

SAFETY LOOP QA				
Test#	Description	Test Method	Expected Results	PASS /FAIL
1.0	Energize Subsystems-24V Power Supplied to GLV Subsystems.	Supplied 24V of power to the GLV system using an external power supply. The 10A circuit breaker, GLVMS, BRBRS, BRBLS, and 10A circuit breaker were closed. The 24V output was measured on J10 (6 pins of GLV power and Can Bus line) on the GLV enclosure.	24V was measured on J10. The GLV LED turned on.	<input checked="" type="checkbox"/>
2.0	Energize AIRS- Power supplied to Accumulator AIRs.	Supplied 24V of power to the GLV system using an external power supply. The GLVMS, BRBLS, BRBRS, TSVMS, circuit breakers, and driver BRB were closed. The exterior master switch and driver reset were pressed.	The GLV LED is on. The SAFETY LED is on. The AIRs LED is on. The FAULT LED is off. The AIRs in the packs closed.	<input checked="" type="checkbox"/>
3.0	Shutdown- All GLV power turns off when the GLVMS or exterior BRBs turn off.	Power was supplied to the AIRs following the procedure in test 2.0. The GLVMS was opened, while checking the output to the J10 pin on the GLV enclosure. This was repeated for both exterior BRBs.	All LEDs turned off. 0V was measured on J10. GLV Subsystems deenergized	<input checked="" type="checkbox"/>
4.0	Fault- GLV System stops supplying power to the AIRs in the following situations.	The AIRs were energized following the procedure described in test 2.0. The following faults will be tested. The Master Reset and Drive Reset were pressed at the end of each test to ensure these inputs do not reenergize the AIRs during a fault.	Pass Tests 4.1-4.3	<input checked="" type="checkbox"/>
4.1	Subsystem Fault	A subsystem breaks the safety loop. This was tested by removing the final jumper on the SL2TSI J9 Connector on the GLV interconnect panel.	The GLV LED is on. The SAFETY LED is off. The AIRs LED is off. The FAULT LED is on.	<input checked="" type="checkbox"/>

4.2	Driver E-Stop Fault	The Driver E-Stop was pressed.	The GLV LED is on. The SAFETY LED is on. The AIRs LED is off. The FAULT LED is off.	☑
4.3	TSVMS Fault	The TSVMS was turned off.	The GLV LED is on. The SAFETY LED is on. The AIRs LED is off. The FAULT LED is off.	☑
5.0	Reenergize AIRs after fault.	The faults in test 4.0 should be resettable in the following ways so that the AIRs can be reenergized without cutting power to the GLV powered subsystems.	Pass Tests 5.1-5.3	☑
5.1	AIRs Reenergize after Subsystem Fault	Ran test 4.1. Fixed the safety loop fault in the subsystem. This was done by plugging the safety loop jumper back into the TSV battery packs, closing the safety loop. Pressed the Master Reset and then the Crash Protection Reset.	The GLV LED is on. The SAFETY LED is on. The AIRs LED is on. The FAULT LED is off. The AIRs in the packs closed.	☑
5.2	AIRS Reenergize after Driver E-Stop Fault	Ran test 4.2. Closed the Driver E-Stop. Pressed the Master Reset and then the Crash Protection Reset.	The GLV LED is on. The SAFETY LED is on. The AIRs LED is on. The FAULT LED is off. The AIRs in the packs closed.	☑
5.3	AIRs Reenergize after TSVMS Fault	Ran test 4.3. Reengaged TSVMS. Pressed the Master Reset and then the Crash Protection Reset.	The GLV LED is on. The SAFETY LED is on. The AIRs LED is on. The FAULT LED is off. The AIRs in the packs closed.	☑

6.0	Connectivity- The safety loop is wired as shown by the schematic in Appendix A.	The safety loop circuit was traced with an ohmmeter to ensure each connection occurred expected.	Each component was connected as expected.	<input checked="" type="checkbox"/>
7.0	Unexpected Input- The reset buttons should not have any effect on the system if pressed at an unexpected time or in the wrong order.	The following unexpected inputs did not affect the system.	Pass Tests 7.1-7.2	<input checked="" type="checkbox"/>
7.1	Master Reset or Driver Reset pressed after AIRs energized.	Followed procedure in test 2.0 to energize the AIRs. Pressed the Master Reset. Pressed the Driver Reset.	No changed occurred.	<input checked="" type="checkbox"/>
7.2	Driver Reset pressed before master reset when energizing AIRs after startup.	Followed procedure in test 1.0 to energize GLV powered subsystems. Ensured there were no subsystem safety loop faults as indicated by on SAFETY LED. Pressed Driver Reset.	The GLV LED is on. The SAFETY LED is on. The AIRs LED is off. The FAULT LED is off. The AIRs were not energized.	<input checked="" type="checkbox"/>

GLV BOB QA *all pin references are to only the GLV BOB rev.4.1 schematic

Test#	Description	Test Method	Expected Results	PASS /FAIL
1.0	Grounding	Pass Tests 1.1-1.4		<input checked="" type="checkbox"/>
1.1	Airs grounded	Continuity Test	Connection between GLV_RTN and AIRs-	<input checked="" type="checkbox"/>
1.2	Can grounded	Continuity Test	Connection between GLV_RTN and CAN_GND	<input checked="" type="checkbox"/>

1.3	Temp Sensor grounded	Continuity Test	Connection between 5V_RTN and U2-14	<input checked="" type="checkbox"/>
1.4	Volt and Amp Sensor Chip grounded	Continuity Test	Connection between 5V_RTN and U4-7	<input checked="" type="checkbox"/>
1.5	Ground Isolation	Continuity Test	No connection between 5V_RTN and GLV_RTN No short between 5V_RTN and 5V No Short between GLV_RTN and 24V	<input checked="" type="checkbox"/>
2.0	Communication (CAN, I2C)	Pass Tests 2.1-2.4		<input type="checkbox"/>
2.1	CAN+	Continuity Test	DB9-p8 is connected to J7-p1	<input checked="" type="checkbox"/>
2.2	CAN-	Continuity Test	DB9-p4 is connected to J7-p6	<input checked="" type="checkbox"/>
2.3	CAN_SHIELD	Continuity Test	DB9-p3 is connected to J7-p3	<input checked="" type="checkbox"/>
2.4	Display CAN data	Check SCADA	Motor Controller / TSI data is displayed by	<input type="checkbox"/>
2.5	SDA	Continuity Test	SDA is connected to P1-p1	<input checked="" type="checkbox"/>
2.6	SCL	Continuity Test	SCL is connected to P1-p3	<input checked="" type="checkbox"/>
2.7	Display I2C data	Check SCADA	GLV temperature, current, and voltage sensor are displayed by SCADA	<input checked="" type="checkbox"/>
3.0	Power	Pass Tests 3.1-3.6		<input checked="" type="checkbox"/>
3.1	GLV+ active	Check LED	D7 is on	<input checked="" type="checkbox"/>
3.2	5V is active	Check LED	D9 is on	<input checked="" type="checkbox"/>

3.3	GLV+ supply	Volt Meter	J12-p1 is 24V	✓
3.4	Safety Loop 1 power loss	Run Safety Loop QA test 2.0 and use Volt Meter	J6-p1 is 24V	✓
3.5	Safety Loop 2 power loss	Run Safety Loop QA test 2.0 and use Volt Meter	J6-p2 is 24V	✓
3.6	5V supply	Volt Meter	P2-p1 is 5V J10-pVBUS is 5V	✓
3.7	Power Isolation	Continuity Test	GLV+ is not connected to 5V	✓
4.0	Relays	Pass Tests 4.1-4.8 (Must supply 24v to J2-p1 for the following)		✓
4.1	SCADA CONTROL ON	Supply P1-p5 with 5V. Check SCADA LED.	On board LED SCADA is on	✓
4.2	SCADA CONTROL OFF	Supply P1-p5 with 0V. Check SCADA LED.	On board LED SCADA is off	✓
4.3	MASTER RESET relay ON	Supply J3-1 and J3-2 with 24V. Then remove 24V supply from J3-2. Check MRESET LED	On board LED MRESET is on	✓
4.4	MASTER RESET relay OFF	Run test 4.3 then remove the supply from J3-1. Check MRESET LED	On board LED MRESET is off	✓
4.5	COCKPIT RESET relay ON	Supply J5-2 and J5-4 with 24V. Then remove 24V supply from J5-4. Check CPR LED	On board LED CPR is on	✓
4.6	COCKPIT RESET relay OFF	Run test 4.5 then remove the supply from J5-4. Check CPR LED	On board LED CPR is off	✓
4.7	DYNO relay ON	Supply J3-p4 with 24V. Check DYNO LED	On board LED DYNO is on	✓
4.8	DYNO relay OFF	Remove J3-p4 with 24V. Check DYNO LED	On board LED DYNO is off	✓
4.9	SCADA relay NC programming	Disconnect SCADA from GLV. Connect J4-p3 to J4-p2 with jumper. Continuity test between J6-p1 and J3-1.	Continuous	✓

5.0	SCADA relay NO programming	Disconnect SCADA from GLV. Connect J4-p1 to J4-p2 with jumper. Continuity test between J6-p1 and J3-1.	Discontinuous	<input checked="" type="checkbox"/>
5.1	DYNO relay NO programming	Connect J11-p3 to J11-p2. Check pins J8-p1 and J8-p2. Resistance test.	Resistance should be 1k ohm.	<input checked="" type="checkbox"/>
5.2	DYNO relay NO programming	Connect J11-p1 to J11-p2. Check pins J8-p1 and J8-p2. Resistance test.	Resistance should be Overload.	<input checked="" type="checkbox"/>
5.0	LED & OPTOISOLATION	Pass Tests 5.1-5.3		<input checked="" type="checkbox"/>
5.1	Jumper Disconnect	Supply 24V to J2-p1 without a jumper between J6-p1 and J6-p4. Volt Meter	The voltage on SAFETY LED is 0V. The voltage on Fault LED is 5V. The voltage on F1 is 0V. The voltage on F2 is 0V.	<input checked="" type="checkbox"/>
5.2	Jumper Connect	Supply 24V to J2-p1 with a jumper between J6-p1 and J6-p4. Volt Meter	The voltage on SAFETY LED is 24V. The voltage on Fault LED is 0V. The voltage on AIRs LED is 0V. The voltage on F1 is 5V. The voltage on F2 is 0V.	<input checked="" type="checkbox"/>
5.3	Air Power	Supply 24V to J6-p2.	The voltage on AIRs LED is 24V The voltage on F2 is 5V	<input checked="" type="checkbox"/>