

# L1 Drift-Chamber Trigger Upgrade GLT Modifications for New DCT System

Version 0.3

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## 1 New ZPD Input and Interface Modifications

The GLT receives trigger ‘primitives’ from the DCT, EMT and IFT at 134ns (clock-8) intervals. These signals are mostly  $\phi$  maps with individual bits indicating the presence of calorimeter energy deposit or tracks in the corresponding  $\phi$  regions. This consists of the EMT signals  $M_{20}, G_{20}, E_{20}, X_{20}, Y_{10}$  (subscripts denote number of bits); the DCT signals  $B_{16}, A_{16}, A'_{16}$ ; and the IFT signal  $U_3$  for patterns representing various muon track topologies. A detailed description of the overall L1 trigger structure and trigger primitive definitions can be found in the DCT upgrade requirements document [1].

The DCT input signals B,A from the BLT for short and long tracks will remain the same as before. The A' for high  $p_T$  tracks is from the current PTDs. The new ZPD system replacing the existing PTDs have a baseline output pattern of 4 bits per ZPD, summing to a total of 32 bits input to the GLT for the 8 ZPD boards. The input from GLT backplane to the GLT is limited by the current active pins routed to the receiver FPGAs. To accommodate the new ZPDs, 16 bits of the ZPD input can use the existing input slot for the A'. The other 16 bits will displace the existing EMT X signal, since the X signal has not been used by any existing L1 configuration. The new GLTi board will have a switch to allow the exchange between the new ZPD signal and the EMT X.

## 2 GLT Modifications for ZPD Signals

The top level diagram of the GLT internal logic is shown in Figure 1. There are a total of 17 objects derived from the input signals used for the trigger line decisions. Some of the inputs are used to derive more than one object, e.g. the B is used for nB, nB\* and nBM. Among the existing objects, three of them were never used for any production configuration: AM, A'M, BMX, i.e. most of the *Match* objects. Given that the X signal carrying the new ZPD signals is directed to the *Match* FPGA, a firmware modification allow many possible options of using the (A',X) coming from the ZPD to derive 3 types of objects.

Our actual operating experience shows that the kinematically stringent signals such as A' are expected to be only used with the criteria of  $A \geq 1$ , as requiring 2 or more are generally too inefficient and biased. The A' signal therefore doesn't need to use the 16  $\phi$  bits for

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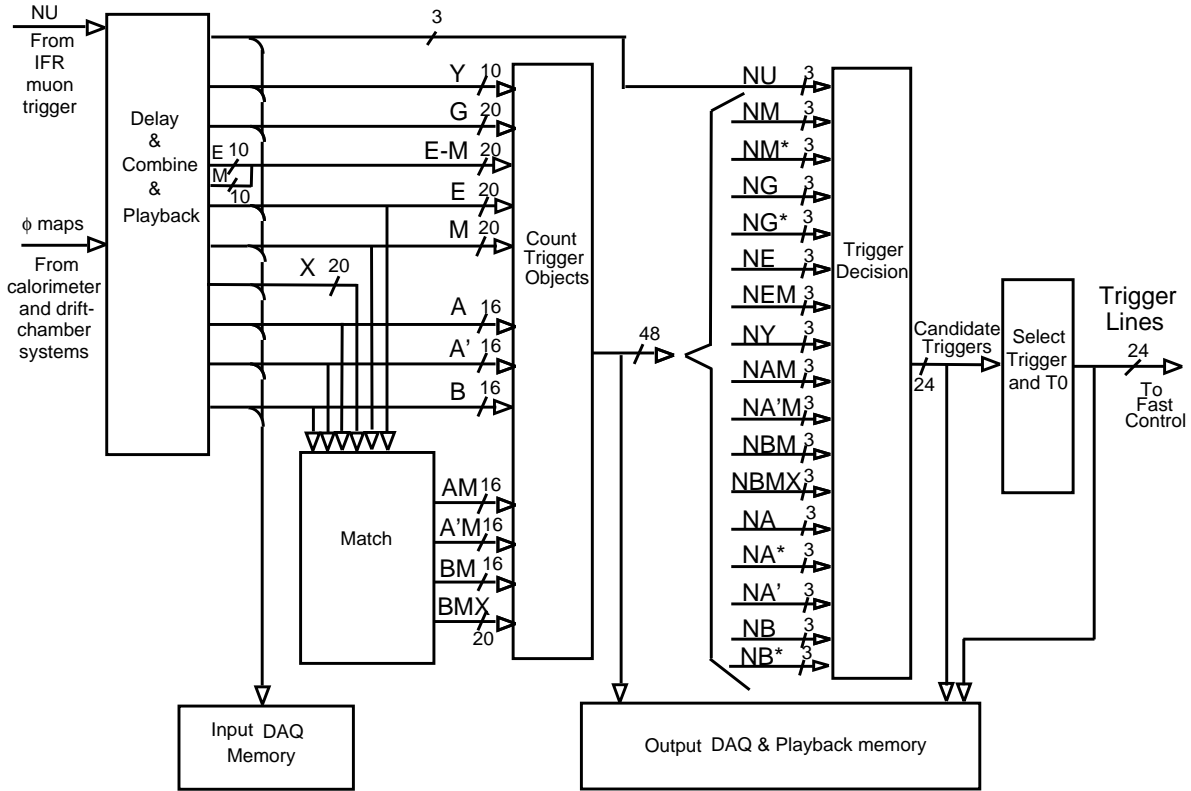


Figure 1: The top level diagram of current GLT.

counting. A 8 bit  $\phi$  map is perfectly adequate. Our studies on the ZPD signals also indicate that the most likely usage of the ZPD-trigger is also just demanding  $\geq 1$  track close to IP in  $z$ . Some ZPD signals can therefore also be 8 bit  $\phi$  maps with each ZPD flagging 1 bit. As an illustration, one *example* usage could be that the input signals are :

Old input	New input	New input description
A'(0:15)	Zstd(0:15)	IP Z tracks with standard $Z, p_T$ cuts
X(0:7)	Zpt(0:7)	High $p_T$ track with loose Z cut
X(8:15)	Zvar(0:7)	Variable Z cut vs. $\tan\lambda$

which can be used to derive the new object counts:

Old object	New object	New input description
nA'	nZstd	IP Z tracks with standard $Z, p_T$ cuts
nA'M	nZpt	High $p_T$ track with loose Z cut
nAM	nZvar	Variable Z cut vs. $\tan\lambda$
nBMX	nZorPt	( ZStd OR Zpt )

Although there are various possible options, one has to decide on one particular set of new object logic definition and program them into the *Match* firmware, while the cut values are of course still configurable.

The *Match* logic shares the same clock-8 tick as the object count lookup so that it was routed to make sure all logic complete in  $\sim 40$ ns and leaving the rest for the object count lookup. All imaginable usage of the ZPD signals are much simpler than the old DCT/EMT  $\phi$  matching. In fact, the new ZPD objects are mostly routing input directly to output with almost no logic. The firmware modification to the *Match* FPGA is therefore expected to be very simple.

## References

- [1] The DCT upgrade requirements including introduction to the L1 system:  
<http://www.slac.stanford.edu/BFROOT/www/Detector/Trigger/upgrade/cdr/docs/requirements.pdf>