



RF TEST REPORT

Applicant	ABB Engineering (Shanghai) Ltd.
FCC ID	2AX5K-FEW450
Product	AquaMaster4 Flowmeter with Inbuilt Cellular/ Wireless Communication
Brand	ABB
Model	AquaMaster 4
Report No.	R2207A0628-R1
Issue Date	January 16, 2023

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 2 (2022)/ FCC CFR 47 Part 22H (2022)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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Summary of measurement results

No.	Test Case	Clause in FCC rules	Verdict
1	RF Power Output and Effective Radiated Power	2.1046 22.913(a)(5)	PASS
2	Radiated Spurious Emission	2.1053 / 22.917 (a)	PASS
Date of Testing: September 14, 2022 ~ September 16, 2022			
Date of Sample Received: July 22, 2022			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard. All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

Only Radiated Spurious Emission is tested for AquaMaster 4 in this report, and because of the change of antenna gain, Effective Radiated Power also re evaluated. Other test items refer to the module report (Report No.: RTWK160705001-00 and RTWK160719001-00; FCC ID: XMR201606EC21A).



1. Test Laboratory

1.1. Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform measurements.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform measurement.

1.3. Testing Location

Company: TA Technology (Shanghai) Co., Ltd.
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E-mail: xukai@ta-shanghai.com

2. General Description of Equipment under Test

2.1. Applicant and Manufacturer Information

Applicant	ABB Engineering (Shanghai) Ltd.
Applicant address	No.4528, KangXin Highway, PuDong New District, Shanghai, 201319, P.R. China
Manufacturer	ABB Engineering (Shanghai) Ltd.
Manufacturer address	No.4528, KangXin Highway, PuDong New District, Shanghai, 201319, P.R. China

2.2. General Information

EUT Description			
Model	AquaMaster 4		
SN	Internal Antenna: 3K672022290152 External Antenna: 3K672022290151		
Hardware Version	1.0		
Software Version	0		
Power Supply	Battery PSU		
Antenna Type	Internal Antenna / External Antenna		
Antenna Gain	Internal Antenna	-0.5 dBi	
	External Antenna	2.75 dBi	
Test Mode(s)	WCDMA Band V		
Test Modulation	BPSK, QPSK,16QAM;		
Maximum E.R.P.	WCDMA Band V:	23.81 dBm	
Rated Power Supply Voltage	3.6V		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	WCDMA Band V	824 ~ 849	869 ~ 894
Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant.			
2. There are 2 kinds of antennas for the products: Internal antenna and external antenna. The products with different antennas are same in electrical and mechanical except antenna part.			



3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR 47 Part 22H (2022)

FCC CFR47 Part 2 (2022)

Reference standard:

ANSI C63.26-2015

KDB 971168 D01 Power Meas License Digital Systems v03r01

4. Test Configuration

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes. EUT stand-up position (Z axis), lie-down position (X, Y axis). Receiver antenna polarization (horizontal and vertical), the worst emission was found in position (External Antenna: Z axis, horizontal polarization; Internal Antenna: Z axis, horizontal polarization) and the worst case was recorded.

Subsequently, only the worst case emissions are reported.

The following testing in WCDMA is set based on the maximum RF Output Power.

Test modes are chosen to be reported as the worst case configuration below:

Test items	Modes/Modulation	Test Channel
	WCDMA Band V	
RF Power Output and Effective Radiated power	RMC HSDPA/HSUPA DC-HSDPA/HSPA+	L/M/H
Radiated Spurious Emission	RMC	M

5. Test Case

5.1. RF Power Output and Effective Radiated Power

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Methods of Measurement

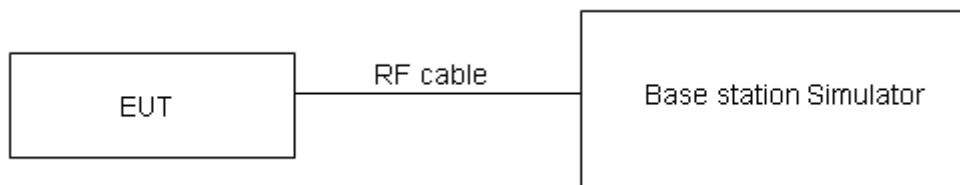
During the process of the testing, The EUT was connected to the Base Station Simulator with a known loss. The EUT is controlled by the Base Station Simulator test set to ensure max power transmission with proper modulation.

ERP can then be calculated as follows:

EIRP (dBm) = Output Power (dBm) + Antenna Gain (dBi)

EIRP (dBm) = ERP (dBm) + 2.15 (dB).

Test Setup



Limits

No specific RF power output requirements in part 2.1046.

Rule Part 22.913(a)(5) specifies that "Mobile/portable stations are limited to 7 watts ERP".

Limit	$\leq 7 \text{ W}$ (38.45 dBm)
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$, $U = 0.4 \text{ dB}$ for RF power output, $k = 2$, $U = 1.19 \text{ dB}$ for ERP.

Test Results

Refer to the section 6.1 of this report for test data.

5.2. Radiated Spurious Emission

Ambient condition

Temperature	Relative humidity	Pressure
23°C ~25°C	45%~50%	101.5kPa

Method of Measurement

1. The testing follows FCC KDB 971168 v03r01 Section 5.8 and ANSI C63.26-2015.
2. Below 1GHz: The EUT is placed on a turntable 0.8 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H). Above 1GHz: (Note: the FCC's permission to use 1.5m as an alternative per TCBC Conf call of Dec. 2, 2014.) The EUT is placed on a turntable 1.5 meters above the ground in the chamber, 3 meter away from the antenna. The maximal emission value is acquired by adjusting the antenna height, polarisation and turntable azimuth. Normally, the height range of antenna is 1 m to 4 m, the azimuth range of turntable is 0° to 360°, and the receive antenna has two polarizations Vertical (V) and Horizontal (H).
3. A loop antenna, A log-periodic antenna or horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
4. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=100kHz, VBW=300kHz, and the maximum value of the receiver should be recorded as (Pr).
5. The EUT shall be replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (PMea) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (Pr). The power of signal source (PMea) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
6. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (Pcl) ,the Substitution Antenna Gain (Ga) and the Amplifier Gain (PAg) should be recorded after test.
7. The measurement results are obtained as described below:
$$\text{Power(EIRP)} = \text{PMea} - \text{PAg} - \text{Pcl} + \text{Ga}$$

The measurement results are amend as described below:

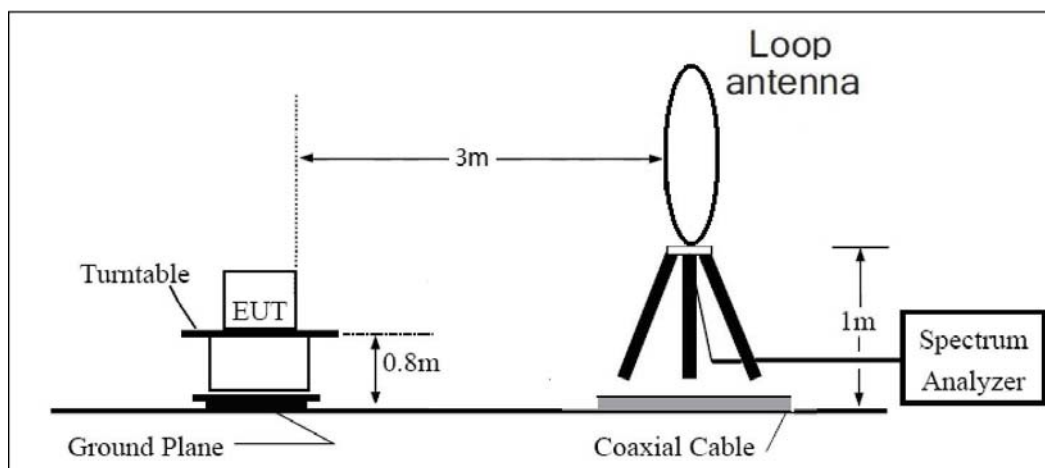
$$\text{Power(EIRP)} = \text{PMea} - \text{Pcl} + \text{Ga}$$
8. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dB) and known input power. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP

= EIRP-2.15dB.

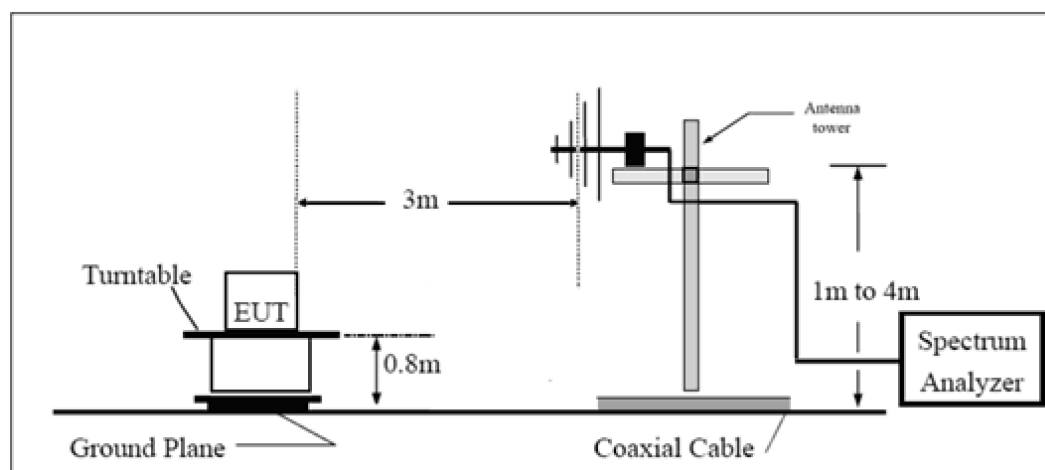
The modulation mode and RB allocation refer to section 5.1, using the maximum output power configuration.

Test setup

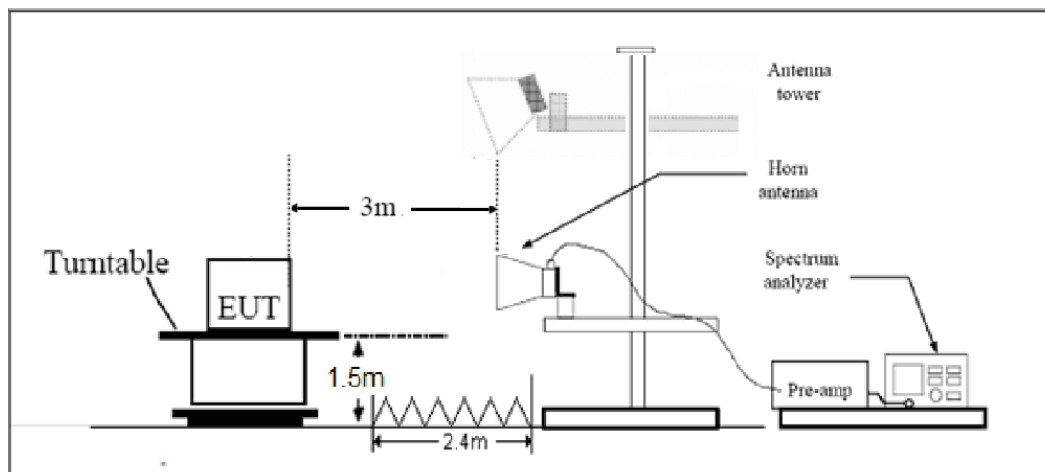
9KHz~ 30MHz



30MHz~ 1GHz



Above 1GHz



Note: Area side: 2.4mX3.6m

Limits

Rule Part 22.917(a) specifies that “The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log (P)$ Db.”

Limit	-13 dBm
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Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$, $U = 3.55$ Db.

Test Results

Refer to the section 6.2 of this report for test data.

6. Test Result

6.1. RF Power Output and Effective Radiated Power

WCDMA Band V		Average Output Power (dBm)			External Antenna ERP (dBm)			Internal Antenna ERP (dBm)		
		Channel/Frequency (MHz)			Channel/Frequency (MHz)			Channel/Frequency (MHz)		
		4132 / 826.4	4183 / 836.6	4233 / 846.6	4132 / 826.4	4183 / 836.6	4233 / 846.6	4132 / 826.4	4183 / 836.6	4233 / 846.6
RMC		22.96	22.81	22.87	23.56	23.41	23.47	20.31	20.16	20.22
HSDPA	Sub - Test 1	23.21	23.18	23.10	23.81	23.78	23.70	20.56	20.53	20.45
	Sub - Test 2	23.02	22.86	22.95	23.62	23.46	23.55	20.37	20.21	20.30
	Sub - Test 3	22.88	22.79	22.85	23.48	23.39	23.45	20.23	20.14	20.20
	Sub - Test 4	22.82	22.73	22.83	23.42	23.33	23.43	20.17	20.08	20.18
HSUPA	Sub - Test 1	23.03	23.05	23.04	23.63	23.65	23.64	20.38	20.40	20.39
	Sub - Test 2	22.86	22.73	22.69	23.46	23.33	23.29	20.21	20.08	20.04
	Sub - Test 3	22.88	22.72	22.82	23.48	23.32	23.42	20.23	20.07	20.17
	Sub - Test 4	22.82	22.69	22.72	23.42	23.29	23.32	20.17	20.04	20.07
	Sub - Test 5	22.85	22.68	22.76	23.45	23.28	23.36	20.20	20.03	20.11
HSPA+	16QAM	23.05	22.54	22.76	23.65	23.14	23.36	20.40	19.89	20.11

6.2. Radiated Spurious Emission

Sweep the whole frequency band through the range from 9kHz to the 10th harmonic of the carrier, the emissions below the noise floor will not be recorded in the report.

Internal Antenna

WCDMA Band V CH-Middle

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1671.20	-31.30	1.70	8.70	Horizontal	-26.45	-13.00	13.45	45
3	2510.40	-39.03	2.30	12.00	Horizontal	-31.48	-13.00	18.48	180
4	3346.40	-60.22	2.70	12.70	Horizontal	-52.37	-13.00	39.37	135
5	4183.00	-64.17	3.00	12.50	Horizontal	-56.82	-13.00	43.82	225
6	5019.60	-60.36	3.40	12.50	Horizontal	-53.41	-13.00	40.41	45
7	5856.20	-59.07	3.40	12.80	Horizontal	-51.82	-13.00	38.82	180
8	6692.80	-58.73	4.10	11.50	Horizontal	-53.48	-13.00	40.48	90
9	7529.40	-57.44	4.20	12.20	Horizontal	-51.59	-13.00	38.59	135
10	8366.00	-56.18	4.30	12.50	Horizontal	-50.13	-13.00	37.13	45

Note: 1. The other Spurious RF Radiated emissions level is no more than noise floor.

2. The worst emission was found in the antenna is Horizontal position.

External Antenna

WCDMA Band V CH-Middle

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	1671.20	-65.75	1.70	8.70	Horizontal	-60.90	-13.00	47.90	225
3	2510.40	-65.79	2.30	12.00	Horizontal	-58.24	-13.00	45.24	45
4	3346.40	-66.58	2.70	12.70	Horizontal	-58.73	-13.00	45.73	135
5	4183.00	-64.01	3.00	12.50	Horizontal	-56.66	-13.00	43.66	45
6	5019.60	-60.53	3.40	12.50	Horizontal	-53.58	-13.00	40.58	145
7	5856.20	-60.16	3.40	12.80	Horizontal	-52.91	-13.00	39.91	0
8	6692.80	-59.62	4.10	11.50	Horizontal	-54.37	-13.00	41.37	135
9	7529.40	-56.27	4.20	12.20	Horizontal	-50.42	-13.00	37.42	45
10	8366.00	-56.28	4.30	12.50	Horizontal	-50.23	-13.00	37.23	225

Note: 1. The other Spurious RF Radiated emissions level is no more than noise floor.

2. The worst emission was found in the antenna is Horizontal position.



7. Main Test Instruments

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
Signal Analyzer	R&S	FSV30	104028	2021-12-12	2022-12-11
Loop Antenna	SCHWARZBECK	FMZB1519	1519-047	2020-04-02	2023-04-01
TRILOG Broadband Antenna	Schwarzbeck	BBHA 9120D	01799	2019-09-21	2022-09-20
Horn Antenna	Schwarzbeck	VULB 9163	01439	2021-06-30	2024-06-29
Software	R&S	EMC32	10.35.10	/	/

*****END OF REPORT *****



ANNEX A: The EUT Appearance

The EUT Appearance is submitted separately.



ANNEX B: Test Setup Photos

The Test Setup Photos is submitted separately.