



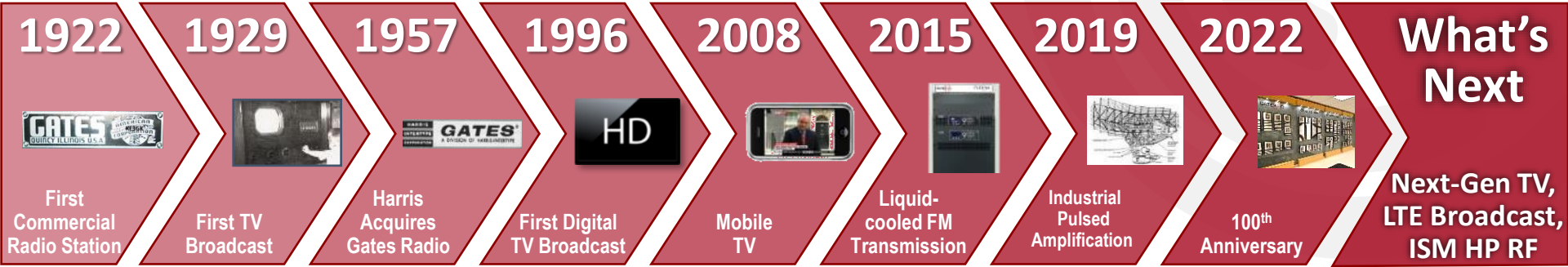
Transmission solutions to manage cost

Eng. Oscar Hu

AGENDA

- General Introduction
- Transmitter system
- Total Cost of Ownership
- Gates Air DAB solutions
- Multi Carrier Transmitter
- PMT Transmitter
- Summary

A LONG HISTORY OF INNOVATION



- GatesAir has been a pioneer in over-the-air broadcasting for more than 100 years
- We developed groundbreaking over-the-air radio and television transmitter designs that continue to this day
- GatesAir actively and proudly participates in projects that set new standards in broadcasting, content delivery, and more





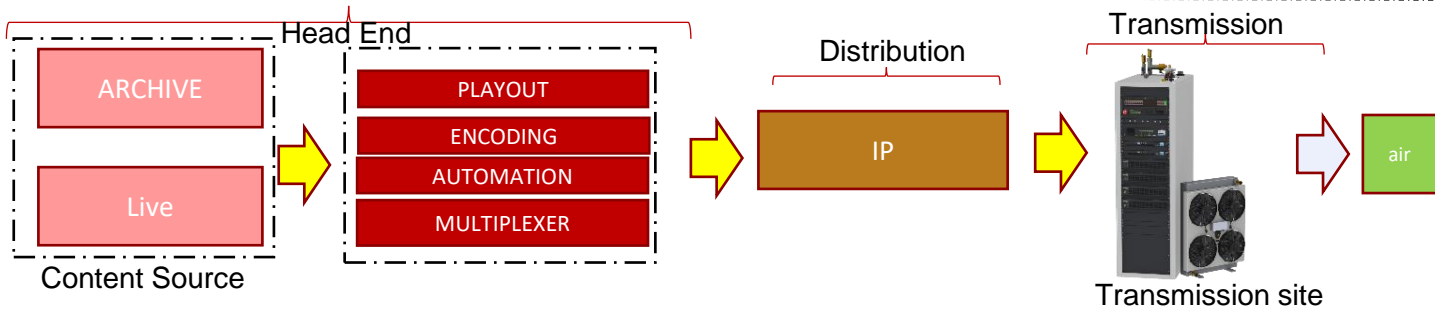
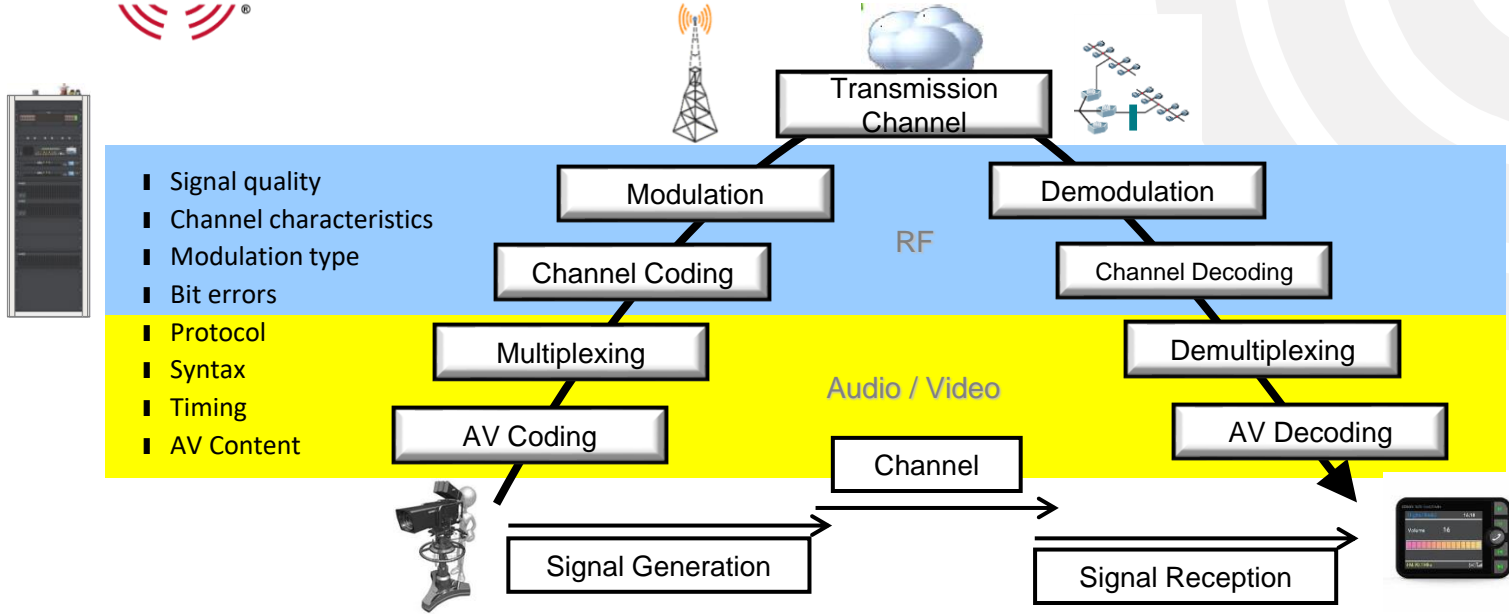
Connecting What's Next

Gates Air Transmission chain



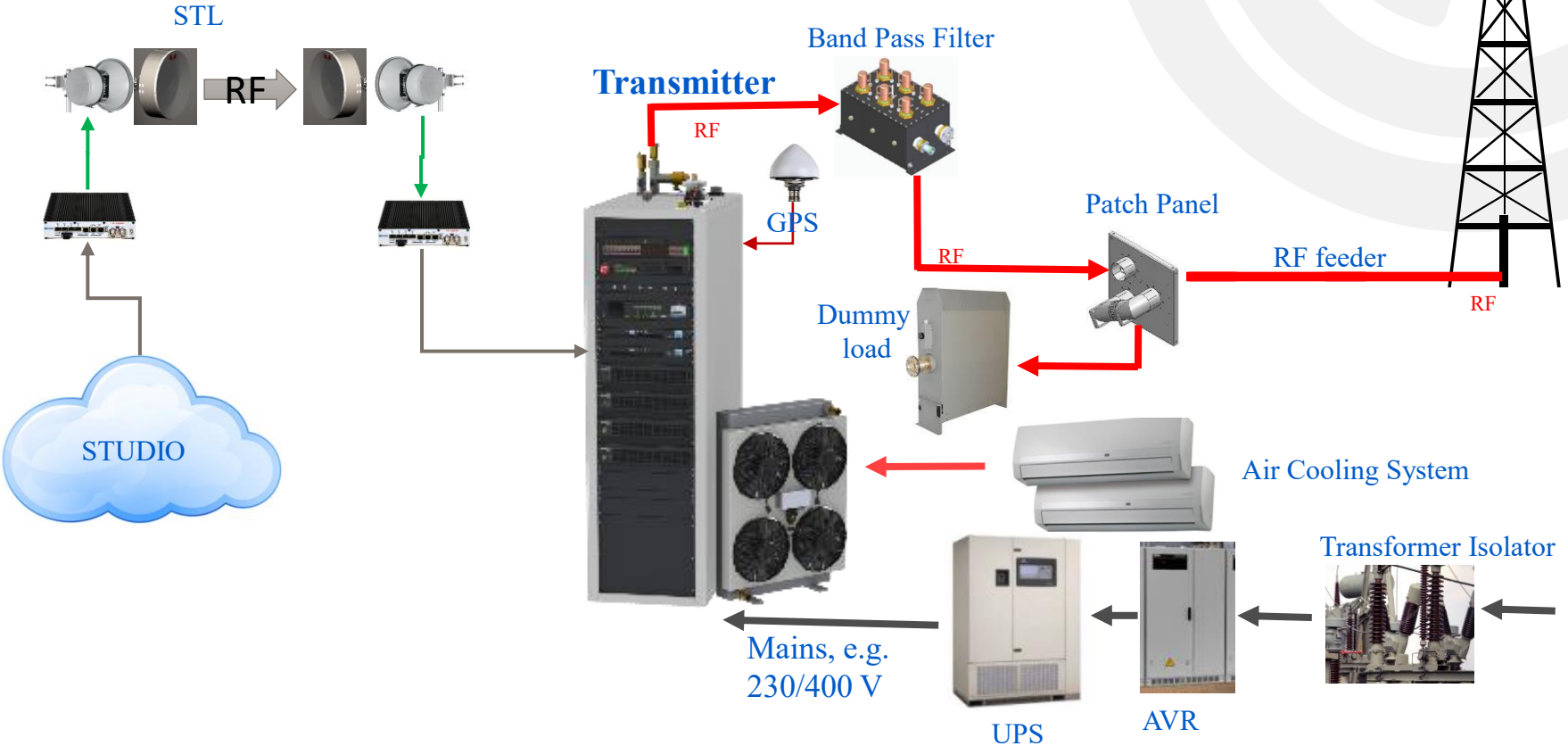
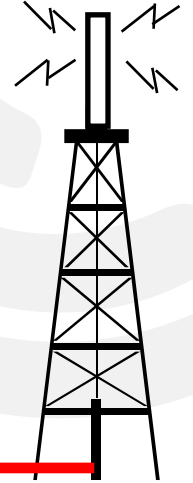


DIGITAL TRANSMISSION DISTRIBUTION CHAIN





DIGITAL TRANSMISSION STATION SETUP



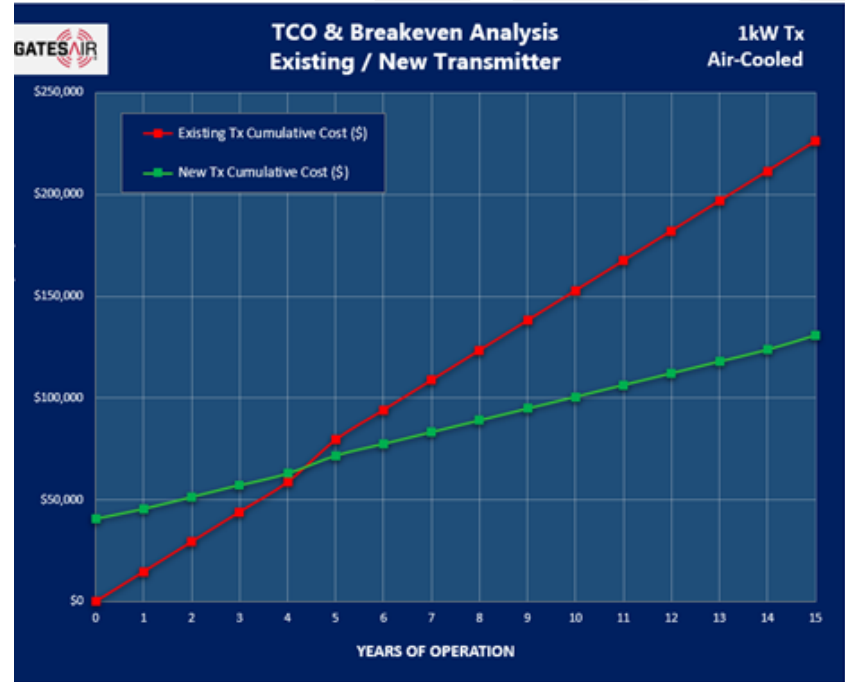
TOTAL COST OF OWNERSHIP



TOTAL COST OF OWNERSHIP (TCO)

Topic

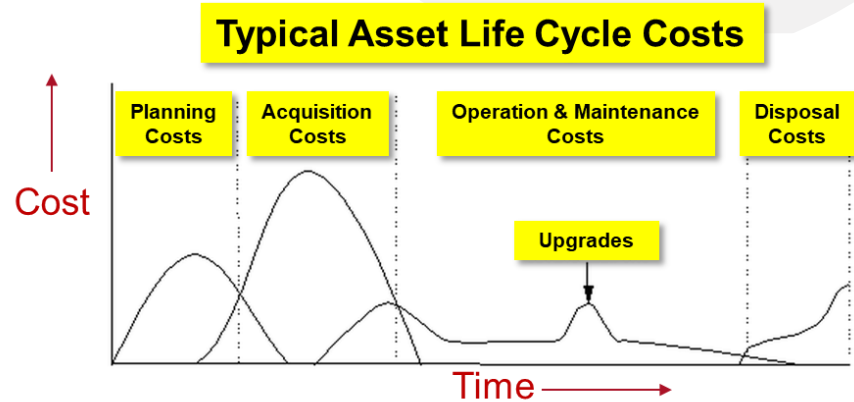
- High-efficiency transmitters are the cornerstone of low TCO, though many other factors are equally important.
- Today we will look at all the major drivers of total cost of ownership, including repairability, modularity, footprint, and several other factors that can help you select a reliable transmitter that will provide you cost-effective operation throughout the life of the product.



TOTAL COST OF OWNERSHIP DEFINITION

There are many definitions for TCO, these fit best:

1. **“Total Cost of Ownership is the total cost of acquisition and operating costs over the asset life cycle”.** A TCO analysis can be used to gauge the viability of any capital investment.
2. **“Total cost of ownership (TCO) is an analysis that places a single value on the complete life cycle of a capital purchase”.** This value includes every phase of ownership: acquisition, operation, and the softer costs of change management that flows down from acquisition such as documentation and training.



Courtesy: <http://www.wilsonmar.com/1tco.htm>

SYSTEM EFFICIENCY



SYSTEM EFFICIENCY - LOSS ANALYSIS

This example uses 200 meters transmission line. Frequency 560MHz.

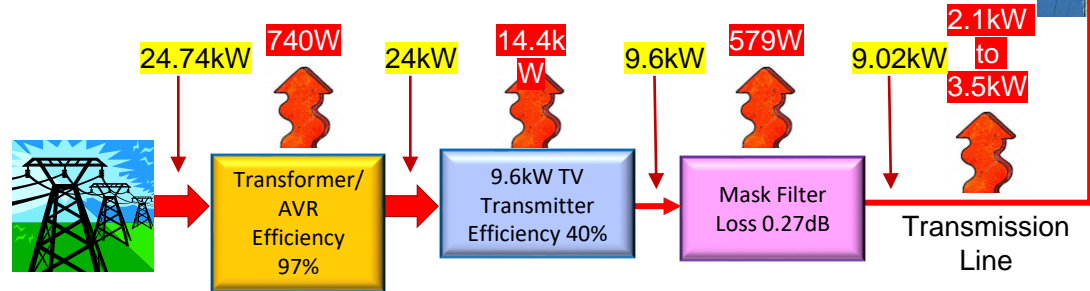
Ch 29 (560MHz)										
Line size / type	Loss/ 100ft (dB)	Line Loss (dB) 200 meters (656ft)	Mask Filter Loss (dB)	Total Loss (dB)	Tx Power (kW)	Antenna Input Power (kW)	Tx AC Input Power (kW)	AVR Efficiency	AC Input Power	System Efficiency
3" Flex HCA-300-50J	0.325	-2.132	-0.270	-2.402	9.6	5.52	24	97%	24.74	22.3%
3-1/8" 50 Ohm Rigid	0.220	-1.443	-0.270	-1.713	9.6	6.47	24	97%	24.74	26.2%
4-1/16" 50 Ohm Rigid	0.174	-1.141	-0.270	-1.411	9.6	6.94	24	97%	24.74	28.0%

Power at Antenna
Input
5.52kW to 6.94kW

ANTENNA

- The transmitter is only one part
- Adding losses for:
 - AVR
 - Mask Filter (typ. 0.27dB)
 - 200 meters transmission line (See table for losses)
- Assume Tx is 40% Efficient
 - AC input = $9.6 / 0.40 = 24\text{kW}$

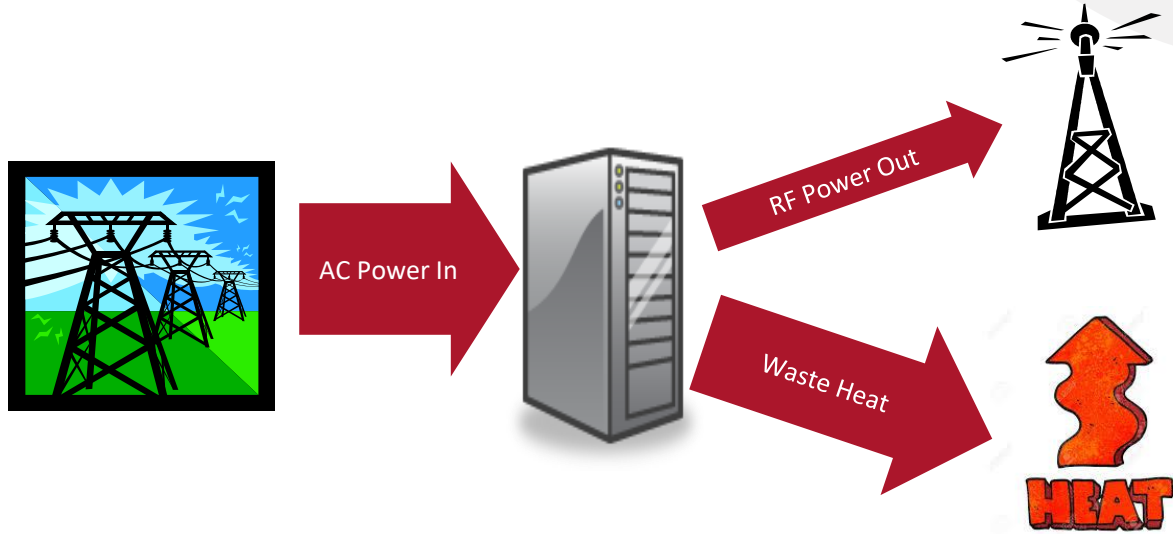
System Efficiency (AC in vs. Power to Antenna) = 22.3%



Of the 24.74kW power going into the transmitter, only 5.52kW feeds the antenna

- **Efficiency of a transmitter:**

- Definition: $(\text{RF Power Out} / \text{AC Power In}) \times 100\%$



- **Older Technology TV Transmitter**

- 10kW Class AB UHF DTV Transmitter
- Efficiency $10/50 \times 100\% = 20\%$



AC Power In
50kW



RF Power Out 10kW



Waste Heat 40kW



- Input Power 50kW
- Heat Load to Room 40kW

- **Very Efficient TV Transmitter**

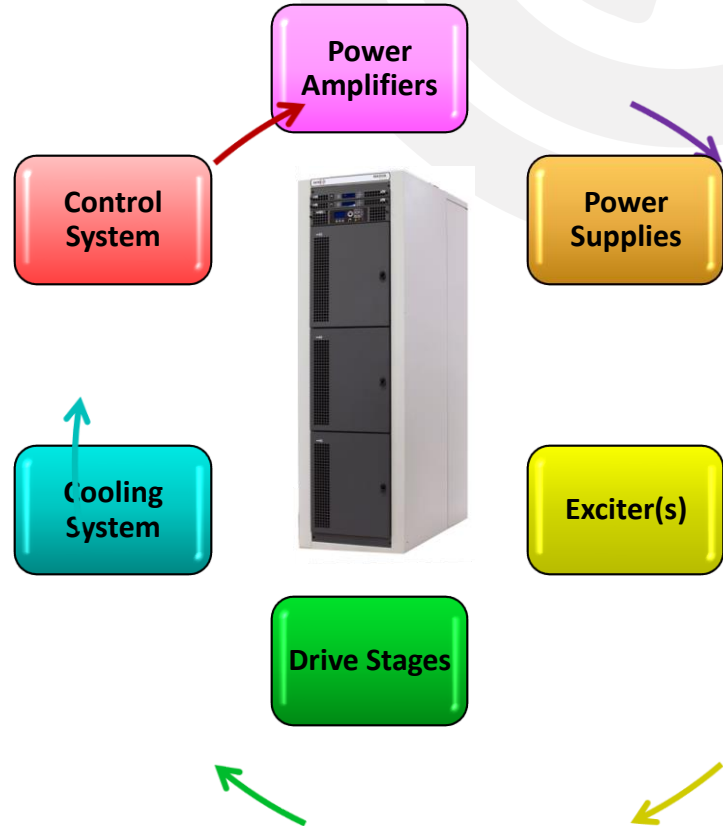
- 10kW High-Efficiency UHF DTV Transmitter (New Generation)
- Efficiency $10/24 \times 100\% = 41.7\%$



- Input Power 24kW (-52%)
- Heat Load to Room 14kW (-65%)

TRANSMITTER EFFICIENCY

- Transmitter System Efficiency
- Some Items may have fixed losses:
 - Control System
 - Exciters
- Some Items may have varying losses:
 - PA Module (varies with modulation, saturation)
 - Drivers (varies with modulation, saturation)
 - Cooling System (speed-controlled pumps and fans)
 - Power Supplies (can vary depending on load)
- Why are low power transmitters less efficient than high power?
 - As power is reduced, fixed losses become a larger part of the equation



PRIMARY EFFICIENCY DRIVERS IN A TX

- Power Amplifiers
 - Most older designs used Class AB PA's
 - PA Efficiency in range 23% to 33% (Overall Tx efficiency in range of 16% to 27%)
 - Most new designs uses High-Efficiency (Doherty) PA's
 - PA Efficiency over 50% VHF and UHF (Overall Tx efficiency often > 40%)
- Power Supplies
 - 12 years ago 86% was “state-of-the-art” efficiency
 - Today – power supplies can be up to 96% efficient
- Cooling System
 - Older less efficient transmitters used large high volume and pressure blowers
 - Large pumps and heat exchangers in liquid-cooled transmitters
 - New systems use variable speed fans and pumps and have less heat to remove

EFFECT OF POWER SUPPLY EFFICIENCY

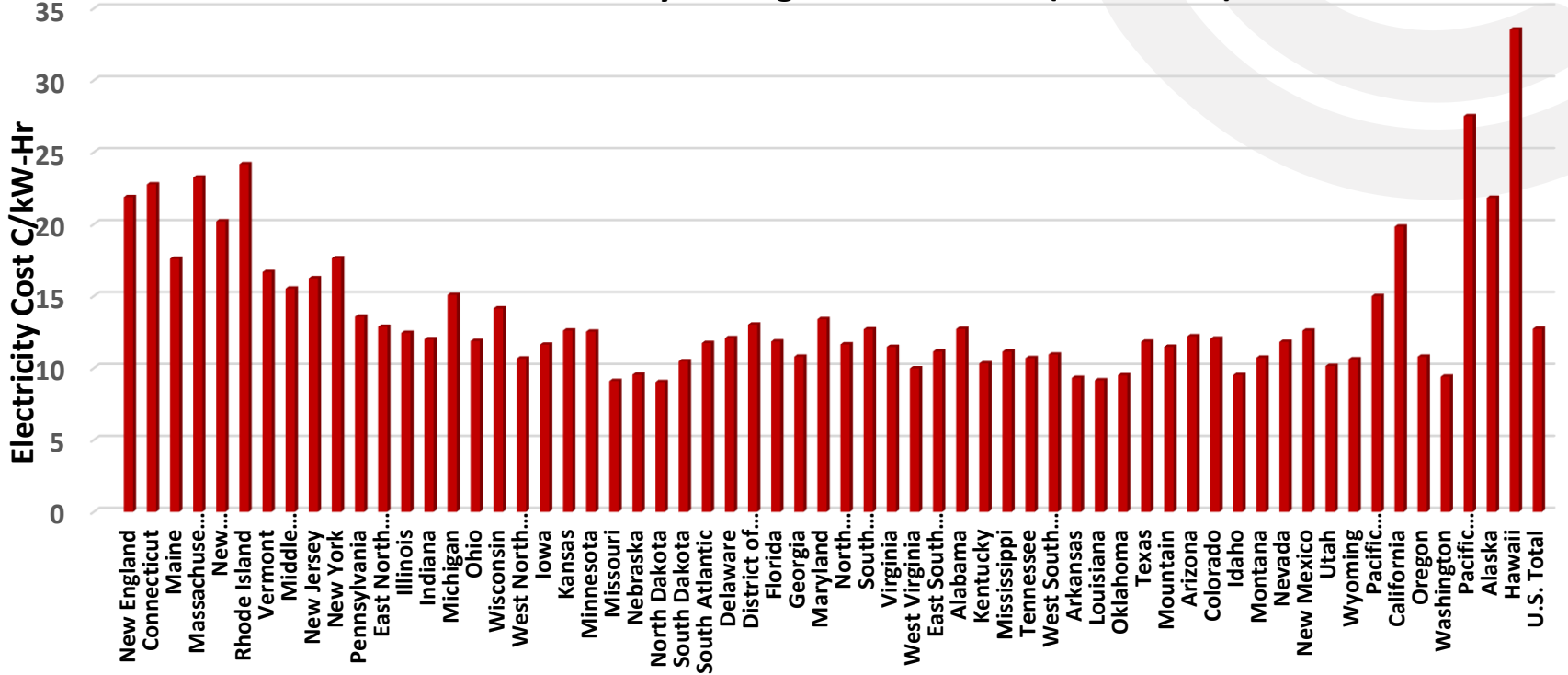
Item	Old Technology PS 86% Effy.	Recent Power Supply 90% Effy	New High Eff. PS 96% Effy.
RF Power Output (W)	10,000	10,000	10,000
Power Amplifier Efficiency	51%	51%	51%
Combining losses (dB)	0.30	0.30	0.30
RF power before losses (W)	10,715	10,715	10,715
DC Power to PA's (W)	21,010	21,010	21,010
Power Supply Efficiency	86%	90%	96%
AC Power to Power Supplies (W)	24,430	23,345	21,886
Power Supply Loss (W)	3420	2334	875
Drivers	600	600	600
Exciters	150	150	150
Control	120	120	120
Cooling	600	600	600
Total AC Input (kW)	29,321	27,149	24,231
Overall Tx Efficiency	34%	37%	41%

- Clearly, the design of the power supply has a significant impact on total efficiency
- Example of a high-efficiency power supply:
 - Efficiency 96% at 50% FL
 - Power factor typ. 0.995
- Input voltage range typ. 185 – 300 VAC



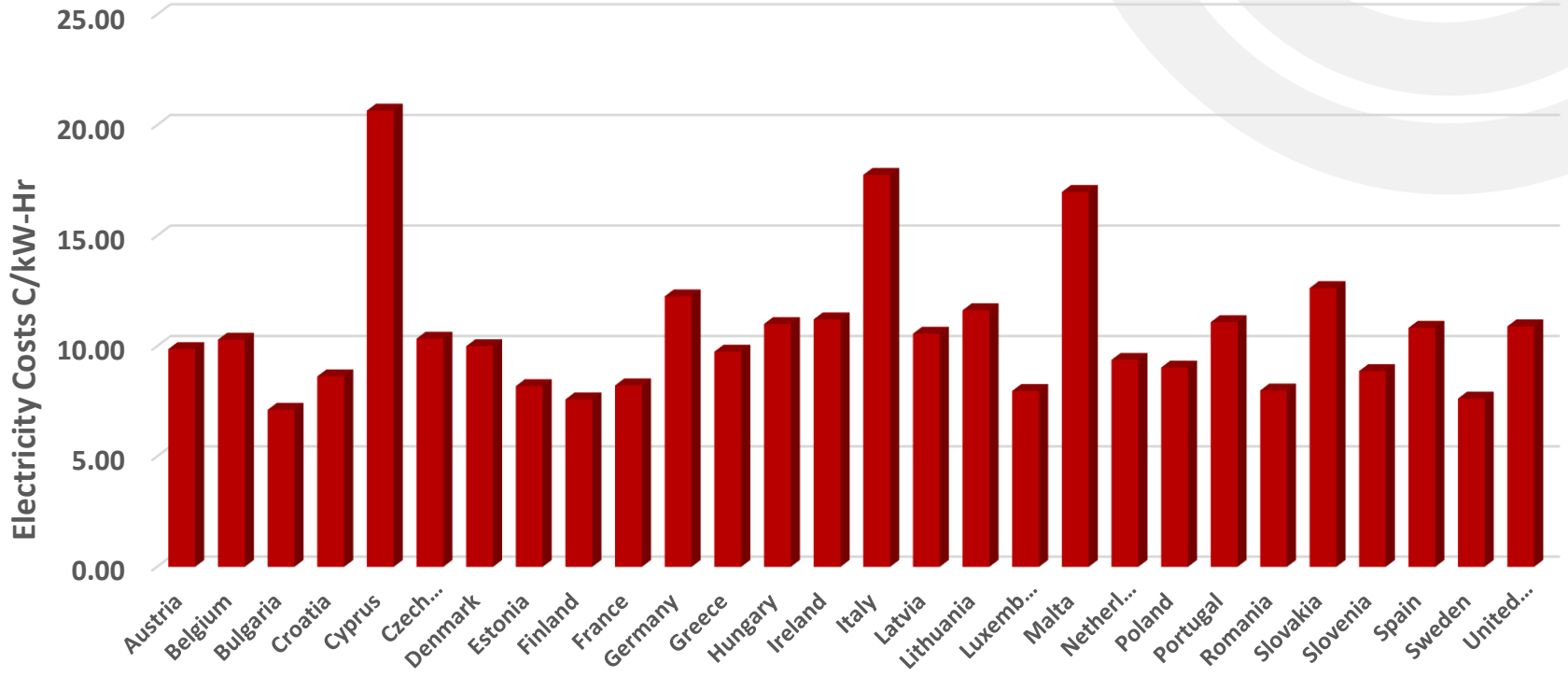
ELECTRIC POWER COSTS

USA Electricity Pricing - Cents/kW-Hr (2019 Data)



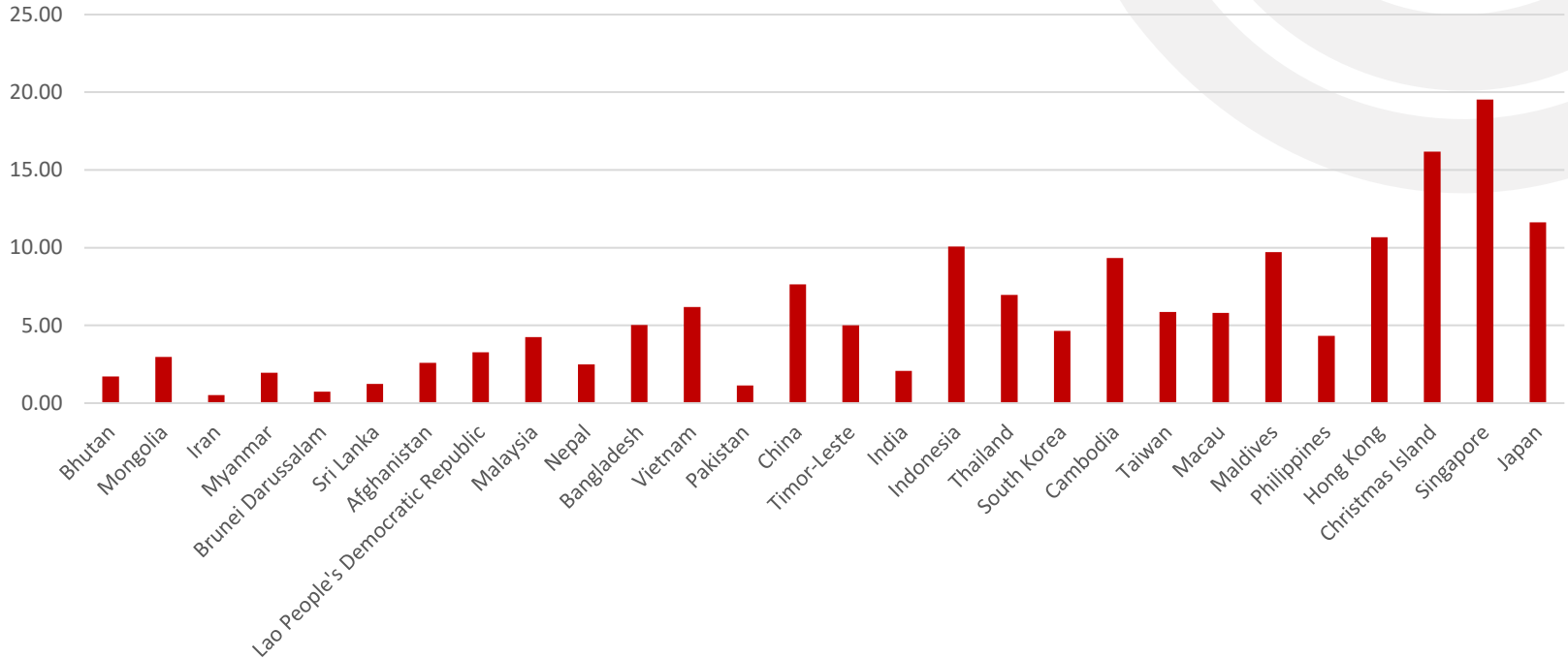
ELECTRIC POWER COSTS

European Electricity Pricing - Cents/kW-Hr (2019 Data)



ELECTRIC POWER COSTS - ASIA

ASIA (EX. NEAR EAST) Electricity Pricing - C/kW-Hr 2021





DAB PRODUCTS

MAXIVA LOW POWER ULTRA-COMPACT SERIES

KEY FEATURES

- Available output power: 15W - 30W – 80W – 150W average DTV
- High-efficiency, Doherty broadband VHF BIII
- Adaptive pre-correction
- ETI + EDI + DVB-S/S2 + RF input interfaces available
- Configurable as: Transmitter, Transposer, Regenerative Gap Filler
- Hot Swappable Power Supply & RF amplifier
- DAB+/DMB Standard
- HTML5 Interface



MAXIVA ULTRA-COMPACT SERIES

KEY FEATURES

- Available power levels: 300W (2RU) – 450W (2RU) – 550W – 750W (3RU)
- High-efficiency broadband VHF BIII
- Adaptive pre-correction circuits with MER >33 dB typical
- EDI + ETI + DVB-S/S2 + RF input interfaces available
- Transmitter, Repeater, Transposer, Regenerative Gap Filler
- Hot-swappable Power Supply from front panel
- DAB+/DMB



MEDIUM POWER AIR-COOLED

KEY FEATURES

- Available output power: 300W, 450W, 550W, 750W, 1200W, 1500W, 1900W. Single or Dual redundant Exciters
- High-efficiency broadband VHF
- Adaptive pre-correction circuits with MER > 33 dB typical
- ETI + EDI + DVB-S/S2 + RF input interfaces available
- Embedded ETI/EDI & RF Switch Over matrix for Dual Redundant Exciters
- Hot Swappable Power Supplies
- DAB+/DMB



HIGH POWER AIR & LIQUID -COOLED

KEY FEATURES

- Available output power: from 3000W to 13,600W
Air cooled and 45,600W Liquid Cooled
- High-efficiency broadband VHF BIII
- Adaptive pre-correction with MER >up to 33 dB typical
- ETI + EDI + DVB-S/S2 + RF input interfaces available
- Hot-swappable Power Supplies with 2 of 3 redundancy
- Low consumption Pump and Heat Exchanger (pump + heat exchanger + external fans = 535W)
- Dual Redundant Pumps standard
- 2 x coolant reserve tanks (8 litres) for automatic liquid refilling, reduces on-site maintenance
- Very small external heat exchanger with 24V power
- DAB+/DMB

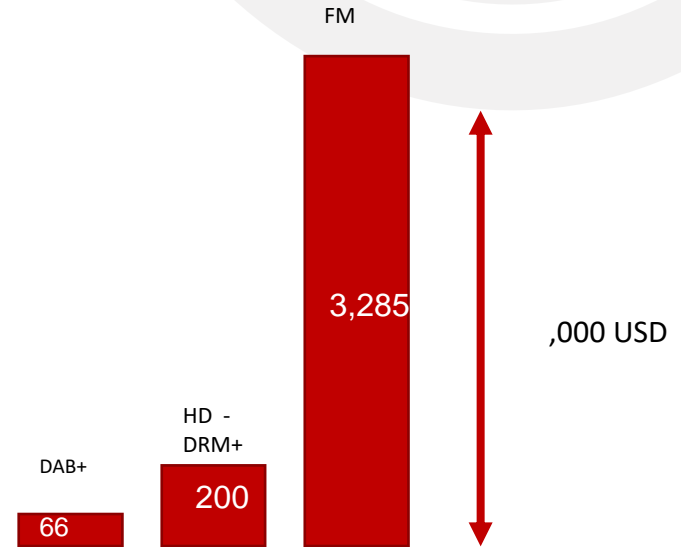


ENERGY CONSUMPTION – ANALOG & DIGITAL

Transmitter	FM	DAB+
Power	10 kW	2.5 kW rms
Efficiency	72%	50%
Consumption per Transmitter	13.9 kW	5 kW
Transmitters	18	1
Energy all Transmitters	250 kW	5 kW
Annual cost of energy	328,500	6,570

- **DAB+ energy savings 50x lower compared to FM**
- Power consumption in kW
- Assumes 0.15 USD per kWh

- Energy costs over 10 years of operation
- **DAB+ energy savings over 10 years 3,219,300 USD compared to FM**

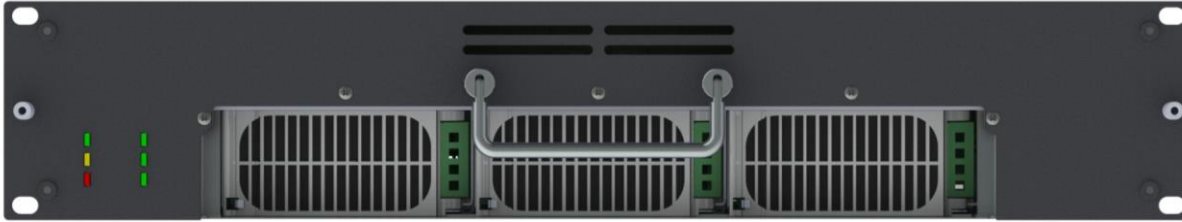


Example: 18 Radio Programs same coverage



POWER SUPPLIES

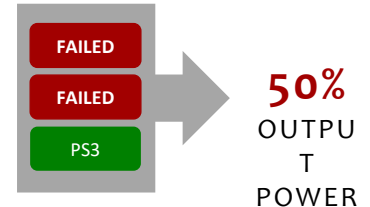
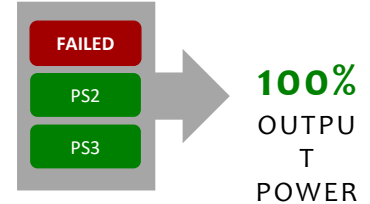
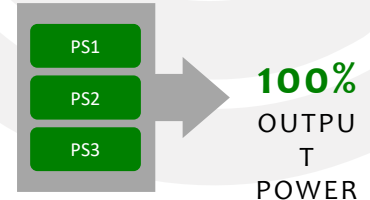
2 of 3 High Redudancy Power supply system



Liquid-cooled PA module with front panel removed

- Same Power supply as FAX/FLX:
 - GE Power CP2725
 - 450,000 hrs. MTBF
 - 96.3% efficient
- Hot-swap, front access

RoHS Compliant



HIGH EFFICIENCY TECHNOLOGY - VHF BAND III

TECHNOLOGIES ON THE MARKET

Narrow Band Doherty

- Up to 1-2 Channels
- Problem with spare parts
- Problem with N+1 systems



Not supported by GatesAir s.r.l.

Broadband Doherty

- Complete VHF BIII from 170 to 240 MHz
- Convenient for N+1 and Spares
- Optimized Efficiency up to 41%



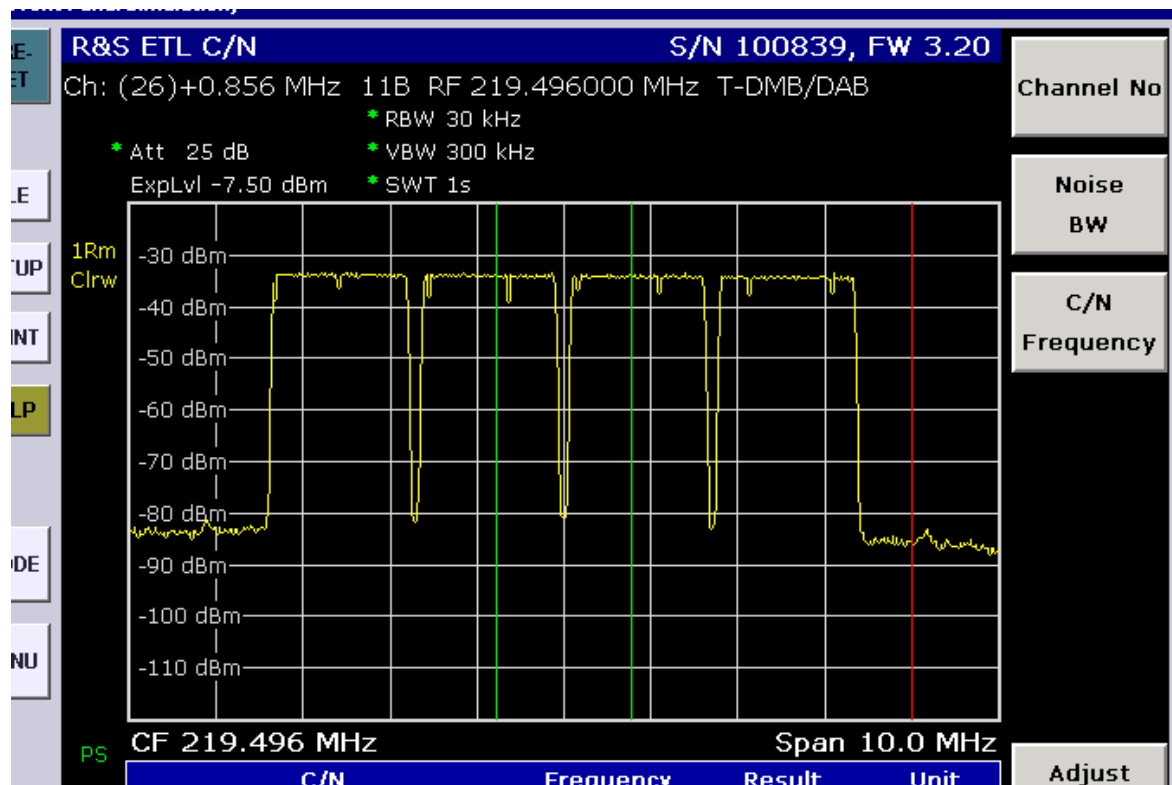
Supported by GatesAir s.r.l.



CASE MULTICARRIER TRANSMITTER

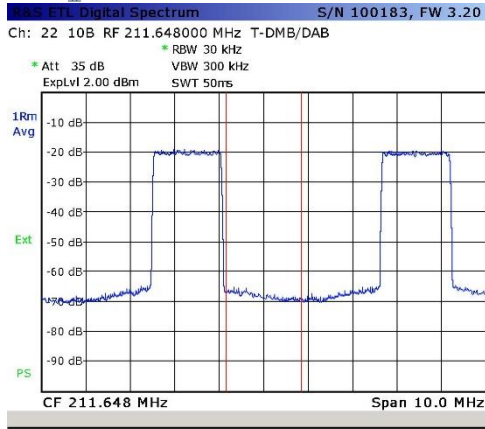
DAB Multicarrier

MULTICARRIER DAB Spectrum – Up to 4 CH

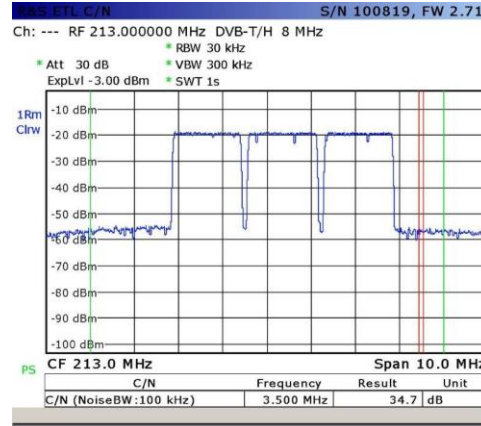




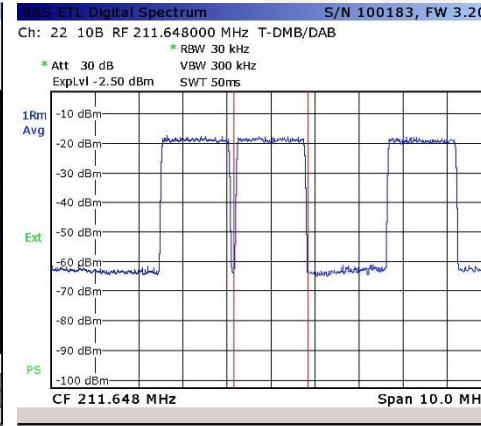
MULTI CARRIER DAB SOLUTIONS REDUCE COSTS, AND INCREASE ROI



2 non adjacent channels



3 adjacent channels



3 non adjacent channels

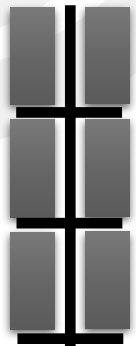
Ch: 24 10D RF 215.072000 MHz T-DMB/DAB

Att 30 dB
ExplLvl -2.50 dBm

MER (total,rms) 38.3 dB

Ensemble	EnsembleTest	Date & Time(UTC:--)
Pass	Limit	< Results < Limit Unit
Level	-60.0	-2.3 10.0 dBm
Sideband		Normal
Transmission Mode		Mode 1, 1536 carriers
Carrier Freq Offset	-30000.0	0.0 30000.0 Hz
BR Rate Offset	-20.0	0.0 20.0 ppm
MER/EVM (rms)	24.0	38.3 ---- dB
MER/EVM (peak)	10.0	26.8 ---- dB
BER before Viterbi		0.0e-7(39/100) 1.0e-2
FIB Errors		0 1 /s

Tx Antenna



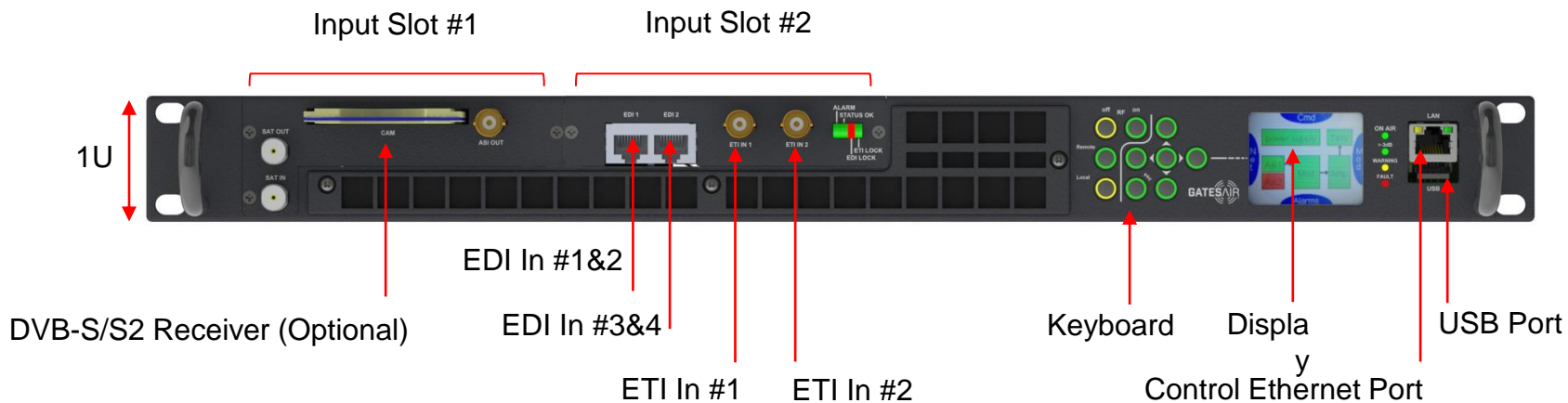
VHF BIII Band Pass Filter





MULTICARRIER DAB 1RU Up to 150 Wrms Total

FRONT VIEW

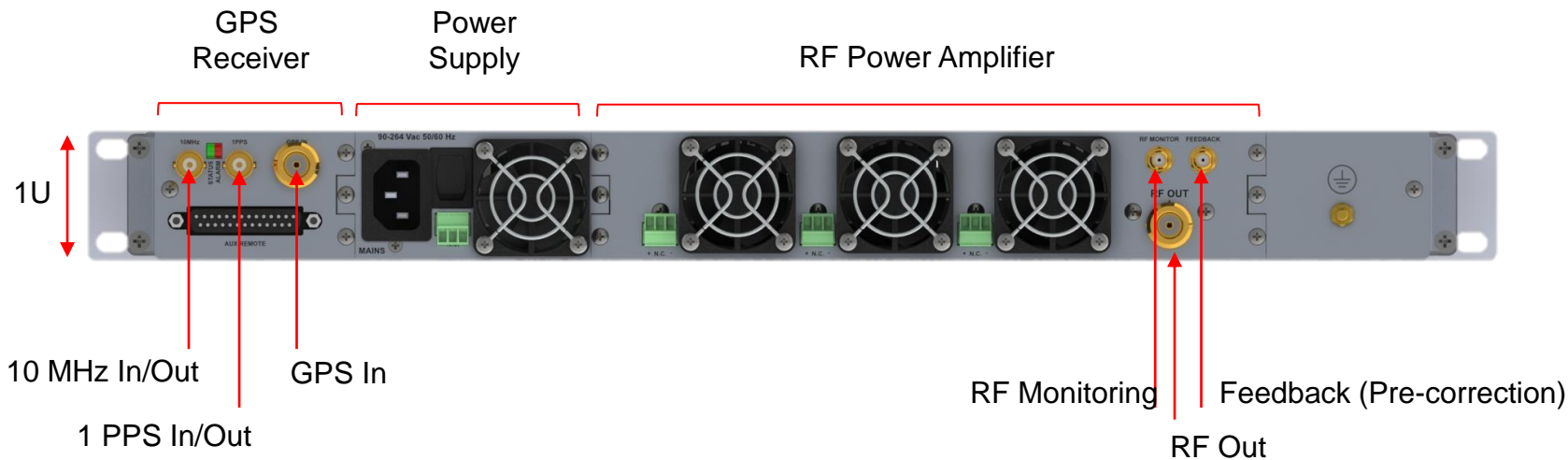




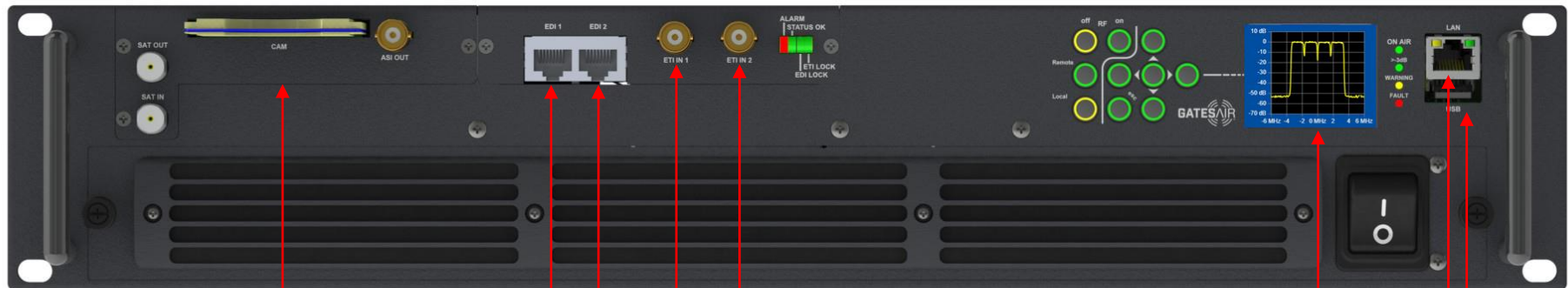
MULTICARRIER DAB

1RU Up to 150 Wrms Total

BACK VIEW



MULTICARRIER DAB - 240 Wrms Total



DVB-S/S2 Input

EDI In #1&2

ETI In #1 ETI In #2

Touch screen LCD

Control Ethernet Port

USB Port

EDI In #3&4



10 MHz In/Out

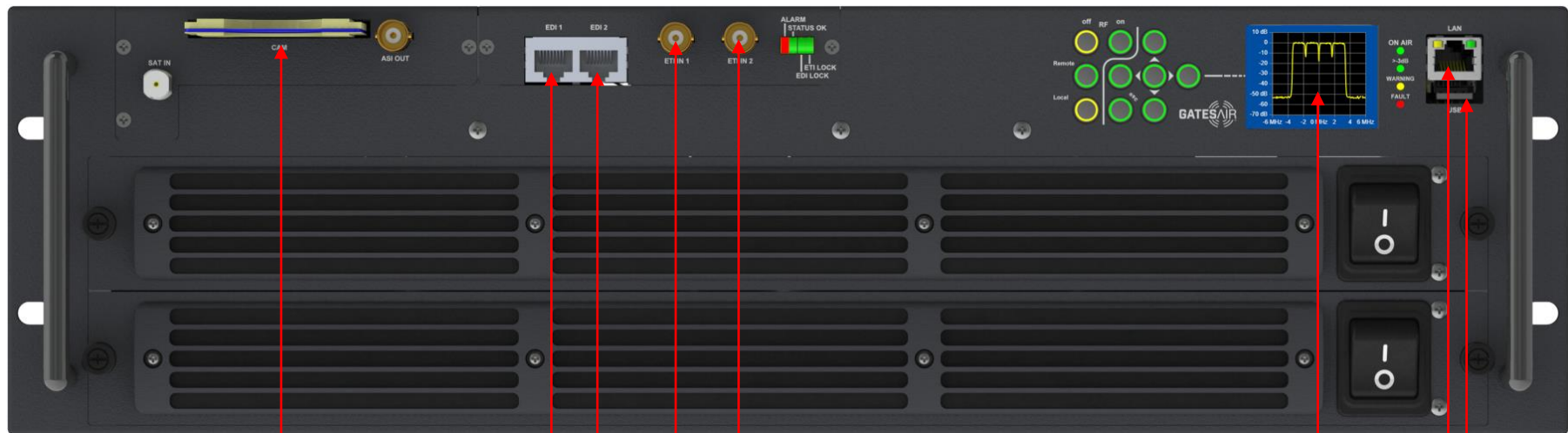
GPS In (Opzionale)

RF Out

Feedback

1 PPS In/Out

RF Monitoring



DVB-S/S2 Input

EDI In #1&2

EDI In #3&4

ETI In #1 ETI In #2

Touch screen LCD

Control Ethernet Port

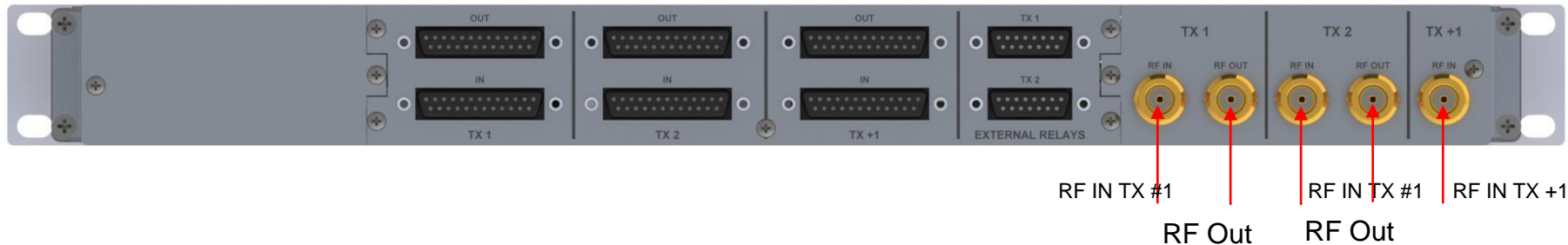
USB Port

2+1 or 1+1 Configuration (N Connectors)

Front View



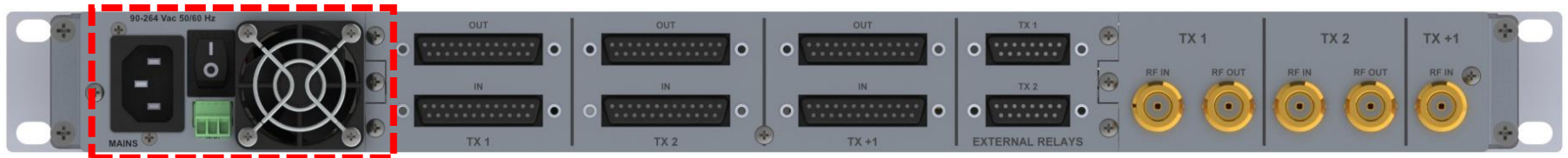
Rear View



Options



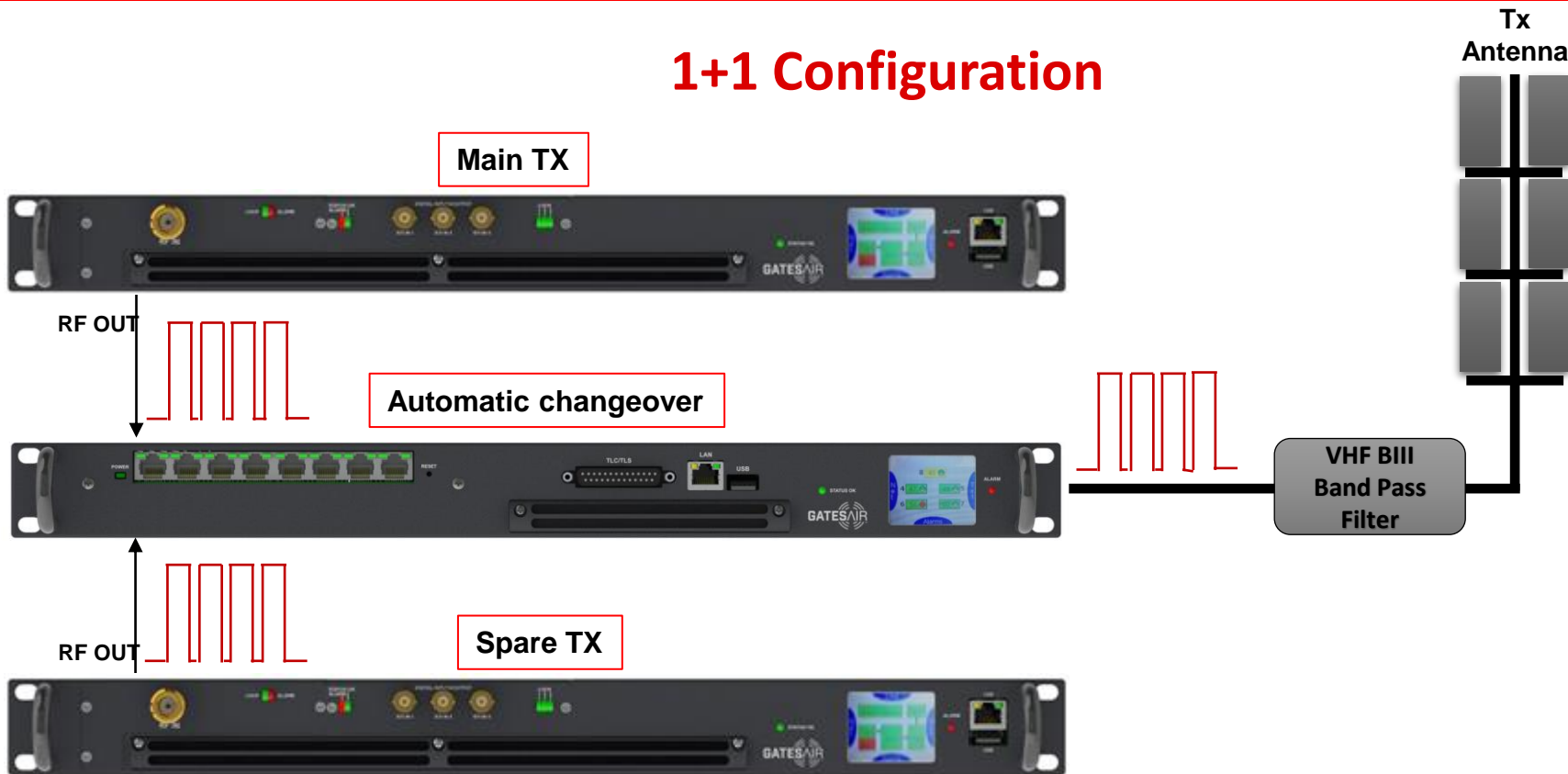
Option: ETI Input Splitter / Matrix



Option: Power supply

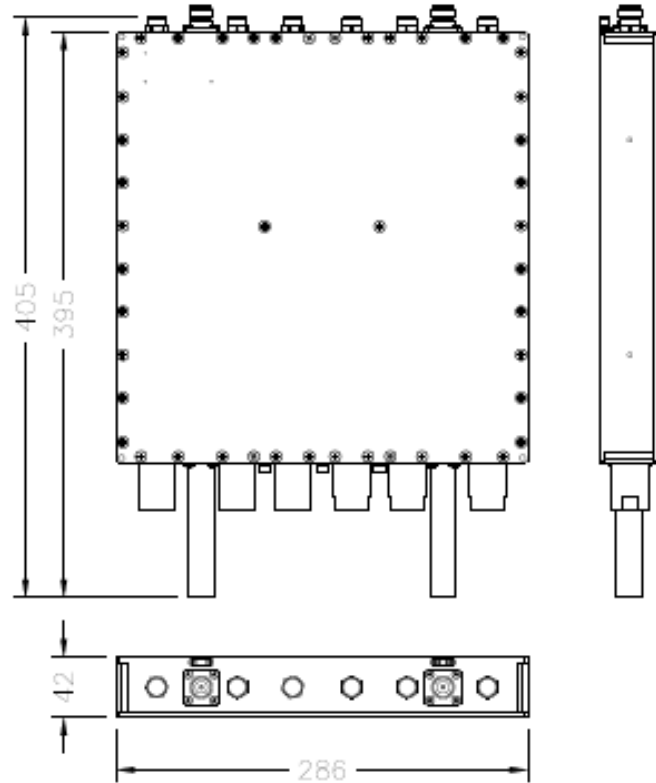
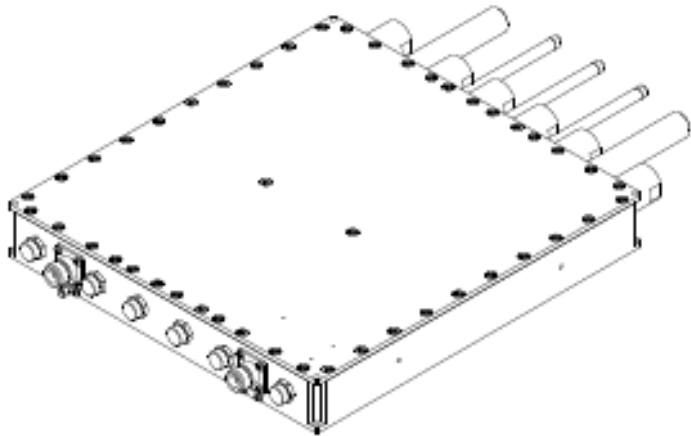
EXAMPLE: 1+1 (4+4ch) Configuration

1+1 Configuration



EXAMPLE: 1+1 (4+4ch) Configuration

Output filter: STANDARD VHF BIII Band Pass (NO DAB Filter required)



Multicarrier DAB

Standard solution

Number of Transmitters	1	●	●	4
Dimensions TX	1U	●	●	4 X 1U/2U/3U or bigger
Independent management of single mux	YES	●	●	YES
RF DAB Combiner	NO	●	●	YES
Special Filter Combiner: DAB + Services (for special applications only - ex: tunnel coverage)	YES	●	●	YES
Power output W/CH *	175W rms	●	●	175W rms
Efficiency	Always better than standard solution	●	●	Always worst than Multicarrier

*higher powers available



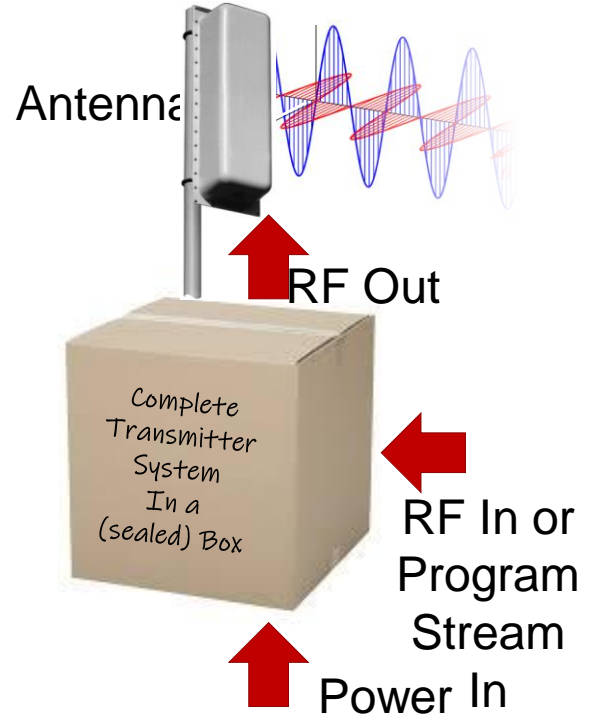
GATESAIR[®]

PMTX-1
OUTDOOR
TRANSMITTER



GETTING AWAY FROM THE 19" PARADIGM

- Why an outdoor transmitter?
 - Breaking the normal Broadcast tradition
 - A complete "Transmitter in a box" concept
 - Well-proven in other industries (cellular)
 - No building, no indoor lease space
 - Save \$\$, lower TCO
 - Fast & easy to deploy
 - Can make a great alternative solution for the lowest power level transmitters, repeaters





IT'S NOT A TOTALLY NEW CONCEPT



Courtesy Vanu Inc.

Low Power Cell Tx (Vanu)

Efficient transmitter: This 50-watt (power consumption) unit is the lowest-power outdoor cell-phone base station in the world, according to an analysis by its maker.

Examples of outdoor transmitters



Courtesy Samsung Group

Cellular Base Station Tx (Samsung)



Power Pole-mounted 5G Tx & Antenna (Unknown Brand)



INSTALLATION FLEXIBILITY!

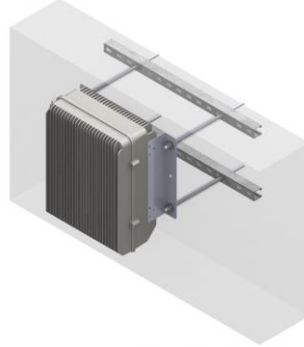


OUTDOOR TRANSMITTER

- Mount on any suitable structure
- Waste heat dissipated via heatsink fins
- Simple bracket designs for pole, mast, wall mount, etc.
- Versatility in terms of mounting location vs. pole-mount only
- Available to order now



Mount
"anywhere"
" design



Wall / Side of Building

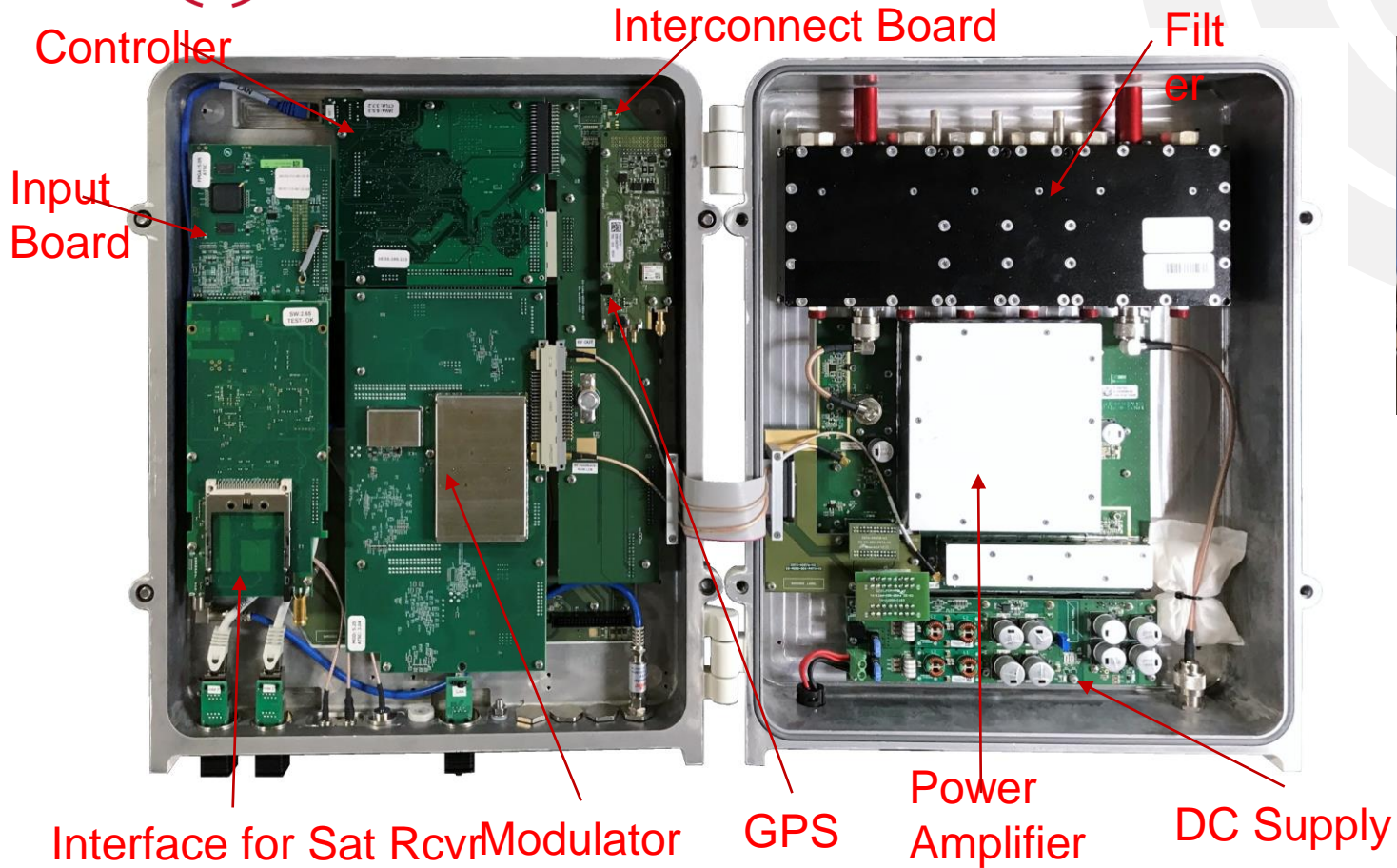


Tower/Pole Mount



Top of Building

GATESAIR PMTX-1 COMPONENTS





TECHNICAL CHARACTERISTICS

- Basic Configurations
 - Transmitter / Transposer / On-Channel Gap Filler
 - Integrated Mask Filter
 - Up to 50W TPO average DTV after filter
 - or 100W Analogue
 - Modulations: DAB/+, T-DMB, ATSC-1, DVB-T/T2, ISDB-T, Analogue
 - GPS - Option
- Inputs & Options
 - 1 x TS (ETI / EDI / BTS / ASI / SMPTE-310M) + 1 x GbE (TSoIP) - Included
 - Off-Air Receiver (Regenerative or Direct Conversion) - *Option*
 - Satellite Receiver DVB-S2/S2X - *Option*
- Power source
 - External DC: 36V to 72V
 - External AC to DC Power Supply - *Option*



Maxiva™ PMTX-1

Low-Power UHF Outdoor
Transmitter / Transposer



GatesAir's new Maxiva™ PMTX-1, is a complete self-contained, outdoor transmitter system. Housed in a completely environmentally sealed enclosure, the PMTX-1 includes many options, allowing configuration flexibility for many applications.

The unit is capable of being configured as a Transmitter or Transposer (Translator). Waste heat is efficiently dissipated via the metal housing and heatsink; there is no active cooling and no fans. This allows the unit to be mounted on a variety of structures, including tower, legs, poles, or building walls. For regions with extreme climate conditions, options for ambient air temperatures up to +50°C (122°F) and down to -40°C (-40°F) are available.

The compact dimensions (429W x 280D x 503H mm) of the Maxiva PMTX-1 chassis are key to this unique design, allowing installation on a wide variety of outdoor poles, or mast structures. Access is via a lockable and sealed door. The sealed metal housing of the PM-TX-1 has been engineered to remove heat efficiently from the internal circuitry. The unique design of the PMTX-1 provides a high level of installation versatility, allowing it to be installed on virtually any suitable outdoor structure.

This versatile unit does not require a building, shelter or any additional outdoor enclosure. The totally sealed metal case has been designed specifically for outdoor environmental conditions, providing protection from all humidity levels, precipitation and wide temperature extremes.

The unit can be configured and operated as a 50W digital / 100W analogue transmitter or transposer, with various input options. A satellite receiver card with CAM slot is also available. The unit includes an internal mask filter. The external power source requirement is 36-72 VDC.

Product Features

- Compact chassis: 429W x 280D x 503H mm
- Outdoor, pole-mounted, using adapter plate
- Output Power (Post-Filter): 50W rms Digital or 100W analogue
- Input interface options:
 - ASI, BTS, T2M, SMPTE-310M, ETI
 - Gbe port (TS over IP)
- DVB-S/S2 Satellite Receiver input available (including CAM interface)
- RF receiver input for Transposer/Gap-Filler configuration (Direct Conversion - zero IF)
- Regenerative receiver input option for Transposer
- Supports DVB-T/H, ISDB-T/Tb, DVB-T2, ATSC & Analogue modulations
- Embedded Re-Multiplexer/Layer Combiner/TS to BTS (188 to 204 byte) converter for ISDB-Tb
- Adaptive pre-correction circuits
- Optional High stability GPS / GLONASS receiver with battery
- SNMP, Web User Interface



TECHNICAL CHARACTERISTICS

- Environmental
 - Ambient air temperature range:
 - -20°C to +45°C (standard)
 - -40°C to +50°C (optional)
 - Weatherproof, sealed enclosure
- Performance (Adaptive correction is included):
 - MER ≥ 34dB
 - Shoulders ≤ -37dB
- Remote Control
 - GPIO (parallel remote)
 - Full-featured HTML-5 Web Remote GUI
 - LTE Module (option)

Maxiva™ PMTX-1

Specifications
Specifications and designs are subject to change without notice

General	
RF Output Frequency Range	PMTX-1-U: UHF Band, 470-700MHz
Transmission Standards	ATSC, DVB-T, DVB-T2, DVB-Tb, Analogue
RF Channel Bandwidth	6, 7 or 8MHz
Number of Transmitters per Unit	1
RF Power Output per Transmitter	At output of integrated filter: 50W average DTW, 100W analogue p.s.
VSWR Protection	Included
Mechanical Dimensions	420W x 200L x 500H mm
Power Supply Configuration	External DC power source, connected to bottom of unit.
Power Supply Voltage	DC 36 to 72V
Remote Control	Web Remote and SNMP
Pre-correction	Real Time Adaptive
RF Connector (per RF module)	
RF Input	Type N (F) connector, 50 ohms
ASI/IS172-MU/SMPTE-310M	BNC (F), 75 ohms
QAM P1 (TSOP)	RJ-45
DVB-S/S2 Converter Receiver	Type F, CAM slot included, with Multi-Stream capabilities
Environmental	
Operational Temperature Range	Standard range: -20°C to +50°C; options to -40°C available
Relative Humidity	0 to 90% non-condensing
Altitude	Up to 2,500m AMSL. Derate max. temperature 2°C per 300m of elevation. > 2,500m on request.
DVB-T/T2 Transmitter Performance	
Standard	EN300744, EN302304, EN302755, TS101191, TS102773 (T2-M), TS102034
Power Output Stability	±0.2dB typical
RF Load Impedance	50 Ohms
Operating Load VSWR	Up to 1.4:1
MER	≥ 38 dB
Shoulder Level	≥ -39dB
Sourcious and Harmonics	46dBc (After mask filter)
Channel Bandwidth	6-7.8 Mhz
FFT	1x (DVB-T2), 2x, 4x, 8x, 8K ext. (DVB-T2), 16K & 16K ext. (DVB-T2), 32K & 32K ext. (DVB-T2)
All modes available according to the standard	
Block Short or Normal (DVB-T2)	
DVB-T: Reed Solomon (204, 188)	
DVB-T2: BCH, LDPC	
1/32, 1/16, 1/8, 1/4, 19/256 (DVB-T2), 19/128 (DVB-T2), 1/128 (DVB-T2)	
QPSK, 16QAM, 64QAM, 256QAM (DVB-T2), Rotated and non-rotated (DVB-T2)	
Complies to ETSI EN 101 191	
ABNT NBR 15601, ABNT NBR 15603	
4x ASI TS/BTS BNC (F), 75 Ohm or 2x ASI TS/BTS BNC (F), 75 Ohm and 2x ASI TS/BTS SFP	
Mode 1 (2K), Mode 2 (4K), Mode 3 (8K)	

Technical Engineering Data (TED)

Sheet

TV Transmitter Technical Engineering Data Sheet

Transmitter Type	PMTX-1E	T2E: Air-Cooled, Solid State Transmitter Risk Model Transmitter system
General Data:	RF Mod & VSWR Modulation	
RF Out Pin Line Loss	TYPE-N	
Power Amplifier Type	Broadband	
Frequency Range	470MHz-860MHz	
Named Peak Mod Filter RF Power Output	50W *	
Typical Power Consumption (W)	250W *	
Power Factor	≥ 1.00	
DC Current (36V to 72V DC)	6-18amp	
Estimated Mod Filter Losses	-1.40 dB	Mask filter designed to meet FCC A57C Low Power Mask mask with or without standard mask requirement.
Estimated Efficiency**	20%	
<p>Power Configurations: System designed for DC power input 36V-72V. DC Power factor is always 1.0. For power factor of the AC to DC supply should be ≥ 0.95</p> <p>Warranty / Overload: Safety ground for shield wires of antenna cables (RF ground wires). Safety ground should have isolation connection back to earth point at antenna distribution point. Thermal ground and provided on bottom of amplifier chassis for connection to safety ground. Connection should be via separated surface and isolated/ground for low resistance.</p>		
<p>AC to DC power supply: 10 Amp DC Minimum Output Current Rating</p>		
<p>Cooling System: Convection Air-Cooled. Designed for outdoor applications. Unit should be installed on air flow toward the unit to not restricted.</p>		
<p>Environmental: Transmitter operating Temperature: -20° to 47° C. Standard. Transmitter Lenses View to the Outdoors: -30°K Transmitter Noise: -105dBa</p>		
<p>Mechanical: Transmitter Dimensions: Height: 490mm (19.1 in) Width: 375mm (14.8 in) Depth: 200mm (8.0 in) Transmitter Weight: 35 kg (77 lbs)</p>		

See GatesAir Engineering for additional details.
*Power level varies with frequency & duty factor.
**The efficiency may vary with frequency, duty factor and power level.
Technical data is subject to change at any time without notification. GatesAir takes no responsibility for issues caused by the data provided. Local or national laws and electrical codes may also require changes to the data provided and should be reviewed.

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Brochure Specifications

Summary



- Worldwide Electricity Price increase
 - We need go green, high efficiency with multiple service
- Multi carrier DAB
 - Save TCO for repeater and gapfiller sites
- PMT
 - NO cost of rental for building or dedicated room
 - NO additional OPEX cost for Air conditioning
 - Less maintenance cost





THANK YOU

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