The Americas YASKAWA Representative

- 24-hour Telephone Number: **(937) 847-3200**
  Use for urgent or emergency needs for technical support, service and/or replacement parts
- Routine Technical Inquiries: *techsupport@motoman.com*
  Allow up to 36 hours for response

YASKAWA

MOTOSIGHT™ 2D INSTRUCTIONS

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

Have the following information available when contacting the YASKAWA Representative:

- System
- Primary Application
- Software Version *(Located on Programming Pendant by selecting: {Main Menu} - {System Info} - {Version})*
- Warranty ID *(Located on Robot Controller)*
- Robot Serial Number *(Located on Manipulator data plate)*
- Robot Sales Order Number *(Located on Robot controller data plate)*

MANUAL NO.
169004-1CD ◈6

Printed in the United States of America

First Printing, 2014

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www.motoman.com

Safety

For Your Safety

Robots generally have requirements which are different from other manufacturing equipment, such as larger working areas, high-speed operation, rapid arm movements, etc., which can pose safety hazards.

Read and understand the instruction manuals and related documents, and observe all precautions in order to avoid the risk of injury to personnel and damage to equipment.

Carelessness contributes to serious accidents in the work area.

It is the user's responsibility to ensure that all local, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions are met and followed.

DANGER

- Teaching, operations, and maintenance of the Robot must conform to:
  - Industrial Safety and Health Law
  - Order for Enforcement of the Industrial Safety and Health Law
  - Industrial Safety and Health Regulations
  - Technical Standards for Electrical Facilities

  Other related laws and regulations are:
  - Occupational Safety and Health Act in USA
  - Factory Act (Gewerbeordnung) in Germany
  - Health and Safety at Work, etc. Act in UK
  - EC Machinery Directive 2006/42/EC
- Prepare:
  - SAFETY WORK REGULATIONS
    based on concrete policies for safety management complying with related laws and regulations.
- Observe:
  - JIS B 8433-1: 2015 "Robots for industrial environments-Safety requirements" (ISO 10218-1: 2011) for safe operation of the robot. (JIS B 8433 is for Japan only)
- Reinforce:
  - SAFETY MANAGEMENT SYSTEM
    by designating authorized operators and safety managers for the Robot, as well as giving continuing safety education and training.
- Teaching, operation, and maintenance of the Robot are specified as "Hazardous Operations" in the Industrial Safety and Health Act (for Japan only).
  Personnel engaged in these operations must receive special training offered by YASKAWA.

DANGER

- Personnel engaged in operation, maintenance, or management of the Robot must receive required training before using the Robot.

For more information on training, contact a YASKAWA representative.

- Make sure to have and follow all manuals, read them thoroughly and understand the contents of them.

Confirm that you have all required manuals. If any of the manuals are missing, contact a YASKAWA representative.

- Read and understand these instructions throughly before installing, operating, or maintaining the Robot.

Any matter not described in this manual must be regarded as “prohibited” or “improper”.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association
900 Victors Way
P.O. Box 3724
Ann Arbor, Michigan 48106
TEL: (734) 994-6088
FAX: (734) 994-3338
www.roboticsonline.com

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment.

We recommend approved YASKAWA training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

WARNING

- Safe operation of this equipment is the users responsibility.
  - The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-2012 safety standards, and other local codes that may pertain to the installation and use of this equipment.

Not following all national codes, safety standards and local codes can result in death or serious injury

- Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location.
  - The following safety equipment is provided as standard:
    - Safety barriers
    - Door interlocks
    - EMERGENCY STOP button

Not providing additional safety measures as required can result in death or serious injury.

- Check all safety equipment frequently for proper operation.
  - Repair or replace any non-functioning safety equipment immediately.

If safety equipment does not operate properly death or serious injury can result.

CAUTION

- Only trained personnel familiar with the operation, manuals, electrical design, and interconnections of this equipment should program, or maintain the system.

Any personnel involved with the operation of the equipment must understand potential dangers of operation.

NOTICE

- The drawings and photos in this manual are examples. Differences may exist between them and the delivered product.
- YASKAWA may modify this model without notice due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.
- Some operations require standard passwords and while others require special passwords.
- If a manual is damaged or lost, contact a YASKAWA representative to order a new copy. Make sure to tell the YASKAWA representative the Manual Number listed on the front cover.

Notes for Safe Operation

Read this manual carefully before installing, operating, maintaining, or inspecting the system.

In this instruction, Safe Operations are classified as “DANGER”, “WARNING”, “CAUTION” or “NOTICE”.

	Indicates an imminently hazardous situation which, if not avoided, **WILL result in death or serious injury**.
	Indicates a potentially hazardous situation which, if not avoided, **MAY result in death or serious injury**.
	Indicates a hazardous situation, which if not avoided, **MAY result in minor to moderate injury**.
	Indicate a situation which if not avoided **may result in equipment damage.**
	Indicates **practices not related to personal injury**.

NOTICE

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

Installation and Wiring Safety

Review the Robot and Controller Instructions for details on installation and wiring.

In planning installation, adapt an easy to observe arrangement to ensure safety. Take safety into consideration when planning the installation. Observe the following when installing the Robot:

DANGER

- Maintenance and inspection must be performed by specified personnel.

Failure to observe this caution may result in electric shock or injury.

- For disassembly or repair, contact a YASKAWA representative.
- Do not remove the motor, and do not release the brake.

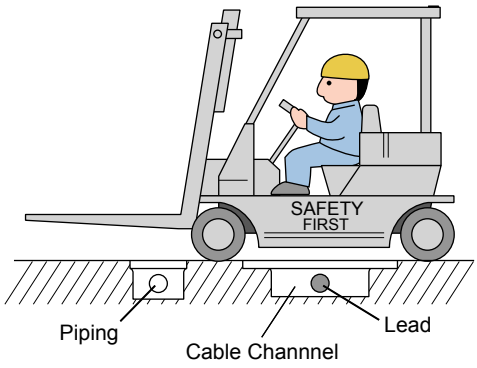
Failure to observe these safety precautions may result in death or serious injury from unexpected motion of the Robot's arm.

- Any person who programs, teaches, operates, maintains or repairs the included system MUST be trained and demonstrates competence to safely perform assigned tasks.

Failure to observe these safety precautions may result in death or serious injury from unexpected movements.

WARNING

- Run the piping, wiring, and cables for the Controller, Robot, Positioner control panel, peripheral devices, etc. in a pit so that they are not stepped on by personnel or run over by a forklift.



Failure to observe this Warning may cause personnel to trip over exposed piping, wiring, or a cables, which may result in personal injury. Additionally it may also cause damage to piping, wiring, or cables, and unexpected movement of the Robot, which may result in personal injury and/or equipment damage.

CAUTION

- Make sure all covers and shields are installed correctly before operating.
  - Some drawings in this manual may have protective covers or shields removed to show details.

Not having all covers and shields installed correctly can result in injury.

- When installing the Robot system, avoid interference with buildings, structures, utilities, other machines.

Not avoiding these items may create trapping or pinch points.

- Do not make unauthorized modifications.

Unauthorized modifications can result in injury or equipment damage and will void the warranty.

- Inspect:
  - For problems with movement
  - Damages to external wires

Repair any problems immediately and perform all necessary procedures. If problems are not repaired or procedures are not fixed unexpected results can occur causing injury.

NOTICE

- If supplying a supplementary audible means for Robot operation, it shall exceed the ambient noise at the end-use of the application.
- Any changes or additions to the applicable information as provided by the manufacturer is to be provided by the party that makes the change or addition to the Robot system

Ensure Safety

DANGER

- When the power supplies of the Robot and Controller are turned ON at start-up, be sure to confirm the following:
  - Safety protection devices such as the E-STOP circuit, door interlocks, etc. operate normally.
  - Each axis operates normally in TEACH mode.
  - Robot operates normally at the speed limit or less in the TEACH mode.(Speed limit: 250 mm/s at the TCP or the flange)
  - The teaching function and the playback function operate normally.
- The Robot may stop movements while waiting for a condition to be satisfied during operation.

Once meeting the condition, the Robot starts movement causing a danger that will cause death or severe injury.

- Make sure to clearly indicate when the Robot is in operation:
  - Use a pilot lamp and/or an audible alert or
  - The Robot stops operation if the operator comes close.
- Install a safety fence around the Robot to prevent any accidental contact with the Robot when power is applied.
  - Display a warning sign stating “Off-Limits During Operation” at the entrance of the safety fence.
  - The gate of the safety fence must be equipped with a safety interlock to turn the servo power OFF when the gate opens.
  - Make sure interlocks operate properly before use.
- For areas not enclosed by safety fences, use a photoelectric sensor, a safety light curtain, etc. to make sure that the Robot stops its operation if the operator enters its operating range.

Failure to observe this Danger notice will result in death or serious injury due to contact with the Robot.

All personnel working with the Robot (safety administration, installation, operation, and maintenance personnel) must always be prepared and “Safety First” minded, to ensure the safety of all personnel.

WARNING

- In the vicinity of the area where the Robot is installed, avoid any dangerous actions, such as entering the Robot's operating range without due care.

Failure to observe this instruction may cause contact with the Robot or peripheral equipment, which may result in death or serious injury.

- Strictly observe the safety precautions and signs in the factory, such as “Flammable”, “High Voltage”, “Danger”, “Off-limits to Unauthorized Personnel”.

Failure to observe this instruction may result in death or serious injury do to fire, electric shock, caused by contact with the Robot or other equipment.

- Strictly observe the following precautions about clothing:
  - Always wear approved work clothes (no loose-fitting clothes).
  - To prevent mis-operation, do not wear gloves when operating the Robot.
  - Do not allow underwear, shirts, or neckties hang out from the work clothes.
  - Do not wear accessories, such as earrings, rings, or necklaces.
  - Always wear protective safety equipment, such as hard hats, safety shoes (with slip-proof soles), face shields, safety glasses, and gloves as necessary.

Failure to observe this instruction may result in death or serious injury.

- The following must be understood and strictly observed by all personnel as rules:
  - Unauthorized personnel other than the operator must not approach the area where the Robot is installed.

Failure to observe this instruction may cause contact with the Robot, Controller, control panel, workpiece, or Positioner, etc., may result in death or serious injury.

YRC1000, DX200, and DX100

WARNING

- Turn OFF servo power before operating.
  - Press the EMERGENCY STOP button to turn off SERVO POWER. When servo power is OFF, the SERVO ON LED on the Programming Pendant is OFF.

If the EMERGENCY STOP button(s) do not work correctly, death or serious injury may result. Do not use if the EMERGENCY STOP button does not perform correctly.

Fig. : EMERGENCY STOP Button

- Clear the cell of all items which could interfere with the operation before releasing the EMERGENCY STOP button.

Death or serious injury may result from unintentional or unexpected motion.

Fig. : Release of EMERGENCY STOP Button

- Make sure no person is in the operating range and the operator is in a safe location before:
  - Turning ON power to the Controller
  - Moving the Robot with the Programming Pendant
  - Running the system in the TEACH mode
  - Performing automatic operations

Death or serious injury may result if a person enters the operating range during operation. Immediately press an EMERGENCY STOP button whenever there is a problem.

YRC1000micro and FS100

DANGER

- Before operating the manipulator, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the Programming Pendant turns OFF.
  - Press the EMERGENCY STOP button on the Programming Pendant or on the external control device, etc.
  - Disconnect the safety plug of the safety fence. (when in play mode or in the remote mode)

If operation of the manipulator cannot be stopped in an emergency, personal injury and/or equipment damage may result.

Fig. : EMERGENCY STOP Button

- Make sure to supply an EMERGENCY STOP button, if not using a Programming Pendant
  - Connect an external EMERGENCY STOP button to pin 5-6 and 16-17 pin of the robot system signal connector (CN2)
- Make sure servo power turns OFF by pressing the EMERGENCY STOP button before operating the manipulator.
- Upon shipment of the controller, this signal is connected by a safety signal short circuit 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 releasing the EMERGENCY STOP button, clear the cell of all items that may 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 a teaching operation within the manipulator's operating range:
  - Be sure to perform lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence. In addition, the operator of the teaching operation must display the sign that the operation is being performed so that no other person closes the safety fence.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always keep in mind emergency response measures against the manipulator's unexpected movement toward a person.
  - Ensure a safe place to retreat in case of emergency.

Failure to observe this instruction may cause improper or unintended movement of the manipulator, which may result in personal injury.

YRC1000micro and FS100

DANGER

- Confirm that no person is present in the manipulator's operating range and that the operator is in a safe location before:
  - Turning ON the YRC1000micro power
  - Moving the manipulator by using the Programming Pendant
  - Running the system in the check mode
  - Performing automatic operations

Personal injury may result if a person enters the manipulator's operating range during operation. Immediately press an EMERGENCY STOP button whenever there is a problem.

Read and understand the Explanation of the Warning Labels before operating the manipulator.

CAUTION

- All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must be familiar with the operation of this equipment.
  - All personnel involved with the operation of the equipment must understand potential dangers of operation.
- General safeguarding tips:
  - Place system in E-STOP mode whenever it is not in use.
  - Use lockout/tagout procedures during equipment maintenance in accordance with ANSI/RIA R15.06-2012, section 4.2.5, Sources of Energy. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).
  - Only trained personnel familiar with the operation of this equipment, the operator's manuals, the system equipment, and options and accessories can operate equipment.

Improper operation can result in personal injury and/or damage to the equipment.

- If the light in the operator's working space is not bright enough, provide the space with appropriate lighting.

CAUTION

- Store industrial tools, etc. in a safe location outside the Robot's operating range.

If an industrial tool, etc. is left unattended on the Robot, on a fixture, or on the floor, etc., the Robot may come in contact with the industrial tool left unattended, which may result in damage to the Robot and/or the fixture.

Operation Safety

DANGER

- Personnel engaged in teaching or inspection, etc. of the Robot must receive special training required by applicable laws and regulations.
- While performing inspection and maintenance, wiring, or attaching a tool to the Robot, etc., make sure to turn OFF the power supply of the Controller and the tool, and keep the switch of the power supply locked so that unauthorized personnel cannot turn ON the power supply.
  In addition, display a warning sign stating “Energizing Prohibited”.

  Turning ON the power supply without due care during inspection and maintenance, etc., may cause electric shock or unexpected movement of the Robot, which may result in personal injury.

- Use the Robot only within the specifications described in the manuals for the Robot.

Failure to observe this instruction may result in personal injury and/or equipment damage.

- Observe the following precautions when performing a teaching operation within the Robot's operating range:
  - Be sure to perform lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence. In addition, the operator of the teaching operation must display the sign that the operation is being performed so that no other person closes the safety fence.
  - View the Robot from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always keep in mind emergency response measures against the Robot’s unexpected movement toward a person.
  - Ensure a safe place to retreat in case of emergency.

Failure to observe this instruction may cause improper or unintended movement of the Robot, which may result in personal injury.

DANGER

- Before operating the Robot, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the Programming Pendant is turned OFF.
  - Press the EMERGENCY STOP buttons on the front door of the Controller, on the Programming Pendant, on the external control device, etc.
  - Disconnect the safety plug of the safety fence. (when in the PLAY mode or REMOTE mode)

If operation of the Robot cannot be stopped in an emergency, personal injury and/or equipment damage may result.

- Make sure that all safety protection devices are activated before starting a job in the PLAY mode.
- Confirm that no person is present in the Robot's operating range and that the operator is in a safe location before:
  - Turning ON the Controller
  - Moving the Robot by using the Programming Pendant
  - Running the system in the TEACH mode
  - Performing automatic operations

Personal injury may result if a person enters the Robot's operating range during operation

- Immediately press an EMERGENCY STOP button whenever there is a problem.

WARNING

- Read “Safety” of the Controller instructions before operating.

Not reading and understanding chapter 1 of the Controller instruction can result in death or serious injury.

- Read and understand all Warning Labels before operating.

Not reading and understanding all Warning Labels can result in death or serious injury.

- Confirm that no person is present in the P-point maximum envelope of the Robot before:
  - Turning on the power for the Controller.
  - Moving the Robot with the Programming Pendant.
  - Running the system in the TEACH mode.
  - Performing automatic operations.

Injury may result if anyone enters the working envelope of the Robot during operation. Always press an EMERGENCY STOP button immediately if there are problems.

- Observe the following when performing teaching operation within the operating range:
  - Lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence.
  - Display a sign that operations are being performed so no other person closes the safety fence.
  - View from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always keep in mind emergency response measures against unexpected movement toward a person.
  - Ensure a safe place to retreat in case of emergency.

Failure to observe this precautions may cause improper or unintended movement, which may result in personal injury.

- Maintenance and inspection must be performed by specified personnel.

Failure to observe this Warning may result in electric shock or injury.

- Contact a YASKAWA representative for disassembly or repairs.

Not contacting a YASKAWA representative can result in electrical shock or injury.

CAUTION

Robot Cells have Collaborative Motion functionality:

Collaboration is a special type of operation between a person and Robot sharing a common workspace. The following are the guidelines for collaborative operation.

1. Used for pre-determined tasks.
2. Possible when all protective measures are active.
3. For Robots with features specifically designed for collaborative operation.

The integrator shall include in the information for use the safeguards and mode selection required for collaborative operation.

CAUTION

- Do not operate the Robot when a [COOLING FAN2 ERROR] appears on the Programming Pendant.

If operation continues with a warning message, equipment damage can occur.

- During high speed continuous operation Robot temperature may rise quickly depending on ambient temperature and operation pattern.

If a warning message displays stop operations or equipment damage may occur.

- Monitor warning messages on the Programming Pendant.

Not monitoring warning messages may cause equipment damage.

- Refer to the Controller Concurrent I/O manual for details on the signal output.

Not referring to Controller Concurrent I/O manual can result in equipment damage.

Maintenance Safety

WARNING

- Make sure equipment has no potentially hazardous conditions.
  - area is clean and free of water, oil, debris, etc.
  - all safeguards are in place.
  - all safety equipment work correctly. Repair or replace any non-functioning safety equipment immediately.
  - Check the EMEREGENCY STOP button(s) for proper operation before programming. The equipment must be in E-STOP mode when not in use.

If a hazardous condition is present death or serious injury may occur.

- Use care when modifying software.
  - The equipment allows modifications to the software for maximum performance.

All modifications made to the software will change the way the equipment operates and may cause death or serious injury, as well as damage parts of the system.

- Make sure all modifications did not make create a hazardous or dangerous condition in all modes.

All modifications made to the software will change the way the equipment operates and may cause death or serious injury, as well as damage parts of the system.

- Disconnect and lockout/tagout all sources of energy before making modifications or connections.

Not disconnecting and doing lockout/tagout of all sources of energy can result in death or serious injury.

- Read and understand all maintenance procedures before completing procedures.

Not reading and understanding maintenance procedure may result in death or serious injury.

CAUTION

- Do not modify the Controller.

Making modifications without written permission from YASKAWA will void the warranty.

- Back up all programs and jobs onto suitable media before program changes are made.

To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.

- Use proper replacement parts only.

Not using proper replacement parts can cause damage to equipment.

- All connections must be made within the standard voltage and current ratings of the equipment.

Improper connections can damage the equipment.

Notes for Moving and Transferring the Robot

DANGER

- When relocating, transferring, or selling the Robot, make sure that the Robot is always accompanied by its manuals so that all users have access to necessary manuals.

See the Bill of Material for a list of the manuals.

If any of them is missing, contact a YASKAWA representative. The telephone numbers of our offices are listed on the back cover of this manual.

- If a warning label on the Robot or the Controller is dirty and unreadable, clean the label to make it clearly readable. If a warning label has come off, put the label back in place. Note that some local laws and regulations may prohibit equipment operation if safety labels are not in place.

Contact a YASKAWA representative if requiring new warning labels.

- After the Robot is relocated, inspection by a YASKAWA representative is recommended.

If installation or wiring of a device is incorrect, personal injury and/or equipment damage may result.

Definition of Terms Used Often in This Manual

The Robot is the YASKAWA industrial robot product.

The Robot usually consists of a Robot, Controller, Programming Pendant, and Robot cables.

In this manual, the equipment is designated as follows:

Equipment	Manual Designation
YRC1000micro, YRC1000, YRC1000micro, DX200, DX100, or FS100 controller	Controller
YRC1000micro, YRC1000, YRC1000micro, DX200, DX100, or FS100 Programming Pendant	Programming Pendant
MotoSight 2D™ Manipulator	Robot
Cable between the Robot and the Controller	Robot cable
Positioner	Positioner
YRC1000micro or FS100 safety signal short circuit connector	Safety signal short circuit connector (optional)

Descriptions of the Programming Pendant keys, buttons, and displays are shown as follows:

Equipment		Manual Designation
Programming Pendant	Character Keys /Symbol Keys	The keys which have characters or symbols printed on them are denoted with [ ]. e.g. [ENTER]
	Axis Keys /Numeric Keys	[Axis Key] and [Numeric Key] are generic names for the keys for axis operation and number input.
	Keys pressed simultaneously	When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, e.g. [SHIFT]+[COORD].
	Mode Switch	Mode Switch can select three kinds of modes that are denoted as follows: REMOTE, PLAY or TEACH. (The switch names are denoted as symbols)
	Button	The three buttons on the upper side of the Programming Pendant are denoted as follows: START, HOLD, or EMERGENCY STOP. (The button names are denoted as symbols)
	Displays	The menu displayed in the Programming Pendant is denoted with { }. e.g. {JOB}

Registered Trademark

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or bland names for each company or corporation. The indications of ® and ™ are omitted.

Robot Disposal

WARNING

- Take precautionary measures to prevent the Robot from overturning, such as anchoring it firmly, etc., even when temporarily storing it before disposal.

Failure to observe this instruction may cause overturning of the Robot, which may result in personal injury.

CAUTION

- Do not modify the Robot or the Controller

Failure to observe this instruction can cause fire, mechanical failure, or malfunction, which may result in personal injury and/or equipment damage.

NOTICE

- When disposing of or recycling the Robot, follow the applicable national/local laws and regulations.
- This symbol is applicable in some locations.

The wheelie bin symbol on this product, manual or its packaging indicates that at the end of life the product should enter the recycling system. It must be disposed at an appropriate collection point for electrical and electronic equipment (EEE) and should not be put in the normal waste stream.

Table of Contents

1 Introduction

MotoSight™ 2D is part of the YASKAWA family of standardized solutions. It is a fully integrated hardware/software 2D vision solution, supported by YASKAWA. MotoSight™ 2D enables the Controller to communicate with a camera.

The MotoSight™ 2D includes a Programming Pendant application that assigns supported vision tool results directly to robot variables for use in robot programs.

1.1 System Requirements

MotoSight™ 2D only works with specific software versions. If there are any questions regarding system versions, contact the local YASKAWA representative (see *section 1.3 "Reference Documentation"*). See system requirements in *Table 1-1*:

Table 1-1: System Requirements

Function	YRC1000micro	YRC1000	DX200	FS100	DX100
Controller Software	Any that works with YRC1000micro controller	Any that works with YRC1000 controller	Any that works with DX200 controller	Any that works with FS100 controller	DS1.XX.00A (JP/US)-14 (MotoPlus enabled) and 64 MB Pendant
Vision Device	Cognex In-Sight 8000 Series cameras (and most POE cameras supporting both EasyBuilder and Spreadsheet mode).				
		MS-Series or In-Sight 7000 Series two cables cameras (and most two cable cameras supporting both EasyBuilder and Spreadsheet mode).			
MotoSight Global Edition Version	Use with YASKAWA MotoSight Version between 5.0.0 and 6.0.0 (excluded).				DX100: Requires Programming Pendant.Net Library Upgrade
MotoSight HMI Protocol Version	Use with YASKAWA MotoSight Version 6.0.0 or higher and In-Sight Firmware 6.0.3 or higher.[a)]				

a New firmware may not be available on older camera models.

1.2 About This Document

This manual provides a description of functionality, usage instructions, as well as application examples for the MotoSight™ 2D system. For details on specific system components in this document, refer to the included documentation package.

NOTICE

This manual documents a standard Motoman system. If the system is custom or modified, use this manual in conjunction with the drawings, schematics, and parts listing (Bill of Material) for the specific system.

The included documentation package consists of schematics, and parts listing for the Motoman system.

1.2.1 Major Components

The MotoSight™ 2D system includes the following major components:

- YASKAWA MotoSight Image Sensor
- In-Sight Explorer Software (version 4.8.5 and higher)
- YASKAWA MotoSight (version 5.0.0 or higher)
- YASKAWA MotoSight™ 2D Pendant application
- Motoman manipulator
- One controller assembly
- One Programming Pendant (located with the controller)

1.3 Reference Documentation

For additional information on individual components of the MotoSight™ 2D system, refer to *Table 1-2* for various documentation included with the system:

Table 1-2: Reference Documentation

Manual Description	YRC1000	YRC1000micro	DX200	DX100	FS100
YASKAWA Manipulator Manual	Based upon Manipulator Model				
YASKAWA Operator's Manual for your Application	Based upon Application Installed.				
Vendor manuals not manufactured by Motoman	N/A				
YASKAWA Controller Manual	*RE-CTO-A221*	*RE-CTO-A222*	*RE-CTO-A220*	*RE-CTO-A217*	*RE-CSO-A043*
YASKAWA Maintenance Manual	*RE-CHO-A114*	*RE-CHO-A115*	*RE-CHO-A113*	*RE-CHO-A108*	*RE-CHO-A111*
YASKAWA Concurrent I/O Manual	*RE-CKI-A467*	*RE-CKI-A469*	*RE-CKI-A465*	*RE-CKI-A453*	*160621-1CD*
YASKAWA Macro Command Function Manual	*HW1483378*	*HW1484488*	*HW1482041*	*HW0485673*	*HW1480720*
YASKAWA INFORM User's Manual	*RE-CKI-A466*	*RE-CKI-A468*	*RE-CKI-A464*	*RE-CKI-A452*	*RE-CKI-A458*
YASKAWA Relative Job Function Manual	*HW1483390*	*HW1484476*	*HW1481817*	*HW0482494*	*HW1480734*

YASKAWA Representative Information

The following information is for a YASKAWA representative in America, for other locations refer to the back cover.

(937) 847-3200

For **routine** technical inquiries, you can also contact a YASKAWA representative at the following e-mail address:

techsupport@motoman.com

When using e-mail to contact a YASKAWA representative, 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.

NOTICE

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 a YASKAWA representative at the telephone number shown above or on the back cover.

Please have the following information ready before calling a YASKAWA representative:

- System: MotoSight™ 2D
- Manipulator: _____
- Positioner: _____
- Primary Application: _____

  Select {MAIN MENU} > {SYSTEM INFO} > {VERSION} - APPLI:
- Robot Controller: _____

  YRC1000micro/YRC1000/DX200/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 Manipulator data plate
- Robot Sales Order Number: _____

  Located on the Robot Controller data plate
- Warranty ID: _____

  Located on Robot Controller

2 Installation and Setup

The customer is responsible for supplying and installing the PC, and camera if not supplied by YASKAWA. If using a non-MotoSight series camera refer to the Cognex In-Sight vendor documentation for complete installation instructions for your camera sensor and equipment.

The MotoSight 2D Pendant application hardware may vary depending on the robot controller model, the number of cameras and model of the cameras. MotoSight™ 2D can support up to four cameras. The Cognex cameras come in two versions:

- **Two-cable version** - power and Ethernet use two separate cables (like the MS-series, the IS7000 series).
- **POE (power over Ethernet) version** - single cable combining both the Power and Ethernet (like the IS8000-series).

Fig. 2-1(a) through *Fig. 2-1(c)* are a few examples of hardware combinations.

For further information refer to the system specific hardware configuration, refer to the system electric drawings or contact the local YASKAWA representative.

Fig. 2-1(a): Basic Equipment Attachments YRC1000 Controller

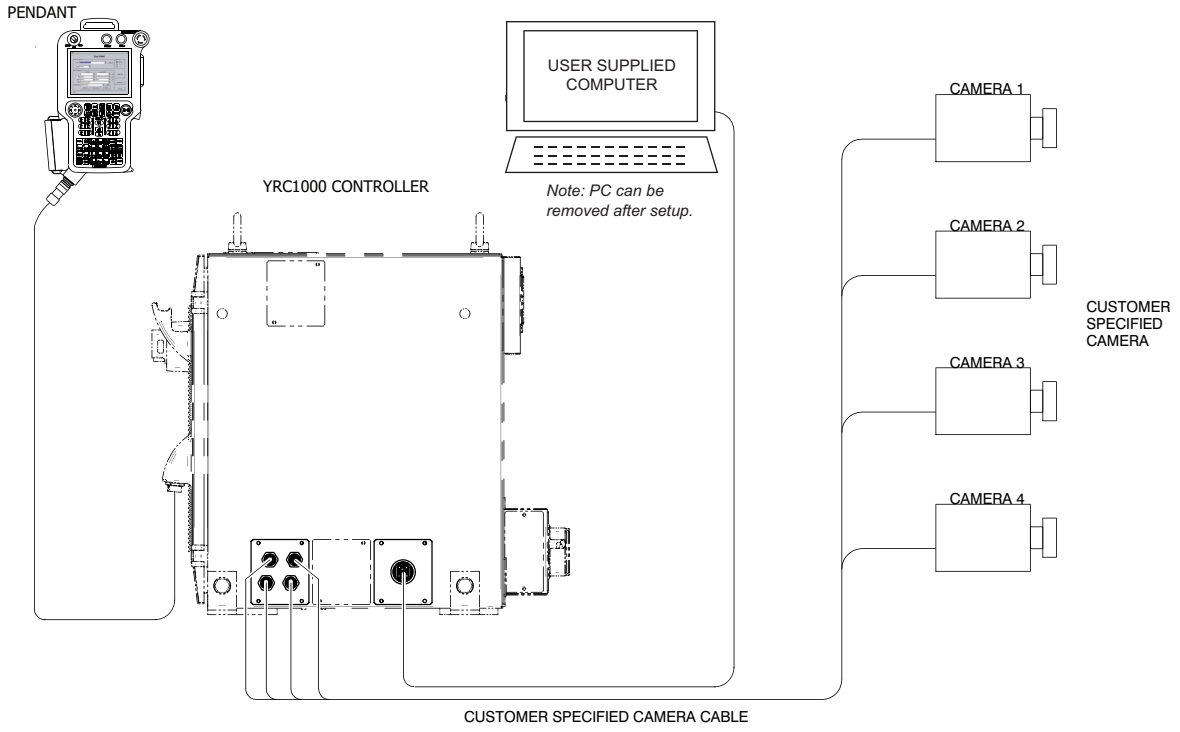


Fig. 2-1(b): Basic Equipment Connections YRC1000micro Controller

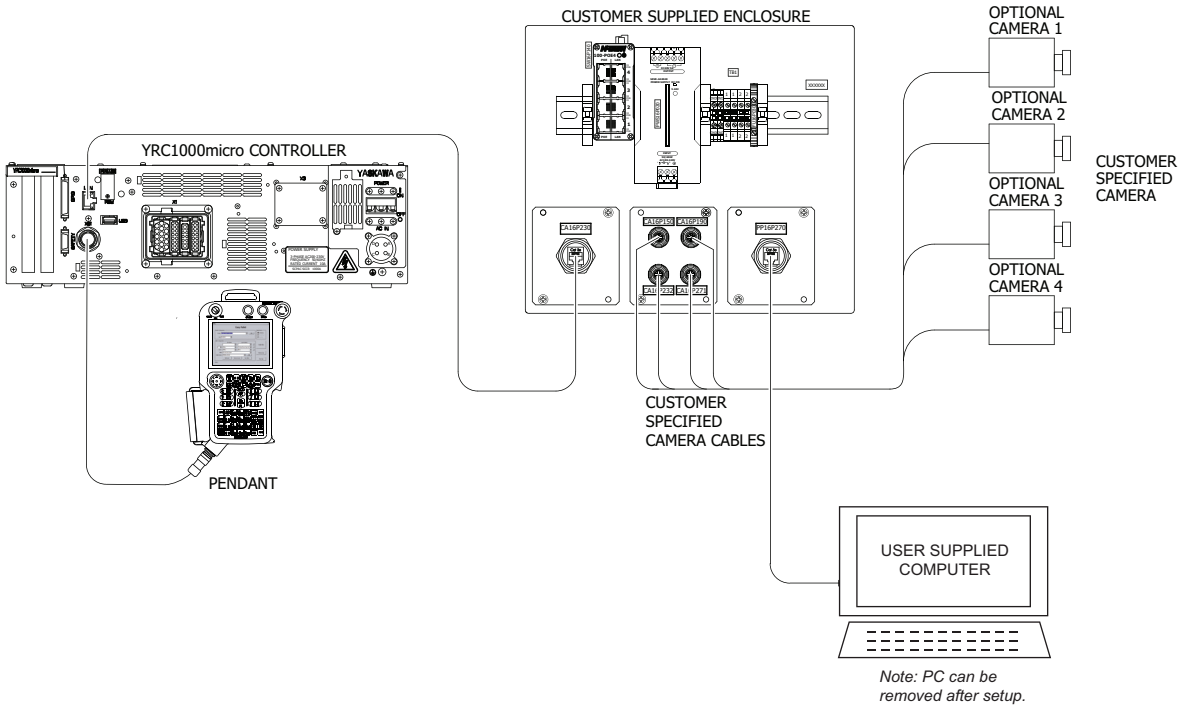
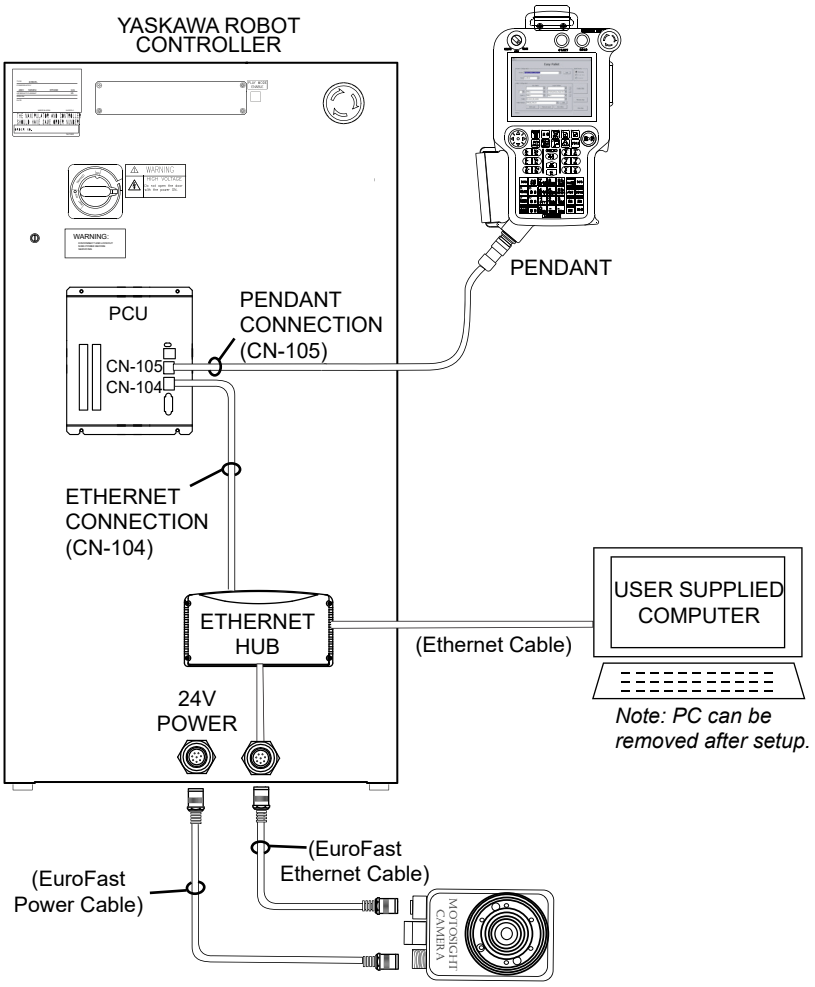


Fig. 2-1(c): Basic Equipment Connections DX200, DX100, and FS10



2.1 Network IP Addresses

The IP addresses for the YRC1000micro/YRC1000/DX200/DX100/FS100 controllers are in *Table 2-3*.

The YASKAWA MotoSight system follows the configuration of the IP addresses from the factory. If needing to change the addresses, follow the instructions in *section 2.2*

Table 2-3: Controller IP Addresses

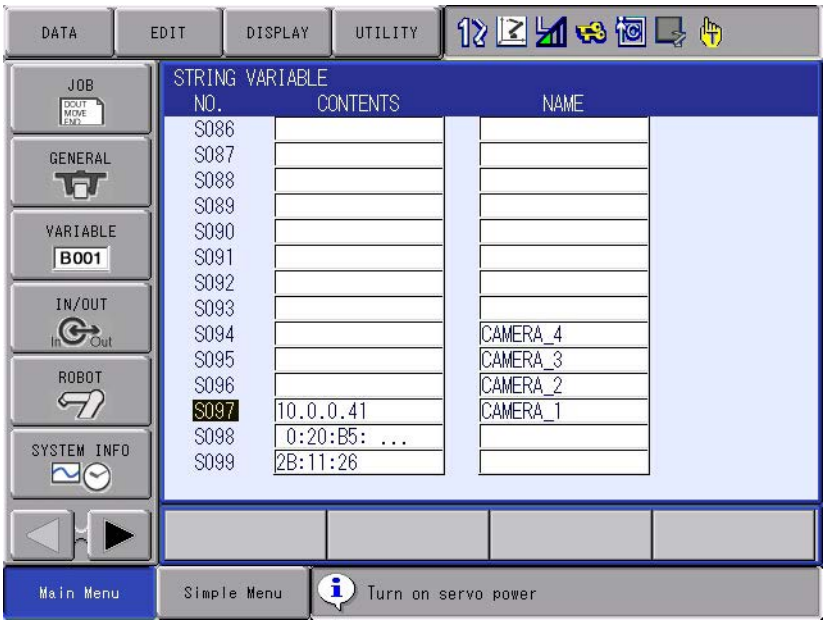
IP Address	YRC1000micro/ YRC1000/ DX200/DX100	FS100	Allowable Range
Robot	192.168.1.31	10.0.0.2	**FS100**: Any valid IP address[a]. **Any Controller Except FS100:** Any valid IP address other than 10.0.0.x.
Camera1	192.168.1.41	10.0.0.41	Any IP address that puts the camera in the same subnet address space.
Camera2	192.168.1.42	10.0.0.42	
Camera3	192.168.1.43	10.0.0.43	
Camera4	192.168.1.44	10.0.0.44	
Computer	192.168.1.45	10.0.0.45	Any IP address that puts the computer in the same subnet address space.
Subnet Mask	255.255.255.0	255.255.255.0	Always set to 255.255.255.0.

a) Changing the IP address of the FS100 controller to an address outside the 10.0.0.x address range requires the Programming Pendant address to change to stay within the subnet mask.

2.2 Setting Camera IP Address in the Robot Controller

Enter the IP Addresses of the camera(s) into string variables within the robot controller.

Fig. 2-2: String Variable Window



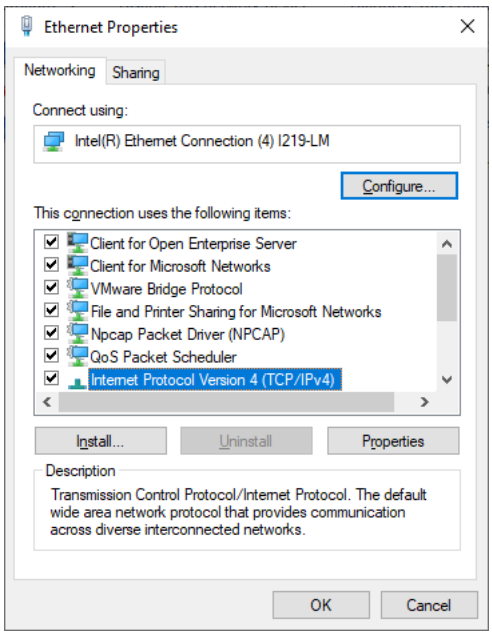
If loading the IONAME.dat file, the file names the variables. If not, the camera IP Addresses are;

- S097 - Camera 1
- S096 - Camera 2
- S095 - Camera 3
- S094 - Camera 4

2.3 PC Network Settings

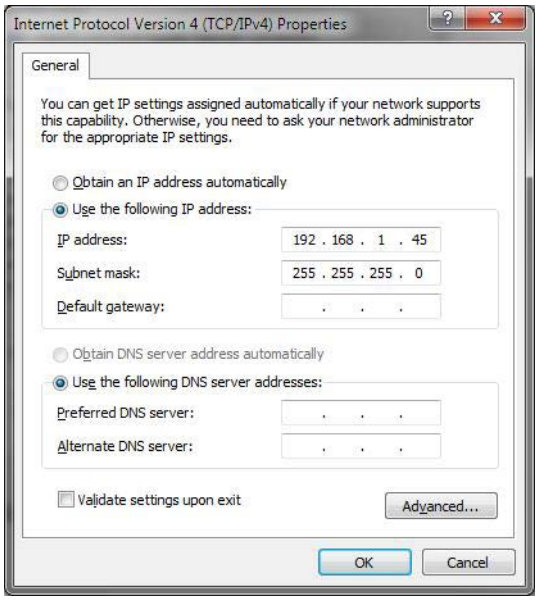
1. Open Network Connections in Control Panel.
   – {Start} ⟶ {Settings} ⟶ In the “Find a setting” search bar, type “Network Connections” and press Enter.
2. Right-click on the desired connection (typically Ethernet) from the Network Connections window and select {Properties].
   – The Ethernet Properties window appears.

Fig. 2-3: Ethernet Properties Window



3. From the “Networking” tab, highlight “Internet Protocol Version 4 (TCP/IPv4)” from the “This connection uses the following items:” list and press {Properties}. The Internet Protocol (TCP/IP) Properties window appears.

Fig. 2-4: IP Address Settings



4. Select “Use the following IP address:”.
5. Set the IP address and subnet mask so that they are on the same network as the robot and camera(s).

NOTICE

The IP addresses for the PC, YRC Controller and In-Sight camera are all set on the same network.

6. Select the “Use the following DNS server addresses:”. Leave both addresses blank.
   - Preferred DNS server: Leave blank
   - Alternate DNS server: Leave blank
7. Click {OK} and close all open windows.

2.4 In-Sight Software Setup

The following instructions are based on In-Sight Explorer ver. 6.0.

2.4.1 Install Software

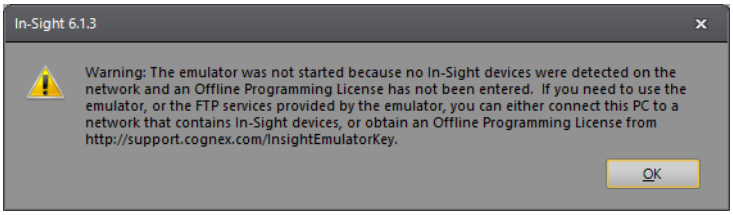
Install the Cognex In-Sight Explorer software. Refer to Cognex documentation for PC requirements and detailed instructions.

2.4.2 First Time Use

Start the In-Sight Explorer program from the PC.

When running the In-Sight Explorer software for the first time, you may receive the following warning:

Fig. 2-5: Warning! Camera Not Found



If you receive this warning, modify the IP address of the camera as described below. If no warnings appear and the camera is found, verify the IP address of the camera as described in *section 2.4.2.2*.

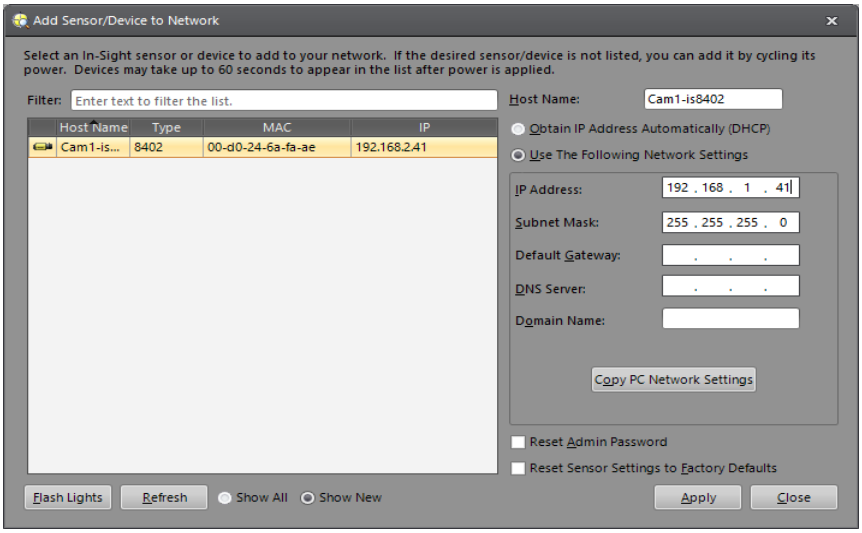
2.4.2.1 Modify Camera IP Address

1. Locate the camera, select {System} ⟶ {Add Sensor/Device To Network…} from the menu. The “Add Sensor/Device to Network” window appears.

NOTICE

If camera does not appear in the list, try selecting {Show All} and/or clicking the {Refresh} button.

Fig. 2-6: Add Sensor/Device to Network Window



2. Select a camera from the list and modify the network settings including IP address and Subnet Mask to match the settings shown.
3. Click {Apply}. A message box appears stating that network settings will be change and existing communications with the device will be broken.
4. Click {OK}. A message box appears stating that the “Network settings are changed successfully.”
5. Click {OK}.
6. Click the [Close] button on the “Add Sensor/Device to Network” window.

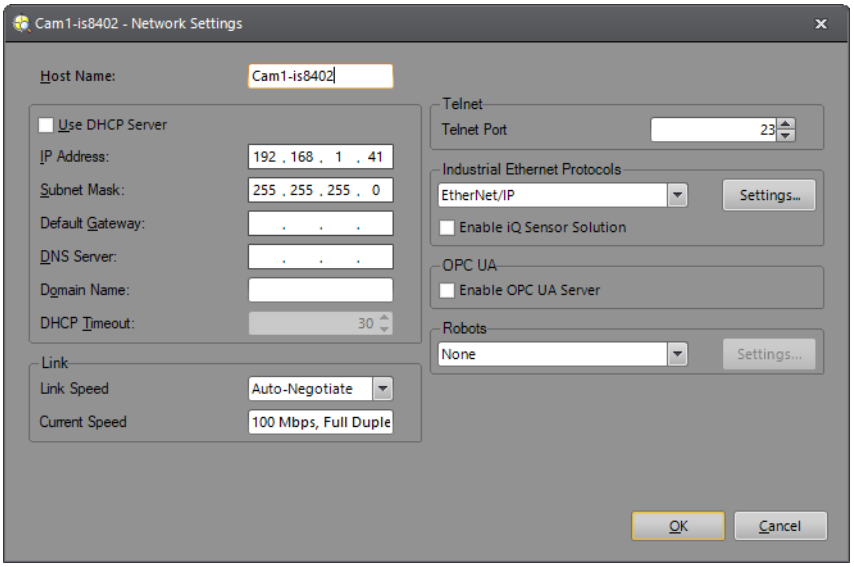
NOTICE

If the IP address is changed, In-Sight Explorer may need to be closed and the In-Sight Camera may need to be manually powered down and back up and In-Sight Explorer restarted before the new IP address is correctly recognized.

2.4.2.2 Verifying IP Address

1. Put the camera Offline, select {Sensor} ⟶ {Online}.
2. To verify the IP address, select the camera host name from the In-Sight Network window and select {Sensor} ⟶ {Network Settings...} from the menu. The Network Settings window appears.

Fig. 2-7: Network Settings Window



3. Verify the IP address and Subnet Mask. If they need to be changed, type in the correct information and click [OK].

4. If necessary, click [Yes] in the message box that appears stating that the camera must be rebooted.

NOTICE

If the IP address is changed, In-Sight Explorer may need to be closed and the In-Sight Camera may need to be manually powered down and back up and In-Sight Explorer restarted before the new IP address is correctly recognized.

2.4.3 Loading the Camera Job

This operation loads the MotoSight2D job template to the In-Sight Sensors.

1. Double-click on the camera in the “In Sight Network” Window.
2. Select {File} ⟶ {Open Job...}.
3. Select the folder containing the template supplied by YASKAWA.
4. Select and load the appropriate template job based on your camera firmware:
   – Template version 506 is for cameras containing firmware up to 4.10.5.
   – For cameras with firmware starting with 5.x try selecting the template that closely matches the firmware version of the camera.
     • For example, a camera with 5.5.0 uses MS2D-**-550.job template. A camera with 5.7.4 firmware uses MS2D-**-573.job template.
   – Starting with MS2D 5.4.2 changes were made to increase transfer speed. Templates are optimized for this change and are designated by ending with the digit '1'.
     • For example MS2D-**-5731.job is the optimized version of MS2D-**-573. MS2D 5.4.2 and up can work with non-optimized templates but for a maximum transfer speed use the optimized versions.

NOTICE

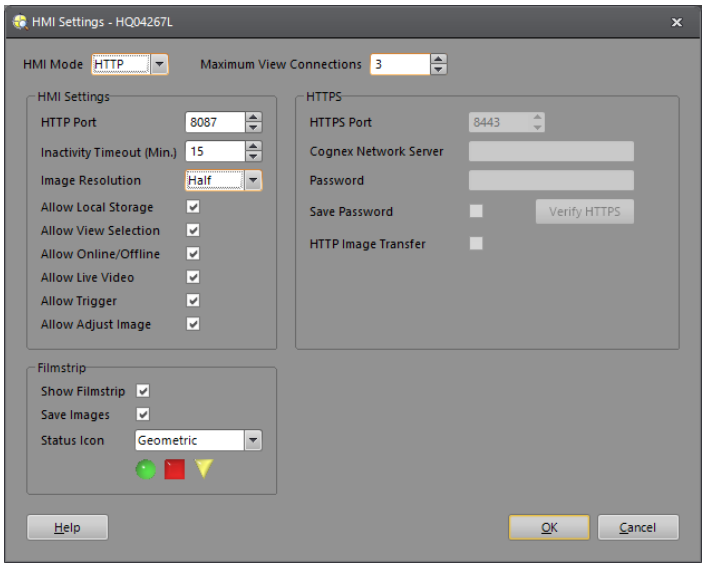
- “**” represents the abbreviated language on the Template job name.
- If you do not have the MS2D template or would like to check for updates, contact the local YASKAWA representative.

2.4.4 HMI Settings

For MS2D 6.x, changes are made to use the In-Sight HMI protocol. In-Sight Camera Firmware 6.0.3 or later is required. For a proper connection to be established, the HMI settings must be properly set.

1. Double-click on the camera in the “In Sight Network” Window.
2. Select {Sensor} ⟶ {HMI Settings} to display the HMI Settings window.

Fig. 2-8: HMI Settings



3. Verify:
   - **HMI Mode:** is set to “HTTP”
   - **Maximum View Connections:** is set to “2” or more.
     - 3 connections is recommended for simultaneous connections from the Robot Controller, Programming Pendant, and PC browser.
   - **HTTP Port:** 8087
   - **Allow** options: All have a check-mark

NOTICE

There may be a prompt to restart the camera for changes to take effect.

2.4.5 TCP/IP Communication Settings

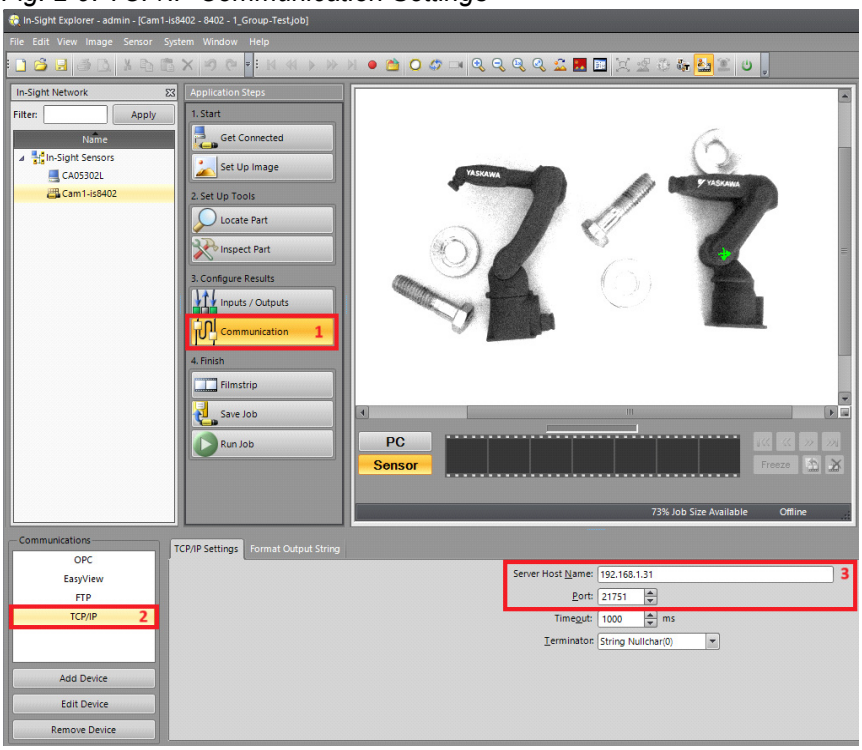
For MS2D 5.x, the camera job template sends a TCP/IP message to signal to the controller that new data is ready. The TCP/IP communication information must match the robot controller information.

1. Click the ‘Communication’ link under ‘Application Steps’ section.
2. In the lower ‘Communications’ selection box, select ‘TCP/IP’.
3. Check that the ‘Server Host Name’ field matches the IP Address of the robot controller. (For default I/P address values refer to Table 2-3).
4. Check that the ‘Port’ field matches the port number for the designated camera number.

– Camera 1 port – 21751
– Camera 2 port – 21752
– Camera 3 port – 21753
– Camera 4 port – 21754

5. If the information is incorrect, set the camera mode to ‘Offline’ and edit the values to the correct ones.

Fig. 2-9: TCP/IP Communication Settings



3 Operation

This section provides a general outline of the operating procedures for the MotoSight 2D Pendant application.

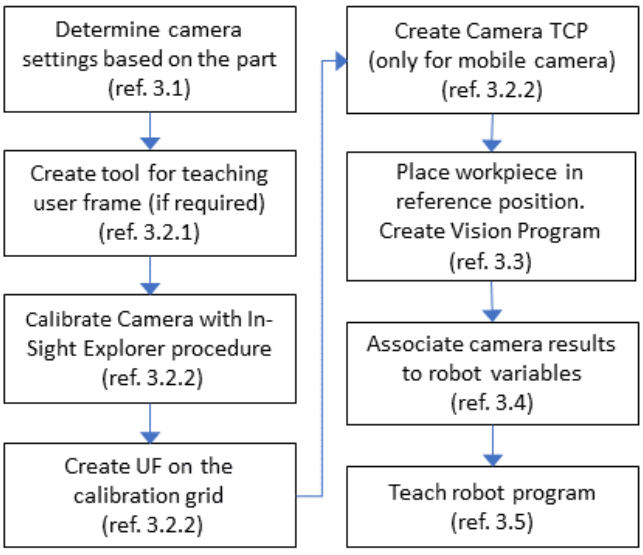
Vision systems process images using “tools” created in the vision program. These vision tools can perform a variety of functions, such as; counting the number of parts, locating a part in the field of view (FOV), measuring a part, counting specified features on a part, as well as many other functions. Once a vision program (referred to as a “job” by Cognex) processes an image, it creates a result value for each function in the job. Start each new vision job using the default MotoSight 2D Pendant application template. The template allows the vision tool results to be available for assignment to the robot variables. If a new vision job is started from scratch without using the MotoSight 2D Pendant application template, the robot will not interface with that camera job.

The programmer must designate where the camera job tool results are stored in robot memory. Using the MotoSight 2D Pendant application screen, the camera results can be assigned to a compatible robot variable type (Byte/Real/Robot Position) depending on the tool result type. Once assigned, the camera job tool result values are transferred to the robot variables each time the camera is triggered via the button on the MotoSight 2D Pendant application screen, using the INSPECT macro in a robot job, or the In-Sight Explorer software.

NOTICE

Refer to the YASKAWA Operator’s manual included with the system for more information on the robot variable types.

For more detailed operating information, refer to the specific component manuals that are part of the MotoSight 2D system documentation package (see *section 1.3 “Reference Documentation” on page 1-3*)



3.1 Determine Camera Settings

Based on the camera field of view, working distance, and workpiece type and size, determine the physical position of the camera and required lighting of the part. The camera can be in a fixed position or mounted on the robot (mobile camera).

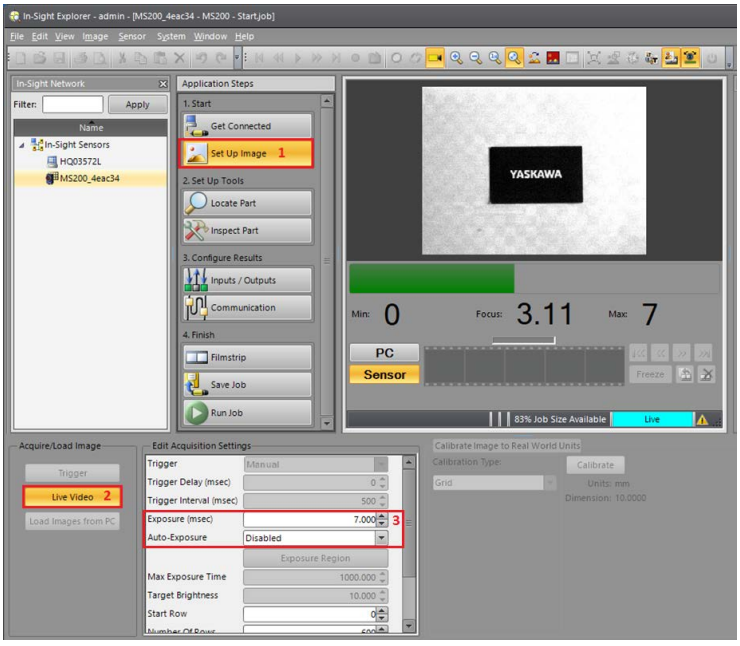
Fig. 3-1: Cameras

Fixed Camera

Mobile Camera

1. Connect the camera and select “Set Up Image” using the Cognex In-Sight Explorer application.
2. Switch camera to “Offline”
3. Press {Live Video}.
4. Adjust the camera focus and exposure to get a clear image and consistent illumination of the part.
5. Press {Live Video} to stop the image streaming and set back Online, once complete.

Fig. 3-2: Cognex In-Sight Explorer



For more details on setting up an image in In-Sight Explorer refer to the Cognex In-Sight Explorer documentation.

3.2 Camera Calibration

To use the vision results for part correction, the camera and robot must have a common point of reference. The normal position result unit for a processed image is in “pixels”. The number of pixels within the field of view (FOV) is a fixed number based on the camera. As the field of view is expanded the amount of area each pixel represents also expands. The Cognex software includes a calibration command that allows the user to set the linear length for each pixel.

This calibration can also compensate for lens and perspective distortion.

NOTICE

Once this calibration is completed, if the distance between the camera and the part changes (working distance,) the calibration changes and is no longer valid.

3.2.1 Create a TCP for Teaching the User Frame

A user frame must be defined for the calibration grid. If the calibration grid positions cannot be reached using the defined tool TCP, a modified TCP can be used to program the user frame. If required, a threaded pointer can be created and attached to the tool.

1. Create a threaded pointer of a known length and attach it to the End of Arm Tooling (EOAT).
2. From the Programming Pendant, select “ROBOT” under the Main Menu.
3. Select “TOOL”. The TOOL COORDINATE window appears.
4. Select the desired tool number using the arrow key(s) and press [SELECT].
   The TOOL window appears
5. Calibrate the TCP by using the 5 points calibration method refer to the following manuals for detailed instructions:
   - **YRC1000 Instructions**, section 8.3.2 “Tool Calibration” (RE-CTO-A221)
   - **YRC1000micro Instructions,** section 8.3.2 “Tool Calibration” (RE-CTO-A222)
   - **DX200 Instructions**, section 8.3.2 “Tool Calibration” (RE-CTO-A220)
   - **DX100 Instructions**, section 8.3.2 “Tool Calibration” (RE-CTO-A215)
   - **FS100 Instructions**, section 8.1.2 “Calibrating Operation” (RE-CTO-A218)

3.2.2 Camera Calibration with In-Sight Explorer

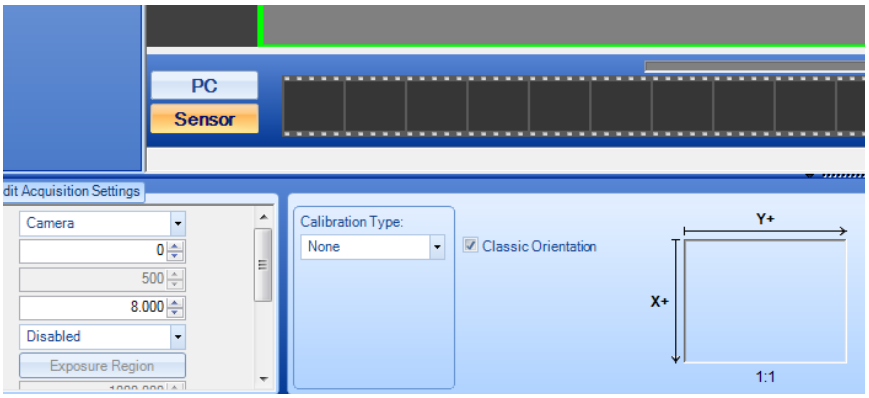
The camera can be calibrated using one of the three approaches presented in this section.

3.2.2.1 Grid Camera Calibration

The grid calibration generally gives the most accurate results but may not be available on some older cameras.

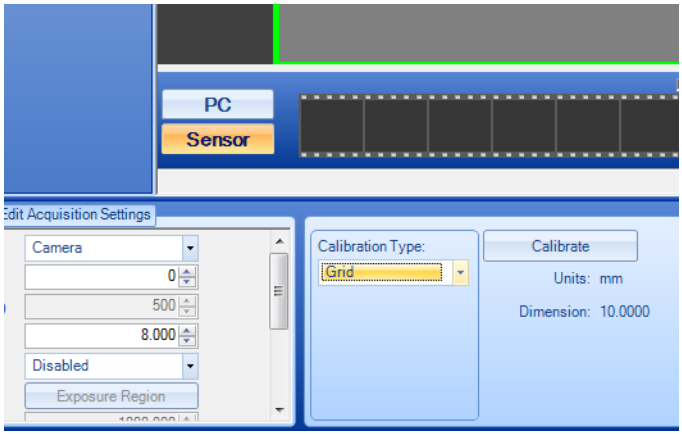
1. Position the camera above the work area at the appropriate height to achieve the required field of view.
2. If the camera is mounted on the robot arm, teach the robot position/ height above the work area using the Programming Pendant.
   – Record this position to an unused P-variable as “CALIB POS” or to a new robot job for quick reference, allowing easily returning to this exact position later in the process.
3. From In-Sight Explorer select “Set Up Image”
4. In the calibration area located at the bottom of the In-Sight Explorer window check the “Classic Orientation” check box.

Fig. 3-3: In-Sight Explorer Window Classic Orientation Check Box



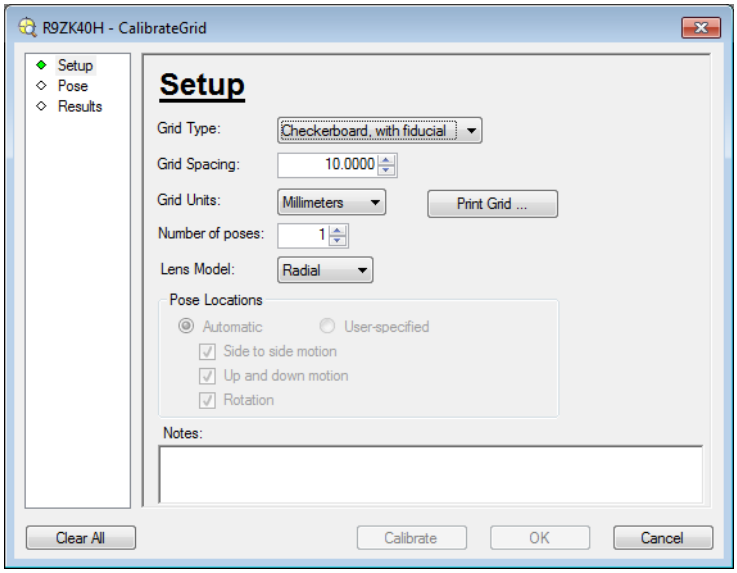
5. Select “Grid” from the “Calibration Type” drop down list.

Fig. 3-4: In-Sight Explorer Window Selecting Calibration Type



6. Click the {Calibrate} button. The “CalibrateGrid” window appears.

Fig. 3-5: Setup CalibrateGrid Window



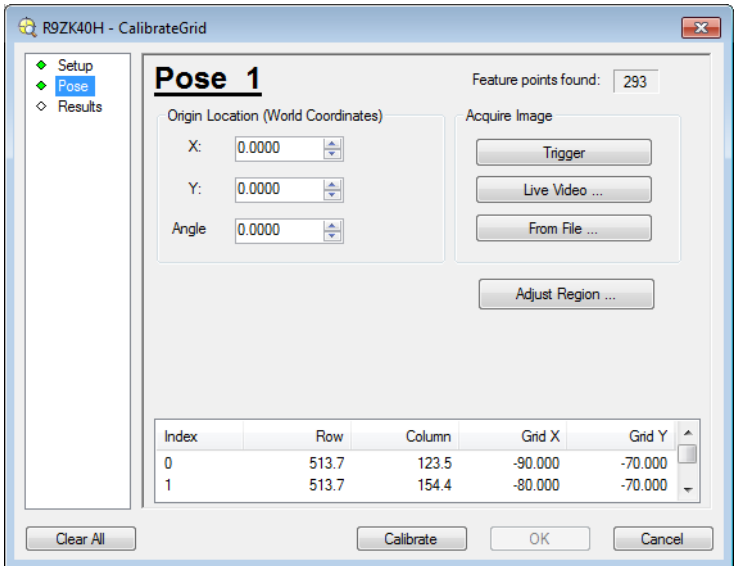
7. Select “Checkerboard, with Fiducial” from the “Grid Type” drop down list.
8. Set the Grid Spacing appropriately for the camera field of view.
9. Select “Millimeters” from the “Grid Units” list.
10. To print the calibration grid click the {Print Grid} button. Then click the {Print} button.
11. Place the calibration grid on the work area in the camera field of view.

NOTICE

For a fixed camera setup, make sure grid is at the same work height as the part.

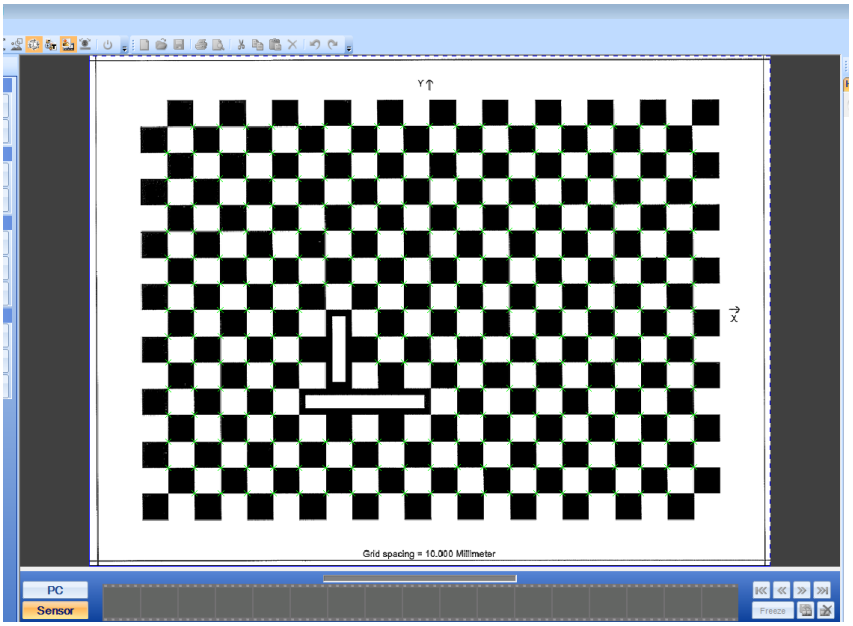
12. Click {Pose} in the CalibrateGrid Window.

Fig. 3-6: Pose CalibrateGrid Window



13. Click {Live Video} to adjust the camera focus and aperture so the calibration grid is in sharp focus. Ensure the calibration grid is within the camera field of view.
14. Press the {Esc} key to exit “Live Video” mode.
15. Ensure all the feature points of the calibration grid are found.

Fig. 3-7: Feature Points of the Calibration Grid



16. From the “CalibrateGrid” window click the {Calibrate} button.
17. Click on the “Results tab” to view the calibration results and verify that Calibration score is below 0.5 pixels.
18. Click {OK} to accept the calibration.

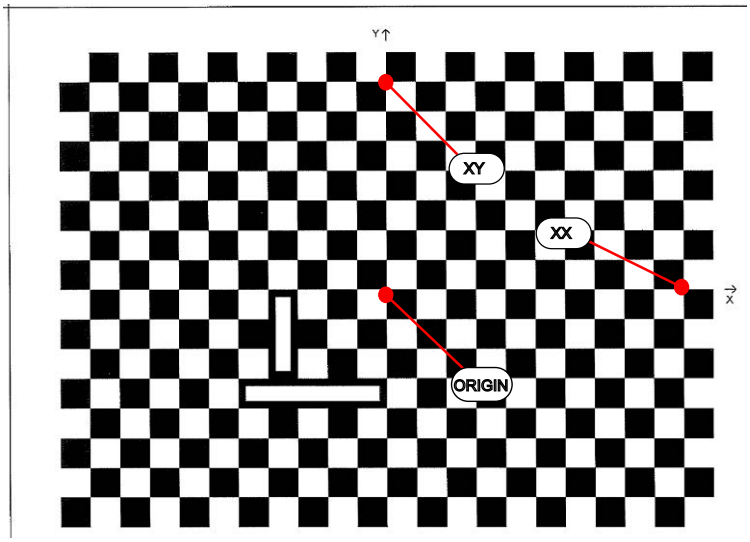
NOTICE

- If the calibration results are 0.5 pixels or above, adjust grid and camera settings and recalibrate.
- For best results the calibration grid must be completely visible within the camera field of view.

19. Save the calibration for the job before continuing, refer to *section 3.3.1.4*.

20. Create a user coordinate system for the calibration grid. Refer to “User Coordinate Setting” of the Controller manual for more information.
    – Follow the axis orientation direction indicated on the calibration grid.
    – The origin, XX and XY must be located as illustrated in *Fig. 3-8*.

Fig. 3-8: Calibration Grid

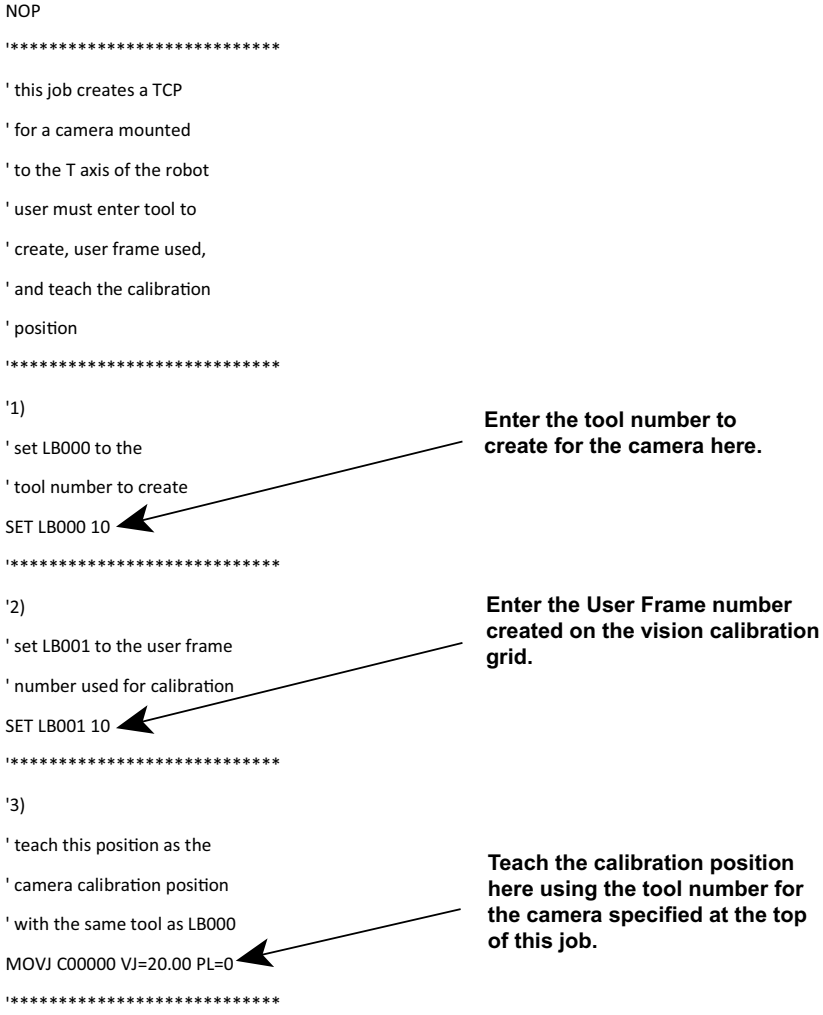


21. Return the robot to calibration position recorded in *step 2*.
22. If the camera is mounted to the EOAT of the robot, select the job to set the camera TCP as follows, otherwise skip *step 22* through *step 24*.
    a) Select “JOB” under the {Main Menu}.
    b) Select “SELECT JOB”. The JOB LIST window appears.
    c) Select the “TOOL” job from the list.

The “TOOL” job appears in the “JOB CONTENT” window.

Modify the job as noted in *Fig. 3-9*.

Fig. 3-9: Tool Job



23. Run the “TOOL” job.
24. Verify the Camera TCP.
    a) Press [COORD] button to select the tool coordinate.
    b) Press the [SHIFT] + [COORD] buttons (both should be held at the same time).
    c) Cursor to the tool number set in LB000 in the “TOOL” job.
    d) Go to live video mode on the EasyBuilder software (refer to EasyBuilder instructions).
    e) Rotate the camera using the Rz, Rx, and Ry keys.
    The camera display should remain in focus and the window should rotate about the origin point.

For reference, record values here:

Table 3-1: Calibration Values

Camera TCP#		
User Frame for Cal. Grid		
EOAT TCP#		

3.2.2.2 9-Point Calibration

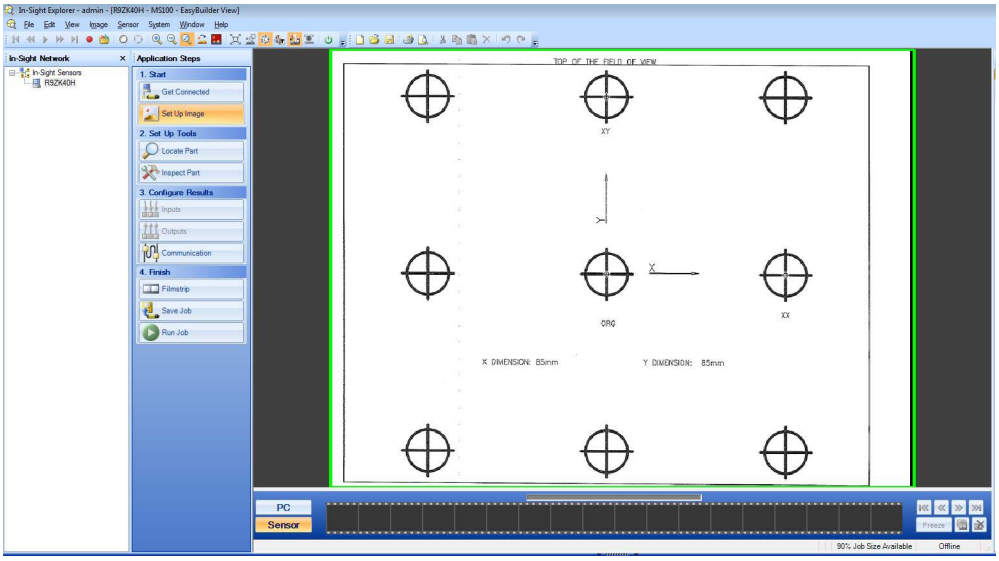
To calibrate the vision system proceed as follows:

1. Position the camera above the work area at the appropriate height to achieve the required field of view.
2. If the camera is mounted on the robot arm, teach the robot position/ height above the work area using the Programming Pendant.
   – Record this position to an unused P-variable as “CALIB POS” or to a new robot job for quick reference, allowing easily returning to this exact position later in the process.
3. Print a copy of the 9-point calibration grid included in the MotoSight 2D Pendant application.
4. Click “Live Video”. Adjust the camera focus and aperture so the 9-point calibration grid is in sharp focus. Ensure the calibration grid is within the camera field of view and the text “Top of the Field of View” is located at the top of the window. Exit “Live Video” mode.
5. From In-Sight Explorer select “Set Up Image”.
6. Place the 9-point calibration grid in the work area.

NOTICE

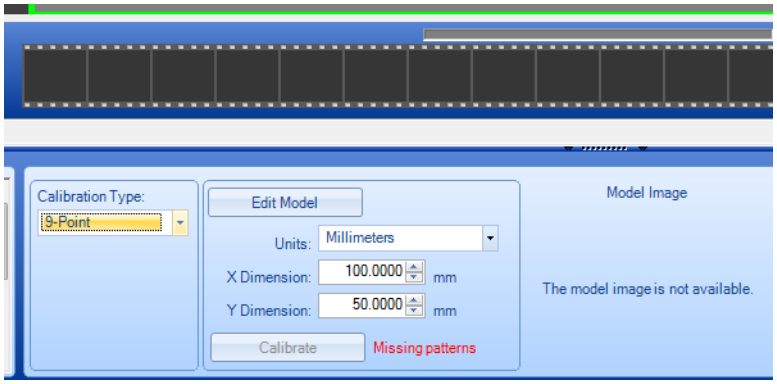
For a fixed camera setup, make sure grid is at the same work height as the part.

Fig. 3-10: 9-Point Field of View



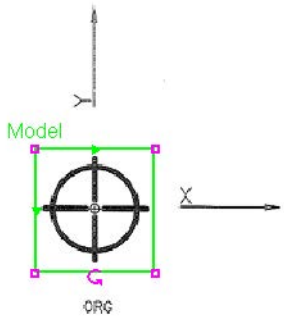
7. In the calibration area located at the bottom of the In-Sight Explorer window select “9-Point” from the “Calibration Type” drop down list.

Fig. 3-11: Selecting Calibration Type



8. Click the {Edit Model} button and train the target located near the center of the field of view by adjusting the “Model Region” around the target and clicking the {Train} button.

Fig. 3-12: Centering Target

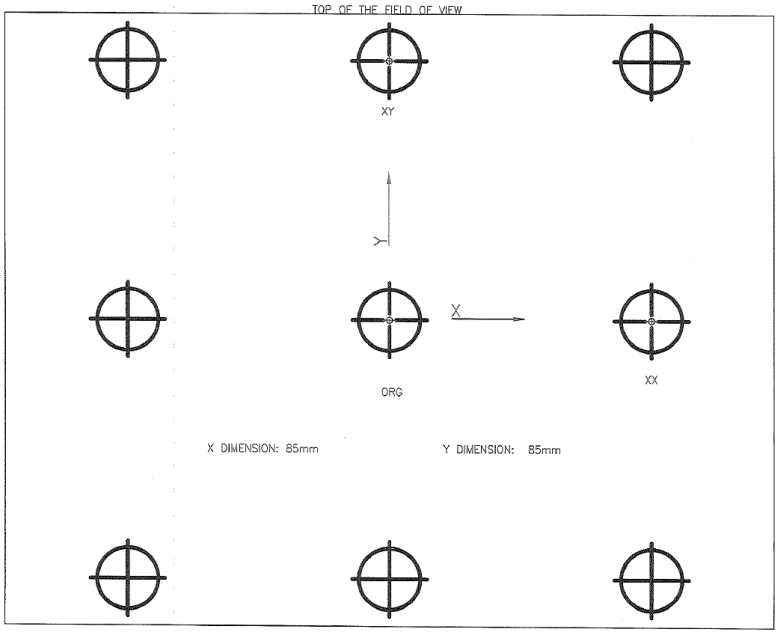


9. Ensure all 9 targets were found. If the camera failed to find all 9 targets ensure all targets are completely visible in the field of view.
10. Ensure “Millimeters” is selected. Also ensure the “X Dimension”, and “Y Dimension” are set properly. If using the 9-point grid included with MotoSight 2D Pendant application set each dimension to 85 mm.

11. Click the {Calibrate} button. If the calibration is successful the calibrated image will display. Save the vision program, by referring to *section 3.3.1.4*.

Fig. 3-13: 9-Point Calibration Success

Fig. 3-14: 9-Point Target



Teach a user frame as marked on the 9-point calibration grid.

12. If the camera is mounted to the EOAT of the robot, select the “TOOL” job to set the camera TCP as follows, otherwise skip *step 13* and *step 14*.

    a) Select “JOB” under the Main Menu.

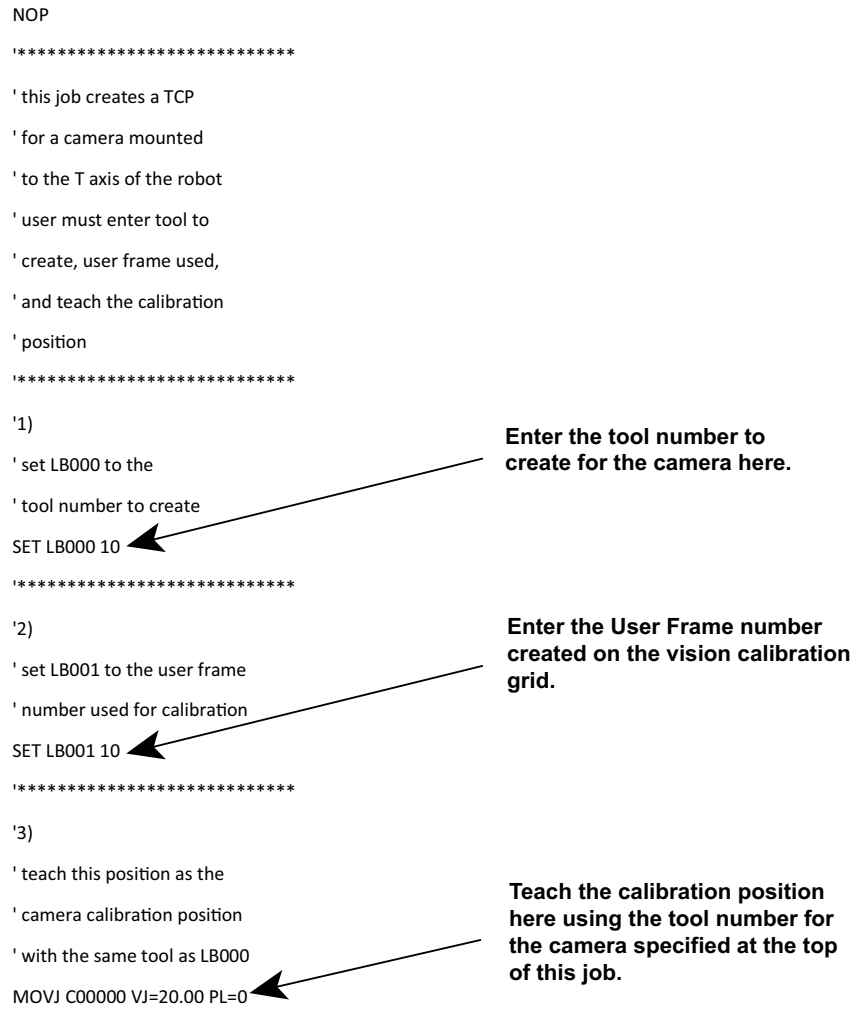
    b) Select “SELECT JOB”. The JOB LIST window appears.

    c) Select the “TOOL” job from the list.

The “TOOL” job appears in the “JOB CONTENT” window.

Modify the job as noted below.

Fig. 3-15: Tool Job



13. Run the “TOOL” job.

14. Verify the Camera TCP.

    a) Press [COORD] button to select the tool coordinate.

    b) Press the [SHIFT] + [COORD] buttons (both should be held at the same time).

    c) Cursor to the tool number set in LB000 in the “TOOL” job.

    d) Go to live video mode on the EasyBuilder software (refer to the EasyBuilder instructions).

    e) Rotate the camera using the Rz, Rx, and Ry keys.
    The camera display should remain in focus and the display should rotate about the Origin point of the calibration grid.

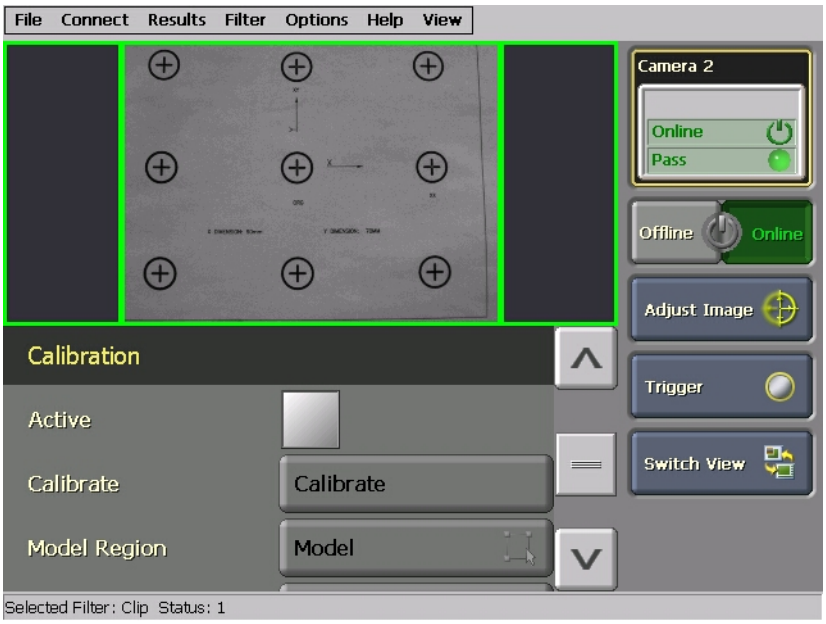
For reference, record values here:

Table 3-2: Calibration Values

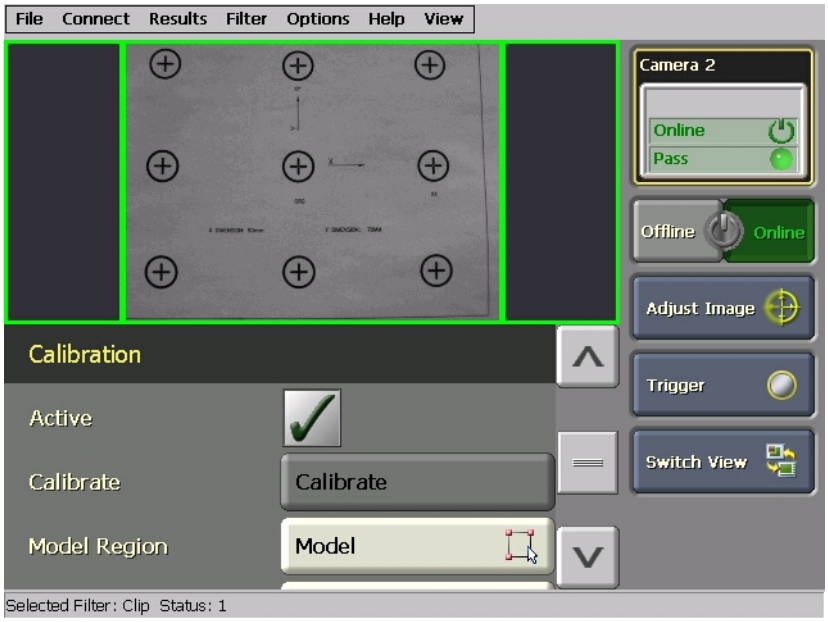
Camera TCP #		
User Frame for Cal. Grid		
EOAT TCP #		

3.2.2.3 Programming Pendant 9-Point Calibration

1. Print a calibration target of the size that will fill the largest portion of your field of view, at your working height. It may be necessary to shrink or enlarge the calibration target to accomplish the best fit. Scroll to the “Calibration” VisionView tag heading into view on the bottom of the screen.

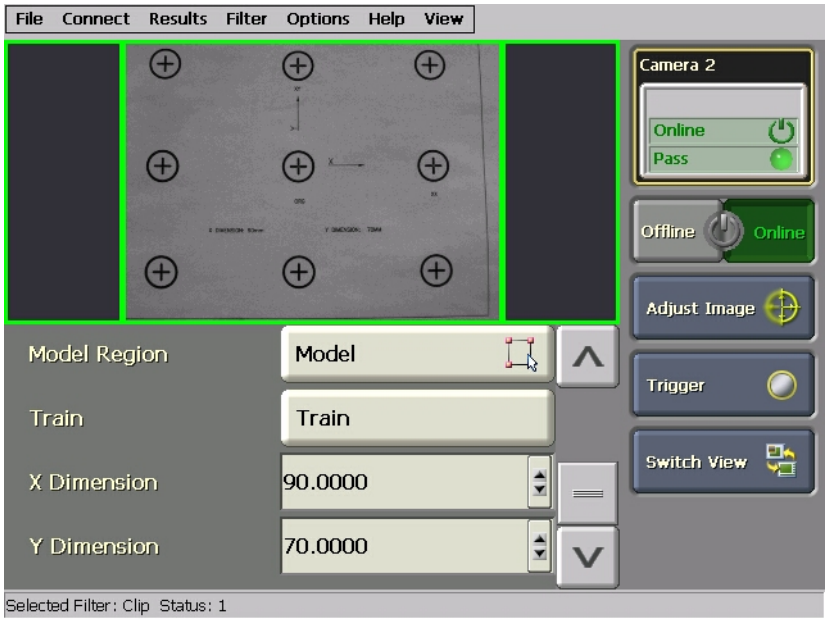


2. Click the Calibration “Active” check box to enable the calibration controls.



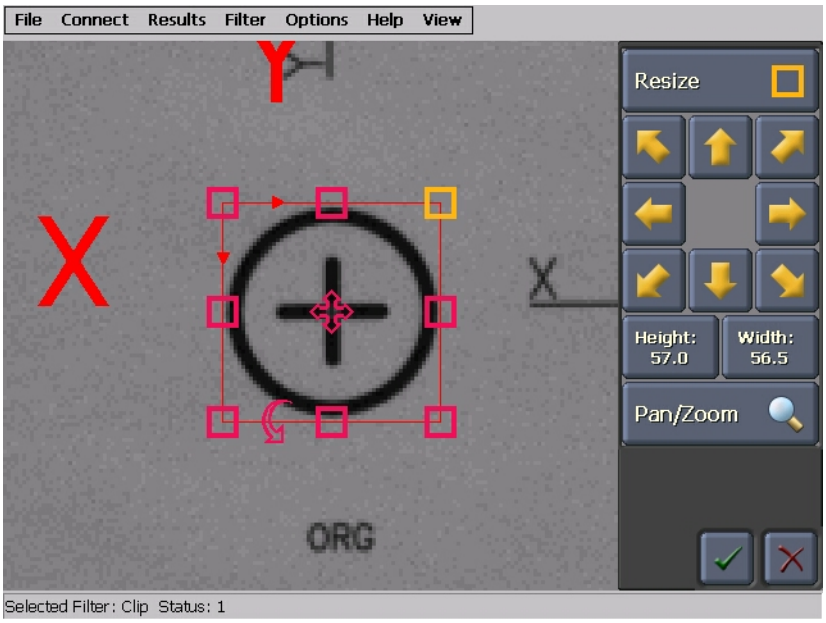
NOTICE

If you have re-sized the calibration target, input the new dimensions for the X and Y dimensions

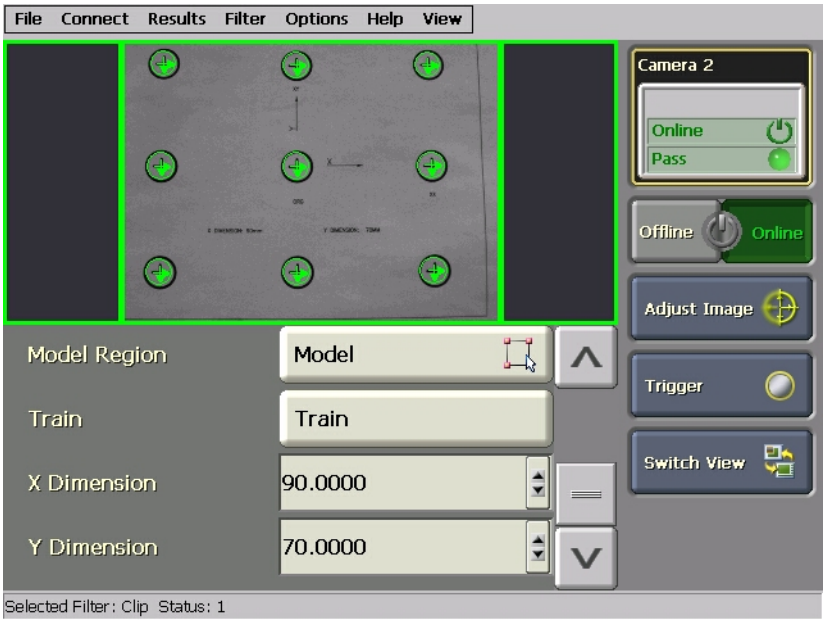


3. Press {Model}.

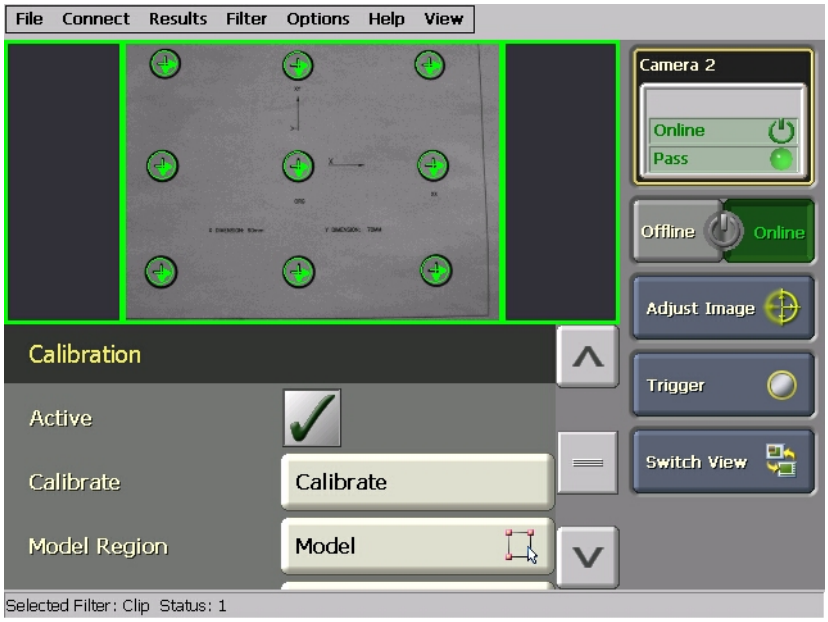
4. Adjust the model region to encompass the center target as shown. You may want to use the Pan/Zoom controls to ensure you can see the target with enough detail. When you are satisfied, press the {Check Mark}.



5. Press the {Train} button. You should see all nine targets identified with a crosshair signifying that each target was found. If there are any targets that are not found, you will need to re-verify the model teaching step or perhaps adjust the size/position of the target grid. Repeat this process until you have all nine targets found.



6. Scroll up until you can access the {Calibrate} button. Press it to register the calibration.



3.3 Create a Vision Program

Vision systems process images using “tools” created in the vision program. These vision tools 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 processing an image a camera job creates a result value for each function in the job.

Start each new vision job using the default MS2D template. The template allows the vision tool results to be available for assignment to the robot variables. If a new vision job is started from scratch without using the MS2D template, the robot will not be able to interface with that camera job.

The MS2D template should be loaded in the camera as the Start.job. If that is not the case, refer to *section 2.4.3 “Loading the Camera Job” on page 2-9*.

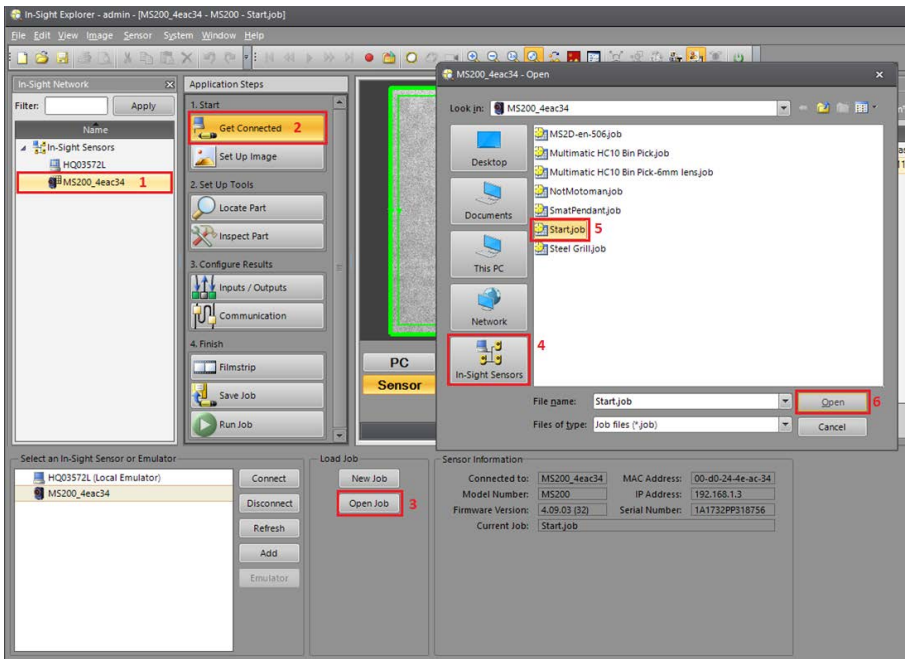
3.3.1 Simple Vision Job Example

This section will illustrate the procedures to create a simple vision job. For more advanced vision job and descriptions of the various tools available, refer to the Cognex In-Sight Explorer documentation.

3.3.1.1 Open “Start Job”

1. Double-click on the appropriate camera in the In-Sight network / In-Sight Sensors.
2. Put the camera in Offline mode by selecting “Sensor” ⟶ “Online” from the menu.
3. Select the “Get Connected” tab under application steps.
4. Press {Open Job} under the “Load Job” section.
5. Select “In-Sight-Sensors” and then select the correct Camera directory.
6. Load the camera template job “Start.Job”

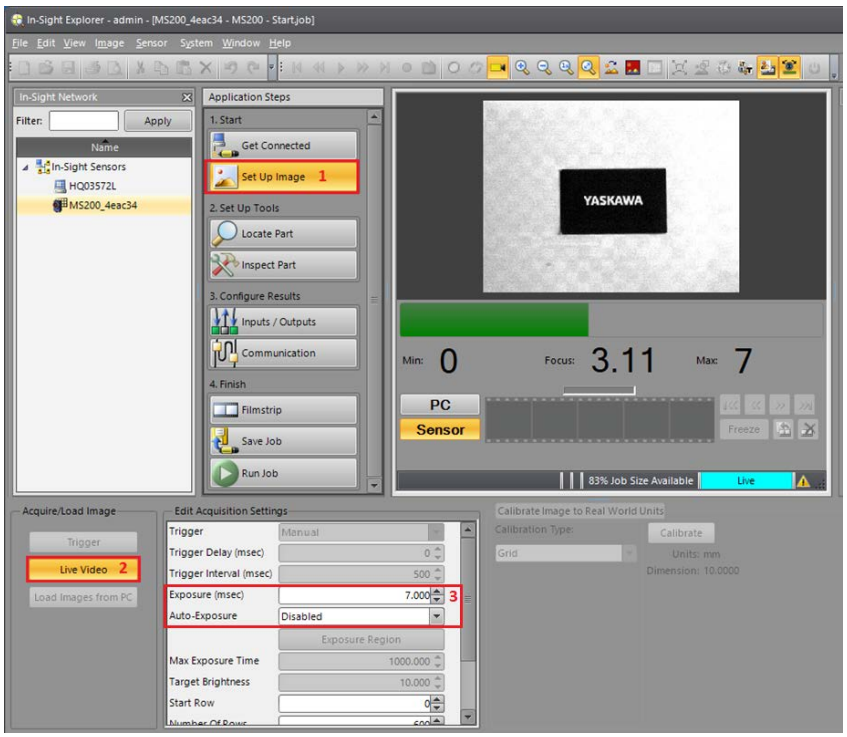
Fig. 3-16: Open “Start.Job”



3.3.1.2 Setting Up Image

1. Press “Set Up Image” then select “Live Video” on the Insight software.
2. Place an item of your choosing under the camera and adjust the focus and brightness.
   – Focus is normally adjusted on the camera lens.
   – The brightness can be adjusted by changing the lighting or adjusting the “Exposure” setting in the “Edit Acquisition Settings” section.
3. For a mobile camera, jog the robot in the Z-direction until the camera is at the correct working distance from the part (needs to be the same working distance as the calibration grid to the camera).
   – Record this position as the inspection position either in an unused P-Variable or to a new robot job for quick reference
4. Press “Live Video” to turn off live feed.

Fig. 3-17: Turning On Live Feed



3.3.1.3 Adding a Tool

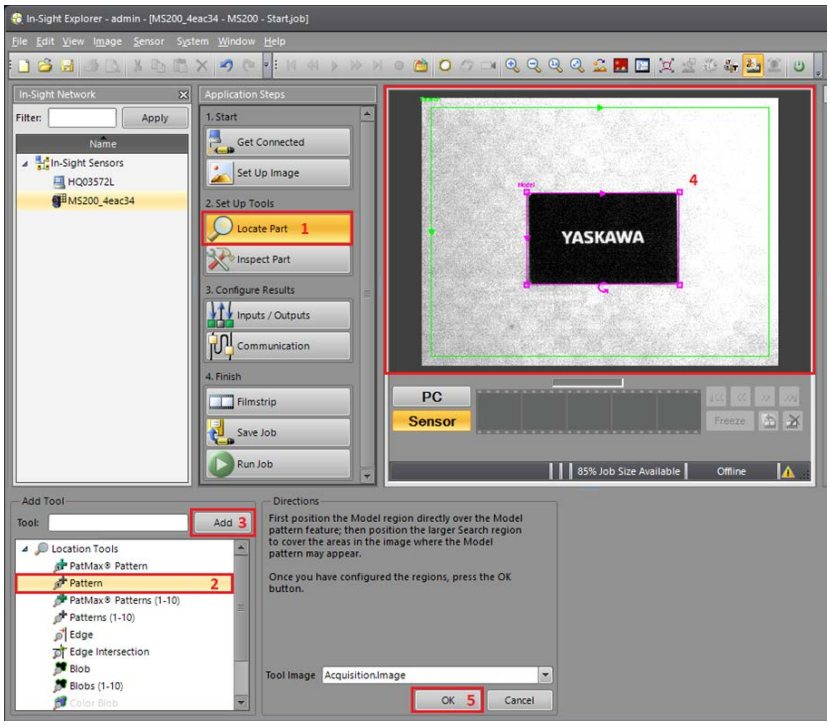
1. Select the “Locate Part” tab and select “Pattern” from the “Application Steps”.

NOTICE

If a pattern that has been created needs to be removed or edited, select Application Steps → 2. Set up Tools → Locate Part → Palette section, then right click on the pattern that needs edited or deleted.

2. Double-click on the selected tool or press {Add}.
3. Position the model (Pink Box) region on some feature of the part and press {OK}.
   – Make sure the image pattern created appears in the model region.

Fig. 3-18: Adding Tool



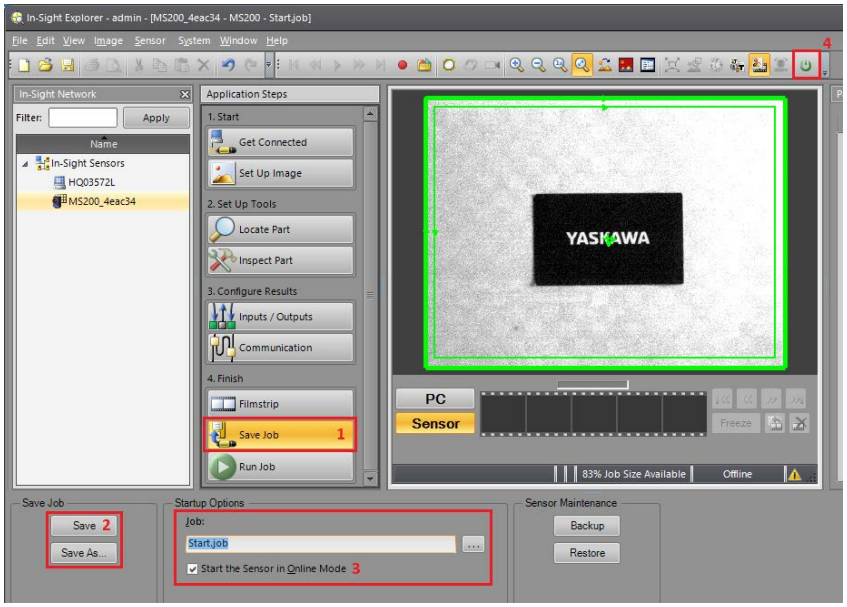
3.3.1.4 Saving a Job

1. Press {Save Job} under Application Steps.

NOTICE
• Press {Save} to save a job under the current name. • Press {Save As} to save the job under a different name.

2. Select the job to automatically load when the camera is powered on and check the “Start the sensor in Online Mode” box in “Startup Options”.
3. Place the camera in “Online mode”. (Using Sensor Menu or {Online}.

Fig. 3-19: Saving Job



3.4 Associate Camera Results to Robot Variables

To use the vision results in a robot job, the camera tool result can be assigned to robot variables. Every time the camera is triggered, the associated robot variables will update with the new results. The result assignment uses the MotoSight 2D Pendant application. For further details about the MotoSight 2D Pendant application, refer to *Chapter 4 "Understanding the Programming Pendant Vision Interface"*.

3.4.1 Select Camera and Camera Job

1. Start the MotoSight 2D Pendant application by pressing the {MS2D} button, on the bottom-right corner of the Programming Pendant screen (if available), or from the menu: {APPLICATION} → {MS2D}.
   – Application starts with camera 1 selected in Online mode.

Fig. 3-20: MotoSight 2D Pendant Application Main Screen

NOTICE

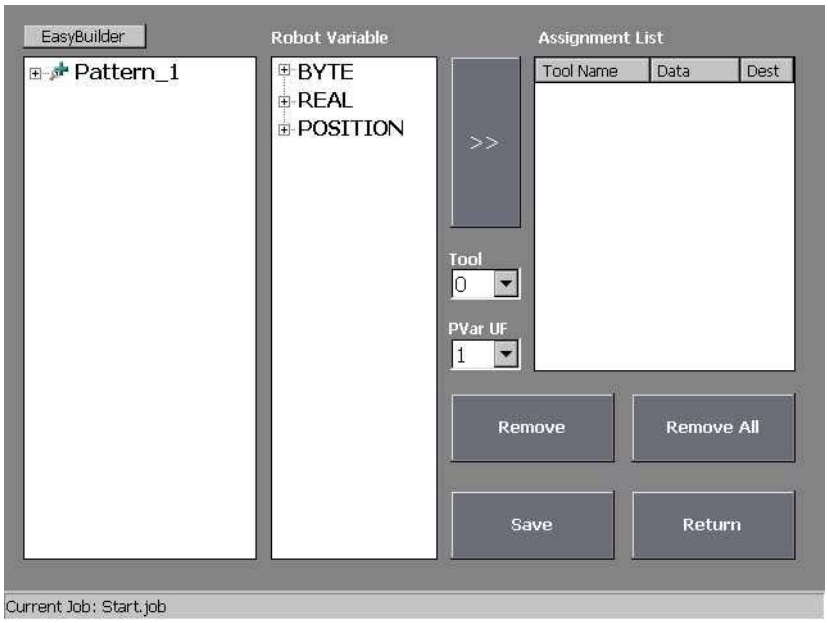
- The MotoSight 2D Pendant application cannot connect to a camera while the In-Sight Explorer is connected to the same camera.
  – Either close In-Sight Explorer or log-off from the camera before starting the MotoSight 2D Pendant application.

2. Press the "Connect" menu and select desired camera from the list.
3. Press "File" then "Load"
   – The camera "Job List" dialog displays.
4. Select the desired job and press {Load}.

3.4.2 Display Camera Results Assignment

1. Select “Result” → “Assign Results”

Fig. 3-21: Camera Result Assignment Screen



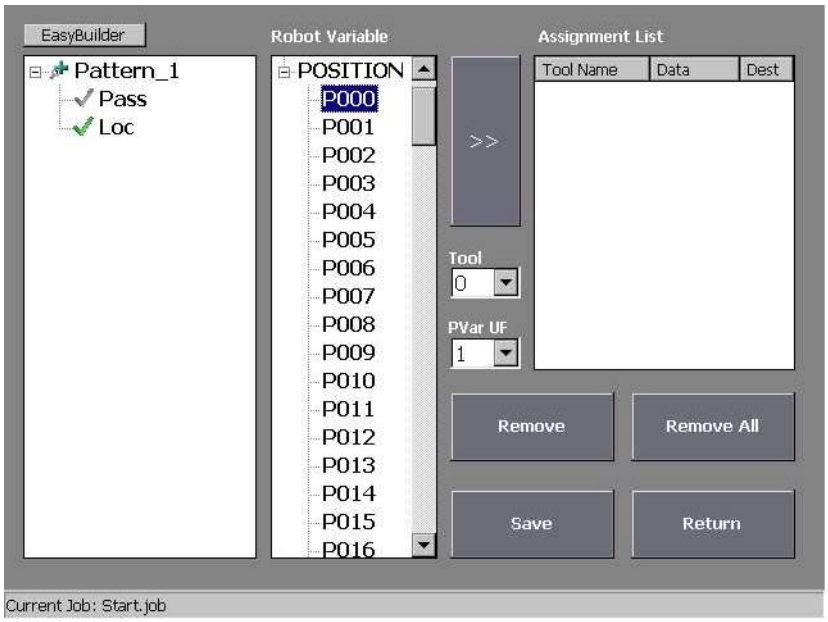
3.4.3 Add New Assignments

1. Expand the “Pattern_1” tool (+) listed on the left-hand side. Select the “Loc” attribute.
2. Select “P000” (or any other preferred P-variable) as the destination from the “Robot Variable” list.

NOTICE

Make sure the P-variable chosen is unused.

Fig. 3-22: New Assignment Selection



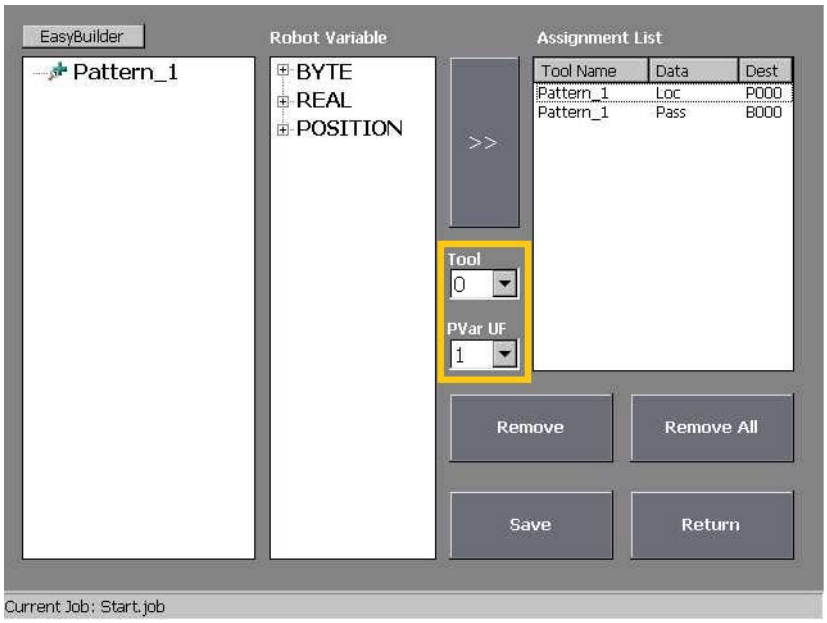
3. Press the {>>} assignment button to add the assignment to the “Assignment List”.
4. Select the “Pass” attribute.
5. Select ‘B000’ (or any other preferred B-variable) list as the destination from the “Robot Variable” list.

NOTICE

Make sure the B-variable chosen is unused.

6. Press the {>>} assignment button to add the assignment to the “Assignment List”.

Fig. 3-23: New Assignment Completion



7. Select the tool from the “Tool” drop-down list that corresponds to the tool of the end effector in use.
8. Select the User Frame from the “PVar UF” list that corresponds to the user frame used for the calibration (*section 3.2*).
9. Press the {Save} button and wait for the “Save Complete” confirmation message.
10. Press {OK} to close the confirmation message.
11. Press the {Return} button to go back to the main screen.
    – Verify the camera is in Online mode.
12. Press “File” → “Exit” to close the MS2D Pendant application.

NOTICE

- For more details about the Assign Result screen refer to *section 4.3 “Assign Results Window” on page 4-5*
- The same results cannot be assigned multiple times. Already assigned results will not appear in the tool list.

3.4.4 Test Assignment

To test the assignment, manually trigger the camera with the robot outputs.

1. Press “IN/OUT” → “GENERAL PURPOSE OUTPUT” on the Programming Pendant Main Menu, to display the output screen.
2. Move the cursor to the “OUT#...” text and press [SELECT].
3. Type in the output# 961 for camera 1 (969, 977, 985 for cameras 2, 3, 4 respectively) and press [ENTER].
4. Move the cursor to the O on that line, and press [INTERLOCK] + [SELECT] to toggle the output on and off.
   – This triggers the camera.
5. Select “VARIABLE” → “POSITION (ROBOT)” from the Main Menu to display the position variable screen.
6. Press the [Page] button and enter “0” (or the number of the variable selected when doing the variable assignment (*section 3.4.3*).
7. Verify the X, Y, and Rz values of the variable correspond to the part location and orientation in the camera frame.

NOTICE

Repeat these steps as required while moving the part slightly between each attempt to cause the position values to change with the new part location.

3.5 Teach Robot Program

Create a new job on the Programming Pendant (ex: VISION-MASTER). This job will do the following steps:

- Position the robot
- Trigger the camera
- Calculate an adjusted frame
- Call a job to process part

3.5.1 Position the Robot

Program the robot start position. In the case of a mobile camera mounted on the robot, this would be the home position taught in *section 3.3.1.2 "Setting Up Image"*. Otherwise, any position where the robot is not obstructing the fixed camera field of view.

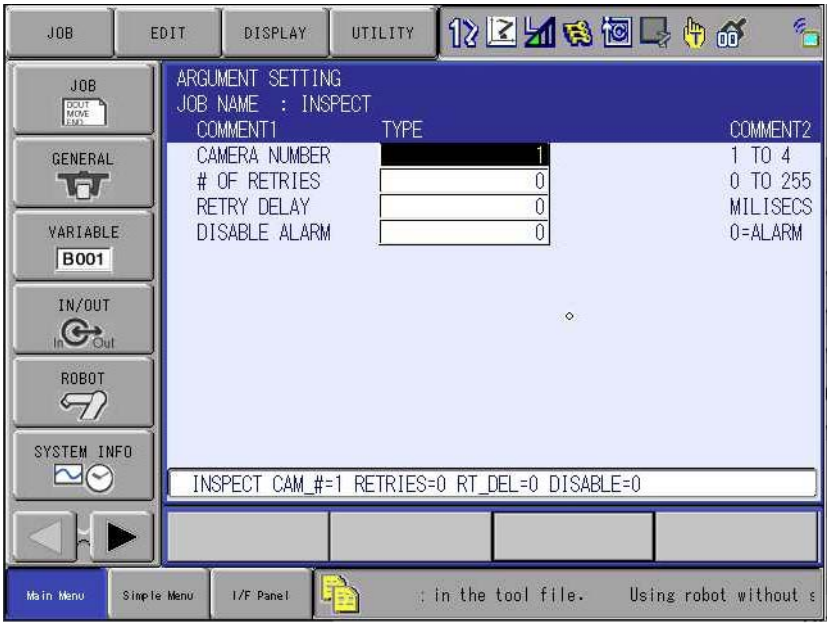
3.5.2 Trigger the Camera (INSPECT macro)

To trigger the camera, the INSPECT macro (included with MotoSight 2D) triggers the specified camera and waits for the image analysis result to be stored into the robot variables as per the Camera Result Assignment defined in *section 3.4 "Associate Camera Results to Robot Variables"*. The arguments for this job allow the user to control the behavior of the system if the inspection fails to find an object.

To add the INSPECT macro to the job:

1. Press {INFORM LIST} key and select "MACRO" → "INSPECT"
   - The INSPECT instruction appears at the bottom of the screen.
2. Press [SELECT] to edit the instruction.
3. Set values for the macro arguments.

Fig. 3-24: Inspect Detail Macro



NOTICE

This example assumes using camera #1, there are no retries and alarms enabled. So, the arguments are set to:

CAMERA NUMBER = 1

OF RETRIES = 0

RETRY DELAY = 0

DISABLE ALARM = 0

For more details about the argument, refer to *section 5.1 “INSPECT Macro” on page 5-1*.

4. Press [ENTER] until the instruction appears in the job content.

3.5.3 Calculate the Adjustment Frame (ADJUST macro)

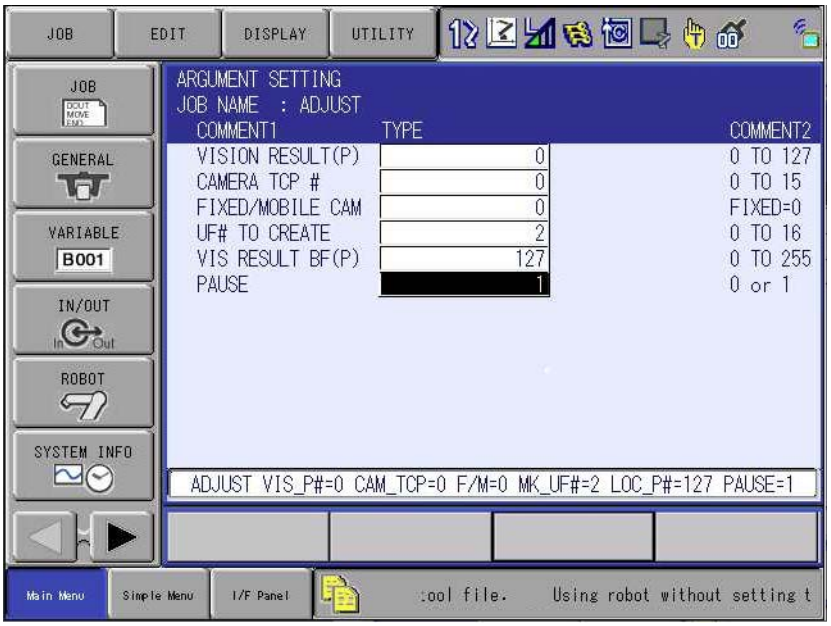
To adjust the robot path based on the location of a part or feature, the ADJUST macro (included with MotoSight 2D Pendant application) creates a user-defined coordinate system (User Frame) based on vision inspection results.

The argument for this job allows the user to control which inspection results to use and what user frame to create.

To add the ADJUST instruction to the job:

1. Press the {INFORM LIST} key and select “MACRO” → “ADJUST” from the inform menu.
   – The ADJUST instruction appears at the bottom of the screen.
2. Press [SELECT] to edit the instruction.
3. Set values for the macro arguments.

Fig. 3-25: Add Macro Adjust



NOTICE

This example assumes the camera inspection result for the part location is stored to variable P000, the camera is fixed and therefore the CAMERA TCP# is irrelevant. The user frame #2 is used to create a reference frame on the part. The vision result relative to the base frame is not needed, so the value is set to 127 to disable the calculation. Finally, PAUSE is enabled to allow programming of the part. The arguments are set to:

VISION RESULT(P) = 0 (P000 result from camera)

CAMERA TCP # = 0 (Unused)

FIXED/MOBILE CAM = 0 (Fixed camera = 0,
Mobile camera =1)

UF# TO CREATE = 2 (UF#2)

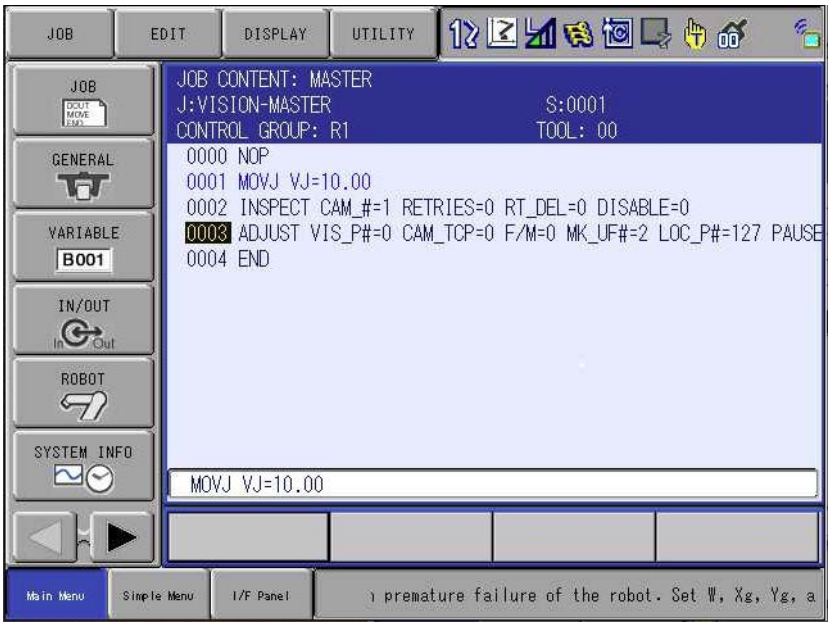
VIS RESULT BF(P) = 127 (disabled)

PAUSE = 1 (enabled)

For further details about the argument, refer to *Chapter 5 "Macro Commands"*.

4. Press [ENTER] until the instruction appears in the job content.
   – The MASTER-VISION job should look like *Fig. 3-26*

Fig. 3-26: Job Master Vision



3.5.4 Program the Process

This step consists of programming the process of a reference workpiece.

1. Place the workpiece in the desired reference position and run the MASTER-VISION job.
   – When the MASTER-VISION stops, reference the user frame for the part being created.
2. Create a new job to program the process to be executed on the workpiece. For this example, the job will be called “PROCESS-PART”.
3. Start creating the process program relative to the workpiece.
   a) Move the robot into position and teach the points along the process path.
   b) Insert other commands as needed (DigitalOut, Timer…)

NOTICE

- Do not move the workpiece while creating the program.

Moving the workpiece while creating the program may cause damage to workpieces due to the program not being set correctly.

A finalize job might look like the following:

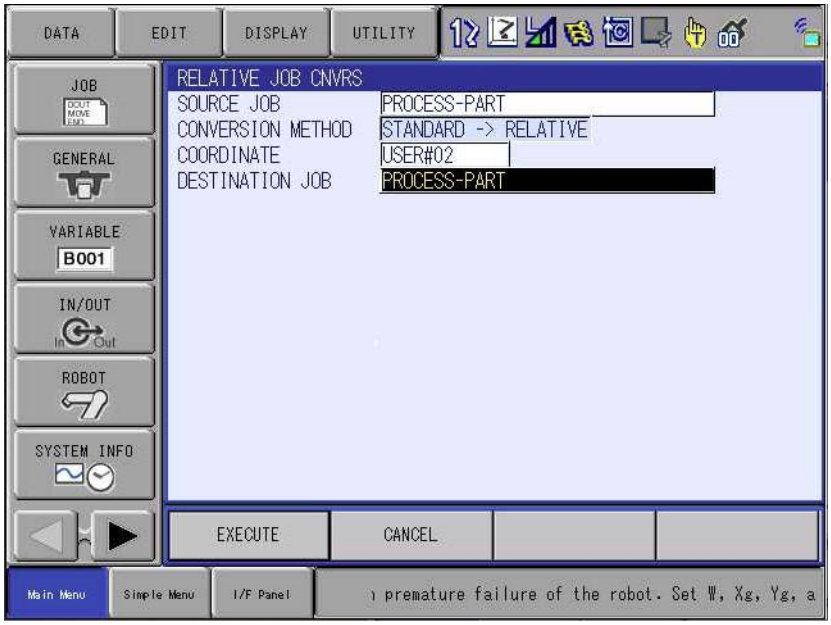
Fig. 3-27: Figure: Job Process Part Program

4. Convert job relative to workpiece user frame.

   a) From the top menu, press “UTILITY” → “RELATIVE JOB” to display the relative job conversion screen.

   b) Select the “SOURCE JOB” as the process job (ex: PROCESS-PART) to be converted.

Fig. 3-28: Job Conversion to Relative



   c) For the “COORDINATE” field, select “USER” then enter the same User Frame as the one selected in the ADJUST macro job.

   d) For the “DESTINATION JOB” field, enter either the same name as the source job to overwrite it or a different name to create a new job. If you choose to create a new job, make sure to call the converted job in the next step.

NOTICE

If creating a new job make sure to call the converted job in *section 3.5.5*.

   e) Press {EXECUTE} to convert the job to relative.

Refer to the Relative Job Function Manual for more information. See *section 1.3 “Reference Documentation” on page 1-3*

3.5.5 Finalizing and Testing

In the MASTER-VISION,

1. Modify the ADJUST instruction to change the PAUSE argument to 0, so that the program execution does not stop during normal operation.
2. Add a Call job to the PROCESS-PART:
   a) Press the {INFORM LIST} key and select “CONTROL” → “CALL” from the inform menu.
   b) Move the cursor to the “JOB” field and press [SELECT]
   c) Select the name of the converted job PROCESS-PART (or destination job name from *section 3.5*) from the job list.
   d) Press [ENTER] until the instruction appears in the job content.

Fig. 3-29: PROCESS-PART Job

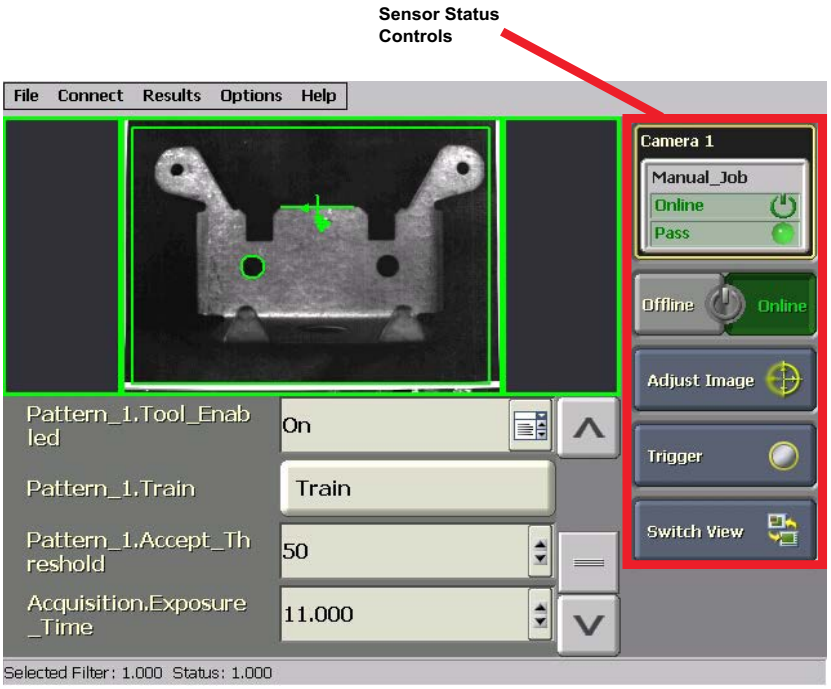
Programming is complete. At this point the part can be moved or a new part placed in position to run the program. The process should adjust itself for the new part location.

4 Understanding the Programming Pendant Vision Interface

MotoSight 2D Pendant application features an easy to use graphic interface. The application can be started by pressing the {MS2D} button, on the bottom-right corner of the Programming Pendant screen (if available), or from the menu: {APPLICATION} → {MS2D}.The various windows, fields, and buttons are described in the following sections.

4.1 Main Window

Fig. 4-1: Main Window



4.1.1 On Screen Mode Controls

Sensor Status: Displays information for the active sensor.

- The sensor's Display Name.
- The active job name (if available).
- Whether the sensor is Online, Offline, Forced Offline, if an image is being saved or if the filmstrip is frozen or paused (if available).
- The inspection pass, warning or fail status (if available).

NOTICE

If the MotoSight sensor is placed Offline using any method other than the user interface, the sensor status displays “Forced Offline”. When the sensor is in this state, no job changes are allowed and the sensor cannot be placed in Focus Mode. To allow job changes and enable Focus Mode, place the sensor Offline from the user interface.

Offline: Places the sensor Offline.

Online: Places the sensor Online.

Adjust Image: Allows the operator to make adjustments to the image.

Trigger: Triggers an inspection on the sensor.

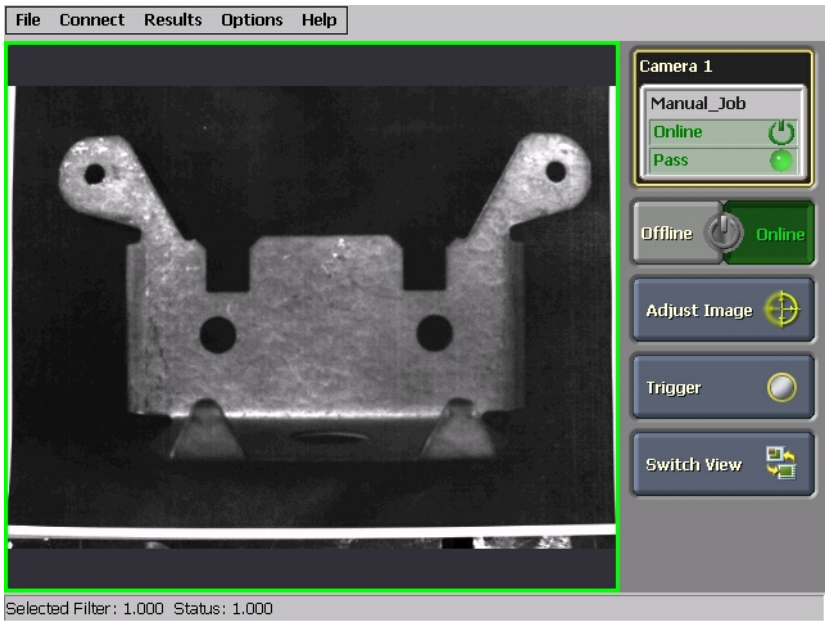
NOTICE
The Trigger button is disabled in “Online” mode

Switch View: Displays the next view available on the sensor

The following views are available in the following default order:

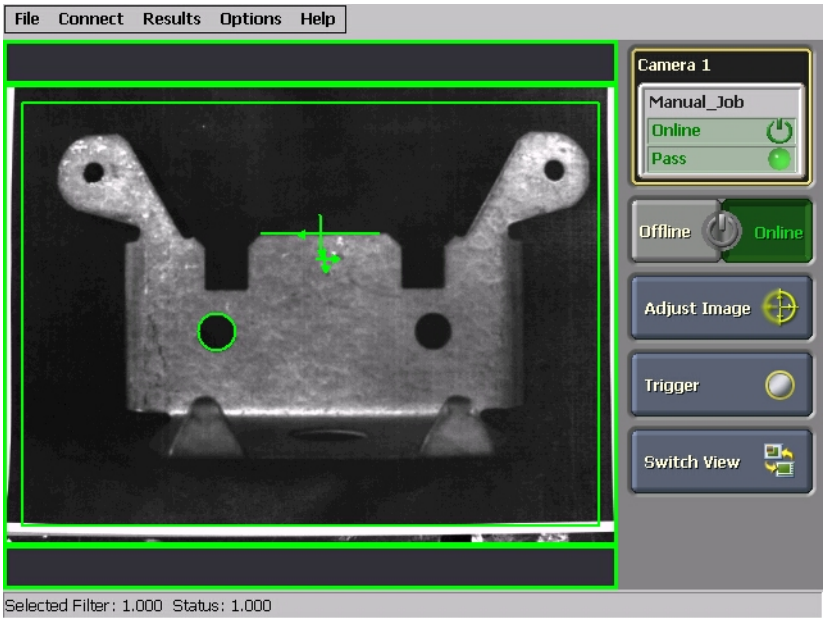
- **Image with Graphics and EasyView:** Displays the image, tool graphics and the EasyView. For Image with Graphics and EasyView to be displayed, EasyView tags must first be configured within In-Sight Explorer and saved to the sensor's job. (Shown Above)
- **Image Only:** Displays only the image.

Fig. 4-2: Image Only Display



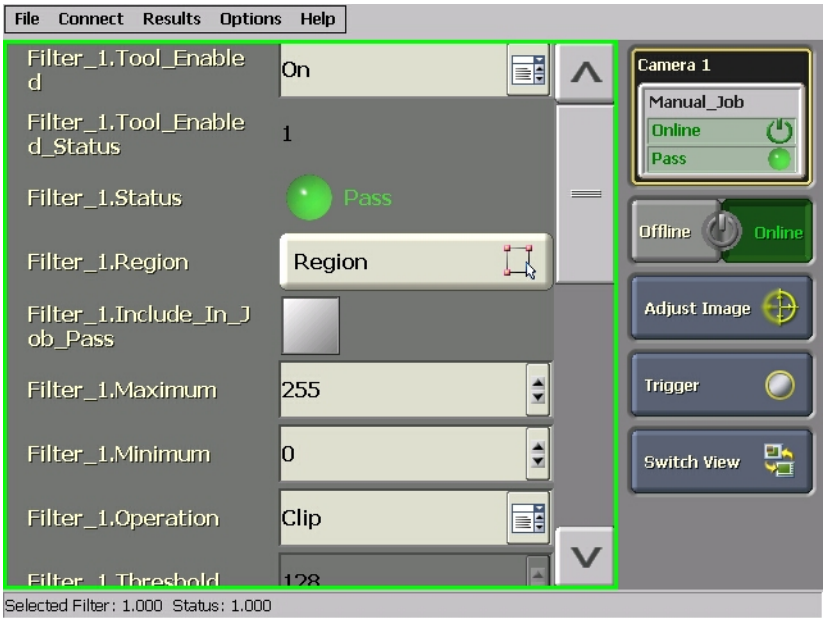
– **Image with Graphics:** Displays the image and tool graphics.

Fig. 4-3: Image with Graphics Display



– **EasyView Only:** Displays only the EasyView. For EasyView Only to be displayed, EasyView tags must first be configured within In-Sight Explorer and saved to the sensor's job.

Fig. 4-4: EasyView Only Display

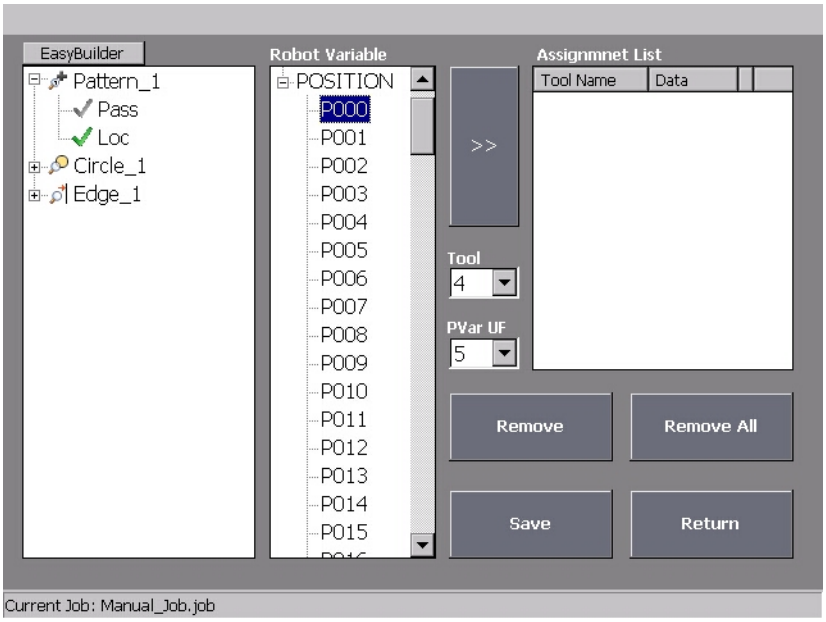


4.2 Menus

- **File Menu** - Selecting {Exit} from the File menu shuts down the MotoSight™ 2D Pendant application.
- **Connect Menu** - Selecting {Camera 1-4} will change the current connected camera
- **Results Menu** - Selecting {Assign Results} will take you to the assign results window
- **Options Menu** - Selecting {Language} will display a list of the available language selections. Changing language will require the application to be re-started for the new language selection to take effect.
- **Help Menu** - Selecting {About} will display a dialog showing the current version of MotoSight2D.

4.3 Assign Results Window

Fig. 4-5: Assign Results Window

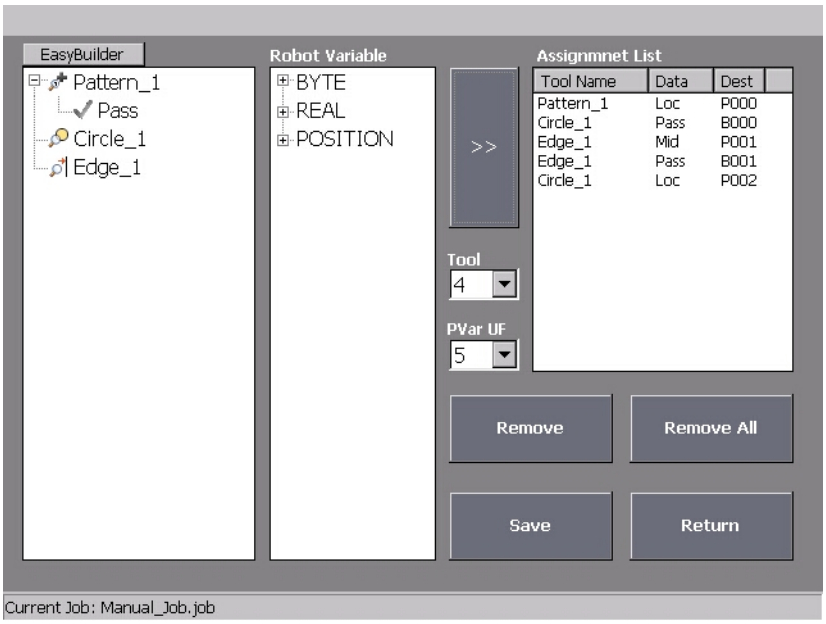


The Assign Results window is used to assign supported tool results to robot variables. Available tool results are listed in the left window. When a tool result is selected, the appropriate robot variables are listed in the 'Robot Variables' window. Once the desired robot variable is selected to store the vision tool results, pressing the {>>} button loads the vision tool name and variable information into the selected robot variable and is added to the Assignment List.

If the destination is a “P” variable, the user can select the tool and user frame associated with that Pvar. The tool selection should match the tool number created for the end effector in use. Ensure the Pvar UF selection matches the user frame used for calibration.

Once assigned the robot variables will be updated automatically each time the camera is triggered.

Fig. 4-6: Assignment Results Window



You can remove individual variable assignments by highlighting a single assignment and pressing {Remove}. To remove all the assignments, press the {Remove All} button.

When all the assignments have been made, press {Save} to save the assignments to the vision job.

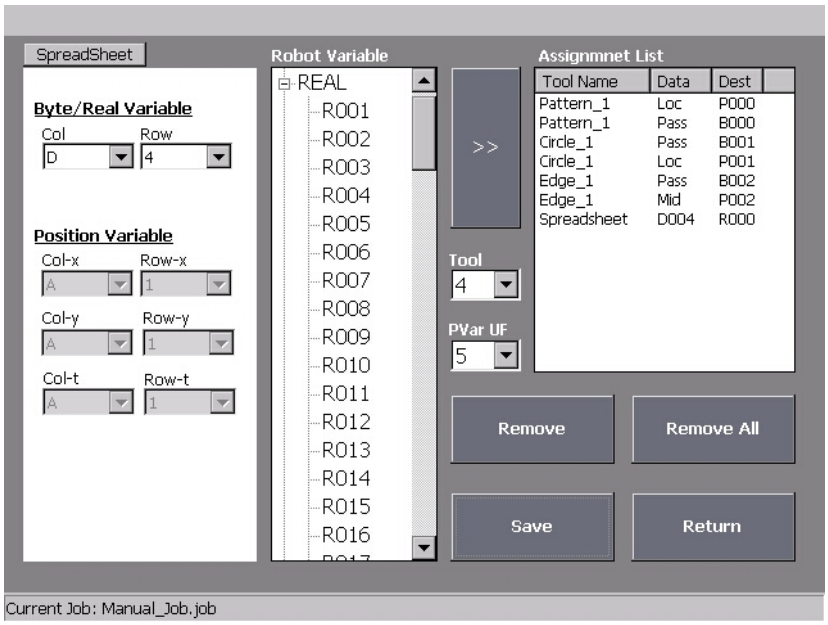
Pressing {Return} will take you back to the main window.

To make individual assignments from the camera spreadsheet, press {EasyBuilder}. This will display the row and column tools to allow you to make assignments from any camera spreadsheet location to robot variables.

NOTICE

The MotoSight 2D Pendant application template must be used as a starting point for spreadsheet programming.

Fig. 4-7: EasyBuilder Window



To display the standard result tree press {Spreadsheet}.

4.4 EasyView Tags

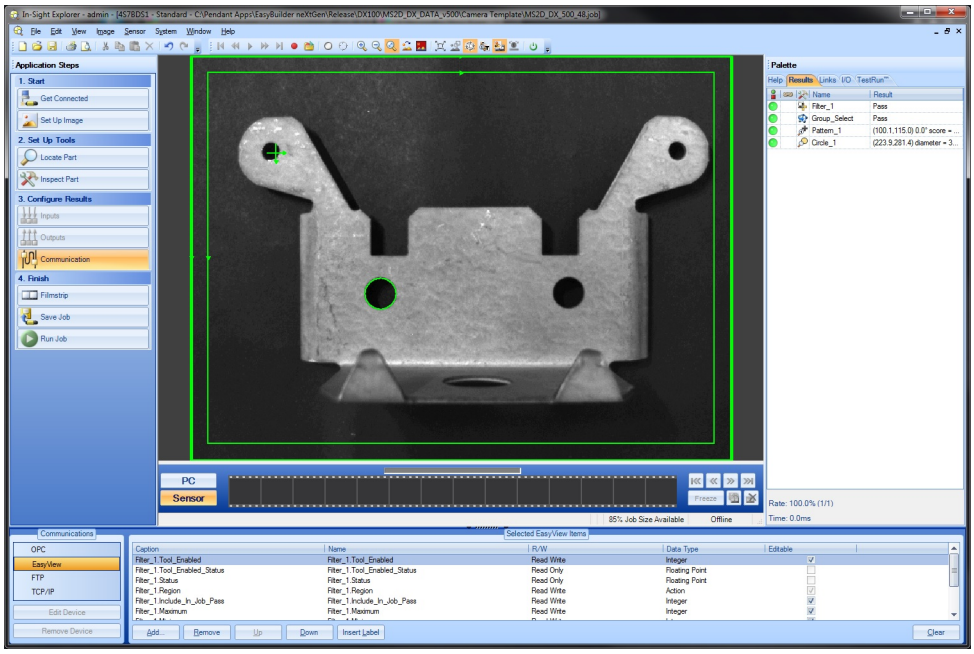
MotoSight2D gives you the ability to modify virtually any setting or tool through the power of EasyView tags.

The MS2D template contains a base collection of tools that allow the robot and camera to communicate. Specialized templates will allow some simple applications to be accomplished without any additional configuration.

However, some projects will require the addition of other vision processing tools. Once these tools are added to the camera job, the user can enable “EasyView” tags for these tools which will then allow those settings to be updated from the MotoSight 2D Pendant application without the use of a computer.

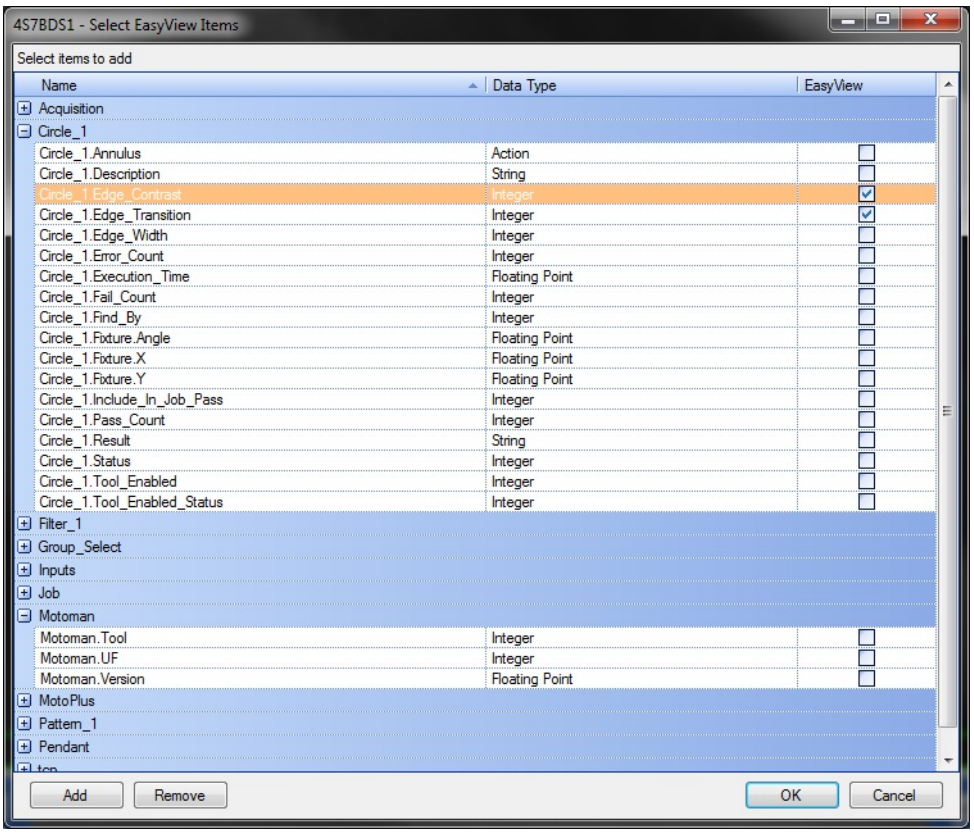
By selecting {Communication} and then {EasyView} the user is presented with a list of tags that are currently enabled.

Fig. 4-8: In-Sight Explorer Admin Window



To add additional tags click {Add}

Fig. 4-9: Select EasyView Items Window



The user is then presented with a list of all the available tools. From this list the user can enable settings and values that they would like the ability to edit from the Programming Pendant app.

(It is recommended that the camera job contain no more than 70 “EasyView” enabled Items.)

5 Macro Commands

The macro command function registers a prepared job as a macro command and then carries out the job using the macro command instruction. Users can create macro commands using the INFORM programming language. Macro commands can be used in the same way as other instructions. For more information, refer to the instructions for Macro Command Function.

For a multi-robot controller application (i.e. DR2C) where you are intending to use parallel jobs, you must integrate additional INFORM commands in order for the macros to be utilized one at a time. See *Appendix A.3 “Parallel Jobs on Multi-Robot Controller Applications” on page A-2* for more information.

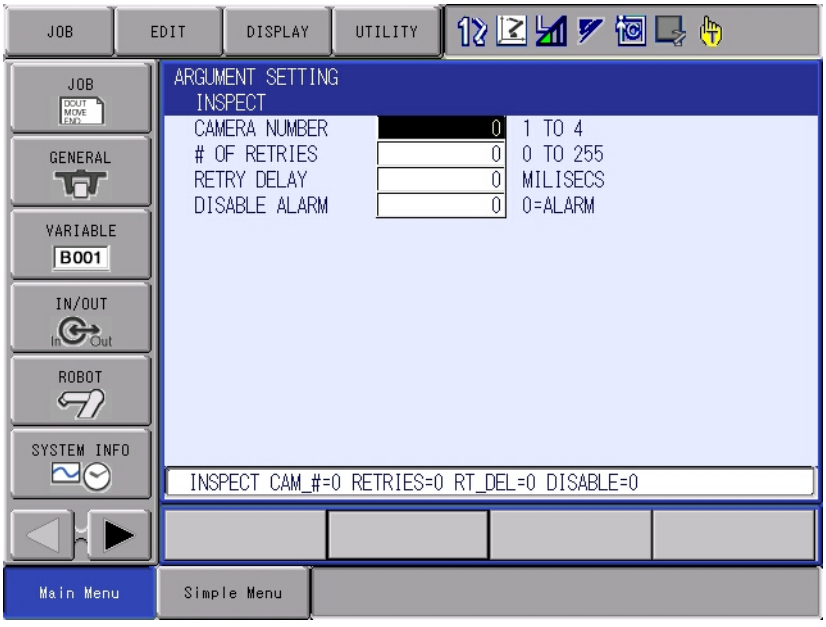
YASKAWA has provided several optional macro jobs to help set up and use the MotoSight™ 2D function. These jobs can be added to a robot program to set up and use the data returned from the camera, provide a method of job change, and control different inspections in a particular camera job.

5.1 INSPECT Macro

The INSPECT macro is used to trigger an inspection using the specified camera. The arguments for this macro allow the user to control the behavior of the system if the inspection fails to find an object.

5.1.1 Format

Fig. 5-1: Detail Edit View



INSPECT CAM_#=1 RETRIES=0 RT_DEL=0 DISABLE=0
① ② ③ ④

① Set the “CAMERA NUMBER” argument to the index of the camera to be used for this inspection. Setting range is 1 - 4
② Set the “# OF RETRIES” argument to number of times to trigger another inspection if the previous inspection failed to find an object. Setting range is 0 to 255.

③ Set the “RETRY DELAY” argument to the time in milliseconds the robot should wait before executing a retry. This time is only used if a retry is specified. Setting range is 0 to 32767. (32.767 seconds)
④ Set the “DISABLE ALARM” argument to a 0 to allow the macro to generate an alarm if an object is not found. This alarm will stop the robot. Setting the argument to 1 disables the alarm in the macro. If the alarm is disabled then the programmer must handle the vision alarm after the macro call. Disable the alarm when you want the robot program to continue when an object is not found. This argument will only disable object not found alarms. Camera communication alarms will be handled by the macro.

NOTICE

To change argument values directly in the job, use the cursor to highlight the command on the instruction side and press the {SELECT} button. The command appears in the buffer section of the Programming Pendent window and the cursor can be used to select the argument to modify.

5.1.2 Camera Trigger Methods

The INSPECT instruction triggers and processes an image capture during robot playback mode. However, there are several other ways that a camera image can be triggered. If the camera is in “offline” mode and the Cognex In-Sight Explorer software is active, the “trigger” button in the In-Sight Explorer software can be used. The operator can also initiate an image to be triggered using the trigger button in the MotoSight™ 2D Pendant application.

NOTICE

When using a moving camera to search for a part, adjusting the INSPECT instruction’s retry and retry delay settings can be helpful to prevent camera error for “no part present.’

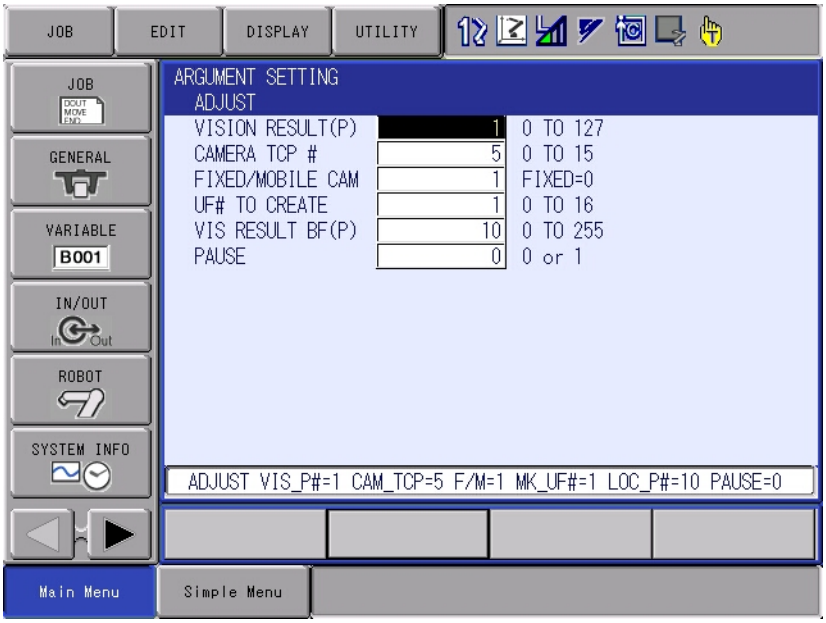
5.2 ADJUST Macro

Creates a user-defined coordinate system (User Frame) based upon vision inspection results. The user frame created can be used to adjust the robot path.

In order for the robot to correct its path, the command positions must be relative to the User Frame that is created. The robot path to be adjusted should be contained within a separate job. This way the job can be easily converted to relative. Refer to *section 3.5 “Teach Robot Program” on page 3-26* for a step by step example.

5.2.1 Format

Fig. 5-2: Adjust Setting Window



ADJUST VIS_P#=1 ① CAM_TCP=1 ② F/M=0 ③ MK_UF#=11 ④ LOC_P#=10 ⑤ PAUSE=0 ⑥

(1) Set the “VISION RESULT(P)” argument to the index of the robot position variable that contains the vision inspection results. This is the same position variable that was assigned using the Assign Results window from the robot Programming Pendant. See *section 4.3 “Assign Results Window” on page 4-5*.
(2) If the camera is mounted to the 6th axis of the robot set the “CAMERA TCP #” argument to the TCP number used for the camera. This TCP is created during the calibration procedure. See *section 3.2 “Camera Calibration” on page 3-4*. If you are using a fixed mounted camera, this argument is not used.
(3) If the camera is mounted to a stand or somewhere other than the 6th axis of the robot, then set the “FIXED/MOBILE CAM” argument to 0. If the camera is mounted to the 6th axis of the robot, then set the argument to 1.
(4) Set the “UF# TO CREATE” argument to the User Frame number you wish to create. Setting this argument to 0 disables User Frame creation.
(5) The Adjust macro will calculate the vision result location based upon the robot Base Frame. This location is the origin of the User Frame that is created. This is useful when inspecting larger objects with a mobile

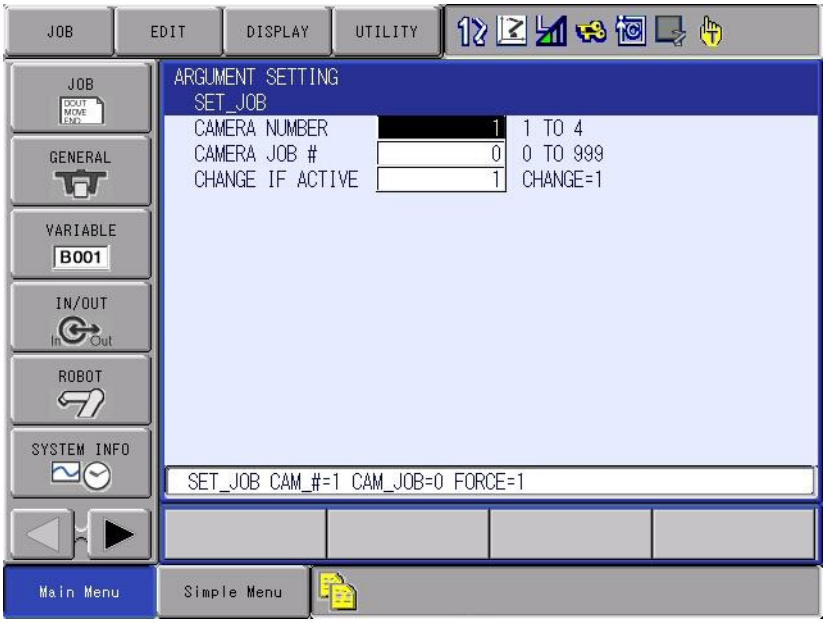
camera. The user can collect multiple locations and create a User Frame based upon those locations. Set the “VIS RESULTS BF” to the index of the Position variable you wish to contain this location. Setting this argument to a value greater than 127 will disable this calculation. (6) Set the “PAUSE” argument to a one in order to interrupt execution of the macro after the User Frame is calculated. This is useful for set-up and debug. Once execution is paused the user can manually check the results or convert a pulse job to relative referencing the user frame that was created. To resume normal operation set this argument to 0.

5.3 SET_JOB Macro

Changes the active vision job.

5.3.1 Format

Fig. 5-3: Set Job Edit Window



SET_JOB CAM_#=1 CAM_JOB=0 FORCE=1
① ② ③

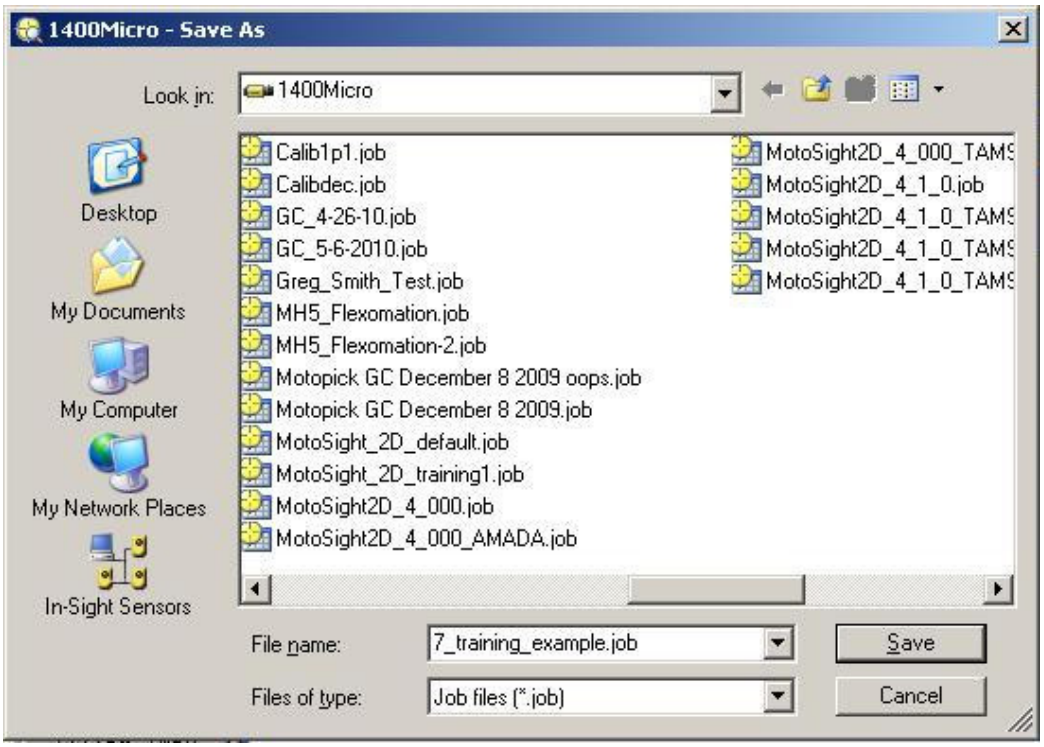
(1) Set the “CAMERA NUMBER” argument to the index of the camera to perform the job change. Setting range is 1 - 4.
(2) Set the “CAMERA JOB #” argument to the ID number of the job to set as the active camera job.
(3) If the “CHANGE IF ACTIVE” argument is set to 0, the vision job will change if the requested job is different from the active camera job. If the requested job is the same as the active camera job, no action will be taken. Set the “CHANGE IF ACTIVE” argument to 1 in order to force a job change if the active camera job equals the requested job.

5.3.2 SET_JOB Example

The SET_JOB macro performs a job change on the Cognex camera.

To use SET_JOB, first we will need to save the job on the camera in the correct naming format. The vision job must begin with a number. This Job ID number is used to select that job. For this example, use “7”.

1. Modify the job name on the camera so that it begins with a number. For this example, use number “7”.



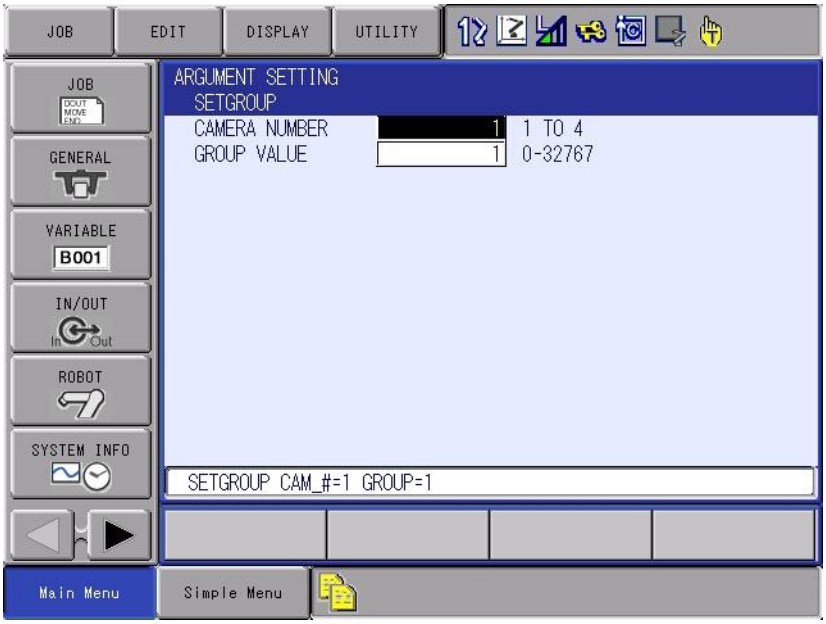
2. Then, from the Macro on the Programming Pendant, simply match the integer setting.

5.4 SETGROUP Macro

Transmits the group integer number to the camera.

5.4.1 Format

Fig. 5-4: Set Group Window



SETGROUP CAM_#=1 GROUP=1
① ②

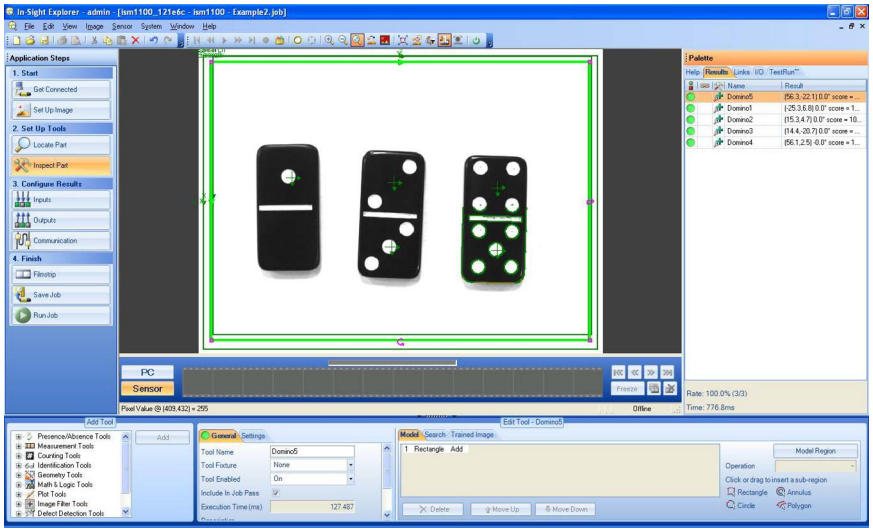
(1) Set the “CAMERA NUMBER” argument to the index of the camera to receive the group data. Setting range is 1 - 4.
(2) Set the “GROUP VALUE” argument to the integer value to be sent to the camera. Setting Range is 0 - 32767. See *Appendix A.1 “Tips & Tricks” on page A-1* for more information regarding groups.

5.4.2 Group Tool Example

Using the Group tool can help reduce process time when performing a single inspection out of multiple inspections loaded in the vision job.

For this example, let's assume our vision job contains five different inspections. Each inspection is for a different part. If we only want to find part one, the camera executes all five inspections. However, if we put the five inspections into five separate groups, we can enable and execute only one inspection. This will eliminate the time needed to process the other five inspections.

We'll start by setting up five inspections using tools from the Locate parts tab of EasyBuilder.

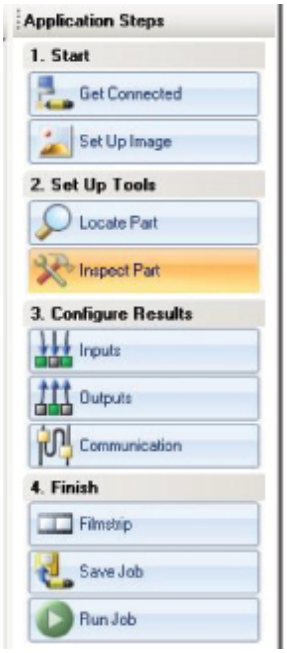


- Domino1
- Domino2
- Domino3
- Domino4
- Domino5

If we click the [Trigger] button, we can look at the lower-right corner of the displayed camera image to see that the processing time of the camera for all of these inspections is approximately 770 to 780 ms.

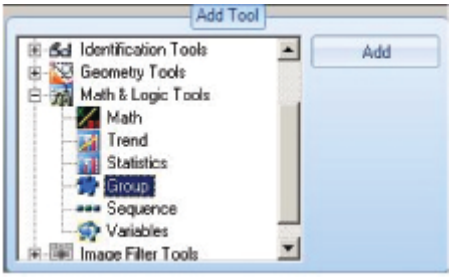
Now, let's add groups to see the difference.

1. From the Application Steps area, select Inspect Part.

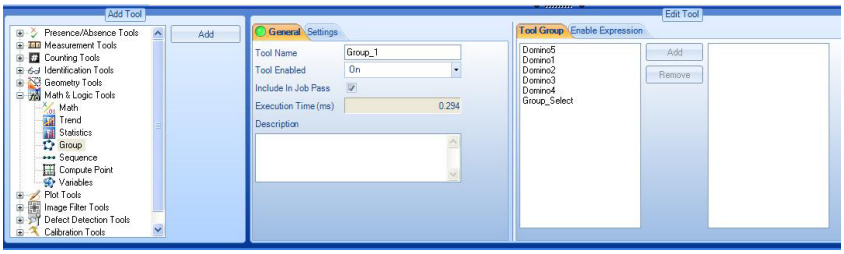


The Add Tool box changes.

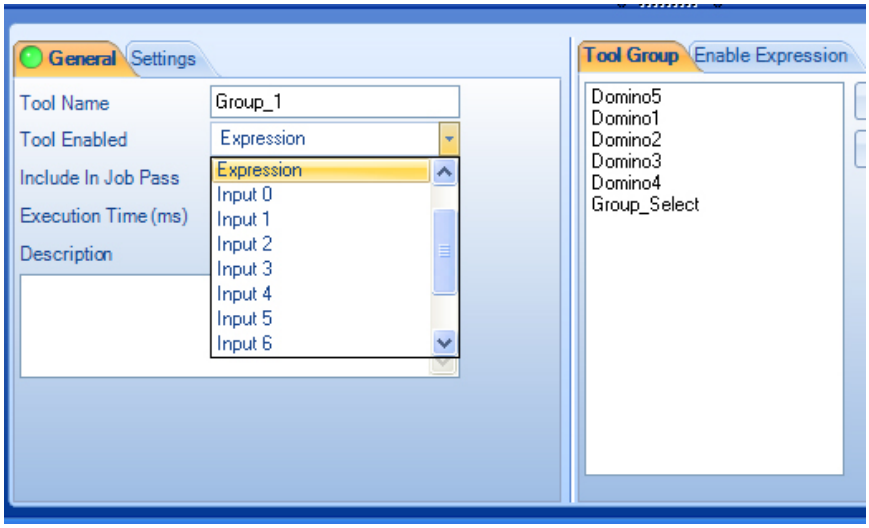
2. Click the [+] sign next to Geometry Tools to expand the set of vision tools.



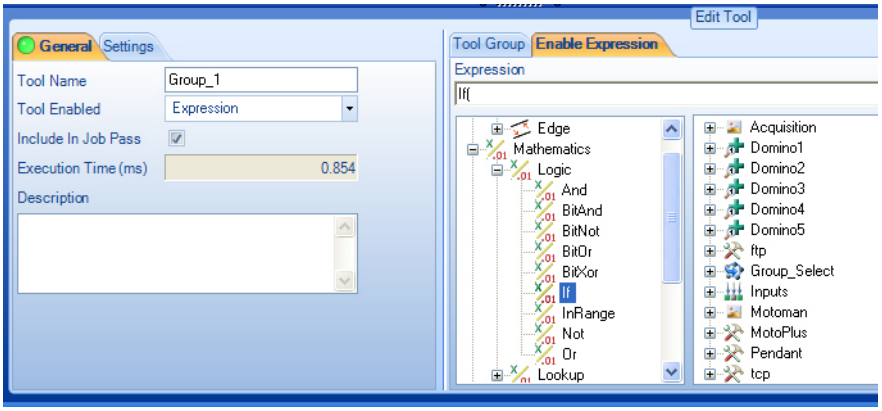
3. Select Group and click Add. The Edit Tool window appears.



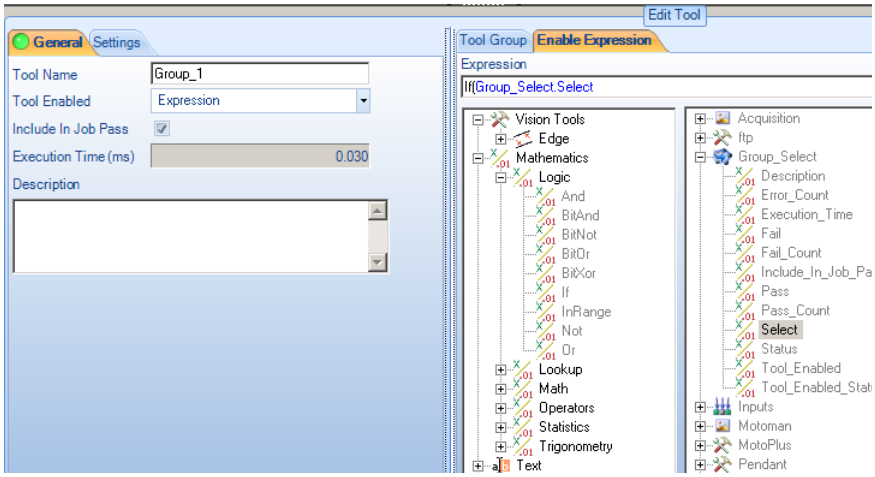
4. Select the Tool Enable window and set to Expression.



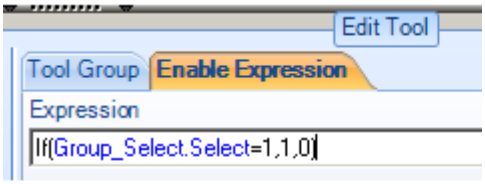
5. Select the Enable Expressions tab.
6. Expand the Mathematics set.
7. Expand the Logic set.
8. Double-click “IF” to make it appear in the Expression entry line.



9. Double-click [Select]. “If(GROUP_SELECT.Select” appears in the Expression entry line.



10. In the Expression entry line, manually type “=1,0 “ at the end of the expression and press Enter.

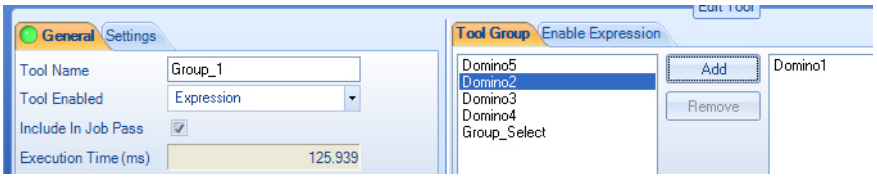


=1 means that if the integer set by the GROUP macro is 1 then….

,1,0 means enable if true, disable if false.

Now we will set one of the inspections to be in this group.

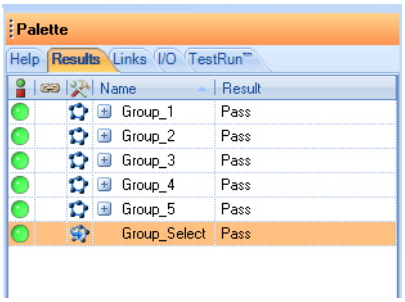
1. Select the Tool Group Tab.
2. Select the Inspection(s) you want to add to this group and click Add. The desired inspection moves from the left window list of available items to the right window list of added items.



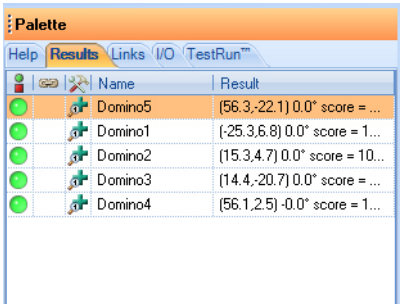
3. Repeat the process four more times to create Groups 2,3,4, and 5.

Make sure when entering the Enabling Expression to use different values after the = sign while keeping the last portion the same “,1,0”.

Once all five Groups are created, your Palette should show:

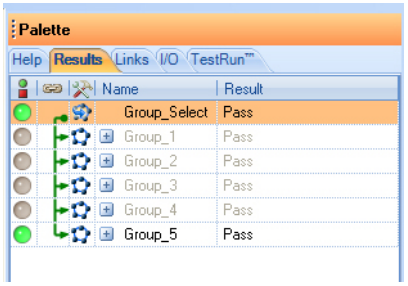


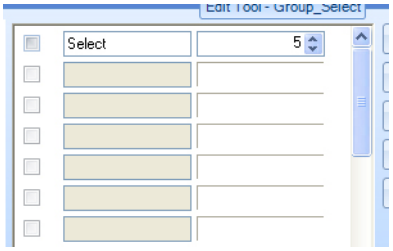
Where before any groups were created it showed.



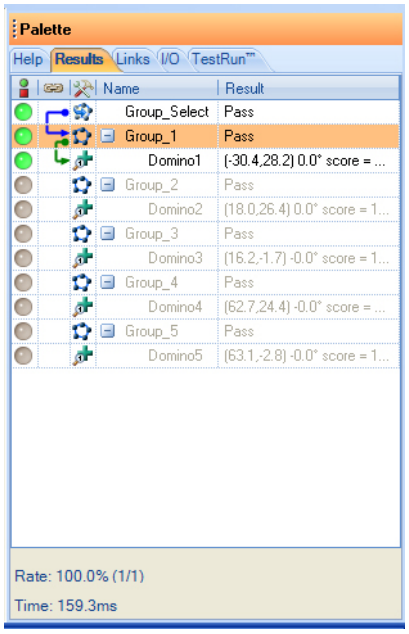
Click on the + signs to expand the groups to be able to see and edit your original five inspections.

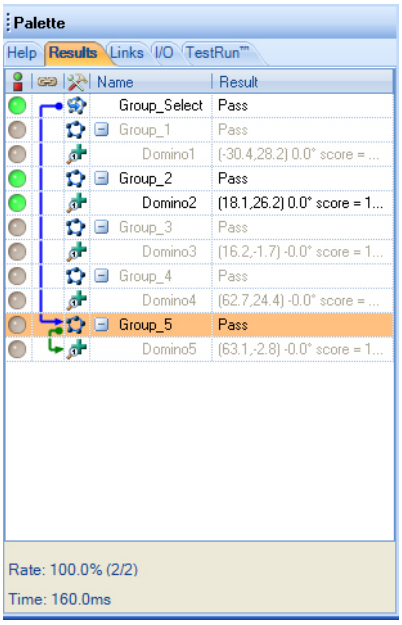
If you double-click the GROUP_SELECT tool in the Palette, an edit tool opens that allows you to force the selection integer to desired values so that you do not have to use the GROUP macro to enable Camera items during setup. As you change the Select Integer value, you should see the Palette display highlight the items you forced to be active.

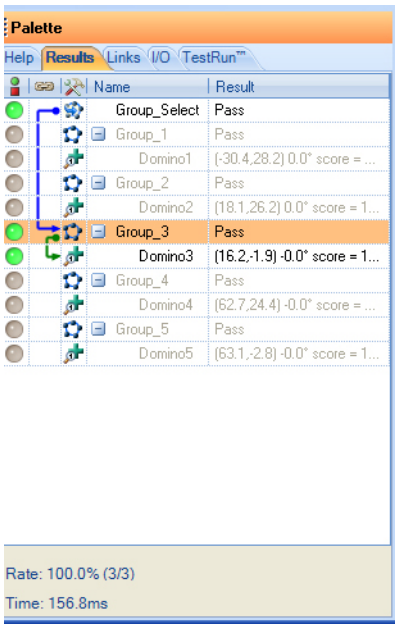


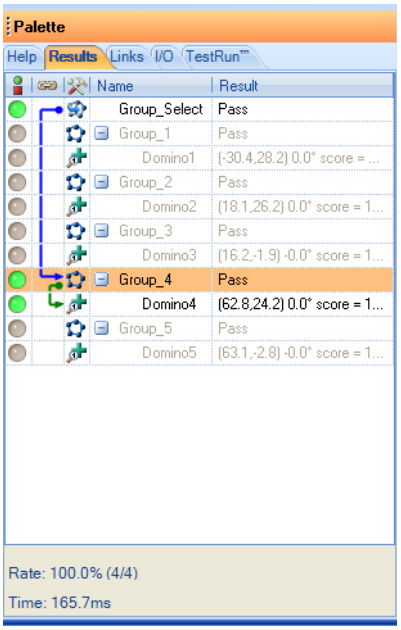


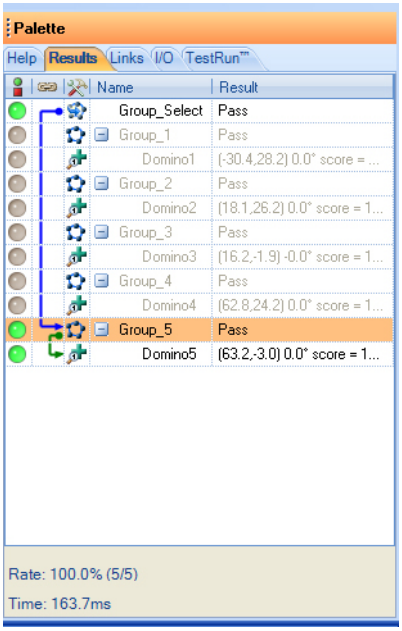
Let's see the camera's inspection times for each of the five inspections when it only has to perform one at a time. Triggering with the Selection Integer set at each of the five values yields.











So individually the inspections run at 159 ms, 160 ms, 156 ms, 165 ms and 163 ms. All significant reductions from the 776 ms when it had to run all the inspections every time.

Appendix A

A.1 Tips & Tricks

- The Pendant Application is stored on the Programming Pendant. If you swap Programming Pendants, you will have to reload the Pendant Application.
  The robot job communication is handled by MotoSight and will still be functional. Only the Pendant application is lost with a Programming Pendant swap.
- Do not delete the Group Select tool or the Filter tool from the Default camera job.
- MotoSight 2D Pendant application is designed to work with EasyBuilder. You can use the spreadsheet to make edits, but be careful with the spreadsheet side or you may break some of the communications.
- Be careful with the job setup, especially if using groups. If you enable Group1, all of the other groups, variables are set with the last active values, not the current inspection data.

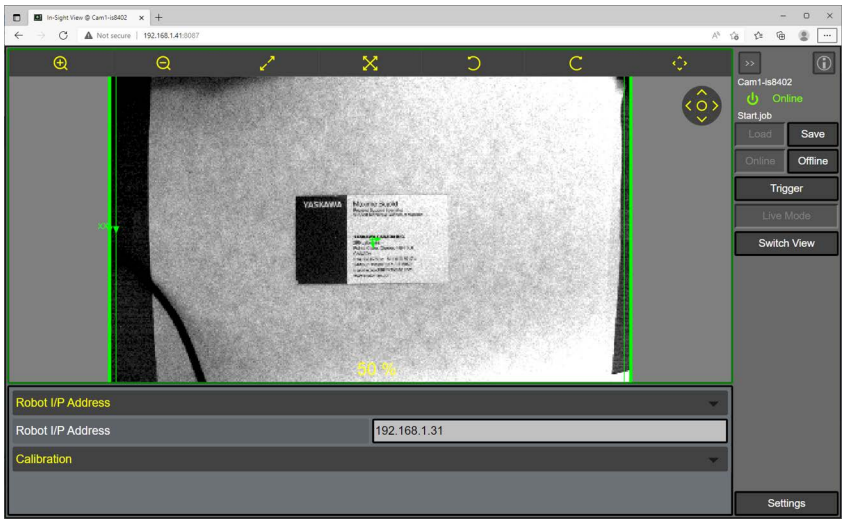
A.2 Web Browser View

For Cognex cameras with In-Sight firmware 5.6.0 and later, the Web HMI application is available. This application can be use to monitor the camera view from a PC during MS2D operation.

Open a web browser on a PC connected to the camera network, and enter the IP address of the camera followed by the port number ":8087" in the browser navigation bar. For example: http://192.168.1.41:8087. For further information about the Web Browser View requirements and operation, refer to the Cognex In-Sight Documentation.

NOTICE

Review *section 2.4.4 "HMI Settings" on page 2-10* if there are problems connecting the camera.



A.3 Parallel Jobs on Multi-Robot Controller Applications

When using parallel robot jobs on a multi-robot controller application (i.e. DR2C) with the SET_JOB, INSPECT, and SETGROUP macros, it is not uncommon to receive “Alarm 8013: MACRO WAIT TIME OUT” while running parallel robot jobs together. Alarm 8013 occurs because both Robot 1 and Robot 2 jobs are trying to utilize the same macro at the same time. This may cause signal conflicts within the macro job while communicating with the camera and eventually cause timeouts and unexpected results. To prevent this from happening and disrupting normal operation, a series of basic INFORM commands can be added to each parallel job to prevent two jobs from accessing the same macro at the same time.

Use the following example as a reference to update parallel jobs. The examples use outputs from 1 through 6, but they can be changed to any unused outputs, if outputs 1 through 6 are being used for other purposes. The added INFORM commands are highlighted in RED.

Table A-1: JOB #1

JOB #1	
WAIT OT#(2)=OFF	Make sure Camera 2 is not using the SET_-JOB macro
DOUT OT#(1) ON	Camera 1 initials that it is using SET_JOB
SET_JOB CAM_#=1 CAM_JOB=1 FORCE=?	
DOUT OT#(1) OFF	Camera 1 signals that it is done using SET_-JOB
WAIT OT#4=OFF	Make sure Camera 2 is not using the SET-GROUP macro
DOUT OT#3 ON	Camera 1 initiates that it is using SETGROUP

JOB #1	
SETGROUP CAM_#=1 DATA=1	
DOUT OT#(3) OFF	Camera 1 signals that it is done using SET-GROUP
WAIT OT#(6)=OFF	Make sure Camera 2 is not using the INSPECT macro
DOUT OT#(5) ON	Camera 1 initiates that it using INSPECT
INSPECT CAM_#1=1 RETRIES=0 RT DEL=0 DISABLE=1	
DOUT OT#(5)=OFF	Camera 1 signals that it is done using INSPECT
ADJUSTR1 VIS_P#=? CAM_TCP=? F/M=? MK_UF#=? LOC_P#=? PAUSE=0	

Table A-2: JOB #2

JOB #2	
TIMER T=0.10	Allows for Job #1 to start before Job #2
WAIT OT#(1)=OFF	Make sure Camera 1 is not using the SET_-JOB macro
DOUT OT#(2) ON	Camera 2 initiates that it is using SET_-JOB
SET_JOB CAM_#=2 CAM_JOB=1 FORCE=?	
DOUT OT#(2) OFF	Camera 2 signals that it is done using SET_-JOB
WAIT OT#(3)=OFF	Make sure Camera 1 is not using the SET-GROUP macro
DOUT OT#(4) ON	Camera 2 initiates that it is using SET-GROUP
SETGROUP CAM #=2 DATA=1	
DOUT OT#(4) OFF	Camera 2 signals that it is done using SET-GROUP
WAIT OT#(5)=OFF	Make sure Camera 1 is not using the INSPECT macro
DOUT OT#(6) ON	Camera 2 initiates that it is using INSPECT
INSPECT CAM #=2 RETRIES=0 RT DEL=0 DISABLE=1	
DOUT OT#(6) OFF	Camera 2 signals that it is done using INSPECT

JOB #2
ADJUSTR2 VIS_P#=? CAM_TCP=? F/M=? MK_UF#=? LOC_P#=? PAUSE=0

Appendix B

B.1 Hardware Allocation

B.1.1 Network Inputs

	YRC1000 micro	YRC1000	DX200	DX100	FS100
MS2D Heartbeat	27240			25240	
MS2D License Valid	27241			25241	
Camera 1 Active	27244			25244	
Camera 2 Active	27245			25245	
Camera 3 Active	27246			25246	
Camera 4 Active	27247			25247	

B.1.2 TCP/IP Port Assignment

	YRC1000 micro	YRC1000	DX200	DX100	FS100
PORT_TELNET	23				
PORT_COGNEX	1069				
PORT_TCP_1	21751				NA
PORT_TCP_2	21752				NA
PORT_TCP_3	21753				NA
PORT_TCP_4	21754				NA
PORT_UDP_DEBUG	21760				

B.1.3 I/O

B.1.3.1 Universal Outputs Commands

- Universal Output 11210; //OUT#961 OG#121 CAM#1 Command
- Universal Output 11220; //OUT#969 OG#122 CAM#2 Command
- Universal Output 11230; //OUT#977 OG#123 CAM#3 Command
- Universal Output 11240; //OUT#985 OG#124 CAM#4 Command

B.1.3.2 Within Each Camera Command Word

0 - TRIGGER

1 - GO_ONLINE

2 - GO_OFFLINE

3 - SET_JOB

4 - GET_JOB

5 - SET_GROUP

- **Universal Output Results**
  - Universal Output 11250; //OUT#993 OG#125 CAM#1 Results
  - Universal Output 11260; //OUT#1001 OG#126 CAM#2 Results
  - Universal Output 11270; //OUT#1009 OG#127 CAM#3 Results
  - Universal Output 11280; //OUT#1017 OG#128 CAM#4 Results

- **Within Each Camera Result Word**

0 - DATA_VALID

1 - ONLINE

2 - PART_GOOD

3 - PART_BAD

4 - ERROR

5 - JOB_VALID

B.1.4 M-Register

M Register	Description
250	CAM#1 Current Job Register
251	CAM#2 Current Job Register
252	CAM#3 Current Job Register
253	CAM#4 Current Job Register
254	CAM#1 Job Load Register
255	CAM#2 Job Load Register
256	CAM#3 Job Load Register
257	CAM#4 Job Load Register
260	CAM#1 Group Set Register
261	CAM#2 Group Set Register
262	CAM#3 Group Set Register
263	CAM#4 Group Set Register
264	CAM#1 Error Register
265	CAM#2 Error Register
266	CAM#3 Error Register
267	CAM#4 Error Register

B.1.4.1 M-Register Error Code Values

If MS2D detects an error, it will set the MotoPlus error bit, (bit 5 within each camera's result word) and place the appropriate error code value in the error M-Register.

M Register Value	Description
101	Failed to set robot output
102	Failed to set robot variable
103	Good Part - Bad Part set simultaneously
104	Failed to set Online
105	Failed to set Offline
106	Failed to set group select
107	Failed to read current user frame
108	Failed to read a value from the spreadsheet
109	Camera contains no variable assignments
110	Failed to read a string from the spreadsheet
111	Failed to change camera job
112	Failed to retrieve camera job
113	Attempt to set invalid job number
114	Failed to read tool number

B.1.5 MotoSight 2D Camera Comparison

Model	Resolution	Performance Factor	Frames/ Second	Connection	Vision Tools[a)]
MS100 or In-Sight 7050	800 X 600	0.1X	102	Two cables (separate Power and Ethernet)	Pattern, Edge, Blob, Circle, Curve, Histogram, Geometry, Image Filters, and Standard Calibration
MS200 or In-Sight 7200	800 X 600	0.3X	102	Two cables (separate Power and Ethernet)	MS100 Tools + PatMax, non-linear calibration, and caliper tool, OCR, OCV, 2D Matrix, and Barcode reading
MS300 or In-Sight 7402	1280 X1024	0.6X	60	Two cables (separate Power and Ethernet)	MS100 Tools + PatMax, non-linear calibration, and caliper tool, OCR, OCV, 2D Matrix, and Barcode reading
In-Sight 8101	1280 X1024	1X[b)]	54	POE cable (Power Over Ethernet)	MS100 Tools + PatMax, non-linear calibration, and caliper tool, OCR, OCV, 2D Matrix, and Barcode reading
In-Sight 8401	1280 X1024	3.9X	76	POE cable (Power Over Ethernet)	MS100 Tools + PatMax, non-linear calibration, and caliper tool, OCR, OCV, 2D Matrix, and Barcode reading
In-Sight 8402	1600 X1200	3.9X	53	POE cable (Power Over Ethernet)	MS100 Tools + PatMax, non-linear calibration, and caliper tool, OCR, OCV, 2D Matrix, and Barcode reading

a) These are the vision tools available on the camera. Some of these tools may not be directly supported by MotoSight 2D software. Refer to *Table C* for the supported tools. Some unsupported tools may be mapped using the Math tool or a direct reference to a spreadsheet cell.
   – MotoSight 2D software supports PatMax Redline, but the option must be purchased separately for the camera.

b) Base model for speed comparison.

NOTICE

MS100, MS200 and MS300 camera's are listed for older systems (FS100, DX100 and DX200) but are no longer sold. Newer systems (YRC1000micro, YRC1000 and DX200) are using the In-Sight 8000 series cameras.

B.2 Optional Configuration

With MotoSight 2D version 6.0.0 or higher, some of the MotoSight 2D default configurations can change by creating a robot job with the name MS2D_CONFIG. A setting can be defined in a job comment with the setting key word followed by its value. *Table B-1* lists the available keyword and the possible values for it.

Table B-1: Keywords and Values

Keyword	Value
DEBUG	0=Not debug info (default); 1=Debug Info; 2=Detailed Info
BROADCAST	0=Debug info displayed to terminal; 1=Debug info broadcast UDP port 21760 (default)
COMMAND_TIMEOUT	1000 (default; min=100) Time [msec] to get a reply to a normal command
TRIGGER_TIMEOUT	7500 (default; min=500) Time [msec] to get the result changed event after “camera trigger”
JOBCHANGE_TIMEOUT	7500 (default; min=1000) Time [msec] to get the job changed event after “set job”
OUTPUT_SCANTIME	4 (default; min=1) Interval [msec] at which the outputs are scanned.
SET_ACQUISITION_MODE	FALSE or 0 (default: TRUE) Prevents MS2D from changing the acquisition mode to Manual Trigger (which is normally needed to trigger while being Online)
CAMERA[a)]	# of camera (1-4; default: 1) sets the camera ID for the following settings:
OUTPUT_ADDR:	11210 (camera 1 default) Starting output address for the outputs to the camera
INPUT_ADDR:	11250 (camera 1 default) Starting input address for the inputs from the camera
MREG_CUR_JOB:	250 (camera 1 default) M-register to store the camera current job
MREG_LOAD_JOB:	254 (camera 1 default) M-register to store the camera job # to load
MREG_GROUP_SET	260 (camera 1 default) M-register to store the camera group # to select
MREG_ERROR	264 (camera 1 default) M-register to store the error code when the input error bit turns on.

a) See *Appendix B.1.3* and *Appendix B.1.4* for default values of all cameras

B.3 Debugging Information

The MotoSight 2D MotoPlus can broadcast debugging information in case of an issue on the network. If needed to troubleshoot, these messages are retrievable by connecting a PC to the network and listening for UDP messages on port 21760 using a network packet analyzer or sniffer (such as WireShark).

The amount of data generation and enabling of the broadcast are configurable using MotoSight 2D version 6.0.0 or higher and *Appendix B.2*. For older versions, information is limited to error reporting, unless using a special debugging version from YASKAWA.

B.4 Parameter List

Table B-1: Parameter List

Parameter	Setting	Content
S2C211	2	Language Level (expanded)
S2C231	1	Motion in FWD/BWD/TEST Operation
S2C400	1	Enable User Alarms
S2C431	1	Multiple Tool
S2C541	0	Read/Write in Play Mode
S2C542	0	Read Write in Prohibit-Edit Mode
S2C688	3	BWD Motion
S2C1402	3	Allow File Save/Load During Alarms and Errors
S3C1192	2000000	Max Set Tool Correction Amount
S4C1057	0	Send Message Timeout. 0 = Disable

Appendix C

C.1 MotoSight 2D Pendant Application Supported Tools

When using MotoSight 2D Pendant application tools, the X, Y, and Angle results can be assigned as a single entity to a P-variable.

C.1.1 Location Tools

Tool	Assignable Values
Pattern	X, Y, Angle (Two Tools)
	Qty Found (1 or 10 found items)
	Pass/Fail Status
PatMax Pattern	X, Y, Angle (Two tools)
	Qty Found (1 or 10 found items)
	Pass/Fail Status
PatMax Pattern Redline[a)]	X, Y, Angle (Two tools)
	Qty Found (1 or 10 found items)
	Pass/Fail Status
Blob	X, Y, Angle
	Pass/Fail Status
Circle	X, Y
	Diameter
	Pass/Fail Status
Edge	X, Y, Angle
	Pass/Fail Status

a) MotoSight 2D software supports PatMax Redline, but the option must be purchased for the camera.

C.1.2 Inspection Tools

Tool	Assignable Values
Pattern	Pass/Fail Status
PatMax Pattern	Pass/Fail Status
PatMax Pattern Redline[a)]	Pass/Fail Status
Blob	Pass/Fail Status
Circle	Pass/Fail Status
Edge	Pass/Fail Status

a) MotoSight 2D software supports PatMax Redline, but the option must be purchased for the camera.

C.1.3 Measurement Tools

Tool	Assignable Values
Blob Area	Area
	Pass/Fail Status
Diameter	Diameter
	Pass/Fail Status
Distance	Distance
	Pass/Fail Status
Angle	Angle
	Pass/Fail Status
Math	Results
	Pass/Fail Status

C.1.4 Geometry Tools

Tool	Assignable Values
Point-to-Point: MidPoint	X,Y, Angle
	Pass/Fail Status
Line Intersection	X, Y
	Pass/Fail Status

C.1.5 Counting Tools

Tool	Assignable Values
Blob	Qty
	Pass/Fail Status

Appendix D

D.1 Troubleshooting

Alarm	Error Codes	Description	Remedy
8000	---	Inspection failed to find the part.	The camera job did not find the part. Review camera job, lighting, focus, etc.
8004	---	Logout In-Sight Explorer from the camera.	Logout In-Sight Explorer from the camera to allow the MS2D to properly initialize the camera at start-up.
8007	---	Job number out of range.	Review the SET_JOB macro arguments to set a job number between 1 and 999.
8008	---	Group number out of range.	Review the SETGROUP macro arguments to set a group number between 1 and 9999.
8009	---	Camera number out of range.	Review the macro arguments to set a camera number between 1 and 4.
8013	---	Macro wait timeout.	Verify the connection between the camera and the robot controller. If using a large/complex camera job, you might need to edit the macro job and edit the WAIT OT#(_)T=#.## instructions to increase the allowed time.
8101	101	Failed to clear robot outputs for camera #	Unable to set controller output. Check controller state for active alarm. Restart the controller.
		Failed to set data valid for camera #	
8103	103	Good Part - Bad Part set simultaneously for camera #	Check camera job. Inspection reports both pass and fail state at the same time.
8104	104	Setting Online failed for camera # (with source indication)	The indicated source is forcing the mode to stay Offline. Change the setting from the indicated source to Online.
		- softOnline is Off	
		- nativeOnline is Off	
		- discreteOnline is Off	
		Setting Online failed for camera # (with no precision)	For ver.6.x, make sure that In-Sight Explorer is not connected to the camera during operation (it will prevent switching Offline/ Online mode from the robot controller). If monitoring is required during operation, use the Web Browser View (refer to *section A.2 "Web Browser View" on page A-1*).
8105	105	Setting Offline failed for camera #	
8106	106	Failed to change group on camera #	Check that the selected group is defined in the camera job.
8111	111	Failed to change job on camera #	Check that the selected job is defined in the camera, or the same as alarm 105.
8112	112	Failed to retrieve job for camera #	Check that the selected job is defined in the camera, or the same as alarm 105.
8113	113	Attempt to load invalid job on camera	Check camera job: incompatible job version, corrupted file…

Alarm	Error Codes	Description	Remedy
8113	113	Communication Timeout	- Make sure to logout of the camera before exiting In-Sight Explorer to prevent leaving an unnecessary connection opened. - Ver 6.x: Check the trigger mode in the camera job (Acquisition settings or cell A3). It needs to be set to Manual to be able to trigger the camera from the robot controller output. - Ver 5.x: Check that the Communication TCP/IP Settings are correct. - Make sure that the camera is not being triggered a second time before the previous trigger has been processed. - Make sure that there isn't multiple versions of the MS2D MotoPlus application installed on the controller. - If the camera job is very large and slow, the timeout may occur before the inspection is completed. Increase the INSPECT macro timeout time. *'wait for MotoPlus or timeout* *WAIT OT#(LI012)=ON T=5.00* - If the camera and robot is on a large network with a lot of network traffic, the packet might have been lost. Check that there are no IP Address duplicates.
8114	114	Invalid camera job range.	Review the SET_JOB macro arguments to set a job number between 1 and 999.
8115	115	Invalid group range.	Review the SETGROUP macro arguments to set a group number between 1 and 9999.
8200	200	Invalid Template: 'Inspection_Completed' cell missing.	Contact Yaskawa support.
8201	201	Invalid Template: 'Job.Pass' cell missing.	Check that the correct Motoman camera job template was used and that the indicated cell Symbolic tag is defined.
8202	202	Invalid Template: 'Job.Fail' cell missing.	
8203	203	Invalid Template: 'Motoman.UF' cell missing.	
8204	204	Invalid Template: 'Motoman.Tool' cell missing.	
8205	205	Invalid Template: 'MotoPlus.#' cell missing.	
8207	207	Invalid Template: 'Motoman.Update' cell missing.	
8208	208	Set session info failure.	Contact Yaskawa support.
8209	2089	Set trigger mode failure.	Contact Yaskawa support.
8210	210	Camera busy with previous request.	Make sure that multiple MS2D macros for the same camera are being called in parallel (in multiple tasks) or MS2D related output being triggered outside of macros.
8211	211	Camera trigger failure.	Check connection between camera and robot controller.
8212	212	Camera resource unavailable	For ver.6.x, make sure that In-Sight Explorer is not connected to the camera during operation. It may prevent some operations from the robot controller. If monitoring is required during operation, use the Web Browser View (refer to section *Appendix A.2 "Web Browser View" on page A-1*).

Alarm	Error Codes	Description	Remedy
8213	213	Trigger Camera Failed - Timeout	Check the trigger mode in the camera job (Acquisition settings or cell A3). It needs to be set to “Manual” to be able to trigger the camera from the robot controller output.
8219	219	Unknown camera error	MS2D might be in the process of connecting/ disconnecting from the camera. Logout In-Sight Explorer from the camera to allow the MS2D to properly initialize the camera connection.

D.2 Differences Between Version 5.x and 6.x

Operation	Condition	5.x (Native communication / ASCII protocol)	6.x (WebSocket communication / HMI protocol)
General	Camera Firmware	Version 5.x or 6.x	Version 6.x
	Sensor - HMI Settings	Not required	Required. (See *section 2.4.4 “HMI Settings” on page 2-10*)
Trigger (INSPECT macro)	Trigger Mode	“Manual” or “Camera” are typical. Other modes, like "Continuous" or "External" can also be used, but the triggering from the Robot Controller I/O will no longer work.	Should be "Manual". The MS2D MotoPlus application will automatically set the mode to "Manual" at boot-up. If other modes, like "Continuous" or "External", are needed, the mode override can be disabled by the MS2D_CONFIG file (see *Appendix B.2 “Optional Configuration” on page B-5*"). If mode is not "Manual", then there is no response from camera to the robot controller trigger signal. The INSPECT macro will report alarm 8113 - MACRO WAIT TIMEOUT
	Camera is Offline	No response. The INSPECT macro will report alarm 8113 - COMMUNICATION TIMEOUT. Only works when camera is Online.	Works in both Offline and Online mode.
	Communication TCP/IP Settings	Wrong communication settings will causes the camera to not response to the controller trigger. The INSPECT macro will report alarm 8113 - COMMUNICATION TIMEOUT.	Works. Communication TCP/IP Settings are not required.
Set Job (SET_JOB macro)	In-Sight Explorer Connected	Works.	If another device like In-Sight Explorer is connected, the camera job cannot be changed from the Robot Controller. Alarm 8112 or Error 212 - RESOURCE IS NOT AVAILABLE.
Set Group (SETGROUP macro)		Works.	Works.
Change Online/Offline Mode	In-Sight Explorer Connected	Works.	If another device like In-Sight Explorer is connected, the camera cannot change between Online and Offline mode from the Robot Controller. Error 212 - RESOURCE IS NOT AVAILABLE.

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