Power Increase

Reality in 2010

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Nautel Market Development Mgr.

Las Vegas SBE Ennes Workshop

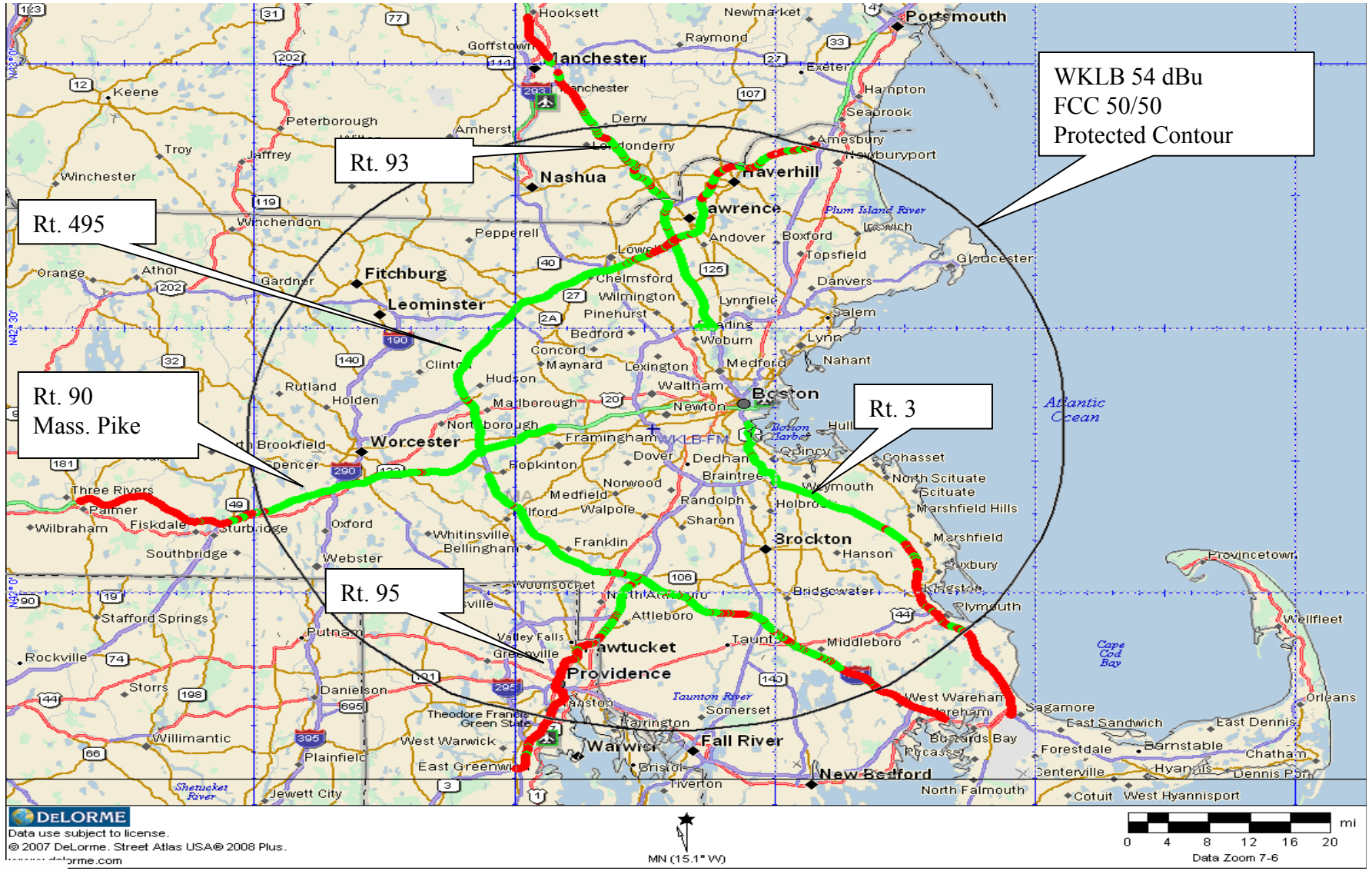
April 10, 2010

Making Digital Radio Work.

Why a Power **Increase?**

- Better building penetration
- Reliable outdoor coverage to 60 dBu contour or beyond (less blending or multicast dropouts)
- Better reception on portables
- More viability for brokered SPS channels ($$)
- More viability for Conditional Access ($$)
- Potential for interference in minority of cases

WKLB Performance @ -20 dBc



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WKLB Performance @ -14 dBc

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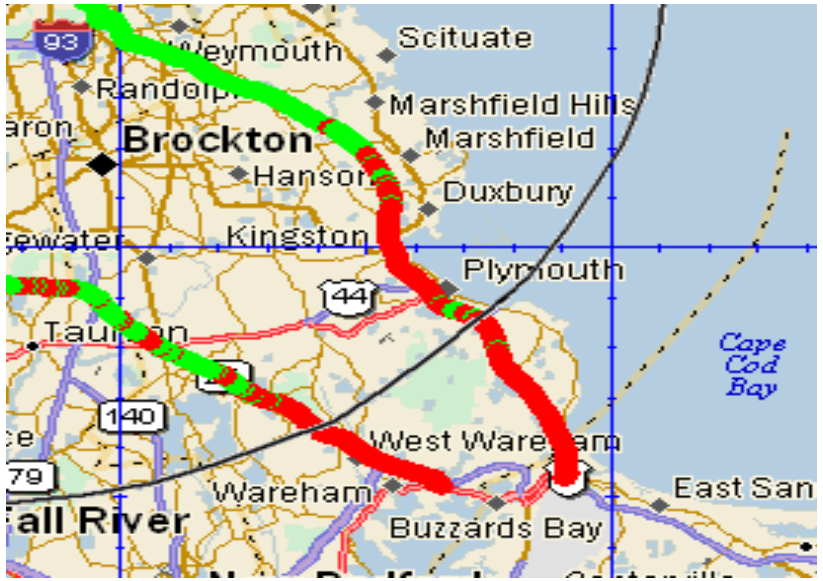
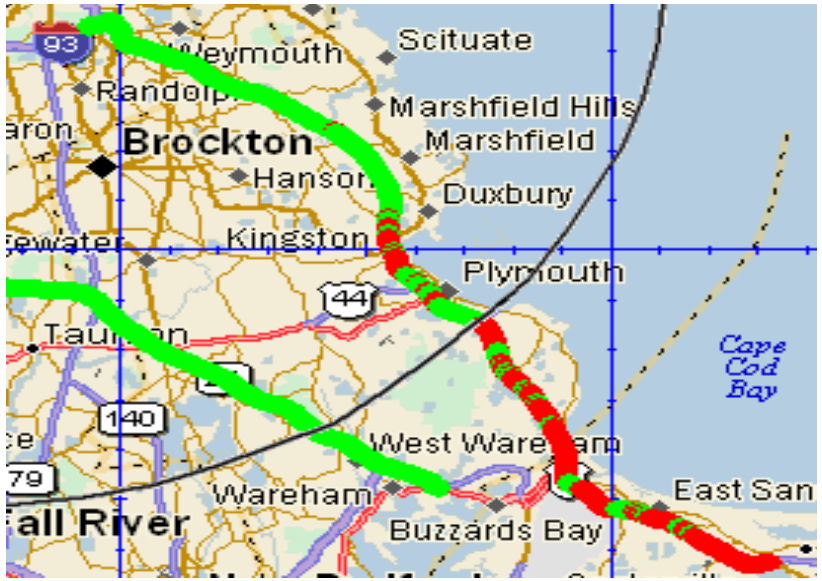
WKLB Performance @ -10 dBc

Coverage Example: SE Boston

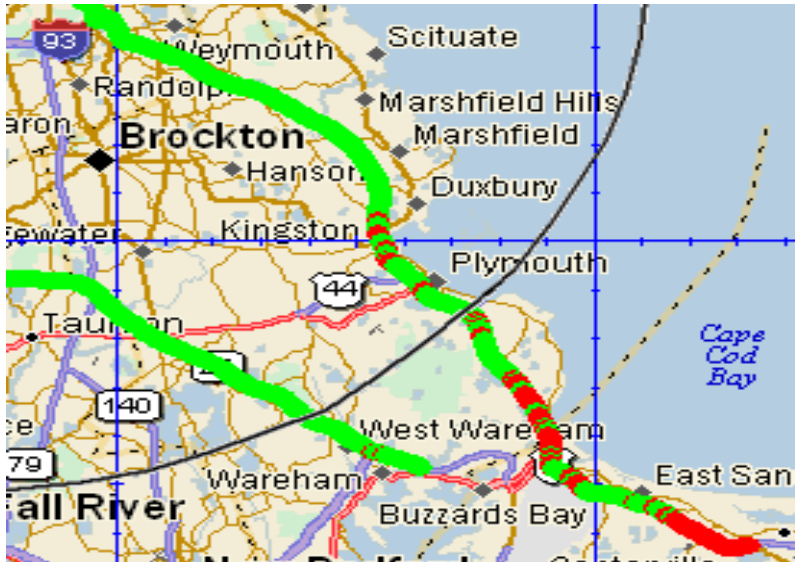
-20 dBc



-14 dBc`q



-10 dBc



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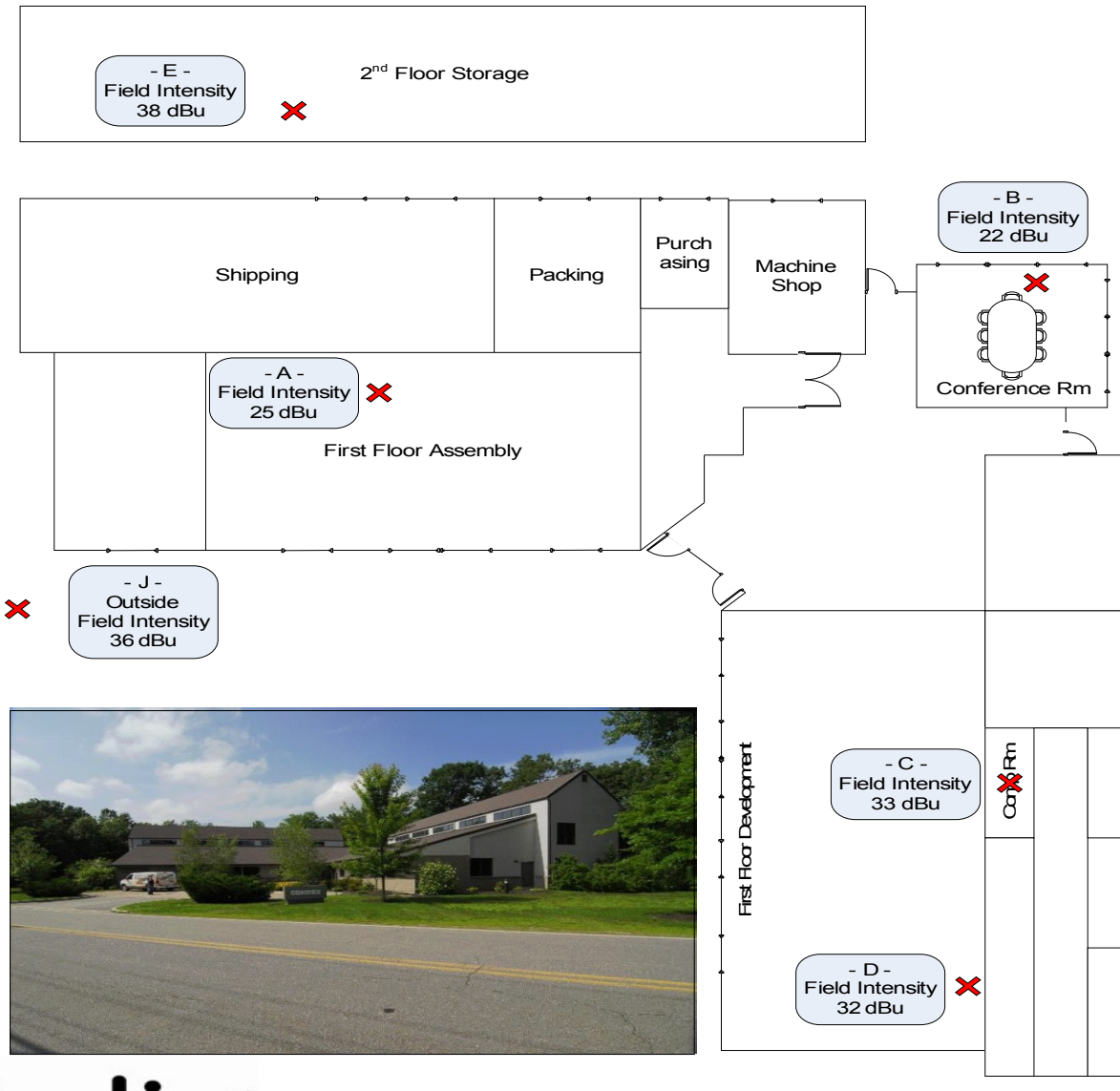
Indoor Study – One Example



D/A Power Ratio (dBc) →		-20	-18	-16	-14	-12	-10
Portable Armband Rx's	FI (dBu)	% Reception on Walking Tour					
Portable 1st FI	Varies	1%	5%	10%	40%	50%	65%
Portable 2nd FI		10%	20%	50%	60%	70%	80%
Portable Outside		5%	15%	40%	50%	60%	75%
1st Floor Tabletops		Front Panel LCD Display					
Loc. "A" Sony	25	None	None	None	None	None	Flash
Loc. "B" Sony	22	None	None	None	None	Flash	100%
Loc. "C" Sony	33	None	None	None	None	None	None
Loc. "D" Sony	32	None	None	Flash	Flash	100%	100%
2nd Floor Tabletops		Front Panel LCD Display					
Loc. "E" Sony	38	None	None	None	None	Flash	100%
Loc. "F" Sony	42	100%	100%	100%	100%	100%	100%
Loc. "G" Sony	38	Flash	100%	100%	100%	100%	100%
Loc. "H" Sony	35	Flash	Flash	Flash	100%	100%	100%
Loc. "I" Sony	33	Flash	100%	100%	100%	100%	100%
Outside Tabletop		Front Panel LCD Display					
Loc. "J" Sony	36	Flash	Flash	Flash	100%	100%	100%

Location #5

Comrex Corporation
19 Pine Rd
Devens, MA 01434

N 42° 32' 35.90"
W 71° 37' 11.40"

Two Floor / Steel Frame
Wood Construction

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Power Increase **Timeline**

2007

- Experimental Period testing of -10 dBc
- FCC issues 9 STAs for -10 dBc testing

2008

- "Joint Parties" and iBiquity request power increase
- NPR Labs Report: 1% inadequate but 10% interference potential
- FCC Public Notice seeking comment on increase

2009

- NPR Labs "metric" for determining interference
- FCC issues 2nd Public Notice
- Objectives: defer or not defer until NPR studies done?
- NPR Labs Report to FCC – listener impact to mobile interference
- iBiquity and NPR Labs jointly submit 5-point proposal to FCC

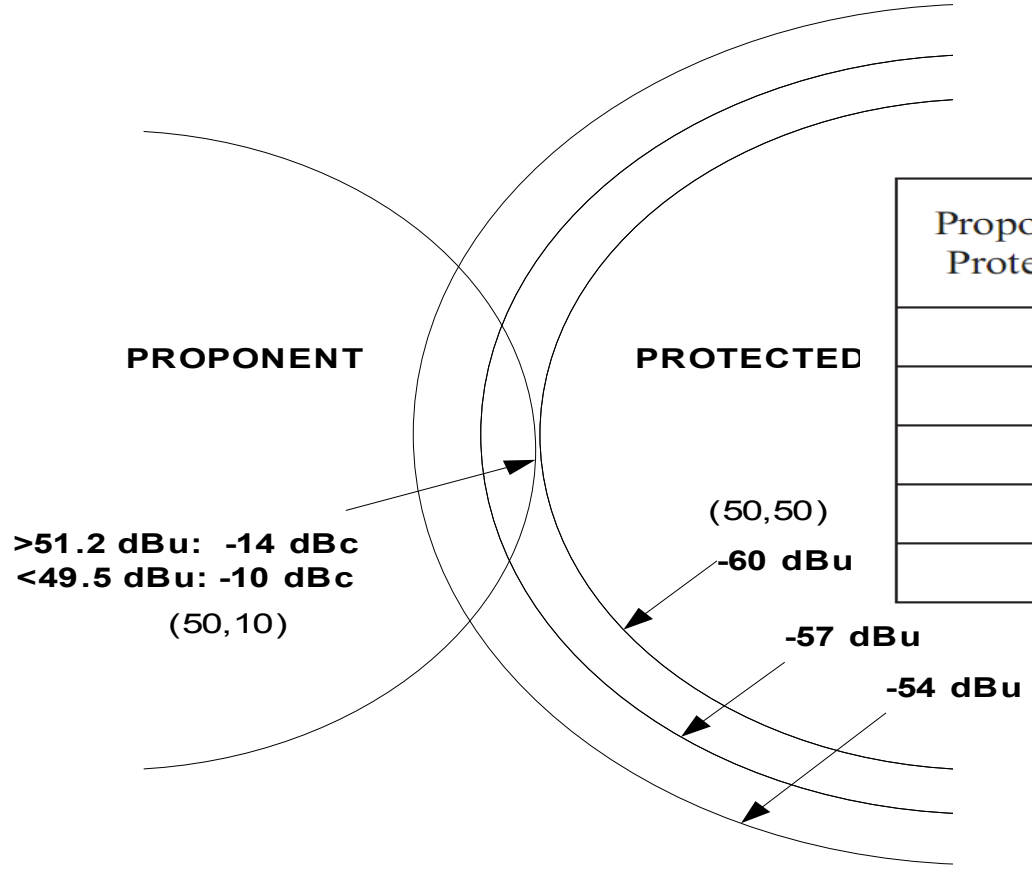
2010

- ***FCC approves power increase (January 27)***

Key Points – FCC Report & Order

- Blanket 6 dB for all stations except “Super B/C”
- Beyond 6 dB, up to 10 dB, subject to formula developed by NPR Labs
- Established procedures for remediating harmful interference cases above -20 dBc
- FCC may revisit the issue if widespread interference results
- Asymmetrical sidebands not specifically addressed, but it would presumably be compliant with established interference criteria in the R&O.

Adjacent Channel Protection



Proponent Analog F(50,10) Field Strength at Protected Analog 60 dBu F(50,50) Contour	Maximum Permissible FM Digital ERP
51.2 dBµ and above	-14 dBc
50.7 dBµ - 51.1 dBµ	-13 dBc
50.3 dBµ - 50.6 dBµ	-12 dBc
49.6 dBµ - 50.2 dBµ	-11 dBc
49.5 dBµ or less	-10 dBc

Interference Complaint Remediation

Initial:

- Voluntary reductions
- Mutual resolution between parties

Escalation:

6 documented complaints required for filing with FCC:

- Submit maps of ongoing interference ***inside*** protected contour
- Document tests and equipment used for tests
- FCC to resolve within 90 days
- In absence of FCC action, must reduce to -14 dBc
- LPFM and Translators excluded from protection

MIA-FLL-WPB MARKET **HIGHLIGHTS**

-10 dBc (both SB)	Asymmetrical	-14 dBc (both SB)
WHDR	WDNA -14 -10	WLDI
WMIA	WLRN -10 -14	
WMGE	WLYF -12.6 -10	
WPOW	WXEL -14 -10	
WFLC	WKGR -14 -10	
WRTO -11.3 -11.3		
WEDR		
WKIS		
WMXJ		
WMIB		
WHQT		
WBBG		
WEAT		

Notification **Procedure**

- For -14 dBc operation:
  - Notify FCC within 10 days after commencing operation
  - Digital Notification Form, online at CDBS (not yet there) STA needed until May 10.

- For above -14 dBc operation:
  - File informal request with showing of calculation of proponent (50,10) contour on protected station's 60 dBu (50,50) contour.
  - *This is essentially the NPR Labs online calculator.*

- Note:
  - Super-powered FMs must file an informal application for ***any*** proposed increase in digital power.

How Much Injection is Enough?

Analyze your digital coverage

- High noise environment?
- Interference to other stations?
- Interference to your own analog?
- Regulatory clearance beyond -14?

Consultants can help

-14dB

-12dB

-20dB

?

-13dB

-10dB

-15dB

-16dB

Digital **Upgrade** Options

- **Antenna upgrades**
- **Digital-only boosters**
- **Transmitter solutions:**
  - Add separate digital transmitter
    - High power combined
    - Space combined
  - Higher power hybrid mode transmitter
  - HD PowerBoost™

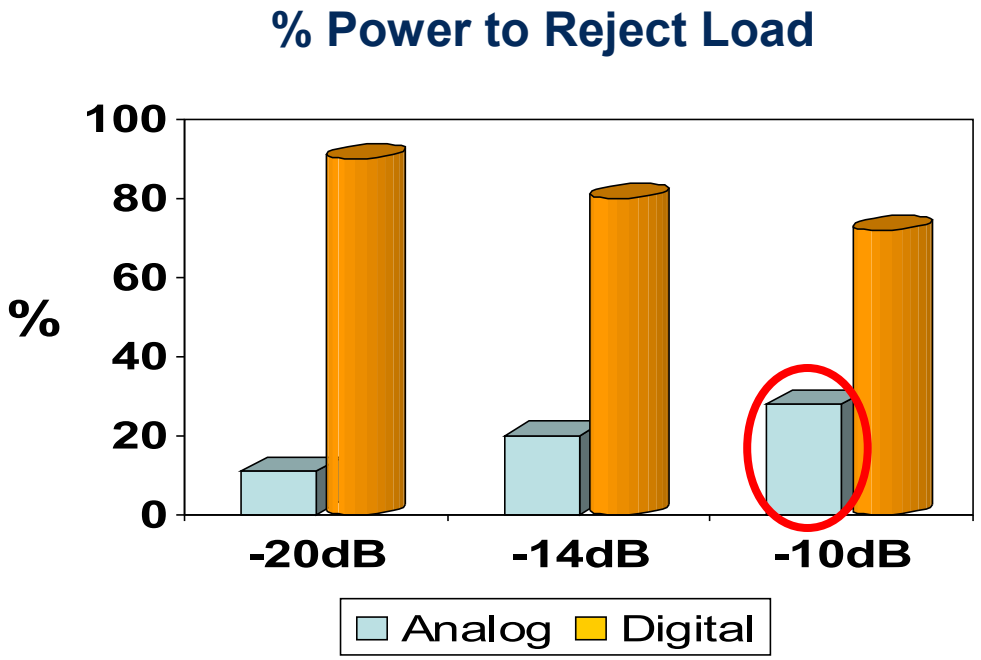
Antenna Options: More Gain

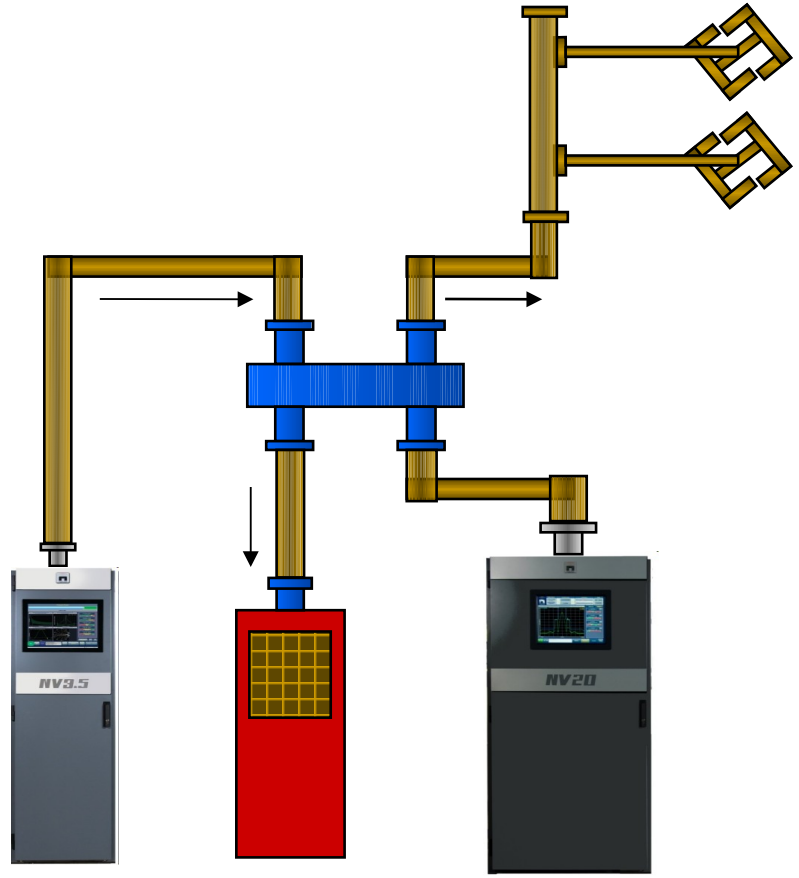
- Add bays to increase gain
- Increase injection without changing the transmitter power
- Increases system efficiency

- **Considerations**
  - Space on tower (additional $$ for rent?)
  - Weight and wind load
  - Impedance matching
  - Coverage in antenna nulls
  - Digital spectral purity – tighter requirement

Transmitters: High Power Combined

- Higher injection means more power wasted in reject load





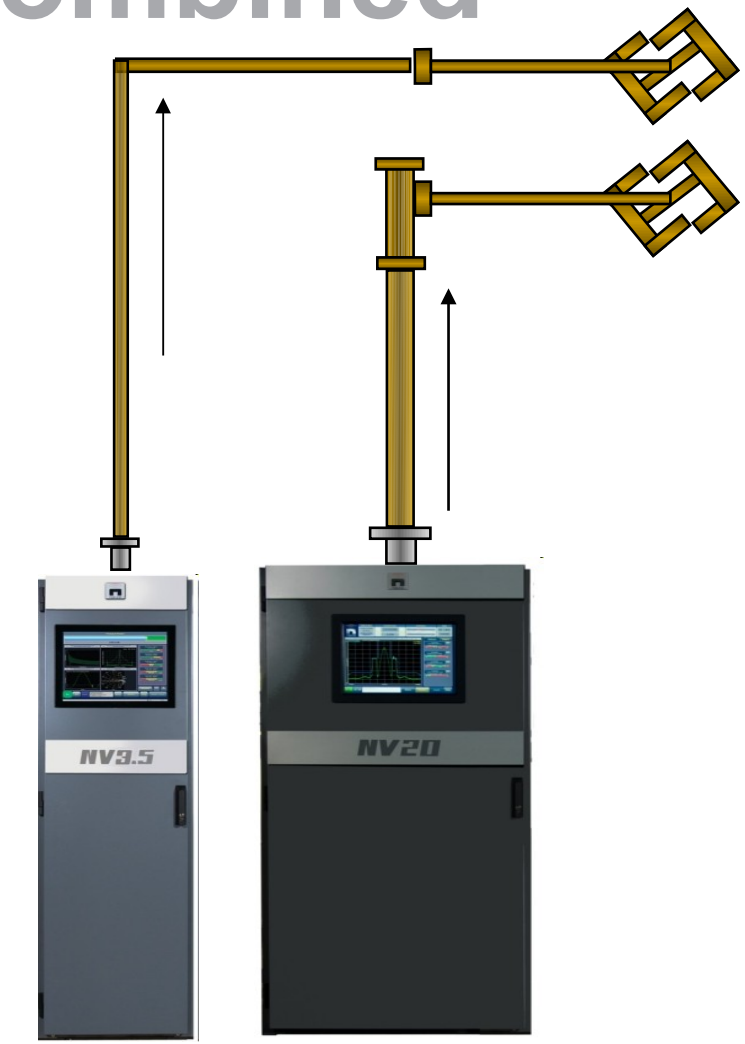
High Level Combining
Modification

Coupling Ratio	Licensed TPO	Total Analog Power Required	Digital Power Total	New Digital Power	Boost in dB	Total Reject Power
10	100.00	111.00	10.00	1.00	0	20.00
9	100.00	114.17	10.00	1.26	1	22.92
8	100.00	118.36	10.00	1.58	2	26.78
7	100.00	123.93	10.00	2.00	3	31.94
6	100.00	131.43	10.00	2.51	4	38.92
5	100.00	141.62	10.00	3.16	5	48.46
4	100.00	155.66	10.00	3.98	6	61.68

Transmitters: Space Combined

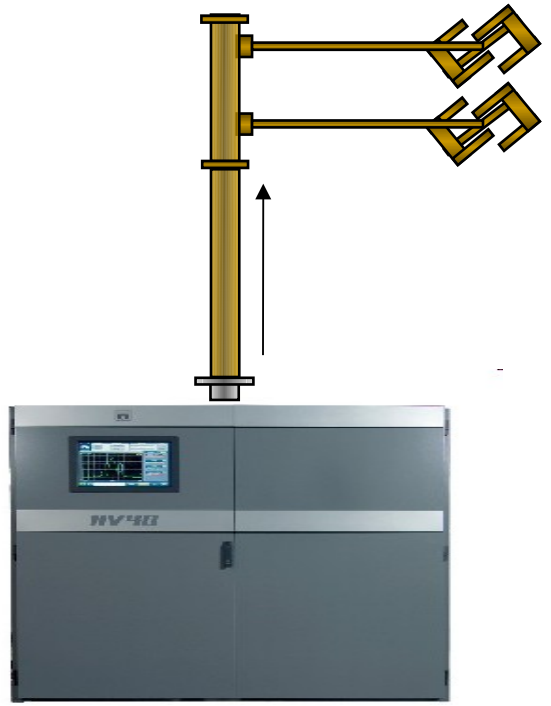
- **Considerations**
  - Tower and building space?
  - analog vs. digital radiation pattern differences
  - RF IMD issues:
    - **higher power filters required**
    - **circulators may be required**
  - Verify digital antenna ratings: voltage and power
  - New developments in digital-only transmitters

    (11kW digital from an NV20)

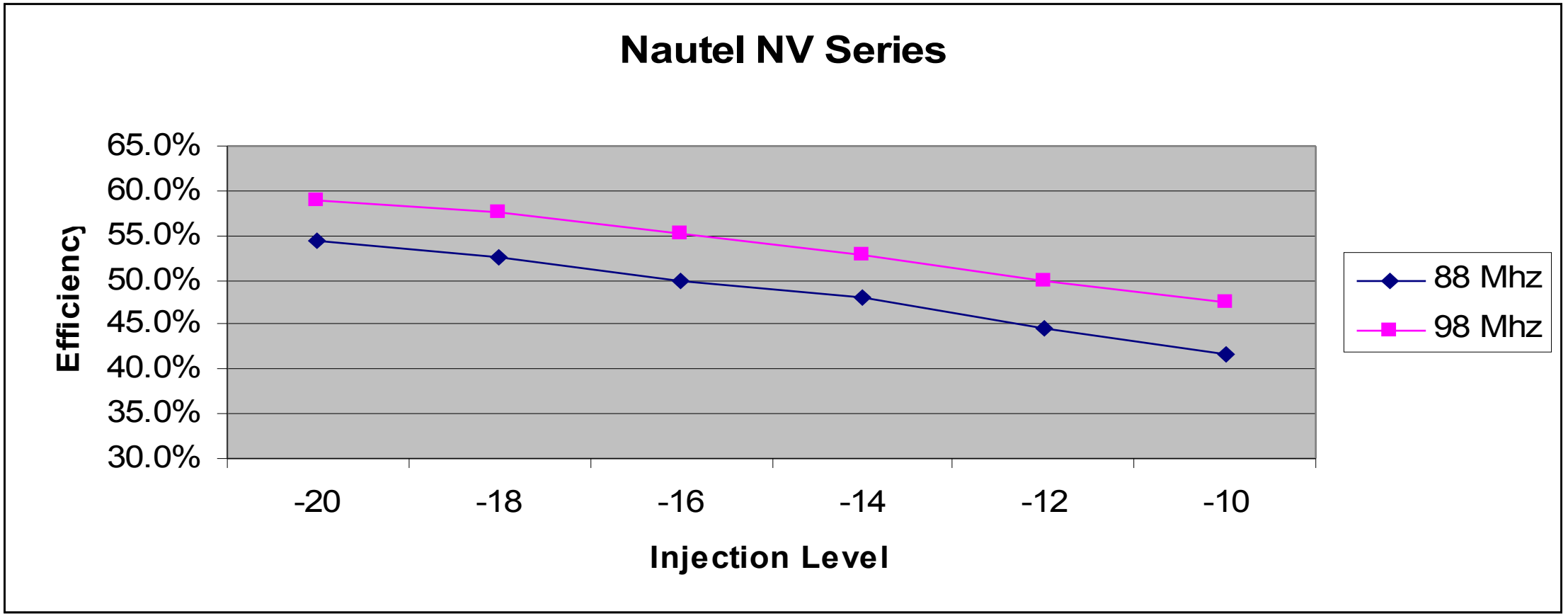


Transmitters: Higher Power Hybrid

- Simple architecture - simplest method
- Single box installation (unless paralleling)
- Higher HD injection level may reduce the analog TPO capability (see power chart)
- May need to replace your transmitter or combine another for higher total power
- Higher injection levels reduce efficiency



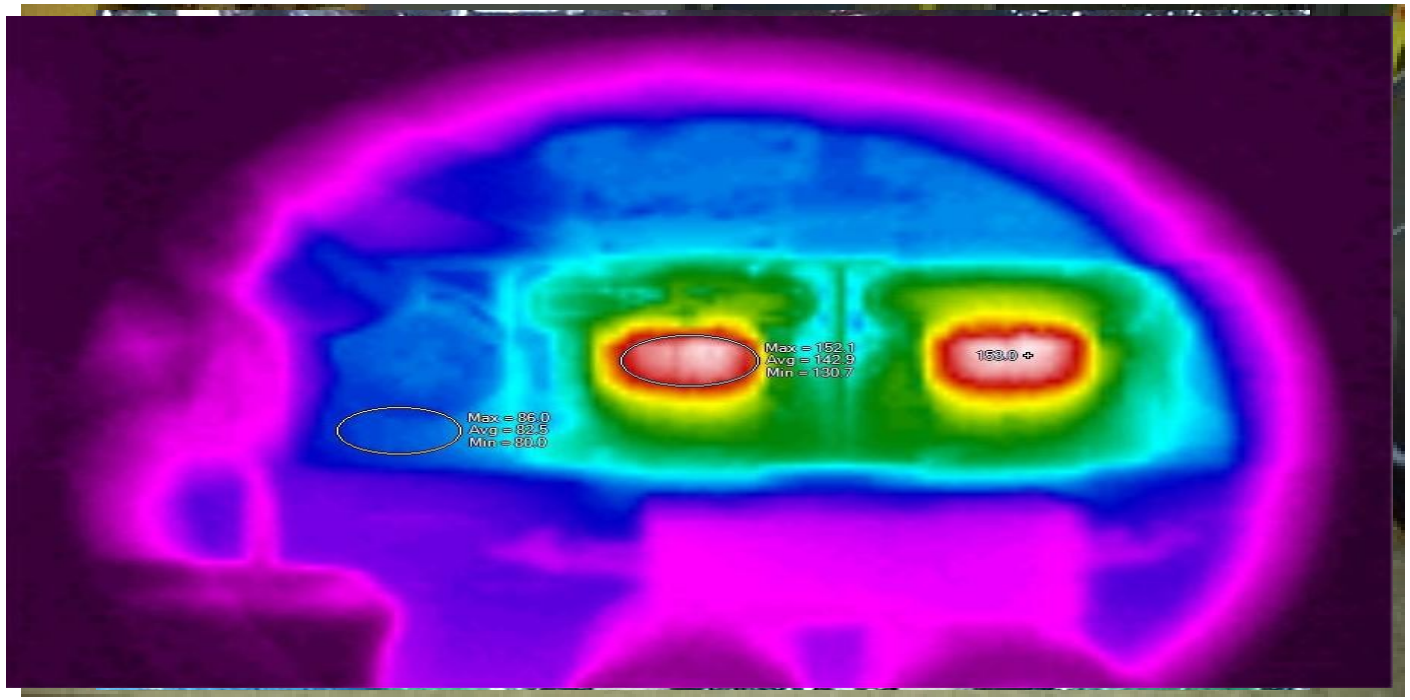
Efficiency vs. Injection Level - Common Amp (Low Level Combined)



Transmitters: Higher Injection Implications

Limitations:

- Linearity (spectral mask)
- Thermal dissipation
- Most transmitters with adaptive pre-correction are thermally limited today

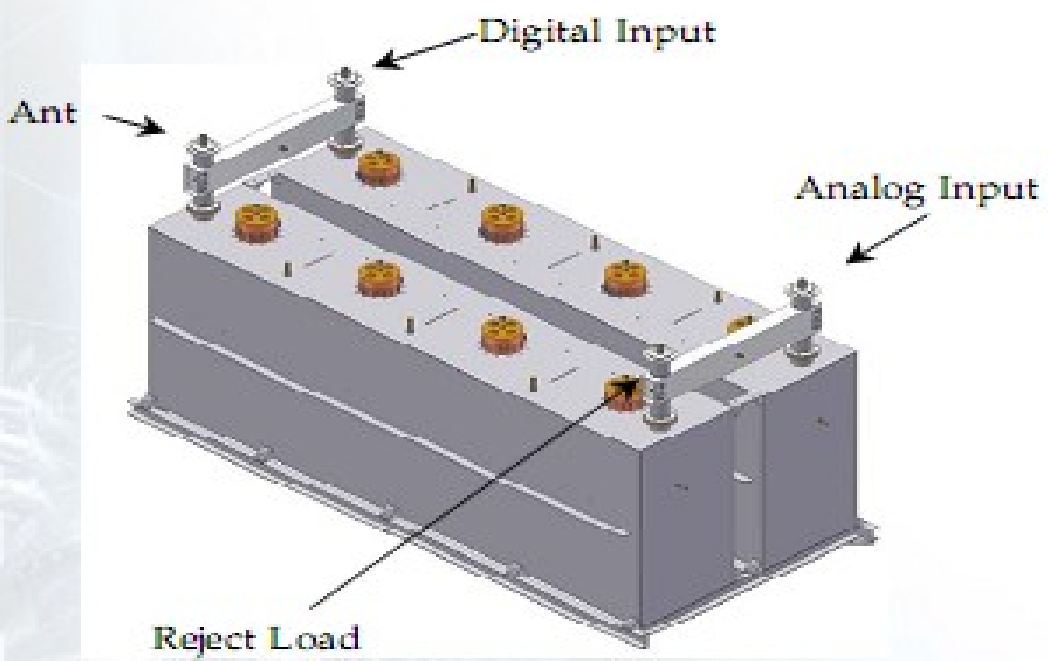


Therefore it's important to KNOW before you just crank up power, thinking that as long as you make mask…….

Myat *"LO-LOSS SOLUTION"*

PATENT PENDING

EVANESCENT COUPLED
TECHNOLOGY



- Attractive solution for combining FM + HD Radio signals at powers above 20KW
- Efficient high level combining technique
- Ideal for the proposed 10dB digital sideband increase
- Allows existing Tx facilities to go from $20dB_c$ to $10dB_c$
- Lower operating cost, less waste
- Evanescent Coupled Technology for superior efficiency
- Compact design suitable for floor, or ceiling mount

Recent article in RW on this technology
Down side: large size, weight, cost

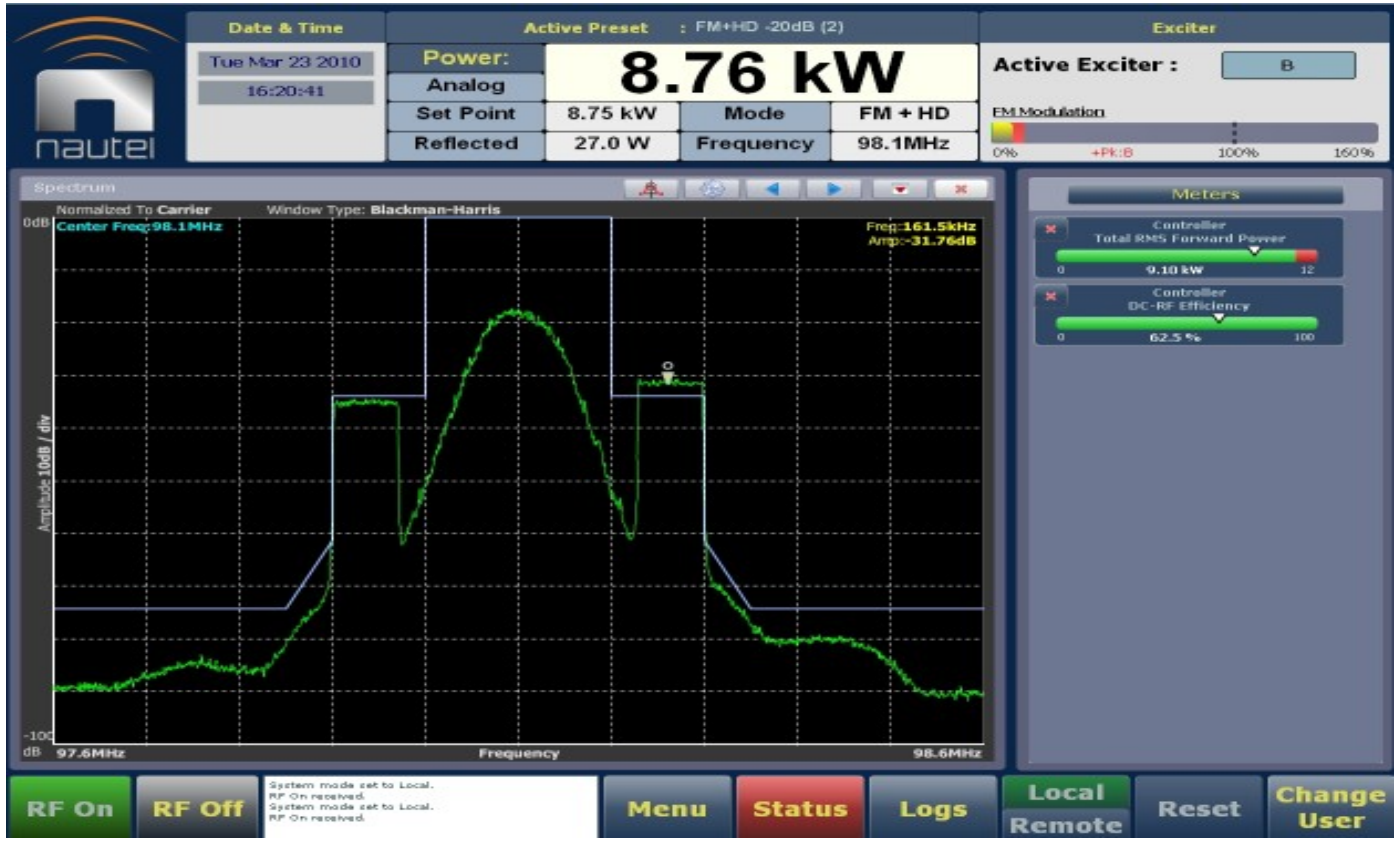
Attention to Specifications

Model #	-10		
	Comb	FM (TPO)	IBOC
NV 3.75	*2,184*	*1,985*	*199*
NV 5	2,912	2,647	265
NV 7.5	*4,368*	*3,971*	*397*
NV 10	5,824	5,294	529
NV 15	*8,736*	*7,941*	*794*
NV 20	11,647	10,589	1,059
NV 30	*17,471*	*15,883*	*1,588*
NV 40	23,295	21,177	2,118

- Keep in mind the relationship between ***combined total RMS power***, and ***available analog FM TPO***.

Factors That Can Improve **De-rating**

- Peak-to-Average Power Ratio Reduction (PAPR) such as Nautel PowerBoost™ can yield an additional 30% in available analog power @ -10 dBc
- Asymmetrical sideband technology – optimizes power in upper and lower sidebands.



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Factors That Can Degrade **De-rating**

- Tube vs. Solid State – Tubes generally de-rate faster as injection approaches -10 dBc
- Extended hybrid modes – Depending on the Mode (MP2, MP3, MP11,etc.), require additional de-ratings due to additional digital carriers
- MP3 mode ~6% at -10 dBc (2 extended partitions)
- MP11 mode ~13% at -10 dBc (4 extended partitions)
- Check with your transmitter manufacturer!!

Transmitters: Power Ratings

HD Radio Injection Level Analysis Tool

HD PowerBoost → No
Enter VSWR Capability → 1.2:1
Enter HD mode → MP1
Enter Frequency → 98.1 MHz.

HD Injection Level / Analog TPO

Model	-20dB	-18dB	-16dB	-14db	-12dB	-10dB
NV3.5	3,707	3,537	3,369	3,032	2,560	2,107
NV5	4,942	4,716	4,492	4,042	3,413	2,809
NV7.5	7,413	7,074	6,738	6,063	5,119	4,214
NV10	9,884	9,432	8,983	8,084	6,826	5,618
NV15	14,827	14,148	13,475	12,126	10,239	8,428
NV20	19,769	18,864	17,967	16,169	13,652	11,237
NV30	29,653	28,296	26,950	24,253	20,477	16,855
NV40	39,537	37,728	35,934	32,337	27,303	22,474
NV60	59,306	56,592	53,900	48,506	40,955	33,711
NV80	79,075	75,456	71,867	64,674	54,606	44,948

All specifications subject to change. CK 3/24/10
All specifications based on 3dB mask headroom, and the NRSC measurement protocol.

HD Radio Injection Level Analysis Tool

HD PowerBoost → Yes
Enter VSWR Capability → 1.2:1
Enter HD mode → MP1
Enter Frequency → 98.1 MHz.

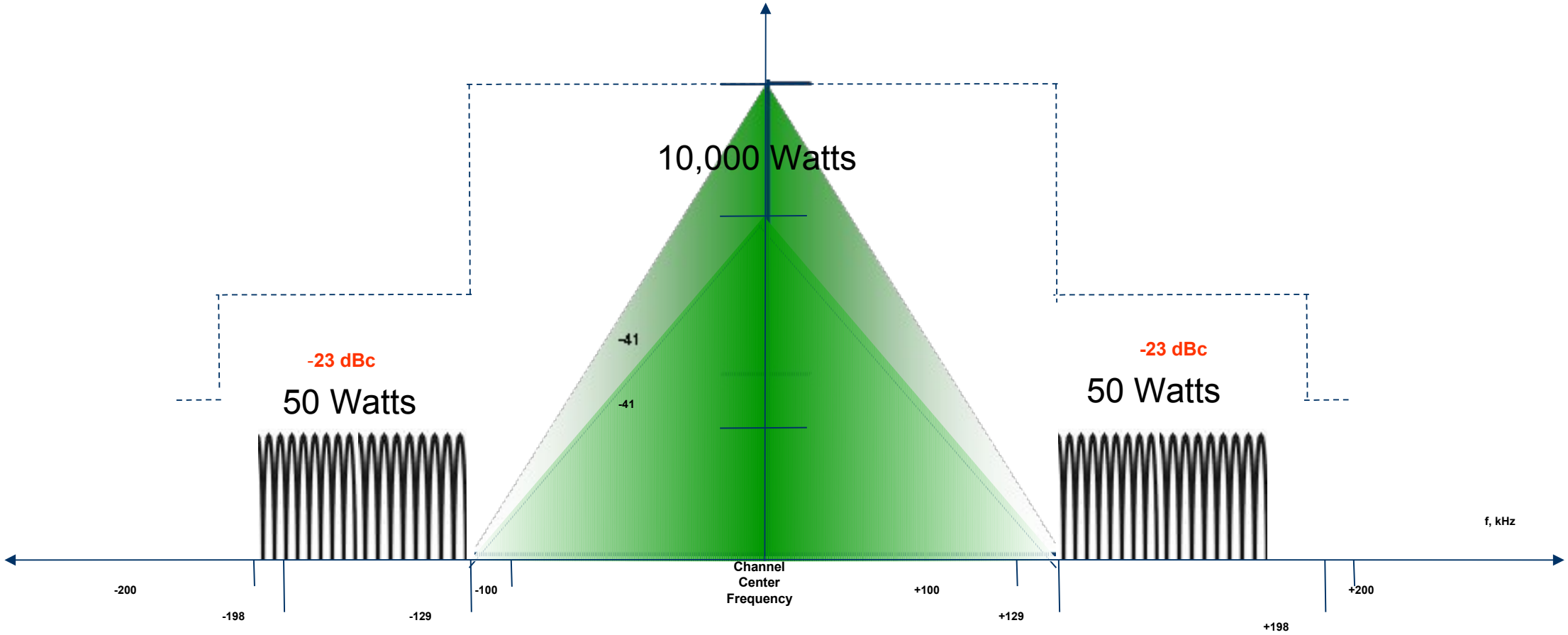
HD Injection Level / Analog TPO

Model	-20dB	-18dB	-16dB	-14db	-12dB	-10dB
NV3.5	3,799	3,723	3,650	3,411	3,076	2,715
NV5	5,066	4,964	4,866	4,547	4,101	3,620
NV7.5	7,599	7,446	7,299	6,821	6,151	5,430
NV10	10,131	9,928	9,732	9,095	8,201	7,240
NV15	15,197	14,893	14,598	13,642	12,302	10,859
NV20	20,263	19,857	19,464	18,190	16,403	14,479
NV30	30,394	29,785	29,196	27,285	24,604	21,719
NV40	40,526	39,714	38,928	36,379	32,806	28,958
NV60	60,789	59,571	58,392	54,569	49,208	43,437
NV80	81,052	79,428	77,856	72,759	65,611	57,916

All specifications subject to change. CK 3/24/10
All specifications based on 3dB mask headroom, and the NRSC measurement protocol.

An Important Point to Ponder

Each sideband's digital carriers were originally at -23 dBc, and added together = -20 dBc or 1%



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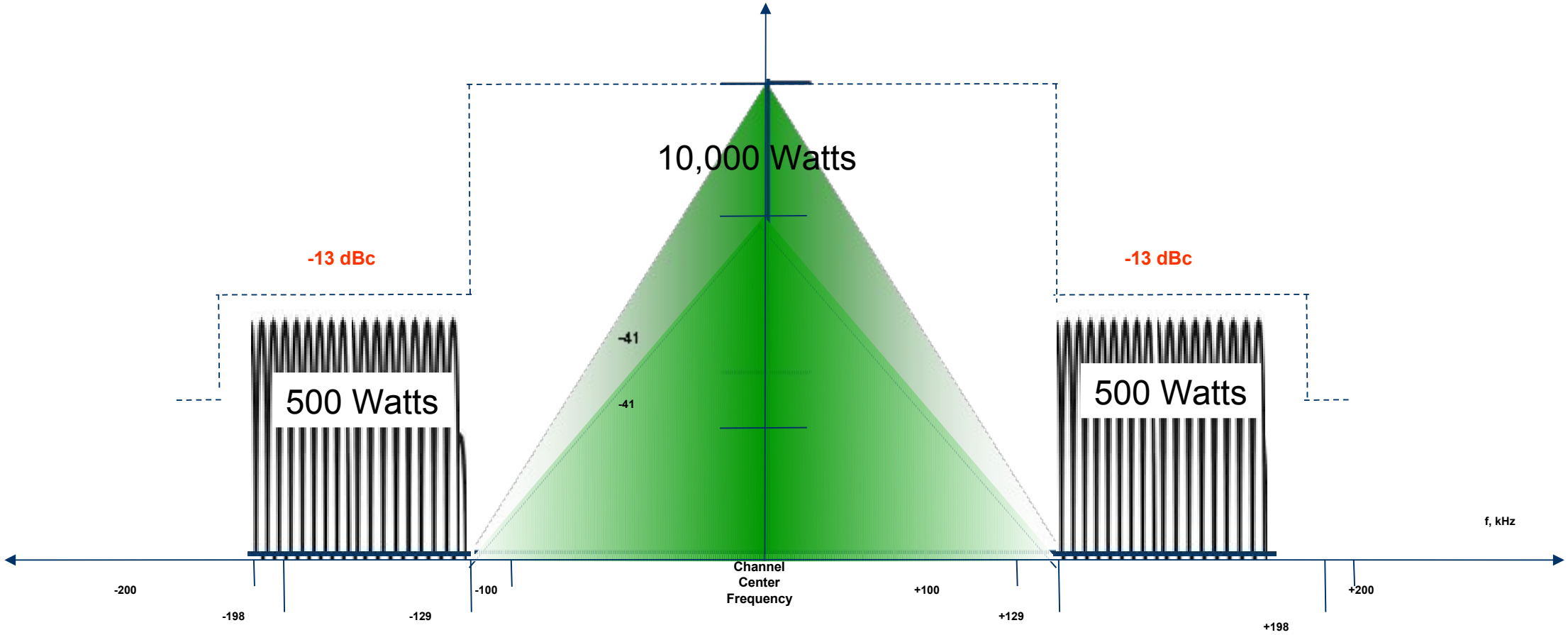
An Important Point to Ponder

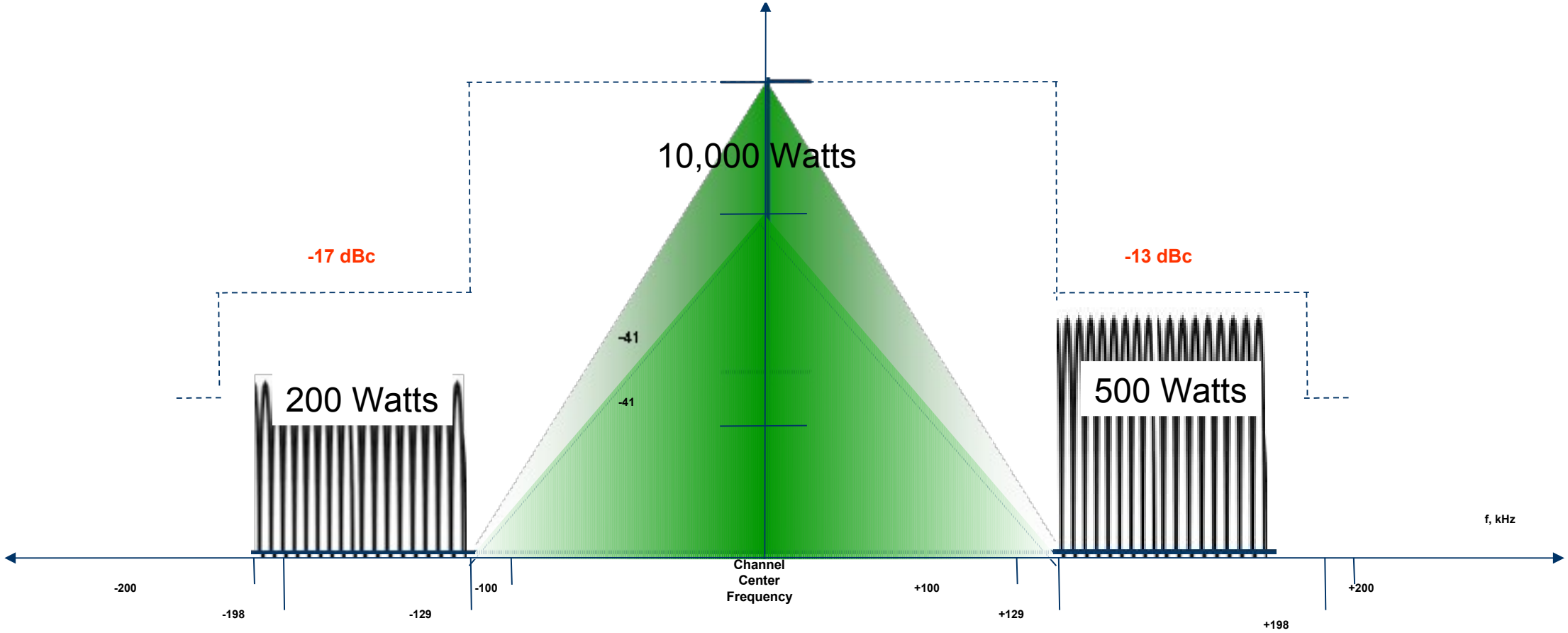
At "-10 dBc", we really are at -13 dBc or added together, at -10 dBc or 10% of analog power



An Important Point to Ponder

Example of station with “-14 dBc” lower and “-10 dBc” upper sideband power

Total integrated power is -11.55 dBc or 7% of analog



Calculating the True Integrated (Total) **Digital Power**

- Convert to simple power ratio
  -13 dBc = .05 and -17 dBc = .02
- Combined power = 10*log (.05 + .02) = 11.55 dBc
- LSB 200 W + USB 500 W = 700 W
- 700/10,000 = .07 * 100 = 7% of analog power

Thank You!

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