*LIGO Laboratory / LIGO Scientific Collaboration*

LIGO-T1100472-v22 Advanced LIGO December 22, 2017

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-SHG\_SERVO\_ERR, CM Servo, I monitor | |
| DB9\_2 | 5 | SQZ-SHG\_SERVO\_CTRL, CM Servo, Fast monitor | |
| 6 | SQZ-SHG\_SERVO\_SLOW, CM Servo, Slow monitor | |
| 7 | SQZ-LO\_SERVO\_ERR, CM Servo, I monitor | |
| 8 | SQZ-LO\_SERVO\_CTRL, CM Servo, Fast monitor | |
| DB9\_3 | 9 | SQZ-LO\_SERVO\_SLOW, CM Servo, Slow monitor | |
| 10 | SQZ-CLF\_SERVO\_ERR, CM Servo, I monitor | |
| 11 | SQZ-CLF\_SERVO\_CTRL, CM Servo, Fast monitor | |
| 12 | SQZ-CLF\_SERVO\_SLOW, CM Servo, Slow monitor | |
| DB9\_4 | 13 | SQZ-HD\_A\_DC | |
| 14 | SQZ-HD\_B\_DC | |
| 15 | SQZ-HD\_DIFF\_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 0 | 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 | Unused | | |
| 30 | Unused | | |
| 31 | Unused | | |
| 32 | Unused | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Card | AA/AI conn. | ADC/DAC Chs. | Signal | |
| ADC 1 | 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 | | |
| ADC1 | 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 |
| DAC 0 | 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.