The World's Most Widely Used HF Radar System for Ionospheric Research and Monitoring

Lowell Digisonde International manufactures and markets the Digisonde-Portable-Sounder-4D (DPS4D), the latest model in the DIGISONDE® series of advanced ionosondes built in Lowell since 1969. The Digisonde is an ionospheric radar that uses high-frequency radio waves for the remote sensing of the ionosphere, the ionosonde technology pioneered by Sir Edward Appleton in the late 1920s. DIGISONDE stands for "Digitally Integrating Goniometric IonoSONDE". The DPS4D is the only commercially available ionosonde system that measures all parameters of the ionospherically reflected HF radio signals, and automatically calculates the local ionospheric electron density profile in real time.

Building on the Evolution of Digisonde® Sounders since 1969

DIGISONDE®128
1969

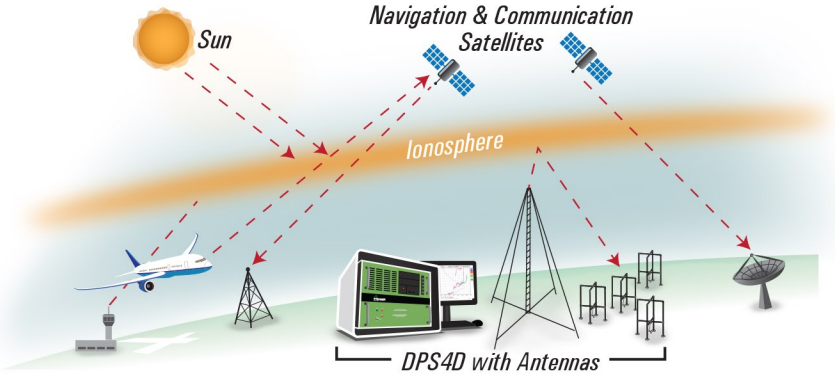
DIGISONDE®256
1978

DIGISONDE®DPS
1993

DIGISONDE®4D
CURRENT

The ***DPS4D*** monitors the effects of space weather on Earth's ionosphere, supporting communication & navigation satellite operations, and HF and VHF radiowave communication.

Reinisch et al. (2009), The New Digisonde for Research and Monitoring Applications, Radio Sci., 44 RS0A24, doi:10.1029/2008RS004115



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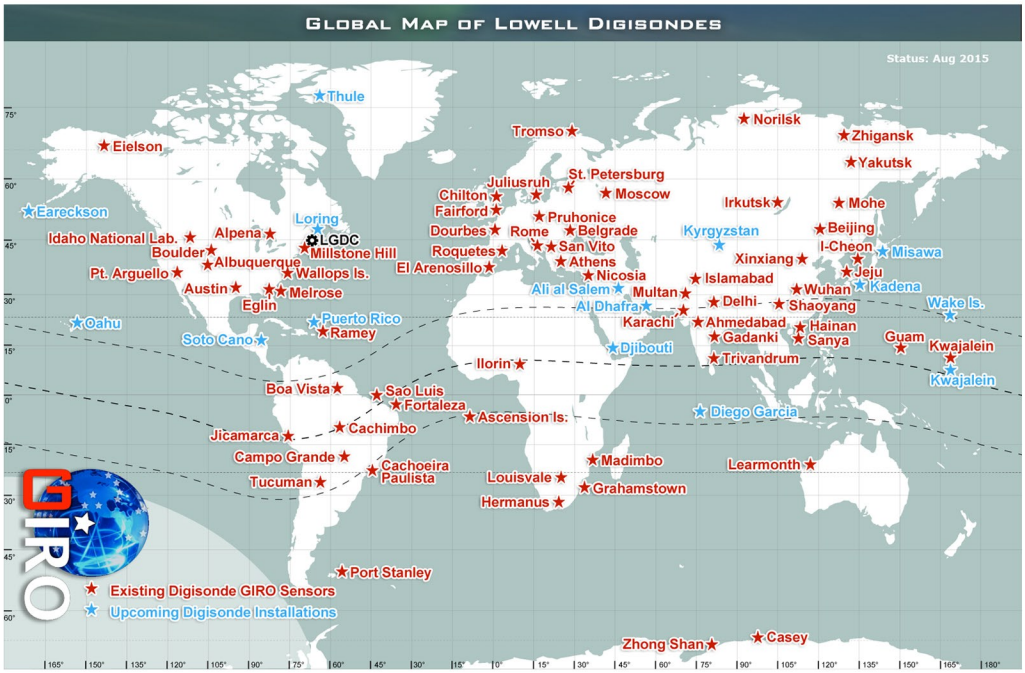
Features: Unmatched Performance, Programming Flexibilty, Reliability

- Measurement of all observable parameters of the ionospheric echoes:
  Amplitude, phase, direction of arrival, virtual height, Doppler frequency & spread, ordinary & extraordinary wave polarization identification.
- Real-time ionospheric electron density profiles with density error bars for each height; vertical ionospheric total electron content (ITEC); real time classical ionospheric characteristics including foF2, foF1, foE, foEs, MUF(3000)F2, hmF2, hmF1, hmE, and the IRI parameters B0, B1.
- Real-time radio skymaps of ionospheric reflection points
- Real-time E and F region drifts
- Compliance of output format for autoscaled ionogram and profile data with the URSI approved data exchange format SAO-XML
- Real-time Internet data dissemination
- Low-interference solid state transmitter capable of transmitting RHC and LHC or linear polarizations with peak power of less than 300 W
- Programmable selection of any number of "null" frequencies or frequency bands for which no RF power is transmitted during an ionogram scan.
- Remote systems operation via the internet
- Remote error diagnostics via the Internet
- Proven capability for automated bi-static oblique sounding between two or more DPS4Ds

Global: Simultaneous Ionospheric Observations Around The Globe



GIRO - Global Ionospere Radio Observatory

- The Digisonde Global Ionosphere Radio Observatory "GIRO" makes simultaneous measurements every 5 or 15 minutes at more than 60 locations around the world.
- All Digisonde data are ingested in the Lowell GIRO Data Center (LGDC)
- Currently 37* GIRO stations feed data in real-time to LGDC

** as of August 2015*

Reinisch and Galkin (2011), Global Ionospheric Radio Observatory (GIRO), Earth Planets Space, vol. 63 no. 4 pp. 377-381, doi:10.5047/eps.2011.03.001

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Applications: Research & Monitor With Confidence

Monitoring Network
High reliability and capability of remote control means the DPS4D provides an excellent foundation for inclusion in unmanned operational Ionosphere monitoring networks.

Travelling Ionospheric Disturbance Studies
Direct TID measurements with vertical and oblique sounding.

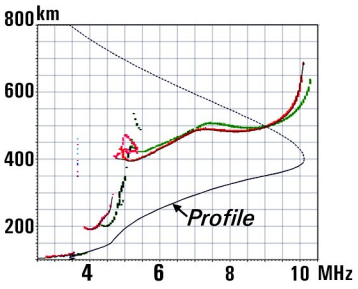
Equatorial and Auroral Zone Studies
DPS4D Doppler frequency and angle-of-arrival measurements provide enhanced capability when monitoring Ionospheric structure and dynamics.

Space Weather
Real-time monitoring of space weather effects.

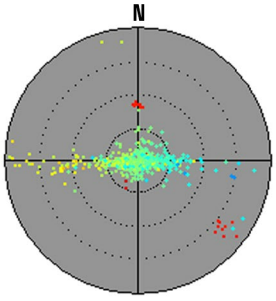
Synchronized Oblique Transmission / Reception
GPS-disciplined timing provides built in synchronization between all DPS4D systems and allows easy setup of transmission / reception between systems.

Particular Events / High Cadence Campaigns
Highly flexible scheduling protocols support different research objectives requiring high data sampling cadences and complex series of measurements.

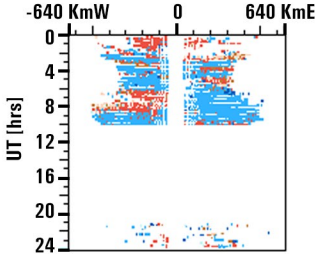
Data Products: Visualize The Ionosphere



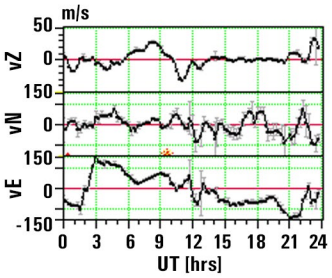
Ionogram



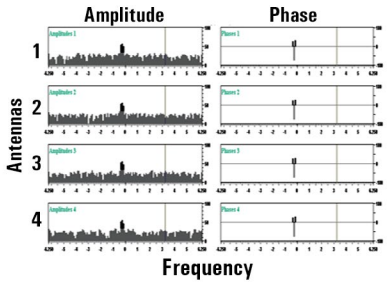
Skymap



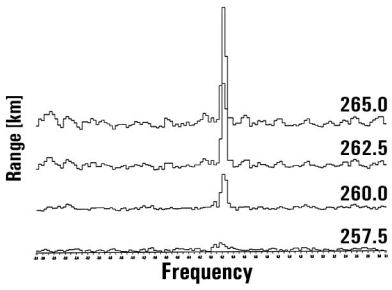
Directogram



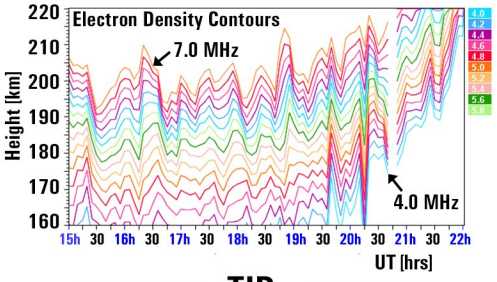
Drift Velocities



Doppler Spectra



Doppler Waterfall



TIDs

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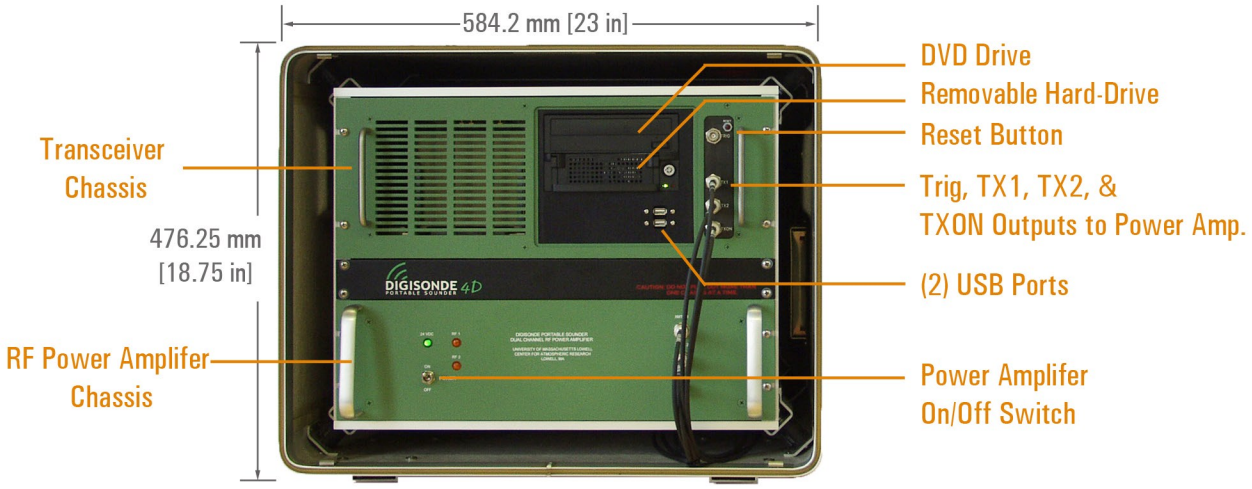
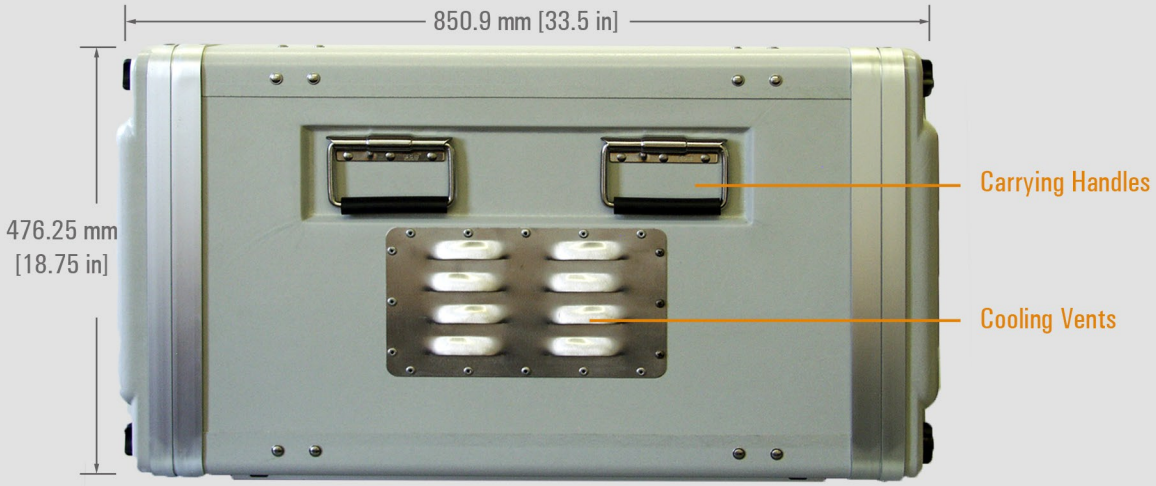
DIGISONDE 4D
PORTABLE SOUNDER

Hardware: Layout and Dimensions

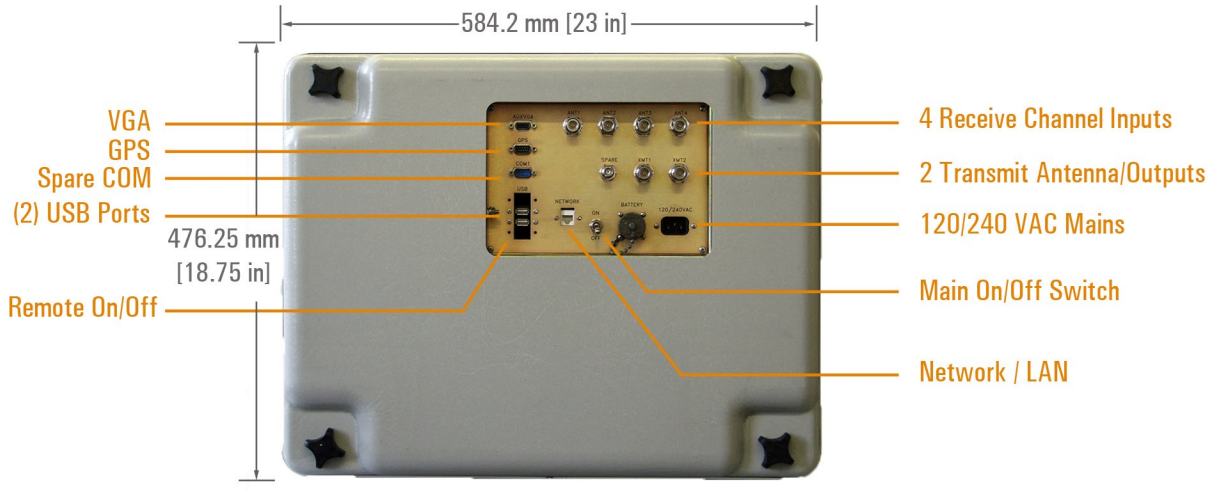
Front View (without covers)



Side View (with covers)



Rear View (with covers)



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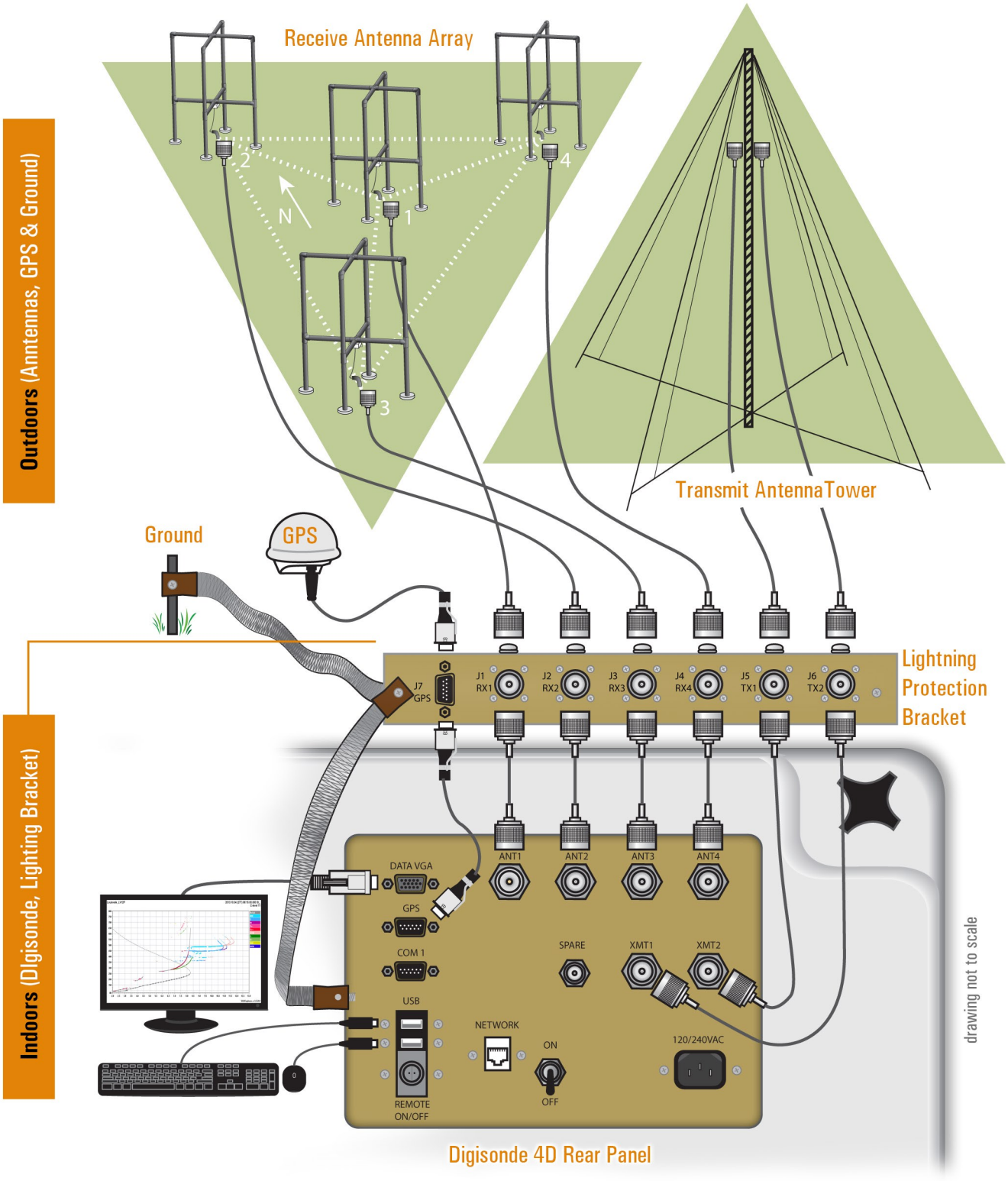
DIGISONDE 4D
PORTABLE SOUNDER

Hardware: Connection Diagram



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Specifications: Technology To Precisely Measure The Ionosphere

Quad Receiver

Frequency Range:	0.5 – 30 MHz (all modes of operation)
Bandwidth:	34 kHz @ 3 dB (theorectical) 42 kHz (measured)
Input Impedance:	50 Ω
Noise Figure:	11 dB (at receiver antenna preamplifier)
Receiver Sensitivity:	-130 dBm (+/-6 dB) into main chassis; better at preamplifier (amount depending on preamp gain setting)
Dynamic Range:	> 90 dB instantaneous > 140 dB total operating range including gain control
Recovery:	Time 40 μs
Output:	16-bit quadrature samples

Signal Processing

Processors:	Two Embedded Intel Core 2 Duo processor SBCs (Control and Data Platforms)
# of Range Bins:	Selectable: 256 or 512
Height Range:	0 – 1200 km (0 km used for self-calibration)
Height Resolution:	2.5 km sample spacing, 500 m using differential phase technique
RF Interference Mitigation:	RFIM reduces coherent interference up to 35 dB
Waveform Processing:	Pulse compression of 16-chip phase code provides 15 dB signal processing gain
Doppler Processing:	4 to 128 integrations can provide up to 21 dB signal processing gain
Doppler Range:	+/-3 Hz to +/-50 Hz
Doppler Resolution:	.0125 to 12.5 Hz
Amplitude Resolution:	< 0.01 dB
Wave Polarization:	Alternating transmission of O and X polarized pulses supports O (ordinary) and X (extraordinary) echo identification. Linear polarization available for equatorial stations.

User Interface

Unattended operation:	Controlled by as many as 128 measurement programs, 128 schedules, automatic schedule switch rules & preprogrammed campaign events
Remote access & control:	Network interface for Input/Output access to schedules, measurement data, diagnostic data, and operating software. Standard Remote Control Interface uses Microsoft Remote Desktop or similar over Internet or LAN.
Time Setting:	Integrated GPS receiver keeps time to +/-2 μs
Built-in-Test (BIT):	Full diagnostics to isolate failures to line replaceable units runs automatically, remotely accessible
Self Calibration:	Built-in channel equalization automatically updates phase and amplitude adjustment tables. Remotely accessible results.

RF Output

Frequency Scan:	0.5 – 30 MHz, start, stop and step size selectable to 1 kHz
Restriction of Transmission:	Programmable list of frequencies without RF transmission
Ionogram Scan Time:	Standard VIS ionogram 2 – 200 sec (varies with programmable settings)
Frequency Synthesis:	Fully digital (frequency switching time < 1μs)
Pulse Repetition Rate:	100 and 200 pps
Pulse Width:	533 μs (16 chips of 33.3 μs) waveform with 30 kHz signal bandwidth
Peak Pulse Power:	2 channels @ 150 W each
Output Impedance:	50 Ω
Transmitter Type:	Dual RF MOSFET Amplifiers for polarized transmission using turnstile transmit antenna
Lightning Protection:	In-line spark gap discharge devices

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