

RAW DATA FORMAT

Records in the data stream:

SOR	Start of run record.
EVENT	Event record.
RCU	Each event record consists of RCU data, each RCU has a header.
DATA	Event data of ALTRO format for each RCU.
EOR	End Of Run record.
BOF	If local data logging. If the file size exceeds a maximum size then the file is closed and a new file is opened and the first record in the new file is a Beginning Of File record.
EOF	If local logging. If the file size exceeds a maximum size then the file is closed and a new file is opened. The last record in the closed file is End Of File record.
POR	Pause run record
COR	Continue run record

If the data logging is done locally, then the filename is: readout-<runnb>_<filenb>.dat, where runnb is the run number, and <filenb> is a file counter, incremented with one for each file opened within the current run, and starting from 0 for the first file.

START OF RUN FORMAT

Total length (exclusive)			
Header length (exclusive)			
Block identifier = BLOCK_SOR (=0x11111111)			
Data format version			
Run number			
Year		Month	Day
Hour		Minute	Second

END OF RUN FORMAT

Total length (exclusive)			
Header length (exclusive)			
Block identifier = BLOCK_EOR (=0x33333333)			
Number of events			
Year		Month	Day
Hour		Minute	Second

PAUSE RUN FORMAT

Total length (exclusive)		
Header length (exclusive)		
Block identifier = BLOCK_POR (=0x11112222)		
Number of events		
Year	Month	Day
Hour	Minute	Second

CONTINUE RUN FORMAT

Total length (exclusive)		
Header length (exclusive)		
Block identifier = BLOCK_COR (=0x11113333)		
Number of events		
Year	Month	Day
Hour	Minute	Second

RAW EVENT FORMAT (32-bit words)

Total event length (exclusive, added by software)
Header length (exclusive, added by software)
Block identifier = BLOCK_EVENT (=0x22222222) (added by software)
Software event number (incremented by software for each read event)
Hardware trigger number (read from distributor box)
Time stamp (read from distributor box)
RCU block length (exclusive, added by software)
RCU identifier (added by software)
RCU HEADER – 8 words
ALTRO DATA – N40 = # of 40 bit words = (N40*5)/4 32 bit words = N32
...
...
RCU block length (exclusive, added by software)
RCU identifier (added by software)
RCU HEADER – 8 words
ALTRO HW DATA – N40 40 bit words = (N40*5)/4 32 bit words = N32

RCU HEADER

BLOCK LENGTH [31..0] = FFFFFFFF				
FORMAT [31..24] = 1		L1 Type [21..14]	[13:12] = 0	EVT ID1 [11..0] = 0
[31..24] = 0		EVT ID2 [23..0] = N => 0 ??		
Block [31..24] = 0		Participating sub-detectors [23..0] = 0		
[31..28] = 0	Status/Error [27..12]		Bunch [11..0]	
Trigger classes low [31..0] = 0				
ROI [31..28]	[27..18] = 0		Trigger classes high [17..0] = 0	
Region Of Interest (ROI) [31..0]				

ALTRO HW 40 bit word DATA example for one channel:

40 30 20 10

S05	S04	S03	S02 (sample)
S10	007 (length)	T06 (time stamp)	S06
005	T12	S12	S11

....

S91	S90	S89	S88 (sample)
2AA	007 (length)	T92 (time stamp)	S92
2AAA (14 -bits)	# 10 bit words (10 bits)	A (4 bits)	12-bit hardware address

End of data structures depending on the number of 40 bit ALTRO data words. There is a description of the format later in this document.

N32 modulus 5 = 0

ALTRO WORD1 [31..0]		
ALTRO WORD2 [23..0]		ALTRO WORD1 [39..32]
ALTRO WORD3 [15..0]		ALTRO WORD2 [39..24]
ALTRO WORD4 [7..0]	ALTRO WORD3 [39..16]	
ALTRO WORD4 [39..8]		

N32 modulus 5 = 2

ALTRO WORD1 [31..0]		
AAAAAAA		ALTRO WORD1 [39..32]

N32 modulus 5 = 3

ALTRO WORD1 [31..0]		
ALTRO WORD2 [23..0]		ALTRO WORD1 [39..32]
AAAA	ALTRO WORD2 [39..24]	

N32 modulus 5 = 4

ALTRO WORD1 [31..0]		
ALTRO WORD2 [23..0]		ALTRO WORD1 [39..32]
ALTRO WORD3 [15..0]	ALTRO WORD2 [39..24]	
AA	ALTRO WORD3 [39..16]	

BEGINNING OF FILE FORMAT

Total length (exclusive)			
Header length (exclusive)			
Block identifier = BLOCK_BOF (=0x44444444)			
Data format version			
Run number			
		Year	Month
		Day	
		Hour	Minute
		Second	

File number
Last event number

END OF FILE FORMAT

Total length (exclusive)			
Header length (exclusive)			
Block identifier = BLOCK_EOF (=0x55555555)			
Last event number			
		Year	Month
		Day	
		Hour	Minute
		Second	

Last file number

RCU data format over the DDL

The RCU data formatter converts the blocs of 4x40 bit altro words into blocks of 5 32 bit words. One such block will from now on be called a DDL block. In general the number of 40 bit altro words of a RCU payload is not divisible by 4, therefore the last DDL data block might have either 2,3 or 4 32 bit words. It is necessary to find the position of the last altro word since the RCU payload is a back linked list of altro data. The position of the last 40 bit altro word can be found by taking the size of the payload modulus 5. more specific $(\text{sizeof}(\text{ddlbuffer})/4 - \text{header size} - \text{Ntrailerwords}) \bmod 5$. The mod 5 value of the DDL buffer determines unambiguous the position of the last altro word and thereby the total number of altro word. In addition the RCU trailer contains the count of 40 bit altro words that can e used as a consistency check. Given the payload size mod 5 value the position of the last altro word can be determined as given below.

- **Segmentation 0:** The number of 40 bit altro words is divisible by 4, the last DDL block is filled according to the table below. Position of last altro word when the a DDL block is exactly filled i.e the number of altro words is divisible by 4. This corresponds to the case when $N_{40bitwords} \bmod 4 = 0$, or alternatively $N_{32altroPayloadsize} \bmod 5 = 0$

$N_{32} \bmod 5 = 0$

ALTRO WORD1 [31..0]	
ALTRO WORD2 [23..0]	ALTRO WORD1 [39..32]
ALTRO WORD3 [15..0]	ALTRO WORD2 [39..24]
ALTRO WORD4 [7..0]	ALTRO WORD3 [39..16]
ALTRO WORD4 [39..8]	

- **Segmentation 1;** The number of 40 bit altro words modulus 4 equals one, the DDL block is filled according to the table below. Position of the last altroword of the last DDL block in the case where the last DDL block is filled with just one 40 bit word. In this case the last DDL block consists of two 32 bit words. The least significant 24 bits of the last 32 bit word of the DDL block indicated by the gray area is not used and is padded with 0xAAAAAA. This corresponds to the case when $N_{40bitwords} \bmod 4 = 1$, or alternatively $N_{32altroPayloadsize} \bmod 5 = 2$

$N_{32} \bmod 5 = 2$

ALTRO WORD1 [31..0]	
AAAAAAA	ALTRO WORD1 [39..32]

- **Segmentation 2;** The number of 40 bit altro words modulus 4 equals two, the DDL block is filled according to the table below. Position of the last altro word of the last DDL block when the last DDL block is filled with two 40 bit words. In this case the the last DDL block consists of three 32 bit words. The least significant 16 bits of the last 32 bit word of the DDL block indicated by the gray area is not used and is padded with 0xAAAA. This corresponds to the case when $N_{40bitwords} \bmod 4 = 2$, or alternatively $N_{32altroPayloadsize} \bmod 5 = 3$

$N_{32} \bmod 5 = 3$

ALTRO WORD1 [31..0]	
ALTRO WORD2 [23..0]	ALTRO WORD1 [39..32]
AAAA	ALTRO WORD2 [39..24]

- **Segmentation 3;** The number of 40 bit altro words modulus 4 equals three, the DDL block is filled according to the table below. Position of the last altro word of the last DDL block when the last DDL block is filled with three 40 bit words. In this case the the last DDL block consists of four 32 bit words. The least significant 8 bits of the last 32 bit word of the DDL block indicated by the gray area is not used and is padded with 0xAA. This corresponds to the case when $N_{40bitwords} \bmod 4 = 3$, or alternatively $N_{32altroPayloadsize} \bmod 5 = 4$

$N_{32} \bmod 5 = 4$

ALTRO WORD1 [31..0]		
ALTRO WORD2 [23..0]		ALTRO WORD1 [39..32]
ALTRO WORD3 [15..0]		ALTRO WORD2 [39..24]
AA	ALTRO WORD3 [39..16]	