To whom it may concern: The following is offered as a reference for Shulins' Solutions drone IR scans.

I have known Paul Shulins for over 10 years and first met him when he was chief engineer for a group of Boston radio stations owned by Greater Media (now part of Beasley Media Group). Throughout that time he has been an excellent industry veteran, vendor, non-profit colleague, and personal friend. Flying has long been a passion of Paul's and it seemed natural that he would expand his monitoring business, which I had already used as a vendor, into offering drones (UAS) in his offerings. Like everything that he takes on, he wanted the best equipment available and to provide the most professional results. His UAS measurement system results demonstrated their value to me several times while building and operating extremely high power multi-channel combined TV and FM systems. As a result of my former success with his drone business when I left my former job and opened my consulting practice, I offered to form a partnership with him to promote these measurements to other broadcasters.

My 35+ year RF engineering career in the design, manufacture and operation of high-power broadcast equipment including antennas, transmission lines and filters has made me acutely aware of the methods of component failure and the telltale signs of imminent failure. Primary amongst these signs is the formation of localized hot spots. While all components carrying high RF power have some rise in temperature, those nearing failure exhibit hot spots due to either increased insertion loss (bad contact) or localized arcing(voltage breakdown). Any component that shows significantly higher temperature than its surrounding similar components is likely to fail soon. How long before it fails is often a mystery. Prior to drones we had very little hope of finding issues before they caused off-air time for stations.

Drone based scans provide a quick and easy method to see an entire external transmission system in one flight while operating at full power before there is a failure. If there are no hot spots found, all the better! You now have a baseline to use in subsequent scans or if the transmitter vswr were to change, you have a reference to look at. Of course, interpretation of the IR images is a fairly difficult art and it is important that operators are highly experienced with both IR measurement equipment AND RF equipment.

Paul scanned two newly installed systems in Boston for me in 2019 and 2020. One of those systems was experiencing slightly higher vswr levels but network analyzer plots looked "normal". Paul quickly located localized heating from one piece of 8" transmission line at approximately 900 ft AGL (he found the position within inches) and a crew was called in to open the line. What they found was a blackened but not completely melted o-ring, used to maintain line pressure, dropped inside the line at initial assembly resting on an insulator that had not been removed. This o-ring had very little effect on the line vswr so it had not been found using tdr at original commissioning, but did have more loss than the bare line next to it. We had to replace three inner conductors that had some signs of foreign material from the failing o-ring but using the drone kept us from losing the entire run and days, weeks, months of lost air time.

In conclusion, I was extremely pleased with Paul's IR measurement offering, experienced the benefit of locating hot spots before they failed and recommend using this technique for any high power system.

Sincerely,
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