



FCC PART 90 TEST REPORT

For

Hytera Communications Corporation Ltd.

Hyt Tower, Hi-Tech Industrial Park North, Nanshan District, Shenzhen China.

FCC ID: YAMDS-6211U1C4

Report Type: Original Report	Product Type: Lite Digital Trunking base station
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* This report may contain data that are not covered by the NVLAP accreditation and shall be marked with an asterisk "★" (Rev.2)

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Hytera Communications Corporation Ltd.*'s product, model number: *DS-6211U1C4* (FCC ID: *YAMDS-6211U1C4*) (the "EUT") in this report is a *Lite Digital Trunking base station*, which was measured approximately: 60 cm(L) x 60 cm(W) x 190 cm(H), rated input voltage: AC120V.

* All measurement and test data in this report was gathered from production sample serial number: 130329003 (Assigned by BAACL, Dongguan). The EUT was received on 2013-04-01.

Objective

This test report is prepared on behalf of *Hytera Communications Corporation Ltd.* in accordance with Part 2, and Part 90 of the Federal Communication Commissions rules.

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D and ANSI 63.4-2003.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

The uncertainty of any RF tests which use conducted method measurement is ± 0.96 dB, the uncertainty of any radiation on emissions measurement is:

30M~200MHz: 5.0 dB

200M~1GHz: 6.2 dB

1G~6GHz: 4.45 dB

6G~18GHz: 5.23 dB

And the uncertainty will not be taken into consideration for all test data recorded in the report.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 02, 2012. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratories Corp. (Dongguan) is an ISO/IEC 17025 accredited laboratory, and is accredited by National Voluntary Laboratory Accredited Program (Lab Code 500069-0).



The current scope of accreditations can be found at <http://ts.nist.gov/standards/scopes/5000690.htm>

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

Specification:

Operating Frequency Band	400-470 MHz
Modulation Mode	4FSK
Channel Separation	12.5 kHz
Transmitter Power	41.5 dBm

Equipment Modifications

No modifications were made to the unit tested.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
FCC §1.1310	MAXIMUM PERMISSIBLE EXPOSURE (MPE)	Compliance
§2.1046; §90.205	RF Output Power	Compliance
§2.1047; §90.207	Modulation Characteristic	Not Applicable
§2.1049; §90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliance
§2.1051; §90.210	Spurious Emission at Antenna Terminal	Compliance
§2.1053; §90.210	Spurious Radiated Emissions	Compliance
§2.1055; §90.213	Frequency Stability	Compliance
§90.214	Transient Frequency Behavior	Compliance

FCC §1.1310 - MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to 1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

MPE Calculation

Predication of MPE limit at a given distance

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Frequency (MHz)	Input Power of Antenna		Typical Antenna Gain (dBi)	Typical Antenna Gain (numeric)	Distance (cm)	Power Density Seq (mW/cm ²)	Power Density Limit (mW/cm ²)
	(dBm)	(mW)					
400.5	41.59	14421	9	7.9	250	0.15	0.27
435.5	41.48	14060	9	7.9	250	0.14	0.29
469.5	41.27	13397	9	7.9	250	0.13	0.31

Result: Pass

FCC §2.1046 & §90.205- RF OUTPUT POWER

Applicable Standard

FCC §2.1046 and §90.205.

Test Procedure

Conducted RF Output Power:

TIA-603-D section 2.2.1

Radiated method:

TIA 603-D section 2.2.17

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer setting:

<i>RBW</i>	<i>Video B/W</i>
<i>100 kHz</i>	<i>300 kHz</i>

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum analyzer	FSP38	100478	2012-5-14	2013-5-13

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	24.7 °C
Relative Humidity:	60 %
ATM Pressure:	101 kPa

The testing was performed by Leon Chen on 2013-04-10.

Test Mode: Transmitting

Test Result: Compliance.

Please refer to following table.

Frequency	High Power Level	Rated power
MHz	dBm	dBm
400.5	41.59	41.5±1.5
435.5	41.48	41.5±1.5
469.5	41.27	41.5±1.5

Note: the rated power is 41.5 dBm.

FCC §2.1049, §90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

Applicable Standard

FCC §2.1049, §90.209 and §90.210

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 , 0dB.
- 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 $7.27 (f_d - 2.88 \text{ kHz}) \text{ dB}$.
- 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: $50 + 10 \log P$

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum analyzer	FSP38	100478	2012-5-14	2013-5-13

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The resolution bandwidth of the spectrum analyzer was set at 300 Hz and the spectrum was recorded in the frequency band $\pm 35 \text{ kHz}$ from the carrier frequency.

Test Data

Environmental Conditions

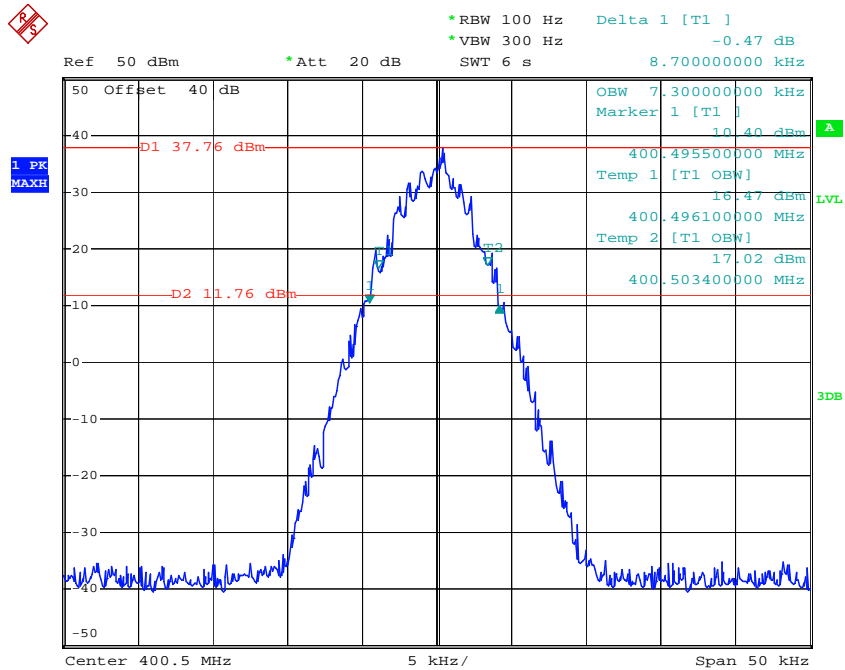
Temperature:	24.7 °C
Relative Humidity:	60 %
ATM Pressure:	101 kPa

The testing was performed by Leon Chen on 2013-04-10.

Frequency (MHz)	99% Occupied Bandwidth (kHz)	26 dB Bandwidth (kHz)
400.5	7.3	8.7
435.5	7.6	8.8
469.5	7.1	9.0

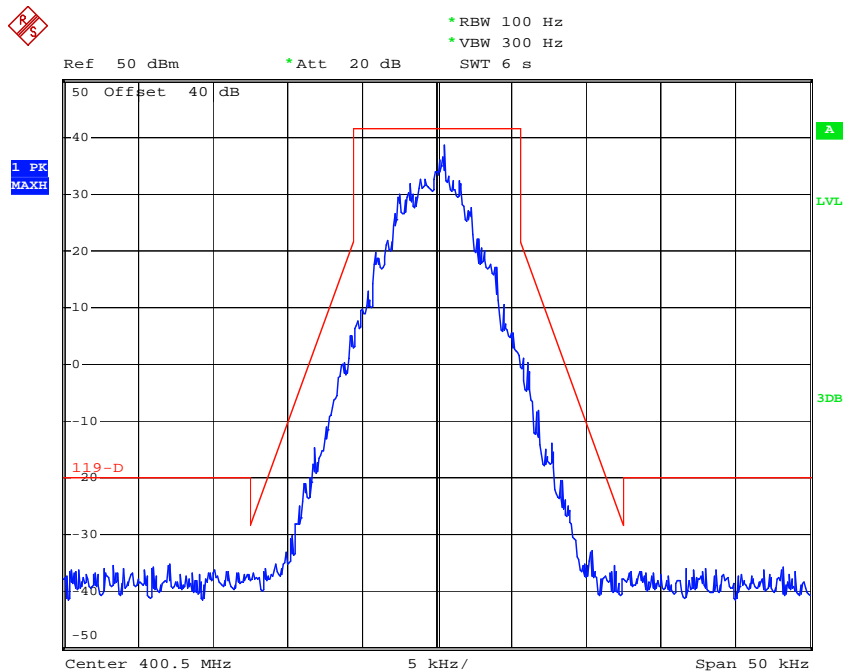
Please refer to the emission mask hereinafter plots.

Occupied Bandwidth – 400.5 MHz



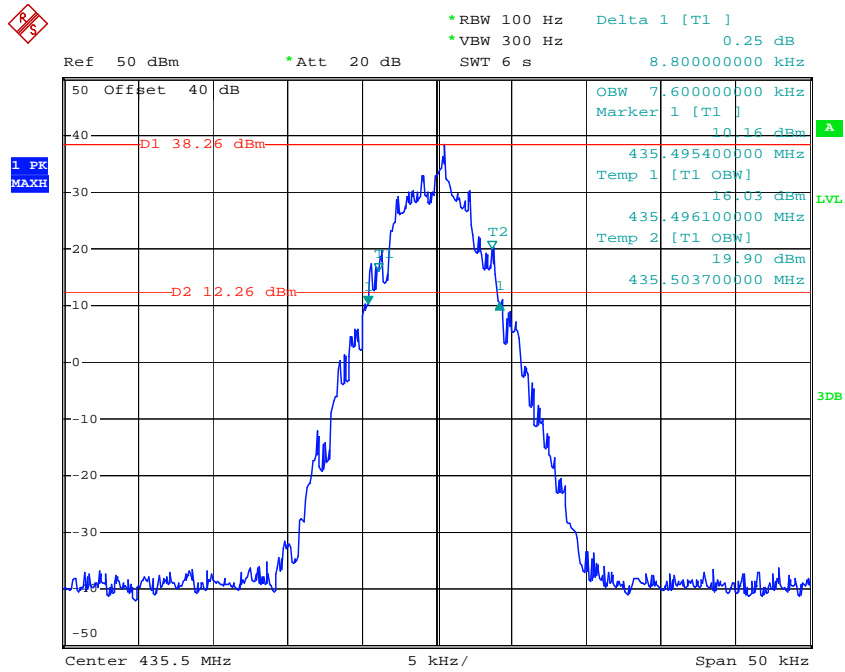
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Emission Mask - Type D



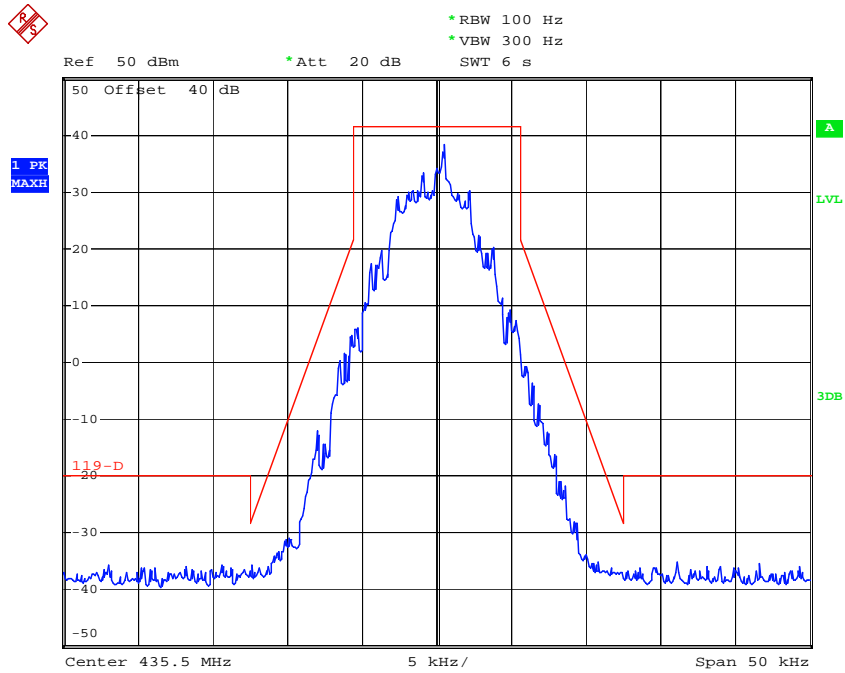
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Occupied Bandwidth - 435.5 MHz



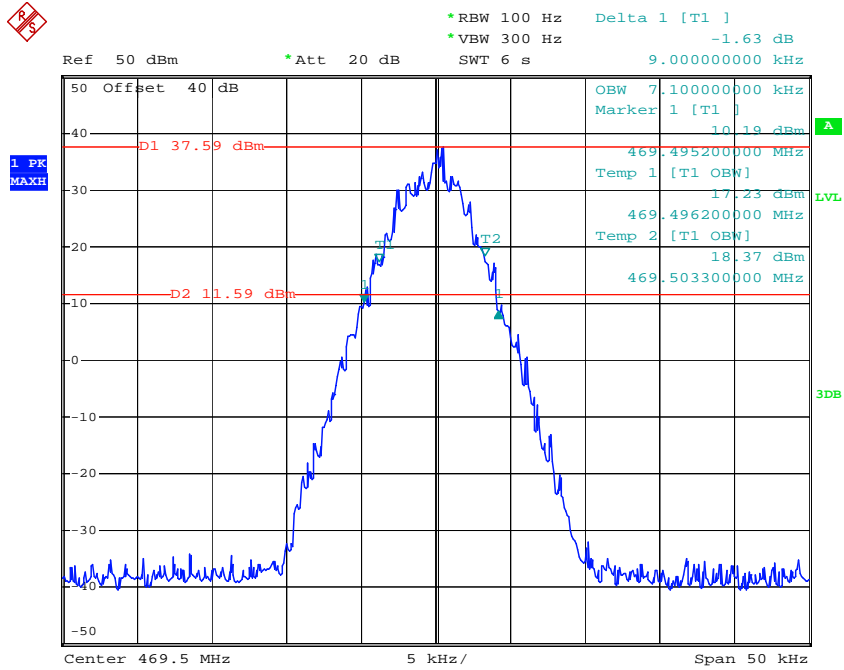
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Emission Mask - Type D



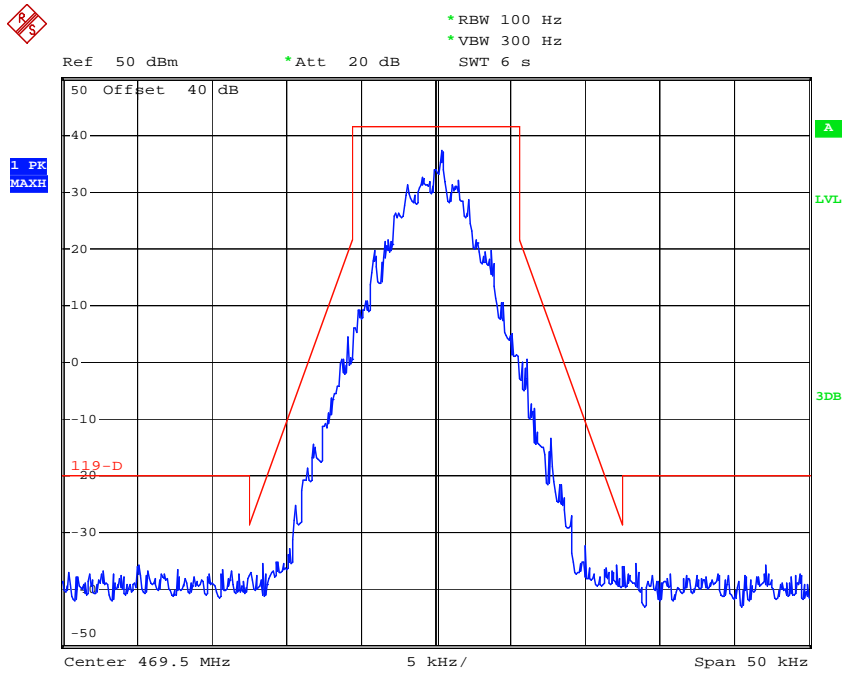
Date: 10.APR.2013 20:32:51

Occupied Bandwidth - 469.5 MHz



Date: 10.APR.2013 21:23:10

Emission Mask - Type D



Date: 10.APR.2013 21:24:08

FCC §2.1051 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

Applicable Standard

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:

$$50 + 10 \log P = 50 + 10 \log (P) \text{ dB}$$

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum analyzer	FSP38	100478	2012-5-14	2013-5-13

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 1MHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Data

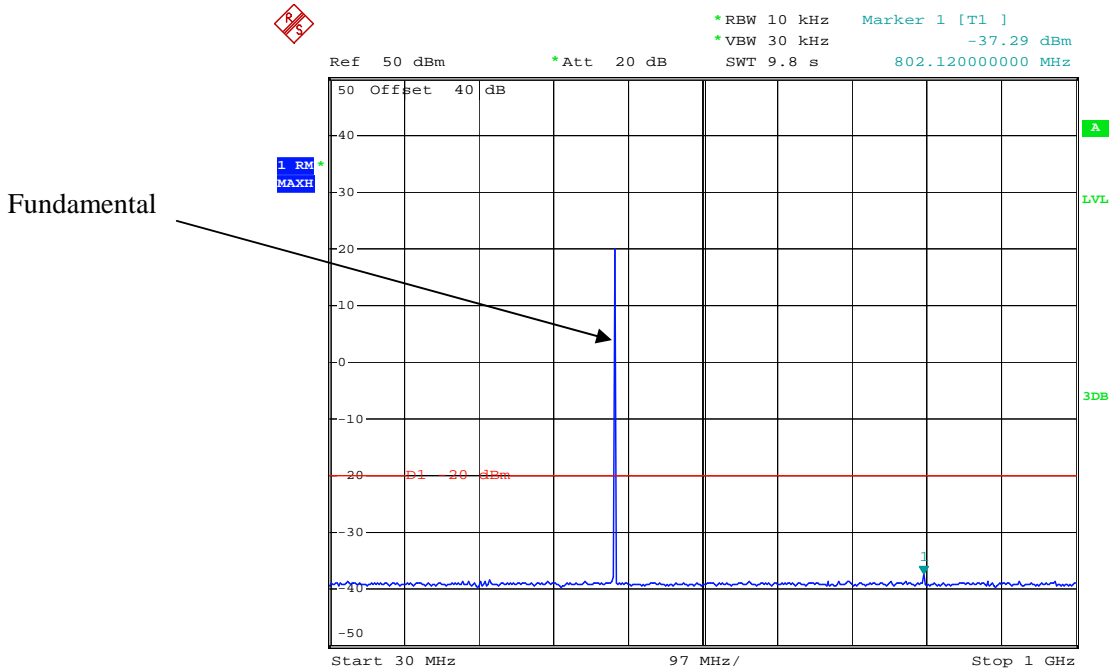
Environmental Conditions

Temperature:	24.7 °C
Relative Humidity:	60 %
ATM Pressure:	101 kPa

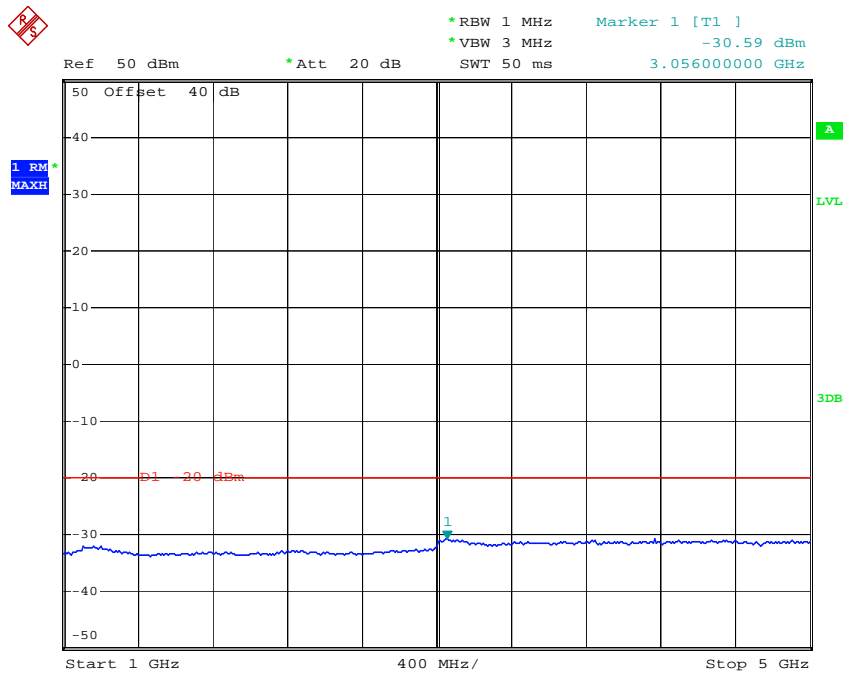
The testing was performed by Leon Chen on 2013-04-10.

Please refer to the following plots.

Low channel



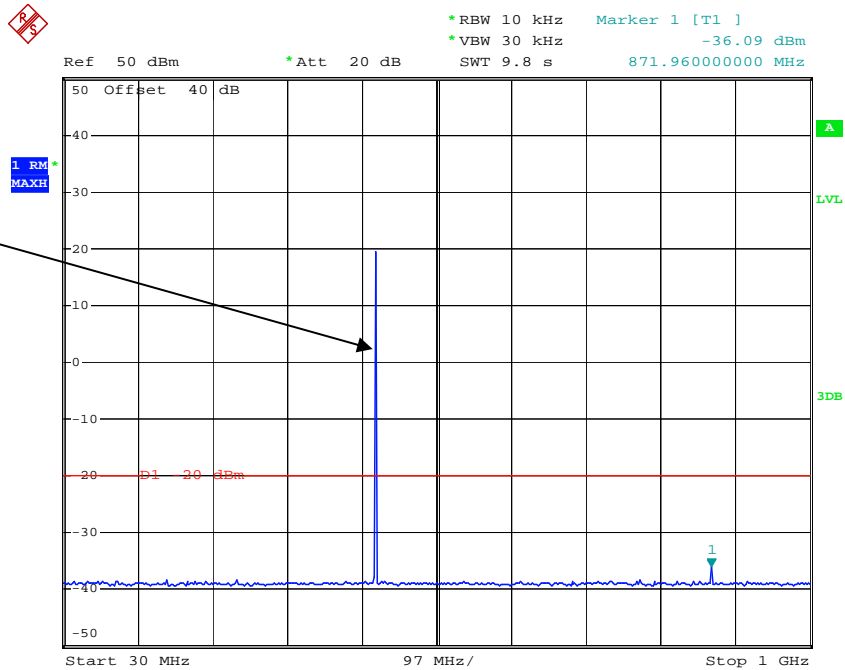
Date: 10.APR.2013 21:15:22



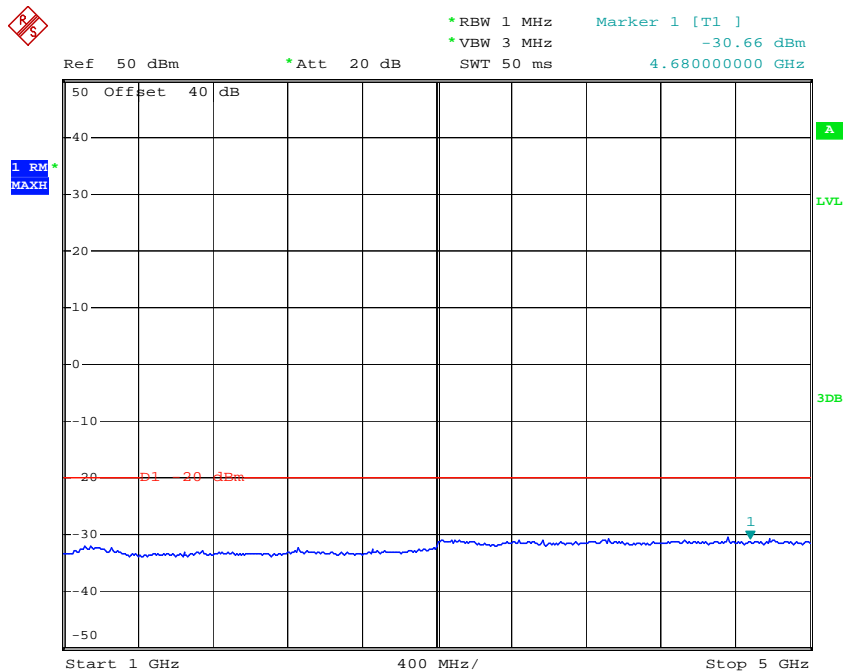
Date: 10.APR.2013 21:15:36

Middle channel

Fundamental test with Band Reject Filter



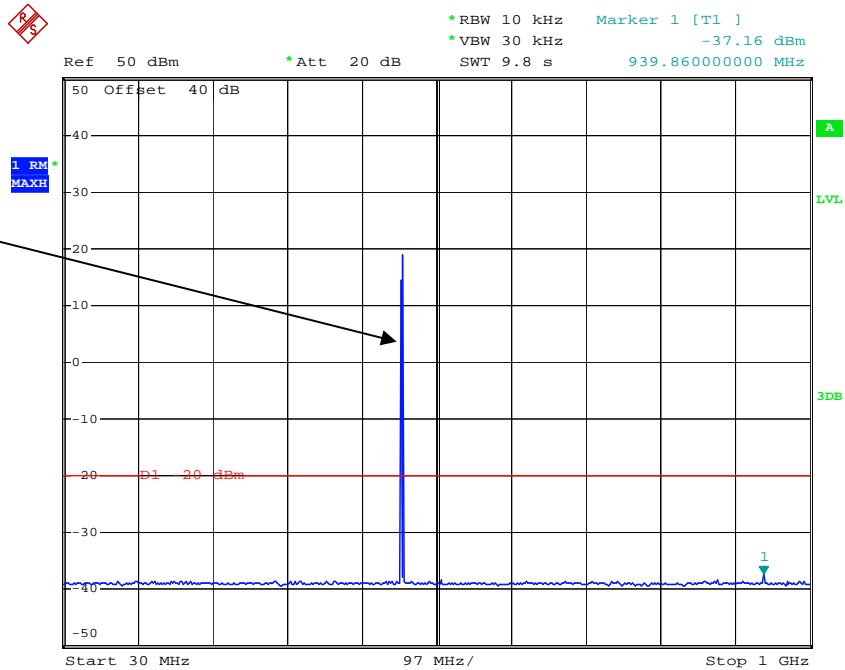
Date: 10.APR.2013 20:34:01



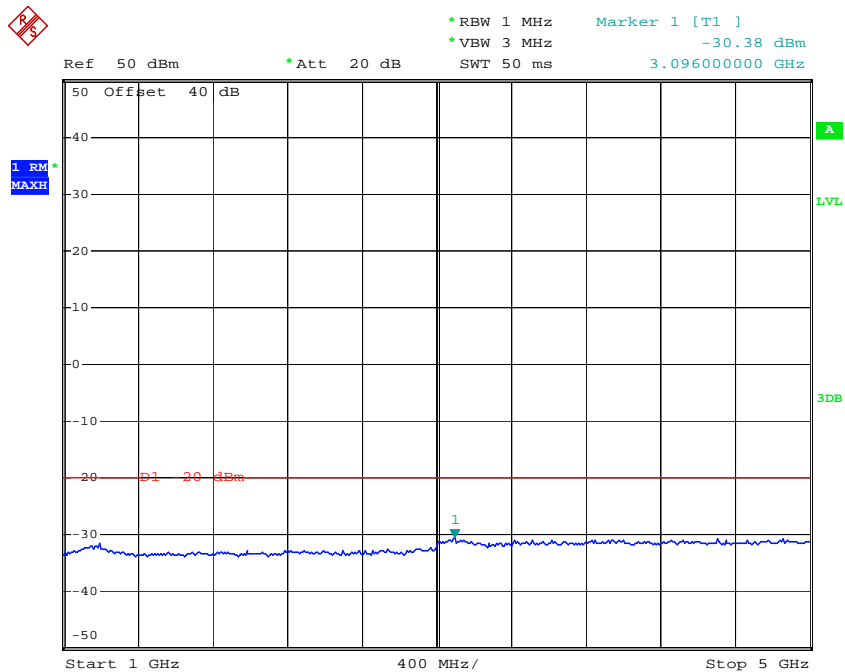
Date: 10.APR.2013 20:34:13

High Channel

Fundamental test with Band Reject Filter



Date: 10.APR.2013 21:25:30



Date: 10.APR.2013 21:25:46

FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 and §90.210

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum analyzer	FSEM 30	849016/001	2012-9-4	2013-9-3
Sunol Sciences	Antenna	JB3	A060611-1	2012-9-6	2015-9-5
TDK RF	horn antenna	HRN-0118	130 084	2012-9-6	2015-9-5
EMCO	Adjustable dipole antenna	3121C	9109-753	N/A	N/A
ETS LINDGREN	horn antenna	3115	000 527 35	2012-9-6	2015-9-5
HP	Signal Generator	8648A	3426A00831	2012-11-29	2013-11-28
Giga	Signal Generator	1026	320408	2013-3-15	2014-3-14
HP	HP AMPLIFIER	8447E	2434A02181	N/A	N/A
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	N/A	N/A
R&S	EMI TEST RECIEVER	ESCI	100224	2012-5-14	2013-5-13

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to teeth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB =10 lg (TXpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB =43+10 Log₁₀ (power out in Watts)

Spurious attenuation limit in dB =50+10 Log₁₀ (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

Test Data**Environmental Conditions**

Temperature:	24.7 °C
Relative Humidity:	60%
ATM Pressure:	101 kPa

The testing was performed by Leon Chen on 2013-04-10.

Frequency	Polar	S.A. Reading	S.G. Level	Antenna Gain	Cable Loss	Absolute Level	Limit	Margin
MHz	H/V	dB μ V	dBm	dBd/dBi	dB	dBm	dBm	dB
f_c = 400.500MHz								
111.480	H	47.88	-59.5	0.0	0.2	-59.7	-20.0	39.7
801.000	H	47.47	-44.4	0.0	0.8	-45.2	-20.0	25.2
2547.640	H	34.34	-64.2	13.1	2.2	-53.3	-20.0	33.3
47.460	V	55.45	-33	-17.4	0.2	-50.6	-20.0	30.6
801.000	V	48.33	-41	0.0	0.8	-41.8	-20.0	21.8
2433.280	V	33.72	-63.5	12.6	2	-52.9	-20.0	32.9
f_c = 435.500MHz								
111.480	H	46.95	-60.4	0.0	0.2	-60.6	-20.0	40.6
871.000	H	47.33	-44.7	0.0	0.7	-45.4	-20.0	25.4
2672.180	H	33.52	-65.2	13.1	2.8	-54.9	-20.0	34.9
47.460	V	55.67	-32.7	-17.4	0.2	-50.3	-20.0	30.3
871.000	V	48.17	-40.5	0.0	0.7	-41.2	-20.0	21.2
1896.370	V	34.08	-63.8	11.8	1.6	-53.6	-20.0	33.6
f_c = 469.975MHz								
111.480	H	47.28	-60.1	0.0	0.2	-60.3	-20.0	40.3
939.950	H	47.70	-40.5	0.0	0.9	-41.4	-20.0	21.4
1942.330	H	34.06	-63.9	11.9	1.6	-53.6	-20.0	33.6
47.460	V	54.17	-34.2	-17.4	0.2	-51.8	-20.0	31.8
939.950	V	47.22	-38.2	0.0	0.9	-39.1	-20.0	19.1
1568.260	V	32.81	-68.6	9.9	1.4	-60.1	-20.0	40.1

Note:

- 1) The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.
- 2) Absolute Level = SG Level - Cable loss + Antenna Gain
- 3) Margin = Limit - Absolute Level
- 4) The unit of antenna gain is dBd for frequency below 1GHz and dBi for frequency above 1GHz.
- 5) The substituted antenna (dipole antenna) was the same as 80 MHz half wave length, therefor the antenna gain is negative blew 80 MHz

FCC §2.1055 & §90.213- FREQUENCY STABILITY

Applicable Standard

FCC §2.1055 & §90.213

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Qualmark	Temperature & Humidity Chamber	Typhoon 3.0	20021115	2012-06-04	2013-06-03
Dongzhixu	Humidity tester	DP1000	201105083-3	2012-7-3	2013-7-2

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external AC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The AC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

The frequency stability shall be measured with variation of primary supply voltage as follows:

- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value.

Test Data

Environmental Conditions

Temperature:	24.7 °C
Relative Humidity:	60 %
ATM Pressure:	101 kPa

The testing was performed by Leon Chen on 2013-04-10.

Test Mode: Transmitting

Reference Frequency: 435.5 MHz				
Temperature	Voltage	Reading	Frequency Error	Limit
°C	V _{AC}	MHz	ppm	ppm
-30	120	435.499799	-0.46	1.5
-20	120	435.499798	-0.46	1.5
-10	120	435.499792	-0.48	1.5
0	120	435.499824	-0.40	1.5
10	120	435.499815	-0.42	1.5
20	120	435.499825	-0.40	1.5
30	120	435.499824	-0.40	1.5
40	120	435.499825	-0.40	1.5
50	120	435.499814	-0.43	1.5
25	102	435.499820	-0.41	1.5
25	138	435.499826	-0.40	1.5

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

Regulations: FCC §90.214

Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

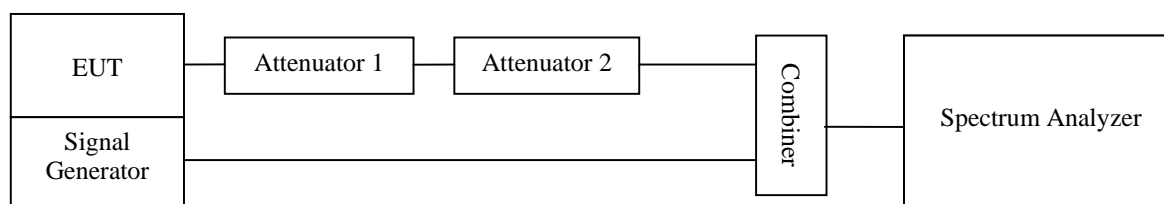
Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
R&S	Spectrum analyzer	FSEM 30	849016/001	2012-9-4	2013-9-3
HP	Signal Generator	8648A	3426A00831	2012-11-29	2013-11-28

* Statement of Traceability: Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

- Connect the EUT and test equipment as shown on the following block diagram.
- Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
- Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ± 12.5 kHz deviation and set its output level to -100dBm.
- Turn on the transmitter.
- Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB 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 P_0 .
- Turn off the transmitter.
- Adjust the RF level of the signal generator to provide RF power equal to P_0 . This signal generator RF level shall be maintained throughout the rest of the measurement.
- Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
- Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz 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 "trigger offset" to -10ms for turn on and -15ms for turn off.
- 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 t_{on} . The trace should be maintained within the allowed divisions during the period t_1 and t_2 .
- Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period t_3 .



Test Data**Environmental Conditions**

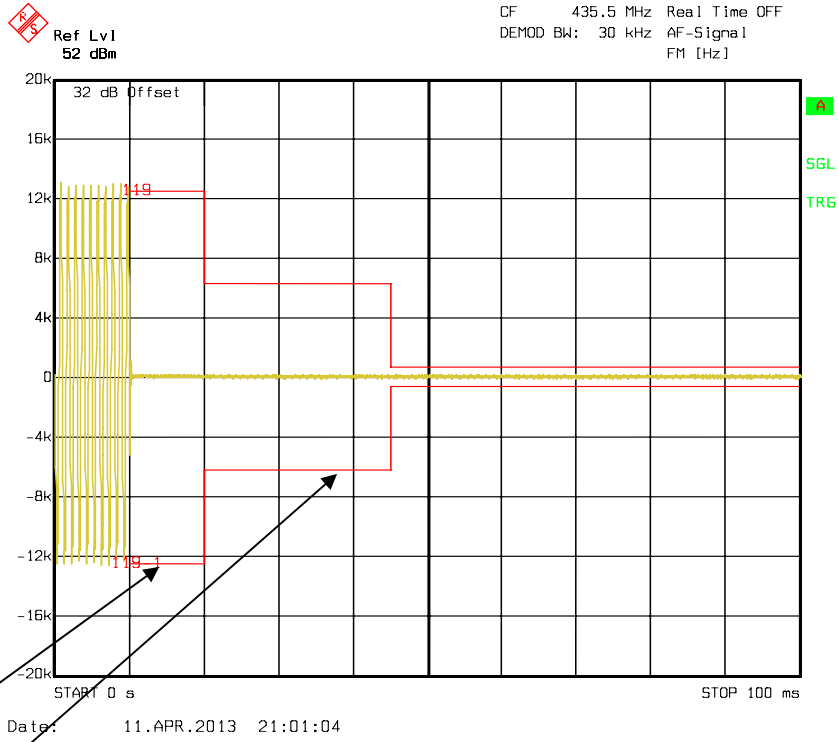
Temperature:	23.6 °C
Relative Humidity:	47%
ATM Pressure:	100.9 kPa

The testing was performed by Leon Chen on 2013-04-11.

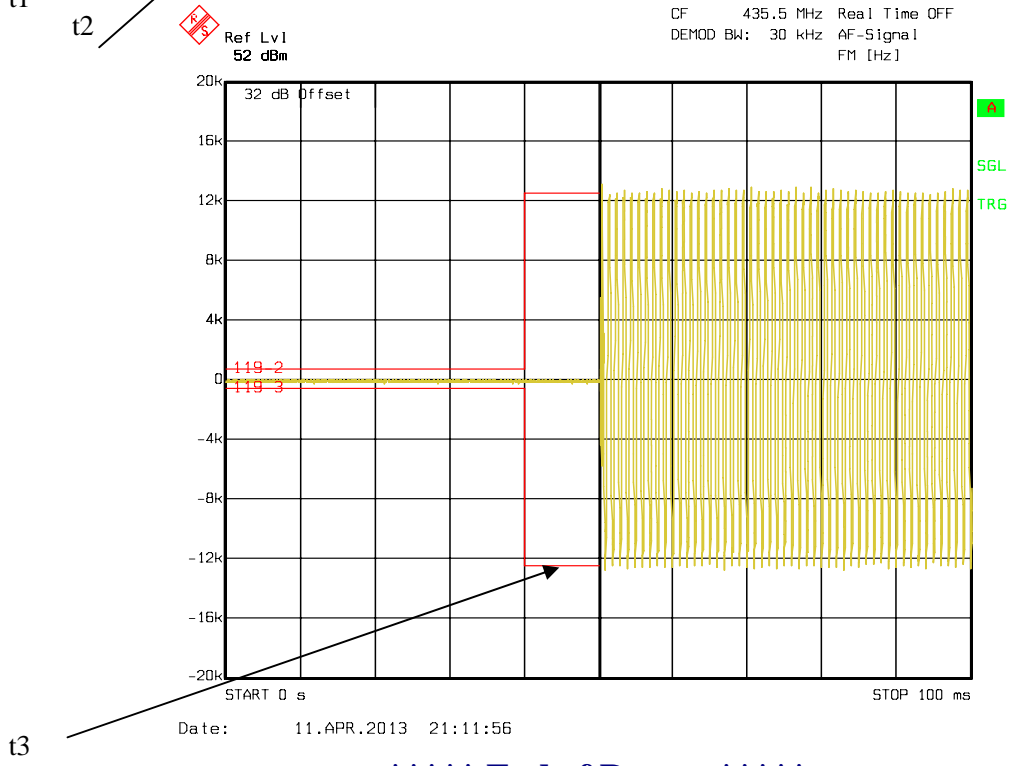
Channel Separation (kHz)	Transient Period (ms)	Transient Frequency	Result
12.5	<10 (t1)	± 12.5 kHz	Pass
	<25 (t2)	± 6.25 kHz	
	<10 (t3)	± 12.5 kHz	

Please refer to the following plots.

Turn on – Middle Channel



Turn off – Middle Channel



***** End of Report *****