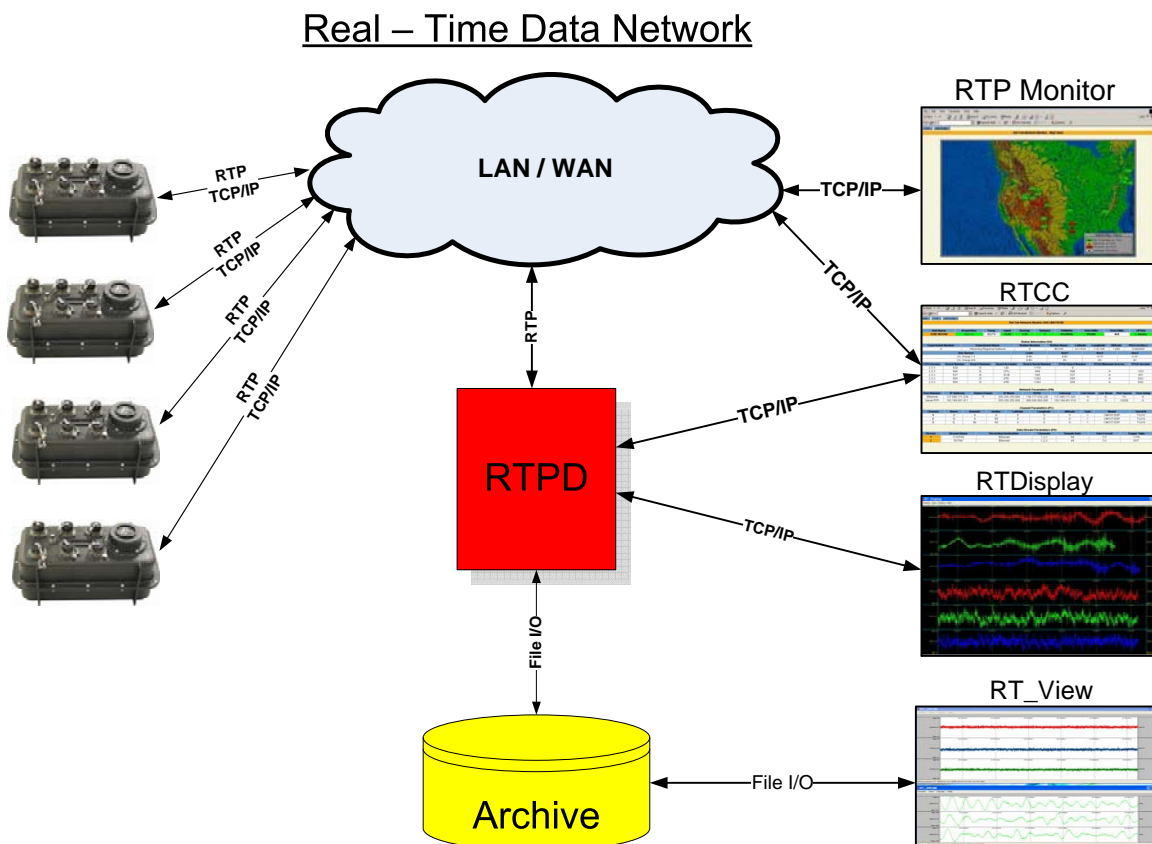




REF TEK Data Utilities 4.10

with RT_View 1.4.3

Refraction Technology



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Update Notification

REF TEK Support and update notifications

As a valued user of REF TEK equipment we would like to provide the best support possible by keeping you up to date with our product updates.

If you would like to be notified of any REF TEK product updates please spend a couple of minutes to register with the reftek customer support team.

To Register, either send an email to updates@reftek.com giving us your name and REF TEK product you currently have or fill out our online registration form at www.reftek.com/registration

Once we register your contact we will only send necessary notifications via email. The same notifications will be shown on our website's www.reftek.com/support page

Thanks,

Your REF TEK support team

Who Should Use This Manual

This manual was written assuming the user has basic computer skills and is familiar with DOS, Windows and networking concepts.

Notation Conventions

The following notation conventions are used throughout Ref Tek documentation:

Notation	Description
ASCII	Indicates the entry conforms to the American Standard Code for Information Interchange definition of character (text) information.
Binary	Indicates the entry is a raw, numeric value.
Hex	Indicates hexadecimal notation. This is used with both ASCII characters (0 – 9, A – F) and numeric values.
BCD	Indicates the entry is a numeric value where each four bits represents a decimal digit.
FP n	Indicates the entry is the ASCII representation of a floating-point number with n places following the decimal point.
< n >	Indicates a single 8-bit byte. When the contents are numeric, it indicates a hexadecimal numeric value; i.e. <84> represents hexadecimal 84 (132 decimal). When the contents are capital letters, it represents a named ASCII control character; i.e. <SP> represents a space character, <CR> represents a carriage return character and <LF> represents a line feed character.
MSB	Most Significant Byte of a multi-byte value.
MSbit	Most Significant Bit of a binary number.
LSB	Least Significant Byte of a multi-byte value.
LSbit	Least Significant Bit (bit 0) of a binary number.
YYYY	Year as a 4-digit number
DDD	Day of year
HH	Hour of day in 24-hour format
MM	Minutes of hour
SS	Seconds of minute
TTT	Thousandths of a second (milliseconds)
IIII	Unit ID number
n, nS	nano, nanoSecond; $10^{-9} = 0.000000001$
u, uS	micro, microSecond; $10^{-6} = 0.000001$
m, mS	milli, milliSecond; $10^{-3} = 0.001$
K, KHz	Kilo, KiloHertz; $10^3 = 1,000$
M, MHz	Mega, MegaHertz; $10^6 = 1,000,000$
G, GHz	Giga, GigaHertz; $10^9 = 1,000,000,000$
Kb, KB	Kilobit, KiloByte; $2^{10} = 1,024$
Mb, MB	Megabit, MegaByte; $2^{20} = 1,048,576$
Gb, GB	Gigabit, GigaByte; $2^{30} = 1,073,741,824$

Related Manuals:

130-01 System Documents	Number	PDF file
130-01 System Startup	Doc-130-Ops	130_startup_01.pdf
PFC_130 Users Guide	Doc-130-PFC	130_pfc.pdf
Data Utilities Users Guide	Doc-DataUtils	130_utilities.pdf
Archive Utilities	Doc-ArcUtils	arcutil.pdf
130 Theory of Operations	Doc-130-Theory	130_theory.pdf
130 PFC Release Notes	Doc-130-PFCRel	130_PFCRN.pdf
130 CPU Release Notes	Doc-130-CPURel	130_CPURN.pdf
130 Command Reference	Doc-130-Cmd	130_command.pdf
130 Recording Format	Doc-130-Record	130_record.pdf
130-GPS Manual	Doc-GPS-Ops	130_gps.pdf
130-01 Board Documents	Number	PDF file
RT505 - A/D Board	Doc-130-RT505	RT505r.pdf ^a
RT506 - CPU Board	Doc-130-RT506	RT506r.pdf
RT520 - Lid Interconnect Board	Doc-130-RT520	RT520r.pdf
RT526 - MicroDrive/Flash Board	Doc-130-RT526	RT526rB01.pdf
RT527 - Sensor Control Board (Optional)	Doc-130-RT527	RT527rB01.pdf
RT535 - Mass Memory Board (Optional)	Doc-130-RT535	RT535rB01.pdf
Optional Manuals	Number	PDF file
SNDP Reference Guide	Doc-SNDP-Ref	SNDPRef.pdf
SNDP Installation and Users Guide	Doc-SNDP-Install	SNDPUser.pdf
RTPD Installation and Users Guide	Doc-RTPD	RTPD.pdf
RTP Protocol	Doc-RTP	RTP.pdf
RT_View Users Guide*	Doc-RTView	RTView.pdf
RTCC Command and Control Users Guide*	Doc-RTCC	RTCC.pdf
130 RTCC Release Notes*	Doc-RTCCRel	130_RTCCRN.pdf
RT_Display Users Guide*	Doc-RTDis	RTDisplay.pdf
RTPMonitor Installation and Users Guide	Doc-RTPMon	RTPM.pdf
131A-01/3 Standard Triaxial Accelerometer	Doc-131A-01/3	131A.pdf
131A-01/2 Low Noise Triaxial Accelerometer	Doc-131A-01/2	
131B-01/1 Uniaxial Accelerometer	Doc-131B-01/1	131A011.pdf

a. r = Revision level of 130 Board

* = Programs included in the optional Reftek Command and Control Interface (RTI)

Revision History

Rev	Date	Reason for change	Affected Pages
0.1	1/12/02	Initial release	
A	10/04/02	Converted to separate document	All
B	9/2/03	Added RT_SEIS(D)	Section 6
C	10/27/05	Moved Archive Utilities	Removed to separate document
		Added RT_View 3.0	Section 2
D	7/8/06	Added RT_COS update	Section 7
	1/22/07	Version 4.00: Cross-Platform support modified and increased allowed open files	All
E	7/13/07	RT_View 1.4.3 release	Section 2
		RT_COS Update	Section 7
		RT_MSEED Updated	Section 8
		RT_CM6 Added	Section 9

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B.6 Version 1.2.0 (June 8, 2004)B-175

B.7 Version 1.1.0 (February 26, 2004)B-178



Section 1

Introduction to REF TEK data utilities

1.1 Overview

Refraction Technology, Inc. provides a set of utility programs for viewing and converting data recorded with a **REF TEK** DAS. This section provides a general introduction to the **REF TEK** utility programs, including the following:

- A list of the **REF TEK** data utility programs
- Hardware requirements to run **REF TEK** data utilities
- The procedure to install **REF TEK** data utilities
- Procedure to run the **REF TEK** data utilities

1.2 Program List

The utilities provided by Refraction Technology include the following utility programs:

Sec	Title	Description
2	RT_View	RT_View provides direct viewing of REF TEK DAS data.
3	RTCnvt	Utility that converts a raw PASSCAL data to ASCII data files
4	REF2SUDS	Converts data from PASSCAL format to SUDS format.
5	RT_SEGY	Converts a REF TEK PASSCAL raw data file into one of three file formats, all based on the SEGY standard.
6	RT_SEIS	Converts a REF TEK PASSCAL raw data file into SEISAN data.
7	RT_COS	Converts a REF TEK PASSCAL raw data file into COSMOS data files.
8	RT_MSEED	Converts a REF TEK PASSCAL raw data file into Mini-SEED (MSEED) data files.
9	RT_CM6	Converts a REF TEK PASSCAL raw data file into raw GSED 2.1 CM6 compressed data
10	MATLAB	Process data files and display FFT plots. Macros for displaying time series and FFT plots in Matlab.
11	Utilities reference	CHKFMB - Reads a file containing 1K format block of a disk and outputs values with labels in readable format. PCTIME - Allows setting of the PC time clock using an external UTC clock. REF2SUDS - Converts data from PASSCAL format to SUDS format. RTCNVRT - Converts data from PASSCAL format to ASCII. TAIL - Displays the contents of the end of a file.

The CD-ROM also includes the following to assist you in using the **REF TEK** utilities and some of the available data analysis software:

1. Script files for the **MATLAB** data analysis software
2. Sample data files

This manual provides only the most basic functions of these programs as related to the operations of **REF TEK** data recording systems. For more information on **MATLAB** and **PITSA**, refer to the following documentation:

- *PC-MATLAB for MS-DOS Personal Computers: User's Guide*, provided by The Mathworks, Inc. with the MATLAB software.
- The *Programmable Interactive Toolbox for Seismological Analysis* user's manual, provided with the PITSA software by the *Institute fur Allgemeine und Angewandte Geophysik* and authors Frank Scherbaum and Jim Johnson.

1.3 Hardware Requirements to Run the REF TEK Utilities

To run the **REF TEK** software utilities, the IBM-compatible PC you use must adhere to the following specifications:

Specification	Description
PC Ram	256k (or greater)
Operating System	MS-DOS 2.0 (or later versions)
PCMCIA PC card slot	Read data from a CompactFlash
CD-ROM:	Required to load utilities software



Note: Refraction Technology strongly recommends that your PC also include a hard drive. The MATLAB software program may require additional hardware.

1.4 Installing the REF TEK Utilities and Programs

Before installing the **REF TEK** utilities, install either the **MATLAB** program, the **DADiSP** program, or the **PITSA** program as instructed in the available literature for those products. With your DAS, Refraction Technology has provided a CR-ROM.

Install these programs by performing the following:

1. Insert the CD-ROM, labeled "**REF TEK** Utilities", into a CD-ROM drive (for example, D:)
2. Type *D:\install* and press the enter key; follow the on-screen instructions.



Note: (The D: directory portion of the install command is shown in italics because it is variable; the drive specified, however, must match the drive containing the CD-ROM.)

3. Your PC also copies the *Rtutils.txt* documentation file along with the program files to the specified destination drive.
4. The CD-ROM also includes source code. The source code for utility programs is installed automatically in a subdirectory (also named *source*) of the directory you specified for the utilities.

1.5 Running the REF TEK Utilities

Running the **REF TEK** utilities requires entering a command at the DOS command prompt followed by any of the applicable command variables (called *switches*). The applicable switches differ for each utility, and are described in detail in the appropriate sections later in this manual.

You may arrange the switches used for the **REF TEK** utilities in any order on the command line. If a program requires any particular switch or switches, but you do not enter the command variables on the command line, the program prompts you for a value for each switch it requires before it continues to execute the utility.



Section 2 RT_View

2.1 Overview of the RT_View program

This document introduces the **REF TEK** RT_View, an application designed to allow viewing of **REF TEK** data. **REF TEK**/PASSCAL data files are binary in nature. The data is grouped in 1024 byte packets. There are a number of different packet types. Some packets (i.e. State-of-Health) are mostly plain text. Other packets (like data) are mostly binary.

The RT_View program decodes packets and presents them in readable form. For more information on actual internal packet structure see the **REF TEK** Recording Format document. RT_View scans the data file and presents a table of contents of packet types found. The contents list serves as a jump point to decoded packet information.

With a decoded packet displayed, the user has options available to move through the file displaying packets of the same type. Displaying the packets in its raw binary state is available. Event data and packets can be displayed in graphs as well.



Note: At the present time RT_View runs only on the windows platform. Windows 95 or above is required.

2.2 Sensor Sensitivity Relationship

RT_view can display event data in one of three measurements: 1) counts, 2) volts and 3) G's (acceleration of gravity). The counts format is the raw numerical data from the A/D chips. Volts format is the counts data multiplied by the specific volts per count value for a data channel. The G's format is the volts data divided by the specific volts per G value for a data channel. The user can change the current display format from the "Options" menu item. The user can tell the current selection from the Y axis data labels. Values will end in "V" for volts and "G" for G's

When displaying a graph, the status line at the bottom of the display shows the current mouse pointer position. The values are channel number, X axis actual time, X axis relative time (from event start) and Y axis value in the current selected display format (counts, volts, G's).

Using RT_View the user can select a portion of an event for examination. By changing the X axis scales the user can zoom in on a particular point of time. Channels can also be selected/deselected to include/remove them from the display. The user can then (by using the mouse and status line) read values from the graph by positioning the cursor. Again the status line values are in the current data display format.

2.3 Data Conversion Information

RT_View uses conversion information stored in the header packet of all event files. Conversion information is specific to each data channel.

Conversion information consists of:

- A/D volts per count
- A/D number of bits
- A/D full scale volts
- Sensor full scale volts
- Sensor measurement units
- Sensor volts per measurement unit

If sensor information is not present in the header packet, RT_View will use 2.4 Volts/G as a default value.

There are several sources for the conversion information. The A/D volts per count is measured at REFTEK and stored in each A/D board when built. The A/D number of bits is stored in each A/D board when built. The A/D full scale volts is dependent on A/D board options and is stored in each A/D board when built.

The sensor values are supplied by the sensor manufacturer. For SM units with internal sensors the data is programmed into a serial EPROM that the RefTek 130 reads on boot. For the MC-12 and MC-18 units the user will have to enter the manufacturers data at installation time. See the MC-12/18 User manual for information entry details.

2.4 To execute the RT_View program

To run the RT_View program:

1. Copy the **RT_View.exe** program from the CD win32 directory to the **C:\vreftek** directory and execute.
2. When first executed an **RT_View.ini** file is created and saved in the same directory as the .exe program.

RT_View.ini file stores settings:

- This file contains options and settings that are stored in the file when the user changes options.
- When the user creates options on the **Options** menu they can be saved to the **RT_View.ini** file with the **SaveOptions** menu command located on the **Options** menu.
- The display size and location of the main window is saved in the **RT_View.ini** file.

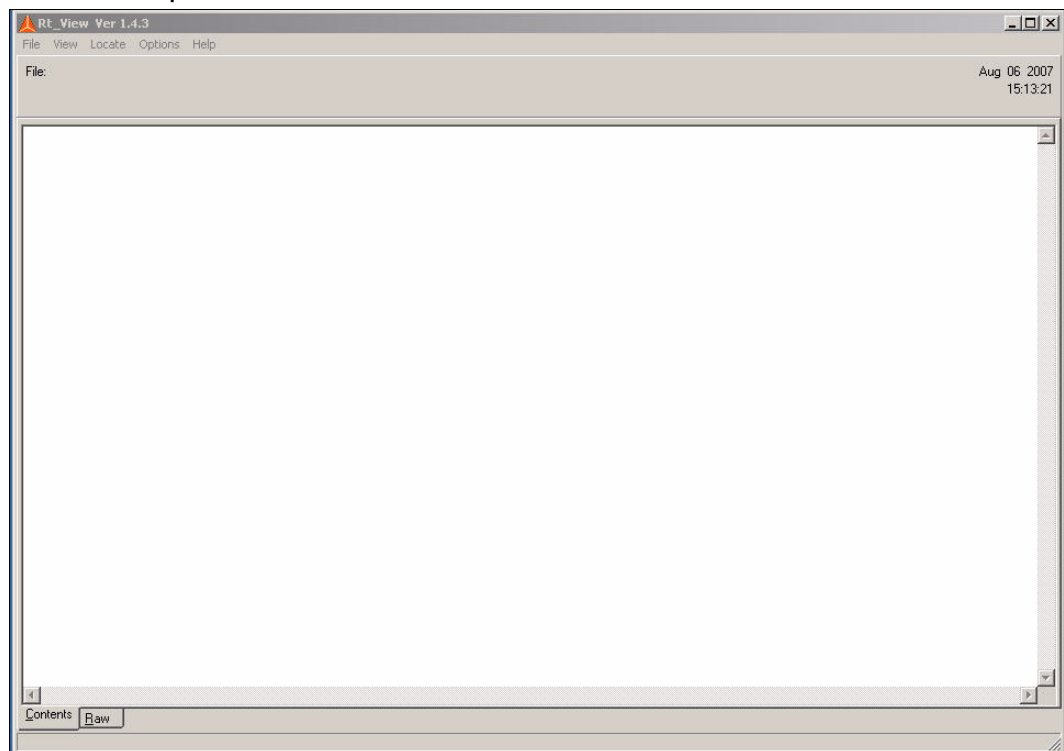
2.5 Viewing a file

The following screens show **RT_View** and explain what each screen is used for by using example steps to open a file.

There are 3 ways to open files:

- Drag and Drop files on an **RT_View** shortcut or executable.
- Drag and Drop files onto a running **RT_View** application.
- Use the **File** and **Open** menu from the drop-down menu after opening the **RT_View** program.

1. Start the **RT_View** application and the following display will open.



2. Use the **File** > **Open** drop-down menu to open and view a file contents.

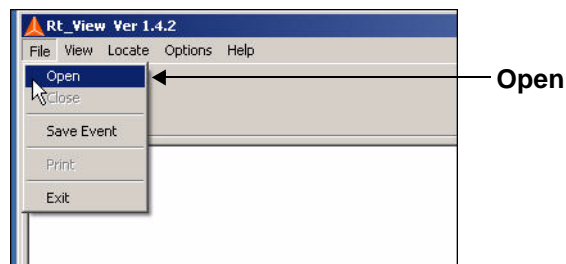


Figure 2 - 1 RT_View main application window

3. The file manager window opens to allow browsing for a file
4. Select a file to view.

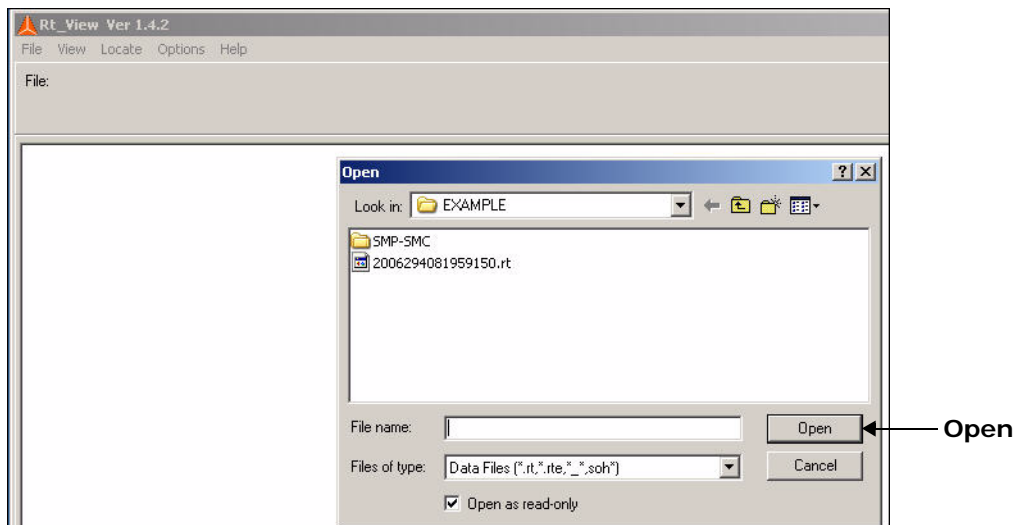


Figure 2 - 2 Open file manager

5. Depending on the options selected in the **Options** menu, (shown below) the file selected will open and display either:
 - **Graph of the first event data**
 - **Table of Contents**
6. By default data is graphed because these two options (shown below on the **Options** menu) are selected.

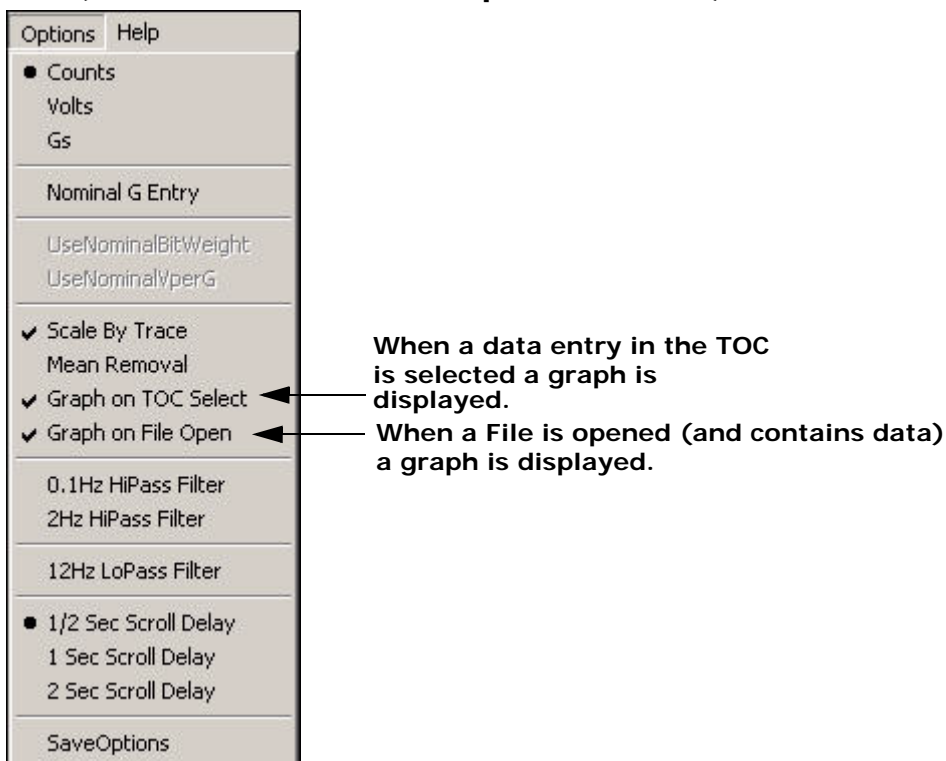
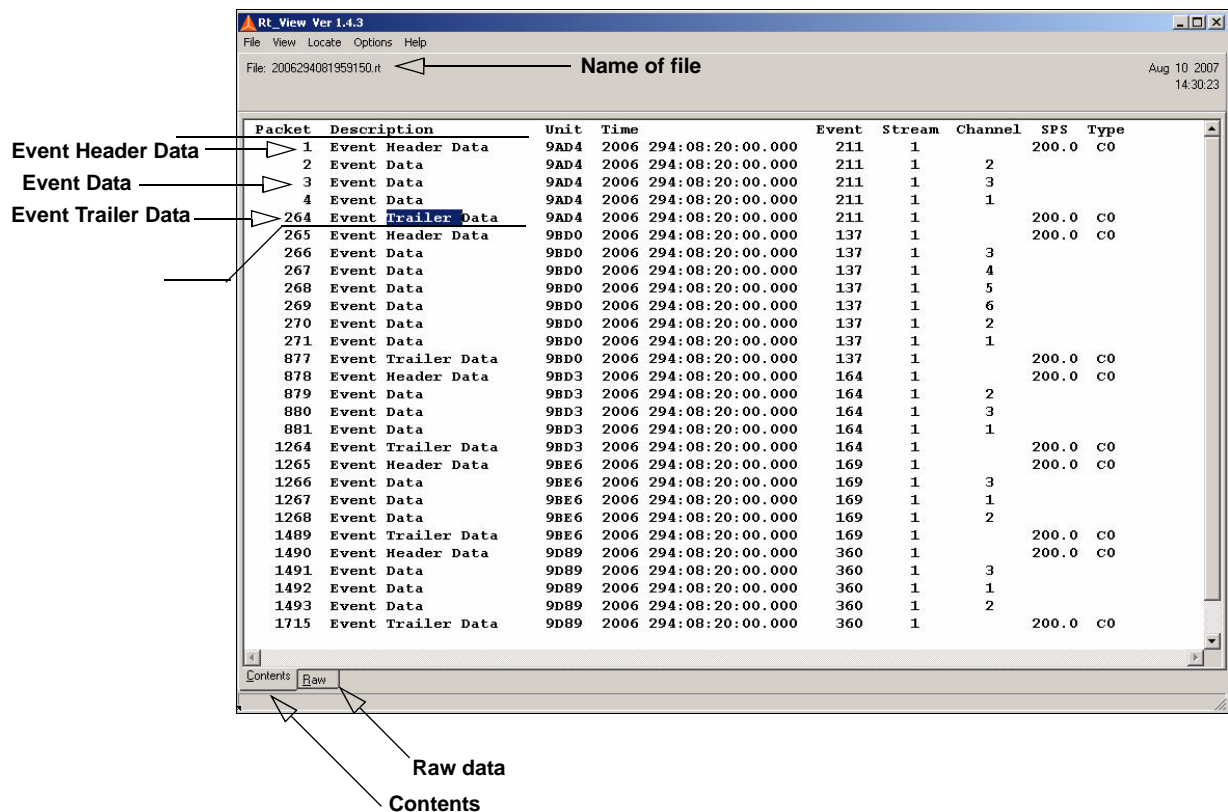


Figure 2 - 3 Options menu

7. If there is no event data, the viewer will open showing the table of contents of the event file as shown in Figure 2 - 4.

-OR-

Contents of a State-Of-Health file (Figure 2 - 5).



File: 2006294081959150.rt

Aug 10 2007 14:30:23

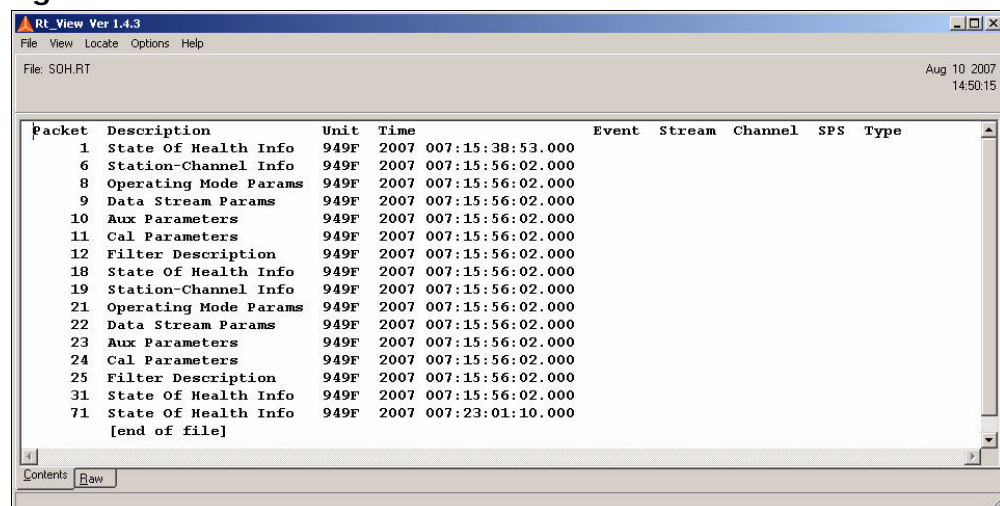
Packet	Description	Unit	Time	Event	Stream	Channel	SPS	Type
1	Event Header Data	9AD4	2006 294:08:20:00.000	211	1		200.0	C0
2	Event Data	9AD4	2006 294:08:20:00.000	211	1	2		
3	Event Data	9AD4	2006 294:08:20:00.000	211	1	3		
4	Event Data	9AD4	2006 294:08:20:00.000	211	1	1		
264	Event Trailer Data	9AD4	2006 294:08:20:00.000	211	1		200.0	C0
265	Event Header Data	9BD0	2006 294:08:20:00.000	137	1		200.0	C0
266	Event Data	9BD0	2006 294:08:20:00.000	137	1	3		
267	Event Data	9BD0	2006 294:08:20:00.000	137	1	4		
268	Event Data	9BD0	2006 294:08:20:00.000	137	1	5		
269	Event Data	9BD0	2006 294:08:20:00.000	137	1	6		
270	Event Data	9BD0	2006 294:08:20:00.000	137	1	2		
271	Event Data	9BD0	2006 294:08:20:00.000	137	1	1		
877	Event Trailer Data	9BD0	2006 294:08:20:00.000	137	1		200.0	C0
878	Event Header Data	9BD3	2006 294:08:20:00.000	164	1		200.0	C0
879	Event Data	9BD3	2006 294:08:20:00.000	164	1	2		
880	Event Data	9BD3	2006 294:08:20:00.000	164	1	3		
881	Event Data	9BD3	2006 294:08:20:00.000	164	1	1		
1264	Event Trailer Data	9BD3	2006 294:08:20:00.000	164	1		200.0	C0
1265	Event Header Data	9BE6	2006 294:08:20:00.000	169	1		200.0	C0
1266	Event Data	9BE6	2006 294:08:20:00.000	169	1	3		
1267	Event Data	9BE6	2006 294:08:20:00.000	169	1	1		
1268	Event Data	9BE6	2006 294:08:20:00.000	169	1	2		
1489	Event Trailer Data	9BE6	2006 294:08:20:00.000	169	1		200.0	C0
1490	Event Header Data	9D89	2006 294:08:20:00.000	360	1		200.0	C0
1491	Event Data	9D89	2006 294:08:20:00.000	360	1	3		
1492	Event Data	9D89	2006 294:08:20:00.000	360	1	1		
1493	Event Data	9D89	2006 294:08:20:00.000	360	1	2		
1715	Event Trailer Data	9D89	2006 294:08:20:00.000	360	1		200.0	C0

Contents Raw

Raw data

Contents

Figure 2 - 4 Table of Contents - File view



File: SOH.RT

Aug 10 2007 14:50:15

Packet	Description	Unit	Time	Event	Stream	Channel	SPS	Type
1	State Of Health Info	949F	2007 007:15:38:53.000					
6	Station-Channel Info	949F	2007 007:15:56:02.000					
8	Operating Mode Params	949F	2007 007:15:56:02.000					
9	Data Stream Params	949F	2007 007:15:56:02.000					
10	Aux Parameters	949F	2007 007:15:56:02.000					
11	Cal Parameters	949F	2007 007:15:56:02.000					
12	Filter Description	949F	2007 007:15:56:02.000					
18	State Of Health Info	949F	2007 007:15:56:02.000					
19	Station-Channel Info	949F	2007 007:15:56:02.000					
21	Operating Mode Params	949F	2007 007:15:56:02.000					
22	Data Stream Params	949F	2007 007:15:56:02.000					
23	Aux Parameters	949F	2007 007:15:56:02.000					
24	Cal Parameters	949F	2007 007:15:56:02.000					
25	Filter Description	949F	2007 007:15:56:02.000					
31	State Of Health Info	949F	2007 007:15:56:02.000					
71	State Of Health Info	949F	2007 007:23:01:10.000					

[end of file]

Contents Raw

Raw data

Contents

Figure 2 - 5 SOH file

Menu Options:

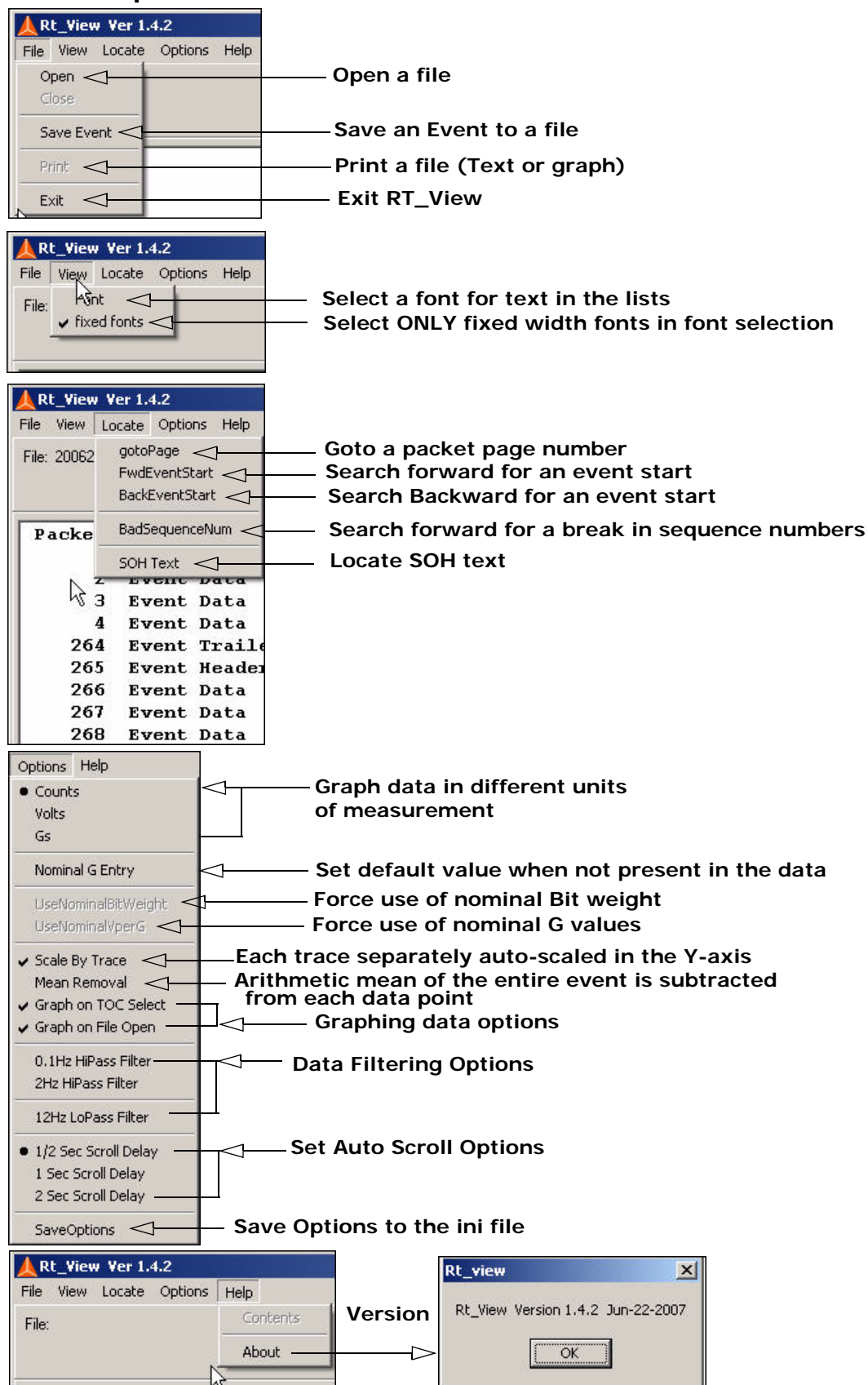


Figure 2 - 6 Menu Options

2.6 Viewing Event Header Data

To view Event Header Data:

1. Double-click the **Event Header Data** entry in the table of contents. This allows viewing of the header part of the file.

RT View Ver 1.4.3
File View Locate Options Help
File: 2006294081959150.rt Aug 10 2007 14:30:23

Packet	Description	Unit	Time	Event	Stream	Channel	SPS	Type
1	Event Header Data	9AD4	2006 294:08:20:00.000	211	1		200.0	C0
2	Event Data	9AD4	2006 294:08:20:00.000	211	1	2		
3	Event Data	9AD4	2006 294:08:20:00.000	211	1	3		
4	Event Data	9AD4	2006 294:08:20:00.000	211	1	1		
264	Event Trailer Data	9AD4	2006 294:08:20:00.000	211	1		200.0	C0
265	Event Header Data	9BD0	2006 294:08:20:00.000	137	1		200.0	C0
266	Event Data	9BD0	2006 294:08:20:00.000	137	1	3		
267	Event Data	9BD0	2006 294:08:20:00.000	137	1	4		
268	Event Data	9BD0	2006 294:08:20:00.000	137	1	5		
269	Event Data	9BD0	2006 294:08:20:00.000	137	1	6		
270	Event Data	9BD0	2006 294:08:20:00.000	137	1	2		
271	Event Data	9BD0	2006 294:08:20:00.000	137	1	1		
877	Event Trailer Data	9BD0	2006 294:08:20:00.000	137	1		200.0	C0
878	Event Header Data	9BD3	2006 294:08:20:00.000	164	1		200.0	C0
879	Event Data	9BD3	2006 294:08:20:00.000	164	1	2		
880	Event Data	9BD3	2006 294:08:20:00.000	164	1	3		
881	Event Data	9BD3	2006 294:08:20:00.000	164	1	1		
1264	Event Trailer Data	9BD3	2006 294:08:20:00.000	164	1		200.0	C0
1265	Event Header Data	9BE6	2006 294:08:20:00.000	169	1		200.0	C0
1266	Event Data	9BE6	2006 294:08:20:00.000	169	1	3		
1267	Event Data	9BE6	2006 294:08:20:00.000	169	1	1		
1268	Event Data	9BE6	2006 294:08:20:00.000	169	1	2		
1489	Event Trailer Data	9BE6	2006 294:08:20:00.000	169	1		200.0	C0
1490	Event Header Data	9D89	2006 294:08:20:00.000	360	1		200.0	C0
1491	Event Data	9D89	2006 294:08:20:00.000	360	1	3		
1492	Event Data	9D89	2006 294:08:20:00.000	360	1	1		
1493	Event Data	9D89	2006 294:08:20:00.000	360	1	2		
1715	Event Trailer Data	9D89	2006 294:08:20:00.000	360	1		200.0	C0

Contents Raw

2. The **Header** display opens a view of the header page.

RT View Ver 1.4.3
File View Locate Options Help
File: 2006294081959150.rt Aug 10 2007 14:30:54
Back Packet 1 of 1,715 Next

Unit 9AD4 Header Page Bytes 416 Experiment 0 Seq 0
2006 294:08:20:00.000

Station Name MAC5
Station Comment

Total Installed Channels in Recorder 6

Stream number 1
Stream Name Continuo

Event 211

Data Format Compressed Steim 1
Sample Rate 200.0 sps

Time Source Internal Timeclock
Time Quality Last PLL < 1 Day

Trigger Type CON

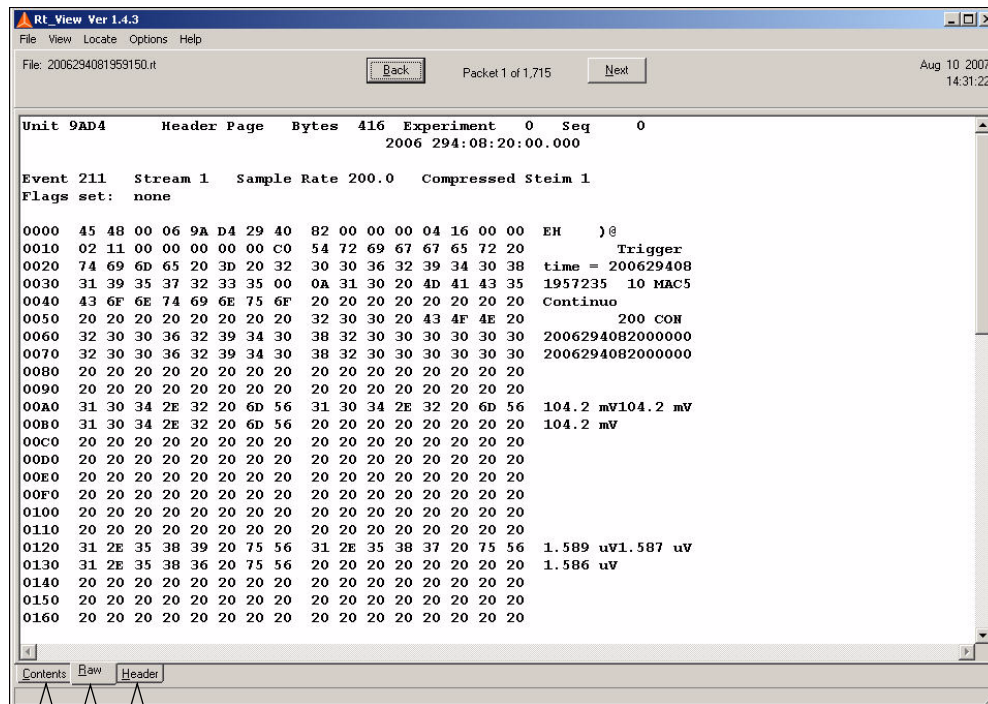
Trigger Time 2006 294:08:20:00.000
First Samp Time 2006 294:08:20:00.000

Das	Station	Bit Weight	Gain	A/D	Channel	Chan	Sensor	Sensor
Chan	Chan	Nominal	True		FS Analog	Code	FS Analog	V/Unit
1		104.2 mV	1.589 uV	x1	24 bit	+/- 10.0V	+/- 5.0V	
2		104.2 mV	1.587 uV	x1	24 bit	+/- 10.0V	+/- 5.0V	

Contents Raw Header

Figure 2 - 7 Header

- Clicking the tabs located at the bottom of the display allow a different view of the file header.



Contents
Header
Raw

- Event Header - Raw



Note: The file classifications at the bottom of the display reveal the supported viewing formats of the data page.

2.7 Event Data Header/Trailer description

To view an Event Header or trailer:

1. Double-click the **Event Header Data** or **Event Trailer Data** entry in the table of contents. This allows viewing of the header part of the file.

Packet	Description	Unit	Time	Event	Stream	Channel
1	Event Header Data	91C8	2004 133:15:48:53.895			
2	Event Data	91C8	2004 133:15:48:53.895	3	1	1
3	Event Data	91C8	2004 133:15:48:53.895	3	1	2
4	Event Data	91C8	2004 133:15:48:53.895	3	1	3
32	Event Trailer Data	91C8	2004 133:15:48:53.895			

Figure 2 - 8 Table of contents

2. The **Header** display opens a view of the header page.

Unit	Header Page	Bytes	Experiment	Seq
91C8		416	10	0
2004 133:15:48:53.895				
Station Name	99999			
Station Comment	999991-LOAD TEST			
Stream number	1			
Stream Name	Triggered Stream			
Event	3			
Data Format	Compressed			
Sample Rate	200 sps			
Time Source				
Time Quality				
Trigger Type	CHD			
Trigger Time	2004 133:15:48:53.895			
First Samp Time	2004 133:15:48:53.895			
Chan 1 Nom Bit Weight	52.08 mV			
Chan 2 Nom Bit Weight	52.08 mV			
Chan 3 Nom Bit Weight	52.08 mV			
Chan 1 True Bit Weight	818.9 nV			
Chan 2 True Bit Weight	819.5 nV			
Chan 3 True Bit Weight	819.0 nV			
Chan 1 Gain	x1			
Chan 2 Gain	x1			
Chan 3 Gain	x1			

Figure 2 - 9 Top of header page

3. Use the scroll-bar to view the bottom page of the header.

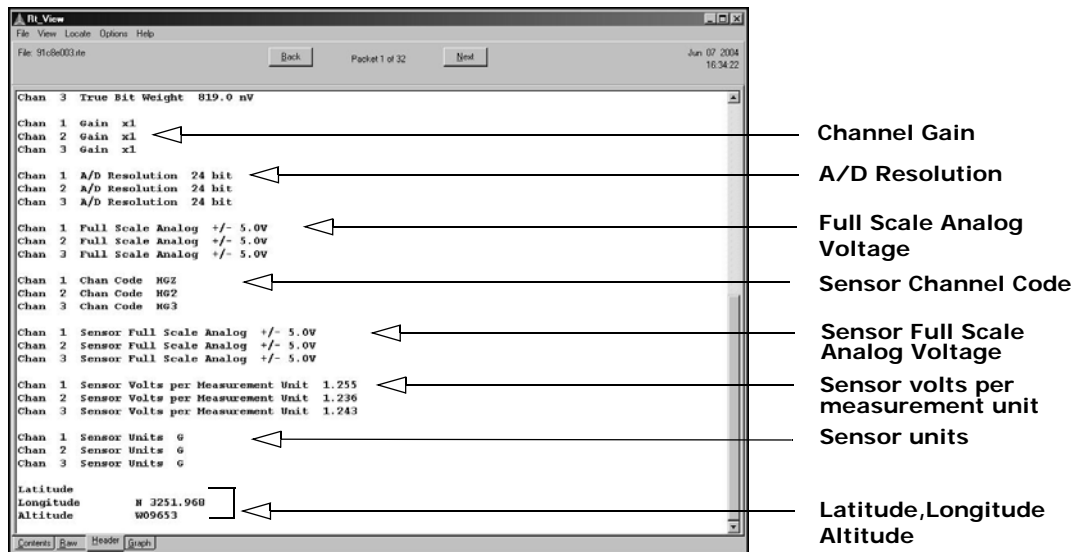


Figure 2 - 10 End of header page

2.8 Viewing Event Data

To view Event Data:

1. Double-click the Event Data entry in the table of contents. This allows viewing of the data.

Rt_View Ver 1.4.3
File View Locate Options Help
File: 2006294081959150.rt Aug 10 2007 14:30:23

Packet	Description	Unit	Time	Event	Stream	Channel	SPS	Type
1	Event Header Data	9AD4	2006 294:08:20:00.000	211	1		200.0	C0
2	Event Data	9AD4	2006 294:08:20:00.000	211	1	2		
3	Event Data	9AD4	2006 294:08:20:00.000	211	1	3		
4	Event Data	9AD4	2006 294:08:20:00.000	211	1	1		
264	Event Trailer Data	9AD4	2006 294:08:20:00.000	211	1		200.0	C0
265	Event Header Data	9BD0	2006 294:08:20:00.000	137	1		200.0	C0
266	Event Data	9BD0	2006 294:08:20:00.000	137	1	3		
267	Event Data	9BD0	2006 294:08:20:00.000	137	1	4		
268	Event Data	9BD0	2006 294:08:20:00.000	137	1	5		
269	Event Data	9BD0	2006 294:08:20:00.000	137	1	6		
270	Event Data	9BD0	2006 294:08:20:00.000	137	1	2		
271	Event Data	9BD0	2006 294:08:20:00.000	137	1	1		
877	Event Trailer Data	9BD0	2006 294:08:20:00.000	137	1		200.0	C0
878	Event Header Data	9BD3	2006 294:08:20:00.000	164	1		200.0	C0
879	Event Data	9BD3	2006 294:08:20:00.000	164	1	2		
880	Event Data	9BD3	2006 294:08:20:00.000	164	1	3		
881	Event Data	9BD3	2006 294:08:20:00.000	164	1	1		
1264	Event Trailer Data	9BD3	2006 294:08:20:00.000	164	1		200.0	C0
1265	Event Header Data	9BE6	2006 294:08:20:00.000	169	1		200.0	C0
1266	Event Data	9BE6	2006 294:08:20:00.000	169	1	3		
1267	Event Data	9BE6	2006 294:08:20:00.000	169	1	1		
1268	Event Data	9BE6	2006 294:08:20:00.000	169	1	2		
1489	Event Trailer Data	9BE6	2006 294:08:20:00.000	169	1		200.0	C0
1490	Event Header Data	9D89	2006 294:08:20:00.000	360	1		200.0	C0
1491	Event Data	9D89	2006 294:08:20:00.000	360	1	3		
1492	Event Data	9D89	2006 294:08:20:00.000	360	1	1		
1493	Event Data	9D89	2006 294:08:20:00.000	360	1	2		
1715	Event Trailer Data	9D89	2006 294:08:20:00.000	360	1		200.0	C0

Contents Raw

Figure 2 - 11 Event Data contents

2. Clicking the **Graph** button opens a time series graph of the Event data.

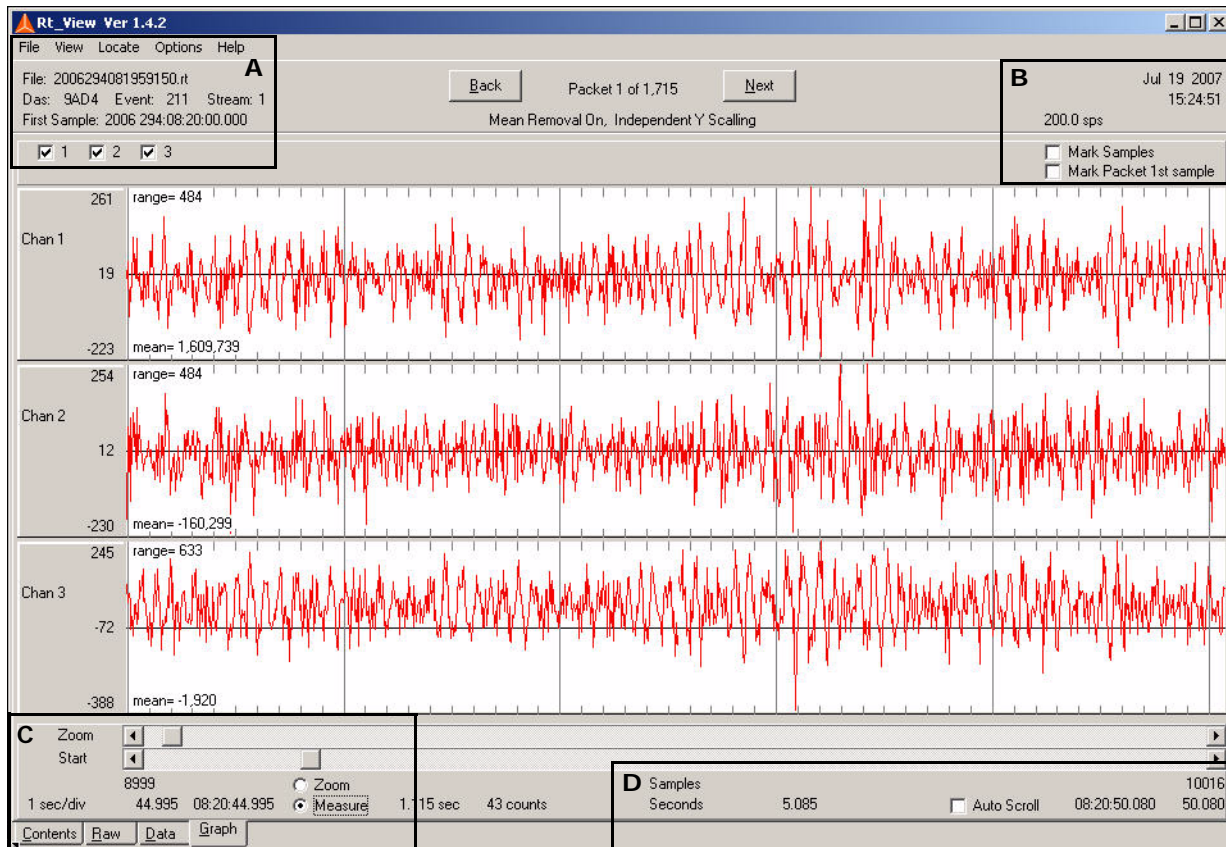


Figure 2 - 12 RT_View of the data

The following close-up views of the displays show how to use areas of the display.

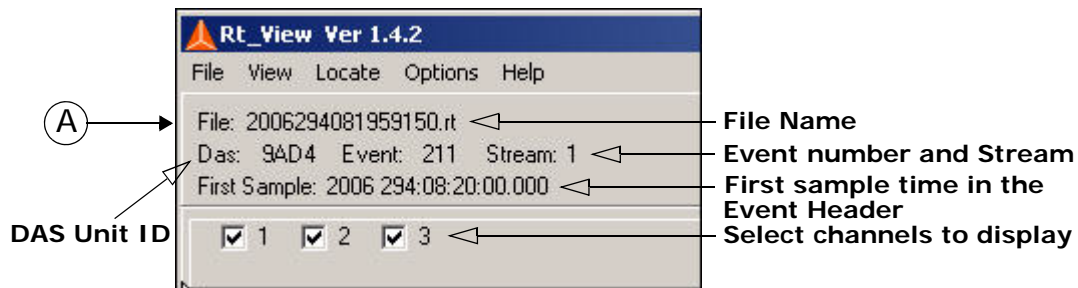


Figure 2 - 13 Section A - Upper-Left display

Figure 2 - 14 Pull-Down menu options

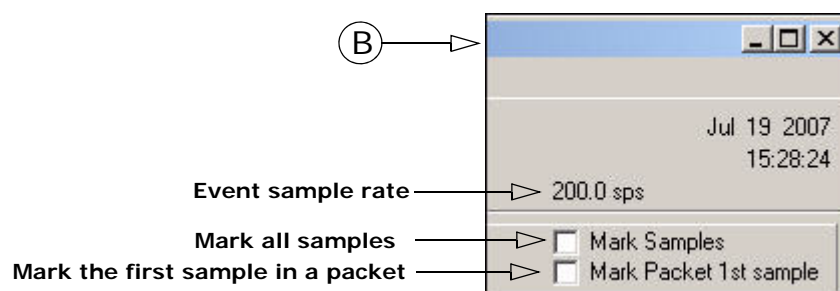


Figure 2 - 15 Section B - Upper-Right display

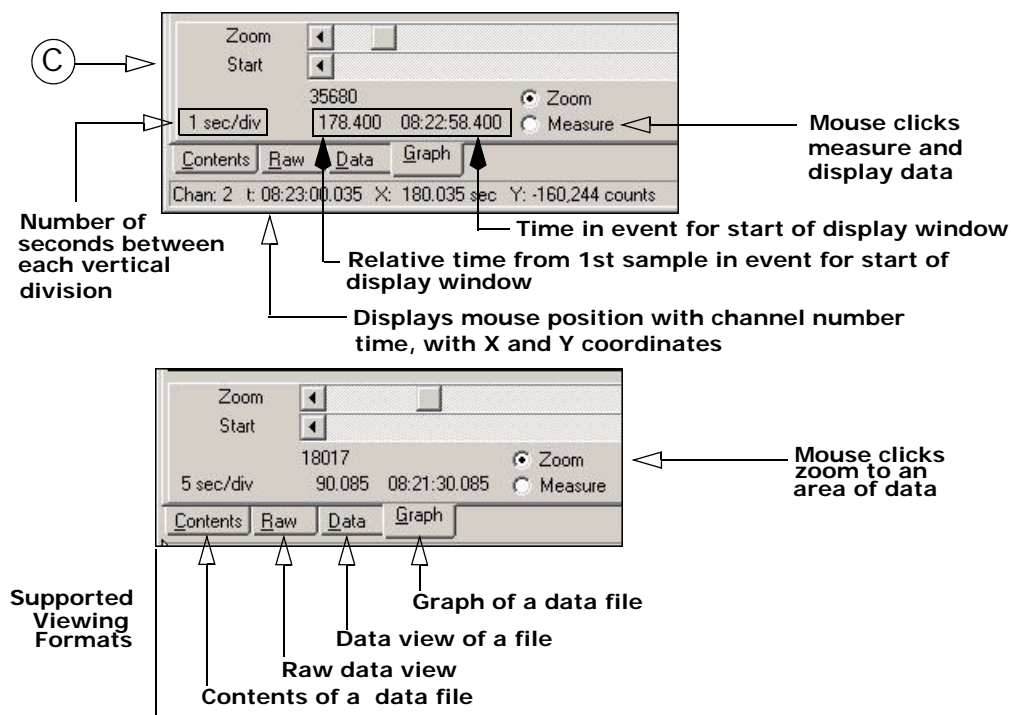


Figure 2 - 16 Section C - Lower-Left display

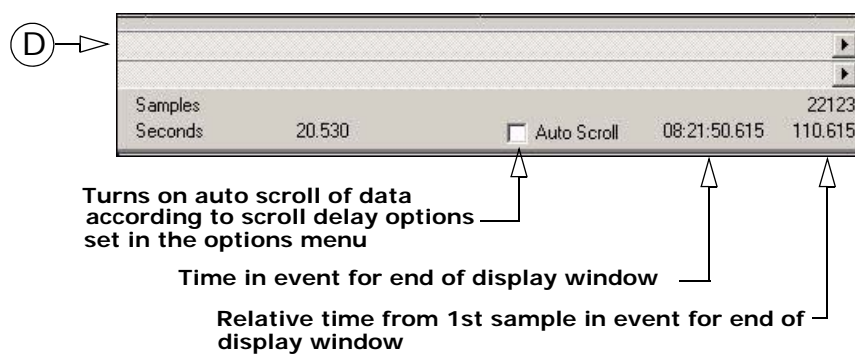


Figure 2 - 17 Section D - Lower-Right display

3. Click the **Data** button opens a view of sample data.

n	time	Data
1	08:20:00.000	-160329 -160254 -160293 -160254 -160303
6	08:20:00.025	-160305 -160317 -160306 -160295 -160310
11	08:20:00.050	-160196 -160354 -160374 -160227 -160277
16	08:20:00.075	-160220 -160335 -160357 -160232 -160281
21	08:20:00.100	-160276 -160317 -160333 -160288 -160283
26	08:20:00.125	-160317 -160278 -160274 -160321 -160268
31	08:20:00.150	-160375 -160365 -160346 -160344 -160202
36	08:20:00.175	-160284 -160223 -160226 -160338 -160273
41	08:20:00.200	-160312 -160285 -160277 -160271 -160277
46	08:20:00.225	-160300 -160264 -160311 -160350 -160418
51	08:20:00.250	-160354 -160294 -160288 -160247 -160302
56	08:20:00.275	-160282 -160277 -160306 -160285 -160268
61	08:20:00.300	-160331 -160312 -160225 -160324 -160292
66	08:20:00.325	-160241 -160298 -160274 -160265 -160208
71	08:20:00.350	-160277 -160412 -160382 -160229 -160316
76	08:20:00.375	-160404 -160267 -160442 -160284 -160119
81	08:20:00.400	-160385 -160291 -160272 -160277 -160223
86	08:20:00.425	-160306 -160275 -160264 -160273 -160417
91	08:20:00.450	-160303 -160142 -160314 -160219 -160328
96	08:20:00.475	-160379 -160237 -160375 -160269 -160350
101	08:20:00.500	-160450 -160280 -160310 -160240 -160218
106	08:20:00.525	-160294 -160276 -160330 -160378 -160301

Figure 2 - 18 Data view

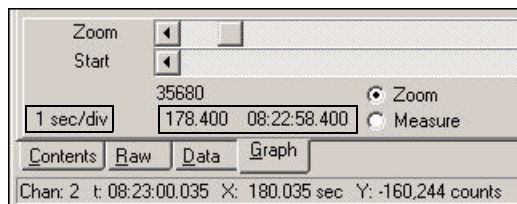
4. Clicking the **Raw** button open a raw data view of the Header Page.

Address	Hex Data	ASCII
0000	44 54 00 06 9A D4 29 40	DT)@ \$
0010	02 11 00 01 01 11 00 C0	0D 82 BC AE 0D 82 B7 AC
0020	44 54 00 06 9A D4 29 40	81 95 72 35 00 00 03 06
0030	02 11 00 01 00 00 00 C0	41 38 32 44 32 34 30 30
0040	03 5A 95 69 FF FD 8D B7	FF FD 8D DE FF FD 8D B7
0050	4B D9 27 CF FE F4 0B 0B	FF F1 00 72 FF 62 FF EC
0060	00 93 FF CE 39 8D EA 7D	CF 05 D7 F0 2D 05 DE 27
0070	04 D1 35 95 00 0A 00 13	00 02 00 8E AE 3D FD 90
0080	15 55 6A A5 41 D9 1B 08	06 FA E9 24 D1 D9 BC 40
0090	3C 06 29 C9 14 05 E3 15	11 C1 13 57 9D 20 33 C7
00A0	18 09 39 BB FF 79 00 1E	00 99 FF A9 FF A8 00 89
00B0	FF 51 00 9E 00 A5 FE F6	5E 13 FB 36 AD 1F 0B F7
00C0	2A AA 50 00 FF 70 00 72	00 A1 FF 54 00 5F FF 93
00D0	FF CD 00 8E FF 76 00 6A	FF AF FF 9C 00 AA FF E2
00E0	46 16 B4 12 CA D0 4D 0B	CE F1 EF BB E1 DA 62 1D
00F0	FF B7 00 9D 00 8F FF 7F	00 56 FF A2 FF 57 00 B2
0100	00 00 00 00 FF 48 FF F6	00 8C FF 51 0A D4 38 78
0110	10 7E B0 EF 00 2B 00 13	00 18 FF 60 CD 00 28 B3
0120	00 55 00 7D FF 2E 00 85	FF EC 00 10 00 95 FF 46
0130	55 DB BE 60 FF 62 FF 9E	00 83 00 54 EB 0C DE 4B
0140	00 00 00 00 47 BC 4F 09	FF 54 FF D2 3D F6 1D 0A
0150	D7 2D DF D8 0B 28 26 02	EF D1 38 F8 BF 17 3E 90
0160	00 05 00 9B FF 64 00 5E	00 47 FF B3 00 A6 FF 97
0170	FF 70 00 46 ED C1 14 CD	1A 45 10 68 B6 EE 29 9D
0180	00 00 00 00 17 29 0F B8	10 1B C1 57 B7 3B 06 BA

5. Select the **Contents** button to return to the table of contents to view another part of the file.

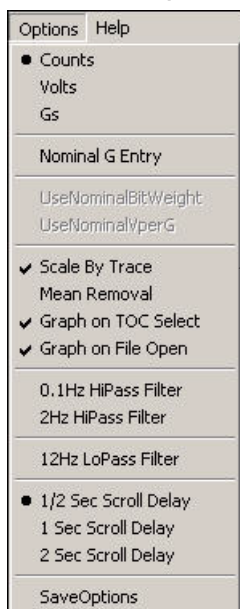
2.9 Options menu

The RT_view program has several viewing options that can be applied as each screen of data is viewed. Placing the mouse cursor anywhere in the graphic area displays on the status line the cursor position in the graph. The status line displays **x** and **y** values.



Displays mouse position with channel number time, with X and Y coordinates

1. Select the drop-down **Option** menu to allow graphing of the event data with different units (Counts, Volts, or G's), set G_Entry options, add viewing options, and to save present options as default.



Viewing options

Save options as default

Figure 2 - 19 Counts option



Note: Select the *Graph on TOC Select* option to open any data view with the graphical view option as default.

2. Select the **counts** option to view the data in raw digital counts.

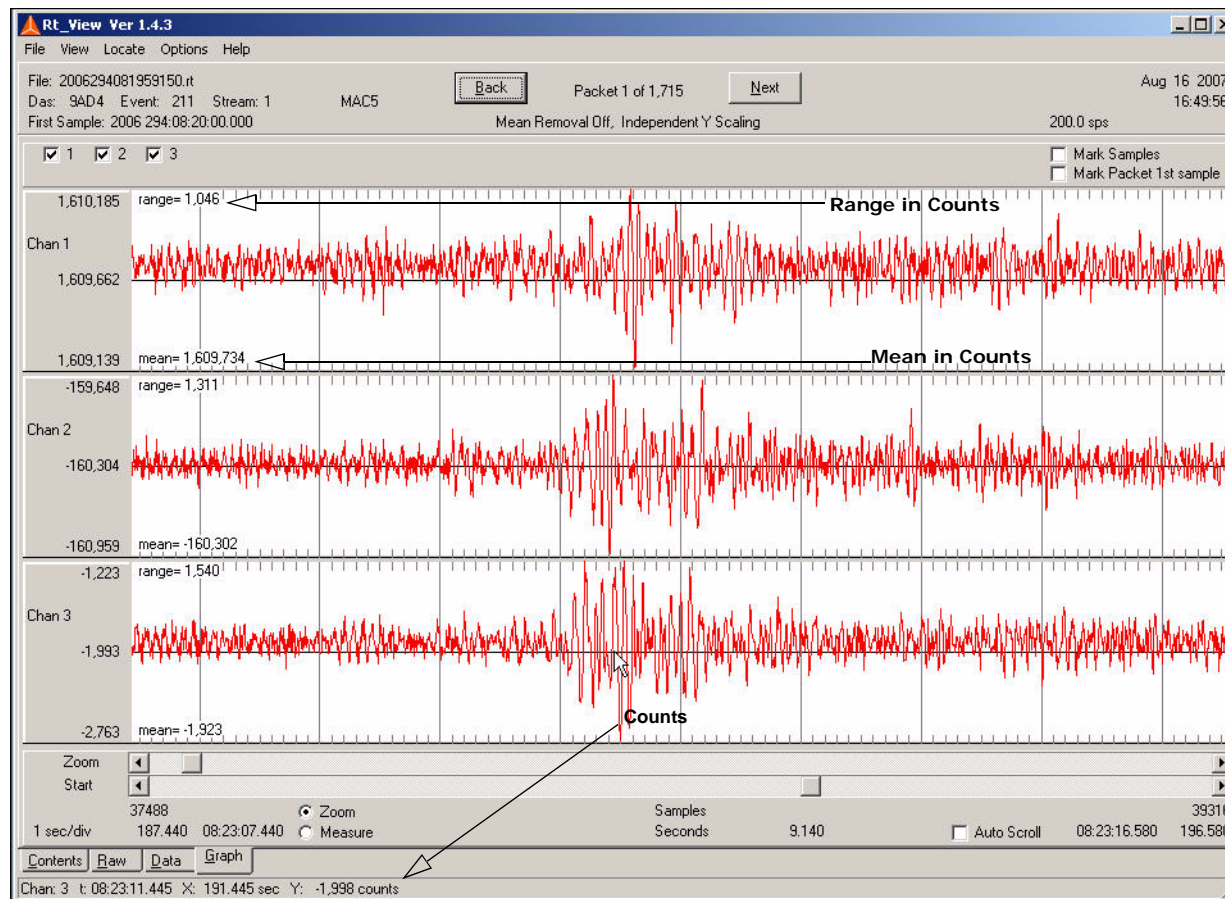


Figure 2 - 20 Counts display example



Note: Counts updated from cursor position are displayed on the bottom of the window. Range, Mean, and status line Y values are in counts.

2.9.1 Using the Volts option

1. Select the **Volts** option to view the data with volts as the units of measurement.

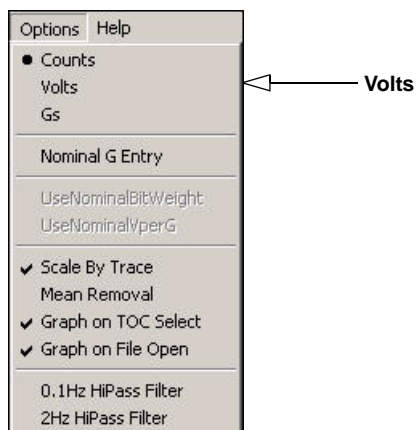


Figure 2 - 21 Volts option

2. The volts per count conversion is automatically read from the Event Header packet (a true Bit Weight field).

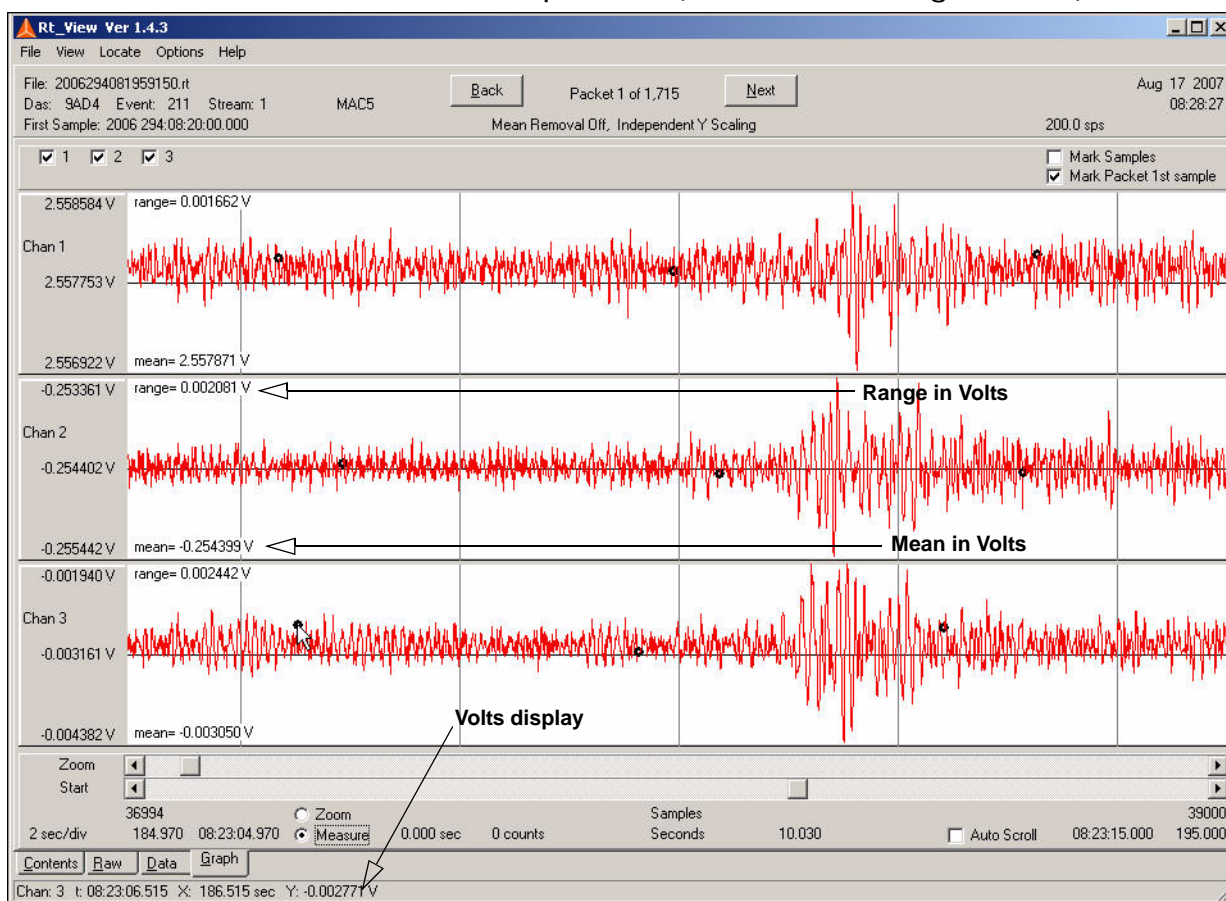


Figure 2 - 22 Volts display example



Note: Volts updated from cursor position are displayed on the bottom of the window. Range, Mean, and status line Y values are in volts.

2.9.2 Using the G's option

1. Select the **G's** option to view the data with G's as the units of measurement.

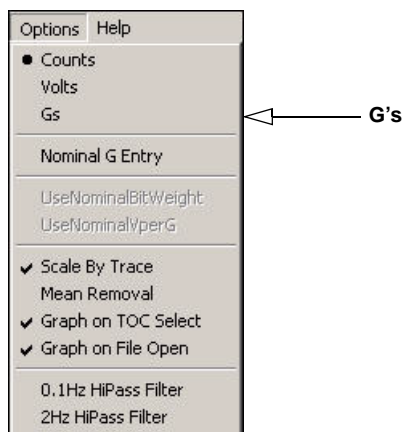


Figure 2 - 23 G's option

2. The window refreshes to view the data with G's as the units of measurement.

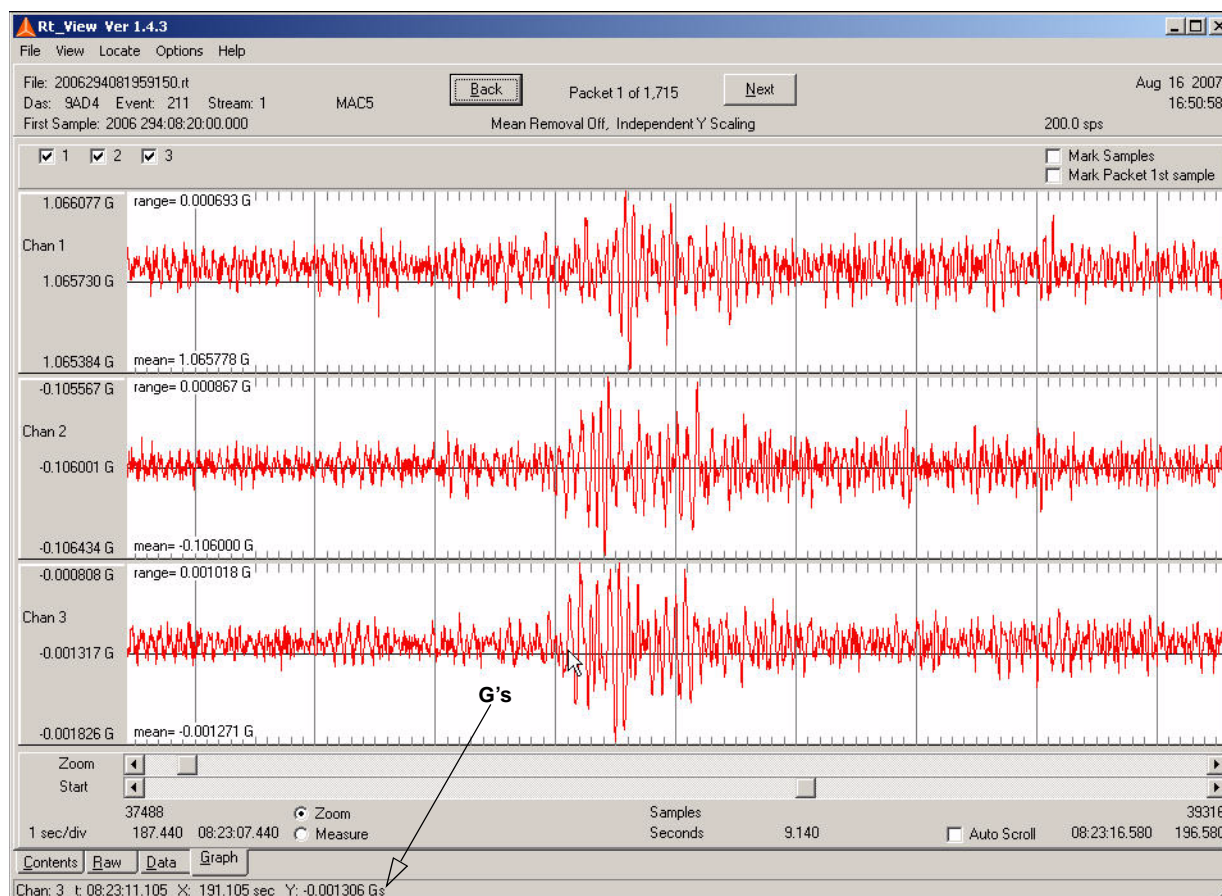


Figure 2 - 24 G's display example



Note: G's updated from cursor position are displayed on the bottom of the window. Range, Mean, and status line Y values are in G's.

2.9.3 Using the G's entry option

Nominal G entry is used to set default values for when they are not present in the event data. If the event data contains these values then they take priority over any of these user entered values.

1. To change the per channel volts per G conversion value use the **G's entry** option on the **Option** menu.

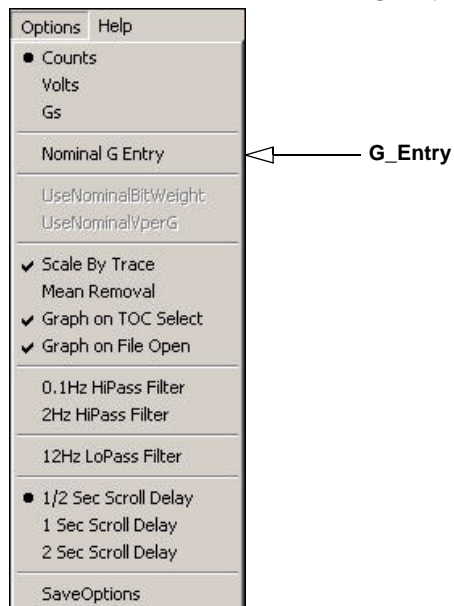


Figure 2 - 25 G_Entry option

2. Under the **Options** menu, select the **Gs_Entry** option.

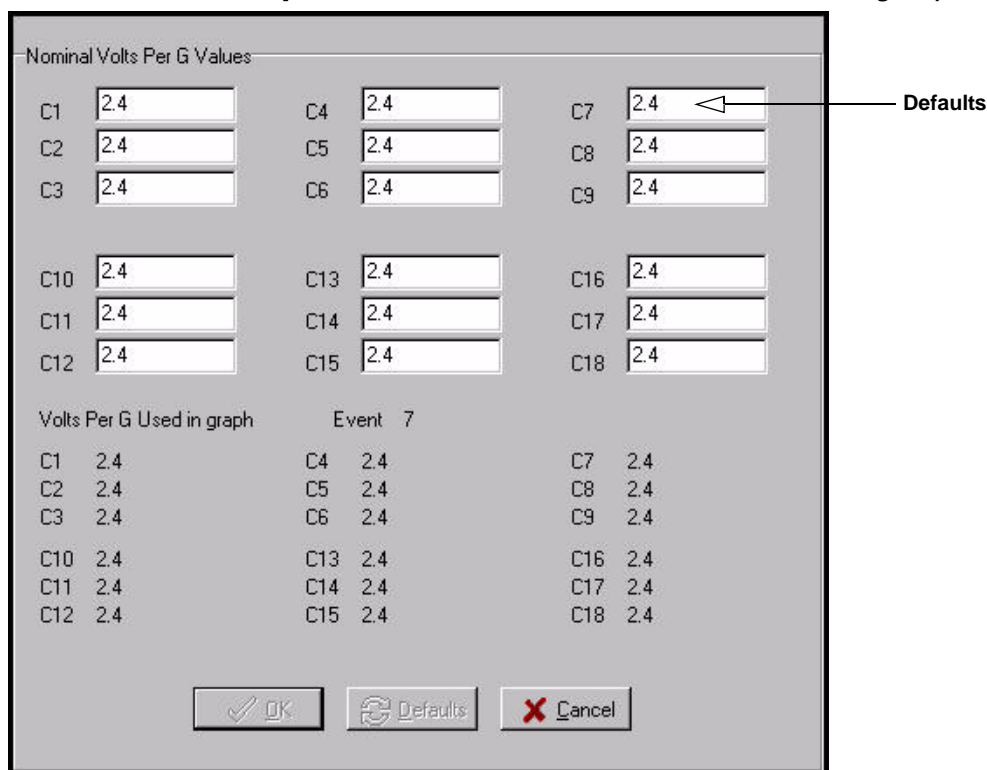


Figure 2 - 26 G_Entry display

If the defaults icon is disabled (grayed out) the RT_View.ini file must be updated with any windows editor to enable editing.

1. Open the RT_View.ini file.

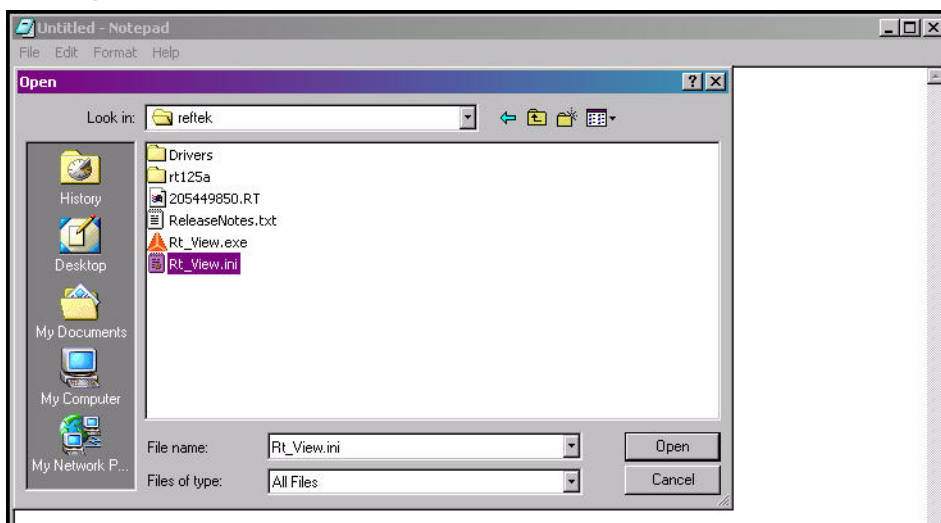
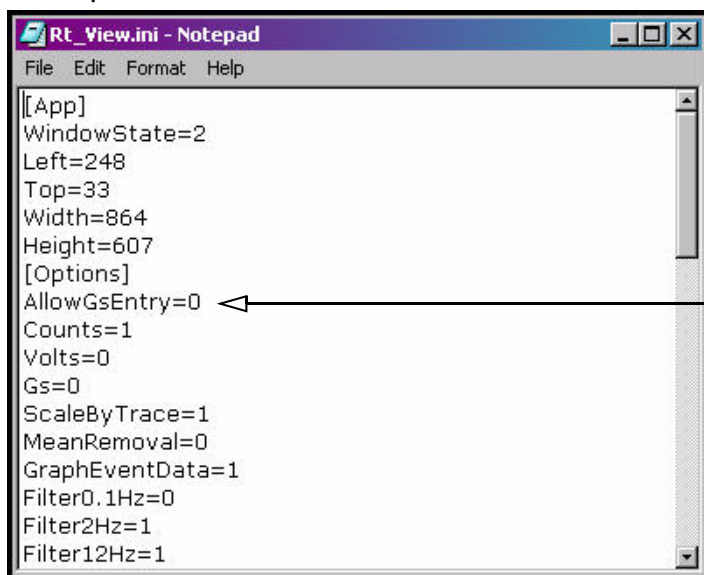


Figure 2 - 27 Edit RT_View.ini file

Example RT_View.in file



Change this value to a 1 to allow editing of default values.

Figure 2 - 28 RT_View.ini file

2.9.4 Using Independent-Y-Scaling (Scale By Trace)

Scale-by-trace (in the option menu) is defined as each trace separately auto-scaled in the Y-axis (amplitude).

If Scale-By-Trace is on the display reads "Independent Y Scaling".

If Scale-By-Trace is off the display reads "Common Y Scaling".

With these enabled or disabled the window is updated as shown below with the current option selected.

1. Select the **Scale By Trace** option on the **Option** menu to enable this option.

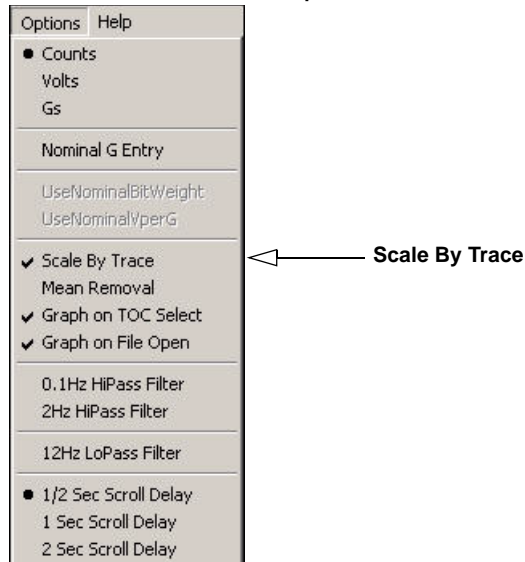


Figure 2 - 29 Scale By Trace option

2. The screen redraws with **Scale By Trace** enabled.

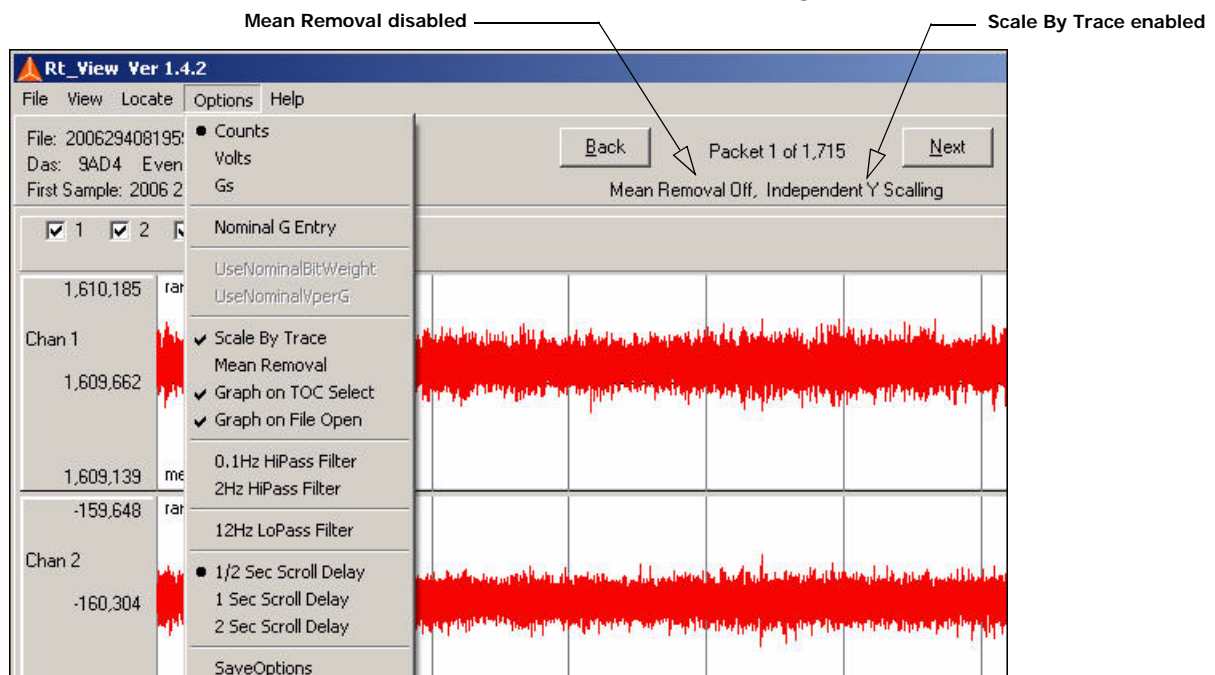


Figure 2 - 30 Counts display with Scale By Trace enabled

2.9.5 Using the Mean Removal option

Mean removal is when an arithmetic mean of the entire event is subtracted from each data point (or sample).

With these enabled or disabled the window can be updated as shown below with Common-Y-scaling and Mean Removal Off.

1. Select the **Mean Removal** option on the **Option** menu to enable this option.

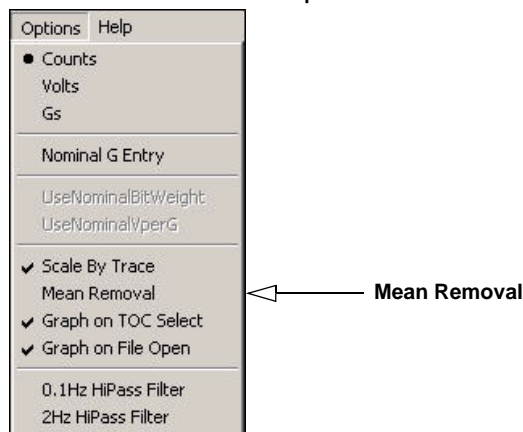


Figure 2 - 31 Mean Removal option

2. The screen redraws with **Mean Removal** and **Scale By Trace** enabled

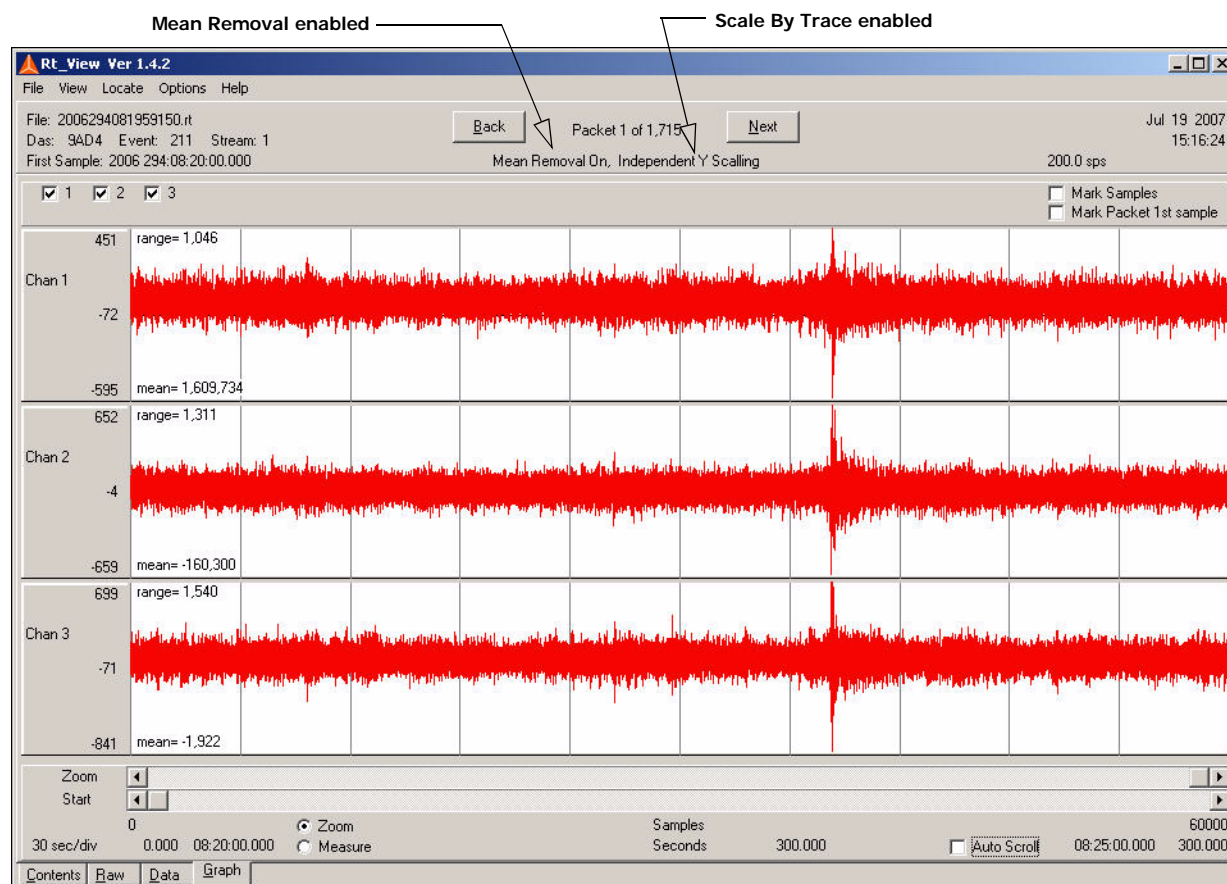


Figure 2 - 32 Counts display example with Mean Removal enabled.

2.9.6 Using the Data Filtering option

Data filtering is used to allow the user to view the event data as the triggering software in the DAS does.

1. Select the **2Hz HiPass Filter** and **12Hz LoPass Filter** option on the **Option** menu to enable this option.

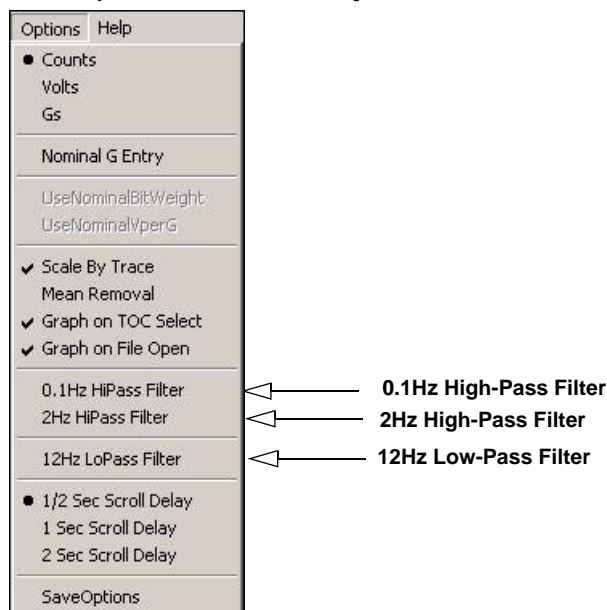


Figure 2 - 33 Mean Removal option

2. The screen redraws with **2Hz HiPass Filter** and **2Hz LoPass Filter** enabled

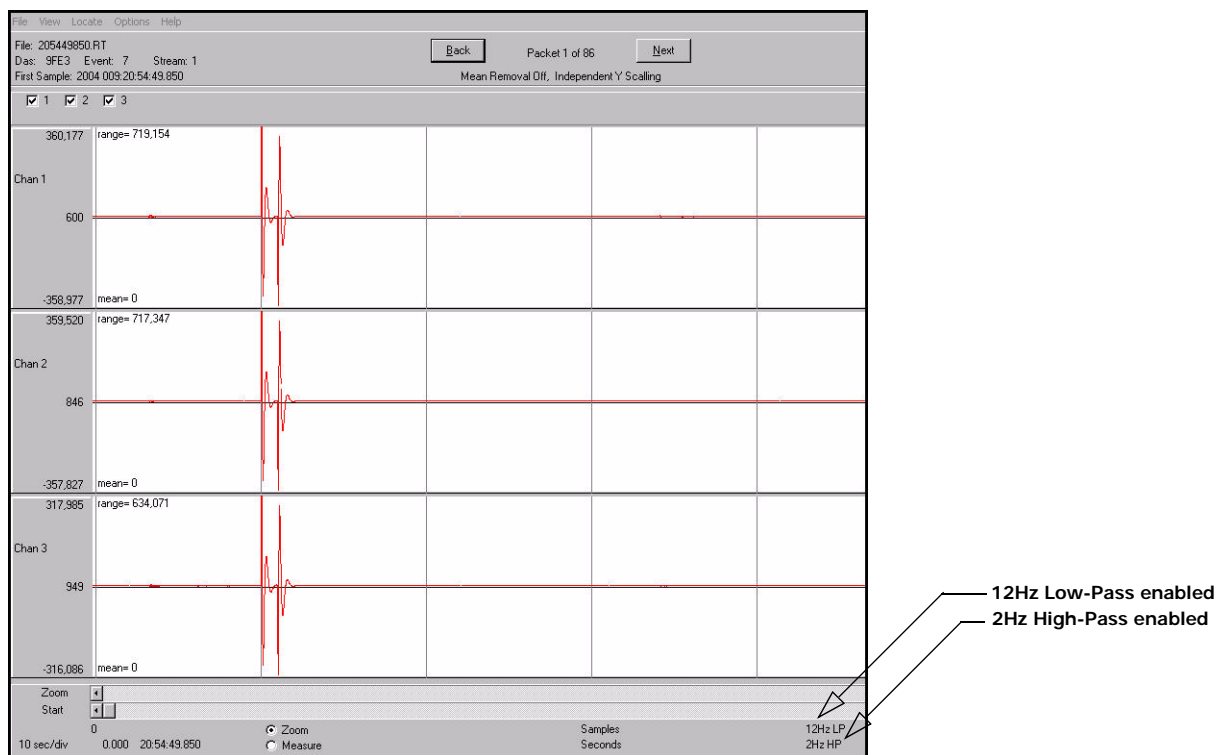


Figure 2 - 34 Display example with filtering options enabled.

This detail view shows the 2Hz HiPass Filter and 12Hz LoPass Filter indicators as enabled.

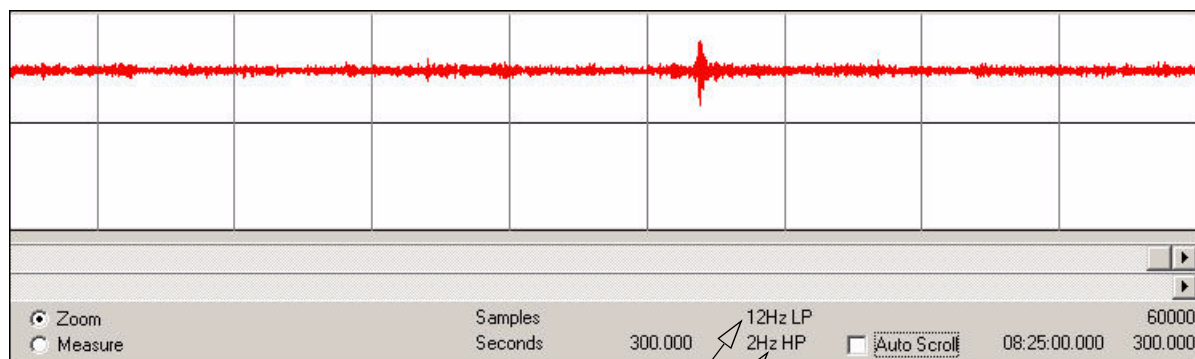


Figure 2 - 35 Display example with filtering indicators enabled.

2.10 Zooming

1. It is also possible to zoom in to an area of data by using the left mouse button to select a window area in one data window as shown below, and dragging across to select a new viewing window.

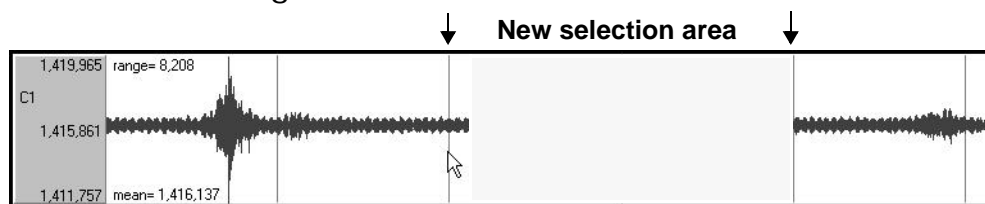


Figure 2 - 36 Dragging a new selection area

2. A new window is displayed based on the new selection area. All channels are zoomed the same amount.

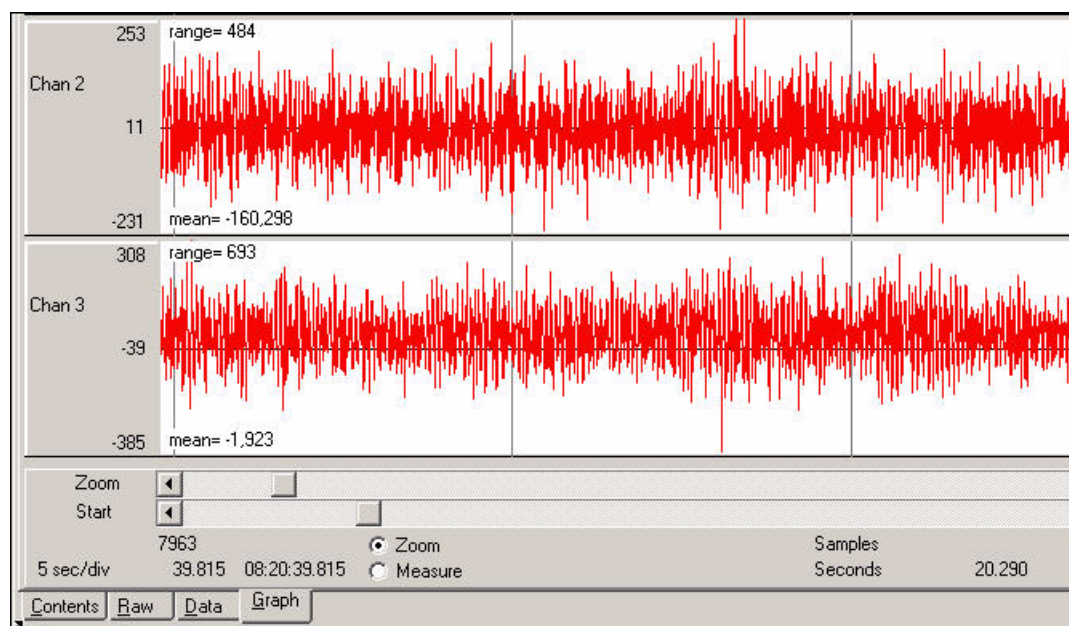


Figure 2 - 37 Zoomed data view



Note: It is possible to undo up to 99 zoom in operations.

Note: The scroll bars may also be used for a zoom operation but changes are not remembered for undo operations.

3. To cancel a zoom right click in the graph. Each right click cancels one level of zoom and restores the previous display.

2.11 Measure

It is also possible to measure amplitude or time

1. Select the **Measure** option check box.

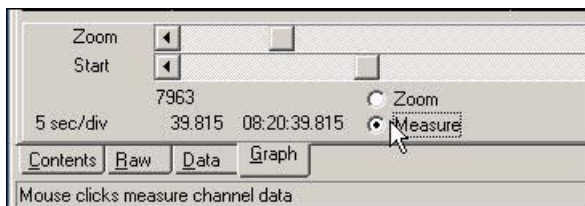


Figure 2 - 38 Measure options

2. Select an area to measure using the mouse.
3. Note the measurement in the area shown below in units of time and amplitude.

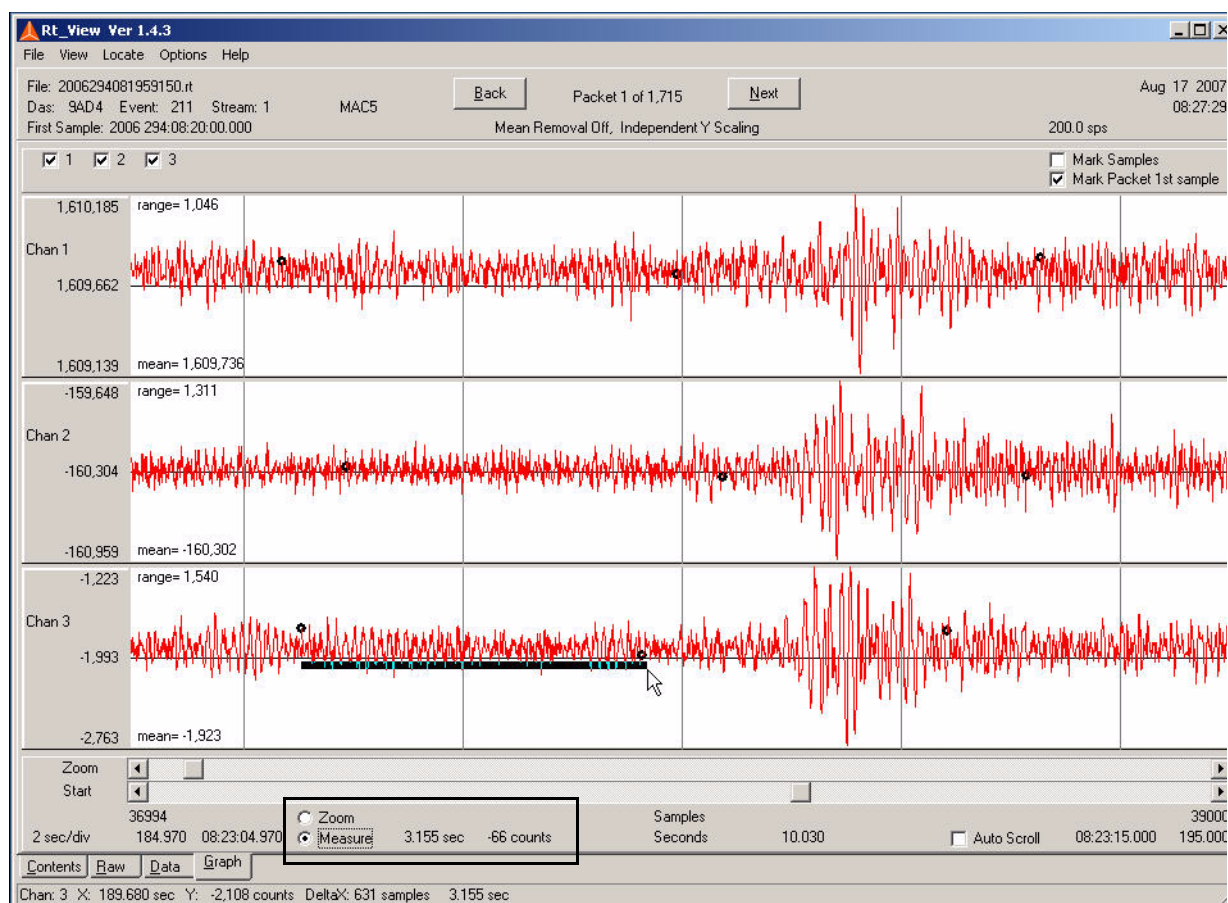


Figure 2 - 39 Measuring

2.12 Viewing a State-of-Health file

To view a State-of-Health file:

- Drag and Drop files on an **RT_View** shortcut or executable.
 - Drag and Drop files onto a running **RT_View** application.
 - Use the **File** and **Open** menu from the drop-down menu after opening the **RT_View** program.
1. Close any open file first before opening a State-of-Health file by selecting **File** and **Close**.
 2. Open a State-of-health file by selecting the file and using the **Open** button.

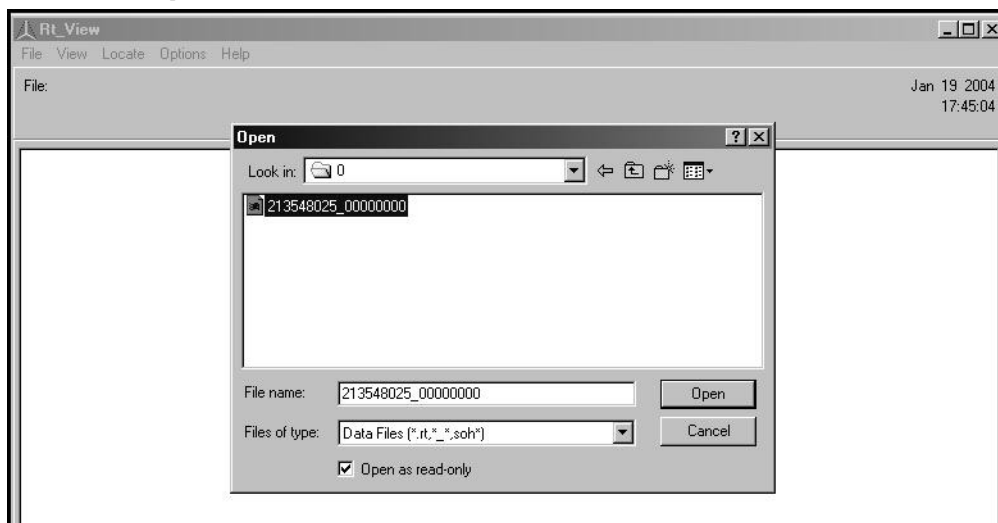


Figure 2 - 40 Select a State-of-health file

3. Double-clicking a **State of Health Info** entry in the table of contents allows viewing of the state-of-health packets in the file.

Packet	Description	Unit	Time	Event	Stream	Channel
1	State Of Health Info	9181	2004 005:00:00:00.000			
16	Station-Channel Info	9181	2004 005:22:00:00.000			
18	Operating Mode Params	9181	2004 005:22:00:00.000			
19	Data Stream Params	9181	2004 005:22:00:00.000			
20	Aux Parameters	9181	2004 005:22:00:00.000			
21	Cal Parameters	9181	2004 005:22:00:00.000			
22	State Of Health Info	9181	2004 005:22:00:06.000			

Figure 2 - 41 State of Health contents.



Note: The file classifications at the bottom of the display reveal the supported viewing formats of the file.

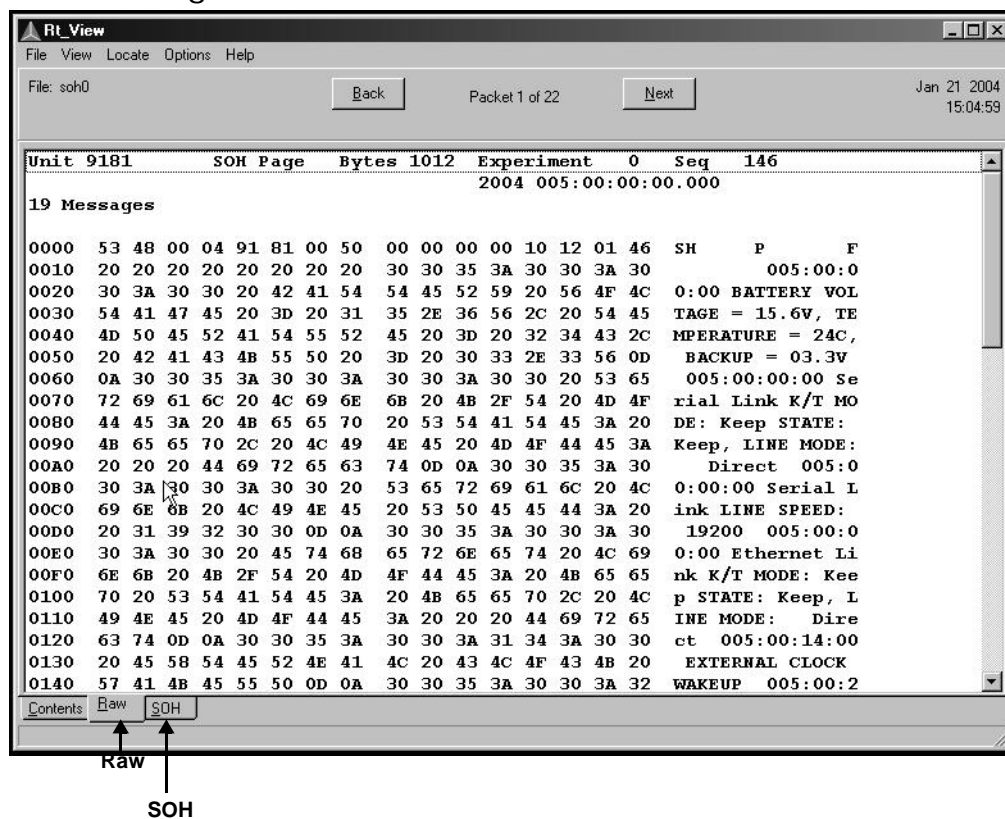
4. Clicking **Raw** allows different views of the data.

Figure 2 - 42 Event file contents

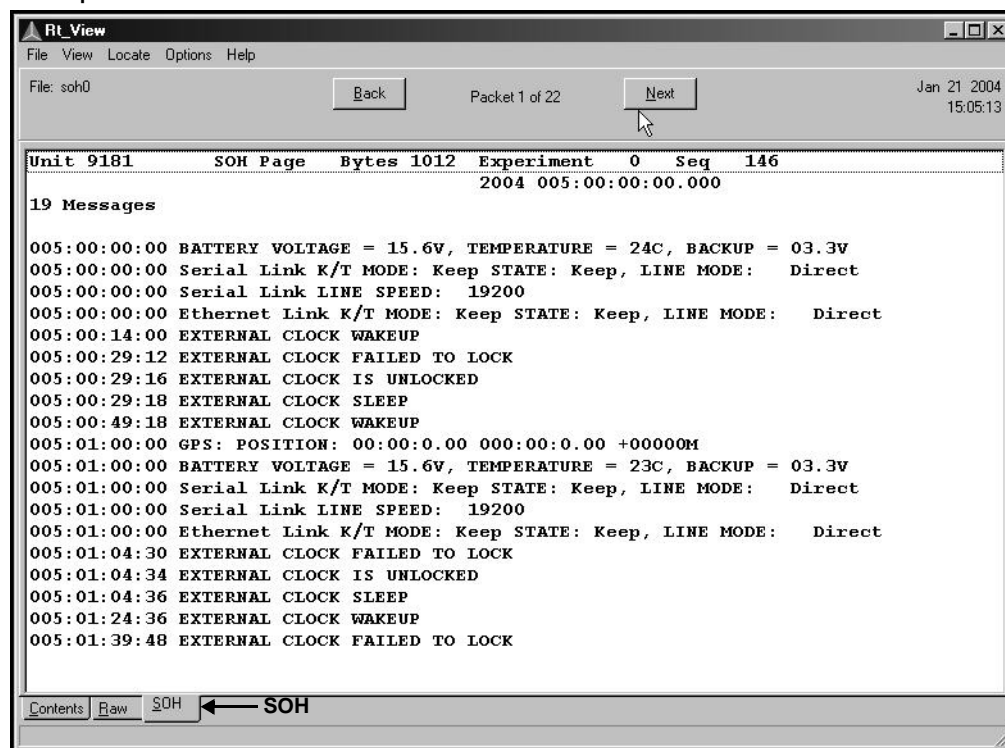
5. Clicking **SOH** tab opens an entry listing view of the SOH packet.

Figure 2 - 43 SOH view



Section 3

Using **REF TEK** to ASCII Conversion (RTCNVRT)

3.1 Overview

The **RTCNVRT** utility program converts a raw **PASSCAL** data file (as recorded by a DAS) to create the following:

- A separate data file for each channel in each event of each DAS
- A log file that contains all state-of-health and parameter information for each DAS
- As an option, the **RTCNVRT** utility creates a file for each DAS that contains quality control calculations for each channel of each event.

The program creates new sub-directories under a directory you specify and places its output files into these new sub-directories. These directories have the form, **id####**, where **####** is the unit ID number. As necessary, **RTCNVRT** uses zeroes as the left-most digits in directory names. This sub-directory structure allows the **RTCNVRT** utility to process data files which contain blocks from more than one unit.

You may use any valid path, either fully-qualified or partial (except the root directory), but the directory must be on the current default drive. The output directory that you assign must already exist, but the **RTCNVRT** program creates the unit ID sub-directories as necessary. You may use a dot (.) to indicate the current directory.

This section provides information on the **RTCNVRT** utility and the files it creates.

RTCNVRT includes the following:

- Explanation of available switches for the RTCNVRT program
- Explanation for how to start and use the RTCNVRT program
- Description of the log file
- Description of the converted data files
- Description of the quality control calculations (QCC) file

```

RTCNVRT - Version 03.41
Copyright (c) 1988 - 2006 Refraction Technology, Inc. All Rights Reserved

Purpose:
  Reads a file containing PASSCAL data packets and converts
  the data to ASCII format.

Usage:
  RTCNVRT [switches] sourceFile [output_path] [switches]

Switches
-----
-DC  DT LOG output: Y, +, N or -      <NO>
-LC  LOG File output: Y, +, N or -    <YES>
-Pn  output Path levels               <0>
      0 = no additional subdirectories
      1 = one subdirectory level: YYYY_DDD
      2 = two subdirectory levels: YYYY_DDD\HH
      3 = two subdirectory levels: YYYY_DDD\HH_MM
      4 = two subdirectory levels: YYYY_DDD\HH_MM_SS
-Qc  QCC File output: Y, +, N or -    <NO>
-Rn  sample Rate (if not found in the data)  <100>
-Sn  Sample count per channel per event  <4294967295>
-Tn  Trash n samples from each event      <0>
-Uc  Verbose message output: Y, +, N or - <ENABLED>

Switches may appear anywhere on the command line.
Arguments and switches are NOT case sensitive.

```


3.2 Available Switches for the REF TEK Data Conversion Utility

You can modify the functionality of the **RTCNVRT** utility by including one or more of the following switches (control variables) to its invocation on the DOS command line:

Switch	Default	Description
/Ppath	current	Designates the path name of the directory in which the RTCNVRT utility will create the sub-directories for its output.
/Q+	on	Turns the QCC calculations on.
/Q-		Turns the QCC calculations off.
/S	100	Designates the default sample rate if a data file does not include an event header (EH) block.
/C#	0	Defines the number of the samples per event in the input file that you want the utility to convert. If this number equals or exceeds the total number of samples in the input file, the utility will convert all the data in that file. You may convert as few samples in the file as you want. The RTCNVRT program can convert any number of samples up to 4,294,967,295.
/R	Scaled	Disables the utility's scaling factor when converting 32-bit data (maintains data in its raw form) The RTCNVRT utility ignores this switch when processing 16-bit data.
/D	Enabled	Disables the inclusion of data block headers in the log file.

3.3 Starting and using the RTCNVRT utility program

To use the **RTCNVRT** program, perform the following actions:

Transfer the raw PASSCAL data from the 130 DAS RAM or peripheral storage to a file in a PC by one of the following methods:

- With a **DAS** use FTP to GET the data.
 - With a **DAS**, with a CompactFlash™, use 130-Reader-2 adapter with a laptop or PC.
1. Enter the core DOS command line invocation for the RTCNVRT program, including any optional switches. Specify the file that you created in the previous step.
 2. The core invocation for the **RTCNVRT** program is:
RTCNVRT filename /ppath
 3. When the conversion is completed, the converted data file is ready for further processing and use with **MATLAB** data analysis software. By default, the RTCNVRT utility scales all 32-bit data converted, dividing by 65536. You can use the /r switch to maintain 32-bit data in full scale.
 4. To obtain the log file created by the **RTCNVRT** utility without converting the data files for MATLAB, enter zero (0) for the number of samples (that is, use a /c0 switch). The format of the log file produced by the **RTCNVRT** utility is similar to the format of the log file produced by the Log function of SCSI Commander used with a 72A DAS.
 5. For an example of a converted data file, see the **REF TEK** *Recording Format Specification portion of the 130 Command Reference*.

3.3.1 The Log File

The log file contains all state-of-health and parameter information. Header information for each block is provided in fields on one line. A space separates each field. A description of Log File Fields follows.

Field	Description
First	Denotes the type of the packet. If this is a data packet (designated DT), it may be followed by a plus (+) or a minus (-) symbol to indicate a positive or negative timetag jump from its predecessor in sequence. A blank following a data packet indicates no timetag jump.
Second	Contains the time tag (YY:DDD:HH:MM:SS.TTT).
The X:	Displays the experiment number
The U:	Displays the unit ID number.
The N:	Displays the sequence number.
The E:	Displays the event number.
The D:	Displays the datastream number.
The C:	Displays the channel number
The S:	Displays the number of samples.
The F:	Displays the data format type
The M:	Displays the filemark number encountered (applies to selected storage only).
The B:	Displays the number of the current block.

In addition, all blocks except data blocks are followed by the contents of the block, in a readable format.

3.3.2 The Quality Control Calculations (QCC) File

The QCC file contains quality control calculations for each channel of each event. Values included are maximum, minimum, range, mean (offset), and standard deviation (root mean square).

Sample QCC file					
ET 92:150:11:50:22.452 X:00 U:0538 N:0031 E:0001 D:0 C:0B:00041					
	Min	Min	Max	Range	Mean Std Dev
Channel 0:	- 3.0000	0.0000	3.0000	- 1.5200	0.6532
Channel 1:	-19.0000	-15.0000	4.0000	-17.2400	0.9695
Channel 2:	- 1.0000	2.0000	3.0000	0.5200	0.8226
Channel 3:	-16.0000	-12.0000	4.0000	-13.2800	0.9798
Channel 4:	- 5.0000	- 2.0000	3.0000	- 3.3200	0.8524
Channel 5:	- 8.0000	- 4.0000	4.0000	- 5.9600	1.2069



Section 4

Using REF TEK to SUDS (REF2SUDS)

4.1 Overview

This section provides detailed information on the function and use of Refraction Technology's **REF2SUDS** conversion program, it includes the following:

- An explanation of the **REF2SUDS** program's function
- Using the **REF2SUDS** program

4.2 The Purpose of REF2SUDS

The **REF2SUDS** program allows you to convert data from **PASSCAL** format to **SUDS** format. The data can reside on a **PASSCAL**-format file on the local hard disk.

Typing **REF2SUDS** at the DOS prompt produces a syntax message similar to the following:

```
C:\>ref2suds
REF2SUDS - Version 1.53 <Beta>
Copyright (c) 1993-97, Refraction Technology, Inc. - All Rights Reserved.

Usage: REF2SUDS [host:lid!filespec [output_dir]

Switches:
  /B[n][l,m] - Start at block n, process m blocks. <all blocks>
  /Mn        - Start at filemark n on tape. <2>
  /E         - Output event number filenames. <Timestamp>
  /Q[VU]     - Generate REF2SUDS.QCC file, /Q=unit is counts, /QU=volts.

First argument specifies SCSI ID of input device or filespec of input file.
Second argument specifies path of output directory. <current dir>

[]=Optional, <>=Default, !=Mutually exclusive.
Switches are not case sensitive and may appear anywhere in the command line.
C:\>
```

If the first argument passed to **REF2SUDS** is a number, **REF2SUDS** assumes it is a SCSI ID, otherwise it assumes it is a filename

4.3 The Operation of REF2SUDS

REF2SUDS uses the contents of several parameter comment fields to perform conversions. It uses the first two characters of the STATION NAME field as the Station Identifier. If the STATION NAME field is blank, **REF2SUDS** manufactures a unique station identifier for each unit ID it encounters in the PASSCAL format file. **REF2SUDS** uses the Station Identifier plus the datastream number as the extension for the **SUDS** format files it creates.

REF2SUDS examines the first character of the Channel Name Field for the channel orientation. Letter V is interpreted to mean vertical, N to mean North, and E to mean East.

Parm Field	SUDS Field	Usage
Station Name	Station Identifier	First two characters must be unique between DAS's. Used as first two characters of extension of filename at SUDS data file
Channel Name	Component Identifier	The first character indicates the direction of positive motion: V or Z or U is Vertical / Up N or Y or L is North / Latitude E or X or T is East / Transverse
Sensor Type	Sensor Identifier	First character indicates the type of motion being recorded: A acceleration D displacement V velocity T time code

The names of the **SUDS** files created by **REF2SUDS** are of the form **hhhhhhhh.IIn** where **h** represents a hexadecimal digit (0-9, A-F). **II** represents the Station Identifier and **n** is the datastream number. The eight digit hexadecimal number is the time tag of the first sample in the file, expressed as the number of seconds since Jan.1, 1980.

REF2SUDS creates several files besides the **SUDS** format data files. Files named **UNITnnnn.log** contain a log of the data for DAS unit ID **nnnn**. The log file is an ASCII file that can be viewed on screen or printed out. Files named **UNITnnnn.tim** are binary files containing time correction information for DAS unit **nnnn**. Files named **UNITnnnn.rec** are binary files containing the portion of the DAS parameters needed by **REF2SUDS**. The file REF2SUDS.ID is only created when **REF2SUDS** must manufacture a station identifier for a DAS. It contains binary information that associates the manufactured Station Identifier with a particular DAS unit ID.



Section 5 RT_SEGY(D)

5.1 General Description

The **REF TEK RT_SEGY(D)** program converts a **REF TEK** PASSCAL raw data file into one of three file formats, all based on the **SEGY** standard. True **SEGY** data files contain a file header followed by one or more traces. Each trace is composed of a trace header followed by the trace data. By default, the **RT_SEGY(D)** program creates a separate output file for each trace and omits the file header. If present, the **RT_SEGY(D)** program uses the RT_EDF.EDF Experiment Deployment File to fill in one of the Geophone Group Number fields in the trace header. If the RT_EDF file is not found, or does not contain information for a particular Unit, this field is set to zero.



Note: RT_SEGYD.EXE is the DOS version. RT_SEGY.EXE is the Win32 version. rt_segy is the Linux/Unix version.

5.2 RT_SEGY(D) program usage

The **RT_SEGY(D)** program is invoked using the following command:

```
C:\data>RT_SEGY(D) [switches] input_file [output_path]
           [switches]
```

The input file is a **REF TEK** PASSCAL raw data file. It can include a fully-qualified path. The output path defaults to the current directory. The table below describes the available switches. The switches are NOT case sensitive and can appear anywhere on the command line.

```
C:\REFTEK>rt_segdy
RT_SEGYD - Version 03.41
Copyright (c) 1988 - 2006 Refraction Technology, Inc. All Rights Reserved

Purpose:
  Reads a file containing PASSCAL data packets and converts
  the data to SEG-Y format.

Usage:
  RT_SEGYD [switches] sourceFile [output_path] [switches]

Switches
```

Switches	Description	Default
-Dc	DT LOG output: Y, +, N or -	<NO>
-Gc	output Gathered file	<N/N>
	R = receiver gather file	
	S = shot gather file	
	N or - = do not gather	
-Hc	output file Header	<N/->
	Y or + = output file header	
	N or - = do not output file header	
-Lc	LOG File output: Y, +, N or -	<NO>
-Pn	output Path levels	<1>
	0 = no additional subdirectories	
	1 = one subdirectory level: IDuuuu	
-Qc	QCC File output: Y, +, N or -	<NO>
-Rn	sample Rate (if not found in the data)	<1000>
-Sn	Sample count per channel per event	<4294967295>
-In	Trash n samples from each event	<0>
-Uc	Verbose message output: Y, +, N or -	<ENABLED>

```
Switches may appear anywhere on the command line.
Arguments and switches are NOT case sensitive.
```

Figure 5 - 1 RT_SEGYD program switches

5.3 Switches

Sw	Cmd	Description	Syntax
-Fn	Format	Output Data Format	n: IEEE 32-bit floating point 32-bit integer (ex: -F0)
-Gc	Gather	Control output of receiver-gather or shot gather files	c: S: output shot-gathers R: output receiver-gathers N/ -:output REF TEK SEG-Y (ex: -GS or -GR; gathered files always contain a file header and the -H switch is ignored)
-Hc	Header	File Header output control	c: Y/+:output file header N/ -:do not output file header (ex: -H+)
-Lc	Log File	Log File Output	c: Y/+:output log file N/ -:do not output log file (ex: -OY)
-Pn	Path	DOS output path control	n: no additional subdirectories one level: IDnnnn (ex: -P0)
		Win32 output path control	n: 0no additional subdirectories 1one level: yyyy_ddd two levels: yyyy_ddd, then hh two levels: yyyy_ddd, then hh_mm two levels: yyyy_ddd, then hh_mm_ss (ex: -P2)
-Qc	Qcc File	Qcc File Output	c: Y/+:output QCC file N/ -:do not output QCC file (ex: -Q+)
-Rn	Sample Rate	Default Sample Rate	n: constant (ex: -S100; only used when actual rate unknown)
-Sn	Sample Count	Limit the number of samples in the output file	n: constant (ex: -C3000)
-Tn	Trash samples	Trash n samples from each event	n: constant (ex: -T100)
-Vc	Verbose	Verbose message output	c: Y/+:output verbose message N/ -:do not verbose messages (ex: -VY)

5.4 REF TEK Experiment Deployment File (EDF) Format

RT_SEGY(D) uses the first RT_EDF.EDF file it finds. It searches for the RT_EDF.EDF file in the following locations:

- The fully-qualified file specified by the RTU environment variable.
- The current working directory.
- The directory where **RT_SEGY(D)** is located.



Note: The RT_EDF program can be used to create RT_EDF.EDF. Refer to RT_EDF.DOC for information on the RT_EDF program and the Experiment Deployment File.

5.5 REF TEK SEG-Y Data Formats

Refer to SEG_Y_FMT.DOC for information on REF TEK SEG-Y data formats.

5.6 RT_SEGY(D) Output Files

All output file specifications adhere to the ISO-9660 level 2 standard. This limits file names to 32 characters with a three-character extension. Only letters, numbers and the underscore character can be used. The file name and file extension are separated by a period. Only one period is permitted. Path components have the same limitations as file names.

The **RT_SEGYD** program is further limited to DOS file names of 8 characters with a three-character extension. Files are stored in a subdirectory named IDnnnn, where nnnn represents the DAS Unit ID. The files are named using the four-digit event number, the stream number and the channel; i.e. 1234_1_1.RSY.

Data	Format		
PASSCAL Raw Data File	Data as collected by a DAS 72-07 or 72-08.	inputfile-name.RT	ID7986.RT
SEG Y Single Trace Data File	Data in SEG Y data format.	eeee_s_c.SGY	1234_1_1.SGY
SEG Y Single Trace Data File (no file header)	Data in REF TEK single-trace SEG Y data format.	eeee_s_c.RSY	1234_1_1.RSY
SEG Y Receiver Gather Data File	Data in REF TEK Receiver-gather SEG Y data format.	IDiiii.RGY	ID7986.RGY
SEG Y Event Gather Data File	Data in REF TEK Event (shot)-gather SEG Y data format.	eeee_s.EGY	1234_1.EGY
Log File	Text log of the conversion process.	IDiiii.LOG	ID7986.LOG



Note: * eeee = event number iiiii = uid (serial no.) s = stream number c = channel number

The **RT_SEGY** program creates output file names using the first sample time of the trace and the Unit ID (serial) number of the **REF TEK** DAS that collected the data. This naming scheme is consistent with other **REF TEK** conversion program.

Data	Format		
PASSCAL RAW Data File	Data as collected by a DAS The input file for RT_SEGY.	inputfilename.RT	1999260115841097_00 36F0E2_7986_1.RT
SEG Y Single Trace Data File	Data in RefTek SEG Y data format.	yyyy_ddd_hh_mm_ss_iiii_s.c.SGY	1999_260_11_58_41_0 7986_1_1.SGY
SEG Y Single Trace Data File (no file header)	Data in RefTek single-trace SEG Y data format.	yyyy_ddd_hh_mm_ss_iiii_s.c.RSY	1999_260_11_58_41_0 7986_1_1.RSY
SEG Y Receiver Gather Data File	Data in RefTek Receiver-gather SEG Y data format.	yyyy_ddd_hh_mm_ss_iiii.RGY	1999_260_11_58_41_0 7986.RGY
SEG Y Event Gather Data File	Data in RefTekEvent (shot)-gather SEG Y data format.	*yyyy_ddd_hh_mm_ss_iiii_i_s.EGY	1999_260_11_58_41_0 7986_1.EGY
Log File	Text log file	inputfilename.LOG	1999260115841097_00 36F0E2_7986_1.LOG



Note: * yyyy = year, ddd = julian day, hh = hour, mm = minute, ss = second, iiii = uid (serial no.), eeee = event no., s = stream, c = channel

5.7 RT_SEGY program switches

The RT_SEGY program switches shown below:

```

RT_SEGY - Version 03.41
Copyright (c) 1988 - 2006 Refraction Technology, Inc. All Rights Reserved

Purpose:
  Reads a file containing PASSCAL data packets and converts
  the data to SEG-Y format.

Usage:
  RT_SEGY [switches] sourceFile [output_path] [switches]

Switches      Description      Default
-----
-Dc    DT LOG output: Y, +, N or -      <NO>
-Gc    output Gathered file             <N/N>
      R = receiver gather file
      S = shot gather file
      N or - = do not gather
-Hc    output file Header               <N/->
      Y or + = output file header
      N or - = do not output file header
-Lc    LOG File output: Y, +, N or -      <NO>
-Pn    output Path levels                <0>
      0 = no additional subdirectories
      1 = one subdirectory level: YYYY_DDD
      2 = two subdirectory levels: YYYY_DDD\HH
      3 = two subdirectory levels: YYYY_DDD\HH_MM
      4 = two subdirectory levels: YYYY_DDD\HH_MM_SS
-Qc    QCC File output: Y, +, N or -      <NO>
-Rn    sample Rate (if not found in the data) <1000>
-Sn    Sample count per channel per event <4294967295>
-Tn    Trash n samples from each event    <0>
-Uc    Verbose message output: Y, +, N or - <ENABLED>

Switches may appear anywhere on the command line.
Arguments and switches are NOT case sensitive.

```

Figure 5 - 2 RT_SEGY switches



Section 6 RT_SEIS(D)

6.1 General Description

The Ref Tek **RT_SEIS(D)** program converts a Ref Tek PASS-CAL raw data file into SEISAN data. SEISAN data (waveform) files contain a file header followed by one or more traces. Each trace is composed of a trace header followed by the trace data. The **RT_SEIS(D)** program searches the **RTU.INI** file for some of the SEISAN header information. If the **RTU.INI** file cannot be found, the **RT_SEIS(D)** program outputs default values in each SEISAN header field.



Note: RT_SEISD.EXE is the DOS version and RT_SEIS.EXE is the Win32 version.

6.2 RT_SEIS windows switches

```

C:\REFTEK>rt_seis
RT_SEIS - Version 03.41
Copyright (c) 1988 - 2006 Refraction Technology, Inc. All Rights Reserved

Purpose:
  Reads a file containing PASSCAL data packets and converts
  the data to SEISAN format.

Usage:
  RT_SEIS [switches] sourceFile [output_path][switches]

Switches          Description          Default
-----
-Dc      DT LOG output: Y, +, N or -    <NO>
-Lc      LOG File output: Y, +, N or -    <NO>
-Pn      output Path levels              <0>
          0 = no additional subdirectories
          1 = one subdirectory level: YYYY_DDD
          2 = two subdirectory levels: YYYY_DDD\HH
          3 = two subdirectory levels: YYYY_DDD\HH_MM
          4 = two subdirectory levels: YYYY_DDD\HH_MM_SS
-Qc      QCC File output: Y, +, N or -    <NO>
-Rn      sample Rate <if not found in the data> <1000>
-Sn      Sample count per channel per event <4294967295>
-Tn      Trash n samples from each event  <0>
-Uc      Verbose message output: Y, +, N or - <ENABLED>

Switches may appear anywhere on the command line.
Arguments and switches are NOT case sensitive.

```

Figure 6 - 1 RT_SEIS switches

6.3 RT_SEIS(D) program usage

The RT_SEIS(D) program is invoked using the following command:

```
C:\data>RT_SEIS(D) [switches] input_file [output_path]
[switches]
```

Where: input_file = Ref Tek PASSCAL raw data file.

It can include a fully-qualified path.

Where: output_path = defaults to the current directory.

```
C:\REFTEK>rt_seisd
RT_SEISD - Version 03.41
Copyright (c) 1988 - 2006 Refraction Technology, Inc. All Rights Reserved

Purpose:
  Reads a file containing PASSCAL data packets and converts
  the data to SEISAN format.

Usage:
  RT_SEISD [switches] sourceFile [output_path][switches]

Switches
```

Switches	Description	Default
-Dc	DT LOG output: Y, +, N or -	<NO>
-Lc	LOG File output: Y, +, N or -	<NO>
-Pn	output Path levels 0 = no additional subdirectories 1 = one subdirectory level: IDuuuu	<1>
-Qc	QCC File output: Y, +, N or -	<NO>
-Rn	sample Rate (if not found in the data)	<1000>
-Sn	Sample count per channel per event	<4294967295>
-Tn	Trash n samples from each event	<0>
-Uc	Verbose message output: Y, +, N or - <ENABLED>	

```
Switches may appear anywhere on the command line.
Arguments and switches are NOT case sensitive.
```

Figure 6 - 2 RT_SEISD switches

6.4 Switches

The table below describes the available switches. The switches are NOT case sensitive and can appear anywhere on the command line.

Sw	Name	Description	Switch command	Default
-Lc	Log File	Log File Output	Y/+ : output file N/ - : do not output file (ex: -LY)	N / -
-Pn	Path	DOS output path control	n: 0 no additional subdirectories 1 one level: IDnnnn (ex: -P0)	1
		Win32 output path control	n: 0 no additional subdirectories 1 one level : yyyy_ddd 2 two levels: yyyy_ddd, then hh 3 two levels: yyyy_ddd, then hh_mm 4 two levels: yyyy_ddd, then hh_mm_ss (ex: -P2)	0
-Qc	Qcc File	Qcc File Output	Y/+ : output file N/ - : not output file (ex: -Q+)	N / -
-Rn	Sample Rate	Default Sample Rate	n : constant (ex: -S100)	100
-Sn	Sample Count	Limit the number of samples in the output file	n : constant (ex: -C3000)	4,294,967,295
-Tn	Trash samples	Trash n samples from each event	n : constant (ex: -T100)	0
-Vc	Verbose	Verbose message output	Y/+ : output message N/ - : not output message (ex: -VY)	N / -

6.5 Ref Tek RTU Initialization (INI) File Format

The **RTU.INI** file is broken into separate sections for each Ref Tek DAS unit. Each section is named using the 4-digit Unit ID (serial) number of the DAS.

Each section is broken into fields. Each field is on a separate line with an equal sign (=) between the field name and the field value. White space is NOT permitted.

Field	Description	Type
Station	Station name; only the first 4 characters are stored in the SEISAN header	ASCII text
Network	Network name	ASCII text
CHnAxis	Channel n Orientation	ASCII character

RT_SEIS(D) uses the first **RTU.INI** file it finds. It searches for the **RTU.INI** file in the following locations:

1. The fully-qualified file specified by the RTU environment variable.
2. The current working directory.
3. The directory where RT_SEIS(D) is located.

If RT_SEIS(D) cannot find the INI file or cannot find the station name for the current unit, it uses the Unit ID (serial) number as the station name in the SEISAN header and uses its default settings for the other header fields.

Example RTU.INI file:

```
[8025]
Station=RT25
Network=REFTEK
CH1Axis=Z
CH2Axis=N
CH3Axis=E
```

6.6 RT_SEIS(D) Output Files

All output file specifications adhere to the ISO-9660 level 2 standard. This limits file names to 32 characters with a three-character extension. Only letters, numbers and the underscore character can be used. The file name and file extension are separated by a period. Only one period is permitted. Path components have the same limitations as file names.

The **RT_SEIS** program is further limited to DOS file names of 8 characters with a three character extension. Files are stored in a subdirectory named IDnnnn, where nnnn represents the DAS Unit ID. The files are named using the four-digit event number, the stream number and the channel; i.e. 1234_1_1.SEI

File Type	File Description	File Name Structure	Example
PASSCAL Raw Data File	Data as collected by a DAS 72-07 or 72-08.	inputfilename.RT	ID7986.RT
SEISAN Data File	Data in RefTek SEISAN data format.	*eeee_s_c.SEI	1234_1_1.SEI
Log File	Text log of the conversion process.	IDiiii.LOG	ID7986.LOG



Note: *yyyy = year, ddd = julian day, hh = hour, mm = minute, ss = second, iiii = uid (serial no.) s = stream number c = channel number

The **RT_SEISW** program creates output file names using the first sample time of the trace and the Unit ID (serial) number of the Ref Tek 72A-series DAS that collected the data. This naming scheme is consistent with other Ref Tek conversion programs.

File Type	File Description	File Name Structure	Example
PASS-CAL RAW Data File	Data as collected by a DAS 72-07 or 72-08. The input file for RT_SEIS.	inputfilename.RT	1999260115841097_0036F0E2_7986_1.RT
SEISAN Data File	Data in RefTek SEIS data format.	*yyyy_ddd_hh_mm_ss_iiii_s_c.SEI	1999_260_11_58_41_07986_1_1.SEI
Log File	Text log file	inputfilename.LOG	1999260115841097_0036F0E2_7986_1.LOG



Note: *yyyy = year, ddd = julian day, hh = hour, mm = minute, ss = second, iiii = uid (serial no.) s = stream number c = channel number

6.7 Ref Tek SEISAN File Format

SEISAN data files contain a 1040 byte file header followed by at least one trace. Each trace contains a 1040 byte trace header followed by the trace data. Data files created by SEISAN under Unix are not identical to data files created by SEISAN on a PC. The format specification is the same, but the file contents are broken into blocks differently on the two platforms and the byte order is different. The current version of SEISAN for either platform can read data files created on either platform.

All versions of **RT_SEIS(D)** create files that are consistent with those created by SEISAN under Unix. In the file header section, the **RT_SEIS(D)** program breaks the 1040 bytes into 12 blocks, each containing 80 bytes of file header information. In each trace section, the **RT_SEIS(D)** program breaks the 1040 byte trace header and the data into several blocks. In addition, each block presents 128-bytes data value for event file channel (trace) information or real data. Moreover, it has one byte value to store the block length before and after each block.

The **RT_SEIS(D)** program generates a SEISAN data file for each trace.

6.7.1 Ref Tek SEISAN Event File Header

Each SEISAN file header contains 1040 bytes of information in 12 blocks of 80 bytes; the first 80-byte (line 1) for brief header information, the second 80-byte (line 2) for free block, the third 80-byte (line 3) for detail header information for each channel (trace), and the rest of 800-byte (line 4 to line 12) with same format as the third 80-byte (line 3).

Byte Offset	Byte Number	Field Name	SEISAN Waveform Standard format	Ref Tek SEISAN Description	Ref Tek SUDSEI Description
0	1	Reserved byte for space	Free	ASCII space	ASCII space
1	2 – 30	Network name	Network Name, could E.G. be Western Norway Network	REFTEK NETWORK (or the network name in RTU.INI file)	Header for REFTEK
30	31 – 33	Number of Stations	Number of Stations, MAX 999	Total number of Channels	Total number of Channels
33	34	Reserved byte for space	Space	ASCII space	ASCII space
34	35 – 36	Time – Year	Year	Year (first sample time)	Year
36	37	Reserved byte for space	Space	ASCII space	ASCII space
37	38 – 40	Time – Julian Day	DOY	Julian Day (first sample time)	Julian Day
40	41	Reserved byte for space	Space	ASCII space	ASCII space
41	42 – 43	Time – Month	Month	Month (first sample time)	Month
43	44	Reserved byte for space	Space	ASCII space	ASCII space
44	45 – 46	Time – Day	Day	Day (first sample time)	Day
46	47	Reserved byte for space	Space	ASCII space	ASCII space
47	48 – 49	Time – Hour	Hour	Hour (first sample time)	Hour
49	50	Reserved byte for space	Space	ASCII space	ASCII space
50	51 – 52	Time – Minute	Minute	Minute (first sample time)	Minute
52	53	Reserved byte for space	Space	ASCII space	ASCII space
53	54 – 59	Time - Second	Second (Format F6.3)	Second + m-second (first sample time)	Second + m-second
59	60	Reserved byte for space	Space	ASCII space	ASCII space
60	61 – 69	Total Time Window	Total Time Window (Secs) (Format F9.3)	(last sample time – first sample time) – (1000/ (sample rate * 0.001))	(last sample time – first sample time) – (1000/ (sample rate * 0.001))
69	70 – 80	Reserved byte for space	Free	ASCII space	ASCII space
0	1 – 80	Reserved byte for space	Free	ASCII spaces	ASCII spaces

Byte Offset	Byte Number	Field Name	SEISAN Waveform Standard format	Ref Tek SEISAN Description	Ref Tek SUDSEI Description
0	1	Reserved byte for space	Free	ASCII space	ASCII space
1	2 – 5	Station Code	Station Code (A4)	Station name (or Unit Number if the RTU.INI file is not exist)	Station Name + Stream number + Channel number
5	6 – 9	Component	Component (A4)	Stream number + Channel number + Component character for different channel. (ex: Z, N, E for channel 1, 2, 3, or 4, 5, 6) (Or the Axis value defined in RTU.INI file)	Character "S" + two spaces + Channel number
9	10	Reserved byte for space	Space	ASCII space	ASCII space
10	11 – 17	Start time	Start Time Relative to Event File Time (Secs) (F7.2)	(channel first sample time) – (event first sample time)	(channel first sample time) – (event first sample time)
17	18	Reserved byte for space	Space	ASCII space	ASCII space
18	19 – 26	Station Interval Length	Station Data Interval Length (Secs) (F8.2)	(Sample counter) / Sample rate	(Sample counter) / Sample rate
26	27 – 52	Second Channel	Second Channel (26 bytes for Channel 2; same format as byte 1 – 26)	Same as byte 1 - 26	Same as byte 1 – 26
52	53 – 78	Third Channel	Third Channel (26 bytes for Channel 3; same format as byte 1 – 26)	Same as byte 1 - 26	Same as byte 1 – 26
78	79 – 80	Reserved byte for space	Blank	ASCII spaces	ASCII spaces

Line 4:

Line 12:

- line 4 – XX has the same format as byte 1-26 in line 3; XX depends on number of channels. However, XX is at least 12 so there might be some blank lines.

6.7.2 Ref Tek SEISAN Trace Header

Each SEISAN trace header contains 1040 bytes of information in two sections; a 160-byte ASCII section and an 880-byte ASCII section which depends on character (byte) 78.

Byte Offset	Byte Number	Field Name	SEISAN Waveform standard format	Ref Tek RT_SEIS(D) Description	SEISAN SUDSEI Desc.
0	1 - 4	Station Code	Station Code (A4)	Station name (or Unit Number if the RTU.INI file is not exist)	Station name + Stream number + Channel number
4	5	Reserved byte for space	Space	ASCII space	ASCII space
5	6 - 9	Component	Component (A4)	Stream number + Channel number + Component character for different channel. (ex: Z, N, E for channel 1, 2, 3, or 4, 5, 6) (Or the Axis value defined in RTU.INI file)	Character "S" + two spaces + Channel number
9	10	Reserved byte for space	Space	ASCII space	ASCII space
10	11 - 12	Time – Year	Year	Year (first sample time)	Year
12	13	Reserved byte for space	Space	ASCII space	ASCII space
13	14 – 16	Time – Julian Day	DOY	Julian Day (first sample time)	Julian Day
16	17	Reserved byte for space	Space	ASCII space	ASCII space
17	18 – 19	Time – Month	Month	Month (first sample time)	Month
19	20	Reserved byte for space	Space	ASCII space	ASCII space
20	21 – 22	Time – Day	Day	Day (first sample time)	Day
22	23	Reserved byte for space	Space	ASCII space	ASCII space
23	24 – 25	Time – Hour	Hour	Hour (first sample time)	Hour
25	26	Reserved byte for space	Space	ASCII space	ASCII space
26	27 – 28	Time – Minute	Minute	Minute (first sample time)	Minute

Byte Offset	Byte Number	Field Name	SEISAN Waveform standard format	Ref Tek RT_SEIS(D) Description	SEISAN SUDSEI Desc.
28	29	Reserved byte for space	Space	ASCII space	ASCII space
29	30 – 35	Time – Second	Second (F6.3)	Second (first sample time)	Second
35	36	Reserved byte for space	Space	ASCII space	ASCII space
36	37 – 43	Sample Rate	Sample Rate (F7.2)	Sample Rate	Sample Rate
43	44	Reserved byte for space	Space	ASCII space	ASCII space
44	45 – 50	Number of Sample	Number of Sample	Sample count	Sample count
50	51	Reserved byte for space	Space	ASCII space	ASCII space
51	52 – 59	Latitude	Latitude (F8.4)	ASCII spaces	ASCII spaces
59	60	Reserved byte for space	Space	ASCII space	ASCII space
60	61 - 69	Longitude	Longitude (F9.4)	ASCII spaces	ASCII spaces
69	70	Reserved byte for space	Space	ASCII space	ASCII space
70	71 – 75	Elevation	Elevation (Meters)	ASCII space	ASCII space
75	76	Reserved byte for space	Free	ASCII space	ASCII space
76	77	Bit Integer	Bit Integer (2 or 4 for 2 or 4 bit integer, blank is 2 bit; 2 = 16-bit, 4 = 32-bit)	4	4
77	78	Response Information	Response Information. (P: Poles and zeros used for response info. See optional structure for details. T: Use the 30 tabulated values irrespective of what is given above.)	ASCII space	ASCII space

Byte Offset	Byte Number	Field Name	SEISAN Waveform standard format	Ref Tek RT_SEIS(D) Description	SEISAN SUDSEI Desc.
78	79	Combina- tion infor- mation	Combination Information. (If C, a combina- tion of table, poles and zeros or instrument constants have been used, for information only. Value in 78 must then be T.)	ASCII space	ASCII space
79	80	Reserved byte for space	Free	ASCII space	ASCII space
80	81 – 160	Com- ments	Comment line describing the system response (A80)	ASCII spaces	ASCII spaces

Ref Tek SEISAN Event File Channel (Trace) Header -- Character 78 - Optional Structure

In the event file channel (trace) header, if character (byte) 78 is blank, then event file channel (trace) header needs to use option 1 structure; if character (byte) 78 is P, then event file channel (trace) header need to use option 2 structure:

Byte Offset	Byte Number	Field Name	SEISAN Waveform standard format	Ref Tek RT_SEIS(D) Description	SEISAN SUDSEI Desc.
160	161 - 240	Response Information column	Seismometer Period Fraction of Critical Damping Seismometer Generator Constant (V/ m/ s) or Accelerometer Sensitivity (V/ G) Amplifier Gain Recording Media Gain (i.e. 2048 Counters/ Volt) Gain at 1.0 Hz, Units: Counts/ Meter Cutoff Frequency for Filter1 (Hz) # of Poles for Filter1 (Negative for High pass) Cutoff Frequency for Filter2 (Hz) # of Poles for Filter2 (Negative for High pass) (10G8.3)	9	9
240	241 - 320	Poles Filter	Frequencies and #'s of Poles for Five More Filter (10G8.3)	ASCII spaces	ASCII spaces
320	321 - 1040	Response Curves	Response Curves FREQ., AMPL. (REL. 1.0 Hz) and Phase, Written in Groups of 10 Frequencies, 10 Amplitudes and 10 Phases. (9(10G8.3))	ASCII spaces	ASCII spaces
Byte Offset	Byte Number	Field Name	SEISAN Waveform standard format	Ref Tek RT_SEIS(D) Description	SEISAN SEIS
160	161 – 182	Number Response	Number of Poles Number of Zeros Normalization Constant, Counts/ M (1X, 2I5, G11.4)	ASCII spaces	ASCII spaces
182	183 – 240	Poles Pairs	2 Poles in pairs of real and imaginary parts (5G11.4)	ASCII spaces	ASCII spaces
240	241 - 1040	Remaining Poles and Zeros	Remaining Poles and Zeros. 7 values are written and then 3 spaces are left blank.	ASCII spaces	ASCII spaces



Section 7 Using RT_COS(D)

7.1 General Description

The **REF TEK RT_COS(D)** program converts a **REF TEK** PASSCAL raw data file into COSMOS data files. The **RT_COS(D)** program uses the **RTU.INI** file for COSMOS header information not available in the recording packets.



Note: **RT_COSD.EXE** is the DOS version, **RT_COS.EXE** is the Win32 version and **rt_cos** is the name of the Solaris and Linux versions.

7.2 RT_COS(D) program usage

The **RT_COS(D)** program is invoked using the following command:

```
C:\data>RT_COS(D) [switches] input_file [switches]
```

The input file is a **REF TEK** PASSCAL raw data file. It can include a fully-qualified path.

The table below describes the available switches. The switches are NOT case sensitive and can appear anywhere on the command line.

7.3 RT_COS(D) Program Switches

Switch	Name	Description	Switch command	Ex:	Default
-Dc	DT log	Output Data packet header lines into log file (ignored if log file is disabled)	c: Y/+ : output DT header lines to logfile N/- : do not output DT header lines	-D-	Y / +
-Gc	Gather	Control output of event-gather files	c: Y/+ : output event-gathered files N/- : output single-trace files	-gn	Y / +
-Lc	Log File	Log File Output	c: Y/+ : output log file N/- : do not output log file	-Ln	Y / +
-Pn	Path	DOS output path control	n: no subdirectories one level: Station ID or Diiii ¹	-P0	1
		Non-DOS output path control	n: 0 - No additional subdirectories 1 - One level: yyyy_ddd ² 2 - Two levels: yyyy_ddd, then hh ³ 3 - Two levels: yyyy_ddd, then hh_mm ⁴ 4 - Two levels: yyyy_ddd, then hh_mm_ss ⁵	-p2	0
-Qc	QCC File	Quality Control Calculation File Output	c: Y/+ : output QCC file N/- : do not output QCC file	-Q+	N / -
-Rn	Sample Rate	Default Sample Rate (only used if rate not known)	n: constant	-R100	200
-Sn	Sample Count	Limit the number of samples in the output file to n	n: constant	-S3000	4,294,967,295
-Tn	Trash samples	Trash n samples from start of each event	n: constant	-T100	0
-Vc	Verbose	Verbose message output	c: Y/+ : verbose messages N/- : minimal messages	-VY	Y / +

1. iiii = uid (serial no.)

2. yyyy = year, ddd = day of year, hh = hour, mm = minute, ss = second

3. yyyy = year, ddd = day of year, hh = hour, mm = minute, ss = second

4. yyyy = year, ddd = day of year, hh = hour, mm = minute, ss = second

5. yyyy = year, ddd = day of year, hh = hour, mm = minute, ss = second

7.4 RT_COS(D) Output Files

All output file specifications adhere to the ISO-9660 level 2 standard. This limits file names to 32 characters with a three-character extension. Only letters, numbers and the underscore character can be used. The file name and file extension are separated by a period. Only one period is permitted. Path components have the same limitations as file names.

The **RT_COSD** program is further limited to DOS file names of 8 characters with a three-character extension. By default, files are stored in a subdirectory named using the 5-character Station ID. If the Station ID is not valid, the subdirectory is named Diili, where iiii represents the DAS Unit ID.

By customer request, the **RT_COS** program creates output file names in the same manner as the DOS version. This naming scheme is different from other Ref Tek conversion programs.

Besides the COSMOS data files, **RT_COS(D)** also creates result files not generated by other Ref Tek conversion programs. When conversion is successful, a file is created with the extension '.OK'. When an error is encountered in the conversion process, a file with the extension '.ERR' is created. These files are non-zero length, but their contents are inconsequential.

7.4.1 RT_COS(D) Files

File Type	Description	File Name Structure	Example
PASSCAL Raw Data File	Data as collected by a RefTek DAS.	inputfilename.RTE	91C6E011.RTE
Master Log File	Text log of the conversion process.	inputfilename.RTL	91C6E011.RTL
Master QCC File	Text file containing quality control calculations; data max, min, std dev (RMS).	inputfilename.QCC	91C6E011.QCC
Successful result file	Text file of non-zero length.	inputfilename.OK	91C6E011.OK
Error result file	Text file of non-zero length.	inputfilename.ERR	91C6E011.ERR
COSMOS Data File	Single trace data in RefTek COSMOS data format.	iiiiEeec.V0 ¹	91C6E112.V0
COSMOS Data File	Combined trace data in RefTek COSMOS data format.	iiiiEeee.V0 ²	91C6E011.V0

1. iiii = uid (serial number), eee = event number modulo 1000, ee = event number modulo 100, c = channel number (1-9, A-I)

2. iiii = uid (serial number), eee = event number modulo 1000, ee = event number modulo 100, c = channel number (1-9, A-I)

7.4.2 Ref Tek RTU Initialization (INI) File

The **RT_COS(D)** program uses the first **RTU.INI** file it finds. It searches for the **RTU.INI** file in the following locations:

- The fully-qualified file specified by the RTU environment variable.
- The current working directory.
- The directory where the **RT_COS(D)** program is located.

Each time the **RT_COS(D)** program encounters a new event in the input file, it initializes all settings to default values. It then opens the **RTU.INI** file, if one can be found, and overwrites only those settings it finds in the **RTU.INI** file. As it continues processing the input file, it overwrites the settings with the information it finds in the recording packets.

The **RTU.INI** file is broken into separate sections for each Ref Tek DAS unit. Each section is named using the 4-hexadecimal digit Unit ID (serial) number of the DAS.

Ex: [8025]

Each section is broken into fields. Each field is on a separate line with an equal sign (=) between the field name and the field.

Ex: Station=STAPP2

All section markers and fields must be at the beginning of a line. Only one section marker or field may be on a line. Comments begin with a semicolon (;). Comments may be on a line by themselves or at the end of a line containing a section marker or field.

Ex: ;This is a comment.

Ex: Station=STAPP2 ;this is another comment

The following table lists the fields used by the **RT_COS(D)** program and how it uses a particular field. In this table, EH refers to values read from the Event Header packet for an event and RH, IH, TH and DH refer to the Real Header, Integer Header, Text Header and Data Header, respectively, of the COSMOS format. These are explained more fully in the section titled **Ref Tek COSMOS File Format**.

7.4.3 RTU.INI Fields

Field	Description	Type	Size/Range	Default	COSMOS
DASType	REF TEK DAS type	Text	See table 9	0	IH-30 TH-7
Altitude	Station Altitude; meters up from sea level	Integer	+/- 6000	0, EH	RH-3
Latitude	Station Latitude; degrees North	Float.4	0 – 90.0	0, EH	RH-1 TH-6
Longitude	Station Longitude; degrees East	Float.4	0 – 180.0	0, EH	RH-2 TH-6
Station	Station Name/Number	Text	5	Unit ID	IH-8 TH-5
Orientation	DAS orientation; degrees clockwise from North, 360 = North	Integer	1 - 360	-	IH-20
StnRecorders	Number of DAS units at a station	Integer	1 - 9	-	IH-22
StnChnCnt	Total number of channels at a station	Integer	1 – 999	EH	IH-23
CosGeology	COSMOS site geology	Text	40	-	TH-6
CosNet	COSMOS Network Abbreviation ¹	Code	4	-	IH-11 IH-12 TH-5
CosStn	COSMOS station type ²	Integer	See table 6	0	IH-19
CHnStnChn	Channel n station channel number	Integer	1 – 999	EH	IH-50
CHnType	Channel n Seismometer Type ³	Character	1	N, EH	IH-2 TH-1 DH-1 DH-(n+2)
CHnAzm	Channel n Azimuth; degrees clockwise from North	Integer	1 – 360, other: see table 11	0	IH-54
CHnRes	Channel n Resolution	Integer	8, 16, 24, or 32	24, EH	IH-36
CHnFSA	Channel n full-scale analog (V)	Float.3	0 – 20.0	1.2, EH	RH-23
CHnSnsMake	Channel n sensor make	Text	-	-	IH-52 TH-7
CHnSnsModel	Channel n sensor model	Text	-	-	IH-52 TH-7
CHnSnsSN	Channel n sensor serial number	Text	-	-	IH-53 TH-7
CHnSnsFreq	Channel n sensor natural Frequency	Float.3	-	-	RH-40
CHnSnsDamp	Channel n sensor damping	Float.3	-	-	RH-41
CHnSnsVPU	Channel n sensor volts per measurement unit	Float.3	-	-, EH	RH-42 RH-44
CHnSnsFSA	Channel n sensor full scale analog (V)	Float.3	-	-, EH	RH-43 RH-44

1. See Table 4, Strong Motion Network Codes of the *COSMOS Strong Motion Data Format v1.20*.

2. See Table 6, Station Type of the *COSMOS Strong Motion Data Format v1.20*.

3. See Appendix A of the *Reference Manual for the Standard for the Exchange of Earthquake Data (SEED) v2.3*.

7.4.4 Example RTU.INI file

```
[9FE3]
;Station settings:
DASType      =130-SM5V
Latitude     =44.0235
Longitude    =160.65
Altitude     =180
CosStn       =4
CosNet       =CDMG
CosGeology   =shallow alluvium over granite

;Channel 1 settings:
CH1Res       =24      ;bits
CH1FSA       =5.0     ;volts
CH1Band      =B
CH1Type      =N
CH1Axis      =Z
CH1Depth     =-1
CH1Azm       =360
CH1Dip       =-60
CH1SnsMake   =Refraction Technology
CH1SnsModel  =131A-02/03/INT
CH1SnsSN     =123A56
CH1SnsFreq   =1000.0
CH1SnsDamp   =0.6
CH1SnsVPU    =1.2
CH1SnsFSA    =5.0

;Channel 2 settings:
CH2Res       =24
CH2FSA       =5.0
CH2Band      =B
CH2Type      =N
CH2Axis      =N
CH2Depth     =0
CH2Azm       =360
CH2Dip       =0
CH2SnsMake   = Refraction Technology
CH2SnsModel  =131A-02/03/INT
CH2SnsSN     =123A56
CH2SnsFreq   =1000.0
CH2SnsDamp   =0.6
CH2SnsVPU    =1.2
CH2SnsFSA    =5.0

;Channel 3 settings:
CH3Res       =24
CH3FSA       =5.0
CH3Band      =B
CH3Type      =N
CH3Axis      =E
CH3Depth     =-5
CH3Azm       =360
CH3Dip       =-90
CH3SnsMake   =Refraction Technology
CH3SnsModel  =131A-02/03/INT
CH3SnsSN     =123A56
CH3SnsFreq   =1000.0
CH3SnsDamp   =0.6
CH3SnsVPU    =1.2
CH3SnsFSA    =5.0
```

7.5 Ref Tek COSMOS File Format (Volume 0)

The **RT_COS(D)** program generates one COSMOS output file per event. COSMOS files contain only ASCII text, broken into lines terminated with a carriage return (CR) and a line feed (LF). Typical line length is 80 characters or less, not counting the line delimiters. The **RT_COS(D)** program enforces an 80 character line length.

Each COSMOS data file contains 1 or more traces. Each trace contains a header section followed by a data section. The header section is broken into four sub-sections; the Text header, the Integer header, the Real header and Comments. The Data section contains a format line, multiple data lines and a termination line. All "empty" or "blank" space is filled with ASCII spaces.

7.5.1 Text Header Description (TH)

The Text header (**TH**) is composed of a minimum of 13 lines. Lines can be added following the 13 defined lines, if desired. The **total** number of lines, **including** the first line, is specified in the first line.

7.5.2 Integer Header Description (IH)

The Integer header (**IH**) is composed of a 'definition' line and a minimum of 100 integer values. The definition line specifies the **number of lines that follow, excluding the definition line** and the format of those lines. The format specifier is typically 10I8, indicating each line contains 10 values of 8 characters each. This dictates a minimum line count of 10, for a total of 11 lines in the Integer header. More integer values than the 100 defined values may be included if desired, but must adhere to the same format and the line count must be adjusted appropriately. Unset, or unspecified values are set to **NANI** (not a number – integer), a value that is defined in Text Header line 13.

7.5.3 Real Header Description (RH)

The Real header (**RH**) is composed of a 'definition' line and a minimum of 100 fixed point (real number) values. The definition line specifies the **number of lines that follow, excluding the definition line** and the format of those lines. The format specifier is typically 6F13.6, indicating each line contains 6 values of 13 characters each, with 6 digits following the decimal point. This dictates a minimum line count of 17, for a total of 18 lines in the Real header. More real values than the 100 defined values may be included if desired, but must adhere to the same format and the line count must be adjusted appropriately. Unset, or unspecified values are set to **NANR** (not a number – real), a value that is defined in Text Header line 13.

7.5.4 Comments Description

The Comments header is composed of a 'definition' line followed by comment lines. The definition line specifies the **number of lines that follow, excluding the definition line**. Each line after the definition line must start with the 'pipe' character (|). If no additional lines are in the file, the definition line must exist and indicate a line count of 0.

7.5.5 Data Description (DH)

The Data section is composed of a 'definition', or header line (**DH-1**), data lines and an 'end of data' line (**DH-(n+2)**). The definition line specifies the **number of data values that follow, not the total number of lines**, and the format of the data. The format specifier follows the same conventions as found in the Integer header and Real header.

7.5.6 Text Header

Line #1:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	25	Data type	Data type string (Table 0)	IH-2 used to select string from Table 0
26	10		" (Format v"	" (Format v"
36	5	Format version	COSMOS format version	"01.20"
41	6		" with "	" with "
47	2	Line count	Text header line count (inclusive)	"13"
49	13		" text lines) "	" text lines) "
62	19	Agency	Reserved for preparing agency	"Src: <i>filename</i> "

Line #2:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	40	Earthquake name	If not assigned, use "Record of" or "Test Record of"	"Record of"
41	40	Earthquake time	Date and time, including time zone	blank

Line #3:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	11		"Hypocenter: "	"Hypocenter: "
12	9	Hypocenter Latitude	Hypocenter Latitude (positive North)	blank
21	1		undefined	blank
22	10	Hypocenter Longitude	Hypocenter Longitude (positive East)	blank
32	3		"H= "	"H= "
35	3	Hypocenter Depth	Hypocenter Depth (km	blank
38	2		"km"	"km"
40	7	Hypocenter Agency	Source agency for Hypocenter information	blank
47	34	Magnitude	Magnitude(s), including source agency	blank

Line #4:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	8		"Origin: "	"Origin: "
9	34	Earthquake time UTC	Earthquake time UTC, with source agency	blank
43	38	Reserved for preparing agency	Reserved for preparing agency	blank

Line #5:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	9		"Statn No: "	"Statn No: "
10	3	Network Number	Network Number (Table 4)	IH-12
13	1		" _ "	" _ "
14	6	Station Number	Station Number	IH-8
20	6		" Code: "	" Code: "
26	2	Network Code	Network Code (IRIS) (Table 4)	IH-12
28	1		" _ "	" _ "
29	6	Station ID	Station alphanumeric	IH-8
35	1		" "	" "
36	5	Network Abbr.	Network abbreviation (Table 4)	IH-12
41	40	Station Name	Station Name	EH: Station Comment

Line #6:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	7		"Coords: "	"Coords: "
8	9	Station Latitude	Station Latitude (positive North)	RH-1 (F9.4)
17	10	Station Longitude	Station Longitude (positive East)	RH-2 (F9.4 and 1 space)
27	14		" Site geology: "	" Site geology: "
41	40	Site Geology	Site Geology	INI: Geology

Line #7:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	10		"Recorder: "	"Recorder: "
11	16	Recorder	Recorder Type (Table 9) and serial number	IH-30 and Unit ID
27	1		"("	"("
28	2	Recorder Channel count	Recorder Channel count	IH-33 (I3)
30	9		" Chns of "	" Chns of "
39	3	Station Channel count	Station Channel count	IH-33 (I3)
42	16		" at Sta) Sensor: "	" at Sta) Sensor: "
58	23	Sensor info	Sensor type (Table 10) and serial number	IH-52 and IH-53

Line #8:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	16		"Rcrd start time: "	"Rcrd start time: "
17	34	Record Start Time	Record Start Time and time quality (worst 0-5 best)	IH-40 through IH-46, RH 30 in the form " <i>mm/dd/yyyy, hh:mm:ss.ttt</i> UTC (Q=n)"
51	8		" RcrdId: "	" RcrdId: "
59	22	Record ID	Record identification, assigned by preparing agency	blank

Line #9:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	8		"Sta Chan"	"Sta Chan"
9	3	Station channel number	Station channel	IH-50 (I3)
12	2		": "	": "
14	3	Channel (sensor) Azimuth	Sensing direction	IH-54 (I3) OR string from Table 11
17	16		" deg (Rcrdr Chan"	" (Rcrdr Chan"
33	3	Recorder channel number	Recorder channel number	IH-51 (I3)
36	11		") Location: "	") Location: "
47	34	Sensor location	Sensor location	blank

Line #10:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	19		"Raw record length ="	"Raw record length ="
20	8	Record length	Length of raw record (seconds)	RH-63 (F8.3)
28	17		" sec, Uncor max ="	" sec, Uncor max ="
45	10	Data Peak Value	Maximum of raw record (signed with units)	RH-64 (I8) followed by "c"
55	5		", at "	", at "
60	8	Data Peak time offset	Time of maximum value (seconds after start)	RH-65 (F8.3)
68	13		" sec."	" sec."

Line #11:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	10		"Processed: "	"Processed: "
11	30	Processing info	Processing time, date, agency	blank
41	7		" Max = "	" Max = "
48	33	Data Maximum Value	Maximum of data series in file, unit and time of maximum (seconds after start)	blank

Line #12:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	21		"Record filtered below"	"Record not filtered "
22	6	Lo Filter band Hz	Low frequency filter band used in processing (3dB corner frequency) in Hz	blank
28	17		" Hz (periods over"	" Hz (periods over"
45	6	Lo Filter band Period	Low frequency filter band used in processing (3dB corner frequency) period in seconds	blank
51	17		" secs), and above"	" secs), and above"
68	5	Hi Filter band Hz	High frequency filter band used in processing (3dB corner frequency) in Hz	blank
73	8		" Hz"	" Hz"

Line #13:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	64		"Values used when parameter or data value is unknown/unspecified: "	"Values used when parameter or data value is unknown/unspecified: "
65	7	Integer NAN	Integer value used to indicate unknown or unspecified value (NANI)	-9999
72	1		" , "	" , "
73	8	Real NAN	Float value used to indicate unknown or unspecified value (NANR)	-99999.0

7.6 Integer Header

Line #1:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	4	Value count	" 100"	" 100"
5	33		" Integer-header values follow on "	" Integer-header values follow on "
38	3	Line count	Line count	" 20"
41	16		" lines, Format= "	" lines, Format= "
57	24	Format	Line format	"(5116)"

Line #2 - #N:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	16	Value 1	See table below	See table below
17	16	Value 2	See table below	See table below
33	16	Value 3	See table below	See table below
49	16	Value 4	See table below	See table below
65	16	Value 5	See table below	See table below

7.7 Real Header

Line #1:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	4	Value count	" 100"	" 100"
5	30		" Real-header values follow on "	" Real-header values follow on "
35	3	Line count	Line count	" 20"
38	16		" lines, Format= "	" lines, Format= "
54	27	Format	Line format	"(5F16.5)"

Line #2 - #N:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	16	Value 1	See table below	See table below
17	16	Value 2	See table below	See table below
33	16	Value 3	See table below	See table below
49	16	Value 4	See table below	See table below
65	16	Value 5	See table below	See table below

7.8 Comments

Line #1:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	4	Line count	Count of comment lines	" 1"
5	76		" Comment line(s) follow, each starting with a " ": "	" Comment line(s) follow, each starting with a " ": "

Line #2:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	1	Marker	Comment Marker	" "
2	17		Comment	"File produced by "
19	10	Program Name	Comment	<Program name> (A10)
29	2		Comment	" v"
31	50	Program Version	Comment	<Program version> (A50)

7.9 Data

Line #1:

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	8	Data count	Number of data points following	Number of data values in record
9	1		" "	" "
10	12	Physical parameter	Physical parameter of data (Table 1)	IH-2 (A12)
22	13		" pts, approx "	" pts, approx "
35	4	Record Length	Record length rounded to seconds	RH-63 (I4)
39	13		" secs, units="	" secs, units="
52	7	Data units	Units of the data values (Table 2)	IH-3 (A7)
59	1		" ("	" ("
60	2	Units Index code	Index code for units (Table 2)	IH-3 (I2)
62	9		"),Format="	"),Format="
71	10	Data format	Data format	"(8I10)"

Line #2 – #(N+1):

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	10	Value 1	Data	Data
11	10	Value 2	Data	Data
21	10	Value 3	Data	Data
31	10	Value 4	Data	Data
41	10	Value 5	Data	Data
51	10	Value 6	Data	Data
61	10	Value 7	Data	Data
71	10	Value 8	Data	Data

Line # (N+2):

Byte	Field Width	Field Name	Standard COSMOS Description	Ref Tek COSMOS Description
1	15	EOD	End of data string containing "End-of-data for"	"End-of-data for"
16	5		" Chan"	" Chan"
21	3	Station Channel Number	Station Channel Number and physical parameter of data	IH-51
25	1		" "	" "
25	12	Physical parameter	Physical parameter of data (Table 1)	IH-2
37	44		Undefined (optional checksum)	blank

7.10 Numeric Header Information

- The 'I' column contains the Integer header (IH) parameter number.
- The 'R' column contains the Real number header (RH) parameter number.
- The 'V' column contains the COSMOS volume number in which the parameter first appears.
- NANI and NANR are defined in Text Header line 13.

I	R	V	Description	Ref Tek Reference
1		0	Processing stage index (0, 1, 2, 3 = v0 – v3)	0
2		0	Physical parameter of data (Table 0, 1)	EH: Channel code or INI: CHnType (SEED Instrument Type)
3		0	Units of data (Table 2; 50 = counts)	50
4		0	COSMOS format version (major.minor * 100)	120
5		0	Type of record (Table 3)	EH: Trigger Type + EH: Function Test Flag
6		-	-	NANI
7		-	-	NANI
8		0	Station number	EH: Station Name
9		0	Secondary station number	NANI
10		-	-	NANI
11		0	Network: Operator (Table 4)	INI: NetCos
12		0	Network: Owner (Table 4)	INI: NetCos
13		0	Network: Secondary responsibility (Table 4)	NANI
14		1	Network: Processor (Table 4)	NANI
15		-	-	NANI
	1	0	Station Latitude (decimal degrees, North positive)	EH: Position (Lat) or INI: Latitude
	2	0	Station Longitude (decimal degrees, East positive)	EH: Position (Lon) or INI: Longitude
	3	0	Station Elevation (meters above sea level)	EH: Position (Alt) or INI: Altitude
16		0	Reference Datum (Table 5; 1 = WGS84)	1
17		-	-	NANI
	4	0	Site geology parameter V30 (km/s)	NANR
18		0	Site geology code	NANI
19		0	Station type (Table 6)	INI: CosStn
20		0	Instrument orientation – freefield (1-360 degrees CW from N)	INI: Orientation
21		0	Instrument orientation – structure (1-360 degrees CW from N)	NANI
22		0	Number of recorders at station	INI: StnRecorders
23		0	Total number of channels at station	INI: StnChnCnt
24		-	-	NANI
	5	-	-	NANR
	6	-	-	NANR
	7	-	-	NANR

I	R	V	Description	Ref Tek Reference
	8	-	-	NANR
	9	-	-	NANR
	10	0	Earthquake Latitude (decimal degrees, North positive)	NANR
	11	0	Earthquake Latitude (decimal degrees, East positive)	NANR
	12	0	Earthquake Elevation (meters above sea level)	NANR
25		?	Reference for earthquake location & depth (Table 7)	NANI
	13	0	Earthquake moment magnitude (M)	NANR
	14	0	Earthquake surface wave magnitude (MS)	NANR
	15	0	Earthquake local magnitude (ML)	NANR
26		?	Reference for earthquake moment magnitude (Table 7)	NANI
27		?	Reference for earthquake surface wave magnitude (Table 7)	NANI
28		?	Reference for earthquake local magnitude (Table 7)	NANI
	16	0	Earthquake other magnitude (see comments if used)	NANR
	17	0	Earthquake epicenter distance to station (km)	NANR
	18	0	Earthquake Epicenter-to-station azimuth (degrees CW from North)	NANR
	19	-	-	NANR
	20	-	-	NANR
	21	-	-	NANR
29		-	-	NANI
30		0	Recorder type (Table 9)	Unit ID + INI:DASType
31		0	Recording media (1, 2, 3 = film, tape, solid state)	3
32		0	Recorder Serial Number	NANI (found in TH-7)
33		0	Number of channels in recorder	EH: total channels
34		0	Number of channels recorded	EH: included channels
	22	0	Recorder least significant bit (LSB) in micro-volts (uV)	EH: true bit-weight
	23	0	Recorder full-scale input (volts)	EH: ChnFSA or INI:CHnFSA
35		0	Sample word length as originally recorded (bits)	DT: Data format (C0 = 32)
36		0	Effective bits	EH: Chn A/D Res or INI:CHnRes
	24	0	Pre-trigger recording time (seconds)	EH: trigger time – 1 st sample time
	25	0	Post-trigger recording time (seconds)	ET: last sample time – dettrigger time
	26	0	Anti-alias filter corner frequency (Hz)	0.41 * sample rate
	27	0	Anti-alias filter decay (dB/octave)	600
	28	0	Film record digitizer y-step (accel.)	NANR
	29	-	-	NANR
37		-	-	NANI
38		0	Trigger number	EH: Event number
39		0	Shock number	1
40		0	Record start time - year	EH: 1 st sample time
41		0	Record start time – day of year (DOY)	EH: 1 st sample time
42		0	Record start time - month	EH: 1 st sample time
43		0	Record start time – day of month (DOM)	EH: 1 st sample time
44		0	Record start time - hour	EH: 1 st sample time

I	R	V	Description	Ref Tek Reference
45		0	Record start time - minute	EH: 1 st sample time
	30	0	Record start time - second	EH: 1 st sample time
46		0	Time quality (1 – 5 = poorest to best: 0 = never locked, 1 – 5 = 5 minus days since last lock)	EH: TimeQuality: ? = 0, else days since last lock
47		0	Time source (Table 8; 1 = recorder, 5 = GPS)	1 (IH-46 = 0) or 5 (IH-46 > 0)
	31	0	Correction applied to recorder time (seconds)	0.0
	32	0	Offset of local time zone to UTC	NANR
	33	-	-	NANR
	34	0	Sample interval (period) in original V0 record (seconds)	EH: 1.0 / sample rate
	35	0	Length of raw (V0) record (seconds)	Calculated
	36	1	Mean value removed to make V1 time series be zero-mean	NANR
	37	-	-	NANR
	38	-	-	NANR
	39	-	-	NANR
48		-	-	NANI
49		-	-	NANI
50		0	Station channel number	EH: ChnStnChn or INI: CHnStnChn
51		0	Recorder channel number	DT: channel number
52		0	Sensor type (Table 10; -1 if no sensor attached)	INI: CHnSnsMake + ChnSnsModel
53		0	Sensor serial number (if numeric)	INI: CHnSnsSN
	40	0	Sensor natural frequency (Hz)	INI: CHnSnsFreq
	41	0	Sensor damping (fraction of critical)	INI: CHnSnsDamp
	42	0	Sensor sensitivity (volts per unit of motion)	EH: ChnSnsVPU or INI: CHnSnsVPU
	43	0	Sensor full scale output (volts)	EH: ChnSnsFSA or INI: CHnSnsFSA
	44	0	Sensor full scale sensing capacity (motion units)	RH43/RH42
	45	0	Sensor low-frequency corner (Hz)	NANR
	46	0	Sensor low-frequency decay (dB/octave)	NANR
	47	0	Gain applied to sensor output prior to recording	1
	48	-	-	NANR
	49	-	-	NANR
54		0	Sensor azimuth to True North (1-360, other) (Table 11)	INI: CHnSnsAzm
55		0	Sensor azimuth to Reference Orientation (1-360)	NANI
56		0	Location index of sensor site at station	NANI
	50	0	Sensor site north offset from station location reference (m)	NANR
	51	0	Sensor site east offset from station location reference (m)	NANR
	52	0	Sensor vertical offset (m)	NANR
	53	-	-	NANR
57		-	-	NANI
58		-	-	NANI
59		-	-	NANI
60		1	Processing stage (1 – 3 = preliminary, intermediate, final)	NANI

I	R	V	Description	Ref Tek Reference
61		2	Low-frequency filter used in V2 processing (Table 12)	NANI
	54	2	Low-frequency filter corner frequency (Hz)	NANR
	55	2	Low-frequency filter decay (dB/octave)	NANR
	56	2	Low-frequency filter roll-off width (Hz)	NANR
62		2	High-frequency filter used in V2 processing (Table 12)	NANI
	57	2	High-frequency filter corner frequency (Hz)	NANR
	58	2	High-frequency filter decay (dB/octave)	NANR
	59	2	High-frequency filter roll-off width (Hz)	NANR
63		-	-	NANI
64		2	Filter domain flag (1, 2 = time domain, frequency domain)	NANI
	60	2	Length of time-domain filter operator (seconds)	NANR
65		2	Special processing flag (0, 1 = normal, special as described in comments)	NANI
	61	-	-	NANR
	62	0	Time series sample interval (period) (milliseconds)	EH: 1000/sample rate
	63	0	Time series length (seconds)	calculate
	64	0	Time series maximum value	calculate
	65	0	Time series maximum value time (offset from start; seconds)	calculate
	66	?	Time series average value	NANR
	67	-	-	NANR
	68	2	Initial velocity (cm/sec)	NANR
	69	2	Initial displacement (cm)	NANR
66		-	-	NANI
67		-	-	NANI
68		-	-	NANI
69		-	-	NANI
70		3	Number of periods for which response spectra is computed	NANI
71		3	Number of damping values for which response spectra are computed	NANI
	70	3	Sa spectrum (5% damping) value at 0.2 seconds (g)	NANR
	71	3	Sa spectrum (5% damping) value at 0.2 seconds (g)	NANR
	72	3	Sa spectrum (5% damping) value at 0.2 seconds (g)	NANR
	73	3	Sa spectrum (5% damping) value at 0.2 seconds (g)	NANR
	74	3	Sa spectrum (5% damping) maximum value (g)	NANR
	75	3	Sa spectrum (5% damping) period at maximum value (secs)	NANR
	76	3	Sa spectrum (5% damping) offset time of maximum value (secs)	NANR
	77	-	-	NANR
	78	-	-	NANR
	79	-	-	NANR
	80	2	Duration, bracketed (seconds over 5% g)	NANR
	81	2	Duration, interval (seconds between 5% - 75% g)	NANR
	82	2	RMS of channel	NANR
	83	2	Cumulative absolute velocity (m/s)	NANR
	84	2	Housner Intensity (SI)	NANR
	85	2	Arias Intensity	NANR

I	R	V	Description	Ref Tek Reference
	86	-	-	NANR
	87	-	-	NANR
	88	2	Xcaling factor used to conver V1 units (g) to cm/s ²	NANR
	89	-	-	NANR
72		-	-	NANI
73		-	-	NANI
74		-	-	NANI
75		1	Nominal-constants indicator (1 if used in processing)	NANI
76		0	Record problem indicator (0, 1, 2 = none, fixed, unfixed)	0 = okay, 2 if incomplete file or decompression error
77		?	Instance code/processing index number	NANI
78		-	-	NANI
79		-	-	NANI
80		-	Parameters assigned and used by individual networks	NANI
81		-	Parameters assigned and used by individual networks	NANI
82		-	Parameters assigned and used by individual networks	NANI
83		-	Parameters assigned and used by individual networks	NANI
84		-	Parameters assigned and used by individual networks	NANI
85		-	Parameters assigned and used by individual networks	NANI
86		-	Parameters assigned and used by individual networks	NANI
87		-	Parameters assigned and used by individual networks	NANI
88		-	Parameters assigned and used by individual networks	NANI
89		-	Parameters assigned and used by individual networks	NANI
90		-	Parameters assigned and used by individual networks	NANI
91		-	Parameters assigned and used by individual networks	NANI
92		-	Parameters assigned and used by individual networks	NANI
93		-	Parameters assigned and used by individual networks	NANI
94		-	Parameters assigned and used by individual networks	NANI
95		-	Parameters assigned and used by individual networks	NANI
96		-	Parameters assigned and used by individual networks	NANI
97		-	Parameters assigned and used by individual networks	NANI
98		-	Parameters assigned and used by individual networks	NANI
99		-	Parameters assigned and used by individual networks	NANI
100		-	Parameters assigned and used by individual networks	NANI
	90	-	Parameters assigned and used by individual networks	NANR
	91	-	Parameters assigned and used by individual networks	NANR
	92	-	Parameters assigned and used by individual networks	NANR
	93	-	Parameters assigned and used by individual networks	NANR
	94	-	Parameters assigned and used by individual networks	NANR
	95	-	Parameters assigned and used by individual networks	NANR
	96	-	Parameters assigned and used by individual networks	NANR
	97	-	Parameters assigned and used by individual networks	NANR
	98	-	Parameters assigned and used by individual networks	NANR
	99	-	Parameters assigned and used by individual networks	NANR
	100	-	Parameters assigned and used by individual networks	NANR

7.11 Tables

7.11.1 Table 0 - Data Type Strings

(Not a COSMOS-defined table – listing from explanation of COSMOS text header line 1, bytes 1-25. The first 4 entries were arranged to correspond to the first 4 entries of Table 1. Only the first 4 entries are used.)

Code	String (25 chars)	EH:SnsUnits	INI:ChnType
00	Raw digital counts (not defined by COSMOS spec)	<SP>	<SP>
01	Raw acceleration counts	A	N, G
02	Raw velocity counts (not defined by COSMOS spec)	V	-
03	Raw displacement counts (not defined by COSMOS spec)	D	else
	Velocity data	-	-
	Corrected acceleration	-	-
	Uncorrected acceleration	-	-
	Response spectra	-	-
	Displacement data	-	-
	Rel. Displacement data	-	-
	Pore pressure data	-	-

7.11.2 Table 1 - Data Physical Parameter Codes

Code	Meaning
00	Raw digital (not defined by COSMOS spec)
01	Acceleration
02	Velocity
03	Displacement (absolute)
04	Displacement (relative)
10	Angular acceleration
11	Angular velocity
12	Angular displacement
20	Pressure (absolute)
21	Pressure (relative)
30	Volumetric strain
31	Linear strain

7.11.3 Table 2 - Data Units Codes

Code	Meaning
01	seconds
02	g
03	seconds & g
04	cm/sec/sec
05	cm/sec
06	centimeters (cm)
07	inches/sec/sec
08	inches/sec
09	inches
10	gallons
11	milligravities (mg)
12	microgravities (ug)
23	degrees/sec/sec
24	degrees/sec
25	degrees
50	counts
51	volts
52	millivolts (mv)
60	pounds per square inch (psi)
80	microstrains (ustrain)

7.11.4 Table 3 - Record Types

Code	Meaning	Ref Tek equivalent
1	Seismic trigger	Event, Level or Vote trigger
2	Remote trigger	External trigger
3	Preset trigger	Continuous, Time or Time List trigger
4	Manual trigger	Command trigger
5	Function test	Sensor test caused Seismic trigger
10	Sensor calibration	
11	Amplifier calibration	
12	Recorder calibration	Calibration trigger
13	Other calibration	

7.11.5 Table 4 - Strong Motion Network Codes

Code	Agency	Abbr.	FDSN
1	U.S Coast and Geodetic Survey	C&GS	--
2	U.S. Geological Survey	USGS	NP
3	U.S. Bureau of Reclamation	USBR	RE
4	U.S. Army Corps of Engineers	ACOE	--
5	California Division of Mines and Geology	CDMG	CE
6	California Institute of Technology	CIT	CI
7	UC Berkeley	UCB	BK
100	Taiwan Central Weather Bureau	CWB	TW

7.11.6 Table 5 - Position Datum Codes

Code	Meaning
1	WGS84
2	NAD83
3	NAD27
4	WGS72

7.11.7 Table 6 - Station Type

Code	Meaning
1	Small, fiberglass shelter
2	Small prefab metal building
3	Sensors buried/set in ground
4	Reference station
5	Base of building larger than above
10	Building
11	Bridge
12	Dam
20	Other structure
50	Geotechnical array
51	Other array

7.11.8 Table 7 - Earthquake Parameter Information Sources

Code	Meaning
1	USGS
2	NEIC, Golden, Colorado
3	UC Berkeley
4	Caltech, Pasadena
5	NCSN, Northern California
6	SCSN, Southern California
7	UCSD, San Diego, California
8	UNR, Reno, Nevada
9	USCGS
100	Taiwan Weather Bureau
200	Other

7.11.9 Table 8 - Recorder Timing Type

Code	Meaning
0	None
1	Recorder clock
2	Auxiliary clock (e.g., TCG)
3	Radio time signal (e.g., WWVB, WWVH)
4	Clock that tracks radio signals (e.g., WWVB)
5	GPS
20	Other

7.11.10 Table 9 - Recorder/Datalogger Codes

Code	Meaning	String for Line 7 (11 chars)
1	C&GS Standard, USC&GS	
2	Teledyne AR-240	
3	Teledyne RFT-250	
4	Teledyne RFT-350	
5	MO-2 (New Zealand)	
6	RMT-280	
7	Kinematics SMA-1	
8	Kinematics SMA-2	
9	Kinematics SMA-3	
10	Kinematics CRA-1	
100	Kinematics DSA-1	
101	Kinematics DSA-3	
102	Kinematics PDR-1	
103	Kinematics PDR-2	
104	Kinematics SSA-1	
105	Kinematics SSA-2	
106	Kinematics SSA-16	
107	Kinematics SSR-1	
108	Kinematics K2	
109	Kinematics Etna	
110	Kinematics Mt Whitney	
111	Kinematics Everest	
200	Sprengnether DR-100	
201	Sprengnether DR-200	
202	Sprengnether DR-300, DR3016	
203	Sprengnether DR-3024	
300	Terratech DCA-300	
301	Terratech DCA-310	
302	Terratech DCA-333	
310	Terratech IDS-3602	
311	Terratech IDS-3602A	
400	Geotech A700	
401	Geotech A800	
402	Geotech A900	
403	Geotech A900A	
500	USGS GEOS	
600	Quanterra Q4120	
601	Quanterra Q4128a	
602	Quanterra Q730	
603	Quanterra Q736	
604	Quanterra Q980	
700	Ref Tek 72(A) (SN < 0x9000)	RT 072
701	Ref Tek 130-01	RT 130-01
702	Ref Tek 130-SM	RT 130-SM
703	Ref Tek 130-SMA (18-bit)	RT 130-SMA
704	Ref Tek 130-ANSS	RT 130-ANSS
705	Ref Tek 130-SM5V	RT 130-SM5V
706	Ref Tek 130-MC	RT 130-MC
1000	Other	

7.11.11 Table 10 - Sensor Codes

Code	Meaning	String for Line 7 (14 chars)
1	Optical-mechanical (SMA, RFT, etc)	Optical-Mechan
2	Kinemetrics FBA-1	FBA-1
3	Kinemetrics FBA-3	FBA-3
4	Kinemetrics FBA-11	FBA-11
5	Kinemetrics FBA-13	FBA-13
6	Kinemetrics FBA-13DH	FBA-13DH
7	Kinemetrics FBA-23	FBA-23
8	Kinemetrics FBA-23DH	FBA-23DH
20	Kinemetrics Episensor	ES
21	Kinemetrics Episensor ES-U	ES-U
50	Sprengnether FBX-23	FBX-23
51	Sprengnether FBX-26	FBX-26
100	Terratech SSA 120	SSA 120
101	Terratech SSA 220	SSA 220
102	Terratech SSA 320	SSA 320
150	Wilcoxon 731A	731A
200	Guralp CMG-5	CMG-5
250	Ref Tek 131A-02/1	131A-02/1
251	Ref Tek 131A-02/3	131A-02/3
252	Ref Tek 131A-02/BH	131A-02/BH
253	Ref Tek 131B-01/1	131B-01/1
254	Ref Tek 131B-01/3	131B-01/3
255	Ref Tek 131A-02/3/INT	131A-02/3/INT
256	Ref Tek 131-8019	131-8019
900	Other accelerometer	Unknown Accel.
1001	Kinemetrics SS-1 Ranger	SS-1
1050	Sprengnether S-3000	S-3000
1201	Guralp CMG-1	CMG-1
1202	Guralp CMG-3T	CMG-3T
1203	Guralp CMG-3ESP	CMG-3ESP
1204	Guralp CMG-40	CMG-40
1250	Strecheisen STS-1	STS-1
1251	Strecheisen STS-2	STS-2
1300	Mark Products L4	L4
1301	Mark Products L22D	L22D
1900	Other seismometer	Unknown Seism.
3000	Pressure sensor	Pressure Snsr.
3500	Dilatometer sensor	Dilatometer
4000	Relative displacement sensor	Rel. displcmnt
4500	Rotational sensor	Rotatnl. Snsr.
9000	Other sensor	Unknown Sensor

7.11.12 Table 11 Sensor Direction (Azimuth) Codes

Code	Meaning	String for Line 9 (3 chars)
0	Undefined	???
1-360	Horizontal azimuth, clockwise from North	(value)
400	Up	Up
401	Down	Dow
402	Vertical (sense not indicated)	Ver
500	Radial, inward (-500 for outward)	Rad
501	Transverse, 90 degrees CW from radial component (-501 for CCW)	Tra
600	Longitudinal (relative to structure)	Lon
601	Tangential (relative to structure)	Tan
700	H1 (horizontal sensor, azimuth unknown)	H1
701	H2 (horizontal sensor, azimuth unknown)	H2
1001-1360	Horizontal azimuth relative to Channel 1, if absolute not known	Rel
2000	Other (described in comments)	Oth

7.11.13 Table 12 - Filter Types used in Processing

Code	Meaning
0	None
1	Rectangular
2	Cosine bell
3	Ormsby
4	Butterworth, single direction (causal)
5	Butterworth, bi-direction (noncausal)
6	Bessel

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Section 8 RT_MSEED

8.1 General Description

The **REF TEK RT_MSEED** program converts a Ref Tek PASSCAL raw data file into Mini-SEED (MSEED) data files. By default it creates a separate MSEED file for each trace.

8.2 RT_MSEED program usage

The RT_MSEED program is invoked using the following command:

```
C:\data>RT_MSEED(D) [switches] input_file [output_path] [switches]
```

where: input file = Ref Tek PASSCAL raw data file.

It can include a fully-qualified path.

where: output_path = defaults to the current directory.

```
C:\REFTEK>rt_mseed
Invalid Reftek File name
RT_MSEED - Version 01.01B
Copyright (c) 2005 - 2005 Refraction Technology, Inc. All Rights Reserved

Purpose:
  Reads a file containing PASSCAL data packets and converts
  the data to MSEED format.

Usage:
RT_MSEED [switches] sourceFile [output_path][switches]

Switches      Description      Default
-----
-Gc           output Gathered file      <->
              + = gather files
              - = do not gather files
-Bn           output mseed block size <256,512,1024,4096>      <4096>
-Cn           output Steim compression level <1,2>      <2>
-Ppath       Path for output      <CURRENT>
-Rn          Sample Rate used if EH,ET are absent      <1000>

[] = Optional      <> = default
Switches may appear anywhere on the command line
```

Figure 8 - 1 RT_MSEED swicthes

8.3 RT_MSEED Program Switches

The table below describes the available switches. The switches are NOT case sensitive and can appear anywhere on the command line.

Switch	Name	Description	Switch command	Ex:	Default
-Gc	Gather	Output Gathered file	c: Y/+ : gather files N/ - : do not gather files	-D+	N / -
-Bn	Block	Control MSEED block size	n: (256,512,1024,4096)	-Bn	4096
-Cn	Compression	Control Steim compression level	n: 1 : Steim 1 2 : Steim 2	-C1	2
-Ppath	Path	Output Path	path:	-PC:\REFTEK	current
-Rn	Sample Rate	Sample Rate used if EH, ET are absent	n: constant	-R1000	1000

8.4 MSEED Data Format

Complies with the MSEED format document published by the IRIS Consortium.

8.5 RT_MSEED Output Files

All output file specifications adhere to the ISO-9660 level 2 standard. This limits file names to 32 characters with a three-character extension. Only letters, numbers and the underscore character can be used. The file name and file extension are separated by a period. Only one period is permitted. Path components have the same limitations as file names.

The Output extension is *.msd.

Data	Format		
PASSCAL Raw Data File	Data as collected by a DAS	inputfilename.RT	ID7986.RT
MSEED Single Trace Data File	Data in MSEED data format.	yyyyddd_hhmmss _iiii_s_c.msd yyyy: Year ddd: Julian date (day) hh: Hour mm: Minute ss: Second iii: Unit number s: Stream c: Channel	2001222_1209 42_07963_1_1 .msd

Example output file(s)

2001222_120942_07963_1_1.msd

2001222_120944_07963_1_3.msd

2001222_120957_07963_1_2.msd



Section 9 RT_CM6

9.1 General Description

The **REF TEK RT_CM6** (Windows Only) program converts a **REF TEK** PASSCAL raw data file into raw GSED 2.1 CM6 compressed data files. The **RT_CM6** program uses the **RTU.INI** file for GSE2.1 header information not available in the recording packets.

9.2 RT_CM6 program usage

The **RT_CM6** program is invoked using the following command:

```
C:\data> rt_cm6 [input file] [rtu.ini] <output path>
```

[input file] - filename with raw reftek data packets

[rtu.ini] - filename with WID2 & STA2 parameters

<output path> - (optional) Path for output, ending with \

9.3 REF TEK RTU Initialization (INI) File

The **RT_CM6** program uses the **RTU.INI** given in command prompt.

Also **RTU.INI** contains the [defaults] section which can be used to configure common fields specific for all DAS units at the same time

The **RTU.INI** file is broken into separate sections for each **REF TEK** DAS unit. Each section is named using the 4-hexadecimal digit Unit ID (serial) number of the DAS.

Ex: [8025]

Each section is broken into fields. Each field is on a separate line with an equal sign (=) between the field name and the field.

Ex: Station=PET01

All section markers and fields must be at the beginning of a line. Only one section marker or field may be on a line. Comments begin with a semicolon (#). Comments may be on a line by themselves or at the end of a line containing a section marker or field.

Ex: #This is a comment.

Ex: Station=PET #this is another comment

The **RTU.INI fields** table lists the fields used by the **RT_CM6** program and how it uses a particular field. In this table, EH refers to values read from the Event Header packet for an event. WID2 and STA2 refer to GSE 2.1 headers requested by the CTBTO customer. Where:

9.3.1 STA2 header has the following structure:

Position	Name	Format	Description
1-4	"STA2"	A4	Must be "STA2"
6-14	Network	A9	Network ID
16-34	Latitude	F9.5	Latitude in degrees, south is negative
36-45	Longitude	F10.5	Longitude in degrees, west is negative
47-58	Coordinate System	A12	Reference coordinate system (e.g., WGS-84)
60-64	Elevation	F5.3	Elevation (km)
66-70	Edepth	F5.3	Emplacement depth (km)

9.3.2 WID2-header:

Position	Name	Format	Description
1-4	"WID4"	A4	Must be "WID4"
6-15	Date	I4,A1,I2,A1,I2	Date of first sample: yyyy/mm/dd
17-28	Time	I2,A1,I2,A1,F6.3	Time of first sample: hh:mm:ss.sss
30-34	Station	A5	Station code
36-38	Channel	A3	FDSN channel code
40-43	AuxID	A4	Auxiliary identification code
45-47	Sub_format	A3	INT, CMn or AUx INT - free format integers as ASCII characters CM - compressed data with n either 6 (6-bit compression) or 8 (8-bit binary compression) AU - signifies authentication with x either T (uncompressed binary integers), 6 (6-bit compression) or 8 (8-bit binary compression)
49-56	Samps	I8	Number of samples
58-68	Samprate	F11.6	Data sampling rate (Hz)
70-79	Calib	E10.2	Calibration factor: i.e., the ground motion in nanometers per digital count at calibration period (calper)
81-87	Calper	F7.3	Calibration reference period; i.e., the period in seconds at which calib is valid; calper should be near the flat part of the response curve (in most cases, 1 sec)
89-94	Insstype		Instrument type (Table 8)
96-100	Hang		Horizontal orientation of the sensor measured in positive degrees clockwise from North (-1.0 if vertical)
102-105	Vang		Vertical orientation of the sensor measured in degrees from vertical (90.0 if horizontal)

9.3.3 RTU.INI Fields

Field	Description	Type	Size/ Range	Default priority	CM6
Station	Station Name/Number	Text	5	RTU.INI Unit ID	WID2
Network	Network identifier	Text	9	RTU.INI	STA2
Latitude	Latitude (degrees, S is negative) Coordinate system (WGS-84)	Float		RTU.INI EH	STA2
Longitude	Longitude (degrees, W is negative) Coordinate system (WGS-84)	Float		RTU.INI EH	STA2
Altitude	Elevation (km) coordinate system (WGS-84)	Float		RTU.INI EH	STA2
CHnDepth	Emplacement depth (km)	Float		RTU.INI 0	STA2
DSnCHkName	FDSN channel code	Text	3	RTU.INI EH channel	WID2
DsnCHkAux	Auxiliary identification code	Text	4	RTU.INI EH stream	WID2
CHkSSNModel	Instrument type	Text	6	RTU.INI	WID2
CHkLookUP	Sensor lookup units	Text	M M/S M/S/S	RTU.INI	Used to calculate Calib value WID2
CHkVPU	Volts per sensor Unit	Float		RTU.INI	Used to calculate Calib value WID2
CHkPeriod	Calibration reference period; i.e., the period in seconds at which calib is valid; calper should be near the flat part of the response curve. (in most cases, 1 sec)	Float		RTU.INI	Used to calculate Calib value WID2
CHkAzimuth	Horizontal orientation of sensor, measured in positive degrees clockwise from North (-1.0 if vertical)	Float		RTU.INI	WID2
CHkDip	Vertical orientation of sensor, measured in degrees from vertical (90.0 if horizontal)	Float		RTU.INI	WID2

9.3.4 Example RTU.INI file:

```
[Defaults]

#####
# Default rtu.ini values for CTBTO:
# Asuming that 130recorder is configured the following way
# Stream 1 is active & aquiring data from channel 1,2,3,4,5,6
# where :
# Channels 1,2,3 are Vertical,North/South,East/West from Lennartz LE3D-Lite
# Channels 4,5,6 are all Verticals from Lennartz LE-1DV
# All channels are has Sensitivity 400 V/m/s, precisely adjusted on Period=2sec
#####

# Strings started with '#' are ignored!!!
# DSnCHk ----- field corresponding to DataStream=n & Channel=k
# CHk ----- field corresponding Channel=k
# Program will pick up BitWeight in Volts from RefTek 'EH' header

Network=CTBTO                                #network identifier
CH1Depth= 0                                #Emplacement Depth Channel1 (meters)
CH2Depth= 0                                #Emplacement Depth 2 (meters)
CH3Depth= 0                                #Emplacement Depth 3 (meters)
CH4Depth= 0                                #Emplacement Depth 4 (meters)
CH5Depth= 0                                #Emplacement Depth 5 (meters)
CH6Depth= 0                                #Emplacement Depth 6 (meters)
#!!!!!!!!!!!!Depends on Recording Steam Number!!!!!!!!!!!!!!!!!!!!!!
DS1CH1Name=SHZ                                #FDSN channel code: Stream1 Channel1
DS1CH2Name=SHN                                #FDSN channel code: Stream1 Channel2
DS1CH3Name=SHE                                #FDSN channel code: Stream1 Channel3
DS1CH4Name=EHZ                                #FDSN channel code: Stream1 Channel4
DS1CH5Name=EHZ                                #FDSN channel code: Stream1 Channel5
DS1CH6Name=EHZ                                #FDSN channel code: Stream1 Channel6

DS1CH1Aux=aux0                                #Auxilliary ID : Stream1 Channel1
DS1CH2Aux=aux0                                #Auxilliary ID : Stream1 Channel2
DS1CH3Aux=aux0                                #Auxilliary ID : Stream1 Channel3
DS1CH4Aux=aux1                                #Auxilliary ID : Stream1 Channel4
DS1CH5Aux=aux1 #Auxilliary ID : Stream1 Channel5
DS1CH6Aux=aux1 #Auxilliary ID : Stream1 Channel6
#!!!!!!!!!!!!Depends on Recording Steam Number!!!!!!!!!!!!!!!!!!!!!!
CH1SnsModel=LE-3D #Channel1 instrument type
CH2SnsModel=LE-3D #Channel2 instrument type
CH3SnsModel=LE-3D #Channel3 instrument type
CH4SnsModel=LE-1D #Channel4 instrument type
CH5SnsModel=LE-1D #Channel5 instrument type
CH6SnsModel=LE-1D #Channel6 instrument type
CH1LookUP=M/S #Channel1 Measurement Units: (M,M/S,M/S/S)
CH2LookUP=M/S #Channel2 Measurement Units: (M,M/S,M/S/S)
CH3LookUP=M/S #Channel3 Measurement Units: (M,M/S,M/S/S)
CH4LookUP=M/S #Channel4 Measurement Units: (M,M/S,M/S/S)
CH5LookUP=M/S #Channel5 Measurement Units: (M,M/S,M/S/S)
CH6LookUP=M/S #Channel6 Measurement Units: (M,M/S,M/S/S)
CH1VPU=400 #Channel1 Sensitivity: Volts/Measur_Units
CH3VPU=400 #Channel2 Sensitivity: Volts/Measur_Units
CH2VPU=400 #Channel3 Sensitivity: Volts/Measur_Units
CH4VPU=400 #Channel4 Sensitivity: Volts/Measur_Units
CH5VPU=400 #Channel5 Sensitivity: Volts/Measur_Units
CH6VPU=400 #Channel6 Sensitivity: Volts/Measur_Units
CH1Period=1 #Calibration reference period Channel1
CH2Period=1 #Calibration reference period Channel2
CH3Period=1 #Calibration reference period Channel3
CH4Period=1 #Calibration reference period Channel4
CH5Period=1 #Calibration reference period Channel5
CH6Period=1 #Calibration reference period Channel6
CH1Azimuth=-1 #Horizontal orientation of channel1 (degrees)
CH2Azimuth=0 #Horizontal orientation of channel2 (degrees)
```

```
CH3Azimuth=90           #Horizontal orientation of channel3 (degrees)
CH4Azimuth=-1           #Horizontal orientation of channel4 (degrees)
CH5Azimuth=-1           #Horizontal orientation of channel5 (degrees)
CH6Azimuth=-1           #Horizontal orientation of channel6 (degrees)
CH1Dip=0                #Vertical orientation of channel1 (degrees)
CH2Dip=90               #Vertical orientation of channel1 (degrees)
CH3Dip=90               #Vertical orientation of channel1 (degrees)
CH4Dip=0                #Vertical orientation of channel1 (degrees)
CH5Dip=0                #Vertical orientation of channel1 (degrees)
CH6Dip=0                #Vertical orientation of channel1 (degrees)
```

#DAS specific section [HEX_DAS_ID] (ex. [91CF]) can follow [Defaults] section
#exactly with the same fields as above; Plus additional fields to overwrite EH
#packet header can be added:

```
#Station=ST1           #Station code
#Latitude= 38.36538     #Geographic latitude      (degrees)
#Longitude= 22.07300    #Geographic longitude     (degrees)
#Altitude=72           #Elevation above Sea Level (meters)
```

Note: DSnCHkNameSEED contains 2 character of Location Code & 3 Characters of Channel Name delimited with '-' character



Section 10

Using the MATLAB Data Analysis Software

10.1 Overview

After you have used your DAS to collect data, and have used the **RTCNVRT** utility to convert the raw **PASSCAL** data, you have a file or set of files that are ready for further data analysis. The **MATLAB** (matrix laboratory) software program, available from The Mathworks, Inc., can process your data files and display FFT plots. The **MATLAB** software used with the **REF TEK** DAS systems is DOS-based, and is driven by commands that you enter on a command line.

MATLAB's full capabilities and operational procedures are provided in the document, PC-MATLAB for MS-DOS Personal Computers: User's Guide, which you should have received when you obtained your **MATLAB** software.

For your convenience, however, this section provides a quick summary of **MATLAB** operations as they apply to processing data files from DAS systems.

10.2 Prerequisite Operations

Before using the **MATLAB** program, you must perform some general data collection and conversion operations, as follows:

1. Complete all the essential steps for selecting data recording parameters and using the DAS to collect data.
2. Use one of the following methods to transfer the PASS-CAL data to a file or files in your PC's memory or storage:

Option	Description
Compact-Flash	Copy the data from the CompactFlash of the 130 DAS by inserting the CompactFlash in a PCMCIA PC card adapter on the PC.
In RTP mode	Transfer the data over the ethernet
FTP	Using another DAS or LAN PC.

3. Use the RTCNVRT utility program to prepare the file(s) for use with MATLAB.
4. You can now use the MATLAB software to analyze the prepared file or files.

10.3 Running the MATLAB Software

The available operations of the **MATLAB** program are numerous, and this manual provides only a basic application of the program. However, in general, use **MATLAB** to analyze files containing data obtained using a **REF TEK** DAS by performing the following actions:

1. Install the MATLAB software as described in the **MATLAB User's Guide**.
2. Type `matlab` and press the enter key to start the **MATLAB** program.
3. Type `dir *.dat` and press the enter key to display a list of the available data files.
4. Type `load filename` to load the data in the desired file into PC memory; include the file's extension.
5. To use MATLAB to generate and display a time series plot for the data file, type `plot(filename(3:1026))` and press the enter key. Do not include the file's extension. The 3:1026 argument causes **MATLAB** to process 1024 samples in your converted data file. Note that you add two to the samples you want to include in the plot, because the first two entries in the data file contain header information and should not be included when **MATLAB** generates a plot.
6. If your data file contains a number of samples other than 1024, use a number two greater than the number of samples in the data file in place of the 1026. For example, use the argument 3:514 to process all the data in a file with 512 samples.

Note: Figure 10 - 1 on page 10-120 provides an example time series plot produced by MATLAB.

7. To use MATLAB to generate and display an FFT plot for the data in the data file, type `rtfft (filename)` and press the enter key. Do not include the file's extension.

Note: The `rtfft` command is not a MATLAB command; rather, it is a MATLAB macro file (M-file) that Refraction Technology has supplied with your software utilities; this macro file automatically provides all the arguments that the MATLAB `Fft` command requires to produce an FFT plot from a **REF TEK** data file.

Note: Figure 10 - 2 on page 10-121 provides an example FFT plot produced by MATLAB.

8. After viewing either the time series or FFT plot, press any key to leave the graphics display and return to the command screen.

10.4 Additional MATLAB Considerations

The **MATLAB** program can not process any data file until it has been loaded into RAM (as included in the previous procedure). If the files you load exceed the PC's available RAM, **MATLAB** displays an insufficient memory message.

1. To clear the RAM, type clear and press the enter key.
2. Reload the data file you need and continue.

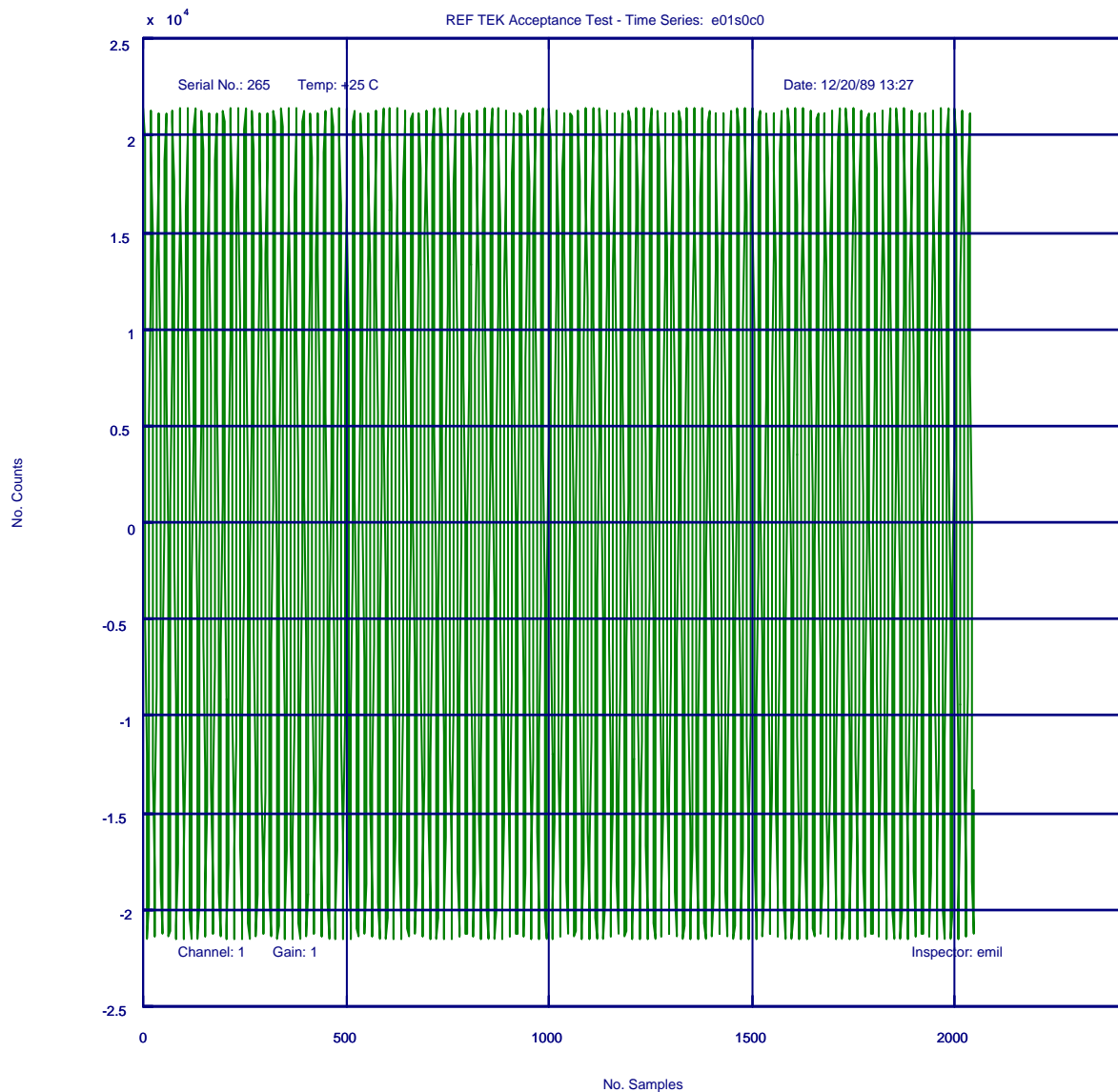


Figure 10 - 1 Example MATLAB Time Series Plot

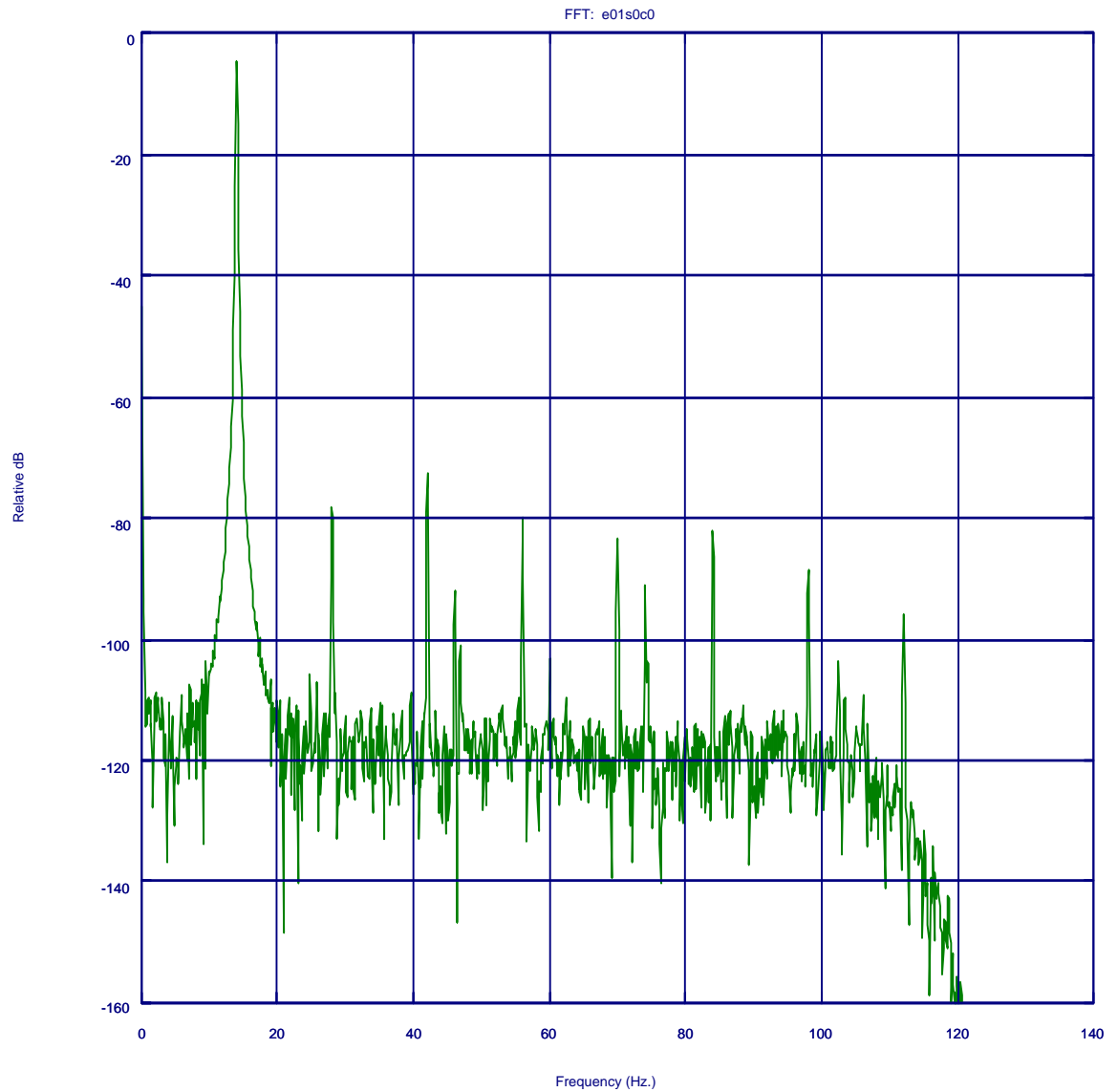


Figure 10 - 2 Example MATLAB FFT Plot



Section 11

REF TEK Utility Programs Reference

11.1 PCTIME

PCTIME - Version 02.90

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Purpose:

Reports the current PC time and sets the PC time to the time received on the serial port.

Usage:

PCTIME [switches]

Switches:

/Bn Baud rate: 300 - 115200 (9600)
/Cn Comm port: 1 or 2 (1)
/Dn Data bits: 7 or 8 (8)
/Lc Lock indicator: observed (Y or +) or ignored (N or -) (IGNORED)
/On hour Offset from time source: up to +/- 12 (0)
/Pc Parity: O or E or N (NONE)
/Sn Stop bits: 1 or 2 (1)

Notes:

Serial time string must begin with an SOH character (1h) and be in industry-standard format: <SOH>DDD:HH:MM:SSQ<CR><LF>

[] = Optional () = default

Switches may appear anywhere on the command line.

Arguments and switches are not case sensitive.

PCTIME allows you to set the PC time clock using an external UTC clock such as the REF TEK 111, 111A or 111B GPS clock. By default, **PCTIME** assumes that the external clock is more accurate than the PC, even if the external clock is not declaring locked time. The PC time is NOT synchronized to the 1 Hz.

11.2 REF2SUDS

REF2SUDS - Version 1.53 <Beta>

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Usage: REF2SUDS [host:]id|filespec [output_dir]

Switches:

/B[n][,m] - Start at block n, process m blocks. (all blocks)

/Mn - Start at filemark n on tape. (2)

/E - Output event number filenames. (Timestamp)

/Q[V] - Generate REF2SUDS.QCC file, /Q=unit is counts, /QV=volts.

First argument specifies SCSI ID of input device or filespec of input file.

Second argument specifies path of output directory. (current dir)

[]=Optional, ()=Default, |=Mutually exclusive.

Switches are not case sensitive and may appear anywhere in the command line.

REF2SUDS converts data from PASSCAL format to **SUDS** format. The PASSCAL data can reside on a PASSCAL SCSI device or in a local file.

11.3 RTCNVRT

RTCNVRT - Version RTU 02.90

Copyright (c) 1988 - 1997 Refraction Technology, Inc. All Rights Reserved

Purpose:

Reads a file containing PASSCAL data packets and converts the data to ASCII format.

Usage:

RTCNVRT sourceFile [switches]

Switches:

/Q QCC File output: Y, +, N or - (NO)
/Ppath Path for output subdirectories (CURRENT)
/Cn sample Count per channel per event (0)
/Sn Sample Rate (100)
/D Disable data block header info (ENABLED)
/R RAW data output (SCALED data output)
/Tn Trash n samples from each event (0)
/V Verbose message output: Y, +, N or - (ENABLED)

[] = Optional () = default

Switches may appear anywhere on the command line.

Arguments and switches are not case sensitive.

RTCNVRT converts data from PASSCAL format to ASCII format. The resulting ASCII files can be imported into most data processing programs for data analysis.

11.4 TAIL

TAIL - Version 02.90

Copyright (c) 1994 - 1997 Refraction Technology, Inc. All Rights Reserved

Purpose:

Display the tail (end portion) of a file.

Usage:

TAIL [switches] [filename]

Switches:

/L[n] display the last n Lines from a text file (10)

/B[n] display the last n Bytes from a binary file (1024)

Notes:

This program reads from standard input if no filename is given.

[] = Optional () = default

Switches may appear anywhere on the command line.

Arguments and switches are not case sensitive.

Tail displays the contents of the end of a file. It is similar to the Unix TAIL program.



Appendix A

REF TEK Utilities Release Notes

A.1 PASSCAL Version 4.00 (22 January, 2007)

This section lists and describes the functional software modifications made to REF TEK Utilities version 3.51 to create version 4.00, as follows:

1. Conversions: Correction to Dual EH/ET
2. Conversions: Modifications for Cross-Platform Support
3. Conversions: Modification to Increase Allowed Open Files
4. RT_COS: Modifications to Azimuth

1 Conversions: Correction to Dual EH/ET

A correction was made to the logic used to detect complete events when dual EH/ET packets are present .

2 Conversions: Modifications for Cross-Platform Support

Modifications were made to support DOS, Windows32, Linux-Intel and Solaris-Sparc platforms.

3 Conversions: Modification to Increase Allowed Open Files

The number of files allowed open at one time was increased from 10 to 32. This improves program speed when handling a large number of traces simultaneously.

4 RT_COS: Modifications to Azimuth

Modifications were made to the handling of the Azimuth value. Previously, the azimuth was expected to be 1 – 360. Now, additional azimuth codes can be used.

A.2 PASSCAL Version 3.51 (04 Aug, 2006)

This section lists and describes the functional software modifications made to **REFTEK** Utilities version 3.50 to create version 3.51, as follows:

1. All: Correction to Version Report
2. RT_COS: Modifications to Output Directory Names

1 All: Correction to Version Report

The version reported by the programs was not properly updated. Each program reported version 3.42 instead of 3.50. With this release they report 3.51.

2 RT_COS: Modifications to Output Directory Names

Modifications were made to the naming of output subdirectories. Previously, the directory was named using the DAS Unit ID number stored in the data. Now, the Station Name will be used, when available. Previously, the Win32 version named directories differently than the DOS version. Now, both versions behave the same.

A.3 PASSCAL Version 3.50 (16 June, 2006)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 3.41 to create version 3.50, as follows:

1. Conversions: Modifications for Dual EH/ET
2. Conversions: Modification to Sensor Serial Number
3. RT_COS: Modifications to COSMOS Output
4. RT_COS: Addition of Result File

1 Conversions: Modifications for Dual EH/ET

Modifications were made to handle dual EH and dual ET packets for an event. The second EH/ET provides channel information for channels 17 – 32. The event information is the same as in the first EH/ET. The second EH/ET is distinguished from the first EH/ET by a bit-flag in the Flags field of the packet header. The second EH is recorded immediately **after** the first EH. The second ET is recorded immediately **before** the first ET.

2 Conversions: Modification to Sensor Serial Number

Modifications were made to handling the Sensor Serial Number. This is now handled strictly as a decimal number rather than a hexadecimal or text value.

3 RT_COS: Modifications to COSMOS Output

Various modifications were made to better conform the output of RT_COS to the COSMOS Volume 0 format.

4 RT_COS: Addition of Result File

A result file is now created at the completion of RT_COS. The filename matches the COSMOS output file name. The file extension is ERR if an error occurred or OK if no error occurred. The file contains a simple text message saying whether an error occurred. Specific errors are not listed.

A.4 PASSCAL Version 3.41 (24 February, 2006)

This section lists and describes the functional software modifications made to **REFTEK** Utilities version 3.30 to create version 3.41, as follows:

1. Conversions: Modifications for Consistent Command Line
2. Conversions: Modification to Support High Compression
3. RT_MSEED: New Program

1 Conversions: Modifications for Consistent Command Line

Significant modifications were made to make the command line switches uniform across all of the conversion programs. Each program may use different defaults for the available options.

2 Conversions: Modification to Support High Compression

Modifications were made to support the high compression recording mode of the **REF TEK** 130 DAS.

3 RT_MSEED: New Program

A new conversion program has been added to the **REF TEK** Utilities. RT_MSEED converts data from **REF TEK** PASSCAL format to Mini-SEED format.

A.5 PASSCAL Version 3.30 (12 April, 2005)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 3.22A to create version 3.30, as follows:

1. Conversions: Correction to Reading RTU.INI
2. Conversions: Modification of Log File
3. RT_SEIS: Correction of Dates in Header
4. RT_SEIS: Modification of Component Descriptor
5. RT_COS: New Program

1 Conversions: Correction to Reading RTU.INI

A correction was made to ensure the conversion programs properly handle the end of file when reading the RTU.INI initialization file.

2 Conversions: Modification of Log File

The log file produced by the various conversion programs has been changed to output additional information stored in the EH/ET recording packets.

3 RT_SEIS: Correction of Dates in Header

Previously, the date stamp stored in the Seisan trace header was corrupted for dates containing 10; i.e. day 10 or month 10. This has been corrected.

4 RT_SEIS: Modification of Component Descriptor

The channel component descriptor stored in the Seisan trace header was changed to the following format: Sscx, where s represents the data stream number, c represents the channel number and x represents the axis of orientation. The component descriptor can be changed using the ChnSeisComp setting in the RTU.INI file.

5 RT_COS: New Program

A new conversion program has been added to the Ref Tek Utilities. RT_COS (Win32) and RT_COSD (DOS) convert data from Ref Tek PASSCAL format to COSMOS Volume 0 format.

A.6 PASSCAL Version 3.22A (14 January, 2003)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 3.21 to create version 3.22A, as follows:

1. RTCNVRT & RT_WGSN: Correction to SOH Only Output¹³²
2. Conversions: Modification to Unit ID¹³²
3. RT_PDB: New Program¹³²
4. RT_VIEW: New Program¹³²

1 RTCNVRT & RT_WGSN: Correction to SOH Only Output

A correction was made to eliminate a crash condition when only generating a State of Health log.

2 Conversions: Modification to Unit ID

A change was made to the handling of the Unit ID in recording packets to support the new hexadecimal Unit ID of the **REF TEK** 130.

3 RT_PDB: New Program

A new program has been added to the **REF TEK** Utilities. RT_PDB runs under DOS and Windows and converts between FSC parameter files and PFC parameter files.

4 RT_VIEW: New Program

A new program has been added to the **REF TEK** Utilities. RT_View runs under Windows and graphs data contained in a Ref Tek PASSCAL data file.

A.7 PASSCAL Version 3.21 (22 November, 2000)

This section lists and describes the functional software modifications made to **REFTEK** Utilities version 3.20 to create version 3.21, as follows:

1. RTCNVRT: Correction of Lockup Problem

1 RTCNVRT: Correction of Lockup Problem

RTCNVRT v3.20 was locking up under Windows. This has been corrected.

A.8 PASSCAL Version 3.20(24 October, 2000)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 3.10 to create version 3.20, as follows:

1. FSC: Serial Port Access
2. RTCNVRT: Change in Log Format
3. RTCNVRT: Change in Operating Environment
4. New Conversion Programs

1 FSC: Serial Port Access

FSC was modified to close and reopen the serial port at startup. This was added to work around a problem discovered under Windows ME. Prior to this change, FSC would lock up under Windows ME on the first access of the serial port unless the user first re-implemented the FSC port settings.



IMPORTANT: We recently experienced some situations where FSC would not run properly under Windows 9x on some machines while it ran fine on others. The problem was finally traced down to the FIFO settings for the serial ports under Windows. If you experience lock-up problems with FSC, check the following:

1. Check the file C:\WINDOWS\SYSTEM.INI. Look in the 386ENH section. If there is a line that says COM1Fifo=0 it should be commented out by placing a semicolon (;) at the beginning of the line. If there is a line that starts with COM1AutoAssign= either comment it out or change it to -1. This should be done for whichever port FSC will be using.
2. Check the Advanced Port settings in the Windows Device Manager for the Com port used by FSC. Make sure the FIFO settings are enabled. We recommend setting the receive FIFO to at least 3/4 of the range and setting the transmit FIFO to the maximum.
3. Check the Properties for the FSC DOS box. Under the Misc tab, set the Idle Sensitivity to the minimum. This ensures the screen updates correctly instead of only updating when a key is pressed or every 10 seconds or so.

2 RTCNVRT: Change in Log Format

The log file generated by RTCNVRT has been modified. The contents of packets have been indented to make it easier to distinguish the packet contents from the packet header lines. This affects State-of-Health packets, Parameter packets, Event Header packets and Event Trailer packets.

3 RTCNVRT: Change in Operating Environment

RTCNVRT is now a 32-bit Windows console application and must be run under Windows.

4 New Conversion Programs

The following data conversion programs have been added to the Ref Tek Utilities:

Program	Platform	Description
RTCNVRTD.EXE	MS-DOS	Convert PASSCAL data to REFTEK ASCII trace
RT_SEGY.EXE	Win32	Convert PASSCAL data to IRIS SEG-Y trace files
RT_SEGYD.EXE	MS-DOS	Convert PASSCAL data to IRIS SEG-Y trace files
RT_SEIS.EXE	Win32	Convert PASSCAL data to SEISAN format
RT_SEISD.EXE	MS-DOS	Convert PASSCAL data to SEISAN format
RT_WGSN.EXE	Win32	Convert PASSCAL data to WGSN trace files
RT_WGSND.EXE	MS-DOS	Convert PASSCAL data to WGSN trace files

A.9 PASSCAL Version 3.10(08 June, 2000)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 3.00 to create version 3.10, as follows:

1. FSC: Addition of SCSI Retry Control
2. RTCNVRT: Additional Log Information

1 FSC: Addition of SCSI Retry Control

FSC was modified to add control of the period in days for the periodic SCSI retry added to DAS v3.10 firmware. This field is located with the other SCSI parameters.

2 RTCNVRT: Additional Log Information

Several fields were added to the information stored by RTCNVRT in its log file. This includes the SCSI retry period and information specific to the Ref Tek 120.

A.10 PASSCAL Version 3.00(April 15, 1999)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 2.93 to create version 3.00, as follows:

1. RTCNVRT: Modification to update the sample count.
2. RTCNVRT: Modification to program parameters display.
3. RTCNVRT: Modification to window title.
4. RTPRMCVT: Addition of screen output.
5. ALL: Y2K Compliance

1 RTCNVRT: Modification to update the sample count.

RTCNVRT stores the sample count as the first value in the output data file. Previously, RTCNVRT stored the sample count requested by the user, even if fewer samples were actually available. Now, RTCNVRT updates the sample count to match the number of samples actually stored in the output file.

2 RTCNVRT: Modification to program parameters display.

Modifications were made in the way RTCNVRT displays its control settings. The display is more complete and better organized.

3 RTCNVRT: Modification to window title.

Previously, when RTCNVRT was executed in a DOS window under Microsoft Windows, it modified the window title in such a way that the title did not revert to its previous state after RTCNVRT ended. Now, the window title reverts to its previous state.

4 RTPRMCVT: Addition of screen output.

RTPRMCVT has been modified to optionally output the parameter information to the screen in a user-readable format instead of to a file. This output can be redirected into a file or to a printer.

5 All: Y2K Compliance.

All of the programs in the standard **REF TEK** Utilities package were checked for Y2K compliance and modified as needed to ensure proper interpretation of dates as output by the 72A-series DAS units.

A.11 PASSCAL Version 2.93(July 31, 1998)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 2.90 to create version 2.93, as follows:

1. ALL: Change in method of opening files.
2. NCI: Correction to log file name corruption.

1 ALL: Change in method of opening files.

The method of opening disk files was changed to prevent access problems in a multi-tasking environment. Access collisions (a program opening a file that another program already has open) caused some PCs to lock up and caused others to terminate running programs. The change prevents a file from being opened by more than one program at a time. This change was implemented in all programs that perform file access, including: FSC, NCI, RTPRMCVT, RTCNVRT, CHKFMB, TAIL, STNINFO, SRREAD and SRSCRIPT.

2 NCI: Correction to log file name corruption.

Previous versions of NCI corrupted the log file name when a parameter set was loaded using the File menu. This prevented NCI from opening and appending to the log file. Under DOS, there was no other adverse effect. However, under other operating systems, this sometimes caused the PC to lock-up or caused communications with network DAS units to slow down. Changes were made to eliminate the corruption of the log file name and to display a message to the user whenever NCI is unable to open the log file.

A.12 PASSCAL Version 2.90 (December 9, 1997)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 2.86 to create version 2.90, as follows:

1. FSC: Addition of SCSI Configuration support.
2. FSC: Modification in detecting changed parameters.
3. NCI: Addition of SCSI Configuration support.
4. NCI: Correction to serial port control.
5. RTPRMCVT: Modification to support SCSI Configuration parameters.
6. 1FSC: Addition of SCSI Configuration support.

A SCSI Configuration command has been added to FSC. The SCSI configuration options are considered part of the DAS parameter set. The SCSI configuration options can be accessed from the Edit Menu and from the Data Menu.

When the SCSI configuration options are accessed from the Edit Menu, they are treated just like other DAS parameters. They can be modified and saved in a parameter set without being connected to a DAS.

When the SCSI configuration options are accessed through the Data Menu, a DAS must be connected. FSC queries the connected DAS for its current SCSI configuration information before displaying the options for editing. When the modifications are accepted (F10 is pressed), the new configuration is sent to the DAS. The DAS implements the new SCSI configuration as soon as the command is received, but after any current SCSI operation is complete.

1 FSC: Modification in detecting changed parameters.

Previously, FSC would assume the parameters had been changed if any of the parameter editing forms were entered. Now, FSC does not consider the parameters changed unless F10 (accept changes) is pressed while in a parameter editing form.

2 NCI: Addition of SCSI Configuration support.

NCI has been modified to accept FSC parameter files that contain the SCSI configuration options.

3 NCI: Correction of serial port control.

Previous versions of NCI left the PC serial port open when it should be closed. NCI incorrectly opened Com1 when Mailbox mode (port 0) was selected. NCI left ports open when it terminated. NCI left Com1 open when switching to Com2. The serial ports are now closed properly.

4 RTPRMCVT: Modification to support SCSI Configuration parameters.

RTPRMCVT has been modified to read and write parameter files that contain the SCSI configuration options. When converting older parameter files to the new format, the SCSI configuration options are set to their default values.

A.13 PASSCAL Version 2.86(October 1, 1997)

This section lists and describes the functional software modifications made to **REF TEK** Utilities version 2.84 to create version 2.86, as follows:

1. FSC: Close-aware.
2. FSC: DTR control.
3. NCI: Close-aware.
4. NCI: DTR control.
5. NCI: Unit ID output.
6. PCTIME: Hour adjustment across year boundary.
7. RTPARSE: Close-aware.
8. RTCNVRT: Close-aware.
9. RTCNVRT: makes global QCC file.
10. RTCNVRT: Verbose message control.
11. RTCNVRT: QCC Syntax modification.
12. RTCNVRT: REFTEK 120 support.
13. SRREAD: Close-aware.
14. SRREAD: Command line order.
15. SRREAD: Prompt control.

1 FSC: Close-aware.

FSC has been modified to be 'close-aware'. For a description of 'close-aware', see the explanation at the end of the notes in this section (page144).

2 FSC: DTR control.

FSC now asserts DTR when opening a port and de-assert DTR when closing a port. This has no affect on direct communications with a **REF TEK** 72A-series DAS or **REF TEK** 112. Some terminal devices require DTR before they will recognize data on the serial port. This change allows the output of FSC to be recognized by other terminal equipment, such as a dumb terminal.

3 NCI: Close-aware.

NCI has been modified to be 'close-aware'. For a description of 'close-aware', see the explanation at the end of these notes. (page144).

4 NCI: DTR control.

NCI now asserts DTR when opening a port and de-assert DTR when closing a port. This has no affect on direct communications with a **REF TEK** 72A-series DAS or **REF TEK** 112. Some terminal devices require DTR before they will recognize data on the serial port. This change allows the output of NCI to be recognized by other terminal equipment, such as a dumb terminal.

5 NCI: Unit ID output.

A bug was fixed which caused the unit ID field of commands issued by NCI to contain the wrong value. This only occurred with several specific non-zero unit ID values.

6 PCTIME: Hour adjustment across year boundary.

The adjustment of time using the hour offset from UTC was modified to properly handle year boundaries. Problems with previous versions would only be seen on December 31 or January 1, depending on the hour offset being used.

7 RTPARSE: Close-aware.

FSC has been modified to be 'close-aware'. For a description of 'close-aware', see the explanation at the end of these notes.

8 RTCNVRT: Close-aware.

RTCNVRT has been modified to be 'close-aware'. For a description of 'close-aware', see the explanation at the end of these notes.

9 RTCNVRT: Global QCC file.

RTCNVRT now creates a .QCC file containing QCC information for all units found in the input file. This is in addition to the QCC file that is created for each unit. All .QCC files are controllable with the /Q command line switch.

10 RTCNVRT: Verbose message control.

A command line switch has been added to RTCNVRT to control the messages it outputs. /V+ produces the same messages as previous versions of RTCNVRT. /V- reduces the messages to a display of the number of megabytes of data processed.

11 RTCNVRT: QCC Syntax modification.

The usage of the /Q command line switch has been modified. Previously, /QY turned on QCC file output and /QN turned it off. Now, /Q+ can be used in place of /QY and /Q- can be used in place of /QN.

12 RTCNVRT: REF TEK 120 support.

Modifications have been made to support fields in the EH, ET, NH and NT recording blocks that are specific to the **REF TEK** 120 Data Acquisition Unit (DAU) and Central Recording Unit (CRU).

13 SRREAD: Close-aware.

FSC has been modified to be 'close-aware'. For a description of 'close-aware', see the explanation at the end of these notes below.

14 SRREAD: Command line order.

A bug was fixed in SRREAD which caused it to always use the first entry on the command line as the output filename. Now, the output filename can occur anywhere on the command line.

15 SRREAD: Prompt control.

SRREAD displays its parameters and prompts the user to validate them before continuing. The /Y command line switch forces SRREAD to bypass the prompt and assume the settings are correct.

Close-aware

Note: DOS programs that are run under Windows 3.x or Windows 95 cannot normally be terminated using the Close button on the window bar or by a 'close' message issued by the operating system. DOS programs can be made 'close-aware' by adding some system calls that are benign under DOS but responsive under Windows. A DOS program that is 'close-aware' can be closed using the Close button on the window bar or by the 'close' message issued by the operating system IF they were started using a shortcut (Windows 95) or PIF file (Windows 3.1). They will NOT shut down if they are started from a command prompt or a batch file in a DOS box.

A.14 PASSCAL Version 2.84(October 7, 1996)

This section of this manual lists and describes the functional software modifications made to **REF TEK** Utilities version 2.83A to create version 2.84, as follows:

1. SRREAD and SRSCRIPT: Fixed a bug trying to flush the keyboard buffer.
2. SRSCRIPT: Fixed a bug in the handling of the port selection command line switch.
3. PCPWR: Modified to use serial ports and handle more RS232 signals.
4. TAIL: New program to output tail (end) portion of a file.
5. FSC and NCI: Fixed bug in printing parameter file to a printer.
6. PCTIME: Lock quality control.
7. RTCNVRT: Output of program parameters added.

1 SRREAD and SRSCRIPT: Fixed a bug handling the keyboard buffer.

A bug was fixed that sometimes caused the program to hang. While waiting for the transfer to start, the program detects when a key is pressed. Previously, if any key presses were found, the program would get stuck in an infinite loop.

2 SRSCRIPT: Fixed a bug in the handling of the port selection command line switch.

A bug was fixed which caused the /c command line switch to be case sensitive. Previously, it only worked when it was typed in lower case.

3 PCPWR: Modified to use serial ports and handle more RS232 signals.

This program was modified to use serial port instead of the parallel port signals. It also handles signals such as DCD, RI and DSR. In addition, the program now sets the DOS error level depending on the signal status and action (such as OFF, ON & STATUS) required.

4 TAIL: New program to output tail (end) portion of a file.

This program was written to output the end (tail) portion of a file. This is similar to the UNIX version of the tail program, but without the various switches. This program is useful to display the end of a large file. It can also be used to trim growing log files.

5 FSC and NCI: Fixed bug in printing parameter file to a printer.

These programs were modified to explicitly print carriage return characters to the printer when printing the parameter file.

6 PCTIME: Lock quality control.

A command line switch has been added to control whether the program observes or ignores the lock quality factor when setting the PC time. By default, the program ignores the lock quality. Using /L+ in the program invocation causes the program to set the time only when the external clock source indicates the clock is locked.

A.15 PASSCAL Version 2.83A (June 6, 1996)

This section of this manual lists and describes the functional software modifications made to **REF TEK** Utilities version 2.83 to create version 2.83A, as follows:

1. RTCNVRT:
2. FSC, NCI: Modified to handle UPS shutdown.

1 RTCNVRT:

Correction to Time Tag Error Calculations

2 FSC, NCI: Modified to handle UPS shutdown

Removed the keyboard flush function before exiting the program, as this would cause the program to miss the shutdown command keystrokes sent by the UPS software.

A.16 PASSCAL Version 2.83 (February 23, 1996)

This section of this manual lists and describes the functional software modifications made to **REF TEK** Utilities version 2.80A to create version 2.83, as follows:

1. RTPRMCVT: New Program to Convert Parameter Files
2. FSC: Correction to Sound Option
3. FSC: Corrections to DAS Configurations
4. FSC, NCI: Modification to PC Serial Port Delay
5. FSC, NCI: Modification to DAS Serial Port Control
6. FSC, NCI: Correction to Misspelled Message
7. RTCNVRT: Addition of /T Command Line Switch
8. RTCNVRT: Addition of Customer-Specific Information

1 RTPRMCVT: New program to convert parameter files

The RTPRMCVT (parameter convert) program reads existing FSC parameter files and outputs a new file that matches the format of the current version of FSC and NCI. A command line option is available to change the output format.

2 FSC: Correction to sound option

A bug was introduced in FSC v2.70 to the sound option of the FSC program. Whenever the FSC Configuration file was saved, the sound option was forced off. This has been corrected.

3 FSC: Corrections to DAS configurations

The DAS Configuration file used by FSC (FSC.DAS) has been modified to correct several errors reported by users. These corrections include:

Configuration Modification

```
020, 021, 022 and 023 Allow 32-bit data format
023 Correct the channel relays
060 and 061 Correct the gains
080 Change the configuration number for the following DASes
    to configuration 080: 0146, 0150, 0192, 0195, 0229, 0231,
    0338, 0344, 0345, 0347, 0358, 0359, 0366, 0381, 0384,
    0387, 0388, 0396, 0403, 0418, 0476, 0530, 0552 and 0554.
```

4 FSC, NCI: Modification to PC serial port delay

Setting the Delay field in the PC Serial Port Configuration to 0 milliseconds causes the PC to overrun the DAS serial port receive capabilities. Therefore, the option of setting the Delay field to 0 milliseconds has been removed. Delay options of 60, 70, 80 and 90 milliseconds have been added.

5 FSC, NCI: Modification to DAS serial port control

FSC and NCI no longer provide the option of configuring DAS serial port 0 (the NULL port) or 1 (the TERMINAL port), since the DAS does not allow these ports to be configured, anyway. In addition, the DAS Port Use fields now default to 0 (the NULL port) instead of to 1 (the TERMINAL port).

6 FSC, NCI: Correction to misspelled message

A word was misspelled in one of the messages common to FSC and NCI. This has been corrected.

7 RTCNVRT: Addition of /T command line switch

The /T command line switch has been added to RTCNVRT. It allows you to 'trash' (skip) a requested number of samples at the beginning of each event.

8 RTCNVRT: Addition of customer-specific information

Customer-specific information has been added to the end of a few of the PASSCAL recording blocks. RTCNVRT has been modified to identify this information.

A.17 PASSCAL Version 2.80A (October 25, 1995)

This section of this manual lists and describes the functional software modifications made to **REF TEK** Utilities version 2.80 to create version 2.80A, as follows:

1. RTCNVRT: Correction to Handling of Command Line Switches
2. PCTIME: Addition of Full Serial Port Support
3. NCI: Addition of Disk Load Commands
4. NCI: Modification of SCSI Load and SCSI Format Menus
5. NCI: Modification of Tape Backup Options
6. FSC, NCI: Addition of Parameter File Qualification

1 RTCNVRT: Correction to handling of command line switches

A bug was introduced in v2.80 when the behavior of RTCNVRT was changed. The bug caused some of the command line switches to be ignored. This has been corrected.

2 PCTIME: Addition of full serial port support

Previously, the PCTIME program allowed the selection of a COM port but only operated at 9600 bps, No parity, 8 data bits and 7 stop bits. Now, all of the serial port parameters are configurable, including baud rate(bps), data bits, stop bits, and parity control.

3 NCI: Addition of disk load commands

Menu options were added to issue Disk Load commands to the REFTEK 44D firmware in the REFTEK 112A.

4 NCI: Modification of SCSI load and SCSI format menus

The SCSI Load and SCSI Format menus were modified so that disk 1 is selection 1, disk 2 is selection 2 and the tape drive is selection 3.

5 NCI: Modification of tape backup options

The tape backup options have been modified. The choices are: ON (data automatically backed up to tape), OFF-PRESERVE (no backup, overwrite NOT allowed) and OFF-OVERWRITE (no backup, disk overwrite enabled).

6 FSC, NCI: Addition of parameter file qualification

FSC and NCI will no longer load parameter files that are not in the current parameter file format.

A.18 PASSCAL Version 2.80 (September 21,1995)

This section of this manual lists and describes the functional software modifications made to **REF TEK** Utilities version 2.70 to create version 2.80, as follows:

1. ALL: Modification of Syntax Message
2. RTCNVRT: Modification of Time List Trigger in Output Log
3. RTCNVRT: Addition of System Time in Output Log
4. RTCNVRT: Modification of Default Behavior
5. NCI: Addition of Support for Time List Trigger

1 ALL: Modification of syntax message

All of the command line utility programs now generate a syntax message that provides basic usage information and default behavior.

2 RTCNVRT: Modification of time list trigger in output log

The Time List Trigger parameters are now properly parsed and labeled in the log file created by RTCNVRT.

3 RTCNVRT: Addition of system time in output log

The PC system time is now output at the top of the log file produced by RTCNVRT.

4 RTCNVRT: Modification of default behavior

Previously, RTCNVRT required multiple parameters on the command line invocation and prompted the user for missing parameters. Now, RTCNVRT defaults all of the parameters except the filename. If the filename is not supplied, RTCNVRT produces a syntax message and quits. The new default behavior of RTCNVRT is to only create LOG files, one for each DAS Unit ID it encounters in the input file.

5 NCI: Addition of support for time list trigger

NCI has been modified to properly handle the addition of the Time List Trigger parameters to the parameter files created by FSC.

A.19 PASSCAL Version 2.70 (June 7, 1995)

This section of this manual lists and describes the functional software modifications made to **REF TEK** Utilities version 2.60 to create version 2.70, as follows:

1. SRREAD: Modification of Syntax Message
2. SRSCRIPT: Addition of Timeout Switch
3. FSC: Addition of Time List Trigger Support
4. FSC: Modification of Configuration File
5. FSC: Addition of Parameter Restriction Logic
6. FSC: Modification to Keystroke Support
7. FSC: Addition of Forced Auto-Dump Option

1 **SRREAD: Modification of syntax message**

The syntax message in SRREAD has been modified so that it accurately reflects the program's default values.

2 **SRSCRIPT: Addition of timeout switch**

A new switch (/Tsecs) has been added which allows the user to vary the amount of time SRSCRIPT will wait for a command response before it terminates. The time is expressed in seconds with a maximum of 32767 seconds. The minimum timeout is three seconds, which is also the default.

3 **FSC: Addition of time list trigger support**

Support has been added for the new Time List trigger. This trigger is implemented in CPU v2.70 and later. The Time List trigger allows the entry of up to eleven unrelated trigger times for each stream.

4 **FSC: Modification of configuration file**

The contents of the FSC configuration file (FSC.CFG) have been modified. The field names have been changed from two-letter mnemonics to English words. Several new fields and comment lines have been added, as well. Refer to **REFTEK'S** Operations Tasks Manual *"Using FSC Software"* for more information.

5 **FSC: Addition of parameter restriction logic**

FSC has been modified to restrict some parameter choices based on the Unit ID of the DAS for which the parameter set is being created. Information on the configuration of each DAS is located in the file FSC.DAS. This file is required for the restrictions to take effect. The file is readable ASCII text. If incorrect restrictions are encountered by the user, that user should notify Refraction Technology so that corrections can be made. **THE FSC.DAS FILE SHOULD NOT BE MODIFIED BY THE USER UNLESS INSTRUCTED TO DO SO BY REFTEK PERSONNEL.** For more information, refer to **REFTEK'S** Operations Tasks Manual *"Using FSC Software"*.

6 **FSC: Modification to keystroke support**

FSC now responds to alternate keystrokes for the usual function (Fn) keys. In the Main Menu, the regular number keys can be used to select a menu. In addition, CTRL-E (hold down the CONTROL key and press E) can be used in place of the F10 key to confirm a response or save changes to the entries in a form.

7 **FSC: Addition of forced auto-dump option**

An option has been added to the DAS DATA menu which issues the appropriate commands to the DAS to force the DAS to do a destructive copy of RAM to the auto-dump device



Appendix B

RT_View Release Notes

B.1 Version 1.4.3 (August 7, 2006)

This section of this manual lists and describes the functional modifications made to the Ref Tek RT_View software version 1.4.2 to create version 1.4.3, as follows:

WARNING: Please review all release notes between the software version you are running and the version you wish to install.

1. Corrected spelling of scaling on graph page.
2. Modified Print Graph horizontal center grid line to a dash at each vertical seconds grid line.
3. Added Station Name to on screen graph and printed graph.
4. Added detection of new Sensor Test flag and display on Event Header, Trailer and Data pages.
5. Added Display Sensor Test message on Graph page.

- 1 Corrected spelling of scaling.**
Corrected spelling of scaling on the graph page.
- 2 Modified Print Graph horizontal center grid.**
Modified Print Graph horizontal center grid line to a dash at each vertical seconds grid line
- 3 Added Station Name to screen display.**
Added Station Name to screen graph and printed graph.
- 4 Added detection of new Sensor Test flag.**
Add detection of new Sensor Test flag and display on Event Header, Trailer and Data pages.
- 5 Added Display Sensor Test message.**
Added Display Sensor Test message on graph page.

B.2 Version 1.4.2 (June 18, 2007)

This section of this manual lists and describes the functional modifications made to the Ref Tek RT_View software version 1.4.1 to create version 1.4.2, as follows:

WARNING: Please review all release notes between the software version you are running and the version you wish to install.

1. Corrected marked samples color.
2. Corrected ALT+left_click on graph failure.
3. Corrected saved graph image 4Kx2K.
4. Corrected overlap of auto scroll check box.
5. Corrected vertical scaling.
6. Modified Graph Tab (removed).
7. Modified saved image size.
8. Modified saved graph image.
9. Modified Options menu item **GraphEventData**.
10. Modified SPS, Event # and add Stream #.
11. Modified filter tags to say **Off**.
12. Modified to allow any mouse click in graph.
13. Added listing packets in Table of Contents.
14. Added support for data format codes **33**, **C1** and **C3**.
15. Added forcing of the file last packet displayed.
16. Added more graphing of events.
17. Added time width of current graph.
18. Added Options menu item **Graph on File Open**.
19. Added analog filter code.
20. Added line for overscale count if it is non-zero.
21. Added gain and full scale voltage support.
22. Added scroll delay values to the **Options**.
23. Added Auto Scroll check box to allow scanning.

- 1 Corrected marked samples color.**
Corrected marked samples color changing from black to red on refresh.
- 2 Corrected ALT+left_click on graph failure.**
Corrected ALT+left_click on graph failure due to changes to display graph on program open.
- 3 Corrected saved graph image 4Kx2K.**
Corrected saved graph image 4Kx2K caused "out of memory" when multiple programs opened.
- 4 Corrected overlap of auto scroll check box.**
Corrected overlap of auto scroll check box and enabled filter flags.
- 5 Corrected vertical scaling.**
Corrected vertical scaling during auto scroll.
- 6 Modified Graph Tab (removed).**
Modified Graph Tab (removed) when Header or Trailer Tabs displayed (part of ALT+left_click problem).
- 7 Modified saved image size.**
Modified saved image size to current system screen resolution.
- 8 Modified saved graph image.**
Modified saved graph image from 2000 x 2000 to 4000 x 2000.
- 9 Modified Options menu item *GraphEventData*.**
Modified Options menu item *GraphEventData* to Graph on *TOC Select*.
- 10 Modified SPS, Event # and add Stream #.**
Modified SPS, Event # and add Stream # to printer plot.
- 11 Modified filter tags to say *Off*.**
Modified filter tags to say *Off* instead of blank on printer plot.
- 12 Modified to allow any mouse click in graph.**
Modified to allow any mouse click in graph window to disable auto scroll.
- 13 Added listing packets in Table of Contents.**
Added listing packets in Table of Contents with packet overscale flag set.

14 Added support for data format codes 33, C1 and C3.

Added support data format codes *3*, *C1* and *C3* for samples marked overscale.

15 Added forcing of the file last packet displayed.

Added forcing of the file last packet displayed in the table of contents along with a 'end of file' message.

16 Added more graphing of events.

Added graphing of events without event headers and/or trailers.

17 Added time width of current graph.

Added time width of current graph to bottom of graph.

18 Added Options menu item Graph on File Open.

Added Options menu item *Graph on File Open* to skip display of the contents.

19 Added analog filter code.

Added analog filter code to channel gain field.

20 Added line for overscale count if it is non-zero.

Added line for overscale count if it is non-zero.

21 Added gain and full scale voltage support.

Added gain and full scale voltage support for RT601 A/D boards (QH DAS firmware).

22 Added scroll delay values to the Options.

Added 3 scroll delay values to the Options menu.

23 Added Auto Scroll check box to allow scanning.

Added Auto Scroll check box to allow scanning through the entire event.

B.3 Version 1.4.1 (August 7, 2006)

This section of this manual lists and describes the functional modifications made to the Ref Tek RT_View software version 1.4.0 to create version 1.4.1, as follows:

WARNING: Please review all release notes between the software version you are running and the version you wish to install.

1. Corrected bug when graphing filtered data that did not scale traces correctly.
2. Modified click on X scroll bar behavior to small change of 1 sec and large change of current zoom width.
3. Added text to printer output if filters are on.
4. Added version display in top left of window.

B.4 Version 1.4.0 (September 23, 2005)

This section of this manual lists and describes the functional modifications made to the Ref Tek RT_View software version 1.3.0 to create version 1.4.0, as follows:

WARNING: Please review all release notes between the software version you are running and the version you wish to install.

New Features since 1.3.0

1. Add data filtering of 12Hz low pass, 0.1Hz High pass and 2Hz High pass.
2. Add decode of Trigger Out Delay in Event Headers and Trailers.
3. Added a INI file entry to enable/disable editing of nominal Volts per G values.
4. Added support for 18 channels.

Changes for version 1.4.0

1. Corrected zoom glitch.
2. Corrected contents list.
3. Corrected Next and Back Button.
4. Corrected not reading header.
5. Corrected existing print bug.
6. Corrected long integer overflow calculating time.
7. Corrected memory overwrite.
8. Modified text windows.
9. Modified header 2 and trailer 2.
10. Modified file open.
11. Modified Menu subitem.
12. Modified the Gs Entry screen.
13. Modified AllowGsEntry.
14. Modified Event header and trailer.
15. Modified data page contents.
16. Modified stream number.
17. Added SOH text search.
18. Added total recorder channels.
19. Added decode calibration schedule.
20. Added flag data decompression.
21. Added display of stream number.
22. Added marker for first sample of data packet.
23. Added save filter selection to ini file.

- 24. Added filtering options.
- 25. Added decode of Trigger Out Delay.
- 26. Added the actual used Volts per G values.
- 27. Added an INI file entry for AllowGsEntry.
- 28. Added Decode calibration schedule.
- 29. Added detection of data compression control flag errors.
- 30. Added detection of number of decompressed values error.
- 31. Added ability to flag above errors in contents and on data tab.

Version 1.4.0

1 Corrected zoom glitch

Corrected glitch when zoomed in middle of event at beginning of window. Start filter 1000 samples before displayed data.

2 Corrected contents list

Corrected contents list jump to page for long lists, bug introduced with 18 chan support (1.3.0.10).

3 Corrected Next and Back Button

Corrected Next and Back Button on graphs for multiple events, bug introduced with 18 chan support (1.3.0.10).

4 Corrected not reading header 1

Corrected not reading header 1 for bit-weights in 18 channel file.

5 Corrected print bug

Corrected existing print bug that overwrote the top of page.

6 Corrected long integer overflow calculating time

Corrected long integer overflow calculating time. When using the mouse to point at data, the reported time would suddenly change drastically.

7 Corrected memory overwrite

Corrected memory overwrite in getgamples for steim 2 when data packet number of samples equals zero and when data packet number of samples equals zero.

8 Modified text windows

Modified text windows to allow vert and horz scroll bars.

9 Modified header 2 and trailer 2

Modified header 2 and trailer 2 in contents, raw, header and trailer tabs.

10 Modified file open

Modified file open to be ReadOnly and ShareDenyNone.

11 Modified Menu subitem

Modified Menu subitem from G_Entry to "Nominal G Entry".

12 Modified the Gs Entry screen

Modified the Gs Entry screen title text to read "Nominal Volts Per G Values".

13 Modified AllowGsEntry

Modified AllowGsEntry to disable the Option submenu items Use-NominalBitWeight and UseNominalVperG and also to disable the OK and Defaults buttons in the Nominal G Entry screen.

14 Modified Event header and trailer

Modified Event header and trailer; time source, time quality decoding. Added to Event header and trailer; total recorder channels.

15 Modified data page contents

Modified data pages in contents for a second event in the file with the same event number. Added display of data pages in contents for a second event in the file with the same event number.

16 Modified stream number

Modified stream number to display in top panel when graphing.

17 Added SOH text search

Case insensitive

18 Added total recorder channels

Added total recorder channels to Event header and trailer decoding.

19 Added decode calibration schedule

Added decode calibration schedule in Cal packets produced by 130 firmware release 2.7.0.

20 Added flag data decompression

Added flag data decompression and number of decompressed values errors in contents and on data tab.

21 Added display of stream number

Added display of stream number in top panel when graphing.

22 Added display of stream number

23 Added marker for first sample of data packet

24 Added save filter selection to ini file

25 Added filtering options

Added filtering, 12Hz Lopass, 0.1Hz Hipass and 2Hz Hipass.

26 Added decode of Trigger Out Delay

Added decode of Trigger Out Delay in Event Headers and Trailers.

27 Added the actual used Volts per G

Added the actual used Volts per G values to the Nominal G Entry Screen.

28 Added an INI file entry for AllowGsEntry

Added an INI file entry for AllowGsEntry. Default entry to off.

29 Added Decode calibration schedule

Added Decode calibration schedule in Cal packets produced by 130 firmware release 2.7.0.

30 Added detection of data compression control flag errors.

Added ability to flag above errors in contents and on data tab.

31 Added detection of number of decompressed values error.

Added ability to flag above errors in contents and on data tab.

B.5 Version 1.3.0 (September 23, 2005)

This section of this manual lists and describes the functional modifications made to the Ref Tek RT_View software version 1.2.0 to create version 1.3.0, as follows:

New Features since 1.2.0

1. Added support for filter description packet.
2. Added support for Steim 2 decompression.
3. Added G's entry for channels 7-16.
4. Added Time align the graph x axis.
5. Added time to each line of samples in Data tab.
6. Added use of ALT key with mouse to switch to the data tab for that time.
7. Added MarkSamples check box to draw circles around sample points.
8. Added time in hh:mm:ss format to status bar for mouse position in graph.
9. Added channel display check boxes to top panel.
10. Added Menu Options for force use of nominal bit weight and nominal volts per G
11. Added zoom button, measure button and measure text to graph page.
12. Added Left and right mouse click either hi-light/zoom or hi-light/measure time.
13. Added support for 72A scsi disk data (multiple units and events interleaved.)
14. Modified to speed up graphing
15. Modified table of contents to remember the last selected item.

Changes for version 1.3.0

WARNING: Please review all release notes between the software version you are running and the version you wish to install.

1. Corrected printing problem.
2. Corrected run time error.
3. Corrected decoding of Data Stream packet.
4. Corrected runtime error.
5. Corrected bug in 32-bit data.
6. Corrected bug in steim 2.
7. Corrected decode of steim.
8. Corrected mean value computation.
9. Corrected printing lockup.
10. Corrected scroll bar arrows.
11. Corrected mouse click.
12. Corrected rounding error.
13. Corrected plotting error.
14. Corrected measuring Y value.
15. Corrected graphing data.
16. Corrected mouse move display.
17. Corrected event without data.
18. Corrected Date conversion.
19. Corrected packet graphing.
20. Corrected data page error.
21. Corrected graphing bad date error.
22. Corrected end event errors.
23. Corrected channel graphing.
24. Corrected search functions.
25. Corrected contents tab.
26. Corrected graph interleave.
27. Modified decode data destination.
28. Modified filter packet decode.
29. Modified sample rate.
30. Modified multiple program copies.
31. Modified filter packet format.
32. Modified event channels.
33. Modified to work with rtcnvrt.
34. Modified G's.
35. Modified X graphing grid.
36. Modified Mark Sample.
37. Modified Packet time.
38. Modified default to 3 channel.

39. Modified channel number.
40. Modified channel check boxes.
41. Modified hi-light region limit.
42. Modified left and right mouse click.
43. Modified graphing speed.
44. Modified disk access.
45. Modified zoom.
46. Modified windows short date.
47. Modified draw.
48. Modified screen graph.
49. Modified printed plot.
50. Modified TOC.
51. Added data packet type.
52. Added data tab message.
53. Added graph color change.
54. Added SaveEvent function.
55. Added FD decode.
56. Added Steim 2 decompression.
57. Added G's entry for Ch 7-16.
58. Added PI decode.
59. Added event header info.
60. Added time to Data tab.
61. Added use of ALT key.
62. Added MarkSamples.
63. Added time format.
64. Added channel display boxes.
65. Added status bar.
66. Added bit weight menu options.
67. Added zoom button.
68. Added channel check boxes.
69. Added 0.1 graphing.
70. Added disable of NEXT and BACK.
71. Added Save screen.
72. Added DAS checking of S/N.
73. Added drag and drop.

- 1 Corrected printing of filter description**
Corrected printing of filter description packet.
- 2 Corrected run time error**
Corrected run time error when a packet is more than 24 days from event start. Time is forced to a max of 24 days from event start.
- 3 Corrected decoding of Data Stream packet**
Corrected decoding of Data Stream packet with two streams having the same trigger type.
- 4 Corrected runtime error**
Corrected runtime error on close due to small array size filter packet coefficients.
- 5 Corrected bug in 32 bit data**
Corrected bug in 32 bit data introduced in 1.2.0.20.
- 6 Corrected bug in steim 2**
Corrected bug in steim 2, 15 bit value decode.
- 7 Corrected decode**
Corrected decode of steim 2. Corrected decode of steim 1 bug introduced in 1.2.0.20.
- 8 Corrected mean value computation**
Corrected mean value computation to be the displayed data instead of entire event.
- 9 Corrected printing lockup**
Corrected lockup in printing the graph from beta 15.
- 10 Corrected scroll bar arrows**
Corrected click of scroll bar arrows to move in step size of 1 sample.
- 11 Corrected mouse click**
Corrected ALT mouse click not display correct channel or time. Corrected mouse to status bar display when channels are not displayed.
- 12 Corrected rounding error**
Corrected rounding in calc of date time from mouse position result in 1mS error.
- 13 Corrected plotting error**
Corrected plotting of very first sample, 1 sample period late.

14 Corrected measuring Y value

Corrected measure Y value jump when mouse moves to another channel area.

15 Corrected graphing data

Corrected Graph Data (when units of G's selected) to use event header volts per G otherwise use value in G's entry table.

16 Corrected mouse move display

Corrected mouse move display of x value to use a saved sps from graphing event.

17 Corrected event without data

Corrected to handle event with no data.

18 Corrected Date conversion

Corrected Date conversion to use windows DateSeperator character.

19 Corrected packet graphing

Corrected problem in graphing when back to back packets are the same channel.

20 Corrected data page error

Corrected going to last data page if no event trailer.

21 Corrected graphing bad date error

Corrected "Bad Date" error on graph. Reload event header after scanning for data min max because another event header for a new event could have been read.

22 Corrected end event errors

Corrected more places checking for end event with DAS and event numbers.

23 Corrected channel graphing

Corrected graph if channel data first samples are not time aligned.

24 Corrected search functions

Corrected search functions to exit proper when starting 1 page from end(forward search) or beginning (back search).

25 Corrected contents tab

Corrected contents tab to display every event header and trailer. Other like pages that follow are suppressed in the contents as before.

26 Corrected graph interleave

Corrected graph if more than one event in file and the events are interleaved.

27 Modified decode data destination

Modified decode data destination in stream info and aux info to be position dependent instead of value dependent.

28 Modified filter packet decode

Modified filter packet decode per change in recording format.

29 Modified sample rate

Modified to handle 0.1 sample per second rate.

30 Modified multiple program copies

Modified spawn multiple copies of program when more than one file drag and drop on program.

31 Modified filter packet format

Modified format of filter packet scaller display.

32 Modified event channels

Modified the channels of an event to be written to ascii files.

33 Modified to work with rtcnvr

Modified filenames and content to match that of **REF TEK** rtcnvr program.

34 Modified G's

Modified default G's to 2.4.

35 Modified X graphing grid

Modified graph X grid to be time aligned instead of relative to first sample. Modified graph X grid to show short ticks at 0.1 second intervals and top to bottom line on the second when grid is 1 sec/div.

36 Modified Mark Sample

Modified and moved "Mark Samples" option from menu to a Check box on the Graph tab.

37 Modified Packet time

Modified the Packet time to locate where to place the first sample of packet on the graph.

38 Modified default to 3 channel

Modified default to 3 channel check boxes visible at file open.

39 Modified channel number

Modified channel number text limit if more than 6 channels on screen.

40 Modified channel check boxes

Modified visible only channel check boxes for active channels in event.

41 Modified hi-light region limit

Modified the limit of the hi-light region to present channel when measure button checked.

42 Modified left and right mouse click

Modified left and right mouse click to be either hi-light/zoom or hi-light/measure time.

43 Modified graphing speed

Modified and speed up graphing by reducing the line drawing calls made.

44 Modified disk access

Modified and reduced disk access by storing select information for each packet in an array.

45 Modified zoom

Modified zoom to not allow zoom scroll bar to go to zero.

46 Modified windows short date

Modified windows short date format to properly position the year (m/d/y y/m/d) in internal date conversion (started in v1.2.0.7 beta).

47 Modified draw

Modified draw to save the bitmap at same time as screen to allow window to go to background and finish the plot.

48 Modified screen graph

Modified screen graph limitation of 6 channels to now be 16.

49 Modified printed plot

Modified printed plot if first channel is not 1.

50 Modified TOC

Modified the table of contents remember the last selected item for when the user goes back to the contents.

51 Added data packet type

Added data packet type to contents header and trailer message.

52 Added data tab message

Added message in data tab if decompressed last page sample does not match the stored last value.

53 Added graph color change

Added change of graph plot color from red to black for packet that the decompressed last sample does not match the stored last value.

54 Added SaveEvent function

Added the Enable of the SaveEvent menu function.

55 Added FD decode

Added decode of FD (filter description) packet type.

56 Added Steim 2 decompression

Added Steim 2 decompression for C2 data packet.

57 Added G's entry for ch 7-16

Added G's entry for channels 7-16.

58 Added PI decode

Added decode of Parameter Implement Time field in Aux, Cal, Data Stream, Op Mode and Station Channel packets.

59 Added event header info

Added event header channel gain codes F to J.

60 Added time to Data tab

Added time to each line of samples in Data tab.

61 Added use of ALT key

Added use of ALT key with mouse left click to switch to the data tab and packet containing that time point.

62 Added MarkSamples

Added MarkSamples menu item to draw circles around sample points.

63 Added time format

Added time in hh:mm:ss format to status bar for mouse position in graph.

64 Added channel display boxes

Added channel display check boxes to top panel.

65 Added status bar

Added status bar hints for menu items.

66 Added bit weight menu options

Added Menu Options for force use of nominal bit weight and nominal volts per G.

67 Added zoom button

Added zoom button, measure button and measure text to graph page.

68 Added channel check boxes

Added channel check boxes to a panel in the graph tab sheet.

69 Added 0.1 graphing

Added 0.1 sec/div capability to graphing.

70 Added disable of NEXT and BACK

Added disable of NEXT and BACK button during graphing.

71 Added Save screen

Added Save screen to bitmap for fast repaint when switching between windows programs.

72 Added DAS checking of S/N

Added checking of the DAS s/n and event num for Back and Next buttons.

73 Added drag and drop

Added function to allow file drag and drop without doing a file/close first.

B.6 Version 1.2.0 (June 8, 2004)

This section of this manual lists and describes the functional modifications made to the Ref Tek RT_View software version 1.1.0 to create version 1.2.0, as follows:

1. Corrected an off by one problem.
2. Corrected divide by zero.
3. Corrected display problem.
4. Corrected close file windows handle.
5. Corrected continuos trigger start time.
6. Corrected event header and trailer station.
7. Corrected field sizes in event header and trailer.
8. Modified hard coded field length.
9. Modified all hard coded field position/length values.
10. Added event header and trailer sensor units fields.
11. Added changed size of sensor VPU field.
12. Added decoding of filter list codes.
13. Added event header and trailer fields.
14. Added chan and sensor fields to event header and trailer.
15. Added time source, time quality and station comment.

Please review all release notes between the software version you are running and the version you wish to install.

- 1 Corrected an off by one problem.**
Corrected an off by one problem in Menu > Locate > gotopage.
- 2 Corrected divide by zero.**
Corrected divide by zero when file had only and event header, no data and user clicked on "graph" tab.
- 3 Corrected display problem.**
Corrected display problem with event header and trailer new fields.
- 4 Corrected close file windows handle type.**
Corrected close file windows handle type from menu File Exit.
- 5 Corrected continuos trigger start time.**
Corrected continuos trigger start time field length.
- 6 Corrected event header and trailer.**
Corrected event header and trailer station comment field length.
- 7 Corrected field sizes in event header and trailer.**
Corrected field sizes in event header and trailer per Recording format doc dated May 13, 2004.
- 8 Modified hard coded field length.**
Modified hard coded field length for sensor volt per unit in event header and trailer packet decode.
- 9 Modified all hard coded field position/length values.**
Modified all hard coded field position/length values (in event header and trailer decode) with entries already defined in include file.
- 10 Added event header and trailer sensor units fields.**
Added event header and trailer sensor units fields.
- 11 Added changed size of sensor VPU field.**
Added changed size of sensor VPU field in header and trailer.
- 12 Added decoding of filter list codes.**
Added decoding of filter list codes.
- 13 Added event header and trailer fields.**
Added event header and trailer new fields.

14 Added chan and sensor fields to event header and trailer.

Added chan gain, chan a/d resolution, chan FSA, chan code, sensor FSA and sensor VPU to event header and trailer.

15 Added time source, time quality and station comment.

Added time source, time quality and station comment to event header and trailer.

B.7 Version 1.1.0 (February 26, 2004)

This section of this manual lists and describes the functional modifications made to the Ref Tek RT_View software version 1.0 to create version 1.1.0, as follows:

1. Corrected drag and drop of a file to shortcut.
2. Corrected print graph x axis.
3. Corrected scroll bars to default on file open.
4. Corrected close file handle.
5. Corrected event station comment.
6. Corrected continuous trigger start time.
7. Corrected display problem.
8. Corrected divide by zero with no data.
9. Removed range from status line display.
10. Modified opening files to be Read-Only.
11. Modified hard coded field lengths.
12. Modified field sizes (event header and trailer).
13. Added vertical range to Status line text.
14. Added drag and drop of a file to running program.
15. Added units label to y scale values.
16. Added ScaleByTrace option.
17. Added graph Y center line value.
18. Added mean removal option.
19. Added graph zoom/unzoom.
20. Added print graph Y center line value.
21. Added text mode display.
22. Added display of range and mean.
23. Added delta time to click-and-drag.
24. Added file extension .rte.
25. Added GraphEventData to Options menu.
26. Added set defaults button.
27. Added Save Options menu.
28. Added ini file.
29. Added new event header and trailer fields.
30. Added decode of filter list.

Please review all release notes between the software version you are running and the version you wish to install.

- 1 Corrected drag and drop of a file to shortcut**
Fixed drag and drop of a file on to the non running executable (or a shortcut) that generated a "Cannot focus a disabled or invisible window" popup box.
- 2 Corrected print graph x axis**
Fixed print graph x axis min. and max values when zoomed.
- 3 Corrected scroll bars to default on file open**
Forced scroll bars to default on file open.
- 4 Corrected close files handle**
Fixed file closing handle type on "File" "Exit" menu.
- 5 Corrected event station comment**
Fixed event header and trailer station comment field length.
- 6 Corrected continuous trigger start time**
Fixed continuous trigger start time field length.
- 7 Corrected display problem**
Fixed display problem with added event header and trailer fields.
- 8 Corrected divide by zero with no data**
Fixed divide by zero when file has only an event header and no data when a user clicks the "graph" tab.
- 9 Removed range from status line display**
Removed range from status line display.
- 10 Modified opening files to be Read-Only**
Change file routines from pascal type to windows handle type so that the data files can be opened read-only.
- 11 Modified hard coded field lengths**
Replaced hard coded position/length values (in event header and trailer decode) with entries already defined in the include file.
- 12 Modified filed sizes in event header and trailer**
Change size of sensor VPU field in header and trailer. Applied change in field sizes in event header and trailer per Recording Format Specification (May 13, 2004).

13 Added vertical range to Status line text

In data graph window, added vertical range to Status line text.

14 Added drag and drop of a file to running program

Added drag and drop of a file from Windows Explorer on to the running executable. Rt_View cannot have a file open when drag and drop is performed.

15 Added units label to Y scale values

Added units label (V,G) to y scale values.

16 Added ScaleByTrace option

Added ScaleByTrace option to allow common scaling of all displayed channels or independent scaling of each channel.

17 Added graph Y center line value

Added graph Y center line value.

18 Added mean removal option

Added mean removal option.

19 Added graph zoom/unzoom

Added graph zoom/unzoom via left/right mouse button clicks.

20 Added print graph Y center line value

Added print graph Y center line value.

21 Added text mode display

Added text mode display of ScaleByTrace and MeanRemoval to display and print.

22 Added display of range and mean

Added display of range and mean to each graph for display and print.

23 Added delta time to click-and-drag

Added delta time to click-and-drag to zoom.

24 Added file extension .rte

Added file extension .rte to file open dialog box.

25 Added GraphEventData to Options menu

Added GraphEventData to Options menu to allow graphing of event data to display when Event Header, Trailer or Data is clicked on in the Contents list.

26 Added set defaults button

Added set defaults button (1.2V/G) to Gs Entry window under options.

27 Added Save Options menu

Added Save Options menu item to put Option menu setting to ini file.

28 Added ini file

Added ini file for the application window size and state save/restore.

29 Added new event header and trailer fields

Added time source, time quality and station comment to event header and trailer. Added channel gain, channel A/D resolution, channel FSA, channel code, sensor FSA and sensor VPU to event header and trailer. Added sensor units fields.

30 Added decode of filter list

Added decoding of filter list codes.

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