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List of ISC Photodetectors in Advanced LIGO

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1 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

2 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

3 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	SR3/IN1	ISCT1
	RF45	Acq	45 MHz		ISCT1
ASC-ASAIR_A	RF45	Acq	45 MHz	Diff Hard	ISCT6
	RF36	Acq	36 MHz		ISCT6
ASC-ASAIR_B	RF45	Acq	45 MHz	BS	ISCT6
	RF36	Acq	36 MHz		ISCT6

4 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

5 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

6 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