MotoSoft®

MotoEye-LT Laser Tracking Function Manual

Part Number: 152347-1CD
Revision 1
Chapter 1

Introduction

1.1 About This Document

This manual provides information for the MotoEye-LT Laser Tracking function and contains the following sections:

CHAPTER 1 - INTRODUCTION
Provides general information about the structure of this manual, a list of reference documents, and customer service information.

CHAPTER 2 - SAFETY
This section provides information regarding the safe use and operation of Motoman products.

CHAPTER 3 - MOTOEYE-LT LASER TRACKING INSTRUCTIONS
Provides detailed information for the MotoEye-LT Laser Tracking function.

1.2 Reference to Other Documentation

For additional information refer to the following:

- NX100 Controller Manual (P/N 149201-1)
- Concurrent I/O Manual (P/N 149230-1)
- Operator's Manual for your application
- Vendor manuals for system components not manufactured by Motoman

1.3 Customer Service Information

If you are in need of technical assistance, contact the Motoman service staff at (937) 847-3200. Please have the following information ready before you call:

- Robot Type (EA1900N, HP20, IA20)
- Application Type (welding, handling, etc.)
- Robot Serial Number (located on back side of robot arm)
- Robot Sales Order Number (located on back of controller)
Chapter 2

Safety

2.1 Introduction

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.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems. This information can be obtained from the Robotic Industries Association by requesting ANSI/RIA R15.06-1999. The address is as follows:

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

Ultimately, the best safeguard is trained personnel. The user is responsible for providing personnel who are adequately trained to operate, program, and maintain the robot cell. The robot must not be operated by personnel who have not been trained!

We recommend that all personnel who intend to operate, program, repair, or use the robot system be trained in an approved Motoman training course and become familiar with the proper operation of the system.
This safety section addresses the following:

- Standard Conventions (Section 2.2)
- General Safeguarding Tips (Section 2.3)
- Mechanical Safety Devices (Section 2.4)
- Installation Safety (Section 2.5)
- Programming, Operation, and Maintenance Safety (Section 2.6)

2.2 Standard Conventions

This manual includes the following alerts – in descending order of severity – that are essential to the safety of personnel and equipment. As you read this manual, pay close attention to these alerts to insure safety when installing, operating, programming, and maintaining this equipment.

**DANGER!**
Information appearing in a DANGER concerns the protection of personnel from the immediate and imminent hazards that, if not avoided, will result in immediate, serious personal injury or loss of life in addition to equipment damage.

**WARNING!**
Information appearing in a WARNING concerns the protection of personnel and equipment from potential hazards that can result in personal injury or loss of life in addition to equipment damage.

**CAUTION!**
Information appearing in a CAUTION concerns the protection of personnel and equipment, software, and data from hazards that can result in minor personal injury or equipment damage.

*Note: Information appearing in a Note provides additional information which is helpful in understanding the item being explained.*
2.3 General Safeguarding Tips

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot 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 robot, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this robot system.
- Do not enter the robot cell while it is in automatic operation. Programmers must have the teach pendant when they enter the robot cell.
- Improper connections can damage the robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
- The robot must be placed in Emergency Stop (E-STOP) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-1999, 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).

2.4 Mechanical Safety Devices

The safe operation of the robot, positioner, auxiliary equipment, and system is ultimately the user's 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 R15.06-1999 safety standards, and other local codes that may pertain to the installation and use of industrial 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 fences and barriers
- Light curtains and/or safety mats
- Door interlocks
- Emergency stop palm buttons located on operator station, robot controller, and programming pendant

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

Safe installation is essential for protection of people and equipment. The following suggestions are intended to supplement, but not replace, existing federal, local, and state laws and regulations. Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. Installation tips are as follows:

- Be sure that only qualified personnel familiar with national codes, local codes, and ANSI/RIA R15.06-1999 safety standards are permitted to install the equipment.
- Identify the work envelope of each robot with floor markings, signs, and barriers.
- Position all controllers outside the robot work envelope.
- Whenever possible, install safety fences to protect against unauthorized entry into the work envelope.
- Eliminate areas where personnel might get trapped between a moving robot and other equipment (pinch points).
- Provide sufficient room inside the workcell to permit safe teaching and maintenance procedures.

2.6 Programming, Operation, and Maintenance Safety

All operators, programmers, plant and tooling engineers, maintenance personnel, supervisors, and anyone working near the robot 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 robot should be permitted to program, operate, and maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the robot and work envelope 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.
- Do not enter the robot cell while it is in automatic operation. Be sure that only the person holding the programming pendant enters the workcell.
- Check the E-STOP button on the programming pendant for proper operation before programming. The robot 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 PART 1, System Section, of the robot controller concurrent I/O program can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to PART 1, System Section. Making any changes without the written permission of Motoman will VOID YOUR WARRANTY!

• Some operations require standard passwords and some require special passwords. Special passwords are for Motoman use only. YOUR WARRANTY WILL BE VOID if you use these special passwords.

• The robot controller allows modifications of PART 2, User Section, of the concurrent I/O program and modifications to controller parameters for maximum robot performance. Great care must be taken when making these modifications. All modifications made to the controller will change the way the robot operates and can cause severe personal injury or death, as well as damage the robot and other parts of the system. Double-check all modifications under every mode of robot operation to ensure that you have not created hazards or dangerous situations.

• Check and test any new or modified program at low speed for at least one full cycle.

• This equipment has multiple sources of electrical supply. Electrical interconnections are made between the 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 robot. All connections must be made within the standard voltage and current ratings of the robot I/O (Inputs and Outputs).
Notes
NX100 OPTIONS
INSTRUCTIONS

FOR LASER-TRACKING FUNCTION: MOTOEYE-LT

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

MOTOMAN INSTRUCTIONS
MOTOMAN-□□□ INSTRUCTIONS
NX100 INSTRUCTIONS
NX100 OPERATOR’S MANUAL

The YASNAC NX100 operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
MANDATORY

• This manual explains the laser-tracking function, MOTOEYE-LT, of the NX100 system and general operations. Read this manual carefully and be sure to understand its contents before handling the NX100.

• General items related to safety are listed in Section 1: Safety of the Setup Manual. To ensure correct and safe operation, carefully read the Setup Manual before reading this manual.

CAUTION

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

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

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

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

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product’s warranty.
NOTES FOR SAFE OPERATION

Read this manual carefully before installation, operation, maintenance, or inspection of the NX100.

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

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

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

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

- **PROHIBITED**
  Must never be performed.

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

**NOTE**
To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “CAUTION” and “WARNING”.
Before operating the manipulator, check that servo power is turned off when the emergency stop buttons on the playback panel or programming pendant are pressed. When the servo power is turned off, the SERVO ON READY lamp on the playback panel and the SERVO ON LED on the programming pendant are 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.

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

Injury may result from unintentional or unexpected manipulator motion.

Always set the Teach Lock before entering the robot work envelope to teach a job.

Operator injury can occur if the Teach Lock is not set and the manipulator is started from the playback panel.

Observe the following precautions when performing teaching operations within the working envelope of the manipulator:
- View the manipulator from the front whenever possible.
- Always follow the predetermined operating procedure.
- Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

Confirm that no persons are present in the manipulator's work envelope and that you are in a safe location before:
- Turning on the NX100 power
- Moving the manipulator with the programming pendant
- Running check operations
- Performing automatic operations

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an emergency stop button immediately if there are problems. The emergency stop button is located on the right side of both the NX100 playback panel and programming pendant.
Defini tion of Terms Used Often in This Manual
The MOTOMAN manipulator is the YASKAWA industrial robot product.
The manipulator usually consists of the controller, the playback panel, the programming pendant, and supply cables.
The MOTOMAN manipulator is the YASKAWA industrial robot product.
In this manual, the equipment is designated as follows.

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<thead>
<tr>
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<th>Manual Designation</th>
</tr>
</thead>
<tbody>
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<td>NX100 Controller</td>
<td>XRC</td>
</tr>
<tr>
<td>NX100 Playback Panel</td>
<td>Playback Panel</td>
</tr>
<tr>
<td>NX100 Programming Pendant</td>
<td>Programming Pendant</td>
</tr>
</tbody>
</table>
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<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td></td>
</tr>
<tr>
<td>Character Keys</td>
<td>The keys which have characters printed on them are denoted with [ ].</td>
</tr>
<tr>
<td></td>
<td>ex. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td>The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture.</td>
</tr>
<tr>
<td></td>
<td>ex. page key [P]</td>
</tr>
<tr>
<td></td>
<td>The cursor key is an exception, and a picture is not shown.</td>
</tr>
<tr>
<td>Axis Keys Number Keys</td>
<td>“Axis Keys” and “Number Keys” are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Keys pressed</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td>simultaneously</td>
<td></td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }.</td>
</tr>
<tr>
<td></td>
<td>ex. {JOB}</td>
</tr>
<tr>
<td>Playback Panel</td>
<td></td>
</tr>
<tr>
<td>Buttons</td>
<td>Playback panel buttons are enclosed in brackets. ex. [TEACH] on the playback panel</td>
</tr>
</tbody>
</table>

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1 Laser-tracking Function

The laser-tracking function uses a laser sensor manufactured by ServoRobot, Inc. and the NX100 option board. This function can be used to correct the target position during welding according to the information of the target position on the welding line detected by the laser sensor.

Laser tracking includes the following control functions:

- Start point search
- Real-time tracking
- Target position offset

The following diagram shows the system configuration for the laser tracking.
1.1 Start Point Search

The laser sensor detects the start point of the welding line by an LTSRCH command. The difference between the detected point and the start point that is registered is calculated. If the difference is within the allowable value, the taught welding line is shifted by an LTSFT command to compensate for this difference.
1.2 Real-time Tracking

Using the target position data from the laser sensor, the welding line data is prepared in the base coordinate system. Based on the welding line data and the taught direction of movement, the path of the center point of the manipulator's tool is corrected. This function is carried out by an LTRCKON command and an LTRCKOF command.
The target position offset function shifts the target position in the tool coordinate system when the target position has deviated from the desired welding position.
2 Hardware Setup

2.1 Connection of Laser Vision System

Connect the laser vision system as shown in the following diagram.

![Laser Vision System Connection Diagram](image)


2.2 Settings for Cooling Air

For cooling air, use clean and oil-free air or carbonic acid gas for the shielding gas. An air flow of 10 litre/min. (pressure: 4 bars) is required for sufficient cooling and for protection of the laser head and the work surfaces.

- Oil and dust in the cooling air may cause the sensor to malfunction.
- When using carbonic acid gas for the cooling air, be sure to use a heater to avoid condensation.
2.3 Emergency Stop Button on SMART-BOX

An emergency stop button is provided on the SMART-BOX to stop the laser.

- The emergency stop button on the SMART-BOX is not interlocked with the XRC’s emergency stop.
- Refer to “4.4.2 Emergency Stop Alarm I/O (CN2)” in the “SMART-BOX Vision System Control Unit User’s Manual” provided by ServoRobot Inc. for the connection of the SMART-BOX’s emergency stop button to the robot controller’s emergency stop loop or the safety interlock circuit for work places where the system for the automatic device is installed.
3 Start-up

Start up SMART-BOX, NX100, and WinUser in the following order.

1. SMART-BOX
2. NX100
3. WinUser

3.1 Start-up of the SMART-BOX

The following procedure describes how to start up the SMART-BOX.

1. On the rear panel of the SMART-BOX, turn ON the power switch.

![Rear panel diagram with power switch and main power supply label]
3.2 Start-up of the NX100

2. Wait for 5 to 10 seconds. Then, on the front panel of the SMART-BOX, turn ON the laser-ready key switch.

To start up the NX100, turn ON the main power supply of the NX100.
WinUser is application software for the personal computer. WinUser is used for serial communications with the SMART-BOX, the settings for image processing, and the monitoring of the detected status. For more information about how to install WinUser, refer to “15.2 Installation” of "15 WinUser: Application Software." For more information about how to use WinUser, refer to "15 WinUser: Application Software."

The following procedure describes how to start up WinUser.

1. Start up the personal computer where WinUser is installed.
2. Click the “Start” button, point to “Programs,” and then click “WinUser” to start up WinUser.
3.3 Start-up of WinUser
4 Settings for Sensor Parameters and Job Files

4.1 Sensor Parameters

The minimum interval for sampling must be set using the sensor parameters. The minimum interval is the minimum value of the distance between the points detected by the sensor. Because the buffer has limited memory, set the minimum interval to limit the distance between samples so that the buffer will not overflow with an excessive amount of information.

1. The distance between the point of light emitted by the laser and the manipulator’s tool center point is called a “lookahead.” The minimum interval for sampling can be calculated from this “lookahead” by the following formula.

Where “Lookahead” is \( L \) [mm] and the minimum interval for sampling is \( I \) [\( \mu \)m]:

\[ I = 12 \times L \]
2. The following table shows the settings for the parameter SxE032 according to the set minimum interval for sampling.

<table>
<thead>
<tr>
<th>Minimum Interval for Sampling [µm]</th>
<th>SxE032 [µm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 500</td>
<td>500</td>
</tr>
<tr>
<td>501 to 1000</td>
<td>1000</td>
</tr>
<tr>
<td>1001 to 1500</td>
<td>1500</td>
</tr>
<tr>
<td>1501 to 2000</td>
<td>2000</td>
</tr>
</tbody>
</table>

3. Set the corresponding value for the parameter SxE032.
   (1) Set the security mode to “Management mode.”
   (2) Set parameter SxE032 to the appropriate value using the following procedure.

**Operation**

Select {PARAMETER} under main menu ➔ Select {SxE} ➔ Move the cursor to the parameter number, and press [SELECT] ➔ Type “32” using the number keys, and press [ENTER] ➔ Press [SELECT] ➔ Type the value obtained in Step 2 above using the number keys, and press [ENTER]

**Explanation**

*1 With the selected parameter highlighted, press [SELECT].
2. Type the parameter number whose setting is to be changed, and press [ENTER].

3. With the setting of the selected parameter highlighted, press [SELECT].

4. Type the new setting, and press [ENTER].
4.2 Required Job Files

Confirm that the following job files are registered in the XRC.

<table>
<thead>
<tr>
<th>Job File Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT-CALIB.JBI</td>
<td>Job for execution of the sensor calibration</td>
</tr>
<tr>
<td>SMPL0.JBI</td>
<td>An example of a tracking job without the search for the start point</td>
</tr>
<tr>
<td>SMPL1.JBI</td>
<td>An example of a tracking job with the search for the start point</td>
</tr>
<tr>
<td>STRTCHK.JBI</td>
<td>Job for inspection before starting an operation</td>
</tr>
<tr>
<td>CAL_OFST.JBI</td>
<td>Job for calculating the amount of the tool offset</td>
</tr>
</tbody>
</table>

If any job is missing, load the job from the Compact Flash card provided with the NX100.
5 Laser Sensor Calibration

The data obtained by the laser vision sensor is sent to the NX100 as data for a three-dimensional position in the camera coordinate system of the camera. The NX100 converts the input data to position data in the robot coordinate system. For this conversion, the manipulator’s current position in the tool coordinate system and that in the camera coordinate system relative to the tool coordinate system are required. The manipulator’s current position in the camera coordinate system relative to the tool coordinate system can be obtained by sensor calibration.

5.1 Workpiece for Calibration

Yaskawa recommends using a workpiece with a lap joint. To make the teaching easier, set the workpiece so that the welding line on the workpiece is parallel to the X-axis or the Y-axis in the robot coordinate system.

Draw a line perpendicular to the welding line in white paint. If the line is drawn in black paint, the laser beam may be absorbed and the data for the image cannot be obtained.
5.2 Tool Calibration for Reference Tool

Refer to “9.9.2 Tool Calibration” of “NX100 INSTRUCTIONS” for the information about how to calibrate the tool. Any tool number can be set.

![Diagram of tool calibration](image)

5.3 Sensor Camera’s Mounting Position

The following procedure describes how to position the sensor camera.

1. Adjust the mounting position of the camera so that the joint of the workpiece can be detected at the center of the sensor detecting depth.

![Diagram of sensor camera mounting](image)

<Tool Posture>
Correction of the target position is performed to the direction of each axis in the tool coordinate system. To make the correction easier, position the tool so that the tool coordinate system’s X-axis is parallel to the welding direction (the mounting direction of the laser sensor) and the tool coordinate system’s Z-axis is parallel to the torch’s direction of ejection.

Distance: 20 mm to 100 mm (40 mm: standard)
Consider the tool interference, welding line curvature, and disturbances caused by spatters when adjusting the distance.
5.3 Sensor Camera’s Mounting Position

2. Adjust the position of the sensor camera so that the image of the joint is taken in the center of the sensor’s field of vision.

   (1) Use the following procedure to open the LASER SENSOR MONITOR display to shine the laser beam on the workpiece.

   **Operation**

   Select {OPTION} under the main menu ➔ Select {LASER SENSOR MONITOR}∗1

   **Explanation**

   ∗1 The LASER SENSOR MONITOR display appears.

   Laser turn on: Push both the Key[inter lock] and Key[5].
   Laser turn off: Push both the Key[inter lock] and Key[8].

   (2) Adjust the position of the camera so that the image of the joint can be viewed in the center of the WinUser graphic display.
5.4 Sensor Adjustment

The laser vision sensor can be adjusted to detect the target position on the lap joint of the workpiece. Using WinUser, adjust the lap joint settings in VISUS, the image processing software module for the SMART-BOX, so they are the same as those in the following illustration. Refer to “15 WinUser: Application Software” for information about how to use WinUser.

5.5 Teaching of Calibration Job [LT-CALIB]

To carry out sensor calibration, a job for calibration called [LT-CALIB] must be prepared. The job, [LT-CALIB], includes the macro command “LTCLIB” to instruct the laser-tracking function to do calibration calculations. Six reference points must be taught and registered in the job [LT-CALIB].
5.5 Teaching of Calibration Job [LT-CALIB]

5.5.1 Opening the Display to Register Reference Points in LT-CALIB

**Operation**

Move the cursor to the line of macro command “LTCLIB” *1 ➤ Move the cursor to the right *2 ➤ Press [SELECT] *3 ➤ Press [SELECT] *4

**Explanation**

*1 The job number is highlighted by being shown in reverse.

```
JOB CONTENT: MASTER
JOB NAME: LT-CALIB       STEP NO:   000
CONTROL GROUP: RI       TOOL:   **
0003 *= into LTCLIB inst. =
0004 *=---------------------
0005 LTCLIB LT:40 LTC:1 flgA:2
0006 "If step at PAUSE,call lib was NG."
0007 PAUSE IF B002=0
0008 END
```

*2 The “LTCLIB LT:40 LTC:0 flgB:2” is highlighted by being shown in reverse.

```
JOB CONTENT: MASTER
JOB NAME: LT-CALIB       STEP NO:   000
CONTROL GROUP: RI       TOOL:   **
0003 *= into LTCLIB inst. =
0004 *=---------------------
0005 LTCLIB LT:40 LTC:1 flgB:2
0006 "If step at PAUSE,call lib was NG."
0007 PAUSE IF B002=0
0008 END
```

*3 The contents of the display change.

```
JOB CONTENT: MASTER
JOB NAME: LT-CALIB       STEP NO:   000
CONTROL GROUP: RI       TOOL:   **
0003 *= into LTCLIB inst. =
0004 *=---------------------
0005 LTCLIB LT:40 LTC:1 flgB:2
0006 "If step at PAUSE,call lib was NG."
0007 PAUSE IF B002=0
0008 END
```
5.5 Teaching of Calibration Job [LT-CALIB]

*4 The ARGUMENT SETTING display appears.

<table>
<thead>
<tr>
<th>Item</th>
<th>Setting</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT FUNC. FILE</td>
<td>An integer between 1 and 40</td>
<td>The tracking function file* number to be used. The file number 40 is recommended for calibration.</td>
</tr>
<tr>
<td>CALIB. FILE</td>
<td>An integer between 0 and 23</td>
<td>The calibration file number. Enter the set teaching tool number.</td>
</tr>
<tr>
<td>TOOL REFP.</td>
<td>Teaching point</td>
<td>Refer to &quot;5.5.2 Teaching of Tool Reference Points&quot;</td>
</tr>
<tr>
<td>sensing#1 to #4 REFP.</td>
<td>Teaching point</td>
<td>Refer to Sections &quot;5.5.3 Teaching of Calibration Reference Point 1&quot; to &quot;5.5.6 Teaching of Calibration Reference Point 4.&quot;</td>
</tr>
<tr>
<td>ESCAPE REFP.</td>
<td>Teaching point</td>
<td>Refer to &quot;5.5.7 Teaching of Escape Position.&quot;</td>
</tr>
<tr>
<td>RESULT FLAG</td>
<td>An integer between 0 and 255</td>
<td>B variable number to save the calibration results. 1: Calibration succeeded 0: Calibration failed</td>
</tr>
</tbody>
</table>

*: The file of the conditions to use the laser-tracking function
To view the file, select [OPTION] under the top menu, and select [LASER TRACKING].
5.5.2 Teaching of Tool Reference Points

The following procedure describes how to teach the tool reference points.

1. Move the end of the tool to the end of the marked line on the lap joint of the workpiece to be calibrated.

2. Use the following procedure to register the position as the tool reference point.

**Operation**

Move the cursor to (REGIST) of TOOL REFP. ➔ Press [MODIFY] ➔ Press [ENTER] *1

➔ Press [ENTER] *2 ➔ Press [ENTER] *3

**Explanation**

*1 The position has been registered. The manipulator’s current position is the same as the registered position. (REGIST) stops flashing.
5.5 Teaching of Calibration Job [LT-CALIB]

**2** When [ENTER] is pressed the second time, the ARGUMENT SETTING display closes, and the JOB CONTENT display appears.

```
JOB CONTENT: MASTER
JOB NAME: LT-CALIB
STEP NO: 000
CONTROL GROUP: M1
TOOL: **

0008 "Into LTOLIB inst.
0004 "-------------------
0005 LTOLIB LT::40 LTC::1 f1g::2
0006 "(If stop at PAUSE, calib was NG.)
0007 PAUSE IF B002=0
0008 END
```

**3** When [ENTER] is pressed the third time, the settings updated on the ARGUMENT SETTING display are registered.

```
JOB CONTENT: MASTER
JOB NAME: LT-CALIB
STEP NO: 000
CONTROL GROUP: M1
TOOL: **

0008 "Into LTOLIB inst.
0004 "-------------------
0005 LTOLIB LT::40 LTC::1 f1g::2
0006 "(If stop at PAUSE, calib was NG.)
0007 PAUSE IF B002=0
0008 END
```

---

**NOTE**

If [CANCEL] is pressed instead of [ENTER] to close the ARGUMENT SETTING display, the modified teaching position and numerical values are lost. To validate the modified data, be sure to press [ENTER] and close the ARGUMENT SETTING display.
5.5.3 Teaching of Calibration Reference Point 1

The following procedure describes how to teach calibration reference point 1.

1. Use the following procedure to shine the laser beam on the workpiece.

   **Operation**
   
   Select {OPTION} under the main menu ➔ Select {LASER SENSOR MONITOR} *1 ➔
   Select the file number ➔ Enter "40" by using the number keys ➔ Press [ENTER]

   **Explanation**

   *1 The LASER SENSOR MONITOR display appears. The laser beam is emitted and shines on the workpiece.

   ![Laser Sensor Monitor Table](image)

2. Using the following procedure, register the position shown in the figure on the next page as calibration reference point 1.
   (1) Move the manipulator so that the image of the joint can be viewed in the center of the WinUser graphic display.
   (2) Move the manipulator towards the welding line so that the laser beam is focussed along the marked line.
   (3) Open the ARGUMENT SETTING display to register the manipulator’s position for calibration reference point 1.
Move the manipulator so that the laser beam is focussed along the marked line.

Calibration reference point 1

Image of the Joint on the WinUser Graphic Display
5.5 Teaching of Calibration Job [LT-CALIB]

5.5.4 Teaching of Calibration Reference Point 2

The following procedure describes how to teach the calibration reference point 2.

1. Open the LASER SENSOR MONITOR display to shine the laser beam on the work-piece.

2. Using the following procedure, register the position shown in the figure below as calibration reference point 2.
   (1) Move the manipulator downward so that the image of the joint can be viewed in the upper part of the WinUser graphic display.
   (2) Move the manipulator towards the welding line so that the laser beam is focussed along the marked line.
   (3) Open the ARGUMENT SETTING display to register the manipulator’s position for calibration reference point 2.

<table>
<thead>
<tr>
<th>ARGUMENT SETTING</th>
<th>LT-CALIB</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT FUNC. FILE</td>
<td>40</td>
</tr>
<tr>
<td>CALIB. FILE</td>
<td>1</td>
</tr>
<tr>
<td>TOOL REFP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensingH1 REFP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensingH2 REFP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensingH3 REFP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensingH4 REFP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>ESCAPE REFP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>RESULT FLAG</td>
<td>2</td>
</tr>
</tbody>
</table>

Move the manipulator so that the laser beam is focussed along the marked line.

Image of the Joint on the WinUser Graphic Display
5.5.5 Teaching of Calibration Reference Point 3

The following procedure describes how to teach calibration reference point 3.

1. Open the LASER SENSOR MONITOR display to shine the laser beam on the workpiece.

2. Using the following procedure, register the position shown in the figure below as calibration reference point 3.
   (1) Move the manipulator up so that the image of the joint can be viewed in the bottom of the WinUser graphic display.
   (2) Move the manipulator traversing the welding line so that the target position as a red cross is viewed in the lower left of the WinUser graphic display.
   (3) Move the manipulator towards the welding line so that the laser beam is focussed along the marked line.
   (4) Open the ARGUMENT SETTING display to register the manipulator’s position for calibration reference point 3.

---

**ARGUMENT SETTING**

<table>
<thead>
<tr>
<th>LT FUNC. FILE</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALIB. FILE</td>
<td>1</td>
</tr>
<tr>
<td>TOOL REPP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensing1 REPP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensing2 REPP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensing3 REPP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>sensing4 REPP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>ESCAPE REPP.</td>
<td>RESIST</td>
</tr>
<tr>
<td>RESULT FLAG</td>
<td>2</td>
</tr>
</tbody>
</table>

---

*Image of the Joint on the WinUser Graphic Display*
5.5.6 Teaching of Calibration Reference Point 4

The following procedure describes how to teach calibration reference point 4.

1. Open the LASER SENSOR MONITOR display to shine the laser beam on the work-piece.

2. Using the following procedure, register the position shown in the figure below as calibration reference point 4.
   (1) Move the manipulator traversing the welding line so that the target position as a red cross can be viewed in the lower right of the WinUser graphic display.
   (2) Move the manipulator towards the welding line so that the laser beam is focussed along the marked line.
   (3) Open the ARGUMENT SETTING display to register the manipulator’s position for calibration reference point 4.
5.5.7 Teaching of Escape Position

The escape position is required to avoid interference between the end of the tool and the workpiece when moving from the tool reference point to calibration reference point 1. Register the position shown in the figure below as the escape position (ESCAPE REFP.). To register the manipulator’s position as the escape position, open the ARGUMENT SETTING display.

![Diagram showing escape position and marked line](image-url)

- Move the end of the tool 10 mm up to avoid interference with the workpiece.
- The laser beam must be shone about 10 mm behind the marked line.
5.6 Execution of Calibration

5.6.1 Execution of a Calibration Job

The following procedure describes how to carry out a calibration job.

1. Move the cursor to the beginning of the calibration job, and set the NX100 to play mode.
2. Press [START].

Then, the calibration job is carried out.

5.6.2 Confirmation of the Calibration Results

The following procedure describes how to confirm the results of the calibration.

1. Confirm that the [START] lamp is unlit and that the execution of the job has stopped.
2. Check the position of the cursor.
   - If the cursor is on {END}, the calibration has been successfully completed.
   - If the job is paused, the calibration has failed.
Corrective Actions when the Job is Paused

1. Check the sensing state.
   (1) Move the manipulator to one of the taught reference points.
   (2) Open the LASER SENSOR MONITOR display to shine the laser beam. The sensor detection starts.
   (3) Specify file number 40 for the laser-tracking function that was set for the calibration job in the LASER SENSOR MONITOR display.
   (4) Check the value of the target position in the LASER SENSOR MONITOR display. If it is changing, the sensor detection is working.
   (5) Also check the target position with a red cross in the WinUser graphic display of your personal computer. The image of the target position should be clear and stable.
   (6) Move the manipulator to other taught reference points, and check the sensor detection in the same manner.

2. Check the file number setting.
   (1) Call up file number 40 for the laser-tracking function that was selected for the file number setting.
   (2) Check if the joint file number that is displayed is the same as the Joint file number that was set on your personal computer.
   (3) Confirm that the arguments of the macro command “LTCLIB” to be carried out in the calibration job [LT-CALIB] are as follows.
      - File number for the laser tracking LT: 40
      - Calibration file number LTC: (Teaching tool number)
6 Settings for Tracking Job

6.1 Tracking without a Welding-start-point Search

This section explains how to make settings for tracking without a search for the start point of the welding. Those settings can be used when the deviation of the start point of the welding is so small that the laser beam always shines on the welding line while the manipulator is approaching the start point of the welding. The sample job, “SMPL0,” is used as an example.
6.1 Tracking without a Welding-start-point Search

6.1.1 Teaching of Sample Job “SMPL0”

NIP
SFOF
SFOTOF3D
'-- TL mode [B000]-------------------------
'0:W/O TRACKING, 1:TRACKING --
'-----------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500 (Standby position)
MOVL V=500-----------------------------①
LTRCKON SW=B000 LT:1 V=100-------------②
'arcon
MOVL-------------------------------------③
LTEDSRCH SW=B000 LT:1
MOVL-------------------------------------④
'arcof
LTRCKOF SW=B000
MOVL V=500-------------------------------⑤
MOVJ VJ=10.0 (Standby position)
END

① **Approach point**
Set the approach point so that the laser beam is shone 5 mm to 10 mm before the start point of the welding.

② **Start point of the welding**
Teach the start point of the welding, and register it as an argument of the macro command, “LTRCKON.”

③ **Mid-way point to start the search for the end point of the welding**
Teach a point to specify the start position to carry out the macro command, “LTEDSRCH.”

④ **End point of the welding**
Teach a point that is 20 mm to 30 mm away from the actual end point of the welding of the reference workpiece.

⑤ **Escape point**
Teach a point to specify the tool’s escape motion after welding.

Teach the points ① to ⑤ as shown in the following diagram.

![Diagram of teaching points](image_url)
6.1.2 Settings for Macro Commands

**LTRCKON**

With moving the manipulator to the start point of the welding registered in the LTRCKON command, the XRC starts the laser tracking.

```
NOP
SFTOF
SFTOF3D
'-- TL mode [B000]-----------------------
' 0:W/O TRACKING, 1:TRACKING
'--------------------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
LTRCKON SW=B000 LT:1 V=100
'arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
'arcof
LTRCKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>① LT MODE (B var.)</td>
<td>B000</td>
<td>B000 to B039</td>
<td>B variable number to specify whether to carry out or skip the macro command. 1: Carries out the macro command 0: Skips the macro command</td>
</tr>
<tr>
<td>② LT FUNC_FILE#</td>
<td>1</td>
<td>1 to 40</td>
<td>Specifies the tracking function file to be used for detection during the approach to the start point of the welding.</td>
</tr>
<tr>
<td>③ APPROACH SPEED</td>
<td>50</td>
<td>Approx. the same speed as welding speed</td>
<td>Specifies the motion speed for the approach to the start point of the welding.</td>
</tr>
<tr>
<td>④ WELD START REFP. (Teaching point)</td>
<td>(Teaching point)</td>
<td></td>
<td>Teach the start point of the welding of the reference workpiece.</td>
</tr>
</tbody>
</table>
6.1 Tracking without a Welding-start-point Search

- **LTEDSRCH**

The LTEDSRCH command starts the search for the end point of the welding. The search automatically ends at the last detected point when the XRC recognizes the welding end in the section that was continuously undetected.

```plaintext
NOP
SFTOF
SFTOF3D
'-- TL mode [B000]-------------------------
' 0:W/O TRACKING, 1:TRACKING - -
'-------------------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
LTRCKON SW=B000 LT:1 V=100
'arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
'arcof
LTRCKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>① LT MODE (B Var.)</td>
<td>B000</td>
<td>B000 to B039</td>
<td>B variable number to specify whether to carry out or skip the macro command. 1: Carries out the macro command 0: Skips the macro command</td>
</tr>
<tr>
<td>② ALT FUNC. FILE#</td>
<td>1</td>
<td>1 to 40</td>
<td>Specifies the tracking function file to be used for the search for the end point of the welding.</td>
</tr>
</tbody>
</table>
6.1 Tracking without a Welding-start-point Search

### LTRCKOF

The LTRCKOF command ends the tracking.

```plaintext
NOP
SFTOF
SFTOF3D
  '--- TL mode [B000]------------------------
  ' 0:W/O TRACKING, 1:TRACKING - -
  '----------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
LTRCKON SW=B000 LT:1 V=100
  'arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
  'arcof
LTRCKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```

<table>
<thead>
<tr>
<th>Argument</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT MODE (B VAR.)</td>
<td>B000</td>
<td>B000 to B039</td>
<td>B variable number to specify whether to carry out or skip the macro command. 1: Carries out the macro command 0: Skips the macro command</td>
</tr>
</tbody>
</table>

### 6.1.3 Settings for the Laser-tracking Function File

Refer to “7. Settings for the Laser-tracking Function File” to set the number of each tracking function file which was specified for a macro command.
6.2 Tracking with a Welding-start-point Search

This section explains how to make settings for tracking with a search for the start point of the welding. The sample job, “SMPL1,” is used as an example in the search for the start point, OK→NG. Refer to “7.2 Conditions to be Set for Start Point Search” for details of the search type.
6.2 Tracking with a Welding-start-point Search

6.2.1 Teaching of Sample Job “SMPL1”

NOP
SFTOF
SFTOF3D
'-- TL mode [B000]------------------------
' 0:W/O TRACKING, 1:TRACKING --
'----------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
*retry
LTSRCH SW=B000 LT:1 V=60 sns P:10 ······
JUMP *retry IF B002=0
LTSFT SW=B000 sns=P010 flgB:2 ·······
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=100 ·············
'arcon
MOVL··········································
LTEDSRCH SW=B000 LT:1
MOVL··········································
'arcof
LTRCKOF SW=B000
MOVL V=500······································
MOVJ VJ=10.0
END

① **Approach point**
If there is no risk of interference, assign the same point as the start point of the search ②.

② **Start point for the welding-start-point search**
Teach the start point of the search, and register it as an argument of the macro command, “LTSRCH.”

③ **End point for the welding-start-point search**
Teach the end point of the search, and register it as an argument of the macro command, “LTSRCH.”

④ **Reference point for the start point of the welding**
Teach the same point as the start point of the welding, and register it as an argument of the macro command, “LTSFT.”

⑤ **Start point of the welding**
Teach the start point of the welding and register it as an argument of the macro command, “LTRCKON.”

⑥ **Mid-way point to start the search for the end point of the welding**
Teach a point to specify the start position to carry out the macro command, “LTEDSRCH.”

⑦ **End point of the welding**
Teach a point that is 20 mm to 30 mm away from the actual end point of the welding of the reference workpiece.

⑧ **Escape point**
Teach a point to specify the tool’s escape motion after welding.
Teach the points ① to ⑧ as shown in the following diagram.

Teach the start point ① and the end point ⑧ of the search so that the laser beam is shone 20 mm before and after the actual start point of the welding of the reference workpiece.

Teach the end point of the welding ⑧ 20 mm to 30 mm away from the actual end point of the welding of the reference workpiece.
### 6.2.2 Settings for Macro Commands

**LTSRCH**

The LTSRCH command starts the search for the start point of the welding.

```
NOP
SFTOF
SFTOF3D
\'- TL mode [B000]-
\' 0:W/O TRACKING, 1:TRACKING --
\'- ------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
*retry
LTSRCH SW=B000 LT:1 V=60 snsP:10
JUMP *retry IF B002=0
LTSFT SW=B000 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50
'arcon
MOVL
LTRCKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>① LT MODE (B var.)</td>
<td>B000</td>
<td>B000 to B039</td>
<td>B variable number to specify whether to carry out or skip the macro command. 1: Carries out the macro command 0: Skips the macro command</td>
</tr>
<tr>
<td>② LT FUNC. FILE#</td>
<td>1</td>
<td>1 to 40</td>
<td>Specifies the tracking function file to be used for detection during the approach to the start point of the welding.</td>
</tr>
<tr>
<td>③ SEARCH START REF</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>The point to start the search.</td>
</tr>
<tr>
<td>⑤ SEARCH END REFP.</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>The point to end the search.</td>
</tr>
<tr>
<td>⑥ SEARCH SPEED</td>
<td>50</td>
<td>20 to 80</td>
<td>The motion speed during the search.</td>
</tr>
</tbody>
</table>
6.2 Tracking with a Welding-start-point Search

The LTSFT command calculates the amount of shifting based on the detection results obtained by the search for the start point of the welding, and then carries out a parallel shift.

### LTSFT

The LTSFT command calculates the amount of shifting based on the detection results obtained by the search for the start point of the welding, and then carries out a parallel shift.

**Arguments**

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>DETECT POS. (P#)</td>
<td>10</td>
<td>0 to 127</td>
<td>Specifies the P variable number to save the start point of the welding obtained by the search function.</td>
</tr>
<tr>
<td>SEARCH RESULT (b#)</td>
<td>2</td>
<td>0 to 32</td>
<td>Specifies the B variable number to save the search results. 1: Detected 2: Not detected</td>
</tr>
</tbody>
</table>

### Arguments Initial Value Setting Range Remarks

1. DETECT POS. (P#) 10 0 to 127 Specifies the P variable number to save the start point of the welding obtained by the search function.
2. SEARCH RESULT (b#) 2 0 to 32 Specifies the B variable number to save the search results. 1: Detected 2: Not detected

**LTSFT**

The LTSFT command calculates the amount of shifting based on the detection results obtained by the search for the start point of the welding, and then carries out a parallel shift.

```plaintext
NOP
SFTOF
SFTOF3D
'-- TL mode [B000]------------------------
' 0:W/O TRACKING, 1:TRACKING --
----------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
'retry
LTSRCH SW=B000 LT:1 V=60 snsP:10
JUMP *retry IF B002=0
LTSFT SW=B000 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50
'arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
'arcof
LTRCKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```

### Arguments Initial Value Setting Range Remarks

1. LT MODE (B var.) B000 B000 to B039 B variable number to specify whether to carry out or skip the macro command. 1: Carries out the macro command 0: Skips the macro command
6.2 Tracking with a Welding-start-point Search

Moving the manipulator to the start point of the welding registered in the LTRCKON command, the XRC starts the laser tracking.

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>① DETECT POS. (P#)</td>
<td>10</td>
<td>0 to 127</td>
<td>Specifies the P variable number to save the detected point for calculating the shift amount.</td>
</tr>
<tr>
<td>② WELD START REFP.</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>Set the same point as the start point of the welding to be used for calculating the shift amount.</td>
</tr>
<tr>
<td>③ SHIFT RESULT (B#)</td>
<td>2</td>
<td></td>
<td>Judgement of the calculated amount of shifting. 1: Acceptable 0: Outside the allowable range</td>
</tr>
<tr>
<td>④ SFT MOV.PARMIT R</td>
<td>15</td>
<td>0 to</td>
<td>Allowable range of shift amount</td>
</tr>
</tbody>
</table>

LTRCKON

Moving the manipulator to the start point of the welding registered in the LTRCKON command, the XRC starts the laser tracking.

```
NOP
SFTOF
SFTOF3D
'-- TL mode [B000]------------------------
' 0:W/O TRACKING, 1:TRACKING --
'S----------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
'retry
LTSRCH SW=B000 LT:1 V=60 snsP:10
JUMP *retry IF B002=0
LTSFT SW=B000 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50
'arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
'arcof
LTRCKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```
6.2 Tracking with a Welding-start-point Search

The LTEDSRCH command starts the search for the end point of the welding. The search automatically ends at the last detected point when the XRC recognizes the welding end in the section that was continuously undetected.

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>①LT MODE (B var.)</td>
<td>B000</td>
<td>B000 to B039</td>
<td>B variable number to specify whether to carry out or skip the macro command. 1: Carries out the macro command 0: Skips the macro command</td>
</tr>
<tr>
<td>②LT FUNC. FILE#</td>
<td>1</td>
<td>1 to 40</td>
<td>Specifies the tracking function file to be used for detection during the approach to the start point of the welding.</td>
</tr>
<tr>
<td>③APPROACH SPEED</td>
<td>50</td>
<td>Approx. the same as welding speed</td>
<td>Specifies the motion speed for the approach to the start point of the welding.</td>
</tr>
<tr>
<td>④WELD START REFP.</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>Teach the start point of the welding on the reference workpiece.</td>
</tr>
</tbody>
</table>

**LTEDSRCH**

The LTEDSRCH command starts the search for the end point of the welding. The search automatically ends at the last detected point when the XRC recognizes the welding end in the section that was continuously undetected.

```
NOP
SFTOF
SFTOF3D
'-- TL mode [B000]------------------------
' 0:W/O TRACKING, 1:TRACKING --
'------------------------------------------------
SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
*retry
LTSRCH SW=B000 LT:1 V=60 snsP:10
JUMP *retry IF B002=0
LTSFT SW=B000 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50
'arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
'arcof
LTRCKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```
6.2 Tracking with a Welding-start-point Search

<table>
<thead>
<tr>
<th>Arguments</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| ① LT MODE (B var.)     | B000          | B000 to B039  | B variable number to specify whether to carry out or skip the macro command.  
1: Carries out the macro command  
0: Skips the macro command |
| ② LT FUNC.FILE#        | 1             | 1 to 40       | Specifies the tracking function file to be used for the search for the end point of the welding. |

**LTRCKOF**

The LTRCKOF command ends the tracking.

```plaintext
NOP  SFTOF  SFTOF3D  
'-- TL mode [B000]------------------------
' 0:W/O TRACKING, 1:TRACKING --
'------------------------------------------------
SET B000 1  
SPEED V=16.7  
MOVL V=500  
MOVL V=500  
*retry  
LTSRCH SW=B000 LT:1 V=60 snsP:10  
JUMP *retry IF B002=0  
LTSFT SW=B000 sns=P010 flgB:2  
PAUSE IF B002=0  
LTRCKON SW=B000 LT:1 V=50  
'arcon  
MOVL  
LTEDSRCH SW=B000 LT:1  
MOVL  
'arcof  
LTRCKOF SW=B000  
MOVL V=500  
MOVJ VJ=10.0  
END
```

<table>
<thead>
<tr>
<th>Argument</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
</table>
| ① LT MODE (B VAR.)    | B000          | B000 to B039  | B variable number to specify whether to carry out or skip the macro command.  
1: Carries out the macro command  
0: Skips the macro command |
6.2.3 Settings for the Laser-tracking Function File

Refer to “7. Settings for the Laser-tracking Function File” to set the number of each tracking function file which was specified for a macro command.
7 Settings for the Laser-tracking Function File

The laser tracking function file includes the conditions for each process in laser tracking.

<File Components>

Operation

Select {OPTION} under the top menu ➔ Select {LASER TRACKING}
7.1 Conditions for the Laser Sensor

Selects one of the joint files stored in the SMART-BOX of the laser vision sensor. The joint file includes the conditions to specify the processing method for detection.

- Setting range: 0 to 100
- Standard setting: 0

2 WORK ORIENTATION BREAKPOINT

Selects one of the breakpoints transmitted from the laser vision system to get the information on the inclination of the joint.

- Setting range: 0 to 7
- Standard setting: 0
**TARGET PT Y(Z)-SHIFT (SENSOR)**

Shifts the target in the direction of the Y-axis and Z-axis in the camera coordinate system of the laser vision sensor.
- Setting range: -10.0 to 10.0
- Standard setting: 0
7.2 Conditions for Welding-start-point Search

### Conditions for Welding-start-point Search

#### SEARCH TYPE

Specifies the search type.
- Setting range: NG→OK; OK→NG; STOP
- Standard setting: OK→NG

Three search types are available:
- Type NG→OK and type OK→NG: Searches for the transition point to and from the section that is continuously detected to and from the section that is continuously undetected, and recognizes this point as the start point.
- Type STOP: Recognizes the first detected point as the start point.

- Type NG→OK

  Searches for the transition point from the section that is continuously undetected to the section that is continuously detected.

  Teach the motion for the search to be done from a section away from the welding line to the welding line.
7.2 Conditions for Welding-start-point Search

- **Type OK→NG**
  Searches for the transition point from the section that is continuously detected to the section that is continuously undetected.
  Teach the motion for the search to be done from the welding line to a section away from the welding line.

![Diagram showing the search process for Type OK→NG](image)

- **Type STOP**
  The first detected point after the start of the search is recognized as the start point.

![Diagram showing the search process for Type STOP](image)

### OVERLAP DISTANCE
Shifts the start point of the search towards the welding line. Searches for the start point on the bead end on the welding line and uses this point as the start point of the welding when welding on the bead end. This function is invalid when “STOP” is selected as the search type.
- Setting range: 0 to 10
- Standard setting: 0

### WELD DETECTION OVERLAP
For the search type, NG→OK, specifies the length of the section that is continuously detected to be recognized as the welding line.
- Setting range: 5 to 50
- Standard setting: 0
7.3 Conditions for Welding-end-point Search

④ NON-WELD DETECTION OVERLAP
For the search type, OK→NG, specifies the length of the section that is continuously undetected to be recognized that the torch is away from the welding line.
• Setting range: 5 to 50
• Standard setting: 10

7.3 Conditions for Welding-end-point Search

① OVERLAP DISTANCE
Shifts the end point of the search towards the welding line. Searches for the end point on the bead end on the welding line and uses this point as the end point of the welding when welding on the bead end. This function is invalid when “STOP” is selected as the search type.
• Setting range: -10 to 10
• Standard setting: 0

② NON-WELD DETECTION OVERLAP
For the search type, OK→NG, specifies the length of the section that is continuously undetected to be recognized that the torch is away from the welding line.
• Setting range: 5 to 50
• Standard setting: 10
### 7.4 Conditions for Laser Tracking

<table>
<thead>
<tr>
<th>Laser Tracking</th>
<th>File No.: 1 / 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition</td>
<td>END POS SEARCH</td>
</tr>
<tr>
<td>Overlap Distance</td>
<td>0.0 mm</td>
</tr>
<tr>
<td>Non-Veld Detection Overlap</td>
<td>10.0 mm</td>
</tr>
</tbody>
</table>

1. **XYZ Correction**
   - Turns the output of the path correctional amount ON/OFF.
   - Setting range: ON or OFF
   - Standard setting: ON

2. **RxRyRz Correction**
   - For future use. Do not change the initial setting.

3. **Sensing Position Correction**
   - For future use. Do not change the initial setting.

4. **TCP Y-Shift (Tool Frame)**
   - **TCP Z-Shift (Tool Frame)**
   - Shifts the target point in the tool coordinate system if the target point has deviated from the desired welding point.
   - Setting range: -99.9 to 99.9
   - Standard setting: 0.0

5. **TCP Rx-Shift (Tool Frame)**
   - For future use. Do not change the initial setting.
7.5 Conditions for No-detection and Error Detection

TCP Ry-SHIFT (TOOL FRAME)
For future use. Do not change the initial setting.

TCP Rz-SHIFT (TOOL FRAME)
For future use. Do not change the initial setting.

### 7.5 Conditions for No-detection and Error Detection

<table>
<thead>
<tr>
<th>LASER TRACKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILE No.: 1 / 40</td>
</tr>
<tr>
<td>CONDITION</td>
</tr>
<tr>
<td>①</td>
</tr>
<tr>
<td>②</td>
</tr>
<tr>
<td>③</td>
</tr>
<tr>
<td>④</td>
</tr>
<tr>
<td>⑤</td>
</tr>
</tbody>
</table>

#### ① ACTION AFTER NON-DETECTION

Specifies the manipulator motion when nothing is detected in the specified distance.

- NO ACTION
  - The manipulator continues moving in the taught direction without stopping even if data is no longer sent from the sensor because nothing has been detected. Tracking is restarted when the sensor detects the data again.

- STOP
  - An alarm occurs, and the manipulator stops when data is no longer sent from the sensor because nothing has been detected.

- Setting range: NO ACTION, STOP
- Standard setting: NO ACTION

#### ② NON-DETECTION DISTANCE

Specifies the distance to be checked.

Specify approximately half the distance of the “lookahead.”

- If the detecting ratio is low, specify a longer distance.
- If the detecting ratio is high, specify a shorter distance.

- Setting range: 5 to 100
- Standard setting: 10

#### ③ DATA ACQUISITION LENGTH

Specifies the length of the approximate line to be used for judgement of error detection.
specify approximately half the distance of the “lookahead.”
If the curvature 1/R of the welding line is large, specify a shorter distance.
If the curvature 1/R of the welding line is small, specify a longer distance.
• Setting range: 5 to 100
• Standard setting: 10

**Detect Err Limit (Start/End, Middle)**
Specifies the distance to judge whether the point to be checked is mistakenly detected or not.
START/END: The distance to be used to judge the points detected during the approach to the start point of the welding and during the search for the end point.
MIDDLE: The distance to be used to judge the points detected in the tracking sections other than those in the START/END.
• Setting range: 0.0 to 50.0
• Standard setting: 5 for START/END; 5 for MIDDLE

---

**7.6 Conditions to Pass Over**

For future use. Do not set.
7.6 Conditions to Pass Over
8 Settings for Inspection Job Before Starting Operations

After making the settings for the tool and the sensor, make the initial settings for the inspection job before starting operations.
8.1 Teaching an Inspection Job Before Starting Operations

NOP
'AUTO/MANUAL switching flag [0: AUTO, 1: MANUAL]
SET LB000 0
'Initial setting flag [0: Normal, 1: Initial setting]
SET LB001 0
'Standby position
MOVJ VJ=5.0
'Approach motion====
MOVJ VJ=5.0
MOVJ VJ=5.0
MOV L V=100
'==============
'Position for checking the welding point deviation
REFP 1
Posture 1 for checking the welding point deviation
REFP 2
Posture 2 for checking the welding point deviation
REFP 3
Position for checking the camera deviation
REFP 4
'Posture 1 for checking the camera deviation (start)
REFP 5
'Posture 1 for checking the camera deviation (end)
REFP 6
'Posture 2 for checking the camera deviation (start)
REFP 7
'Posture 2 for checking the camera deviation (end)
REFP 8
'...
8.1 Teaching an Inspection Job Before Starting Operations

NOP

"AUTO/MANUAL switching flag [0: AUTO, 1: MANUAL]
SET LB000 0

"Initial setting flag [0: Normal, 1: Initial setting]
SET LB001 0

"Standby position
MOVJ VJ=5.0

"Approach motion=====
MOVJ VJ=5.0
MOVJ VJ=5.0
MOVL V=100

"=================

"Position for checking the welding point deviation
REFP 1

"Posture 1 for checking the welding point deviation
REFP 2

"Posture 2 for checking the welding point deviation
REFP 3

"Posture 1 for checking the camera deviation (start)
REFP 4

"Posture 1 for checking the camera deviation (end)
REFP 5

"Posture 2 for checking the camera deviation (start)
REFP 6

"Posture 2 for checking the camera deviation (end)
REFP 7

"Posture 2 for checking the camera deviation (end)
REFP 8

: 

Move the manipulator so that the laser beam shines on the marked line.

Posture 1 for checking the camera deviation
(Tilt the tool five more degrees.)

Start position

End position

Approx. 5 mm

Move the manipulator so that the laser beam shines on the marked line.

Posture 2 for checking the camera deviation
(Tilt the tool five more degrees. (to the other side))

Start position

End position

Approx. 5 mm

Move the manipulator so that the laser beam shines on the marked line.
8.2 Acquisition of Reference Data

The following procedure describes how to get the reference data.
1. Set [1] (initial setting) to the initial setting flag.
2. Set [0] (AUTO) to the AUTO/MANUAL switching flag.
3. Carry out the inspection job before starting an operation in auto or test mode.

The data of the target point and the actual data which was detected are obtained at the position for checking the camera deviation, the posture 1 for checking the camera deviation, and the posture 2 for checking the camera deviation to store as the position data of the user variables.
9 Tool Offset Setting

If the tool center point (TCP) always deviates from the target in one direction, the deviation can be corrected by using the tool offset function.

9.1 How to Obtain the Tool Offset Amount

The following procedure describes how to obtain the amount of the tool offset.

1. Carry out tracking in a test run.
2. When a deviation is found, stop the manipulator.
   To obtain the exact amount of the deviation, keep the servo power supply ON.
3. Select the job for offset calculation, “CAL OFFSET.”
4. Set the number of the tool used for tracking as the teaching tool.
5. Register the TCP position when the manipulator is stopped as the reference point, “Deviated Position.”
6. Correct the TCP’s position in the direction perpendicular to the tracking direction in the JOG operation.
7. Register the corrected position of the TCP as the reference point, “Corrected Position.”

8. Move the cursor to the beginning of the job, and carry out the test run.
9. The calculated amount of the tool offset is stored as the position data of the user variable \([P088]\). Take note of the values for the X-, Y-, and Z-axes.

**9.2 How to Reset the Tool Offset Amount**

Open the tracking function file used for tracking, and add the values obtained in Step 9 of “9.1 How to Obtain the Tool Offset Amount” to the offset settings.

*Example*
When the offset “0.0, 0.3, -0.1” has been set, add the obtained offset (0.0, 0.1, -0.2) to the offset settings.
The offset values to be reset are:
- X: 0.0 mm
- Y: 0.3 + 0.1 = 0.4 mm
- Z: -0.1 + (-0.2) = -0.3 mm
### 9.2 How to Reset the Tool Offset Amount

#### LASER TRACKING

**FILE NO.: 1 / 40**

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>TRACKING</th>
<th>XYZ CORRECTION</th>
<th>RX+RZ CORRECTION</th>
<th>SENSING POSITION CORRECTION</th>
<th>GAP COND FILE NO.</th>
<th>TCP X-SHIFT (TOOL FRAME)</th>
<th>TCP Y-SHIFT (TOOL FRAME)</th>
<th>TCP Z-SHIFT (TOOL FRAME)</th>
<th>TCP Rx-SHIFT (TOOL FRAME)</th>
<th>TCP Ry-SHIFT (TOOL FRAME)</th>
<th>TCP Rz-SHIFT (TOOL FRAME)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>1</td>
<td>0.0 mm</td>
<td>0.0 mm</td>
<td>-0.1 mm</td>
<td>0 deg</td>
<td>0 deg</td>
<td>0 deg</td>
</tr>
</tbody>
</table>

---

**FILE NO.: 1 / 40**

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>TRACKING</th>
<th>XYZ CORRECTION</th>
<th>RX+RZ CORRECTION</th>
<th>SENSING POSITION CORRECTION</th>
<th>GAP COND FILE NO.</th>
<th>TCP X-SHIFT (TOOL FRAME)</th>
<th>TCP Y-SHIFT (TOOL FRAME)</th>
<th>TCP Z-SHIFT (TOOL FRAME)</th>
<th>TCP Rx-SHIFT (TOOL FRAME)</th>
<th>TCP Ry-SHIFT (TOOL FRAME)</th>
<th>TCP Rz-SHIFT (TOOL FRAME)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>1</td>
<td>0.3 mm</td>
<td>0.4 mm</td>
<td>-0.3 mm</td>
<td>0 deg</td>
<td>0 deg</td>
<td>0 deg</td>
</tr>
</tbody>
</table>
9.2 How to Reset the Tool Offset Amount
10 Settings for the Gap Adaptation Function

This chapter explains the function to adapt the welding condition (current, voltage, analog 3ch., 4ch., target position and speed) to the gap value.

- User set the change value of the welding condition which adapts to the gap into GAP CONDITION FILE.

**GAP CONDITION FILE**

<table>
<thead>
<tr>
<th>GAP CONDITION: 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAP VOLT CURR 3ch 4ch x y z SPEED</td>
</tr>
<tr>
<td>ON ON OFF OFF OFF ON ON</td>
</tr>
<tr>
<td>0.1 100 100 0 0 0 0 0 100</td>
</tr>
<tr>
<td>0.2 110 105 0 0 0 0 -0.2 90</td>
</tr>
<tr>
<td>0.4 120 110 0 0 0 0 -0.5 85</td>
</tr>
<tr>
<td>0.6 126 113 0 0 0 0 -0.7 80</td>
</tr>
<tr>
<td>0.7 130 115 0 0 0 0 -0.9 70</td>
</tr>
</tbody>
</table>

- The XRC makes linear functions from the first ‘GAP CONDITION FILE’.
- The controller calculates the correction values which adapts to GAP by using the function.
10.1 Settings for the Gap Condition File

The Gap Condition file includes the conditions for each gap value.

<File Components>
10.2 Conditions for Welding

10.2 Conditions for Welding

1. **SWITCH of FUNCTION**
   - ON : Enable of adaptive control. / OFF : Disable of adaptive control.
   - Initial setting: ON

2. **GAP VALUE**
   The gap value to make the condition correspond. It is possible to set gap by ten stages. This data are displayed same data in POSITION and SPEED.
   - Setting range: 0.0 to 99.9[mm]
   - Initial setting: 0.0[mm]

3. **VOLTAGE RATIO**
   Analog 1ch. which control the welding voltage is corrected in proportion to gap. Set ratio of changing analog 1ch. output, which is programed by AOUT(1) in the JOB.
   - Setting range: 0 to 200[%]
   - Initial setting: 0[%]

4. **CURRENT RATIO**
   Analog 2ch. which control the welding current is corrected in proportion to gap. Set ratio of changing analog 2ch. output, which is programed by AOUT(2) in the JOB.
   - Setting range: 0 to 200[%]
   - Initial setting: 0[%]

5. **ANALOG 3ch. RATIO**
   Analog 3ch. is corrected in proportion to gap. Set ratio of changing analog 3ch. output, which is programed by AOUT(3) in the JOB.
   - Setting range: 0 to 200[%]
   - Initial setting: 0[%]
10.3 Conditions for Position

**ANALOG 4ch. RATIO**
Analog 4ch. is corrected in proportion to gap.
Set ratio of changing analog 4ch. output, which is programmed by AOUT(4) in the JOB.
- Setting range: 0 to 200[%]
- Initial setting: 0[%]

**SWITCH of FUNCTION**
- ON : Enable of adaptive control. / OFF : Disable of adaptive control.
- Initial setting: ON

**GAP VALUE**
The gap value to make the condition correspond. It is possible to set gap by ten stages.
This data are displayed same data in WELD and SPEED.
- Setting range: 0.0 to 99.9[mm]
- Initial setting: 0.0[mm]

**SHIFT VALUE of TARGET POSITION (X,Y,Z)**
It is possible to shift the tool central point (TCP) axially of the tool coordinate system in proportion to gap value.
Set shift values of each axially of the tool coordinate system.
- Setting range: -99.9 to 99.9[mm]
- Initial setting: 0.0[mm]

**CHANGE VALUE of TOOL POSTURE (Rx,Ry,Rz).**
For future use. Do not change the initial setting.
10.4 Conditions for Speed

①**SWITCH of FUNCTION**
- ON : Enable of adaptive control. / OFF : Disable of adaptive control.
- Initial setting: ON

②**GAP VALUE**
The gap value to make the condition correspond. It is possible to set gap by ten stages. This data are displayed same data in WELD and POSITION.
- Setting range: 0.0 to 99.9[mm]
- Initial setting: 0.0[mm]

③**CHANGE RATIO of SPEED**
Speed is changed in proportion to gap value. Set ratio of speed, which is programmed by 'MOV V=' in the JOB.
- Setting range: 0 to 200[%]
- Initial setting: 0[%]
1. When using gap adaptation function to analog output, it have to add INSTRUCTION(AOUT) before INSTRUCTION (LTRACKON).
2. Use the INSTRUCTION AOUT for setting the voltage value of analog output directly.
3. Changing analog output is invalid during the tracking, when using gap adaptation function to analog output.
4. When using gap adaptation function to control of speed, speed can be changed by using the INSTRUCTION 'MOV V=' in the JOB.
5. It is possible to change analog channel by setting the sensor parameter (S1E).

<table>
<thead>
<tr>
<th>Initial</th>
<th>Setting range</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1E040</td>
<td>1 1 to 12 ch.</td>
</tr>
<tr>
<td>S1E041</td>
<td>2 1 to 12 ch.</td>
</tr>
<tr>
<td>S1E042</td>
<td>3 1 to 12 ch.</td>
</tr>
<tr>
<td>S1E043</td>
<td>4 1 to 12 ch.</td>
</tr>
</tbody>
</table>
11 Inspection Before Starting Operations

11.1 Automatic Inspection Before Starting Operations

For the best performance of the laser-tracking function, perform the inspection before starting operations.

Automatic Inspection Procedure Before Starting Operations

1. Assign "0" to the auto/manual flag at the beginning of the job.
2. Set the XRC to play mode, and start the operation.

Before starting operations, select the inspection job.

Carry out the automatic inspection?

Yes

No

1. Assign "0" to the auto/manual flag at the beginning of the job.
2. Set the XRC to play mode, and start the operation.

[Error 1]
Has the manipulator stopped due to camera deviation?

Yes

No

Refer to "11.2 Manual Inspection Before Starting Operations."

Refer to "11.2 Manual Inspection Before Starting Operations."

[Error 2 and 3]
Has the manipulator stopped due to camera deviation when the posture was changed?

Yes

No

Start the sensor-monitor software, WinUser.

Is 10 μm assigned to the X-, Y-, and Z-axes parameters in "Robot Setting"?

Yes

No

Assign 10 μm to the X-, Y-, and Z-axes parameters in "Robot Setting."

Refer to "11.2 Manual Inspection Before Starting Operations."
11.2 Manual Inspection Before Starting Operations

Procedure of Manual Inspection Before Starting Operations

Assign "1" to the auto/manual flag at the beginning of the job.

Attach a tip for teaching.

Set the XRC to teaching mode, and start a test run.

Restart the manipulator in the test run.

Restart the manipulator in the test run.

In all of the three postures, does the tip for teaching point to the tip for checking?

No: Restart the manipulator in the test run to move the manipulator to posture 1 for checking the welding point deviation.

Yes: Select the tool number of the teaching tool for tracking, and change the posture by pressing the X, Y, and Z keys in the JOG operation.

After changing the posture, does the tip for teaching still point to the tip for checking?

No: Refer to "11.4 Verification of Tool Constants."

Yes: Refer to "11.5 Verification of Detected Data."

The manipulator pauses.

Move the manipulator to the posture 1 for checking the welding point deviation, and temporarily stop the manipulator.

Move the manipulator to the posture 2 for checking the welding point deviation, and temporarily stop the manipulator.

Move the manipulator to the posture 3 for checking the welding point deviation, and temporarily stop the manipulator.

Move the manipulator to the posture 1 for checking the welding point deviation, and temporarily stop the manipulator.

Refer to "11.3 Camera Deviation Check at Welding-point Deviation Check."

Refer to "11.4 Verification of Tool Constants."

Refer to "11.5 Verification of Detected Data."

Key:

Refer to the section for more information.

Comment
11.3 Camera Deviation Check at Welding-point Deviation Check

1. Move the manipulator to the standby position.
2. Move the cursor to the beginning of the job.
3. Assign "0" to auto/manual flag.
4. Start the test run.

[Error 1]
Has the manipulator stopped due to camera deviation?

No

Is the tip for teaching or the tip for checking deformed?

No

The entire tool has not deviated, but the surface around the welding point may be deformed. Correct the deformation on the surface.

No

Is the deviation less than 1 mm?

Yes

Check for target deviation by carrying out a tracking job in a test run.

No

End

Yes

Replace the tip and restart the procedure described in "11.2 Manual Inspection Before Starting Operations."

Yes

Correct the target deviation by setting the amount of offset. Refer to "9 Tool Offset Setting."

Yes

Refer to "12.3 Corrective Action for Tool Deviation."

Yes

Refer to "12.3 Corrective Action for Tool Deviation."

Comment

Key:

Refer to the section for more information.
11.4 Verification of Tool Constants

- Tool constant has been changed.
  - Is there a record of the previously registered tool constants?
    - Yes
      - Assign the original values to the tool constants.
      - Press the BWD button to move the manipulator to the posture 1 for checking the torch deviation, and restart the jog operation to check if the settings are correct.
    - No
      - After changing the posture, does the tip for teaching still point to the tip for checking?
        - Yes
          - Carry out tool calibration.
        - No
          - Carry out the sensor calibration again. Refer to "5. Laser Sensor Calibration."

- Key:
  - Refer to the section for more information.
  - Comment

- Yes
  - Carry out tool calibration.

- No
  - Redo the initial settings for the inspection job before restarting operations. Refer to "8. Settings for Inspection Job Before Starting Operations."
11.5 Verification of Detected Data

Carry out the automatic inspection before starting operations.
1. Move the manipulator to the standby position.
2. Move the cursor to the beginning of the job.
3. Assign "0" to auto/manual flag.

Start the test run.

[Error 1]
Has the manipulator stopped due to camera deviation?

Yes

No

[Errors 2 and 3]
Has the manipulator stopped due to camera deviation when changing the posture?

Yes

No

Is 10 μm assigned to the X-, Y-, and Z-axes parameters in "Robot Setting"?

Yes

No

Assign 10 μm to the X-, Y-, and Z-axes parameters in "Robot Setting."

End

Refer to the section for more information.
11.5 Verification of Detected Data
12 Troubleshooting

12.1 Corrective Actions after Torch Collision

Take corrective actions following the flowchart.

Torch Collision

Any target deviation?

Yes

Check for tool deviation and camera deviation by carrying out the inspection job before starting operations. Refer to "11.2 Manual Inspection Before Starting Operations."

No

End

Any target deviation?

Yes

Contact your Yaskawa representative.

No

End

Key:

Refer to the section for more information.

Comment

Yes

No

Yes

No
12.2 Corrective Actions for Target Deviation

Take corrective actions following the flowchart.

**Target Deviation**

- Check the status of the detection on the WinUser graphic display.

- Is the target point (a red cross) unstable?
  - Yes
  - No

- Has an offset been applied to the target position?
  - Yes
  - No

- Adjust the parameters with WinUser.
  - No
  - Yes

- Has the target position offset been cancelled?
  - Yes
  - No

- Any target deviation?
  - Yes
  - No

- End

**Key:**

- Refer to the section for more information.
- Comment

**Comment Key:**

- Yes
- No

Check for tool deviation and camera deviation by carrying out the inspection job before starting operations. Refer to "11.2 Manual Inspection Before Starting Operations."

Contact your Yaskawa representative.
12.3 Corrective Actions for Tool Deviation

Take corrective actions following to the flowchart.

**Key:**
- Refer to the section for more information.
- Comment

---

**Tool Deviation**

1. Change the tool with the tip for teaching.
2. Carry out the manual inspection job before starting operations, and move the manipulator to the position for checking the welding point deviation.
3. Check if the tip end for teaching points to the tip end for checking.

---

Check if the flange and the torch are attached and fixed securely. Tighten the screws if necessary.

---

Check if the torch or sensor cables have been stretched too much that the torch has been moved. Adjust the stretching tension of the connection cable if necessary.

---

Has the tool deviation been corrected?

- **Yes**
  - Correct the tool deviation, and tighten the mounting screws.
  - Carry out tool calibration.
  - Carry out the sensor calibration again. Refer to "5. Laser Sensor Calibration."
  - Redo the initial settings for the inspection job before restarting operations. Refer to "8. Settings for Inspection Job Before Starting Operations."

---

- **No**

---

End
12.4 Corrective Actions for Camera Deviation

Take corrective actions following the flowchart.

**Key:**

- Refer to the section for more information.
- Comment

[Flowchart Diagram]

- **Camera Deviation**
  - The mounting position of the sensor's camera may have deviated.
  - Move the manipulator to the position for checking the camera deviation of the inspection job before starting operations. If the manipulator is at the position for the detection test when changing the posture, press the [BWD] button to return the manipulator to the previous position.
  - Adjust the mounting position of the camera so that the laser beam shines on the marked line on the joint of the workpiece for the detection test.
  - Tighten the mounting screws.
  - Carry out the sensor calibration again. Refer to "5. Laser Sensor Calibration."
  - Redo the initial settings for the inspection before restarting operations. Refer to "8. Settings for Inspection Job Before Starting Operations."

**End**
<table>
<thead>
<tr>
<th>Alarm No.</th>
<th>Data</th>
<th>Message</th>
<th>Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1003</td>
<td>-</td>
<td>ROM error (NCP02)</td>
<td>A checking error in the memory for the tracking program.</td>
<td>Replace the NCP02 board.</td>
</tr>
<tr>
<td>5020</td>
<td>0 to 199</td>
<td>Parameter error (NCP02), [decimal data]</td>
<td>Set values for the sensor parameter are incorrect. The decimal data indicates the number of the sensor parameter whose setting is incorrect.</td>
<td>Set the sensor parameter to a value within the setting range described in the parameter list.</td>
</tr>
<tr>
<td>5011</td>
<td>0000 0001 to 0011 1111</td>
<td>Transmission error (NCP02), [binary data]</td>
<td>An error in serial communications. The binary data indicates the type of transmission error.</td>
<td>Check the communications cable between the NX100 and the SMART-BOX for any disconnection, misconnection, or similar problem. Replace the NCP02 board.</td>
</tr>
<tr>
<td>5050</td>
<td>1 to 233</td>
<td>Motion extension processing error, [decimal data]</td>
<td>An interface error between the tracking processing system and the operating section for the laser-tracking function. The decimal data indicates the type of error.</td>
<td>Requires investigation at Yaskawa. Contact your Yaskawa representative, stating the situation, the alarm number, and the decimal data of the alarm.</td>
</tr>
<tr>
<td>5051</td>
<td>1 to 201</td>
<td>Skill command processing error, [decimal data]</td>
<td>An error occurred in a macro command. The decimal data indicates the type of the error.</td>
<td>Requires investigation at Yaskawa. Contact your Yaskawa representative, stating the alarm number, decimal data, and the macro command where the error occurred.</td>
</tr>
<tr>
<td>5052</td>
<td>0 to 19</td>
<td>System error (Laser tracking), [decimal data]</td>
<td>An error occurred in the tracking processing system of the laser-tracking function. The decimal data indicates the type of error.</td>
<td>Requires investigation at Yaskawa. Contact your Yaskawa representative, stating the situation, the alarm number, and the decimal data of the alarm.</td>
</tr>
<tr>
<td>Alarm No.</td>
<td>Data</td>
<td>Message</td>
<td>Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>---------</td>
<td>-------</td>
<td>------------------</td>
</tr>
<tr>
<td>*</td>
<td></td>
<td>Laser tracking processing error, [decimal data]</td>
<td>The decimal data indicates the type of error.</td>
<td></td>
</tr>
<tr>
<td>1 to 9</td>
<td></td>
<td>An error occurred in the corresponding process of the laser-tracking function.</td>
<td>Requires investigation at Yaskawa. Contact your Yaskawa representative, stating the situation, the alarm number, and the decimal data of the alarm.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>An error occurred in the sensing mode.</td>
<td>Return the manipulator to its standby position, and restart the job for tracking from the beginning.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>The Coordinate/Independent attribute of a move instruction has been changed in the middle of tracking.</td>
<td>Use either coordinate move instructions or independent move instructions for the teaching in the tracking section.</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>A tool change error</td>
<td>Use the same teaching tool throughout the tracking section.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>The control group has been changed in the middle of tracking.</td>
<td>Use either coordinate move instructions or independent move instructions for the teaching in the tracking section.</td>
<td></td>
</tr>
</tbody>
</table>
| 17       |      | The laser sensor has continuously detected no point. | Increase the detecting frequency of the sensor.  
- Remove the polish on the workpiece’s surface.  
- Correct the teaching posture so that the laser beam can be shone on the welding line of the reference workpiece.  
- Adjust the image processing parameter in WinUser. | |
<p>| 19,20    |      | The manipulator cannot move to the position that was corrected during tracking. | Correct the taught position for the reference workpiece, considering the posture of the L- and U-axes. | |
| 21       |      | The correction amount exceeds the allowable value. | For teaching, minimize the posture change so that the manipulator can move in a smooth motion. | |</p>
<table>
<thead>
<tr>
<th>Alarm No.</th>
<th>Data</th>
<th>Message</th>
<th>Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 to 27</td>
<td></td>
<td>An error occurred in the calculation for the calibration of the external axis in the tracking function of the external axis’s control method.</td>
<td>Check the teaching points for the calibration of the external axis. (For example, the arrangement of 7 points of manipulator position data and 6 points of external axes.)</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>An error response has been received in FC1 transmissions.</td>
<td>Clear the error of the external memory unit.</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
<td>An undefined response has been received in FC1 transmissions.</td>
<td>Use a FC1 or FC2 emulator for the external memory unit.</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>The laser sensor’s transmission channel has not been set.</td>
<td>Assign “2” to the sensor parameter SxE180.</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td></td>
<td>The FC1’s transmission channel has not been set.</td>
<td>Assign “1” to the sensor parameter SxE170.</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td></td>
<td>No response has been received in communications with the laser sensor.</td>
<td>Turn OFF the power supply of the SMART-BOX, and turn it ON again.</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td>No response has been received in communications with the external memory unit.</td>
<td>Turn OFF the power supply of the external memory unit, and turn it ON again.</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>The specified file number for the laser-tracking function is out of the allowable range.</td>
<td>Specify a file number between 1 and 40 for the laser-tracking function.</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td></td>
<td>The specified file number for laser calibration is out of the allowable range.</td>
<td>Specify a file number between 0 and 23 for laser calibration.</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td></td>
<td>The specified file number for external axis calibration is out of the allowable range.</td>
<td>Specify a file number between 0 and 23 for external axis calibration.</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td></td>
<td>No local variable for the sensor.</td>
<td>Extend the definition of the local variable.</td>
<td></td>
</tr>
<tr>
<td>50 to 56</td>
<td></td>
<td>There is no sensing-data when end search.</td>
<td>Adjust the vision sensor to do steady detection.</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td>The ratio of the speed fell below a minimum value of permit.</td>
<td>Adjust the parameter S1E044 for falling below the ratio of the speed.</td>
<td></td>
</tr>
<tr>
<td>Alarm No.</td>
<td>Data</td>
<td>Message</td>
<td>Cause</td>
<td>Corrective Action</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>---------</td>
<td>-------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>*</td>
<td>Laser sensor error, [decimal data]</td>
<td>An error occurred in the communications between the XRC and the SMART-BOX. The decimal data indicates the type of error.</td>
<td>Check the communications cable between the XRC and the SMART-BOX for any disconnection, misconnection, or similar problem. Turn OFF the power supply of the SMART-BOX, and turn it ON again.</td>
</tr>
<tr>
<td>0 to 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>97</td>
<td></td>
<td>An external alarm occurred.</td>
<td></td>
<td>Reset the emergency stop switch on the SMART-BOX.</td>
</tr>
<tr>
<td>104</td>
<td></td>
<td>Camera failure.</td>
<td></td>
<td>If the temperature of camera surface is too high, cool it down. Turn OFF the power supply of the SMART-BOX, and turn it ON again.</td>
</tr>
<tr>
<td>107</td>
<td></td>
<td>An error occurred in the final processing for tracking.</td>
<td></td>
<td>Turn OFF the power supply of the SMART-BOX, and turn it ON again.</td>
</tr>
<tr>
<td>112</td>
<td></td>
<td>The parameter instructed from the XRC does not exist.</td>
<td></td>
<td>Requires investigation at Yaskawa. Contact your Yaskawa representative, stating the alarm number, decimal data, and the macro command where the error occurred.</td>
</tr>
<tr>
<td>115</td>
<td></td>
<td>An error occurred at the setup.</td>
<td></td>
<td>Turn OFF the power supply of the SMART-BOX, and turn it ON again. Refer to “3. Start-up.”</td>
</tr>
<tr>
<td>116</td>
<td></td>
<td>The operating temperature exceeds the allowable range.</td>
<td></td>
<td>Cool the SMART-BOX down. Clean the cooling fan on the SMART-BOX. Cool the camera down. Turn OFF the power supply of the SMART-BOX, and turn it ON again.</td>
</tr>
<tr>
<td>118</td>
<td></td>
<td>The value instructed from the XRC is out of the allowable range.</td>
<td></td>
<td>Requires investigation at Yaskawa. Contact your Yaskawa representative, stating the alarm number, decimal data, and the macro command where the error occurred.</td>
</tr>
</tbody>
</table>
## Sensor Parameters (SxE)

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Initial Value</th>
<th>Setting Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reserved for system</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Real-time data delay time (*when using MOTOMAN-UP6) [ms]</td>
<td>*286</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Updated angle for seam frame reference [0.01 deg.]</td>
<td>6000</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Updated distance for seam frame reference [µm]</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Average number of travels for stabilizing workpiece direction vector [number of travels]</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Maximum correction distance [µm]</td>
<td>5000</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Buffer size for judging OK and NG [amount of memory]</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>OK judging level [%]</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>NG judging level [%]</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Pixel → µm conversion [conversion constant]</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Sampling minimum cycle [ms]</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Sampling minimum interval [mm]</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Number of stop-search sampling times [number of times]</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>conversion constant for target position offset (0:default)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Analog output channel for gap adaptation function</td>
<td>1</td>
<td>1 to 12</td>
</tr>
<tr>
<td>41</td>
<td>Analog output channel for gap adaptation function</td>
<td>2</td>
<td>1 to 12</td>
</tr>
<tr>
<td>42</td>
<td>Analog output channel for gap adaptation function</td>
<td>3</td>
<td>1 to 12</td>
</tr>
<tr>
<td>43</td>
<td>Analog output channel for gap adaptation function</td>
<td>4</td>
<td>1 to 12</td>
</tr>
<tr>
<td>44</td>
<td>Min. of speed ratio for gap adaptation function [0.01%]</td>
<td>0</td>
<td>0 to 20000</td>
</tr>
<tr>
<td>51</td>
<td>Reserved for system</td>
<td>0</td>
<td>Do not change.</td>
</tr>
<tr>
<td>58</td>
<td>Reserved for system</td>
<td>20</td>
<td>Do not change.</td>
</tr>
</tbody>
</table>

*Note: Certain parameters are reserved for system use and should not be changed.*
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Initial Value</th>
<th>Setting Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>Reserved for system</td>
<td>0</td>
<td>Do not change.</td>
</tr>
<tr>
<td>61</td>
<td>Reserved for system</td>
<td>100</td>
<td>Do not change.</td>
</tr>
<tr>
<td>62</td>
<td>Reserved for system</td>
<td>20</td>
<td>Do not change.</td>
</tr>
<tr>
<td>63</td>
<td>Reserved for system</td>
<td>***</td>
<td>Do not change.</td>
</tr>
<tr>
<td>64</td>
<td>Reserved for system</td>
<td>***</td>
<td>Do not change.</td>
</tr>
<tr>
<td>170</td>
<td>Reserved for system</td>
<td>1</td>
<td>Do not change.</td>
</tr>
<tr>
<td>171</td>
<td>Reserved for system</td>
<td>8</td>
<td>Do not change.</td>
</tr>
<tr>
<td>172</td>
<td>Reserved for system</td>
<td>0</td>
<td>Do not change.</td>
</tr>
<tr>
<td>173</td>
<td>Reserved for system</td>
<td>2</td>
<td>Do not change.</td>
</tr>
<tr>
<td>174</td>
<td>Reserved for system</td>
<td>7</td>
<td>Do not change.</td>
</tr>
<tr>
<td>175</td>
<td>Reserved for system</td>
<td>1000</td>
<td>Do not change.</td>
</tr>
<tr>
<td>179</td>
<td>FC1 SCU channel</td>
<td>1</td>
<td>Do not change.</td>
</tr>
<tr>
<td>180</td>
<td>FC1 character length</td>
<td>8</td>
<td>Do not change.</td>
</tr>
<tr>
<td>181</td>
<td>FC1 stop bit</td>
<td>0</td>
<td>Do not change.</td>
</tr>
<tr>
<td>182</td>
<td>FC1 parity</td>
<td>0</td>
<td>Do not change.</td>
</tr>
<tr>
<td>183</td>
<td>FC1 baud rate</td>
<td>8</td>
<td>Do not change.</td>
</tr>
<tr>
<td>185</td>
<td>FC1 response waiting time</td>
<td>1000</td>
<td>Do not change.</td>
</tr>
<tr>
<td>190</td>
<td>Reserved for system</td>
<td>0</td>
<td>Do not change.</td>
</tr>
<tr>
<td>191</td>
<td>Reserved for system</td>
<td>***</td>
<td>Do not change.</td>
</tr>
<tr>
<td>199</td>
<td>Monitor display mode (0: Normal, 1: Transmission trigger for Tracking process data)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
15 WinUser: Application Software

15.1 Hardware Requirements

Win User, the application software used with the laser-tracking function, requires the following system configuration:

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU Processor</td>
<td>Pentium MMX-233 MHz (Pentium II-400 MHz recommended)</td>
</tr>
<tr>
<td>Memory (RAM)</td>
<td>32 MB or more (64 MB recommended)</td>
</tr>
<tr>
<td>Operating system (OS)</td>
<td>Windows 95/98 (Windows NT4.0 recommended)</td>
</tr>
<tr>
<td>Video card</td>
<td>Video card with 2 MB memory or more</td>
</tr>
<tr>
<td></td>
<td>Video card with 4 MB memory recommended</td>
</tr>
<tr>
<td>Hard disk</td>
<td>20 MB of free hard disk space</td>
</tr>
<tr>
<td>Pointing device</td>
<td>Mouse (Microsoft-compatible mouse)</td>
</tr>
<tr>
<td>CD-ROM drive</td>
<td>Required at installation</td>
</tr>
<tr>
<td>Serial port</td>
<td>One or more RS-232C serial ports</td>
</tr>
<tr>
<td></td>
<td>Required for communications with the SMART-BOX</td>
</tr>
</tbody>
</table>
15.2 Installation

The following procedure describes how to install the WinUser.

1. Start up your personal computer (PC).
2. Insert the WinUser CD-ROM in the PC's CD-ROM drive.
3. In My Computer, click the WinUser icon. Then, click the Setup icon.
4. To install WinUser, follow the on-screen messages.
5. When the Setup Complete dialog box appears, the installation has been successfully completed. Click [Finish].
15.3 Operation Method

15.3.1 Adjustment of Laser Vision Sensor

Adjust the image processing and the sensor camera so that the joint on the workpiece can be detected by the laser vision system. Follow these steps to make adjustments.

1. Run WinUser.
2. Open the LASER SENSOR MONITOR display to shine the laser beam.
3. Move the manipulator so that the laser beam shines on the joint of the workpiece.
4. Adjust the laser vision sensor in VISUS, the image processing software.
5. Adjust the camera.

End
15.3 Operation Method

15.3.2 Running WinUser

The following procedure describes how to run WinUser.

1. Start up the PC.
2. Click the “Start” button, point to “Programs,” and then click “WinUser” to run WinUser.
15.3.3 Shining the Laser Beam

**Operation**

Select {OPTION} under the top menu ➡ Select {LASER SENSOR MONITOR} *1

**Explanation**

*1  The LASER SENSOR MONITOR display appears.

15.3.4 Settings for the Image-processing Software: VISUS

The following procedure describes how to make the settings for the image-processing software, VISUS.

1. Click [VISUS] on the menu bar, and click the joint to be examined.
15.3 Operation Method

The dialog box for setting the image processing parameters for the selected joint appears.

2. Set each item to an appropriate value.
3. When all the parameters are set, click [OK].

Refer to the “VISUS Image Processing Software Module User’s Manual,” which was provided with the laser vision system manufactured by ServoRobot Inc., for the descriptions and settings of each parameter.

15.3.5 Settings for Camera

The following procedure describes how to set the camera.

1. Click [Camera] on the menu bar, point to [Camera Settings], and then click [Video Settings].
The Video Settings dialog box appears.

2. Set each item to an appropriate value.
   - Yaskawa recommends setting the video gain to “Low,” and the dynamic gain to “Normal.”
   - Use the filter if the profile image (the joint form indicated by yellow lines) is not clear. If not using the filter, select “None.”
   - Yaskawa recommends filter sizes 3 to 7.
3. When all the parameters are set, click [OK].

Refer to the “Camera Menu Commands” of “WinUser - Help” manual, which was provided with the laser vision system manufactured by ServoRobot Inc., for the descriptions and settings of each parameter for the camera.
15.3.6 Registration of Settings to Joint File

When the settings for VISUS and the camera have been completed, the settings must be saved in a joint file. The following procedure describes how to register the settings in the joint file.

1. Click [Settings Library], and the Settings Library dialog box appears.
   - The tree display of the joint files that are registered appears under the Joint Library.
   - Joint files can be registered until the size of the flash memory that is displayed on the right reaches 100 percent.

2. Right-click the name of the joint file to be registered.
3. Click [Define Joint].

The lamp for [Modified] is lit in yellow.

4. Click [Save to Flash].

Refer to the “Library Setting Menu Commands” of “WinUser - Help” manual, which is provided with the laser vision system manufactured by ServoRobot Inc., for details of the joint library.
15.3.7 Settings for Manipulator

The following procedure describes how to make the settings for the manipulator.

1. Click [Robot] on the menu bar, and click [Robot Settings].

   The Robot Settings dialog box appears.

2. Confirm that all the parameters have set to the settings shown in this figure.

   Refer to the “Robot Menu Commands” of “WinUser - Help” manual, which is provided with the laser vision system manufactured by ServoRobot Inc., for the descriptions of each parameter for the manipulator.
NX100
INSTRUCTIONS
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