

# MEASUREMENT/TECHNICAL REPORT

**Company: Krohne, Inc.**

**FRN: 0006-7986-64**

**Model: BM 702**

**FCC ID: JH5-702**

Description: This is a report to support a request for an original grant of equipment authorization.

Equipment Type: Radiolocation device

Report prepared for:

Krohne, Inc.  
7 Dearborn Road  
Peabody, MA 01960  
Phone: (978) 535-6060  
Fax: (978) 535-1720

Report prepared by:

Evan D. Gould  
Curtis-Straus LLC  
527 Great Road  
Littleton, MA 01460 USA  
Phone: 978-486-8880  
FAX: 978-486-8828

## Introduction

This report is an application for Certification of a Transmitter operating pursuant to Part 15.209 of the FCC Rules, 47 CFR. The model number covered by this report is BM 702. This report is designed to demonstrate the compliance of this device with the requirements outlined in 47 CFR Part 15 using the methods outlined in 47 CFR Part 2.

The BM 702, in its most general form, is an FCC Part 90 licensed device. This application is an attempt to gain certification as an unlicensed transmitter under Part 15 using a waiver for operation in the band 9-10GHz issued by the FCC to Krohne on October 26, 2001 (included). As per the conditions of the waiver, this application is only for those installations of the BM 702 which are inside a steel tank.

The BM 70 A Level-Radar level gauging system can be implemented with different antennas. The particular antenna considered in this application for certification is the 6" Horn. A list of the different antenna types follows:

- Antenna Type:**
- 1) Wave-Stick
  - 2) 8" Horn (Type 4)
  - 3) 6" Horn (Type 3)
  - 4) 4" Horn (Type 2)
  - 5) 3" Horn (Type 1)

The sample tank used for testing can accommodate only up to a 6" horn antenna. All horn antenna testing was performed using the 6" horn. As the horn size increases, so does the gain of the antenna. Since the output of the transmitter cannot be varied, the worst-case configuration would be with the 8" horn. To compensate for the use of the 6" horn during testing, an out of tank measurement was made with both the 6" and 8" horns. This allowed us to generate a correction factor to determine the compliance of the worst-case 8" horn configuration.

### Statement of Conformity

The Krohne, Inc. BM 702 has been found to conform to the following parts of the 47 CFR as detailed below:

Part 2	Part 15	Comments
	15.15(b)	The product contains no user accessible controls that increase transmission power above allowable levels.
2.925	15.19	The label is shown in the label exhibit.
	15.21	Information to the user is shown in the instruction manual exhibit.
	15.27	A section in the installation manual details the use of special accessories that are required for compliance.
	15.31(e)	Details of the voltage regulation circuit have been included in the application.
	15.205	The fundamental operating frequency range includes two restricted bands from 15.205. (9.0-9.2GHz and 9.3-9.5GHz) Krohne has been granted a waiver by the FCC, which is included with this application.
	15.209	All other emissions comply with the general emission limits of 15.209.
	15.207	The unit complies with the conducted limits of 15.207.

### **Test Methodology**

Radiated emission testing was performed according to the procedures in ANSI C63.4 (1992). The testing was performed at an antenna to EUT distance of 3 meters below 1GHz, and at a distance of 0.1 meter above 1GHz. The test distance used is noted in the test data sheets. The device's performance was investigated to 40GHz. The emissions were maximized around the vertical axis and the maximum reading was recorded. The antenna cannot be maximized separately.

All other performance tests were made in accordance with the procedures outlined in 47 CFR Part 15. The applicable sections provided under Part 15 are provided in the measurement section of this report.

## Test Facility

*Curtis-Straus LLC*

All radiated emissions testing in the range 30–40,000MHz 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.

## Test Equipment Used

<b>SPECTRUM ANALYZERS</b>					
<b>x</b>	<b>Analyzer</b>	<b>Model No.</b>	<b>Company</b>	<b>Serial No.</b>	<b>Calibration Due</b>
<b>X</b>	<b>WHITE</b> 9kHz-22GHz	8593E	HP	3547U01252	25-JAN-2003
<b>X</b>	<b>GREEN</b> 9kHz-26.5GHz	8593E	HP	3829A03618	04-OCT-2002
<b>X</b>	<b>ORANGE</b> 9kHz-26.5GHz	E4407B	HP	US39440975	18-MAY-2002

<b>LISNs</b>					
<b>x</b>	<b>LISN</b>	<b>Model No.</b>	<b>Company</b>	<b>Serial No.</b>	<b>Calibration Due</b>
<b>X</b>	<b>YELLOW-BLACK</b> 10kHz-30MHz	8012-50-R-24-BNC	Solar	984735	02-OCT-2002

<b>OPEN AREA TEST SITES (OATS)</b>					
<b>x</b>	<b>Site</b>	<b>FCC Code</b>	<b>IC Code</b>	<b>VCCI Code</b>	<b>Calibration Due</b>
<b>X</b>	<b>“M”</b> Maine	93448	IC 2762-M	R-904/ C-480	23-JUN-2002

<b>ANTENNAS</b>					
<b>x</b>	<b>Antenna</b>	<b>Model No.</b>	<b>Company</b>	<b>Serial No.</b>	<b>Calibration Due</b>
<b>X</b>	<b>GREEN-BLACK</b> Bilog: 30MHz-2GHz	CBL6112B	Chase	2412	28-JUN-2002
<b>X</b>	<b>BLACK</b> Horn: 1-18GHz	3115	EMCO	9703-5148	12-JUN-2003
<b>X</b>	<b>WHITE</b> Std Gain Horn: 18-26.5GHz	3160-09	EMCO	9610-1068	26-JUN-2003

<b><i>HARMONIC MIXER</i></b>					
<b>x</b>	<b>Mixer</b>	<b>Model No.</b>	<b>Company</b>	<b>Serial No.</b>	<b>Calibration Due</b>
<b>X</b>	<b>HARMONIC MIXER</b> 26.5-40 GHz	11970A	HP	2332A00900	07-JUL-2002

<b><i>PREAMPLIFIERS</i></b>					
<b>x</b>	<b>Preamplifier</b>	<b>Model No.</b>	<b>Company</b>	<b>Serial No.</b>	<b>Calibration Due</b>
<b>X</b>	<b>BLACK</b> 0.01-2000MHz	ZFL-1000-LN	MiniCircuits/ C-S	n/a	22-MAR-2003
<b>X</b>	<b>YELLOW-BLACK</b> 1-20GHz	SMC-12A	MITEQ	535055	21-SEP-2002
<b>X</b>	<b>YELLOW</b> 18-26.5GHz	AFS4-18002650- 60-8P-4	MITEQ	467559	29-AUG-2002

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 in the range 8.5-9.5GHz.

### Radiated and Conducted Electric Field Strength Measurements

Radiated Emissions Table				Curtis-Straus LLC		
Date: 11-Oct-00		Company: Krohne America				
Engineer: Stacey C. Costa		EUT Desc: BM702				
Work Order: A0897		Measurement Distance: 1 m				
Frequency Range: 8.75-10GHz						
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)
3 Inch H	9322.0	87.1	---	---	---	---
4 Inch H	9300.0	89.3	18.0	40.7	2.2	112.0
6 Inch H	9319.0	91.9	18.0	40.7	2.2	114.2
8 Inch H	9313.0	92.8	18.0	40.7	2.2	116.8
Wavestick H	9322.0	90.8	18.0	40.7	2.2	117.7
Test Site: "F"			Pre-Amp: White		Cable: 3m Sucoflex	
Analyzer: Orange			Antenna: Black Horn			

**Note:** The preceding data table shows that the difference in electric field strength amplitude between the 8" Horn antenna and the 6" Horn antenna is 0.9dB. Since the measurements that follow prove that the 6" Horn antenna passes the limits specified in 47 CFR 15.209(a) by *at least* 1dB, it follows that the 8" Horn antenna passes those limits as well.

Radiated Emissions Table							Curtis-Straus LLC		
Date: 25-Jul-00			Company: Krohne America				Table 2		
Engineer: Chad A. Bell			EUT Desc: BM702				Work Order: EA0897		
Frequency Range: 1-26.5Ghz					Measurement Distance: 10 cm				
Notes: 6" Horn					EUT Max Freq: 9.5Ghz Test Site: "M"				
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	47 CFR 15.209(a)		
							Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Noise Floor	9000.0	36.0	18.4	40.7	2.2	60.5	83.5	-23.0	Pass
Noise Floor	18000.0	26.5	20.8	46.5	3.1	55.3	83.5	-28.2	Pass
Table Result:		Pass	by		-23.0 dB		Worst Freq:		9000.0 MHz
1-18GHz >>		Pre-Amp: Yel-Blk		Cable: 3m Sucoflex		Analyzer: Orange		Antenna: Black Horn	
18-16.5GHz >>		Pre-Amp: Yellow		Cable: 3m Sucoflex		Analyzer: Orange		Antenna: White	

Radiated Emissions Table										Curtis-Straus LLC		
Date: 25-Jul-00				Company: Krohne America				Table 3				
Engineer: Chad A. Bell				EUT Desc: BM702				Work Order: EA0897				
Frequency Range: 26.5-40.0Ghz							Measurement Distance: 10cm					
Notes: 6" Horn							EUT Max Freq: 9.5Ghz					
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)	47 CFR 15.209(a)				
								Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)		
Noise Floor	27000.0	17.6	22.5	23.0	38.9	0.3	57.3	83.5	-26.2	Pass		
Noise Floor	36000.0	14.3	22.5	23.2	41.4	0.3	56.7	83.5	-26.8	Pass		
Table Result: Pass by -26.2 dB Worst Freq: 27000.0 MHz												
Test Site: "M"		Pre-Amp: Black			Cable: 2 Microflex cable:		Analyzer: Orange		Antenna: 40GHz Mixer			

Radiated Emissions Table							Curtis-Straus LLC		
Date: 03-Jul-00			Company: Krohne America				Table: 4		
Engineer: David Heald			EUT Desc: BM702				Work Order: A0897		
Frequency Range: 30-1000 MHz					Measurement Distance: 3 m				
Notes: 6" Horn					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)	47 CFR 15.209(a)		
							Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
V	114.0	42.5	22.4	12.4	1.0	33.5	43.5	-10.0	Pass
V	126.0	41.6	22.3	13.2	1.1	33.6	43.5	-9.9	Pass
V	134.0	33.0	22.3	12.6	1.1	24.4	43.5	-19.1	Pass
V	170.0	41.2	22.3	10.6	1.3	30.8	43.5	-12.7	Pass
V	174.0	43.1	22.3	10.4	1.3	32.5	43.5	-11.0	Pass
V	190.0	43.9	22.4	10.4	1.4	33.3	43.5	-10.2	Pass
H	230.0	32.8	22.4	12.2	1.7	24.3	46.0	-21.7	Pass
H	270.0	30.9	22.5	13.7	1.9	24.0	46.0	-22.0	Pass
H	294.0	31.2	22.5	14.4	2.0	25.1	46.0	-20.9	Pass
H	306.0	35.7	22.5	14.7	2.0	29.9	46.0	-16.1	Pass
Table Result: Pass by -9.9 dB Worst Freq: 126.0 MHz									
Test Site: "M"		Pre-Amp: Black		Cable: 65 ft RG8A/U		Analyzer: Green		Antenna: Grn-Blk	



AC Mains Conducted Emissions						Curtis-Straus LLC		
Date: 26-Jul-00			Company Krohne			Table No: 5		
Engineer: Chad A. Bell			EUT Desc BM702			Work Order: EA0897		
Notes: Measured on the AC side of the DC supply								
Range: 0.45-30Mhz			LISN(s): Yellow-Black			Spectrum Analyzer: White		
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor (dB)	47 CFR 15.207(a)		Overall Result (Pass/Fail)
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	
0.45	25.0	25.0			0.0	47.9	-22.9	Pass
0.55	28.3	28.2			0.0	47.9	-19.6	Pass
0.65	25.8	26.0			0.0	47.9	-21.9	Pass
1.56	26.1	26.0			0.0	47.9	-21.8	Pass
3.63	25.8	26.0			0.0	47.9	-21.9	Pass
20.30	26.0	26.0			0.0	47.9	-21.9	Pass
Table Result:		Pass	by	-19.6 dB		Worst Freq:		0.55 MHz

Emissions Plot

