



**Nuclear Physics Division**  
*Fast Electronics Group*

## **VETROC Manual**

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## 1. Readout Data Format

The SSP readout data format utilizes the same encoding scheme defined for the JLAB FADC250. The word length for the readout data is 32bits. The event length is variable and depends on several factors (detector occupancy, headers, trailers, filler words).

### Data Word Categories

Data words from the module are divided into two categories: Data Type Defining (bit 31 = 1) and Data Type Continuation (bit 31 = 0). Data Type Defining words contain a 4-bit data type tag (bits 30 - 27) along with a type dependent data payload (bits 26 - 0). Data Type Continuation words provide additional data payload (bits 30 - 0) for the *last defined data type*. Continuation words permit data payloads to span multiple words and allow for efficient packing of various data types spanning multiple data words. Any number of Data Type Continuation words may follow a Data Type Defining word.

### Data Type List

0	Block Header
1	Block Trailer
2	Event Header
3	Trigger Time
4	Reserved
5	Reserved
6	Reserved
7	Reserved
8	TDC Hit
9	Reserved
10	Reserved
11	Reserved
12	Reserved
13	Reserved
14	Data Not Valid (empty module)
15	Filler Word (non-data)

### Data Type: Block Header

Type: 0x0  
 Size: 1 word  
 Description: Indicates the beginning of a block of events. (High-speed readout of a board or a set of boards is done in blocks of events)

31	30	29	28	27	26	25	24
1	0	0	0	0	SLOTID		
23	22	21	20	19	18	17	16
SLOTID		0	0	0	0	BLOCK_NUMBER	
15	14	13	12	11	10	9	8
BLOCK_NUMBER							
7	6	5	4	3	2	1	0
BLOCK_SIZE							

#### BLOCK\_NUMBER:

Event block number (used to align blocks when building events)

#### BLOCK\_SIZE:

Number of events in block

#### SLOTID:

Slot ID (set by VME64x backplane)

**Data Type: Block Trailer**

Type: 0x1  
Size: 1 word  
Description: Indicates the end of a block of events. The data words in a block are bracketed by the block header and trailer.

31	30	29	28	27	26	25	24
1	0	0	0	1	SLOTID		
23	22	21	20	19	18	17	16
SLOTID		NUM_WORDS					
15	14	13	12	11	10	9	8
NUM_WORDS							
7	6	5	4	3	2	1	0
NUM_WORDS							

**NUM\_WORDS:**

Total number of words in block of events

**SLOTID:**

Slot ID (set by VME64x backplane)

**Data Type: Event Header**

Type: 0x2  
Size: 1 word  
Description: Indicates the start of an event. The included trigger number is useful to ensure proper alignment of event fragments when building events. The 27bit trigger number (134M count) is not a limitation, as it will be used to distinguish events within event blocks, or among events that are concurrently being built or transported.

31	30	29	28	27	26	25	24
1	0	0	1	0	TRIGGER_NUMBER		
23	22	21	20	19	18	17	16
TRIGGER_NUMBER							
15	14	13	12	11	10	9	8
TRIGGER_NUMBER							
7	6	5	4	3	2	1	0
TRIGGER_NUMBER							

**TRIGGER\_NUMBER:**

Accepted event/trigger number

**Data Type: Trigger Time**

Type: 0x3

Size: 2 words

Description: Time of trigger occurrence relative to the most recent global reset. The time is measured by a 48bit counter that is clocked from the 250MHz system clock. The assertion of the global reset clears the counter. The de-assertion of global reset enables counter and thus sets t=0 for the module. The trigger time is necessary to ensure system synchronization and is useful in aligning event fragments when building events.

Word 1:

31	30	29	28	27	26	25	24
1	0	0	1	1	0	0	0
23	22	21	20	19	18	17	16
TRIGGER_TIME_L							
15	14	13	12	11	10	9	8
TRIGGER_TIME_L							
7	6	5	4	3	2	1	0
TRIGGER_TIME_L							

**TRIGGER\_TIME\_L:**

This is the lower 24bits of the trigger time

Word 2:

31	30	29	28	27	26	25	24
0	0	0	0	0	0	0	0
23	22	21	20	19	18	17	16
TRIGGER_TIME_H							
15	14	13	12	11	10	9	8
TRIGGER_TIME_H							
7	6	5	4	3	2	1	0
TRIGGER_TIME_H							

**TRIGGER\_TIME\_H:**

This is the upper 24bits of the trigger time

**Data Type: TDC Hit**

Type: 0x8

Size: 1 word

Description: This data type provides the time, channel, and edge of TDC hits

Word 1:

31	30	29	28	27	26	25	24
1	1	0	0	0	EDGE	0	0
23	22	21	20	19	18	17	16
CHANNEL							
15	14	13	12	11	10	9	8
TIME							
7	6	5	4	3	2	1	0
TIME							

**EDGE:**

Edge:

0	TDC measure of rising edge
1	TDC measure of falling edge

**CHANNEL:**

TDC channel number

**TIME:**

TDC hit time: 1ns resolution measured from beginning of trigger window

**Data Type: Data Not Valid**

Type: 0x14

Size: 1 word

Description: Module has no data available for readout. This can if the module is being read out too quickly after receiving (event building is in process and no data words have been put into the buffer yet) a trigger or if the module doesn't have any events to report.

31	30	29	28	27	26	25	24
1	1	1	1	0	UNDEFINED		
23	22	21	20	19	18	17	16
UNDEFINED							
15	14	13	12	11	10	9	8
UNDEFINED							
7	6	5	4	3	2	1	0
UNDEFINED							

**Data Type: Filler Word**

Type: 0x15

Size: 1 word

Description: Non-data word appended to the block of events. This is used to force the total number of 32-bit words read out of a module to be a multiple of 2 or 4 when

31	30	29	28	27	26	25	24
1	1	1	1	1	UNDEFINED		
23	22	21	20	19	18	17	16
UNDEFINED							
15	14	13	12	11	10	9	8
UNDEFINED							
7	6	5	4	3	2	1	0
UNDEFINED							