Radio 1: A modular transmitter system

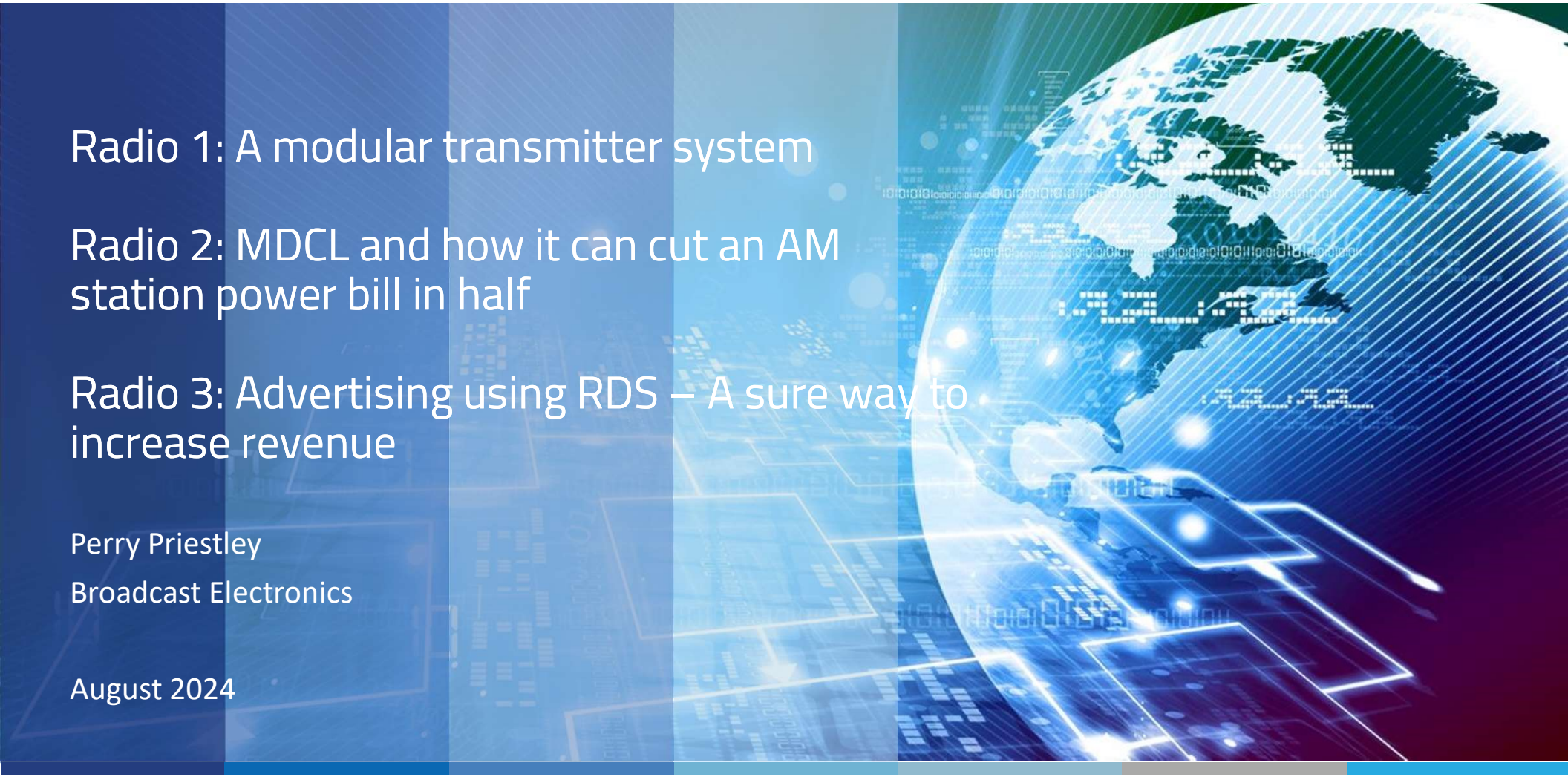
Radio 2: MDCL and how it can cut an AM station power bill in half

Radio 3: Advertising using RDS – A sure way to increase revenue

Perry Priestley

Broadcast Electronics

August 2024



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About Elenos

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Established in Quincy, Illinois in **1959**, and has played an influential role in radio. Offers a wide range of TV and Radio broadcast products, including transmitters for TV, AM, FM and HD Radio and automation software.

Founded in 1977 in Ferrara, Italy. Provides a wide range of FM Transmitters, focusing on efficiency, reliability and performance.

Began in 1962 in Orvieto, Italy, specializing in digital modulation medium power air cooled and high-power liquid-cooled systems TV transmitters.

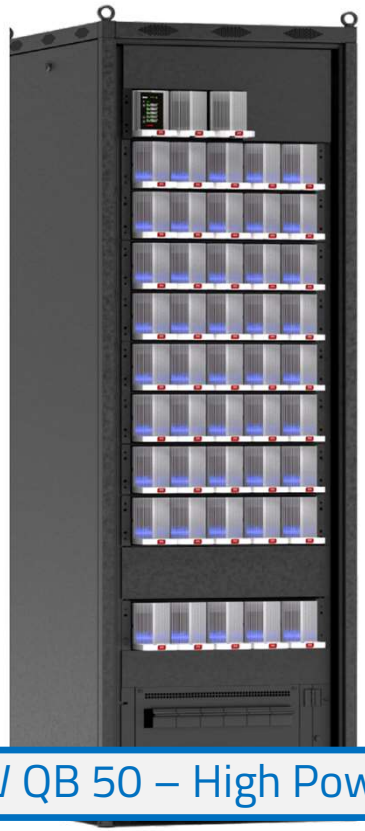
Established in Denmark, with 50 years of experience. Formerly Philips TV, PTV is a leading designer of future-proof modulation solutions for all broadcast standards.

A New transmitter design

QUICK BLOCK

5kW QB 4 – Low Power

10 kW QB 9 – Medium Power



50kW QB 50 – High Power

A New transmitter design – A comparison

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PARTIAL MODULAR

STX-10

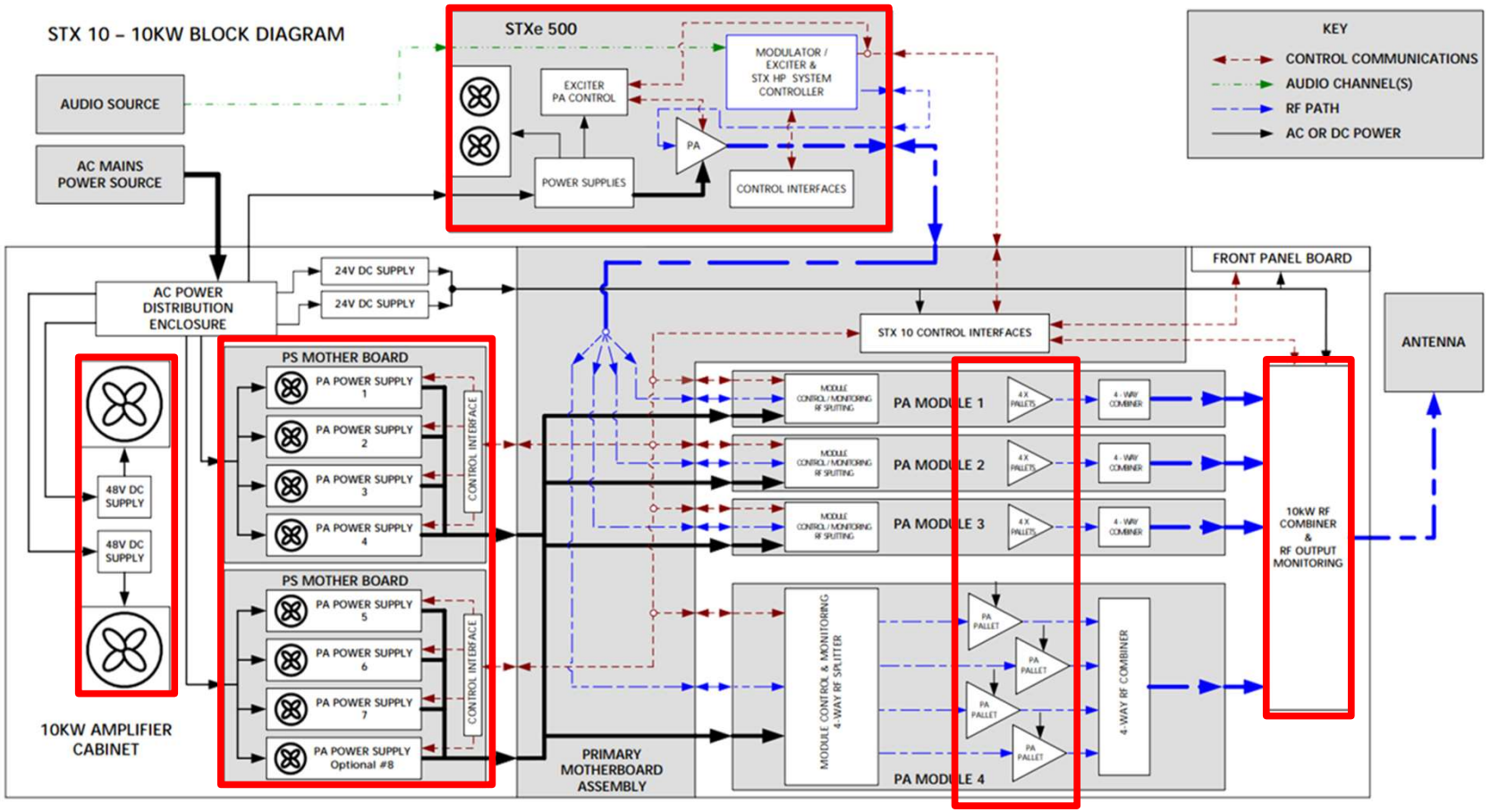
- Four (4) 2.5kW RF power amplifiers each with four power devices
- Eight power supplies
- Single exciter or dual exciter
- Two Internal four-way splitter combiners
- One external four-way combiner
- One RF Filter

COMPACT

ETG-10000

- Two (2) 5kW RF power amplifiers
- One control System
- Two power supplies
- Single or dual exciter
- One External two-way combiner
- One RF Filter

A New transmitter design – System Design Options



A New transmitter design – System Design Options

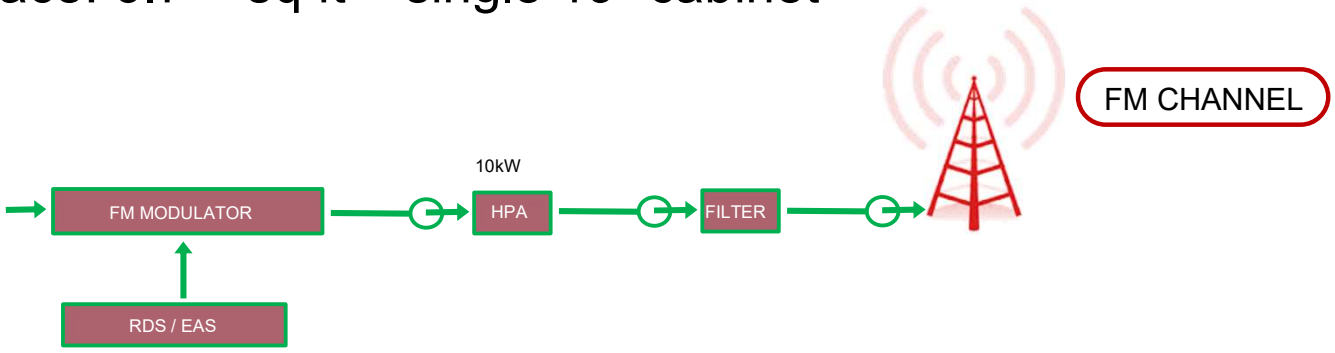
STX-10 can be configured in four different ways to provide different redundancy

- Single transmitter with single exciter
- Single transmitter with dual exciter
- Two 5kW transmitters in a 1+1 Active Reserve (AR) parallel system
- Two 10kW transmitters in a 1+1 Passive Reserve (PR) main/standby system

A New transmitter design – Single

SINGLE TRANSMITTER SYSTEM – NO REDUNDANCY

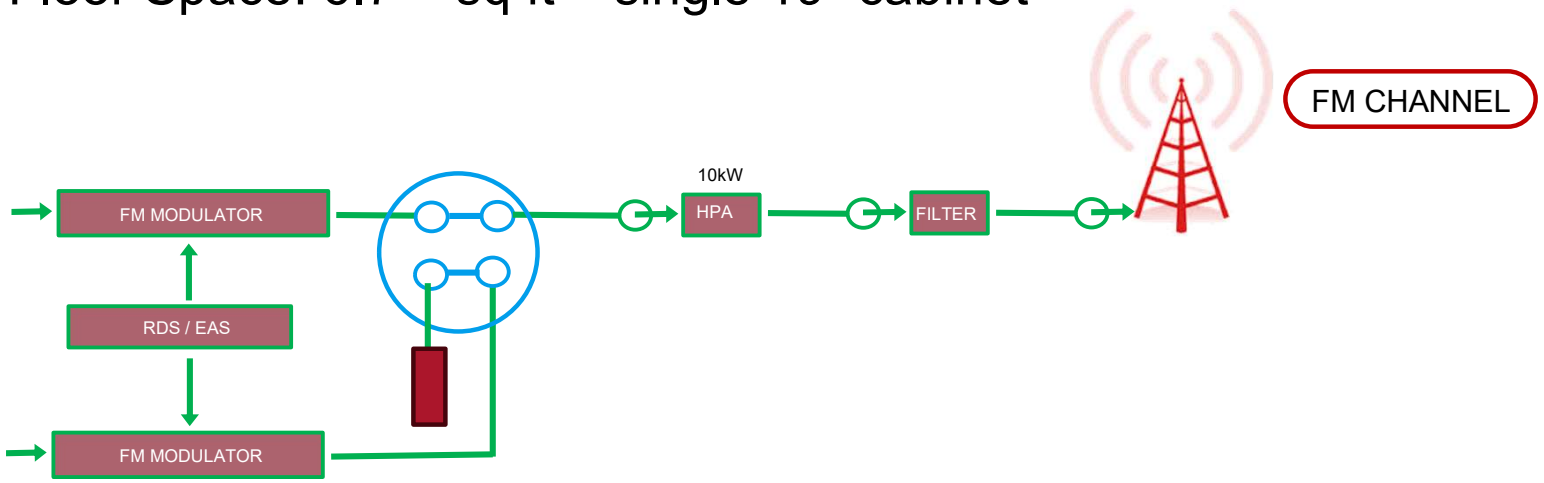
Market Price: $45,000.00
Floor Space: 6.7 = sq ft – single 19” cabinet



A New transmitter design – Dual Exciter

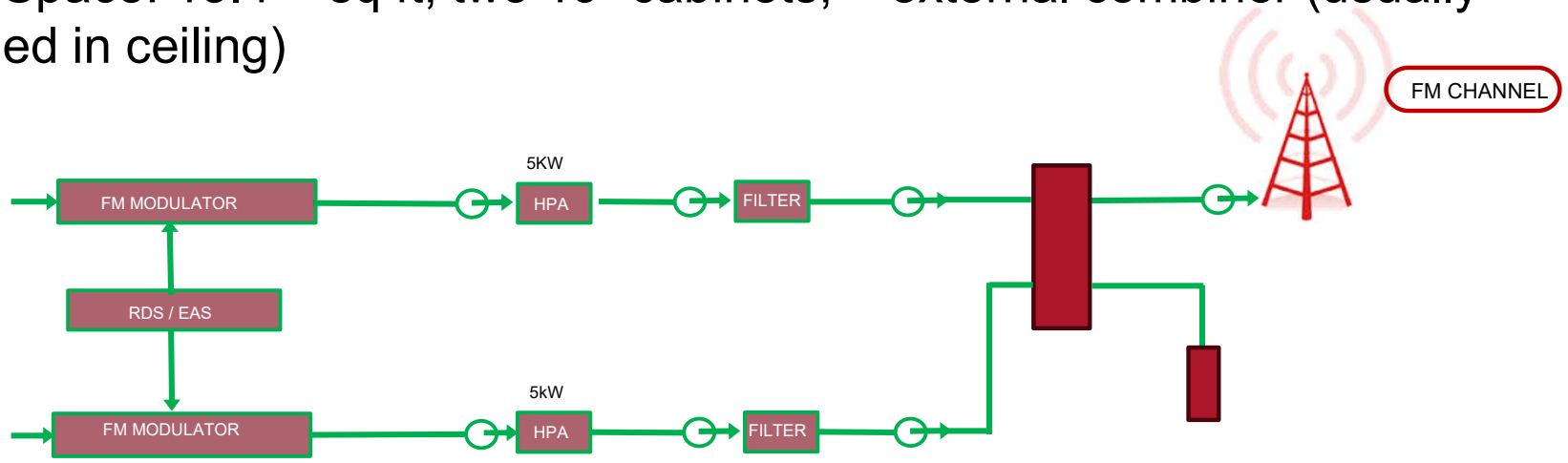
SINGLE TRANSMITTER SYSTEM – EXCITER REDUNDANCY

Market Price: $50,000.00
Floor Space: 6.7 = sq ft – single 19” cabinet



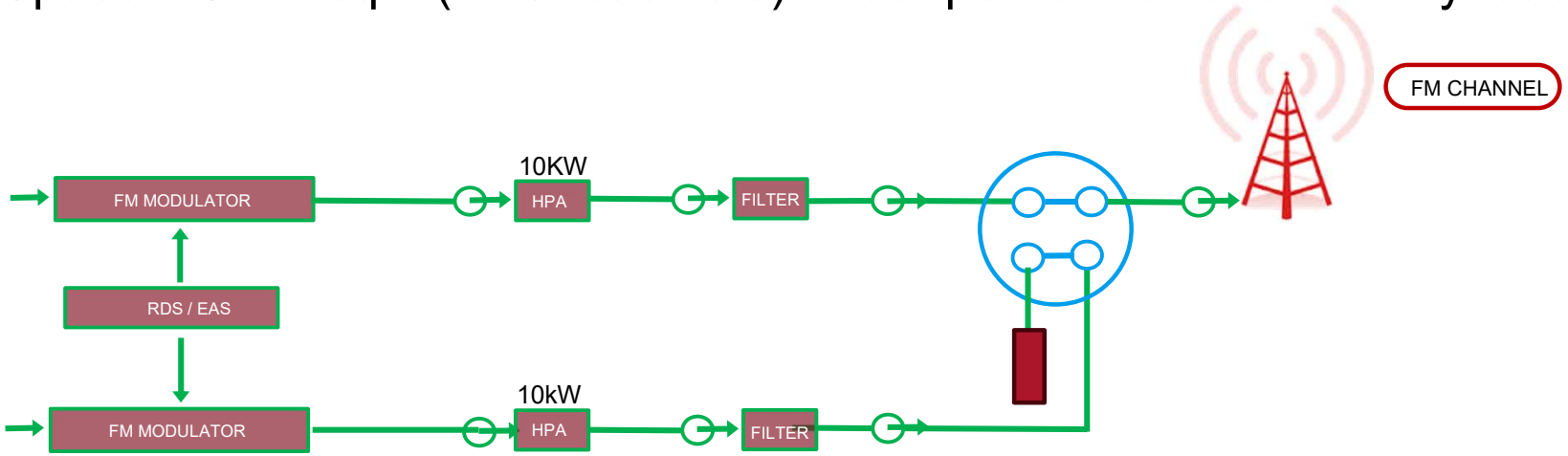
DUAL TRANSMITTER SYSTEM – ACTIVE RESERVE (PARALLEL)

Market Price: $70,000.00
Floor Space: 13.4 = sq ft, two 19” cabinets, + external combiner (usually installed in ceiling)



DUAL TRANSMITTER SYSTEM – PASSIVE RESERVE (MAIN/STANDBY)

Market Price: $110,000.00
Floor Space: 13.4 = sq ft (2 19” cabinets) + four port switch and dummy load



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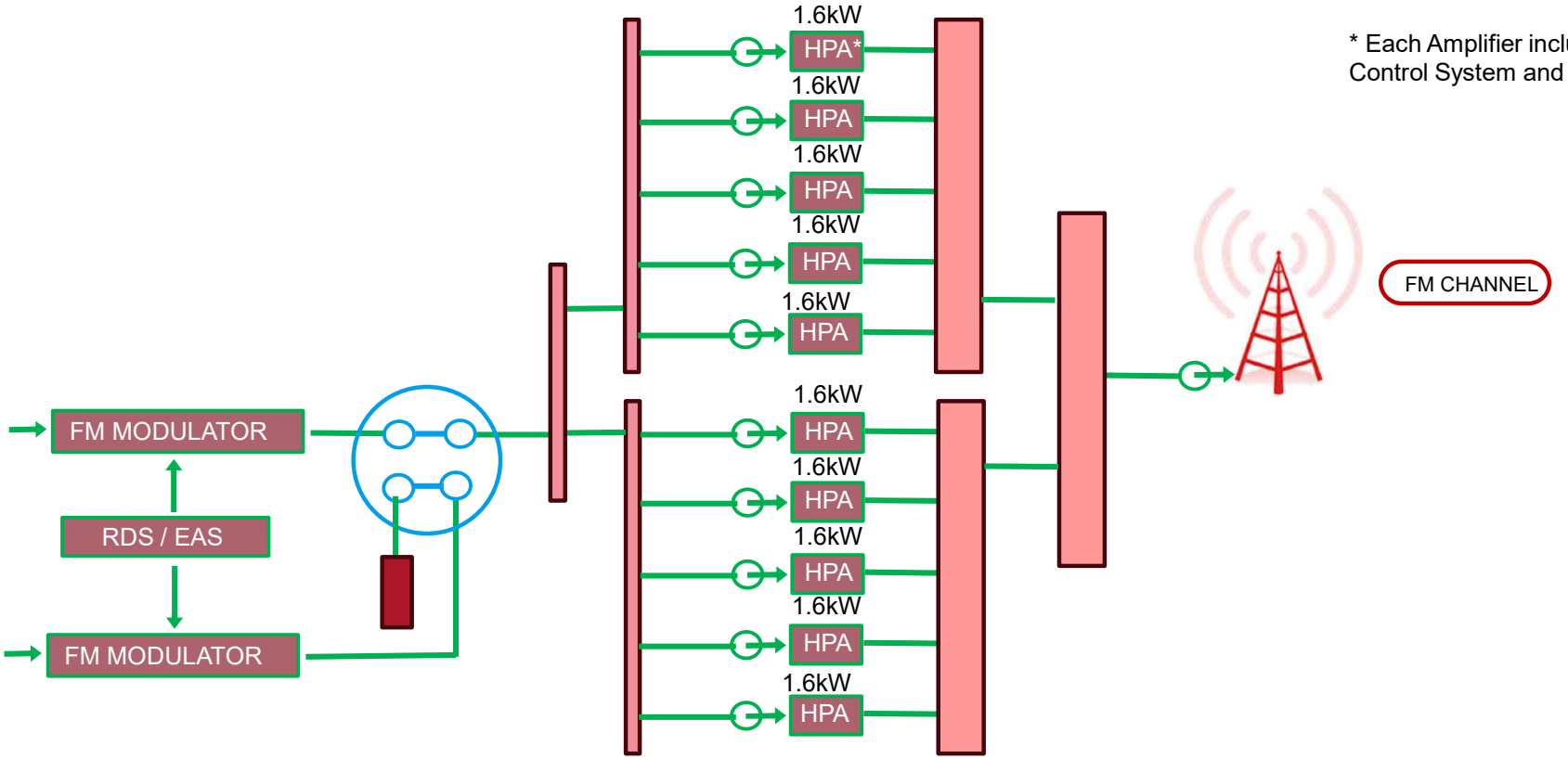
The Quick Block approach to redundancy

- The premise of the approach is that, instead of requiring two complete and independent transmitters and switching between them if a failure occurs (usually a 50% or 100% temporary off-air period, redundancy can, and should, be an intrinsic part of the transmitter design itself.
- Each critical part of the system has its own redundancy
- Costs are dramatically reduced as compared to the equivalent system

A New transmitter design – Quick Block

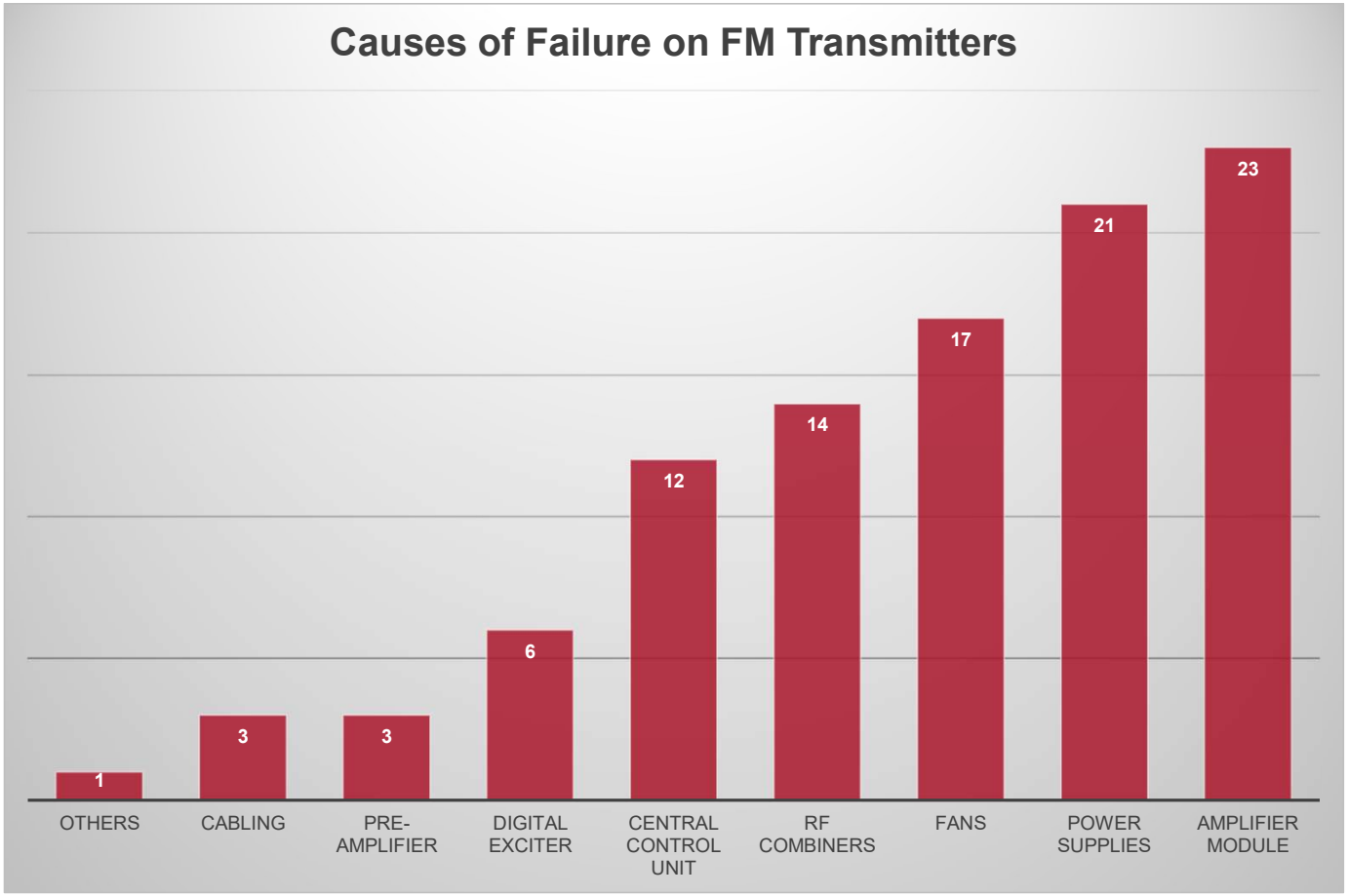


* Each Amplifier includes PSU, Control System and Filter.

A New transmitter design – Failure analysis

Causes of failure

- Amplifier Modules
- Power Supplies
- Fans
- Exciter
- Central Control
- Cabling
- RF Combiners
- Pre-amplifier
- Others:
  - Switches
  - Coax
  - ….



A New transmitter design – removal of single points of failure

- **Amplifiers Modules -** A QB-10 has 10 power amplifiers each with its own fan, power supply, control system, Low Pass Filter and Power Monitoring. It plugs directly into the combiner which means no cables.
- **Power Supplies** – A QB-10 has 10 Power Supplies
- **Fans** – A QB-10 has 10 fans
- **Exciter -** Most transmitters have a single point of failure in the Exciter. A failure in either would be catastrophic. The new QB-10 has dual exciters as standard.
- **Central Control Unit (CCU)** The ability for the transmitter to continue operating even under failure conditions is a key consideration. The QB-10 includes the option of a second CCU, and even in the single mode option, in the unlikely event of a failure the transmitter stays on-air with its last known parameters.

A New transmitter design – removal of single points of failure

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- **Cabling –** All amplifiers and exciters (95% of the equipment) is hot pluggable reducing significantly the need for any cables.
- **Combiners (and Splitters)** - A QB-10 has two five-way combiners and one two-way combiner, the single point of failure is the two-way combiner, which is designed for twice the nominal power, reducing the possibility of failure.
- **Pre-amplifier** – A QB-10 includes a second and fully redundant pre-amplifier
- **Others** On the QB series of transmitters the design is such that air flow (and hence dust) is focused mostly on the heat sink and PSU. There are no cables on connectors increasing the Mean Time Between Failure The amplifier of the Quick Block series offers a “Planar Design” which means that these critical components are no longer present. In this way, production, maintenance, performance and consistency are improved.

A New transmitter design – The Results

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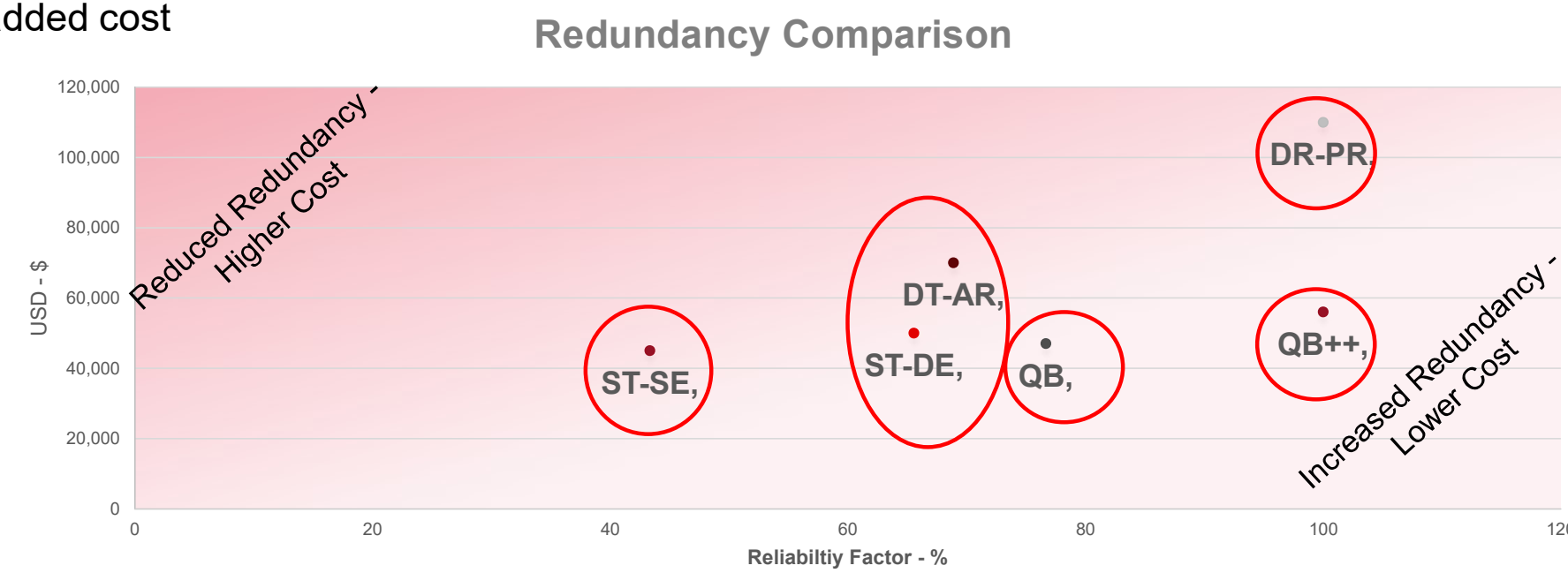
- Chart below shows different configurations under various fault conditions
  - Single Transmitter
  - Single Transmitter with dual exciters
  - Dual transmitters in active reserve and Passive reserve

Failure % Power	Single Transmitter	Dual Exciter Single Transmitter	Active Reserve 5 + 5 Reserve	Passive 10 + 10 Reserve *	QB-10 DD 10 Modules	QB - 12 DD 12 Modules
1 Pallet	70	70	70	100	70	100
2 Pallets	50	50	50	100	60	100
1 Fan	100	100	100	100	70	100
2 Fans	0	0	50	100	60	100
1 PSU	100	100	100	100	70	100
2 PSU	70	70	50	100	60	100
1 Exciter	0	100	100	100	100	100
1 CCU	0	0	50	100	100	100
1 Pre-amplifier	0	100	50	100	100	100

	ST-SE	ST-DE	DT-AR	DR-PR	QB	QB++
Level of Redun.	43	66	69	100	77	100
Price - $	45,000	50,000	70,000	110,000	47,000	56,000

A New transmitter design – The Results

- Typical redundancy level (0 = no redundancy, 100 = perfect redundancy)
- Average purchasing cost of that level of redundancy
- Cost/benefit ratio of the BE Quick Block 10kW and the QB++ makes it the most economical and professional proposition on the market. The QB++ is has almost 100% redundancy with a small added cost



A New transmitter design – The Result

- When compared to a full 1+1 system, there are significant savings to be made on the initial purchase price. However, purchase price is not the only consideration. The BE Quick Block 10 kW occupies a single 29U cabinet with a 23” x 42” footprint, meaning that space savings of up to 50% can be achieved.

- Easier installation & maintenance Traditional Passive Reserve or Active Reserve solutions are comprised of additional rigid lines, RF switches, dummy loads, cabling and control unit, they can be incredibly challenging to install, configure and maintain.

- With the BE Quick Block FM 10kW there is only one transmitter to manage so configuration is easier, especially with our intuitive graphical Web GUI.

- There is no need to configure switching rules and, with only one transmitter and fewer peripherals, monitoring and maintenance are also much simpler.

- Higher efficiency is obtained by removing the requirement for RF lines and reserve transmitters in this intelligent design approach, RF losses and electrical consumption are reduced.

A New transmitter design – Summary

The intelligent design of the BE Quick Block FM 10kW without or without additional modules can deliver the redundancy and performance of a full 1+1 system for a much-reduced initial investment and a lower Total Cost of Ownership.

Radio 2: MDCL+ and how it can cut an AM station power bill in half

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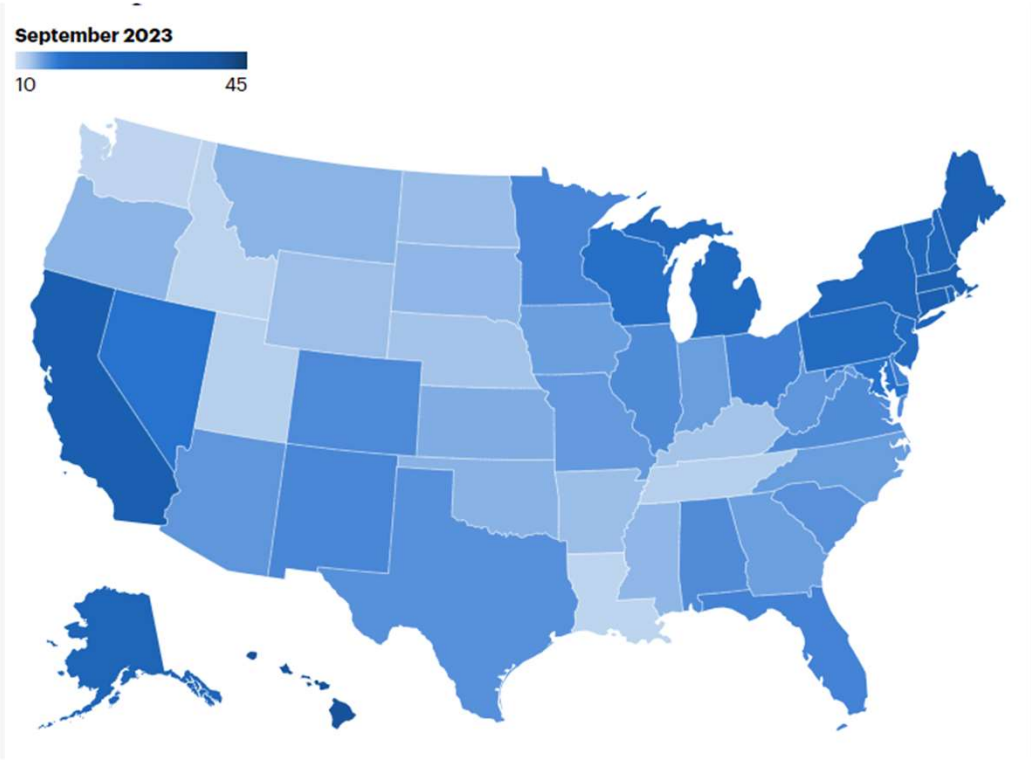
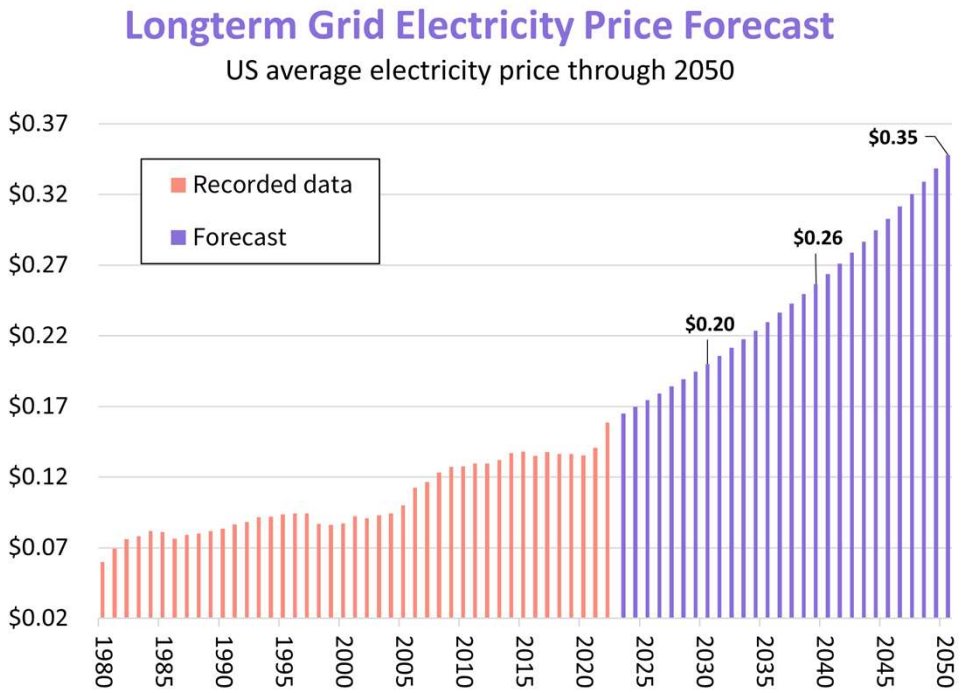
Energy costs continue to rise

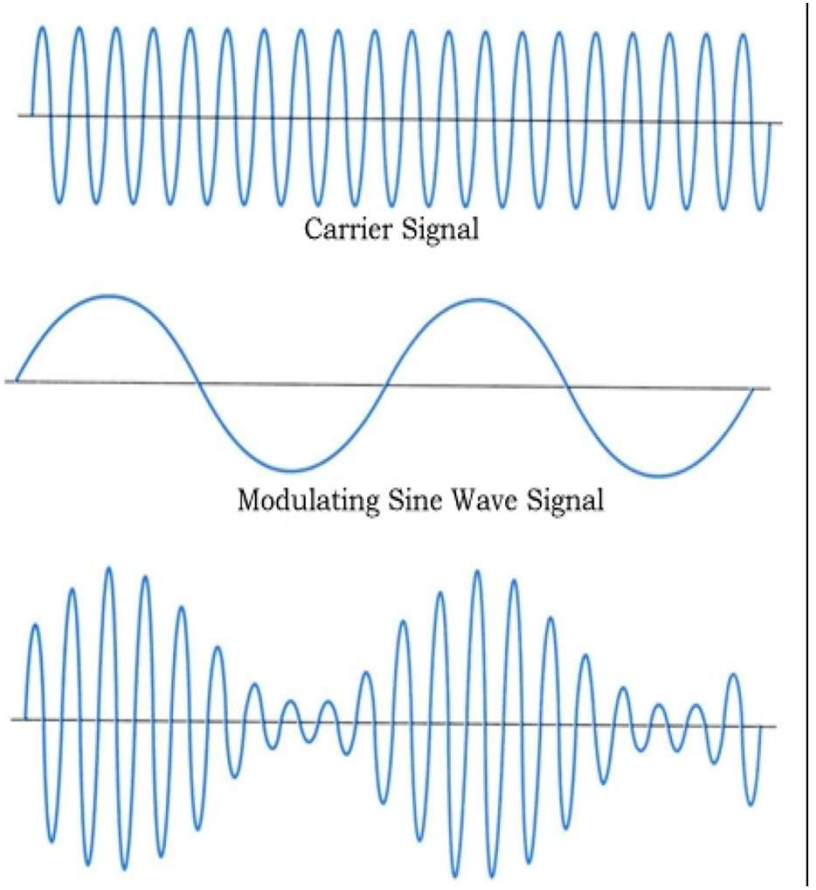




AM Radio

- Outside of Spark-Gap and CW it's the oldest form of modulation
- Take a carrier and modulate it with audio!
- Simple and easy to implement and it's been on the air for 100 years

GE XT-1-A AM Transmitter



AM Efficiency

The downside to AM

- Very inefficient to transmit
- The AM carrier uses 66% of the transmitter power - Yet delivers no useful information!
- Even with modern PWM AM transmitters the power consumption for a 50 kW AM station is substantial
- So how do we make AM more efficient?

AM MDCL

- Modulation Dependent Carrier Level (MDCL)
- There are two ways of achieving MDCL
  - Dynamic Amplitude Modulation (DAM), which reduces the carrier level when audio is low
  - Amplitude Modulation Companding (AMC), which maintains the carrier at maximum when no audio is present and reduces the carrier and the modulation together by up to 6 dB when modulation is at a maximum

AM Efficiency

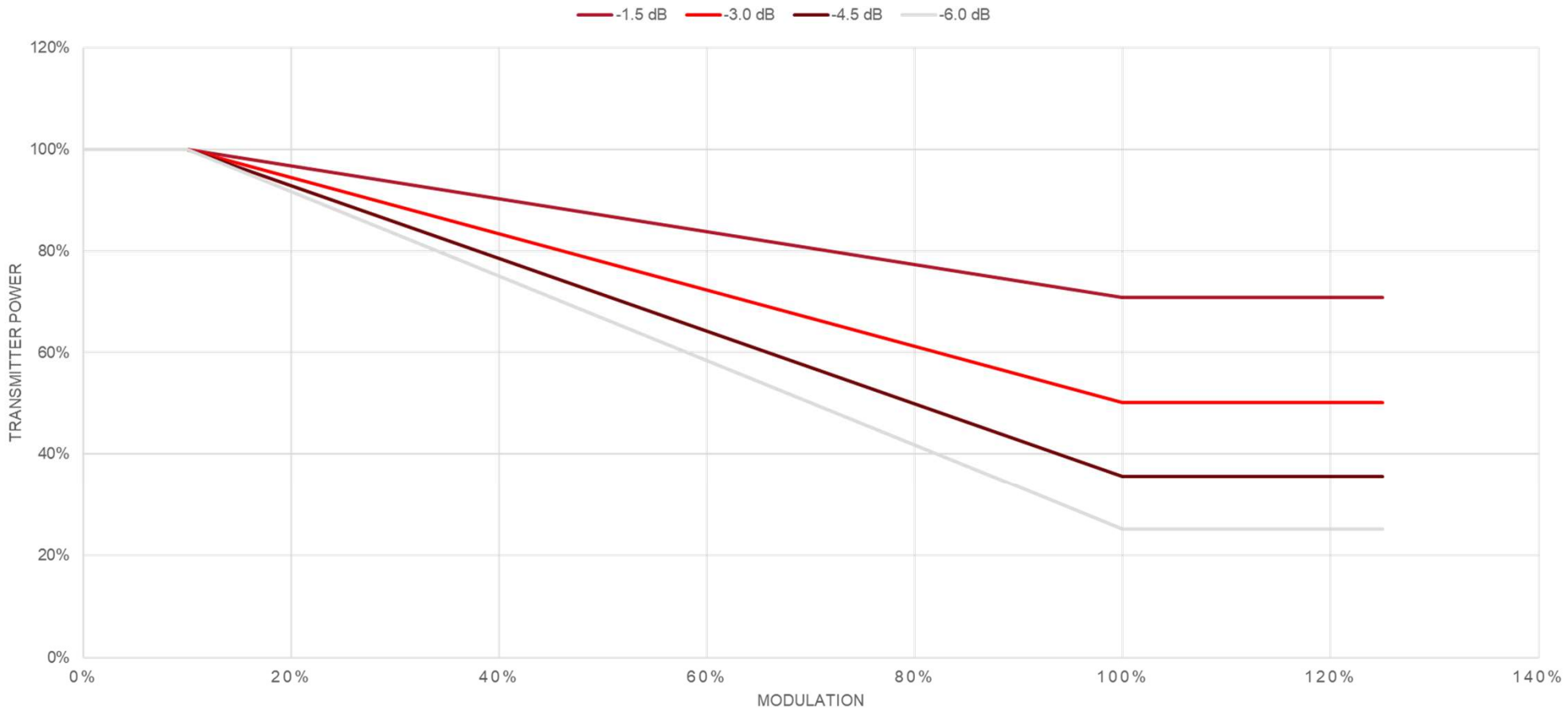
- This problem has been studied for a very long time
- The solution is to modulate the carrier based upon the audio input to suppress the carrier and reduce its power consumption
- The BBC (UK) investigated the idea in the 1980's and implemented it using analog control http://downloads.bbc.co.uk/rd/pubs/reports/1994-01.pdf
- It never caught on in the US until 2010

AM MDCL "AMC" Version

- Carrier and modulation together are decreased with increasing audio modulation
- The carrier is increased to full power during quiet periods when noise is most easily perceived
- As modulation density has substantially increased with modern audio processing AMC can generate greater efficiency

- Only going to focus on AMC… FCC approved

AM MDCL AMC Gain Function



AM MDCL AMC Field Testing

- Field testing was done to determine the impact of running AMC at 3dB, 4dB, 5dB and 6 dB of carrier suppression at 100%, 125% and 150% positive modulation
- Townsquare Media KFXD in Boise ID was the test station
- Power: 5.0 kilowatts (kW) Daytime on 630 kHz
- Format is “Sports Talk”

AM MDCL AMC Field Testing

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AM MDCL AMC Field Testing

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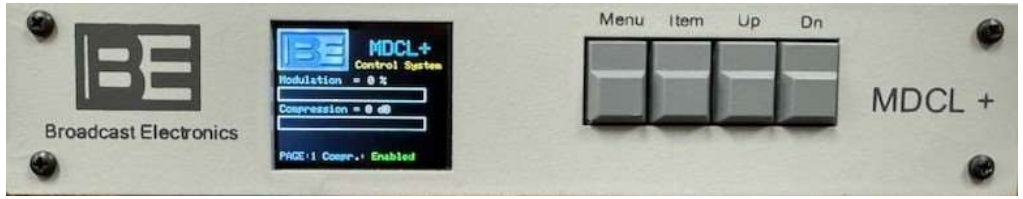
At the 0.5 mV/m location

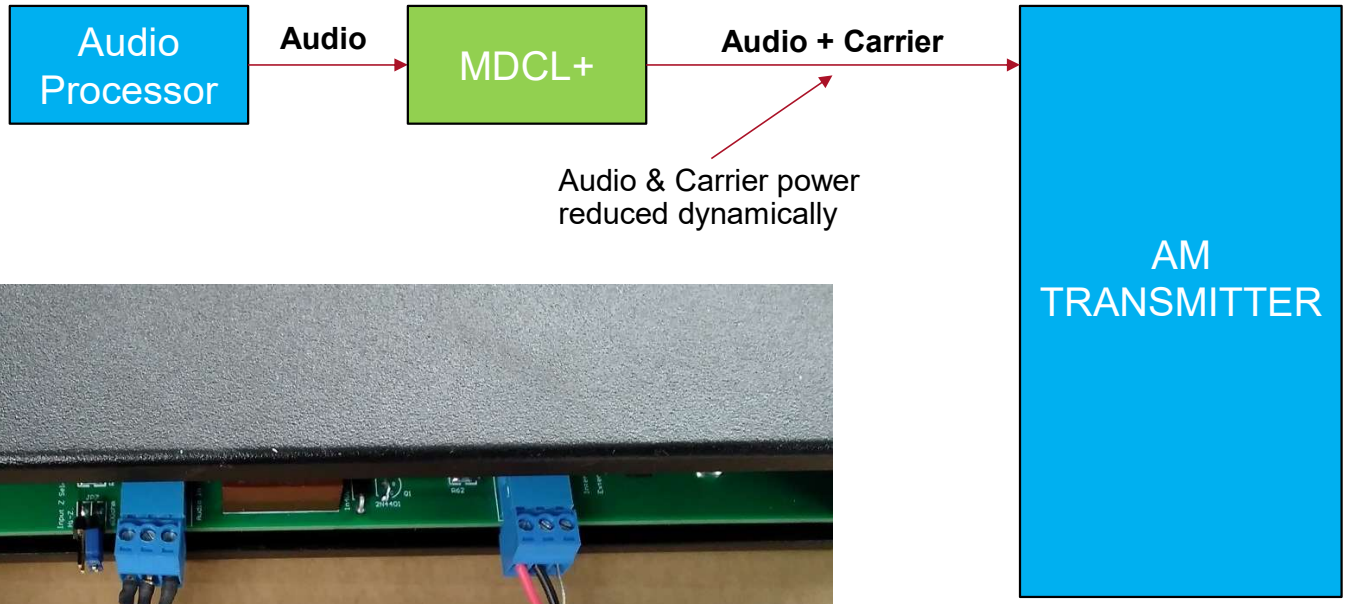
AM 100% Symmetrical Field Strength uV/m	dBm	AC Power kW	MDCL AMC 125%	Field Strength uV/m	dBm	Delta dBm	AC Power kW	Delta AC kW	Reduction in power consumption
610	-51.28	5.26	3 dB	436	-54.20	-2.92	2.74	-2.52	-47.83%
			4 dB	386	-55.28	-4.00	2.21	-3.05	-57.98%
			5 dB	349	-56.13	-4.85	1.96	-3.30	-62.74%
			6 dB	325	-56.75	-5.47	1.18	-4.08	-77.51%

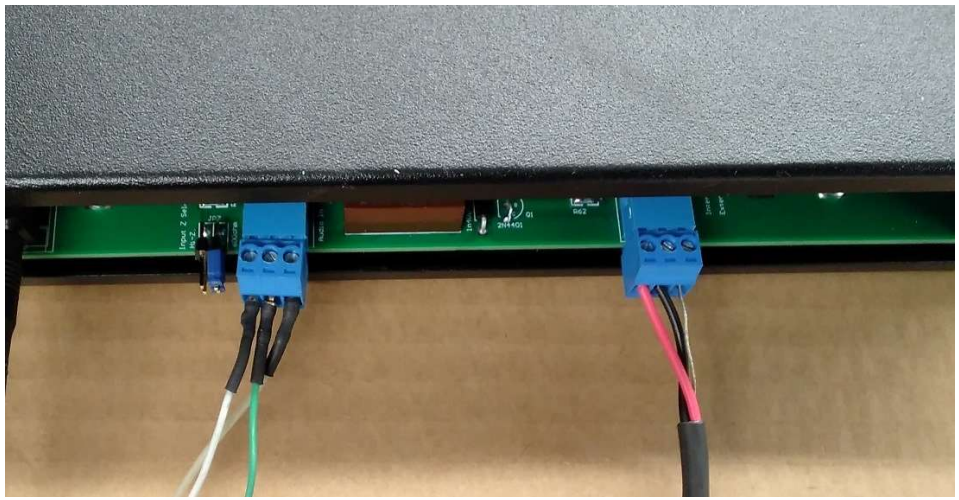
AM MDCL AMC Field Testing

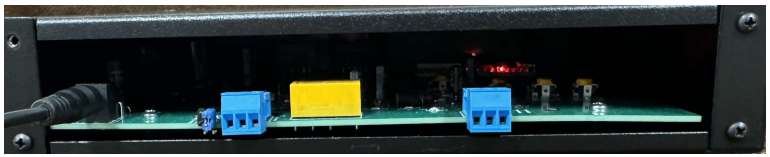
- Higher modulation density gives the MDCL system the ability to suppress the carrier to a much greater extent for longer periods of time – Best results with a modern audio processing
- At 6dB of AMC a 77% reduction in transmitter power consumption was observed
- Slight degradation in fringe coverage at AMC levels greater than 3 dB
- Townsquare & Bonneville are running 6 dB AMC on their stations that have transmitters that can do that with zero listener complaints since 2020 and significant power savings



Block Diagram - Implementation







MDCL+ - Overview

- What is it? - A technology to reduce the carrier power of an AM transmitter to reduce energy consumption.
- The Benefits - A reduction in electricity cost of 25-60% is expected.
- Is it easy to install? – Yes. Typically, less than 30 minutes.

Compatibility

- All Broadcast Electronics “A” and “E” Series AM transmitters have jumper settings in the exciter that are configured to allow the external unit to control carrier power.
- Compatibility – All BE transmitters since early 2000s should be compatible. Also compatible with other manufacturers products. In general, an HD Radio compatible transmitter should be OK. i.e. GatesAir, Nautel and Continental

MDCL+ Example of Cost Savings

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- 10kW Transmitter.
- 24/7 full power operation
- Electrical cost $0.20 per kW hr.
- Current electrical cost approx. $25,700 per year
- Expected savings: 40% = $10,300 per year (3DB)
- Cost savings scale with hours of operation and power
- 5kW, 24 hr. ~ $5100 / 5kW, 12 hr. ~ $2500 / 1kW, 24 hr. ~ $1000

* Assume 75% efficient, 10% extra power due to audio modulation

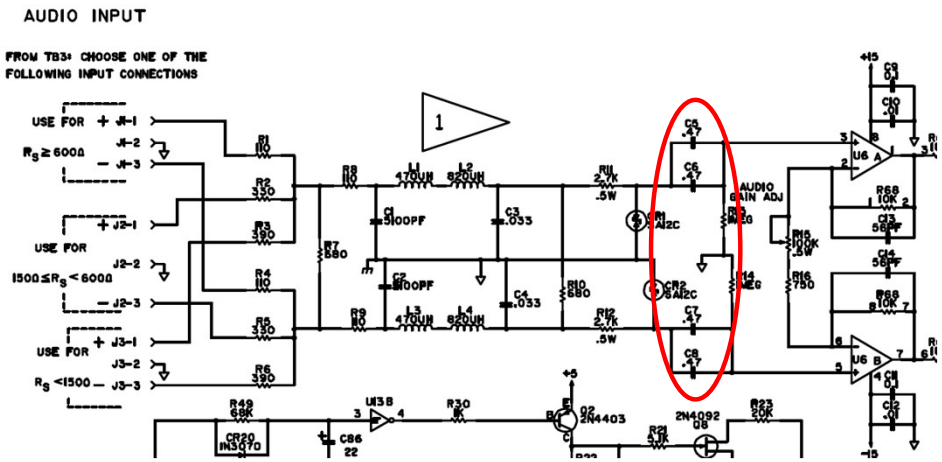
MDCL+ - How easy is it to install?

- 1 Rack unit of rack space required
- Connections only: power, input audio, output audio.
- Only simple hand tools - e.g. Screwdrivers.
- Transmitter exciter is configured using jumpers' settings.
- Ideally transmitter connected to dummy load
- An audio processor which can source a 100% audio tone for calibration
- Method to measure carrier power (RF Current Meter or Mod Monitor)
- Method to measure modulation depth (Mod Monitor or Oscilloscope)

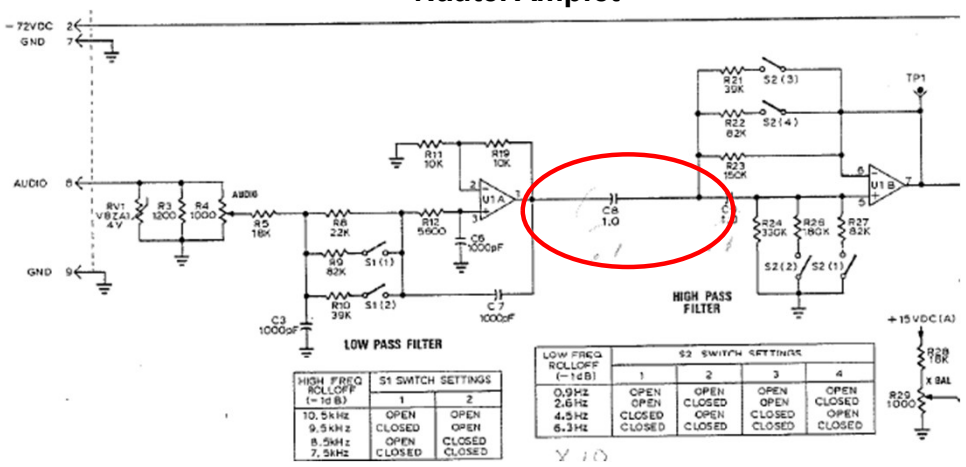
Older Transmitters

- Older transmitters do not have jumper settings to enable DC on audio
- In most cases, simply need to short circuit DC blocking capacitors
- A simple test with DC source into audio input can confirm compatibility

Harris/Gates Air DX50



Nautel Ampfet



Thanks….

References

- Orban
- Townsquare
- BSW
- Nautel
- Broadcast Electronics

Radio 3: Advertising using RDS – An easy way to increase revenue

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Evolving delivery platforms & in car displays

- Fact: 100% of new vehicles can display text and 96% have FM Radios
- High-resolution screens are finding their way into every part of our day-to-day lives, including the car dashboard
- The car radio is evolving into a highly capable infotainment system with dynamic content display capability

Why Visual Content Matters

- Over 80% of vehicles on the road today can display visual content using proven RDS technology on analog FM radio
- Over 25% of vehicles can display enhanced full-color graphics and text using HD Radio® or hybrid radio (according to Xperi®)
- Using the combination of sound and visual content is a powerful tool for radio operators to build a deep connection with their listeners, community, and advertisers

But does anyone care?

- Visual content gains the attention of radio listeners
- **Nearly 70%** of regular radio listeners pay attention to content on the display screen
- **Two-thirds** of regular radio users recall seeing visual content displayed on the car dashboard and recall the retailer's radio ads
  - an increase of 30% over messages with no visual content
- **Nearly 85%** of listeners who recalled the radio ad with visual content indicated they planned to or had visited retailers' locations
  - 12% more than those who didn't see visual content

- Over half of the ad agencies surveyed were familiar with visual display technology in cars, and of those who knew about it – **nearly 75% were interested in using visual content** along with radio ads.
- They indicated a **willingness to pay a 15% premium** to include visual content.

The digital dash has elevated consumer expectations

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- Consumers are expecting to see visual content along with their favorite audio programs
- Once consumers experience having relevant visual content in the car, only seeing your frequency gives the impression something is lacking.
- Make your station more relevant and dynamic with visual station branding, music awareness
- Your station can capture their attention and increase engagement using the powerful tools from The Radio Experience - TREplus.

Analog Radio - No RDS

Analog Radio TREplus - Song Title & Artist

Analog RDS provides significant opportunities

- Beyond RDS – (Artist and title)
- NOW: Format, positioning statements , Program names , Personality names, News headlines and story names. Sports scores
- Local sponsors: adds additional revenue (and simple with annual contracts)
  - Attorneys , Doctors and Insurance Agents

Analog Radio TREplus - Station Branding

Analog Radio TREplus – Advertising

HD Radio® offers enhanced graphic capability

- HD Radio® - full color graphics
  - “Album Art” adds any color image
- Station Branding- station logos
  - While announcers are speaking or mixed in with music
  - Personality photos, Program logos, News or weather logos

HD Radio TREplus - Album Art

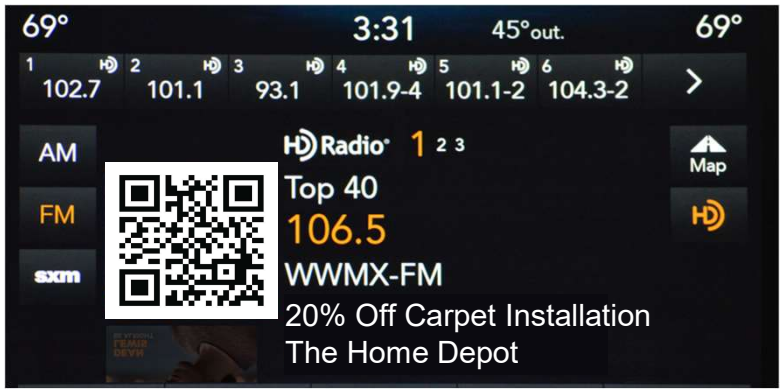
HD Radio TREplus - Station Branding

HD Radio® offers enhanced graphic capability

- Company logos provide more enhanced brand recall
- Non-commercial - donors – and create revenue (operating under the same rules as audio underwriting announcements)
- QR Code provides link to coupon downloads or websites

Use of images is limited only by your creativity!

HD Radio TREplus - Advertising



HD Radio TREplus – QR Code

Visual Content Management

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- **The Radio Experience – TRE+ t**he original, and most powerful comprehensive RDS software platform
- TRE+ manages data across all the multiple audio delivery methods – Analog FM – RDS, HD Radio®, streaming, mobile apps, station website …… ***wherever your audio goes***
- TRE+ provides increased connection with your community,
  - Up-to-date song titles and artists
  - Station promotions
  - News headlines
  - Weather, and local events
  - Advanced advertising - ns to deliver new incremental revenue

Powerful and intuitive user interface

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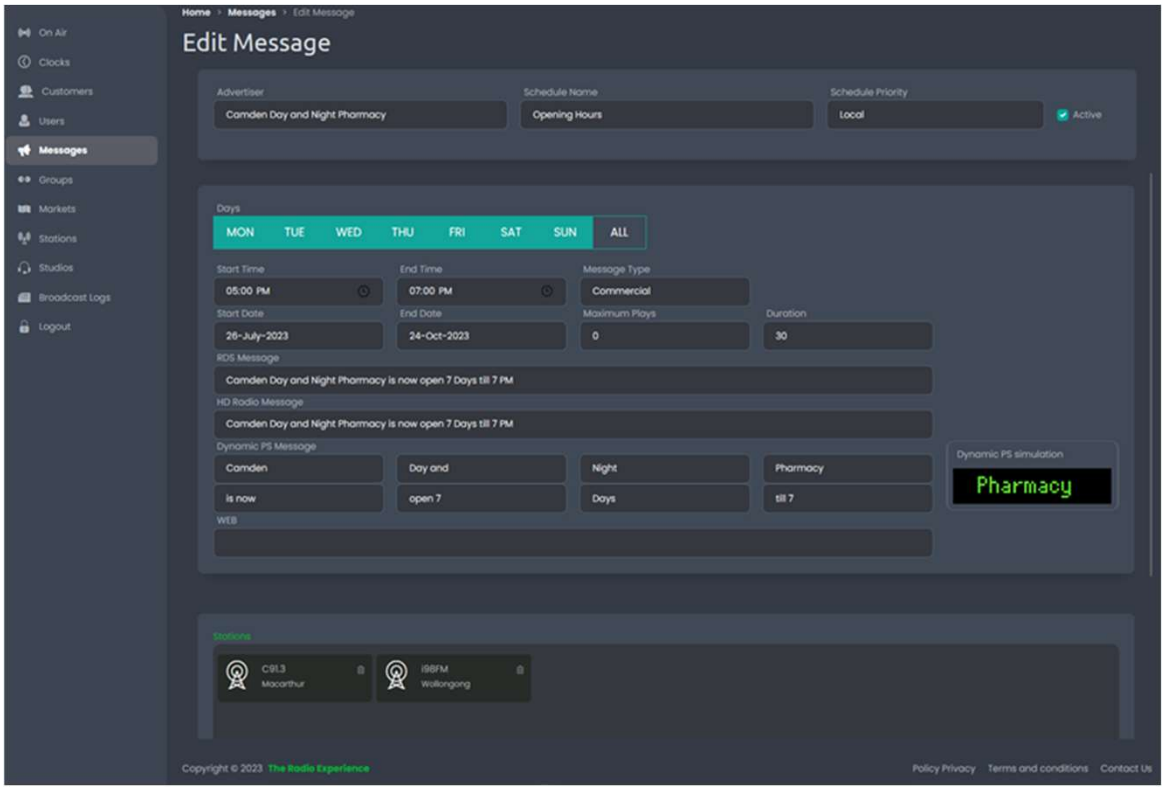
- Create, edit and schedule messages
- Different content Analog RDS and HD Radio,
- Verify message
- Simplified scheduling your messages across day-parts, days-of-the-week, and even multiple stations in your local market, region or national footprint.



Powerful and intuitive user interface

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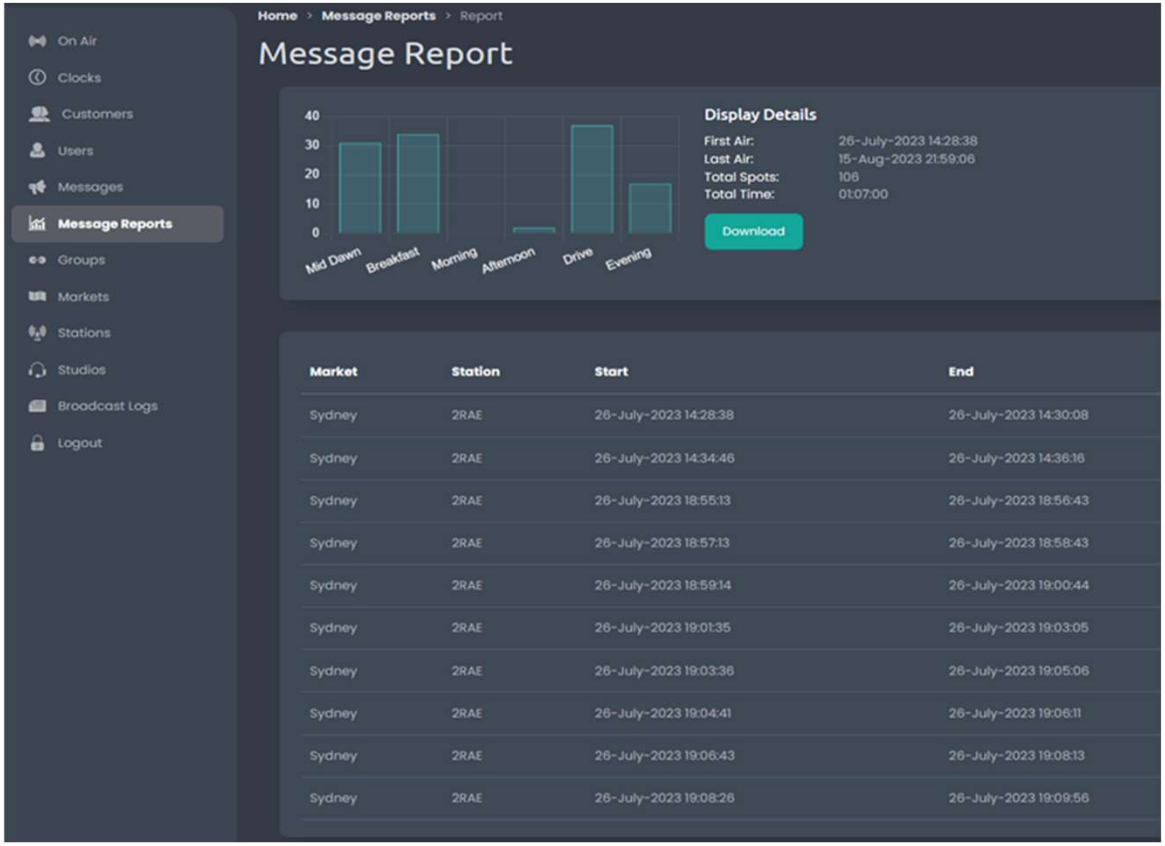
- Extensive monitoring and reporting capabilities allow you to accurately log when and how often your message is displayed.
- This simplifies any billing or contract performance
- Content Watchdog which monitors your signal in real time and validates that content is received and displayed on radios.



Real world payoff – Technical tool that makes money

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- A cluster of 5 stations in a mid-west, grew new revenue by more than $300,000 annually
  - Exclusive sponsorship for a single sponsor per station to have a visual ad displayed on radios during each commercial break per hour, 24 hours a day seven days a week.

- A West Coast broadcaster added TREplus during a recent upgrade of their BE AudioVAULT playout system got an annual contract with a major car dealership $45,000 / year in new revenue.

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THANK YOU

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