MIDAS - The Multiple Instance Data Acquisition System

TDR Data Format: Version 3.2.1

Version 2.0

This proposal reduces the GREAT data word size from 48 bits to 32 bits. It is further proposed that this format is used in the interface between the Event collector, and the Event Sorter.

The information that is lost in this change is the top 20 bits of the timestamp. There is a SYNC information event, transmitted from each ADC module every 655uS, which consists of all 48 bits of the Timestamp. The Timestamp sent with every event consists of 28 bits (2^{28} => 2.7 seconds), this overlaps with 4096 SYNC pulses. The probability of a data error in the time being undetected is very small.

The flow control between the ADC card and the SHARC require particular types of timestamp to be transmitted from the ADC to indicate the Pause, and Resume states of the ADC card.

The following format is proposed to meet these existing requirements, and to allow future flexibility.

Version 3.1

Addition of a data structure to handle ADC Sample Buffers from the SAGE/LISA LyrTech modules. Addition of information word to handle TimeStamp information from SAGE/LISA LyrTech Modules. This is similar to the SYNC100 TimeStamp except that the information originates within the LyrTech ADC module firmware and will not have the same strict periodic nature as the SYNC100 information. Data within an output stream can however be assumed to be time ordered.

Note that while all data items occupy 64 bits and hence are aligned on a 64 bit boundary they are generated as 2 32 bit data words. This is important when considering byte ordering.

Version 3.1.1

Add layout of bits within **Channel Ident** field. Add Sequence Number Information Item.

Version 3.1.2 - August 19 2009

Add additional Information Codes.

Version 3.1.3 - April 18 2011

Additions for use with Aida (FEE64 modules).

Version 3.1.4 - August 24 2011

Additions for use with at GSI with MBS (Aida).

Version 3.2.0 - July 1 2013

Add support for R3B.

Version 3.2.1 - July 1 2014

Add note regards White Rabbit 64 bit timestamp.

All ADC channels send 64 bits of data via the SHARC link for each ADC conversion, in two 32 bit words. The same format is used for the computed energy from the Lyrtech digitial ADCs. These two words are formatted as follows.

ADC Data Format

Bit Position	31	30	29	28	27 to 16	15 to 0
Field Value	1	1	Fail	Veto	Channel Ident	ADC data
Bit Position	31 to 28				27 to 0	
Field Value	0				Time Stamp 27:0	

For the Aida fee64 module the Fail bit is currently not used. Will be 0.
The Veto bit (bit 28) will contain the ADC Range setting: (0 = low; 1 = high).

For R3B data the ADC data occupies 12 bits which enables support for the 4K channels per module. These two words are formatted as follows.

R3B Data Item Format

Bit Position	31	30	29	28 to 12	11 to 0
Field Value	1	1	Hit	Channel Ident	ADC data
Bit Position	31 to 28			27 to 0	
Field Value	0			Time Stamp 27:0	

For the R3B 4K module the Hit bit is set to 1.

The Lyrtech digitial ADCs may also generate a data buffer containing the ADC sample data. This is sent as a 64 bit header in two 32 bit words followed by n samples where each sample is a 16 bit data item. These words are formatted as follows.

Sample Trace Buffer Format

Bit Position	31	30	29	28	27 to 16	15 to 0
Field Value	0	1	0	0	Channel Ident	Sample Length

Bit Position	31 to 28	27 to 0
Field Value	0	Time Stamp 27:0

The "Sample Length" defines the number of 14 bit sample data items following and will be a multiple of 4. These data items follow in the following format.

Field Value	0	0	Sample n (14 bits)	0	0	Sample n+1 (14 bits)
Field Value	0	0	Sample n+2 (14 bits)	0	0	Sample n+3 (14 bits)

Note that for normal data the 2 most significant bits of each 16 bit sample word will be zero. However the header does contain the number of samples. This should be used when processing the data since for diagnostic purposes the raw data from the hardware may be passed by this path and this may contain data in which the 2 most significant bits are used. This diagnostic information is likely to be removed before the data stream is written to final storage.

Channel Ident format (VXI modules) (12 bits)

Bit Position	**11**	**10 to 5**	**4 to 0**
Field Value	0	VXI Module Number	ADC Number

Channel Ident format (Lyrtech modules - ADC item) (12 bits)

Bit Position	**11**	**10 to 5**	**4**	**3 to 0**

Field Value	0	VHSADC Module Number	0=energy; 1=baseline	ADC Number

Channel Ident format (Lyrtech modules - Sample item) (12 bits)

Bit Position	**11**	**10 to 5**	**4**	**3 to 0**
Field Value	0	VHSADC Module Number	0=trace data; 1=raw data	ADC Number

Channel Ident format (Aida FEE64 modules) (12 bits)

Bit Position	**11 to 6**	**5 to 0**
Field Value	FEE64 Module Number	Channel Number

Channel Ident format (R3B 4K modules) (17 bits)

Bit Position	**16 to 11**	**10 to 7**	**6 to 0**
Field Value	R3B Module ID (0=>0x3f)	R3B ASIC Number (0=>15)	Channel Number (0=>127)

All other Information is sent in the following format

Bit Position	31	30	29 to 24	23 to 20	19 to 0
Field Value	1	0	Module Number	Information Code	Information Field

Bit Position	31 to 28	27 to 0
Field Value	0	Time Stamp 27:0

The Module number identifies the source of the information. This will be an ADC VXI card, Lyrtech ADC module or FEE64 module.

Information code will be able to identify one of 16 possible information words. The information Field is defined for each of the codes.

The Information codes identified are as follows

Information Type	Code	Information Field Definition
Undefined Data	0	
ADC Channel Pile-Up	1	Channel Number
Pause TimeStamp	2	Timestamp bits 47:28
Resume TimeStamp	3	Timestamp bits 47:28
SYNC100 TimeStamp	4	Timestamp bits 47:28
White Rabbit TimeStamp Marker	4	Timestamp bits 47:28
White Rabbit TimeStamp Marker	5	Timestamp bits 63:48
Aida FEE64 discriminator data	6	FEE64 discriminator data
Extended Item TimeStamp	7	Timestamp bits 47:28
Scanning Table/MBS Information	8	information index (16-19) + data (0-15)
ADC Channel/Energy Over-Range	9	Channel Number
ADC Channel/Energy Under-Range	10	Channel Number
ADC Channel Overflow	11	Channel Number
ADC Channel Underflow	12	Channel Number
Trigger Sequence Number (event number)	13	module sequence number
Data Link Statistics	14	Link Number. Transfer between Sender and Receiver. Timestamp is replaced by a buffer count
SHARC Link number	15	Link Number. Transfer between SHARC and Receiver. Timestamp is replaced by a buffer count

Main documentation index
