MEASUREMENT/TECHNICAL REPORT

Company: Krohne America, Inc.
Model: BM702
FCC ID: JH5BM702

Description: This is a report to support a request for a type acceptance.

Equipment Type: Radiolocation device

Report prepared for: Krohne America, Inc.
7 Dearborn Road
Peabody, MA 01960
Phone: 978-535-6060
Fax: 978-535-1720

Report prepared by: Chad A. Bell
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Letter of Agency

KROHNE

KROHNE, INC.
7 Dearborn Road
Peabody, MA 01960
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Website: http://www.krohne.com

105184
Peabody, MA

September 12, 2000

LETTER OF AGENCY

I hereby authorize, until further notice, Curtis-Straus LLC, of 527 Great Road, Littleton, MA 01460, to act on our behalf in dealings before the Federal Communications Commission with respect to all matters relating to equipment authorizations for licensed transmitters under Part 90 of 47 CFR.

I further certify that no party (as defined in Paragraph 1.2002(b) of CFR47, 1992) to this application, including myself, is subject to a denial of federal benefits, that includes FCC benefits, pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U. S. C., 853(a).

Certified by: Robert B. Senk

Robert B. Senk
Manufacturing Manager
KROHNE, INC.

Offices in: Houston, TX; Anaheim, CA; Bordentown, NJ

Innovative Solutions Time And Time Again

Introduction

This report is an application for Certification of a Transmitter operating pursuant to Part 90 of the FCC Rules, Code of Federal Regulations 47. The model number covered by this report is BM702. This report is designed to demonstrate the compliance of this device with the requirements outlined in Part 90 of CFR 47 using the methods outlined in Part 2 of CFR 47. The current revision date, October 1,1998, of each Part has been used for technical requirements.

The confidential information and descriptions included in this application are detailed descriptions of the products, block diagrams, component specifications, and schematic diagrams. We hereby respectfully request under the provision of section 0.457d of the code that the documents listed below be held confidential.

Technical Descriptions and Block Diagrams

Schematics

Bill of Materials

Krohne America, Inc. is requesting that the Technical Descriptions, Block Diagrams, Schematics and Bill of Materials be kept confidential in the FCC application because of the proprietary design developed by Krohne America, Inc. that is unique to the industry.

Product Description

The BM 702 level gauge is designed solely for measuring the level, distance, volume and reflection of liquids, pastes, slurries, particulate materials and solids. Five different antennas are available for use with the unit depending on the application. There are four horn antennas and one Wave-Stick antenna. The Wave-Stack antenna has several different part numbers which correspond to the different lengths of waveguide that lead to the radiating potion of the Wave-Stick. We tested the 6in Wave-Stick.

Unit Tested
Model Number: BM702
Serial Number: 0/311883.001
Antennas:

3in horn	2116340100
4in horn	2113010100
6in horn	2113000100
8in horn	2112540100
Wave-Stick	3159860600

Related Submittal(s) Grants

There are no other approvals required for this device.

Test Methodology

Radiated emission testing was performed according to the procedures in ANSI C63.4 (1992). Radiated testing was performed at an antenna to EUT distance of 3 meters below 1 GHz, and at a distance of 3 or 1 meter(s) above 1 GHz. The actual test distance used is noted in the test data sheets. The device's performance was investigated to 40GHz. The EUT was powered by a DC power supply for all tests. All other performance tests were made in accordance with the procedures outlined in Part 90 of CFR 47.

Each of the antennas was investigated at the fundamental frequency to determine which was the most efficient radiator – this was the 8in horn antenna. Using the 8in horn antenna, harmonics and spurious emissions were checked from 7 – 40GHz.

Test Facility

Curtis-Straus LLC
All testing for the range 30–40000MHz was performed at Curtis-Straus (A2LA Certificate Number: 1627-01). The open area test site used to collect the radiated data is located at 527 Great Road, Littleton, MA 01460. Site "M" was used.
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Equivalent Radiated Power

Conducted measurements of the transmitter output were not possible, since the horn antenna is permanently affixed. Therefore field strength measurements with a horn antenna were done instead. The following is the calculation of the limit in field strength based on the limit in power.

ERP = Equivalent Radiated Power
PD = Power Density
V = Volts

Fundamental Maximum Measured Output =117.7dBμV/m = **0.767V/m @ 1m**

PD = (V/m)^2/(resistance of free space [Ω])
PD = $0.767^2/377$
PD = 0.00156W/m^2

ERP = $4\pi PD*R^2$
ERP = $4\pi(0.00156)*1^2$
ERP = 19.6mW = 0.0196W = P_{fund}

Emissions 250% or more outside the fundamental should be attenuated by at least:
43dB + 10 log P_{fund}
25.9dB

To calculate the limit of the harmonics:

E = 5.5/(distance) x SQRT(P_{tot}) - Formula for E-field from isotropic antenna
P_{tot} = 19.6mW – 25.9dB = 12.92dBm – 25.9dB = -13dBm = -43dBW
P_{tot} = 0.00005W

E_{1m} = (5.5/1) * SQRT (0.00005)
E_{1m} = 0.039V/m = -28.1dBV/m = 91.8dBμV/m
E_{1m} = 91.8 dBμV/m

Therefore the limit in field strength at 250% outside of the authorized bandwidth is as follows:
E_{1m} = 91.8 dBμV/m

Test Equipment Used

SPECTRUM ANALYZERS

X	Analyzer	Model No.	Company	Serial No.	Calibration Due
X	**WHITE** 9kHz-22GHz	8593E	HP	3547U01252	24-APR-2001
X	**GREEN** 9kHz-26.5GHz	8593E	HP	3829A03618	04-OCT-2000
X	**BLACK** 9kHz-12.8GHz	8596E	HP	3710A00944	28-JUN-2001
X	**ORANGE** 9kHz-26.5GHz	E4407B	HP	US39440975	05-MAY-2001

LISNS

X	LISN	Model No.	Company	Serial No.	Calibration Due
X	**YELLOW-BLACK** 9kHz-30MHz	8012-50-R-24-BNC	Solar	984735	26-OCT-2000

OPEN AREA TEST SITES (OATS)

X	Site	FCC Code	IC Code	VCCI Code	Calibration Due
X	**"F"** Florida	93448	IC 2762-F	R-468/ C-480	28-JUN-2001
X	**"M"** Maine	93448	IC 2762-M	R-904/ C-480	22-MAY-2001

ANTENNAS

X	Antenna	Model No.	Company	Serial No.	Calibration Due
X	**GREEN-BLACK** Bilog: 30MHz-2GHz	CBL6112B	Chase	2412	23-JUN-2001
X	**BLACK** Horn: 1-18GHz	3115	EMCO	9703-5148	31-MAY-2001
X	**WHITE** Std Gain Horn: 18-26.5GHz	3160-09	EMCO	9610-1068	10-MAY-2001

HARMONIC MIXER

X	Mixer	Model No.	Company	Serial No.	Calibration Due
X	**HARMONIC MIXER** 26.5-40 GHz	11970A	HP	2332A00900	24-MAY-2001

PREAMPLIFIERS

X	Preamplifier	Model No.	Company	Serial No.	Calibration Due
X	**WHITE** 1-20GHz	SMC-12A	MITEQ	426643	09-OCT-2001
X	**BLACK** 0.01-2000MHz	ZFL-1000-LN	MiniCircuits/ C-S	n/a	01-MAR-2001
X	**YELLOW-BLACK** 1-20GHz	SMC-12A	MITEQ	535055	17-OCT-2000
X	**YELLOW** 18-26.5GHz	AFS4-18002650-60-8P-4	MITEQ	467559	28-AUG-2001

METEOROLOGICAL METERS

X	Meter	Model No.	Company	Serial No.	Calibration Due
X	**TEMPERATURE /HUMIDITY GAUGE**	TH300	Dickson	9044101	27-MAR-2001
X	**ATMOSPHERIC PRESSURE GAUGE**	BA928	Oregon Scientific	C3166-1	21-AUG-2001

TRACEABLE CLOCKS

X	Clock	Model No.	Company	Serial No.	Calibration Due
X	**5003**	5003	Control Company	99026940	16-NOV-2000

Unless otherwise noted the calibration interval is one year. All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

Measurement Results

Operating Frequency

This device operates at spread source from 8.8-9.8 GHz.

Electric Field Strength Radiation Measurements

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 03-Jul-00 **Company:** Krohne America **Table:** 1
Engineer: David Heald **EUT Desc:** BM702 **Work Order:** A0897

Frequency Range: 30-1000 MHz **Measurement Distance:** 3 m
Notes: EUT not mounted in the tank **EUT Max Freq:** 9.5 GHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	CISPR Class B Limit (dBµV/m)	CISPR Class B Margin (dB)	CISPR Class B Result (Pass/Fail)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
EUT sitting on the table			---	---	---	---	---	---	---	---	---	---
V	86.0	37.2	22.4	8.9	0.8	24.5	40.5	-16.0	Pass	40.0	-15.5	Pass
V	122.0	41.1	22.4	13.0	1.0	32.7	40.5	-7.8	Pass	43.5	-10.8	Pass
V	126.0	38.0	22.3	13.2	1.1	30.0	40.5	-10.5	Pass	43.5	-13.5	Pass
V	134.0	34.8	22.3	12.6	1.1	26.2	40.5	-14.3	Pass	43.5	-17.3	Pass
V	154.0	38.4	22.3	11.4	1.2	28.7	40.5	-11.8	Pass	43.5	-14.8	Pass
V	166.0	46.4	22.3	10.7	1.3	36.1	40.5	-4.4	Pass	43.5	-7.4	Pass
V	170.0	49.6	22.3	10.6	1.3	39.2	40.5	-1.3	Pass	43.5	-4.3	Pass
V	174.0	46.0	22.3	10.4	1.3	35.4	40.5	-5.1	Pass	43.5	-8.1	Pass
V	186.0	48.0	22.4	10.4	1.4	37.4	40.5	-3.1	Pass	43.5	-6.1	Pass
V	190.0	45.1	22.4	10.4	1.4	34.5	40.5	-6.0	Pass	43.5	-9.0	Pass
V	230.0	39.2	22.4	12.2	1.7	30.7	40.5	-9.8	Pass	46.0	-15.3	Pass
V	254.0	33.4	22.5	13.3	1.8	26.0	47.5	-21.5	Pass	46.0	-20.0	Pass
V	270.0	33.6	22.5	13.7	1.9	26.7	47.5	-20.8	Pass	46.0	-19.3	Pass
H	294.0	34.4	22.5	14.4	2.0	28.3	47.5	-19.2	Pass	46.0	-17.7	Pass
H	306.0	31.9	22.5	14.7	2.0	26.1	47.5	-21.4	Pass	46.0	-19.9	Pass

Table Result: Pass by -1.3 dB ***Worst Freq:*** 170.0 MHz

Test Site: "M" **Pre-Amp:** Black **Cable:** 65 ft RG8A/U **Analyzer:** Green **Antenna:** Grn-Blk

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 11-Oct-00 **Company:** Krohne America **Table** 2
Engineer: Stacey C. Costa **EUT Desc:** BM702 **Work Order:** A0897

Frequency Range: 8.75-10GHz **Measurement Distance:** 1 m
Notes: Comparison at fundamental to determine highest gain antenna

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
3 Inch			---	---	---	---	---	---	---	---	---	---
H	9322.0	87.1	18.0	40.7	2.2	112.0	---	---	---	---	---	---
4 Inch			---	---	---	---	---	---	---	---	---	---
H	9300.0	89.3	18.0	40.7	2.2	114.2	---	---	---	---	---	---
6 Inch			---	---	---	---	---	---	---	---	---	---
H	9319.0	91.9	18.0	40.7	2.2	116.8	---	---	---	---	---	---
8 Inch			---	---	---	---	---	---	---	---	---	---
H	9313.0	92.8	18.0	40.7	2.2	117.7	---	---	---	---	---	---
Wavestick			---	---	---	---	---	---	---	---	---	---
H	9322.0	90.8	18.0	40.7	2.2	115.7	---	---	---	---	---	---

Test Site: "F" **Pre-Amp:** White **Cable:** 3m Sucoflex **Analyzer:** Orange **Antenna:** Black Horn

Radiated Emissions Table

Curtis-Straus LLC

Date: 11-Oct-00 **Company:** Krohne America **Table** 3
Engineer: Stacey C. Costa **EUT Desc:** BM702 **Work Order:** A0897

Frequency Range: 1-18GHz **Measurement Distance:** 1 m

Notes: 8in horn antenna

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	FCC Part 90 Limit (dBµV/m)	FCC Part 90 Margin (dB)	FCC Part 90 Result (Pass/Fail)
H	9313.0	92.8	18.0	40.7	2.2	117.7	---	---	---	---	---	---
noise floor	18000.0	40.4	20.4	45.2	3.1	68.3	---	---	---	91.8	-23.5	Pass

Test Site: "F" **Pre-Amp:** White **Cable:** 3m Sucoflex **Analyzer:** Orange **Antenna:** Black Horn

Radiated Emissions Table

Curtis-Straus LLC

Date: 11-Oct-00 **Company:** Krohne America **Table** 4
Engineer: Stacey C. Costa **EUT Desc:** BM702 **Work Order:** EA0897

Frequency Range: 18-40GHz **Measurement Distance:** 1 m

Notes: 8in horn antenna

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Correction Loss (dB)	Antenna Factor (dB/m)	IF Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	FCC Part 90 Limit (dBµV/m)	FCC Part 90 Margin (dB)	FCC Part 90 Result (Pass/Fail)
noise floor	27000.0	15.4	22.5	23.0	38.9	0.3	55.1	---	---	---	91.80	-36.7	Pass
noise floor	36000.0	13.8	22.5	23.2	41.4	0.3	56.2	---	---	---	91.80	-35.7	Pass

Test Site: "F" **Pre-Amp:** Black **Cable:** Sucoflex **Analyzer:** Orange **Antenna:** 26.5-40Ghz with mixer

Conducted Emissions Chart

Curtis-Straus LLC

Date: 26-Jul-00 **Company:** Krohne America **Table No:** 5
Engineer: Chad A. Bell **EUT Desc:** BM702 **Work Order:** EA0897

Notes: Measured on the AC side of the DC supply

Range: 0.45 - 30.0 MHz **LISN(s):** Yellow-Black **Spectrum Analyzer:** White

Frequency (MHz)	Quasi-Peak L1 (dBµV)	Quasi-Peak L2 (dBµV)	Quasi-Peak Reading (dBµV)	FCC Class B Limit (dBµV)	FCC Class B Result (Pass/Fail)	Average L1 (dBµV)	Average L2 (dBµV)	Average Reading (dBµV)	FCC Class B Limit (dBµV)	FCC Class B Result (Pass/Fail)	Overall Margin (dB)
0.45	25.0	25.0	25.0	48.0	Pass			25.0	48.0	Pass	-23.0
0.55	28.3	28.2	28.3	48.0	Pass			28.3	48.0	Pass	-19.7
0.65	25.8	26.0	26.0	48.0	Pass			26.0	48.0	Pass	-22.0
1.56	26.1	26.0	26.1	48.0	Pass			26.1	48.0	Pass	-21.9
3.63	25.8	26.0	26.0	48.0	Pass			26.0	48.0	Pass	-22.0
20.30	26.0	26.0	26.0	48.0	Pass			26.0	48.0	Pass	-22.0

Frequency Stability

FREQUENCY STABILITY DATA SHEET

Work Order: A0897
Date(s): 11-Aug-00
Engineer: Mike Buchholz and Matt Deeter
EUT: BM702
Company: Krohne America Inc.

Modifications since start date:
none

Modifications this test:
none

Test Equipment Used:
Analyzer: Black
B-M-A Inc Environmental Chamber Model SGTH-315

Atmospheric Conditions:
Temp: 24.0°C **Humidity:** 30.60% **Pressure:** 1006mbar

Temperature(°C)	f_L* (GHz)	% Deviation	f_H* (GHz)	% Deviation
-30	8.861	0.147	9.715	0.103
-20	8.838	0.113	9.712	0.134
-10	8.841	0.079	9.719	0.062
0	8.844	0.045	9.722	0.031
10	8.844	0.045	9.725	0.000
20	8.848	0.000	9.725	0.000
30	8.867	0.215	9.738	0.134
40	8.874	0.294	9.745	0.206
55	8.874	0.294	9.754	0.298
Stability with 85% and 115% Input Voltage at 20°C				
24V	8.870	0.000	9.751	0.000
20.4V	8.870	0.000	9.751	0.000
27.6V	8.870	0.000	9.748	0.031

*The fundamental is a spread frequency, swept from f_L to f_H

Emissions Plots:

Fundamental