



Nuclear Physics Division
Fast Electronics Group

SSP_MPD Event Format

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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	Reserved
4	Reserved
5	MPD Data Frame
6	Reserved
7	Reserved
8	Reserved
9	Reserved
10	Reserved
11	Reserved
12	MPD event info
13	MPD debug header
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	ROTARY_ID		
23	22	21	20	19	18	17	16
ROTARY_ID		0			EVENT_PER_BLOCK		
15	14	13	12	11	10	9	8
EVENT_PER_BLOCK					0		
7	6	5	4	3	2	1	0
BLOCK_NUMBER							

BLOCK_NUMBER:

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

EVENT_PER_BLOCK:

Number of events in block

ROTARY_ID:

Rotary switch ID (set on MPD)

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	ROTARY_ID		
23	22	21	20	19	18	17	16
ROTARY_ID		0		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 (this is from the MPD and won't reflect what the VTP processing may rebuild – ignore this this quantity other than for sanity checking what the MPD original event block size was)

ROTARY_ID:

Rotary switch ID (set on MPD)

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	0		
23	22	21	20	19	18	17	16
0				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: MPD Frame

Type: 0x5

Size: variable (up to 1+3*N words)

Description: This data type contains a complete APV data frame (SSP processing). After the header word, an integer number of 6 APV sample sets follow supplied in groups of 3 words

Word 1:

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

FLAGS(5): ENABLE_CM

‘1’ common-mode subtraction is enable

‘0’ common-mode subtraction is disabled

FLAGS(4): BUILD_ALL_SAMPLES

‘1’ all samples are recorded (i.e. zero suppression disabled)

‘0’ zero suppression is applied (i.e. zero suppression enabled)

FLAGS(3): CM_OR

‘1’ common-mode out of range, common-mode and zero suppression will be disabled for the following APV frame (due to not having enough pedestal samples to average). When this bit is set, ENABLE_CM=0 and BUILD_ALL_SAMPLES=1 flags will also be forced

‘0’ common-mode was computed successfully (had the minimum number of pedestal samples to average)

FIBER:

SSP fiber number MPD frame is received from (0 to 63)

MPD_ID:

This ID is a programmable on the MPD (or dipswitch setting?)

Word 2+3*N+0

31	30	29	28	27	26	25	24
0	APV_CHANNEL_NUM4:0					APV_SAMPLE1	
23	22	21	20	19	18	17	16
APV_SAMPLE1							
15	14	13	12	11	10	9	8
APV_SAMPLE1				APV_SAMPLE0			
7	6	5	4	3	2	1	0
APV_SAMPLE0							

APV_CHANNEL_NUM(4:0):

APV channel number for samples reported in this group of 3 words. Channel number ranges from 0 to 127 and must be combined with next word to form full 7bit APV_CHANNEL_NUM.

APV_SAMPLE0:

APV sample 0 for APV_CHANNEL_NUM. 13bit, signed integer.

APV_SAMPLE1:

APV sample 1 for APV_CHANNEL_NUM. 13bit, signed integer.

Word 2+3*N+1

31	30	29	28	27	26	25	24
0	APV_CHANNEL_NUM(6:5)					APV_SAMPLE3	
23	22	21	20	19	18	17	16
APV_SAMPLE3							
15	14	13	12	11	10	9	8
APV_SAMPLE3				APV_SAMPLE2			
7	6	5	4	3	2	1	0
APV_SAMPLE2							

APV_CHANNEL_NUM(6:5):

APV channel number for samples reported in this group of 3 words. Channel number ranges from 0 to 127 and must be combined with previous word to form full 7bit APV_CHANNEL_NUM.

APV_SAMPLE2:

APV sample 2 for APV_CHANNEL_NUM. 13bit, signed integer.

APV_SAMPLE3:

APV sample 3 for APV_CHANNEL_NUM. 13bit, signed integer.

Word 2+3*N+2

31	30	29	28	27	26	25	24
0	APV_ID					APV_SAMPLE5	
23	22	21	20	19	18	17	16
APV_SAMPLE5							
15	14	13	12	11	10	9	8
APV_SAMPLE5				APV_SAMPLE4			
7	6	5	4	3	2	1	0
APV_SAMPLE4							

APV_ID:

APV_ID that samples are for.

APV_SAMPLE4:

APV sample 4 for APV_CHANNEL_NUM. 13bit, signed integer.

APV_SAMPLE5:

APV sample 5 for APV_CHANNEL_NUM. 13bit, signed integer.

Data Type: MPD Header

Type: 0xc
Size: 1

Description: this data type contains the MPD timestamp/event number which may be used for timing correction and event alignment sanity checks. Timestamp/trigger refers to the Fiber reported last (from MPD Frame, data type=5)

Word 1:

31	30	29	28	27	26	25	24
1	1	1	0	0	-	-	-
23	22	21	20	19	18	17	16
TIMESTAMP_COARSE0							
15	14	13	12	11	10	9	8
TIMESTAMP_COARSE0							
7	6	5	4	3	2	1	0
TIMESTAMP_FINE							

TIMESTAMP_FINE: 8bit “FINE_TRIGGER_TIME” from MPD. When MPD TDC is configured for “Low Resolution” mode, the units here are MPD reference clock period/6 (4.166ns for internal 40MHz reference, but if connected to Jlab TI system this will be 4ns units). When MPD TDC is configured “High Resolution” mode, the upper (most significant) 4 bits will be the same resolution as “Low Resolution” mode, but the lower (least significant) 4 bits will be a measure with resolution well below a low resolution clock cycle using the MPD FPGA carry chain taps (which will require calibration, likely per MPD, to determine their equivalent delay).

TIMESTAMP_COARSE0: lower (least significant) 16bits of “COARSE_TRIGGER_TIME” from MPD. Units for the fully assembled 40bit TIMESTAMP_COARSE1/0 are in MPD reference clock ticks (25ns units for internal 40MHz reference, but if connected to Jlab TI system this will be 24ns units).

Word 2:

31	30	29	28	27	26	25	24
0	-	-	-	-	-	-	-
23	22	21	20	19	18	17	16
TIMESTAMP_COARSE1							
15	14	13	12	11	10	9	8
TIMESTAMP_COARSE1							
7	6	5	4	3	2	1	0
TIMESTAMP_COARSE1							

TIMESTAMP_COARSE1: upper (most significant) 24bits of “COARSE_TRIGGER_TIME” from MPD

Word 3:

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

EVENT_NUMBER: 20bit “EVENT_COUNT” from MPD

Data Type: MPD debug header

Type: 0xd
Size: 3

Description: this data type contains the SSP computed common-mode offsets for each time sample of the previous Fiber/APV data (from MPD Frame, data type=5)

Word 1							
31	30	29	28	27	26	25	24
1	1	1	0	1	-	CM_T1	
23	22	21	20	19	18	17	16
CM_T1							
15	14	13	12	11	10	9	8
CM_T1				CM_T0			
7	6	5	4	3	2	1	0
CM_T0							

CM_T0:
13bit signed common-mode correction value for time sample 0

CM_T1:
13bit signed common-mode correction value for time sample 1

Word 2							
31	30	29	28	27	26	25	24
0	-	-	-	-	-	CM_T3	
23	22	21	20	19	18	17	16
CM_T3							
15	14	13	12	11	10	9	8
CM_T3				CM_T2			
7	6	5	4	3	2	1	0
CM_T2							

CM_T2:

13bit signed common-mode correction value for time sample 2

CM_T3:

13bit signed common-mode correction value for time sample 3

Word 3							
31	30	29	28	27	26	25	24
0	-	-	-	-	-	CM_T5	
23	22	21	20	19	18	17	16
CM_T5							
15	14	13	12	11	10	9	8
CM_T5				CM_T4			
7	6	5	4	3	2	1	0
CM_T4							

CM_T4:

13bit signed common-mode correction value for time sample 4

CM_T5:

13bit signed common-mode correction value for time sample 5

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							