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Application Note #156 AcqKnowledge File Format for Windows/PC

This document describes file formatting for all Windows versions of AcqKnowledge **3.9.0** or below, BSL 3.7.0 or below, and BSL PRO v3.7.0 or below. The File Format allows the user to get to the data section of the BIOPAC file format; Journal text is not included but can be exported separately if needed. Where noted, marker details (such as Type: Append or Event) may not be accessible, but the marker tag can be identified.

NOTE Programmers are strongly encouraged to use the <u>BIOPAC File Format API</u> for BSL or AcqKnowledge, which should simplify data extraction for most programmers. If the API does not satisfy your needs, additional file format info is in this document.

Document Log

Version 3.9.0 February 23, 2007 Magenta Bold

Version 3.8.2 July 15, 2005 Green Bold

Version 3.7 (BSL & PRO) February 1, 2005 (markers are generic)

Version 3.8.1 November 09, 2004 Changes are in **Aqua Bold**

AcqKnowledge API link April 28, 2003; Software library for programmers to parse ACQ files

Version 3.7.3December 25, 2002; Changes are in Orange BoldVersion 3.7.0-3.7.2August 21, 2001; Changes are in Green BoldVersion 3.7.xJune 08, 2001; Changes are in Grayed Bold

Version 3.5xSeptember 29, 1998Version 3.03October 4, 1995

Graph Header Section...

Item	Туре	Size	Offset	Description
nItemHeaderLen	short	2	0	Not currently used.
IVersion	long	4	2	File version identifier:

30 = Pre-version 2.0	
31 = Version 2.0 Beta 1	
32 = Version 2.0 release	
33 = Version 2.0.7 (Mac)	
34 = Version 3.0 In-house Release 1	
35 = Version 3.03	
36 = version 3.5x (Win 95, 98, NT)	
37 = version of BSL/PRO 3.6.x	
38 = version of Acq 3.7.0-3.7.2 (Win 98, 9	8SE, NT, Me, 2000)
39 = version of Acq 3.7.3 or above (Win 98	8, 98SE, 2000, Me, XP)
41 = version of Acq 3.8.1 or above (Win 98	8, 98SE, 2000, Me, XP)
42 = version of BSL/PRO 3.7.X or above (Win 9	98, 98SE, 2000, Me, XP)
43 = version of Acq 3.8.2 or above (Win 98	8, 98SE, 2000, Me, XP)
44 = version of BSL/ <i>PRO</i> 3.8.x or above	
45 = version of Acq 3.9.0 or above	

lExtItemHeaderLen	long	4	6	Extended item header length.
nChannels	short	2	10	Number of channels stored.
nHorizAxisType	short	2	12	Horizontal scale type, one of the

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							following	
								0 = Time in seconds
								1 = Time in HMS format
								2 = Frequency
								3 = Arbitrary
nCurChannel	short		2		14	Curr	ently selected	d channel.
dSampleTime	doubl	е	8		16	The number of milliseconds per sample.		
dTimeOffset	doubl	е	8		24	The initial time offset in milliseconds.		
dTimeScale	doubl	е	8		32	The time scale in milliseconds per division.		
dTimeCursor1	doubl	e	8		40	Curs	or 1 time pos	sition in milliseconds.
dTimeCursor2	doubl	е	8		48	Curs	or 2 time pos	sition in milliseconds.
rcWindow	RECT		8		56	The chart's size and position relative to Acq <i>Knowledge</i> client area. When each F field is set to 0, the chart is displayed default a size and position.		ent area. When each RECT the chart is displayed with
nMeasurement[6]	5	short		6*2	64			currently selected , one of the following:

0 = No measurement	
1 = Value Absolute voltage	
2 = Delta Voltage difference	•
3 = Peak to peak voltage	
4 = Maximum voltage	
5 = Minimum voltage	
6 = Mean voltage	
7 = Standard deviation	
8 = Integral	
9 = Area	
10 = Slope	
11 = LinReg	
13 = Median	
15 = Time	
16 = Delta Time	
17 = Freq	
18 = BPM	
19 = Samples	
20 = Delta Samples	
21 = Time of Median	
22 = Time of Max	
23 = Time of Min	
25 = Calculation	
26 = Correlation	

fHilite	BOOL	2	76	Gray non-selecte	ed waveforms:
					0 = Don't gray
					1 = Grav.

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dFirstTimeOffset	double	double		'8	Initial tim	e offset in milliseconds.		
nRescale	short		. 8	36	Autoscale after trans	forms:		
						0 = Don't autoscale		
						1 = Autoscale.		
szHorizUnits1	char	40	88	3	Horizontal units tex	t.		
szHorizUnits2	char	10	128	18	Horizontal units tex	t (abbreviated).		
nInMemory	short	2	138	88	Keep data file in me	Keep data file in memory:		

0 = Keep 1 = Don't keep.

fGrid	BOOL	2	140	Enable grid display.
fMarkers	BOOL	2	142	Enable marker display.
nPlotDraft	short	2	144	Enable draft plotting.
nDispMode	short	2	146	Display mode:

0 = Scope 1 = Chart.

nRReserved short 2 148 Reserved.

Version 3.0 and above ...

Item	Туре	Size	Offset	Description
BShowToolBar	short	2	150	
BShowChannelButtons	short	2	152	
BShowMeasurements	short	2	154	
BShowMarkers	short	2	156	
BShowJournal	short	2	158	
CurXChannel	short	2	160	
MmtPrecision	short	2	162	

Version 3.02 and above ...

Item	Туре	Size	Offset	Description
NMeasurementRows	short	2	164	Number of measurement rows
mmt[40]	short	2 * 40	166	Measurement functions
mmtChan[40]	short	2 * 40	246	Measurement channels

Version 3.5x and above ...

Item	Туре	Size	Offset	Description
MmtCalcOpnd1	short	2 * 40	326	Measurement, Calculation - Operand 1
MmtCalcOpnd2	short	2 * 40	406	Measurement, Calculation - Operand 2
MmtCalcOp	short	2 * 40	486	Measurement, Calculation - Operation
MmtCalcConstant	double	8 * 40	566	Measurement, Calculation - Constant

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Version 3.7.0 and above ...

Item		Туре	Туре		fset	Size	Description	
bNewGridwithMinor		BOOL		88	6	4	New Grid with minor line	
colorMajorGrid		long		89	0	4	COLORREF	
colorMinorGrid		long		89	4	4	COLORREF	
wMajorGridStyle		short		898	8	2	PS_SOLID, PS_DASH, PS_DOT, PS_DASHDOT, PS_DASHDOTDOT	
wMinorGridStyle		short		90	0	2	PS_SOLID, PS_DASH, PS_DOT, PS_DASHDOT, PS_DASHDOTDOT	
wMajorGridWidth		short		90	2	2	width of line in Pixels	
wMinorGridWidth		short		904	4	2	width of line in Pixels	
bFixedUnitsDiv		BOOL		90	6	4	Locked/Unlocked grid lines	
bMid_Range_Show		BOOL		91	0	4	show gridlines as MidPoint and Range	
dStart_Middle_Point		doubl	е	91	4	8	Startpoint to draw grid	
dOffset_Point		doubl	e	92	2	8 * 60	Offset of VERTICAL value per channel	
hGrid		double		14	02	8	Horizontal grid spacing	
vGrid	vGrid		double		10	8 * 60	Vertical grid spacing per channel	
bEnableWaveTools		BOOL		189	90	4	Enable Wavetools during acquisition	
Version 3.7.3 and above								
Item		Туре		Offs	set	Size	Description	
horizPrecision		short		189	94 2		digits of precision for units in Horizontal Axis	
Version 3.8.1 and above								
Item	Туре		Offset		Size	Description		
RESERVED	byte		1896		20	RESERVED		
bOverlapMode	BOOL	L 1916			4	Overlap Mod		
bShowHardware	BOOL	1920			4		Hardware visibility	
bXAutoPlot	BOOL	1924			4	-	ing acquisition	
bXAutoScroll	BOOL		1928		4	Autoscroll during acquisition		
bStartButtonVisible	BOOL		1932		4	Start button		
	bCompressed BOOL		1936		4	The file is co		
bAlwaysStartButtonVisible	BOOL		1940		4	Always show	SIDE DULLON	
Version 3.8.2 and above	T		Office		Cino	Description		
Item pathVideo	Type char		Offset 1944		Size 260	Description	pack video file	
patrivideo					200		sync delay between start	
optSyncDelay	BOOL		2204		4		and graph start.	
syncDelay	double		2208		8	Value of synd	c delay (ms)	
bHRP_PasteMeasurements	BOOL		2216		4	Option: past	e measurements to	

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journal (when Hold Relative Position is selected)

Version 3.9.0 and above ...

† 256 is a string required for the expression; 40 = 5*8 (max columns * max rows)

Item	Туре	Offset	Size †	Description
graphType	DWORD	2220	4	Type of the graph. The graph type identifies the source of the graph and whether any special transformations apply.
mmtCalcExpr[40][256]	char	2224	1*256*40	Measurements parameters: holds the expression entered by the user.
mmtMomentOrder[40]	long	12464	4*40	Measurements parameters: the order of the moment for moment measurements.
mmtTimeDelay[40]	long	12624	4*40	Measurements parameters: the time delay to use for the computation in sample intervals.
mmtEmbedDim[40]	long	12784	4*40	Measurements parameters: the embedding dimension for a measurement.
mmtMIDelay[40]	long	12944	4*40	Measurements parameters: the delay for which the mutual information should be computed.

Per Channel Data Section...

Item	Туре	Offset	Size	Description
lChanHeaderLen	long	0	4	Length of channel header.
nNum	short	4	2	Channel number.
szCommentText	char	6	40	Comment text.
rgbColor	RGB	46	4	Color.
nDispChan	short	50	2	Display option.
dVoltOffset	double	52	8	Amplitude offset (volts).
dVoltScale	double	60	8	Amplitude scale (volts/div).
szUnitsText	char	68	20	Units text.
lBufLength	long	88	4	Number of data samples.
dAmplScale	double	92	8	Units/count.
dAmplOffset	double	100	8	Units
nChanOrder	short	108	2	Displayed channel order.
nDispSize	short	110	2	Channel partition size.

Version 3.0 and above ...

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Item	Туре	Offset	Size	Description
plotMode	short	112	2	
vMid	double	114	8	

Version 3.7.0 and above ...

Item	Туре	Offset	Size	Description
szDescription	char	122	128	String of Channel description
nVarSampleDivider	short	250	2	Channel divider of main frequency

Version 3.7.3 and above ...

Item	Туре	Offset	Size	Description
vertPrecision	short	252	<i>'</i>	digits of precision for units in Vertical Axis for each channel

Version 3.8.2 and above ...

Item	Туре	Offset	Size	Description
ActiveSegmentColor	COLORREF	254	4	Color of active segment (Overlapped Mode)
ActiveSegmentStyle	long	258	4	Style of active segment (Overlapped Mode)

Foreign Data Section...

Item	Туре	Size	Offset	Description
nLength	short	2	0	Total length of foreign data packet.
nID	short	2	2	ID of foreign data.
ByForeignData	ВУТЕ	nLength-4	4	Foreign data.

Per Channel Data Types Section...

This block is repeated for as many channels that were detected in the graph header packet nChannels field.

Item	Туре	Size	Offset	Description
nSize	short	2	1()	Channel data size in bytes.
пТуре	short	2	2	Channel data type:

1 = double

2 = int

Channel Data Section...

The individual channel data is stored after the Per Channel Data Types Section. The channel data is in an interleaved format. The start of the real Channel Data is described by the following equation:

[IExtItemHeaderLen] + [IChanHeaderLen * nChannels] + [nlength] + [4 * nChannels]

The size of the Graph header section is defined in <code>IExtItemHeaderLen</code> (for Acq 3.7x this is 1894 bytes) if you take this value it will give you a pointer to the **Per Channel Data** section...

• The **Per Channel Data** section size is defined by IChanHeaderLen for each channel. Use the nChannels variable from the Graph header section and multiply by IChanHeaderLen (252 bytes for Acq 3.7x), add to the value from above this will then give you a pointer to the Foreign Data section.

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- The Foreign Data section length is defined by nLength and will vary depending on your acquisition setup. Add this to
 your running sum to get a pointer to the Per Channel Data Types section.
- The **Per Channel Data Types** section is where you find out if your data is double or integer and 2 bytes (Analog) or 8 bytes (Calculation channel) again this is repeated for each channel so multiply nChannels by 4 to get the total length of this section and add to your running sum to get a pointer to the real data.

A note of caution here, since we have added the variable sampling ability this could make the interleaved data format very complex to understand. For this reason, you will want to be sure all channels are at the same rate and length in order to export the data correctly. The data is stored in an interleaved format.

For 3 channels it would look something like:

Ch1 sample1, Ch2 sample1, Ch3 sample1, Ch1s2, Ch2s2, ch3s2, Ch1s3, Ch2s3, Ch3s3, etc.

If channels are sampled at different rates rather than having 3 channels of data for each sample it will skip the channel that has no value at that sample. For 3 channels, Channel 2 is half the sample rate it would look like:

Ch1 sample1, Ch2 sample1, Ch3 sample1, Ch1s2, ch3s2, Ch1s3, Ch2s3, Ch3s3, etc.

With Ch2s2 missing you can see how this would create disruption if the reading program is expecting a sample for each waveform.

Markers Header Section...

Item	Туре	Size	Offset	Description
lLength	long	4		Total length of all markers.
IMarkers	long	4	4	Number of markers.

Marker Item Section...

Item	Туре	Size	Offset	Description
Sample	long	4	0	Location of marker.
fSelected	BOOL	2	4	Select this marker.
fTextLocked	BOOL	2	6	Lock this text.
fPositionLocked	BOOL	2	8	Lock this location.
nTextLength	short	2	10	Length of marker text (including NULL).
szText	char	nTextLength	12	Marker text string.

Hardware structure...

For MP100 and MP150 (added adaptive filter channel settings): 16 is the number of calculation channels.

Item	Туре	Size	Description
adaptiveFilter_valueCha n	short	2*16	Value (source) channel number: this is the data consisting of the source data mixed with noise.
adaptiveFilter_noiseCha n	short	2*16	Noise channel number: it is correlated with the noise that is desired to be eliminated from the source channel.
adaptiveFilter_order	long	4*16	The number of terms that are used in the internal FIR filter.
adaptiveFilter_stepSize	double	8*16	The rate of adaptation of the coefficients within the FIR filter.

BIOPAC File Format API for BSL or AcqKnowledge Files

The **BIOPAC File Format Application Programming Interface (API)** is a software library that people with programming knowledge can use to identify and parse information in BIOPAC's ACQ binary file format.

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• The API is a software library programmers can use to create applications—it is not a data extraction program.

The API was developed using Microsoft Visual Studio C/C++ and is designed to be compatible with Microsoft C++ and Microsoft Visual Basic. The API may work with other developer's tools, but has not been tested for compatibility.

The API is the easiest way for people with programming knowledge to extract data from ACQ files for advanced analysis.

The API can be used for *.ACQ files created by BSL Lessons, BSL *PRO* or Acq*Knowledge*. It works with acquisitions of a single sample rate saved in the standard (not compressed) ACQ file format. The API can be used for files created on PCs with Windows (98, 98SE, Me, 2000 and XP) or Macintosh files that have been transferred to a PC running Windows.

The AcqKnowledge API allows you to:

- Initialize an ACQ file structure
- Close an ACQ file structure
- · Retrieve channel information
- Retrieve samples by segment of a specified channel
- Retrieve all the samples of a specified channel
- Retrieve a particular sample of a specified channel

- Retrieve samples by time slice of a specified channel
- Retrieve Journal Text for AcqKnowledge 3.7.3 or below
- Retrieve marker information
- Retrieve marker text of a specified marker

Use these base functions in a variety of combinations to extract specific data from an ACQ file and then use or transform the data in other analysis programs.

The API includes:

acqfile.dll Dynamic link library*
acqfile.lib COFF import library for acqfile.dll
acqfile.h Header file
sample.acq A small .acq file to use for testing

* To run executables generated by the sample projects, a copy of acqfile.dll must exist in the same directory as the executable.

Directories

docs html documentation for the *acq* File Format **cplusplusample** sample VC++ 6.0 project folder **vbsample** sample VB 6.0 project folder

Open **acqfile_8h.htm** from the "docs" folder for the Main Page of the documentation and navigate as desired from there, or start with a sample file for C++ or VB projects.

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