FactoryTalk Analytics VisionAI

AOP/AOI Reference Guide

Version 1.00.00

FTALK-RM001A-EN-P

Rockwell Automation

Original Instructions

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

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.

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, and recognize the consequence.

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

These labels may also be on or inside the equipment to provide specific precautions.

SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.

BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.

ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

The following icon may appear in the text of this document.

Identifies information that is useful and can help to make a process easier to do or easier to understand.

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Overview

This guide offers a comprehensive overview of the Ethernet/IP Adapter capabilities of the FactoryTalk Analytics VisionAI providing terminology and communication specifications. The Visual Inspection System can communicate with a manufacturing facility via Ethernet/IP for the Control and Status of the system.

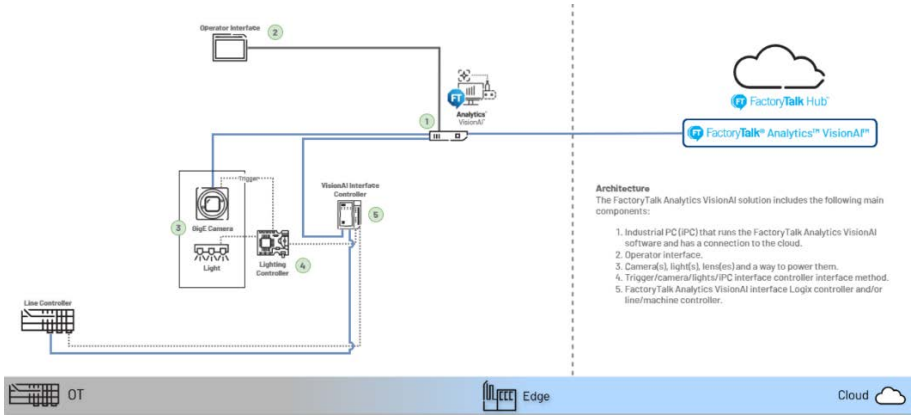
This guide explains the full Ethernet/IP specification, but extensive knowledge of these details is generally not required when using Rockwell Automation PLCs. We've developed a Library that includes FactoryTalk Analytics VisionAI AOI's on page 25 to simplify the programming process. This negates the need for an in-depth understanding of the specification unless you prefer to create all the logic independently.

System Overview

FactoryTalk Analytics VisionAI delivers a full-stack next-generation machine vision platform that leverages the power of AI to open new use cases, provide insights, and close the loop on the manufacturing process.

A FactoryTalk Analytics VisionAI typically consists of an Edge Compute, 1 or more cameras, lights, triggers, a trigger board, and a PLC. These components are intended to be part of larger manufacturing systems, where it will perform the quality inspections for its processes.

FactoryTalk Analytics VisionAI offers a comprehensive vision solution that seamlessly integrates into new or existing systems, catering to a wide variety of applications.



Terminology

Tag	Comment
EIP Server / Adapter	An **Ethernet/IP Server/Adapter** is a device that enables communication over an Ethernet network using the Ethernet/IP (Ethernet Industrial Protocol) standard. In Ethernet/IP a Server and Adapter are the same.
EIP Client / Scanner	An **Ethernet/IP Client/Scanner** is a device that acts as a master in an Ethernet/IP network. It sends data to and collects data from devices known as adapters. In Ethernet/IP a Client and Scanner are the same.
HMI	The **HMI (Human Machine Interface)** is a graphical user interface that the FactoryTalk Analytics VisionAI provides for customer configuration. You can use the local Monitor, Keyboard, and Mouse or access it remotely using a web browser.
Inspection Camera Settings	The I**nspection Camera settings** such as camera exposure, trigger settings, and FOV crop, are used to configure the image a camera takes for an inspection.

Inspection Tool	The **Inspection Tools** are the programmed functions used to inspect the image and determine the outcome. Examples of tools are "Anomaly Detection", "Match", "Barcode Scan", "Align", etc. Each tool has its own Inspection Area.
Inspection Area - AOI (Area of Interest)	An **Inspection Area** is a specified area within the camera's Field of View (FOV) on which a Tool will run the inspection. This could be the whole FOV or a small region within the FOV. It can be a Square, Circle, or Polygon.
Inspection Recipe	The **Inspection Recipe** settings, including all cameras, tools, models, Item settings, and other settings through which an inspection can be configured. • Inspection Camera Settings • Inspection Tools • Inspection Areas
Recipe Slot	A **Recipe Slot** is a mapping between an Inspection Recipe and a Recipe Slot. Slots allow the PLC to indicate which Inspection recipe configured via the HMI should be run.
Tool Slot	A **Tool Slot** is a mapping between an Inspection Tool within a recipe and the Tool Slot in which it reports its results.
Deploy	To use a new Recipe, you will **Deploy** it to the system and set it to an available Recipe Slot. Once a recipe is deployed, it is physically present on the camera and can be launched via the PLC.
Item	In a Multi-Cam system, an **Item** is one result of a single item from Multiple cameras. This is set up under "Settings / Item Creation".
Batch	A **Batch** is a specific quantity of a product that is produced during a single production run using the same materials, machinery, and processes. This batch is treated as a single unit for quality control, inventory, and tracking purposes.

HMI Configuration

Recipe Creation

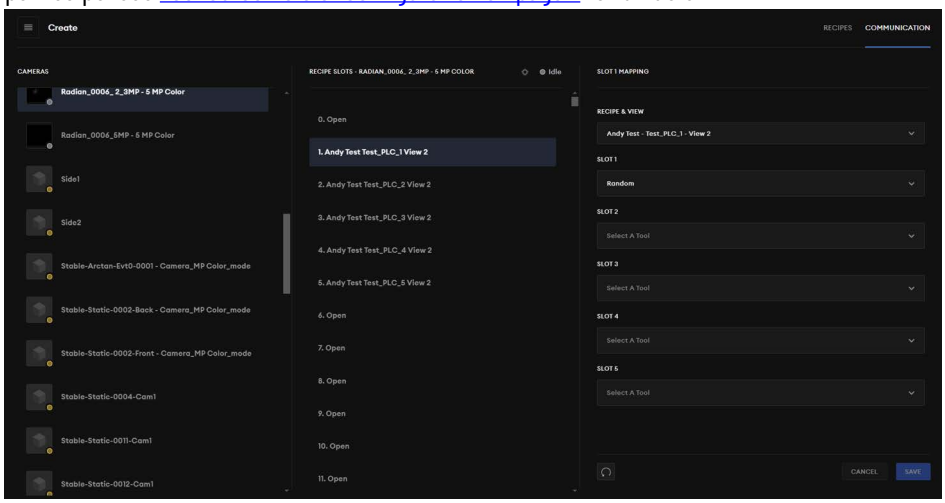
The FactoryTalk Analytics VisionAI is primarily configured via the system's Human-Machine Interface (HMI) or Web Browser. The user will create a new inspection recipe in FactoryTalk Analytics VisionAI to define the specifications of that application. After the user configures an Inspection recipe, they will set up the Slot Configuration for PLC access.

Recipe Slot Configuration

Once recipes have been created and have been deployed to the system. A recipe is mapped to a Recipe Slot so the hardware interface can load and run the recipe via the RecipeStart command in the specification. This will need to be set up for each camera used in that recipe.

Tool Outcome Slot Configuration

Once a recipe is mapped to a slot, the user can also set up tool slots on which individual tools within the recipe report their results. In the standard I/O specification, there are 16 Tool Slots per recipe. See Tool Outcome Slot Configuration on page 7 for bit details



In FactoryTalk Analytics VisionAI software, in Station View, go to the Manage Station button and select the Communication tab to set the Slot mappings.

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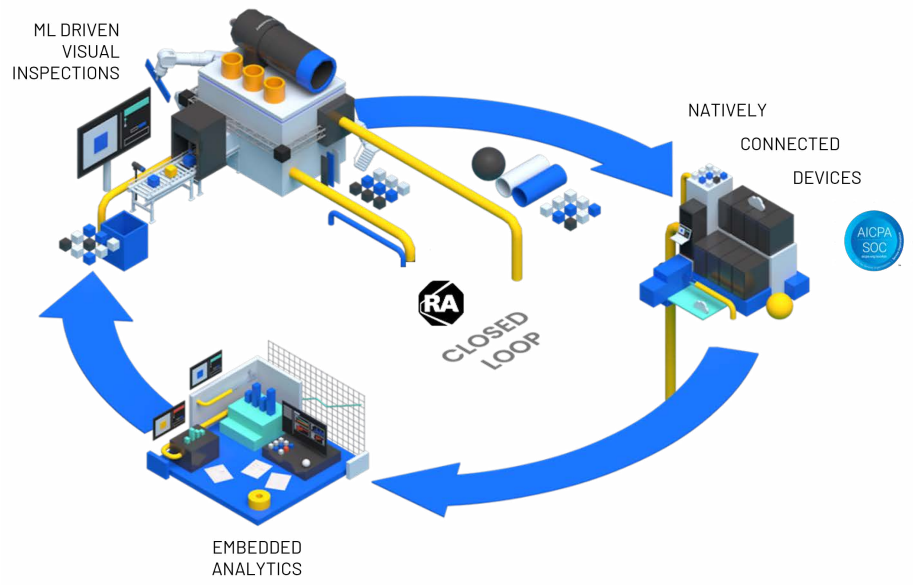
PLC Communication

The PLC communication to the customer's PLC uses our Ethernet/IP Adapter interface to communicate control and status of the system. The PLC, functioning as an EtherNet/IP scanner (client / master), initiates communication with the adapter (server / slave). This ensures reliable, real-time, and secure communication critical for industrial automation and network safety. The combination of redundancy, security measures, and diagnostic capabilities helps maintain the integrity and reliability of the communication network.

In summary, the Ethernet/IP adapter initiates communication from the PLC through a well-defined process of connection establishment, data exchange, and adherence to safety protocols.

The Visual Inspection System can be configured with a static IP address on the same network as the PLC via a dedicated ethernet interface. Allen Bradley/Rockwell PLCs are supported. We have an Add-On Profile (AOP) that allows you to install and configure our system into the PLC network easily.



Ethernet/IP IO Assemblies

The AOP allows you to select from 1 to 11 cameras. It uses 2 different Assembly Types, each 496 bytes long, and you can have up to 6 Assembly instances.

- The first Assembly Type is for the System Area and Camera 1 IO.
  - **Note:** This Instance is always added and required.
  - **Note:** The System Area is reserved for future use.
- The second Assembly Type is for Cameras 2-11, this can be up to 5 Assembly instances (assemblies 2-6) of Assembly Instance 2.
  - **Note:** Each assembly Instance can include 2 cameras, so the first will be Cameras 2-3. If you only select 2 cameras then the second set will be unused.

Each camera will have the following data structure available in the IO Assemblies:

Output Assembly (O2T)	Input Assembly (T20)
Control bits	Status bits
Slot ID	ImageID
Additional Data	Tool Outcome Bits
	UTC Timestamp
	Additional Data

Output / Input Assembly Structure - System and Camera 1

Output (O2T) Assembly 1

Byte		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	System	Reserved Compute (248 Bytes)							
...									
247									
248	Camera 1	Heartbeat Out	Unused Bit_6	Unused Bit_5	Unused Bit_4	Recipe Stop Cmd	Unused Bit_2	Recipe Start Cmd	Image Trigger Cmd
249		Unused Bit_15	Tool Criteria Array Cmd	Unused Bit_13	Tool Criteria Cmd	Use Batch Name Cmd	Tool Mute Val	Tool Mute Cmd	Unused Bit_8
250		Slot ID (2 Bytes)							
251									
252		Additional Data (244 Bytes)							
....									
495									

Input (T20) Assembly 1

Byte		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	System	Reserved Compute (248 Bytes)							
...									
247									
248	Camera 1	Heartbeat In	Error Code Bit_1	Error Code Bit_0	Recipe Running	Recipe Loaded	Command Success	Command Processing	Ready
249		Unused Bit_15	Unused Bit_14	Unused Bit_13	Unused Bit_12	Unused Bit_11	Image Outcome Bit_1	Image Outcome Bit_0	Image Processed
250		Image ID (2 Bytes)							
251									
252		Tool_4_Outcome		Tool_3_Outcome		Tool_2_Outcome		Tool_1_Outcome	
253		Tool_8_Outcome		Tool_7_Outcome		Tool_6_Outcome		Tool_5_Outcome	
254		Tool_12_Outcome		Tool_11_Outcome		Tool_10_Outcome		Tool_9_Outcome	
255		Tool_16_Outcome		Tool_15_Outcome		Tool_14_Outcome		Tool_13_Outcome	
256		UTC Timestamp (8 Bytes)							
...									
263									
264		Additional Data (232 Bytes)							
...									
495									

Output Assembly Structure - Cameras 2 - 11

Output (O2T) Assembly 2-6

Byte		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Camera 2, 4, 6, 8, 10	Heartbeat Out	Unused Bit_6	Unused Bit_5	Unused Bit_4	Recipe Stop Cmd	Unused Bit_2	Recipe Start Cmd	Image Trigger Cmd
1		Unused Bit_15	Tool Criteria Array Cmd	Unused Bit_13	Tool Criteria Cmd	Use Batch Name Cmd	Tool Mute Val	Tool Mute Cmd	Unused Bit_8
2		Slot ID (2 Bytes)							
3									
4		Additional Data (244 Bytes)							
...									
247									
248	Camera 3, 5, 7, 9, 11	Heartbeat Out	Unused Bit_6	Unused Bit_5	Unused Bit_4	Recipe Stop Cmd	Unused Bit_2	Recipe Start Cmd	Image Trigger Cmd
249		Unused Bit_15	Tool Criteria Array Cmd	Unused Bit_13	Tool Criteria Cmd	Use Batch Name Cmd	Tool Mute Val	Tool Mute Cmd	Unused Bit_8
250		Slot ID (2 Bytes)							
251									
252		Additional Data (244 Bytes)							
...									
495									

Input Assembly Structure - Cameras 2 - 11

Input (T20) Assembly 2-6

Byte		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Camera 2, 4, 6, 8, 10	Heartbeat In	Error Code Bit_1	Error Code Bit_0	Recipe Running	Recipe Loaded	Command Success	Command Processing	Ready
1		Unused Bit_15	Unused Bit_14	Unused Bit_13	Unused Bit_12	Unused Bit_11	Image Outcome Bit_1	Image Outcome Bit_0	Image Processed
2		Image ID (2 Bytes)							
3									
4		Tool_4_Outcome		Tool_3_Outcome		Tool_2_Outcome		Tool_1_Outcome	
5		Tool_8_Outcome		Tool_7_Outcome		Tool_6_Outcome		Tool_5_Outcome	
6		Tool_12_Outcome		Tool_11_Outcome		Tool_10_Outcome		Tool_9_Outcome	
7		Tool_16_Outcome		Tool_15_Outcome		Tool_14_Outcome		Tool_13_Outcome	
8		UTC Timestamp (8 Bytes)							
...									
15									
16		Additional Data (232 Bytes)							
...									
247									
248	Camera 3, 5, 7, 9, 11	Heartbeat In	Error Code Bit_1	Error Code Bit_0	Recipe Running	Recipe Loaded	Command Success	Command Processing	Ready
249		Unused Bit_15	Unused Bit_14	Unused Bit_13	Unused Bit_12	Unused Bit_11	Image Outcome Bit_1	Image Outcome Bit_0	Image Processed
250		Image ID (2 Bytes)							
251									
252		Tool_4_Outcome		Tool_3_Outcome		Tool_2_Outcome		Tool_1_Outcome	
253		Tool_8_Outcome		Tool_7_Outcome		Tool_6_Outcome		Tool_5_Outcome	
254		Tool_12_Outcome		Tool_11_Outcome		Tool_10_Outcome		Tool_9_Outcome	
255		Tool_16_Outcome		Tool_15_Outcome		Tool_14_Outcome		Tool_13_Outcome	
256		UTC Timestamp (8 Bytes)							
...									
263									
264		Additional Data (232 Bytes)							
...									
495									

Camera Control /Status Bits Specifications

The following tables describe each bit's functions in the camera input and output arrays and when they are processed.

Camera Control Bits

These bits will be Outputs from your PLC and are used to control the FactoryTalk Analytics VisionAI. You can get more details on the full use in the Operation section.

Note: The FactoryTalk Analytics VisionAI requires a minimum pulse width (signal on time) of 20ms, with a minimum recommendation of 40ms.

Tag Name	Byte Offset, Bit Number	Description	Event Edge
ImageTriggerCmd	0 / 248 , 0	Signal to manually Trigger an Image (hardware trigger mode only)	Rising
RecipeStartCmd	0 / 248 , 1	Signal to Start a new batch from the selected Recipe Slot	Rising
UnusedBit_2	0 / 248 , 2	Unused Bit	None
RecipeStopCmd	0 / 248 , 3	Signal to Stop the currently running batch	Rising
UnusedBit_4	0 / 248 , 4	Unused bit	None

Tag Name	Byte Offset, Bit Number	Description	Event Edge
UnusedBit_5	0 / 248 , 5	Unused bit	None
UnusedBit_6	0 / 248 , 6	Unused bit	None
HeartbeatOut	0 / 248 , 7	Heartbeat output signal. Will be matched on Heartbeat input	Both
UnusedBit_8	1 / 249 , 0	Unused bit	None
ToolMuteCmd	1 / 249 , 1	Signal to mute/unmute the tool for the selected Slot_ID	Rising
ToolMuteVal	1 / 249 , 2	If True when `ToolMuteCmd` is signaled, mute the tool, else unmute	None
UseBatchNameCmd	1 / 249 , 3	Signal to update the batch name of the currently running batch	Rising
ToolCriteriaCmd	1 / 249 , 4	Signal to update the tool criteria for the Selected SlotID uses TOOL_CRITERIA_KEY and TOOL_CRITERIA_VAL messages	Rising
UnusedBit_13	1 / 249 , 5	Unused bit	None
ToolCriteriaArrayCmd	1 / 249 , 6	Signal to update the tool criteria for the Selected SlotID uses TOOL_CRITERIA_KEY and TOOL_CRITERIA_ARRAY messages	Rising
UnusedBit_15	1 / 249 , 7	Unused bit	None

Camera Status Bits

These bits will be Inputs to your PLC and are used to get the status of the FactoryTalk Analytics VisionAI. You can get more details on the full use in the Operation section.

Note: The FactoryTalk Analytics VisionAI is set for a minimum pulse width (signal on time) of 60ms, with a 20ms off duration. These can be changed with internal settings if needed.

Bit Name	Byte, Bit Number	Description
Ready	0 / 248 , 0	The system is Ready to receive a Recipe Start command
CommandProcessing	0 / 248 , 1	A command has started processing; Ack/Handshake for all commands;
CommandSuccess	0 / 248 , 2	A command has completed successfully; Will be True on the falling edge of `CommandProcessing` if a command succeeded, else False
RecipeLoaded	0 / 248 , 3	A recipe is loaded
RecipeRunning	0 / 248 , 4	A recipe is running
ErrorCodeBit_0	0 / 248 , 5	A minor error occurred
ErrorCodeBit_1	0 / 248 , 6	A major error occurred
HeartbeatIn	0 / 248 , 7	Mirrors the HEARTBEAT output, i.e. if the output is True this bit will be True. Response will be <10ms
ImageProcessed	1 / 249 , 0	An image has completed processing. On the rising edge of this signal, all Outcomes, ID, timestamp, and data are valid for a minimum of RESULT_MIN_DURATION, 20ms by default. Outcomes will stay True until the next `ImageProcessed`
ImageOutcomeBit_0	1 / 249 , 1	Image outcome - Bit 1
ImageOutcomeBit_1	1 / 249 , 2	Image outcome - Bit 0
UnusedBit_11	1 / 249 , 3	Unused Bit
UnusedBit_12	1 / 249 , 4	Unused Bit
UnusedBit_13	1 / 249 , 5	Unused Bit
UnusedBit_14	1 / 249 , 6	Unused Bit
UnusedBit_15	1 / 249 , 7	Unused Bit

Camera Tool Outcome Status Bits

You can set up Tool Outcomes in FactoryTalk Analytics VisionAI to get outputs specific to only the desired tool. You can set up a maximum of 16 different tool outcomes per recipe.

The Tool Outcome Slot Configuration above explains this in more detail.

Bit Name	Byte, Bit Number	Description
Tool_1_Outcome_0	4 / 252 , 0	Tool 1 outcome - Bit 0
Tool_1_Outcome_1	4 / 252 , 1	Tool 1 outcome - Bit 1
Tool_2_Outcome_0	4 / 252 , 2	Tool 2 outcome - Bit 0
Tool_2_Outcome_1	4 / 252 , 3	Tool 2 outcome - Bit 1
Tool_3_Outcome_0	4 / 252 , 4	Tool 3 outcome - Bit 0
Tool_3_Outcome_1	4 / 252 , 5	Tool 3 outcome - Bit 1
Tool_4_Outcome_0	4 / 252 , 6	Tool 4 outcome - Bit 0
Tool_4_Outcome_1	4 / 252 , 7	Tool 4 outcome - Bit 1
Tool_5_Outcome_0	5 / 253 , 0	Tool 5 outcome - Bit 0
Tool_5_Outcome_1	5 / 253 , 1	Tool 5 outcome - Bit 1
Tool_6_Outcome_0	5 / 253 , 2	Tool 6 outcome - Bit 0
Tool_6_Outcome_1	5 / 253 , 3	Tool 6 outcome - Bit 1
Tool_7_Outcome_0	5 / 253 , 4	Tool 7 outcome - Bit 0
Tool_7_Outcome_1	5 / 253 , 5	Tool 7 outcome - Bit 1
Tool_8_Outcome_0	5 / 253 , 6	Tool 8 outcome - Bit 0
Tool_8_Outcome_1	5 / 253 , 7	Tool 8 outcome - Bit 1
Tool_9_Outcome_0	6 / 254 , 0	Tool 9 outcome - Bit 0
Tool_9_Outcome_1	6 / 254 , 1	Tool 9 outcome - Bit 1
Tool_10_Outcome_0	6 / 254 , 2	Tool 10 outcome - Bit 0
Tool_10_Outcome_1	6 / 254 , 3	Tool 10 outcome - Bit 1
Tool_11_Outcome_0	6 / 254 , 4	Tool 11 outcome - Bit 0
Tool_11_Outcome_1	6 / 254 , 5	Tool 11 outcome - Bit 1
Tool_12_Outcome_0	6 / 254 , 6	Tool 12 outcome - Bit 0
Tool_12_Outcome_1	6 / 254 , 7	Tool 12 outcome - Bit 1
Tool_13_Outcome_0	7 / 255 , 0	Tool 13 outcome - Bit 0
Tool_13_Outcome_1	7 / 255 , 1	Tool 13 outcome - Bit 1
Tool_14_Outcome_0	7 / 255 , 2	Tool 14 outcome - Bit 0
Tool_14_Outcome_1	7 / 255 , 3	Tool 14 outcome - Bit 1
Tool_15_Outcome_0	7 / 255 , 4	Tool 15 outcome - Bit 0
Tool_15_Outcome_1	7 / 255 , 5	Tool 15 outcome - Bit 1
Tool_16_Outcome_0	7 / 255 , 6	Tool 16 outcome - Bit 0
Tool_16_Outcome_1	7 / 255 , 7	Tool 16 outcome - Bit 1

Camera Status Multi-Bit Specification

Camera Pass / Fail Bits

Camera Pass/Fail outcome results are 2 bits in length. Both bits should be read and interpreted together.

Bit 0	Bit 0	Integer	Result
0	0	0	Pass
1	0	1	Fail
0	1	2	Unknown/Needs Data
1	1	3	Error

Camera Error Bits

The error code output is 2 bits in length. Both bits should be read and interpreted together to get the full error code

Bit 0	Bit 0	Integer	Result
0	0	0	Ok
1	0	1	Camera Not Connected
0	1	2	System Error
1	1	3	Reserved

Camera Heartbeat Specification

To verify that each camera is connected and communicating properly, we use a Heartbeat methodology to detect issues. The Heartbeat In will mirror the Heartbeat out within 10ms. You will toggle the Heartbeat Out every 100ms - 1sec.

Detecting when the system is online requires two successful heartbeat responses in a row. While the system is offline, the heartbeat output will retain its current value because the system is either unable to process the heartbeat command or unable to communicate with the PLC. Therefore, programs need to check the two most recent heartbeat responses in a row to confirm that the system is online.

Heartbeat In	Heartbeat Out	Result
N/A	0	Initial Value
0	0	System is Online
1	1	System is Online
0	1	System is Offline
1	0	System is Offline

Extended Functions

We use Explicit messaging for some Extended Functions that require moving larger amounts of String data to set different settings within FactoryTalk Analytics VisionAI. These use EIP Explicit message instructions to set the data and then Standard EIP Implicit IO to control the process. This is explained in greater detail below in the Operation section.

- Batch Name
  - You can set the batch name before starting the Batch or while it is running.
  - If set after running, it will only show up in analytics.
- Tool Criteria
  - You can set the Criteria to match against for some Tools in order to determine the Tool Pass/Fail Outcome. This is used currently with the Barcode, Text, and Match tools. These can also be manually set in the FactoryTalk Analytics VisionAI Interface.

Function Name	Description	Datatype	Max Bytes	Service Code	Class	Instance	Attribute
Batch_Name	Use to set Batch Name to update the batch name	STR0482	482	10	64	1	1
Tool_ Criteria_Key	Use to set the Tool Criteria Key Regex: Barcode, OCR Expected Class: Match	STR0482	482	10	64	1	2
Tool_ Criteria_Val	Set the Tool Criteria Value Used with Barcode, and OCR	STR0482	482	10	64	1	3
Tool_ Criteria_Array	Set the Tool Criteria Value Used with Match You can have Multiple values as long as they are comma-separated.	STR0482	482	10	64	1	4

Note: We have AOIs to simplify this programming so you do not need to understand this unless you want to write your own logic.

Operation

This section explains the PLC-controlled operation of the FactoryTalk Analytics VisionAI and the handshaking of the Outputs to Inputs needed to write the minimal logic. You will need to add process and error handling logic for your application. Information for commands supported by input bits is detailed below.

Note: The FactoryTalk Analytics VisionAI requires a minimum pulse width of 20ms, with a recommendation of 40ms.

Command	Description	Implementation
Software Image Trigger	Used to trigger a new frame (Hardware mode only)	-Set `ImageTriggerCmd` True -Wait for `CommandProcessing` falling edge pulse -Monitor `CommandSuccess` to know it finished
Start a recipe	Load a recipe from one of the slots and start running the recipe	-Set the recipe slot number in SlotID -Set `StartRecipeCmd` True -Wait for `CommandProcessing` falling edge pulse -Monitor `CommandSuccess` to know it finished
Stop a recipe	Stop the currently running recipe	-Set `StopRecipeCmd` True -Wait for `CommandProcessing` falling edge pulse -Monitor `CommandSuccess` to know it finished
Mute a tool or all tools	Send the mute command/ setting to one or all tools on a camera, causing their outcomes to the integration framework to "pass" where they otherwise might not	-Set `ToolMuteVal` – True to mute – False to unmute - Set the `SlotID` to the desired tool to mute/ unmute – Set to 0 for all running tools - Set `ToolMuteCmd` True -Wait for `CommandProcessing` falling edge pulse -Monitor `CommandSuccess` to know it finished
Update the batch name of an inspection	Update the batch name of the inspection	-Send the Batch Name Message -Set `UseBatchNameCmd` True -Wait for `CommandProcessing` falling edge pulse -Monitor `CommandSuccess` to know it finished
Update tool criteria	Update tool criteria via key-value pair over message instructions. For Barcode and Text tools, you can use plain text or a regex expression in the Tool Criteria Val message	-Set `SlotID` for the tool to update -Send the `Tool Criteria Key` Message -Send the `Tool Criteria Val` message -Set `ToolCriteriaCmd` to True -Wait for `CommandProcessing` falling edge pulse -Monitor `CommandSuccess` to know it finished
Update tool array criteria	Update tool criteria via key-value pair over message instructions. For Match tool, you use expected class UID. You can have multiple UIDs in the Tool Criteria Array message as long as they are comma separated.	-Set `SlotID` for the tool to update -Send the `Tool Criteria Key` message -Send the `Tool Criteria Array` message -Set `ToolCriteriaArrayCmd` to True -Wait for `CommandProcessing` falling edge pulse -Monitor `CommandSuccess` to know it finished

Inspection Runtime

Once all HMI configuration is complete, the system is ready to be run. The runtime process is:

- Start the desired recipe
  - Specify the Recipe Slot ID on `SlotID` tag
  - Set `RecipeStartCmd` to True
  - Wait for `CommandProcessing` to be True
    - This indicates that the Command was received
  - Wait for `CommandProcessing` Falling Edge
    - This indicates the Command has completed
  - Monitor CommandSuccess
    - True if Success
    - False if Error
  - Wait for `RecipeLoaded` to be True
    - This indicates the recipe is successfully loaded
  - Wait for `RecipeRunning` to be True
    - This indicates the recipe is successfully running
- Inspect an Item
  - If not using a physical trigger, Set the `ImageTriggerCmd` to True
  - Wait for the `ImageProcessed` to be True
    - This indicates the item has completed being inspected
  - Check the `ImageOutcome` bits to see if the item outcome
    - Camera Pass / Fail Bits
  - Check the individual Tool Result for each Tool_#_Outcome bits for an indication of which tools failed on the item. This can give the operator an indication of where to look to find the defect that the Inspection System is flagging
    - This information is also shown on the HMI
- Stop the running recipe
  - Set the `RecipeStopCmd` to True
  - Wait for `CommandProcessing` to be True
    - This indicates that the Command was received
  - Wait for `CommandProcessing` Falling Edge
    - This indicates the Command has completed
  - Monitor `CommandSuccess`
    - True if Success
    - False if Error
  - Wait for the `RecipeLoaded` to be False
    - This indicates the recipe is successfully unloaded
  - Wait for the `RecipeRunning` to be False
    - This indicates the recipe is successfully stopped

Extended Functions Detail

This section details the extended functions of our EIP Adapter implementation. Using the AOIs for this will make this easier but can be done without them. Here is how to do that.

We use Explicit messaging for some Extended Functions that require moving larger amounts of String data to set different settings within FactoryTalk Analytics VisionAI. These use message instructions to set the data and then Standard EIP Implicit IO to control the process.

Updating the Name of a Running Batch

To update the name of the current batch, first ensure that the batch is running. Then set the batch name tag to the desired batch name and send the BATCH_NAME message. The strings in the string array will be concatenated and all white-space will be trimmed off of the beginning and end of the string. Only printable characters are accepted; the command rejects a name that contains non-printable characters.

1. Send the BATCH_NAME messages to the desired batch name
2. Then set Use BatchNameCmd to True until CommandProcessing falling edge pulse and then monitor CommandSuccess to know it finished successfully, then set UseBatchNameCmd to False

Note: If CommandSuccess does not go True, then the system failed to update the tool criteria

Setting Tool Criteria Val (Barcode and Text Tools)

To update the tool criteria in the current recipe, ensure that the batch is running and the tool is mapped to one of the tool slots (can be set on the "Communication" page).

Two message instructions will be sent from the PLC to update parameters in FactoryTalk Analytics VisionAI, TOOL_CRITERIA_KEY and TOOL_CRITERIA_VAL, which represent the name of the user arg and its value respectively.

(i.e. "regex" and "Clorox" or "[A-Za-z]{6}") This example uses a Regex expression for either the Barcode or Text tool and the match string is "Clorox"

Note: The data in TOOL_CRITERIA_VAL and the key in TOOL_CRITERIA_KEY must be strings. For keys where the value is a list/array see the Tool Criteria Array Below

1. Set the SlotID tag to the tool slot whose criteria should be updated.
2. Send the TOOL_CRITERIA_KEY and TOOL_CRITERIA_VAL messages to set the desired tool key and value to be updated.
3. Then set ToolCriteriaCmd to True until CommandProcessing falling edge pulse and then monitor CommandSuccess to know it finished successfully, then set ToolCriteriaCmd to False

Note: If CommandSuccess does not go True, then the system failed to update the tool criteria

Setting Tool Criteria Array (Match Tool)

Two message instructions will be sent from the PLC to update TOOL_CRITERIA_KEY and TOOL_CRITERIA_ARRAY which represent the name of the tool criteria and its values respectively (i.e. "expected class" and "01879570-d531-b001-5372-17c599820651").

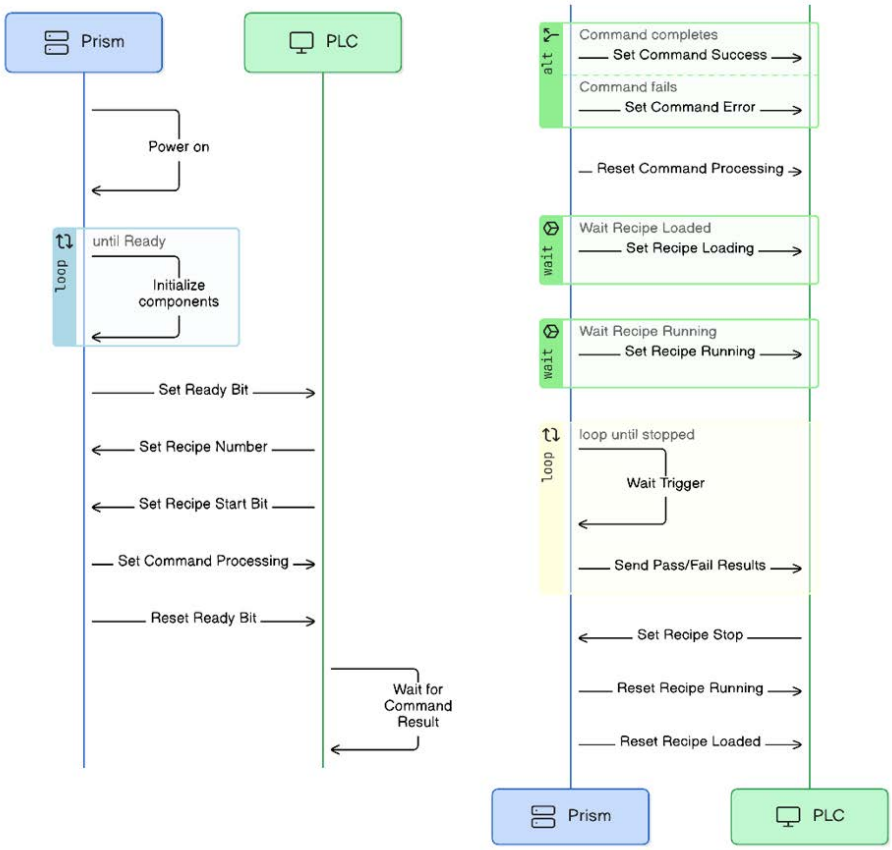
Note: You can send several UIDs in the Tool Criteria Array message as long as the entire string fits and each value is comma-separated.

1. Set the SlotID to the tool slot whose user args should be updated.
2. Send the TOOL_CRITERIA_KEY and TOOL_CRITERIA_ARRAY messages to the desired tool key and values to be updated
3. Then set ToolCriteriaArrayCmd to True until CommandProcessing falling edge pulse and then monitor CommandSuccess to know it finished successfully, then set ToolCriteriaArrayCmd to False

Note: If CommandSuccess does not go True, then the system failed to update the tool criteria

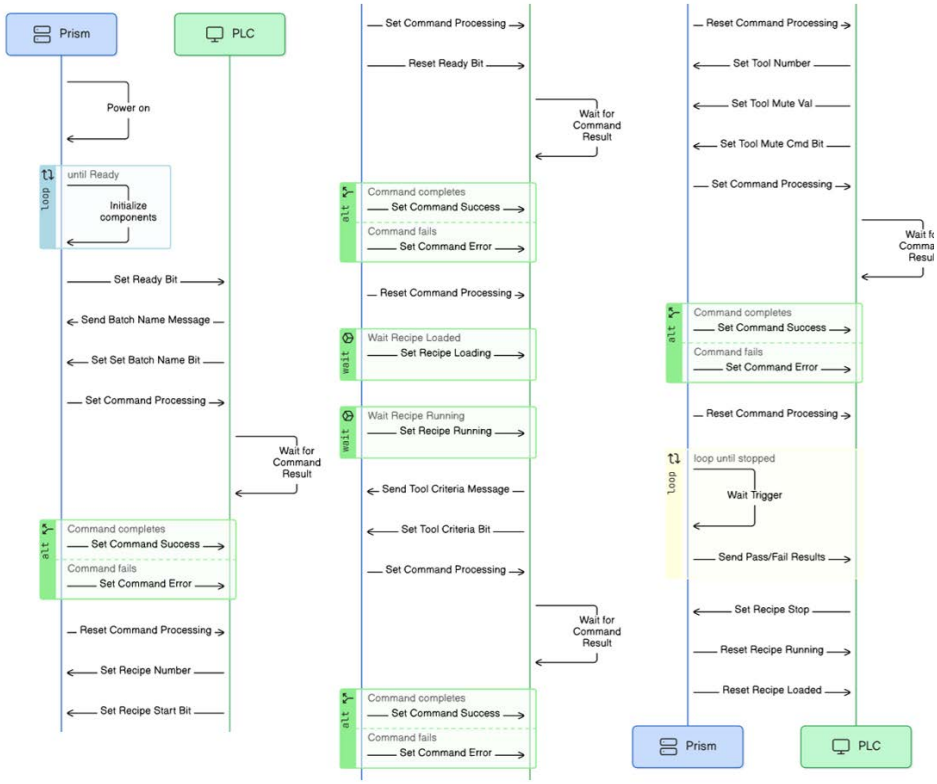
PLC Process Flow Simple Interaction

This diagram outlines a simple PLC interaction that Powers On, Starts a Recipe, Gets Result Outcomes using a Hardware Trigger and Stops the Recipe. This shows all IO handshaking for this process.



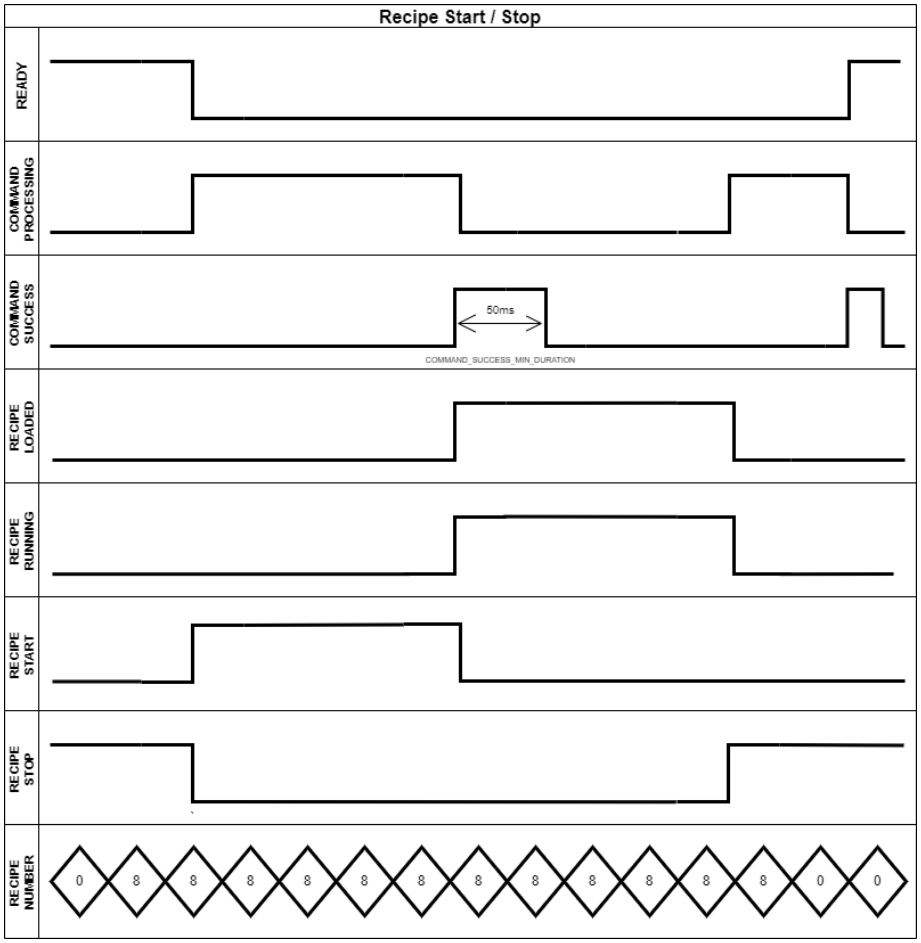
PLC Process Flow Full Interaction

This diagram outlines a full PLC interaction that Powers On, Sets the Batch Name, Starts a Recipe, Sets Tool Criteria, Mutes a Tool, Gets Result Outcomes using a Hardware Trigger and Stops the Recipe. This shows all IO handshaking for this process.



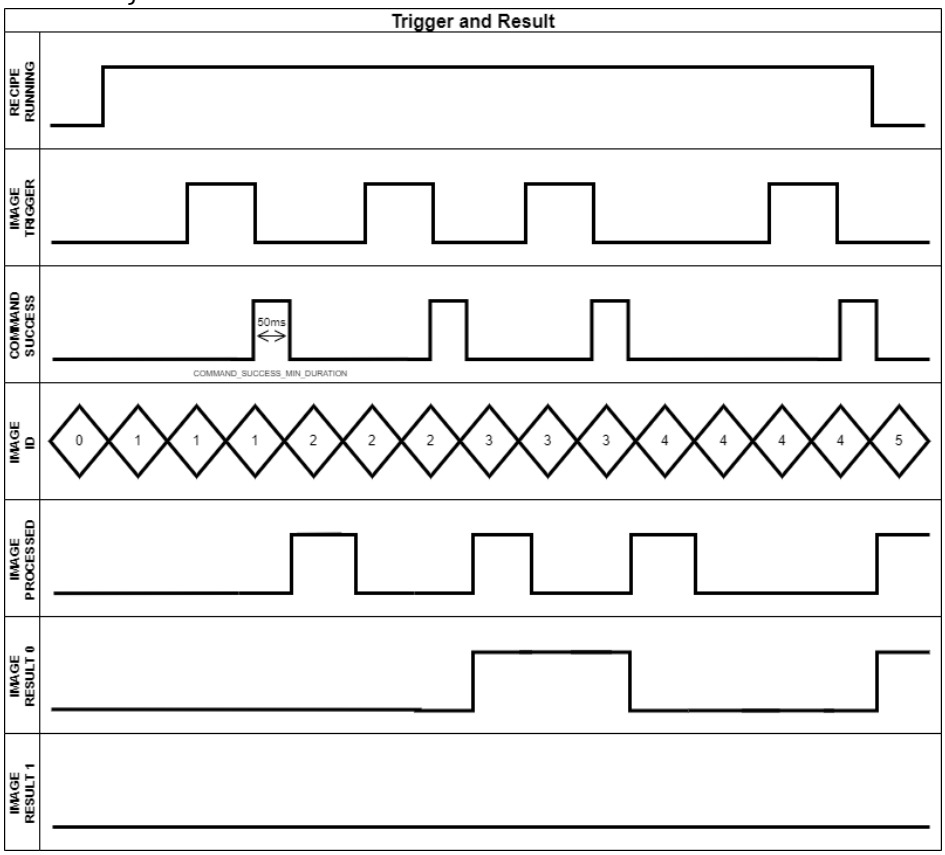
Recipe Start / Stop Timing Diagram

This timing diagram shows the timing of the IO for a typical cycle to Start and Stop a Recipe using the PLC.



Trigger and Results Timing Diagram

This timing diagram shows the timing of the IO for a typical cycle for Triggering and Getting Results using the PLC

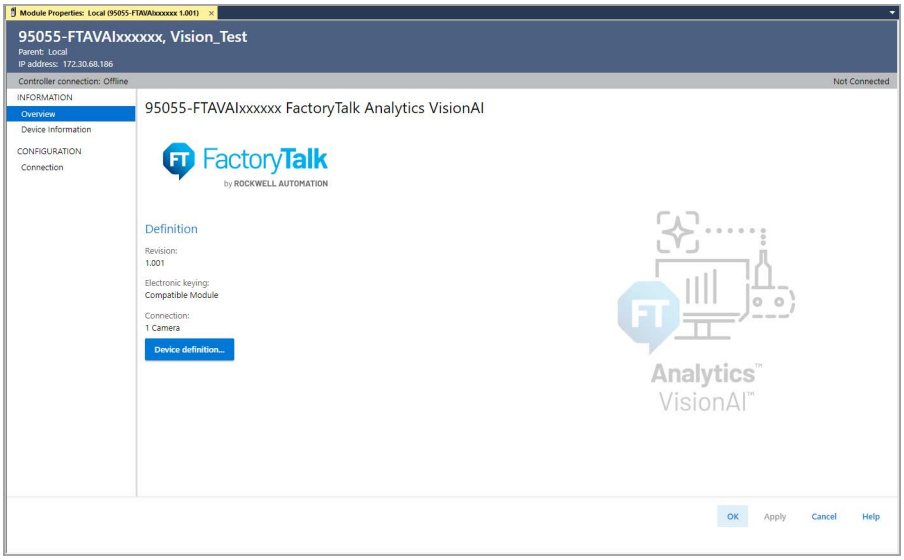


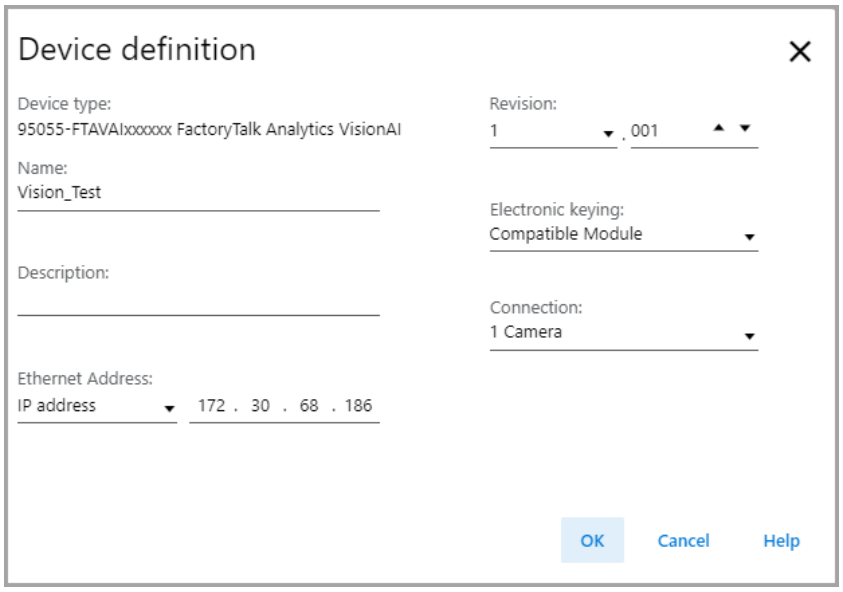
FactoryTalk Analytics VisionAI Studio5000 Library

Studio5000 Library is available that includes an Add-On Profile (AOP) and several Add-On Instructions (AOIs) to simply the integration and programming with the FactoryTalk Analytics VisionAI.

FactoryTalk Analytics VisionAI Add-On Profile (AOP)

Add-On Profiles (AOPs) are predefined templates that simplify the integration and configuration of hardware devices in Studio5000. The profile provides information needed to establish topology and module-defined data types, as well as graphical user interface for configuration.



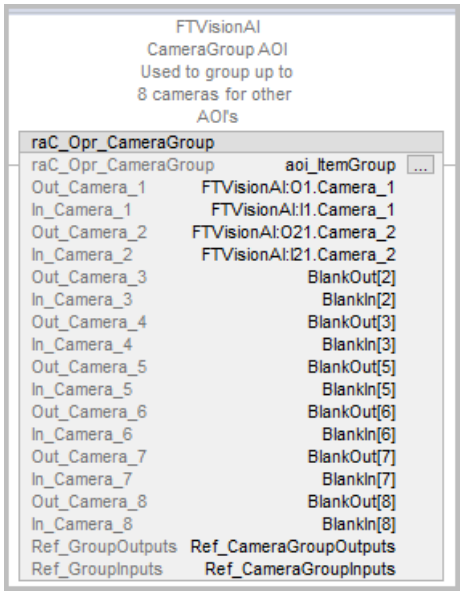

Device definition
Device type:
95055-FTAVAIxxxxxx FactoryTalk Analytics VisionAI
Revision:
1 . 001
Name:
Vision_Test
Electronic keying:
Compatible Module
Description:
Connection:
1 Camera
Ethernet Address:
IP address
172 . 30 . 68 . 186
OK
Cancel
Help

FactoryTalk Analytics VisionAI AOI's

Several Add-on Instructions (AOIs) for Studio5000 are available to simplify the programming of our systems. These can be used in place of writing your own logic and help to have a working program much faster.

Camera Group

The Camera Group AOI is used to group the control of up to 8 cameras. This is used in all other AOIs to allow for easier Control and Status functionality of multiple cameras looking at a single item.



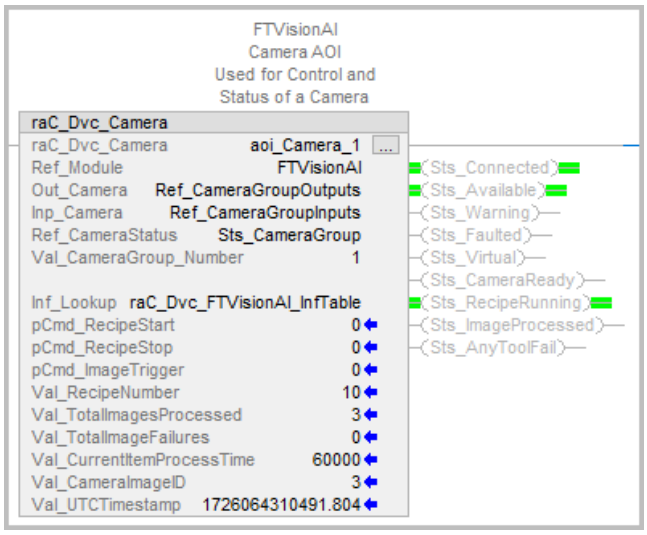
Camera AOI

The Camera AOI is used to simplify the control of an individual camera.

The following Control and Status functionality is included in this AOI:

- Start / Stop a camera recipe
- Trigger an Inspection
- Mute Tools
- Get Overall Result Outcomes
- Get Individual Tool Outcomes

- Get Overall Result Totals

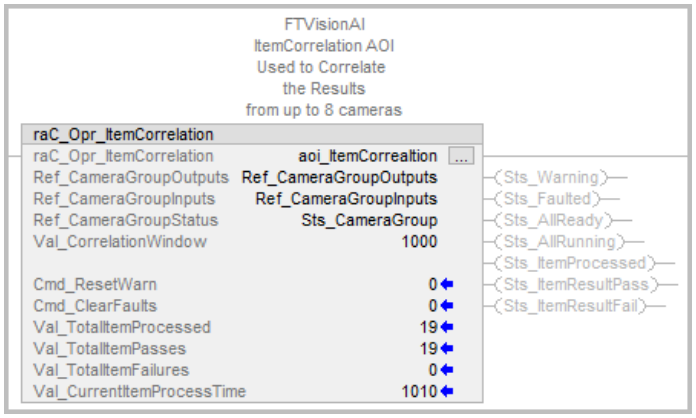


Item Correlation AOI (Multi-Cam)

The Item Correlation AOI is used to Correlate an Item result in a Multi-Cam system where multiple cameras Inspect an item and you want one result output for that item.

To use this AOI, add the AOI and create its tag, then use the Camera Group AOI Ref_CameraGroupOutputs and Inputs tags and the AOI will correlate the results from all cameras in that array to be included in the overall result. We use the Cameras Image Timestamp and the Val_CorrelationWindow in ms to determine what images belong to an item.

- Get Item-level results
- Get Item-level Counts

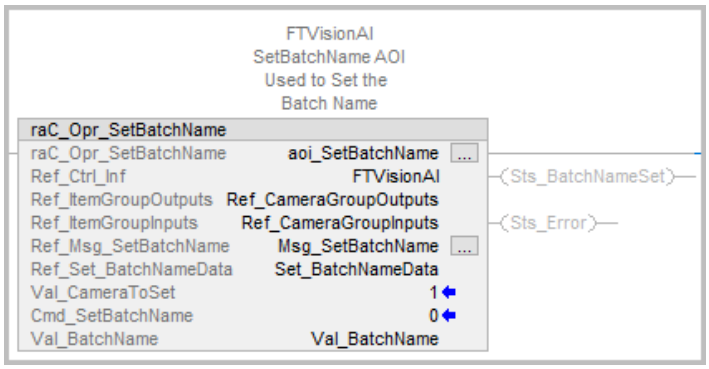


Set Batch Name AOI

The Set Batch Name AOI is used to set the batch name using the Cameras Array and message instruction to update the BatchName message, then set the IO to complete the update.

- Set the batch name while starting a batch

- Set the batch name for the currently running batch



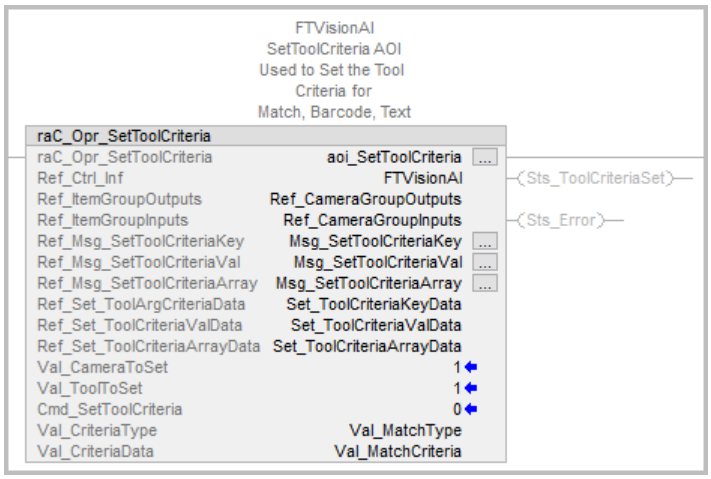
Tool Criteria AOI

The Set Tool Criteria AOI is used to set the Criteria that determines the Tool Pass/Fail Outcome. For the Barcode and Text tools, you can use the exact string or a regular expression (regex) string to validate the tool results.

For the Match tool, it is looking for the label UID. The Match tool uses a custom String data-type (STR0482) and can have several label UIDs in Val_CriteriaData as long as the entire string fits and each UID is comma-separated.

- Set Tool Criteria for Barcode and Text tools
  - `Val_CriteriaType` = 1
  - `Val_CriteriaData` = '12345' or [1-5]{5}
  - More info on Regex Expressions
- Set Tool Criteria for Match
  - `Val_CriteriaType` = 2
  - `Val_CriteriaData` = '01879570-d531-b001-5372-17c599820651'

Note: You can have several UIDs in `Val_CriteriaData` as long as the entire string fits and each UID is comma-separated.



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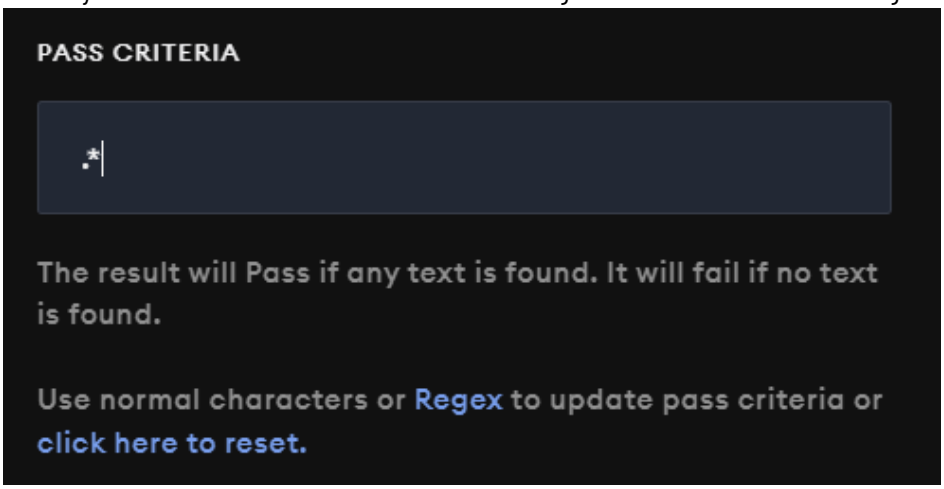
Appendix - Regular Expressions (Regex)

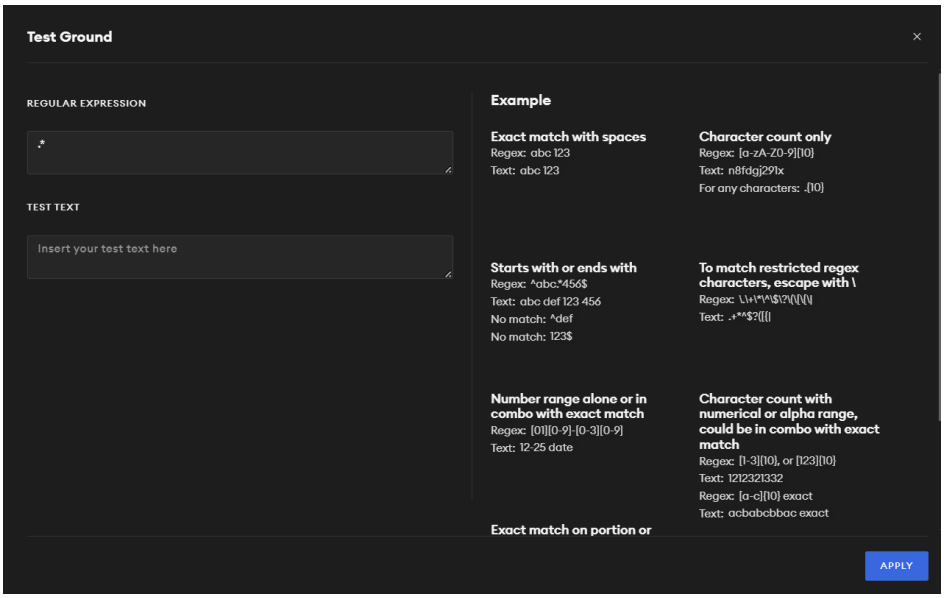
Regular expressions, also known as regex, are a powerful tool for matching patterns in text. They are used in programming and text processing to find, replace, and manipulate text based on specific conditions and rules.

The Tool Criteria for Barcode and Text tools can use a direct String but can also use Regex Expressions to allow for a larger set of criteria to match.

FactoryTalk Analytics VisionAI Regex Utility

We have a utility built into FactoryTalk Analytics VisionAI to help understand and test regex expressions. At the bottom of the Barcode or Text tool, you can Click the Regex hyperlink and get to our regex utility. This gives some tips on some of the most used Regex expressions and how they can be used. It also has a section to enter a regex and test it with a known string.





How to Use Regex

Regex expressions are written in a specific syntax that the regex engine uses to compare with the input string. Here are some common regex syntax elements:

- .: Matches any single character except newline.
- *: Matches zero or more of the preceding character or group.
- [A-Z]: Matches any uppercase character from "A" to "Z".
- [a-z]: Matches any lowercase character from "a" to "z".
- [0-9]: Matches any digit from 0 to 9.
- [asdf]: Matches any character that's either "a", "s", "d", or "f".
- [^asdf]: Matches any character that's not any of the following: "a", "s", "d", or "f".
- {n}: Matches exactly 'n' occurrences of the preceding character or group.
- |: Acts as a logical OR. Matches the pattern before or the pattern after the |.
- (): Defines a group that you can apply other expressions to.

Regex Examples

- .*: This expression will match any string, or said differently, it says that zero or more of any character may occur.
- [A-Z]{3}: This will match any three uppercase letters. For example, "ABC" and "XYZ" would be matches, but "AB" and "abcd" would not.
- [a-z0-9]{6}: This will match any combination of six lowercase letters or numbers. For example, "abc123" and "xyz789" would be matches, but "ABC123" and "abcd" would not.
- [^0-9]: This will match any non-digit character. For example, "a" and "!" would be matches, but "1" and "2" would not.
- ^[A-Z]: This will match any string that starts with an uppercase letter. For example, "Hello" would be a match, but "hello" would not.
- abc|def: This will match any string containing either "abc" or "def". For example, "abcdef", "abc", and "def" would all be matches.
- ^abc$: This will match the string "abc" exactly, with no other characters before or after it.
- [0-9]{2,4}: This will match any string of at least 2 and at most 4 digits. For example, "12", "123", and "1234" would be matches, but "1" and "12345" would not.
- a{3,}: This will match any string of "a" repeated 3 times or more. For example, "aaa", "aaaa", and "aaaaa" would be matches, but "aa" would not.
- ^[\w\d\s.,!?]*$: This will match any string made up of word characters (\w), digits (\d), whitespace (\s), and the punctuation characters .,!?.

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Use these resources to access support information.

Technical Support Center	Find help with how-to videos, FAQs, chat, user forums, Knowledgebase, and product notification updates.	rok.auto/support
Local Technical Support Phone Numbers	Locate the telephone number for your country.	rok.auto/phonesupport
Technical Documentation Center	Quickly access and download technical specifications, installation instructions, and user manuals.	rok.auto/techdocs
Literature Library	Find installation instructions, manuals, brochures, and technical data publications.	rok.auto/literature
Product Compatibility and Download Center (PCDC)	Download firmware, associated files (such as AOP, EDS, and DTM), and access product release notes.	rok.auto/pcdc

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