

What is SEED ?

- SEED is an international standard for the exchange of digital seismological data
- SEED was designed for use by the earthquake research community, primarily for the exchange between institutions of unprocessed earth motion data
- SEED is a format for digital data measured at one point in space and at equal intervals of time.

SEED history

- < 1985:** IDA, GDSN,
- 1985:** IASPEI Commission on Practice ⇒ working group on digital data exchange ⇒ FDSN (International Federation of Digital Seismograph Networks)
- 1987:** FDSN draft standard (USGS)
- 1988:** official release (version 2.0)
(document by Halbert, Buland and Hutt)
- 1990:** version 2.1 (indexing, improved cross references)
- 1991:** version 2.2 (dataless SEED)
- 1992:** version 2.3 (mini-SEED, FDSN network code)
- 2004:** version 2.4 (data quality type code)

SEED in practice

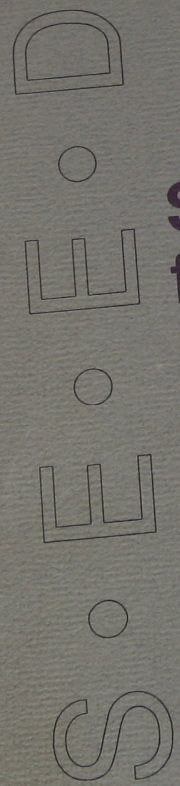
- recordings of digital time-series data (seismic waveforms)
- exchange of waveform data (real-time, archive)
- archiving of digital waveform data (global to local)
- storage of meta-data (information about the data,
e.g. station information, sensor)
- end user (analysis software)
- not for non-time series data
- not for unequal time-interval sampled data (except logs)
- not designed for processed or synthetic data, but possible
- parametric data possible (e.g. phase readings) but never used;
IASPEI Seismic Format (ISF)

* SLog: dispatch.c.v \$
* Revision 1.1 2003/03/27 18:07:18 alex
* Initial revision
* Revision 1.7 2003/03/17 11:21:20 root
* #
* Revision 1.6 2003/02/28 17:08:27 root
* #
* Revision 1.5 2003/02/28 17:05:37 root
* #

193.136.137.166
sycop
sismo

SEED Reference Manual (current version 2.4)
available from IRIS: www.iris.washington.edu

Reinoud Sleeman



Standard for the Exchange of Earthquake Data

Reference Manual
SEED Format Version 2.3
February, 1993

Federation • of • Digital • Seismographic • Networks
Incorporated • Research • Institutions • for • Seismology
United • States • Geological • Survey

SEISMIC NETWORK TO THE GRID
anati²
Department of Electronics, via Ferraria 1 - 27100 Pavia (ITALY)

experience and lessons learnt during customization of a
system for the grid technology. Our goal is to shorten the
time that final users have direct access to data sources, i
intermediaries and without leaving the environment
strongly rely on remote instrumentation capa-
bility. This platform very attractive for scientific
computational procedures and data access in a
distributed virtual laboratory
could be a distributed virtual laboratory
increase or the number of participants.
infrastructure as a part of the DORII
structure) project. In next sections
vision, the experience perceived
perspectives.

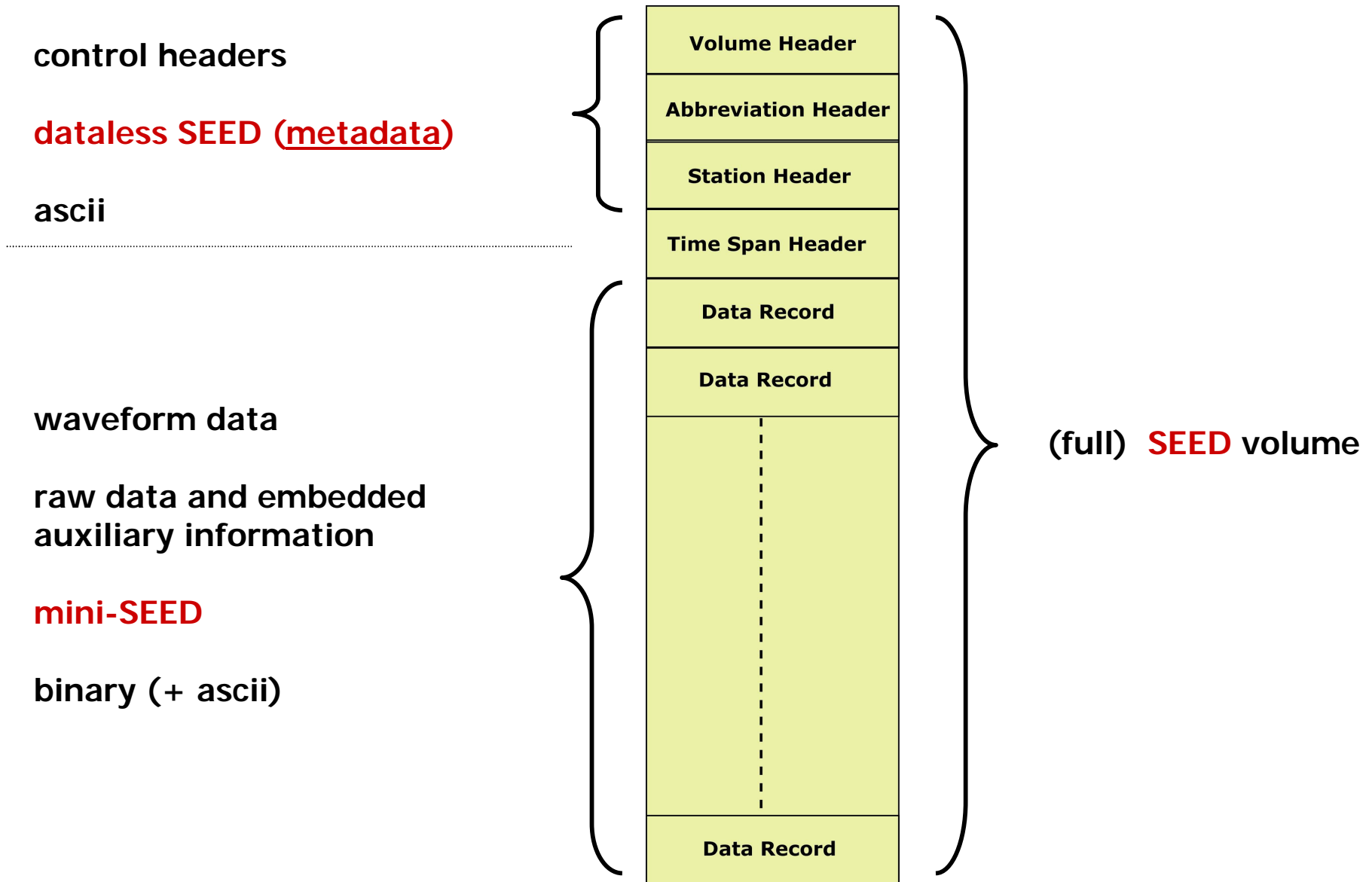
Nanometrics proto-

Phase Identification
Institut für Geologie, Mineralogie und
petrologie
rub@rub.de

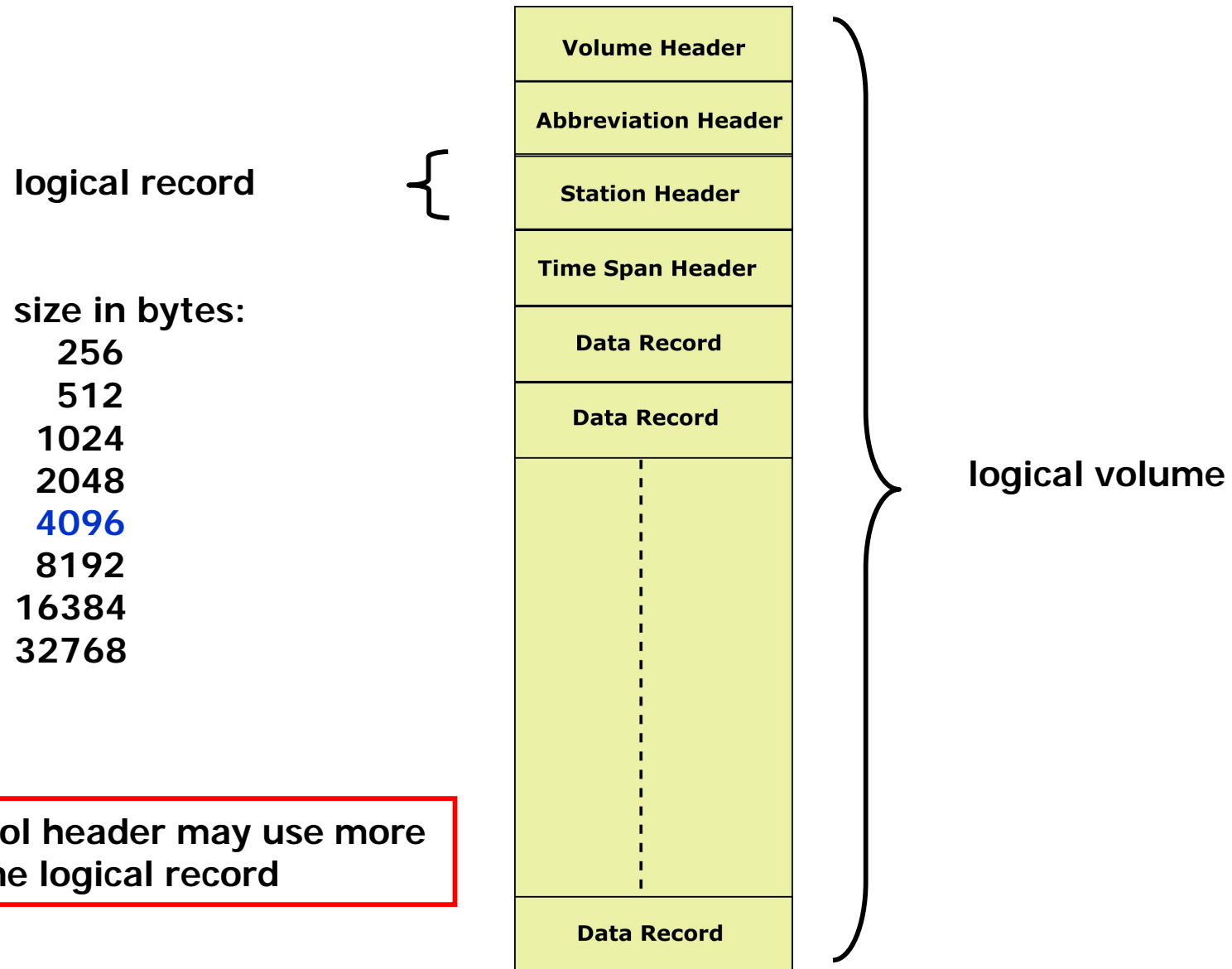
ated real-time event detection and
Long Period (HGLP) stations,
developed by the Seismic Research
(DWWSN), which made up the
network in 1995). At the same time, rapid
increasing amount of seismic
data is in operation, monitoring
earthquakes within minutes.
Real-time data of regional
stations. Modern, digital seismic
data are processed manually. Even
data during stimulation
reservoirs, monitor ten-
sion studies, where the data
are accurate and consistent
indications of automated
processing schemes

ation.
are
re precise and
algorithms. For
and related
x and time
pickers
studies.
may be
on and
complete
s. He

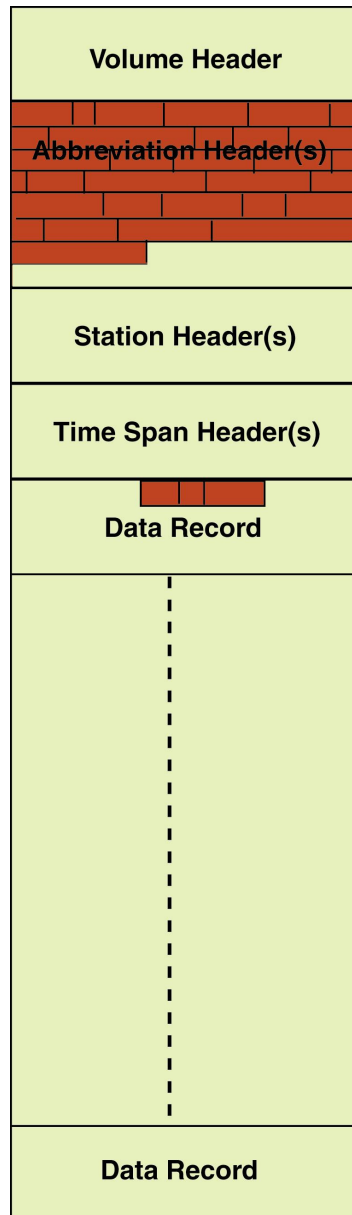
Standard for the Exchange of Earthquake Data (SEED): structure



Standard for the Exchange of Earthquake Data (SEED): organization

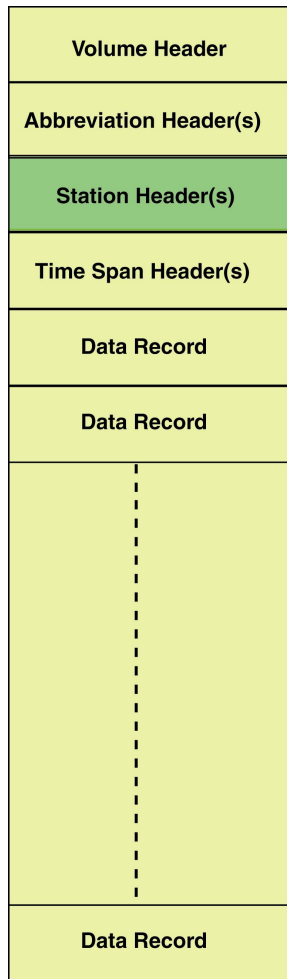


Standard for the Exchange of Earthquake Data (SEED): blockettes



blockettes:

- **building blocks of (control) headers**
- **defined data structures**
- **different and variable length**
- **not restricted to logical record boundaries**
- **ascii (in control headers) or binary (in data records)**



[50] Station Identifier Blockette

Name: Station Identifier Blockette
Blockette Type: 050
Control Header: Station
Field Station Volume: Required
Station Oriented Network Volume: Required
Event Oriented Network Volume: Required

ISC/NEIC registration
<http://www.isc.ac.uk>

46200-106.456700+1740.00006001Albuquerque,ΔNewMexico,ΔUSA~0013210101989,241~~

FDSN network code
<http://www.fdsn.org>

Note	Field name	Type	Length	Mask or Flags	
1	Blockette type — 050	D	3	###	
2	Length of blockette	D	4	####	
3	Station call letters	A	5	[UN]	
4	Latitude (degrees)	D	10	-.#####	
5	Longitude (degrees)	D	11	-.#####	
6	Elevation (m)	D	7	-#####.	
7	Number of channels	D	4	####	
8	Number of station comments	D	3	###	
9	Site name	V	1–60	[UNLPS]	
10	Network identifier code	D	3	###	
11	32 bit word order	D	4	####	
12	16 bit word order	D	2	##	
13	Start effective date	V	1–22	TIME	
14	End effective date	V	0–22	TIME	
15	Update flag	A	1		
V2.3-	16	Network Code	A	2	[ULN]

Volume Header
Abbreviation Header(s)
Station Header(s)
Time Span Header(s)
Data Record
Data Record
Data Record

[53] Response (Poles & Zeros) Blockette

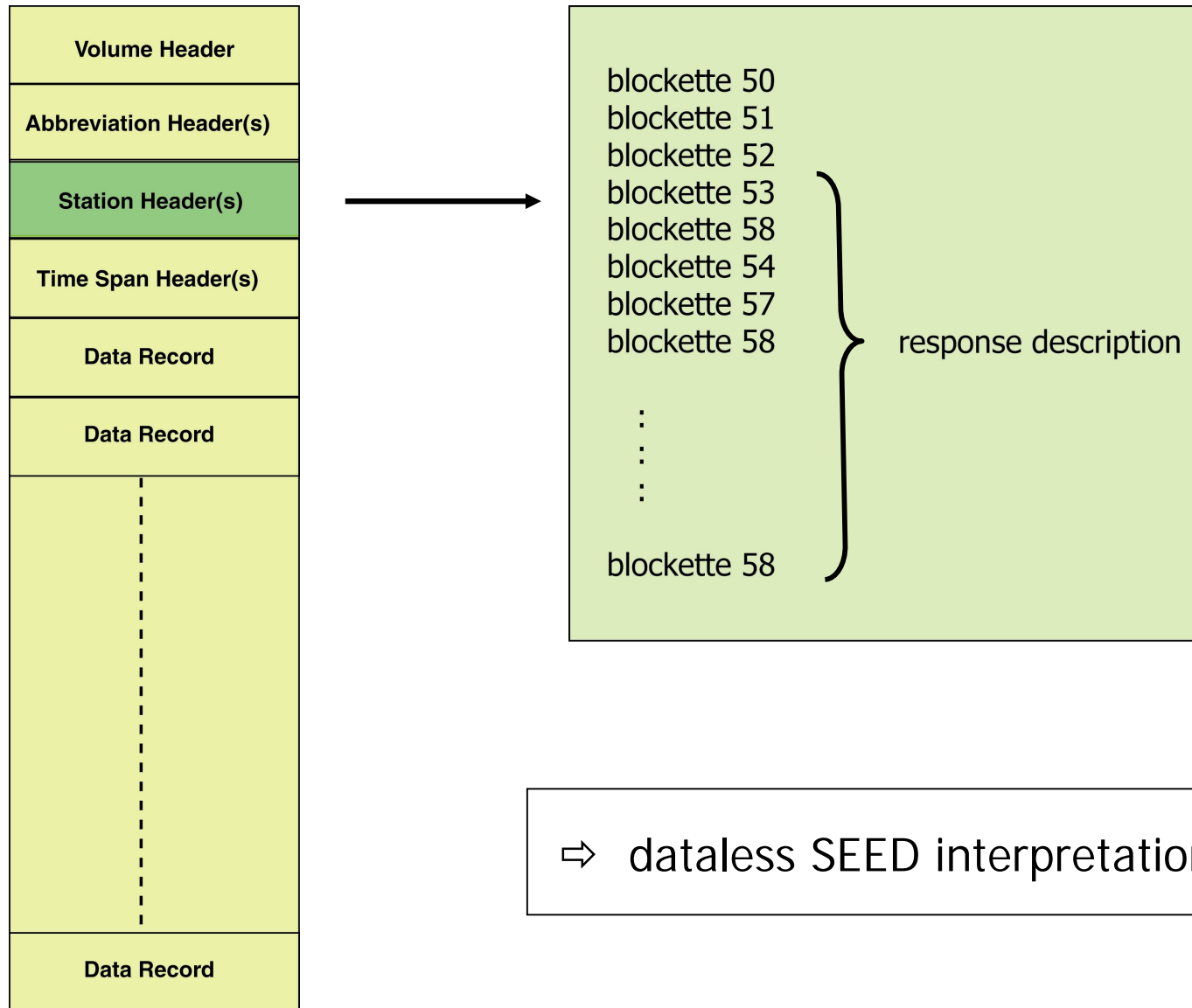
Name: Response (Poles & Zeros) Blockette
Blockette Type: 053
Control Header: Station
Field Station Volume: Some Response Required
Station Oriented Network Volume: Some Response Required
Event Oriented Network Volume: Some Response Required

usually b53 - b58

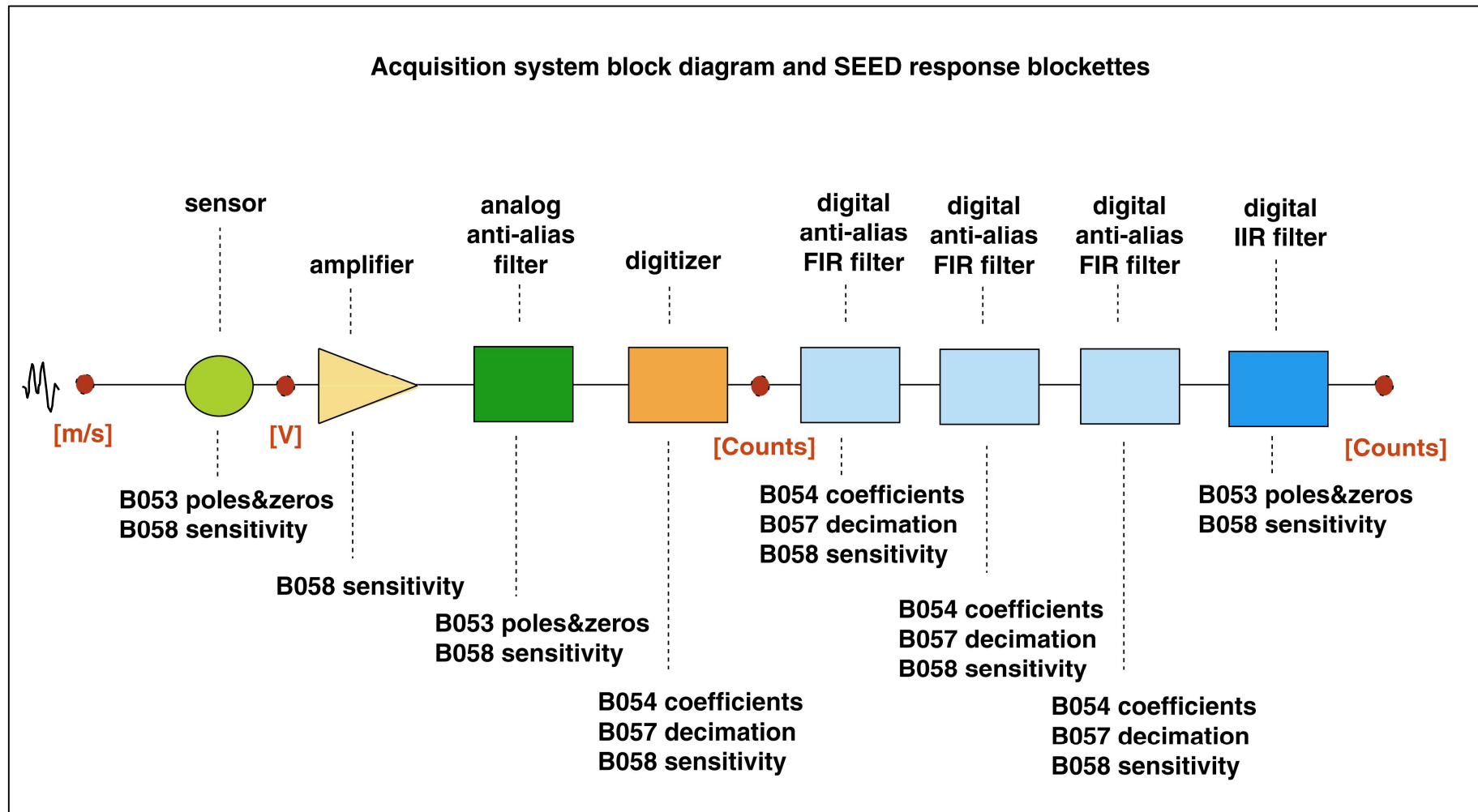
Use this blockette for the analog stages of filter systems and for infinite impulse response (IIR) digital filters. Digital filters usually have a Decimation Blockette [57] following, and most stages have a Sensitivity/Gain Blockette [58] following. The stage sequence takes into account the fact that newer seismic systems will contain combinations of analog and digital filtering, allowing different deconvolution algorithms to be run sequentially (in cascade). SEED reserves the composite function to describe analog instruments with digital feedback circuitry. Stage order is the same as the original convolution order. Use the original earth units for the input units of stage 1. Use digital counts for the output units on the last stage. (See Appendix C for more information.)

Note	Field name	Type	Length	Mask or Flags
1	Blockette type — 053	D	3	###
2	Length of blockette	D	4	####
3	Transfer function type	A	1	[U]
4	Stage sequence number	D	2	##
5	Stage signal input units	D	3	###
6	Stage signal output units	D	3	###
7	AO normalization factor (1.0 if none)	F	12	-.#####E-##
8	Normalization frequency fn(Hz)	F	12	-.#####E-##
9	Number of complex zeros	D	3	###
	REPEAT fields 10 — 13 for the Number of complex zeros:			
10	Real zero	F	12	-.#####E-##
11	Imaginary zero	F	12	-.#####E-##
12	Real zero error	F	12	-.#####E-##
13	Imaginary zero error	F	12	-.#####E-##
14	Number of complex poles	D	3	###
	REPEAT fields 15 — 18 for the Number of complex poles:			
15	Real pole	F	12	-.#####E-##
16	Imaginary pole	F	12	-.#####E-##
17	Real pole error	F	12	-.#####E-##
18	Imaginary pole error	F	12	-.#####E-##

SEED: metadata and system response



Comprehensive Metadata SEED Representation



```

#
#####
#
B050F03      Station:      BOSA
B050F16      Network:      GT
B052F03      Location:     00
B052F04      Channel:      BHZ
B052F22      Start date:   2002,308,00:00:00
B052F23      End date:     2599,365,23:59:59
#
#
#           +-----+
#           | Response (Poles and Zeros) |
#           |   GT  BOSA  00  BHZ       |
#           | 11/04/2002 to 12/31/2599 |
#           +-----+
#
#
B053F03      Transfer function type:      A
B053F04      Stage sequence number:      1
B053F05      Response in units lookup:    M/S - Velocity in Meters Per Second
B053F06      Response out units lookup:   V - Volts
B053F07      A0 normalization factor:    +1.08711E+05
B053F08      Normalization frequency:    +1.00000E+00
B053F09      Number of zeroes:          3
B053F14      Number of poles:           6

real_error   imag_error
0E+00 +0.00000E+00 +0.00000E+00
0E+00 +0.00000E+00 +0.00000E+00
0E+00 +0.00000E+00 +0.00000E+00

real_error   imag_error
0E+00 +0.00000E+00 +0.00000E+00
0E+01 +0.00000E+00 +0.00000E+00
0E+01 +0.00000E+00 +0.00000E+00
0E+00 +0.00000E+00 +0.00000E+00
0E+00 +0.00000E+00 +0.00000E+00
0E+00 +0.00000E+00 +0.00000E+00

#####
#
#           Channel Sensitivity/Gain
#           |   GT  BOSA  00  BHZ       |
#           | 11/04/2002 to 12/31/2599 |
#           +-----+
#
#
B058F03      Stage sequence number:      1
B058F04      Sensitivity:                +2.95820E+04
B058F05      Frequency of sensitivity:    +1.00000E+00
B058F06      Number of calibrations:      0
#

```

RESP file

readable representation of dataless SEED

output of: rdseed -R

Stage 1 = Sensor

In this case,
KS-54000
Borehole in
Boshof, South Africa

Goes from M/S ground
Motion to Volts

```
#
#####
#
B050F03 Station: BOSA
B050F16 Network: GT
B052F03 Location: 00
B052F04 Channel: BHZ
B052F22 Start date: 2002,308,00:00:00
B052F23 End date: 2599,365,23:59:59
#
#
# +-----+
# | Response (Poles and Zeros) |
# | GT BOSA 00 BHZ |
# | 11/04/2002 to 12/31/2599 |
# +-----+
#
#
B053F03 Transfer function type: A
B053F04 Stage sequence number: 1
B053F05 Response in units lookup: M/S - Velocity in Meters Per Second
B053F06 Response out units lookup: V - Volts
B053F07 A0 normalization factor: +1.08711E+05
B053F08 Normalization frequency: +1.00000E+00
B053F09 Number of zeroes: 3
B053F14 Number of poles: 6
#
# Complex zeroes:
# i real imag real_error imag_error
B053F10-13 0 +0.00000E+00 +0.00000E+00 +0.00000E+00 +0.00000E+00
B053F10-13 1 +0.00000E+00 +0.00000E+00 +0.00000E+00 +0.00000E+00
B053F10-13 2 +0.00000E+00 +0.00000E+00 +0.00000E+00 +0.00000E+00
#
# Complex poles:
# i real imag real_error imag_error
B053F15-18 0 -1.00850E+02 +0.00000E+00 +0.00000E+00 +0.00000E+00
B053F15-18 1 -2.23000E+01 +2.41000E+01 +0.00000E+00 +0.00000E+00
B053F15-18 2 -2.23000E+01 -2.41000E+01 +0.00000E+00 +0.00000E+00
B053F15-18 3 -1.50000E-02 +0.00000E+00 +0.00000E+00 +0.00000E+00
B053F15-18 4 -3.00000E-02 +0.00000E+00 +0.00000E+00 +0.00000E+00
B053F15-18 5 -8.00000E-02 +0.00000E+00 +0.00000E+00 +0.00000E+00
#
#
# +-----+
# | Channel Sensitivity/Gain |
# | GT BOSA 00 BHZ |
# | 11/04/2002 to 12/31/2599 |
# +-----+
#
#
B058F03 Stage sequence number: 1
B058F04 Sensitivity: +2.95820E+04
B058F05 Frequency of sensitivity: +1.00000E+00
B058F06 Number of calibrations: 0
#
```

Stage 2 = Datalogger

Volts are converted
To counts

```
#
#
#           +-----+
#           | Response (Coefficients) |
#           | GT BOSA  00 BHZ         |
#           | 11/04/2002 to 12/31/2599 |
#           +-----+
#
#
B054F03   Transfer function type:      D
B054F04   Stage sequence number:      2
B054F05   Response in units lookup:   V - Volts
B054F06   Response out units lookup:  COUNTS - Digital Counts
B054F07   Number of numerators:      0
B054F10   Number of denominators:    0
#
#
#           +-----+
#           | Decimation                |
#           | GT BOSA  00 BHZ           |
#           | 11/04/2002 to 12/31/2599 |
#           +-----+
#
#
B057F03   Stage sequence number:      2
B057F04   Input sample rate (HZ):    1.6384E+05
B057F05   Decimation factor:         00004
B057F06   Decimation offset:         00000
B057F07   Estimated delay (seconds):  +0.0000E+00
B057F08   Correction applied (seconds): +0.0000E+00
#
#
#           +-----+
#           | Channel Sensitivity/Gain  |
#           | GT BOSA  00 BHZ           |
#           | 11/04/2002 to 12/31/2599 |
#           +-----+
#
#
B058F03   Stage sequence number:      2
B058F04   Sensitivity:                +2.62151E+05
B058F05   Frequency of sensitivity:   +0.00000E+00
B058F06   Number of calibrations:     0
```

Stage 3 = Digital FIR filter and decimation

Transfer function type

```
#
B054F03      Transfer function type:
B054F04      Stage sequence number:
B054F05      Response in units lookup:
B054F06      Response out units lookup:
B054F07      Number of numerators:
B054F10      Number of denominators:
#
#           i coefficient error
B054F08-09  0 +0.00000E+00 +0.00000E+00
B054F08-09  1 +0.00000E+00 +0.00000E+00
B054F08-09  2 +1.00000E+00 +0.00000E+00
B054F08-09  3 +4.00000E+00 +0.00000E+00
B054F08-09  4 +1.00000E+01 +0.00000E+00
B054F08-09  5 +2.00000E+01 +0.00000E+00
B054F08-09  6 +3.50000E+01 +0.00000E+00
B054F08-09  7 +5.60000E+01 +0.00000E+00
B054F08-09  8 +8.40000E+01 +0.00000E+00
B054F08-09  9 +1.20000E+02 +0.00000E+00
B054F08-09 10 +1.61000E+02 +0.00000E+00
B054F08-09 11 +2.04000E+02 +0.00000E+00
B054F08-09 12 +2.46000E+02 +0.00000E+00
B054F08-09 13 +2.84000E+02 +0.00000E+00
B054F08-09 14 +3.15000E+02 +0.00000E+00
B054F08-09 15 +3.36000E+02 +0.00000E+00
B054F08-09 16 +3.44000E+02 +0.00000E+00
B054F08-09 17 +3.36000E+02 +0.00000E+00
B054F08-09 18 +3.15000E+02 +0.00000E+00
B054F08-09 19 +2.84000E+02 +0.00000E+00
B054F08-09 20 +2.46000E+02 +0.00000E+00
B054F08-09 21 +2.04000E+02 +0.00000E+00
B054F08-09 22 +1.61000E+02 +0.00000E+00
B054F08-09 23 +1.20000E+02 +0.00000E+00
B054F08-09 24 +8.40000E+01 +0.00000E+00
B054F08-09 25 +5.60000E+01 +0.00000E+00
B054F08-09 26 +3.50000E+01 +0.00000E+00
B054F08-09 27 +2.00000E+01 +0.00000E+00
B054F08-09 28 +1.00000E+01 +0.00000E+00
B054F08-09 29 +4.00000E+00 +0.00000E+00
B054F08-09 30 +1.00000E+00 +0.00000E+00
B054F08-09 31 +0.00000E+00 +0.00000E+00
B054F08-09 32 +0.00000E+00 +0.00000E+00
#
D
3
COUNTS - Digital Counts
COUNTS - Digital Counts
33
0
```

Reporting Filter Delays & Decimation

```
#
#
#      +-----+
#      |              Decimation              |
#      |      GT  BOSA   00  BHZ              |
#      |      11/04/2002 to 12/31/2599      |
#      +-----+
#
B057F03  Stage sequence number:                3
B057F04  Input sample rate (HZ):              4.0960E+04
B057F05  Decimation factor:                   00008
B057F06  Decimation offset:                   00000
B057F07  Estimated delay (seconds):            +4.0260E-04
B057F08  Correction applied (seconds):          +0.0000E+00
#
#
#      +-----+
#      | Channel Sensitivity/Gain             |
#      |      GT  BOSA   00  BHZ             |
#      |      11/04/2002 to 12/31/2599     |
#      +-----+
#
B058F03  Stage sequence number:                3
B058F04  Sensitivity:                        +1.00000E+00
B058F05  Frequency of sensitivity:             +0.00000E+00
B058F06  Number of calibrations:                0
#
```


Overall Gain (also called Sensitivity)

The very last stage in the response cascade is the overall gain of the whole system, which is the multiple of all stage gains at the same frequency, and called Stage 0

```
-  
#  
B058F03 Stage sequence number: 0  
B058F04 Sensitivity: +7.75495E+09  
B058F05 Frequency of sensitivity: +1.00000E+00  
B058F06 Number of calibrations: 0
```

JPlotResp

JPlotResp, Version 1.57

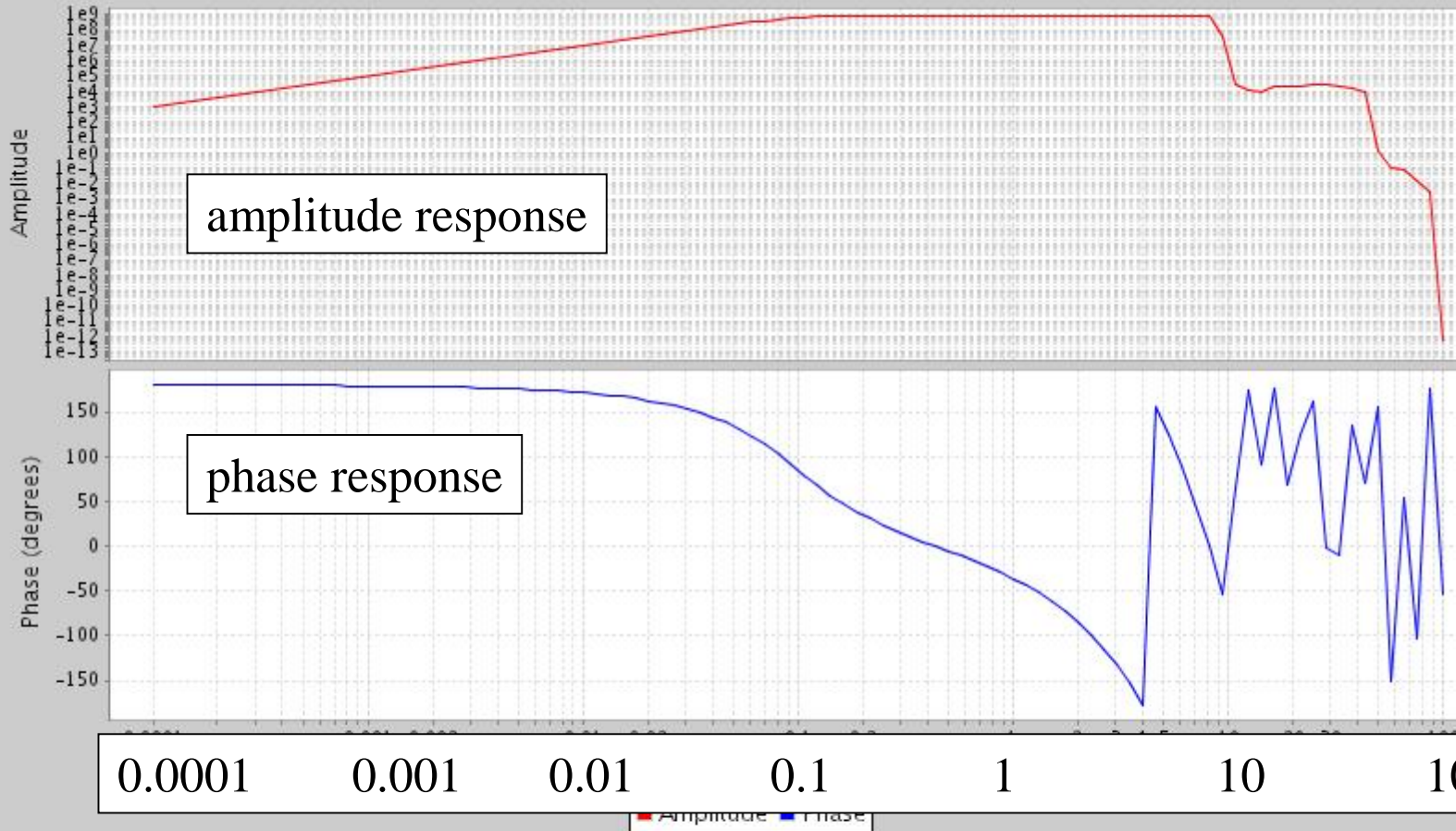
RO.CRAR.BHZ_2

RO.CRAR.BHZ_3

RO.CRAR.BHZ_4

RO.CRAR.BHZ_5

RO.CRAR.BHZ



0.0001

0.001

0.01

0.1

1

10

100 Hz

Amplitude Phase

Network: RO, Station: CRAR, Channel: BHZ

BeginTime: 2005,228,00:00:00

MinFreq: 0.0001, MaxFreq: 100, NumFreqs: 100, Spacing: Logarithmic

OutputUnits: Velocity

Display: Amplitude/Phase

Show Datapoints

Logarithmic Amplitude

Combine Amplitude/Phase

Print

Save

Close