Futaba

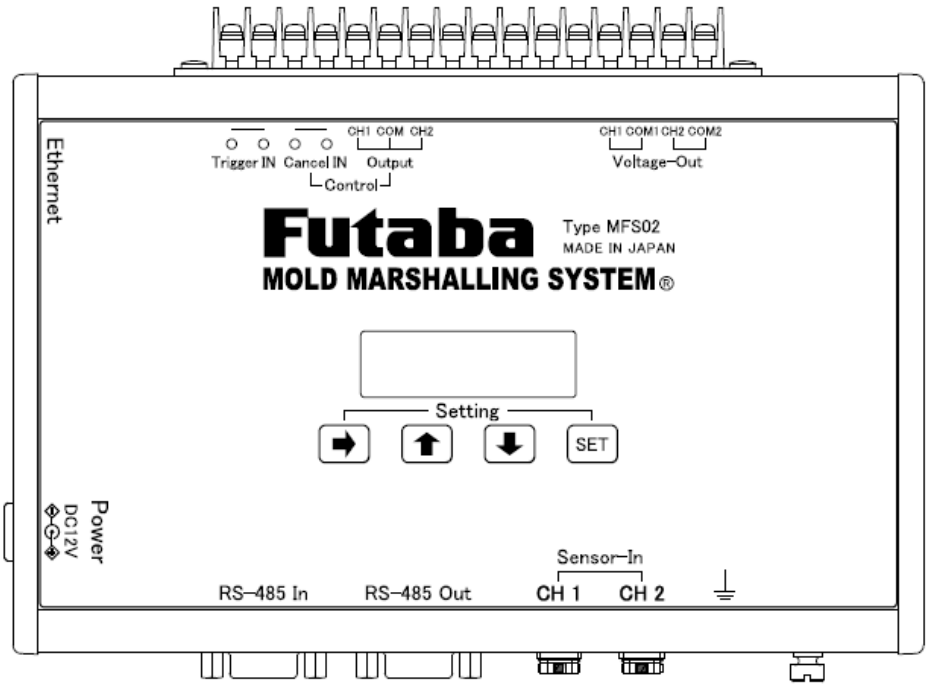
Mold Marshalling System for Measuring Melt Front Speed inside the Mold

Melt Front Speed Measuring Amplifier

MFS02

Instruction Manual

Thank you for your purchasing a product of Futaba Corporation.
Please read this instruction manual carefully and patronize the product for many years to come.
Do not use the product in any way other than explained in this instruction manual.



Contents

Safety Precautions (Be sure to read before use)

■ Before Use

Before using the product, read this “Safety Precautions” and the instruction manual carefully.

After reading the manual, keep it in a safe place so that it can be used whenever needed.

When using the product, be sure to observe the following safety precautions.

Futaba Corporation assumes no liability for the injury caused by using the product contrary to these precautions.

■ This manual uses the following alert symbols for safe use of the product.

WARNING	**Failure to observe the instructions with this symbol could result in death or serious personal injury.**
CAUTION	**Failure to observe the instructions with this symbol could result in injury or only damage to property.**

■ General Precautions

- When starting product operation, make sure in advance that the functions of the product are normally working with normal performance.
- If the product fails, use adequate safety measures to prevent various types of damage.
- Note that we cannot guarantee the functionality and performance for use of the product not conforming to the specifications or any remodeled product.
- When using the product in combination with other equipment, evaluate it thoroughly because the functionality and performance may not be satisfactory depending on the use conditions and environment.

■ Precautions

WARNING	**When installing the product or connecting cables, be sure to disconnect the power cable from the outlet in advance. It could result in electric shock or malfunction.**
WARNING	**Do not use a broken cable or a cable with a flaw in the covering. It could result in fire, electric shock, or device damage or failure.**
WARNING	**Use the power to the AC adaptor within the range (100 to 240 V) stipulated in the specifications. Using power outside the range could result in fire or device damage or failure.**
WARNING	**Use the AC adaptor that comes with the product. Using any other AC adaptor could result in device damage or failure.**
CAUTION	**Keep the sensor, measurement amplifier and relay amplifier away from water. It could result in electric shock or device damage.**

Preface

“Mold Marshalling System MFS 02 series” is a system for measuring resin flow velocity inside injection molds using an optical fiber sensor of Futaba Corporation.
Using the supplied measurement software, you can measure the flow velocity of the molten resin and observe the waveforms generated when it passes over the sensor, store the data, and set control outputs on the personal computer.

Major features are as follows:

- ●The system performs measurements using a single sensor.
- ●A measurement of up to 2 channels can be made at the same time.
- ●Flow velocity of each shot and historical waveform data are automatically saved.
- ●Data is saved in CSV format and can be easily read with commercially available spreadsheet software.
- ●It can output a signal when the flow front of molten resin passes the sensor, which can be used to control the injection machine.
- ●Waveforms being measured can be overlaid on the waveforms saved in the past.

Please read this instruction manual carefully and use the product correctly.
If you have any questions, please contact our sales department.

Standard Accessories

■ This equipment comes with the following standard accessories.
After unpacking the equipment, make sure all accessories are included.

- ・Flow velocity measurement amplifier “MFS02” ····· 1
- ・AC adapter “TAS8803” ····· 1
  (One ferrite core for noise suppression is supplied with the adapter)
- ・LAN cable “WCL0020” ····· 1
- ・Software “PFS series” ····· 1
  (CD-ROM, the latest version at the time of shipment)
- ・Instruction Manual (this manual) ····· 1
- ・Installation Manual ····· 1
- ・Warranty and Certificate of Registration ····· 1

■ Optional Accessories (Sold Separately)

- ・Relay amplifier “UPV01” ····· 1 (or 2 if two amplifiers are ordered)

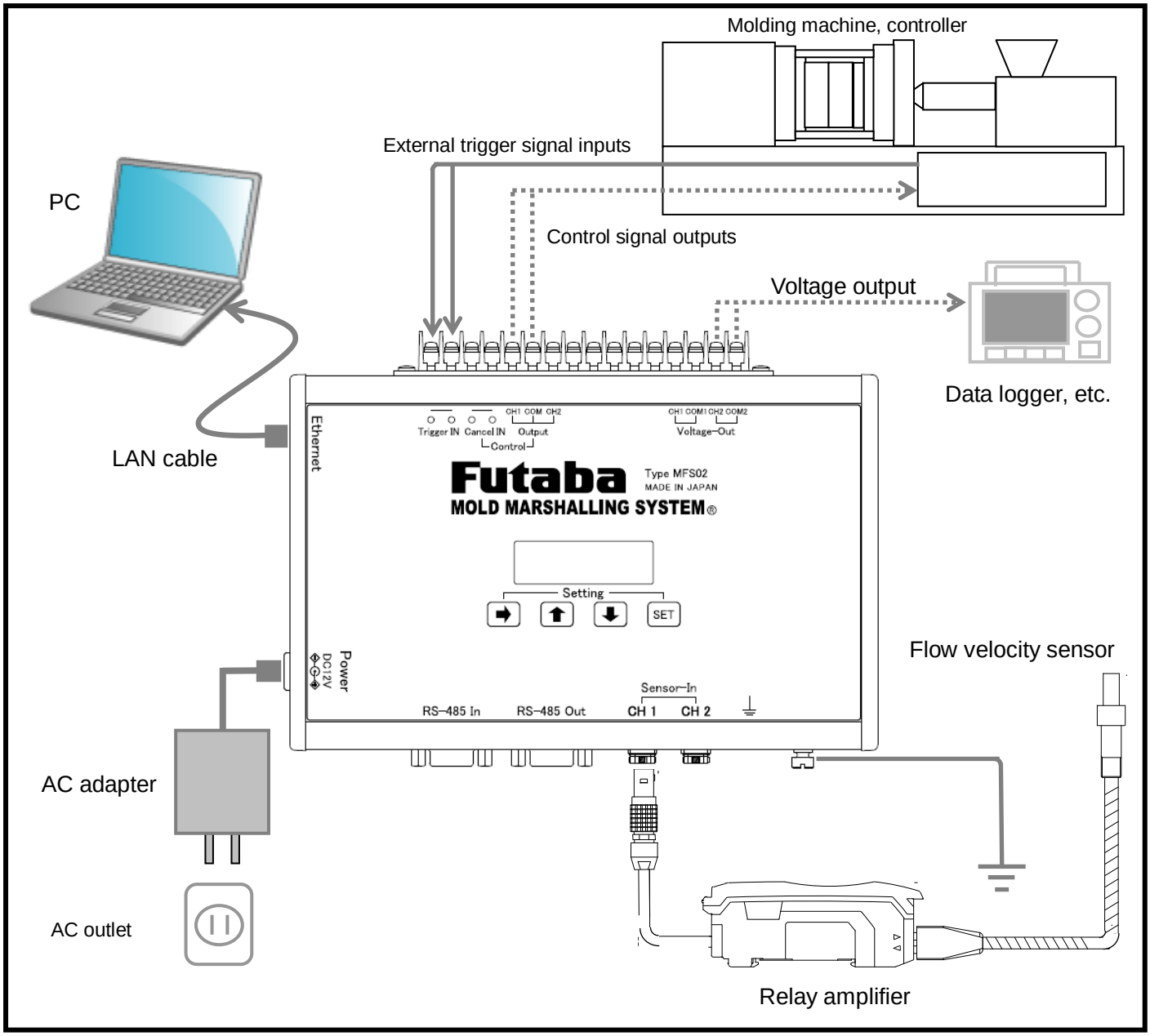
If you purchased this at the same time with the MFS02 main unit, please make sure it is included in the package.

Handling Precautions

- Turn on the power to the amplifier after connecting between the systems. Be sure to connect the power cable of the amplifier to the AC outlet. Do not turn on/off the power supply by disconnecting and connecting the I/O cable connector. It could damage the amplifier and AC adaptor.
- When the power is once turned off, wait for at least 5 seconds before turning it on again. If the power is turned on within 5 seconds or turned on and off repeatedly, power failure may be caused by rush current generated at power on.
- Warm up the system before use, for about 30 minutes after power on.
- Before turning off the power to the amplifier, be sure to exit the measurement software. If the power is turned off with the software running, communication operation may not be terminated normally and an unexpected failure may occur.
- When turning off the power after setting operation is performed, wait at least 3 seconds. The setting is stored in the non-volatile memory in the amplifier but is not stored correctly if the power is turned off soon after the setting operation.
- This system stores the data measured by the amplifier in the storage device (such as a hard disk) of PC. To prevent the degradation of PC performance or unexpected failure, move the data frequently.
- When measurement is performed in monitor mode, “measurement” is executed when the signal (IN1) is input from the molding machine or when the “SET” key on the amplifier is pressed.
- Avoid using the system in an environment subject to remarkably high or low temperature. The allowable range of operating temperature is 0 to 50°C. If it is unavoidable to use the system at a place subject to direct sunlight or in a cold area, protect it from sunlight or keep it warm.
- Use the system in the relative humidity range from 35 to 85%. Using it out of the humidity range or in an environment subject to water splashes could result in performance deterioration or failure.
- Do not use the system in a dusty place. Performance degrades if the dust gets inside. Prevent dust from getting inside not only during operation but also during storage. Use the system in an environment in which personal computers can be used.
- If the environment changes drastically, do not operate the system soon. Leave the system in the new operating environment to adapt it to the environment and then use it. If the ambient temperature or humidity is changed drastically due to movement, condensation may cause performance degradation and failure.
- Do not use the system in an environment subject to vibration or impact. Continuous vibration or large impact could cause performance degradation or failure.
- Do not use the system in strong electromagnetic fields. Use it in an environment in which personal computers can be used. Using it in the vicinity of a radio, microwave oven, or electric furnace that generates a strong electromagnetic field could cause performance degradation, malfunction, or failure.
- Do not use the system in locations with poor power supply conditions. Use it with a power supply at 100 VAC, 50/60 Hz, free from momentary power failure and noise.
- Do not pull connection cables. Connect each connection cable with a margin so that excessive force is not applied to the connection. Pulling the cable or applying excessive force to it could cause failure, measurement interruption, or abnormal measurements.

System Configuration

The following figure shows a system configuration that is required to measure the flow velocity inside the mold using Mold Marshalling System “MFS02”.



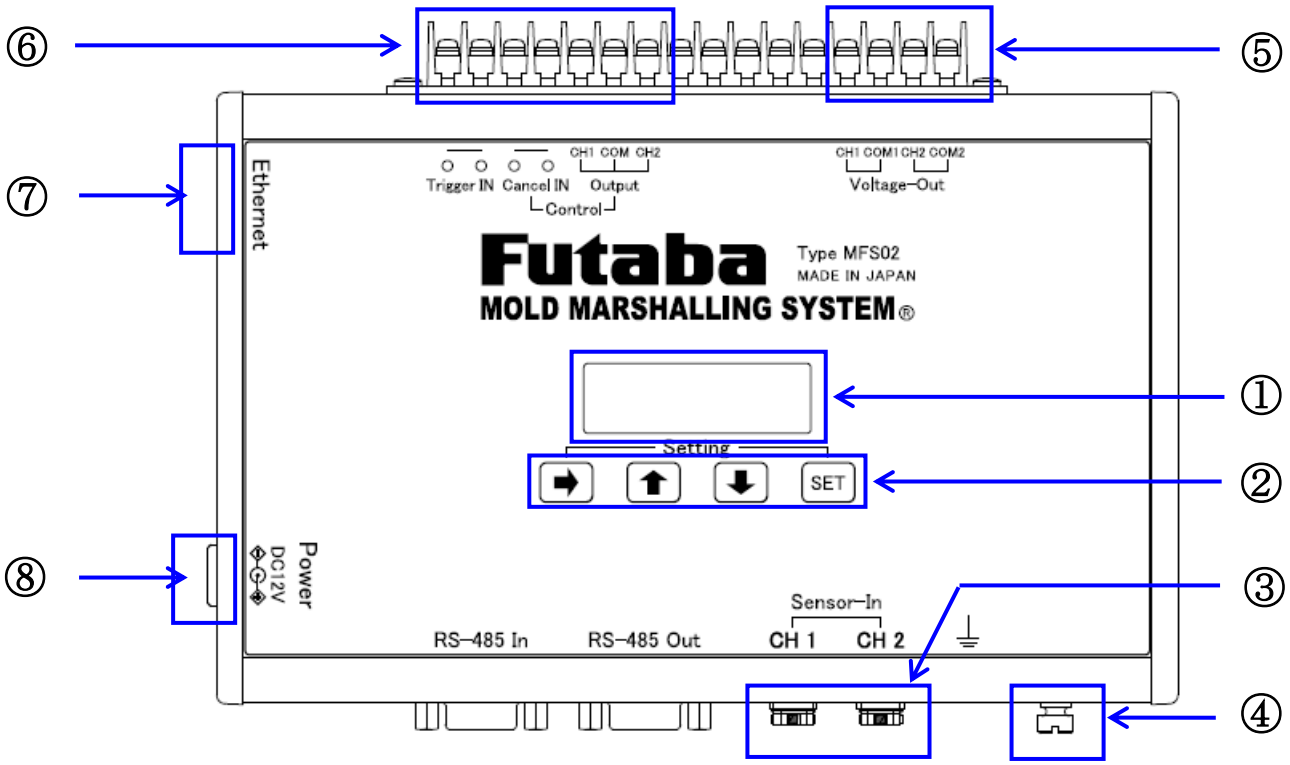
As shown in the above figure, the “MFS02” is designed to connect an optical fiber sensor to the input. The flow velocity sensor is connected to a relay amplifier, and connected to the connector of the MFS02 main unit amplifier via a junction cable.

The measurement amplifier and PC exchange data via the LAN cable. The measurement software that comes with this equipment needs to be installed in advance in the PC. Resin flow velocity values and velocity waveforms and historical data are stored in the PC.

An I/O cable is to be prepared by the customer. The system is connected to the molding machine and peripheral control equipment using the cable. This enables to start measurement, output control signals and clear control signals automatically. The “MFS02” has a voltage output feature, so a commercially available data logger can be connected to measure velocity waveforms.

1. Names and Major Functions of Components

1-1 Front



① Display panel ····· Displays version information, IP address, input voltage and flow velocity measurement values, etc.

② Control keys"→", "↑", "↓", "SET" ····· "→" key: Changes the display contents when held down.
"↑", "↓" keys: Not used.
"SET" key: Used as manual trigger key.

③ Relay amplifier connector ····· Connected to a relay amplifier using a dedicated junction cable. Two relay amplifiers can be connected.

④ Grounding terminal ····· Terminal for ground.

⑤ Voltage output terminal ····· Connected to the external measuring equipment such as data logger and oscilloscope.

⑥ I/O cable connector ····· Inputs trigger signals and clear control signals, and outputs control signals.

⑦ Wired LAN connector ····· Connected to the PC using a LAN cable.

⑧ AC Adapter connector ····· Connected to the AC adapter

2. Preparation

This section explains the preparation required before turning on the power.

2-1 Setting up the Network Connections

■ Make settings for communication between the amplifier MFS02 and PC.

＊For the Network setting procedure, refer to the “Measurement Software (PFS) Installation Manual”.

2-2 Installing PC Software

2−2−1 Hardware Requirements

■ Supported OS

The operations of this software have been verified with the following operation systems.

Windows XP, Windows 7, Windows 8

■ Capability

The following specifications are recommended.

CPU: Core2Duo or higher

Memory: 1GB or more

＊As a rough guide, the PC should have been released in 2007 or later and have 1GB or more memory.

2-2-2 Installation

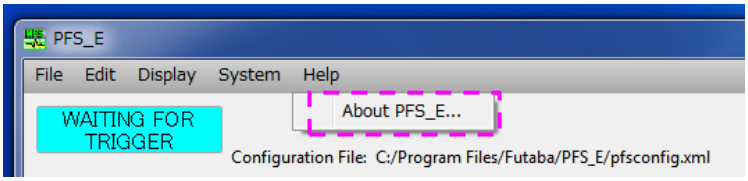
＊For the installation procedure, refer to the “Measurement Software (PFS) Installation Manual”.

2-2-3 Checking the version

The version of the software currently used can be checked.

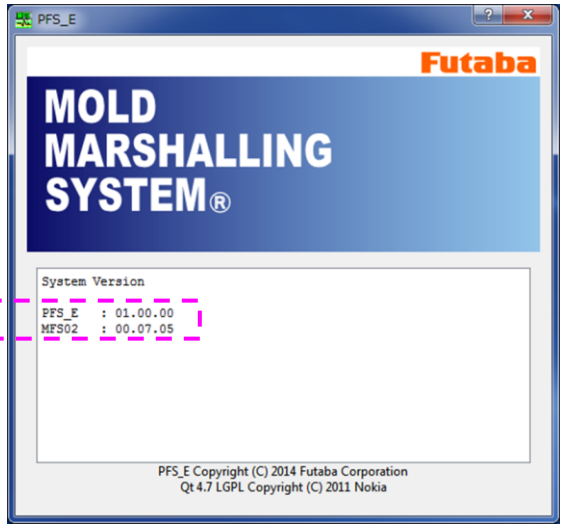
＊Unless there is particular reason, always use the latest software for operation.

From the main menu, select [Help] →[About PFS].



PC software version on the upper row

Amplifier software version on the lower row



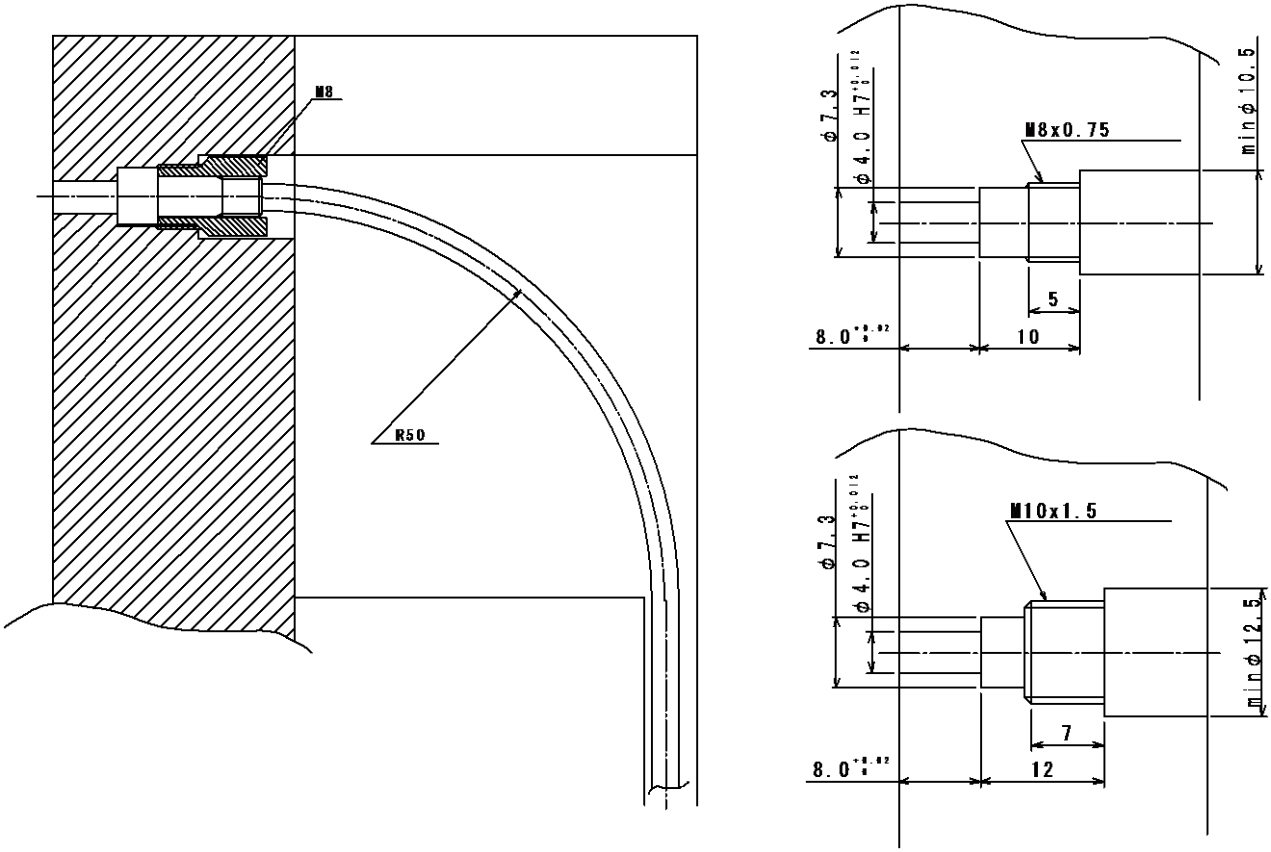
2-3-1 Installing the Flow velocity Sensor

The following figure shows an example of the installation.

One fixation screw (sold separately) is required for one sensor.

A wrench (sold separately) is needed to tighten the fixation screw.

※Provided, however, that this does not apply to the cases where the customer determines the fixation method of the sensor.



"Flow Velocity Sensor Reference Diagram"

2-3-2 Installing the Relay Amplifier

Install the relay amplifier near the mold. The temperature limit is 55℃. Be careful not to expose it to temperature higher than this limit.

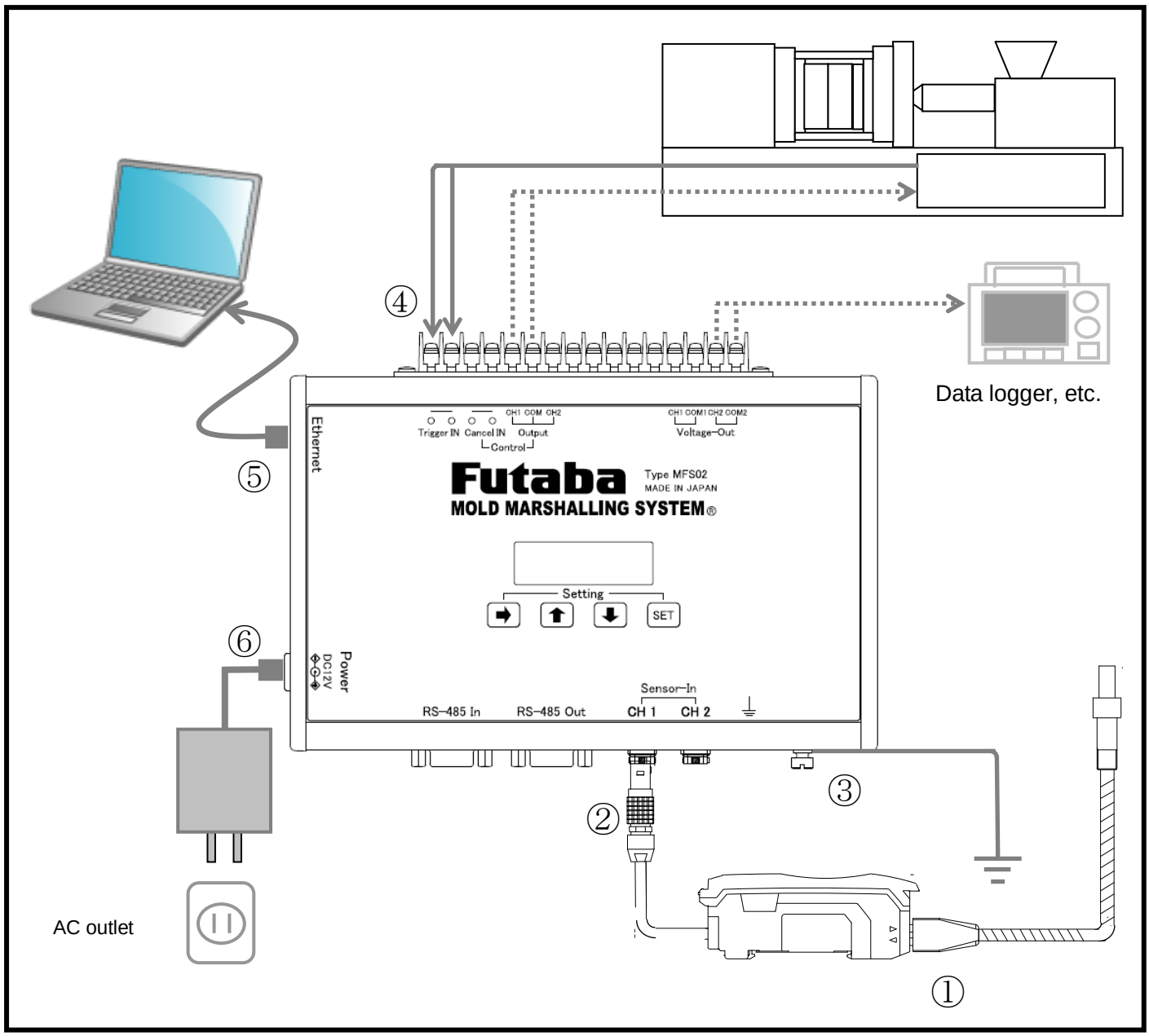
To fix the amplifier, prepare mechanical means such as DIN rail, etc by the customer.

Be careful not to allow the sensor cable to get caught in the molds or pulled by the movable mold while it is in operation.

2-3-3 Installing measurement amplifier

Install the amplifier by fixing it on the molding machine or preparing a dedicated placing table. Operating temperature range is from 0 to 50℃.

■ Connect the components in order of the numbers shown in the following figure.
Connect the power supply ⑥ after completing the connections ① to ⑤.



① Connect the sensor to the relay amplifier (see "9-1 How to Connect Sensor to the Relay Amplifier" on P. 32.)

Open the upper lid of the relay amplifier, pull down the lock lever forward to unlock the amplifier.
Insert the sensor and push up the lock lever back to lock the amplifier.
Ensure that the sensor plug is inserted to the bottom.

② Connect the relay amplifier to the measurement amplifier.

Insert the relay amplifier plug to the measurement amplifier connector by aligning the red marks on the plug and the connector.
Ensure that the sensor plug is inserted to the bottom.

③ Connect the “GND” terminal to ground.

④ Connect the trigger signals from the injection molding machine.

⑤ Connect the LAN cable to the amplifier and PC.

Make sure that the connector is locked with a “click”.

⑥ Connect the AC adapter.

2-5 Connecting I/O Signals

<<What is the input signal?>>

An input signal means a signal input to the amplifier from an external devices such as a molding machine or ejector machine.

Trigger signal	Required to start measurement. Upon the input of the trigger signal, “measurement” is performed. Connect the “mold closing complete signal”.
Clear control signal	Connected to clear (or cancel) the control signal being output from the amplifier. Connect the signal as needed.

＊ The control signal can be cleared automatically by specifying the time in the software settings (for details, see “Setting control outputs” on Page 17).
If automatic clear at the specified time causes no operational problem, the connection of the clear control signal can be omitted.

<<What is the output signal?>>

An output signal means a signal input from the amplifier to an external device such as a molding machine or ejector robot.

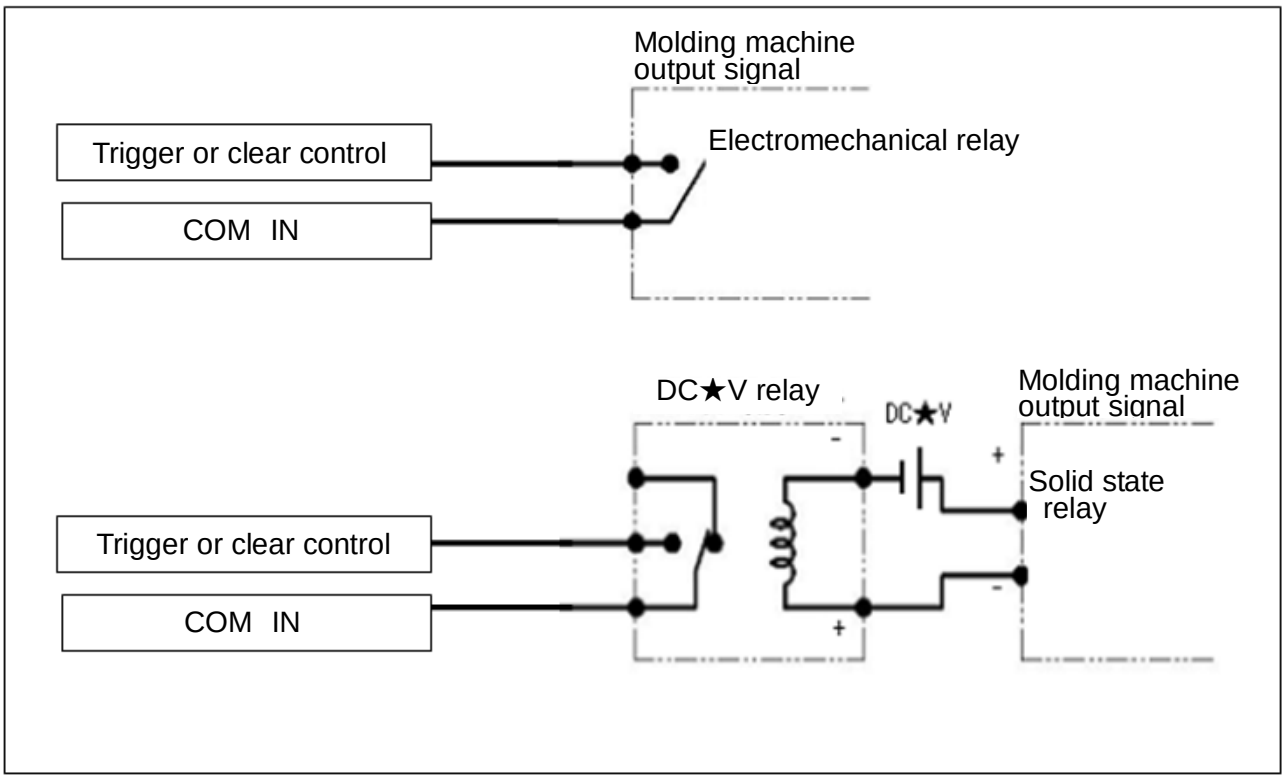
Control Output signal	A Control Output signal is output when the molten resin passes through the sensor. This signal is used to control the injection molding machine.

●Input signal circuit specification (trigger signal, clear control signal)

⚠ Caution Input the signal to the amplifier via the electromechanical relay.
Do not apply voltage.

Example 1: When the output of the molding machine connected to the amplifier is ”relay output”:

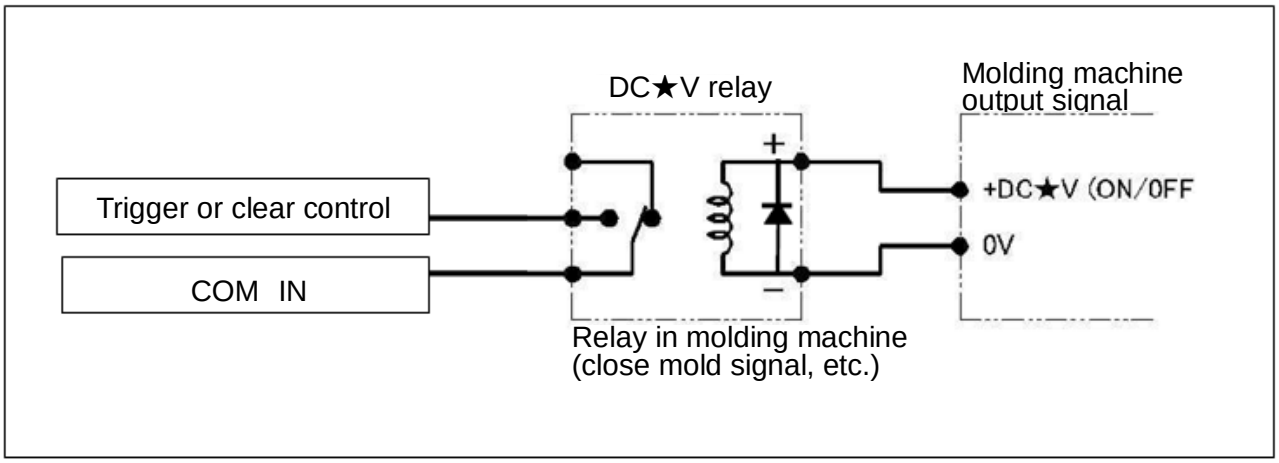
Example of connection of input signal when the molding machine output signal is contact output



Example 2: When the output of the molding machine connected to the amplifier is “voltage output”:

Connect the signal by using a relay adaptable to the output voltage of the output signal from the molding machine.

∗ When using an electromechanical relay, a relay equipped with the coil surge absorption circuit.
Example of connection of input signal using a relay when the molding machine output signal is DC★V ON/OFF output.

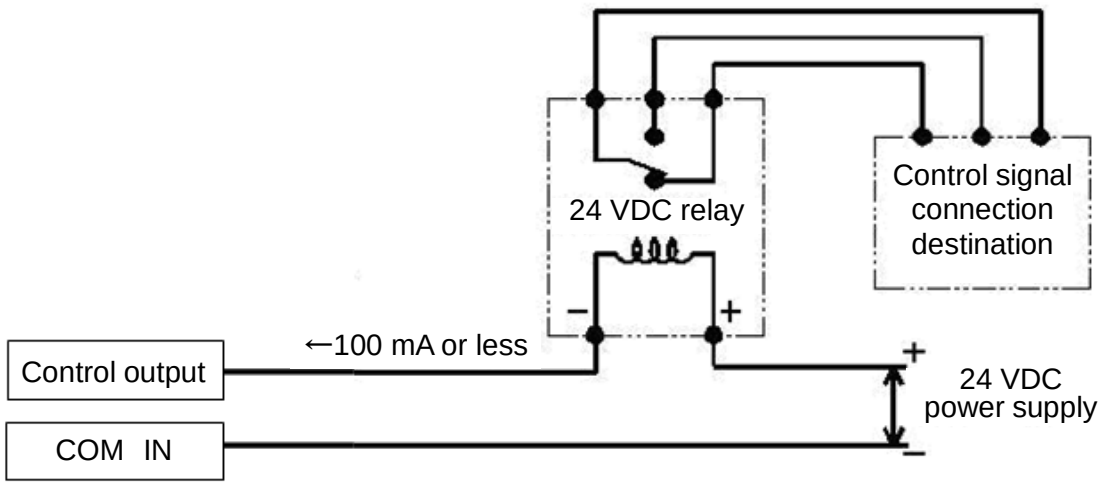


●Output signal circuit specifications (control output signal)

Warning The control output from the amplifier is up to 100 mA (30 V or less) in the NPN open collector. Use the power supply with the negative side connected to the ground.

Example: Connect I/O signals using the 24 VDC power supply and 24 VDC relay.

＊ When using an electromechanical relay, use a relay equipped with the coil surge absorption circuit.



＊ Use an independent power supply separate from the power supply for the molding machine.

2-6 Connecting the Power Supply

■ Supply power to this equipment through the AC adapter that comes with this equipment.

＊The amplifier does not have a power switch.

■ Check the supply voltage before connecting the AC adapter to the AC power source.

The operating voltage of the AC adapter is 100 V AC.

＊If each terminal voltage of the power supply has higher potential than the supply voltage against the ground, never connect it to the equipment. It could cause failure or accidents.

＊Warm up the system for over 30 minutes after power on. Insufficient warmup could make measurements unstable.

3. Basic Operation of Measurement Amplifier

This section describes the basic operation of amplifier “MFS02”.

3-1 Turning Power ON/OFF

■Turning power ON

Turn on the power to the amplifier by referring to Section 2-6 “Connecting the Power Supply” on Page 10.

■Turning power OFF

Disconnect the AC plug of the AC adapter from the AC outlet.

＊The amplifier does not have a power switch.

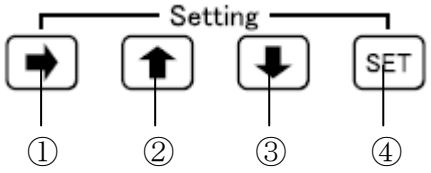
3-2 Operating the Amplifier

3-2-1 Operating the key switches

■ Operate the keys on the amplifier as needed on the following cases.

●Checking the IP address of the amplifier or firmware version

●Starting measurement manually (Pressing the SET key starts the measurement)

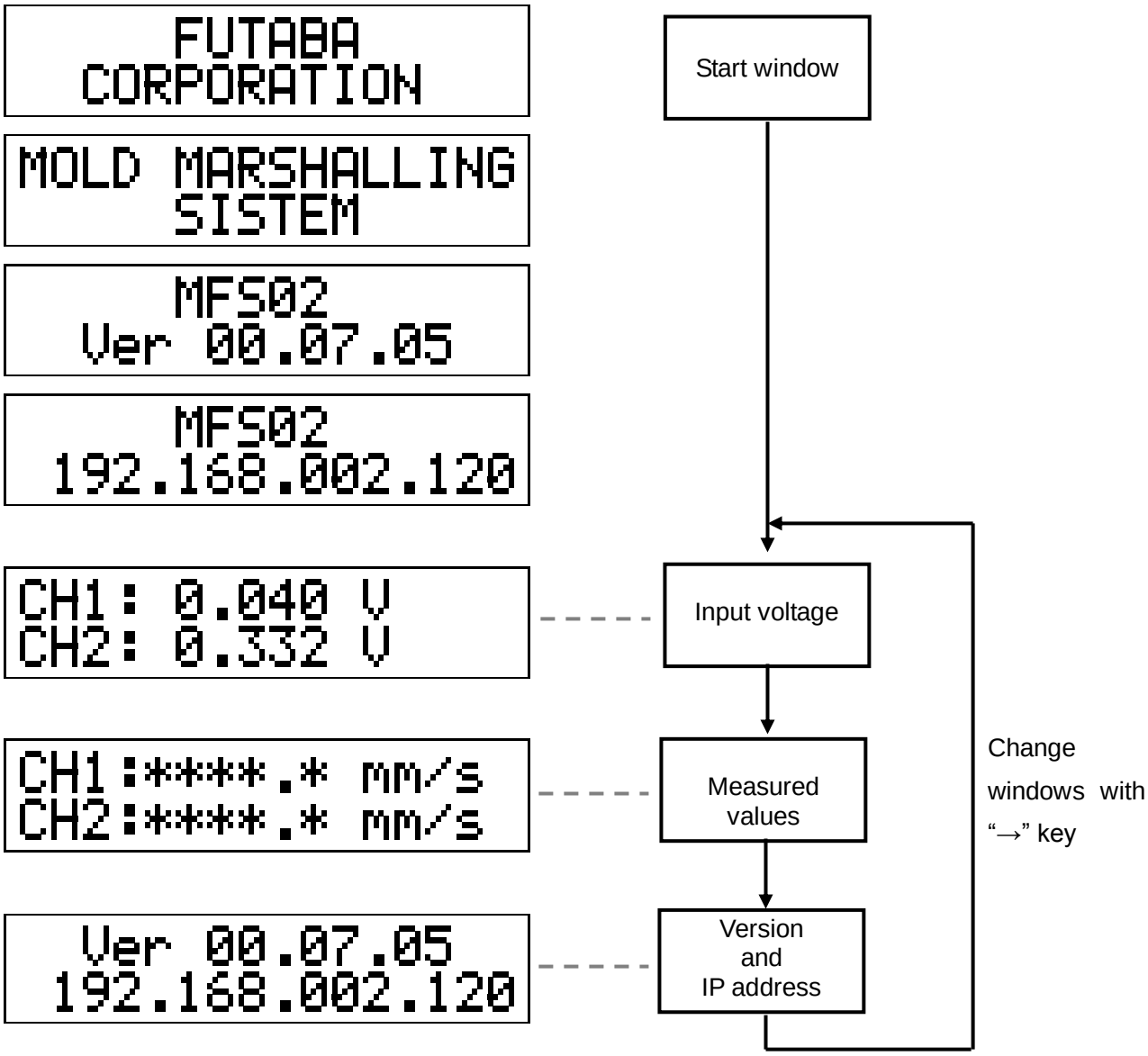


①	“→” key	Changes the display content when held down
②	“↑” key	Not used.
③	“↓” key	Not used.
④	“SET” key	Usable as the manual trigger

3-2-2 LCD window display

Turning on the power displays the following LCD window (The photo below shows the default window when shipped).

■ Holding down "→" key (for over one second) changes the display content.
Window changes as follows.



4. Basic Operation of Measurement Software

This section describes the basic operation of measurement software.

4-1 Starting and Exiting Software

■ Starting software

Double-click the shortcut “PFS” on the desktop.

＊If the shortcut “PFS” is not found, specify the “PFS” executable file in c:¥Program files¥Futaba¥pfs and click “Create Link” to create a shortcut.

■ Exiting software

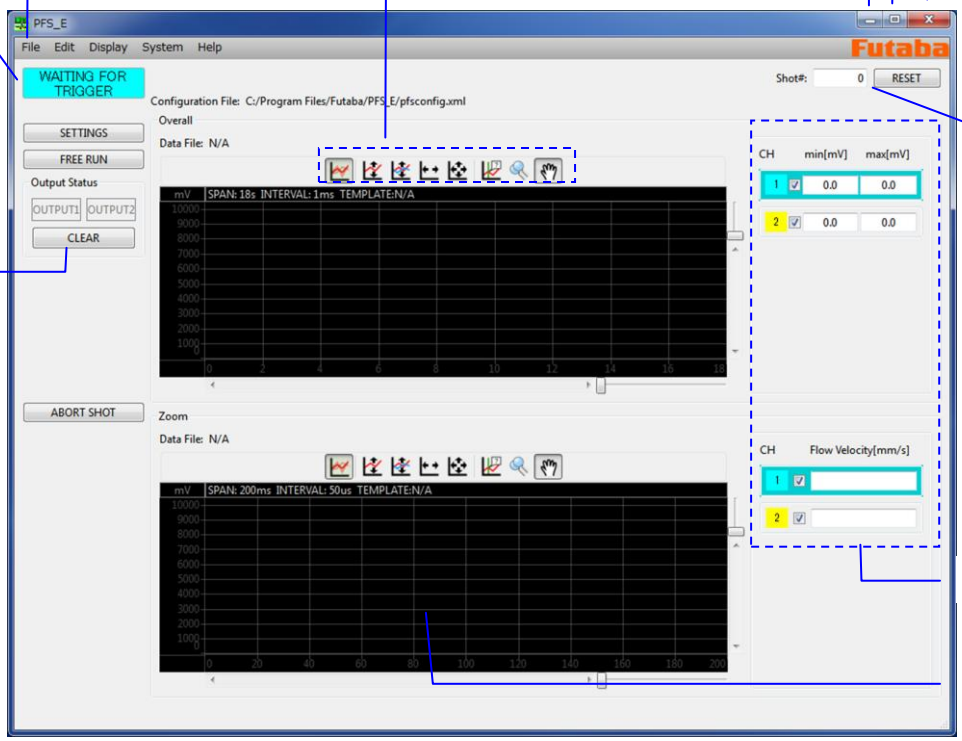
Select “Quit” from “File” in the menu bar, or click close button “×” on the upper right corner of the screen.

4-2 Names and Functions of Screen Components

This section explains the basic screen components and the operations that are often used.

■ Operation screen

When software starts up, the screen shown below appears. This screen is referred to as the operation screen. Here, remember the concepts of individual screen components.



Menu bar
Displays the menu to execute commands

Toolbar
Provides buttons to execute commands

Minimize button

Maximize button

Close button

Status display
Displays the status of communication and measurement

Counter display

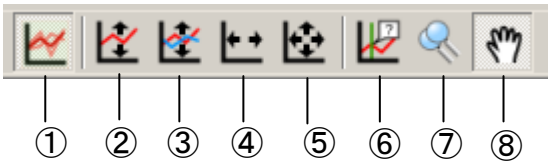
Control output display
Displays the status of control output signal

Channel information

Frame window
Displays resin velocity waveforms and template waveforms.

■ Toolbar

The frequently used commands are provided as buttons. The functions of individual commands are explained below.



①	Show/Hide Template wave	Shows or hides the Template waveforms read into the frame screen.
②	Fit to measurement voltage (selected waveform)	Enlarges the selected waveform in the Y axis (voltage axis) direction.
③	Fit to measurement voltage (all waveforms)	Enlarges all waveforms in the Y axis (voltage axis) direction.
④	Fit to measurement time	Reduces only in the X axis (time axis) direction.
⑤	Fit to measurement conditions	Reduces along both the X axis (time axis) and Y axis (voltage axis).
⑥	Cursor tool	Displays the time and voltage value at the cursor position.
⑦	Zoom	Enlarges the specified view.
⑧	Hand tool	Drags and moves the enlarged view.

■ Various buttons

SETTINGS	Opens settings screen (For details, see Page 16).
FREE RUN	Executes free run (For details, see Page 29).
ABORT SHOT	Stops the measurement (For details, see Page 18).
RESET	Resets the counter.
CLEAR	Clears control output signal manually.

4-3 Setting Conditions

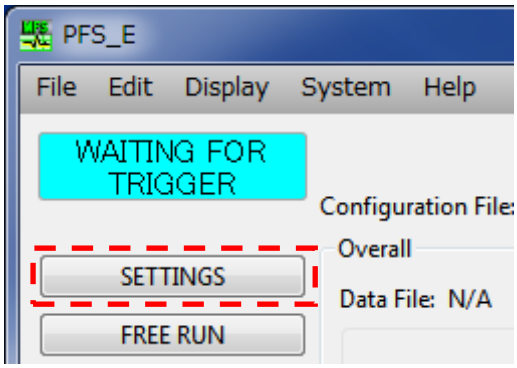
Here, set the conditions under which data is retrieved. The conditions once set are saved to the setting file, so the same conditions are automatically set when the setting file is read next and after.

■ Set “measurement conditions”, “flow front”, “trigger conditions”, “waveform search algorithm” and “control output conditions” sequentially in this order.

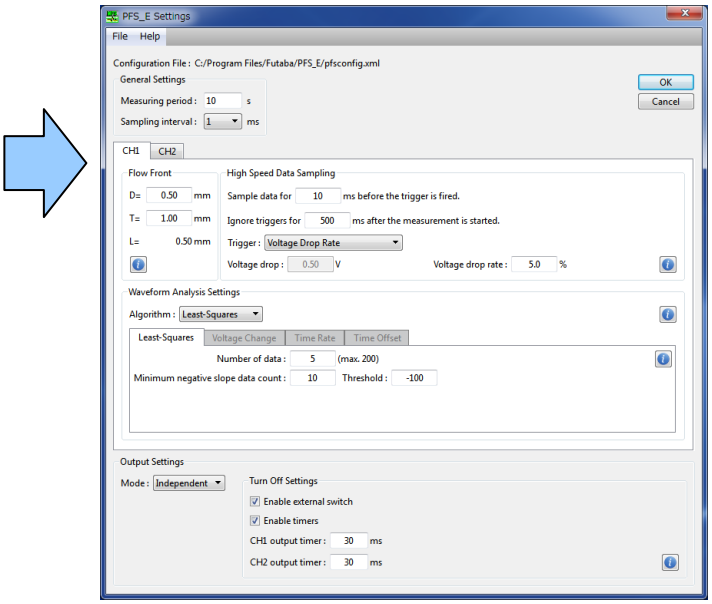
※Set ”control output conditions” as needed.

■ Setting measurement conditions

Click the “Settings” button.

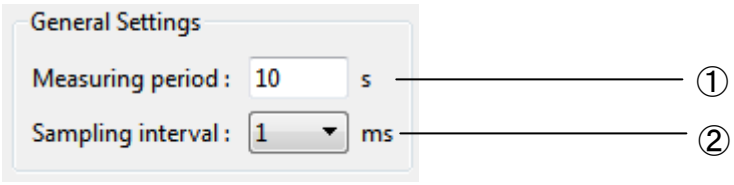


The Settings screen appears.



■ Measurement conditions

Set the time to make measurements.

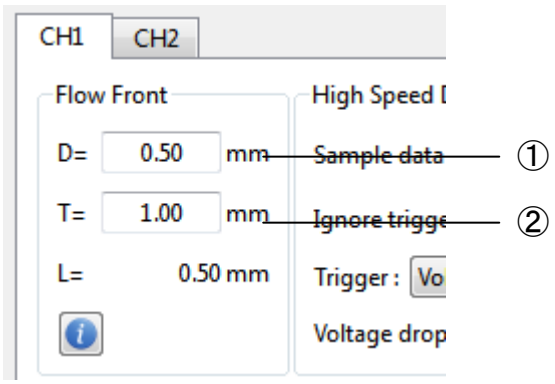


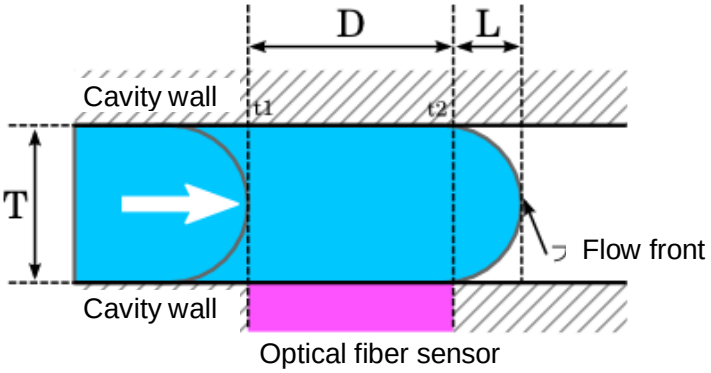
①	Measurement time	Set in units of seconds from 1 to 120. Set a shorter time than the molding cycle time.
②	Sampling interval	Select one from 1, 5, 10, and 20 ms.

■ Flow front

Input the diameter of the fiber and the product thickness.

※ When running two-point measurements, input the values for CH1 and CH2 respectively. The tab can be switched by clicking the channel tag.



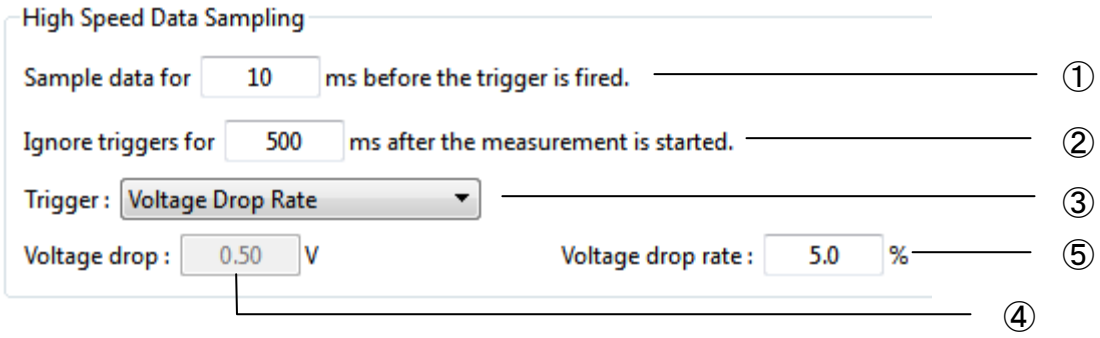


①	Fiber diameter	Use a fiber with a diameter of 0.50 mm.
②	Product thickness	Input the thickness of the molded part at the sensor mounting position.

■ Setting trigger conditions

Set trigger conditions for detecting velocity waveform.

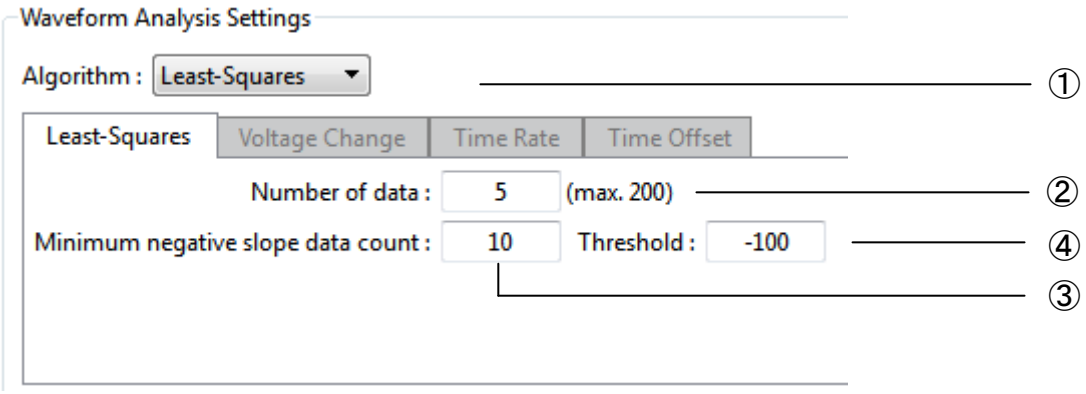
※ When running two-point measurements, input the values for CH1 and CH2 respectively. The tab can be switched by clicking the channel tab.



①	Set a point to capture a waveform	Time until a trigger occurs after the trigger conditions are met.	
②	Time for ignoring trigger conditions after a measurement starts	Time for which trigger conditions are to be ignored after a measurement is started(Use this condition when waveforms are distorted)	
③ ～ ⑤	Select trigger conditions.	・Voltage drop after measurement starts	Trigger the detection of a waveform when the voltage at the time of starting the measurement drops by the specified voltage value (④).
		・Percentage of a voltage drop after a measurement start	Trigger the detection of a waveform when the voltage drops by the specified percentage with the voltage at the time of starting the measurement defined as 100%.
		・Elapsed time	Trigger the detection of waveform when the specified time (②) has elapsed after the measurement is started.

■ Setting a waveform search algorithm

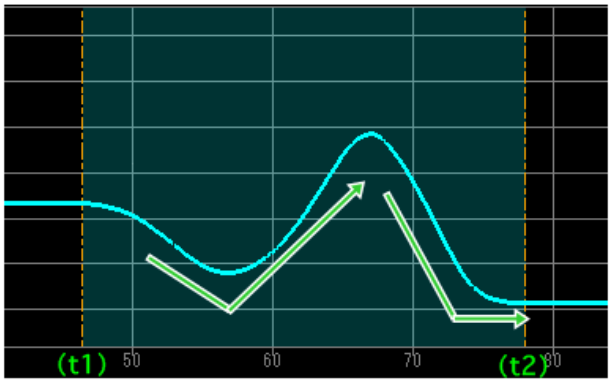
※ When running two-point measurements, input the values for CH1 and CH2 respectively. The tab can be switched by clicking the channel tab.



①	Select a search algorithm	Select least square method search. ※For the information for other search methods, refer to “9-3 Other Search Algorithms” on Page 34.
②	Number of data samples	Set the number of data samples in the process range.

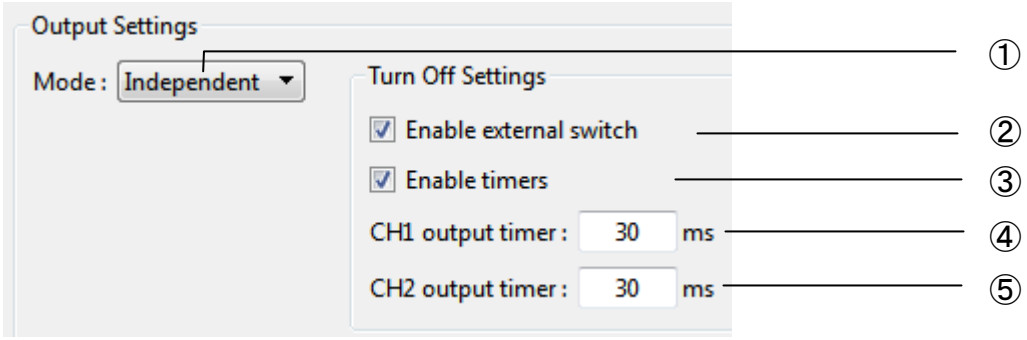
③	Number of contiguous data on the decay wave slope	The number of contiguous data on the decay wave slope
④	Set inclination of a waveform	Set the angle of the inclination of a waveform for conditions of searching a passage start point.

Calculate the inclination of the entire waveform by using the least square method.
(t1) on the right figure is a passage start point whereas (t2) is a passage end point.
The passage time is calculated by (t-2)－(t1).



■ Setting control output

Output a signal at the timing when resin passes over the sensor. The output condition shall be when the “high speed data capture” condition is satisfied.



①	Select an output mode	“None” ……No output “Independent output” ……Output when output conditions are independently satisfied in CH1 and CH2. “Simultaneous output OR” …Output when output conditions are satisfied in either of CH1 or CH2. “Simultaneous output AND” …Output when output conditions are satisfied in both CH1 and CH2.
②	Set external clear	Use this option when clearing the output with an external signal. Check the checkbox to enable this option.
③	Set time clear	Check the checkbox when enabling the clear by elapsed time.
④	Clear time (output 1)	Output in CH1 is cleared automatically after the specified time elapses.
⑤	Clear time (output 2)	Output in CH2 is cleared automatically after the specified time elapses.

■ Help mode

Click this button to display the help window (detailed explanations).

4-4 Saving Settings As

■ After completion of “setting the measurement conditions”, “flow front”, “trigger conditions”, “waveform search algorithm” and “control output conditions”, save the new settings.

Select “Save As” from “File” in the Settings window and input a file name to save the file.

・ Save the file in :C:¥Program Files¥/Futaba/pfs/

5. Using the System

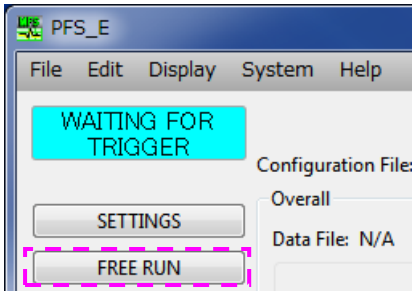
The previous operations have completed the necessary preparations. Now, the user can run the system and observe flow velocity waveforms.

5-1 Adjusting Light Intensity

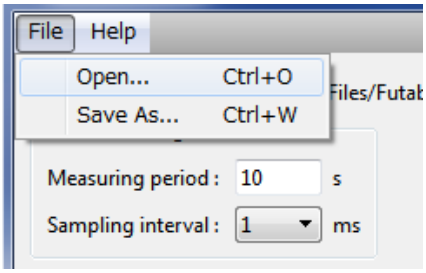
■Close the mold once and check the voltage level before the resin passes over the sensor.
Adjust the light intensity of the relay amplifier in the range of 2000 to 3000 mV.
※For the operation, refer to Section 9-2-2 “Adjusting the light intensity of relay amplifier” on Page 34.

5-2 Selecting Setting File

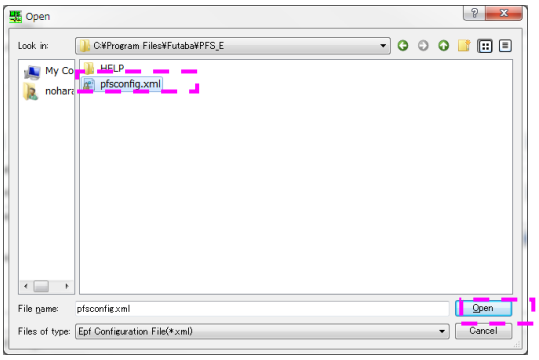
① Press the “Settings” button.



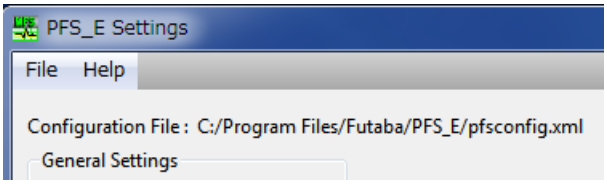
② Press “Open” from “File” in the menu bar.



③ Select a setting file and press “Open”.



④The conditions in the selected settings are displayed.



⑤ Press the “OK” button on the upper right to close the Settings screen.

※At shipment, the default settings file (pfsconfig.xml) is stored in the PC.
※For creating and saving the setting file, refer to Section 4-3 “Setting the Conditions” on Page 14 and Section 4.4 “Saving Settings As” on Page 18.

5-3 Starting Measurement

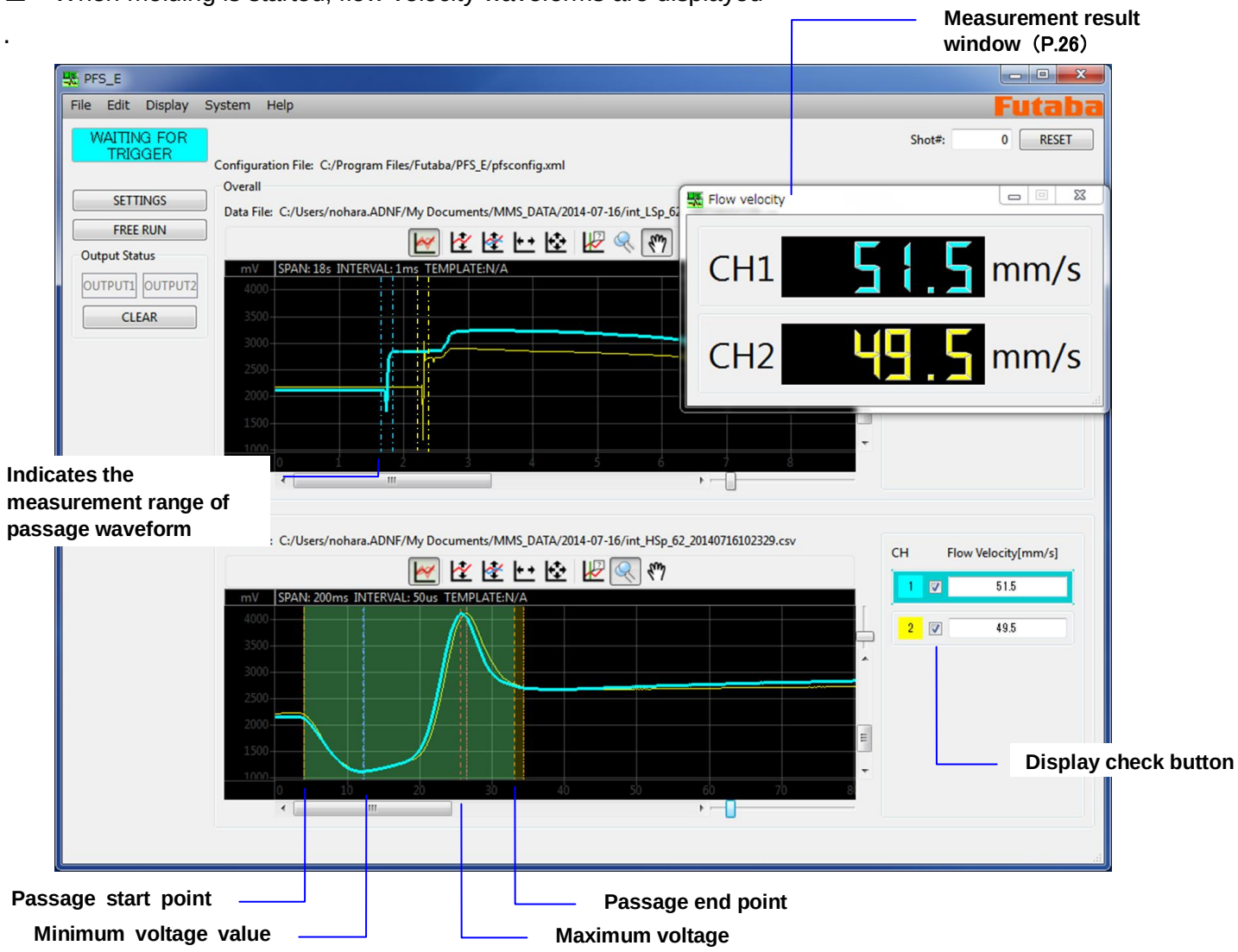
Now, the system is completely ready to observe waveforms.

■ Measurement of flow velocity begins when a trigger signal (measurement start signal) is input from the molding machine.
※A trigger signal can also be input manually by pressing the “SET” key of the amplifier.

■ If you need to stop the measurement during the process, press the “Stop measurement” button.
※If you stop the measurement mid-way, data file is not created.

■ When molding is started, flow velocity waveforms are displayed

.



※ If waveforms are not displayed, check the following.

① Has resin reached the sensor?

→Check the molded parts and the sensor mounting position.

② Is the display channel checked?

→Confirm the check mark in the channel information display section (at the right side of the operation window).

③ Is the system connected correctly (sensor, relay amplifier, power supply, LAN and trigger signal)?

→Check the Network settings by referring to Section 2-4, “Connections in the system” on Page 7.

④ Isn’t the sensor damaged?

→Check the sensor by referring to Section 7-3 “Checking the Operation of Sensor” on Page 30.

※ If the peak of the velocity waveform exceeds 5000mV and is saturated, the light intensity needs to be adjusted. Adjust the light intensity so that the peak and the trough of the waveform will not be saturated.

(For the light intensity adjustment procedure, refer to “Adjusting the Light Intensity of Relay Amplifier” on Page 34.)

6. Function Description

This section explains specific functions and advanced operations.

6-1 Displaying Template Waveforms

Flow velocity waveforms stored in the past can be displayed in the frame window.
Overlaying the template waveforms on the waveforms being measured makes it possible to visually check “flow velocity transition at molding condition adjustment”, “flow velocity variation during mass production”, and “flow velocity change when the molding conditions are changed”.

■ Open a template waveform of the measured waveforms.

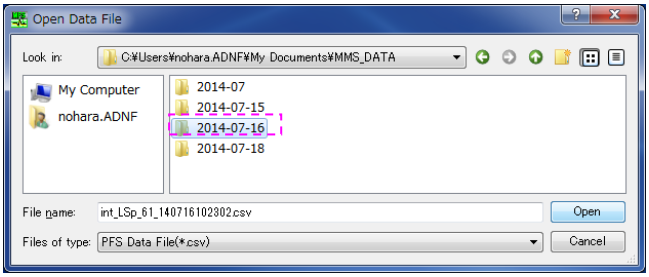
Select [Open a measured waveform (LSp File) as a Template waveform] from “File” in the menu bar.

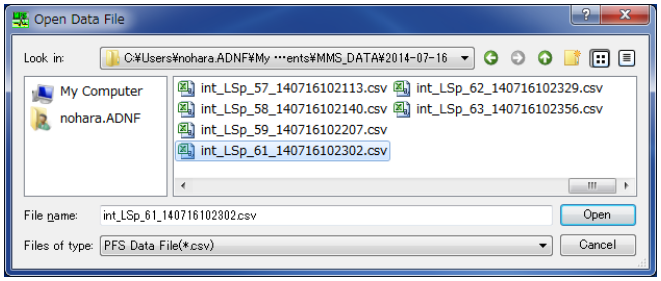
The measured waveforms are stored in the following folder.

C:/Documents and Settings¥<User Name>¥My Documents¥MMS_DATA

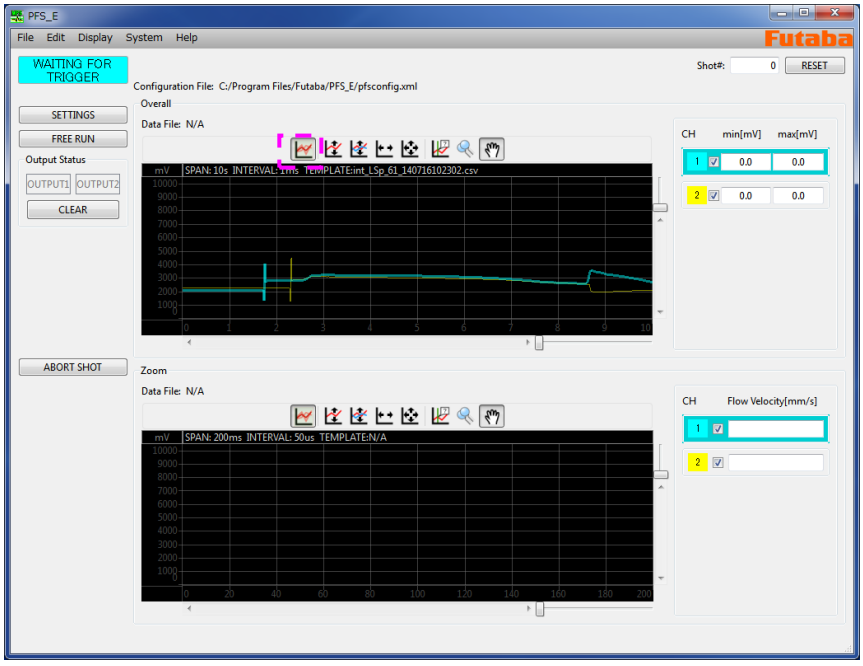
Select a file from the folder displayed with the date, and press “Open”.

※Each template waveform file is automatically stored with a name consisting of a shot number, date and time.





The template waveform is displayed on the waveform being measured (in the upper frame window).



※ If the template waveform is not displayed, check whether the “Show/Hide template waveform” button on the toolbar is set to “Hide”.

■ Open a template waveform of velocity waveforms

Select [Open a velocity waveform（HSp File）as a template waveform] from “File” in the menu bar.

Velocity waveforms are stored in the following folder along with other measured waveforms.

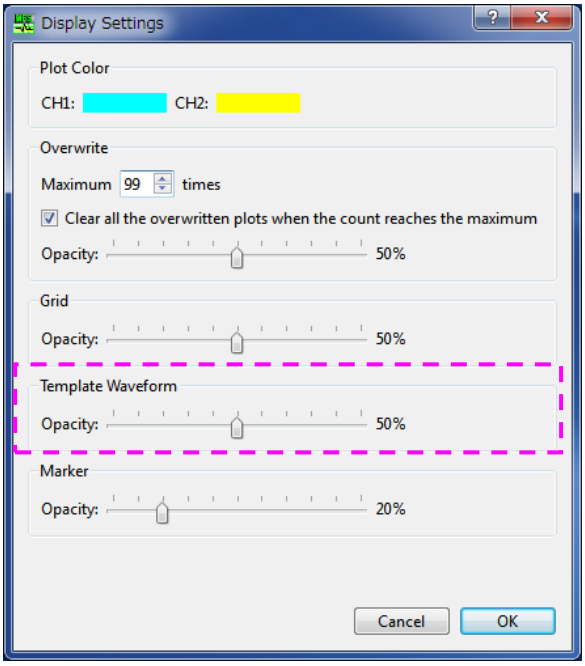
C:/Documents and Settings¥<User name>¥My Documents¥MMS_DATA

Select a file from the folder displayed with the date and press [Open].

The template waveform is displayed on the waveform being measured (in the lower frame window).

■ Color density of template waveforms

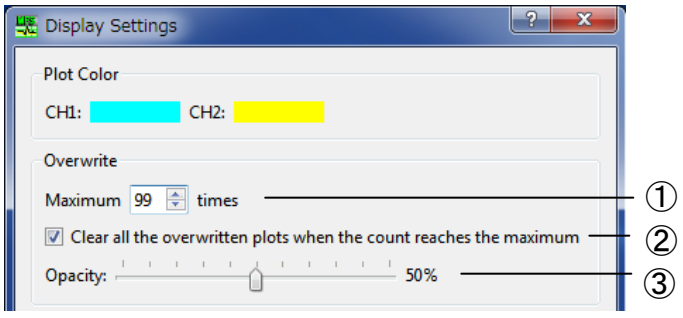
The density of the display color of the template waveform can be adjusted by selecting [View] → [Display settings] →[Opacity of template waveform].



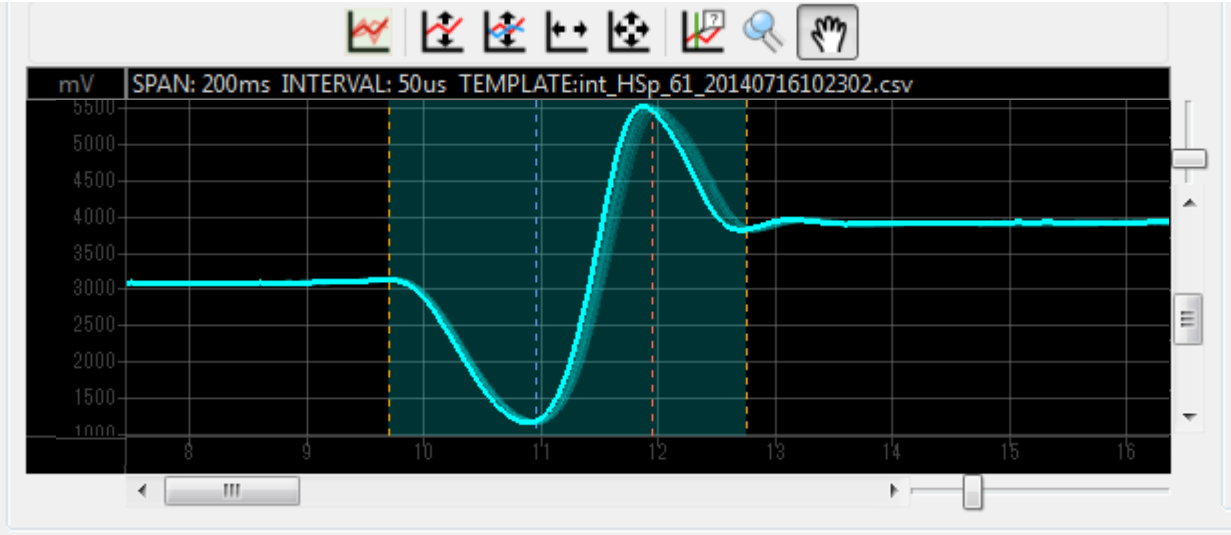
The density can be set in 5% steps in the range of 0 to 100%. The higher the set value is, the denser the display color becomes.

6-2 Overlaying Waveforms

■ The overlay count can be set by selecting [Display settings] from [View] in the menu bar.



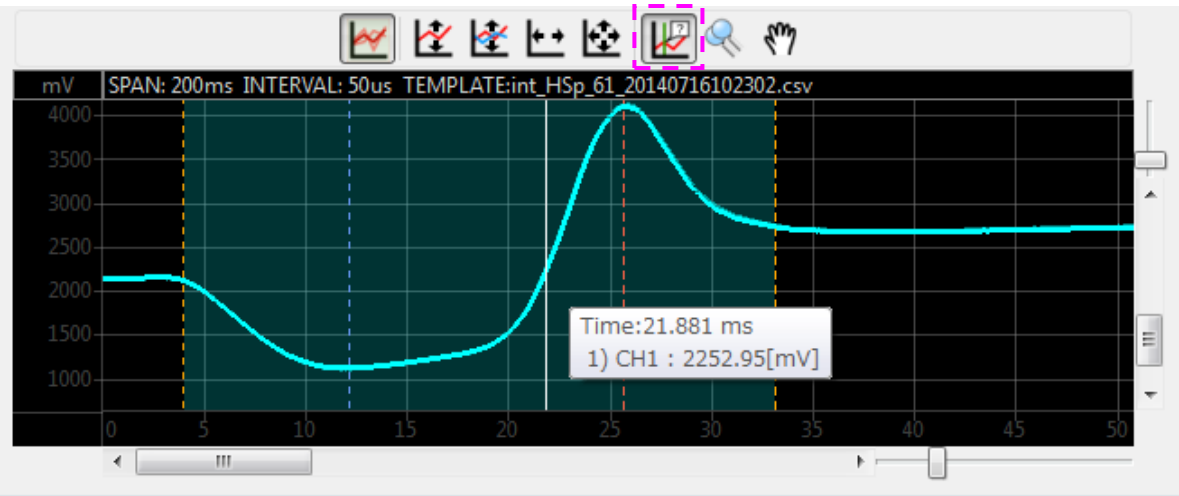
①	Overlay count setting	Set in the range from 0 to 99.
②	Overlaid waveform display setting	Check: After overlay is performed the specified number of times, the overlaid-waveforms are entirely erased. Uncheck: Overlaid-waveforms are erased in order from the old one.
③	Template-waveform opacity setting	A value can be set in steps of 5% from 0 to 100%. As the value is increased, the template waveform is displayed darker.



※If you want to hide overlay, set the overlay count to 0.

6-3 Using the Cursor Functions

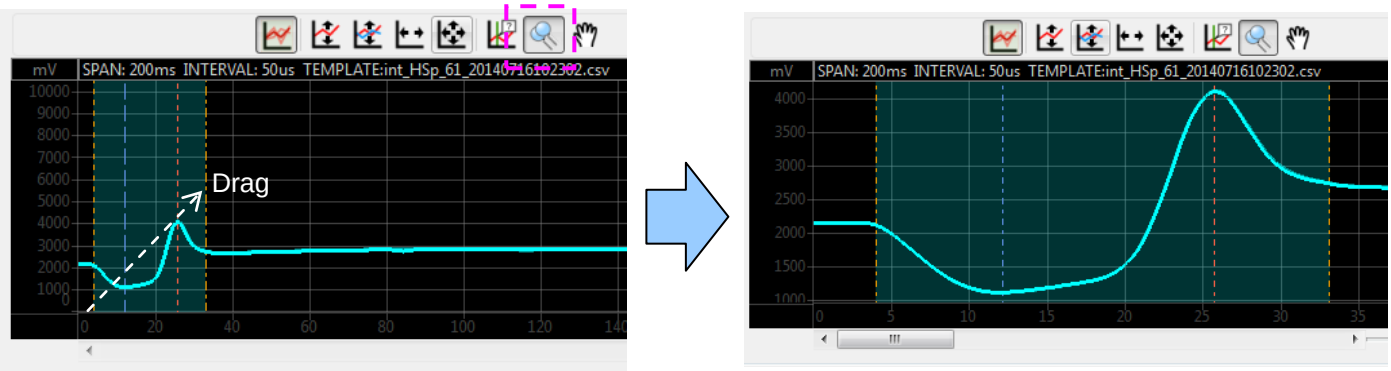
Time and voltage values can be displayed by placing the cursor on the waveforms being measured. To do so, use “Cursor tool” on the toolbar.



6-4 Waveform Display Settings

6-4-1 Enlarging waveforms (zoom)

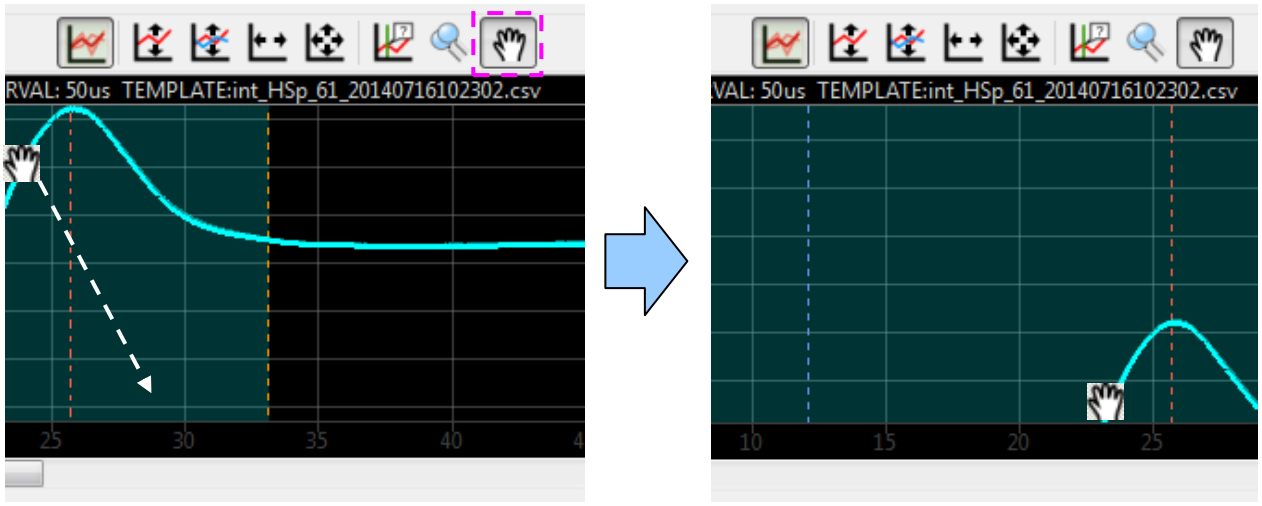
■ Using the “Zoom” button on the toolbar, select the part to enlarge.



※Mouse operation: Enclose the start point to the end point of the part to be enlarged, and release the mouse button.

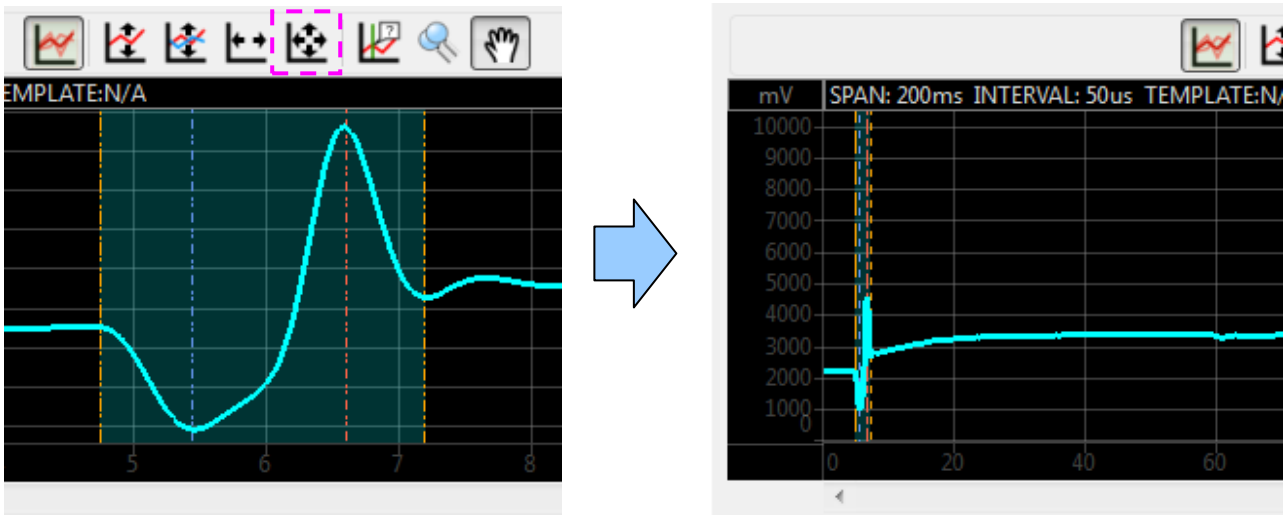
6-4-2 Moving the waveform position

■ A position in the enlarged part can be moved by using the “Hand” button on the toolbar.



6-4-3 Displaying the entire waveform (zoom out)

■ The entire waveform display can be restored by using the “Fit to measurement conditions” button on the toolbar.

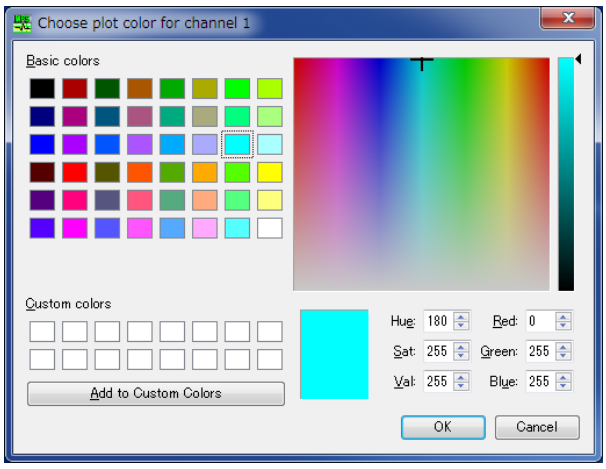


6-4-4 Changing the color of waveforms

Select [Display settings] from [View] in the menu bar.

Click the color box in the plotting colors.

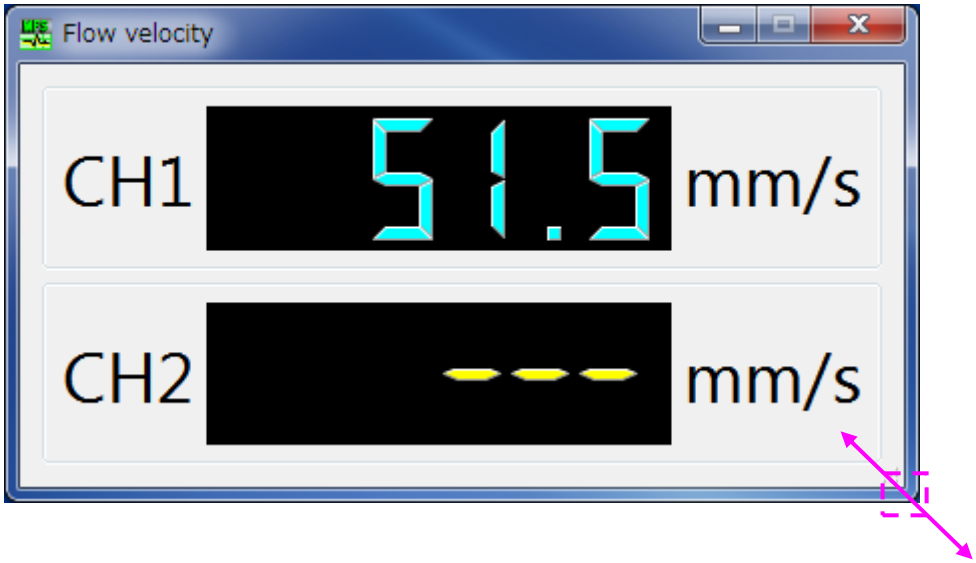
Select desirable drawing color and click [OK].



Select [Display results] from [View] in the menu bar.

Flow velocity window opens.

Grab the lower right corner with the mouse and drag it to resize a window.



6-6-1 Type of saved data

This software can save setting files, waveform data, and numerical data.

Data type	Item	Extension	Save destination folder (default)	Remarks
Setting file	Condition settings	.xml	C:/Program Files/Futaba/pfs	A setting file contains conditions that are set to perform measurement and monitoring. Select one from the relevant folder in the PC to use.
Waveform data	Measured waveforms (LSp) Velocity waveforms (HSp)	.csv	C:/Users/<User name>/My Documents/MMS_DATA/ year- month- day folder	Saved for each shot number. Can be read as the template waveform data into PFS software. Can be read to spreadsheet software to edit the data.
Numerical data (monitoring item)	Peak files (Peak)	.csv	C:/Users/<User name>/My Documents/MMS_DATA/ year-month folder	This data file is created once a day. Saved by date. Can be read to spreadsheet software to edit data.

■ Measured data file (int_LSp_<Shot number>_<Year, month, day and time (hour, minute and second)>.csv)

Format

The numbers on the left are line number.

1	Low Speed Data			
2	Time:xxxx/xx/xx xx:xx:xx			
3	Observation Period: xxxs Sampling Interval:xxxms			
4	Shot No:xxxx			
5	Data Attribute:xxx			
6	==========			
7	INDEX	Time	CH1	CH2
8	1	xxx	xxx	xxx

Low Speed Data: File title

Time: Measurement end time (Year/month/day hour:minute:second)

Observation Period: xxxs Sampling Interval:xxxms

Measurement time (S) and sampling interval (ms) (values set for the measurement)

Shot No: Measurement number

Data Attribute: Measurement time, sampling interval

Index: Data number

Time: Data number × time for sampling interval (ms)

CH1: Voltage values in 1CH (mV)

CH2: Voltage values in 2CH (mV)

※ The voltage value in the channel not selected will be 0mV.

■ Velocity data file (int_HSp_<Shot number>_<Year, month, day, hour, minute, second>.csv）

Format

The numbers on the far left are the respective line numbers.

1	High Speed Data			
2	Time:xxxx/xx/xx xx:xx:xx			
3	Observation Period: 200ms Sampling Interval:50us			
4	Shot No:xxxx			
5	Trigger at:			
6	Transit time before minimum voltage：			
7	Minimum voltage at：			
8	Maximum voltage at：			
9	Transit time after maximum voltage：			
10	==========			
11	INDEX	Time	CH1	CH2
12	1	xxx	xxx	xxx

High Speed Data: File title

Time: Measurement end time (Year/month/day hour：minute：second)

Observation Period: 200ms Sampling Interval:50us

Fixed values of measurement time 200ms and sampling interval 50us

Shot No: Measurement number

Trigger at: Relative time from measurement start to passage detection trigger (ms)

Transit time before minimum voltage：

Time calculated by subtracting the “time before minimum voltage” from the time at the minimum voltage detected position

Minimum voltage at： Minimum voltage detected position

Maximum voltage at： Maximum voltage detected position

Transit time after maximum voltage：

Time calculated by adding the time after maximum voltage to the time at the maximum voltage detected position.

Index： Data number

Time： Data number × time for sampling interval (ms)

CH1： Voltage values in 1CH (mV)

CH2： Voltage values in 2CH (mV)

※ The voltage value in the channel not selected will be 0 mV.

※ The values in the line 5, 6, 7, 8, 9 and 10 become 0 if the passage data are not detected.

■ Log file (log_<year, month, day>.csv)

Format

The numbers on the far left are respective line numbers.

1	Time	Shot	Result	CHxx Result CH1-CH2	CHxx Peak CH1-CH2	CHxx Start voltage CH1-CH2
…	…	…	…	…	…	…

CHxx Hi Trigger Time CH1-CH2	CHxx Minimum voltage after time CH1-CH2	CHxx Minimum voltage time CH1-CH2	CHxx Maximum voltage time CH1-CH2	CHxx Maximum voltage after time CH1-CH2
…	…	…	…	…

Time　Measurement end time (Year/month/day　hour:minute:second)

Shot　Measurement time

Result　When the comprehensive evaluation and flow velocity calculation is completed successfully, OK is displayed.

CHxx Result　If successful, flow velocity (mm/sec) in the selected channel is displayed. If failed, NG is displayed.

CHxx Peak　Peak voltage in the selected channel (unit: mV)

CHxx Start voltage　Voltage observed at the time when a trigger starts (unit: mV)

CHxx Hi Trigger Time　Relative time (ms) from the start trigger to high speed trigger in the selected channel

CHxx Minimum voltage after time

Time (ms) calculated by adding the “time before minimum voltage” to the time at the minimum voltage detected　position

CHxx Minimum voltage time　Time at the minimum voltage detected position on the velocity waveform data (ms)

CHxx Maximum voltage time　Time at the maximum voltage detected position (ms) on the velocity waveform data

CHxx Maximum voltage after time

Time calculated by adding the time after the maximum voltage to the time at the maximum voltage detected position.

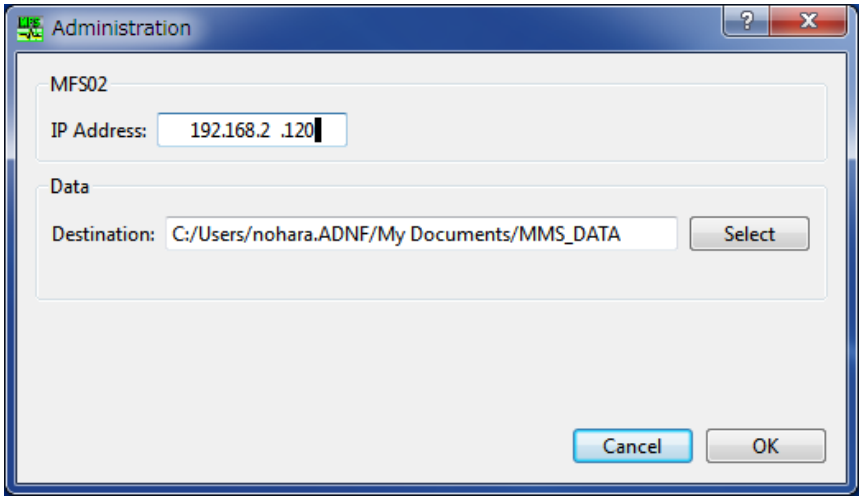
6-6-2 Setting the save　folder

Data is saved to the respective pre-specified folders.

The save folder can be changed by selecting [System] from the menu bar → [Administration].

Press [Select] button to select the destination to save the data and then press [OK] button.

※A message appears to prompt you to restart the PC. Restart the PC by following the message.

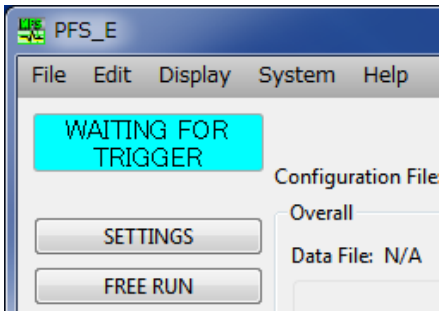


7. Checking the Operation

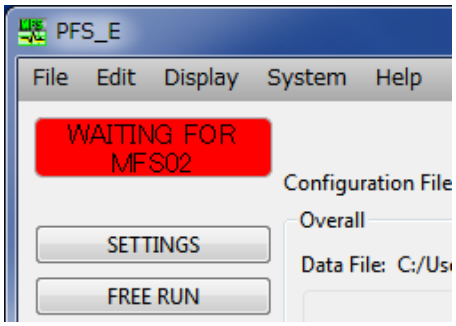
This section explains how to check whether the system runs normally.

7-1 Checking the Communication between Amplifier and PC

The amplifier communicates with the PC through LAN connection. Whether the communication is implemented normally can be checked with the color of the indicator at the upper right of the operation window.



Communication normal status



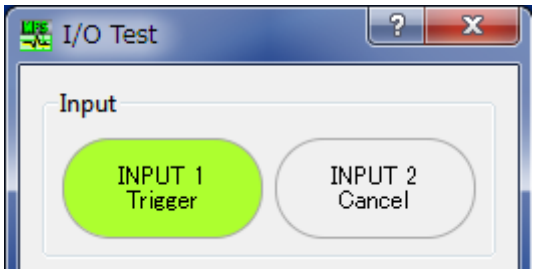
Communication failure status

7-2 Checking the I/O Signal

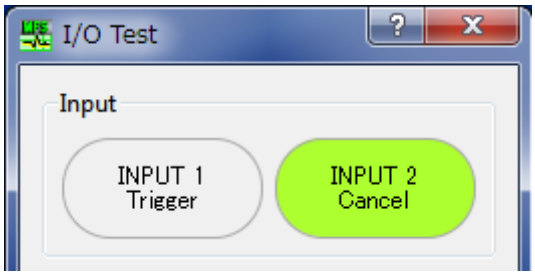
Check whether the connected I/O signal works correctly.
From the main menu, select [System] to run [I/O Test].

■ Checking the operation of input signal

Input a signal (trigger signal or clear control signal). If it is input normally, the signal name is displayed in green as shown in the following figure.



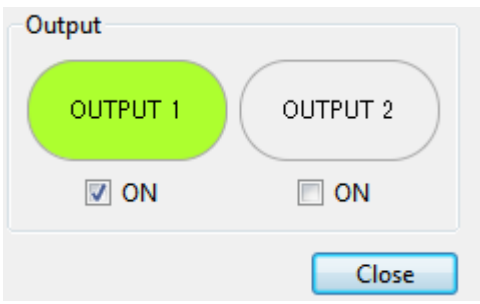
When trigger signal (IN1) is input



When clear control signal (IN2) is input

■ Checking the operation of output signal

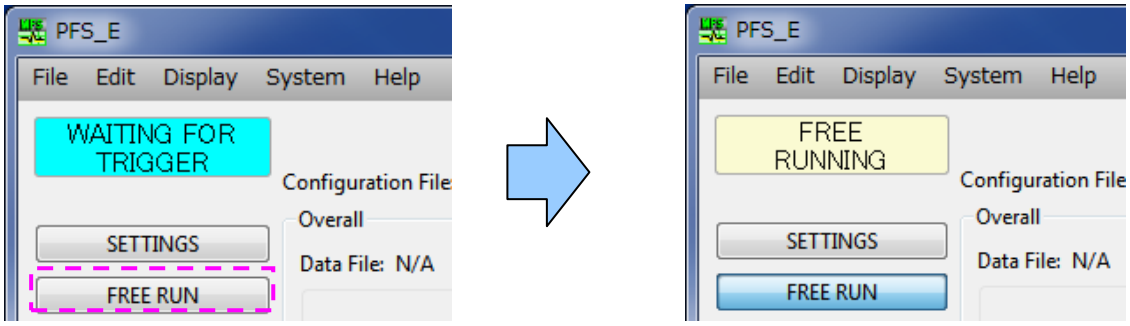
Check the “ON” check box shown on the right figure. The signal name illuminates in green and an alarm signal is forcibly output. Check whether the signal operates normally at the output signal connection destination.



Follow the procedure below to simply check the operation of the sensor.

■ Press “Free run”.

Sensor begins producing its outputs.



■ Move an appropriate reflective plate closer to the tip of the sensor and check whether the voltage level changes.
(This is only a simple test to check whether the sensor works.)

8. Specifications

■ List of specifications

＜Flow velocity measuring amplifier MFS02＞

Number of measurement points	2
Sampling period	1ms / 5ms / 10ms / 20ms
Sampling speed	Up to 120 sec
Velocity measurement range	10 to 1000 mm/sec ※1
Operating ambient temperature	0 to +50℃
Operating ambient humidity	35 to 85%RH (no condensation)
Power supply specifications	Dedicated AC adapter should be used. Input 12 VDC 0.5 A
Weight	Approx. 1,000 g

※1 The measurement range may vary slightly depending on the thickness (t) of the molded part.

＜AC adapter＞

External dimensions (Main unit)	48.6(W)×63.5(D)×31(H)mm (See outline drawing)
Operating temperature range	0 to +40℃
Operating ambient humidity	20 to 80%RH (no condensation)
Power supply specifications	Input AC100V 50Hz/60Hz Output DC12V 1.2A
Weight	Approx. 104 g

＜LAN Cable WCL0020＞

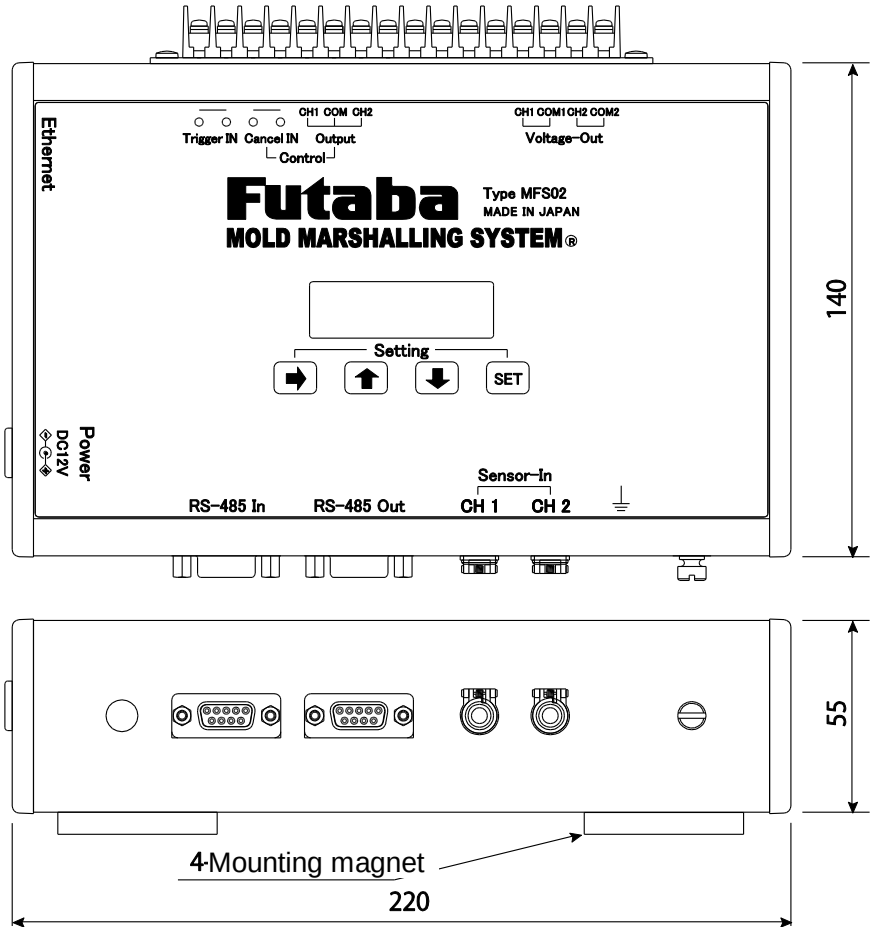
Standard	CAT 7
Total length	2 m
Operating temperature range	0 to +40℃

＜Relay amplifier＞ (Sold separately)

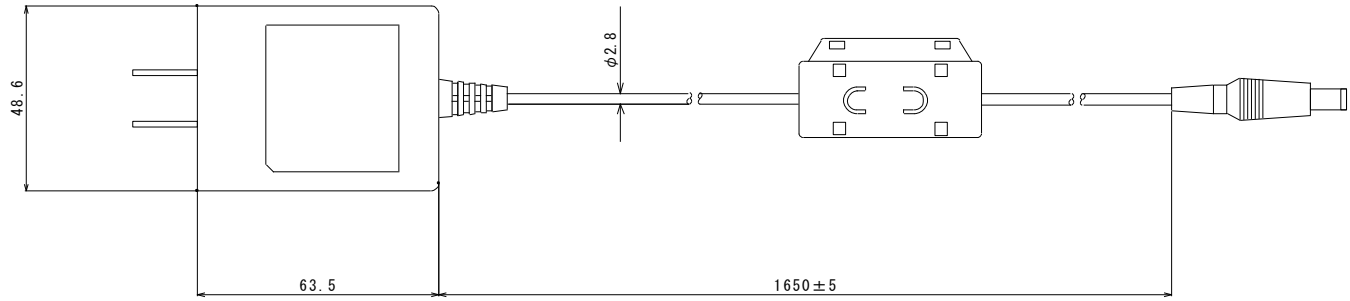
Light source LED	Red 4-element LED (waveform 630nm)
Operating temperature range	-20 to +55℃
Operating ambient humidity	35 to 85%RH (no condensation)
Weight	Approx. 75 g

■ Outline drawing [Unit: mm]

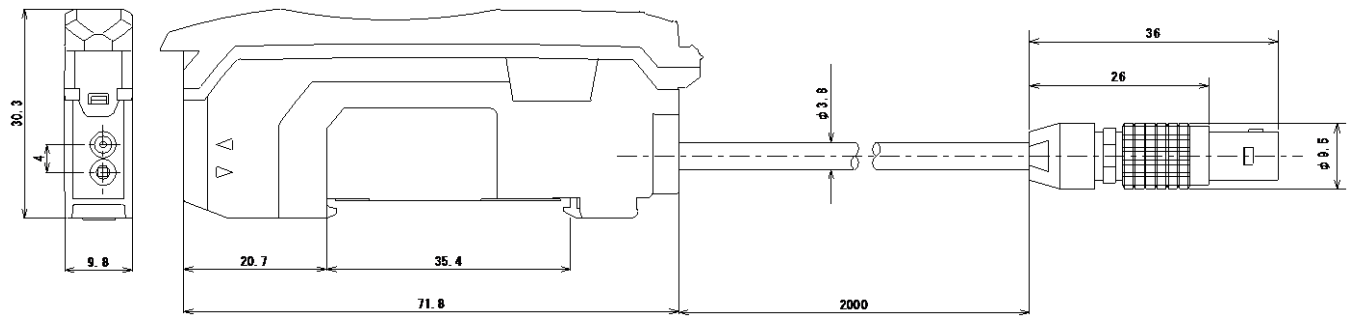
＜Flow velocity Measurement Amplifier MFS02＞



＜AC Adapter＞



＜Relay Amplifier UPV01＞ (Sold separately)



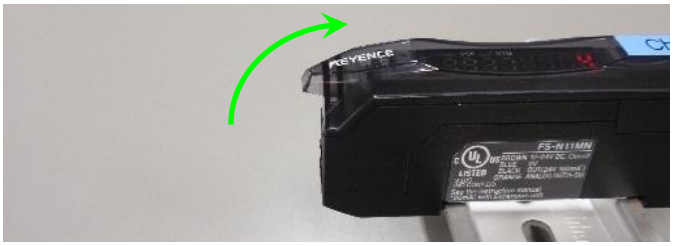
9. Reference Materials

9-1 How to Connect Sensor to the Relay Amplifier

Caution **Do not insert a sensor with the locking lever in a locking position. Doing so could cause damage or failure of the devices.**

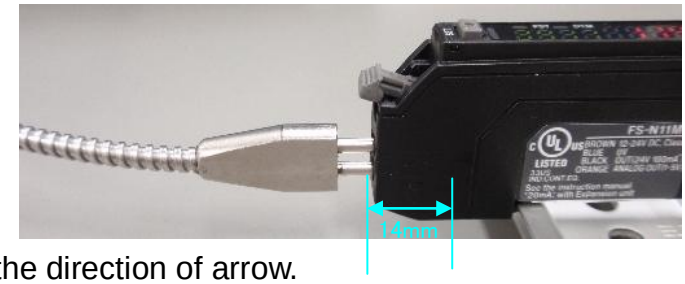
Caution **Do not push the sensor too strongly against the bottom as it may damage or break the parts inside the amplifier. Insert the sensor slowly.**

① Open the dust cover in the direction of the arrow.

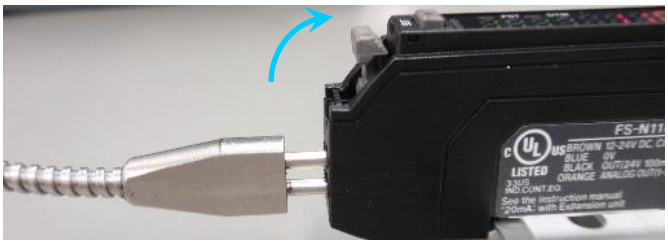


② Pull down the sensor locking lever in the direction of the arrow.

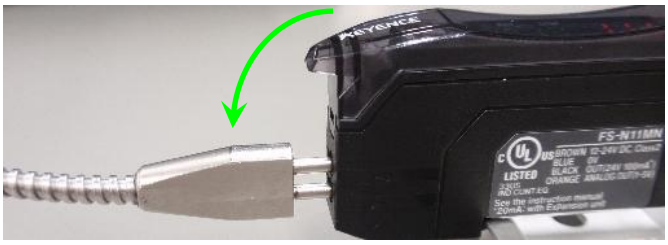
③ Insert the sensor into the mounting holes on the amplifier.



④ Pull up the sensor locking lever back in the direction of arrow.

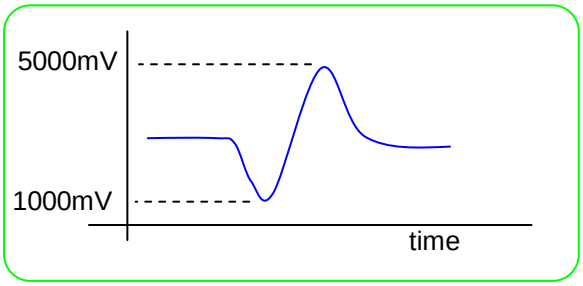


⑤ Close the dust cover.

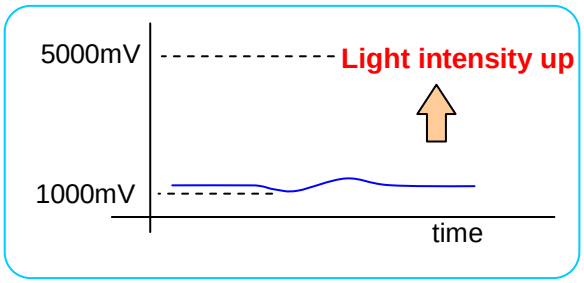


9-2-1 Adjustment of light intensity

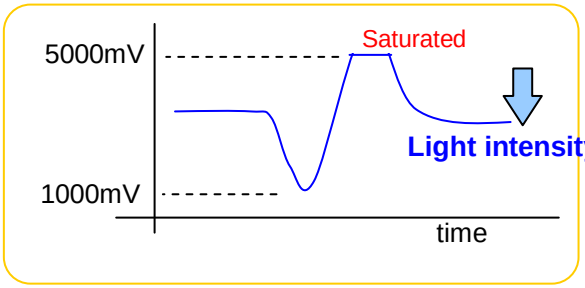
If the light intensity is insufficient or excessive on the measurement screen as shown in the following figures, adjust the light emitting power of the relay amplifier.



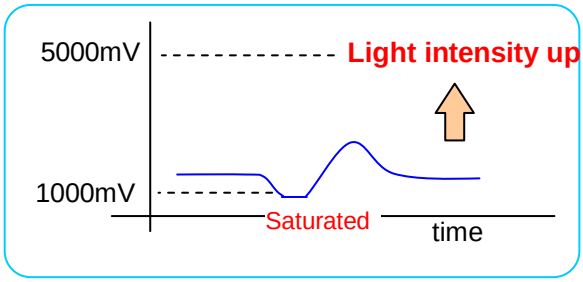
Appropriate light intensity



Insufficient light intensity



Excessive light intensity



■ Adjustment method

(1) Set the measurement screen on the PC to Free Run mode.

(2) Close the mold on the molding machine (this is the basic condition for adjustment).

(3) Adjust the light emitting power of the relay amplifier.

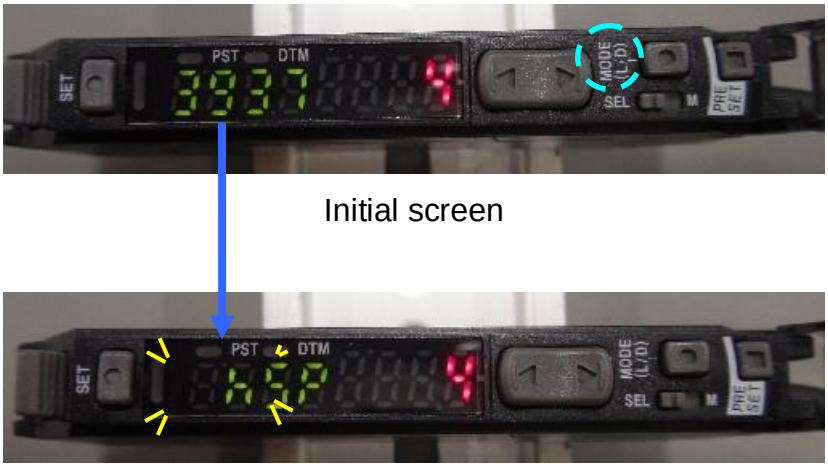
For the adjustment procedure, refer to the “Adjusting the light intensity of relay amplifier” on the next page.

(4) Vary the power and adjust to the vicinity of 2000 mV on the measurement screen.

(5) Run the molding. If the minimum and maximum values of the waveform are not saturated, the adjustment is complete.

9-2-2 Adjusting the light intensity of relay amplifier

1. Open the top cover of the relay amplifier and hold down the “MODE” (for over 3 seconds).



Initial screen

The【hSP】indicator flashes

2. Here, press “MODE” five times to put the unit in light emission power switching mode【Att】. The indicator【Att】and the【setting value】flashes alternately.

3. Press “▲” or “▼” to adjust the value so that appropriate light intensity is obtained (variable range: 1 to 100)

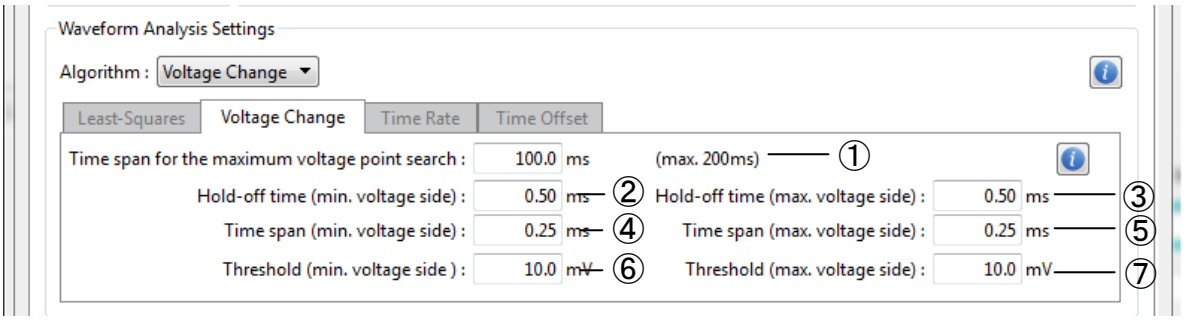
Setting value

4. Press “MODE” twice to complete the setting.

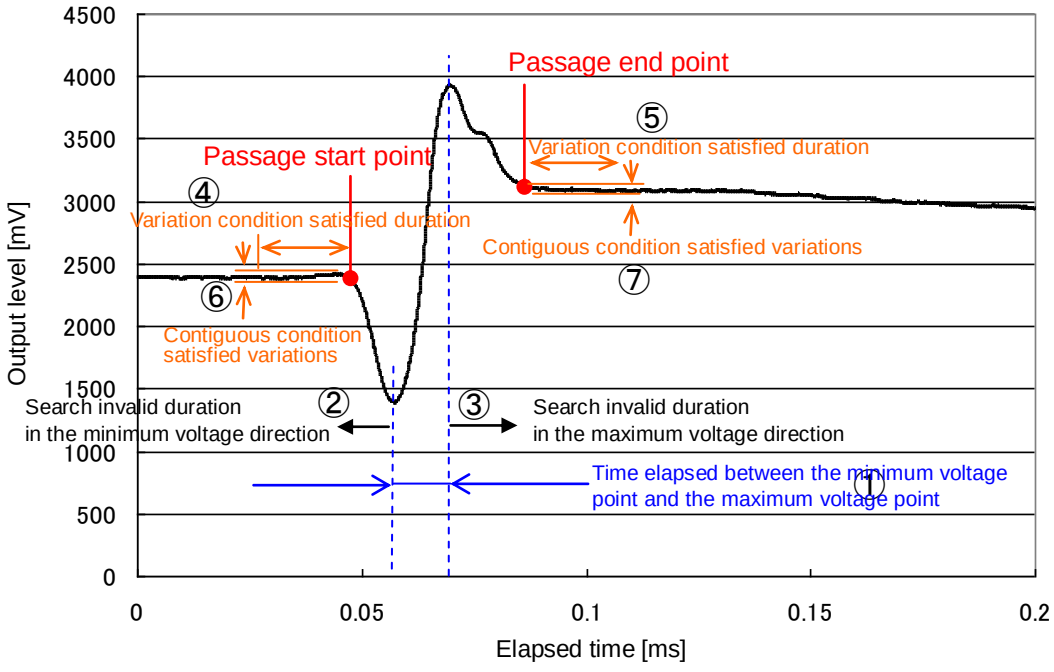
5. Pressing “MODE” one more time displays the following characters and then brings you back to the initial screen.

9-3-1 Variation Search

This algorithm searches the points where the voltage reaches its minimum and maximum values. It sets these points as origins to detect the points where the variations begin to be continuously within the specified range respectively in minimum and maximum voltage directions. It then determines the period between these detected points as the passage time.

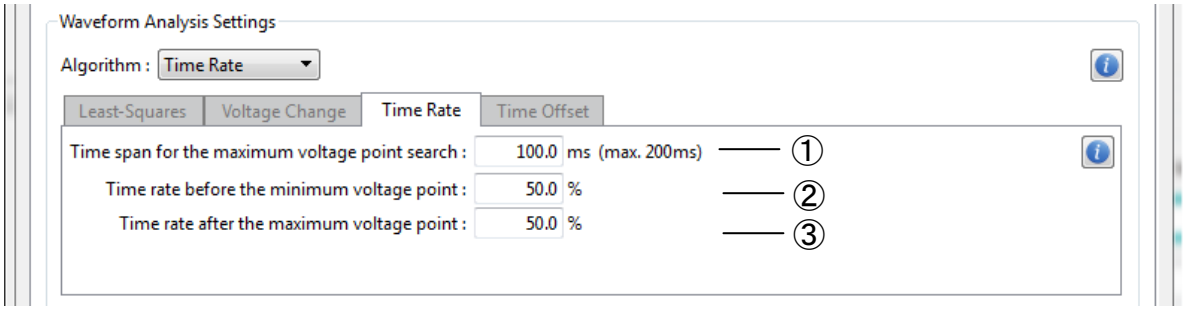


①	Time limit for searching a maximum voltage point from the minimum voltage point: Up to 200ms
②	Duration for which variations are not searched in the minimum voltage direction
③	Duration for which variations are not searched in the maximum voltage direction
④	Duration for which the variation condition continues to be satisfied in the minimum voltage direction
⑤	Duration for which the variation condition continues to be satisfied in the maximum voltage direction
⑥	Variation condition to be continuously satisfied in the minimum voltage direction (mV or less)
⑦	Variation condition to be continuously satisfied in the maximum voltage direction (mV or less)



9-3-2 Percentage time search

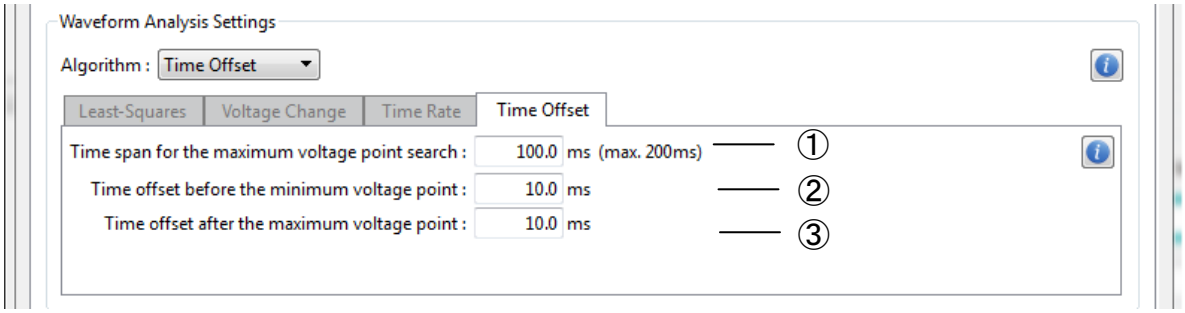
This algorithm searches the points where the voltage reaches its minimum and maximum values and sets these points as origins. It adds specified percentages of the time to the time at these points respectively in minimum and maximum voltage directions with the period between the minimum and maximum voltage points as 100% to determine the passage time.



①	Time limit for searching a maximum voltage point from the minimum voltage point: Up to 200ms
②	Time to be subtracted from the time at the minimum voltage point (Specify the time by a percentage of the time with the period between the minimum and maximum voltage points as 100 %.)
③	Time to be added to the time at the maximum voltage point (Specify the time by a percentage of the time with the period between minimum and maximum voltage points as 100%)

9-3-3 Absolute time search

This algorithm searches the points where the voltage reaches its minimum and maximum value points and sets these points as origins. It adds specified times defined as parameters to the times at these points respectively in the minimum and maximum direction to determine the passage time.



①	Time limit for searching a maximum voltage point from the minimum voltage point: Up to 200ms
②	Time to be subtracted from the time at the minimum voltage point
③	Time to be added to the time at the maximum voltage point

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