1      Test Area: Pinewood Site 1 (3m)  
 Test Method: 15.247C      Test Date: 12-23-1999  
 EUT Model #: FA-202      EUT Power: 3 VDC Battery Powered  
 EUT Serial #: 1      Temperature: 22 °C  
 Manufacturer: Inovonics Corporation      Relative Humidity: <18 %  
 EUT Description: Transmitter Module      Air Pressure: 81 kPa  
 Notes: Frequency Hopping      Page: 3 of 5

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 None	DELTA2 None
4597.02	67.1Pk	4.5 / 33.6 / 40.0	65.2	V / 1.0 / 215.0	N/A	N/A
5436.94	60.6Pk	5.0 / 36.5 / 40.0	62.2	V / 1.0 / 265.0	N/A	N/A
5475.03	58.6Pk	5.0 / 36.6 / 40.0	60.2	V / 1.0 / 265.0	N/A	N/A
5516.32	55.5Pk	5.0 / 36.9 / 40.0	57.4	V / 1.0 / 265.0	N/A	N/A
6343.16	58.5Pk	5.0 / 36.9 / 40.0	60.4	V / 1.0 / 212.0	N/A	N/A
6387.44	54.0Pk	5.0 / 36.9 / 40.0	55.8	V / 1.0 / 212.0	N/A	N/A
6435.63	52.7Pk	5.0 / 36.8 / 40.0	54.5	V / 1.0 / 212.0	N/A	N/A
7249.19	44.9Pk	5.0 / 36.4 / 40.0	46.3	V / 1.0 / 212.0	N/A	N/A
7299.97	44.6Pk	5.0 / 36.4 / 40.0	46.0	V / 1.0 / 212.0	N/A	N/A
7355.22	46.3Pk	5.0 / 36.5 / 40.0	47.8	V / 1.0 / 212.0	N/A	N/A
8155.36	60.4Pk	5.0 / 37.5 / 47.0	55.9	V / 1.0 / 314.0	N/A	N/A
8212.60	58.8Pk	5.0 / 37.7 / 47.0	54.5	V / 1.0 / 314.0	N/A	N/A
8274.33	58.5Pk	5.0 / 38.0 / 47.0	54.4	V / 1.0 / 314.0	N/A	N/A
9061.52	62.2Pk	5.0 / 40.4 / 47.0	60.6	V / 1.0 / 255.0	N/A	N/A
9125.17	60.6Pk	5.0 / 40.4 / 47.0	58.9	V / 1.0 / 255.0	N/A	N/A
9194.13	60.2Pk	5.0 / 40.3 / 47.0	58.6	V / 1.0 / 255.0	N/A	N/A
8155.58	61.8Pk	5.0 / 37.5 / 47.0	57.3	H / 1.0 / 297.0	N/A	N/A
8212.63	61.8Pk	5.0 / 37.7 / 47.0	57.5	H / 1.0 / 297.0	N/A	N/A
8274.65	61.6Pk	5.0 / 38.0 / 47.0	57.6	H / 1.0 / 297.0	N/A	N/A
9061.52	66.2Pk	5.0 / 40.4 / 47.0	64.7	H / 1.1 / 279.0	N/A	N/A
9125.17	64.6Pk	5.0 / 40.4 / 47.0	63.0	H / 1.1 / 279.0	N/A	N/A
9194.13	62.7Pk	5.0 / 40.3 / 47.0	61.0	H / 1.1 / 279.0	N/A	N/A

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# Radiated Electromagnetic Emissions



Test Report #:	B9526 Run 1	Test Area:	Pinewood Site 1 (3m)
Test Method:	15.247C	Test Date:	12-23-1999
EUT Model #:	FA-202	EUT Power:	3 VDC Battery Powered
EUT Serial #:	1	Temperature:	22 °C
Manufacturer:	Inovonics Corporation	Relative Humidity:	<18 %
EUT Description:	Transmitter Module	Air Pressure:	81 kPa
Notes:	Frequency Hopping		Page: 4 of 5

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 None	DELTA2 None
---------------	-----------------	------------------------------	-------------------	-------------------------	-----------------	----------------

***** MEASUREMENT SUMMARY *****						
906.11	69.2Pk	1.8 / 22.7 / 0.0	93.8	V / 1.2 / 213.0	N/A	N/A
912.40	69.0Pk	1.8 / 22.9 / 0.0	93.8	V / 1.2 / 220.0	N/A	N/A
919.37	70.2Pk	1.9 / 23.2 / 0.0	95.2	V / 1.3 / 215.0	N/A	N/A
1812.29	68.1Pk	2.8 / 28.0 / 30.0	68.9	V / 1.0 / 279.0	N/A	N/A
1824.92	65.7Pk	2.8 / 28.1 / 30.0	66.5	V / 1.0 / 280.0	N/A	N/A
1838.64	62.0Pk	2.8 / 28.1 / 30.0	62.9	V / 1.0 / 278.0	N/A	N/A
2718.40	58.5Pk	3.5 / 31.4 / 30.0	63.3	H / 2.0 / 202.0	N/A	N/A
2737.59	55.6Pk	3.5 / 31.5 / 30.0	60.6	H / 2.0 / 198.0	N/A	N/A
2758.05	53.0Pk	3.5 / 31.5 / 30.0	58.0	H / 1.9 / 198.0	N/A	N/A
3624.61	53.1Pk	4.2 / 33.3 / 30.0	60.6	H / 1.4 / 185.0	N/A	N/A
3649.96	50.9Pk	4.2 / 33.3 / 30.0	58.4	V / 1.8 / 241.0	N/A	N/A
3677.51	51.1Pk	4.3 / 33.3 / 30.0	58.7	H / 1.4 / 195.0	N/A	N/A
4530.74	70.2Pk	4.5 / 33.3 / 40.0	67.9	V / 1.0 / 218.0	N/A	N/A
4562.47	69.3Pk	4.5 / 33.4 / 40.0	67.2	V / 1.0 / 215.0	N/A	N/A
4597.02	67.1Pk	4.5 / 33.6 / 40.0	65.2	V / 1.0 / 215.0	N/A	N/A
5436.94	60.6Pk	5.0 / 36.5 / 40.0	62.2	V / 1.0 / 265.0	N/A	N/A
5475.03	58.6Pk	5.0 / 36.6 / 40.0	60.2	V / 1.0 / 265.0	N/A	N/A
5516.35	57.4Pk	5.0 / 36.9 / 40.0	59.2	H / 1.3 / 266.0	N/A	N/A
6343.16	60.8Pk	5.0 / 36.9 / 40.0	62.7	H / 1.3 / 305.0	N/A	N/A
6387.40	58.9Pk	5.0 / 36.9 / 40.0	60.8	H / 1.3 / 305.0	N/A	N/A
6435.60	57.4Pk	5.0 / 36.8 / 40.0	59.2	H / 1.3 / 305.0	N/A	N/A
7249.20	45.2Pk	5.0 / 36.4 / 40.0	46.6	H / 1.3 / 305.0	N/A	N/A
7299.98	46.2Pk	5.0 / 36.4 / 40.0	47.7	H / 1.3 / 305.0	N/A	N/A
7355.23	49.4Pk	5.0 / 36.5 / 40.0	50.8	H / 1.3 / 305.0	N/A	N/A
8155.58	61.8Pk	5.0 / 37.5 / 47.0	57.3	H / 1.0 / 297.0	N/A	N/A
8212.63	61.8Pk	5.0 / 37.7 / 47.0	57.5	H / 1.0 / 297.0	N/A	N/A
8274.65	61.6Pk	5.0 / 38.0 / 47.0	57.6	H / 1.0 / 297.0	N/A	N/A

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Reviewed by: <u>Shawn Singh</u>	<i>Shawn Singh</i>
Printed	Signature

# Radiated Electromagnetic Emissions



Test Report #: B9526 Run 1 Test Area: Pinewood Site 1 (3m)  
 Test Method: 15.247C Test Date: 12-23-1999  
 EUT Model #: FA-202 EUT Power: 3 VDC Battery Powered  
 EUT Serial #: 1 Temperature: 22 °C  
 Manufacturer: Inovonics Corporation Relative Humidity: <18 %  
 EUT Description: Transmitter Module Air Pressure: 81 kPa  
 Notes: Frequency Hopping Page: 5 of 5

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 None	DELTA2 None
9061.52	66.2Pk	5.0 / 40.4 / 47.0	64.7	H / 1.1 / 279.0	N/A	N/A
9125.17	64.6Pk	5.0 / 40.4 / 47.0	63.0	H / 1.1 / 279.0	N/A	N/A
9194.13	62.7Pk	5.0 / 40.3 / 47.0	61.0	H / 1.1 / 279.0	N/A	N/A

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# Radiated Electromagnetic Emissions



Test Report #:	B9526 Run 2	Test Area:	Pinewood Site 1 (3m)
Test Method:	FCC Class B	Test Date:	12-23-1999
EUT Model #:	FA-202	EUT Power:	3 VDC Battery Powered
EUT Serial #:	1	Temperature:	22 °C
Manufacturer:	Inovonics Corporation	Relative Humidity:	<18 %
EUT Description:	Transmitter Module	Air Pressure:	81 kPa
Notes:	Frequency Hopping		Page: 1 of 3

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 FCC B (< 1GHz)	DELTA2 None
Log/vertical						
No emissions were found at 0 deg						
No emissions were found at 90 deg						
No emissions were found at 180 deg						
No emissions were found at 270 deg						
Log/horizontal						
No emissions were found at 0 deg						
No emissions were found at 90 deg						
No emissions found at 180 deg						
No emissions were found at 270 deg						
The following are noise floor measurements:						
220.00	22.8Qp	0.8 / 13.7 / 30.0	7.2	H / 1.0 / 270.0	-38.8	N/A
400.00	23.0Qp	1.2 / 15.7 / 30.0	9.8	H / 1.0 / 270.0	-36.2	N/A
500.00	22.4Qp	1.3 / 17.1 / 30.0	10.8	H / 1.0 / 270.0	-35.2	N/A
600.00	22.2Qp	1.5 / 19.6 / 30.0	13.4	H / 1.0 / 270.0	-32.6	N/A
700.00	22.2Qp	1.6 / 20.8 / 30.0	14.6	H / 1.0 / 270.0	-31.4	N/A
800.00	21.9Qp	1.7 / 21.3 / 30.0	15.0	H / 1.0 / 270.0	-31.0	N/A

Tested by: Steve Brauns  
Printed

On File  
Signature  
*Shawn Singh*  
Signature

Reviewed by: Shawn Singh  
Printed



# Radiated Electromagnetic Emissions



Test Report #: B9526 Run 2 Test Area: Pinewood Site 1 (3m)  
 Test Method: FCC Class B Test Date: 12-23-1999  
 EUT Model #: FA-202 EUT Power: 3 VDC Battery Powered  
 EUT Serial #: 1 Temperature: 22 °C  
 Manufacturer: Inovonics Corporation Relative Humidity: <18 %  
 EUT Description: Transmitter Module Air Pressure: 81 kPa  
 Notes: Frequency Hopping Page: 2 of 3

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 FCC B (< 1GHz)	DELTA2 None
Bicon/vertical						
No emissions were found at 0 deg						
No emissions were found at 90 deg						
No emissions were found at 180 deg						
No emissions were found at 270 deg						
Bicon/Horizontal						
No emissions were found at 0 deg						
No emissions were found at 90 deg						
No emissions were found at 180 deg						
No emissions were found at 270 deg						
The following are noise floor measurements						
35.00	30.9Qp	0.4 / 12.8 / 30.0	14.1	H / 1.0 / 270.0	-25.9	N/A
65.00	30.2Qp	0.5 / 8.9 / 30.0	9.6	H / 1.0 / 270.0	-30.4	N/A
85.00	30.9Qp	0.5 / 7.9 / 30.0	9.2	H / 1.0 / 270.0	-30.8	N/A
115.00	26.4Qp	0.6 / 10.6 / 30.0	7.5	H / 1.0 / 270.0	-36.0	N/A
140.00	24.8Qp	0.7 / 12.1 / 30.0	7.5	H / 1.0 / 270.0	-36.0	N/A
185.00	23.9Qp	0.8 / 13.1 / 30.0	7.8	H / 1.0 / 270.0	-35.7	N/A

Tested by: Steve Brauns  
Printed

On File

Signature

*Shawn Singh*

Reviewed by: Shawn Singh  
Printed

Signature

# Radiated Electromagnetic Emissions



Test Report #: B9526 Run 2      Test Area: Pinewood Site 1 (3m)  
 Test Method: FCC Class B      Test Date: 12-23-1999  
 EUT Model #: FA-202      EUT Power: 3 VDC Battery Powered  
 EUT Serial #: 1      Temperature: 22 °C  
 Manufacturer: Inovonics Corporation      Relative Humidity: <18 %  
 EUT Description: Transmitter Module      Air Pressure: 81 kPa  
 Notes: Frequency Hopping      Page: 3 of 3

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB)	FINAL (dBuV/m)	POL/HGT/AZ (m)/(deg)	DELTA 1 FCC B (< 1GHz)	DELTA2 None
---------------	-----------------	------------------------------	-------------------	-------------------------	---------------------------	----------------

***** MEASUREMENT SUMMARY *****						
35.00	30.9Qp	0.4 / 12.8 / 30.0	14.1	H / 1.0 / 270.0	-25.9	N/A
65.00	30.2Qp	0.5 / 8.9 / 30.0	9.6	H / 1.0 / 270.0	-30.4	N/A
85.00	30.9Qp	0.5 / 7.9 / 30.0	9.2	H / 1.0 / 270.0	-30.8	N/A
115.00	26.4Qp	0.6 / 10.6 / 30.0	7.5	H / 1.0 / 270.0	-36.0	N/A
140.00	24.8Qp	0.7 / 12.1 / 30.0	7.5	H / 1.0 / 270.0	-36.0	N/A
185.00	23.9Qp	0.8 / 13.1 / 30.0	7.8	H / 1.0 / 270.0	-35.7	N/A
220.00	22.8Qp	0.8 / 13.7 / 30.0	7.2	H / 1.0 / 270.0	-38.8	N/A
400.00	23.0Qp	1.2 / 15.7 / 30.0	9.8	H / 1.0 / 270.0	-36.2	N/A
500.00	22.4Qp	1.3 / 17.1 / 30.0	10.8	H / 1.0 / 270.0	-35.2	N/A
600.00	22.2Qp	1.5 / 19.6 / 30.0	13.4	H / 1.0 / 270.0	-32.6	N/A
700.00	22.2Qp	1.6 / 20.8 / 30.0	14.6	H / 1.0 / 270.0	-31.4	N/A
800.00	21.9Qp	1.7 / 21.3 / 30.0	15.0	H / 1.0 / 270.0	-31.0	N/A

Tested by: Steve Brauns  
Printed

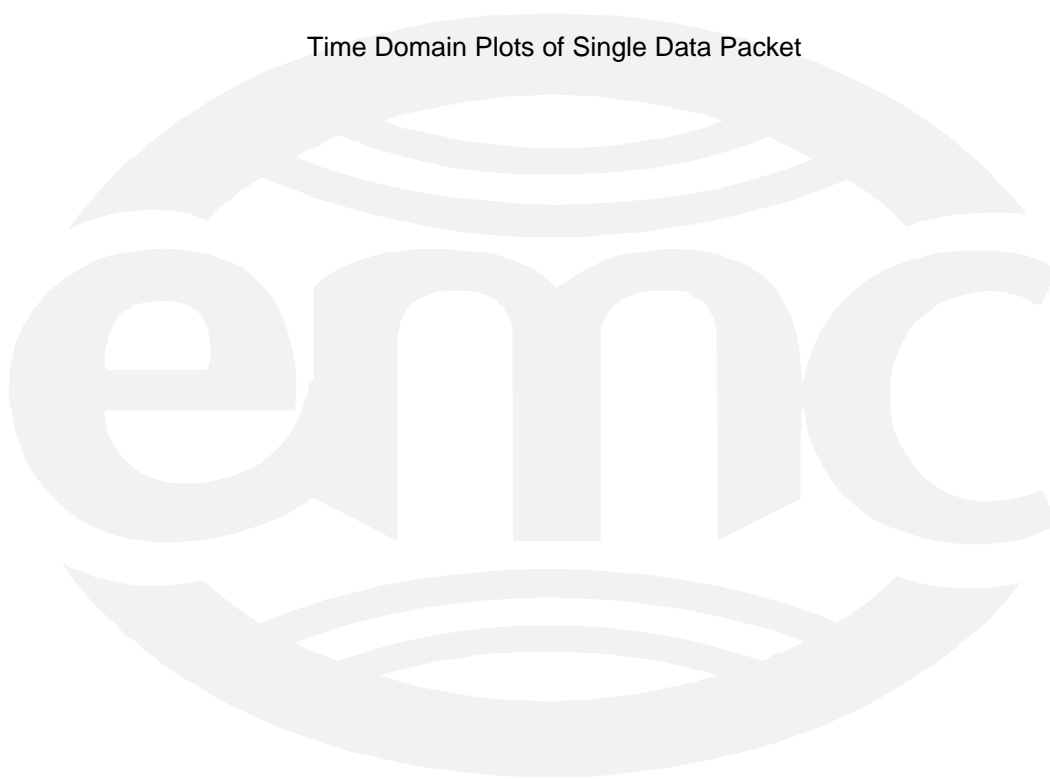
On File  
Signature  
*Shawn Singh*

Reviewed by: Shawn Singh  
Printed

Signature

## Appendix C

Time Domain Plots of Single Data Packet

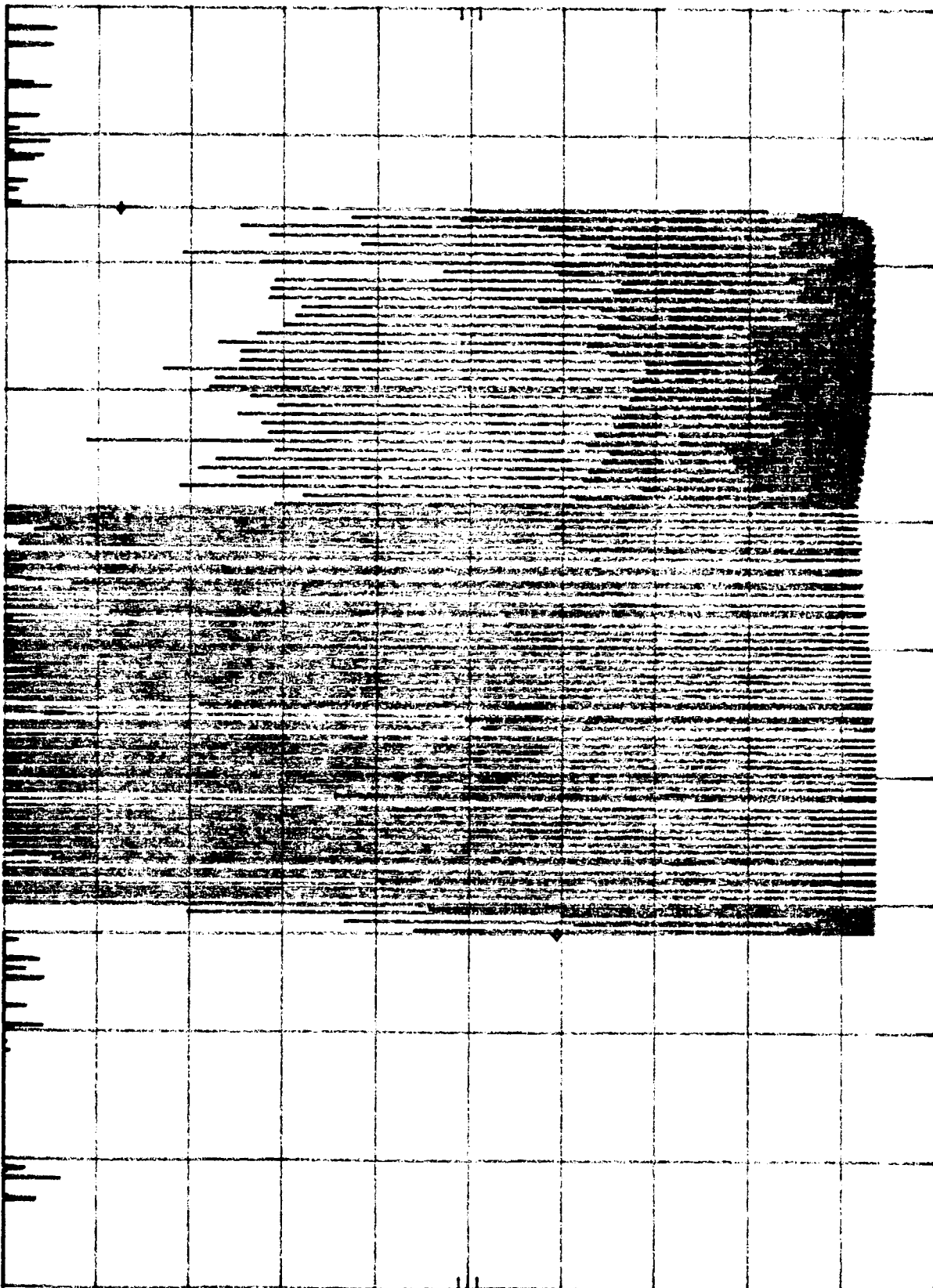


INOVONICS FA-202  
REF 57.0 DBμV ATTEN 0 DB

MKR Δ 28.30 msec  
23.55 DB

5 DB/

POS PK

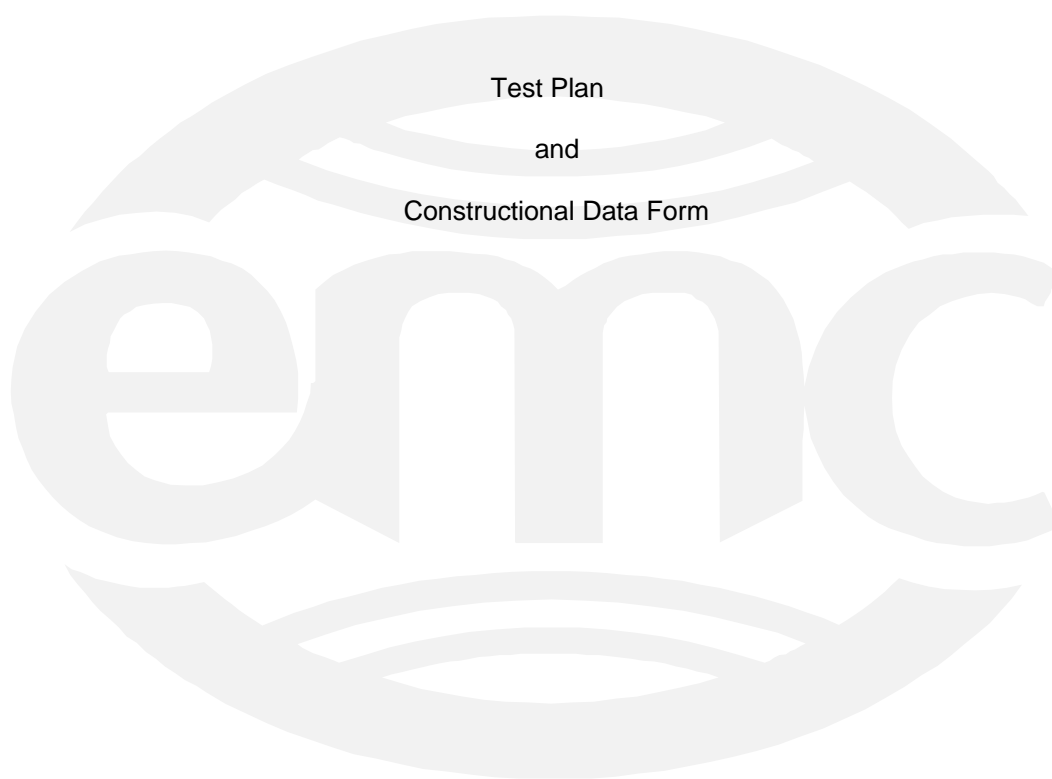


CENTER 912.428 006 MHZ  
RES BW 30 KHZ

VBW 30 KHZ

SPAN 0 HZ  
SWP 50.0 msec

## Appendix D



Test Plan  
and  
Constructional Data Form

# Constructional Data Form for Electromagnetic Compatibility Testing



A completed form helps ensure that product testing will go smoothly. Add attachments as necessary for additional documentation. For additional help, please contact your TÜV Product Service Representative.

**Applicant** -- Enter company information pertaining to the location where the product is manufactured and for the manufacturer's contact soliciting the testing.

Company: Inovonics Corporation  
Address: 2100 Central Ave  
Boulder, Colorado 80301  
Phone: 303-939-9336 Fax: \_\_\_\_\_  
Contact: Lindy Beane Ext. 113 Position: \_\_\_\_\_

**General Equipment Description** -- Indicate which attachments you are providing with this document. It is recommended that you provide those listed.

Type of Equipment: Transmitter Module Model No.: FA-202  
Serial No.: 1 FCC ID No.: HCQ3B6ESL

General description: Board level, battery powered, transmitter module  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Attachments: (only required for certification)

- External Photographs  Product Literature  High Level Bill of Materials

Date and sign each page of the CDF. Original signatures must be present on each page.

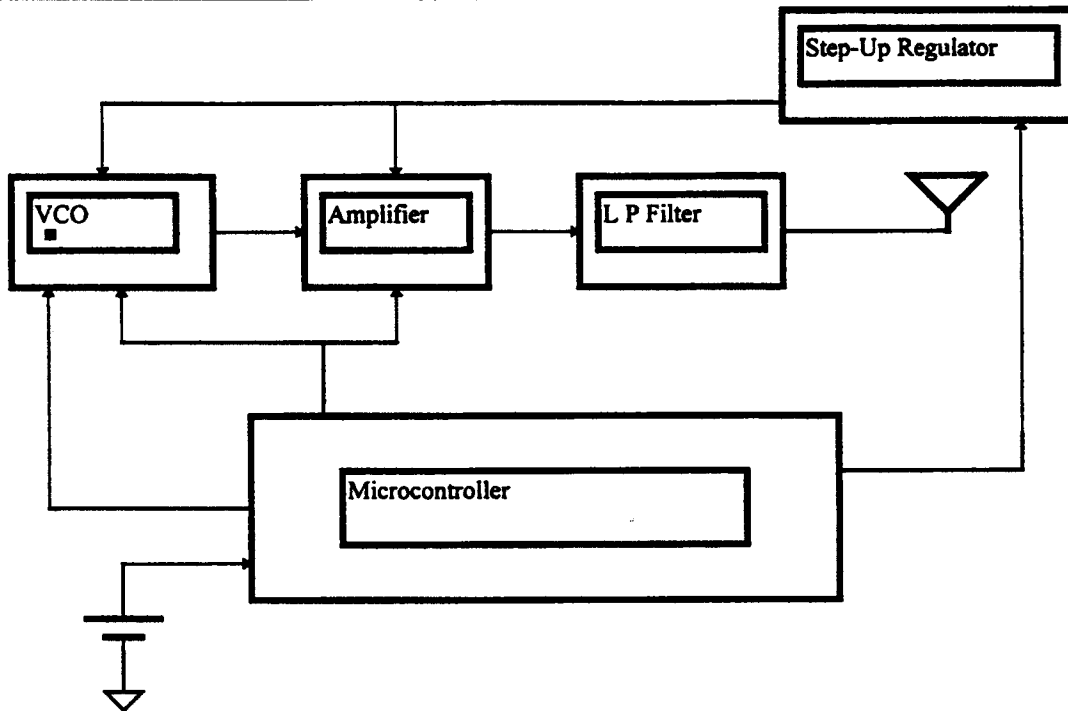
Date: 12/21/97 Signature of Applicant: *Donald J. Hunt*

UEMCO902.doc, Revision 1.0  
Author: B. Gill  
Revised: 20 March 1997

# Constructional Data Form for Electromagnetic Compatibility Testing



**System Configuration Block Diagram** -- Provide a line drawing identifying the EUT, simulators, support equipment, I/O cables, power cables, and any other pertinent components to be used during testing. Use a dashed line to separate the equipment in the testing field versus equipment outside testing field.



Date and sign each page of the CDF. Original signatures must be present on each page.

Date:

12/21/89

Signature of Applicant:

*Donald J. Hume*

UEMC0902.doc, Revision 1.0  
Author: B. Dill  
Revised: 20 March 1997

# Constructional Data Form for Electromagnetic Compatibility Testing



**Installation and Environmental Conditions (describe)** – Describe the intended installation. Include details such as power connection and system grounding approaches. Describe the intended operating environment, include details such as humidity, cooling, heating and hazardous environments. Attaching a copy of an installation manual is recommended for proper documentation of your system. Please indicate.

No external wires, Battery powered, room temperature operation (+10° to +45°c)

Installation manual/instructions (attached, only required for certification)

**Power Requirements** – Indicate your system power requirements for the equipment to be tested.

Rated Voltage \_\_\_\_\_ Rated Input Power \_\_\_\_\_

**Protection Class** – Indicate your product's protection class. Contact your TÜV Product Service representative and is only required for certification.

Type: \_\_\_\_\_ Class: \_\_\_\_\_

Date and sign each page of the CDF. Original signatures must be present on each page.

Date: 12/21/95 Signature of Applicant: *Donald J. Heine*

UEMC0902.doc, Revision 1.0  
Author: B. Dill  
Revised: 20 March 1997



# Constructional Data Form for Electromagnetic Compatibility Testing



## I/O Ports and Cables

Indicate all interface cables which can be attached to the equipment even if they are not sold as part of your system. Describe the port (e.g., Parallel, Serial, SCSI), list its type (e.g., AC, DC, Signal, Control) and number of ports/cables of type. Indicate if the I/O port is to be exercised during testing. List the type of transmission and if the cable is an EUT assembly-to-assembly interconnection cable (PC to printer, to modem). Indicate whether the cable is shielded or not, type of shield (e.g. Braid, Foil) and how terminated (e.g. 360 degree to conductive shell, pigtail) at both ends of the cable. If a cable can have a typical length of  $\geq 3.0$  meters, then it is required to test with a cable of at least 3.0 meters.

### O Ports and Cables

description: \_\_\_\_\_

type of Port: \_\_\_\_\_ # of ports/cables of type \_\_\_\_\_

exercised during testing?  Yes  No

assembly ↔ Assembly Interconnect  Yes  No

able shielded:  Yes  No

shield Type (describe) \_\_\_\_\_

termination: (describe) \_\_\_\_\_

transmission Type:  Analog  Digital

length of cable: Maximum: \_\_\_\_\_ Tested: \_\_\_\_\_

### O Ports and Cables

description: \_\_\_\_\_

type of Port: \_\_\_\_\_ # of ports/cables of type \_\_\_\_\_

exercised during testing?  Yes  No

assembly ↔ Assembly Interconnect  Yes  No

able shielded:  Yes  No

shield Type (describe) \_\_\_\_\_

termination: (describe) \_\_\_\_\_

transmission Type:  Analog  Digital

length of cable: Maximum: \_\_\_\_\_ Tested: \_\_\_\_\_

### O Ports and Cables

description: \_\_\_\_\_

type of Port: \_\_\_\_\_ # of ports/cables of type \_\_\_\_\_

exercised during testing?  Yes  No

assembly ↔ Assembly Interconnect  Yes  No

able shielded:  Yes  No

shield Type (describe) \_\_\_\_\_

termination: (describe) \_\_\_\_\_

transmission Type:  Analog  Digital

length of cable: Maximum: \_\_\_\_\_ Tested: \_\_\_\_\_

Date and sign each page of the CDF. Original signatures must be present on each page.

Date: \_\_\_\_\_ Signature of Applicant: \_\_\_\_\_

UEMC0902.doc, Revision 1.0  
Author: B. Dill  
Revised: 20 March 1997

# Constructional Data Form for Electromagnetic Compatibility Testing



**EUT configurations** -- Provide a technical description of all possible EUT configurations. Specify if more than one configuration is to be tested.

**EUT Software and Operation Modes to be Tested** -- list the operating modes to be used during test. It is recommended the equipment be tested while operating in a typical operation mode. Consult with your TÜV Product Service Representative when typical operating modes are not practical. FCC testing of personal computers and/or peripherals requires that a simple program generate a complete line of upper case H's. This pattern must be sent to the parallel port device, serial port device, and must be write/read/verified to each storage device. Monitors must display the H pattern, typically in white letters on a black background. Provide a general description of all software, firmware, and PLD algorithms used in the equipment. List all code modules as described above, with the revision level used during testing.

General Description:  
(describe)

Software Revision Level:  
(list and describe)

Operating modes to be  
tested: (list and describe)

*Frequency Hopping*

Operation manual/instructions (attached)

Date and sign each page of the CDF. Original signatures must be present on each page.

Date:

Signature of Applicant:

UEMC0902.doc, Revision 1.0  
Author: B. Dill  
Revised: 20 March 1997

# Constructional Data Form for Electromagnetic Compatibility Testing



**System, Subsystem, Major Subassemblies or Internal Peripherals** -- List and describe all system, subsystem, major subassemblies and all internal peripherals. This should include such things as an external monitor, parallel interface peripheral, serial interface peripheral, internal disk drives or internal circuit boards. It is recommended that circuit diagrams, assembly and subassembly drawings be attached. Please indicate.

Description	Model #	Serial #	FCC ID #

Technical Drawings attached

**Interfacing Equipment and/or Simulators (which are not part of the EUT)** -- List and Describe all equipment or peripherals that will be connected to the EUT. For FCC testing a minimum configuration is required. If you have questions about this minimum configuration contact your TÜV Product Service representative.

Description	Model #	Serial #	FCC ID #

Date and sign each page of the CDF. Original signatures must be present on each page.

**Date:** \_\_\_\_\_ **Signature of Applicant:** \_\_\_\_\_

UEMC0902.doc, Revision 1.0  
Author: B. Dill  
Revised: 20 March 1997

# Constructional Data Form for Electromagnetic Compatibility Testing



**EMC System Details** -- List all frequencies and sub-harmonics which are 10kHz or above for such things as oscillators, horizontal line rate of monitors, and clock rates of incorporated OEM assemblies. List all power supplies. Indicate switching frequencies. List power line filters and indicate the manufacturer, model and location on EUT. Indicate all components used for high frequency noise reduction. (e.g., ceramic capacitor, 0.01µF, 1 ea. at C12 - C20).

### Oscillator Frequencies

Frequency	Sub-harmonics	EUT Location	Description of Use
2 MHz			
<del>Ceramic</del> Ceramic Resonator			Freq. Control

### Power Supply

Frequency	Manufacturer	Model #	Serial #	Type (list frequency)
3V Battery				

### Power Line Filters

Manufacturer	Model #	Qty	Location on EUT

### Critical EMI Components (Capacitors, ferrites, etc.)

Description	Manufacturer	Part # or Value	Qty	Location on EUT

Date and sign each page of the CDF. Original signatures must be present on each page.

Date: 12/21/75      Signature of Applicant: *Donald J. Hume*

UEMC0802.doc, Revision 1.0  
Author: B. Oll  
Revised: 20 March 1997

# Constructional Data Form for Electromagnetic Compatibility Testing



**Other EMI Critical Construction Detail** -- Indicate any other measures taken to reduce high frequency noise, (e.g., grounding the circuit board on the right rear corner with 0.25" braid, 3 inches long to the chassis).

**Description of Enclosure** -- Describe the principle materials of the enclosure (e.g., plastic, plastic with shielding material, metal, metal with specific shielding contact points, metal with paint on all surfaces).

Date and sign each page of the CDF. Original signatures must be present on each page.

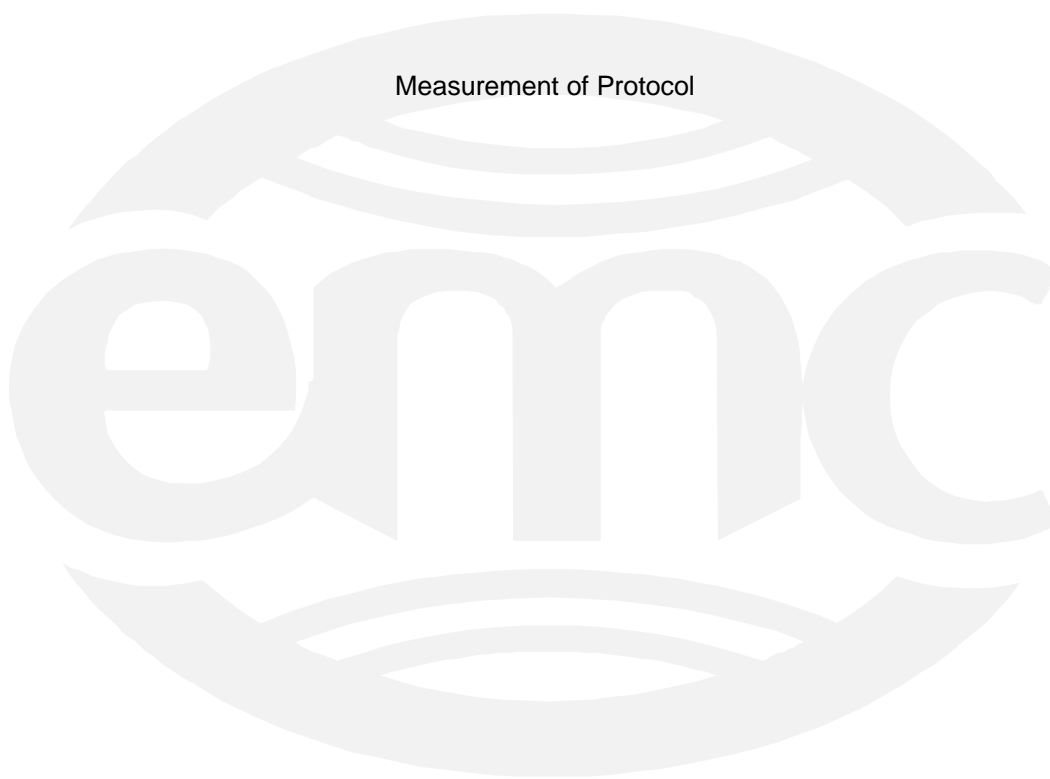
**Date:**

**Signature of Applicant:**

UEMC0902.doc, Revision 1.0  
Author: B. Dill  
Revised: 20 March 1997

## Appendix E

Measurement of Protocol



# MEASUREMENT PROTOCOL FOR FCC

## GENERAL INFORMATION

### Measurement Uncertainty

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. These test systems have a measurement uncertainty of  $\pm 4.5$  dB. The equipment comprising the test systems are calibrated on an annual basis.

### Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

## CONDUCTED EMISSIONS

The final level, expressed in  $\text{dB}\mu\text{V}$ , is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between  $\text{dB}\mu\text{V}$  and  $\mu\text{V}$ , the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

## RADIATED EMISSIONS

The final level, expressed in  $\text{dB}\mu\text{V}/\text{m}$ , is arrived at by taking the reading from the spectrum analyzer (Level  $\text{dB}\mu\text{V}$ ) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the FCC limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example:

Frequency (MHz)	Level ( $\text{dB}\mu\text{V}$ )	+	Factor & Cable (dB)	=	Final ( $\text{dB}\mu\text{V}/\text{m}$ )	-	FCC B Limit ( $\text{dB}\mu\text{V}/\text{m}$ )	=	Delta FCC B (dB)
32.21	13.9	+	16.3	=	30.2	-	40.0	=	-9.8

## DETAILS OF TEST PROCEDURES

### General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

### Conducted Emissions

Conducted emissions on the 60 Hz power interface of the EUT are measured in the frequency range of 450 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50  $\Omega$ /50  $\mu$ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

### Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 9193.7 MHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Average field strength levels were computed from peak readings and duty cycle of the transmitter. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees. Intentional radiators are rotated through three orthogonal axes to determine the attitude that maximizes the emissions.