Flexiva™ FLX

Liquid-Cooled High-Power FM Transmitters

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GatesAir Connect | NAB Show 2016

Featuring GatesAir's

Tim Anderson
Radio Product & Business Development Manager

Flexiva FLX™ Liquid-Cooled High-Power FM Transmitters

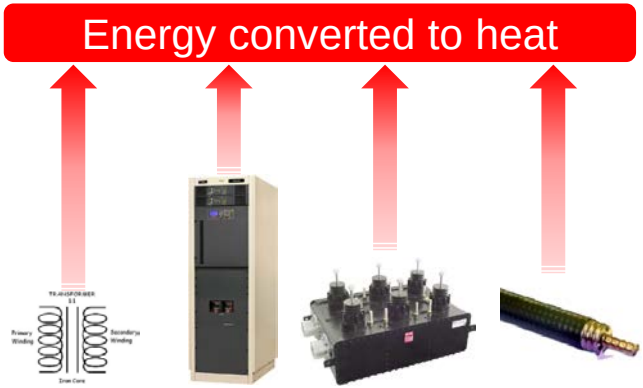
Tim Anderson

Product & Business Development

TCO versus Efficiency

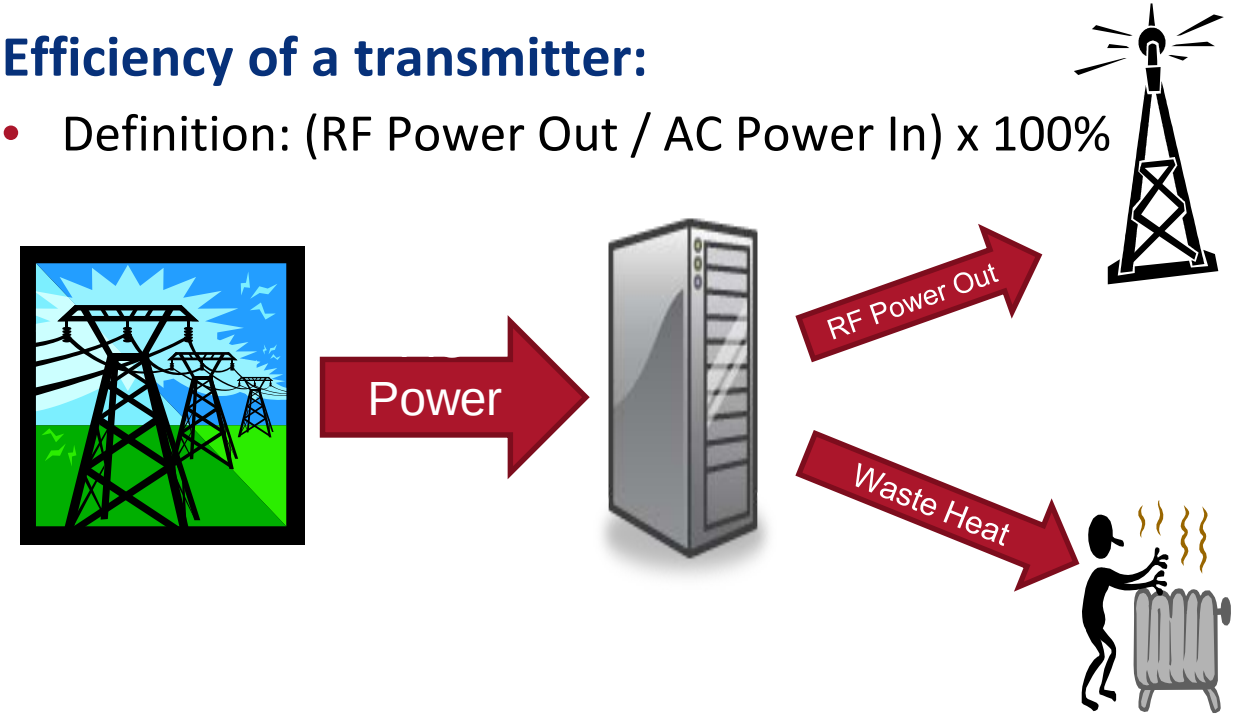
- **TCO is what is really important to a transmission operator:**
  - It's the total cost to own and operate the transmitter system over time
  - Includes initial equipment cost and delivery
  - Includes the installation/commissioning cost
  - Includes routine and unscheduled maintenance costs
  - Repair/replacement and other operational costs

- **AC power consumed by the transmitteris important**
  - However, other factors also affect the system efficiency:
    - AC transformers and voltage regulators
    - Heat load to the room (HVAC costs)
    - RF system losses (often significant)
    - RF feeder losses
      - ex: 98.1MHz, 2,000ft, 3-1/8" rigid line, energy loss = 35%
    - Non-optimal antenna pattern (throwing RF energy away)



Efficiency: What Does It Mean?

- **Efficiency of a transmitter:**
  - Definition: (RF Power Out / AC Power In) x 100%

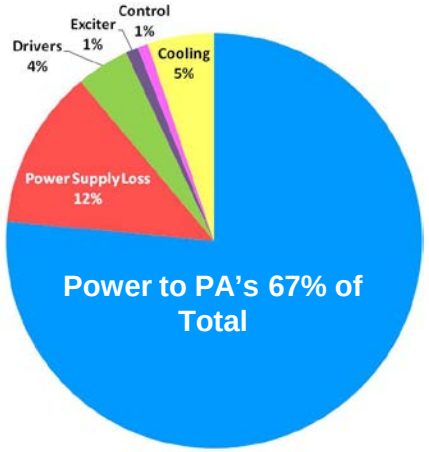


Increased efficiency: reduces power consumed and reduces energy wasted

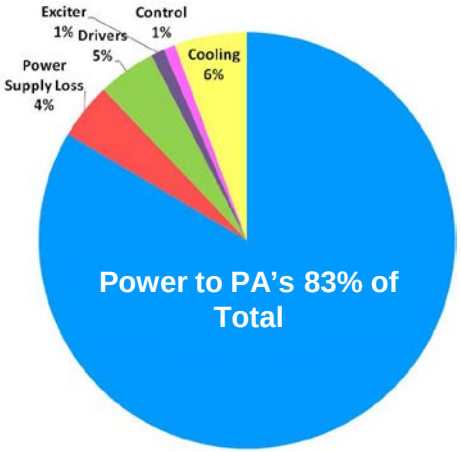
Every Part of The Transmitter Matters

Effect of power supply efficiency on overall system efficiency

	Tx with older PS	Tx with new High Eff. PS
RF Power Output (kW)	10.00	10.00
Power Amplifier Efficiency	76%	76%
DC Power to PA's	13.16	13.16
Power Supply Efficiency	84%	96%
AC Power to PA's	15.59	13.65
Power Supply Loss	2.43	0.49
Drivers	0.60	0.60
Exciter	0.14	0.14
Control	0.12	0.12
Cooling	0.75	0.75
Total AC Input (kW)	19.63	15.75
Overall Tx Efficiency	51%	63%



Distribution of Power Usage with Older Technology Power Supplies



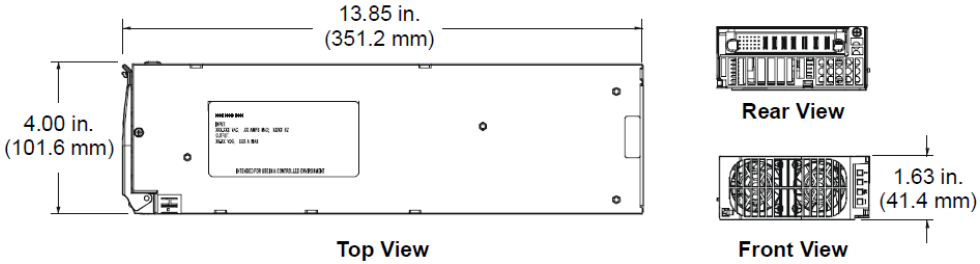
Distribution of Power Usage with High Efficiency Power Supplies

Power Supplies make 13% difference!

Power Supply Technology

- Improvements in Power density/weight
- Very high conversion efficiency
  - 96.3% versus 84% only 6 years ago
- With 48-50V DC requirement, can leverage the Telecomm industry:
  - Very high MTBF (900,000hrs)
  - High volume part
  - Widely available Worldwide
- Versatile
  - Use same part in FM and TV products

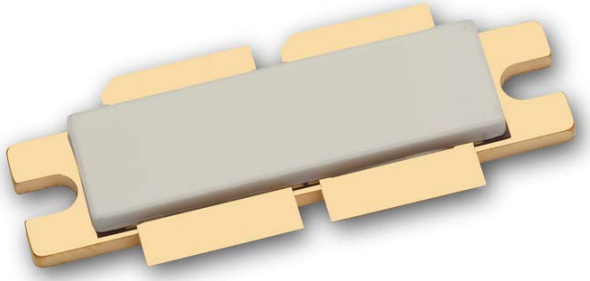
2,725 Watt high-efficiency power supply (weight 2kg)



Reliability (calculated)		900,000		Hours	At ambient of 25°C at full load per Telcordia SR-332, issue 2, Reliability Prediction for Electronic Equipment, Method I Case III.

RF Device Technology

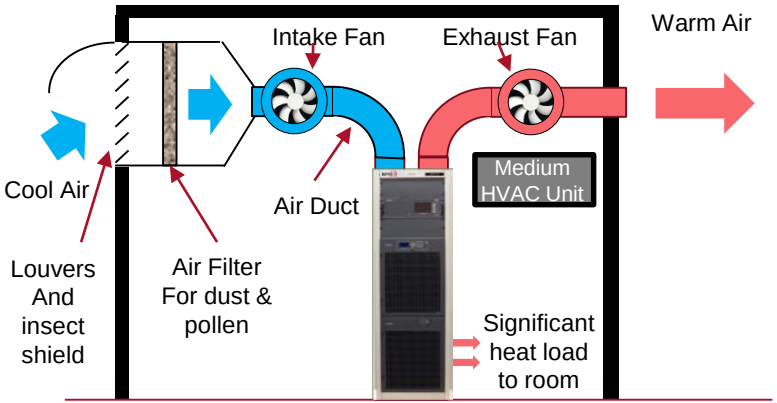
- **Latest 50V LDMOS Power FET devices dramatically increase power density, efficiency and reliability**
  - Higher peak power (1400W)
  - Higher Gain (> 22dB)
  - High DC-RF Efficiency (> 82%)
  - Improved thermal characteristics
  - Improved Ruggedness
  - Very High MTBF (> 20K years)



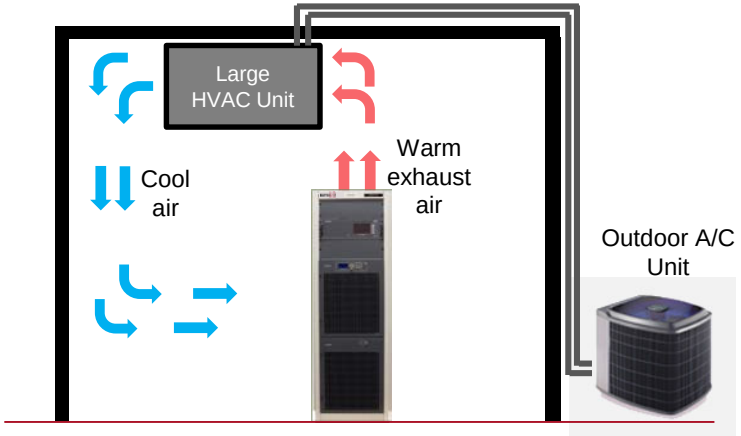
Features and benefits

- High power
- High power gain
- High efficiency
- Designed for broadband operation (HF to 600 MHz)
- Excellent ruggedness (VSWR > 65 : 1 through all phases)
- Excellent thermal stability and transfer properties
- Integrated ESD protection
- Internal input matching for ease of use
- Designed for broadband operation (HF to 600 MHz)

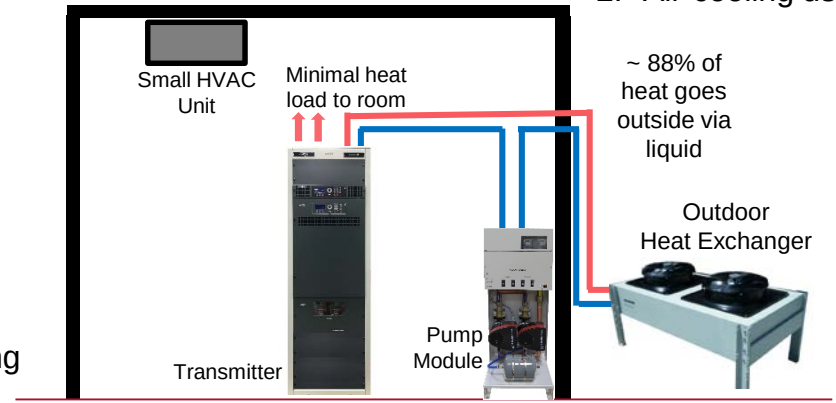
Three Ways to Cool the Transmitter



1. Air-cooling using outside air



2. Air-cooling using inside air and Air-Conditioning

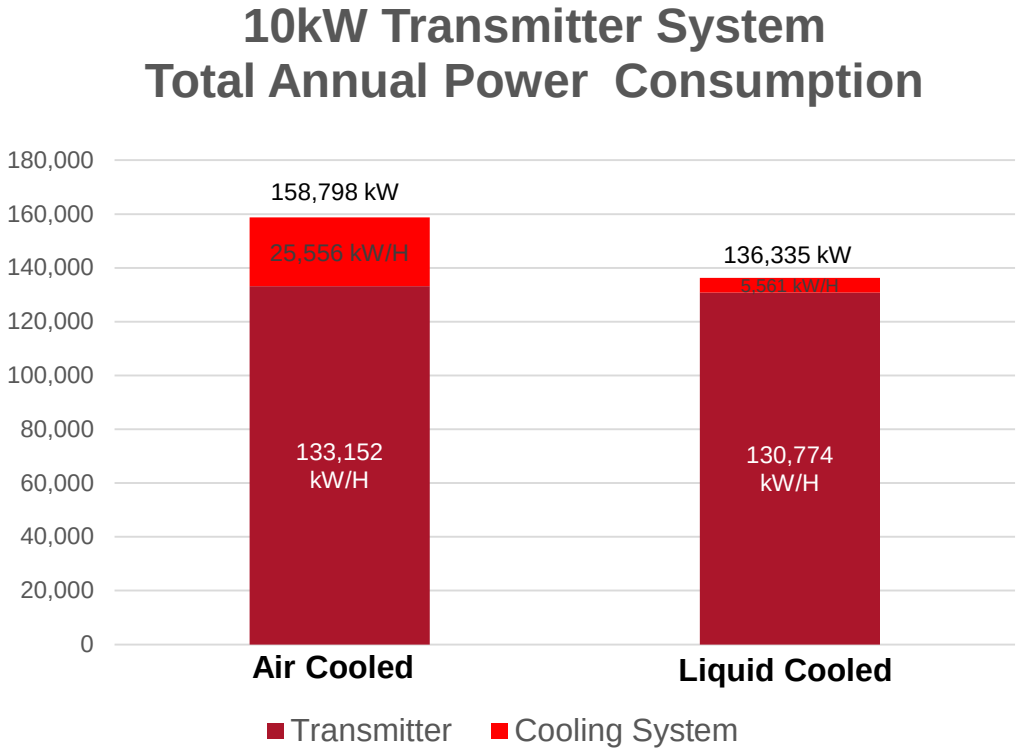


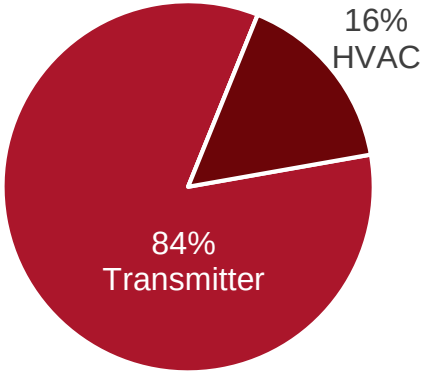
3. Liquid-cooling

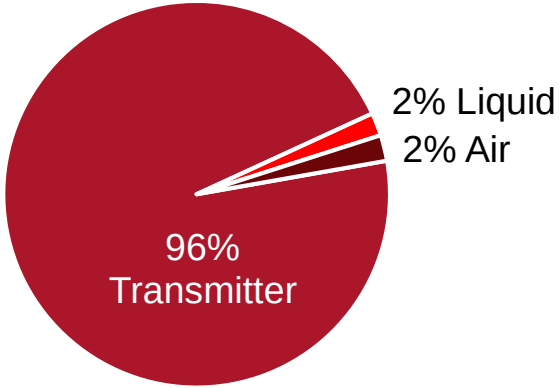
Cooling Comparison

Item	Air-Cooled (outside air)	Air-Cooled (HVAC)	Liquid Cooled
Energy cost	Low	Very High	Low
Maintenance	Very High	High	Low
Installation cost	High	Medium	Medium/Low
Site visits	Frequent	Infrequent	Infrequent
Humidity control	None	Good	Excellent
Dust & dirt	Filter dependent	Good	Excellent
Reliability	Medium	Low	Excellent
TCO Rank	**3**	**2**	**1**

HVAC vs. Liquid Cooled Power Consumption







Flexiva™ FLX Liquid-Cooled FM Transmitters

Flexiva™ FLX Liquid-Cooled FM Transmitters

- Up to 86% heat to liquid transfer efficiency reduces room heating
- Two 10kW transmitters with dual exciters, in a single rack
- 20kW with dual exciters in a single rack
- 30 & 40kW in two racks
- Single High Efficiency Pump Module and Heat Exchanger up to 40kW.
- Dual High Efficiency Pump Modules and Heat Exchangers for redundancy or above 40kW

PowerSmart®

Flexiva™ FLX Liquid-Cooled FM Transmitters

Scalable to 80kW Liquid Cooled

FLX10K PowerBlock

10kW Power Block

Integrated IPA switching
(Automatic drive chain redundancy)

Hot-Swappable, Hot Pluggable 2725W High Efficiency PS
1 to 1 PS to PA Ratio

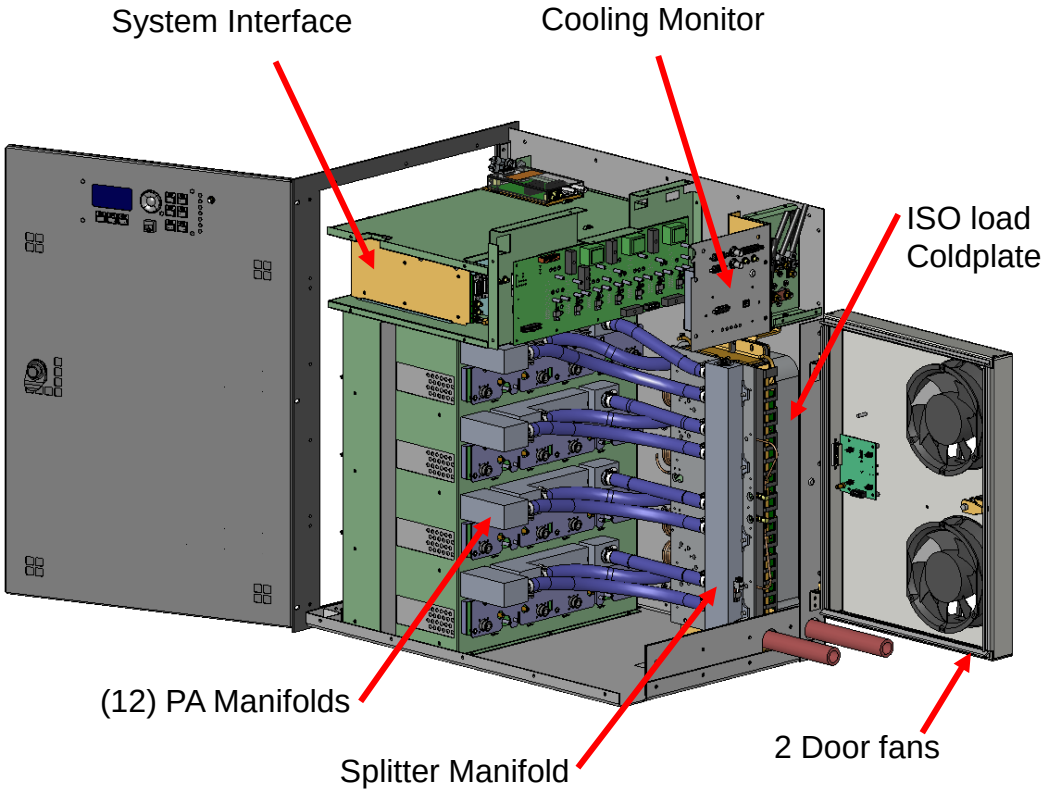
Hot Pluggable Dual IPA module Same module as PA

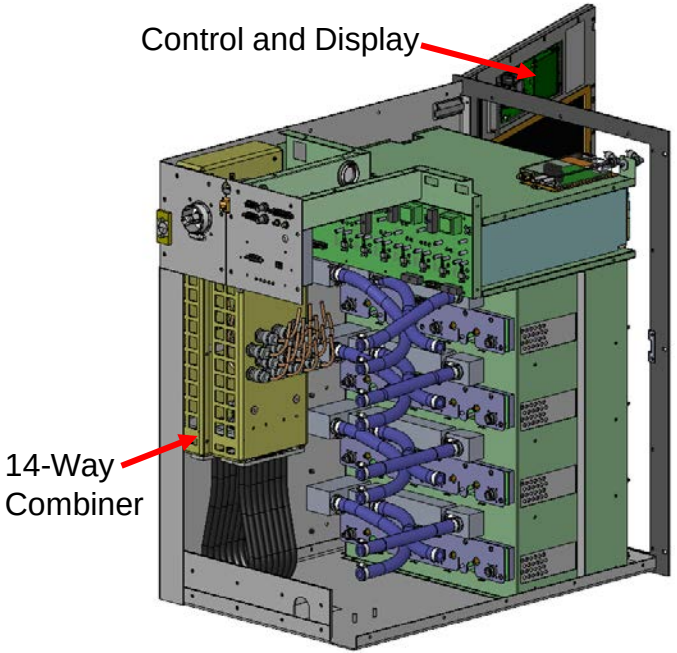
Seven Hot-Pluggable, Hot Swappable 1750 Watt PA modules for redundancy

Microcontroller for Local Display, Remote Web Interface, SNMP Support

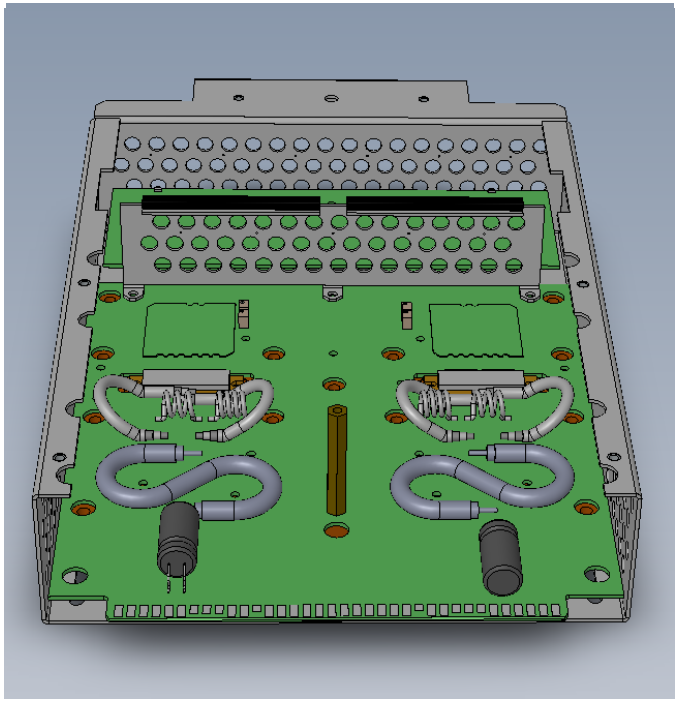
Hardware based controller with backup controller & life-support maintains basic functions and provides system operation without reliance on the microprocessor

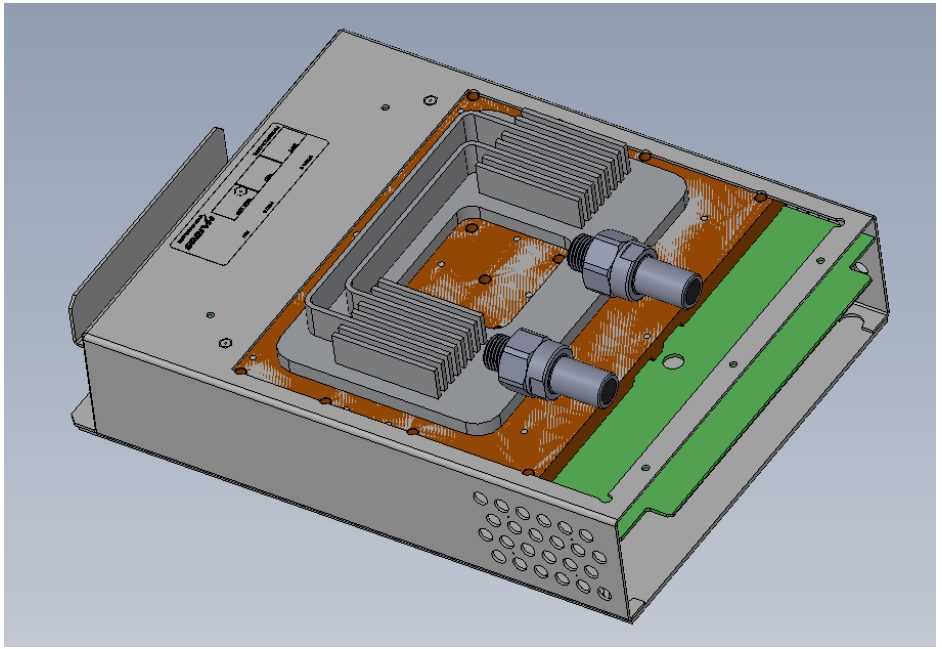
FLX10K PowerBlock



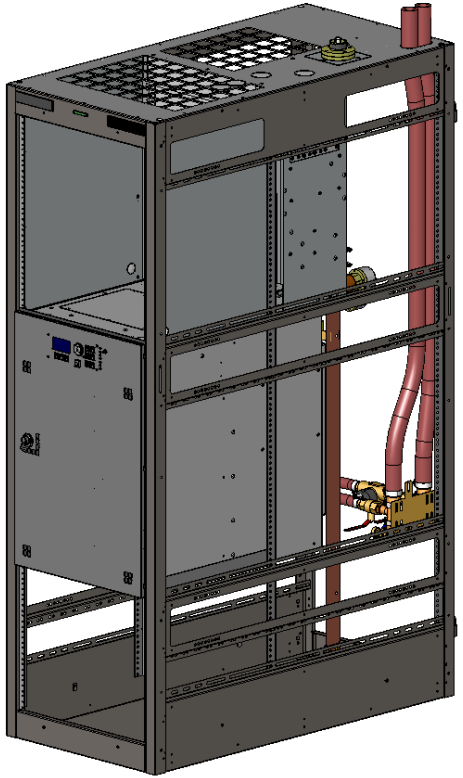


FLX Liquid Cooled PA Module with Chiller Plate

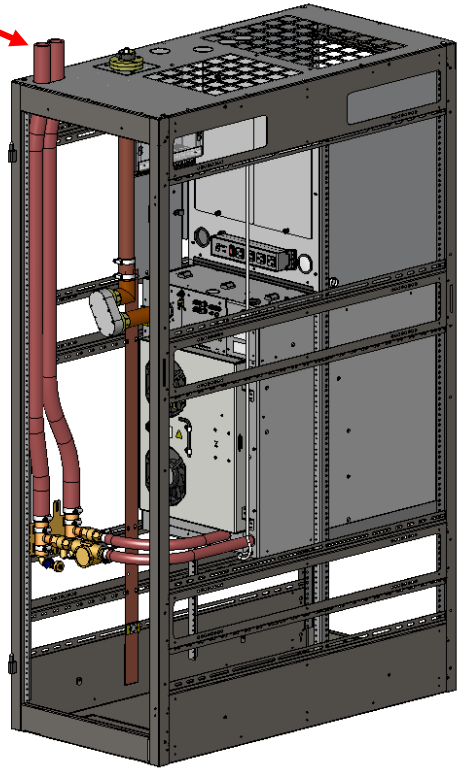




FLX10K Xmtr



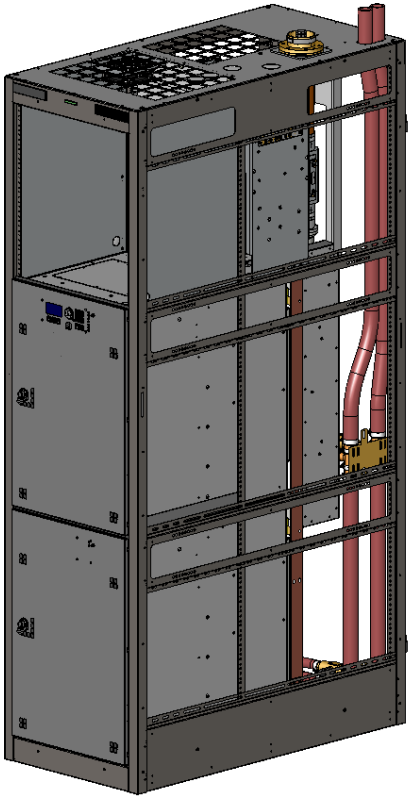
Supply/Return



Xmtr Size

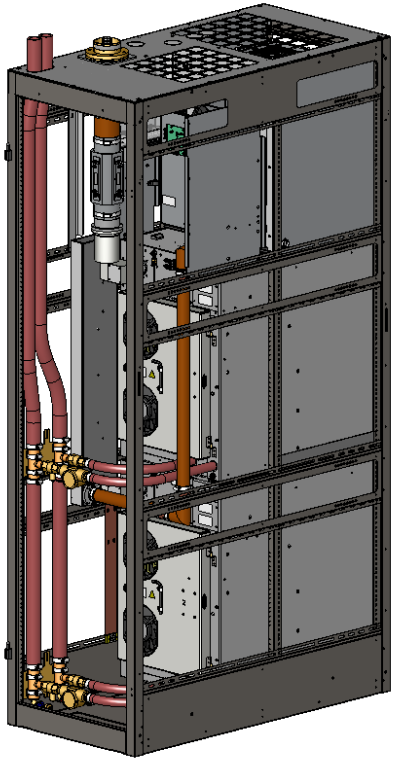
- 23.51 wide
- 71.00 tall
- 45.75 deep with doors
- 44.43 deep without doors

FLX20K Xmtr

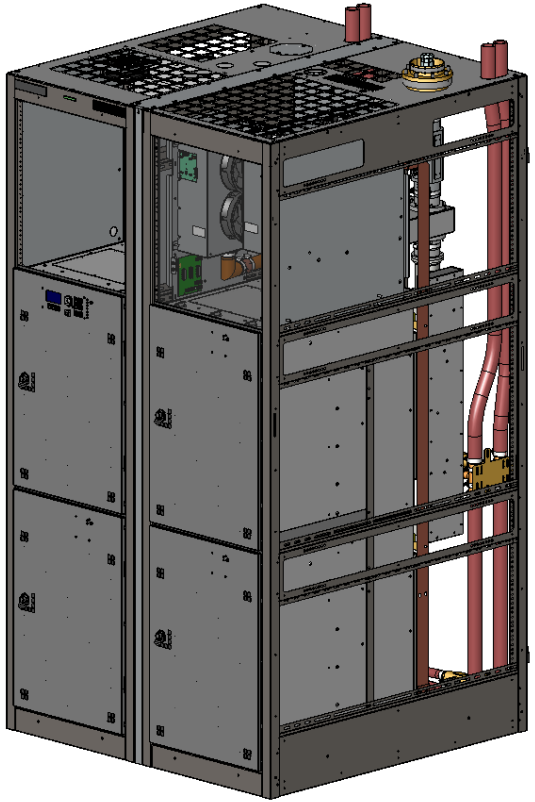


Xmtr Size

- 23.51 wide
- 83.25 tall
- 45.75 deep with doors
- 44.43 deep without doo

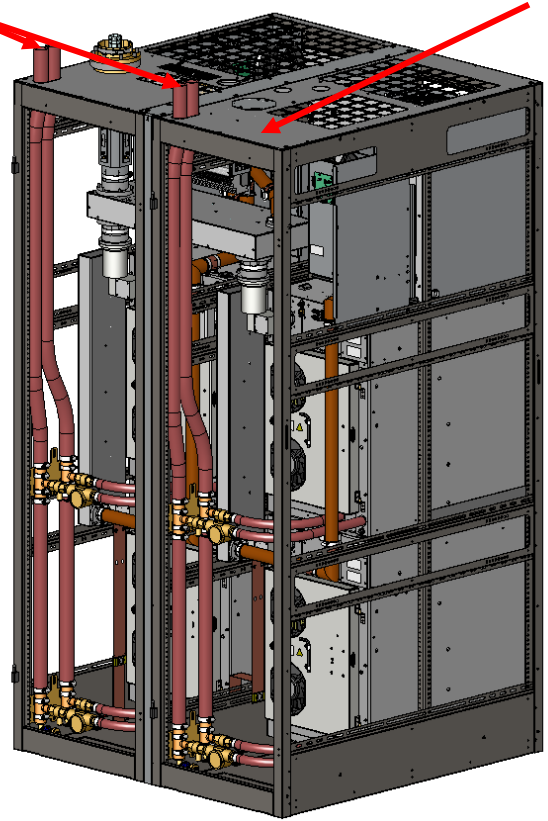


FLX40K Xmtr

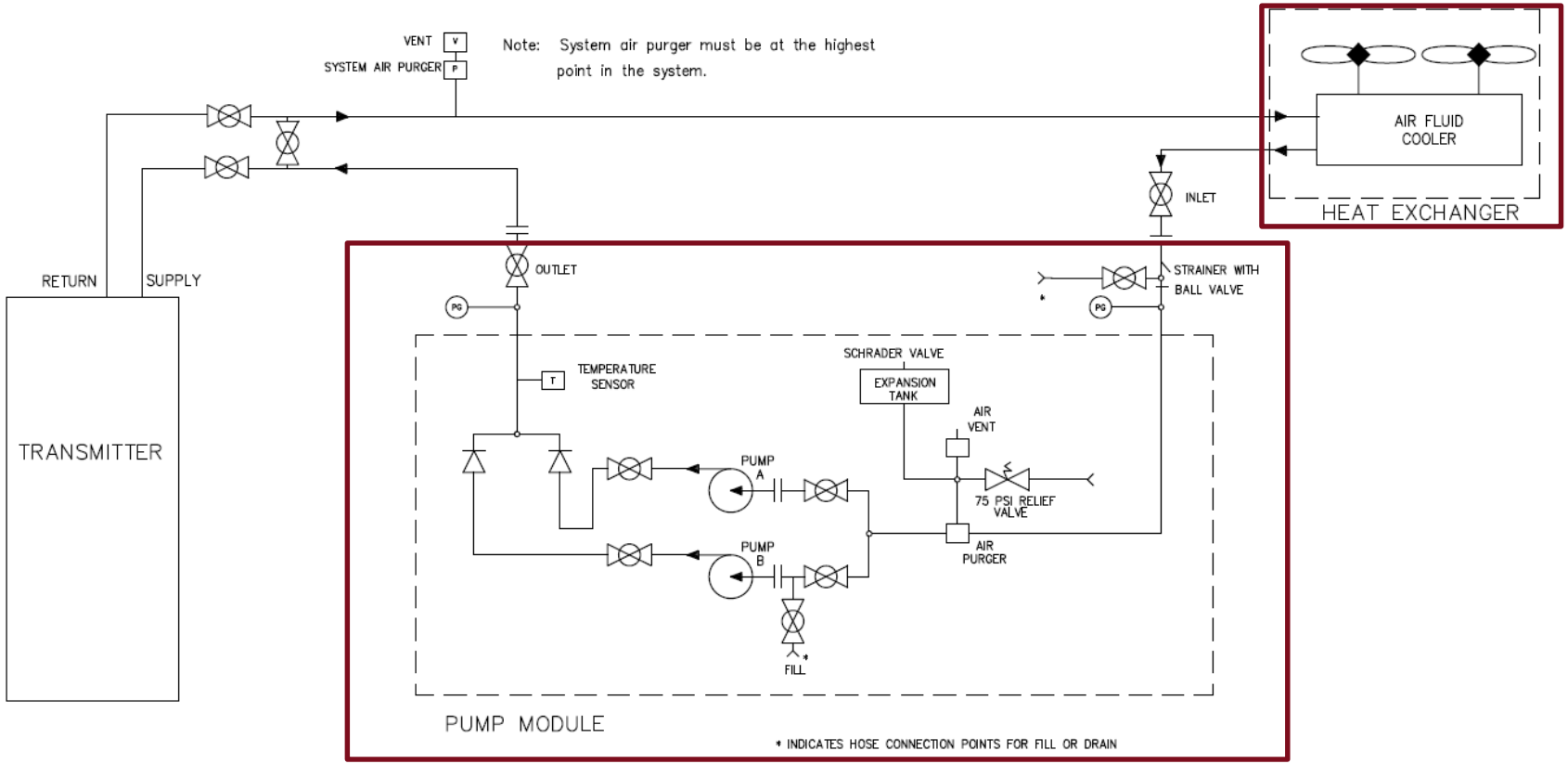


Xmtr Size

- 47.09 wide
- 83.25 tall
- 45.75 deep with doors
- 44.43 deep without doors



COOLING SYSTEM BLOCK DIAGRAM



High Efficiency Pump Module

- GatesAir design and manufacture
- 3rd generation – Optimized for High Efficiency
- Small physical size
- 2 Pumps, with auto/manual changeover
  - Low-noise, high efficiency pumps
  - Replace a pump during on-air operation!
- Low maintenance, closed-loop pressurized system
- Quiet – Designed for indoor installation
- Pump speed adjustable to optimize flow rate and efficiency

High Efficiency Heat Exchanger

- GatesAir manufacture
- Dual fans - on-air replacement
- Low noise, high-efficiency fan blades
- Speed controlled for maximum efficiency
- Vertical or horizontal airflow (mounting can be adapted on site for either configuration)
- Two sizes available 20kW & 50kW heat dissipation

Vertical Air Flow

Horizontal Air Flow

1st FLX20K
Acceptance Testing in Quincy

Ed Allen
Transmission Chief Engineer
Cox Media, Tampa
With WSUN's FLX10K at Factory Acceptance Testing in Quincy
October 20, 2015

First FLX10K Serial # 00001 – On Air

GatesAir Field Service Engineer Dan Carcopo, Market Transmitter Chief Ed Allen, Market Operations Manager Dylan Scott commissioning the 1st FLX10k at COX Media Group's WSUN, in Tampa.

Thank You!

Questions?

CONNECT WITH US

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