

Sample Programming Guide for the Mission
Control Altimeter.

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Programming a Control can be a bit daunting the first time and the NControl.exe application is not always intuitive. This is a basic dual deploy flight with an added backup pyro charge to deploy the main chute if the PEAK (apogee) chute fails to deploy properly.

When developing a new flight profile, I first like to write down a script of how I believe the flight should perform, and then transfer the information to the Control Flight Programming Worksheet.

Example Script:

1. Launch - Acceleration sensor detection of launch only
2. Motor burnout – this is not a required step for the flight
3. Apogee – Acceleration sensor of apogee, (I don't need to worry about mach delays)
4. Deploy drogue chute (PEAK Channel)
5. IF the drogue chute does not deploy I want the main chute to deploy as soon as possible to prevent a ballistic recovery. We will use the AIRSTART Channel for the backup deployment and use a high Falling Velocity event.
6. Main Deployment – Altimeter Event at 900' (FLOOR Channel)
7. Landing – Detect landing and end the flight

I often refine the script adding information as needed (timing delays, timeouts, channels and such)

Next fill out the Programming Worksheet (MCii_Worksheet.pdf)

CONTROL Flight Programming Worksheet

Description Dual Deploy with Backup

Date Aug 1, 2007 By Rincon Rocketry

".msc" Filename Dual Deploy w_Backup.msc

Flight Parameters

Acceleration threshold	<input type="text" value="3.0"/>	Minimum battery voltage	<input type="text" value="8.9"/> V
Pressure ceiling	<input type="text"/>	AIRSTART delay	<input type="text"/> s
Pressure floor	<input type="text" value="900"/>	PEAK delay	<input type="text"/> s
Landing threshold	<input type="text" value="3.3"/>	FLOOR delay	<input type="text"/> s
FALLING! threshold	<input type="text" value="150"/>	AUXILIARY delay	<input type="text"/> s

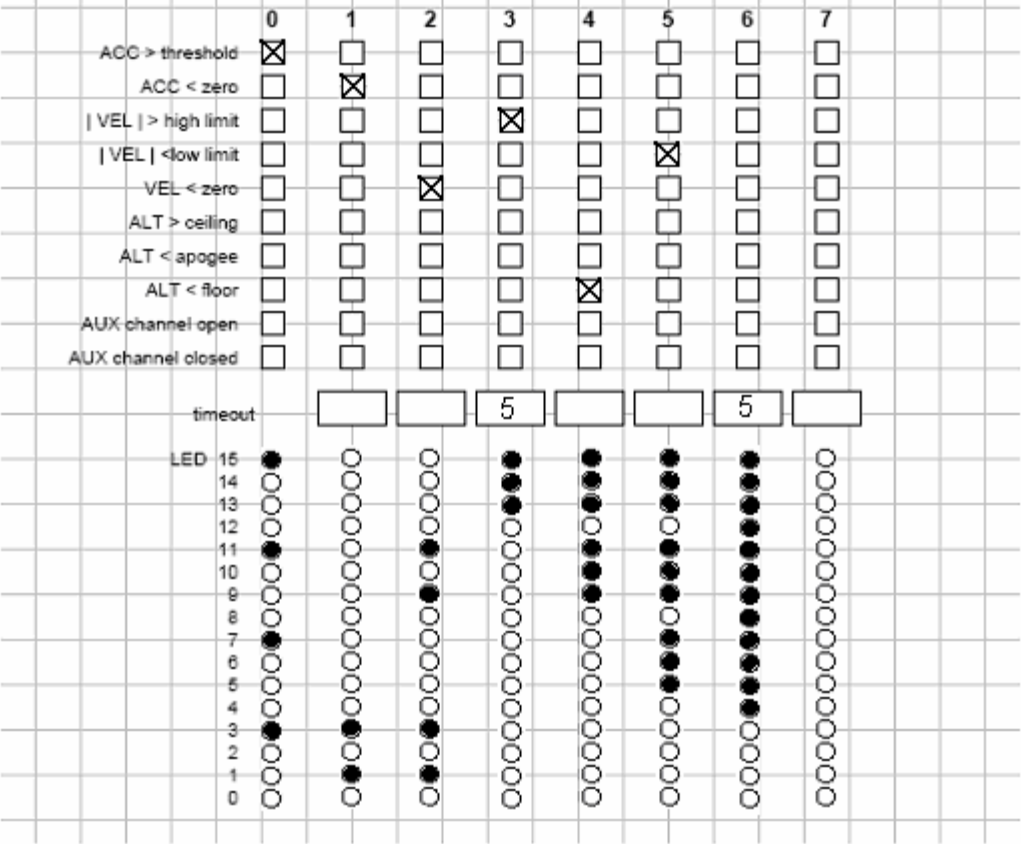
Trigger Sequencing

<input checked="" type="checkbox"/> Fire airstart	<input type="text" value="0"/> s from event timer #	<input type="text" value="3"/>	<input checked="" type="checkbox"/> latch
<input checked="" type="checkbox"/> Fire peak	<input type="text" value="0"/> s from event timer #	<input type="text" value="2"/>	<input type="checkbox"/> latch
<input checked="" type="checkbox"/> Fire Floor	<input type="text" value="0"/> s from event timer #	<input type="text" value="4"/>	<input type="checkbox"/> latch
<input type="checkbox"/> Fire auxiliary	<input type="text"/> s from event timer #	<input type="text"/>	<input type="checkbox"/> latch

Selftest Checks

Show Version	<input type="checkbox"/>	Confirm AUX continuity	<input type="checkbox"/>
Check Battery	<input checked="" type="checkbox"/>	Confirm FLOOR continuity	<input checked="" type="checkbox"/>
Check Altimeter	<input checked="" type="checkbox"/>	Confirm PEAK continuity	<input checked="" type="checkbox"/>
Confirm AUX open	<input type="checkbox"/>	Confirm AIR continuity	<input checked="" type="checkbox"/>

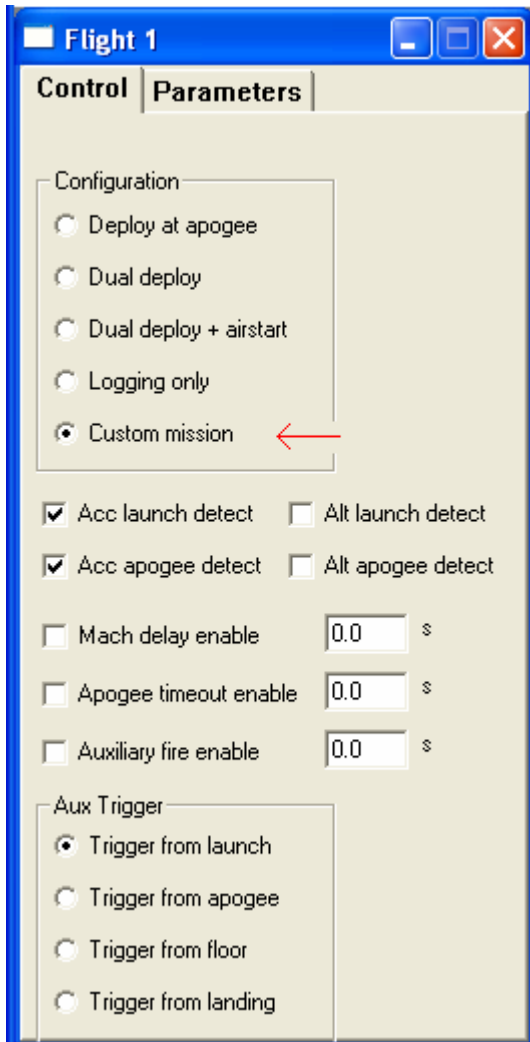
State Descriptions	
State 0	LAUNCH DETECT
State 1	Motor Burnout
State 2	Vel < Zero Acc Apogee Deploy Peak
State 3	Vel > High Limit Deploy Backup (Airstart channel)
State 4	ALT < FLOOR Deploy Main Chute
State 5	Landing detected
State 6	End Flight
State 7	



After I am satisfied with the worksheet, I connect the Control to my PC via the serial cable and launch the NControl application.

Start a new flight by selecting **Control** from the top bar, then **New Control**.

CUSTOM MISSION: Dual Deploy with backup Peak Deployment,



Select a Custom Mission

Review the boxes that are checked:

ACC Launch Detect – Remark 1
ACC Apogee Detect – Remark 2
ALT Launch Detect – Not used
ALT Apogee Detect – Not used

All other parameters will not be used for this flight.

Aux Trigger Box: the AUX channel was not planned to be used for this flight.

Remark 1, ACC Launch Detect will start the flight based on acceleration off of the pad (State 0).
Remark 2, ACC Apogee Detect will determine the Peak altitude based on zero velocity, and control the PEAK channel event (STATE 2)

Select the **Parameters** Tab

Parameter	Value	Unit
Acceleration threshold	3.00	G
Pressure ceiling	328	ft
Pressure floor	900	ft
Pressure apogee	32.8	ft/s
Landing threshold	3.3	ft/s
FALLING! threshold	150.0	ft/s
Minimum battery voltage	8.9	V
AIRSTART delay	0.0	s
PEAK delay	0.0	s
FLOOR delay	0.0	s
AUXILIARY delay	0.0	s

Review each Parameter value:

ACC Threshold set to 3.0 Gs.

Pressure Floor, set to 900' AGL, (Main Chute Deployment altitude)

3.3 ft/s is a reasonable value for landing detection.

FALLING Threshold to 150 feet per second. This is the value to initiate our Backup Deployment Charge.

I always use NEW 9v alkaline batteries for each flight, I want a Minimum Battery Voltage that is appropriate for this power source (8.9V)

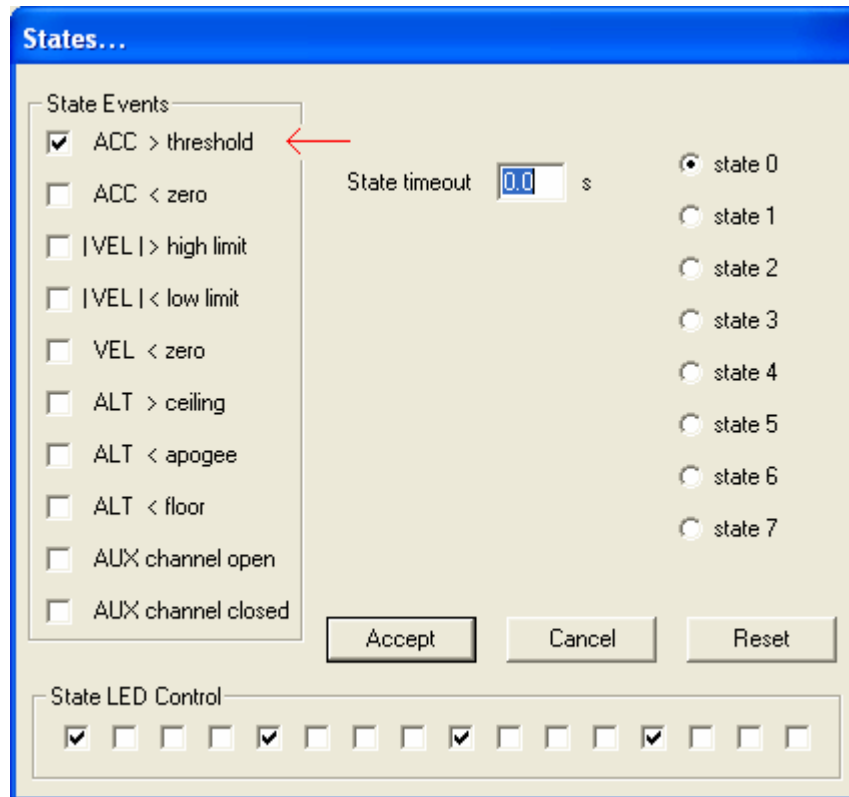
The Delays are not used for this flight

Save the Flight Program with a name that you will know later, such as:
Dual Deploy w_Backup.msc

Next we will need to configure the STATES for this mission. Open the STATE dialog from the top menu bar.

STATE 0 Launch Detection: Greater than 3.0 Gs

Always review each box for every state. Additionally it is very important to remember that a state with no programmed events and no state timeout is an IDLE state. CONTROL will never exit an idle state until powered off and on again. Unused states should be programmed to be idle states. If all eight states are programmed with useable events or timeouts, CONTROL will automatically go to a last idle state.



ACC > Threshold We selected ACC Launch Detect on the Control Tab and set a parameter Value of 3.0 Gs. (Acceleration Threshold)

STATE LED Control: This is a blinking rate of 4 times per second. This is the FAST rate and is indicating that Control has completed self-tests and is ready to fly (Armed).

STATE Timeout BOX; **DO NOT SET A TIMEOUT for STATE 0.** If a timeout were set for this state, the altimeter would automatically move to STATE 1. If you do not understand this point, then you possibly should not be using this altimeter.

DANGER: There is nothing to prevent you from specifying an invalid sequence of events or states! ALWAYS GROUND TEST FLIGHT CONFIGURATIONS. FAILURE TO GROUND TEST A CUSTOM FLIGHT CONFIGURATION CAN RESULT IN LOSS OF YOUR ROCKET!

STATE 1 Motor Burnout

The screenshot shows the 'States...' configuration window. On the left, under 'State Events', the checkbox for 'ACC < zero' is checked and has a red arrow pointing to it. Other events like 'ACC > threshold', '|VEL| > high limit', etc., are unchecked. In the center, 'State timeout' is set to '0.0' s. On the right, the 'state 1' radio button is selected. At the bottom, the 'State LED Control' row contains 11 checkboxes, with the 11th one checked. Buttons for 'Accept', 'Cancel', and 'Reset' are at the bottom right.

ACC < Zero: Indicates a negative Acceleration. This event is Motor Burnout.

A State Timeout is not required for this event.

The State LED Control is user defined.

STATE 2 Apogee Detect (Acceleration)

The screenshot shows the 'States...' configuration window for State 2. Under 'State Events', the checkbox for 'VEL < zero' is checked and has a red arrow pointing to it. The 'State timeout' is set to '0.0' s. The 'state 2' radio button is selected. The 'State LED Control' row has 11 checkboxes, with the 5th, 6th, 10th, and 11th ones checked. Buttons for 'Accept', 'Cancel', and 'Reset' are at the bottom right.

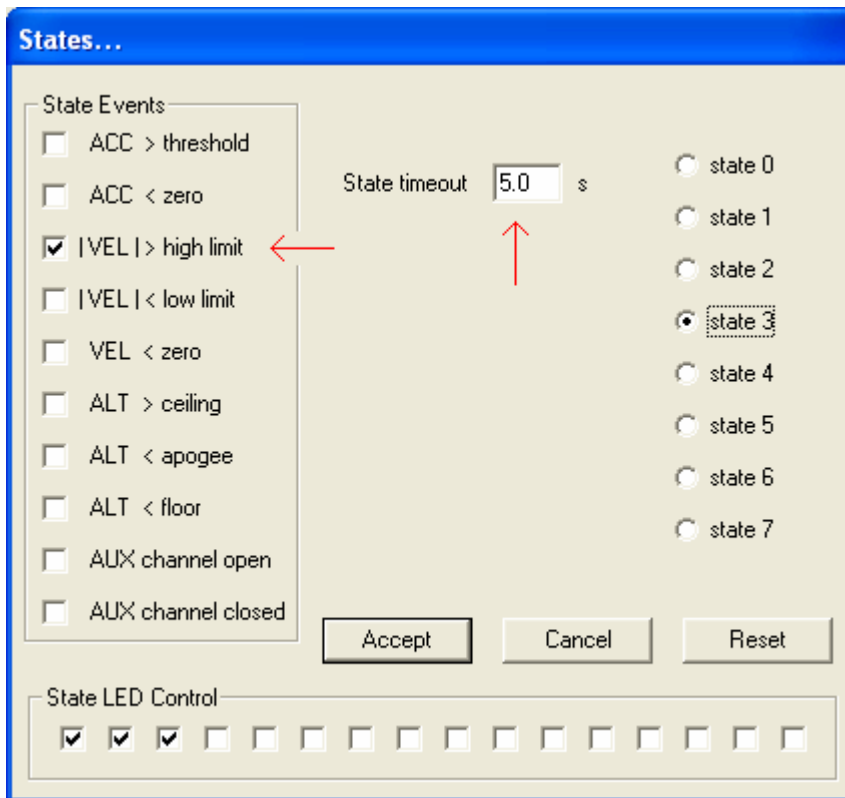
VEL < Zero: Velocity has slowed to zero indicated by the Acceleration sensor, again we are not using a State Timeout.

A State Timeout is not required for this event.

The State LED Control is user defined.

Trigger Sequencing: Fire PEAK Channel will be configured to fire 0 seconds from this event.

STATE 3 Drogue Failure (Backup pyro for deployment)



|VEL| > High Limit: is the Falling Parameter of 150 feet per second.

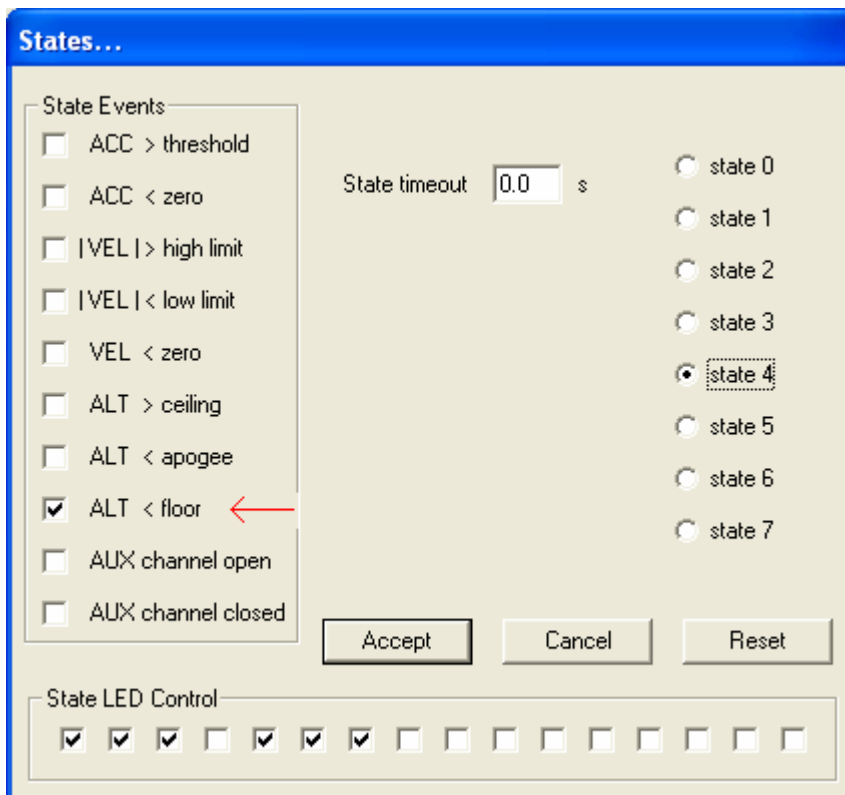
STATE Timeout 5.0 sec.

Notice that there is a State Timeout of 5 seconds. If the parachute deploys normally, the rocket should be falling at much slower rate than the "Falling Threshold" velocity. This event is set to Timeout so that State 3 will proceed to the next event. If we did not allow this event to timeout, it would remain in this STATE and the Main (FLOOR) parachute would not deploy. Additionally, we would not be able to use

any other channels, events, or end the flight.

Trigger Sequencing: Fire Airstart Channel will be configured to fire 0 seconds from this event.

STATE 4 FLOOR (Main) parachute deployment



ALT < Floor (900' AGL)

A State Timeout is not required for this event.

The State LED Control is user defined.

Trigger Sequencing: Fire FLOOR Channel will be configured to fire 0 seconds from this event.

STATE 5 Landing

States...

State Events

- ACC > threshold
- ACC < zero
- |VEL| > high limit
- |VEL| < low limit
- VEL < zero
- ALT > ceiling
- ALT < apogee
- ALT < floor
- AUX channel open
- AUX channel closed

State timeout: 0.0 s

state 0
state 1
state 2
state 3
state 4
state 5
state 6
state 7

Accept Cancel Reset

State LED Control

|VEL| < Low Limit: is the Landing Threshold Parameter of 3.3 feet per second. In other words, the rocket is on the ground and no longer descending.

State Timeout is not needed.

The State LED control is user defined.

STATE 6 Flight Ending

States...

State Events

- ACC > threshold
- ACC < zero
- |VEL| > high limit
- |VEL| < low limit
- VEL < zero
- ALT > ceiling
- ALT < apogee
- ALT < floor
- AUX channel open
- AUX channel closed

State timeout: 5.0 s

state 0
state 1
state 2
state 3
state 4
state 5
state 6
state 7

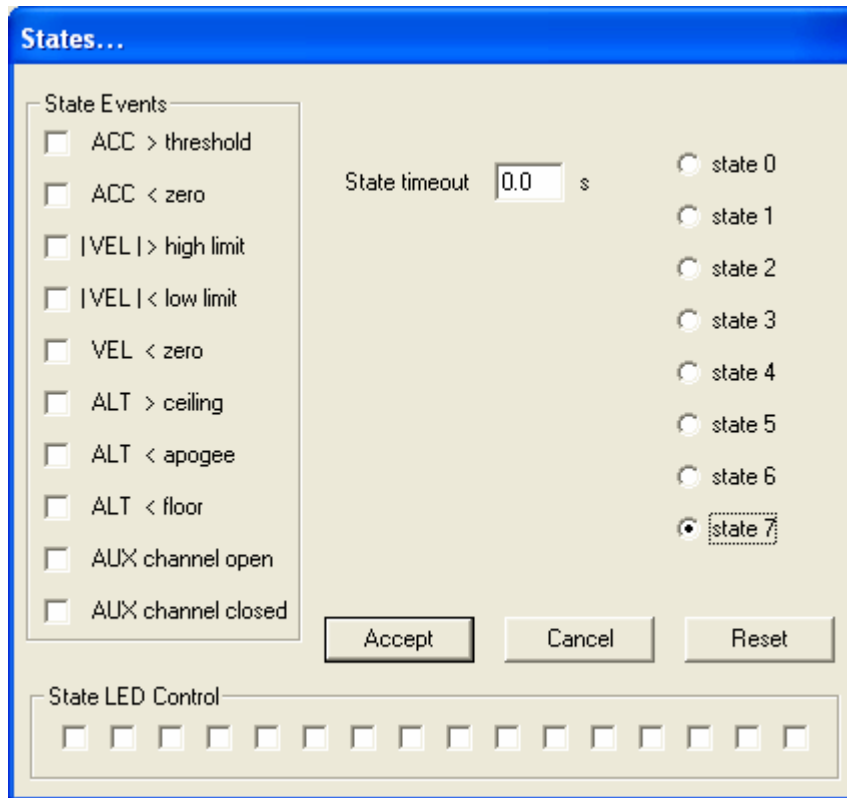
Accept Cancel Reset

State LED Control

All State Events check boxes have been cleared, and a State Timeout set to 5 seconds. The Rocket has landed (State 5) and the flight is over awaiting pickup. This will gracefully end the flight and data recording.

The State LED control is user defined.

STATE 7 Unused States



Any and all STATES that are not used should be cleared of all check boxes and timeout value.

Accept Changes, the States dialog box will automatically close.

Save changes to the Custom Mission file.

CHANNELS

Now that we have configured all of our Parameters and State events, we need to configure the Channels. Open the Channels dialog box from the top menu bar, Control then Channels...

As a reminder from our notes, we are using the PEAK channel at apogee for the drogue chute, FLOOR channel for the MAIN chute and the AIRSTART channel as a backup for drogue failure.

Channel	Fire	Time (s)	Event Timer #	Latch
Fire airstart	<input checked="" type="checkbox"/>	0.0	3	<input checked="" type="checkbox"/>
Fire peak	<input checked="" type="checkbox"/>	0.0	2	<input type="checkbox"/>
Fire floor	<input checked="" type="checkbox"/>	0.0	4	<input type="checkbox"/>
Fire auxiliary	<input type="checkbox"/>	0.0	0	<input type="checkbox"/>

AIRSTART will fire 0 seconds for Event 3 if the rocket is falling faster than 150 ft/s.

PEAK will Fire 0 seconds from Event STATE 2.

FLOOR will Fire 0 seconds from Event STATE 4.

Notice that I choose to Latch the Airstart Channel, since this is a backup due to a failure, I want to ensure that the ematch fires and deploys the main.

Accept Changes, the Channel dialog box will automatically close.

The Auxiliary channel was not used.

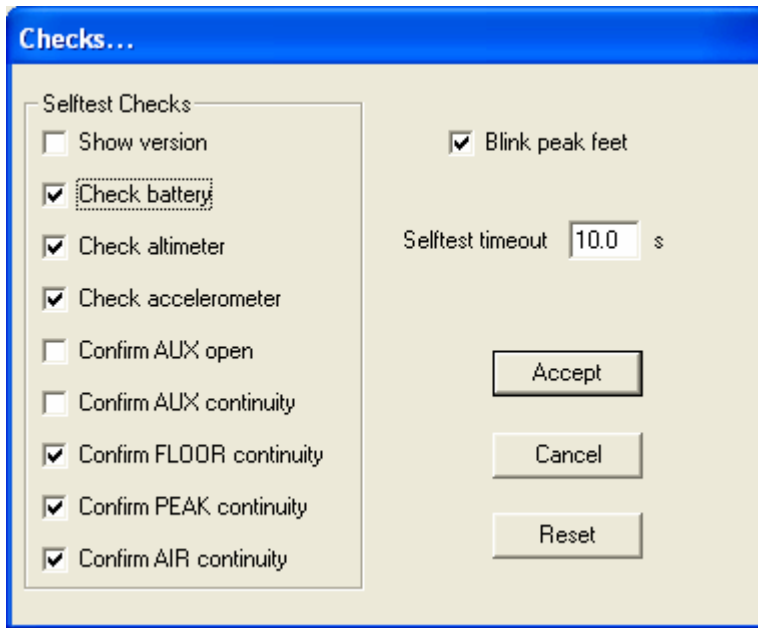
LATCH, the standard latch time is $\frac{1}{2}$ second. Checking the LATCH box for a pyro channel will keep the pyro circuit latched ON for the duration of the flight. This could be useful for hard to ignite e-matches, airstart igniters or other purposes.

Save Changes.

Next set the required checks to perform during Control power up self tests.

Open the Checks dialog box from the top menu bar.

CHECKS



Check Battery – Minimum battery Voltage was set to 8.9 volts

Check Altimeter- verifies barometric sensor is functional

Check Accelerometer- Verifies ACC Sensor is functional

Confirm FLOOR Continuity

Confirm PEAK Continuity

Confirm AIR Continuity

The Continuity checks look for closed circuits on each selected pyro channel.

Selftest Timeout – If all checks selected are successful, the Mission Control will ARM and enter STATE 0 awaiting Launch Detection. The LED status will change from the slow rate to a rapid blinking when the Control ARMS and is ready for flight.

Accept Changes, the Checks dialog box will automatically close.

Save changes to the Custom Mission file.

Uploading the Custom Mission configuration to the Control

From the top menu bar, select CONTROL, then SET CONTROL

The configuration will take a few seconds to upload to the Control.

Close the Custom Mission file.

In order to verify that the file has been uploaded correctly, select GET FLIGHT from the top menu bar. After downloading the image file you will be able to verify that the settings.