LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY

LIGO Laboratory / LIGO Scientific Collaboration

LIGO- E1200040-v2 *ADVANCED LIGO* 11 Oct 2013

Pre-Stabilized Laser Subsystem Acceptance documentation - H1 PSL-

Benno Willke and the PSL team

Distribution of this document:
LIGO Science Collaboration

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of the LIGO Project.

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Purpose and general description

This document provides links to the acceptance documentation package (as defined in M1100282-v1. (some acronyms are defined at the end of this document).

The aLIGO H1 PSL (sometimes referred to as the Observatory 2 PSL (OBS2)) was first completely installed and tested in the Hanford H2 PSL enclosure and H2 laser diode room (Sep-Dec 2011). A complete test document for the H2 installation (similar to the one generated for the L1 acceptance (LIGO-E1100716)) was compiled under LIGO-E1200385.

After the decision was taken to first install the H1 Interferometer in Hanford, the full PSL was moved to the H1 location (Apr-Jun 2012). After this move the test measurements were redone and are documented in LIGO-E1200385 as well.

1 Requirements documentation:

The design requirements document must be brought up to date, and pointers to background material, analyses, etc. added to the Requirements document. Pointers to prototyping endeavors should be included here.

a. **Design Requirements Document (DRD)** T050036
2. **Supporting documents (models, analyses, …)**

2 Design overview and detailed design documentation:

The Final Design Document must be brought up to date, and the detailed design made available via a tree structure pointing to the DCC and design vaults. Lower-level software (control laws, basic machine state and reporting) should be documented in this way, pointing to a software version control system.

document	DCC number
main documents	
final design document	T0900649
FD presentation	L1000084
FD committee report (accepted)	L1000084
optical layout	
PSL table layout	T0900610
PSL component list (shape data generated from Visio file, optics, mounts, DCC numbers, etc)	T0900633
list of optics and their data sheets	T1200041
control	

PSL control and DAQ layout	T1200085
electronic infrastructure document (power supplies, racks, crades)	T0900650
function and interface document: injection locking (ILS) and PMC servo	T0900578
ILS / PMC circuit board documentation	T0900577
function and interface document ISS inner loop	T0900630
ISS inner loop circuit board documentation	T0900631 D1001985
PSL monitoring fieldbox circuit board documentation	T0900632 D1002292
aLIGO PSL FSS Modifications	T1100119
PSL Input/Output fieldbox	D1300008
aLIGO PSL TTFSS fieldbox	D1100367
aLIGO PSL VCO fieldbox	D1100369
PSL photodiodes design document	T0900618
aLIGO PSL PD mechanical drawings	D1200121
PSL rf electronic components	T0900589
interfaces	
interface document	T0900644
rooms and infrastructure	
laser room design document	T1000028
laser diode room design document	T070195
L1 and H1 PSL/IO optical table and Laser Area Enclosure layout drawing	D1003076
Mechanical Sections and Details - H1 Laser Area Enclosure Acoustic Shell	D1002388
electro-optical components	
aLIGO bow-tie Pre-Mode Cleaner document	T0900616
PMC tecnhnical drawings	T1000088
PMC construction manual	T1000430
manuals and descriptions	

user manual 35W laser	T0900646
user manual 200W laser	T0900641
Advanced LIGO PSL Diagnostic Breadboard Instruction Manual	T0900133
Advanced LIGO PSL Diagnostic Breadboard Computer Control Manual	T0900579
PSL EPICS user interfaces	T0900634
Coolant system operating & maintenance manual	T1100373
CDS channel list with short descriptions	T1200092
miscellaneous	
Coolant distribution system schematic	T1100372
spare concept	T0900645
Advanced LIGO PSL Installation Plan	T0900568
aLIGO PSL Safety Plan	T0900614
aLIGO PSL Interlock Concept	T1000005
failure mode document	T080247
Slow_Ethercad_PSL_Control_Chasis	T1100326

Laser Area Enclosure - Cleanroom

DCC #	Description
C1002229-v1	PSL Laser Area Enclosure Cleanrooms - Specifications, Requirements, and Design Considerations
D1002633-v2	Ante-room Plan, H1 Laser Area Enclosure
D1002634-v1	Ante-room Elevations, H1 Laser Area Enclosure
D1002781-v2	Ante-room Plan, H2 Laser Area Enclosure
D1002786-v2	Ante-room Elevations, H2 Laser Area Enclosure
D1002787-v2	Ante-room Plan, L1 Laser Area Enclosure
D1002789-v2	Ante-room Elevations, L1 Laser Area Enclosure

Acoustic Shell Drawings :

DCC #	Description
D1002386-v3	Mechanical Plan, H1 Laser Area Enclosure Acoustic Shell
D1002387-v2	Mechanical Plan and schedules, H1 Laser Area Enclosure Acoustic
D1002388-v3	Mechanical Sections and Details, H1 Laser Area Enclosure Acoustic Shell
D1002389-v2	Room Layout/Framing Plan, H1 Laser Area Enclosure Acoustic Shell
D1002390-v2	Framing Plans and Elevations, H1 Laser Area Enclosure Acoustic Shell
D1002396-v2	Mechanical Plan, H2 Laser Area Enclosure Acoustic Shell
D1002397-v2	Mechanical Plan and schedules, H2 Laser Area Enclosure Acoustic Shell
D1002398-v2	Mechanical Sections and Details, H2 Laser Area Enclosure Acoustic Shell
D1002399-v2	Room Layout/Framing Plan, H2 Laser Area Enclosure Acoustic Shell
D1002411-v2	Framing Plans and Elevations, H2 Laser Area Enclosure Acoustic Shell
D1002391-v3	Mechanical Plan, L1 Laser Area Enclosure Acoustic Shell
D1002392-v2	Mechanical Plan and schedules,L1 Laser Area Enclosure Acoustic Shell
D1002393-v2	Mechanical Sections and Details, L1 Laser Area Enclosure Acoustic Shell
D1002394-v2	Room Layout/Framing Plan, L1 Laser Area Enclosure Acoustic Shell
D1002395-v2	Framing Plans and Elevations, L1 Laser Area Enclosure Acoustic Shell

drawings of PSL components

		35W Laser Container
available at LZH		mechanical design
available at LZH		electrical design
T1100372		cooling water design
		200W High Power Laser Oscillator Container
available at LZH		mechanical design (LZH)
available at		mechanical design (NeoLase)

neoLASE		
available at neoLASE		electrical design
T1100372		cooling water design
D1200121		OSC monitoring photodiodes mechanical design
D1002164		OSC monitoring photodiodes schematic
		Diagnostic Breadboard Container
T0900133		cabeling reference
T0900133		Breadboard optical layout
T0900133		Simplified schematic of the whole electronics.
T1200078		HV Amplifier module front
T1200078		HV Amplifier module schematic
T1200078		Demodulator front
T1200078		Demodulator schematic
T1200078		Controller 1 module front
T1200078		Controller 1 module schematic
T1200078		Controller 2 module front
T1200078		Controller 2 module schematic
T1200078		Miscelleneaus module front
T1200078		Miscelleneaus module schematic
T1200078		DBB interface adapter (at DBB box)
T1200078		DBB RIN PD schematic
T1200078		DBB RIN PD mechanical design
T1200078		DBB quadrant PD schematic
T1200078		DBB quadrant PD mechanical design
		PreModecleaner Container

D1001618		PMC servo module schematic
T0900577		PMC servo module front
D1001619		PMC field box module schematic
T0900577		PMC field box module front
D1001955		PMC spacer
D1001955		PMC tank
D1002163		PMC photodiode schematic
D1200121		PMC photodiode mechanical design
		Injection Locking Container
D1001618		ILS servo module schematic
T0900577		ILS servo module front
D1001619		ILS field box module schematic
T0900577		ILS field box module front
D1002163		ILS photodiode schematic
D1200121		ILS photodiode mechanical design
D1001811		Heat sink for aLIGO PSL Servo PCB
		Frequency Stabilization Container
D040105-B		FSS table top servo schematic
D040424-A		FSS daughter board
D040469-00		FSS rf summation box
T1100119		TTFSS modification electronic components
D1100371		TTFSS Daughterboard
D1100367		TTFSS field box module schematic
D1100367		TTFSS field box module front
D1100369		VCO field box module schematic
D1100369		VCO field box module front

D980670-00-D		FSS reference cavity
D980676-00-D		FSS tank
D1200164		FSS reference cavity mount
D000214-00-C		FSS reference cavity temperature stabilization schematic
D980454-00-C		FSS rf-photodiode schematic
D989677-00-D		FSS rf-photodiode mechanical design
D1100677		FSS RPD 4inch mount
D1002164		FSS trans-photodiode schematic
D1200121		FSS trans-photodiode mechanical design
D1002841		aLIGO PSL FSS periscope adapter
D1100031		aLIGO PSL FSS periscope adapter angled
D1100676		FSS EOM/AOM mount
		Power Stabilization Container (first loop)
D1001985		ISS servo module inner loop, schematic
D1001986		ISS servo module inner loop, front
D1001998		ISS photodiode schematic
D1200121		ISS photodiode mechanical design
D1002280		Quadrant photodiode for aLIGO PSL ISS
D1003121		ISS inner loop photodiode box
D1002707		aLIGO PSL AOM driver
D1100587		aLIGO PSL AOM Base mechanical drawing
D1100588		aLIGO PSL ISS tube adapter for PMC
D1100589		aLIGO PSL ISS tube mirror base
D1100590		aLIGO PSL ISS tube base
D1100591		aLIGO PSL ISS tube apertures
		Laser Room Container

D1002633-v2		Ante-room Plan, H1 Laser Area Enclosure
D1002634-v1		Ante-room Elevations, H1 Laser Area Enclosure
D1002781-v2		Ante-room Plan, H2 Laser Area Enclosure
D1002786-v2		Ante-room Elevations, H2 Laser Area Enclosure
D1002787-v2		Ante-room Plan, L1 Laser Area Enclosure
D1002789-v2		Ante-room Elevations, L1 Laser Area Enclosure
D1002386-v3		Mechanical Plan, H1 Laser Area Enclosure Acoustic Shell
D1002387-v2		Mechanical Plan and schedules, H1 Laser Area Enclosure Acoustic
D1002388-v3		Mechanical Sections and Details, H1 Laser Area Enclosure Acoustic Shell
D1002389-v2		Room Layout/Framing Plan, H1 Laser Area Enclosure Acoustic Shell
D1002390-v2		Framing Plans and Elevations, H1 Laser Area Enclosure Acoustic Shell
D1002396-v2		Mechanical Plan, H2 Laser Area Enclosure Acoustic Shell
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D1002392-v2		Mechanical Plan and schedules,L1 Laser Area Enclosure Acoustic Shell
D1002393-v2		Mechanical Sections and Details, L1 Laser Area Enclosure Acoustic Shell
D1002394-v2		Room Layout/Framing Plan, L1 Laser Area Enclosure Acoustic Shell
D1002395-v2		Framing Plans and Elevations, L1 Laser Area Enclosure

		Acoustic Shell
D1200954- D1200960		Gerbig fabrication plans H1 enclosure
		Laser Diode Room Container
T070195		Laser Diode Room design
		miscellaneous
D1002292		PSL monitoring fieldbox, schematic
D1002293		PSL monitoring fieldbox, front
D050339		Delay Lines
D1100115		PSL CCD breakout panel
T1200085		PSL top level control design, rack location, rack partition, wiring
		Laser Table Container
T0900610		PSL table layout
D1002708		aLIGO PSL table power distributor
D1002929		aLIGO PSL Power monitoring PD, schematics
D1200121		aLIGO PSL Power monitoring PD, mechanical design
D1002657		aLIGO PSL standard mirror mount base
D1002659		aLIGO PSL off-grid mirror mount base, variant 1
D1002660		aLIGO PSL off-grid mirror mount base, variant 2
D1002662		aLIGO PSL beam dump holder for mirror mount base
D1002658		aLIGO PSL 0deg mirror mount base
D1100580		aLIGO PSL mirror base AOM diffracted beam
D1100582		aLIGO PSL PBS mount

D1100631		aLIGO PSL beam dump holder for PBS mount
D1100583		aLIGO PSL low power attenuator
D1100584		aLIGO PSL high power attenuator
D1100585		aLIGO PSL waveplate base
D1100586		aLIGO PSL power meter mount
D1100592		aLIGO PSL lens mount rail (SDS 40)
D1100593		aLIGO PSL lens mount (SDS 40)
D1100594		aLIGO PSL lens mount rail
D1100595		aLIGO PSL lens mount, option 1
D1100596		aLIGO PSL lens mount, option 2
D1100597		aLIGO PSL lens mount adapter (SDS 40)
D1100120		aLIGO PSL CCD post

3 Materials and Fabrication specifications:

Any special materials, or treatment of materials including preparation for in-vacuum use; this may be integrated into the Design documentation.

4 Parts and spares

Parts and spares inventoried: All elements of aLIGO must be recorded in the ICS or in the DCC using the S-number scheme. As-built modifications for parts or assemblies should be found here.

- see tables in: *L1 Pre-Stabilized Laser Subsystem Testing and Acceptance* E1100716
- see ICS for US components
- components shipped from Germany (will be added to ICS after transfer of title)
- please note: the spare numbers marked in red need to be reduced by one if the third interferometer will be installed on a different continent (e.g. India)

		Obs 2		
Component	**DCC-number**	**Amount**	**Spares**	**Total**
PMC	D1001955	1	1	**2**
ISS-Box	D1003121	1	1	**2**

Periscope Rod		2	0	2
Periscope Mounts		4	1	5
Periscope Adapter normal	D1002841	3	1	4
Periscope Adapter special	D1100031	1	0	1
Shutter		2	1	3
Shutter Mounts	D1100581	2	1	3
Mirrors				
Mirror Bases (Standard Design)	D1002657	23	7	30
Mirror Bases (Offgrid Design oP)	D1002659	5	4	9
Mirror Bases (Offgrid Design mP)	D1002660	1	7	8
Plates for Mirror Bases (Offgrid Design mP)	D1002660	1	7	8
Mirror Bases Dump Holder	D1002662			5
Mirror Bases (0deg Design)	D1002658	1	1	2
Mirror Base AOM Diffracted Beam	D1100580	1	1	2
Mirror HR		27	8	35
Mirror Ts=1%		3	2	5
Mirror Tp=1%		3	2	5
Mirror Tp=50%		1	1	2
Mirror Tp=0.20%		3	3	6
Mirror Tp=200ppm		1	1	2
Mirror Mount U100-A-2H-LH		18	7	25
Mirror Mount U100-A-2H		18	7	25
distance plate for mirror mounts				2
PBS		5	1	6
PBS Mount	D1100582	5	2	7
Dump Holder	D1100631			6
PBS Holder (PM3)		5	1	6
Low Power **Attenuator**	D1100583	1	2	3
High Power Attenuator	D1100584	1	1	2
Wave Plate Mount Base	D1100585	6	2	8
precision Rotationmount		1	1	2
Half-wave plates HP		2	1	3
Rotationmount (RSP1)		7	1	8
Half-wave plates		3	1	4
Quarter-wave plates		3	1	4

Low Power **Dumps** (LB1)				**10**
Medium Power Dumps (BT610)		1	1	**2**
High Power Dumps		1	1	**2**
Mounts Thorlabs (CL5)				**20**
PH2				**10**
TR1.5				**10**
BA2				**3**
BA1S				**4**
BA1				**3**
Power Meter (numbers?)		1	1	**2**
Power Meter Mounts	D1100586	3	1	**4**
Photo diodes				
Power Mon PD (PD1)	D1002929	1	1	**2**
PMC Locking PD (PD2)	D1002163	1	1	**2**
FSS refl. (PD3)		1	0	**1**
FSS trans. (PD4)	D1002164	1	1	**2**
ILS Locking PD	D1002163	0	1	**1**
OSC PD AMP	D1002164	0	1	**1**
OSC PD INT	D1002164	0	1	**1**
OSC PD BP	D1002164	0	1	**1**
OSC PD ISO	D1002164	0	1	**1**
AOM		1	1	**2**
AOM Base	D1100587	1	1	**2**
AOM Driver	D1002707	1	1	**2**
AOM Slider		1	1	**2**
AOM Mount 9071		1	1	**2**
FSS RPD Mounts	D???????	2	2	**4**
FSS AOM Base + NP9071	D???????	1	0	**1**
FSS EOM Base + NP9071	D???????	1	0	**1**
Ref. Cav. Upper Mount		2	0	**2**
Ref. Cav. Lower Mount		2	0	**2**
ISS Tube Adapter PMC	D1100588	1	1	**2**
Mirror Mount (KCB1)		2	0	**2**
Base Tube Mirror	D1100589	2	1	**3**
Base Tube	D1100590	1	1	**2**
SM1RC		1	1	**2**

SM1T2		4	0	**4**
SM1T10		0	2	**2**
SM1L03		0	4	**4**
SM1L05		0	4	**4**
SM1L10		2	0	**2**
SM1L20		2	0	**2**
SM1L30		0	2	**2**
SM1M30		1	0	**1**
SM1V10		4	2	**6**
Tube Aperatures	D1100591	10	0	**10**
CF125		5	0	**5**
Rail 1m		1	1	**2**
Rail 0.4m		1	0	**1**
Rail 0.2m		2	0	**2**
Rail slider		9	2	**11**
SDS 40		6	2	**8**
Alignment Adapters		2	0	**2**
Alignment Adapters inner part		4	0	**4**
Lenses				
FS f=-50 (Quioptic)		1	0	**1**
FS f=-50 (super polished)		1	1	**2**
FS f=300 (super polished)		2	1	**3**
FS f=400 (super polished)		1	1	**2**
BK7 f=50 (PDs)		2	0	**2**
BK7 f=80 (DBB)		1	0	**1**
BK7 f=100 (FE to DBB, PD, FSS)		3	0	**3**
BK7 f=150 (FE to DBB, DBB)		2	0	**2**
BK7 f=200 (FSS)		3	0	**3**
Lens Mounts on Rail with SDS 40	D1100592	4	1	**5**
Lens Mounts no Rail with SDS 40	D1100593	2	0	**2**
Lens Mounts on Rail no SDS 40	D1100594	2	0	**2**
Lens Mounts simple	D1100595	1	1	**2**
Lens Mount no Holder needed	D1100596	5	3	**8**
SDS Adapter	D1100597	8	1	**9**
Lens Holder X-Y		1	3	**4**
Lens Holder (OH40-D30)		4	3	**7**
Lens Holder (OH40-D25)		8	1	**9**
TFP		2	4	**6**

Cables				
13m LEMO 00 cables		55	0	55
0.5m LEMO 5pin cables		2	1	3
2m LEMO 5pin cables		3	1	4
13m SMA to LEMO		2	1	3
13m LEMO 0S to LEMO 0S		1	1	2
2m SMA to BNC		3	2	5
13m 4-pin LEMO		1	1	2
13m LEMO 0S to LEMO 2-pin		1	1	2
13m BNC to LEMO 00		1	1	2
13m SMB to BNC		1	1	2
13m LEMO 5pin to LIGO		2	1	3
13m BNC to SMA (Hälfte gewinkelt)		2	1	3
GEO male to GEO male		1	1	2
Adapter Power Meter		1	1	2
3m SMA to SMA (both gewinkelt) with RG58 cable		1	1	2
13m Shutter cable		2	1	3
9-pin Sub-D 50m bzw. 75m		35	2	37
25-pin Sub-D 50m bzw. 75m		5	2	7
Electronics				
Monitoring Fieldbox	D1002292	1	1	2
ILS/PMC fieldbox	D1001619	2	2	4
ILS Servo	D1001618	1	1	2
PMC Servo	D1001618	1	1	2
ISS	D1001985	1	1	2
Delay Lines	D050339	2	1	3
TTFSS Fieldbox	D1100367	1	1	2
VCO Fieldbox	D1100369	1	1	2
TTFSS Daughterboard	D1100371	1	1	2
TTFSS modifaction electronic components	T1100119	1	1	2
Power Distributor	D1002708	2	1	3
CCD		6	1	7
Adapter C-Mount-SM1 (SM1A9)		6	1	7
CCD Mounts	D1100120 + NP	6	1	7
Brakeoutpanel	D1100115	1	0	1
power cables		6	1	7
signal cables		6	1	7

LEMO				
1m LEMO 00				**5**
2m LEMO 00				**5**
5m LEMO 00				**3**
Water stuff				
Hosts 50m (PUN 8x6 BLAU LE)				**1**
cap nut (Landefeld MCK 6 ES)				**12**
Adapter flow meter (Landefeld K146 ES)				**6**
Adapter power meter (Landefeld K186 ES NPT)				**6**
float flow meter (Profimess SW-02.1.2.1.06.1.1.0)				**3**
water connector (Werder PLCD130-M8)				**5**
water connector (Werder PLCD200-M8)				**5**
Computer				
Laptop		1	1	**2**
DBB				
Breadboard with side and top plates		1	0	**1**
Small cover plate		1	0	**1**
Electronic crate		1	1	**2**
HV		1	1	**2**
demod		1	1	**2**
misc		1	1	**2**
fieldbox		1	1	**2**
cali		1	0	**1**
HV power supply		1	0	**1**
CCD power supply		1	0	**1**
Lemo 00 cable, 13m		7	1	**8**
Lemo 3pin, 13m		2	1	**3**
Lemo 4pin, 13m		5	1	**6**
Lemo 0S, 13m		1	1	**2**
Shutter cable, 13m		1	1	**2**
Geo 4pin, 13m		1	1	**2**
Geo 5pin-Sub-D, 13m		1	1	**2**
Geo 5pin-Sub-D, 5m		1	1	**2**
US power cable		1	0	**1**
CCD cable, 13m		1	0	**1**
CD-ROM with documents		1	0	**1**
Adapter fieldbox		3	0	**3**
spare shutter		2	0	**2**

spare QPD		2	0	**2**
heat cond. foil and washer for QPD		1	0	**1**
spare TPD		1	0	**1**
spare RPD		1	0	**1**
spare CCD		2	0	**2**
spare PZT		2	0	**2**
spare servo for ML		2	0	**2**
gap pad for shutter		1	0	**1**

5 Assembly procedures:

All assembly procedures must be in the DCC and annotated or updated for lessons learned. Storage, if used, should be described here along with procedures to maintain the equipment in good condition (e.g., purge frequency). Transportation procedures and cautions must be noted. Assembly procedures for the larger sub-assemblies like the high power laser, 35W front-end laser, DBB are available from LZH, neoLASE or AEI.

Installation procedures: *All installation procedures must be in the DCC and annotated or updated for lessons learned.*

- Advanced LIGO PSL Installation Plan T0900568

6 Test documents

Test rationale, plans, and data for each unit must be documented as described in M1000211. That tree structure should be pointed to by the overall tree structure laid out in this Acceptance prescription. The top-level objective is to make clear how the measurements performed, which often will not directly measure a required performance parameter, give confidence that the subsystem will fulfill the requirements.

aLIGO PSL Testing and Commissioning Documentation E1000443-x0

1. aLIGO PSL Testing- Phase 1: Testing prior to integrationE1000703-x0
    a. PSL Testing: High-Power-Laser (HPL)E1000722-x0
        i. PSL Testing: HPL sub-assembly component testsE1000728-x0
            1. HPL electronic (Control-Box, Frontend Diode-Box, Interlock-Box, PSL-Computer)
                a. High Power Laser (HPL) electronic test procedure E1000444
                b. High Power Laser (HPL) electronic test report - OBS1 E1000445
                c. High Power Laser (HPL) electronic test report - OBS2 E1100116
                d. High Power Laser (HPL) electronic test report - OBS3 E1200190
                e. High Power Laser (HPL) electronic test report - spares E1200191
            2. HPL Diode-Box
                a. High Power Laser (HPL) laser diode box test procedure E1000446
                b. High Power Laser (HPL) laser diode box test report - OBS1 E1000447
                c. High Power Laser (HPL) laser diode box test report - OBS2 E1100117
                d. High Power Laser (HPL) laser diode box test report - OBS3 E1200190

e. High Power Laser (HPL) laser diode box test report - spares E1200191

3. HPL front end laser (in paper form at AEI)
4. HPL pump light fiber
   . OBS1 E1100214,
   a. OBS2 E1100444,
   b. OBS3 E1200193
5. HPL chiller (in paper form at AEI)
6. HPL injection locking electronics
   a. Locking photodiodes

      Locking photodiodes test procedure T1000479
      testplan for ILS PDs installed in L1 is in S1103594
      Locking photodiodes test report S1107859
      Locking photodiodes test report S1107852
      Locking photodiodes test report S1107851

      a. injection locking modules

      Injection Locking and PMC Locking Fieldbox Module Test Plan T1000343
      injection locking modules test report S1103536 LLO
      injection locking modules test report S1103537
      injection locking modules test report S1107797
      injection locking modules test report S1107803
      injection locking modules test report
7. HPL monitoring diodes

   Monitor photodiodes test procedure T1000478
   L1 monitor photodiodes
   Monitor photodiodes test report S1103592 (L1 ref. cav. trans)
   Monitor photodiodes test reportS1103593 (L1 ref. cav. trans, spare)
   testplans for all mon. PDs installed in L1 are in S1103594
   Hanford and India monitor photodiodes
   testplans for all mon. PDs installed in H2 HPL are in S1107826
   testplans for all mon. PDs installed in H1 HPL will be at
   Monitor photodiodes test reportS1107849
   Monitor photodiodes test reportS1107853
   Monitor photodiodes test reportS1107854
   Monitor photodiodes test reportS1107861
   Monitor photodiodes test reportS1107862
   Monitor photodiodes test reportS1107855
   Monitor photodiodes test reportS1107863
   Monitor photodiodes test reportS1107865
   Power monitor photodiode test procedureT1000668
   L1 monitor photodiodes
   Power monitor photodiode test report S1107864
   Power monitor photodiode test report S1107860
   Power monitor photodiode test report S1107858 (L1 spare)
   Power monitor photodiode test report S1107857
   Power monitor photodiode test report S1107856
   Power monitor photodiode test report S1103590 (L1 installed)

ii. PSL Testing: HPL test procedure (LZH after assembly of sub-components)
   a. PSL Testing: HPL OBS1 test protocol E1100213

b. PSL Testing: HPL OBS2 test protocol E1100955
c. PSL Testing: HPL OBS3 test protocol E1200192

b. PSL Testing: pre-modecleaner (PMC)E1000723-x0
   i. PMC testing
      a. PMC test procedure T1000429
      b. PMC OBS1 test protocol E1100123 S1102964
      c. PMC OBS2 test protocol S1107832
      d. PMC OBS3 test protocol: E1300760-v1
      e. PMC spares LLO test protocol E1100124 S1102965
      f. PMC spares LHO test protocol S1107833
      g. PMC spares LHO test protocol: E1300761-v1
   ii. PMC locking photodiode
      a. PMC locking photodiode test procedure T1000479
      b. PMC locking photodiode test report S1107847SN35 PMC H2
      c. PMC locking photodiode test report S1107850 SN37
      d. PMC locking photodiode test report S1107848 SN44
      e. PMC locking photodiode test report S1103588 SN26 PMC LLO
      f. PMC locking photodiode test report S1103589 SN27 PMC LLO spare
   iii. PMC locking electronic module
      a. Injection Locking and PMC Locking Fieldbox Module Test Plan T1000343
      b. PMC locking electronic module test report S1107798
      c. PMC locking electronic module test report S1107814
      d. PMC locking electronic module test report S1103538
      e. PMC locking electronic module test report S1103539
      g. PMC locking electronic module test report S1107797
      h. PMC locking electronic module test report: S1107803
c. PSL Testing: diagnostic breadboard (DBB)E1000724-x0
   i. DBB OBS1 02/08 test protocol E1100120
      a. OBS1 DBB calibration module S1103551
      b. OBS1 DBB fieldbox S1103546
      c. OBS1 DBB misc module S1103550
      d. OBS1 DBB demodulator module S1103548
      e. OBS1 HV module S1103544
   ii. DBB spares LLO 02/08S test protocol E1100121 02/08S
      a. OBS1-spare DBB calibration module S1103552
      b. OBS1-spare DBB fieldbox S1103547
      b. OBS1-spare DBB misc module S1103553
      c. OBS1-spare DBB demodulator module S1103549
      d. OBS1-spare HV module
   iii. DBB OBS2 test protocol S1107846
      a. OBS2 DBB calibration module S1107840
      d. OBS2 DBB fieldbox S1107842 S1107837
      e. OBS2 DBB misc module S1107838 S1107839
      f. OBS2 DBB demodulator module S1107835 S1107836
      g. OBS2 HV module S1107834 S1107802
   iv. DBB OBS3 test protocol : E1300764-v1
      a. OBS3 DBB calibration module E1300764-v1
      b. OBS3 DBB fieldbox E1300764-v1
      c. OBS3 DBB misc module E1300764-v1

d. OBS3 DBB demodulator module E1300764-v1
e. OBS3 HV module E1300764-v1

ii. DBB India spare test protocol :
a. OBS3 DBB calibration module E1300764-v1
b. OBS3 DBB fieldbox E1300764-v1
c. OBS3 DBB misc module E1300764-v1
d. OBS3 DBB demodulator module E1300764-v1
e. OBS3 HV module E1300764-v1

d. PSL Testing: power stabilization (ISS)E1000725-x0
i. aLIGO PSL ISS sensing box test plans
PSL ISS-Box Test Plan template E1000748
PSL ISS inner-loop photodiode testplan template E1000473
PSL ISS inner-loop quadrant photodiode testplan template E1000467
PSL ISS OBS1 and spares LLO test plan portfolio E1100125
PSL ISS OBS2 test plan portfolio E1200187
PSL ISS OBS3 test plan portfolio E1200188
PSL ISS LHO spare test plan portfolio E1200189

ii. aLIGO PSL ISS servo module test plans
ISS servo module test plan - OBS 1 S1103557
ISS servo module test plan - LLO spare S1103556
ISS servo module test plan - OBS2 S1107804
ISS servo module test plan- LHO spare - S1107805
ISS servo module test plan- OBS3 E1300752-v1

a. PSL Testing: frequency stabilization (FSS)E1000726-x0

iii. table top frequency stabilization servo - field box
TTFSS fieldbox S1107816-x0 (no test reports)
TTFSS fieldbox S1107844-x0 (no test reports)
TTFSS fieldbox S1103554-x0 (no test reports)
TTFSS fieldbox S1103905-x0 (no test reports)

iv. table top frequency stabilization servo - field box
VCO fieldbox S1107815-x0 (obsolete, no longer part of PSL)
VCO fieldbox S1107845-x0 (obsolete, no longer part of PSL)
VCO fieldbox S1103555-x0 (obsolete, no longer part of PSL)
VCO fieldbox S1103906-x0 (obsolete, no longer part of PSL)

e. PSL Testing: miscellaneous components E1000727-x0
i. monitoring field box
monitoring field boxOBS1 and spare LLO E1100127
monitoring field boxOBS2_3 and spare LHO E1100126
Input/Output field box S1300304
Input/Output field box S1300305
Input/Output field box S1300306
Input/Output field box S1300307
Input/Output field box S1300308

ii. Injection Locking and PMC Locking Fieldbox Module
Injection Locking and PMC Locking Fieldbox Module test report S1103541
Injection Locking and PMC Locking Fieldbox Module test report S1103540
Injection Locking and PMC Locking Fieldbox Module test report S1103542
Injection Locking and PMC Locking Fieldbox Module test report S1103543
Injection Locking and PMC Locking Fieldbox Module test report S1107806

Injection Locking and PMC Locking Fieldbox Module test report S1107809
Injection Locking and PMC Locking Fieldbox Module test report S1107808
Injection Locking and PMC Locking Fieldbox Module test report S1107808
Injection Locking and PMC Locking Fieldbox Module test report: E1300755-v1
Injection Locking and PMC Locking Fieldbox Module test report: E1300753-v1
Injection Locking and PMC Locking Fieldbox Module test report: E1300754-v1

2. aLIGO PSL Testing-Phase 2: After shipment before installationE1000704-x0
   only visual inspections were done before installation
3. aLIGO PSL Testing-Phase 3: stand-alone PSL testing after installationE1000705-x0
   a. neoLase test document (Laser Diodes, computer control,interlock)
      OBS1 E1100539
      OBS2 E1100540
      OBS3 E1100541 only available after installation in India
   b. PSL performance and acceptance document
      OBS1 E1100716
      OBS2 E1200385 / E1300129
      OBS3 only available after installation in India
4. aLIGO PSL Testing-Phase 4: PSL part of integrated PSL/IO testing E1000706-x0

7 User interface software

User interface software, and the test routines indicating proper functioning of the software, must be described in words and have code under configuration control (SVN). Watchdog and Guardian routines must also be treated in this way.

- four PSL related RT control modules (ISS, DBB, PMC, FSS) under version control https://redoubt.ligo-wa.caltech.edu/svn/cds_user_apps/trunk/psl
  - the models consist of two part: a site specific part in the ../psl/h1/models tree and a common part in the ../psl/common/models tree
  - the c-code used in the models is in the ../psl/common/scr tree
- several EPICS MEDM user interfaces exist, all are under version control in https://redoubt.ligo-wa.caltech.edu/svn/cds_user_apps/trunk/psl/common/medm tree
- several scripts exist to perform DBB measurements and generate noise reports, the scripts are under version control in https://redoubt.ligo-wa.caltech.edu/svn/cds_user_apps/trunk/psl/h2/scripts
- there are no PSL related watchdog and guardian routines

8 User's manual:

A manual appropriate for operators, covering alignment/adjustments and normal operations, must be available (and in the DCC). It must describe what not to do as well, and give clear guidance and cross-pointers to activities which require safety considerations. It must be accessible from standard user screens.

manuals and descriptions	
user manual 35W laser	T0900646
user manual 200W laser	T0900641
table layout with component list (incl. DCC of optics and mounts etc.)	T0900610
control and DAQ topology and rack layout	T1200085
Advanced LIGO PSL Diagnostic Breadboard Instruction Manual	T0900133
Advanced LIGO PSL Diagnostic Breadboard Computer Control Manual	T0900579
PSL EPICS user interfaces	T0900634
LLO PSL training session	G1100837
HPL quick start guide	T1100383
How-to change between high and low power mode of the PSL	T1200025
aLIGO high power laser maintenance	T1200118
aLIGO PSL - 35W laser power adjust procedure	T1200560
PSL Startup Procedure - Hanford	T1200259
Procedure: Change PSL power mode	T1200025

9 Troubleshooting:

A guide must be developed that helps understand common error messages and events, and provides guidance for recovery and repair procedures as appropriate. Safety issues must be flagged.

- currently there is no Troubleshooting guideline as no *typical* errors occurred in the operation of the reference system, we have. however, started a troubleshooting section on the PSL wiki and will update this list
- documents on how to compensate for the aging of the laser diodes can be found in T1200118 (high power oscillator) and T1200560 (35W front end)

- **Safety** documentation
  Safety documentation must be in the DCC for all phases of the subsystem development, including any needed for normal use or foreseen maintenance/repair scenarios.

aLIGO PSL Safety Plan	T0900614
aLIGO PSL Interlock Concept	T1000005

LLO 200 W PSL Installation SOP	M1100038
Hazard Analysis	T1000160

Acronyms

AOM	Acousto-Optic Modulator
CB	Control Box
CCD	Charge Coupled Device (camera)
DB	Diode Box
DBB	Diagnostic Bread Board
DCC	Document Control Center
EPICS	Experimental Physics and Industrial Control System: a set of Open Source software tools, libraries and applications developed collaboratively and used worldwide to create distributed soft real-time control systems for scientific instruments
FE	Front End
FSR	Free Spectral Range
FSS	Frequency Stabilization Servo
IL	Interlock Box
LAE	Laser Area Enclosure
LED	Light Emitting Diode
LD	Laser Diode
LDR	Laser Diode Room
LH	Laser Head
LHO	LIGO Hanford Observatory
LLO	LIGO Livingston Observatory
HPFI	High Power Faraday Isolator
HPO	High Power Oscillator?
ISS	Intensity Stabilization Servo
LVEA	Laser Vacuum Equipment Area
medm	a Motif graphical user interface for designing and implementing control screens, called displays, that consist of a collection of graphical objects that display and/or change the values of EPICS process variables
NPRO	Non-Planer Ring Oscillator

OPC	Open Process Control is a software application that acts as an API (Application Programming Interface) or protocol converter
PD	photodiode
PMC	Pre-Mode Cleaner
PS	Power Supply?
PSL	Pre-Stabilized Laser
PZT	Lead zirconate titanate, a piezo-electric actuator
RSD	remote shut down
RIN	Relative Intensity Noise
RPN	Relative Power Noise
rt	real time
TEC	Thermo-Electric Cooler Power Supply
UG	unity gain
VNC	Virtual Network Computing (VNC) is a platform-independent, graphical desktop sharing system that uses the RFB protocol to remotely control another computer
WinCAM	CCD camera for beam shape analysis