VAS CORPORATION

Conveyor Tracking Application User's Manual

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1. Brief Description Conveyor Tracking

Conveyor tracking is a function to keep track of workpieces carried by the conveyor without stopping the conveyor and independent of speed. With an optical sensor or vision system, the robot can perform conveyor tracking after the encoder values and the positions of the target objects are sent back to the robot controller.

1.1. Sensor Tracking

The sensor tracking is applied to pick up workpieces which are placed linearly (but with arbitrary interval) on the moving conveyor.

In this system, a signal is generated when a workpieces traverses in front of a photoelectric sensor. Once this signal is generated, position data of the workpiece is registered in the controller. Based on that, the controller calculates the expected workpieces position on the conveyor and instructs the robot to follow the workpiece. This process is performed whenever a workpiece passes in front of the photoelectricity.

1.2. Vision Tracking

The vision tracking is applied to pick up workpieces which are placed on arbitrary position and attitude on the moving conveyor.

In this system, a signal is generated when an image recognition unit of the vision sensor detects a workpiece. Once this signal is generated, the position and the angle of the workpiece are registered in the controller. Based on that, the controller calculates the expected workpieces position on the conveyor and instructs the robot to follow the workpiece. This process is performed whenever the signal is generated.

2. Conveyor Calibration

Conveyor Calibration is preceded with two steps below:

- Configuring a Trigger position
- Configuring Conveyor Coordinate system

2.1. Configuring a Trigger Position

To configure Trigger position, the location of camera or sensor installed on the conveyor must be configured. Follow these steps to calibrate conveyor frame:

1. Go to TRACKING Panel from Navigation Bar.
2. Select {Conveyor Frame}
   - The conveyor frame calibration window appears.

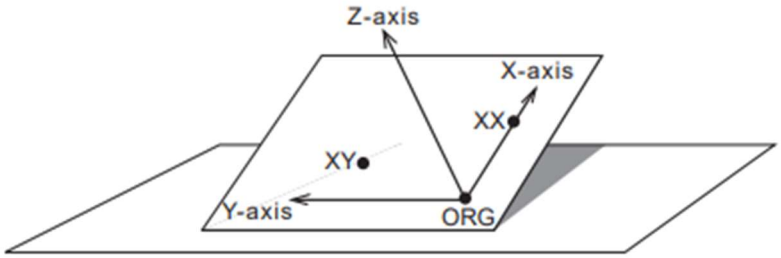
3. Press {TRIGGER} to select the trigger position.
4. Place workpiece at trigger position.
5. Tap on OffsetX and OffsetY text fields to enter these values by using numeric keypad.
   - In case of using Vision, OffsetX and OffsetY are distances from the origin of camera to the center of calibration workpiece. (Unit: mm)
   - In case of using Photo sensor, OffsetX and OffsetY are set 0.

6. Press {SET TRIGGER} to save the current conveyor position and OffsetX, OffsetY values.

2.2. Configuring a Conveyor Coordinate System

2.2.1. Method for Conveyor Coordinate System Setting

Conveyor Coordinate System is defined by three points that have been taught by the manipulator. These three defining points are ORG, XX, XY, as shown in the figure below.



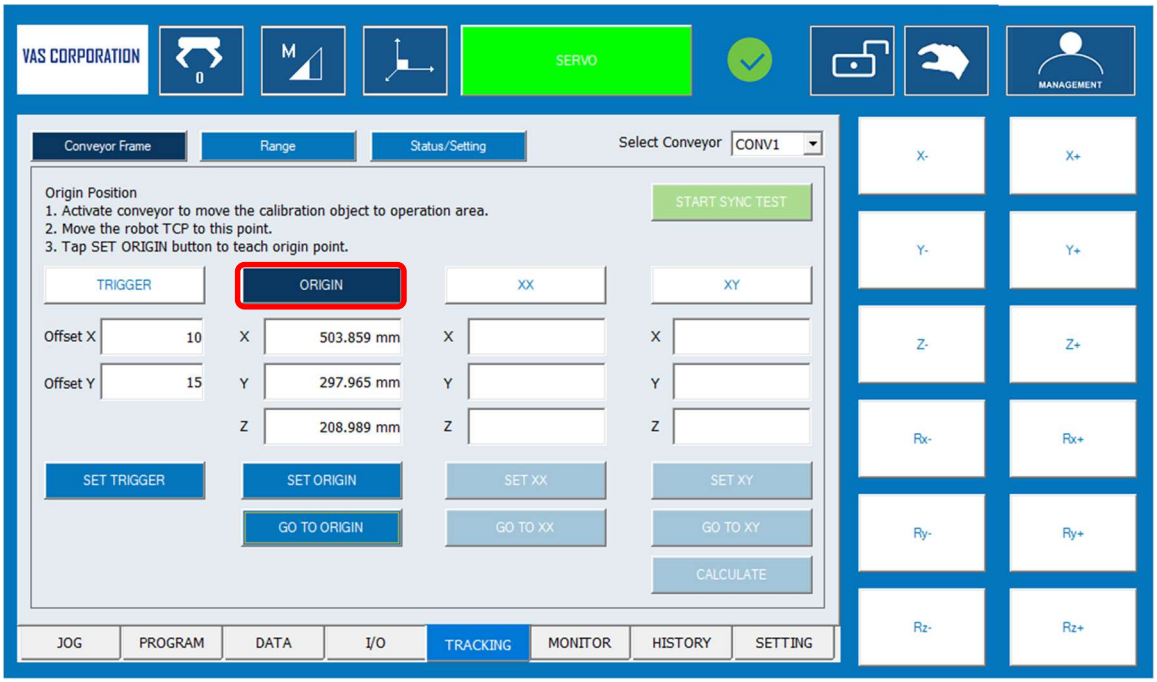
- ORG is the origin position.
- XX is a point on the X-axis.
- XY is a point on the Y-axis side of the taught conveyor coordinates.
- The directions of the Y- and Z-axes are determined by point XY.

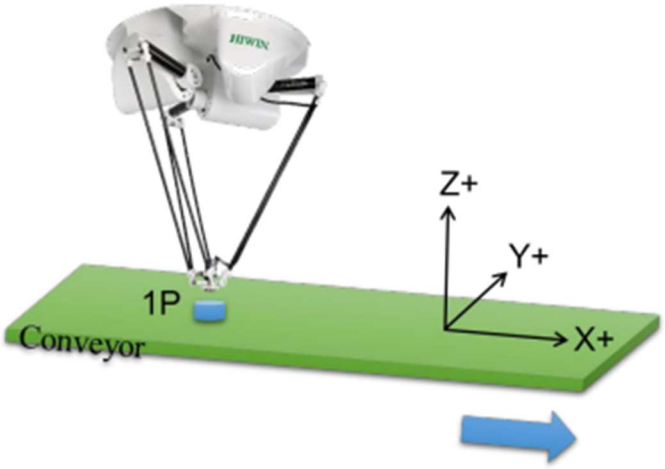
NOTE:

It is important that ORG and XX are taught accurately.

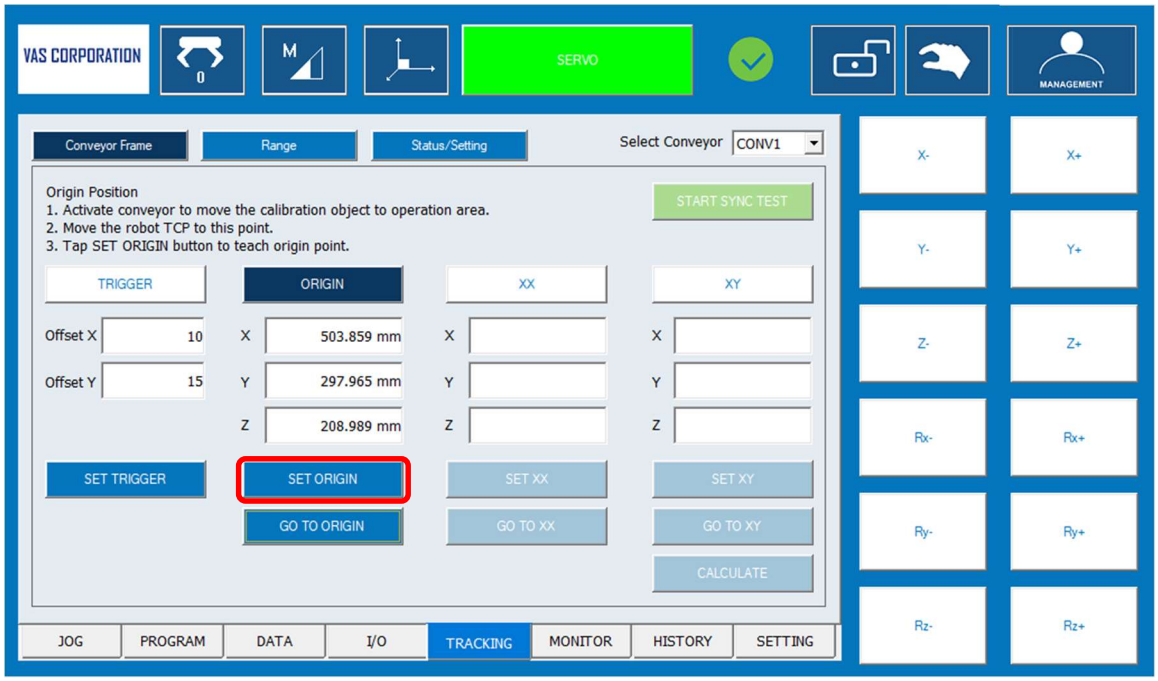
2.2.2. Conveyor Coordinate System Setting

1. Activate conveyor to move the calibration workpiece from Trigger position to operation area and deactivate conveyor.
2. Select {ORIGIN}.
   - Move the manipulator to the center of the calibration workpiece using any of the Jog Coordinates.

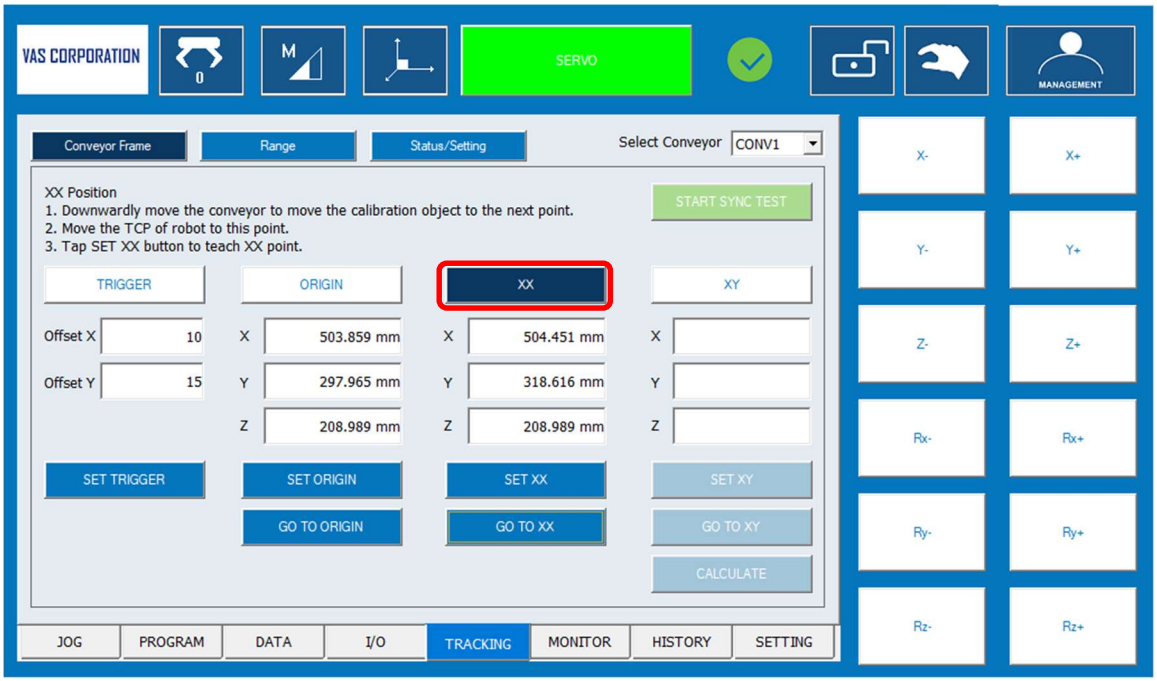


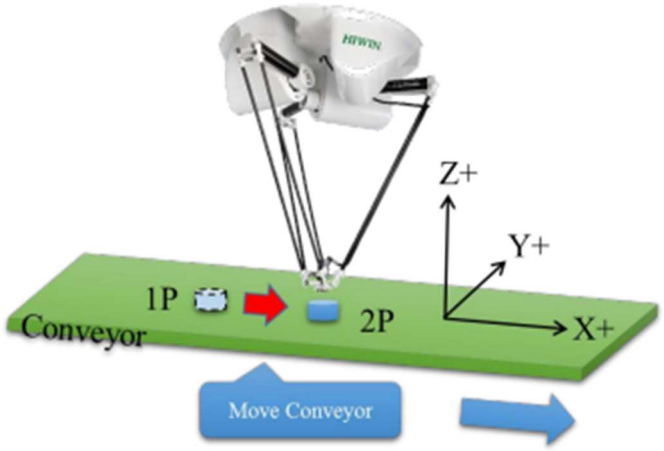


- Press {SET ORIGIN}, the taught position and the current conveyor position are registered.

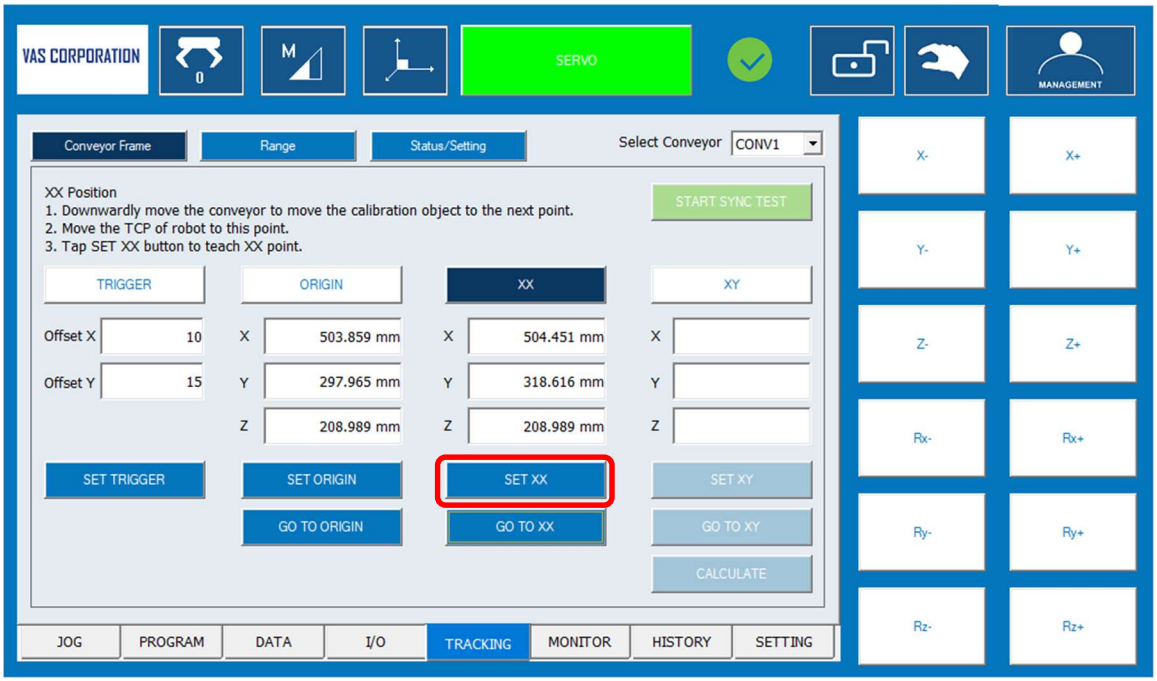


3. Acivate conveyor to move the calibration workpiece 3-40 centimeters away, deactivate the conveyor.
4. Select {XX}.
   - Move the manipulator to the center of the calibration workpiece using any of the Jog Coordinates.

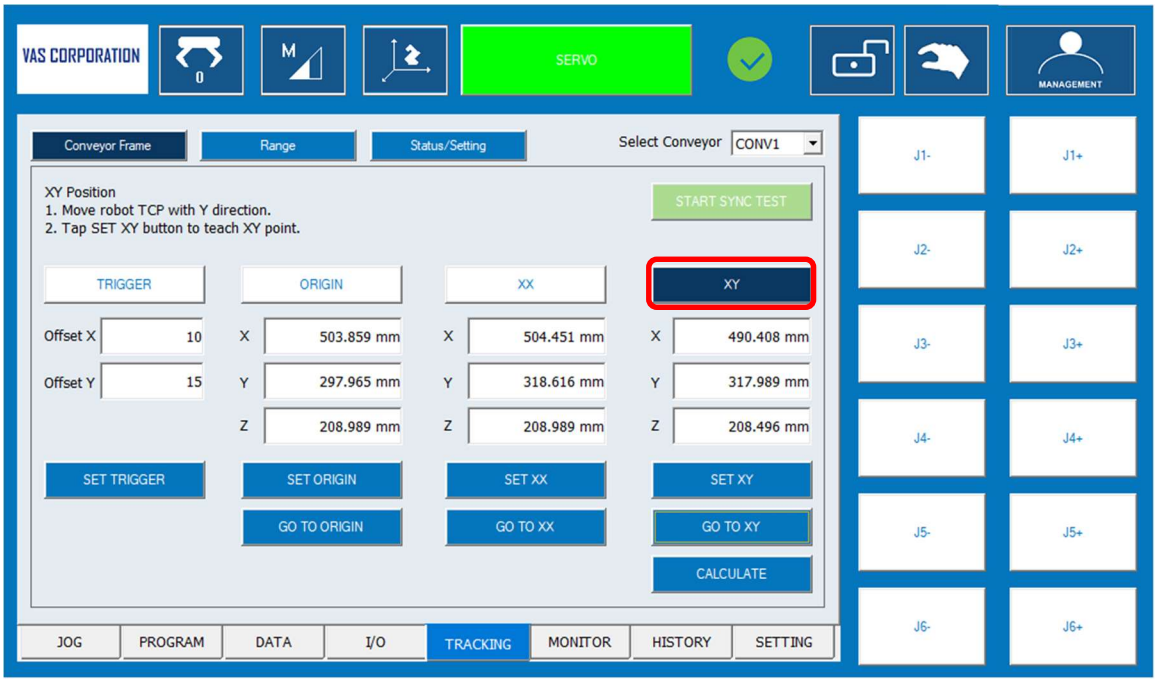


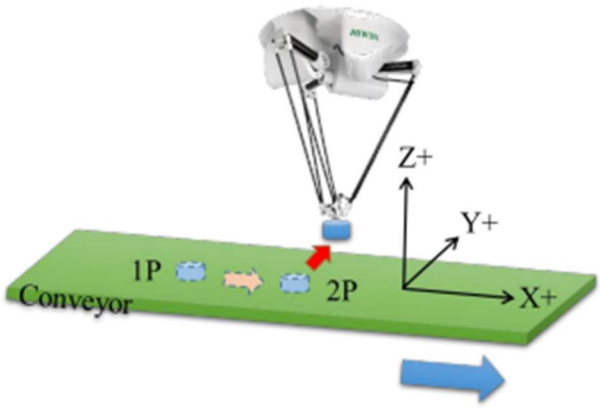


- Press {SET XX}, the taught position and the current conveyor position are registered.

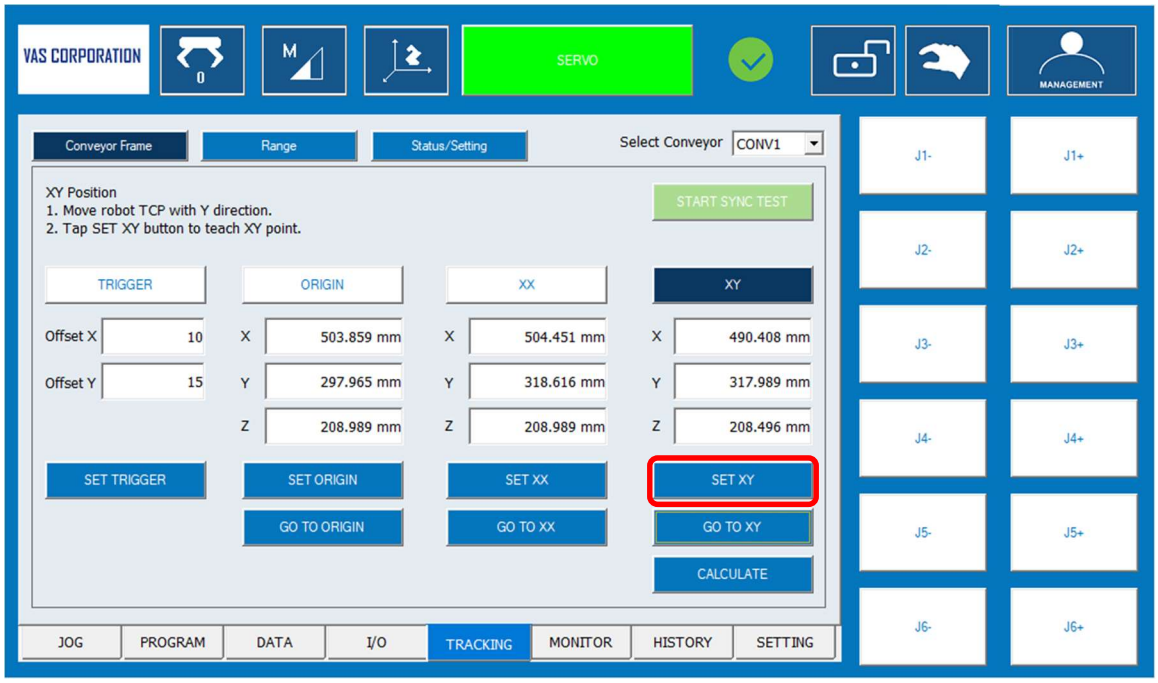


5. Select {XY}
   - Move the calibration workpiece with Y direction of conveyor and move robot to center of the calibration workpiece by using any of Jog Coordinates. (Setting Z direction to go upward is recommended)

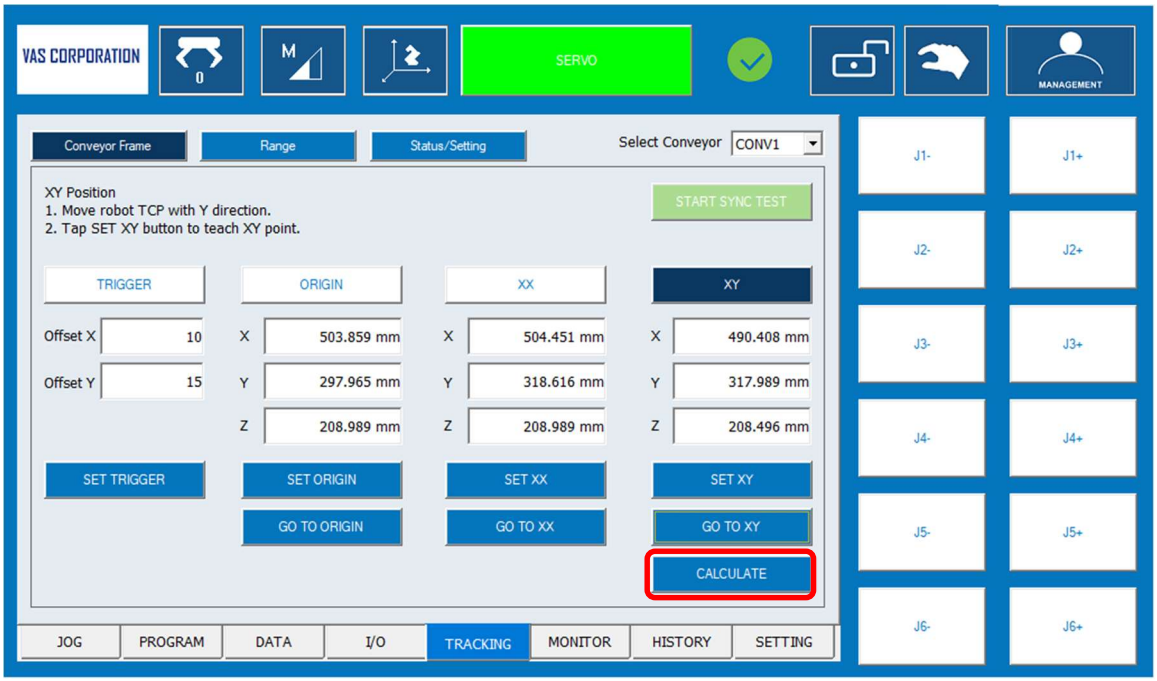




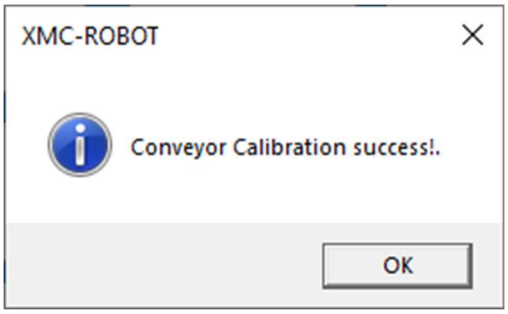
- Press {SET XY}, the taught position is registered.



6. To check the taught positions, press {GO TO ORIGIN}, {GO TO XX}, {GO TO XY}. The manipulator will move to the set position.
7. Press {CALCULATE} to calculate the Conveyor Coordinate System.



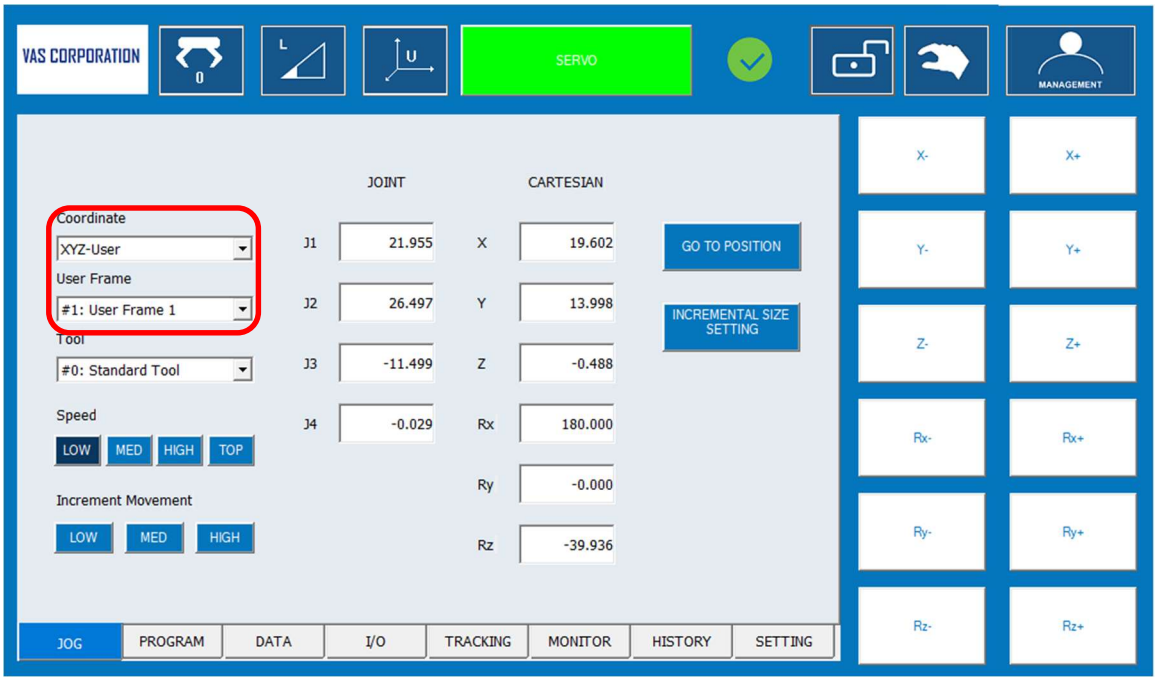
The conveyor calibration procedure is done. A notification displays.



2.3. Verify Conveyor Coordinate

After calibration, the conveyor coordinate needs to be verified.

1. Go to {JOG} panel from Navigation Bar.
2. Select {XYZ-User} Coordinate from the dropdown list.
3. Select the desired User Frame from the dropdown list.

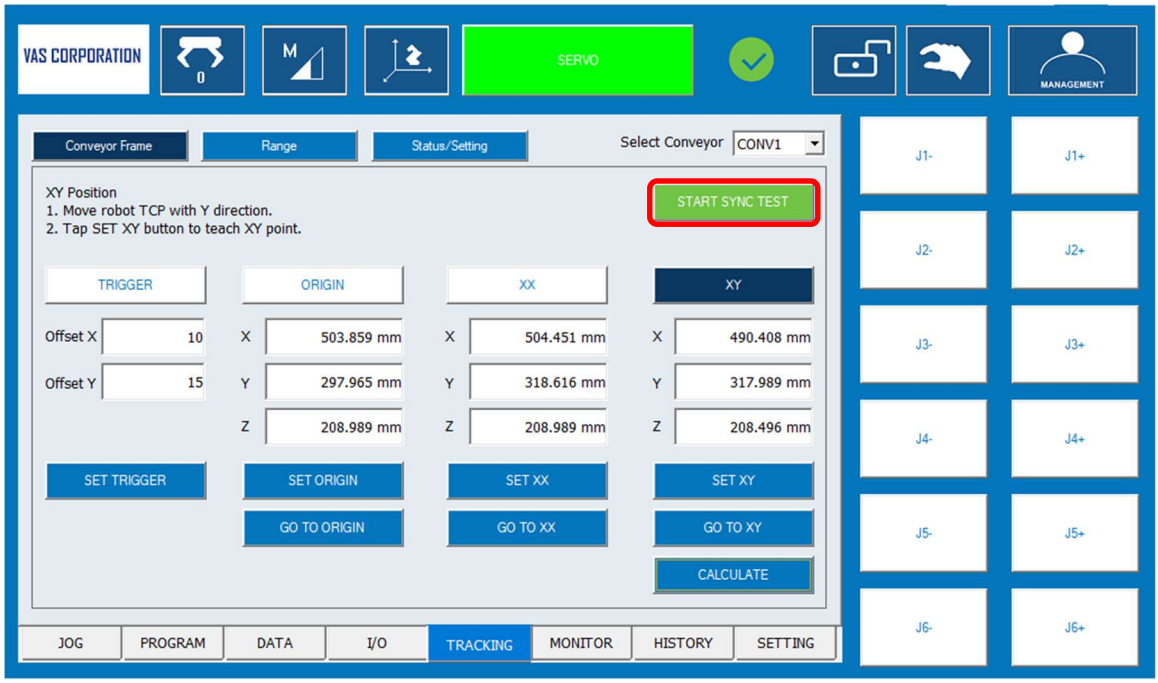


4. Move robot to the calibration origin point by using jogging.
5. In {JOG} panel, check the X, Y, Z position of the robot. The robot TCP position in the conveyor coordinates should be 0.0 mm (or very close).

2.4. Test Synchronization Motion

To test synchronization between TCP and conveyor's movement, follow these steps:

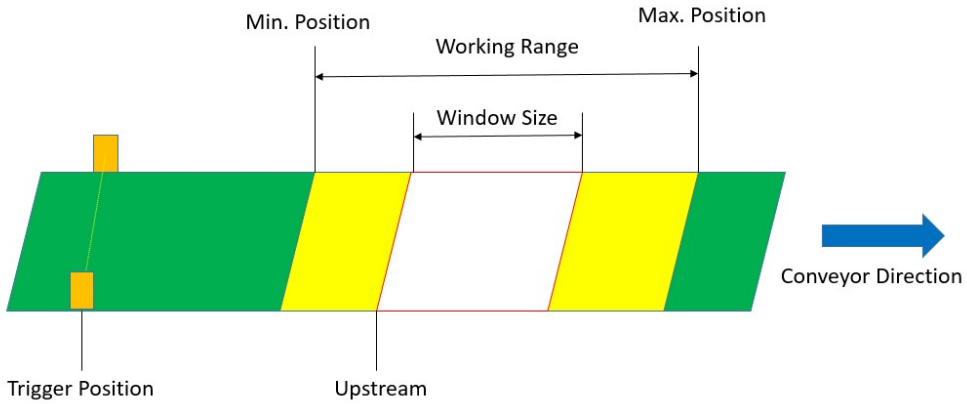
1. Press {START SYNC TEST}



2. Move conveyor manually and verify the motion of the robot, robot will track the conveyor motion.
3. To stop synchronization test, press {STOP SYNC TEST}.

3. Configuring an operation range

Berfore operating manipulator in conveyor coordinates, operation range must be configured in advanced. It is the working range of robot in the conveyor frame.



1. Min Robot Position

   The minimum position that robot can move from the origin to negative X direction of Conveyor frame.

2. Max Robot Position

   The maximum position that robot can move from the origin to positive X direction of Conveyor frame.

3. Trigger Position

   The trigger position in conveyor frame after calibration procedure. It cannot be edit.

4. Upstream Pos

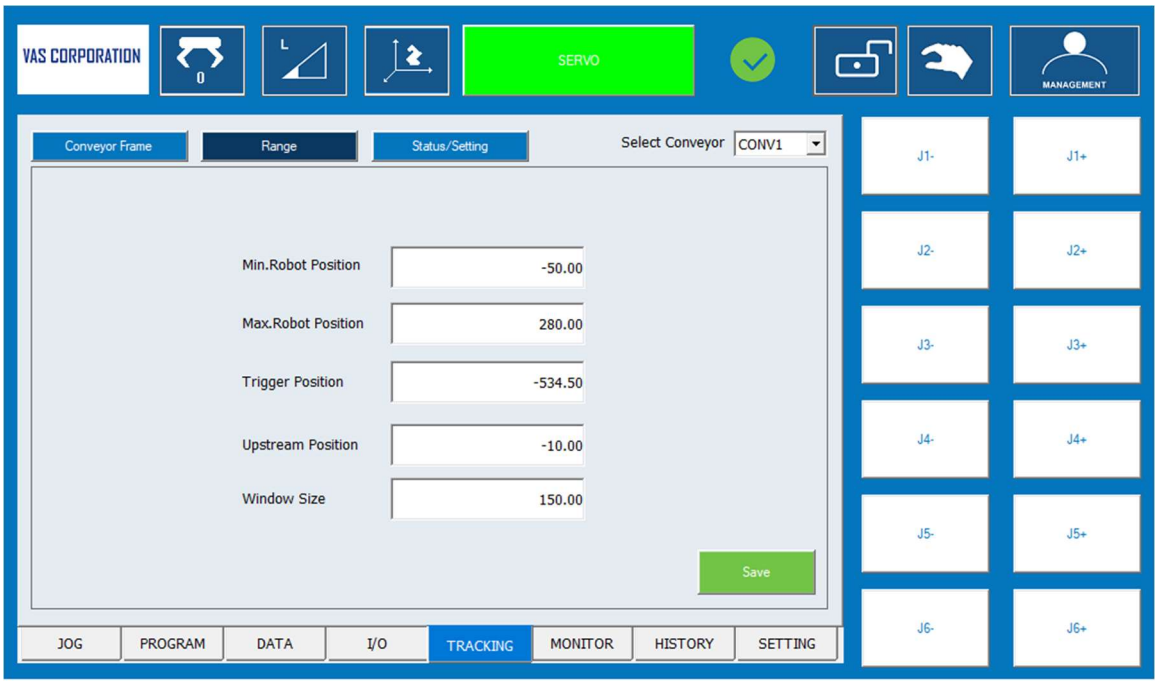
   The position in X direction where robot starts tracking workpiece from the origin.

5. Window Size

   The range in X direction where robot can synchronize the workpiece in this range from the upstream position.

   To setup operation range:

   1. Go to {TRACKING} panel in Navigation Bar.
   2. Select {Range}.
      - The operation range setting window appears.



All parameters can be edit by:

- Tapping on the text fields.
- Using numeric keypad to enter the value.

Press {Save} to save changes.

4. Conveyor Status and Setting

From Navigation Bar, select {TRACKING} panel → {Status/Setting}

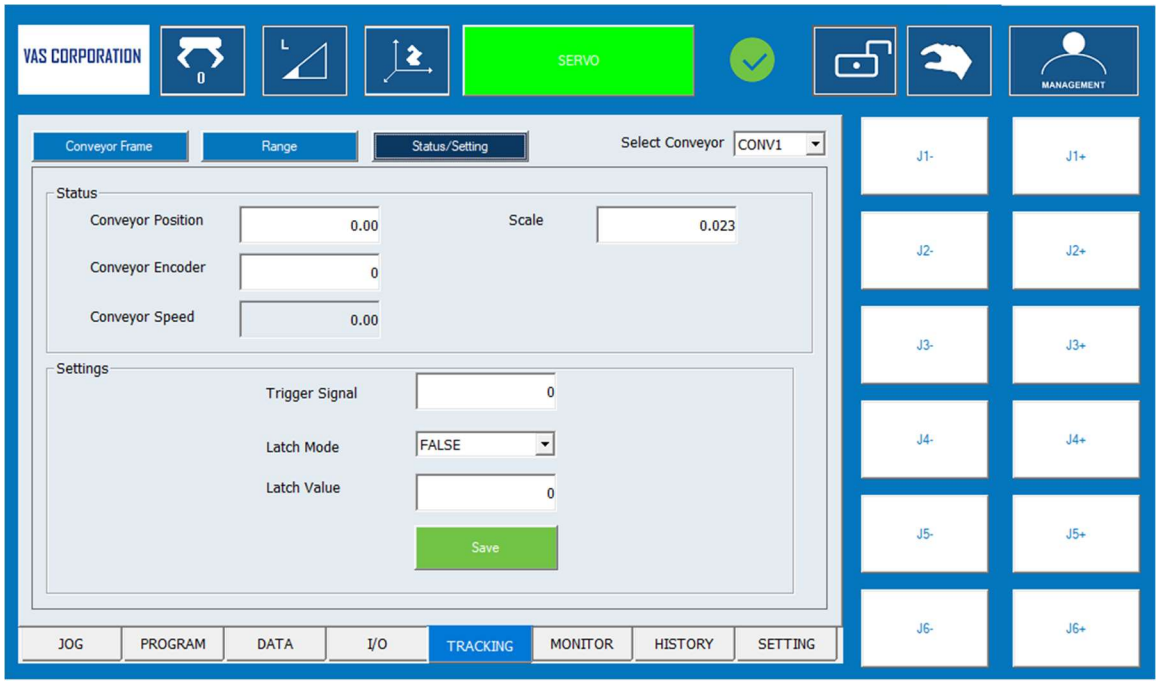
- The Status and Setting window appear.

4.1. Conveyor Status

- Conveyor Position: Display the current conveyor position (mm).
- Conveyor Encoder: Display the current encoder value of the counter (pulse).
- Scale: Display the relation between rotary motion (pulse) and linear motion (mm). This value is calculated in calibration procedure.

4.2. Conveyor Setting

- Encoder Bits: The resolution of the counter.
- Trigger Signal: The digital input signal for trigger signal.



After finishing, press {Save} to apply changes.

5. List of Conveyor Tracking Commands

5.1. Tracking Commands

- TKOBJWAIT CnvID: Wait until the object queue on a conveyor moves toward operation area.
- TKMOVE CnvID, P: Proceed synchronized motion with the conveyor. Implements linear intepolation from the current position to the destination position.
- TKAPPROCH CnvID, Distance: Proceed synchronized motion with the conveyor. Implements linear intepolation from the current position to approach conveyor follow Z-axis of conveyor frame.
- TKDEPART CnvID, Distance: Proceed synchronized motion with the conveyor. Implements linear intepolation from the current position to depart conveyor follow Z-axis of conveyor frame.
- TKOBJCOUNT CnvID: Returns the number of objects in the queue

5.2. Network Commands

5.2.1. Server Mode

- TCPSSTART server, port: Opens server with the current IP address and given port (int) and saves the information to server (int).
- TCPSTOP server: Closes the server.
- TCPSACCEPT server, client: Allows connection attempt of the client (int) to the server and saves the information.
- TCPSWRITE client, msg: Transfers string to client (int).
- TCPSREAD client: Returns string from client (int).

5.2.2. Client Mode

- TCPCONNECT tcpclient, ipaddress, port: Connects to server through ipaddress (string) and port (int) and saves the socket information to tcpclient (int).

- TCPCLOSE tcpclient: Destroys the connectio information of tcpclient and closes the connection.
- TCPREAD tcpclient: Returns string read from server via tcpclient.

6. Example of an object tracking program

The following program is used for simple conveyor tracking application. The trigger signal is photo sensor or digital output from vision sensor. Robot will wait at pick position to wait object come to upstream position. Then, robot will execute synchronization motion to pick object and go to drop position

```
MAIN M0
INT CnvID
CnvID = 1
POINT P[0] = [50, 10, 680, 0, 0, 0]
POINT P[1] = [0,0,0,0,0,0]
POINT P[2] = [100, 50, 680, 0, 0, 0]
LMOVE P[0] //Moves to the waitting point
TKOBJWAIT CnvID //Waits for incoming objects
TKMOVE CnvID, P[1] //Synchronizes and pick object
TKAPPROACH CnvID, -50
SETDO 0, 1 //Pick object
TKDEPART CnvID, -50
LMOVE P[2] //Moves to drop position
SETDO 0, 0 //Drop object
EOP
```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