Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C Specifications for an Intentional Radiator on the Metrotech Corp. Model: Arrow

FCC ID:	GW6HNARROW
GRANTEE:	Metrotech Corp. 488 Tasman Drive Sunnyvale, CA 94089
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	February 22, 1999
FINAL TEST DATE:	February 1, 1999
AUTHORIZED SIGNATORY:	_____ David W. Bare Principal Engineer

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SCOPE

An electromagnetic emissions test has been performed on the Metrotech transmitter model Arrow pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the Metrotech model Arrow and therefore apply only to the tested sample. The sample was selected and prepared by Howard Ngo of Metrotech Corp..

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules for the radiated and conducted emissions of intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

STATEMENT OF COMPLIANCE

The tested sample of Metrotech model Arrow complied with the requirements of Subpart C of Part 15 of the FCC Rules for low power intentional radiators.

Maintenance of FCC compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

EMISSION TEST RESULTS

The following emissions tests were performed on the Metrotech model Arrow. The actual test results are contained in an exhibit of this report.

LIMITS OF CONDUCTED INTERFERENCE VOLTAGE

The EUT tested complied with the limits detailed in FCC Rules Part 15 Section 15.207.

The following measurement was extracted from the data recorded during the conducted emissions scan and represents the highest amplitude emission relative to the specification limit. The actual test data and any correction factors are contained in an exhibit of this report.

Frequency	Meas. Level	Corrected	FCC Limit	FCC Margin	Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
MHz	dBµV	dBm	dBm	dB				
0.035	114.2	32.2	40.0	-7.8	Pk	-	-	

MEASUREMENT UNCERTAINTIES

ISO Guide 25 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	30 to 1000	± 3.2

COMPLIANCE EXPLANATION

When the measurement uncertainties (see above section) associated with the emission test methods and equipment used are taken into consideration there are four possible results as detailed below:

Complied
All measurements recorded were below the specification limit by a margin greater than the measurement uncertainty.

Probably Complied
One or more measurements recorded were below the specification limit by a margin less than the measurement uncertainty. It is not possible to determine that the unit complied with a 95% confidence level from the results. There is a high probability that the product tested does comply.

Probably Did Not Comply
One or more measurements recorded were above the specification limit by a margin less than the measurement uncertainty. It is not possible to determine that the unit failed to comply with a 95% confidence level from the results. There is a high probability that the product tested does not comply.

Did Not Comply
One or more measurements recorded exceeded the specification limit by a margin greater than the measurement uncertainty.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Metrotech model Arrow is a a 35KHz single frequency transmitter which is designed to trnasmit onto utility pipes and cables for cable location purposes. The sample was received and tested on February 1, 1999. The EUT consisted of the following component(s):

Manufacturer/Model/Description	Serial Number	FCC ID Number
Metrotech Corp/ Arrow/ transmitter	001589	GWGHNARROW

INPUT POWER

The EUT iis powered by an internal 9V battery with no provisions for external power connections.

PRINTED WIRING BOARDS

The EUT contained the following printed wiring boards during emissions testing:

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Metrotech Corp/ Main Board	10032	5	0015589	2.2625

ENCLOSURE

The EUT enclosure is primarily constructed of cycoloy plastic It measures approximately 26.5 cm wide by 2.2 cm deep by 16.2 cm high.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on February 1, 1999 at the Elliott Laboratories Open Area Test Site #1 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed with the EUT connected to the receiver through a impedance matching network.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers, allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurments made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the output port of the EUT connected to either the power meter or spectrum analyzer via a suitable matching network, attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS, SECTION 15.207

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

POWER SPECIFICATION LIMITS, SECTION 15.213

Frequency Range (MHz)	Limit Watts
0.009-0.045	10
0.045-0.490	1

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - B = C$$

and

$$C - S = M$$

where:

R_r = Receiver Reading in dBuV

B = Broadband Correction Factor*

C = Corrected Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

* Broadband Level - Per ANSI C63.4, 13 dB may be subtracted from the quasi-peak level if it is determined that the emission is broadband in nature. If the signal level in the average mode is six dB or more below the signal level in the peak mode, the emission is classified as broadband.

EXHIBIT 1: Test Equipment Calibration Data

Test Equipment List - SVOATS#1

January 19, 1999

	Manufacturer/Description		Model	Asset #	Interval	Last Cal	Cal Due
☐	Elliott Laboratories	FCC / CISPR LISN	LISN-3, OATS	304	12	6/24/98	6/24/99
☐	EMCO	Biconical Antenna, 30-300 MHz	3110B	363	12	4/8/98	4/8/99
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	487	12	6/18/98	6/18/99
☐	EMCO	D. Ridge Horn Antenna, 1-18GHz	3115	868	12	9/22/98	9/22/99
☐	EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	12	4/8/98	4/8/99
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	780	12	1/4/99	1/4/2000
☐	Hewlett Packard	EMC Receiver /Analyzer	8595EM	787	12	11/23/98	11/23/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263, (F303)	12	6/8/98	6/8/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	12	11/25/98	11/25/99
☐	Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	12	11/12/98	11/12/99
☐	Hewlett Packard	Power Meter	432A	259, (F304)	12	3/10/98	3/10/99
☐	Hewlett Packard	Spectrum Analyzer	8563E	284, (F194)	12	1/18/99	1/18/2000
☐	Hewlett Packard	Spectrum Analyzer, 9 KHz-6.5 GHz	8595E-041-103-	Metric, 885	12	5/11/98	5/11/99
☐	Hewlett Packard	Thermistor Mount	478A	652	12	3/10/98	3/10/99
☐	Narda West	High Pass Filter	HPF 180	821	12	8/10/98	8/10/99
☐	Narda-West	EMI Filter 2.4 GHz, High Pass	60583 HPF-161	248	12	4/27/98	4/27/99
☐	Narda-West	EMI Filter 5.6 GHz, High Pass	60583 HXF370	247	12	4/27/98	4/27/99
☐	Rohde & Schwarz	10 dB Pad / Pulse Limiter	ESH3Z2	372	12	6/22/98	6/22/99
☐	Rohde& Schwarz	Receiver 20 MHz - 1.3 GHz	ESVP		6	1/18/99	7/18/99
☒	Rohde& Schwarz	Receiver 9KHz - 30 MHz	ESH3		6	1/18/99	7/18/99

File Number: T30112

Date: 2-7-99

Engr: M. Buyard

All measurements are traceable to national standard of measurement such as NIST

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T 30112 2 Pages

Elliott

EMC Test Log

Client:	Metrotech Corp.	Date:	2/1/99	Test Engr:	Mehran M Birgani
Product:	Arrow Transmiter	File:	T30112	Proj. Eng:	David W. Bare
Objective:	Final Qualification	Site:	SVOATS #1	Contact:	Howard Ngo
Spec:	FCC 15.213	Page:	1 of 2	Approved:	
Revision	1.0				

Ambient Conditions
Temperature: 23.2 ℃
Humidity: RH %

Test Objective

The objective of this test session is to perform engineering evaluation testing of the EUT defined below relative to the specification(s) defined above.

The objective of this test session is to perform final qualification testing the EUT defined below relative to the specification(s) defined above.

Test Summary

Run #1 - Conducted Emissions , 9 kHz - 30- MHz

Results: FCC -7.8 dB Pk @ 35 kHz

Equipment Under Test (EUT) General Description

The EUT is a 35KHz single frequency transmitter which is designed to trnasmit onto utility pipes and cables for cable location. Normally, the EUT would be placed on the ground during operation. The EUT was placed on a table during emissions testing to facilitate testing. The electrical rating of the EUT is 9 V, 0.25 Amps.

Equipment Under Test (EUT)

Manufacturer/Model/Description	Serial Number	FCC ID Number
Metrotech Corp/ Arrow/ transmitter	001589	GWGHNARROW

Power Supply and Line Filters

The EUT iis powered by an internal 9V battery:

Printed Wiring Boards in EUT

Manufacturer/Description	Assembly #	Rev.	Serial Number	Crystals (MHz)
Metrotech Corp/ Main Board	10032	5	0015589	2.2625

Client:	Metrotech Corp.	Date:	2/1/99	Test Engr:	Mehran M Birgani
Product:	Arrow Transmiter	File:	T30112	Proj. Eng:	David W. Bare
Objective:	Final Qualification	Site:	SVOATS #1	Contact:	Howard Ngo
Spec:	FCC 15.213	Page:	2 of 2	Approved:	
Revision	1.0				

Subassemblies in EUT

The following information was provided by the manufacturer:

Manufacturer/Description	Assembly Number	Rev.	Serial Number
None			

EUT Enclosure(s)

The EUT enclosure is primarily constructed of cycoloy plastic It measures approximately 26.5 cm wide by 2.2 cm deep by 16.2 cm high.

EMI Suppression Devices (filters, gaskets, etc.)

The following information was provided by the manufacturer:

Description	Manufacturer	Part Number
None		

Local Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None		

Remote Support Equipment

Manufacturer/Model/Description	Serial Number	FCC ID Number
None		

Interface Cabling

Cable Description	Length (m)	From Unit/Port	To Unit/Port
None			

General Test Conditions

Test Data Tables

See attached data

EXHIBIT 5: Proposed FCC ID Label & Label Location

The label will be located on the top of the battery compartment under the lid of the unit.

EXHIBIT 6: Detailed Photographs of Metrotech Model Arrow Construction

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EXHIBIT 7: Operator's Manual for Metrotech Model Arrow

Pages 25

EXHIBIT 8: Block Diagram of Metrotech Model Arrow

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EXHIBIT 9: Schematic Diagrams for Metrotech Model Arrow

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EXHIBIT 10:Theory of Operation for Metrotech Model Arrow

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