Portable Seismological Instrumentation for Polar Environments

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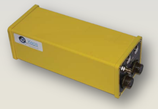
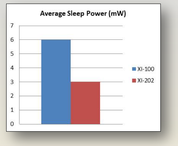
Iridium Telemetry

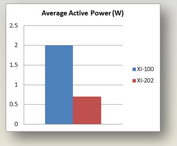
Iridium satellite telemetry is the only form of communication available at extreme latitudes. We have worked closely with **Xeos Technologies** to maximize the reliability, throughput and capability of this limited technology while minimizing power requirements.



XI-100

- Optimized for polar operation – low standby current (470uA), integrated heater allows for transmission of data down to -55°C.
- Real-time RUDICS capable





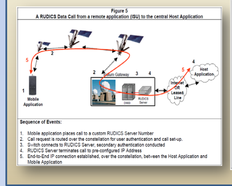
XI-202

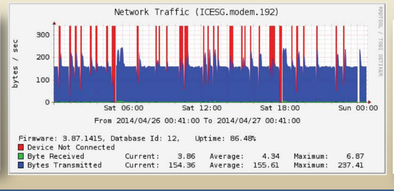
- SBD only (SOH and very small data samples)
- Small form factor, lightweight
- Very low standby current (225uA)

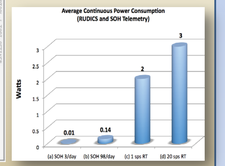
RUDICS

***R**outer-Based **U**nrestricted **D**igital **I**nternet-Working **C**onnectivity **S**olutions*

"Real-Time" Data Transmission

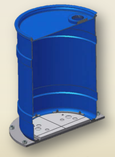






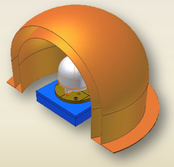
Sensor Emplacement

We have a variety **sensor vault** designs to suit various site types ranging from **surface installations** on bedrock to **direct bury** applications in snow/ice. Designs are optimized to deliver **high quality data** while minimizing installation cost and complexity.



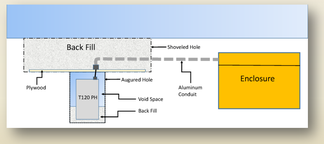
Barrel Vault

- Machined silicon glass inner base for thermal and electronic isolation
- Can be mounted on snow, earth or rock



Insulated Dome

- Insulated for improved operation and reduced noise generating drafts
- Curved for improved wind shedding



RIS T120 PH "Hybrid" Borehole Concept

- Direct bury sensor
- Conduit for cable protection

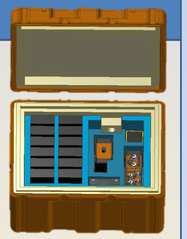
Polar Group

Mission: *To design, build, test and deploy autonomous seismic stations for extreme high latitude environments that minimize logistical overhead and maximize data quality and return.*

- 5 full-time staff
- Lab Space and test equipment, including programmable freezers capable of reaching -70C
- Prototyping and fabrication areas

Systems and Enclosures

All of our seismic stations are optimized for **portability, ease of assembly, cold weather performance and robustness**. We have designs for a variety of conditions ranging from **short term deployments** in relatively mild conditions to **indefinite duration installations** in the coldest conditions on earth.



Semi-permanent, Extreme Cold Station

- 8x 108Ah AGM Batteries
- Heavily insulated enclosure
- Broadband Surface Seismometer in insulated vault
- Appx total weight 1000 lbs
- 5-10 year battery life

2 year, Moderate Cold Station

- 10-12x Lithium Primary batteries +1 34Ah AGM
- Moderately insulated enclosure
- Direct bury broadband posthole seismometer
- Appx total weight 250 lbs
- 2 year battery life

Summer Only Station

- 1 small AGM battery
- Lightly insulated enclosure
- Typically passive sensor
- Appx total weight 75 lbs
- 1-2 week battery life

Power

Batteries being the heaviest and often most expensive aspect of an autonomous seismic station, a great deal of design and development effort has gone into **minimizing our power requirements**. We have worked closely with our vendors such as **Xeos** and **Genasun** to meet our design goals and we can currently operate year-round seismic stations on as little as a **1.5 Watt** average power draw.

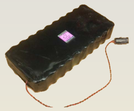
Batteries

$LiFePO_4$ Secondary

- Better energy density (~.3lb/Ah)
- Rechargeable
- Very Expensive (~$20/Ah)
- Low cold de-rate

AGM Secondary

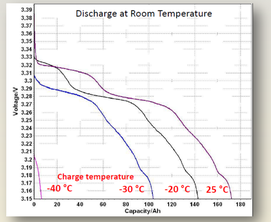
- Heavy (~0.6lb/Ah)
- Rechargeable
- Inexpensive (~$2.50/Ah)
- ~50% cold de-rate



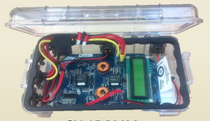
Li-$SOCl_2$ Primary

- High Energy Density (~.06lb/Ah)
- Not rechargeable
- Expensive (~$5.00/Ah)
- Low cold de-rate

$LiFePO_4$ Secondary Battery Testing



Charging and Control



GV-15 PMM

- Low parasitic draw (2.3mA)
- Switching between primary and secondary cells
- Continuous temperature compensation
- Fully configurable for different battery chemistries
- Regulated output for clean sensor power

A-Frame Solar

- 2x 80W Panels
- Mounting on snow, rock or earth
- Battery box used as ballast
- Must be assembled on site
- Low, can be buried easily

Lampshade Solar

- 3x 20W Panels
- Mounting on snow, rock or earth
- Can be fully assembled prior to flight
- Moderate height, can be extended

Tri-Panel Solar

- 3x 80W Panels
- Mounting on snow or earth
- Must be assembled on site
- Tall, good for high accumulation areas

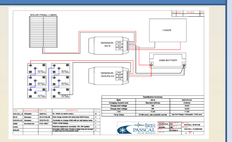
Future Developments

"All-in-One"

- Integrated Seismometer, digitizer, media
- Environmentally sealed, direct bury
- Improved tilt tolerance
- Rapid deploy, large N

Wind Powered Heater

- Ruggedized turbine for harsh environments
- Customizable
- Battery bank isolated with automated dump load for high wind



Air Cell Batteries

- Excellent Power Density
- Cannot source large currents
- Capacity drops sharply in cold
- Possibly use like a solar panel to charge a lead acid battery

For more information visit: **http://www.passcal.nmt.edu/content/polar**