Head office & Test Lab: 28(175-20,Annyeong-dong)
406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea
Tel: +82-31-222-4251 / Fax: +82-31-222-4252

# TEST REPORT

Report No: KST-FCR-150003

| | | |
|---|---|---|
| **Applicant** | Name | SamYoungTech. co., Ltd. |
| | Address | 110, Geomdan-ro, Seo-gu, Incheon, South Korea |
| **Manufacturer** | Name | SamYoungTech. co., Ltd. |
| | Address | 110, Geomdan-ro, Seo-gu, Incheon, South Korea |
| | | |
| **Equipment** | Name | UHF Transceiver |
| | Model No | SY4050-LM |
| | Brand | None |
| | FCC ID | 2AFQD-SY4050-LM |

| | |
|---|---|
| **Test Standard** | FCC CFR 47, Part 90<br>ANSI/TIA-603-D-2010 |
| **Received Date** | 2015. 08. 19 |
| **Test Date(s)** | 2015. 09. 23 - 2015. 09. 25 |
| **Issue Date** | 2015. 09. 30 |
| **Test Result** | Compliance |
| **Note** | - |

## Supplementary Information

The device bearing the brand name and FCC ID specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with measurement procedures specified in ANSI/TIA-603-D-2010.

We attest to the accuracy of data and all measurements reported herein were performed by KOSTEC Co., Ltd. and were made under Chief Engineer's supervision. We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

| | | | |
|---|---|---|---|
| Tested by | Mi Young, Lee | Approved by | Gyeong Hyeon, Park |
| Signature |  | Signature |  |

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# Revision History of test report

| Rev. | Revisions | Effect page | Reviewed | Date |
|---|---|---|---|---|
| - | Initial issue | All | Gyeong Hyeon, Park | 2015. 09. 30 |
| 1 | Retest low frequency | All | Gyeong Hyeon, Park | 2015. 11. 02 |
| 2 | Revised section 5.2.1 and 5.3.6 | 12, 16 - 23 | Gyeong Hyeon, Park | 2015. 11. 06 |
| 3 | Correct the value of emission designator for digital. | 5,7 | Gyeong Hyeon, Park | 2015. 11. 09 |

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# 1. GENERAL INFORMATION

## 1.1 Test Facility

### Test laboratory and address

KOSTEC Co., Ltd.

128(175-20,Annyeong-dong)406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea

The open area field test site and conducted measurement facility are used for these testing. This site at was fully described in a reports submitted to the Federal Communications Commission (FCC).

The facility also complies with the radiated and conducted test site criteria set forth in ANSI C 63.4-2014 and ANSI/TIA-603-D-2010.

The Federal Communications Commission (FCC) has the reports on file and KOSTEC Co., Ltd. is listed under FCC Registration No.525762. The test site has been approved by the FCC for public use and is List in the FCC Public Access Link CORES (Commission Registration System)

### Registration information

KCC (Korea Communications Commission) Number : KR0041

KOLAS(Korea Laboratory Accreditation Scheme) Number : 232

FCC Registration Number(FRN) : 525762

IC Registration Site Number : 8305A-1

## 1.2 Location

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## 2. EQUIPMENT DESCRIPTION

The product specification described herein was declared by manufacturer. And refer to user's manual for the details.

| | |
|---|---|
| Equipment Name | UHF Transceiver |
| Model No | SY4050-LM |
| Type of Equipment | Licensed Non-Broadcast Transmitter Held to Face |
| Intended Operating Environment | Restricted to Occupational Use only |
| Serial Number | Prototype |
| Primary User Functions of EUT | 2-Way Wireless Voice & Data Communication |
| RF Output Power Rating | 5 Watt (High) / 2 Watt (Low) |
| Operating Frequency Range | 406.1 - 440 ㎒ |
| RF Output Impedance | 50 Ω |
| Channel Spacing | 12.5 ㎑ |
| Modulation | FM for analog voice<br>4FSK for digital Voice and data |
| Occupied Bandwidth (99%) | 9.68 ㎑ (for 12.5 ㎑ Channel Spacing / Analog)<br>7.95 ㎑ (for 12.5 ㎑ Channel Spacing / Digital) |
| Emission Designation* | 11K0F3E, 7K950F1D, 7K95F1E |
| Power Source | Li-ion battery / 7.4 VDC nominal / 2.600 ㎃h |
| Antenna Description | Antenna 1(Main): HW-423W-CT405 Whip antenna, 0 ㏈i<br>Antenna 2(Optional): HW-423H-CT405 Helical Antenna, -2 ㏈i |
| FCC ID | 2AFQD-SY4050-LM |
| Remark | The above DUT's information was declared by manufacturer. Please refer to the specifications or user manual for more detailed description. |

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# 3. SYSTEM CONFIGURATION FOR TEST

## 3.1 Characteristics of equipment

The Equipment Under Test (EUT) use for UHF transceiver.

## 3.2 Used peripherals list

| Description | Model No. | Serial No. | Manufacture | Remark |
|---|---|---|---|---|
| AC/DC adaptor | KSAS0121200100VO | None | Kuantech(Beihai)C0.,Ltd. | |
| Charger | WLC-300 | J0O0F | Winnertech | |
| Battery | WLB-2600 | J0O0G | Winnertech | |
| Tube.ear/mic | WEP-100 | None | Winnertech | |

## 3.3 Product Modification

N/A

## 3.4 Operating Mode

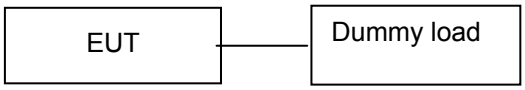
* Constantly transmitting with a modulated carrier at maximum power on the bottom, middle and top channels as required using the supported modulation types.

* The EUT has one transmit/receive RF port. RF cables and attenuators connecting the test equipment to the EUT ports were calibrated before use and the calibration data incorporated into the conducted measurement results.

* Radiated emissions tests were performed with antenna ports terminated.

## 3.5 Test Setup of EUT

The measurements were taken in continuous transmit mode.



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## 3.6 Table for Carrier Frequencies

| Modulation Type | Tested Channel | Channel separation (㎑) | Test freq. (㎒) |
|---|---|---|---|
| Analog | Low | 12.5 | 406.1125 |
| | Mid | | 420.0000 |
| | High | | 440.0000 |
| Digital | Low | 12.5 | 406.1125 |
| | Mid | | 420.0000 |
| | High | | 440.0000 |

## 3.7 Modulation

| Channel space | Mode | Modulation | Description |
|---|---|---|---|
| 12.5 kHz | Analog Voice | 11K0F3E | BW = 2M +2DK, where M = maximum modulating frequency in Hz,<br>D = peak deviation in Hz, and K=1, is as follows:<br>In this case the maximum modulating frequency is 3.0 ㎑ with a 2.5 ㎑ deviation.<br>BW = 2(M+D) = 2*(3.0kHz + 2.5kHz) = 11kHz (11K0 designator) |
| 12.5 kHz | Digital Data | 7K95F1D | Measurement's per Rule Part 2.202(c)(4) where employed because Part 2.202(g) Table III A formulation produces an excessive result using the value of K recommended in the Table. Therefore, the 99% energy rule (Title 47 CFR 2.989) was used for digital mode and is more accurate than Carson's rule. It states that 99 % of the modulation energy falls within X kHz, which in this case is 7.95 kHz (7K95 designator).<br>This product utilizes a Time Division Multiple Access (TDMA) protocol. The complete emissions designator for this transmitter is 7K95F1D. |
| 12.5 kHz | Digital Voice | 7K95F1E | Measurement's per Rule Part 2.202(c)(4) where employed because Part 2.202(g) Table III A formulation produces an excessive result using the value of K recommended in the Table. Therefore, the 99% energy rule (Title 47 CFR 2.989) was used for digital mode and is more accurate than Carson's rule. It states that 99 % of the modulation energy falls within X kHz, which in this case is 7.95 kHz (7K95 designator).<br>This product utilizes a Time Division Multiple Access (TDMA) protocol. The complete emissions designator for this transmitter is 7K95F1E. |

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## 3.8 Used Test Equipment List

| No. | Instrument | Model | S/N | Manufacturer | Due to cal date | Cal interval | used |
|---|---|---|---|---|---|---|---|
| 1 | T & H Chamber | EY-101 | 90E14260 | TABAI ESPEC | 2016.09.17 | 1 year | ☒ |
| 2 | Constant switch Tester | DS-COT | None | Dong sung Ele. | N/A | N/A | ☐ |
| 3 | Vibration Tester | 70UA | L90016 | IDEX Co.,Ltd | N/A | N/A | ☐ |
| 4 | Vibration Meter | VM-6360 | N225098 | LANDTEK | 2016.04.07 | 1 year | ☐ |
| 5 | Falling Tester | SWD-8000 | None | Sinwoo | N/A | N/A | ☐ |
| 6 | Spectrum Analyzer | 8563E | 3846A10662 | Agilent Technology | 2016.02.05 | 1 year | ☐ |
| 7 | Spectrum Analyzer | 8593E | 3710A02859 | Agilent Technology | 2016.02.05 | 1 year | ☐ |
| 8 | Spectrum Analyzer | FSV30 | 20-353063 | Rohde& Schwarz | 2016.02.05 | 1 year | ☒ |
| 9 | EMI Test Receiver | ESCI7 | 100823 | Rohde& Schwarz | 2016.02.02 | 1 year | ☒ |
| 10 | EMI Test Receiver | ESI | 834000/002 | Rohde& Schwarz | 2016.02.05 | 1 year | ☒ |
| 11 | Vector Signal Analyzer | 89441A | 3416A02620 | Agilent Technology | 2016.02.05 | 1 year | ☐ |
| 12 | Network Analyzer | 8753ES | US39172348 | AGILENT | 2016.09.16 | 1 year | ☐ |
| 13 | EPM Series Power meter | E4418B | GB39512547 | Agilent Technology | 2016.02.05 | 1 year | ☒ |
| 14 | RF Power Sensor | E9300A | MY41496631 | Agilent Technology | 2016.02.05 | 1 year | ☒ |
| 15 | Microwave Frequency Counter | 5352B | 2908A00480 | Agilent Technology | 2016.02.02 | 1 year | ☐ |
| 16 | Modulation Analyzer | 8901A | 3538A07071 | Agilent Technology | 2016.02.05 | 1 year | ☒ |
| 17 | Audio Analyzer | 8903B | 3514A16919 | Agilent Technology | 2016.02.02 | 1 year | ☒ |
| 18 | Audio Telephone Analyzer | DD-5601CID | 520010281 | CREDIX | 2016.02.02 | 1 year | ☐ |
| 19 | Digital storage Oscilloscope | TDS3052 | B015962 | Tektronix | 2016.09.16 | 1 year | ☒ |
| 20 | ESG-D Series Signal Generator | E4436B | US39260458 | Agilent Technology | 2016.02.04 | 1 year | ☒ |
| 21 | ESG Vector Signal Generator | E4438C | MY42083133 | Agilent Technology | 2016.09.16 | 1 year | ☒ |
| 22 | Vector Signal Generator | SMBV100A | 257557 | Rohde & Schwarz | 2016.01.10 | 1 year | ☐ |
| 23 | Tracking Source | 85645A | 070521-A1 | Agilent Technology | 2016.02.05 | 1 year | ☐ |
| 24 | SLIDAC | None | 0207-4 | Myoung sung Ele. | 2016.02.02 | 1 year | ☐ |
| 25 | DC Power supply | DRP-5030 | 9028029 | Digital Electronic Co.,Ltd | 2016.02.03 | 1 year | ☐ |
| 26 | DC Power supply | 6038A | 3440A12674 | Agilent Technology | 2016.02.02 | 1 year | ☒ |
| 27 | DC Power supply | E3610A | KR24104505 | Agilent Technology | 2016.02.02 | 1 year | ☐ |
| 28 | DC Power supply | UP-3005T | 68 | Unicon Co.,Ltd | 2016.02.02 | 1 year | ☐ |
| 29 | DC Power Supply | SM 3004-D | 114701000117 | DELTA ELEKTRONIKA | 2016.02.02 | 1 year | ☐ |
| 30 | Dummy Load | 8173 | 3780 | Bird Electronic Co., Corp | 2016.02.04 | 1 year | ☒ |
| 31 | Attenuator | 50FH-030-500 | 140410 9433 | JEW Idustries Inc. | 2016.02.04 | 1 year | ☐ |
| 32 | Attenuator | 765-20 | 9703 | Narda | 2016.09.16 | 1 year | ☐ |
| 33 | Attenuator | 8498A | 3318A09485 | HP | 2016.02.04 | 1 year | ☐ |
| 34 | Step Attenuator | 8494B | 3308A32809 | HP | 2016.02.05 | 1 year | ☐ |
| 35 | Step Attenuator | 8495D | 3308A01464 | HP | 2016.02.05 | 1 year | ☒ |
| 36 | Power divider | 11636B | 51212 | HP | 2016.02.04 | 1 year | ☐ |
| 37 | 3Way Power divider | KPDSU3W | 00070365 | KMW | 2016.09.16 | 1 year | ☐ |
| 38 | Band rejection filter | WTR-BRF2442-84NN | 09020001 | WAVE TECH Co.,LTD | 2016.02.04 | 1 year | ☐ |
| 39 | White noise audio filter | ST31EQ | 101902 | SoundTech | 2016.09.16 | 1 year | ☐ |
| 40 | Dual directional coupler | 778D | 17693 | HEWLETT PACKARD | 2016.02.04 | 1 year | ☐ |
| 41 | Dual directional coupler | 772D | 2839A00924 | HEWLETT PACKARD | 2016.02.04 | 1 year | ☐ |
| 42 | Band rejection filter | 3TNF-0006 | 26 | DOVER Tech | 2016.02.04 | 1 year | ☐ |
| 43 | Band rejection filter | 3TNF-0008 | 317 | DOVER Tech | 2016.02.04 | 1 year | ☐ |
| 44 | Band rejection filter | 3TNF-0007 | 311 | DOVER Tech | 2016.02.04 | 1 year | ☐ |
| 45 | Highpass Filter | WHJS1100-10EF | 1 | WAINWRIGHT | 2016.02.04 | 1 year | ☐ |
| 46 | Highpass Filter | WHJS3000-10EF | 1 | WAINWRIGHT | 2016.02.04 | 1 year | ☐ |
| 47 | Radio Communication Alalyzer | MT8815A | 6200429622 | ANRITSU | 2016.02.04 | 1 year | ☐ |
| 48 | CDMA Mobile Station Test Set | E8285A | US40081298 | AGILENT | 2016.02.05 | 1 year | ☐ |
| 49 | WideBand Radio Communication Tester | CMW500 | 102276 | Rohde & Schwarz | 2016.04.02 | 1 year | ☐ |

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| No. | Instrument | Model | S/N | Manufacturer | Due to cal date | Cal interval | used |
|---|---|---|---|---|---|---|---|
| 50 | RF Up/Down Converter | DCP-1780 | 980901003 | CREDIX | 2016.02.04 | 1 year | ☐ |
| 51 | DECT Test set | 8923B | 3829U00364 | HP | 2016.02.05 | 1 year | ☐ |
| 52 | DECT Test set | CMD60 | 840677/005 | Rohde& Schwarz | 2016.09.16 | 1 year | ☐ |
| 53 | Loop Antenna | 6502 | 9203-0493 | EMCO | 2017.06.04 | 2 year | ☒ |
| 54 | Dipole Antenna | HZ-12 | 100005 | Rohde & Schwarz | 2016.07.01 | 2 year | ☐ |
| 55 | Dipole Antenna | HZ-13 | 100007 | Rohde & Schwarz | 2016.07.01 | 2 year | ☐ |
| 56 | BiconiLog Antenna | 3142B | 1745 | EMCO | 2016.06.16 | 2 year | ☒ |
| 57 | Horn Antenna | 3115 | 9605-4834 | EMCO | 2016.06.16 | 2 year | ☒ |
| 58 | Horn Antenna | 3115 | 2996 | EMCO | 2016.02.26 | 2 year | ☐ |
| 59 | Horn Antenna | BBHA9170 | BBHA9170152 | SCHWARZBECK | 2017.04.10 | 2 year | ☐ |
| 60 | Signal Generator | SMT-06 | 100552 | Rohde & Schwarz | 2016.02.04 | 1 year | ☐ |
| 61 | HYGRO-Thermograph | NSII-Q | 1611545 | SATO | 2016.09.21 | 1 year | ☐ |
| 62 | Barometer | 7612 | 81134 | SATO | 2016.01.20 | 2 year | ☐ |
| 63 | Multi meter | DM-313 | S60901832 | LG Precision Co.,Ltd | 2016.02.02 | 1 year | ☐ |
| 64 | Antenna Mast(OSA) | AT14 | None | Daeil EMC | N/A | N/A | ☐ |
| 65 | Turn table(OSA) | None | None | Daeil EMC | N/A | N/A | ☐ |
| 66 | RF Amplifier(OSA) | 8447D | 2944A07881 | AGILENT | 2016.02.04 | 1 year | ☐ |
| 67 | Antenna Master(3) | AT13 | None | AUDIX | N/A | N/A | ☒ |
| 68 | Turn Table(3) | None | None | AUDIX | N/A | N/A | ☒ |
| 69 | PREAMPLIFIER(3) | 8449B | 3008A02577 | Agilent | 2016.02.05 | 1 year | ☒ |
| 70 | Antenna Master(10) | MA4000-EP | None | inno systems GmbH | N/A | N/A | ☒ |
| 71 | Turn Table(10) | None | None | inno systems GmbH | N/A | N/A | ☒ |
| 72 | AMPLIFIER(10) | TK-PA6S | 120009 | TESTEK | 2016.02.02 | 1 year | ☒ |
| 73 | Vernier Calipers | None | 8280373 | Mitutoyo | 2016.09.17 | 1 year | ☐ |

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# 4. SUMMARY TEST RESULTS

| Description of Test | FCC Rule | Reference Clause | Used | Test Result |
|---|---|---|---|---|
| RF Output Power | Part 90.205 | Clause 5.1 | ☒ | Compliance |
| Modulation Characteristecs | Part 2.1047(a), 90.242(b)(8) | Clause 5.2 | ☒ | Compliance |
| Occupied Bandwidth | Part 90.209 | Clause 5.3 | ☒ | Compliance |
| Emission Mask | Part 90.210 | Clause 5.4 | ☒ | Compliance |
| Frequency Stability | Part 90.213 | Clause 5.5 | ☒ | Compliance |
| Spurious Emission On Antenna Port | Part 90.210 | Clause 5.6 | ☒ | Compliance |
| Transmitter Radiated Unwanted Emissions | Part 90.210 | Clause 5.7 | ☒ | Compliance |
| Transmitter Frequency Behavior | Part 90.214 | Clause 5.8 | ☒ | Compliance |
| Compliance/pass : The EUT complies with the essential requirements in the standard.<br>Not Compliance : The EUT does not comply with the essential requirements in the standard.<br>N/A : The test was not applicable in the standard. | | | | |

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# 5. MEASUREMENT RESULTS

## 5.1 RF Output Power

### 5.1.1 Standard Applicable [FCC §90.205 & 2.1046]

### 5.1.2 Test Environment conditions

- Ambient temperature : (20 - 21) ℃
- Relative Humidity : (43 - 45) % R.H.

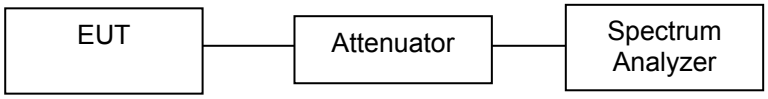
### 5.1.3 Measurement Procedure

The transmitter output was connected to the spectrum analyzer with an attenuator. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted bellow: If the power output is adjustable, measurements shall be made for the highest and lowest power levels.

The spectrum analyzer is set to the as follows :

- RBW : 100 ㎑
- VBW : 300 ㎑

### 5.1.4 Test setup




### 5.1.5 Measurement Result

| Modulation | Frequency [㎒] | Power Level | Conducted output Power [㏈m] | Conducted output Power [W] | Limit [㏈m] | Test Results |
|---|---|---|---|---|---|---|
| Analog | 406.1125 | Low | 32.83 | 1.92 | 1.6 - 2.4 W | Compliance |
| | 420.0000 | Low | 32.82 | 1.91 | | Compliance |
| | 440.0000 | Low | 32.50 | 1.78 | | Compliance |
| | 406.1125 | High | 36.25 | 4.22 | 4 - 6 W | Compliance |
| | 420.0000 | High | 36.87 | 4.86 | | Compliance |
| | 440.0000 | High | 36.97 | 4.98 | | Compliance |
| Digital | 406.1125 | Low | 32.71 | 1.87 | 1.6 - 2.4 W | Compliance |
| | 420.0000 | Low | 32.66 | 1.85 | | Compliance |
| | 440.0000 | Low | 32.46 | 1.76 | | Compliance |
| | 406.1125 | High | 36.69 | 4.67 | 4 - 6 W | Compliance |
| | 420.0000 | High | 36.67 | 4.65 | | Compliance |
| | 440.0000 | High | 36.81 | 4.80 | | Compliance |

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## 5.2 Modulation Characteristecs

### 5.2.1 Standard Applicable [FCC §Part 2.1047(a)]

2.1047(b): Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

Recommended frequency deviation characteristics are given below:

| CH spacing | Frequency deviation |
|---|---|
| 12.5 ㎑ | 2.5 ㎑ |

Part 2.1047(a) A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 ㎐ shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

90.242(b)(8) Recommended audio filter attenuation characteristics are given below:

| Audio freq. | Minimum Attenuation Rel. to 1 ㎑ Attenuation |
|---|---|
| 3 - 20 ㎑ | 60 log10(f/3) ㏈ where f is in ㎑ |
| 20 - 30 ㎑ | 50 ㏈ |

### 5.2.2 Test Environment conditions

• Ambient temperature : (20 - 21) ℃ • Relative Humidity : (43 - 45) % R.H.

### 5.2.3 Measurement Procedure

• Modulation Limit

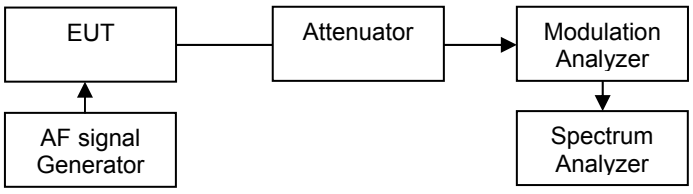
The carrier frequency deviation was measured with the tone adjust the audio input for 60 % of rated system deviation at 1 ㎑ using this level as a reference (0 ㏈) and vary the input level from –20 to +20 ㏈. Record the frequency deviation obtained as a function of the input level at frequencies 0.1, 0.5, 1.0, 3.0 and 5.0 ㎑. The maximum deviation was recorded at each test condition.

• Audio frequency response

The audio input level needed for a particular percentage of modulation was measured in accordance with ANSI/TIA 603-D: 2010. The audio input curves versus modulation are shown below. Curves are provided for audio input frequencies of 300, 1000, and 3000 ㎐.

• Test freq: Mid

### 5.2.4 Test setup



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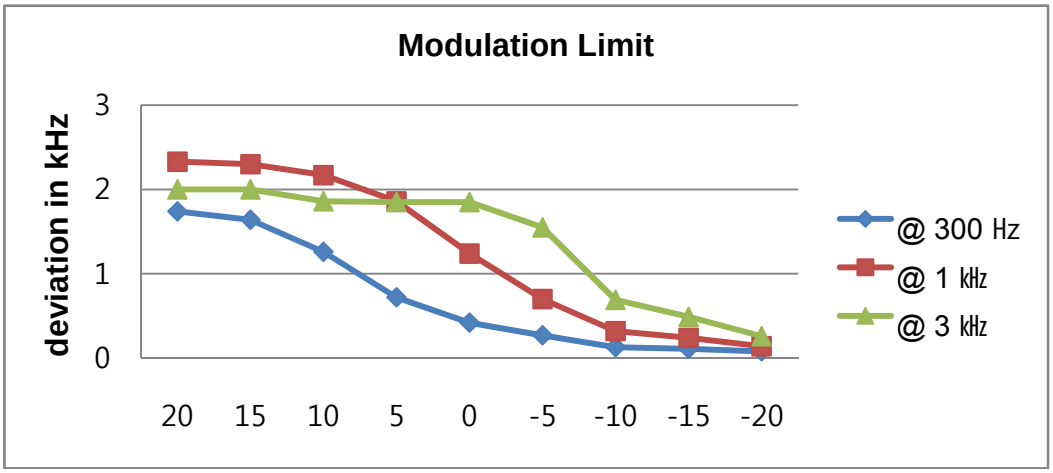
## 5.2.5 Measurement Result

- Modulation Limit

| Audio input Level (dB) | Frequency Deviation (㎑) | | | Limit (㎑) |
|---|---|---|---|---|
| | @ 300 Hz | @ 1 ㎑ | @ 3 ㎑ | |
| 20 | 1.74 | 2.33 | 2.00 | 2.5 |
| 15 | 1.64 | 2.30 | 2.00 | 2.5 |
| 10 | 1.26 | 2.17 | 1.86 | 2.5 |
| 5 | 0.72 | 1.86 | 1.85 | 2.5 |
| 0 | 0.42 | 1.24 | 1.85 | 2.5 |
| -5 | 0.27 | 0.70 | 1.55 | 2.5 |
| -10 | 0.13 | 0.32 | 0.69 | 2.5 |
| -15 | 0.11 | 0.24 | 0.49 | 2.5 |
| -20 | 0.08 | 0.14 | 0.26 | 2.5 |



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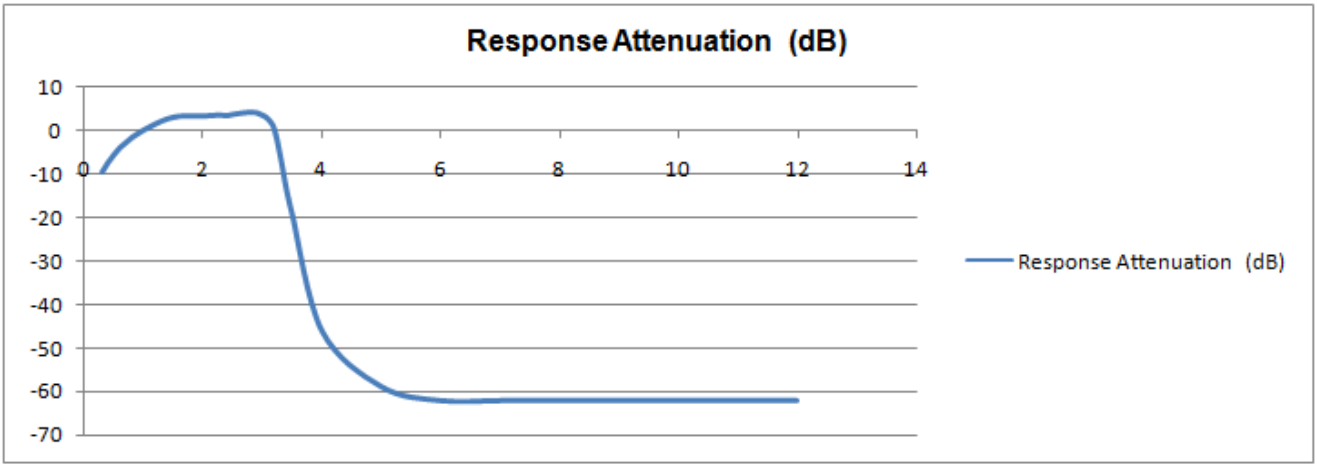
- Audio frequency response

| Audio Frequency (Hz) | Response Attenuation (dB) | Audio Frequency (Hz) | Response Attenuation (dB) |
|---|---|---|---|
| 300 | -9.61 | 2 800 | 4.08 |
| 400 | -7.42 | 2 900 | 3.95 |
| 500 | -5.61 | 3 000 | 3.38 |
| 600 | -4.04 | 3 100 | 2.46 |
| 700 | -2.88 | 3 200 | 0.22 |
| 800 | -1.73 | 3 300 | -5.96 |
| 900 | -0.85 | 3 400 | -13.32 |
| 1 000 | -0.02 | 3 500 | -19.22 |
| 1 200 | 1.42 | 4 000 | -45.86 |
| 1 400 | 2.57 | 5 000 | -58.67 |
| 1 600 | 3.16 | 6 000 | -61.86 |
| 1 800 | 3.25 | 7 000 | -61.86 |
| 2 000 | 3.19 | 8 000 | -61.86 |
| 2 100 | 3.32 | 9 000 | -61.86 |
| 2 200 | 3.37 | 10 000 | -61.86 |
| 2 300 | 3.42 | 12 000 | - |
| 2 400 | 3.29 | 14 000 | - |
| 2 500 | 3.58 | 16 000 | - |
| 2 600 | 3.78 | 18 000 | - |
| 2 700 | 3.95 | 20 000 | - |



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## 5.3 Occupied Bandwidth & 26 dB Bandwidth

### 5.3.1 Standard Applicable [FCC §90.209 & 2.1049]

According to FCC Part 90 Section 90.209:The authorized bandwidth shall be 11.25 kHz for 12.5 kHz channel separation and 6 kHz for 6.25 kHz channel separation.

### 5.3.2 Test Environment conditions

• Ambient temperature : (20 - 21) ℃ • Relative Humidity : (43 - 45) % R.H.

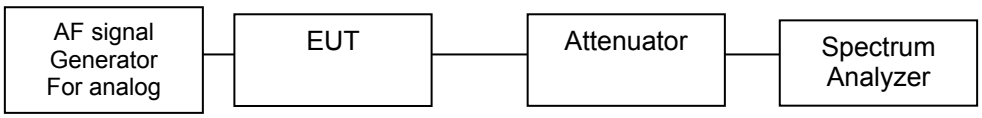
### 5.3.3 Measurement Procedure

1. The EUT was modulated by 2.5 kHz Sine wave audio signal, The level of the audio signal employed is 16 dB greater than that necessary to produce 50 % of rated system deviation. Rated system deviation is 2.5 kHz (12.5 kHz channel spacing).
2. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.
3. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. The 99 % occupied bandwidth is the frequency bandwidth of the signal power at the 99 % channel power of occupied bandwidth.

The spectrum analyzer is set to the as follows :

- RBW : 300 Hz
- VBW : >3 x RBW
- Detector function : peak
- Trace : max hold

### 5.3.4 Test setup




### 5.3.5 Measurement Result

| Modulation | Frequency [MHz] | Power Level | 99 % Bandwidth [MHz] | 26 dB Bandwidth [MHz] | Limit [dBm] | Test Results |
|---|---|---|---|---|---|---|
| Analog | 406.1125 | Low | 9.08 | 10.37 | ≤11.25 | Compliance |
| | 420.0000 | Low | 9.64 | 10.38 | | Compliance |
| | 440.0000 | Low | 9.64 | 10.38 | | Compliance |
| | 406.1125 | High | **9.16** | **10.40** | ≤11.25 | Compliance |
| | 420.0000 | High | **9.60** | **10.38** | | Compliance |
| | 440.0000 | High | **9.68** | **10.38** | | Compliance |
| Digital (Voice and Data) | 406.1125 | Low | 7.73 | 10.12 | ≤11.25 | Compliance |
| | 420.0000 | Low | 7.77 | 10.12 | | Compliance |
| | 440.0000 | Low | 7.95 | 10.12 | | Compliance |
| | 406.1125 | High | **7.95** | **10.03** | ≤11.25 | Compliance |
| | 420.0000 | High | **7.82** | **10.20** | | Compliance |
| | 440.0000 | High | **7.82** | **10.07** | | Compliance |

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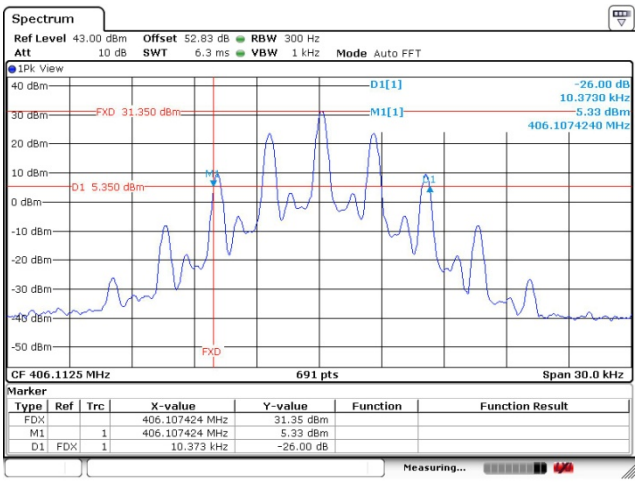
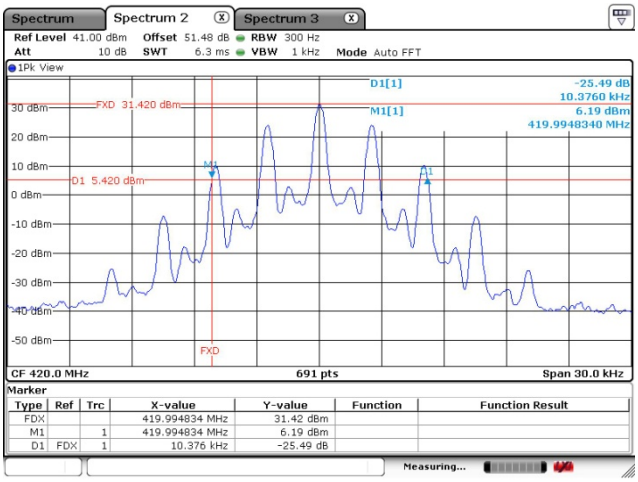
## 5.3.6 Test Plot (26 dB band width for analog)

### Power level: Low

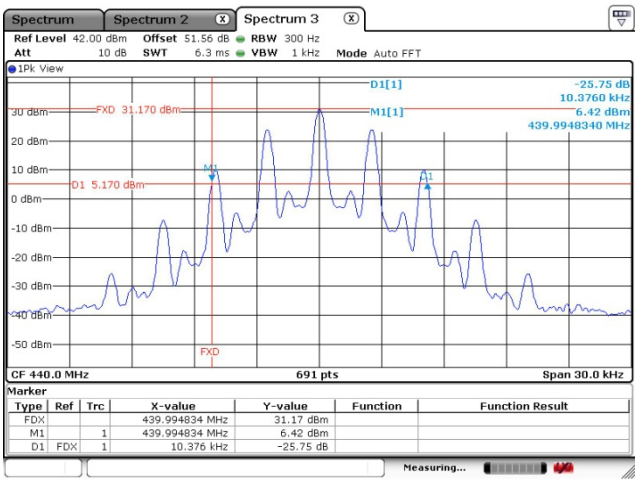
CH Low




CH Middle




CH High



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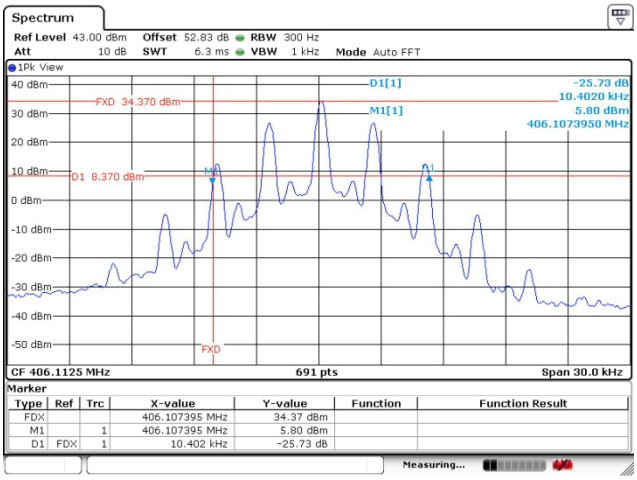
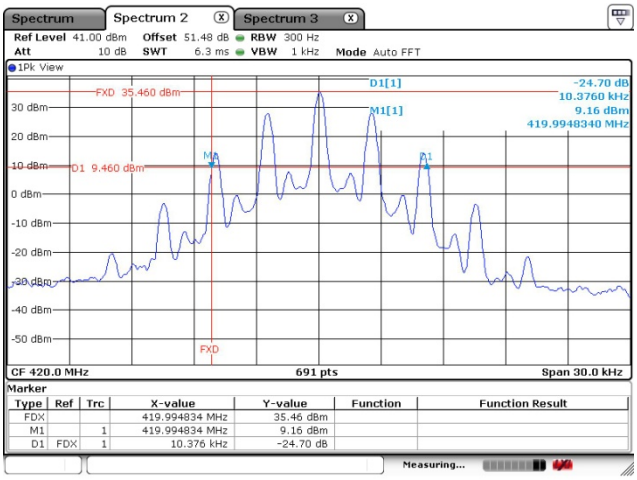
## Power level: High

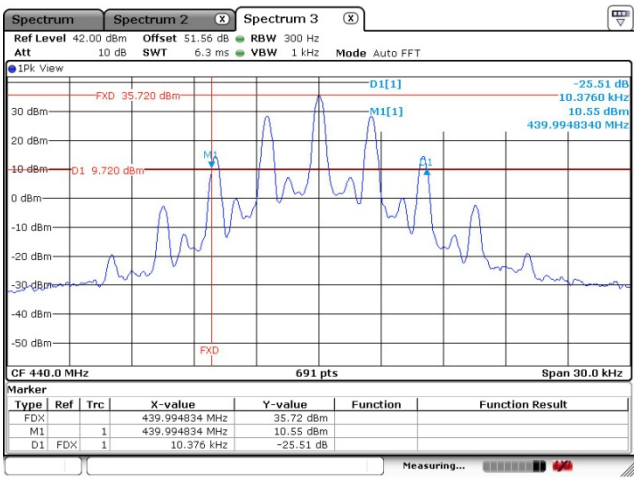
### CH Low




### CH Middle




### CH High



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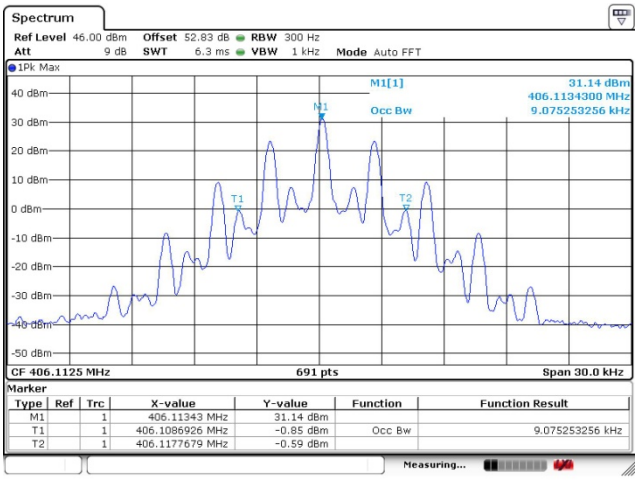
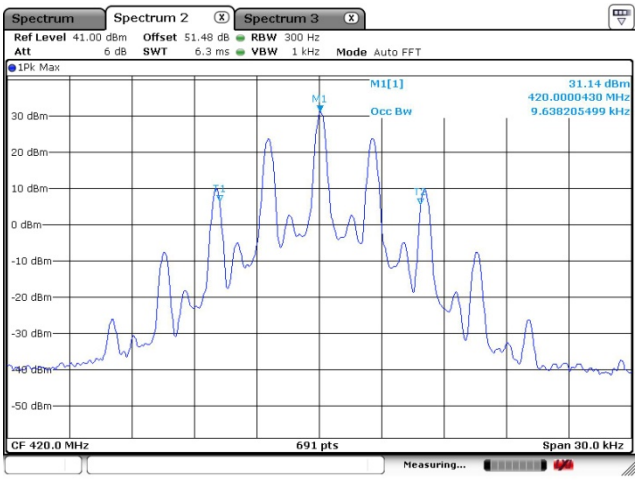
## Test Plot (99 % band width for analog)

### Power level: Low

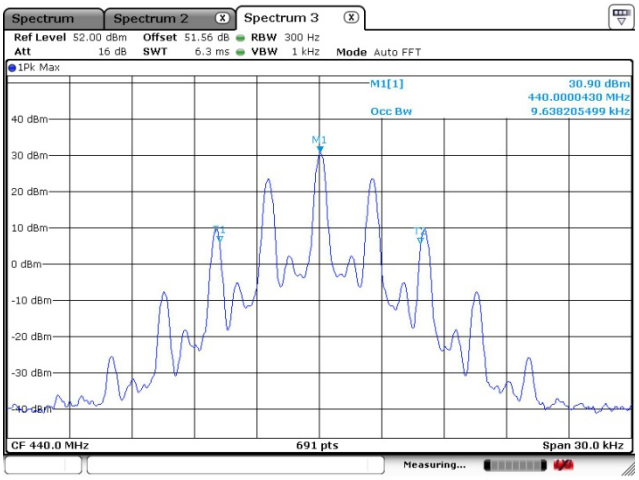
#### CH Low




#### CH Middle




#### CH High



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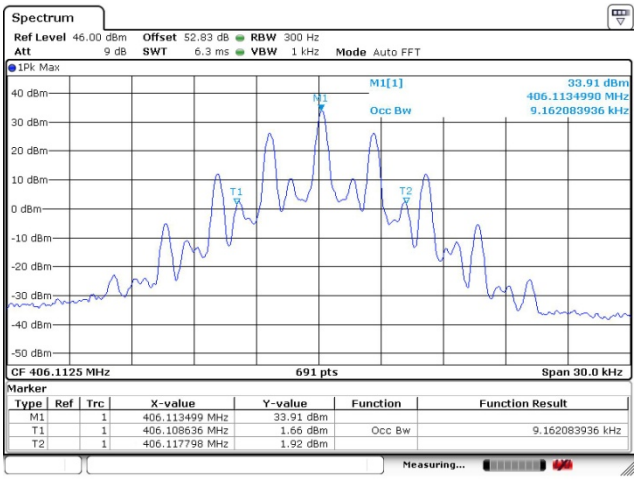
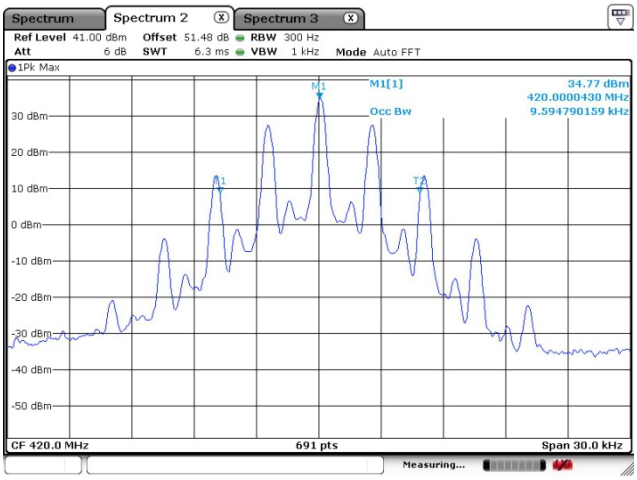
## Power level: High

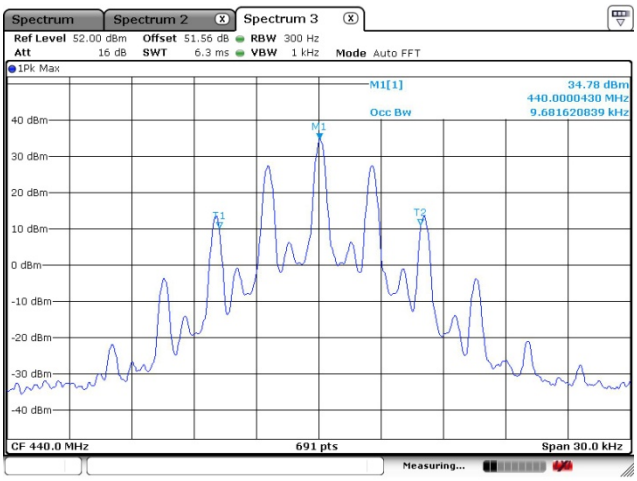
### CH Low




### CH Middle




### CH High



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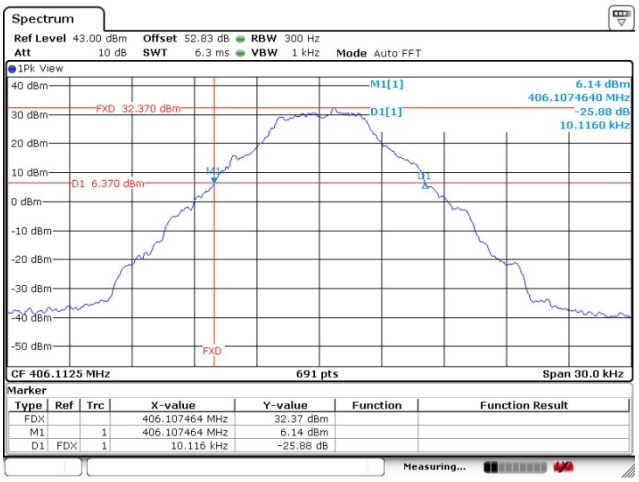
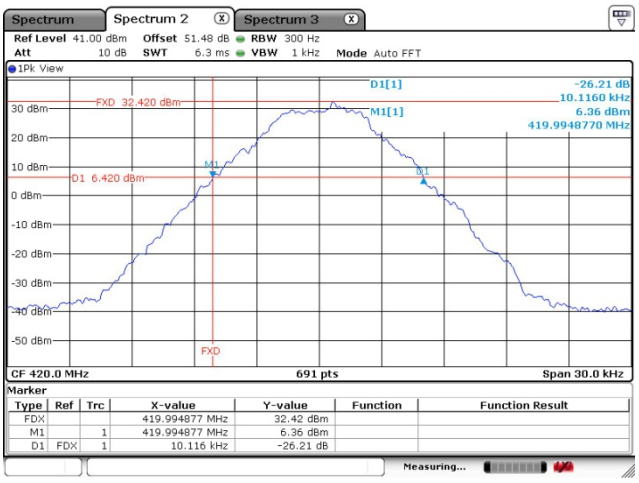
## Test Plot (26 dB band width for digital)

### Power level: Low

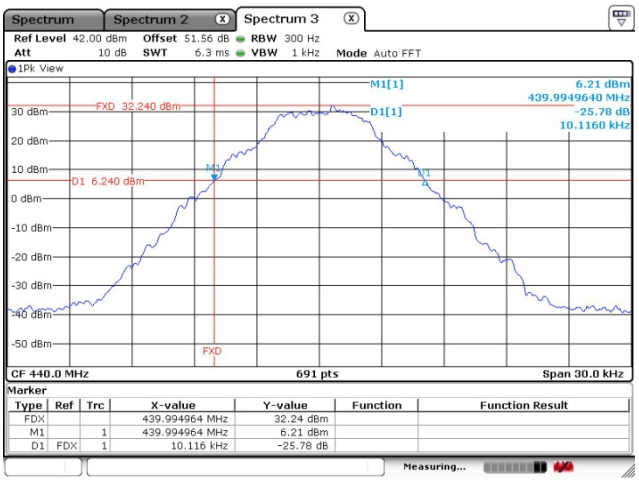
#### CH Low




#### CH Middle




#### CH High



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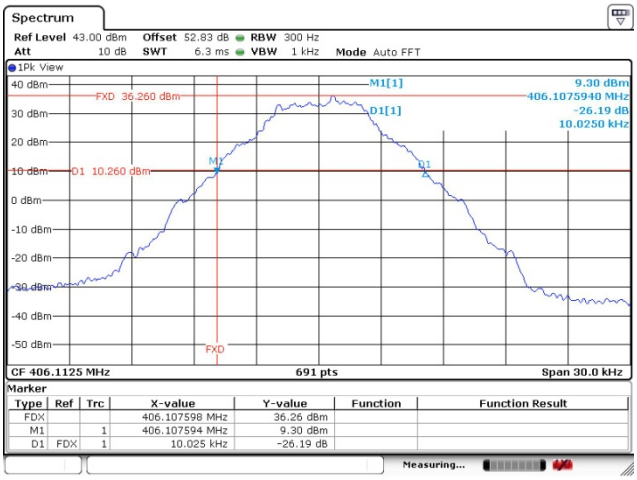
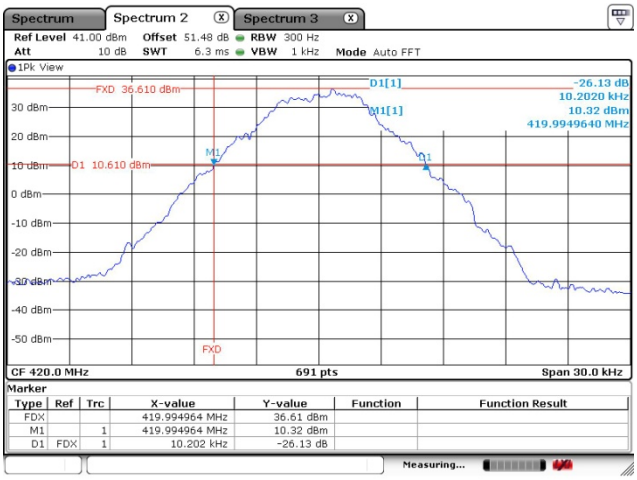
Power level: High

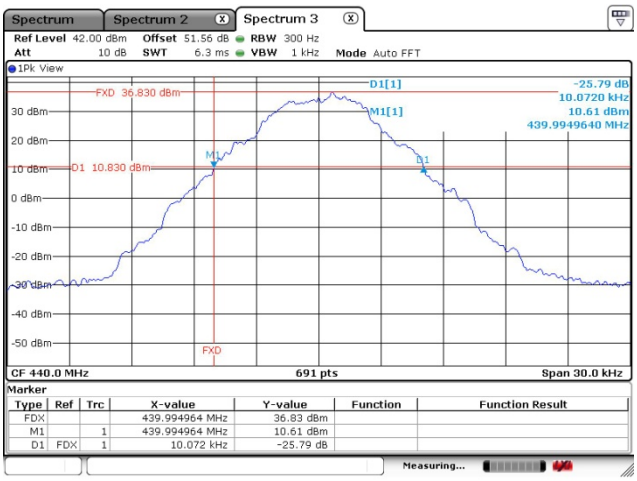
CH Low




CH Middle




CH High



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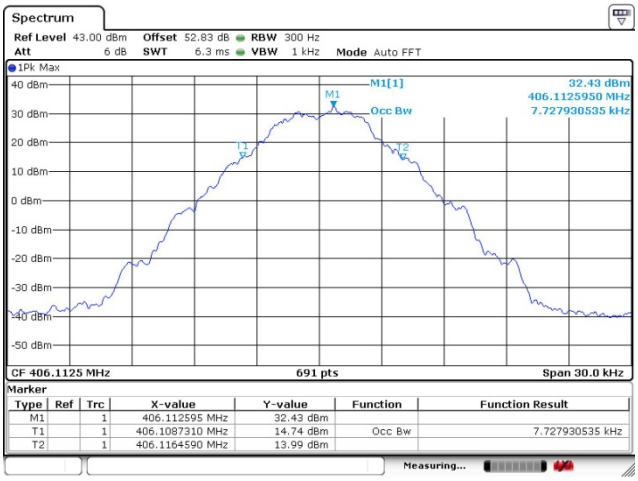
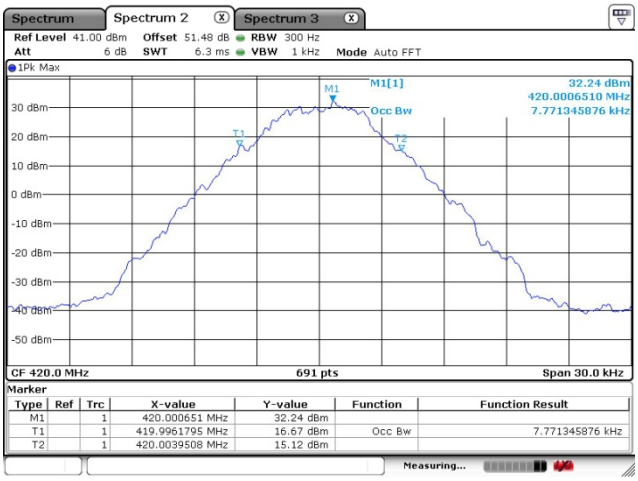
## Test Plot (99 % band width for digital)

### Power level: Low

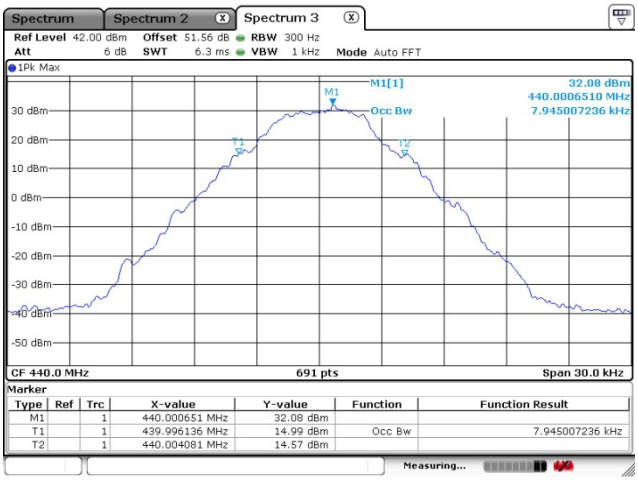
#### CH Low




#### CH Middle




#### CH High



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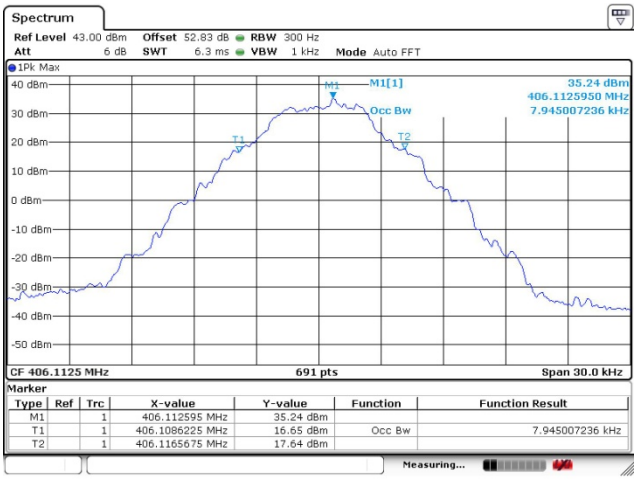
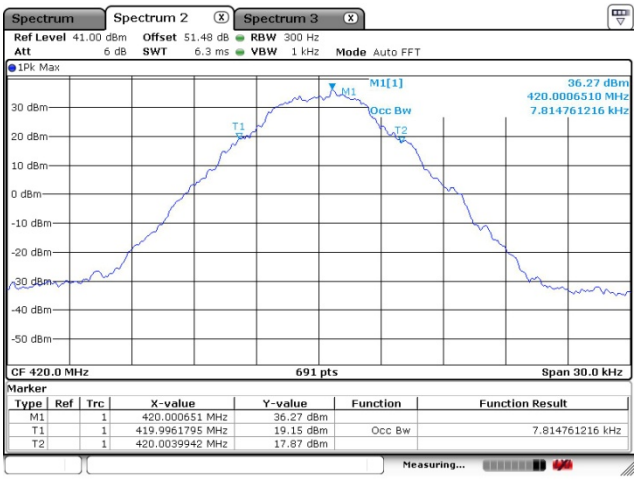
Power level: High

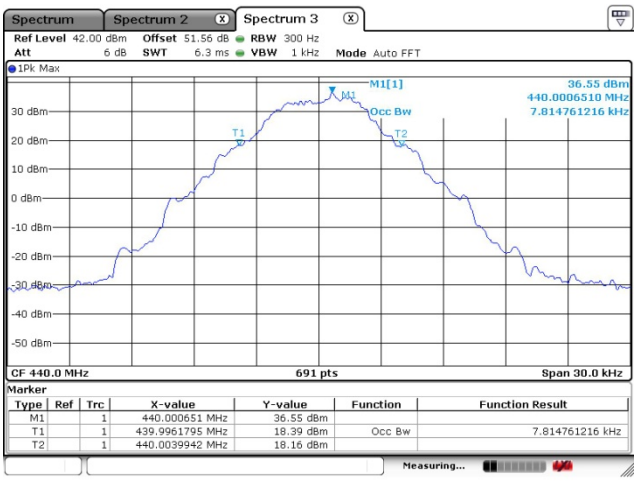
CH Low




CH Middle




CH High



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## 5.4 Emission Mask

### 5.4.1 Standard Applicable [FCC §90.210]

Emission mask D: For transmitters designed to operate with a 12.5 ㎑ channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 5.625 ㎑ removed from f0: Zero ㏈.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in ㎑) of more than 5.625 ㎑ but no more than 12.5 ㎑: At least 7.27(fd−2.88 ㎑) ㏈.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in ㎑) of more than 12.5 ㎑: At least 50 + 10 log (P) ㏈ or 70 ㏈, whichever is the lesser attenuation.

### 5.4.2 Test Environment conditions

- Ambient temperature : (20 - 21) ℃,
- Relative Humidity : (43 - 45) % R.H.

### 5.4.3 Measurement Procedure

• Voice or Digital Modulation Through a Voice Input Port @ 2.1049(c)(i)

The transmitter was modulated by a 2.5 ㎑ tone signal at an input level 16 ㏈ greater than that required to produce 50 % modulation (e.g.: ±2.5 ㎑ peak deviation at 1 ㎑ modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

• Digital Modulation Through a Data Input Port @ 2.1049(h):

Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the Emission Masks shall be shown for operation with any devices used for modifying the spectrum when such devices are operational at the discretion of the user.

The following EMI Receiver bandwidth shall be used for measurement of Emission Mask/Out-of-Band Emission Measurements:

The spectrum analyzer is set to the as follows

- For 25 ㎑ Channel Spacing: RBW = 300 ㎐
- For 12.5 ㎑ or 6.25 ㎑ Channel Spacings: RBW = 100 ㎐
- The all cases are set “VBW: >3xRBW”

### 5.4.4 Test setup

Please refer 5.3.4

### 5.4.5 Measurement Result

Compliance: please refer 5.4.6 for details

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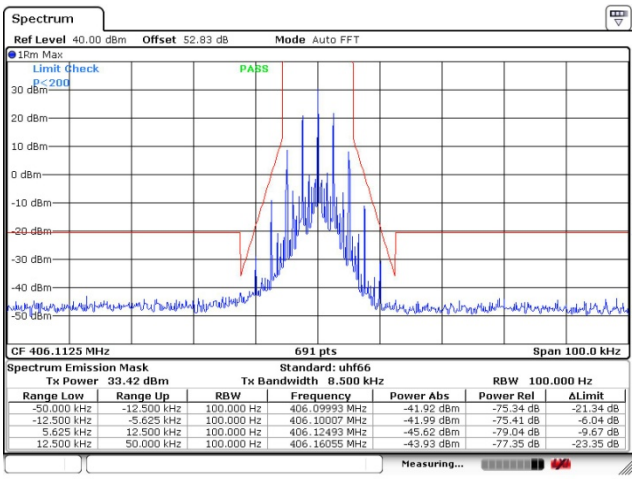
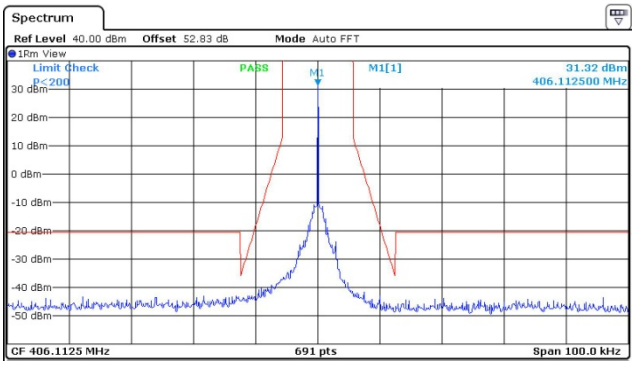
## 5.4.6 Test Plot

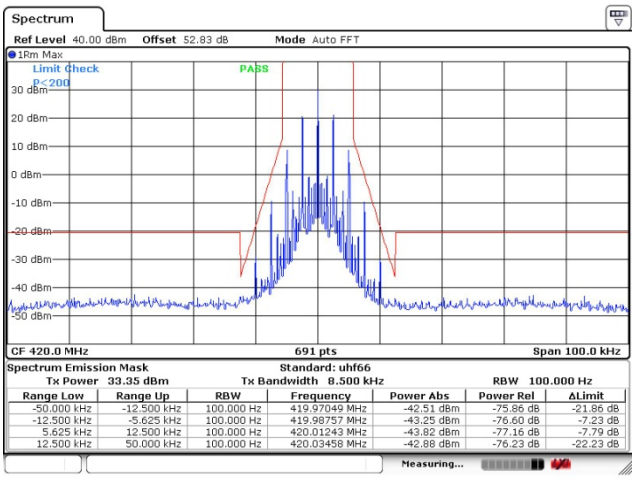
### ▣ Analog

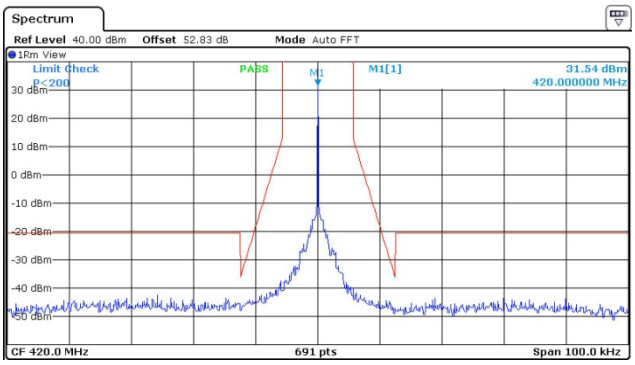
CH Low / Low power



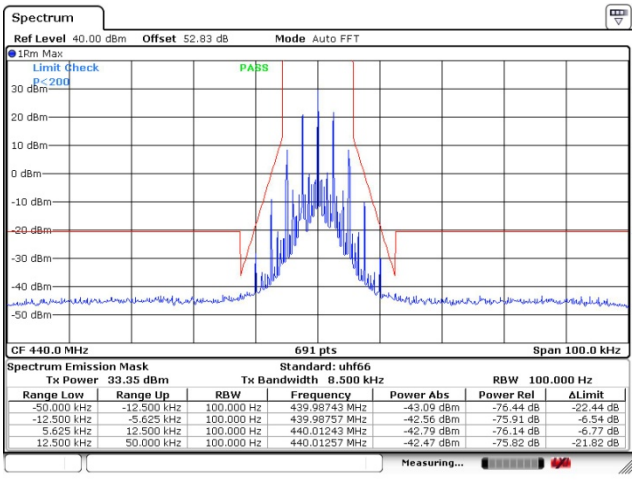



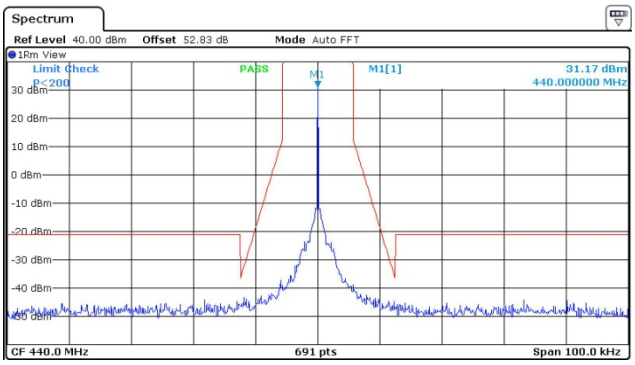

CH Middle / Low power



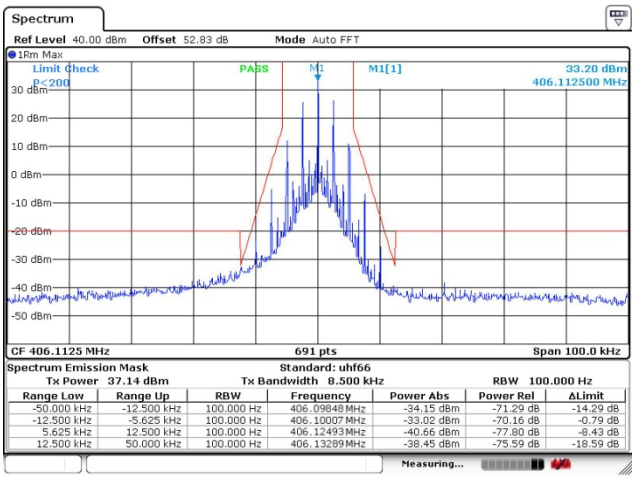

CH High / Low power

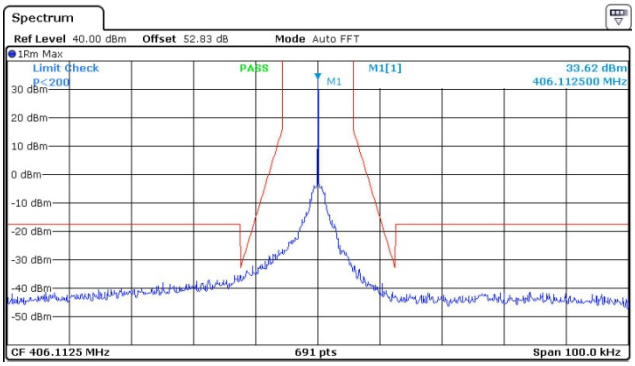


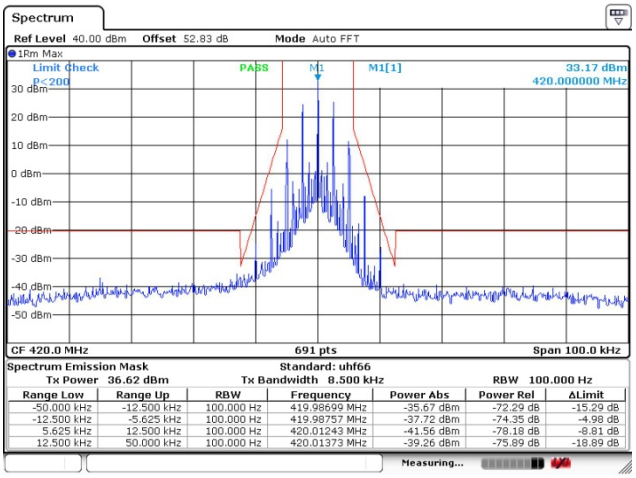
## ▣ Analog

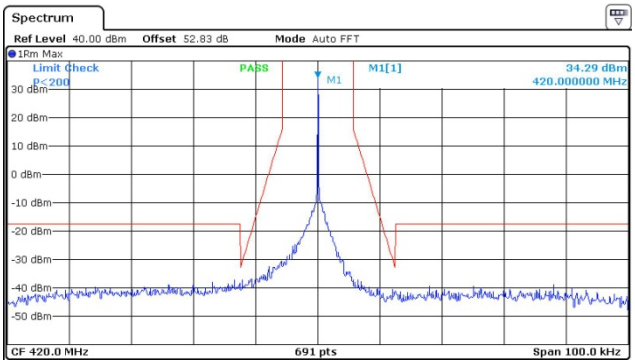
### CH Low / High power



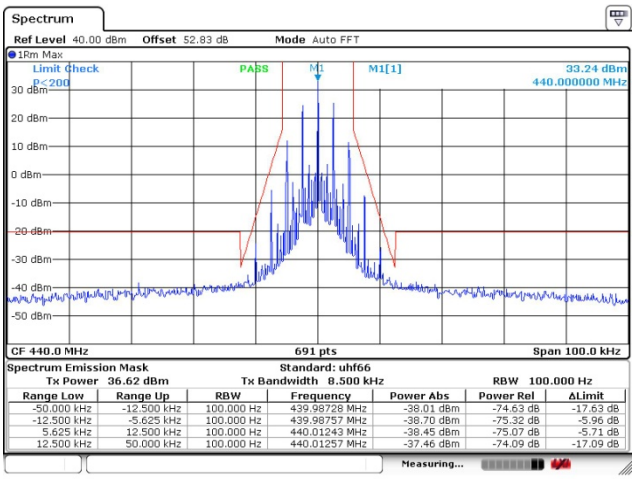



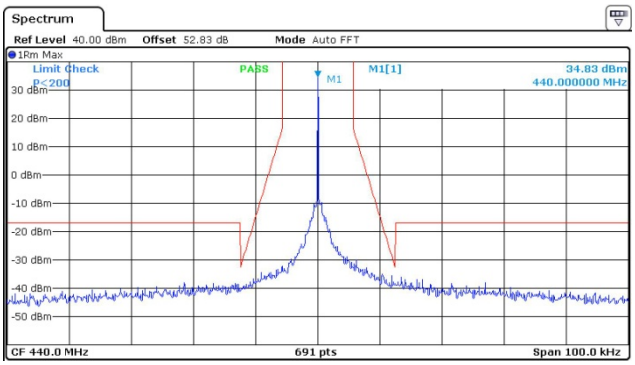

### CH Middle / High power




### CH High / High power



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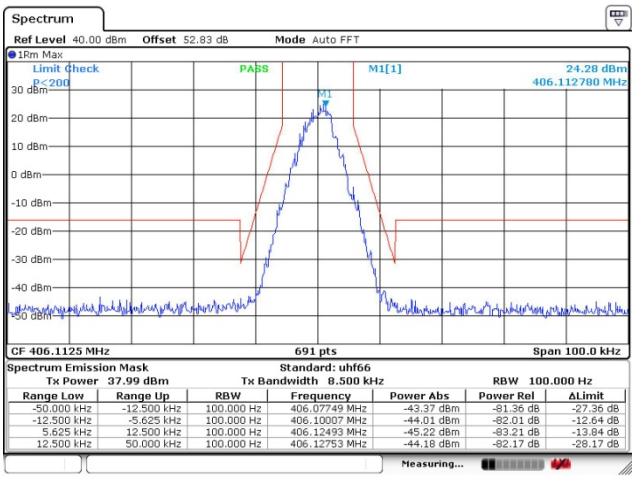
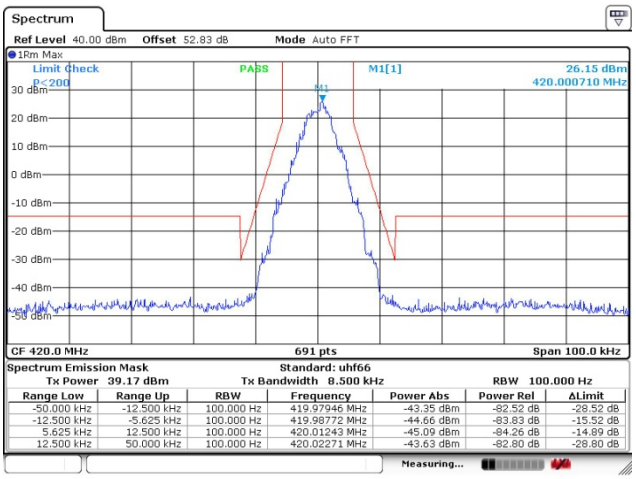
## ▣ Digital (Voice and Data)

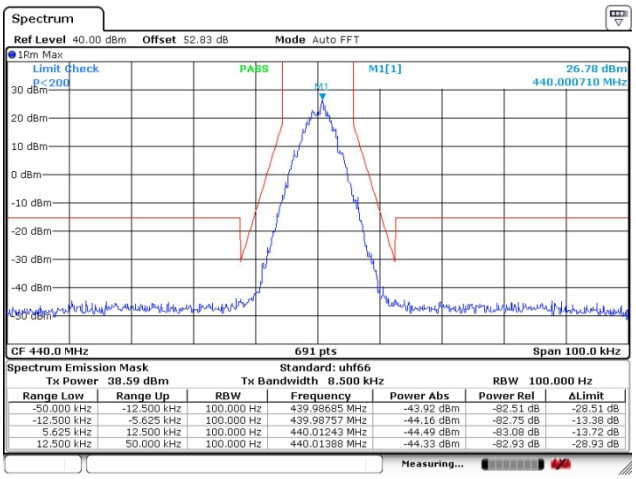
### CH Low / Low power




### CH Middle / Low power




### CH High / Low power



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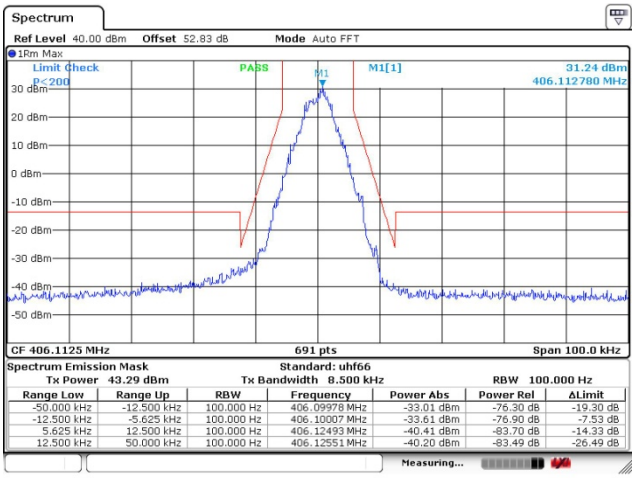
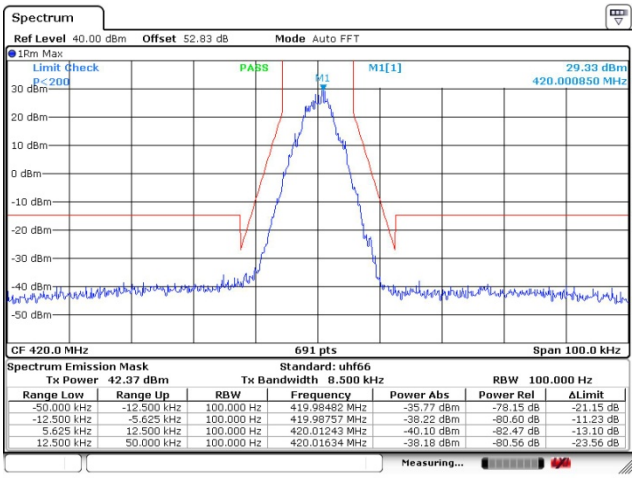
## ▣ Digital (Voice and Data)

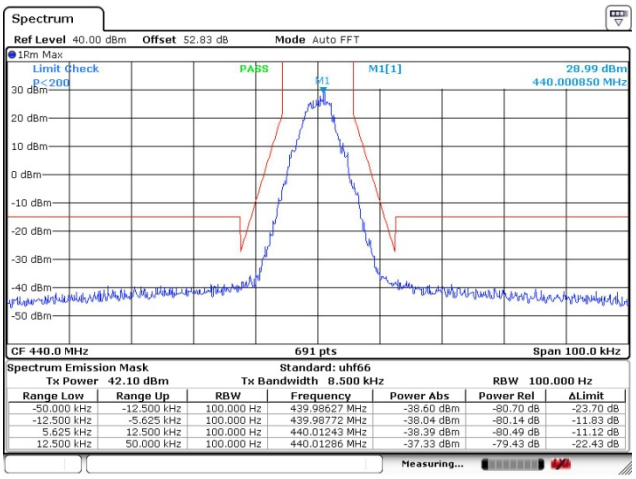
### CH Low / High power




### CH Middle / High power




### CH High / High power



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## ▣ The setup table for emission mask

Low power


| Sweep List | Range 1 | Range 2 | Range 3 | Range 4 | Range 5 |
|---|---|---|---|---|---|
| Range Start | -50 kHz | -12.5 kHz | -5.625 kHz | 5.625 kHz | 12.5 kHz |
| Range Stop | -12.5 kHz | -5.625 kHz | 5.625 kHz | 12.5 kHz | 50 kHz |
| Fast SEM | Off | Off | Off | Off | Off |
| Filter Type | Gaussian | Gaussian | Gaussian | Gaussian | Gaussian |
| RBW | 100 Hz | 100 Hz | 100 Hz | 100 Hz | 100 Hz |
| VBW | 300 Hz | 300 Hz | 300 Hz | 300 Hz | 300 Hz |
| Sweep Time Mode | Auto | Auto | Auto | Auto | Auto |
| Sweep Time | 18.962 ms | 18.962 ms | 18.962 ms | 18.962 ms | 18.962 ms |
| Ref. Level | 40 dBm | 40 dBm | 40 dBm | 40 dBm | 40 dBm |
| RF Att. Mode | Auto | Auto | Auto | Auto | Auto |
| RF Attenuator | 3 dB | 3 dB | 3 dB | 3 dB | 3 dB |
| Preamp | Off | Off | Off | Off | Off |
| Transducer | None | None | None | None | None |
| Limit Check 1 | Relative | Relative | Relative | Relative | Relative |
| Abs Limit Start 1 | -13 dBm | -13 dBm | -13 dBm | -13 dBm | -13 dBm |
| Abs Limit Stop 1 | -13 dBm | -13 dBm | -13 dBm | -13 dBm | -13 dBm |
| Rel Limit Start 1 | -54 dBc | -69.9 dBc | 33 dBc | -19.9 dBc | -54 dBc |
| Rel Limit Stop 1 | -54 dBc | -19.9 dBc | 33 dBc | -69.9 dBc | -54 dBc |

High power


| Sweep List | Range 1 | Range 2 | Range 3 | Range 4 | Range 5 |
|---|---|---|---|---|---|
| Range Start | -50 kHz | -12.5 kHz | -5.625 kHz | 5.625 kHz | 12.5 kHz |
| Range Stop | -12.5 kHz | -5.625 kHz | 5.625 kHz | 12.5 kHz | 50 kHz |
| Fast SEM | Off | Off | Off | Off | Off |
| Filter Type | Gaussian | Gaussian | Gaussian | Gaussian | Gaussian |
| RBW | 100 Hz | 100 Hz | 100 Hz | 100 Hz | 100 Hz |
| VBW | 300 Hz | 300 Hz | 300 Hz | 300 Hz | 300 Hz |
| Sweep Time Mode | Auto | Auto | Auto | Auto | Auto |
| Sweep Time | 18.962 ms | 18.962 ms | 18.962 ms | 18.962 ms | 18.962 ms |
| Ref. Level | 40 dBm | 40 dBm | 40 dBm | 40 dBm | 40 dBm |
| RF Att. Mode | Auto | Auto | Auto | Auto | Auto |
| RF Attenuator | 3 dB | 3 dB | 3 dB | 3 dB | 3 dB |
| Preamp | Off | Off | Off | Off | Off |
| Transducer | None | None | None | None | None |
| Limit Check 1 | Relative | Relative | Relative | Relative | Relative |
| Abs Limit Start 1 | -13 dBm | -13 dBm | -13 dBm | -13 dBm | -13 dBm |
| Abs Limit Stop 1 | -13 dBm | -13 dBm | -13 dBm | -13 dBm | -13 dBm |
| Rel Limit Start 1 | -57 dBc | -69.9 dBc | 33 dBc | -19.9 dBc | -57 dBc |
| Rel Limit Stop 1 | -57 dBc | -19.9 dBc | 33 dBc | -69.9 dBc | -57 dBc |

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## 5.5 Spurious Emission On Antenna Port

### 5.5.1 Standard Applicable [FCC §90.2109(d)]

Emission Mask D: 12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1) For any frequency removed from the center of the authorized bandwidth $f_0$ to 5.625 kHz removed from $f_0$, 0 dB.

2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$ in kHz) of more than 5.626 kHz but no more than 12.5 kHz, at least 7.27 ($f_d$ –2.88 kHz) dB.

3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$ in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

### 5.5.2 Test Environment conditions

• Ambient temperature : (20 - 21) ℃, • Relative Humidity : (43 - 45) % R.H.

### 5.5.3 Measurement Procedure

The carrier was modulated 100 % using a 2500 ㎐ tone. The spectrum was scanned from the lowest frequency generated to at least the 10th harmonic of the fundamental. The measurements were made in accordance with standard ANSI/TIA 603-D: 2010. The RBW = 100 ㎑, VBW = 300 ㎑ and the span set to 10.0 ㎒ and the spectrum was scanned from 30 MHz to the 10th harmonic of the fundamental. Above 1 GHz the resolution bandwidth was 1 ㎒ and the VBW = 3 ㎒ and the span to 50 ㎒.

### 5.5.4 Test setup

Refer 5.3.4

### 5.5.5 Measurement Result

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 406.1125 | Low | 32.83 | 1.92 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 68.95 | 15.95 | 53 | Compliance |
| 1 217.3 | 74.86 | 21.86 | 53 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 420 | Low | 32.82 | 1.91 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 840.2 | 76.96 | 23.96 | 53 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 440 | Low | 32.50 | 1.78 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 878.9 | 77.33 | 24.33 | 53 | Compliance |

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| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 406.1125 | High | 36.25 | 4.22 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 74.00 | 18.00 | 56 | Compliance |
| 1 217.3 | 71.38 | 15.38 | 56 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 420 | High | 36.87 | 4.86 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 840.2 | 77.18 | 20.18 | 57 | Compliance |
| 1 261.4 | 75.87 | 18.87 | 57 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 440 | High | 36.97 | 4.98 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 878.9 | 74.40 | 17.40 | 57 | Compliance |
| 1 321.6 | 74.51 | 17.51 | 57 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 406.1125 | Low | 32.71 | 1.87 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 66.83 | 13.83 | 53 | Compliance |
| 1 217.3 | 76.71 | 23.71 | 53 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 420 | Low | 32.66 | 1.85 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 840.2 | 75.75 | 22.75 | 53 | Compliance |
| 1 201.2 | 78.04 | 25.04 | 53 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 440 | Low | 32.46 | 1.76 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 878.88 | 72.57 | 19.57 | 53 | Compliance |
| 1 201.2 | 77.60 | 24.60 | 53 | Compliance |

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| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 406.1125 | High | 36.69 | 4.67 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 70.50 | 13.50 | 57 | Compliance |
| 1 217.3 | 73.32 | 16.32 | 57 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 420 | High | 36.67 | 4.65 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 840.2 | 79.68 | 22.68 | 57 | Compliance |
| 1 261.4 | 75.50 | 18.50 | 57 | Compliance |

| Modulation | Freq [㎒] | Power Level | output power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 440 | High | 36.81 | 4.80 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 878.88 | 72.81 | 15.81 | 57 | Compliance |
| 1 321.6 | 73.18 | 16.18 | 57 | Compliance |

Note: The formula for limit is below;
50+10 log (P) where, P = EUT's output power in W

## 5.5.6 Limit

Refer 5.5.1

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## 5.6 Transmitter Radiated Unwanted Emissions

### 5.6.1 Standard Applicable [FCC §90.210(d) & 2.1053]

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts,

by at least [50+10 log (P)] (e.i.r.p. -20 ㏈ m)

### 5.6.2 Test Environment conditions

- Ambient temperature : (20 - 21) ℃,
- Relative Humidity : (43 - 45) % R.H.

### 5.6.3 Measurement Procedure

The EUT was setup according to ANSI/TIA 603D:2010 for compliance to FCC 47CFR part 90 requirements.

As a below test procedure (①~⑬), The result value of measurement is performed to condition of the below; The EUT will operate in continuous transmission mode during the time necessary to perform the measured of the frequency. Substitution method was performed to determine the actual $P_{erp}$(or $P_{eirp}$) emission levels of the EUT.

The following test procedure as below;

The test is performed in a fully pyramidal chamber to determine the accurate frequencies, after maximum emissions level will be checked on a test chamber and measuring distance is 3 m from EUT to test antenna.

① The EUT was set on with continuous transmission mode and placed on a 0.8 meter high non-conductive table on the chamber.

② The test antenna is used on Bi-Log antenna at above 30 ㎒, and used on Horn antenna at 1 ㎓ and then the measurements are repeated with the test antenna for vertical and horizontal polarization. The output of the test antenna will be connected to a measuring receiver, and it is set to tuned over the required standard measuring frequency range.

③ At each frequency at which a relevant spurious component is detected, the test antenna will be raised and lowered through the specified range of heights until an maximum signal level is detected on the measuring receiver.

④ The EUT is position x, y, z axis on rotating through 360 degrees in the horizontal plane, until the Max. signal level is detected by the measuring receiver.

⑤ The receiver is scanned from requested measuring frequency band and then the maximum meter reading is recorded. The radiated emissions were measured with requested standard specification (detector and resolution bandwidth etc.)

⑥ The EUT was then removed and replaced with substitution antenna .The center of the antenna was approximately at the same location as the center of the EUT, and calibrated for the frequency of the spurious component detected.

⑦ Signal generator output port connected with substitution antenna input port. If necessary, may use shield cable between signal generator and substitution antenna

⑧ The frequency of the calibrated signal generator is set to frequency of the spurious component detected, and the input attenuator setting of the measuring receiver was adjust in order to increase the sensitivity of the measuring receiver, if necessary

⑨ The test antenna was raised and lowered through the specified range of heights to ensure that maximum signal is received.

⑩ The input signal to the substitution antenna was be adjusted until an equal or a known related level to that detected from the transmitter is obtained on the measuring receiver.

⑪ The input signal to the substitution antenna was be recorded as a power level and corrected for any change of input attenuator setting of the measuring receiver

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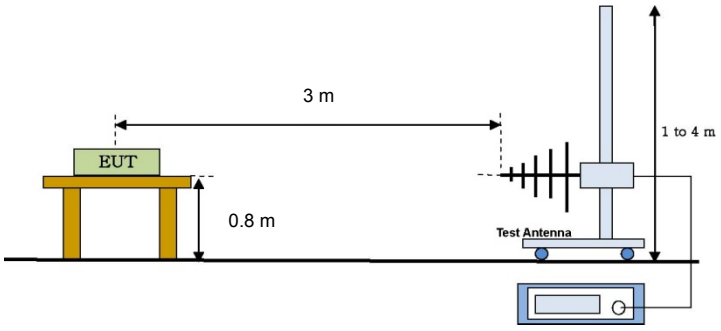
⑫ The measure of $P_{erp}$(or $P_{eirp}$) the spurious components is the larger of the two power levels recorded for each spurious component at the input to the substitution antenna, corrected for the gain of the substitution antenna, if necessary.

⑬ It is correction to signal generator's offset value. In this case of $P_{erp}$(or $P_{eirp}$) shall calculated as follow as formula ;

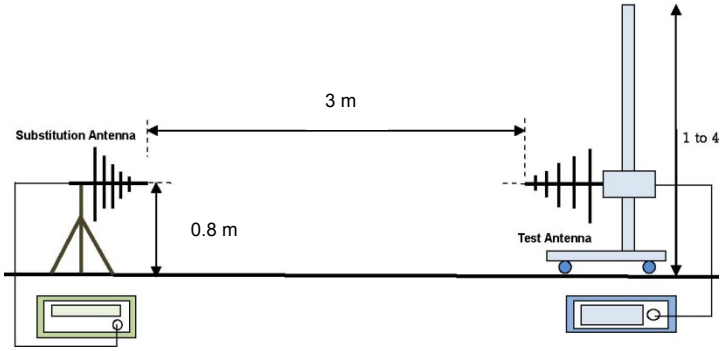
• $P_{erp}$(or $P_{eirp}$) = Signal generator level (㏈m) – Cable loss(㏈)

The measurement frequency range from 30 ㎒ - 10th Harmonic of fundamental was investigated.

## 5.6.5 Test Setup




[ Radiated measurement setup_Below than 1 ㎓ ]




[ Effective Radiated Power measurement setup ]

※ Above the test antenna is used on Horn antenna at above 1 ㎓.

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## 5.6.6 Measurement Result

The following frequencies were selected based on the antenna conducted results, the worst case for each mode are presented.

▣ Antenna 1(Main): HW-423W-CT405

| Modulation | Freq [㎒] | Power Level | ERP power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 406.1125 | Low | 32.83 | 1.92 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 70.74 | 17.74 | 53 | Compliance |
| 1 217.3 | 77.82 | 24.82 | 53 | Compliance |
| Note: The formula for limit is below;<br>50+10 log (P) where, P = EUT's output power in W<br>Therefore 50+10log(1.92) = 53 | | | | |

| Modulation | Freq [㎒] | Power Level | ERP power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 406.1125 | High | 36.69 | 4.67 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 70.11 | 13.11 | 57 | Compliance |
| 1 217.3 | 77.86 | 20.86 | 57 | Compliance |
| Note: The formula for limit is below;<br>50+10 log (P) where, P = EUT's output power in W<br>Therefore 50+10log(4.67) = 57 | | | | |

▣ Antenna 2(Optional): HW-423H-CT405

| Modulation | Freq [㎒] | Power Level | ERP power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Analog | 406.1125 | Low | 32.83 | 1.92 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 70.30 | 17.30 | 53 | Compliance |
| 1 217.3 | 76.46 | 23.46 | 53 | Compliance |
| Note: The formula for limit is below;<br>50+10 log (P) where, P = EUT's output power in W<br>Therefore 50+10log(1.92) = 53 | | | | |

| Modulation | Freq [㎒] | Power Level | ERP power | |
|---|---|---|---|---|
| | | | [dBm] | [W] |
| Digital | 406.1125 | High | 36.69 | 4.67 |

| Emission Frequency [㎒] | Level below Carrier [dBc] | Margin [dB] | Limit [dBc] | Test Results |
|---|---|---|---|---|
| 811.5 | 69.03 | 12.03 | 57 | Compliance |
| 1 217.3 | 75.20 | 18.20 | 57 | Compliance |
| Note: The formula for limit is below;<br>50+10 log (P) where, P = EUT's output power in W<br>Therefore 50+10log(4.67) = 57 | | | | |

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## 5.7 Frequency Stability

### 5.7.1 Standard Applicable [FCC §90.213 & 2.1055]

The EUT is placed in a temperature chamber, the EUT is allowed to soak at room temperature for 20 minutes and a reference frequency is read. The temperature is then lowered to -30 C and stepped up to 50 C soaking 20 minutes at each temperature then a frequency is read. According to §90.213, the frequency stability limit is 2.5 ppm for 12.5 ㎑ channel separation.

### 5.7.2 Test Environment conditions

- Ambient temperature : (20 - 21) ℃
- Relative Humidity : (43 - 45) % R.H.

### 5.6.3 Measurement Procedure

EUT connect to Spectrum analyzer, test is performed in T&H chamber.

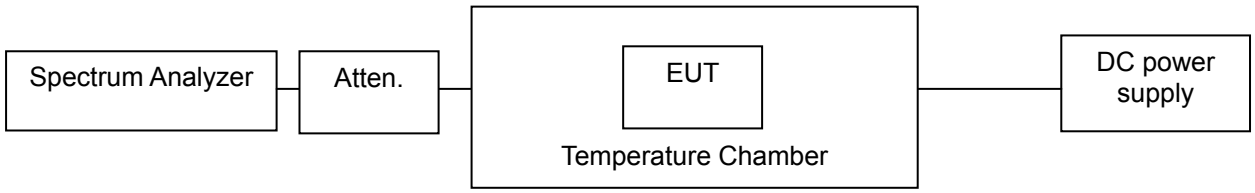
These measurements shall also be performed at normal and extreme test conditions.

▪ Test Method : ANSI/TIA-603-D-2010, clause 3.2.2 for frequency stability tests

-Frequency stability with respect to ambient temperature

-Frequency stability when varying supply voltage

### 5.7.4 Test setup




### 5.7.5 Measurement Result

Analog

| Temp(℃) | Power Supply | Measured Freq(㎒) | Freq Drift(ppm) |
|---|---|---|---|
| 50 | DC 7.4 (Vnom) | 420.000024 | 0.06 |
| 40 | DC 7.4 (Vnom) | 420.000018 | 0.04 |
| 30 | DC 7.4 (Vnom) | 420.000015 | 0.04 |
| 20 | DC 7.4 (Vnom) | 420.000012 | 0.03 |
| 10 | DC 7.4 (Vnom) | 420.000008 | 0.02 |
| 0 | DC 7.4 (Vnom) | 420.000007 | 0.02 |
| -10 | DC 7.4 (Vnom) | 420.000010 | 0.02 |
| -20 | DC 7.4 (Vnom) | 420.000008 | 0.02 |
| -30 | DC 7.4 (Vnom) | 420.000011 | 0.03 |
| | | | |
| Nom Temperature | DC 6.3 (Vmin) | 420.000020 | 0.05 |
| Nom Temperature | DC 8.5 (Vmax) | 420.000013 | 0.03 |

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Digital (Voice and Data)

| Temp(℃) | Power Supply | Measured Freq(㎒) | Freq Drift(ppm) |
|---|---|---|---|
| 50 | DC 7.4 (Vnom) | 420.000047 | 0.11 |
| 40 | DC 7.4 (Vnom) | 420.000038 | 0.09 |
| 30 | DC 7.4 (Vnom) | 420.000035 | 0.08 |
| 20 | DC 7.4 (Vnom) | 420.000025 | 0.06 |
| 10 | DC 7.4 (Vnom) | 420.000025 | 0.06 |
| 0 | DC 7.4 (Vnom) | 420.000019 | 0.05 |
| -10 | DC 7.4 (Vnom) | 420.000022 | 0.05 |
| -20 | DC 7.4 (Vnom) | 420.000019 | 0.05 |
| -30 | DC 7.4 (Vnom) | 420.000020 | 0.05 |
| | | | |
| Nom Temperature | DC 6.3 (Vmin) | 420.000038 | 0.09 |
| Nom Temperature | DC 8.5 (Vmax) | 420.000029 | 0.07 |

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## 5.8 Transmitter Frequency Behavior

### 5.8.1 Standard Applicable [FCC §90.214]

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

| Time Intervals | Maximum frequency difference | All equipment (421 to 512 ㎒) |
|---|---|---|
| Transient Frequency Behavior for Equipment Designed to operate on the 12.5 ㎑ Channels | | |
| $t_1$[4] | ±12.5 ㎑ | 10 ㎳ |
| $t_2$ | ±6.25 ㎑ | 25 ㎳ |
| $t_3$[4] | ±12.5 ㎑ | 10 ㎳ |

### 5.8.2 Test Environment conditions

• Ambient temperature : (20 - 21) ℃ • Relative Humidity : (43 - 45) % R.H.

### 5.8.3 Measurement Procedure

a) Connect the EUT and test equipment as shown on the following test setup diagram.

b) Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.

c) Set the signal generator to the assigned transmitter frequency and modulate it with a 1 ㎑ tone at ±12.5 ㎑ deviation and set its output level to -100 ㏈m.

d) Turn on the transmitter.

e) Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 ㏈ below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as P0.

f) Turn off the transmitter.

g) Adjust the RF level of the signal generator to provide RF power equal to P0. This signal generator RF level shall be maintained throughout the rest of the measurement.

h) Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 ㏈ when the transmitter is turned on.

i) Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 ㎐ at ±4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to “Video”, and tune the “trigger level” on suitable level. Then set the “tiger offset” to -10ms for turn on and -15 ㎳ for turn off.

j) Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be ton. The trace should be maintained within the allowed divisions during the period t1 and t2.

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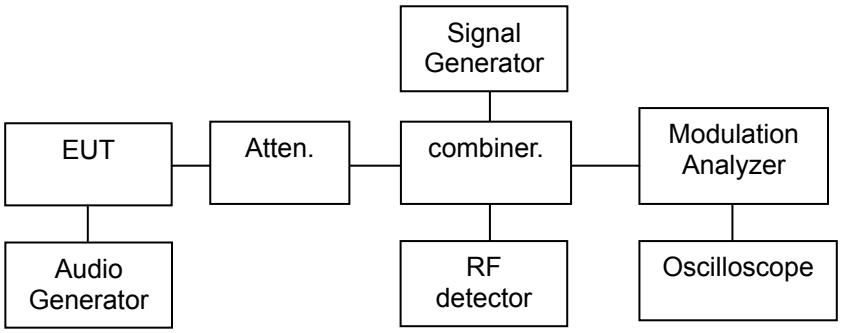
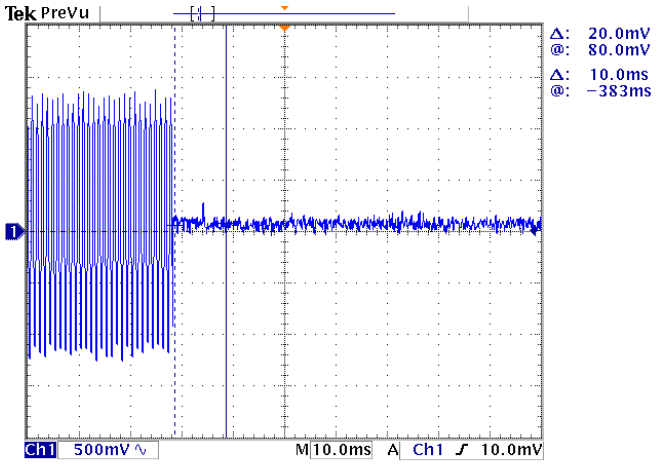
## 5.8.4 Test setup




## 5.8.5 Measurement Result

OFF - ON




ON - OFF