



Nuclear Physics Division
Fast Electronics Group

SSP HPS 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	HPS Cluster
5	HPS Trigger
6	Reserved
7	Reserved
8	Reserved
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: HPS Cluster

Type: 0x4

Size: 2 words

Description: This data type identifies HPS ECAL clusters found in the level 1 trigger. This is intended to be used for trigger efficiency studies and verification.

Word 1:

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

CLUSTER_X:

Cluster center X coordinate. This is a signed value that ranges from -22 to +23

CLUSTER_Y:

Cluster center Y coordinate. This is a signed value that ranges from -5 to +5

CLUSTER_E:

Cluster energy in MeV units. This is an unsigned value that ranges from 0 to 8191

CLUSTER_N:

Number of hits found in cluster. This is an unsigned value that ranges from 0 to 9

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
0	0	0	0	0	0	0	0
15	14	13	12	11	10	9	8
0	0	0	0	0	0	CLUSTER_T	
7	6	5	4	3	2	1	0
CLUSTER_T							

CLUSTER_T:

Time in 4ns ticks measured from beginning of trigger window that cluster is found.

Data Type: HPS Trigger

Type: 0x5

Size: 1 word

Description: This data type identifies HPS ECAL triggers that were found.

Word 1:

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

TYPE:

Trigger type that matches one of the following:

0	Cosmic trigger from top crate
1	Cosmic trigger from bottom crate
2	Cluster singles trigger 0 from top crate
3	Cluster singles trigger 0 from bottom crate
4	Cluster singles trigger 1 from top crate
5	Cluster singles trigger 1 from bottom crate
6	Cluster pair trigger 0
7	Cluster pair trigger 1

DATA:

This data field is specific to the TYPE field and indicates various pass/fail tests:

Cosmic trigger (type 0,1):

DATA(6..0) will be "0000000"

Cluster singles trigger (type 2-5):

DATA(0): 1/0 – pass/fail cluster "E MIN" cut.

DATA(1): 1/0 – pass/fail cluster "E MAX" cut.

DATA(2): 1/0 – pass/fail cluster "N HITS MIN" cut.

Cluster pair trigger (type 6-7):

DATA(0): 1/0 – pass/fail pair "SUM" cut

DATA(1): 1/0 – pass/fail pair "DIFFERENCE" cut

DATA(2): 1/0 – pass/fail pair "ENERGY SLOPE" cut

DATA(3): 1/0 – pass/fail pair "COPLANAR" cut

TIME:

Time in 4ns ticks measured from beginning of trigger window that trigger condition was found.

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							