Board Audio Inputs

P17

| 3 |
| 2 |
| 1 |

Header 3 — AudioIn1

P18

| 3 |
| 2 |
| 1 |

Header 3 — AudioIn2

GND

UI
BoardRev2_UI

SW[0..3]
LED[0..5]

SW[0..3]
LED[0..5]

5V

C1 0.1uF C2 0.1uF C3 0.1uF

GND

Board Audio Outputs

P1 Header 3

| 1 | 2 | 3 |

P2 Header 3

| 1 | 2 | 3 |

GND

U1

Pin	Name		Name	Pin
42	VDD		PB0	4	SW0
14	VDD		PB1	5	SW1
28	AVDD		PB2	6	SW2
			PB3	7	SW3
44	PA0/EXTCLK	LED0	PB4	8
45	PA1	LED1	PB5	9
46	PA2/TWI_SDA	LED2		
47	PA3/TWI_SCL	LED3	PC3	13
48	PA4/SPI_MOSI	LED4	PC2	12
1	PA5/SPI_MISO	LED5	PD1/AIN1	21
2	PA6/SPI_SCK		PD0/AIN0	20
3	PA7//SPI_SS/CLKOUT		PD7/AIN7/VREFA	27
			PD6/AIN6	26
10	PC0		PE3/AIN11	33
11	PC1		PE2/AIN10	32
23	PD3/AIN3			
22	PD2/AIN2		PE0/AIN8	30
16	PC4		PE1/AIN9	31
17	PC5		PD5/AIN5	25
18	PC6		PD4/AIN4	24
19	PC7			
			PF0/TOSC1	34
41	UPDI		PF1/TOSC2	35
			PF2/AIN12	36	TWI_SDA
43	GND		PF3/AIN13	37	TWI_SCL
29	GND		PF4/AIN14	38
15	GND		PF5/AIN15	39
			RESET/PF6	40

ATMEGA3209-AFR

P15

| 1 |
| 2 |

Header 2

For potential connections

For potential connections

P16

| 1 |
| 2 |

Header 2

For potential connections

Routing
BoardRev2_Routing

ReceiverOut1 — Routing_INA
ReceiverOut2 — Routing_INB

Routing_OUTA
Routing_OUTB

OUT1_RLY1+
OUT1_RLY1-
OUT1_RLY2+
OUT1_RLY2-
OUT2_RLY1+
OUT2_RLY1-
OUT2_RLY2+
OUT2_RLY2-

Receiver1
BoardRev2_Receiver

AudioIn1 — IN
ReceiverOut1 — OUT
9V_CTRL
12V_CTRL
RLY+
RLY-
PWR_SLT0
PWR_SLT1
PlateDetect0
PlateDetect1

5V

C4 0.1uF

Place near Relay Driver

GND

U2B

8	OUT3	VCC	1	5V
7	OUT4	IN3	4
6	GND	IN4	5

GND

Receiver2
BoardRev2_Receiver

IN — AudioIn2
OUT — ReceiverOut2
9V_CTRL
12V_CTRL
RLY+
RLY-
PWR_SLT0
PWR_SLT1
PlateDetect0
PlateDetect1

U2A

| 2 | IN1 | OUT1 | 10 |
| 3 | IN2 | OUT2 | 9 |

UPDI 6-Pin Header
for ICE Programmer

5V

C5 0.1uF

P3

2	1
4	3
6	5

Header 3X2

GND

GND

C7 0.1uF

100nF cap to ground as suggested by datasheet

GND

5V

C6 0.1uF

R1 4.7K R2 4.7K

P4

| 1 |
| 2 |
| 3 |
| 4 |

Header 4

GND

PWR
BoardRev2_PWR

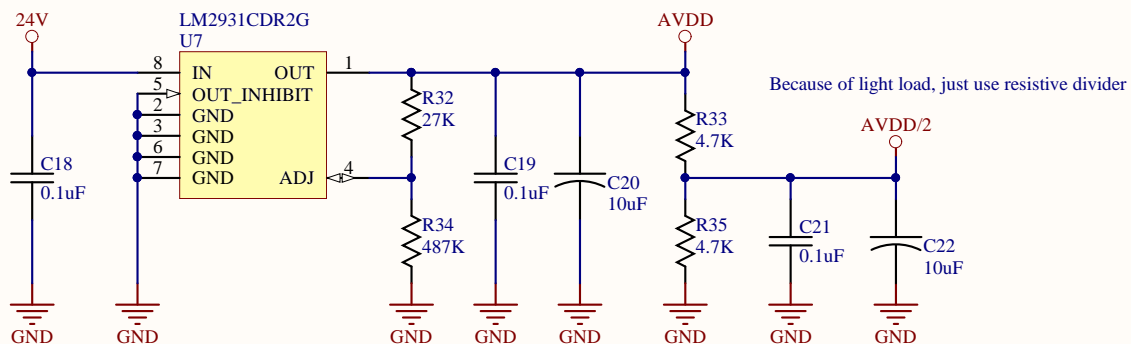| Title	BoardRev2		
Size A	Number		Revision
Date:	4/5/2019	Sheet	of
File:	C:\Users\..\BoardRev2.SchDoc	Drawn By:	

Global 24V input
Place Common Mode Choke on 24V input to take care of switching noise from power supply

24V

P19
1
2
Header 2

C16
0.1uF

C17
10uF

GND   GND

24V

LM2931CDR2G
U7

8 IN   OUT 1
5 OUT_INHIBIT
2 GND
3 GND
6 GND
7 GND   ADJ 4

C18
0.1uF

R32
27K

R34
487K

C19
0.1uF

C20
10uF

AVDD

Because of light load, just use resistive divider

R33
4.7K

AVDD/2

R35
4.7K

C21
0.1uF

C22
10uF

GND   GND   GND   GND   GND   GND   GND   GND   GND
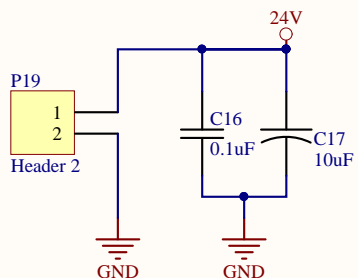
Local 5V supply for receiver and routing relays, uC, LEDs
TO-220 through hole: use >1A 7805

24V

U8
1 IN   OUT 3   5V
   GND
2
L7805CV

C23
0.1uF

C24
0.1uF

C25
10uF

GND
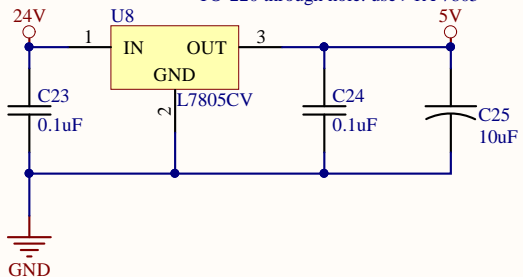
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BoardRev2_PWR		
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Adjustable Voltage Regulator

24V

U6 LM317T
3 IN   OUT 2
ADJ

C31
0.1uF
GND

R12
240

VCC

R11
10K

C30
10uF
GND

C15
0.1uF
GND

R13
2.8K

R14
5.6K

R15
3.3K

9V_CTRL
1
Q1
NX7002AK,215
2

3

12V_CTRL
1
Q2
NX7002AK,215
2

3

GND

PlateDetect0
PlateDetect1
PWR_SLT0
PWR_SLT1
VCC_CL

P5
1
2
3
4
5
6
7
8
9
10
11
12
Header 12

K5C
4
3
2
UD2-5SNU

SEND

IN

RETURN

K5B
7
6
5
OUT
UD2-5SNU

GND
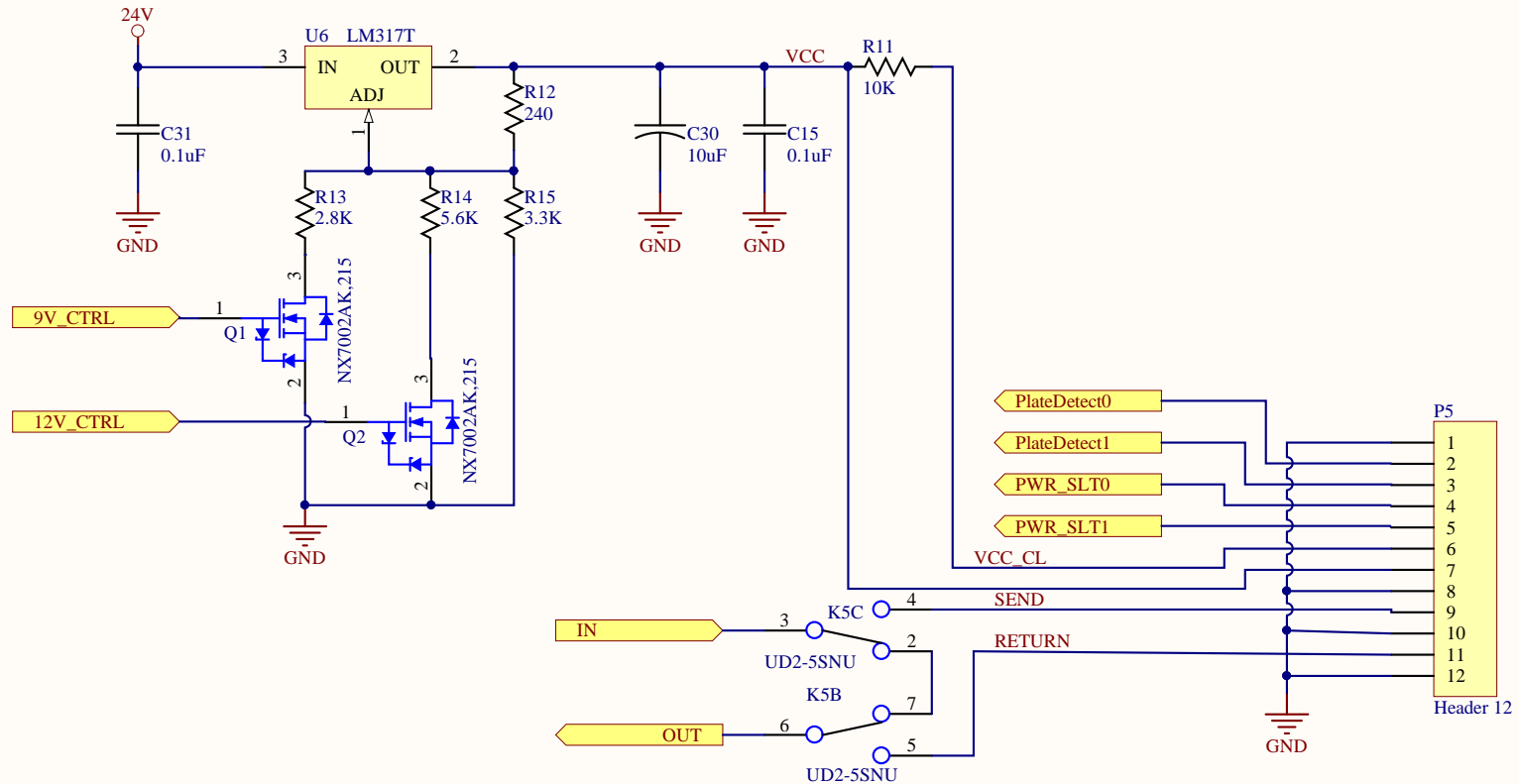
Relay driver on main page
to take advantage of dual driver

RLY+
C32
0.1uF
RLY-

1 S+/R- K5A
8 S-/R+ UD2-5SNU
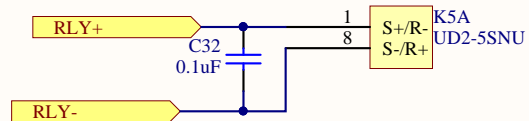
Title		
	BoardRev2_Receiver	

Size	Number		Revision
A			

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Routing_INA

UD2-5SNU

UD2-5SNU

Choose values to block below 10Hz
Fc = 7.23Hz

A

K1C   4
   2

C26
0.022uF

K4C   4
   2

U3A
OPA1679

A_buf

R3
10K

R4
10K

A+B_inv

R5
10K

R6
10K

A+B

R7
1M

Disconnect A from summer when
not needed to reduce loading
K1B + K4B form an OR gate

AVDD/2

R9
1M

U3B
OPA1679

B_buf

R8
10K

U3C
OPA1679

AVDD/2

AVDD

U3D
OPA1679

AVDD/2

C8
0.022uF

R10
1M

GND   GND

K1B
5
6

K2B
7   6   7

Routing_OUTA

UD2-5SNU

UD2-5SNU

OUTA	OUTB	K1	K2	K3	K4	Disconnect
A	A	0	0	1	0	1
A	B	0	0	0	0	1
A	A+B	0	0	X	0	0
B	A	0	1	1	0	0
B	B	0	1	0	0	1
B	A+B	0	1	X	0	0
A+B	A	1	X	1	0	0
A+B	B	1	X	0	0	0
A+B	A+B	1	X	X	1	0

K3B
5
7

K4B
6   7

Routing_OUTB

UD2-5SNU

UD2-5SNU

C9
0.022uF   B

Routing_INB

Balance Johnson noise and input impedance
Audio Capacitors must be plastic film (through hole 0.2" pitch)

Coils controlled from uC via dual H-Bridges

5V

OUT1_RLY1+

OUT1_RLY1-

1   VCC   OUT3   8
4   IN3   OUT4   7
5   IN4   GND   6

U4B

C11
0.1uF

K1A
1   S+/R-
8   S-/R+

UD2-5SNU

GND

AVDD

C10
0.1uF

AVDD/2

C27
0.1uF

GND

5V

C12
0.1uF

GND

OUT1_RLY2+
OUT1_RLY2-

2   IN1   OUT1   10
3   IN2   OUT2   9

U4A

C28
0.1uF

K2A
1   S+/R-
8   S-/R+

UD2-5SNU
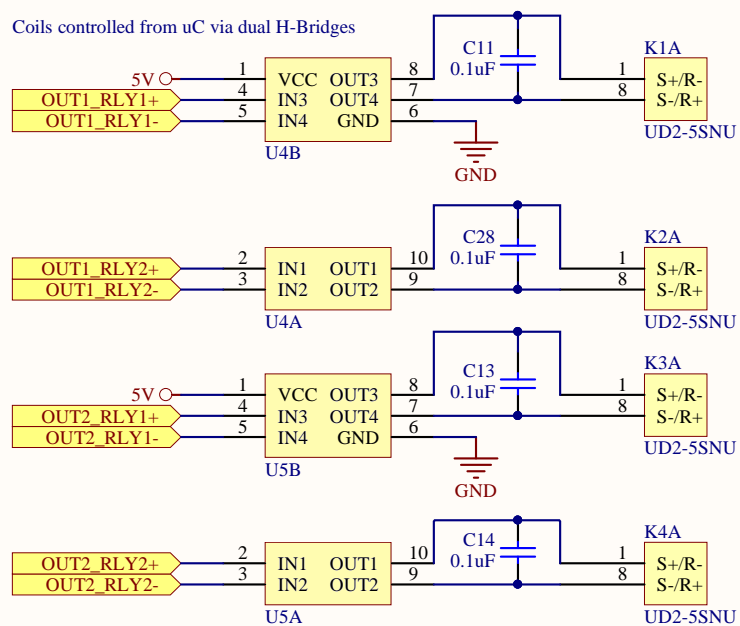
Ground unused relay contacts

3
4
K2C
2   UD2-5SNU

3
4
K3C
2   UD2-5SNU

GND

5V

OUT2_RLY1+
OUT2_RLY1-

1   VCC   OUT3   8
4   IN3   OUT4   7
5   IN4   GND   6

U5B

C13
0.1uF

K3A
1   S+/R-
8   S-/R+

UD2-5SNU

GND

5V

C29
0.1uF

GND

OUT2_RLY2+
OUT2_RLY2-

2   IN1   OUT1   10
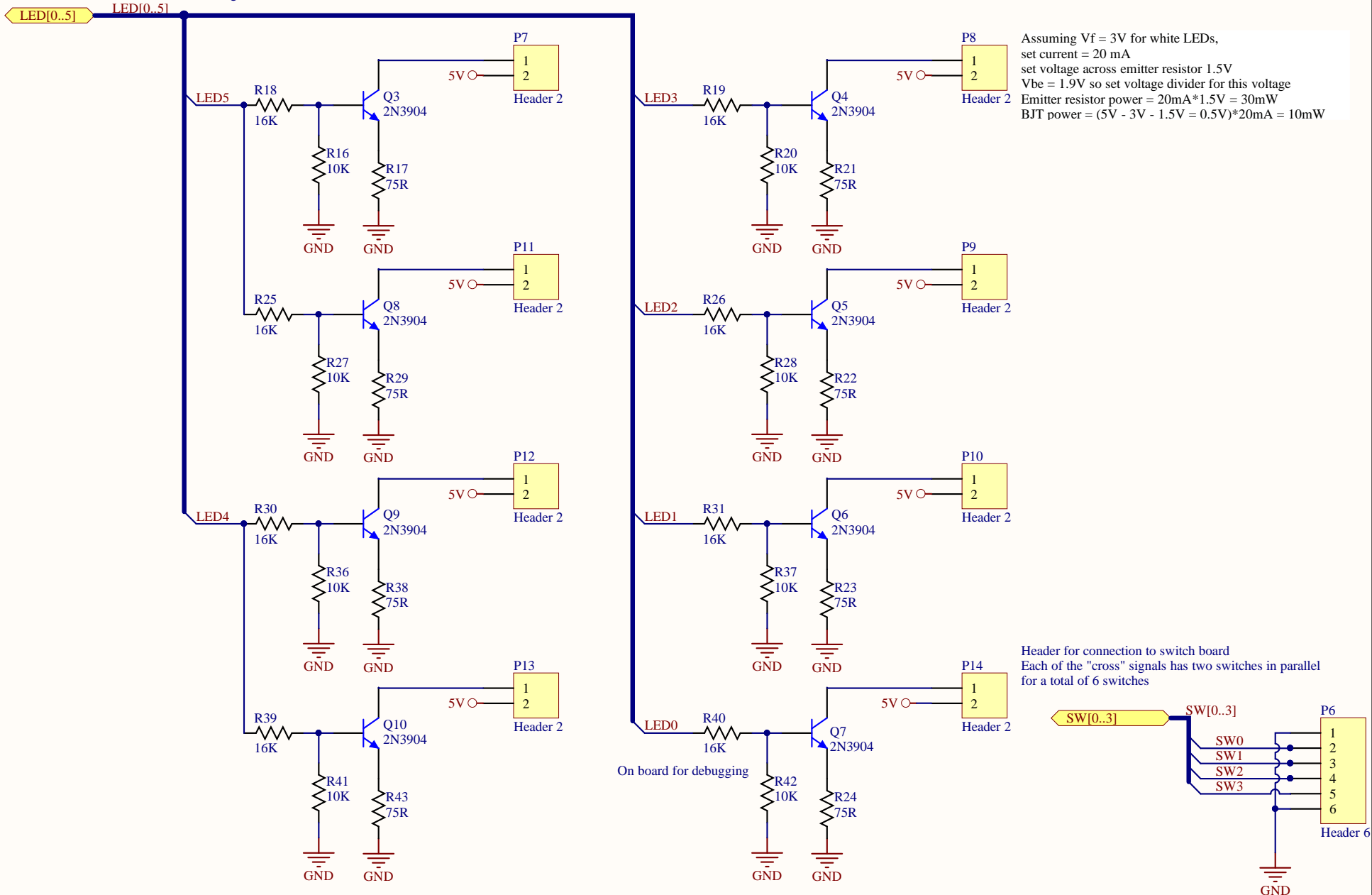3   IN2   OUT2   9

U5A
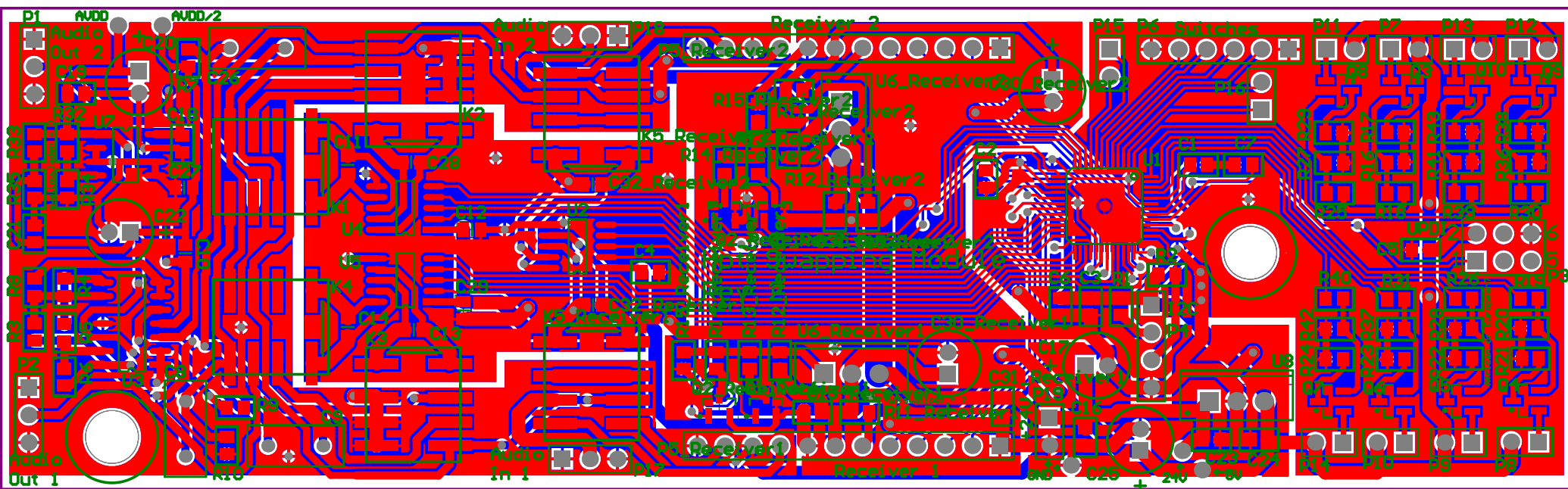
C14
0.1uF

K4A
1   S+/R-
8   S-/R+

UD2-5SNU
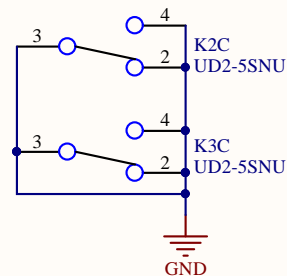
Put footprint for capacitor in parallel to relay switching signal
to provide path for current to discharge (may introduce oscillations)
depop at first

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	BoardRev2_Routing

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Individual headers for Plexiglass mounted LEDs

LED[0..5]

LED[0..5]

Assuming Vf = 3V for white LEDs,
set current = 20 mA
set voltage across emitter resistor 1.5V
Vbe = 1.9V so set voltage divider for this voltage
Emitter resistor power = 20mA*1.5V = 30mW
BJT power = (5V - 3V - 1.5V = 0.5V)*20mA = 10mW

LED5   R18   16K   Q3 2N3904   R16 10K   R17 75R   GND   GND
P7   5V   1 2   Header 2

LED3   R19   16K   Q4 2N3904   R20 10K   R21 75R   GND   GND
P8   5V   1 2   Header 2

LED2   R26   16K   Q5 2N3904   R28 10K   R22 75R   GND   GND
P9   5V   1 2   Header 2

LED   R25   16K   Q8 2N3904   R27 10K   R29 75R   GND   GND
P11   5V   1 2   Header 2

LED4   R30   16K   Q9 2N3904   R36 10K   R38 75R   GND   GND
P12   5V   1 2   Header 2

LED1   R31   16K   Q6 2N3904   R37 10K   R23 75R   GND   GND
P10   5V   1 2   Header 2

R39   16K   Q10 2N3904   R41 10K   R43 75R   GND   GND
P13   5V   1 2   Header 2

LED0   R40   16K   Q7 2N3904   R42 10K   R24 75R   GND   GND
P14   5V   1 2   Header 2

On board for debugging

Header for connection to switch board
Each of the "cross" signals has two switches in parallel
for a total of 6 switches

SW[0..3]   SW[0..3]
SW0
SW1
SW2
SW3

P6
1
2
3
4
5
6
Header 6

GND

Title
BoardRev2_UI

Size
A

Number

Revision

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Comment	Description	Designator	Footprint	LibRef	Quantity
0.1uF		C1, C2, C3, C4, C5, C6, C7, C15_Receiver1, C15_Receiver2, C16, C18, C19, C21, C23, C24, C31_Receiver1, C31_Receiver2	0805	Cap	17
0.022uF		C8, C9, C26	RAD-0.2	Cap	3
Cap	Capacitor	C10, C11, C12, C13, C14, C27, C28, C29, C32_Receiver1, C32_Receiver2	6-0805_L	Cap	10
10uF		C17, C20, C22, C25, C30_Receiver1, C30_Receiver2	CapPol_2mmPitch	CAP_pol	6
UD2-5SNU	5V Single Coil Latching Relay Surface Mount DPDT	K1, K2, K3, K4, K5_Receiver1, K5_Receiver2	UD2-5SNURelay	UD2-5SNU	6
Header 3	Header, 3-Pin	P1, P2, P17, P18	HDR1X3	Header 3	4
Header 3X2	Header, 3-Pin, Dual row	P3	HDR2X3	Header 3X2	1
Header 4	Header, 4-Pin	P4	HDR1X4	Header 4	1
Header 12	Header, 12-Pin	P5_Receiver1, P5_Receiver2	HDR1X12	Header 12	2
Header 6	Header, 6-Pin	P6	HDR1X6	Header 6	1
Header 2	Header, 2-Pin	P7, P8, P9, P10, P11, P12, P13, P14, P15, P16, P19	HDR1X2	Header 2	11
NX7002AK,215	Single N-Channel Trench MOSFET, 60 V, -55 to 150 degC, 3-Pin SOT23, Tape and Reel	Q1_Receiver1, Q1_Receiver2, Q2_Receiver1, Q2_Receiver2	NXP-SOT23_N	NX7002AK,215	4
2N3904	NPN General Purpose Amplifier	Q3, Q4, Q5, Q6, Q7, Q8, Q9, Q10	SOT23_M	2N3904	8
4.7K		R1, R2, R33, R35	0805	Res	4
10K		R3, R4, R5, R6, R8, R11_Receiver1, R11_Receiver2, R16, R20, R27, R28, R36, R37, R41, R42	0805	Res	15
1M		R7, R9, R10	0805	Res	3
240		R12_Receiver1, R12_Receiver2	0805	Res	2
2.8K		R13_Receiver1, R13_Receiver2	0805	Res	2
5.6K		R14_Receiver1, R14_Receiver2	0805	Res	2
3.3K		R15_Receiver1, R15_Receiver2	0805	Res	2
75R		R17, R21, R22, R23, R24, R29, R38, R43	0805	Res	8
16K		R18, R19, R25, R26, R30, R31, R39, R40	0805	Res	8
27K		R32	0805	Res	1
487K		R34	0805	Res	1
ATMEGA3209-AFR	IC MCU 8BIT 32KB FLASH 48TQFP	U1	TQFP48	ATMEGA3209-AFR	1
LV8548MC	Motor Driver Dual H-Bridge, Forward/Reverse, Low Saturation Voltage	U2, U4, U5	SOIC10	LV8548MC	3
OPA1679		U3	SOIC14	OPA1679	1
LM317T	1.5A, 1.2V to 37V Adjustable Voltage Regulator, 3-Pin TO-220	U6_Receiver1, U6_Receiver2	TO-220	LM317T	2
LM2931CDR2G		U7	SOIC8	LM2931CDR2G	1
L7805CV	Positive Voltage Regulator, 5V, 3-Pin TO-220	U8	TO220	L7805CV	1