



# FCC CFR47 PART 27 SUBPART M CLASS II PERMISSIVE CHANGE

# **CERTIFICATION TEST REPORT**

**FOR** 

**3G 4G MODULE** 

**MODEL NUMBER: M600** 

FCC ID: XHG-M600

REPORT NUMBER: 12U14462-2, Revision A

**ISSUE DATE: JULY 10, 2012** 

Prepared for

**FORTINET** 

Franklin Technology Inc. 906 JEI Platz, 459-11, Gasan-Dong, Gumcheon-Gu Seoul, 152-803, South Korea

Prepared by

COMPLIANCE CERTIFICATION SERVICES (UL CCS) 47173 BENICIA STREET FREMONT, CA 94538, U.S.A.

> TEL: (510) 771-1000 FAX: (510) 661-0888



# **Revision History**

| Rev. | Issue<br>Date | Revisions              | Revised By |
|------|---------------|------------------------|------------|
|      | 06/25/12      | Initial Issue          | T. Chan    |
| A    | 07/10/12      | Corrected antenna type | A. Zaffar  |

# **TABLE OF CONTENTS**

| 1. AT | TESTATION OF TEST RESULTS                 | 4  |
|-------|---|----|
| 2. TE | ST METHODOLOGY                            | 5  |
| 3. FA | CILITIES AND ACCREDITATION                | 5  |
| 4. CA | ALIBRATION AND UNCERTAINTY                | 5  |
| 4.1.  | MEASURING INSTRUMENT CALIBRATION          | 5  |
| 4.2.  | SAMPLE CALCULATION                        | 5  |
| 4.3.  | MEASUREMENT UNCERTAINTY                   | 5  |
| 5. EC | QUIPMENT UNDER TEST                       | 6  |
| 5.1.  | DESCRIPTION OF EUT                        | 6  |
| 5.1.  | MAXIMUM OUTPUT POWER                      | 6  |
| 5.1.  | DESCRIPTION OF CLASS II PERMISSIVE CHANGE | 6  |
| 5.2.  | DESCRIPTION OF AVAILABLE ANTENNAS         | 6  |
| 5.3.  | SOFTWARE AND FIRMWARE                     | 6  |
| 5.4.  | WORST-CASE CONFIGURATION AND MODE         | 6  |
| 5.5.  | DESCRIPTION OF TEST SETUP                 | 7  |
| 6. TE | ST AND MEASUREMENT EQUIPMENT              | 9  |
| 7. RA | ADIATED TEST RESULTS                      | 10 |
| 7.1.  | RADIATED POWER (EIRP)                     | 10 |
| 7.2.  | FIELD STRENGTH OF SPURIOUS RADIATION      | 15 |
| 8. SF | TUP PHOTOS                                | 21 |

# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** FORTINET

Franklin Technology Inc.

906 JEI Platz, 459-11, Gasan-Dong, Gumcheon-Gu

Seoul, 152-803, South Korea

**EUT DESCRIPTION**: 3G 4G MODULE

MODEL: M600

SERIAL NUMBER: F463490466C4

**DATE TESTED:** JUNE 19-21, 2012

### **APPLICABLE STANDARDS**

STANDARD TEST RESULTS

FCC PART 27 SUBPART M PASS

Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By: Tested By:

THU CHAN

UL CCS

**ENGINEERING MANAGER** 

CHIN PANG EMC ENGINEER UL CCS

Chin Pany

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with TIA/EIA 603C (2004), FCC CFR 47 Part 2, and FCC CFR 47 Part 27M.

### 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <a href="http://www.ccsemc.com">http://www.ccsemc.com</a>.

# 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

## 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB) 36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER                             | UNCERTAINTY |
|---------------------------------------|-------------|
| Conducted Disturbance, 0.15 to 30 MHz | 3.52 dB     |
| Radiated Disturbance, 30 to 1000 MHz  | 4.94 dB     |

Uncertainty figures are valid to a confidence level of 95%.

# 5. EQUIPMENT UNDER TEST

## 5.1. DESCRIPTION OF EUT

The EUT is 3G 4G Module

## 5.1. MAXIMUM OUTPUT POWER

The RF conducted measurement passed within ± 0.5dBm of the original output power.

The RF radiated measurement with maximum EIRP output powers are as follows:

| Frequency range | Bandwidth | Modulation | EIRP  |       |  |
|-----------------|-----------|------------|-------|-------|--|
| (MHz)           | Danuwium  | Modulation | dBm   | mW    |  |
| 2498.5-2687.5   | 5MHz      | QPSK       | 24.36 | 272.9 |  |
| 2498.5-2687.5   | 5MHz      | 16QAM      | 24.65 | 291.7 |  |
| 2501-2685       | 10MHz     | QPSK       | 24.15 | 260.0 |  |
| 2501-2685       | 10MHz     | 16QAM      | 24.45 | 278.6 |  |

# 5.1. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major change filed under this application is adding dipole antennas.

## 5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an integrated Dipole antenna, with a maximum peak gain of 2.5dBi.

## 5.3. SOFTWARE AND FIRMWARE

The test utility software used during testing was X350 VSG Beceem Diagnostic Control Panel Version 3.3.0.

## 5.4. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

# 5.5. DESCRIPTION OF TEST SETUP

## RADIATED TESTS SUPPORT EQUIPMENT

|   | PERIPHERAL SUPPORT EQUIPMENT LIST |              |                        |     |  |  |  |  |  |  |  |  |
|---|-----------------------------------|--------------|------------------------|-----|--|--|--|--|--|--|--|--|
| Description Manufacturer Model Serial Number FCC ID |                                   |              |                        |     |  |  |  |  |  |  |  |  |
| Tablet Laptop                                       | Lenovo                            | ThinkPad R60 | LV-BB670               | DoC |  |  |  |  |  |  |  |  |
| AC Adapter  | Lenovo                            | 42T4426      | 11S42T4426Z1ZF3F04C4FW | DoC |  |  |  |  |  |  |  |  |
| Vector signal generator                             | Agilent / HP                      | E4438C       | US44271971             | NA  |  |  |  |  |  |  |  |  |
| Antenna, Horn, 18 GHz                               | ETS                               | 3117         | 9702-5118              | NA  |  |  |  |  |  |  |  |  |

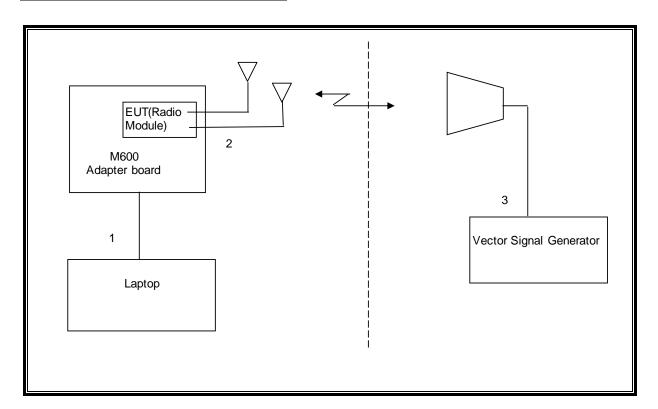
### I/O CABLES

|  | I/O CABLE LIST |   |                   |               |                 |         |  |  |  |  |  |  |
|--|----------------|---|-------------------|---------------|-----------------|---------|--|--|--|--|--|--|
| Cable Port # of Connect No. Identic Type Ports |                |   | Connector<br>Type | Cable<br>Type | Cable<br>Length | Remarks |  |  |  |  |  |  |
| 1  | USB            | 1 | MINI USB          | UN-SHELDED    | 1.0m            | N/A     |  |  |  |  |  |  |
| 2  | RF             | 1 | Dipole            | UN-SHELDED    | 0.1m            | N/A     |  |  |  |  |  |  |
| 3  | RF             | 1 | SMA               | UN-SHELDED    | 3m              | N/A     |  |  |  |  |  |  |

### **TEST SETUP**

The EUT is installed in an adapter board that connected to a laptop computer via USB cable during the tests. Test software exercised the radio card.

# **RADIATED SETUP DIAGRAM FOR TESTS**



# **6. TEST AND MEASUREMENT EQUIPMENT**

The following test and measurement equipment was utilized for the tests documented in this report:

|                             | TEST EQUIPMENT LIST |             |        |          |  |  |  |  |  |  |  |  |
|-----------------------------|---------------------|-------------|--------|----------|--|--|--|--|--|--|--|--|
| Description                 | Manufacturer        | Model       | Asset  | Cal Due  |  |  |  |  |  |  |  |  |
| Spectrum Analyzer, 26.5 GHz | Agilent / HP        | E4440A      | C01178 | 08/30/12 |  |  |  |  |  |  |  |  |
| Antenna, Horn, 18 GHz       | EMCO                | 3115        | C00783 | 06/29/12 |  |  |  |  |  |  |  |  |
| Antenna, Horn, 18 GHz       | EMCO                | 3115        | C00945 | 06/29/12 |  |  |  |  |  |  |  |  |
| Antenna, Bilog, 2 GHz       | Sunol Sciences      | JB1         | C01011 | 07/16/12 |  |  |  |  |  |  |  |  |
| Vector Signal Generator     | Agilent / HP        | E4438C      | N/A    | 09/09/12 |  |  |  |  |  |  |  |  |
| Preamplifier, 26.5 GHz      | Agilent / HP        | 8449B       | C01052 | 07/12/12 |  |  |  |  |  |  |  |  |
| Preamplifier, 1300 MHz      | Agilent / HP        | 8447D       | C00885 | 01/27/12 |  |  |  |  |  |  |  |  |
| Highpass Filter, 2.7 GHz    | Micro-Tronics       | HPM13194    | N02687 | CNR      |  |  |  |  |  |  |  |  |
| Directional Coupler         | RF-Lambda           | RFDC5M06G15 | N/A    | CNR      |  |  |  |  |  |  |  |  |
| Signal Generator, 20 GHz    | Agilent / HP        | 83732B      | C00774 | 07/14/12 |  |  |  |  |  |  |  |  |

# 7. RADIATED TEST RESULTS

# 7.1. RADIATED POWER (EIRP)

## LIMITS

§2.1046 & §27.50 (h)(2) Mobile and other user stations. Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

## **TEST PROCEDURE**

ANSI / TIA / EIA 603 Clause 2.2.17 and §27.50 (i) and KDB 971168

## **RESULTS**

| DIA/    | Na - 11 - | 01 1    | Frequency | EIRP  | EIRP   |
|---------|-----------|---------|-----------|-------|--------|
| BW      | Mode      | Channel | (MHz)     | (dBm) | (mW)   |
|         |           | Low     | 2498.5    | 24.36 | 272.90 |
|         | QPSK      | Middle  | 2593.0    | 23.95 | 248.31 |
| 5841 I- |           | High    | 2687.5    | 24.05 | 254.10 |
| 5MHz    | 16QAM     | Low     | 2498.5    | 24.19 | 262.42 |
|         |           | Middle  | 2593.0    | 23.75 | 237.14 |
|         |           | High    | 2687.5    | 24.65 | 291.74 |
|         |           | Low     | 2501.0    | 23.83 | 241.55 |
|         | QPSK      | Middle  | 2593.0    | 24.05 | 254.10 |
| 400411- |           | High    | 2685.0    | 24.15 | 260.02 |
| 10MHz   |           | Low     | 2501.0    | 24.03 | 252.93 |
|         | 16QAM     | Middle  | 2593.0    | 24.35 | 272.27 |
|         |           | High    | 2685.0    | 24.45 | 278.61 |

## Above 1GHz at 5MHz Bandwidth

# 5MHz\_QPSK

High Frequency Fundamental Measurement Compliance Certification Services Chamber B

 Company:
 Fortinet

 Project #:
 12U14462

 Date:
 06/19/12

 Test Engineer:
 Chin Pang

Configuration: EUT/Dipole Antenna
Mode: 5MHz, QPSK

Test Equipment:

Receiving: Horn T59, and Camber B SMA Cables

Substitution: Horn T217 Substitution, 4ft SMA Cable (244639001) Warehouse

| f              | SG reading                              | Ant. Pol. | Cable Loss   | Antenna Gain | EIRP           | Limit        | Delta         | Notes |
|----------------|---|-----------|--------------|--------------|----------------|--------------|---------------|-------|
| GHz            | (dBm)                                   | (H/V)     | (dB)         | (dBi)        | (dBm)          | (dBm)        | (dB)          |       |
| 2.499          | 15.9                                    | V         | 0.85         | 9,29         | 24.36          | 33.0         | -8.6          |       |
| 2.499          | 7.0                                     | H         | 0.85         | 9.25         | 15.40          | 33.0         | -0.0<br>-17.6 |       |
| 2 502          | , |           | 0.05         | 0.40         | 22.05          | 22.0         |               |       |
| 2.593<br>2.593 | 15.4<br>6.7                             | V         | 0.85<br>0.85 | 9.40<br>9.18 | 23.95<br>15.03 | 33.0<br>33.0 | -9.1<br>-18.0 |       |
| 2.333          | 0.7                                     | 11        | 0.03         | 3.10         | 13.03          | 33.0         | -10.0         |       |
| 2.688          | 15.3                                    | V         | 0.85         | 9.60         | 24.05          | 33.0         | -9.0          |       |
| 2.688          | 6.8                                     | Н         | 0.85         | 9.54         | 15.49          | 33.0         | -17.5         |       |

Rev. 3.17.11

# 5MHz\_16QAM

High Frequency Fundamental Measurement Compliance Certification Services Chamber B

Company: Fortinet
Project #: 12U14462
Date: 06/19/12
Test Engineer: Chin Pang
Configuration: EUT/Dipole Antenna
Mode: 5MHz, 16QAM

### Test Equipment:

Receiving: Horn T59, and Camber B SMA Cables

Substitution: Horn T217 Substitution, 4ft SMA Cable (244639001) Warehouse

| f              | SG reading | Ant. Pol. | Cable Loss | Antenna Gain | EIRP  | Limit | Delta         | Notes |
|----------------|------------|-----------|------------|--------------|-------|-------|---------------|-------|
| GHz            | (dBm)      | (H/V)     | (dB)       | (dBi)        | (dBm) | (dBm) | (dB)          |       |
| 2 400          | 45.0       |           | 0.05       |              | 04.40 |       |               |       |
| 2.499<br>2.499 | 15.8       | <u>V</u>  | 0.85       | 9.29         | 24.19 | 33.0  | -8.8<br>-17.9 |       |
| 2.499          | 6.7        | Н         | 0.85       | 9.25         | 15.10 | 33.0  | -17.9         |       |
| 2.593          | 15.2       | V         | 0.85       | 9.40         | 23.75 | 33.0  | -9.3          |       |
| 2.593          | 6.7        | Н         | 0.85       | 9.18         | 15.03 | 33.0  | -18.0         |       |
| 2 000          | 45.0       | V         | 0.05       | 0.00         | 24.65 | 22.0  |               |       |
| 2.688          | 15.9       | V         | 0.85       | 9.60         | 24.65 | 33.0  | -8.4          |       |
| 2.688          | 6.9        | Н         | 0.85       | 9.54         | 15.59 | 33.0  | -17.4         |       |

Rev. 3.17.11

# 10MHz\_QPSK

High Frequency Fundamental Measurement Compliance Certification Services Chamber B

 Company:
 Fortinet

 Project #:
 12U14462

 Date:
 06/19/12

 Test Engineer:
 Chin Pang

Configuration: EUT WITH Dipole Antenna
Mode: TX, 10MHz BAND\_QPSK MODE

### Test Equipment:

Receiving: Horn T73, and Camber B SMA Cables

Substitution: Horn T217 Substitution, 6ft SMA Cable (208947003) Warehouse

| f     | SG reading | Ant. Pol. | Cable Loss | Antenna Gain | EIRP  | Limit | Delta | Notes |
|-------|------------|-----------|------------|--------------|-------|-------|-------|-------|
| GHz   | (dBm)      | (H/V)     | (dB)       | (dBi)        | (dBm) | (dBm) | (dB)  |       |
|       |            |           |            |              |       |       |       |       |
| 2.501 | 15.4       | V         | 0.85       | 9.28         | 23.83 | 33.0  | -9.2  |       |
| 2.501 | 7.5        | Н         | 0.85       | 9.25         | 15.90 | 33.0  | -17.1 |       |
| 2.593 | 15.5       | V         | 0.85       | 9.40         | 24.05 | 33.0  | -9.0  |       |
| 2.593 | 7.4        | Н         | 0.85       | 9.18         | 15.73 | 33.0  | -17.3 |       |
| 2.685 | 15.4       | V         | 0.85       | 9.60         | 24.15 | 33.0  | -8.9  |       |
| 2.685 | 7.3        | Н         | 0.85       | 9.54         | 15.99 | 33.0  | -17.0 |       |

Rev. 3.17.11

# 10MHz\_16QAM

High Frequency Fundamental Measurement Compliance Certification Services Chamber B

 Company:
 Fortinet

 Project #:
 12U14462

 Date:
 06/19/12

 Test Engineer:
 Chin Pang

Configuration: EUT WITH dipole Antenna
Mode: TX, 10MHz BAND\_16QAM MODE

### Test Equipment:

Receiving: Horn T59, and Camber B SMA Cables

Substitution: Horn T217 Substitution, 6ft SMA Cable (208947003) Warehouse

| f     | SG reading | Ant. Pol. | Cable Loss | Antenna Gain | EIRP  | Limit | Delta | Notes |
|-------|------------|-----------|------------|--------------|-------|-------|-------|-------|
| GHz   | (dBm)      | (H/V)     | (dB)       | (dBi)        | (dBm) | (dBm) | (dB)  |       |
|       |            |           |            |              |       |       |       |       |
| 2.501 | 15.6       | V         | 0.85       | 9.28         | 24.03 | 33.0  | -9.0  |       |
| 2.501 | 7.5        | Н         | 0.85       | 9.25         | 15.90 | 33.0  | -17.1 |       |
|       |            |           |            |              |       |       |       |       |
| 2.593 | 15.8       | V         | 0.85       | 9.40         | 24.35 | 33.0  | -8.7  |       |
| 2.593 | 7.3        | Н         | 0.85       | 9.18         | 15.63 | 33.0  | -17.4 |       |
|       |            |           |            |              |       |       |       |       |
| 2.685 | 15.7       | V         | 0.85       | 9.60         | 24.45 | 33.0  | -8.6  |       |
| 2.685 | 7.5        | Н         | 0.85       | 9.54         | 16.19 | 33.0  | -16.8 |       |

Rev. 3.17.11

73 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0. This report shall not be reproduced except in full, without the written approval of UL CCS.

# 7.2. FIELD STRENGTH OF SPURIOUS RADIATION

## **LIMIT**

§2.1053

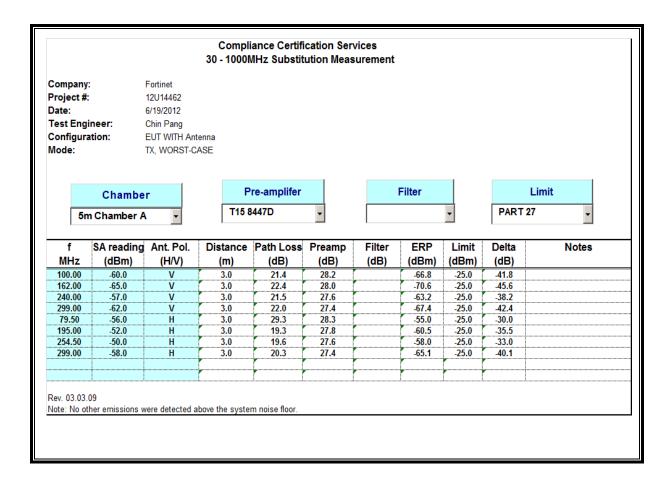
 $\S27.53$  (m)(4) For mobile digital stations, the attenuation factor shall be not less than 43 + 10 log (P) dB at the channel edge and 55 + 10 log (P) dB at 5.5 megahertz from the channel edges.

## **TEST PROCEDURE**

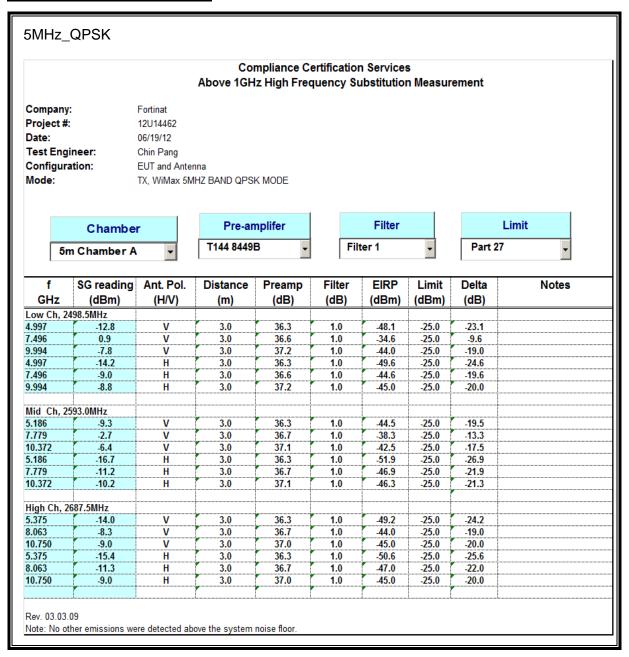
ANSI / TIA / EIA 603 Clause 3.2.12 & FCC 27

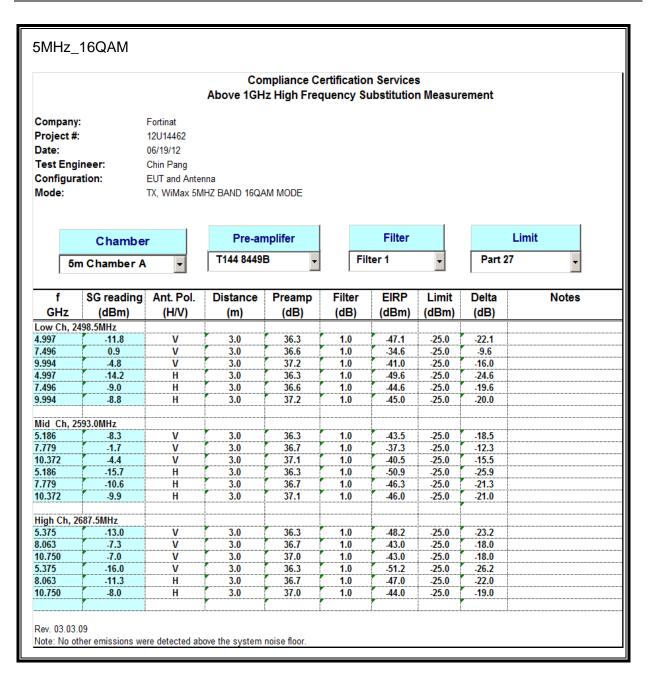
### **RESULTS**

### **Below 1GHz (Worst Case)**



## Above 1GHz at 5MHz Bandwidth





### Above 1GHz at 10MHz Bandwidth

