The ATRAD SIA radar is designed to observe ionospheric irregularities and their drift in the E and F regions. The radar operates as a coherent Doppler backscatter radar, with the radar beam directed perpendicularly to the geomagnetic field at E or F region heights. The radar beam can be steered within ±45° in azimuth around the radar boresight. A typical 3 dB beam polar width is 10° in azimuth and 24° in zenith angle.

The SIA is based on highly reliable ATRAD VHF radar technology. This features the use of efficient and reliable solid-state power amplifiers, and sophisticated monitoring and control for enhanced reliability.

**APPLICATIONS**
- Basic research in the E and F-regions
- Space situational awareness
- Space weather analysis and forecasting

**KEY FEATURES**
- Ionospheric Doppler radar operation with:
  - Conventional beam steering
  - Hybrid Doppler Interferometry (HDI)
- Frequency Domain Interferometry (FDI)
- Pulse coding
- Spaced Antenna operation
- 5-year warranty on power amplifiers
- Real-time Wind Profiles
- Superior performance
- Remote monitoring and control
- Fully automated
- Unattended operation
- Low operating costs

**APPLICATIONS**
- Basic research in the E and F-regions
- Space situational awareness
- Space weather analysis and forecasting

(Above) 24 kW VHF SIA radar with six-channel digital transceiver

(Above) Typical real-time quick-look E-region SNR results from one day of operation of a low latitude 24 kW, six channel SIA radar.

(Above) Ionospheric Doppler radar operation with: Conventional beam steering and Hybrid Doppler Interferometry (HDI).

(Above) Real-time Wind Profiles

(Above) Frequency Domain interferometry (FDI)

(Above) Pulse coding

(Above) Spaced Antenna operation

(Above) 5-year warranty on power amplifiers

(Above) Range-time (a) Doppler spectral width and (b) Doppler velocity plots of irregularity echoes observed in one beam of the Sanya (China) radar. (J. Geophys. Res. Space Physics, 121, 3788–3797, doi:10.1002/2016JA023647)

(Above) Height-time-intensity (HTI) plots of backscatter plume echo observed with the Sanya radar

(Above) Occurrence climatology of F region field-aligned irregularities in middle latitudes as observed by the 40.8 MHz coherent scatter radar in Daejeon, South Korea. (J. Geophys. Res.: Space Physics, 120, 10107–10115, 2015 DOI: 10.1002/2015JA021885)

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Specifications

Transceiver  
(Digital receiver)

- Fully synchronous transmit exciter, six-channel receiver and digital IF acquisition
- Six-channel I and Q output data sent to the Linux analysis PC
- Programmable receiver gain and bandwidth
- Interfacing to the beam-steering system and antenna selectors
- Expandable to 12-channels

Transmitter  
(24 kW transmitter)

- Transmitter Power: 24 kW
- Operating Modes: mono-pulse / pulse coded
- Frequencies: 25 to 65 MHz fixed at factory.
- AC Mains Power: 220-240V or 110-120V AC, Three Phase System Block Diagram:

Antenna Array  
(24 element antenna arrays)

- Array Configuration: 2 x 12 five-element Yagi antenna with $\lambda/\sqrt{2}$ spacing. The required beam elevation angle varies with latitude with typical values between 45 and 90 degrees.
- Antenna Array Footprint: Frequency-dependent (~ 6 m x 40 m at 55 MHz)
- Azimuthal Steering Range: Up to ±45°
- 3 dB Antenna Beamwidth: 10° in azimuth and 24° in zenith
- Steering Resolution: Typically, 20-50 steps across the steering range

General Description

16-bit Digital Transceiver incorporating receiver and exciter

Specifications

Receiver: 6-Channel, 16-bit
Exciter: Single Channel, 16-bit
Typical Sounding Range: 90-850 km
Range Resolution: 100 – 4,000 m (software selectable)
Range Gates: Up to 6,000
Operating Modes: Doppler Beam Steering, Spaced Antenna Interferometric and Mixed-Mode operation
Data output: Wind field, spectral width, signal-to-noise ratio (SNR)
Data Output Formats: ADF, User defined
Remote access: Remote monitoring and control via satellite, 3G/4G, ethernet or dialup.

Transmitter Power: 24 kW
Operating Modes: mono-pulse / pulse coded
Frequencies: 25 to 65 MHz fixed at factory.
AC Mains Power: 220-240V or 110-120V AC, Three Phase System Block Diagram:

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Options

GPS Reference
GPS disciplined oscillator (GPSDO) / GPS locked time and frequency (module shown left). Used for bi-static, multi-static, and / or remote receiver operation

Meteor Mode
The radar can also be fitted with additional switched antenna sets to allow alternative operating modes such as meteor detection

Antenna Arrays
Alternate phased arrays for other beamwidths

(Left) Remote six-channel receiving system. This is a complete receive system for remote ionospheric or meteor operation (with an appropriate antenna system)