光電子技研

Opto-Electronic Engineering Laboratory Corporation

Photo Diode Monitor LogAmp AD8304 Board

OELOGAMP8304

User's Guide

March,2013

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WARNINGS AND RESTRICTIONS

It is important to operate this Board Products within the supply voltage range of +4.8 V to +5.2 V.

Exceeding the specified supply range may cause unexpected operation and/or irreversible damage to the Board Products. Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the Board Products. Please consult the Board Products User's Guide prior to connecting any load to the EVM output.

This Board Products is designed to operate properly within the Board's temperatures range of –20℃ to +60℃.

These types of devices can be identified using the Board Products schematic located in the Board Products User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Contents

Chapter 1

Introduction

1.1 Feature Highlights

The OELOGAMP8304 board includes the following features:

- ☐ Optimized for Fiber Optic Photodiode Monitoring
- ☐ Logarithmic Conversion with Voltage Output
- ☐ Wide Photo Diode Current Range 100pA to 10mA
- ☐ Output Bandwidth of 10MHz
- ☐ 4-Photo Diode Populating Pad/Through Hole on Board
- ☐ Single Supply Input Voltage +5V
- ☐ Operating Temperature Range of Board : – 20° C to 60° C
- ☐ 3-Output Supply Voltage +5V/+3V/-5V
- ☐ Pulse Generator with 5V-TTL for any kind of application such as Optical Source Modulation

1.2 Description

Use the OELOGAMP8304 Board to monitor the Fiber Optic Photo Diode current Ipd with logarithmic con-version.The output of conversion result is voltage signal(-0.2V to +4.0V).This board mounts the AD8304 on. The AD8304 is ADI's monolithic logarithmic detector IC. At the Ipd=1nA level, the AD8304's bandwidth is about 2 kHz(*1), but this increases in proportion to Ipd up to a maximum value of 10 MHz. This board has two kind of output connector port,that is,4V output port and 2.5V output port. The AD8304 has the default value 200 mV/decade of the logarithmic slope as to Ipd at the output VLOG.The 2.5V out-put port has the gain 1.47V/V,so has the value 294 mV/decade of the logarithmic slope as to Ipd.The 4V output port has the gain 2.47V/V,so has the value 494 mV /decade of the logarithmic slope as to Ipd. The supply input voltage is single +5Vin.This board has three power supply voltage output ports,that is, +5V (directly connected to +5Vin; 0.5Amax) / +3.3V (generated from +5Vin ; 0.5Amax) / -5V (generated from +5Vin ; 70mAmax). The mounting of Photo Diode has 2-types on the board, through hole type / Pads type.The recommended dimension of Photo Diode is the PIPD(Oplink Communications Inc.) series with Package 3or4(PIPD-XXXX-XX-0-(31or42)-XX). The Pulse Generator(default approximately 15Hz) is mounted on the board for some kind of application such as Optical Source Modulation. The AD8304 provides for the photo diode a bias that varies linearly with the current in order to provide the adaptive biasing function in minimizing dark current. The bias of the photo diode varies from 0.6 V (reverse-biasing the diode by 0.1 V) for IPD =100 pA and rises to 2.6 V (for a diode bias of 1 V) at IPD = 10 mA.

*1 ; If you do have the operation of on-off keying(lighting off to on), the AD8304 has the dead time delay 7ms at the output VLOG as to rising edge action(lighting off to on).

1.3 Board's Specifications

Supply voltage range, VDD …….… +4.8 V to +5.2 V
Supply current, IDD(Board's net consumption current except external Loads) …..… 0.1Amax
Input Current…….…… 10mAmax
Operating Temperature Range…….. – 20℃ to +60℃
Storage Temperature Range…….. – 40℃ to +85℃

Chapter 2

Operating Instructions

2.1 Precautions

Power Supply Input Polarity and Maximum Voltage Always ensure that the polarity and voltage of the external power connected VDD power input connector CN7 is correct. Overvoltage or reverse-polarity power applied to this terminal can damage the Board Products.

2.2 Operating Instructions List

2.2.1 Functional Block Diagram

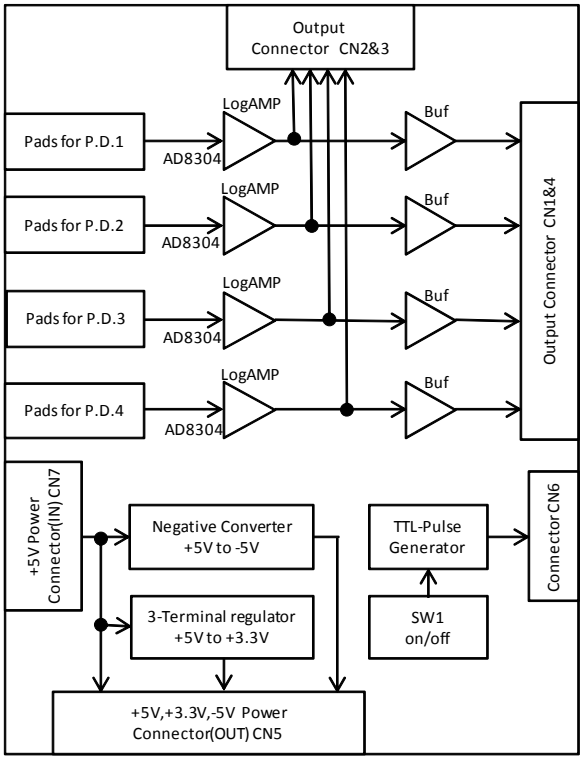


Figure 2–1. Functional Block Diagram

2.2.2 Top View / Bottom View(transparent)

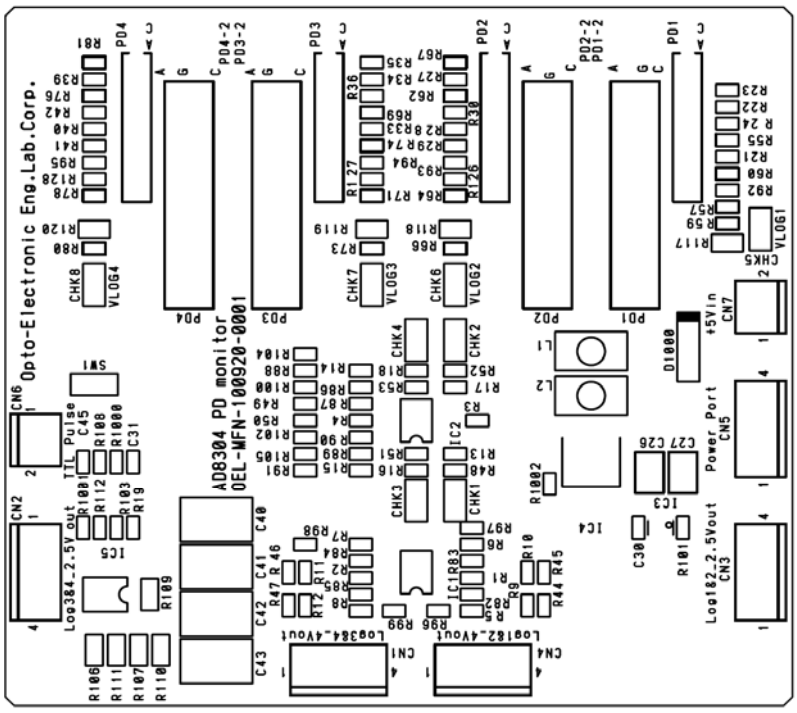


Figure 2–2. Top View

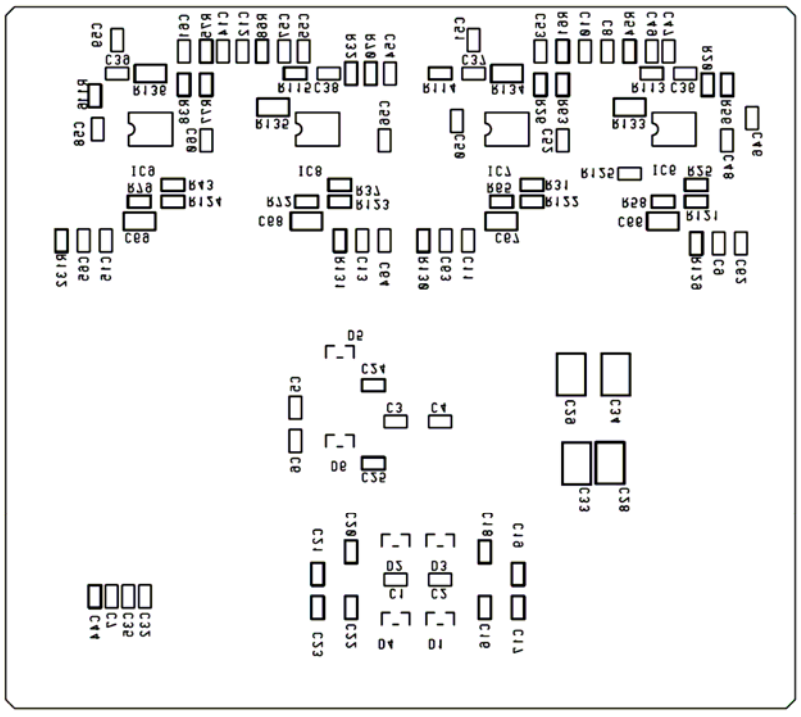


Figure 2–3. Bottom View(transparent)

2.2.3 Board's Dimension

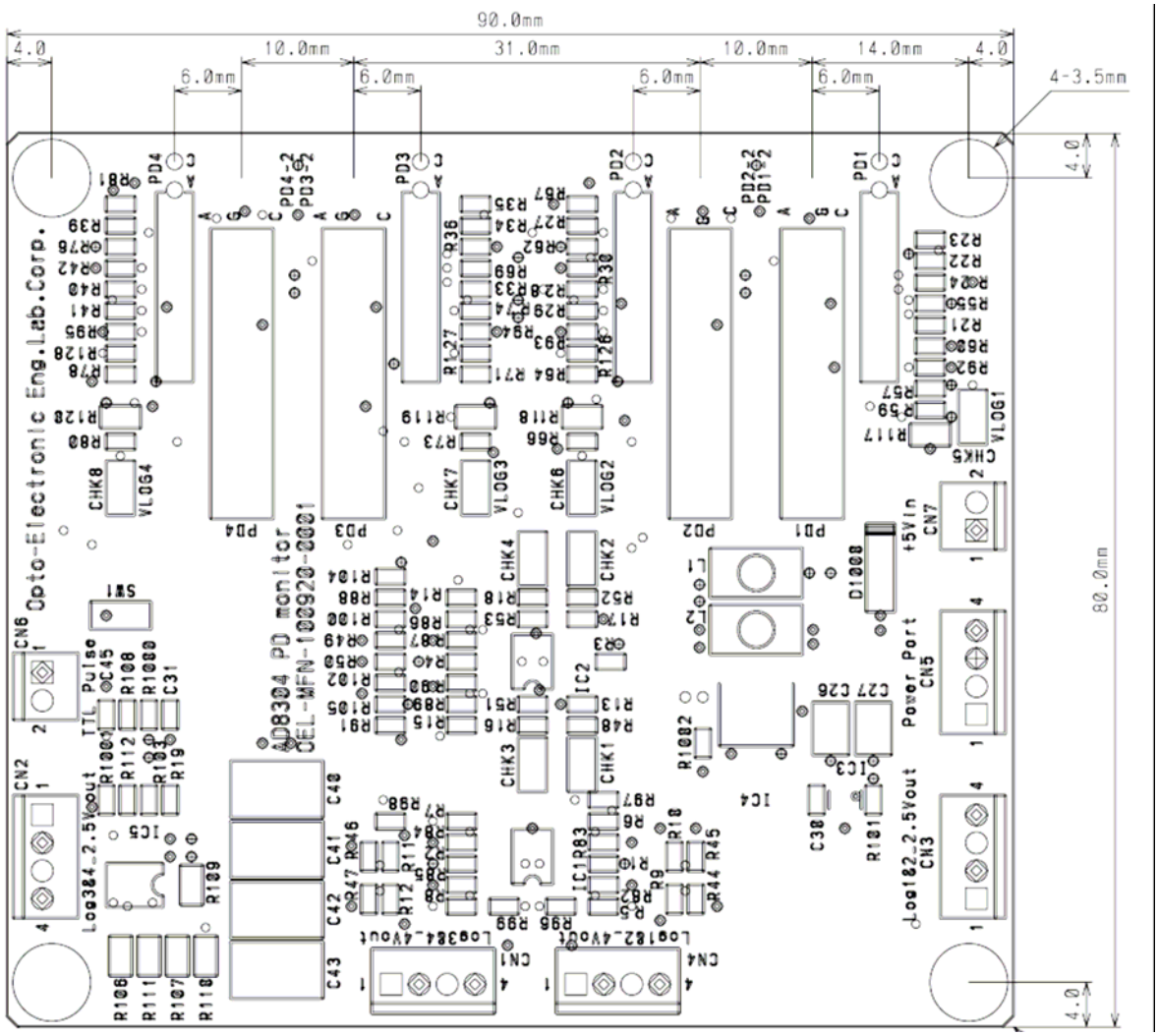


Figure 2–4 Board's Dimension

2.2.4 Connector Layout, Pads Layout, Through-Hole Layout

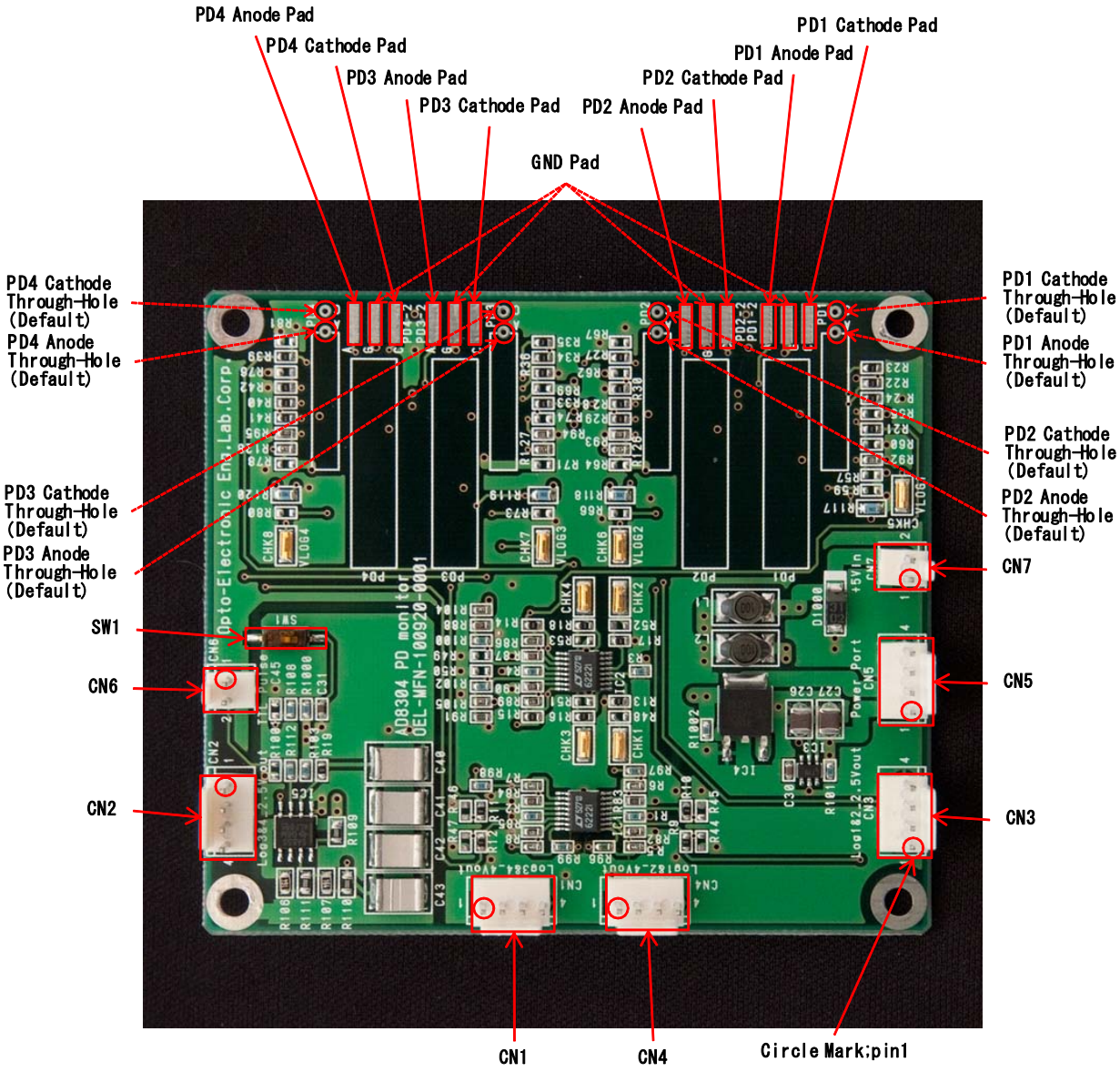


Figure 2–5 Connector Layout, Pads Layout, Through-Hole Layout

2.2.5 Connector Pin Assignment

Table 2–1 Connector Pin Assignment ; CN1

CN1 / Log3&4_4Vout

pin1	LogAmpOut for PD3 with 4Vout scaled	OUT
pin2	AGND	-
pin3	LogAmpOut for PD4 with 4Vout scaled	OUT
pin4	AGND	-

Molex 4pin Header ; 5045-04A / on Board

Molex 4pin Housing ; 5051-04 / for User's preparation

Molex Crimp Terminal 5159TL / for User's preparation

Table 2–2 Connector Pin Assignment ; CN2

CN2 / Log3&4_2.5Vout

pin1	LogAmpOut for PD3 with 2.5Vout scaled	OUT
pin2	AGND	-
pin3	LogAmpOut for PD4 with 2.5Vout scaled	OUT
pin4	AGND	-

Molex 4pin Header ; 5045-04A / on Board

Molex 4pin Housing ; 5051-04 / for User's preparation

Molex Crimp Terminal 5159TL / for User's preparation

Table 2–3 Connector Pin Assignment ; CN3

CN3 / Log1&2_2.5Vout

pin1	LogAmpOut for PD1 with 2.5Vout scaled	OUT
pin2	AGND	-
pin3	LogAmpOut for PD2 with 2.5Vout scaled	OUT
pin4	AGND	-

Molex 4pin Header ; 5045-04A / on Board

Molex 4pin Housing ; 5051-04 / for User's preparation

Molex Crimp Terminal 5159TL / for User's preparation

Table 2–4 Connector Pin Assignment ; CN4

CN4 / Log1&2_4Vout

pin1	LogAmpOut for PD1 with 4Vout scaled	OUT
pin2	AGND	-
pin3	LogAmpOut for PD2 with 4Vout scaled	OUT
pin4	AGND	-

Molex 4pin Header ; 5045-04A / on Board

Molex 4pin Housing ; 5051-04 / for User's preparation

Molex Crimp Terminal 5159TL / for User's preparation

Table 2–5 Connector Pin Assignment ; CN5

CN5 / Power Port

pin1	+5V Output / 0.4Amax	OUT
pin2	+3.3V Output / 0.4Amax	OUT
pin3	-5V Output / 70mAmax	OUT
pin4	AGND	-

Molex 4pin Header ; 5045-04A / on Board

Molex 4pin Housing ; 5051-04 / for User's preparation

Molex Crimp Terminal 5159TL / for User's preparation

Table 2–6 Connector Pin Assignment ; CN6

CN6 / TTL Pulse

pin1	AGND	-
pin2	Pulse Generator Output / 5VTTL	OUT

Molex 2pin Header ; 5045-02A / on Board

Molex 2pin Housing ; 5051-02 / for User's preparation

Molex Crimp Terminal 5159TL / for User's preparation

Table 2–7 Connector Pin Assignment ; CN7

CN7 / +5Vin

pin1	AGND	-
pin2	+5V Power Input / +4.8V to +5.2V	IN

Molex 2pin Header ; 5045-02A / on Board

Molex 2pin Housing ; 5051-02 / for User's preparation

Molex Crimp Terminal 5159TL / for User's preparation

2.2.6 Mounting of the Photo Diode

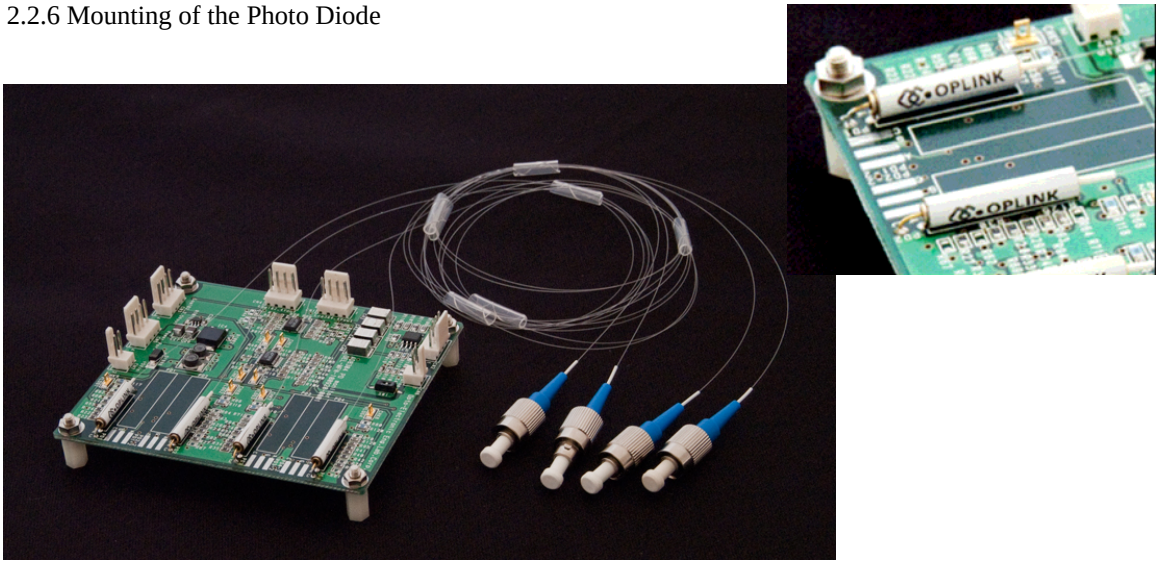
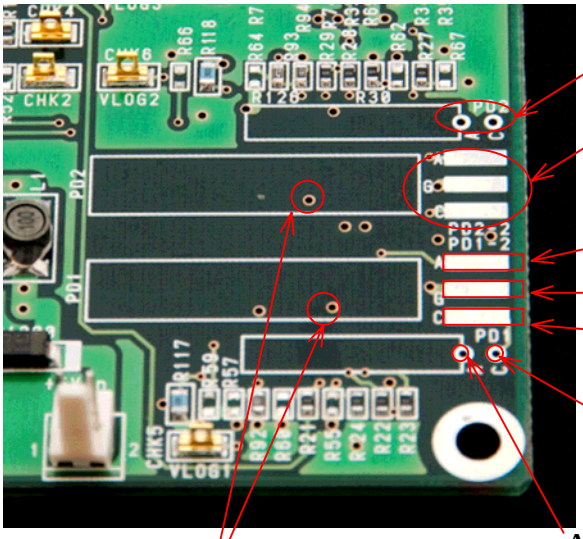


Figure 2–5 Mounting View of Photo Diode(PIPD-1550-05-0-31-1-2)

Figure 2–6 Mounting Pads and Through-Holes View on PCB



Through Hole for mounting the P.D. on

Pads for mounting the P.D. on

Anode Pad with letter "A"

GND Pad with letter "G"

Cathode Pad with letter "C"

Cathode Through-Hole with letter "C"(Default)

Anode Through-Hole with letter "A"(Default)

Caution!
Do not let the electrical parts on board or the Pads or the Through-Hole be short-circuited by the Case body of Photo Diode if the Case body of Photo Diode is made of the electrically-conductive material such as the metal.

This Board provides the two mounting types of the P.D. by soldering treatment. The letters "A","C","G" are noted on the Board. The "A" means Anode of P.D.,the "C" means Cathode, the "G" means Case GND. If you will use the Pads type for mounting of the P.D., once you have to replace the resistor for selecting the P.D.current path by sold-ering treatment.You cannot utilize the each mounting type for P.D. current path simultaneously.

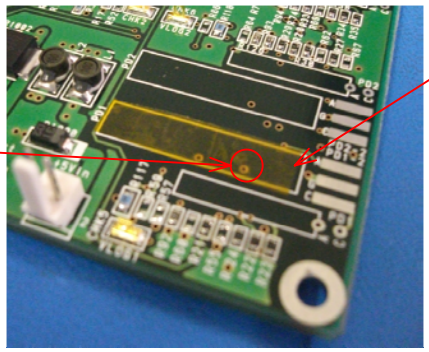


Figure 2–6 Protection Method from short-circuit by Insulation Tape

The case of using the Pads Type in mounting the Photo Diode on the Board

When the user use the Pads Type Mountig of the Photo Diode, the user have to re-populate the 0Ω resistor according to the following lists.The user do not have to use the both type (Through-Hole and Pads) simultaneously.

Table 2–8 Population of 0Ω resistor as to the Mounting type of Photo Diode

	Mounting Type	
	Through Hole Type	Pads Type
PD1	R133=Opened	R133=0Ω populated
PD2	R134=Opened	R134=0Ω populated
PD3	R135=Opened	R135=0Ω populated
PD4	R136=Opened	R136=0Ω populated

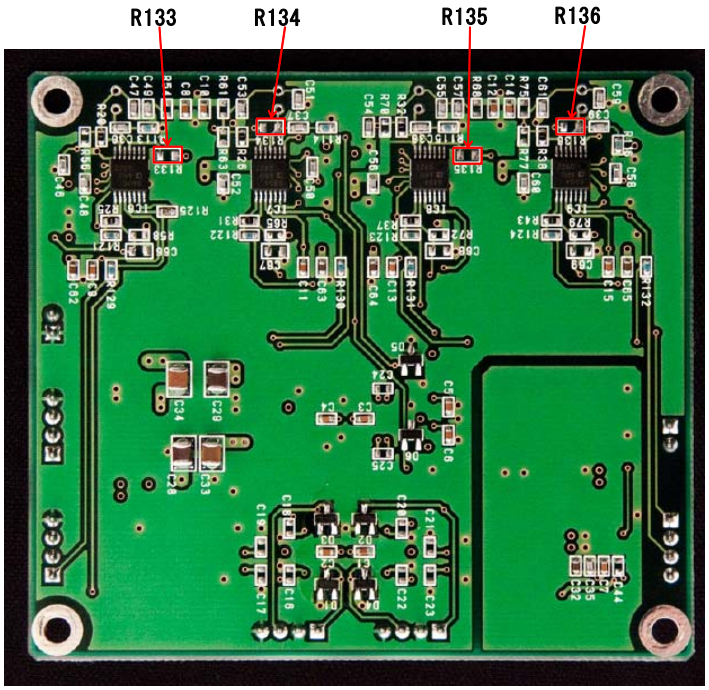


Figure 2–7 Location of 0 Ω as to the Mounting of Photo Diode

2.2.7 Typical Performance Characteristics and Basic Equation

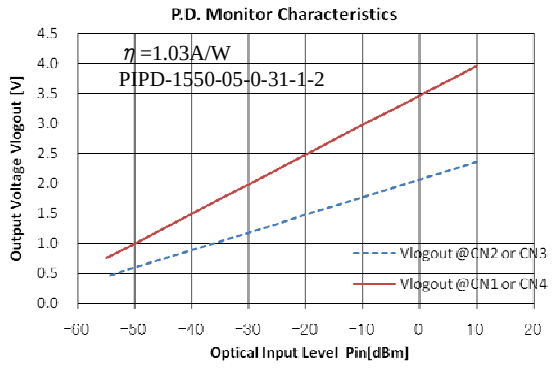


Figure 2–8 P.D. Monitor Characteristics

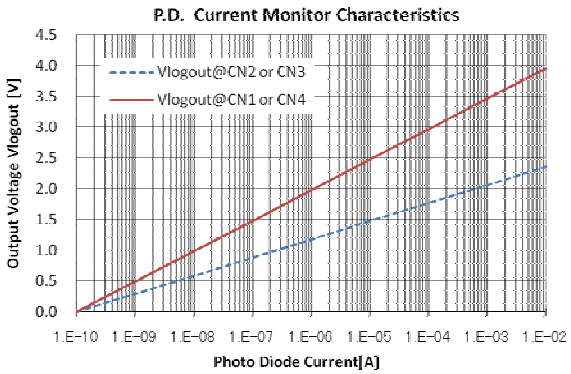


Figure 2–9 Current Monitor Characteristics

Basic Equation :

$$V_{\log out}[V] = G_V \times V_y \times \log_{10}\left(\frac{P_{in} \times \eta \times \zeta}{I_z}\right) = G_V \times V_y \times \log_{10}\left(\frac{I_{PD}}{I_z}\right) \qquad \text{(Eq. 2-1)}$$

$$P_{in}[W] = \frac{I_z}{\eta \times \zeta} \times 10^{\left(\frac{V_{\log out}}{G_V \times V_y}\right)} \qquad \text{(Eq. 2-2)}$$

$$I_{PD}[A] = I_z \times 10^{\left(\frac{V_{\log out}}{G_V \times V_y}\right)} \qquad \text{(Eq. 2-3)}$$

Slope Vy=200mV/decade, Intercept Iz=100pA,
Gv=1.47V/V@CN2&3, 2.47V/V@CN1&4,
Pin ; Input Optical Power[W],
IPD ; Photo Diode Current[A],
η ; PD quantum efficiency[A/W],
ζ ; Fiber Bending Loss & CN Loss, default=1

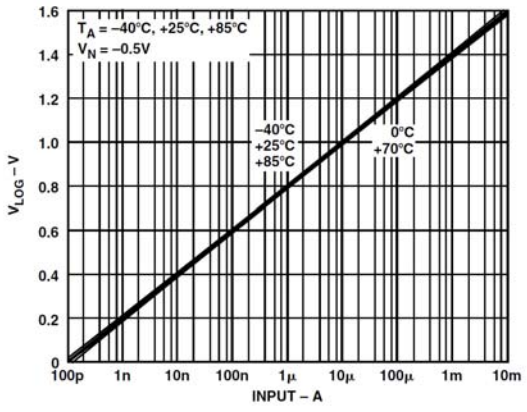


Figure 2–10 AD8304 Temperature Characteristics

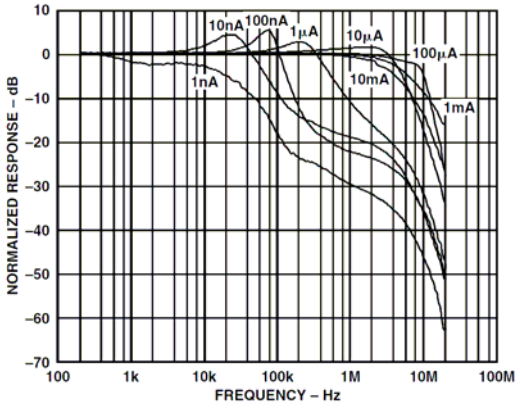


Figure 2–11 Frequency Band Characteristics

2.2.8 Pulse Generator

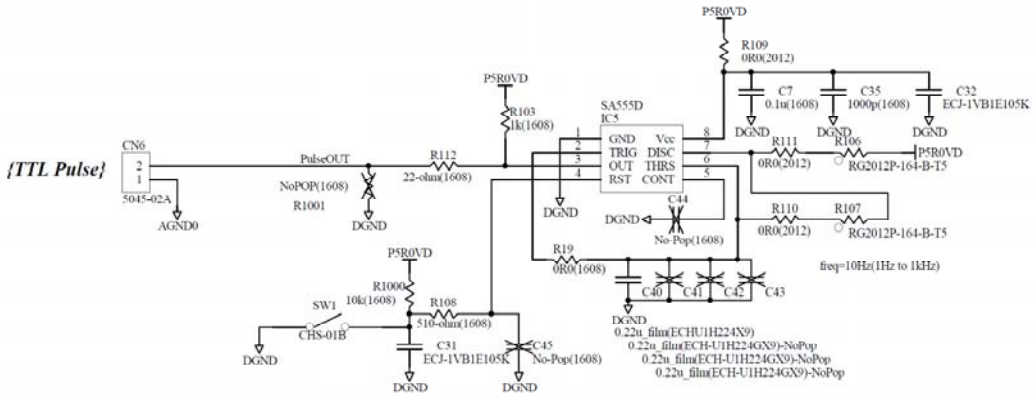


Figure 2–12 Pulse Generator Schematic

RA=R111+R106
RB=R110+R107
C0=C40//C41//C42//C43

Basic Equation :

High Level Duration $t_H = 0.693(R_A + R_B) \times C_0$ (Eq. 2-4)

Low Level Duration $t_L = 0.693 \times R_B \times C_0$ (Eq. 2-5)

Frequency $f = \dfrac{1.44}{(R_A + 2R_B) \times C_0}$ (Eq. 2-6)

Factory Setting :
R111=0Ω, R106=160kΩ, R110=0Ω, R107=160kΩ, C40=0.22uF,C41=C42=C43=NoPop
tH=0.049sec, tL=0.024sec, f=13.6Hz (Approximately 15Hz)

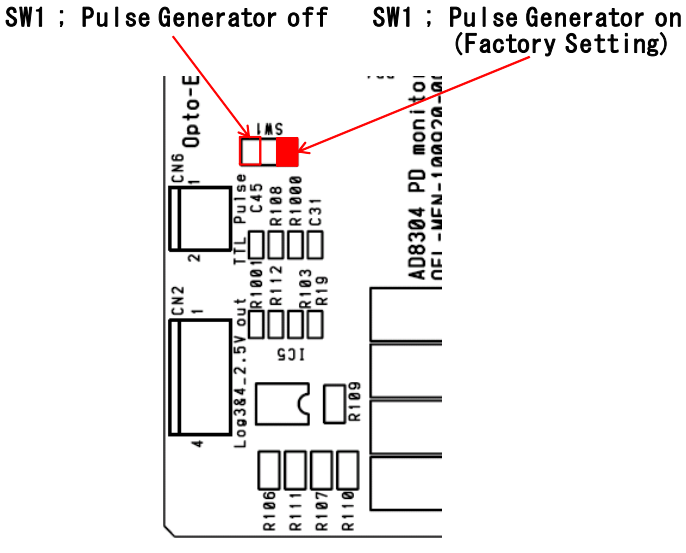
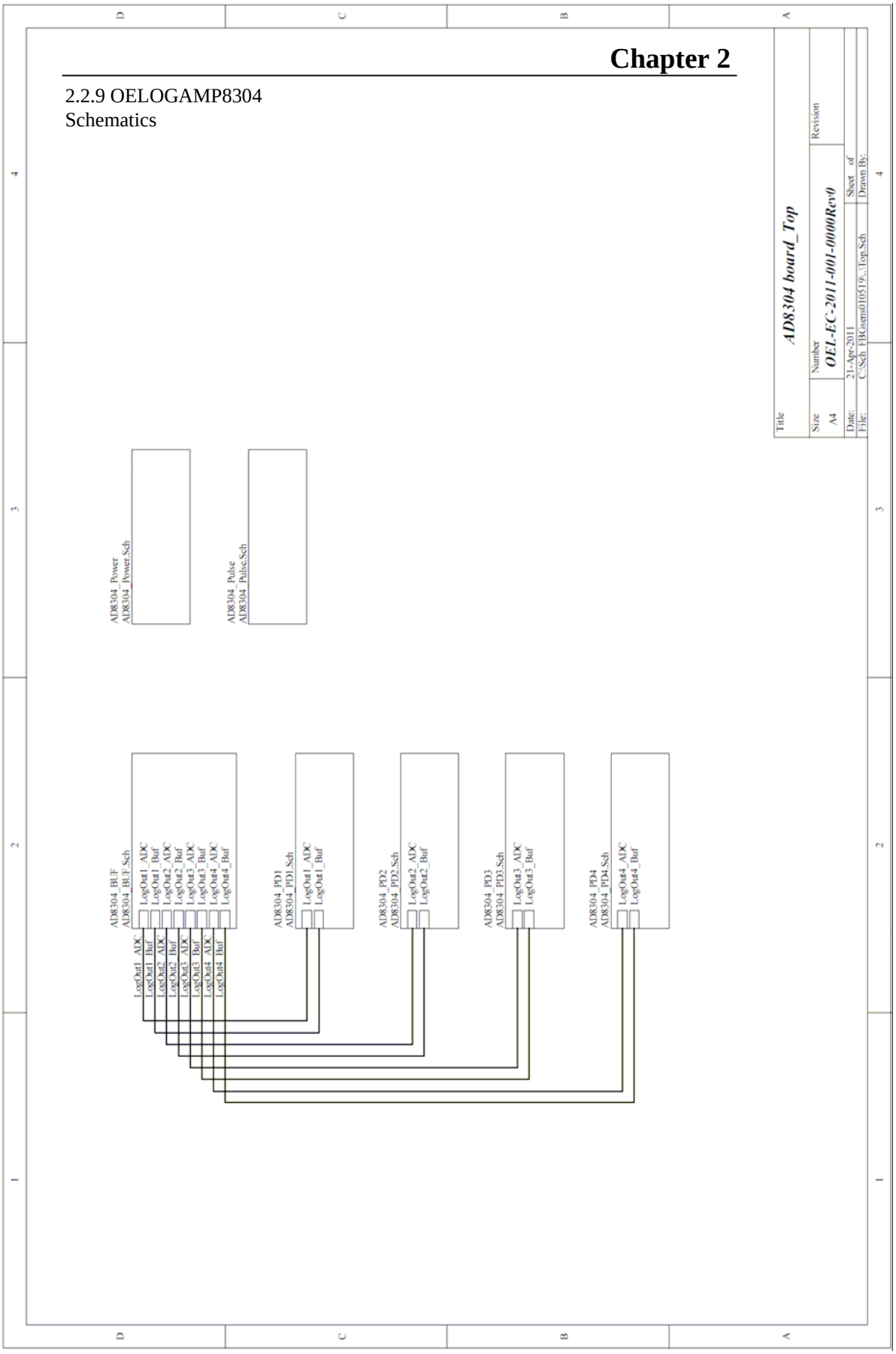
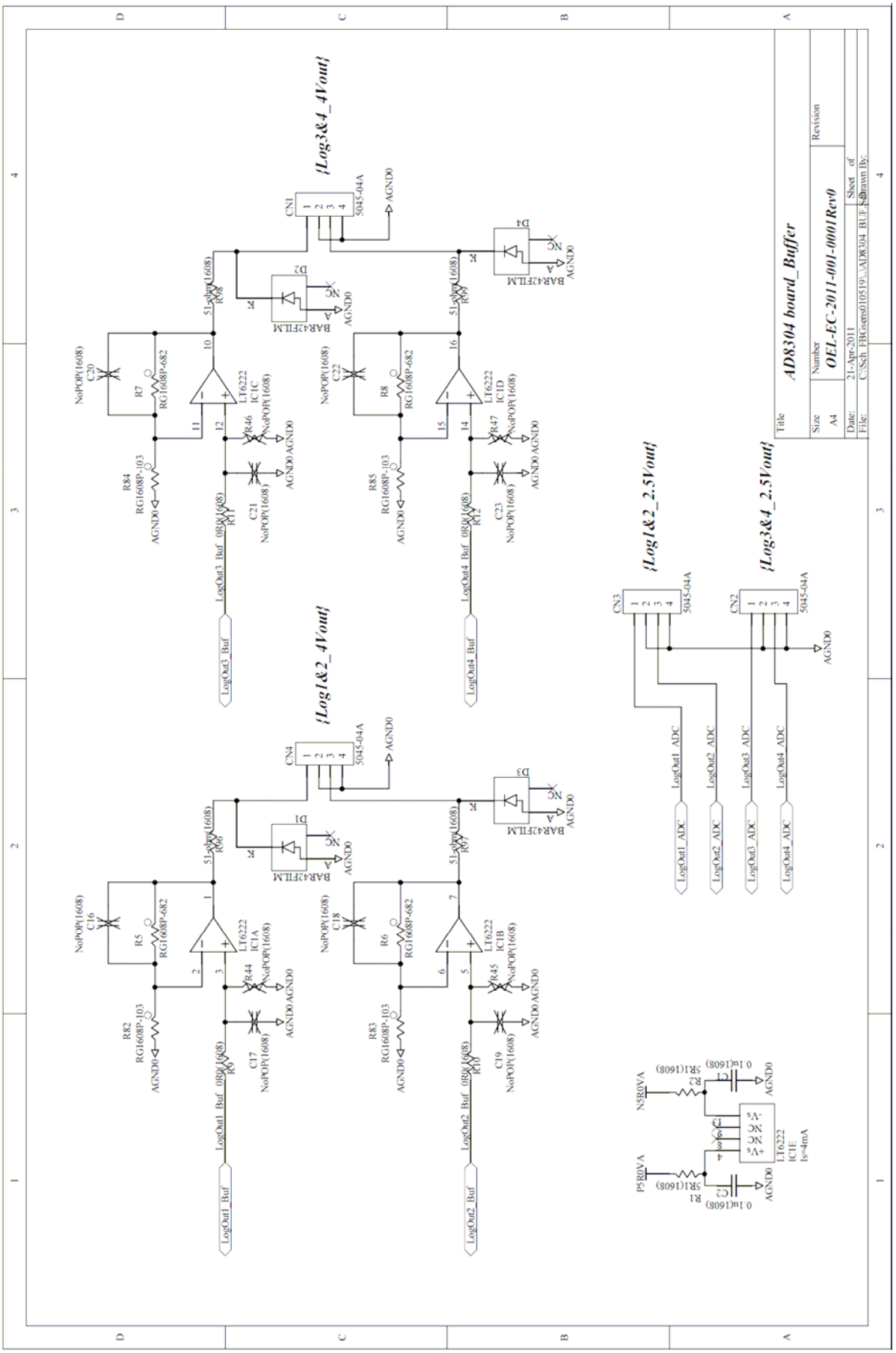
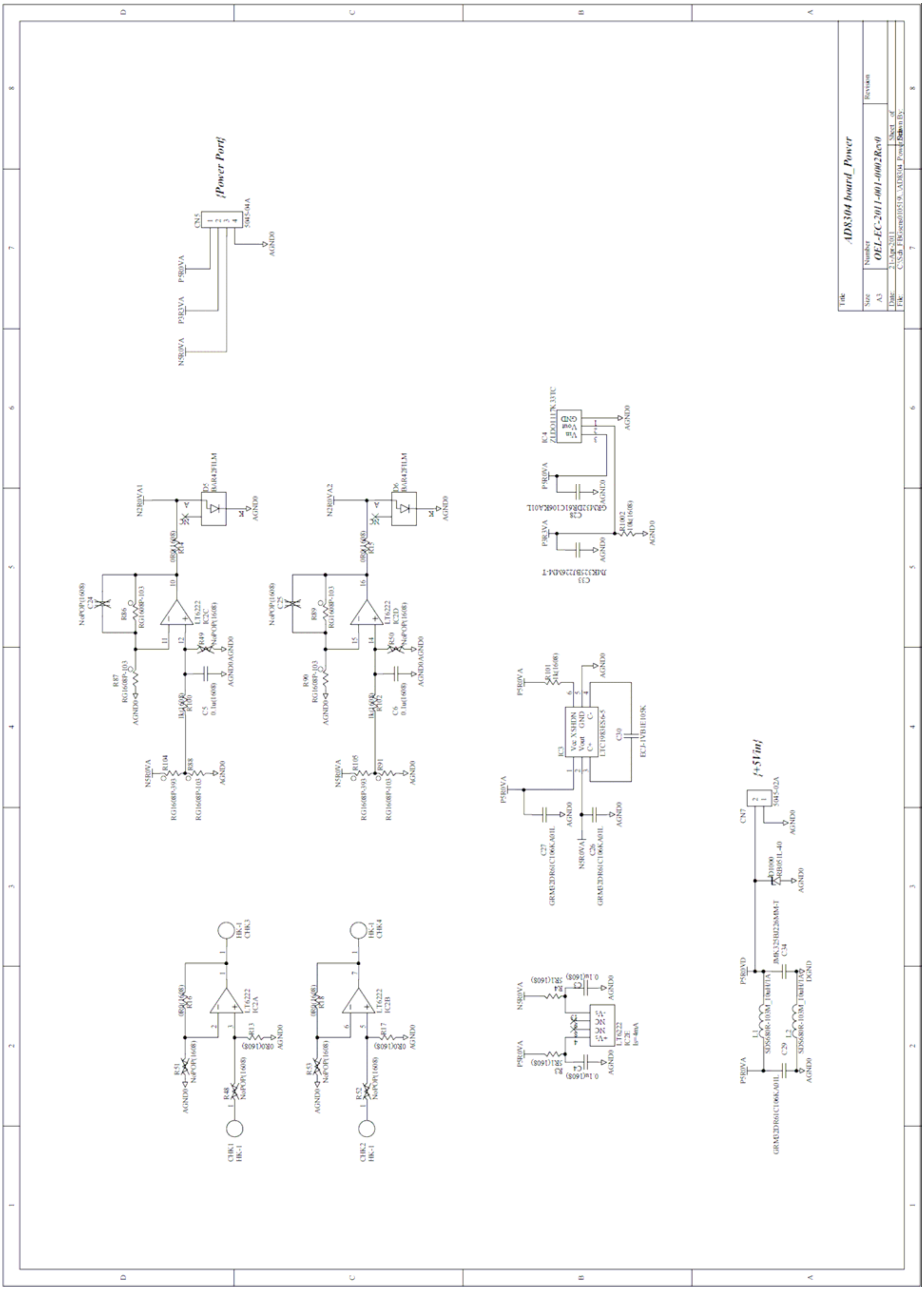


Figure 2–13 SW1 Position

2.2.9 OELOGAMP8304
Schematics




{Log3&4_4Vout}
{Log1&2_4Vout}
{Log1&2_2.5Vout}
{Log3&4_2.5Vout}
AD8304 board_Buffer
OEL-EC-2011-001-0001Rev0
21-Apr-2011
C:\Sch_FBG\sens\010519\...\AD8304_BUF.SchDoc
LT6222
IC1A
IC1B
IC1C
IC1D
IC1E
LogOut1_Buf
LogOut2_Buf
LogOut3_Buf
LogOut4_Buf
LogOut1_ADC
LogOut2_ADC
LogOut3_ADC
LogOut4_ADC
AGND0
5045-04A
BAR42FILM
RG1608P-682
RG1608P-103
NoPOP(1608)
0R0(1608)
51.1R(1608)
0.1u(1608)
5R1(1608)
5R0VA
PSR0VA
Is=4mA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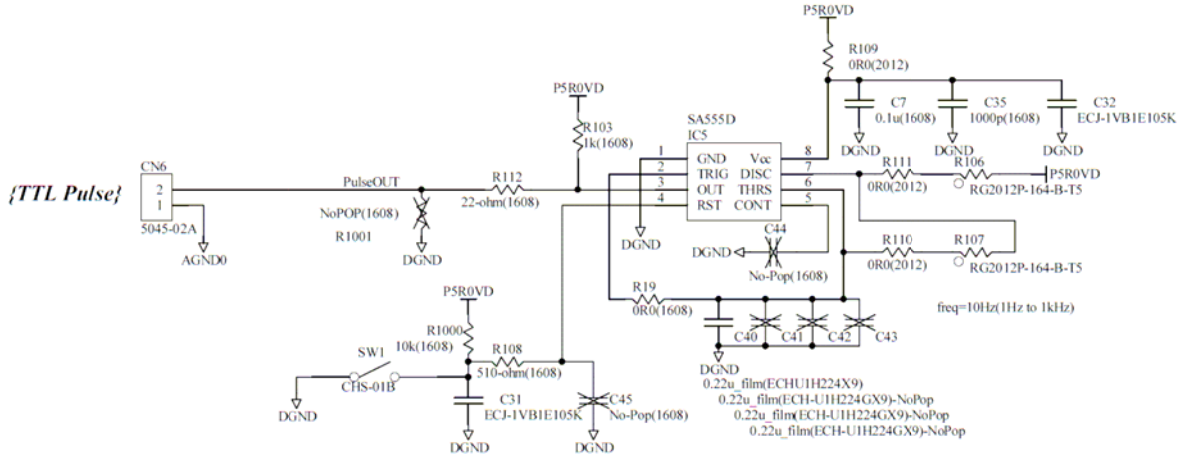
OEL-EC-2011-001-0002Rev0


{TTL Pulse}
CN6
2
1
5045-02A
AGND0
PulseOUT
NoPOP(1608)
R1001
DGND
R112
22-ohm(1608)
P5R0VD
R103
1k(1608)
SA555D
IC5
GND
TRIG
OUT
RST
Vcc
DISC
THRS
CONT
1
2
3
4
8
7
6
5
DGND
P5R0VD
R109
0R0(2012)
C7
0.1u(1608)
C35
1000p(1608)
C32
ECJ-1VB1E105K
DGND
DGND
DGND
R111
0R0(2012)
R106
RG2012P-164-B-T5
P5R0VD
C44
No-Pop(1608)
DGND
R110
0R0(2012)
R107
RG2012P-164-B-T5
R19
0R0(1608)
freq=10Hz(1Hz to 1kHz)
C40
C41
C42
C43
DGND
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0.22u_film(ECH-U1H224GX9)-NoPop
0.22u_film(ECH-U1H224GX9)-NoPop
0.22u_film(ECH-U1H224GX9)-NoPop
P5R0VD
R1000
10k(1608)
SW1
CHS-01B
DGND
R108
510-ohm(1608)
C31
ECJ-1VB1E105K
DGND
C45
No-Pop(1608)
DGND
Title
AD8304 board_Pulse Generator
Size
A4
Number
OEL-EC-2011-001-0003Rev0
Revision
Date:
21-Apr-2011
Sheet of
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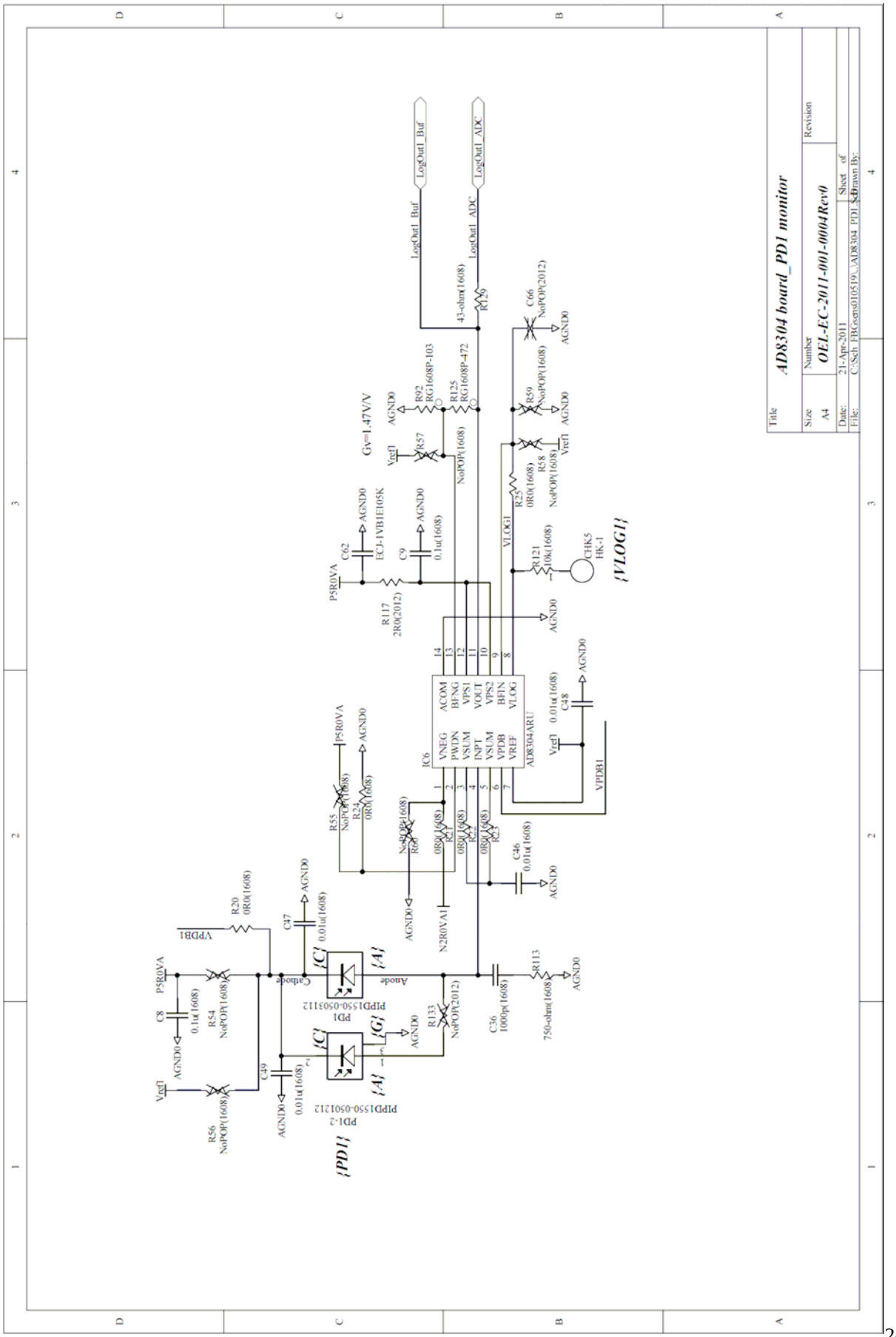
Title
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Size: A4
Number
OEL-EC-2011-001-0004Rev0
Revision
Date: 21-Apr-2011
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Drawn By:
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VLOG1
{VLOG1}
{PD1}
PD1
PD1-2
PIPDI1550-0501212
PIPDI1550-0503112
Cathode
Anode
IC6
AD8304ARU
VNEG
PWDN
VSUM
INPT
VSUM
VPDB
VREF
ACOM
BFNG
VPS1
VOUT
VPS2
BFIN
VLOG
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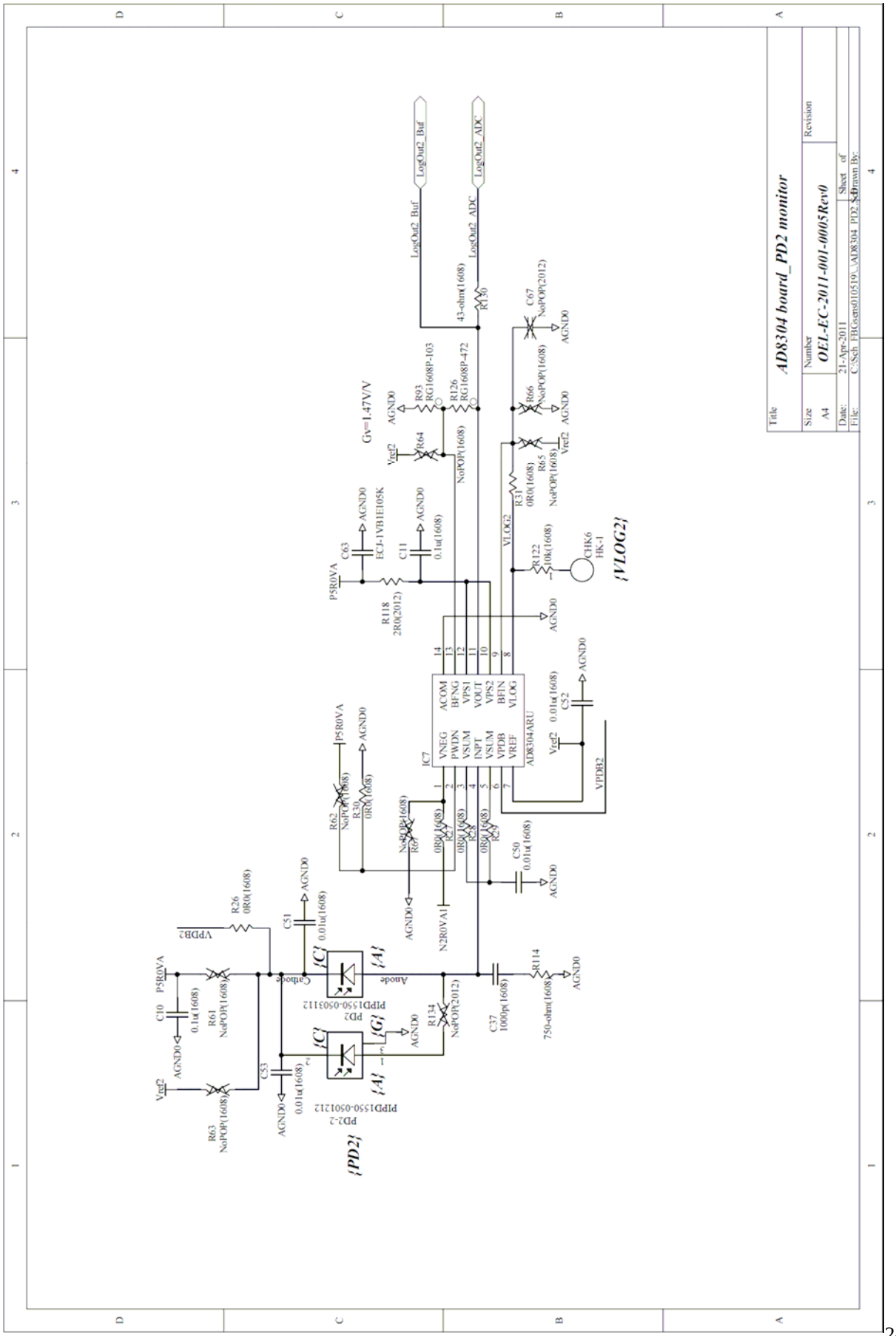
N2R0VA1
VPDB1
AGND0
Vref1
CHK5
HK-1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AD8304 board_PD2 monitor
Size
A4
Number
OEL-EC-2011-001-0005Rev0
Revision
Date:
21-Apr-2011
Sheet of
File:
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Drawn By:
LogOut2_Buf
LogOut2_ADC
43-ohm(1608)
R130
C67
NoPOP(2012)
R66
NoPOP(1608)
R93
RG1608P-103
R126
RG1608P-472
R64
NoPOP(1608)
R65
NoPOP(1608)
R31
0R0(1608)
R122
10k(1608)
CHK6
HK-1
VLOG2
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C63
ECJ-1VB1E105K
C11
0.1uf(1608)
P5R0VA
R118
2R0(2012)
IC7
ADL8304ARU
VNEG
PWDN
VSUM
INPT
VSUM
VPDB
VREF
ACOM
BFNG
VPS1
VOUT
VPS2
BFIN
VLOG
C52
0.01uf(1608)
VPDB2
R62
NoPOP(1608)
R30
0R0(1608)
R67
NoPOP(1608)
R27
0R0(1608)
R28
0R0(1608)
R29
0R0(1608)
C50
0.01uf(1608)
N2R0VA1
R26
0R0(1608)
C51
0.01uf(1608)
C10
0.1uf(1608)
R61
NoPOP(1608)
R63
NoPOP(1608)
C53
0.01uf(1608)
R134
NoPOP(2012)
C37
1000pf(1608)
R114
750-ohm(1608)
PD2
PIPDI550-050311I2
PD2-2
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Cathode
AGND0
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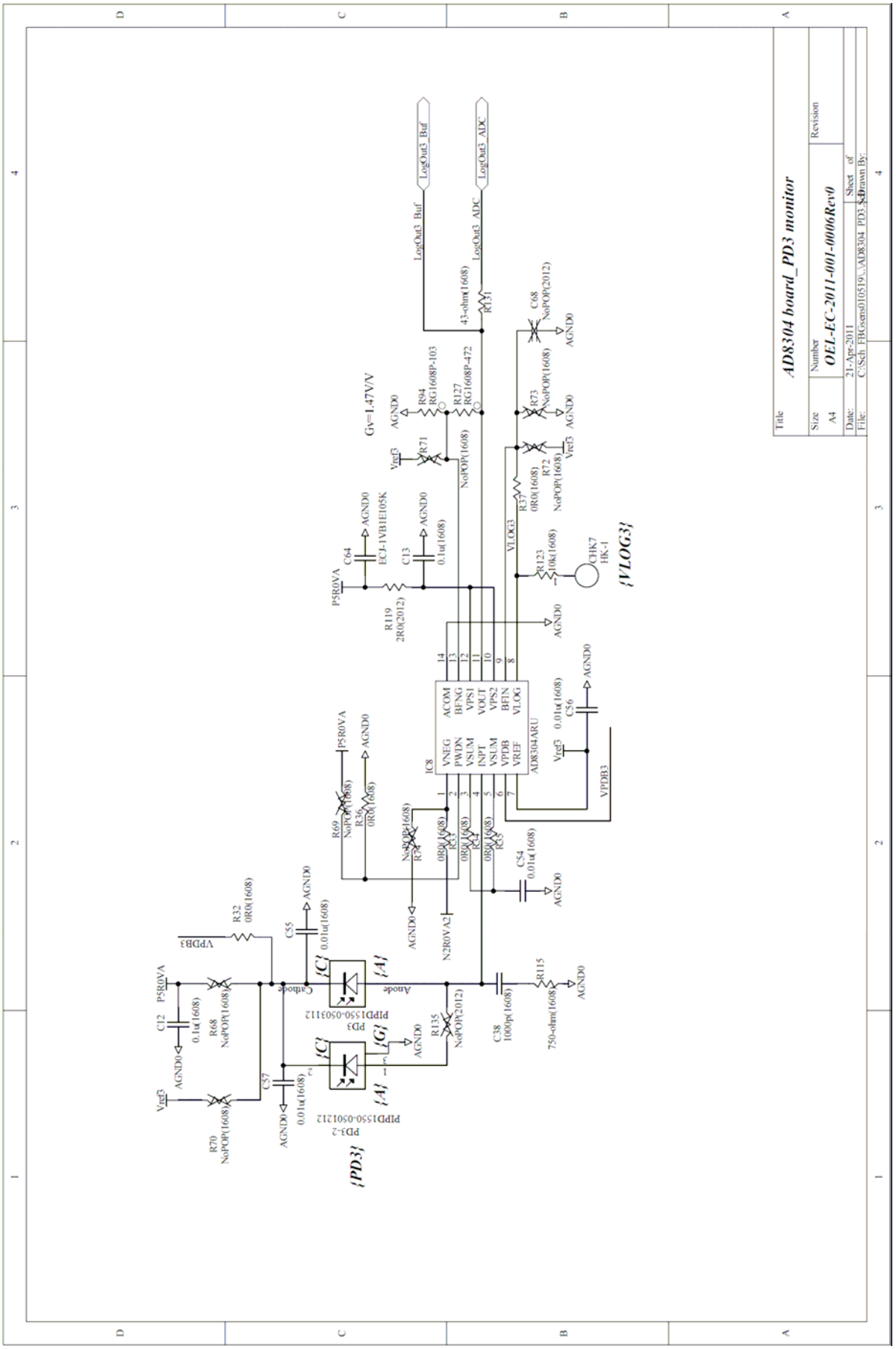
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BFIN
VLOG
VNEG
PWDN
VSLM
INPT
VSUM
VPDB
VREF
P5R0VA
VPDB3
N2R0VA2
AGND0
Vref3
PD3
PIPD1550-0503112
PD3-2
PIPD1550-0501212
Anode
Cathode
{A}
{C}
{G}
R32 0R0(1608)
R68 NoPOP(1608)
R70 NoPOP(1608)
C12 0.1u(1608)
C55 0.01u(1608)
C57 0.01u(1608)
R69 NoPOP(1608)
R36 0R0(1608)
R74 NoPOP(1608)
R53 0R0(1608)
R54 0R0(1608)
R55 0R0(1608)
C54 0.01u(1608)
C56 0.01u(1608)
C64 ECJ-1VB1E105K
C13 0.1u(1608)
R119 2R0(2012)
R94 RG1608P-103
R127 RG1608P-472
R135 NoPOP(2012)
R71 NoPOP(1608)
R131 43-ohm(1608)
R37 0R0(1608)
R72 NoPOP(1608)
R73 NoPOP(1608)
C68 NoPOP(2012)
R123 10k(1608)
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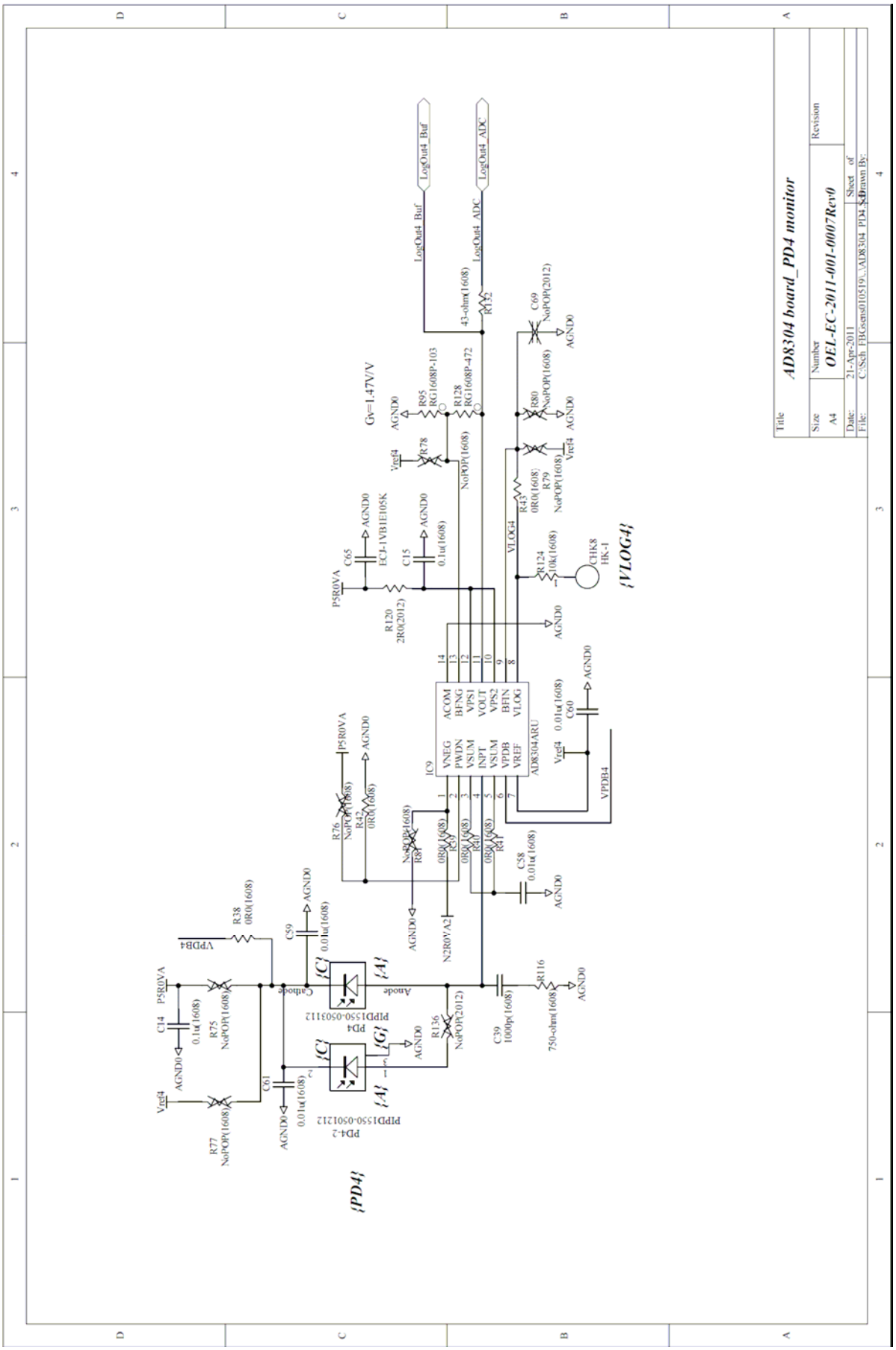
C38 1000p(1608)
R115 750-ohm(1608)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43-ohm(1608)
R132
RG1608P-103
R95
RG1608P-472
R128
NoPOP(1608)
R78
NoPOP(2012)
C69
NoPOP(1608)
R80
NoPOP(1608)
R79
0R0(1608)
R43
10k(1608)
R124
CHK8
HK-1
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VLOG4
AGND0
Vref4
P5R0VA
C65
ECJ-1VB1E105K
C15
0.1u(1608)
R120
2R0(2012)
IC9
AD8304ARU
VNEG
PWDN
VSUM
INPT
VSUM
VPDB
VREF
ACOM
BFNG
VPS1
VOUT
VPS2
BFIN
VLOG
C60
0.01u(1608)
VPDB4
C58
0.01u(1608)
R116
750-ohm(1608)
C39
1000pf(1608)
R136
NoPOP(2012)
N2R0VA2
R38
0R0(1608)
C59
0.01u(1608)
R76
NoPOP(1608)
R42
0R0(1608)
R69
0R0(1608)
R67
0R0(1608)
R41
0R0(1608)
R84
NoPOP(1608)
R75
NoPOP(1608)
C14
0.1u(1608)
R77
NoPOP(1608)
C61
0.01u(1608)
PD4
PIPD1550-0503112
PD4-2
PIPD1550-0501212
Anode
Cathode
{PD4}
{A}
{C}
{G}

2.2.10 Bill of Materials

Table 2–9 Bill of Material

Reference	Description	Value	Part #	MFG
C46-C61	ceramic capacitor(1608)	0.01uF	GRM188R71H103KA01D	Murata
C1-C15	ceramic capacitor(1608)	0.1uF	GRM188R71H104KA93D	Murata
C40-C43		NoPOP		
C40	film capacitor	0.22uF	ECH-U1H224GX9	Panasonic - ECG
C35-C39	ceramic capacitor(1608)	1000pF	GRM188R71H102KA01D	Murata
C16-C25,C44-C45	(1608)	NoPOP		
C66-C69	(2012)	NoPOP		
C33-C34	ceramic capacitor	22uF	JMK325BJ226MM-T	Taiyo Yuden
C30-32,C62-C65	ceramic capacitor	1uF	ECJ-1VB1E105K	Panasonic - ECG
C26-C29	ceramic capacitor	10uF	GRM32DR61C106KA01L	Murata
R9-R43	Resistor(1608)	0Ω	RK73Z1JTTD-RL	KOA
R109-R111	Resistor(2012)	0Ω	RK73Z2ATTD-RL	KOA
R121-R124,R1000,R1002	Resistor(1608)	10kΩ	RK73H1JTTD1002F	KOA
R44-R81,R1001	(1608)	NoPOP		
R133-R136	(2012)	NoPOP		
R100-R103	Resistor(1608)	1kΩ	RK73H1JTTD1001F	KOA
R112	Resistor(1608)	22Ω	RK73H1JTTD22R0F	KOA
R117-R120	Resistor(2012)	2Ω	RK73H2ATTD2R00F	KOA
R129-R132	Resistor(1608)	43Ω	RK73H1JTTD43R0F	KOA
R108	Resistor(1608)	510Ω	RK73H1JTTD5100F	KOA
R96-R99	Resistor(1608)	51Ω	RK73H1JTTD51R0F	KOA
R1-R4	Resistor(1608)	5.1Ω	RK73H1JTTD5R10F	KOA
R113-R116	Resistor(1608)	750Ω	RK73H1JTTD7500F	KOA
R82-R95	Resistor(1608)	10kΩ	RG1608P-103	SSM
R104-R105	Resistor(1608)	39kΩ	RG1608P-393	SSM
R125-R128	Resistor(1608)	4.7kΩ	RG1608P-472	SSM
R5-R8	Resistor(1608)	6.8kΩ	RG1608P-682	SSM
R106-R107	Resistor(2012)	160kΩ	RG2012P-164	SSM
D1-D6	schottkey diode		BAR42FILM	STM
D1000	diode		RB051L-40	ROHM
L1-L2	Inductor	10uH/1A	SDS680R-103M	API Delevan Inc
CN6-CN7	connector/2pin		5045-02A	Molex
CN1-CN5	connector/4pin		5045-04A	Molex
IC6-IC9	LogAmp		AD8304ARU	ADI
IC1-IC2	OP-Amp		LT6222IGN#PBF	LT
IC3	Negative Converter		LTC1983ES6-5#PBF	LT
IC4	3-T Regulator		ZLDO1117K33TC	Diodes Inc
IC5	Pulse Generator		SA555D	TI
PD1-PD4	Photo Diode	NoPop		
PD1-2 - PD4-2	Photo Diode	NoPop		
SW1	Switch		CHS-01B	COPAL
CHK1-CHK8	Check pin		HK-1	MacEight