Power distribution

+24V input with optional redundancy

J1 — D1 STPS15H100CB — R3 DNP — F1 DNP — R4 0 — C2 100uF 50V AlPoly — D23 DNP — R10 10 — R11 0 — C6 100uF 50V AlPoly — TP3 +24V — TP5 +24VA — TP6 GND — TP7 GNDPWR

TVS clamps @ 39V max @ 15A, vs. cap ratings of 50V, LMZ14203 abs-max rating of 43V

Optional quiet +24V input — J2

Filtering for "quiet" +24V sensor power
LPF fc = 159 Hz

Optional onboard 5V supplies

+5V input, critical (CPLD, sensing) — J3 — TP1 — F2 50mA 15V — R5 1 — TP4 +5VA — C3 10uF 50V X7S — C112 100uF 50V AlPoly

3.6 – 30 ohms (<0.5V drop @ 16 mA)
100 ms trip time max. @ 500 mA
Fault current 150 mA max.

Filtering for "quiet" +5V analog power

+5V input, non-critical (Raspberry Pi) — J4

R12 10K — RPi_En — Sheet: 5V Regulator (RPi) — File: 5V_reg.sch

R13 10K — D3 5.1V — Sheet: 5V Regulator (other) — File: 5V_reg.sch

Sensor Inputs

Connections to daughterboard with digital pressure sensors

J17 — CPLD_SDA, CPLD_SCL — +3.3V

J18 — RPi_SDA, RPi_SCL — +3.3V_RPi

Pressure sensor daughterboard — U10

Both sensor fuses:
3.6 – 50 ohms (<0.5V drop @ 10 mA)
1.5 s trip time max. @ 250 mA
Fault current 150 mA max.

Pressure sensor input (Omega PXM309) 0–10V output, 10 mA draw on +24VA — J5 — F4 50mA 60V — Sheet: Pressure Sensor Input 1 — RPi_ADC0, CPLD_ADC0, Pressure1_Lim_H_Alarm, Pressure1_Lim_L_Alarm — File: sensor_input.sch

Pressure sensor input (Omega PXM309) 0–10V output, 10 mA draw on +24VA — J6 — F5 50mA 60V — Sheet: Pressure Sensor Input 2 — RPi_ADC1, CPLD_ADC1, Pressure2_Lim_H_Alarm, Pressure2_Lim_L_Alarm — File: sensor_input.sch

Oxygen sensor input (Teledyne C44611-R22MED?) 7 mV (0%)–13 mV (100% O2) output — J7 — Sheet: Oxygen Sensor Input — RPi_ADC2, CPLD_ADC2, O2_Lim_H_Alarm, O2_Lim_L_Alarm — File: sensor_input_lowlevel.sch

Voltage reference for limit comparators

5 mA from +5VA — R1 1K, R2 1K — U1 TL431A — +2V5 — TP2 — DNP C1

Power rail sensing

Populate if not using the valve driver current sense

DNP (10K) R6, DNP (10K) R7 — CPLD_ADC6 — (2:1) +5V in = +2.5V out — C4 10nF 50V NPO — LPF fc = 3 kHz

10K R8, 1K R9 — CPLD_ADC7 — (11:1) +24V in = 2.182V out — C5 10nF 50V NPO — LPF fc = 18 kHz

Controls and ADC

TP8 GND

LPF fc = 14 kHz

1uF 16V X7R C9 — 100nF 50V X7R C10 — R18 10 — +3.3V_RPi

U3 ADC128D818 — I2C address 0011101 <2 mA current draw active

R21 DNP, R23 DNP, R24 DNP — TP13, TP15 — RPi_SDA, RPi_SCL

R29 1.5K — D9 Orange

Raspberry Pi (GPIO0–8 have pull-ups enabled by default) — J8

+3.3V_RPi not connected to pin 17 for PCB routing reasons

GPIO17 RPi_Alarm_Spkr
GPIO27
GPIO22
GPIO10
GPIO9
GPIO11 Comms6
GPIO4
GPIO14 Comms1
GPIO15 Comms2
GPIO18 RPi_PWM1
GPIO23 Comms3
GPIO24 Comms4
GPIO25 Comms5
GPIO13 RPi_PWM2
GPIO19 RPi_PWM3
GPIO26 RPi_PWM4
RPi_valve4 GPIO12
RPi_valve3 GPIO16
RPi_valve2 GPIO20
RPi_valve1 GPIO21

PWM analog outputs for development/debug (LPF fc = 159 Hz)

TP17 GND — TP11, TP12, TP14, TP16 — R25 10K, R26 10K, R27 10K, R28 10K — RPi_PWM1, RPi_PWM2, RPi_PWM3, RPi_PWM4

LPF fc = 14 kHz

C11 100nF 50V X7R, C12 100nF 50V X7R, C13 100nF 50V X7R, C14 100nF 50V X7R

1uF 16V X7R C7 — 100nF 50V X7R C8 — R16 10 — +3.3V — U2 ADC128D818 — TP9, TP10

I2C address 0011101 <2 mA current draw active

C29 10nF 50V NPO, C30 10nF 50V NPO, C49 10nF 50V NPO — R19 10K — +3.3V

CPLD_ADC0–7 — RPi_valve1–4 — CPLD_SDA, CPLD_SCL, ADC_INT — Pressure1_Lim_H_Alarm, Pressure1_Lim_L_Alarm, Pressure2_Lim_H_Alarm, Pressure2_Lim_L_Alarm, O2_Lim_H_Alarm, O2_Lim_L_Alarm — Enc_A, Enc_B, Enc_Sw

Sheet: CPLD — File: cpld.sch

Valve1–4 — CPLD_valve1–4 — Valve1–4_Fault — Low_Bat, Bat_On, +5VA_On, FPGA_RST, Alarm_Spkr, RPi_En — RPi_Comms1–6 — Comms1–6

Solenoid valve outputs

Sheet: Output Driver 1 — RPi_valve1, CPLD_valve1, CPLD_ADC6, Valve1_Fault — OutHD, OutLD — J9 — File: output_driver.sch

Sheet: Output Driver 2 — RPi_valve2, CPLD_valve2, CPLD_ADC5, Valve2_Fault — J10 — File: output_driver.sch

Sheet: Output Driver 3 — RPi_valve3, CPLD_valve3, CPLD_ADC4, Valve3_Fault — J11 — File: output_driver.sch

Sheet: Output Driver 4 — RPi_valve4, CPLD_valve4, CPLD_ADC3, Valve4_Fault — J12 — File: output_driver.sch

Sheet: Valve Motion Detection — Movement — Valve4_Fault — File: valve_detect.sch

When analog current sense drivers used, CPLD fault input for valve 4 is handled by "valve motion detection" circuit (all other valve fault inputs are inactive)

Alarm(s)

Sheet: Auditory Alarm — Low_Bat, Bat_On, +5VA_On, FPGA_RST, RPi_Alarm_Spkr, CPLD_Alarm_Spkr — In_RPi, In_CPLD — File: audio_alarm.sch

Rotary encoder input:
Designed for Grayhill 61C11-01-08-02 (0.1" header)
or C14D32P-B3 (SMT/through-hole TE connectors)
but will work with mech. encoders too
with pinout swap

RC filters help suppress EMI, ESD

+5V, +5VA, +5VD, +24V, +24VA — R14 3.3K, R15 3.3K, R17 3.3K, R20 24.9K, R22 24.9K — D4 Orange, D5 Orange, D6 Orange, D7 Orange, D8 Orange

30mA max. from +5VD F3 140mA 60V — J15, J21, J16 — R193 3.3K, R194 3.3K, R197 10K — R192 10K, R195 10K — C40 1nF 50V NPO, C43 1nF 50V NPO, C113 1nF 50V NPO — R196 10K — Enc_A, Enc_B, Enc_Sw

H1 #6, H2 #6, H3 #6, H4 #6, H7 #6 GND

Unless otherwise noted: resistors are 1% tolerance, capacitors are 5% tolerance

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Sheet: /
File: RPi_cape.sch

Title: GlobalVent Stand-Alone Controller

Size: B	Date:	Rev: 1.11
KiCad E.D.A. kicad (5.1.4)-1		Id: 1/13

Series input resistors + zener protect against over-voltage
Series input resistors + capacitor filter EMI, reduce ESD amplitude

In
R30 10K
R31 10K
C20 10nF 50V NP0
R32 6.8K
D10 DNP
D11
5.1V
R33 10K
+5VA
GND

U6 TLV6001
C22 1uF 16V X7R
0.1 mA max. from +5VA

Series resistor protects ADC
in case op-amp output exceeds
ADC's +3.3V rail
(5V-3.3V)/3.3K = 0.5 mA max. through ESD diodes

If all 3 sensor inputs are fully over-driven,
this will add ~1.5 mA to +3.3V rail, which is
easily sunk by power LED and misc. pull-ups

R40 3.3K
Out
Out1
C25 DNP
10K R179

U7 TLV6001
C23 1uF 16V X7R
R34 10K
R39 3.3K
Out2
C24 DNP
10K R180
Pull-downs help extend
op-amp low-end output range

U5C LM2903
C21 1uF 16V X7R
1 mA max. from +5VA

TP18

Series resistors prevent comparator
shorted-input failure from masking
sensor reading

Out
R41 1K
Lim_H
R43 1K
R49 DNP
Optional hysteresis
U5A LM2903
R51 10K
Lim_H_Alarm

Lim_L
R44 1K
R42 1K
R50 DNP
U5B LM2903
R52 10K
Lim_L_Alarm

+2V5
DNP (TBD) R45
DNP (TBD) R46
Lim_H
C26 100nF 50V X7R

DNP (TBD) R47
DNP (TBD) R48
Lim_L
C27 100nF 50V X7R

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Sheet: /Pressure Sensor Input 1/
File: sensor_input.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 2/13

Pull-up/down resistors select
default state in case RPi
loses power, leaves GPIO
as input, or GPIO fails open

Safety-combining logic

Series resistor
protects against possible
overvoltage from RPi failure

+3.3V
R55
DNP

+3.3V
1uF 16V X7R
C28
GND

R54
10K

U8
74LVC1G08

From Raspberry Pi In_noncrit
R53
10K
GND

From CPLD In_crit
R198
10K
GND

MAX 10 FPGA floats its pins during
power-up and programming

1
2
4
GND

R56
1.5K
D12
Orange
GND

Option 1: AND (...1G08)
Assumes safe valve state is closed;
needs both inputs active to open -
can't run respiration with only CPLD

Option 2: OR (...1G32)
Assumes safe valve state is open;
can run respiration with only CPLD,
unless RPi output is stuck high

Power solenoid driver

+3.3V
R57
10K
Fault
DNP R58

Fault voltage goes up to 4.9V;
series resistor protects ADC input
For digital fault output, use TPS1H100A instead
and populate these resistors

+3.3V
CS
10K
R59

Ics = Iout / 500 +/- 5%
853 mA = 2.56V
400 mA = 1.2V
100 mA = 0.3V

R110
1.5K
GND

+24V
8
9
10
3
IN
VS
VS
VS
12
DIAG_EN
14
CS
CL
GND
GND
OUT
OUT
OUT
13
2
15
5
6
7
U9
TPS1H100B
GND
R111
2.4K
GND

CL voltage threshold = 1.23V
CL current = Iout/2000 +/- 20%

2.4K = 1.03A nom. limit, 0.82 - 1.23A range

D16
30V
GNDPWR

Protects MOSFET in case of supply overvoltage,
or flyback diode failure

D15
ES2B

OutH
OutL

F10
1A 63VDC
GNDPWR

+24V
C16
100uF 50V AlPoly
GNDPWR

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Sheet: /Output Driver 1/
File: output_driver.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 3/13

Series input resistors + zener protect against over-voltage
Series input resistors + capacitor filter EMI, reduce ESD amplitude

In
R60 10K
R61 10K
GND
10nF 50V NP0 C32
R62 6.8K
GND
+5VA
D17 DNP
5.1V
D18
GND
R63 10K

+5VA
1uF 16V X7R C34
GND
U12 TLV6001
0.1 mA max. from +5VA

Series resistor protects ADC in case op-amp output exceeds ADC's +3.3V rail
(5V-3.3V)/3.3K = 0.5 mA max. through ESD diodes

If all 3 sensor inputs are fully over-driven, this will add ~1.5 mA to +3.3V rail, which is easily sunk by power LED and misc. pull-ups

R70 3.3K
Out
Out1
C37 DNP
GND
10K R181
GND

Series resistors prevent comparator shorted-input failure from masking sensor reading

Out
R71 1K
Lim_H
1K R73
R79 DNP
Optional hysteresis
U11A LM2903
+3.3V
10K R81
Lim_H_Alarm

Lim_L
R74 1K
R72 1K
R80 DNP
U11B LM2903
+3.3V
10K R82
Lim_L_Alarm

+5VA
1uF 16V X7R C35
GND
U13 TLV6001
0.1 mA max. from +5VA

R64 10K
R69 3.3K
Out2
C36 DNP
GND

10K R182
Pull-downs help extend op-amp low-end output range
GND

+2V5
DNP (TBD) R75
DNP (TBD) R76
Lim_H
100nF 50V X7R C38
GND

+2V5
DNP (TBD) R77
DNP (TBD) R78
Lim_L
100nF 50V X7R C39
GND

+5VA
1uF 16V X7R C33
GND
U11C LM2903
1 mA max. from +5VA
GND

TP19
GND

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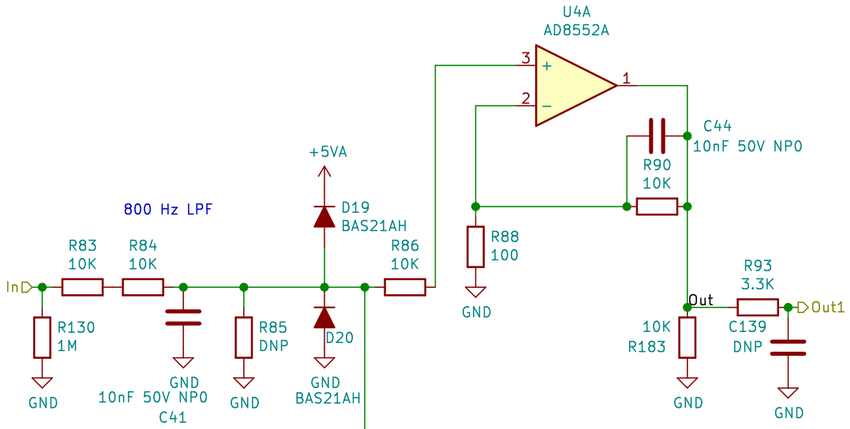
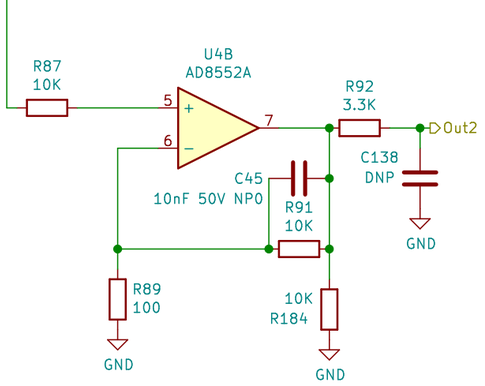
Sheet: /Pressure Sensor Input 2/
File: sensor_input.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 4/13

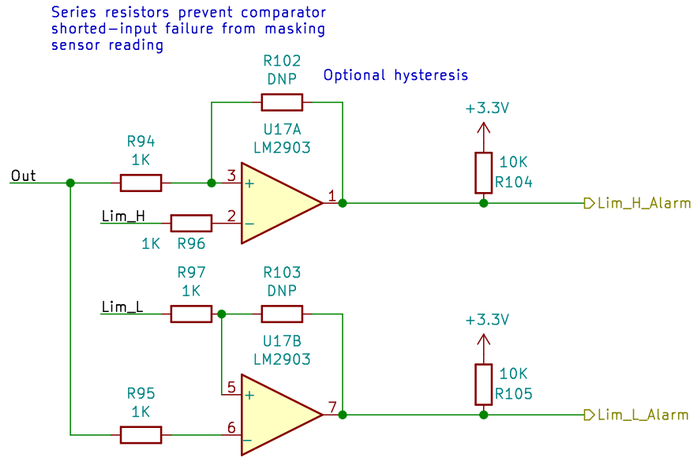


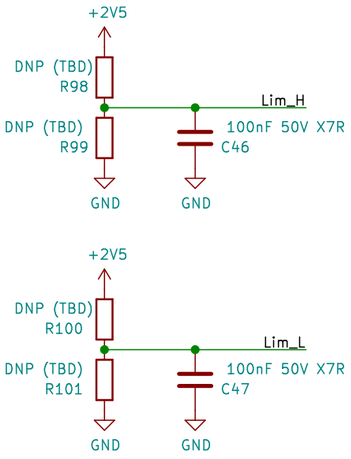
Gain of +101 (7 mV in = 0.707V out, 13 mV in = 1.31V out)
LPF fc = 1.6 kHz

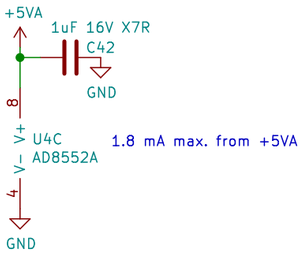


Series resistors prevent comparator shorted-input failure from masking sensor reading

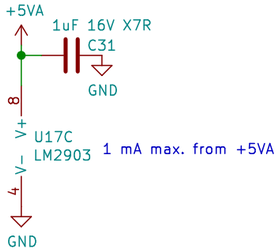
Optional hysteresis







1.8 mA max. from +5VA



1 mA max. from +5VA

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Sheet: /Oxygen Sensor Input/
File: sensor_input_lowlevel.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 5/13

Pull-up/down resistors select
default state in case RPi
loses power, leaves GPIO
as input, or GPIO fails open

Safety-combining logic

Series resistor
protects against possible
overvoltage from RPi failure

+3.3V
R108
DNP

+3.3V
1uF 16V X7R
C48
GND

R107
10K

U18
74LVC1G08

From Raspberry Pi In_noncrit
R106
10K
GND

From CPLD In_crit
R199
10K
GND

MAX 10 FPGA floats its pins during
power-up and programming

1
2
4
GND

R109
1.5K
D21
Orange
GND

Option 1: AND (...1G08)
Assumes safe valve state is closed;
needs both inputs active to open -
can't run respiration with only CPLD

Option 2: OR (...1G32)
Assumes safe valve state is open;
can run respiration with only CPLD,
unless RPi output is stuck high

Power solenoid driver

+3.3V
R112
10K
Fault
DNP R117

Fault voltage goes up to 4.9V;
series resistor protects ADC input

+3.3V
10K
CS
R118

For digital fault output, use TPS1H100A instead
and populate these resistors

Ics = Iout / 500 +/- 5%
853 mA = 2.56V
400 mA = 1.2V
100 mA = 0.3V

R119
1.5K
GND

+24V
8
9
10
3
IN
12
DIAG_EN
14
CS
13
CL
2
GND
15
GND
5
OUT
6
OUT
7
OUT
U19
TPS1H100B

GND
R124
2.4K
GND

CL voltage threshold = 1.23V
CL current = Iout/2000 +/- 20%

2.4K = 1.03A nom. limit, 0.82 - 1.23A range

D25
30V
GNDPWR

Protects MOSFET in case of supply overvoltage,
or flyback diode failure

D24
ES2B
OutH
OutL

F11
1A 63VDC
GNDPWR

+24V
C15
100uF 50V AlPoly
GNDPWR

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Sheet: /Output Driver 2/
File: output_driver.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 6/13

Pull-up/down resistors select
default state in case RPi
loses power, leaves GPIO
as input, or GPIO fails open

Safety-combining logic

Series resistor
protects against possible
overvoltage from RPi failure

+3.3V
R115
DNP

+3.3V
1uF 16V X7R
C51
GND

R114
10K

U20
74LVC1G08

From Raspberry Pi In_noncrit
R113
10K
GND

From CPLD In_crit
R200
10K
GND

MAX 10 FPGA floats its pins during
power-up and programming

R116
1.5K
D26
Orange
GND

Option 1: AND (...1G08)
Assumes safe valve state is closed;
needs both inputs active to open -
can't run respiration with only CPLD

Option 2: OR (...1G32)
Assumes safe valve state is open;
can run respiration with only CPLD,
unless RPi output is stuck high

Power solenoid driver

+24V

+3.3V
R125
10K
Fault
DNP R126

Fault voltage goes up to 4.9V;
series resistor protects ADC input

+3.3V
10K
CS
R208

For digital fault output, use TPS1H100A instead
and populate these resistors

Ics = Iout / 500 +/- 5%
853 mA = 2.56V
400 mA = 1.2V
100 mA = 0.3V

R209
1.5K
GND

U21
TPS1H100B
IN
DIAG_EN
CS
CL
GND
GND
VS
VS
VS
OUT
OUT
OUT

R210
2.4K
GND

CL voltage threshold = 1.23V
CL current = Iout/2000 +/- 20%

2.4K = 1.03A nom. limit, 0.82 - 1.23A range

D30
30V
GNDPWR

Protects MOSFET in case of supply overvoltage,
or flyback diode failure

D29
ES2B

OutH
OutL

F12
1A 63VDC
GNDPWR

+24V
C17
100uF 50V AlPoly
GNDPWR

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Sheet: /Output Driver 3/
File: output_driver.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 7/13

Pull-up/down resistors select
default state in case RPi
loses power, leaves GPIO
as input, or GPIO fails open

Safety-combining logic

Power solenoid driver

Series resistor
protects against possible
overvoltage from RPi failure

+3.3V
R122
DNP

+3.3V
1uF 16V X7R
C54
GND

U22
74LVC1G08

From Raspberry Pi
In_noncrit
R121
10K
R120
10K
GND

From CPLD
In_crit
R201
10K
GND

MAX 10 FPGA floats its pins during
power-up and programming

1
2
4
GND

R123
1.5K
D31
Orange
GND

Option 1: AND (...1G08)
Assumes safe valve state is closed;
needs both inputs active to open -
can't run respiration with only CPLD

Option 2: OR (...1G32)
Assumes safe valve state is open;
can run respiration with only CPLD,
unless RPi output is stuck high

+3.3V
R211
10K
Fault
DNP R212
For digital fault output, use TPS1H100A instead
and populate these resistors

Fault voltage goes up to 4.9V;
series resistor protects ADC input

+3.3V
10K
CS
R213

Ics = Iout / 500 +/- 5%
853 mA = 2.56V
400 mA = 1.2V
100 mA = 0.3V

R214
1.5K
GND

+24V
8
9
10
3
IN
12
DIAG_EN
14
CS
VS
VS
VS
CL
GND
GND
OUT
OUT
OUT
13
2
15
5
6
7
U23
TPS1H100B
GND
R215
2.4K
GND

CL voltage threshold = 1.23V
CL current = Iout/2000 +/- 20%

2.4K = 1.03A nom. limit, 0.82 - 1.23A range

D34
ES2B
OutH
OutL

D35
30V
GNDPWR

Protects MOSFET in case of supply overvoltage,
or flyback diode failure

F13
1A 63VDC
GNDPWR

+24V
C18
100uF 50V AlPoly
GNDPWR

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Sheet: /Output Driver 4/
File: output_driver.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 8/13

Power-down alarm

Sounds power-down alarm if any of 3 main power rails go down

10 mA max. quiescent draw from +BATT

C4 (~261 Hz) oscillator

~1 Hz oscillator

~1 ms filter

Threshold ~2.4-2.9V

Threshold ~21-22V

Threshold ~3.5-4.2V

Keeps FPGA from loading config. until +3.3V rail is high enough

Signal to CPLD, low when +5VA is present

Resistors set volumes for individual audio sources
~16 Hz HPF on each input

Resistor sets global audio gain, capacitor adds harmonic filtering (~640 Hz)

Output speaker (8 ohm) connector

10K resistors provide ~50uA nominal through zeners near threshold input voltage; 1K resistor provides ~0.5mA through BAS21 near threshold input voltage

* +5VD is not monitored because if the Raspberry Pi stops responding, the CPLD will already be able to detect this through its watchdog function and sound a more appropriate alarm.
* +5VA and +24VA monitoring are unpopulated by default, to match the default "power CPLD from backup battery" configuration: if either +5V/+5VA or +24V/+24VA disappears, the CPLD will still have power and be able to detect this through its ADC supply monitoring, and sound a more appropriate alarm.
  If the CPLD is NOT configured to operate from backup battery power, (R185/R186), then these should be populated.
* +3.3V monitoring is most important because if it disappears, the CPLD will not have power (even if connected to backup battery) to sound an alarm on its own.

Low battery monitor

1 mA @ 3.5V
2.5 mA @ 5V

~50 mV hysteresis

Use +3.3V pull-up if "low battery" only signals CPLD; use +BATT pull-up and emitter-follower if "low battery" only lights external LED

Low battery threshold 5V (semi-arbitrary)

-0.3 mA battery load

(Optional) external low-battery LED

1 mA max. from +BATT

Alarm power ORing from backup battery

PNP circuit disables alarm battery output when +5V is present, even though battery voltage is higher than 5V

Bypass resistor in case PNP circuit doesn't work as expected

Threshold ~3.5-4.2V

Optional hysteresis

-0.6 mA battery load

Signal to CPLD, goes low when running from backup battery power

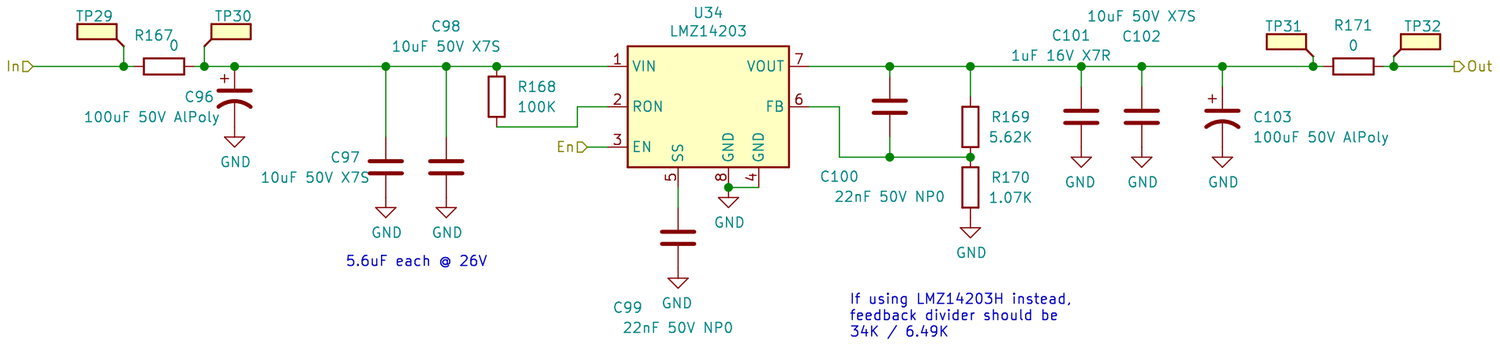
Don Straney

US GlobalVent Team

Sheet: /Auditory Alarm/
File: audio_alarm.sch

Title: GlobalVent Stand-Alone Controller

Size: B	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 9/13



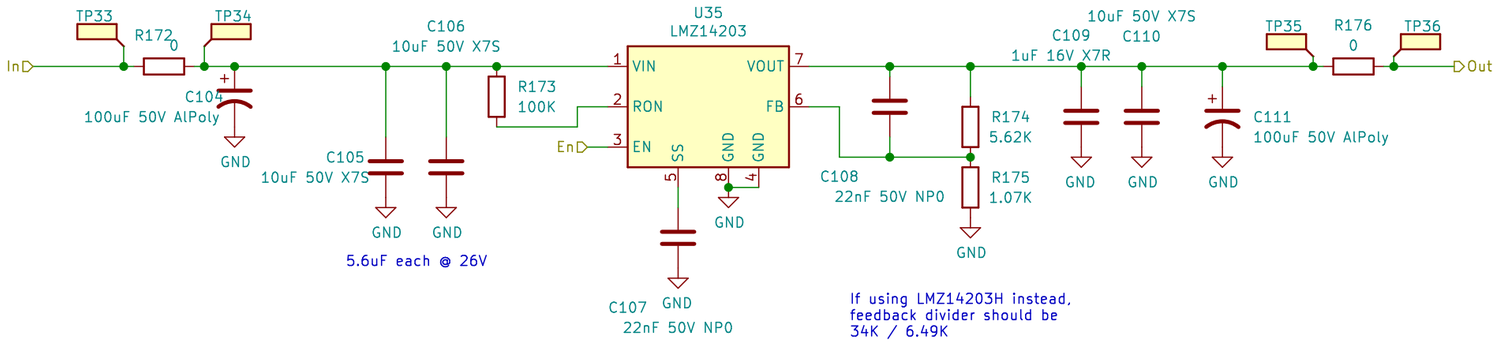
Don Straney

US GlobalVent Team

Sheet: /5V Regulator (RPi)/
File: 5V_reg.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 10/13



Don Straney

US GlobalVent Team

Sheet: /5V Regulator (other)/
File: 5V_reg.sch

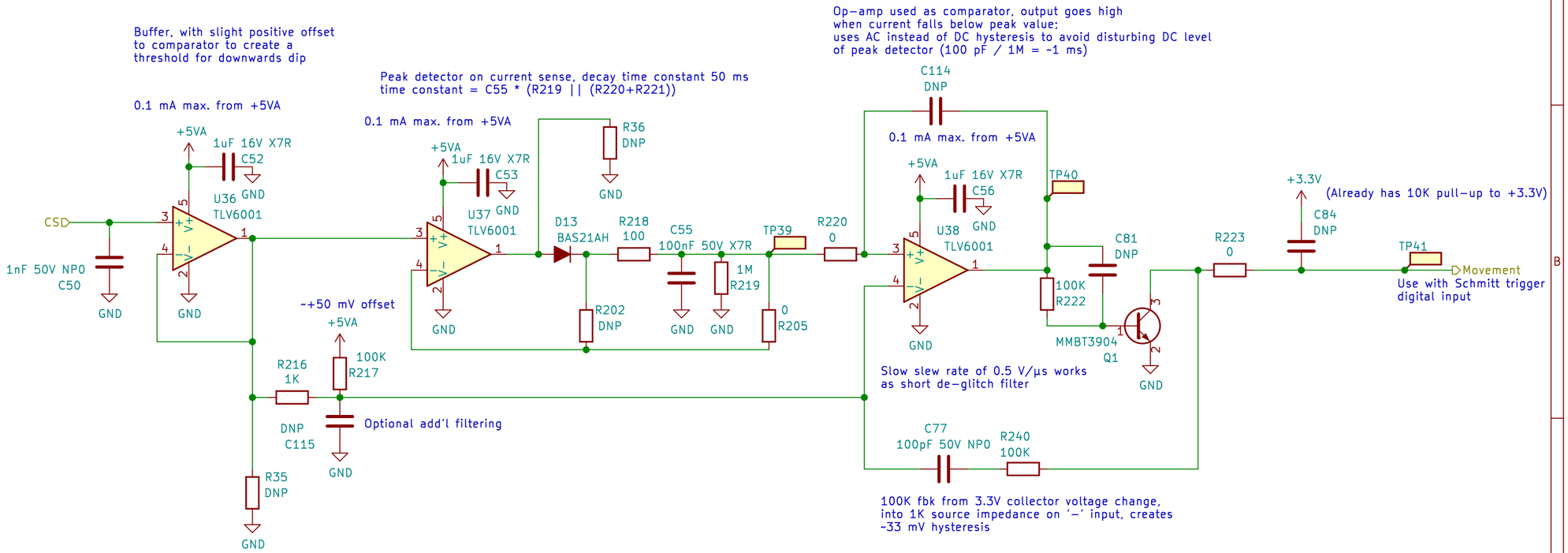
Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 11/13

Valve Motion Detector

Detects a temporary decrease in the solenoid valve current, corresponding to plunger movement, and produces an active-low digital output pulse

DNP all parts if using valve drivers with digital fault outputs instead of analog current sense outputs



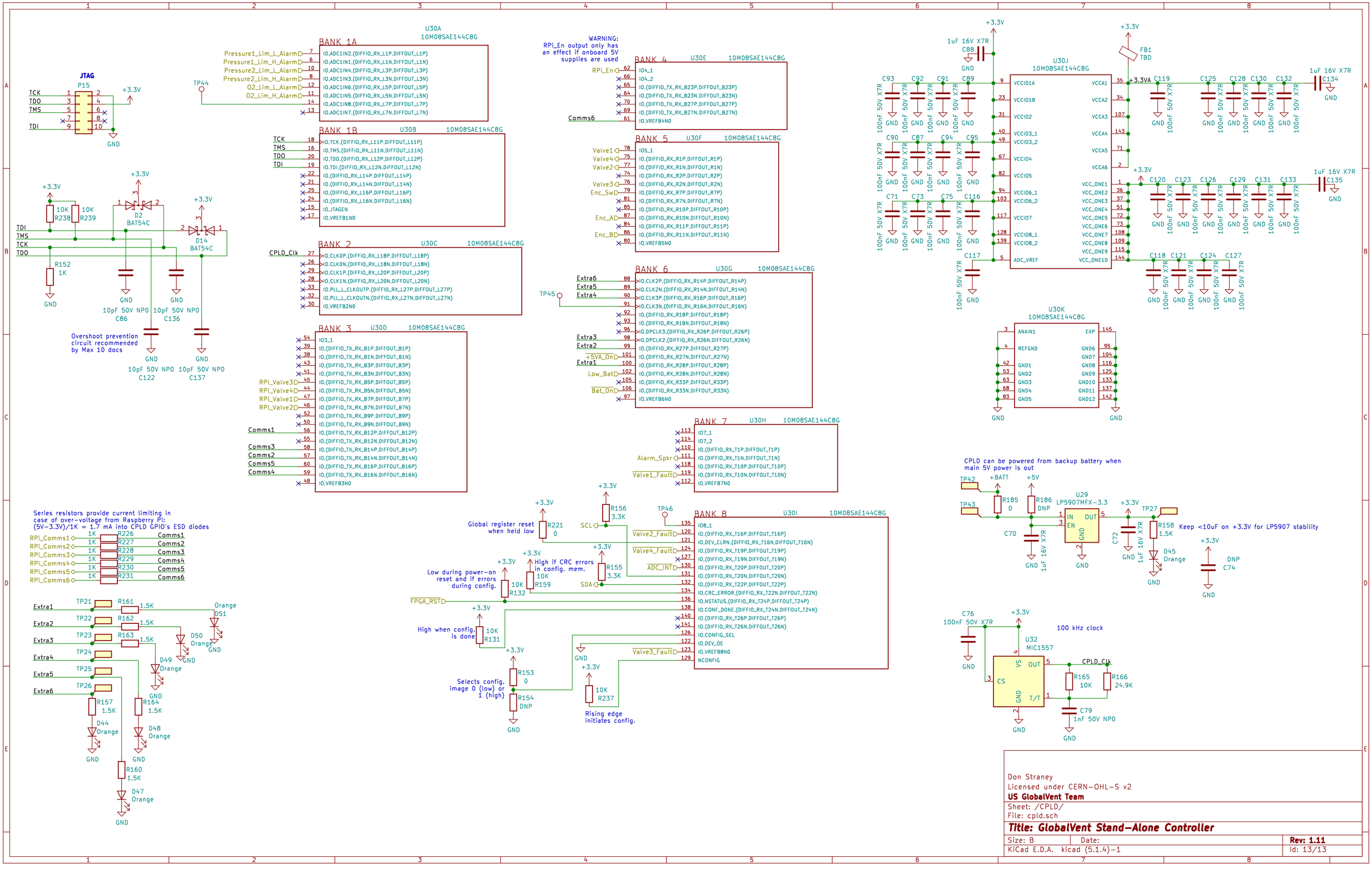
Don Straney

US GlobalVent Team

Sheet: /Valve Motion Detection/
File: valve_detect.sch

Title: GlobalVent Stand-Alone Controller

Size: A4	Date:	**Rev: 1.11**
KiCad E.D.A. kicad (5.1.4)-1		Id: 12/13


JTAG
P15
TCK
TDO
TMS
TDI
GND
+3.3V
U30A
10M08SAE144C8G
BANK 1A
Pressure1_Lim_L_Alarm
Pressure1_Lim_H_Alarm
Pressure2_Lim_L_Alarm
Pressure2_Lim_H_Alarm
O2_Lim_L_Alarm
O2_Lim_H_Alarm
TP44
IO,ADC1IN2,(DIFFIO_RX_L1P,DIFFOUT_L1P)
IO,ADC1IN1,(DIFFIO_RX_L1N,DIFFOUT_L1N)
IO,ADC1IN4,(DIFFIO_RX_L3P,DIFFOUT_L3P)
IO,ADC1IN3,(DIFFIO_RX_L3N,DIFFOUT_L3N)
IO,ADC1IN6,(DIFFIO_RX_L5P,DIFFOUT_L5P)
IO,ADC1IN5,(DIFFIO_RX_L5N,DIFFOUT_L5N)
IO,ADC1IN8,(DIFFIO_RX_L7P,DIFFOUT_L7P)
IO,ADC1IN7,(DIFFIO_RX_L7N,DIFFOUT_L7N)
BANK 1B
U30B
10M08SAE144C8G
IO,TCK,(DIFFIO_RX_L11P,DIFFOUT_L11P)
IO,TMS,(DIFFIO_RX_L11N,DIFFOUT_L11N)
IO,TDO,(DIFFIO_RX_L12P,DIFFOUT_L12P)
IO,TDI,(DIFFIO_RX_L12N,DIFFOUT_L12N)
IO,(DIFFIO_RX_L14P,DIFFOUT_L14P)
IO,(DIFFIO_RX_L14N,DIFFOUT_L14N)
IO,(DIFFIO_RX_L16P,DIFFOUT_L16P)
IO,(DIFFIO_RX_L16N,DIFFOUT_L16N)
IO,JTAGEN
IO,VREFB1N0
BANK 2
U30C
10M08SAE144C8G
CPLD_Clk
IO,CLK0P,(DIFFIO_RX_L18P,DIFFOUT_L18P)
IO,CLK0N,(DIFFIO_RX_L18N,DIFFOUT_L18N)
IO,CLK1P,(DIFFIO_RX_L20P,DIFFOUT_L20P)
IO,CLK1N,(DIFFIO_RX_L20N,DIFFOUT_L20N)
IO,PLL_L_CLKOUTP,(DIFFIO_RX_L27P,DIFFOUT_L27P)
IO,PLL_L_CLKOUTN,(DIFFIO_RX_L27N,DIFFOUT_L27N)
IO,VREFB2N0
BANK 3
U30D
10M08SAE144C8G
IO3_1
IO,(DIFFIO_TX_RX_B1P,DIFFOUT_B1P)
IO,(DIFFIO_TX_RX_B1N,DIFFOUT_B1N)
IO,(DIFFIO_TX_RX_B3P,DIFFOUT_B3P)
IO,(DIFFIO_TX_RX_B3N,DIFFOUT_B3N)
RPi_Valve3
RPi_Valve4
RPi_Valve1
RPi_Valve2
IO,(DIFFIO_TX_RX_B5P,DIFFOUT_B5P)
IO,(DIFFIO_TX_RX_B5N,DIFFOUT_B5N)
IO,(DIFFIO_TX_RX_B7P,DIFFOUT_B7P)
IO,(DIFFIO_TX_RX_B7N,DIFFOUT_B7N)
IO,(DIFFIO_TX_RX_B9P,DIFFOUT_B9P)
IO,(DIFFIO_TX_RX_B9N,DIFFOUT_B9N)
Comms1
IO,(DIFFIO_TX_RX_B12P,DIFFOUT_B12P)
IO,(DIFFIO_TX_RX_B12N,DIFFOUT_B12N)
Comms3
IO,(DIFFIO_TX_RX_B14P,DIFFOUT_B14P)
Comms2
IO,(DIFFIO_TX_RX_B14N,DIFFOUT_B14N)
Comms5
IO,(DIFFIO_TX_RX_B16P,DIFFOUT_B16P)
Comms4
IO,(DIFFIO_TX_RX_B16N,DIFFOUT_B16N)
IO,VREFB3N0
WARNING:
RPi_En output only has
an effect if onboard 5V
supplies are used
BANK 4
U30E
10M08SAE144C8G
RPi_En
Comms6
IO4_1
IO4_2
IO,(DIFFIO_TX_RX_B23P,DIFFOUT_B23P)
IO,(DIFFIO_TX_RX_B23N,DIFFOUT_B23N)
IO,(DIFFIO_TX_RX_B27P,DIFFOUT_B27P)
IO,(DIFFIO_TX_RX_B27N,DIFFOUT_B27N)
IO,VREFB4N0
BANK 5
U30F
10M08SAE144C8G
Valve1
Valve4
Valve2
Valve3
Enc_Sw
Enc_A
Enc_B
IO5_1
IO,(DIFFIO_RX_R1P,DIFFOUT_R1P)
IO,(DIFFIO_RX_R1N,DIFFOUT_R1N)
IO,(DIFFIO_RX_R2P,DIFFOUT_R2P)
IO,(DIFFIO_RX_R2N,DIFFOUT_R2N)
IO,(DIFFIO_RX_R7P,DIFFOUT_R7P)
IO,(DIFFIO_RX_R7N,DIFFOUT_R7N)
IO,(DIFFIO_RX_R10P,DIFFOUT_R10P)
IO,(DIFFIO_RX_R10N,DIFFOUT_R10N)
IO,(DIFFIO_RX_R11P,DIFFOUT_R11P)
IO,(DIFFIO_RX_R11N,DIFFOUT_R11N)
IO,VREFB5N0
BANK 6
U30G
10M08SAE144C8G
TP45
Extra6
Extra5
Extra4
Extra3
Extra2
Extra1
+5VA_On
Low_Bat
Bat_On
IO,CLK2P,(DIFFIO_RX_R14P,DIFFOUT_R14P)
IO,CLK2N,(DIFFIO_RX_R14N,DIFFOUT_R14N)
IO,CLK3P,(DIFFIO_RX_R16P,DIFFOUT_R16P)
IO,CLK3N,(DIFFIO_RX_R16N,DIFFOUT_R16N)
IO,(DIFFIO_RX_R18P,DIFFOUT_R18P)
IO,(DIFFIO_RX_R18N,DIFFOUT_R18N)
IO,DPCLK3,(DIFFIO_RX_R26P,DIFFOUT_R26P)
IO,DPCLK2,(DIFFIO_RX_R26N,DIFFOUT_R26N)
IO,(DIFFIO_RX_R27P,DIFFOUT_R27P)
IO,(DIFFIO_RX_R27N,DIFFOUT_R27N)
IO,(DIFFIO_RX_R28P,DIFFOUT_R28P)
IO,(DIFFIO_RX_R28N,DIFFOUT_R28N)
IO,(DIFFIO_RX_R33P,DIFFOUT_R33P)
IO,(DIFFIO_RX_R33N,DIFFOUT_R33N)
IO,VREFB6N0
BANK 7
U30H
10M08SAE144C8G
Alarm_Spkr
Valve1_Fault
IO7_1
IO7_2
IO,(DIFFIO_RX_T1P,DIFFOUT_T1P)
IO,(DIFFIO_RX_T1N,DIFFOUT_T1N)
IO,(DIFFIO_RX_T10P,DIFFOUT_T10P)
IO,(DIFFIO_RX_T10N,DIFFOUT_T10N)
IO,VREFB7N0
BANK 8
U30I
10M08SAE144C8G
Valve2_Fault
Valve4_Fault
ADC_INT
Valve3_Fault
IO8_1
IO,(DIFFIO_RX_T16P,DIFFOUT_T16P)
IO,DEV_CLRN,(DIFFIO_RX_T16N,DIFFOUT_T16N)
IO,(DIFFIO_RX_T19P,DIFFOUT_T19P)
IO,(DIFFIO_RX_T19N,DIFFOUT_T19N)
IO,(DIFFIO_RX_T20P,DIFFOUT_T20P)
IO,(DIFFIO_RX_T20N,DIFFOUT_T20N)
IO,(DIFFIO_RX_T22P,DIFFOUT_T22P)
IO,CRC_ERROR,(DIFFIO_RX_T22N,DIFFOUT_T22N)
IO,NSTATUS,(DIFFIO_RX_T24P,DIFFOUT_T24P)
IO,CONF_DONE,(DIFFIO_RX_T24N,DIFFOUT_T24N)
IO,(DIFFIO_RX_T26P,DIFFOUT_T26P)
IO,(DIFFIO_RX_T26N,DIFFOUT_T26N)
IO,CONFIG_SEL
IO,DEV_OE
IO,VREFB8N0
NCONFIG
U30J
10M08SAE144C8G
VCCIO1A
VCCIO1B
VCCIO2
VCCIO3_1
VCCIO3_2
VCCIO4
VCCIO5
VCCIO6_1
VCCIO6_2
VCCIO7
VCCIO8_1
VCCIO8_2
ADC_VREF
VCCA1
VCCA2
VCCA3
VCCA4
VCCA5
VCCA6
+3.3VA
VCC_ONE1
VCC_ONE2
VCC_ONE3
VCC_ONE4
VCC_ONE5
VCC_ONE6
VCC_ONE7
VCC_ONE8
VCC_ONE9
VCC_ONE10
FB1
TBD
1uF 16V X7R
C88
C89
C91
C92
C93
C94
C95
C87
C90
C116
C75
C73
C71
C117
C119
C125
C128
C130
C132
C134
C120
C123
C126
C129
C131
C133
C135
C118
C121
C124
C127
100nF 50V X7R
U30K
10M08SAE144C8G
ANAIN1
REFGND
GND1
GND2
GND3
GND4
GND5
EXP
GND6
GND7
GND8
GND9
GND10
GND11
GND12
Overshoot prevention
circuit recommended
by Max 10 docs
10K
R238
10K
R239
D2
BAT54C
D14
BAT54C
R152
1K
10pF 50V NP0
C86
10pF 50V NP0
C136
10pF 50V NP0
C122
10pF 50V NP0
C137
Series resistors provide current limiting in
case of over-voltage from Raspberry Pi:
(5V-3.3V)/1K = 1.7 mA into CPLD GPIO's ESD diodes
RPi_Comms1
RPi_Comms2
RPi_Comms3
RPi_Comms4
RPi_Comms5
RPi_Comms6
R226
R227
R228
R229
R230
R231
1K
Comms1
Comms2
Comms3
Comms4
Comms5
Comms6
Extra1
Extra2
Extra3
Extra4
Extra5
Extra6
TP21
TP22
TP23
TP24
TP25
TP26
R161
R162
R163
R164
R157
R160
1.5K
D51
D50
D49
D48
D44
D47
Orange
Global register reset
when held low
R221
0
SCL
SDA
R156
3.3K
R155
3.3K
Low during power-on
reset and if errors
during config.
R132
10K
High if CRC errors
in config. mem.
R159
10K
FPGA_RST
High when config.
is done
R131
10K
Selects config.
image 0 (low) or
1 (high)
R153
0
R154
DNP
R237
10K
Rising edge
initiates config.
CPLD can be powered from backup battery when
main 5V power is out
TP42
TP43
+BATT
+5V
R185
0
R186
DNP
U29
LP5907MFX-3.3
IN
EN
OUT
GND
C70
1uF 16V X7R
C72
1uF 16V X7R
TP27
R158
1.5K
D45
Orange
DNP
C74
Keep <10uF on +3.3V for LP5907 stability
C76
100nF 50V X7R
100 kHz clock
U32
MIC1557
VS
CS
OUT
GND
T/T
CPLD_Clk
R165
10K
R166
24.9K
C79
1nF 50V NP0
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US GlobalVent Team
Sheet: /CPLD/
File: cpld.sch
Title: GlobalVent Stand-Alone Controller
Size: B
Date:
Rev: 1.11
KiCad E.D.A. kicad (5.1.4)-1
Id: 13/13