REF TEK PAS2SAC

Data Utility Guide

95590-00-UG Rev B

Version 1.1

4/1/2016

This REF TEK manual describes a utility program for converting PASSCAL data recorded with a REF TEK DAS to SAC format.

Revision History:

Revision	Date	Reason for change	Pages
A	2018.10.15	New Program Release	All
B	2016.04.01	Header modifications	9, 12-15

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.
FPn	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; 103 = 1,000
M, MHz	Mega, MegaHertz; 106 = 1,000,000
G, GHz	Giga, GigaHertz; 109 = 1,000,000,000
Kb, KB	Kilobit, KiloByte; 210 = 1,024
Mb, MB	Megabit, MegaByte; 220 = 1,048,576
Gb, GB	Gigabit, GigaByte; 230 = 1,073,741,824

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 REF TEK customer support team.

To register, fill out our online registration form at http://support.reftek.com .

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

Support Email: reftek_support@trimble.com

Support Phone: 1-888-879-2207

Thanks,

Your Trimble Global Services Support Team

Contents

This Page Intentionally Left Blank.

PAS2SAC

1 General Description

The REF TEK **PAS2SAC** program converts a REF TEK PASSCAL raw data file into SAC format data files.

Note: **pas2sac.exe** is the Win32 version and **pas2sac** is the name of the Unix versions.

If present, the **PAS2SAC** program uses an INI file to set values that it cannot find in the raw data file. The **PAS2SAC** program uses the file specified using the –I program switch option. If –I is not used, the **PAS2SAC** program looks for the RTU environment variable. If the RTU environment variable is not found, it then looks for **rtu.ini** in the current directory. If not found, it then looks for **rtu.ini** in the directory where the program is located. If not found, the **PAS2SAC** program uses default values.

2 Program usage

The **PAS2SAC** program is invoked using the following command:

```
pas2sac [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. It can be any path available on the file system.

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

2.1   PAS2SAC Program Switches

Switch	Name	Description	Switch command	Ex:	Default

-Dc	DT log	Output DT headers in log file	c:
			  Y/+ : output DT header in logs
			  N/ - : do not output DT header in logs
				-D+	N / -

-Is	INI File	INI File Name	s: a valid file pathname	-Ic:\RT**my_ini**	**rtu.ini**

-Lc	Log File	Log File Output	c:
			  Y/+ : output logs
			  N/ - : do not output logs
				-Ly	Y / +

-Nc	Name	Control Name options	c:
			  A/0/N/-:auto-select Unit ID/Station
			  1/I : always use Unit ID
				-Ns	(Auto)

-Pn	Path	Output path control	n:
			  0 : no additional subdirectories
			  1 : one level : yyyy_ddd[1]
			  2 : two levels: yyyy_ddd, then hh
			  3 : two levels: yyyy_ddd, then hh_mm
			  4 : two levels: yyyy_ddd, then hh_mm_ss
				-p2	0

-Qc	QCC File	Quality Control Calculations file output	c:
			  Y/+ : output file
			  N/- : do not output file
				-q+	N / -

-Rn	Sample Rate	Default Sample Rate (only used if rate not known)	n: constant	-R40	100
-Sn	Sample Count	Limit the number of samples in the output file	n: constant	-s3000	4,294,967,295
-Tn	Toss samples	Toss the first *n* samples from each channel of an event	n: constant	-T100	0

-Vc	Verbose	Verbose message output	c:
			  Y/+ : output message
			  N/ - : do not output message
				-Vn	Y/+

---

[1] yyyy = year, ddd = day of year, hh = hour, mm = minute, ss = second

This Page Left Intentionally Blank

3   INI Settings

The **PAS2SAC** program uses the first INI file it finds. It searches for the INI file in the following locations:

- File specified by the **–I** program switch option.
- The fully-qualified file specified by the RTU environment variable.
- **rtu.ini** in the current working directory.
- **rtu.ini** in the directory where the **PAS2SAC** program is located.

If the INI file is not found, the **PAS2SAC** program uses default values.

Each time the **PAS2SAC** program encounters a new event in the input file, it initializes all settings to default values. It then opens the INI file, if one can be found, and overwrites only those settings it finds in the INI file. As it continues processing the input file, it overwrites the settings with the information it finds in the recording packets.

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

```
Ex:  [90A5]
```

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=STAP2
```

All sections 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. Lines that begin with white space are also treated as comments.

```
Ex:  ;This is a comment.
Ex:  Station=STAP2  ;This is another comment
Ex:     Yet another comment
```

3.1 INI Fields

The following table lists the fields used by the **PAS2SAC** program and how it uses a particular field.

Field	Description	Type	Example
Network	Network Name	Text.8	Network = USGSLFGN
Station	Station Name	Text.5	Station = 1A2BM
Latitude	Degrees Latitude	Float.4	Latitude = 44.0235
Longitude	Degrees Longitude	Float.4	Longitude = 160.65
Altitude	Altitude in meters	Integer	Altitude = 180
CHnAZM	Channel n Azimuth	Integer	CH1Azm = 90
CHnDIP	Channel n Dip	Integer	CH1Dip = 10
CHnBAND	Channel n SEED band code	Text.1	CH1Band = B
CHnTYPE	Channel n SEED type code	Text.1	CH1Type = H
CHnAXIS	Channel n SEED axis code	Text.1	CH1Axis = Z

3.2 Sample INI File

```
[9FE3]
;Station settings:
Station     =STTA1
Network     =USGSLFGN
Latitude    =44.0235
Longitude   =160.65
Altitude    =180

;Channel 1 settings:
CH1Dip  =10

;Channel 2 settings:
CH2Dip  =-5

;Channel 3 settings:
CH3Dip  =20
```

4 PAS2SAC Output Files

All output file specifications adhere to the ISO-9660 level 2 standard. This standard limits file names to 32 characters including 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.

4.1 PAS2SAC Files

The **PAS2SAC** program creates output file names using the first sample time of the trace and either the Station Name or the Unit ID (serial) number of the REF TEK DAS that collected the data.

File Type	Description	File Name Structure	Example
PASSCAL RAW Data File	Data as collected by a REF TEK DAS.	inputfilename.RT	1999260115841097_0036F0E2_91C6_1.RT
Master QCC File	Text file containing Quality control Calculations; data max, min, std dev (RMS).	inputfilename.QCC	1999260115841097_0036F0E2_91C6_1.QCC
Master Log File	Text log of the conversion process.	inputfilename.RTL	1999260115841097_0036F0E2_91C6_1.RTL
Unit Log File	Text log of packets for each Unit ID in the file	IDiiii.RTL[1]	ID91C6.RTL
SAC Trace Data File	Data in SAC data format.	yyyydddhhmmssttt _iiiii_s_c.SAC[2]	1999260115841097_091C6_1_1.SAC

---

[1] iiii = uid (serial no.)
[2] yyyy = year, ddd = day of year, hh = hour, mm = minute, ss = second, ttt = msecond, iiiii = uid (serial no.) or station name, s = stream, c = channel (1-9, A-W)

This Page Left Intentionally blank

5   SAC File Format

The **PAS2SAC** program generates one output file per channel per event in SAC BINARY format. The **PAS2SAC** program always writes binary values in big-endian byte order. Each of these SAC trace files contains a header section followed by a data section.

5.1   SAC Header Fields

The header section is composed of 158 32-bit values. Each value is one of the following types:

Type	Name	Description	Undefined Value
F	Float	Single-precision floating point	-12345.0
N	Integer	Field names begin with 'N' An integer	-12345
I	Enumerated	Field names begin with 'I' An integer from a fixed list of values	-12345
L	Logical	Field names being with 'L' Either TRUE (1) or FALSE (0)	FALSE
K	Alphanumeric	Field names begin with 'K' 8 or 16 alphanumeric characters	"-12345"

The F, I and L values are 1 (long-)word in length (4 bytes). The K values are all 2 (long-) words (8 bytes) long, except for one field that is 4 (long-)words (16 bytes) long.

Each field belongs to a particular group of variables. The groups are:

Type	Name	Description
R	Required	These MUST be present in the file
T	Time	These contain time information
P	Phase	These contain phase pick information
I	Instrument	These contain recording instrument information
S	Station	These contain station information
E	Event	These contain event information
M	Misc.	These contain miscellaneous information

The following table lists the header fields.

- The *Word* column specifies the 4-byte (long-) word offset from the beginning of the file.
- The *Group* column specifies what group of SAC variables the field belongs to.
- The *Field* column gives the field name. If the field name is INTERNAL then that variable is internal to the SAC program itself. If the field name is set to UNUSED then that variable is currently unused and should be set to the undefined value for its type.
- The *Type* column specifies the field's type.
- The *SAC Description* column gives the SAC definition of the field.
- The *REF TEK Usage* column shows how **PAS2SAC** fills in the field. EH indicates a field in the PASSCAL EH packet. INI indicates a field in the INI file. All fields are set to their UNDEFINDED value except where noted.

Word	Grp	Field	Type	SAC Description	REF TEK usage
0	R	DELTA	F	Increment between evenly spaced samples	Sample period in Seconds
1	T	DEPMIN	F	Min value of dependent var.	Min sample val
2	T	DEPMAX	F	Max value of dependent var.	Max sample val
3	T	SCALE	F	Multiplying scale for dependent var.	1
4	T	ODELTA	F	Observed increment between evenly spaced samples	Sample period in Seconds
5	R	B	F	Beginning value of indep. variable	0
6	R	E	F	Ending value of indep. variable	Sample count – 1
7	T	O	F	Event origin time seconds rel. to ref. time	Offset to trigger in seconds if not equal to 1st sample time
8	P	A	F	First arrival time secs rel. to ref.	
9		INTERNAL	F		
10	P	T0	F	User-defined time picks or markers	
11	P	T1	F	User-defined time picks or markers	
12	P	T2	F	User-defined time picks or markers	
13	P	T3	F	User-defined time picks or markers	
14	P	T4	F	User-defined time picks or markers	
15	P	T5	F	User-defined time picks or markers	
16	P	T6	F	User-defined time picks or markers	
17	P	T7	F	User-defined time picks or markers	
18	P	T8	F	User-defined time picks or markers	
19	P	T9	F	User-defined time picks or markers	
20	P	F	F	Fini or End of event time secs rel. to ref.	
21	I	RESP0	F	Instrument response parms (unused)	
22	I	RESP1	F	Instrument response parms (unused)	
23	I	RESP2	F	Instrument response parms (unused)	
24	I	RESP3	F	Instrument response parms (unused)	
25	I	RESP4	F	Instrument response parms (unused)	
26	I	RESP5	F	Instrument response parms (unused)	
27	I	RESP6	F	Instrument response parms (unused)	
28	I	RESP7	F	Instrument response parms (unused)	
29	I	RESP8	F	Instrument response parms (unused)	
30	I	RESP9	F	Instrument response parms (unused)	

Word	Grp	Field	Type	SAC Description	REF TEK usage
31	S	STLA	F	Station latitude (degrees, N pos)	EH-latitude or INI-Latitude
32	S	STLO	F	Station longitude (degrees, E pos)	EH-longitude or INI-Longitude
33	S	STEL	F	Station elevation (meters) (unused)	EH-altitude or INI-Altitude
34	S	STDP	F	Station depth (meters) (unused)	
35	E	EVLA	F	Event latitude (degrees, N pos)	
36	E	EVLO	F	Event longitude (degrees, E pos)	
37	E	EVEL	F	Event elevation (meters) (unused)	
38	E	EVDP	F	Event depth (meters) (unused)	
39	E	MAG	F	Event magnitude	
40	M	USER0	F	User-defined	
41	M	USER1	F	User-defined	
42	M	USER2	F	User-defined	
43	M	USER3	F	User-defined	
44	M	USER4	F	User-defined	
45	M	USER5	F	User-defined	
46	M	USER6	F	User-defined	
47	M	USER7	F	User-defined	
48	M	USER8	F	User-defined	
49	M	USER9	F	User-defined	
50	E	DIST	F	Station to event distance (km)	
51	E	AZ	F	Event to station azimuth (deg)	
52	E	BAZ	F	Station to event azimuth (deg)	
53	E	GCARC	F	Station to event great circle arc length (deg)	
54		INTERNAL	F		
55		INTERNAL	F		
56	T	DEPMEN	F	Mean value of dependent var	Avg sample val
57	S	CMPAZ	F	Component azimuth (deg from N)	INI-CHnAzm
58	S	CMPINC	F	Component incident angle (deg from vert)	INI-CHnDip
59	M	XMINIMUM	F	Min value of X (spectral files only)	
60	M	XMAXIMUM	F	Max value of X (spectral files only)	
61	M	YMINIMUM	F	Min value of Y (spectral files only)	
62	M	YMAXIMUM	F	Max value of Y (spectral files only)	
63		UNUSED	F		
64		UNUSED	F		
65		UNUSED	F		
66		UNUSED	F		
67		UNUSED	F		
68		UNUSED	F		
69		UNUSED	F		
70	T	NZYEAR	N	GMT year to reference (zero) time in file	UTC 1st Sample Year
71	T	NZJDAY	N	GMT Julian day	UTC day of year
72	T	NZHOUR	N	GMT hour	UTC hour
73	T	NZMIN	N	GMT minute	UTC minute
74	T	NZSEC	N	GMT second	UTC second
75	T	NZMSEC	N	GMT millisecond	UTC millisecond
76	**R**	NVHDR	N	Header version	6
77	E	NORID	N	Event ID (CSS 3.0)	
78	E	NEVID	N	Origin ID (CSS 3.0)	
79	**R**	NPTS	N	# points per data component	Sample count

Word	Grp	Field	Type	SAC Description	REF TEK usage
80		INTERNAL	N		
81	E	NWFID	N	Waveform ID (CSS 3.0)	
82	M	NXSIZE	N	Spectral length (spectral files only)	
83	M	NYSIZE	N	Spectral Width (spectral files only)	
84		UNUSED	N		
85	**R**	IFTYPE	I	Type of File	ITIME = 1
86	T	IDEP	I	Type of dependent variable	IUNKN = 5
87	T	IZTYPE	I	Reference time equivalence	IUNKN = 5
88		UNUSED	I		
89	I	IINST	I	Type of recording instrument (unused)	
90	S	ISTREG	I	Station geographic region (unused)	
91	E	IEVREG	I	Event geographical region (unused)	
92	E	IEVTYP	I	Event type	IUNKN = 5
93	M	IQUAL	I	Data quality (unused)	IGOOD = 45
94	M	ISYNTH	I	Synthetic data (unused)	IRLDTA = 49
95	E	IMAGTYP	I	Magnitude type	
96	E	IMAGSRC	I	Magnitude information source	
97		UNUSED	I		
98		UNUSED	I		
99		UNUSED	I		
100		UNUSED	I		
101		UNUSED	I		
102		UNUSED	I		
103		UNUSED	I		
104		UNUSED	I		
105	**R**	LEVEN	L	TRUE if data is evenly spaced	TRUE
106	S	LPSPOL	L	TRUE if components have pos polarity (left-hand rule)	TRUE
107	M	LOVROK	L	TRUE if okay to overwrite file	TRUE
108	M	LCALDA	L	TRUE if DIST, AZ, BAZ, GCARC calc'ed from stn & evt cords	
109		UNUSED	L		
110	S	KSTNM	K	Station Name	EH station name or INI-Station or UID
111	…	…	K		
112	E	KEVNM*	K	Event name	
113	…	…	K		
114	…	…	K		
115	…	…	K		
116	E	KHOLE	K	Hole ID if nuclear event	
117	…	…	K		
118	**R**	KO	K	Event origin time ID	???
119	…	…	K		
120	P	KA	K	First arrival time ID	
121	…	…	K		
122	P	KT0	K	User-defined pick time ID	
123	…	…	K		
124	P	KT1	K	User-defined pick time ID	
125	…	…	K		
126	P	KT2	K	User-defined pick time ID	
127	…	…	K		
128	P	KT3	K	User-defined pick time ID	
129	…	…	K		
130	P	KT4	K	User-defined pick time ID	

Word	Grp	Field	Type	SAC Description	REF TEK usage
131	…	…	K		
132	P	KT5	K	User-defined pick time ID	
133	…	…	K		
134	P	KT6	K	User-defined pick time ID	
135	…	…	K		
136	P	KT7	K	User-defined pick time ID	
137	…	…	K		
138	P	KT8	K	User-defined pick time ID	
139	…	…	K		
140	P	KT9	K	User-defined pick time ID	
141	…	…	K		
142	P	KF	K	Fini ID	
143	…	…	K		
144	M	KUSER0	K	User-defined	
145	…	…	K		
146	M	KUSER1	K	User-defined	
147	…	…	K		
148	M	KUSER2	K	User-defined	
149	…	…	K		
150	S	KCMPNM	K	Component name	UID-<INI: SEED Band, Type, Axis> or UID-Stm-Chn
151	…	…	K		
152	S	KNETWK	K	Name of seismic network	INI-NETWORK
153	…	…	K		
154	M	KDATRD	K	Date data read onto computer	Convert date:
155	…	…	K		YYYY:DDD
156	I	KINST	K	Generic name of recorder	"RT 130 "
157	…	…	K		

Trimble Navigation Limited
1600 Tenth Street
Suite A
Plano, Texas 75074
Tel: 214-440-1265
Fax: 972-578-0045
www.trimble.com/infrastructure