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Satellite Box Users' Guide

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This is an internal working note
of the Advanced LIGO Project, prepared by members of the UK team.

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http://www.sr.bham.ac.uk/research/gravity/rh,d,2.html
http://www.eng-external.rl.ac.uk/advligo/papers_public/ALUK_Homepage.htm

Satellite Box Users Guide

Contents

1. DOCUMENT ORGANIZATION

Section 2 introduces the LIGO suspensions, and describes the control system
Section 3 describes the functions of the Satellite Box
Section 4 describes how to connect the unit
Section 5 gives the pin functions of the connectors.
Section 6 gives references.

LIGO

The LIGO (Laser Interferometric Gravitational-wave Observatory) experiment is designed to detect gravity waves.
The laser interferometery method used involves mirrors which are held in a steady position to a very high degree of precision.

2.1 The Mirror Suspension System

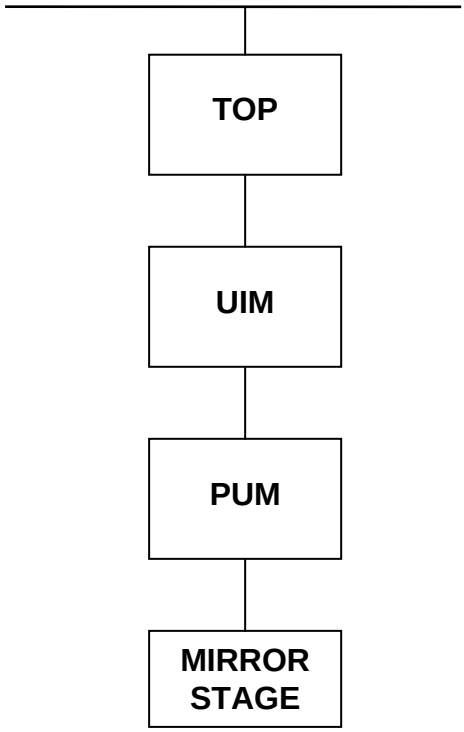

FIG 1 The LIGO Quad suspension.

Mirror stability is achieved by means of a suspension consisting of 4 heavy masses which form a compound pendulum. The position and movement of the top three stages is controlled electromagnetically, while the bottom stage on which the mirror is mounted, is controlled electrostatically.

The purpose of position control is to maintain the output of the interferometer on a dark fringe. Movement control also damps the low frequency pendulum modes.

2.2 The Control System

The Satellite Boxes form part of the control system which controls the position and movement of the pendulum stages electromagnetically. Fig 2 is a simplified diagram of the control system, illustrating the role of the Satellite Box.

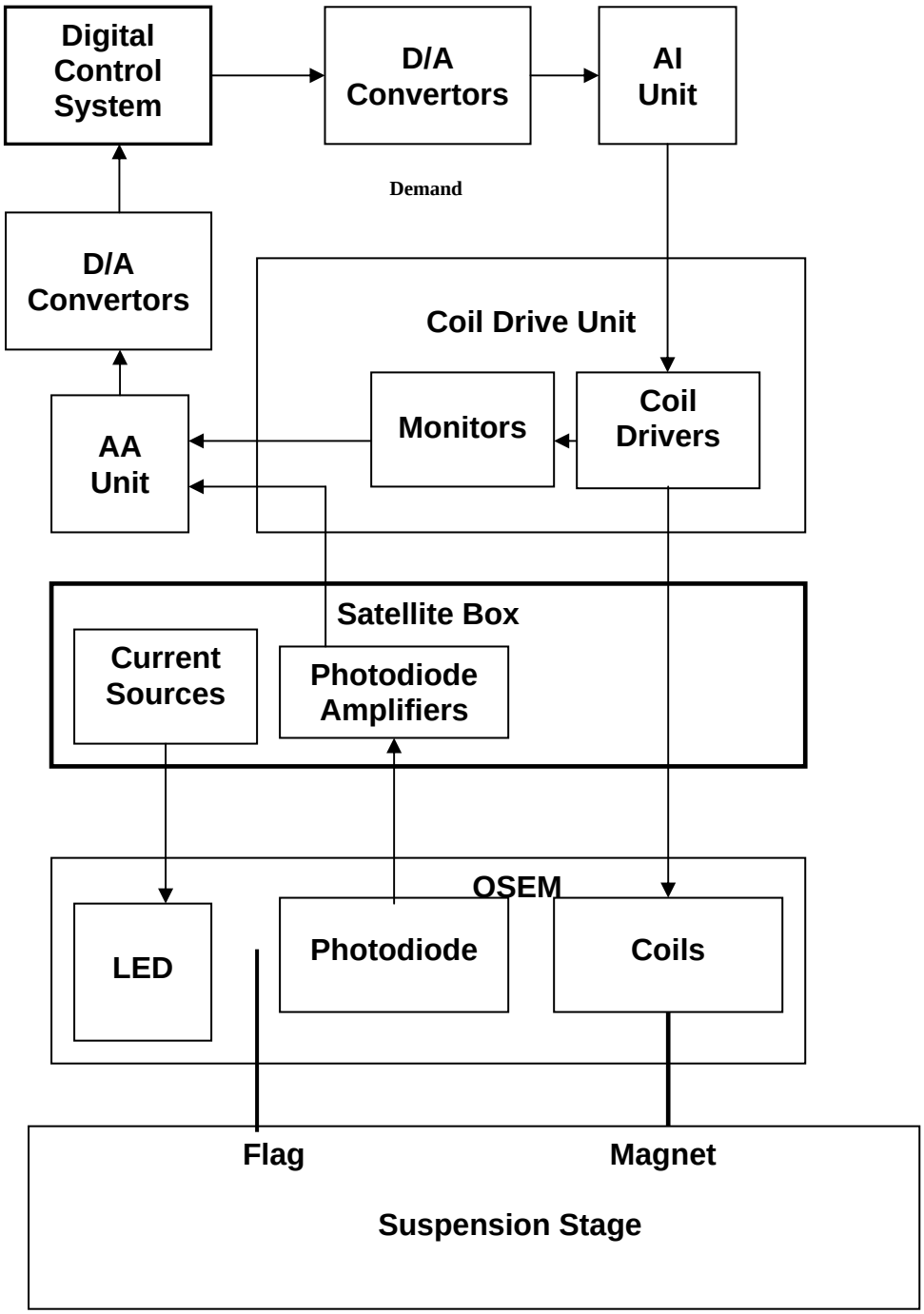

Fig 1 The Control System

The demand signals to the Drive Amplifiers are generated by the Digital Control System, converted to analogue signals, and then filtered in the AI Unit. The signals are then amplified and filtered by the Drive Amplifiers and

pass through the Satellite Box to provide the demanded currents to the drive coils. The position of each stage is indicated by mechanical “flags” to the OSEM optical position detectors. The position detectors consist of LED and photodiode pairs. The photodiode outputs are amplified in the Satellite Box, and then fed back to the Digital Control System via the filters in the AA unit to the A/D convertors.

3. The Satellite Box

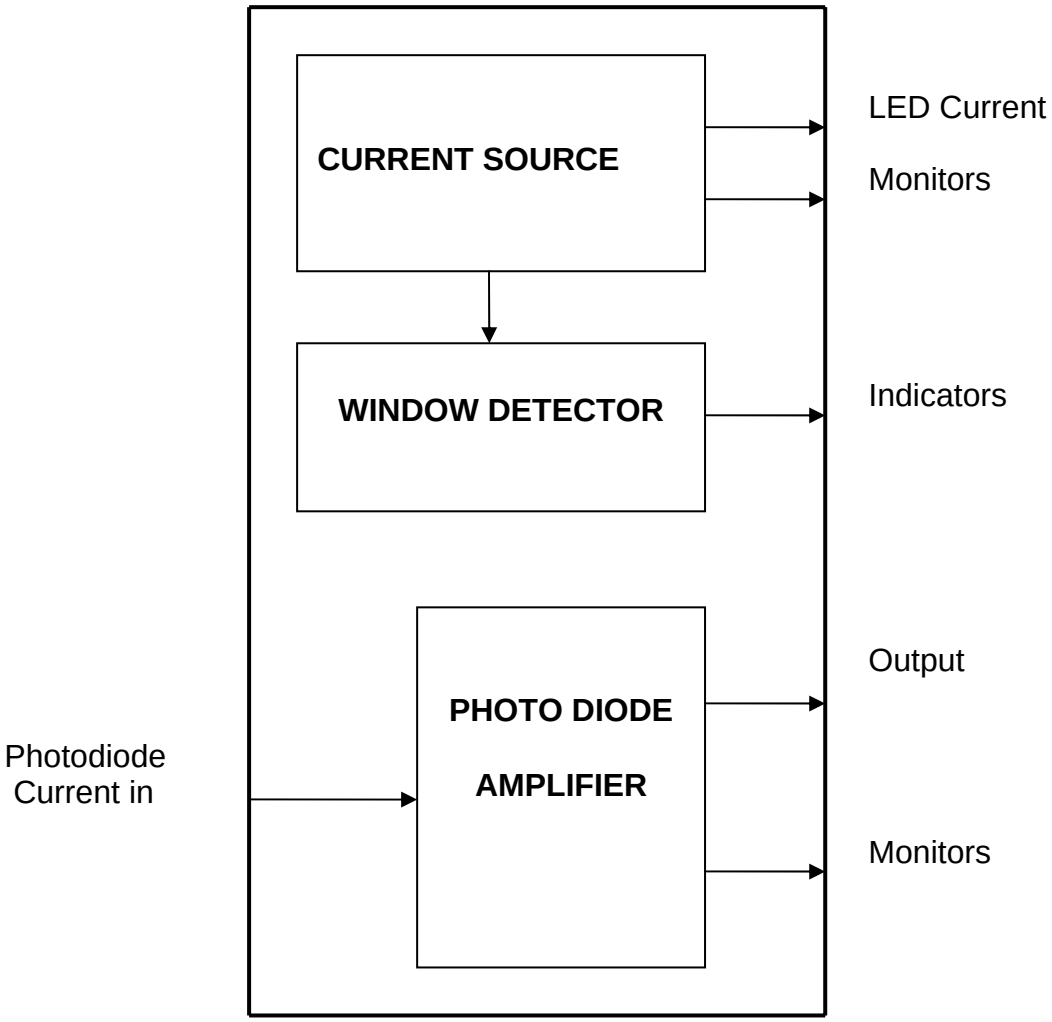

Fig 2 Satellite Box Block diagram

The Satellite Box contains three main functional blocks:
1. The Current Source
2. The Photodiode Amplifier
3. The Window Detector

3.1 The Current Source

The current source provides a stable, low noise current supply (35 mA nominal) to each of 4 OSEM LEDs.

3.2 The Photodiode Amplifier

The photodiode amplifiers amplify and filter the output current from the outputs of 4 OSEM photodiodes. The output is a differential pair. The nominal output is +/- 10 volts for 60µA input.

3.3 The Window Detector

The window detector monitors the operation of the current sources. If they are not operating within specification, an error light on the front panel becomes illuminated.

3.4 Use of LIGO1 OSEMs

The satellite box is designed to be used with either the new Birmingham OSEMs, or with the old LIGO 1 OSEMs as required.

The most important difference between these OSEMs is that the LIGO 1 OSEMs require a bias voltage on the photodiodes, whereas the Birmingham OSEMs do not. The satellite box has an internal link which may be connected when bias is required. To use the Satellite Box with Birmingham OSEMs, connect the links 105, 205, 305 and 405 in the ‘B’ position. To use the Satellite Box with LIGO1 OSEMs, connect the links 105, 205, 305 and 405 in the ‘L’ position.

4 USING THE UNIT

To use the unit, first connect it to the system as described below. The power should be switched off at this stage. The input voltage should be checked before connection (Positive voltage = 17v nominal, 15.5v minimum, 18v maximum, negative voltage = -17v nominal, -15.5 volts minimum, -18 volts maximum.)

Having checked the power supply and connected all the cables correctly, the power may be switched on. The green Power LED indicator lights on the front panel should then become illuminated, indicating that the on board regulators are operating and that the 14v, -14v and 5v supplies are running.

During the power up sequence the red LED Fault indicators should illuminate momentarily.

4.1 Connectors

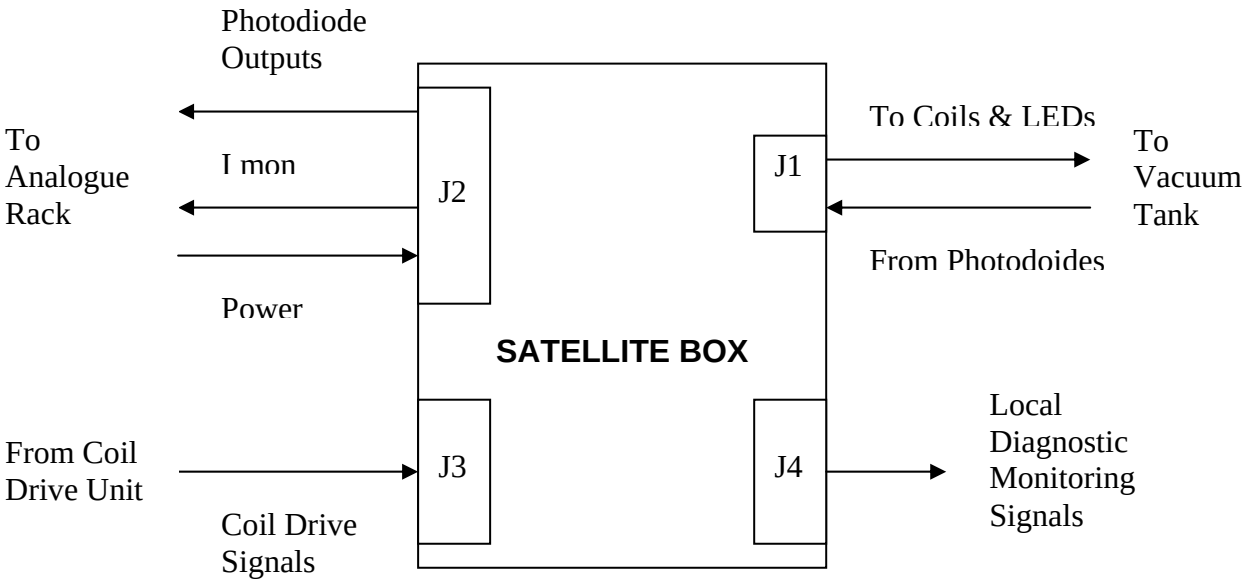

Figure 3 The Satellite Box interconnections

The connections to the Satellite Box were shown on Fig 3.

Details of the connectors follow.

4.2 Connector Functions

The unit should be connected to the system in the following way.

4.2.1 J1 to the Vacuum Tank

J1 is the 25way connector to the vacuum tank. It supplies the 35 mA nominal current to the OSEM LEDs, and collects the photodiode currents from the OSEMs. The coil drive currents, which have passed through the satellite box unprocessed, supply the OSEM coils via J1.

4.2.2 J2 to the Coil Drive Unit in the Analogue Rack

J2 is connected to the appropriate Coil Drive Unit in the Analogue Rack. It carries three types of connections: Power to the satellite box, LED current monitoring signals and the photodiode outputs.

4.2.3 J3 to the Coil Drive Unit in the Analogue Rack

J3 receives the Coil Drive signals from the appropriate Coil Drive Unit. These signals emerge from J1, subsequently driving the coils.

4.2.4 J4 carrying local Monitor signals

J4 is intended for local diagnostics, and makes most of the key signals available for checking and fault finding.

5. Connector Details

J1 Connections to the Vacuum Tank
J2 Connections to the Analogue rack
J3 Connections to the Analogue Rack
J4 Connections to the local diagnostic Connector

Details of these connections follow.

5.1 J1 Connections to the Vacuum Tank

25 way Female 'D' connector

PIN	SIGNAL	DESCRIPTION
1	Coil D ST	Coil D Start
2	LED D K	LED D Cathode
3	PD D A	Photodiode D Anode
4	Coil C ST	Coil C Start
5	LED C K	LED C Cathode
6	PD C A	Photodiode C Anode
7	Coil B ST	Coil B Start
8	LED B K	LED B Cathode
9	PD B A	Photodiode B Anode
10	Coil A ST	Coil A Start
11	LED A K	LED A Cathode
12	PD A A	Photodiode A Anode
13	Shield	
14	Coil D FN	Coil D Winding Finish
15	LED D A	LED D Anode
16	PD D k	Photodiode D Cathode
17	Coil C FN	Coil C Winding Finish
18	LED C A	LED C Anode
19	PD C K	Photodiode C Cathode
20	Coil B FN	Coil B Winding Finish
21	LED B A	LED B Anode
22	PD B K	Photodiode B Cathode
23	Coil A FN	Coil A Winding Finish
24	LED A A	LED A Anode
25	PD A K	Photodiode A Cathode

5.2 J2 Connections to the Coil Driver in the Analogue rack

25 way Male ‘D’ connector

Power and PD signals

PIN	SIGNAL	DESCRIPTION
1	DLD A+	Differential Line Diver Ch A, (+ Sensor o/p)
2	DLD B+	Differential Line Diver Ch B, (+ Sensor o/p)
3	DLD C+	Differential Line Diver Ch C, (+ Sensor o/p)
4	DLD D+	Differential Line Diver Ch D, (+ Sensor o/p)
5	I mon A	LED Current monitor
6	I mon B	LED Current monitor
7	I mon C	LED Current monitor
8	I mon D	LED Current monitor
9	+17v	
10	+17v	
11	-17v	
12	-17v	
13	Shield	
14	DLD A-	Differential Line Diver Ch A, (- Sensor o/p)
15	DLD B-	Differential Line Diver Ch B, (- Sensor o/p)
16	DLD C-	Differential Line Diver Ch C, (- Sensor o/p)
17	DLD D-	Differential Line Diver Ch D, (- Sensor o/p)
18	Ref gnd A	LED Current monitor 0v ref
19	Ref gnd B	LED Current monitor 0v ref
20	Ref gnd C	LED Current monitor 0v ref
21	Ref gnd D	LED Current monitor 0v ref
22	0v	
23	0v	
24	0v	
25	0v	

5.3 J3 Connections to the Coil Drive Unit in the Analogue Rack

15 way Male 'D' connector

Coil drive signals

PIN	SIGNAL	DESCRIPTION
1	ST A	Coil Winding A Start
2		
3	ST B	Coil Winding B Start
4		
5	ST C	Coil Winding C Start
6		
7	ST D	Coil Winding D Start
8	Shield	
9	FN A	Coil Winding A Finish
10		
11	FN B	Coil Winding B Finish
12		
13	FN C	Coil Winding C Finish
14		
15	FN D	Coil Winding D Finish

5.4 J4 Connections local diagnostic Connector

37 Way Female 'D' Connector

PIN	SIGNAL	DESCRIPTION	Normal voltages
1	I mon A	LED Current Monitor A	1.000 V
2	I mon B	LED Current Monitor B	1.000 V
3	I mon C	LED Current Monitor C	1.000 V
4	I mon D	LED Current Monitor D	1.000 V
5	V mon A	LED Voltage Monitor A	1.6v nominal
6	V mon B	LED Voltage Monitor B	1.6v nominal
7	V mon C	LED Voltage Monitor C	1.6v nominal
8	V mon D	LED Voltage Monitor D	1.6v nominal
9	PD A+	Photodiode Amp A + Mon	+10V to -10V
10	PD B+	Photodiode Amp B + Mon	+10V to -10V
11	PD C+	Photodiode Amp C + Mon	+10V to -10V
12	PD D+	Photodiode Amp D + Mon	+10V to -10V
13	Coil A + Mon	Coil A + Voltage Monitor	+12V to -12V (max.)
14	Coil B + Mon	Coil B + Voltage Monitor	+12V to -12V (max.)
15	Coil C + Mon	Coil C + Voltage Monitor	+12V to -12V (max.)
16	Coil D + Mon	Coil D + Voltage Monitor	+12V to -12V (max.)
17	+14v	+14v monitor	+7v
18	+5V MON	+ 5v monitor	+5v
19	Shield		
20	I mon A return	Current mon A return	0V
21	I mon B return	Current mon B return	0V
22	I mon C return	Current mon C return	0V
23	I mon D return	Current mon D return	0V
24	V mon A return	Voltage mon A return	0V
25	V mon B return	Voltage mon B return	0V
26	V mon C return	Voltage mon C return	0V
27	V mon D return	Voltage mon D return	0V
28	PD A **-**	Photodiode Amp A - Mon	-10V to +10V
29	PD B **-**	Photodiode Amp B - Mon	-10V to +10V
30	PD C **-**	Photodiode Amp C - Mon	-10V to +10V
31	PD D **-**	Photodiode Amp D - Mon	-10V to +10V
32	Coil A - Mon	Coil A - Voltage Monitor	-12V to+12V (max.)
33	Coil B - Mon	Coil B - Voltage Monitor	-12V to+12V (max.)
34	Coil C - Mon	Coil C - Voltage Monitor	-12V to+12V (max.)
35	Coil D - Mon	Coil D - Voltage Monitor	-12V to+12V (max.).
36	-14v	-14v monitor	-7v
37	0V	0V Supply	0V Supply

6. REFERENCES

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