Index Panel

SLC Control Program

INDEX

Slac's Software Engineering newsletter

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New TGAS Diagnostic

January 31, 1989

Author: *Tom Himel, Dan Crane* **Subsystem:** *CID* **User Impact:** *Small*
Panel Changes: *Few* **Documents:** *No* **Help File:** *Yes*

What is a TGAS, and how does it work?

The TGAS is a CAMAC module used to control the CID gun. TGAS stands for Trigger Gate And Synchronizer. It performs the three functions implied in its name.

- Trigger: It fires the gun fast pulser.
- Gate: It uses the permissive and the TIU to gate its output.
- Synchronizer: It synchronizes its output pulse to the subharmonic buncher's 178.5 MHz.

The TGAS module has three timing inputs:

- a PDU trigger
- The 2856/24 = 119 MHz = 8.4 nsec signal which is also used by the PDUs. This is used so the TGAS can trigger on either the upgoing or downgoing edge, thus allowing a 4.2 nsec step size.
- The 2856/16 = 178.5 MHz = 5.6 nsec signal which is used by the subharmonic buncher. Before entering the TGAS, this signal goes through a phase shifter controlled with a DAC.

The output of the TGAS is a pulse at the first positive going zero crossing of the 178.5 MHz after the selected edge of the 119 MHz signal. Hence delays are set to the nearest 4.2 nsec by using the PDU and telling the TGAS which edge of the 119 MHz to trigger on. Finer delays are set by using the DAC to vary the phase shifter.

The key to understanding the TGAS is to remember that its output pulse occurs at the first positive going zero crossing of the 178.5 MHz after the selected edge of the 119 MHz. Picture that we want to make gradually longer delays (e.g. by turning the TGAS timing knob). If we do this by gradually increasing the phase shifter setting, the delay won't increase forever. It will increase gradually and then suddenly decrease by 5.6 nsec (1 period of the 178.5 MHz) when a positive going zero crossing of the 178.5 MHz passes the selected PDU edge. To avoid this sudden decrease, the TGAS program in the micro periodically increases the delays requested of the PDU and edge settings by 4.2 nsec. To do this at the right time so it doesn't cause any sudden jumps, it needs to know the relative phases of the 119 and 178.5 MHz. A purpose of the TGAS calibration is to determine this phase. This phase is known by its database name of U0E0 and is expressed in degrees of 178.5 MHz.

Running the TGAS calibration

To run the TGAS calibration: from the INDEX panel, select [INJCTR INDEX] then select [CIDTCH PULSER PANEL] then select the beam code you want to use for the calibration. The beam code must have a non-zero rate. There are no other restrictions. You should also select one of the two TGAS units. Then select [TGAS DIAGS PANEL], a new button which is near the lower right hand corner. This takes you to a new panel.

The three buttons [CALIB TGAS] [SAVE + CHECK CALIB] [CHECK PEP TIMING] all do very similar things. Each of these sets up triggers (**which will kill all non-NPI beams**), does a 350 step calibration (which takes about two minutes) and then returns the triggers to their original states. The calibration consists of requesting the TGAS to make 350 different delays in 0.05 nsec steps, covering a total of 17.5 nsec. The actual delays are measured with a TDC and the results are plotted as shown in Figures 1 and 2. Figure 1 shows a case where U0E0 was wrong. There are 5.6 nsec jumps in the output. Figure 2 shows a case where U0E0 was OK; there are no jumps.

The normal procedure (for SLC) when you suspect there might be something wrong with the TGAS, e.g. setting up after a long shutdown, or when the beam spontaneously debunches, is to hit [CALIB TGAS]. The program will tell you if the calibration was OK, in which case you are done. If there are jumps like in Figure 1, the program will tell you so, calculate the optimum value of U0E0, and tell you to hit [SAVE + CHECK CALIB]. When you do so, the new U0E0 will be saved in the data base, the new and old U0E0s will be logged to the error log, and the calibration will be repeated to make sure that it properly cures the jumps.

SPEAR/PEP

For SPEAR or PEP beam codes there is the [CHECK PEP TIMING] button. This leaves on the triggers which synchronize SLC timing to the storage ring. The result of such a calibration is shown in Figure 3. To understand it, one needs to know how the storage ring synchronization works.

- SPEAR/PEP send a train of their once-per-turn signal up the main drive line.
- The nearest bucket of 2856 MHz (0.35 nsec) is selected. The beam SLC delivers to them will jitter by this much.
- The subharmonic buncher divide by 16 is reset so the TGAS fires exactly synchronous with the selected bucket.
- A fiducial (from which the PDU's timings are derived) is generated at the nearest $2856/6 = 476$ MHz pulse of the MDL frequency. Since it can only pick the nearest pulse, all PDU signals (including those used by the TGAS and the start of the TDC have a $1/476 = 2.1$ nsec) jitter with respect to the beam.

Note how clever this scheme is. Since the fine TGAS timing is determined by the 178.5 MHz, not the PDU timing, there is no jitter on when the gun fires with respect to the subharmonic buncher phase. All other

SLC components (except the damping ring RF whose divide by 4 is reset like the divider of the subharmonic buncher) will have a 2.1 nsec jitter with respect to the beam **which does not matter.**

Now go back to Figure 3 and try to understand it. Vertically, there is a 2.1 nsec jitter because the PDU which is used to start the TDC jitters. There are regions 2.1 nsec wide where the function is double-valued because the PDU which triggers the TGAS jitters. Hence for certain delays the PDU trigger sometimes happens just before and sometimes just after a positive going zero crossing of the 178.5 MHz. Depending on which happens, there can be an extra 5.6 nsec delay. Having regions where the function is double-valued is unavoidable. The goal of this check is to allow one to make sure that at the TGAS delay we are currently using for the beam (represented by the red vertical line) we aren't near one of these double valued regions.

Displays

There are three displays available from the TGAS diagnostics panel. Hitting [PLOT TGAS CALIB] gets plots like those shown in the figures. Hitting [DISPLY CALIB] gets a table with a line for each data point in the plot. There are many columns giving things like the PDU and DAC settings. This table should not normally be needed. It is provided for experts to track down subtle (unforseen) problems. Finally, there is a [SINGLE UNIT DISPLY] which can be used to see the present value of U0E0 without doing a calibration. Note that the last display you looked at is automatically shown after a TGAS calibration is done.

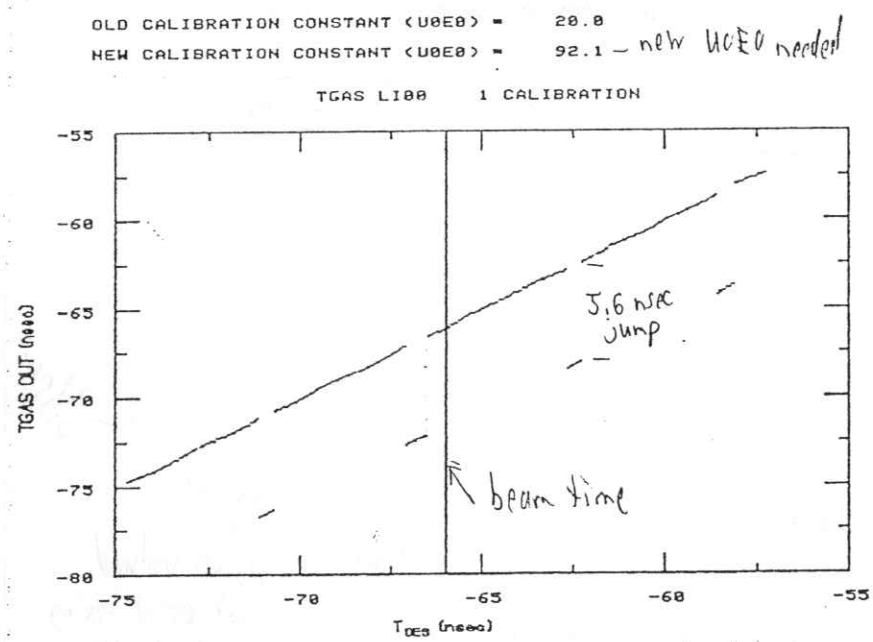
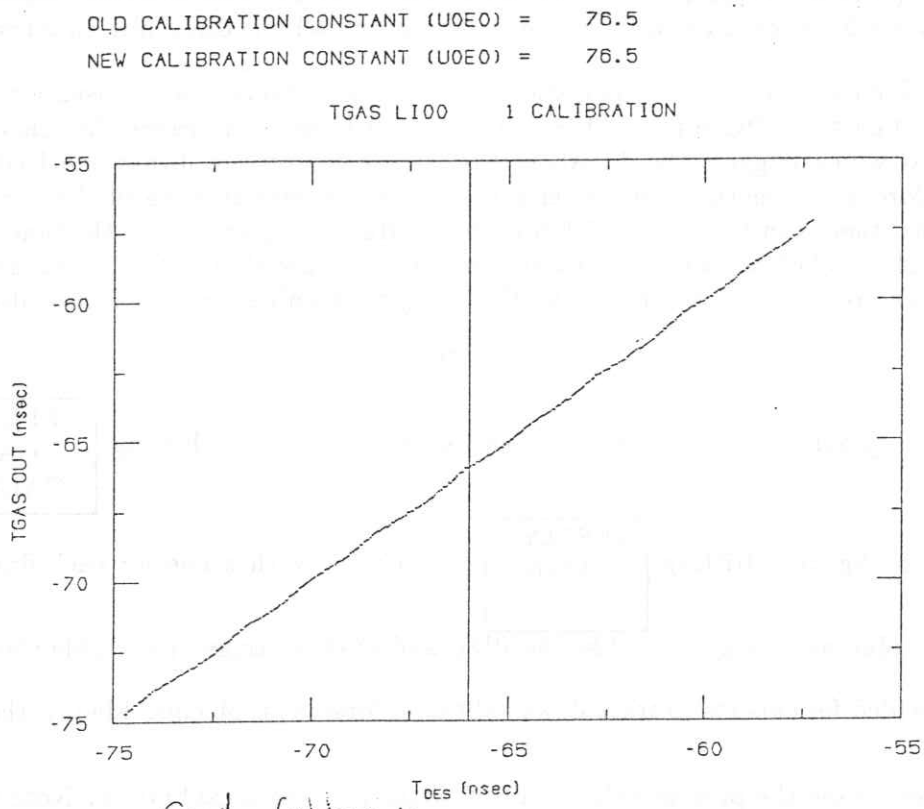


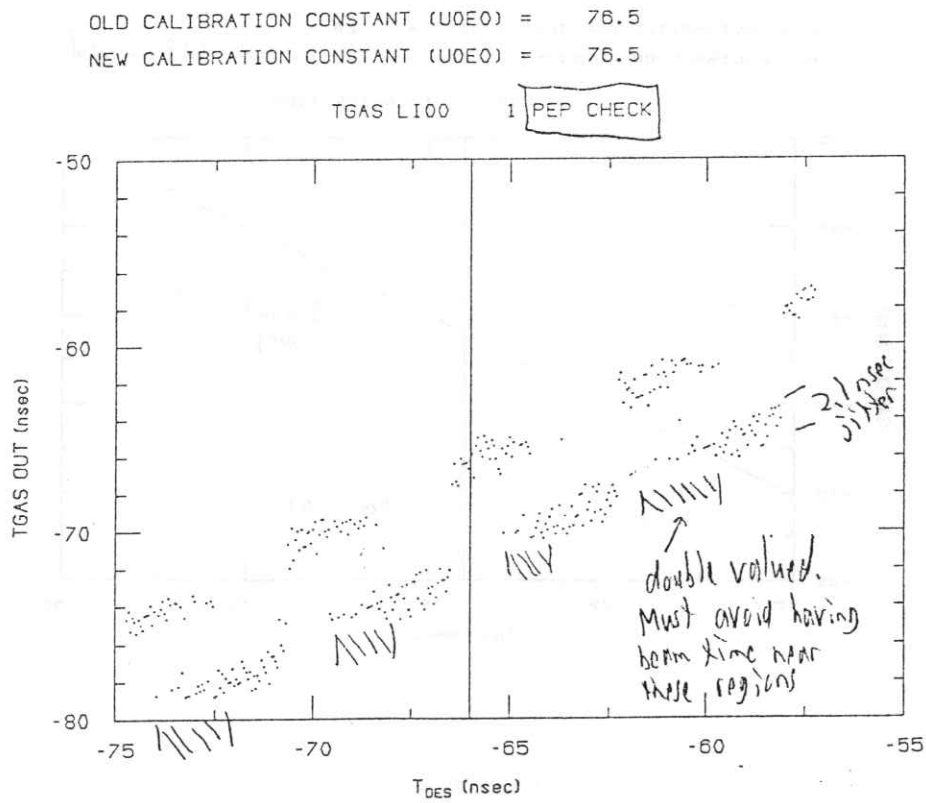
Figure 1

Figure 2



Good Calibration

Figure 3



Veto Fault Recording

January 26, 1989

Author: *Tom Himel, Tony Gromme* **Subsystem:** *Code in Micros* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *None* **Help File:** *None*

The veto fault circular buffer kept in the micros is now limited to containing transitions seen on beam codes that can represent real beam; "transition" here means change since the last time the same beam code was seen. This reduces the likelihood of filling the buffer with useless information.

Changes to POLL and POLL0

January 30, 1989

Author: *Nancy Spencer* **Subsystem:** *Batch* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *No* **Help File:** *Yes*

The following changes have been made to POLL and POLL0:

1. The display of the image name has been fixed (the first three characters of the date had been appended to the end).
2. The syntax of NEW has been modified so that NEW <cr> does nothing. Previously, typing NEW <cr> deleted all micros from the poll list.
3. The syntax of DEL has been modified so that DEL ALL will delete all micros from the poll list.

TMATRIX History Data

January 30, 1989

Author: *Ralph Johnson* **Subsystem:** *History Data* **User Impact:** *Some*
Panel Changes: *Few* **Documents:** *No* **Help File:** *None*

The history buffer facility has been modified to provide the history of tmatrix values.

Currently we are saving timing values for the following:

(KICK,DR12,189) BEAMS (3,8,11,29,30,31,32)

(KICK,DR12,190) BEAMS (3,8,11,29,30,31,32)

(TRIG,DR12,203) BEAMS (3,8,11,29,30,31,32)

(KICK,DR12,410) BEAMS (4,10,14,20,33,34,39,40,41,42)

(KICK,DR12,409) BEAMS (4,10,14,20,33,34,39,40,41,42)

(TRIG,DR12,603) BEAMS (4,10,14,20,33,34,39,40,41,42)

(TRIG,DR12,604) BEAMS (4,10,14,20,33,34,39,40,41,42)

(TRIG,DR12,605) BEAMS (4,10,14,20,33,34,39,40,41,42)

(KICK,DR02,191) BEAMS (4,14,33,39)

(TRIG,DR02,212) BEAMS (4,14,33,39)

(KICK,DR02,411) BEAMS (10,20,41,42)

(TRIG,DR02,205) BEAMS (10,20,41,42)

(TRIG,DR02,214) BEAMS (10,20,41,42)

(KICK,EP01,170) BEAMS (4,14,33,34)

For each of these, 240 points are saved at an interval of 6 minutes. The value saved is the tmatrix value with TREF and TNOMINAL subtracted.

To look at a history plot of any of the data, select one of the devices and a beam by using the timing panels. Then select the timing diagnostics panel. The timing diagnostics panel has a button [PLOT TIME HISTRY] to select the history plot with whatever scaling is in effect. To change the scaling use the [HISTRY PLOTS PANEL] button on the timing diagnostics panel to select a panel which provides for scaling selections.

The history plot of timing values will have a "D" character shown along the lower border wherever the corresponding value is deactivated.

New Not CAL or Not STDZ Message on Magnet Display

February 2, 1989

Author: *Nan Phinney* **Subsystem:** *Magnets* **User Impact:** *Small*
Panel Changes: *None* **Documents:** *None* **Help File:** *Old*

By popular request, the All Magnet display now indicates when a Green (In Tolerance) device has not been Calibrated or is no longer Standardized. The messages Not CALd or Not STDZd will be displayed in Yellow in the Status Text field if the CAL_OK or STDZ_OK bit is not set in STAT and the function is not explicitly disabled in HSTA. All devices which do not need to be Standardized have had the STDZ Disabled bit (800 Hex) turned on in HSTA. Not CALd is considered more severe than Not STDZd and both are displayed before the Yellow RMS status.

SLC COMMISSIONING CALENDAR †

	THURSDAY Feb. 2	FRIDAY Feb. 3	SATURDAY Feb. 4	SUNDAY Feb. 5	MONDAY Feb. 6	TUESDAY Feb. 7	WEDNESDAY Feb. 8
OWL	* S1 RF Process	* S1 RF Process	* S1 RF Process	* S1 RF Process	* S1 RF Process	* S1 RF Process 06-1800 SPEAR Mach. Physics	*
DAY	* 10-1300 VAX Disk Upgrade 1400 DBinstall on MCC VAX	*	*	*	*	0830-0900 ** 0900 Restore NPI Beams SLC DBGEN	0830-0900 ** 0900 Restore NPI BEAMS Restore S23 PPS Cert. CID PPS Cert. e^+PPS MCC DBGEN Recover NPI Beams
SWING	*	* e^+Vault Lockup	*	*	*	*	* S2-21 Lockup

*: NPI $e^- \rightarrow$ESA, $e^- \rightarrow$SPEAR.

**: 12 kV off; S19, 20, 25, 26 e^+Vault.

† This calendar is provided for informational purposes only. Neither the Software Engineering Group nor the SLC management accept any responsibility for its accuracy. Schedule subject to change without notice. All departures are from NPI at 120 times per second.