



Gen IV Controller with Smart Arm Setup

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1. Introduction

The Smart Arm Accessory allows an articulated arm with encoders to be used with the Gen IV controller. Fastener locations can be programmed into the controller so that the controller will perform specific actions when the tool is located on a specific fastener.

2. Equipment/Software

- AIMCO Gen 4 controller.
- Power Supply Cable.
- Smart Arm Accessory – Encoder Interface - 30860
- Ethernet Cable

3. Hardware Setup

- Connect power to the Gen IV controller
- Connect power to the Smart Arm Accessory
- Connect an Ethernet cable from the Accessory box to the second Ethernet port on the Gen IV Controller.
- Connect the encoders from the arm to the accessory box via M12 cables.
- Power up the Smart Arm Accessory
- Power up the Gen IV Controller

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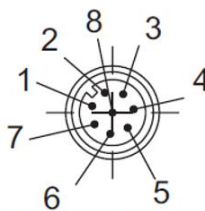


4. Hardware Connections

Connecting the Encoders

The encoders from the arm connect to the controller via M12 connectors. The pinout is shown below.

Top view of mating side,
female contact base



M12 connector, 8-pin

Encoder Circuit	M12-8 Bulkhead Connector Pin
0V	1
+12Vdc	2
A	3
B	5

Encoder Compatibility

The system is compatible with incremental encoders with the following specifications:

- Voltage: 12V
- Signal output: Quadrature with A B outputs
- Pulse rate: System verified with 2048 pulses per revolution and lower

Connecting the Remote Home

An external remote home button can be added to the accessory if needed. This will perform the same function as the 'Home' button on the accessory box. The homing function will be triggered when pin 4 on the M8 connection is pulled high to +12V.

External Circuit	M8-3 Bulkhead Connector Pin
0V	3
+12Vdc	1
Signal	4

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5. Setup Steps Overview

This document covers the details of interfacing an arm outfitted with encoders to a Gen IV Controller. The general steps of the setup are shown below:

1. Make all hardware connections
2. Power on the Smart Arm Accessory and Gen IV Controller
3. Configure the accessory IP settings from the controller
4. Add the Smart Arm accessory in the Gen IV controller settings
5. Configure the accessory settings and add arm locations
6. Configure line side control (if required)

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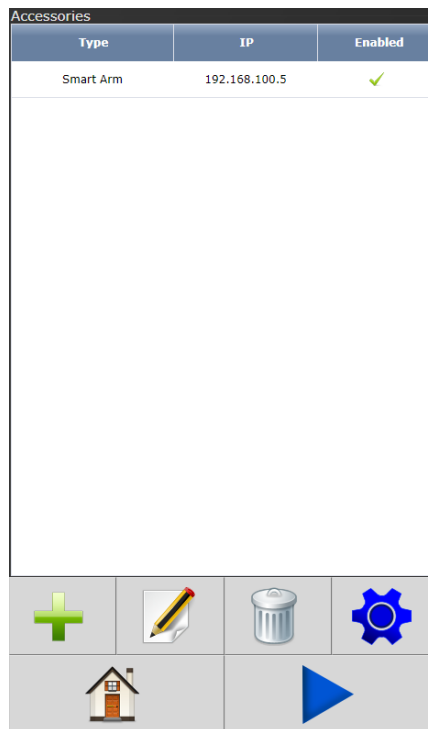
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6. Configuration Screen Summary

Configuration Screens

Accessory Setup Screen



Type	IP	Enabled
Smart Arm	192.168.100.5	✓

The screenshot shows a web interface titled "Accessories". It contains a table with three columns: "Type", "IP", and "Enabled". The table has one data row with the values "Smart Arm", "192.168.100.5", and a green checkmark. Below the table is a toolbar with seven icons: a green plus sign, a pencil, a trash can, a blue gear, a house, and a blue play button.

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This screen shows accessories configured in the controller. New accessories can be added, edited, and deleted using the buttons at the bottom of the table. The gear icon navigates to the Accessory Scanning and Setup page.



Accessory Scanning and IP Setup Screen

Accessories		
Type	MAC	IP
Smart Arm	00-1A-B6-03-3B-C8	192.168.100.5

IP Address	<input type="text" value="192.168.100.5"/>
Subnet Mask	<input type="text" value="255.255.255.0"/>
Gateway	<input type="text" value="0.0.0.0"/>
MAC	<input type="text" value="00-1A-B6-03-3B-C8"/>
	<input type="button" value="Send"/>

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This screen is used to configure the IP settings of the accessory. Clicking the magnifying glass will search for AcraDyne Accessories on the network. Any accessories found will show up in the list. Click on the accessory to be configured to edit its settings. Once clicked, the current settings will autofill in the edit fields. Edit these and click 'Send' to send the new settings to the accessory that matches that MAC address. Ensure that the accessory being modified is the intended accessory by matching the MAC address on the screen to the MAC address labeled on the accessory box.

Main Configuration Screen

Smart Arm




Enabled



IP Address

Function

Locations

#	Position	Verify Job Sequence
1	[0, 0, 0, 0]	1
2	[94, 112, 0, 0]	2
3	[198, 227, 0, 0]	3

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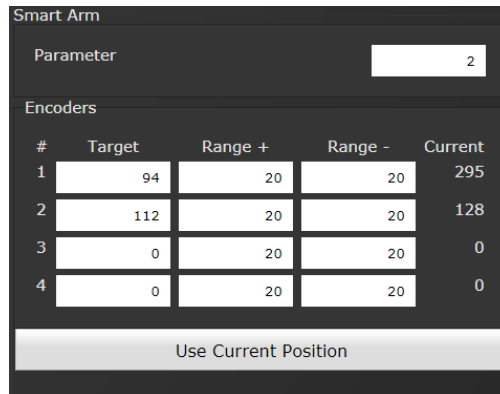
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This is the primary setup screen. It contains the basic settings for what action will be taken when the arm is in position and a list of valid locations. Settings are not saved until the OK/Check button is clicked.

- Enabled: Toggles whether the smart arm accessory is active. If this is unchecked then the smart arm will not control the enabled state of the tool.
- IP Address: This is the IP Address of the smart arm accessory.

Location Setup Screen



The screenshot shows the 'Smart Arm' configuration interface. At the top, there is a 'Parameter' field with the value '2'. Below this is a table titled 'Encoders' with the following data:

#	Target	Range +	Range -	Current
1	94	20	20	295
2	112	20	20	128
3	0	20	20	0
4	0	20	20	0

At the bottom of the screen is a button labeled 'Use Current Position'.

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This screen is where a new location is configured. The 'Parameter' field is a multi-purpose field. This field corresponds to the 'Function' option on the previous page so this field can correspond to PSet or Job Sequence number. The right column labelled 'Current' shows the current state of the encoders. The 'Range' field defines the window around the target that is acceptable for enabling that location. Reducing the range narrows the acceptability window and increasing the range widens the window.

Clicking 'Use Current Position' will grab the current state of the encoders and use it as the target. Use this to easily add a location by locating the tool on the bolt for that location and click 'Use Current Position'. Click OK at the bottom of the screen and this location will be added to the list.

Icon Reference

Icon	Function	Definition
	Position not valid	The current position of the arm does not match any locations in the smart arm configuration. This error will clear when the arm is in a valid position.
	PSet or Job Sequence Mismatch	The currently selected PSet or Job Sequence does not match the PSet or Job Sequence number required by the current location. This error will clear when one of the following happens: <ul style="list-style-type: none"> The arm moves to a position that requires the currently selected PSet/Sequence The active PSet/Sequence is changed to match what is required for this position
	Connection Error	The controller is not communicating with the accessory. Commonly caused by incorrect IP settings in the controller or accessory.



Smart Arm Function

The accessory can be configured to take one of four different actions when a location is matched.

- Select PSet
 - This will pair a location to a PSet and the controller will select the PSet when this location is matched
- Verify PSet
 - The tool will be disabled until the PSet is selected that matches the required PSet from the location configuration
- Select Job Sequence
 - This will pair a location to a job sequence. The controller will select a specific job sequence when the location is matched
- Verify Job Sequence
 - The tool will be disabled until the correct job sequence is selected that matches the job sequence from the location configuration

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Homing

- Pressing the 'Home' button on the accessory will set the '0' position of the arm. All locations will be referenced off this position. This can be the location of a specific bolt or another position in the station that doesn't move.
- The system will need to be 'homed' whenever the station is powered up.
- The encoder accessory has an M8 connector that allows for a remote homing button to be wired in in the case that the homing button on the box is inconvenient.

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Locations

Locations are defined by encoder counts. After the system is homed then locations can be programmed via the Accessories->Smart Arm configuration page. Clicking the Add(+) button will add a new location. The 'Current' column shows the current position of the encoders. Clicking 'Use Current Position' will use those values and fill in the target encoder values for this location. The 'Range' field will define the acceptable distance around the target that will enable this location. Increasing the 'Range' value will allow for a wider area that allows the location to be selected.



7. System Connections

Smart Arm Accessory Connections

- 4x Encoder Connections – M12
 - Connect each encoder to an encoder connector starting at encoder 1
- 1x Remote Home Button Connection – M8
- Ethernet

Controller Connections

- Use second ethernet port to connect to accessory

8. Initial Setup

Configuring the Controller to communicate with the accessory

- Configure the second ethernet port on the controller
 - This example is set up to work with the default IP settings on the second ethernet port of the controller
 - Controller IP Address: 192.168.100.1
 - Subnet: 255.255.255.0
- Set up the accessory ethernet settings
 - Go to the Accessory screen and click the gear icon
 - The accessory attached to the second ethernet port will appear in the list
 - Verify the MAC address shown matches the MAC printed on the accessory box.
 - Click on the accessory in the list and the edit fields below will autofill.
 - Configure the accessory to have the following settings:
 - IP Address: 192.168.100.5
 - Subnet: 255.255.255.0
 - Gateway: 0.0.0.0
 - Click 'Send'
 - The accessory list will refresh and the accessory will show with its new settings.
- Add the smart arm accessory
 - Navigate to the main accessory screen and click Add(+)
 - Enter the IP address that was just configured for the accessory
 - IP Address: 192.168.100.5
 - Click OK/Check
- Verify connection

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- Runscreen status header
 - The main runscreen will now show an arm icon indicating that it is not in a valid location.
- Live encoder values
 - Navigate to Accessories and edit the smart arm accessory
 - Click the the Add(+) button to add a new location. The fields under 'Current' should change as the arm is moved. This shows that the accessory is sending over valid encoder values.

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9. Example: Select PSets Based on Location

Example Overview

This example shows how to set up the most basic control option. Three locations will be programmed in the controller so that the controller will enable the tool and select a specific PSet when the tool is located over a fastener.

PSet Setup

Create three PSets. These can be named in the advanced settings to make it more clear which PSet is for which bolt.

Accessory Setup

Navigate to the Accessories screen, select the Smart Arm accessory configured in the 'Initial Setup' portion and click the edit button.

Set up the accessory function as 'Select PSet'. This allows the controller to select the correct PSet for the arm location.

Before adding locations be sure to move the arm to the home position and press the 'Home' button on the accessory box. This will be the reference position for all added locations.

Add three fastener locations. Click the Add(+) button to add a new location. Move the tool onto the first fastener. The encoder values in the 'Current' column will update with the encoder counts for this position. Click 'Use Current Position' to use the current arm position for the location. Set the 'Parameter' field to 1 to select PSet 1 for this position. Click OK/Check to save this position. Repeat this sequence for fasteners 2 and 3. Set PSet 2 for location 2 and PSet 3 for location 3.

Click the OK/Check button on the main Smart Arm configuration screen to save all the location.



The controller will now select the correct PSet when it is located over a defined location. Once located over the fastener all Smart Arm stops will be cleared, the correct PSet will be selected, and the tool will become enabled.

#	Position	Verify PSet
1	[0, 0, 0, 0]	1
2	[94, 112, 0, 0]	2
3	[198, 227, 0, 0]	3

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10. Example: Command Bolt Locations via External Source

Example Overview

This example shows how to set up a more complex control scheme. This application will have the following requirements:

- Three fasteners
- Each fastener has two unique tightening specifications
 - Initial work
 - Re-work

This application will use jobs to select the work type (initial or rework) and then select a job sequence number that is tied to the fastener number. Two jobs will be created (initial and re-work). Each job will have three job sequences (one for each fastener). Each of the three fasteners have two tightening specs so this gives six PSets. Job 1 will use PSets 1-3 for the 'Initial' work PSets, and Job 2 will use PSets 4-6 for 'Rework' PSets.

PSet Setup

Set up six PSets. These can be named in the advanced settings to make it more clear which PSet is for which bolt.

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Job Setup

Set up two Jobs. Name Job 1 as 'Initial' and Job 2 as 'Rework'.

In Job 1 set up the job sequence as the following

- Sequence 1: PSet 1
 - Action: None
 - Count: 1
- Sequence 2: PSet 2
 - Action: None
 - Count: 1
- Sequence 3: PSet 3
 - Action: None
 - Count: 1

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The setup should result in a job that is shown below.

Advanced Options

	PSet	Action	#
1	1 [3Nm]	None	1
2	2 [2.99Nm]	None	1
3	3 [2.98Nm]	None	1

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In Job 2 set up the job sequence as the following:

- Sequence 1: PSet 4
 - Action: None
 - Count: 1
- Sequence 2: PSet 5
 - Action: None
 - Count: 1
- Sequence 3: PSet 6
 - Action: None
 - Count: 1



The setup should result in a job that is shown below.

Edit Job 2

Job Number: Job 2

Job Name: Rework

Job Action: Disable Tool

Advanced Options

	PSet	Action	#
1	4 [3Nm]	None	1
2	5 [2.99Nm]	None	1
3	6 [2.98Nm]	None	1

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Accessory Setup

Navigate to the Accessories screen, select the Smart Arm accessory configured in the 'Initial Setup' portion and click the edit button.

Set up the accessory function as 'Verify Job Sequence'. This allows an external system to select the job number and job sequence number to define which fastener needs to be run and whether it should be from the 'Initial work' job or the 'Rework' job.

Add three fastener locations. Click the Add(+) button to add a new location. Set 'Parameter' to 1 so that job sequence 1 needs to be selected for the tool to be enabled. Move the tool onto the fastener for this location. Click 'Use Current Position' to populate the target fields with this location's encoder values. Click OK/Check. Repeat this for location 2 and 3. Set 'Parameter' to 2 for location 2 and 3 for location 3. Click OK/Check until all Smart Arm configurations are saved.

Each location is now paired with a job sequence number. Now configure the line side control to select the job and job sequence paired to the fastener and the tool will not be enabled until the tool is located over the correct fastener.

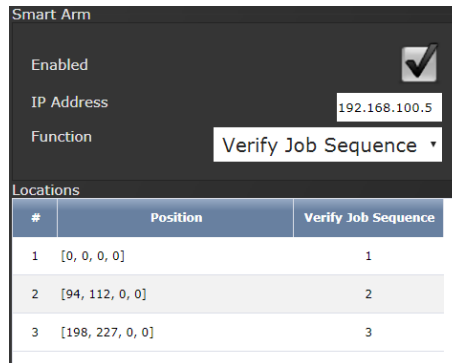
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External Control

Line side control can be used to command which fastener needs to be run. Select the Job that matches the work type (initial or rework) and select the job sequence number that is tied to the fastener location. Configure the assignable IO for the required interface type (CC-Link, Anybus, etc.) to select a job number and job sequence number. Refer to the white paper for the specific interface for configuration details.

In this example, selecting Job 1 and Job Sequence 2 will select PSet 2 and disable the controller until the arm is in the correct position for fastener 2.

Selecting Job 2 and Job Sequence 3 will select PSet 6 and disable the controller until the arm is in the correct position for fastener 3.

The front panel and physical IO can be used to select job number, sequence number, and reset job if needed for testing. The job can be changed by holding the toggle button and pressing an up/down button. Job sequence can be changed by just pressing an up or down button when jobs are enabled.

11. Adding a proximity or limit switch

A proximity switch or limit switch can be wired in to one of the encoder inputs. This will allow one of the encoder readings to read as 0/1 or 0/-1 depending on how the switch is wired. The switch will always read one of two states so the range for that encoder will need to be set to 0. For the configuration in the image below the 3rd encoder is set to work with a proximity switch. The location is only valid when the encoder is reading a -1. The range is 0 so that the target has to be an exact match.



Smart Arm

Parameter

Encoders

#	Target	Range +	Range -	Current
1	0	20	20	8
2	0	20	20	6
3	-1	0	0	0
4	0	20	20	0

Use Current Position

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Use the pinouts in “Hardware Connections” to wire in the proximity switch to an M12-8 connector. Use 0V (pin 1) and 12V (pin 2) to power the switch and connect the signal wire to the ‘A’ input (pin 3)