Quanterra and *Antelope*: an ongoing relationship in research and development for the future

May, 2008

Antelope User Group Meeting

ZAMG, Vienna

BOULDER REAL TIME TECHNOLOGIES, INC.

- BRTT started working with Quanterra dataloggers in 1997 with the then new Q730 MSHEAR systems for a project in Saudi Arabia
- First implementation within Antelope used COMSERV with the program **`cs2orb`**
- By inspecting the COMSERV source code, we were able to infer the raw telemetry protocols and formats that were used to talk to the dataloggers directly
- We discovered that although the data samples were represented as MSEED Steim compressed data blocks, the normal MSEED headers were missing in the raw telemetry transmissions
- Instead the telemetry blocks contained the information needed to formulate MSEED headers and also some other useful “out of band” information relating to status and state of health

- This led us in the direction of writing our own software to talk directly to the dataloggers without using COMSERV which ultimately produced **`qt2orb`**
- Why did BRTT do this?
  - We had a vision of a centralized network acquisition and control system that had **<u>timely</u>** access to all data and state of health information across the entire network
  - We also wanted a fundamental system design that would support early warning
  - The existing MSHEAR-COMSERV view into the data was a completely SEED-centric view
  - Although SEED is a good way of representing data for exchange and archiving, it is not a particularly good representation of data and state of health information in situations that require very low latencies
  - We wanted a view into the "Q330" that was inside of every MSHEAR system

Design of Antelope software module `q3302orb`

- First CVS check-in February, 2001 - well before Q330 was released to the public
- Initial testing done with a Q330 simulator
- About 150 revisions to the main program
- Close collaboration between BRTT and Quanterra continuing to present
- Done entirely with internal BRTT funding - means BRTT has a high opinion of the Q330 datalogger
- Strong commitment by BRTT to support Q330 product line in the future

Requirements for `q3302orb`

- One instance of **`q3302orb`** to acquire data from many Q330 dataloggers
- Acquire and output ALL information from the Q330 dataloggers including the copious status information
- Fully featured support of ALL Q330 acquisition capabilities including very low data latencies (one second packets), base96 encoding, serial port acquisition of high resolution pressure waveforms from Paroscientific sensors and Q330 capabilities for sensor calibration
- Internal generation of additional status information relating to receiver-end communications
- All waveforms, datalogger status, command responses and internally generated log messages output as ORB packets
- Configuration accomplished using standard Antelope mechanisms (i.e. command line arguments, databases and parameter files)
- Dynamic commands to **`q3302orb`** and Q330 dataloggers using command ORB packets generated by the program **`dlcmd`**
- Robust link disconnect/reconnect and **`q3302orb`** stop/restart so no data is lost or repeated
- Ability to arbitrarily define ORB packet channel multiplexing and time durations independent of Q330 waveform data streams
- Ability to represent certain status information as waveforms and/or ASCII log messages and/or pf representations (used by **`dlmon`**)
- Completely compatible with other Q330 acquisition and control agents such as willard
- High performance, high MTF, minimum resource impact

What **`q3302orb`** is not designed to do

- Resample data waveforms (i.e. V.. Channels)
- Any other data waveform processing (except for LCQ channel)
- Detections
- Waveform segmentation
- Conversion to SEED
- Data archiving
- Lots of things done by the BALER
- Lots of things done by MSHEAR systems
- Meant to be compact high performance receiver-side software analog to Q330

Sensor calibration using Quanterra Q330 dataloggers with ***Antelope***

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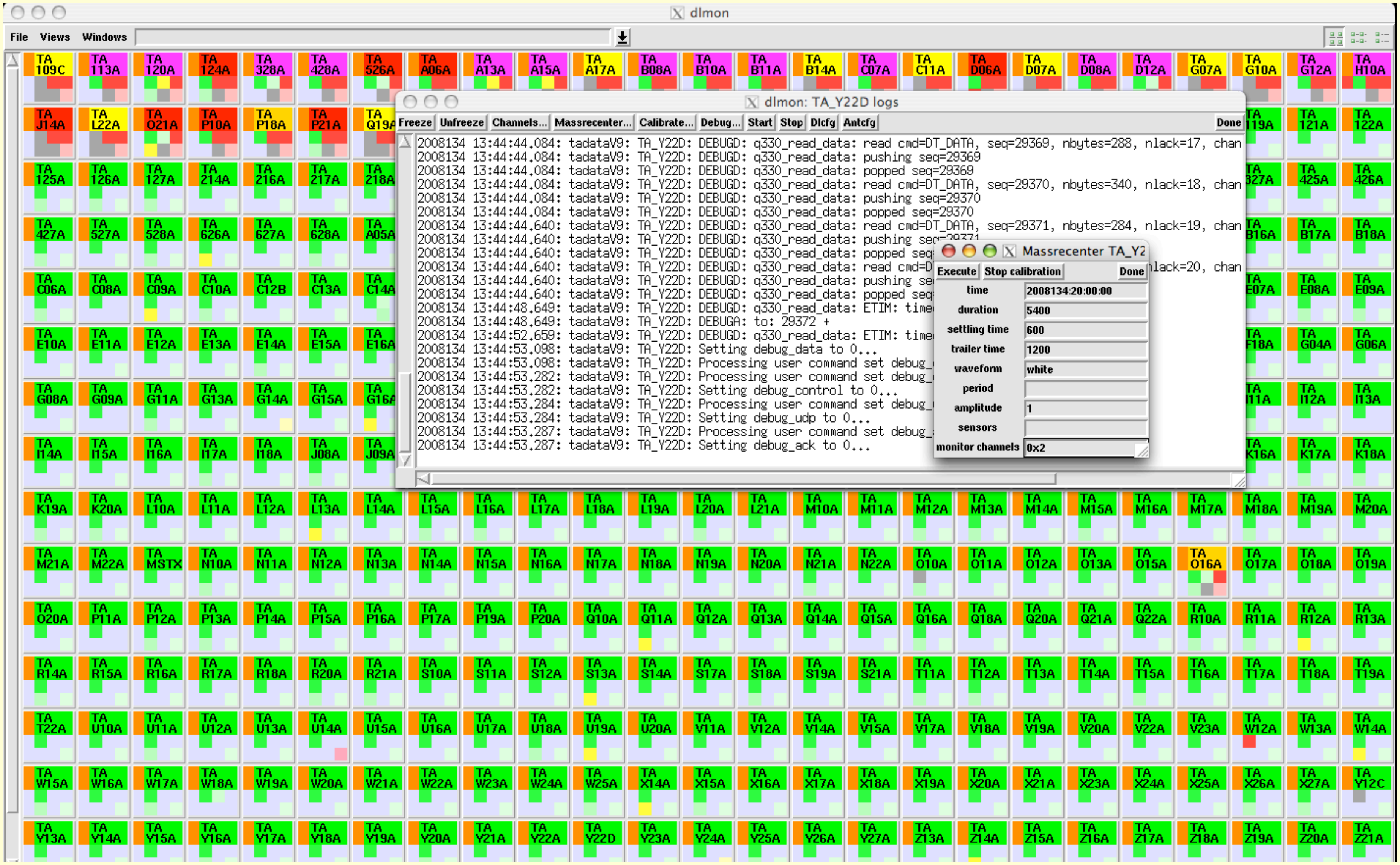
Q330 sensor calibration capabilities

- High resolution DAC with precise timing
- A variety of waveforms including step function, sine, random telegraph, white noise, red noise (white noise produces best results over entire frequency band)
- Ability to monitor DAC output simultaneously with sensor output
- Special data “markers” inserted into output data stream that clearly identify calibrations regardless of the command source

Sensor calibration strategy using Antelope and Q330 dataloggers

- Q330 calibration command can be done either using the Antelope **`dlcmd`** mechanism, or any other extra-Antelope mechanism, such as **`willard`**
- As the calibration sequence runs on the Q330, special data markers are generated and inserted into the waveform data stream.
- **`q3302orb`** looks for these calibration data markers and generates special database ORB packets, using the new **`dlcalwf`** relation, for each data channel that contains calibration waveforms (either sensor or monitor)
- The calibration waveforms and the **`dlcalwf`** relation ORB packets flow through the Antelope real-time system and eventually are stored in one or more archive databases.
- Post analysis is accomplished with the new **`dbcalibrate`** program which reads all of its input and writes all of its output from/to archive databases
- Calibration results can be displayed and hard copy Postscript can be generated by the new **`displayscal`** script
- Note the decoupling of command, capture and analysis functions



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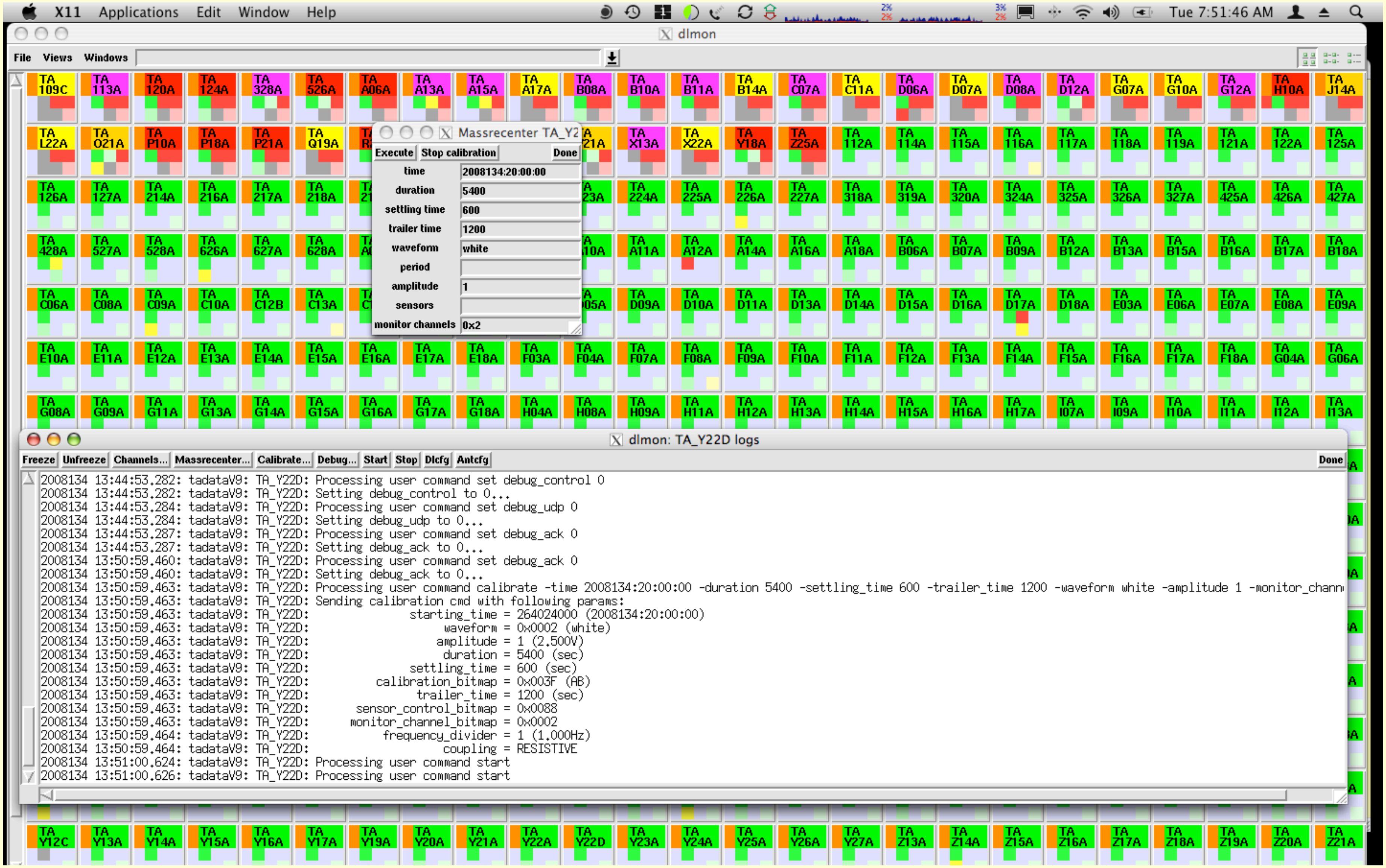

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dbcal dlcalwf

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snet	fsta	fchan	loc	time	model	ssident	dlcalseq	dlcaltype	dlcalerr	dlcalinput	dlcalchanbm	phchan	samprate	dlcalamp	dlcalfreq	dlcalsettle	dlcaltrailer
TA	TCHZ	LHZ		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	s	0x3F	0	1.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	LHN		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	d	0x3F	1	1.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	LHE		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	s	0x3F	2	1.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	BHZ		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	s	0x3F	0	40.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	BHN		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	d	0x3F	1	40.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	BHE		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	s	0x3F	2	40.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	HHZ		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	s	0x3F	0	100.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	HHN		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	d	0x3F	1	100.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	HHE		11/13/2007 (317) 17:00:55.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:00:55	white	ok	s	0x3F	2	100.0000000	5.00000000	1.0000	100.0000	100.0000
TA	TCHZ	LHZ		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	s	0x3F	0	1.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	LHN		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	d	0x3F	1	1.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	LHE		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	s	0x3F	2	1.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	BHZ		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	s	0x3F	0	40.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	BHN		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	d	0x3F	1	40.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	BHE		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	s	0x3F	2	40.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	HHZ		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	s	0x3F	0	100.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	HHN		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	d	0x3F	1	100.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	HHE		11/13/2007 (317) 17:40:00.00000	q330	0100000EA996551D	TA_TCHZ-2007317:17:40:00	white	ok	s	0x3F	2	100.0000000	2.50000000	1.0000	300.0000	300.0000
TA	TCHZ	LHZ		11/14/2007 (318) 21:12:34.00000	q330	0100000EA996551D	TA_TCHZ-2007318:21:12:34	step	ok	s	0x3F	0	1.0000000	2.50000000	1.0000	100.0000	100.0000
TA	TCHZ	LHN		11/14/2007 (318) 21:12:34.00000	q330	0100000EA996551D	TA_TCHZ-2007318:21:12:34	step	ok	d	0x3F	1	1.0000000	2.50000000	1.0000	100.0000	100.0000
TA	TCHZ	LHE		11/14/2007 (318) 21:12:34.00000	q330	0100000EA996551D	TA_TCHZ-2007318:21:12:34	step	ok	s	0x3F	2	1.0000000	2.50000000	1.0000	100.0000	100.0000
TA	TCHZ	BHZ		11/14/2007 (318) 21:12:34.00000	q330	0100000EA996551D	TA_TCHZ-2007318:21:12:34	step	ok	s	0x3F	0	40.0000000	2.50000000	1.0000	100.0000	100.0000
TA	TCHZ	BHN		11/14/2007 (318) 21:12:34.00000	q330	0100000EA996551D	TA_TCHZ-2007318:21:12:34	step	ok	d	0x3F	1	40.0000000	2.50000000	1.0000	100.0000	100.0000
TA	TCHZ	BHE		11/14/2007 (318) 21:12:34.00000	q330	0100000EA996551D	TA_TCHZ-2007318:21:12:34	step	ok	s	0x3F	2	40.0000000	2.50000000	1.0000	100.0000	100.0000
TA	TCHZ	HHZ		11/14/2007 (318) 21:12:34.00000	q330	0100000EA996551D	TA_TCHZ-2007318:21:12:34	step	ok	s	0x3F	0	100.0000000	2.50000000	1.0000	100.0000	100.0000

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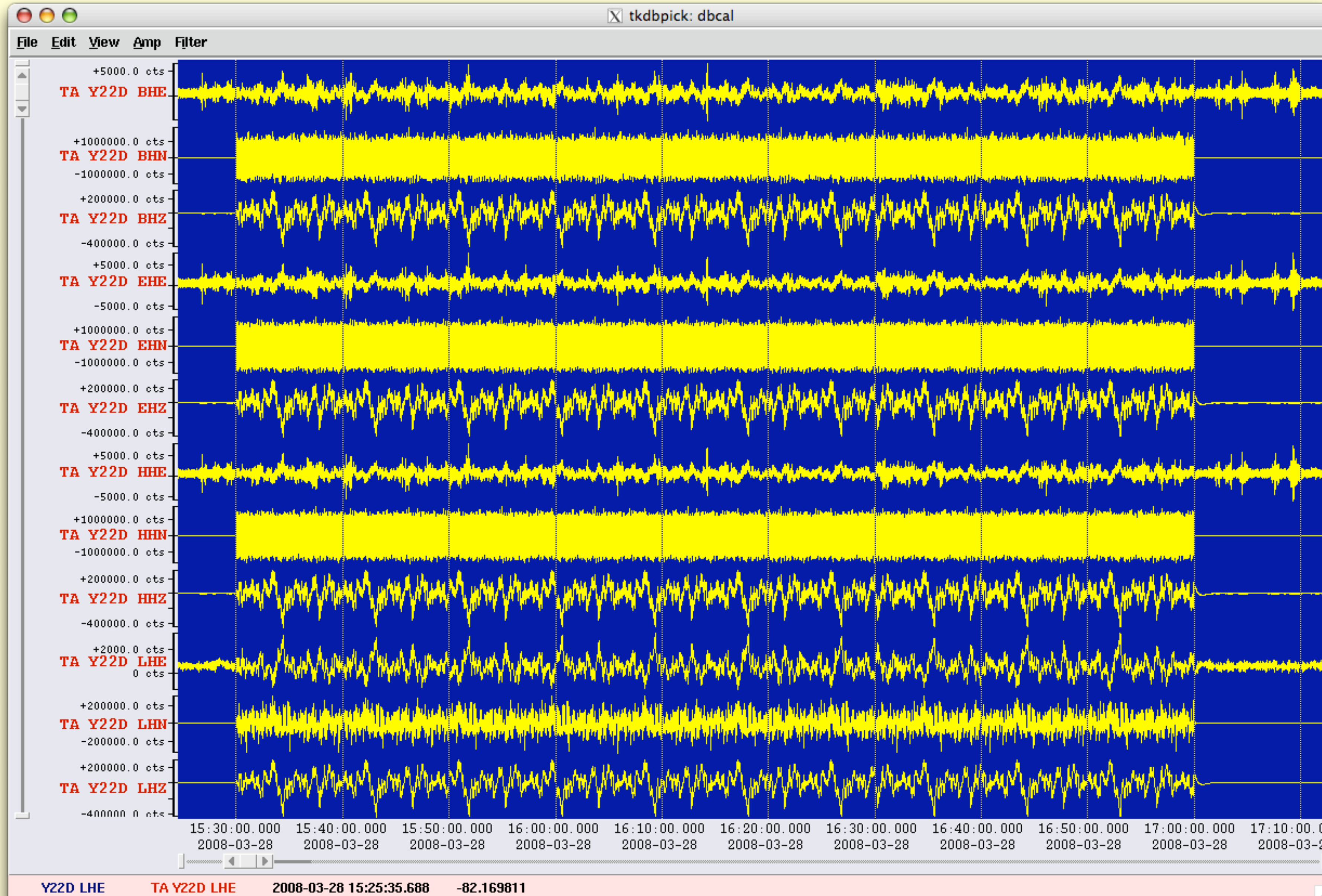
- **`q3302orb`** automatically generates special database ORB packets, using the new **`dlcalwf`** relation, for each data channel that contains calibration waveforms (either sensor or monitor)
- The calibration waveforms and the **`dlcalwf`** relation ORB packets flow through the Antelope real-time system and eventually are stored in one or more archive databases.
- The **`dlcalwf`** rows act as markers in the archive database to identify calibration waveforms and their associated parameters



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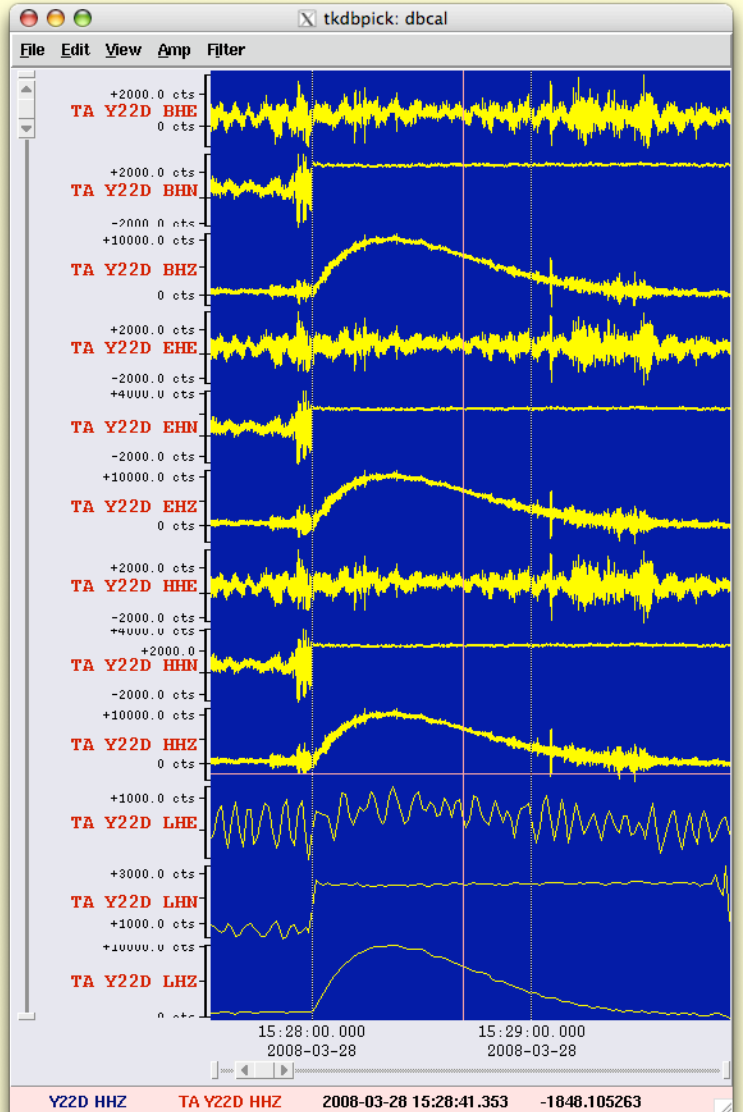

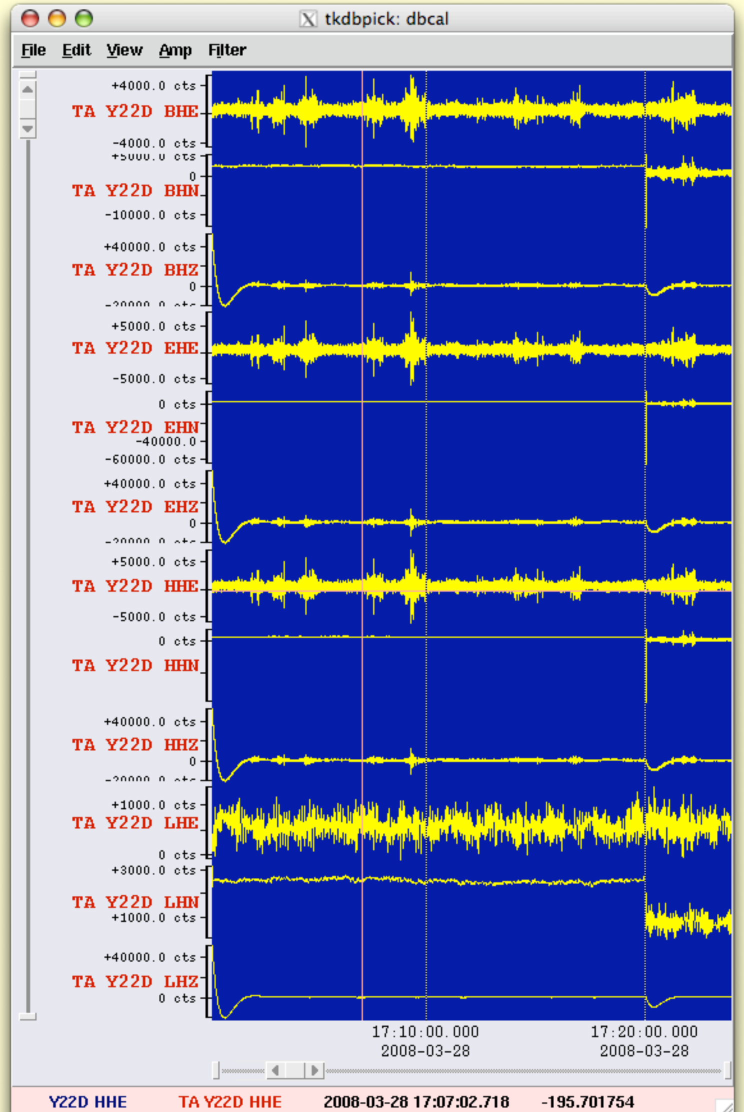

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Sensor calibration analysis using **`dbcalibrate`**

- **`dbcalibrate`** operates strictly by computing smoothed spectral ratios in amplitude and phase, including statistics, between pairs of waveforms that can span different time periods, stations and channels
- An estimate of sensor response (as seen through the calibration circuitry and mechanics) can be obtained by ratioing a recorded sensor calibration output and a direct loopback signal from the datalogger calibration signal DAC back through the datalogger ADC (Q330 monitor channel)
- Spectral comparisons of like calibration output signals across different time period and/or different stations and/or different channels can also be computed to produce spectra of changes (should be flat and zero phase if there are no changes)
- Noise to calibration signal spectral power ratios can also be generated to determine valid comparison spectra frequency ranges
- Note that **`dbcalibrate`** can only compare two recorded waveforms and not a recorded waveform with an internally generated theoretical waveform

Sensor calibration analysis using **`dbcalibrate`**

- **`dbcalibrate`** produces its output spectra only as frequency, amplitude, phase, amplitude error, phase error tables - no pole and zero fitting or "post spectra" smoothing are performed
- Spectral ratios are computed by dividing the cross correlation spectrum between the numerator (subject) and denominator (reference) waveforms by the autocorrelation spectrum of the denominator waveform
- Spectral smoothing and statistics determination are computed through accumulations of the frequency domain cross correlation matrix elements from a set of tapered moving time windows through the waveform data
- In order to reduce the size of the resulting response functions (1000 sec to 100 hz response would produce a spectrum with 200,000 points) and to provide many short time windows for the higher frequencies vs. fewer longer time windows for the lower frequencies, we do the analysis in multiple frequency bands
- Try **`man dbcalibrate`** for more detailed information

Example run of **dbcalibrate**

```
2615 ruper% dbcalibrate -v -outrecno \
                     -dlcalwf_sifter 'fchan =~ /EH./ && (fchan == "EHZ" || dlcalinput == "d")' \
                     -out dbcal dbcal TA_Y22D-2008088:15:30:00

dbcalibrate: Processing calibration sequence TA_Y22D-2008088:15:30:00
dbcalibrate: for q330 sn 0100000A27B8E96F at  3/28/2008  15:30:00.000:
dbcalibrate:              type  =  white
dbcalibrate:          duration  =  5400.0000 Seconds
dbcalibrate:       disposition  =  ok
dbcalibrate:    channel bitmap  =  0x7
dbcalibrate:         amplitude  =  2.5000 Volts
dbcalibrate:         frequency  =  1.0000
dbcalibrate:       settle time  =  120.0000 Seconds
dbcalibrate:      trailer time  =  1200.0000 Seconds
dbcalibrate:     found 1 sensors attached to datalogger:
dbcalibrate:          A -> sts2_g3:30716
dbcalibrate:              type=V, drive=c, active=yes, calgen=0.0300238cm/V, cal2rsp=1, sngen=1500V/cm/s, calper=1.000
dbcalibrate:     found 2 channels in this sequence:
dbcalibrate:          TA_Y22D_EHN -> Y22D:EHN, sensor=sts2_g3:30716, nomresp=yes, input=d, phchan=1, samprate=200.0
dbcalibrate:          TA_Y22D_EHZ -> Y22D:EHZ, sensor=sts2_g3:30716, nomresp=yes, input=s, phchan=0, samprate=200.0
dbcalibrate:     found 1 samplerate groups in this sequence:
dbcalibrate:          for samplerate 200.0, found 1 channels to process:
dbcalibrate:              reference trace at TA_Y22D_EHN -> Y22D:EHN, data samples ok
dbcalibrate:              TA_Y22D_EHZ -> Y22D:EHZ, timing ok, time window ok, data samples ok
dbcalibrate: specdiv: Total process window of 6430.000 seconds starting at 2008088:15:29:30.000:
dbcalibrate: specdiv: Processing 4 frequency bands to produce 1150 frequency points:
dbcalibrate: specdiv: For band 0, Processing 1 windows of 10485.760 seconds with fmax=100.000 and df=0.000095
dbcalibrate: specdiv: For band 1, Processing 18 windows of 655.360 seconds with fmax=100.000 and df=0.001526
dbcalibrate: specdiv: For band 2, Processing 626 windows of 20.480 seconds with fmax=100.000 and df=0.048828
dbcalibrate: specdiv: For band 3, Processing 10045 windows of 1.280 seconds with fmax=100.000 and df=0.781250
0
2616 ruper%
```

- **`dbcalibrate`** disposes its output into a new database relation **`sensorcal`** and a set of ASCII response files
- Response files include the spectral ratio itself, a nominal response and amplitude and phase differences (errors?) between the ratio and the nominal response
- Also computed as an absolute gain term that is used to infer the effective sensor generator constant, although it is unclear how this relates to the true sensor generator constant

dbcal sensorcal

sta	chan	rsta	rchan	tstart	tend	time	rtime	dlcalseq	dlcalseqr	dlcaltype	ptype	pnoise
Y22D	EHZ	Y22D	EHN	3/28/2008 (088) 15:29:30.00000	3/28/2008 (088) 17:16:39.44000	3/28/2008 (088) 15:30:00.00000	3/28/2008 (088) 15:30:00.00000	TA_Y22D-2008088:15:30:00	TA_Y22D-2008088:15:30:00	white	ratio	no
Y22D	EHZ	Y22D	EHZ	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 15:30:00.00000	TA_Y22D-2008088:15:30:00	TA_Y22D-2008088:15:30:00	white	power	yes
Y22D	EHE	Y22D	EHN	3/28/2008 (088) 15:29:30.00000	3/28/2008 (088) 17:16:39.44000	3/28/2008 (088) 15:30:00.00000	3/28/2008 (088) 15:30:00.00000	TA_Y22D-2008088:15:30:00	TA_Y22D-2008088:15:30:00	white	ratio	no
Y22D	EHE	Y22D	EHE	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 15:30:00.00000	TA_Y22D-2008088:15:30:00	TA_Y22D-2008088:15:30:00	white	power	yes
Y22D	EHZ	Y22D	EHE	3/28/2008 (088) 19:59:30.00000	3/28/2008 (088) 21:46:39.44000	3/28/2008 (088) 20:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_Y22D-2008088:20:00:00	TA_Y22D-2008088:20:00:00	white	ratio	no
Y22D	EHZ	Y22D	EHZ	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_Y22D-2008088:20:00:00	TA_Y22D-2008088:20:00:00	white	power	yes
Y22D	EHN	Y22D	EHE	3/28/2008 (088) 19:59:30.00000	3/28/2008 (088) 21:46:39.44000	3/28/2008 (088) 20:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_Y22D-2008088:20:00:00	TA_Y22D-2008088:20:00:00	white	ratio	no
Y22D	EHN	Y22D	EHN	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_Y22D-2008088:20:00:00	TA_Y22D-2008088:20:00:00	white	power	yes
Y22D	EHZ	Y22D	EHZ	3/28/2008 (088) 19:59:30.00000	3/28/2008 (088) 21:46:39.44000	3/28/2008 (088) 20:00:00.00000	3/28/2008 (088) 15:30:00.00000	TA_Y22D-2008088:20:00:00	TA_Y22D-2008088:15:30:00	white	ratio	no
TETH	EHZ	TETH	EHN	3/28/2008 (088) 15:29:30.00000	3/28/2008 (088) 17:16:39.44000	3/28/2008 (088) 15:30:00.00000	3/28/2008 (088) 15:30:00.00000	TA_TETH-2008088:15:30:00	TA_TETH-2008088:15:30:00	white	ratio	no
TETH	EHZ	TETH	EHZ	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 15:30:00.00000	TA_TETH-2008088:15:30:00	TA_TETH-2008088:15:30:00	white	power	yes
TETH	EHE	TETH	EHN	3/28/2008 (088) 15:29:30.00000	3/28/2008 (088) 17:16:39.44000	3/28/2008 (088) 15:30:00.00000	3/28/2008 (088) 15:30:00.00000	TA_TETH-2008088:15:30:00	TA_TETH-2008088:15:30:00	white	ratio	no
TETH	EHE	TETH	EHE	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 15:30:00.00000	TA_TETH-2008088:15:30:00	TA_TETH-2008088:15:30:00	white	power	yes
TETH	EHZ	TETH	EHE	3/28/2008 (088) 19:59:30.00000	3/28/2008 (088) 21:46:39.44000	3/28/2008 (088) 20:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_TETH-2008088:20:00:00	TA_TETH-2008088:20:00:00	white	ratio	no
TETH	EHZ	TETH	EHZ	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_TETH-2008088:20:00:00	TA_TETH-2008088:20:00:00	white	power	yes
TETH	EHN	TETH	EHE	3/28/2008 (088) 19:59:30.00000	3/28/2008 (088) 21:46:39.44000	3/28/2008 (088) 20:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_TETH-2008088:20:00:00	TA_TETH-2008088:20:00:00	white	ratio	no
TETH	EHN	TETH	EHN	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 20:00:00.00000	TA_TETH-2008088:20:00:00	TA_TETH-2008088:20:00:00	white	power	yes
TETH	EHZ	TETH	EHZ	3/28/2008 (088) 19:59:30.00000	3/28/2008 (088) 21:46:39.44000	3/28/2008 (088) 20:00:00.00000	3/28/2008 (088) 15:30:00.00000	TA_TETH-2008088:20:00:00	TA_TETH-2008088:15:30:00	white	ratio	no
N16A	EHZ	N16A	EHN	3/28/2008 (088) 18:59:30.00000	3/28/2008 (088) 20:46:39.44000	3/28/2008 (088) 19:00:00.00000	3/28/2008 (088) 19:00:00.00000	TA_N16A-2008088:19:00:00	TA_N16A-2008088:19:00:00	white	ratio	no
N16A	EHZ	N16A	EHZ	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 19:00:00.00000	TA_N16A-2008088:19:00:00	TA_N16A-2008088:19:00:00	white	power	yes
N16A	EHE	N16A	EHN	3/28/2008 (088) 18:59:30.00000	3/28/2008 (088) 20:46:39.44000	3/28/2008 (088) 19:00:00.00000	3/28/2008 (088) 19:00:00.00000	TA_N16A-2008088:19:00:00	TA_N16A-2008088:19:00:00	white	ratio	no
N16A	EHE	N16A	EHE	3/29/2008 (089) 1:59:30.00000	3/29/2008 (089) 3:30:29.84000	3/29/2008 (089) 2:00:00.00000	3/28/2008 (088) 19:00:00.00000	TA_N16A-2008088:19:00:00	TA_N16A-2008088:19:00:00	white	power	yes

```
2628 ruper% more white_Y22D_EHZ_08088153000
##
## TA_Y22D-2008088:15:30:00 white sta=Y22D chan=EHZ time= 3/28/2008  15:30:00.000 duration=5400.000 sec
## Compared to:
## TA_Y22D-2008088:15:30:00 white sta=Y22D chan=EHN time= 3/28/2008  15:30:00.000 duration=5400.000 sec
##
## response analysis parameters:
#       {bands}[0]{fmax} = 0.02
#       {bands}[0]{fmin} = 0.000001
#       {bands}[0]{nwindows} = 1
#       {bands}[0]{overlap_percent} = 0.0
#       {bands}[0]{taper_percent} = 0.0
#       {bands}[1]{fmax} = 1.0
#       {bands}[1]{fmin} = 0.0025
 ...
#       {tlag} = 1000.0
#       {tlead} = 30.0
##
##Frequency(hz)       Amplitude      Phase(deg)   AmpUncertHigh    AmpUncertLow PhaseUncertHigh  PhaseUncertLow
##
measured 1 complete-white fap2 danny/dbcalibrate
1150
 9.53674316e-05  9.35422577e-05  1.34816925e+02  9.35422577e-05  9.35422577e-05  1.34816925e+02  1.34816925e+02
 1.90734863e-04  2.66779796e-04  1.29471237e+02  2.66779796e-04  2.66779796e-04  1.29471237e+02  1.29471237e+02
 2.86102295e-04  1.06819987e-03  1.77127350e+02  1.06819987e-03  1.06819987e-03  1.77127350e+02  1.77127350e+02
 3.81469727e-04  1.50873035e-03  1.69980560e+02  1.50873035e-03  1.50873035e-03  1.69980560e+02  1.69980560e+02
 4.76837158e-04  3.26205418e-03  1.72308044e+02  3.26205418e-03  3.26205418e-03  1.72308044e+02  1.72308044e+02
  ...
```

White noise sensor calibration processing results

Processed by dbcalbrt:danny:redgarden at 2008134:12:49:37.095

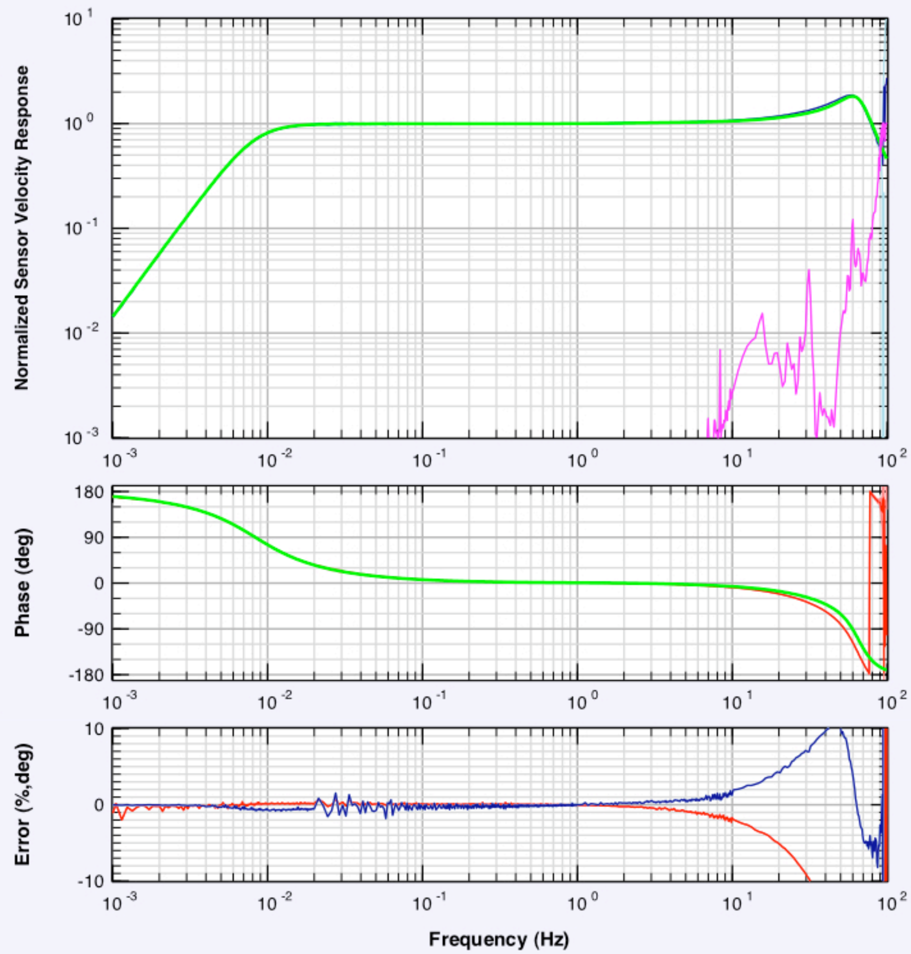
Channel: TA_Y22D_EHZ	Time: 2008088:15:30:00.000	Sequence: TA_Y22D-2008088:15:30:00	
Dlmodel: q330	Dlserial: 0100000A27B8E96F	Snmodel: sts2_g3	Snserial: 30716
Noise Channel: TA_Y22D_EHZ	Noise Time: 2008089:02:00:00.000	Noise Sequence: TA_Y22D-2008088:15:30:00	
Noise Dlmodel: q330	Noise Dlserial: 0100000A27B8E96F	Noise Snmodel: sts2_g3	Noise Snserial: 30716
Ref Channel: TA_Y22D_EHN	Ref Time: 2008088:15:30:00.000	Ref Sequence: TA_Y22D-2008088:15:30:00	
Ref Dlmodel: q330	Ref Dlserial: 0100000A27B8E96F	Ref Snmodel: sts2_g3	Ref Snserial: 30716

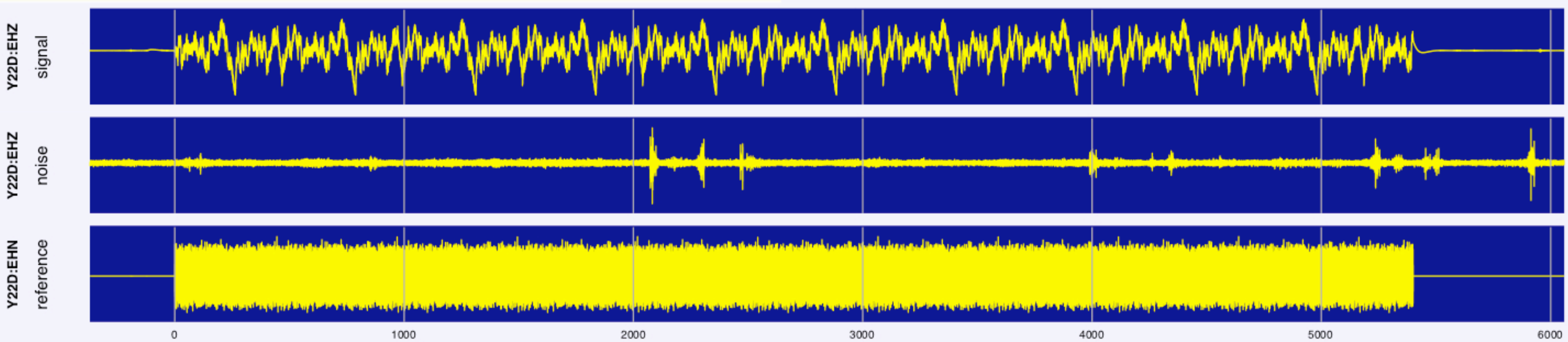
Cal mode: mon	Cal Waveform: white	Cal Duration: 1:30 hours	Samplerate: 200	Cal Amplitude: 2.500 V
Cal processing: ratio	Cal Settle Time: 2:00 minutes	Cal Trailer Time: 20:00 minutes		

Sngen: 1517.30 V/m/s	Nominal Sngen: 1500.00 V/m/s	Norm Freq: 1.000 Hz	Noise Relative To: TA_Y22D-2008088:15:30:00

Processing Parameters:

{bands}{0}{fmax} = 0.02
{bands}{0}{fmin} = 0.000001
{bands}{0}{nwindows} = 1
{bands}{0}{overlap_percent} = 0.0
{bands}{0}{taper_percent} = 0.0
{bands}{1}{fmax} = 1.0
{bands}{1}{fmin} = 0.0025
{bands}{1}{nwindows} = 0
{bands}{1}{overlap_percent} = 50.0
{bands}{1}{taper_percent} = 25.0
{bands}{2}{fmax} = 10.0
{bands}{2}{fmin} = 0.05
{bands}{2}{nwindows} = 0
{bands}{2}{overlap_percent} = 50.0
{bands}{2}{taper_percent} = 50.0
{bands}{3}{fmax} = 200.0
{bands}{3}{fmin} = 1.00
{bands}{3}{nwindows} = 0
{bands}{3}{overlap_percent} = 50.0
{bands}{3}{taper_percent} = 50.0
{tlag} = 1000.0
{tlead} = 30.0





White noise sensor calibration processing results

Processed by dbcalbrt:danny:redgarden at 2008134:12:51:30.613

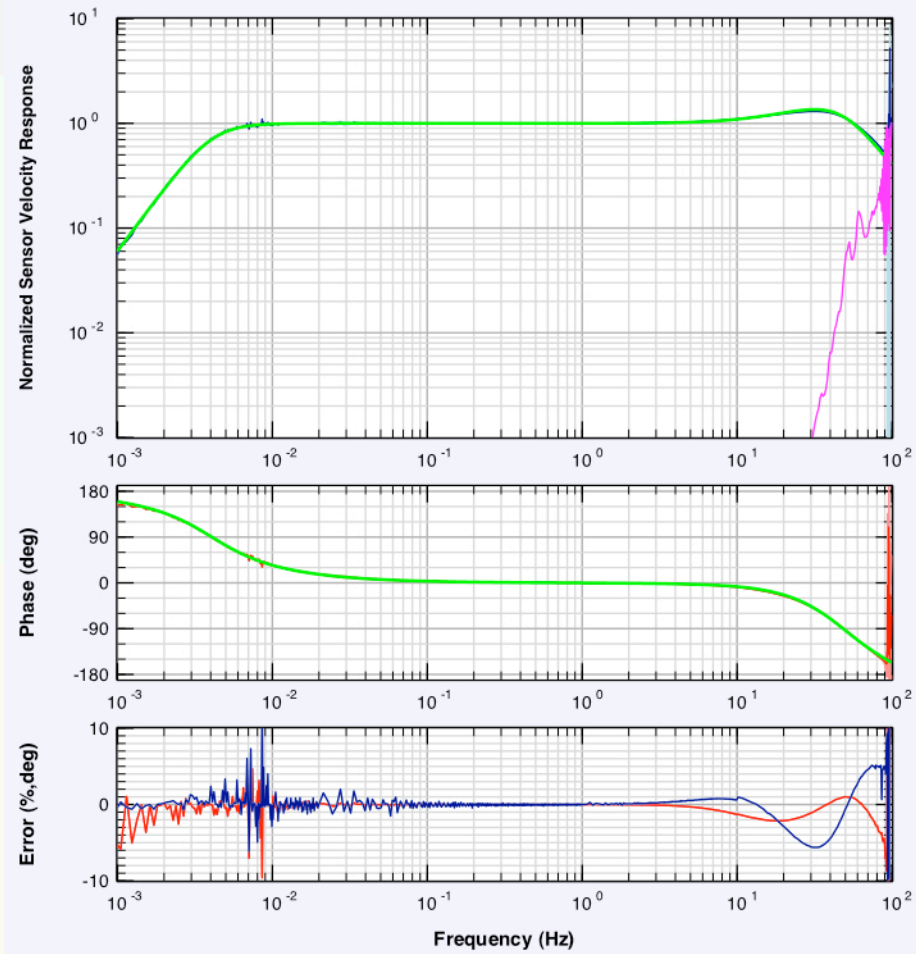
Channel: **TA_N16A_EHZ**	Time: **2008088:19:00:00.000**	Sequence: **TA_N16A-2008088:19:00:00**	
Dlmodel: **q330**	Dlserial: **010000044D889446**	Snmodel: **trillium_240**	Snserial: **252**
Noise Channel: **TA_N16A_EHZ**	Noise Time: **2008089:02:00:00.000**	Noise Sequence: **TA_N16A-2008088:19:00:00**	
Noise Dlmodel: **q330**	Noise Dlserial: **010000044D889446**	Noise Snmodel: **trillium_240**	Noise Snserial: **252**
Ref Channel: **TA_N16A_EHN**	Ref Time: **2008088:19:00:00.000**	Ref Sequence: **TA_N16A-2008088:19:00:00**	
Ref Dlmodel: **q330**	Ref Dlserial: **010000044D889446**	Ref Snmodel: **trillium_240**	Ref Snserial: **252**

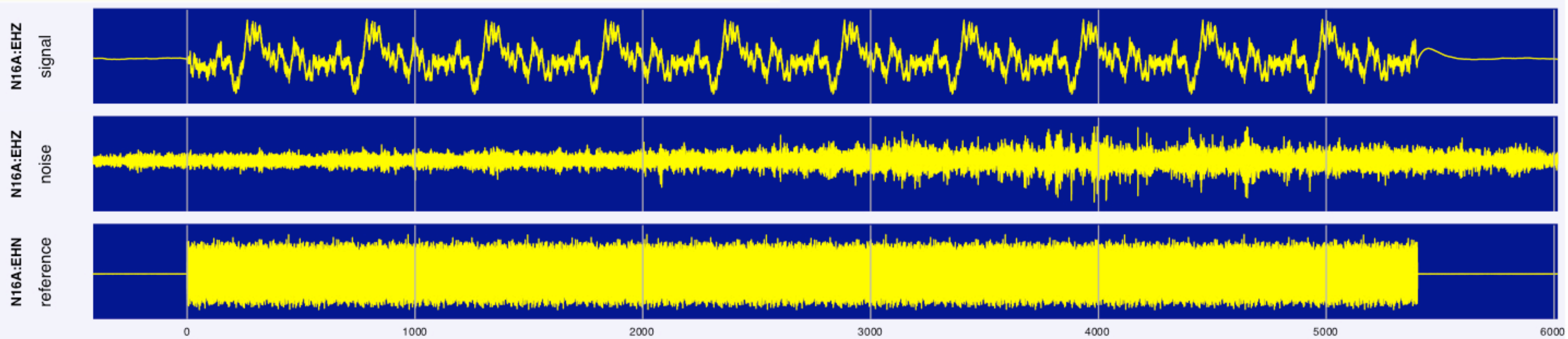
Cal mode: **mon**	Cal Waveform: **white**	Cal Duration: **1:30 hours**	Samplerate: **200**	Cal Amplitude: **0.312 V**
Cal processing: **ratio**	Cal Settle Time: **20:00 minutes**	Cal Trailer Time: **20:00 minutes**		

Sngen: **1500.70 V/m/s**	Nominal Sngen: **1500.00 V/m/s**	Norm Freq: **1.000 Hz**	Noise Relative To: **TA_N16A-2008088:19:00:00**

Processing Parameters:

{bands}{0}{fmax} = 0.02
{bands}{0}{fmin} = 0.000001
{bands}{0}{nwindows} = 1
{bands}{0}{overlap_percent} = 0.0
{bands}{0}{taper_percent} = 0.0
{bands}{1}{fmax} = 1.0
{bands}{1}{fmin} = 0.0025
{bands}{1}{nwindows} = 0
{bands}{1}{overlap_percent} = 50.0
{bands}{1}{taper_percent} = 25.0
{bands}{2}{fmax} = 10.0
{bands}{2}{fmin} = 0.05
{bands}{2}{nwindows} = 0
{bands}{2}{overlap_percent} = 50.0
{bands}{2}{taper_percent} = 50.0
{bands}{3}{fmax} = 200.0
{bands}{3}{fmin} = 1.00
{bands}{3}{nwindows} = 0
{bands}{3}{overlap_percent} = 50.0
{bands}{3}{taper_percent} = 50.0
{tlag} = 1000.0
{tlead} = 30.0





White noise sensor calibration processing results

Processed by dbcalbrt:danny:redgarden at 2008134:12:50:59.008

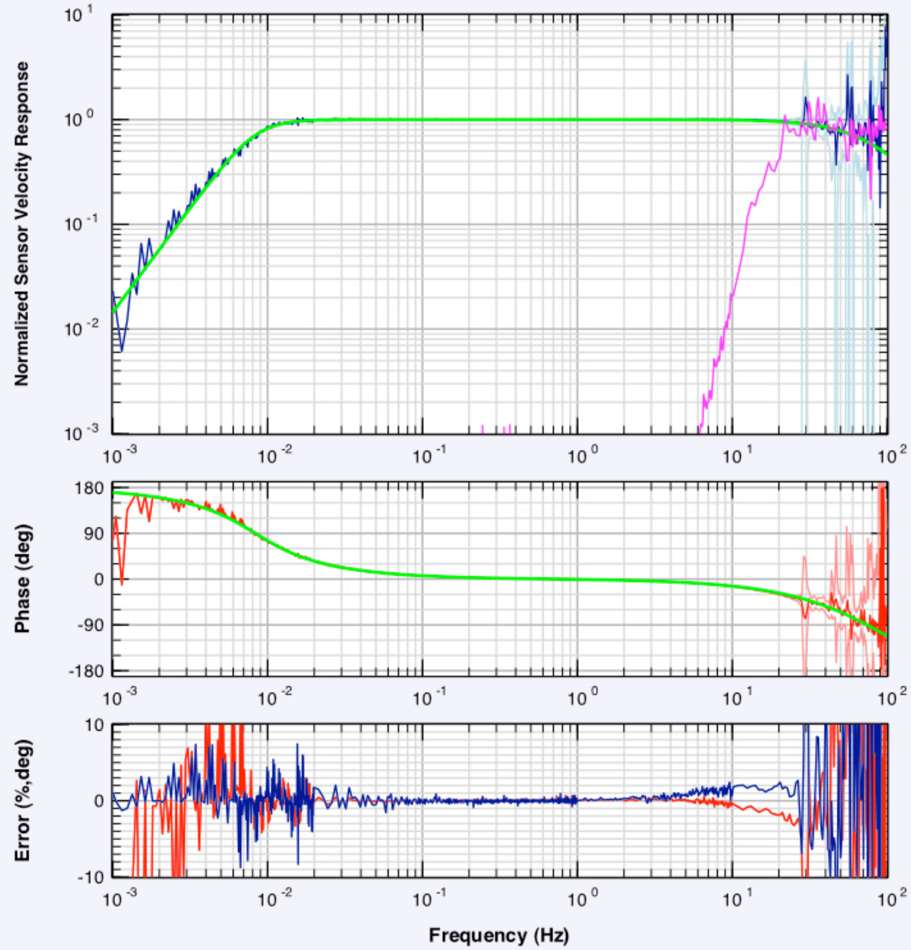
Channel: TA_TETH_EHZ	Time: 2008088:20:00:00.000	Sequence: TA_TETH-2008088:20:00:00	
Dlmodel: q330	Dlserial: 0100000EBDCFB1B8	Snmodel: cmg3t	Snserial: 0001
Noise Channel: TA_TETH_EHZ	Noise Time: 2008089:02:00:00.000	Noise Sequence: TA_TETH-2008088:20:00:00	
Noise Dlmodel: q330	Noise Dlserial: 0100000EBDCFB1B8	Noise Snmodel: cmg3t	Noise Snserial: 0001
Ref Channel: TA_TETH_EHE	Ref Time: 2008088:20:00:00.000	Ref Sequence: TA_TETH-2008088:20:00:00	
Ref Dlmodel: q330	Ref Dlserial: 0100000EBDCFB1B8	Ref Snmodel: cmg3t	Ref Snserial: 0001

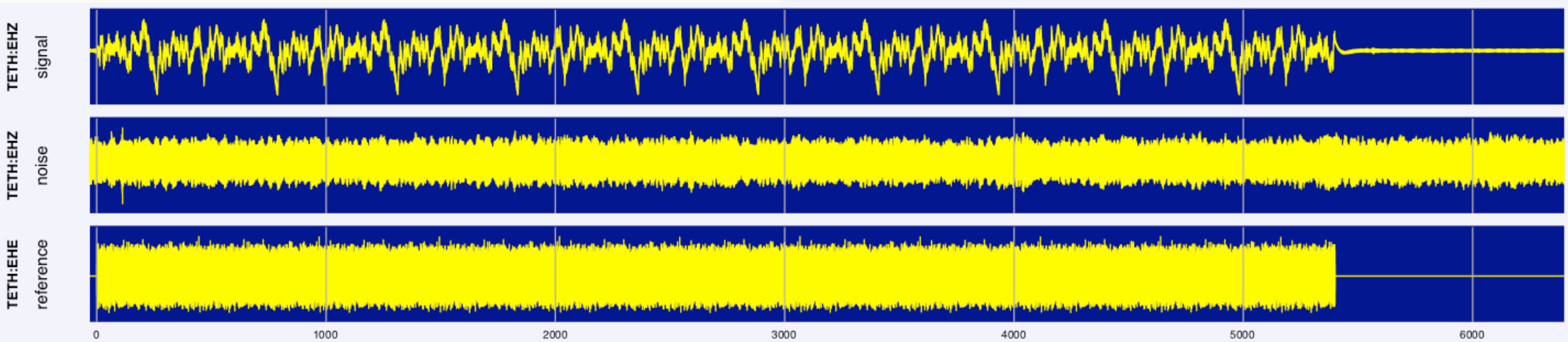
Cal mode: mon	Cal Waveform: white	Cal Duration: 1:30 hours	Samplerate: 200	Cal Amplitude: 2.500 V
Cal processing: ratio	Cal Settle Time: 10:00 minutes	Cal Trailer Time: 20:00 minutes		

Sngen: 1501.90 V/m/s	Nominal Sngen: 1500.00 V/m/s	Norm Freq: 1.000 Hz	Noise Relative To: TA_TETH-2008088:20:00:00

Processing Parameters:

{bands}[0]{fmax} = 0.02
{bands}[0]{fmin} = 0.000001
{bands}[0]{nwindows} = 1
{bands}[0]{overlap_percent} = 0.0
{bands}[0]{taper_percent} = 0.0
{bands}[1]{fmax} = 1.0
{bands}[1]{fmin} = 0.0025
{bands}[1]{nwindows} = 0
{bands}[1]{overlap_percent} = 50.0
{bands}[1]{taper_percent} = 25.0
{bands}[2]{fmax} = 10.0
{bands}[2]{fmin} = 0.05
{bands}[2]{nwindows} = 0
{bands}[2]{overlap_percent} = 50.0
{bands}[2]{taper_percent} = 50.0
{bands}[3]{fmax} = 200.0
{bands}[3]{fmin} = 1.00
{bands}[3]{nwindows} = 0
{bands}[3]{overlap_percent} = 50.0
{bands}[3]{taper_percent} = 50.0
{tlag} = 1000.0
{tlead} = 30.0





White noise sensor calibration processing results

Processed by dbcalbrt:danny:redgarden at 2008134:12:50:26.979

Channel: TA_Y22D_EHZ	Time: 2008088:20:00:00.000	Sequence: TA_Y22D-2008088:20:00:00	
Dlmodel: q330	Dlserial: 0100000A27B8E96F	Snmodel: sts2_g3	Snserial: 30716
Noise Channel: TA_Y22D_EHZ	Noise Time: 2008089:02:00:00.000	Noise Sequence: TA_Y22D-2008088:15:30:00	
Noise Dlmodel: q330	Noise Dlserial: 0100000A27B8E96F	Noise Snmodel: sts2_g3	Noise Snserial: 30716
Ref Channel: TA_Y22D_EHZ	Ref Time: 2008088:15:30:00.000	Ref Sequence: TA_Y22D-2008088:15:30:00	
Ref Dlmodel: q330	Ref Dlserial: 0100000A27B8E96F	Ref Snmodel: sts2_g3	Ref Snserial: 30716

Cal mode: cmp	Cal Waveform: white	Cal Duration: 1:30 hours	Samplerate: 200	Cal Amplitude: 2.500 V
Cal processing: ratio	Cal Settle Time: 10:00 minutes	Cal Trailer Time: 20:00 minutes		

Amp Ratio: 0.997160	Norm Freq: 1.000 Hz	Noise Relative To: TA_Y22D-2008088:15:30:00

Processing Parameters:

{bands}[0]{fmax} = 0.02
{bands}[0]{fmin} = 0.000001
{bands}[0]{nwindows} = 1
{bands}[0]{overlap_percent} = 0.0
{bands}[0]{taper_percent} = 0.0
{bands}[1]{fmax} = 1.0
{bands}[1]{fmin} = 0.0025
{bands}[1]{nwindows} = 0
{bands}[1]{overlap_percent} = 50.0
{bands}[1]{taper_percent} = 25.0
{bands}[2]{fmax} = 10.0
{bands}[2]{fmin} = 0.05
{bands}[2]{nwindows} = 0
{bands}[2]{overlap_percent} = 50.0
{bands}[2]{taper_percent} = 50.0
{bands}[3]{fmax} = 200.0
{bands}[3]{fmin} = 1.00
{bands}[3]{nwindows} = 0
{bands}[3]{overlap_percent} = 50.0
{bands}[3]{taper_percent} = 50.0
{tlag} = 1000.0
{tlead} = 30.0