YRC1000 OPTIONS
INSTRUCTIONS
FOR PENDANT OSCILLOSCOPE FUNCTION

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: 178665-1CD
Revision: 0
DANGER

- This manual explains the pendant oscilloscope function 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.

CAUTION

- 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.

NOTICE

- 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”.
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.

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 result in personal injury caused by unintended manipulator movement.

Observe the following precautions when performing a teaching operation within the P-point maximum envelope of the manipulator:

- 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 result in personal injury caused by improper or unintended manipulator movement.

Confirm that no person is present in the P-point maximum envelope of the manipulator 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

Injury may result if any person should enter the P-point maximum envelope of the manipulator during operation. Immediately press an emergency stop button whenever there is a problem. 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.
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 supply 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>

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, 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.
Descriptions of the programming pendant keys, 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>Character Keys /Symbol Keys: The keys which have characters or its symbol printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td>Axis Keys /Numeric Keys</td>
<td>[Axis Key] and [Numeric Key] 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>Displays: 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.
# Contents

1 Overview ................................................................................................................... 1-1
   1.1 Pendant Oscilloscope Function ............................................................................. 1-1
   1.2 Specification ............................................................................................................. 1-2
   1.3 Setup ......................................................................................................................... 1-2

2 Setting and Operation for Data Measurement ............................................................... 2-1
   2.1 Startup of Pendant Oscilloscope Function ............................................................... 2-1
   2.2 Main Screen Configuration ....................................................................................... 2-2
      2.2.1 Main Screen (Not In-Measurement Mode) ....................................................... 2-2
      2.2.2 Main Screen (In-Measurement Mode) ............................................................... 2-3
   2.3 Setting Measurement Conditions .......................................................................... 2-4
      2.3.1 Channel Setting Window .................................................................................. 2-4
      2.3.2 CH Display Setting Panel ............................................................................... 2-8
      2.3.3 TimeScale Setting Panel ................................................................................. 2-10
      2.3.4 Trigger Setting Panel ...................................................................................... 2-11
   2.4 Starting and Ending Measurement ......................................................................... 2-15
      2.4.1 Continuous Mode ............................................................................................ 2-15
      2.4.2 Trigger Mode .................................................................................................... 2-16
   2.5 Termination and Minimization of Pendant Oscilloscope Function ......................... 2-17
      2.5.1 Termination of PP Oscilloscope ....................................................................... 2-17
      2.5.2 Minimizing PP Oscilloscope Application ....................................................... 2-17

3 Saving and Loading the Measurement Data .................................................................. 3-1
   3.1 SaveMode Setting Panel .......................................................................................... 3-1
      3.1.1 Data File Name and Save Destination .............................................................. 3-1
      3.1.2 CSV File .......................................................................................................... 3-2
   3.2 Load Panel .............................................................................................................. 3-3

4 Other Functions .............................................................................................................. 4-1
   4.1 Zoom Function ........................................................................................................ 4-1
      4.1.1 During Execution of Zoom Function ............................................................... 4-2
   4.2 Cursor Measurement Function ............................................................................... 4-3
      4.2.1 Cursor Measurement Parameters ................................................................... 4-5
   4.3 Job Step No. Saving Function ................................................................................ 4-6
      4.3.1 Channel Setting .............................................................................................. 4-7
      4.3.2 Adjustment of Acquisition Time of Job Name and Step No. ......................... 4-7
Contents

4.4 Operation Function by Dedicated Input ................................................................. 4-9
  4.4.1 Dedicated Input Signal ...................................................................................... 4-9
  4.4.2 Dedicated Output Signal ................................................................................... 4-11

4.5 Simultaneous Display of Waveform Display Area and Reading Job ................. 4-13
  4.5.1 Displaying Method ............................................................................................ 4-13
  4.5.2 Display Items .................................................................................................... 4-15
  4.5.3 Operating Methods ......................................................................................... 4-16
  4.5.4 When in 3D Graphical Display Function ......................................................... 4-18

5 Supplementary Explanation ....................................................................................... 5-1
  5.1 Division [div]: Unit for Measurement Screen Position ....................................... 5-1
  5.2 Reference Unit ..................................................................................................... 5-2

6 Error Messages ........................................................................................................... 6-1
1.1 Pendant Oscilloscope Function

Pendant Oscilloscope Function (hereinafter referred to as “PP oscilloscope”) is the monitoring function of speed reference, torque reference, encoder temperature, as well as of concurrent I/O signals of each robot axis on the Programming Pendant. The PP oscilloscope is configured by the software, which requires no special hardware equipment. By carrying out the PP oscilloscope function, the pendant oscilloscope application (hereinafter referred to as “PP oscilloscope application”) starts on the Programming Pendant.

Equipped with an integral display screen containing the waveform display window and the condition setting panel, the PP oscilloscope application enables to perform several processes from condition setting to measurement at a time. Other available functions include Trigger function that stops the data acquisition at a given condition, Measure and display function of maximum/minimum values after data acquisition, Zoom function that displays the waveform data in a magnified view, and data output function in a format available on the computer. *fig. 1-1 “Display of PP Oscilloscope”* shows a typical display of PP oscilloscope.

*Fig. 1-1: Display of PP Oscilloscope*
1.2 Specification

Main specification of the PP oscilloscope is listed in table 1-1 “Main Specifications of PP Oscilloscope” below:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement data type</td>
<td>Speed reference, Speed FB, Torque reference, Encoder temperature, Concurrent I/O signal, Register value</td>
<td>Number of channels that can be measured at the same time.</td>
</tr>
<tr>
<td>Maximum channel number</td>
<td>10 channels</td>
<td>Number of channels that can be measured at the same time.</td>
</tr>
<tr>
<td>Sampling time</td>
<td>2.0, 4.0, 8.0, 16.0, 32.0, 64.0 [ms]</td>
<td>Indicates time interval for data sampling. Smaller values enable more detailed measurement data, but shorten the data record time due to much data volume.</td>
</tr>
<tr>
<td>Maximum data length</td>
<td>20 [s] to 100 [s]</td>
<td>Indicates data length that can be recorded at a measurement. Some setting of sampling time can limit the maximum data length available.</td>
</tr>
<tr>
<td>Waveform acquisition mode</td>
<td>Continuous mode Trigger mode</td>
<td>Selects the mode according to the Trigger state (valid/invalid): Trigger Invalid: Continuous The Continuous mode displays the acquired data in a time-series order. Trigger Valid: Trigger The Trigger mode automatically stops the measurement and displays waveform when the trigger conditions are satisfied.</td>
</tr>
<tr>
<td>Trigger condition</td>
<td>○Trigger for measurement waveform - Up trigger - Down trigger - Up&amp;Down trigger ○Alarm trigger</td>
<td>Other than normal waveform triggers, alarm trigger is also included.</td>
</tr>
<tr>
<td>Data saving format</td>
<td>○ CSV ○ JPG</td>
<td>➊ Saves the acquired data in SD or USB memory with the CSV (Comma Separated Value) format. ② Saves the displayed data on the screen in SD or USB memory with the JPG (Joint Photographic Experts Group) format.</td>
</tr>
</tbody>
</table>

1.3 Setup

To activate the function, the optional parameters of the pendant oscilloscope function need to be effective (note that the user cannot change the parameter setting).
For the parameter setting other than specified above, contact a YASKAWA sales representative.
2 Setting and Operation for Data Measurement

This chapter describes setting and operation required for the measurement.

Basically the PP oscilloscope is operated by touching on the screen; for pull-down selection box or entry box,

however, the Cursor Keys enable the cursor operation, and [SELECT], [ENTER] or [CANCEL] enables selection, determination, or cancel, just as the normal operation on the pendant screens.

In performing numerical input using an entry box, first activate the parameter to a selective state by [SELECT], input numerical values by the Number Keys of the pendant, and press [ENTER] to determine it. To cancel the input numerical values, press [CANCEL] in the selective state.

2.1 Startup of Pendant Oscilloscope Function

The PP oscilloscope can be started up by the following step:

1. Select {ROBOT} from the menu in the left of screen.
2. Select {PENDANT OSCILLOSCOPE} from the expanded menu (see fig. 2-1 “PP Oscilloscope Startup Menu”).

Fig. 2-1: PP Oscilloscope Startup Menu
2.2 Main Screen Configuration

Here explains the configuration of the Main screen.

The PP oscilloscope is displayed on the entire screen of Programming Pendant. The main screen has two types of modes; in-measurement and without not in-measurement (Waiting), in which functions or availability of some buttons are changed.

Condition setting is only available in not in-measurement mode (Waiting).

2.2.1 Main Screen (Not In-Measurement Mode)

Main screen of not in-measurement mode (Waiting) is shown in fig. 2-2 "Main Screen (Not In-Measurement Mode)" below with description.

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Waveform display area</td>
<td>Displays measured data waveform. When the data is not yet acquired soon after the startup or when the data is cleared, nothing is shown here. At the upper left of the area, measurement value obtained by the cursor measurement function is displayed.</td>
</tr>
<tr>
<td>② (MINIMIZE)</td>
<td>Minimizes the PP oscilloscope application.</td>
</tr>
<tr>
<td>③ (CH)</td>
<td>Opens the Channel Setting window. (For details of the Channel Setting window, refer to chapter 2.3.1 “Channel Setting Window”)</td>
</tr>
<tr>
<td>④ (START)</td>
<td>Starts the data measurement.</td>
</tr>
<tr>
<td>⑤ (CLEAR)</td>
<td>Deletes the displayed data waveform.</td>
</tr>
<tr>
<td>⑥ (CLOSE)</td>
<td>Terminates the PP oscilloscope.</td>
</tr>
<tr>
<td>⑦ Condition setting panel</td>
<td>Enables to set various conditions. Touching the upper tab enables to open the setting screen corresponding to each parameter. (For details of each condition setting, refer to chapter 2.3.2 &quot;CH Display Setting Panel&quot; to chapter 2.3.4 “Trigger Setting Panel”.)</td>
</tr>
<tr>
<td>⑧ Maximum display value</td>
<td>Displays values and units at the uppermost of waveform display area by each channel.</td>
</tr>
<tr>
<td>⑨ Minimum display value</td>
<td>Displays values and units at the lowermost of waveform display area by each channel.</td>
</tr>
</tbody>
</table>
| ⑩ Reference unit | Displays the reference unit by each channel. For details of the reference unit, refer to chapter 5.2 “Reference Unit”.

On the Main screen, information by channels is displayed in each specific color; for example in fig. 2-2 “Main Screen (Not In-Measurement Mode)” , information on CH3 is displayed in green, where the reference unit is 50%/div, the maximum display value is 450%, and the minimum display value is -50%.
2.2.2 Main Screen (In-Measurement Mode)

Main screen of In-measurement mode is shown in fig. 2-3 “Main Screen (In-Measurement Mode)”. In this mode, the states of some buttons are changed. Here describes such buttons:

**Fig. 2-3: Main Screen (In-Measurement Mode)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>① (STOP)</td>
<td>Switched from (START), stops the data measurement.</td>
</tr>
<tr>
<td>② (CLEAR)</td>
<td>In measurement mode, the button operation is disabled.</td>
</tr>
<tr>
<td>③ (CLOSE)</td>
<td>In measurement mode, the button operation is disabled.</td>
</tr>
<tr>
<td>④ Condition setting panel</td>
<td>In measurement mode, the operation on tab is disabled.</td>
</tr>
</tbody>
</table>

**NOTE**

Soon after switching the buttons (START) / (STOP), button operation is not available for a certain period of time to avoid continuous pressing of the buttons.

When the buttons (START) / (STOP) are disabled, wait until the operation becomes available.
2.3 Setting Measurement Conditions

Here describes how to set the measurement conditions on the channel setting window and the condition setting panel.

2.3.1 Channel Setting Window

Pressing {CH} on the Main screen opens the channel setting window. Fig. 2-4 “Channel Setting Window” shows the typical display example of the channel setting window. On this window, data type for measurement at each channel, measurement target axis, and measurement interval of each data can be set.

Fig. 2-4: Channel Setting Window

© Sampling time

Sets the sampling interval of the data to be acquired. Settable options are 2.0, 4.0, 8.0, 16.0, 32.0, and 64.0 [ms], each of which corresponds to the sampling frequencies of 500, 250, 125, 62.5, 31.25, and 15.625 [Hz], respectively.

© Measurement valid/invalid check box

Requires setting for each channel, where the channel with a check mark becomes valid for measurement. When the multiple channels are to be valid, the channel numbers are not necessarily to be sequential.

NOTE

The more the channels are available, the more the process is overloaded, and it affect the data updating speed in the waveform display area; it is recommended that unnecessary channels, if any, should be set to invalid.

© Target

Requires setting for each channel, where the setting of output signal type is available. Servo: Enables to select the servo CPU signals at the option ©. I/O signal: Enables to input the concurrent I/O signal at the option ©. Register: Enables to input the register number at the option ©.
2 Setting and Operation for Data Measurement
2.3 Setting Measurement Conditions

### Signal selection

Requires setting for each channel.

When {Servo} is selected at the option ③: Select speed reference, speed feedback, torque reference or encoder temperature.

When {I/O signal} is selected at the option ④: Input signal number of concurrent I/O. For the details of concurrent I/O, refer to “YRC1000 OPTIONS INSTRUCTIONS FOR Concurrent I/O (RE-CKI-A467).”

### Requirements on Concurrent I/O Signal

The concurrent I/O signal is updated in every 4.0 [ms]. 

Whereas when the PP oscilloscope allows the setting of sampling time as 8.0 [ms] or more, the measurement data has a delay time up to as long as that of the sampling time.

Even when the sampling time is 4.0 [ms], the signal turning ON/OFF only for 4.0 [ms] may have data skipped; ensure to keep the time interval of 20 [ms] or more between the signal ON and OFF for the measurement target of concurrent I/O signal.

When {Register} is selected at the option ⑤: Input register number. Input the numerical value between M000 and M999.

### Axis selection

Set the target axis for data acquisition. (Only when Servo is selected at option ③ Target)

One servo board (CSRA-SDCA01AA) can connect up to 9 motors.

Furthermore, up to 8 servo boards can be connected to a system. This means that the maximum axis configuration on a system allows simultaneous connection of 72 axes of motors.

The PP oscilloscope specifies the measurement target axis by the unique number of physical connection among these 72 axes. This is called as “physical axis connection”.

Under the basic system configuration of a servo board, the physical axes 1 to 6 are occupied by robot axis, and external axes are connected to the physical axes 7, 8, and 9. When every servo board is added, the number of physical axis is represented by offsetting each +9. This relationship is shown in the following table 2-1 “Relationship between the number of servo board and the physical axis number”:

<table>
<thead>
<tr>
<th>No. of servo board</th>
<th>Physical axis number of the board</th>
</tr>
</thead>
<tbody>
<tr>
<td>SV#1</td>
<td>1 to 9</td>
</tr>
<tr>
<td>SV#2</td>
<td>10 to 18</td>
</tr>
<tr>
<td>SV#3</td>
<td>19 to 27</td>
</tr>
<tr>
<td>SV#4</td>
<td>28 to 36</td>
</tr>
<tr>
<td>SV#5</td>
<td>37 to 45</td>
</tr>
<tr>
<td>SV#6</td>
<td>46 to 54</td>
</tr>
<tr>
<td>SV#7</td>
<td>55 to 63</td>
</tr>
<tr>
<td>SV#8</td>
<td>64 to 72</td>
</tr>
</tbody>
</table>

Table 2-1: Relationship between the number of servo board and the physical axis number
The following example shows the typical specification of physical axis number in the main system configuration.

Example:

- **Normal 6-axis robot, R1 to R8**

<table>
<thead>
<tr>
<th>Target axis</th>
<th>S</th>
<th>L</th>
<th>U</th>
<th>R</th>
<th>B</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis selection No. (R1)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Axis selection No. (R2)</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Axis selection No. (R3)</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td>Axis selection No. (R4)</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td>Axis selection No. (R5)</td>
<td>37</td>
<td>38</td>
<td>39</td>
<td>40</td>
<td>41</td>
<td>42</td>
</tr>
<tr>
<td>Axis selection No. (R6)</td>
<td>46</td>
<td>47</td>
<td>48</td>
<td>49</td>
<td>50</td>
<td>51</td>
</tr>
<tr>
<td>Axis selection No. (R7)</td>
<td>55</td>
<td>56</td>
<td>57</td>
<td>58</td>
<td>59</td>
<td>60</td>
</tr>
<tr>
<td>Axis selection No. (R8)</td>
<td>64</td>
<td>65</td>
<td>66</td>
<td>67</td>
<td>68</td>
<td>69</td>
</tr>
</tbody>
</table>

- **7-axis single-arm robot (such as SIA), R1 to R8**

<table>
<thead>
<tr>
<th>Target axis</th>
<th>S</th>
<th>L</th>
<th>U</th>
<th>R</th>
<th>B</th>
<th>T</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis selection No. (R1)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Axis selection No. (R2)</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Axis selection No. (R3)</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
</tr>
<tr>
<td>Axis selection No. (R4)</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
</tr>
<tr>
<td>Axis selection No. (R5)</td>
<td>37</td>
<td>38</td>
<td>39</td>
<td>40</td>
<td>41</td>
<td>42</td>
<td>43</td>
</tr>
<tr>
<td>Axis selection No. (R6)</td>
<td>46</td>
<td>47</td>
<td>48</td>
<td>49</td>
<td>50</td>
<td>51</td>
<td>52</td>
</tr>
<tr>
<td>Axis selection No. (R7)</td>
<td>55</td>
<td>56</td>
<td>57</td>
<td>58</td>
<td>59</td>
<td>60</td>
<td>61</td>
</tr>
<tr>
<td>Axis selection No. (R8)</td>
<td>64</td>
<td>65</td>
<td>66</td>
<td>67</td>
<td>68</td>
<td>69</td>
<td>70</td>
</tr>
</tbody>
</table>

- **7-axis dual-arm robot (such as SDA)**

<table>
<thead>
<tr>
<th>Target axis</th>
<th>S</th>
<th>L</th>
<th>U</th>
<th>R</th>
<th>B</th>
<th>T</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis selection No. (R1)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Axis selection No. (R2)</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Target axis</td>
<td>EX1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis selection No. (S1)</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2 Setting and Operation for Data Measurement
2.3 Setting Measurement Conditions

EX1 in this table corresponds to the waist axis (external axis) of dual-arm robot.

○ Normal 6-axis robot + external axis, R1 to R8 (R1 + S1 [3-axis] setting)

<table>
<thead>
<tr>
<th>Target axis</th>
<th>S</th>
<th>L</th>
<th>U</th>
<th>R</th>
<th>B</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis selection No. (R1)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Target axis</td>
<td>EX1</td>
<td>EX2</td>
<td>EX3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis selection No. (S1)</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

○ 7-axis robot + external axis (R1 + S1 [1-axis] + S2 [1-axis] setting)

<table>
<thead>
<tr>
<th>Target axis</th>
<th>S</th>
<th>L</th>
<th>U</th>
<th>R</th>
<th>B</th>
<th>T</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis selection No. (R1)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Target axis</td>
<td>EX1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis selection No. (S1)</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axis selection No. (S2)</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ø {OK}
Closes the window with the change given on the channel setting window reflected. When there is a measured waveform at the waveform display area, the waveform data is cleared.

When no change has been given after the channel setting window is opened, this button acts just as {CANCEL}.

Ø {CANCEL}
Closes the window without reflecting the change given on the channel setting window. The waveforms data is not cleared.
2.3.2 CH Display Setting Panel

With the data measurement stopped, select (touch) {ChCondition} tab on the condition setting panel. *fig. 2-5 “ChCondition Setting Panel”* shows the typical display example of the CH display setting panel.

*Fig. 2-5: ChCondition Setting Panel*

This panel allows the setting of panel display targeted to the channels validated in the channel setting window.

**Channel**

Select the target channel for setting operation. Upon the channels set here, the setting change given to the following options ② to ⑤ is reflected.

Note that the invalid channels are disabled (in which the radio button is inoperable), and cannot be selected.

**Display**

Enables to select either to display {ON} or hide {OFF} the waveform data of target channel. The data is internally stored even when the data is measured with the Display {OFF}, and the corresponding waveform data is displayed when Display {ON} is selected.
2 Setting and Operation for Data Measurement

2.3 Setting Measurement Conditions

- **Invert**
  Enables to select either to invert the waveform data of target channel or not. Selecting Invert (ON) inverts the display of waveform data in a waveform display area between positive and negative. Selecting Invert (OFF) returns to the original state.

- **Position**
  Sets the zero position of target channel. Specify the zero point within the range of -5.0 to 5.0 [div] in the vertical axis of waveform display area.

  On the extreme left of waveform display area, a marker is provided showing a zero point for each channel in which the current zero point can be confirmed (see fig. 2-6 “Zero Point Marker”).

**Fig. 2-6: Zero Point Marker**

- **Unit (rpm/div, %/div, U/div)**
  Selects the reference unit of target channel in the vertical axis scale. (For description of the unit, refer to chapter 5.2 “Reference Unit”.)

  Displayed unit and its selection depend on the signal output by the target channel.

  Speed reference, Speed FB:
  Unit [rpm/div]: selectable among 250, 500, 1000, and 2000

  Torque reference:
  Unit [%/div]: selectable among 3.3, 5, 6.6, 10, 33, 50, 66, and 100

  Encoder temperature:
  Unit [°C/div]: selectable among 10, 20, and 40

  Concurrent I/O signal:
  Unit [U/div]: selectable among 0.2, 0.5, 1.0, 2.0, 5.0, and 10.0

  Register:
  Unit [-/div]: selectable among 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 3277, 5000, 6554, 10000, 13107, 20000, 32768, 50000 and 65535.
2.3 Setting Measurement Conditions

2.3.3 TimeScale Setting Panel

With the data measurement stopped, touch {TimeScale} tab on the condition setting panel. Fig. 2-7 “TimeScale Setting Panel” shows the typical display example of TimeScale setting panel.

Fig. 2-7: TimeScale Setting Panel

 обычный

ω ms/div

Sets the time for the horizontal axis of the waveform display area. The value selected here should be the time width [ms] per division of horizontal axis. Since there are 10 divisions in the entire horizontal axis, the eventual data length is 10 times of the specified value.

Selectable range of ms/div depends on the combination of sampling time set on the Channel Setting window:

- With the sampling time of 2 [ms]:
  Up to 2000 [ms/div] (data length: 20 [s])

- With the sampling time of 4 [ms]:
  Up to 5000 [ms/div] (data length: 50 [s])

- With the sampling time of 8 [ms] or more:
  Up to 10000 [ms/div] (data length: 100 [s])
2.3.4 Trigger Setting Panel

With the data measurement stopped, select (touch) {Trigger} tab on the condition setting panel. fig. 2-8 "Trigger Setting Panel" shows the typical display example of Trigger setting panel.

This panel allows the setting of trigger function.

Fig. 2-8: Trigger Setting Panel

The trigger function is the function to automatically stop the measurement and display the waveform at the point where a certain condition is satisfied during the data measurement.

As trigger conditions, three options are available: when the target channel data exceeds or falls below the specified value (trigger level), or when any alarm occurs.

The data stop position is determined by Pre-trigger. The measurement result is displayed so that the position satisfying the trigger conditions becomes the Pre-trigger position. For example in fig. 2-9 "Outline of Trigger Function", the data length is 10 [s] and the specified Pre-trigger is 3 [div] in horizontal axis. This allows the setting where the data before the trigger is acquired for 3 seconds, and the data after the trigger is acquired for 7 seconds.

Fig. 2-9: Outline of Trigger Function

Select the channel as trigger target. Only the valid channel is selectable.
2 Setting and Operation for Data Measurement
2.3 Setting Measurement Conditions

☞ TrgType (Trigger type)

Select the trigger type to use. Selectable options are Up, Down, Up&Down, and Alarm.

When selecting Alarm, some of the setting parameters of Trigger Conditions are changed.

Table 2-2: Characteristics of Trigger Type

<table>
<thead>
<tr>
<th>Trigger type</th>
<th>Trigger condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up</td>
<td>When the trigger target channel data exceeds the trigger level</td>
</tr>
<tr>
<td>Down</td>
<td>When the trigger target channel data falls below the trigger level</td>
</tr>
<tr>
<td>Up&amp;Down</td>
<td>When the trigger target channel data is either over or below the trigger level</td>
</tr>
<tr>
<td>Alarm</td>
<td>When the alarm assigned to alarm number occurs</td>
</tr>
</tbody>
</table>

☞ PreTrg (Pre-trigger)

Specify the pre-trigger position by the horizontal axis division (0 to 10.0).

Current pre-trigger position is shown by a marker on the upper part of the waveform display area (see fig. 2-10 “Pre-trigger Marker”).

Fig. 2-10: Pre-trigger Marker
2 Setting and Operation for Data Measurement
2.3 Setting Measurement Conditions

**Level**

Specify the trigger level by the vertical division (-10.0 to +10.0).

The current trigger level is shown by a marker on the left of the waveform display area (see fig. 2-11 “Trigger Level Marker”).

The marker shape depends on the selected trigger type.

*Fig. 2-11: Trigger Level Marker*

The value specified here is regarded as a position with the zero point of trigger target channel as reference. When the trigger level is specified as 2.5 [div] with the channel zero position of -2.0 [div] (in vertical axis), the displayed position of trigger level on the waveform display area is 0.5 [div] (in vertical axis). (See the example of fig. 2-9 “Outline of Trigger Function”.)

**TriggerMode**

Switches the valid/invalid state of trigger. According to this setting, the waveform data acquisition mode is switched.

- Invalid: Continuous mode

When the waveform data measurement is started, the acquired data is continuously displayed in a time-series order.

- Valid: Trigger mode

The measurement is automatically stopped when the trigger conditions are satisfied, and the waveform is displayed.

○ When {Alarm} is selected as TrigType:

When {Alarm} is selected as the trigger type, the only condition for the trigger is when the target alarm specified here by the number occurs. The alarm trigger does not depend on the channel setting, so the settings of {CH} or {Level} are not referred.

*fig. 2-12 “Trigger Setting Panel (Alarm Trigger)” shows the typical display example when the option {Alarm} is selected as TrigType.*
2 Setting and Operation for Data Measurement
2.3 Setting Measurement Conditions

Fig. 2-12: Trigger Setting Panel (Alarm Trigger)

<table>
<thead>
<tr>
<th>CHCondition</th>
<th>TimeScale</th>
<th>Trigger</th>
<th>Zoom</th>
<th>Measure</th>
<th>Save</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH: 4</td>
<td></td>
<td>TrgType: Alarm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PreTrg(div): 5.0</td>
<td>AlarmNo: 4228</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TriggerMode</td>
<td></td>
<td>OFF</td>
<td>ON</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© AlarmNo

Selecting {Alarm} as the trigger type switches {Level} to an entry box of {AlarmNo}. Input a valid alarm number here. When a non-existent alarm number is specified, an error occurs when the measurement starts.

For details of alarm number, refer to “YRC1000 MAINTENANCE MANUAL (RE-CHO-A114)”.

NOTE

Major alarms, when occur, may contain abnormal data transmission between the controller hardware, and a normal operation of pendant oscilloscope cannot be guaranteed.

It is recommended that the target alarm number as the alarm trigger should be Minor or User alarms rather than Major alarms.
2.4 Starting and Ending Measurement

Here describes the step of actual data measurement. Ensure to start the measurement after completing the condition setting described in chapter 2.3 “Setting Measurement Conditions”.

2.4.1 Continuous Mode

The Continuous mode is the mode in which the measurement data is always displayed and updated in the time-series order. Follow the step below:

1. Select OFF for (TriggerMode) on the Trigger setting panel.
2. Start the measurement by (START). The data measurement starts, and the data is displayed in the time-series order on the waveform display area, and updated in series.
3. When the time passes longer than the specified data length from the measurement start, the data is discarded from the oldest one, and the new data is updated in series (see fig. 2-13 “Continuous Mode”).
4. When the target waveform data is displayed on the waveform display area, press (STOP) to stop the measurement.

Fig. 2-13: Continuous Mode

Continuous mode enables to display the measurement data in time-series order, but it does not necessarily assure the real-time display. The data contain a delay to a certain extent, and the delay can be extended as the measured data is large in volume.

The following setting changes help for the challenging of real-time display:

- Trying smaller number of available channels
- Trying longer sampling time
- Trying shorter data length
2.4.2 Trigger Mode

The Trigger mode automatically stops the measurement when the trigger condition is satisfied, and displays the waveform on the screen. Follow the step below:

1. Set the trigger conditions on the Trigger setting panel.
2. Select ON for {TriggerMode}.
3. Start the measurement by {START}. This starts the data measurement, and the waveform display area is turned to the waiting state, and holds the state until the trigger condition is satisfied. On the screen, a message “Waiting for trigger...” is displayed (see fig. 2-14 “Display of Trigger Mode “Waiting for trigger””). To cancel the measurement during this state, press {STOP}.

Fig. 2-14: Display of Trigger Mode “Waiting for trigger”

4. When the trigger condition is satisfied, “Triggered” is displayed on the screen (see fig. 2-15 “Display of Trigger Mode “Triggered””). To collect the waveform data later than the trigger position, the condition is held for as long as 100 seconds according to the setting of data length and pre-trigger. To cancel the measurement during this state, press {STOP}.

Fig. 2-15: Display of Trigger Mode “Triggered”

5. When all the waveform data for an entire window is acquired, the measurement automatically ends and the waveform is displayed.
2.5 Termination and Minimization of Pendant Oscilloscope Function

2.5.1 Termination of PP Oscilloscope

Pressing (CLOSE) on the Main screen terminates the PP oscilloscope. Each condition setting parameter is automatically saved, and the setting at the termination will be reflected at the next startup.

2.5.2 Minimizing PP Oscilloscope Application

Pressing (MINIMIZE) on the Main screen can minimize the PP oscilloscope application. Minimizing means the PP oscilloscope changes to the background process with running. When minimized PP oscilloscope disappears just as the system termination does, but the waveform measurement process is continued. This is useful when the operations on the other system screens are necessary with the waveform data measurement continued.

When an alarm or an error occurs on the controller, the PP oscilloscope application is forcefully minimized to display the alarm preferentially.

When the PP oscilloscope application is minimized during the data measurement, the following message is displayed on the message area of the Pendant System screen: “Measuring the pendant oscilloscope data.” (See fig. 2-16 “Message Display during the Data Measurement”).

Fig. 2-16: Message Display during the Data Measurement

Minimized PP oscilloscope application can be returned to the original state by selecting (Pendant Oscilloscope) from the menu as in the startup operation.
3 Saving and Loading the Measurement Data

This chapter describes the saving and loading of the measurement data.

3.1 SaveMode Setting Panel

With the data measurement stopped, select (touch) {Save} tab in the condition setting panel. fig. 3-1 "SaveMode Setting Panel" shows the typical example of SaveMode setting on the panel.

Fig. 3-1: SaveMode Setting Panel

 SaveMode

Enables to select Manual/Auto of the saving mode. In selecting the automatic saving mode (Auto), ensure to perform the setting with the external SD or USB memory inserted to the Programming Pendant.

NOTE

Automatic save mode

The automatic save function works only when the trigger mode is valid.

The data is saved when the trigger conditions are satisfied and the measurement is completed.

 {HardCopy}

Pressing the button enables to save the hard copy of the screen in SD or USB memory.

 {SaveCSV}

It is available only when {Manual} is selected for the SaveMode option. Pressing the button enables saving the measurement data into SD or USB memory.

3.1.1 Data File Name and Save Destination

The measurement data is saved in the CSV (Comma Separated Value) file format.

The file is automatically given a file name consisting of the time, date and the year when the save operation starts (yyyymmdd_hmmss.csv).

As the CSV file destination, a folder of the following address is automatically created in the external SD or USB memory of the pendant, and the data is saved in the folder:

¥PP_OSCILLOSCOPE¥csv¥user¥

The hard copy data of the screen is saved in the JPG (Joint Photographic Experts Group) format.
3 Saving and Loading the Measurement Data
3.1 SaveMode Setting Panel

The file is automatically given a file name consisting of the time, date and the year when the save operation starts (yyymmdd_hhmmss.jpg). The JPG file is saved in the root folder in the external SD or USB memory of the pendant.

When both SD and USB memory are inserted, USB memory is given priority for the data storage destination.

### 3.1.2 CSV File

The CSV file contains the setting parameters shown in table 3-1 “Parameters to Save for CSV Files”. The CSV file can be used for file output of waveform data, as well as for backup of the current setting status.

The setting parameters of TP oscilloscope are automatically saved to the pendant when {OK} is pressed on the Channel Setting window or {CLOSE} on the Main screen.

However, at system software version-up, these parameters are initialized. Use the CSV file for backup as necessary.

**Table 3-1: Parameters to Save for CSV Files**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling time</td>
<td>As left</td>
</tr>
<tr>
<td>Timescale setting</td>
<td>As left</td>
</tr>
<tr>
<td>(data length)</td>
<td></td>
</tr>
<tr>
<td>Channel setting</td>
<td>Valid/Invalid</td>
</tr>
<tr>
<td></td>
<td>Target</td>
</tr>
<tr>
<td></td>
<td>Signal</td>
</tr>
<tr>
<td></td>
<td>Target axis</td>
</tr>
<tr>
<td>Channel display setting</td>
<td>Zero point position</td>
</tr>
<tr>
<td></td>
<td>Reference unit</td>
</tr>
<tr>
<td></td>
<td>Display ON/OFF</td>
</tr>
<tr>
<td></td>
<td>Invert ON/OFF</td>
</tr>
<tr>
<td>Trigger setting</td>
<td>Target channel</td>
</tr>
<tr>
<td></td>
<td>Trigger type</td>
</tr>
<tr>
<td></td>
<td>Trigger level</td>
</tr>
<tr>
<td></td>
<td>Pre-trigger</td>
</tr>
<tr>
<td></td>
<td>Alarm number</td>
</tr>
<tr>
<td></td>
<td>Valid/Invalid</td>
</tr>
<tr>
<td>Waveform data</td>
<td>Waveform data of available channel(s)</td>
</tr>
</tbody>
</table>
3.2 Load Panel

With the data measurement stopped, select (touch) {Load} tab on the condition setting panel. fig. 3-2 “Load Panel” shows the typical example of the Load panel.

**Fig. 3-2: Load Panel**

The Load panel loads the CSV file previously saved to recreate the waveform and setting parameters (those in table 3-1 “Parameters to Save for CSV Files”) at that time.

The current setting parameters are overwritten by the loaded CSV file data when the data is loaded.

**Pull-down box for file selection**

Select the file to load. The pull-down menu displays the file name stored in the folder of the following address in the external SD or USB memory of the Programming Pendant:

¥PP_OSCILLOSCOPE¥csv¥user¥

When both SD and USB memory are inserted, USB memory is given priority.

When a file other than that saved in the PP oscilloscope is included in the above folder, it may appear on the list, but it will cause an error when it is loaded.

**{LoadCSV}**

After selecting the file to load, touch {LoadCSV}. A message, “Overwrite current setting. OK?” appears. Selecting {OK} starts the data loading.
4 Other Functions

4.1 Zoom Function

With the data measurement stopped, select (touch) {Zoom} tab on the condition setting panel. Fig. 4-1 “Zoom Function Setting Panel” shows the typical example of the Zoom function setting panel.

This panel enables to set and perform the zoom function.

Fig. 4-1: Zoom Function Setting Panel

The Zoom function is the function to enlarge the specified range within the waveform display area to the timescale direction.

Set the range to enlarge as in Fig. 4-2 “Outline of Zoom Function”, to perform the Zoom function.

Fig. 4-2: Outline of Zoom Function

Center

Specify the center position in the zoom range by the division (0 to 10.0) in the horizontal axis. The center position is not shown in the actual screen. It is the center between two width lines.

When pressing [SHIFT] + Cursor with {Zoom} tab opened, the center position may move to right and left at 0.05[div]. And when keep pressing [SHIFT] + Cursor, the center position may move at high speed.
4 Other Functions
4.1 Zoom Function

② Width
Specify the size of zoom range by width, with the center position specified in the Center. The width is shown in the waveform display area by a white line.

In case the width of the range to be zoomed extended outside the waveform display area, the center position is automatically adjusted so that the width fits inside the range.

③ {Zoom}
Touching this button after setting of Center and Width zooms the specified range.

4.1.1 During Execution of Zoom Function
When the Zoom function is performed, the currently displayed waveform disappears, and the data in the zoom range is enlarged and displayed on the waveform display area. Although the waveform before zoomed temporarily disappears, it is retained inside the system; once canceling the zoom function returns to the original state.

While the zoom function is performed, {Zoom} is switched to {ZoomCancel}.

NOTE
While the zoom function is performed, operations of {START} and {CH}, and of the panels as tab switch setting become unavailable. To enable these operations, touch {ZoomCancel}.
4.2 Cursor Measurement Function

With the data measurement stopped, select (touch) {Measure} tab on the condition setting panel. fig. 4-3 "Measure Panel and Cursor Display (with Vertical Cursor)" shows the typical example of the Measure panel.

Fig. 4-3: Measure Panel and Cursor Display (with Vertical Cursor)

The cursor measurement function is the function to read the data within the range selected by two cursors, calculate the values corresponding to the specified measurement parameters, and display the result.

CursorType

Select the cursor type either from Horizontal or Vertical. Select the type according to the usage. The {OFF} option makes the function unavailable.

CH

Specify the channel to which the cursor measurement is targeted. The channel specified as unavailable in the Channel Setting window cannot be selected.

Cursor1, Cursor2

When the vertical cursor is selected in CursorType, specify the cursor position in the horizontal division (0 to 10.0).

When the horizontal cursor is selected in CursorType, specify it in the vertical division (-5.0 to 5.0).

The area enclosed by Cursor1 and Cursor2 becomes the target area of cursor measurement. Even when the positions of Cursor1 and Cursor2 are switched, the target area is always the area inside these two lines.

The cursor is displayed by a white broken line on the waveform display area.

When there is no target channel data within the specified cursor range, a part of the measurement parameters is not calculated. When this happens, the result is shown in hyphens ("--").
4 Other Functions
4.2 Cursor Measurement Function

Cursor Mode

When pressing [SHIFT] + Cursor with {Zoom} tab opened, the center position may move 0.05[div] to right and left. And when keep pressing [SHIFT] + Cursor, the position may move at high speed.

When Horizontal cursor type is selected at ① on the display, the cursor moves horizontally, and it moves vertically when Vertical cursor type is selected.

Only the cursor 1 moves along the key input when “Cursor 1” is selected and only cursor 2 moves when “Cursor 2” is selected. Also, both cursor 1 and 2 moves when “1 and 2” is selected.
4.2 Cursor Measurement Function

4.2.1 Cursor Measurement Parameters

○ For horizontal cursor

With the cursor measurement valid, the measurement parameters and the calculation result are automatically displayed at the upper left of waveform display area. The type of measurement parameters in the horizontal cursor is shown in table 4-1 “Measurement Parameters of Horizontal Cursors”.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cursor1</td>
<td>Value of measurement target channel at the Cursor1</td>
</tr>
<tr>
<td>Cursor2</td>
<td>Value of measurement target channel at the Cursor2</td>
</tr>
<tr>
<td>MAX</td>
<td>Maximum value of measurement target channel between Cursor1 and Cursor2</td>
</tr>
<tr>
<td>MIN</td>
<td>Minimum value of measurement target channel between Cursor1 and Cursor2</td>
</tr>
<tr>
<td>P-P</td>
<td>(Peak to Peak: difference of MAX and MIN) Absolute value of the result obtained by: MAX-MIN</td>
</tr>
</tbody>
</table>

○ For vertical cursor

With the cursor measurement valid, the measurement parameters and the calculation result are automatically displayed at the upper left of waveform display area. The type of measurement parameters in the vertical cursor is shown in table 4-2 “Measurement Parameters of Vertical Cursors”.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Time width between Cursor1 and Cursor2</td>
</tr>
<tr>
<td>Cursor1</td>
<td>Value of measurement target channel at the Cursor1</td>
</tr>
<tr>
<td>Cursor2</td>
<td>Value of measurement target channel at the Cursor2</td>
</tr>
<tr>
<td>MAX</td>
<td>Maximum value of measurement target channel between Cursor1 and Cursor2</td>
</tr>
<tr>
<td>MIN</td>
<td>Minimum value of measurement target channel between Cursor1 and Cursor2</td>
</tr>
<tr>
<td>P-P</td>
<td>(Peak to Peak: difference of MAX and MIN) Absolute value of the result obtained by: MAX-MIN</td>
</tr>
<tr>
<td>RMS</td>
<td>(RMS: Root Mean Square) Data between Cursor1 and Cursor2; calculated actual value of the measurement target channel</td>
</tr>
</tbody>
</table>
4.3 Job Step No. Saving Function

When “1” is set to S2C1242, the job step No. saving function is enabled.

In this function, the job name and the step No. which are under execution at the time are added to the waveform data of the CSV file, and the waveform data and the job step No. are related and saved.

**NOTE** The job step No. saving function is available in the version DN1.61.00A(--)00 and the later.

![Fig. 4-4: Example for Adding Items to Be Saved in CSV File (Job Name and Step No.)](image)

<table>
<thead>
<tr>
<th>Time, ms.</th>
<th>CH1, rpm</th>
<th>CH2, %</th>
<th>Job Name</th>
<th>Step No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.000000</td>
<td>1.178869</td>
<td>“TESTJOB”</td>
<td>1</td>
</tr>
<tr>
<td>4.0</td>
<td>0.000000</td>
<td>1.483749</td>
<td>“TESTJOB”</td>
<td>1</td>
</tr>
<tr>
<td>8.0</td>
<td>0.000000</td>
<td>1.483749</td>
<td>“TESTJOB”</td>
<td>1</td>
</tr>
<tr>
<td>12.0</td>
<td>0.000000</td>
<td>1.483749</td>
<td>“TESTJOB”</td>
<td>1</td>
</tr>
</tbody>
</table>

The job name and the step No. are saved only when the play mode executes a job and when the teach mode executes a trial run or a NEXT operation. In a JOG operation or an IO jog operation, the job name and the step No. are not saved.

**Table 4-3: Conditions that Job Name and Step No. Are Saved**

<table>
<thead>
<tr>
<th>Operation</th>
<th>Saved/not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Playback</td>
<td>Saved</td>
</tr>
<tr>
<td>Trial run</td>
<td>Saved</td>
</tr>
<tr>
<td>Interlock + NEXT</td>
<td>Saved</td>
</tr>
<tr>
<td>NEXT</td>
<td>Saved</td>
</tr>
<tr>
<td>NEXT for P variable</td>
<td>Not</td>
</tr>
<tr>
<td>IO jog</td>
<td>Not</td>
</tr>
<tr>
<td>Jog operation</td>
<td>Not</td>
</tr>
</tbody>
</table>

**NOTE**

The job name and the step No. are assigned to the position instruction. On the other hand, the waveform data interprets the position instruction and acquires data when the motor operates actually. Therefore, deviations of acquisition timing for a certain time occurs between both data. Be careful when referring to the data which is close to the switching point of the step No.
4.3.1 Channel Setting

Only one control group can be specified at one measurement time as the control group which is targeted to acquire the job name and the step No.

The setting can be performed in Channel Setting screen of the PP oscilloscope (fig. 4-5 “Adding Items to “ControlGroup” of Channel Setting Screen”). When the job including a control group which is set in this item works, the job name and the step No. are saved.

Fig. 4-5: Adding Items to “ControlGroup” of Channel Setting Screen

4.3.2 Adjustment of Acquisition Time of Job Name and Step No.

When the job cursor reaches END or when the other job is called (when the assignment of the job name and the step No. to the targeted control group are stopped), the job name and the step No. which are output lastly can be kept recording for a certain time.

This can be performed when assignment of the job name and the step No. are interrupted because of the deviation of the waveform against the instruction.

S4C1039 can adjust this addition time (unit: msec, default value: 500 msec).
Fig. 4-6: Example for Acquisition Time of Job Name and Step No.

- Range that job names and step Nos. are generally added.
- Additional time for acquiring job names and step Nos.
- CH1, Signal for indicating "under running".
- CH2, Speed FB.
- CH3, Torque instruction.
4.4 Operation Function by Dedicated Input

When “1” is set to S2C1244, the signal operation function is enabled. This function makes the following operations performed on the programming pendant executable externally by the dedicated input signals.

- Starting PP oscilloscope
- Starting measurement
- Saving CSV file

Also, the PP oscilloscope status is output to the dedicated output signal, and it can be externally referred.

**NOTE**
This function aims to start measurement externally without operating and referring to the programming pendant. Therefore, it has no dedicated input signal to stop measurement. For stopping measurement, use the trigger mode.

### 4.4.1 Dedicated Input Signal

<table>
<thead>
<tr>
<th>40767</th>
<th>40766</th>
<th>40765</th>
<th>40764</th>
<th>40763</th>
<th>40762</th>
<th>40761</th>
<th>40760</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIN#608</td>
<td>SIN#607</td>
<td>SIN#606</td>
<td>SIN#605</td>
<td>SIN#604</td>
<td>SIN#603</td>
<td>SIN#602</td>
<td>SIN#601</td>
</tr>
<tr>
<td>OSC</td>
<td>SAVE START</td>
<td>OSC</td>
<td>MEAS.START</td>
<td>OSC</td>
<td>STARTUP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **40760: Starting Pendant Oscilloscope**
  Starts PP oscilloscope.
  When PP oscilloscope is in minimized status, it is released.
  This signal performs the same operation as the operation when pressing (Robot) → (Pendant oscilloscope) from the main menu.

**NOTE**
When it is in one of the following status, pendant oscilloscope cannot be started even if this signal is turned ON. After releasing the status, turn ON this signal.

- An error exists.
- Other external application is running.
4. Other Functions
4.4 Operation Function by Dedicated Input

- **40761: Pendant Oscilloscope Starting Measurement**
  Starts measurement.
  This signal performs the same operation as the operation when pressing [START] of PP oscilloscope.

- **40762: Pendant Oscilloscope Saving CSV File**
  Saves the measured data to the CSV file.
  This signal performs the same operation as the operation when pressing [Save CSV] of PP oscilloscope.

---

**NOTE**
The measurement start requesting signal (40761) and the CSV file saving requesting signal (40762) are monitored only when the signal acceptance ready (51172) is ON.

In order to accept the request surely, put a requesting signal with the following procedure.

- After the signal acceptance ready (51172) is turned ON, wait for 1 second, and then put the signal.
- After putting the signal, ON status should be maintained for 1 second or longer.
4.4 Operation Function by Dedicated Input

4.4.2 Dedicated Output Signal

Displays PP oscilloscope operation status. When PP oscilloscope is not running, all signals are OFF.

<table>
<thead>
<tr>
<th>50907</th>
<th>50906</th>
<th>50905</th>
<th>50904</th>
<th>50903</th>
<th>50902</th>
<th>50901</th>
<th>50900</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOUT#720</td>
<td>SOUT#719</td>
<td>SOUT#718</td>
<td>SOUT#717</td>
<td>SOUT#716</td>
<td>SOUT#715</td>
<td>SOUT#714</td>
<td>SOUT#713</td>
</tr>
<tr>
<td>MEASURING PP-OSC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>51177</th>
<th>51176</th>
<th>51175</th>
<th>51174</th>
<th>51173</th>
<th>51172</th>
<th>51171</th>
<th>51170</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOUT#936</td>
<td>SOUT#935</td>
<td>SOUT#934</td>
<td>SOUT#933</td>
<td>SOUT#932</td>
<td>SOUT#931</td>
<td>SOUT#930</td>
<td>SOUT#929</td>
</tr>
<tr>
<td>OSC SAVE ERROR</td>
<td>OSC SAVING</td>
<td>OSC MEAS.ERROR</td>
<td>OSC I/O READY</td>
<td>OSC MINIMIZE</td>
<td>OSC RUNNING</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **50903: Pendant Oscilloscope Under Measurement**
  
  Notifies that measurement is currently performed.
  
  Only this signal varies regardless of S2C1244 setting.

- **51170: Pendant Oscilloscope Running**
  
  Notifies that PP oscilloscope is running.
  
  This signal is turned ON even if PP oscilloscope is in minimized status.

- **51171: Pendant Oscilloscope Minimized**
  
  Notifies that PP oscilloscope is in minimized status.
  
  PP oscilloscope is minimized by the following factors:
  
  - The {MINIMIZE} is pressed.
  - An alarm or an error occurs.

  The minimized status can be canceled by selecting (Pendant oscilloscope) from the main menu or using the start requesting signal (40760).
4 Other Functions
4.4 Operation Function by Dedicated Input

51172: Pendant Oscilloscope IO Acceptance Ready
Notifies that PP oscilloscope is monitoring the start request (40761) and the CSV file saving request (40762).

Only when the following conditions are satisfied, this signal is turned ON.
- Measurement CH settings are completed.
- Not under measurement.
- Not under saving the CSV file.
- Not in the minimized status.
- Not under zooming (Section 4.1.1).

51173: Pendant Oscilloscope Measurement Error
Notifies that the measurement failed to start when {START} or the start requesting signal (40761) tried to start measurement. Check that there are no errors in the measurement conditions.

This signal is turned OFF when newly starting measurement.

51174: Pendant Oscilloscope CSV File Under Saving
Notifies that the CSV file is under saving.

51175: Pendant Oscilloscope CSV File Error in Saving
Notifies that saving is failed when starting saving with {Save CSV} or the CSV file saving requesting signal (40762). Check the condition of the external storage device.

This signal is turned OFF when newly starting saving.

When requesting saving in the condition that the measurement is never performed after starting PP oscilloscope, saving is not performed but this signal is not turned ON.
4.5 Simultaneous Display of Waveform Display Area and Reading Job

After measuring the waveform, the waveform display area and the measured job (reading job) can be displayed simultaneously to check the relation with the waveform and the measured job.

When using this function, set the job step No. saving function described in chapter 4.3 “Job Step No. Saving Function” to be enabled.

A reading job is only for reading. This job cannot be edited.

4.5.1 Displaying Method

1. Set the parameter S2C1242 to 1, and set the job step No. saving function to be enabled.
2. Select {ROBOT} from the menu in the left of screen.
3. Select {PENDANT OSCILLOSCOPE} from the expanded menu.
4. Specify the control group according to chapter 4.3.1 “Channel Setting”.
5. Press {START} to start the measurement.
6. When the targeted data waveform is displayed in the waveform display area, press {STOP} to stop the measurement. {MULTI} is activated.

Fig. 4-7: {MULTI}
7. Press {MULTI}.
   The reading job and the waveform display area are displayed simultaneously.

Fig. 4-8: Reading Job and Waveform Display Area

8. Selecting {ROBOT} - {PENDANT OSCILLOSCOPE} again clears the waveform data.
4.5 Simultaneous Display of Waveform Display Area and Reading Job

4.5.2 Display Items

Fig. 4-9: Reading Job and Waveform Display Area

Each item on the screen means as follows:

① JOB
Displays a job name of the measured data.

② STEP
Displays a step number of the measured data.

③ Cursor
Indicates the data when the step number of the job name displayed at ① and ② is executed.

④ Condition setting panel
Enables to set various conditions.
Touching the upper tab enables to open the setting window corresponding to each item.

⑤ READING JOB
A job only for reading.
The cursor positions of ③ and the cursor position of the job indicate the same position.

⑥ {EDIT JOB}
Pressing this button switches from the reading job to the ordinary job which can be edited.
4.5 Simultaneous Display of Waveform Display Area and Reading Job

### 4.5.3 Operating Methods

1. After finishing displaying the waveform, press {MULTI}.
2. Select a tab of the condition setting panel {Info} or {Save}.
3. Press [SHIFT] + Cursor to move the cursor on the waveform display area and the cursor on the job together in step units. The relation with the waveform and the job can be checked. With {Zoom} tab open, press [SHIFT] + Cursor, the center position may move to right or left.

*Fig. 4-10: Interlocked Movement Between Cursor on Waveform Display Area and Cursor on Reading Job*

4. When editing the job with checking the waveform, press {EDIT JOB}. A reading job is only for reading. This job cannot be edited. Pressing {EDIT JOB} switches from the reading job to the ordinary job, and the job can be edited. When pressing {EDIT JOB}, a dialog which indicates the operation cannot be restarted is displayed.

### NOTICE

When a job is switched from the reading job to the ordinary job by pressing [EDIT JOB], the cursor position of the job moves to the cursor position specified by the reading job. Therefore, after the subsequent restart, the robot cannot resume its operation. When performing the restart, check the robot position and the cursor position, and then execute the restarting operation.
4 Other Functions
4.5 Simultaneous Display of Waveform Display Area and Reading Job

Fig. 4-11: Dialog to Indicate Operation Cannot Be Restarted

5. Selecting (YES) switches to the ordinary job.

Fig. 4-12: Ordinary Job and Waveform Display Area

6. The job is enabled to be edited.
When performing edit other than adding a move instruction, pressing (VIEW JOB) can display READING JOB again.
When adding a move instruction, READING JOB cannot be displayed again.
4.5.4 When in 3D Graphical Display Function

When the 3D graphical display function, which is an optional function, is valid, the waveform display area and the robot's 3D model can be displayed simultaneously to check the relation between the waveform and the robot position.

1. After finishing displaying the waveform, press \{MULTI\}.

**Fig. 4-13: When 3D Graphic Display is Valid**

2. Press \{3D-ROBOT\} to display the 3D model.

**Fig. 4-14: 3D-ROBOT and Waveform Display Area**

3. Select a tab of the condition setting panel \{Info\} or \{Save\}.

4. Press [SHIFT] + Cursor to operate the cursor on the waveform display area and the 3D robot together in step units. The relation between the waveform and the robot position can be checked.
   The 3D robot operates at the teaching position of the step.
5 Supplementary Explanation

Here explains some of the terms used in this manual.

5.1 Division [div]: Unit for Measurement Screen Position

The PP oscilloscope includes the operation that specifies the various positions (or range) in the waveform display area, such as specifying zero point of measurement channel, specifying cursor range, or zoom range. To specify these positions, unit of “division [div]” is used. Here describes the details.

The waveform display area is represented in a range of 10 vertical grids and 10 horizontal grids. The cell consisted of a vertical grid and a horizontal grid is called as Division [div], both for vertical axis and horizontal axis. The vertical axis is divided into 10 cells, 5 for the upper part and 5 for the lower part. The center is regarded as 0 [div], and the maximum value in the upmost position is 5 [div], whereas the minimum value in the bottom position is -5 [div]. For the horizontal axis, the left end position is regarded as 0 [div], and the right end position is 10 [div]. The outline is shown in fig. 5-1 “Illustration of Division in Waveform Display Area”.

For example, in specifying 3 [div], if it is given to the vertical axis, it shows the location 1 in fig. 5-1, whereas if it is given to the horizontal axis, it shows the location 2.

Fig. 5-1: Illustration of Division in Waveform Display Area

Vertical direction

Horizontal direction

-5div

0div

5div

1div

1div

0div

10div

2
5.2 Reference Unit

Here describes the reference unit.

The data of measurement target has each unit, as shown in table 5-1 “Unit of Data”.

Table 5-1: Unit of Data

<table>
<thead>
<tr>
<th>Data type</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed reference</td>
<td>[rpm] Rotating speed of target axis motor in a minute</td>
</tr>
<tr>
<td>Speed feedback</td>
<td>[rpm] Actual rotating speed of target axis motor in one minute</td>
</tr>
<tr>
<td>Torque reference</td>
<td>[%] Current torque reference value when the target axis motor rated torque is converted as 100%.</td>
</tr>
<tr>
<td>Encoder temperature</td>
<td>[°C] Current temperature of target measurement axis encoder</td>
</tr>
<tr>
<td>Concurrent I/O</td>
<td>No unit, for it is just an ON/OFF signal. To differentiate from other signal data, [U] (unit) is used for expediency. OFF: 0 U is output ON: 1.0 U is output</td>
</tr>
<tr>
<td>Register</td>
<td>No unit, for it is just an register value. Register value is output without changed. Example: When the vertical scale is 100[-/div] and the target register value is 200, the output of 2 divisions is given.</td>
</tr>
</tbody>
</table>

When the speed reference is selected as a measurement signal of the target channel, the initial value of the reference unit is 1000 [rpm/div]. This means that the speed is 1000 [rpm] when the output of vertical 1 [div] is given from the target channel zero position. From this relationship, the outline of waveform data output on the waveform display area can be grasped.

Example: with the setting of 1000 [rpm/div]:

- Output of 2.0 [div]: 2000 [rpm]
- Output of -3.3 [div]: -3300 [rpm]

Since the reference unit can be changed in (ChCondition) tab, the waveform display scale in the vertical direction can be changed accordingly.

Example: with the actual output of 1000 [rpm]:

- Setting of 1000 [rpm/div]: Output of 1 division
- Setting of 500 [rpm/div]: Output of 2 divisions

NOTE
This temperature sensor is to detect an encoder error. There might be a little difference between the actual temperature and the encoder temperature which is output by this function.
6 Error Messages

The pendant oscilloscope can output the messages for confirming the operation or notifying the process completion. Especially when the data acquisition error or abnormal setting should occur, the application outputs error messages such as shown in Fig. 6-1 “Example of Error Message” to notify the problem.

When any error message is displayed, first check the content, touch (OK) to clear the message, and follow necessary countermeasures.

Fig. 6-1: Example of Error Message

![Error Message Example](image)

Table 6-1 “Error Messages and Countermeasures of PP Oscilloscope” shows the list of error messages and the countermeasure.

Table 6-1: Error Messages and Countermeasures of PP Oscilloscope

<table>
<thead>
<tr>
<th>Error messages</th>
<th>Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input the value between ** and **. The value to ** decimal places can be input.</td>
<td>The input value is out of the limitation of input box. Retry inputting a correct value according to the error message. This error can occur in all of the input boxes.</td>
</tr>
<tr>
<td>Input the numeric value. (**: numerical value)</td>
<td>A non-existent number is specified as the alarm number of alarm trigger. Retry setting a correct number.</td>
</tr>
<tr>
<td>The specified number for the alarm trigger is not correct.</td>
<td>The trigger level is out of the waveform display area due to excessively large trigger level or channels zero position. Check the trigger level setting.</td>
</tr>
<tr>
<td>Review the setting.</td>
<td>The axis number which doesn’t exist in the system has been specified. Review the channel setting.</td>
</tr>
<tr>
<td>Any trigger can be detected with this setting.</td>
<td>The axis number which does not exist in the system is specified to either of axes in the channel setting window. Set the correct number.</td>
</tr>
<tr>
<td>Review the trigger level setting.</td>
<td>The concurrent I/O number which does not exist is specified. Set the correct number.</td>
</tr>
<tr>
<td>The axis number which doesn’t exist in the system has been specified.</td>
<td>Process time for data acquisition is not enough for the volume of measurement data. Set a slower sampling time, or decrease the available channel number.</td>
</tr>
<tr>
<td>Review the channel setting.</td>
<td></td>
</tr>
<tr>
<td>Input correct I/O number.</td>
<td></td>
</tr>
<tr>
<td>Processing time insufficient.</td>
<td></td>
</tr>
<tr>
<td>Set slower sampling time or decrease the number of available channels.</td>
<td></td>
</tr>
</tbody>
</table>
### Table 6-1: Error Messages and Countermeasures of PP Oscilloscope (Sheet 2 of 2)

<table>
<thead>
<tr>
<th>Error messages</th>
<th>Countermeasures</th>
</tr>
</thead>
</table>
| The acceptable delaying range of graph drawing exceeded. Implement any of the following countermeasures.  
  - Set slower sampling time.  
  - Decrease the number of available channels.  
  - Set shorter value for Time Scale setting. (Shorten the data length.)       | Process time for graph drawing is not enough for the volume of measurement data.  
  Set a slower sampling time, decrease the available channel number, or set shorter timescale value. |
| No corresponding data exists within the zoom range.                            | There is no measurement data within the zoom range currently specified. Set the zoom range again. |
| Cannot recognize Flash Memory. Setting for SaveMode is switched from Auto to Manual. | Insert SD or USB memory and set SaveMode again.                               |
| Cannot recognize Flash Memory. SaveMode is switched from Auto to Manual. Perform manual saving if necessary. | Flash memory could not be recognized at data save. Insert SD or USB memory and retry data saving manually. |
| Failed in saving CSV file. Perform manual saving if necessary.                | An error has occurred in flash memory. Try SD or USB memory insertion again or replacement, and retry data saving manually. |
| Not enough disk space. Make room for the file to perform manual saving.      | Assure enough disk space for SD or USB memory.                                |
| File format is not correct.                                                   | The file to load has not been matched with the data format of PP oscilloscope. Check if the file has been correctly saved. |
| Failed in loading CSV file.                                                   | The file to load has been found not to be the correct file for the PP oscilloscope. The file cannot be loaded. |
| File not specified.                                                           | Specify the file to load.                                                     |
| Specified file not exist.                                                     | The specified file does not exist on the SD or USB memory.                    |
| Failed in starting measurement.                                               | An error has occurred at measurement start, and the measurement cannot be started. Retry the measurement. If the alarm persists, terminate the pendant oscilloscope application, and restart the application. |
| Failed in obtaining measured value.[**] Measurement is canceled. (**: numerical value) | An error was found in the acquired measurement data. The system is forcefully turned into the measurement stop condition. Retry the measurement. If the alarm persists, terminate the pendant oscilloscope application, and restart the application. |
| Failed in completing measurement.                                             | The measurement process has not been correctly completed.                  |

([**]) Measurement is canceled.