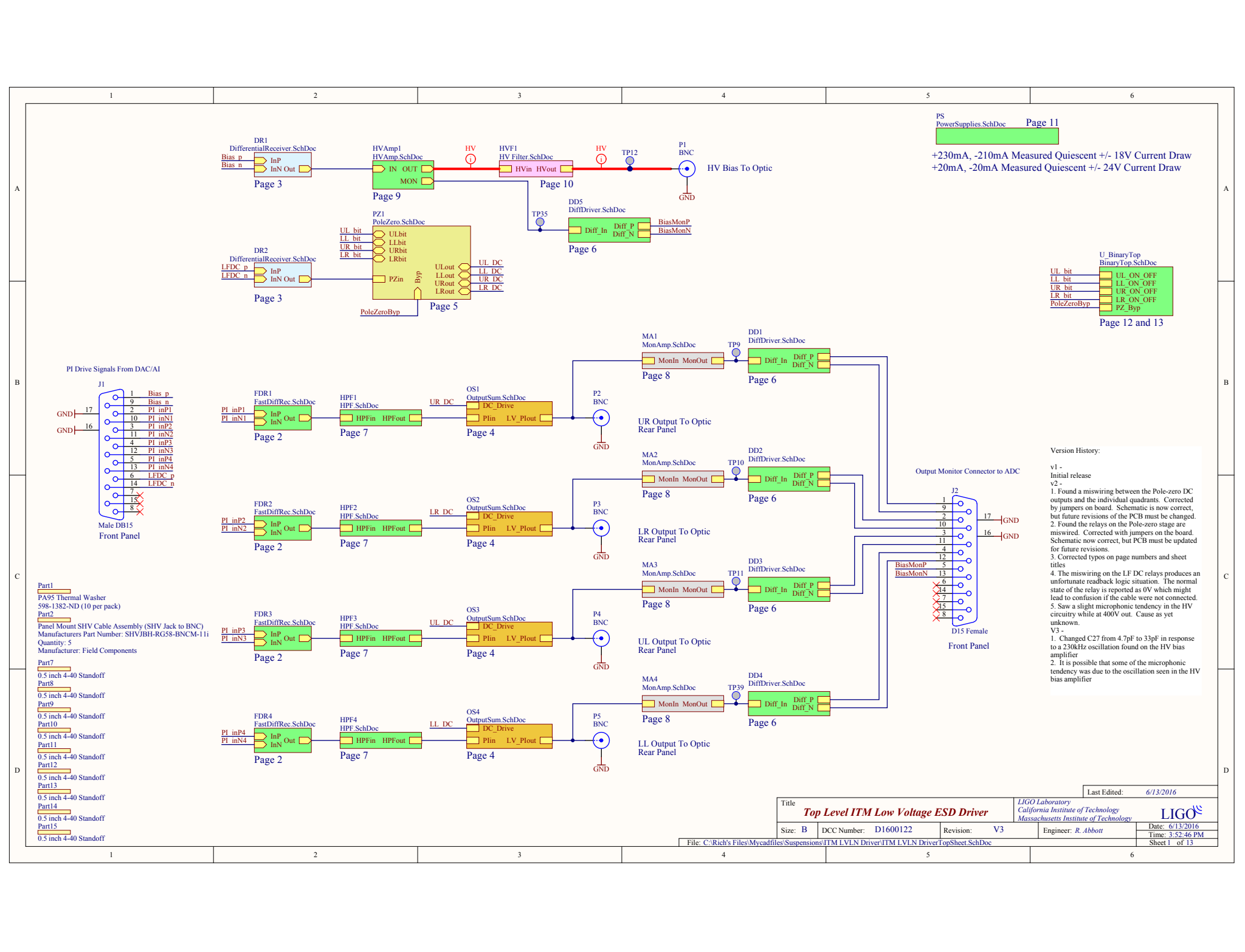
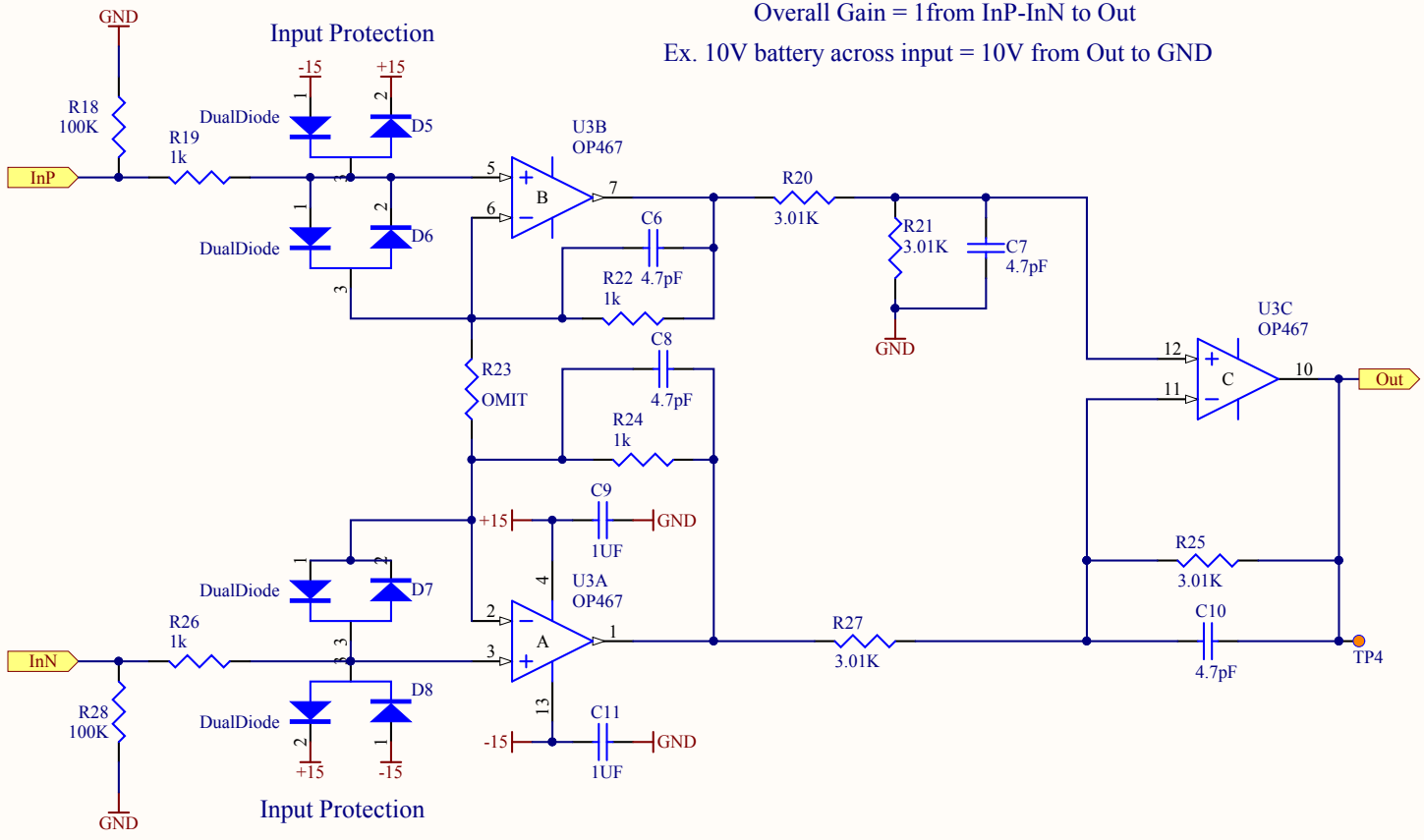
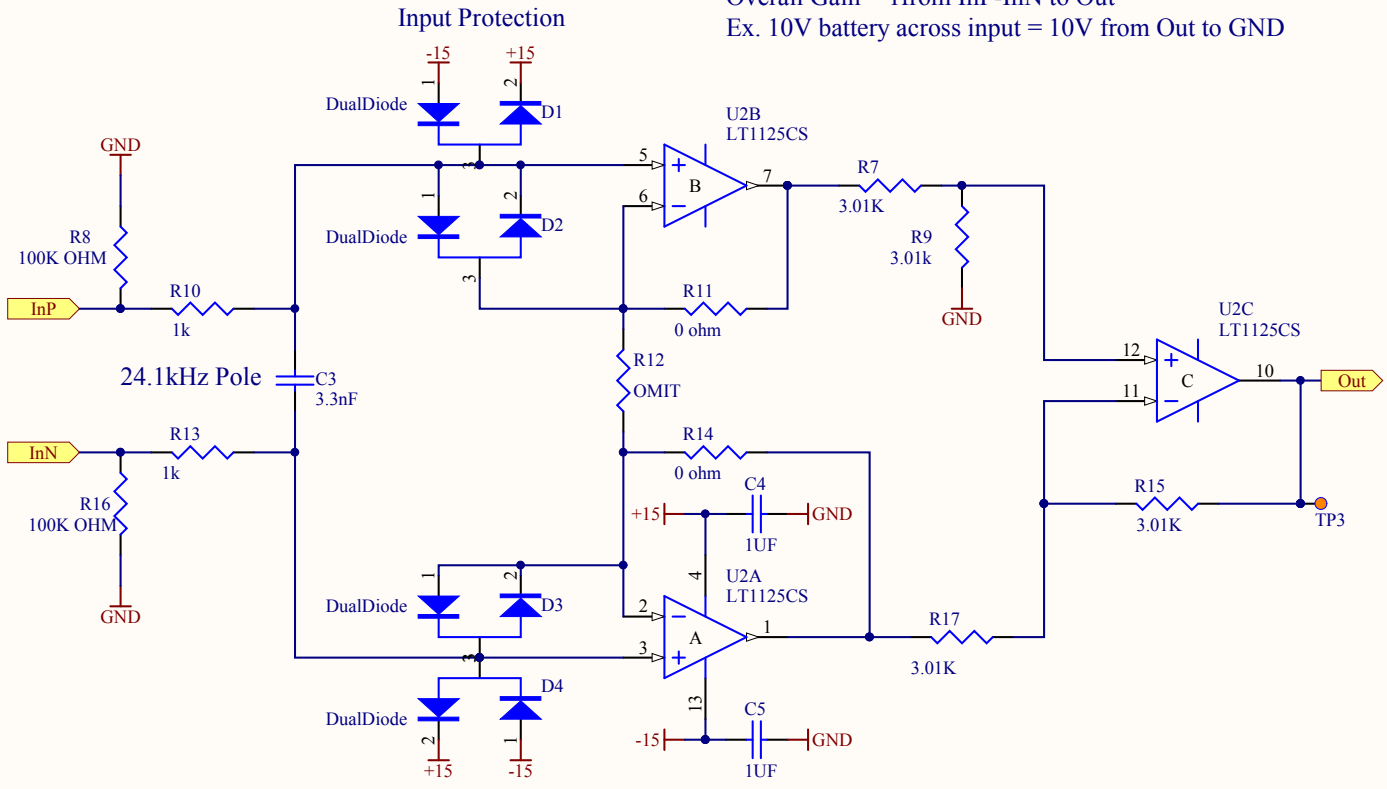

DR1
DifferentialReceiver.SchDoc
Bias_p
Bias_n
InP
InN Out
Page 3
HVAmp1
HVAmp.SchDoc
IN OUT
MON
Page 9
HV
HVF1
HV Filter.SchDoc
HVin HVout
Page 10
TP12
P1
BNC
GND
HV Bias To Optic
PS
PowerSupplies.SchDoc
Page 11
+230mA, -210mA Measured Quiescent +/- 18V Current Draw
+20mA, -20mA Measured Quiescent +/- 24V Current Draw
TP35
DD5
DiffDriver.SchDoc
Diff_In
Diff_P
Diff_N
BiasMonP
BiasMonN
Page 6
PZ1
PoleZero.SchDoc
UL_bit
LL_bit
UR_bit
LR_bit
ULbit
LLbit
URbit
LRbit
PZin
Byp
ULout
LLout
URout
LRout
UL_DC
LL_DC
UR_DC
LR_DC
PoleZeroByp
Page 5
DR2
DifferentialReceiver.SchDoc
LFDC_p
LFDC_n
Page 3
U_BinaryTop
BinaryTop.SchDoc
UL_ON_OFF
LL_ON_OFF
UR_ON_OFF
LR_ON_OFF
PZ_Byp
Page 12 and 13
PI Drive Signals From DAC/AI
J1
Bias_p
Bias_n
PI_inP1
PI_inN1
PI_inN2
PI_inP3
PI_inN3
PI_inP4
PI_inN4
LFDC_p
LFDC_n
GND
Male DB15
Front Panel
FDR1
FastDiffRec.SchDoc
PI_inP1
PI_inN1
InP
InN
Out
Page 2
HPF1
HPF.SchDoc
HPFin
HPFout
Page 7
UR_DC
OS1
OutputSum.SchDoc
DC_Drive
PIin
LV_PIout
Page 4
P2
BNC
UR Output To Optic
Rear Panel
MA1
MonAmp.SchDoc
MonIn MonOut
Page 8
TP9
DD1
DiffDriver.SchDoc
Page 6
FDR2
FastDiffRec.SchDoc
PI_inP2
PI_inN2
Page 2
HPF2
HPF.SchDoc
Page 7
LR_DC
OS2
OutputSum.SchDoc
Page 4
P3
BNC
LR Output To Optic
Rear Panel
MA2
MonAmp.SchDoc
Page 8
TP10
DD2
DiffDriver.SchDoc
Page 6
FDR3
FastDiffRec.SchDoc
PI_inP3
PI_inN3
Page 2
HPF3
HPF.SchDoc
Page 7
UL_DC
OS3
OutputSum.SchDoc
Page 4
P4
BNC
UL Output To Optic
Rear Panel
MA3
MonAmp.SchDoc
Page 8
TP11
DD3
DiffDriver.SchDoc
Page 6
FDR4
FastDiffRec.SchDoc
PI_inP4
PI_inN4
Page 2
HPF4
HPF.SchDoc
Page 7
LL_DC
OS4
OutputSum.SchDoc
Page 4
P5
BNC
LL Output To Optic
Rear Panel
MA4
MonAmp.SchDoc
Page 8
TP39
DD4
DiffDriver.SchDoc
Page 6
Output Monitor Connector to ADC
J2
BiasMonP
BiasMonN
GND
D15 Female
Front Panel
Part1
PA95 Thermal Washer
598-1382-ND (10 per pack)
Part2
Panel Mount SHV Cable Assembly (SHV Jack to BNC)
Manufacturers Part Number: SHVJBH-RG58-BNCM-11i
Quantity: 5
Manufacturer: Field Components
Part7
0.5 inch 4-40 Standoff
Part8
0.5 inch 4-40 Standoff
Part9
0.5 inch 4-40 Standoff
Part10
0.5 inch 4-40 Standoff
Part11
0.5 inch 4-40 Standoff
Part12
0.5 inch 4-40 Standoff
Part13
0.5 inch 4-40 Standoff
Part14
0.5 inch 4-40 Standoff
Part15
0.5 inch 4-40 Standoff
Version History:
v1 -
Initial release
v2 -
1. Found a miswiring between the Pole-zero DC outputs and the individual quadrants. Corrected by jumpers on board. Schematic is now correct, but future revisions of the PCB must be changed.
2. Found the relays on the Pole-zero stage are miswired. Corrected with jumpers on the board. Schematic now correct, but PCB must be updated for future revisions.
3. Corrected typos on page numbers and sheet titles
4. The miswiring on the LF DC relays produces an unfortunate readback logic situation. The normal state of the relay is reported as 0V which might lead to confusion if the cable were not connected.
5. Saw a slight microphonic tendency in the HV circuitry while at 400V out. Cause as yet unknown.
V3 -
1. Changed C27 from 4.7pF to 33pF in response to a 230kHz oscillation found on the HV bias amplifier
2. It is possible that some of the microphonic tendency was due to the oscillation seen in the HV bias amplifier
Last Edited: 6/13/2016
Title
Top Level ITM Low Voltage ESD Driver
LIGO Laboratory
California Institute of Technology
Massachusetts Institute of Technology
LIGO
Size: B
DCC Number: D1600122
Revision: V3
Engineer: R. Abbott
Date: 6/13/2016
Time: 3:52:46 PM
Sheet 1 of 13
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\ITM LVLN DriverTopSheet.SchDoc



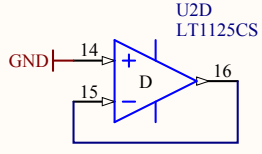
Checked All

Title: *Fast Differential Receiver*				Last Edited: 6/13/2016
				LIGO Laboratory *California Institute of Technology* *Massachusetts Institute of Technology*
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Date: 6/13/2016 Time: 3:52:46 PM
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\FastDiffRec.SchDoc				Sheet 2 of 13

Overall Gain = 1from InP-InN to Out
Ex. 10V battery across input = 10V from Out to GND



The 24.1kHz RC filter is there to cut high frequency noise to prevent slew rate limiting. Overall gain is 1 such that 10 volts peak from DAC yields 10v wrt ground at output

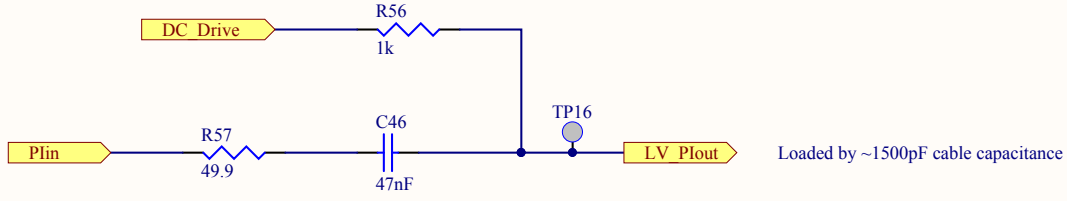


Checked All

Last Edited: 6/13/2016

Title: *Differential Receiver*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Date: 6/13/2016 Time: 3:52:46 PM Sheet 3 of 13

File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\DifferentialReceiver.SchDoc



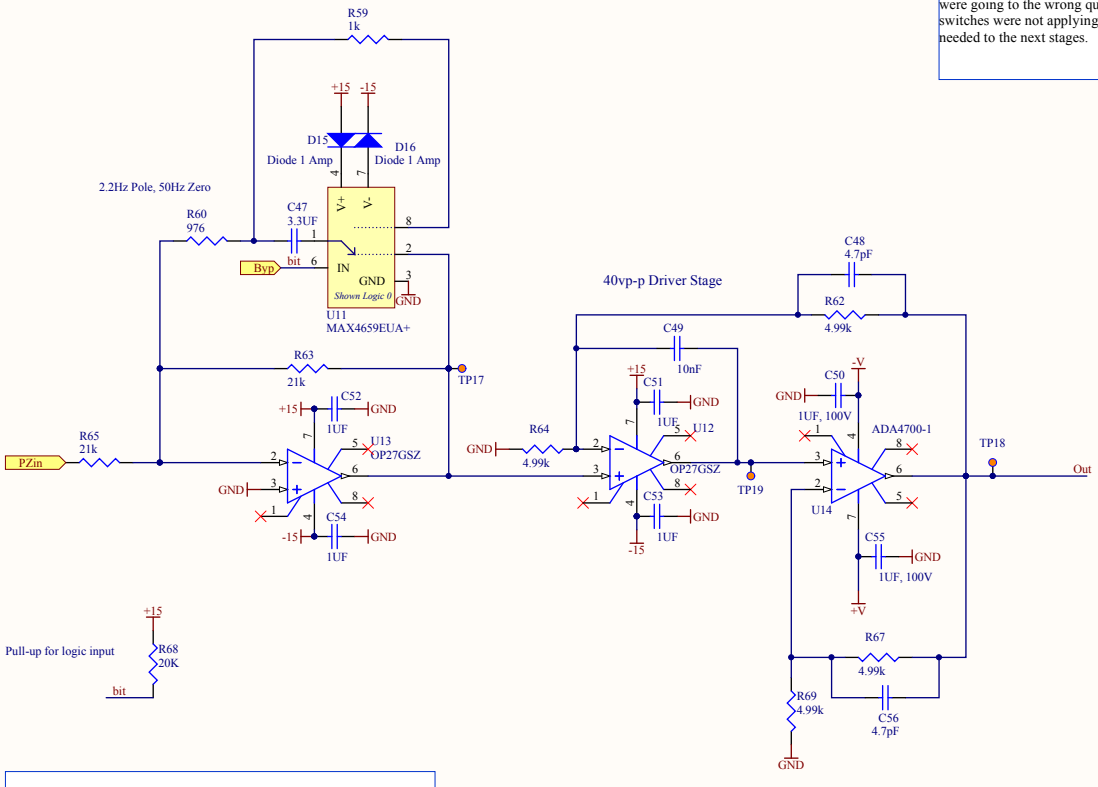
This summing node combines the low frequency DC coupled signals present in the normal feedback path to each quadrant with the parametric instability correction signal. The summing was done passively to allow greater dynamic range than that afforded by an active summing stage.

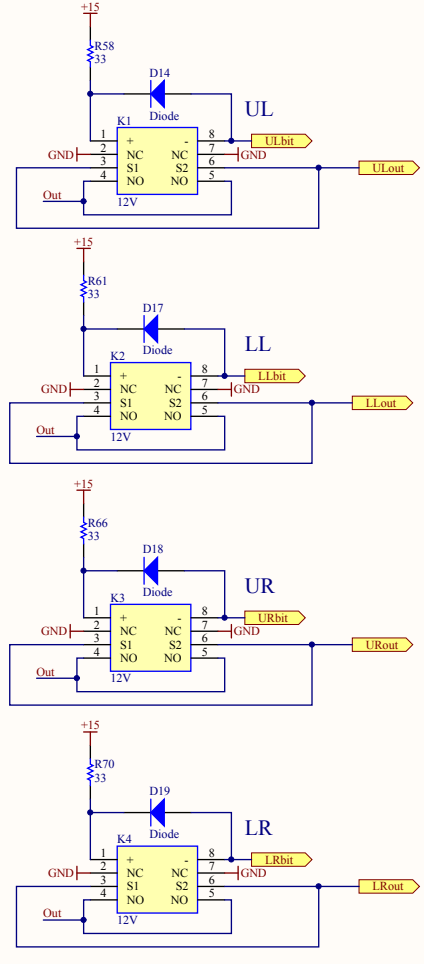
Checked All

Title: *Output Summing Node*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Last Edited: 6/13/2016 Date: 6/13/2016 Time: 3:52:46 PM Sheet 4 of 13
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\OutputSum.SchDoc				

The +/-V input here is to drive the ADA4700 output driver chip. This voltage form can go up to +/-48V. At time of writing, we intend to use +/-24VDC supplies and see how we do.

All the nasty jumper wires are due to reconfiguring K1 through K4 to be according to this schematic. Prior to the jumpers, the outputs were going to the wrong quadrants, and the switches were not applying ground when needed to the next stages.





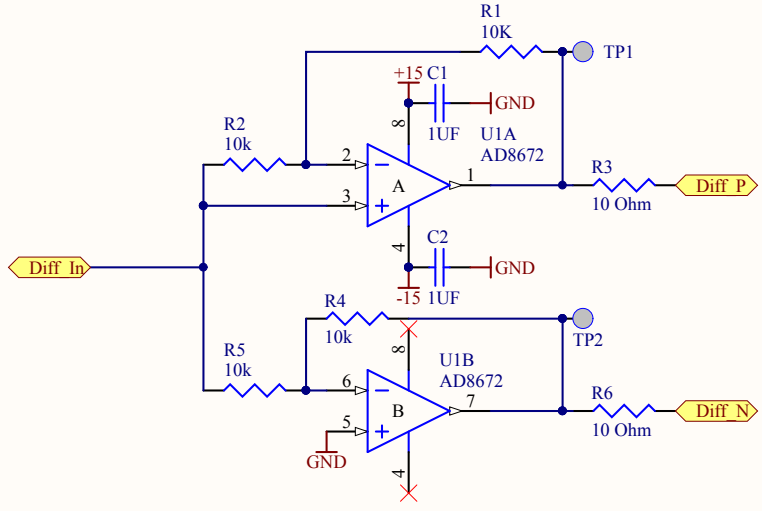
The design of this pole zero stage is motivated by the need to reduce the DAC noise at frequencies greater than 20Hz to a value less than 800nV/rtHz for the ITMs. The DAC noise is estimated (per G1401399-v2) to be 800nV/rtHz at 20 Hz with no filtration, so a single stage of dewhitening was used. The choice of pole and zero frequency above results in a predicted circuit output noise of 200nV/rtHz at 20Hz in the presence of the anticipated DAC noise. The zero preserves some drive dynamic range at intermediate frequencies.

The ADA4700-1 stage provides the capability to increase the dynamic range to 40vp-p

Checked All

Last Edited: 6/13/2016

Title: **Pole-Zero and Driver**			LIGO Laboratory, California Institute of Technology, Massachusetts Institute of Technology	LIGO
Size: B	DCC Number: D1600122	Revision: V3	Engineer: R. Abbott	Date: 6/13/2016
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\PoleZero.SchDoc				Time: 3:52:47 PM
				Sheet 5 of 13

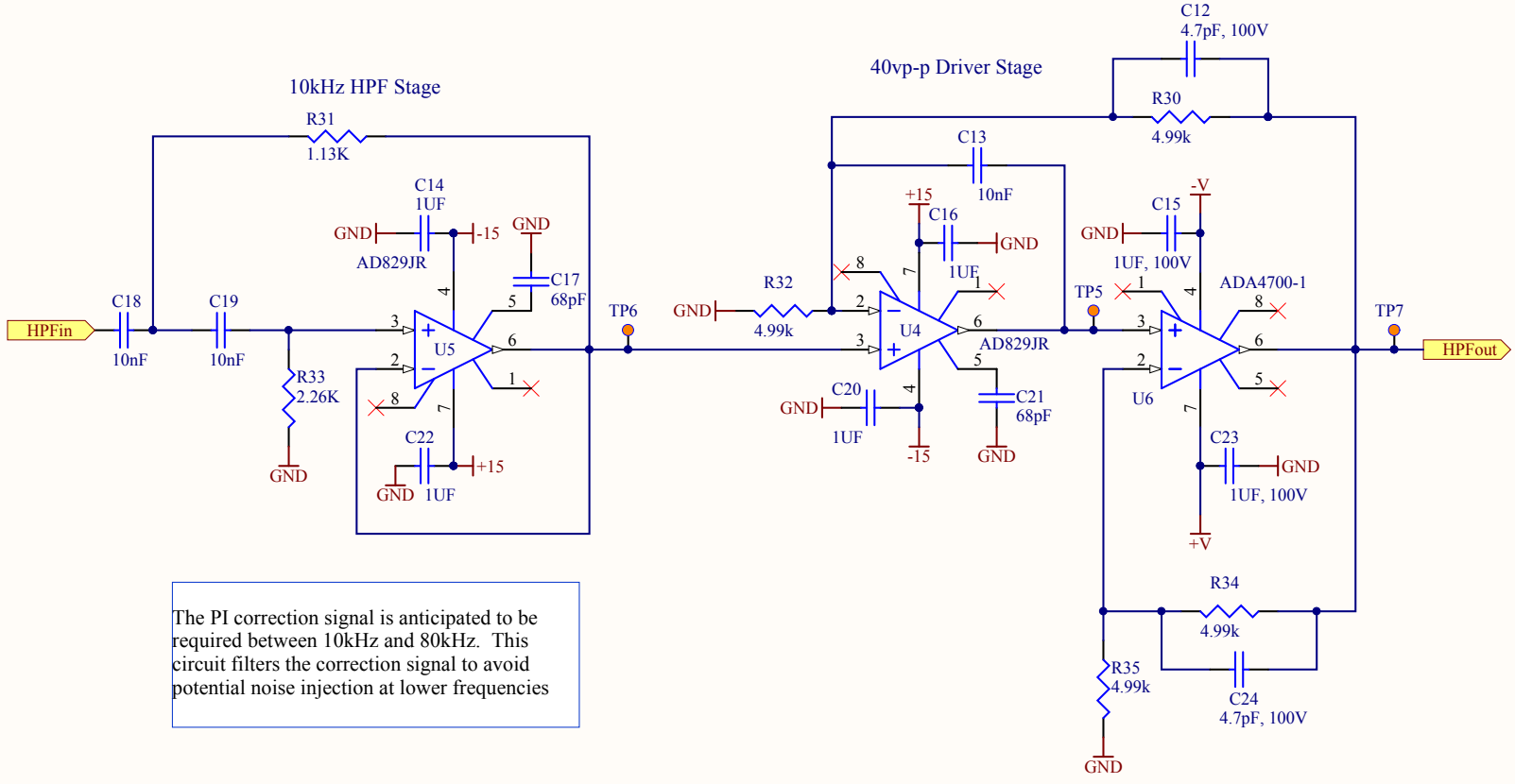


Typical LIGO differential driver circuit for the monitor signals.

Checked All

Title: *Differential Driver*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Last Edited: 6/13/2016 Date: 6/13/2016 Time: 3:52:47 PM Sheet 6 of 13
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\DiffDriver.SchDoc				

The +/-V input here is to drive the ADA4700 output driver chip. This voltage form can go up to +/-48V. At time of writing, we intend to use +/-24VDC supplies and see how we do.



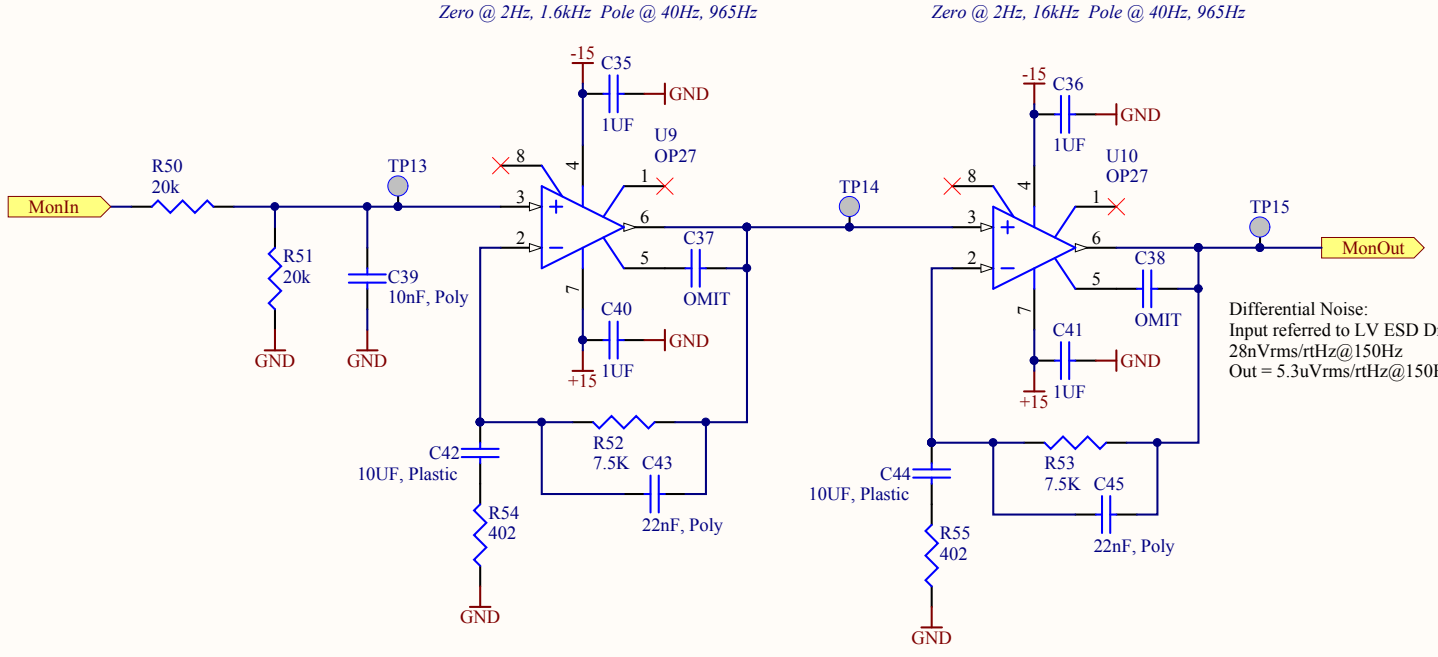
The PI correction signal is anticipated to be required between 10kHz and 80kHz. This circuit filters the correction signal to avoid potential noise injection at lower frequencies

Checked All

Last Edited: 6/13/2016

Title: *10kHz Sallen Key HPF*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Date: 6/13/2016 Time: 3:52:47 PM
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\HPF.SchDoc				Sheet 7 of 13

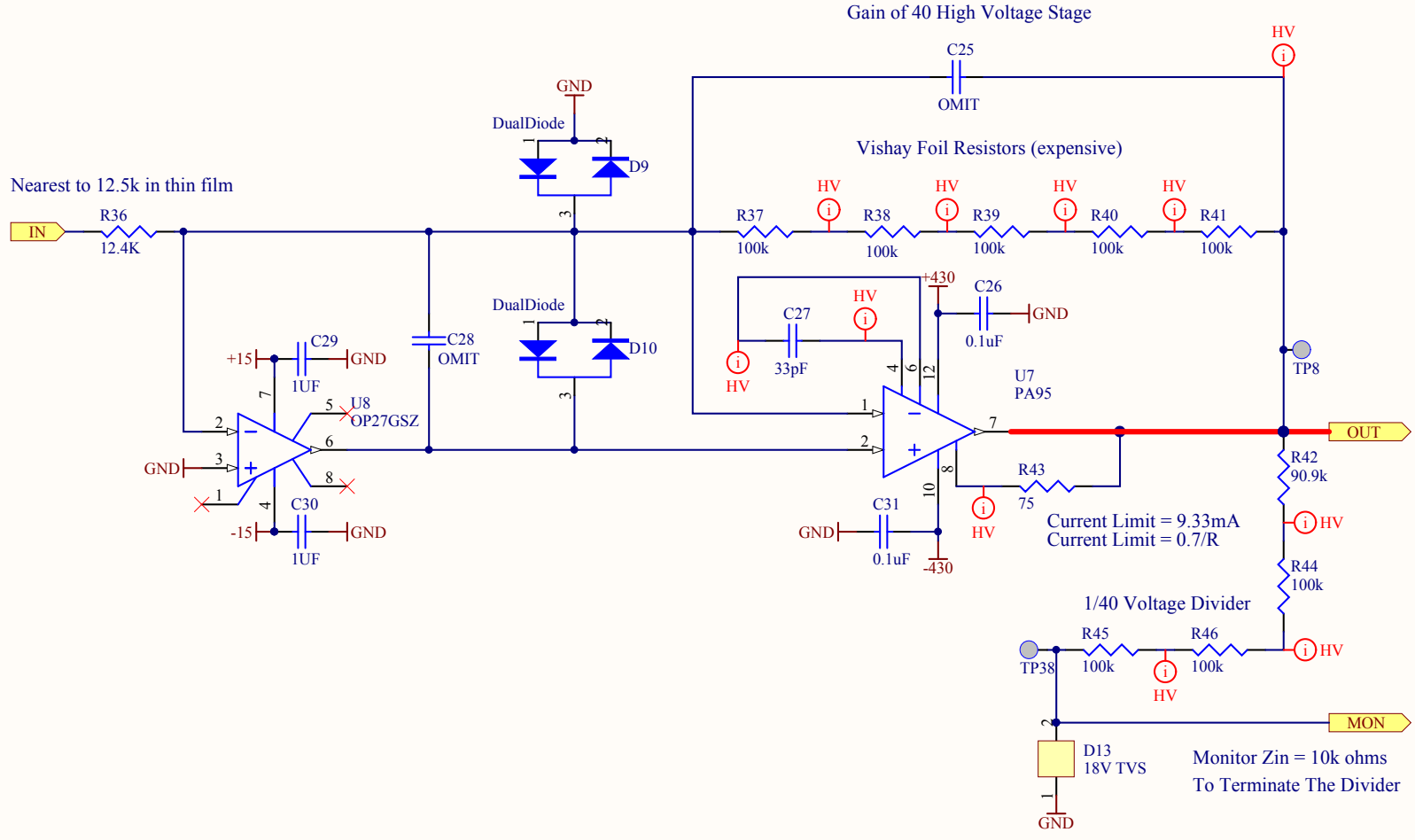
The large dynamic range of the output drivers (40vp-p) requires this monitor to attenuate and whiten the input signal.



Checked All

Last Edited: 6/13/2016

Title: ***Monitoring Amplifier***			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Date: 6/13/2016 Time: 3:52:47 PM
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\MonAmp.SchDoc				Sheet 8 of 13



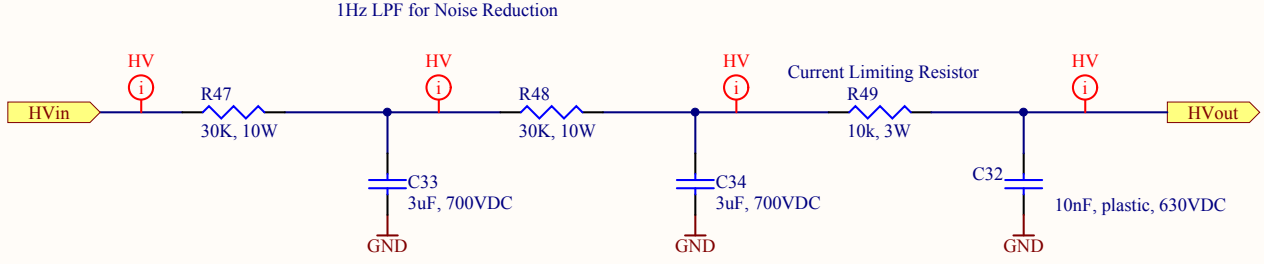
Checked All

Last Edited: 6/13/2016

Title: *High Voltage Amplifier*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Date: 6/13/2016 Time: 3:52:47 PM Sheet 9 of 13

File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\HVAmp.SchDoc

This filter can store charge. Assume the capacitors are charged until positively discharged and measured.



From T1400406 by Rai Weiss, this filter lowers the voltage noise on the bias path. This path has no requirement for fast frequency response beyond the ability to set the bias voltage on a human timescale.

An additional 10k series resistor is conservatively included as a hedge against an in-vacuum discharge event. The 10nF HV capacitor on the output can be optionally utilized to lower the source impedance to the bias electrode in the event that is useful.

Checked All

Last Edited: 6/13/2016

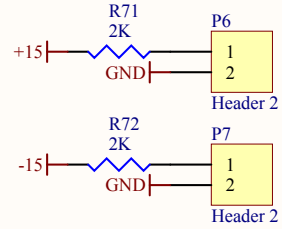
Title: *High Voltage Bias Filter*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Date: 6/13/2016 Time: 3:52:47 PM
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\HV Filter.SchDoc				Sheet 10 of 13

Part3
Pins for female molex connector
WM2307-ND
Quantity: 6

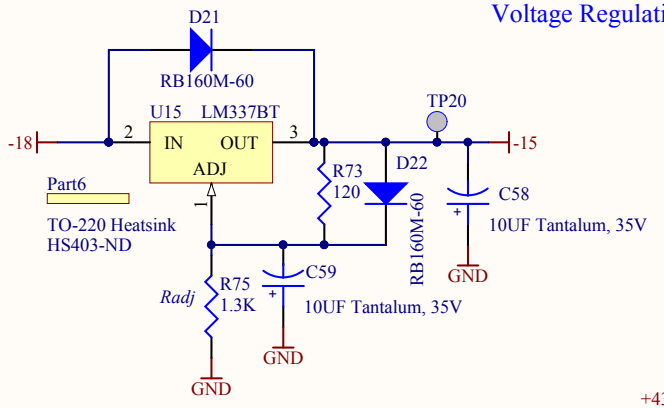
Part4
Mating 6 pin molex connector
WM2126-ND

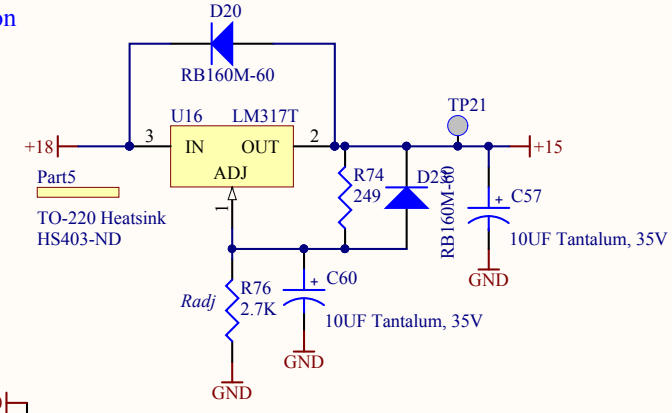
The +/-V input here is to drive the ADA4700 output driver chip. This voltage form can go up to +/-48V. At time of writing, we intend to use +/-24VDC supplies and see how we do.

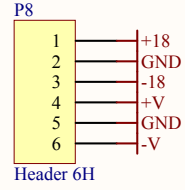
Rear Panel LEDs

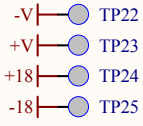


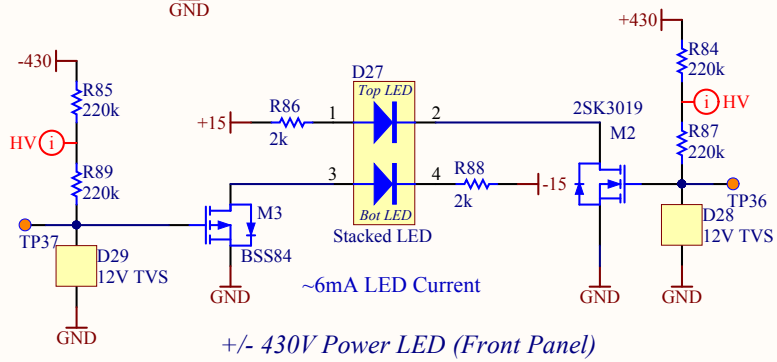
Voltage Regulation







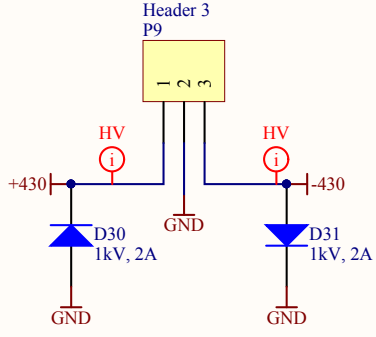




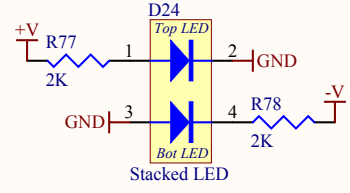
~6mA LED Current

+/- 430V Power LED (Front Panel)

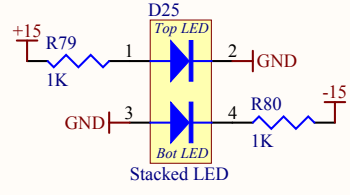
Incoming High Voltage For PA95 in HV Bias Section

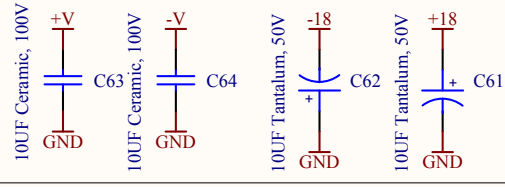


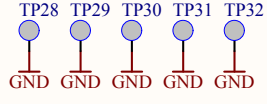
+V/-V Power LED (Front Panel)



15VDC Power LED (Rear Panel)



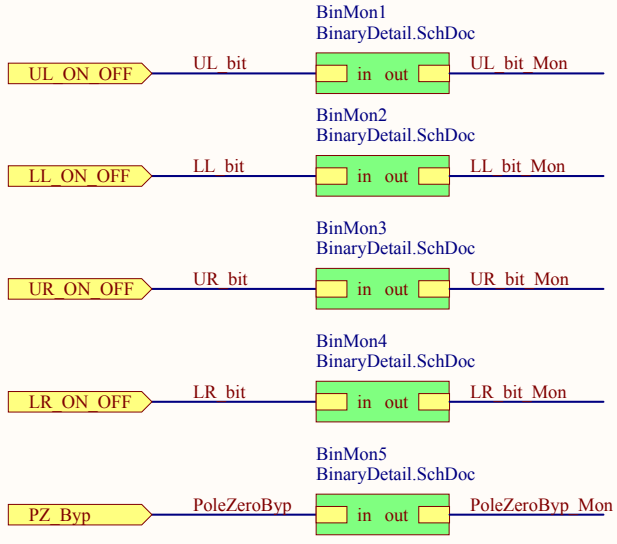




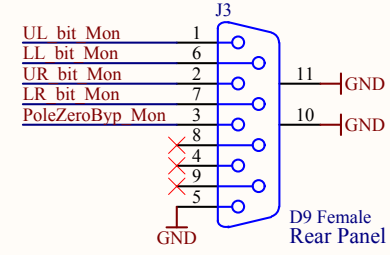
Checked All

Last Edited: 6/13/2016

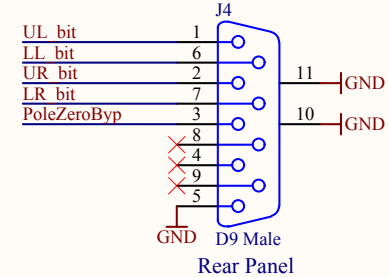
Title: ***Power Supplies***			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Date: 6/13/2016 Time: 3:52:47 PM
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\PowerSupplies.SchDoc				Sheet 11 of 13



Binary Monitors to Binary Input Module
Drives Binary Input Module when monitored parameter is HIGH

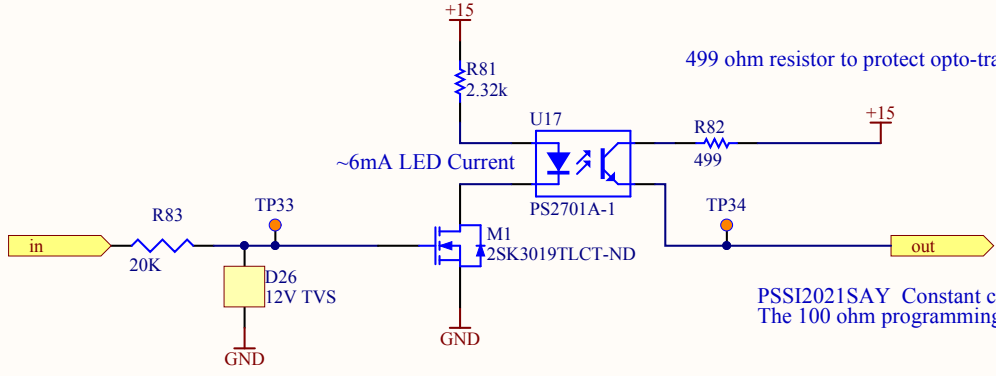


Binary Inputs from Binary Output Module



Checked All

Title: ***Binary Command and Monitor***			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Last Edited: 6/13/2016 Date: 6/13/2016 Time: 3:52:47 PM Sheet 12 of 13
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\BinaryTop.SchDoc				

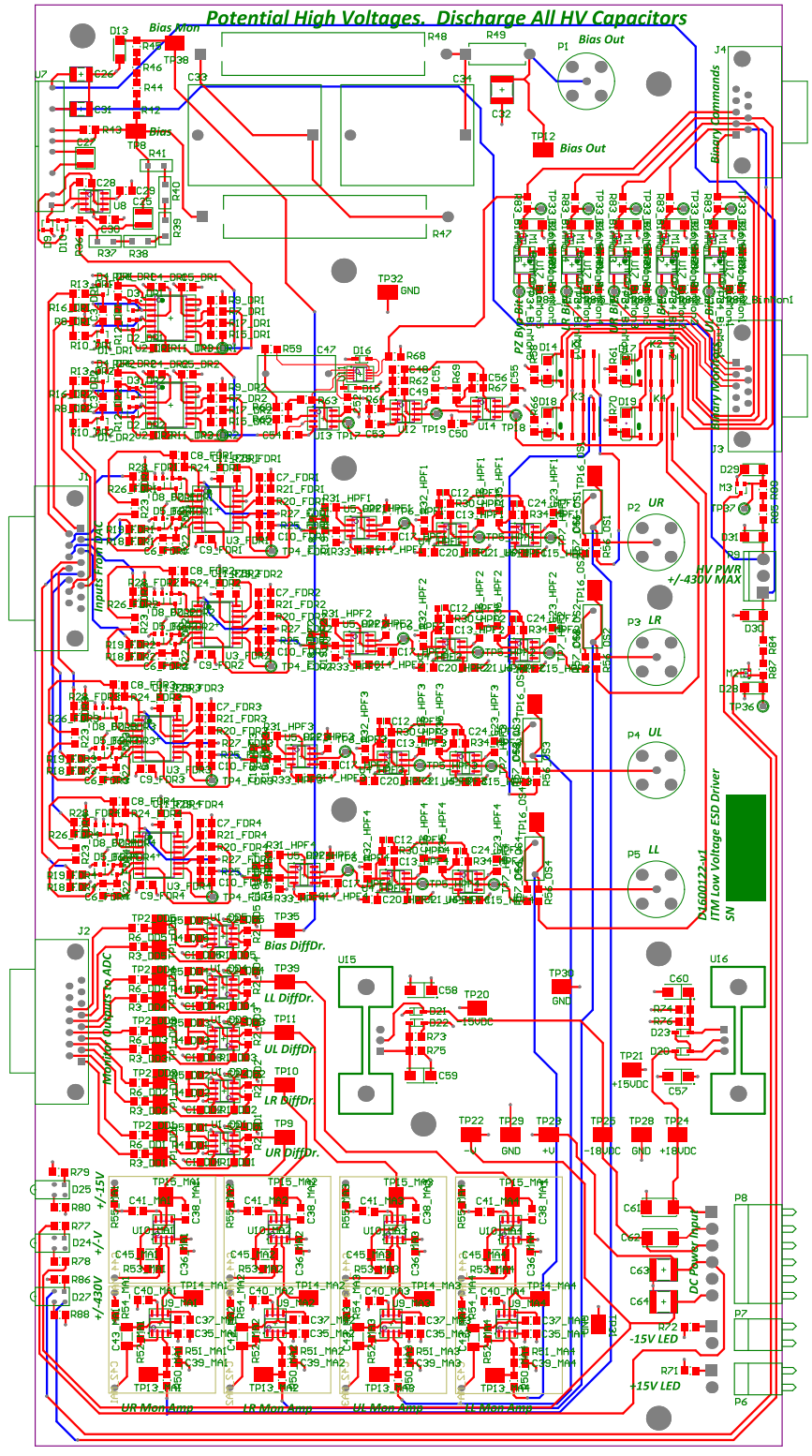


499 ohm resistor to protect opto-transistor from short circuit condition

PSSI2021SAY Constant current source is used inside binary input
The 100 ohm programming resistor sets the current at 6mA

Checked All

Title: *Detail of Binary Monitor*			*LIGO Laboratory* *California Institute of Technology* *Massachusetts Institute of Technology*	LIGO
Size: A	DCC Number: D1600122	Revision: V3	Engineer: *R. Abbott*	Last Edited: 6/13/2016 Date: 6/13/2016 Time: 3:52:47 PM Sheet 13 of 13
File: C:\Rich's Files\Mycadfiles\Suspensions\ITM LVLN Driver\BinaryDetail.SchDoc				


Potential High Voltages. Discharge All HV Capacitors
Bias Mon
Bias
Bias Out
Binary Commands
Inputs from DAC
Monitor Outputs to ADC
Bias DiffDr.
LL DiffDr.
UL DiffDr
LR DiffDr
UR DiffDr.
UR
LR
UL
LL
HV PWR
+/-430V MAX
D4600122-v1
ITM Low Voltage ESD Driver
SN
DC Power Input
-15V LED
+15V LED
+/-15V
+/-V
+/-430V
UR MonAmp
LR MonAmp
UL MonAmp
LL MonAmp

LIGO Bill of Materials

Source Data From:	**ITM_LV_Driver_v3.PrjPCB**
Board Designed By:	**R. Abbott**
Board D-number	**D1600122**
Board Revision	**V3**
Variant:	**None**

Creation Date:	6/13/2016	3:52:56 PM
Print Date:	13-Jun-16	3:53:01 PM

Designator	Comment	Description	Digikey Part Number	Manufacturers Part Number	Quantity
C1_DD1, C1_DD2, C1_DD3, C1_DD4, C1_DD5, C2_DD1, C2_DD2, C2_DD3, C2_DD4, C2_DD5, C4_DR1, C4_DR2, C5_DR1, C5_DR2, C9_FDR1, C9_FDR2, C9_FDR3, C9_FDR4, C11_FDR1, C11_FDR2, C11_FDR3, C11_FDR4, C14_HPF1, C14_HPF2, C14_HPF3, C14_HPF4, C16_HPF1, C16_HPF2, C16_HPF3, C16_HPF4, C20_HPF1, C20_HPF2, C20_HPF3, C20_HPF4, C22_HPF1, C22_HPF2, C22_HPF3, C22_HPF4	1UF	CAP 1.0UF 50V CERAMIC F 1206	478-1580-1-ND		38
C3_DR1, C3_DR2	3.3nF	CAP 3.3nF 50V PPS 1206	PCF1302CT-ND		2
C6_FDR1, C6_FDR2, C6_FDR3, C6_FDR4, C7_FDR1, C7_FDR2, C7_FDR3, C7_FDR4, C8_FDR1, C8_FDR2, C8_FDR3, C8_FDR4, C10_FDR1, C10_FDR2, C10_FDR3, C10_FDR4, C48, C56	4.7pF		478-1464-1-ND		18
C12_HPF1, C12_HPF2, C12_HPF3, C12_HPF4, C24_HPF1, C24_HPF2, C24_HPF3, C24_HPF4	4.7pF, 100V		399-9251-1-ND		8
C13_HPF1, C13_HPF2, C13_HPF3, C13_HPF4, C18_HPF1, C18_HPF2, C18_HPF3, C18_HPF4, C19_HPF1, C19_HPF2, C19_HPF3, C19_HPF4, C49	10nF		PCF1340CT-ND		13
C15_HPF1, C15_HPF2, C15_HPF3, C15_HPF4, C23_HPF1, C23_HPF2, C23_HPF3, C23_HPF4, C50, C55	1UF, 100V	1uF, 100V, 1206 Capacitor	587-1777-1-ND		10
C17_HPF1, C17_HPF2, C17_HPF3, C17_HPF4, C21_HPF1, C21_HPF2, C21_HPF3, C21_HPF4	68pF		399-1204-1-ND		8
C25	OMIT	1500V NPO Ceramic Capacitor	OMIT	OMIT	1
C26, C31	0.1uF	1kV Ceramic Capacitor	399-9854-1-ND	C1812C104KDRAC7800	2
C27	33pF	500V NPO Ceramic Capacitor	1284-1292-1-ND	800B330FT500XT	1
C28, C37_MA1, C37_MA2, C37_MA3, C37_MA4, C38_MA1, C38_MA2, C38_MA3, C38_MA4	OMIT	Ceramic Capacitor 1206	OMIT		9
C29, C30, C51, C52, C53, C54	1UF		399-8147-1-ND		6
C32	10nF, plastic, 630VDC		399-5482-1-ND		1
C33, C34	3uF, 700VDC	10uF, 700VDC Capacitor	BC2786-ND	MKP1848S53070JK2A	2
C35_MA1, C35_MA2, C35_MA3, C35_MA4, C36_MA1, C36_MA2, C36_MA3, C36_MA4, C40_MA1, C40_MA2, C40_MA3, C40_MA4, C41_MA1, C41_MA2, C41_MA3, C41_MA4	1UF		1276-1204-1-ND		16
C39_MA1, C39_MA2, C39_MA3, C39_MA4	10nF, Poly		399-6399-1-ND		4
C42_MA1, C42_MA2, C42_MA3, C42_MA4, C44_MA1, C44_MA2, C44_MA3, C44_MA4	10UF, Plastic		EF1106-ND		8
C43_MA1, C43_MA2, C43_MA3, C43_MA4, C45_MA1, C45_MA2, C45_MA3, C45_MA4	22nF, Poly		399-6404-1-ND		8
C46_OS1, C46_OS2, C46_OS3, C46_OS4	47nF		P14612-ND		4
C47	3.3UF		EF1335-ND		1
C57, C58, C59, C60	10UF Tantalum, 35V	Polarized Cap	478-1701-2-ND	TAJC106K035RNJ	4
C61, C62	10UF Tantalum, 50V	Tantalum Capacitor	478-2380-1-ND		2
C63, C64	10UF Ceramic, 100V		445-13408-1-ND		2
D1_DR1, D1_DR2, D2_DR1, D2_DR2, D3_DR1, D3_DR2, D4_DR1, D4_DR2, D5_FDR1, D5_FDR2, D5_FDR3, D5_FDR4, D6_FDR1, D6_FDR2, D6_FDR3, D6_FDR4, D7_FDR1, D7_FDR2, D7_FDR3, D7_FDR4, D8_FDR1, D8_FDR2, D8_FDR3, D8_FDR4, D9, D10	DualDiode	DUAL SERIES DIODE.	BAS70-04LT1GOSCT-ND	BAS70-04LT1G	26
D13	18V TVS	5V Bi-directional Transient Voltage Suppressor	SMAJ18CALFCT-ND		1
D14, D17, D18, D19	Diode	Default Diode	SE20AFJ-M3/6AGICT-ND		4
D15, D16	60V, 1A Schottky	Diode 1 Amp	RB160M-60CT-ND	RB160M-60TR	2
D20, D21, D22, D23	RB160M-60	High Conductance Fast Diode	RB160M-60CT-ND		4
D24, D25, D27	Stacked LED	Dual Green LED	67-1321-ND		3
D26_BinMon1, D26_BinMon2, D26_BinMon3, D26_BinMon4, D26_BinMon5, D28, D29	12V TVS	12V Bi-directional Transient Voltage Suppressor	SMAJ12CALFCT-ND		7
D30, D31	1kV, 2A	High Voltage Diode	SA2M-E3/5ATGICT-ND	SA2M-E3/5AT	2
J1	Male DB15	Receptacle Assembly, 15 Position, Right Angle	6E17C-015P-AJ-121-ND		1
J2	D15 Female	Receptacle Assembly, 15 Position, Right Angle	6E17C-015S-AJ-120-ND		1
J3	D9 Female	Receptacle Assembly, 9 Position, Right Angle	6E17C-009S-AJ-120-ND		1
J4	D9 Male	Receptacle Assembly, 9 Position, Right Angle	6E17C-009P-AJ-121-ND		1
K1, K2, K3, K4	12V	12V DPDT Omron Relay	Z113CT-ND		4
M1_BinMon1, M1_BinMon2, M1_BinMon3, M1_BinMon4, M1_BinMon5, M2	2SK3019, NMOS	ROHM N-Channel MOSFET	2SK3019TLCT-ND		6
M3	BSS84	NXP P-Channel MOSFET	568-10310-1-ND		1
P1, P2, P3, P4, P5	BNC	BNC Straight Away Connector, Isolated BNC RA	ARF1687-ND		5
P6, P7	Header 2	Header, 2-Pin	A31688-ND		2
P8	Header 6H	Header, 6-Pin, Right Angle	WM5236-ND		1
P9	Header 3	Header, 3-Pin	WM5225-ND		1
Part1	PA95 Thermal Washer	10 Per Pack	598-1382-ND (10 per pack)	TW13	1
Part2	Panel Mount SHV Cable Assembly (SHV Jack to BNC)	Panel Mount SHV Cable Assembly (SHV Jack to BNC)		SHVJBH-RG58-BNCM-11i	1
Part3	Pins for female molex connector	Pins for female molex connector	WM2307-ND		1
Part4	Mating 6 pin molex connector	Mating 6 pin molex connector	WM2126-ND		1
Part5, Part6	TO-220 Heatsink	For BOM Only	HS403-ND		2
Part7, Part8, Part9, Part10, Part11, Part12, Part13, Part14, Part15	0.5 inch 4-40 Standoff	1/2 inch standoff	36-1623-2-ND	1623-2	9
R1_DD1, R1_DD2, R1_DD3, R1_DD4, R1_DD5, R2_DD1, R2_DD2, R2_DD3, R2_DD4, R2_DD5, R4_DD1, R4_DD2, R4_DD3, R4_DD4, R4_DD5, R5_DD1, R5_DD2, R5_DD3, R5_DD4, R5_DD5	10K	Resistor	RNCS1206BKE10K0CT-ND		20
R3_DD1, R3_DD2, R3_DD3, R3_DD4, R3_DD5, R6_DD1, R6_DD2, R6_DD3, R6_DD4, R6_DD5	10 Ohm	Resistor	M251206-10BCT-ND		10
R7_DR1, R7_DR2, R9_DR1, R9_DR2, R15_DR1, R15_DR2, R17_DR1, R17_DR2, R20_FDR1, R20_FDR2, R20_FDR3, R20_FDR4, R21_FDR1, R21_FDR2, R21_FDR3, R21_FDR4, R25_FDR1, R25_FDR2, R25_FDR3, R25_FDR4, R27_FDR1, R27_FDR2, R27_FDR3, R27_FDR4	3.01K, 3.01K OHM	Resistor	P3.01KBCCT-ND		24
R8_DR1, R8_DR2, R16_DR1, R16_DR2, R18_FDR1, R18_FDR2, R18_FDR3, R18_FDR4, R28_FDR1, R28_FDR2, R28_FDR3, R28_FDR4	100K OHM	Resistor	P100KBCCT-ND		12
R10_DR1, R10_DR2, R13_DR1, R13_DR2, R29_FDR1, R29_FDR2, R29_FDR3, R29_FDR4, R56_OS1, R56_OS2, R56_OS3, R56_OS4, R59	1k	Resistor	P1.0KBCCT-ND		13
R11_DR1, R11_DR2, R14_DR1, R14_DR2	0 ohm	Resistor	P0.0ECT-ND		4
R12_DR1, R12_DR2, R23_FDR1, R23_FDR2, R23_FDR3, R23_FDR4	OMIT	Resistor			6
R19_FDR1, R19_FDR2, R19_FDR3, R19_FDR4, R22_FDR1, R22_FDR2, R22_FDR3, R22_FDR4, R24_FDR1, R24_FDR2, R24_FDR3, R24_FDR4, R26_FDR1, R26_FDR2, R26_FDR3, R26_FDR4	1k	Resistor	P1.0KBCCT-ND	ERA-8AEB102V	16
R30_HPF1, R30_HPF2, R30_HPF3, R30_HPF4, R32_HPF1, R32_HPF2, R32_HPF3, R32_HPF4, R34_HPF1, R34_HPF2, R34_HPF3, R34_HPF4, R35_HPF1, R35_HPF2, R35_HPF3, R35_HPF4	4.99k	Resistor	TNP4.99KACCT-ND		16
R31_HPF1, R31_HPF2, R31_HPF3, R31_HPF4	1.13K		P1.13KBCCT-ND		4
R33_HPF1, R33_HPF2, R33_HPF3, R33_HPF4	2.26K		P2.26KBCCT-ND		4
R36	12.4K		P12.4KBCCT-ND		1
R37, R38, R39, R40, R41	100k		Y0062-100KA-ND		5
R42	90.9k		RNCP1206FTD90K9CT-ND		1
R43	75		RNCP1206FTD75R0CT-ND		1
R44, R45, R46	100k		RNCS1206BKE100KCT-ND		3
R47, R48	30K, 10W		20J30KE-ND	20J30KE	2
R49	10k, 3W		ALSR3F-10.0K-ND		1
R50_MA1, R50_MA2, R50_MA3, R50_MA4, R51_MA1, R51_MA2, R51_MA3, R51_MA4	20k	Resistor	TNP20.0KACCT-ND		8
R52_MA1, R52_MA2, R52_MA3, R52_MA4, R53_MA1, R53_MA2, R53_MA3, R53_MA4	7.5K	Thin Film Resistor	RNCP1206FTD7K50CT-ND		8
R54_MA1, R54_MA2, R54_MA3, R54_MA4, R55_MA1, R55_MA2, R55_MA3, R55_MA4	402	Thin Film Resitor	RG32P402BCT-ND		8
R57_OS1, R57_OS2, R57_OS3, R57_OS4	49.9		P49.9BCCT-ND		4
R58, R61, R66, R70	33	Resistor	RHM33ICT-ND		4
R60	976	Resistor	P976BCCT-ND		1
R62, R64, R67, R69	4.99k	Resistor	P4.99KBCCT-ND		4
R63, R65	21k	Resistor	P21KBCCT-ND		2
R68, R83_BinMon1, R83_BinMon2, R83_BinMon3, R83_BinMon4, R83_BinMon5	20K	Resistor	P20.0KFCT-ND		6
R71, R72, R86, R88	2K	Resistor	P2.0KECT-ND		4
R73	120		RG32P120BCT-ND		1
R74	249		TNP249ACCT-ND		1
R75	1.3K		RG32P1.3KBCT-ND		1
R76	2.7K		RG32P2.7KBCT-ND		1
R77, R78	2K	Resistor	RNCP1206FTD2K00CT-ND		2
R79, R80	1K	Resistor	TNP1.00KACCT-ND		2
R81_BinMon1, R81_BinMon2, R81_BinMon3, R81_BinMon4, R81_BinMon5	2.32k	Resistor	RNCP1206FTD2K32CT-ND		5
R82_BinMon1, R82_BinMon2, R82_BinMon3, R82_BinMon4, R82_BinMon5	499	Resistor, surface mount	RG32P499BCT-ND		5
R84, R85, R87, R89	220k	High Voltage Resistor	CHV1206-JW-224ELFCT-ND		4
TP1_DD1, TP1_DD2, TP1_DD3, TP1_DD4, TP1_DD5, TP2_DD1, TP2_DD2, TP2_DD3, TP2_DD4, TP2_DD5, TP8, TP9, TP10, TP11, TP12, TP13_MA1, TP13_MA2, TP13_MA3, TP13_MA4, TP14_MA1, TP14_MA2, TP14_MA3, TP14_MA4, TP15_MA1, TP15_MA2, TP15_MA3, TP15_MA4, TP16_OS1, TP16_OS2, TP16_OS3, TP16_OS4, TP20, TP21, TP22, TP23, TP24, TP25, TP28, TP29, TP30, TP31, TP32, TP35, TP38, TP39	TESTPT	PCB Testpoint	5016KCT-ND		45
U1_DD1, U1_DD2, U1_DD3, U1_DD4, U1_DD5	AD8672	High-Speed, Low-Power Dual Operational Amplifier	AD8672ARZ-ND		5
U2_DR1, U2_DR2	LT1125CS	Quad Low Noise, High-Speed Precision Operational Amplifier	LT1125CSW#PBF-ND		2
U3_FDR1, U3_FDR2, U3_FDR3, U3_FDR4	OP467	Quad Low Noise, High-Speed Precision Operational Amplifier	OP467GSZ-ND		4
U4_HPF1, U4_HPF2, U4_HPF3, U4_HPF4, U5_HPF1, U5_HPF2, U5_HPF3, U5_HPF4	AD829JR	High-Speed, Low-Noise Video Operational Amplifier	AD829AR-ND		8
U6_HPF1, U6_HPF2, U6_HPF3, U6_HPF4, U14	ADA4700-1	High Voltage Opamp	ADA4700-1ARDZ-ND		5
U7	PA95	Apex Inc. High Voltage Opamp	598-1335-ND	Apex PA95	1
U8, U9_MA1, U9_MA2, U9_MA3, U9_MA4, U10_MA1, U10_MA2, U10_MA3, U10_MA4, U12, U13	OP27, OP27GSZ	Ultra-Low Noise, Precision Operational Amplifier, Ultra Low Noise Precision High-Speed Operational Amplifier	OP27GSZ-ND		11
U11	MAX4659	SPDT CMOS Switch, 25 ohms Ron	MAX4659EUA+-ND	MAX4659EUA+	1
U15	LM337BT	3-Terminal Adjustable Negative Voltage Regulator	LM337TFS-ND		1
U16	LM317T	Three-Terminal Adjustable Output Positive Voltage Regulator	497-1575-5-ND		1
U17_BinMon1, U17_BinMon2, U17_BinMon3, U17_BinMon4, U17_BinMon5	PS2701A-1	High Isolation Voltage SOP Photocoupler	PS2701A-1-P-A-ND		5
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