*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO-T1100472-v25 Advanced LIGO June 20, 2018

ADC and DAC Channel Usage for ISC

Rich Abbott, Peter Fritschel, Daniel Sigg

Distribution of this document:

LIGO Scientific Collaboration

This is an internal working note

of the LIGO Laboratory.

|  |  |
| --- | --- |
| **California Institute of Technology**  **LIGO Project – MS 18-34**  **1200 E. California Blvd.**  **Pasadena, CA 91125**  Phone (626) 395-2129  Fax (626) 304-9834  E-mail: info@ligo.caltech.edu | **Massachusetts Institute of Technology**  **LIGO Project – NW22-295**  **185 Albany St**  **Cambridge, MA 02139**  Phone (617) 253-4824  Fax (617) 253-7014  E-mail: info@ligo.mit.edu |
| **LIGO Hanford Observatory**  **P.O. Box 159**  **Richland WA 99352**  Phone 509-372-8106  Fax 509-372-8137 | **LIGO Livingston Observatory**  **P.O. Box 940**  **Livingston, LA 70754**  Phone 225-686-3100  Fax 225-686-7189 |

http://www.ligo.caltech.edu/

# Purpose

This document lists the specific ADC and DAC channels used within the ISC I/O expansion chassis. In the following tables, the entries given in the ‘Signal’ column are *not* meant to be the exact DAQ channel name for that signal (though they may be); rather the entries are intended as descriptors to identify the actual hardware channel that is connected to a given ADC/DAC channel.

The reference document for the actual DAQ channel names is [T1000264](https://dcc.ligo.org/cgi-bin/private/DocDB/ShowDocument?docid=11847), *List of ISC Photodetectors in Advanced LIGO.*

# ASC-IO I/O Chassis

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chns. | Signal | | |
| ADC 0 | DB9\_1 | 1 | IMC-WFS\_A\_RF | Seg 1 | Q-phase |
| 2 | I-phase |
| 3 | Seg 2 | Q-phase |
| 4 | I-phase |
| DB9\_2 | 5 | Seg 3 | Q-phase |
| 6 | I-phase |
| 7 | Seg 4 | Q-phase |
| 8 | I-phase |
| DB9\_3 | 9 | IMC-WFS\_B\_RF | Seg 1 | Q-phase |
| 10 | I-phase |
| 11 | Seg 2 | Q-phase |
| 12 | I-phase |
| DB9\_4 | 13 | Seg 3 | Q-phase |
| 14 | I-phase |
| 15 | Seg 4 | Q-phase |
| 16 | I-phase |
| DB9\_5 | 17-20 | IMC-WFS\_A\_DC | Segs 1-4 | DC Outputs of WFS |
| DB9\_6 | 21-24 | IMC-WFS\_B\_DC | Segs 1-4 |
| DB9\_7 | 25 | ALS-C\_SHG\_IR\_LF | | Aux. signals concentrator 3 REFL PD Amp 1-4 |
| 26 | ALS-C\_SHG\_GR\_LF | |
| 27 | ALS-C\_TRX\_A\_LF | |
| 28 | ALS-C\_TRY\_A\_LF | |
| DB9\_8 | 29-30 | Unused | | |
| 31 | Duotone (DAC) | | |
| 32 | Duotone | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal | | |
| ADC 1 | DB9\_1 | 1-4 | IO QPD: SM2 Transmission | | |
| DB9\_2 | 5-8 | IO QPD: MC2 Transmission | | |
| DB9\_3 | 9 | PD 1: post-EOM | | 4 ch Generic PD interface: PSL/IO table |
| 10 | PD 2: post-power control | |
| 11 | PD 3: unused | |
| 12 | PD 4: unused | |
| DB9\_4 | 13 | PD 1: SM1 Transmission | | 4 ch Generic PD interface: IOT1 |
| 14 | PD 2: IMC\_PDH DC out | |
| 15-16 | PD 3,4: unused | |
| DB9\_5 | 17 | ASC-AS\_A\_RF42 | Seg 1 | Q-phase |
| 18 | I-phase |
| 19 | Seg 2 | Q-phase |
| 20 | I-phase |
| DB9\_6 | 21 | Seg 3 | Q-phase |
| 22 | I-phase |
| 23 | Seg 4 | Q-phase |
| 24 | I-phase |
| DB9\_7 | 25 | ASC-AS\_B\_RF42 | Seg 1 | Q-phase |
| 26 | I-phase |
| 27 | Seg 2 | Q-phase |
| 28 | I-phase |
| DB9\_8 | 29 | Seg 3 | Q-phase |
| 30 | I-phase |
| 31 | Seg 4 | Q-phase |
| 32 | I-phase |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | | | ADC/DAC chan. | | | Signal | | | | | | |
| ADC 2 | DB9\_1 | | | 1 | | | ASC-REFL\_A\_RF9 | | | Seg 1 | Q-phase | | |
| 2 | | | I-phase | | |
| 3 | | | Seg 2 | Q-phase | | |
| 4 | | | I-phase | | |
| DB9\_2 | | | 5 | | | Seg 3 | Q-phase | | |
| 6 | | | I-phase | | |
| 7 | | | Seg 4 | Q-phase | | |
| 8 | | | I-phase | | |
| DB9\_3 | | | 9 | | | ASC-REFL\_A\_RF45 | | | Seg 1 | Q-phase | | |
| 10 | | | I-phase | | |
| 11 | | | Seg 2 | Q-phase | | |
| 12 | | | I-phase | | |
| DB9\_4 | | | 13 | | | Seg 3 | Q-phase | | |
| 14 | | | I-phase | | |
| 15 | | | Seg 4 | Q-phase | | |
| 16 | | | I-phase | | |
| DB9\_5 | | | 17 | | | ASC-REFL\_B\_RF9 | | | Seg 1 | Q-phase | | |
| 18 | | | I-phase | | |
| 19 | | | Seg 2 | Q-phase | | |
| 20 | | | I-phase | | |
| DB9\_6 | | | 21 | | | Seg 3 | Q-phase | | |
| 22 | | | I-phase | | |
| 23 | | | Seg 4 | Q-phase | | |
| 24 | | | I-phase | | |
| DB9\_7 | | | 25 | | | ASC-REFL\_B\_RF45 | | | Seg 1 | Q-phase | | |
| 26 | | | I-phase | | |
| 27 | | | Seg 2 | Q-phase | | |
| 28 | | | I-phase | | |
| DB9\_8 | | | 29 | | | Seg 3 | Q-phase | | |
| 30 | | | I-phase | | |
| 31 | | | Seg 4 | Q-phase | | |
| 32 | | | I-phase | | |
| Card | AA/AI conn. | | | ADC/DAC chan. | | | Signal | | | | | | |
| ADC 3 | DB9\_1 | | | 1 | | | ASC-POP\_A\_RF45  (POP\_X in vacuum) | | | Seg 1 | Q-phase | | |
| 2 | | | I-phase | | |
| 3 | | | Seg 2 | Q-phase | | |
| 4 | | | I-phase | | |
| DB9\_2 | | | 5 | | | Seg 3 | Q-phase | | |
| 6 | | | I-phase | | |
| 7 | | | Seg 4 | Q-phase | | |
| 8 | | | I-phase | | |
| DB9\_3 | | | 9 | | | ASC-POP\_B\_RF45 | | | Seg 1 | Q-phase | | |
| 10 | | | I-phase | | |
| 11 | | | Seg 2 | Q-phase | | |
| 12 | | | I-phase | | |
| DB9\_4 | | | 13 | | | Seg 3 | Q-phase | | |
| 14 | | | I-phase | | |
| 15 | | | Seg 4 | Q-phase | | |
| 16 | | | I-phase | | |
| DB9\_5 | | | 17 | | | ASC-AS\_A\_RF72 | | | Seg 1 | Q-phase | | |
| 18 | | | I-phase | | |
| 19 | | | Seg 2 | Q-phase | | |
| 20 | | | I-phase | | |
| DB9\_6 | | | 21 | | | Seg 3 | Q-phase | | |
| 22 | | | I-phase | | |
| 23 | | | Seg 4 | Q-phase | | |
| 24 | | | I-phase | | |
| DB9\_7 | | | 25 | | | ASC-AS\_B\_RF72 | | | Seg 1 | Q-phase | | |
| 26 | | | I-phase | | |
| 27 | | | Seg 2 | Q-phase | | |
| 28 | | | I-phase | | |
| DB9\_8 | | | 29 | | | Seg 3 | Q-phase | | |
| 30 | | | I-phase | | |
| 31 | | | Seg 4 | Q-phase | | |
| 32 | | | I-phase | | |
| Card | AA/AI conn. | | ADC/DAC chan. | | | Signal | | | | | | |
| ADC 4 | DB9\_1 | | 1 | | | ASC-AS\_A\_RF45 | | | Seg 1 | | | Q-phase |
| 2 | | | I-phase |
| 3 | | | Seg 2 | | | Q-phase |
| 4 | | | I-phase |
| DB9\_2 | | 5 | | | Seg 3 | | | Q-phase |
| 6 | | | I-phase |
| 7 | | | Seg 4 | | | Q-phase |
| 8 | | | I-phase |
| DB9\_3 | | 9 | | | ASC-AS\_A\_RF36 | | | Seg 1 | | | Q-phase |
| 10 | | | I-phase |
| 11 | | | Seg 2 | | | Q-phase |
| 12 | | | I-phase |
| DB9\_4 | | 13 | | | Seg 3 | | | Q-phase |
| 14 | | | I-phase |
| 15 | | | Seg 4 | | | Q-phase |
| 16 | | | I-phase |
| DB9\_5 | | 17 | | | ASC-AS\_B\_RF45 | | | Seg 1 | | | Q-phase |
| 18 | | | I-phase |
| 19 | | | Seg 2 | | | Q-phase |
| 20 | | | I-phase |
| DB9\_6 | | 21 | | | Seg 3 | | | Q-phase |
| 22 | | | I-phase |
| 23 | | | Seg 4 | | | Q-phase |
| 24 | | | I-phase |
| DB9\_7 | | 25 | | | ASC-AS\_B\_RF36 | | | Seg 1 | | | Q-phase |
| 26 | | | I-phase |
| 27 | | | Seg 2 | | | Q-phase |
| 28 | | | I-phase |
| DB9\_8 | | 29 | | | Seg 3 | | | Q-phase |
| 30 | | | I-phase |
| 31 | | | Seg 4 | | | Q-phase |
| 32 | | | I-phase |
| Card | | AA/AI conn. | | | ADC/DAC Chs. | | | Signal | | | | | | |
| ADC 5 | | DB9\_1 | | | 1-4 | | | ASC-REFL\_A\_DC | | | | DC Outputs of WFS | | |
| DB9\_2 | | | 5-8 | | | ASC-REFL\_B\_DC | | | |
| DB9\_3 | | | 9-12 | | | ASC-AS\_A\_DC | | | |
| DB9\_4 | | | 13-16 | | | ASC-AS\_B\_DC | | | |
| DB9\_5 | | | 17-20 | | | ASC-POP\_A\_DC | | | |
| DB9\_6 | | | 21-24 | | | ASC-POP\_B\_DC | | | |
| DB9\_7 | | | 25-28 | | | PSL-BES\_A\_DC | | | | | | |
| DB9\_8 | | | 29-32 | | | Unused | | | | | | |

|  |  |  |  |
| --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal |
| ADC 6 | DB9\_1 | 1-4 | ASC-POP\_A/JAC-QPD\_A (QPD) |
| DB9\_2 | 5-8 | ASC-POP\_B/JAC-QPD\_B (QPD) |
| DB9\_3 | 9-12 | ASC-AS\_C (QPD) |
| DB9\_4 | 13-16 | ASC-OMC\_A (QPD) |
| DB9\_5 | 17-20 | ASC-OMC\_B (QPD) |
| DB9\_6 | 21-24 | ASC-OMCR\_A (QPD) |
| DB9\_7 | 25-28 | ASC-OMCR\_B (QPD) |
| DB9\_8 | 29-32 | Unused |

|  |  |  |  |
| --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal |
| DAC 0 | DB9\_1 | 1-4 | Unused |
| DB9\_2 | 5-6 | JAC-PZT\_A (placeholder) |
| 7-8 | JAC-PZT\_B (placeholder) |
| DB9\_3 | 9 | IO Input beam tip-tilt PZT drive: pitch |
| 10 | IO Input beam tip-tilt PZT drive: yaw |
| 11 | ASC-POP\_X\_PIT/ IO\_PZT\_B\_PIT  MCL PZT Tip-tilt 1: pitch |
| 12 | ASC-POP\_X\_YAW/ IO\_PZT\_B\_YAW  MCL PZT Tip-tilt 1: yaw |
| DB9\_4 | 13-15 | Unused |
| 16 | DuoTone |

# LSC I/O Chassis

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chns. | Signal | | | |
| ADC 0 | DB9\_1 | 1 | PD 1: ALS-C\_DIFF\_A\_LF | | | 4 ch Generic PD interface: ISCT1 |
| 2 | PD 2: ALS-C\_COMM\_A\_LF | | |
| 3 | PD 3: LSC-REFLAIR\_B\_LF | | |
| 4 | PD 4: LSC-POPAIR\_B\_LF | | |
| DB9\_2 | 5 | LSC-POPAIR\_A | | | DC Outputs |
| 6 | LSC-REFLAIR\_A | | |
| 7 | LSC-POP\_A | | |
| 8 | LSC-REFL\_A | | |
| DB9\_3 | 9 | PD1: SQZ-FIBR\_PD\_LF | | | 4 ch Generic PD interface: ISCT6 |
| 10 | PD2: SQZ-SHG\_TRANS\_LF | | |
| 11 | PD3: SQZ-LASER\_IR\_LF | | |
| 12 | PD4: SQZ-SHG\_GR\_LF | | |
| DB9\_4 | 13 | OMC-DCPD\_A | | | |
| 14 | OMC-DCPD\_B | | | |
| 15 | OMC-PI\_DCPD\_A | | | |
| 16 | OMC-PI\_DCPD\_B | | | |
| DB9\_5 | 17 | OMC PZT Monitor: Slow DC path | | | |
| 18 | OMC PZT Monitor: Slow AC path | | | |
| 19 | OMC PZT Monitor: Fast DC path | | | |
| 20 | OMC PZT Monitor: Fast AC path | | | |
| DB9\_6 | 21 | LSC-REFL\_SERVO\_ERR, CM Servo, I monitor | | | |
| 22 | LSC-REFL\_SERVO\_CTRL, CM Servo, Fast monitor | | | |
| 23 | LSC-REFL\_SERVO\_SLOW, CM Servo, Slow monitor | | | |
| 24 | SQZ-CLF\_REFL | RF6 | Q-phase | |
| DB9\_7 | 25 | IMC-I, IMC Servo, I monitor | | | |
| 26 | IMC-F, IMC Servo, Fast monitor | | | |
| 27 | IMC-L, IMC Servo, Slow monitor | | | |
| 28 | SQZ-CLF\_REFL | RF6 | I-phase | |
| DB9\_8 | 29 | MOTION\_C\_SHUTTER\_H\_TRIGGER  (CLF path trigger PD) | | 4 ch Generic PD interface:  SQZT6 | |
| 30 | Unused | |
| 31 | Duotone (DAC) | | | |
| 32 | Duotone | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chns. | Signal | | |
| ADC 1 | DB9\_1 | 1 | LSC-POPAIR\_B | RF18 | Q-phase |
| 2 | I-phase |
| 3 | RF90 | Q-phase |
| 4 | I-phase |
| DB9\_2 | 5 | LSC-REFLAIR\_B | RF27 | Q-phase |
| 6 | I-phase |
| 7 | RF135 | Q-phase |
| 8 | I-phase |
| DB9\_3 | 9 | SQZ-OMC\_TRANS | RF3 | Q-phase |
| 10 | I-phase |
| 11 | SQZ-HD\_DIFF | RF3 | Q-phase |
| 12 | I-phase |
| DB9\_4 | 13 | SQZ-OPO\_REFL | RF80 | Q-phase |
| 14 | I-phase |
| 15 | SQZ-SHG\_TRANS | RF35 | Q-phase |
| 16 | I-phase |
| DB9\_5 | 17 | LSC-POPAIR\_A | RF9 | Q-phase |
| 18 | I-phase |
| 19 | RF45 | Q-phase |
| 20 | I-phase |
| DB9\_6 | 21 | LSC-REFLAIR\_A | RF9 | Q-phase |
| 22 | I-phase |
| 23 | RF45 | Q-phase |
| 24 | I-phase |
| DB9\_7 | 25 | LSC-POP\_A | RF9 | Q-phase |
| 26 | I-phase |
| 27 | RF45 | Q-phase |
| 28 | I-phase |
| DB9\_8 | 29 | LSC-REFL\_A | RF9 | Q-phase |
| 30 | I-phase |
| 31 | RF45 | Q-phase |
| 32 | I-phase |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chns. | Signal | | |
| ADC 2 | DB9\_1 | 1 | IMC-REFL\_A\_DC, RF PD DC output (whitened) | | |
| 2 | ALS-C\_DIFF\_A\_RF\_ERR  PFD signal for ALS Differential | | |
| 3 | PD3: JAC-REFL\_A | | |
| 4 | PD4: Unused | | |
| DB9\_2 | 5 | ALS-C\_REFL\_DC\_ERR (DC signal from REFL\_A PD) | | |
| 6 | LSC-REFL\_A\_RF9\_ERR (Demodulator signal REFL) | | |
| 7 | ALS-C\_COMM\_A\_RF\_ERR (PFD signal ALS Comm) | | |
| 8 | LSC-REFLAIR\_A\_RF9\_ERR (Demod signal REFLAIR) | | |
| DB9\_3 | 9 | LSC EXTRA\_AI\_1 | | |
| 10 | LSC EXTRA\_AI\_2 | | |
| 11 | ALS-REQSTATE\_A (EtherCAT interface) | | |
| 12 | ALS-REQSTATE\_B (EtherCAT interface) | | |
| DB9\_4 | 13 | ALS-C\_COMM\_PLL\_ERR | | |
| 14 | ALS-C\_COMM\_PLL\_CTRL | | |
| 15 | ALS-C\_DIFF\_PLL\_ERR | | |
| 16 | ALS-C\_DIFF\_PLL\_CTRL | | |
| DB9\_5 | 17 | LSC-MOD\_RF9\_AM\_ERR | | |
| 18 | LSC-MOD\_RF9\_AM\_CTRL | | |
| 19 | LSC-MOD\_RF9\_AM\_AC | | |
| 20 | LSC-MOD\_RF9\_AM\_DC | | |
| DB9\_6 | 21 | LSC-MOD\_RF45\_AM\_ERR | | |
| 22 | LSC-MOD\_RF45\_AM\_CTRL | | |
| 23 | LSC-MOD\_RF45\_AM\_AC | | |
| 24 | LSC-MOD\_RF45\_AM\_DC | | |
| DB9\_7 | 25 | JAC\_TRANS\_A\_LF | | |
| 26 | JAC\_PWR\_A\_LF | | |
| 27 | Unused | | |
| 28 | Unused | | |
| DB9\_8 | 29 | LSC-IMC\_REFL\_A | RF24 | Q-phase |
| 30 | I-phase |
| 31 | JAC-REFL\_A | RF23 | Q-phase |
| 32 | I-phase |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chns. | Signal | |
| ADC 3 | DB9\_1 | 1 | SQZ-OPO\_SERVO\_ERR, CM Servo, I monitor | |
| 2 | SQZ-OPO\_SERVO\_CTRL, CM Servo, Fast monitor | |
| 3 | SQZ-OPO\_SERVO\_SLOW, CM Servo, Slow monitor | |
| 4 | SQZ-CLF\_SERVO\_ERR, CM Servo, I monitor | |
| DB9\_2 | 5 | SQZ-SHG\_SERVO\_ERR, CM Servo, I monitor | |
| 6 | SQZ-SHG\_SERVO\_CTRL, CM Servo, Fast monitor | |
| 7 | SQZ-SHG\_SERVO\_SLOW, CM Servo, Slow monitor | |
| 8 | SQZ-CLF\_SERVO\_CTRL, CM Servo, Fast monitor | |
| DB9\_3 | 9 | SQZ-LO\_SERVO\_ERR, CM Servo, I monitor | |
| 10 | SQZ-LO\_SERVO\_CTRL, CM Servo, Fast monitor | |
| 11 | SQZ-LO\_SERVO\_SLOW, CM Servo, Slow monitor | |
| 12 | SQZ-CLF\_SERVO\_SLOW, CM Servo, Slow monitor | |
| DB9\_4 | 13 | SQZ-HD\_B\_DC | |
| 14 | SQZ-HD\_DIFF\_DC | |
| 15 | SQZ-HD\_A\_DC | |
| 16 | Unused | |
| DB9\_5 | 17 | SQZ-FIBR\_MIXER | |
| 18 | SQZ-FIBR\_PZT | |
| 19 | SQZ-FIBR\_EOMRMS | |
| 20 | SQZ-FIBR\_SLOW | |
| DB9\_6 | 21 | SQZ-CLF\_REFL\_LF | DC Outputs |
| 22 | SQZ-OPO\_REFL\_LF |
| 23 | Unused |
| 24 | Unused |
| DB9\_7 | 25 | SQZ-OPO\_TRANS\_LF | DC Outputs |
| 26 | SQZ-OPO\_REFL\_REJECTED\_LF |
| 27 | SQZ- FIBR\_TRANS \_LF |
| 28 | SQZ-SPARE\_DC\_B\_LF |
| DB9\_8 | 29 | SQZ-EXTRA\_AI\_1 | |
| 30 | SQZ-EXTRA\_AI\_2 | |
| 31 | SQZ-EXTRA\_AI\_3 | |
| 32 | SQZ-EXTRA\_AI\_4 | |

|  |  |  |  |
| --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal |
| DAC 0 | DB9\_1 | 1 | SQZ-EXTRA\_AO\_1 |
| 2 | SQZ-EXTRA\_AO\_2 |
| 3 | SQZ-EXTRA\_AO\_3 |
| 4 | SQZ-OPO-PZT |
| DB9\_2 | 5 | SQZ-OPO\_SERVO\_EXC |
| 6 | SQZ-SHG\_SERVO\_EXC |
| 7 | SQZ-LO\_SERVO\_EXC |
| 8 | SQZ-CLF\_SERVO\_EXC |
| DB9\_3 | 9 | ALS-C\_REFL\_DC\_BIAS  CM Summing module control |
| 10 | LSC EXTRA\_AO\_2 |
| 11 | ALS STATE\_A (EtherCAT interface)/JAC\_L |
| 12 | ALS STATE\_B (EtherCAT interface) |
| DB9\_4 | 13 | OMC PZT Dither |
| 14 | OMC PZT Drive (feedback) |
| 15 | Fast Shutter control |
| 16 | Duotone |

# End Stations

PEM and Photon Calibrator are using the first ADC card (ADC 0). This card implements the DuoTone readbacks. The first ISC card is ADC 1 (but the model calls it ADC0). The same is true for the DAC cards, where PEM and Photon Calibrator are using the first DAC.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal | | |
| ADC 1 | DB9\_1 | 1-4 | ASC-TRX(Y)\_A | In-Vac Quad Photodiodes | |
| DB9\_2 | 5-8 | ASC-TRX(Y)\_B |
| DB9\_3 | 9-12 | ALS-X(Y)\_QPD\_A |
| DB9\_4 | 13-16 | ALS-X(Y)\_QPD\_B |
| DB9\_5 | 17 | ALS-X(Y)\_WFS\_A | Seg 1 | DC |
| 18 | Seg 2 | DC |
| 19 | Seg 3 | DC |
| 20 | Seg 4 | DC |
| DB9\_6 | 21 | ALS-X(Y)\_WFS\_B | Seg 1 | DC |
| 22 | Seg 2 | DC |
| 23 | Seg 3 | DC |
| 24 | Seg 4 | DC |
| DB9\_7 | 25 | LSC-X(Y) EXTRA\_AI\_1 | | |
| 26 | LSC-X(Y) EXTRA\_AI\_2 | | |
| 27 | LSC-X(Y) EXTRA\_AI\_3 | | |
| 28 | ALS-X(Y) REQSTATE\_A (EtherCAT interface) | | |
| DB9\_8 | 29 | Used by Electric Field Meter (PEM) | | |
| 30 | Used by Electric Field Meter (PEM) | | |
| 31 | Unused | | |
| 32 | Unused | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal | |
| ADC 2 | DB9\_1 | 1 | ALS-X(Y)\_FIBR\_SERVO\_ERR  CM Servo: ALS phase-locking, I monitor | |
| 2 | ALS-X(Y)\_FIBR\_SERVO\_CTRL  CM Servo: ALS phase-locking, Fast monitor | |
| 3 | ALS-X(Y)\_FIBR\_SERVO\_SLOW  CM Servo: ALS phase-locking, Slow monitor | |
| 4 | Unused | |
| DB9\_2 | 5 | ALS-X(Y)\_REFL\_SERVO\_ERR  CM Servo: ALS PDH-locking, I monitor | |
| 6 | ALS-X(Y)\_REFL\_SERVO\_CTRL  CM Servo: ALS PDH-locking, Fast monitor | |
| 7 | ALS-X(Y)\_FIBR\_SERVO\_SLOW  CM Servo: ALS PDH-locking, Slow monitor | |
| 8 | Unused | |
| DB9\_3 | 9 | ALS-X(Y)\_REFL\_B\_LF  PD1: DC from REFL power mon. | 4 ch. PD interface chassis:  ALS Table |
| 10 | LSC-TRX(Y)\_A\_LF  PD2: Red transmitted beam |
| 11 | ALS-X(Y)\_LASER\_GR\_LF  PD3: Green power monitor |
| 12 | ALS-X(Y)\_FIBR\_A\_LF  PD4: DC from BBPD |
| DB9\_4 | 13 | ALS-X(Y)\_LASER\_IR\_LF  PD1: IR power monitor | 4 ch. Aux. signals concentrator 5: Field rack |
| 14 | ALS-X(Y)\_FIBR\_REJECTED\_LF  PD2: Rejected fiber power |
| 15 | ALS-X(Y)\_FIBR\_TRANS\_LF  PD3: Trans. fiber power |
| 16 | ALS-X(Y)\_SPARE\_B\_LF  PD4: unused |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | | Signal | | |
| ADC2 | DB9\_5 | | 17 | ALS-X(Y)\_WFS\_A | Seg 1 | Q-phase |
| 18 | I-phase |
| 19 | Seg 2 | Q-phase |
| 20 | I-phase |
| DB9\_6 | | 21 | Seg 3 | Q-phase |
| 22 | I-phase |
| 23 | Seg 4 | Q-phase |
| 24 | I-phase |
| DB9\_7 | | 25 | ALS-X(Y)\_WFS\_B | Seg 1 | Q-phase |
| 26 | I-phase |
| 27 | Seg 2 | Q-phase |
| 28 | I-phase |
| DB9\_8 | | 29 | Seg 3 | Q-phase |
| 30 | I-phase |
| 31 | Seg 4 | Q-phase |
| 32 | I-phase |

|  |  |  |  |
| --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal |
| DAC1 | DB9\_1 | 1 | ALS-X(Y)\_PZT1\_PIT  MCL PZT Tip-tilt 1: pitch |
| 2 | ALS-X(Y)\_PZT1\_YAW  MCL PZT Tip-tilt 1: yaw |
| 3 | ALS-X(Y)\_PZT2\_PIT  MCL PZT Tip-tilt 2: pitch |
| 4 | ALS-X(Y)\_PZT2\_YAW  MCL PZT Tip-tilt 2: yaw |
| DB9\_2 | 5 | LSC-X(Y) EXTRA\_AO\_1 |
| 6 | LSC-X(Y) EXTRA\_AO\_2 |
| 7 | LSC-X(Y) EXTRA\_AO\_3 |
| 8 | ALS-X(Y) REQSTATE\_A (EtherCAT interface) |
| DB9\_3 | 9 | ALS-X(Y)\_ PZT3\_PIT  MCL PZT Tip-tilt 3 for WFS\_A: pitch |
| 10 | ALS-X(Y)\_PZT3\_YAW  MCL PZT Tip-tilt 3 for WFS\_A: yaw |
| 11 | ALS-X(Y)\_PZT4\_PIT  MCL PZT Tip-tilt 4 for WFS\_B: pitch |
| 12 | ALS-X(Y)\_PZT4\_YAW  MCL PZT Tip-tilt 4 for WFS\_B: yaw |
| DB9\_4 | 13 | Unused |
| 14 | Unused |
| 15 | Unused |
| 16 | Unused |

# ADC/DAC Channel Concentrator

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Chas. | Conn. | ADC Chns. | Signal | Jumper |
| 1  Front | DB9\_1  IN | 1 | SQZ-OPO\_SERVO\_ERR, CM Servo, I monitor |  |
| 2 | SQZ-OPO\_SERVO\_CTRL, CM Servo, Fast monitor |  |
| 3 | SQZ-OPO\_SERVO\_SLOW, CM Servo, Slow monitor |  |
| 4 | Unused |  |
| DB9\_2  IN | 5 | SQZ-SHG\_SERVO\_ERR, CM Servo, I monitor |  |
| 6 | SQZ-SHG\_SERVO\_CTRL, CM Servo, Fast monitor |  |
| 7 | SQZ-SHG\_SERVO\_SLOW, CM Servo, Slow monitor |  |
| 8 | Unused |  |
| DB9\_3  IN | 9 | SQZ-LO\_SERVO\_ERR, CM Servo, I monitor |  |
| 10 | SQZ-LO\_SERVO\_CTRL, CM Servo, Fast monitor |  |
| 11 | SQZ-LO\_SERVO\_SLOW, CM Servo, Slow monitor |  |
| 12 | Unused |  |
| DB9\_4  IN | 13 | SQZ-CLF\_SERVO\_ERR, CM Servo, I monitor |  |
| 14 | SQZ-CLF\_SERVO\_CTRL, CM Servo, Fast monitor |  |
| 15 | SQZ-CLF\_SERVO\_SLOW, CM Servo, Slow monitor |  |
| 16 | Unused |  |
| DB9\_1  OUT | 1 | SQZ-OPO\_SERVO\_ERR, CM Servo, I monitor | IN1-1&6/OUT1-1&6 |
| 2 | SQZ-OPO\_SERVO\_CTRL, CM Servo, Fast monitor | IN1-2&7/OUT1-2&7 |
| 3 | SQZ-OPO\_SERVO\_SLOW, CM Servo, Slow monitor | IN1-3&8/OUT1-3&8 |
| 4 | SQZ-CLF\_SERVO\_ERR, CM Servo, I monitor | IN4-1&6/OUT1-4&9 |
| DB9\_2  OUT | 5 | SQZ-SHG\_SERVO\_ERR, CM Servo, I monitor | IN2-1&6/OUT2-1&6 |
| 6 | SQZ-SHG\_SERVO\_CTRL, CM Servo, Fast monitor | IN2-2&7/OUT2-2&7 |
| 7 | SQZ-SHG\_SERVO\_SLOW, CM Servo, Slow monitor | IN2-3&8/OUT2-3&8 |
| 8 | SQZ-CLF\_SERVO\_CTRL, CM Servo, Fast monitor | IN4-2&7/OUT2-4&9 |
| DB9\_3  OUT | 9 | SQZ-LO\_SERVO\_ERR, CM Servo, I monitor | IN3-1&6/OUT3-1&6 |
| 10 | SQZ-LO\_SERVO\_CTRL, CM Servo, Fast monitor | IN3-2&7/OUT3-2&7 |
| 11 | SQZ-LO\_SERVO\_SLOW, CM Servo, Slow monitor | IN3-3&8/OUT3-3&8 |
| 12 | SQZ-CLF\_SERVO\_SLOW, CM Servo, Slow monitor | IN4-3&8/OUT3-4&9 |
| DB9\_4  OUT | 13-16 | Unused |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Chas. | Conn. | ADC Chns. | Signal | Jumper |
| 1  Rear | DB9  IN1 | 1 | LSC-REFL\_SERVO\_ERR, CM Servo, I monitor |  |
| 2 | LSC-REFL\_SERVO\_CTRL, CM Servo, Fast |  |
| 3 | LSC-REFL\_SERVO\_SLOW, CM Servo, Slow |  |
| 4 | Unused |  |
| DB9  IN2 | 5 | IMC-I, IMC Servo, I monitor |  |
| 6 | IMC-F, IMC Servo, Fast monitor |  |
| 7 | IMC-L, IMC Servo, Slow monitor |  |
| 8 | Unused |  |
| DB9  IN3 | 9 | SQZ-CLF\_REFL\_RF6\_Q |  |
| 10 | SQZ-CLF\_REFL\_RF6\_I |  |
| 11 | Unused |  |
| 12 | Unused |  |
| DB9  IN4 | 13 | Unused |  |
| 14 | Unused |  |
| 15 | Unused |  |
| 16 | Unused |  |
| DB9  OUT1 | 1 | LSC-REFL\_SERVO\_ERR, CM Servo, I monitor | IN1-1&6/OUT1-1&6 |
| 2 | LSC-REFL\_SERVO\_CTRL, CM Servo, Fast | IN1-2&7/OUT1-2&7 |
| 3 | LSC-REFL\_SERVO\_SLOW, CM Servo, Slow | IN1-3&8/OUT1-3&8 |
| 4 | SQZ-CLF\_REFL\_RF6\_Q | IN3-1&6/OUT1-4&9 |
| DB9  OUT2 | 5 | IMC-I, IMC Servo, I monitor | IN2-1&6/OUT2-1&6 |
| 6 | IMC-F, IMC Servo, Fast monitor | IN2-2&7/OUT2-2&7 |
| 7 | IMC-L, IMC Servo, Slow monitor | IN2-3&8/OUT2-3&8 |
| 8 | SQZ-CLF\_REFL\_RF6\_I | IN3-2&7/OUT2-4&9 |
| DB9  OUT3 | 9 | Unused |  |
| 10 | Unused |  |
| 11 | Unused |  |
| 12 | Unused |  |
| DB9  OUT4 | 13 | Unused |  |
| 14 | Unused |  |
| 15 | Unused |  |
| 16 | Unused |  |

# Summary

Below is a summary of the number of I/O cards, unused channels, and available I/O slots for the ISC I/O Expansion Chassis. This assumes there are a total of 10 slots available in the I/O chassis for ADC and/or DAC cards. For the unused ADC channel column, the number in parentheses is the subset of these channels that are available Anti-Alias (AA) chassis on free DB9 connectors; the other channels are found on AA DB9 connectors which are only partially used.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **I/O Chassis** | **# ADC cards** | **# DAC cards** | **Unused ADC chans** | **Unused DAC chans** | **Available I/O slots** |
| Vertex: ASC | 7 | 1 | 12 (8) | 6 (4) | 2 |
| Vertex: LSC | 4 | 1 | 11 (0) | 0 (0) | 5 |
| End X | 2 | 1 | 7 (4) | 4 (4) | 5 |
| End Y | 2 | 1 | 7 (4) | 4 (4) | 5 |
| Totals | 15 | 4 | 37 (16) | 14 (12) | 17 |

At the end stations, the I/O Expansion Chassis is shared with PEM. PEM has one ADC card, of which 14 channels are used, and one DAC card. The DAC card provides 8 channels (18 bit) of general purpose test outputs. The ‘available slots’ number takes these PEM cards into account.