MotoEye™ SF
SYSTEM MANUAL
For DX100 or DX200 Controller

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

YASKAWA INSTRUCTIONS

DX100 OR DX200 INSTRUCTIONS
DX100 OR DX200 OPERATOR’S MANUAL
DX100 OR DX200 MAINTENANCE MANUAL

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

Part Number: 161204-1CD
Revision: 6
MANDATORY

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

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

• It is the purchaser’s responsibility to ensure that all local, county, state, and national codes, regulations, rules, or laws relating to safety and safe operating conditions for each installation are met and followed.

CAUTION

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

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

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

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

• Yaskawa is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Yaskawa suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-1999). 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. NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR 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.
Notes for Safe Operation
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the MotoEye™ SF.

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

- **DANGER** Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.

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

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

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

- **PROHIBITED** Must never be performed.

Even items described as “CAUTION” may result in a serious accident in some situations.

At any rate, be sure to follow these important items.

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

**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 your 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 turning of the manipulator's arm.
**WARNING**

- Before operating the manipulator, check that servo power is turned OFF by pressing the EMERGENCY STOP buttons on the operator station or Programming Pendant. When servo power is turned OFF, the SERVO ON LED on the Programming Pendant is turned OFF.

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

Fig. : *EMERGENCY STOP Button*

- Release the EMERGENCY STOP button. Once this button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Fig. : *Release of EMERGENCY STOP Button*

- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Ensure that there is a safe place to retreat to in case of emergency.

Improper or unintended manipulator operation may result in injury.

- Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  - Turning on the power for the DX Controller.
  - Moving the manipulator with the Programming Pendant.
  - Running the system in the check mode.
  - Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an EMERGENCY STOP button immediately if there is a problem. The EMERGENCY STOP buttons are located on the operator station and on the Programming Pendant.
CAUTION

• Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately and be sure that all other necessary processing has been performed.
  – Check for problems in manipulator movement.
  – Check for damage to insulation and sheathing of external wires.

• Always return the Programming Pendant to the hook on the cabinet of the DX Controller after use.

• The Programming Pendant can be damaged if it is left in the manipulator’s work area, on the floor, or near fixtures.

• Read and understand the Explanation of Warning Labels in the DX Controller Manual before operating the MotoEye™ SF system.
Definition of Terms Used In this Manual

The Motoman manipulator is a Yaskawa industrial robot product.

The manipulator usually consists of a DX Controller, the Programming Pendant, and supply cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment/Job</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX100 or DX200 controller</td>
<td>DX Robot Controller</td>
</tr>
<tr>
<td>DX100 or DX200 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the DX Controller</td>
<td>Manipulator cable</td>
</tr>
<tr>
<td>Lx-SF-INSPECT</td>
<td>Lx-SF</td>
</tr>
</tbody>
</table>
Explanation of Warning Labels

The following warning labels are attached to the robot. Always follow the warnings on the labels. An identification label with important information is placed on the body of the robot. Prior to operating the robot, confirm the contents.

Fig. : Warning Labels Location

Nameplate:

WARNING Label A:

WARNING

Moving parts may cause injury

WARNING Label B:

WARNING

Do not enter robot work area.
Safeguarding Tips

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become 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 are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this equipment, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this equipment.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
- The system must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-2012, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

Mechanical Safety Devices

The safe operation of this equipment is ultimately 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.

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 palm buttons located on operator station

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.
Programming, Operation, and Maintenance Safety

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this equipment should be permitted to program, or maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the equipment to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Check the E-Stop button on the operator station for proper operation before programming. The equipment must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- 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.
- Any modifications to the DX Controller unit can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the DX Controller unit. Making any changes without the written permission from Yaskawa will void your warranty.
- Some operations require standard passwords and some require special passwords.
- The equipment allows modifications of the software for maximum performance. Care must be taken when making these modifications. All modifications made to the software will change the way the equipment operates and can cause severe personal injury or death, as well as damage parts of the system. Double check all modifications under every mode of operation to ensure that the changes have not created hazards or dangerous situations.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the DX Controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- Do not perform any maintenance procedures before reading and understanding the proper procedures in the appropriate manual.
- Use proper replacement parts.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
Maintenance Safety

Turn the power OFF and disconnect and lockout/tagout all electrical circuits before making any modifications or connections.

Perform only the maintenance described in this manual. Maintenance other than specified in this manual should be performed only by Yaskawa-trained, qualified personnel.

Summary of Warning Information

This manual is provided to help users establish safe conditions for operating the equipment. Specific considerations and precautions are also described in the manual, but appear in the form of Dangers, Warnings, Cautions, and Notes.

It is important that users operate the equipment in accordance with this instruction manual and any additional information which may be provided by Yaskawa. Address any questions regarding the safe and proper operation of the equipment to Yaskawa Customer Support.
# Table of Contents

1 INTRODUCTION ................................................................. 1-1

1.1 About This Document ................................................. 1-1

1.2 System Overview ....................................................... 1-1

1.3 Major Components ................................................... 1-1

1.4 Reference Documentation ........................................... 1-2

1.4.1 General Documentation ........................................... 1-2

1.4.2 DX100 Robot Controller Documentation .................. 1-2

1.4.3 DX200 Robot Controller Documentation .................. 1-2

1.5 Customer Support Information ..................................... 1-3

2 EQUIPMENT DESCRIPTION ............................................ 2-1

2.1 Servo-Robot Seam Finding Sensor ............................... 2-1

2.2 Laser Power and Control: .......................................... 2-2

2.2.1 Laser Power: ....................................................... 2-2

2.2.2 Laser Control: ..................................................... 2-2

2.3 Robot Interface .......................................................... 2-3

3 INSTALLATION ............................................................... 3-1

3.1 System Requirements .................................................. 3-1

3.2 Servo-Robot Software Setup ...................................... 3-1

3.2.1 Create or Edit a Task ............................................ 3-3

3.3 DX Robot Controller Interface ..................................... 3-5

3.4 Setting Robot Data For The Seam-Finding Sensor ........... 3-7

3.4.1 Setting Tool Data with Calibration Macro .................. 3-7

3.4.2 Setting Tool Orientation Manually .......................... 3-14

4 PROGRAMMING .................................................................. 4-1

4.1 New Weld Joint .......................................................... 4-1

4.2 Robot Programming .................................................... 4-3

4.2.1 Detecting a Weld Seam ......................................... 4-3

4.2.2 Programming the Sensor over the Weld Joint ............. 4-4

4.2.3 Advanced Control ............................................... 4-7

4.2.4 Deployment ........................................................ 4-10

4.2.5 Tips for Improving Cycle Time ............................... 4-12
# Table of Contents

Appendix A .......................................................... A-1
  A.1 Output Messages .............................................. A-1
    A.1.1 Lx-SF Macro .............................................. A-1
    A.1.2 SFx-ADV Macro .......................................... A-2
Appendix B .......................................................... B-1
  B.1 Communication Setup ........................................ B-1
Appendix C .......................................................... C-1
  C.1 Alarm List ....................................................... C-1
    C.1.1 v2.4.0 and Above Alarm List ......................... C-1
    C.1.2 v2.3.0 and Below Alarm List ......................... C-4
1 Introduction

1.1 About This Document

This manual is intended for personnel who has received operator training from Yaskawa and who are familiar with the operation of this particular Yaskawa system. For more detailed information on any specific component or peripheral of the Yaskawa MotoEye™ SF system, please review the full documentation package that is included with the Yaskawa MotoEye™ SF system (refer to section 1.4).

1.2 System Overview

The Yaskawa MotoEye™ SF (Seam Finder) function for the DX Controller provides a solution for finding the weld seam using an Ethernet communication interface with a Servo-Robot seam-finding sensor.

1.3 Major Components

The MotoEye™ SF system includes the following major components:

- One Servo-Robot Laser Seam-Finding sensor
- PC software for setup of the laser sensor
1.4 **Reference Documentation**

For additional information on individual components of the MotoEye™ SF system, refer to the following documentation:

### 1.4.1 General Documentation

- Yaskawa Motoman *Operator's Manual for General* (P/N 155507-1CD)
- Vendor manuals for system components not manufactured by Yaskawa

### 1.4.2 DX100 Robot Controller Documentation

- Yaskawa Motoman *DX100 Controller Manual* (P/N 155494-1CD)
- Yaskawa Motoman *DX100 Maintenance Manual* (P/N 155492-1CD)
- Yaskawa Motoman *DX100 Macro Command Function Manual* (P/N 156439-1CD)
- Yaskawa Motoman *DX100 Concurrent I/O Manual* (P/N 155491-1CD)
- Yaskawa Motoman *DX100 MH-Series Positioner Manual* (P/N 156488-1CD)
- Yaskawa Motoman *DX100 Independent/Coordinated Control* (P/N156431-1CD)
- Yaskawa Motoman *DX100 INFORM User’s Manual* (P/N 155493-1CD)

### 1.4.3 DX200 Robot Controller Documentation

- Yaskawa Motoman *DX200 Installation and Operations Manual* (P/N 165292-1CD)
- Yaskawa Motoman *DX200 Maintenance Manual* (P/N 165293-1CD)
- Yaskawa Motoman *DX200 Macro Command Function Manual* (P/N 166242-1CD)
- Yaskawa Motoman *DX200 Concurrent I/O Manual* (P/N 165294-1CD)
- Yaskawa Motoman *DX200 MH185, MH555, and MH1655 Positioner Manual* (P/N 168961-1CD)
- Yaskawa Motoman *DX200 Independent/Coordinated Control* (P/N165836-1CD)
- Yaskawa Motoman *DX200 INFORM User’s Manual* (P/N 165301-1CD)
1.5 Customer Support Information

If you need assistance with any aspect of your MotoEye™ SF system, please contact Yaskawa Customer Support at the following 24-hour telephone number:

(937) 847-3200

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

techsupport@motoman.com

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

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

Please have the following information ready before you call:

- System MotoEye™ SF including name/model of laser sensor
- Robots
- Positioner
- Primary Application Welding
- DX Controller DX100 or DX200
- Software Version Access this information on the Programming Pendant’s LCD by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION}
- Robot Serial Number Located on the robot data plate
- Robot Sales Order Number Located on the DX Controller data plate
2 Equipment Description

2.1 Servo-Robot Seam Finding Sensor

The Servo-Robot laser sensor is used to measure two dimensions (ie. lateral and vertical) of movement in a weld seam.

A laser-sensor projects a laser line perpendicular to the weld seam and through a CCD (charge-couple device) camera captures a reflected image of the laser line. The image that is reflected is then processed by the laser sensor by comparing the actual joint to a predetermined joint profile. Software in the camera then determines a tracking point (ie: the profile of a 2.5 mm lap joint). This tracking point is intended to be attached to a particular user-defined feature of the joint profile (ie. between the upper corners of a v-groove weld joint). The laser sensor’s field/depth of view will track the weld joint if it should fluctuate and the tracking point will adjust accordingly by the Servo Robot software.

Fig. 2-1: Servo-Robot Seam Finder Sensors
2.2 Laser Power and Control:

2.2.1 Laser Power:

Power for the SF laser camera is provided by the Yaskawa DX Robot Controller. Laser safety standards dictate that a key-switch must be supplied and implemented as a means of preventing inadvertent power-up of the laser while within the robotic work cell. For this reason, a key-switch has been added to the front of the Yaskawa DX Robot Controller (one for each laser camera). These key-switches control power to the camera and provide a means of preventing inadvertent operation while in the work cell. See Fig. 2-2 “Laser Switches”

Fig. 2-2: Laser Switches

- While regular in-cell maintenance is taking place, turn the key-switch to the [OFF] position and remove the key.
- While teaching or production, ensure the key-switch is in the [ON] position enabling power to the camera.

2.2.2 Laser Control:

The laser line can be “muted” and “unmuted” either using the WeldCom PC software or directly from the robot’s teach pendant. To enable/disable the laser line from the teach pendant while in [TEACH] mode, press the following:

- Laser#1: [INTERLOCK] + [1]
- Laser#2: [INTERLOCK] + [2]
- Laser#3: [INTERLOCK] + [3]
- Laser#4: [INTERLOCK] + [4]

Pressing the above sequence of buttons toggles the laser line from one state to another (muted-to-unmuted and unmuted-to-muted).
2.3 Robot Interface

In order to calculate a shift offset, the robot needs a nominal location to base future measurements off of. The nominal location is saved during the teaching procedure. The robot compares the nominal locations of Y and Z to the measured position to create this offset. For instance, if the robot is programmed with a nominal Z position value of 100 mm and a measured value of 106 mm is sent from the sensor to the robot, the robot develops a +6mm shift offset. (106-100=6).

The nominal positions are controlled in the L*-SF macro job by two values: a Y and Z setting. These nominal values define a specific location within the laser sensor’s field of view. These two values are defined in the SETUP section of the L*-SF macro job and are global settings (This same location is referenced every time the L*-SF macro instruction is used). See Fig. 3-7: L*-SF Macro on page 3-3 to see the SETUP instructions.

The nominal positions are typically set in the middle of the Field of View/Field of Depth but can be placed almost anywhere in the Field of View/Field of Depth to suit application needs. The typical location of the Nominal Z Position is shown in Fig. 2-3(a “Nominal Z Position using MotoEye™ SF V200/V350”.

In current versions of MotoEyeSF (v2.4.0 and up), the Nominal Z Position is controlled by local variable LR003 in the L*-SF macro job.

In prior versions of MotoEyeSF (v2.3.0 and older), the Nominal Z Position is controlled by LD013.
Fig. 2-3(a): Nominal Z Position using MotoEye™ SF V200/V350

V200 Camera

V350 Camera
2-3 Robot Interface

**MotoEye™ SF**

**Equipment Description**

Fig. 2-3(b): Nominal Z Position using MotoEye™ SF i-CUBE 100L

![Diagram of MotoEye™ SF i-CUBE 100L](image)

**I-CUBE 100L CAMERA**

(652T NECK W/ WIREBREAK SHOWN)

Fig. 2-3(c): Nominal Z Position using MotoEye™ SF i-CUBE 350L

![Diagram of MotoEye™ SF i-CUBE 350L](image)

**I-CUBE 350L CAMERA**

(600T NECK W/ WIREBREAK SHOWN)
The location of the Nominal Y and Z Positions can be adjusted (in the event the application requires it) from within the L*-SF macro job. Adjusting the value of the R003 (Nominal Z Position) parameter to a larger value will move the laser sensor closer to the weld seam. See Fig. 2-4 “Setting Nominal Z Position too High” for an example that could cause the robot to crash.

Fig. 2-4: Setting Nominal Z Position too High

CAUTION

Use care when increasing parameters.
Not using care when increasing the parameter can cause the robot to crash.

For each instance that the L*-SF macro instruction is executed in the job, the robot should be initially (ie. during initial teaching) moved to a location over the weld seam such that if a measurement is made, the nominal locations are measured by the sensor. A convenient feature of the Auto Teach mode of the L*-SF macro instruction is that it discovers this location for the user, and the user is asked to Re-Modify the Reference Position, which saves the desired location to the L*-SF macro job.
After the robot is programmed to each desired detection position for the application (so that the nominal locations are measured by the sensor), the user then programs the weld path(s). If everything was programmed correctly, the (original taught part/"master" part) execution of the various L*-SF macro instructions should produce close to zero shift amounts and the weld path points (because they were programmed to the original part and are getting close to zero shift amounts) should be in the weld joints.

The laser sensor is used to detect and adapt to weld joints that are not located in the same location every time (relative to the robot). Placing new, varying parts into the robot system should produce non-zero shift amounts (this can be observed by monitoring the destination P variable after successful execution of the L*-SF macro instruction). These shift amounts should be shifting the weld points from the original programmed location and into the deviated weld seams.

An example of how the robot calculates the shift offset, by comparing the detected seam location to the nominal positions are shown in Fig. 2-5 “Shift Offset”.

*Fig. 2-5: Shift Offset*
After processing of the weld joint profile is completed, the measured data is available for the robot. The DX Robot Controller receives the data from the laser sensor and calculates a shift amount for the point(s) on the weld path.

The DX Robot Controller calculates the shift amount by using the Y and Z values from the camera and converts them to X, Y, and Z values for the robot.

In order for the measurements to be converted, proper tool files need to be set up (L1-SF uses tool # 60, L2 - tool # 61, L3 - tool # 62, L4 - Tool # 63).

After the measured data is successfully translated into a robot coordinate system, the data is available to the robot job through the use of the {SFTON} instruction (Shift On function).

If needing to weave when welding, use the gap measurement with the {WVADJ} (Weave Adjust) inform command to allow for continuous varying adaptive process control. This will change the weave amplitude and travel speed gradually between two programmed robot positions based on changes in the gap measurements.5

**NOTE**

The SF*-ADV macro is intended only for applications which require advanced control. This macro does not perform position calculations on the sensor data. Therefore, it should not be used for normal functionality, as described above.
3 Installation

3.1 System Requirements

Always comply with all the safety instructions and precautions given throughout this manual during the installation process.

The instructions given in this section are general guidelines for installing the MotoEye™ SF system. Refer to the system drawings and relevant system component manuals for specific installation information.

3.1 System Requirements

Most system components and most hardware items required for installation of the MotoEye™ SF system to a DX Robot Controller are included. Additional cables will need to be purchased through Yaskawa or Servo Robot directly.

3.2 Servo-Robot Software Setup

The current Servo-Robot software platform called “Weldcom” resides on a PC and accesses the vision system for parameter setup, tuning, etc.

1. Load the included Weldcom Software onto a PC.

2. Connect an Ethernet cable from the Servo-Robot interface module to the Ethernet port on the PC.

3. Configure the PC network connection to an IP address that will work with the Servo-Robot SF sensor.

   - The IP address of the PC must not be identical to the SF sensor.
   - It is recommended to set the Subnet Mask to “255.255.255.0”. If this mask is used, then the first three groups of the IP addresses must match. Example: 192.168.1.xxx

   **NOTE**

   A cross over Ethernet cable or standard Ethernet switch/hub is recommended for best performance.

   **NOTE**

   The IP address of the SF sensor can be changed from Microsoft Internet Explorer browser. See Servo-Robot documentation for full instructions.

   Some sensors will require that Internet Explorer use “Compatibility View”.
3 Installation
3.2 Servo-Robot Software Setup

• The IP address of the SF sensor is displayed on the LED panel when the sensor is powered up. If the following is seen “IP … 192 … 168 … 1 … 71 …” this means that the sensor’s IP address is 192.168.1.71.

• It is recommended to use an IP address for the PC of 192.168.1.5 or higher

**NOTE**
The IP range 10.0.0.xxx is reserved on the system and may not be used by the PC or SF sensor.

4. On the PC, manually set the IP (Network Settings >> Local Area Connection >> Properties >> Internet Protocol Version 4 (TCP/IPv4) >>Properties. Use the IP address that user has just created.

5. Start the WeldCom program.

*Fig. 3-1: WeldCom Program Screen*

6. Click on “Link to a new server” and enter the IP address observed during power up of the Servo-Robot sensor.

7. Enter the required port number and click the blue Check button.

**NOTE**
Typically the port number is “10001”. See the included Servo-Robot documentation “Quick Setup Guide” if this port number does not work.
3 Installation

3.2 Servo-Robot Software Setup

8. The main “Vision” screen appears.

*Fig. 3-2: Vision Screen*

9. Click on the Pencil icon to open the editing menu on the right side of the Vision screen.

### 3.2.1 Create or Edit a Task

The instructions below will allow the user to create or edit a task.

Start from the Vision screen when needing to create or edit a task.

1. Press the “+” key located in the PART sub section if no part has been created yet.

2. Press the “+” key located in the TASK sub section.

3. Select a task number and name. Specify if a new blank task if desired or copying data from an existing task and modifying existing parameters.

*Fig. 3-3: Task Screen*
3 Installation

3.2 Servo-Robot Software Setup

4. If editing an existing task parameter click on the “thinking man” icon in the TASK BAR.

5. Select the Recognition Algorithm to use.
   • Select the type of weld joint that is desired to be found.

   **CAUTION**

   It is important to have a stable, consistent tracking point (the red “X” on the screen) when the robot is not moving when adjusting the parameters. The tracking point will be the center of the weld joint.

6. Adjust the required parameters. (Proper training from Servo Robot is highly recommended.) See Servo Robot documentation if unsure how to adjust parameters.

7. Complete one of the following:
   • Press the blue Check button to save data.
   • Press the blue Return button to undo recent changes.
   • Press the blue Exit button to leave screen without saving additional changes.
3.3 DX Robot Controller Interface

The L1-SF-INSPECT, L2-SF-INSPECT, etc macro jobs generate bi-directional communication with the Servo-Robot sensor. The macro job enables the laser emission, selects a profile #, and then populates the specified P variable with the measured shift offsets. The P variables are then used in the job with the \{SFTON\} instruction. See Fig.3-4 “Robot DX Robot Controller Interface Flowchart”.

Fig. 3-4: Robot DX Robot Controller Interface Flowchart

1. The DX robot controller must have a number of functions enabled by Yaskawa Customer Support prior to use.

2. Load the L*-SF, SF*-ADV, SF*-RST, and MACRO.DAT files into the DX Robot Controller.
   a) One laser system: L1-SF.
   b) Two laser system: L1-SF (laser #1 for R1), L2-SF (laser #2).
   c) Three laser system: L1-SF, L2-SF, and L3-SF.
   d) Four laser system: L1-SF, L2-SF, L3-SF, and L4-SF.
3. Open the L*-SF macro(s) and cursor to the “----------SETUP----------” section. This is used to configure the macro for your specific application.

When adjusting the nominal Y and Z distances, this will affect position of the sensor relative to the part.

If the nominal positions of the laser sensor are set too close to the face of the laser sensor, the torch may contact the surface of the part.

The larger the value of the nominal Z distance parameter, the closer the laser sensor will be to the surface of the part!

4. The setup section of the macro contains instructions for each of the following items which must be configured:
   - Model of laser sensor.
   - Nominal Z distance for vertical standoff.
   - Nominal Y distance for lateral offset.
   - Output signal for shutter door.
   - Robot tool file for the sensor calibration data.
   - Error handling and retry attempts.
   - Additional data to retrieve from the sensor.

   - Once beginning to program the application, do not change the values in the Setup Section
   - Reteach the nominal positions if the weld points are relocated.
   - No setup modifications are required for SF*-ADV. This macro is intended only for advanced functionality.

<table>
<thead>
<tr>
<th>Version</th>
<th>Sensor 1</th>
<th>Sensor 2</th>
<th>Sensor 3</th>
<th>Sensor 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>v2.5.0 and above</td>
<td>S090 (DX200)</td>
<td>S091 (DX200)</td>
<td>S092 (DX200)</td>
<td>S093 (DX200)</td>
</tr>
<tr>
<td></td>
<td>S070 (DX100)</td>
<td>S071 (DX100)</td>
<td>S072 (DX100)</td>
<td>S073 (DX100)</td>
</tr>
<tr>
<td>v2.4.0</td>
<td>S090</td>
<td>S091</td>
<td>S092</td>
<td>S093</td>
</tr>
<tr>
<td>v2.3.0 and below</td>
<td>S096</td>
<td>S097</td>
<td>S098</td>
<td>S099</td>
</tr>
</tbody>
</table>
3.4 Setting Robot Data For The Seam-Finding Sensor

Inside the laser sensor, measurements are based on a 2D plane and needs to be converted to a 3D robot coordinate system to be useful to the robot. A specific Tool (for Laser 1, Tool 60 is used) coordinate system is used for this conversion.

3.4.1 Setting Tool Data with Calibration Macro

This calibration routine compares a number of laser measurements to the position of the robot's torch tip at a known location. Based on these comparisons, it is able to automatically detect the position and orientation of the SF sensor.

This routine will generate a new tool file (tool 60 for laser 1) that contains a TCP for the laser line. If desired, this tool can be used for jogging to make part programming easier.

Proper orientation of the laser's tool file is critical for operation of the Lx-SF-INSPECT macro job (Lx-SF).

3.4.1.1 Setup The Calibration Macro

1. Open the Lx_SF_CALIBRATE macro for editing.
2. Cursor down to the SETUP section of the macro.
3. Configure the height of where the tool TCP will be located in the laser's field of view.
   • Recommended heights for each sensor model are listed in the macro. Set variable LI000 to the desired height value.

   **NOTE** Once setting the LI000, do not modify the calibration macro jobs. Please see below for the procedure to register the calibration instruction.

4. Continue with registering the calibration instructions.

CAUTION
Configure the TCP of the welding torch correctly
Not configuring the TCP of the welding torch correctly can cause a crash and/or poor calibration.
### 3.4 Setting Robot Data For The Seam-Finding Sensor

**Fig. 3-5: Setting the Desired Height**

![Diagram showing the setup of the desired height for the Servo Robot SF sensor with the laser field of view.](image)

**Fig. 3-6: Setting LI000 (Height) Screen**

![Screen showing the LI000 setting for height with job content and values set.](image)
3.4.1.2 Programming the Calibration Macro

Calibration is performed by recording a series of reference positions at a known location. First, the welding torch is recorded at a specific location. Then a series of positions are recorded such that the laser's tracking point is always placed at the location of the original torch position.

It is recommended to use a workpiece with a basic lap joint. A point should be marked on the lap joint where the laser will detect a tracking point.

The tool to which the sensor is physically mounted must already have a properly configured TCP. See the controller instruction manual (DX100 Controller Manual part number 162536-1CD or DX200 Controller Manual part number 165292-1CD) for information on configuring a TCP.

The calibration macro will only work properly if the sensor is physically mounted to an EOAT connected at the T flange of the robot arm.

Fig. 3-7: Calibrating Macro Screen
### Table 3-1: Argument Values

<table>
<thead>
<tr>
<th>Argument</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task#</td>
<td>0 - 64</td>
<td>Task number used in the Servo Robot system to detect the joint profile.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For calibration, it is recommended to use a Task that is configured for a basic lap joint.</td>
</tr>
<tr>
<td>Torch tool</td>
<td>0 - 63</td>
<td>TCP number of the robot tool which the sensor is mounted to.</td>
</tr>
<tr>
<td>Tool ref pos</td>
<td></td>
<td>Record robot position</td>
</tr>
<tr>
<td>Sensor ref pos 1</td>
<td></td>
<td>Record robot position</td>
</tr>
<tr>
<td>Sensor ref pos 2</td>
<td></td>
<td>Record robot position</td>
</tr>
<tr>
<td>Sensor ref pos 3</td>
<td></td>
<td>Record robot position</td>
</tr>
<tr>
<td>Sensor ref pos 4</td>
<td></td>
<td>Record robot position</td>
</tr>
<tr>
<td>Escape ref pos</td>
<td></td>
<td>Record robot position</td>
</tr>
<tr>
<td>Calib error amnt</td>
<td>0 - 127</td>
<td>Index of a position variable which will contain the calculated error amount of the calibration.</td>
</tr>
</tbody>
</table>
3.4 Setting Robot Data For The Seam-Finding Sensor

3.4.1.3 Programming Reference Positions for Calibration

1. Using a basic lap joint, scribe a mark on the edge of the top plate.

2. Setup a Servo Robot task to detect the tracking point on the edge of
the top plate.

3. For each argument in the macro detail-edit screen, cursor over the
word UNREGIST and press [MODIFY] then [ENTER] to capture the
position of the TCP.
   • The argument value should change to REGIST to indicate that the
   position has been successfully recorded.

4. Set the Tool Reference Position
   • The first point should be recorded with the TCP of the tool directly on
   the marked point in the joint.

Fig. 3-8: Tool Reference Position

![Tool Reference Position Diagram]
5. Set the Sensor Reference Point 1

- Ensure the Servo Robot Weldcom software visible on the PC during this process.
- Unmute the sensor using the Weldcom software.
- Record the next point such that the Tracking Point of the joint profile is exactly where the Tool Reference Point was recorded in step 4.
- For the first reference position, the Tracking Point should be located near the center of the laser's field of view.

*Fig. 3-9(a): Setting the Sensor Reference Point 1*
3.4 Setting Robot Data For The Seam-Finding Sensor

6. Set Sensor Reference Position 2, 3, and 4

- Record the next point such that the Tracking Point of the joint profile is exactly where the Tool Reference Position was recorded for each sensor reference position.

  - For the second reference position, the Tracking Point should be located near the top-center of the laser's field of view.

  - For the third reference position the Tracking Point should be located near the bottom-left of the laser's field of view

  - For the fourth reference position the Tracking Point should be located near the bottom-right of the laser's field of view.

Fig. 3-9(b): Setting the Sensor Reference Points 2 through 4

Reference Point 2

Reference Point 3

Reference Point 4
3 Installation

3.4 Setting Robot Data For The Seam-Finding Sensor

7. Program the Escape Reference Position

- During the calibration routine, the robot will move to each of the recorded reference positions. Between each point, it will travel to the escape position. The escape position should be programmed such that the robot can move from this position to each of the other reference-positions without colliding into the workpiece or the table.

3.4.1.4 Executing the Calibration Macro

After recording all of the reference positions and setting the remainder of the macro arguments, you must execute this macro routine in a robot job. During execution, the robot will automatically enable the laser and move to each of the recorded positions.

When the macro is done executing, it will populate the position variable specified in the “Calib Error Amnt” argument. This will contain the calculated residual of the calibration routine. It can be used as a gauge of the calibration's accuracy.

This routine automatically modifies your tool data. If the FSU is enabled on this system, you will need to reboot after performing the calibration routine. Upon reboot, you will get an alarm that indicates you need to perform a functional safety flash reset.

3.4.2 Setting Tool Orientation Manually

The following procedure provides the means for defining the correct orientation for the Tool used for the laser sensor.

1. Open the Tool file corresponding to the laser number (MAIN MENU > ROBOT > TOOL).

2. The X, Y, and Z values are irrelevant to the calibration for the laser sensor. However, the orientation of the tool frame is critical. Therefore, adjust the RX, RY, and RZ data fields until the following conditions have been obtained when jogging using Tool File.

3. Scribe a straight line on a non shiny surface to check the setup of the laser. Move the robot so the laser is on top of the line. See Fig. 3-10(a “Orientation of Sensor”, Fig. 3-10(b “Orientation of Sensor”, and Fig. 3-11 “Positioning Laser on Scribed Line”.

NOTE Use the calibration macro (described above) for the most accurate tool setup.
3.4 Setting Robot Data For The Seam-Finding Sensor

Fig. 3-10(a): Orientation of Sensor

Fig. 3-10(b): Orientation of Sensor
3.4 Setting Robot Data For The Seam-Finding Sensor

4. Verify the tool orientation by jogging the robot with the laser ON. Select the correct Tool number: Tool 60 for Laser 1, Tool 61 for Laser 2, Tool 62 for Laser 3, and Tool 63 for Laser 4. While jogging the robot in the Y and Z direction in the tool/frame, the laser line should remain projected along the scribed line.

   a) While jogging the robot in the Y direction of the corresponding tool, the laser line should move in the direction of the scribed line and should stay projected on the scribed line.

   Assuming Fig. 3-11 “Positioning Laser on Scribed Line” as a start position for the laser line, when jogging robot in the Y direction, Fig. 3-12 “Tool Verify Y Direction” should occur.
3.4 Setting Robot Data For The Seam-Finding Sensor

b) While jogging the robot in the Z direction of the corresponding tool, the laser line should grow shorter and longer and stay projected on the scribed line.

Assuming Fig. 3-11 “Positioning Laser on Scribed Line” as a start position for the laser line, when jogging robot in the Z direction, Fig. 3-13 “Tool Verity Z Direction” should occur.

Fig. 3-13: Tool Verity Z Direction

5. Repeat step 2. if Y or Z (Tool Frame) jogging is incorrect in the tool frame coordinate.

**NOTE**

The default numbers are listed on the hardware drawings included with your system.

- If adjustments are needed there is a tolerance of ±1°.
4 Programming

### 4.1 New Weld Joint

When programming a new weld joint, the following sequence must be used.

1. Turn the key switch on the DX Robot Controller box to the ON position.
2. Move the sensor into a position until the laser is roughly perpendicular over the weld joint.
3. Setup a vision system “task” or verify the task that will be used to process the weld joint is operating with a stable tracking point (the red X) using Servo-Robot's Weldcom PC software.
4. Insert the seam finding macro instruction (ie. L1-SF) into the robot job. The L*-SF macro instruction(s) can be found under [INFORM LIST] > {MACRO}.
5. Reference the vision system task number by setting the TASK# argument of the L*-SF macro instruction to the task number.
6. Program the remaining argument fields of the seam finding macro instruction.
   
   a) Status Msg Bvar#: defines the B variable number to have the status of the macro job set to. After execution of the macro job, the L*-SF macro sets a value to B variable Number (Status Msg Bvar#). The value of the B variable will describe if the macro job executed successfully or if an error condition occurred. See Appendix A: for details on Status Message values.
   
   b) Teach Mode: enables/disables the AutoTeach function; 0 = AutoTeach off, 1 = AutoTeach on.
   
   c) Shift Amnt Pvar#: defines the P variable number to have the calculated shift amount saved to. After successful execution of the L*-SF macro, the shift amount is saved to P Variable Number (Shift Amnt Pvar#). This P variable should then be used with the {SFTON} instruction to shift the programmed weld path.
   
   d) Max Shift Amount: before the calculated shift amount is stored into the requested P variable number, the shift amount is compared to the Max Shift Amount setting. If the shift amount is greater than the maximum amount it is either (1) stored into the P variable or (2) optionally set to a value of 0.00mm (zero) and then stored into the P variable. The “Status Msg Bvar#” argument is also set to a value signifying that the Maximum Shift Amount has been exceeded.
   
   e) Gap Size Dvar#: defines the D variable number that will contain the measured size of the joint gap. If the macro is configured to obtain area, mismatch, and normal angle, then these values will be stored in the D variables immediately after gap.
   
   f) # retry on failu: The number of times to retry a measurement if any error is detected.
4 Programming
4.1 New Weld Joint

- g) Alarm on failure: In addition to populating the Bvar with an error code, the system can optionally alarm in the event of a failure. This will stop robot motion.
- h) Don't Mute Laser: If it is known that this measurement will be followed by subsequent measurements, you can optionally leave the laser visible after execution. This should only be used in applications where cycle time is very critical.

7. Program the Ref Position such that the weld seam is in range of the laser sensor (automatically or manually) and that a tracking point can be established by the laser sensor.

8. Program the weld path.

**NOTE**
If using coordinated motion during execution of the shift amount, use the \{SSFTON\} and \{SSFTOF\} command. Make sure that use of the \{CNVRT\} command is used for this conversion process. When programming the job with these functions make sure that the \{CNVRT\} command is used prior to the \{SSFTON\} and immediately after execution of the L*-SF macro. The Master Tool Frame shift amounts should be used as a target for the conversions.

9. Deploy the \{SFTON\} instruction(s) into the weld job, referencing the P Variable number registered in step 6c and (optionally) combine with other measured P variable shift amounts if needed (contact Yaskawa customer support, if needed).
4.2 Robot Programming

The control interface of the robot to the SF sensor is through a 
L*-SF (ie. L1-SF, L2-SF, L3-SF, and L4-SF) macro job.

Every time a location is to be detected on the weld joint or part feature a 
L*-SF macro instruction needs to be registered.

Execution of the L*-SF macro instruction will manage communication with 
the sensor.

4.2.1 Detecting a Weld Seam

For weld seams to be detected, the following steps needs to be taken.

1. Insert a L*-SF macro instruction into the robot job (done by [INFORM 
LIST] > {MACRO}).
2. Position the camera so the laser is on the weld joint roughly 
perpendicular to the weld seam.
3. Set remaining arguments of the L*-SF macro instruction.
   • See Fig. "" for details.
4. Insert other L*-SF macro instructions and teach the sensor to the weld 
joints if needed.
5. Set remaining arguments of the L*-SF macro instruction as needed.
6. Condition/combine/calculate shift amounts made by the L*-SF macro 
instructions in the previous step.
7. Insert {SFTON}/{SFTOF} (or {SSFTON}/(SSFTOF)) instruction(s) into 
the weld path section of the robot job.
4.2.2 Programming the Sensor over the Weld Joint

Once properly programmed to the weld joint, the laser sensor will provide an offset (i.e. how far the new part is located from the original taught part). This offset is calculated from the nominal position in the camera’s field of view. The further the weld joint or tracking point is from this nominal position, the larger the calculated offset will be.

To program the camera to the nominal position, it is recommended to use the following procedure:

1. Insert the L*-SF macro instruction into the robot job above the {ARCON} instruction.
   • The instruction can be accessed from [INFORM LIST] > {MACRO}.
   • This macro instruction after insertion, should have the following structure (although the data of each argument may differ from Fig. 4-1).

   Fig. 4-1: Macro Instruction

   ![Macro Instruction](image1)

2. Open the Argument Setting screen of the L*-SF macro instruction.
   • To open the instruction, cursor to the instruction side of the instruction and press [SELECT] two times.

   Fig. 4-2: Argument Setting

   ![Argument Setting](image2)
### Table 4-1: Arguments of the L*-SF-INSPECT Macro Instruction

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
<th>Data Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Task #</td>
<td>Task number used in the Servo-Robot control.</td>
<td>(-1), 0 - 64</td>
</tr>
<tr>
<td></td>
<td>If (-1) is specified, then the sensor will not change Task #. The previously loaded task will be preserved.</td>
<td></td>
</tr>
<tr>
<td>RefPosition</td>
<td>Robot position used for joint measurement.</td>
<td>[MODITY] &gt; [ENTER]</td>
</tr>
<tr>
<td>Status Msg Bvar#</td>
<td>Every execution of the macro will write a value to this user-definable B variable. If there are any errors during execution, the B variable will contain a non-zero error code.</td>
<td>0 - 99</td>
</tr>
<tr>
<td>Teach Mode</td>
<td>Set to “1” if user wishes to execute an AutoTeach routine. Set to “0” for normal playback mode.</td>
<td>0 or 1</td>
</tr>
<tr>
<td>Shift Amnt Pvar#</td>
<td>Destination P variable number to save shift amount to.</td>
<td>0 - 127 or more</td>
</tr>
<tr>
<td>Max Shift Amount</td>
<td>If the calculated shift amount exceeds the Maximum Shift Amount argument value, the (1) calculated shift amount or (2) optionally a 0.0mm shift amount is set to the P variable. The default is the &quot;calculated&quot; shift amount (contact Yaskawa customer service if a change to this setting is required).</td>
<td>mm</td>
</tr>
<tr>
<td>Gap Size DVar#</td>
<td>Destination D variable number that will contain the measured size of the joint gap. If the macro is configured to obtain area, mismatch, and normal angle, then these values will be stored in the D variables immediately after gap.</td>
<td>0 - 99</td>
</tr>
<tr>
<td># retry on failure</td>
<td>In the event of a failure, this is the number of attempts that should be made prior to raising an error.</td>
<td>0 - 5</td>
</tr>
<tr>
<td>Alarm on failure</td>
<td>In addition to populating the Bvar with an error code, the system can optionally alarm in the event of a failure to stop robot motion.</td>
<td>0 = No alarm 1 = Alarm</td>
</tr>
</tbody>
</table>
4 Programming
4.2 Robot Programming

3. Verify that each parameter is set correctly for the application.
   • For example, adjust the Max Shift Amount to no greater than the
     maximum shift amount that is expected to be experienced.
     Erroneous measurements during the search attempt may result in a
     crash with the robot.

4. Move the robot into position over the part.
   • Make sure you have a stable tracking point using Weldcom
     software on the PC.
   • [MODIFY] > [ENTER] the current robot position in the RefPosition.

5. Set the Teach Mode parameter to a value of “1”.

6. Press [ENTER] > [ENTER] to save all the displayed argument settings.

7. Press and hold [INTERLOCK] + [TEST START] to execute the routine.
   • If everything is working properly the laser should turn on, the robot
     should move slightly closer to the weld joint and then a message
     should be displayed on the bottom of the teach pendant instructing
     the user to “ReModify the RefPosition, and set Teach Mode to 0.”

8. Re-open the argument setting screen of the L*-SF macro instruction.
   • From the instruction side of the macro press [ENTER] > [ENTER].

9. Place the cursor over the RefPosition parameter and press [MODIFY]
    > [ENTER] to capture the newly defined position of the camera over
    the weld joint.

10. Set the Teach Mode parameter to a value of “0”.

11. Press [ENTER] > [ENTER] to save all the displayed argument settings.
   • The L*-SF macro instruction is now programmed to this specific
     location of the weld joint.

12. Repeat the above process for each weld joint location to be detected.

### Table 4-1: Arguments of the L*-SF-INSPECT Macro Instruction

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
<th>Data Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t Mute Laser</td>
<td>Set this to “1” to leave the laser unmuted at the end of the L*-SF routine</td>
<td>1 = Do not mute</td>
</tr>
</tbody>
</table>

If the AutoTeach mode is successful, the robot moves such
that the laser sensor measures a Nominal Z Position of
150.0 mm (this value is adjustable, and is set inside the
L*-SF macro job and can be changed, SYSTEM WIDE) and
Nominal Y Position 0.0 mm (corresponding to the center of
the field of view). These measurements can be observed
from the Weldcom portal as well. As the weld seam varies,
the vision system measurements are compared to these
two nominal values and shift offsets are made based on the
distance between: taught Nominal Z Position (150.0 mm) -
measured Nominal Z Position = Z offset; Nominal Y Position
(center of field of view, or 0 mm) - measured Nominal Y
Position = Y offset.
### 4.2.3 Advanced Control

The SF*-ADV macro is provided for users who desire advanced control/calculation abilities. This macro is intended for use by users who are experienced with the Servo-Robot product and familiar with position calculations.

The advanced macro does not perform any calculations on the raw data returned from the SF sensor. Therefore, it does not provide the positional offset data which can be obtained from the L*-SF macro.

This job is useful for users who want to calculate their own joint geometry given the raw data returned from the Servo-Robot sensor. It can also be used to perform an individual task, without doing an entire cycle of [Set Task] - [Unmute] - [Measure] - [Calculate] - [Mute] - [Check Status]. Users can pick and choose any or all of the functions to perform.

If multiple tasks are enabled in the SF*-ADV macro, they will execute in the order that they appear in the argument list below.

Fig. 4-3: Argument Setting
### Table 4-2: Arguments of the L*-ADV Macro Instruction

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
<th>Data Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Set Task</strong></td>
<td>This sets the internal Sensor Task # inside the Servo Robot SF sensor. The details of each task must be pre-configured using Servo Robot's WeldCom software.</td>
<td>1 = Select Sensor Task #&lt;br&gt;0 = Do not select Sensor Task #</td>
</tr>
<tr>
<td><strong>Task Index</strong></td>
<td>This is the task number to select in the camera. A list of configured task numbers can be viewed in WeldCom. <em>(This argument is N/A if SET TASK = 0)</em></td>
<td>0 - 64</td>
</tr>
<tr>
<td><strong>Unmuted Laser</strong></td>
<td>This will unmute the laser so that it is visible. The laser must be un-muted to take a measurement.</td>
<td>1 = Unmute laser&lt;br&gt;0 = Do not unmute laser</td>
</tr>
<tr>
<td><strong>Measure</strong></td>
<td>This will trigger the SF sensor and retrieve the raw measurement data. No additional calculations are performed on the data returned from the sensor.</td>
<td>1 = Return measurements&lt;br&gt;0 = Do not measure</td>
</tr>
<tr>
<td><strong>Meas D-Var IDX</strong></td>
<td>This is the starting index of robot D-Variables to return data from the camera. If the EXTENDED MEAS parameter is disabled, then only 1 D-variable will be returned, containing the GAP measurement. If the EXTENDED MEAS parameter is enabled, then a total of 4 D-variables will be populated, containing GAP, AREA, MISMATCH, and NORMAL. <em>(This argument is N/A if MEASURE = 0)</em></td>
<td>0 - 99</td>
</tr>
<tr>
<td><strong>Meas P-Var IDX</strong></td>
<td>This is the index of the robot P-variable to return the Tracking Point data. This position variable will contain the Y and Z coordinates of the tracking point. <em>(This argument is N/A if MEASURE = 0)</em></td>
<td>0 - 99</td>
</tr>
<tr>
<td>Extended Meas</td>
<td>This action causes additional data to be returned from the SF into the robot D variables. <em>(This argument is N/A if MEASURE = 0)</em></td>
<td>0 = Gap only&lt;br&gt;1 = Gap, area, mismatch, and normal</td>
</tr>
</tbody>
</table>
### 4.2 Robot Programming

**Table 4-2: Arguments of the L*-ADV Macro Instruction**

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
<th>Data Range</th>
</tr>
</thead>
</table>
| Get Breakpoints | This will trigger the SF sensor and retrieve data into robot variables. However, instead of asking the camera to process the joint profile, this will fetch the raw positions of each of the 8 breakpoints which compose the joint profile. This is used when you want to calculate your own joint-geometry. | 1 = Get breakpoint data  
0 = Do not get breakpoint data |
| BP D-Var IDX    | This is the starting index of the robot D-variables to populate with the breakpoint data. This will consume a total of 16 D-variables. They will be populated in the following order: BP-0-Y, BP-0-Z, BP-1-Y, BP-1-Z, ..., BP-7-Z  
(This argument is N/A if GET BREAKPOINTS = 0) | 0 - 99 |
| Mute Laser     | This will mute the laser so that it is not visible. The laser must not be muted to take a measurement.                                                                                                     | 1 = Mute laser  
0 = Unmute laser |
| Get Status     | This will ask the SF sensor for its current status. The status will be encoded into a robot M-Register. R1 - M482, R2 - M484, R3 - M486, R4 - M488  
Please consult the Servo Robot SF manual for definition of the STATUS and ERROR fields. | 1 = Get status  
0 = Do not get status |
| Error Check    | This will perform a GET STATUS action, and then display any appropriate alarms and/or error messages accordingly.                                                                                           | 1 = Perform error check  
0 = Do not perform error check |
| Err Code B-Var | This is the index of a robot B-variable which will be populated with an error code if an error condition exists. After executing the macro, this B-variable can be checked to determine if the measurement data is valid.  
See Appendix A.1.2 for a lookup table to determine the definition of each possible value. | 0 - 99 |
4.2.4 Deployment

As previously mentioned, the L*-SF macro instruction needs to be programmed each time the user wishes to measure for part deviation. Simple weld joints will only need one macro instruction.

For longer weld joints, or weld joints experiencing multi-dimensional variation (i.e., X, Y, and Z), multiple L*-SF macros will need to be programmed into the job. Carefully combine/condition resulting shift amounts to get full shift amounts.

4.2.4.1 Status Message

Every execution of the L*-SF macro will save a value to a B variable. The value written to this variable corresponds to a Status Message. In the event the L*-SF macro was unsuccessful, these messages will give the robot program a value to base corrective action on. The list of possible Message Codes, their descriptions, and recommended corrective action is shown in Appendix A section of this document.

The variable number used to store the Status Message code is user definable based on the “StatusMessageBvar#” parameter of the L*-SF macro instruction. For example, if the user sets StatusMessageBvar# to a value of 44, the B044 will receive a value (0 through 16) upon execution of the L*-SF macro. In general, a value of 0 or 1 corresponds to a successful execution of the routine, and a value between 2-16 denotes unsuccessful execution. It is up to the user what the robot job's code will do with this data. For example, if the robot program receives a value of 9 (no joint detected) then the robot program could re-try the L*-SF but with a shifted detection position (i.e., executing a {SFTON} before executing the L*-SF macro). If a received value of 7 (Maximum shift amount exceeded) then the robot program may be structured and to skip the weld and notify the PLC that the weld joint positioning is out of limits. In the event a User Message occurs (Alarm 8000 series and labeled “L*-SF Comm Alarm: xxxxxx”) user should note the full description of the alarm and contact Yaskawa Customer Support Group.

4.2.4.2 Short Welds

If the weld lengths are very short and/or the amount of variation of the weld start and weld end are virtually the same measurement, only one L*-SF macro may be needed. In this example, the P variable is P000 (to modify robot path). Even though a value is always written to the measured Gap D variable, for this weld joint, the D variable is not being used. See Fig. 4-4 “Example of a Short Weld Job” for sample programming.

Fig. 4-4: Example of a Short Weld Job

```plaintext
JOB CONTENT
J:SHRTWELDS | 4-0001
CONTROL GROUP: BI | TOOL 09

0001 RUP

0051 Move V=88
0002 LI-SF-JMNOTE Task 0 Teach 0 Pvar 0 Bvar 0
0003 Move V=88
0004 SFTON P000
0005 Move V=88
0006 JACON
0007 ViceX MEUB(1)
0008 Move V=88
0009 VEKF
0010 ARQF
0011 SFTTO
0012 Move V=88
0013 END

Move V=88
```
4 Programming

4.2 Robot Programming

4.2.4.3 Long Welds

For longer weld lengths where the start point may vary by a different amount and/or direction than the end position, multiple measurements would be required. Normally two measurements are made. One at weld start and one at weld end.

Fig. 4-5: Example of a Long Weld Job

In Fig. 4-5, two L*-SF macro instructions have been inserted and taught. The first instruction, programmed at the start position of the weld joint, saves the shift amount to P000 and the gap measurement to D000. The second instruction utilizes P001 and D001. Before the first weld position is reached, a Shift Amount is registered using P000, and before the second weld position is reached the other Shift Amount is executed using the amount in P001.

4.2.4.4 Adaptive Weaving

An additional feature of the L*-SF macro is the ability to collect a gap measurement and then use this measurement to affect welding parameters using the \{WVADJ\} (weave adjust) instruction.

The \{WVADJ\} instruction is an optional function that must be enabled into the DX Robot Controller. Contact Yaskawa Customer Support if you would like to have this enabled in the DX Robot Controller.

Fig. 4-6: Example of a Adaptive Weaving Job
4 Programming

4.2 Robot Programming

In Fig. 4-6, all robots and L*-SF macro instructions programmed are just like that of the Long Welds example above. However, in addition to using the P variables to adjust weld path via the {SFTON} instruction, the {WVADJ} instruction deploys to adjust the Weave Amplitude and Travel Speed between the two weld positions.

The {WVADJ} instruction behaves such that the Start Gap, or ST= parameter, and the End Gap, or END= parameter are compared to the Standard Gap, or STD= parameter, and target values for both weave amplitude and travel speed are calculated for the weld start and weld end position. The weaving amplitude and travel speed are smoothly interpolated, or sloped, between these two points. The weave amplitude is adjusted based on its nominal value - the value referenced by the {WVON} instruction, and in this case saved in the weave file. The travel speed is adjusted based on its nominal value set in either the job (by a SPEED= instruction or referenced by the MOV instruction of the second weld point) or by the {ARCON} instruction (by the SPD: Robot Speed field of the Arc Start File).

Fig. 4-7: WVADJ Detail Edit Screen

4.2.5 Tips for Improving Cycle Time

- The time required to take a measurement varies greatly based on the weld profile setup in the Weldcom software. Simplifying the parameters of a weld joint can have the largest impact on cycle time.

- Do not mute the laser between a series of back-to-back measurements.
  - The Lx-SF macro has a parameter “Do Not Mute Laser”. This will leave the laser unmuted after measurement is complete. Not only will skipping this action save time, you will save more time on your next measurement since the laser is already unmuted.
  - When all your measurements for the weld seam are complete, be sure to mute the laser. This can be done by setting the “Do Not Mute Laser” argument to 0 on your last measurement. Or, the SF-ADV macro can be called to mute the laser without performing other actions.
4 Programming

4.2 Robot Programming

- Do not switch task number between a series of back-to-back measurements.
  - Switching task number inside the SF sensor is the second largest consumer of cycle time. However, it is common to perform a series of back-to-back measurements using the same task.
  - The Lx-SF macro contains an argument for Task Number. If a number is specified, it will always try to change task, regardless of the currently selected task. However, by placing a “-1” in this argument, the macro will skip task selection and use the currently selected task for the measurements.
  - Additionally, the SFx-ADV macro can be used to select a task number without performing other actions. This is useful at the start of a robot job which performs a series of measurements.
Appendix A

A.1 Output Messages

A.1.1 Lx-SF Macro

The Status Msg Bvar# parameter sets the B variable number specified in the L*-SF macro with the status of the joint locating routine. The value of this B variable can then be used to skip welds (in the event the measured offset amount is outside of a user defined allowable window), alert a PLC, or execute another user-defined routine.

In addition to the Status Msg Bvar, the Lx-SF macro routine will print a status message at the bottom of the pendant display. In the event of an error, the macro can optionally raise an alarm as well.

The possible messages are listed in Table A-1.

Table A-1: Output Messages for Lx-SF Macro

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
<th>Robot Action</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-Modify Ref Positn; Set Teach = 0</td>
<td>Using the AutoTeach mode, the routine executed as expected.</td>
<td>PAUSE Message</td>
<td>Re-Modify the RefPosition argument. Set &quot;Teach Mode&quot; to 0.</td>
</tr>
<tr>
<td>L*-SF Routine Successful</td>
<td>Using the normal playback mode, the routine executed as expected. Measurements were collected and written to variables.</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>L*-Comm Alarm:XXXXX</td>
<td>Communication messages from the Servo-Robot control were not given as expected.</td>
<td>User Alarm</td>
<td>Re-execute routine. If problem persists contact the Yaskawa Customer Support Group.</td>
</tr>
<tr>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
<td>Reserved</td>
</tr>
<tr>
<td>Reserved</td>
<td>Reserved</td>
<td>*Reserved</td>
<td>Reserved</td>
</tr>
<tr>
<td>Improper *Com Arg</td>
<td>--</td>
<td>User Alarm</td>
<td>If problem persists contact the Yaskawa Customer Support Group.</td>
</tr>
<tr>
<td>System Error</td>
<td>--</td>
<td>User Alarm</td>
<td>Re-execute routine. If problem persists contact the Yaskawa Customer Support Group. Note the error code name and sub-code.</td>
</tr>
<tr>
<td>Max Shift Amount Exceeded</td>
<td>The calculated shift amount exceeds the limit imposed by the Max Shift Amount parameter.</td>
<td>Message</td>
<td>Increase the allowable shift amount parameter or take other corrective actions, either with robot programming or with part variability.</td>
</tr>
<tr>
<td>Sensor Application Error</td>
<td>An error occurred with the system software.</td>
<td>Message</td>
<td>Contact Yaskawa Customer Support Group.</td>
</tr>
<tr>
<td>L*: No Joint Detected</td>
<td>Not enough profiles were measured in order to detect proper joint configuration.</td>
<td>Message</td>
<td>Adjust laser sensor parameters to detect weld.</td>
</tr>
</tbody>
</table>
## A.1 Output Messages

### A.1.2 SFx-ADV Macro

#### Table A-1: Output Messages for Lx-SF Macro

<table>
<thead>
<tr>
<th>Message</th>
<th>Description</th>
<th>Robot Action</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>L*: Z Over Limit</td>
<td>The Z element of the tracking point was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>L*: Y Over Limit</td>
<td>The Y element of the tracking point was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>L*: Gap Over Limit</td>
<td>The measured gap value was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>L*: Mismatch Over Limit</td>
<td>The measured mismatch was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>L*: Area Over Limit</td>
<td>The calculated area was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>L*: Normal Over Limit</td>
<td>The calculated joint normal vector was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
</tbody>
</table>

#### Table A-2: Error Values and Messages for SFx-ADV Macro

<table>
<thead>
<tr>
<th>Value of B- Variable</th>
<th>Message</th>
<th>Description</th>
<th>Robot Action</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(Success, no message)</td>
<td>No Error</td>
<td>Alarm</td>
<td>Reboot the DX Robot Controller and try again. If problem persists contact the Yaskawa Customer Support Group with the code number.</td>
</tr>
<tr>
<td>2-8, 100</td>
<td>L*: Comm Alarm:xxx</td>
<td>Internal error code returned from the SF sensor.</td>
<td>Message</td>
<td>Adjust laser sensor parameters to detect weld.</td>
</tr>
<tr>
<td>9</td>
<td>L*: No Joint Detected</td>
<td>Not enough profiles were measured in order to detect proper joint configuration.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>10</td>
<td>L*: Z Over Limit</td>
<td>The Z element of the tracking point was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
</tbody>
</table>
NOTE: The measurement limits for the weld joint are set using Servo-Robot's Weldcom software.

### Table A-2: Error Values and Messages for SFx-ADV Macro

<table>
<thead>
<tr>
<th>Value of B-Variable</th>
<th>Message</th>
<th>Description</th>
<th>Robot Action</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>L*: Y Over Limit</td>
<td>The Y element of the tracking point was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>12</td>
<td>L*: Gap Over Limit</td>
<td>The measured gap value was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>13</td>
<td>L*: Mismatch Over Limit</td>
<td>The measured mismatch was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>14</td>
<td>L*: Area Over Limit</td>
<td>The calculated area was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
<tr>
<td>15</td>
<td>L*: Normal Over Limit</td>
<td>The calculated joint normal vector was outside of the standard deviation limit.</td>
<td>Message</td>
<td>Weld joint could be outside of acceptable limit or increase allowable deviation.</td>
</tr>
</tbody>
</table>
Appendix B

B.1 Communication Setup

The SF communication driver is controlled through the robot's M Registers and Universal Inputs/Outputs. In Fig. B-1 "L1-SF Macro Job Example", a series of LI variables are set to reference which M Reg number uses each communication point. They are set internally in the Lx-SF macro. For multiple-laser systems, like an R1 + R2 system where each robot has its own laser sensor, the L2-SF (and L3-SF) macro job uses different M Reg numbers for control of the communication driver.

NOTE: These register I/O addresses are for reference only and should not be modified by the user.

Fig. B-1: L1-SF Macro Job Example

'----------Comm Config-----------

'LI1 = MREG# rcv AppErrorCode
SET LI001 480
'LI2 = MREG# rcv AppErrorSubCode
SET LI002 481
'LI3 = MREG# rcv L1SensorStatus
SET LI003 482
'LI4 = MREG# rcv L1ErrorCode
SET LI004 483
'LI10 = MREG# send CMDid
SET LI010 490
'LI11 = MREG# send TPadd/Task
SET LI011 491
'LI12 = MREG# send GapAddress
SET LI012 492
'LI13 = MREG# send ParamCode
SET LI013 493
'LI14 = MREG# send ParamStrtIndex
SET LI014 494

'LI5 = CommandComplete IN#
SET LI005 1785
'LI6 = ConnectionEstab IN#
SET LI006 1789
'LI7 = CommError IN#
SET LI007 1793
'LI8 = MREGCmdReady OT#
SET LI008 1785

'------Comm Config Complete------
Appendix C

C.1 Alarm List

For all other alarms, please contact Yaskawa Customer Support with the alarm number and subcode.

C.1.1 v2.4.0 and Above Alarm List

<table>
<thead>
<tr>
<th>Alarm Code</th>
<th>Subcode</th>
<th>Alarm Name</th>
<th>Counter Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>0</td>
<td>UNKNOWN SENSOR MODEL</td>
<td>An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Edit the macro job and scroll to the Setup Section. Set the &quot;Laser sensor model&quot; to one of the listed values.</td>
</tr>
<tr>
<td>8000</td>
<td>7</td>
<td>L* Inspect: Max Shift Exceeded</td>
<td>The joint was detected outside of the allowable distance. This limit is designed to prevent false detections which could lead to a robot collision. If you are confident that the detected point is valid, then you can increase the &quot;Max Shift Amount&quot; argument of the L*-SF-INSPECT macro.</td>
</tr>
<tr>
<td>8000</td>
<td>9</td>
<td>L* Inspect: No Joint Detected</td>
<td>The laser sensor was unable to locate a valid joint profile. Open the Weldcom PC software and edit the joint profile to properly detect your weld joint.</td>
</tr>
<tr>
<td>8000</td>
<td>10</td>
<td>L* Inspect: Z Over Limit</td>
<td>The Z coordinate of the joint’s Tracking Point was over the allowable limit. The allowable limit is configured in the joint profile using the Weldcom PC software.</td>
</tr>
<tr>
<td>8000</td>
<td>11</td>
<td>L* Inspect: Y Over Limit</td>
<td>The Y coordinate of the joint’s Tracking Point was over the allowable limit. The allowable limit is configured in the joint profile using the Weldcom PC software.</td>
</tr>
<tr>
<td>8000</td>
<td>12</td>
<td>L* Inspect: Gap Over Limit</td>
<td>The gap in the joint was over the allowable limit. The allowable limit is configured in the joint profile using the Weldcom PC software.</td>
</tr>
<tr>
<td>8000</td>
<td>13</td>
<td>L* Inspect: Mismatch Over Limit</td>
<td>The mismatch in the joint was over the allowable limit. The allowable limit is configured in the joint profile using the Weldcom PC software.</td>
</tr>
<tr>
<td>8000</td>
<td>14</td>
<td>L* Inspect: Area Over Limit</td>
<td>The area in the joint was over the allowable limit. The allowable limit is configured in the joint profile using the Weldcom PC software.</td>
</tr>
</tbody>
</table>
### C.1 Alarm List

<table>
<thead>
<tr>
<th>Alarm Code</th>
<th>Subcode</th>
<th>Alarm Name</th>
<th>Counter Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>15</td>
<td>L*: Inspect: Normal Over Limit</td>
<td>The joint normal angle was over the allowable limit. The allowable limit is configured in the joint profile using the Weldcom PC software.</td>
</tr>
<tr>
<td>8000</td>
<td>18</td>
<td>MotoEye L*: Internal Com Error</td>
<td>Please reboot the robot controller and laser sensor. If you continue to receive this error, please contact Yaskawa support.</td>
</tr>
<tr>
<td>8006</td>
<td>5</td>
<td>Sensor Error Code</td>
<td>The robot has received an error code from the Servo Robot laser sensor. Please use the Weldcom PC software to resolve the error in the sensor. The specific error code can be found in the robot M registers: Laser 1: M483 Laser 2: M485 Laser 3: M487 Laser 4: M489 The most common error occurs when you specify a joint profile number that doesn’t exist in the sensor.</td>
</tr>
<tr>
<td>8007</td>
<td>1</td>
<td>L*: INVALID PARAMETERS</td>
<td>An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “AutoTeach” to a value of 0 or 1.</td>
</tr>
<tr>
<td>8007</td>
<td>2</td>
<td>L*: INVALID PARAMETERS</td>
<td>An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Edit the macro job and scroll to the Setup Section. Set the number of additional scans to a value between 0 and 5</td>
</tr>
<tr>
<td>8007</td>
<td>3</td>
<td>L*: INVALID PARAMETERS</td>
<td>An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Edit the macro job and scroll to the Setup Section. Set the number of additional scans to a value between 0 and 5</td>
</tr>
<tr>
<td>8007</td>
<td>4</td>
<td>L*: INVALID PARAMETERS</td>
<td>An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “Alarm on failure” to a value of 0 or 1.</td>
</tr>
<tr>
<td>8007</td>
<td>5</td>
<td>L*: INVALID PARAMETERS</td>
<td>An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the arguments for “WeldCom Task #” and “Status Msg Bvar#” to be different values.</td>
</tr>
<tr>
<td>8007</td>
<td>6</td>
<td>L*: INVALID PARAMETERS</td>
<td>An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “Status Msg Bvar#” to a value between 0 and 99.</td>
</tr>
<tr>
<td>8007</td>
<td>7</td>
<td>L*: INVALID PARAMETERS</td>
<td>An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “Gap Size Dvar#” to a value between 0 and 99.</td>
</tr>
</tbody>
</table>
### Appendix C

#### C.1 Alarm List

<table>
<thead>
<tr>
<th>Alarm Code</th>
<th>Subcode</th>
<th>Alarm Name</th>
<th>Counter Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>8007</td>
<td>9</td>
<td>L*: INVALID PARAMETERS Message: Set MaxShiftAmount between 0-25mm</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>10</td>
<td>L*: INVALID PARAMETERS Message: Set Y-offset between -25 to 25mm</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>11</td>
<td>L*: INVALID PARAMETERS Message: Set Z-offset to allowable range</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>12</td>
<td>L*: INVALID PARAMETERS Message: Set ShiftVariable between 0-127</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>13</td>
<td>L*: INVALID PARAMETERS Message: Set U.F. # or 0 for BaseFrame</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>15</td>
<td>L*: INVALID PARAMETERS Message: Set WeldCom task # between 0-64</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>16</td>
<td>L*: INVALID PARAMETERS Message: Set Tool # between 0-63</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>17</td>
<td>L*: INVALID PARAMETERS Message: Set Max Shift Condition 0-2</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>18</td>
<td>L*: INVALID PARAMETERS Message: Set Pvar Reset Condition 0 or 1</td>
<td></td>
</tr>
<tr>
<td>8007</td>
<td>21</td>
<td>L*: INVALID PARAMETERS Message: Set PRINT log condition to 0-1</td>
<td></td>
</tr>
</tbody>
</table>

An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Edit the macro job and scroll to the Setup Section. Set the “Nominal Y distance” to a value between -25 and 25.

An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Edit the macro job and scroll to the Setup Section. Set the “Nominal Z distance” to a value within the range described in the Setup Section. The valid range varies based on the selected sensor model.

An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “Shift Variable” to a value between 0 and 127.

An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Edit the macro job and scroll to the Setup Section. Set “LI024” to a value between 0 and 63.

An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “Maximum shift behavior” to a value between 0 and 2.

An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “WeldCom Task #” to a value between 0 and 64.

An argument for the L*-SF-INSPECT macro is set incorrectly. Open the DETAIL EDIT view for the macro instruction and set the argument “Laser Tool File #” to a value between 0 and 63.

An item in the setup section of the L*-SF-INSPECT macro is set incorrectly. Edit the macro job and scroll to the Setup Section. Set “Print log to TERMINAL” to either 0 or 1.
### C.1 Alarm List

#### C.1.2 v2.3.0 and Below Alarm List

<table>
<thead>
<tr>
<th>Alarm Code</th>
<th>Alarm Subcode</th>
<th>Alarm Name</th>
<th>Counter Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>3</td>
<td>Transactions out of Sync</td>
<td>Reboot the DX Robot Controller and laser sensor. If the problem persists, try limiting the number of other devices on the local Ethernet network.</td>
</tr>
<tr>
<td>8000</td>
<td>5</td>
<td>Sensor Communication Error</td>
<td>Use the Servo Robot Weldcom Software to ensure requested task number is configured in the sensor. Reboot the DX Robot Controller and laser sensor. If the problem persists, please contact Yaskawa Customer Support.</td>
</tr>
<tr>
<td>8000</td>
<td>6</td>
<td>Polling out of Sync</td>
<td>Increase the value of M Register 358 to 2500, then Reboot the DX Controller. If problem persists, contact Yaskawa Customer Support.</td>
</tr>
<tr>
<td>8002</td>
<td>2</td>
<td>Could not connect to sensor</td>
<td>Check all network connections on the local Ethernet network. Try to “ping” both the sensor and the DX Robot Controller. Check String(s) variables S096 - S099 to ensure the IP address of the sensor is saved in the corresponding variable. Reboot DX Robot Controller and laser sensor. If problem persist, contact Yaskawa Customer Support. Please provide information on the last action performed and prior to the alarm.</td>
</tr>
</tbody>
</table>
MOTOEYETM SF
SYSTEM MANUAL
For DX100 or DX200 Controller

HEAD OFFICE
2-1 Kurosakishiroishi, Yahatanishi-ku, Kitakyushu 806-0004, Japan
Phone +81-93-645-7703 Fax +81-93-645-7802

YASKAWA America Inc. (Motoman Robotics Division)
100 Automation Way, Miamisburg, OH 45342, U.S.A.
Phone +1-937-847-6200 Fax +1-937-847-6277

YASKAWA Europe GmbH (Robotics Division)
Yaskawastrasse 1, 85391 Allershausen, Germany
Phone +49-8166-90-100 Fax +49-8166-90-103

YASKAWA Nordic AB
Verkstadsgatan 2, Box 504, SE-385 25 Torsas, Sweden
Phone +46-480-417-800 Fax +46-486-414-10

YASKAWA Electric (China) Co., Ltd.
22F, One Corporate Avenue, No.222, Hubin Road, Huangpu District, Shanghai 200021, China
Phone +86-21-5385-2200 Fax +86-21-5385-3299

YASKAWA SHOUGANG ROBOT Co. Ltd.
No7 Yongchang North Road, Beijing E&T Development Area, China 100176
Phone +86-10-8789-2858 Fax +86-10-8789-2878

YASKAWA Electric Korea Corporation
35F, Three IFC, 10 Gujejeumyeong-ro, Yeongdeungpo-gu, Seoul, Korea 07326
Phone +82-2-784-7844 Fax +82-2-784-8495

YASKAWA Electric Taiwan Corporation
12F, No.207, Sec. 3, Beishin Rd., Shindian District, New Taipei City 23143, Taiwan
Phone +886-2-8913-1333 Fax +886-2-8913-1513

YASKAWA Electric (Thailand) Co., Ltd.
59,1st-5th Floor, Flourish Building, Soi Ratchadapisek 18, Ratchadapisek Road, Huaykwang, Bangkok 10310, THAILAND
Phone +66-2-017-0099 Fax +66-2-017-0199

PT. YASKAWA Electric Indonesia
Secure Building-Gedung B Lantai Dasar & Lantai 1 Jl. Raya Protokol Halim Perdanakusuma, Jakarta 13610, Indonesia
Phone +62-21-2982-6470 Fax +62-21-2982-6741

Specifications are subject to change without notice
for ongoing product modifications and improvements.

YASKAWA