

BSPD

Rule Analysis:

T11.6.1

A standalone non-programmable circuit, the BSPD, must open the shutdown circuit, see EV6.1 and CV4.1, when hard braking occurs, whilst:

- [EV ONLY] ≥ 5 kW power is delivered to the motors,
- [CV ONLY] The throttle position is more than 25% over idle position.

The shutdown circuit must remain open until *power cycling* the LVMS or the BSPD may reset itself if the opening condition is no longer present for more than 10s.

Comments:

BSPD must be implemented on a PCB using unprogrammable components like an ECU.

T11.6.5 To detect hard braking, a brake system pressure sensor must be used. The threshold must be chosen such that there are no locked wheels, and the brake pressure is ≤ 30 bar.

T11.6.6 [EV ONLY] To measure power delivery, a DC circuit current sensor only must be used. The threshold must be chosen to an equivalent of 5kW for maximum TS voltage.

Power cycling is switching the LVMS off and on.

Will need to implement a timer for the 10s.

T11.6.9

[EV ONLY] The team must prove the function of the BSPD during technical inspection by sending an appropriate signal that represents the current, in order to achieve 5 kW whilst pressing the brake pedal. This test must prove

the functionality of the complete BSPD except for any commercially available current sensors.

IN4.2.1 The following items must be presented at electrical inspection:

- Tools needed for the BSPD check, see T11.6.9

Comments:

After the circuit is finished, we will develop the test procedure based on this rule.

T11.6.10

[EV ONLY] The BSPD including all required sensors must not be installed inside the TSAC

Comments:

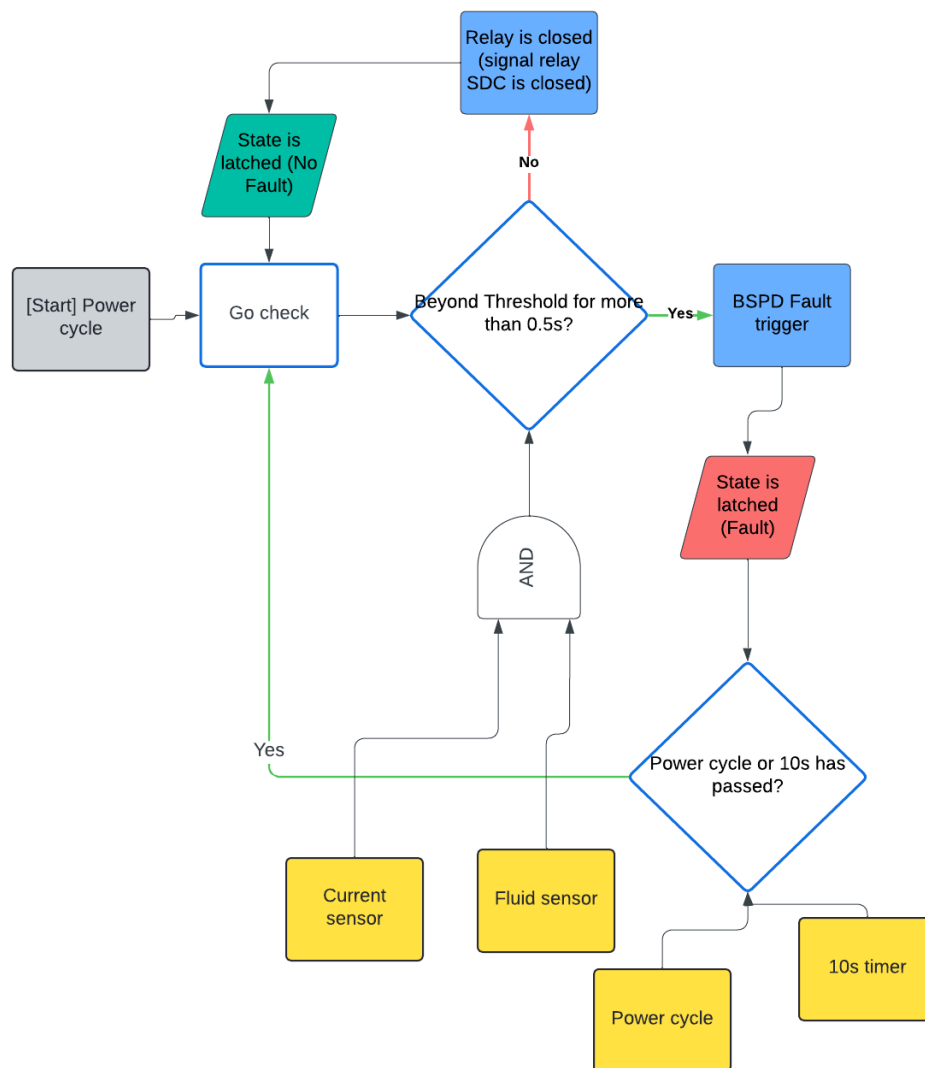
Not within the accumulator container.

T11.9.2

Any of the following SCS single failures must result in a safe or error state of all connected systems:

- Failures of signals transmitted by cable:
 - i. Open circuit, ii. Short circuit to ground.
- Failures of analogue sensor signals transmitted by cable:
 - i. Short circuit to supply voltage.

Process flow chart:



1. [start] Circuit is power cycled.
2. Sensors are checked (0.5s condition) [Two comparators with sensors on the -ve terminal. Goes into an RC-Comparator delay circuit. Goes through an AND gate.]

If fault:

- A. Fault triggered (BSPD LED)
- B. State is Latched (Logic is Low ie.: a reversed latch, because the relay is normally open)
- C. 555 timer for 10s

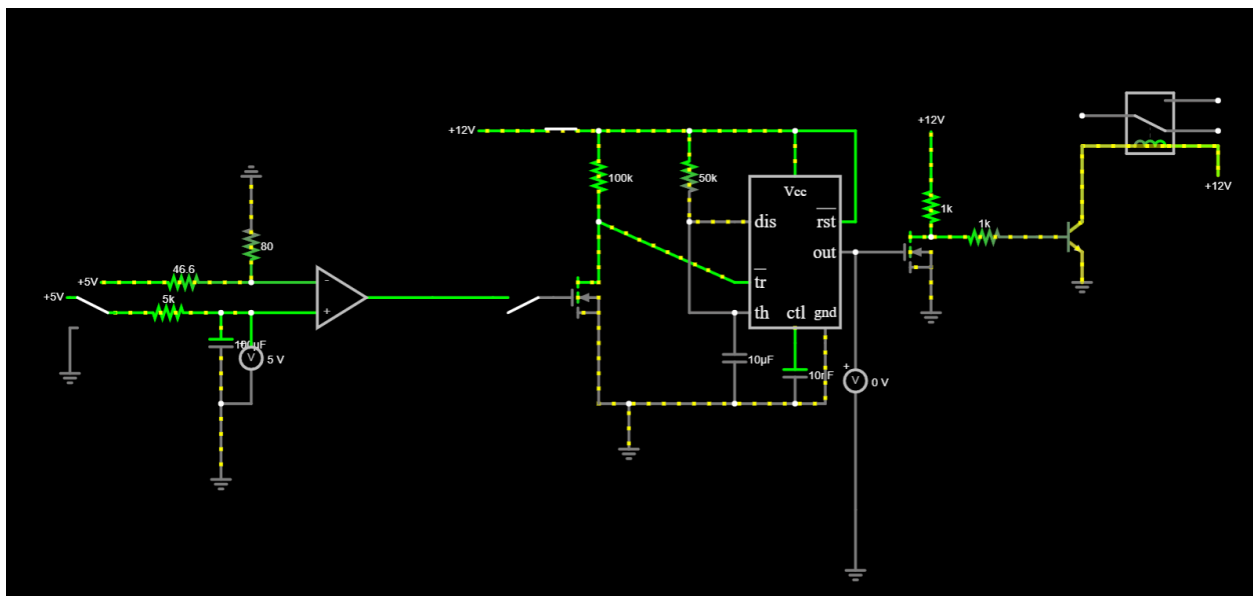
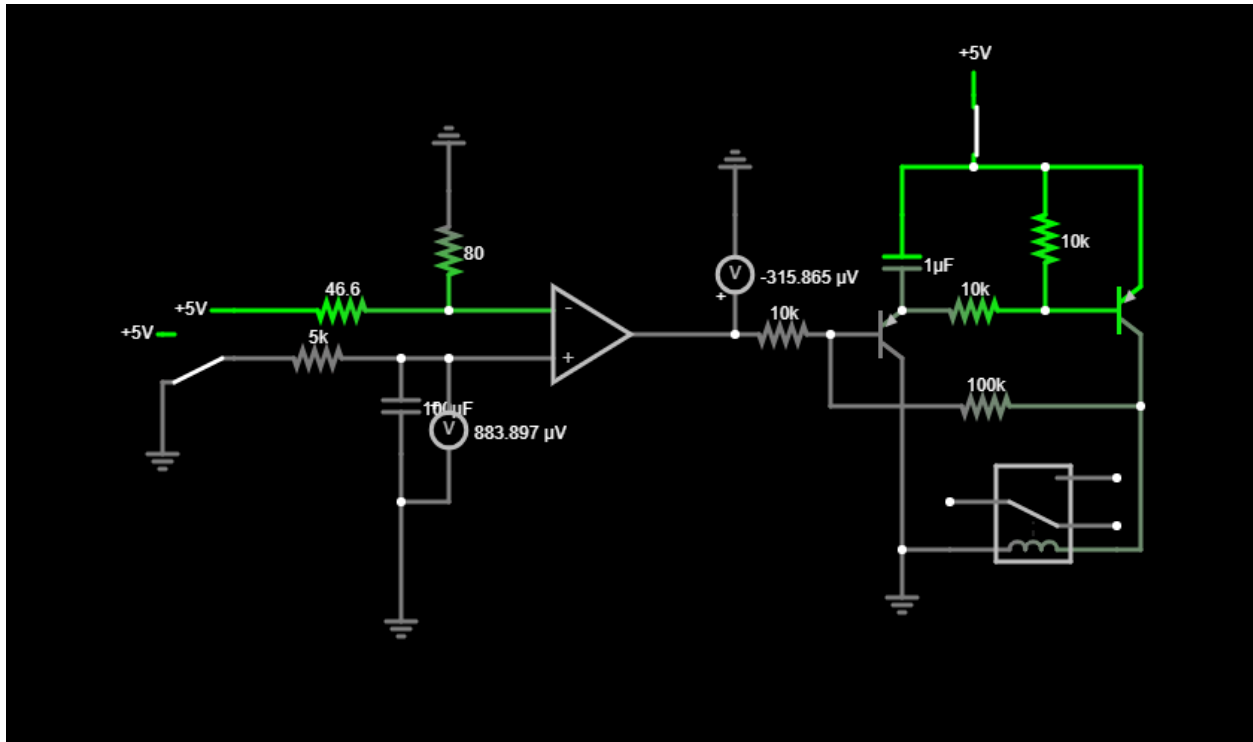
If Power cycled or timer finishes:

➤ Go back to step 2.

If no fault:

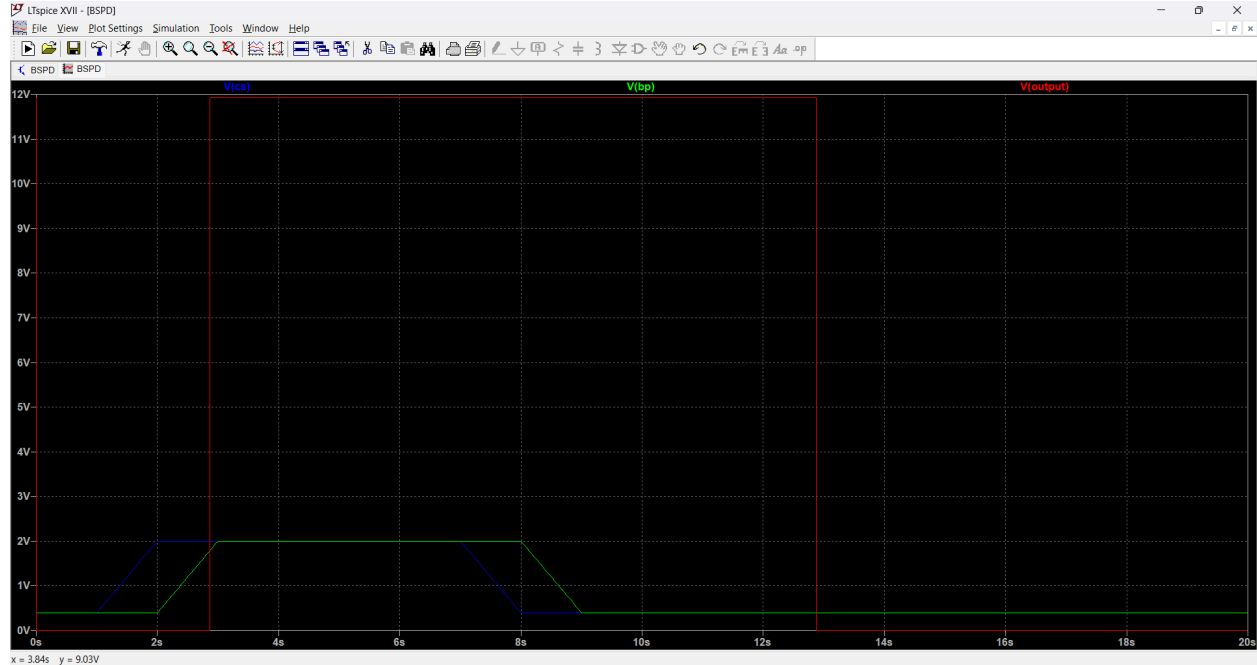
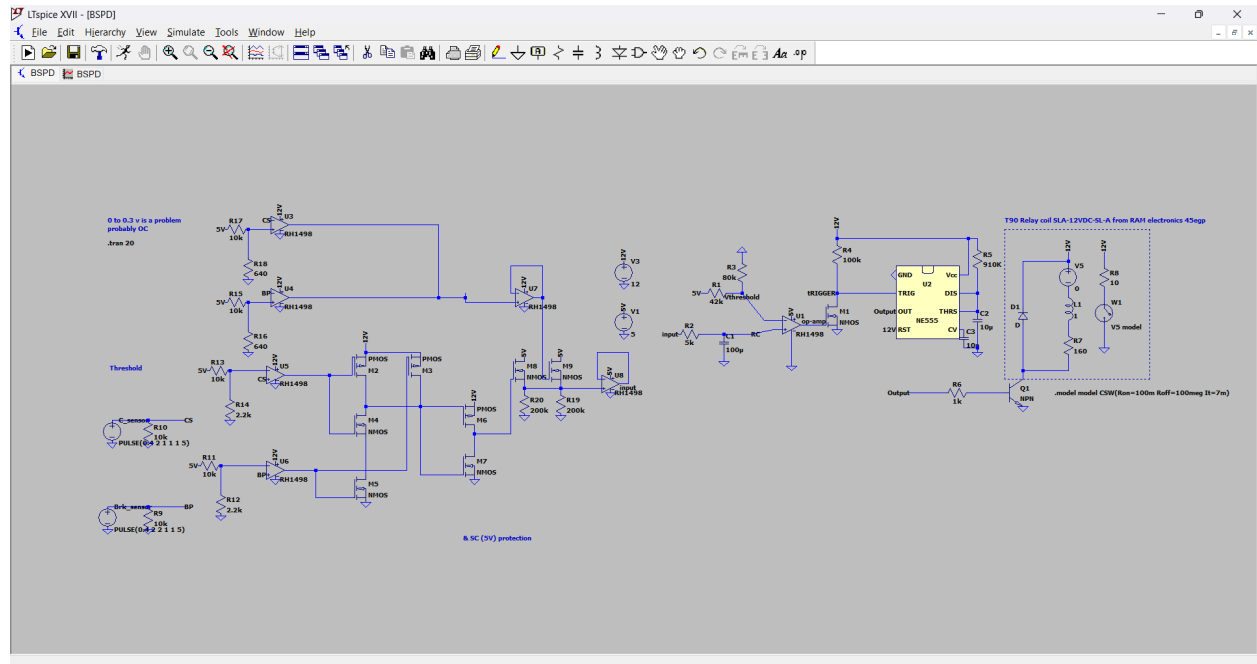
- A. BSPD relay is energized.
- B. State is latched.
- C. Go back to step 2.

Simulation of the RC and latching circuit:

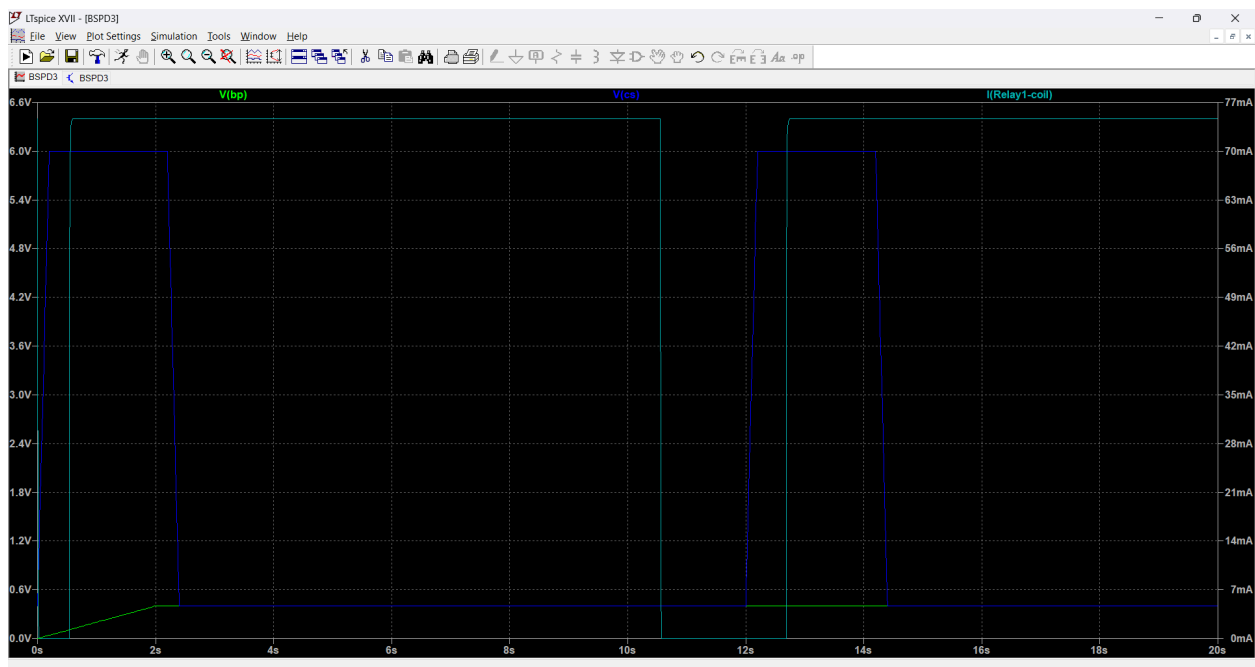
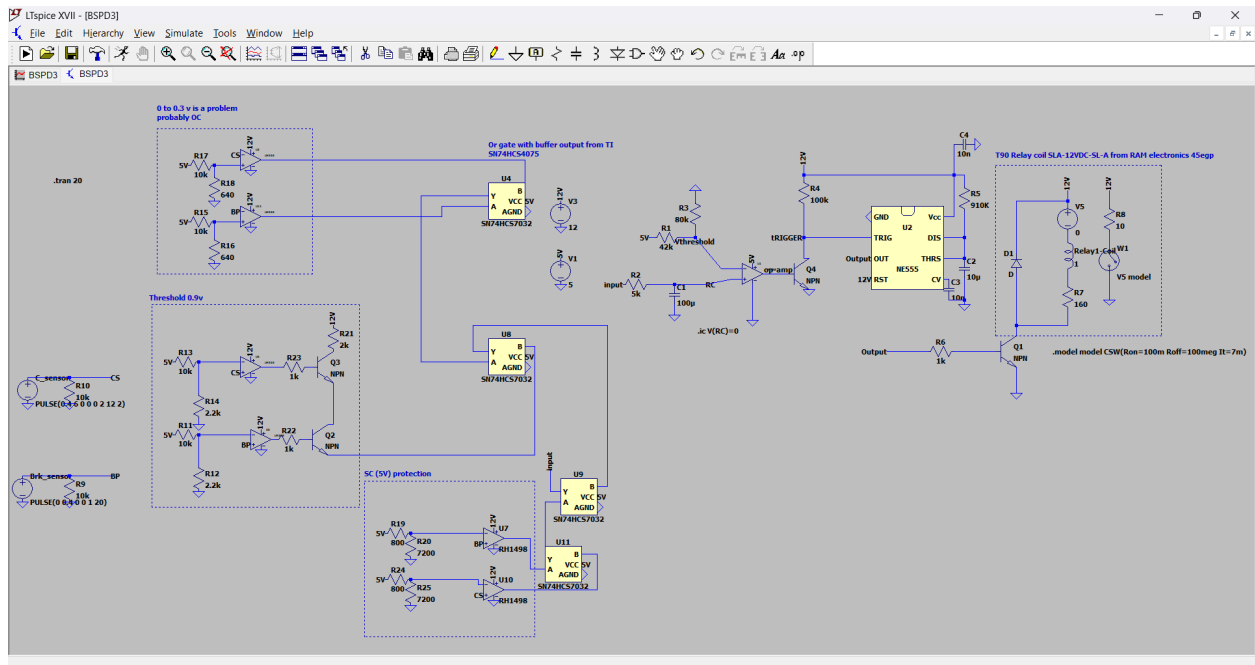


Ltspice:

First Prototype:

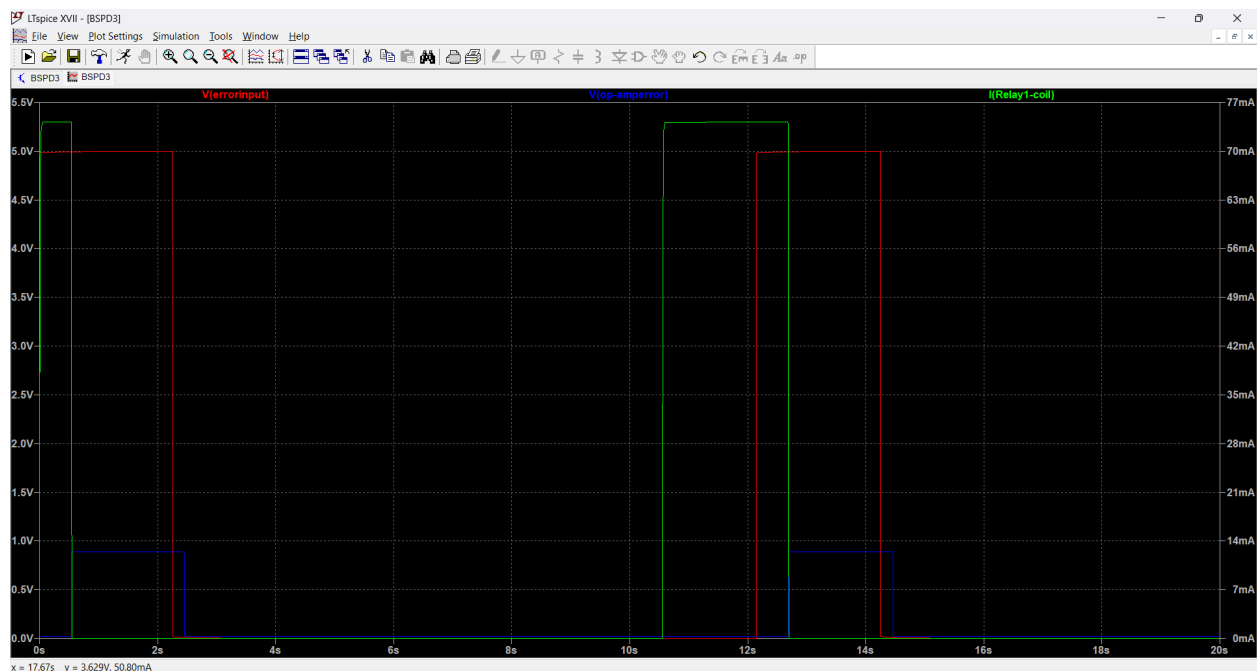
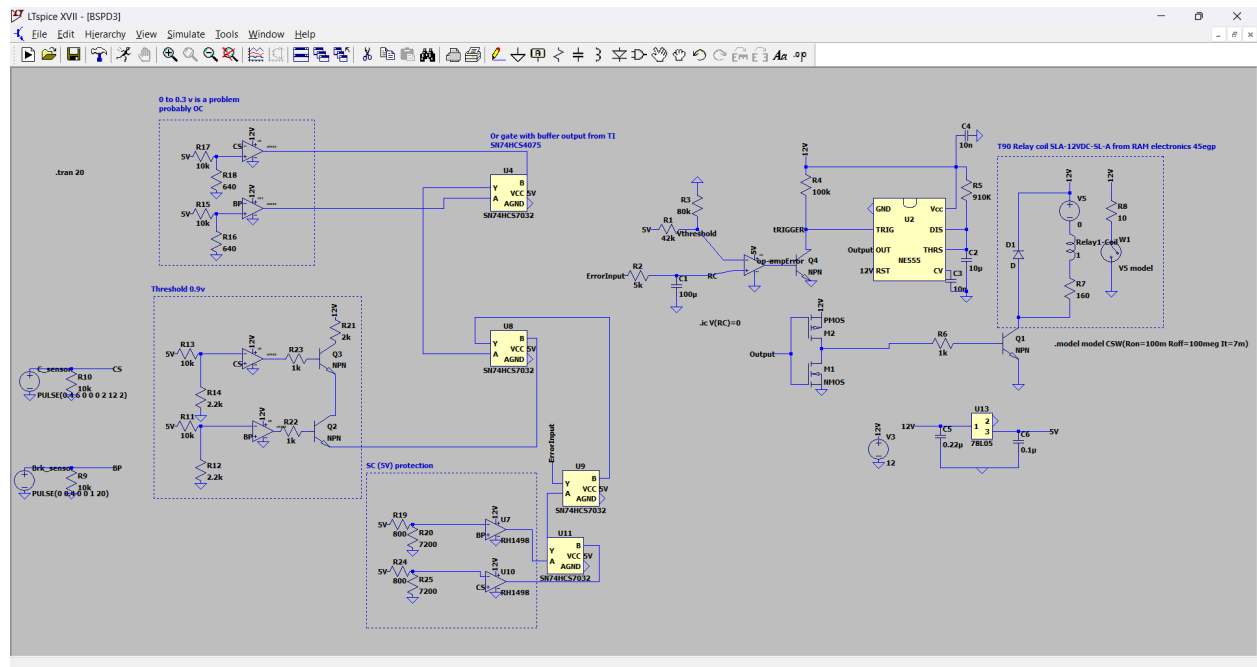


Added sensor SC shutdown case and reduced the number of transistors replacing them with an OR gate ic from Texas Instruments. The IC has 3 channels and each channel takes 3 inputs unlike the one in the simulation, so it will not take much space. Used LM358 comparator instead of the normal op-amp.



Third Prototype:

Added a CMOS not gate and a voltage regulator instead of a buck converter.

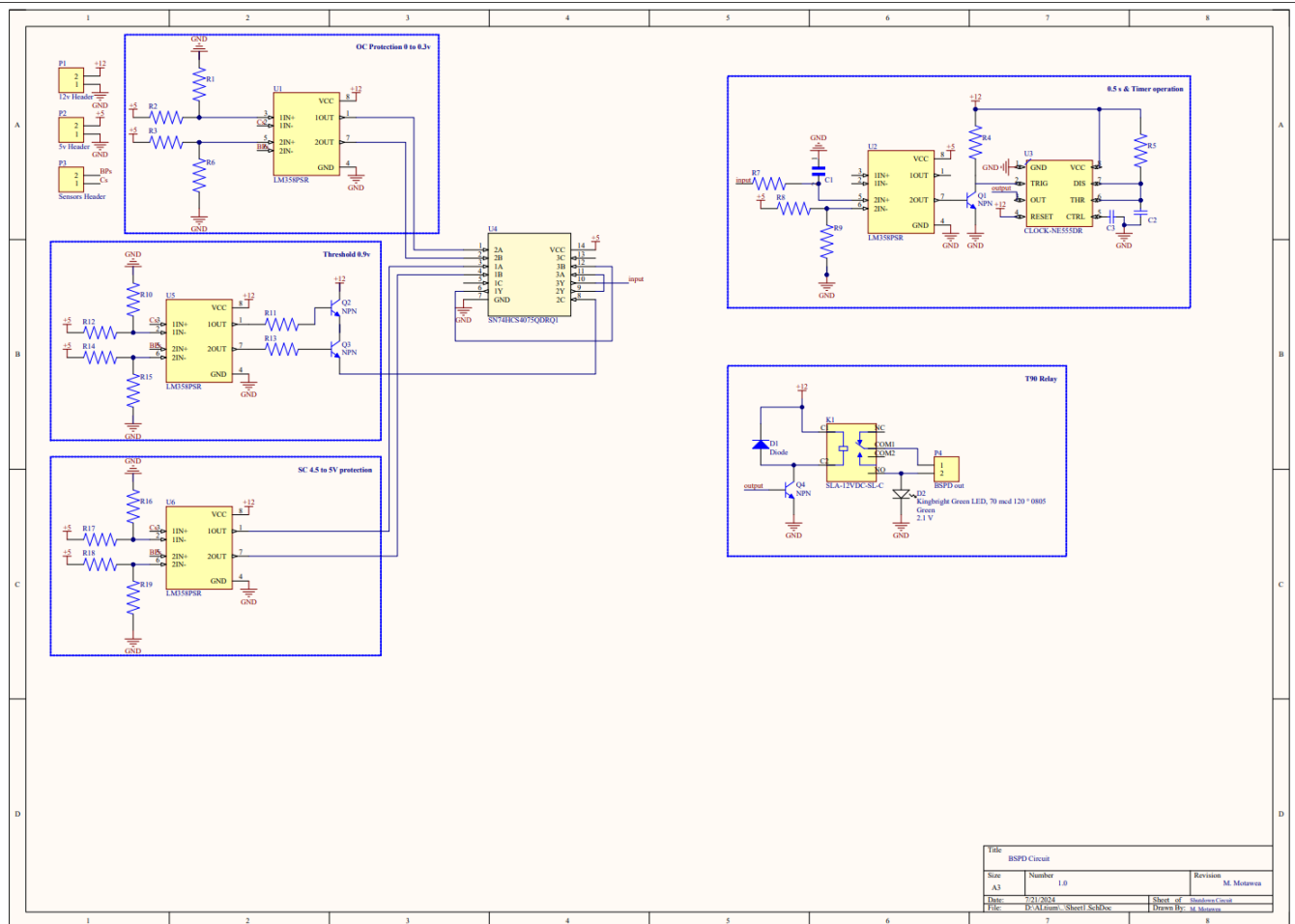


Parts:

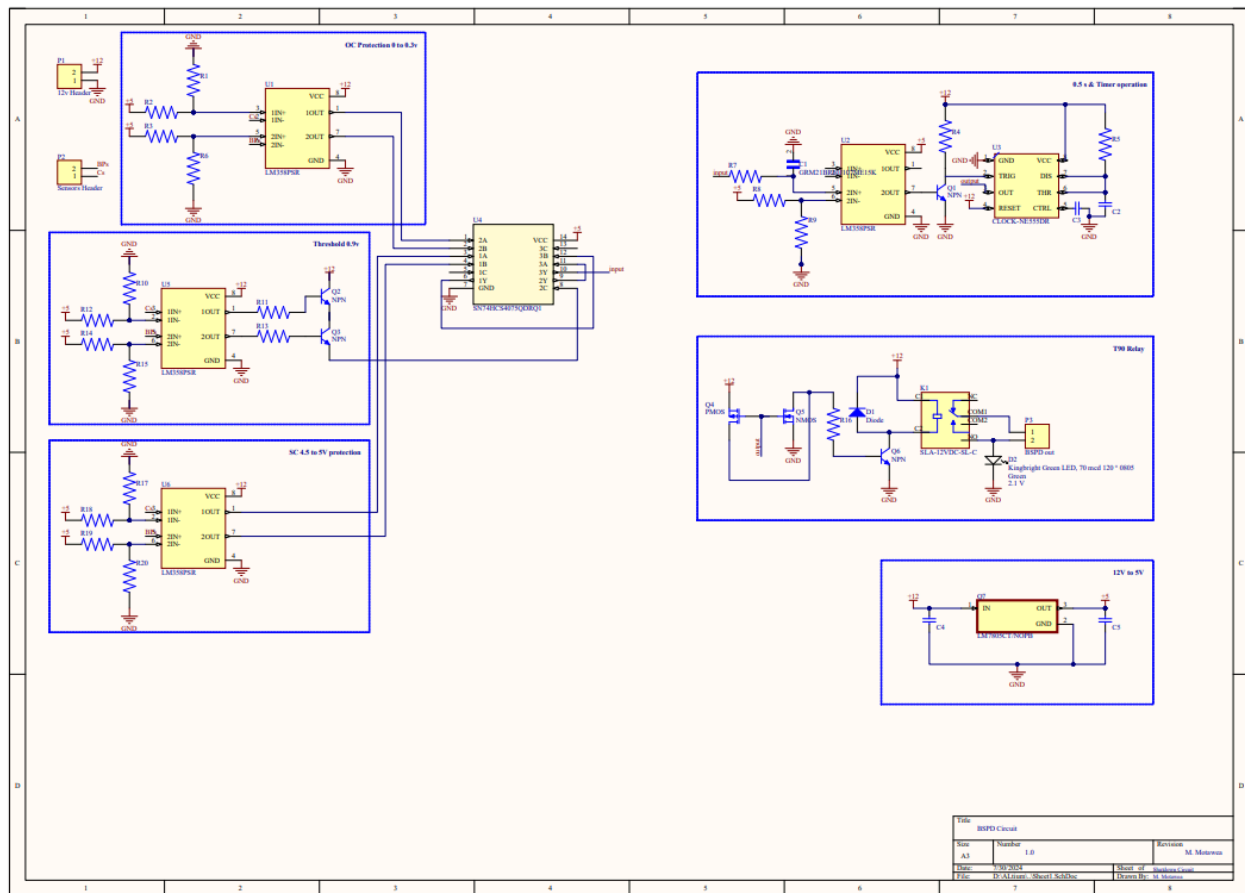
- T90 Relay (SLA-12VDC-SL-A) From Ram electronics 45egp
- Or gate (SN74HCS4075) From Texas Instruments

- Op-amps (LM358)
- NE555
- 4 NPNs
- LM7805CT

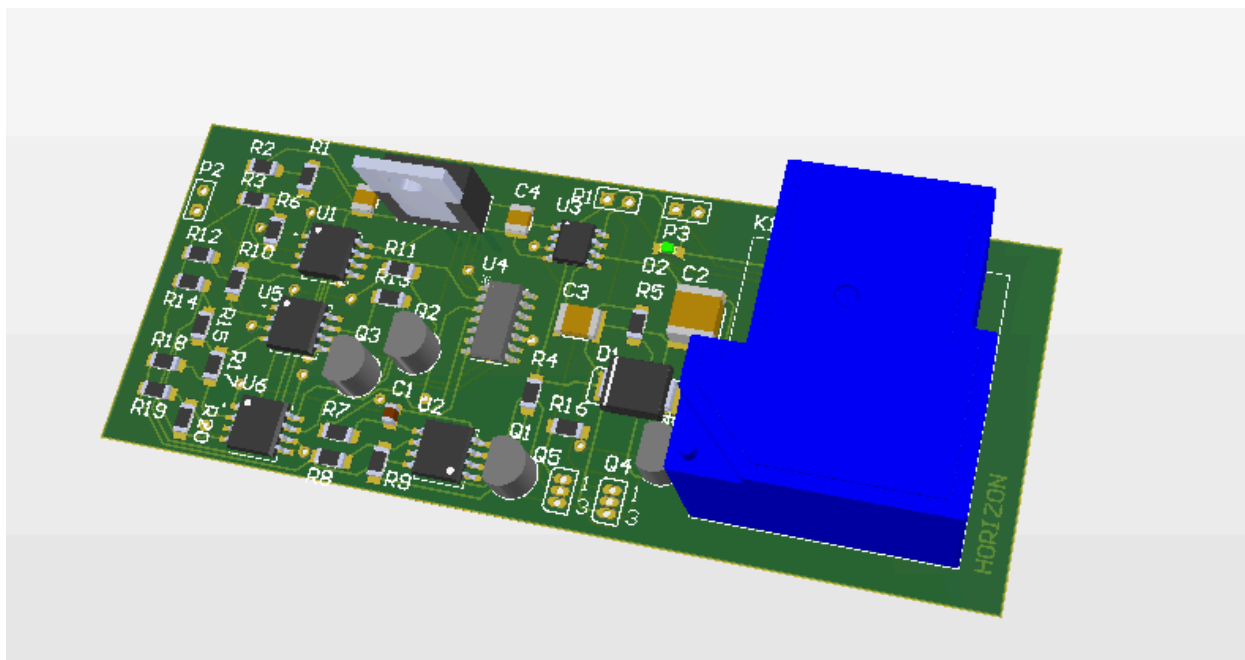
Schematic:

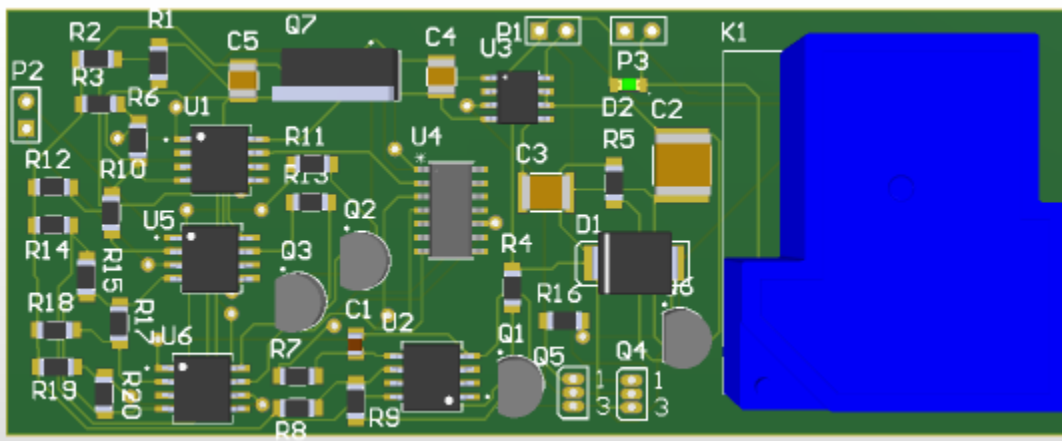
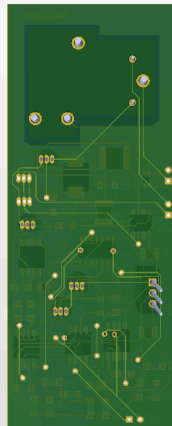


V2:



PCB:





BOM:

Comment	Description	Designator	Footprint	LibRef	Quantity
GRM21BR60J107ME15K	0805 100 uF 6.3 V ±20% Tolerance X7S Multilayer Ceramic Chip Capacitor	C1	CAPC2012X145N	GRM21BR60J107ME15K	1
10uF	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 2220, X7R Class II, 10uF, 100VDC	C2	WCAP- CSGP_2220_L5.7W5H2. 8	885012214006	1
10nF	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 1812, X7R, 10nF, 50VDC	C3	WCAP- CSGP_1812_L4.5W3.2H 1.25	885012210019	1
Diode	Default Diode	D1	SMC	Diode	1
Kingbright Green LED, 70 mcd 120 ° 0805	Kingbright Green LED, 70 mcd 120 ° 0805	D2	LED1913X12NGREEN	Kingbright Green LED, 70 mcd 120 ° 0805	1
SLA-12VDC-SL-C	SUBMINATURE HIGH POWER RELAY	K1	RELAY_SL-12VDC-SL- C	SLA-12VDC-SL-C	1
12v Header	Header, 2-Pin	P1	HDR1X2	Header 2	1
5v Header	Header, 2-Pin	P2	HDR1X2	Header 2	1
Sensors Header	Header, 2-Pin	P3	HDR1X2	Header 2	1
BSPD out	Header, 2-Pin	P4	HDR1X2	Header 2	1
NPN	NPN Bipolar Transistor	Q1, Q2, Q3, Q4	TO-226-AA	NPN	4
ERJU08J274V	1206 anti-sulfurated resistor 1206 Anti- Sulfurated	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19	RES_ERJU08J274V	ERJU08J274V	19
LM358PSR	General Purpose Amplifier 2 Circuit 8-SO	U1, U2, U5, U6	SOIC127P780X200-8N	LM358PSR	4
CLOCK-NE555DR	Single Precision Timer	U3	SOIC8-1.27-5X4MM	CLOCK- NE555DR(SOIC8)	1
SN74HCS4075QDRQ1	No Description Available	U4	SOIC14_D_TEX	SN74HCS4075QDRQ1	1

Updated BOM:

Comment	Description	Designator	Footprint	LibRef	Quantity
GRM21BR60J107ME15K	0805 100 uF 6.3 V ±20% Tolerance X7S Multilayer Ceramic Chip Capacitor	C1	CAPC2012X145N	GRM21BR60J107ME15K	1
10uF	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 2220, X7R Class II, 10uF, 100VDC	C2	WCAP- CSGP_2220_L5.7WSH2 8	885012214006	1
10nF	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 1812, X7R, 10nF, 50VDC	C3	WCAP- CSGP_1812_L4.5W3.2H 1.25	885012210019	1
220nF	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 1210, X7R, 220nF, 25VDC	C4	WCAP- CSGP_1210_L3.2W2.5H 0.95	885012209020	1
100nF	WCAP-CSGP Multilayer Ceramic Chip Capacitor, General Purpose, size 1210, X7R, 100nF, 25VDC	C5	WCAP- CSGP_1210_L3.2W2.5H 0.95	885012209019	1
Diode	Default Diode	D1	SMC	Diode	1
Kingbright Green LED, 70 mcd 120 ° 0805	Kingbright Green LED, 70 mcd 120 ° 0805	D2	LED1913X12NGREEN	Kingbright Green LED, 70 mcd 120 ° 0805	1
SLA-12VDC-SL-C	SUBMINATURE HIGH POWER RELAY	K1	RELAY_SLA-12VDC-SL- C	SLA-12VDC-SL-C	1
12v Header	Header, 2-Pin	P1	HDR1X2	Header 2	1
Sensors Header	Header, 2-Pin	P2	HDR1X2	Header 2	1
BSPD out	Header, 2-Pin	P3	HDR1X2	Header 2	1
NPN	NPN Bipolar Transistor	Q1, Q2, Q3, Q6	TO-226-AA	NPN	4
PMOS	P-Channel MOSFET	Q4	E3	MOSFET-P	1
NMOS	N-Channel MOSFET	Q5	E3	MOSFET-N	1
LM7805CT/NOPB		Q7	TO254P1054X470X195 5-3	LM7805CT/NOPB	1
ERJU08J274V	1206 anti-sulfurated resistor 1206 Anti- Sulfurated	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R15, R16, R17, R18, R19, R20	RES_ERJU08J274V	ERJU08J274V	20
LM358PSR	General Purpose Amplifier 2 Circuit 8-SO	U1, U2, U5, U6	SOIC127P780X200-8N	LM358PSR	4
CLOCK-NE555DR	Single Precision Timer	U3	SOIC8-1.27-5X4MM	CLOCK- NE555DR(SOIC8)	1
SN74HCS4075QDRQ1	No Description Available	U4	SOIC14_D_TEX	SN74HCS4075QDRQ1	1

Will be updated with Egyptian currency.

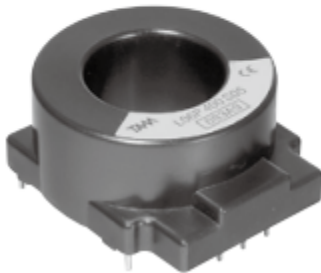
Sensors:

-Current sensor [Hall effect]

L06P S05 TAMURA

Model will be chosen according to battery voltage.

L06P S05 SERIES



Reference current will be calculated after the Battery is done.

Connector: MOLEX 5.08mm Pitch KK Crimp Housing, 3 Circuits, Natural

-BP sensor

To do:

- ☒ Timer
- ☒ A faster path for RC discharge
- ☒ Ltspice
- ☒ Buck converter
- ☐ Parts and sensors selection [add to BOM]
- ☒ Make sure transistors are compatible with relays and every thing
- ☒ Schematic design
- ☒ BOM
- ☒ PCB
- ☐ Mounting holes
- ☐ fuse