

## CMS Internal Note

*The content of this note is intended for CMS internal use and distribution only*

September 4, 2009

# CMS Level-1 Global Trigger Extra Algo inputs

## **Second Draft**

H. Bergauer, M. Jeitler, A. Taurok  
*HEPHY, Wien, Austria*

### **Abstract**

The CMS Level-1 Global Trigger receives inputs from the Global Muon Trigger and the Global Calorimeter Trigger, which can be combined in logical expressions in so-called trigger algorithms, and “Technical Triggers”, which cannot be combined with other signals.

On top of these inputs, another 64 input lines are available for additional trigger objects, which can also be freely combined in logical expressions.

These “Extra Algo” inputs have to be delivered to the Global Trigger as LVDS signals, grouped in a total of 16 Channel Link cables equipped with RJ45 connectors. At the Global Trigger, these lines go into the Pipelined Synchronized Buffer (PSB) board in slot 15 of the Global Trigger crate. Cabling, data format, and timing are described.

## 1 Introduction

Trigger signals (“Extra Algos”) that have to be combined in logical expressions with other signals (i.e., with signals from the GCT, the GMT, or with each other) may be delivered to the GT as LVDS signals.

## 2 Extra Algo data to the Global Trigger

The Extra Algo data arrive through the so-called “GT calorimeter input channel #10”, which is physically represented by the Pipelined Synchronized Buffer (PSB) board in slot 15 of the Global Trigger crate. (Channels 1 through 8 go into the PSBs in slots 13 and 14. Channel 9 will not be used in the current scheme.)

The details of the bit mapping on the cables are shown on the *twiki* page <https://twiki.cern.ch/twiki/bin/view/CMS/L1ExtraAlgoBits>

### 2.1 CASTOR

Description: not yet available.

### 2.2 BPTX

The BPTX (beam pickup) signal to the Extra Algos will in particular be used in anti-coincidence for the so-called “long-lived particle” trigger. This will allow to trigger on relatively low-energy objects (e.g., jets) during the proton gap, when no particles are received from the LHC accelerator.

In addition, BPTX also has 8 inputs in the “Technical Trigger” input board (PSB in slot 9 of the GT crate).

### 2.3 BSC

Description: not yet available.

### 2.4 ZDC

Description: not yet available.

### 2.5 RPC TTU

Description: not yet available.

### 2.6 TOTEM

Description: not yet available.

## 3 Hardware details

### 3.1 Cables and connectors

The LVDS data will arrive on Channel Link cables equipped with RJ45 connectors. (These are the same as Ethernet connectors. However, Ethernet cables may not be used as in them the signal lines are paired in a different way from Channel Link cables.)

### **3.2 Timing and synchronization**

A signal (logic “1”) is to be electronically encoded as a negative differential LVDS signal. The signal length is expected to be 25 ns for a given bunch crossing.

### **3.3 Error detection**

There will be no error detection bits. However, offline and online running of test pattern generation, transmission, and decoding will be used.

## **4 References**

- [1] CMS collaboration, “The Trigger and Data Acquisition Project, Volume 1: The Level-1 Trigger”, CERN LHCC 2000-038.

## Appendix: Definitions of bit assignments on cables

**Table 1: Definition of Calorimeter and Extra Algo channels in the GT-system**

Calorimeter channel	Cable Content	Connector on PSB [present use]	Connector on PSB [future use]
CA1	Isolated electron/photon objects	PSB_V2 slot #13 IN 6-7 used	PSB_OPT slot #13 fiber U3 (OGTI) used
CA2	Non-isolated electron/photon objects	PSB_V2 slot #13 IN 4-5 used	PSB_OPT slot #13 fiber U2 (OGTI) used
CA3	Central jet objects	PSB_V2 slot #13 IN 2-3 used	PSB_OPT slot #13 fiber U1 (OGTI) used
CA4	Forward jet objects	PSB_V2 slot #13 IN 0-1 used	PSB_OPT slot #13 fiber U0 (OGTI) used
CA5	Tau-flagged jet objects	PSB_V2 slot #14 IN 6-7 used	PSB_OPT slot #14 fiber U3 (OGTI) used
CA6	Energy summary information (total Et, Ht and EtMiss)	PSB_V2 slot #14 IN 4-5 used	PSB_OPT slot #14 fiber U2 (OGTI) used
CA7	Ring rapidity HF/Et-sums, HtMiss	PSB_V2 slot #14 IN 2-3 used	PSB_OPT slot #14 fiber U1 (OGTI) used
CA8	TBD (free)	PSB_V2 slot #14 IN 0-1 or 16xRJ45 [63-0] free	PSB_OPT slot #14 fiber U0 (OGTI) or 8xRJ45 [31-0] free
CA9	TBD (free)	PSB_V2 slot #15 IN 2-3 free	PSB_OPT slot #15 fiber U1 (OGTI) free
CA10	EXTRA ALGOS	PSB_V2 slot #15 3xRJ45 used [12 bits, 11-0] 13xRJ45 free [52 bits, 63-12]	PSB_OPT slot #15 3xRJ45 used [12 bits, 11-0] 5xRJ45 free [20 bits, 31-12]
There is an option for CA9 and CA10 - using PSB_V2 for future use:			
CA9	not useable	-	PSB_V2 in slot #15 with infiniband inputs
CA10	EXTRA ALGOS	-	PSB_V2 slot #15 3xRJ45 used [12 bits, 11-0] 13xRJ45 free [52 bits, 63-12]

TBD means “to be defined”

**Table 2: Bit assignments on GT Calorimeter channel 10 (CA10, obj. 1 and 3)**

For names and description of objects, see <https://twiki.cern.ch/twiki/bin/view/CMS/L1ExtraAlgoBits>  
(object 2 and 4 see next table)

Bit no.	CA1013			
	conn. obj. 1	object 1	conn. obj. 3	object 3
0	RJ45 3-0		RJ45 19-16	
1				
2				
3				
4	RJ45 7-4		RJ45 23-20	
5				
6				
7				
8	RJ45 11-8		RJ45 27-24	
9				
10				
11				
12	RJ45 15-12		RJ45 31-28	
13				
14				
15				

**Table 3: Bit assignments on GT Calorimeter channel 10 (CA10, obj. 2 and 4)**

For names and description of objects, see <https://twiki.cern.ch/twiki/bin/view/CMS/L1ExtraAlgoBits>

Bit no.	CA1024			
	conn. obj. 2	object 2	conn. obj. 4	object 4
0	RJ45 35-32		RJ45 51-48	
1				
2				
3				
4	RJ45 39-36		RJ45 55-52	
5				
6				
7				
8	RJ45 43-40		RJ45 59-56	
9				
10				
11				
12	RJ45 47-44		RJ45 63-60	
13				
14				
15				