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LIGO

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BSC-ISI Update – Release Notes

Version 2

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Distribution of this document:)
Advanced LIGO Project

This is an internal working note
of the LIGO Laboratory

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Update Summary

Update described in SEI aLog 897 and comments. List on pages 1-2, followed by discussion

Items requested as of 03/04. Items not covered by this update in gray :

- 1) frame updates:
 - a) store drive channels at full model rate
 - b) store GS-13s, cart basis, at full model rate
 - c) stop storing multiple copies of the ground STS-2s
- 2) fix the blend glitch - temp fix checked in, *make a real fix.*
- 3) BIO
 - a) implement the 10sec mandate on the BIO for LLO BSCs and for HAMS
 - b) add monitor channels for the individual HAM bios
- 4) BIO_OUT block
 - a) fix low case names of the STS-2 commands in the BIO_OUT block for the isi2stagemaster.mdl
 - b) clean up BIO_OUT block content
- 5) make an MEDM screen with the STS-2 commands and monitors
- 6) St1-2 FF and St1 compensation
<https://alog.ligo-la.caltech.edu/SEI/index.php?callRep=882>
add path to compensate all of the st2 drive.
- 7) change the way the T240 gain switching is done
https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=915
- 8) increase number of allowed saturations for BSC-ISI WDs
https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=1125
- 9) add "saturations since model start" epics channel to SEI watchdogs
https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=1134
- 10) need to record the mass positions for the STS-2s
(add decently named epics channel)
https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=1148
- 11) add Reflected memory path for gnd STS-2s so we can isolate against only the differential motion
- 12)
 - a) *the outdated, top-level, binary IO blocks should be upgraded.*
 - b) *we'd like to upgrade the reset momentary to use the*
`/${userapps}/cgs/common/src/LONG_PULSE.c`
c-code where the duration of the pulse is user-defined such that it can send out the desire ~0.5 [sec] voltage pulse. (This is presumably what the additive STS2_Reset_ADD was trying to do).
 - c) *All of the cdsEpicsIn parts need to have their channel names capitalized in order to be functional.*

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d) The CAL, SIGSEL, and PERIOD should be changed to epicsBinIns, such that they can appear as rocker switches in MEDM just like they do on the front panels.

13) create ISI to SUS point library block to be placed on the top level model

14) SEI aLog 943

a) Add an SCSUM block after the ST2, SENSCOR block, just like what is in place for the GND to ST1 sensor correction in the ST1 block

b) Store the new sensor correction channels

```
$$ {IFO} : ISI-$$ {OPTIC}_ST2_SCSUM_T240_$$ {DOF}_IN
```

```
$$ {IFO} : ISI-$$ {OPTIC}_ST2_SCSUM_CPS_$$ {DOF}_IN
```

at 256 [Hz]

c) Store the pre-existing channels feed forward channels

```
$$ {IFO} : ISI-$$ {OPTIC}_ST1_FF12_$$ {DOF}_IN1
```

at 256 [Hz] in order to help diagnosis and characterization of these control paths.

15) SEI aLog 943: Employ tilt sensor correction from ST1 to ST2, recently proven successful in augmenting translational degrees of freedom (see LHO aLOG 25623)

16) BSC-ISI: Remove T240 signals going into ST2 SENSCOR. Instead pick off 6x signals of T240-L4C blends and send them into ST2 SENSCOR + send resulting drive signals to ST1 to allow compensating for ST2 drive there - to make it available to compensate for back-reaction.

17) ISI WD request - let the ISI model run w/o tripping if the SUS model goes down give a 60 sec. window to operator. (HughR)

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- 1) frame updates:
 - a) store drive channels at full model rate
matched the ham model rate

```
# DAC OUTPUTS
ST1_MASTER_H1_DRIVE* 512
ST1_MASTER_H2_DRIVE* 512
ST1_MASTER_H3_DRIVE* 512
ST1_MASTER_V1_DRIVE* 512
ST1_MASTER_V2_DRIVE* 512
ST1_MASTER_V3_DRIVE* 512
ST2_MASTER_H1_DRIVE* 512
ST2_MASTER_H2_DRIVE* 512
ST2_MASTER_H3_DRIVE* 512
ST2_MASTER_V1_DRIVE* 512
ST2_MASTER_V2_DRIVE* 512
ST2_MASTER_V3_DRIVE* 512
```

Fig.1: 1.a. Before

```
# DAC OUTPUTS
ST1_MASTER_H1_DRIVE* 2048
ST1_MASTER_H2_DRIVE* 2048
ST1_MASTER_H3_DRIVE* 2048
ST1_MASTER_V1_DRIVE* 2048
ST1_MASTER_V2_DRIVE* 2048
ST1_MASTER_V3_DRIVE* 2048
ST2_MASTER_H1_DRIVE* 2048
ST2_MASTER_H2_DRIVE* 2048
ST2_MASTER_H3_DRIVE* 2048
ST2_MASTER_V1_DRIVE* 2048
ST2_MASTER_V2_DRIVE* 2048
ST2_MASTER_V3_DRIVE* 2048
```

Fig.2: 1.a. After

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b) store GS-13s, cart basis, at full model rate

```
# ST2 - GS13
ST2_BLND_RX_GS13_CUR_IN1*
ST2_BLND_RY_GS13_CUR_IN1*
ST2_BLND_RZ_GS13_CUR_IN1*
ST2_BLND_X_GS13_CUR_IN1*
ST2_BLND_Y_GS13_CUR_IN1*
ST2_BLND_Z_GS13_CUR_IN1*
```

Fig.3: 1.b after

c) stop storing multiple copies of the ground STS-2s

```
## Sensor correction
ST1_SENSCOR_GND_STS_X_FIR_IN1 512
ST1_SENSCOR_GND_STS_Y_FIR_IN1 512
ST1_SENSCOR_GND_STS_Z_FIR_IN1 512
ST1_SENSCOR_GND_STS_X_IN1 512
```

Fig.4: channels removed from frames

2) fix the blend glitch - temp fix checked in, make a real fix.
BTL temp fix in place. Larger fix pending.

3) BIO

a) implement the 10sec mandate on the BIO for LLO BSCs and for HAMs
already fixed by BTL on 11/0215 (BSC-ISI)

b) add monitor channels for the individual HAM bios

issue only appears at Stanford. S1:ISI-HAMX_BIO_IN_CD_V1_STATUS are blank on HAM-ISI WD screens. Non-issue for sites.

4)BIO_OUT

a) fix low case names of the STS-2 commands in the BIO_OUT block for the isi2stagemaster.mdl

b) clean up BIO_OUT block content

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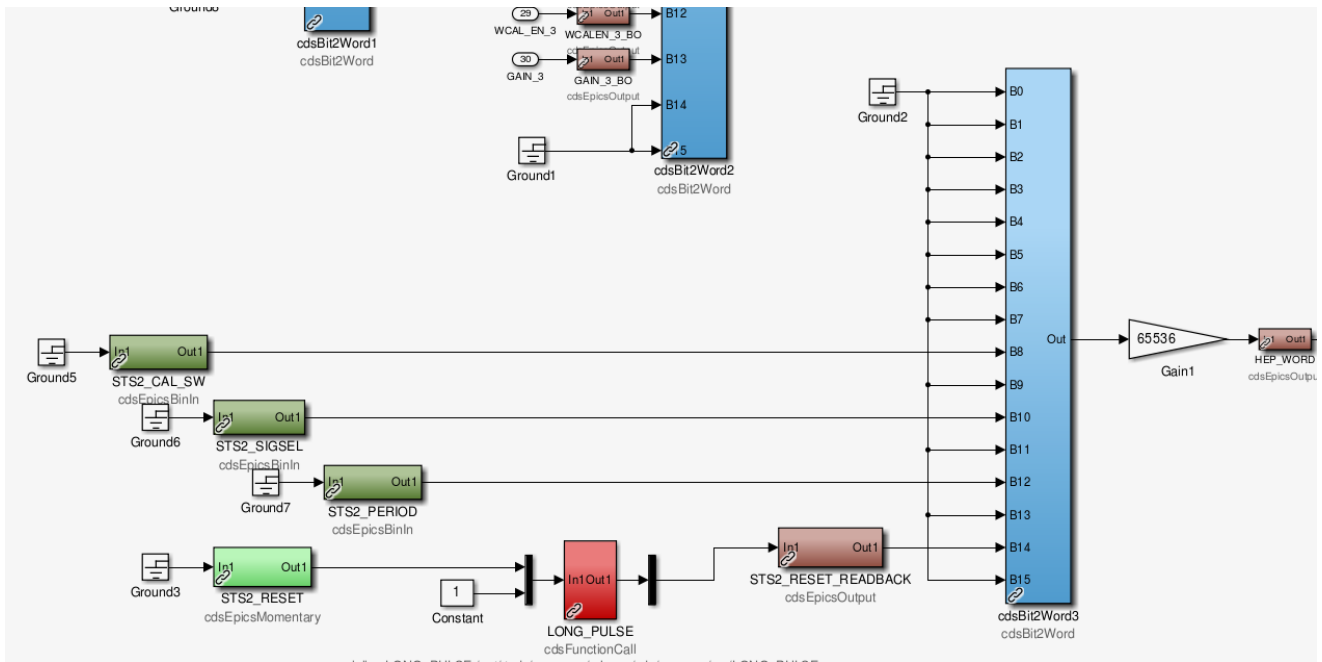


Fig. 5: 4.a. after

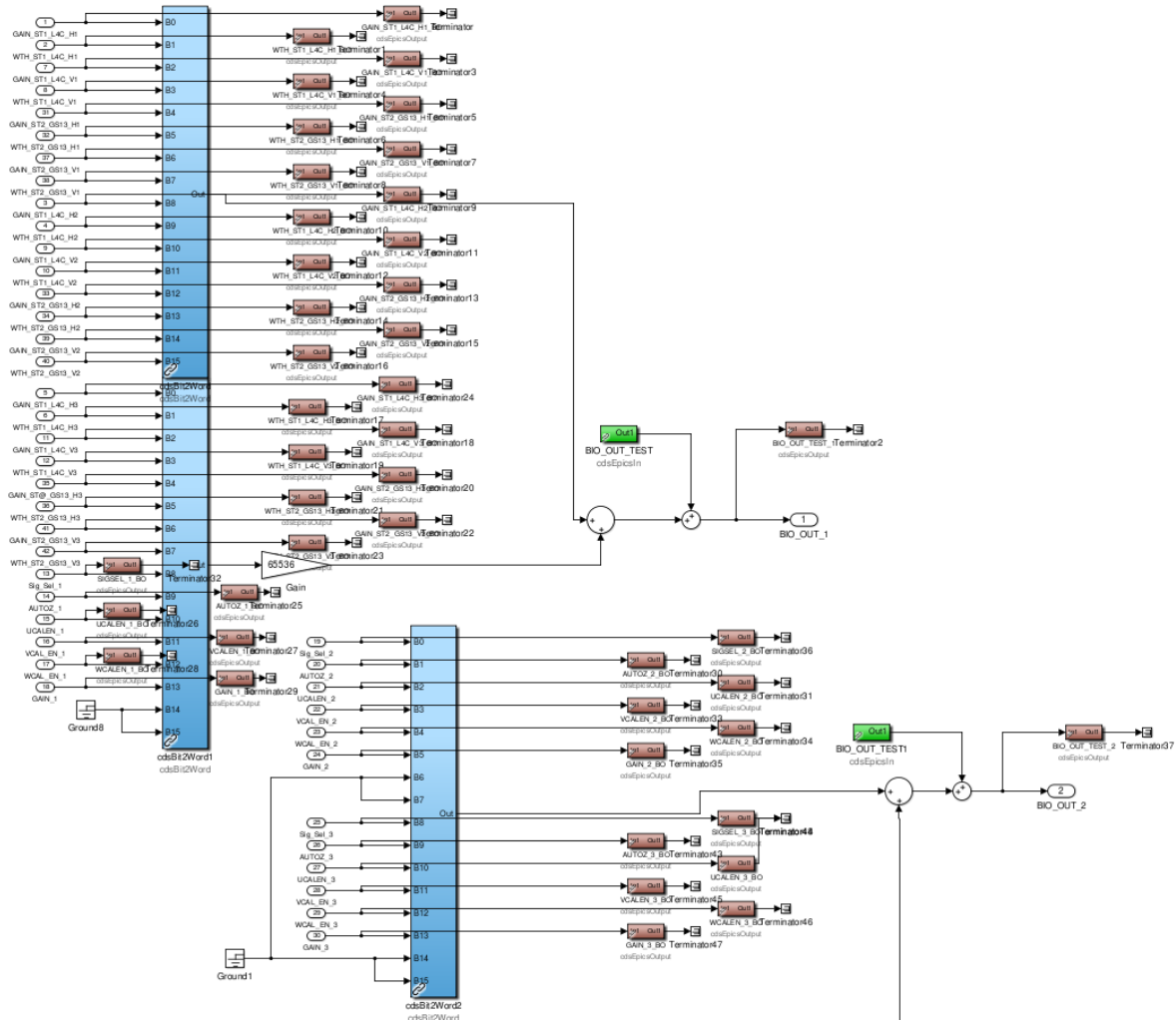


Fig. 6: 4.b before

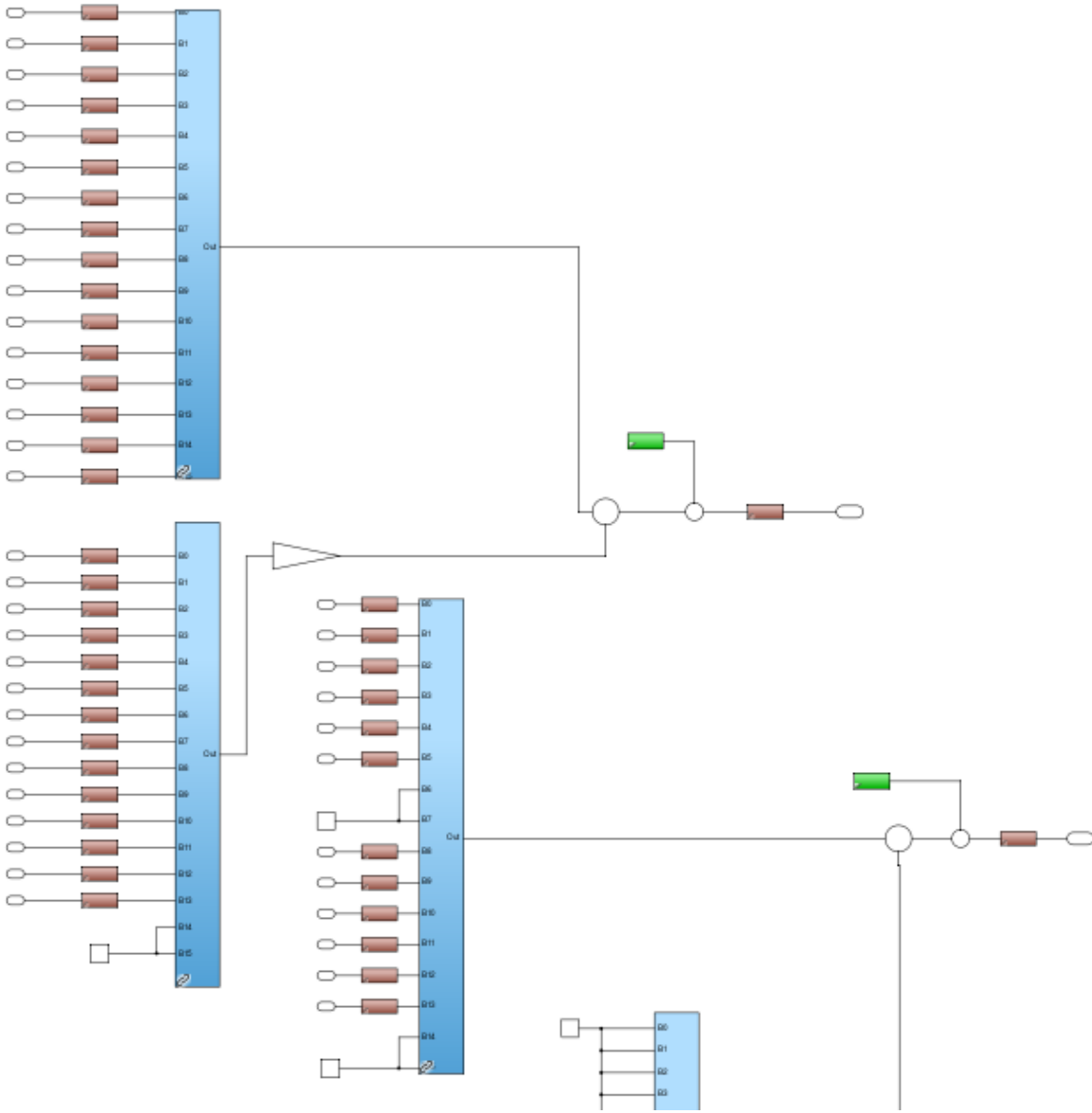


Fig. 7: 4.b After

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5) make an MEDM screen with the STS-2 commands and monitors
HughR will take care of it once he gets the model (SEI aLog 941)

7) change the way the T240 gain switching is done

Decided to leave as is. This switching method is different than for the other sensors, but it works fine so we decided to leave it as it is. see: https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=915

8) increase number of allowed saturations for BSC-ISI WDs

https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=1125

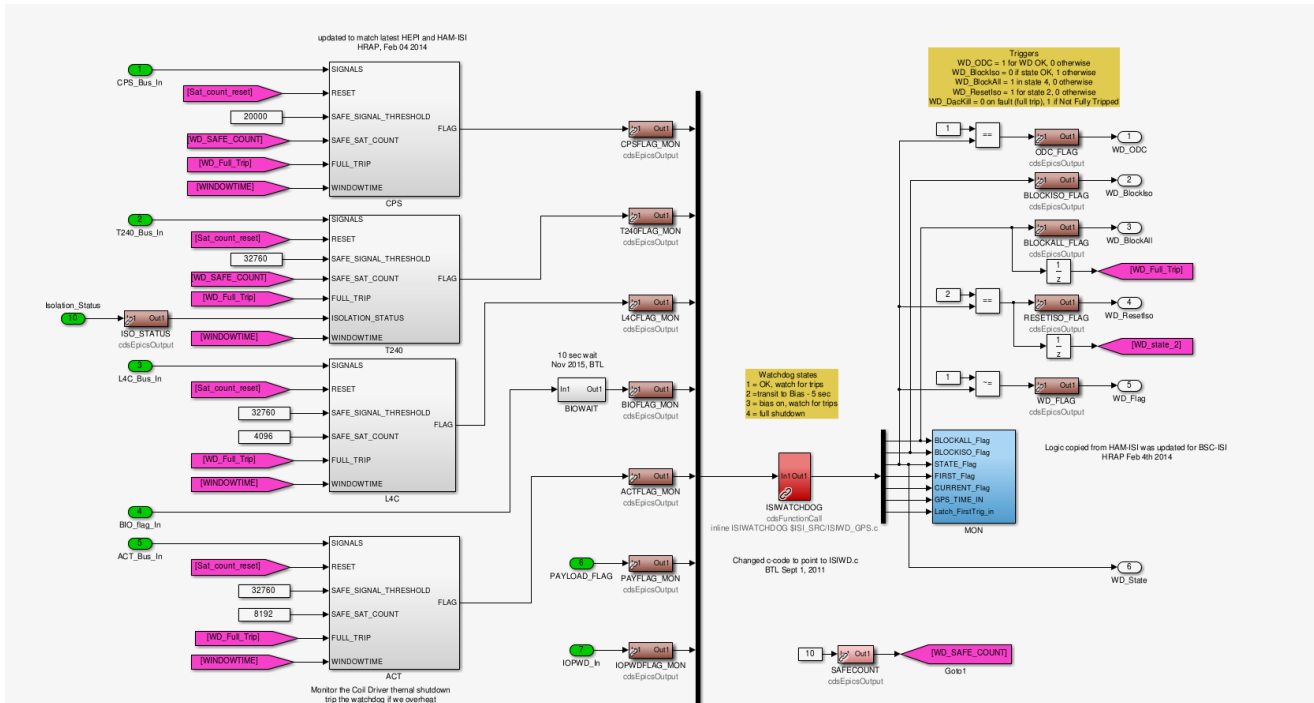


Fig. 8: ST1 updated (item 8)

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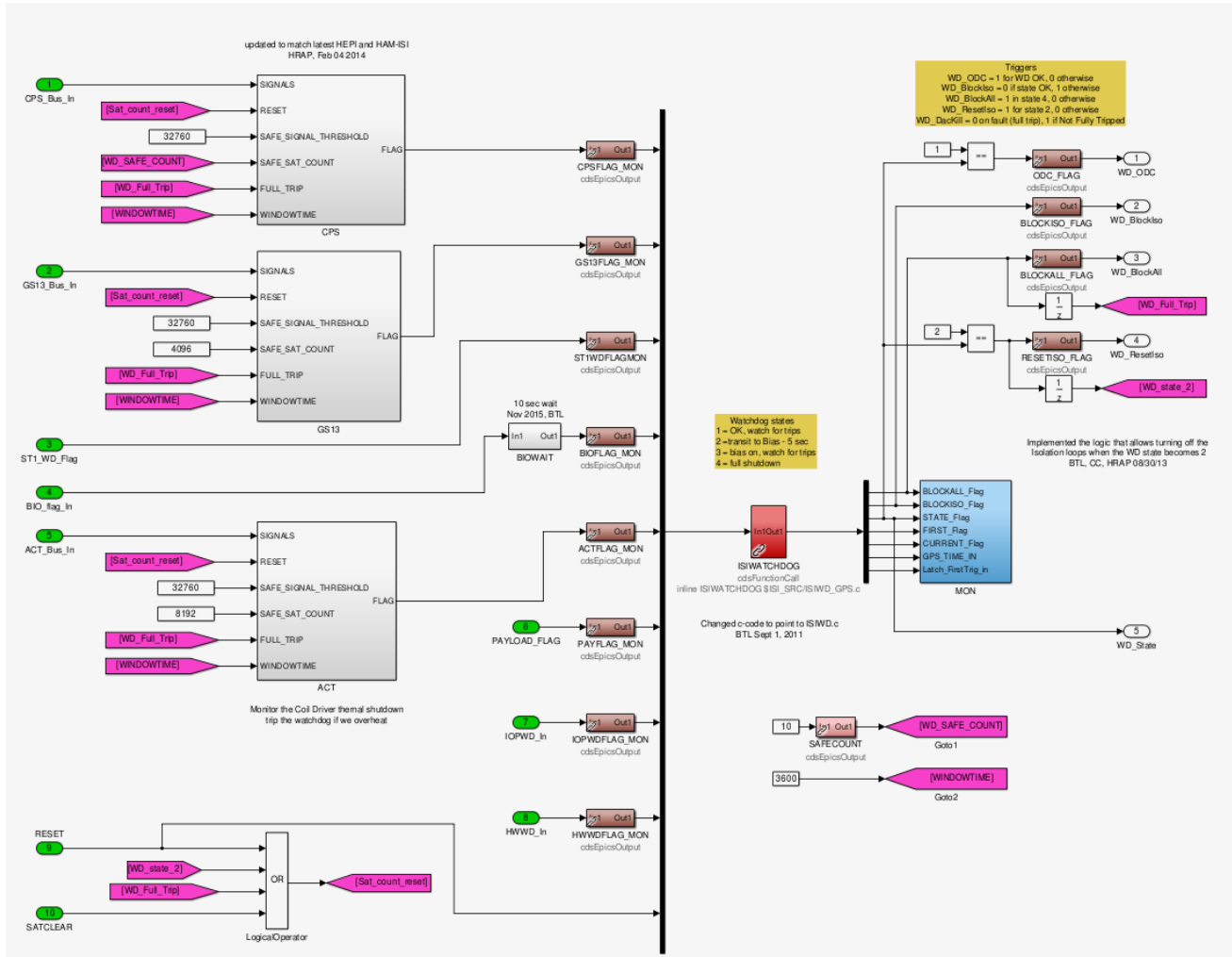


Fig. 9: ST2 updated (item 8)

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9) add "saturations since model start" epics channel to SEI watchdogs
https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=1134

**a new version of WD_SATCOUNT.c was created to prevent from impacting the HAM-
ISIs which have not received the model update yet: WD_SATCOUNT_vb.c**

```
144 static int AVAILABLE_BIN = 0;
145 static int BIN_SAT_TOTAL = 0;
146 int SATURATIONS_TOTAL = 0;
147 int i = 0; // simple counter
148
149 // -----Computation-----
150
151 // Apply RESET:
152 if (RESET == 0)
153 {
154     BUFFER = 0; // clear buffer
155     SAT_SINCE_RESET = 0; // clear the number of saturations since last reset.
156     SATURATIONS_TOTAL = 0;
157     // do not reset SAT_SINCE_RESTART
158     BIN_SAT_TOTAL = 0; // this fixes the initial 'not clearing consistently' bug.
159     for(i = 0; i < BINS; i++)
160     {
161         WINDOW[i] = 0; // clear window
162     }
163 }
164
165 // Apply reset of saturations since last restart
166 if (CLEAR_SAT_SINCE_RESTART == 0)
167 {
168     SAT_SINCE_RESTART = 0;
169 }
170
171 // Store the number of saturations in the buffer, and the number of saturations
172 // since last reset, at every sample
173 BUFFER = BUFFER + SATURATION_IN ;
174 SAT_SINCE_RESET = SAT_SINCE_RESET + SATURATION_IN ;
175 SAT_SINCE_RESTART = SAT_SINCE_RESTART + SATURATION_IN;
176
177 // Update the cycle number
178 CYCLE++;
179
180 // If new bin ready
181 if (CYCLE >= NUM_BINCYCLES)
182 {
183     // Store buffer in next available bin in the window
184     WINDOW[AVAILABLE_BIN] = BUFFER;
185
186     // Update AVAILABLE_BIN location in WINDOW
187     AVAILABLE_BIN++;
188
189     // Limit AVAILABLE_BIN to the number of bins available in WINDOW
190     if (AVAILABLE_BIN >= BINS)
191     {
192         AVAILABLE_BIN = 0 ;
193     }
194
195     // Clear BUFFER
196     BUFFER = 0;
197
198     // start counting CYCLES over
199     CYCLE = 0;
200
201     // SUM the saturations in the whole window
202     BIN_SAT_TOTAL = 0; // initialize sum
203 }
```

Fig. 10: WD_SATCOUNT_vb.c updated with SATURATIONS_SINCE_RESTART

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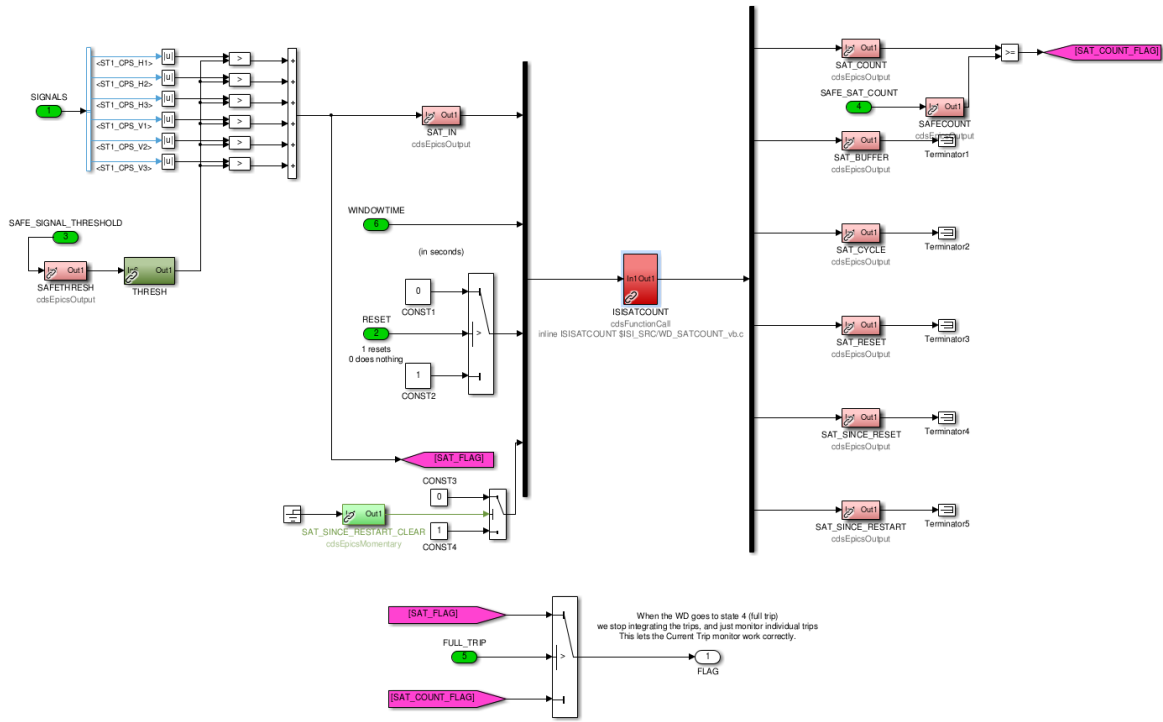


Fig. 11: BSC-ISI model updated with SATURATIONS_SINCE_RESTART

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```
controls@ligo-ops2: ~  
File Edit View Search Terminal Help  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:13.388415 165966  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:13.515796 169092  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:13.637749 172092  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:13.760862 175116  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:13.884145 178146  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:14.013908 181338  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:21.636729 184260  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:21.762021 187338  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:21.885386 190368  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.012161 193488  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.134928 196500  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.259317 199560  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.391516 202806  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.510595 205734  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.635145 208794  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.760942 211890  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:22.885277 214944  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:23.010783 218028  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:23.134457 221064  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:23.266542 224310  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:23.388594 227310  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:57:23.514063 227316  
S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART 2016-03-04 15:59:53.760108 0  
  
controls@ligo-ops2: ~  
File Edit View Search Terminal Help  
bash: /ligo/apps/ubuntu12/css/etc/css-user-env.sh: No such file or directory  
bash: /ligo/apps/linux-x86_64/guardian/et/guardian-user-env.sh: No such file or directory  
bash: /ligo/apps/ubuntu12/awgstream/etc/awgstream-user-setup.sh: No such file or directory  
controls@ligo-ops2:~$ caput S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
Old : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
New : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
controls@ligo-ops2:~$ caput S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 1  
Old : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
New : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 1  
controls@ligo-ops2:~$ caput S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
Old : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
New : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
controls@ligo-ops2:~$ caput S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 1  
Old : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
New : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 1  
controls@ligo-ops2:~$ caput S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 1  
Old : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 0  
New : S1:ISI-MAST_ST1_WD_ACT_SAT_SINCE_RESTART_CLEAR 1  
controls@ligo-ops2:~$ caput S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART_CLEAR 1  
Old : S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART_CLEAR 0  
New : S1:ISI-MAST_ST1_WD_CPS_SAT_SINCE_RESTART_CLEAR 1  
controls@ligo-ops2:~$
```

Fig.12: Testing: SATURATIONS_SINCE_RESTART

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10) need to record the mass positions for the STS-2s
(add decently named epics channel)

https://services.ligo-wa.caltech.edu/integrationissues/show_bug.cgi?id=1148

Decided to leave as is. The channels come in to the top level and we just call them from the awkward, but functional, names of the ADC numbers.

12) BIO Out – largely redundant with item 4.

Model updated. Hugh updates MEMD screens (ISI_CUST_CHAMBER_BIO). The correct setting for the new epics bin is 0. See SEI aLog 903 which shows what they were before at LHO.

b) we'd like to upgrade the reset momentary to use the

```
${userapps}/cds/common/src/LONG_PULSE.c
```

c-code where the duration of the pulse is user-defined such that it can send out the desire ~0.5 [sec] voltage pulse. (This is presumably what the additive STS2_Reset_ADD was trying to do).

c) All of the cdsEpicsIn parts need to have their channel names capitalized in order to be functional.

d) The CAL, SIGSEL, and PERIOD should be changed to epicsBinIns, such that they can appear as rocker switches in MEMD just like they do on the front panels.

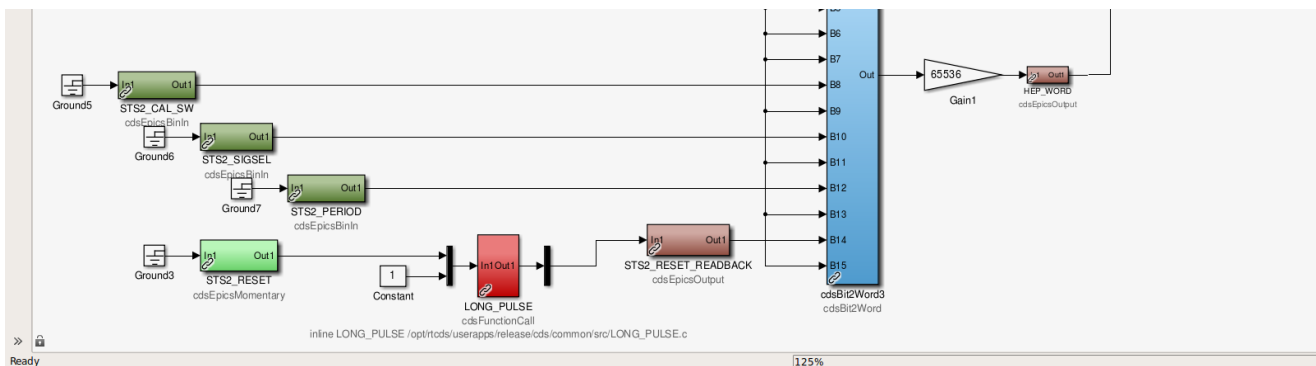


Fig. 13: BSC=ISI BIO Out updated

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13) create ISI to SUS point library block to be placed on the top level model

library can be found under: /opt/rtdcs/userapps/release/isi/common/models/ISI_to_SUS_library.mdl

Parts should be copied from the library into the top-level model of each BSC-ISI. The “chamber” and “optics” portion of the library blocks should be updated to the relevant upper case entries.

For the moment, leave the inter-model communications as they are. Once the Detchar pages showing system performance have been pointed to the new channels, we can remove the GS-13 communications to the SUS model, and also remove those calculations from the SUS model. The filters and matrix should be copied from the appropriate SUS model. The filters need to be checked because the model rates are different.

For the names of the suspension points, Brian and Jeff suggest names like the following

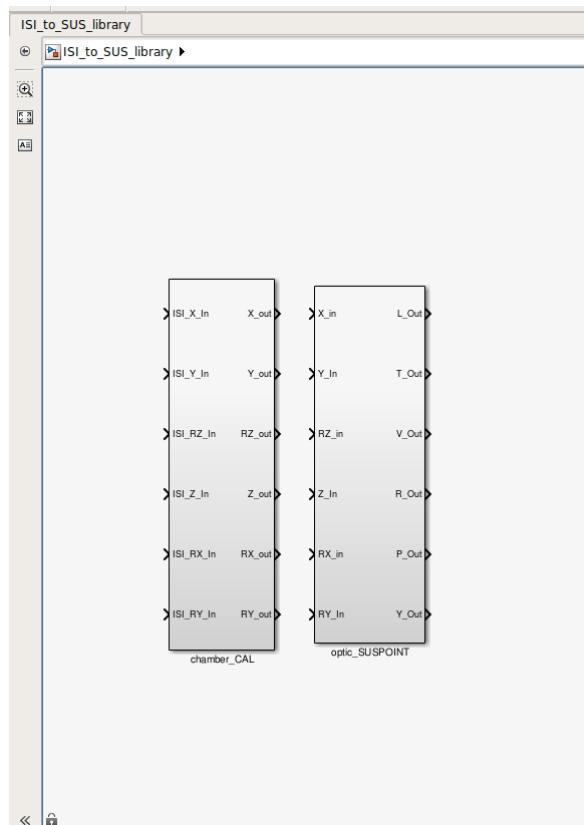
H1:ISI-HAM2_CAL_CART_X_DQ

H1:ISI-PR3_SUSPOINT_EUL_L_DQ

ie.

{ifo}:ISI-{chamber}_CAL_CART_{dof}_DQ and

{ifo}:{optic}-SUSPOINT_EUL_{dof}_DQ



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Fig 14: Library blocks

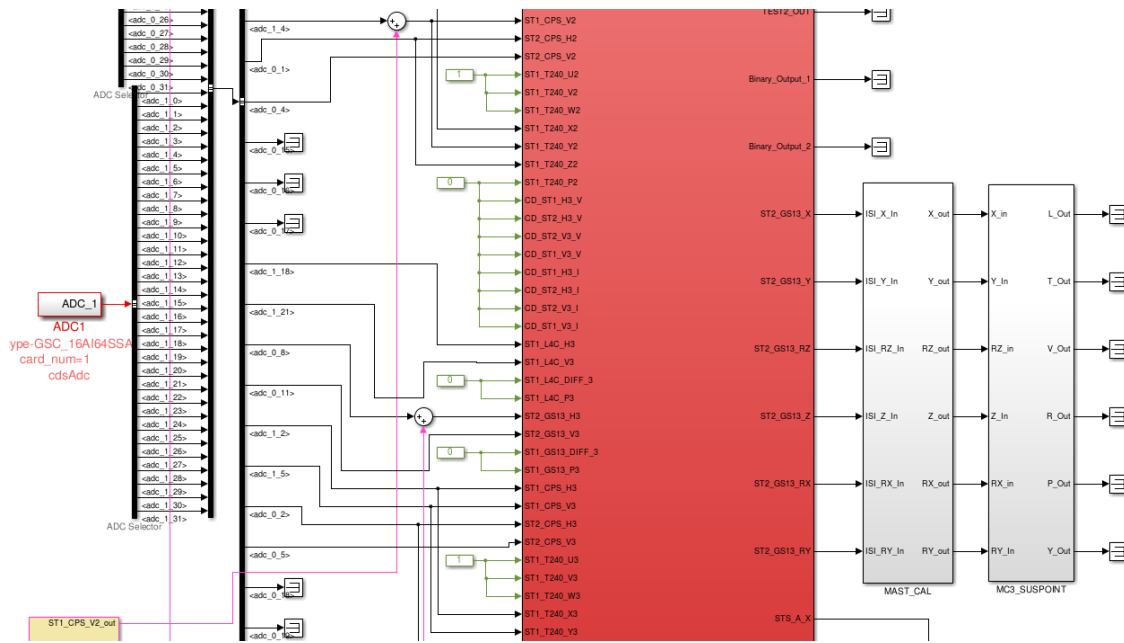


Fig 15: Top-Level installation example (s1isimast)

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```
S1:ISI-MAST_CAL_ISIINF_Z_SWSTAT 1 0 0 4 16 0
S1:ISI-MAST_CAL_ISIINF_Z_TRAMP 1 0 0 4 16 0
controls@ligo-ops2:~$ chndump | grep MAST_CAL_CART
S1:ISI-MAST_CAL_CART_RX 1 0 30893 4 4096 0
S1:ISI-MAST_CAL_CART_RXMON 1 0 0 4 16 0
S1:ISI-MAST_CAL_CART_RY 1 0 30892 4 4096 0
S1:ISI-MAST_CAL_CART_RYMON 1 0 0 4 16 0
S1:ISI-MAST_CAL_CART_RZ 1 0 30891 4 4096 0
S1:ISI-MAST_CAL_CART_RZMON 1 0 0 4 16 0
S1:ISI-MAST_CAL_CART_X 1 0 30890 4 4096 0
S1:ISI-MAST_CAL_CART_XMON 1 0 0 4 16 0
S1:ISI-MAST_CAL_CART_Y 1 0 30889 4 4096 0
S1:ISI-MAST_CAL_CART_YMON 1 0 0 4 16 0
S1:ISI-MAST_CAL_CART_Z 1 0 30888 4 4096 0
S1:ISI-MAST_CAL_CART_ZMON 1 0 0 4 16 0
controls@ligo-ops2:~$
controls@ligo-ops2:~$ chndump | grep MC3_SUSPOINT_EUL
S1:ISI-MC3_SUSPOINT_EUL_L 1 0 30899 4 4096 0
S1:ISI-MC3_SUSPOINT_EUL_LMON 1 0 0 4 16 0
S1:ISI-MC3_SUSPOINT_EUL_P 1 0 30898 4 4096 0
S1:ISI-MC3_SUSPOINT_EUL_PMON 1 0 0 4 16 0
S1:ISI-MC3_SUSPOINT_EUL_R 1 0 30897 4 4096 0
S1:ISI-MC3_SUSPOINT_EUL_RMON 1 0 0 4 16 0
S1:ISI-MC3_SUSPOINT_EUL_T 1 0 30896 4 4096 0
S1:ISI-MC3_SUSPOINT_EUL_TMON 1 0 0 4 16 0
S1:ISI-MC3_SUSPOINT_EUL_V 1 0 30895 4 4096 0
S1:ISI-MC3_SUSPOINT_EUL_VMON 1 0 0 4 16 0
S1:ISI-MC3_SUSPOINT_EUL_Y 1 0 30894 4 4096 0
S1:ISI-MC3_SUSPOINT_EUL_YMON 1 0 0 4 16 0
controls@ligo-ops2:~$
```

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Fig 16: testing: ISI to suspension point channels exist

14) SEI aLog 943

a) Add an SCSUM block after the ST2, SENS COR block, just like what is in place for the GND to ST1 sensor correction in the ST1 block

b) Store the new sensor correction channels

```
/${IFO}:ISI-${OPTIC}_ST2_SCSUM_T240_${DOF}_IN
/${IFO}:ISI-${OPTIC}_ST2_SCSUM_CPS_${DOF}_IN
at 256 [Hz]
```

c) Store the pre-existing channels feed forward channels

```
/${IFO}:ISI-${OPTIC}_ST1_FF12_${DOF}_IN1
at 256 [Hz] in order to help diagnosis and characterization of these control paths.
```

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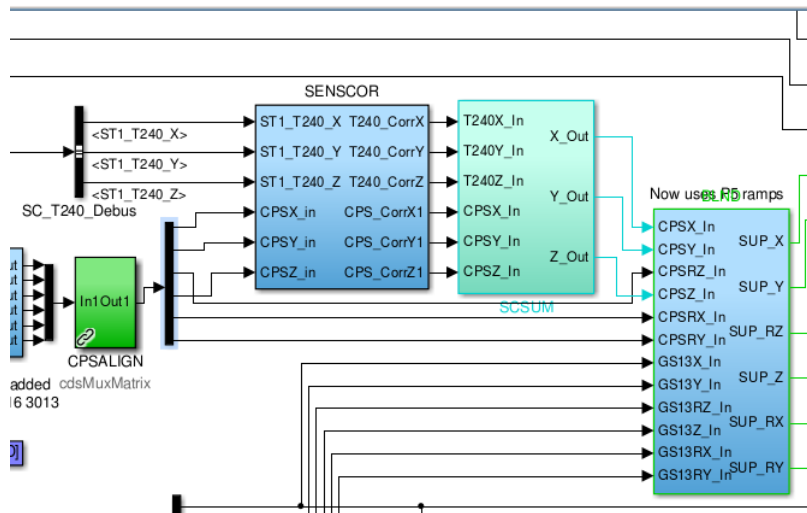


Fig 17: BSC-ISI - ST2 SENSOR SCSUM added (item 14)

```

# ST1 - T240
ST1_BLND_RX_T240_CUR_IN1* 512
ST1_BLND_RY_T240_CUR_IN1* 512
ST1_BLND_RZ_T240_CUR_IN1* 512
ST1_BLND_X_T240_CUR_IN1* 512
ST1_BLND_Y_T240_CUR_IN1* 512
ST1_BLND_Z_T240_CUR_IN1* 512

## Stage 1 Feedforward
ST1_FF01_X_IN1 2048
ST1_FF01_Y_IN1 2048
ST1_FF01_Z_IN1 2048
ST1_FF01_RX_IN1 2048
ST1_FF01_RY_IN1 2048
ST1_FF01_RZ_IN1 2048

ST1_FF12_X_IN1* 256
ST1_FF12_Y_IN1* 256
ST1_FF12_Z_IN1* 256
ST1_FF12_RX_IN1* 256
ST1_FF12_RY_IN1* 256
ST1_FF12_RZ_IN1* 256

## Sensor correction
ST1_SCSUM_STS_X_IN 256
ST1_SCSUM_STS_Y_IN 256
ST1_SCSUM_STS_Z_IN 256
    
```

Fig 18: Related science frame channels added (item 14)

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Remaining items for future update(s):

2) Make new fix for blend glitch

6) St1-2 FF and St1 compensation

<https://alog.ligo-la.caltech.edu/SEI/index.php?callRep=882>

add path to compensate all of the st2 drive.

11) add Reflected memory path for gnd STS-2s so we can isolate against only the differential motion

12) a) the outdated, top-level, binary IO blocks should be upgraded.

15) SEI aLog 943: Employ tilt sensor correction from ST1 to ST2, recently proven successful in augmenting translational degrees of freedom (see [LHO aLOG 25623](#))

16) BSC-ISI: Remove T240 signals going into ST2 SENSCOR. Instead pick off 6x signals of T240-L4C blends and send them into ST2 SENSCOR + send resulting drive signals to ST1 to allow compensating for ST2 drive there - to make it available to compensate for back-reaction.

17) ISI WD request - let the ISI model run w/o tripping if the SUS model goes down give a 60 sec. window to operato. (HughR)

18) Last minute update – we need to add the SUSPOINT_EUL and CAL_CART channels to the DQ list. (dang). Same rate as saved by SUS.