



TECHNICAL DESCRIPTION
OF A
RADAR WIND PROFILER
BASIC SYSTEM

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RADAR WIND PROFILER TECHNICAL SUMMARY

BACKGROUND

Radar wind profiler (RWP) systems are highly specialized radars that obtain backscatter signal from clear-air turbulence. Very weak reflected energy is collected and processed to measure both profiles of horizontal mean wind flow and vertically air motion directly above the radar. An RWP can also measure turbulence in the form of the index-of-refraction structure function (C_n^2) and spectral width calculated from the radial velocity measurements. And with a radio acoustic sounding system (RASS), it can measure virtual temperature profiles.

Various types of RWP systems have been in existence for over twenty-five years, with their first use being for atmospheric research. Over the years they have been increasingly used operationally for weather forecasting, climate change, pollution studies, shipboard use, rocket launch support, and even aerostat support. While new hardware and software techniques are always being studied by researchers, RWPs represent a mature product, and will continue to find increasing use in satisfying atmospheric sensing requirements.

RWP systems can be manufactured that use center frequencies as low as 40-50 MHz and as high as 3 GHz. While a RWP antenna will ordinarily be smaller at high frequencies, a user must be aware that in general the higher the frequency of the radar, the lower its maximum height. In the United States 449 MHz has been designated a primary frequency for RWPs, but still there are many 915-1300 MHz systems in use here and throughout the world. The frequency a customer needs is both dependent on what is allowed in their locality, and the maximum height they wish to see.

APPLIED TECHNOLOGIES, INC. RADAR WIND PROFILERS

ATI has been designing and manufacturing atmospheric sensing systems for over 30 years. To add to their product line and satisfy customer needs, ATI is now producing state-of-the-art radar

wind profiling systems. The first of these newly designed systems will be installed in late 2003, for direct onsite operational support of a 71-meter long, cable-tethered aerostat.

The new systems have been purposely designed for ease of use, reliability, upgradability, and to be easily adapted for individual customer needs. ATI wind profilers are vertically pointing pulse Doppler radars, which use a common data processing system tied to an antennas and a transmitter selected to best fit the customer needs. Typical range resolutions are 75, 150, and 300 meters, with maximum heights depending on the transmitted frequency, power and antenna size.

ANTENNA SYSTEM

All ATI radar wind profiler antenna systems use a proprietary antenna control scheme, which allows full steering of the antenna beam. This means the RWP can be set to obtain radial wind measurements from several directions and zenith angles, thus allowing standard 5-position Doppler Beam Swinging (DBS) measurements, or even 9-position DBS. The increased options for beam pointing allow higher data quality, but also can also be used for motion compensation installations such as ship, buoy, or trailer mounting, or re-pointing the beam directions after installation, to avoid ground clutter. This unique design, regardless of the transmit frequency, also enables ATI to build the antenna of a size specific to the customers needs.

RECEIVER SYSTEM

ATI uses a fully digital receiver and transmit pulse modulation system. The direct creation and digitization of the intermediate frequency (IF) allows for increased dynamic range and the use of more sophisticated data processing methods. It also allows for the future *software-only* upgrade of the radar to take advantage of current research endeavors such as increased range resolution. The digital receive and transmit pulse system also are off-the-shelf technology, which allows the use of proven technology and long-term support.

POWER AMPLIFIER

ATI uses a robust final amplifier, which can be scaled in power for the customer needs, and additionally has soft-fail capability. The system has on-board monitoring and built-in self-protection. Like the rest of the RWP, it is designed for easy maintenance and high reliability.

HARDWARE MONITORING

Supplied standard with all ATI radars is a hardware health monitoring system. This system monitors key parts of the radar for improper operation, and can safely shut down the radar in the event of a failed component. The status of the monitor and its measurements are displayed in real-time and logged for later examination.

RADAR HOST PROCESSOR SYSTEM

ATI utilizes the highly robust CompactPCI hardware chassis along with the LINUX computer operating system to provide an *extremely reliable* radar data system. These unique design choices, along with other system features, give the customer an easy-to-maintain and dependable system. The control and display of the radar and its data can also take place remotely over modem or network connections. Security features are built to prevent unauthorized tampering. ATI also understands that some customers (e.g., researchers or established operational sites) have hard requirements for data systems with different operating systems or hardware chassis configurations. ATI is flexible and will work with the customer to produce a system tailored to their specific needs.

SIGNAL PROCESSING SYSTEM

Many improvements have been made in the speed and ability of signal processing techniques in the last decade. ATI takes advantage of these improved software and hardware technologies by including *standard* (not just as an option) a sophisticated wind signal processing system. The system is designed to identify and screen out

spurious signals present in the backscatter data, such as birds, planes, and interference from other radiating systems. The system greatly improves overall data quality, while also greatly reducing the display of data products that simply are not representative of the wind.

RWP CUSTOMIZATION

While ATI radar wind profilers are designed to a standard layout, ATI understands that customers have unique needs and other factors affecting the final desired configuration of the radar system. This is a normal part of satisfying customer requirements for large system such as a radar wind profiler. Let ATI be your expert guide in specifying, assembling, installing, and maintaining your radar wind profiler.

APPLIED TECHNOLOGIES, INC.

ATI has been serving customer needs for over 30 years. We are experts in many types of atmospheric sensing systems and techniques, and have a strong reputation for quality personal service before, during, and after the sale. We are located in Longmont, Colorado, close to the National Center for Atmospheric Research (NCAR), several National Oceanic and Atmospheric Administration (NOAA) laboratories, and two universities (University of Colorado at Boulder, and Colorado State University in Ft. Collins) with strong atmospheric and remotes sensing departments. ATI draws its expertise from experienced employees and from outside experts in atmospheric sensing. Contact ATI for you atmospheric sensing needs.