



# **FD CONTROLLER INSTRUCTION MANUAL OSCILLOSCOPE FUNCTION**

**1st edition**

- Before attempting to operate the robot, please read through this operating manual carefully, and comply with all the safety-related items and instructions in the text.
- The installation, operation and maintenance of this robot should be undertaken only by those individuals who have attended one of our robot course.
- When using this robot, observe the law related with industrial robot and with safety issues in each country.
- This operating manual must be given without fail to the individual who will be actually operating the robot.
- Please direct any queries about parts of this operating manual which may not be completely clear or any inquiries concerning the after-sale service of this robot to any of the service centers listed on the back cover.

**NACHI-FUJIKOSHI CORP.**



# Table of Contents

## Chapter1 Outline

1.1 General description of oscilloscope function .....	1-1
1.1.1 Read this first.....	1-1
1.1.2 General description of oscilloscope function.....	1-1
1.1.3 Specifications of oscilloscope function .....	1-2
1.2 Overview of operation.....	1-3
1.2.1 Setup .....	1-3
1.2.2 Operation from settings to display.....	1-3

## Chapter2 Operation

2.1 Setting the measurement data and conditions .....	2-1
2.1.1 Specifying the measurement data .....	2-1
2.1.2 Specifying the name of the data file to be saved .....	2-4
2.1.3 Specifying the sampling time and sampling frequency .....	2-5
2.1.4 Specifying the trigger condition .....	2-6
2.1.5 Completing the settings (= starting the measurement) .....	2-8
2.1.6 Selecting the measurement conditions from the existing files .....	2-9
2.2 Performing the measurements .....	2-10
2.2.1 Starting the measurements.....	2-10
2.2.2 Checking the current trace status.....	2-10
2.2.3 Aborting the measurements .....	2-11
2.3 Displaying the measurement results .....	2-12
2.3.1 Select [25 Robot Diagnosis] from <Service Utilities>.....	2-12
2.3.2 Adjusting the scale automatically and displaying it .....	2-13
2.3.3 Various operations using f12<Viewer Setting> .....	2-13
2.3.4 Displaying or not displaying the waveforms for each channel .....	2-14
2.3.5 Moving waveforms up or down or to the left or right .....	2-15
2.3.6 Zooming in and zooming out the waveforms up or down or to the left or right.....	2-16
2.3.7 Reading data from the waveforms .....	2-18
2.3.8 Returning the scale, etc. to the default setting .....	2-20
2.3.9 Checking the detailed settings of the measurement conditions.....	2-21
2.3.10 Saving data in data files .....	2-22
2.3.11 Copying waveforms using bitmap files .....	2-24
2.3.12 Exiting waveform browsing.....	2-24

NOTE

# Chapter1 Outline

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This chapter gives a general description of the oscilloscope function.

1.1 General description of oscilloscope function.....	1-1
1.1.1 Read this first .....	1-1
1.1.2 General description of oscilloscope function .....	1-1
1.1.3 Specifications of oscilloscope function .....	1-2
1.2 Overview of operation .....	1-3
1.2.1 Setup .....	1-3
1.2.2 Operation from settings to display.....	1-3



## 1.1 General description of oscilloscope function

### 1.1.1 Read this first

The oscilloscope function is an optional software.

To handle the oscilloscope function, users must have a certain level of technical knowledge. Therefore, this instruction manual is meant for users who can perform general operations and have the basic knowledge regarding the robot control.

### 1.1.2 General description of oscilloscope function

As shown in the figure below, the control unit is a configuration of the motion controller that controls the position by interpreting the task program, the I/O device that manages I/O signals, and the drive unit that controls the servo motor.

The oscilloscope is a very useful function that can measure the motion data such as the speed, position, accel. commands, speed command to the servo motor, servo data such as the command current and the condition of the I/O signal, without using any measuring devices other than the teach pendant.

There is no need to use a digital oscilloscope or any other measuring instruments available on the market since all the necessary operations can be performed using the teach pendant.

Naturally, it is also possible to undertake measurements during playback operations of the robot.

With the oscilloscope function, the motion control unit samples the data. This means that not only the command speeds and other motion control unit output data but the actual speeds, actual current levels and other feedback data from the servo control unit as well as the input/output signals can be measured at the same time. The logical input/output signals inside the motion control unit are directly observed. This means that all the input/output signals can be measured independently of such physical devices as the DC 24 V power supply and field bus.

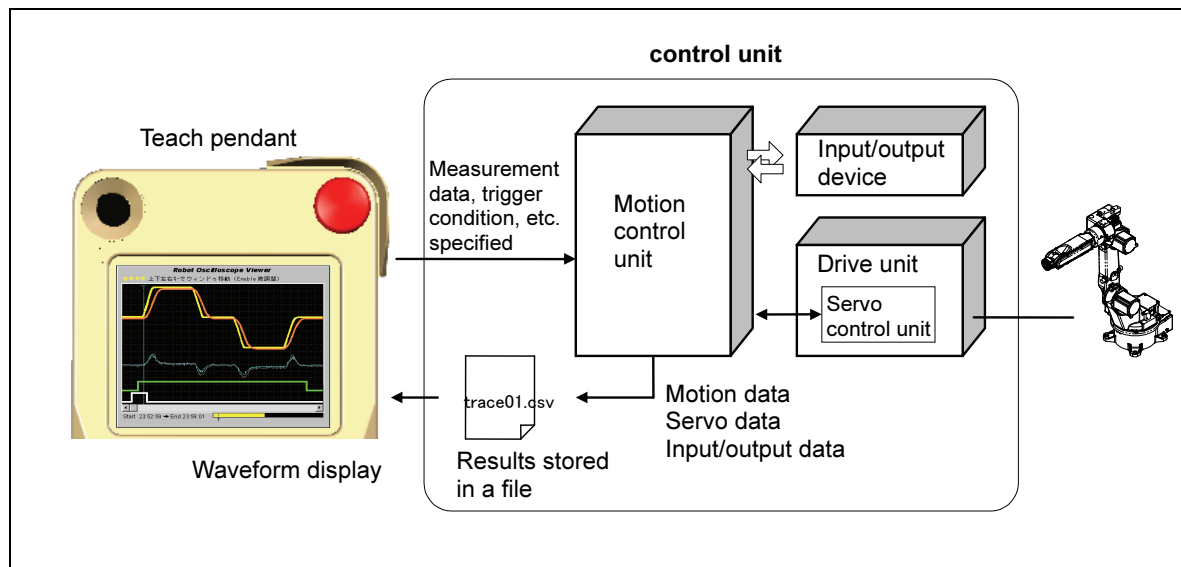


Fig. 1.1.1 Configuration of oscilloscope function

When the measurement conditions are exited, they are automatically stored in a file, after which the waveforms are displayed on the teach pendant. If the filenames are changed and a multiple number of files are stored in the memory, filenames can be specified and waveforms browsed at any time.

The files are stored in the CSV (Comma Separated Value) text file format, and their data can therefore be browsed using Excel (\*1) or other software programs available on the market. When input/output data (data consisting of 0's and 1's) and other data have been measured at the same time, the scales differ significantly and, as a result, it is not possible to display the data satisfactorily using a software program available on the market. However, using the oscilloscope function of the control unit, the scale is automatically adjusted and clearly defined waveforms can be browsed at any time.

(\*1) Excel is a registered trademark of Microsoft Corporation of the U.S.A.

### 1.1.3 Specifications of oscilloscope function

Table 1.1.1 Specifications of oscilloscope function

Item	Specification		
Measurement data	The data listed below, can be obtained. The motion and servo data can specify any of the units/mechanisms/axes.		
	Source	Data	Details
	Motion	Position Command	Displays the position command with each axes' angle.
		Position Command(Motor)	Displays the command position with the motor's position.
		Velocity Command	The position command's time derivation.
		Accel Command	The position command's time derivation (twice).
		Command Torque	The position command's occurrence torque.
		Interpolation Time	The command value's calculation time.
		Tcp CMD Velocity	The command speed of TCP.
		Tcp CUR Velocity	The current speed of TCP.
		Tcp CMD Position	The command position of TCP.
		Tcp CUR Position	The current position of TCP.
		Analog input	The input voltage of when mounting the analogue input board.
	Servo	Servo Status#1,#2	Currently unsupported
		Position	Motor's current position
		Velocity	Motor's speed
		Velocity cmd	Motor's speed command
		Q Phase	Motor's current
		Command Current	Motor's current command
		Current	Currently unsupported
		A.P.Monitor#1-#4	Currently unsupported
	Input	—	Input signal
	Output	—	Output signal
Number of channels	Up to 10 channels simultaneously		
Sampling frequency	10Hz - 100 Hz (*1)		
Sampling time	The maximum number of data that can be sampled in a single measurement is 1000. Therefore, sampling cycles and maximal length will be as follows; Sampling cycle 10 Hz; maximal length of 100 seconds Sampling cycle 25 Hz; maximal length of 40 seconds Sampling cycle 50 Hz: maximal length of 20 seconds		
Trigger conditions	Can be selected from the following 6 types; "Fault", "Rise & Fall", "Start tracing key", "Playback Start", "Playback Stop" and "Step Start." For the details of each condition, refer to "2.1.4 Specifying the trigger condition."		
Waveform browsing	Movement, zooming in and zooming out, and data readout for each channel		
Data storage	Data stored as text files (in CSV format) Copying of bitmap image files also possible		

(\*1)

Depending on the mechanism and unit configurations, the values that can be selected will change. Also, when measuring an order that is more specific (for example, in occasions such as observing the current's behavior with the micro-second order), this function cannot be used. In this case, use other measuring instruments that are available in the market, such as the digital oscilloscope, that can measure the analogue current, outputted from the drive unit (the servo data will be the only data that will be measured. Motion data, such as the speed command, and input/output data will not be measured.)



## 1.2 Overview of operation

### 1.2.1 Setup

The oscilloscope function is an optional software. When using this function, the options of the “Oscilloscope Function” must be set so that it can be used.

The hardware is unnecessary for this function.

### 1.2.2 Operation from settings to display

The oscilloscope function of the control unit displays the waveforms after the data measurements have been completed. It is not a function that monitors the data being measured on a realtime basis.

The sequence of steps taken is as follows. Measurement commences after the data items to be measured, trigger condition, name of the file in which the data is to be stored and so on have been specified. Upon completion of the measurements, the measurement data stored in the memory is saved in a file, after which the data is displayed on the teach pendant.

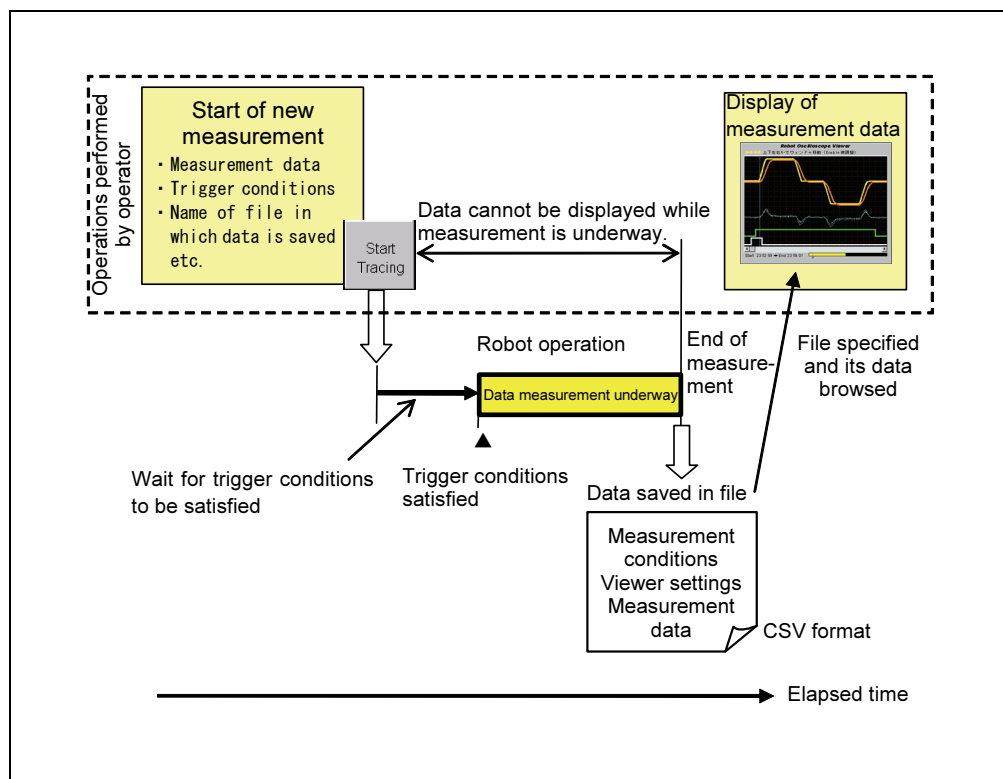


Fig. 1.2.1 Operation from settings to display

NOTE

# Chapter2 Operation

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This chapter describes how to actually measure the data using the oscilloscope function.

2.1 Setting the measurement data and conditions .....	2-1
2.1.1 Specifying the measurement data .....	2-1
2.1.2 Specifying the name of the data file to be saved .....	2-4
2.1.3 Specifying the sampling time and sampling frequency .....	2-5
2.1.4 Specifying the trigger condition .....	2-6
2.1.5 Completing the settings (= starting the measurement) .....	2-8
2.1.6 Selecting the measurement conditions from the existing files .....	2-9
2.2 Performing the measurements .....	2-10
2.2.1 Starting the measurements .....	2-10
2.2.2 Checking the current trace status .....	2-10
2.2.3 Aborting the measurements .....	2-11
2.3 Displaying the measurement results .....	2-12
2.3.1 Select [25 Robot Diagnosis] from <Service Utilities>. ....	2-12
2.3.2 Adjusting the scale automatically and displaying it .....	2-13
2.3.3 Various operations using f12<Viewer Setting> .....	2-13
2.3.4 Displaying or not displaying the waveforms for each channel .....	2-14
2.3.5 Moving waveforms up or down or to the left or right .....	2-15
2.3.6 Zooming in and zooming out the waveforms up or down or to the left or right .....	2-18
2.3.7 Reading data from the waveforms .....	2-18
2.3.8 Returning the scale, etc. to the default setting .....	2-20
2.3.9 Checking the detailed settings of the measurement conditions .....	2-21
2.3.10 Saving data in data files .....	2-22
2.3.11 Copying waveforms using bitmap files .....	2-24
2.3.12 Exiting waveform browsing .....	2-24



## 2.1 Setting the measurement data and conditions

This chapter explains the procedure for setting the measurement data when conducting new measurements. Set the measurement data, trigger condition, and the name of the file in which the data is to be saved, etc. for each channel.

To display data which has already been measured, start reading from 2.3 Displaying the measurement results.

In order to perform operations regarding the oscilloscope function, the operator qualification must be set above *EXPERT*. Make sure to change the qualifications beforehand.

### 2.1.1 Specifying the measurement data

First, specify which data is to be measured.

Since there are up to 10 channels, perform the following settings for each of the channels whose data is to be measured.

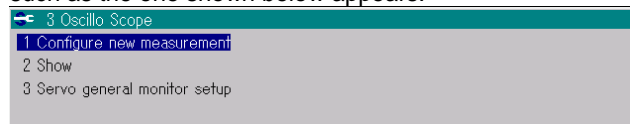
When a multiple number of channels are to be used, it is not necessary for the channel numbers to be consecutive.



#### 1 Select [25 Robot Diagnosis] from <Service Utilities>.

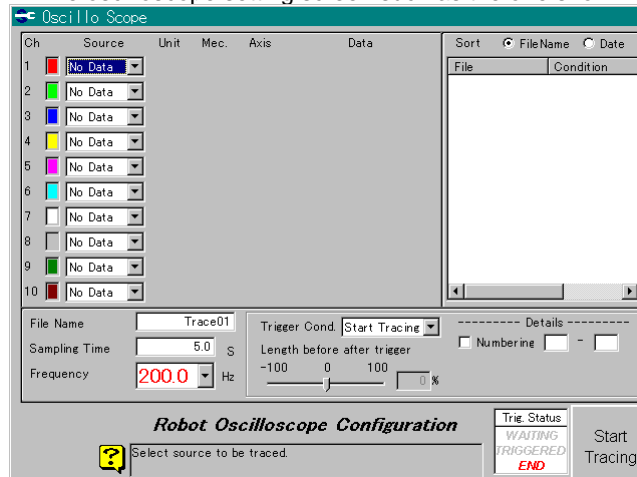


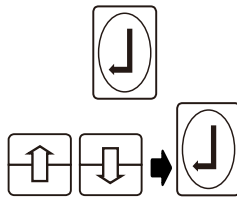
When [3 Oscillo Scope] is selected from the items on the menu displayed, a screen such as the one shown below appears.



#### 2 Select [1 Configure new measurement].

>>The oscilloscope setting screen such as the one shown below appears.





- 3 Align the cursor with the top left CH1 (channel 1) source box, and press the [Enter].**

>>The options listed below are displayed in the combo box. Select the desired option using the [Up] or [Down], and press the [Enter] again.

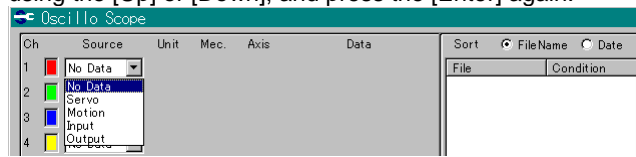
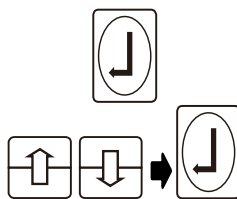
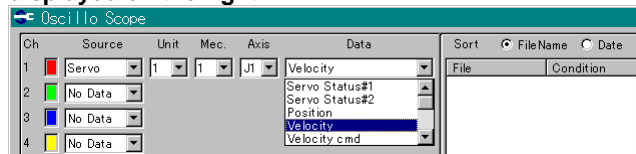


Table 2.1.1 List of sources

Displayed title	Details
No Data	No measurement data.
Servo	For measuring servo data.
Motion	For measuring motion data.
Input	For measuring the logical input signals.
Output	For measuring the logical output signals.



- 4 When "Servo" is selected, for instance, a more detailed setting menu is displayed on the right.**



After specifying the unit, mechanism and axis, specify the data source.

The options displayed in the data field are as follows.

In the example given above, the speed data (feedback speed) for axis J1 of mechanism 1 of unit 1 has been set for CH1.

Table 2.1.2 Data options when "Servo" has been selected as the source

Displayed title	Details
Servo Status#1	(Currently unsupported)
Servo Status#2	(Currently unsupported)
Position	For measuring the feedback position.
Velocity	For measuring the feedback speed.
Velocity cmd	For measuring the speed command (position deviation x speed gain).
Q phase	For measuring the feedback current (Q phase only).
Command Current	For measuring the current command.
Current	(Currently unsupported)
A.P.Monitor#1	(Currently unsupported)
A.P.Monitor#2	(Currently unsupported)
A.P.Monitor#3	(Currently unsupported)
A.P.Monitor#4	(Currently unsupported)

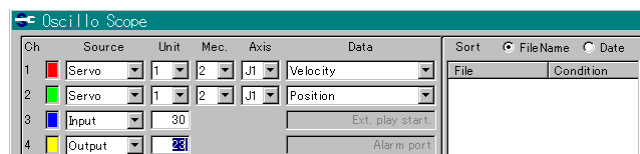
Table 2.1.3 Data options when "Motion" has been selected as the source

Displayed title	Details
Position Command	This expresses the command position in terms of the angle of each axis.
Position Command(Motor)	This expresses the command position in terms of the motor position.
Velocity Command	This is the time differential of the command position.
Accel Command	This is the double time differential of the command position.
Command Torque	This is the command position torque. It is produced by adding all the components such as the unbalanced torque and centrifugal torque.
Interpolation Time	This is the interpolation operation time.
Tcp CMD Velocity	This expresses the command position as the linear speed of the robot tip.
Tcp CUR Velocity	This expresses the current position as the linear speed of the robot tip.
Tcp CMD Position	This is the command position of the robot tip.
Tcp CUR Position	This is the current position of the robot tip.
Analog input	This is the input voltage of the analogue input board when it is mounted.

When "Input" or "Output" has been set as the source, input the number of the input or output signal in the edit box (1 to 2048).



- 5** When "Input" or "Output" is selected, an edit box where the signal number is to be input on the right appears so set the number of the signal here.



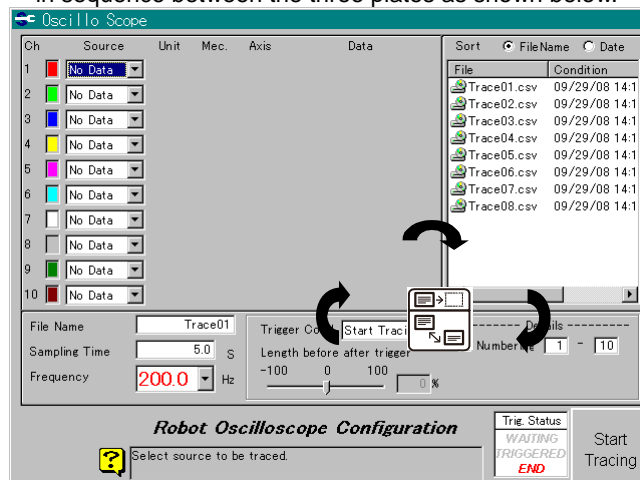
When the signal name is registered and the signal number is inputted, the signal name will be displayed on the right side.

- 6** Perform the above steps for all the channels whose data is to be measured.



- 7** Upon completion of the data settings, press the [CLOSE/SELECT SCREEN] and move the cursor in order to set other items.

>>Each time the [CLOSE/SELECT SCREEN] is pressed, the cursor is moved in sequence between the three plates as shown below.



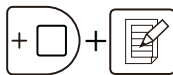
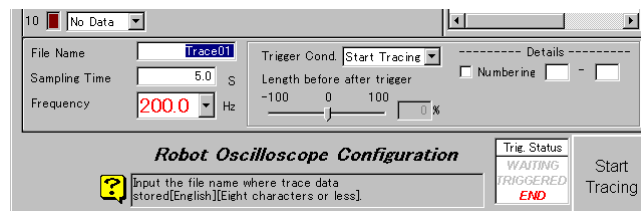
**POINT**

To start a new measurement, the oscilloscope function must be in the "idle" (non-operational) status. The new measurement cannot be started if the satisfaction of the trigger condition for the measurement set last is awaited or if data is still being gathered. The oscilloscope function status is referred to as the "trace status," and this status is shown at all times at the bottom right of the screen. For further details, refer to 2.2.2 Checking the current trace status.

### 2.1.2 Specifying the name of the data file to be saved

Specify the name of the file in which the measurement data is to be saved. The oscilloscope function requires that files (CSV format text files) must be saved without fail. (Data not saved in a file will not be displayed.)

#### 1 Align the cursor with the edit box for "File name".



"Trace01" (filename: Trace01.csv) is displayed as the default value. Changing only the number is the easiest way to change the filename.

To change the entire filename, press the [ENABLE] and [EDIT] keys to display the soft keyboard for inputting alphanumerics, and input a name consisting of not more than 8 alphanumerics.

#### 2 The name of the file which was stored last appears first among the filenames. If the filename is used without making any changes, the measurement data in that file will be overwritten.

>>Take care with this operation since a confirmation message will not appear before the data is overwritten.



#### How to automatically update the stored filenames in sequential numbers.

Put a check mark for "Numbering" and input the start/end numbers (0 to 99). Then the filenames will automatically be updated in sequential number and overwriting of the measured data can be avoided.



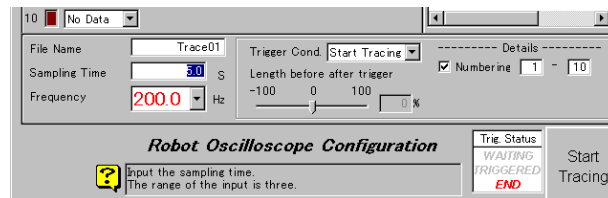
### 2.1.3 Specifying the sampling time and sampling frequency

Set the sampling time and sampling frequency.

The memory will be compressed as the sampling frequency rises (the more detailed it gets) or when the sampling time takes longer. However, generally, the initial setting value is to be kept and changes are unnecessary.



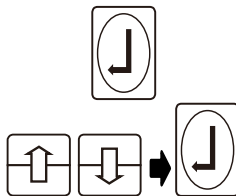
#### 1 Align the cursor with the Sampling Time edit box.



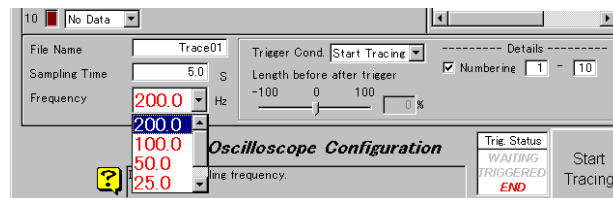
Specify the sampling time (= data gathering time) in seconds.

Input range: 0 to 999 sec. in 0.1 second increments

The trigger condition satisfaction wait time is not included. Furthermore, depending on the trigger condition which is set separately, it may not be referenced (used).



#### 2 Next, align the cursor with Frequency, and press the [Enter].



Select the one that is appropriate, by using the [Up] or [Down] cursor, and press [Enter].

Depending on the device's configuration, the sampling frequencies that can be selected will differ.

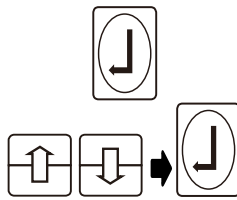
#### POINT

The number of data that can be sampled in a single measurement is 1000. Therefore, the sampling time and frequency must be set so that it will be as follows:

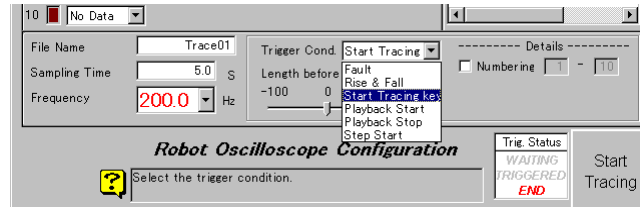
$$\text{sampling time} \times \text{sampling frequency} < 1000$$

### 2.1.4 Specifying the trigger condition

The trigger condition determines when and with what timing the data measurement is to be started. For instance, it is possible to immediately start the measurement or to start the measurement at the same time as the robot is activated.



**Align the cursor with Trigger Cond., and press the [Enter].**

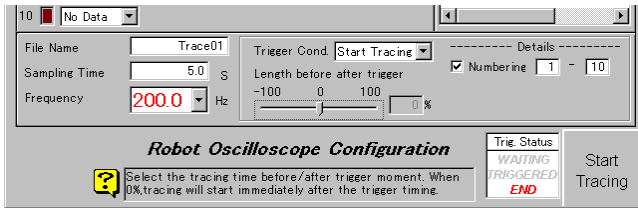


The trigger condition options listed below are displayed. Select the appropriate one using the [Up] or [Down], and press the [Enter]. "Start Tracing key" is the default setting.

Table 2.1.4 Trigger conditions

Displayed title	Measurement start	End of measurement
Fault	The measurement starts when an error, alarm or information occurs for the code number which was specified. If no code number is specified, measurement starts if any error, alarm or information occurs.	The measurement ends after the Sampling Time has elapsed or when [ENABLE] + [Abort Tracing] are pressed.
Rise & Fall	The measurement starts when the specified channel's data exceeds (rises) or falls below (falls) the specified data.	The measurement ends after the Sampling Time has elapsed or when [ENABLE] + [Abort Tracing] are pressed.
Start Tracing key	The measurement starts when the operator presses the f12 <Start Tracing>.	The measurement ends after the Sampling Time has elapsed or when [ENABLE] + [Abort Tracing] are pressed.
Playback Start	The measurement starts when startup is initiated (when the start lamp lights in the playback mode). It is possible to either specify or not specify the program or step to be played back.	The measurement ends after the Sampling Time has elapsed or when [ENABLE] + [Abort Tracing] are pressed.
Playback Stop	The measurement starts when startup ends (when the start lamp goes off in the playback mode).	The measurement ends after the Sampling Time has elapsed or when [ENABLE] + [Abort Tracing] are pressed.
Step Start	The measurement starts when the step number of the specified program is executed.	The measurement ends after the Sampling Time has elapsed or when [ENABLE] + [Abort Tracing] are pressed.

2 Next, align the cursor with "Length before after trigger."



It is possible with the oscilloscope function to sample the data before the trigger condition is satisfied. The ratio of the sampling time before and after the trigger condition is satisfied is set in "Length before after trigger." If it is assumed that the total length of the data to be recorded is 100%, exactly where the time is to be placed when the trigger condition is considered to be satisfied is specified as a percentage. Move the length setting using the [Left] or [Right].

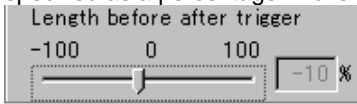
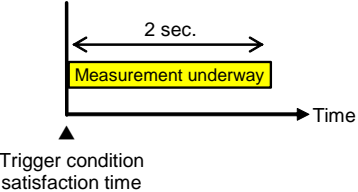
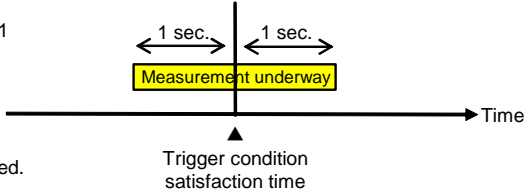
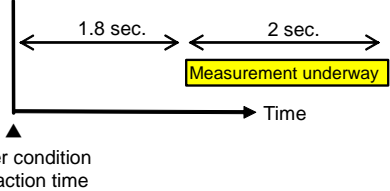


Table 2.1.5 Length before after trigger

Length before after trigger	Details
When 0 is set	<p>Example where sampling time = 2 sec. and length before after trigger = 0%</p> <p>Data gathering starts after the trigger condition is satisfied.</p> 
When a minus value is set	<p>Example where sampling time = 2 sec. And length before after trigger = -50%</p> <p>Data gathering starts 1 second before the trigger condition is satisfied, and it ends 1 second after the condition is satisfied.</p> 
When a plus value is set	<p>Example where sampling time = 2 sec. and length before after trigger = -90%</p> <p>Data gathering starts 1.8 seconds after the trigger condition is satisfied, and it continues for another 2 seconds, after which it ends.</p> 

When a minus value has been specified for "Length before after trigger" and the trigger condition is already satisfied when the Start Tracing key is pressed, data gathering starts immediately.

The sampling end time cannot be set before the trigger condition is satisfied. If the power supply is turned off while the trigger condition is not yet satisfied, measurement will not start even when the power is turned back on.

### 2.1.5 Completing the settings (= starting the measurement)

All the measurement conditions have now been set.

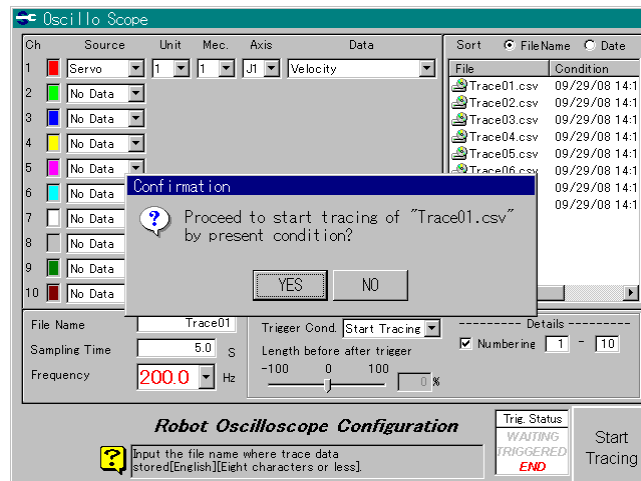
The operation for completing the settings is the same as the operation for starting the measurement (establishing the trigger condition satisfaction wait status). Proceed as follows.

Upon completion of the settings (= when measurement starts), the oscilloscope function immediately generates a file (in which only the measurement conditions have been stored), and the trigger condition satisfaction wait status is established.

Start  
Tracing

#### 1 Press the f12<Start Tracing> to start measurement.

>>The popup menu shown below appears.



#### 2 Check the settings, and if there are no errors, use the [Left] or [Right] to select [Yes], and press the [Enter].

>>At this point, the oscilloscope function generates the file, and the trigger condition satisfaction wait status is established. The setting screen is exited, and the menu screen is restored.

However, if "Start Tracing" has been selected for Trigger Cond., the setting screen is not exited, and measurement starts immediately.

Upon completion of the measurement, the display automatically jumps to the waveform display screen.

For details on the subsequent operations, refer to 2.2 Performing the measurements.

#### 3 If an error has been made, select [NO].

The display now returns to the setting screen so that the setting can be corrected.

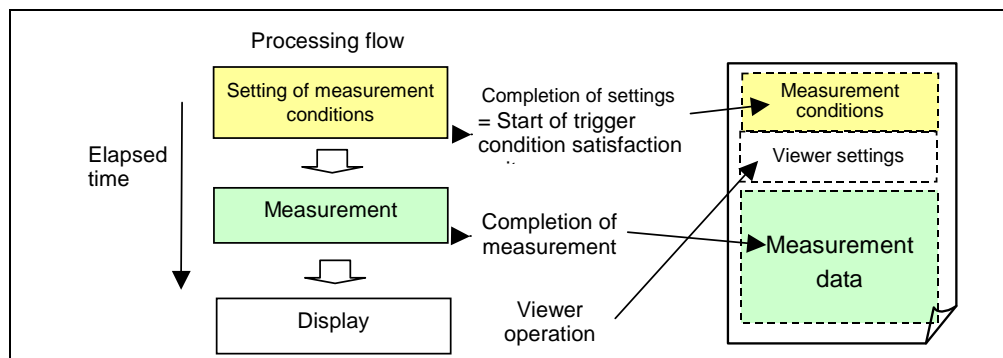


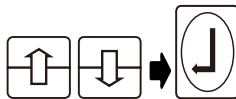
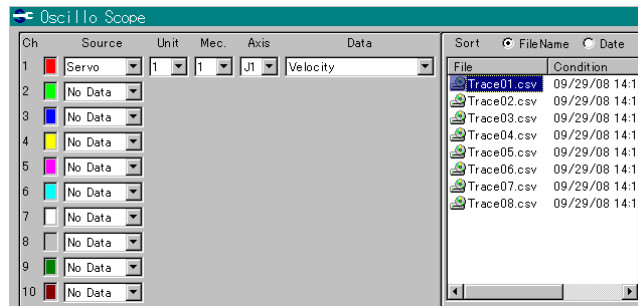
Fig. 2.1.1 Data file write timing

### 2.1.6 Selecting the measurement conditions from the existing files

Instead of setting each condition in turn, it is possible to call conditions that have already been set from a file, and then use those conditions. This is very useful when, for instance, almost all the settings can be used as is with just a few modifications.



- 1** Press the [CLOSE/SELECT SCREEN] on the setting screen, and move the cursor to the file list at the right.



- 2** A list of the oscilloscope files stored in the memory is displayed. Use the [Up] or [Down] to select the file to be called, and press the [Enter].  
 >>The selected file is called, and the measurement conditions (all the data, trigger conditions, filenames, etc.) stored in that file are displayed.

- 3** Modify the filename or whatever else needs to be changed.

## 2.2 Performing the measurements

### 2.2.1 Starting the measurements

As explained in the previous section 2.1.5 Completing the settings (= starting the measurement), the measurement starts (trigger condition realization wait starts) as soon as the measurement condition settings are completed.

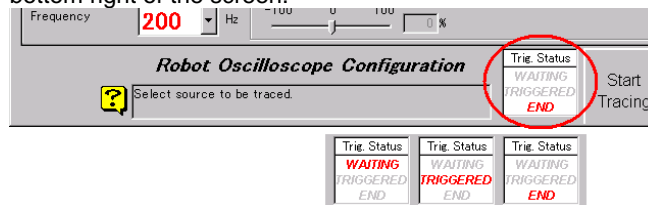
No other special operations need to be performed.

### 2.2.2 Checking the current trace status

Except when "Start Tracing key" is selected as the trigger condition, the oscilloscope function continues to wait for the trigger condition to be satisfied in the background while the teach or playback operation is performed.

To prevent a new measurement from being started while overlooking the fact that the trigger condition satisfaction wait status is established, the oscilloscope function enables the current trigger condition to be monitored. This condition is referred to as the "trace status," and it can be checked by performing the following step.

- 1 Open either the setting screen or display screen (which is described in the next chapter).  
 >>The trace status is displayed at all times on the left of the f12<Start Tracing> at the bottom right of the screen.



There are three trace statuses.

The one in red is the current trigger status.

Table 2.2.1 Trace status

Trace status	Details
<i>WAITING</i>	In this status, the measurement has started and the satisfaction of the trigger condition is awaited. No new measurements can be started when this status is established.
<i>TRIGGERED</i>	In this status, the trigger condition is satisfied, and the data is now being gathered. No new measurements can be started when this status is established.
<i>END</i>	In this status, the data gathering is completed, and nothing is happening. New measurements can be started when this status is established.

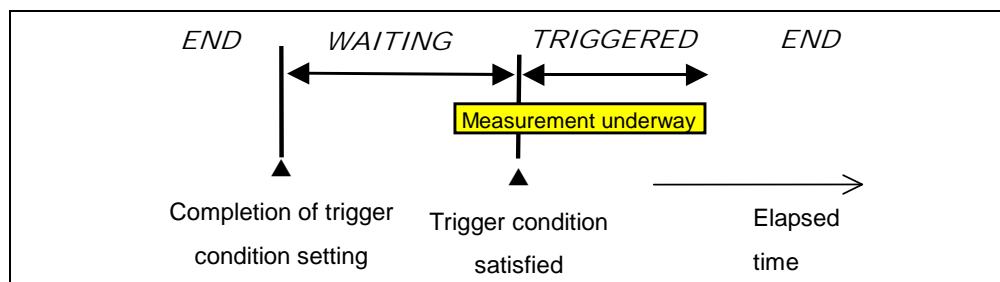


Fig. 2.2.1 Trace status

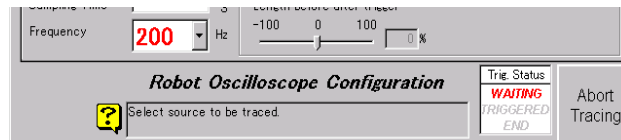
### 2.2.3 Aborting the measurements

As explained in the previous section 2.1.5 Completing the settings (= starting the measurement), the measurement ends once the end condition corresponding to the specified trigger condition is satisfied. However, in order to start a new measurement without waiting for this, the trigger condition satisfaction wait status or measurement now underway status must be forcibly canceled. This is done as follows.

- 1 First, on the setting screen check that **WAITING** or **TRIGGERED** is the current trace status.



- 2 On the setting screen, press the [ENABLE] and f12<Abort Tracing> at the same time.



- 3 A confirmation message appears. If [YES] is selected in response to the message, the trace status changes to **END**.

## 2.3 Displaying the measurement results

This section describes the steps for displaying the data which has been obtained by the measurements. If the measurements have been performed with "Start Tracing key" as the trigger condition, as soon as the setting screen is exited (the measurements are completed) the waveforms are displayed automatically as described in 2.3.2 Adjusting the scale automatically and displaying it In this case proceed to sections 2.3.2 and following.

### 2.3.1 Select [25 Robot Diagnosis] from <Service Utilities>.

Since the measurement results are stored in all the files, the sequence of steps consists in selecting the file and then displaying its contents. For the sake of convenience, when the display screen is initially opened, the file generated last (with the waveforms measured last) is automatically displayed.



#### 1 Select [25 Robot Diagnosis] from <Service Utilities>.



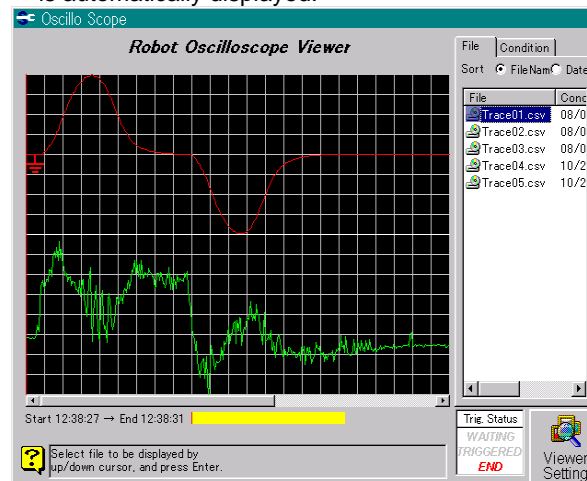
When [3 Oscilloscope] is selected from the items on the menu displayed, a screen such as the one shown below appears.



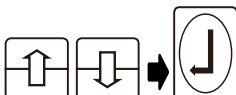
#### 2 Select [2 Show].

>>An oscilloscope display screen such as the one shown below appears.

It is on this screen that the file generated last (with the waveforms measured last) is automatically displayed.



If no further action is required, proceed to the next step.



#### 3 To view other waveforms, use the [Up] or [Down] to align the cursor with the desired filename, and press the [Enter].

>>The selected file is called, and the display is refreshed.

If no waveforms are displayed even after a file is selected:

This means that the measurement was aborted in the trigger condition satisfaction wait status or while the data was being gathered.

Since the file itself was already generated at the point in time when the f12<Start Trace> was pressed, it is not possible to tell by the filename whether the file is the one in which the measurement data was stored. (See Fig. 2.1.1 Data file write timing.)

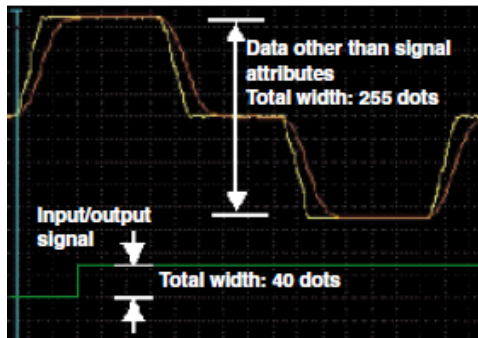


### 2.3.2 Adjusting the scale automatically and displaying it

The useful automatic scaling function adjusts the waveforms in such a way that the entire measurement data fills the whole screen of the teach pendant without overflowing.

An input/output signal is displayed with a total width of 40 dots while a signal of other type is displayed with a total width of 255 dots. They are offset in such a way that they fit exactly into the display range.

The input/output signals come in the form of "0" or "1," and they are always displayed in an easily recognizable way by the automatic scaling function.



The automatic scaling function works only when a data file whose data has remained completely unchanged since the measurement ended — that is to say, whose data has not been adjusted for scale — has been opened.

If the data file has been updated by changing the scale using the method described later, the waveforms will not be automatically scaled even when any waveforms are displayed.




### 2.3.3 Various operations using f12<Viewer Setting>

When the f12 [Viewer Setting] key is pressed, the f keys are displayed. Scale changes are made and various other operations are performed using these f keys and the cursor keys.

First, all the f key functions will be introduced. This section may be skipped since the operation of each function will be described in turn starting on the next page.

Table 2.3.1 Table of f key functions available when the f12<Viewer Setting> is pressed

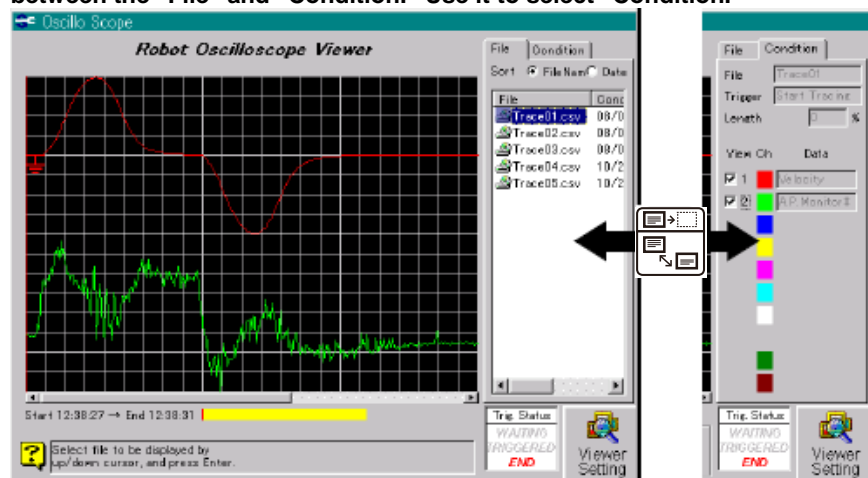
Position	Display	Application		
f7		The channel indicated on this f key is the channel for which the current scale change or other operation will be performed. Each time the f key is pressed, the channel number changes. (Only the number of one of the channels for which there are some measurement data is selected.) When the f key and [ENABLE] are pressed at the same time, the sequence in which the channel number is selected is switched between ascending and descending order.		
f8	(See right)	<b>Movement</b> 	<b>Scale change</b> 	<b>Data readout</b> 
		This is used to move the waveforms up or down or to the left or right.	This is used to change the waveform scale (zoom in/ zoom out).	This is used to move the ruled lines for reading the data.
f9	(See right)			
		This makes it possible to restore the status immediately after the measurement using a single action to see the entire waveform.	This makes it possible to specify the zoom-in area by moving the cursor on the screen.	This is used to select the ruled lines (L or R or both) to be moved.

Position	Display	Application
f10	 Display Details	This is used to display the trigger condition and other detailed setting conditions.
f11	 Image Copy	This is used to store the waveform display images as bitmap files (BMP format) in the memory. (The data files (CSV text files) are already stored when the waveforms are displayed.)
f12	 Quit	This is used to exit [Viewer Setting]. The same result can be obtained by pressing the [RESET].

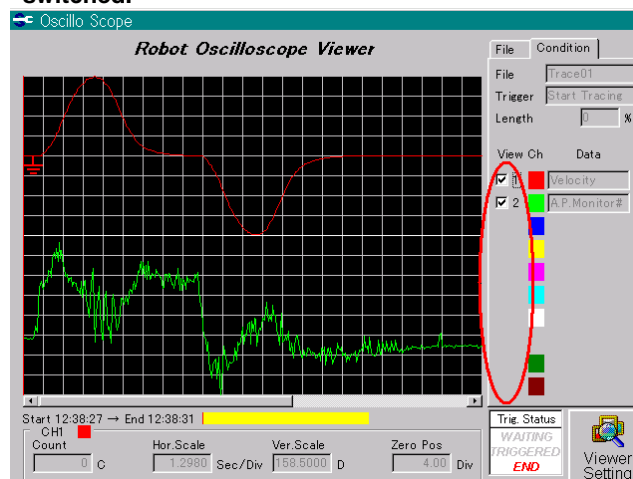
### 2.3.4 Displaying or not displaying the waveforms for each channel



- 1 Press the [CLOSE/SELECT SCREEN]. Each time this key is pressed, the work sheet at the right is switched between the "File" and "Condition." Use it to select "Condition."



- 2 Align the cursor to the channel's check box, using the [Up] or [Down] keys and press [Enter]. By doing so, the display of display/ non display can be switched.

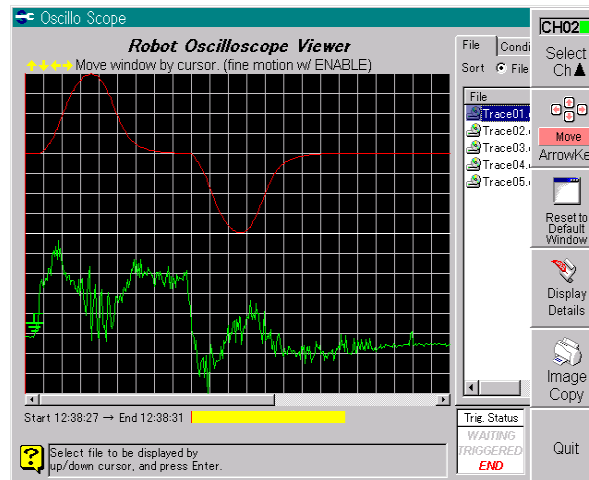


>>The waveforms are cleared for any channel whose check mark has been removed.

### 2.3.5 Moving waveforms up or down or to the left or right



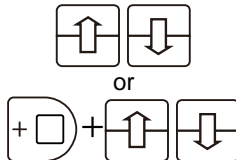
- 1 Press the f12<Viewer Setting>.  
>>The f keys are displayed as shown below.



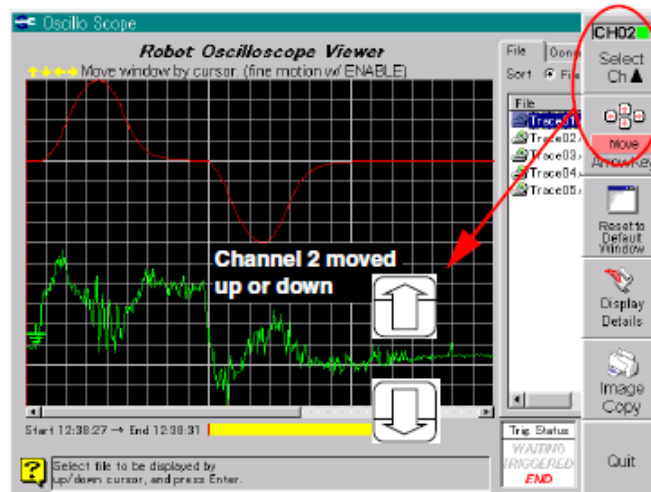
- 2 Press the f8<Arrow Key> a few times until the "Move" status is established.  
>>At this point, the cursor keys of the teach pendant can be used for movement applications.

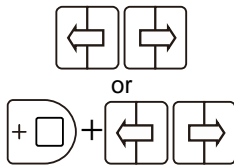


- 3 Press the f7<Select Ch> a few times until the channel whose waveforms are to be moved up or down is displayed. In the case of left/right (time axis) movements, the data of all the channels moves together so it does matter where the setting is made.  
>>In the example shown on the left, channel 2 is targeted for the up/down movement operations.

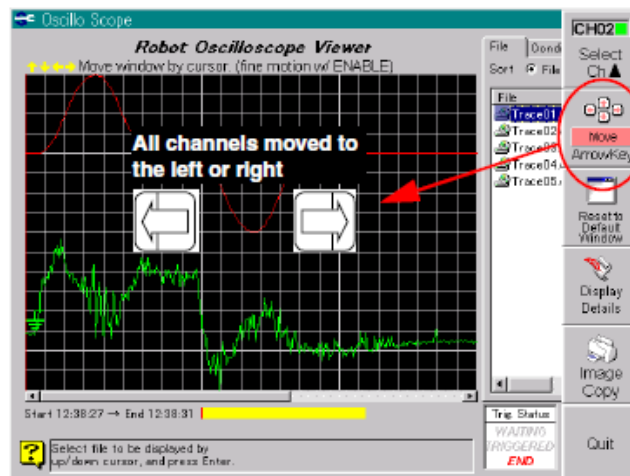


- 4 When the [Up] or [Down] is pressed, the selected channel moves up or down. When either key is pressed together with the [ENABLE], movements can be made in very small increments.





- 5 When the [Left] or [Right] is pressed, all the channels move to the left or right. When either key is pressed together with the [ENABLE], movements can be made in very small increments.



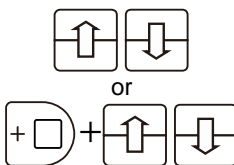
### 2.3.6 Zooming in and zooming out the waveforms up or down or to the left or right



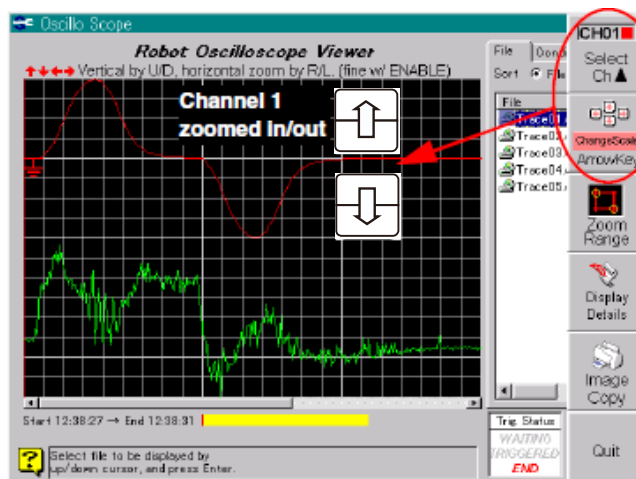
- 1 Press the f12<Viewer Setting>.
- 2 Press the f8<Arrow Key> a few times until the "Change Scale" status is established.  
>>At this point, the cursor keys of the teach pendant can be used for scale changing applications.

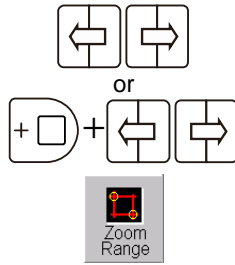


- 3 Press the f7<Select Ch> a few times until the channel whose scale is to be changed (zoomed in or zoomed out) is displayed. In the case of left/right (time axis) movements, the data of all the channels is zoomed in or zoomed out together so it does matter where the setting is made.  
>>In the example shown on the left, channel 2 is targeted for the scale change operations.



- 4 When the [Up] is pressed, the selected channel is zoomed in the up/down direction. When the [Down] is pressed, the selected channel is zoomed out in the up/down direction. When either key is pressed together with the [ENABLE], adjustments can be made in very small increments.



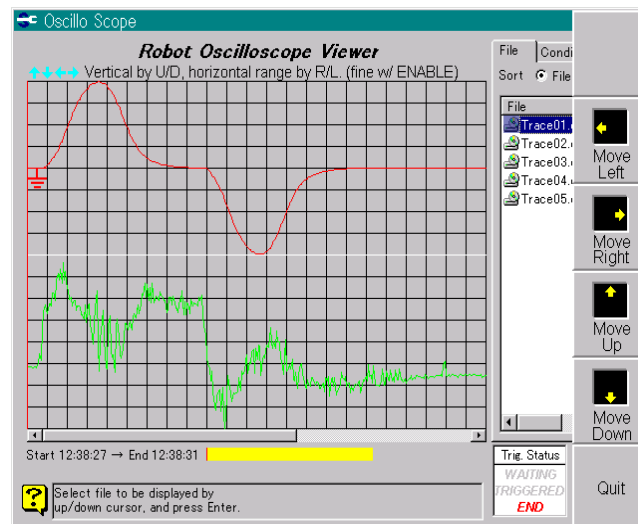


- 5 When the [Right] is pressed, all the channels are zoomed in the left/right direction (time axis), and when the [Left] is pressed, all the channels are zoomed out in the left/right direction (time axis). When either key is pressed together with the [ENABLE], adjustments can be made in very small increments.

- 6 Described next is a way of specifying the zoom-in area by moving the cursor on the screen.

The movement and zooming in are specified together on this image. For this, first press f9<Zoom Range>.

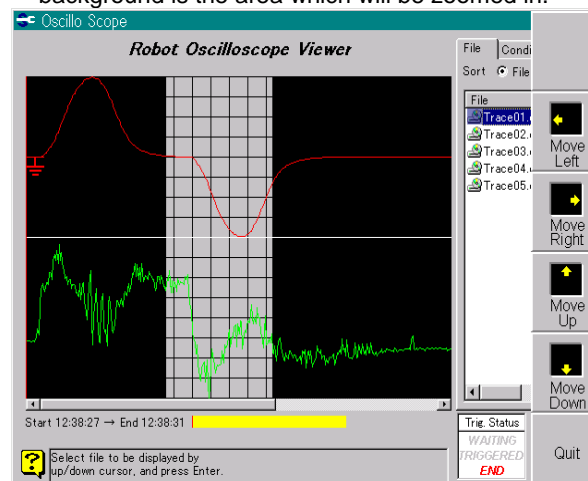
>>The waveform background changes to gray, and the f keys are replaced with the following ones.



- 7 Adjust the horizontal width of the area to be zoomed in using the [Left] or [Right].

Next, move the area to be zoomed in toward the left or right using f8<Move Left> or f9<Move Right>.

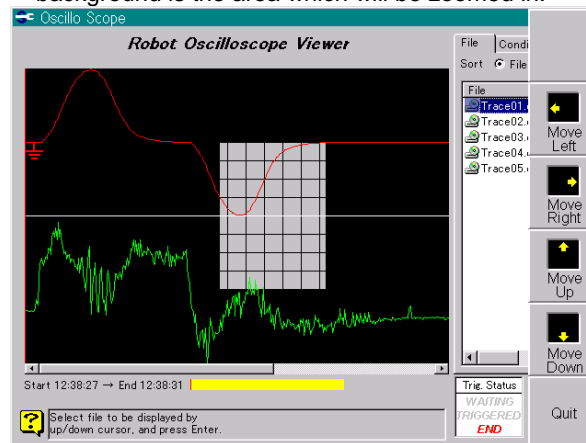
>>The background is divided up into light and shade, and the part with the gray background is the area which will be zoomed in.



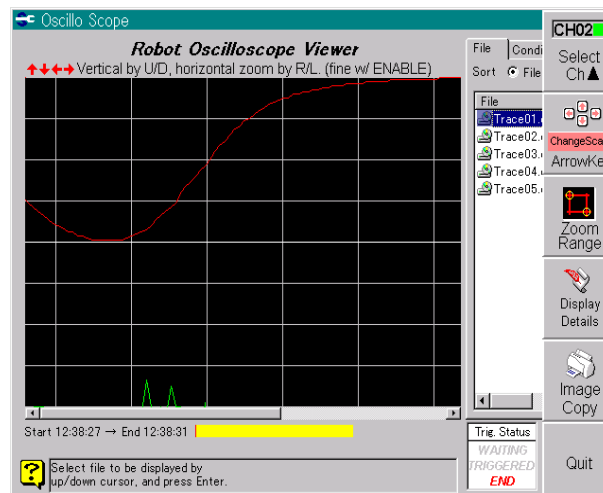


- 8 Adjust the vertical length of the area to be zoomed in using the [Up] or [Down]. Next, move the area to be zoomed in the up or down direction using f10<Move Up> or f11<Move Down>.**

>>The background is divided up into light and shade, and the part with the gray background is the area which will be zoomed in.



- 9 Once the area to be zoomed in has been determined, press f12<Quit>.**  
>>The display of the specified area fills the entire screen. The original f keys are restored.

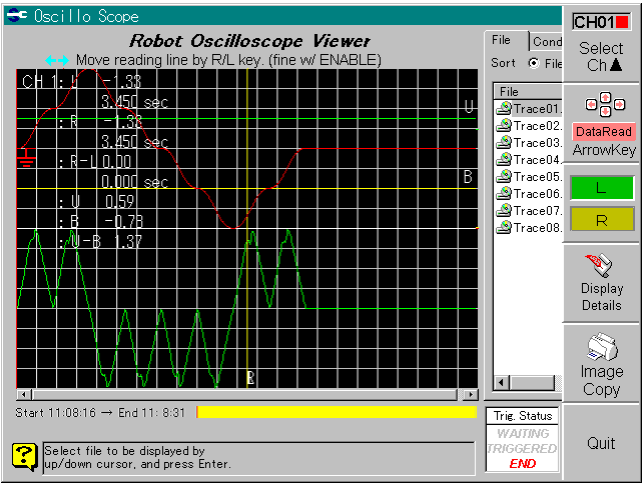


### 2.3.7 Reading data from the waveforms

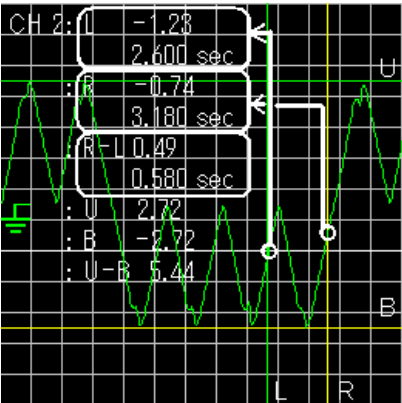


- 1 Press the f12<Viewer Setting>.**
- 2 Press the f8<Arrow Key> a few times until the "Data Read" status is established.**  
>>In the example shown on the left, channel 2 is targeted for the data read operations.
- 3 Press the f7<Select Ch> a few times until the channel whose data is to be read is displayed.**  
>>In the example shown on the left, channel 2 is targeted for the data read operations.

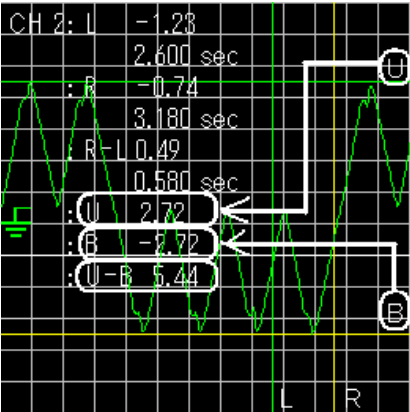
For the displayed part of the waveform, the data readout vertical line (the two lines, L and R) and the data readout horizontal line (the two lines, U and B) will be displayed. In the upper left side, the readout data of the specified channel will be displayed.



The data that will be displayed are the following: the readout data of the L and R lines, the difference between the L and R lines (R-L), the readout data of the U and B lines and the difference between the U and B lines (U-B). Regarding the horizontal axis, the L and R lines will be displayed in terms of 1/100 seconds which is the time when the trigger condition satisfaction time is set to "0". For the vertical axis, the readout value of the selected channel will be displayed.



The readout value of the vertical axis will be displayed for lines U and B.



4

Press f9<Select L/R> a few times to select which of the two data readout lines is to be moved.



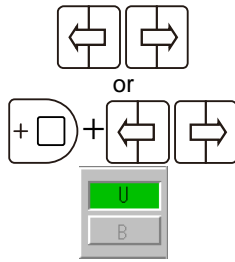
The L line will move.



The R line will move.



The L and R lines will move together.



- 5 When the [Left] or [Right] is pressed, the selected data readout line moves. When either key is pressed together with the [ENABLE], movement can be made in very small increments.

- 6 Press [Enable] + f9<Select U/B> several times and select which one of the two readout data horizontal lines to move.



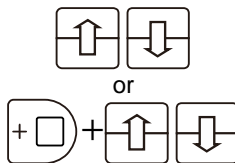
The U line will move.



The B line will move.



The U and B lines will move together.



- 7 When the [Up] or [Down] keys is pressed, the selected readout data horizontal line will move. When either key is pressed together with the [ENABLE], movement can be made in very small increments.

### 2.3.8 Returning the scale, etc. to the default setting

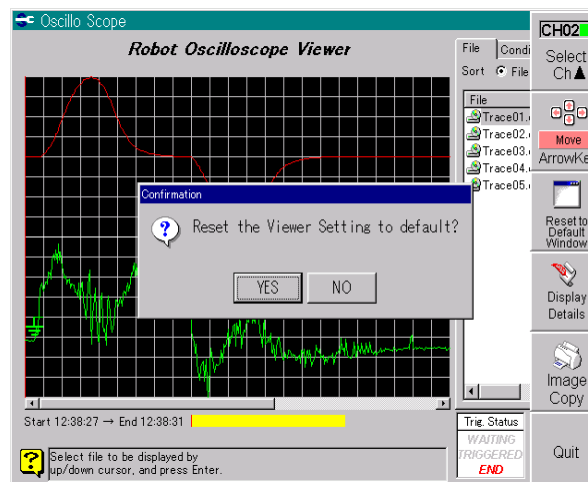
Even after the scale or offset has been changed, their original statuses (default settings) can be restored by a single action. As the default setting, the waveform displayed reflect the automatic adjustments of the scale and other factors so as to ensure that the data of all the channels is easily recognizable. As such, this feature is useful for seeing all the data.



- 1 Press the f12<Viewer Setting>.

- 2 Press f9<Reset to Default Window>.

>>A confirmation message such as the one below is displayed.



- 3 If [YES] is selected in response, the default settings are restored, and the waveform display is refreshed.



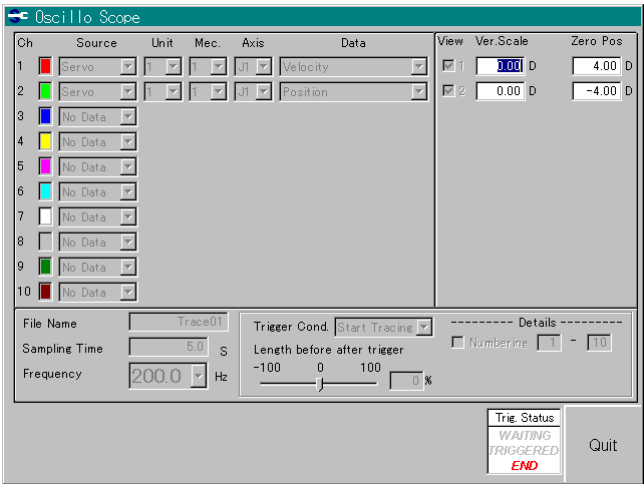
2.3.9 Checking the detailed settings of the measurement conditions



1 Press the f12<Viewer Setting>.

2 Press f10<Display Details>.

>>As shown below, a screen identical to the setting screen appears, enabling the trigger conditions and all other conditions to be checked.



3 Upon completion of the check, the waveform display screen in step 1 is or restored if the [RESET/R] or f12<Quit> is pressed.

### 2.3.10 Saving data in data files

At the point when the waveforms are displayed, a data file (CSV text file) is already generated.  
(Waveforms which do not have data files are not displayed.)

An outline of the data files is presented below.

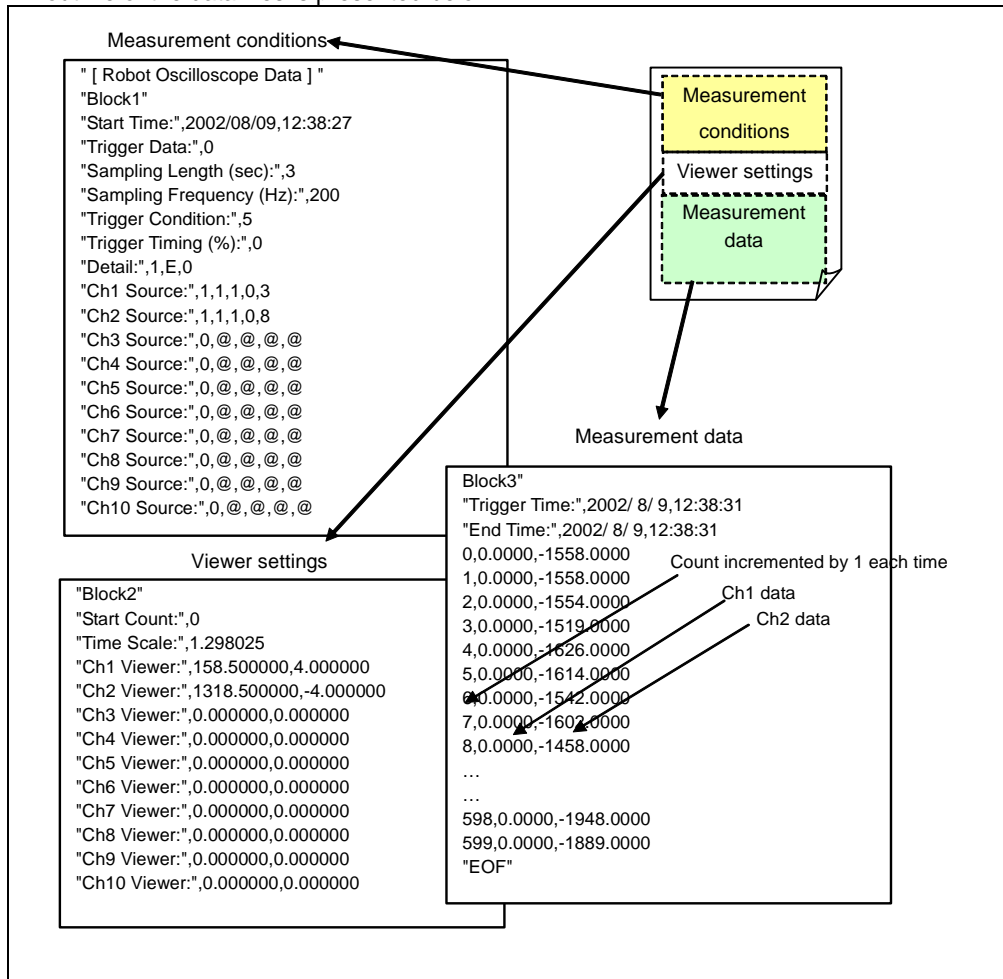


Fig. 2.3.1 General content of data files

Data files consist of three blocks.

Table 2.3.2 General content of data files

Block	Files stored in folders
Measurement conditions	The names of the data, trigger conditions and other measurement conditions for each channel are recorded in this block. They are stored in the file when [Start Tracing] is pressed.
Viewer settings	These are the scale, offset and other settings used for displaying the waveforms. The conditions are stored in the file to enable the previous statuses to be restored even when the next waveforms are displayed.
Measurement data	This is the sample data. The data accumulated in the memory upon completion of the measurements is stored altogether in the file.

Table 2.3.3 Source= Unit of the measurement data for "Servo".

Measurement Data	Units
Position	[rad]
Velocity	[rpm]
Velocity cmd	[rpm]
Q Phase	[Apeak]
Command Current	[Apeak]

Table 2.3.4 Source= Unit of the measurement data for "Motion".

Measurement Data	Units
Position Command	[rad]
Position Command Motor	[pulse]
Velocity Command	[rad/sec]
Accel Command	[rad/sec <sup>2</sup> ]
Command Torque	[kgf/m]
Interpolation Time	[msec]
Tcp CMD Velocity	[mm/sec]
Tcp CUR Velocity	[mm/sec]
Tcp CMD Position	[mm]
Tcp CUR Position	[mm]
Analog input	[V]

### 2.3.11 Copying waveforms using bitmap files

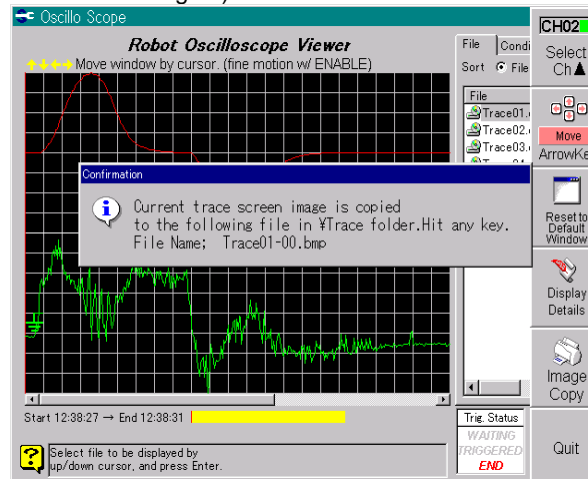


**1** Press the f12<Viewer Setting>.

**2** Press f11<Image Copy>.

>>The waveforms currently displayed are immediately stored in the memory as bitmap images (BMP files), and a confirmation message such as the one below appears.

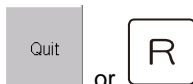
The filenames are the same as the names of the data files (CSV text files). (They cannot be changed.)



As the filename, a 2-digit number is added to the storage filename.

The numbers are automatically assigned, and they are cleared to zero each time the power is turned on.

### 2.3.12 Exiting waveform browsing



**1** Press f12<Quit> or the [RESET/R] to exit the setting screen of the viewer.>>Return as follows to the screen which was initially opened for viewing the waveforms.

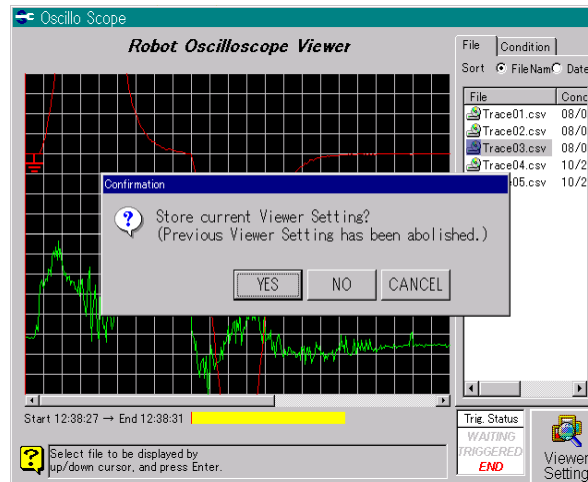
R

2

**Press the [RESET/R].**

>>If the viewer settings (scale, offset, etc.) have not been changed at all, the screen is simply exited.

If the viewer settings (scale, offset, etc.) have been changed, a confirmation message appears asking the operator to decide whether the settings are to be reflected in a data file.



R

3


**Select [YES] if the waveforms are to be displayed with the currently displayed scale and offset statuses reflected when a file is next opened. If not, select [NO].**

>>Whether [YES] or [NO] is selected, the sample data itself is not changed.

The viewer's setting statuses such as the scale and offset will be stored, only.

NOTE



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<b>United Kingdom</b>		<a href="http://www.nachi.co.uk/">http://www.nachi.co.uk/</a>	
<b>Nachi U.K. LTD.</b>	Phone: +44-(0)121-250-1895 Fax: +44-(0)121-250-1899	Unit 7, Junction Six Industrial Estate, Electric Avenue, Birmingham B6 7JJ, U.K.	
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