Fourteenth or Fifteenth QUG and Joint AUG

Marrakech

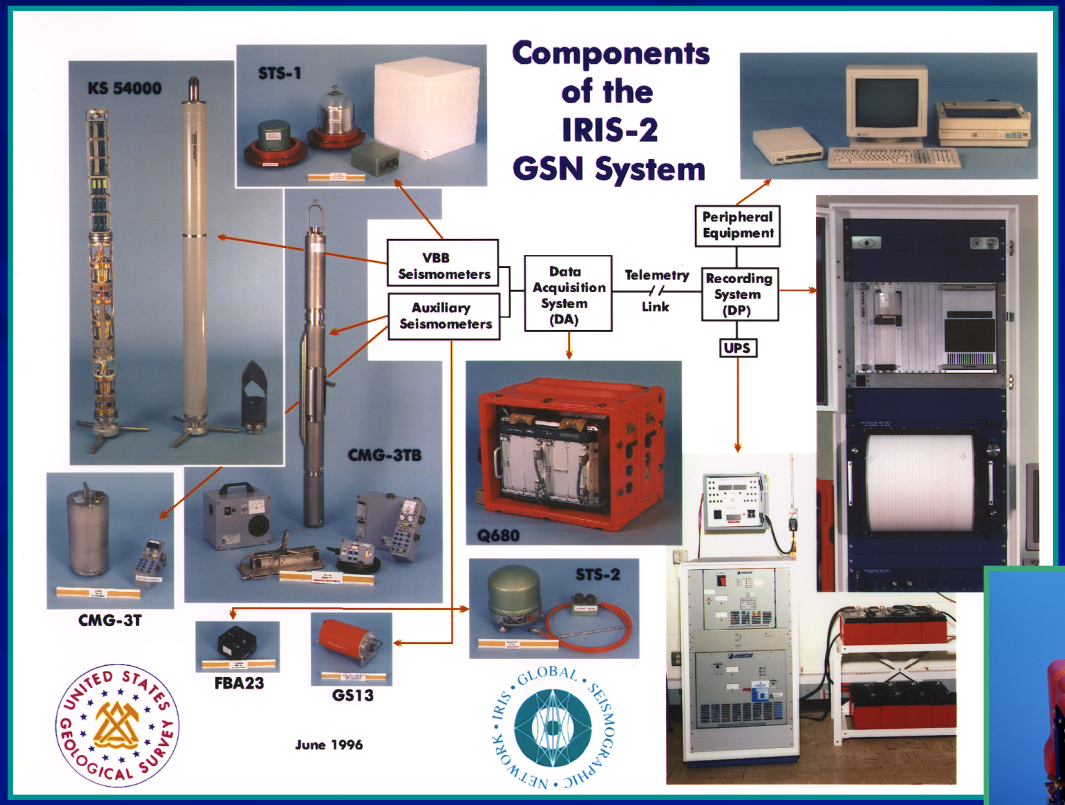
Mar 11, 2009

QUANTERRA®

US 4866442
Japan 2787445
EPO 0293780
Germany P3883081.7-08
France 0,293,780
UK 0 293 780
Singapore P9790690

Jun 15, 1987

1990


Components of the IRIS-2 GSN System
KS 54000
STS-1
CMG-3TB
CMG-3T
FBA23
GS13
STS-2
Q680
VBB Seismometers
Auxiliary Seismometers
Data Acquisition System (DA)
Telemetry // Link
Recording System (DP)
Peripheral Equipment
UPS
June 1996
UNITED STATES GEOLOGICAL SURVEY
IRIS • GLOBAL • SEISMOGRAPHIC • NETWORK

1995


Q4120
QUANTERRA
ADVANCED BROAD-BAND SYSTEM
TAPE
ACQUISITION
ATTENTION

20+ year research, $20M R&D to reconcile requirements

Performance: Noise, Dynamic Range, Bandwidth
Data Completeness [….”continuous” digital data stream…]
Time Accuracy
Operational Longevity and Reliability
Minimum Power to enable science-driven siting
Survivability, Physical Size, and Robustness
Environmental Ingress protection
Consistency
Communications, Monitoring, Control, and Calibration
Cost

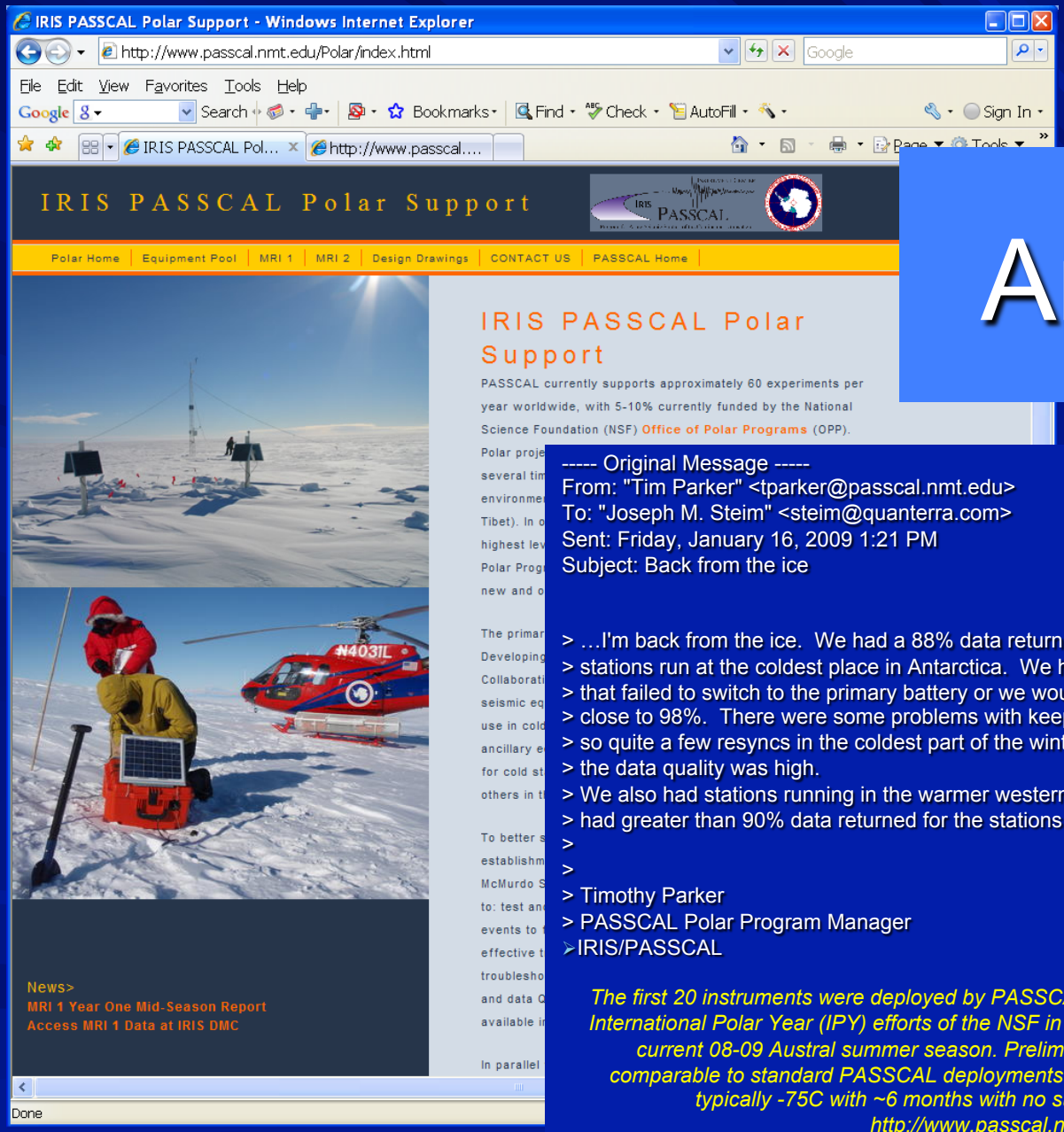
Quanterra Q330®

0.5 watt – ~3200 in service 5/2008

2003

Performance in Difficult Environments

Antarctica



----- Original Message -----
From: "Tim Parker" <tparker@passcal.nmt.edu>
To: "Joseph M. Steim" <steim@quanterra.com>
Sent: Friday, January 16, 2009 1:21 PM
Subject: Back from the ice

> …I'm back from the ice. We had a 88% data return from the 10
> stations run at the coldest place in Antarctica. We had one station
> that failed to switch to the primary battery or we would have had
> close to 98%. There were some problems with keeping the PLL locked
> so quite a few resyncs in the coldest part of the winter but over all
> the data quality was high.
> We also had stations running in the warmer western Antarctica and we
> had greater than 90% data returned for the stations we serviced.
>
>
> Timothy Parker
> PASSCAL Polar Program Manager
> IRIS/PASSCAL

The first 20 instruments were deployed by PASSCAL during the 2007-2008 Austral Summer as part of International Polar Year (IPY) efforts of the NSF in the Antarctic, and were recently serviced during the current 08-09 Austral summer season. Preliminary results show a >88% data return which is comparable to standard PASSCAL deployments. Temperatures in the high Antarctic Plateau were typically -75C with ~6 months with no sun. Designs information may be found at http://www.passcal.nmt.edu/Polar/Design/.

Gamburtsev Antarctic Mountains Seismic Experiment (GAMSEIS)

File Edit View History Bookmarks Tools Help

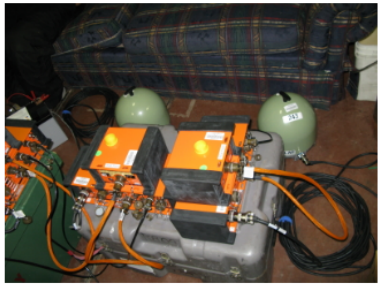
http://epsc.wustl.edu/seismology/GAMSEIS/photos.html

Most Visited 7-Day Forecast for Latit...

SEISMOLOGY GROUP

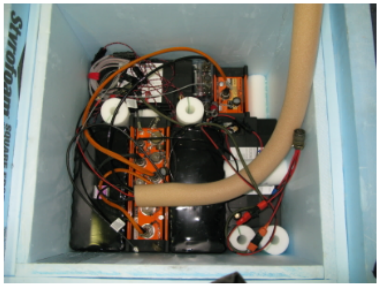
DEPARTMENT OF EARTH AND PLANETARY SCIENCES
WASHINGTON UNIVERSITY

GAMSEIS Photo Gallery



Testing the sensors before deployment

Electronics were stored in insulated boxes



Instruments were wired to front of box for connections in field

One complete station weighs ~800lbs

Sensors were insulated from the cold

David Heeszel checking a station in the field

Done

Greenland

The 24-bit “barrier”

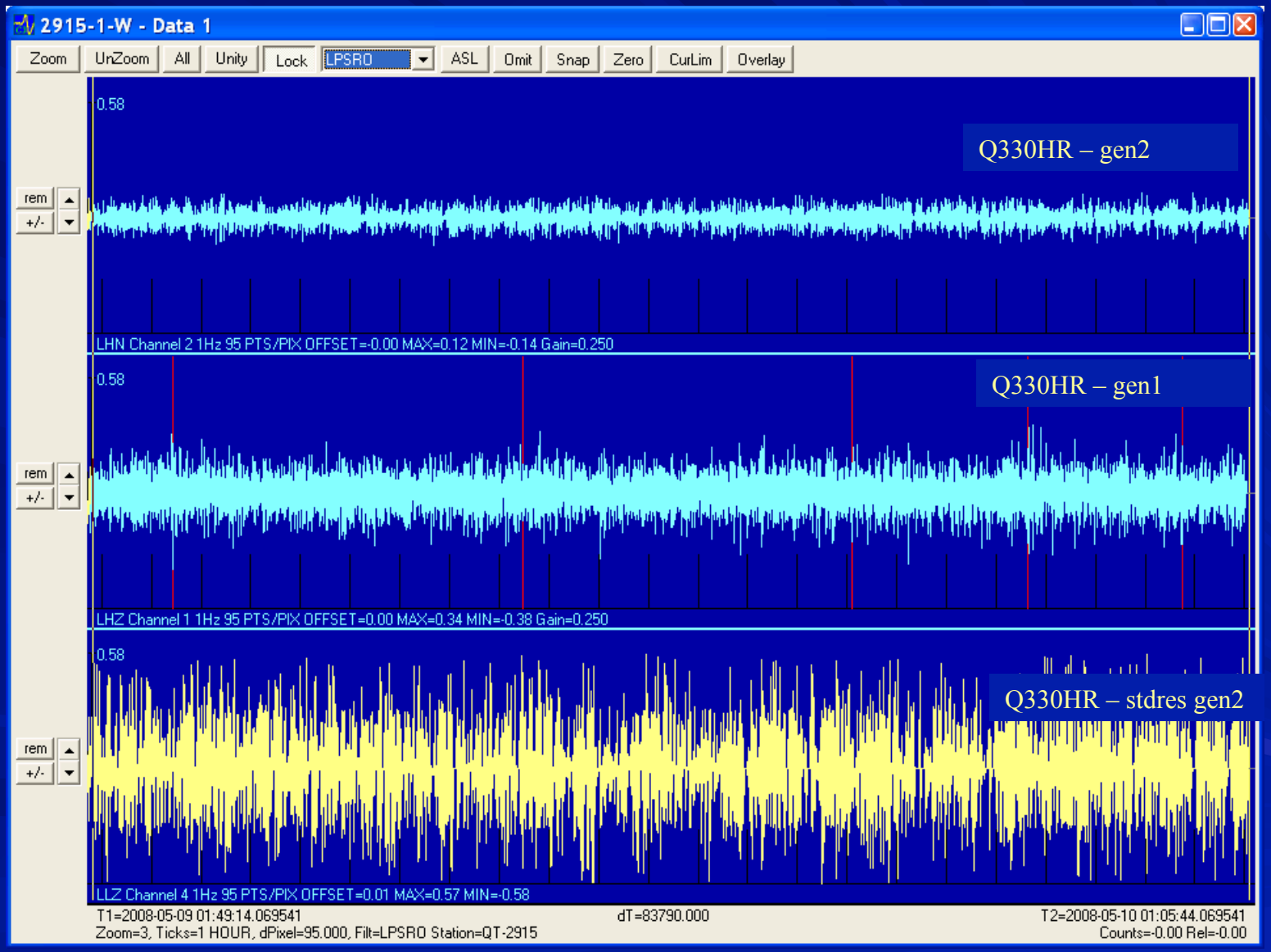
Q330HR


QUANTERRA® Q330 HR
SENSOR A
SENSOR B
STATUS
FAULT
CONTROL
SYSTEM
LINK OK
IRIDA
DATACOMM
CPU
BOOT
GPS
ANALOG
PRIMARY
OVER CURRENT
EXT GPS
CONSOLE
POWER
GPS ANT
18VDC MAX
QNET
AUXIL
SERIAL

Q330HR

- 100% Compatibility with Q330
- 3 Ultra-High 26-bit resolution
- 3 Standard 24-bit resolution
- 4-channel true 16-bit Auxiliary
- ~3mA cal current drive
- Common-Mode >±10V
- 32Mb packet ram standard
- Now Generation 2 – lower noise – full production
- Dual HR version available

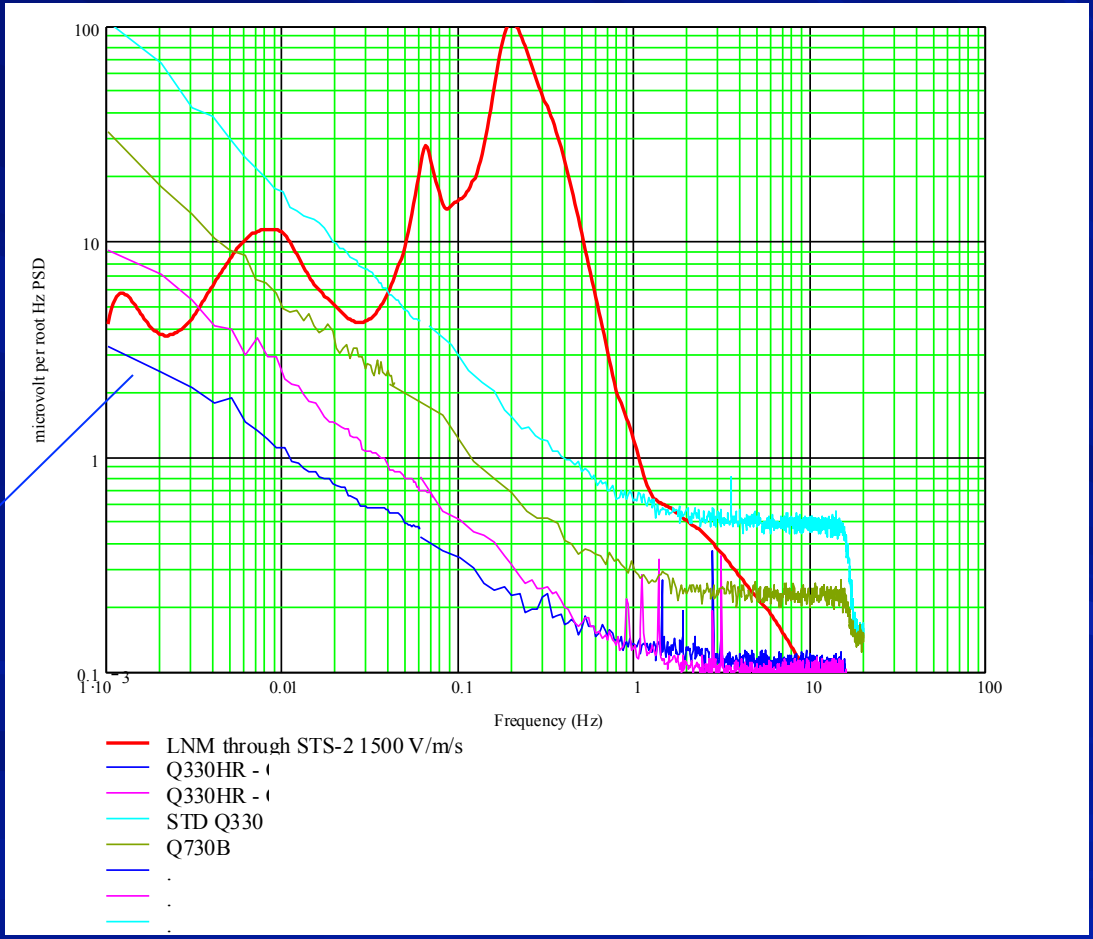
Q330HR Generation 2



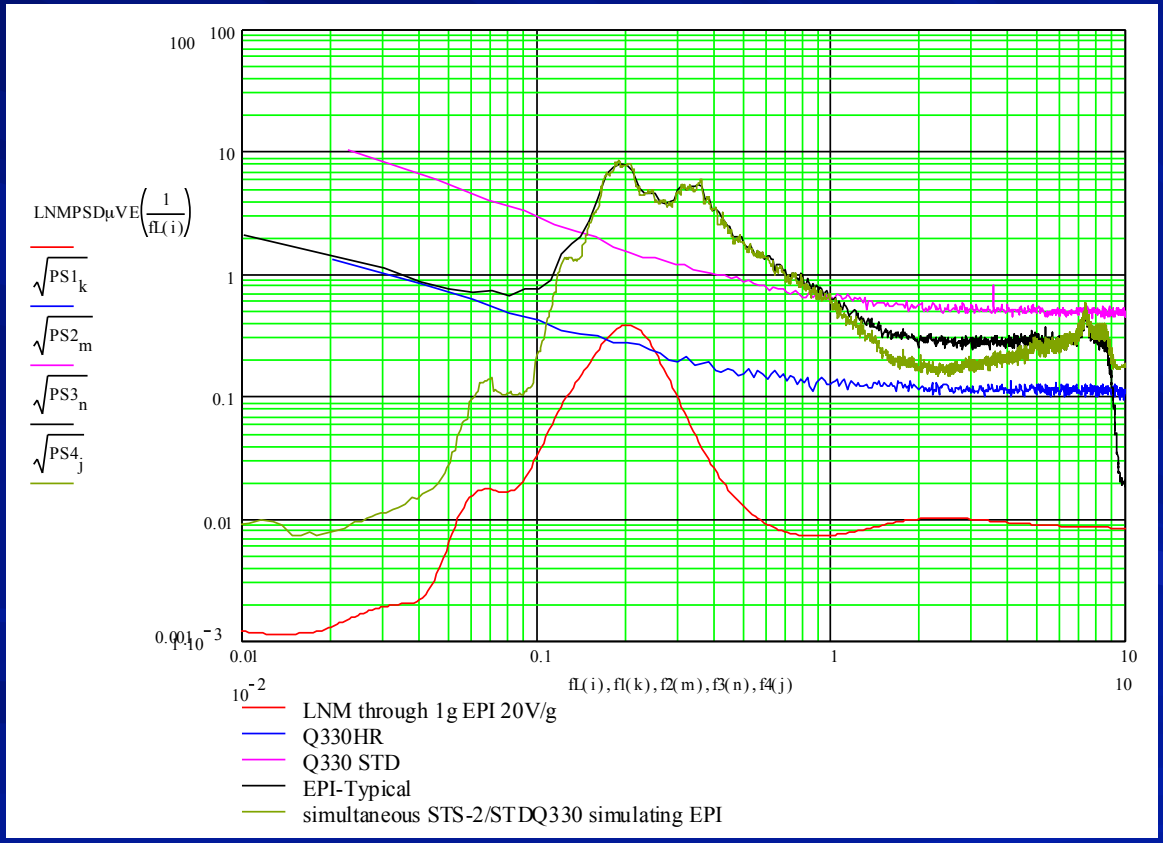
Why?

Q330HR Generation 2

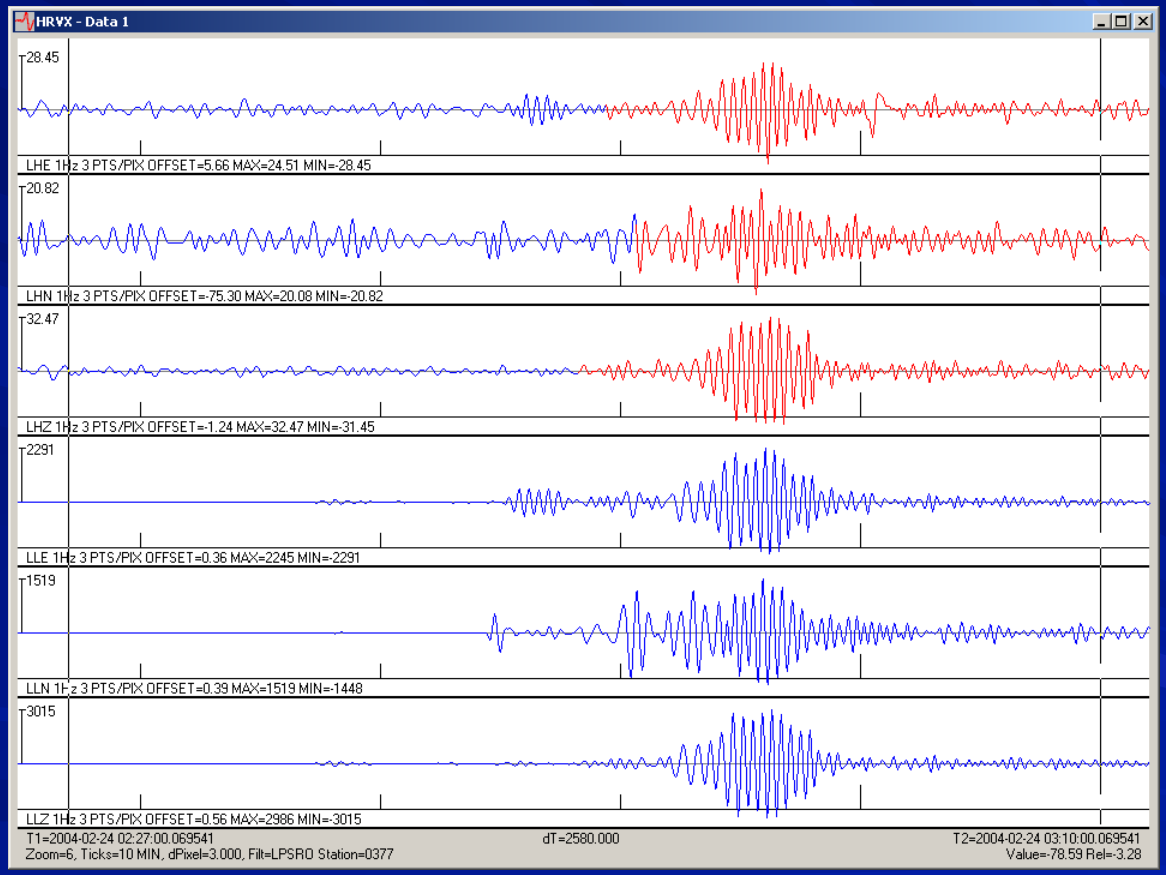
Gen 2 HR



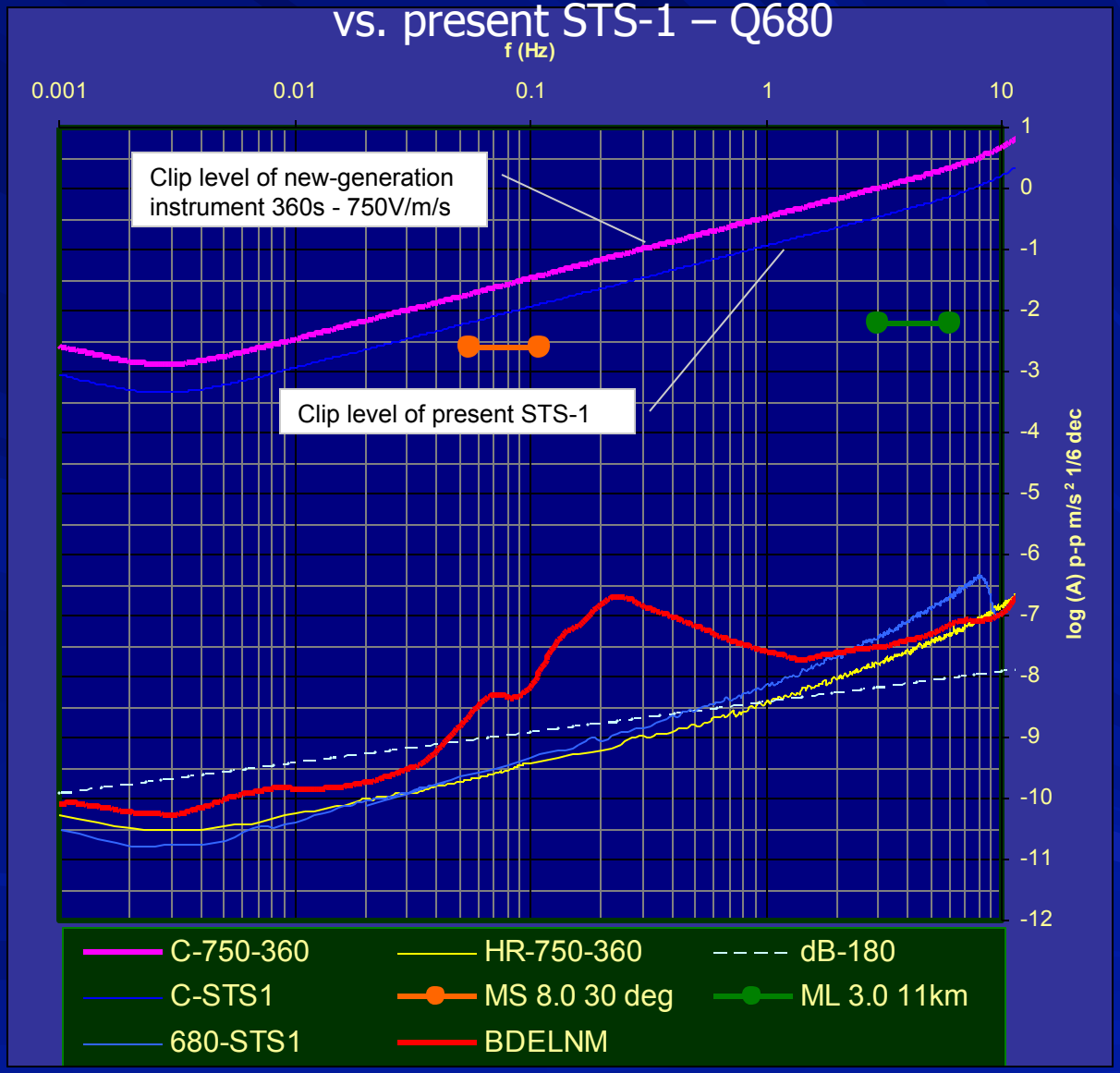
The Q330HR in combination with a high dynamic range, nearly 150dB accelerometer such as an Episensor, can provide not only useful high-frequency data and recording of strong ground shaking, but also useful short-period equivalent and general-purpose wide band recordings in many applications.

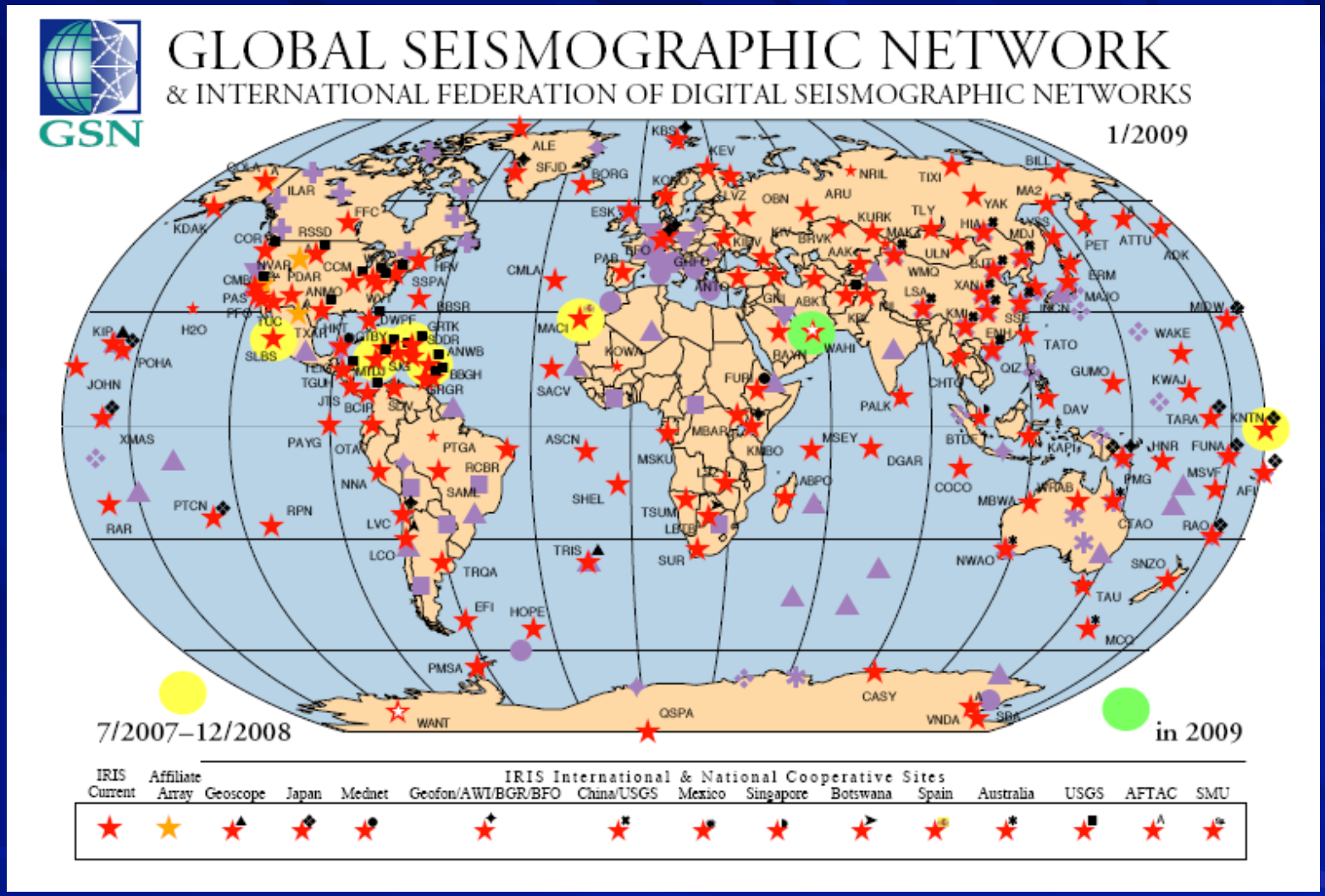


And below, LP WWSSN-filtered vertical data from a 5.9 event in Guatemala, 2004/02/25.



Future Reduced-Gain 360s sensor – Q330HR operating range vs. present STS-1 – Q680



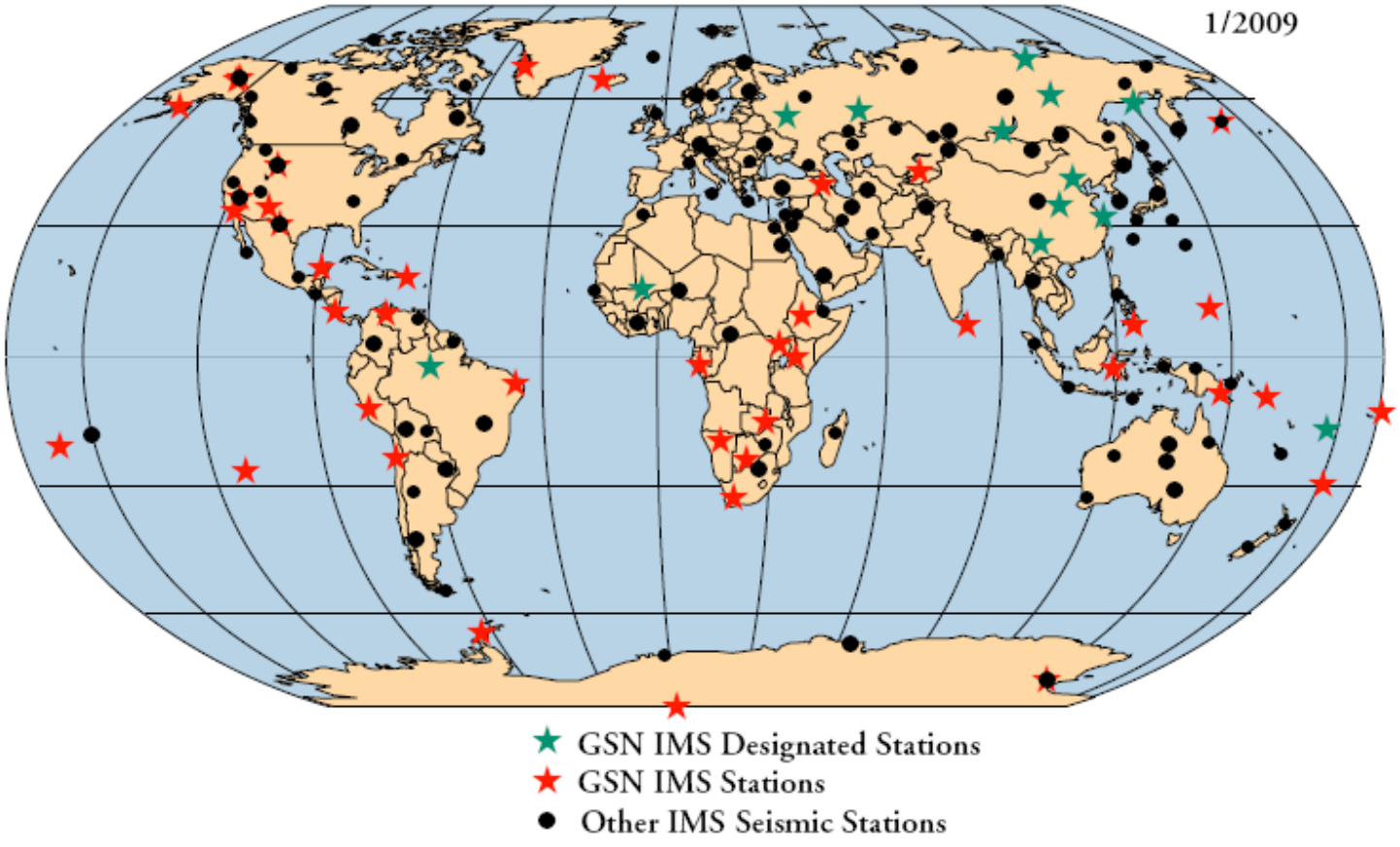


New Instrumentation

Next Generation Data Acquisition Systems (NGS). Systems integration of the NGS, based on the Quanterra Q330HR, has been completed by the USGS Albuquerque Seismological Laboratory and the UCSD IRIS/IDA group. Since July 2007, 14 NGS have been deployed in the GSN (see map).

GLOBAL SEISMOGRAPHIC NETWORK

& INTERNATIONAL MONITORING SYSTEM (IMS)



Q330 Roll-out

- 7 stations since spring GSN SC
  - June – ANMO
  - July – BBSR
  - Sept – KEV, LSZ, TSUM, SFJD, HRV

Goodbye Q680

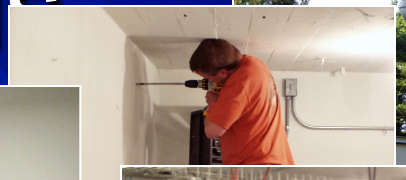
- Status
  - Stations are operating well
  - New software is working well
  - Using Falcon for monitoring and control
  - Problems with some microbarographs
  - Still under development
    - Applications for some station operators
    - Command and control scripts

Hello Q330

Q330 Postcards



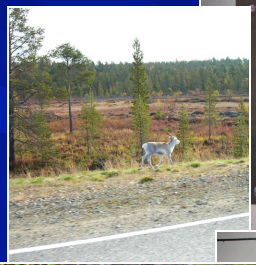














20+ year research, $10M R&D to reconcile requirements

Performance: Noise, Dynamic Range, Bandwidth
Data Completeness [….”continuous” digital data stream…]
Time Accuracy
Operational Longevity and Reliability
Minimum Power to enable science-driven siting
Survivability, Physical Size, and Robustness
Deployability, Consistency
Communications, Monitoring, Control, and Calibration
Cost

What causes data loss problems? Here's a very non-scientific sampling, for example, from II's status reports. A word count gives a flavor of problem areas – no surprise:

122 DAS
31 EPROM
104 power
34 supply
42 GPS
6 disk
---
339 total mentions related to acquisition, timing, power

49 54000
41 STS-1
26 STS-2
19 CMG-3
---
135 total mentions related to sensors

It's hard to run computers in the field! …seismometers too

Data transmission. [….]
With a reliable telemetry system in place, field instrumentation could perhaps be simplified, to eliminate local recording and/or moving parts, which would in turn result in lower power requirements and reduced field maintenance. Other goals of the GSN […] should be secondary to assuring a fast and reliable data stream from source to user across the existing network.

From:

Review of the Global Seismographic Network

July 2003

At the support level of the GSN or any seismic network, a "reliable telemetry system" is illusory.

In fact, the situation is exactly opposite as prior GSN experience would suggest. A system employing "diversity" stores data on-site close to the sensor in a high-reliability "core" and in addition sends data to a collector via independent telemetry to greatly improve overall data completeness. The TA, a field laboratory that has accelerated research for systems development because of the large numbers of deployed systems (~400), has shown this convincingly. Critical-path maintenance and power requirements and operational and capital cost are minimized when "diversity" is employed. The demands on telemetry availability (with a highly non-linear associated cost) are relaxed. Data completeness, and hence quality, improves dramatically.

MSHEAR vs Q330
or
Why did we do that?

MSHEAR

- Complete, very compact data
- No timely data delivery
- Highly configurable time-sharing OS. Text based, free-form
- Specialized interfaces on VME bus (only 1990 bus still mfg'ed). Disk based. Disks fail.
- Non-deterministic response to loading
- Good, but h/w & s/w failures in unattended operation
- Systems are high power consumption and generate heat.
- Remote deployments impractical because of high power
- 1990's analog
- Limited SOH – high latency limits usefulness in real-time QOS monitoring

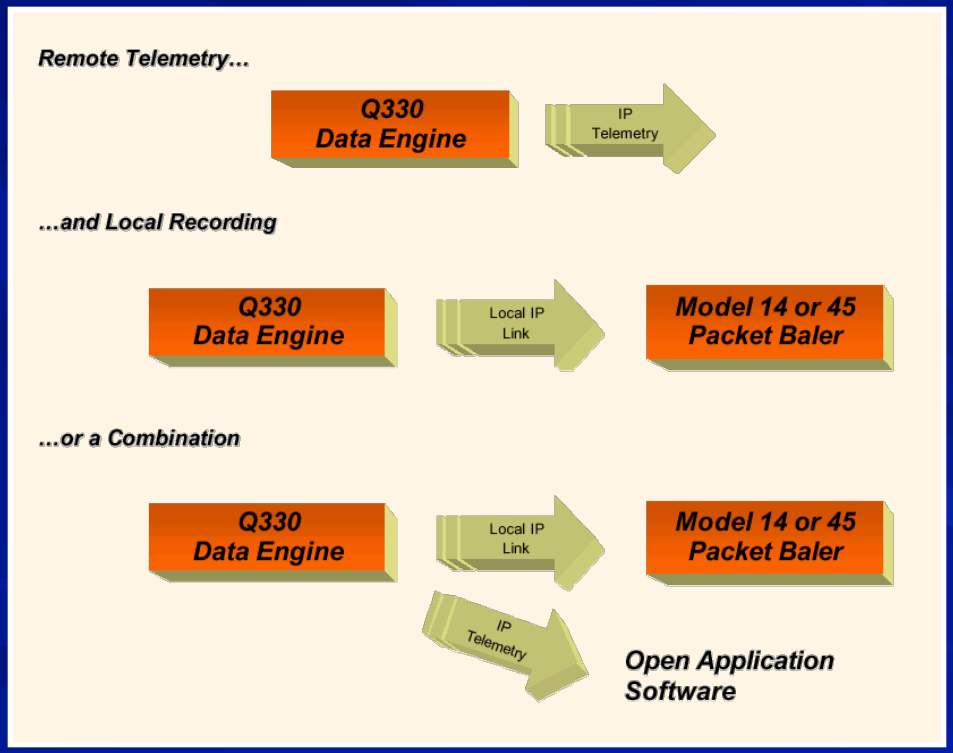
Q330

- Complete, reasonably compact data (Level ~2)
- Very timely data delivery
- Highly configurable, "discplined" & documented interface. "Local is remote".
- Entirely new current technology analog hardware.
- Deterministic OS – ~0 crashes!
- Very high availability hardware, high MTBF
- Deployments anywhere using lowest power. Heat kills. Power systems weakest link.
- Extensive SOH, in-band and *out-of-band* drive timely QOS management.

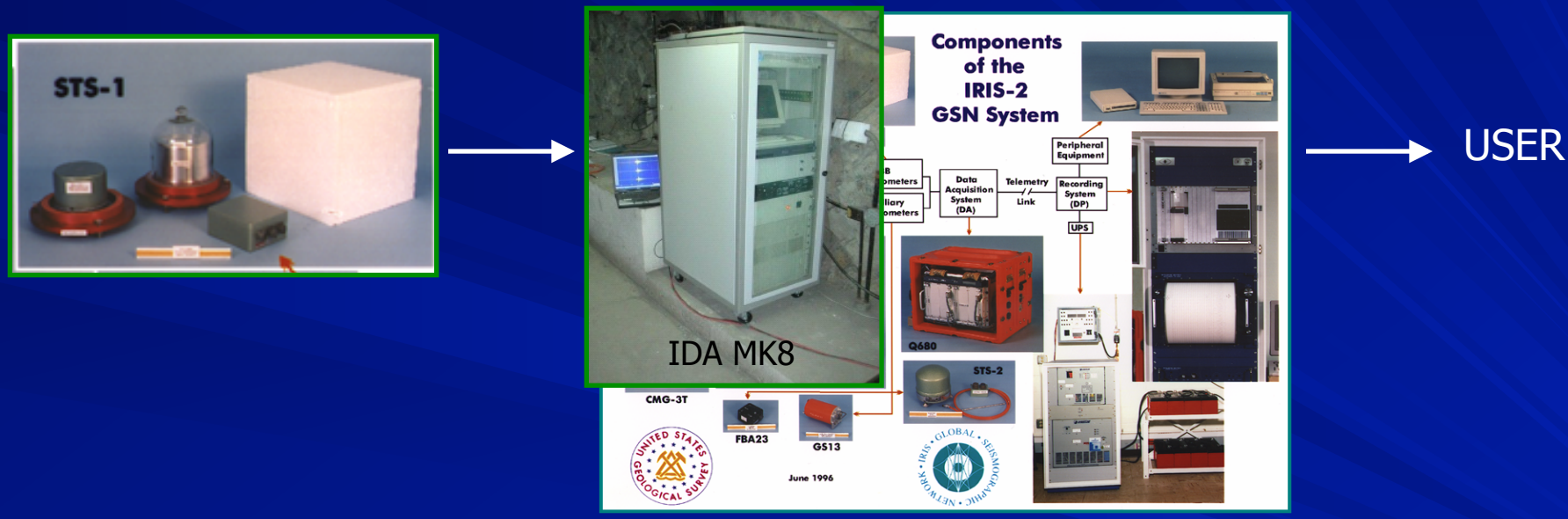
Q330 Improvements

- *Telemetry Protocols Hardened. With proper DP management, 0 data are lost or overlapped upon any disconnection*
- *Reduce the power so science, not conveniently available AC power, drives the siting, and heat-related failures are eliminated.*
- *Improve timing accuracy (~100x). Simultaneous sampling.*
- *Integrate preamps*
- *Improve analog (Q330HR >24 bits, auto single-double conversion)*
- *Built-in sensor calibration signal recording.*
- *Consistent, complete SOH*
- *Design for manufacturing (ISO, CE)*
- *6 yrs & ~4000 units: ~10^6 hr MTBF*

Q330 Design Philosophy
The Well-Connected Data Engine



In prior-generation systems, general-purpose computer and communications equipment are in the critical data flow path. Although these systems may contain a data copy, recoverability is limited by a single pathway through the equipment.



prior-generation GSN systems – critical path

Experience learned in ~3500 data loggers in 20 years has moved us away from general-purpose computer systems in high-reliability environments.

General-purpose computer equipment are moved out of the critical data flow path. Close to the sensor there is a redundant data copy in high-reliability hardware that consumes very little power. User systems may continue to provide other services and “normal” data flow paths.

core on-site data repository
high-reliability
minimal power
close to sensor

Diverse data paths
maximize recovery

USER

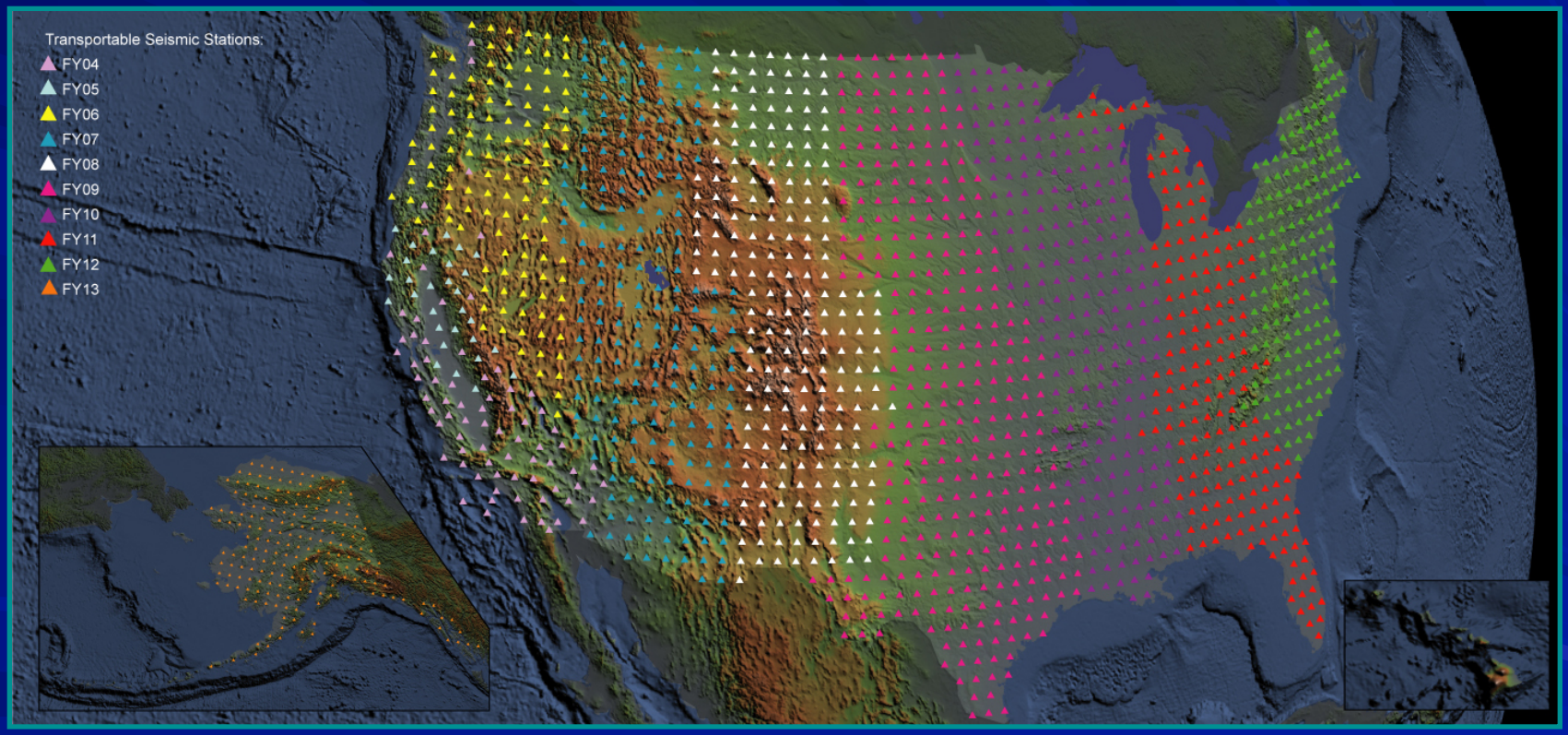
user systems

Fourth generation systems architecture incorporating data flow “diversity” addresses some of the major causes of data loss. Purpose-built hardware and software contains critical elements.

How well does the new technology incorporating “diversity” work?

What kind of network can be built using real-time VBB technology?

USArray Transportable Array (TA),
…an accelerated network and systems field laboratory

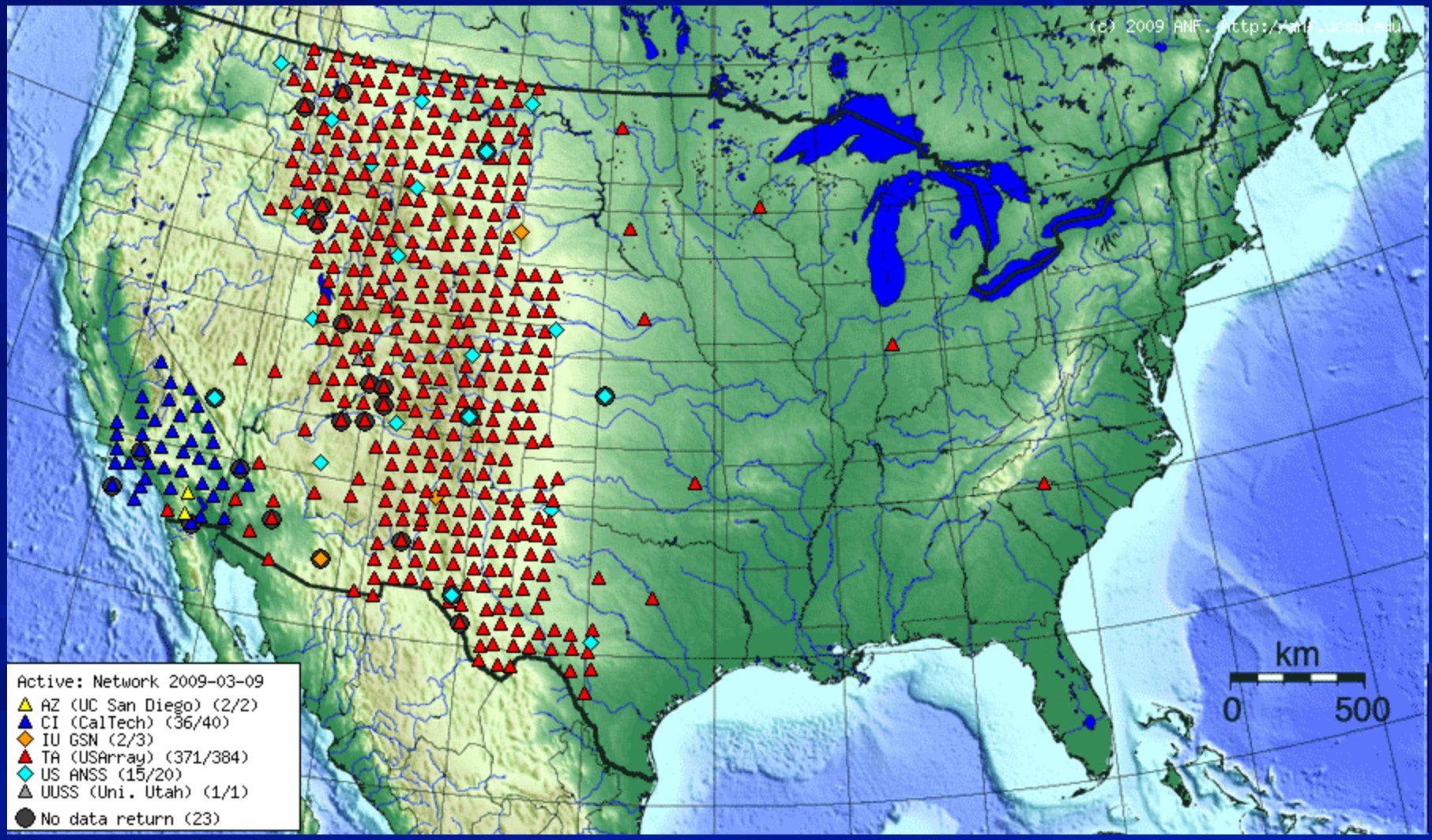


TA Project Requirements

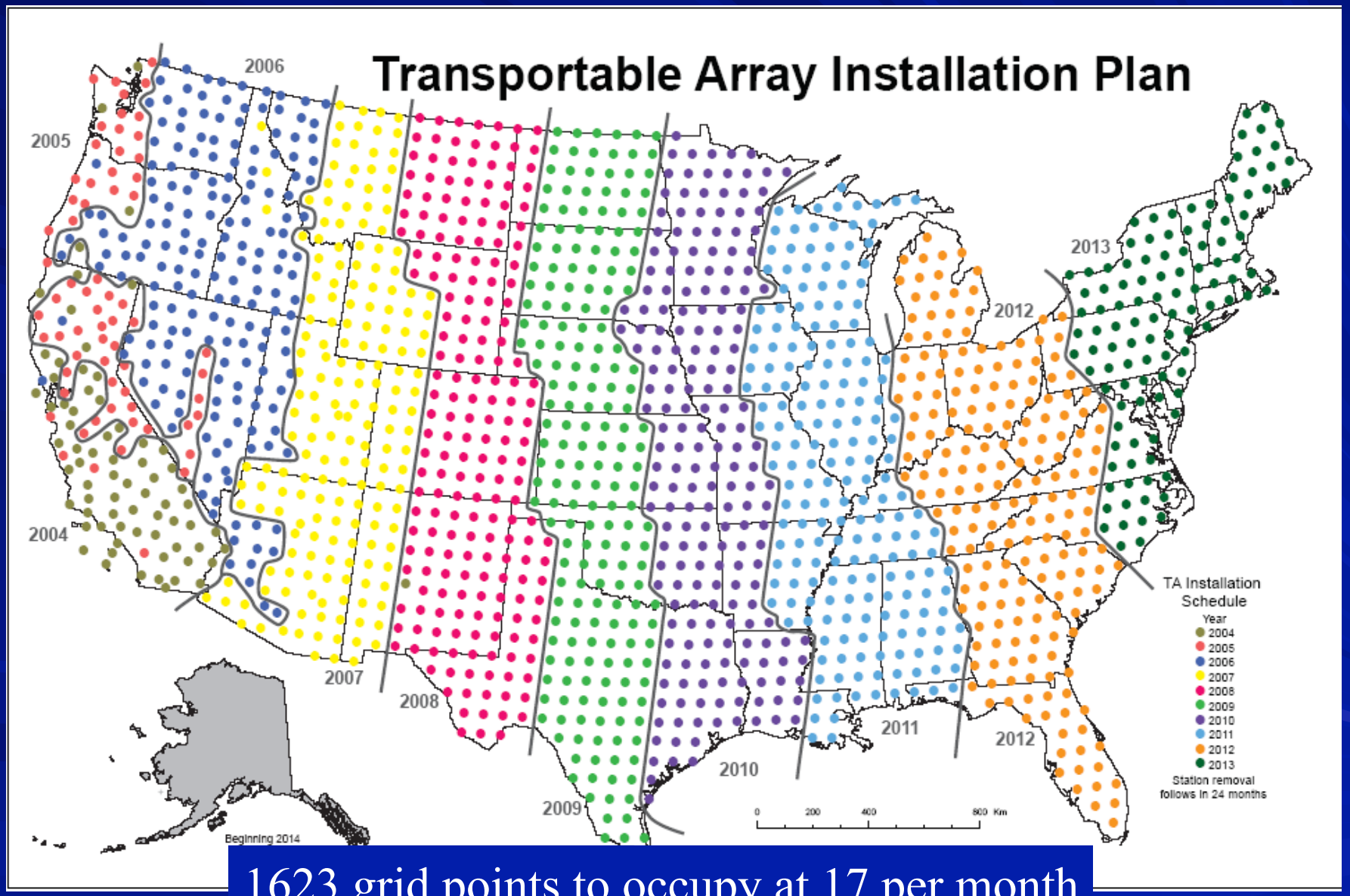
- 400 Broadband Stations on a 70km grid
- Real-time telemetry, 85% data return
- Station duration of 18-24 months
- Station equipment deployed five times
- High-Quality Long-period performance

450 Operating Stations

Geographical Status Mar 2009



The next 6 years…

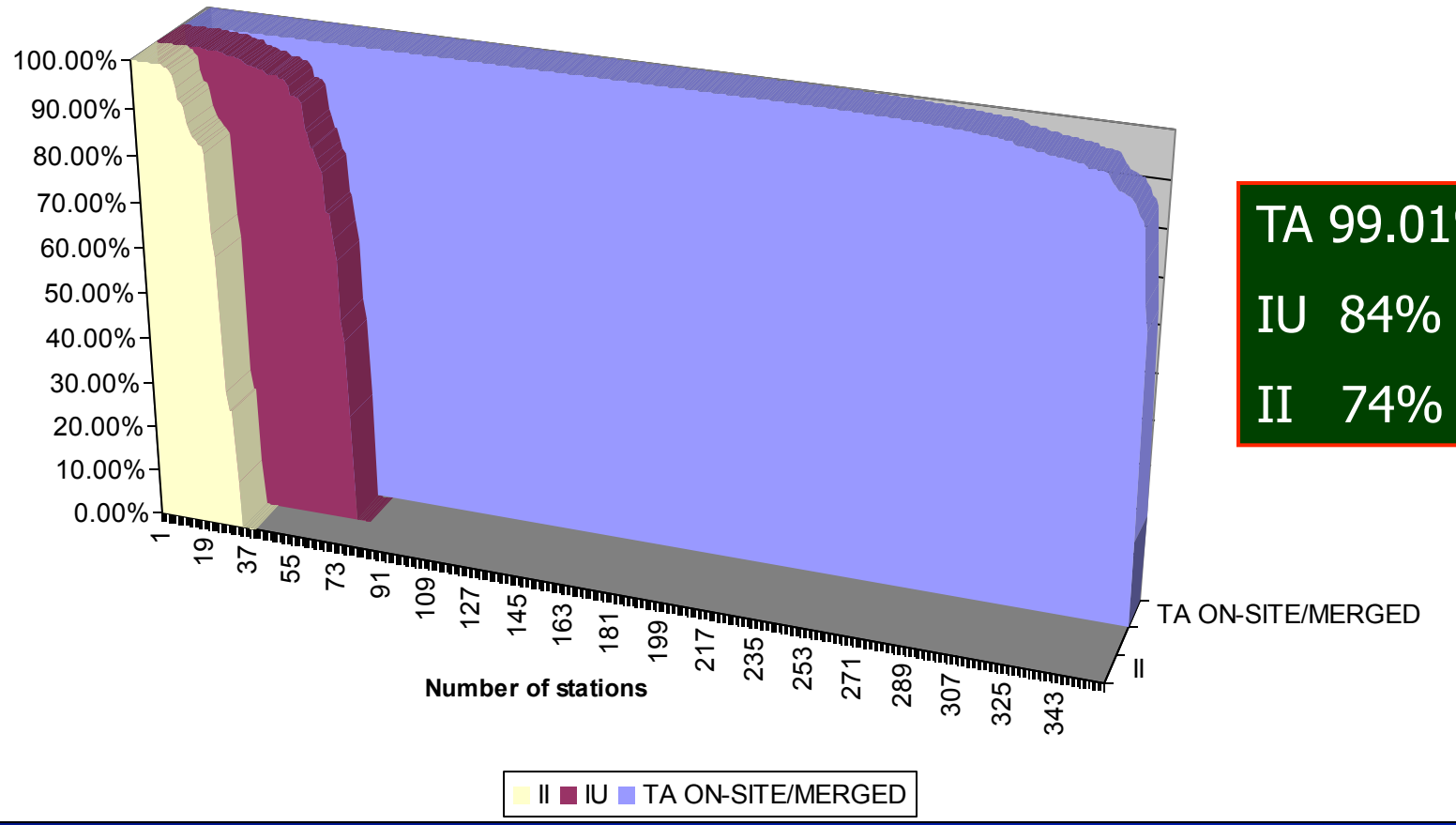


1623 grid points to occupy at 17 per month

Design Principles of Station

- Low power to avoid cultural noise sources and to maximize siting opportunities. 3-5W solar powered.
- compact design, to ease siting.
- Fast construction, uniform and modular.
- available materials, transport costly
- high quality LP data requires thermal isolation.
- High power comms isolated from station power.
- Local recording, minimum complexity in uplink

6-Month Sample Total Data Availability – II,IU,TA



TA 99.01%

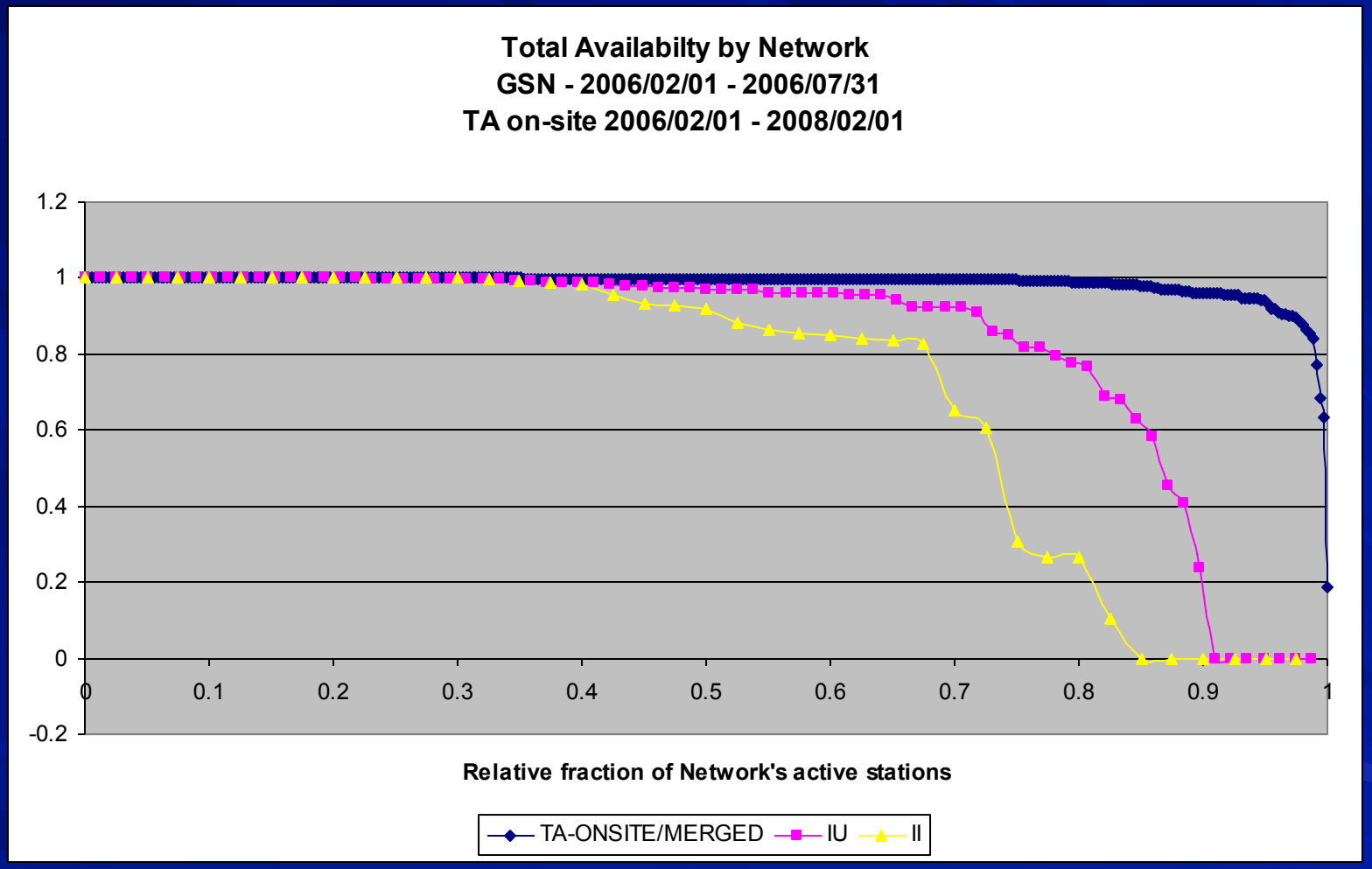
IU 84%

II 74%

TA “diversity” (on-site & ANF) achieves demonstrated >99% recovery

TOTAL AVAILABILITY RELATIVE TO ALL STATIONS BY NETWORK (TA, IU, II)

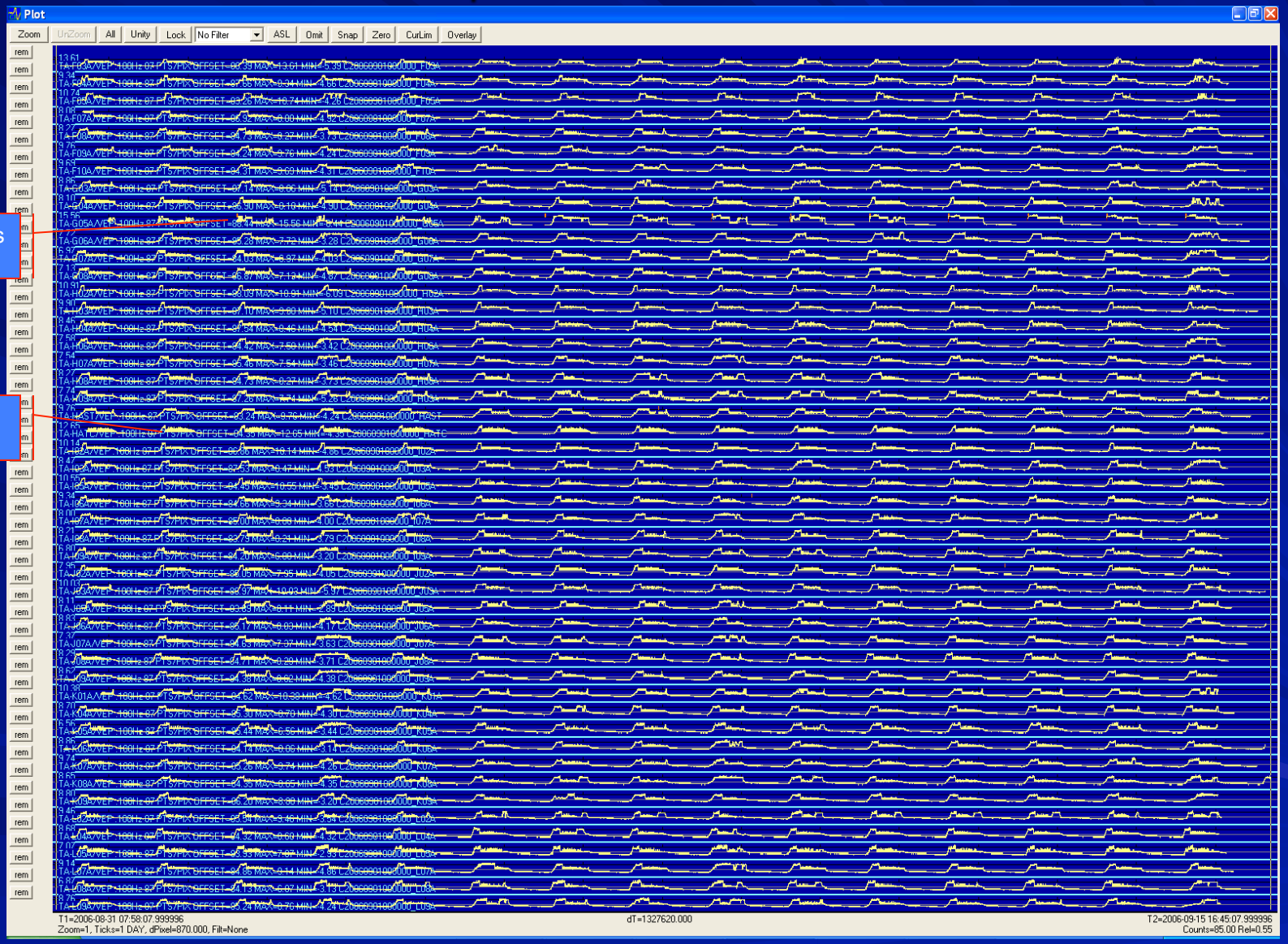
Each dot is a station



present-generation GSN technology and “diversity” used in TA

Examples of SOH analysis – sensor magnetic interference

2 weeks, solar power, 50 USArray TA stations: rapid SOH assessment



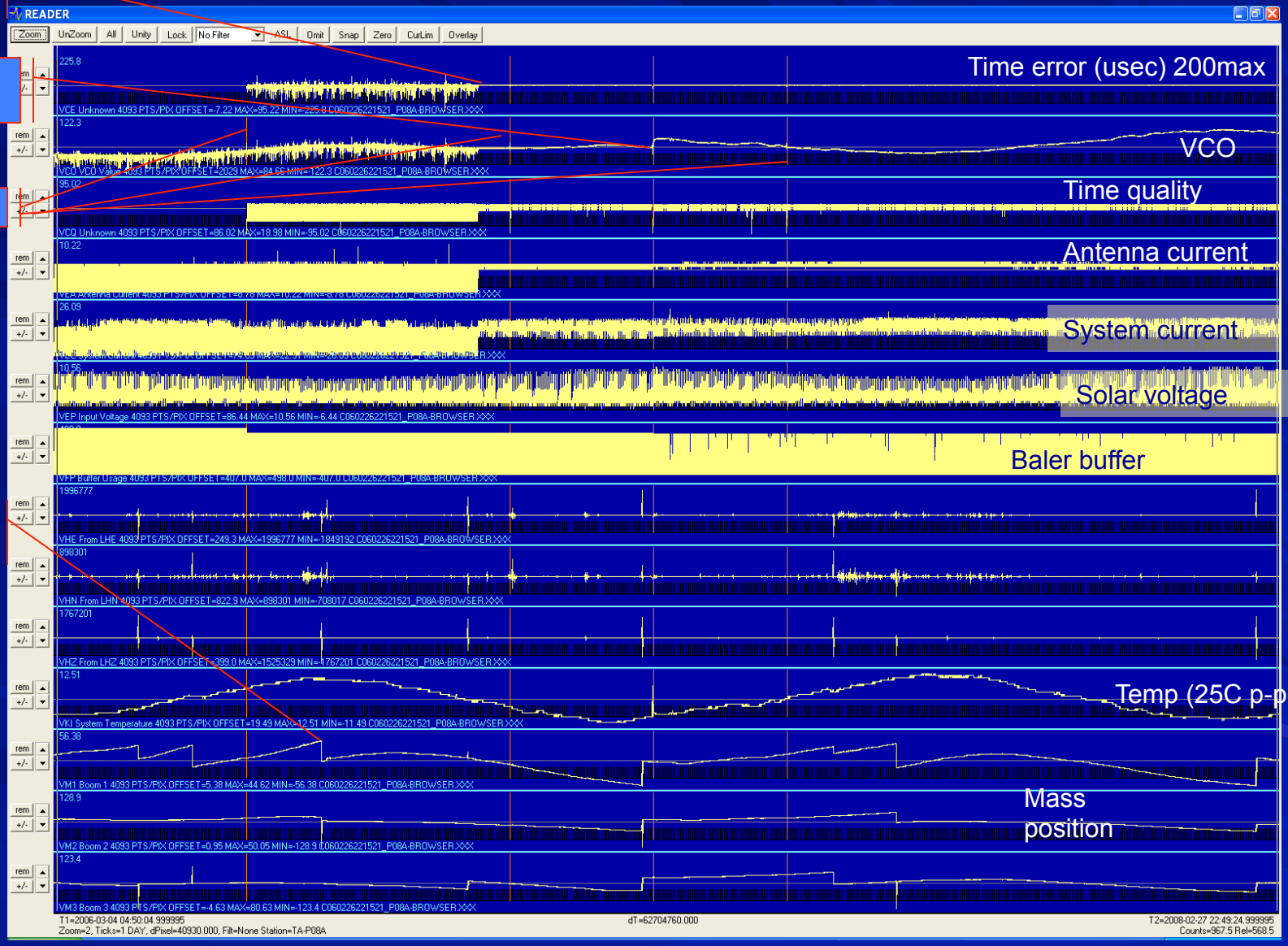
2 years, all SOH channels. Typical end-of-deployment baler data recovery

GPS continuous

exchange Q330

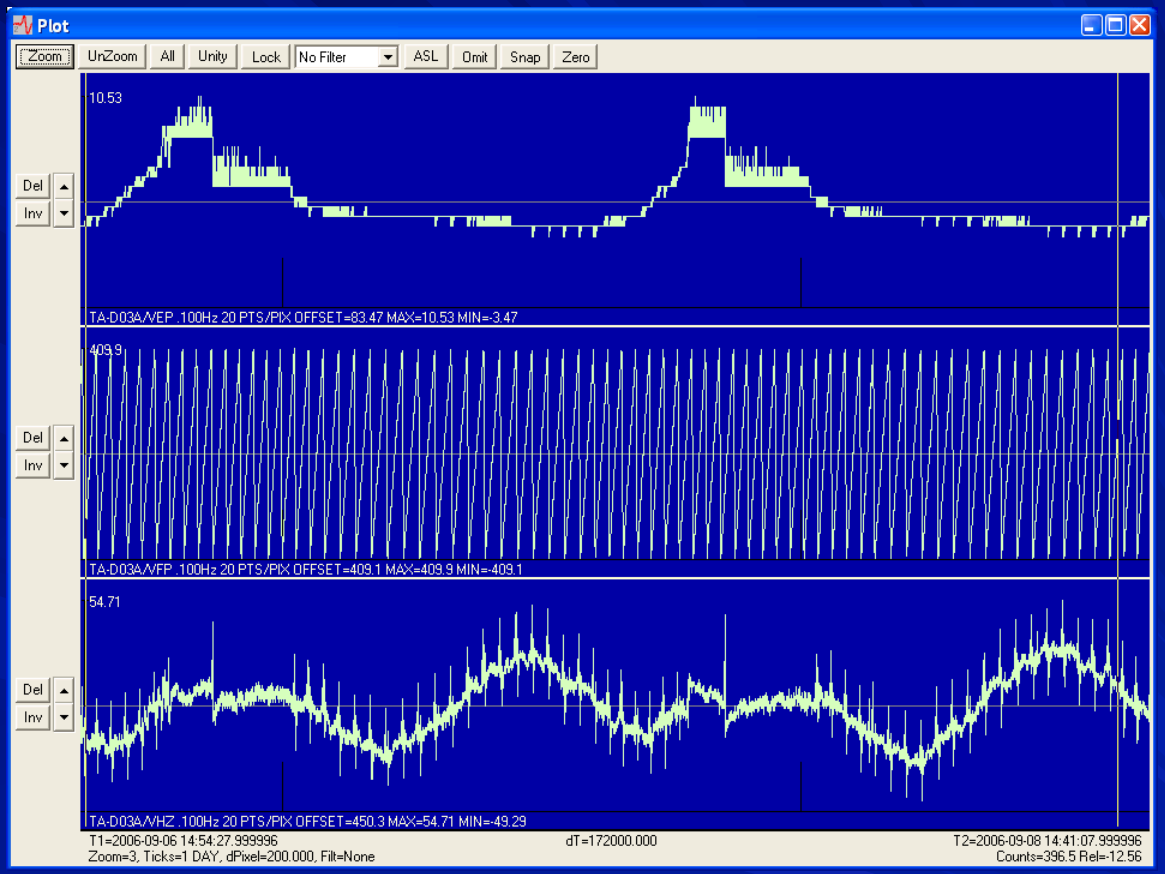
reboots

recenter sensor



Time-synchronous SOH data assists diagnosis of magnetic effect on seismometer

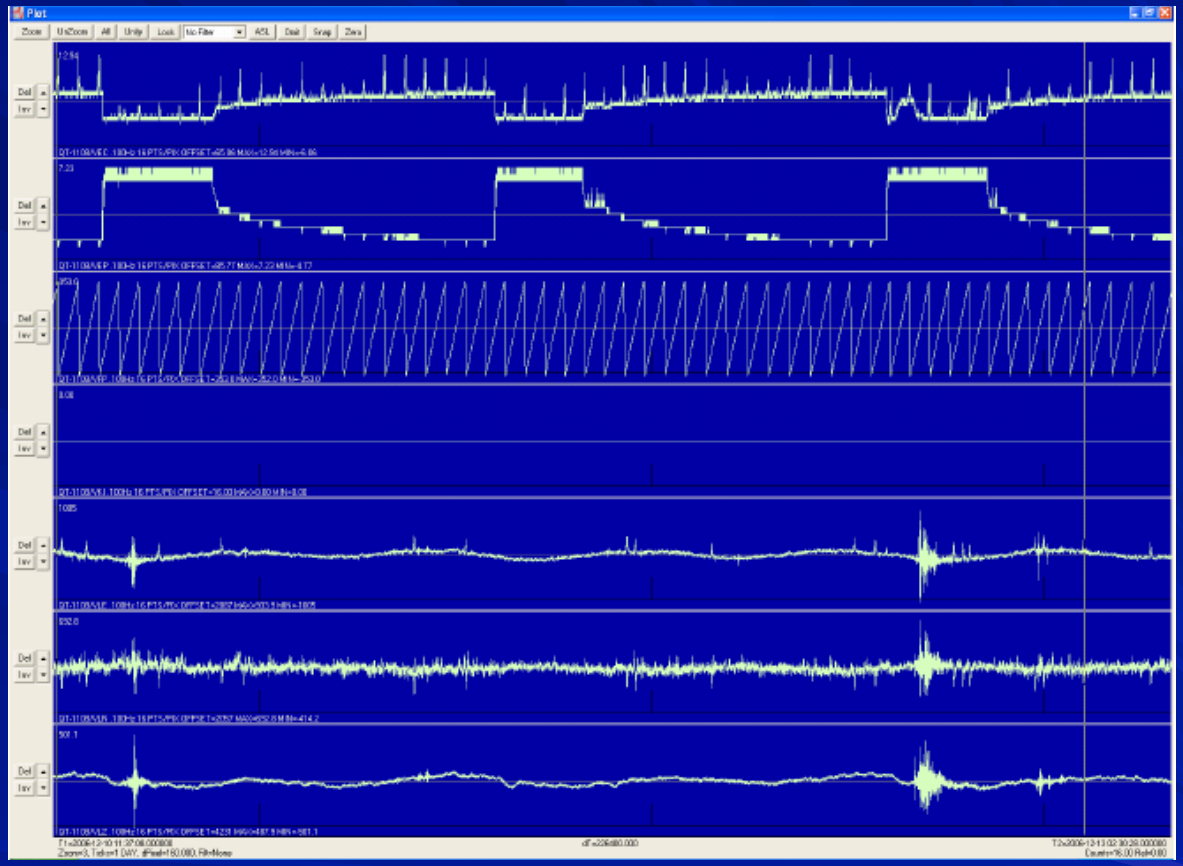
Effect seen in T240, CMG3, and STS-2



Approximately 2 days of STS-2 vertical (VHZ) data. Here, very strong effects of variation in primary power during daily battery charger cycling from 12.6 to 13.8 VDC (VEP) and during power system load steps when Baler cycling is active (VFP) are seen in the VHZ STS-2 vertical data superimposed upon the earth tide.

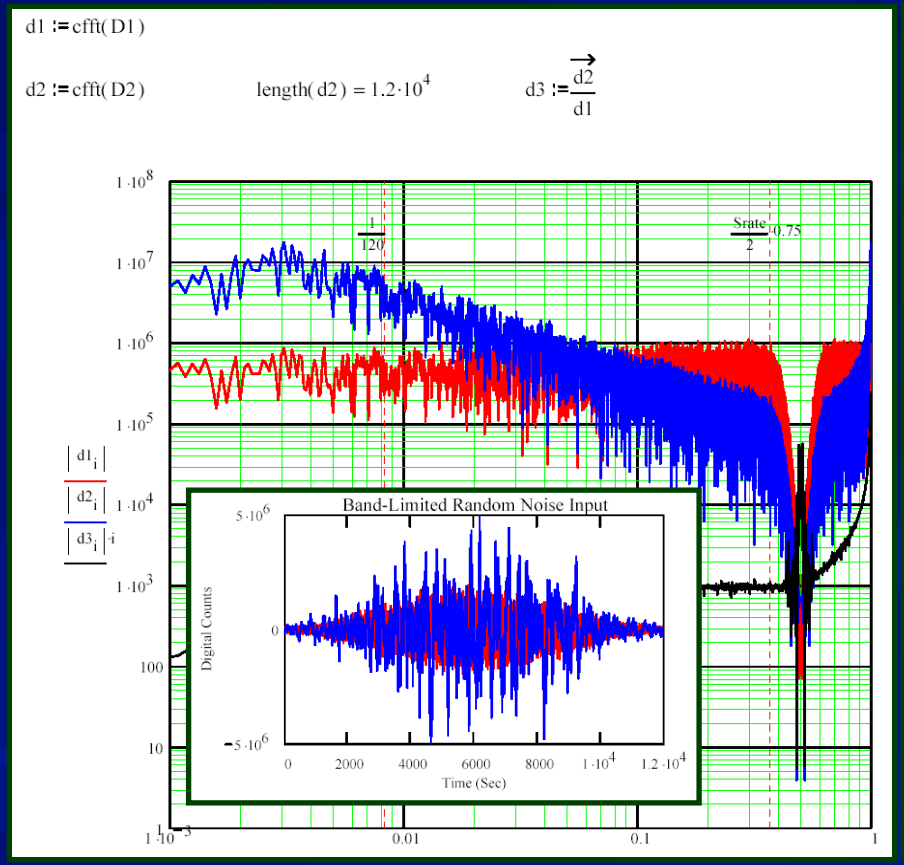
The problem is caused by current flowing from the battery when there is no sun. Cables connecting the solar charger to the battery pass within 1/2m of the sensor. When the sun is supplying power, little current passes through the cables to the battery, instead directly supplying the station equipment. The solution is to move the battery and cables another 1/2m away from the sensor. Problem disappears.

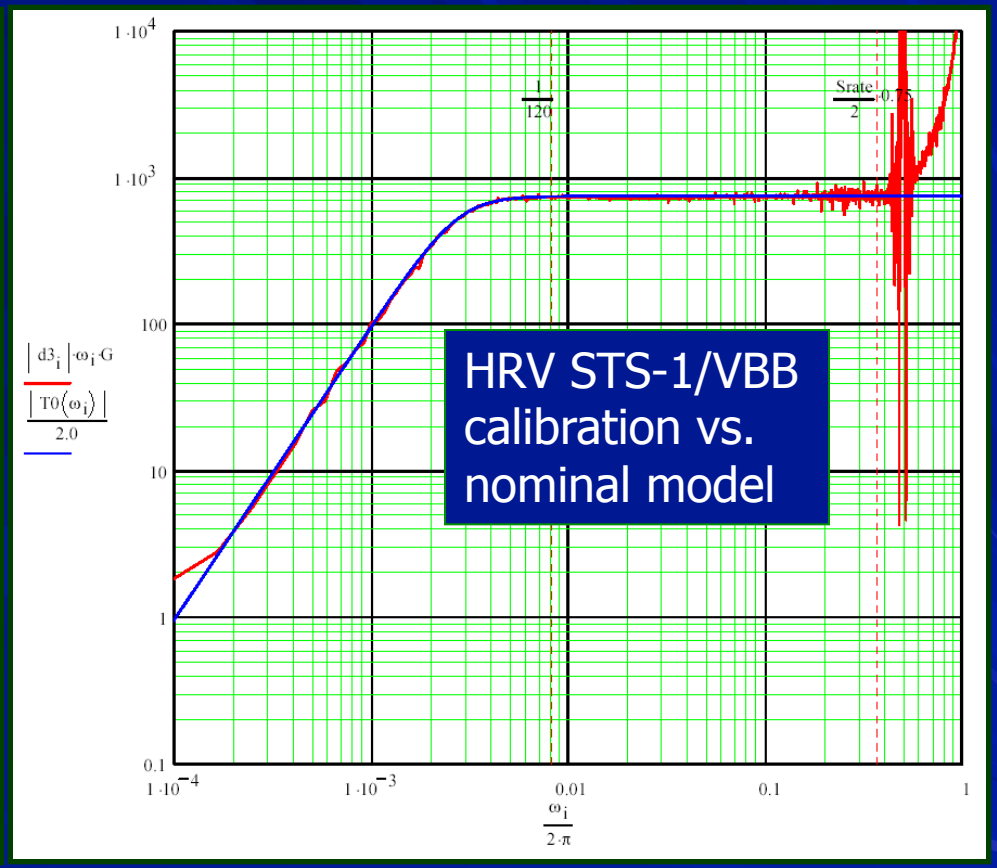
Problem Gone



Sensor Transfer function Calibration using the Q330

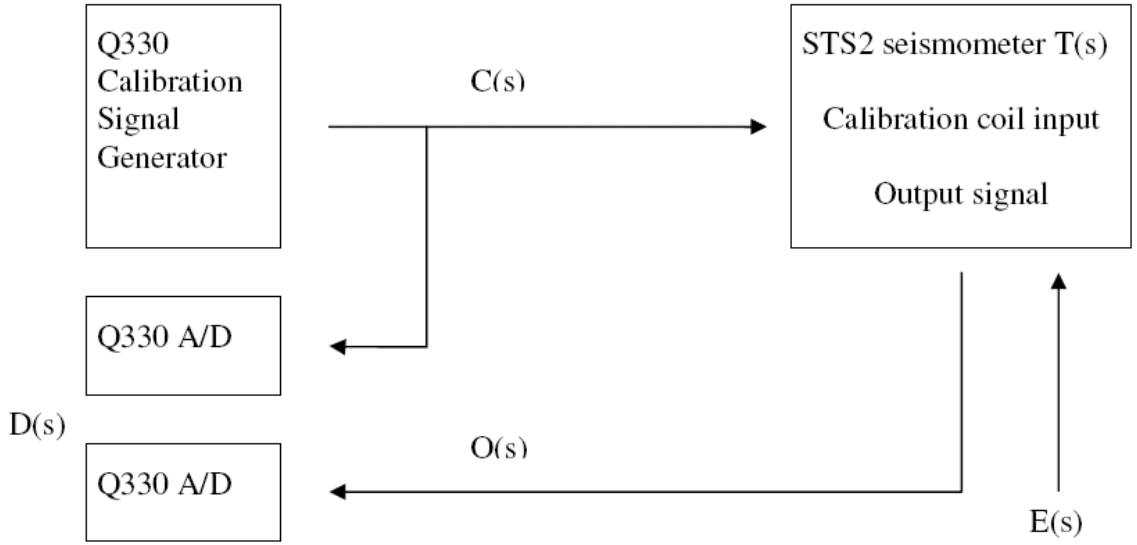
Simple robust in-situ network-wide freq response analysis using Q330HR's arbitrary signal capability





The GSN's new Q330HR enables uniform arbitrary signal calibration (cal signal recording) of any conforming sensor using a uniform, robust, simple, and fast procedure suited to automation.

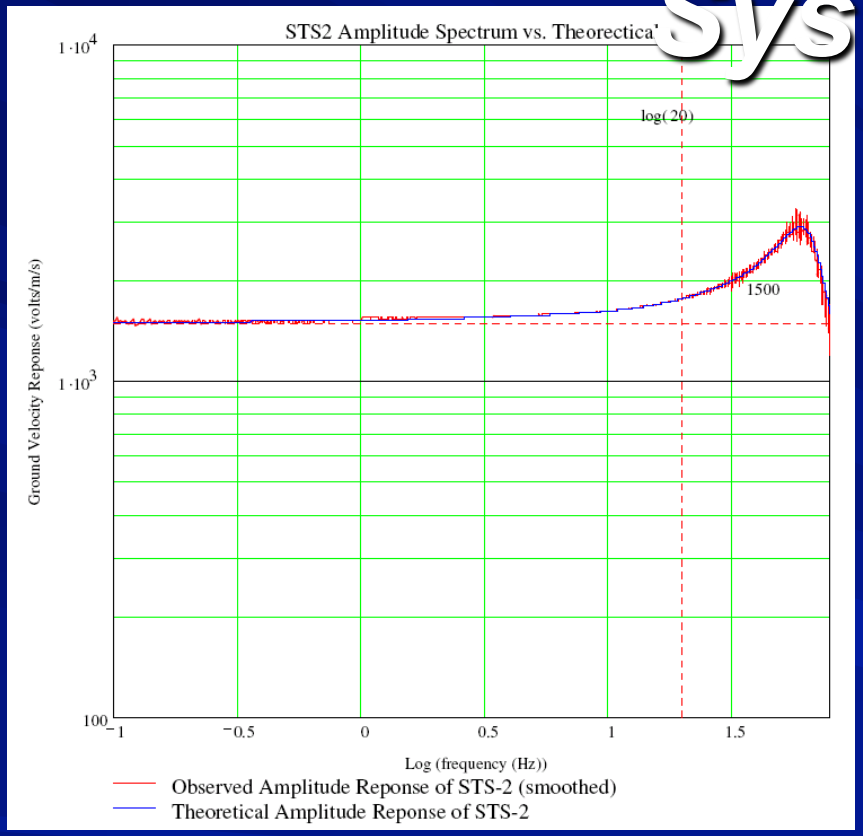
Quanterra Q330 Arbitrary Signal Calibration Revised 20070614

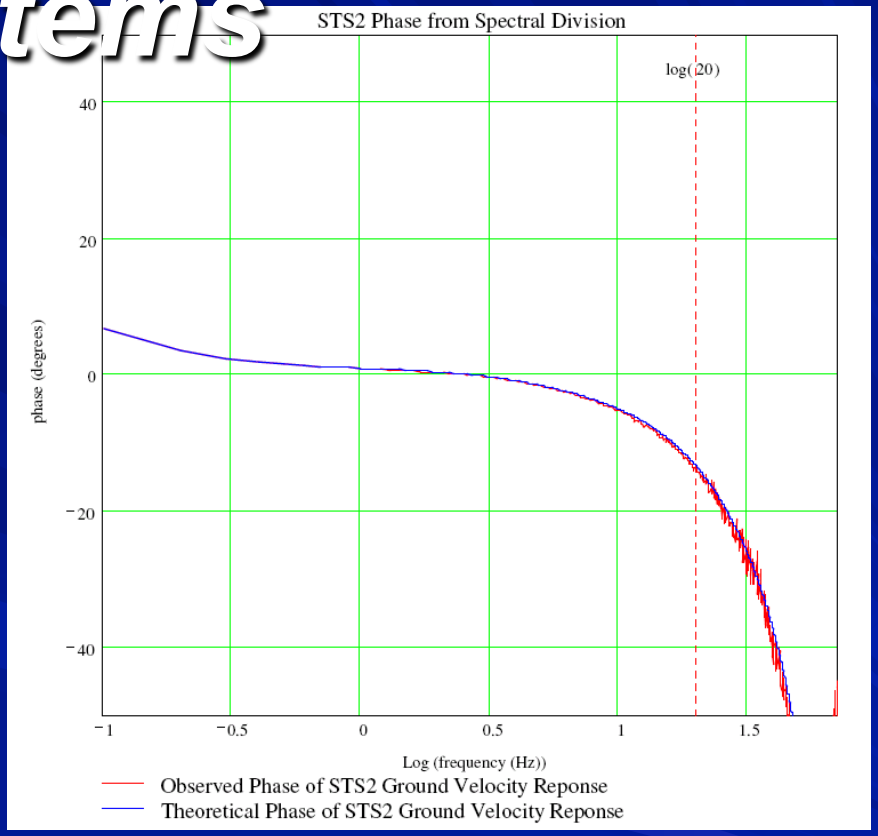


"Arbitrary Signal" Calibration capability of Q330 illustrated with an STS-2.

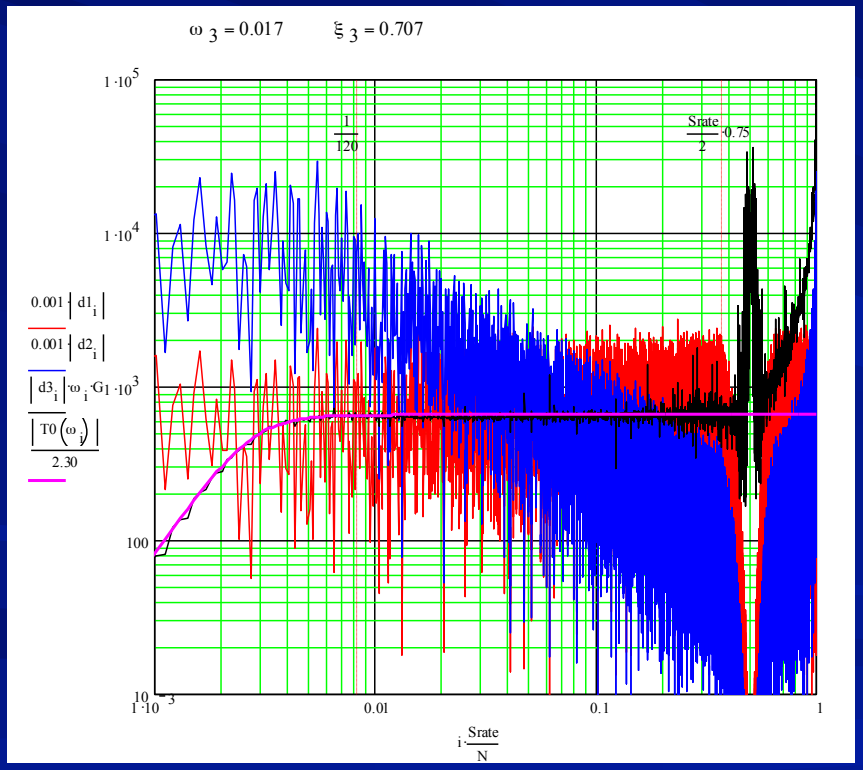
The Q330 incorporates a unique capability not only to apply a variety of calibration signal source waveforms to a seismometer under test, but also to *record* the stimulus signal while recording the seismometer's output. The transfer function of the seismometer, T(s), can then be recovered with a high degree of precision because the frequency response of the digitizer, and any specific assumptions about the frequency content or calibration signal waveform, are not required and do not affect the measurement.

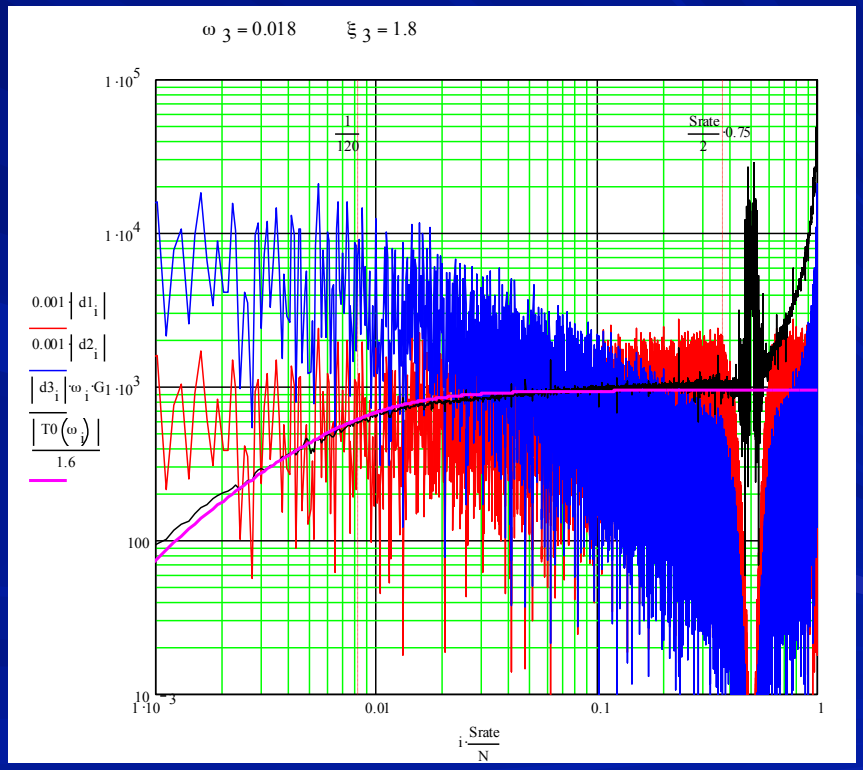
Calibrated Sensors and Systems





STS-1 Mechanical





Absolute calibration of low-frequency response asymptote using tides

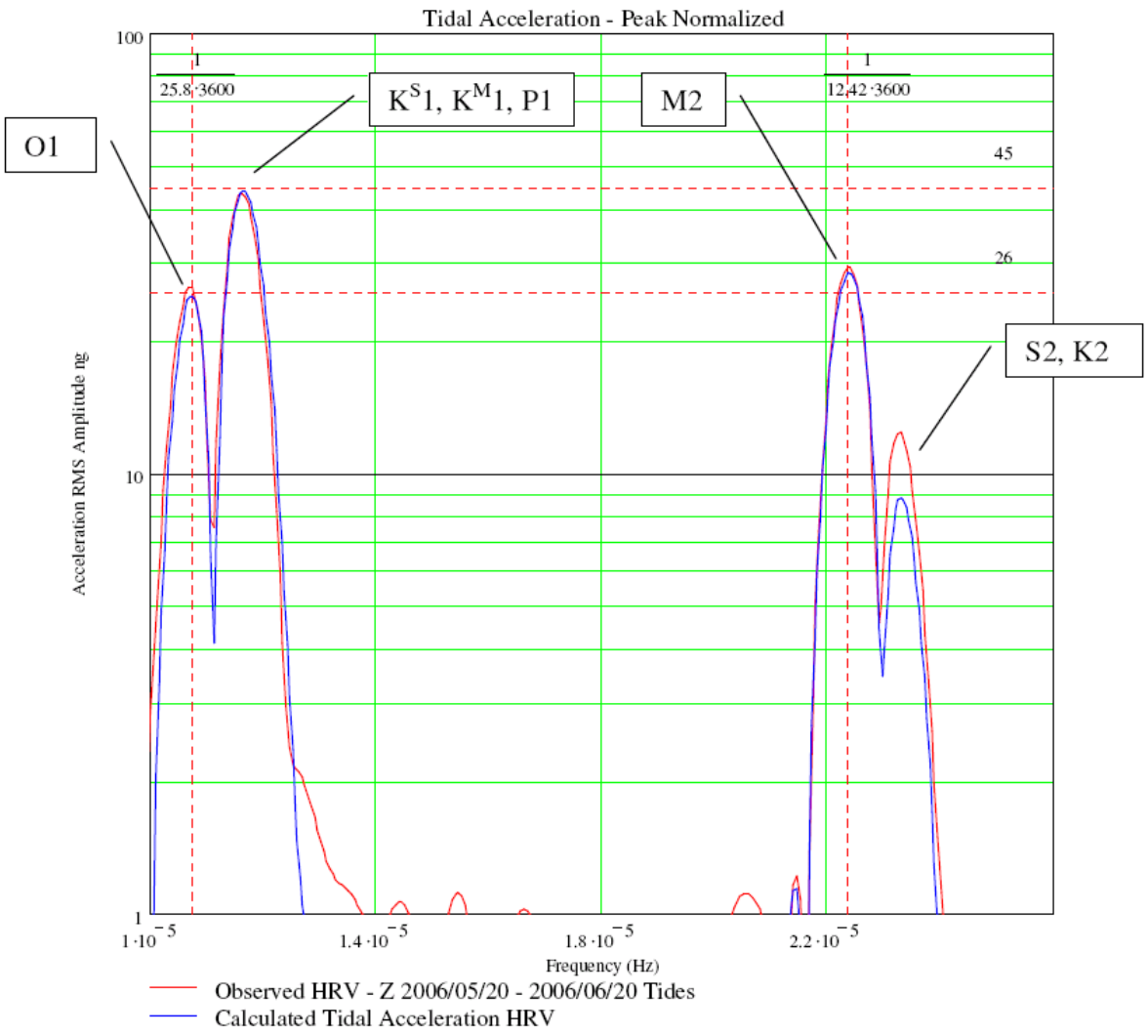


Figure 6 One-month vertical STS-1 tidal observation at HRV (RED) compared with calculated (BLUE) tidal spectra. Scale is absolute acceleration (nano-g), normalized to retain height of the spectral peaks (not power) after Blackman windowing. Major calculated constituents match closely with observation except for the solar semi-diurnal component. Ocean loading is a possible contributor to the observed tides that is not accounted for in the calculation. HRV is located about 35 mi from the Atlantic Ocean.

Orientation

Ekstrom measurements are found and described at:

http://www.ldeo.columbia.edu/~ekstrom/Projects/USARRAY/POLARIZATION

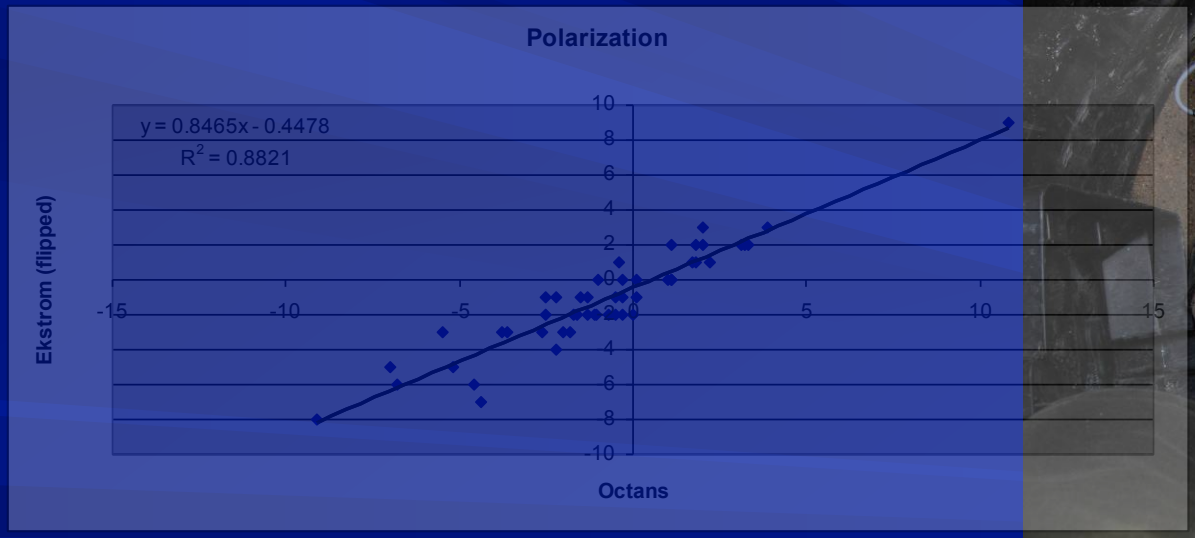
Network	# Obs.	0°–3°	4°–6°	7°–9°	10°–90°
All	467	75.4% (352)	14.1% (66)	6.0% (28)	4.5% (21)
TA	358	79.6% (285)	12.8% (46)	4.8% (17)	2.8% (10)
US	43	53.5% (23)	23.3% (10)	7.0% (3)	16.3% (7)
CI	41	56.1% (23)	17.1% (7)	17.1% (7)	9.8% (4)
BK	20	90.0% (18)	10.0% (2)	0.0% (0)	0.0% (0)
Other[a]	5	60.0% (3)	20.0% (1)	20.0% (0)	0.0% (0)

[a]These five stations are from the AZ and NN networks.

Orientation

Octans refers to an IXSEA Octans IV interferometric fiber optic Gyroscope
http://www.ixsea.com/en/products/002.001.002.001/octans.html

Measure 49 TA stations vs Ekstrom estimate



The polarization estimate is within a 1.1 degree Std dev of the measured orientation

Unexplained behavior

Non-linear “station” behavior, such as seen by *e.g., Zahradnik and Plesinger*, 2005

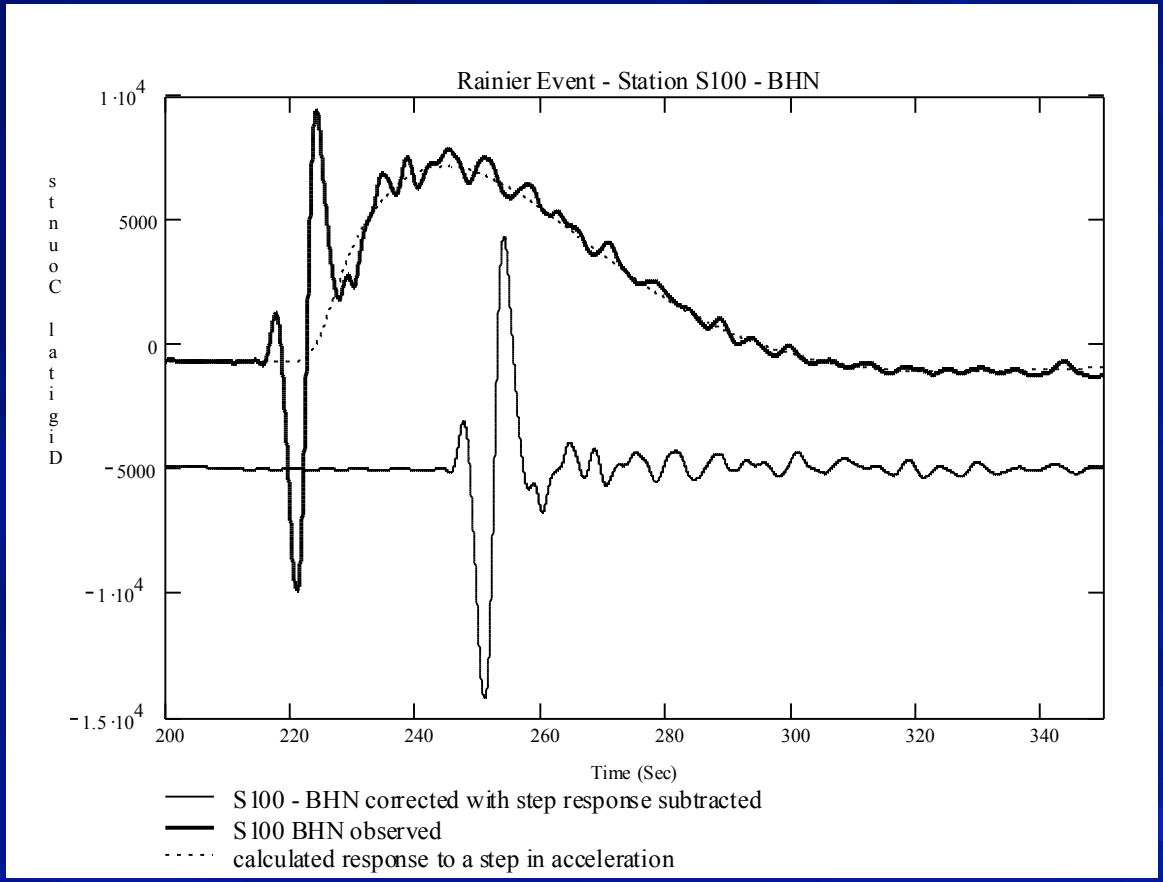


Figure 8. The signal recorded on station S100 (BHN) is almost an ideal acceleration step response – an analytic step expression does a good job of describing it sufficient to removing it, resulting in a corrected, interpretable seismogram. Peak acceleration 1.4 μm/s^2

Stations with non-linear anomalies (CA 2004)

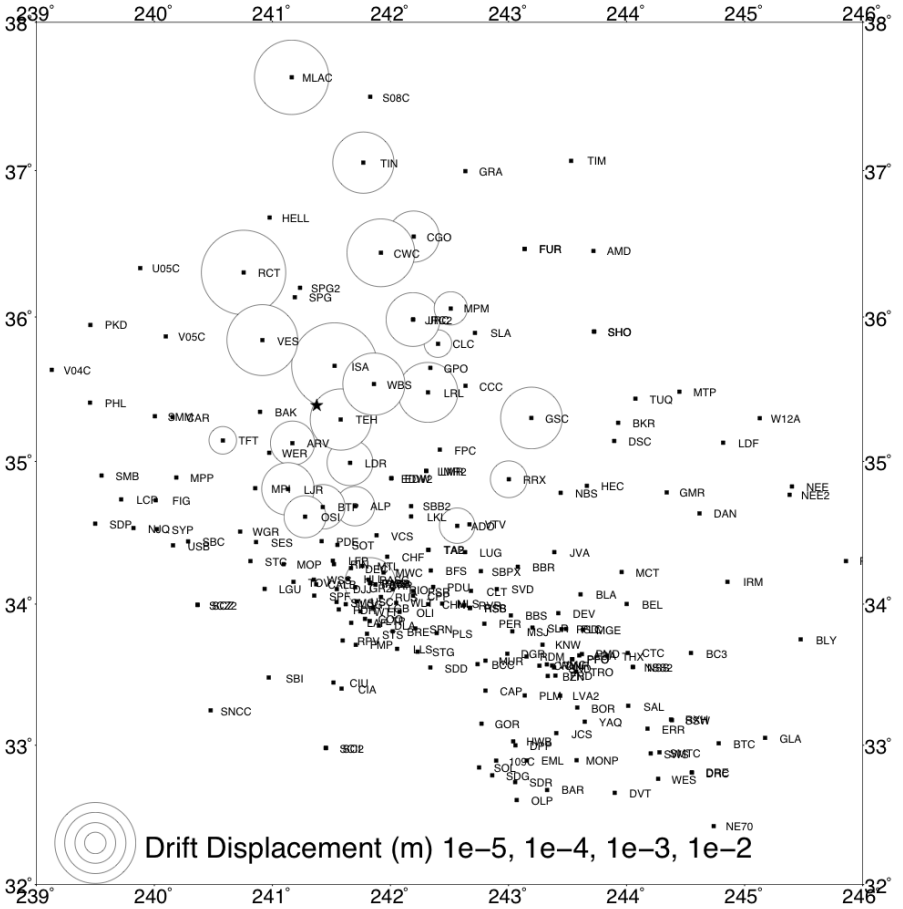


Figure 6. "Drift Displacement" for California event (09/29/2004, M5.0). Drift displacement is determined by viewing the displacement response and determining how much the mean of the signal drifts from zero. See figure 1c for an example. The earthquake location is indicated by star near station TEH. Circle size indicates the relative drift amplitude using a log scale.

News

Available since last QUG/AUG

-**Baler44** USB recording system – upgrade for Baler14
-**Q330/S** Integrated USB recording
-**Q330HR** Gen 2 now full production
-**VIE** (rugged system level package, developed with IRIS)
-very cold temp systems (< -45C tested)
-lib330 software library: (comserv2, earthworm)
-Q330 timebase oscillator improvements, effective early 2008

Nearing release

-Streckeisen AG, **STS-3**
-**QEP** Environmental Processor: pressure, meterological, SD-12

Next-Generation Developments

-**Q3300** system (1000sps, integrated USB baler)
-borehole 330?

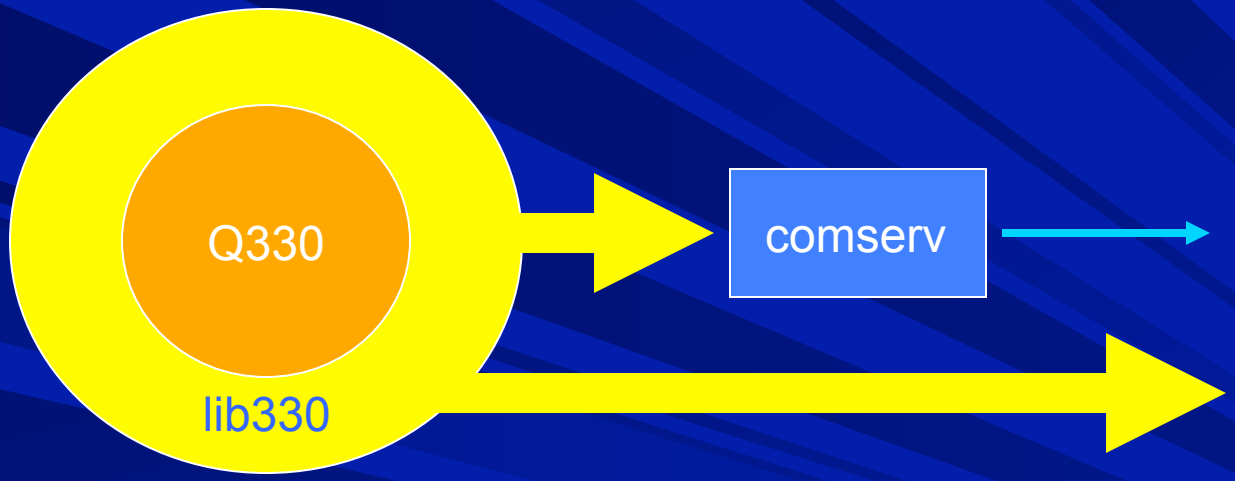
Increased Packet RAM

- *Entirely new packet memory board*
- *Now 32MB*
- *Design accomodates 64MB*
- *Ultra low power*
- *Previous partitioning of 8MB packet memory results, say, in 4MB for telemetry, and 4MB for a baler.*
- *Baler typically requires no more than 4MB, allowing up to 28MB for telemetry, or 7x increase.*
- *In stand-alone deployments using high sample rates (100,200), baler cycling can be reduced using a large buffer, resulting in effective power reduction.*
- *Increased telemetry allocation buffers typical 24hr cycles seen in telemetry throughput*
- *Now standard equipment all Q330 family*

lib330 – open-source core for Q330's

-Quanterra supported detailed management of Q330's.
-Toolbox ported to many environments (Unix, Linux, MAC, Win).
-Incorporates all facilities of Q330. Facilitates uniform view across networks.
-Rapid incorporation of new feature and reliability enhancements.
-Library capable of generating fully annotated MSEED
-Low latency data access at 1s data-packet level.
-Rigorously tested and proven code core.
-Dynamic IP address management.
-Netserv (liss) support.
-Extensive communications QOS monitoring added.
-Released, end 2006
-incorporated within Mountainair2 and Earthworm environments.

Q330 Early Notification



Latency & fine control can only be optimized using Q330 native interface.
The native Q330 interface can deliver data within a few seconds.

STS-3

STS-3

compared with STS-2 under repair in Quanterra's office, not in the HRV vault.

STS-3

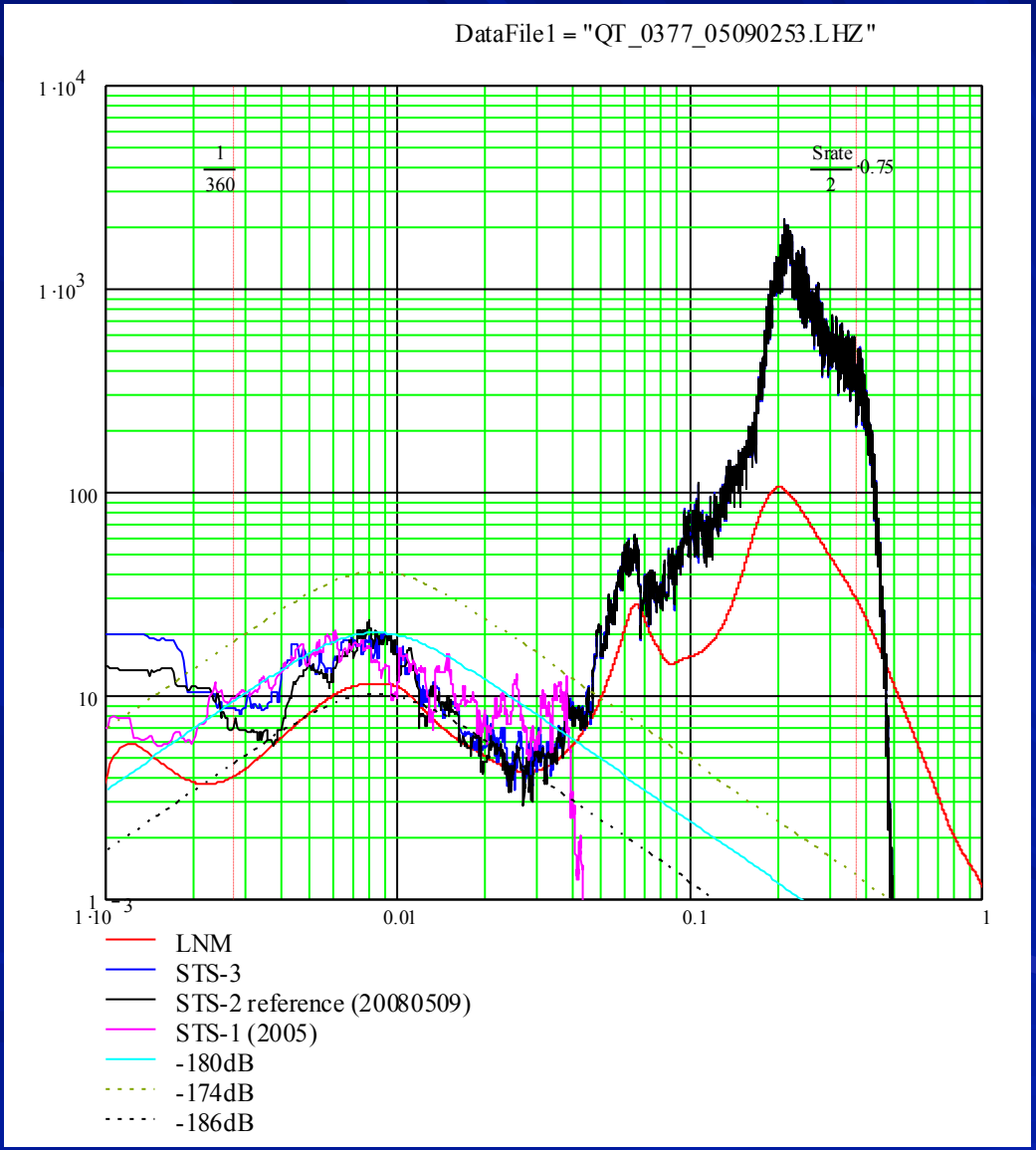
Two models of the STS-3 are being teste. All have a 120-s repsone. One model includes completely automatic:

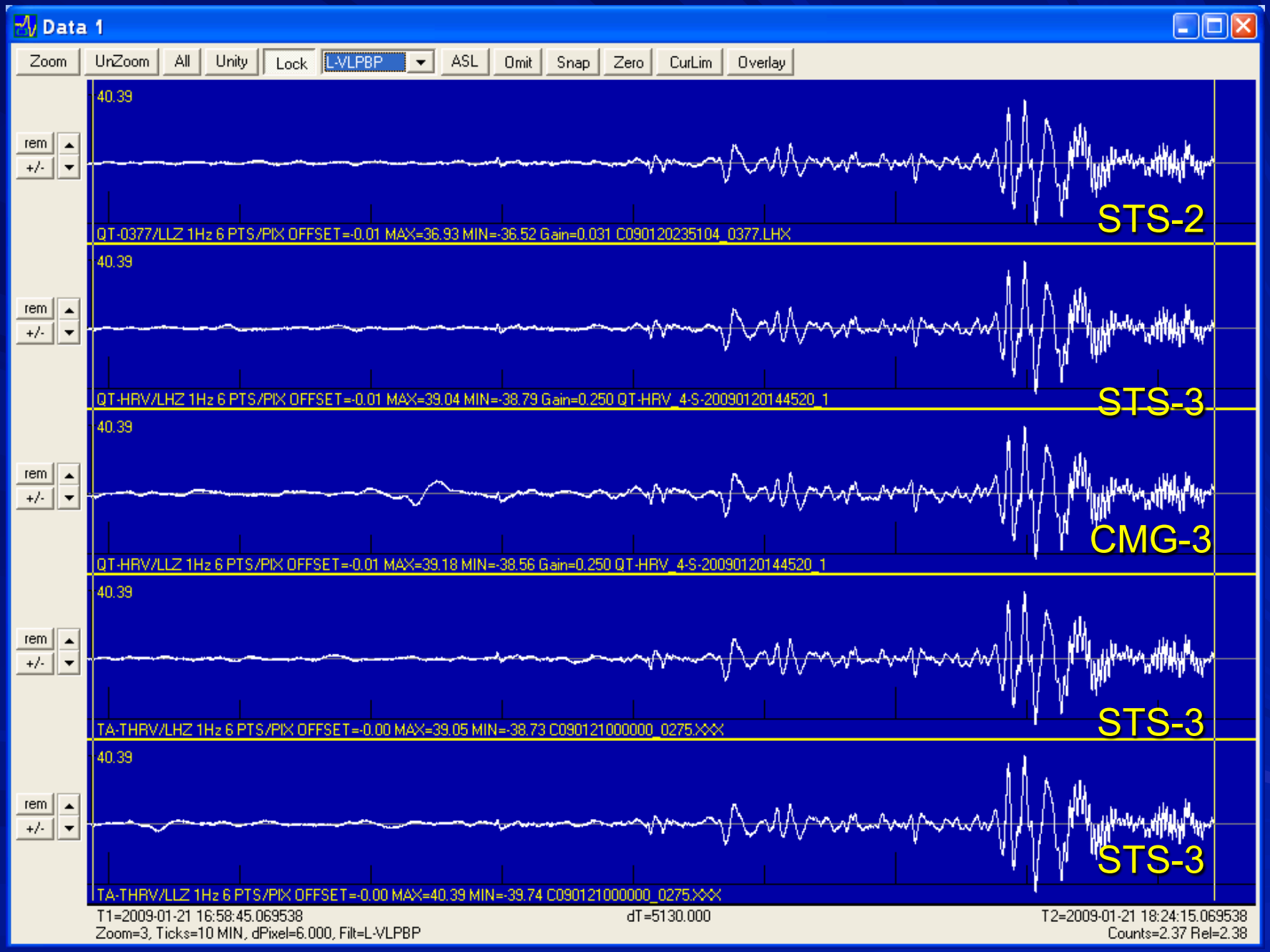
- *remote lock/unlock*
- *remote leveling with 1.5 deg*
- *remote centering*

The other model does not include the auto-levelling system.

STS-2
STS-3
STS-1

vertical




Data 1
Zoom
UnZoom
All
Unity
Lock
L-VLPBP
ASL
Omit
Snap
Zero
CurLim
Overlay
rem
+/-
40.39
QT-0377/LLZ 1Hz 6 PTS/PIX OFFSET=-0.01 MAX=36.93 MIN=-36.52 Gain=0.031 C090120235104_0377.LHX
STS-2
QT-HRV/LHZ 1Hz 6 PTS/PIX OFFSET=-0.01 MAX=39.04 MIN=-38.79 Gain=0.250 QT-HRV_4-S-20090120144520_1
STS-3
QT-HRV/LLZ 1Hz 6 PTS/PIX OFFSET=-0.01 MAX=39.18 MIN=-38.56 Gain=0.250 QT-HRV_4-S-20090120144520_1
CMG-3
TA-THRV/LHZ 1Hz 6 PTS/PIX OFFSET=-0.00 MAX=39.05 MIN=-38.73 C090121000000_0275.XXX
STS-3
TA-THRV/LLZ 1Hz 6 PTS/PIX OFFSET=-0.00 MAX=40.39 MIN=-39.74 C090121000000_0275.XXX
STS-3
T1=2009-01-21 16:58:45.069538
dT=5130.000
T2=2009-01-21 18:24:15.069538
Zoom=3, Ticks=10 MIN, dPixel=6.000, Filt=L-VLPBP
Counts=2.37 Rel=2.38

Baler44

Baler44

Quanterra Does It Again!

BALER44

Advanced USB Recorder

- Low Power!
- Up to 2 x 16 GByte of field removable USB thumb drive storage
- Hot swappable, no need to shut down the system
- Internet savvy communications and security
- 4-pin USB interface;not fragile CF
- Flat file structure, no need for special software to read the files: Linux, Solaris, MS Windows and Mac OS
- Extended temperature options
- USB thumb drive storage rated -40°C to +85°C
- Compact and rugged

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www.kinemetrics.com

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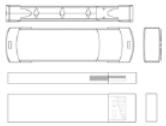
325 Ayer Rd., Harvard, MA 01451
Exclusive U.S. distributor for G. Streckeisen AG

Quanterra: 20+ Years of Leadership in Broadband Seismic Data Acquisition Systems

Baler44 features

- *Three models:*
  - *Rugged Standalone (replacement for Baler14 for use with existing Q330, Q330HR)*
  - *Embedded in new Q330/S – integrated package*
  - *Low-cost Plastic Transparent-Lid package for incorporation in user IP69 enclosure*
- *"enhanced" Lib330 based*
- *application manages power, media, and lib330 execution. ARM/linux*
- *two removable robust USB media: rugged 4-wire interface. No fragile CF*
- *-40C, +85C certified system and media (2 x 4G)*
- *Up to 2 x 16G media for typical applications (-20C +65C). 32G in development*
- *internal backup supply – power removal OK*
- *program update from media: insert media containing update. Process is automatic.*
- *file servers (ftp, http, ssh), others automatic media power on access.*
- *IP routing between interfaces. Single IP Q330; direct WAN/cellular connection.*
- *continuous power requirements ~1W, eliminates need for router*
- *Can be statically addressed or DHCP*
- *forwarding UDP access to Q330*
- *tunneling TCP access to Q330*
- *"stateless" miniseed files recording,like a tape, universally readable.*
- *simple User interface:*
  Run/Format selectable by switch
- *simple, display of operational status: "status" LED and "fault" LED – no bicolor.*
- *no special configuration and support software tools (NO BaleAddr, Reload, BalerAdmin… etc) - uses transparent standards.*
- *write-protected program for security.*
- *Flat file structure: simple file copy only needed to read media.*
- *Media readable in any host: Win, Mac, Linux*
- *Media may be exchanged without powering down.*



128MB to 4GB
Industrial Grade USB Flash Drive

STEC
www.stec-inc.com

SLUFDxxx(M/G)U1U(I)-y

- Capacity: 128MB - 4GB
- USB 2.0 Compliant
- LED activity indicator
- Customizable for logo/graphic design
- High Reliability:
  - Endurance Guarantee of 2,000,000 Write/Erase Cycles
  - Built-in Wear-leveling
  - 5 Bytes Detect/4 Bytes Correct EDC/ECC
  - Automatic Bad Block Management
  - Single Level Cell (SLC) NAND Flash Memory
  - 10 Year Data Retention
- NEBS Level 3 compliant for ESD
  - 8KV Contact, 15KV Air
- Lot Traceability
- Commercial and Industrial Operating Temperature
- RoHS-6 Compliant
- 5-Year Warranty

General Description

STEC's Industrial Grade USB Flash Drive (UFD) is more than just portable storage. Tailored for industrial applications that require high reliability and data throughput, it provides non-volatile, industrial grade solid-state storage in a thumb-drive package. In addition, laser-etched manufacturing information allows for lot traceability and complete info on the Bill of Materials.

The Industrial Grade UFD is available in a Standard enclosure with LED light indicator, or an ESD-rated enclosure for applications that require NEBS Level 3 compliancy. The ESD-rated enclosure has been tested for immunity from ESD for 8KV contact and 15KV air.

STEC's proprietary state-of-the-art USB 2.0 flash memory controller is incorporated in the Industrial Grade UFD, providing high data integrity and endurance. The flash management software that is embedded in the controller emulates a hard disk, enabling read/write operations that are identical to a standard, sector-based hard disk. Sophisticated wear leveling algorithms guarantee 2,000,000 Write/Erase Cycles, while automatic bad block management and a built-in ECC Engine guarantee the highest data reliability. Based on the Reed-Solomon algorithm, the ECC engine can detect up to 5-byte errors and correct up to 4-byte errors per 512 bytes.

High performance, high reliability and a controlled Bill-Of-Materials make the Industrial Grade UFD the product of choice in industrial applications, such as POS Workstations, Networking Equipment, automotive diagnostics and Industrial PCs.

The UFD is fully customizable to add a company logo, graphic design or text, either by silk screen or laser etching. In addition, STEC offers value-added services to OEM customers, such as pre-loaded content, custom firmware, controlled Bill Of Materials, and serialization.

Ordering Information

Industrial Grade USB Flash Drive

Part Number	UFD Form Factor	Capacity
SLUFD128MU1U(I)-y	y=A, B	128 MBytes
SLUFD256MU1U(I)-y	y=A, B	256 MBytes
SLUFD512MU1U(I)-y	y=A, B	512 MBytes
SLUFD1GU1U(I)-y	y=A, B	1 GBytes
SLUFD2GU1U(I)-y	y=A, B	2 GBytes
SLUFD4GU1U(I)-y	y=A, B	4 GBytes

Legend:

- **(M/G)** indicates if proceeding capacity (xxx) is in MBytes (M) or GByte
- **U** = RoHS-6 compliant
- **(I)** = Industrial Temperature Range (-40°C to +85 °C)
- **Part numbers without (I)** = Commercial Temperature Range (0°C to
- **(y)** = A for Standard Enclosure, B for ESD-rated Enclosure

Simple, Robust Media

Full Industrial or Commercial Rated

- 4 robust pins
- No special drivers like CF
- read in any host PC,MAC, Linux
- two 16G media

SanDisk > Products > USB Flash Drives > High Performance

SanDisk Ultra® Titanium

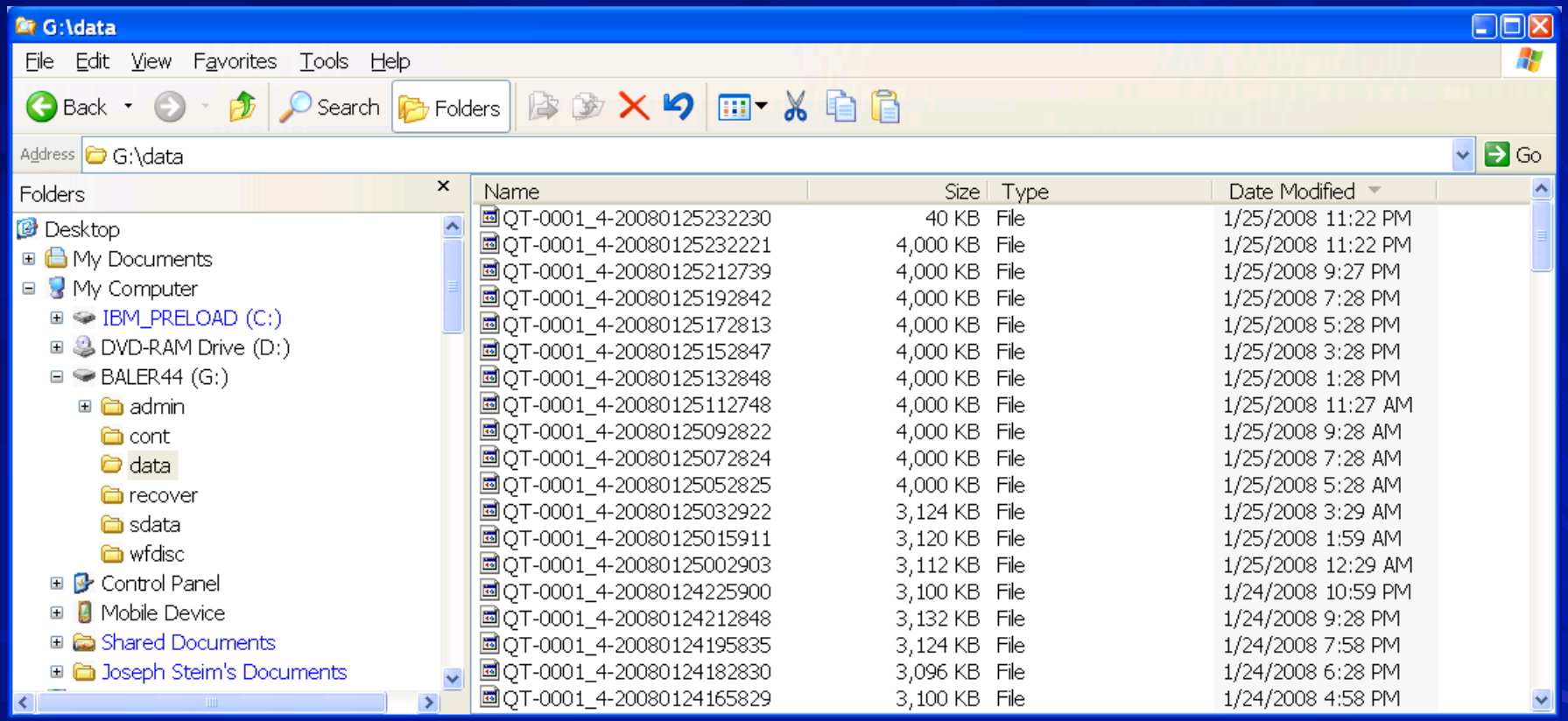
Overall Rating ★★★★½ 4.6

16 of 18 (89%) customers would recommend this product to a friend.

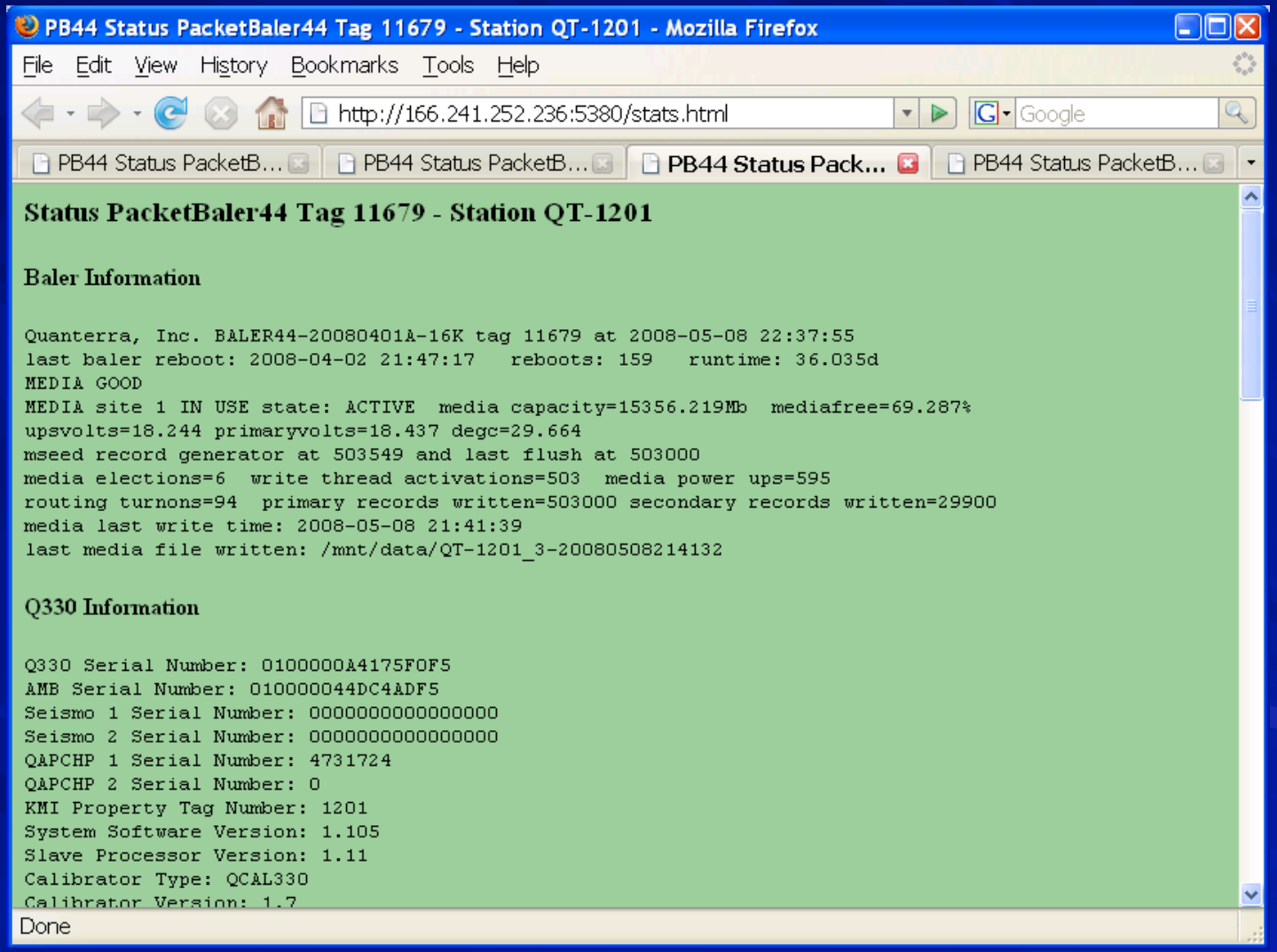
Read all 18 reviews | Write a review

Cruzer-resistant strength, state-of-the-art features, and U3™ smart-drive technology are all packed into one incredibly small high-speed device.

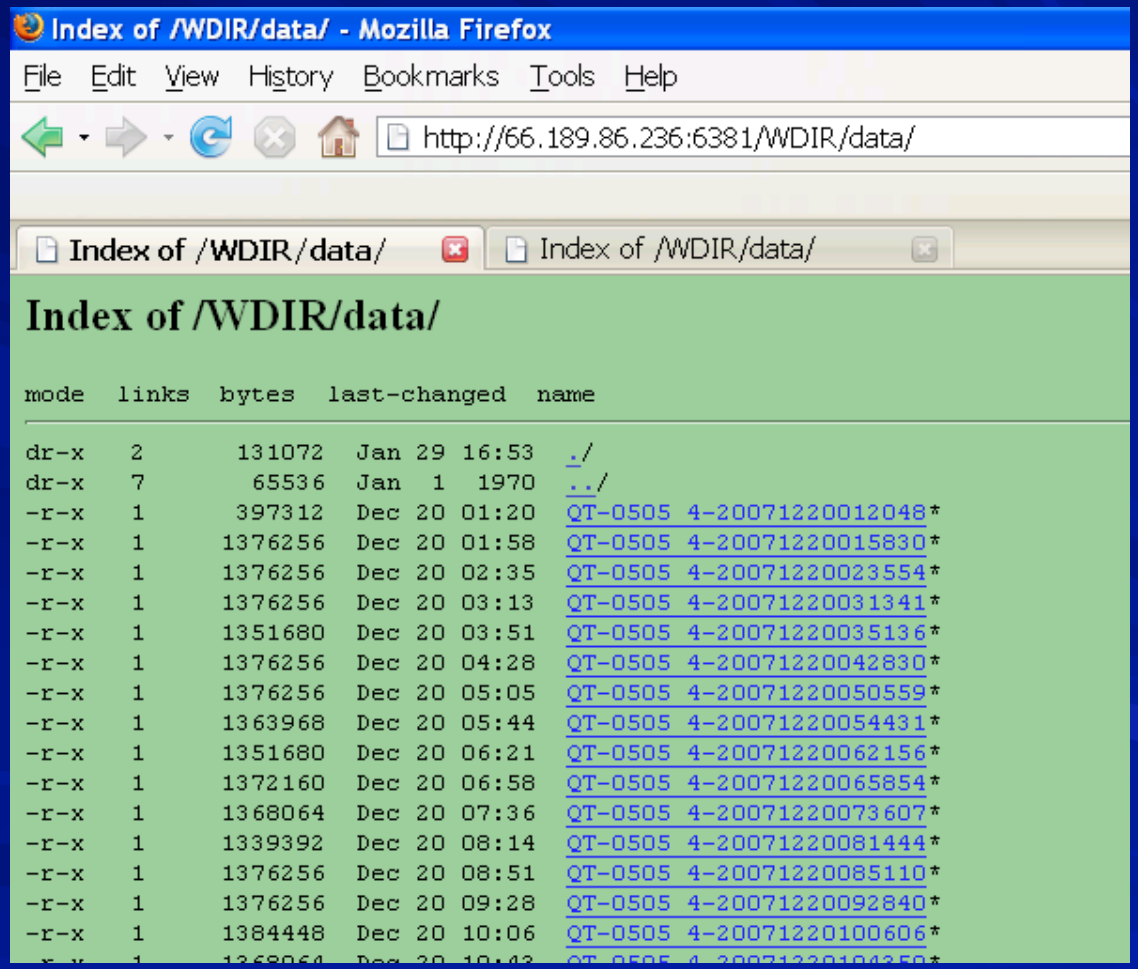
Baler44 FAT media



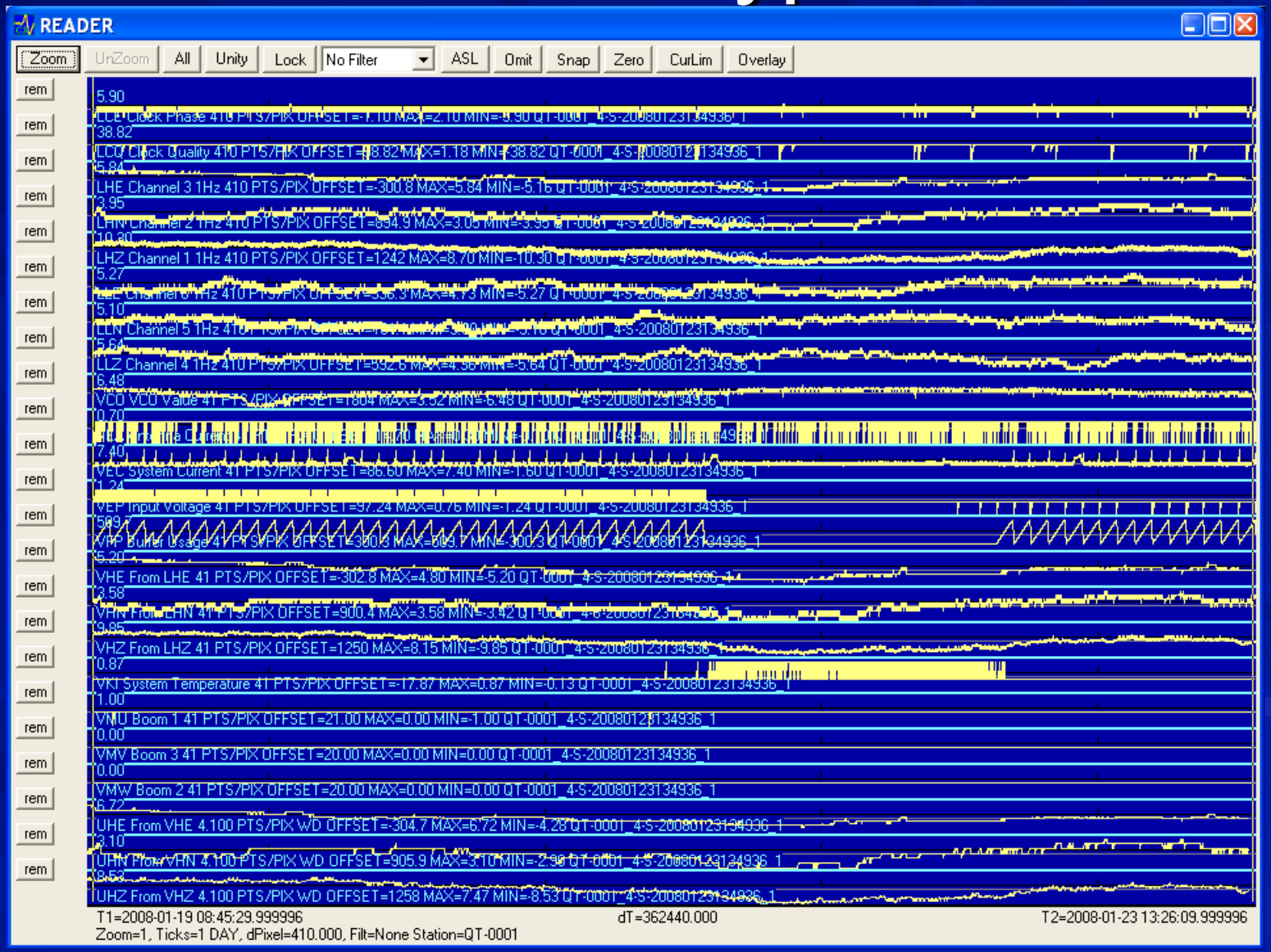
Baler44 http status



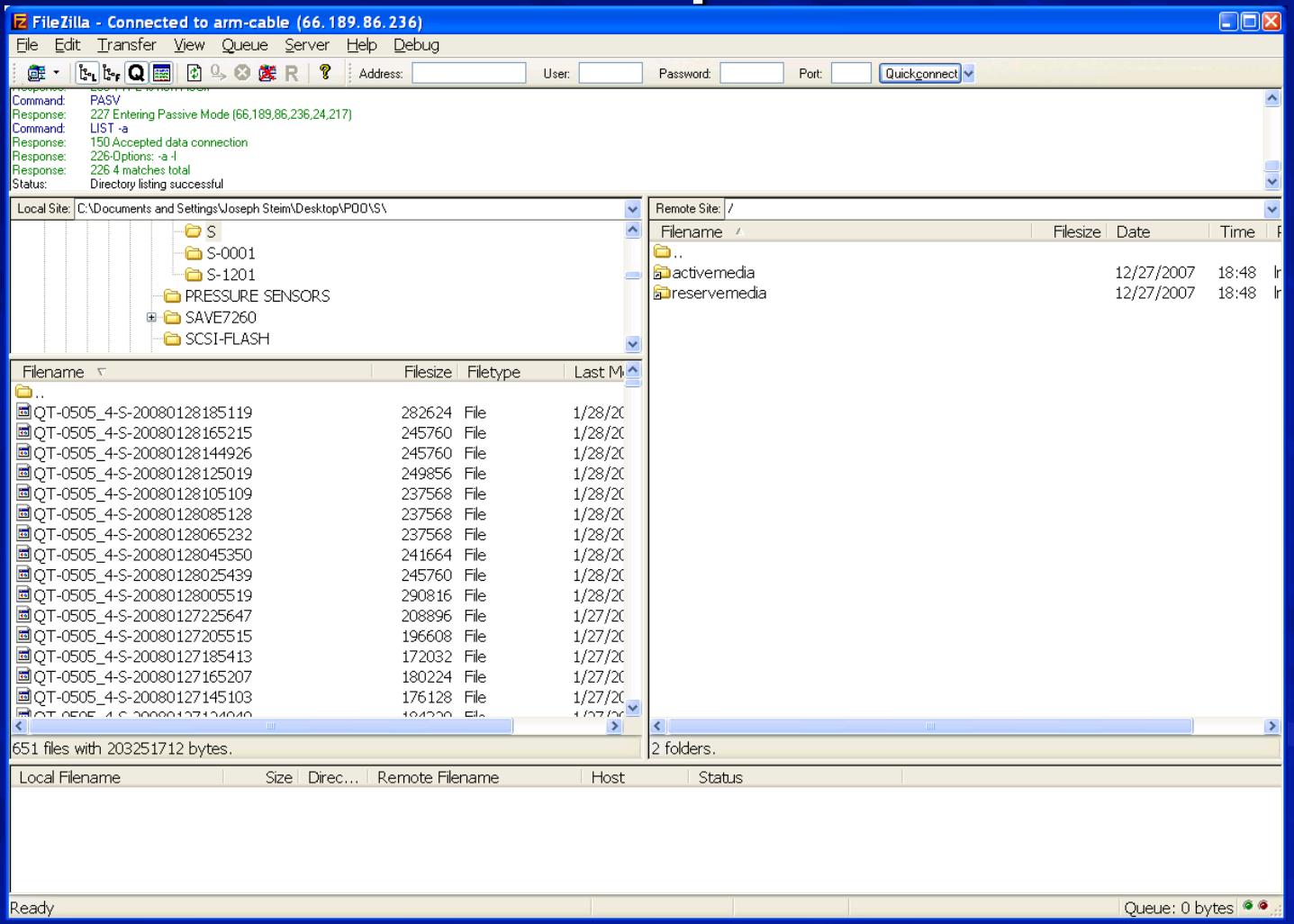
Baler44 flat files - http



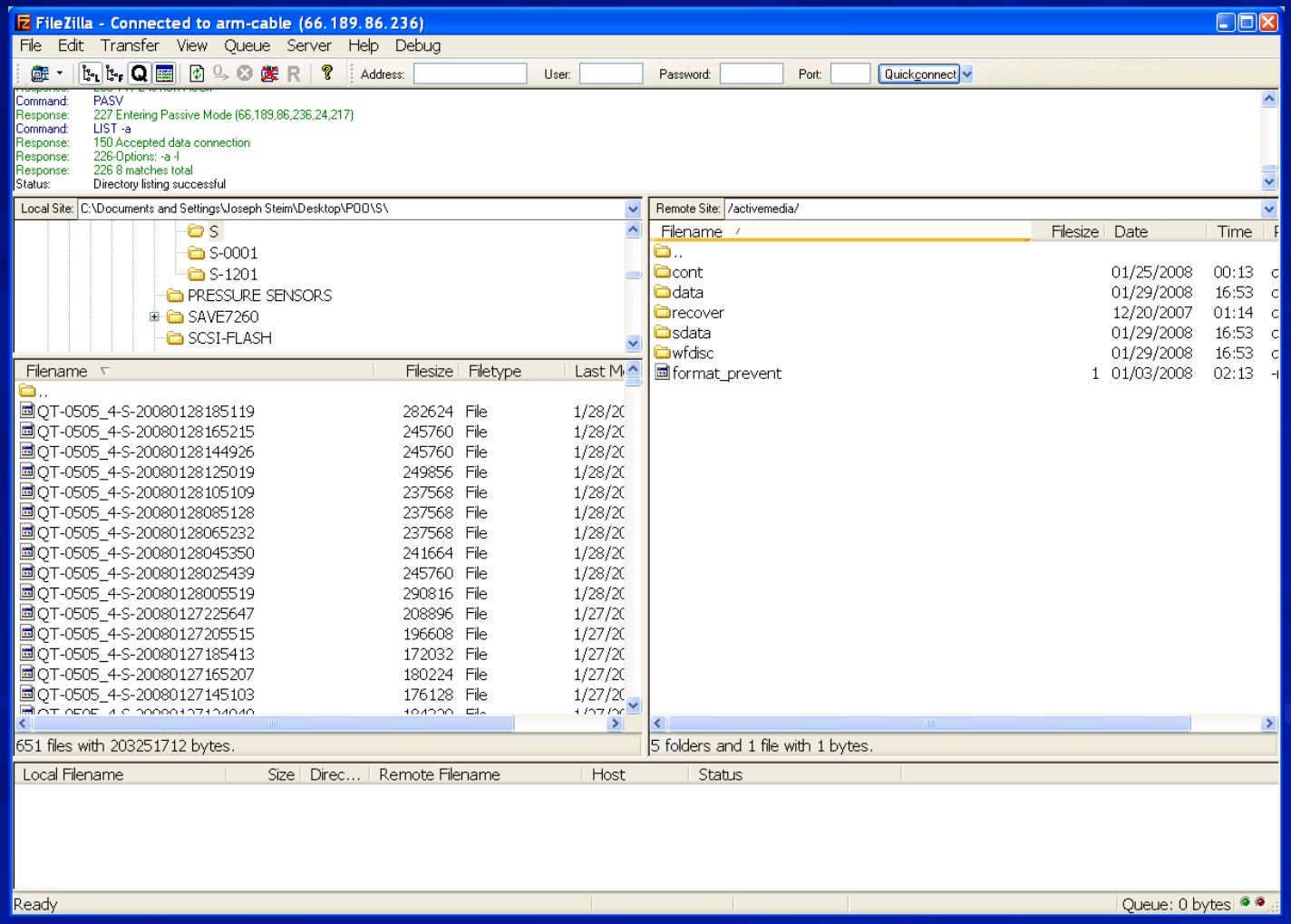
Baler44 typical



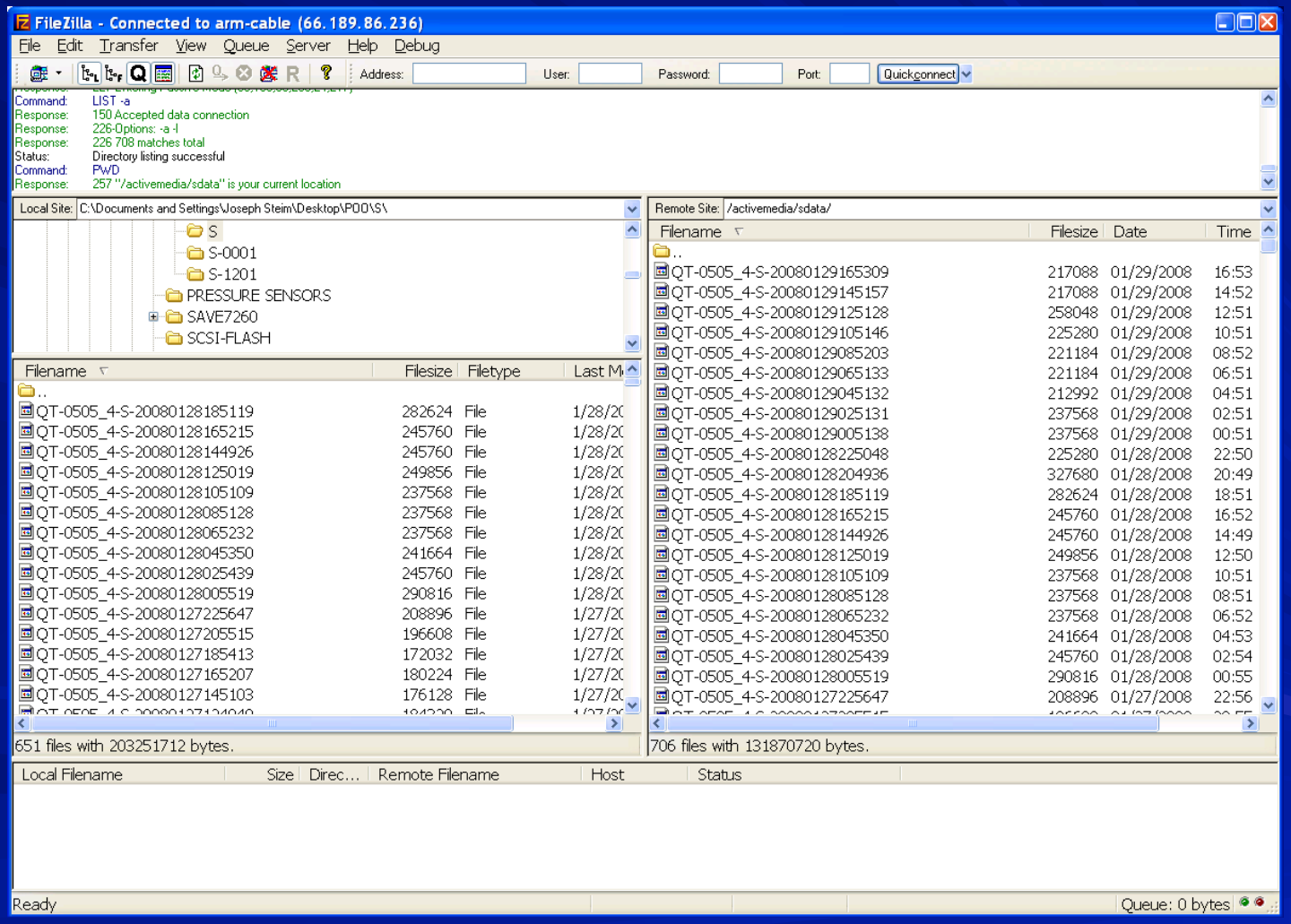
Baler44 ftp access



Baler44 ftp access



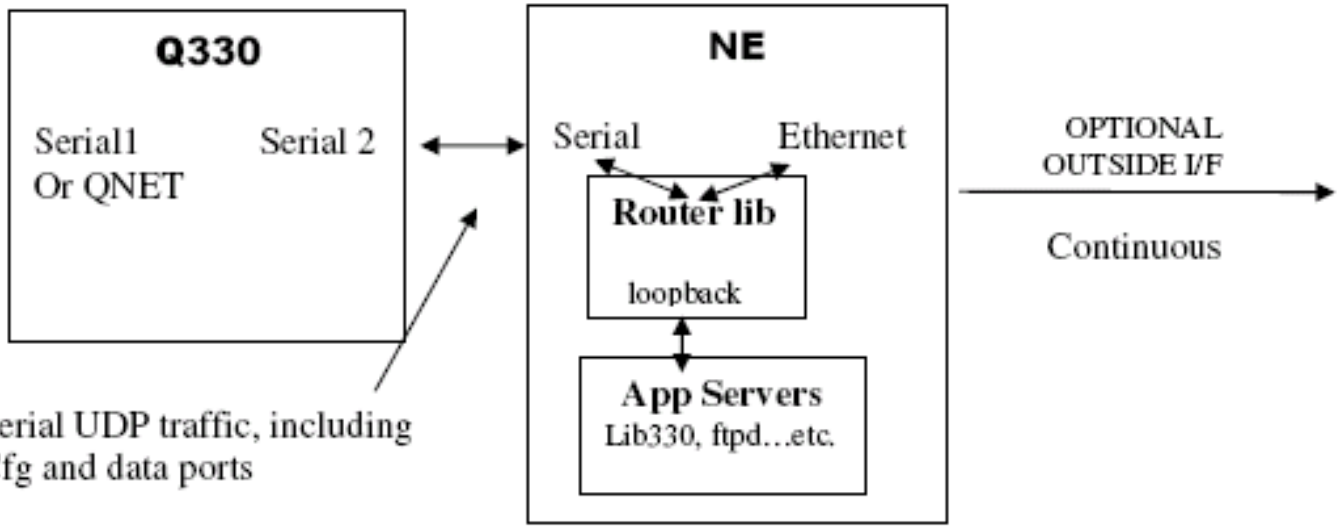
Baler44 ftp access



Baler44 forwarding

CONNECTION MODES

2. NE's Interface is exterior gateway



- Serial UDP traffic, including Cfg and data ports

When the NE is the exterior gateway, all traffic appears at a single IP, the address of the NE. Traffic to the Q330 is routed through the NE. When there is no connection to the exterior gateway, the NE is simply a standalone recorder.

Q330/S integrated

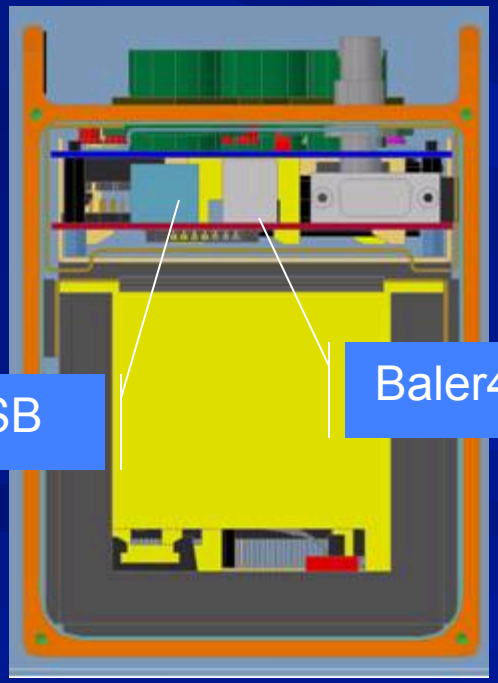
Baler44 + Q330 = Q330/S

Omit some infrequently-used connectors

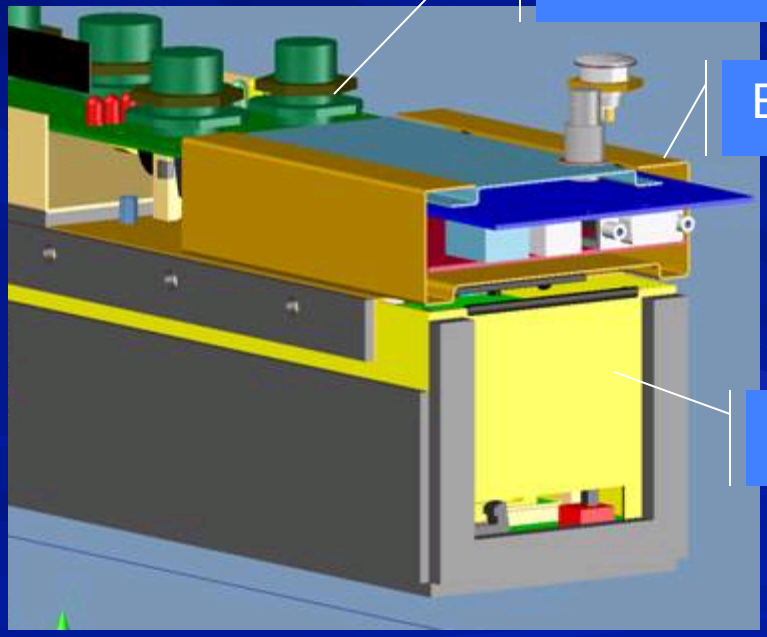
- External GPS
- Dual serial

Omit AUXAD option

Extrusion end-view



Internal view



Q330S

Quanterra Does It Again!

www.q330.com

Q330S

New Generation Ultra-High Resolution
PORTABLE SEISMIC SYSTEM

- Ultra-low Power!
  - Typical 600 mW 3-ch broadband continuous recording
- Quanterra's own A/D patented technology (US Patent 4866442,Japan Patent 2787445, others pending)
- Extensive sensor interface and calibration
- 3 or 6 channels with flexible auxiliary I/O
- Streamlined and powerful remote administration
- Up to 2 x 16 GByte of field removable USB thumb drive storage
- Internet savvy communications and security
  - Multiple simultaneous telemetry links
- Extended temperature option good for -40°C to +85°C
- Compact and rugged

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Q330S


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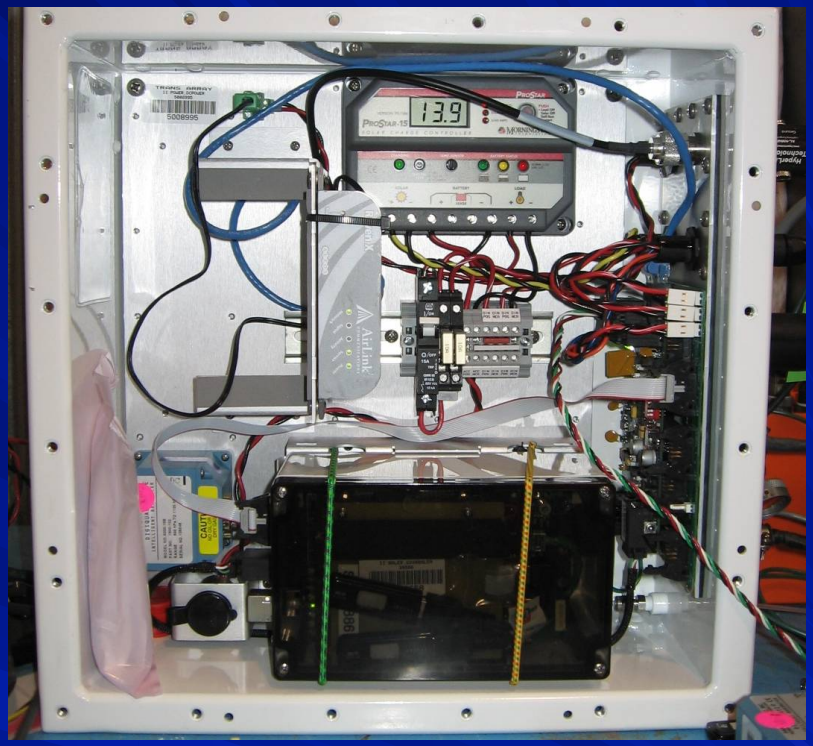
SENSOR A
SENSOR B
ANT.
STATUS
SYSTEM
LINK OK
IRDA
FAULT
CPU/BOOT
GPS
ANALOG
PRIMARY
CONSOLE
QNET
ADVANCED USB
RECORDING SYSTEM
STATUS
MEDIA
FAULT
POWER
FMT MODE
F/W UPDATE
TX
RX
SHUT DOWN
RECORDING SYSTEM INDICATORS
FAULT
1 = POWER, 2 = MEDIA, 3 = FORMAT LOCKED,
4 = FORMAT NEEDED
STATUS
SLOW BLINK = RUNNING, CAPACITY GB REMAINING
FAST OR NO BLINK = NOT RECORDING
MEDIA
NEVER REMOVE WHEN LIT
SEE INSIDE MEDIA COMPARTMENT
FOR FORMATTING INSTRUCTIONS
ATTN


AFMT
DHCP Only
Run

Vault Interface Enclosure (VIE)

IRIS TA Vault Interface Enclosure (VIE)

- 16x16x8” Enclosure, hangs inside vault.
  - IP68, 0.5” Lexan Clear lid, bulletproof!
- Q330 interfaces converted to industrial standard connections;
  - IDC flat ribbon, RJ45.
- Custom power regulation circuit
  - Faultfree switchover to alkaline backup battery
  - Signalling via existing data channels for power SOH
  - Sensor power regulation, filtered power for Q330 and Baler
  - High efficiency regulation, load shedding/mode switch on backup power
  - Independent fault isolation of powered devices.
- Station Integration
  - Integration of new Baler44CT, Environmental sensor
  - Simplified Data collection via new Baler44
  - Reset power cycle for comms equipment
  - Remotely controlled power interrupt for sensor
  - Monitor and signalling of pump operation
- Protected housing for electronics and auxiliary equipment-allowing better flexibility and increased reliability.
  - Allows economical packaging choices for small ancillary devices
  - Protects commercial modems, charge controllers and circuit boards.
  - Simplifies troubleshooting, acts as a field replacable unit.
- Uniform cabling for installation
  - MS style connectors, molded termination
- Commercial production in uniform runs; Enclosure, cables, PCB, testing, etc
  - Custom cable fabrication, custom metal, factory assembly and testing.



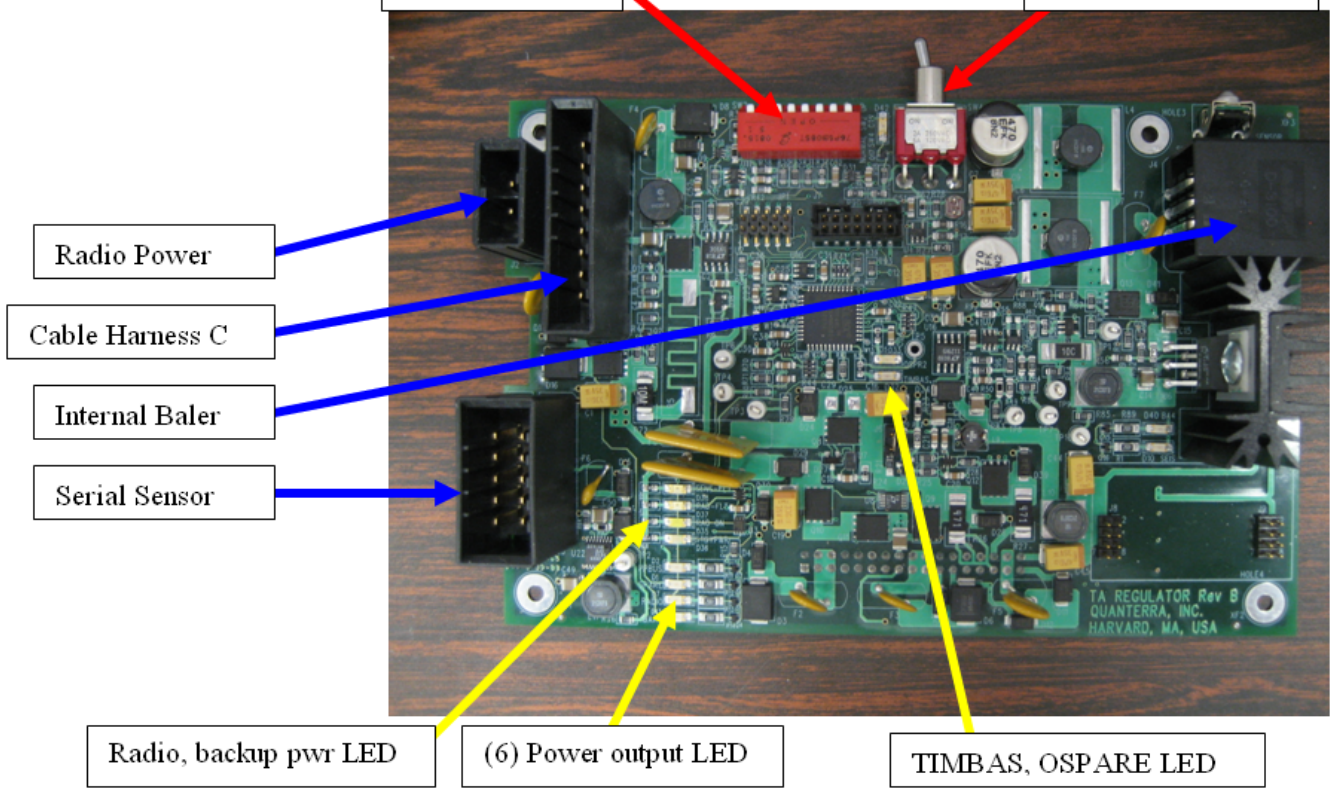
the IRIS CONSORTIUM

SOLARCRAFT POWER PRODUCTS

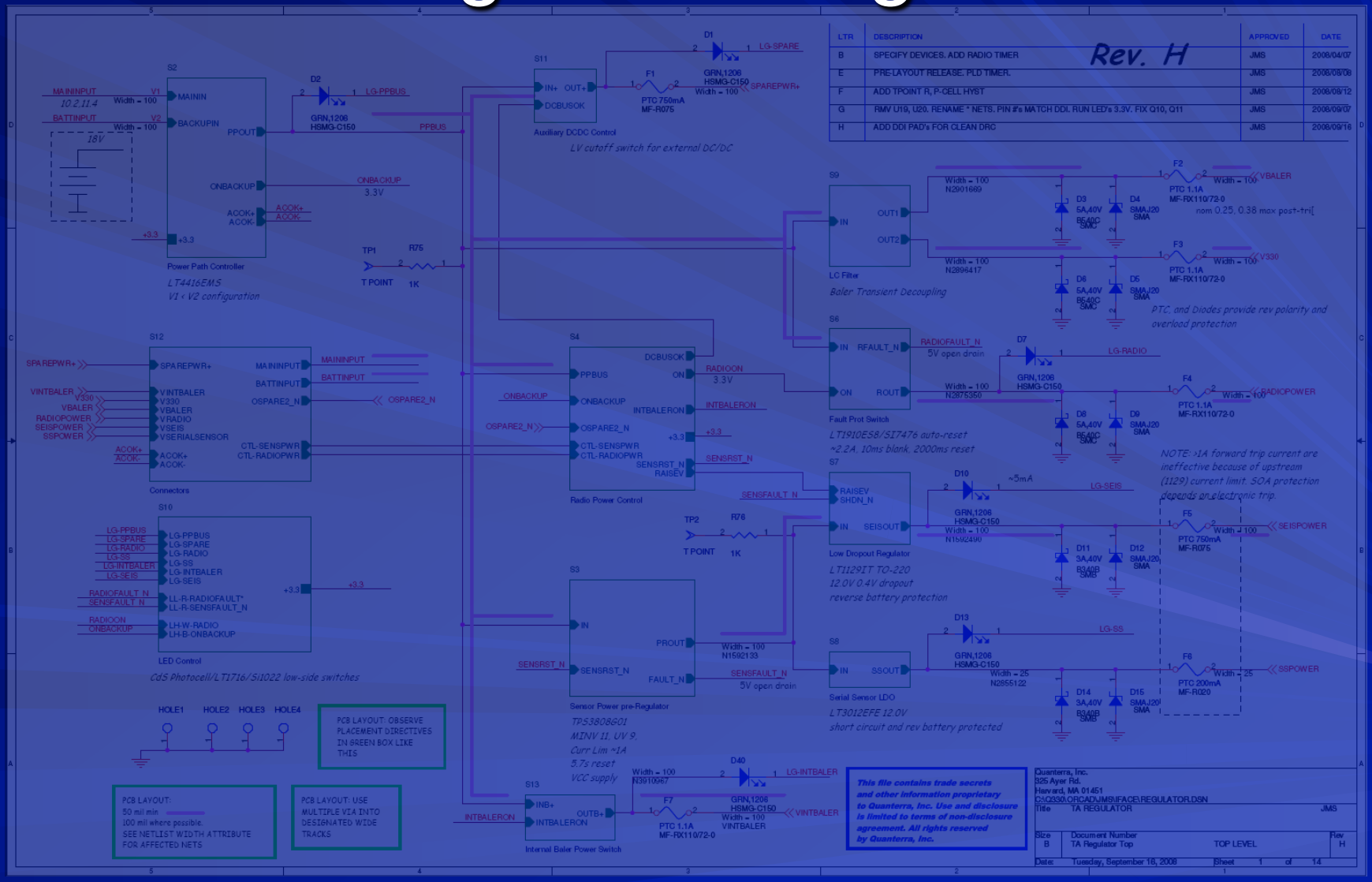
QUANTERRA, INC.

Quanterra VIE Intelligent Power Management Regulator

5.2 Regulator assembly

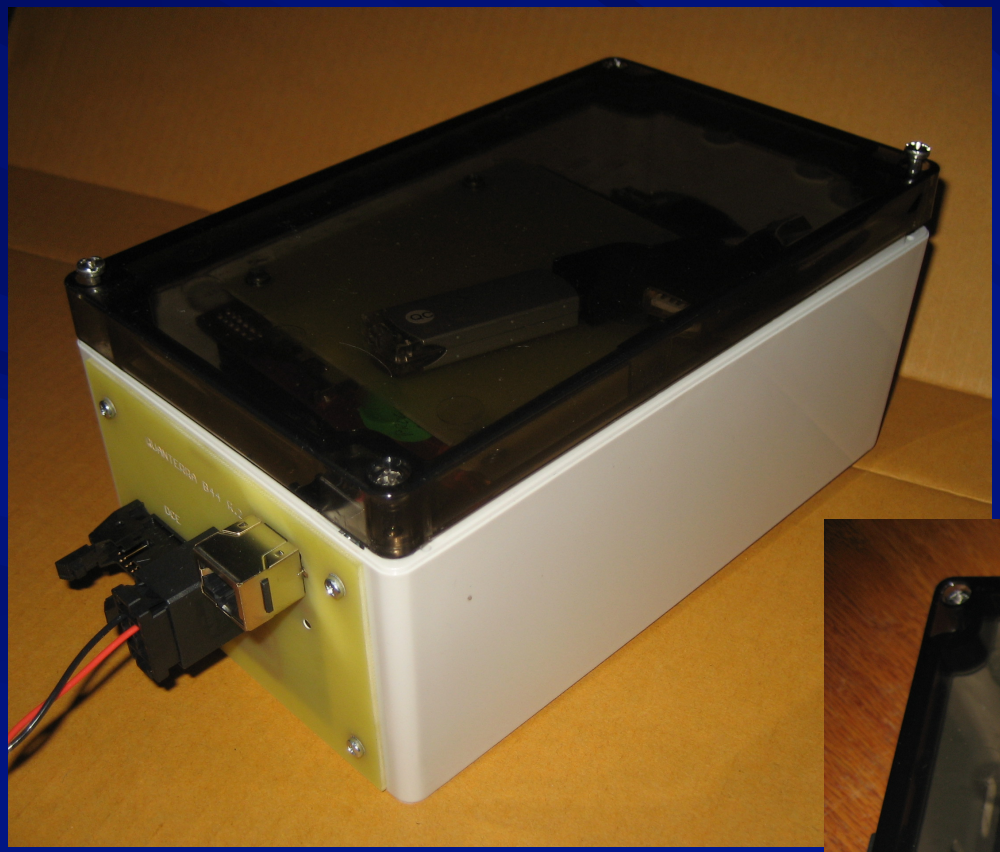


Quanterra VIE Intelligent Power Management Regulator



VIE Regulator

- *Custom Design*
- *Filtered Power: Q330, Baler*
- *Regulated Sensor Power*
- *Seamless Backup Failover*
- *Protected I/O's: subsystem shutdown*
- *Radio Power Cycle*
- *Failover Power Conservation*
- *Sensor Power Control*



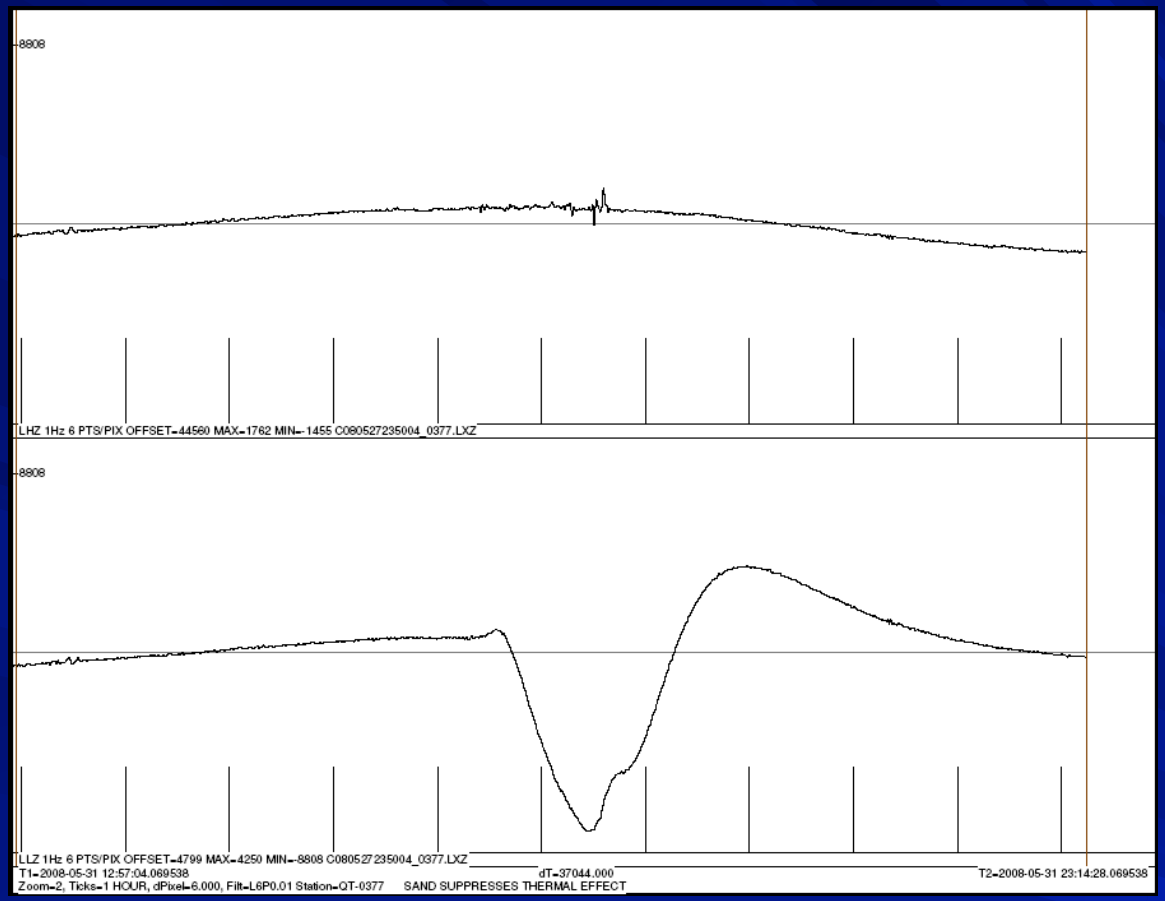
Baler44CT
“clear top”
IP51

VIE in operation

Harvard University HRV GSN station and development facility

HRV GSN station and development facility

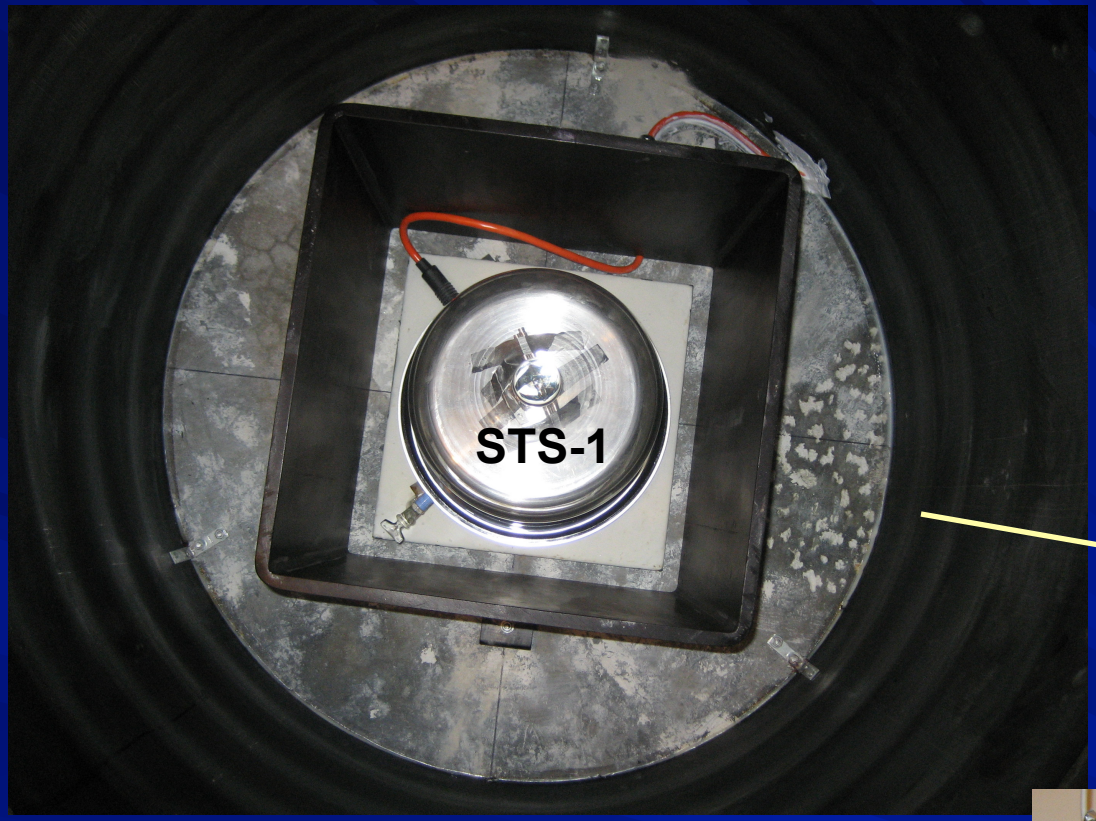
Pressure



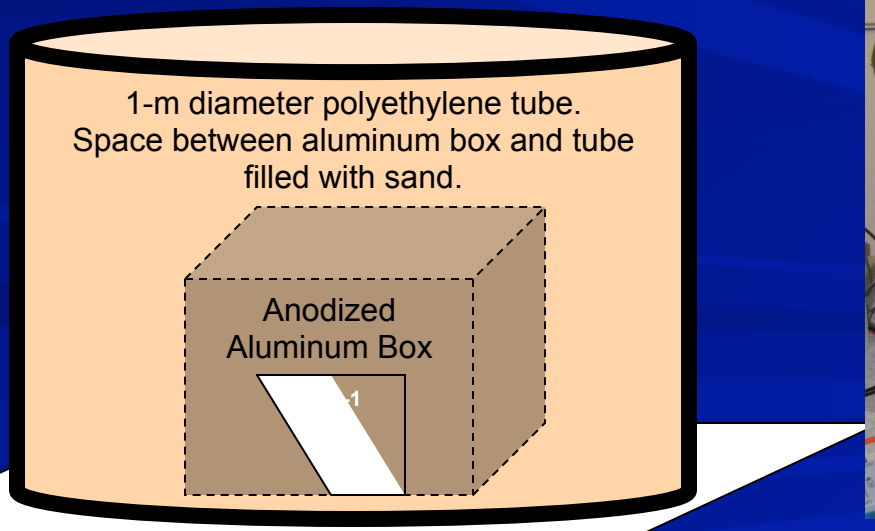
Thermal Time Constant

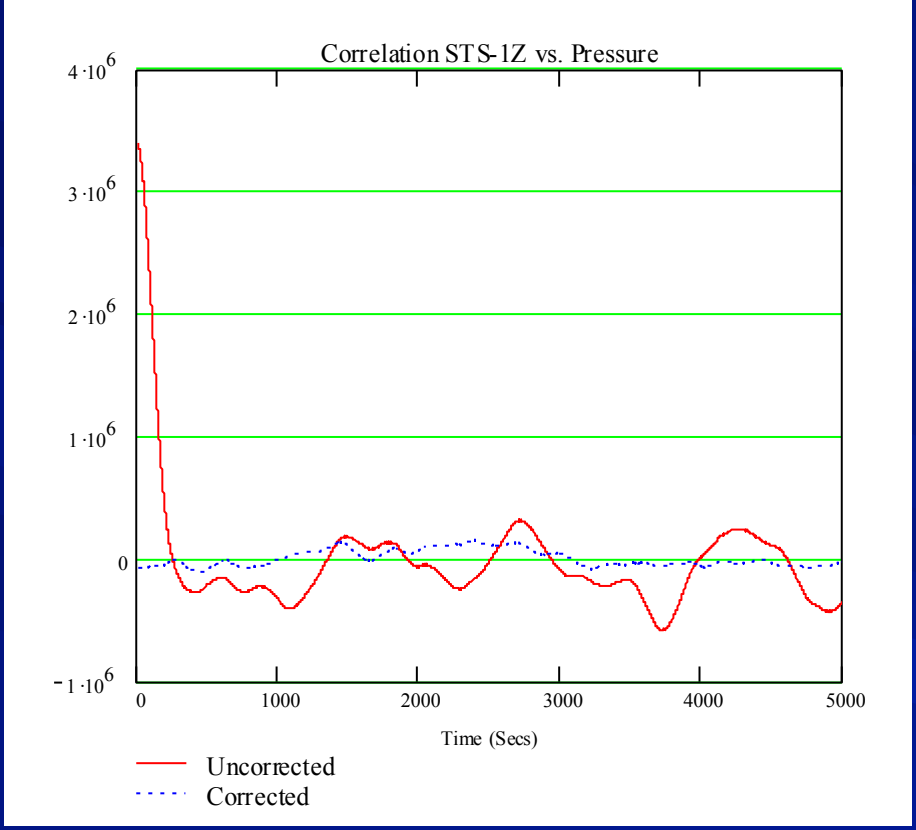
With this isolation, previously large thermal disturbances such as caused by opening the vault door are not visible in the very long period records. The figure below shows the effect of a similar installation on an STS-2. In the top panel, the low-frequency data from an STS-2 installed inside a similar 1-m sand-filled tube is shown. On the bottom panel, an STS-2 is installed in a more typical manner inside a Styrofoam box with 3-in thick walls. The tick marks are hours. The thermal effect of walking in the vault room and working for about 2 hours in the vault, although not directly on these seismometers, is clearly seen as a mainly thermally-induced pulse on the no-sand STS-2. This behavior seen on STS-2's suggested that an STS-1 may also benefit from the thermal mass of a large volume of sand isolating the sensor from ambient temperature changes.

Thermal Mass



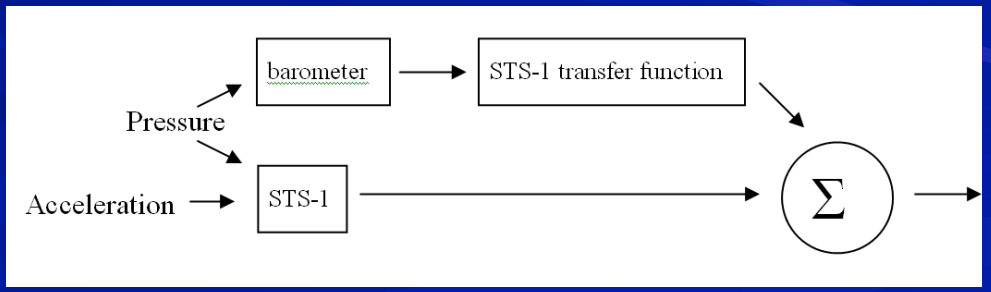
SAND FILLS
THIS SPACE



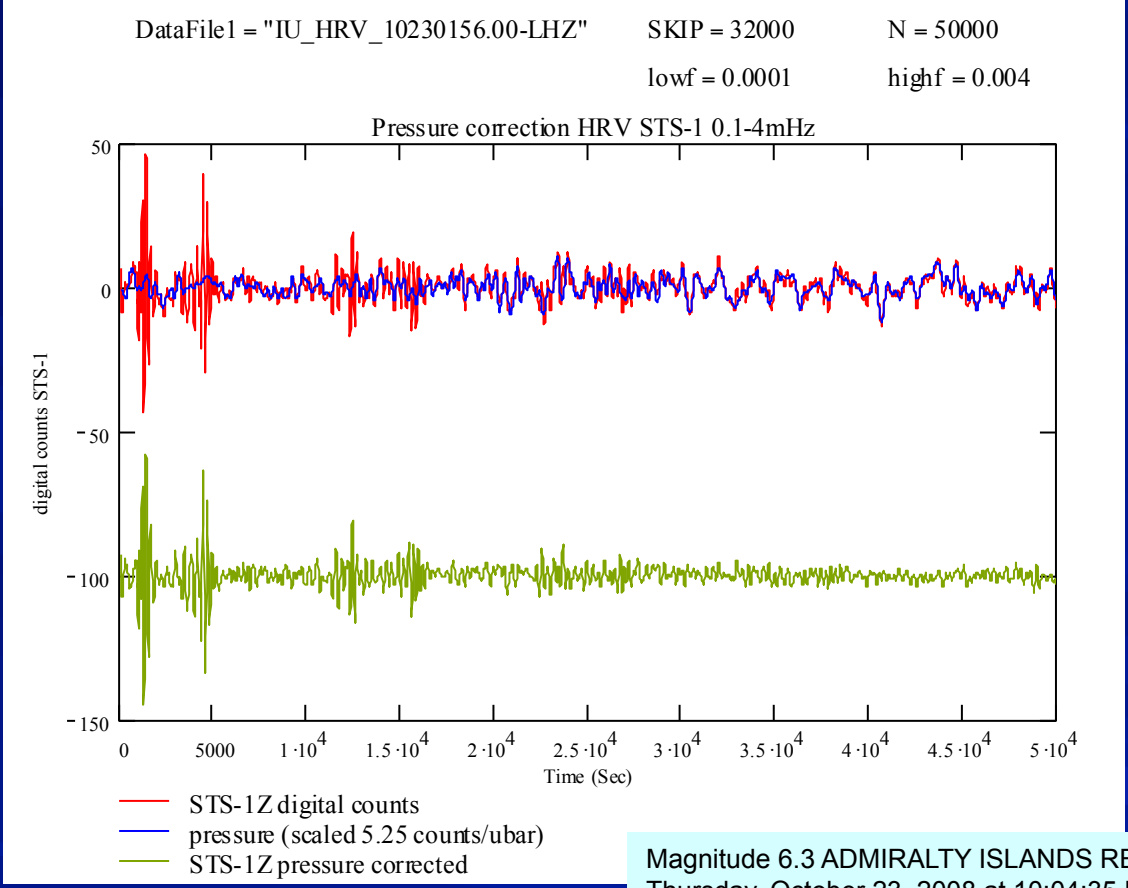


Vertical Correlation w/ Pressure seen on STS-1

These results are consistent with results, e.g. shown by Zürn and E. Wielandt, *Geophys. J. Int.*, **142**, 2006 for correction of the predominant air-mass gravitational effect. The present results perhaps show greater improvement in the corrected data.



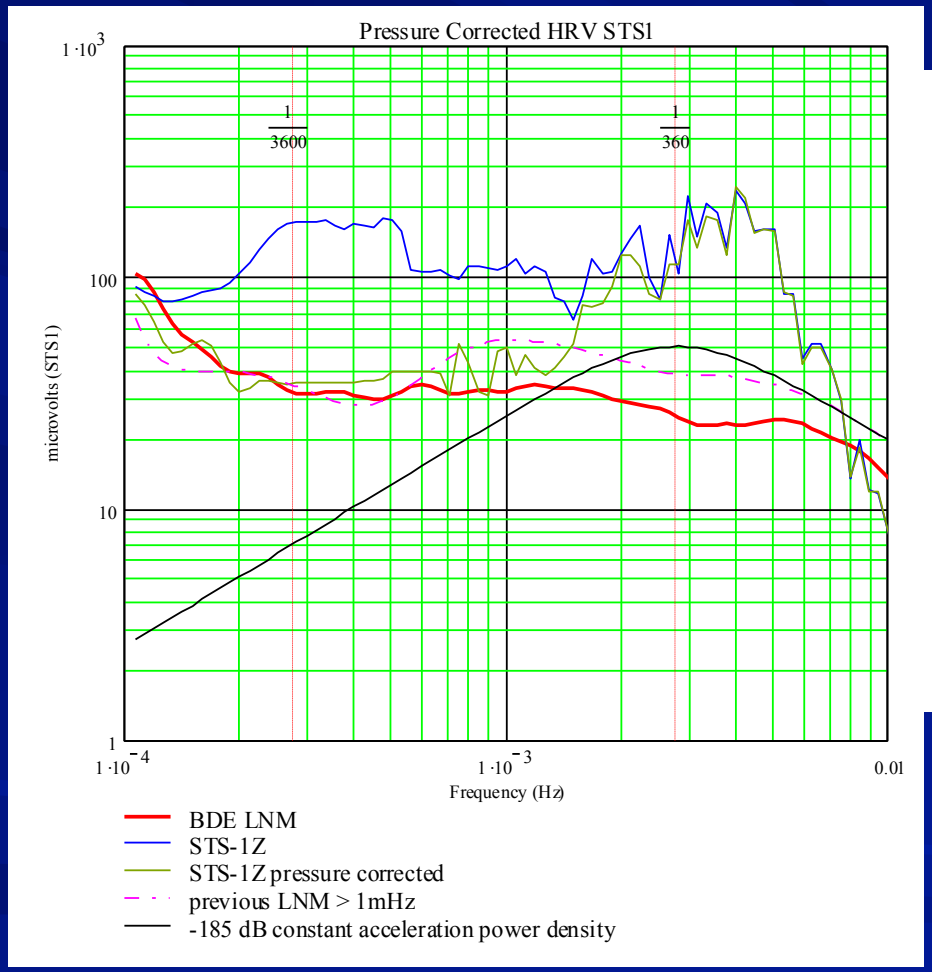
Pressure Corrected

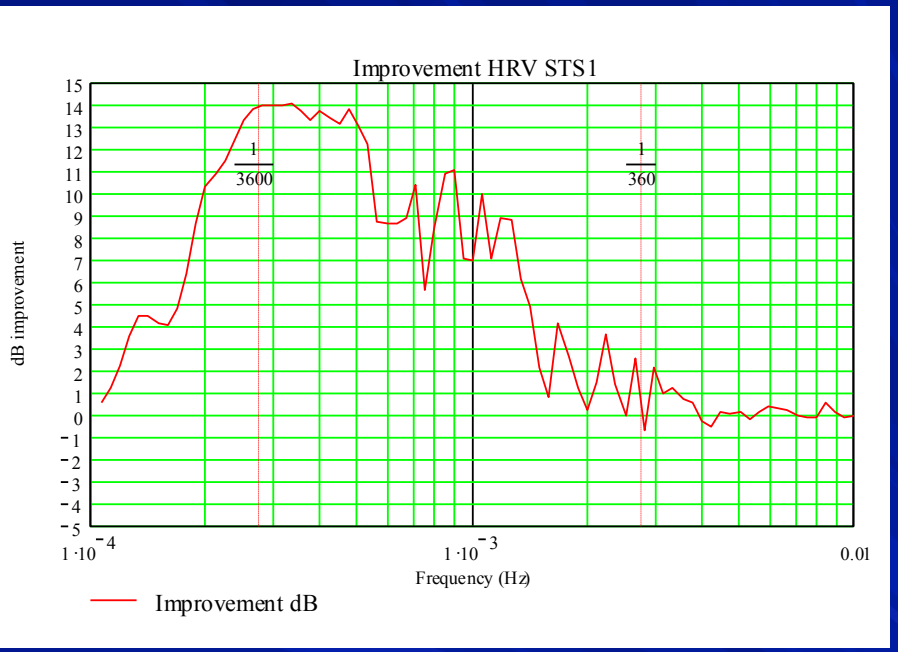


Magnitude 6.3 ADMIRALTY ISLANDS REGION, P.N.G.
Thursday, October 23, 2008 at 10:04:35 UTC

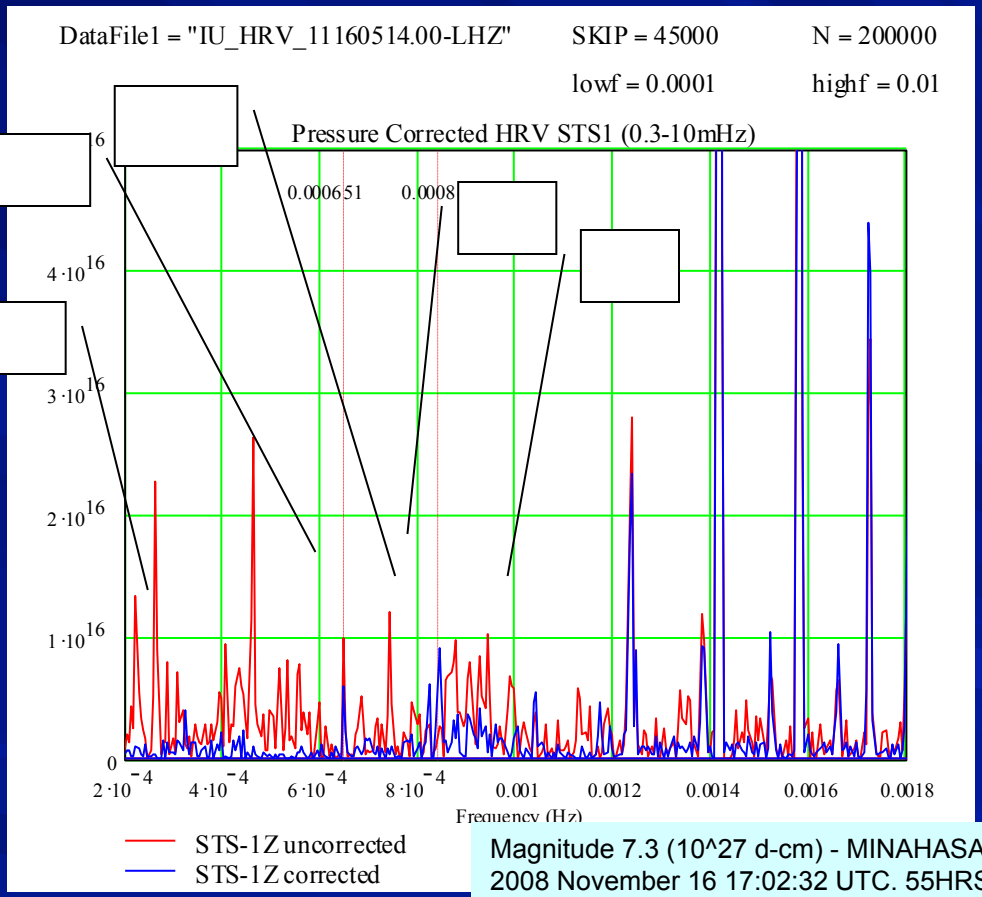
The vertical scale is digital counts on a Q330 24-bit digitizer (~1.1 nm/count in the flat-velocity response region of the sensor from 0.3mHz to the limit of the bandpass filter in this example, 33 mHz). The pressure is scaled at 5.25 counts/μbar, equivalent to 5.25 nm/s^2/hPa. The pressure data are corrected with a recursive digital filter, an approach that may be adapted to continuous real-time correction in a data acquisition system.

Pressure Corrected STS-1 HRV GSN station





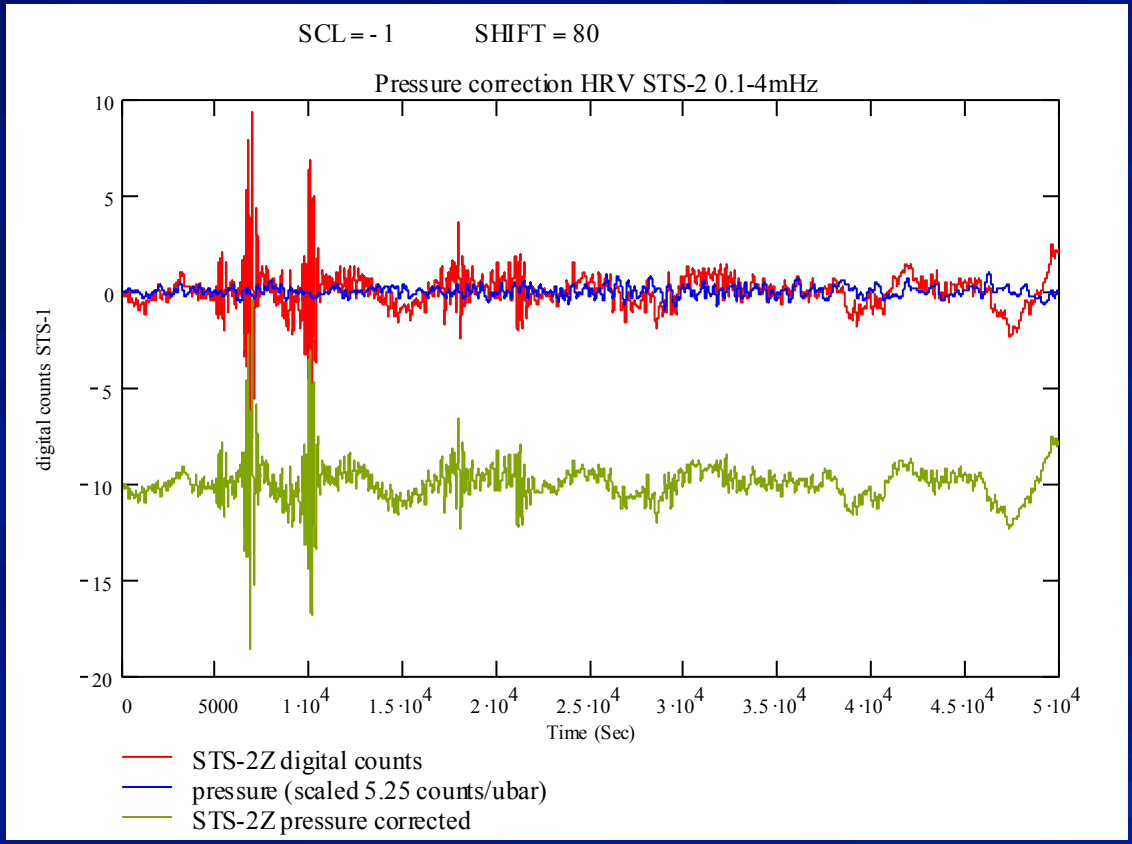
Pressure Corrected STS-1 HRV



Magnitude 7.3 (10^27 d-cm) - MINAHASA, SULAWESI, INDONESIA
2008 November 16 17:02:32 UTC. 55HRS DATA

text

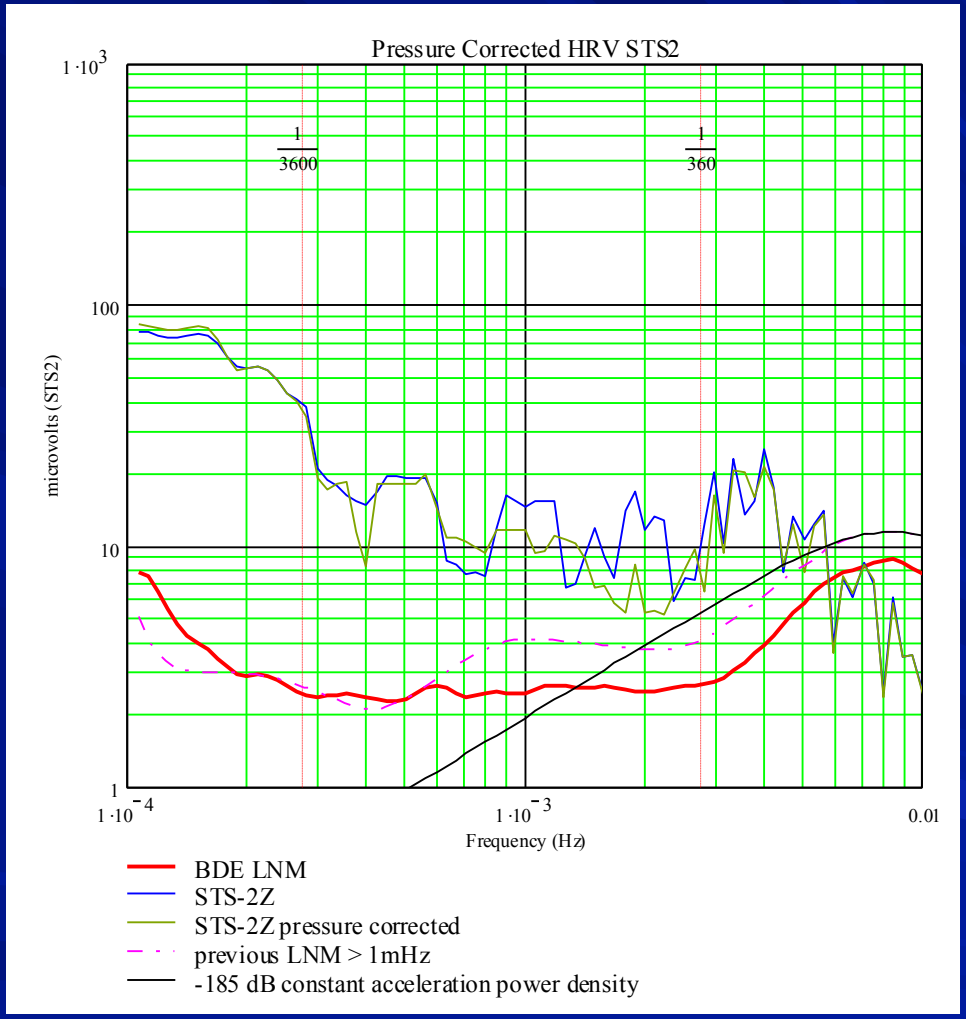
STS-2 vertical



The method effective on the highly-isolated STS-1 vertical was applied to a quiet STS-2 operating without external pressure shielding. This STS-2 is installed in a typical way, using a styrofoam box placed on the pier in the HRV vault. The same event is shown in the STS-1 data above.

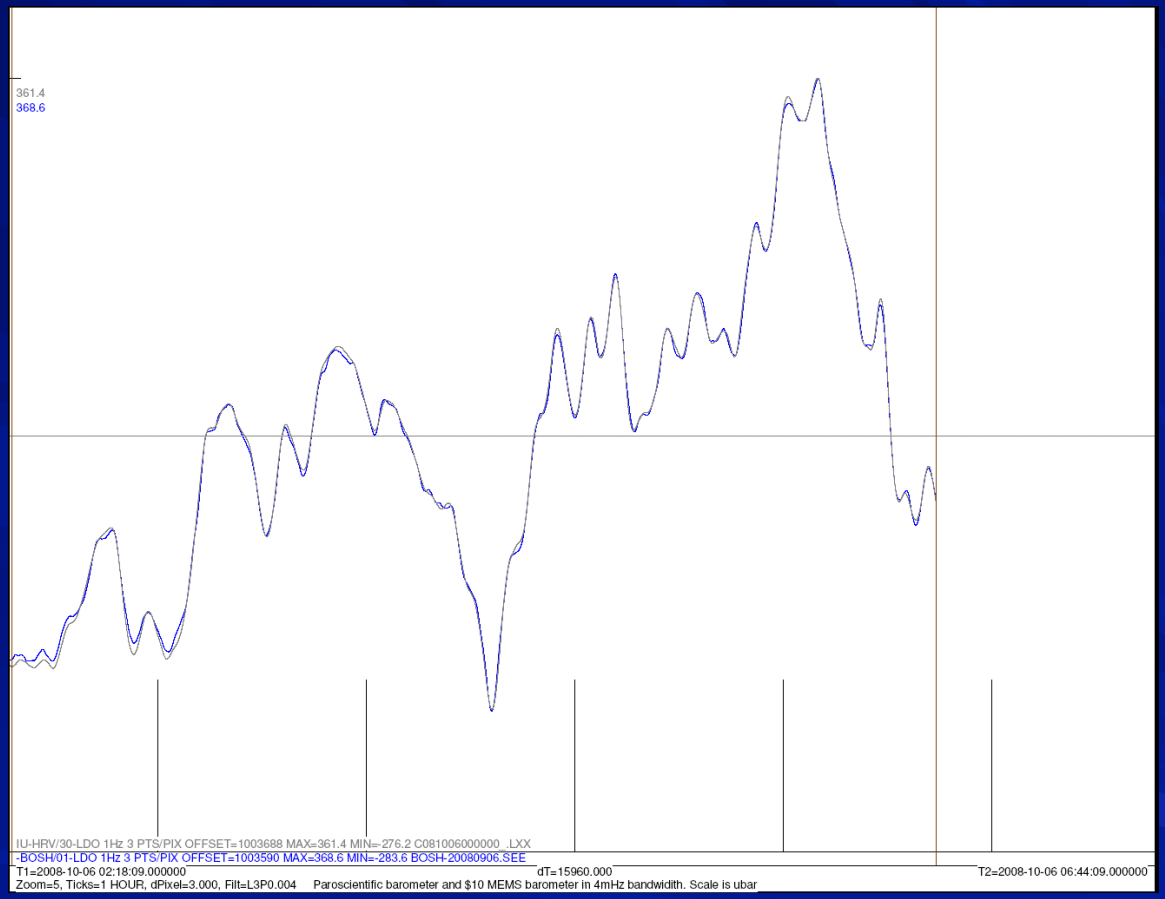
The simple zero-phase correlation with pressure is now absent. A correlation is seen with an 80s phase shift, and negative sign. Further low-frequency correlation persists however. There are likely thermal, possible adiabatic, effects and direct distortion of the STS-2 pressure case. Effective usage of the pressure data therefore requires external physical isolation of thermal and pressure effects on the STS-2.

STS-2 correction



text

Barometer Requirements



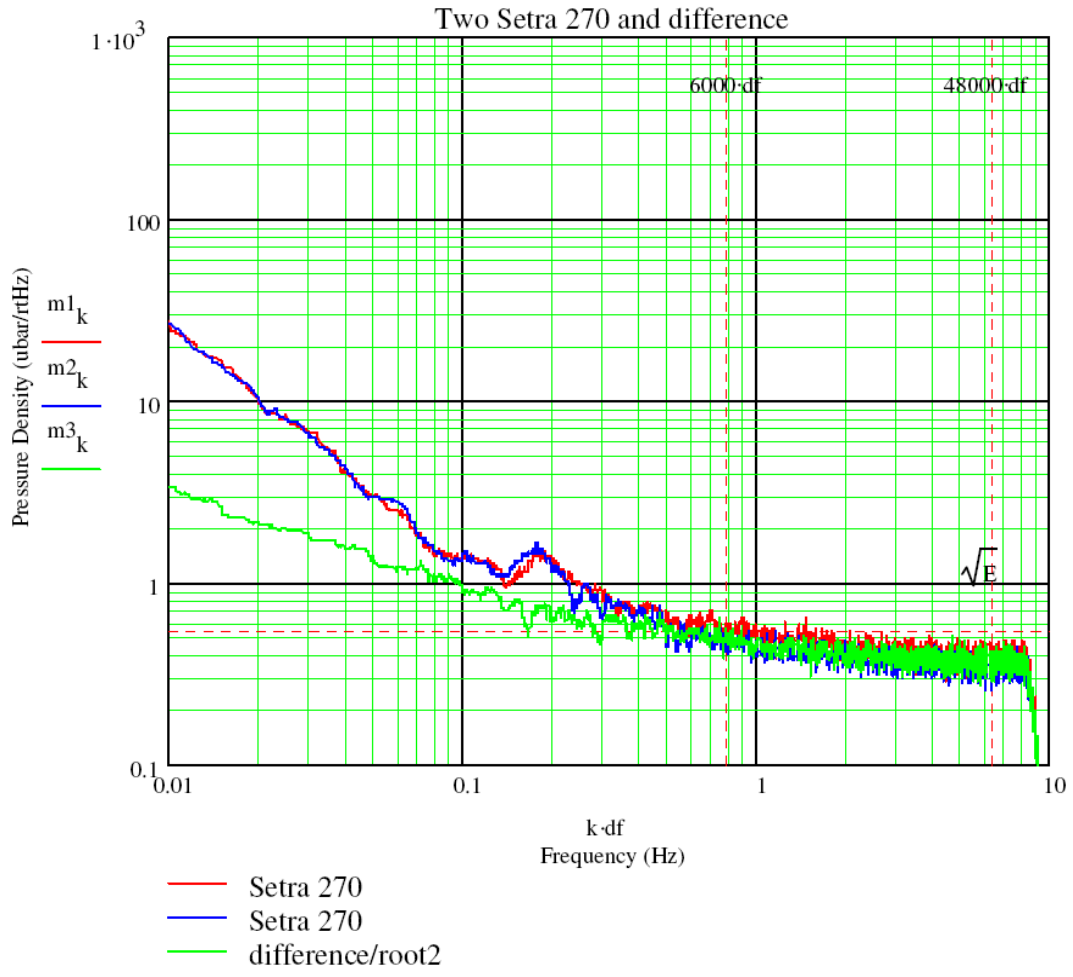
What sort of barometer is required to obtain a correction in this bandwidth (up to 4mHz)? The figure below shows comparison of barometric pressure variation recorded over a 4.75 hr period on a ($5000) Paroscientific barometer, and a $10 MEMS barometer. The signals are essentially indistinguishable at the level required for correction of pressure effects on long-period sensors. The data are low-pass filtered at 4mHz, and are therefore directly comparable in absolute pressure.

VTI SCP1000 MEMS

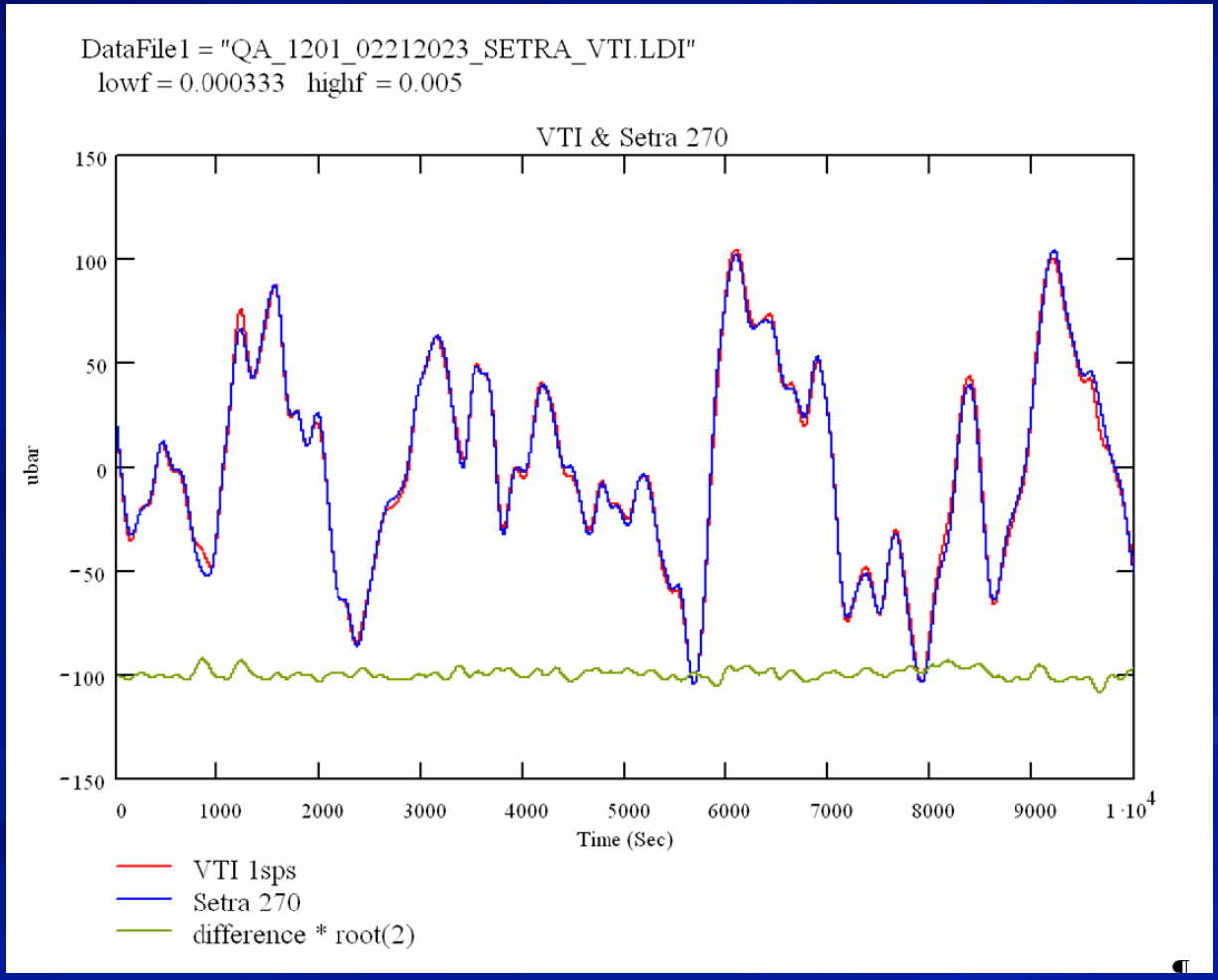
Few ubar resolution below 4mHz. Size ~ 5mm x 5mm

Setra 270 Precision Analog

~ 1 to a few ubar resolution up to some Hz . Size ~ 2.5in diameter



ESTIMATED FLOOR ~ 0.3 µbar/√Hz, or ~ 1 µbar rms above 1 Hz, or ~ 2.4 µbar p-p in a 1Hz band 1Hz-2Hz, below typical ambient pressure variation. Exceptionally quiet barometric sample 2009/01/23


DataFile1 = "QA_1201_02212023_SETRA_VTI.LDI"
lowf = 0.000333 highf = 0.005
VTI & Setra 270
150
100
50
0
-50
-100
-150
ubar
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1·10^4
Time (Sec)
VTI 1sps
Setra 270
difference * root(2)

Environmental Processor

- *DSP-enhanced MEMS barometer*
- *0.1 deg Termperature*
- *Internal Humidity*
- *Optional 1,2, or 3-channel 24-bit "expander" channels up to 40sps*
- *Interface to SDI-12 meteorological devices*
- *Precision Phase-Locked Timebase*
- *Serial Interface to Q330*

SDI-12 Standard for Meterology

VAISALA

P.O. Box 26, FI-00421 Helsinki, FINLAND
Tel: +358 9 894 91
Fax: +358 9 8949 2485
Email: industrialsales@vaisala.com
www.vaisala.com/WXT520

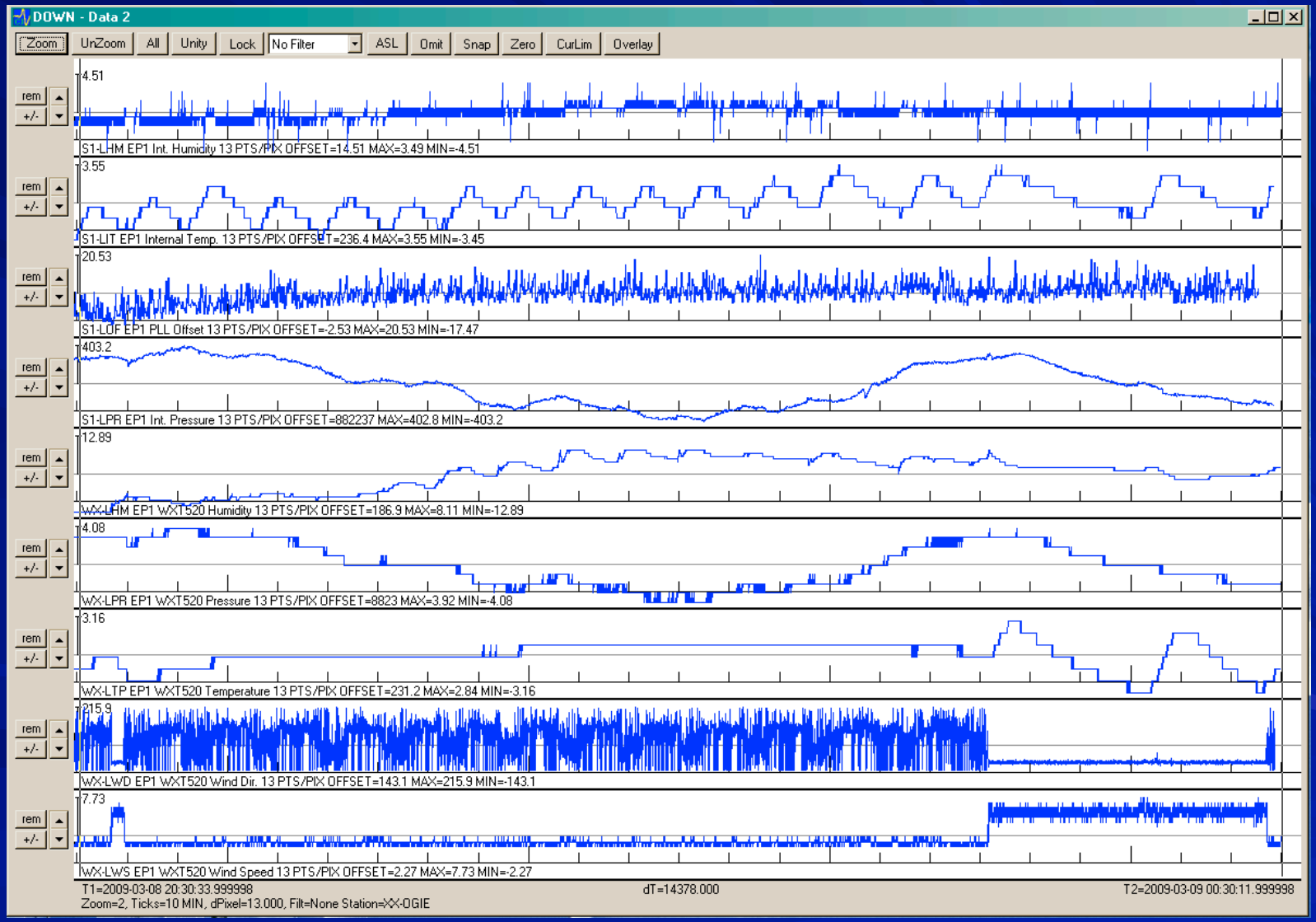
Vaisala Weather Transmitter WXT520
Access to Real Time Weather Data

The Vaisala Weather Transmitter WXT520.

Features/Benefits

- Measures 6 most essential weather parameters
- Accurate and stable
- Low power consumption - works also with solar panels
- Compact, light-weight
- Easy to install
- No moving parts
- Vaisala Configuration Tool for pc
- USB connection
- IP66 housing with mounting kit
- Applications: weather stations, dense networks, harbors, marinas

EP1 First Data



Ultra Low Distortion Oscillator for Systems Analysis

- Frequency Range for both single or dual tones minimum 0.1 to 20 hertz capability in 0.01 Hz steps.
- Synchronized to GPS and starting at a second, minute or hour time mark.

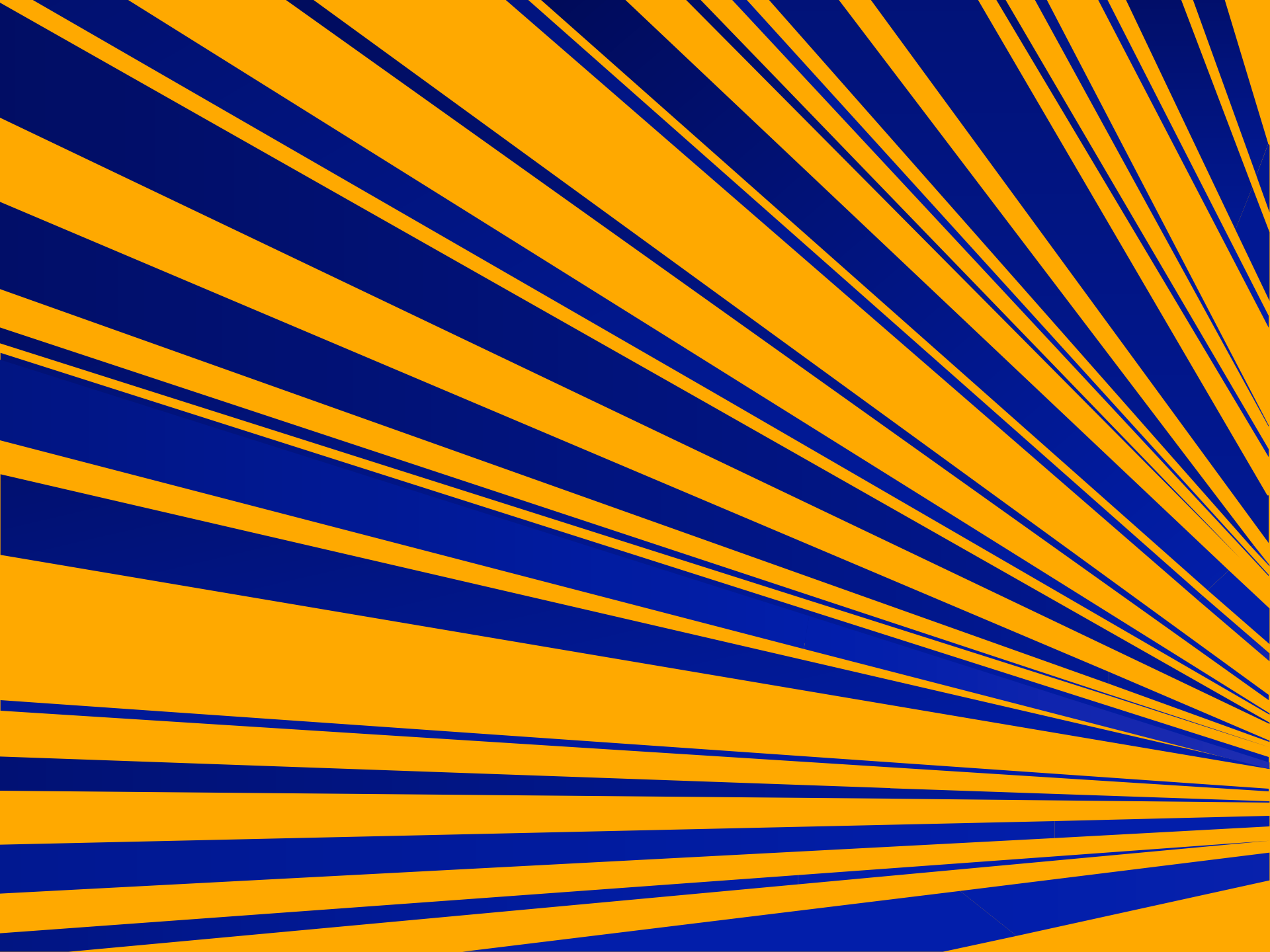
Sinusoidal initial phase to start at zero degrees synchronized to GPS.

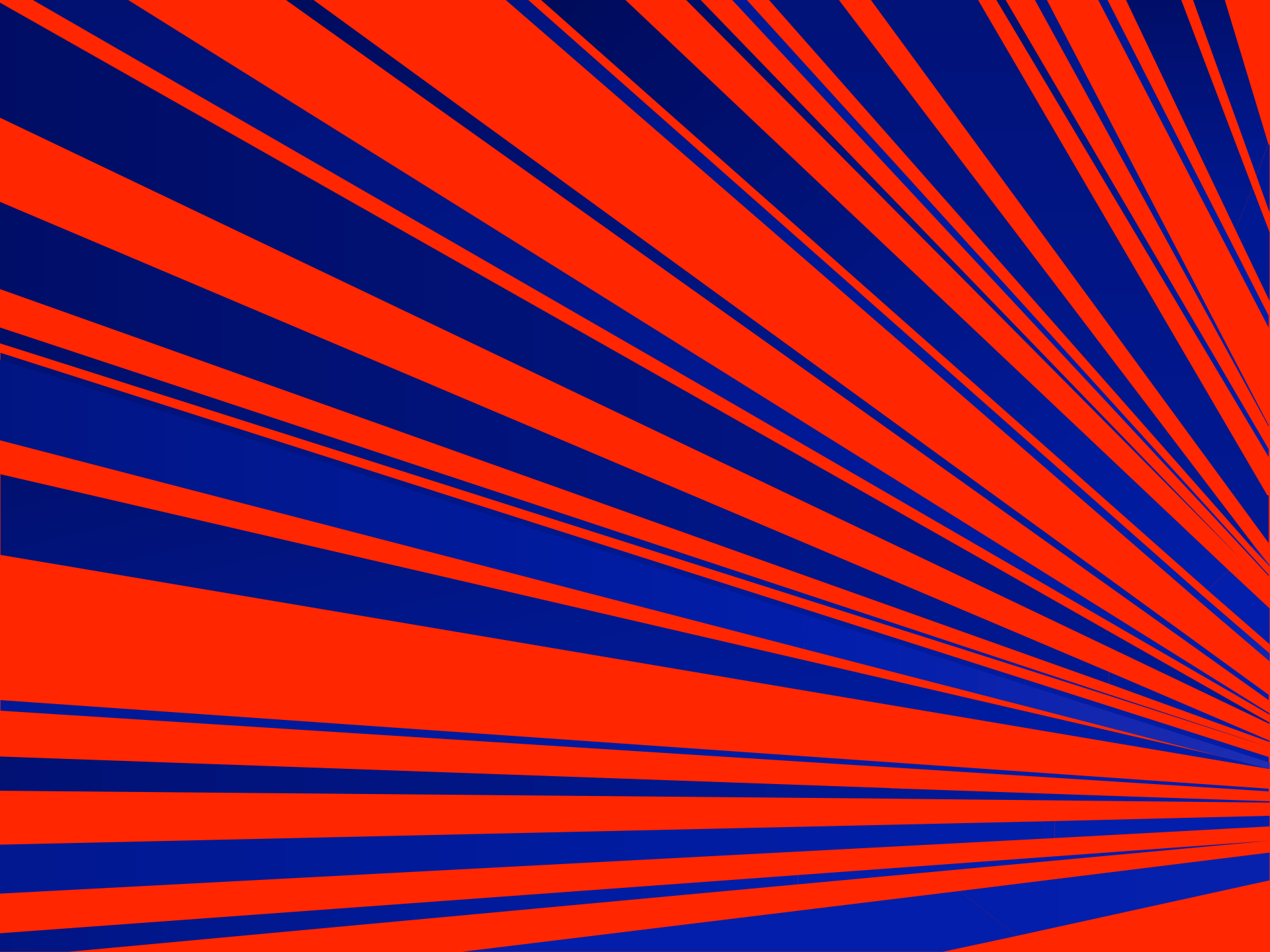
- Total Harmonic Distortion better than –126 db from full-scale using first 9 harmonics (-130 dB desired). This would be a unique capability.
- Independent amplitude and frequency selection
- Single-ended output full-scale selectable from 0.001 to 5V p-p at 75ma.
- Differential full-scale output to 10V p-p (5V p-p from each output).

Q3300 – Next Generation Preview

- Compatibility with Q330 family
- Hybrid performance
- Up to 1kHz sampling
- 4 to 8 channels
- Smaller size, higher integration
- Lower Cost to manufacture
- USB media

Thanks for the first 22 years!





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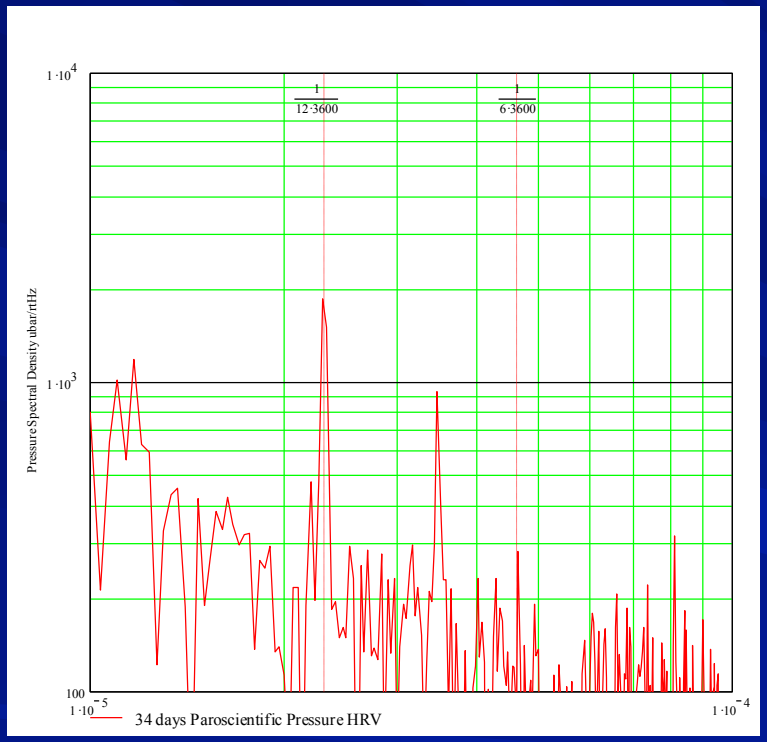
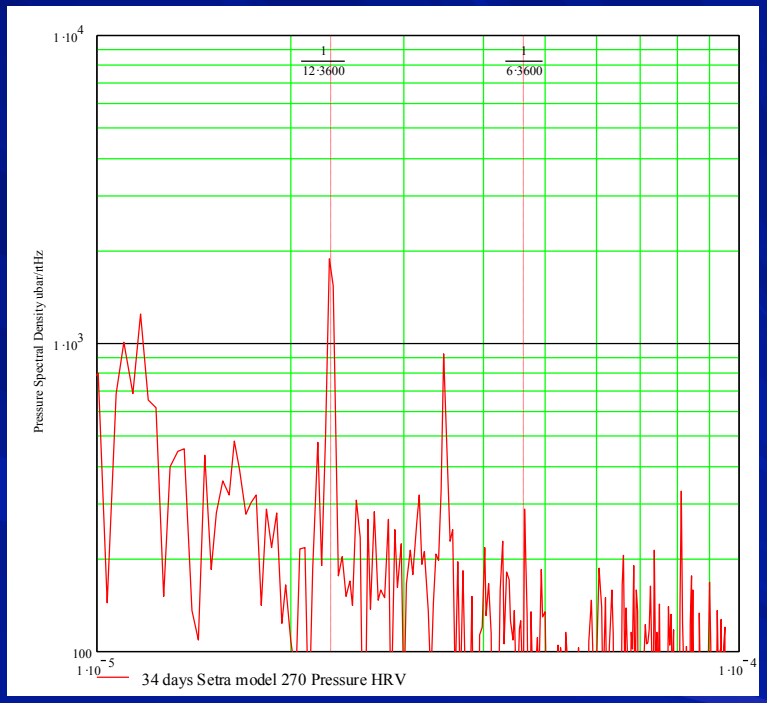
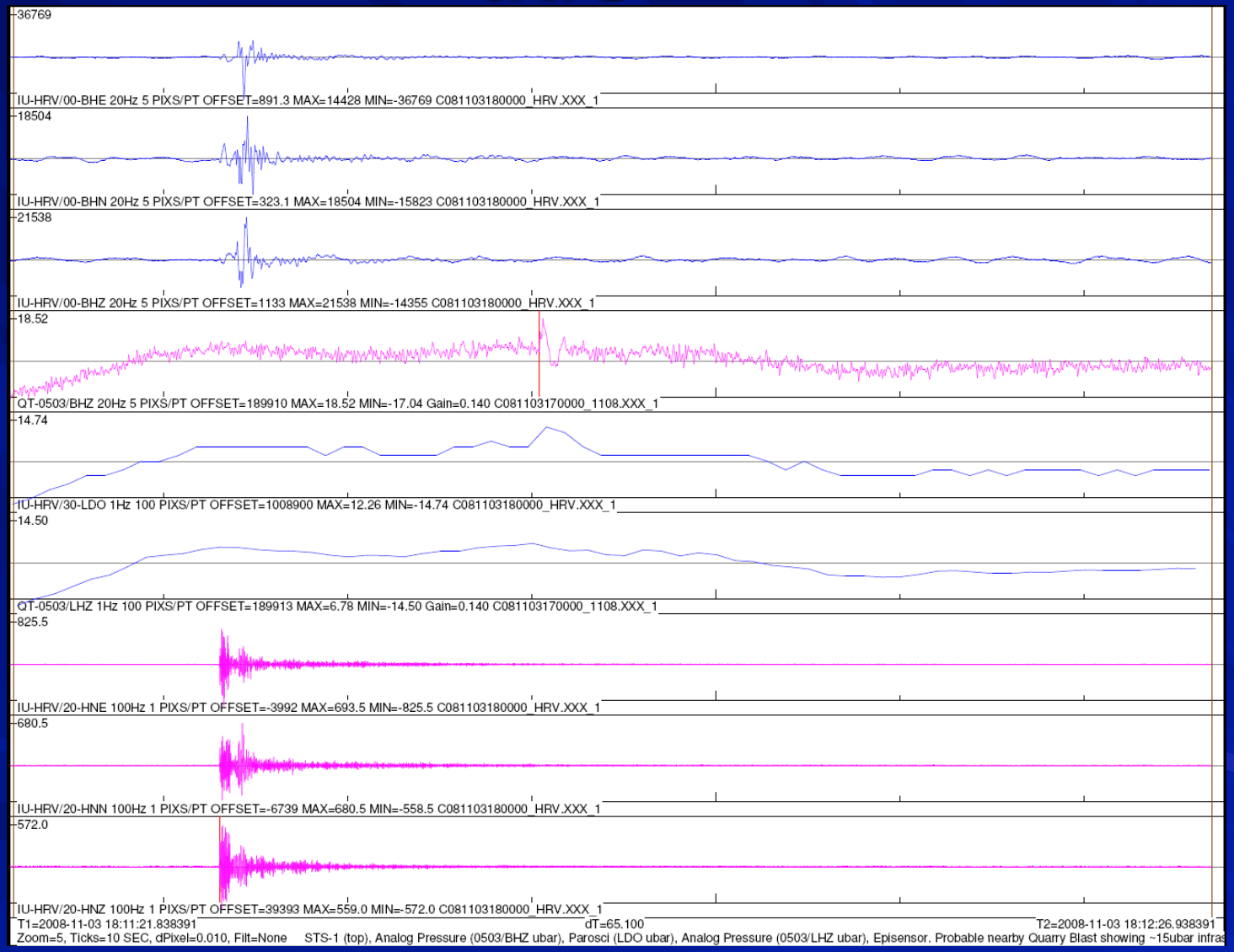
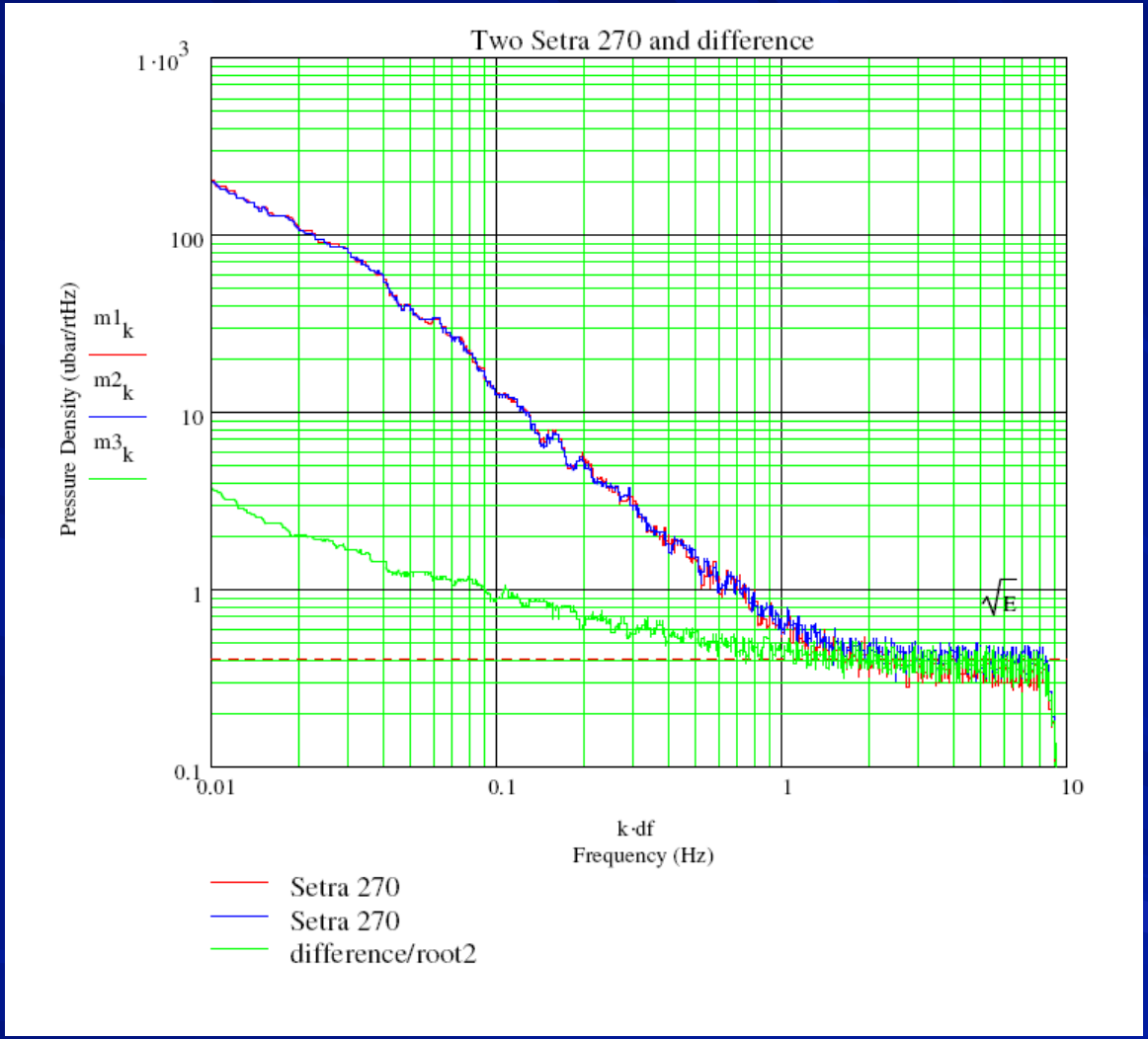

1·10^4
1·10^3
100
1·10^-5
1·10^-4
1/(12·3600)
1/(6·3600)
Pressure Spectral Density ubar/rtHz
34 days Paroscientific Pressure HRV


1·10^4
1·10^3
100
1·10^-5
1·10^-4
1/(12·3600)
1/(6·3600)
Pressure Spectral Density ubar/rtHz
34 days Setra model 270 Pressure HRV

text

title


36769
IU-HRV/00-BHE 20Hz 5 PIXS/PT OFFSET=891.3 MAX=14428 MIN=-36769 C081103180000_HRV.XXX_1
18504
IU-HRV/00-BHN 20Hz 5 PIXS/PT OFFSET=323.1 MAX=18504 MIN=-15823 C081103180000_HRV.XXX_1
21538
IU-HRV/00-BHZ 20Hz 5 PIXS/PT OFFSET=1133 MAX=21538 MIN=-14355 C081103180000_HRV.XXX_1
18.52
QT-0503/BHZ 20Hz 5 PIXS/PT OFFSET=189910 MAX=18.52 MIN=-17.04 Gain=0.140 C081103170000_1108.XXX_1
14.74
IU-HRV/30-LDO 1Hz 100 PIXS/PT OFFSET=1008900 MAX=12.26 MIN=-14.74 C081103180000_HRV.XXX_1
14.50
QT-0503/LHZ 1Hz 100 PIXS/PT OFFSET=189913 MAX=6.78 MIN=-14.50 Gain=0.140 C081103170000_1108.XXX_1
825.5
IU-HRV/20-HNE 100Hz 1 PIXS/PT OFFSET=-3992 MAX=693.5 MIN=-825.5 C081103180000_HRV.XXX_1
680.5
IU-HRV/20-HNN 100Hz 1 PIXS/PT OFFSET=-6739 MAX=680.5 MIN=-558.5 C081103180000_HRV.XXX_1
572.0
IU-HRV/20-HNZ 100Hz 1 PIXS/PT OFFSET=39393 MAX=559.0 MIN=-572.0 C081103180000_HRV.XXX_1
T1=2008-11-03 18:11:21.838391
dT=65.100
T2=2008-11-03 18:12:26.938391
Zoom=5, Ticks=10 SEC, dPixel=0.010, Filt=None
STS-1 (top), Analog Pressure (0503/BHZ ubar), Parosci (LDO ubar), Analog Pressure (0503/LHZ ubar), Episensor. Probable nearby Quarry Blast showing ~15ubar infras



ESTIMATED FLOOR ~ 0.4 µbar/√Hz, or ~ 1 µbar rms above 1 Hz, or ~ 2.4 µbar p-p in a 1Hz band 1Hz-2Hz, below typical ambient pressure variation.
SAMPLE 2009/01/01

Construction

Have truck, will travel

Using 3 vehicles, 1 trailers, 1 backhoe, and three people, it is feasible to construct 4 sites in 5 days

42" dia. pipe set into 7' deep pit with concrete on either side of rubber membrane

Current method; custom trailer with water tank, room for cement bags, and onboard mixer

Flex conduit was replaced with straight sticks reducing field time significantly. Wires are pulled during construction phase

Modularity in Communications

- Cellular Modem
- AC VSAT or BB providor
- Solar VSAT

IRIDIUM

Sky▶Connect

Secure Flight Deck Communications

In today's volatile environment, the utility of having a telephone on the flight deck cannot be understated. One-to-one, secure communications enables access to people and resources which can't be obtained through other means.

The new MMU-II integrated dialer and text messaging terminal from Sky Connect. provides access to the best features of the Iridium satellite network on any flight deck of any type of aircraft, from airliners to helicopters.

Building on the successful original MMU, the MMU-II adds the flexibility of a full DTMF dial pad. Working in unison with the unique MMU rotary controller, the dialpad can be used to enter phone numbers, text messages, and mini-flight plan data.

The MMU-II storage capacity is huge, for pre-programming grouped sets of telephone numbers and specialized custom text messages and mini-forms. This lowers pilot workload by reducing the keystrokes needed to conduct routine communications between the aircraft and fleet dispatch centers.

- *Stores numbers with names*
- *Full standard DTMF dial pad*
- *Two-way text messaging*
- *User-defined stored messages*
- *WiFi-ready for virtual MMU*
- *Multiple MMU-IIs supported*
- *Up to 8 discrete inputs*
- *NVG/NVIS filter options*