L19 - Develop Advanced Safety Applications Using the Allen-Bradley® Integrated Safety Controller Platform

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**WARNING**

Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.

**IMPORTANT**

Identifies information that is critical for successful application and understanding of the product.

**ATTENTION**

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you:

- identify a hazard
- avoid a hazard
- recognize the consequence

**SHOCK HAZARD**

Labels may be located on or inside the drive to alert people that dangerous voltage may be present.

**BURN HAZARD**

Labels may be located on or inside the drive to alert people that surfaces may be dangerous temperatures.
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Before you begin

This lab assumes a basic understanding of RSLogix 5000 software.

About this lab

In this lab, you will see how Rockwell Automation has integrated safety products, features and functions into an environment that allows effective and efficient programming for your safety needs. Parallel safety processing, dedicated safety tasks in the PLC, certified safety function blocks and safety I/O handling work together allowing you to achieve your safety goals in a much simpler, straightforward manner.

This lab takes approximately 90 minutes to complete.

Tools & prerequisites

The following software programs, hardware, and files are required for use with this lab.

- **Software Programs:**
  - RSLinx Classic 3.70 or later
  - Studio 5000 Professional v30 or later

- **Hardware Devices:**
  - High Performance Demo Case (set of 3)
    - DEMO-L8PERF1
    - DEMO-K570021
    - DEMO-TUNING460

- **Files required:**
  - HP_MotionLabCore_SafetyLab_L73S_v30.ACD  PATH Desktop \ Lab Files \ L73S \ 
  - HP_CoreDemo_L73S_LOCKdemo.ACD  PATH Desktop \ Lab Files \ L73S \ Lock Demo \ 
  - L75_Slot1_v30.ACD  PATH Desktop \ Lab Files \ L75 \ 
  - L85E_Slot0_v30.ACD  PATH Desktop \ Lab Files \ L85E \ 
  - Adv_Motion_Lab_SafetyFP.MER  PATH Desktop \ Lab Files \ MER \ 

Getting started – Hardware Setup

Setup the interconnection between the demo hardware as shown below:

**Cable Routing:**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Connected to</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fast Ethernet Port 2</td>
<td>to Computer</td>
</tr>
<tr>
<td>2*</td>
<td>Gigabit Ethernet Port 2 (CBL 2)</td>
<td>to 5069-AEN2TR Compact 5000 I/O, Port 1 (CBL 2)</td>
</tr>
<tr>
<td>3*</td>
<td>Gigabit Ethernet Port 1 (CBL 1)</td>
<td>to L85E Controller, Port 1 (CBL 1)</td>
</tr>
<tr>
<td>4*</td>
<td>Fast Ethernet Port 1 (CBL 3)</td>
<td>to 1756-EN2T (CBL 3)</td>
</tr>
<tr>
<td>5*</td>
<td>Fast Ethernet Port 6 (CBL 4)</td>
<td>to PanelView Plus</td>
</tr>
<tr>
<td>6</td>
<td>Fast Ethernet Port 4</td>
<td>to Kinetix 5700 Power Module, Port 1</td>
</tr>
<tr>
<td>7</td>
<td>Kinetix 5700 Power Module, Port 2</td>
<td>to Kinetix 5700 Dual Axis Module, Port 2</td>
</tr>
<tr>
<td>8</td>
<td>Kinetix 5700 Dual Axis Module, Port 2</td>
<td>to 1734-AENTR Point I/O, Port 2</td>
</tr>
<tr>
<td>9</td>
<td>Kinetix 5700 Dual Axis Motor Cable</td>
<td>to Tuning Rig VPL Motor</td>
</tr>
</tbody>
</table>

*these cables are internal to the demo cases*
Set up the DEMO-L8PERF1 demo case

Use the image provided to locate these items on the demo and verify the lab setup:

- Verify power cord is connected to a 120v supply.
- Verify the demo power switch labeled “120/220V” is “ON”.

Set up the DEMO-K570021 demo case

Use the image provided above to locate these items on the demo and verify the lab setup.

- Verify power cord is connected to 120v supply (located on back of demo housing).
- Verify that the circuit breaker is “ON” (located on back of demo housing).
- Verify that the switch labeled “K5700 DRIVE POWER” is “ON”.
- Verify that the switch labeled “K5700 CONTROL POWER” is “ON”.
- Verify that the red mushroom button labeled “SAFE OFF” is pulled “OUT”.
- The AXIS A IN 1 and AXIS B IN 1 switches located in the K5700 demo case must be in the left position.

- Verify the motor cable is connected to the VPL motor on the Tuning Rig Demo.
**Set up the DEMO-TUNING460 demo case**

Use the image provided above to locate these items on the demo and verify the lab setup.

- Verify the motor cable from the K5700 Demo is connected to the VPL motor.

**IP Addresses**
Getting started – Software Setup and initial startup sequence

1. Download the `L85E_Slot0_v30.ACD` program to the L85E controller in Slot 0 at IP address `192.168.1.10`.

2. Once the program is downloaded, set the controller to **Run Mode**.

3. Download the `L75_Slot1_v30.ACD` program to the L75 controller in Slot 1.

4. Once the program is downloaded, set the controller to **Run Mode**.

5. Download the `HP_MotionLabCore_SafetyLab_L73S_v30.ACD` program to the L73S controller in Slot 2.

6. Once the program is downloaded, set the controller to **Run Mode**.
7. The PanelViewPlus 7 should be running the `Adv_Motion_Lab_SafetyFP.mer` FactoryTalk View ME application, and the main screen (shown below) should be displayed.

8. Select 'Integrated Safety Lab' button. The following screen should be displayed.


10. Press the blue reset button in the DEMO-L8PERF1 demo case. When you press the button you should hear the gate lock. When you release the blue button, the K5700 STO should enable, and the STO indicator (circled below) should no longer be yellow.
11. If the FAULTED indicator is RED, press **Clear Faults** (top right), and the indicator should appear as shown below.

12. To start motion on both axis, press the green **START** button
Getting started – Troubleshooting

Resetting Ownership on Safety Devices

1. If you have yellow triangle indicators in the L73S safety controller program you may need to reset ownership on the safety devices. First open the motion program HP_MotionLabCore_SafetyLab_L73S_v30.ACD while online with the controller.

2. If there is a yellow triangle next to the K5700, open the properties of the K5700 module in the I/O configuration.

3. Navigate to the Safety tab and click the Reset Ownership button to re-establish ownership with the connected safety controller. Confirm changes.
4. The **Configuration Ownership** should now read **Local** instead of “??”.

5. Repeat these steps for both the 1734-IB8S and the 1734-OB8S if they have the yellow triangle indicated. Navigate to the safety tab and Reset Ownership.
Safety Task

GuardLogix is a ControlLogix controller with integrated safety, certified to be used in safety control systems up to SIL3 (IEC61508), CAT4 (EN954-1) and PLe (ISO13849-1). It performs all of the same functions as a standard ControlLogix in addition to performing safety control. To achieve these safety ratings GuardLogix uses a 1oo2 dual controller architecture. The two controllers are called the primary and the partner.

- The primary controller runs both the standard and safety tasks
- The partner controller runs only the safety task

The primary and partner controllers compare the outputs generated by the safety task. If they ever disagree, GuardLogix will go to the safe state (de-energized).

GuardLogix is configured with a single software package, Studio 5000, simplifying your engineering efforts. You create a single project to manage both your standard and safety code.

1. If not already open, open the HP_MotionLabCore_SafetyLab_L73S_v30.ACD file located within the Lab Files \ L73S folder on your desktop.

A single project contains both the standard and safety code.
2. Expand the **SafetyProgram** in the **SafetyTask**

All of the safety code is contained within the Safety Task. It has the same structure as a standard task; but it is unique in that it is scanned in both the primary and partner processors. The red bar under the routines and folders in the safety task indicate these routines perform safety logic.
3. Double-click **R02 Logic** routine in the **SafetyProgram** to open the routine.

4. Cursor through the rungs to view some typical instructions being used within the safety task.

   - If the ladder code looks typical, it should. The only unique feature of code within the safety task is that it is scanned twice, by both the primary and partner controllers.

5. Notice the Guard safety icon in the bottom-right side of the MainRoutine window, indicating you are accessing safety code. Also notice the red labels on the instructions available in the safety task. **Select some of the other instruction tabs** to see what instructions are available within the safety task.

6. Close the **R02 Logic** routine.
Safety Tags

A special class of tag called a Safety tag is used within the Safety Task. The integrity of a safety tag is protected because they can only be written to by logic within the Safety Task. However, Safety tags can be read in the Standard or Safety Task.

1. Make sure you are offline.
2. Open R01_Tag Mapping standard routine in the Main Program of the continuous task called Main Task.
3. Double left click on Motion_Axis_Stop in rung 3. This area to click on is circled below.

4. Select the pulldown that appears. Circled below.

5. Scroll through the list of available tags.

As you scroll through the tag list, what kind of tags are available to select? Safety tags have a red bar on the icon to the left of the tag. Standard tags do not.
6. Click anywhere outside the tag window to close it.
7. Close this routine.
8. Open the **R02_Logic** safety routine in the safety task.
9. Repeat the same procedure as above on the first XIC in rung 0.

As you scroll through the tag list, what kind of tags are available to select? You should be able to select only safety tags.

Prior to safety PLCs, users would hardwire the auxiliary contacts on all of their safety devices back to the standard PLC for status information. This practice is obsolete with the GuardLogix because this status information is readily available for the standard side of the application with the Safety Tags.

10. Click anywhere outside this window to close it.
11. Close any open routines.
Mapping Tool

1. Select the **Logic** pulldown and **Map Safety Tags**

2. Click on the pulldown for a new standard tag (circled below)

    ![Image](image1.png)

    **Note that only standard tags are available**
3. Click on the pulldown for a new safety tag (circled below)

![Image of Safety Tag Mapping window]

Note that only safety tags are available.
This tool directly maps a standard tag to a safety tag. That safety tag can now be used in the safety task.
Note that this safety tag must still be considered a standard tag in terms of safety integrity.

4. The Std_FaultReset is the blue button labeled RESET in the L8PERF demo case. Press it a couple times and note which module in the 1756 chassis it is wired to. It is wired to the local 24VDC input module. This is a standard module. But it is being mapped to a safety tag called ‘Blue_Button_SafetyTag’.

5. Close the Safety Tag Mapping window using Close

6. Open the safety routine R02_Logic

7. Make sure you are online with the controller

8. Press the blue RESET button and note what happens to the safety tag called Blue_Button_SafetyTag in rungs 1 and 2

![Image of program code]

9. Close R02_Logic
Safety Input Instructions

The safety input instructions are located in the ‘safety’ instruction tab. These instructions all have one thing in common. They assume that the input device has two channels.

1. If not already, go online with the controller:

2. Call up the safety routine named **R01_Inputs**:

   In rung 0 there is a DCS safety instruction. DCS stands for Dual Channel Stop. This instruction monitors the Emergency Stop button labeled SAFE OFF on the DEMO-K570021 demo case.
3. Press the Emergency Stop button (bottom E-Stop button) and note that the DCS output (circled below) in rung 0 goes LO:

4. Release (pull out) the Emergency Stop button.

When you cycle the Emergency Stop button on the demo case, notice that the output O1 simply follows the state of the button. This is caused by the AUTOMATIC restart parameter for Restart Type. Automatic means a manual reset is not required to energize the DCS output O1 after a 'normal' restart. Normal means that there are no faults and this is not the initial power-up.
5. To simulate a wire off of channel A of the Emergency Stop, move the **AXIS A IN1** selector switch to the right position. The channels are now in different states, and if they remain in different states until the 3 second discrepancy timer expires, the DCS declares a fault.

Note that typically the AENTR:2:I.Pt00/01 Estop input tags would be used directly in the DCS Channel A and Channel B parameters, but rungs 1 and 2 were added to allow you to simulate wire OFF faults.

The **AXIS A IN 1** and **AXIS A IN 2** switches located in the K5700 demo case logically drop out the Estop_Wire_OFF_chA and Estop_Wire_OFF_chB interlocks on rungs 1 and 2. This causes the **Channel A** or **Channel B** tag on the DCS instruction to drop out.
6. Right click on the DCS backing tag called Zone1_EStop and select Monitor Zone1_EStop

7. Expand the Zone1_Estop tag, so you can see the Fault Code (circled below)

8. Change the style of the Fault Code from decimal to Hex

The fault code is 4001 (hex)
9. Close the Controller Tag window

10. Right click anywhere inside the DCS instruction and select **Instruction Help**

11. Scroll near the end of the help file until you see the Fault Codes

<table>
<thead>
<tr>
<th>Fault Code</th>
<th>Description</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>00H</td>
<td>No fault.</td>
<td>None.</td>
</tr>
<tr>
<td>30H</td>
<td>The Input Status input transitioned from ON (1) to OFF (0) while the instruction was executing.</td>
<td>Check the I/O module connection or the internal logic used to source input status. Reset the fault.</td>
</tr>
<tr>
<td>4000H</td>
<td>Channel A and Channel B were in an inconsistent state for longer than the Discrepancy Time. At the time of the fault, Channel A was in the active state. Channel B was in the safety state.</td>
<td>Check the wiring. Perform a functional test of the device (put Channel A and Channel B in a safety state). Reset the fault.</td>
</tr>
<tr>
<td>4001H</td>
<td>Channel A and Channel B were in an inconsistent state for longer than the Discrepancy Time. At the time of the fault, Channel A was in the safety state. Channel B was in the active state.</td>
<td></td>
</tr>
<tr>
<td>4002H</td>
<td>Channel A went to the safety state and back to</td>
<td></td>
</tr>
</tbody>
</table>

Fault Code 4001 indicates channels A and B on the DCS were inconsistent, and channel A was in the safe (LO) state and channel B remained in the active (HI) state. Recall you toggled channel A LO with Axis A IN 1...
12. Close the Help window

13. Fix the wire OFF fault by moving the **AXIS A IN1** switch back to the left position.

   Channel A on the DCS instruction should be HI

14. Press the blue **RESET** button in the L73S controller demo case to reset the fault on the DCS instruction.

   FP on the DCS instruction should now be OFF

15. Cycle the Emergency Stop button to prove that the fault that caused the discrepancy has been repaired.

   Note that this energizes the output O1 of the DCS

16. Press the blue **RESET** button again to lock the gate and restart the K5700 STO; enabling the drive to operate.

17. Press **Clear Faults** on the HMI if it is active as circled below

To summarize, the DCS instruction monitors dual channel devices and sets the output when both channels are in the active state (HI), and proper restart actions are completed. If the channels are not equivalent for longer than the discrepancy time, a fault is declared.

Many of the other safety input instructions simply build onto this base functionality.
Safety Output Instructions

There actually is only one (1) safety output instruction, **CROUT**. The CROUT instruction controls two (2) outputs and monitors feedback. When the outputs change state, the feedback is expected to follow within a configurable reaction time. Essentially, the CROUT has similar functionality as a safety relay.

1. Open the **R03_Outputs** safety routine:

   ![Image of R03_Outputs safety routine](image)

2. Verify you are online. Note that the CROUT instruction is located on rung 1.

3. If necessary, Press the blue **RESET** button to energize the CROUT outputs. (circled below)

   ![Image of CROUT instruction](image)

   This CROUT instruction is being used to drive STO (Safe Torque OFF) on the Kinetix 5700 drive. (see rungs 2 and 3 above) Since the instruction is configured for NEGATIVE feedback, the feedback should be LO when the outputs are HI, and HI when the outputs are LO.
4. To simulate a feedback fault, move the **AXIS B IN1** selector switch to the right position.

If either of the feedback signals unexpectedly change, the CROUT will fault. The FP (fault present) output should be HI.

Note that typically the K5700_Dual:SI.TorqueDisabled1 and 2 tags from the Kinetix 5700 would be used directly in the CROUT Feedback 1 and 2 parameters, but rungs 5 and 6 were added to allow you to simulate feedback faults.

When Axis B IN 1 is switched to the right position, K5700_STO_FB1_SimulatedFault goes HI, which energizes the FB1 input parameter of the CROUT.
Why did Feedback 2 also go HI? Because when the instruction faulted, both CROUT outputs were dropped out. This causes the other feedback channel to go HI as well.

5. Right click on the CROUT backing tag called Zone1_K5700_STO and select Monitor Zone1_K5700_STO

6. Expand the Zone1_K5700_STO tag, so you can see the Fault Code (circled below)
7. Change the style of the Fault Code from decimal to Hex

```
| Zone K5700 STO.PER | 1 | Decimal 8 |
| Zone K5700 STO FaultCode | 20481 | Decimal 0 |
| Zone K5700 STO Diagnostic | 0 | Binary 1 |
```

The fault code is 5001 (hex)

8. Close the Controller Tag window

9. Right click anywhere inside the CROUT instruction and select **Instruction Help**

10. Scroll near the end of the help file until you see the Fault Codes

Fault Code 5001 indicates Feedback 1 turned OFF unexpectedly. Although this fault code may appear to be incorrect because you changed the feedback HI (ON), the fault codes assume POSITIVE FB, and so they are reversed since this lab uses NEGATIVE FB.
11. Close the Help window

12. Fix the feedback fault by moving the **AXIS B IN1** selector switch back to the left position.

13. Press the blue **RESET** button in the L73S controller demo case to reset the fault on the CROUT instruction.

   FP on the DCS instruction should now be OFF. When you released the RESET button, the trailing edge initiated the restart of the safety circuit, which enabled the CROUT outputs. Typically, this would be done with a separate manual action, but allowances were made in this lab since there is only a single reset button.

14. Press **Clear Faults** on the HMI if it is active as circled below:

   In summary, the CROUT instruction controls dual outputs and monitors up to two (2) feedback channels.

15. Press **Start** on the HMI to start motion

16. Close **R03_Outputs**
Diagnostics

From a safety perspective, it is critical that a safety device operate properly when a demand is placed on it. This is typically accomplished using redundancy and diagnostics. Redundant channels allow you to tolerate a single fault, and diagnostics allow you to detect that fault and keep your machine from restarting with that fault.

By wiring each individual safety device to a separate channel in the traditional PLC fashion, you can provide granular diagnostics for your operators and maintenance personnel. If the machine stops, HMIs can instantly direct maintenance personnel to the proper device, reducing MTTR (Mean Time to Repair).

The Emergency Stop is wired to channels 0 and 1 on the 1734-IB8S PointGuard input module. The configuration of this module is shown below. Channels 0 and 1 are configured for Single Point Operation as well as pulse testing.

If configured for single channel, discrepancy faults can be detected by the dual channel safety instructions, providing instruction defined tags that make it easy to diagnose and annunciate fault(s) on your HMI.

1. Open the **R01_Inputs** safety routine

2. Make sure you are still online
Discrepancy Faults

3. The PanelViewPlus 7 should be running the `Adv_Motion_Lab_SafetyFP.mer` FactoryTalk View ME application. If the main screen (shown below) is displayed, proceed to step 4. Otherwise, proceed to step 9.

![Main Screen Image](image)

4. Select 'Integrated Safety Lab' button (top left). The following screen should be displayed.

![Integrated Safety Lab Screen](image)

5. Cycle the Emergency Stop button
6. Press the blue reset button
7. Press **Clear Faults** on the HMI if it is active
8. Press **Start** on the HMI to restart motion
9. Press the Safety Faceplates button (circled in step 4) to call up the safety faceplates screen

10. To generate a wire off, switch the **AXIS A IN1** selector switch to the right position.

   When one DCS channel is logically dropped out, the normally dual equivalent channels go to diverse states; one HI and one LO. The safety system stops the motor because one of the E-Stop channels went LO. Note that this is the same condition that would occur if there was a short to 24Vdc or short around one of the contacts when a demand is placed on the device.

11. Press the **Zone1 EStop DCS** instruction faceplate icon on the HMI (note the banner is flashing red due to the fault you generated)

12. Press the Fault button on the bottom of the HMI screen:
The DCS instruction faceplate for the Emergency Stop button provides the probable cause of the 4001h fault code. This is identical to the fault code in the instruction help you saw in the prior Safety Instructions lab. The fault information on the HMI indicates precisely that channel A was LO while channel B was HI, which is correct since the simulated wire OFF affected channel A.

13. Return the **AXIS A IN1** selector switch to the left position to fix the wire OFF fault.

When the wire off is fixed, the channels both return to HI and are equivalent. But the safety system will not allow the motor to restart because it assumes one of the contacts still has a short around it.

14. Press the blue **RESET** button to clear the fault (code)

Note the fault present indicator (FP) on the DCS is de-energized, and the fault code on the HMI has gone away.

15. Press the green Diagnostics button on the HMI screen.

It informs you that the DCS instruction is waiting for the device to be cycled, to prove that the fault has been repaired, before it will energize the instruction output O1. Diagnostic Code (13685 decimal) in the Diagnostic Code tag (directly below the Fault Code tag) is the indicator that the DCS channels must be cycled. Perform the next two steps in the lab to view the diagnostic code.
12. Right click on the DCS backing tag called **Zone1_EStop** and select **Monitor Zone1_EStop**

13. Expand the **Zone1_EStop** tag, so you can see the Diagnostic Code (circled below)
14. Close the controller tag window

15. Cycle the Emergency Stop button

You must prove that the fault has been fixed by cycling the safety input through the safe state; which occurs when both channels go LO. Notice that the diagnostic code has gone away on the HMI, and the DCS output (O1) has energized.

16. Close the DCS instruction faceplate on the HMI using the [X] in the top right corner.

Notice that the label for the Zone1_Estop_DCS is now solid green because there are no DCS faults and the DCS output is energized.

17. Press blue RESET button to lock the gate and enable the safety output STO circuit

18. Press **Clear Faults** on the HMI if it is active as circled below

19. Press **Start** on the HMI to restart motion
20. Generate a wire OFF for channel B of the Estop by switching the AXIS A IN2 button to the right and then releasing it within 3 seconds to return to the middle position.

21. Press the Zone1 EStop DCS instruction faceplate icon on the HMI (note the banner is flashing red due to the fault you generated)

22. Press the Fault button on the bottom of the HMI screen:

24. Press the blue RESET button to clear the fault (code).
25. Press the green Diagnostics button on the HMI screen.

Just like before, it informs you that the DCS is waiting for the device to be cycled before it will energize the instruction output O1. This is required to prove that no faults still exist. Recall that Diagnostic Code (13685 decimal) is the indicator that the DCS channels must be cycled.


27. Close the DCS instruction faceplate on the HMI using the [X] in the top right corner.

28. Press blue RESET button to lock the gate and enable the safety output STO circuit.

29. Press Clear Faults on the HMI if it is active as circled below.

30. Press Start on the HMI to restart motion.
DCSTL diagnostics

DCSTL (DCS with Test and Lock) controls and monitors the gate locking switch

31. Go to rung 5 in the safety routine R01_Inputs to view the DCSTL instruction

   If the motor is spinning, output O1 on the DCSTL will be energized

32. Notice the green banner on the DCSTL instruction faceplate. This indicates the instruction output is energized. Press the Zone1_Gate_DCSTL instruction faceplate icon (shown below) to see for yourself.

   Zone1_Gate_DCSTL

33. Close the DCSTL instruction faceplate

34. Press the Estop button located in the K5700 demo case

   If the STO selector switch on the K5700 demo case is set to CAT0, the gate will unlock when zero speed is detected. If the STO selector switch is set to CAT1, then the gate unlocks after a three (3) second delay.

   Note the banner on the DCSTL instruction faceplate changed to blue when the gate unlocked, and the ULC (unlock command) on the DCSTL is energized

35. Press the Zone1_Gate_DCSTL instruction faceplate

   Zone1_Gate_DCSTL
36. Press the green Diagnostics button on the HMI screen.

The faceplate indicates there are no faults. All is operating properly, but the gate is unlocked.

37. Close the DCSTL instruction faceplate

38. Open the gate and leave it open

Note the banner on the DCSTL faceplate has changed to yellow, to indicate the gate is open.

39. Open the Zone1_Gate_DCSTL instruction faceplate

It informs that there has been a demand placed on the gate. This makes sense, because you just opened the gate.
40. Close the gate

41. Press the green Diagnostics button on the HMI screen. It returns to the Device Unlocked diagnostic code, because the demand on the gate has gone away.

42. Close the DCSTL instruction faceplate

43. Release (pull out) the Emergency Stop button

44. Press blue \textit{RESET} button

The gate locks, and the DCSTL instruction output (O1) is energized. The DCSTL instruction faceplate banner returns to green because the DCSTL output is HI.

45. Press \textbf{Clear Faults} on the HMI if it is active as circled below

<table>
<thead>
<tr>
<th>Machine Status</th>
<th>Machine Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>\textbf{FAUL TED}</td>
<td>Program</td>
</tr>
<tr>
<td>\textbf{Ready}</td>
<td>\textbf{Start}</td>
</tr>
<tr>
<td>\textbf{STO}</td>
<td>\textbf{Stop}</td>
</tr>
<tr>
<td>State: \textbf{ABORTED}</td>
<td>\textbf{Clear Faults}</td>
</tr>
</tbody>
</table>

46. Press \textbf{Start} on the HMI to restart motion

47. Close the safety task \textbf{R01\_Inputs} using the [x] in the top right corner of the window.
CIP Safety Diagnostics

CIP safety connections are directly between the safety controller (L73S) and safety IO modules (PointGuard). The status of each safety connection is a 'ConnectionFaulted' tag that can be easily monitored by your code and displayed on an HMI for your maintenance personnel.

1. Verify the safety faceplate screen is viewable on the Panelview terminal. If necessary, click on the Safety Faceplates button (circled below) within the Integrated Safety Lab.

2. Remove the Ethernet cable from the 1734-AENTR on the DEMO-K570021 demo case (circled in yellow below)

Note that the motion has stopped; because the safety connections to the PointGuard modules have been broken.
3. Call up the IB8S and/or OB8S faceplates by pressing the PointGuard I/O faceplates (shown below)

4. Select the yellow flashing alarm bell (circled below)

The error is a Connection Fault.

5. Select the [?] on the right hand side of the menu bar (circled below)

The probable cause is that the safety connection between GuardLogix controller and module has been broken.

6. Re-insert the Ethernet cable

The connection will automatically re-establish in approximately 20 seconds. When the connection re-established, the fault/probable cause will disappear on the PointGuard faceplate. Notice that the motor does not restart automatically.
7. Close the PointGuard faceplate, using the X in the top right corner (circled below):

![Image of PointGuard faceplate with X highlighted]

The banner on the 1734-IB8S is yellow. It is yellow because all the input channels went LO when the connection faulted. The demand indication is latched until a ‘demand reset’ is selected on the faceplate. Select this faceplate and press ‘demand reset’ if you want to clear this indication. Press IN 0-7 if you do not see the demand reset button.

8. Note some safety instruction faceplates have flashing red banners because the connection fault caused their instruction status tags to go LO. Press the blue RESET button to clear the faults on the safety instructions.

![Image of safety instruction faceplates with red banners and reset buttons]

The Estop instruction banner is green because its output is now HI. The Gate Switch instruction banner is blue because the gate is unlocked.

9. Press the blue RESET button again to lock the gate and restart the K5700 STO safety outputs

10. Close the Safety Faceplate screen on the HMI using the X in the top right corner (circled below)

![Image of HMI screen with X highlighted]

11. Press Clear Faults on the HMI if it is active as circled below

![Image of HMI screen with Clear Faults highlighted]

12. Press Start on the HMI to restart motion
1. While online with RSLogix 5000, place the GuardLogix into Program mode. Click on circled area below and select **Program Mode**

2. Answer [Yes] to the prompt if performing the mode change using software

3. Call up the controller properties (circled below)

To generate the safety signature, you have to be online and in Program mode.
4. Select the **Safety** tab (circled in red below)

![Controller Properties - Integrated_Safety](image)

5. Click on the **Generate** button (circled below in red).

![Controller Properties - Integrated_Safety](image)

It takes a few seconds to generate the signature. When complete, the signature will appear in the area circled above in blue. The signature consists of the CRC of safety memory, along with a time date stamp to the millisecond. This guarantees it to be unique.
6. Open up any of the safety routines and notice that the code is grayed out.

   To edit the safety task once the signature has been applied, you must delete the safety signature; make the edits; and apply a new signature that has ZERO chance of being the same as the original. So as an OEM, you can generate a safety signature, store the signature in a safe place, and years later if there is a safety incident, you can determine if the safety task has been changed.

7. Close the safety routine

8. Open up any of the standard routines and notice code can still be edited. The safety signature only affects the safety memory.

9. Close the standard routine

One last critical point regarding the safety signature is that to operate as a SIL3 controller, the GuardLogix must have a safety signature. This is because the memory protection units that are used to prohibit writing to safety memory and the memory check between the primary and partner only operate with a signature in place.
Safety Lock

Once you are running with a safety signature, you need to avoid someone inadvertently downloading a project to the controller with a different safety task. The safety lock provides this protection.

1. Click the Safety Lock/Unlock button (circled below)

2. Press Lock (circled below)

The following will appear in the controller window

When locked, only projects with an identical safety signature can be downloaded to the controller. This enables changes to the standard tasks, while protecting the safety task.
3. Press **Cancel** to close the controller properties window

4. Close the ACD file and save the changes when prompted by selecting [Yes]
5. Open the ACD file called **HP_CoreDemo_L73S_LOCKdemo.ACD** (located in folder on desktop with the following path: LabFiles \ L73S \ LockDemo)

6. Attempt to go online
7. When you see the following window; select Download (circled below)

The following prompt appears

If you try to download a project with a different safety signature, you will be prompted to unlock the controller. Unlock can be password protected to keep unauthorized users from succeeding. A second purpose of the Lock is to prohibit the deletion of the safety signature. Now the safety program and memory is truly protected from inadvertent changes.
8. Press **Cancel** to close this window

9. Press **Cancel** again to close the online connection window

10. Close the **HP_CoreDemo_L73S_LOCKdemo.ACD** project

11. Open the original **HP_MotionLabCore_SafetyLab_L73S_v30.ACD** project. It should be the second program in the File List.

12. Go online
13. Call up the controller properties window

14. Select **Safety** tab

15. Select **Safety Lock/Unlock**

16. Select **Unlock**
17. Select **Delete** (circled below) to delete the Safety Signature

18. Answer **Yes** at the prompt

19. Press **Cancel** to close the module properties window

20. Go to Run Mode and answer **Yes** to the prompt