MOTOSIGHT 3D® VISIONPRO
OPERATION MANUAL
for Cognex VisionPro

Upon receipt of the product and prior to initial operation, read these instructions thoroughly and retain for future reference.

MOTOMAN INSTRUCTIONS
MOTOMAN MANIPULATOR MANUAL
DX100 INSTRUCTIONS
DX100 OPERATOR’S MANUAL
DX100 MAINTENANCE MANUAL
FS100 INSTRUCTIONS
FS100 OPERATOR’S MANUAL
FS100 MAINTENANCE MANUAL

The DX100 or FS100 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.

Part Number: 158354-1CD
Revision: 2
MANDATORY

- This user guide provides an overview of the Yaskawa MotoSight 3D® system. It gives general information about the system, a description of its major components, and the procedures for installation, system operation, and preventive and repair maintenance. Be sure to read and understand this manual thoroughly before installing and operating the MotoSight 3D® system.

- General items related to safety are listed in Section 2 of the DX100 or FS100 Controller Manual. To ensure correct and safe operation, carefully read the DX100 or FS100 Controller Manual before reading this manual.

CAUTION

- Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure that all covers and shields are replaced before operating this product.

- The drawings and photos in this manual are representative examples, and differences may exist between them and the delivered product.

- YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such a modification is made, the manual number will also be revised.

- If such a modification is made, the manual number will also be revised.

- If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

- YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the Yaskawa MotoSight 3D® system.

In this manual, the Notes for Safe Operation are classified as “WARNING,” “CAUTION,” “MANDATORY,” or “PROHIBITED.”

**WARNING**
Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

**CAUTION**
Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.

**MANDATORY**
Always be sure to follow explicitly the items listed under this heading.

**PROHIBITED**
Must never be performed

Even items described as “CAUTION” may result in a serious accident in some situations. At any rate, be sure to follow these important items.

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as "CAUTION" and "WARNING."
WARNING

• Before operating the manipulator, check that servo power is turned OFF pressing the emergency stop buttons on the front door of the DX100 and the programming pendant. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Fig. : Emergency Stop Button

• Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Fig. : Release of Emergency Stop

• Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  – View the manipulator from the front whenever possible.
  – Always follow the predetermined operating procedure.
  – Keep in mind the emergency response measures against the manipulator's unexpected motion toward you.
  – Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

• Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  – Turning ON the power for the DX100.
  – Moving the manipulator with the programming pendant.
  – Running the system in the check mode.
  – Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem.

The emergency stop buttons are located on the right of front door of the DX100 and the programming pendant.
WARNING

• Before operating the manipulator, check that servo power is turned OFF when the emergency stop button on the programming pendant is pressed. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF. Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency.

*Fig. : Emergency Stop Button*

• In the case of not using the programming pendant, be sure to supply the emergency stop button on the equipment. Then before operating the manipulator, check to be sure that the servo power is turned OFF by pressing the emergency stop button. Connect the external emergency stop button to the 5-6 pin and 16-17 pin of the robot system signal connector (CN2).

• Upon shipment of the FS100, this signal is connected by a jumper cable in the dummy connector. To use the signal, make sure to supply a new connector, and then input it.

If the signal is input with the jumper cable connected, it does not function, which may result in personal injury or equipment damage.

• Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

*Fig. : Release of Emergency Stop*

• Observe the following precautions when performing teaching operations within the manipulator’s operating range:
  – Always follow the predetermined operating procedure.
  – Keep in mind the emergency response measures against the manipulator’s unexpected motion toward you.
  – Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

• Confirm that no person is present in the manipulator’s operating range and that you are in a safe location before:
  – Turning ON the FS100 power.
  – Moving the manipulator with the programming pendant.
  – Running the system in the check mode.
  – Performing automatic operations.

Injury may result if anyone enters the manipulator’s operating range during operation. Always press the emergency stop button immediately if there is a problem. The emergency stop button is located on the right of the programming pendant.
Definition of Terms Used Often in This Manual (DX100)

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and manipulator cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX100 controller</td>
<td>DX100</td>
</tr>
<tr>
<td>DX100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>

Definition of Terms Used Often in This Manual (FS100)

The MOTOMAN is the YASKAWA industrial robot product.

The MOTOMAN usually consists of the manipulator, the FS100 controller, manipulator cables, the FS100 programming pendant (optional), and the FS100 programming pendant dummy connector (optional).

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS100 controller</td>
<td>FS100</td>
</tr>
<tr>
<td>FS100 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator Cable</td>
</tr>
<tr>
<td>FS100 programming pendant dummy connector</td>
<td>Programming pendant dummy connector</td>
</tr>
</tbody>
</table>
Description of Keys Used Often in This Manual

Descriptions of the programming pendant keys, buttons, displays and keyboard of the PC are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td></td>
</tr>
<tr>
<td>Character Keys</td>
<td>The keys which have characters printed on them are denoted with [ ].</td>
</tr>
<tr>
<td></td>
<td>e.g. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td>The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture.</td>
</tr>
<tr>
<td></td>
<td>e.g. PAGE key</td>
</tr>
<tr>
<td></td>
<td>The cursor key is an exception, and a picture is not shown.</td>
</tr>
<tr>
<td>Axis Keys</td>
<td>“Axis keys” and “Numeric keys” are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Numeric Keys</td>
<td></td>
</tr>
<tr>
<td>Keys Pressed Simultaneously</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a &quot;+&quot; sign between them.</td>
</tr>
<tr>
<td></td>
<td>e.g. SHIFT key + COORD key</td>
</tr>
<tr>
<td>Mode Key</td>
<td>Three kinds of modes that can be selected by the mode key are denoted as follows:</td>
</tr>
<tr>
<td></td>
<td>REMOTE, PLAY, or TEACH</td>
</tr>
<tr>
<td>Button</td>
<td>Three buttons on the upper side of the programming pendant are denoted as follows:</td>
</tr>
<tr>
<td></td>
<td>HOLD button</td>
</tr>
<tr>
<td></td>
<td>START button</td>
</tr>
<tr>
<td></td>
<td>EMERGENCY STOP button</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }.</td>
</tr>
<tr>
<td></td>
<td>e.g. {JOB}</td>
</tr>
<tr>
<td>PC Keyboard</td>
<td>The name of the key is denoted.</td>
</tr>
<tr>
<td></td>
<td>e.g. Ctrl key on the keyboard</td>
</tr>
</tbody>
</table>
**Explanation of Warning Labels**

The following warning labels are attached to the manipulator (refer to *Figure 1*).

Always follow the warnings on the labels.

Also, an identification label with important information is placed on the body of the manipulator. Prior to operating the manipulator, confirm the contents.

*Figure 1: Warning Labels Location*

![Warning Labels](image)

- **WARNING**
  - Do not enter robot work area
  - Moving parts may cause injury

**Description of the Operation Procedure**

In the explanation of the operation procedure, the expression “Select • • •” means that the cursor is moved to the object item and the SELECT key is pressed, or that the item is directly selected by touching the screen.

**Registered Trademark**

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and TM are omitted.
# Table of Contents

## 1 Introduction ....................................................................................................................................... 1-1

1.1 System Requirements.......................................................................................................... 1-2

1.2 About This Document .......................................................................................................... 1-2

1.2.1 Major Components ................................................................................................. 1-3

1.3 Reference Documentation ................................................................................................... 1-3

1.4 Customer Support Information............................................................................................. 1-3

## 2 MotoSight 3D® VisionPro Overview .................................................................................................. 2-1

2.1 Vision-Guided Motion........................................................................................................... 2-1

2.2 Fixed Camera and Robot-Mounted Camera........................................................................ 2-1

2.2.1 Fixed Camera/ Fixed Part....................................................................................... 2-1

2.2.2 Robot-mounted Camera ......................................................................................... 2-1

2.2.3 Fixed Camera/ Robot-mounted Part ....................................................................... 2-1

2.3 MotoSight 3D® VisionPro Software Interface....................................................................... 2-2

2.3.1 Robot Controller Tab .............................................................................................. 2-2

2.3.1.1 Connect Group .......................................................................................... 2-3

2.3.1.2 [Map Variable Data] .................................................................................. 2-3

2.3.1.3 Camera View Windows ............................................................................. 2-4

2.3.1.4 Tools Panels.............................................................................................. 2-4

2.3.1.5 Camera Status Bar.................................................................................... 2-4

2.3.2 Image Acquisition Tab ............................................................................................ 2-5

2.3.2.1 Image Database (IDB) .............................................................................. 2-5

2.3.2.2 Camera Configuration .............................................................................. 2-5

2.3.2.3 Acquire Viewset ........................................................................................ 2-6

2.3.3 Calibration Tab ....................................................................................................... 2-6

2.3.3.1 Calibration ................................................................................................ 2-7

2.3.4 Location Tab........................................................................................................... 2-7

2.3.4.1 Coarse Part Location ................................................................................ 2-7

2.3.4.2 Subfeature Location ................................................................................. 2-8

2.3.4.3 Configure Subfeatures Window ................................................................ 2-8

2.3.4.4 Nominal 3D Model Data ............................................................................ 2-9

2.3.5 Test Run Program Tab ........................................................................................... 2-9

2.3.5.1 Run Options ............................................................................................. 2-9
# Table of Contents

3 Setup ................................................................................................................................................ 3-1
  3.1 Camera Installation........................................................................................................ ...... 3-1
  3.2 Robot Calibration.......................................................................................................... ....... 3-1
    3.2.1 Calibration Grid User Frame................................................................................... 3-1
  3.3 Camera Calibration.............................................................................................................. 3-2
    3.3.1 Gaining Remote Access to the Embedded PC....................................................... 3-2
    3.3.2 Configure the Cameras .......................................................................................... 3-2
    3.3.3 Calibration .............................................................................................................. 3-5
    3.3.4 3D Calibration Wizard............................................................................................. 3-7
    3.3.5 Validation................................................................................................................3 - 8

4 MotoSight 3D® VisionPro Application ............................................................................................... 4-1
  4.1 Defining a Part............................................................................................................ ......... 4-1
    4.1.1 Define Coarse Part Features.................................................................................. 4-1
    4.1.2 Define Part Subfeatures ......................................................................................... 4-3
    4.1.3 Test Run Program .................................................................................................. 4-4
    4.1.4 Map Results ........................................................................................................... 4-5
  4.2 Production Operation....................................................................................................... .... 4-5
  4.3 Inform macros:............................................................................................................. ........ 4-6
    4.3.1 LOC3D_Rx ............................................................................................................. 4-6
    4.3.2 SET_PART............................................................................................................. 4-7
  4.4 Pendant Application:....................................................................................................... ..... 4-8

5 Maintenance/TroubleShooting.................................................................................................. ........ 5-1
  5.1 Calibration Recovery ....................................................................................................... 5-1
  5.2 Cognex VisionPro Help........................................................................................................ 5-1
  5.3 MotoSight 3D® VisionPro Troubleshooting.......................................................................... 5-1
    5.3.1 Check Feedback Signals........................................................................................ 5-1
    5.3.2 Alarm Codes............................................................................................................ 5-3
MotoSight 3D® is part of the Yaskawa family of standardized solutions. It is a fully integrated hardware/software 3D vision solution, supported by Yaskawa. MotoSight 3D® enables the robot controller to adjust robot motion based on camera feedback.

Integrated Cognex VisionPro® tool results are mapped directly to robot variables for use in robot programs. MotoSight 3D® measures the position of the work piece using cameras, and adjusts the robot motion to allow the robot to manipulate the work piece as originally programmed when the position of the work piece has changed from the originally taught position.

Fig. 1-1: MotoSight VisionPro Hardware

Fig. 1-2:
1 Introduction
1.1 System Requirements

1.1 System Requirements

MotoSight 3D requires MotoPlus software on the robot controller. DX100 software versions 3.04 and higher include MotoPlus functionality as does all FS100 software. If there are questions regarding your system version, contact Yaskawa Motoman Customer Support (see Section 1.4). System requirements are shown below:

Table 1-1: System Requirements

<table>
<thead>
<tr>
<th>Function</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot Controller</td>
<td>DX100 or FS100</td>
</tr>
<tr>
<td>Controller Software</td>
<td>DS3.04.00A-00 or higher (MotoPlus enabled)</td>
</tr>
<tr>
<td>Pendant</td>
<td>64 MB Pendant</td>
</tr>
<tr>
<td>Vision Device</td>
<td>GigE &quot;Enabled&quot; Vision Device</td>
</tr>
</tbody>
</table>

1.2 About This Document

This manual is intended as an introduction and overview for personnel who are familiar with the operation of their Motoman robot model, Cognex VisionPro tools, and robot programming.

This User’s Manual provides a description of functionality, usage instructions, as well as application examples for the MotoSight 3D® system. For detailed information on specific system components listed in this document, please refer to the documentation package included with your system. This manual contains the following sections:

Section 1 – Introduction

This section provides general information about the MotoSight 3D® system, a list of reference documents, and Yaskawa Motoman Customer Support contact information.

Section 2 – MotoSight 3D® Overview

This section provides a basic overview of the types of vision methods.

Section 3 – Setup

This section provides installation procedures for the MotoSight 3D® system.

Section 4 – MotoSight 3D® Application

This section provides an overview of MotoSight 3D® software including image processing, calculation, and control.

Section 5 – Command Tools

This section provides a description of each of the command tools used with the MotoSight 3D® system.

Section 5 – Maintenance/TroubleShooting

This section basic troubleshooting and recovery procedures for the MotoSight 3D® system.
1.2.1 Major Components

MotoSight 3D® system includes the following major components:

- MotoSight 3D® Software
- Cognex VisionPro® Software (version 7.0 only)
- Cognex 3D Locate Addin

1.3 Reference Documentation

For additional information on individual components of the MotoSight 3D® system, refer to the following documentation that is included with your system:

- Motoman Manipulator
- Motoman DX100 Controller Manual (P/N 155494-1CD)
- Motoman DX100 Concurrent I/O Manual (P/N 155491-1CD)
- Motoman DX INFORM User’s Manual (P/N 155493-1CD)
- Motoman FS100 Controller Manual (P/N 159644-1CD)
- Motoman FS100 Concurrent I/O Manual (P/N 160621-1CD)
- Motoman FS INFORM User’s Manual (P/N 159549-1CD)
- Vendor manuals for system components not manufactured by Motoman

1.4 Customer Support Information

If you need assistance with any aspect of your MotoSight 3D® system, please contact Yaskawa Motoman Customer Support at the following 24-hour telephone number:

(937) 847-3200

For routine technical inquiries, you can also contact Yaskawa Motoman Customer Support at the following e-mail address:

techsupport@motoman.com

When using e-mail to contact Yaskawa Motoman Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.

Please use e-mail for routine inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact Yaskawa Motoman Customer Support at the telephone number shown above.
1.4 Customer Support Information

Please have the following information ready before you call:

- **System** MotoSight 3D®
- **Robots** MA1400, MA1900, etc
- **Primary Application** Select (MAIN MENU)>({SYSTEM INFO})>({VERSION})-{APPLI:
- **Controller** DX100, FS100
- **Software Version** Access this information on the Programming Pendant's LCD display screen by selecting (MAIN MENU) - (SYSTEM INFO) - (VERSION)
- **Robot Serial Number** Located on the robot data plate
- **Robot Sales Order Number** Located on the controller data plate
2 MotoSight 3D® VisionPro Overview

The MotoSight 3D® VisionPro software processes images using Cognex VisionPro® vision tools. These vision tools can perform a variety of functions, such as; counting the number of parts, locating a part in the field of view (FOV), measuring a part, counting specified features on a part, as well as many other functions. Once a vision program (referred to as a "job" by Cognex) has processed an image, it creates a result value for each function in the job. MotoSight 3D® VisionPro maps these result values so they can be used by the robot in a standard format.

2.1 Vision-Guided Motion

There are two methods for vision-guided robot motion - absolute positioning and relative position offset. With absolute positioning, the sensors measure the absolute position of the work piece and the robot moves directly to that position. With relative position offset, the sensors measure how the work piece has moved relative to the originally taught position set. The robot then adjusts the taught position by this relative position before moving to it. MotoSight 3D® VisionPro adopts the first approach - absolute positioning.

MotoSight 3D® VisionPro makes use of cameras to 'measure' the 3D position and orientation of a work piece in an absolute reference frame that the kinematics of the robot have previously been calibrated. MotoSight 3D® VisionPro calculates the local relationship between a cartesian coordinate system (xyz) and the image-plane coordinate system of each camera. This is done using the detected and identified image-plane location of specific points or features on the object.

2.2 Fixed Camera and Robot-Mounted Camera

The cameras can be installed as either fixed or a robot-mounted. Motoman supports any of these positioning methods.

2.2.1 Fixed Camera/ Fixed Part

A fixed camera is attached to the top of a pedestal or other fixed structure. In this method, the camera always sees the same view from the same distance. An advantage of a fixed camera is reduced robot cycle time. MotoSight 3D® VisionPro is able to take and process a picture while the robot performs another task.

2.2.2 Robot-mounted Camera

The robot-mounted camera is mounted on the tool axis of the robot. By moving the robot, measurement can be done at different locations or with different distances between the work piece and the camera. This method is usually used to determine the robot pose required to pickup a part resting in a random position/orientation.

2.2.3 Fixed Camera/ Robot-mounted Part

The robot-mounted part is mounted on the tool axis of the robot. By moving the robot, measurement can be done at different locations or with different distances between the work piece and the camera. This method is usually used to determine the position/orientation which the robot will need to move in order to consistently place a part in a given pose.
2.3 MotoSight 3D® VisionPro Software Interface

- **[New]**
  The [New] button creates a new part file.

- **[Load]**
  The [Load] button opens an existing part file.

- **[Save]**
  The [Save] button saves the currently open part file.

- **[SaveAs]**
  The [SaveAs] button saves the currently open part under a new name.
  The original part name is not modified.

2.3.1 Robot Controller Tab

The Robot Controller tab contains the connection tools for establishing connections between MotoSight 3D® VisionPro and the cameras.
2.3.1.1 Connect Group

The Connect group determines how MotoSight 3D® VisionPro connects with the controller. Three automatic connection options are available and can be selected by clicking the check mark next to each selection.

- **[Connect]**
  The [Connect] button opens a connection between the robot controller and the MotoSight 3D® VisionPro software. The Connection Options submenu is where you set the connection information such as IP Address, TCP Port, Robot Number, User Frame Number, and Tool Number. To access the Connection Options submenu, click the bottom drop down portion of the [Connect] button.

- **[Go Online]**
  The [Go Online] button transfers control of the MotoSight 3D® VisionPro software to the robot controller. Commands programmed in the robot job control the software directly. This option is not available until a complete “part” file is programmed.

- **Auto-connect at startup**
  The “Auto-connect at startup” check box automatically establishes a connection between the robot controller and the software when the application is first started.

- **Go online at startup**
  The “Go online at startup” check box automatically transfers control of the MotoSight 3D® VisionPro software to the robot controller when the application is first started.

2.3.1.2 [Map Variable Data]

The [Map Variable Data] button opens the Variable Data screen and is used to assign supported Cognex VisionPro tool results to robot variables.
2.3.1.3 Camera View Windows

The left and right camera view windows show the camera output for each camera. Right clicking on either window provides some tool selection and save image commands.

![Camera View Windows](image)

2.3.1.4 Tools Panels

The left and right camera tool panels provide some basic tools for manipulating the camera views.

- **Selection Tool**
  The Selection tool selects objects.

- **Hand Tool**
  The Hand tool moves the image within the window.

- **Zoom Tools**
  The Zoom tools increase and decrease the view magnification in the window.

- **Center Tool**
  The Center tool centers the camera view within the window.

- **1X Tool**
  The 1X tool displays the window in a 1 to 1 resolution. One camera pixel equals 1 screen pixel.

- **Pixel Grid Tools**
  The Pixel Grid tools display a pixel grid or sub pixel grid.

2.3.1.5 Camera Status Bar

The left and right camera status bars, located at the bottom of the screens, provide basic information regarding the camera status including zoom percentage, and the XY coordinate location and intensity for the cursor location.
2.3.2 Image Acquisition Tab

The Image Acquisition tab contains image acquisition, camera calibration and image storage tools.

2.3.2.1 Image Database (IDB)

MotoSight 3D® VisionPro allows you to record and store camera image captures in an image database (IDB). These stored images can be reused for testing, debugging, and training purposes while the cameras are offline.

- **[Playback IDB]**
  The [Playback IDB] button opens previously saved images from the IDB.

- **[Record IDB]**
  The [Record IDB] button opens a new IDB recording entry. IDB recording name and file storage location are defined.

- **[Capture Viewset]**
  The [Capture Viewset] button captures the current pair of camera images from Camera 0 and Camera 1 and saves them in the IDB. The [Capture Viewset] button is only enabled when actively Recording in the IDB.

2.3.2.2 Camera Configuration

The Camera Configuration group provides tools for configuring each camera. Refer to Cognex documentation for additional information regarding camera settings.
2 MotoSight 3D® VisionPro Overview

2.3 MotoSight 3D® VisionPro Software Interface

- **[Configure Cam0]**
  The [Configure Cam0] button opens the Cognex Configure Camera 0 window to enable adjustment of camera settings for exposure, brightness, contrast among other camera adjustments.

- **[Configure Cam1]**
  The [Configure Cam1] button opens the Cognex Configure Camera 1 window to enable adjustment of camera settings for exposure, brightness, contrast among other camera adjustments.

- **[Sequential Acq]**
  The [Sequential Acq] check box allows you to switch between parallel image acquisition and sequential. Some acquisition timing problems can be resolved by selecting the sequential acquisition. However, parallel acquisition is recommended for production use due to improved cycle times.

2.3.2.3 Acquire Viewset

The Acquire Viewset group is used to capture images and provide a live display for camera monitoring.

- **[Get Image]**
  The [Get Image] button triggers a single image acquisition.

- **[Acquire Continuously]**
  The [Acquire Continuously] button provides a continuous image stream for part/robot placement and live display monitoring.

2.3.3 Calibration Tab

The Calibration tab is used to calibrate the two cameras for stereoscopic vision and coordinate camera positioning with robot position.
2.3.3.1 Calibration

The Calibration group provides tools for performing and editing 3D camera calibration.

- **[Calibration Wizard]**
  The [Calibration Wizard] button starts the calibration process, walking you through each step individually.

- **[View Results]**
  The [View Results] button allows you to see your previously saved calibration results.

- **[Validate Calibration]**
  The [Validate Calibration] button allows you to run a small routine to validate that your current calibration files are valid for your current setup. This can be helpful after a robot crash or other minor changes to the camera configuration such as lens replacement and camera position changes.

  The validation feature can be used to check the current camera calibrations and ensure it is within an acceptable tolerance. This should be performed after the initial calibration to establish a “baseline”. Subsequent validations compare the new results to this baseline and allow you to decide if a new calibration is required.

2.3.4 Location Tab

The Location tab is used to define part features.

2.3.4.1 Coarse Part Location

The Coarse Part Location group is used to setup the Cognex VisionPro tool settings for locating the coarse features of the part. The default template uses the Cognex CogPMAlignTool to locate the coarse features of the part. You may modify or add other Cognex tools as required for your application. Refer to the Cognex documentation for more information. This part locator is used to narrow the search region for the detailed sub feature locations.

- **[Part Locator0]**
  The [Part Locator0] button opens the Cognex VisionPro window. Cognex Command tools can be added or modified to define the coarse features of the part for Camera 0.
2 MotoSight 3D® VisionPro Overview

2.3 MotoSight 3D® VisionPro Software Interface

- **[Part Locator1]**
  The [Part Locator1] button opens the Cognex VisionPro window. Cognex Command tools can be added or modified to define the coarse features of the part for Camera 1.

- **[Copy from Part Locator 0]**
  The [Copy from Part Locator 0] buttons allows you to quickly copy the VisionPro routine to the second camera.

- **[Run Part Location]**
  The [Run Part Location] button starts both camera Cognex Part Locator Command tools to locate the coarse features of the part. The camera view windows on the main screen updates with a live display so you can test your part locator within the entire work envelope.

### 2.3.4.2 Subfeature Location

The Subfeature Location group is used to setup the Cognex Command tool settings for locating the subfeatures of the part.

- **[Configure Subfeatures]**
  The [Configure Subfeatures] button opens the Subfeature window allowing you to add, copy, delete and define how each subfeature is used for 3D location. See Chapter 2.3.4.3 Configure Subfeatures Window.

- **[Run Subfeature]**
  The [Run Subfeature] button starts both camera Cognex Subfeature Locator Command tools to locate the subfeatures of the part. This updates the camera view windows with a live display of your part. [Run Subfeature] should be used to verify that the subfeatures are located as the part is moved throughout the entire work envelope.

#### 2.3.4.3 Configure Subfeatures Window

The Subfeature window allowing you to add, copy, delete and define how each subfeature is used for 3D location.

- **[Add]**
  The [Add] button is used to add a row to the subfeature table.

- **[Copy]**
  The [Copy] button is used to copy an existing row. The new duplicate row appears directly below the copied row.
[Delete] Button
The [Delete] button deletes the selected row.

Subfeature ToolBlocks
The Subfeature ToolBlocks tab is used to setup Cognex tools to locate features for each camera.

2.3.4.4 Nominal 3D Model Data

Reference Location
Reference Location runs the saved Part Locators and Subfeature Locators to establish a nominal part position relative to the cameras. This should be your “golden” part in perfect position.

Pickup Location
Pickup Location will record the robot’s TCP position and set the nominal pickup location. Before setting this point, you must jog the robot into exact position where it would pickup the nominal part.

NOTE
You must not move the part between setting the Reference Location and the Pickup Location.

2.3.5 Test Run Program Tab
The Test Run Program tab allows you to test run your part location program before using it in a robot job.

2.3.5.1 Run Options
The Run Options group provides a variety of options for running the test part.

[Run Once]
The [Run Once] button initiates a single image capture and part location.

[Run Continuously]
The [Run Continuously] button initiates a continuous “live” feed and part location.

[Show Part Location]
The [Show Part Location] check box displays a graphical overlay of the coarse part location tool results on the display.
[Show Subfeature Locations]
The [Show Subfeature Locations] check box displays a graphical overlay of the part subfeature location tool results on the display.

[Show Final Pose]
The [Show Final Pose] check box displays a graphical overlay of the final pose results on the display. Indicates what points were used to calculate the final pose.
3 Setup

This chapter explains the setup operation that is required before MotoSight 3D® VisionPro can be used.

3.1 Camera Installation

Refer to your vendor manuals for detailed information regarding installation of your specific camera model.

3.2 Robot Calibration

It is recommended that the robot be calibrated using MotoCal V and required that an accurate Tool Control Point (TCP) is established prior to using the MotoSight 3D® VisionPro system. Contact Yaskawa Motoman Customer Support for additional information (chapter 1.4).

3.2.1 Calibration Grid User Frame

Before you calibrate the camera, you must create a robot user coordinate frame based on the origin of the calibration grid.

For more information on registration of the user coordinates, refer to User Coordinate Setting of the controller instructions.

Fig. 3-1: Calibration User Frame
3.3 Camera Calibration

Before using MotoSight 3D® VisionPro for the first time, it is necessary to calibrate the cameras for stereoscopic vision using a grid target to correct for lens and perspective distortion. To perform the camera calibration, you must gain remote access of the embedded PC using the Remote Desktop Connection application provided with your Windows operating system.

3.3.1 Gaining Remote Access to the Embedded PC

1. Open the Remote Desktop Connection application.
   a) Click [Start].
   b) Click [Programs] or [All Programs].
   c) Click Accessories from the drop down menu and Click on Remote Desktop Connection from the drop down menu.

2. Enter the IP address for the embedded PC (default: 192.168.254.10).
3. Click [Connect].
4. Enter “Remote” for the User name and “remote” for the Password.
5. Click [Enter]. The embedded PC desktop appears.

Depending on your Remote Desktop settings, the camera display windows can sometimes appear black after logging in. Close the MotoSight 3D® VisionPro application on the remote desktop and re-open the application by double clicking the desktop icon.

3.3.2 Configure the Cameras

1. Locate the calibration plate as required for your installation (fixed or robot mounted).
2. With the embedded PC remotely accessed, open the MotoSight 3D® VisionPro application by double clicking the desktop icon.
3. Click the Robot Controller tab.
4. Click the [Connection Options] button.
5. Set the IP Address, Robot Number, Tool Number, and User Frame.
6. Then click the [Connect] button.

**NOTE** The robot’s TCP and user frame must be established before beginning calibration.

- **Configure Camera 0**
  1. Click the Image Acquisition tab.

2. Click the [Configure Cam0] button. The “Configure Camera 0” screen appears.

3. Select “Type” of camera being used for Camera 0 from the “Image Acquisition Device/Frame Grabber” drop-down list.

4. Select the “Video Format” from the drop-down list. Select (mono) for standard Yaskawa camera package.

5. Click the [Initialize Acquisition] button.

6. While observing the display image, adjust the camera position so that all square intersections in the calibration pattern appear in the image.

7. Click the Run button to update the image.
8. Adjust the “Exposure” duration, “Brightness”, and “Contrast” to eliminate gaps between the intersections of the squares and obtain a clear image with high contrast for calibration.

![Chessboard Image]

9. Once you have a good image, click [Done] to close the “Configure Camera 0” screen.

**Configure Camera 1**

1. Click the [Configure Cam1] button. The “Configure Camera 1” screen appears.

2. Select the correct device being used for Camera 1 from the “Image Acquisition Device/Frame Grabber” drop-down list.

3. Select (Mono) from the “Video Formats” drop-down list.

4. Click the [Initialize Acquisition] button.

5. Jog the robot to the inspection position until the target completely fills the field of view.

6. Click the Run button to update the image.
7. Adjust the “Exposure” duration, “Brightness”, and “Contrast” to eliminate gaps between the intersections of the squares and obtain a clear image with high contrast for calibration.

3.3.3 Calibration

**NOTE** The robot's TCP and user frame must be established before beginning calibration.

1. Click the Calibration tab.
2. Click the [Calibration Wizard] button. The Calibration Setup window appears.

3. Select the desired Calibration Type using the radio buttons.
   - Quick Calibration (Simpler) = 15 steps
   - Detailed Calibration (More Accurate) = 25 steps

4. Select the Camera Configuration.
   - Moving Camera = The camera is mounted on the robot and the calibration plate is in a fixed location.
   - Fixed Camera = The camera is mounted in a fixed location and the calibration plate is mounted on the robot.
3.3 Camera Calibration

5. Enter the Grid Information data. This is the total number of tiles on the calibration plate and the number of tiles to be used for error percentage.
   • Plate Tile Size = size (in mm) of each square in the calibration grid. (10 mm or 20 mm is typical).
   • # of Tiles for Residuals = number of tiles on the grid pattern to take into account when calculating the possible error amount after calibration.

6. Select a Distortion Model from the drop down menu.
   • 3 Param Radial (default) = Used with typical low-distortion cameras where distortion is not apparent to the human eye.
   • No distortion = Used with ideal lenses with no distortion.
   • Sine Tangent Law = Used with high distortion lenses such as fisheye. These typically have a short focal length.
   • Telecentric = Used with telecentric lenses.

7. Click [Next]. The 3D Calibration Wizard appears.

3.3.4 3D Calibration Wizard

The 3D Calibration wizard walks you through each step of the calibration process. The MotoSight 3D® VisionPro requires image acquisitions at a variety of angles and rotation to produce an accurate calibration.

Recommendations:
   • Observe calibration images and provide appropriate lighting support to eliminate gaps between the intersections of the squares and obtain a clear image with high contrast for each calibration image.
Setup

MotoSight 3D® VisionPro

3.3 Camera Calibration

- Avoid disconnected X-junctions in calibration image caused by excessive lighting.
- Place camera in an appropriate position so that X-junction intersections cover the display image as much as possible.
- Alter camera positions so that the angle between camera positions have at least 15 degrees of rotation in x or y.
- It is strongly recommended to record the robot pose for each calibration step into a robot job. If re-calibration becomes necessary, you can easily recall the calibration points.

**NOTE**

All calibration poses must have a varying rotation.

### Calibration Results

Once MotoSight 3D® VisionPro is finished with the calibration process, the Calibration Results screen appears. This can be used to determine the quality of your calibration.

**NOTE**

Bad calibrations results can be caused by poor orientation images. If you receive poor calibration results with a Root Mean Squared error value greater than 0.10 for Phys3D residuals, click [BACK] and replace images with poor lighting and/or coverage.

### 3.3.5 Validation

A validation routine should now be performed to set a "baseline" for later comparison. Click the [Validate Calibration] button and follow the onscreen wizard to perform the validation.

Future validations can be performed to check the current camera calibrations and ensure it is within an acceptable tolerance. Subsequent validations compare the new results to this baseline and allow you to decide if a new calibration is required.
4 MotoSight 3D® VisionPro Application

4.1 Defining a Part

1. Click the Image Acquisition tab.
2. Click the [Get Image] button to place part image in view.

3. Click the Location tab.

4.1.1 Define Coarse Part Features

The Part Locator is designed to find the location of the part in the 2D image for each camera. The subfeature locators are used to determine the final pose of your part. However, the Part Locators will narrow the search field for the subfeatures. When configuring your subfeatures, the locations will always be relative to the zero-point of your Part Locator. Therefore, it is crucial that you ensure the zero point (and orientation) of both Part Locators correlate to the same location/feature on the part image.

The default template uses the Cognex CogPMAlignTool to locate the coarse features of the part. Modify or add other Cognex tools as required for your application. Refer to the Cognex documentation for more information.
1. Click the [Part Locator0] button. The PartLocator0 window appears.

2. Use the Cognex Command tools to locate the coarse features of the part. Double click on the Cognex tool from the tree view and edit the course features. Refer to Cognex vendor documentation for more information.

3. Click Done.

4. Click the [Part Locator1] button. The PartLocator1 window appears.

5. Use the Cognex Command tools to locate the coarse features of the part or simply copy the coarse feature tools from PartLocator0.

6. Click the [Run Part Location] button. MotoSight 3D® VisionPro locates the part.
4.1.2 Define Part Subfeatures

1. Click the [Configure Subfeatures] button. The Configure Subfeatures window appears.

2. Click [New] to add a new subfeature row.

3. Enter the 3D Subfeature name in the text box.

4. Setup Cognex tools to find features for each camera.

5. Click the [New from Template] button for camera 0. A blank template is available for expert VisionPro users.

6. Repeat the procedure for camera 1. Or, simply click the Copy button to duplicate the tool block for camera 0.

7. For pose estimation, a minimum of 3 subfeatures are required. More accurate results can be obtained from additional points across the entire part.

8. Close the subfeature configuration screen.

9. Click the [Run Subfeature] button and move the part around to ensure detection within the entire work envelope.

10. Place part in nominal location and click the [Reference Location] button. This stores this location as the nominal location point. Do not move the part.

11. Jog the robot to the nominal pick up location and click the [Pickup Location] button. The Set Pickup Location window appears.

   **NOTE** The part must not be moved between setting the Reference Location and Pickup Location.
12. Click the [Set Position] button.

When recording your reference location, it is strongly recommended that this same point be used during the robot inspection. Therefore, this point should be recorded into a robot P-variable or Inform-job for easy recall later.

### 4.1.3 Test Run Program

1. Click the Test Run Program tab.

2. Click the [Run Once] button to verify that the part is located.

3. Click the [Run Continuously] button and modify the part position to verify that MotoSight 3D® VisionPro is still able to locate the part effectively throughout the entire work envelope.

4. Toggle the run option check boxes and verify that the part location, subfeature, and final pose graphical overlay work properly.
4.1.4 Map Results

Once MotoSight 3D® VisionPro has been tested and the Cognex Command tools work properly; map the location to store these results in the controller.

1. Click the Robot Controller tab.

2. Click the [Map Data] button. The map variable screen appears.

3. Use the Map Variable screen to assign supported Cognex Command tool results to robot variables. Available tool results are listed in the left window. When a tool result is selected, the appropriate robot variables are listed in the Available Robot Variables window. Selecting the vision result data from the available vision results, changes the available robot variables.

4. Once the desired robot variable is selected to store the vision tool results, press the [>] button to load the vision tool name and variable information into the selected robot variable and add it to the Assignment List.

5. Click [Done] to store your settings.

**Note:** The “Go online” button is disabled until all variable mapping is complete.

4.2 Production Operation

After you have programmed your part and mapped the tool results to robot variables, you can run your MotoSight 3D® VisionPro tool jobs in production.

1. Click the Robot Controller tab.
2. Click the [Go Online] button to transfer control of the MotoSight 3D® VisionPro software to the controller. The robot Inform macros will not function until the PC application is Online.

The “Go online at startup” check box should be checked to automatically transfer control of the software to the controller at startup.

3. Program your robot job to include the MotoSight 3D® VisionPro inform commands.

4. When your job is run, the results are stored in the robot variables and can be used as required for your application.

4.3 Inform macros:

Two Inform macros are included with this software to control the vision PC from the robot job. The PC application must be Online in order for the macro commands to control the PC.

4.3.1 LOC3D_Rx

The LOC3D_Rx macro instructs the PC to run the MotoSight 3D® VisionPro job and return the vision results into robot variables in the controller.

You must use the correct LOC3D_Rx macro based on which robot control group is being used for the current job.

Example: LOC3D_R1 is only used for R1 robot jobs.

Arguments:

PC Index

- Indicates which vision PC to run (if multiple PC's exist in the current robot cell)
MotoSight 3D® VisionPro Application

4.3 Inform macros:

• Valid range: 0 or 1

USER FRAME

• Specifies which user frame to calculate robot pose on. Please note that this must match the user frame selected on the vision PC when connecting to the robot controller.

• Valid range: 1 - 63

TOOL NUMBER

The robot pose will be calculated using this TCP index. Please note that this must match the user frame selected on the vision PC when connecting to the robot controller.

• Valid range: 0 - 23

4.3.2 SET_PART

The SET_PART macro instructs the vision PC to open a particular saved part file. When LOCATE3D is called, the vision PC will run the job for the currently loaded part.

Usage:

A robot String Variable must contain the name of the part you wish to load:

Example

SET S010 “Part6"

SET_PART PC_INDEX=0 S-VAR_INDEX=10

Arguments:

PC Index (#)

– Indicates which vision PC to run (if multiple PC’s exist in the current robot cell)

– Valid range: 0 or 1

S-Var Index (Sxxx)

– Indicates which robot String Variable contains the part name.
4.4 Pendant Application:

The MotoSight 3D® VisionPro pendant application comes pre-installed on your robot controller. This application allows for the most basic of operations to be done without the need of connecting a remote PC.

To open the MotoSight 3D® VisionPro pendant application, navigate to the main menu of your pendant display. Touch [APPLICATION] > [MotoSight3DVPro].

The button to launch the application is only available when the pendant is in TEACH mode and all alarms have been cleared.
The tabs across the top can be used to switch between Vision PC 0 and Vision PC 1. The PC application must be connected to the robot controller to be able to use this pendant application.

The radio buttons at the bottom allow you to switch the image display to show the image from camera 0 or camera 1.

The Current Part label will indicate the name of the part which is currently loaded.

The PC Status box indicates if the PC is connected and/or online. [Toggle Online] can be used to switch a connected PC between Online and Offline.

[Trigger Cameras] will instruct the PC to obtain new images, run the vision job, and transfer the robot variables setup in the variable mapping. This is equivalent to running the LOCATE3D macro from Inform. This button is only enabled when the PC is Online.

The [Variable Mapping] button allows you to modify the mapping of vision results to robot variables. This is the same as the variable mapping screen.
in the PC application. See chapter 4.1.4 for more information. This button is only enabled when the PC is Offline.

The [Load Part] button allows you to load a different part on the vision PC. Select your desired part from the list below the button and touch [Load Part]. This is equivalent to running the SET_PART macro from Inform. This button is only enabled when the PC is Online.
5 Maintenance/TroubleShooting

Maintenance must be performed by authorized personnel who are familiar with the MotoSight 3D® VisionPro system. Be sure to read and understand the documentation for a particular component before doing repair maintenance or preventive maintenance on that component. Be sure that you understand the maintenance procedures, have the proper tools at hand, and comply with all the safety instructions and precautions given throughout this manual.

5.1 Calibration Recovery

The [Validate Calibration] button allows you to check the current accuracy of your calibration and determine if it is still acceptable. This can be helpful after a robot crash or other minor changes to the camera configuration such as lens replacement and camera position changes.

5.2 Cognex VisionPro Help

Integrated Cognex help topics are accessible on all Tool Edit controls.

5.3 MotoSight 3D® VisionPro Troubleshooting

5.3.1 Check Feedback Signals

Feedback signals to the robot have been implemented to provide a “status” of the MotoSight 3D® VisionPro application. These signals can be used to help determine why the vision system is not working.

Controller Software Status:

1. From the robot pendant, touch [In/Out] > [Network Input].
2. Press [SELECT] and type “25190”, then press [ENTER].

<table>
<thead>
<tr>
<th>Signal</th>
<th>Meaning</th>
<th>Definition</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>#25190</td>
<td>Controller Program Running</td>
<td>1 = OK</td>
<td>&gt; Boot the controller into MAINTENANCE mode by holding [Main Menu] during power up.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Controller software not running</td>
<td>&gt; Upgrade the security level to MANAGEMENT level.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; Touch the [MotoPlus] menu button.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; Touch [MotoPlusFunc Setting].</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; Ensure that the Auto Start option is set to “ENABLE”.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; If not, press [SELECT] to toggle the setting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; Press [ENTER] to save the setting.</td>
</tr>
<tr>
<td>#25191</td>
<td>Controller License Valid</td>
<td>1 = OK</td>
<td>Contact Yaskawa Motoman Customer Support for a new license file.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = The license is either missing or invalid</td>
<td></td>
</tr>
<tr>
<td>#25200</td>
<td>PC 0 Connected</td>
<td>1 = Embedded PC 0 is connected</td>
<td>&gt; Check internal network connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Embedded PC 0 not connected</td>
<td>&gt; Connect to PC via Remote Desktop and click the [Connect] button in the MotoSight3D VisionPro application.</td>
</tr>
<tr>
<td>#25201</td>
<td>PC 0 Online</td>
<td>1 = Embedded PC 0 is online</td>
<td>&gt; Check internal network connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Embedded PC 0 not online</td>
<td>&gt; Open the MotoSight3D VPro pendant application and toggle the Online status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; Connect to PC via Remote Desktop and click the [Online] button in the MotoSight3D VisionPro application.</td>
</tr>
<tr>
<td>#25204</td>
<td>PC 1 Connected</td>
<td>1 = Embedded PC 1 is connected</td>
<td>&gt; Check internal network connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = Embedded PC 1 not connected</td>
<td>&gt; Connect to PC via Remote Desktop and click the [Connect] button in the MotoSight3D VisionPro application.</td>
</tr>
</tbody>
</table>
5.3.2 Alarm Codes

<table>
<thead>
<tr>
<th>Alarm Number</th>
<th>Message</th>
<th>Troubleshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>9064</td>
<td>MotoSight3D PC(s) Not Connected</td>
<td>&gt; Check internal network connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Connect to PC via Remote Desktop and click the [Connect] button in MotoSight3D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VisionPro application.</td>
</tr>
<tr>
<td>8000</td>
<td>MS3D application is not online</td>
<td>&gt; Check internal network connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Open the MotoSight3D VPro pendant application and toggle the Online status.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Connect to PC via Remote Desktop and click the [Online] button in MotoSight3D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VisionPro application.</td>
</tr>
<tr>
<td>8001</td>
<td>MS3D Application not connected</td>
<td>&gt; Check internal network connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Connect to PC via Remote Desktop and click the [Connect] button in MotoSight3D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VisionPro application.</td>
</tr>
<tr>
<td>8002</td>
<td>MS3D Part file doesn't exist</td>
<td>&gt; Check the name of the part you are attempting to load.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Connect to the PC via Remote Desktop and ensure you are able to manually open</td>
</tr>
<tr>
<td></td>
<td></td>
<td>the part from the MotoSight3D VisionPro application.</td>
</tr>
<tr>
<td>8003</td>
<td>Unknown MotoSight3D error</td>
<td>&gt; Reboot the robot controller and try again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Contact Yaskawa Motoman Customer Support.</td>
</tr>
<tr>
<td>8004</td>
<td>MotoPlus IO Error</td>
<td>&gt; Reboot the robot controller and try again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Contact Yaskawa Motoman Customer Support.</td>
</tr>
<tr>
<td>8005</td>
<td>Cmd Ready Signal Timeout</td>
<td>&gt; Reboot the robot controller and try again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Reload all Macro Jobs into the robot controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Reload the CIO ladder program.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Contact Yaskawa Motoman Customer Support.</td>
</tr>
<tr>
<td>8006</td>
<td>MS3D server aborting...</td>
<td>&gt; Reboot the robot controller and try again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Contact Yaskawa Motoman Customer Support.</td>
</tr>
<tr>
<td>8007</td>
<td>MS3D, Unknown Command Received</td>
<td>&gt; Reboot the robot controller and try again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Reload all Macro Jobs into the robot controller.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Reload the CIO ladder program.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Contact Yaskawa Motoman Customer Support.</td>
</tr>
<tr>
<td>Alarm Number</td>
<td>Message</td>
<td>Troubleshooting</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8008</td>
<td>Connection from invalid PC IP</td>
<td>&gt; Check network connections.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Connect to PC via Remote Desktop and check the IP address setting for the network connection labeled “LAN 1”.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Default:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PC 0 - 192.168.255.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PC 1 - 192.168.255.11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; The last digit of the last octet must end in a “0” for PC 0 and a “1” for PC 1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Example:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>172.10.20.30 - OK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>172.10.20.33 - No Good</td>
</tr>
<tr>
<td>8009</td>
<td>Could not create MS3D tasks</td>
<td>&gt; Reboot the robot controller and try again.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Contact Yaskawa Motoman Customer Support and send them your ALL.PRM file from the robot controller.</td>
</tr>
</tbody>
</table>
Specifications are subject to change without notice for ongoing product modifications and improvements.