Buffers

U1A MCP6004
Rear_Brake_Sensor 3 +, 2 −, 1 → Rear_Brake_Buffered

U1C MCP6004
Current_Sensor_VREF 10 +, 9 −, 8 → Current_Sensor_VREF_Buffered

U1B MCP6004
Front_Brake_Sensor 5 +, 6 −, 7 → Front_Brake_Buffered

U1D MCP6004
Current_Sensor_Output 12 +, 13 −, 14 → Current_Sensor_Output_Buffered

Opens

U2A MCP6004
100k R23
open_circuit_threshhold 3
GND — Rear_Brake_Buffered 2 → 1 rear_brake_open

U2B MCP6004
100k R24
open_circuit_threshhold 5
GND — Front_Brake_Buffered 6 → 7 front_brake_open

U2C MCP6004
100k R25
open_circuit_threshhold 10
GND — Current_Sensor_VREF_Buffered 9 → 8 current_VREF_open

U2D MCP6004
100k R28
open_circuit_threshhold 12
GND — Current_Sensor_Output_Buffered 13 → 14 current_sensor_open

Hard braking and high current

U4A MCP6004
differential_current_output 3
high_current_threshhold 2 → 1 high_current

U4B MCP6004
differential_front_brake_output 5
front_braking_threshhold 6 → 7 front_hard_braking

U5B MCP6004
differential_rear_brake_output 5
rear_braking_threshhold 6 → 7 rear_hard_braking

Shorts

U3A MCP6004
Current_Sensor_Output_Buffered 3
short_circuit_threshhold 2 → 1 current_sensor_short

U3B MCP6004
Current_Sensor_VREF_Buffered 5
short_circuit_threshhold 6 → 7 current_VREF_short

U3C MCP6004
Front_Brake_Buffered 10
short_circuit_threshhold 9 → 8 front_brake_short

U3D MCP6004
Rear_Brake_Buffered 12
short_circuit_threshhold 13 → 14 rear_brake_short

Op-amp Power

C1 0.1µF +5V, GND — U1E MCP6004 11
C2 0.1µF +5V, GND — U2E MCP6004 11
C3 0.1µF +5V, GND — U3E MCP6004 11
C4 0.1µF +5V, GND — U5E MCP6004 11
C5 0.1µF +5V, GND — U4E MCP6004 11

Amplifiers

GND
R3 1k, R4 20k
Current_Sensor_Output_Buffered 10
Current_Sensor_VREF_Buffered 9
U4C MCP6004 → 8 differential_current_output
R5 1k, R6 20k

U5A MCP6004
Front_Brake_Buffered 3 +, 2 − → 1 differential_front_brake_output
RV2 3296W_10K
GND

U8A MCP6004
Rear_Brake_Buffered 3 +, 2 − → 1 differential_rear_brake_output
RV1 3296W_10K
GND

linear regulator
U7 LD1086DT50TR
+12V 3 IN — ADJ/GND — OUT 2 +5V
0.33µF C12
GND
0.1µF C13

J2 Conn_01x12
1 +12V
2 GND
3 Rear_Brake_Sensor
4 Front_Brake_Sensor
5 Current_Sensor_Output
6 Current_Sensor_VREF
7 Shutdown_In
8 Shutdown_Out
9 BSPD_Fault_LOW
10
11
12

Voltage_Dividers
short_circuit_threshhold
rear_braking_threshhold
high_current_threshhold
open_circuit_threshhold
front_braking_threshhold
File: voltage_dividers.kicad_sch

logic
front_brake_open
high_current
front_high_braking
current_VREF_short
rear_brake_open
front_brake_short
current_sensor_short
BSPD_Fault_HIGH
current_VREF_open
current_sensor_open
rear_brake_short
rear_hard_braking
File: bspd_logic.kicad_sch

status_lights
rear_hard_braking
front_hard_braking
high_current
BSPD_Fault_LOW
File: status_lights.kicad_sch

BSPD_timer
BSPD_Fault_LOW → BSPD_Fault_HIGH
BSPD_Fault_LOW → BSPD_Fault_LOW
Shutdown_In → Shutdown_In
Shutdown_Out → Shutdown_Out
File: BSPD_timer.kicad_sch

front_hard_braking — front_hard_braking
rear_hard_braking — rear_hard_braking
high_current — high_current
current_VREF_short — current_VREF_short
current_sensor_short — current_sensor_short
front_brake_short — front_brake_short
rear_brake_short — rear_brake_short
current_VREF_open — current_VREF_open
current_sensor_open — current_sensor_open
front_brake_open — front_brake_open
rear_brake_open — rear_brake_open
BSPD_Fault_HIGH — BSPD_Fault_HIGH

C6 +5V
0.1µF
GND

U9E
74HC00
14 VCC GND 7 GND
GND

NAND gate power supply

C7 +5V
0.1µF
GND

U6C
4072
14 VDD VSS 7 GND
GND

C10 +5V
0.1µF
GND

U10C
4072
14 VDD VSS 7 GND
GND

OR gate power supply

Extra NAND gate
U9C
74HC00
9
10
8

BSPD Logic

U10A
4072
front_hard_braking 2
rear_hard_braking 3
4
5 1 hard_braking
GND

U9A
74HC00
hard_braking 1
high_current 2 3

U9D
74HC00
12
13 11 hard_braking_high_current

U6A
4072
front_brake_short 2
front_brake_open 3
rear_brake_short 4
rear_brake_open 5 1 brake_opens_shorts

U10B
4072
9
10
11 13 BSPD_Fault_HIGH
12
GND

current_VREF_short 9
current_VREF_open 10
current_sensor_short 11
current_sensor_open 12 13 current_opens_shorts
U6B
4072

+5V

RV3
3296W_10K
front_braking_threshhold
threshhold for hard braking
ideally 0.9V
exact value: 0.9V
GND

+5V

RV4
3296W_10K
high_current_threshhold
current sensor threshhold
ideally: 2.8V
exact value: 2.778V
GND

+5V

RV5
3296W_10K
open_circuit_threshhold
threshhold for open circuit
ideally: 0.25V
exact value: 0.259V
GND

+5V

RV6
3296W_10K
short_circuit_threshhold
threshhold for short circuit
ideally: 4.5V
exact value: 4.47V
GND

+5V

RV7
3296W_10K
rear_braking_threshhold
threshhold for hard braking
ideally 0.9V
exact value: 0.9V
GND

front_braking_threshhold — front_braking_threshhold

high_current_threshhold — high_current_threshhold

rear_braking_threshhold — rear_braking_threshhold

open_circuit_threshhold — open_circuit_threshhold

short_circuit_threshhold — short_circuit_threshhold

rear_hard_braking ▷ rear_hard_braking

front_hard_braking ▷ front_hard_braking

high_current ▷ high_current

BSPD_Fault_LOW ▷ BSPD_Fault_LOW

D1
QBLP631-R3A

R7
300

front_hard_braking

D5
QBLP631-R3A

R1
300

rear_hard_braking

GND ◁

D2
QBLP631-R3A

R8
300

high_current

D3
QBLP631-R3A

R9
300

BSPD_Fault_LOW

Sheet: /status_lights/
File: status_lights.kicad_sch

Title:

Size: A4   Date:

KiCad E.D.A. 8.0.5

Rev:

Id: 4/5

BSPD_Fault_HIGH
BSPD_Fault_LOW
Shutdown_In
Shutdown_Out

BSPD_Fault_HIGH
BSPD_Fault_LOW
Shutdown_In
Shutdown_Out

BSPD_Fault_HIGH

+5V   0.1µF
       C8

GND

C9
1µF

R2
10k

U9B
74HC00

BSPD_Fault_LOW

4 R   VCC 8

2 TR   U13   DIS 7

6 THR LM555xM Q 3

          CV 5

1 GND

GND

0.1µF
C14

GND

R10
430k

GND

0.473 second delay

t = 1.1(R1)(C1)
0.5s = 1.1(R1)(1µF)
0.5 = 1.1(0.000001)(R1)
0.5 = 0.0000011R1
454545.45 = R1

450k is not standard resistor value

t = 1.1(430k)(1µF)
t = 0.473

CR1
STS6NF20V

GND

1 S   D 8
2 S   D 7
3 S   D 6
4 G   D 5

BSPD_Fault_LOW

+12V

D4
D

Shutdown_In 4   3 Shutdown_Out

6 NO   5
NC

K2
DK1A1B−12V