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aLIGO DC Power System Design

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1 Introduction

This document describes the design of the DC Power system that provides the DC power required to power Advanced LIGO (aLIGO) electronic racks.

2 Scope

The scope of this document is to outline the design of the DC power distribution system required to support aLIGO electronic chasses. Due to the existence of a variety of power requirements, the scope is limited to a known specific subset of DC power distribution components. Outlying requirements are discussed briefly at the end..

This document is limited to discussing:

- 1) Provision of two ubiquitous voltages, +/- 18VDC and +/- 24VDC, at 20A.
- 2) Room layouts as related to DC power requirements
- 3) Rack layouts as related to DC power requirements
- 4) DC Power supplies
- 5) DC Power strips (and the existing DC power box for high current usage)
- 6) Cables that externally connect DC power supplies to electronics rack

Specifically *not* in the scope of this document are complete discussions of:

- 1) Power to rooms not specified in the rooms list
- 2) Power to racks not specified in the racks list
- 3) Power supply requirements for voltages other than the four listed
- 4) Cables that are internal to racks, i.e., from power strips to electronics chasses

3 Overview

This design is concerned with:

1. DC power supplies
2. +/-18VDC power strips
3. +/-24VDC power strips
4. High current power boxes
5. +24VDC power strips
6. Cabling between DC power supplies and DC power strips (and boxes)

For aLIGO installation, electronics racks are strategically positioned near chambers throughout the LVEA and end station VEAs to supply many of the necessary interconnects for control and monitoring of crucial functions of the interferometer. (See [LIGO-D1003141](#) and [LIGO-D1002704](#) for room layouts.) Additional racks have been designed that are repositories of similar control and monitoring functions organized by subsystem but designed to be offloaded from the LVEA and VEAs into rooms designed for that purpose. (See [LIGO-G1001032](#) for rack layouts.)

These racks often have similar requirements for the DC power that runs the electronics that they contain. Electronic chasses for aLIGO have been designed to extensively use +/- 18VDC and +/- 24VDC. (See [LIGO-T1100047](#) for power supply requirements.) Wiring conventions exist that include specifications for cable jacket colors, single conductor wiring insulation colors, and connector types. (See [LIGO-T1100048](#) for these wiring conventions.) In addition, the IO chasses

specified by the DAQ subsystem are designed to use +24VDC exclusively. These facts allow for a common method of providing these specific DC power requirements - DC power strips. Such power strips have been designed and prototyped.

Each rack that requires one is provided a power strip (see [LIGO-D1002189](#)) that sources both positive and negative voltages for a specific voltage. Two power strip variations have been designed: one for +/-18VDC and one for +/-24VDC. These use different connectors to prevent accidental erroneous connections and cables with different colored jackets as visual indicators of their assigned potential. Typically, a set of two DC power supplies needs to be provided for each such rack power strip. These two power supplies share a common return connection. Note that for IO chasses, only one power supply is required because there is no requirement for -25V. However, due to power consumption, this one supply can only service up to four IO chasses. (See [LIGO-T1100049](#) for IO chassis power usage.)

In the case of the IO chasses, previous discussions have established the need for IO chasses to be powered from power supplies that are not also used to power electronics, for the purpose of being able to manage computer on/off functions separately from electronics on/off functions. In addition, not all electronics racks require IO chasses. Therefore each rack that requires one is to be provided with a +24V power strip that can be used to power up to four (4) IO chasses. (See [LIGO-D1100034](#))

High current power boxes may be required for some applications. These boxes provide up to 14 connections via bus bar methodology. (See [LIGO-D070124](#) for the high current box design.)

A list of the rack requirements for these power strips is below. Note that this assessment is for the Livingston interferometer and when adjusted for all three IFOs, the estimated number of components must be 3 times as many. Additional equipment will be required for the college laboratories.

4 Design

The following figures provide an overview of the relationships between

1. Rooms and types of rack they house

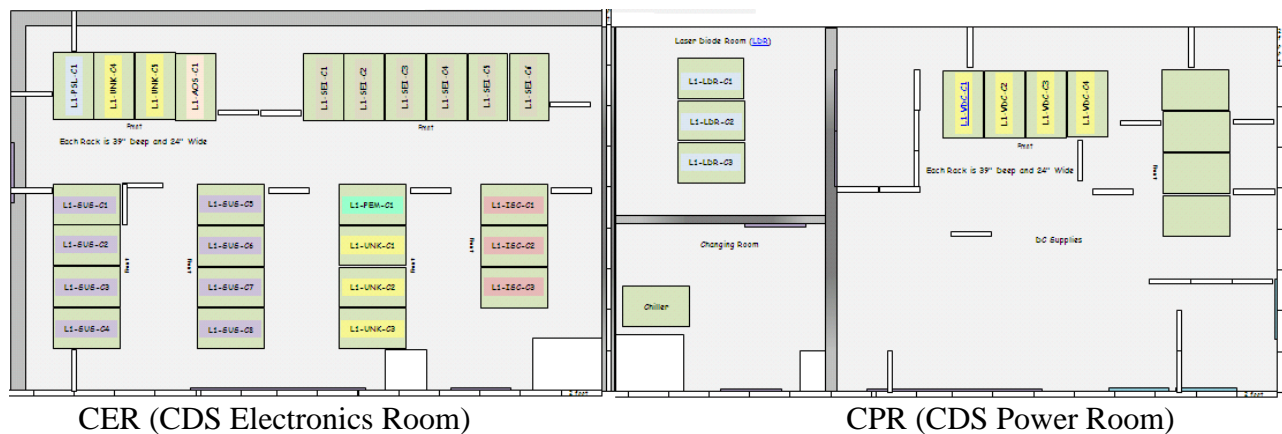


Figure 1: CDS Electronics Room and CDS Power Room

2. Subsystem electronics racks and DC power supply racks

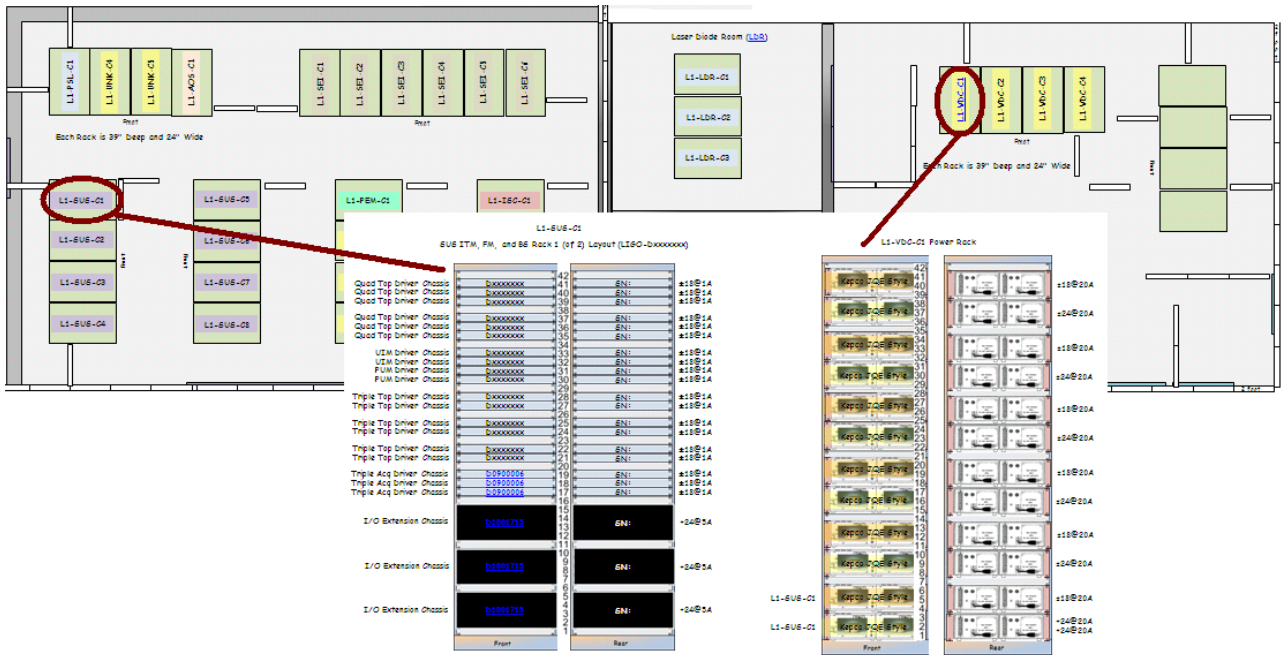


Figure 2: Electronics Rack and DC Power Supply Rack

3. DC power supplies and subsystem electronics racks

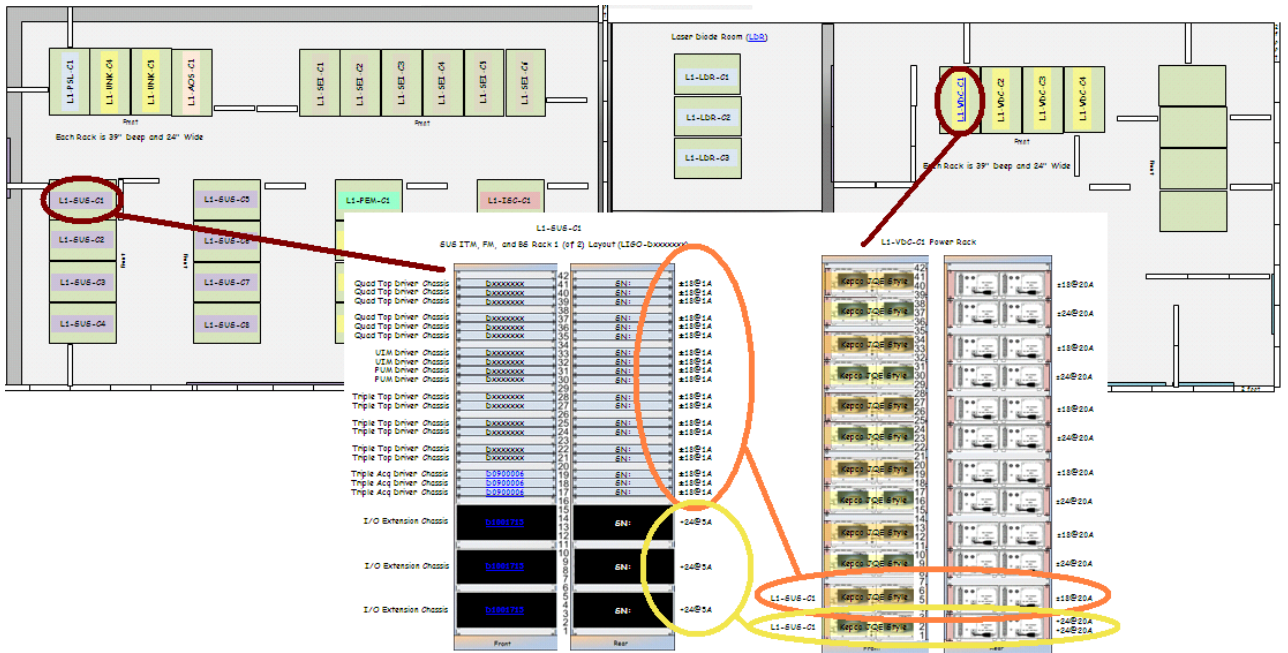


Figure 3: Each DC Power Supply Sources Only One Electronics Rack

4. DC extension cables that interconnect DC power supplies and subsystem electronics racks

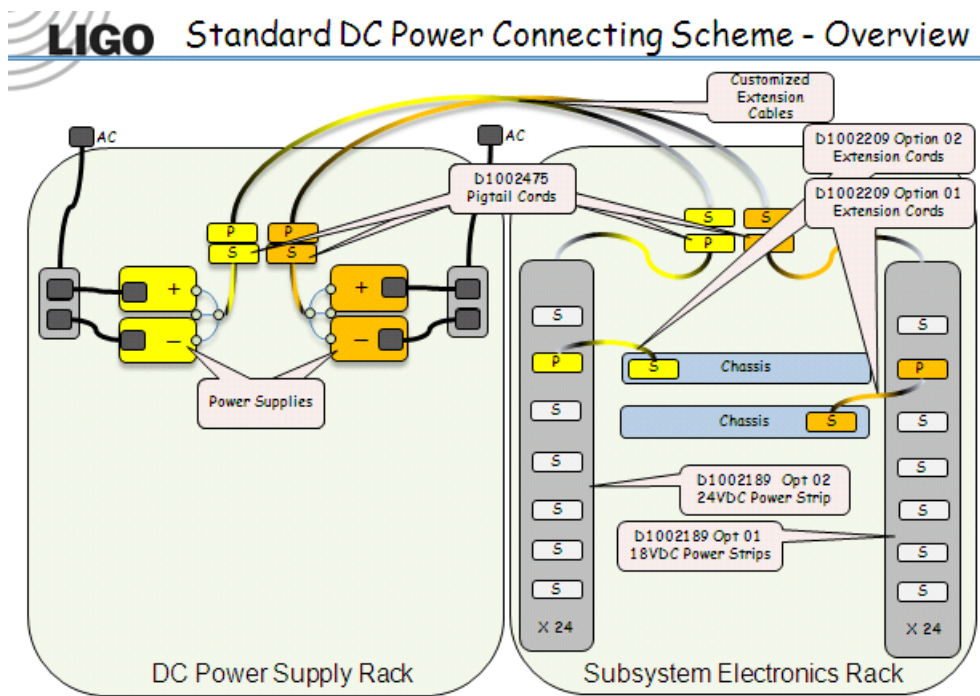


Figure 4: Standard DC Power Connecting Scheme

4.1 Common Components

The DC power distribution system will use the following standard components.

- DC power supplies
- +/-18VDC power strips
- +/-24VDC power strips
- High current power boxes
- +24VDC power strips
- Cabling between DC power supplies and DC power strips (and boxes)
- Note that common DC extension cords have been designed and are preferred for interconnecting between the DC power strips and the electronics chasses. Their specifications may be found in [LIGO-D1002209](#).

4.2 End Stations

At the end stations, similar rooms and racks have been determined and will use the same types of components.

5 Equipment Lists

The following tables describe the DC power distribution components required for the current LLO L1 IFO configuration.

5.1 Table 1: Power Supplies Required by Rack

Table 1 provides a list of power supplies required for the LLO DC Power distribution system. For LLO L1 there are a total of 102 18V supplies required, and 70 24V supplies.

Power Rack Name	Position	Provides Power For	Electronics Rack Name	Voltage	Subsystem
L1-VDC-C1	U01-A	IO Chasses	L1-SUS-C2	+24	SUS
L1-VDC-C1	U01-B	IO Chasses	L1-SUS-C3	+24	SUS
L1-VDC-C1	U04-A	Electronics	L1-SUS-C1	-18	SUS
L1-VDC-C1	U04-B	Electronics	L1-SUS-C1	+18	SUS
L1-VDC-C1	U08-A	Electronics	L1-SUS-C2	-18	SUS
L1-VDC-C1	U08-B	Electronics	L1-SUS-C2	+18	SUS
L1-VDC-C1	U11-A	Electronics	L1-SUS-C3	-18	SUS
L1-VDC-C1	U11-B	Electronics	L1-SUS-C3	+18	SUS
L1-VDC-C1	U15-A	Electronics	L1-SUS-C4	-18	SUS
L1-VDC-C1	U15-B	Electronics	L1-SUS-C4	+18	SUS
L1-VDC-C1	U18-A	Electronics	L1-SUS-C4	-18	SUS
L1-VDC-C1	U18-B	Electronics	L1-SUS-C4	+18	SUS
L1-VDC-C1	U22-A	IO Chasses	L1-SUS-C5	+24	SUS
L1-VDC-C1	U22-B	IO Chasses	L1-SUS-C8	+24	SUS
L1-VDC-C1	U25-A	Electronics	L1-SUS-C5	-18	SUS
L1-VDC-C1	U25-B	Electronics	L1-SUS-C5	+18	SUS
L1-VDC-C1	U29-A	Electronics	L1-SUS-C6	-18	SUS
L1-VDC-C1	U29-B	Electronics	L1-SUS-C6	+18	SUS
L1-VDC-C1	U32-A	Electronics	L1-SUS-C6	-18	SUS
L1-VDC-C1	U32-B	Electronics	L1-SUS-C6	+18	SUS
L1-VDC-C1	U36-A	Electronics	L1-SUS-C7	-18	SUS
L1-VDC-C1	U36-B	Electronics	L1-SUS-C7	+18	SUS
L1-VDC-C1	U39-A	Electronics	L1-SUS-C8	-18	SUS
L1-VDC-C1	U39-B	Electronics	L1-SUS-C8	+18	SUS
L1-VDC-C2	U01-A	IO Chasses	L1-AOS-C1	+24	AOS
L1-VDC-C2	U01-B	IO Chasses	L1-PEM-C1	+24	DAQ
L1-VDC-C2	U04-A	Electronics	L1-AOS-C1	-18	AOS
L1-VDC-C2	U04-B	Electronics	L1-AOS-C1	+18	AOS
L1-VDC-C2	U08-A	Electronics	L1-PEM-C1	-18	DAQ
L1-VDC-C2	U08-B	Electronics	L1-PEM-C1	+18	DAQ
L1-VDC-C2	U11-A	Electronics	L1-ISC-C1	-24	ISC

L1-VDC-C2	U11-B	Electronics	L1-ISC-C1	+24	ISC
L1-VDC-C2	U15-A	Electronics	L1-ISC-C1	-18	ISC
L1-VDC-C2	U15-B	Electronics	L1-ISC-C1	+18	ISC
L1-VDC-C2	U18-A	IO Chasses	L1-ISC-C2	+24	ISC
L1-VDC-C2	U18-B	IO Chasses	L1-PSL-C1	+24	PSL
L1-VDC-C2	U22-A	Electronics	L1-ISC-C2	-24	ISC
L1-VDC-C2	U22-B	Electronics	L1-ISC-C2	+24	ISC
L1-VDC-C2	U25-A	Electronics	L1-ISC-C2	-18	ISC
L1-VDC-C2	U25-B	Electronics	L1-ISC-C2	+18	ISC
L1-VDC-C2	U29-A	Electronics	L1-ISC-C3	-24	ISC
L1-VDC-C2	U29-B	Electronics	L1-ISC-C3	+24	ISC
L1-VDC-C2	U32-A	Electronics	L1-ISC-C3	-18	ISC
L1-VDC-C2	U32-B	Electronics	L1-ISC-C3	+18	ISC
L1-VDC-C2	U36-A	Electronics	L1-PSL-R1	-24	PSL
L1-VDC-C2	U36-B	Electronics	L1-PSL-R1	+24	PSL
L1-VDC-C2	U39-A	Electronics	L1-PSL-R1	-18	PSL
L1-VDC-C2	U39-B	Electronics	L1-PSL-R1	+18	PSL
L1-VDC-C3	U01-A	IO Chasses	L1-SEI-C1	+24	SEI
L1-VDC-C3	U01-B	IO Chasses	L1-SEI-C2	+24	SEI
L1-VDC-C3	U04-A	High Current	L1-SEI-C1	-24	SEI
L1-VDC-C3	U04-B	High Current	L1-SEI-C1	+24	SEI
L1-VDC-C3	U08-A	Electronics	L1-SEI-C1	-18	SEI
L1-VDC-C3	U08-B	Electronics	L1-SEI-C1	+18	SEI
L1-VDC-C3	U11-A	High Current	L1-SEI-C2	-24	SEI
L1-VDC-C3	U11-B	High Current	L1-SEI-C2	+24	SEI
L1-VDC-C3	U15-A	Electronics	L1-SEI-C2	-18	SEI
L1-VDC-C3	U15-B	Electronics	L1-SEI-C2	+18	SEI
L1-VDC-C3	U18-A	IO Chasses	L1-SEI-C3	+24	SEI
L1-VDC-C3	U18-B	IO Chasses	L1-SEI-C4	+24	SEI
L1-VDC-C3	U22-A	High Current	L1-SEI-C3	-24	SEI
L1-VDC-C3	U22-B	High Current	L1-SEI-C3	+24	SEI
L1-VDC-C3	U25-A	Electronics	L1-SEI-C3	-18	SEI
L1-VDC-C3	U25-B	Electronics	L1-SEI-C3	+18	SEI
L1-VDC-C3	U29-A	High Current	L1-SEI-C4	-24	SEI
L1-VDC-C3	U29-B	High Current	L1-SEI-C4	+24	SEI
L1-VDC-C3	U32-A	Electronics	L1-SEI-C4	-18	SEI
L1-VDC-C3	U32-B	Electronics	L1-SEI-C4	+18	SEI
L1-VDC-C3	U36-A	Electronics	L1-TCS-R1	-18	AOS
L1-VDC-C3	U36-B	Electronics	L1-TCS-R1	+18	AOS
L1-VDC-C3	U39-A	Electronics	L1-TCS-R2	-18	AOS
L1-VDC-C3	U39-B	Electronics	L1-TCS-R2	+18	AOS

L1-VDC-C4	U01-A	IO Chasses	L1-SEI-C5	+24	SEI
L1-VDC-C4	U01-B	IO Chasses	L1-SEI-C6	+24	SEI
L1-VDC-C4	U04-A	High Current	L1-SEI-C5	-24	SEI
L1-VDC-C4	U04-B	High Current	L1-SEI-C5	+24	SEI
L1-VDC-C4	U08-A	Electronics	L1-SEI-C5	-18	SEI
L1-VDC-C4	U08-B	Electronics	L1-SEI-C5	+18	SEI
L1-VDC-C4	U11-A	High Current	L1-SEI-C6	-24	SEI
L1-VDC-C4	U11-B	High Current	L1-SEI-C6	+24	SEI
L1-VDC-C4	U15-A	Electronics	L1-SEI-C6	-18	SEI
L1-VDC-C4	U15-B	Electronics	L1-SEI-C6	+18	SEI
L1-VDC-C4	U18-A	Electronics	L1-ISC-R1	-24	ISC
L1-VDC-C4	U18-B	Electronics	L1-ISC-R1	+24	ISC
L1-VDC-C4	U22-A	Electronics	L1-ISC-R1	-18	ISC
L1-VDC-C4	U22-B	Electronics	L1-ISC-R1	+18	ISC
L1-VDC-C4	U25-A	Electronics	L1-ISC-R2	-24	ISC
L1-VDC-C4	U25-B	Electronics	L1-ISC-R2	+24	ISC
L1-VDC-C4	U29-A	Electronics	L1-ISC-R2	-18	ISC
L1-VDC-C4	U29-B	Electronics	L1-ISC-R2	+18	ISC
L1-VDC-C4	U32-A	Electronics	L1-ISC-R3	-24	ISC
L1-VDC-C4	U32-B	Electronics	L1-ISC-R3	+24	ISC
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L1-VDC-C4	U36-B	Electronics	L1-ISC-R3	+18	ISC
L1-VDC-C4	U39-A	Electronics	L1-PSL-C1	-18	PSL
L1-VDC-C4	U39-B	Electronics	L1-PSL-C1	+18	PSL
L1-VDC-C5	U01-A	Electronics	L1-PSL-R2	-24	PSL
L1-VDC-C5	U01-B	Electronics	L1-PSL-R2	+24	PSL
L1-VDC-C5	U04-A	Electronics	L1-PSL-R2	-18	PSL
L1-VDC-C5	U04-B	Electronics	L1-PSL-R2	+18	PSL
L1-VDC-C5	U08-A	Electronics	L1-SUS-R1	-18	SUS
L1-VDC-C5	U08-B	Electronics	L1-SUS-R1	+18	SUS
L1-VDC-C5	U11-A	Electronics	L1-SUS-R2	-18	SUS
L1-VDC-C5	U11-B	Electronics	L1-SUS-R2	+18	SUS
L1-VDC-C5	U15-A	Electronics	L1-SUS-R3	-18	SUS
L1-VDC-C5	U15-B	Electronics	L1-SUS-R3	+18	SUS
L1-VDC-C5	U18-A	Electronics	L1-SUS-R4	-18	SUS
L1-VDC-C5	U18-B	Electronics	L1-SUS-R4	+18	SUS
L1-VDC-C5	U22-A	Electronics	L1-SUS-R5	-18	SUS
L1-VDC-C5	U22-B	Electronics	L1-SUS-R5	+18	SUS
L1-VDC-C5	U25-A	Electronics	L1-SUS-R6	-18	SUS
L1-VDC-C5	U25-B	Electronics	L1-SUS-R6	+18	SUS
L1-VDC-C5	U29-A				
L1-VDC-C5	U29-B				

L1-VDC-C5	U32-A				
L1-VDC-C5	U32-B				
L1-VDC-C5	U36-A				
L1-VDC-C5	U36-B				
L1-VDC-C5	U39-A				
L1-VDC-C5	U39-B				
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L1-VDC-C6	U01-B				
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L1-VDC-C6	U36-A				
L1-VDC-C6	U36-B				
L1-VDC-C6	U39-A				
L1-VDC-C6	U39-B				
L1-VDC-XR1	U01-A	IO Chasses	L1-TCS-XC1	+24	AOS
L1-VDC-XR1	U01-B	IO Chasses	L1-PEM-XR1	+24	DAQ
L1-VDC-XR1	U04-A	Electronics	L1-TCS-XC1	-24	AOS
L1-VDC-XR1	U04-B	Electronics	L1-TCS-XC1	+24	AOS
L1-VDC-XR1	U08-A	Electronics	L1-TCS-XC1	-18	AOS
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L1-VDC-XR1	U11-B	Electronics	L1-TCS-XR1	+24	AOS
L1-VDC-XR1	U15-A	Electronics	L1-TCS-XR1	-18	AOS
L1-VDC-XR1	U15-B	Electronics	L1-TCS-XR1	+18	AOS
L1-VDC-XR1	U18-A	Electronics	L1-PEM-XR1	-24	DAQ

L1-VDC-XR1	U18-B	Electronics	L1-PEM-XR1	+24	DAQ
L1-VDC-XR1	U22-A	Electronics	L1-PEM-XR1	-18	DAQ
L1-VDC-XR1	U22-B	Electronics	L1-PEM-XR1	+18	DAQ
L1-VDC-XR1	U25-A	Electronics	L1-ISC-XR1	-24	ISC
L1-VDC-XR1	U25-B	Electronics	L1-ISC-XR1	+24	ISC
L1-VDC-XR1	U29-A	Electronics	L1-ISC-XR1	-18	ISC
L1-VDC-XR1	U29-B	Electronics	L1-ISC-XR1	+18	ISC
L1-VDC-XR1	U32-A				
L1-VDC-XR1	U32-B				
L1-VDC-XR1	U36-A				
L1-VDC-XR1	U36-B				
L1-VDC-XR1	U39-A				
L1-VDC-XR1	U39-B				
L1-VDC-XR2	U01-A	IO Chasses	L1-SEI-XC1	+24	SEI
L1-VDC-XR2	U01-B	IO Chasses	L1-SUS-XC2	+24	SUS
L1-VDC-XR2	U04-A	High Current	L1-SEI-XC1	-24	SEI
L1-VDC-XR2	U04-B	High Current	L1-SEI-XC1	+24	SEI
L1-VDC-XR2	U08-A	Electronics	L1-SEI-XC1	-18	SEI
L1-VDC-XR2	U08-B	Electronics	L1-SEI-XC1	+18	SEI
L1-VDC-XR2	U11-A	Electronics	L1-SUS-XC1	-18	SUS
L1-VDC-XR2	U11-B	Electronics	L1-SUS-XC1	+18	SUS
L1-VDC-XR2	U15-A	Electronics	L1-SUS-XC2	-18	SUS
L1-VDC-XR2	U15-B	Electronics	L1-SUS-XC2	+18	SUS
L1-VDC-XR2	U18-A	Electronics	L1-SUS-XR1	-18	SUS
L1-VDC-XR2	U18-B	Electronics	L1-SUS-XR1	+18	SUS
L1-VDC-XR2	U22-A				
L1-VDC-XR2	U22-B				
L1-VDC-XR2	U25-A				
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L1-VDC-XR2	U32-A				
L1-VDC-XR2	U32-B				
L1-VDC-XR2	U36-A				
L1-VDC-XR2	U36-B				
L1-VDC-XR2	U39-A				
L1-VDC-XR2	U39-B				
L1-VDC-YR1	U01-A	IO Chasses	L1-TCS-YC1	+24	AOS
L1-VDC-YR1	U01-B	IO Chasses	L1-PEM-YR1	+24	DAQ
L1-VDC-YR1	U04-A	Electronics	L1-TCS-YC1	-24	AOS
L1-VDC-YR1	U04-B	Electronics	L1-TCS-YC1	+24	AOS

L1-VDC-YR1	U08-A	Electronics	L1-TCS-YC1	-18	AOS
L1-VDC-YR1	U08-B	Electronics	L1-TCS-YC1	+18	AOS
L1-VDC-YR1	U11-A	Electronics	L1-TCS-YR1	-24	AOS
L1-VDC-YR1	U11-B	Electronics	L1-TCS-YR1	+24	AOS
L1-VDC-YR1	U15-A	Electronics	L1-TCS-YR1	-18	AOS
L1-VDC-YR1	U15-B	Electronics	L1-TCS-YR1	+18	AOS
L1-VDC-YR1	U18-A	Electronics	L1-PEM-YR1	-24	DAQ
L1-VDC-YR1	U18-B	Electronics	L1-PEM-YR1	+24	DAQ
L1-VDC-YR1	U22-A	Electronics	L1-PEM-YR1	-18	DAQ
L1-VDC-YR1	U22-B	Electronics	L1-PEM-YR1	+18	DAQ
L1-VDC-YR1	U25-A	Electronics	L1-ISC-YR1	-24	ISC
L1-VDC-YR1	U25-B	Electronics	L1-ISC-YR1	+24	ISC
L1-VDC-YR1	U29-A	Electronics	L1-ISC-YR1	-18	ISC
L1-VDC-YR1	U29-B	Electronics	L1-ISC-YR1	+18	ISC
L1-VDC-YR1	U32-A				
L1-VDC-YR1	U32-B				
L1-VDC-YR1	U36-A				
L1-VDC-YR1	U36-B				
L1-VDC-YR1	U39-A				
L1-VDC-YR1	U39-B				
L1-VDC-YR2	U01-A	IO Chasses	L1-SEI-YC1	+24	SEI
L1-VDC-YR2	U01-B	IO Chasses	L1-SUS-YC2	+24	SUS
L1-VDC-YR2	U04-A	High Current	L1-SEI-YC1	-24	SEI
L1-VDC-YR2	U04-B	High Current	L1-SEI-YC1	+24	SEI
L1-VDC-YR2	U08-A	Electronics	L1-SEI-YC1	-18	SEI
L1-VDC-YR2	U08-B	Electronics	L1-SEI-YC1	+18	SEI
L1-VDC-YR2	U11-A	Electronics	L1-SUS-YC1	-18	SUS
L1-VDC-YR2	U11-B	Electronics	L1-SUS-YC1	+18	SUS
L1-VDC-YR2	U15-A	Electronics	L1-SUS-YC2	-18	SUS
L1-VDC-YR2	U15-B	Electronics	L1-SUS-YC2	+18	SUS
L1-VDC-YR2	U18-A	Electronics	L1-SUS-YR1	-18	SUS
L1-VDC-YR2	U18-B	Electronics	L1-SUS-YR1	+18	SUS
L1-VDC-YR2	U22-A				
L1-VDC-YR2	U22-B				
L1-VDC-YR2	U25-A				
L1-VDC-YR2	U25-B				
L1-VDC-YR2	U29-A				
L1-VDC-YR2	U29-B				
L1-VDC-YR2	U32-A				
L1-VDC-YR2	U32-B				
L1-VDC-YR2	U36-A				
L1-VDC-YR2	U36-B				

L1-VDC-YR2	U39-A			
L1-VDC-YR2	U39-B			

5.2 Table 2: Power Strips (and Boxes) Required by Rack

Table 2 provides a list of power strips required for the LLO DC Power distribution system.

Rack Designator	+/-18V Power Strip Count (D1002189 Option 01)	+/-24V Power Strip Count (D1002189 Option 02)	High Current Box Count (D070124)	+24V IO Chassis Count	+24V Power Strip (Short) Count (D110034 Option 02)	Subsystem	Location / Comment
L1-AOS-C1	1	0	0	1	1	AOS	Common Electronics Room
L1-TCS-R1	1	0	0	0	0	AOS	Remote Electronics Rack
L1-TCS-R2	1	0	0	0	0	AOS	Remote Electronics Rack
L1-TCS-XC1	1	1	0	1	1	AOS	X End Remote Electronics Rack
L1-TCS-XR1	1	1	0	0	0	AOS	X End Remote Electronics Rack
L1-TCS-YC1	1	1	0	1	1	AOS	Y End Common Electronics Rack
L1-TCS-YR1	1	1	0	0	0	AOS	Y End Remote Electronics Rack
L1-PEM-C1	1	0	0	1	1	DAQ	Common Electronics Room
L1-ETR-01	0	0	1	0	0	DAQ	DAQ Electronics Test Rack
L1-PEM-XC1	1	1	0	1	1	DAQ/ISC	X End Common Electronics Rack
L1-PEM-YC1	1	1	0	1	1	DAQ/ISC	Y End Common Electronics Rack
L1-ISC-C1	1	1	0	0	0	ISC	Common Electronics Room
L1-ISC-C2	1	1	0	2	1	ISC	Common Electronics Room
L1-ISC-C3	1	1	0	0	0	ISC	Common Electronics Room
L1-ISC-R1	1	1	0	0	0	ISC	Remote Electronics Rack
L1-ISC-R2	1	1	0	0	0	ISC	Remote Electronics Rack
L1-ISC-R3	1	1	0	0	0	ISC	Remote Electronics Rack
L1-ISC-XR1	1	1	0	0	0	ISC	X End Remote Electronics Rack
L1-ISC-YR1	1	1	0	0	0	ISC	Y End Remote Electronics Rack
L1-ETR-04	0	0	1	0	0	OPTICS	Optics Electronics Lab Test Rack
L1-PSL-C1	1	0	0	1	1	PSL	Common Electronics Room
L1-PSL-R1	1	1	0	0	0	PSL	Remote Electronics Rack
L1-PSL-R2	1	1	0	0	0	PSL	Remote Electronics Rack
L1-SEI-C1	1	0	1	1	1	SEI	Common Electronics Room
L1-SEI-C2	1	0	1	1	1	SEI	Common Electronics Room

L1-SEI-C3	1	0	1	1	1	SEI	Common Electronics Room
L1-SEI-C4	1	0	1	1	1	SEI	Common Electronics Room
L1-SEI-C5	1	0	1	1	1	SEI	Common Electronics Room
L1-SEI-C6	1	0	1	1	1	SEI	Common Electronics Room
L1-SEI-XC1	1	0	1	1	1	SEI	X End Common Electronics Rack
L1-SEI-YC1	1	0	1	1	1	SEI	Y End Common Electronics Rack
L1-ETR-05	0	0	1	0	0	SEI	HAM ISI Electronics Test Rack
L1-ETR-07	0	0	1	0	0	SEI	Triple Electronics Test Rack
L1-SUS-C1	1	0	0	0	0	SUS	Common Electronics Room
L1-SUS-C2	1	0	0	2	1	SUS	Common Electronics Room
L1-SUS-C3	1	0	0	3	1	SUS	Common Electronics Room
L1-SUS-C4	2	0	0	0	0	SUS	Common Electronics Room
L1-SUS-C5	1	0	0	3	1	SUS	Common Electronics Room
L1-SUS-C6	2	0	0	0	0	SUS	Common Electronics Room
L1-SUS-C7	1	0	0	0	0	SUS	Common Electronics Room
L1-SUS-C8	1	0	0	2	1	SUS	Common Electronics Room
L1-SUS-R1	1	0	0	0	0	SUS	Remote Electronics Rack
L1-SUS-R2	1	0	0	0	0	SUS	Remote Electronics Rack
L1-SUS-R3	1	0	0	0	0	SUS	Remote Electronics Rack
L1-SUS-R4	1	0	0	0	0	SUS	Remote Electronics Rack
L1-SUS-R5	1	0	0	0	0	SUS	Remote Electronics Rack
L1-SUS-R6	1	0	0	0	0	SUS	Remote Electronics Rack
L1-SUS-XC1	1	0	0	0	0	SUS	X End Common Electronics Rack
L1-SUS-XC2	1	0	0	2	1	SUS	X End Common Electronics Rack
L1-SUS-XR1	1	0	0	0	0	SUS	X End Remote Electronics Rack
L1-SUS-YC1	1	0	0	0	0	SUS	Y End Common Electronics Rack
L1-SUS-YC2	1	0	0	2	1	SUS	Y End Common Electronics Rack
L1-SUS-YR1	1	0	0	0	0	SUS	Y End Remote Electronics Rack
L1-ETR-02	0	0	1	0	0	SUS	BSC Electronics Test Rack
L1-ETR-03	0	0	1	0	0	SUS	RM Electronics Test Rack
L1-ETR-06	0	0	1	0	0	SUS	STS Huddle Electronics Test Rack
L1-VAC-R1	0	0	0	0	0	VAC	Remote Electronics Rack
L1-VAC-R2	0	0	0	0	0	VAC	Remote Electronics Rack
L1-VAC-R3	0	0	0	0	0	VAC	Remote Electronics Rack
L1-VAC-XR1	0	0	0	0	0	VAC	X End Remote Electronics Rack
L1-VAC-YR1	0	0	0	0	0	VAC	Y End Remote Electronics Rack
Total Estimate	51	16	15	31	22		

5.3 Table 3: DC Cables Required by Rack

The cables needed to connect the power supplies to the power strips for the LLO DC Power distribution system will be built in-situ. Specifications have been provided in [LIGO-G1000552](#).

6 Non-standard Voltages

Non-standard voltages, though not completely discussed in this document, can be implemented using the conventions discussed. Cable jacket colors have been assigned, as have connector types. An alternative to running wires for non-standard voltages would be running one of the standard voltages to a step-down transformer within the rack of interest.

7 DC Extension Cords

DC extension cords that connect the DC power strips to electronic chassis have been defined and prototyped. The position that this document takes is that those cables are part of the chassis they serve, and are therefore the responsibility of the chassis provider.