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## ADC and DAC Channel Usage for ISC

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## 1 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](#), *List of ISC Photodetectors in Advanced LIGO*.

## 2 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<br>REFL PD<br>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           |                          | ASC-AS_B_RF42 | 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           |                          | ASC-AS_B_RF42 | 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             |                 | ASC-REFL_A_RF9  | 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            |                 | ASC-REFL_A_RF45 | 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            |                 | ASC-REFL_B_RF9  | 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            |                 | ASC-REFL_B_RF45 | 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<br>(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             |               | ASC-AS_A_RF36 | Seg 3   | Q-phase |
|       |             | 6             |               |               |         | I-phase |
|       |             | 7             |               |               | Seg 4   | Q-phase |
|       |             | 8             |               |               |         | I-phase |
|       | DB9_3       | 9             | ASC-AS_B_RF45 |               | Seg 1   | Q-phase |
|       |             | 10            |               |               |         | I-phase |
|       |             | 11            |               |               | Seg 2   | Q-phase |
|       |             | 12            |               |               |         | I-phase |
|       | DB9_4       | 13            |               | ASC-AS_B_RF36 | Seg 3   | Q-phase |
|       |             | 14            |               |               |         | I-phase |
|       |             | 15            |               |               | Seg 4   | Q-phase |
|       |             | 16            |               |               |         | I-phase |
|       | DB9_5       | 17            | ASC-AS_A_RF45 |               | Seg 1   | Q-phase |
|       |             | 18            |               |               |         | I-phase |
|       |             | 19            |               |               | Seg 2   | Q-phase |
|       |             | 20            |               |               |         | I-phase |
|       | DB9_6       | 21            |               | ASC-AS_A_RF36 | Seg 3   | Q-phase |
|       |             | 22            |               |               |         | I-phase |
|       |             | 23            |               |               | Seg 4   | Q-phase |
|       |             | 24            |               |               |         | I-phase |
|       | DB9_7       | 25            | ASC-AS_B_RF45 |               | Seg 1   | Q-phase |
|       |             | 26            |               |               |         | I-phase |
|       |             | 27            |               |               | Seg 2   | Q-phase |
|       |             | 28            |               |               |         | I-phase |
|       | DB9_8       | 29            |               | ASC-AS_B_RF36 | 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 |
|       | 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<br>MCL PZT Tip-tilt 1: pitch |
|       |             | 12           | ASC-POP_X_YAW/ IO_PZT_B_YAW<br>MCL PZT Tip-tilt 1: yaw   |
|       | DB9_4       | 13-15        | Unused   |
|       |             | 16           | DuoTone  |

### 3 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             | SQZ-CLF_REFL_LF                                  |     |                                  | DC Outputs                       |
|       |             | 10            | SQZ-OPO_REFL_LF                                  |     |                                  |                                  |
|       |             | 11            | Unused   |     |                                  |                                  |
|       |             | 12            | Unused   |     |                                  |                                  |
|       | 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            | SQZ-OPO_IR                                       |     |                                  |                                  |
|       |             | 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<br>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            | PD1: SQZ-FIBR_PD_LF                        | 4 ch Generic PD interface:<br>ISCT6<br>w/ whitening |
|       |             | 22            | PD2: SQZ-SHG_TRANS_LF                      |   |
|       |             | 23            | PD3: SQZ-LASER_IR_LF                       |   |
|       |             | 24            | PD4: SQZ-SHG_GR_LF                         |   |
|       | DB9_7       | 25            | SQZ-OPO_TRANS_LF                           | DC Outputs<br>w/ whitening                          |
|       |             | 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<br>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   |

|                       |
|-----------------------|
| PD1: SQZ-FIBR_PD_LF   |
| PD2: SQZ-SHG_TRANS_LF |
| PD3: SQZ-LASER_IR_LF  |
| PD4: SQZ-SHG_GR_LF    |

## 4 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<br>CM Servo: ALS phase-locking, I monitor     |  |
|       |             | 2            | ALS-X(Y)_FIBR_SERVO_CTRL<br>CM Servo: ALS phase-locking, Fast monitor |  |
|       |             | 3            | ALS-X(Y)_FIBR_SERVO_SLOW<br>CM Servo: ALS phase-locking, Slow monitor |  |
|       |             | 4            | Unused  |  |
|       | DB9_2       | 5            | ALS-X(Y)_REFL_SERVO_ERR<br>CM Servo: ALS PDH-locking, I monitor       |  |
|       |             | 6            | ALS-X(Y)_REFL_SERVO_CTRL<br>CM Servo: ALS PDH-locking, Fast monitor   |  |
|       |             | 7            | ALS-X(Y)_FIBR_SERVO_SLOW<br>CM Servo: ALS PDH-locking, Slow monitor   |  |
|       |             | 8            | Unused  |  |
|       | DB9_3       | 9            | ALS-X(Y)_REFL_B_LF<br>PD1: DC from REFL power mon.                    | 4 ch. PD interface chassis:<br>ALS Table         |
|       |             | 10           | LSC-TRX(Y)_A_LF<br>PD2: Red transmitted beam                          |  |
|       |             | 11           | ALS-X(Y)_LASER_GR_LF<br>PD3: Green power monitor                      |  |
|       |             | 12           | ALS-X(Y)_FIBR_A_LF<br>PD4: DC from BBPD                               |  |
|       | DB9_4       | 13           | ALS-X(Y)_LASER_IR_LF<br>PD1: IR power monitor                         | 4 ch. Aux. signals concentrator<br>5: Field rack |
|       |             | 14           | ALS-X(Y)_FIBR_REJECTED_LF<br>PD2: Rejected fiber power                |  |
|       |             | 15           | ALS-X(Y)_FIBR_TRANS_LF<br>PD3: Trans. fiber power                     |  |
|       |             | 16           | ALS-X(Y)_SPARE_B_LF<br>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<br>MCL PZT Tip-tilt 1: pitch           |
|      |             | 2            | ALS-X(Y)_PZT1_YAW<br>MCL PZT Tip-tilt 1: yaw             |
|      |             | 3            | ALS-X(Y)_PZT2_PIT<br>MCL PZT Tip-tilt 2: pitch           |
|      |             | 4            | ALS-X(Y)_PZT2_YAW<br>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<br>MCL PZT Tip-tilt 3 for WFS_A: pitch |
|      |             | 10           | ALS-X(Y)_PZT3_YAW<br>MCL PZT Tip-tilt 3 for WFS_A: yaw   |
|      |             | 11           | ALS-X(Y)_PZT4_PIT<br>MCL PZT Tip-tilt 4 for WFS_B: pitch |
|      |             | 12           | ALS-X(Y)_PZT4_YAW<br>MCL PZT Tip-tilt 4 for WFS_B: yaw   |
|      | DB9_4       | 13           | Unused   |
|      |             | 14           | Unused   |
|      |             | 15           | Unused   |
|      |             | 16           | Unused   |

## 5 ADC/DAC Channel Concentrator

| Chas.        | Conn.        | ADC Chns.                                  | Signal                                     | Jumper           |
|--------------|--------------|--|--|------------------|
| 1<br>Front   | DB9_1<br>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<br>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<br>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<br>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<br>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<br>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<br>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<br>OUT | 13-16        | Unused                                     |  |                  |

| Chas.       | Conn.      | ADC Chns.                               | Signal                                  | Jumper |
|-------------|------------|---|---|--------|
| 1<br>Rear   | DB9<br>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<br>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<br>IN3 | 9                                       | SQZ-CLF_REFL_RF6_Q                      |        |
|             |            | 10                                      | SQZ-CLF_REFL_RF6_I                      |        |
|             |            | 11                                      | Unused                                  |        |
|             |            | 12                                      | Unused                                  |        |
|             | DB9<br>IN4 | 13                                      | Unused                                  |        |
|             |            | 14                                      | Unused                                  |        |
|             |            | 15                                      | Unused                                  |        |
|             |            | 16                                      | Unused                                  |        |
| DB9<br>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<br>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<br>OUT3 | 9          | Unused                                  |   |        |
|             | 10         | Unused                                  |   |        |
|             | 11         | Unused                                  |   |        |
|             | 12         | Unused                                  |   |        |
| DB9<br>OUT4 | 13         | Unused                                  |   |        |
|             | 14         | Unused                                  |   |        |
|             | 15         | Unused                                  |   |        |
|             | 16         | Unused                                  |   |        |

## 6 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.