



# For

# Dali Wireless, Inc.

535 Middlefield Road, Suite 280 Menlo Park, CA 94025

Date:	02 DECEMBER 2019
Report No.:	18280-3E
Revision No.:	1
Project No.:	18280
Equipment:	Advanced Digital Distributed Antenna System
Model No.:	hd37-3-PS-FHB-21-5N-D0
FCC ID:	HCOHD373PSFHB21A

# ONE STOP GLOBAL CERTIFICATION SOLUTIONS



Unit 205 – 8291 92 ST., Delta, BC V4G 0A4, Canada Phone: 604-247-0444 Fax: 604-247-0442 www.labtestcert.com

Client: Dali Wireless, Inc. Report No.: 18280-3E Revision No.: 1

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TEST REPORT_FCC Part 90					
Private Land Mobile Services					
Report Reference No	18280-3E				
Report Revision History	<ul> <li>✓ Rev. 0: 21 NOVEMBER 2019</li> <li>✓ Rev. 1: 02 DECEMBER 2019</li> </ul>				
Compiled by (+ signature)	Daniel Lee Toy Fullow				
Approved by (+ signature)	Jeremy Lee	grow ping			
Date of issue:	02 December 2019				
Total number of pages	98				
FCC Site Registration No.:	CA5970				
IC Site Registration No.:	5970A-2				
Testing Laboratory	LabTest Certification Inc.				
Address:	Unit 3128-20800 Westminster HWY, Richmond, B.C. V6V 2W3 Canada				
Applicant's name	Dali Wireless, Inc.				
Address	535 Middlefield Road, Suite 280, Menlo Park, CA 94025				
Manufacture's Name	Dali Wireless (Canada) Inc.				
Address	8618 Commerce Cour	t, Burnaby, B.C. V5A 4N6, Canada			
Test specification:					
Standards:	<ul> <li>FCC Part 2; 2019</li> <li>FCC Part 90; 201</li> </ul>				
Test procedure:	<ul> <li>: ➤ FCC KDB 935210 D05 Indus Booster Basic Meas v01r03: April 15, 2019</li> <li>&gt; ANSI/TIA-603- E-2016</li> <li>&gt; ANSI C63.4:2014</li> </ul>				
Non-standard test method	N/A				
Test Report Form(s) Originator:	Jeremy Lee				
Master TRF:	1036_Rev2 – RF Repo	ort Template			
Test item description :					
Trade Mark:	hd37™				
Model/Type reference:	hd37-3-PS-FHB-21-5N-D0				

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Serial Number:	10911111RA1B98001		
FCC ID:	HCOHD373PSFHB21A		
Possible test case verdicts:			
- test case does not apply to the test object	N/A		
- test object does meet the requirement:	P (Pass)		
- test object does not meet the requirement:	F (Fail)		
Testing:			
Date of receipt of test item:	07 November 2019		
Date (s) of performance of tests:	07 to 08 November 2019		

# **Revision History**

Revisio	n Date	Reason For Change	Author(s)
0	21 November 2019	Initial Data	Daniel Lee
1	02 December 2019	Corrected information on page 74 , 76	Jeremy Lee

# **Device Under Test Description**

Application for:	PS 800/450/150 Remote Unit, Tri Band Medium Power DAS
Passing Transmit Frequency::	851 MHz – 862 MHz 450 MHz – 470 MHz 152 MHz – 174 MHz
Operating Transmit Frequency FCC:	851 MHz – 861 MHz 450 MHz – 454 MHz 456 MHz – 462.5375 MHz 462.7375 MHz – 467.5375 MHz 467.7375 MHz – 512 MHz 150.8 MHz – 156.2475 MHz 157.1875 MHz – 161.575 MHz 161.775 MHz – 161.9625 MHz 162. 0375 MHz – 173.4 MHz
Passing Receive Frequency	806 MHz – 817 MHz 450 MHz – 470 MHz

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Operating Receive Frequency FCC	806 MHz – 816 MHz 450 MHz – 454 MHz 456 MHz – 462.5375 MHz 462.7375 MHz – 467.5375 MHz 467.7375 MHz – 512 MHz			
Number of Channels:	Up to 64 channels			
Rated RF Output(e.i.r.p.):	37 dBm			
Modulation Type:	P25 Phase I C4FM, CQPSK; P25 Phase II HDQPSK on full band of Band 800, Band 450 and Band 150; FM on Band 800 between 851 MHz – 854 MHz only;			
Equipment mobility:	Fixed			
Operating condition:	-40 to +50 °C			
Mass of equipment (g):	< 27,700g			
Dimension(W X D X H)	410 mm X 230 mm X 696 mm			
Nominal Voltages for:	<u>48 V</u> stand-alone equipment <u>48 V</u> combined (or host) equipment			
Supply Voltage:	ACAmps _ <u>48V</u> DC <u>7.083</u> Amps			
If DC Power:	<ul> <li>Internal Power Supply</li> <li>✓ External Power Supply</li> <li>Battery</li> <li>Nickel Cadmium</li> <li>Alkaline</li> <li>Nickel-Metal Hydride</li> <li>Lithium-Ion</li> <li>Other</li> </ul>			

# **Program details**

Testing	Testing Facility by procedure:					
Radiated Measurement		LabTest Certification Inc.				
Testing location/ address		Unit 3128-20800 Westminster HWY, Richmond, B.C. V6V 2W3 Canada				
$\square$	Conducted Measurement:	LabTest Certification Inc.				
Testing location/ address		Unit 3128-20800 Westminster HWY, Richmond, B.C. V6V 2W3 Canada				

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#### Summary of testing:

# Tests performed (name of test and test clause):

Conducted Measurement Radiated Emissions on Enclosure Testing location: Bench top, Richmond In SAC, Richmond

The tests indicated in Test Summary were performed on the product constructed as described below. The test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. LabTest does not make any claims of compliance for samples or variants which were not tested.

# **Description of Equipment Under Test and Variant Models**

#### **Description:**

The hd37 /800PS/450PS/150 PS is a tri-band remote unit that provides at least 5 W of output power on each band. The tri-band unit supports up to 3 bands in a sealed type 2 chassis for Class A operation.

On the downlink path the hd37 PS remote receives an aggregated stream of digitized RF signals from an *air*Host PS, which it then converts into analog RF signals. Depending on the frequency band, the signal is amplified in the RF module and then sent out through simplex RF ports to an external filter.

On the UL path the hd37 PS remote receives analog RF signals for the RF band, from an external filter. The RF signals are converted into a digital data stream and then delivered over optical fiber to an *air*Host PS. The hd37 PS remote also accommodates a 1 Gbps Ethernet backhaul for transporting the data from nearby IP devices such as security cameras and Wi-Fi access points.

The intentional transmitter only exists in the downlink path and hence the EMC tests in this report dedicated to the downlink emission.

In order to build up a complete signal booster system, the *air*Host was connected as the Auxiliary device. The *air*Host does not have anntenna port, where the signal was injected and ejected via coaxial cables.

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# **Client Equipment Used During Test**

Use*	Product Type	Manufacturer	Model	Comments			
EUT	hd37, 800PS, 450PS, 150PS	Dali Wireless Inc.		EUT where the RF (I/O) antenna attached via duplexers/multiplexer when necessary.			
AE1	airHost, 800PS, 450PS, 150PS	Dali Wireless Inc.		Auxiliary equipment, which is the front end of signal booster system air interfaced to donor Base Station.			
AE2	Dali Matrix Console	Dali Wireless Inc.	120G-AC	<ul> <li>Auxiliary equipment provides the configuration and control interface to <i>air</i>Host and <i>hd</i>'37.</li> </ul>			
AE3	AE3 Power Supply MeanWell HLG-480H-48 AC to DC Converter, I/P: 120VAC, 60Hz, 5.5A O/P: +48VDC, 480W						
Abbreviations: EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment, or SIM - Simulator (Not Subjected to Test)							

# Software and Firmware

Use*	Description	Version		
EUT	Software installed	1.0.10_dev431		
AE1	Software installed	1.0.10_dev431		
AE2	Software installed	1.0.10_dev431		
Abbrev EUT AE - J SIM -				

# Input/Output Ports

Port #	Name	Туре*	Cable Max. >3m	Cable Shielded	Comments
1	DC Power Port	DC	No	No	Dual feed 48 VDC Assembly
2	8 * RF Input/Output Ports	I/O	No	No	N-Type Coaxial
3	2 * Optical Fibre I/O Ports	I/O	No	No	LC/UPC Duplex
4	2 * TP	TP	No	No	RJ-45

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\*Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical I/O = Signal Input or Output Port (Not Involved in Process Control) TP = Telecommunication Ports

# **Power Interface**

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
1	48	-	-	DC	-	

# EUT Operation Modes

Mode #	Description
1	UL and DL transmission and receiving ON

# **EUT Configuration Modes**

Mode	e # Description	
1	airHost maximum input threshold set to -55 dBm, uplink attenuation set to 0dB; hd37 uplink and downlink attenuation set to 0dB.	

# **Test Equipment Verified for function**

Model #	Description	Checked Function	Results
N9038A	Spectrum Analyzer	Frequency and Amplitude Connected 50MHz and -20 Connec	
JB1	Antenna, 30 to 2000MHz	Checked structure	Normal – no damage.
SAS-571	Antenna, 1 to 18GHz	Checked structure	Normal – no damage.
AL-130	Antenna, 9kHz to 30MHz	Checked structure	Normal – no damage.
KT- N5172B	Signal Generator, up to 6GHz	Frequency, Amplitude and Modulation	Within MFR Specs
KT- N9010A	Spectrum Analyzer	Frquency and Amplitude	Within MFR Specs

# **Test Station Cables and Loads**

Model #	Manufacture	Manufacture Description	
3 * TM8-N1S1-59 MegaPhase 3 times N male to SMA male coaxial cable in 6		3 times N male to SMA male coaxial cable in 60 inches	
TM8-N1S1-24	MegaPhase	N male to SMA male coaxial cable in 24 inches	
2 * 49-30-34	Aeroflex	30dB 150W attenuators	

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# **Test Station Insertion Loss**

	Band 800	Band 450	Band 150	
DL Transmitter	31 dB	30.7 dB	30.3 dB	
DL Receiver	30.6 dB	30.4 dB	30.2 dB	

# **Measurement Uncertainty**

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

Parameter	Uncertainty
Radio Frequency	±1 ppm
Total RF Power: Conducted	±1 dB
RF Power Density: Conducted	±2.75 dB
Spurious Emissions: Conducted	±3 dB
Temperature	±1 °C
Humidity	±5 %
Radiated Emission, 30 to 300MHz	± 3.87 dB
Radiated Emission, 300 to 1,000MHz	± 4.79 dB
Radiated Emission, 1 to 10GHz	± 5.03 dB

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

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# **Result Summary**

The Compliance Status is a judgment based on the direct measurements and calculated highest emissions to appropriate standard limits. Measurement uncertainty values, provided on calibration certificates, were not be used in the judgment of the final status of compliance.

FCC Part 2 & 90					
Test Type	Regulation	Measurement Method	Result		
AGC Threshold	FCC KDB 935210 D05, v01r03, Section 4.2	ANSI TIA-603- E-2016	PASS		
Out of Band Rejection	FCC KDB 935210 D05, v01r03, Section 4.3	ANSI TIA-603- E-2016	PASS		
Input-versus-output Signal Comparison	FCC KDB 935210 D05, v01r03, Section 4.4	ANSI TIA-603- E-2016	PASS		
Input/output Power and Amplifier/Booster Gain	FCC KDB 935210 D05, v01r03, Section 4.5	ANSI TIA-603- E-2016	PASS		
Noise Figure	FCC KDB 935210 D05, v01r03, Section 4.6	ANSI TIA-603- E-2016	PASS		
Measuring out-of- band/out-of-block (including intermodulation) and spurious emissions	FCC KDB 935210 D05, v01r03, Section 4.7	ANSI TIA-603- E-2016	PASS		
Frequency stability	FCC KDB 935210 D05, v01r03, Section 4.8	ANSI TIA-603- E-2016	PASS		
Spurious emissions radiated measurements	FCC KDB 935210 D05, v01r03, Section 4.9	ANSI C63.4:2014	PASS		

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# AGC Threshold

Governing Doc	FCC Part 2 2.1046(a) FCC Part 90.219(d)	Room Temperature (°C)		20.5		
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05, v	Relative Humi	Relative Humidity (%)			
Test Location	Richmond		Barometric Pr	essure (kPa)	101.8	
Test Engineer	Daniel Lee		Date		Nov. 08, 2019	
EUT Voltage	⊠ +48VDC		120VAC @ 6	OHz		
Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due	
Signal Generator	Keysight	N5172B	MY53050270	06/12/19	06/12/21	
Spectrum Analyzer	Keysight	N9010A	MY50520285	07/29/19	07/23/21	
Frequency Range:	🗵 851 MHz – 861 MHz	⊠ 450 MH	z – 470 MHz 🗵	152 MHz –	174 MHz	
Detector:	⊠ Peak	⊠ Peak				
Type of Facility:	⊠ Test bench					
Distance:	⊠ Direct					
Arrangement of EUT:	⊠ Table-top only [	ding only	🗆 Rack Mou	Inted		
less than 37.9 dBm in b	Output Power is less than 37.8 dBm in band 800, less than 37.9 dBm in band 450, and less than 37.7 dBm in band 150.					
Compliant 🖂	Non-Compliar	nt 🗆	Not Appl	icable 🗆		

### Test setup

Description of test set-up:

Output power is measured by connecting a spectrum analyzer to RF output connector of EUT via 30dB Attenuator. With a nominal input power and the amplifier properly adjusted the RF output is measured.

### The EUT was set to Operation Mode #1 with configuration Mode #1.

The maximum output power is measured when the Automatic Level Control (ALC) starting to compress the power and hold to a constant level.



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### **Results – Output Power FCC Requirement**

Frequency Range (MHz)	Frequency (MHz)	Input Power Trip ALC (dBm)	Output Power (dBm)	Output Power (Watt)
	851.0125	-53.5	37.8	6.03
851 - 861	856	-53.5	37.5	5.62
	860.9875	-52.5	37.4	5.50
	450.0125	-56.5	37.7	5.89
450 -470	460	-55.5	37.4	5.50
	469.9875	-53	37.9	6.17
	152.025	-56.5	37.7	5.89
152 - 174	161.79	-56	37.4	5.50
	173.275	-57	37.2	5.25

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# **Occupied Bandwidth**

Governing Doc	FCC Part 2 2.1049		Room Temper	Room Temperature (°C)		
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05, v01r03		Relative Humi	Relative Humidity (%)		
Test Location	Richmond		Barometric Pr	essure (kPa)	101.8	
Test Engineer	Daniel Lee		Date		Nov 08, 2019	
EUT Voltage	⊠ +48VDC		120VAC @ 60	)Hz		
Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due	
Signal Generator	Keysight	N5172B	MY53050270	06/12/19	06/12/21	
Spectrum Analyzer	Keysight	N9010A	MY50520285	07/29/19	07/29/21	
Frequency Range:	🖂 851 MHz – 861 MHz 🖂 450 MHz – 470 MHz 🖂 152 MHz – 174 MHz					
Detector:	⊠ Peak					
Type of Facility:	⊠ Test bench					
Distance:	⊠ Direct					
Arrangement of EUT:	⊠ Table-top only [	∃ Floor-stand	ling only	🗆 Rack Mou	Inted	
<ul> <li>Output signal has an occupied channel bandwidth less than the designated channel bandwidth on any location on the operating band.</li> <li>C4FM &lt; 12.5 kHz</li> <li>CQPSK &lt; 6.25 kHz</li> <li>HDQPSK &lt; 12.5 kHz</li> <li>4 kHz FM with 1kHz deviation &lt; 12.5 kHz</li> </ul>						
Compliant 🖂	Non-Compliar	nt 🗆	Not Appl	icable 🗆		

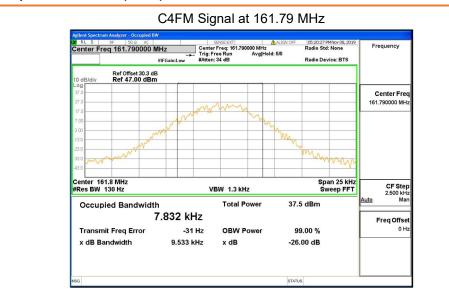
### Test setup

Description of test set-up:
Occupied Bandwidth is measured by connecting a Spectrum Analyzer to the RF output connector via 30dB attenuator. The required measurement resolution bandwidth (RBW) is 1% of the emission bandwidth. 99% energy rule was applied to measure the occupied channel bandwidth. The emission bandwidth is measured as the width of the signal between two frequency points on the channel edge, outside of which the transmission power is attenuated at least 26dB below the transmitter output power The EUT was set to <b>Operation Mode #1 with configuration Mode #1</b> .
The occupied bandwidth of DL output is measured under one input conditions: - Nominal: with input 0.5dB below AGC threshold
Vector Signal Generator BUT EUT 30 dB Spectrum Attenuator Analyzer

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#### **Results – Occupied Bandwidth (OBW)**



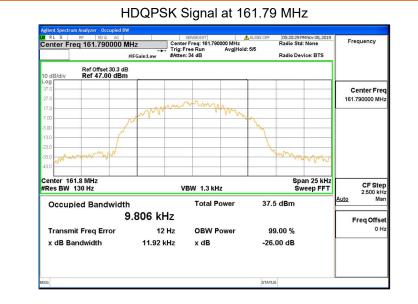
#### CQPSK Signal at 161.79 MHz



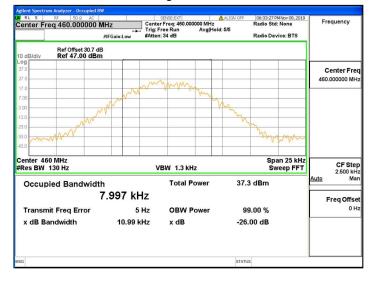
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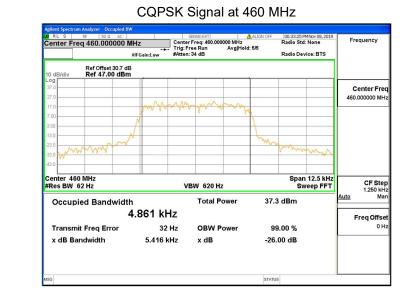
DCN: 1036, Rev 2



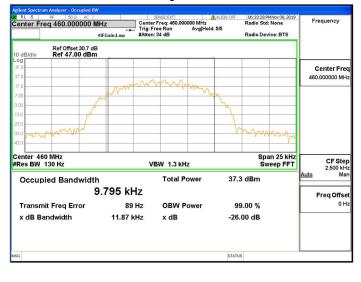
### C4FM Signal at 460 MHz



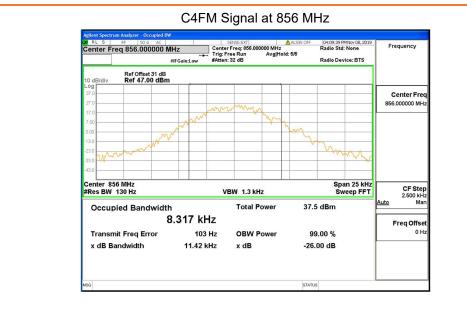
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#### HDQPSK Signal at 460 MHz



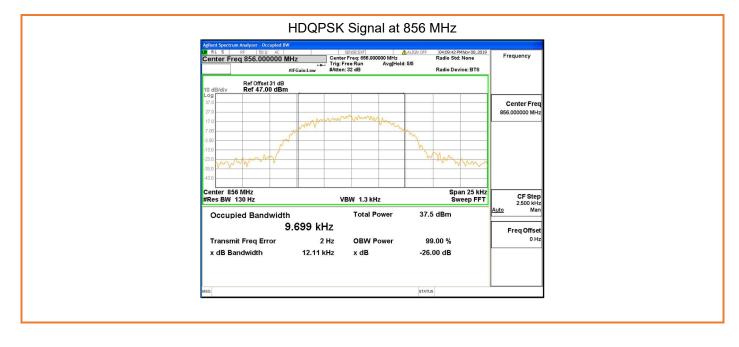
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### CQPSK Signal at 856 MHz

Center Freq 856.000000 MH	Trig: f	SENSE:EXT ////////////////////////////////////	ALIGN OFF 04:09:36 PM Nov 0 Radio Std: None 5/5 Radio Device: B	Frequency
Ref Offset 31 dB Ref 47.00 dBm				
-og 37.0 27.0	a monte and	Mam Ap Ma		Center Fre 856.000000 MH
7.00		000 0.0000		
13.0 23.0 pm mp W mm W mm			mounter	A-4
43.0				
Center 856 MHz Res BW 62 Hz		'BW 620 Hz	Span 12.5 Sweep	
Occupied Bandwidth 4.	827 kHz	Total Power	37.5 dBm	Auto Ma
Transmit Freq Error	27 Hz	OBW Power	99.00 %	он
x dB Bandwidth	5.397 kHz	x dB	-26.00 dB	
sg			STATUS	

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# **Out of Band Rejection**

Governing Doc	FCC Part 2 2.1046(a) FCC Part 90.219(d)		Room Temperature (°C)		20.5
Test Procedure	ANSI/TIA-603- E; FCC KDB 935210 D05, v01r03		Relative Humidity (%)		38.6
Test Location	Richmond		Barometric Pressure (kPa)		101.8
Test Engineer	Daniel Lee		Date		Nov. 08, 2019
EUT Voltage	⊠ +48VDC □ 120VAC @ 60Hz				
Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	06/12/19	08/12/21
Spectrum Analyzer	Keysight	N9010A	MY50520285	07/29/19	08/23/21
Frequency Range:	⊠ Product Passband ± 250%				
Detector:	⊠ Peak				
RBW/VBW:	⊠ 1 to 5% of the EUT passband / ≥ 3 X RBW				
Type of Facility:	⊠ Tabletop				
Distance:	⊠ Direct				
Compliant 🖂	Non-Compliant 🗆		Not Applicable $\Box$		

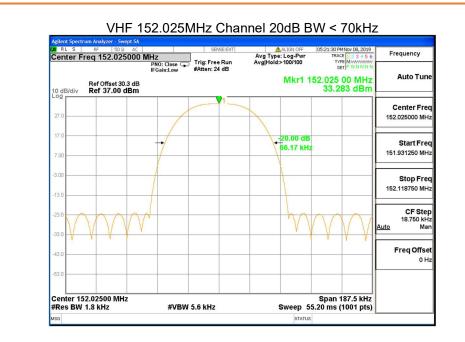
### Test setup

Description of test set-up:					
The procedure used was ANSI/TIA-603-E-2016 and FCC KDB 935210 D05 Indus Booster Basic Meas v01r03. The signal booster was set to maximum gain. A swept CW signal was set to the range of ±250 % of the product pass band. The CW ampltitude was set to 3 dB below the AGC threshold so that the ALC should not activate throughout the test.					
After the max-hold sweep trace was completed, a marker was set to the peak amplitude, and a 20dB bandwidth was measured between two additional markers fall 20 dB from the peak.					
The EUT was set to <b>Operation Mode #1 with configuration Mode #1.</b>					
Vector Signal Generator     airHost     EUT     30 dB Attenuator     Spectrum Analyzer					

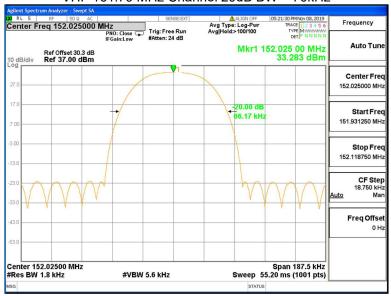
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#### Results



#### VHF 161.79 MHz Channel 20dB BW < 70kHz



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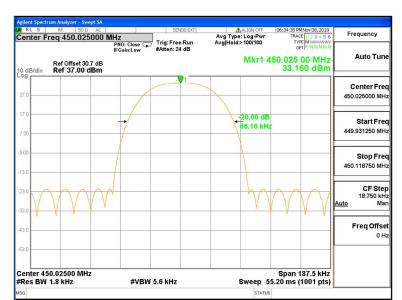
#### VHF 173.275 MHz Channel 20dB BW < 70kHz

#### BPMNov 08, 2014 enter Freq 163.275000 MHz FRO: Fast IFGain:Low Trig: Free Run Atten: 18 dB Frequency Avg Type: Log-Pwr Avg|Hold:>100/100 Auto Tun ΔMkr2 21.759 MHz 0.001 dB Ref Offset 30.3 dB Ref 37.00 dBm Center Fred 163.275000 MH: Start Free 135.775000 MH Stop Free 190.775000 MH Center 163.28 MHz #Res BW 180 kHz Span 55.00 MHz Sweep 2.133 ms (8001 pts) CF Step 5.500000 MHz #VBW 560 kHz MKB MODEL 33.701 dBm 0.001 dB 13.844 dBm 163.000 MHz 21.759 MHz (Δ) 151.780 MHz N ∆3 F **(**Δ) f Freq Offse 0 H: 8 9 10 11 > STATUS

### 150PS Total 20dB BW < 21.8MHz

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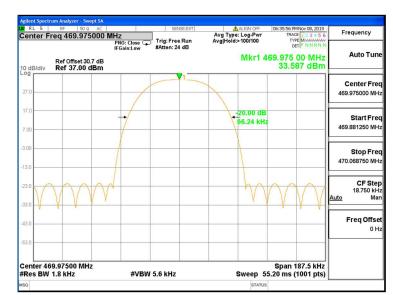
# UHF 450.025 MHz Channel 20dB BW < 70kHz

### UHF 460 MHz Channel 20dB BW < 70kHz



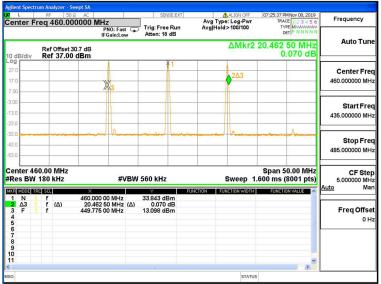
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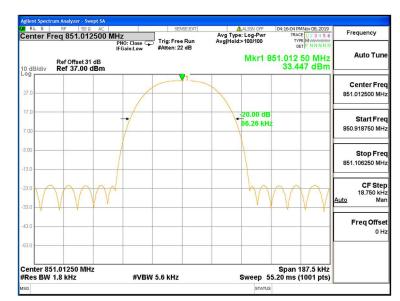
### UHF 469.975 MHz Channel 20dB BW < 70kHz

#### 450PS Total 20dB BW < 20.5MHz



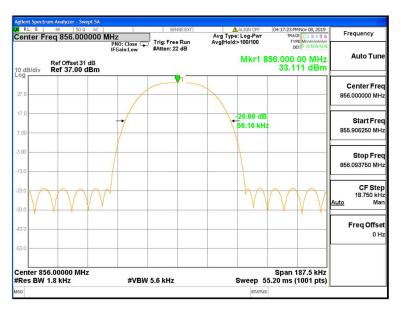
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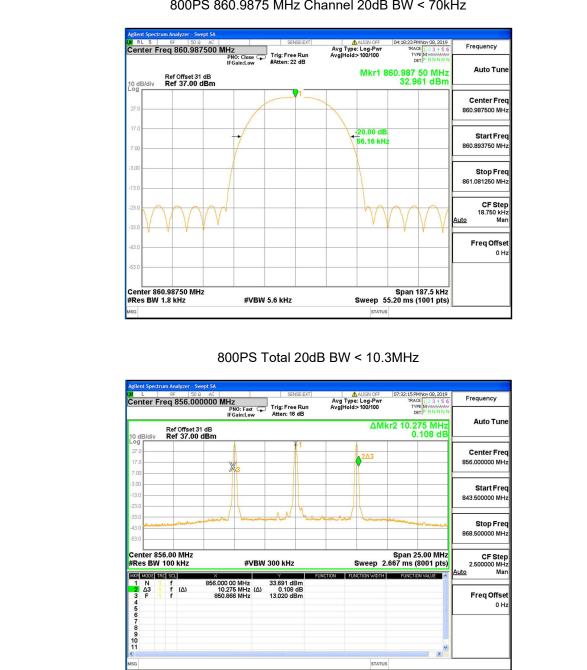
### 800PS 851.0125 MHz Channel 20dB BW < 70kHz





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# 800PS 860.9875 MHz Channel 20dB BW < 70kHz

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