Radio Test Report

Application for Grant of Equipment Authorization

FCC Part 90.217(b)

FCC ID:	2AB6OTX1605
Models:	TX-1605-1 and TX-1605-5
APPLICANT:	Long Range Systems, LLC 4550 Excel Parkway, Suite 200 Addison, TX 75001
TEST SITE(S):	National Technical Systems - Plano 1701 E Plano Pkwy #150 Plano, TX 75074
REPORT DATE:	July 10, 2014
TEST DATES:	April 23, 2014 and May 30, 2014
TOTAL NUMBER OF PAGES:	23

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REVISION HISTORY

Rev#	Date	Comments	Modified By
	July 10, 2014	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Long Range Systems Model TX-1605-5, pursuant to the following rules:

FCC Part 90.217

Conducted and radiated emissions data has been collected; reduced and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards:

TIA-603-C
FCC Licensed Radio Measurement Guidance KDB 971168

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height and antenna polarization when applicable.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, the device requires certification.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Long Range Systems Model TX-1605-5 complied with the requirements of the following regulations:

FCC Part 90.217(b)

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

Test results recorded herein also represent Model TX-1605-1. RF circuitries on both models are identical. Differences are only on the peripheral circuitry. TX-1605-5 has 5 buttons while TX-1605-1 has a single button.

The sample was selected and prepared by Mike Williams of Long Range Systems. It was received on Apr 23, 2014 and was tested on Apr 23, 2014 and May 30, 2014.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

FCC Rule Part	Description	Test Procedure	Measured Value / Comments	Limit / Requirement	Result
2.1047	Modulation	N/A	System uses FSK modulation	Modulation shall be specified	-
2.1049	Occupied Bandwidth	TIA-603-C FCC KDB 971168 D01 v02r01 Section 4.2	11.7kHz	12.5kHz	Complies
2.1046 90.217	Output Power	TIA-603-C FCC KDB 971168 D01 v02r01 Section 5.1.1	17.14dBm (52mW) Conducted	120mW	Complies
2.1051 90.217(b)	Antenna Port Spurious Emissions 9kHz – 5GHz	TIA-603-C FCC KDB 971168 D01 v02r01 Section 6.0	All emissions < -30dBc	<-30dBc	Complies
2.1055 90.217(b)	Frequency Stability	TIA-603-C FCC KDB 971168 D01 v02r01 Section 9.0	Emissions remained within 50kHz band	<-30dBc outside 50kHz band	Complies
1.1310	RF Exposure Requirements	N/A	Refer to RF exposure exhibit and user manual statements	Refer to OET 65, FCC Part 1	Complies

Note: Client provided a test sample equipped with an accessible test point at its antenna output. All tests were performed on that sample.

MEASUREMENT UNCERTAINTIES

The measurement of uncertainty is not included with the data in this test report.

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

Frequency Range:	467.75MHz – 467.75MHz (single channel)
Modulation:	FSK
Transmits:	Paging data only (no voice)
Receive Functionality:	None
Intended Use:	Paging for service
Channel Bandwidth:	12.5kHz
99% Occupied Bandwidth:	11.7kHz (Measured)
Output Power:	17.14dBm = 52mW Peak (Measured at the antenna port)
Antenna:	Internal wire soldered on PCB with 0dBi gain
Dimensions:	18cm L x 4cm W x 2cm H
Enclosure Material:	Plastic
Power:	3xAAA Batteries
Ports:	1x mini-USB port (for setup and programming only)
	1x dry-contact

MODE OF OPERATION: Device was transmitting continuously with modulation on its single channel at its maximum output power.

SUPPORT EQUIPMENT: None

DEVIATIONS FROM TEST PROCEDURES: None

MODIFICATIONS TO THE PRODUCT: None

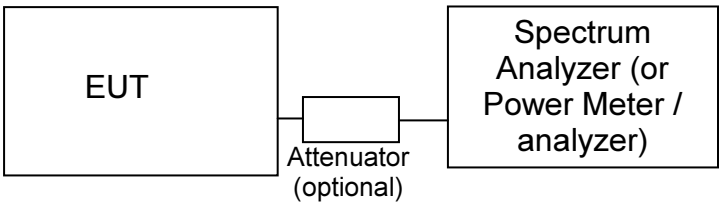
TEST SITE

GENERAL INFORMATION

Antenna port measurements were taken at NTS Plano facility located at 1701 E Plano Pkwy #150 Plano, TX 75074.

RF PORT MEASUREMENT PROCEDURES

Conducted measurements are performed with the EUT's RF input/output connected to the input of a spectrum analyzer, power meter or modulation analyzer. When required an attenuator, filter and/or dc block is placed between the EUT and the spectrum analyzer to avoid overloading the front end of the measurement device. Measurements are corrected for the insertion loss of the attenuators and cables inserted between the RF port of the EUT and the measurement equipment.



Test Configuration for Antenna Port Measurements

OUTPUT POWER

Output power is measured using a power meter and an average sensor head, a spectrum analyzer or a power meter and peak power sensor head as required by the relevant rule part(s). Where necessary measurements are gated to ensure power is only measured over periods that the device is transmitting.

Power measurements made directly on the rf power port are, when appropriate, converted to an EIRP by adding the gain of the highest gain antenna that can be used with the device under test, as specified by the manufacturer.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN. The measurement bandwidth is set to be at least 1% of the instrument's frequency span.

CONDUCTED SPURIOUS EMISSIONS

Initial scans are made using a peak detector (RBW=VBW) and using scan rates to ensure that the EUT transmits before the sweep moves out of each resolution bandwidth (for transmit mode measurements). Where the limits are expressed as an average power the spectrum analyzer is tunes to that frequency with a narrow span (wide enough to capture the emission and its sidebands) and the resolution and video bandwidths are adjusted as required by the reference measurement standards. For transmitter measurements the

appropriate detector (average, peak, normal ,sample, quasi-peak) is used when making measurements for licensed devices. For receiver conducted spurious measurements the detector is set to peak.

TRANSMITTER MASK MEASUREMENTS

The transmitter mask measurements are made using resolution bandwidths as specified in the pertinent rule part(s). Where narrower bandwidths are used the measurement is corrected to account for the reduced bandwidth by either using the adjacent channel power function of the spectrum analyzer to sum the power across the required measurement bandwidth. The frequency span of the analyzer is set to ensure the fundamental signal and all significant sidebands are displayed.

The top of the mask may be set by the total output power of the signal, the power of the unmodulated signal or the peak value of the signal in the reference bandwidth being used for the mask measurement.

FREQUENCY STABILITY

The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The temperature is varied across the specified frequency range in 10 degree increments with frequency measurements made at each temperature step. The EUT is allowed enough time to stabilize at each temperature variation.

The spectrum analyzer is configured to give a 5- or 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. Where possible the device is set to transmit an unmodulated signal. Where this is not possible the frequency drift is determined by finding a stable point on the signal (e.g. the null at the centre of an OFDM signal) or by calculating a centre frequency based on the upper and lower XdB points (where X is typically 6dB or 10dB) on the signal’s skirts.

INSTRUMENTATION

For all conducted measurements a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis.

Measurement bandwidths for the test instruments are set in accordance with the requirements of the standards referenced in this document.

Software control is used to correct the measurements for transducer factors (e.g. antenna) and the insertion loss of cables, attenuators and other series elements to obtain the final measurement value. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are exported in a graphic and/or tabular format, as appropriate.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the EUT antenna port or receiving antenna and the test receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

SAMPLE CALCULATIONS

SAMPLE CALCULATIONS - CONDUCTED SPURIOUS EMISSIONS

Measurements are compared directly to the conducted emissions specification limit (decibel form). The calculation is as follows:

$$R_r - S = M$$

where:

R_r = Measured value in dBm
S = Specification Limit in dBm
M = Margin to Specification in +/- dB

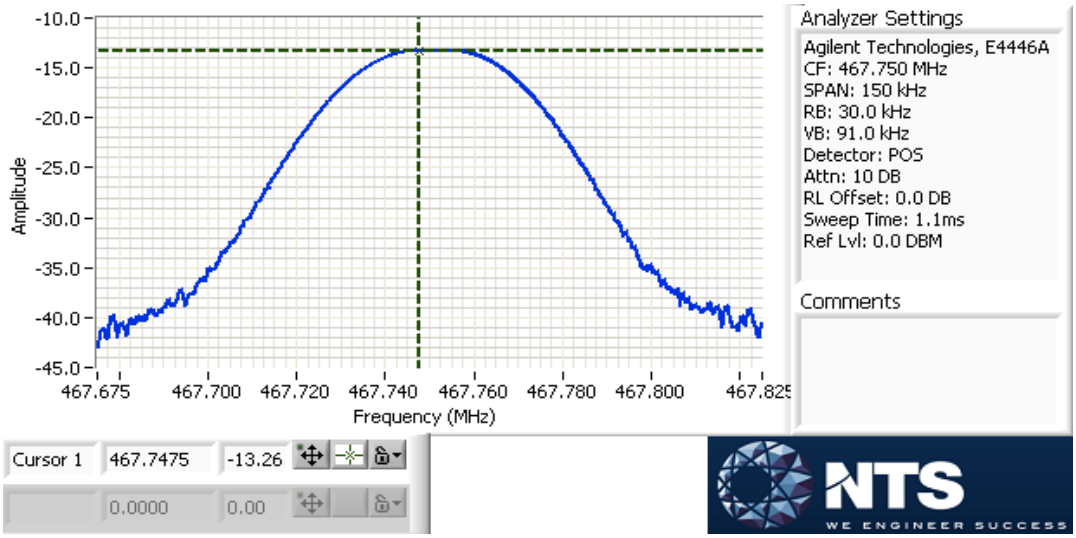
Appendix A Test Data

RF Power Output (CFR 47 §90.217, CFR 47 §2.1046)

Date: May 30, 2014

Spectrum Analyzer (dBm)	External Attenuator and Cable Loss (dB)	Corrected (dBm)	Corrected (mW)	Limit (mW)	Verdict
-13.26	30.4	17.14	52.0	120.0	Pass

Note: 60s max hold, auto-sweep, 8000 data points across span

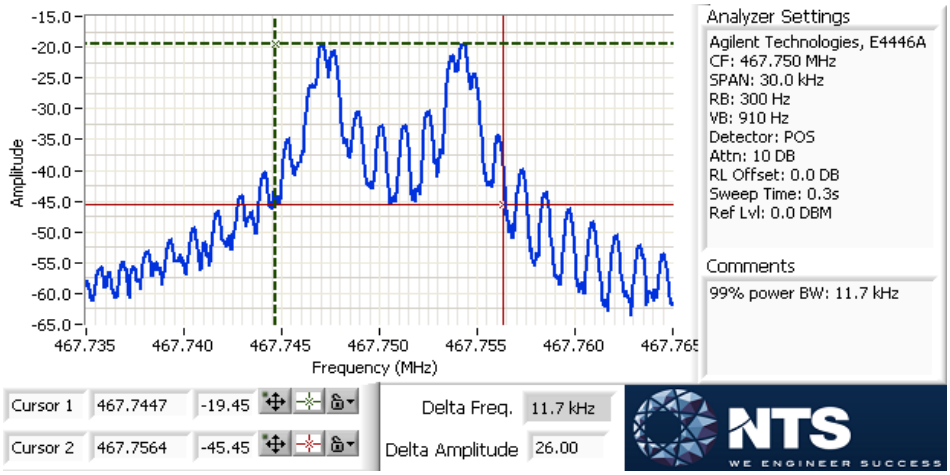


99% Occupied Bandwidth (CFR 47 §2.1049)

Date: May 30, 2014

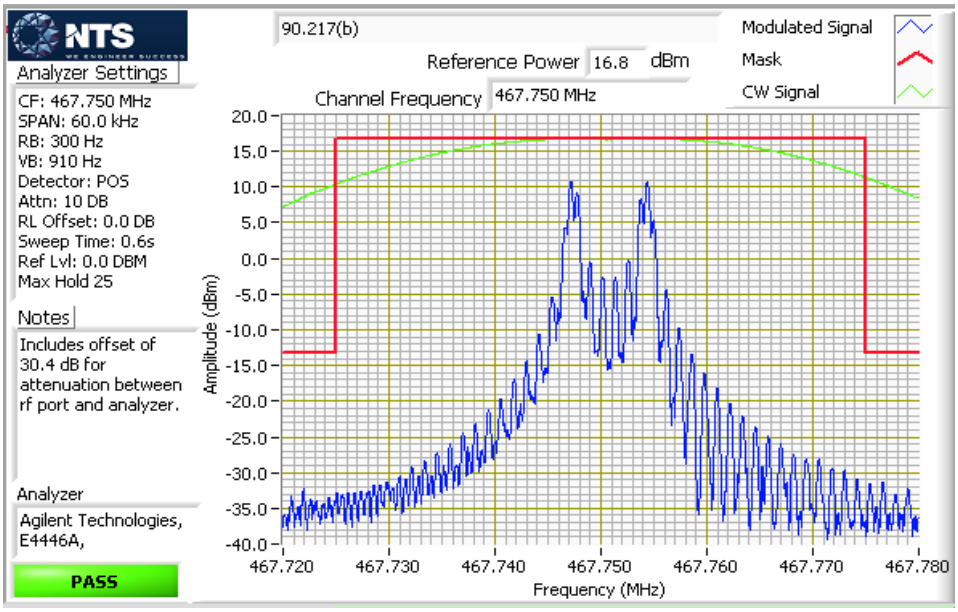
99% Occupied Bandwidth (kHz)	Limit (kHz)	Verdict
11.7	12.5	Pass

Note: 60s max hold, auto-sweep, 8000 data points across span



Emission Mask (CFR 47 §90.217(b))

Date: May 30, 2014
Auto-sweep, 8000 data points across span

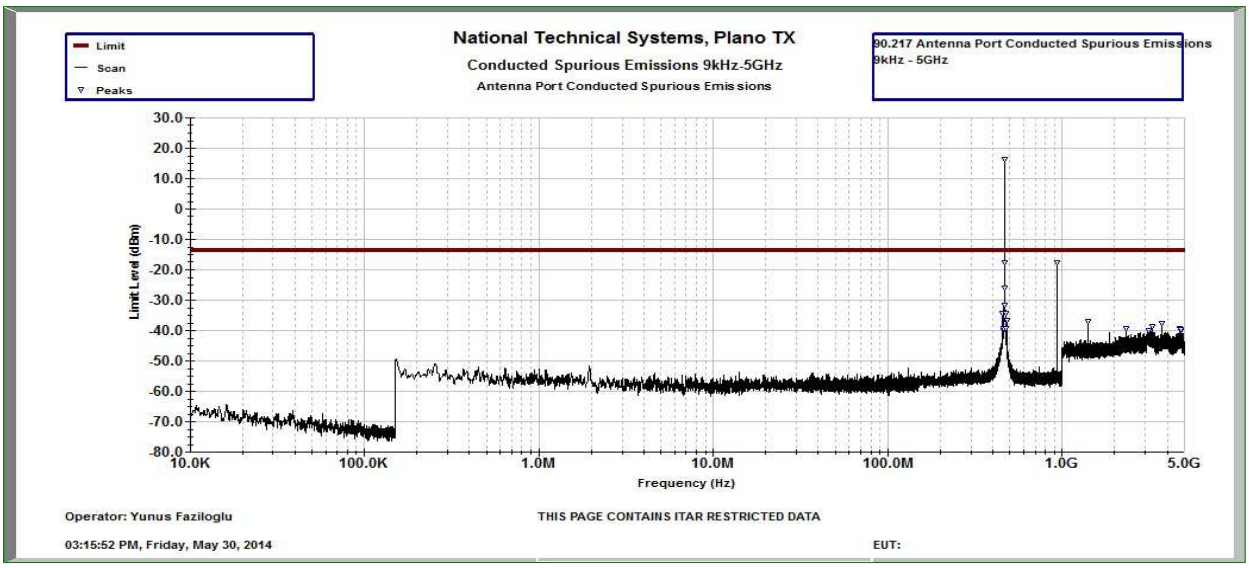


Spurious Emissions at the Antenna Terminal (CFR 47 §90.217(b), CFR 47 §2.1051)

Date: May 30, 2014
Frequency Range: 9kHz-5GHz
Instrumentation settings in accordance with CFR 47 §90.210(o).

Frequency Range	RBW	VBW	Number of data points	Divided into	Detector	Sweep Time	Max hold over
9kHz-150kHz	1kHz	3kHz	8000	2 segments	Peak	Auto	50 sweeps
150kHz-1GHz	100kHz	300kHz	8000	2 segments	Peak	Auto	50 sweeps
1GHz-5GHz	1MHz	3MHz	8000	2 segments	Peak	Auto	50 sweeps

Frequency	Reading (dBm)	Limit (dBm)	Margin (dB)	Verdict
453.13 MHz	-34.37	-13.61	-20.76	Pass
457.27 MHz	-39.88	-13.61	-26.27	Pass
458.87 MHz	-39.24	-13.61	-25.63	Pass
467.79 MHz	16.39	Reference	N/A	N/A
469.07 MHz	-17.69	-13.61	-4.08	Pass
470.34 MHz	-25.96	-13.61	-12.35	Pass
471.41 MHz	-31.7	-13.61	-18.09	Pass
473.11 MHz	-34.31	-13.61	-20.7	Pass
474.17 MHz	-36.55	-13.61	-22.94	Pass
475.44 MHz	-39.31	-13.61	-25.7	Pass
482.35 MHz	-36.54	-13.61	-22.93	Pass
935.51 MHz	-17.61	-13.61	-4.0	Pass
1.4033 GHz	-36.91	-13.61	-23.3	Pass
2.339 GHz	-39.25	-13.61	-25.64	Pass
3.1182 GHz	-39.93	-13.61	-26.32	Pass
3.2744 GHz	-38.72	-13.61	-25.11	Pass
3.7418 GHz	-37.55	-13.61	-23.94	Pass
4.7269 GHz	-39.35	-13.61	-25.74	Pass
4.7797 GHz	-39.95	-13.61	-26.34	Pass
4.808 GHz	-39.69	-13.61	-26.08	Pass



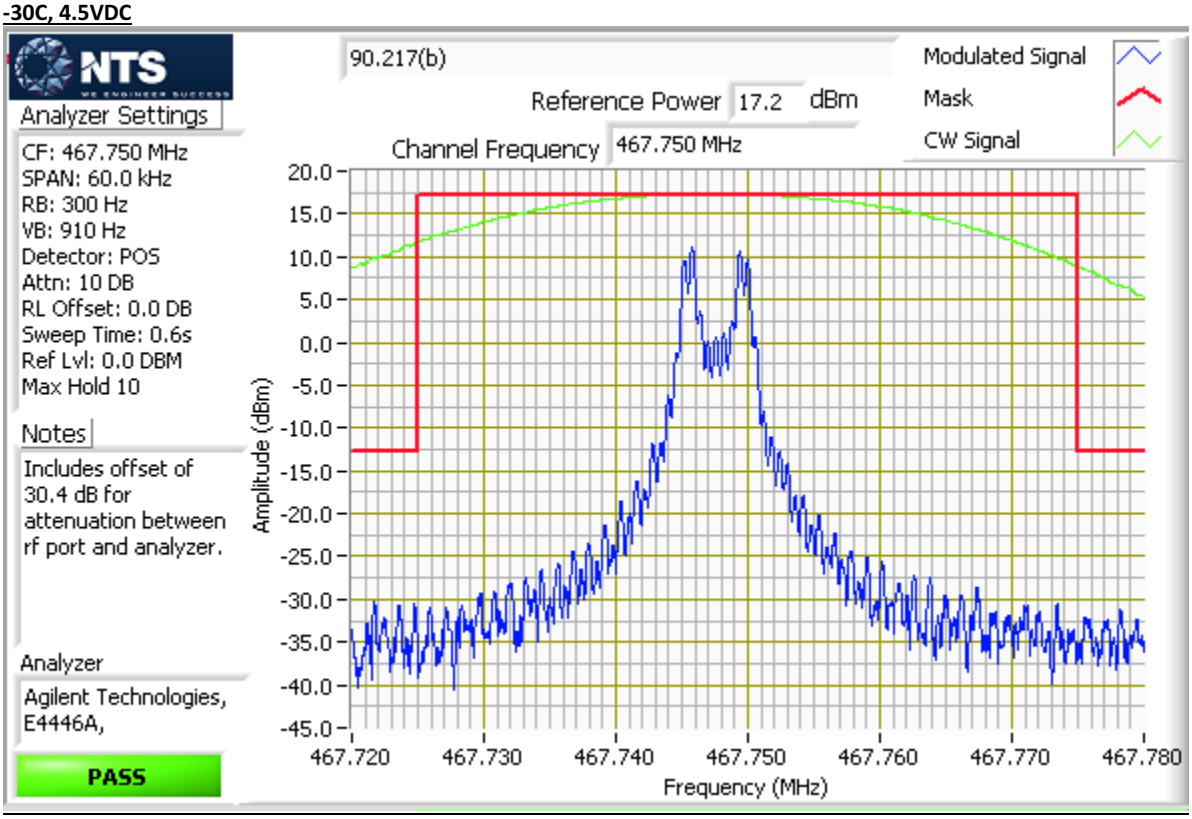
Frequency Stability (CFR 47 §90.217(b), CFR 47 §2.1055)

Date: Apr 23, 2014
90.217(b) requires the emission to stay within the defined mask over extreme temperatures and voltages. Emission mask measurements were repeated under the following voltages and temperatures and plots presented below.

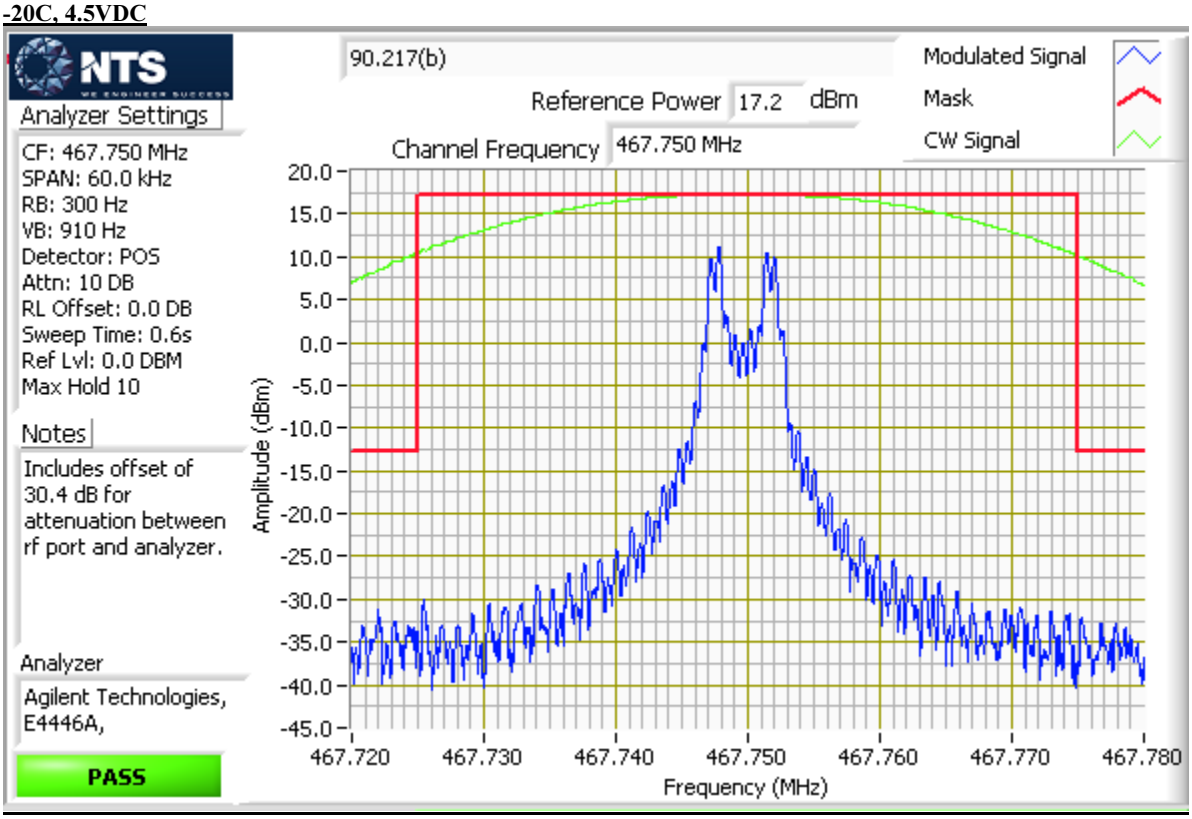
Device is powered by 3xAAA batteries. Battery end-point is specified as 3.0VDC by the client.

Temperature (C)	DC Voltage (V)	Verdict
-30	4.5	Pass
-20	4.5	Pass
-10	4.5	Pass
0	4.5	Pass
10	4.5	Pass
20	3.0 (battery end-point)	Pass
20	4.5	Pass
30	4.5	Pass
40	4.5	Pass
50	4.5	Pass

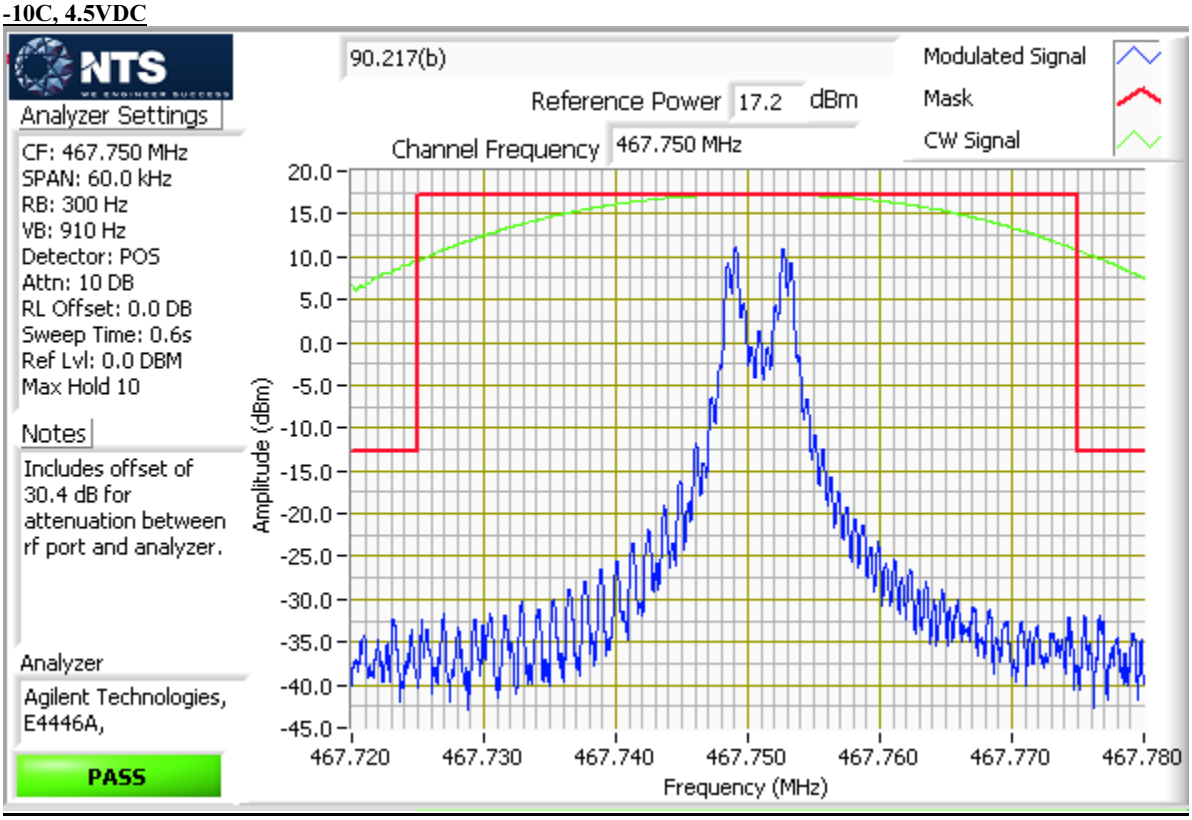
-30C, 4.5VDC



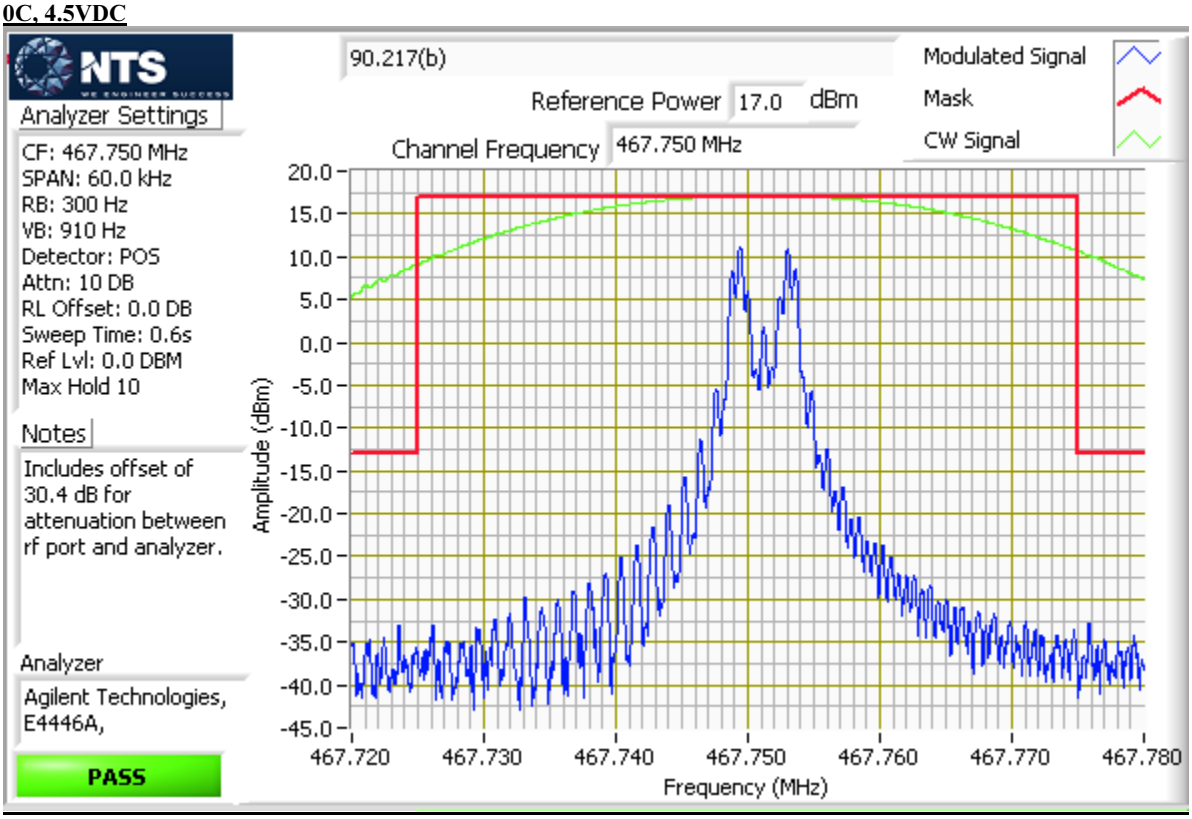
-20C, 4.5VDC



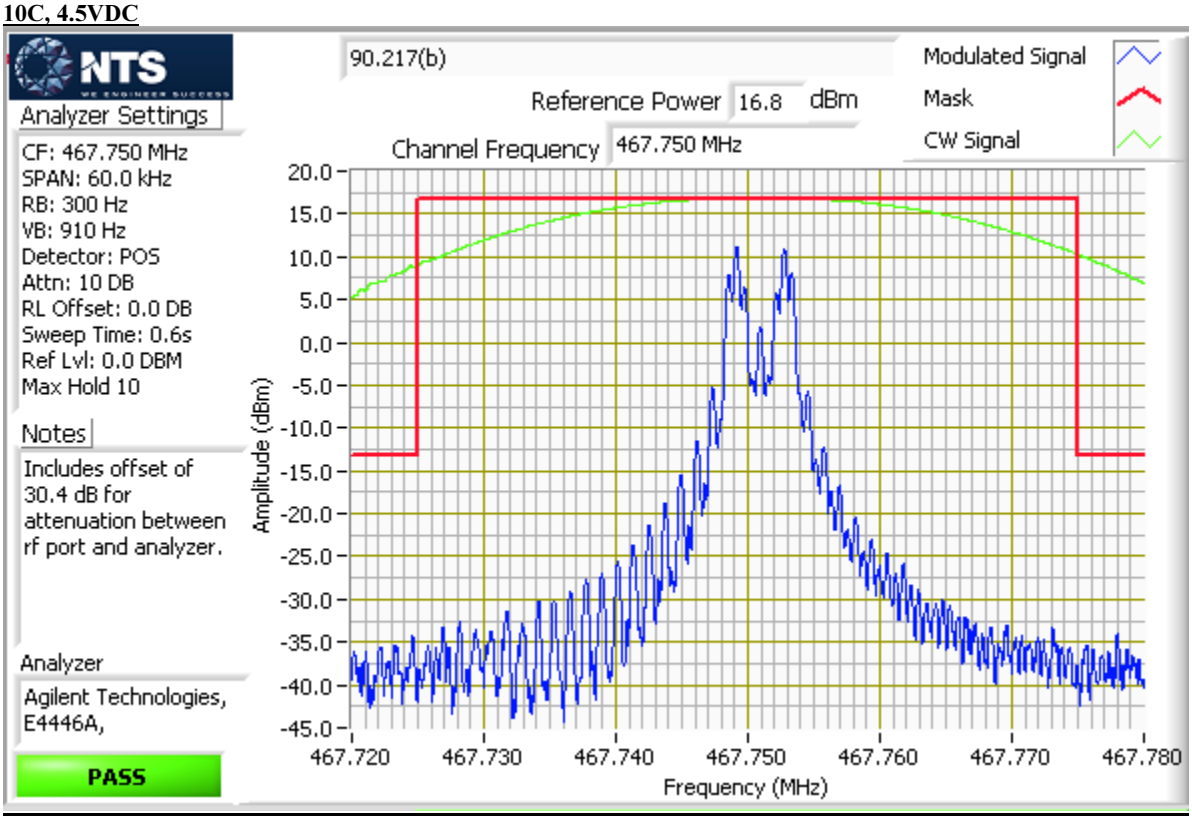
-10C, 4.5VDC



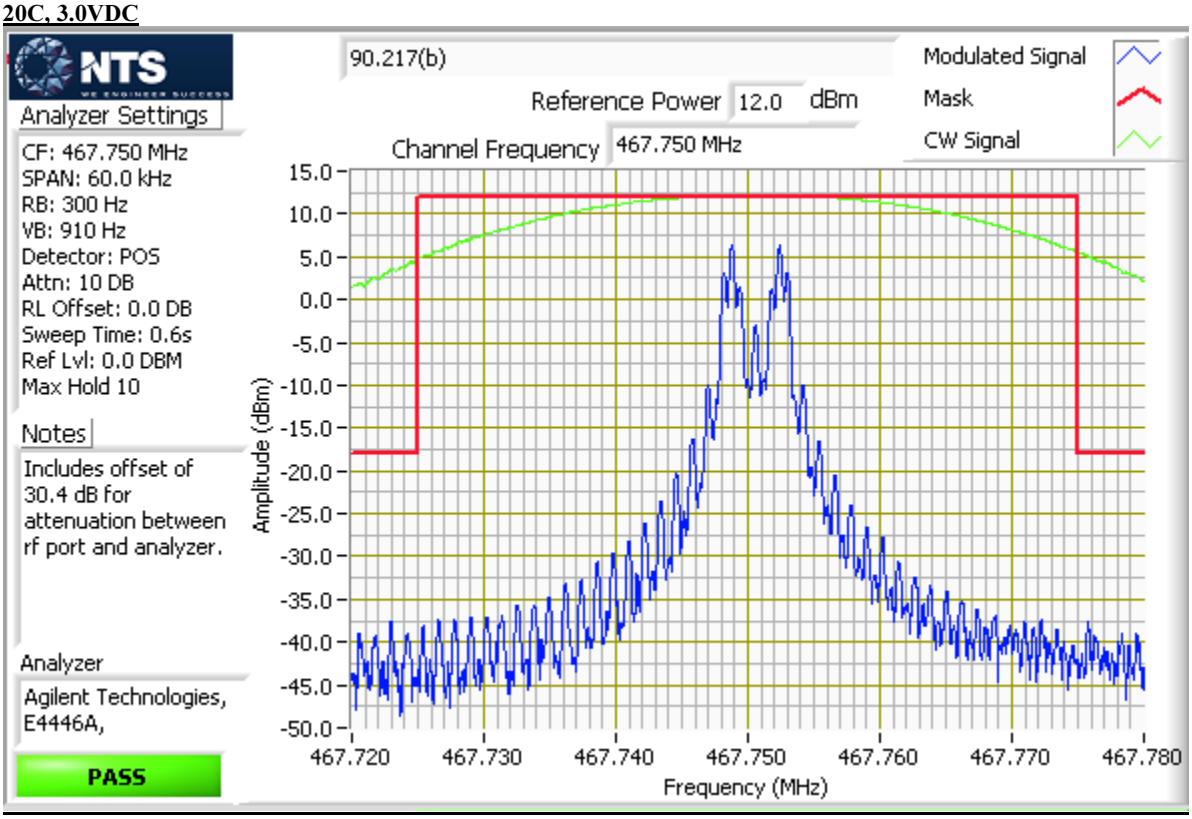
0C, 4.5VDC



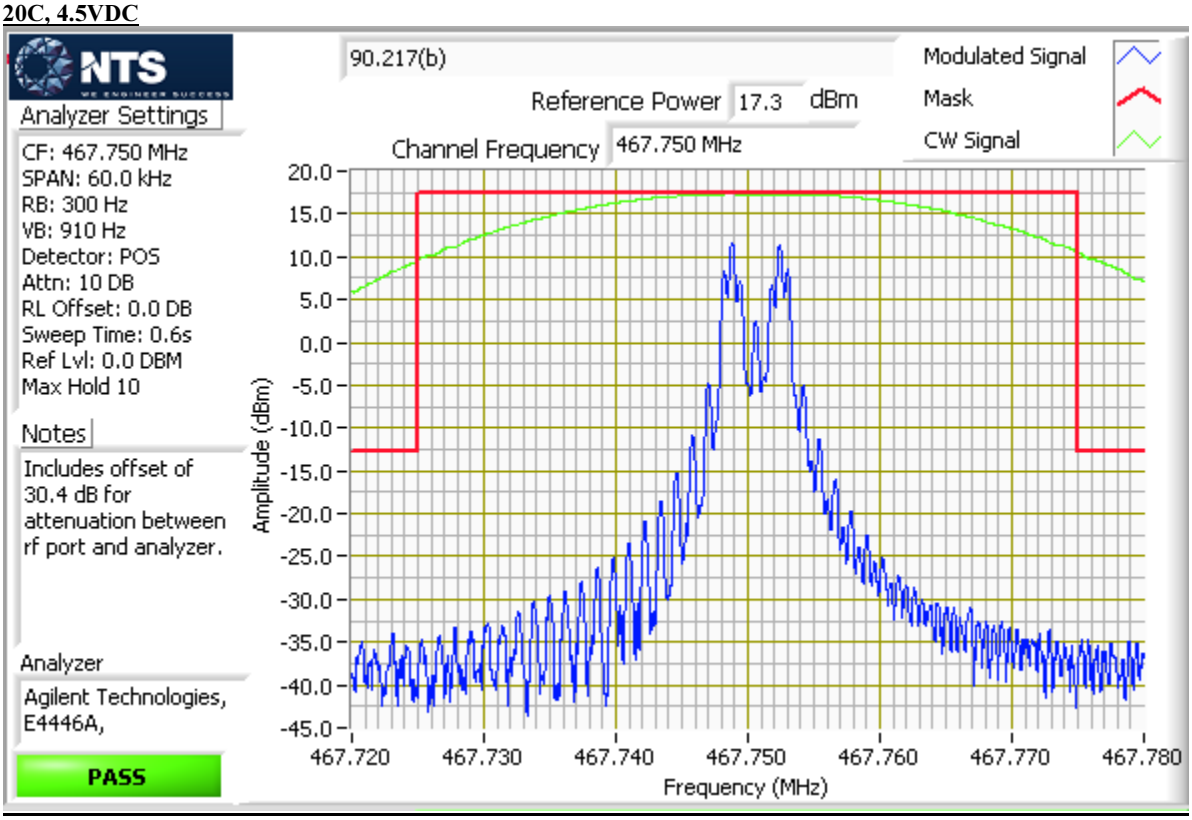
10C, 4.5VDC



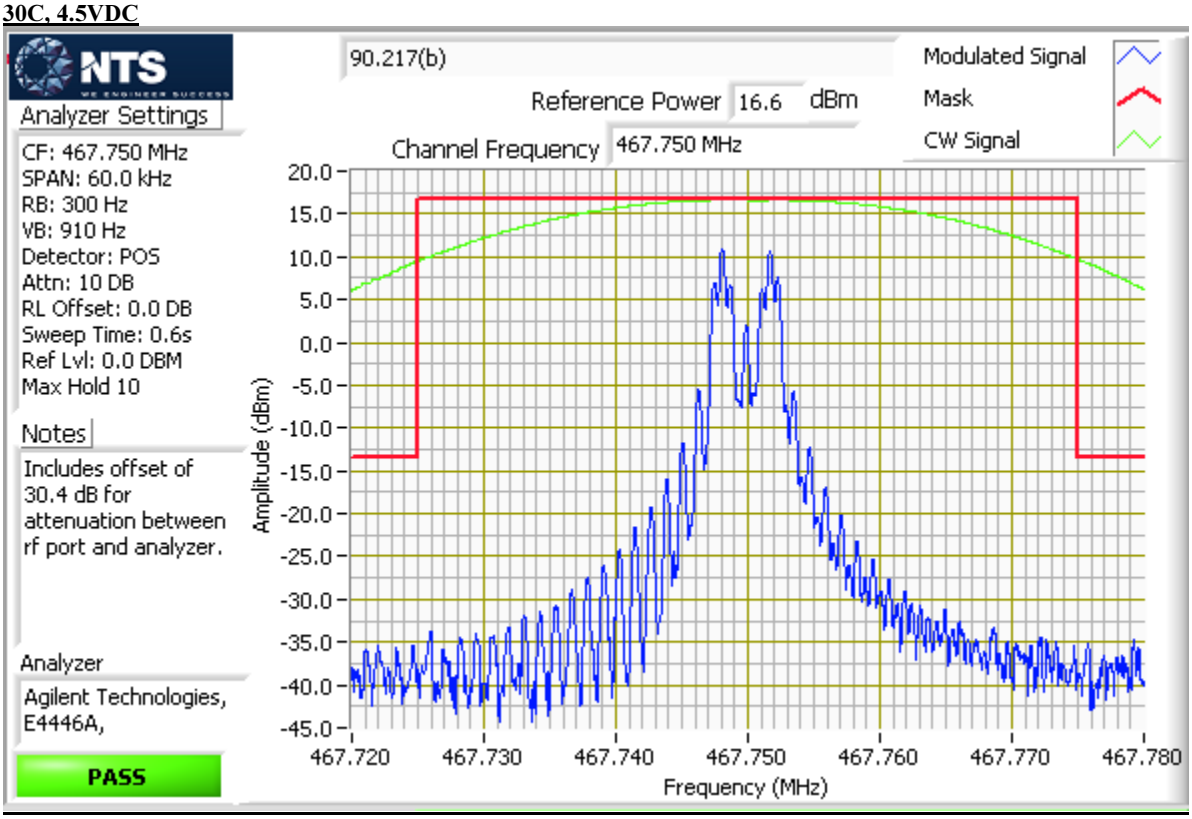
20C, 3.0VDC



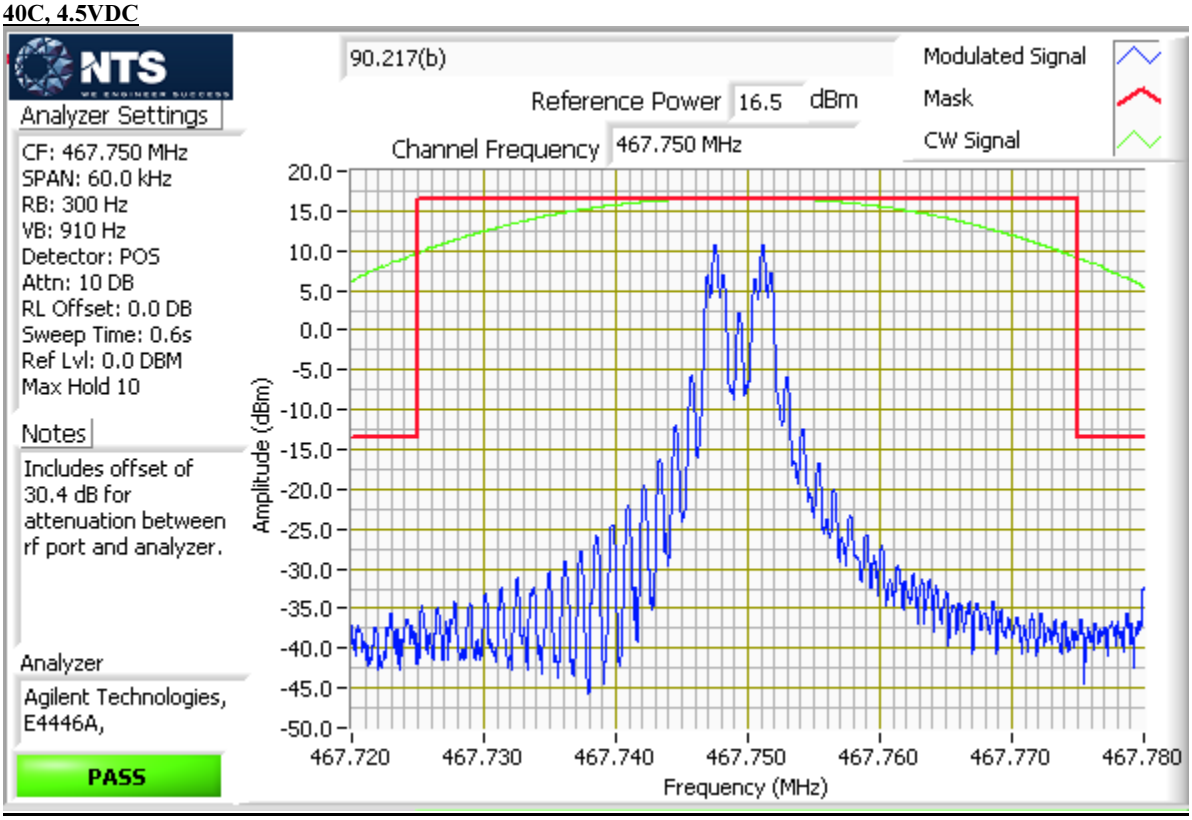
20C, 4.5VDC



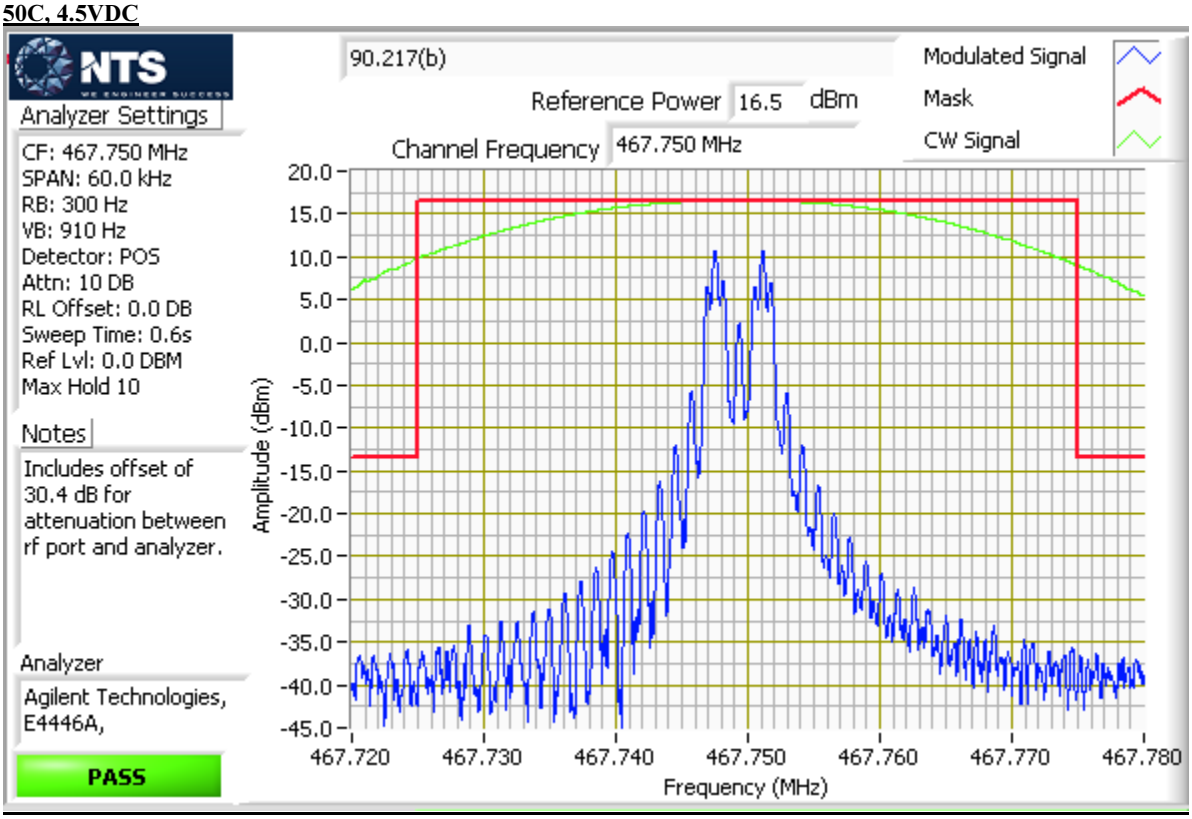
30C, 4.5VDC



40C, 4.5VDC



50C, 4.5VDC


NTS
Analyzer Settings
CF: 467.750 MHz
SPAN: 60.0 kHz
RB: 300 Hz
VB: 910 Hz
Detector: POS
Attn: 10 DB
RL Offset: 0.0 DB
Sweep Time: 0.6s
Ref Lvl: 0.0 DBM
Max Hold 10
Notes
Includes offset of 30.4 dB for attenuation between rf port and analyzer.
Analyzer
Agilent Technologies, E4446A,
PASS
90.217(b)
Reference Power 16.5 dBm
Channel Frequency 467.750 MHz
Modulated Signal
Mask
CW Signal
Amplitude (dBm)
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
467.720
467.730
467.740
467.750
467.760
467.770
467.780
Frequency (MHz)

APPENDIX B - TEST EQUIPMENT

NTS ID#	Description	Duration	Calibration Due
E1529P	Spectrum Analyzer Agilent E4446A	12 months	2/14/2015
ENV1195P	Chamber Thermotron	N/A	No Calibration Required
ENV1384P	Data Acq/Switch Unit Agilent 34970A	12 months	2/24/2015
E1422P	E3634A Agilent DC Power Supply	N/A	No Calibration Required
E1390P	RMS Voltmeter Fluke 87V	12 months	1/31/2015

End of Report

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