



Shulins' Solutions

Multi-Station Transmission Site
Monitoring:
Beyond the station remote control

Paul Shulins
President,
Shulins' Solutions



Introduction to Shulins' Solutions

- Provides unique monitor, control and protection solutions for transmission sites, drone-based tower inspections and a full range of consulting services based on years of practical experience on the ground building and operating broadcast facilities.
- Solves problems with an attention to detail that only comes from firsthand experience in the field. All of our products and services come from the point of view of the user, and are crafted with the passion of a lifelong broadcaster.



Paul Shulins - President and CTO

RF System Monitoring

Stellar Eclipse broadcast site monitoring platform provides a systems approach to monitoring and protection of RF systems from simple to complex featuring the exclusive VSWR Sentinel protection technology.

sUAS Drone Inspections

sUAS Drone based tower structure visual and infra-red surveys provide an indispensable tool to diagnose the health of RF systems and tower structures without the risk of climbing the towers.

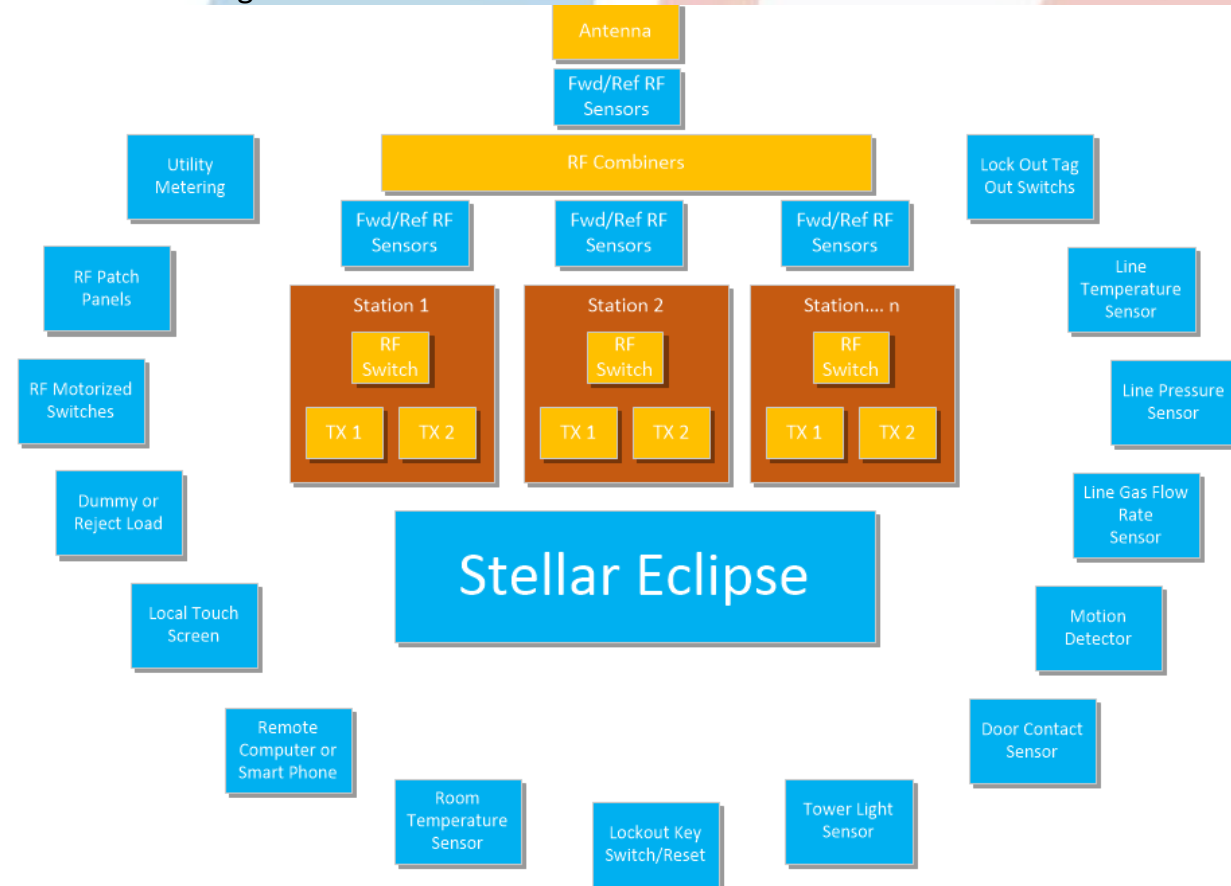
Broadcast Technology

Consulting to meet the demands of broadcasters specializing in remote control solutions, studio design and construction, antenna protection systems and ratings metrics.



Stellar Eclipse

- Site Monitoring and VSWR protection for single or multiplexed TV and FM transmission systems
 - Modular design so the system can grow as you do
 - Carefully tracks transmission line gas pressure with options for gas flow rate monitoring
 - Proactively monitors dehydrator/nitrogen generator run times to prevent costly surprises
 - Flexible Motorized RF switch control and status built in eliminating extra costs
 - Simple connections for building security, electrical consumption, and tower light monitoring
- Comprehensive VSWR Sentinel
 - Opens transmitter interlocks within 100 milliseconds of VSWR being detected above the desired threshold
 - 3 Strikes automatic reset logic included
 - Interlocking of RF patch panels and lockout/tag-out
 - Secure key-switch to lockout RF during tower climbing
- Flexible cloud based remote access
 - Secure SSL and password protected Web Access to real time and historical data
 - Limitless user accounts for web data access
 - Secure cloud Based data storage for all parameters
 - Provides alarms via text message and email for any parameters that fall out of tolerance
- Proven reliability protects your investment
 - On-the-air protecting hundreds of stations and millions of revenue
 - Ideal for new builds or a simple upgrade to existing installations
 - Easy bypass of critical transmitter interlocks for maintenance
 - Fail safe operation keeps your stations on the air during a power loss to the monitoring



Protecting over 70 markets and hundreds of stations in 2021



So... what is the problem?

- Stuff burns up!
- There is no good way to predict when disaster will strike.
- VSWR Changes usually indicate you already have a problem!
- Thermal measurements of transmission lines and elbows can establish a normal baseline and can help detect changes that could lead to a failure.



It's a question of when, not if!

- Mother nature! Expansion and contraction of metal line sections
- Mechanical vibrations over time, metal fatigue
- Improper antenna or transmission line installation
- Loss of transmission line gas pressure
- Property damage
- The rated power level of the system compared to the actual power level being used combine to define the operating margin
- Failure to inspect the tower, antenna and feed line on a regular basis



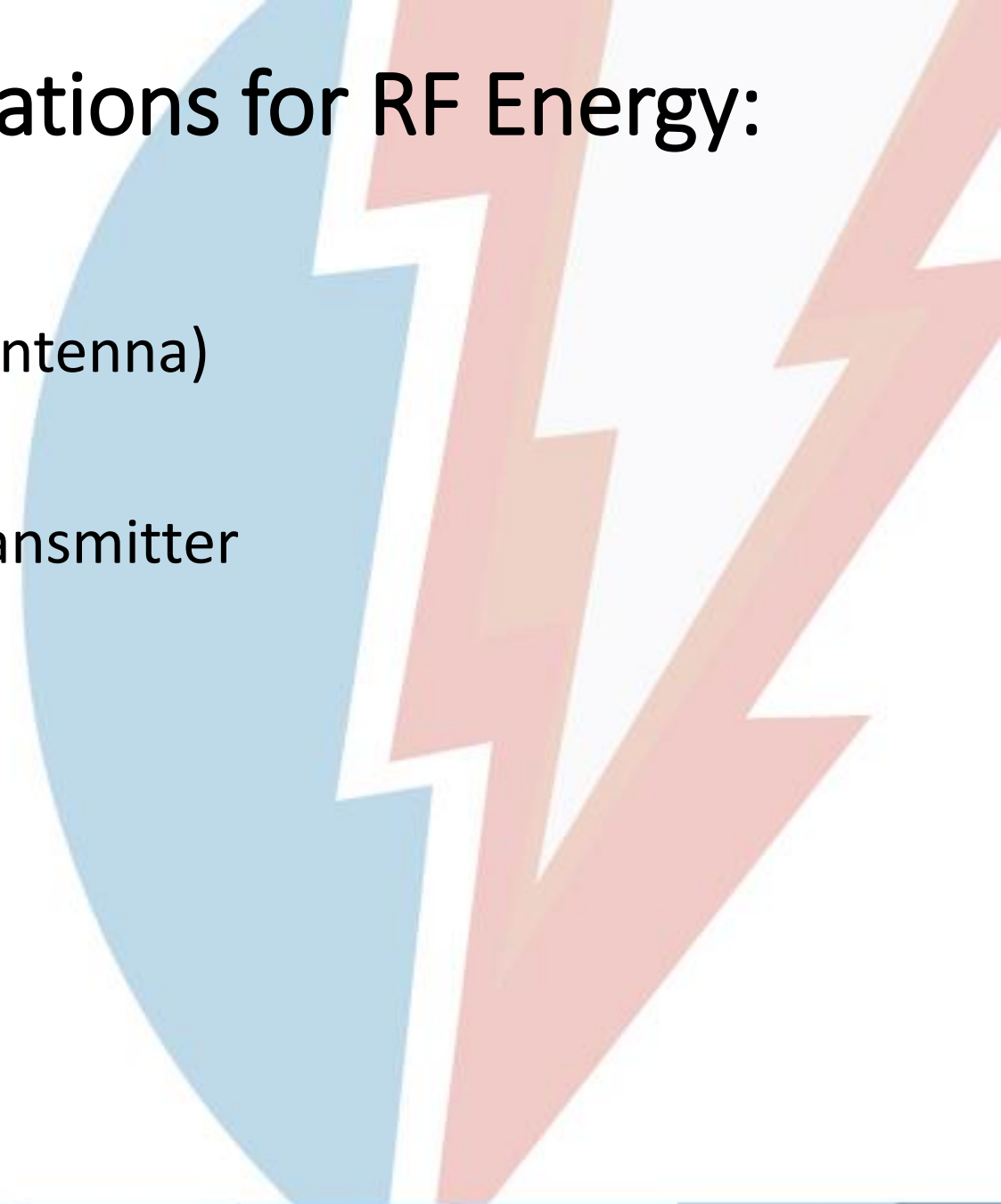
What is the real danger of excessive VSWR?

- The forward (or incident) signal mixes with the reverse (or reflected) signal to cause a voltage standing wave pattern on the transmission line.
- The ratio of the maximum to minimum voltage is known as VSWR, or Voltage Standing Wave Ratio. A VSWR of 1:1 means that there is no power being reflected back to the source.
- In cases where the VSWR is other than ideal, the peak voltages are higher than expected, and can cause arcing between the inner and outer conductors.



The three possible destinations for RF Energy:

- Eventually, all power is either:
- Absorbed by the load (radiated by the antenna)
- Lost as heat in the transmission line
- Absorbed and lost as heat within the transmitter





Problems with transmitter behavior:

- Solid State RF devices are susceptible to dramatic failure with high VSWR
 - Transmitter VSWR foldback circuits are designed to protect RF devices in the transmitter
- VSWR Foldback internal to transmitters can and will cause problems
- Looking at reverse power alone is not enough
- VSWR is a better indication of what is really going on
- Stations should employ external protection for VSWR besides just the transmitter power foldback logic



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Teflon melts at about 620 degrees F





Calculate VSWR

$$\text{VSWR} = \frac{1 + \sqrt{\frac{\text{REFLECTED POWER}}{\text{FORWARD POWER}}}}{1 - \sqrt{\frac{\text{REFLECTED POWER}}{\text{FORWARD POWER}}}}$$



Feeder Loss



Diagram showing how feeder loss can improve the VSWR seen at the transmitter end of the feeder



Typical RF Sensor (Outdoor/Indoor)



● With the DACS sensor the RL/VSWR (Voltage Standing Wave Ratio) can be determined at every pylon- or panel - antenna and splitter

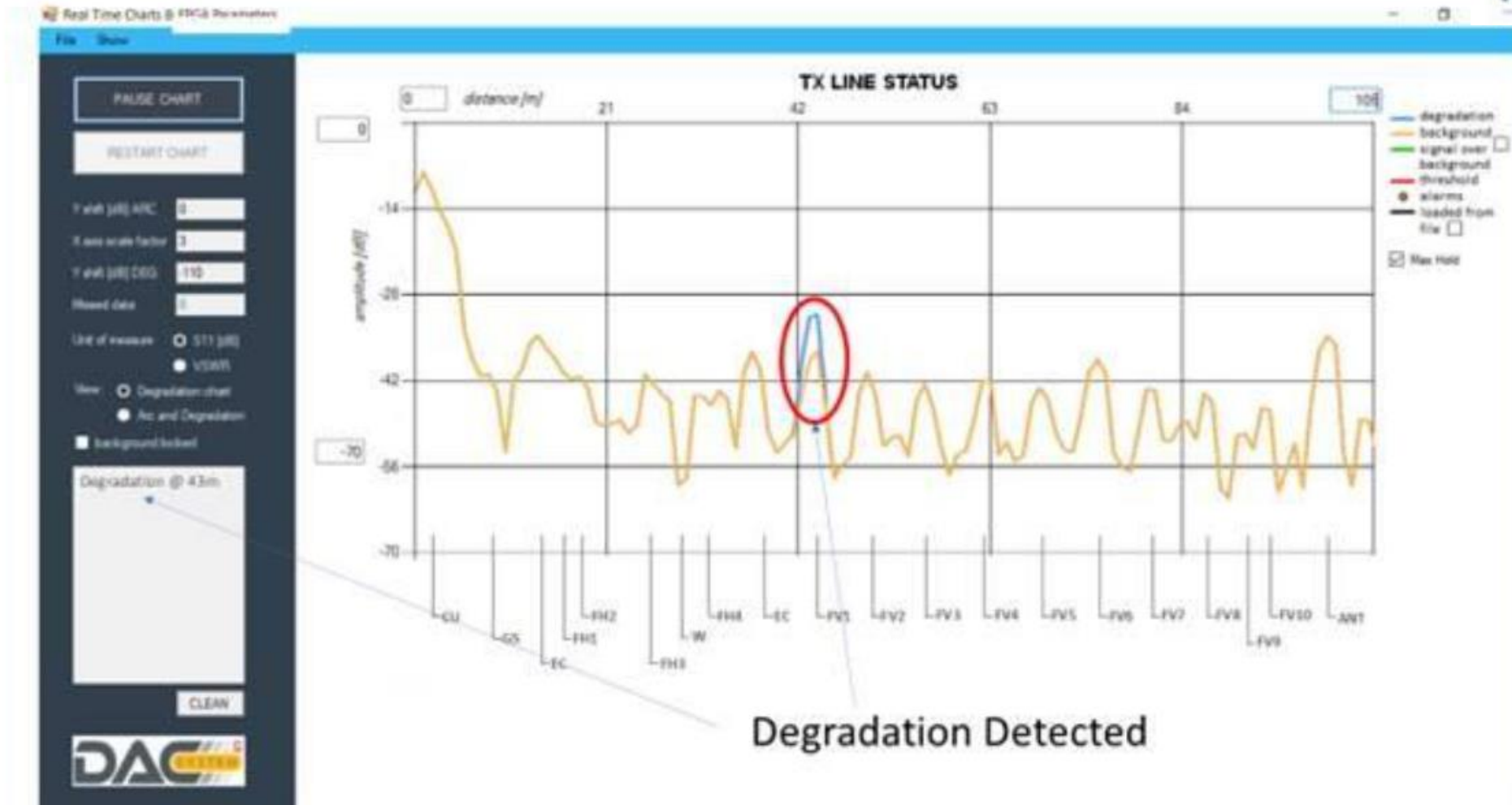
● The DACS sensor capture the PTx and the PRx values. The results are transmitted with one shielded cables to the Junction Box.

- The sensor is:
- remotely powered, IP 66
 - very high dynamic range
 - broadband 50 - 860 MHz



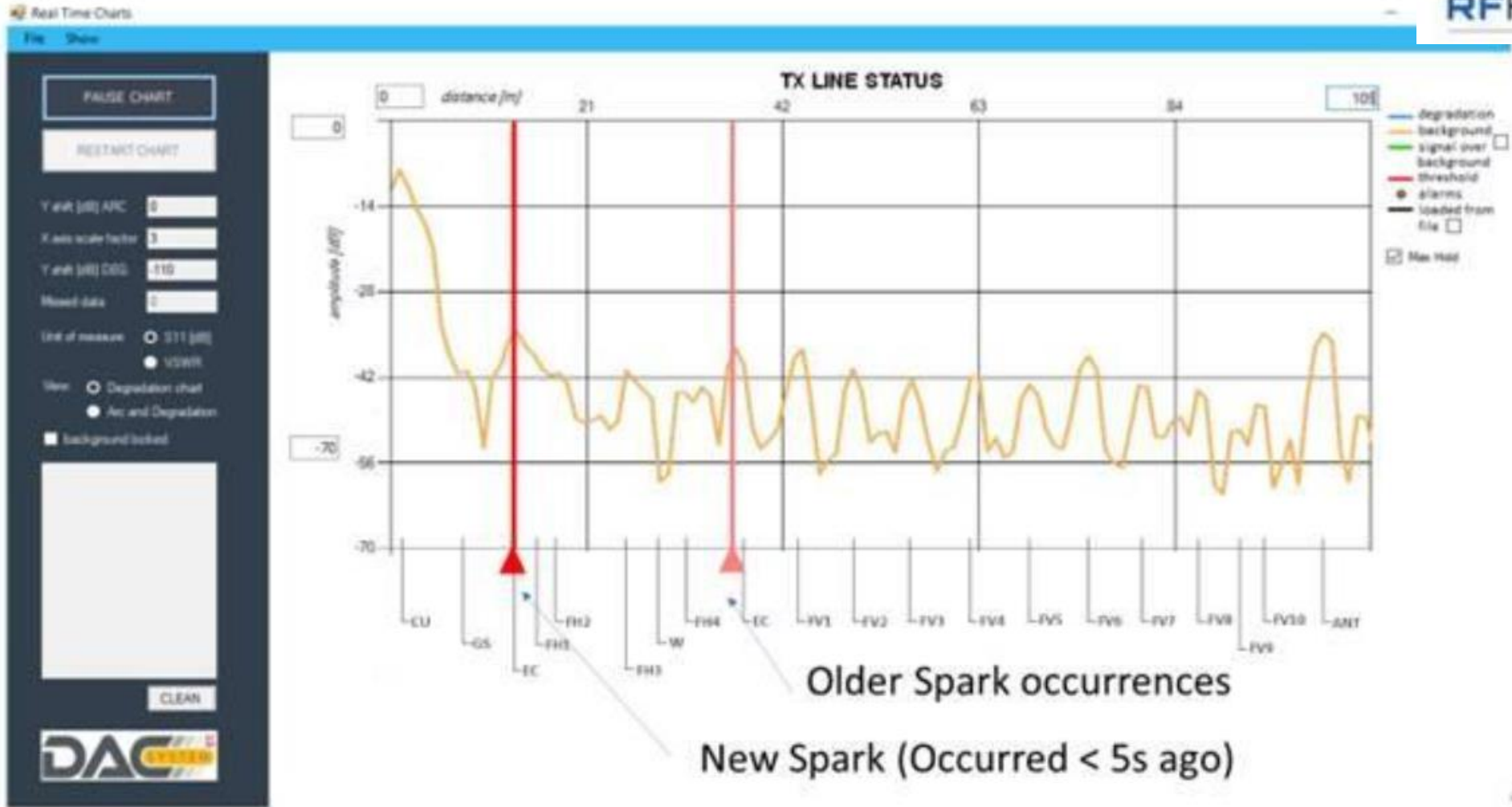


Full Time TDR now possible!





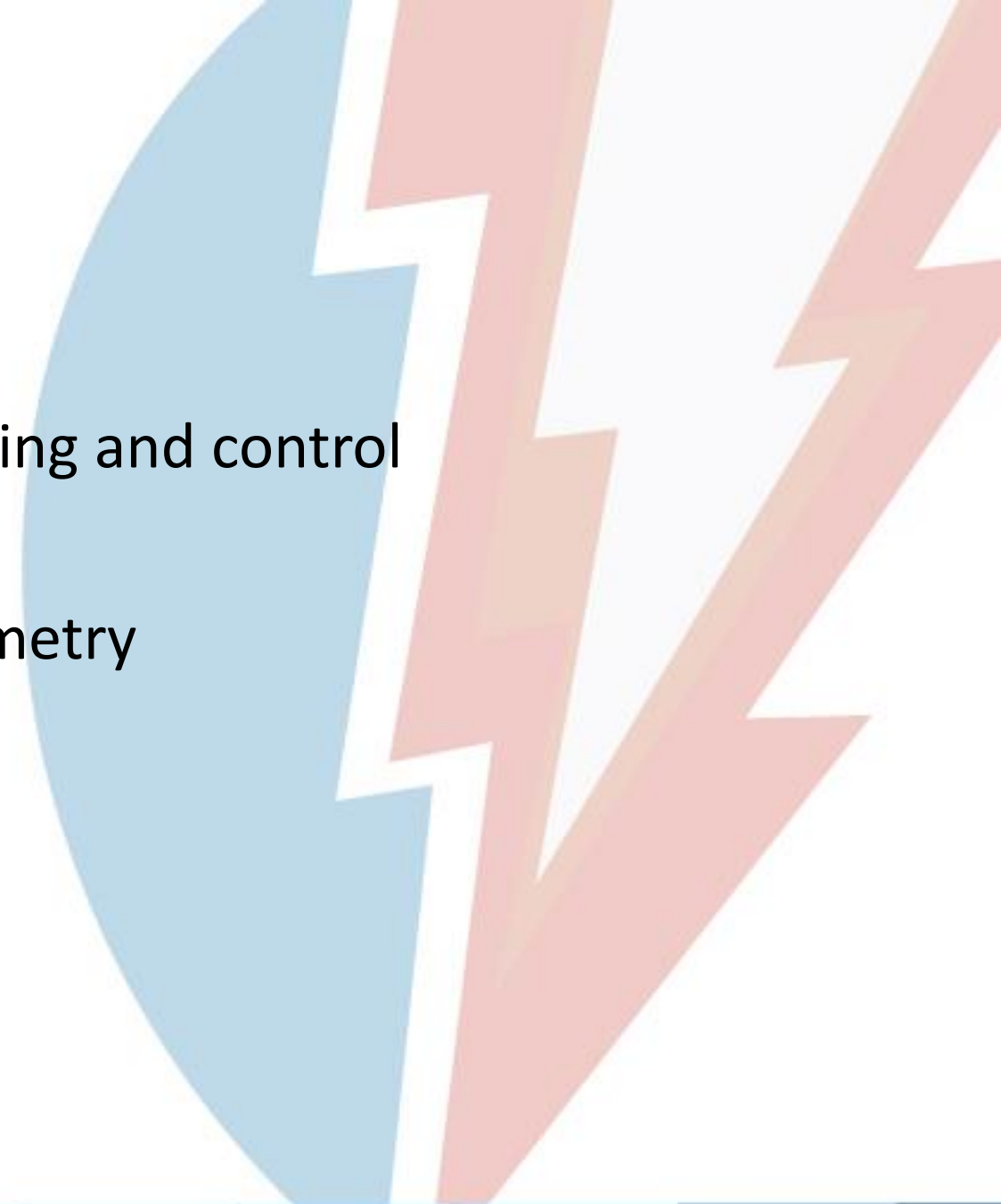
Arc Detection now possible!





Computer Algorithms

- Trend Analysis
- Data Logging
- Coaxial and Waveguide Switch Interlocking and control
- Dummy load interlocking
- Real time web page generation for telemetry
- Heartbeat monitor
- Email/Text Message Notifications





A/D converter (16 bit for high resolution)





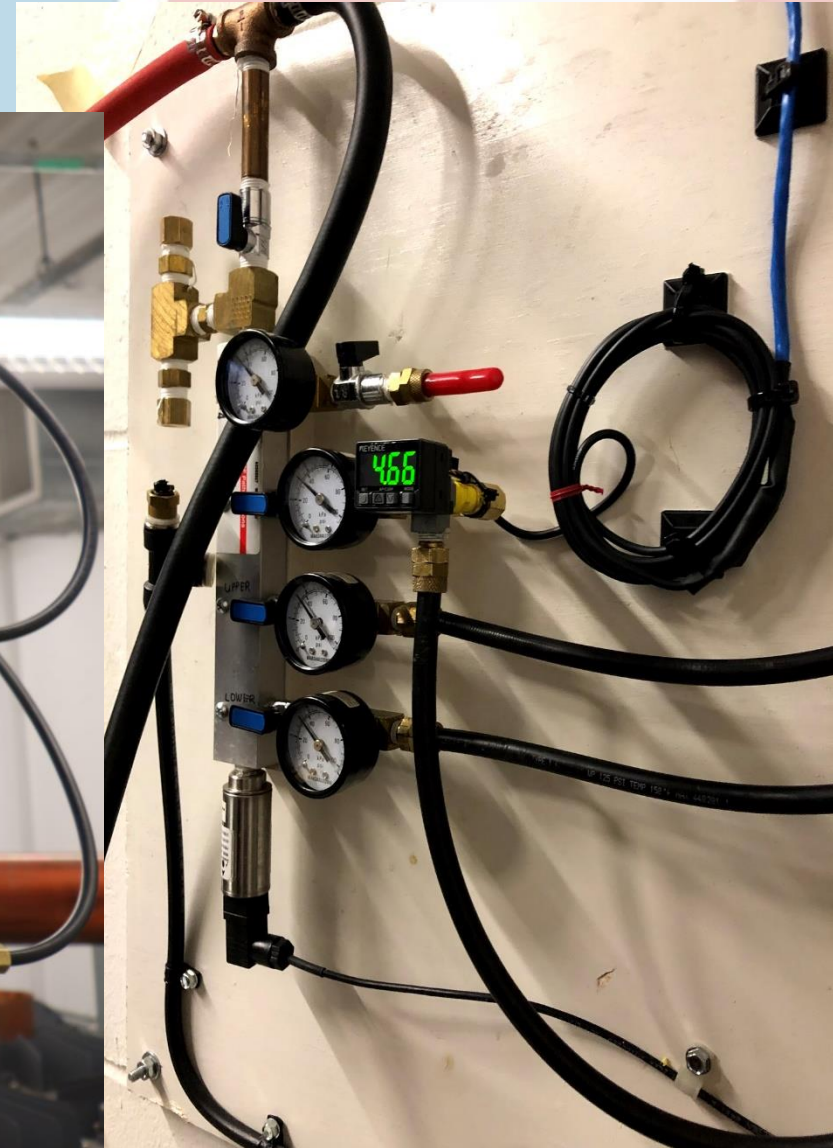
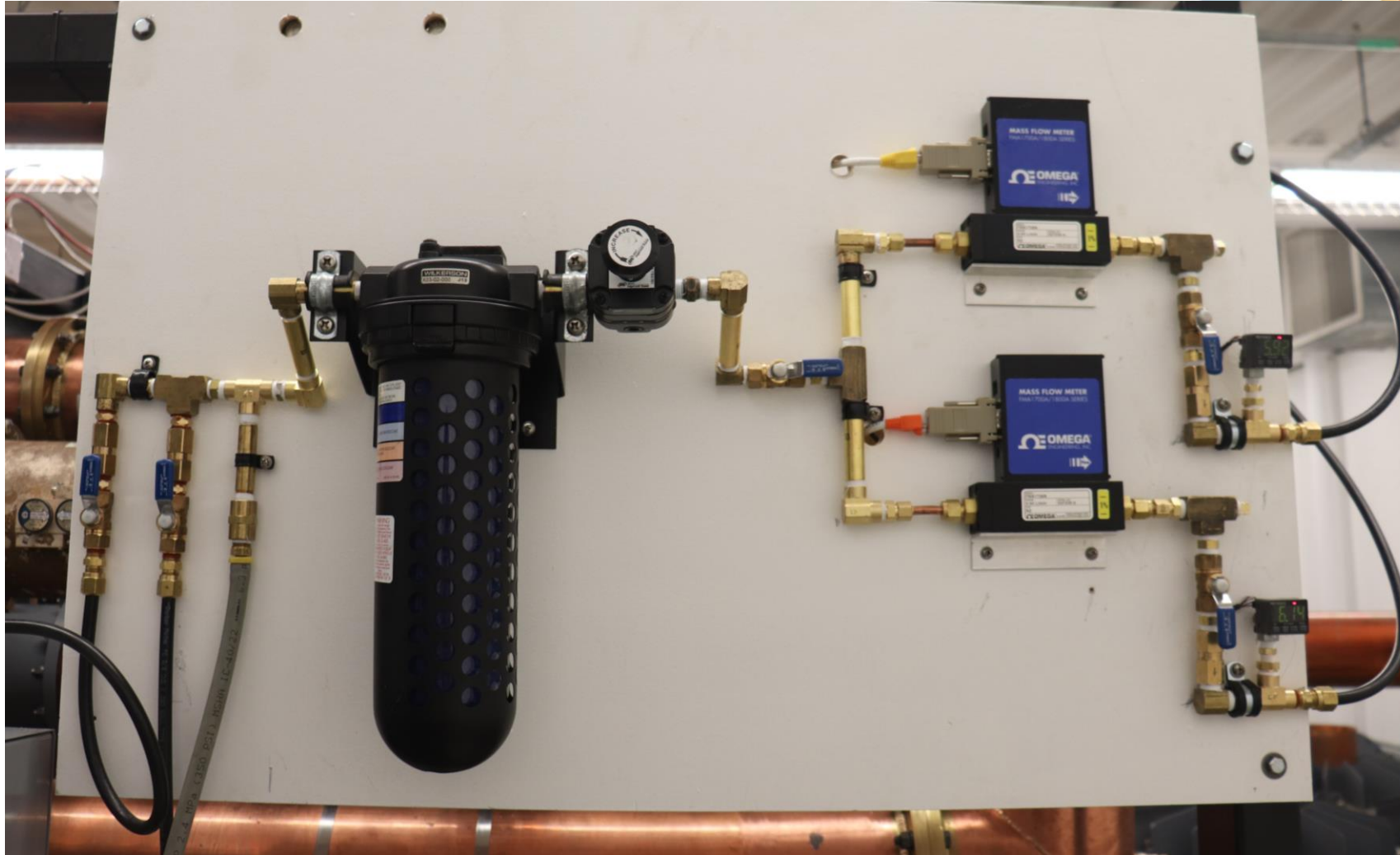
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Example of thermal sensor on transmission line





Monitor Line Pressure and Dry Air Flow



Lock Out – Tag Out Control

Key-switch for climber safety lockout





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Station Interlock Control

Clearly marked demarcation points for all stations to connect their interlocks to:

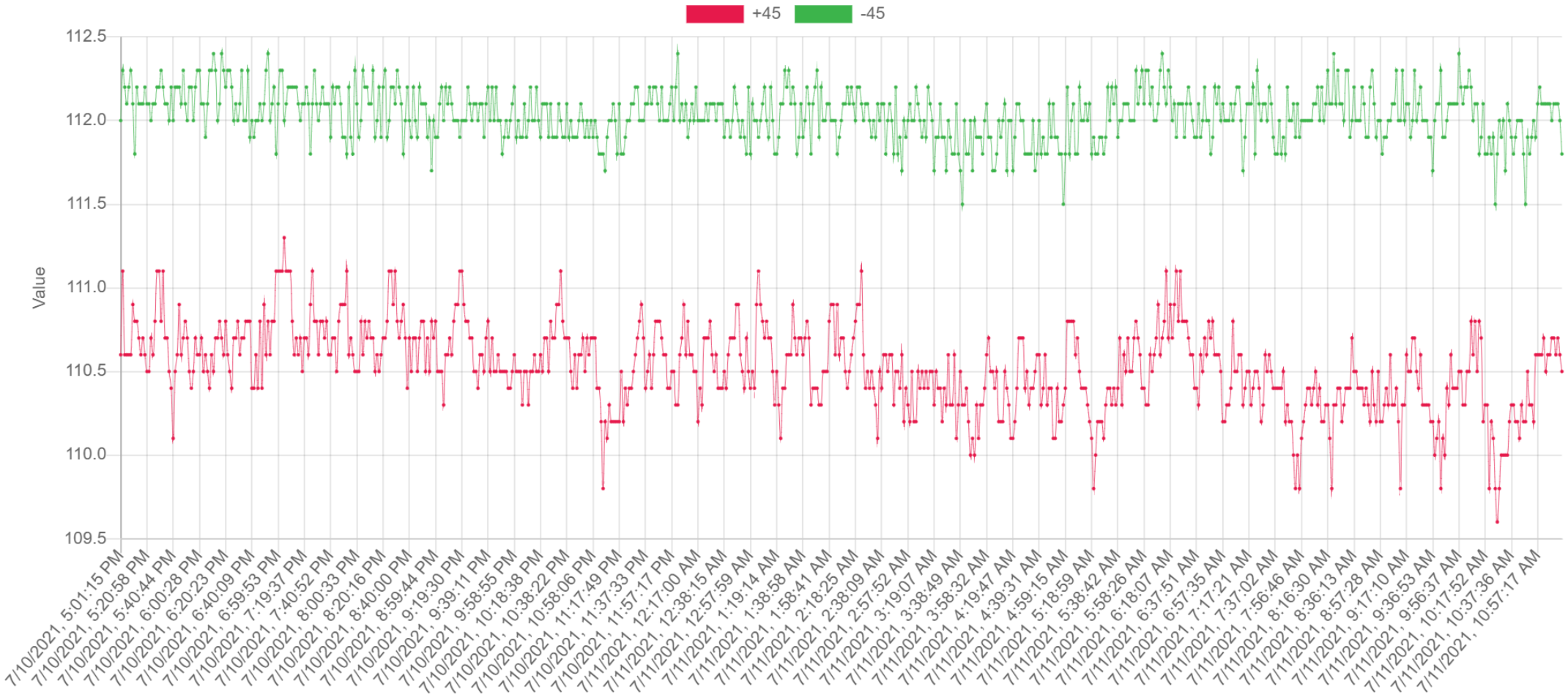




Typical Historical Web Page for VPT Combiner Output

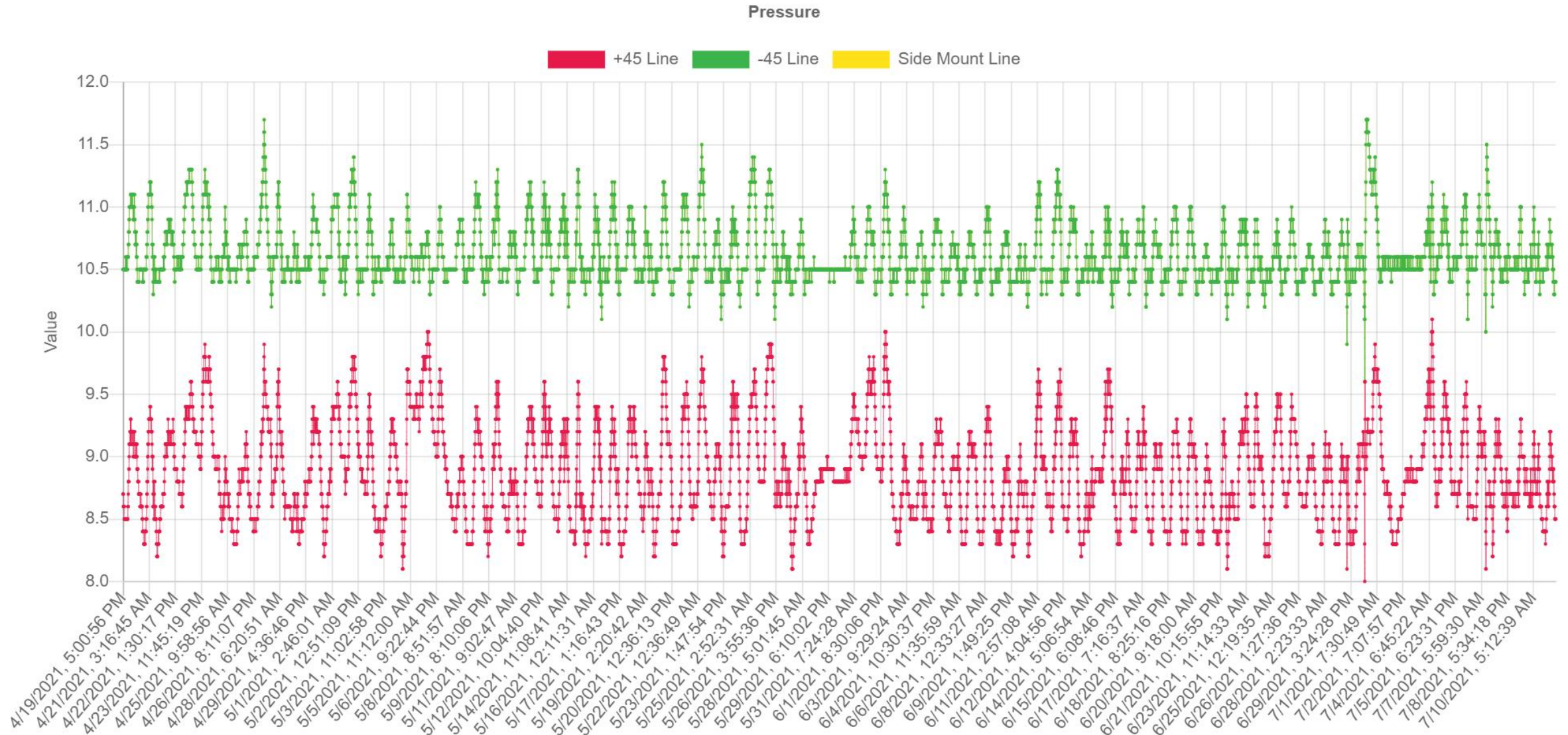
VPT Combiner FWD(kW) Outputs

VPT Combiner FWD(kW) Outputs





Typical Historical Web Page for Transmission Line Pressure





American Tower Chicago Aux Site Monitoring Screen

Chicago Antenna System Current Time: 09:58:54 Saturday 09-28-2019 Room Air Temp: 75.8°F

Chicago Antenna System

Forward Power (Kw) 00.0 00.0 UPPER LOWER	Reflected Power (W) 00 00 UPPER LOWER	VSWR 1.00:1 1.00:1 UPPER LOWER
Line Pressure PSI 3.3 3.0 UPPER LOWER	Line Temperature (°F) 67 66 UPPER LOWER	Outside Air Temp (°F) 42

00.0
Kilowatts Fwd
Active Minutes: 00000

00.0
Kilowatts Fwd
Active Minutes: 00000

00.0
Kilowatts Fwd
Active Minutes: 00280

00.0
Kilowatts Fwd
Active Minutes: 00000

Temp/Pressure Graphs

Inputs Forward 24 Hr

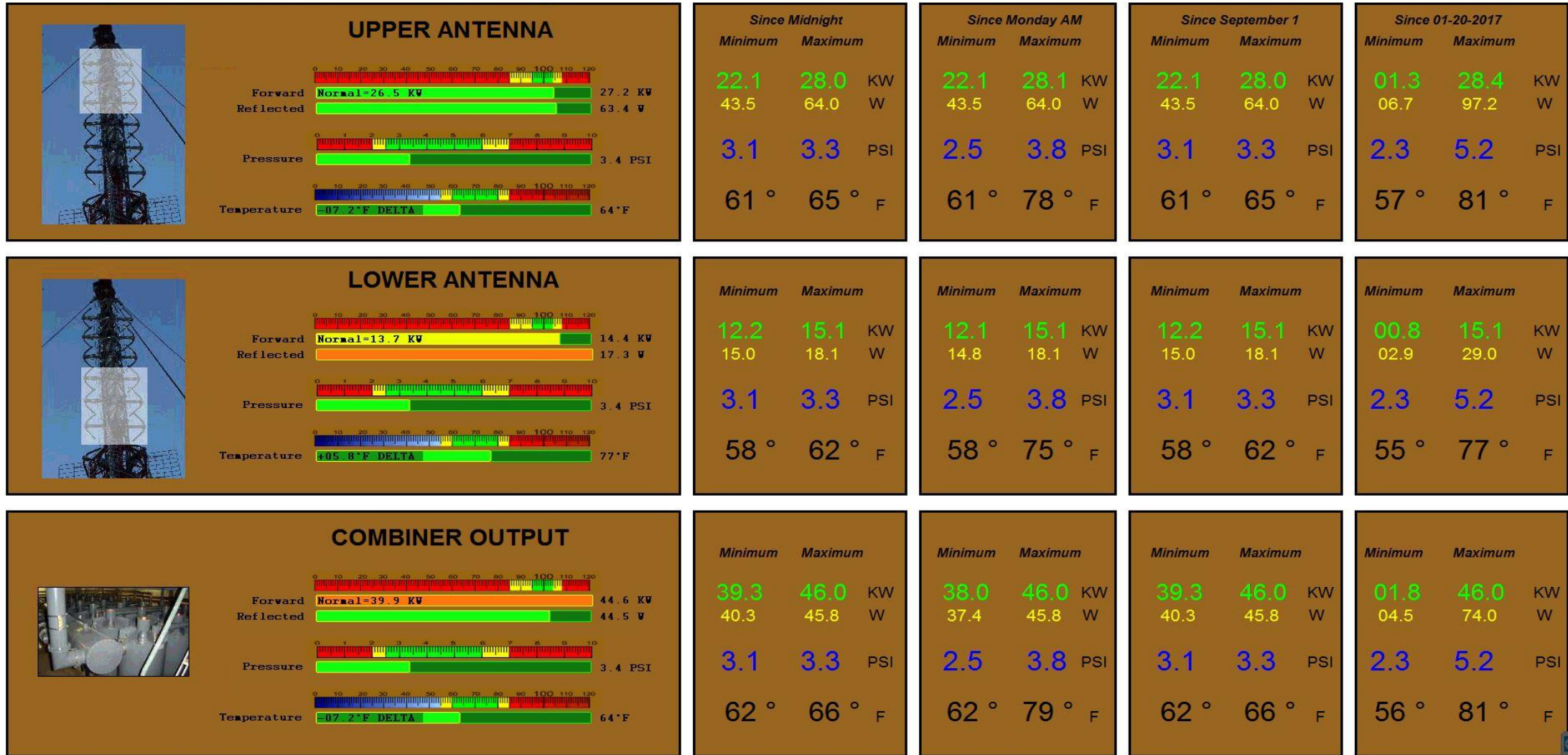
Most Recent Events

Inputs Reflected 24 Hr



Prudential Building Boston Output Statistical View

PRUDENTIAL MASTER ANTENNA SYSTEM



Current Program Time: 10:56:24 on Saturday 09-28-2019

Combiner Room Ambient Air Temperature: 71.2° F

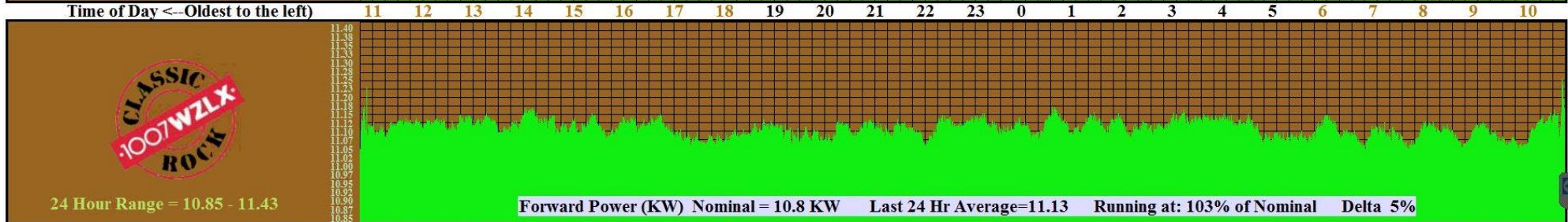
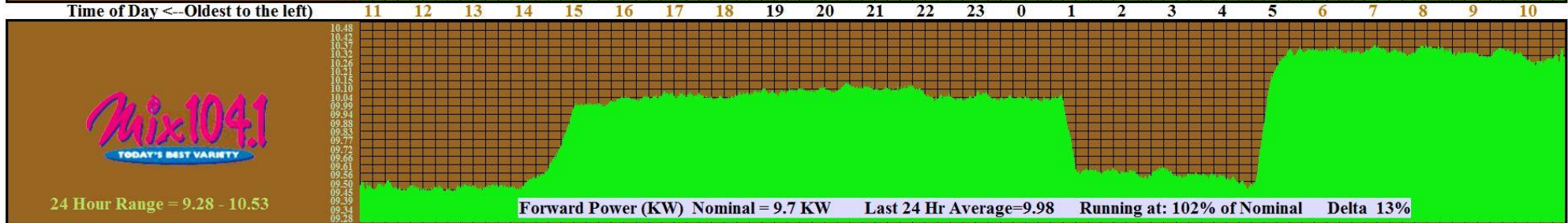
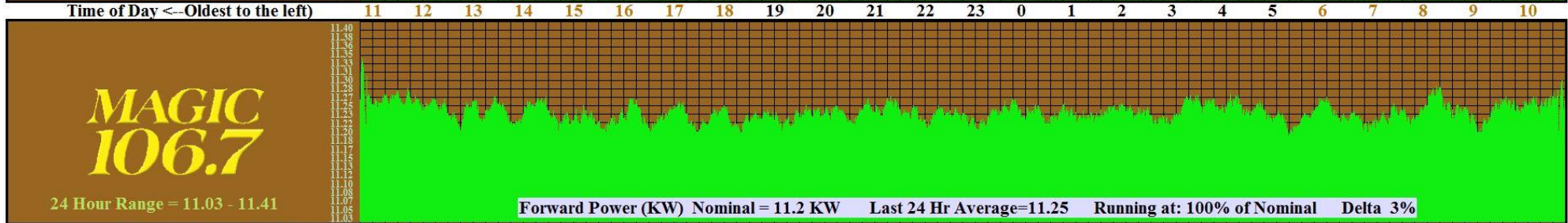
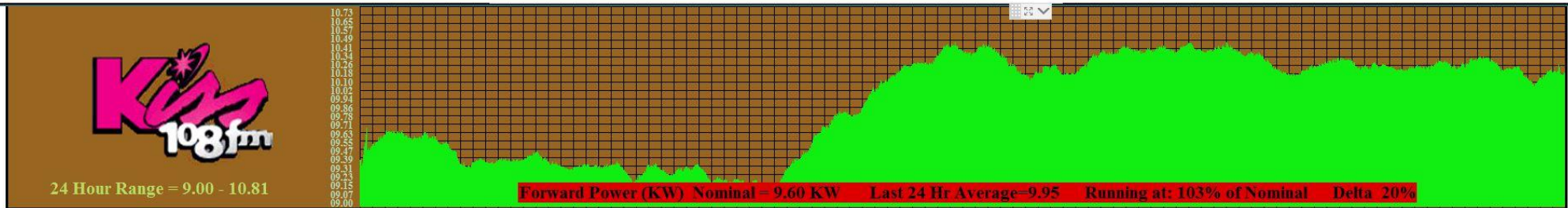
INPUTS

GRAPHS



Prudential Building Boston 24 Hour Historical View

Pru Combiner - TeamViewer





Effective Multiplex Facility Program Management

- Require all stations to connect to the interlocks
- Calibrate system at least annually (forward and reflected power)
- Require all stations to participate in annual interlock checks
- Have regular multiplex group meetings to discuss the operation of the facility, upgrades, tower and combiner inspections, room cleaning, business matters, etc.



Conclusions

- Broadcast transmission systems are expensive, complex, exposed to the elements, and difficult to access when certain components are located thousands of feet in the air.
- Repairs are always expensive both from a parts and labor standpoint and possible lost air time.
- You have a significant investment in your transmission system, it makes good sense to use cutting edge technology to help minimize problems and maximize the life of your asset.
- To ensure your viewers and listeners receive a reliable crisp immersive experience that they can count on when they need you the most, put the power of Stellar Eclipse to work for you today and enjoy an ROI you can take to the bank.
- Your signal is worth protecting and we have both the experience and the technology to help!



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Thank You

Questions?

Shulinsolutions.com

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