GLV BREAK OUT BOARD: MEMO-02

Abstract

This document describes the purpose, design, and functionality of the basic GLV BOB for ECE492's electric formula vehicle project. The Break out board was designed to consolidate all safety loop relays and monitoring devices onto a PCB. It include reset relays, temp monitoring, current monitoring and ADC/DAC.

April 7, 2017

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Introduction

A major design goal for the GLV team this year was to consolidate components used for the complete safety loop and VSCADA onto one PCB. We achieved this by creating a Board to replace din rail relays used in the past. In addition to this we were required to add new functionality to the PCB including monitoring systems and ADC/DAC capability. These side systems will be controlled by the raspberry pi computer.

The Design

The design schematic of the GLV BOB is shown in appendix A. Screw terminals are used for the majority of connections. A D-sub connector and pin headers are used for can bus and pi connections. A 24V to 5V DC/DC converter is used to provide power to the pi and on board ICs. One 5V relay is controlled by SCADA using an IC switch. The next two 24V relays are used in the safety loop for master reset and cockpit reset relays. The last relay is normally shut for use with the 100V supply in the dyno room. A lda210 opto-isolator is used as a monitoring device to turn on leds and inform VSCADA if the safety loop is broken in certain places. An ina226 is used to measure current and voltage of the GLV battery. It uses I2C to communicate with raspberry pi. An AD5593R is used for temp sensing and ADC/DAC converting via I2C as well. The ADC/DAC is used to control or read load, torque and RPM from the dyno room huff box. Finally an MCP6004 is used to buffer the load, torque and RPM signals. Appendix B shows the physical layout design.

Design Verification

Description	**Test Method**	**Detailed Results**
1.) Connectivity- The on board safety loop connections must be verified.	The pins were probed with and Ohmmeter to check correct continuity.	Each component was connected as expected. PASS (Appendix C)
2.) Energize- Relays latch open when shorted.	An ohmmeter was used to check continuity across the relays before and after energized.	The relays latched as expected. PASS (Appendix D)
3.) Deenergize- When the Safety loop is broken the relays latch back to the open position as intended.	Break the safety loop using a big red button and assure the relays open and remain open when power is restored	The relays functioned as expected. PASS (Appendix E)
4.) GLV LED	When GLV power is present to subsystems the LED will turn on.	The LED turned on. PASS
5.) Safety Loop LED	When subsystems verify ok state 24V appears on master reset and SL LED turns on.	The LED turned on. PASS

6.) AIRs LED	When all steps of the safety loop pass 24Vs is applied to the AIRs pin and the LED turns on.	The LED turns on. PASS
7.) Fault LED	If no voltage is present on the safety loop after subsystem checks then a fault has occurred and the LED will turn on.	The Led turns on. PASS
In submitting this checklist as part of our report, I/We certify that the tests described above were conducted and that the results of these tests are accurately described and represented. I/We understand that any misrepresentation of the tests or the results constitutes a violation of the College policy on academic dishonesty.		
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Data Collection

In order to verify the functionality of our I2C devices we used an Arduino to test the current sensor. We were able to specify the size of our shunt resistor and get accurate current readings from the chip. We compared these voltage and current readings to the ones we read on our power supply. The matched steadily to within .005A or V. This will provide us with ample accuracy.

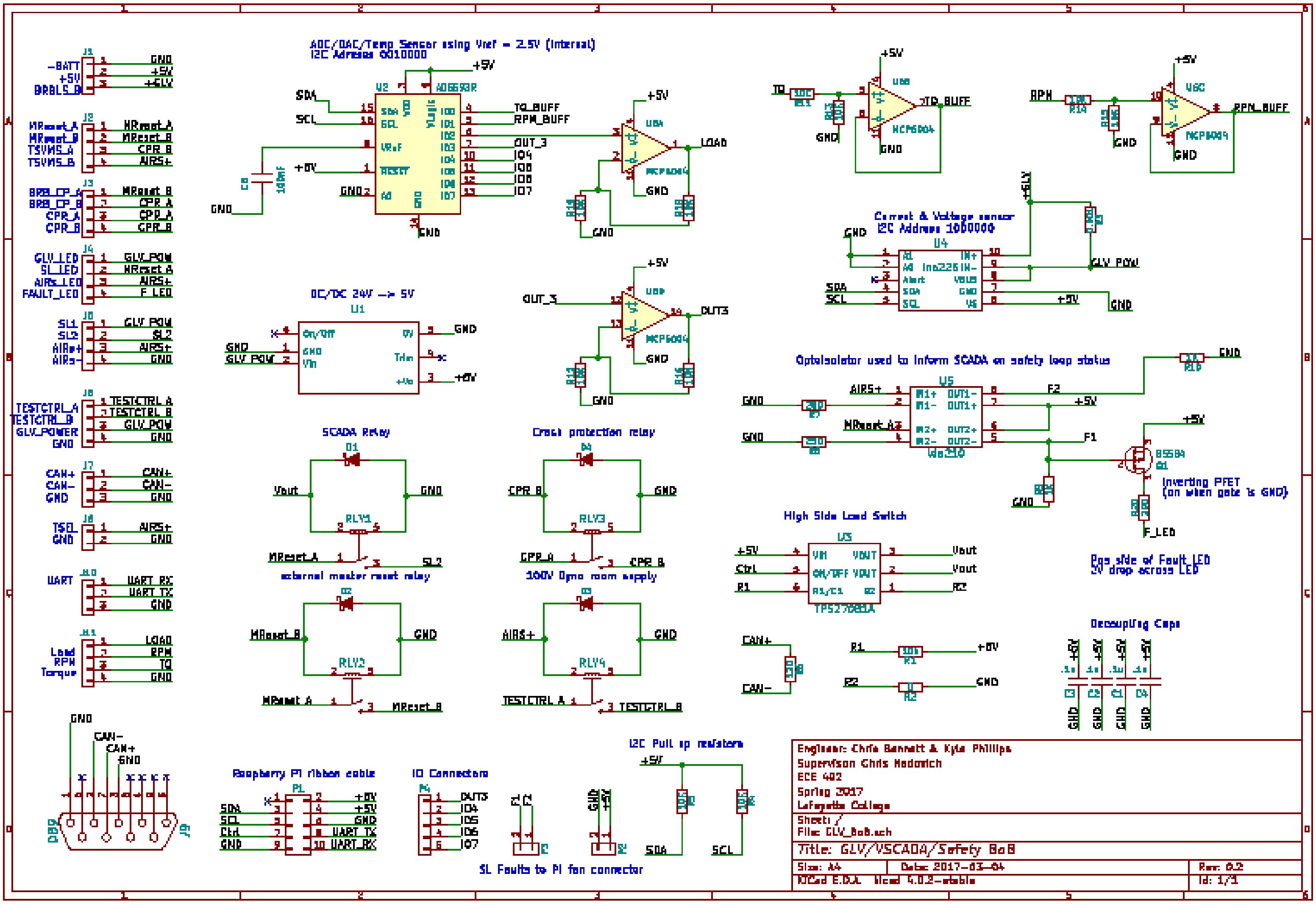
Conclusion

Upon the completion of the GLV BOB, the GLV team had provided a functioning safety system and monitoring system for the other subsystem. All systems will be integrated in the dyno room and car using our system and PCB.

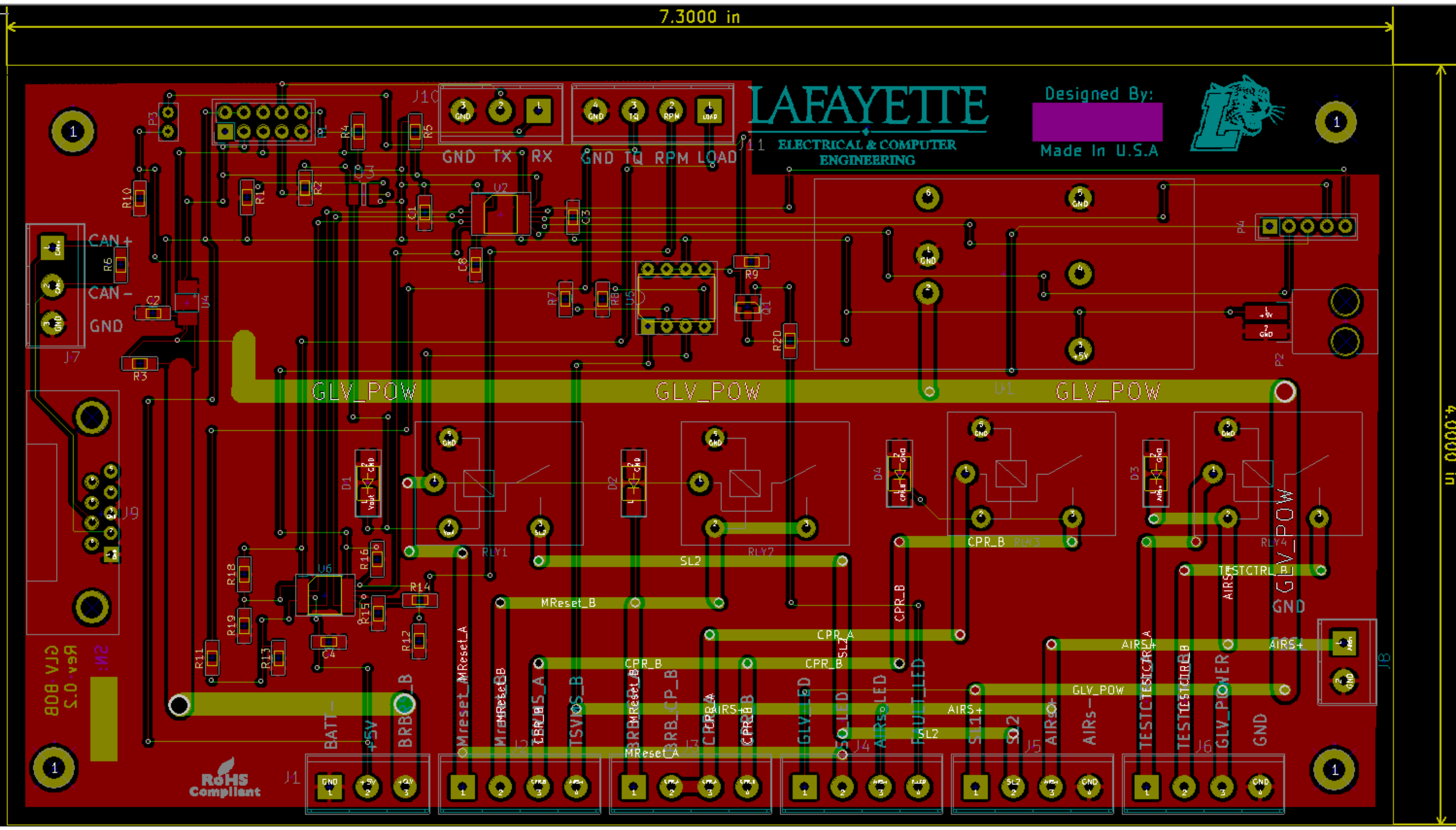
References

The GLV BOB design from the class of 2016 created by Joe Cericola was referenced for the design of the 2017 PCB.

Appendix A - GLVBOB Schematic



Appendix B – GLVBOB Layout



Appendix C – Continuity Tests

<u>Continuity (tests to be done with no external connections or power supplied to board)</u>			
Ground Nets			
1	Connection between -BATT and AIRs-		
		Expected:	0 Ohms
		Observed:	0 Ohms
2	Connection between -BATT and TESTCTRL_GND		
		Expected:	0 Ohms
		Observed:	0 Ohms
3	Connection between -BATT and CAN_GND		
		Expected:	0 Ohms
		Observed:	0 Ohms
4	Connection between -BATT and TSEL_GND		
		Expected:	0 Ohms
		Observed:	0 Ohms
5	Connection between -BATT and UART_GND		
		Expected:	0 Ohms
		Observed:	0 Ohms
6	Connection between -BATT and ADC/DAC_GND		
		Expected:	0 Ohms
		Observed:	0 Ohms
Safety Loop			
1	Connection between BRBLS_B and SL1		
		Expected:	0 Ohms
		Observed:	0 Ohms
2	Connection between BRBLS_B and GLV_LED		
		Expected:	0 Ohms
		Observed:	0 Ohms
3	Connection between BRBLS_B and GLV_POWER		
		Expected:	0 Ohms
		Observed:	0 Ohms

4	Connection between BRBLS_B and SL2		
		Expected:	MegaOhms/Open
		Observed:	MegaOhms/Open
5	Connection between BRBLS_B and AIRs+		
		Expected:	MegaOhms/Open
		Observed:	MegaOhms/Open
6	Connection between SL2 and Mreset_A		
		Expected:	MegaOhms/Open
		Observed:	MegaOhms/Open
7	Connection between Mreset_A and Mreset_B		
		Expected:	MegaOhms/Open
		Observed:	MegaOhms/Open
8	Connection between Mreset_B and BRB_CP_A		
		Expected:	0 Ohms
		Observed:	0 Ohms
9	Connection between BRB_CP_A and BRB_CP_B		
		Expected:	MegaOhms/Open
		Observed:	MegaOhms/Open
10	Connection between BRB_CP_B and CPR_A		
		Expected:	0 Ohms
		Observed:	0 Ohms
11	Connection between CPR_A and CPR_B		
		Expected:	MegaOhms/Open
		Observed:	MegaOhms/Open
12	Connection between CPR_B and TSVMS_A		
		Expected:	0 Ohms
		Observed:	0 Ohms
13	Connection between TSVMS_A and TSVMS_B		
		Expected:	MegaOhms/Open
		Observed:	MegaOhms/Open
14	Connection between TSVMS_B and AIRs+		
		Expected:	0 Ohms
		Observed:	0 Ohms
15	Connection between AIRs+ and AIRs_LED		
		Expected:	0 Ohms
		Observed:	0 Ohms
16	Connection between AIRs+ and TSEL		

		Expected:	0 Ohms	
		Observed:	0 Ohms	
17	Connection between TESTCTRL_A and TESTCTRL_B			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
VCI				
1	Connection between CAN+ and Pin7 of 9-USB			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
2	Connection between CAN- and Pin2 of 9-USB			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
3	Connection between CAN- and Pin7 of 9-USB			
		Expected:	MegaOhms/Open	
		Observed:	MegaOhms/Open	
4	Connection between BATT- and Pin1 of 9-USB			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
5	Connection between BATT- and Pin3 of 9-USB			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
6	Connection between BATT- and Pin7 of 9-USB			
		Expected:	MegaOhms/Open	
		Observed:	MegaOhms/Open	
7	Connection between UART_RX and Pin10 of 10-pin header			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
8	Connection between UART_TX and Pin8 of 10-pin header			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
9	Connection between UART_TX and Pin10 of 10-pin header			
		Expected:	MegaOhms/Open	
		Observed:	MegaOhms/Open	
10	Connection between BATT- and Pin9 of 10-pin header			
		Expected:	0 Ohms	
		Observed:	0 Ohms	
11	Connection between BATT- and Pin6 of 10-pin header			

		Expected:	0 Ohms	
		Observed:	0 Ohms	
12	Connection between BATT- and Pin8 of 10-pin header			
		Expected:	MegaOhms/Open	
		Observed:	MegaOhms/Open	

Appendix D – Power on Tests

Below is a list of test for 24V supplied with no external connections.		
1	GLV_LED terminal voltage	
	Expected:	24V
	Observed:	24V
2	GLV_POWER terminal voltage	
	Expected:	24V
	Observed:	24V
3	SL1 terminal voltage	
	Expected:	24V
	Observed:	24V
4	+5V terminal voltage	
	Expected:	5V
	Observed:	5V
5	Pin 2 on 10 pin header voltage	
	Expected:	5V
	Observed:	5V
6	Pin 4 on 10 pin header voltage	
	Expected:	5V
	Observed:	5V

Appendix E – Relay Tests

5V VSCADA Relay		
1	Connect Pin 7 to Pin 6 on 10 Pin Header	

		Connection between SL2 and MresetA	
		Expected	Mega Ohms (Open)
		Observed	Mega Ohms (Open)
2	Connect Pin 7 to Pin 2 on 10 Pin Header		
		Connection between SL2 and MresetA	
		Expected	0 Ohms
		Observed	0 Ohms
Mreset Relay			
1	Normal MresetA and Mreset B (pre shorting)		
	Expected	Mega Ohms (Open)	
	Observed	Mega Ohms (Open)	
2	Short MresetA and Mreset B (check for latch)		
	Expected	0 Ohms	
	Observed	0 Ohms	
CPR Relay			
1	Normal CPRA and CPR B (pre shorting)		
	Expected	Mega Ohms (Open)	
	Observed	Mega Ohms (Open)	
1	Short CPRA and CPR B terminals and then check for latch		
	Expected	0 Ohms	
	Observed	0 Ohms	
TestCTRL Relay			
1	Make sure AIRs does not have 24V		
	Expected	0 Ohms	
	Observed	0 Ohms	
2	Complete Safety Loop to power AIRs (make sure AIRs terminal reads 24Vs)		
	Expected	Mega Ohms (Open)	
	Observed	Mega Ohms (Open)	

Appendix F – LED and Opto Test

Turn GLV Power ON and open SL1 and SL2, connect header Pin 7 to header Pin 6		
1	Check Voltage on SL LED	
	Expected:	0V
	Observed	0V
2	Check Voltage on Fault LED	
	Expected:	5V
	Observed	5V
Turn GLV Power ON and short SL1 and SL2, connect header Pin 7 to header Pin 6		
1	Check Voltage on SL LED	
	Expected:	0V
	Observed	0V
2	Check Voltage on Fault LED	
	Expected:	5V
	Observed	5V
3	Check Voltage on F1	
	Expected:	0V
	Observed	0V
4	Check Voltage on F2	
	Expected:	0V
	Observed	0V
Turn GLV Power ON and short SL1 and SL2, connect header Pin 7 to header Pin 2		
1	Check Voltage on SL LED	
	Expected:	24V
	Observed	24V
2	Check Voltage on Fault LED	
	Expected:	0V
	Observed	0V
3	Check Voltage on AIRs LED	
	Expected:	0V
	Observed:	0V
4	Check Voltage on F1	
	Expected:	5V

	Observed:	5V
5	Check Voltage on F2	
	Expected:	0V
	Observed:	0V
Turn on AIRs Power by connecting relays		
1	Check Voltage on AIRs LED	
	Expected:	24V
	Observed	24V
2	Check Voltage on F2	
	Expected:	5V
	Observed:	5V