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List of ISC Photodetectors in Advanced LIGO

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# Introduction

This document lists the photodetectors deployed by the ISC subsystem. The detectors are split into three categories: Length Sensing & Control (LSC); Alignment Sensing & Control (ASC); Arm Length Stabilization (ALS).

Here we also intend to establish a naming convention for these detectors. The basic naming pattern for a given photodetector is:

<IFO>:<CATEGORY>-[<ARM>\_]PORT\_UNIT\_OUTPUT

where

<IFO>: Interferometer (H1, L1, I1, etc.)

<CATEGORY>: ISC subsystem, (LSC, ASC, or ALS)

<PORT>: IFO port location (REFL, AS, POP, etc)

<UNIT>: A, B, C, …

<OUTPUT>: signal output type (DC, RF9, RF45, etc.)

The IFO specifies the interferometer. The "<IFO>:" prefix will be implied in the rest of this document.

The CATEGORY reflects the main ISC subsystem or LSC, ASC, or ALS. Normally this field designates the global IFO subsystem, but it is subdivided for the case of ISC.

The PORT designator indicates where in the IFO the detector is located, e.g. reflected port (REFL), antisymmetric port, 'AS', etc.

Additionally we often have two instances of a given type of detector, one located in the vacuum system and one located on an optical table in air. In this case we add ‘AIR’ to the port name for the in-air version (e.g., REFLAIR). This is motivated by the fact that the in-vacuum units are intended for low-noise, science mode operation, so we keep their names terse.

The UNIT designator simply distinguishes different detectors of the same type at a given port. For example, a port may have two wavefront sensors that are separated by 90 degrees of Gouy phase; one would be labeled ‘A’, the other ‘B’.

A given detector may produce multiple signals (e.g., multiple RF signals, or RF and DC signals). A particular output is specified by appending to the detector name either ‘DC’ or ‘RF?’, where the question mark ('?') represents the RF frequency in MHz, e.g. 'RF45' for the 45MHz output. Detectors with a single RF frequency output may be designated simply as 'RF'.

Note that this naming convention does not distinguish between wavefront sensors and (DC) quadrant-photodetectors in the detector name; that distinction would be made in the signal name; e.g.:

ASC\_AS\_A\_RF45: AS port wavefront sensor signals at modulation frequency 45 MHz

ASC\_AS\_C\_DC: AS port QPD signals

# Length Sensing & Control Detectors (incl. OMC)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Detector** | **Output** | **Acq/SM** | **Freq.** | **DOF** | **Location** |
| LSC-REFLAIR\_A | RF9 | Acq | 9 MHz | CARM | ISCT1 |
| DC | Acq |  | CARM |  |
| RF45 | Acq | 45 MHz | SRCL | ISCT1 |
| LSC-REFLAIR\_B | RF27 | Acq | 27 MHz | PRCL/MICH | ISCT1 |
| RF135 | Acq | 135 MHz | SRCL/MICH | ISCT1 |
| LSC-POPAIR\_A | RF9 | Acq | 9 MHz | PRCL | ISCT1 |
| RF45 | Acq | 45 MHz | MICH/SRCL | ISCT1 |
| LSC-POPAIR\_B | RF18 | Acq | 18 MHz | SPOP | ISCT1 |
| RF90 | Acq | 90 MHz | SPOP | ISCT1 |
| LSC-ASAIR\_A | RF45 | Acq | 45 MHz | DARM | ISCT6 |
| LSC-ASAIR\_B | RF18 | Acq | 18 MHz | SASY | ISCT6 |
| RF90 | Acq | 90 MHz | SASY | ISCT6 |
| LSC-X\_TR\_A | DC | Acq |  | Xarm power, hi gain | ISCTEX |
| LSC-X\_TR\_B | DC | Acq |  | Xarm power, lo gain | ISCTEX |
| LSC-Y\_TR\_A | DC | Acq |  | Yarm power, hi gain | ISCTEY |
| LSC-Y\_TR\_B | DC | Acq |  | Yarm power, lo gain | ISCTEY |
| LSC-REFL\_A | RF9 | SM | 9 MHz | CARM | HAM1 |
| RF45 | SM | 45 MHz | SRCL | HAM1 |
| LSC-POP\_A | RF9 | SM | 9 MHz | PRCL | HAM1 |
| RF45 | SM | 45 MHz | MICH/SRCL | HAM1 |
| OMC-DCPD\_A | DC | SM |  | DARM | HAM6 |
| OMC-DCPD\_B | DC | SM |  | DARM | HAM6 |

# Alignment Sensing & Control Detectors

In Science Mode some of the ASC detectors control multiple degrees-of-freedom. The DOF entries in the table below indicate the more dominant DOF for a given sensor; see LIGO-T0900511 for the full details of the alignment sensing.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name** | **RF/DC** | **Acq/SM** | **Freq.** | **DOF** | **Location** |
| ASC-X-TR\_A | DC | SM |  | Soft mode | Xarm TransMon |
| ASC-X\_TR\_B | DC | SM |  | Xarm TransMon |
| ASC-Y\_TR\_A | DC | SM |  | Soft Mode | Yarm TransMon |
| ASC-Y\_TR\_B | DC | SM |  | Yarm TransMon |
| ASC-REFL\_A | RF9 | SM | 9 MHz | Comm Hard | HAM1 |
| RF45 | SM | 45 MHz | SR3 | HAM1 |
| ASC-REFL\_B | RF9 | SM | 9 MHz | Comm Hard | HAM1 |
| RF45 | SM | 45 MHz | SR3/IN1 | HAM1 |
| ASC-AS\_A | RF45 | SM | 45 MHz | Diff Hard | HAM6 |
| RF36 | SM | 36 MHz | SRM/IN1/BS | HAM6 |
| ASC-AS\_B | RF45 | SM | 45 MHz | Diff Hard | HAM6 |
| RF36 | SM | 36 MHz | SRM/IN1/BS | HAM6 |
| ASC-AS\_C | DC | SM |  | SRM | HAM6 |
| ASC-OMC\_A | DC | SM |  | OMC | HAM6 |
| ASC-OMC\_B | DC | SM |  | OMC | HAM6 |
| ASC-OMCR\_A | DC | SM |  | OMC | HAM6 |
| ASC-OMCR\_B | DC | SM |  | OMC | HAM6 |
| ASC-POP\_A | DC | SM |  | PRM | HAM3 |
| ASC-POP\_B | DC | SM |  | PR3 | HAM3 |
| ASC-REFLAIR\_A | RF9 | Acq | 9 MHz | Comm Hard | ISCT1 |
| RF45 | Acq | 45 MHz |  | ISCT1 |
| ASC-REFLAIR\_B | RF9 | Acq | 9 MHz |  | ISCT1 |
| RF45 | Acq | 45 MHz | SR3/IN1 | ISCT1 |
| ASC-ASAIR\_A | RF45 | Acq | 45 MHz | Diff Hard | ISCT6 |
| RF36 | Acq | 36 MHz |  | ISCT6 |
| ASC-ASAIR\_B | RF45 | Acq | 45 MHz |  | ISCT6 |
| RF36 | Acq | 36 MHz | BS | ISCT6 |

# Arm Length Stabilization Detectors

The naming for the ALS detectors does not really use the PORT convention, but uses other descriptors that should be self-explanatory.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Detector** | **Output** | **Acq/SM** | **Freq.** | **DOF** | **Location** |
| ALS-X\_QPD\_A | DC | Acq |  | input beam | Xarm TransMon |
| ALS-X\_QPD\_B | DC | Acq |  | input beam | Xarm TransMon |
| ALS-Y\_QPD\_A | DC | Acq |  | input beam | Yarm TransMon |
| ALS-Y\_QPD\_B | DC | Acq |  | input beam | Yarm TransMon |
| ALS-X\_PDH | RF | Acq | 24.5 MHz | ALS laser freq. | ISCTEX |
| ALS-X\_FIBR\_A | RF | Acq | 40 MHz | ALS/PSL PLL | ISCTEX |
| ALS-Y\_PDH | RF | Acq | 24.5 MHz | ALS laser freq. | ISCTEY |
| ALS-Y\_FIBR\_A | RF | Acq | 40 MHz | ALS/PSL PLL | ISCTEY |
| ALS\_COMM | RF | Acq | 78.95 MHz | PSL freq. | ISCT1 |
| ALS\_DIFF | RF | Acq | 157.9 MHz | Arm diff. length | ISCT1 |
| ALS-Y\_WFS\_A | RF | Acq | 24.5 MHz | Alignment | ISCTEY |
| ALS-Y\_WFS\_B | RF | Acq | 24.5 MHz | Alignment | ISCTEY |

Slow controls (monitor) detectors (X arm only listed; same exists on Y arm):

|  |  |  |
| --- | --- | --- |
| **Detector** | **Beam** | **Location** |
| ALS-X\_FIBR\_TRANS | Fiber-delivered PSL beam from the corner | ISCTEX |
| ALS-X\_FIBR\_REJECTED | Fiber beam power: wrong polarization | ISCTEX |
| ALS-X\_LASER\_IR | Prometheus laser IR | ISCTEX |
| ALS-X\_LASER\_GR | Prometheus laser 532nm | ISCTEX |
| ALS-X\_FIBR\_A | DC from BBPD used for PLL | ISCTEX |
| ALS-X\_REFL\_B | Arm cav 532nm reflected | ISCTEX |
| ALS-C\_LASER\_IR | Before ALS SHG | ISCT1 |
| ALS-C\_LASER\_GR | After ALS SHG | ISCT1 |
| ALS-C\_TRX\_A | Green cavity transmission, X arm | ISCT1 |
| ALS-C\_FIBR\_INTERNAL | Ref cav beam coupled into fiber | ALS fiber distribution chassis |
| ALS-C\_FIBR\_EXTERNAL | Rev cav beam into fiber | PSL/IO table |

# Input Mode Cleaner

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Detector** | **Output** | **Acq/SM** | **Freq.** | **DOF** | **Location** |
| IMC-PDH | RF | SM | 24 MHz | IMC L/Freq | IOT1 |
| IMC-WFS\_A | RF | SM | 24 MHz | Align. | IOT1 |
| IMC-WFS\_B | RF | SM | 24 MHz | Align. | IOT1 |

# Acronyms

|  |  |
| --- | --- |
| Acq | Acquisition mode |
| ALS | Arm Length Stabilization |
| AS | Anti-Symmetric port |
| ASC | Alignment Sensing and Control |
| BS | Beam Splitter |
| CARM | Common ARM length |
| DARM | Differential ARM length |
| DIFF | Differential mode |
| GR | Green |
| IMC | Input Mode Cleaner |
| IN1 | Input beam |
| IR | Infrared |
| LSC | Length Sensing and Control |
| OMC | Output Mode Cleaner |
| OMCR | Output Mode Cleaner, Reflection port |
| PDH | Pound-Drever-Hall refl. Locking signal |
| POP | Pick-Off, Power recycling cavity |
| PRM | Power Recycling mirror |
| PR3 | Power Recycling cavity mirror 3 |
| QPD | Quadrant Photo Detector |
| REFL | Reflection port |
| SASY | Sideband power in AS |
| SM | Science Mode |
| SPOP | Sideband power in POP |
| SRM | Signal Recycling mirror |
| SR3 | Signal Recycling cavity mirror 3 |
| TR | Transmitted port |
| WFS | Wavefront Sensor |