

SC Timing Trigger User Guide ATCA System

Thanks to Matt Weaver, Kukhee Kim, Mike Zelazny, Justin Chen and Ernest Williams. -Author: Carolina Bianchini Mattison

What does SC Timing Provides:

SC Timing Patterns from LCLS-II Project for Commissioning:

1. AC Rates (using Timeslot 3 and 6): 0Hz, 1Hz, 10Hz, 30Hz, 60Hz, 90Hz, 110Hz, 119Hz, 120Hz
2. Fixed Rates: 0Hz, 1Hz, 10Hz, 50Hz, 100Hz, 120Hz, 200Hz, 500Hz, 1KHz, 1.4KHz, 5KHz, 10KHz, 23KHz, 33KHz (special req. not in Tab 4 from PRD), 46KHz, 93KHz (special req. not in Tab 4 from PRD), 464KHz, 929KHz

The patterns 1) can be interleaved between multiple destinations (SC_DIAG0, SC_BSYD, SC_HXR, SC_SXR, SC_DASEL) up to max 120Hz total.

The patterns 2) can also be interleaved between multiple destinations (SC_DIAG0, SC_BSYD, SC_HXR, SC_SXR, SC_DASEL) up to max 929KHz.

And Special Triggers:

The Timing System provides the following Controls Sequence bits to satisfy other requirements. Such as:

- BPM Calibration bit, this bit is asserted to allow BPM calibration in between beam pulses when rate is less than 100Hz. This calibration bit can be found by selecting:

Rate Mode = Expt, Expt Seq Number = 1, Expt Seq Bit = 0, Destination Mode = Disable

- Keep Alive Trigger, beam request for SC_BSYD, this bit always scheduled as part of all patterns to currently trigger as following:

- For Rates higher than 1KHz

SC_BSYD will have 100Hz

- For Rates lower or equal than 1KHz

SC_BSYD 10Hz

- For Rates lower or equal to 10Hz

SC_BSYD 1Hz

(This trigger was extensively discussed, and the above trigger logic was agreed upon and replaces previously requirement to be always set to 10KHz).

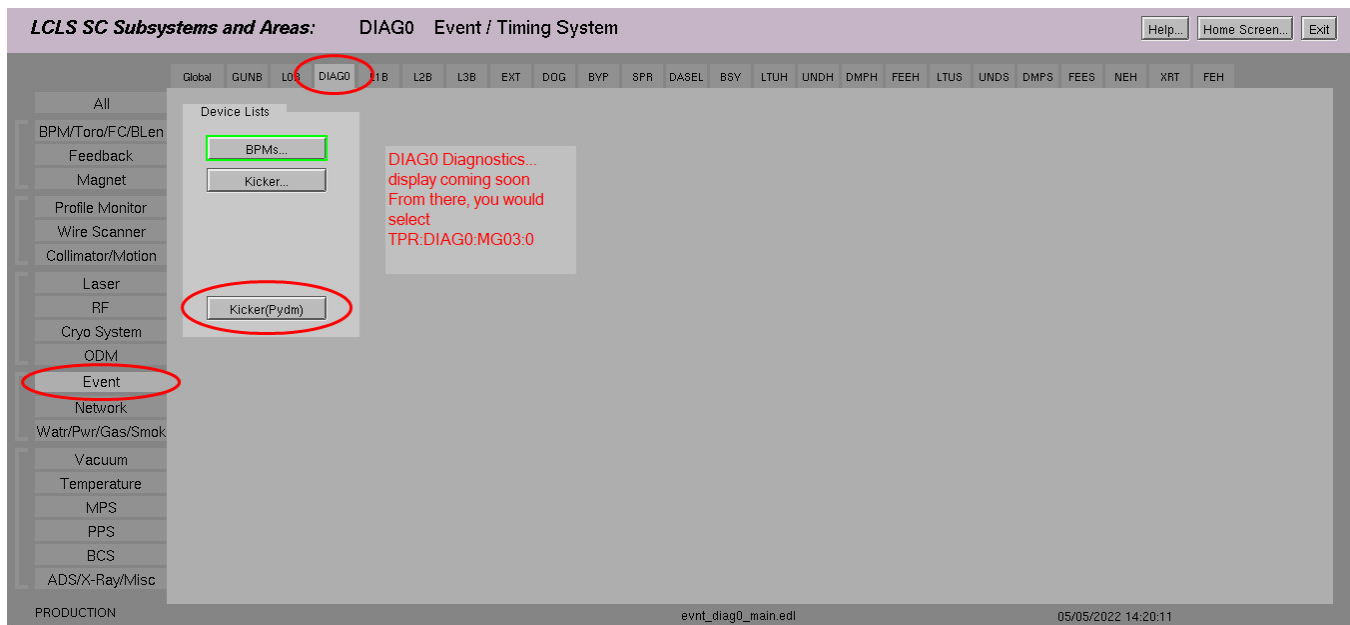
This trigger is set on Engine 15 to always maintain a high priority on beam requests over other engines but schedules the beam request for destination 2 SC_BSYD. The setup to trigger on this bit is to select:

Rate Mode = Same as Beam Fixed/AC, Rate = Max allowed {120Hz or 1MHz} Destination Mode= include, Destn = 2

- Kicker Magnet standby triggers for beam request above 10KHz to the SC_BSYD, will consist in two bits one for HXR and one for SXR to match the undulator requested rate. This is needed to maintain the kicker trigger thermal stability. This is not a requirement for SC_DIAG0.
- Data Acquisition triggers to match beam pulse location respect the destinations: SC_HXR, SC_SXR for 1H, TH and HH. (TBD SC_BSYD)

User Guide Start

1) Access the timing trigger displays



\$TOOLS/pydm/display/evnt/tprDiag.ui & \$TOOLS/pydm/display/evnt/tprDiagExp.ui

*Add Example to how to open related display tprTrigger

*Autogen display from DB

Configure mode to SC

Trigger number

Channel configuration next slide

Trigger Num	Desc	TWID	TDES	Source	AND/OR	Pair Source	Rate
0	Trigger Number Description	0	0.00	Channel 00	Disable	TRG01	0.0
1	Trigger Number Description	0	0.00	Channel 00	Disable	TRG00	0.0
2	Trigger Number Description	0	0.00	Channel 02	Disable	TRG03	0.0
3	Trigger Number Description	0	0.00	Channel 03	Disable	TRG02	0.0
4	Trigger Number Description	0	0.00	Channel 04	Disable	TRG05	0.0
5	Trigger Number Description	0	0.00	Channel 05	Disable	TRG04	0.0
6	Trigger Number Description	0	0.00	Channel 06	Disable	TRG07	0.0
7	Trigger Number Description	0	0.00	Channel 07	Disable	TRG06	0.0
8	Trigger Number Description	0	0.00	Channel 08	Disable	TRG09	0.0
9	Trigger Number Description	0	0.00	Channel 09	Disable	TRG08	0.0
10	Trigger Number Description	0	0.00	Channel 10	OR	TRG11	0.0
11	Trigger Number Description	0	0.00	Channel 11	OR	TRG10	0.0
12	Trigger Number Description	0	0.00	Channel 12	Disable	TRG13	0.0
13	Trigger Number Description	0	0.00	Channel 13	Disable	TRG12	0.0
14	Trigger Number Description	0	0.00	Channel 14	Disable	TRG15	0.0
15	Trigger Number Description	0	0.00	Channel 15	Disable	TRG14	0.0

*Fixing undefined macros

2)General TPR Setup:

2a) Make sure the MODE PV is set to SC, Link is up and set the Message Delay

Define the Message Delay for your system: 107692 nsec is the default default delay calculated = Injector Laser 100 microsec + beam to your device (You time this) + fiber delay (TPG-Laser and TPG-fanout-ATCA)

Example = 112597 nsec BPMS Message Dealy set in Diag0

Set through caput!

2b)Setup TPR Trigger

The Triggers are linked to the firmware by the Firmware Engineer, talk to the Firmware Engineer to find out what is associated with each Trigger and then set meaningful names to each trigger "Desc".

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TPR Diagnostics

TPR NameTPR-DIAG0-MG03-0Timing Uptime (sec)5950823

Fiducial Counter1539816598Timing Link StatusLink Up

ModeSCUptime5950823

Device System Information

IOC NameSIOC-DIAG0-MG03Crate\$(CRATE)

CPU\$(CPU)Crate Slot\${DEV0}:SLOT

Expert...

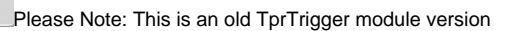
Trigger Num	Desc	TWID	TDES	Source	AND/OR	Pair Source	Rate
0	Trigger Number Description	0	0.00	Channel 00	Disable	TRG01	0.0
1	Trigger Number Description	0	0.00	Channel 00	Disable	TRG00	0.0
2	Trigger Number Description	0	0.00	Channel 02	Disable	TRG03	0.0
3	Trigger Number Description	0	0.00	Channel 03	Disable	TRG02	0.0
4	Trigger Number Description	0	0.00	Channel 04	Disable	TRG05	0.0
5	Trigger Number Description	0	0.00	Channel 05	Disable	TRG04	0.0
6	Trigger Number Description	0	0.00	Channel 06	Disable	TRG07	0.0
7	Trigger Number Description	0	0.00	Channel 07	Disable	TRG06	0.0
0	Trigger Number Description	0	0.00	Channel 08	Disable	TRG09	0.0
0	Trigger Number Description	0	0.00	Channel 09	Disable	TRG08	0.0
10	Trigger Number Description	0	0.00	Channel 10	OR	TRG11	0.0
11	Trigger Number Description	0	0.00	Channel 11	OR	TRG10	0.0
12	Trigger Number Description	0	0.00	Channel 12	Disable	TRG13	0.0
13	Trigger Number Description	0	0.00	Channel 13	Disable	TRG12	0.0
14	Trigger Number Description	0	0.00	Channel 14	Disable	TRG15	0.0
15	Trigger Number Description	0	0.00	Channel 15	Disable	TRG14	0.0

*Change the TWID and TDES to enterable fields Verify that SYS0 and SYS2 does update with Mode switching

*Allow to view NC and SC displays

\$TOOLS/pydm/display/evnt/tprDiag.ui

This will help you understand how to setup the Channels used by your Triggers.



\$TOOLS/pydm/display/evnt/tprDiagExp.ui

3) Setup the Channels

The Channel is the trigger logic that allows you to trigger your system.

Channel 1: N Triggers This means you can configure a Channel and re-use it for multiple triggers, just like an event code but at the Client level.

BSYS TPR Expert Display - PyDM

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Tpr Diagnostics				Device System Information	
TPR Name	TPR-BSYS-MP04.1	Timing Uptime (sec)	16905323	LCLS2 master delay (nsec) 107692	
Fiducial Counter	817726376	Timing Link Status	Link Up		
Mode	LCLS1	Uptime	16905323		

Ch #	Rate Mode	Fixed Rate	AC Rate	Timeslot Mask	Exp Rate	Rate	Dest Mode	Dest Mask	Ch Enable	Event Counts
00	Fixed	1Hz	0.5Hz	TimeSlot	0	120.5	Inclusive	0	Disabled	2011044921
01	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
02	Fixed	1Hz	0.5Hz	TimeSlot	0	1.0	Inclusive	0	Disabled	10750728
03	Fixed	1Hz	0.5Hz	TimeSlot	0	1.0	Inclusive	0	Disabled	10750725
04	Fixed	1Hz	0.5Hz	TimeSlot	0	300.5	Inclusive	0	Disabled	1790240715
05	Fixed	1Hz	0.5Hz	TimeSlot	0	120.5	Inclusive	0	Disabled	2011044921
06	Fixed	1Hz	0.5Hz	TimeSlot	0	10.0	Inclusive	0	Disabled	107507090
07	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
08	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
09	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
10	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
11	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
12	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
13	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
14	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
15	Fixed	1Hz	0.5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0

The Channel has different sections that needs to be setup:

Q1) Do you need to trigger when a Destination is included?

LASER 0X1
 DIAG0 0X2
 DUMPBSY 0X4
 DUMPHXR 0X8
 DUMPSXR 0X10
 LESA 0X20

Q2) Do you need to trigger at a Lower Frequency?

if YES, AC or Fixed?

AC Rates out of the SC Laser will be scheduled on TS3 and TS6, keep this in mind!

Q3) Do you have a special trigger, like a Calibration, Kicker or BSA BUFF?

The SECTIONS of Channel setup are organized by column and repeated by row (x15 configurable channels)

Rate Mode can be Fixed, AC or Seq

Fixed Rates are 1Hz, 10Hz, 100Hz, 1KHz, 10KHz, 71.5KHz and 1MHz (929KHz) - If different, you are loading the wrong db!

AC Rates are 0.5Hz, 1Hz, 5Hz, 10Hz, 30Hz, 60Hz To achieve 120Hz INCLUDE TIMESLOT MASK TS3 and 6!

*0.5Hz Please review DB Should that be there?

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Tpr Diagnostics

TPR Name: TPR-DIAG0-MG03-0 Timing Uptime (sec): 8951522

Fiducial Counter: 888843449 Timing Link Status: Link Up

Mode: SC Uptime: 8951522

Device System Information

LCLS2 master delay (nsec): 107692

Ch #	Rate Mode	Fixed Rate	AC Rate	Timeslot Mask	Exp Rate	Rate	Dest Mode	Dest Mask	Ch Enable	Event Counts
00	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Don't care	2	Enabled	1
01	Fixed	1Hz	2Hz	TimeSlot	0	0.0	Don't care	2	Enabled	1
02	Fixed	1Hz	5Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
03	Fixed	1Hz	10Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
04	Fixed	1Hz	30Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
05	Fixed	1Hz	60Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0

Exp Rate THIS SECTION NEEDS EDITS! Apologies...

Dest Mode= Inclusive, Exclusive or Don't care

Dest Mask = Enter Destination bit

Use Cases:

3a) Trigger based on a Destination receiving Beam

Rate Mode = Fixed

Fixed Rate = 1MHz

Destination Mode = Include

Destination Mask = Dest Bit

Ch Enabled Only when you are done configuring, to avoid high undesired triggers on your device!

This will trigger your device in either Fixed rate or AC Rate beam, anytime there is beam.

3b) Trigger based on AC and/or Fixed Rate at a Lower rate than beam rate with Destination Requirement

Fixed Rate Case:

Rate Mode = Fixed

Fixed Rate = 10Hz

Destination Mode = Include

Destination Mask = Dest Bit

Ch Enabled Only when you are done configuring, to avoid high undesired triggers on your device!

AC Rate Case:

Rate Mode = AC

AC Rate = 10Hz

Destination Mode = Include

Destination Mask = Dest Bit

Ch Enabled Only when you are done configuring, to avoid high undesired triggers on your device!

3c) Trigger based on AC and/or Fixed Rate at a Lower rate than beam rate withOUT Destination Requirement

Fixed Rate Case:

Rate Mode = Fixed

Fixed Rate = 10Hz

Destination Mode = Don't care

Ch Enabled Only when you are done configuring, to avoid high undesired triggers on your device!

AC Rate Case:

Rate Mode = AC

AC Rate = 10Hz

Destination Mode = Don't care

Ch Enabled Only when you are done configuring, to avoid high undesired triggers on your device!

Set rate mode to AC and rate for AC

Set destination mode and channel

Ch #	Rate Mode	Fixed Rate	AC Rate	Timeslot Mask	Exp Rate	Rate	Dest Mode	Dest Mask	Ch Enable	Event Counts
00	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Don't care	2	Enabled	1
01	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Don't care	2	Enabled	0
02	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
03	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
04	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
05	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
06	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
07	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
08	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
09	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
10	AC	1Hz	60Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
11	Fixed	500kHz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	0
12	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	-1
13	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	-1
14	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	-1
15	Fixed	1Hz	1Hz	TimeSlot	0	0.0	Inclusive	0	Disabled	-1

Time Slot Selection - PyDM

Timeslot Mask (HEX) 0x0

☒ TS1 ☐ TS2 ☐ TS3 ☒ TS4 ☐ TS5 ☐ TS6

****Each timeslot has AC rate up to 60 Hz; by selecting the two timeslots we get 120 Hz**

3d)

Trigger on special bits like the Calibration Bit for BPMS Control Sequence Setup

Trigger on special bits like the Standby Trigger for Kicker Control Sequence Setup Seq = # and bit = # & INCLUDE dest = # this provides the in time trigger.

Seq = # and bit = # & EXCLUDE dest = # this provides the out of time trigger.

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Tpr Diagnostics

TPR Name

TPR-DIAG0-MG03-0

Timing Uptime (sec)

5950823

Fiducial Counter

-1539816598

Timing Link Status

Link Up

Mode

SC

Uptime

5950823

Device System Information

IOC Name

SIOC-DIAG0-MG03

Crate

\$(CRATE)

CPU

\$(CPU)

Crate Slot

\$(DEV0)-SLOT

Expert...

Trigger Num	Desc	TWID	TDES	Source	AND/OR	Pair Source	Rate
0	Trigger Number Description	0	0.00	Channel 00	Disable	TRG01	0.0
1	Trigger Number Description	0	0.00	Channel 00	Disable	TRG00	0.0
2	Trigger Number Description	0	0.00	Channel 02	Disable	TRG03	0.0
3	Trigger Number Description	0	0.00	Channel 03	Disable	TRG02	0.0
4	Trigger Number Description	0	0.00	Channel 04	Disable	TRG05	0.0
5	Trigger Number Description	0	0.00	Channel 05	Disable	TRG04	0.0
6	Trigger Number Description	0	0.00	Channel 06	Disable	TRG07	0.0
7	Trigger Number Description	0	0.00	Channel 07	Disable	TRG06	0.0
0	Trigger Number Description	0	0.00	Channel 08	Disable	TRG09	0.0
0	Trigger Number Description	0	0.00	Channel 09	Disable	TRG08	0.0
10	Trigger Number Description	0	0.00	Channel 10	OR	TRG11	0.0
11	Trigger Number Description	0	0.00	Channel 11	OR	TRG10	0.0
12	Trigger Number Description	0	0.00	Channel 12	Disable	TRG13	0.0
13	Trigger Number Description	0	0.00	Channel 13	Disable	TRG12	0.0
14	Trigger Number Description	0	0.00	Channel 14	Disable	TRG15	0.0
15	Trigger Number Description	0	0.00	Channel 15	Disable	TRG14	0.0

3e)Trigger on a SYS BSA Buffer at 1Hz, 10Hz, 100Hz Control Sequence Setup