Analog Threshold Detect (ATD) User Guide

High Performance Simultaneous Data Acquisition

Reference document for details relating to D-TACQ Analog Threshold Detect DSP Module

Revision History

Revision	Date	Author(s)	Description
1	28/10/2024	SR/PGM	Created

Contents

1 ATD Functional Summary

Programmable per channel threshold function, EPICS PVs are provided for all of:

- M: Mode Rising, Falling, Inside, Outside
- L1 : threshold for Rising, Falling
- L1 and L2 : limits for Inside, Outside.
- H : Hysteresis.

Standard DSP behaviour is to emit an EVENT on the first of any threshold crossings. This event may be used in several ways.

- To trigger a ”live scope” display
- As the trigger in a PRE/POST capture to the limit of memory, eg in the Fault Monitor application
- In a streaming application, the Events are embedded in the data stream for remote processing

Grouping: the DSP logic triggers on first of many, always. However it’s possible to group multiple triggers together, and allow embedded software to trigger the system. Grouping includes:

- Group CURRENT : all channels in group need to be active at the same time to output a trigger.
- Group HISTORY: trigger is emitted when all channels in group have been active since the previous trigger.
- Group FIRST_N: trigger when the first-n channels in the group are active (CURRENT mode) or have been active (HISTORY mode).

Events - the capture system must be configured to respond to the appropriate event:

- The DSP will typically emit EVENT.d0
- The ESW will emit EVENT.d1

In a DISTRIBUTED SCOPE application, the EVENT can be used to trigger a White Rabbit Trigger, to cause all units to trigger at time shortly in the future, then each unit stops, and rewinds time in the memory buffer to the exact moment of trigger. Any participating box in the distributed scope can declare a threshold crossing trigger, and trigger the entire fleet.

2 Thresholds

There are four 8-bit thresholds per channel. These are organised within a 32-bit quantity as follows :

0xAABBCCDD

- AA = Bits 31 downto 24
- BB = Bits 23 downto 16
- CC = Bits 15 downto 8
- DD = Bits 7 downto 0

The selected function can be inferred by the logic based on the state of these thresholds. For a rising or falling test, two of the unused threshold values are set to ±full-scale.

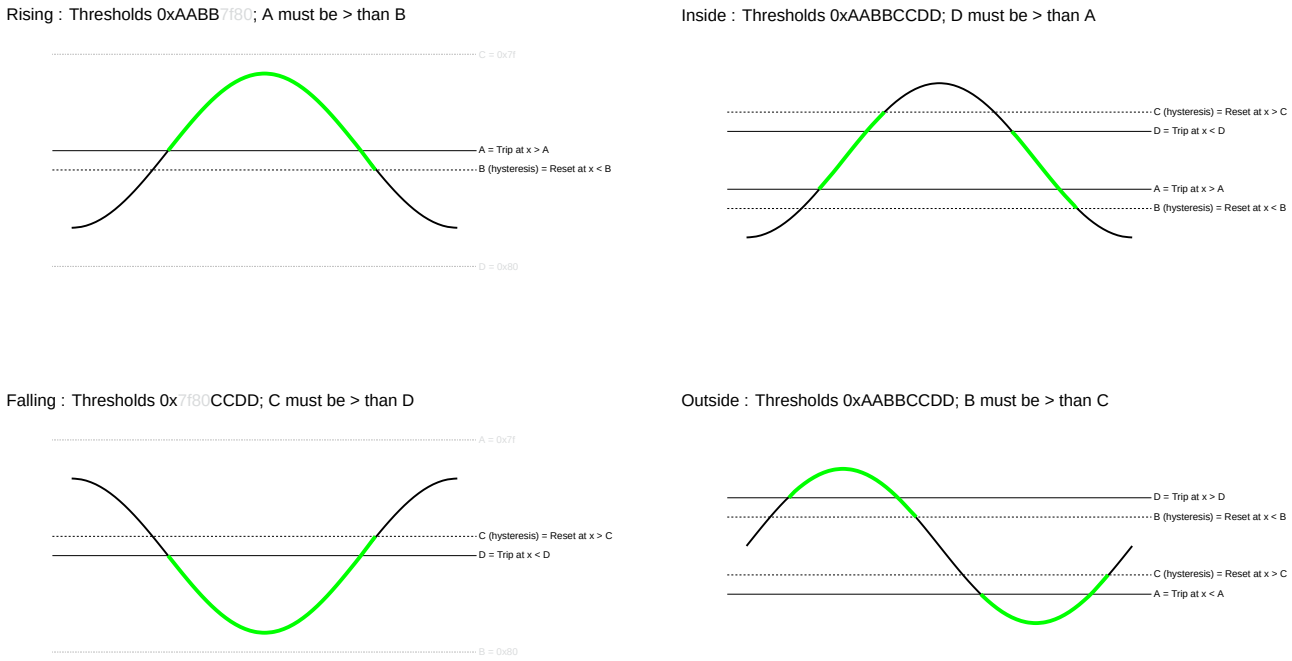


Figure 1: Diagram showing the 4 supported threshold conditions

The hystereses in these examples are purposely exaggerated for clarity.

2.1 Threshold Scale

2.1.1 Minimum Resolution

ADC resolution for a ±10 V, 16-bit ADC :

$$\frac{20}{2^{16}} = 305\,\mu V$$

8 MSBs of comparison gives us a minimum resolution of :

$$2^8 \times 305 \times 10^{-6} = 78\,mV$$

N.B. As an example, for the rising edge case, one would have to **clear the threshold by at least the minimum comparison resolution** to trip the ATD.

2.1.2 Bitshift for greater resolution

Shift Left	Scale	Maximum	Minimum Resolution
0	1	10 V	78 mV
1	2	5 V	39 mV
2	4	2.5 V	20 mV
3	8	1.25 V	10 mV

Table 1: Lorem ipsum

3 ATD EPICS Interface

ATD: Analog Threshold Detect
Live Scope with up to NCHAN triggers.

Default personality NCHAN=64
(2 x ACQ423ELF-32-200)

NCHAN can be 4..192
Supported on ACQ42x, ACQ43x, ACQ465

Definition: 4GUG: #13.3

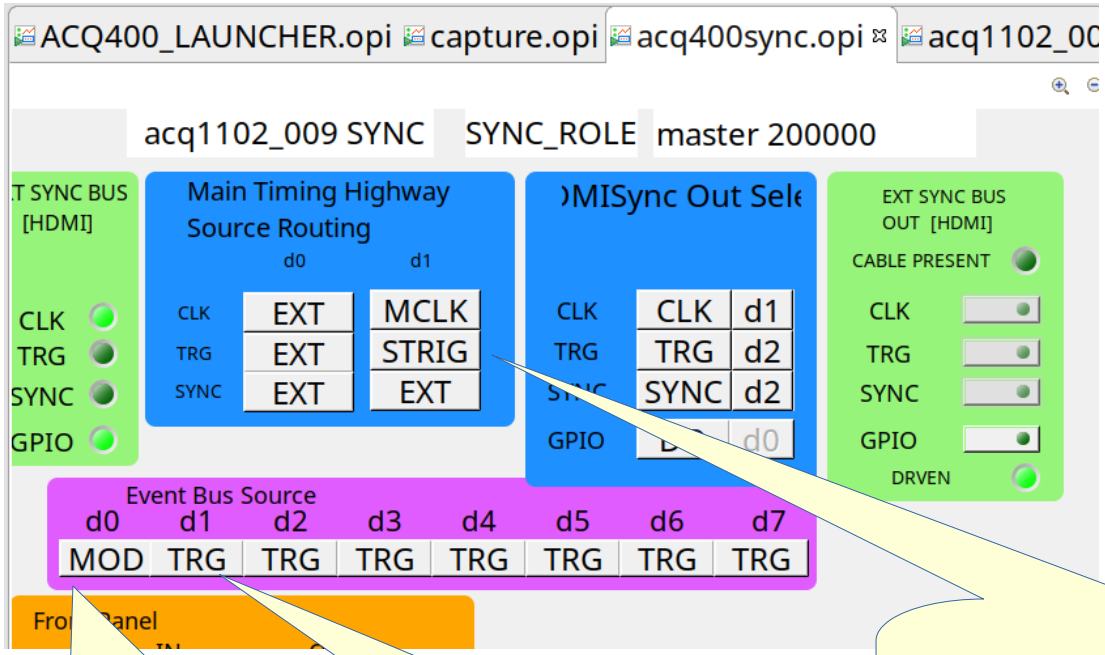
EPICS PV's

1.0	${UUT}:${S}:ANATRG:${CC}:M	enum	Mode. none|rising|falling|inside|outside
1.1	${UUT}:${S}:ANATRG:${CC}:H	enum	Hysterisis % 1|2|5|10|20
1.2	${UUT}:${S}:ANATRG:${CC}:L1	double	Level 1 V
1.3	${UUT}:${S}:ANATRG:${CC}:L2	double	Level 2 V
2.0	${UUT}:${S}:ANATRG:ALL:M H/L1/L2	enum/ double	Parameters as above
2.1	${UUT}:${S}:ANATRG:ALL:SET	bo	SET all channels to ALL:M H/L1/L2
3	${UUT}:${S}:ANATRG:LIVE:${CC}	bi	Live State monitor
4.0	${UUT}:${S}:ANATRG:GROUP:${CC}	bo	Channel ${CC} is part of GROUP
4.1	${UUT}:${S}:ANATRG:GROUP:ALL:SET	bo	Set all channels in Group
4.2	${UUT}:${S}:ANATRG:GROUP:ALL:CLR	bo	Clear all channels from Group
4.3	${UUT}:${S}:ANATRG:GROUP_MODE	enum	CURRENT (active same time) | HISTORY (active in period)
4.4	${UUT}:${S}:ANATRG:GROUP:FIRST_N	int	Trigger on first N channels in group.
5	${UUT}:${S}:ANATRG:SCALE	enum	1,2,4,8 : 1:level is -127..+127 <<8, <<7, <<6, <<5 Ie as scale rises, level is closer to zero and more precise.
6	${UUT}:${S}:ANATRG:RESET	bo	Reset all logic.
	${UUT} : UUT NAME, ${S} : Site 1..6 ${CC} Channel 01..192		

Prams For One Channel set immediate

Prams For ALL CH Commit with SET

Event Source Selection

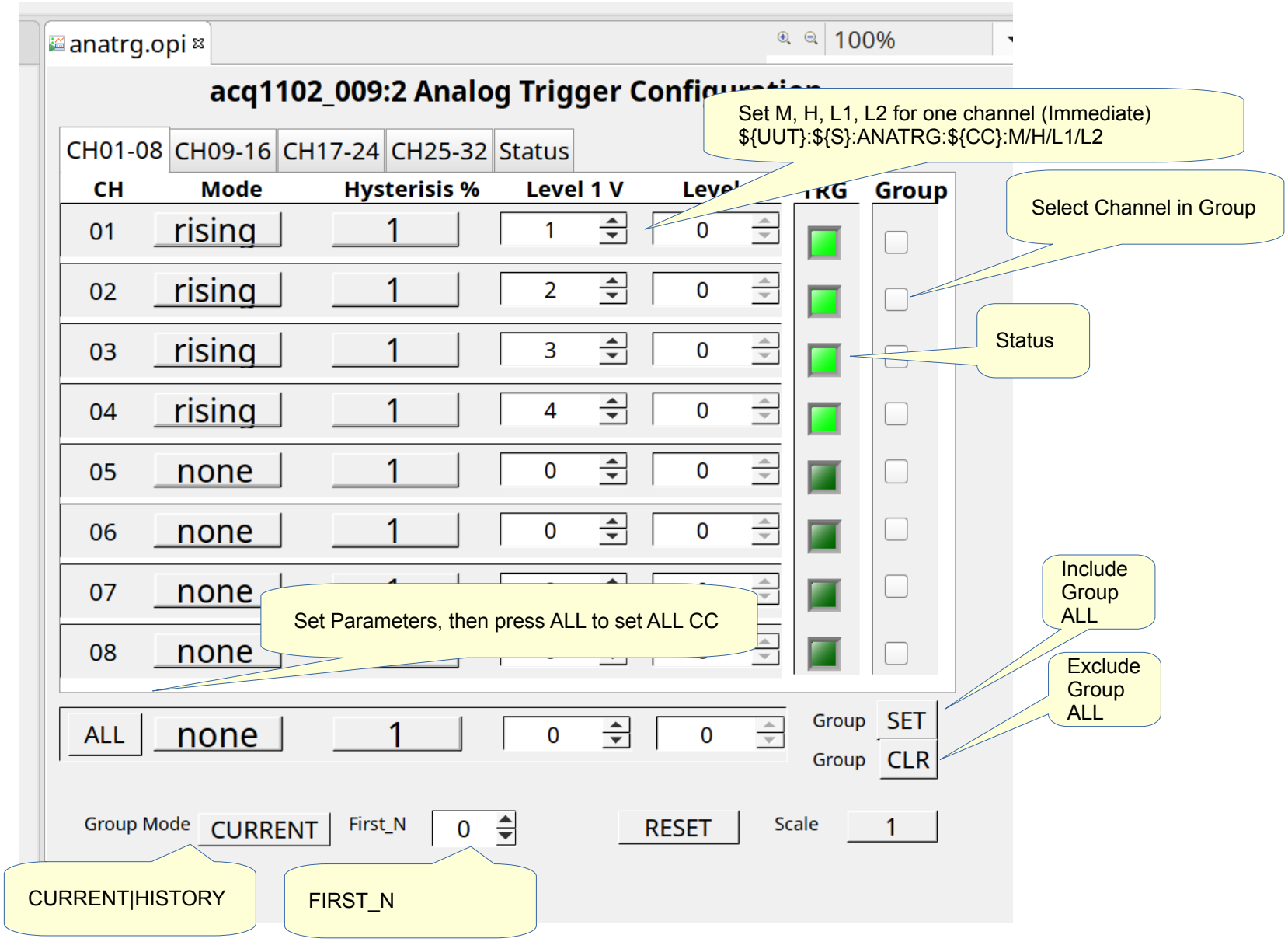


${UUT}:0:SIG:EVENT_SRC:0
EVT.d0 SRC set MOD (ATD DSP)

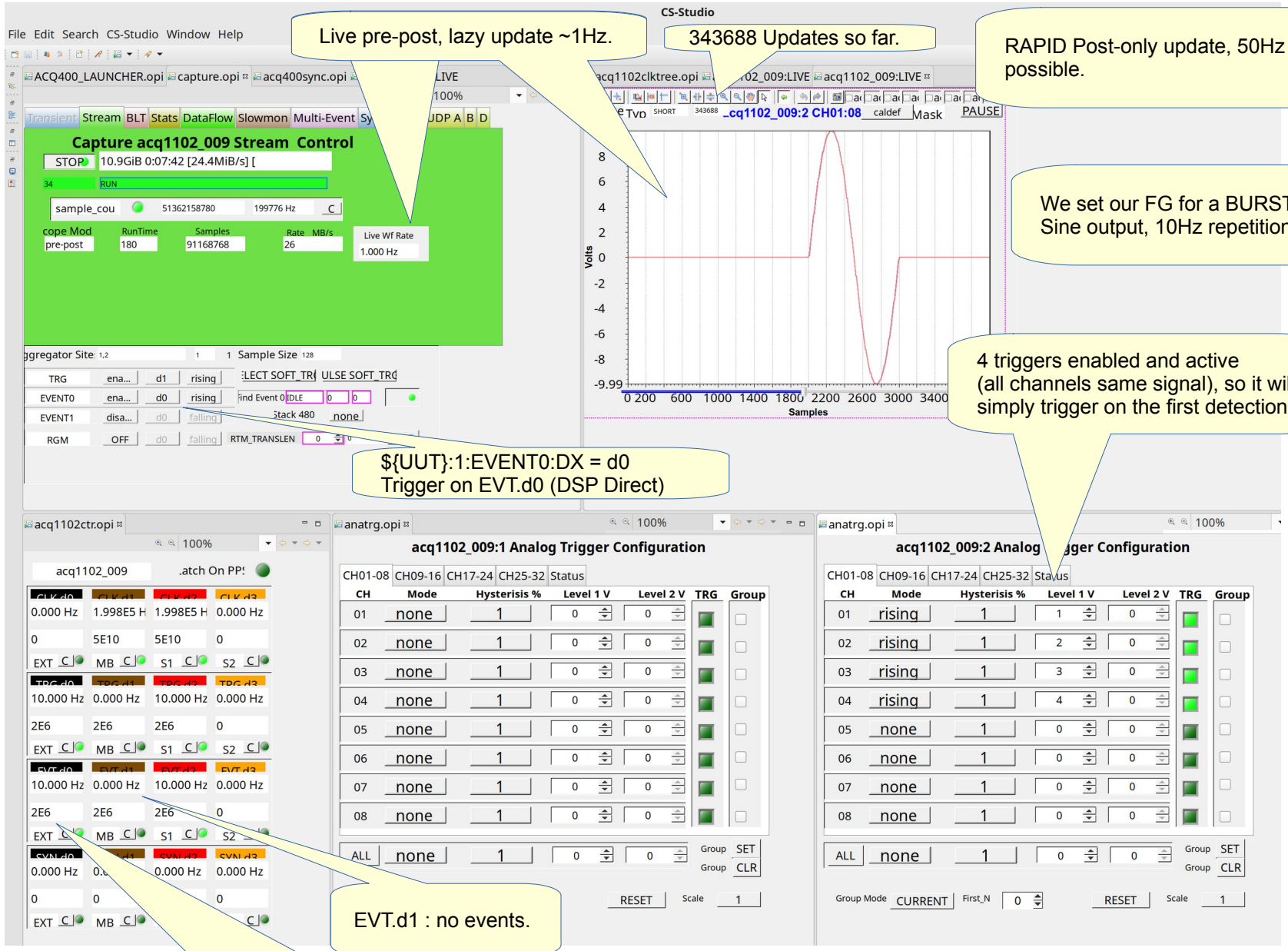
${UUT}:0:SIG:EVENT_SRC:1
EVT.d1 SRC set TRG

${UUT}:0:SIG:SRC:TRG:1 STRIG
TRG.d1 SRC set STRIG
(soft-trigger). The ATD Interrupt Routine sets soft-trigger to drive the system

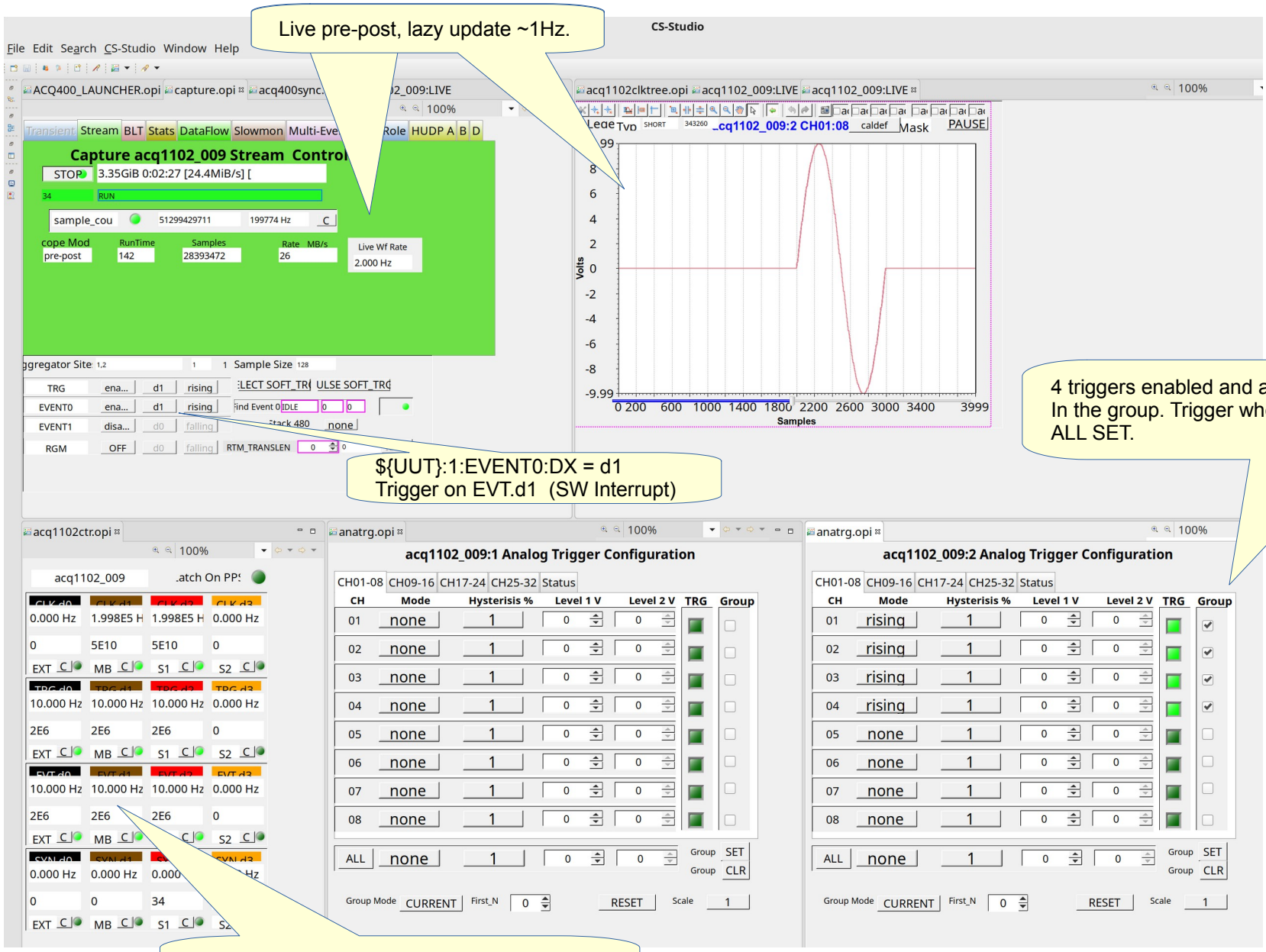
Controls



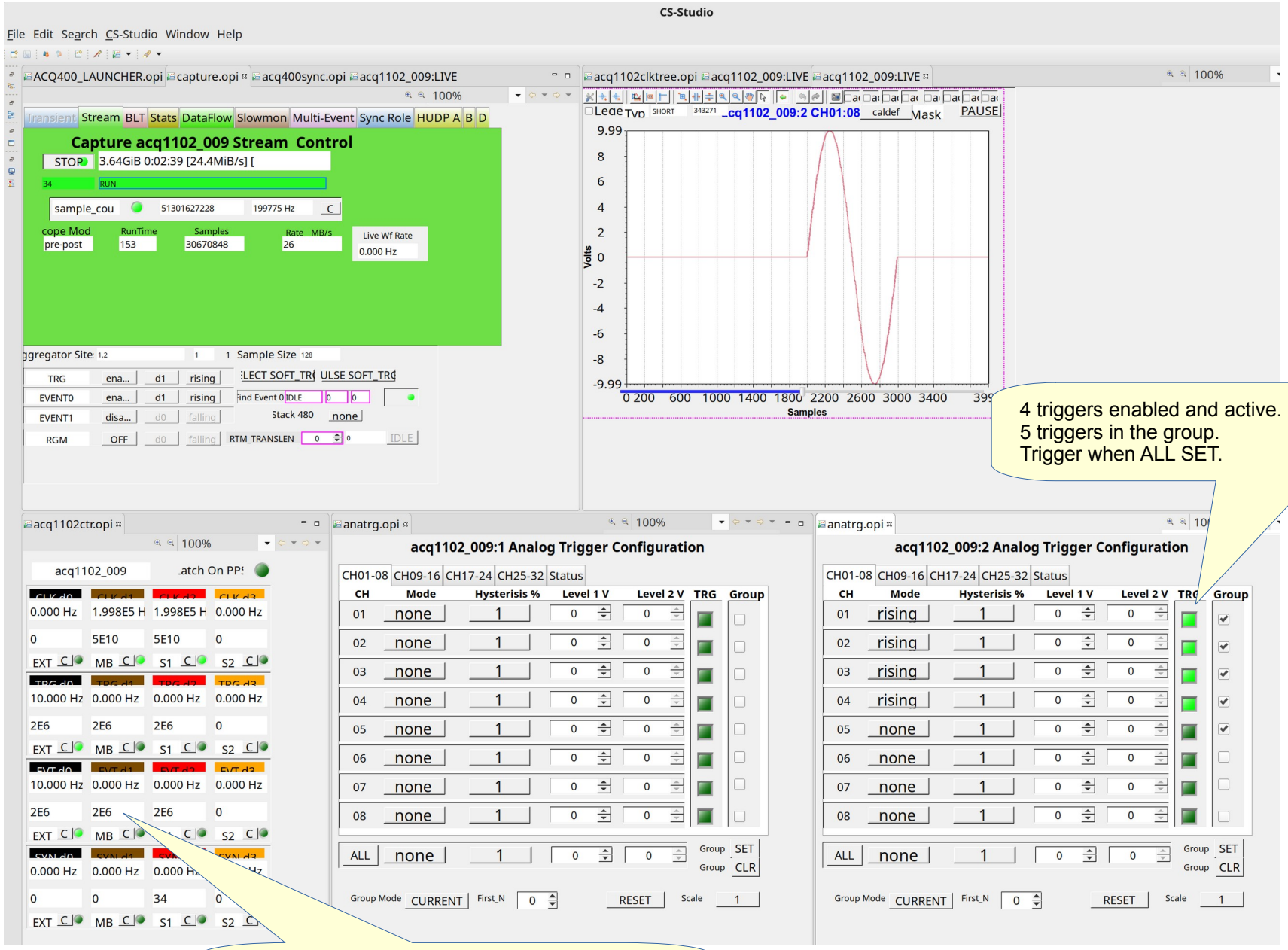
Standard (Direct DSP) Triggers



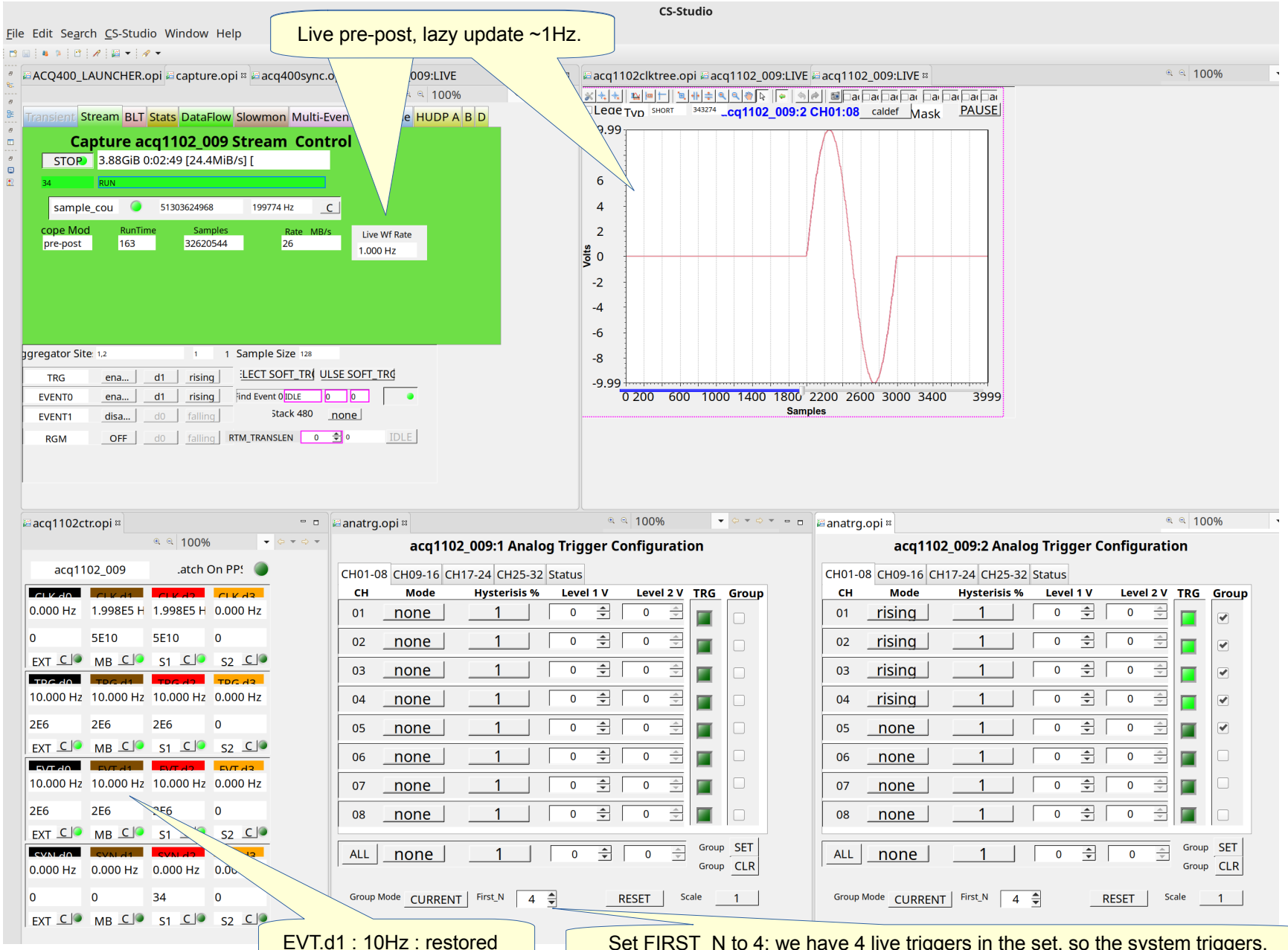
Group Trigger



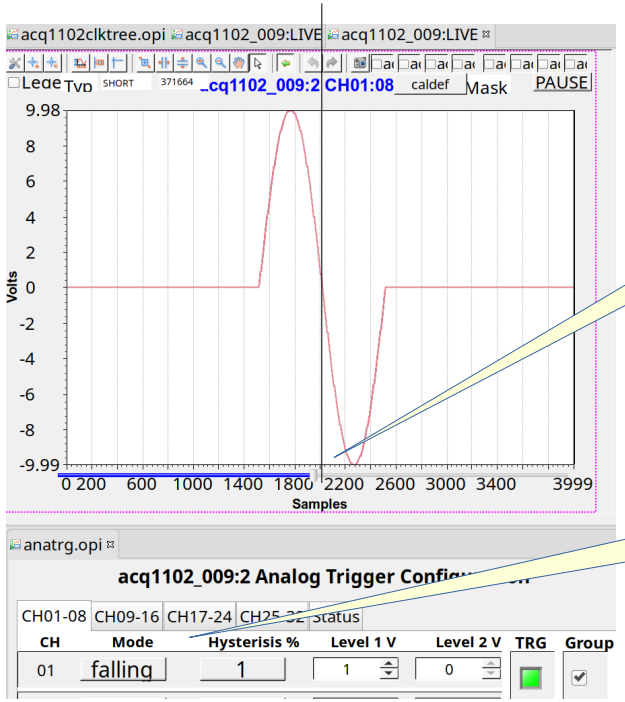
Group Trigger 2



Group Trigger 3



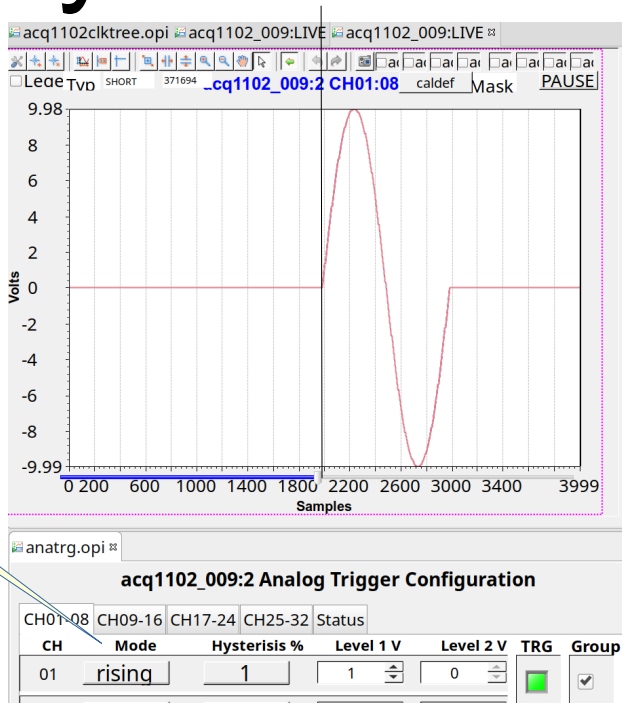
Live Delay Control



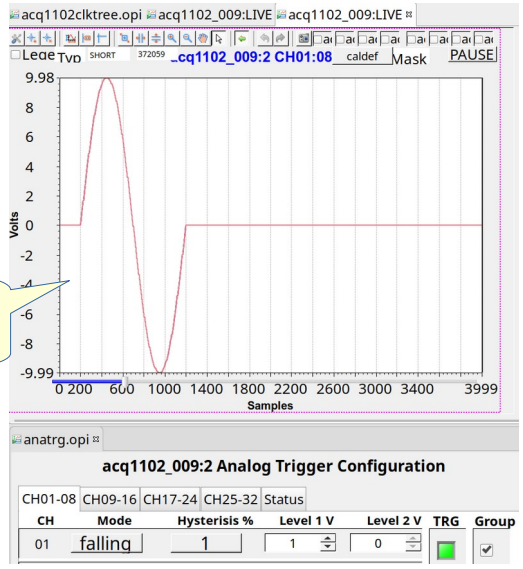
PRE=POST

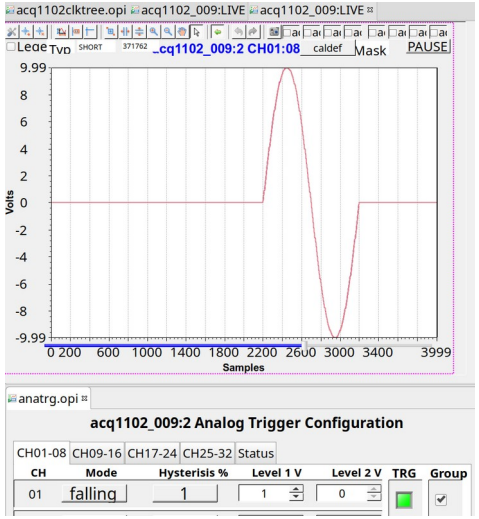
falling

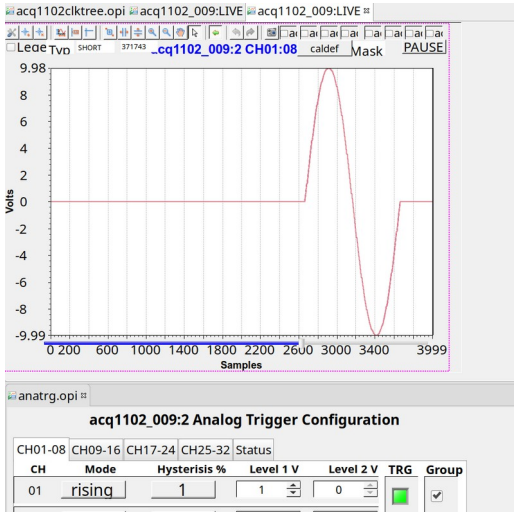
falling



Live Delay adjust: 0..100%
${UUT}:LIVE:PREPCT







4 Interrupts and Events - HW/SW Interaction

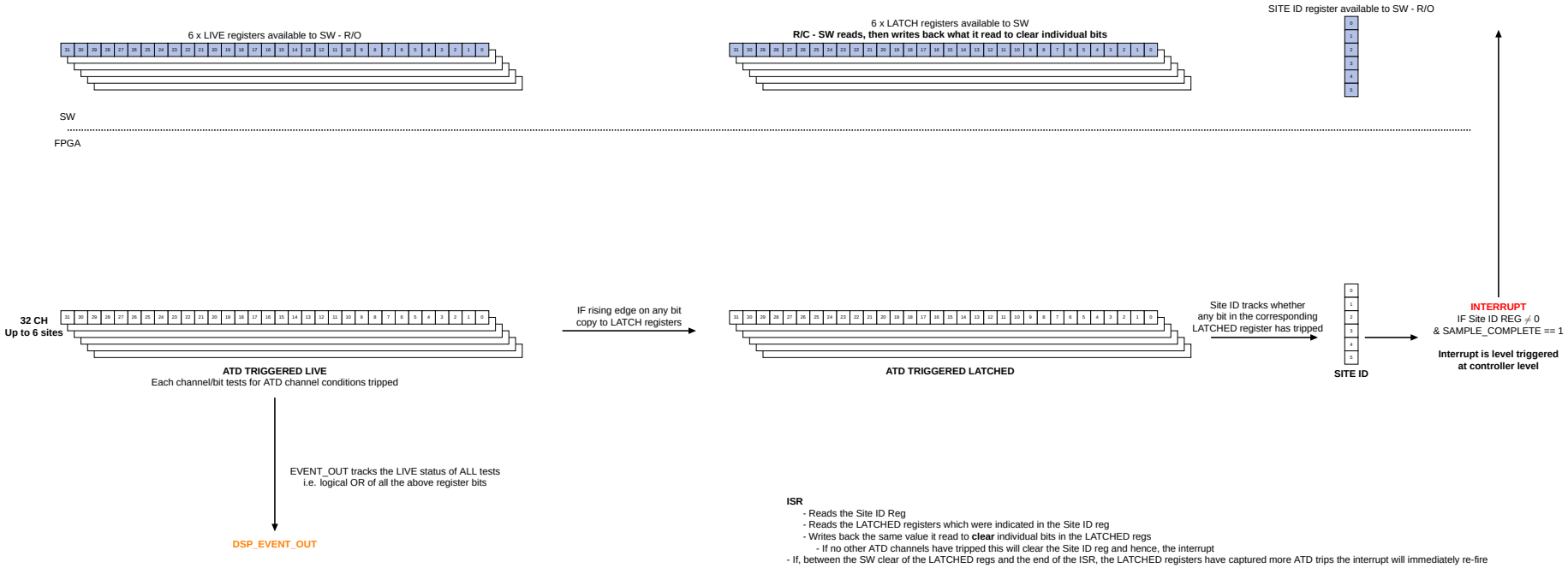


Figure 2: Illustrating the Event and Interrupt interaction between HW and SW