

TCS3 Electronics

Hazard Analysis and T3 Design

Sources of Hazards

- Drive or feedback components: Motor, Amplifier, Tachometer, Encoder
 - Mechanical: Jammed telescope, Dome, Cooling
 - Loss of TCS3 Components: Computer, Motor controller, Electronics, Safety Switch
 - Operator error: Inadvertent movement, Platform or Crane not stowed, Slew speed near end of axis
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Potential Hazards 1

Hazard	Telescope Condition	TCS3 module(s) responding to condition
<ul style="list-style-type: none"><input type="checkbox"/> Loss of Motor<input type="checkbox"/> Loss of Motor Amplifier<input type="checkbox"/> Loss of one Motor Amplifier Drive Signal<input type="checkbox"/> Loss of Motor Tachometer<input type="checkbox"/> Loss of Encoder	Runaway	Software, T3 over speed circuit, stop and emergency safety switches to software and T3 circuit

Potential Hazards 2

Hazard	Telescope Condition	TCS3 module(s) responding to condition
Jammed Telescope or dome	Slow or no movement, excessive amplifier current	Software, T3 over current and thermal disable circuit, amplifier thermal disable
Loss of TCS3 computer	Runaway or no movement	T3 watchdog circuit, over speed circuit, operator intervention
Loss of T3 electronics	Loss of fault detection	Software, operator intervention
Loss of motor controller card	Runaway or no movement	T3 motor control signal, T3 over speed circuit, stop and emergency safety switches to software and T3 circuit

Potential Hazards 3

Hazard	Telescope Condition	TCS3 module(s) responding to condition
Inadvertent movement of telescope or dome while maintenance is being performed	Personnel safety	T3 Keyed Lockout switch signal, software lockout signal
Platform not stowed	Platform, telescope damage	Software, operator intervention
Crane not stowed	Crane, telescope damage	Software, operator intervention
Telescope in slew speed nearing the end of axis	Runaway?	Software detection, slew safety switch to software

Response to Hazards

Disabled on Fault Condition:

- Motor and Dome amplifier drive input
 - System Power Relay
 - Brake Release Relay
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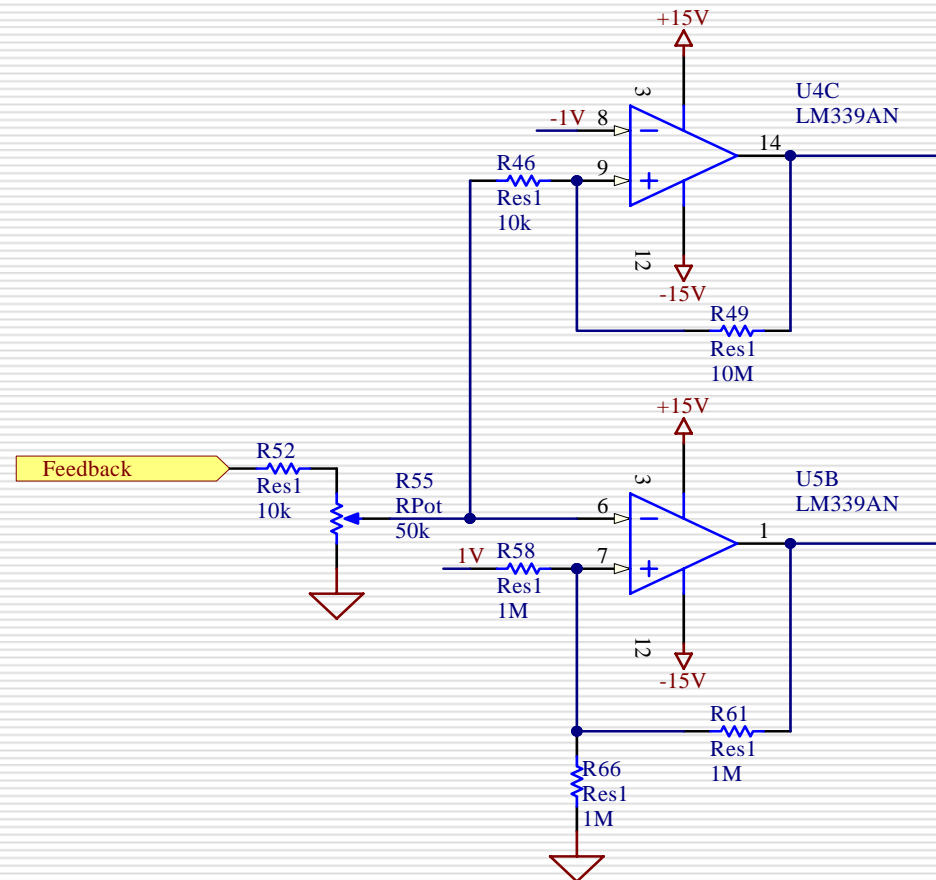
Enabling the Telescope

- Dome Key Switch Enabled
 - Telescope Key Switch Enabled
 - Emergency Stop Button Released
 - External Signals in Safe State
 - TCS3 Computer issues Reset Pulse
 - TCS3 Computer issues System Power Enable
 - TCS3 issues Brake Release Command
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T3 Electronics Overview

- Tachometer
 - Adapted from TCS1
 - Used in Simulink model
 - Watchdog Timer
 - Monitors TCS3 computer
 - Timeout period is 150ms, can be changed to 600ms
 - Over speed and Over current
 - Adapted from TCS1
 - Fault Logic
 - Implemented with CPLD
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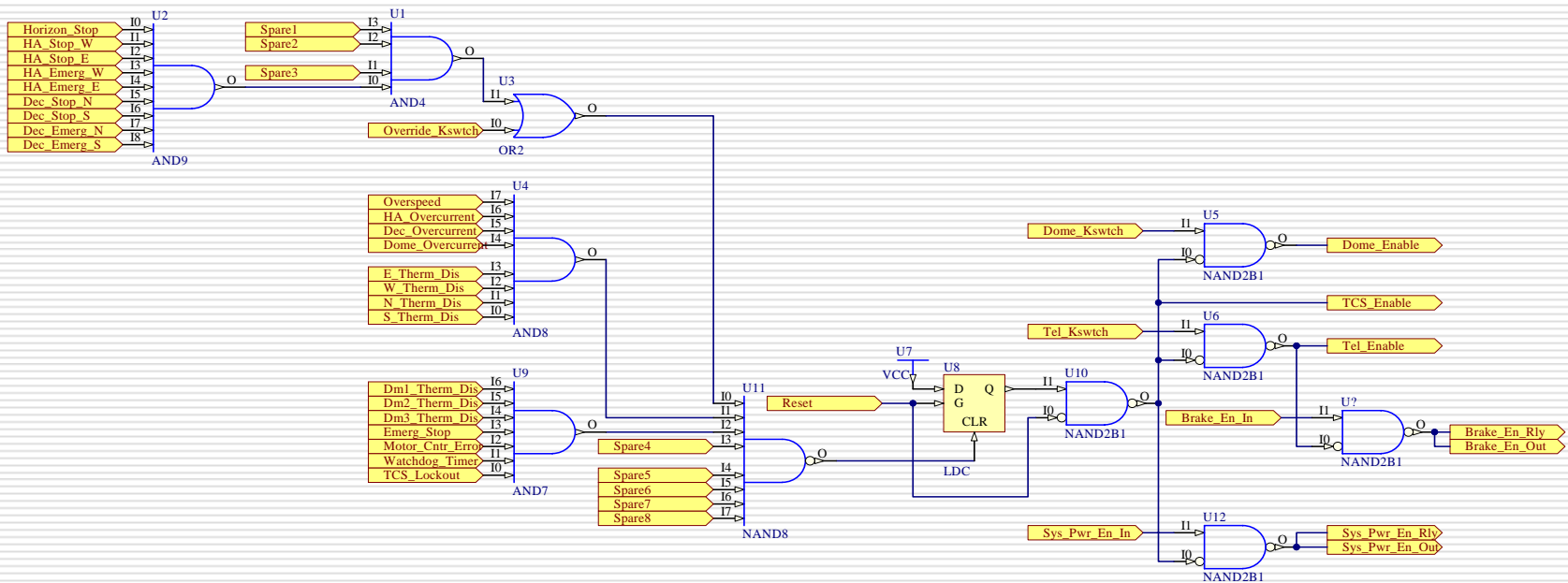
Over Speed and Over Current



Fault Logic Overview

- 9 Safety Switch Inputs
 - Can be overridden with key switch
 - 3 Spares
 - 15 Fault Inputs
 - 5 Spares
 - Fault is latched
 - TCS3 Computer applies Reset Pulse
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Fault Logic



TO Panel Overview

- 24 Indicator LEDs
 - 2 Axis Variable Joystick
 - Dome Enable Key Switch
 - Telescope Enable Key Switch
 - Override Key switch
 - Overrides Safety Switches for Maintenance
 - Emergency Stop Mushroom Switch
 - Floor Light Switch
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TO Panel Rough Layout

