FCC Certification Test Report

FCC Certification Test Report
for
SWR Engineering GMBH
QK9SR082002AT
FCC PART 15.249

September 11, 2002

Prepared for:

SWR Engineering GMBH
c/o Dallas Enterprises Int., LLC
4900 NC Hwy 55 #160-313
Durham, NC 27713

Prepared By:

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FCC Certification Test Program

FCC Certification Test Report
for the
SWR Engineering GMBH
SolidFlow Microwave Sensor
QK9SR082002AT

September 11, 2002

WLL JOB# 7222

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Reviewed by: Michael F. Violette
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Abstract

This report has been prepared on behalf of SWR Engineering GMBH to support the attached Application for Equipment Authorization. The test report and application are submitted for a Periodic Intentional Radiator under Part 15.249 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a SWR Engineering GMBH SolidFlow Microwave Sensor.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The SWR Engineering GMBH SolidFlow Microwave Sensor complies with the limits for a Intentional Radiator device under Part 15.249 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The SWR Engineering GMBH SolidFlow Microwave Sensor complies with the limits for a Periodic Intentional Radiator device under Part 15.249 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer: SWR Engineering GMBH
c/o Dallas Enterprises Int., LLC
4900 NC Hwy 55 #160-313
Durham, NC 27713

Quotation Number: 60174

1.4 Test Dates

Testing was performed from August 13, 2002 to August 15, 2002.

1.5 Test and Support Personnel

Washington Laboratories, LTD James Ritter

2 Equipment Under Test

2.1 EUT Identification & Description

The SWR Engineering GMBH SolidFlow Microwave Sensor is a measuring system based on microwave technology. The sensor detects moving particles within a velocity range of 2–30 m/s using the Doppler principle.

It is employed by installing in a duct or other type of closed channel. The SolidFlow is energized and provides a field inside the duct. Particles moving in the duct cause a frequency shift in the output of the SolidFlow sensor, which is proportional to the velocity of the particles.

A microprocessor calculates a proportional flow rate and produces an output signal over a RS485 interface in ModBUS protocol.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	SWR Engineering GMBH
FCC ID Number	QK9SR082002AT
EUT Name:	Microwave Sensor
Model:	SolidFlow
FCC Rule Parts:	§15.249
Frequency Range:	24.125 GHz +/- 100MHz
Maximum Output Power:	3 mW
Modulation:	CW
Necessary Bandwidth:	N/A
Keying:	None
Type of Information:	Sensor
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Aperture
Frequency Tolerance:	N/A
Emission Type(s):	CW
Interface Cables:	Two wire, 0-5V proportional output
Power Source & Voltage:	24V dc

2.2 Test Configuration

The SolidFlow is powered by a 24 Vdc power supply.

2.3 Testing Algorithm

The SolidFlow was operated continuously by applying power to the unit.

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Manufacturer	Model/Type	Function	S/N or Asset Number	Cal. Due
HP	8564E	Spectrum Analyzer	3643A00657	4/18/03
HP	85650A	Quasi-Peak Adapter	3303A01786	7/05/03
Solar	8012-50-R-24BNC	LISN	8379493	8/15/02
ARA	LPB-2520	BiconiLog Antenna	1044	6/19/03
HP	85685A	RF Preselector	3221A01395	5/17/03
NARDA	638	18-26.5 GHz Standard Gain Horn	210	7/1/03
NARDA	V637	26.5-40 GHz Standard Gain Horn	209	7/1/03
Hewlett Packard	11970U Harmonic Mixer w/SGH-19	Antenna and Mixer Assembly	00083	7/30/03
Hewlett Packard	11970V Harmonic Mixer W/SGH-15	Antenna and Mixer Assembly	00054	9/10/03
Hewlett Packard	11970W Harmonic Mixer W/SGH-10	Antenna and Mixer Assembly	00055	9/10/03

4 Test Results

4.1 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by measuring the output of the EUT with the use of an antenna.

At full modulation, the occupied bandwidth was measured as shown in Figure 1:

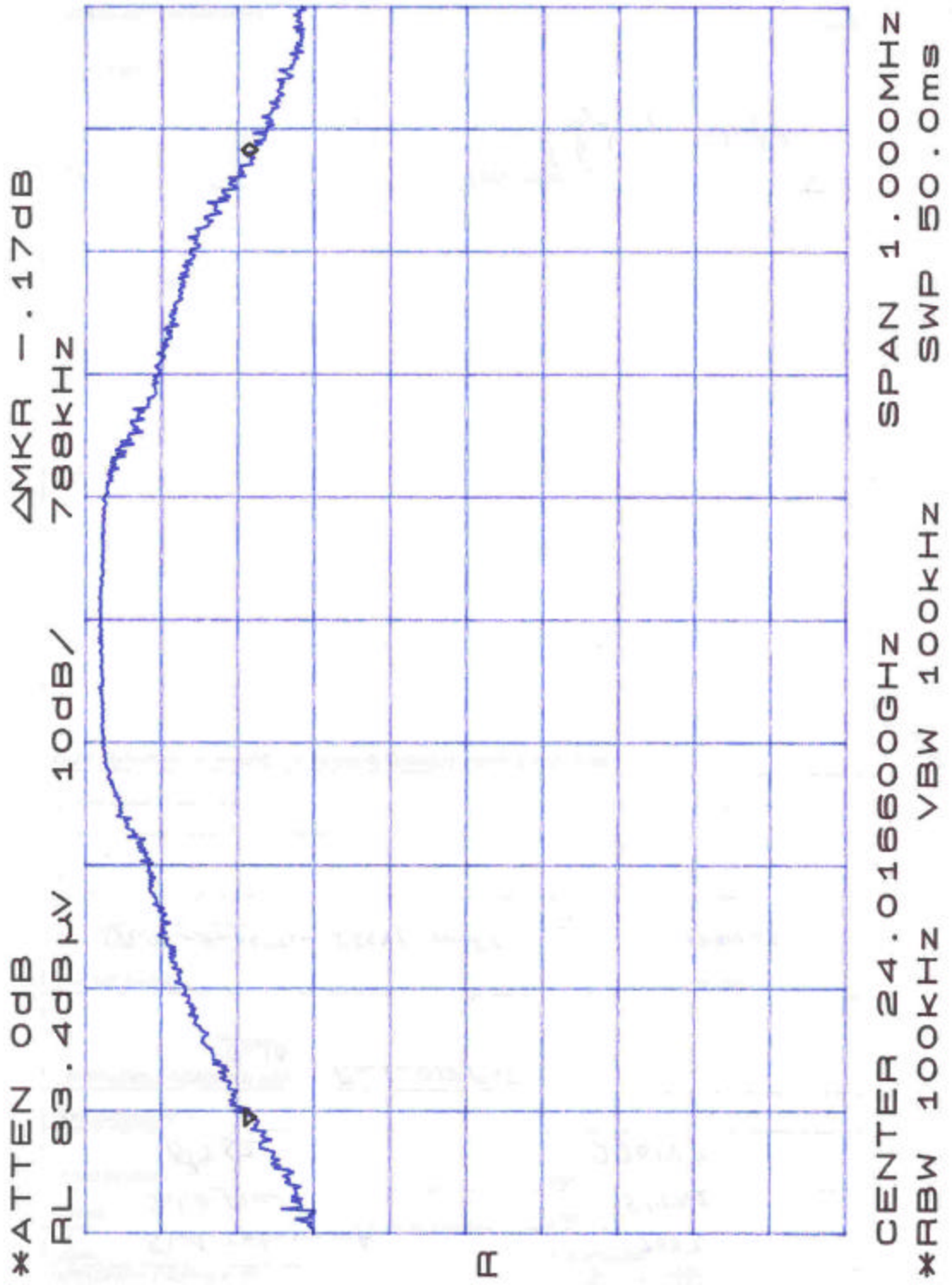

Figure 1. Occupied Bandwidth

Table 3 provides a summary of the Occupied Bandwidth Results.

Table 3. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
24.01GHz	788 kHz	N/A	Pass

4.2 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions. The limits are as shown in the following table.

Table 4. Radiated Spurious Emissions Limits (Average Limits)

Frequency	Fundamental @ 3m	Harmonic Level (-dBc or E-Field)
Fundamental 24.018 GHz	250 mV/m	
Harmonics		2.5 mV/m

4.2.1 Test Procedure

For emissions below 1 GHz in frequency, the EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

For emissions above 1 GHz, the EUT was set up on a non-conductive table. High frequency standard gain horn antennas were used to scan the unit for emissions. Because of the low levels associated with the output of the EUT, the fundamental of the EUT was measured at a distance of 50 cm from the opening of the EUT aperture antenna.

A distance correction factor of 20LOG(r/3) was applied to arrive at the 3m equivalent field strength. This is compared to the 3m limit.

For frequencies above the fundamental, the measurement distance was 10cm. An emission was detected at the second harmonic of the fundamental at that distance, but was undetectable at 3m. At harmonic emissions levels above the first harmonic, energy was undetectable at 10cm.

Table 5: Radiated Emission Test Data

CLIENT: SWR Engineering DATE: 8/13/02
TESTER: James Ritter JOB #: 7222
EUT: Solid Flow Sensor ST-52 S/N: 230147.0
CONFIGURATION: EUT mounted in Horizontal (Feedhorn) direction
CLOCKS: TX @ 24.035 GHz , Clock 16 MHz,

Test Equipment/Limit: **Test Requirements:**
ANTENNA: A_00008 TEST STANDARD: FCC Part 15.249
CABLE: CSITE2_3m DISTANCE: 3m
LIMIT: LFCC_3m_Class_B CLASS: B

Frequency (MHz)	Polarity H/V	Azimuth Degree	Antenna Height (m)	SA Level dBuV	AF dB/m	Cable Loss dB	E-Field dBuV/m	E-Field uV/m	Limit uV/m	Margin dB
	Peak									
64.00	V	0	1.5	16.8	8.0	1.8	26.6	21.4	100	-13.4
111.99	V	45	1.2	8.2	12.7	2.4	23.2	14.5	150	-20.3
143.00	V	45	1.6	13.8	13.1	2.7	29.6	30.4	150.	-13.9
208.00	V	80	1.5	7.5	10.9	3.4	21.8	12.3	150	-21.7
240.01	V	145	1.2	9.3	11.7	3.5	24.5	16.9	200	-21.5
255.98	V	125	1.4	4.8	11.7	3.7	20.2	10.2	200	-25.8
64.00	H	20	2.0	9.0	8.0	1.8	18.8	8.7	100	-21.2
111.99	H	20	3.0	8.2	12.7	2.4	23.2	14.5	150	-20.3
143.00	H	0	3.0	7.9	13.1	2.7	23.7	15.4	150	-19.8
208.00	H	20	2.4	13.7	10.9	3.4	28.0	25.1	150	-15.5
240.01	H	180	1.4	10.5	11.7	3.5	25.7	19.4	200	-20.3
255.98	H	45.0	2.1	8.1	11.7	3.7	23.5	14.9	200	-22.5
	QP									
64.00	V	0	1.5	16.8	8.0	1.8	26.6	21.4	100	-13.4
111.99	V	45	1.2	8.2	12.7	2.4	23.2	14.5	150	-20.3
143.00	V	45	1.6	13.8	13.1	2.7	29.6	30.4	150	-13.9
208.00	V	80	1.5	7.5	10.9	3.4	21.8	12.3	150	-21.7
240.01	V	145	1.2	9.3	11.7	3.5	24.5	16.9	200	-21.5
255.98	V	125	1.4	4.8	11.7	3.7	20.2	10.2	200	-25.8
64.00	H	20	2.0	9.0	8.0	1.8	18.8	8.7	100	-21.2
111.99	H	20	3.0	8.2	12.7	2.4	23.2	14.5	150	-20.3
143.00	H	0	3.0	7.9	13.1	2.7	23.7	15.4	150	-19.8
208.00	H	20	2.4	13.7	10.9	3.4	28.0	25.1	150	-15.5
240.01	H	180	1.4	10.5	11.7	3.5	25.7	19.4	200	-20.3
255.98	H	45	2.1	8.1	11.7	3.7	23.5	14.9	200	-22.5

Table 6. Harmonic and Spurious Emissions Data

CLIENT: SWR Engineering DATE: 8/13/02
TESTER: James Ritter JOB #: 7222
EUT: Solid Flow Sensor ST-52 S/N: 230147.0
CONFIGURATION: EUT mounted in Horizontal (Feedhorn) direction
CLOCKS: TX @ 24.035 GHz , Clock 16 MHz,
Test Equipment/Limit:
FCC Part 15.249

Frequency (MHz)	Polarity H/V	Azimuth Degree	SA Level	SA Level (corrected for distance) dBuV	AF dB/m	Cable Corr dB	E-Field dBuV/m	E-Field uV/m	Limit uV/m	Margin dB	Notes
	Peak										
24018.30	V	0	60.1	44.5	40.5	1.8	86.8	21877.6	2500000	-41.2	note 1
48031.53	V	0	47.2	17.7	43.6	0.0	61.3	1161.4	25000	-26.7	note 2
72039.00	V	0	49.2	19.7	45.5	0	65.2	1819.7	25000	-22.8	note 3
96052.00	V	0	53.0	23.5	46.6	0	70.1	3198.9	25000	-17.9	note 4
24018.30	H	0	78.4	52.8	40.5	1.8	95.1	56885.3	2500000	-32.9	note 1
48031.53	H	0	46.0	16.5	43.6	0.0	60.1	1011.6	25000	-27.9	note 2
72039.00	H	0	49.3	19.8	45.5	0.0	65.3	1840.8	25000	-22.7	note 3
6052.00	H	0	53.0	23.5	46.6	0.0	70.1	3198.9	25000	-17.9	note 4
	Avg										
24018.30	V	0	53.7	38.1	40.5	1.8	80.4	10471.3	250000	-27.6	note 1
48031.53	V	0	44.5	15.0	43.6	0.0	58.6	851.1	2500	-9.4	note 2
72039.00	V	0	33.7	4.2	45.5	0.0	49.7	305.5	2500	-18.3	note 3
96052.00	V	0	43.0	13.5	46.6	0.0	60.1	1011.6	2500	-7.9	note 4
24018.30	H	0	77.2	61.6	40.5	1.8	103.9	156675.1	250000	-4.1	note 1
48031.53	H	0	43.5	14.0	43.6	0.0	57.6	758.6	2500	-10.4	note 2
72039.00	H	0	33.9	4.4	45.5	0.0	49.9	312.6	2500	-18.1	note 3
96052.00	H	0	43.2	13.7	46.6	0.0	60.3	1035.1	2500	-7.7	note 4

note 1: EUT horizontal polarity 50 cm from EUT antenna; 18-26 GHz ant # 210

note 2: EUT horizontal polarity10 cm from EUT antenna; 40-60 GHz ant # 00083 SGH-19 (w/mixer)

note 3: Ambient EUT horizontal polarity 10 cm from EUT antenna; 60-75 GHz ant # 000543 SGH-15 (w/mixer)

note 4: Ambient Reading. EUT horizontal polarity10 cm from EUT antenna; 75-100 GHz ant # 00055 SGH-10 (w/mixer)