

SAFETY LOOP QA					
Test #	Description	Test Method	Expected results	PASS/FAIL	Initial
1.0	Energize subsystems	Supply 24 V to the GLV board.	24V seen at J6-p2, J7-p5, J12-p1, J5-p5	<input type="checkbox"/>	
2.0	Energize AIRS - Supply power to accumulator AIRs.	Supply 24V to the GLV system using external power supply. Close GLVMS, BRBs, TSVMS, circuit breakers, and CP BRB. Press exterior master switch and driver reset.	Cockpit LEDs: GLV on SAFE on AIRs on FAULT off AIRs in pack close	<input type="checkbox"/>	
3.0	Shutdown - All GLV power turns off when the GLVMS or side BRBs turn off.	Supply following previous procedure. Open GLVMS and check GLV output pins on board.		<input type="checkbox"/>	
4.0	Fault - GLV system stops supplying power to the AIRs in the following situations.	Energize AIRs following procedure listed above. Test the following faults.		<input type="checkbox"/>	
4.1	Subsystem fault - A subsystem breaks the safety loop.	Remove the final jumper on the SL2 TSI J9 connector on the GLV interconnect panel.	LEDs: GLV on SAFE off AIRs off FAULT on	<input type="checkbox"/>	
4.2	Driver E-stop fault	Press the driver E-stop button.	LEDs: GLV on SAFE on AIRs off FAULT off	<input type="checkbox"/>	
4.3	TSVMS fault	Turn off TSVMS.	LEDs: GLV on SAFE on AIRs off FAULT off	<input type="checkbox"/>	
5.0	Reenergize AIRs after fault.	Faults in the previous test should be resettable in the following methods so that the AIRs can be reenergized without cutting power to the GLV powered subsystems.		<input type="checkbox"/>	
5.1	AIRs reenergize after subsystem fault.	Run test 4.1. Fix safety loop by plugging jumper back into TSI. Press master reset and CP reset	LEDs: GLV on SAFE on AIRs on FAULT off AIRs in packs are closed	<input type="checkbox"/>	
5.2	AIRs reenergize after Driver E-stop fault.	Run test 4.2. Open the driver E-stop. Press the master reset and CP reset.	LEDs: GLV on SAFE on AIRs on FAULT off AIRs in packs are closed	<input type="checkbox"/>	
5.3	AIRs reenergize after TSVMS fault.	Run test 4.3. Reengage TSVMS. Press the master reset and CP reset.	LEDs: GLV on SAFE on AIRs on FAULT off AIRs in packs are closed	<input type="checkbox"/>	
6.0	Connectivity - The safety loop is wired as shown in the Interconnectivity Diagram.	Trace the safety loop circuit with an ohmmeter to ensure expected connections.	Components connected as expected.	<input type="checkbox"/>	
7.0	Unexpected Input - The reset buttons should not have an effect on the safety loop if pressed at the wrong time or wrong order	The following tests should not affect the safety loop		<input type="checkbox"/>	
7.1	Master reset or driver reset pressed after the AIRs are energized	Follow procedure 2.0 to energize the AIRs. Press the master reset and driver reset	No changes to safety loop occur	<input type="checkbox"/>	

7.2	Driver reset pressed before master reset when energizing AIRs after startup.	Follow procedure 1.0 to energize GLV powered subsystems. Press driver reset	LEDs: GLV on SAFE on AIRs off FAULT off AIRS are not energized	<input type="checkbox"/>			
GLV BOB QA							
Test #	Description	Test Method	Expected results	PASS/FAIL			
1.0	Grounding	Pass 1.1-1.4		<input checked="" type="checkbox"/>	NE		
1.1	AIRs grounded	Continuity Test - Check for connection between GLV_RTN and AIRs-.	Connection exists as expected.	<input checked="" type="checkbox"/>	NE	Note: AIRs- was renamed to GLV_RTN	
1.2	CAN grounded	Continuity Test - Check for connection between GLV_RTN and CAN_GND.	Connection exists as expected.	<input checked="" type="checkbox"/>	NE	Note: CAN_GND was renamed to GLV_RTN	
1.3	Temp sensor grounded	Continuity Test - Check for connection between 5V_RTN and [INSERT IMU PIN HERE].	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
1.4	Volt and Amp sensor grounded	Continuity Test - Check for connection between GLV_RTN and U4-7.	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
1.5	Ground isolation	Continuity Test - Check that there is no connection between 5V_RTN and GLV_RTN. Check that there are no shorts between 5V_RTN and 5V. Check that there are no shorts between GLV_RTN and 24V.	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
2.0	Communication (CAN, I2C)	Pass 2.1-2.7		<input type="checkbox"/>			
2.1	CAN+	Continuity Test - Check for connection between DB9-p8 and J7-p1	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
2.2	CAN-	Continuity Test - DB9-p4 is connected to J7-p2	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
2.3	CAN_SHIELD	Continuity Test - DB9-p3 is connected to J5-p10	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
2.4	Display CAN data	Check SCADA	Motor controller/TSI data is displayed by SCADA	<input type="checkbox"/>			
2.5	SDA	Continuity Test - SDA is connected to P1-p1	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
2.6	SCL	Continuity Test - SCL is connected to P1-p3	Connection exists as expected.	<input checked="" type="checkbox"/>	NE		
2.7	Display I2C data	Check SCADA	GLV temp, current, and voltage are displayed by SCADA	<input type="checkbox"/>			
3.0	Power	Pass 3.1-3.6		<input checked="" type="checkbox"/>			
3.1	GLV+ active	Check LED	GLV LED on	<input checked="" type="checkbox"/>	NE		
3.2	5V is active	Check LED	5V LED on	<input checked="" type="checkbox"/>	NE		
3.3	GLV+ supply	Use Voltmeter to read voltage at J12-p1 (GLV+)	24V measured at pin	<input checked="" type="checkbox"/>	NE		
3.4	Safety loop 1 power loss	Run safety loop QA test 2.0 and use voltmeter to check J6-p1 (SL2)	24V measured at pin	<input checked="" type="checkbox"/>	NE		
3.5	Safety loop 2 power loss	Run safety loop QA test 2.0 and use voltmeter to check J6-p3 (AIRs+)	24V measured at pin	<input checked="" type="checkbox"/>	NE		
3.6	5V supply	Use voltmeter to check P2-p1 (+5V) and J10-pVBUS (+5V)	5V measured at pins	<input checked="" type="checkbox"/>	NE		
3.7	Power Isolation	Continuity Test - Check for connections between GLV+ and 5V	No connections detected	<input checked="" type="checkbox"/>	NE		
4.0	Relays	Pass 4.1-4.9		<input type="checkbox"/>			
4.1	SCADA control on	Supply P1-p5 (Ctrl) with 5V. Check SCADA LED on board	LED is on	<input type="checkbox"/>		There is no SCADA LED	

4.2	SCADA control off	Supply P1-p5 (Ctrl) with 0V. Check SCADA LED on board	LED is off	<input type="checkbox"/>			
4.3	Master Reset A on	Supply J3-p1 (MRESET_A) with 24V. Check D10 (MRESET_A LED)	MRESET_A LED (D10) is on	<input checked="" type="checkbox"/>	NE		
4.4	Master Reset B on	Supply J3-p1 (MRESET_A) with 0V. Check D10 (MRESET_A LED)	MRESET_A LED (D10) is off	<input checked="" type="checkbox"/>	NE		
4.5	Master reset on	Supply J3-p1 (MRESET_A) and J3-p2 (MRESET_B) with 24V. Then remove 24V supply from J5-p4 (CPR_B). Check D8 (MRESET_B LED) on board	MRESET_B LED (D8) is on MRESET_A LED (D10) is on	<input checked="" type="checkbox"/>	NE		
4.6	Master reset off	Run test 4.3 then remove the supply from J3-p1 (MRESET_A). Check D8 (MRESET_B LED) on board	MRESET_B LED (D8) is on MRESET_A LED (D10) is on	<input checked="" type="checkbox"/>	NE		
4.7	Cockpit reset on	Supply J5-p2 (CPR_A) and J5-p4 (CPR_B) with 24V. Then remove 24V supply from J5-p4 (CPR_B). Check D6 (CPR_B LED) on board	CPR_B LED (D6) is on	<input checked="" type="checkbox"/>	NE		
4.8	Cockpit reset off	Run test 4.5 then remove the supply from J5-p4 (CPR_B). Check D6 (CPR_B LED) on board	CPR_B LED (D6) is off	<input checked="" type="checkbox"/>	NE		
4.9	SCADA relay NC programming	Disconnect SCADA from GLV. Connect J4-p3 to J4-p2 with jumper. Continuity test between J6-p1 (SL2) and J3-p1 (MRESET_A).	Connection exists as expected	<input checked="" type="checkbox"/>	NE		
5.0 LED and Optoisolation		Pass 5.1-5.7		<input checked="" type="checkbox"/>			
5.1	Jumper disconnect	Supply 24V to J2-p1 (BATT+) without a jumper between J6-p1 (SL2) and J6-p2 (GLV+). Measure with voltmeter	Voltage of LEDs: SAFE: 0V FAULT: 0V AIRS: 0V Voltage on F1: 5V Voltage on F2: 0V	<input checked="" type="checkbox"/>	NE	check again with cockpit LEDs	Voltage on F1 is approx 4.2V
5.2	Jumper connect	Supply 24V to J2-p1 (BATT+) with a jumper between J6-p1 (SL2) and J6-p2 (GLV+). Measure with voltmeter	Voltage of LEDs: SAFE: 0V FAULT: 0V AIRS: 0V Voltage on F1: 5V Voltage on F2: 0V	<input checked="" type="checkbox"/>	NE	check again with cockpit LEDs	Voltage on F1 is approx 4.2V
5.3	AIR power	Supply 24V to J6-p3 (AIRS+)	Voltage on AIRS+ is 24V Voltage on F2 is 5V	<input checked="" type="checkbox"/>	NE	approx 4.2V on F2	check again with cockpit LEDs
5.4	Master Reset power	Supply 24V to J3-p1 (MRESET_A)	Voltage on F LED is 5V Voltage on F1 is 5V	<input checked="" type="checkbox"/>	NE	approx 4.2V on F1	check again with cockpit LEDs
5.5	Cockpit Reset power	Supply 24V to J5-p3 (CPR_A)	Voltage on F3 is 5V	<input checked="" type="checkbox"/>	NE	approx 4.2V on F3	check again with cockpit LEDs
5.6	Safety Loop Pre AIRs power	Supply 24V to J8-p1 (SL_PRE_AMS). Check J5-p11 (AMS_FAULT) with voltmeter	Voltage on SL_Pre_5V is 5V Voltage on AMS_FAULT is 24V	<input checked="" type="checkbox"/>	NE	check again with cockpit LEDs	
5.7	Safety Loop Post AIRs power	Supply 24V to J8-p2 (SL_POST_AMS). Check J5-p11 (AMS_FAULT) with voltmeter	Voltage on SL_Post_5V is 5V Voltage on AMS_FAULT is 24V	<input checked="" type="checkbox"/>	NE	check again with cockpit LEDs	
5.8	AMS_FAULT power (SL_Pre_AMS HIGH)	Supply 24V to J8-p1 (SL_PRE_AMS) and J8-p2 (SL_PRE_AMS). Check J5-p11 (AMS_FAULT) with voltmeter	Voltage on AMS_FAULT is 0V	<input checked="" type="checkbox"/>	NE	check again with cockpit LEDs	
				<input type="checkbox"/>			
				91.89%			