YRC1000 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
YRC1000 INSTRUCTIONS
YRC1000 OPERATOR’S MANUAL (GENERAL) (SUBJECT SPECIFIC)
YRC1000 MAINTENANCE MANUAL
YRC1000 ALARM CODES (MAJOR ALARMS) (MINOR ALARMS)

The YRC1000 operator’s manual above corresponds to specific usage. Be sure to use the appropriate manual.
The YRC1000 operator’s manual above consists of “GENERAL” and “SUBJECT SPECIFIC”.
The YRC1000 alarm codes above consists of “MAJOR ALARMS” and “MINOR ALARMS”.

Please have the following information available when contacting Yaskawa Customer Support:

- System
- Primary Application
- Software Version (Located on Programming Pendant by selecting: [Main Menu] - [System Info] - [Version])
- Robot Serial Number (Located on robot data plate)
- Robot Sales Order Number (Located on controller data plate)

Part Number: 188394-1CD
Revision: 0
This manual explains the LASER-Tracking function: MOTOEYE-LT of the YRC1000 system. Read this manual carefully and be sure to understand its contents before handling the YRC1000. Any matter, including operation, usage, measures, and an item to use, not described in this manual must be regarded as "prohibited" or "improper".

General information related to safety are described in "Chapter 1. Safety" of the YRC1000 INSTRUCTIONS. To ensure correct and safe operation, carefully read "Chapter 1. Safety" of the YRC1000 INSTRUCTIONS.

In some drawings in this manual, protective covers or shields are removed to show details. Make sure that all the covers or shields are installed in place before operating this product.

YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids the product warranty.

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.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the YRC1000.

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

- **DANGER**: Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Safety Signs identified by the signal word DANGER should be used sparingly and only for those situations presenting the most serious hazards.

- **WARNING**: Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury. Hazards identified by the signal word WARNING present a lesser degree of risk of injury or death than those identified by the signal word DANGER.

- **CAUTION**: Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. It may also be used without the safety alert symbol as an alternative to “NOTICE”.

- **NOTICE**: NOTICE is the preferred signal word to address practices not related to personal injury. The safety alert symbol should not be used with this signal word. As an alternative to “NOTICE”, the word “CAUTION” without the safety alert symbol may be used to indicate a message not related to personal injury.

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 “DANGER”, “WARNING” and “CAUTION”.

iii
DANGER

- Before operating the manipulator, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.
  - Press the emergency stop buttons on the front door of the YRC1000, on the programming pendant, on the external control device, etc.
  - Disconnect the safety plug of the safety fence.
    (when in the play mode or in the remote mode)

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

*Fig.: Emergency Stop Button*

- Before releasing the emergency stop, make sure to remove the obstacle or error caused the emergency stop, if any, and then turn the servo power ON.

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

*Fig.: Release of Emergency Stop*

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

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

- Confirm that no person is present in the manipulator's operating range and that the operator is in a safe location before:
  - Turning ON the YRC1000 power
  - Moving the manipulator by using the programming pendant
  - Running the system in the check mode
  - Performing automatic operations

Personal injury may result if a person enters the manipulator's operating range during operation. Immediately press an emergency stop button whenever there is a
The emergency stop buttons are located on the front panel of the YRC1000 and on the right of the programming pendant.

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

---

**DANGER**

![Lasersafety labels](image)

Fig. Labels of laser sensor: PowerCam manufactured by ServoRobot Inc.

- The information such as a class and the wavelength of the laser is written in the manual of a label such as the above affixed to a laser sensor and the laser sensor. Confirm operational instructions of the manuals of the laser sensor which a sensor maker publishes well, and, use it.

- Do not directly look at the laser beam emitted from the laser sensor.

- When the laser beam is emitted from the laser sensor onto a mirror-like surface with a high reflection ratio, such as a stainless surface or other shiny surfaces, be careful that the reflected laser beam does not make direct contact with the eyes.

- YRC1000 MOTOEYE-LT function uses the laser sensor emitting laser beam. The laser beam emitted from the laser has a high power density, and could harm the human body even in small amounts. In Japan, in order to prevent injuries to operators of the laser products, guidelines based on the standard of International Electrotechnical Commission (IEC), “Safety of laser products” JIS C 6802 is...
specified. In JIS C 6802, the laser products are classified according to its risk evaluation and the safety actions required are specified for each class.

The outline of the classification is as follows.
For example, PowerCam manufactured by ServoRobot Inc. corresponds to class3B. Refer to the standard text and the laser sensor manual for the details.

<table>
<thead>
<tr>
<th>Class</th>
<th>Outline of risk evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class1</td>
<td>Essentially safe in design</td>
</tr>
<tr>
<td>Class1M</td>
<td>Low output (wavelength: 302.5 to 4000 nm) Safe under certain conditions, including visual contact with the inside of the beam. Observation of the inside of the beam with optical manners may pose a risk.</td>
</tr>
<tr>
<td>Class2</td>
<td>Visible laser and low output (wavelength: 400 to 700 nm) Eyes are protected by blink reflex, including direct visual contact with the inside of the beam.</td>
</tr>
<tr>
<td>Class2M</td>
<td>Visible laser and low output (wavelength: 400 to 700 nm) Eyes are protected by blink reflex. Visual contact with inside of the beam with optical manners may pose a risk.</td>
</tr>
<tr>
<td>Class3R</td>
<td>In the visible laser, output is five times or less than that of Class 2 (wavelength: 400 to 700 nm). In the laser except for the visible laser, output is five times or less than that of Class 1 (wavelength: 302.5 nm or longer). The direct visual contact with the inside of the beam may pose a risk.</td>
</tr>
<tr>
<td>Class3B</td>
<td>0.5 W or smaller output. Direct visual contact with the inside of the beam poses a risk. However, observation of pulse laser which does not connect focused points with scattered reflection is safe and it can be safely observed under certain conditions.</td>
</tr>
<tr>
<td>Class4</td>
<td>High output. Danger, scattered reflections may result. These can cause skin injuries and may cause fires.</td>
</tr>
</tbody>
</table>
WARNING

- Perform the following inspection procedures prior to conducting manipulator teaching. If there is any problem, immediately take necessary steps to solve it, such as maintenance and repair.
  - Check for a problem in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the YRC1000 cabinet after use.

If the programming pendant is left unattended on the manipulator, on a fixture, or on the floor, etc., the Enable Switch may be activated due to surface irregularities of where it is left, and the servo power may be turned ON. In addition, in case the operation of the manipulator starts, the manipulator or the tool may hit the programming pendant left unattended, which may result in personal injury and/or equipment damage.

Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.
The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and the manipulator cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>YRC1000 controller</td>
<td>YRC1000</td>
</tr>
<tr>
<td>YRC1000 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant</td>
<td><strong>Character Keys</strong> and <strong>Symbol Keys</strong> are denoted with [ ].</td>
</tr>
<tr>
<td></td>
<td>ex. [ENTER]</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 simultaneously</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>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</td>
</tr>
</tbody>
</table>

**Description of the Operation Procedure**

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

**Registered Trademark**

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or brand names for each company or corporation. The indications of (R) and ™ are omitted.
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1. Laser-tracking Function

The laser-tracking function uses a laser sensor manufactured by ServoRobot, Inc. and is the YRC1000 option. 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

Fig 1-1 Laser Sensor Camera Appearance
Laser-tracking Function

1.1 Functions

Fig 1-2 System Structure

Table 1-1 Parts List

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Power Cam (Laser sensor camera)</td>
<td>Purchased from ServoRobot Inc.</td>
</tr>
<tr>
<td>②</td>
<td>Power Box (image processing system)</td>
<td>Include in ①</td>
</tr>
<tr>
<td>③</td>
<td>Camera cable (5 m)</td>
<td>Include in ①</td>
</tr>
<tr>
<td>④</td>
<td>Cooling air unit (with a 5 m control signal cable)</td>
<td>Purchased from ServoRobot Inc. (option)</td>
</tr>
<tr>
<td>⑤</td>
<td>Fume purge air</td>
<td>Purchased from ServoRobot Inc. (option)</td>
</tr>
<tr>
<td>⑥</td>
<td>Cooling air (in-flow and out-flow air)</td>
<td>Include in ⑤</td>
</tr>
<tr>
<td>⑦</td>
<td>Air filter unit (oil, dry, regulator)</td>
<td>Purchased from ServoRobot Inc. (option)</td>
</tr>
<tr>
<td>⑧</td>
<td>LAN cable between personal computer from monitor and the Power-BOX (5m)</td>
<td>Include in ①</td>
</tr>
<tr>
<td>⑨</td>
<td>LAN cable between the YRC1000 and the Power-BOX (5 m)</td>
<td>Include in ①</td>
</tr>
<tr>
<td>⑩</td>
<td>Sensor monitor application WeldCom</td>
<td>Include in ① (the customer prepares a personal computer)</td>
</tr>
<tr>
<td></td>
<td>Insulation support</td>
<td>Purchased from ServoRobot Inc.</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>⑫</td>
<td>Sensor clamp</td>
<td><strong>Needed to be designed and manufactured</strong></td>
</tr>
<tr>
<td></td>
<td>Software dedicated for YRC1000 MOTOEYE-LT</td>
<td>Arranged by Yaskawa (YRC1000 is set up)</td>
</tr>
<tr>
<td></td>
<td>Macro job for YRC1000 MOTOEYE-LT</td>
<td>Arranged by Yaskawa (YRC1000 is set up)</td>
</tr>
</tbody>
</table>
1.1. Functions

- 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.

*Fig 1-3 Welding Line Shift by the Start Point Search Function*
### Laser-tracking Function

#### 1.1 Functions

- **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.

![Real-time Tracking Diagram](image1)

**Fig 1-4 Correction by the Real Time Tracking Function**

- **Target Position Offset**
  
  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.

![Target Position Offset Diagram](image2)

**Fig 1-5 Shifted Tracking Path by the Target Position Offset**
2. Hardware Setup

2.1. Connection of Laser Vision System

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

Before installing the laser vision system of ServoRobot Inc., thoroughly read the following manuals provided by ServoRobot Inc. and fully observe the precautions:

- Power-BOX Installation and Operation Manual (ZPBXV21106E02)
- Power-CAM Installation and Operation Manual (ZPWRCAM1003E00)
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 liters/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 Power-BOX

Connect the Power-BOX emergency stop button to robot controller emergency stop loop and safety interlock circuit for work place with automatic device.

Refer to "14.7 Safety Terminal Block Board (IM-YE250/5-80P)" in the "YRC1000 INSTRUCTIONS" (RE-CTO-A221).

Refer to "4.4.2 Emergency Stop Alarm I/O (CN2)" in the manual "Power-BOX Installation and Operation Manual {ZPBXV21106E02}" provided with the laser vision system of ServoRobot Inc.
3. Start-up

3.1. Start-up of the Power-BOX

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

1: Turn ON the power switch ① in the following diagram.

=> The power lamp ② illuminates and the system status lamp ⑤ starts flashing.

=> After approximately one minute, the system status lamp ⑤ changes from flashing to illumination.

2: Turn ON the laser enable key switch ③.

=> The laser ON lamp ④ illuminates.

=> After two or three seconds, a laser beam is emitted from the laser sensor camera Power-CAM.

3.2. Start-up of the YRC1000

To start up YRC1000, turn ON the main power supply of the YRC1000.

=> When the YRC1000 properly starts up, the laser beam automatically goes out. (The laser ON lamp ④ does not go out.)
3.3. Start-up of the WeldCom

WeldCom is an application software for the personal computer. WeldCom is used for Ethernet communication with the Power-BOX, the settings for image processing, and the monitoring of the detected status. Though WELDCOM does not start up, the manipulator tracking operates properly.

The following procedure describes how to start up WeldCom:

Start up the personal computer where WeldCom is installed.

Fig 3-2 Laser Vision System Connection Diagram
4. Settings for Sensor Parameters and Job Files

4.1. Sensor Parameters

- Minimum interval for sampling

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 “look ahead”.

The minimum interval for sampling can be calculated from this “look ahead” by the following formula.

When "Look ahead" is \( L \) [mm] and the minimum interval for sampling is \( I \) [μm]:

\[
I = (12 \times L) \text{ [μm]} \quad \text{(Example: When } L \text{ is } 40 \text{ [mm], } I = 12 \times 40 = 480 \text{ [μm]})
\]

Fig 4-1 Sensor Camera Mounting and Look ahead
2. Determine the value to be entered as a sensor parameter from the obtained minimum interval for sampling, and enter the value.

<table>
<thead>
<tr>
<th>Calculated Minimum Interval [μm]</th>
<th>0 to 1000</th>
<th>1001 to 2000</th>
<th>2001 to 4000</th>
<th>4001 or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>S5E32</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
<td>5000</td>
</tr>
</tbody>
</table>

### 4.2. Required Application Job Files

Confirm that the following macro job files are registered in the Robot Controller.

* Set the security mode of the YRC1000 to “Management mode”.
* If any job is missing, load the job from the CD-ROM “YRC1000 MOTOEYE-LT” provided with the YRC1000 to the SD card or USB memory storage, and then load the job to the YRC1000.

#### 4.2.1. Macro Job

<table>
<thead>
<tr>
<th>Macro Job Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LTCLIB.JBI</td>
<td>Used in the laser sensor calibration job for the calibration detection and calculation processing.</td>
</tr>
<tr>
<td>LTSRCH2.JBI</td>
<td>Obtains the detection point from the joint form by sensing.</td>
</tr>
<tr>
<td>LTSFT2.JBI</td>
<td>Carries out the parallel shift with the difference between the detection point obtained by the start point search and the taught welding start point. When the shift amount is outside of the allowable range, it is judged NG.</td>
</tr>
<tr>
<td>LTRCKON.JBI</td>
<td>Used in the tracking job to start the tracking correction processing.</td>
</tr>
<tr>
<td>LTRCKON2.JBI</td>
<td>During tracking, outputs step amount to set registers.</td>
</tr>
<tr>
<td>LTCHGJN.JBI</td>
<td>Used in the tracking job to order the sensor to change the joint file (file for the image processing parameters).</td>
</tr>
<tr>
<td>LTCHGGP.JBI</td>
<td>Used in the tracking job to change the Gap Condition File number.</td>
</tr>
<tr>
<td>LTEDSRCH.JBI</td>
<td>Starts the end point search. The end point search is a function to end the tracking by recognizing the last detection point as the end point of the welding line when the laser sensor continuously detects no points during the tracking.</td>
</tr>
<tr>
<td>LTRCKOF.JBI</td>
<td>Used in the tracking job to end the tracking correction processing.</td>
</tr>
</tbody>
</table>
### 4.2.2. Job

#### Table 4-3 Job List

<table>
<thead>
<tr>
<th>Job File</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 and end point search</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>
5. Laser Sensor Calibration

The data obtained by the laser vision sensor is sent to the YRC1000 as data for a three-dimensional position in the camera coordinate system of the camera. The YRC1000 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.

![Diagram of Tool Coordinate System and Camera Coordinate System]

**Fig 5-1 Tool Coordinate System and Camera Coordinate System**

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.
5.2. Tool Calibration for Reference Tool

- Refer to "Tool Dimensions" and "Tool Calibration" of “YRC1000 INSTRUCTIONS" for the information about how to calibrate the tool.

![Diagram of Arc Welding Torch Tool Coordinate System](image)

*Fig 5-2 Arc Welding Torch Tool Coordinate System*

**<Tool Posture>**

The amount of the targeted offset used for correction is adjusted with 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.
5.3. Sensor Camera’s Mounting Position

The following procedure describes how to position the sensor camera. Adjust the mounting position of the camera so that the joint of the workpiece can be detected at the center of the sensor’s field of vision when the processing posture is taken for the target workpiece.

1. Shine the laser beam.
   - Laser turn ON: Push both the Key [inter lock] and Key [5] of the programming pendant.
   - Laser turn OFF: Push both the Key [inter lock] and Key [5] of the programming pendant again.

2. Connect the personal computer to the Power-BOX, and start up WeldCom to display the graphic display.

3. 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.

Fig 5-3 Sensor Camera Mounting

Distance: 20 mm to 100 mm (40 mm: standard)
(Consider the disturbances caused by the tool interference, welding line curvature, weld fumes, and splatters when adjusting the distance.)
For the sensor camera position adjustment, set the WELDCOM graphic display so that it will be at full range, with the horizontal and vertical scale size of 1:1. Click the icon for the display setting. Select “FOV Auto Zoom”.

Fig 5-4 WeldCom Graphic Display

Fig 5-5 FOV Auto Zoom Selection

<Graphic Display Adjustment>
5.4. Sensor Adjustment

The laser vision sensor can be adjusted to detect the target position on the lap joint of the workpiece.

- Using WeldCom, adjust the Recognition Algorithm for the Power-BOX as shown in the following illustration. (Refer to WeldCom manual of ServoRobot Inc.)

![Sensor Camera Position Adjustment](image)

**Fig 5-6 Sensor Camera Position Adjustment**

![Recognition Algorithm Adjustment](image)

**Fig 5-7 Recognition Algorithm Adjustment**
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].

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

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
</tr>
<tr>
<td>J:LT-CALIB</td>
</tr>
<tr>
<td>J:LT-CALIB</td>
</tr>
<tr>
<td>CONTROL GROUP: R1</td>
</tr>
<tr>
<td>CONTROL GROUP: R1</td>
</tr>
</tbody>
</table>
| 0003"="_into_LTCLIB_inst.=========
0004"="______________________
0005 LTCLIB LT:40 LTC:0 flgB:2
0006"<IF_stop_at_PAUSE, calib_was_NG>
0007 PAUSE IF B002=0
0008 END |

The job number is highlighted by being shown in reverse.

<table>
<thead>
<tr>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
</tr>
<tr>
<td>J:LT-CALIB</td>
</tr>
<tr>
<td>J:LT-CALIB</td>
</tr>
<tr>
<td>CONTROL GROUP: R1</td>
</tr>
<tr>
<td>CONTROL GROUP: R1</td>
</tr>
</tbody>
</table>
| 0003"="_into_LTCLIB_inst.=========
0004"="______________________
0005 LTCLIB LT:40 LTC:0 flgB:2
0006"<IF_stop_at_PAUSE, calib_was_NG>
0007 PAUSE IF B002=0
0008 END |

The “LTCLIB LT:40 LTC:0 flgB:2” is highlighted by being shown in reverse.
Press [SELECT].

The contents of the display change.

Press [SELECT].

The ARGUMENT SETTING display appears.

<table>
<thead>
<tr>
<th>LT-CALIB Macro Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item</strong></td>
</tr>
<tr>
<td>LT FUNC. FILE#</td>
</tr>
<tr>
<td>CALIB. FILE</td>
</tr>
</tbody>
</table>
5.5.2. Teaching of Tool Reference Points (TOOL REFP.)

- The following procedure describes how to teach the tool reference points.
- Move the end of the tool to the end of the marked line on the lap join, and register it.

* 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].)
### Operation

<table>
<thead>
<tr>
<th>手順</th>
<th>解説</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move the cursor to (UNREGIST) of TOOL REFP. Press [MODIFY] and [ENTER]. (Displayed with (REGIST) if registered.)</td>
<td><img src="image" alt="ARGUMENT SETTING" /></td>
</tr>
<tr>
<td>Press [ENTER].</td>
<td><img src="image" alt="JOB CONTENT" /></td>
</tr>
</tbody>
</table>

The position has been registered. The manipulator's current position is the same as the registered position. (REGIST) stops flashing.

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

LTCLIB LT:40 LTC:0 f1&B:2
Press [ENTER] again.

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

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 (sensing#1 REFP.)

The following procedure describes how to teach the calibration reference point 1. Shine the laser beam on the workpiece.

- Laser turn ON: Push both the Key [inter lock] and Key [5]. (Laser turn OFF: Push both the Key [inter lock] and Key [5] again.)
- Weaken the laser beam power with WeldCom.

**DANGER**

During the calibration reference position teaching, it is necessary to visually check the scattered light (laser shined on the workpiece) of the laser beam. When the reflection ratio on the surface of the workpiece is high (mirror-like surface such as stainless workpiece), wear laser protection glasses. The mirror-like surface workpiece has a high laser power in the scattered light, and this may cause damages to the retina.
# WeldCom Operation: Laser Power Adjustment

<table>
<thead>
<tr>
<th>Operation</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press icon to display the TASK BAR.</td>
<td>The TASK BAR is displayed.</td>
</tr>
<tr>
<td>Press icon to display the Task edit screen.</td>
<td>The submenu to edit is displayed.</td>
</tr>
<tr>
<td>Press icon to display the laser power adjustment screen.</td>
<td>The laser power adjustment screen is displayed.</td>
</tr>
</tbody>
</table>

1. Press icon to display the TASK BAR.
2. Press icon to display the Task edit screen.
3. Press icon to display the laser power adjustment screen.
After changing the control to [Manual], adjust the Manual Power to approximately 5%.

The laser beam becomes sharp and not bright.

To return the laser power to the original state after the teaching, press the icon. The laser beam becomes bright again.
2. Register the position shown in the following figure as the calibration reference point 1. (sensing#1 REFP.)

- Move the manipulator so that the laser beam passes through the edge of the marked line of the lap joint, and then register the manipulator's position.
5.5.4. Teaching of Calibration Reference Point 2 (sensing#2 REFP.)

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

1. Shine the laser beam on the workpiece.

2. Using the following procedure, register the position shown in the figure below as calibration reference point 2.

   • Move the camera downward so that the laser beam of the WELDCOM graphic display can be viewed in the upper part of the vision. ①
   • Move the manipulator so that the laser beam detects the end of the marked line. ②
   • Open the ARGUMENT SETTING display to register the manipulator's position for calibration reference point 2.

Fig 5-12 Teaching Point of Calibration Reference Point 2

ARGUMENT SETTING
JOB NAME : LTCLIB

<table>
<thead>
<tr>
<th>COMMENT</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT FUNC. FILE</td>
<td>40</td>
</tr>
<tr>
<td>CALIB. FILE</td>
<td>0</td>
</tr>
<tr>
<td>TOOL REFP.</td>
<td>REGIST</td>
</tr>
<tr>
<td>sensing#1 REFP.</td>
<td>REGIST</td>
</tr>
<tr>
<td>sensing#2 REFP.</td>
<td>REGIST</td>
</tr>
<tr>
<td>sensing#3 REFP.</td>
<td>UNREGIST</td>
</tr>
<tr>
<td>sensing#4 REFP.</td>
<td>UNREGIST</td>
</tr>
<tr>
<td>ESCAPE REFP.</td>
<td>UNREGIST</td>
</tr>
<tr>
<td>RESULT FLAG</td>
<td>2</td>
</tr>
</tbody>
</table>

Fig 5-13 Calibration Reference Point 2
Graphic Display (upper part)

Fig 5-14 Calibration Reference Point 2
Registration
5.5.5. **Teaching of Calibration Reference Point 3 (sensing#3 REFP.)**

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

1. 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.
   - Move the camera up so that the laser beam of the graphic display can be viewed in the bottom of the vision. ①
   - Move the camera in a traverse direction so that the target position is viewed in the lower left of the graphic display. ②
   - Move the camera so that the laser beam detects the end of the marked line. ③
   - Open the ARGUMENT SETTING display to register the manipulator’s position for calibration reference point 3.

![Fig 5-15 Teaching Point of Calibration Reference Point 3](image1)

![Fig 5-16 Calibration Reference Point 3 Registration](image2)
5.5.6. **Teaching of Calibration Reference Point 4 (sensing#4 REFP.)**

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

1. Shine the laser beam on the workpiece.
2. Using the following procedure, register the position shown in the figure below as calibration reference point 4.
   - Move the camera in a traverse direction so that the target position can be viewed in the lower right of the graphic display.
   - Move the camera so that the laser beam detects on the end of the marked line.
   - Open the ARGUMENT SETTING display to register the manipulator's position for calibration reference point 4.

![Diagram](image)

*Fig 5-18 Teaching Point of Calibration Reference Point 4*

![Diagram](image)

*Fig 5-19 Calibration Reference Point 4 Registration*

*Fig 5-20 Calibration Reference Point 3 Graphic Display (lower right)*
5.5.7. Teaching of Escape Position (ESCAPE REFP.)

1. Register the position shown in the figure below as the escape position (ESCAPE REFP.).

- 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.
- To register the manipulator’s position as the escape position, open the ARGUMENT SETTING display.

![Fig 5-21 Teaching Point of Escape Position](image)

![ARGUMENT SETTING](image)

**Fig 5-22 Escape Position Registration**
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 YRC1000 to the play mode.
2. Press [START] to execute the calibration job.

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 the 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 WELDCOM graphic display of the 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 detections 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 the personal computer.
   - (3) Check 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)
5.6.3. **Confirmation of the Calibration Data**

Can confirm the calibration data when the calibration has been successfully completed.

- **Confirmation way**

Select 「OPTION」→「LASER SENSOR CALIB」

```
<table>
<thead>
<tr>
<th>LASER SENSOR CALIB</th>
<th>CALIBRATION FILE NO.</th>
<th>SENSOR</th>
<th>SLT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALIBRATION DATA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>4.756 mn</td>
<td>Rx -179.037  deg.</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>-73.475 mn</td>
<td>Ry -18.5594 deg.</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>-114.950 mn</td>
<td>Rz -85.4009 deg.</td>
<td></td>
</tr>
<tr>
<td>CALIBRATION ACCURACY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>-0.085 mn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>-0.096 mn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>0.284 mn</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

*Fig 5-23 LASER SENSOR CALIB display*

**NOTE**

When a value of the calibration precision of the LASER SENSOR CALIB display is worse than tracking precision to expect, tracking precision to expect may not appear.

Review instruction position (TOOL RESP. sensing#1 - 4 RESP.) and the tool file and recommend to calibrate it again.
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.
6.1.1. Tracking of Sample Job "SMPL0"

Teach the points 1 to 6 as shown in the following diagram.

Teach the approach point 1 so that the laser beam is shown 5 mm to 10 mm before the start point of the welding.

Teach the end point of the welding 4: 20 mm to 30 mm away from the actual end point of the welding of the reference workpiece.

Fig 6-1 Teaching Points of Job "SMPL0"
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 YRC1000 starts the laser 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
MOVJ VJ=10.0
END
```

### Arguments

<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 B099</td>
<td>B variable number to specify whether to carry out or skip the macro command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excluding B030</td>
<td>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 the tracking.</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.</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>Teach the start point of the welding of 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 YRC1000 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
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>①LT MODE(B Var.)</td>
<td>B000</td>
<td>B000 to B099</td>
<td>B variable number to specify whether to carry out or skip the macro command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excluding</td>
<td>1: Carries out the macro command</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B030</td>
<td>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 the search for the end point of the welding.</td>
</tr>
</tbody>
</table>

Arguments

- **LT MODE** (B Var.)
  - **Initial Value**: B000
  - **Setting Range**: B000 to B099
  - **Remarks**: 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

- **LT FUNC. FILE#**
  - **Initial Value**: 1
  - **Setting Range**: 1 to 40
  - **Remarks**: Specifies the tracking function file to be used for the search for the end point of the welding.
6.1.3. Settings for the Laser-tracking Function File

Refer to chapter "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.

6.2.1. Teaching of Sample Job "SMPL1"

<table>
<thead>
<tr>
<th>NOP</th>
<th>Approach point</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFTOF</td>
<td>If there is no risk of interference, assign the same point as the start point of the search.</td>
</tr>
<tr>
<td>SFTOF3D</td>
<td></td>
</tr>
<tr>
<td>'← TL mode [B000]</td>
<td></td>
</tr>
<tr>
<td>'→ 0: W/O TRACKING, 1: TRACKING</td>
<td></td>
</tr>
<tr>
<td>SET B000 1</td>
<td></td>
</tr>
<tr>
<td>SPEED V=18.7</td>
<td></td>
</tr>
<tr>
<td>MOVL V=500</td>
<td></td>
</tr>
<tr>
<td>MOVL V=500</td>
<td></td>
</tr>
<tr>
<td>*retry</td>
<td></td>
</tr>
<tr>
<td>LTSRCH SW=B000 LT:1 V=80 snsP:10 ⋯ ⋯</td>
<td></td>
</tr>
<tr>
<td>JUMP *retry IF B002=0</td>
<td></td>
</tr>
<tr>
<td>LTSFT SW=B000 sns=P010 flgB:2 ⋯ ⋯</td>
<td></td>
</tr>
<tr>
<td>PAUSE IF B002=0</td>
<td></td>
</tr>
<tr>
<td>LTRCKON SW=B000 LT:1 V=100 ⋯ ⋯</td>
<td></td>
</tr>
<tr>
<td>'arcon</td>
<td></td>
</tr>
<tr>
<td>MOVL</td>
<td></td>
</tr>
<tr>
<td>LTEDSRCH SW=B000 LT:1</td>
<td></td>
</tr>
<tr>
<td>MOVL</td>
<td></td>
</tr>
<tr>
<td>'arcof</td>
<td></td>
</tr>
<tr>
<td>LTRCKOF SW=B000</td>
<td></td>
</tr>
<tr>
<td>MOVL V=500</td>
<td></td>
</tr>
<tr>
<td>MOVJ VJ=10.0</td>
<td></td>
</tr>
<tr>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

© 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".

© 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".

© 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".

© Start point of the welding
Teach the start point of the welding and register it as an argument of the macro command, "LTRCKON".

© 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".

© 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.

© 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.

Fig 6-2 Teaching Points of Job "SMPL1"
6.2.2. Settings for Macro Commands

**LTSRCH2**

The LTSRCH2 command starts the search for the start point of the welding.

```plaintext
LTSRCH2 SW=B000 LT:39 V=50 snsP:10 figB:2 GAP:10
```

### Arguments

<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 B099</td>
<td>B variable number to specify whether to carry out or skip the macro command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excluding B030</td>
<td>1: Carries out the macro command</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>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 SEACH START REF</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>The point to end the search.</td>
</tr>
<tr>
<td>④ SEACH END REFP.</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>The point to end the search.</td>
</tr>
<tr>
<td>⑤ SEACH SPEED</td>
<td>50</td>
<td>20 to 80</td>
<td>The motion speed during the search.</td>
</tr>
<tr>
<td>⑥ 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.</td>
</tr>
</tbody>
</table>
6.2 Tracking with a Welding-start-point Search

The LTSFT2 command calculates the amount of parallel shift based on the detected point obtained by the welding-start-point search and the start point of the welding taught in the LTSFT2 command, and then carries out a parallel shift.

<table>
<thead>
<tr>
<th>Settings for Tracking Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2 Tracking with a Welding-start-point Search</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SEARCH RESULT (B#)</th>
<th>2</th>
<th>0 to 99 Excluding 30</th>
<th>Specifies the B variable number to save the search results. 1: Detected 0: Not detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAP MOUNT(R#)</td>
<td>0</td>
<td>0 to 99</td>
<td>Specifies the R variable number to save the GAP mount</td>
</tr>
</tbody>
</table>

LTSFT2

The LTSFT2 command calculates the amount of parallel shift based on the detected point obtained by the welding-start-point search and the start point of the welding taught in the LTSFT2 command, and then carries out a parallel shift.

<table>
<thead>
<tr>
<th>ARGUMENT SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOB NAME : LTSFT2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMAND1</th>
<th>TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:LT MODE(B var.)</td>
<td>5000</td>
</tr>
<tr>
<td>2:DETECT POS.(R#)</td>
<td>P010</td>
</tr>
<tr>
<td>3:WELD START REP#</td>
<td>RESIST</td>
</tr>
<tr>
<td>4:SHIFT RESULT(R#)</td>
<td>2</td>
</tr>
<tr>
<td>5:SFT MOV.PARMTXT R</td>
<td>30</td>
</tr>
<tr>
<td>6:SHIFT MOUNT(HP)</td>
<td>11</td>
</tr>
</tbody>
</table>

N年后

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
LTSRCH2 SW=B000 LT:39 V=50 snsP:10 flgB:2 GAP:10
JUMP retry IF B002=0
LTSFT2 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50
arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
arcof
LTRACKOF 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>
<tbody>
<tr>
<td>① LT MODE(B Var.)</td>
<td>B000</td>
<td>B000 to B099 Excluding B030</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 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>③ WELD START REFP. (Teaching point)</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>Sets the same point as the start point of the welding to be used for calculating the shift amount.</td>
</tr>
<tr>
<td>④ SHIFT RESULT(B#)</td>
<td>2</td>
<td>0 to 99 Excluding 30</td>
<td>Judgment of the calculated amount of shifting. 1: Acceptable 0: Outside the allowable range</td>
</tr>
<tr>
<td>⑤ SFT MOV.PARMIT R</td>
<td>15</td>
<td>0 to</td>
<td>Allowable range of shift amount (unit: mm)</td>
</tr>
<tr>
<td>⑥ SHIFT MOUNT(#P)</td>
<td>11</td>
<td>0 to 127</td>
<td>Specifies the P variable number to save the shift amount.</td>
</tr>
</tbody>
</table>
## LTRCKON

Moving the manipulator to the start point of the welding taught in the LTRCKON command, the YRC1000 starts the laser 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
LTSRCH2 SW=B000 LT:39 V=50 snsP:10 flgB:2 GAP:10
JUMP *retry IF B002=0
LTSFT2 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50

arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
arcof
LTRACKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```

### Arguments

<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 B099 Excluding B030</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 the tracking.</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.</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>Teaches the start point of the welding of the reference workpiece.</td>
</tr>
</tbody>
</table>
The LTEDSRCH command starts the search for the end point of the welding. The search automatically ends at the last detected point when the YRC1000 recognizes the welding end in the section that was continuously undetected.

```
NOP
SFTOF
SFTOF3D
[TM mode][B000]---------------------
0:W/O TRACKING, 1:TRACKING --

SET B000 1
SPEED V=16.7
MOVL V=500
MOVL V=500
*retry
LTSRCH2 SW=B000 LT:39 V=50 snsP:10 flgB:2 GAP:10
JUMP *retry IF B002=0
LTSFT2 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50
arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
arcof
LTRACKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```

### Arguments

<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 B099</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></td>
<td></td>
<td>Excluding B030</td>
<td></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 the search for the end point of the welding.</td>
</tr>
</tbody>
</table>
6.2. Tracking with a Welding-start-point Search

■ LTRCKOF

The LTRCKOF command ends the 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
*retry
LTSRCH2 SW=B000 LT:39 V=50 snsP:10 flgB:2 GAP:10
JUMP *retry IF B002=0
LTSFT2 sns=P010 flgB:2
PAUSE IF B002=0
LTRCKON SW=B000 LT:1 V=50
'arcon
MOVL
LTEDSRCH SW=B000 LT:1
MOVL
'arcof
LTRACKOF 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 B099</td>
<td>B variable number to specify whether to carry out or skip the macro command.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Excluding B030</td>
<td>1: Carries out the macro command</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0: Skips the macro command</td>
</tr>
</tbody>
</table>

6.2.3. Settings for the Laser-tracking Function File

Refer to chapter “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
7.1. Conditions for the Laser Sensor

1. **TASK NO.**
   Selects one of the task no. stored in the POWER-BOX of the laser vision sensor. The task no. includes the conditions to specify the processing method for detection.
   - Setting range: 0 to 100
   - Initial 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
   - Initial setting: 0

3. **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
   - Initial setting: 0
7.2. Conditions for the Welding-start-point-Search

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>START POS SEARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>① SEARCH TYPE</td>
<td>STOP</td>
</tr>
<tr>
<td>② OVERLAP DISTANCE</td>
<td>0 mm</td>
</tr>
<tr>
<td>③ WELD DETECTION DISTANCE</td>
<td>10 mm</td>
</tr>
<tr>
<td>④ NON-WELD DETECTION DISTANCE</td>
<td>10 mm</td>
</tr>
</tbody>
</table>

① SEARCH TYPE
Specifies the search type.
• Setting range: NG → OK; OK → NG; STOP
• Initial setting: STOP

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.
• 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]

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

![Diagram showing the start point recognition]

② 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
• Initial setting: 0
3. WELD DETECTION DISTANCE
   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: 10

4. NON-WELD DETECTION DISTANCE
   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
   • Initial setting: 10

7.3. Conditions for the 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
   • Initial setting: 10

   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
   • Initial setting: 10
### 7.4. Conditions for Laser Tracking

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>① XYZ CORRECTION</td>
<td>Turns the output of the path correctional amount ON/OFF.</td>
</tr>
<tr>
<td></td>
<td>• Setting range: ON or OFF</td>
</tr>
<tr>
<td></td>
<td>• Initial setting: ON</td>
</tr>
<tr>
<td>② RxRyRz CORRECTION</td>
<td>For future use. Do not change the initial setting.</td>
</tr>
<tr>
<td>③ SENSING POSITION CORRECTION</td>
<td>For future use. Do not change the initial setting.</td>
</tr>
<tr>
<td>④ GAP COND FILE NO.</td>
<td>Specifies the gap condition file number. This file includes the data to correct the welding condition according to the gap obtained by the sensor.</td>
</tr>
<tr>
<td></td>
<td>• Setting range: 1 to 30</td>
</tr>
<tr>
<td></td>
<td>• Initial setting: 1</td>
</tr>
<tr>
<td>⑤ TCP X-SHIFT(TOOL FRAME)</td>
<td>TCP Y-SHIFT(TOOL FRAME) TCP Z-SHIFT(TOOL FRAME)</td>
</tr>
<tr>
<td></td>
<td>• Setting range: -99.9 to 99.9</td>
</tr>
<tr>
<td></td>
<td>• Initial setting: 0.0</td>
</tr>
</tbody>
</table>
7.5 Conditions for NON-detection and Error Detection

① ACTION AFTER NON-DETECTION
Specifies the manipulator motion when nothing is detected in the specified distance.

- NONE
  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: NONE, STOP
- Initial setting: NONE
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
• Initial setting: 10

③ DATA ACQUISITION LENGTH
Specifies the length of the approximate line to be used for judgment 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
• Initial setting: 10

④ 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
• Initial setting: 5 for START/END; 5 for MIDDLE
7.6. Conditions to Pass Over

1. ACTION AFTER NON-DETECTION

   Specifies the manipulator motion when the path correctional amount pass
   over RADIUS.
   
   • NONE
     Pass over function is invalid. The manipulator continue tracking.
   
   • STOP
     An alarm occurs, and the manipulator stops when the path correctional
     amount pass over RADIUS.
   
   • CONTINUE
     The manipulator continue tracking with RADIUS as the upper limit when the
     path correctional amount pass over RADIUS.

   • Setting range: NONE, STOP, CONTINUE
   
   • Initial setting: NONE

2. RADIUS

   RADIUS is the distance be used when judge Pass Over.

   • Setting range: 0 to 100
   
   • Initial setting: 0
8. Settings for Inspection Job before Starting Operations

When the sensor mounted onto the manipulator is displaced, the tracking deviation occurs.
The inspection job before starting checks the deviation of the sensor before the actual operation by tracking.
This is also used to check the sensor deviation and torch deviation when the target deviation occurs.

If the inspection job before starting fails to be properly set, the sensor may fail to be properly checked.
After the tool calibration and sensor calibration, be sure to set the inspection job again before starting.
8.1. Teaching an Inspection Job before Starting

```
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
' 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. Settings for Inspection Job before Starting Operations

8.1 Teaching an Inspection Job before Starting

NPO
'1. AUTO/MANUAL switching flag [0: AUTO, 1: MANUAL]
  SET LB000 0
'2. Initial setting flag [0: Normal, 1: Initial setting]
  SET LB001 0

'Standby position
MOVJ V=5.0

Approach motion
MOVJ V=5.0
MOVJ V=x=5.0
MOVJ V=100

'Regive...

Position for checking the camera deviation

Posture 1 for checking the camera deviation
REFP 1

Posture 1 for checking the camera deviation
(REFP 2)

Posture 2 for checking the camera deviation
(REFP 3)

Posture for checking the camera deviation
REFP 4

Posture 1 for checking the camera deviation
REFP 5

Posture 1 for checking the camera deviation
(REFP 6)

Posture 2 for checking the camera deviation
(REFP 7)

Posture 2 for checking the camera deviation
(REFP 8)
8.2. Teaching an Inspection Job before Starting

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”.

![Diagram showing 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 [P 088]. Take note of the values for the X-, Y-, and Z-axes.
9.2. **How to Set the Tool Offset Amount**

10. 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

<table>
<thead>
<tr>
<th>LASER TRACKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILE NO.: 1 / 40</td>
</tr>
<tr>
<td>CONDITION TRACKING</td>
</tr>
<tr>
<td>XYZ CORRECTION</td>
</tr>
<tr>
<td>Rx/Ry/Rz CORRECTION</td>
</tr>
<tr>
<td>SENSING POSITION CORRECTION</td>
</tr>
<tr>
<td>GAP COND FILE NO.</td>
</tr>
<tr>
<td>TOP X-SHIFT(_TOOL FRAME)</td>
</tr>
<tr>
<td>TOP Y-SHIFT(_TOOL FRAME)</td>
</tr>
<tr>
<td>TOP Z-SHIFT(_TOOL FRAME)</td>
</tr>
<tr>
<td>TOP Rx-SHIFT(_TOOL FRAME)</td>
</tr>
<tr>
<td>TOP Ry-SHIFT(_TOOL FRAME)</td>
</tr>
<tr>
<td>TOP Rz-SHIFT(_TOOL FRAME)</td>
</tr>
</tbody>
</table>
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.

- The user sets the change value of the welding condition which adapts to the gap into GAP CONDITION FILE.

<table>
<thead>
<tr>
<th>GAP CONDITION FILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAP VOLT CURR 3ch 4ch x  y  z SPEED</td>
</tr>
<tr>
<td>ON ON OFF Off Off OFF OFF ON ON</td>
</tr>
<tr>
<td>0.1 100 100 0 0 0.0 0.0 0.0 0.0 100</td>
</tr>
<tr>
<td>0.2 110 110 0 0 0.0 0.0 0.0 -0.2 90</td>
</tr>
<tr>
<td>0.4 120 110 0 0 0.0 0.0 0.0 -0.5 85</td>
</tr>
<tr>
<td>0.6 125 113 0 0 0.0 0.0 0.0 -0.7 80</td>
</tr>
<tr>
<td>0.7 130 115 0 0 0.0 0.0 0.0 -0.9 70</td>
</tr>
</tbody>
</table>

- The YRC1000 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

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

2. GAP VALUE
   The gap value to make the condition correspond. It is possible to set gap by ten stages.
   The same data is displayed in POSITION and SPEED.
   - Setting range: 0.1 to 99.9 [mm]
   - Initial setting: 0 [mm]

3. VOLTAGE RATIO
   Analog 1ch. which controls 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. Analog channel No. is changeable by sensor parameter S1E040.
   - Setting range: 0 to 200 [%]
   - Initial setting: 0 [%]

4. CURRENT RATIO
   Analog 2ch. which controls 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. Analog channel No. is changeable by sensor parameter S1E041.
   - Setting range: 0 to 200 [%]
   - Initial setting: 0 [%]
1. When using gap adaptation function of analog output, ensure to add INSTRUCTION (ARCSET) set by analog output before starting the tracking.

2. Changing analog output by INSTRUCTION is invalid during the tracking, when using gap adaptation function of analog output.

3. When using gap adaptation function of speed control, speed can be changed by INSTRUCTION.
   - When the speed decreases to 80% by gap adaptation function, changing the speed by INSTRUCTION from 100 to 150 [cm/min], the actual speed becomes 150 x 0.8 = 120 [cm/min].

4. It is possible to change analog channel by setting the sensor parameters (S5E040 to 043).

<table>
<thead>
<tr>
<th>Initial setting</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>S5E040: 1</td>
<td>1 to 12 ch. that are not specified by S5E040 to 043</td>
</tr>
<tr>
<td>S5E041: 2</td>
<td>1 to 12 ch. that are not specified by S5E040, 042, 043</td>
</tr>
<tr>
<td>S5E042: 3</td>
<td>1 to 12 ch. that are not specified by S5E040, 041, 043</td>
</tr>
<tr>
<td>S5E043: 4</td>
<td>1 to 12 ch. that are not specified by S5E040 to 042</td>
</tr>
</tbody>
</table>
10.3. Conditions for Position

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

② GAP VALUE
The gap value to make the condition correspond. It is possible to set gap by ten stages.
The same data is displayed in WELD and SPEED.
- Setting range: 0.1 to 99.9 [mm]
- Initial setting: 0 [mm]

③ 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 [mm]

④ CHANGE VALUE of TOOL POSTURE (Rx, Ry, Rz).
- Setting range: -90 to 90 [degree]
- Initial setting: 0 [degree]
* 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: OFF

**② GAP VALUE**
The gap value to make the condition correspond. It is possible to set gap by ten stages.
The same data is displayed in WELD and POSITION.
- Setting range: 0.1 to 99.9 [mm]
- Initial setting: 0 [mm]

**③ CHANGE RATIO of SPEED**
Adjust the welding speed, which specified by the job, by overriding the speed with the specified value.
- Setting range: 1 to 200 [%]
- Initial setting: 0 [%]

### 10.5. Conditions for Weaving
For future use. Do not change the initial setting, and cannot tracking during weaving at now version.
10.6. Changing the GAP Condition File during Tracking Function

When the gap condition file is specified by the gap condition file switching command (LTCHGGP), the gap condition file can be switched during tracking. The change amount of each condition (welding, position, speed) at the time of gap condition file switching can be changed smoothly by setting the upper limit to the change amount for each control cycle.

10.6.1. Setting the GAP Condition File Change during Tracking

**LTCHGGP**

Switch the gap condition file to the specified number.

<table>
<thead>
<tr>
<th>Argument</th>
<th>Initial Value</th>
<th>Setting Range</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>① GAP COND FILE</td>
<td>1</td>
<td>1 to 30</td>
<td>Specified the gap condition file number of the switching destination.</td>
</tr>
</tbody>
</table>

ARGUMENT SETTING

JOB NAME: LTCHGGP

COMENT1

① GAP COND FILE | 20 |

<table>
<thead>
<tr>
<th>ARGUMENT</th>
<th>SETTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAP COND FILE</td>
<td>1 to 30</td>
</tr>
</tbody>
</table>

Example:

```
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
LTRACKON SW=B000 LT:1 V=100
'arcon
MOVL
LTCHGGP GF:3
MOVL
LTRACKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```
10.6.2. Control of Change Amount When Switching the Gap Condition File

The change amount of each condition (welding, position, speed) at the time of gap condition file switching can be changed smoothly by setting the upper limit to the change amount for each control cycle.

The upper limit value is set by the following S5E parameters.

*When set to zero, the change amount for each control cycle can be calculated using the upper limit amount within the software fair.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>S5E110</td>
<td>the upper limit to the change amount: position</td>
<td>[0.001mm]</td>
</tr>
<tr>
<td>S5E112</td>
<td>the upper limit to the change amount: analog ch1 (for setting weld volt)</td>
<td>[0.01V]</td>
</tr>
<tr>
<td>S5E113</td>
<td>the upper limit to the change amount: analog ch2 (for setting weld current)</td>
<td>[0.01V]</td>
</tr>
<tr>
<td>S5E114</td>
<td>the upper limit to the change amount: analog ch3</td>
<td>[0.01V]</td>
</tr>
<tr>
<td>S5E115</td>
<td>the upper limit to the change amount: analog ch4</td>
<td>[0.01V]</td>
</tr>
<tr>
<td>S5E116</td>
<td>the upper limit to the change amount: speed</td>
<td>[0.01%]</td>
</tr>
</tbody>
</table>
11. Laser Sensor Monitor Function

The YRC1000 MOTOEYE-LT function allows you to check the values acquired by the sensor from the programming pendant of the robot controller. If the fitting cannot be recognized, the value is not updated.

- Confirmation way

Select 「OPTION」 → 「LASER SENSOR MONITOR」

<table>
<thead>
<tr>
<th>LASER SENSOR MONITOR</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SENS: SL5</td>
<td></td>
</tr>
<tr>
<td>FILE NO.</td>
<td>1</td>
</tr>
<tr>
<td>ROBOT: R1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>TARGET POS</td>
<td>0.000</td>
</tr>
<tr>
<td>BREAK POS</td>
<td>0.000</td>
</tr>
<tr>
<td>DETECT POS</td>
<td>0.000</td>
</tr>
<tr>
<td>CAP</td>
<td>0.000</td>
</tr>
<tr>
<td>MISMATCH</td>
<td>0.000</td>
</tr>
<tr>
<td>AREA</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Fig 11-1 Laser Sensor Monitor Screen
12. Output Function of Correction Amount, Gap Amount, Step Amount

The YRC1000 MOTOEYE-LT function has a function to output the correction amount (x, y, z), the gap amount and the step amount during tracking to a general-purpose register starting with the number specified by the sensor parameter S5E100.

However, it is necessary to specify the break point number used to calculate the step amount by the tracking start command (LTRACKON2) with BKP setting.

12.1. Setting Output Destination Register Number

Each data is output to the following registers, starting with the general-purpose register number specified in S5E100.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>S5E100</td>
<td>Tracking information output destination general purpose register top number</td>
<td>General-purpose register start number</td>
</tr>
</tbody>
</table>

M [(S5E100)]: Correction amount x (unit: μm)
M [(S5E100) +1]: Correction amount y (unit: μm)
M [(S5E100) +2]: Correction amount z (unit: μm)
M [(S5E100) +3]: Gap amount (unit: μm)
M [(S5E100) +4]: Step amount (unit: μm)

※ Output is invalid when S5E100 is zero.
※ 0 is output except during tracking
※ When the correction amount and the step amount become negative values, it is expressed as a 2's complement. This is because the general-purpose register is displayed as unsigned 0 to 65535. Convert the values of the logged general-purpose registers by code conversion.
12.2. How to Create a Job to Output the Step Amount (LTRACKON2)

Use the tracking start command (LTRACKON2) with BKP setting to output the step amount during tracking.

If there is no start point search, replace the LTRACKON command of the job with “6.2 With welding start point search” with the LTRACCON2 command with “6.1 Without welding start point search”.

**LTRACKON2**

Set the break point of the ServoRobot's sensor and start tracking while outputting the step amount to the general purpose register.

---

**ARGUMENT SETTING**

<table>
<thead>
<tr>
<th>Argument</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 B099</td>
<td>B variable number to specify whether to carry out or skip the macro command. <strong>1:</strong> Carries out the macro command <strong>0:</strong> 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 the tracking.</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.</td>
<td>(Teaching point)</td>
<td>(Teaching point)</td>
<td>Teach the start point of the welding of the reference workpiece.</td>
</tr>
</tbody>
</table>

---

**EXAMPLE**

```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
LTRACKON2 SW=B000 LT:1 V=100 BKP1:2
BKP2:3
arcon
MOVL
LTRACKOF SW=B000
MOVL V=500
MOVJ VJ=10.0
END
```
Output Function of Correction Amount, Gap Amount, Step Amount

12.2 How to Create a Job to Output the Step Amount (LTRACKON2)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>⑤BLP1</td>
<td>0</td>
<td>0 to 7</td>
</tr>
<tr>
<td>⑥BLP2</td>
<td>0</td>
<td>0 to 7</td>
</tr>
</tbody>
</table>

The step amount is the distance from BKP1 to BKP2. When z (sensor coordinates) of BKP1 is larger than z (sensor coordinates) of BKP2, it becomes a positive value.

Ex.) BKP1 = 2, BKP2 = 3

Fig 12-1 Break Point and Step Pont
13. Tracking Disable Specification Function

Tracking can be disabled by the general-purpose input signal specified by sensor parameter S5E105. However, if you specify something other than 7, you need to change the macro job. (For details, see the important part below)

When the designated general-purpose input is turned on, communication with the sensor and tracking processing are disabled.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>S5E105</td>
<td>Tracking function disabled General purpose input signal number</td>
<td>General-purpose input number</td>
</tr>
<tr>
<td></td>
<td>※ The No.7 recommendation that change of macro job is unnecessary</td>
<td></td>
</tr>
</tbody>
</table>

* If the tracking invalid signal is turned on during tracking, the accumulated correction amount up to that point will continue to operate while being held. Suddenly, it does not return to the original teaching trajectory.

* When using the I / F panel function to provide a tracking border switch, assign the I / F panel control signal # 6xxxx to the general-purpose input signal with the concurrent IO ladder.

**NOTE**

The tracking start instruction (LTRCKON, LTRCKON2), search instruction (LTCRCH2), and shift instruction (LTSFT2) monitor general-purpose inputs in the macro job and skip each processing. Since DIN # (7) is used as the initial value, if the general-purpose input signal is set to a number other than 7 in S5E105, change the signal number in each macro instruction and change it.

Except for the start command, search command, and shift command, it is not necessary to change the macro job because signal monitoring is performed in the software, not in the macro job.
13 Tracking Disable Specification Function
12.2 How to Create a Job to Output the Step Amount (LTRACKON2)

JOB CONTENT
J: LTRCKON2 S:0000
CONTROL GROUP: R1 TOOL: **

0019 GETARG LB002 IARG#(5)
0020'--- BKP1 INDEX -------
0021 GETARG LB003 IARG#(6)
0022'
0023 JUMP *skp1 IF LB000<>1
0024'--- LT mode by DOUT#(*)----
0025 DIN LB004 IN#(7)
0026 JUMP *skp1 IF LB004<>1
0027'

JOB CONTENT
J: LTSFT2 S:0000
CONTROL GROUP: R1 TOOL: **

0013 SET B[LBO03] 0
0014'--- LT mode -------------
0015 GETARG LB000 IARG#(1)
0016 JUMP *skp-sft IF LB000<>1
0017'--- LT mode by DOUT#(*)----
0018 DIN LB001 IN#(7)
0019 JUMP *skp1 IF LB001<>1
0020'--- detect pos -------------
0021'

JOB CONTENT
J: LSTSRCH2 S:0000
CONTROL GROUP: R1 TOOL: **

0010'--- srch. rslt. -------------
0011 GETARG LB005 IARG#(8)
0012 SET B[LBO05] 1
0013'--- LT mode -------------
0014 GETARG LB000 IARG#(1)
0015 JUMP *skp-srch IF LB000<>0
0016'--- LT mode by DOUT#(*)----
0017 DIN LB009 IN#(7)
0018 JUMP *skp-srch IF LB009<>1
0019'--- init SRCH -------------
14. Inspection before Starting Operations

14.1. Automatic Inspection before Starting Operations

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

![Flowchart of Automatic Inspection Procedure Before Starting Operations]

- Turn ON the power supply to the DX100 and the laser vision sensor. Refer to "3. Start-up."
- Before starting operations, select the inspection job.
- Carry out the automatic inspection?
  - Yes:
    1. Assign "0" to the auto/manual flag at the beginning of the job.
    2. Set the DX100 to play mode, and start the operation.
    - [Error 1]: Has the manipulator stopped due to camera deviation?
      - Yes: Refer to "11.2 Manual Inspection Before Starting Operations."
      - No:
        - [Error 2 and 3]: Has the manipulator stopped due to camera deviation when the posture was changed?
          - Yes: Start the sensor-monitor software, WinUser.
          - No: Refer to "11.2 Manual Inspection Before Starting Operations."
        - No: Refer to "11.2 Manual Inspection Before Starting Operations."
    - No: Assign 10 nm to the X-, Y-, and Z-axes parameters in "Robot Setting."
- Is 10 nm assigned to the X-, Y-, and Z-axes parameters in "Robot Setting."
  - Yes:
    - Refer to "11.2 Manual Inspection Before Starting Operations."
  - No: Refer to "11.2 Manual Inspection Before Starting Operations."

Procedure of Manual Inspection Before Starting Operations

1. Assign "1" to the auto/manual flag at the beginning of the job.
2. Attach a tip for teaching.
3. Set the DX100 to teaching mode, and start a test run.
4. Restart the manipulator in the test run.
5. Restart the manipulator in the test run.
6. In all of the three postures, does the tip for teaching point to the tip for checking?
   - No: Refer to "11.3 Camera Deviation Check at Welding-point Deviation Check."
   - Yes: Restart the manipulator in the test run to move the manipulator to posture 1 for checking the welding point deviation.
7. 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.
8. 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."

Key:
- Refer to the section for more information.
- Comment
14.3. 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?

Yes → Refer to “12.3 Corrective Action for Tool Deviation.”

No

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

Yes → Replace the tip and restart the procedure described in “11.2 Manual Inspection Before Starting Operations.”

No

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

Is the deviation less than 1 mm?

Yes

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

Any deviation?

Yes → Correct the target deviation by setting the amount of offset. Refer to “9 Tool Offset Setting.”

No

End
14.4 Verification of Tool Constants

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.
  - Carry out the sensor calibration again. Refer to "5. Laser Sensor Calibration."

- No
  - Recom the initial settings for the inspection job before restarting operations. Refer to "B. Settings for Inspection Job Before Starting Operations."

End
14.5. Verification of Detected Data

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 the 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

Refer to "15.4 Corrective Actions for Camera Deviation."

No

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

End
15. Troubleshooting

15.1. Corrective Actions after Torch Collision

Take corrective actions following the flowchart.

1. 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."
     - Any target deviation?
       - Yes
         - Contact your Yaskawa representative.
       - No
         - End
     - No
   - End
15.2. 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: Has an offset been applied to the target position?
      - Yes: Assign "0" to "TARGET PT Y- and Z-SHIFT (SENSOR)" in the CONDITION for the "LASER SENSOR" in the LASER TRACKING display.
      - No: Adjust the parameters with WinUser.
    - No: Has the target position offset been canceled?
      - 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: Any target deviation?
        - Yes: Contact your Yaskawa representative.
        - No: End
15.3. Corrective Actions for Tool Deviation

Take corrective actions following the flowchart.

- **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**
  - Repeat the previous steps.

End
15.4. Corrective Actions for Camera Deviation

Take corrective actions following the flowchart.

- **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
### 16. Alarm List

#### 16.1 Alarm List

<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>5020</td>
<td>0 to 199</td>
<td>Parameter error [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>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 error.</td>
<td>Requires investigation at Yaskawa. Contact your Yaskawa representative, stating the situation, 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>5053</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>5054</td>
<td>1 to 9</td>
<td>Laser tracking processing error, [decimal data]</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>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Laser tracking processing error, [decimal data]</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>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Laser tracking processing error, [decimal data]</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>
</tr>
<tr>
<td>Alarm List</td>
<td>Alarm List</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>12</strong> Laser tracking processing error, [decimal data]</td>
<td>A tool change error</td>
<td>Use the same teaching tool throughout the tracking section.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>13</strong> Laser tracking processing error, [decimal data]</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>
<td></td>
</tr>
<tr>
<td><strong>14</strong> Laser tracking processing error, [decimal data]</td>
<td>The external reference point has not been registered.</td>
<td>Register the external reference point.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>15,16</strong> Laser tracking processing error, [decimal data]</td>
<td>An error occurred in the gap condition data setting.</td>
<td>The same gap amounts are defined. Change either of the gap amount settings.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| **17** Laser tracking processing error, [decimal data] | The laser sensor has continuously detected no points. | 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 WeldCom. |
| **19,20** Laser tracking processing error, [decimal data] | 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** Laser tracking processing error, [decimal data] | The correction amount exceeds the allowable value. | For teaching, minimize the posture change so that the manipulator can move in a smooth motion. |
| **22 to 27** Laser tracking processing error, [decimal data] | An error occurred in the calculation for the calibration of the external axis in the tracking function of the external axis’s control method. | 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.) |
<p>| <strong>32</strong> Laser tracking processing error, [decimal data] | The laser sensor’s transmission channel has not been set. | Assign “2” to the sensor parameter S5E180. |
| <strong>34</strong> Laser tracking processing error, [decimal data] | No response has been received in communications with the laser sensor. | Turn OFF the power supply of the Power-BOX, and turn it ON again. |
| <strong>40</strong> Laser tracking processing error, [decimal data] | The specified file number for the laser-tracking function is out of the allowable range. | Specify a file number between 1 and 40 for the laser-tracking function. |</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Details</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>Laser tracking processing error,</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>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Laser tracking processing error,</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>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Laser tracking processing error,</td>
<td>No local variable for the sensor.</td>
<td>Extend the definition of the local variable.</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 to 56</td>
<td>Laser tracking processing error,</td>
<td>An error occurred in the end point search processing.</td>
<td>Adjust the vision sensor to do steady detection.</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>Laser tracking processing error,</td>
<td>The ratio of the speed fell below a minimum value of permit.</td>
<td>Adjust the parameter S5E044 for falling below the ratio of the speed.</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>Laser tracking processing error,</td>
<td>BKP1 INDEX setting range error</td>
<td>Specify a breakpoint number 1 (BKP1) within 0 to 7</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>134</td>
<td>Laser tracking processing error,</td>
<td>BKP2 INDEX setting range error</td>
<td>Specify a breakpoint number 2 (BKP2) within 0 to 7</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>Laser tracking processing error,</td>
<td>BKP2 not set</td>
<td>Set a breakpoint number 2 (BKP2)</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>136</td>
<td>Laser tracking processing error,</td>
<td>BKP1 and BKP2 are the same breakpoint</td>
<td>Specify different breakpoint numbers for BKP1 and BKP2</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5054*</td>
<td>Laser tracking processing error,</td>
<td>An error occurred in the communications between the YRC1000 and the Power-BOX. The decimal data indicates the type of error.</td>
<td>Check the communications cable between the YRC1000 and the Power-BOX for any disconnection, misconnection, or similar problem. Turn OFF the power supply of the Power-BOX, and turn it ON again.</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 9</td>
<td>Laser tracking processing error,</td>
<td>An error occurred in data check from the YRC1000.</td>
<td>Check the communications cable between the YRC1000 and the Power-BOX for any disconnection, misconnection, or similar problem. Turn OFF the power supply of the Power-BOX, and turn it ON again.</td>
</tr>
<tr>
<td></td>
<td>[decimal data]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98</td>
<td></td>
<td>An error occurred in data check from the YRC1000.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td></td>
<td>No response has been received from the YRC1000.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>Description</td>
<td>Action</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Camera failure.</td>
<td>If the temperature of camera surface is too high, cool it down.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turn OFF the power supply of the Power-BOX, and turn it ON again.</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>An error occurred in the final processing for tracking.</td>
<td>Turn OFF the power supply of the Power-BOX, and turn it ON again.</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>The parameter instructed from the YRC1000 does not exist.</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>
<td></td>
</tr>
<tr>
<td>115</td>
<td>An error occurred at the setup.</td>
<td>Turn OFF the power supply of the Power-BOX, and turn it ON again.</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>The operating temperature exceeds the allowable range.</td>
<td>Cool the Power-BOX down. Clean the cooling fan on the Power-BOX.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cool the camera down.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turn OFF the power supply of the Power-BOX, and turn it ON again.</td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>The value instructed from the YRC1000 is out of the allowable range.</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>
<td></td>
</tr>
</tbody>
</table>
### 17. Sensor Parameters

#### 17.1. S5E Parameters

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Initial Value</th>
<th>Setting Range</th>
</tr>
</thead>
<tbody>
<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 [μm]</td>
<td>500</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>100</td>
<td>Tracking information output destination general purpose register number</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td>Tracking function disabled general purpose input signal number</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>The upper limit to the change amount: position</td>
<td>2000</td>
<td>[0.001mm]</td>
</tr>
<tr>
<td>112</td>
<td>The upper limit to the change amount: analog ch1 (for setting weld volt)</td>
<td>10</td>
<td>0.01V</td>
</tr>
<tr>
<td>113</td>
<td>The upper limit to the change amount: analog ch2 (for setting weld current)</td>
<td>5</td>
<td>0.01V</td>
</tr>
<tr>
<td>114</td>
<td>The upper limit to the change amount: analog ch3</td>
<td>0</td>
<td>0.01V</td>
</tr>
<tr>
<td>115</td>
<td>The upper limit to the change amount: analog ch4</td>
<td>0</td>
<td>0.01V</td>
</tr>
<tr>
<td>116</td>
<td>The upper limit to the change amount: speed</td>
<td>10</td>
<td>0.01%</td>
</tr>
</tbody>
</table>
### Sensor Parameters

#### SSE Parameters

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Initial Value</th>
<th>Setting Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>Sensor IP address 1</td>
<td>192</td>
<td>Match the YRC1000 and sensor settings</td>
</tr>
<tr>
<td>161</td>
<td>Sensor IP address 2</td>
<td>168</td>
<td></td>
</tr>
<tr>
<td>162</td>
<td>Sensor IP address 3</td>
<td>255</td>
<td></td>
</tr>
<tr>
<td>163</td>
<td>Sensor IP address 4</td>
<td>3</td>
<td>Match the sensor settings</td>
</tr>
<tr>
<td>164</td>
<td>Sensor Ethernet port</td>
<td>6344</td>
<td>Do not change.</td>
</tr>
</tbody>
</table>
YRC1000 OPTIONS

INSTRUCTIONS

FOR LASER-TRACKING FUNCTION: MOTOEYE-LT

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