

Testing Tomorrow's Technology

**CFR 47 FCC Part 2, Subpart J, and FCC Part 90, Subpart I
Certification for Private Land Mobile Radio Services
and
ANSI/TIA-603-D (2010), Equipment Measurement and Performance
Standards
And
Innovation, Science and Economic Development Canada, RSS-131,
Spectrum Management and Telecommunications Radio Standards
Specification, Zone Enhancers**

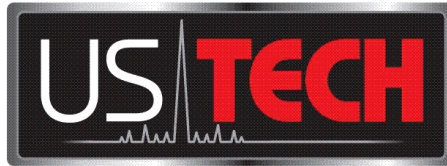
For the

**Safe-Com Wireless
Model: SAFE-1000**

**FCC ID: 2AKSM-SAFE1
IC: 22303-SAFE1**

**UST Project No: 17-0001
March 14, 2017**

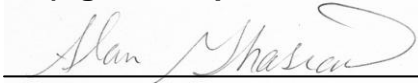
**3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com**



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I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (Agent Responsible For Test):

By: 

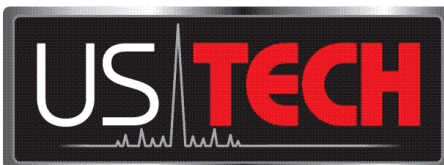
Name: Alan Ghasiani

Title: Consulting Engineer/President

Date: March 14, 2017

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MEASUREMENT/TECHNICAL REPORT

This report concerns (check one): Original grant
Class II change

Reevaluation

Equipment type: **Part 90 Distributed Antenna System (DAS)**

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes No N/A

If yes, defer until: _____
 date

 N/A agrees to notify the Commission by N/A

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
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TABLE OF CONTENTS

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
1	General Information	10
1.1	Product Description.....	10
1.2	Related Submittal(s)/Grant(s)	10
2	Test and Measurements	10
2.1	Configuration of Tested System.....	10
2.2	Characterization of Tested System	10
2.3	Test Facility	11
2.4	Test Equipment.....	11
2.5	Modifications to Equipment under Test (EUT)	11
2.6	RF Power Output (FCC Section 2.1051, 90.219(e)(1))	14
2.7	Output Power Plots	15
2.8	Noise (FCC Section 90.219(e)(2) and RSS-131, 6.4)	23
2.9	Retransmitted Signals (FCC Section 90.219(e)(4) and RSS-131, 6.6)	23
2.10	Emissions Mask Definitions (FCC Section 2.1049, 90.219(e)(4iii), 90.210)....	24
2.10.1	Emissions Mask B (FCC Part 90.210, 2.1051)	24
2.10.2	Emissions Mask D (FCC Part 90.210, 2.1051)	24
2.10.3	Emissions Mask E (FCC Part 90.210, 2.1051)	25
2.10.4	Mask I (FCC Part 90.210, 2.1051)	25
2.11	Emissions Mask and Retransmitted Signal Measurements	26
2.11.1	VHF Channel	26
2.11.2	UHF Channels	53
2.11.3	700 MHz Channels	77
2.11.4	800 MHz Channel	95
2.11.5	900 MHz Channel	113
2.12	Intermodulation (FCC Section 90.219(d)(6i) and RSS-131, 6.3).....	125
2.13	Frequency Stability (FCC 2.1055, 90.213 and RSS-131 5.2.4)	125
2.14	Spurious Emissions (FCC Section 90.219(d)(e)(3) and RSS-131, 6.5)	125
2.14.1	Radiated Spurious Emissions Measurement	125
2.14.2	Conducted Spurious Emissions Measurement	183
2.15	Unintentional Emissions (FCC Section 15.109, 15.107 and RSS-Gen)	214
2.15.1	Radiated Spurious Emissions	214
2.15.2	Conducted Powerline Emissions	215
2.16	Measurement Uncertainty	216
2.16.1	Radiated Spurious Emissions Measurement Uncertainty	216
2.16.2	Conducted Powerline Emissions Measurement uncertainty	216
3	Conclusion.....	217
3.1	Test Outcome	217

List of Figures

<u>Figure</u>	<u>Title</u>	<u>Page</u>
Figure 1.	Block Diagram of Test Configuration.....	11
Figure 2.	150 MHz Output Power Plot.....	15
Figure 3.	162 MHz Output Power Plot.....	16
Figure 4.	174 MHz Output Power Plot.....	16
Figure 5.	450 MHz Output Power Plot.....	17
Figure 6.	459 MHz Output Power Plot.....	17
Figure 7.	490 MHz Output Power Plot.....	18
Figure 8.	512 MHz Output Power Plot.....	18
Figure 9.	763 MHz Output Power Plot.....	19
Figure 10.	768.5 MHz Output Power Plot.....	19
Figure 11.	775 MHz Output Power Plot.....	20
Figure 12.	851 MHz Output Power Plot.....	20
Figure 13.	860 MHz Output Power Plot.....	21
Figure 14.	869 MHz Output Power Plot.....	21
Figure 15.	929.5 MHz Output Power Plot.....	22
Figure 16.	937 MHz Output Power Plot.....	22
Figure 17.	Input 150 MHz @ 6.25 kHz	26
Figure 18.	150 MHz @ 6.25 kHz, Mask E	27
Figure 19.	150 MHz @ 6.25 kHz +3.0 dB, Mask E	28
Figure 20.	Input 150 MHz @ 12.5 kHz	29
Figure 21.	150 MHz @ 12.5 kHz, Mask D	30
Figure 22.	150 MHz @ 12.5 kHz +3.0 dB, Mask D.....	31
Figure 23.	Input 150 MHz @ 25 kHz	32
Figure 24.	150 MHz @ 25 kHz, Mask B	33
Figure 25.	150 MHz @ 25 kHz,+ 3.0 dB, Mask B.....	34
Figure 26.	Input 162 MHz @ 6.25 kHz	35
Figure 27.	162 MHz @ 6.25 kHz, Mask E	36
Figure 28.	162 MHz @ 6.25 kHz +3.0 dB, Mask E	37
Figure 29.	Input 162 MHz @ 12.5 kHz	38
Figure 30.	162 MHz @ 12.5 kHz, Mask D	39
Figure 31.	162 MHz @ 12.5 kHz +3.0 dB, Mask D.....	40
Figure 32.	Input 162 MHz @ 25 kHz	41
Figure 33.	162 MHz @ 25 kHz, Mask B	42
Figure 34.	162 MHz @ 25 kHz +3.0 dB, Mask B.....	43
Figure 35.	Input 174 MHz @ 6.25 kHz	44
Figure 36.	174 MHz @ 6.25 kHz, Mask E	45
Figure 37.	174 MHz @ 6.25 kHz +3.0 dB, Mask E	46
Figure 38.	Input 174 MHz @ 12.5 kHz	47
Figure 39.	174 MHz @ 12.5 kHz, Mask D	48
Figure 40.	174 MHz @ 12.5 kHz +3.0 dB, Mask D.....	49
Figure 41.	Input 174 MHz @ 25 kHz	50
Figure 42.	174 MHz @ 25 kHz, Mask B	51
Figure 43.	174 MHz @ 25 kHz +3.0 dB, Mask B.....	52

Figure 44. Input 450 MHz @ 12.5 kHz	53
Figure 45. 450 MHz @ 12.5 kHz, Mask D	54
Figure 46. 450 MHz @ 12.5 kHz +3.0 dB, Mask D.....	55
Figure 47. Input 450 MHz @ 25 kHz	56
Figure 48. 450 MHz @ 25 kHz, Mask B	57
Figure 49. 450 MHz @ 25 kHz +3.0 dB, Mask B.....	58
Figure 50. Input 459 MHz @ 12.5 kHz	59
Figure 51. 459 MHz @ 12.5 kHz, Mask D	60
Figure 52. 459 MHz @ 12.5 kHz +3.0 dB, Mask D.....	61
Figure 53. Input 459 MHz @ 25 kHz	62
Figure 54. 459 MHz @ 25 kHz, Mask B	63
Figure 55. 459 MHz @ 25 kHz +3.0 dB, Mask B.....	64
Figure 56. Input 490 MHz @ 12.5 kHz	65
Figure 57. 490 MHz @ 12.5 kHz, Mask D	66
Figure 58. 490 MHz @ 12.5 kHz +3.0 dB, Mask D.....	67
Figure 59. Input 490 MHz @ 25 kHz	68
Figure 60. 490 MHz @ 25 kHz, Mask B	69
Figure 61. 490 MHz @ 25 kHz +3.0 dB, Mask B.....	70
Figure 62. Input 512 MHz @ 12.5 kHz	71
Figure 63. 512 MHz @ 12.5 kHz, Mask D	72
Figure 64. 512 MHz @ 12.5 kHz +3.0 dB, Mask D.....	73
Figure 65. Input 512 MHz @ 25 kHz	74
Figure 66. 512 MHz @ 25 kHz, Mask B	75
Figure 67. 512 MHz @ 25 kHz +3.0, Mask B	76
Figure 68. Input 762 MHz @ 12.5 kHz	77
Figure 69. 762 MHz @ 12.5 kHz, Mask B	78
Figure 70. 762 MHz @ 12.5 kHz +3.0 dB, Mask B.....	79
Figure 71. Input 763 MHz @ 25 kHz	80
Figure 72. 763 MHz @ 25 kHz, Mask B	81
Figure 73. 763 MHz @ 25 kHz +3.0 dB, Mask B.....	82
Figure 74. Input 768 MHz @ 12.5 kHz	83
Figure 75. 768 MHz @ 12.5 kHz, Mask B	84
Figure 76. 768 MHz @ 12.5 kHz +3.0 dB, Mask B.....	85
Figure 77. Input 768 MHz @ 25 kHz	86
Figure 78. 768 MHz @ 25 kHz, Mask B	87
Figure 79. 768 MHz @ 25 kHz +3.0 dB, Mask B.....	88
Figure 80. Input 774 MHz @ 12.5 kHz	89
Figure 81. 774 MHz @ 12.5 MHz, Mask B	90
Figure 82. 774 MHz @ 12.5 kHz +3.0 dB, Mask B.....	91
Figure 83. Input 774 MHz @ 25 kHz	92
Figure 84. 774 MHz @ 25 kHz, Mask B	93
Figure 85. 774 MHz @ 25 kHz +3.0 dB, Mask B.....	94
Figure 86. Input 851 MHz @ 12.5 kHz	95
Figure 87. 851 MHz @ 12.5 kHz, Mask B	96
Figure 88. 851 MHz @ 12.5 kHz +3.0 dB, Mask B.....	97
Figure 89. Input 851 MHz @ 25 kHz	98

Figure 90. 851 MHz @ 25 kHz, Mask B	99
Figure 91. 851 MHz @ 25 kHz +3.0 dB, Mask B	100
Figure 92. Input 860 MHz @ 12.5 kHz	101
Figure 93. 860 MHz @ 12.5 kHz, Mask B	102
Figure 94. 860 MHz @ 12.5 kHz +3.0 dB, Mask B	103
Figure 95. Input 860 MHz @ 25 kHz	104
Figure 96. 860 MHz @ 25 kHz, Mask B	105
Figure 97. 860 MHz @ 25 kHz +3.0 dB, Mask B	106
Figure 98. Input 869 MHz @ 12.5 kHz	107
Figure 99. 869 MHz @ 12.5 kHz, Mask B	108
Figure 100. 869 MHz @ 12.5 kHz +3.0 dB, Mask B	109
Figure 101. Input 869 MHz @ 25 kHz	110
Figure 102. 869 MHz @ 25 kHz, Mask B	111
Figure 103. 869 MHz @ 25 kHz +3.0 dB, Mask B	112
Figure 104. Input 929.5 MHz @ 12.5 kHz	113
Figure 105. 929.5 MHz @ 12.5 kHz, Mask B	114
Figure 106. 929.5 MHz @ 12.5 +3.0 dB, Mask B	115
Figure 107. Input 929.5 MHz @ 25 kHz	116
Figure 108. 929.5 MHz @ 25 kHz, Mask B	117
Figure 109. 929.5 MHz @ 25 kHz +3.0 dB, Mask	118
Figure 110. Input 937 MHz @ 12.5 kHz	119
Figure 111. 937 MHz @ 12.5 kHz, Mask I	120
Figure 112. 937 MHz @ 12.5 kHz +3.0 dB, Mask I	121
Figure 113. Input 937 MHz @ 25 kHz	122
Figure 114. 937 MHz @ 25 kHz, Mask I	123
Figure 115. 937 MHz @ 25 kHz +3.0 dB, Mask I	124
Figure 116. 150 MHz Vertical 30 – 200 MHz	126
Figure 117. 150 MHz Vertical 200- 1000 MHz	127
Figure 118. 150 MHz Vertical 1- 10 GHz	128
Figure 119. 162 MHz Vertical 30 -200 MHz	129
Figure 120. 162 MHz Vertical 200 – 1000 MHz	130
Figure 121. 162 MHz Vertical 1 -10 GHz	131
Figure 122. 174 MHz Vertical 30- 200 MHz	132
Figure 123. 174 MHz Vertical 200- 1000 MHz	133
Figure 124. 174 MHz Vertical 1 -10 GHz	134
Figure 125. 450 MHz Vertical 30 - 200 MHz	135
Figure 126. 450 MHz Vertical 200 – 1000 MHz	136
Figure 127. 450 MHz Vertical 1 – 2.9 GHz	137
Figure 128. 450 MHz Vertical 2.9 -10 GHz	138
Figure 129. 459 MHz Vertical 30 - 200 MHz	139
Figure 130. 459 MHz 200 -1000 MHz	140
Figure 131. 459 MHz Vertical 1 -2.9 GHz	141
Figure 132. 459 MHz Vertical 2.9 – 10 GHz	142
Figure 133. 490 MHz Vertical 30 - 200 MHz	143
Figure 134. 490 MHz Vertical 200 - 1000 MHz	144
Figure 135. 490 MHz Vertical 1 - 2.9 GHz	145

Figure 136. 490 MHz Vertical 2.9 -10 GHz.....	146
Figure 137. 512 MHz Vertical 30 - 200 MHz	147
Figure 138. 512 MHz Vertical 200 – 1000 MHz.....	148
Figure 139. 512 MHz Vertical 1 -2.9 GHz.....	149
Figure 140. 512 MHz Vertical 2.9 -10 GHz.....	150
Figure 141. 763 MHz Vertical 30 – 200 MHz.....	151
Figure 142. 763 MHz Vertical 200 - 1000 MHz	152
Figure 143. 763 MHz Vertical 1 – 2.9 GHz.....	153
Figure 144. 763 MHz Vertical 2.9 - 10 GHz.....	154
Figure 145. 768 MHz Vertical 30 – 200 MHz.....	155
Figure 146. 768 MHz Vertical 200 -1000 MHz	156
Figure 147. 768 MHz Vertical 1 – 2.9 GHz.....	157
Figure 148. 768 MHz Vertical 2.9 – 10 GHz.....	158
Figure 149. 774 MHz Vertical 30 – 200 MHz.....	159
Figure 150. 774 MHz Vertical 200 -1000 MHz	160
Figure 151. 774 MHz Vertical 1 - 2.9 GHz.....	161
Figure 152. 774 MHz Vertical 2.9 - 10 GHz.....	162
Figure 153. 851 MHz Vertical 30 – 200 MHz.....	163
Figure 154. 851 MHz Vertical 200 - 1000 MHz	164
Figure 155. 851 MHz Vertical 1 – 2.9 GHz.....	165
Figure 156. 851 MHz Vertical 2.9 – 10 GHz.....	166
Figure 157. 860 MHz Vertical 30 - 200 MHz	167
Figure 158. 860 MHz Vertical 200 – 1000 MHz.....	168
Figure 159. 860 MHz Vertical 1 – 2.9 GHz.....	169
Figure 160. 860 MHz Vertical 2.9 - 10 GHz.....	170
Figure 161. 869 MHz Vertical 30 - 200 MHz	171
Figure 162. 869 MHz Vertical 200 - 1000 MHz	172
Figure 163. 869 MHz Vertical 1 - 2.9 GHz.....	173
Figure 164. 869 MHz Vertical 2.9 -10 GHz.....	174
Figure 165. 929.5 MHz Vertical 30 - 200 MHz	175
Figure 166. 929.5 MHz Vertical 200 - 1000 MHz	176
Figure 167. 929.5 MHz Vertical 1 - 2.9 GHz.....	177
Figure 168. 929.5 MHz Vertical 2.9 - 10 GHz.....	178
Figure 169. 937 MHz Vertical 30 - 200 MHz	179
Figure 170. 937 MHz Vertical 200 - 1000 MHz	180
Figure 171. 937 MHz Vertical 1 - 2.9 GHz.....	181
Figure 172. 937 MHz Vertical 2.9 - 10 GHz.....	182
Figure 173. 150 MHz below 1 GHz	184
Figure 174. 150 MHz above 1 GHz.....	185
Figure 175. 162 MHz below 1 GHz	186
Figure 176. 162 MHz above 1 GHz.....	187
Figure 177. 174 MHz below 1 GHz	188
Figure 178. 174 MHz above 1 GHz.....	189
Figure 179. 450 MHz below 1 GHz	190
Figure 180. 450 MHz above 1 GHz.....	191
Figure 181. 459 MHz below 1 GHz	192

U.S. Tech Test Report:
FCC ID:
IC:
Report Number:
Issue Date:
Customer:
Model:

FCC Part 90 Certification
2AKSM-SAFE1
22303-SAFE1
17-0001
March 14, 2017
Safe-Com Wireless
SAFE-1000

Figure 182. 459 MHz above 1 GHz	193
Figure 183. 490 MHz below 1 GHz	194
Figure 184. 490 MHz above 1 GHz	195
Figure 185. 512 MHz below 1 GHz	196
Figure 186. 512 MHz above 1 GHz	197
Figure 187. 763 MHz below 1 GHz	198
Figure 188. 763 MHz above 1 GHz	199
Figure 189. 768 MHz below 1 GHz	200
Figure 190. 768 MHz above 1 GHz	201
Figure 191. 774 MHz below 1 GHz	202
Figure 192. 774 MHz above 1 GHz	203
Figure 193. 851 MHz below 1 GHz	204
Figure 194. 851 MHz above 1 GHz	205
Figure 195. 860 MHz below 1 GHz	206
Figure 196. 860 MHz above 1 GHz	207
Figure 197. 869 MHz below 1 GHz	208
Figure 198. 869 MHz above 1 GHz	209
Figure 199. 929.5 MHz below 1 GHz	210
Figure 200. 929.5 MHz above 1 GHz	211
Figure 201. 937 MHz below 1 GHz	212
Figure 202. 937 MHz above 1 GHz	213

List of Tables

<u>Table</u>	<u>Title</u>	<u>Page</u>
Table 1.	EUT and Peripherals	12
Table 2.	Test Instruments.....	13
Table 3.	Radiated Spurious Emissions.....	214
Table 4.	Conducted Powerline Emissions	215

1 General Information

1.1 Product Description

The Equipment Under Test (EUT) is the Safe-Com Safe-1000 which part of a fiber Distributed Antenna System. The EUT accepts multiple modulated RF signals from a radio base station to a head-end unit which then transmits that information over fiber optic lines to the Remote Unit (EUT). The EUT is equipped with multiple cards; each one set to operate across a specific frequency band. The cards are designed to be hot-swap cards which enable the user to easily replace the cards as needed, depending on the band of operation required.

The EUT is designed to operate in the following downlink bands:

150-174MHz VHF band
450-512MHz UHF band
763-775MHz
851-869MHz
929-941MHz

The EUT does not transmit uplink signals wirelessly. The uplink communication is via fiber connection.

The EUT is considered a Class B (non-SMR) Zone Enhancer.

1.2 Related Submittal(s)/Grant(s)

There are no related submittals or grants associated with this project.

2 Test and Measurements

2.1 Configuration of Tested System

A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious emissions measurements are shown in Figure 2. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions.

2.2 Characterization of Tested System

The sample used for testing was received by US Tech on February 2, 2017 in good condition.

2.3 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. Conducted and digital device testing was performed at US Tech's 3 meter EMC chamber measurement facility. This site has been fully described and registered by the FCC under Registration Number 186022. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

2.4 Test Equipment

The test equipment used for this evaluation is listed in Table 2 below.

2.5 Modifications to Equipment under Test (EUT)

No modifications were made by US Tech to bring the EUT into compliance with the FCC limits for the transmitter portion of the EUT.

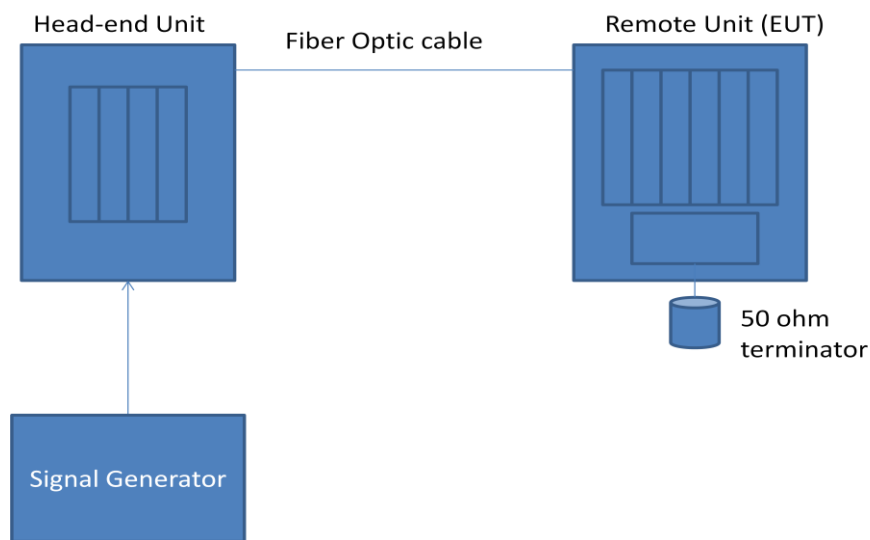


Figure 1. Block Diagram of Test Configuration

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 IC:
 Report Number:
 Issue Date:
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 Model:

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 17-0001
 March 14, 2017
 Safe-Com Wireless
 SAFE-1000

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID/ IC ID	CABLES P/D
Remote Unit with RF cards Safe-Com	SAFE-1000	Engineering Sample	FCC ID: 2AKSM-SAFE1 IC: 22303-SAFE1	3m U D 1m U P
700 Mhz Safe-Com	SAFE-1000	Engineering Sample	--	--
800 Mhz Safe-Com	SAFE-1000	Engineering Sample	--	--
900 MHz Safe-Com	SAFE-1000	Engineering Sample	--	--
UHF Safe-Com	SAFE-1000	Engineering Sample	--	--
VHF Safe-Com	SAFE-1000	Engineering Sample	--	--
Head End Unit	SAFE-1010	Engineering Sample	None	3m U D 1.5m U P

U= Unshielded, S= Shielded, P= Power cable, D= Data cable

U.S. Tech Test Report:
 FCC ID:
 IC:
 Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 90 Certification
 2AKSM-SAFE1
 22303-SAFE1
 17-0001
 March 14, 2017
 Safe-Com Wireless
 SAFE-1000

Table 2. Test Instruments

EQUIPMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	DSA815	RIGOL	DSA8A18030 0138	6/30/2017
SPECTRUM ANALYZER	E4407B	Agilent	US41442935	5/11/2017
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	8/23/2017
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	1937A02980	4/02/2017
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2434A02157	9/26/2017
RF PREAMP > 1 GHz	8449B	HEWLETT PACKARD	3008A00480	4/01/2017
LOG PERIODIC	3146	EMCO	9305-3600	9/21/2018 2 YR
BICONNICAL	3110B	EMCO	9307-1431	8/25/2017 2 YR
HORN ANTENNA	3115	EMCO	9107-3723	9/22/2018 2 YR
SIGNAL GENERATOR	MG3671B	Anritsu	M52073/ M53573/ M17473	Verified with Agilent E4407B analyzer
SIGNAL GENERATOR	HP8648B	HEWLETT-PACKARD	3642U01679	Verified with Agilent E4407B analyzer

Note: The calibration interval of the above test instruments is 12 months and all calibrations are traceable to NIST/USA.

2.6 RF Power Output (FCC Section 2.1051, 90.219(e)(1))

The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel.

The EUT was connected to a spectrum analyzer through a 20 dB power attenuator. All cables and attenuator losses were input into the spectrum analyzer as either a reference level offset or an external preamp gain correction to ensure that accurate readings were obtained.

A CW signal was utilized and transmitted through the EUT. The RF input signal was set at least 0.2 dB below the AGC threshold. The spectrum analyzer was set to the following settings: RBW= 100 kHz, Video= 3x RBW, Span of 1 MHz.

The output power levels are recorded below:

Band	Tuned Frequency	Measured Output power (dBm)	Manufacturer rated max Output Power limit (< 5 Watt)	Margin (dB) From the rated output
VHF	150.00 MHz	27.66	30 dBm	2.34
	162.00 MHz	25.90	30 dBm	4.10
	174.00 MHz	24.15	30 dBm	5.85
UHF	450.00 MHz	30.90	33 dBm	2.10
	459.00 MHz	30.73	33 dBm	2.27
	490.00 MHz	29.80	33 dBm	3.20
	512.00 MHz	28.70	33 dBm	4.30
700	763.00 MHz	31.16	33 dBm	1.84
	768.50 MHz	31.45	33 dBm	1.55
	775.00 MHz	31.69	33 dBm	1.31
800	851.00 MHz	32.33	33 dBm	0.67
	860.00 MHz	32.31	33 dBm	0.69
	869.00 MHz	32.26	33 dBm	0.74
900	929.50 MHz	32.20	33 dBm	0.80
	937.00 MHz	31.80	33 dBm	1.20

2.7 Output Power Plots

Following are the Output Power Plots.

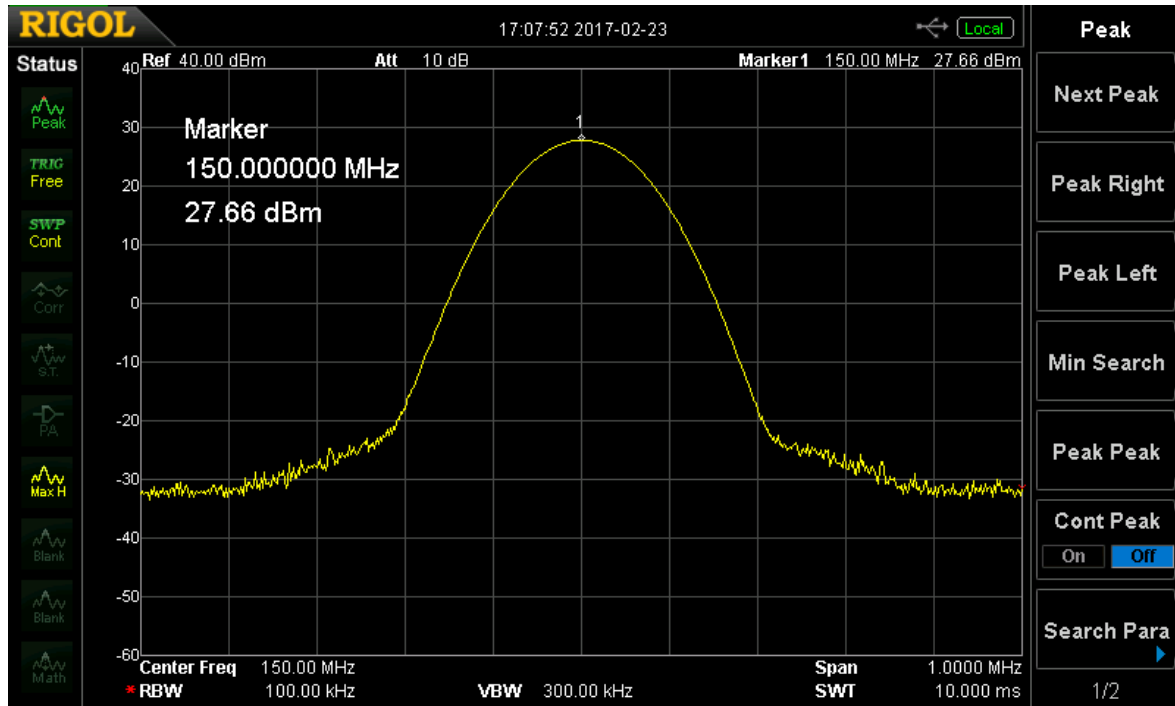


Figure 2. 150 MHz Output Power Plot

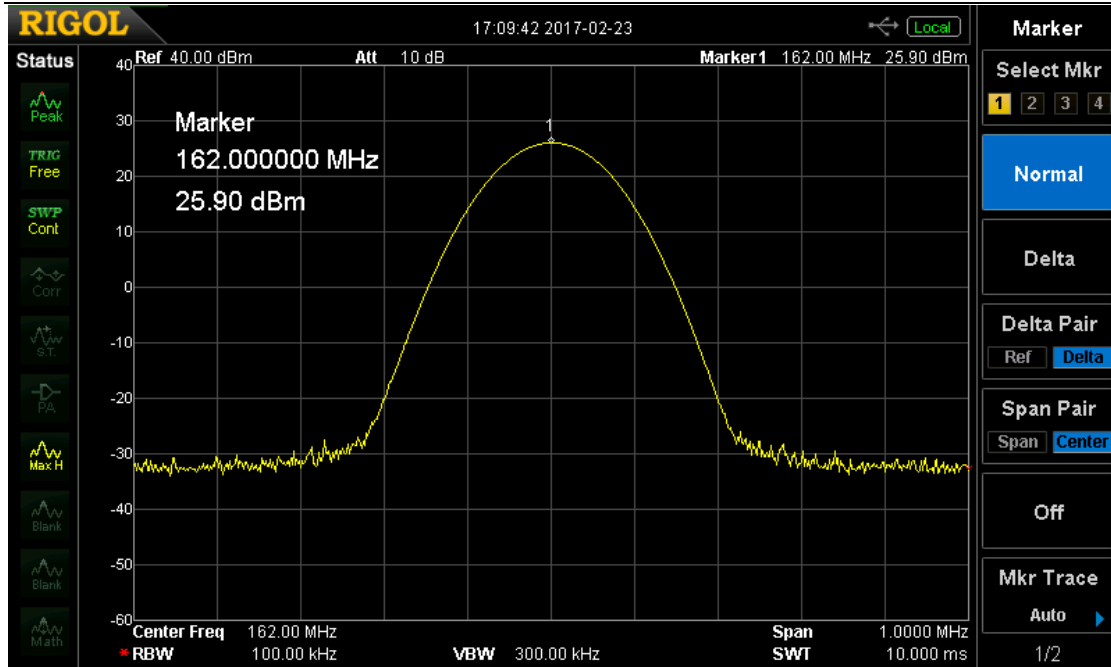


Figure 3. 162 MHz Output Power Plot

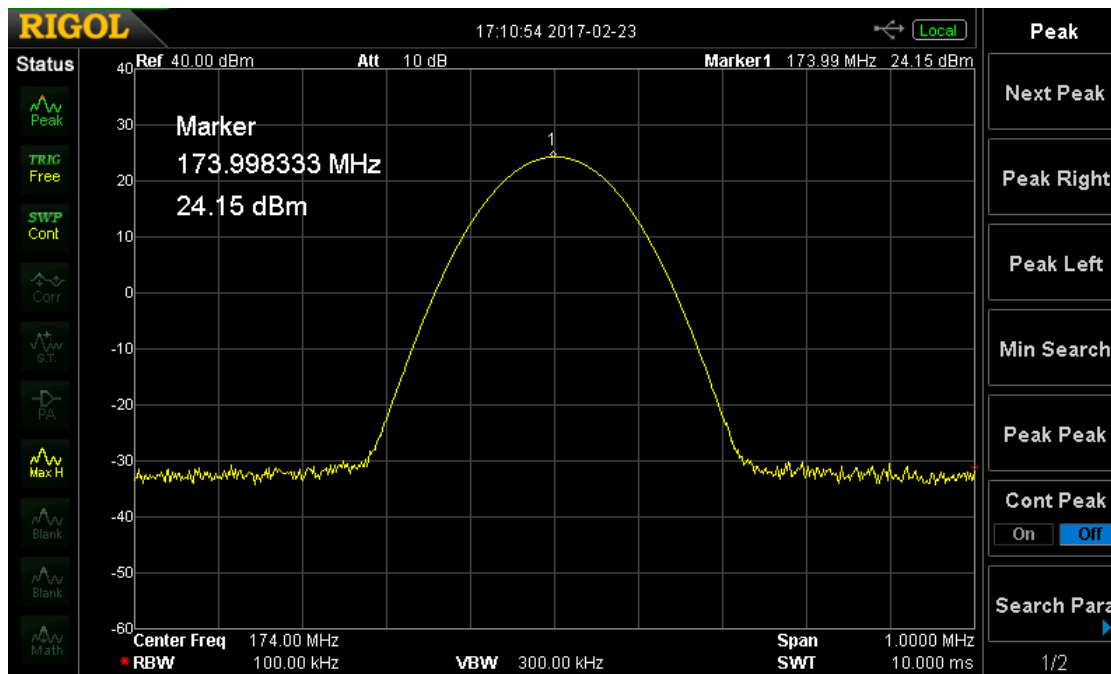


Figure 4. 174 MHz Output Power Plot

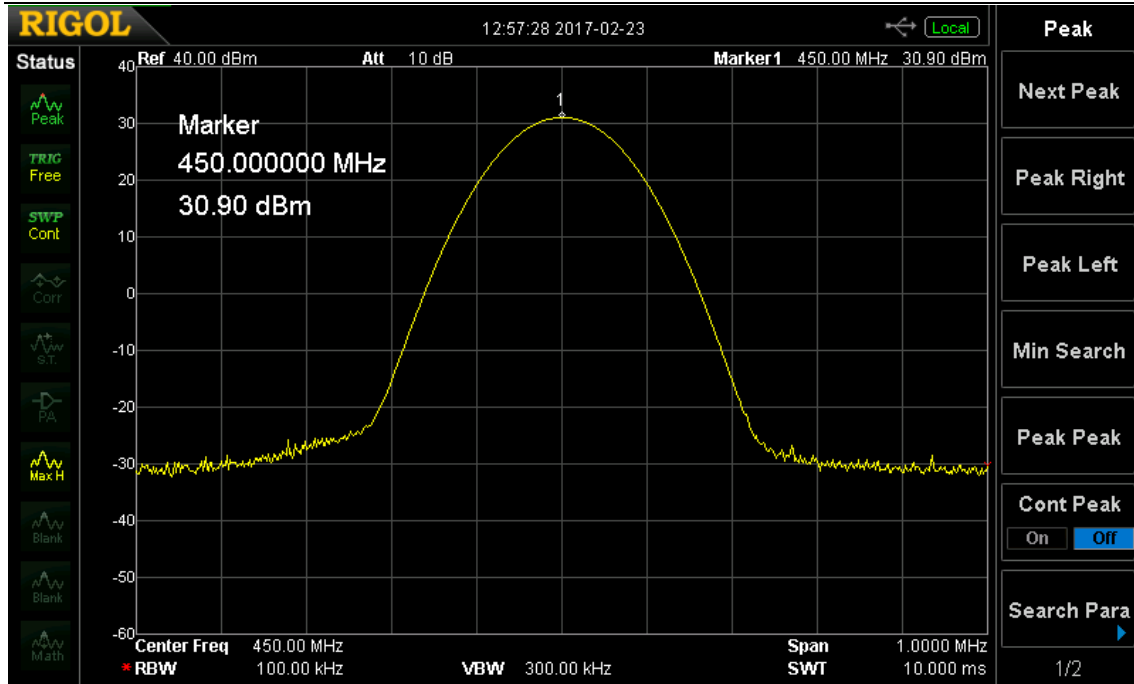


Figure 5. 450 MHz Output Power Plot

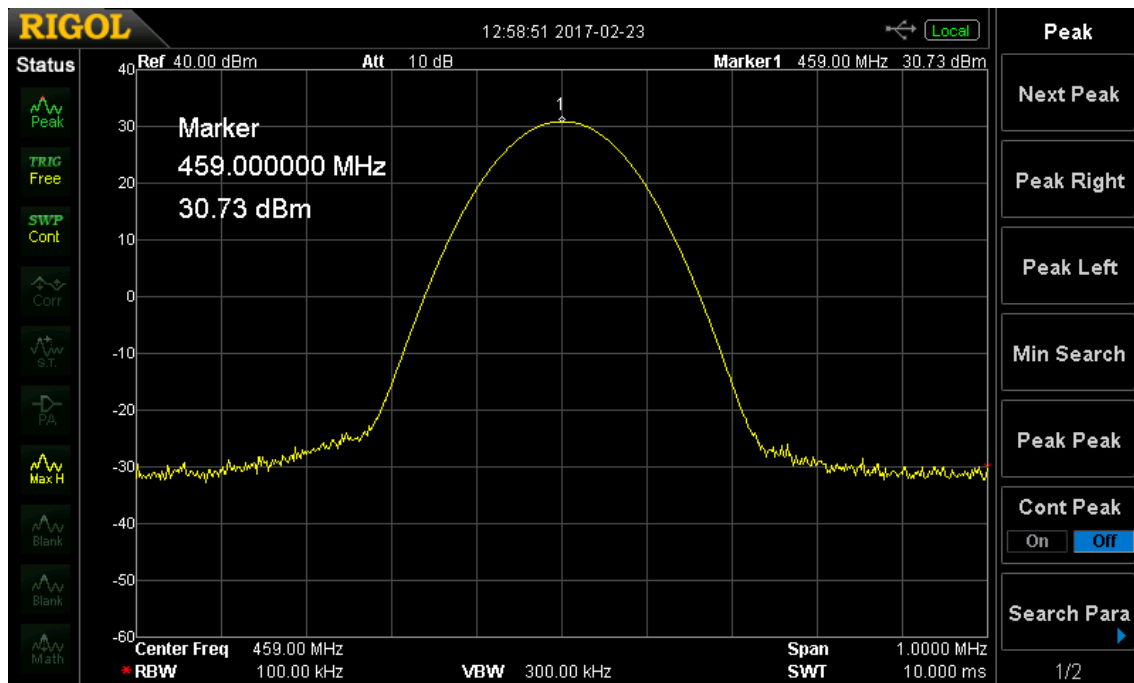


Figure 6. 459 MHz Output Power Plot

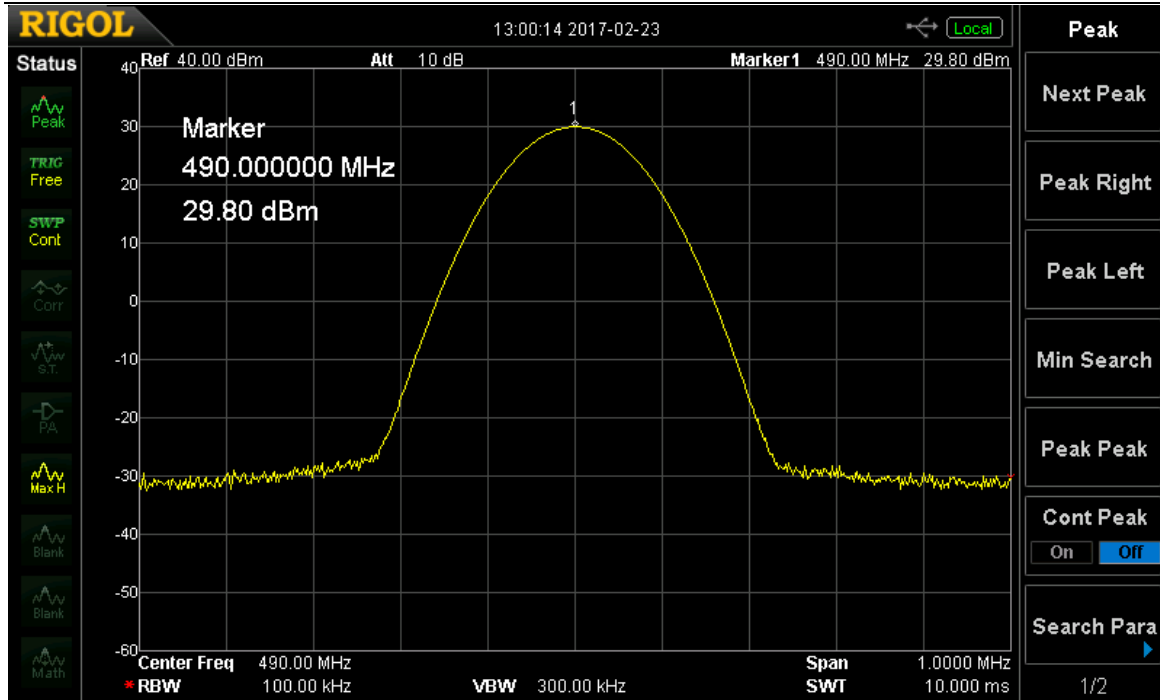


Figure 7. 490 MHz Output Power Plot

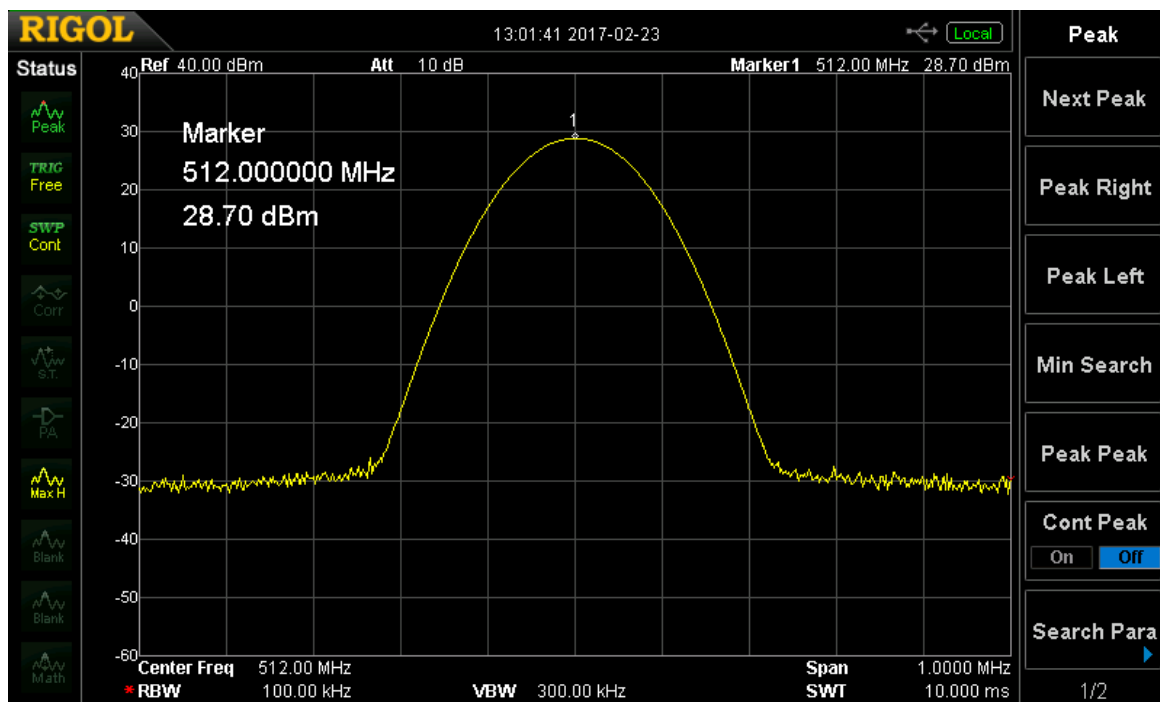


Figure 8. 512 MHz Output Power Plot

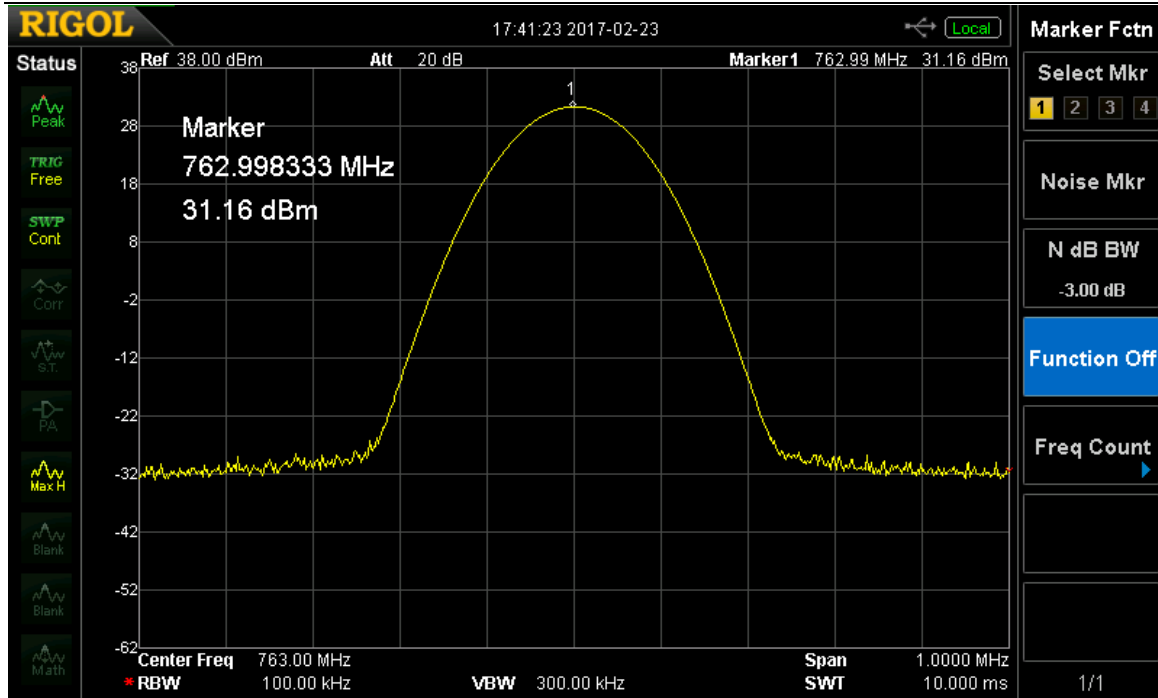


Figure 9. 763 MHz Output Power Plot

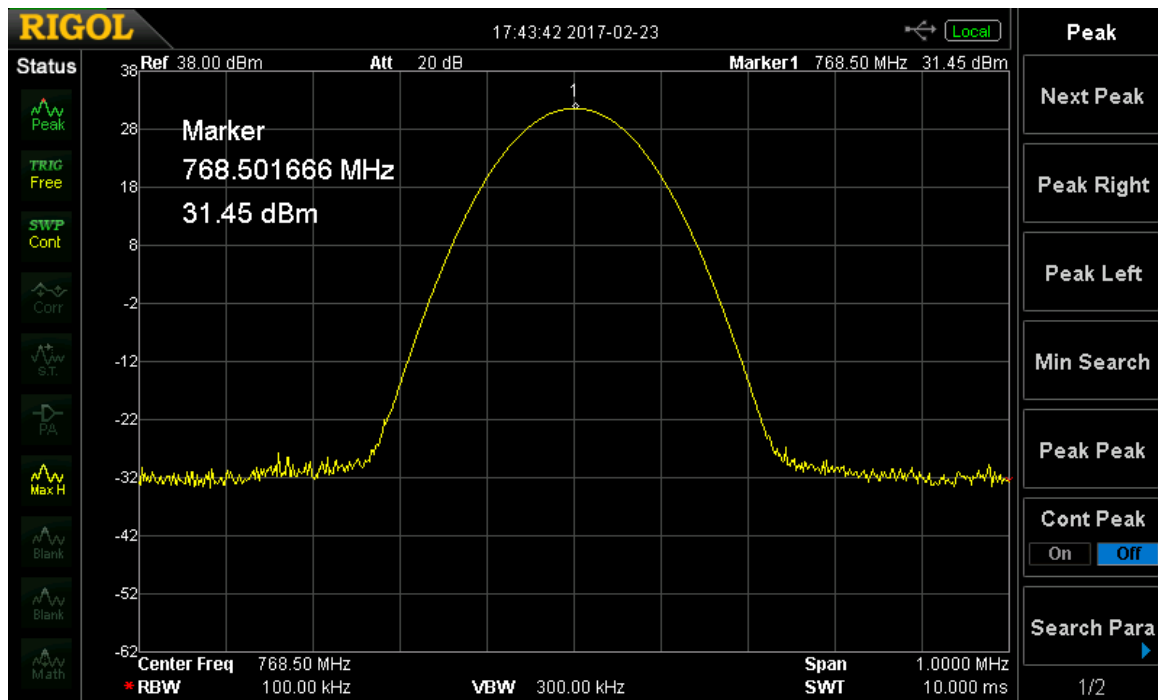


Figure 10. 768.5 MHz Output Power Plot

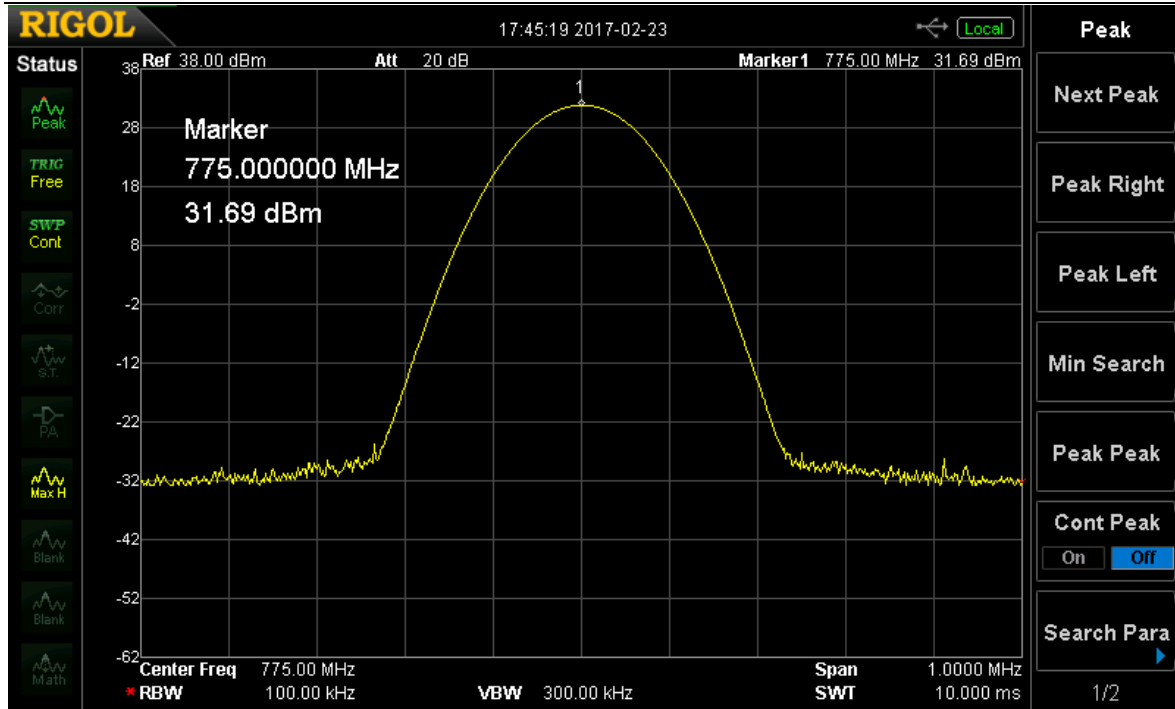


Figure 11. 775 MHz Output Power Plot

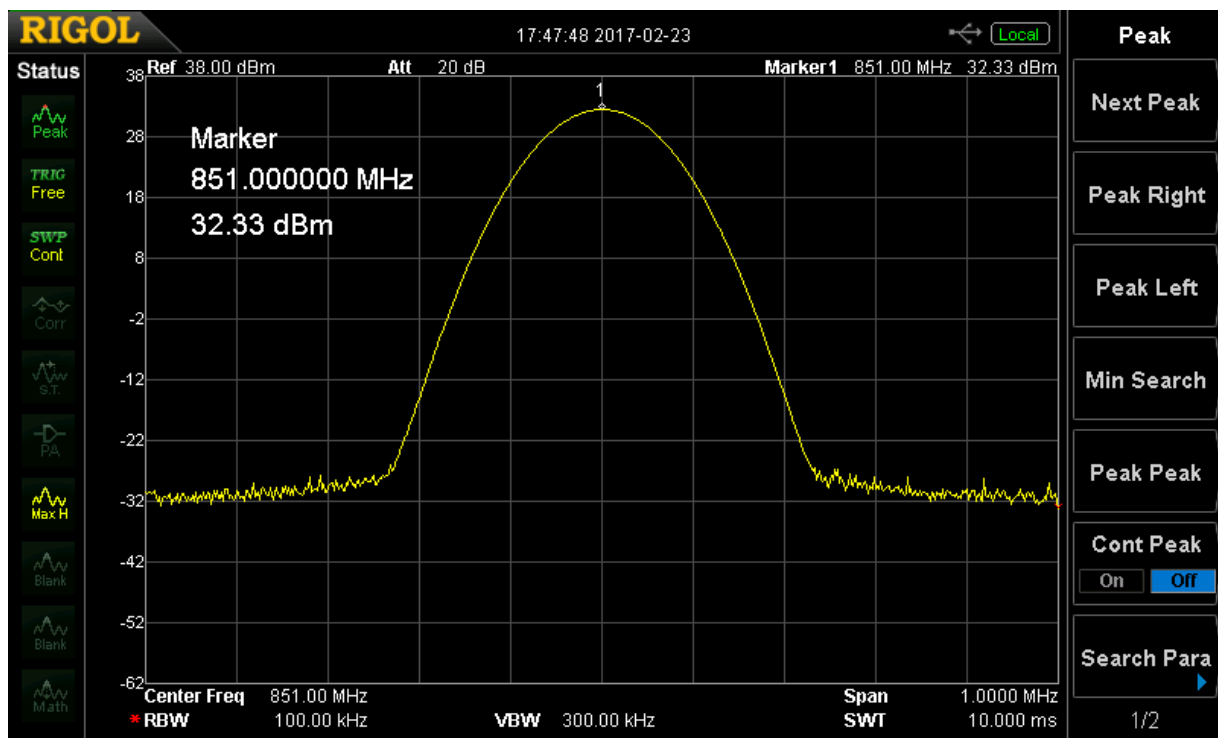


Figure 12. 851 MHz Output Power Plot

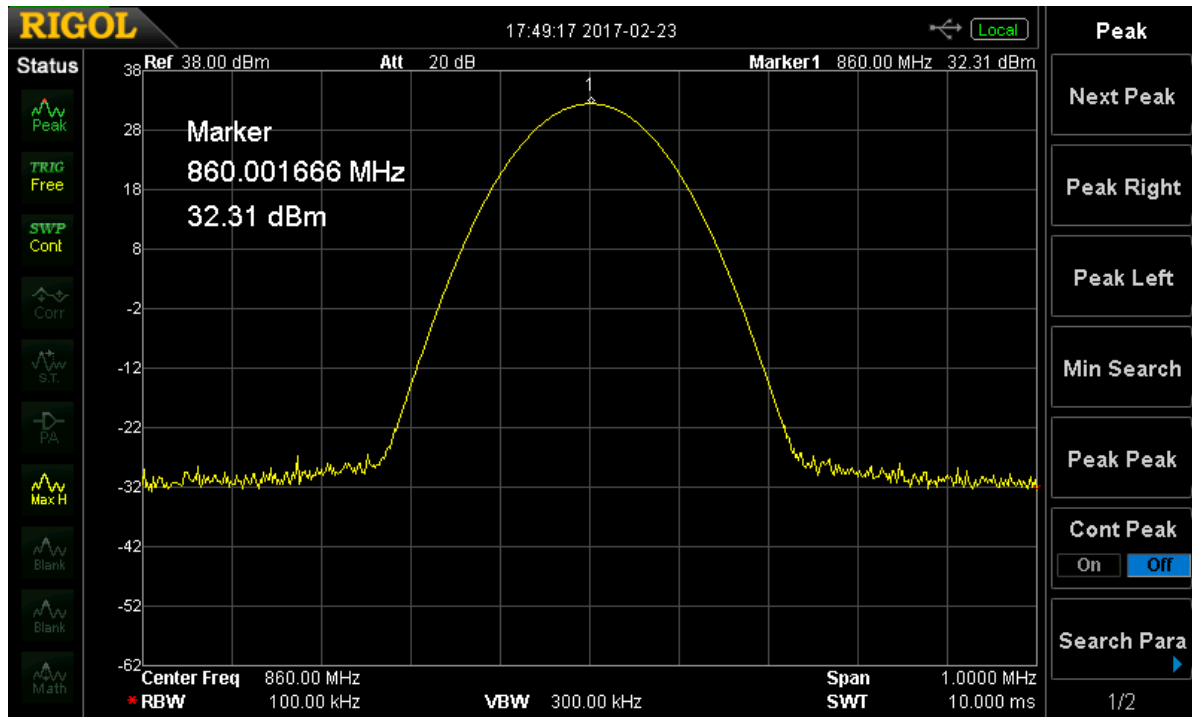


Figure 13. 860 MHz Output Power Plot

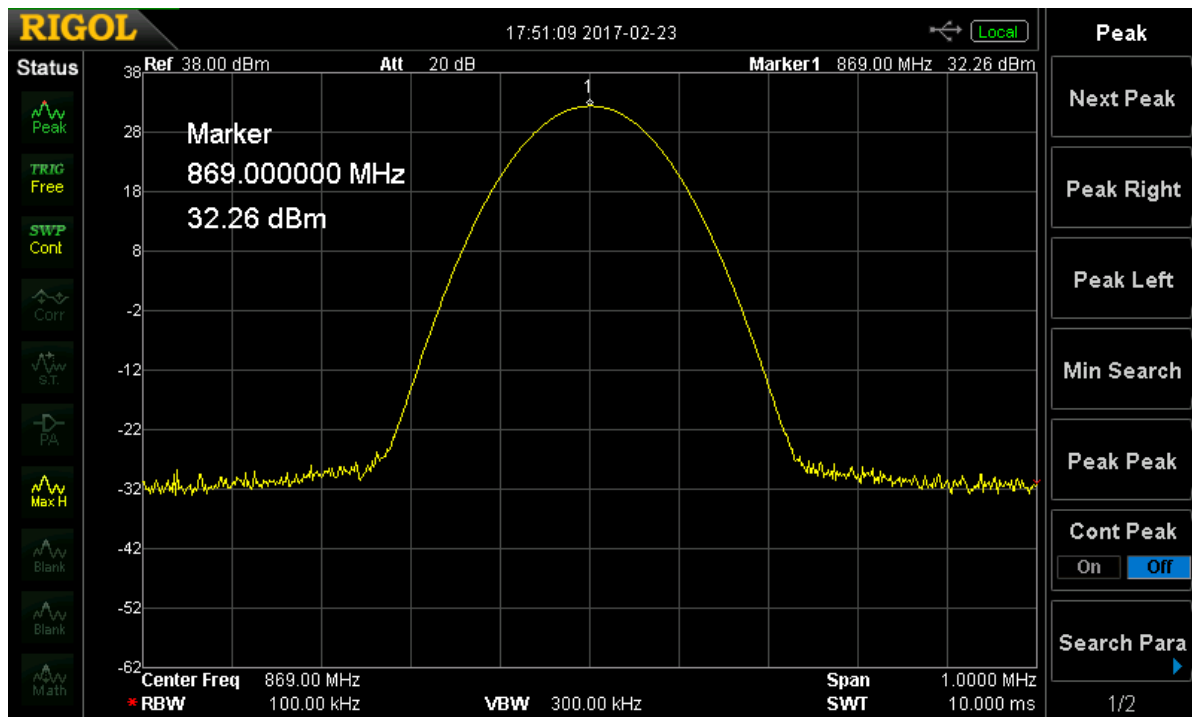


Figure 14. 869 MHz Output Power Plot

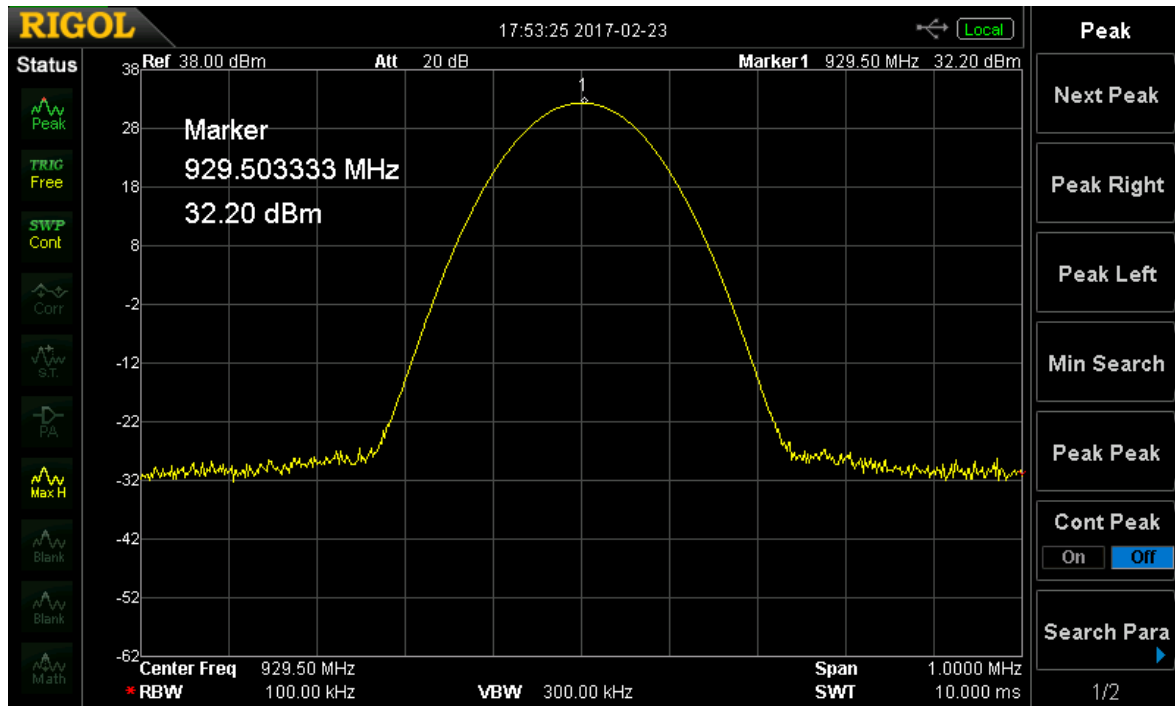


Figure 15. 929.5 MHz Output Power Plot

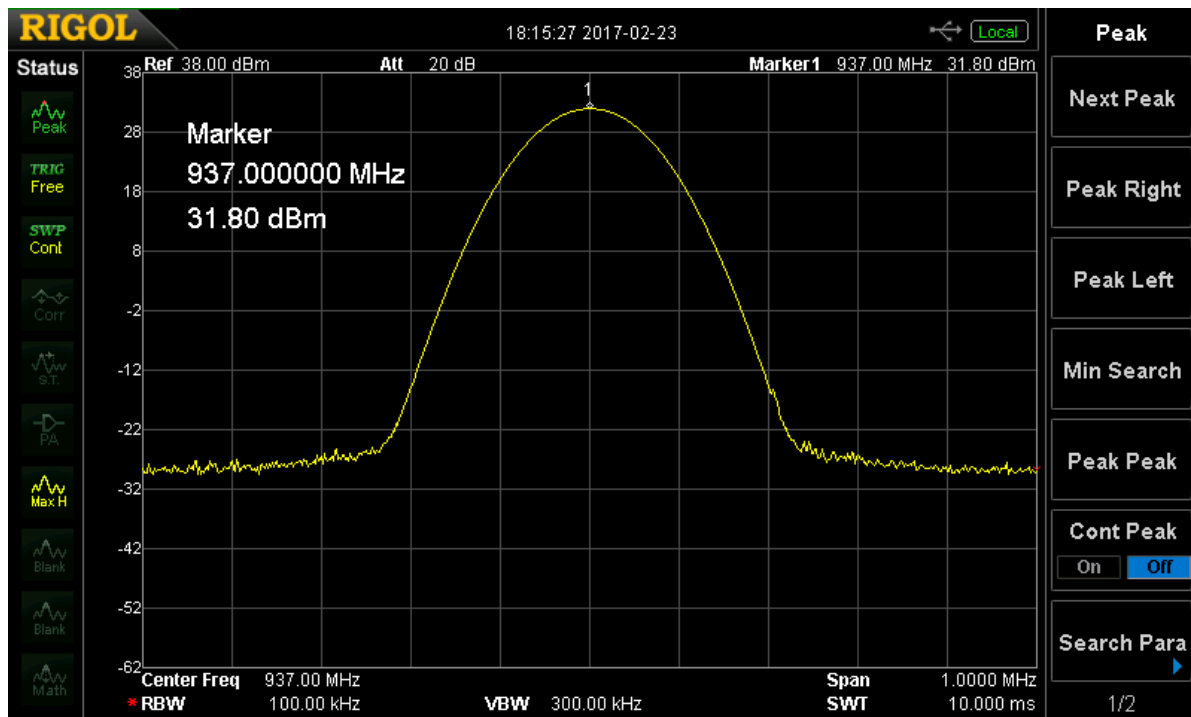


Figure 16. 937 MHz Output Power Plot

2.8 Noise (FCC Section 90.219(e)(2) and RSS-131, 6.4)

The noise figure of a signal booster must not exceed 9 dB in either direction.

The EUT is a DAS system; this test was deemed not applicable.

2.9 Retransmitted Signals (FCC Section 90.219(e)(4) and RSS-131, 6.6)

A signal booster must be designed such that all signals, when retransmitted meet the following requirements:

1. The signals are retransmitted on the same channels as received. Minor departures from the exact provider or reference frequencies of the input signals are allowed provided that the retransmitted signals meet the requirements of 90.213.

In this case the EUT is exempt from meeting these requirements.

2. There is no change in the occupied bandwidth of the retransmitted signals.

The EUT meets this requirement; see the plots in the following section which show the input signal compared to the retransmitted signal.

3. The retransmitted signals continue to meet the unwanted emissions limits of Part 90.210 applicable to the corresponding received signal.

The EUT meets this requirement; see the emissions mask test data presented in the next section.

U.S. Tech Test Report:
FCC ID:
IC:
Report Number:
Issue Date:
Customer:
Model:

FCC Part 90 Certification
2AKSM-SAFE1
22303-SAFE1
17-0001
March 14, 2017
Safe-Com Wireless
SAFE-1000

2.10 Emissions Mask Definitions (FCC Section 2.1049, 90.219(e)(4iii), 90.210)

The EUT is equipped with a low pass filter; therefore the emissions masks for equipment utilizing a low pass filter were applied.

2.10.1 Emissions Mask B (FCC Part 90.210, 2.1051)

Emission Mask B. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

- (1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
- (2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
- (3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

2.10.2 Emissions Mask D (FCC Part 90.210, 2.1051)

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) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least $7.27(f_d - 2.88 \text{ kHz})$ 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.

2.10.3 Emissions Mask E (FCC Part 90.210, 2.1051)

Emission Mask E—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less 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 f_0 to 3.0 kHz removed from f_0 : Zero dB.
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least $30 + 16.67(f_d - 3 \text{ kHz})$ or $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation.
- (3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least $55 + 10 \log (P)$ or 65 dB, whichever is the lesser attenuation.

2.10.4 Mask I (FCC Part 90.210, 2.1051)

Emission Mask I. For transmitters that are equipped with an audio low pass filter, the power of any emission must be attenuated below the unmodulated carrier power of the transmitter (P) as follows:

- (1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency of more than 6.8 kHz, but no more than 9.0 kHz: At least 25 dB;
- (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency of more than 9.0 kHz, but no more than 15 kHz: At least 35 dB;
- (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency of more than 15 kHz: At least $43 + 10 \log (P)$ dB, or 70 dB, whichever is the lesser attenuation.

2.11 Emissions Mask and Retransmitted Signal Measurements

The EUT was connected to a spectrum analyzer through a 20 dB attenuator. All cable and attenuator losses were input into the spectrum analyzer as a combination of reference level offset and/or external correction factor offset to ensure accurate readings were obtained. Measurements were collect to verify that the EUT meets the required emissions mask parameters as cited in section 2.10 of this test report. A reference level plot is provided to show that the retransmitted signal meets the parameters as cited in section 2.10 of this test report.

The Emissions Mask were measured with the RF input set to at least 0.2 dB below the AGC level and then at +3.0 dB above the AGC level per KDB 935210 D03 V04.

2.11.1 VHF Channel

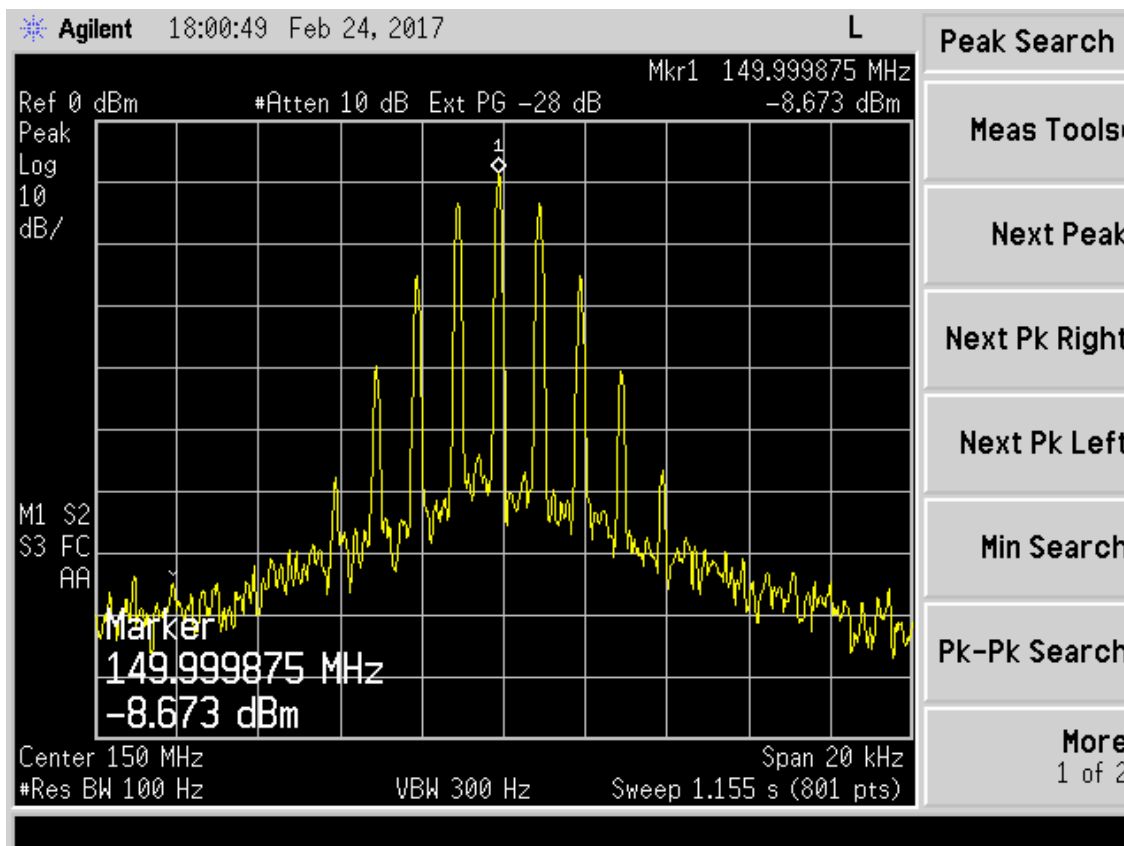


Figure 17. Input 150 MHz @ 6.25 kHz

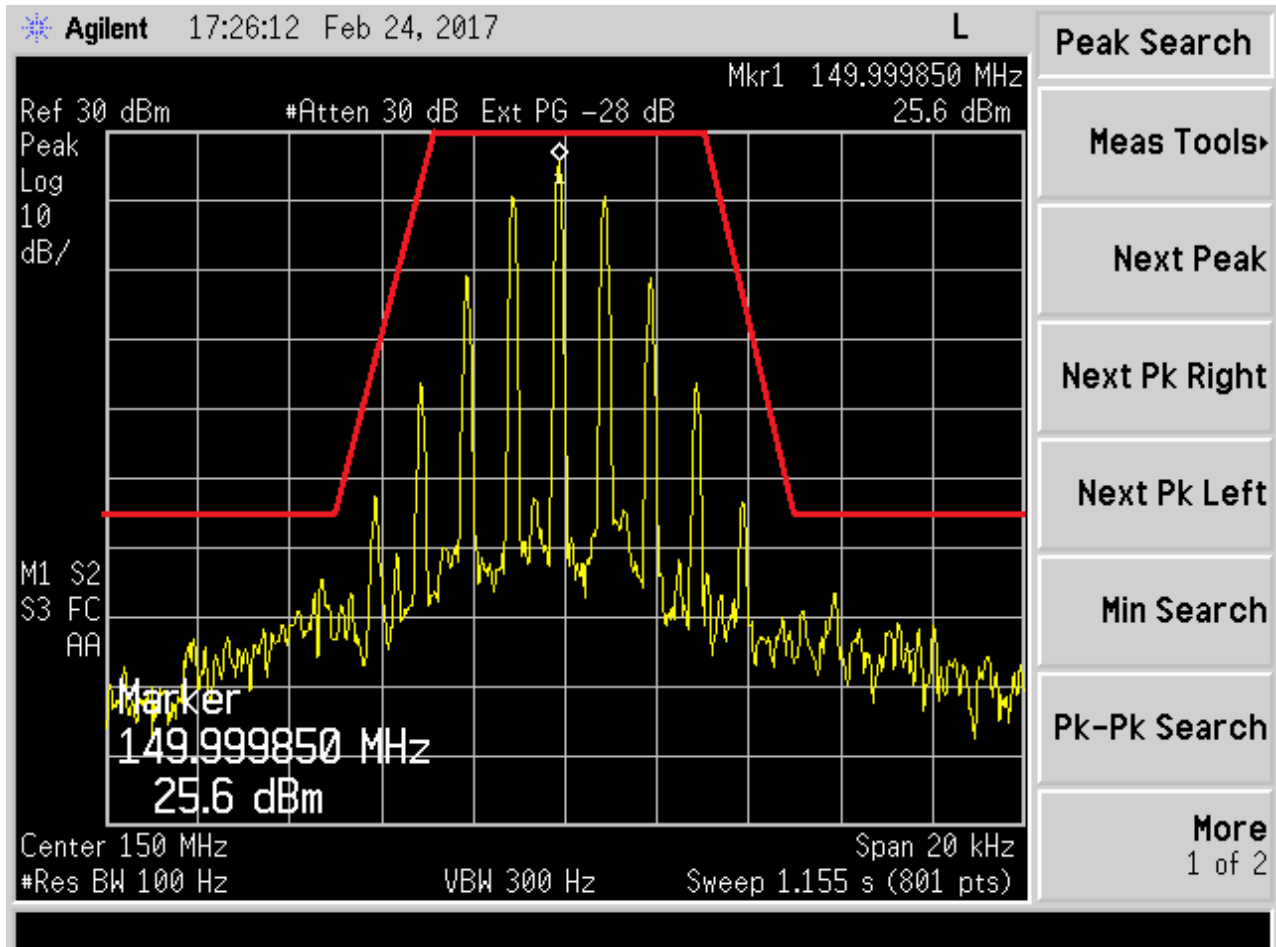


Figure 18. 150 MHz @ 6.25 kHz, Mask E

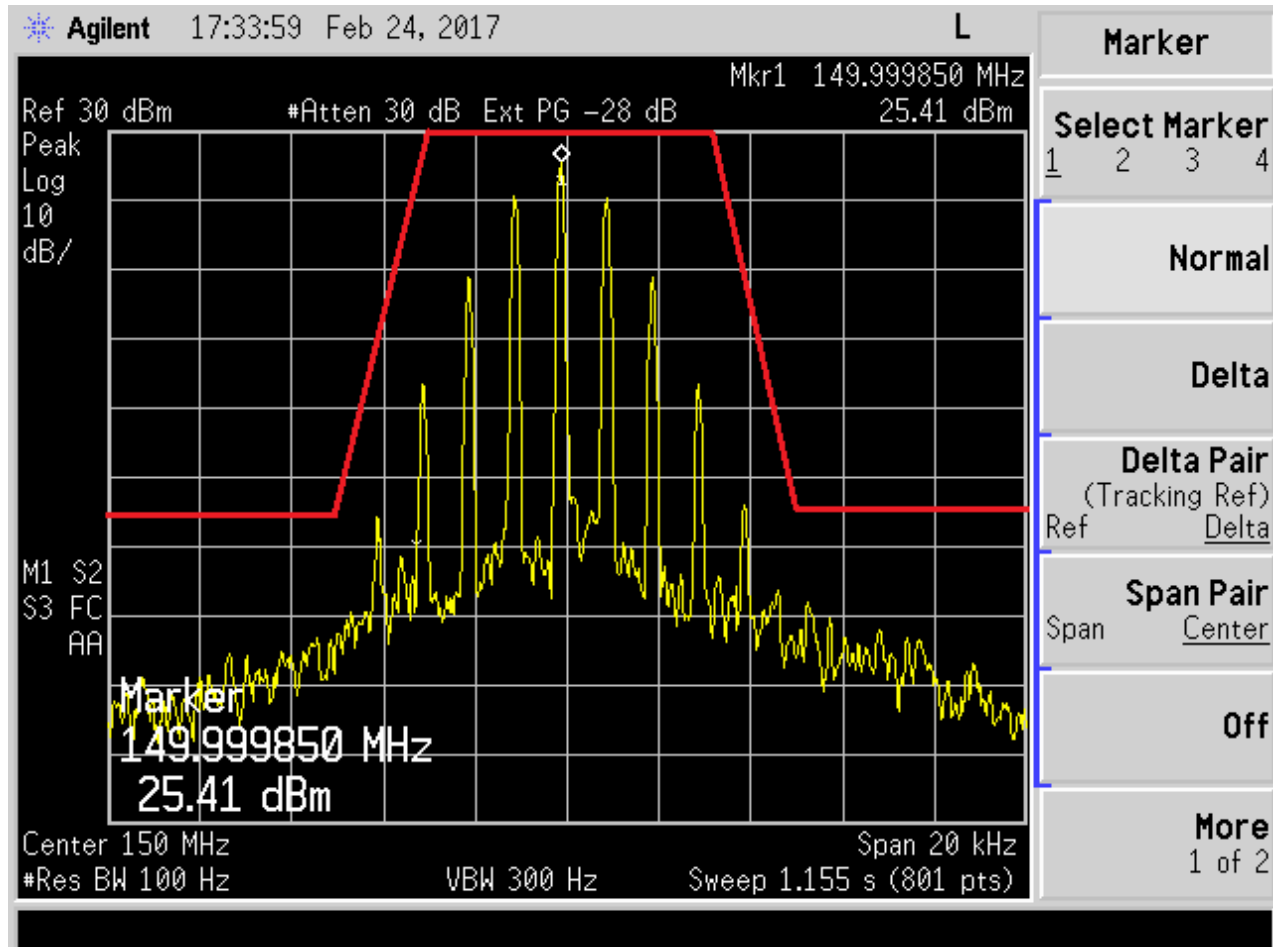


Figure 19. 150 MHz@ 6.25 kHz +3.0 dB, Mask E

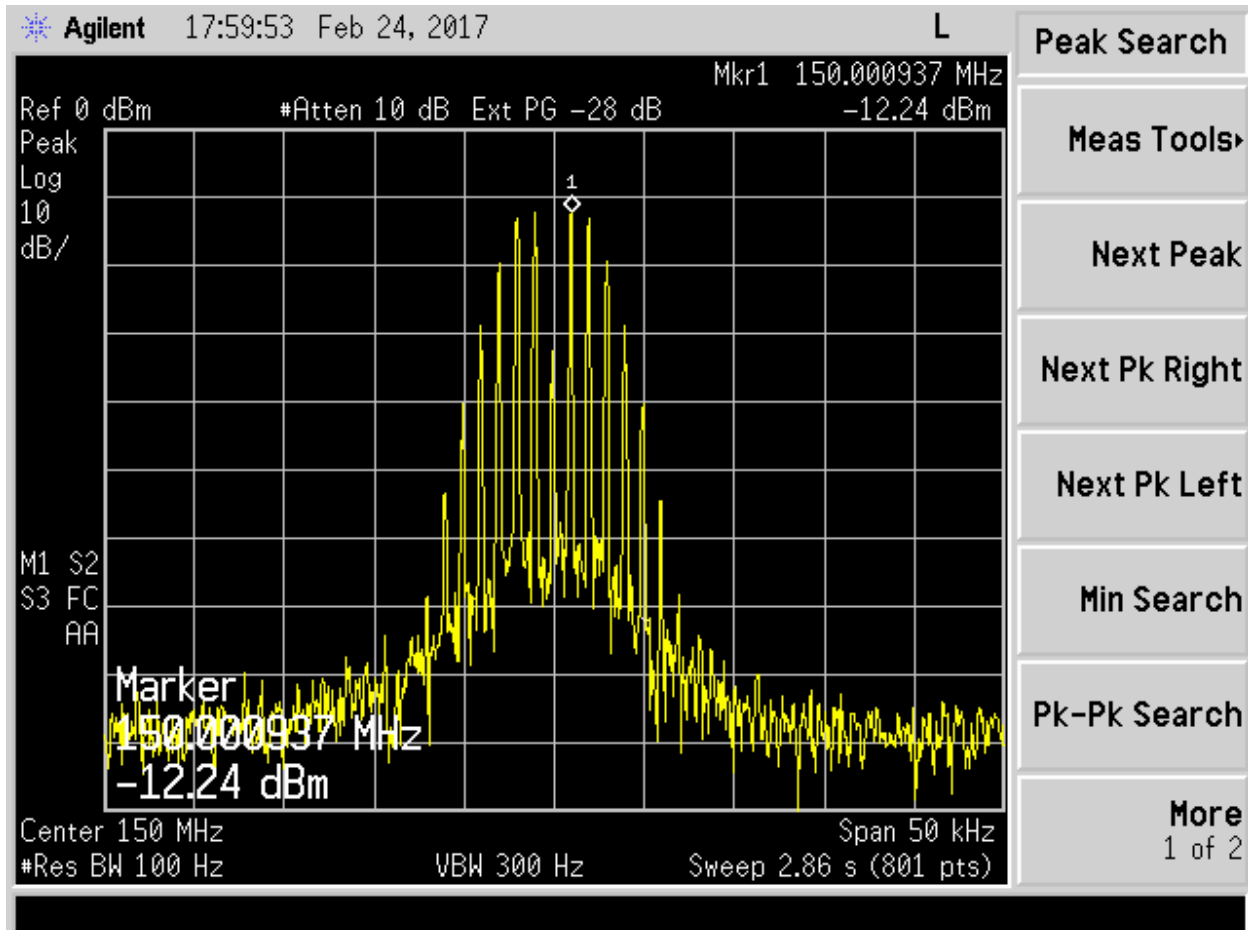


Figure 20. Input 150 MHz @ 12.5 kHz

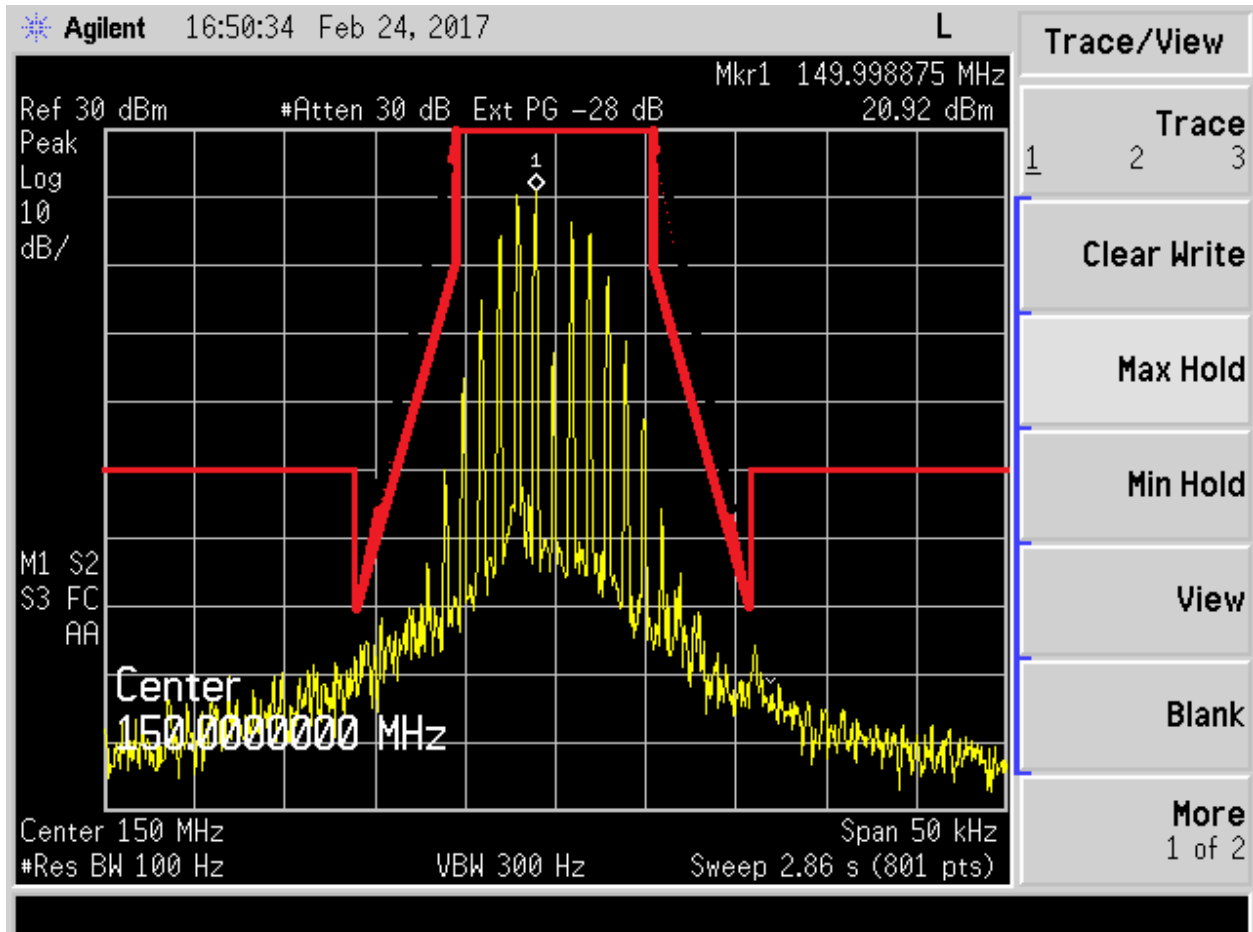


Figure 21. 150 MHz @ 12.5 kHz, Mask D

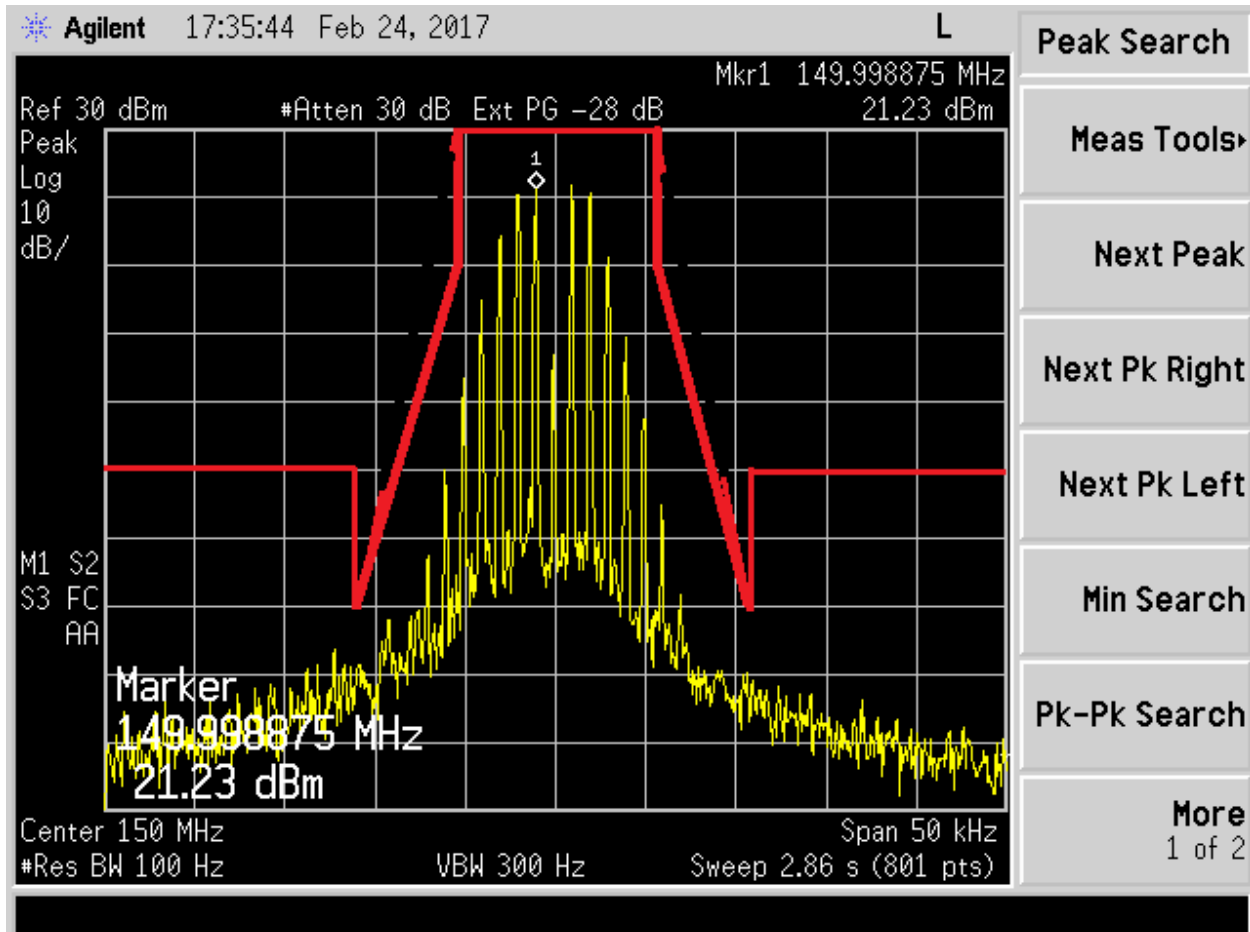


Figure 22. 150 MHz @ 12.5 kHz +3.0 dB, Mask D

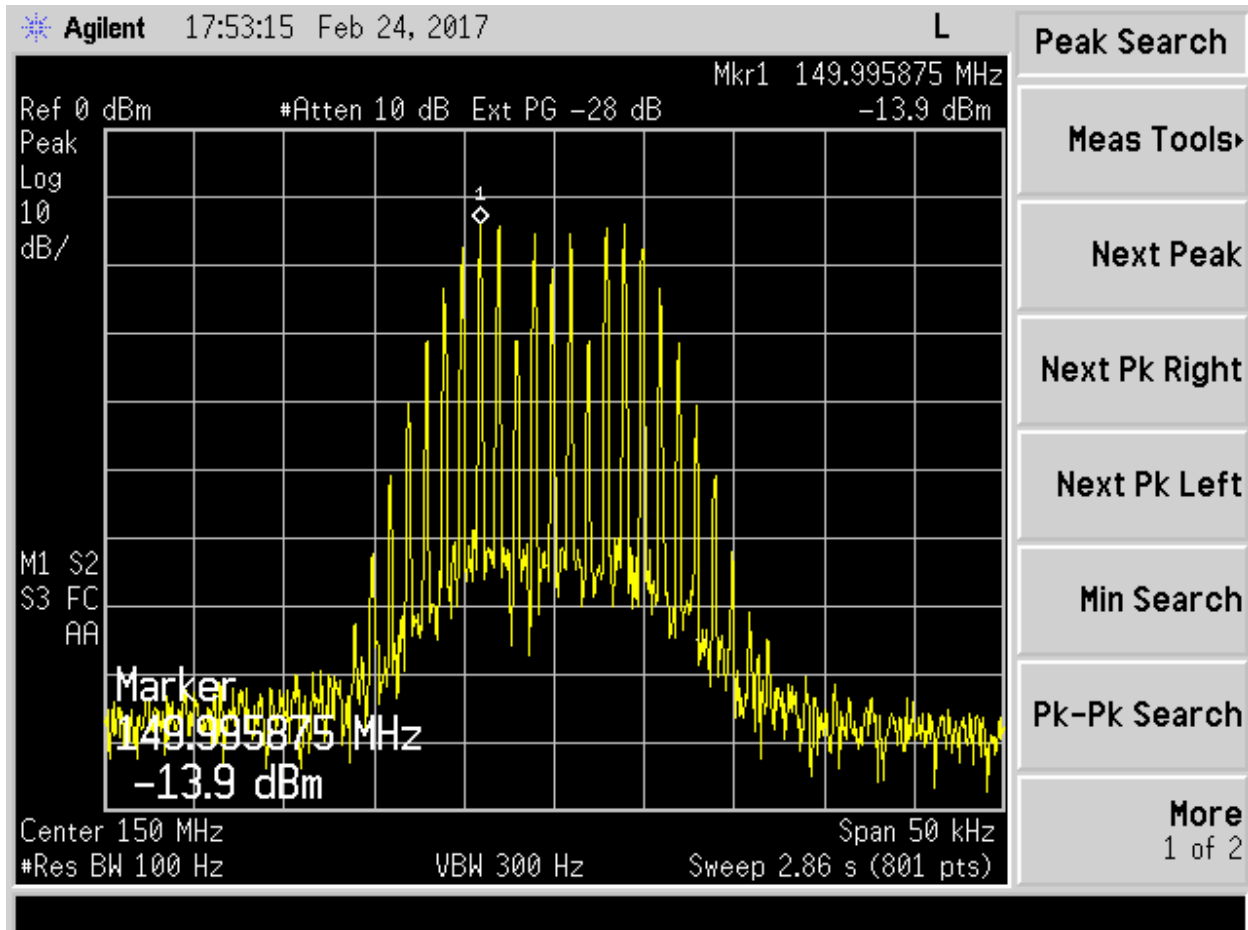


Figure 23. Input 150 MHz @ 25 kHz

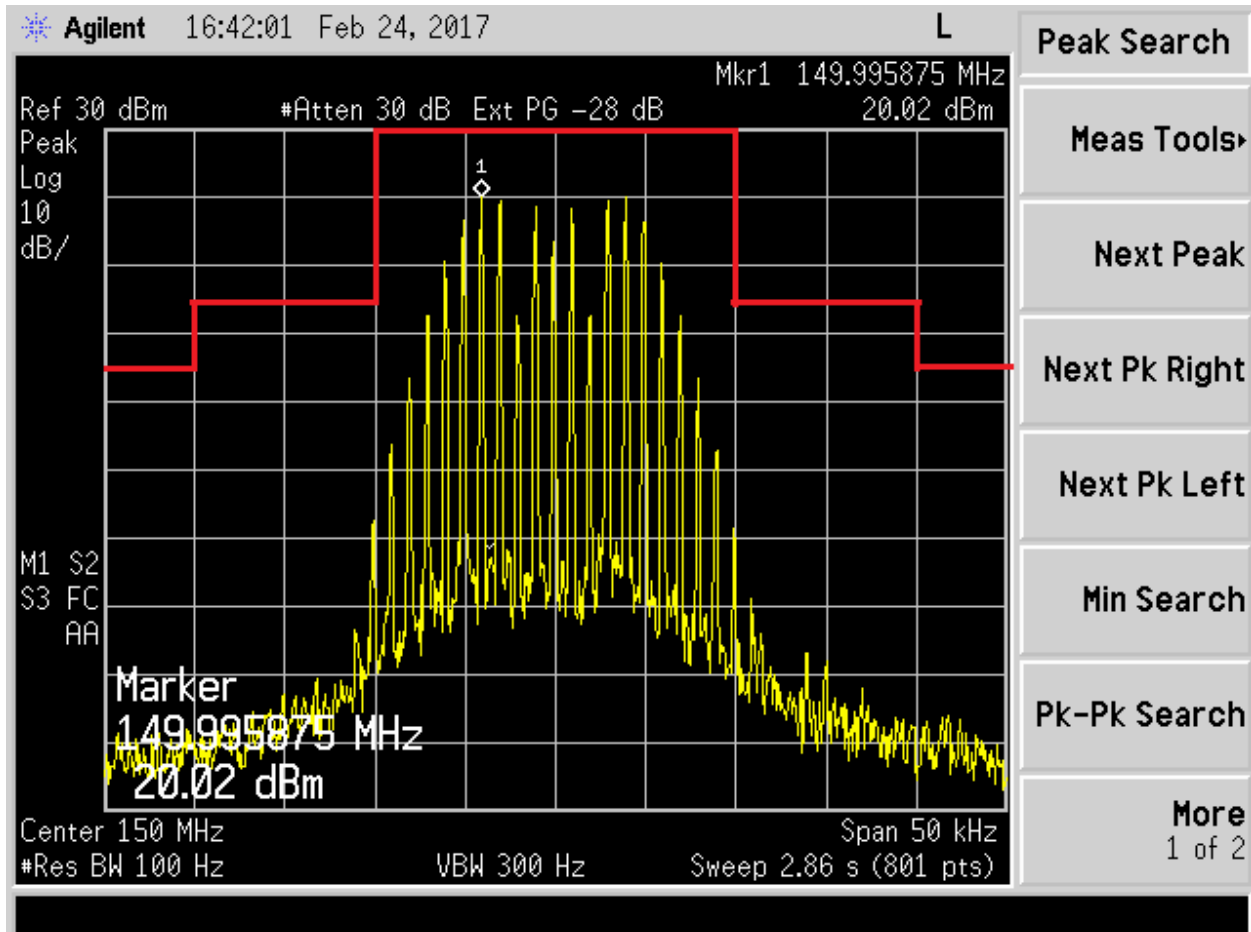


Figure 24. 150 MHz @ 25 kHz, Mask B

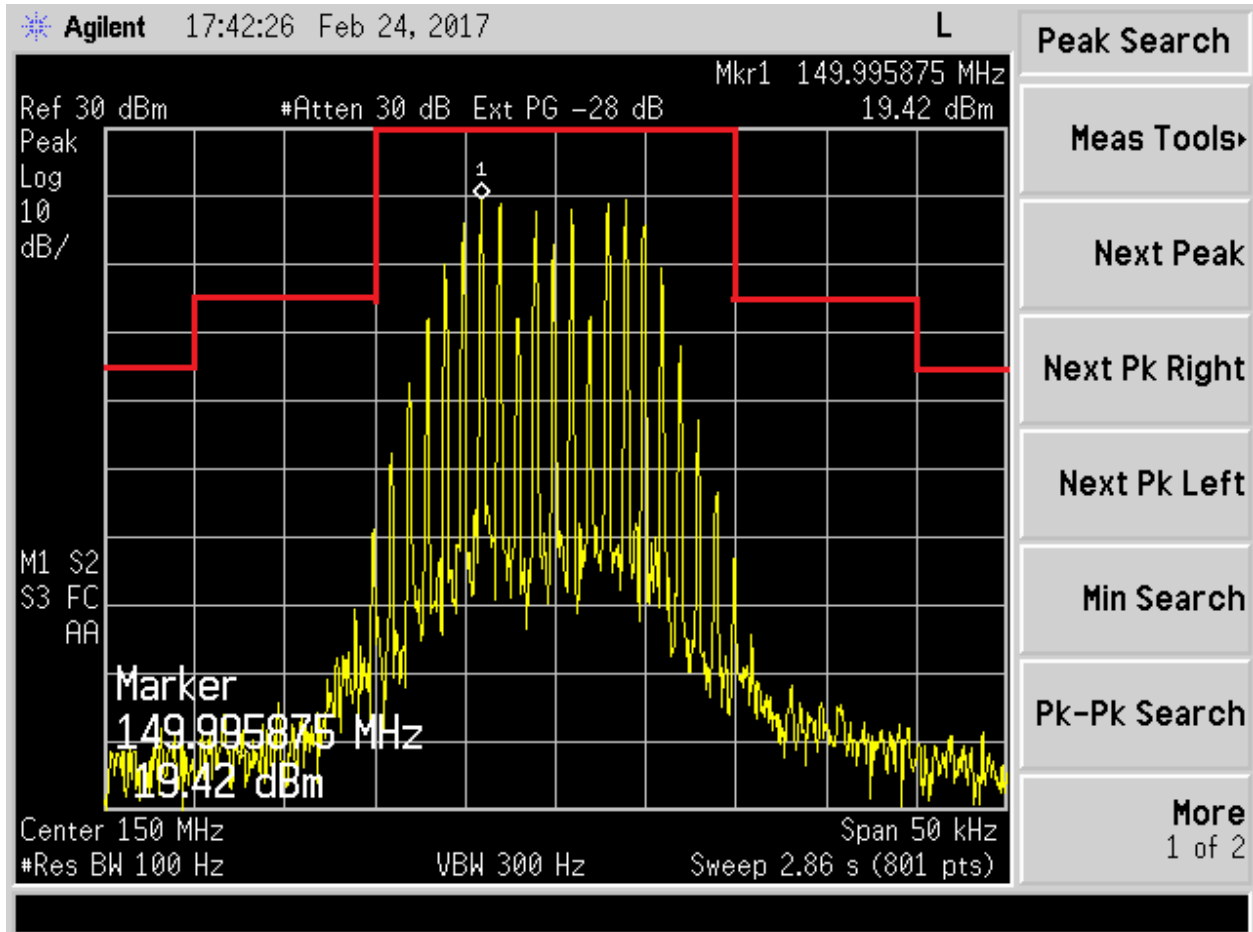


Figure 25. 150 MHz @ 25 kHz,+ 3.0 dB, Mask B

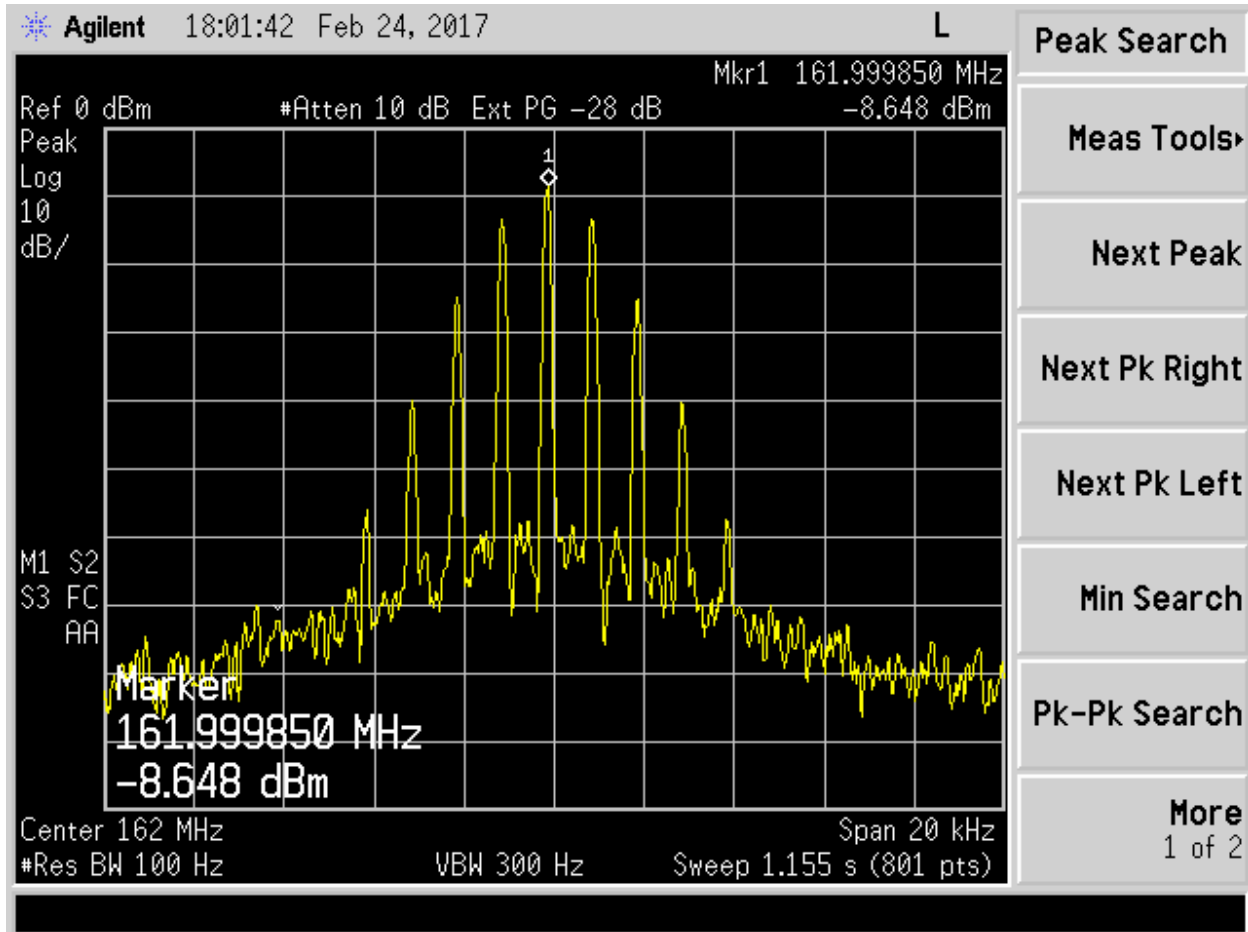


Figure 26. Input 162 MHz @ 6.25 kHz

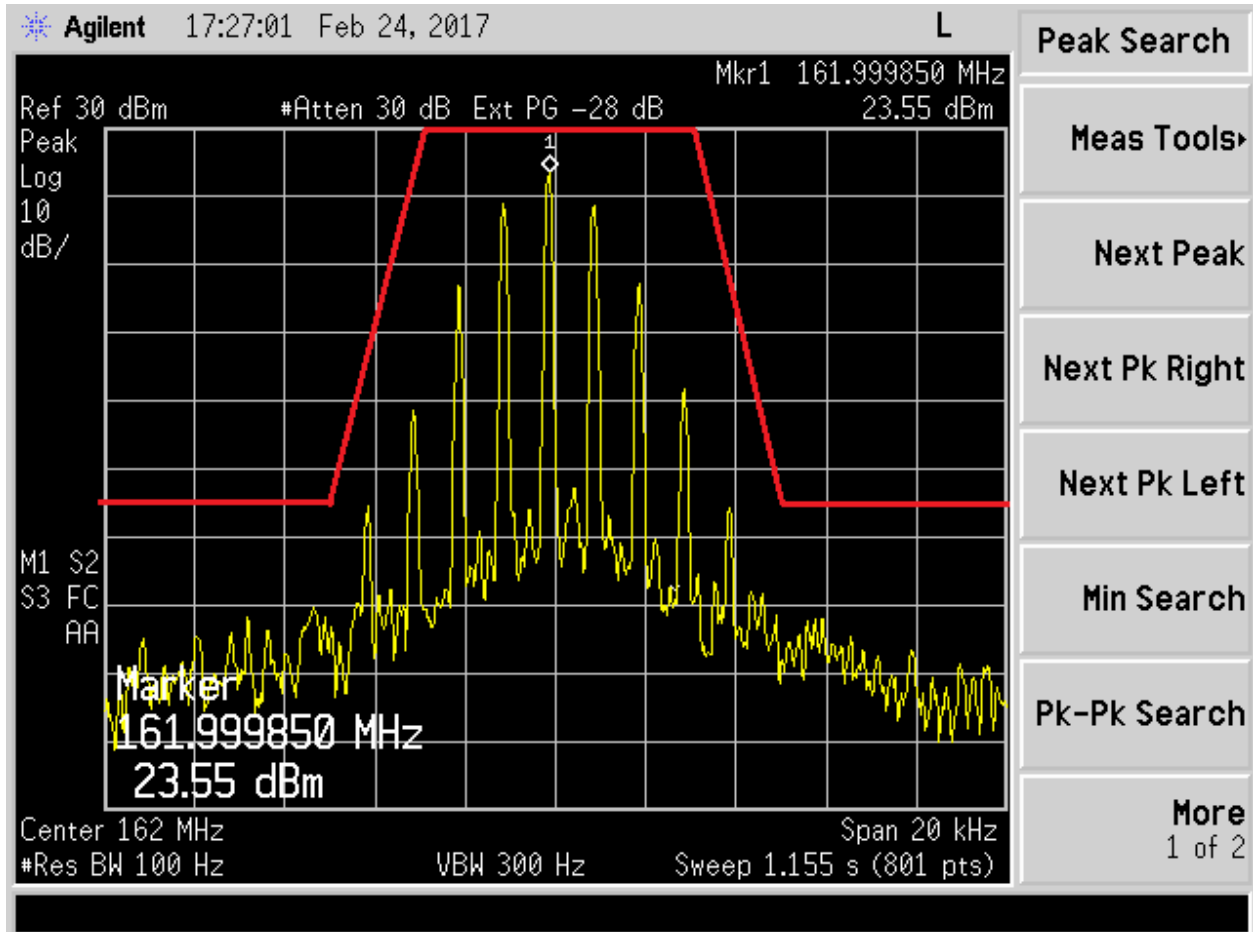


Figure 27. 162 MHz @ 6.25 kHz, Mask E

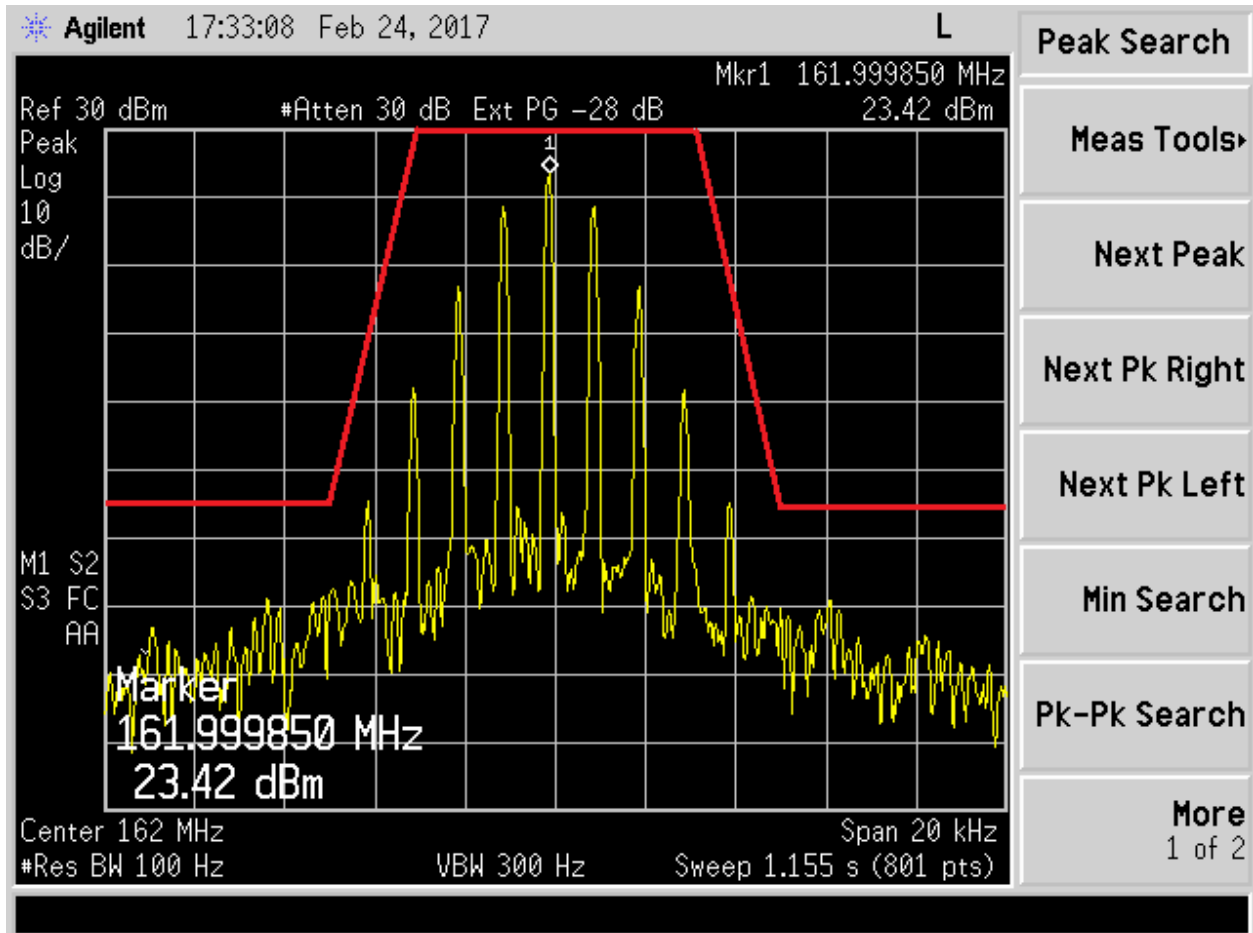


Figure 28. 162 MHz @ 6.25 kHz +3.0 dB, Mask E

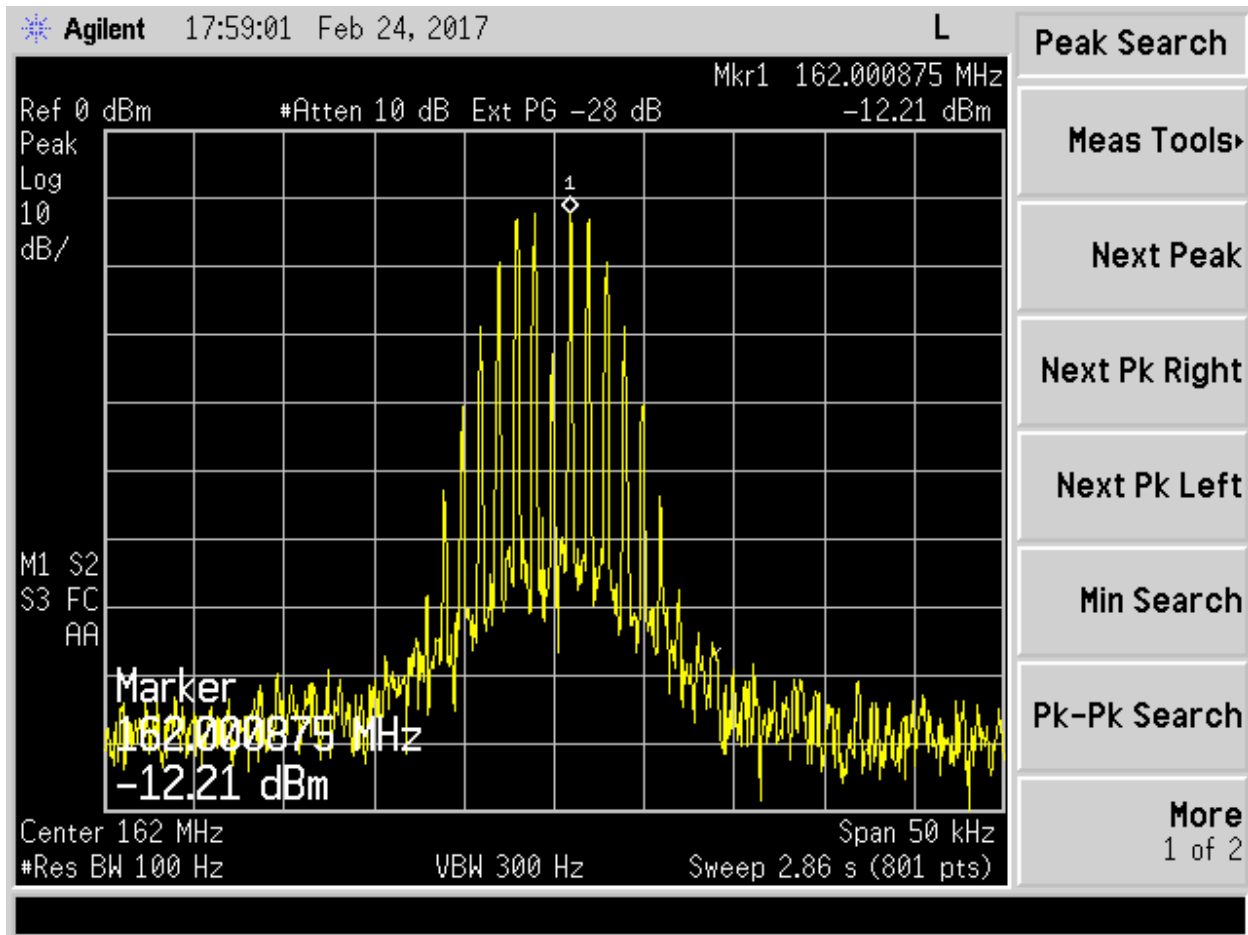


Figure 29. Input 162 MHz @ 12.5 kHz

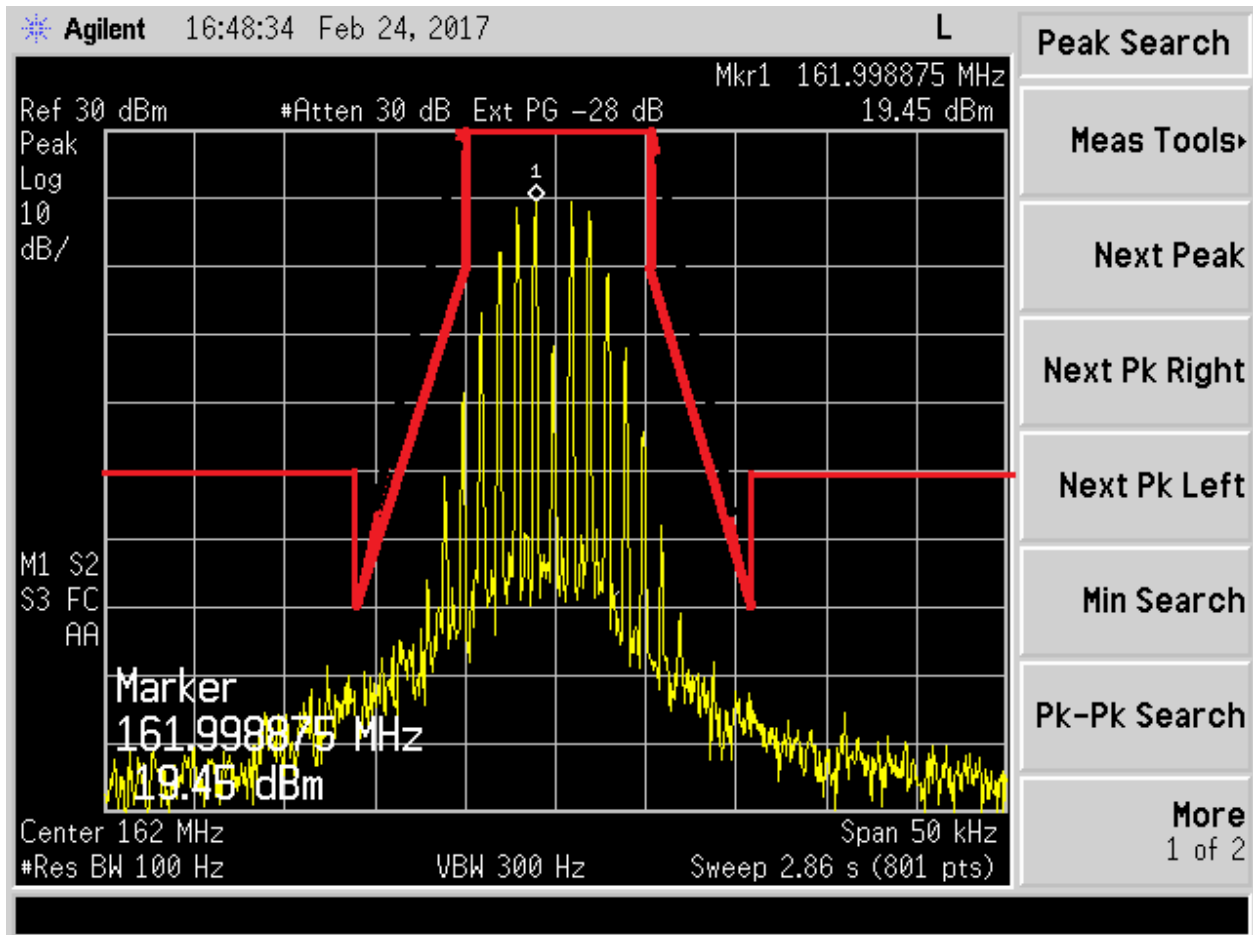


Figure 30. 162 MHz @ 12.5 kHz, Mask D

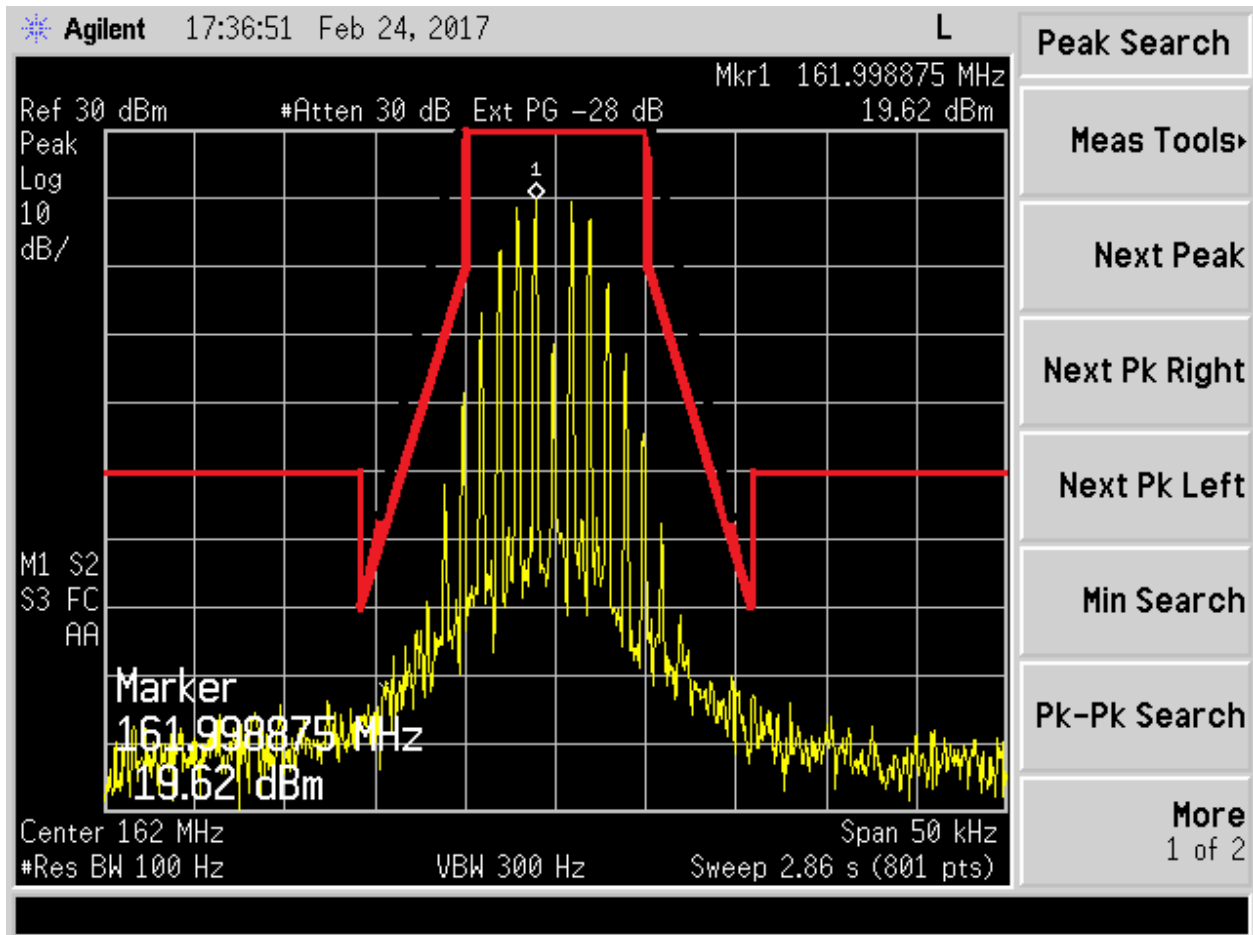


Figure 31. 162 MHz @ 12.5 kHz +3.0 dB, Mask D

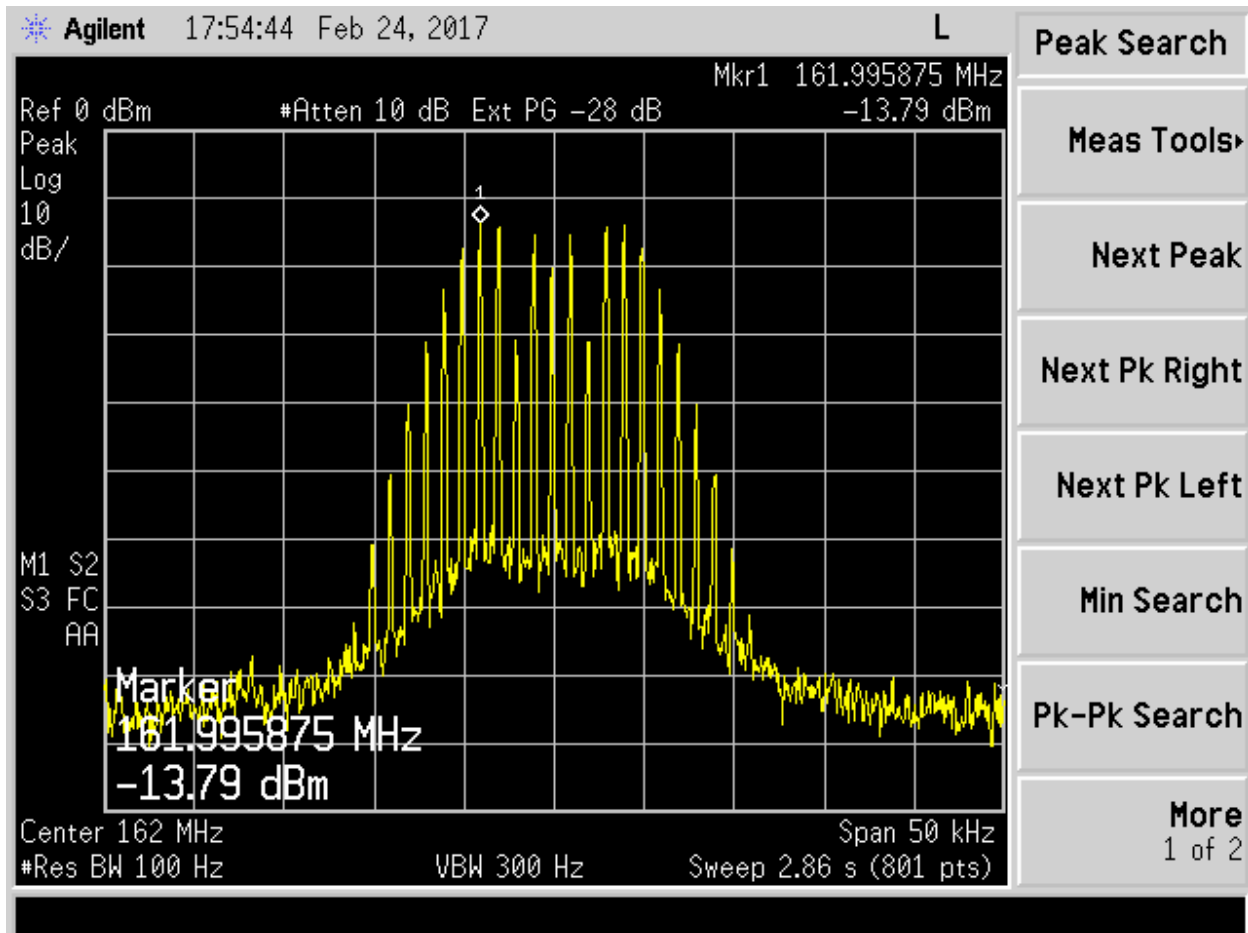


Figure 32. Input 162 MHz @ 25 kHz

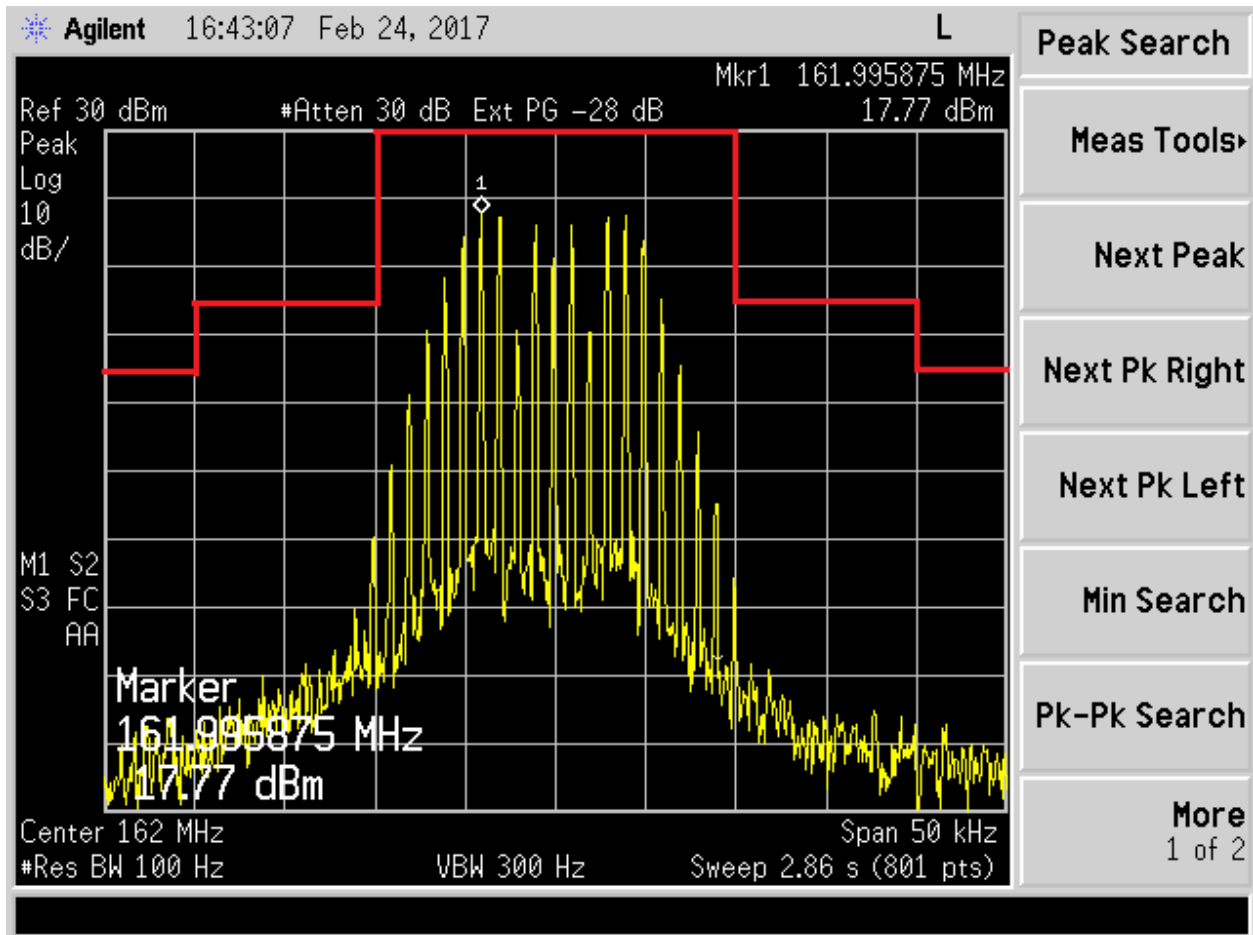


Figure 33. 162 MHz @ 25 kHz, Mask B

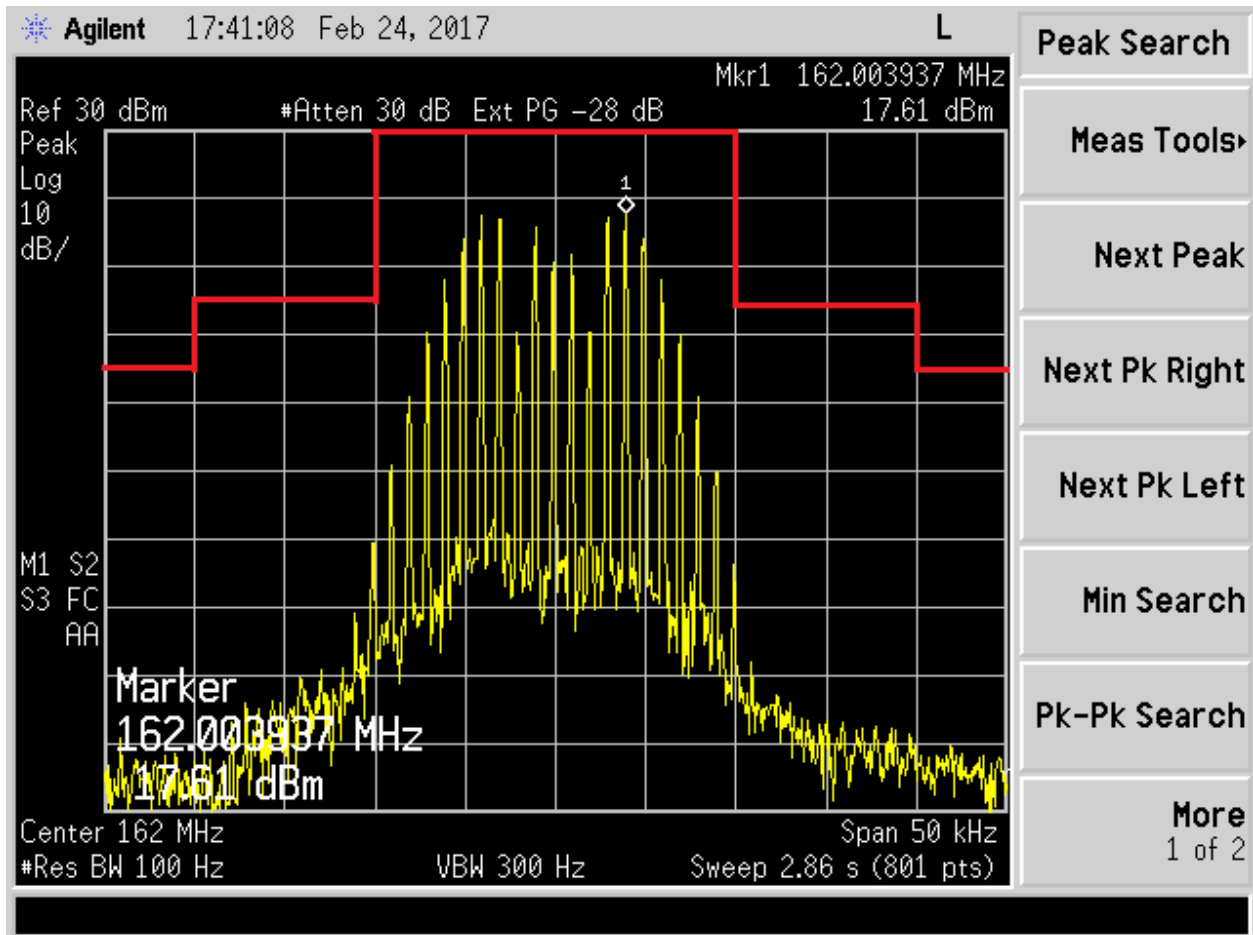


Figure 34. 162 MHz @ 25 kHz +3.0 dB, Mask B

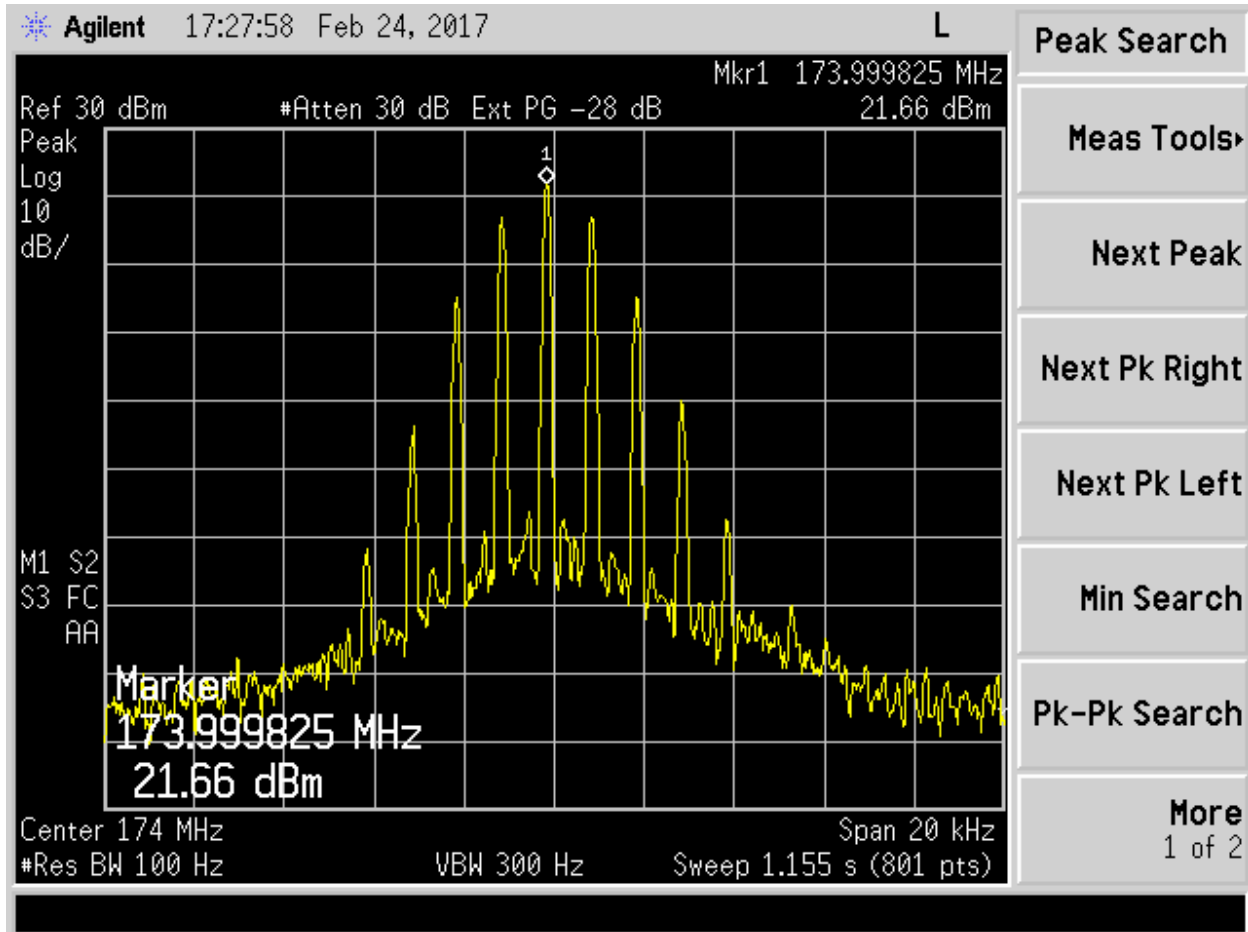


Figure 35. Input 174 MHz @ 6.25 kHz

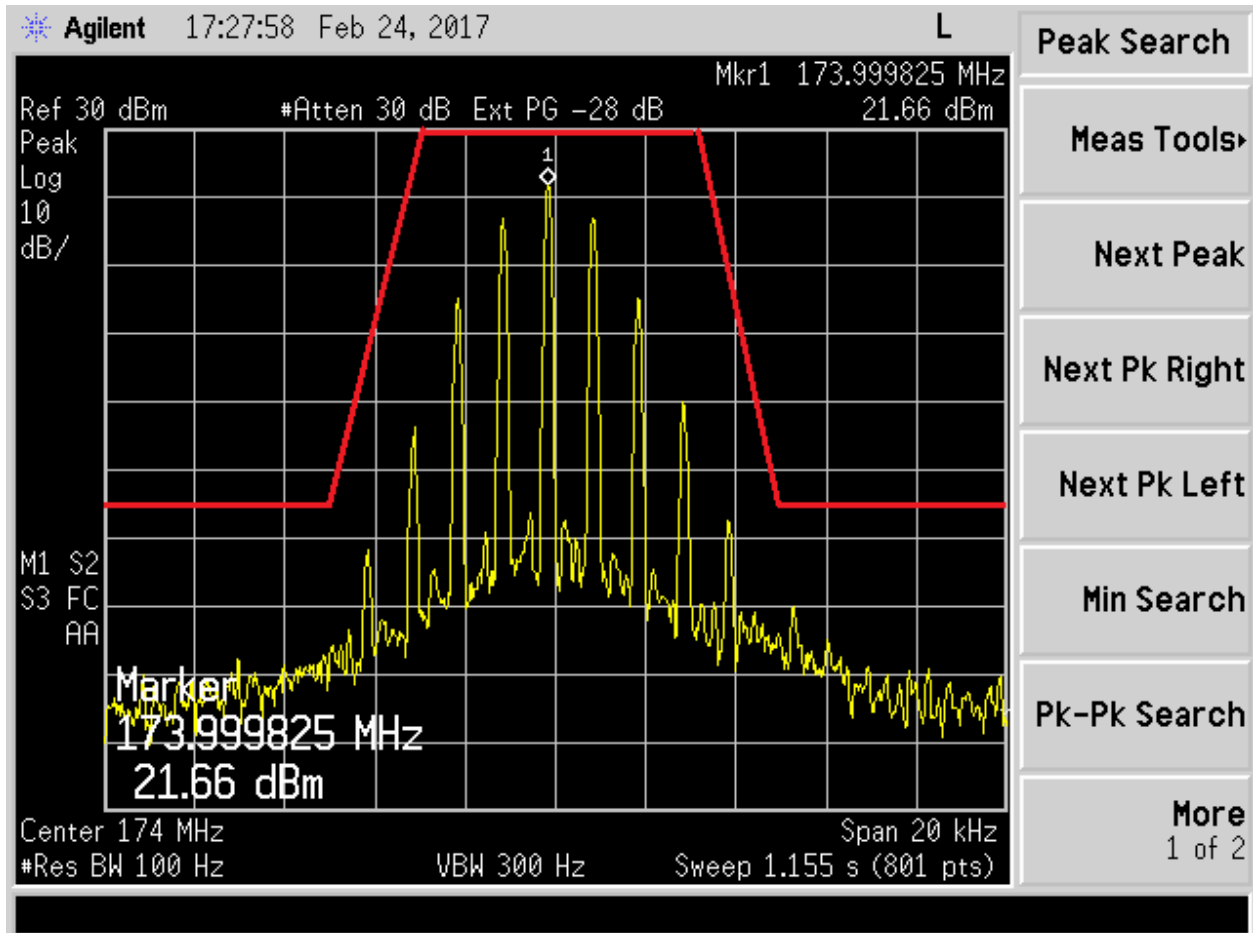


Figure 36. 174 MHz @ 6.25 kHz, Mask E

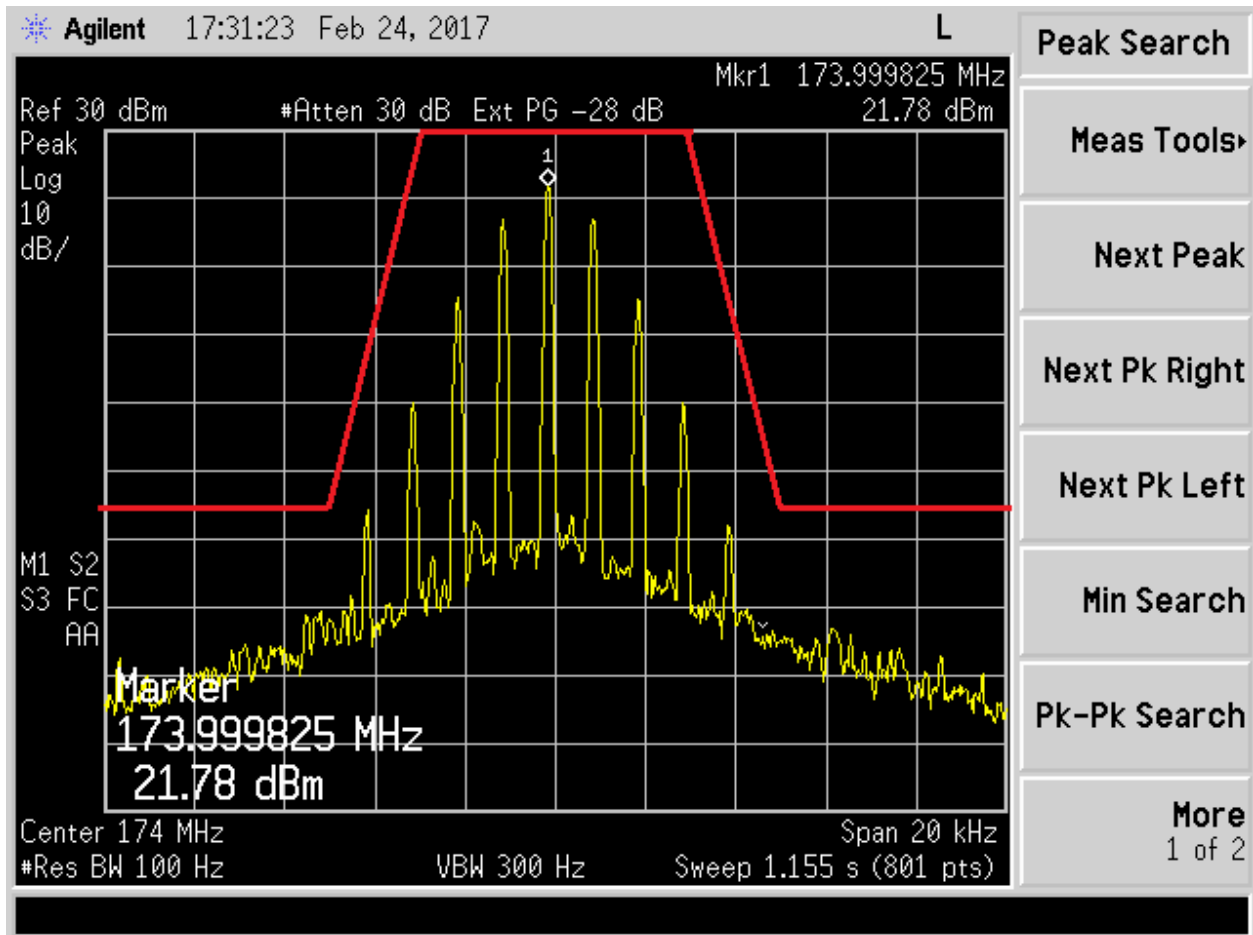


Figure 37. 174 MHz @ 6.25 kHz +3.0 dB, Mask E

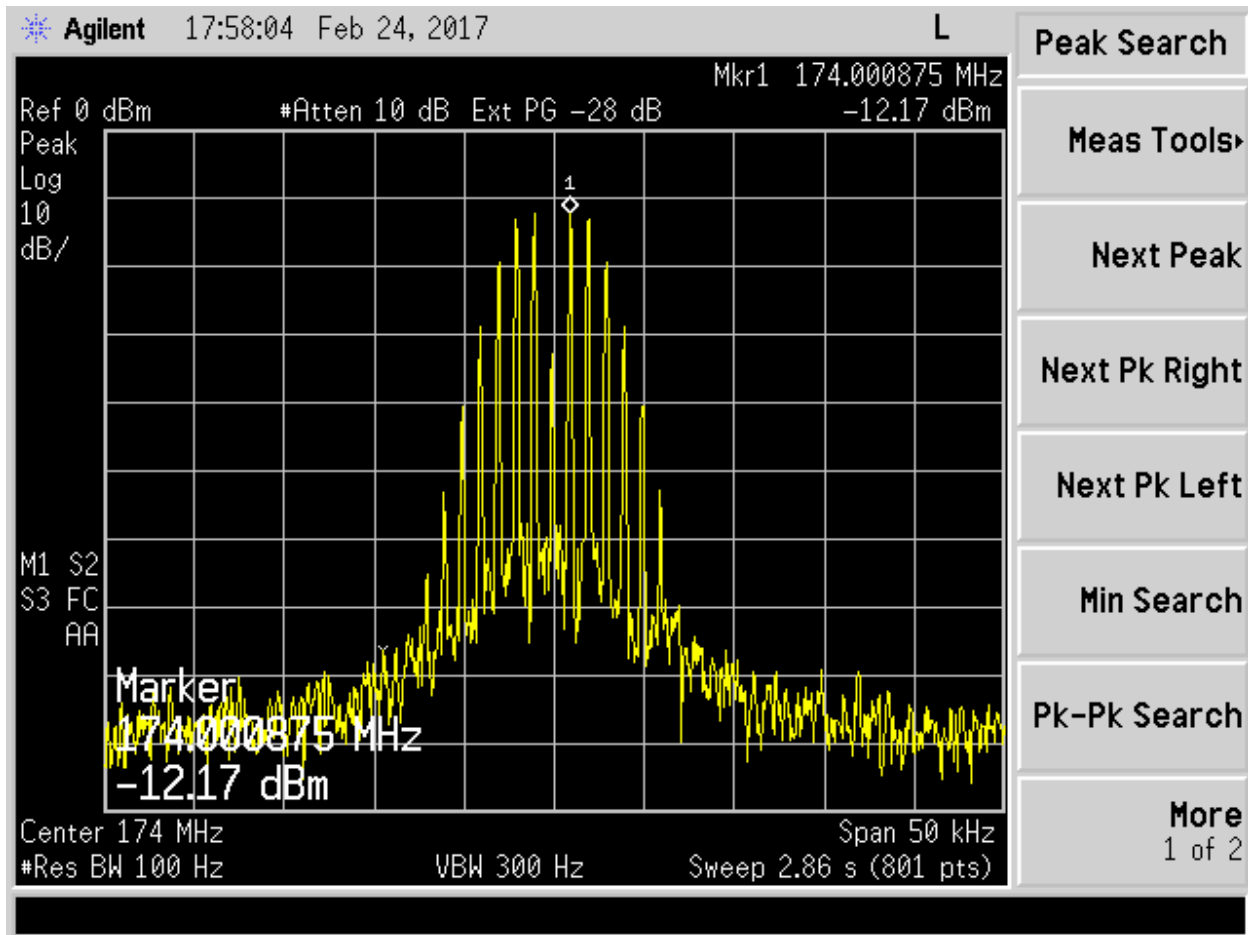


Figure 38. Input 174 MHz @ 12.5 kHz

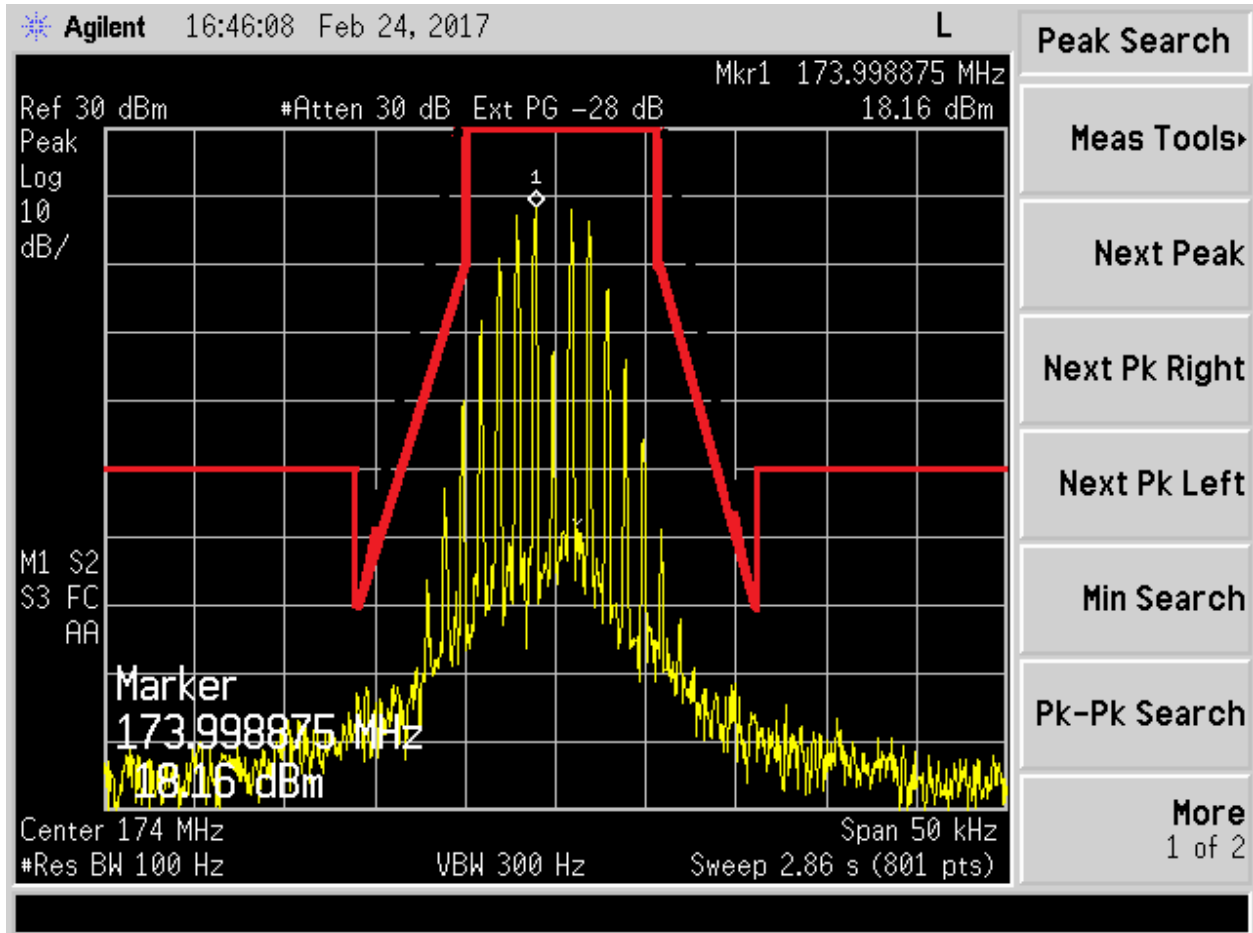


Figure 39. 174 MHz @ 12.5 kHz, Mask D

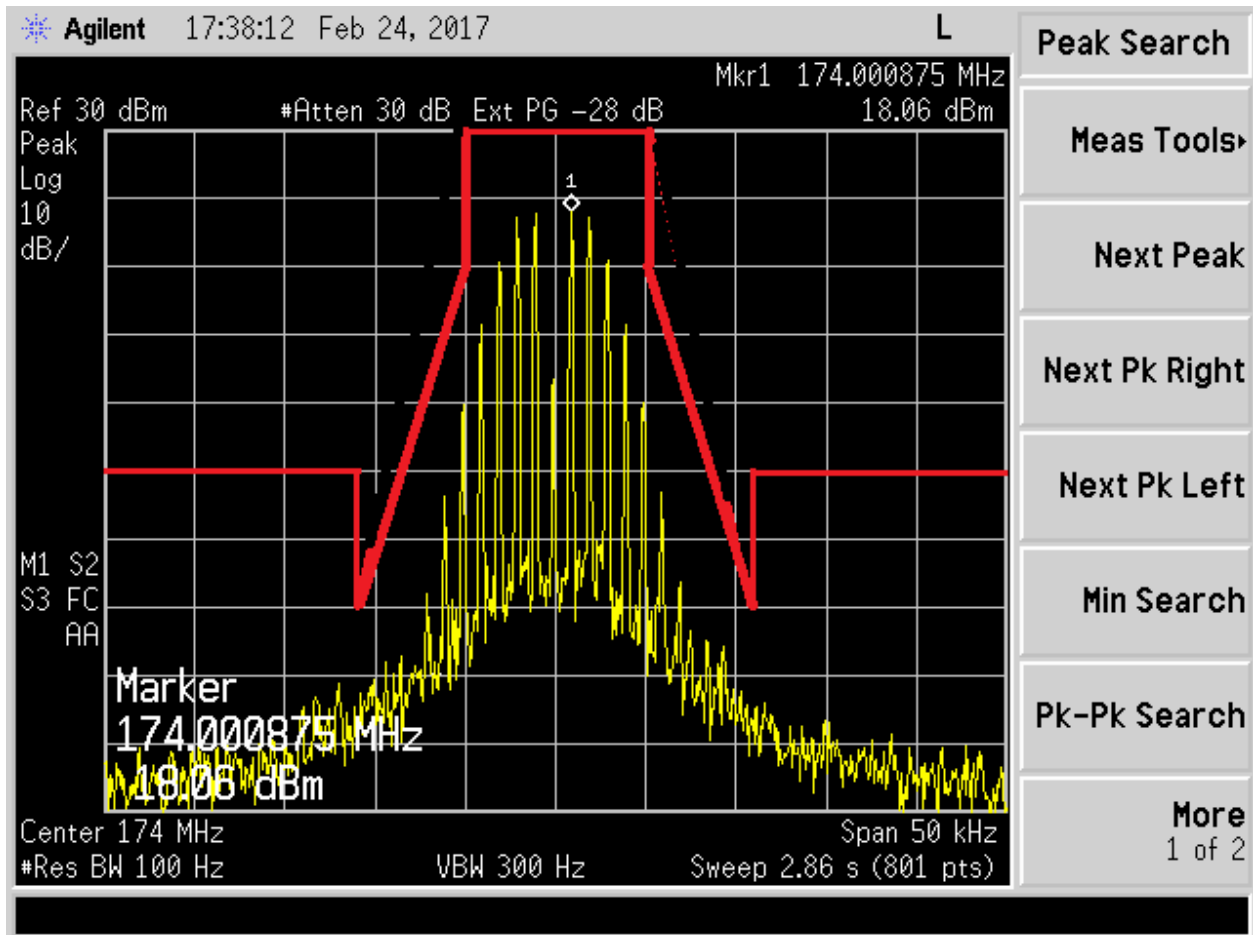


Figure 40. 174 MHz @ 12.5 kHz +3.0 dB, Mask D

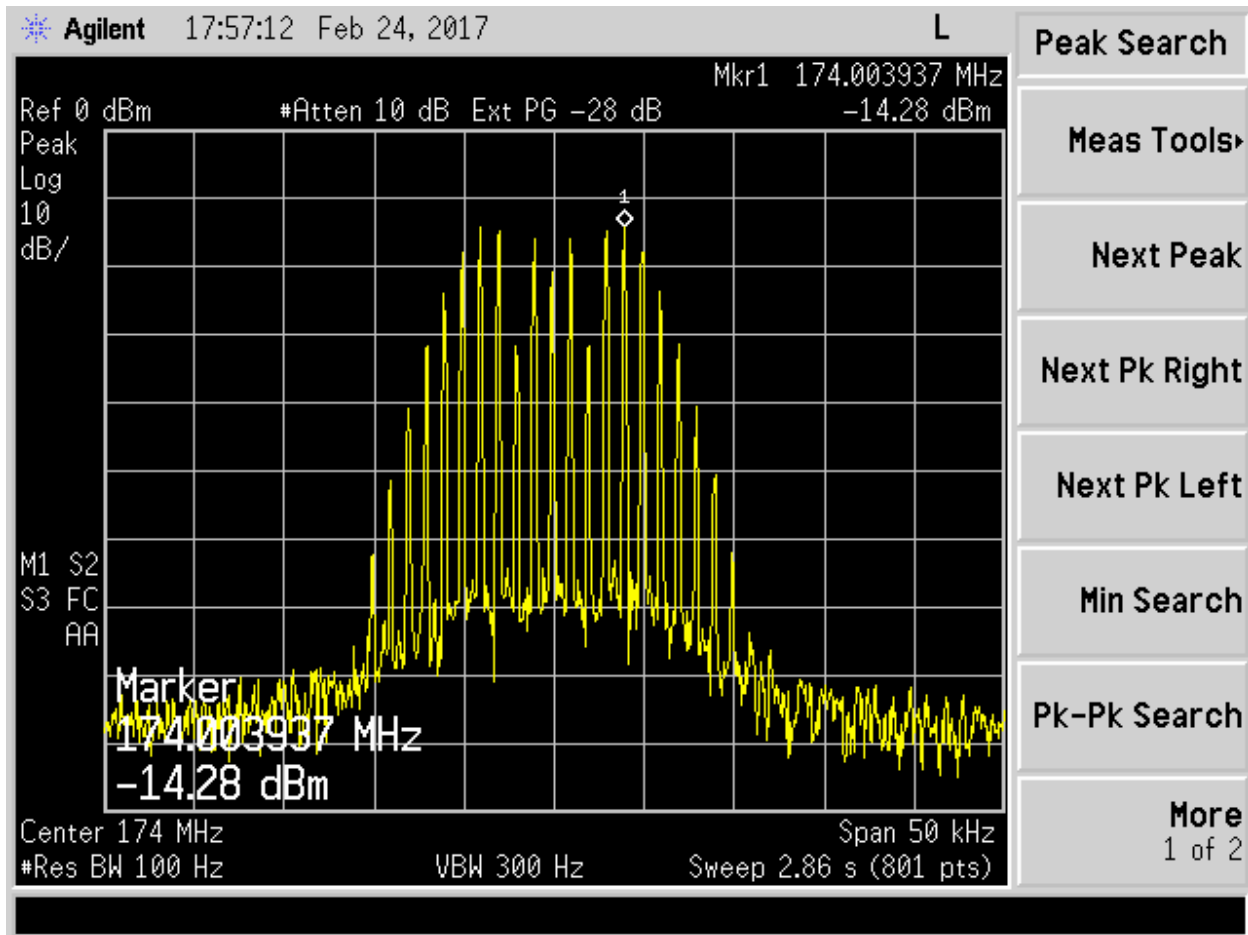


Figure 41. Input 174 MHz @ 25 kHz

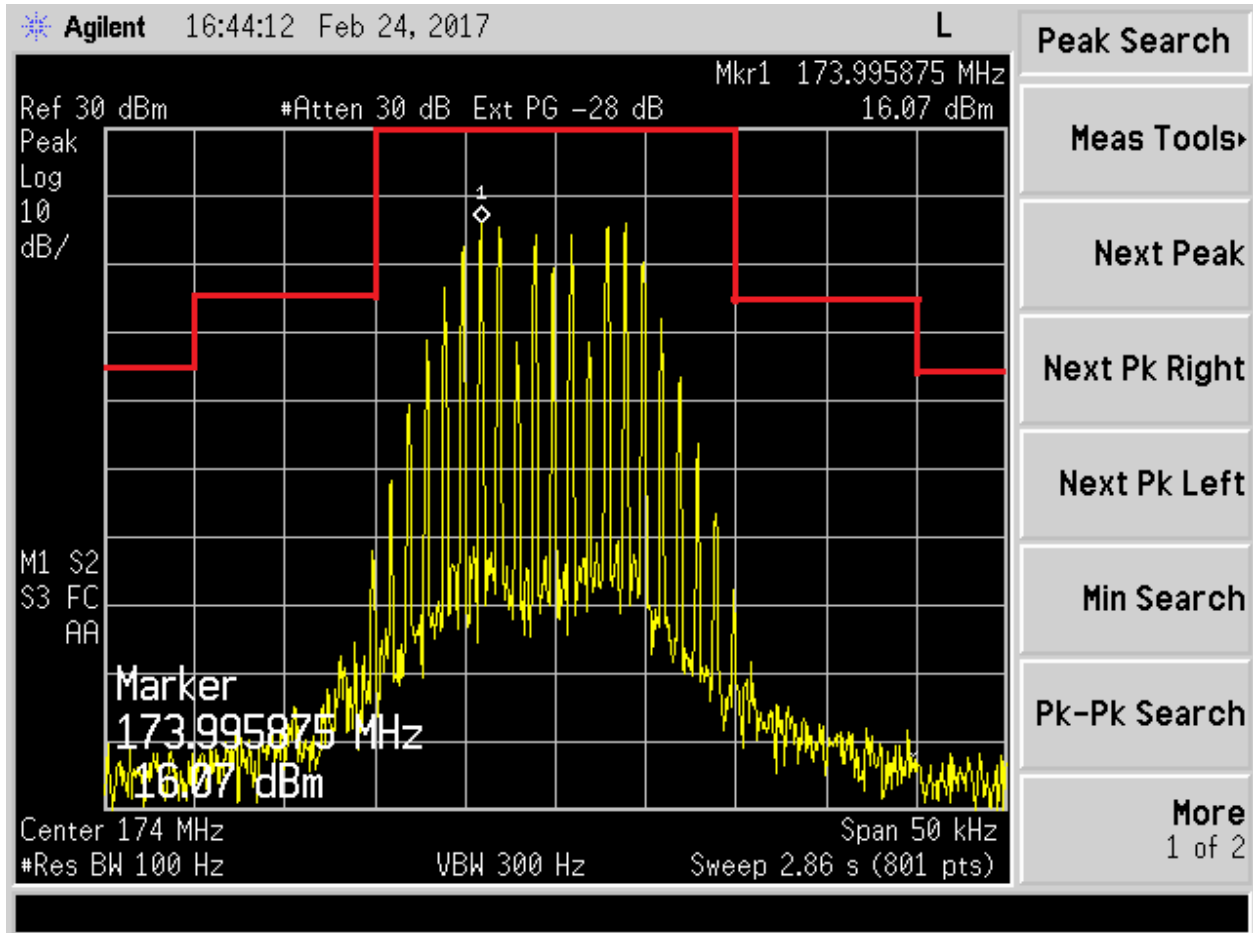


Figure 42. 174 MHz @ 25 kHz, Mask B

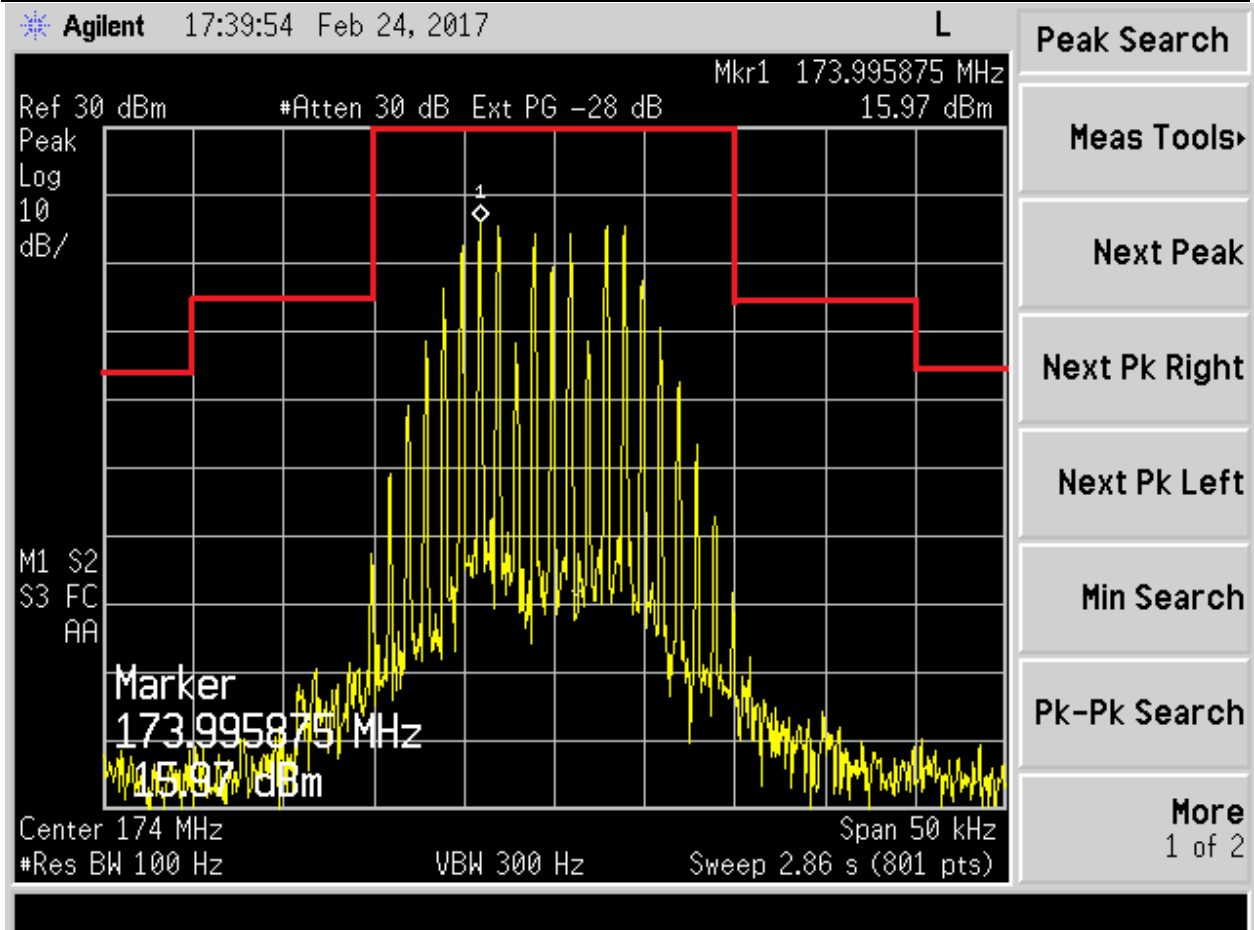


Figure 43. 174 MHz @ 25 kHz +3.0 dB, Mask B