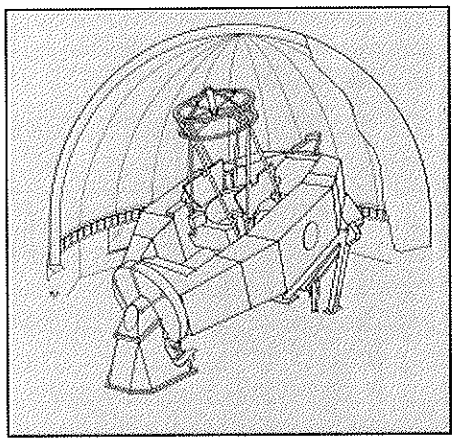
REV	DESCRIPTION	DATE	BY
-	Initial Release	4/17/08	EAW

T3-3003
Safety Board Test Procedure
Revision: -

SERIAL NUMBER TESTED 002 Rev C



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1 Test Overview

This test procedure is for validating and setting hardware limits on the TCS3 Safety Board. This procedure is primarily intended to be used for board level testing. However, since the TCS3 software and the lab setup are used during testing, some minor system level interface testing will also be included where it is convenient. Only after completing and passing this procedure is the Safety Board acceptable for operational use.

All fields with a *yellow background* are recordable data fields and must be completed.

Note: making a test procedure that is completely independent of the TCS3 lab setup was determined to be very cumbersome due to the number and types of interfaces. Therefore, it is important that the lab setup be maintained and functional for this test procedure.

2 Equipment and Tools Required

The table below lists the equipment and tools required to complete this test procedure.

Item #	Qty	Model / Part Number	Description
1	2	Fluke 179 (or equivalent)	Fluke Multimeter
2	1	-	TCS3 Lab System
3	1	-	Latest TCS3 Software
4	1	TDS2014B (or equivalent)	Oscilloscope, 100 MHz, 4 channel
5	REF	TCS-T3	Safety Board Schematics
6	1	-	14 pin DIP Test Clip
7	1	-	Safety Board (unit under test)

Table 1 Required Test Equipment

3 Test Setup

Follow these steps to setup the lab system:

1. Power down the TCS3 motor amp supplies. This is the big supply at the bottom of the rack.
2. Power down the TCS3 rack box containing the Safety Board.
3. Disconnect all connectors from the Safety Board in the rack box and remove the Safety Board. Install Safety Board that is to be tested and connect all connectors to it.
4. Remove jumpers W1, W2, W3, and W4 from the Safety Board.
5. Power up the TCS3 rack box and motor amp power supply.
6. Turn on the "t9h" PC if it is not already running. This is the analog tachometer emulator.
7. Start up the latest version of the TCS3 software.
8. Bring up two mcc windows and display mcc1 and mcc2.
9. Press the "T3.Reset" button on mcc1.
10. Press the system power on button on mcc2.
11. Select the track button on mcc1.

The lab unit should be tracking. If it is not, look for any errors listed in the mcc1 window. Most likely the error will be related to the limit switches on the test panel. If not, refer to the TCS3 lab unit documentation.

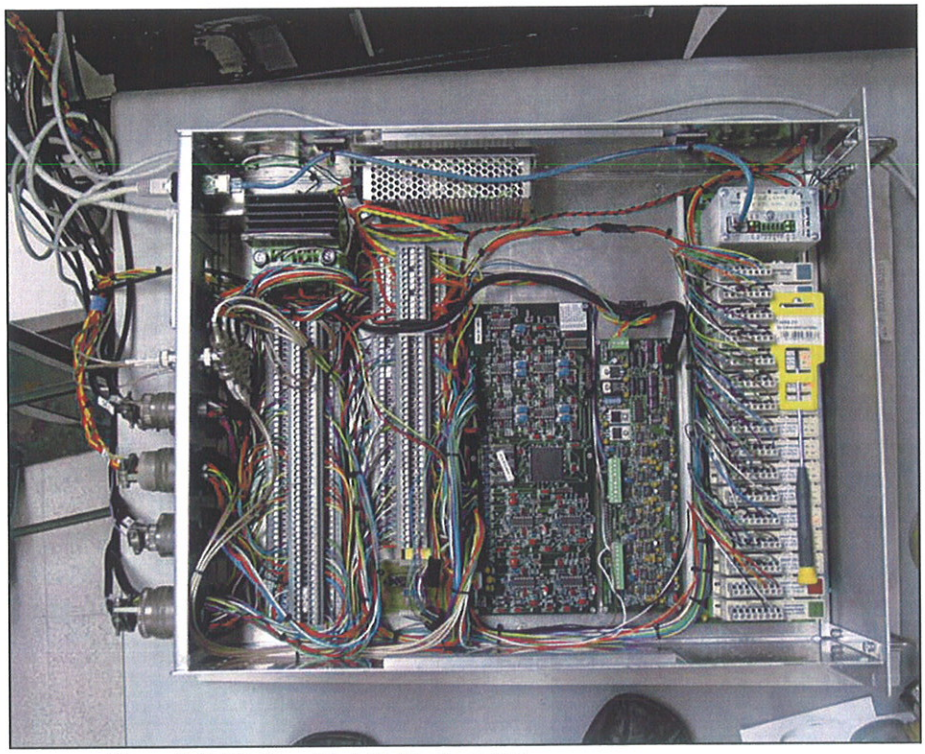

Figure 1 Safety Board Installed in Servo Box

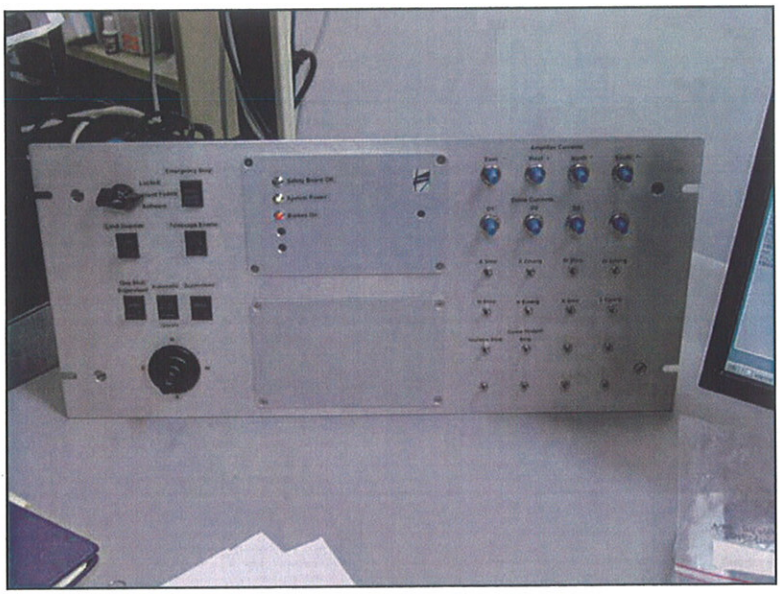

Figure 2 TCS3 Lab Setup TO Control Panel

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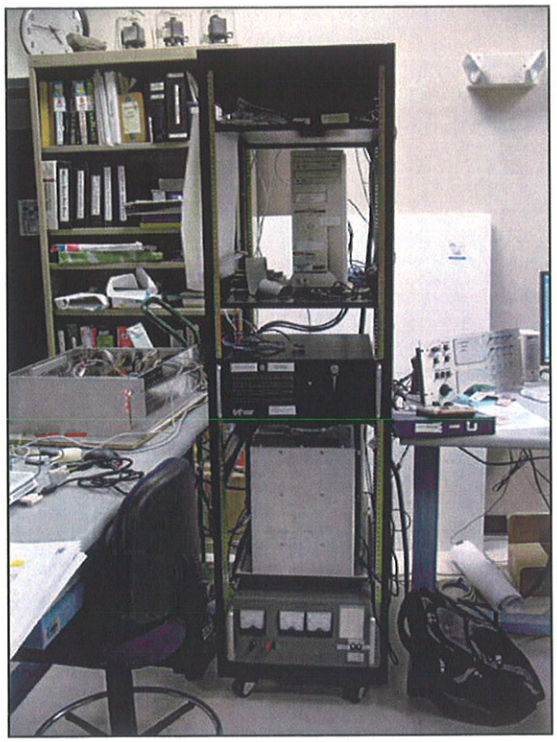

Figure 3 TCS3 Lab Rack

4 Testing

4.1 Limit & Stop Switches

Each switch in the table below will simulate a fault when it is switched. Start each test in tracking mode. After each fault, move the switch back to its non-fault position and push the "T3.Reset" (mcc1) button followed by the power on button (mcc2) and select tracking again. Repeat this procedure for the next switch listed. In addition to testing the switches (simulated fault conditions), the testing below also tests the reset and brake signals by using theses functions in the procedure.

Check the conditions that apply to each switch. If all boxes are checked, then the fault that the switch simulates passes.

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Switch	mcc1 display (✓)				Lab TO Panel LEDs (✓)			Final Result - All boxes checked (circle one)	Tester Initials	Date
	Unique mcc1 Error Message	Unique Error	"Safety Board Error Exist"	"System Power is off"	System Power = OFF	Brakes On = ON	Safety Board OK = OFF			
E stop	SafetyBrd_HA_Stop_E_Latch	✓	✓	✓	✓	✓	✓	PASS / FAIL	EaW	6/13/08
E Emerg	SafetyBrd_HA_Emerg_E_Latch							PASS / FAIL		
W Stop	SafetyBrd_HA_Stop_W_Latch							PASS / FAIL		
W Emerg	SafetyBrd_HA_Emerg_W_Latch							PASS / FAIL		
N Stop	SafetyBrd_Dec_Stop_N_Latch							PASS / FAIL		
N Emerg	SafetyBrd_Dec_Emerg_N_Latch							PASS / FAIL		
S Stop	SafetyBrd_Dec_Stop_S_Latch							PASS / FAIL		
S Emerg	SafetyBrd_Dec_Emerg_S_Latch							PASS / FAIL		
Horizon Stop	SafetyBrd_Horizon_Stop_Latch							PASS / FAIL		
Hand Paddle Stop	SafetyBrd_DomeHP_Stop_Latch							PASS / FAIL		
Emergency Stop	Safety Brd_Emerg_Stop_Latch							PASS / FAIL		

Table 2 Limit Switch Tests

4.2 Limit Override Switch

Start tracking mode. Move the "Limit Override" switch to the up position. With this switch in the up position, activate each switch and record the data in the table below until all switches are active.

Switch	mcc1 display (✓)			Lab TO Panel LEDs (✓)			Final Result - All boxes checked (circle one)	Tester Initials	Date
	Unique mcc1 Error Message	Unique Error	Hardware Limit Override On	System Power = ON	Brake = OFF	Safety Brd OK =ON			
E stop	SafetyBrd_HA_Stop_E_Latch						PASS / FAIL	EaW	6/19/08
E Emerg	SafetyBrd_HA_Emerg_E_Latch						PASS / FAIL		
W Stop	SafetyBrd_HA_Stop_W_Latch						PASS / FAIL		
W Emerg	SafetyBrd_HA_Emerg_W_Latch						PASS / FAIL		
N Stop	SafetyBrd_Dec_Stop_N_Latch						PASS / FAIL		
N Emerg	SafetyBrd_Dec_Emerg_N_Latch						PASS / FAIL		
S Stop	SafetyBrd_Dec_Stop_S_Latch						PASS / FAIL		
S Emerg	SafetyBrd_Dec_Emerg_S_Latch						PASS / FAIL		
Horizon Stop	SafetyBrd_Horizon_Stop_Latch						PASS / FAIL		

Table 3 Override Switch Tests #1

Deactivate all of the switches from the above table. Move the "Limit Override" switch to the up position. For each mode below, start in tracking mode. Unlike the test above, the tests in the table below should cause faults. Reset, turn on power, and start tracking after each fault. After the completion of the tests, move the Limit Override to the down position (off).

Switch	mcc1 display (✓)				Lab TO Panel LEDs (✓)			Final Result - All boxes checked (circle one)	Tester Initials	Date
	Unique mcc1 Error Message	Unique Error	"Safety Board Error Exist"	"System Power is off"	System Power = OFF	Brake = ON	Safety Brd OK = OFF			
Hand Paddle Stop	SafetyBrd_DomeHP_Stop_Latch	✓	✓	✓	✓	✓	✓	PASS / FAIL	EaW	6/18/08
Emergency Stop	SafetyBrd_Emerg_Stop_Latch	✓	✓	✓	✓	✓	✓	PASS / FAIL	EaW	6/18/08

Table 4 Override Switch Tests #2

4.3 Telescope Enable Switch

The telescope enable switch will not cause the TCS3 to remove system power. It simply disables the telescope (and applies brakes) as its name implies. Begin in tracking mode, move the switch down to disable the telescope, and record the data. After completion of the tests, move the switch to the up position.

Switch	mcc1 display (✓)		Lab TO Panel LEDs (✓)			Final Result - All boxes checked (circle one)	Tester Initials	Date
	Unique mcc1 Error Message	Unique Message	System Power = ON	Brake = ON	Safety Brd OK = ON			
Telescope Enable	TOP Tele Enable is OFF	✓	✓	✓	✓	PASS / FAIL	EaW	6/18/08

Table 5 Telescope Enable Switch Tests

4.4 Overcurrent

There are several overcurrent telemetry points used to protect the amplifiers and motors for both the dome and the telescope axes. To test these points, the lab TO Panel has potentiometers that can vary the voltage, emulating the current feedback in the actual system.

There are two steps to this testing section. The first step is to adjust the Safety Board potentiometer to the correct value. The second is to test the Safety Board and TCS3 software together. Repeat the steps for each point listed in the table.

NOTE: The current limits will be set fairly high relative to the average current usage. Based on the position of the telescope much higher current may be required during acceleration. If the dome "sticks" or binds at a certain point, maximum current may be required. Therefore,

the dome current limits are set very high and may only trip under a catastrophic condition such as a short or amplifier malfunction.

1. Adjusting the Safety Board Current Trip Point

Set TCS3 to idle mode. It is likely that the TCS will have overcurrent conditions when adjusting the potentiometers. These errors can be ignored. While monitoring the "current telemetry", "comparator input", and "Logic State", adjust the TO Panel potentiometer until the "current telemetry" reaches the specified value. Adjust the Safety Board potentiometer until the overcurrent logic state changes from a logic "1" to a logic "0". Record the requested values in the table. All measurements are referenced to "AGND". There is no pass or fail in this subsection. This an adjustment section and the values must be within the setpoint. If the potentiometer is not adjusted correctly, the next subsection tests will not be passed.

Note: For the the West, East, North, and South overcurrent circuits, only one direction (voltage polarity) will actually need to be tested. TCS3 has opposing motors with each motor driving in only one direction. Therefore, the opposite polarity will never trip outside of an unexpected catastrophic type of failure.

The dome amplifiers may be expected to put out maximum current for a significant amount of time due to the dome "sticking" at certain points. Therefore the current limits are set above the amplifier limit and would only be tripped during a catastrophic type of event.

The nominal current telemetry factor is 11.66 A/V.

Current Point	Monitor Overcurrent Logic State At	Current Telemetry (Vdc) (Using TO Panel)				Comparator Input (Vdc) (Using Safety Board Pot)				Tester Initials	Date
		Approx. Current Trip Point	Measure At	Setpoint (Vdc)	Actual	Pot	Measure At	Expected (Vdc)	Actual		
West Current	U10-1	35 A	TB1-B1	3.0 +/- 10mV	2.99	R128	TP5	0.42 to 0.50V	.445	EQDN	6/18/08
East Current	U10-14	35 A	TB1-B2	-3.0 +/- 10mV	3.00	R130	TP8	-0.42 to -0.50V	~~.448~~ .486		
North Current	U7-1	35 A	TB1-B3	3.0 +/- 10mV	3.00	R99	TP2	0.42 to 0.50V	.445		
South Current	U7-14	35 A	TB1-B4	-3.0 +/- 10mV	-3.01	R101	TP3	-0.42 to -0.50V	-.490		
DOME #1 Current	U9-1	47 A	TB1-B5	4.0 +/- 100mV	3.99	R127	TP6	0.42 to 0.50V	.478		
DOME #2 Current	U9-14	47 A	TB1-B6	4.0 +/- 100mV	4.03	R129	TP7	0.42 to 0.50V	.483		
DOME #3 Current	U13-1	47 A	TB1-B7	4.0 +/- 100mV	4.00	R152	TP9	0.42 to 0.50V	.481		

Table 6 Overcurrent Trip Point Adjustment

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2. Testing the Overcurrent Telemetry

Reset by pushing the "T3.Reset" (mcc1) button followed by the power on button (mcc2). While monitoring the "current telemetry" and the "overcurrent" telemetry, adjust the TO Panel potentiometer until the "overcurrent" telemetry changes states from a logic "1" to a logic "0". Record the requested values in the table. All measurements are referenced to "AGND".

NOTE: *The overcurrent trip points are not symmetrical due to the design and current build of all of the Safety Boards. It was decided not to modify the built boards to be symmetrical since the TCS operation isn't affected by it. Motors are driven in one direction only, so having unsymmetrical trip points in the other direction doesn't matter. A shorted, catastrophic condition would still be detected. The Dome motor overcurrents are set high, above the maximum continuous current available by the amps, so their function is only to detect high current, catastrophic conditions.

Current Point and Polarity	Monitor Overcurrent Logic State At	Current Telemetry (V)				Trip Point SPEC	Unique mcc1 Error Message	Unique mcc1 Error Present	Tester Initials	Date
		Approx. Current Trip Point	Measure At	Actual Trip Point (V)	Trip Point SPEC (Vdc)					
West+	U10-1	35 A	TB1-B1	3.02	2.9 to 3.1	PASS / FAIL	SafetyBrd_OC_ West _Latch	PASS / FAIL	EaW	6/18/08
West-	U10-1	*-42 A	TB1-B1	-3.55	-3.5 to -3.7	PASS / FAIL	SafetyBrd_OC_ West _Latch	PASS / FAIL		
East+	U10-14	*28 A	TB1-B2	2.55	~~2.3~~ to 2.5 2.4 to 2.6	PASS / FAIL	SafetyBrd_OC_ East _Latch	PASS / FAIL		
East-	U10-14	-35 A	TB1-B2	-3.02	-2.9 to -3.1	PASS / FAIL	SafetyBrd_OC_ East _Latch	PASS / FAIL		
North+	U7-1	35 A	TB1-B3	3.01	2.9 to 3.1	PASS / FAIL	SafetyBrd_OC_ North _Latch	PASS / FAIL		
North-	U7-1	*42 A	TB1-B3	-3.58	-3.5 to -3.7	PASS / FAIL	SafetyBrd_OC_ North _Latch	PASS / FAIL		
South+	U7-14	*28 A	TB1-B4	2.52	~~2.3~~ to 2.5 2.4 to 2.6	PASS / FAIL	SafetyBrd_Sout OC h _Latch	PASS / FAIL		
South-	U7-14	35 A	TB1-B4	-2.98	-2.9 to -3.1	PASS / FAIL	SafetyBrd_Sout OC h _Latch	PASS / FAIL		
DOME 1+	U9-1	47 A	TB1-B5	3.99	3.9 to 4.1	PASS / FAIL	SafetyBrd_OC_ Dome1 _Latch	PASS / FAIL		
DOME 1-	U9-1	54 A	TB1-B5	-4.56	-4.5 to -4.7	PASS / FAIL	SafetyBrd_OC_ Dome1 _Latch	PASS / FAIL		
DOME 2+	U9-14	47A	TB1-B6	4.04	3.9 to 4.1	PASS / FAIL	SafetyBrd_OC_ Dome2 _Latch	PASS / FAIL		
DOME 2-	U9-14	54 A	TB1-B6	-4.60	-4.5 to -4.7	PASS / FAIL	SafetyBrd_OC_ Dome2 _Latch	PASS / FAIL		
DOME 3+	U13-1	47 A	TB1-B7	4.05	3.9 to 4.1	PASS / FAIL	SafetyBrd_OC_ Dome3 _Latch	PASS FAIL		
DOME 3-	U13-1	54 A	TB1-B7	-4.61	-4.5 to -4.7	PASS / FAIL	SafetyBrd_OC_ Dome3 _Latch	PASS / FAIL		

Table 7 Overcurrent Testing

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4.5 Overspeed

There are two overspeed circuits that prevent the HA or DEC axis from exceeding a set, maximum speed

Two steps must be completed in this testing section. The first step is to adjust the Safety Board overspeed potentiometers to the correct values. The second is to test the Safety Board and TCS3 software together.

1. Adjusting the Safety Board Overspeed Trip Point

Turn pots R100 and R102 clockwise to lower the potentiometer resistances. This will effectively disable the overspeed circuit and prevent the board from reporting an overcurrent condition that would shutdown the TCS3 system, preventing this test from being completed.

OPTIONAL: To verify that the potentiometers are low enough, measure TP1 (for R100) and TP4 (for R102) to AGND with TCS3 powered down. Adjust the potentiometers until the resistance is less than 100Ω.

While monitoring the "velocity telemetry" and "comparator input", set and execute an "MV" command at 2000 arcsec/sec on mcc1. This command should produce a voltage that falls within the desired velocity telemetry range. If not, there is an issue. Adjust the Safety Board potentiometer until the overspeed logic state changes from a logic "1" to a logic "0". This will cause a fault and the TCS3 will have to be reset and the MV command will have to be reissued. Record the requested values in the table. All measurements are referenced to "AGND".

Note: The scale factor for velocity is approximately 596 (arcsec/s)/V.

Overspeed Axis	Monitor Overspeed Logic State At	Velocity Telemetry (V)			Comparator Input (V)				Tester Initials	Date
		Measure At	Setpoint (Vdc)	Actual	Pot	Measure At	Desired (mV dc)	Actual		
HA Axis	U8-1	U1-1	3.4 +/- 100mV	3.47	R100	TP1	0.41 to 0.49V	0.44	EGON	6/18/08
DEC Axis	U8-14	U3-1	3.4 +/- 100mV	3.50	R102	TP4	0.41 to 0.49V	0.488	↓	↓

Table 8 Overspeed Trip Point Adjustment

2. Testing the Overspeed Telemetry

Reset by pushing the "T3.Reset" (mcc1) button followed by the power on button (mcc2). While monitoring the "velocity telemetry" and the "overspeed" telemetry, increment and execute the MV command until the "overspeed" telemetry changes states from logic "1" to logic "0". The overspeed circuit will be tested with both positive and negative velocities. Start the MV command at +1900 arcsec/s (-1900 arcsec/s) and increase magnitude in increments of 10 arcsec/s. Record the requested values in the table below. All measurements are referenced to "AGND".

Overspeed Axis	Monitor Overspeed Logic State At	Velocity Telemetry (V)			Overspeed Trip Point SPEC	Last MV CMD @ Trip Point (arcsec/s)	Unique mcc1 Error Message	Unique mcc1 Error Present	Tester Initials	Date
		Measure At	Actual Trip Point (V)	Trip Point SPEC (V)						
HA Axis (positive)	U8-1	U1-1	3.45	3.35 +/- 50mV 3.3 - 3.5	PASS / FAIL	2000	SafetyBrd_OS_Ha_Latch	PASS / FAIL	EAAW	6/18/08
HA Axis (negative)	U8-1	U1-1	-3.40	~~-3.35~~ +/- 50mV -3.3 to -3.5	PASS / FAIL	-2000	SafetyBrd_OS_Ha_Latch	PASS / FAIL	↓	↓
DEC Axis (positive)	U8-14	U3-1	3.38	3.35 +/- 50mV 3.3 to 3.5	PASS / FAIL	1980	SafetyBrd_OS_Dec_Latch	PASS / FAIL		
DEC Axis (negative)	U8-14	U3-1	-3.44	-3.35 +/- 50mV -3.3 to -3.5	PASS / FAIL	~~1980~~ -1990	SafetyBrd_OS_Dec_Latch	PASS / FAIL	↓	↓

Table 9 Overspeed Testing Tests

4.6 Velocity Loop Testing

The velocity loop is an analog loop on the Safety Board. This section will test the DC gain of the circuit. Using two multimeters, measure and record the values listed in the table below while using the MV command to move at the specified rate (use mcc1). All measurements are referenced to "AGND". There are not any convenient test points or pins for the "Vel In" values, so resistors will have to be probed. The side of the resistor to measure is the side that connects to P1 and is a nonzero value when the axis is moving. The other side is a virtual ground on the input of an op-amp and will read very close to zero.

Motor Under Test	MV CMD Velocity	Measure At	"Vel In" Value (V)	Measure At	"Vel Out" (V)	Gain= "Vel_Out" / "Vel_In"	GAIN SPEC	GAIN PASS / FAIL	Tester Initials	Date
WEST	500	R5	-760	TB1-T9	-760	1	0.95 to 1.05	PASS / FAIL	EAAW	6/18/08
WEST	1500	R5	-800	TB1-T9	-800	1	0.95 to 1.05	PASS / FAIL		
EAST	-500	R8	800	TB1-T7	800	1	0.95 to 1.05	PASS / FAIL		
EAST	-1500	R8	900	TB1-T7	900	1	0.95 to 1.05	PASS / FAIL		
NORTH	500	R46	-700	TB1-T13	-700	1	0.95 to 1.05	PASS / FAIL		
NORTH	1500	R46	-740	TB1-T13	-740	1	0.95 to 1.05	PASS / FAIL		
SOUTH	-500	R45	760	TB1-T11	760	1	0.95 to 1.05	PASS / FAIL		
SOUTH	-1500	R45	760	TB1-T11	760	1	0.95 to 1.05	PASS / FAIL	↓	↓

Table 10 Velocity Loop DC Gain Tests

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4.7 Tachometer Gain

TCS3 uses a filtered, average velocity from the two opposing motor tachometers. To verify that the velocity gain is correct, several points will be measured and the corresponding data will be used to calculate the gain. Use the MV command to set the velocity as indicated in the table. Record the required data. All measurements are referenced to "AGND" with the exception of "measure from" values. Measure from red (+) to black (-).

4.7.1 HA Axis

MV CMD Velocity	East Tach (V) (measure from TB1-T20 to TB1-T21)	West Tach (V) (measure from TB1-T23 to TB1-T24)	"HA Vel Feedback" (V) (measure at U1-1)	Tach_Gain= $\frac{"HAVel"}{(East+West)/2}$	GAIN SPEC	GAIN PASS / FAIL	Tester Initials	Date
100	.84	.84	.17	.202	0.20 to 0.22	PASS / FAIL	EAW	6/15/09
1000	8.4	8.4	1.17	.202	0.20 to 0.22	PASS / FAIL	↓	↓
1800	15	15	3	.20	0.20 to 0.22	PASS / FAIL	↓	↓

Table 11 HA Axis Tachometer Gain Tests

4.7.2 DEC Axis

MV CMD Velocity	North Tach (V) (measure from TB1-T29 to TB1-T30)	South Tach (V) (measure from TB1-T26 to TB1-T27)	"HA Vel Feedback" (V) (measure at U3-1)	Tach_Gain= $\frac{"HAVel"}{(East+West)/2}$	GAIN SPEC	GAIN PASS / FAIL	Tester Initials	Date
~~15~~ 100	.80	.80	.17	.213	0.20 to 0.22	PASS / FAIL	EAW	6/15/09
1000	8.3	8.3	1.7	.204	0.20 to 0.22	PASS / FAIL	↓	↓
1800	15	15	3.1	.207	0.20 to 0.22	PASS / FAIL	↓	↓

Table 12 DEC Axis Tachometer Gain Tests

4.8 Power & Miscellaneous Board Signals

Power and board level signals that do not fit into any specific category and are tested in this section. All measurements are referenced to "AGND".

Signal Name	Measure At	Value	Units	SPEC	PASS / FAIL	Tester Initials	Date
-0.44 V Reference	R154 / R153 Node	-430	mVdc	-400 to -480 mV	PASS / FAIL	EAW	6/18/08
+0.44 V Reference	R150 / R143 Node	433	mVdc	400 to 480 mV	PASS / FAIL		
CLK OUT Frequency	U13 pin 14	7.418	Hz	7.0 to 8.0 Hz	PASS / FAIL		
CLK OUT Vmax	U13 pin 14	5.09	Vdc	4.5 to 5.1	PASS / FAIL		
CLK OUT Vmin	U13 pin 14	-520	mVdc	-400 to -530 mV	PASS / FAIL		
+15V Power	U7-3	15.27	Vdc	14.5 to 15.5 V	PASS / FAIL		
-15V Power	U1-1	-15.33	Vdc	-14.5 to -15.5 V	PASS / FAIL		
VCC Power	U11-16	5.036	Vdc	4.75 to 5.25 V	PASS / FAIL		
TCS Lockout	TB1-T36	87	mVdc	< 100 mV	PASS / FAIL		
Mtr Cntr Err	TB1-T35	86	mVdc	< 100 mV	PASS / FAIL	✓	✓

Table 13 Miscellaneous Board Signal Testing

4.9 Watch Dog Timer

The Safety Board has two watch dog timers. The watchdog timer reset signal is sent from the TCS3 Control PC to the Safety Board. With the TCS3 software and Safety Board powered, measure the signal at the specified point. Then, push and hold the momentary contact switch located at TB1-T38 for about 1-2 seconds. This disconnects the watchdog timer connection. Record the results. Depending on the timing, it may take a few attempts to get both errors to appear at the same time on the mcc1 screen.

Condition	mcc1 Error Message	PASS / FAIL	Tester Initials	Date
Normal	No Errors	PASS / FAIL	EAW	6/18/08
Switch Pressed	SafetyBrd_Watchdog_Tmr_Latch	PASS / FAIL	✓	✓
Switch Pressed	SafetyBrd_Clocking_Error_Latch	PASS / FAIL	✓	✓

Table 14 Watchdog Timer Test

4.10 Brake & Telescope Relays

To test these relays, start tracking (turns off brakes) and measure between the specified points in the table. Then enter idle mode (turns brakes on) and measure the specified points again.

NOTE: In the lab system, the outputs of the relays do not ultimately connect to anything.

Condition	Relay Under Test	Measure Between	Value	Units	SPEC	PASS / FAIL	Tester Initials	Date
Tracking (brakes OFF)	Brake Enable	TB1-B49 to TB2-B33	24.1	V	23V to 25V	PASS / FAIL	EGW	6/19/08
Tracking (brakes OFF)	Telescope Amp	TB1-T1 to TB1-T2	0.4	Ω	Less than 1Ω	PASS / FAIL	↓	↓
Idle (brakes ON)	Brake Enable	TB1-B49 to TB2-B33	0.0	V	Less than 100 mV	PASS / FAIL	↓	↓
Idle (brakes ON)	Telescope Amp	TB1-T1 to TB1-T2	off scale	Ω	Greater than 1 MΩ	PASS / FAIL	↓	↓

Table 15 Brake & Telescope Relay Tests

4.11 Dome Switch & Relay

The dome switch on the TO panel selects what controls the dome. Move the switch to the desired position and measure across the specified points.

NOTE: On the lab system, the output of this relay is not ultimately connected to anything.

Dome Switch Position	mcc1 message	mcc1 message present?	Measure Between	Value (Ω)	SPEC	PASS / FAIL	Tester Initials	Date
Locked	"TO Panel has locked Dome Control"	PASS / FAIL	TB1-T4 and TB1-T5	off scale	Greater than 1MΩ	PASS / FAIL	EGW	6/19/08
Hand Paddle	"Dome Control Hand Paddle Mode"	PASS / FAIL	TB1-T4 and TB1-T5	0.4	Less than 1Ω	PASS / FAIL	↓	↓
Software	"Software Mode Is Locked"	PASS / FAIL	TB1-T4 and TB1-T5	0.4	Less than 1Ω	PASS / FAIL	↓	↓

Table 16 Dome Switch & Relay Tests

4.12 Overall Servo

The overall servo testing will consist of tracking, offsets, and slewing. Use the specified PID and velocity feed forward values with the appropriate command. When performing these tests, look for any abnormal signs, specifically large oscillations. A basic knowledge of using the TCS3 control software is assumed. If more information on using it is required, please contact someone who is familiar with it (software programmer, TO, etc).

The measurements required for all the tables below come from the sub-tab "Perf-G" in the "Details" tab.

Basic commands used in command line prompt:

pg.ferr 2	Zooms in on following error window.
beam.set 30 30	Sets beam switch to 30 arcsec for both HA and DEC.
next.hadec 1 40	Sets slew position to 1hr (HA) and 40 degrees (DEC).

Operation	HA Axis				DEC Axis			
	P	I	D	Vff	P	I	D	Vff
Tracking	~~100k~~ 60K	~~25k~~ 15K	~~2k~~ 3K	~~15k~~ 10K	~~100k~~ 50K	~~25k~~ 15K	~~2k~~ 5K	~~15k~~ 10K
SLEW	~~100k~~ 40K	100	~~2k~~ 3K	~~15k~~ 1280	~~100k~~ 60K	100	~~2k~~ 3K	~~15k~~ 1280

Table 17 Servo PID Settings for mcc3 window.

Operation	Axis	Following Error - "pmac" plot				SPECS PASS / FAIL	Tester Initials	Date
		"range" arcsec peak-peak	SPEC "range" arcsec peak-peak	std dev arcsec	SPEC std dev arcsec			
Tracking	HA	.426	0.5	0.07	0.1	PASS / FAIL	EAM	6/19/08
Tracking	DEC	0.08	0.1	0.022	0.03	PASS / FAIL	EAM	6/19/08

Table 18 Tracking Tests

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* There are some issues with the lab system. Performance is OK and is typical. EAW 6/19/08

Operation	Axis	Offset (arcsec)	Settling Time "pmac" plot (yellow)	SPEC Settling Time (back to within 0.2 arcsec p-p band)	SPECS PASS / FAIL	Tester Initials	Date
Tracking	HA	+30	1.2	< 2 seconds	PASS / FAIL	EAW	6/19/08
Tracking	HA	-30	2.2	< 2 seconds	PASS / FAIL		
Tracking	HA	+100	1.5	< 2.5 seconds	PASS / FAIL		
Tracking	HA	-100	2.5	< 2.5 seconds	PASS / FAIL		
Tracking	DEC	+30	1.5	< 2 seconds	PASS / FAIL		
Tracking	DEC	-30	1.5	< 2 seconds	PASS / FAIL		
Tracking	DEC	+100	1.5	< 2.5 seconds	PASS / FAIL		
Tracking	DEC	-100	1.4	< 2.5 seconds	PASS / FAIL		

Table 19 Offset Tests

Operation	Axis	Movement	Velocity Error - "pmac" plot (yellow) (during constant velocity portion of SLEW)				SPECS PASS / FAIL	Tester Initials	Date
			"range" arcsec/s peak-peak	SPEC "range" arcsec/s peak-peak	"std dev" arcsec/s	SPEC " std dev" arcsec/s			
SLEW	HA	+	112	150	2	20	PASS / FAIL	EAW	6/19/08
SLEW	HA	-	150	150	32	20	PASS / FAIL		
SLEW	DEC	+	20	15		3	PASS / FAIL		
SLEW	DEC	-	17	15	3.5	3	PASS / FAIL		

Table 20 Slew Tests

This section will need to have new limits established if lab system is modified. If not, this section is more of a basic operation test.

5 Completion

1) Power down the TCS3 lab setup.

2) Remove the safety board.

3) Verify that the correct build revision sticker is on the Safety Board.

4) Insert jumpers W1, W2, W3, and W4 back into the Safety Board.

5) Place "tested (date)" sticker on Safety Board.

5) Testing for the Safety Board is now complete and is acceptable for use in TCS3.

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