

Wisconsin Broadcasters Association Wireless Discussion



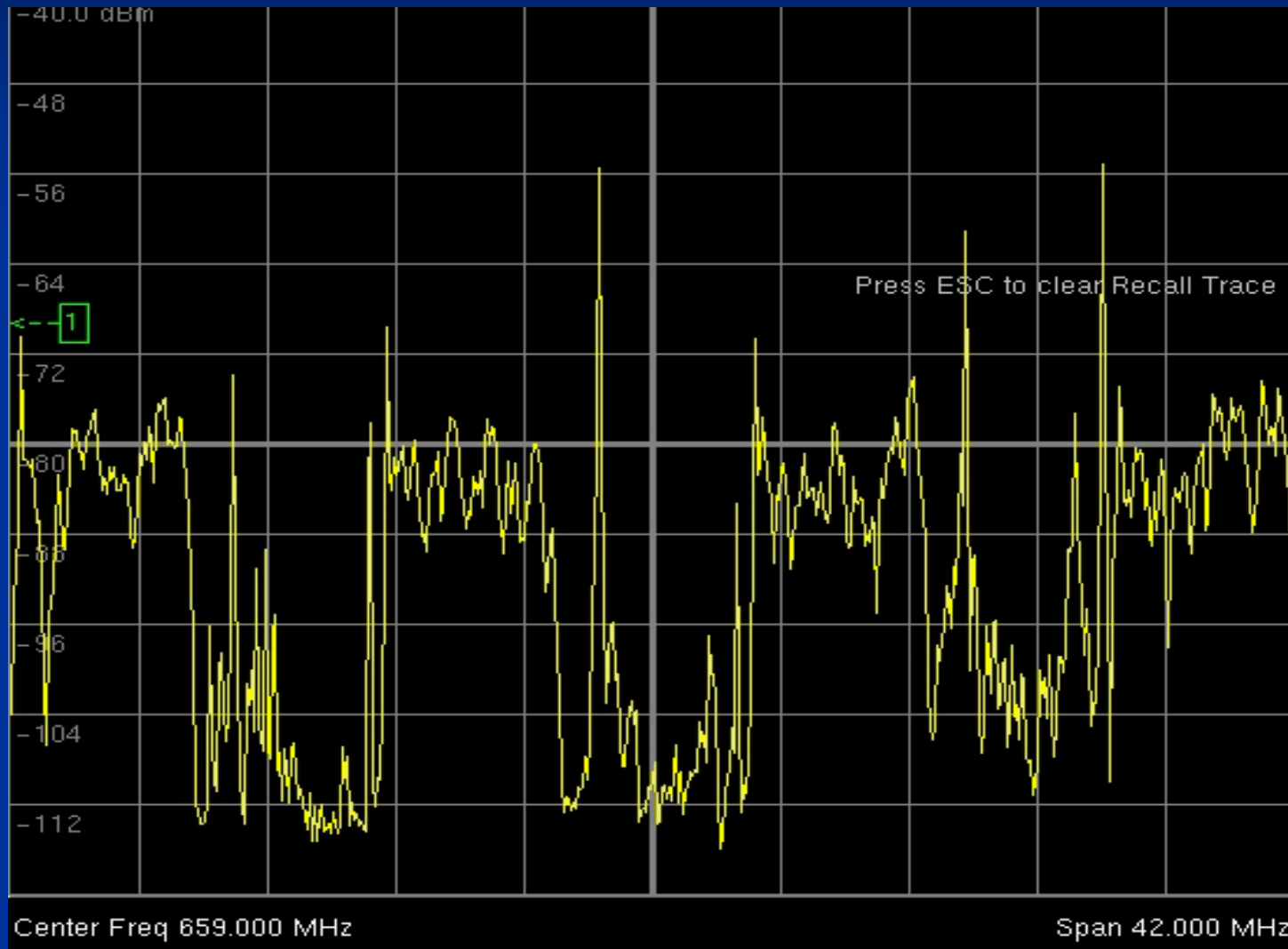
James Stoffo CTO
Radio Active Designs

US Television Station Frequencies

1941 (TV) 1962 (WM)-2009

Channel	Band	Video	Color	Audio	Channel	Band	Video	Color	Audio
2	54-60	55.250	58.829	59.750	36	602-608	603.250	606.829	607.750
3	60-66	61.250	64.829	65.750	37	608-614	Radio Astronomy		
4	66-72	67.250	70.829	71.750	38	614-620	615.250	618.829	619.750
5	76-82	77.250	80.829	81.750	39	620-626	621.250	624.829	625.750
6	82-88	83.250	86.829	87.750	40	626-632	627.250	630.829	631.750
7	174-180	175.250	178.829	179.750	41	632-638	633.250	636.829	637.750
8	180-186	181.250	184.829	185.750	42	638-644	639.250	642.829	643.750
9	186-192	187.250	190.829	191.750	43	644-650	645.250	648.829	649.750
10	192-198	193.250	196.829	197.750	44	650-656	651.250	654.829	655.750
11	198-204	199.250	202.829	203.750	45	656-662	657.250	660.829	661.750
12	204-210	205.250	208.829	209.750	46	662-668	663.250	666.829	667.750
13	210-216	211.250	214.829	215.750	47	668-674	669.250	672.829	673.750
14	470-476	471.250	474.829	475.750	48	674-680	675.250	678.829	679.750
15	476-482	477.250	480.829	481.750	49	680-686	681.250	684.829	685.750
16	482-488	483.250	486.829	487.750	50	686-692	687.250	690.829	691.750
17	488-494	489.250	492.829	493.750	51	692-698	693.250	696.829	697.750
18	494-500	495.250	498.829	499.750	52	698-704	699.250	702.829	703.750
19	500-506	501.250	504.829	505.750	53	704-710	705.250	708.829	709.750
20	506-512	507.250	510.829	511.750	54	710-716	711.250	714.829	715.750
21	512-518	513.250	516.829	517.750	55	716-722	717.250	720.829	721.750
22	518-524	519.250	522.829	523.750	56	722-728	723.250	726.829	727.750
23	524-530	525.250	528.829	529.750	57	728-734	729.250	732.829	733.750
24	530-536	531.250	534.829	535.750	58	734-740	735.250	738.829	739.750
25	536-542	537.250	540.829	541.750	59	740-746	741.250	744.829	745.750
26	542-548	543.250	546.829	547.750	60	746-752	747.250	750.829	751.750
27	548-554	549.250	552.829	553.750	61	752-758	753.250	756.829	757.750
28	554-560	555.250	558.829	559.750	62	758-764	759.250	762.829	763.750
29	560-566	561.250	564.829	565.750	63	764-770	765.250	768.829	769.750
30	566-572	567.250	570.829	571.750	64	770-776	771.250	774.829	775.750
31	572-578	573.250	576.829	577.750	65	776-782	777.250	780.829	781.750
32	578-584	579.250	582.829	583.750	66	782-788	783.250	786.829	787.750
33	584-590	585.250	588.829	589.750	67	788-794	789.250	792.829	793.750
34	590-596	591.250	594.829	595.750	68	794-800	795.250	798.829	799.750
35	596-602	597.250	600.829	601.750	69	800-806	801.250	804.829	805.750

The Recent Past; Both Analogue And Digital TV Carriers Present





NEWS

Federal Communications Commission
445 12th Street, S.W.
Washington, D. C. 20554

News Media Information 202 / 418-0500
Internet: <http://www.fcc.gov>
TTY: 1-888-835-5322

This is an unofficial announcement of Commission action. Release of the full text of a Commission order constitutes official action.
See MCI v. FCC, 518 F.2d 388 (D.C. Cir. 1974).

FOR IMMEDIATE RELEASE:
September 23, 2010

NEWS MEDIA CONTACT:
Bruce Romano, 202-418-2124
Bruce.Romano@fcc.gov

FCC FREES UP VACANT TV AIRWAVES FOR “SUPER WI-FI” TECHNOLOGIES

Washington, D.C. – The Federal Communications Commission today took steps to free up vacant airwaves between TV channels -- called “white spaces” -- to unleash a host of new technologies, such as “super Wi-Fi,” and myriad other diverse applications. This is the first significant block of spectrum made available for unlicensed use in more than 20 years.

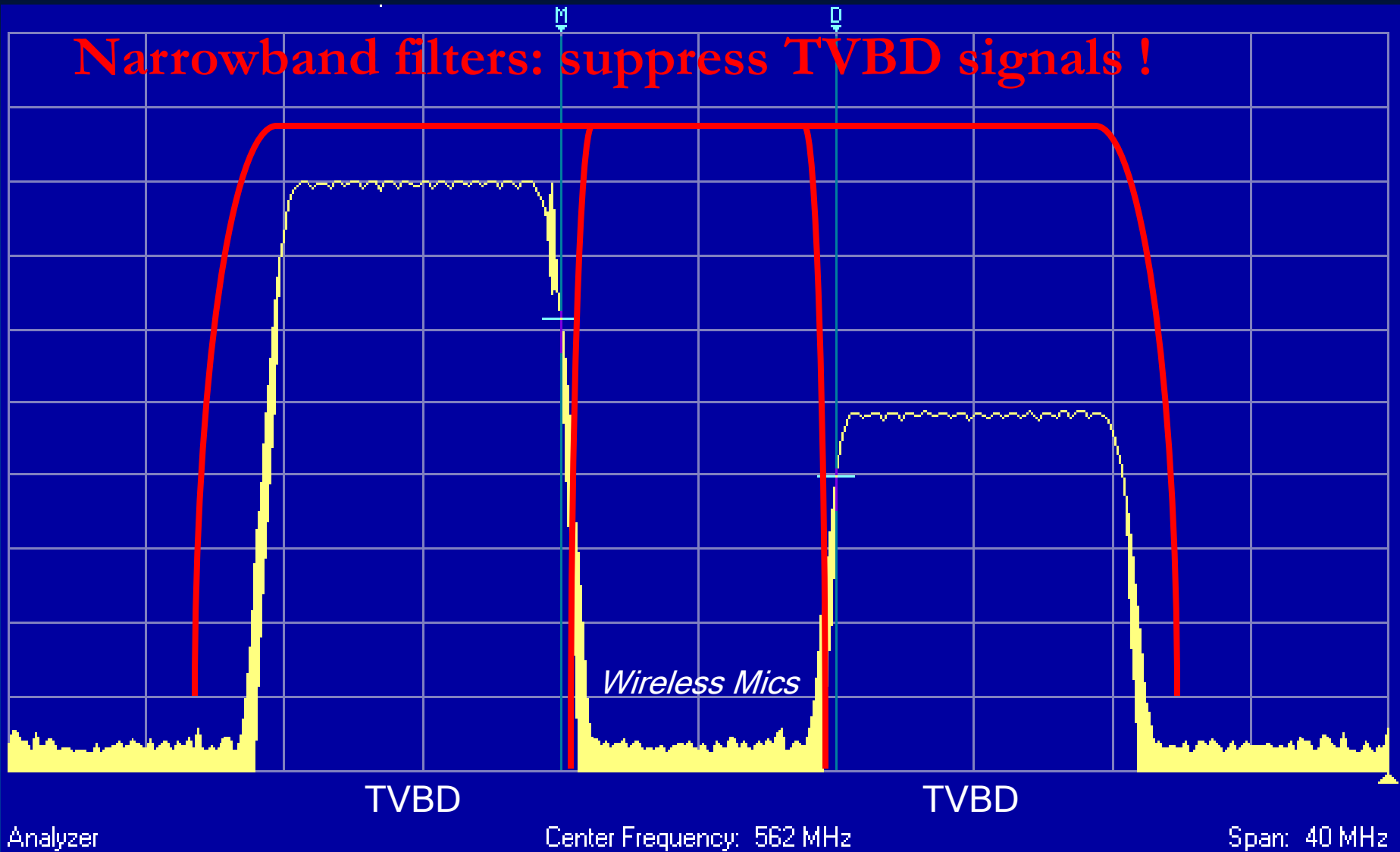
TV white space spectrum is considered prime real estate because its signals travel well, making it ideally suited for mobile wireless devices. Unlocking this valuable spectrum will open the doors for new industries to arise, create American jobs, and fuel new investment and innovation. The National Broadband Plan noted the importance of unlicensed spectrum in creating opportunities for new technologies to blossom and recommended that the Commission complete the TV white spaces proceeding as expeditiously as possible.

The Second Memorandum Opinion and Order (Second MO&O) adopted today resolves numerous legal and technical issues. Notably, the Order eliminates the requirement that TV bands devices that incorporate geo-location and database access must also include sensing technology to detect the signals of TV stations and low-power auxiliary service stations (wireless microphones). It also requires wireless microphone users who seek to register in the TV bands databases to certify that they will use all available

6 MHz Tuned Cavity Filter



Narrowband filters: suppress TVBD signals !



Digital Transition in the U.S.

- Since June 12, 2010 Wireless Microphones, IFB, Intercommunications and In Ear Monitors Are Authorized To Operate Below 698 MHz only
- White Space/TV Band Device Interference
- Must Operate in Less Than 10% of Previous Radio Spectrum Used by Wireless Microphones
- 600 MHz UHF FCC Auction 1st 1/4 2016
- Less Than 5% of UHF Spectrum Will Remain



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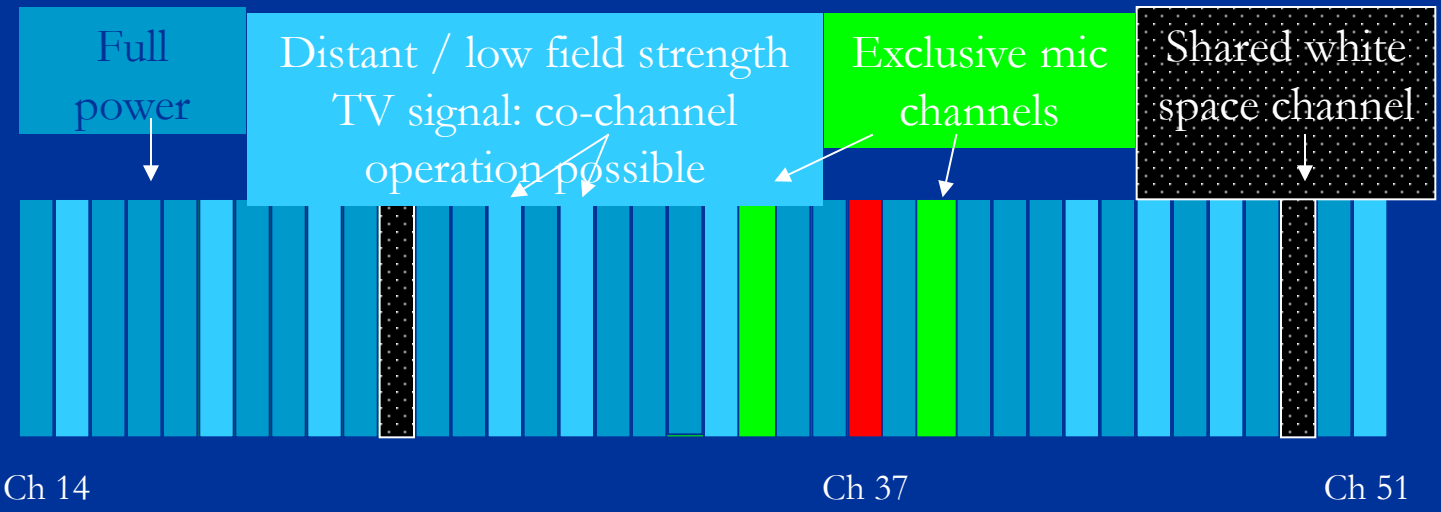
FOR IMMEDIATE RELEASE:
September 28, 2012

NEWS MEDIA CONTACT:
Tammy Sun (202) 418-0505
Email: tammy.sun@fcc.gov

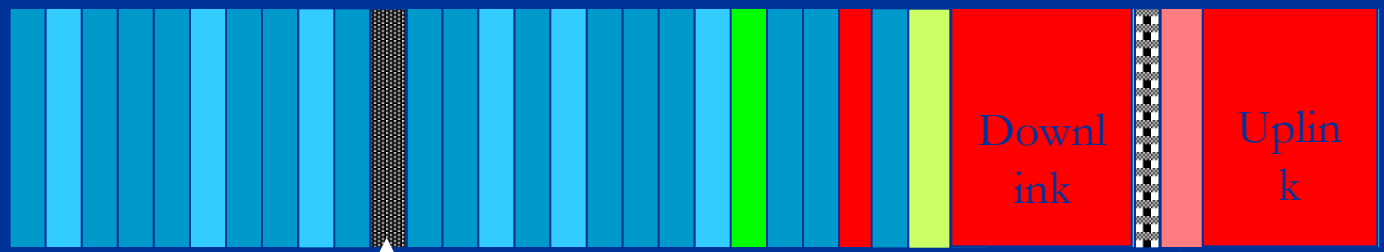
FCC LAUNCHES FIRST-IN-THE-WORLD INCENTIVE AUCTION TO REPURPOSE BROADCAST TELEVISION SPECTRUM FOR MOBILE BROADBAND; AUCTION SET TO UNLEASH WAVE OF ECONOMIC & INNOVATION OPPORTUNITIES FOR U.S.

Market-based policy innovation will help alleviate growing 'spectrum crunch' while providing unique financial opportunities and other benefits to broadcasters; Auction planned for 2014

(Washington, D.C.) – The Federal Communications Commission today voted to officially launch the incentive auction process, making the United States the first nation in the world to implement this major policy innovation, which aims to repurpose broadcast television spectrum for mobile broadband use. The concept was first introduced in the National Broadband Plan as part of the Commission's multi-pronged strategy to meet skyrocketing demand for mobile Internet in the United States, and became the foundation for legislation that was signed into law in February 2012. As mobile device adoption continues to grow



Current TV band



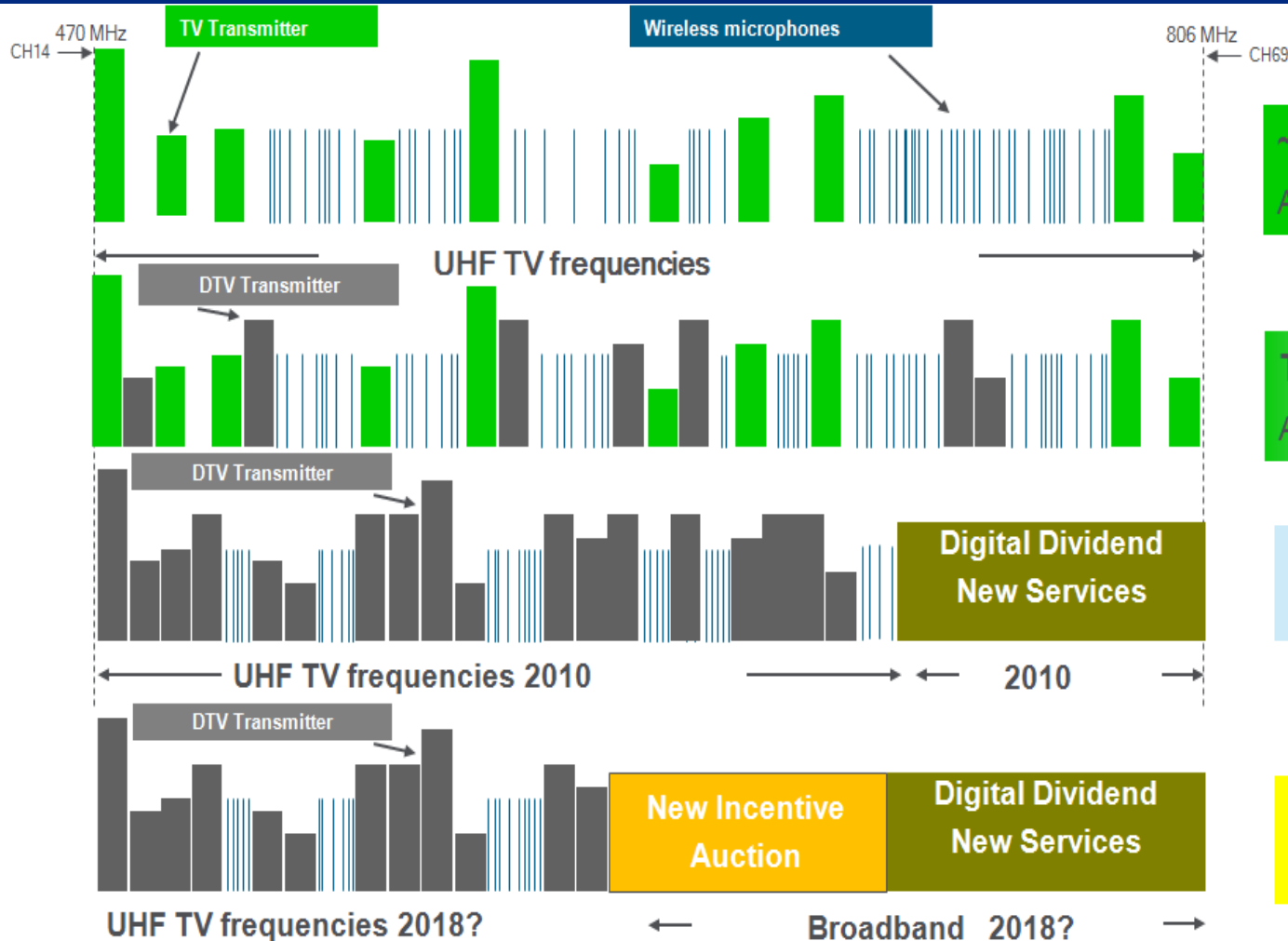
Naturally occurring White Space channel. Higher activity as more TVWS devices enter the market

Guard band: unlicensed operation of unlicensed TVWS & mics

Duplex Gap for licensed mic use. High noise floor possible

Duplex Gap for unlicensed TVWS

The Future? UHF Spectrum 2016-2020



~20 years ago:
Analog TV only

Transition:
Analog & DTV

Now:
Full Digital Scenario

Future:
More Broadband services

Geo-location Database

- Database shows which TV channels are reserved for wireless mics and comms
- Registering event protects you from interference on non-reserved channels
 - Licensed users get immediate access
 - Unlicensed users need FCC approval first
 - 30-day advance notice required
 - *Expect them to be very selective*

Geo-location Database

- Currently active databases:

- <http://keybridgeglobal.com>

- <http://whitespaces.spectrumbridge.com/whitespaces/home.aspx>

- https://prism.telcordia.com/tvws/home/contour_vis.shtml

- <https://www.google.com/get/spectrumdatabase/>

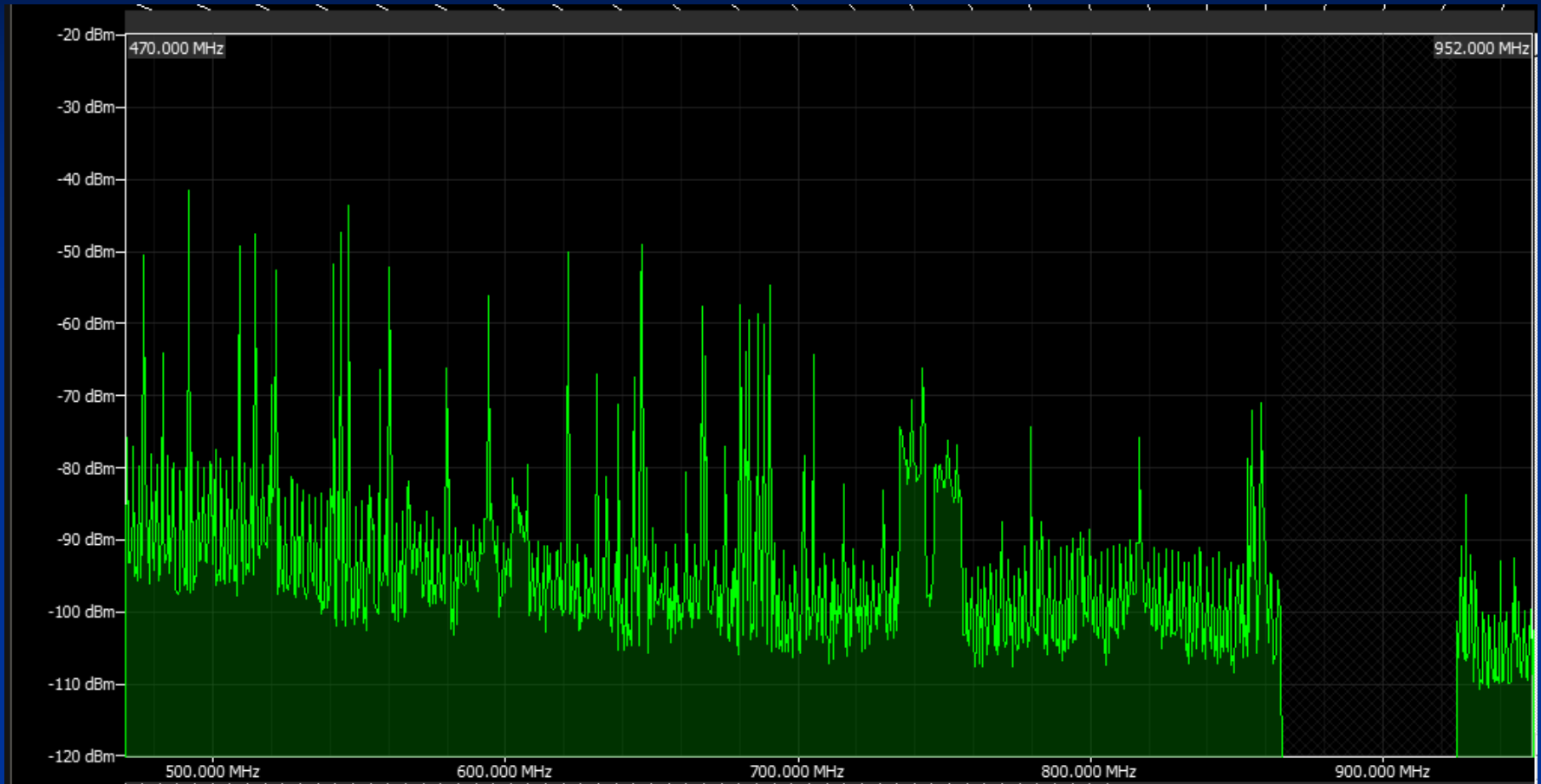
[Professional Wireless Systems License Assistance](#)

- www.part74.com

Strategies for Dealing With This...

- Don't panic!
- Careful system design + good quality gear
 - Widest tuning range
 - Best spectral efficiency
 - Best filtering
 - Proper set of features/tradeoffs for your application
- Proper site evaluation
- Band planning & frequency coordination
 - Consider alternate frequency bands where appropriate
- Register in the database for event protection

Large Video Wall



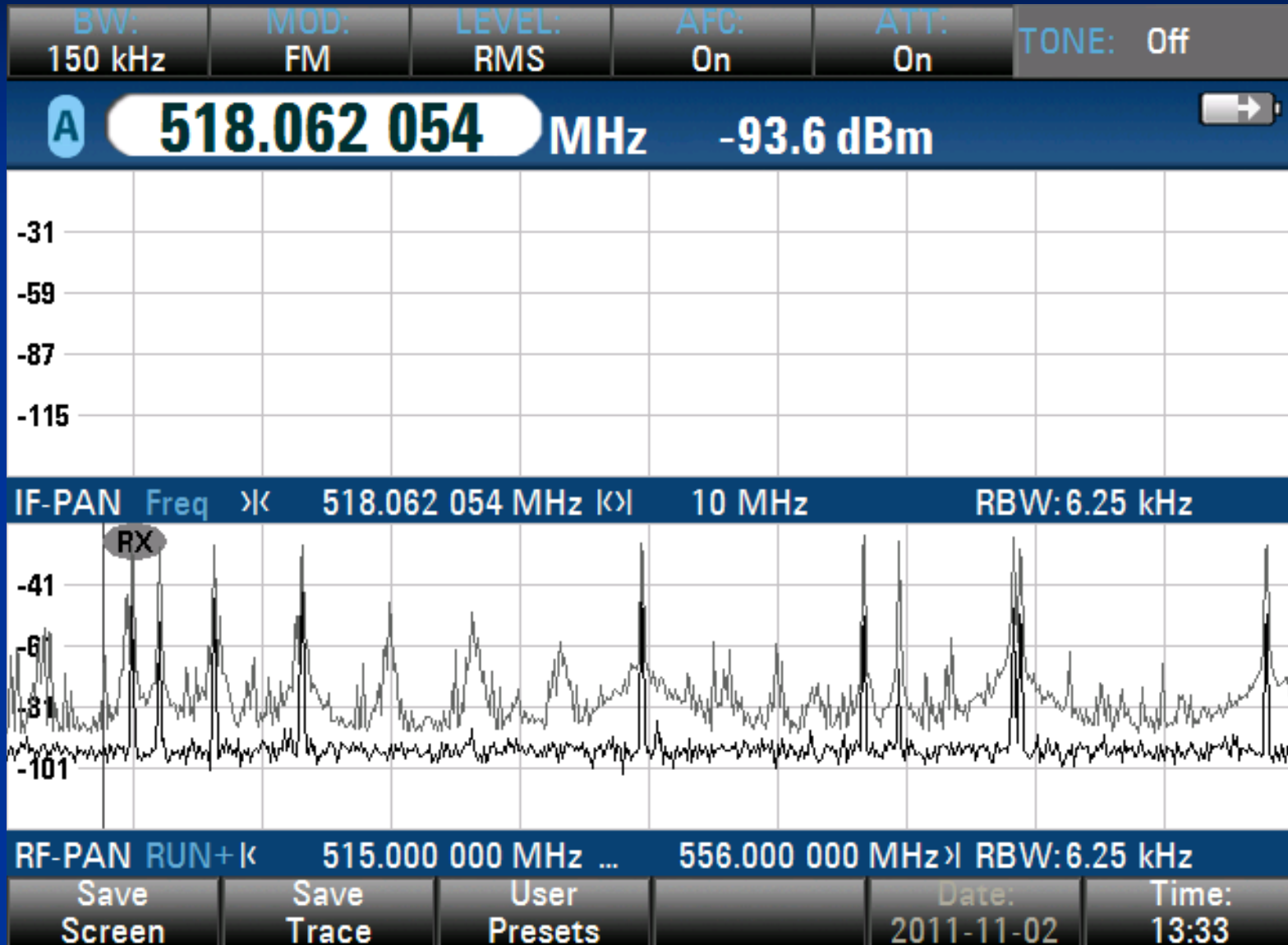
Get the Antennas As Close to the Performing Artist as Possible



Metal Trays Reduce IMD



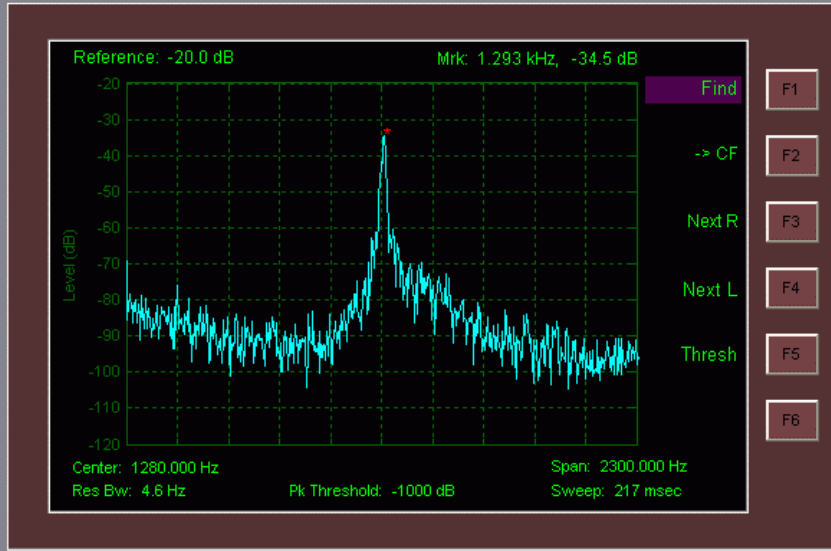
RF Level Comparison In Tin Tray and Out



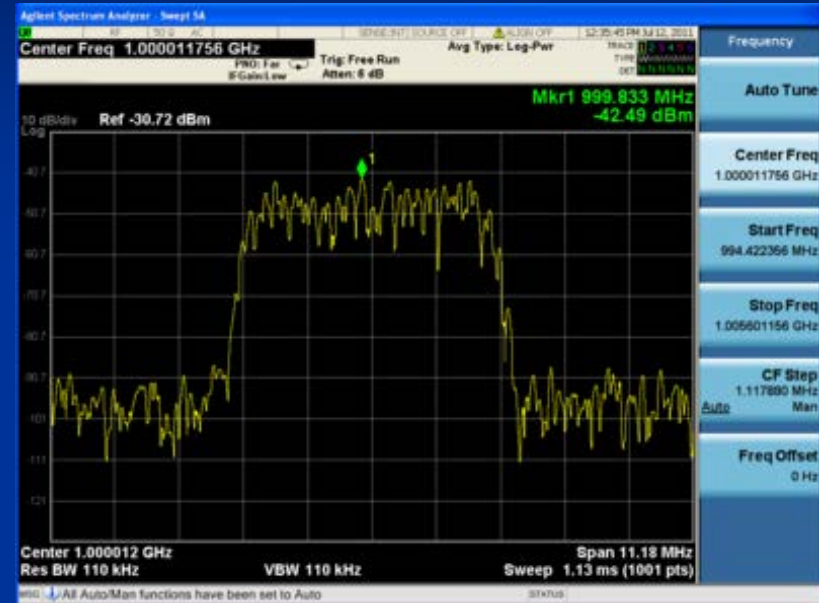
Digital vs. Analog RF Spectrum

Fatpigdog Industries

A subsidiary of Blueberry Technology, LLC



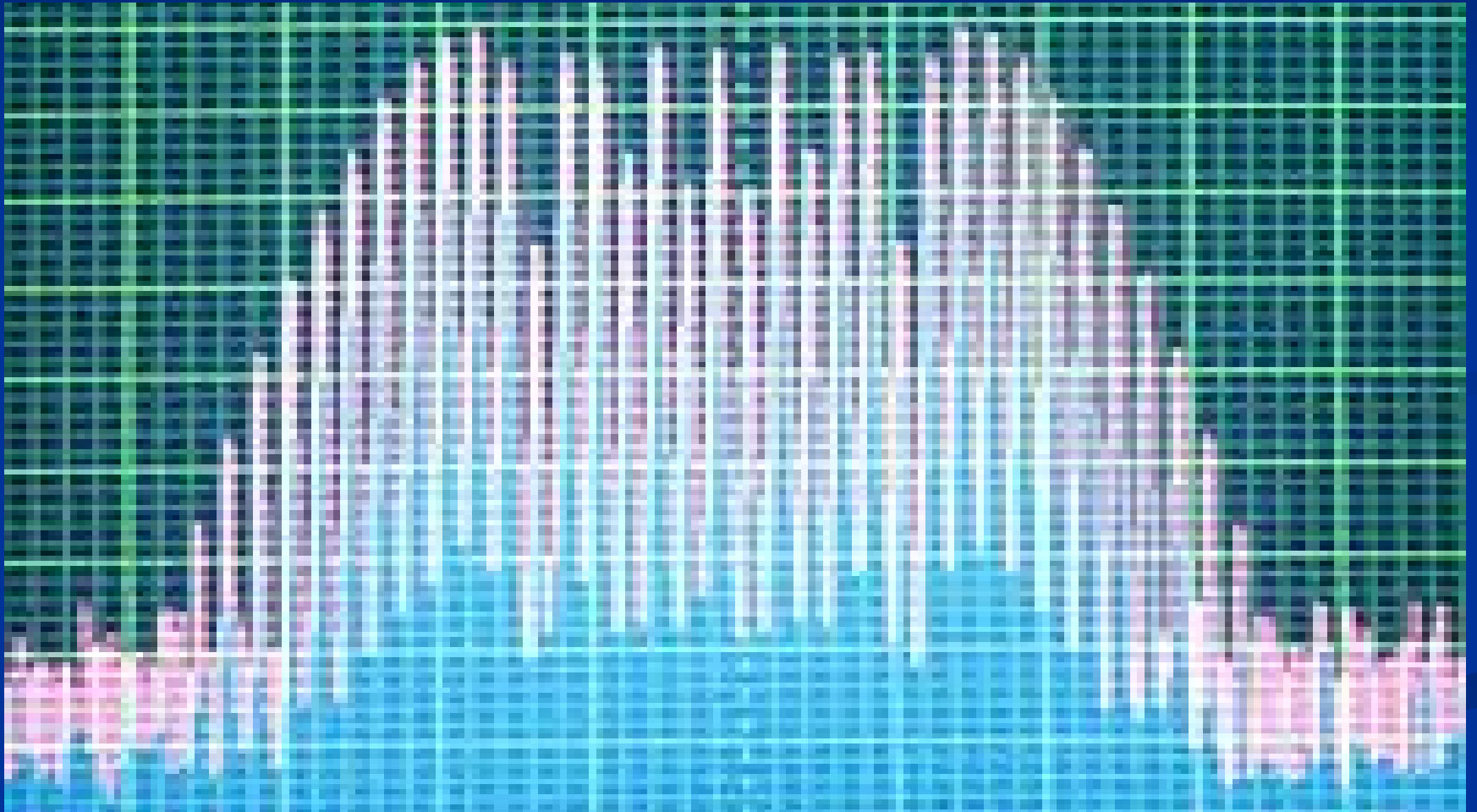
Analog modulation concentrates the RF energy around the carrier frequency.



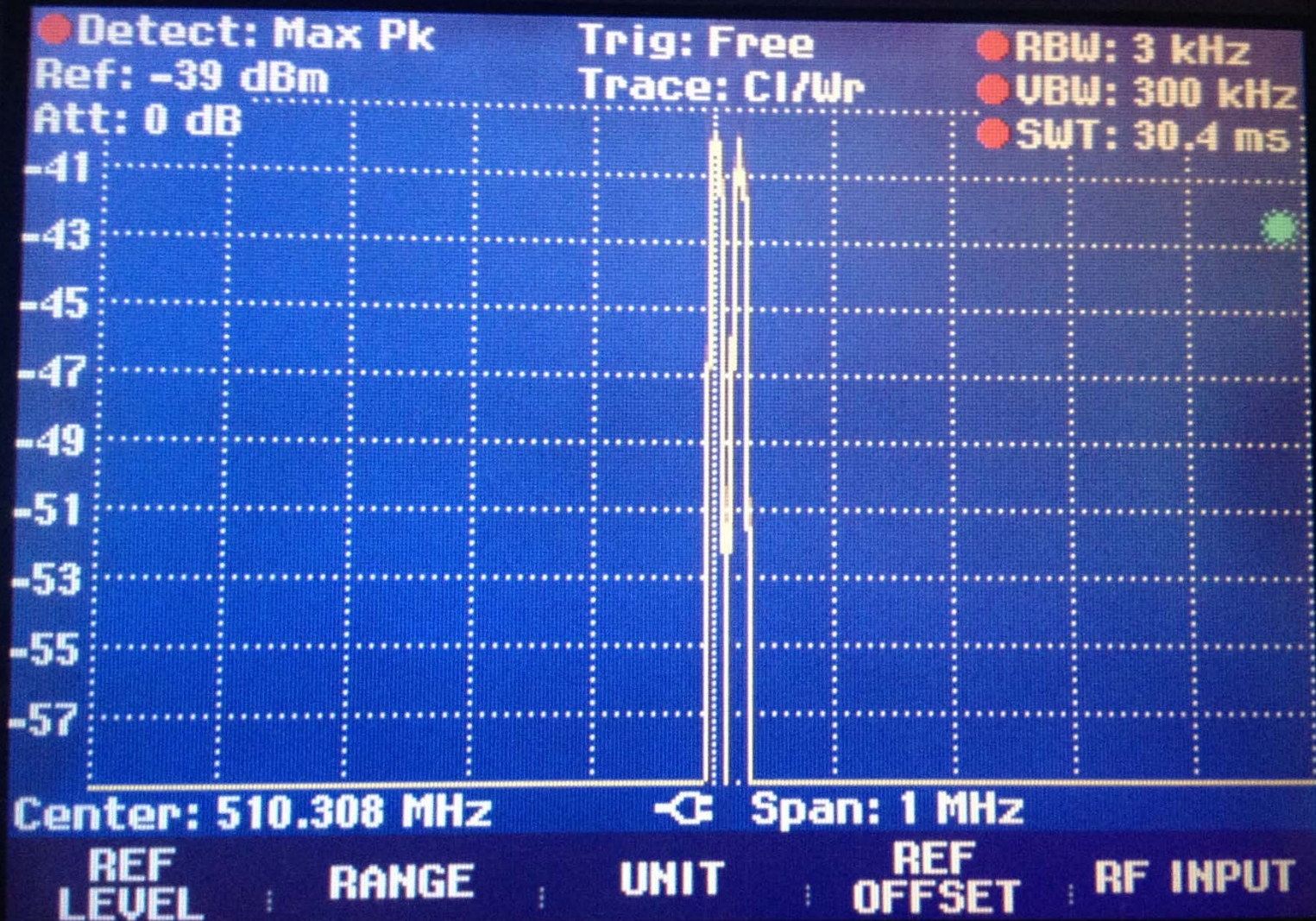
Digital modulation spreads the RF energy across the channel.

Frequency Modulation

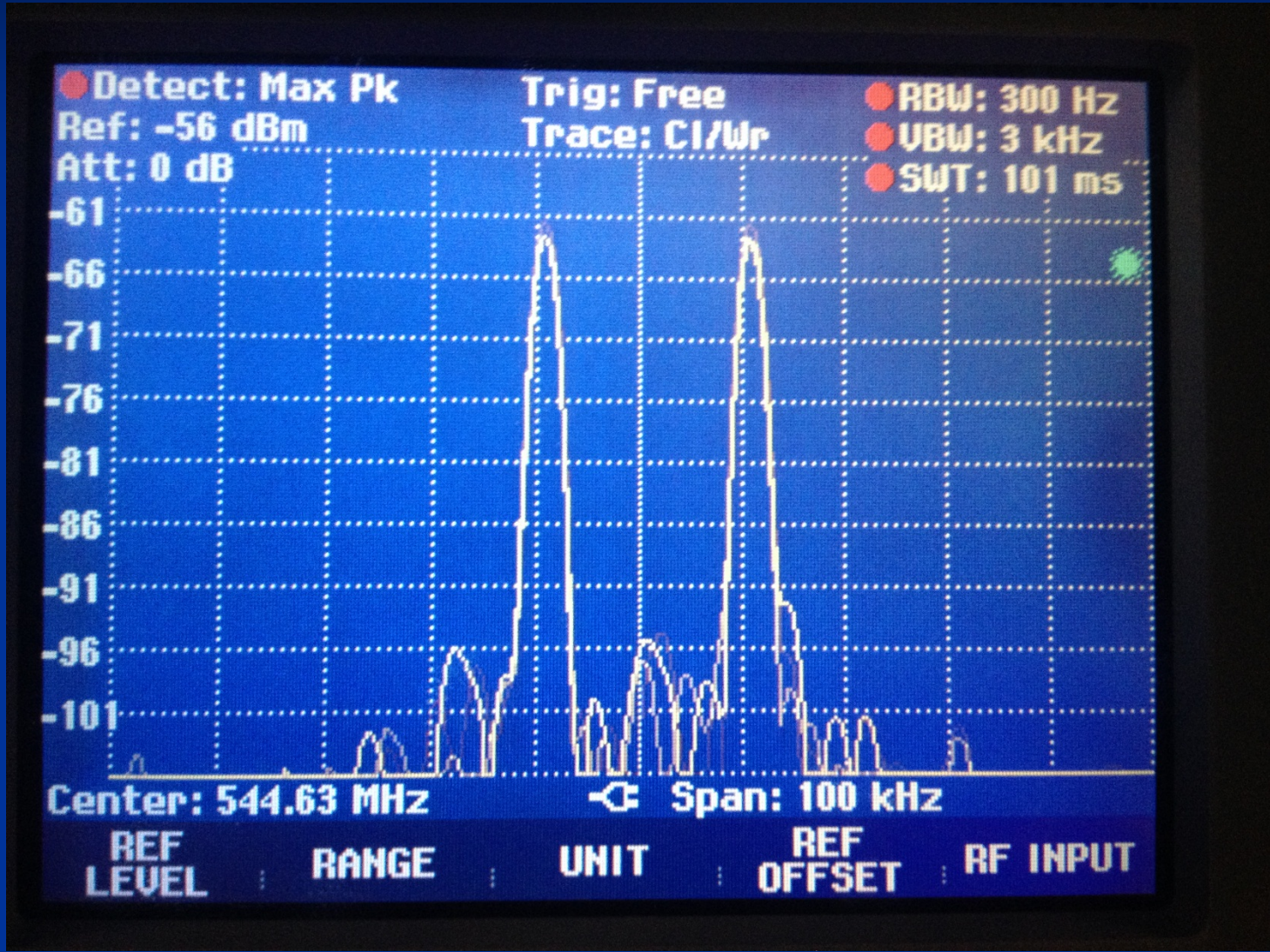
300-400 kHz band width



Enhanced Narrow Band 20 kHz Occupied Bandwidth



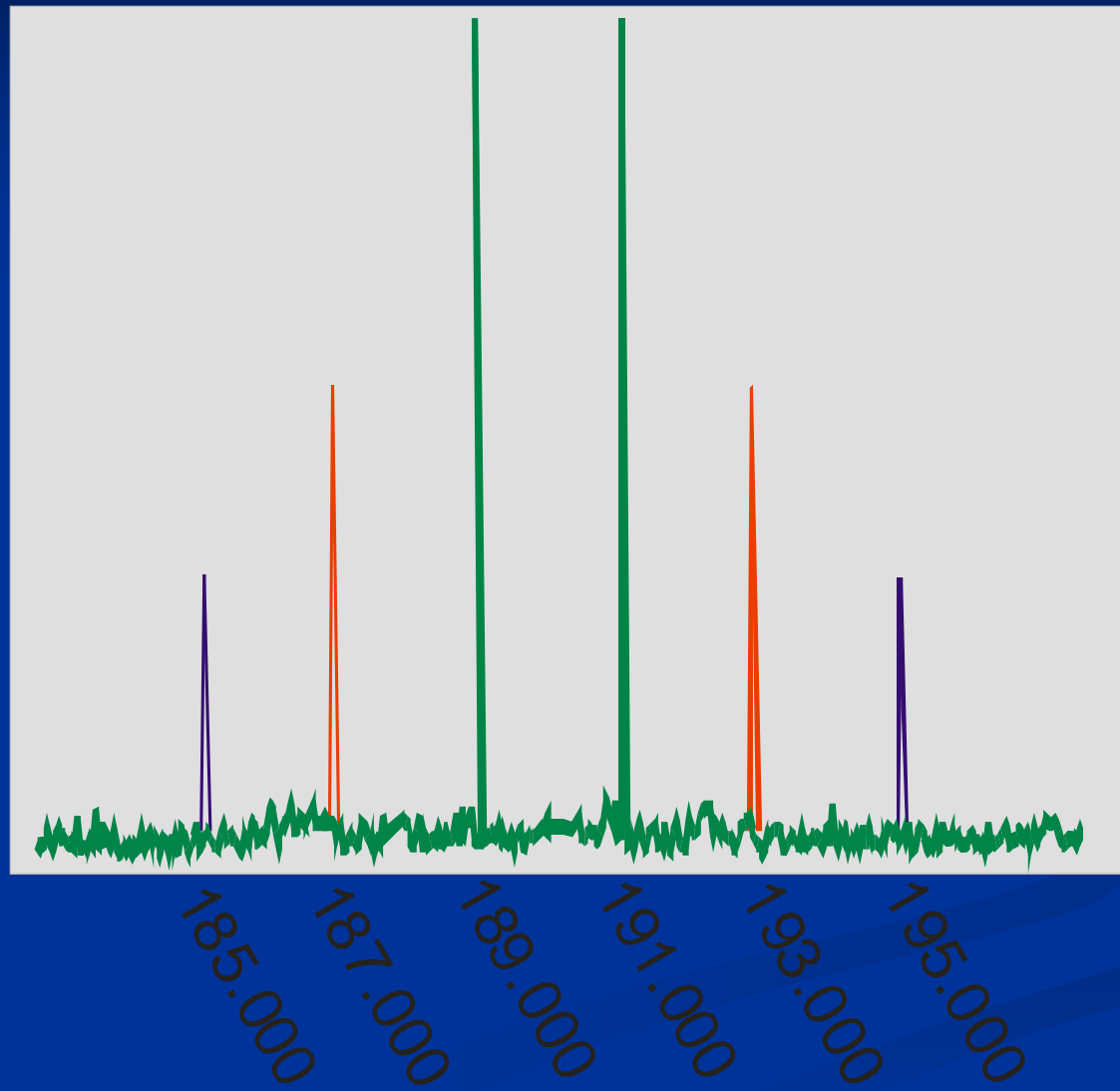
DSB Suppressed Carrier AM 20 kHz band width



RF Spectrum Band Planning

- 72-88 MHz RF IFB Transmitters
- 169-172 MHz ?? ??
- 174-216 MHz RF Intercom Receivers
- 470-495 MHz Wireless Intercom and Microphone Receivers
- 512-555 MHz Wireless Intercom, IFB and In Ear Transmitters
- 565-600 MHz Wireless Microphones
- 902-928 MHz Wireless Intercoms (WiFi)
- 944-952 MHz Wireless Microphones (Part 74)
- 1.4 GHz Wireless Microphones (Aero)
- 1.9 GHz Wireless Intercoms (DECT)
- 2.4 GHz Wireless Intercoms (WiFi)

Intermodulation Distortion





TV Wizard

Make **Telex**

Model **BTR-800**

Range **A TX**

Channel **518.100,**

Single Range

Start

Stop

Step



Calculate

Undo

Recalculate



Print



Print Preview



Options

Test Frequencies

Print

Calcul...

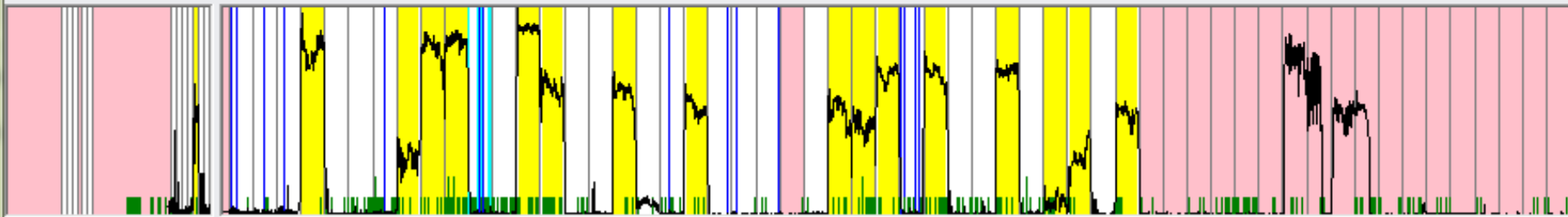
16 Frequencies

- [-] Untitled
 - [-] TV Stations (Chuluota, FL 32766)
 - ... ATSC (DTV): 11, 17, 21, 22, 23, 26, 27, 30, 33, 39, 4
 - [-] Zone 1
 - [-] BTR-800
 - ... 532.550, Telex BTR-800 A TX
 - ... 533.675, Telex BTR-800 A TX
 - ... 638.075, Telex BTR-800 2 RX
 - ... 638.975, Telex BTR-800 2 RX
 - ... 642.025, Telex BTR-800 2 RX
 - ... 642.875, Telex BTR-800 2 RX
 - [-] IEM
 - ... 470.350, Shure PSM-1000 G10
 - ... 471.825, Shure PSM-1000 G10
 - ... 478.800, Shure PSM-1000 G10
 - ... 483.925, Shure PSM-1000 G10
 - ... 509.125, Shure PSM-1000 G10
 - [-] Mics
 - ... 580.100, Shure UHF-R J5
 - ... 580.400, Shure UHF-R J5
 - ... 594.925, Shure UHF-R J5

Candidate Freqs Properties

5 Candidates

Freq	Make	Model	Range	Channel	TV Ch
<input type="checkbox"/> 530.175	Telex	BTR-800	A TX		TV 24
<input type="checkbox"/> 532.250	Telex	BTR-800	A TX		TV 24
<input type="checkbox"/> 533.050	Telex	BTR-800	A TX		TV 24
<input type="checkbox"/> 535.225	Telex	BTR-800	A TX		TV 24
<input type="checkbox"/> 535.675	Telex	BTR-800	A TX		TV 24



Potential 3rds = 165,600

Marker Freq: 597.143 (ch 35) -87.7db

**RADIO
ACTIVE
DESIGNS**



The wireless audio industry is about to experience the most challenging period in its history due to the FCC's allocation of frequency bands that these devices transmit on. With the introduction of digital television and frequency allocation for other purposes, the wireless industry continues to be increasingly burdened with less and less "space" to operate within.

**We made what we needed.
We are ready to share.**

Radio Active Designs UV-1G Split Band



Wireless Intercomm System
VHF/UHF AM Narrow Band

RAD Addresses Spectral Congestion and TVBD Ops

- All Packs Transmit in VHF from 174-216 MHz
- Modulation Scheme is Enhanced Narrow Band
- Allows operation of over 120 Devices Within One 6 MHz TV Band
- Uses Internal Narrow Band Antennas for Greater Chances for Success no antenna to lose
- Clears Up Radio Spectrum for Wireless Microphones and In Ear Monitors

Familiar Rear Panel



Coaxial Cable Types – Loss Over Distance

Coaxial cable allows remote positioning of antennas, but it also attenuates the signal.

It is imperative to consider cable type and length for a particular application.

<u>Coax Type</u>	<u>Belden #</u>	(Loss at 698 MHz) <u>dB/100ft.</u>	(at 200 MHz)
RG-174/U	8216	27.0	9 dB
RG-58A/U	8240	11.7	4 dB
RG-8A/U	8214	5.6	2 dB
RG-8A/U	9913F7	3.8	1.5 dB

Stay Tuned
RadioActiveRF.com



Stoffo@RadioActiveRF.com

Thank You

