Green Broadcasting – Saving your station money, each and every day, and saving the environment as well

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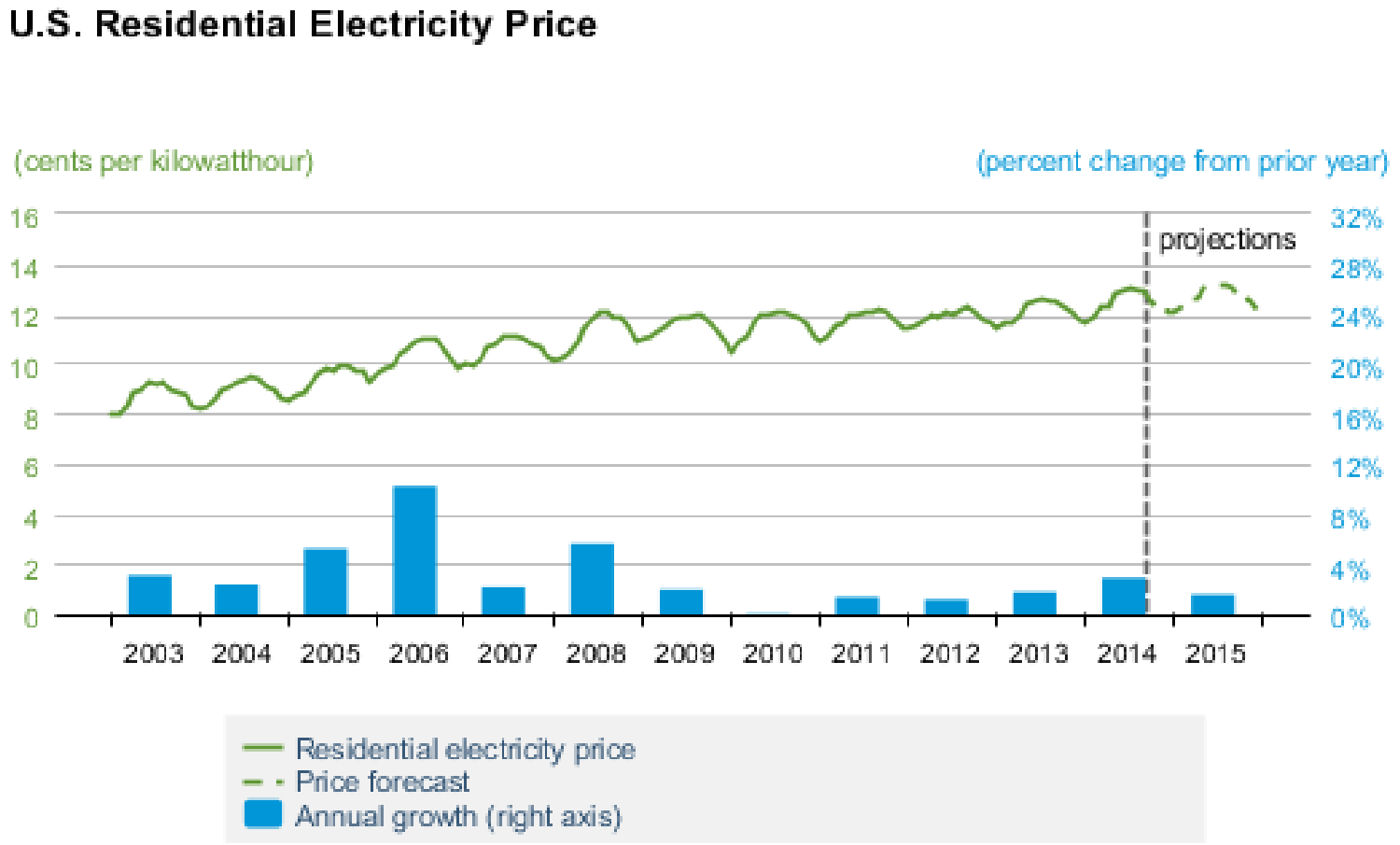
The problem: Rising energy costs



eia Source: Short-Term Energy Outlook, October 2014

The problem: It's worldwide

Tonga	57.95	Portugal	25.25	China	16
Denmark	40.38	Australia	25	Latvia	15.4
Germany	36.48	Hungary	23.44	Pakistan	14.62
Brazil	34.18	Chile	23.11	Turkey	13.1
Philippines	30.46	Uruguay	22.89	Israel	12.34
Belgium	29.06	Singapore	22.83	Hong Kong	12.04
Netherlands	28.89	UK	21.99	USA	11.2
Italy	28.39	Finland	20.65	Moldova	11.11
Ireland	28.36	France	19.39	Canada	10.78
Sweden	27.1	New Zealand	19.15	Vietnam	10
Spain	27.06	Iran	19	Iceland	10
Guyana	26.8	Jamaica	16.8	Thailand	9.79

2011 Averages, US¢/kWh Source: Wikipedia

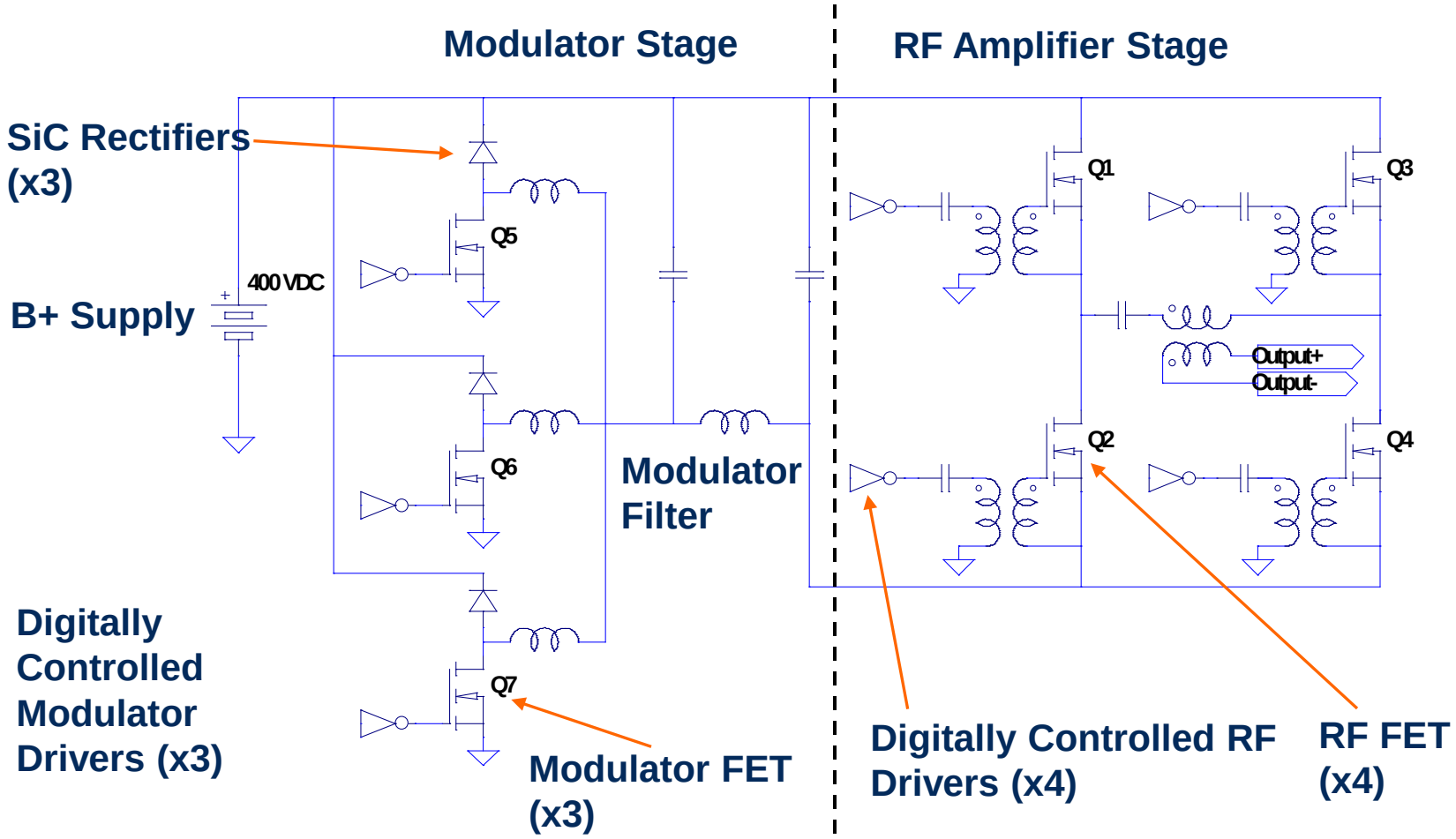
Calculating what can be saved

	Current	New #1	New #2	New #3
Cost per kW/h:	$0.12	$0.12	$0.12	$0.12
Power of transmitter in kW:	50	50	50	50
Efficiency:	60%	70%	80%	90%
Hours of operation / day:	24	24	24	24
Days of operation / year:	365	365	365	365
Consumption in kW/H:	730,000	625,714	547,500	486,667
Total transmitter cost (USD):	$87,600.00	$75,085.71	$65,700.00	$58,400.00
Transmitter Power Savings:		$12,514.29	$21,900.00	$29,200.00
A/C costs may add 15-20%:	$14,892.00	$12,764.57	$11,169.00	$9,928.00
Total electrical cost (USD):	$102,492.00	$87,850.29	$76,869.00	$68,328.00
Total Electrical Savings / Yr:		$14,641.71	$25,623.00	$34,164.00
Total Carbon footprint savings:		93	163	218

AM: Efficiency Improvements

- Solid State Designs
- Digital modulation techniques
- Modulation Dependant Carrier Level

AM: Solid State Design

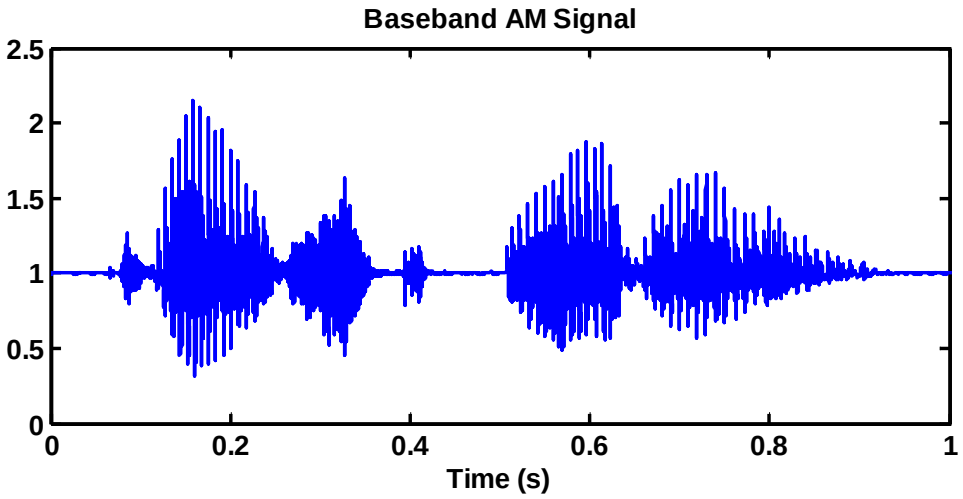


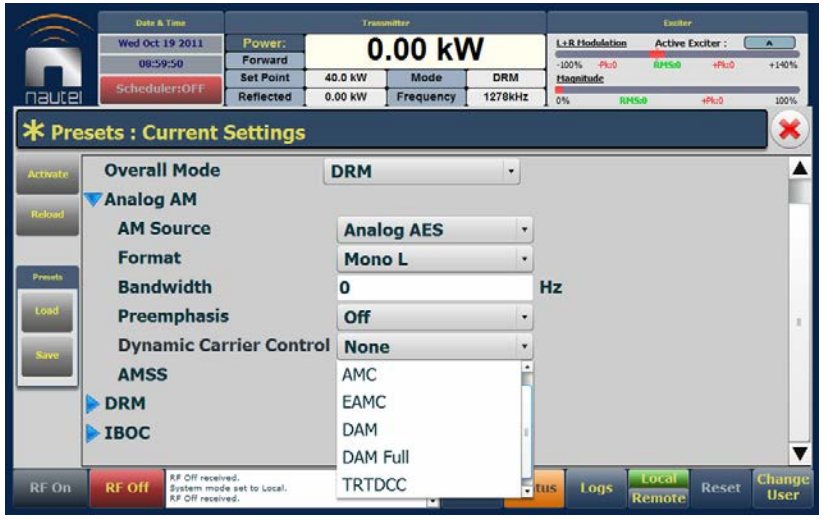
AM: Digital exciter techniques

- Precision digital controlled modulation samples the audio at 2.5 msps.
- 9 phase PDM reduces demand on modulator filter.
- Turns on and off the output FET's at the time when there is no voltage across them – so there is reduced capacitive losses.
- Output transistors are 200A devices – so less on resistance, thus less loss.

AM: Modulation Dependent Carrier Level

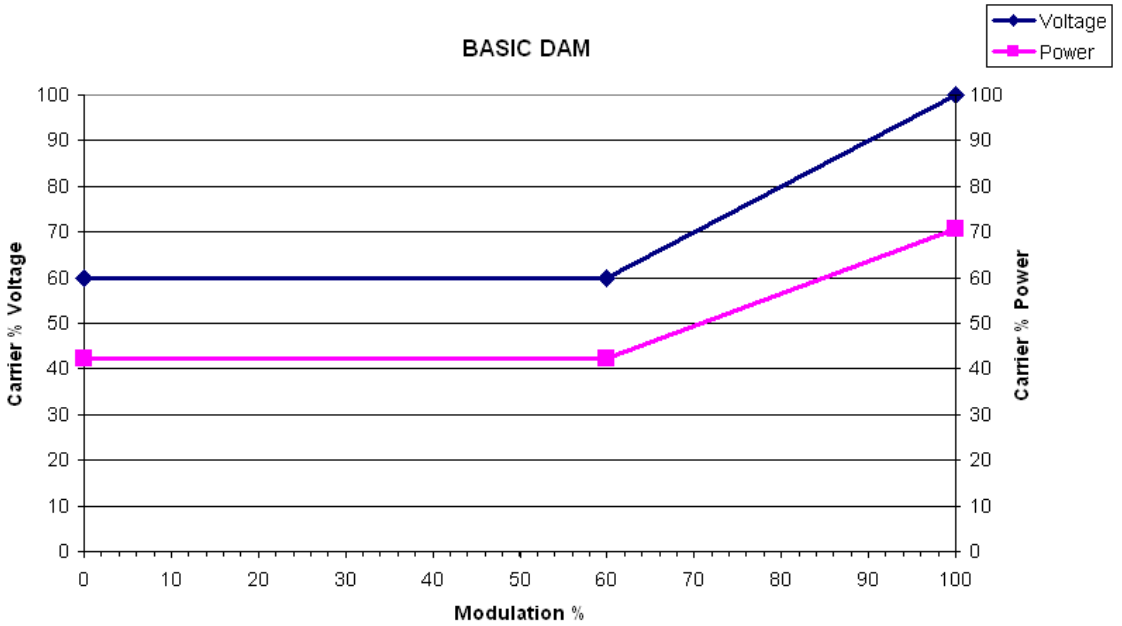
- AM carrier
  - no information yet contains >2/3 of the transmitted power.
- Challenge:
  - modify transmitted waveform to reduce power without reducing received quality in receivers





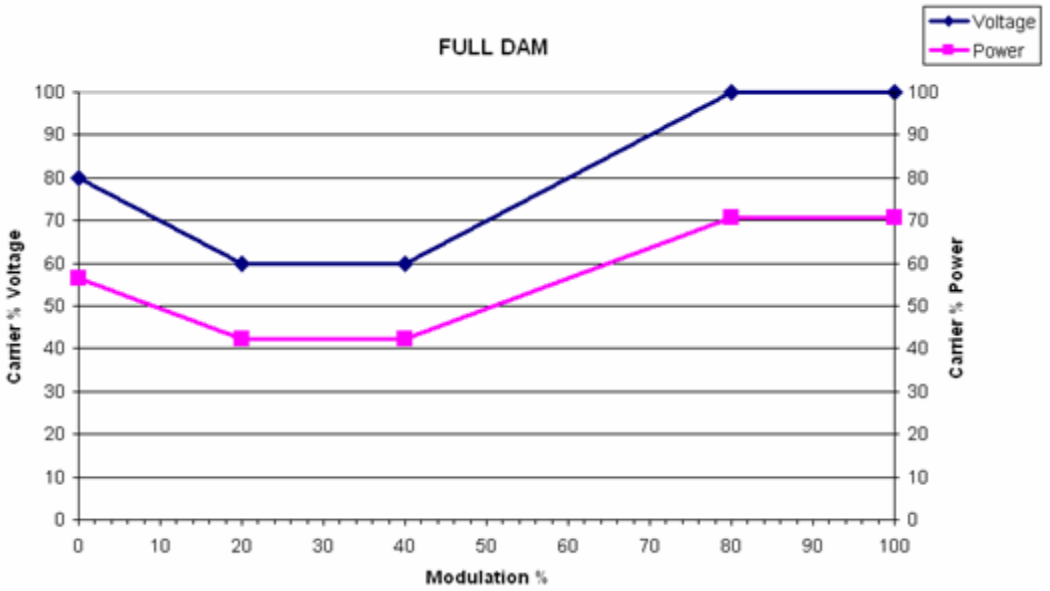
DAM: Dynamic Amplitude Modulation

- Carrier decreased the most at moderate modulation levels.
- Carrier increased at higher modulation levels so that distortion does not occur.
- Audio not adjusted.



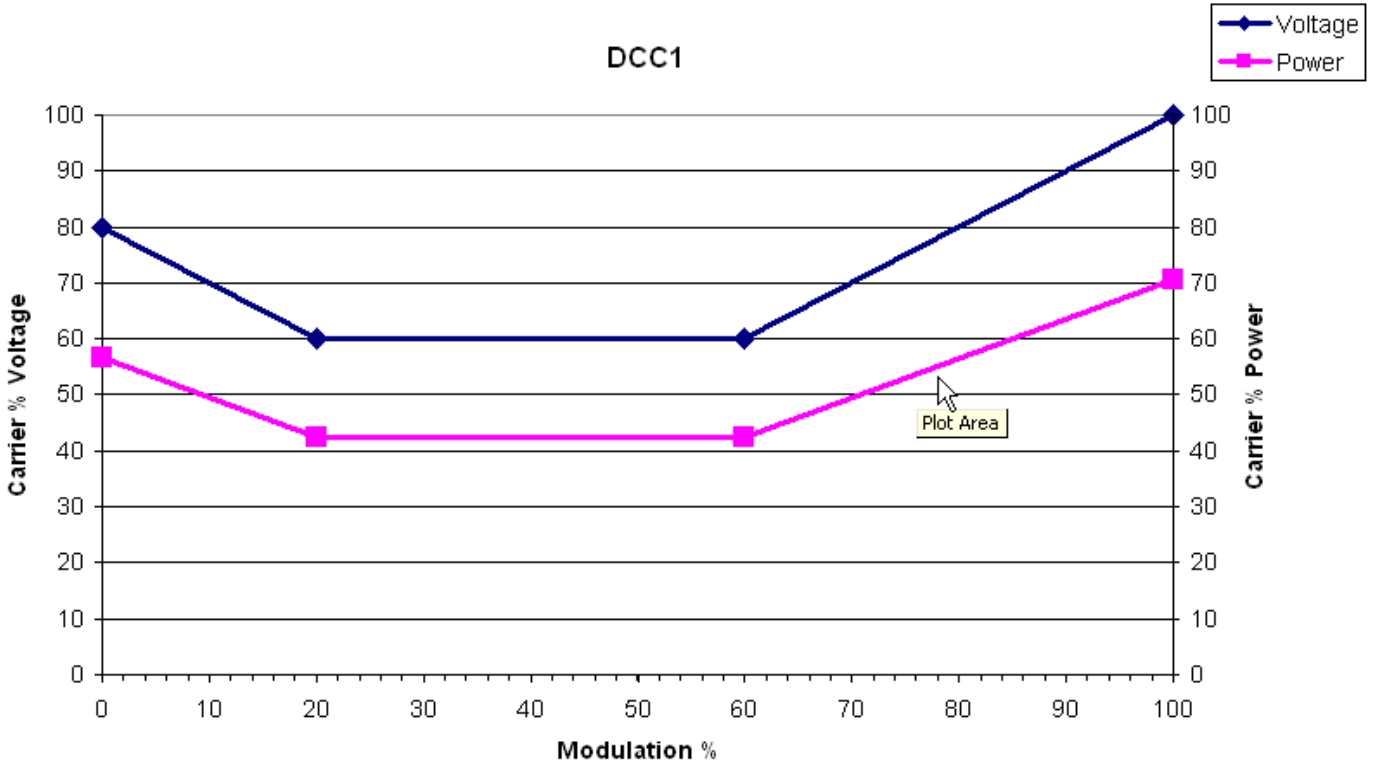
Full DAM: Dynamic Amplitude Modulation

- Carrier decreased the most at moderate modulation levels.
- Carrier also increased at lower modulation levels to minimize distortion.
- Again audio not adjusted.



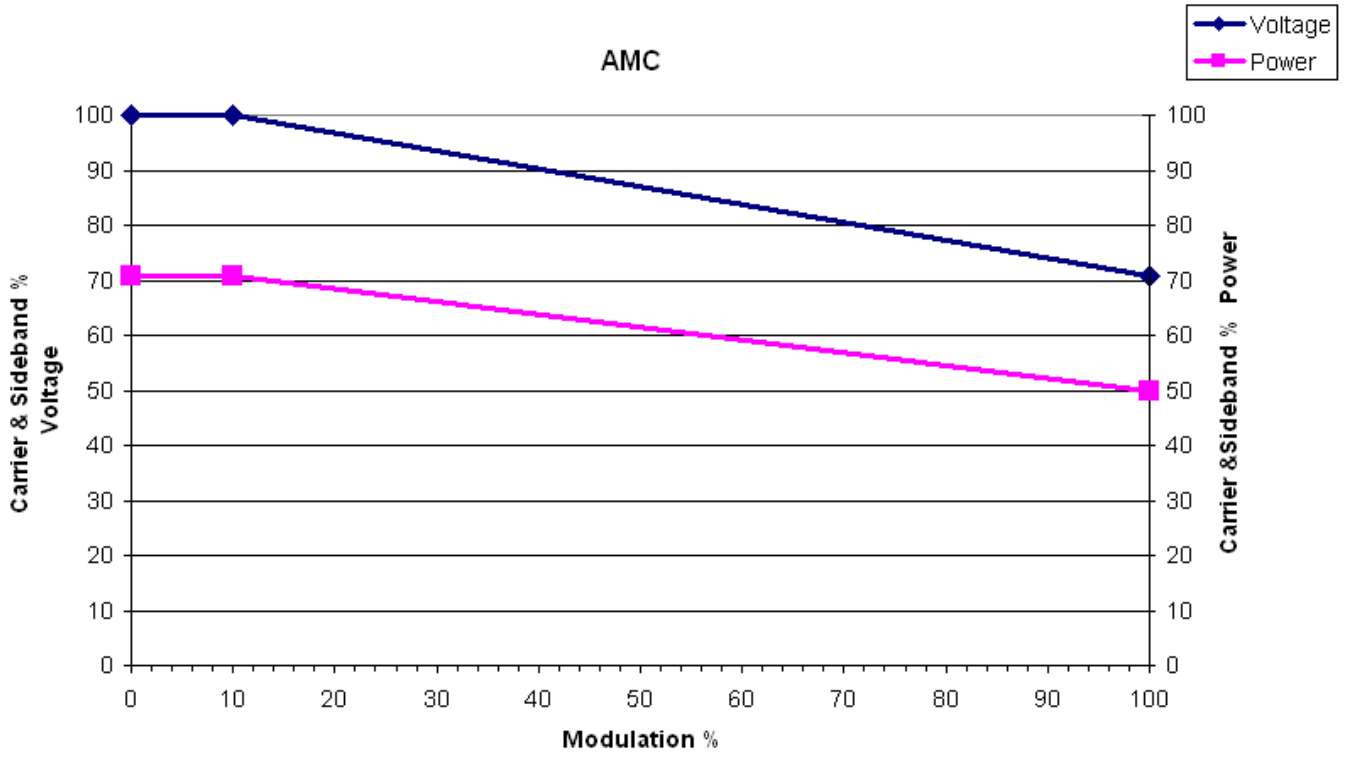
DCC: Dynamic Carrier Control

- Another variation of DAM
- Carrier also increased at lower modulation levels to minimize distortion.
- Again audio not adjusted.

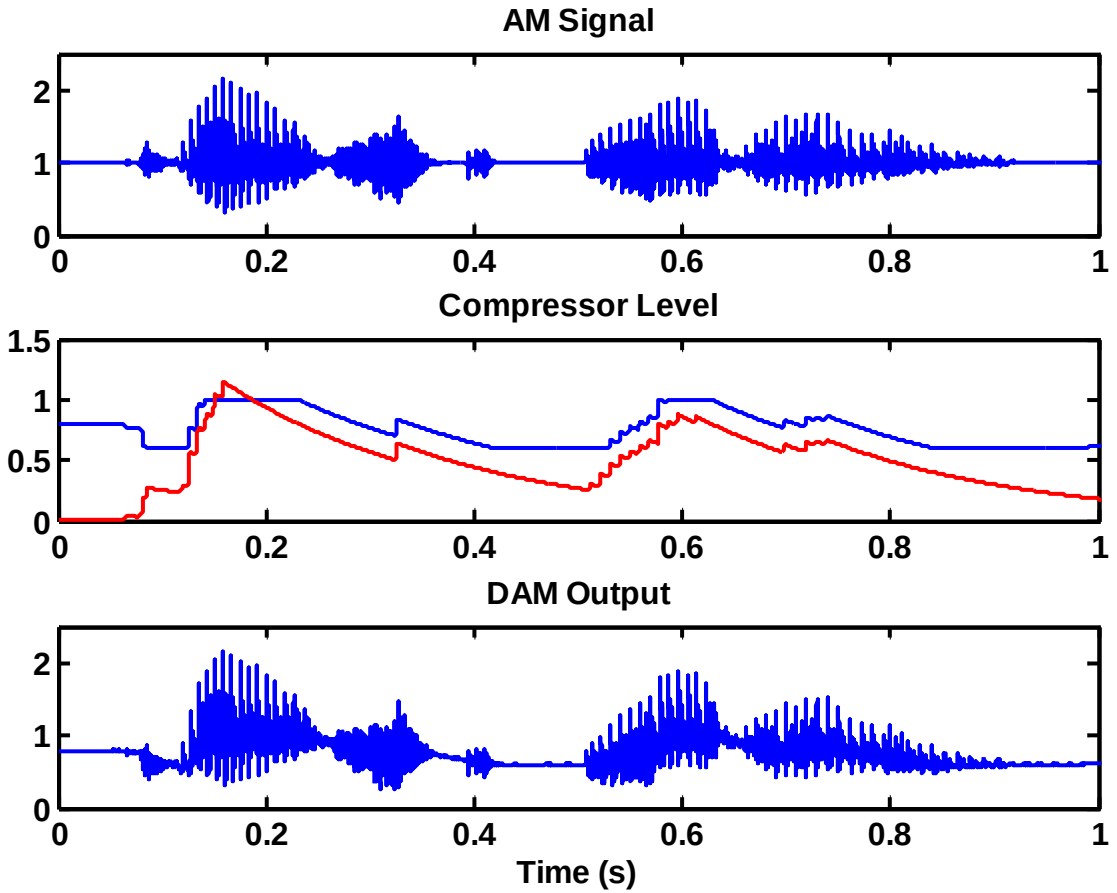


AMC: Amplitude Modulation Companding

- Carrier + modulation both decreased with increasing modulation
- Full carrier power during quiet periods when noise is easily perceived.
- Very little impact on received loudness.

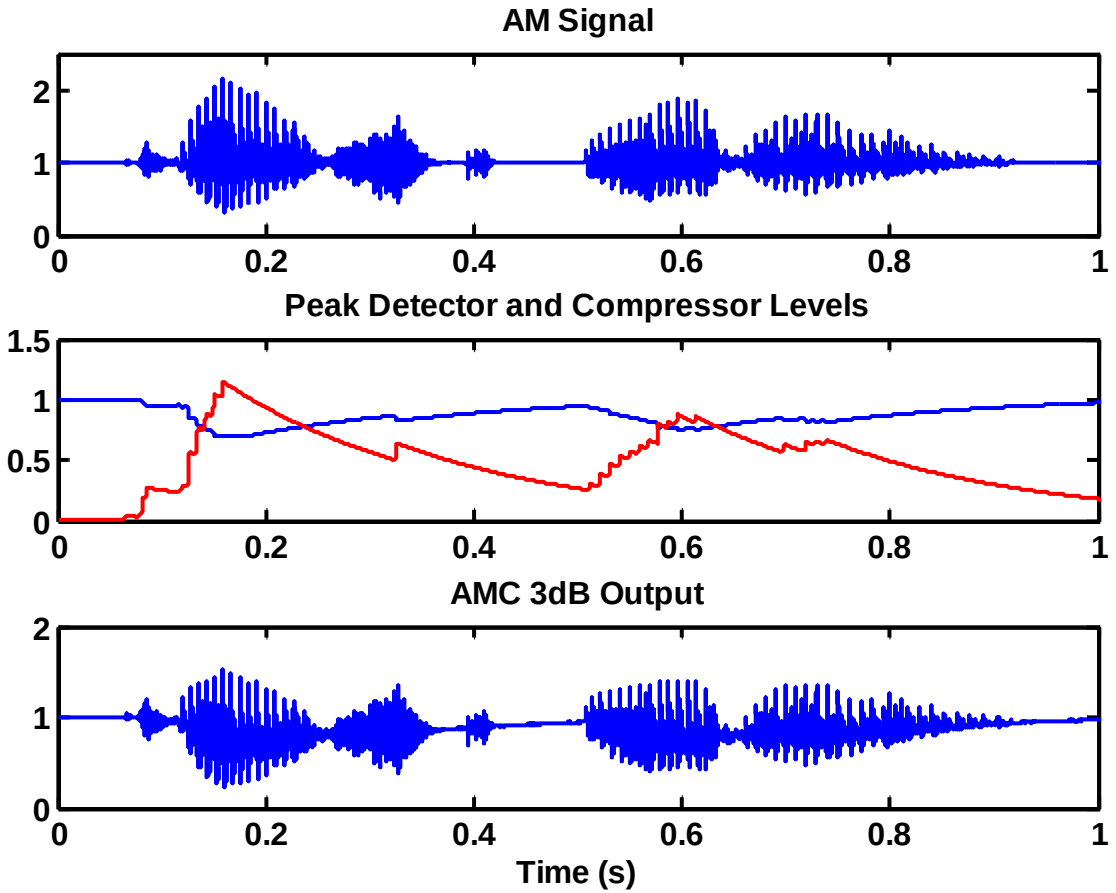


DAM Waveforms



Average Power Reduction 40%

AMC (3 dB) Waveforms



Average Power Reduction 23%

AMC Perceived Quality

- Laboratory tests on subjective listening quality
  - degradation was **not significant**.
- Subjective testing with interference (co-channel)
  - **did not** indicate a significant change in quality.
  - Comparisons with simple power reductions were done.
  - A 1dB power decrease was imperceptible (with noise or interference) to 90% of listeners.
  - This corresponded to 3 dB AMC with noise tests and 7dB AMC with interference.
- Brookman's Park field trial,100kW site near London
  - assessments at 29 locations in the daytime
  - 10 locations at night.
  - **No impairments** were observed.

AM: State of the art

- AC in to RF out efficiency: 90%
- Further improvement of 30% less overall energy usage with MDCL

	Current	New #3	With MDCL
Cost per kW/h:	$0.12	$0.12	$0.12
Power of transmitter in kW:	50	50	50
Efficiency:	60%	90%	90%
Hours of operation / day:	24	24	24
Days of operation / year:	365	365	365
Consumption in kW/H:	730,000	486,667	340,667
Total transmitter cost (USD):	$87,600.00	$58,400.00	$40,880.00
Transmitter Power Savings:		$29,200.00	$34,205.71
A/C costs may add 15-20%:	$14,892.00	$9,928.00	$6,949.60
Total electrical cost (USD):	$102,492.00	$68,328.00	$47,829.60
Total Electrical Savings / Yr:		$34,164.00	$40,020.69
Total Carbon footprint savings:		218	348

Tons of CO_2

FM: Efficiency Improvements

- New high efficiency LDMos amplifiers
- High efficiency power supplies
- PAPR Techniques
- Design optimized for analog
- Spectrum Efficiency Optimizer

FM: High efficiency LDMOS amplifiers

- LDMOS amplifiers are:
  - Higher efficiency
  - Higher gain (less power needed to drive)
  - Higher power per device (less splitter and combiner losses)

FM: High efficiency power supplies

- New switchmode supplies are:
  - 95% efficient, AC in to DC out
  - Conservatively operated

FM: State of the art

- AC in to RF out efficiency: 72%

	Current	New
Cost per kW/h:	$0.12	$0.12
Power of transmitter in kW:	10	10
Efficiency:	50%	72%
Hours of operation / day:	24	24
Days of operation / year:	365	365
Consumption in kW/H:	175,200	121,667
Total transmitter cost (USD):	$21,024.00	$14,600.00
Transmitter Power Savings:		$6,424.00
A/C costs may add 15-20%:	$3,574.08	$2,482.00
Total electrical cost (USD):	$24,598.08	$17,082.00
Total Electrical Savings / Yr:		$7,516.08
Total Carbon footprint savings:		48

Tons of CO_2

Other Areas for Improvement

- Tower lights – switching to strobes or LED
- Change to blower cooling rather than HVAC

Nautel Transmitter Site Energy Audit Spreadsheet

- Helps estimate your monthly transmitter site energy expense
- Starts with a recent power bill
- Allows estimate of the power usage of:
  - Transmitter
  - Cooling system
  - Tower Lights
  - Other gear
- Play “what-if” to estimate savings based on assumptions
- Available from the WBA site with the presentation

Thank You