M5X Series
Super-mini Terminal Block Signal Conditioners

PC CONFIGURATOR SOFTWARE
Model: M5CFG

Users Manual

MSYSTEM
M-SYSTEM CO., LTD.

CONTENTS

1. INTRODUCTION

1.1. GENERAL DESCRIPTION

M-System M5CFG is used to program parameters for M5X Super Mini Terminal Block Signal Conditioners (referred hereunder as 'device'). The following major functions are available:

- Edit parameters online (connected to the device) in real time
- Edit parameters offline (not connected to the device)
- Download parameters to the device, upload parameters from the device
- Save parameters as files, read parameters from files
- Compare parameters edited on the screen with the ones stored in the device

1.2. APPLICABLE DEVICES

The M5CFG is applicable to the following products:

Function	M5X Model	Symbol	Version
Signal Transmitter	M5XV	V	1.0 or later
Universal Transmitter	M5XU	U	1.1 or later
Universal Temperature Transmitter	M5XTR	TR	1.2 or later
Inverted Output Transmitter	M5XUDS	UDS	1.3 or later
Ratio Transmitter	M5XREB	REB	1.3 or later
Ratio Transmitter	M5XRTS	RTS	1.3 or later
Ramp Buffer	M5XCRS	CRS	1.3 or later
Square Root Extractor	M5XFLS	FLS	1.3 or later
Linearizer	M5XF	F	1.3 or later
High/Low Selector	M5XSES	SES	1.4 or later
Adder	M5XADS	ADS	1.4 or later
Subtractor	M5XSBS	SBS	1.4 or later
Multiplier	M5XMLS	MLS	1.4 or later
Divider	M5XDIS	DIS	1.4 or later
Track/Hold	M5XAMS	AMS	1.4 or later
Peak Hold	M5XPHS	PHS	1.4 or later

The lowest software version applicable to each hardware model is indicated in the above table. Confirm that the software you have is compatible with the hardware you have.

The latest version of the M5CFG is downloadable at M-System's web site (www.m-system.co.jp) if you need higher version software.

In this manual, descriptions given with the above symbols are applied only to the models those symbols are assigned to. Other descriptions with no specific symbol are applied to all models.

1.3. PC REQUIREMENTS

The following PC performance is required for adequate operation of the M5CFG.

PC	IBM PC compatible
OS	Windows 8.1 (32-bit/ 64-bit), 10 (32-bit/ 64-bit) Does not operate on Windows RT 8.1. Operation has not been verified on Windows 10 (ARM). The software may not operate adequately in certain conditions.
CPU	Must meet the relevant Windows' requirements.
Memory	Must meet the relevant Windows' requirements.
Network port	USB port

One of the dedicated cables as listed below is also required to connect the transmitter device to the PC.

Port	PC Configurator Cable Model No.
USB	COP-US

1.4. INSTALLING & DELETING THE PROGRAM

INSTALL

The program is provided as compressed archive. Decompress the archive and execute 'setup.exe' to start up the M5CFG installer program. Follow instructions on the Windows.

When User Account Control window appears, choose 'Continue' or 'Yes'.
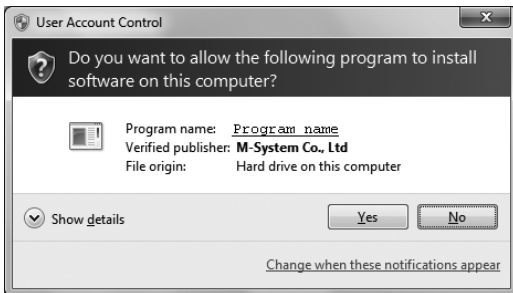
For 'Program name', M5CFG is shown.

DELETE

The procedure to delete program differs according to your OS.

For Windows 8.1, choose Control Panel from Charms bar, uninstall with [Uninstall a program] in the Control Panel. Choose the M5CFG from [Uninstall or change a program] list, click [Uninstall].

For Windows 10, choose Settings of Start menu, choose System from Settings menu, uninstall with [Apps & features] in the System. Choose the M5CFG from [Apps & features] list, click [Uninstall].
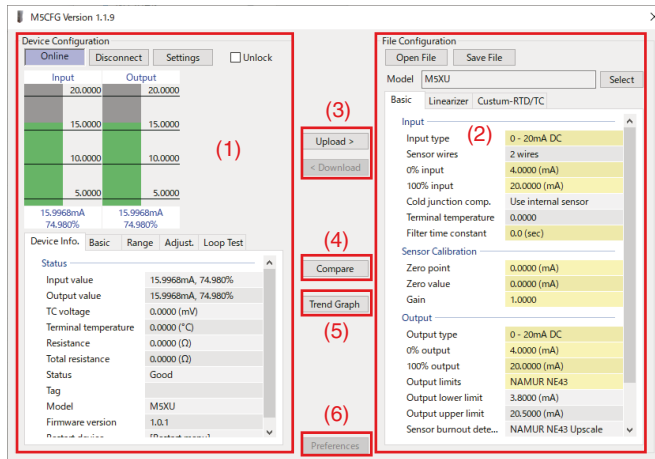
2. GETTING STARTED

2.1. STARTING THE M5CFG

In order to start the M5CFG, on the PC installed with the M5CFG,

>   for Windows 8.1, select All apps => M-System => M5CFG in the Start view.

>   for Windows 10, select All apps => M-System => M5CFG in the Start menu.

2.2. SCREEN COMPONENT IDENTIFICATION

ITEM	DESCRIPTION
(1) Device Configuration	Shows the parameters of the device presently connected online. You can edit these parameters in real time.
(2) File Configuration	Used to create and edit parameter sets on the PC. You can upload a parameter set from a device, edit it and download it to the device again.
(3) Upload / Download	Used to read parameter setting in the device and to write one to the device.
(4) Compare	Opens Compare window to compare edited parameters from actual setting.
(5) Trend Graph	Opens Trend Graph window to show a trend graph for the connected device
(6) Preferences	Button to change the settings of this softwawre. Click the button to open the following screen. Switch the language (Japanese/English) and select the temperature unit from °C (Celsius), °F (Fahrenheit), K (Kelvin), and °R (Rankine) (some of are fixed to °C). The program starts up in English mode as initial state when the OS is other than Japanese version. You can switch to Japanese only when the OS supports Japanese language.

2.3.   CONNECTING TO THE DEVICE

By connecting to the device, indicating device's information and editing and adjusting basic parameters are possible.
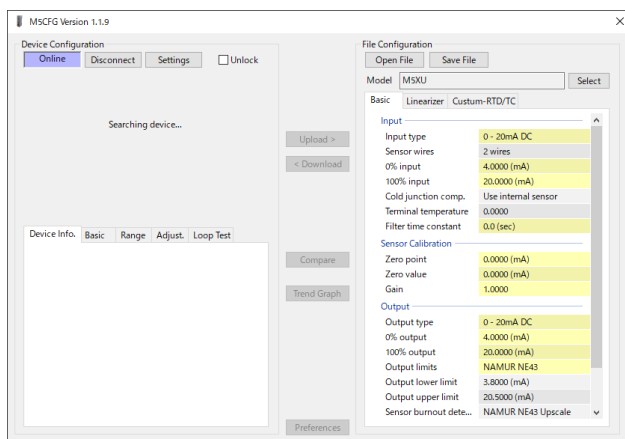
Click [Settings] button and choose the COM port number to which the device is to be connected.
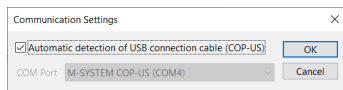
When using COP-US, check the "Auto detect USB connection cable (COP-US)" checkbox (default: checked).

The COM port will be detected automatically.

Click [Connect] button to start connecting with the device.

Connecting the compatible device to the PC via the configurator connection cable, the device model will be automatically recognized and the device information will be displayed as shown below.
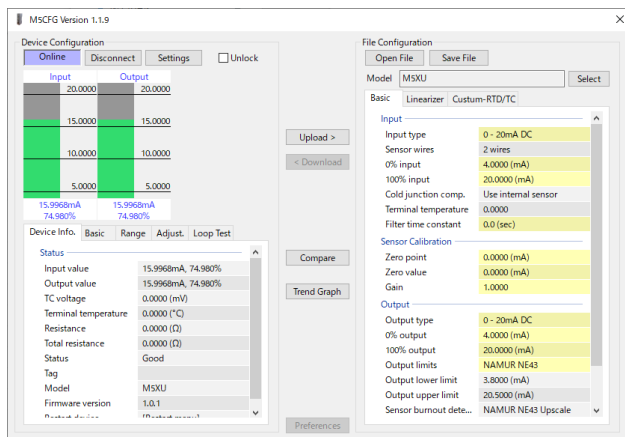
The I/O levels of the device are displayed in a bar graph. Various operations can be performed from the each tab, "device information", "basic settings", "range setting", fine adjustment" and "loop test".

When the cable is disconnected, the device info returns to blank status and the PC Configurator is ready to be connected to another device. In order to continue, just connect a new device. Clicking [Connect] button is unnecessary.

2.4. DEVICE INFO – DEVICE INFORMATION

Shows the present I/O data and status, model number and other information.
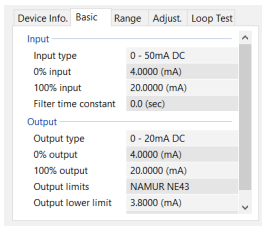

Potentiometer

ITEM	DESCRIPTION		
Input value	Shows the current input value in engineering unit and in percent.		
Output value	Shows the current output value in engineering unit and in percent.		
TC voltage $\mathbb{U}/\mathbb{TR}$	Shows the voltage (mV) of the TC sensor.		
Terminal temperature $\mathbb{U}/\mathbb{TR}$	Shows the terminal temperature (°C) at cold junction compensation during TC measurement.		
Resistance $\mathbb{U}/\mathbb{TR}$	Shows sensor resistance value (Ω) when the input type is resistor or RTD. For potentiometer, shows resistance (Ω) between 1 and 2 in the above diagram.		
Total resistance $\mathbb{U}/\mathbb{TR}$	Shows total resistance before subtracting line resistance when the input type is 3-wire resistance or RTD. For potentiometer, shows resistance (Ω) between 1 and 3 in the above diagram.		
Status	Shows the current device status.		
	Normal	The device is operating in normal parameters.	
	Input out of limits	The input is out of the specification range.	
	Sensor burnout $\mathbb{U}/\mathbb{TR}$	Detected the burnout (breakdown) of the sensor.	
	Sensor short $\mathbb{U}/\mathbb{TR}$	Detected the shortcircuit of the sensor.	
	Terminal temperature out of limits $\mathbb{U}/\mathbb{TR}$	Terminal temperature is out of the range (-100 to +200°C)	
	AO saturated	The output is at the output limit.	
	AO fixed	The device in the loop test mode, supplying a fixed output.	
	User parametr corrupted	The parameters of the device have been corrupted. Reconfigure with this software. If the setting value is still corrupted after reconfiguration, device failure is suspected. Please contact to the M-System.	
	Factory parameter corrupted	The device have a breakdown. Please contact to the M-System.	
Tag No.	Shows the device's tag name. When 'Unlock' box located above Device Info tab is checked, the tag can be modified. Enter at the maximum of 16 alphanumeric characters.		
Model	Model number of the device.		
Firmware	Firmware version of the device.		
Reboot	Select "reboot" from the menu to reboot the device.		

2.5. BASIC SETTING

Shows and changes basic I/O setting of the device.

Parameter items on the screen may change depending upon models. When 'Unlock' box located above Device Info tab is checked, modifiable parameters are highlighted on the light orange background. Click one of such parameters or select with carsol key and press enter key, to show a drop-down list or an edit box to modify it.

For example to select the Input Type, click the value of Input Type to open the drop-down list, and click or press Enter to select.
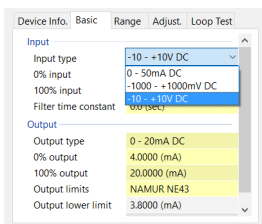
For example to edit Filter Time Constant, click the value of Filter Time Constant to show the edit box, enter an appropriate value and press Enter key.
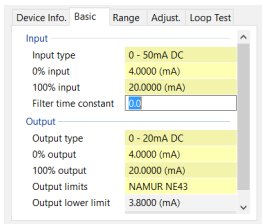
In any setting, press ESC key to not confirm the editing and return to the value before editing.

Refer to "5.1. PARAMETERS LIST" for details of each parameter.

2.6. RANGE SETTING

Set the input / output range on this page. For the two-input function modules, select input 1 or 2 to perform setting firstly.

Click Start Setting to enable to click 0% input , 100% input, OK, and Cancel.
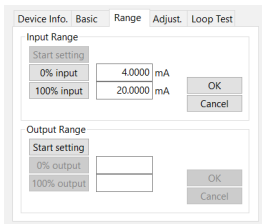
Apply 0% to the device and then click 0% input, and apply 100% and click 100% input, each input value will be displayed as the value of 0% and 100%.

For example, apply 0mA and click 0% input, and apply 10mA and click 100% input, the screen will change as following.
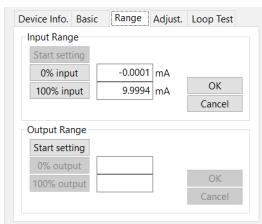
Set the output range in t he same way. However, for the output range, set after confirming with the external measuring instrument that the output has reached the desired value.

Click OK to set the value to the device and finish range setting mode.

Click Cancel to discard the values and quit the range setting mode.

Caution!
Be sure not to forget to return the device to the normal mode after the range setting.

The range setting mode is not cancelled until the power supply to the device is turned off.

2.7. FINE ADJUSTMENTS

Fine-adjust the input and output on this page. For the two-input function modules, select input 1 or 2 to fine-adjust firstly.
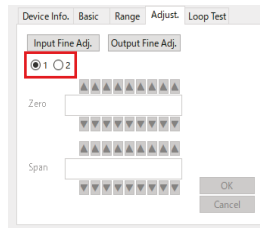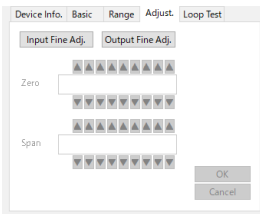
Zero is adjusted by offset adjustment, while Span is adjusted by gain adjustment.

Click Input Fine Adj. to start fine adjustment.
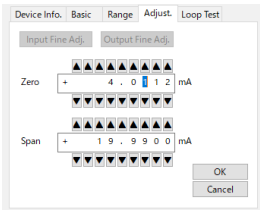
Press ▲ and ▼ buttons at the top and the bottom of each digit, or use up and down arrow keys on the key board to adjust the value. Use left and right arrow keys on the key board to move digits.

For input fine adjustment, adjust zero adjustment when applying 0% input, and adjust span adjustment when applying 100% input, so that the the input values are 0% and 100% in the bar graph on the screen.

For output fine adjustment, the device outputs 0% output when adjusting zero adjustment, and the device outputs 100% output when adjusting span adjustment.

Click OK to set the value to the device and finish fine adjustment mode.

Click Cancel to discard the values and quit the fine adjustment mode.

Caution!

When adjusting the zero or span value in output fine adjustment, the output of the device switches to the adjusted value regardless of the input.

Be sure not to forget to return the device to the normal mode after the fine adjustment.

The fine adjustment mode is not cancelled until the power supply to the device is turned off.

2.8. LOOP TEST

The device outputs simulate output to conduct a loop test.
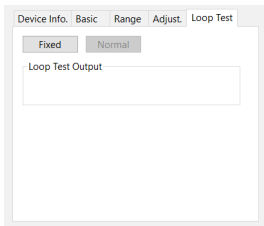
Click Fixed to fix the output at the current status, so that the output will not follow any change in the input.

The screen will change into following and output can be controlled.
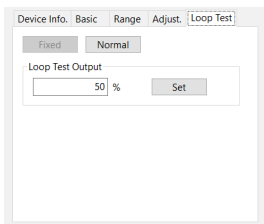
Enter the output value in percent into the field and click set to change the output of the device to the entered output value in percent.

The output value in percent can be specified in the range of -10000.000 to +10000.000%, and the output value in percent will be converted to the actual output value and then output from the device.

However, even if a value outside the output range is entered for the output value in percent, the device will not output the value outside of the output range.

Refer to "4. CONVERSION OPERATION" for the calculation from output value in percent to actual output value.

Click Normal to return to the normal mode that te output follows the changes of input.

Caution!
Be sure not to forget to return the device to the normal mode after the loop test.

The loop test mode is not cancelled until the power supply to the device is turned off.

2.9.   READING/WRITING PARAMETERS

The parameters of the device can be read into the PC (upload), and the parameters edited in the PC can be written into the device (download).

■ READING PARAMETERS FROM DEVICE (UPLOAD)

Connect the device with the configurator cable and click Connect and then the device information is displayed, click Upload. After clicked, a progress bar will appear and start uploading.
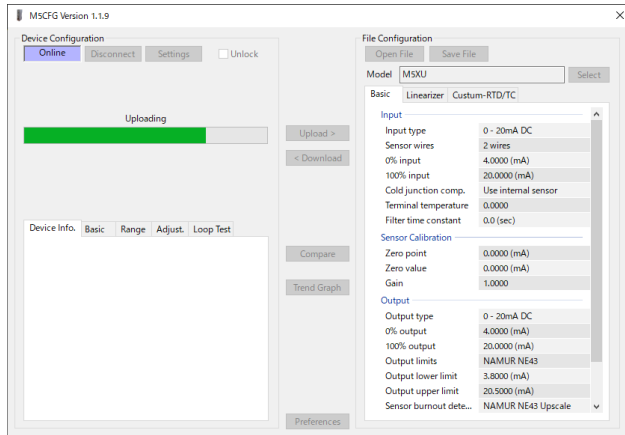
The upload will be completed in a few seconds, and the loaded parameters will be displayed in the file settings on the right side of the screen and can be edited.

■ WRITING PARAMETERS TO DEVICE (DOWNLOAD)

Connect the device with the configurator cable, click the Connect button, and with the device information and other information displayed, check Unlock, and then click the Download button. After clicked, a progress bar will appear and start downloading.
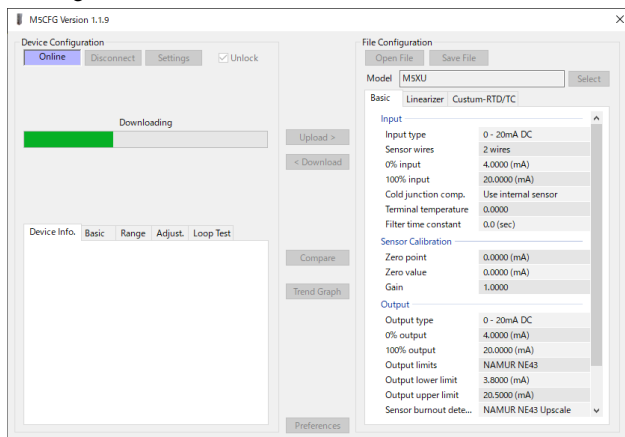
Caution!

DO NOT tuen off the power suppy to the device or disconnect the cable while downloading.
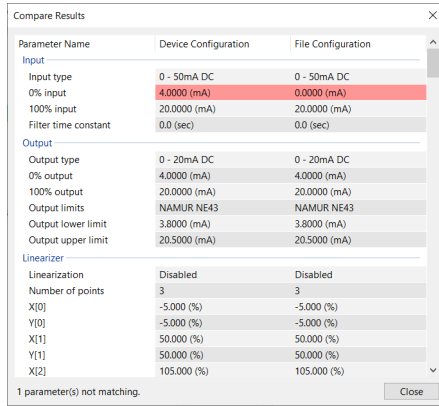
The device setting may not be complete as expected.

2.10. COMPARING PARAMETERS

Parameters presently edited on the screen and those stored in the connected device can be compared side by side.

If the parameters have loaded from a file in advance, compare the parameters between the connected device and the file, if the parameters have loaded from another device in advance, compare the parameters between devices.

Click Compare to load parameters from device, and compare results are shown as following.

Compare Results			✕
Parameter Name	Device Configuration	File Configuration	
Input			
Input type	0 - 50mA DC	0 - 50mA DC	
0% input	4.0000 (mA)	0.0000 (mA)	
100% input	20.0000 (mA)	20.0000 (mA)	
Filter time constant	0.0 (sec)	0.0 (sec)	
Output			
Output type	0 - 20mA DC	0 - 20mA DC	
0% output	4.0000 (mA)	4.0000 (mA)	
100% output	20.0000 (mA)	20.0000 (mA)	
Output limits	NAMUR NE43	NAMUR NE43	
Output lower limit	3.8000 (mA)	3.8000 (mA)	
Output upper limit	20.5000 (mA)	20.5000 (mA)	
Linearizer			
Linearization	Disabled	Disabled	
Number of points	3	3	
X[0]	-5.000 (%)	-5.000 (%)	
Y[0]	-5.000 (%)	-5.000 (%)	
X[1]	50.000 (%)	50.000 (%)	
Y[1]	50.000 (%)	50.000 (%)	
X[2]	105.000 (%)	105.000 (%)	
1 parameter(s) not matching.			Close

The compared parameters are displayed in the order of parameter name, device set value, and file set value for each line.

The lines where there is a difference between the device setting and the file setting are highlighted in red, and the number of differences is displayed at the bottom of the screen.

2.11. FILES

■ READING PARAMETERS SAVED AS FILE

Clicking [Open File] calls up the Windows-standard Open dialog box.
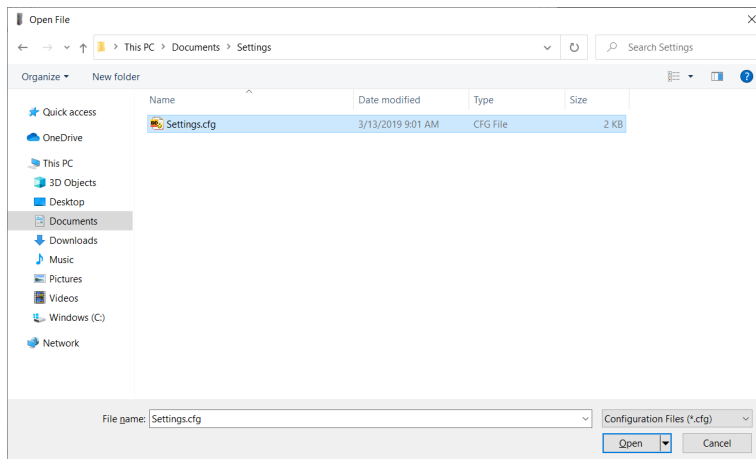
Select a parameter file to show a stored parameter setting.

In order to download the parameters to the connected device, click [Download] button.

■ SAVING PARAMETERS IN A FILE

Clicking [Save File] calls up the Windows-standard Save As dialog box.
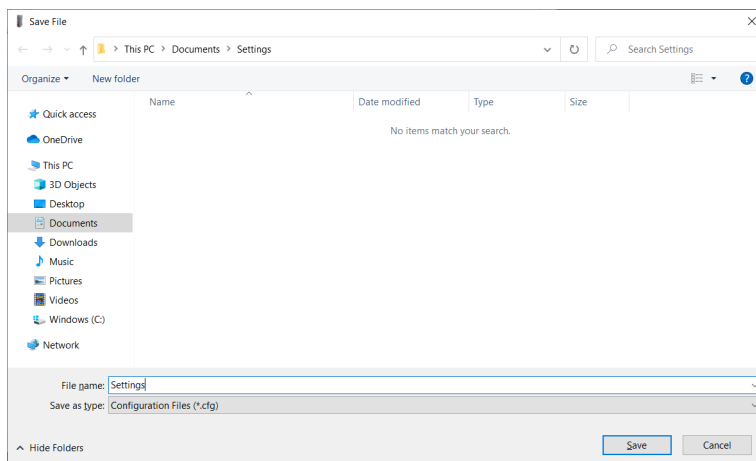
Enter a desired file name to File Name field and click [Save] to store a parameter setting.

In order to save the parameters of the connected device, click [Upload] first and then save them as a file.

■ OFFLINE OPERATION

The parameters under File Configuration on the right side of the window can be edited freely regardless of the status of the connection or the connected device.

With a device connected online, only the parameters under Basic tabcan be edited in real time. In the offline state, all parameters under File Configuration including Linearizer and Option setting can be edited.

If you want to modify setting for the connected device, first upload the parameters from the device, edit them and then download them to the device.

In addition to the basic parameters editable in real time in the connected status on the left side of the screen, linearizer is also editable.

Refer to "5.1. PARAMETERS LIST" for details of each parameter.

2.12. TREND GRAPH

Click Trend Graph to show the following screen

I/O signal of the device can be monitored on a trend graph. The trend is recorded and displayed in 0.1 second intervals.
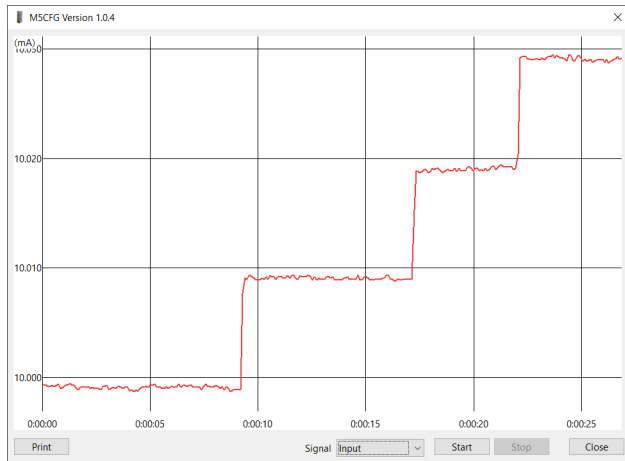
Choose the signa to record and click [Start] to start recording and displaying in real time.

Click [Stop] to stop monitoring, and the recorded trend graph can be studied more closely by scrolling and enlarging the screen:

Mouse	Screen
Press left mouse button and drag	Scrolls the screen to all directions.
Press right mouse button and drag	Forms an area on the screen to enlarge and fit it to the full-screen area when the mouse button is released.
Double-click left mouse button	Display range is reduced by half (trend curve is zoomed in).
Double-click right mouse button	Display range is doubled (trend curve is zoomed out).
Click Print button	Print the displayed graph on a printer. This button is available only when the recording is stopped by Stop button.

3. HOW TO SETUP I/O (EXAMPLE)

Basic input/output range setting is as in the following.

The M5XV is to be configured to

> input ange: 4 – 20mA DC
>
> output range: 1 – 5V DC

3.1. CONNECTING TO THE DEVICE

Start up the M5CFG software. Choose the COM port to which the device is connected and click [Connect]. Present parameter setting is uploaded and displayed under Device Configuration on the screen. Check 'Unlock' box to change the parameters.

3.2. INPUT RANGE

1) Click [Input type] field. Choose an input type adequate for the desired range from the list below.

> DC 0 – 50mA
> DC -1000 – +1000mV
> DC -10 – +10V

> For 4 – 20 mA input, choose the input type 'DC 0 – 50mA.'

2) The input range uses same unit selected with input type.

> For 4 - 20mA DC,
>
> enter 4.0000 to 0% input value,
>
> enter 20.0000 to 100% input value.

3.3. OUTPUT RANGE

1) Click [Output type] field. Choose an output type adequate for the desired range from the list below.

> DC 0 – 20mA
> DC -5 – +5V
> DC -10 – +10V

> For 1 – 5 V DC input, choose the input type 'DC -5 – +5V.'

2) The input range uses same unit selected with input type.

> For 1 - 5V DC,
>
> enter 1.0000 to 0% output value,
>
> enter 5.0000 to 100% output value.

3.4. OTHER SETTING

The M5XV has more variety of functions than explained in the previous sections, including filter time constant setting and linearization. Basic procedure is mostly the same as the above example.

Linearizer and Option setting must be edited offline. Upload the present setting to the PC (Refer to "2.9. READING/WRITING PARAMETERS"), edit the file and then download the new setting (Refer to "2.9. READING/WRITING PARAMETERS").

Refer to "5.1. PARAMETERS LIST" for details of parameter.

4. CONVERSION OPERATION

This page describes conversion operation of M5 series transmitter.

4.1. BASIC OPERATION

1. The input is carried out AD-conversion to the input engineering value.

2. Convert the engineering value to the input value in percent by the 0% input and 100% scaling setting.

3. Linearizer ON: convert the input value in percent to the output value in percent (refer to the conversion by the linearizer).

   Linearizer OFF: Substitute the input value in percent to the output value in percent.

4. Convert the output value in percent to the output engineering value by the 0% output and 100% scaling setting.

5. Output engineering value is carried out DA-conversion and outputs from the device.

4.2. CONVERSION EXAMPLE

A conversion example with the following conditions is shown below.

Parameter	Value
0% input	4.0000mA
100% input	20.0000mA
Linearizer	Disable
0% output	1.0000V
100% output	5.0000V

Input engineering value = 14.5 mA

Input value in percent = (input engineering value - 0% input value) ÷ (100% input value - 0% input value) = 0.65625 (65625%)

Output value in percent = input value in percent = 0.65625 (65.625%)

Output engineering value = output value in percent x (100% output value - 0% output value) + 0% output value = 3.625V

4.3. THE CONVERSION BY THE LINEARIZER

The conversion by the linearizer searches for the X[n] corresponding to the input value in percent and sets the pairing Y[n] as output value in percent.
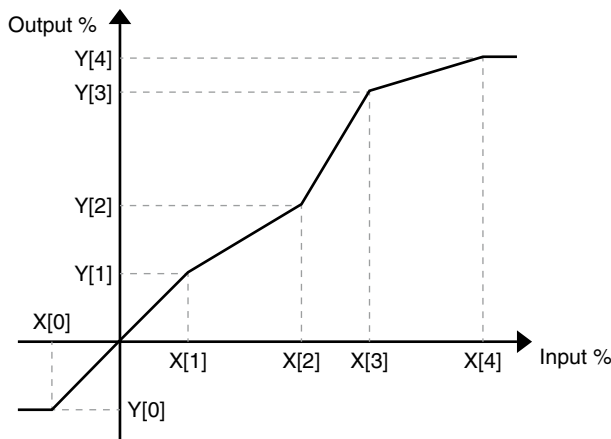
If a value equal to the input % value is not set in X[n], extract the closest value in each of the positive and negative directions from the set X[n], and then linearly complete the two points as shown in the formula below to obtain the output % value.

Set the extracted points be (X[p1], Y[p1]) and (X[p2], Y[p2]),

$$\text{Output value in percent} = Y[p1] + (\text{input value in percent} - X[p1]) \cdot \frac{Y[p2] - Y[p1]}{X[p2] - X[p1]}$$
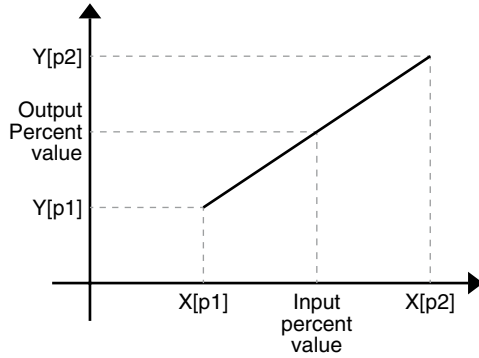
If the input value in percent is out of the table, set Y[n] that pairs to the closest X[n] as output value in percent.

5. PARAMETER DETAILS

5.1. PARAMETERS LIST

Supported parameters depend upon model types. Supported ones are marked with 'X' in the following table.

	M5XV	M5XU	M5XTR	M5XUDS	M5XREB	M5XRTS	M5XCRS	M5XFLS	M5XF	M5XSES	M5XADS	M5XSBS	B5XMLS	M5XDIS	M5XAMS	M5XPHS	Page
BASIC SETTING — Input type / 0% input / 100% input	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20
Low-end cutout point / Input low limit / Input high limit										X	X	X	X	X			22
Input 2 — Input type / 0% input / 100% input / Low-end cutout point / Input low limit / Input high limit										X	X	X	X	X			23
Sensor wires		X	X														20
Cold junction comp. / Terminal temperature		X	X														21
Filter time constant	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	23
Zero point / Zero value / Gain		X	X														21
Ratio / Bias					X	X											22
Responce time							X										22
Low-end cutout								X									22
Output filte (linearizer)									X								22
Select input										X							23
Computing (K0 - K2, A0 - A2)											X	X	X	X			23
Control logic															X	X	24
Hold																X	24
Output type / 0% output / 100% output	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	24
Output limits / Output low limit / Output high limit	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	25
Sensor burnout detection / Sensor burnout output		X	X														25
Sensor short detection / Sensor short output		X	X														26
LINE-ARIZER — User's table linearization / Number of points / Linearize table / X[0], Y[0] ... X[100], Y[100]	X	X	X						X	X	X	X	X	X	X	X	26
Custom RTD/TC — Custom RTD type / R0 / A / B / C / Lower temperature / Upper temperature / Table start / Table step / Number of table element / T[0] to T [299]		X	X														27

5.2. BASIC SETTING

■ INPUT TYPE, 0% INPUT , 100% INPUT
Select the input type and the scaling.

V/UDS/ REB/RTS/ CRS/FLS/F SES/ADS/ SBS/MLS/ DIS/AMS/ PHS	U	TR	SELECTABLE INPUT TYPE	0% input, 100% input	
				Selectable range	Minimum span
X			0 – 50mA DC	-1.0000 - +52.5000mA	1.9000mA
	X		0 – 20mA DC	-1.0000 - +23.0000mA	0.9500mA
X	X		-1000 – +1000mV DC	-1100.00 - +1100.00mV	95.00mV
X	X		-10 – +10V DC	-11.0000 - +11.0000V	0.9500V
	X		Potentiometer 0 – 4kΩ	0.000 - +100.000%	4.750%
	X		Resistor 0 – 4kΩ	0.000 - +4400.000Ω	23.750Ω
	X	X	RTD Pt100 (JIS'97, IEC)	-200.000 - +850.000°C	9.500°C
	X	X	RTD Pt500	-200.000 - +850.000°C	9.500°C
	X	X	RTD Pt1000	-200.000 - +850.000°C	9.500°C
	X	X	RTD JPt100 (JIS'89)	-200.000 - +510.000°C	9.500°C
	X	X	RTD custom RTD	*depends to the setting of custom RTD	1.000°C
	X	X	TC K (CA)	-180.000 - +1372.000°C	47.500°C
	X	X	TC E (CRC)	-100.000 - +1000.000°C	47.500°C
	X	X	TC J (IC)	-100.000 - +1200.000°C	47.500°C
	X	X	TC T (CC)	-200.000 - +400.000°C	47.500°C
	X	X	TC B (RH)	+400.000 - +1820.000°C	95.000°C
	X	X	TC R	-50.000 - +1760.000°C	95.000°C
	X	X	TC S	-50.000 - +1760.000°C	95.000°C
	X	X	TC C (WRe 5-26)	0.000 - +2300.000°C	95.000°C
	X	X	TC D (WRe 3-25)	0.000 - +2300.000°C	95.000°C
	X	X	TC N	-180.000 - +1300.000°C	47.500°C
	X	X	TC U	-200.000 - +600.000°C	47.500°C
	X	X	TC L	-100.000 - +900.000°C	47.500°C
	X	X	TC custom TC	*depends to the setting of custom TC	1.000°C

0% input must be smaller than 100% input.

Difference between 0% input and 100% input must be larger than minimum span.

■ SENSOR WIRES U/TR
Set the number of input wiring when the resistor or RTD is selected for input type.

Selectable numbers of wire
2 wires
3 wires
4 wires

For DC current and TC (Thermocouple), fixed to 2-wire.

For potentiometer, fixed to 3-wire.

■ COLD JUNCTION COMP.AND TERMINAL TEMPERATURE U/TR

Set the CJC when the thermocouple input is selected.

SELECTABLE CJC	DESCRIPTION
Fixed terminal temperature	The terminal temperature is not measured by the temperature sensor, and cold junction compensation is performed at the temperature set by the terminal temperature.
Use internal sensor	Temperature is measured using the internal sensor of the module and cold junction compensation is performed at that temperature.

■ ZERO POINT, ZERO VALUE, AND GAIN U/TR

Apply offset and gain compensation with following formula for the raw value before converting to actual value.

Input value = (RawValue - ZeroX) x Gain + Zero Y

InputValue	Input value after compensation
RawValue	Input value before compensation
ZeroX	Zero point
ZeroY	Zero value
Gain	Gain

Input resistance of the RTD TC, and input TC voltage can be applied compensation directly.

Offset compensation procedure

1. Input the value that can be a reference.

2. Set the reference value (REF1) to the zero value.

3. Confirm the input value (REAL1) measured by the device from device information and set it to the zero point.

By following this procedure, input value after applied offset compensation is calculated.

Gain compensation procedure

1. Apply offset compensation by following above procedure.

2. Input the value to be a reference (REF2) far from the zero value of offset compensation.

3. Confirm the input value (REAL2) measured by the device from device information, calculate and set gain with following formula.

Gain = (REF2 - REF1) ÷ (REAL2 - REAL1)

By following these procedure, input value after applied offset and gain sompensation is calculated.

Offset and gain compensation can be improved by setting the offset compensation reference (REF1) around 0% input and the gain compensation reference (REF2) around 100% input.

Line resistance compensation procedure for 2-wire RTD

1. Set line resistance to subtract to zero point.

2. set 0.0000 (Ω) to zero point.

By following this procedure, input value after applied subtracting line resistance compensation is calculated.

■ RATIO, BIAS ℝⅇℬ/ℝ𝕋𝕊

Set the ratio and bias of the equation.

When the negative number is set for ratio, the gradient of linear function of the module is negative.

ITEM	SELECTABLE RANGE
Ratio	0.10 to 4.00 or -0.10 to -4.00
Bias	-100 to 100 (%)

■ RESPONCE TIME ℂℝ𝕊

Set the responce time.

ITEM	SELECTABLE RANGE
Responce time	0.5 to 40.0 (sec.)

■ LOW-END CUTOUT 𝔽𝕃𝕊

Select enable/disable the low-end cutout that clamps output of 4 to 8% or less to 0%.

ITEM	SELECTABLE RANGE
Low-end cutout	Disable/Enable

■ OUTPUT FILTER (linearizer) 𝔽

Select the output characteristics among following.

Linear	The input is converted into an output. (Output) = (Input)
User's table linearization	The input is converted into a linearized output according to the user specified segment data table. Refer to "linearizer setting" for setting of linearizer.
X^2	$(Output) = \dfrac{(Input)^2}{100}$
X^5/2	$(Output) = \dfrac{(Input)^{\frac{5}{2}}}{1000}$
X^3/2	$(Output) = \dfrac{(Input)^{\frac{3}{2}}}{10}$

■ LOW-WND CUTOUT POINT SES/ADS/SBS/MLS/DIS

The input signals below the low-end cutout point are handled as 0%.

The point has 0.2% hysteresis (deadband). The low-end cutout is applied exactly at the point when an increasing signal passes through the point, while it is applied at -0.2% of the point when a decreasing signal passes through it.

Set between 0.0000% and 99.9999%. With 0.0000% setting, the low-end cutout function is cancelled.
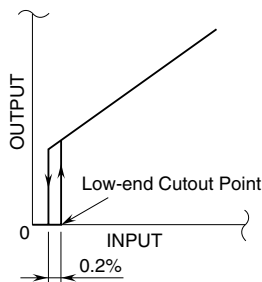
When the output low limit is set to a value higher than 0%, the input below the low-end cutout point is forced to the value, not 0%.

■ INPUT HIGH LIMIT, INPUT LOW LIMIT SES/ADS/SBS/MLS/DIS

The output signal is limited within the range between the high limit and the low limit.

For example, when the high limit is set to 90% and the low limit to 10%, the input signal between 90% and 102% is converted as 90%, while the input between -2% and 10% is converted as 10%

■ SELECT INPUT SES

Input 1 (X1) and Input 2 (X2) are converted into Output (X0).

High selector	$X_0 = X_1$ with $X_1 \geq X_2$
	$X_0 = X_2$ with $X_1 < X_2$
Low selector	$X_0 = X_2$ with $X_1 \geq X_2$
	$X_0 = X_1$ with $X_1 < X_2$

■ COMPUTING (K0 - K2, A0 - A2) ADS/SBS/MLS/DIS

The following functions and parameters are selectable for the two-input function module. Input 1 (X1) and Input 2 (X2) are applied with the selected function and converted into Output (X0).

Gains K0, K1 and K2 are selectable within -29.9999 to 29.9999, while biases A0, A1 and A2 are selectable within -299.9999 and 299.9999%.

Adder	$X_0 = K_0\{K_1(X_1 + A_1) + K_2(X_2 + A_2)\} + A_0$
Subtractor	$X_0 = K_0\{K_1(X_1 + A_1) - K_2(X_2 + A_2)\} + A_0$
Multiplier	$X_0 = K_0(K_1X_1 + A_1)(K_2X_2 + A_2) + A_0$
Divider	$X_0 = \dfrac{K_0(K_1X_1 + A_1)}{(K_2X_2 + A_2)} + A_0$ When $(K_2X_2 + A_2) = 0$ $X_0 = +102$ with $K_0(K_1X_1 + A_1) > 0$ $X_0 = A_0$ with $K_0(K_1X_1 + A_1) = 0$ $X_0 = -2$ with $K_0(K_1X_1 + A_1) < 0$

■ FILTER TIME CONSTANT

Apply the filtering with the set time constant to the input engineering value. Set in the range of 0.5 to 30.0 second and set 0.0 to invalidate the filtering.

The first order lag filter is equivalent to a first-order lag low-pass filter configured in a general RC circuit. The set time constant is the time to follow until about 63 %, when input varies from 0 % to 100 %.

■ CONTROL LOGIC AMS/PHS
Choose among the following:

Hold at open	When CONTROL is open, Hold Function is available.
(Track at close)	When CONTROL is close, Hold Function is unavailable and the OUTPUT tracks the INPUT.
Hold at close	When CONTROL is close, Hold Function is available.
(Track at open)	When CONTROL is open, Hold Function is unavailable and the OUTPUT tracks the INPUT.

■ HOLD PHS
Choose among the following.

Peak hold	The output is held at the maximum input value during HOLD. If the maximum input is updated, the output changes to that value. When CONTROL turns to TRACK, the maximum value is reset.
Valley hold	The output is held at the minimum input value during HOLD. If the minimum input is updated, the output changes to that value. When CONTROL turns to TRACK, the minimum value is reset.
Peak-to-peak hold	The output is held at the difference between the maximum and minimum input value during HOLD. If the maximum or minimum input is updated, the output changes to that value. When CONTROL turns to TRACK, the difference value is reset.

■ OUTPUT TYPE, 0% OUTPUT, 100% OUTPUT
Select the output type and the scaling.

	SELECTABLE OUTPUT TYPE	0% output, 100% output	
		Selectable range	Minimum span
V/U/TR/ UDS/REB/ RTS/CRS/ FLS/F/SES/ ADS/SBS/MLS/ DIS/AMS/PHS	0 - 20mA DC	-1.0000 - +23.0000mA	0.9500mA
	-5 - +5V DC	-5.7500 - +5.7500mV	0.4750V
	-10 - +10V DC	-11.5000 - +11.5000V	0.9500V

Difference between 0% output and 100% output must be larger than minimum span.

Setting 100% output < 0% output, can reverse the output from the device.

Caution!
Be sure to change the output setting DIP SW of the device after changing the output type.

■ OUTPUT LIMITS, OUTPUT LOWER LIMIT, OUTPUT UPPER LIMIT

Set the output limits of the device.

SELECTABLE OUTPUT LIMIT	DESCRIPTION
Span	Outputs in the range of 0% output and 100% output.
	Settable range for output lower limit and output upper limit follows to the change of 0% output and 100% output.
Max.	Outputs in the selectable range of 0% output and 100% output.
Specified	Outputs in the range of specified output lower limit and output upper limit.
	Settable range for output lower limit and output upper limit are same as 0% output and 100% output.
	Be sure to set output lower limit ≤ 0% output and 100% output ≤ output upper limit.
	Even if the output is reversed, be sure to set output lower limit < output upper limit.
NAMUR NE43	Outputs in the range of 3.8 to 20.5 mA to conform to NAMUR NE43.
	Selectable only when the "0 - 20 mA DC" is selected for output type and, 0% output and 100% output are in the range of 3.8 to 20.5 mA.

■ SENSOR BURNOUT DETECTION, SENSOR BURNOUT OUTPUT U/TR

Set the burnout detection at POT (potentiometer), RES (resistor), RTD (resistance temeperature detection), and TC (thermocouple) input.

SELECTABLE BURNOUT DETECTION	DESCRIPTION
No detection	Does not detect burnout
Specify	Detects burnout and outputs the value set at output at sensor burnout detection.
NAMUR NE43 upscale	Detects burnout and outputs NAMUR NE43 conformed upscale abnormal value (23 mA).
	Selectable only when the "0 - 20 mA DC" is selected for output type, and 0% output and 100% output are in the range of 3.8 to 20.5 mA.
NAMUR NE43 downscale	Detects burnout and outputs NAMUR NE43 conformed downscale abnormal value (3.5 mA).
	Selectable only when the "0 - 20 mA DC" is selected for output type, and 0% output and 100% output are in the range of 3.8 to 20.5 mA.

■ SENSOR SHORT DETECTION, SENSOR SHORT OUTPUT U/TR

Set the burnout detection at POT (potentiometer), RES (resistor), RTD, and input.

| SELECTABLE SHORT CIRCUIT	DESCRIPTION
No detection	Does not detect short
Specify	Detects short and outputs the value set at output at sensor burnout detection.
NAMUR NE43 upscale	Detects short and outputs NAMUR NE43 conformed up-scale abnormal value (23 mA).
	Selectable only when the "0 - 20 mA DC" is selected for output type, and 0% output and 100% output are in the range of 3.8 to 20.5 mA.
NAMUR NE43 downscale	Detects short and outputs NAMUR NE43 conformed down-scale abnormal value (3.5 mA).
	Selectable only when the "0 - 20 mA DC" is selected for output type, and 0% output and 100% output are in the range of 3.8 to 20.5 mA.

Caution!

When using total resistances of RES, RTD, and POT, 5 Ω or less inputs are recognized as shortcircuited.

Set short detection to "no detection" for using such inputs.

5.3. LINEARIZATION

As with the other settings, in addition to entering one item at a time, the linearizer table can be loaded and saved as a table file.User's Table Linearization.

Click [Table File] to load/save the table file.
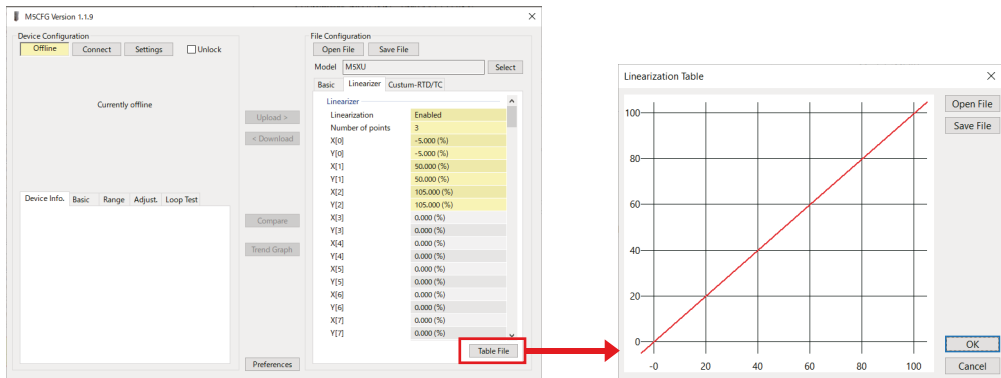
Click the [Table File] to show the screen as shown in the figure on the right.

Clicking [Open File] loads the table file, and [Save File] saves the table file.

Refer to the "6. APPENDIX" for format of the table file.

■ LINEARIZATION, NUMBER OF POINTS, X[0], Y[0] ... X[100], Y[100]

Select "Enable" on the linearizer tab to activate the linearization.

The Linearizer sets the XY table for the conversion.

Both X and Y can be set in the range of -10000.000 to +10000.000%.

X must be set in ascending order from X[0], otherwise the conversion will not be accurate.

5.4. CUSTOM RTD/TC U/TR

Define the custom RTD/TC with user specified characteistics.

Custom RTD can be set using the coefficients of Callendar-Van Dusen expression or a table (Ω) with up to 300 points.

Custom TC can be set using a table (mV) with up to 300 points.

The tables are common in custom RTD/TC, so it is not possible to set both properties individually.

As with other settings, a table can be read and saved as a table file in addition to input one item at a time.

Click the Table button to read and save the table file.
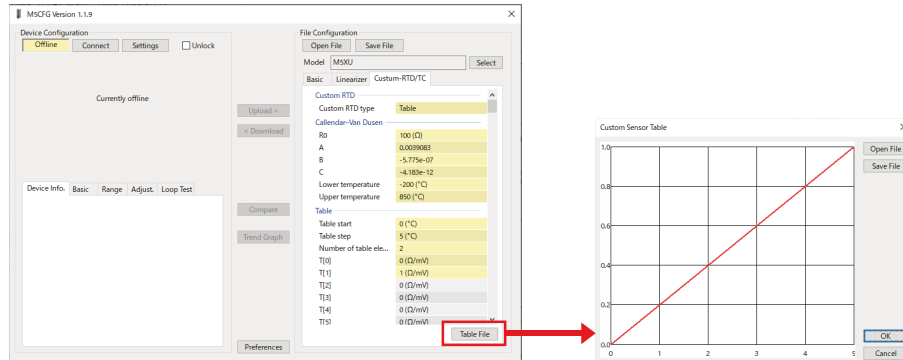
Click table button to show the screen on the right side.

Click "Open file" to read the table file, and click "save file" to save the table file.

Refer to "6. APPENDIX" for format of the table file.

■ CUSTOM RTD TYPE
Set the definition method of the custom RTD.

SELECTABLE CUSTOM RTD TYPE	DESCRIPTION
Table	Define the custom RTD by the table
Callender-Van Dusen	Define the custom RTD by the coefficient of Callender-Van Dusen expression.

■ R0, A, B, C, LOWER TEMPERATURE, AND UPPER TEMPERATURE
For R0, A, B, and C, set the variable of Callender-Van Dusen expresseion to any single precision floating point number

Callendar-Van Dusen expression shows the relation between the temperature and the resistance as shown below.

$R(T) = R0 \cdot (1 + A \cdot T + B \cdot T^2) \dots 0\ °C \leq T$

$R(T) = R0 \cdot [1 + A \cdot T + B \cdot T^2 + C \cdot (T - 100) \cdot T^3] \dots T < 0\ °C$

T   Temperature (°C)

R(T)   Resistance value (Ω) corresponding to temperature (T)

R0   Resistance value at 0 °C (Variables)

A, B, C   Variables

Lower and upper temperature limit can set the sensor effective temperature range in the range of -300 to +9999°C (the unit is fixed in °C).

■ TABLE START, TABLE STEP, NUMBAER OF TABLE ELEMENTS, AND T[0] TO T[299]

Set the table for conversion.

Set the temperature (°C) at the top of the table (T[0]) for the table start (the unit is fixed in °C).

The table step sets the temperature (°C) between the table elements (the unit is fixed in °C).

For the number of table elements, set the table T[0] to the number of elements in the range of 2 to 300.

The table elements T[0] to T[299] can be set to any value (mV or Ω) of single precision floating point in ascending or descending order.

The setting mixing ascending and descending order will not work properly.

Resistance and mV values that can be input to hardware are as shown in the table below.

CUSTOM RTD	CUSTOM TC
0 to 4.4 kΩ	-137.5 - +137.5 mV

6. APPENDIX

6.1. XY TABLE FILE FORMAT

Describe the format of the XY table file handled by this software on this page.

In the XY table file, X and Y are saved in CSV format that each line is separated by commas as shown below.

A file made in Excel or other spread sheet software and saved in CSV format can be imported directly.

```
/* XY table comment */
{
   -5.000, -5.000
   0.000, 1.000
   50.000, 49.000
   105.000, 105.000
}
```

1. Same way as entering the data using this software, enter the data in the range of -10000.000 to +10000.000%, starting from X[0] and Y[0] in ascending order.

2. X[n] and Y[n] are rounded to the fourth decimal place and read as a value with three decimal places.

3. A pair of X[n] and Y[n] will be read up to a minimum of 2 points and a maximum of 101 points, and the values after the 102nd point will be ignored.

4. Lines begin with / and lines with comma-separated values will be ignored.

5. The braces {} at the beginning and end of the data may or may not be present. This software saves the data with braces.

6. Table files created by other PC configurator software can also be read without modification, but be sure that the maximum number of points differs depending on the model.

6.2. CUSTOM RTD/TC TABLE FILE FORMAT

Describe the format of the custom RTD/TC table file handled by this software on this page.

```
/* XY table comment */
Minimum Temperature = -10.0000
Step = 5
{
   10.0000
   20.0000
   29.0000
   37.0000
   45.0000
}
```

1. Same way as entering the data using this software, enter the data in single precision floating point number, starting from T[0] in ascending or descending order.

2. Use Ω for custom RTD and use mV for custom TC.

3. T[n] will be read up to a minimum of 2 points and a maximum of 300 points, and the values after the 301st point will be ignored.

4. Lines begin with / and lines with comma-separated values will be ignored.

5. The braces {} at the beginning and end of the data may or may not be present. This software saves the data with braces.

6. Minimum Temperature = -10.0000 and Step = 5 are also recognized by the form that matches only the first character, followed by any character and write the value at the last.
   For example, Min-10.0000, Min Value-10.0000, S 5, Space 5, and so on are recognized.

7. Write the start temperature in -300 to 9999 for lines starting with M, and the temperature step in the range of 1 to 50 for lines starting with S in °C.

8. Table files created by other PC configurator software can also be read without modification, but be sure that the maximum number of points differs depending on the model.