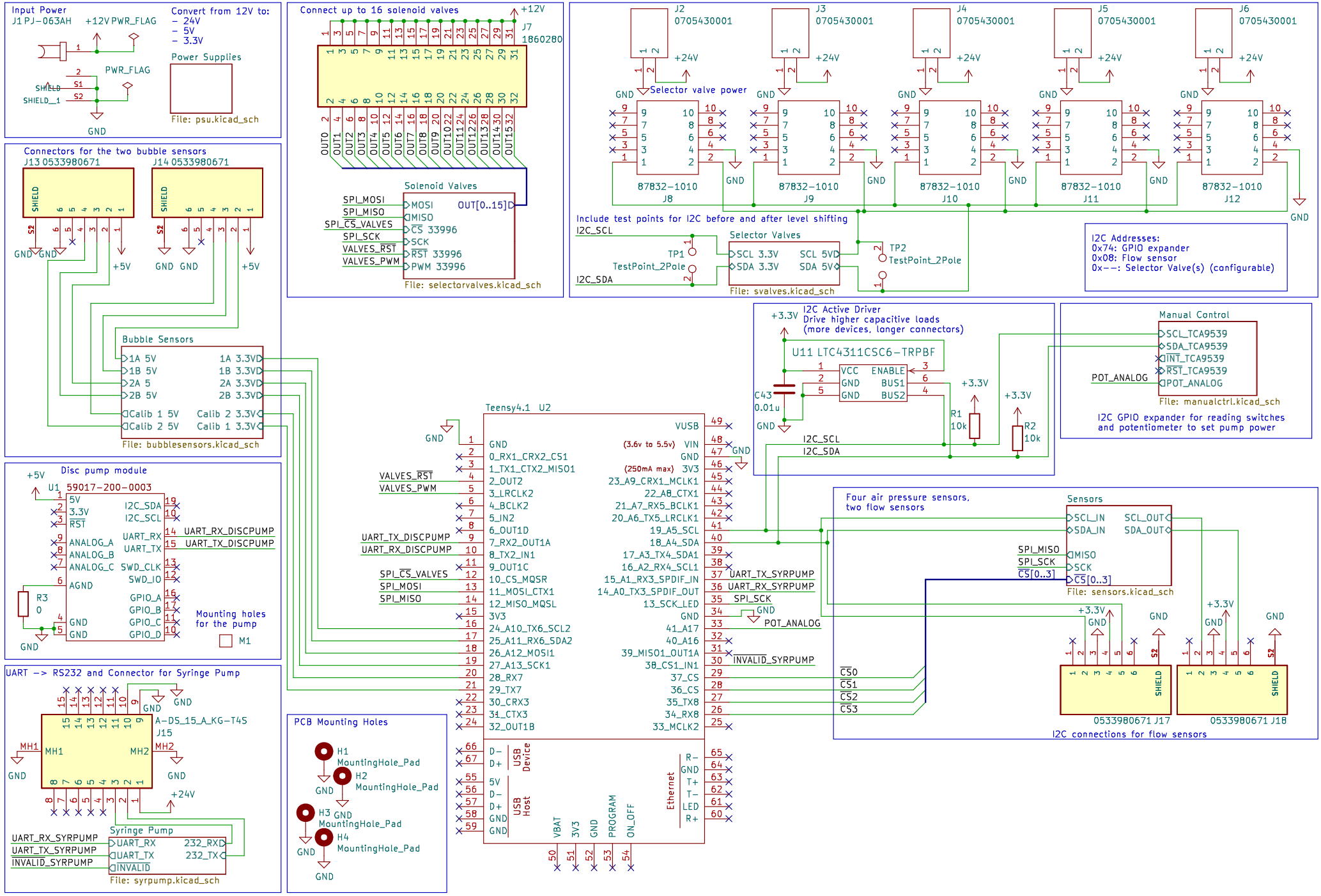
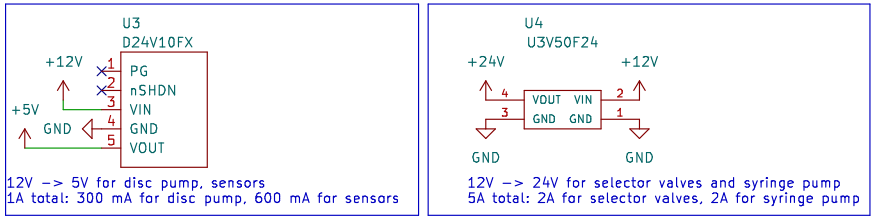
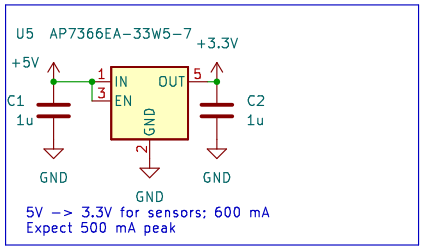
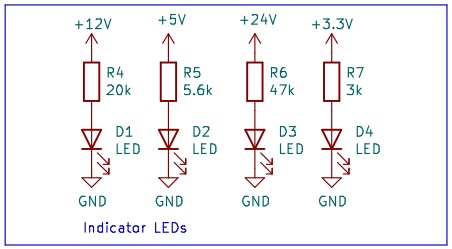
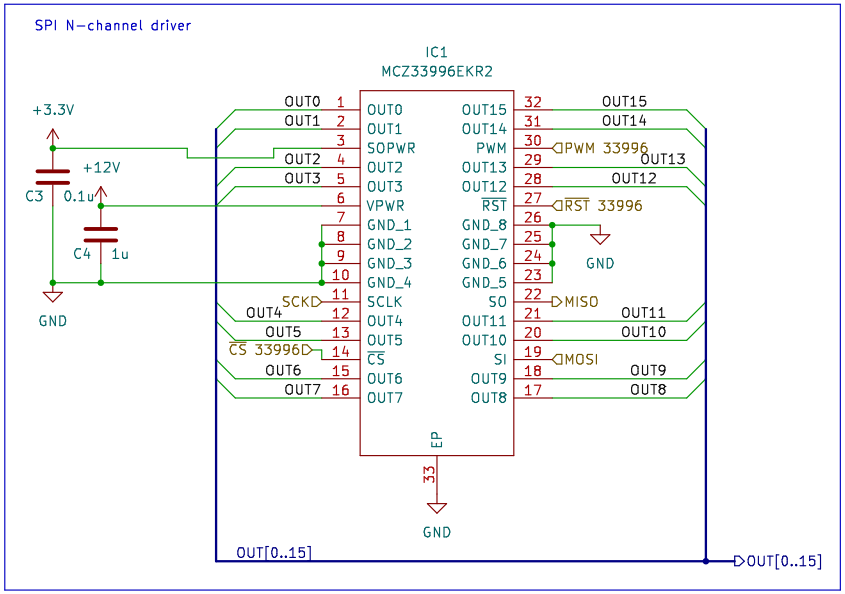

Input Power
J1 PJ-063AH
+12V PWR_FLAG
PWR_FLAG
SHIELD
SHIELD_1
S1
S2
GND
Convert from 12V to:
- 24V
- 5V
- 3.3V
Power Supplies
File: psu.kicad_sch
Connect up to 16 solenoid valves
+12V
J7
1860280
OUT0 OUT1 OUT2 OUT3 OUT4 OUT5 OUT6 OUT7 OUT8 OUT9 OUT10 OUT11 OUT12 OUT13 OUT14 OUT15
Solenoid Valves
SPI_MOSI
SPI_MISO
SPI_CS_VALVES
SPI_SCK
VALVES_RST
VALVES_PWM
MOSI
MISO
CS 33996
SCK
RST 33996
PWM 33996
OUT[0..15]
File: selectorvalves.kicad_sch
J2 0705430001
J3 0705430001
J4 0705430001
J5 0705430001
J6 0705430001
+24V
GND
Selector valve power
87832-1010
J8
J9
J10
J11
J12
Include test points for I2C before and after level shifting
I2C_SCL
I2C_SDA
TP1
TP2
TestPoint_2Pole
Selector Valves
SCL 3.3V
SDA 3.3V
SCL 5V
SDA 5V
File: svalves.kicad_sch
I2C Addresses:
0x74: GPIO expander
0x08: Flow sensor
0x--: Selector Valve(s) (configurable)
Connectors for the two bubble sensors
J13 0533980671
J14 0533980671
SHIELD
S2
GND
+5V
Bubble Sensors
1A 5V
1B 5V
2A 5
2B 5V
Calib 1 5V
Calib 2 5V
1A 3.3V
1B 3.3V
2A 3.3V
2B 3.3V
Calib 2 3.3V
Calib 1 3.3V
File: bubblesensors.kicad_sch
+3.3V
I2C Active Driver
Drive higher capacitive loads
(more devices, longer connectors)
U11 LTC4311CSC6-TRPBF
VCC
ENABLE
GND
BUS1
BUS2
C43
0.01u
R1
10k
R2
10k
Manual Control
SCL_TCA9539
SDA_TCA9539
INT_TCA9539
RST_TCA9539
POT_ANALOG
File: manualctrl.kicad_sch
I2C GPIO expander for reading switches
and potentiometer to set pump power
Disc pump module
U1 59017-200-0003
5V
3.3V
RST
ANALOG_A
ANALOG_B
ANALOG_C
AGND
I2C_SDA
I2C_SCL
UART_RX
UART_TX
SWD_CLK
SWD_IO
GPIO_A
GPIO_B
GPIO_C
GPIO_D
UART_RX_DISCPUMP
UART_TX_DISCPUMP
R3
0
Mounting holes
for the pump
M1
Teensy4.1 U2
VUSB
VIN
3V3
GND
0_RX1_CRX2_CS1
1_TX1_CTX2_MISO1
2_OUT2
3_LRCLK2
4_BCLK2
5_IN2
6_OUT1D
7_RX2_OUT1A
8_TX2_IN1
9_OUT1C
10_CS_MQSR
11_MOSI_CTX1
12_MISO_MQSL
3V3
24_A10_TX6_SCL2
25_A11_RX6_SDA2
26_A12_MOSI1
27_A13_SCK1
28_RX7
29_TX7
30_CRX3
31_CTX3
32_OUT1B
23_A9_CRX1_MCLK1
22_A8_CTX1
21_A7_RX5_BCLK1
20_A6_TX5_LRCLK1
19_A5_SCL
18_A4_SDA
17_A3_TX4_SDA1
16_A2_RX4_SCL1
15_A1_RX3_SPDIF_IN
14_A0_TX3_SPDIF_OUT
13_SCK_LED
41_A17
40_A16
39_MISO1_OUT1A
38_CS1_IN1
37_CS
36_CS
35_TX8
34_RX8
33_MCLK2
USB Device
USB Host
Ethernet
VBAT
PROGRAM
ON_OFF
VALVES_RST
VALVES_PWM
UART_TX_DISCPUMP
UART_RX_DISCPUMP
SPI_CS_VALVES
SPI_MOSI
SPI_MISO
UART_TX_SYRPUMP
UART_RX_SYRPUMP
SPI_SCK
POT_ANALOG
INVALID_SYRPUMP
Four air pressure sensors,
two flow sensors
Sensors
SCL_IN
SDA_IN
SCL_OUT
SDA_OUT
SPI_MISO
SPI_SCK
CS[0..3]
File: sensors.kicad_sch
0533980671 J17
0533980671 J18
I2C connections for flow sensors
UART -> RS232 and Connector for Syringe Pump
A-DS_15_A_KG-T4S
J15
MH1
MH2
+24V
Syringe Pump
UART_RX_SYRPUMP
UART_TX_SYRPUMP
INVALID_SYRPUMP
UART_RX
UART_TX
INVALID
232_RXD
232_TX
File: syrpump.kicad_sch
PCB Mounting Holes
H1 MountingHole_Pad
H2 MountingHole_Pad
H3 MountingHole_Pad
H4 MountingHole_Pad

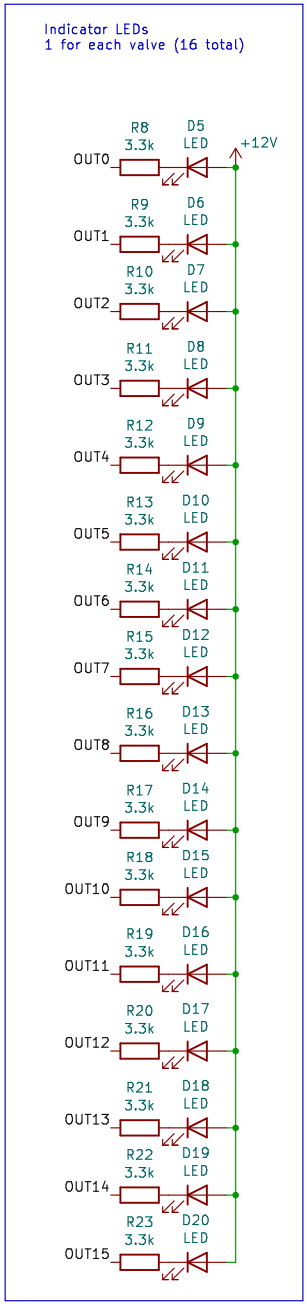

U3
D24V10FX
+12V
+5V
GND
PG
nSHDN
VIN
GND
VOUT
1
2
3
4
5
12V –> 5V for disc pump, sensors
1A total: 300 mA for disc pump, 600 mA for sensors

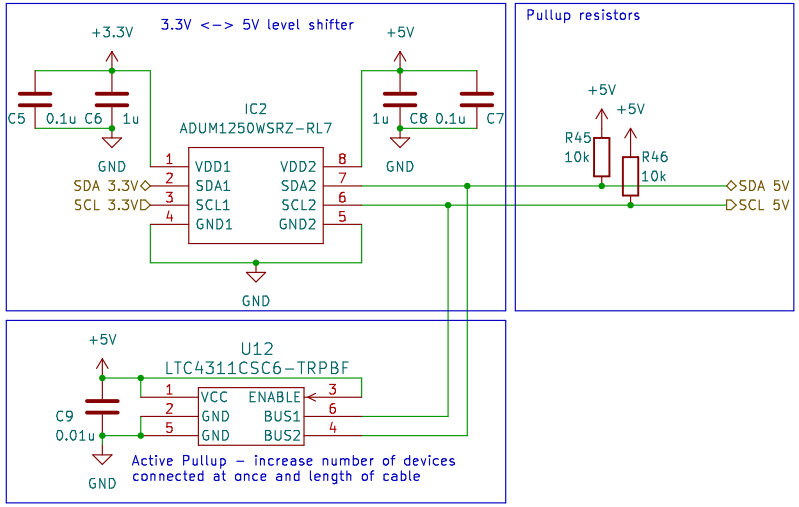
U4
U3V50F24
+24V
+12V
VOUT
VIN
GND
GND
4
3
2
1
GND
GND
12V –> 24V for selector valves and syringe pump
5A total: 2A for selector valves, 2A for syringe pump

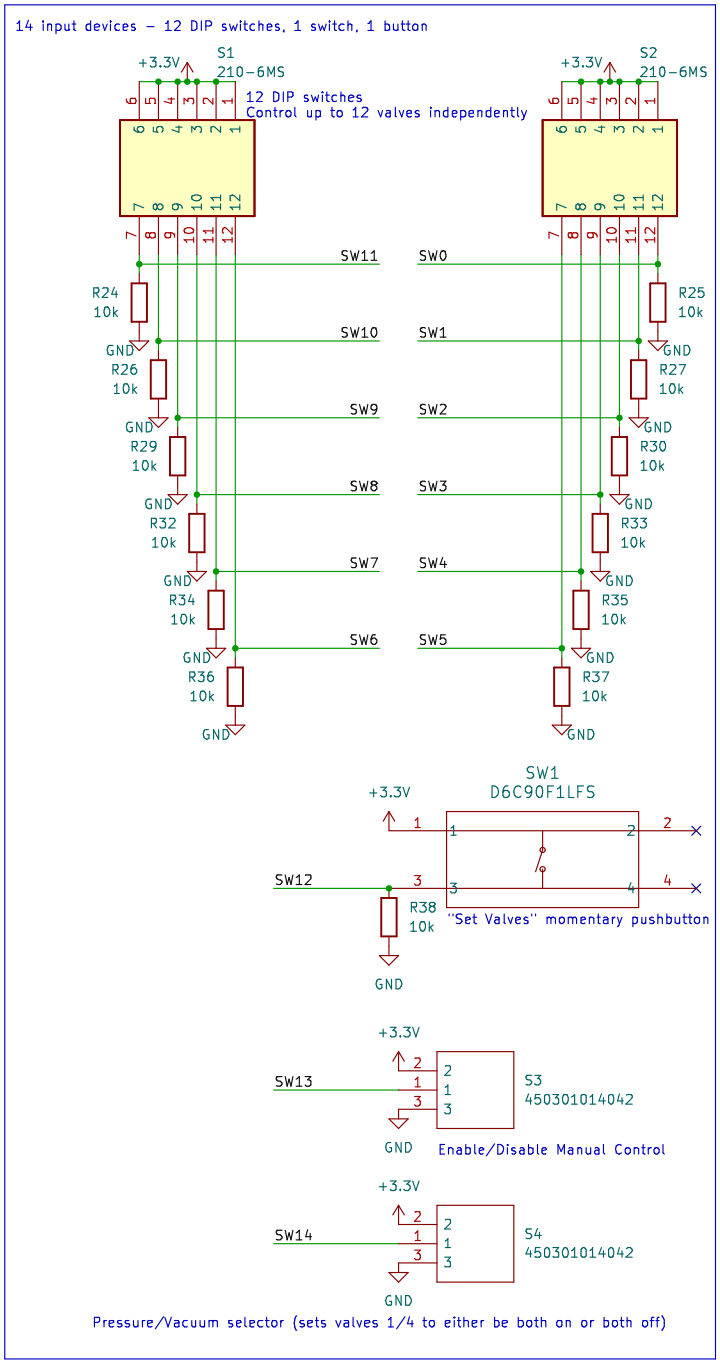

U5 AP7366EA-33W5-7
+3.3V
+5V
C1
1u
IN
EN
OUT
GND
C2
1u
1
3
5
2
GND
GND
GND
5V –> 3.3V for sensors; 600 mA
Expect 500 mA peak

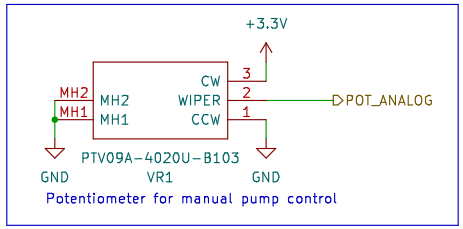

+12V
+5V
+24V
+3.3V
R4
20k
R5
5.6k
R6
47k
R7
3k
D1
LED
D2
LED
D3
LED
D4
LED
GND
GND
GND
GND
Indicator LEDs

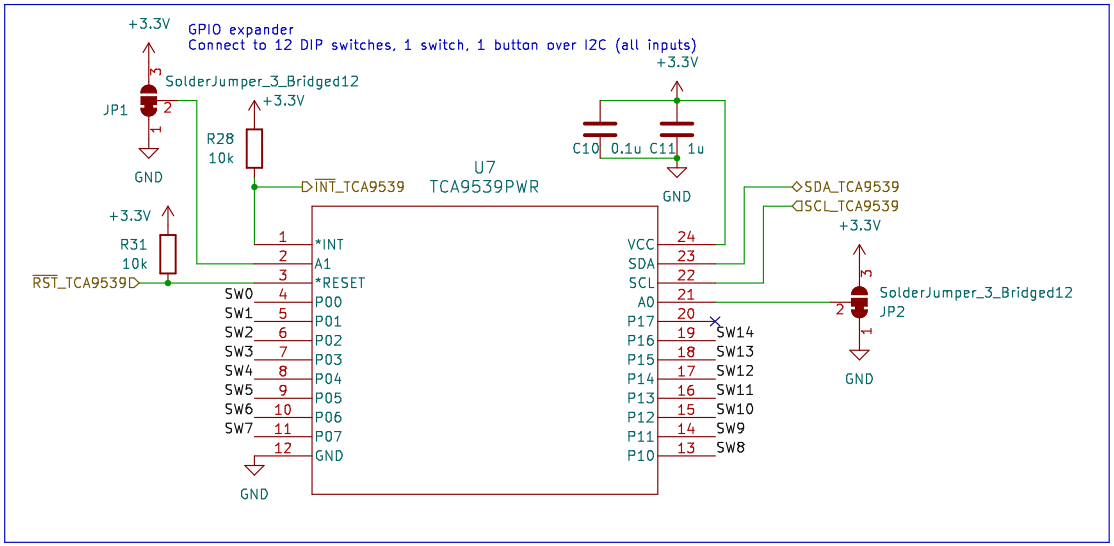

SPI N-channel driver
IC1
MCZ33996EKR2
+3.3V
+12V
C3
0.1u
C4
1u
GND
OUT0
OUT1
SOPWR
OUT2
OUT3
VPWR
GND_1
GND_2
GND_3
GND_4
SCLK
OUT4
OUT5
CS
OUT6
OUT7
OUT15
OUT14
PWM
OUT13
OUT12
RST
GND_8
GND_7
GND_6
GND_5
SO
OUT11
OUT10
SI
OUT9
OUT8
EP
33
SCKD
CS 33996
PWM 33996
RST 33996
MISO
MOSI
OUT[0..15]

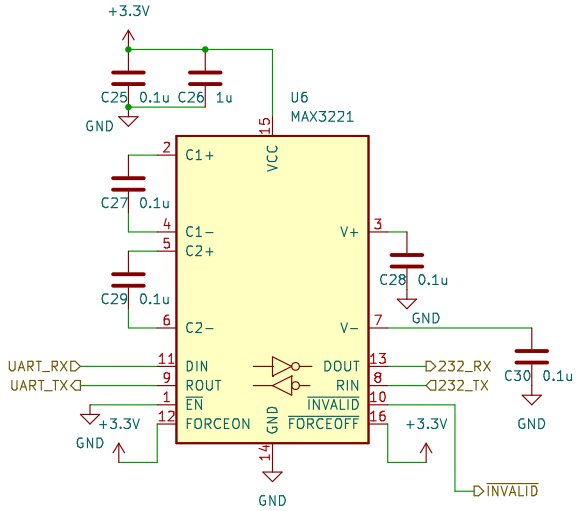

Indicator LEDs
1 for each valve (16 total)
+12V
R8 3.3k
D5 LED
OUT0
R9 3.3k
D6 LED
OUT1
R10 3.3k
D7 LED
OUT2
R11 3.3k
D8 LED
OUT3
R12 3.3k
D9 LED
OUT4
R13 3.3k
D10 LED
OUT5
R14 3.3k
D11 LED
OUT6
R15 3.3k
D12 LED
OUT7
R16 3.3k
D13 LED
OUT8
R17 3.3k
D14 LED
OUT9
R18 3.3k
D15 LED
OUT10
R19 3.3k
D16 LED
OUT11
R20 3.3k
D17 LED
OUT12
R21 3.3k
D18 LED
OUT13
R22 3.3k
D19 LED
OUT14
R23 3.3k
D20 LED
OUT15


3.3V <-> 5V level shifter
+3.3V
+5V
C5
0.1u
C6
1u
IC2
ADUM1250WSRZ-RL7
1u
C8
0.1u
C7
GND
GND
SDA 3.3V
SCL 3.3V
VDD1
SDA1
SCL1
GND1
VDD2
SDA2
SCL2
GND2
GND
Pullup resistors
+5V
+5V
R45
10k
R46
10k
SDA 5V
SCL 5V
+5V
U12
LTC4311CSC6-TRPBF
C9
0.01u
VCC
GND
GND
ENABLE
BUS1
BUS2
GND
Active Pullup – increase number of devices
connected at once and length of cable

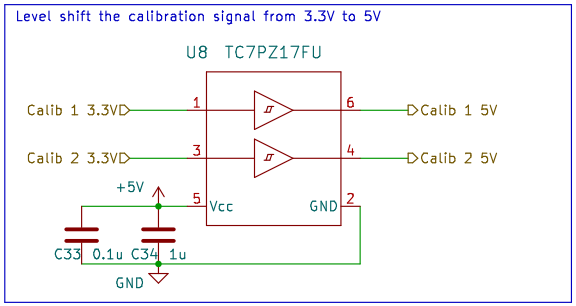

14 input devices – 12 DIP switches, 1 switch, 1 button
S1
210-6MS
12 DIP switches
Control up to 12 valves independently
S2
210-6MS
+3.3V
SW11
SW0
SW10
SW1
SW9
SW2
SW8
SW3
SW7
SW4
SW6
SW5
R24 10k
R25 10k
R26 10k
R27 10k
R29 10k
R30 10k
R32 10k
R33 10k
R34 10k
R35 10k
R36 10k
R37 10k
GND
SW1
D6C90F1LFS
SW12
R38 10k
"Set Valves" momentary pushbutton
SW13
S3
450301014042
Enable/Disable Manual Control
SW14
S4
450301014042
Pressure/Vacuum selector (sets valves 1/4 to either be both on or both off)

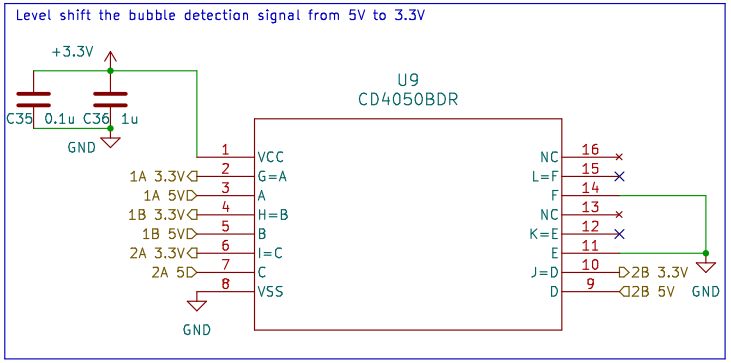

+3.3V
MH2
MH1
CW
WIPER
CCW
POT_ANALOG
PTV09A-4020U-B103
GND
VR1
GND
Potentiometer for manual pump control

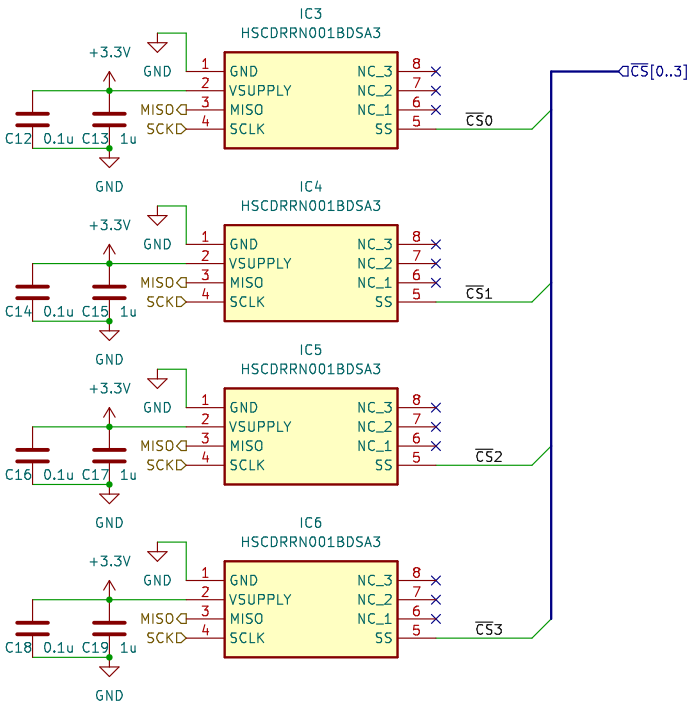

GPIO expander
Connect to 12 DIP switches, 1 switch, 1 button over I2C (all inputs)
+3.3V
JP1
SolderJumper_3_Bridged12
R28 10k
INT_TCA9539
U7
TCA9539PWR
C10 0.1u
C11 1u
R31 10k
RST_TCA9539
SDA_TCA9539
SCL_TCA9539
JP2
SolderJumper_3_Bridged12
*INT
A1
*RESET
P00
P01
P02
P03
P04
P05
P06
P07
VCC
SDA
SCL
A0
P17
P16
P15
P14
P13
P12
P11
P10
SW0
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW14
SW13
SW12
SW11
SW10
SW9
SW8

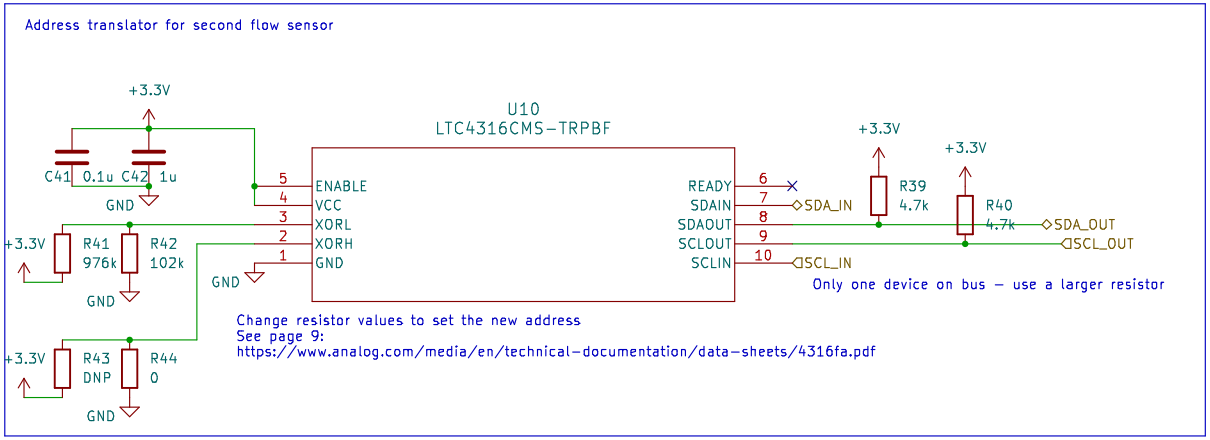


Convert from 3.3V UART to RS232


Level shift the calibration signal from 3.3V to 5V
U8 TC7PZ17FU
Calib 1 3.3V
Calib 2 3.3V
Calib 1 5V
Calib 2 5V
+5V
Vcc
GND
C33 0.1u
C34 1u
GND


Level shift the bubble detection signal from 5V to 3.3V
+3.3V
C35 0.1u
C36 1u
GND
U9
CD4050BDR
VCC
G=A
A
H=B
B
I=C
C
VSS
1A 3.3V
1A 5V
1B 3.3V
1B 5V
2A 3.3V
2A 5V
GND
NC
L=F
F
NC
K=E
E
J=D
D
2B 3.3V
2B 5V
GND


IC3
HSCDRRN001BDSA3
IC4
HSCDRRN001BDSA3
IC5
HSCDRRN001BDSA3
IC6
HSCDRRN001BDSA3
+3.3V
GND
MISO
SCKD
C12 0.1u C13 1u
C14 0.1u C15 1u
C16 0.1u C17 1u
C18 0.1u C19 1u
CS0
CS1
CS2
CS3
CS[0..3]


Address translator for second flow sensor
U10
LTC4316CMS-TRPBF
+3.3V
C41 0.1u C42 1u
GND
R41 976k
R42 102k
R43 DNP
R44 0
ENABLE
VCC
XORL
XORH
GND
READY
SDAIN
SDAOUT
SCLOUT
SCLIN
SDA_IN
SCL_IN
R39 4.7k
R40 4.7k
SDA_OUT
SCL_OUT
Only one device on bus — use a larger resistor
Change resistor values to set the new address
See page 9:
https://www.analog.com/media/en/technical-documentation/data-sheets/4316fa.pdf