

Programmable Controller

MELSEC iQ-F
series

MELSEC iQ-F

FX5 User's Manual (Analog Control -
CPU module built-in, Expansion adapter)

6 FX5U CPU MODULE BUILT-IN ANALOG

This chapter describes the built into analog the FX5U CPU module.

6.1 Specifications

This section describes the specifications.

Generic specifications

For the general specification, refer to the following manual.

📖 MELSEC iQ-F FX5U User's Manual (Hardware)

Performance specifications

Analog input/output specification is shown below.

This section describes the performance specifications.

Analog input

Item		Specifications
No. of analog input points		2 points (2 channels)
Analog input	Voltage	0 to 10 V DC (input resistance 115.7 kΩ)
Digital output		Unsigned 12-bit binary
Device allocation		SD6020 (Input data of ch1) SD6060 (Input data of ch2)
Input characteristics, max. resolution	Digital output value	0 to 4000
	Max. resolution	2.5 mV
Precision (Accuracy for the full scale of the digital output value)	Ambient temperature 25 ±5°C	Within ±0.5 % (±20 digit ^{*2})
	Ambient temperature 0 to 55°C	Within ±1.0 % (±40 digit ^{*2})
	Ambient temperature -20 to 0°C ^{*1}	Within ±1.5 % (±60 digit ^{*2})
Conversion speed		30 μs /Channel (data refreshed every operation cycle)
Absolute max. input		-0.5 V, +15 V
Insulation method		Inside the CPU module and the analog input circuit are not insulated. Between input terminals (channels) is not insulated.
No. of occupied input/output points		0 point (does not pertain to the max. No. of input/output points of the CPU module.)

*1 This specification does not apply to products manufactured before June 2016.

*2 "Digit" refers to digital values.

Analog output

Item		Specifications
No. of analog output points		1 point (1 channel)
Digital input		Unsigned 12-bit binary
Analog output	Voltage	0 to 10 V DC (external load resistance 2 k to 1 MΩ)
Device allocation		SD6180 (Output setting data of ch1)
Output characteristics, max. resolution* ¹	Digital input value	0 to 4000
	Max. resolution	2.5 mV
Precision* ² (Accuracy for the full scale of the analog output value)	Ambient temperature 25 ±5°C	Within ±0.5 % (±20 digit* ⁴)
	Ambient temperature 0 to 55°C	Within ±1.0 % (±40 digit* ⁴)
	Ambient temperature -20 to 0°C* ³	Within ±1.5 % (±60 digit* ⁴)
Conversion speed		30 μs (data refreshed every operation cycle)
Insulation method		Inside the CPU module and the analog output circuit are not insulated.
No. of occupied input/output points		0 point (does not pertain to the max. No. of input/output points of the CPU module.)

*¹ There is a dead band near 0 V output, which is an area where some digital input values do not reflect analog output values.

*² External load resistance is set to 2 kΩ when shipped from the factory. Thus, output voltage will increase somewhat if the resistance is set higher than 2 kΩ. When the resistance is 1 MΩ, output voltage increases by a maximum 2 %.

*³ This specification does not apply to products manufactured before June 2016.

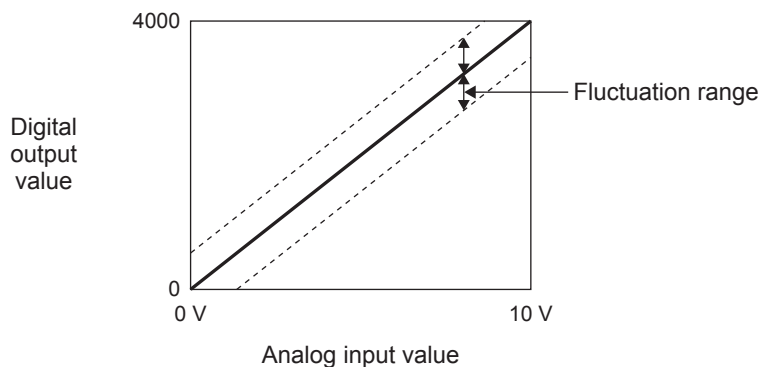
*⁴ "Digit" refers to digital values.

Accuracy

Built-in analog input

Accuracy of A/D conversion is determined by the accuracy for the full scale of digital output value.

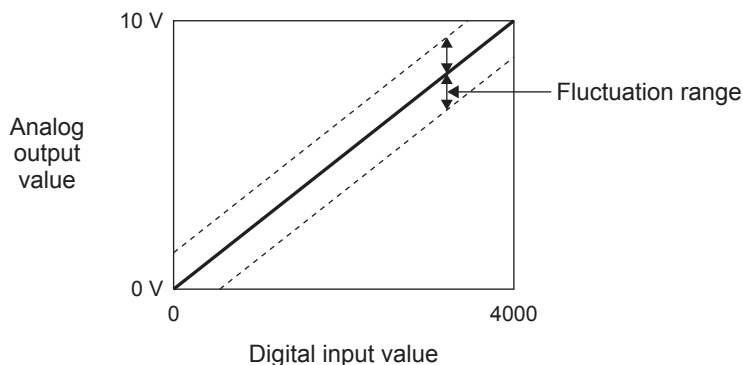
±0.5 % (±20 digit) at ambient temperature of 25±5°C; the accuracy is ±1.0 % (±40 digit) at ambient temperature of 0 to 55°C; the accuracy is ±1.5 % (±60 digit) at ambient temperature of -20 to 0°C (except for the conditions under noise influence).



Built-in analog output

Accuracy of D/A conversion is determined by the accuracy for the full scale of analog output value.

±0.5 % (±20 digit) at ambient temperature of 25±5°C; the accuracy is ±1.0 % (±40 digit) at ambient temperature of 0 to 55°C; the accuracy is ±1.5 % (±60 digit) at ambient temperature of -20 to 0°C (except for the conditions under noise influence).



6.2 List of functions

The following table lists the functions.

Analog input

List of Functions		Description	Reference
A/D conversion enable/disable setting function		Function to enable or disable A/D conversion per channel. The conversion process time can be reduced by disabling conversion for unused channels.	Page 271
A/D conversion method	Sampling processing	Method of converting each analog input at END processing to generate the equivalent digital output.	Page 271
	Time average	Method of averaging the time of A/D conversion values and outputting these average values as the digital signal.	
	Count average	Method of averaging the count of A/D conversion values and outputting these average values as the digital signal.	
	Moving average	Method of averaging the analog input for a specified count measured at every END process, and outputting these average values as the digital signal.	
Over scale detection function		Function to detect analog input values that are over a input range.	Page 273
Scaling function		Function that converts user-defined maximum and minimum digital values in accordance with a configured scale.	Page 274
Shift function		Function that adds a specified amount to the A/D conversion value. Fine adjustments during system startup can be easily performed.	Page 275
Digital clipping function		Function that specifies the maximum A/D conversion value as 4000 and the minimum value as 0 when voltage is input that exceeds the input range.	Page 276
Maximum value/minimum value hold function		Function that holds the minimum and maximum digital operation values.	Page 276
Warning output function		Function to output warning when digital operation values exceed the specified range.	Page 277
Event history function		Collects errors from functions of the built into analog, and stores them as event information into the CPU module.	Page 278

Analog output

List of Functions		Description	Reference
D/A conversion enable/disable function		Function to enable or disable D/A conversion. When analog output is not used, the conversion process time can be reduced by disabling conversion.	Page 280
D/A output enable/disable setting function		Specifies whether to output the D/A conversion value or output an offset value (HOLD setting value).	Page 280
Analog output HOLD/CLEAR function		Sets the digital value before D/A conversion to the previous value or clears the value (0) depending on the operation status of the CPU module (RUN, STOP, and STOP error).	Page 281
Analog output test when CPU module is in STOP status function		Outputs a user-defined analog value by setting the output enable/disable flag to enabled when the CPU module is stopped, and changing the digital value.	Page 282
Scaling function		Function that converts user-defined maximum and minimum digital values in accordance with a configured scale.	Page 283
Shift function		Function that adds a specified amount to the digital value. Fine adjustments during system startup can be easily performed.	Page 284
Warning output function		Function to output warning when digital values exceed the specified range.	Page 284
Event history function		Collects errors from functions of the built into analog, and stores them as event information into the CPU module.	Page 286

6.3 Functions (Analog input)

This section describes the functions of the built into analog the FX5U CPU module and the setting procedures for those functions.



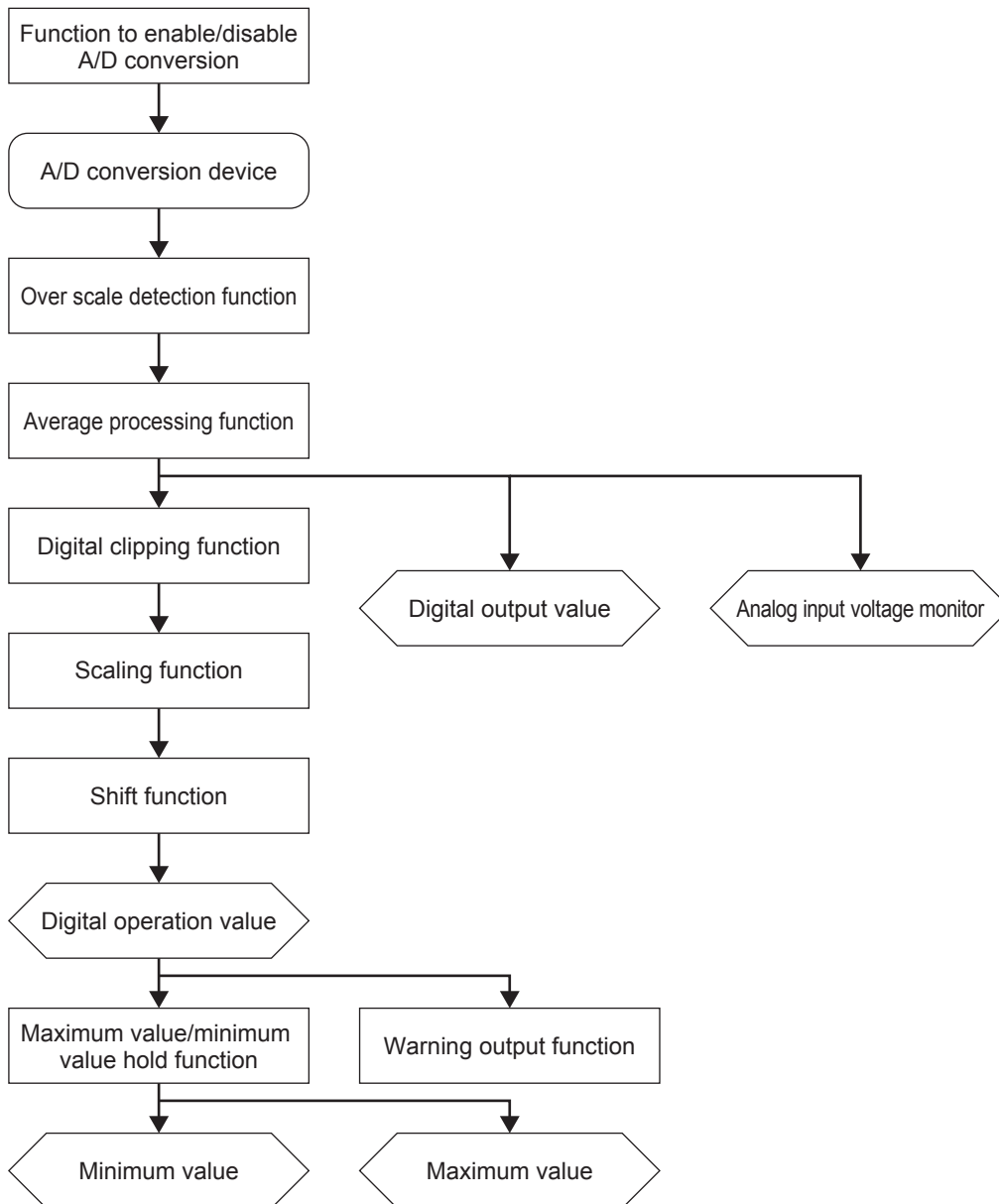
This section describes the special relays and special registers for the CH1.

For checking the special relays and special registers for the CH2, refer to the following:

☞ Page 295 List of Special Relays, ☞ Page 296 List of Special Registers

Processing of each function

The functions are processed in the order shown below.



Digital output value

These values are the digital values after the sampling processing, or each averaging processing has been performed.

Digital operation value

These values are obtained by operating a digital output value using the digital clipping function, scaling function, or shift function. When each function is not used, the same value as the digital output value is stored.

Analog input voltage monitor

The input voltage value is displayed. Voltage is displayed in the following units.

Voltage: mV

Maximum and minimum value

The maximum and minimum values of the digital operation values are stored.

■Detection cycle

This function is executed during the END process.

■Clearing the over-scale

After the analog input value returns to 10.2 V, cycle the alarm clear flag through OFF → ON → OFF.

Clearing the over-limit will result in the following status.

- The over-limit detection flag is cleared.
- The alarm code stored for the latest alarm code is cleared.

Scaling Function

Function that converts user-defined maximum and minimum digital values in accordance with a configured scale.

Corresponding devices

The devices used with the scaling function are listed below.

Name	CH1	CH2
A/D conversion scaling enable/disable setting	SM6028	SM6068
A/D conversion error flag	SM6059	SM6099
Scaling upper limit value	SD6028	SD6068
Scaling lower limit value	SD6029	SD6069
A/D conversion latest error code	SD6059	SD6099

Setting methods

The procedure to use the scaling function is described below.

1. Disable scaling.

Name	Allowable setting range	Default value
Scaling enable/disable setting	0: Enabled	1: Disabled
	1: Disabled	

2. Set the scaling upper limit value/scaling lower limit value.

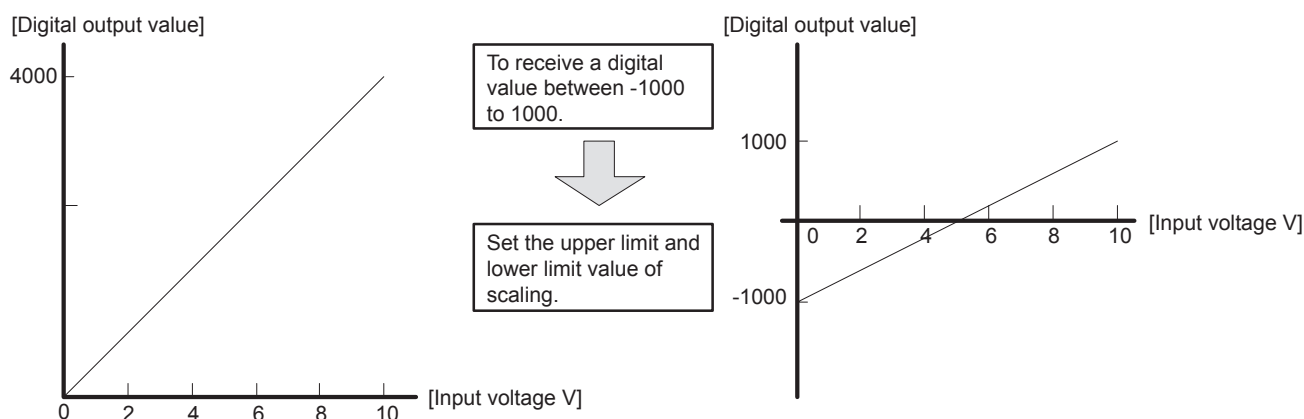
Set the scaling upper limit value to a value corresponding to the upper limit value for A/D conversion values (4000). Set the scaling lower limit value to a value corresponding to the lower limit value for A/D conversion values (0).

Name	Allowable setting range	Default value
Scaling upper limit value	-32768 to +32767 (upper limit value ≠ lower limit value)	0
Scaling lower limit value		

3. Enable scaling.

Operation

The output digital value is scaled within a range between the user-defined scaling upper limit value and the scaling lower limit value.



■Calculation method of the scaling value

The value used is calculated from the following expression. (Values after the decimal point are rounded.)

Value after scaling =
$$\frac{\text{Digital output value} \times (\text{scaling upper limit value} - \text{scaling lower limit value})}{4000} + \text{Scaling lower limit value}$$

Point

- The max. resolution will not increase even if the scaling upper limit value and the scaling lower limit value are set such that each digit is smaller than the max. resolution.
- When the scaling upper limit value is set lower than the scaling lower limit value, the digital operation value decreases as the input voltage increases.

Precautions

When both the scaling function and the digital clipping function are enabled at the same time, the scaling calculation will occur on the resulting digital value after digital clipping.

Shift Function

Function to add a user-definable shifting amount to the A/D conversion value and store the digital operation value. Changes to the shifting amount will be reflected in the digital operation value in real time, which enables fine adjustments to be easily made during system startup.

Corresponding devices

The devices which are used by the shift function are listed below.

Name	CH1	CH2
Conversion value shift amount	SD6030	SD6070

Setting methods

Sets the conversion value shift amount for the channel for which you want to use the conversion value shift.

Name	Allowable setting range	Default value
Conversion value shift amount	-32768 to +32767	0

Point

This function does not need to be set in advance. The user can perform conversion value shifts at any time.

Operation

Adds a shifting amount to the A/D conversion value. The A/D conversion value with the added shift is stored as the digital operation value.

When the digital operation value resulting from the shift processing exceeds the range between -32768 to +32767, the value is set to the lower limit (-32768) or the upper limit (32767).

When using the Sampling processing, the shift amount is added every conversion cycle. When using the averaging process, the shift amount is added every averaging process cycle. The results are stored as the digital operation value.

When using the scaling function at the same time, shift processing is performed on the resulting value after scaling processing.

Precautions

When the shift function, digital clipping function, and the scaling function are enabled simultaneously, the added shift is applied to the value after digital clipping and scaling, which results in a digital operation value range between -32,768 to 32,767.

Digital Clipping Function

Function that specifies the maximum A/D conversion value as 4000 and the minimum value as 0 when voltage is input that exceeds the input range.

Corresponding devices

The devices in which the digital clipping function can be used are listed below.

Name	CH1	CH2
Digital clipping enable/disable setting	SM6029	SM6069

Setting methods

Enable digital clipping for the channels for which you want to use the digital clipping function.

Name	Allowable setting range	Default value
Digital clipping enable/disable setting	0: Enabled	1: Disabled
	1: Disabled	

Point

- When the digital clipping function is disabled: digital output range (0 to 4095)
- When the digital clipping function is enabled: digital output range (0 to 4000)

Operation

This section describes the operation of the digital clipping function.

This function specifies the maximum A/D conversion value as 4000 and the minimum value as 0 when voltage is input that exceeds the input range.

Point

Scaling and shift processing occur after digital clipping.

Precautions

The scaling function operates as follows when not using the digital clipping function.

The value after scaling will exceed the scaling upper limit value when a voltage is input that exceeds the voltage range.

Maximum Value/Minimum Value Hold Function

Function that holds the minimum and maximum digital operation values.

Corresponding devices

The devices which are used by the function to hold minimum and maximum values are listed below.

Name	CH1	CH2
Maximum value/minimum value reset completed flag	SM6025	SM6065
Maximum value reset request	SM6026	SM6066
Minimum value reset request	SM6027	SM6067
Maximum value	SD6026	SD6066
Minimum value	SD6027	SD6067

Setting methods

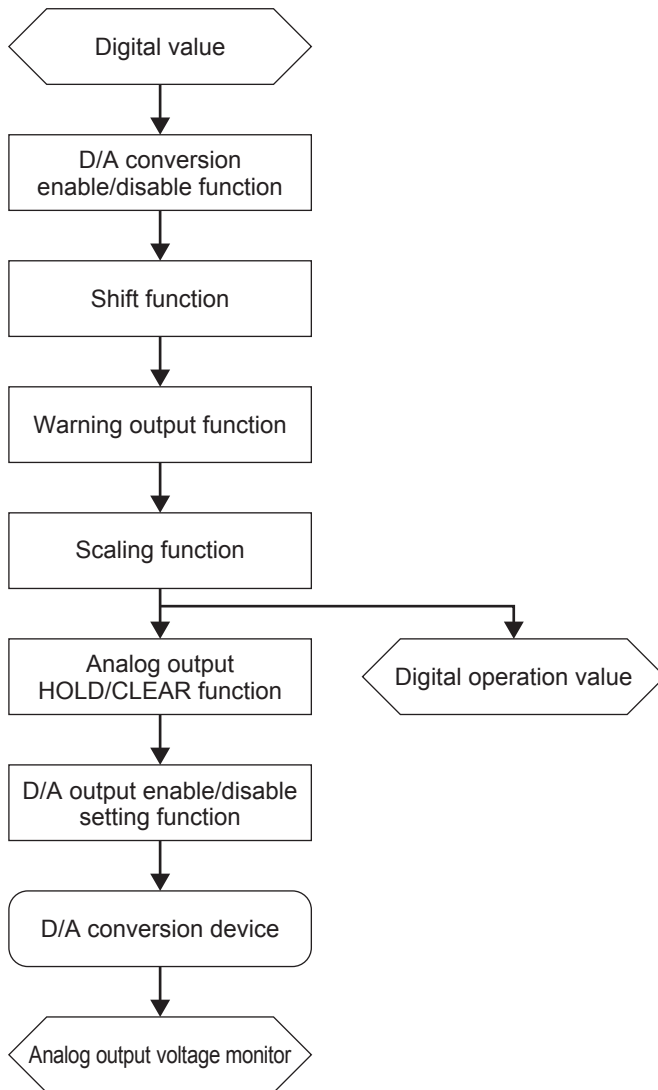
The user does not need to configure any settings.

6.4 Functions (Analog output)

This section describes the functions of the built into analog the FX5U CPU module and the setting procedures for those functions.

Processing of each function

The functions are processed in the order shown below.



Digital value

Digital input values are stored.

Digital operation value

These values are obtained by operating a digital value using the scaling function or shift function. When neither function is used, the same value as the digital value is stored.

Analog output voltage monitor

The output analog value is displayed. Voltage and current are displayed in the following units.

Voltage: mV

Scaling Function

Function that converts user-defined maximum and minimum digital values in accordance with a configured scale.

Corresponding devices

The devices which are used by the scaling function are listed below.

Name	CH1
Scaling enable/disable setting	SM6188
Scaling upper limit value	SD6188
Scaling lower limit value	SD6189

Setting methods

The procedure to use the scaling function is described below.

1. Disable scaling.

Name	Allowable setting range	Default value
Scaling enable/disable setting	0: Enabled	1: Disabled
	1: Disabled	

2. Set the scaling upper limit value/scaling lower limit value.

The allowable setting range is shown in the following table.

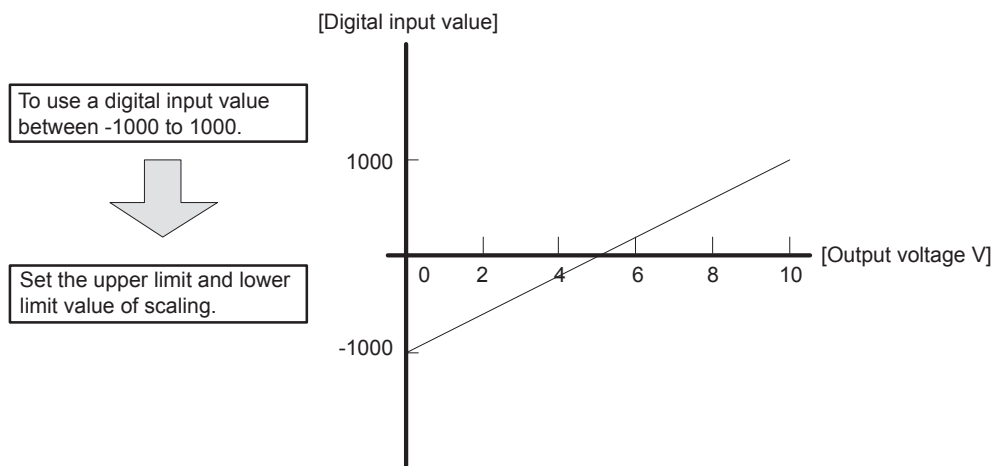
Name	Allowable setting range	Default value
Scaling upper limit value	-32768 to +32767	0
Scaling lower limit value	(upper limit value ≠ lower limit value)	

3. Enable scaling.

Operation

Scaling is performed on the resulting value after shift processing is performed on the set digital value using the scaling upper limit value and scaling lower limit value. The value resulting after scaling is used for the D/A conversion.

An example of scaling setting is shown below.



■Calculation method of the scaling value

When using the factory settings for the output range.

$$\text{Value after scaling} = \frac{4000}{\text{Scaling upper limit value} - \text{scaling lower limit value}} \times (\text{digital input value} - \text{scaling lower limit value})$$

Shift Function

Function that adds the set input value shift amount to the digital value.

Changes to the input value shift amount will be reflected in the digital operation value in real time, which enables fine adjustments to be easily made during system startup.

Corresponding devices

The devices which are used by the shift function are listed below.

Name	CH1
Input value shift amount	SD6190

Setting methods

Set the desired input value shift amount when performing a shift addition.

Name	Allowable setting range	Default value
Input value shift amount	-32768 to +32767	0

Operation

When the added digital value resulting from the shift processing exceeds the range between -32768 to +32767, the value is set to the lower limit (-32768) or the upper limit (32767).

After the value is written for the input value shift amount, the input value shift amount is added to the digital value.

Precautions

The scaling function and the warning output function executes for the digital value with the added shift amount.

Warning Output Function

Function that checks the digital value set for output against the warning output upper limit and lower limit values previously configured for each channel, and outputs a warning when the value is outside the set range.

Corresponding devices

The devices which are used by the warning output function are listed below.

Name	CH1
Warning output upper limit value flag	SM6191
Warning output lower limit value flag	SM6192
Warning output setting	SM6193
Alarm clear request	SM6218
Error flag	SM6219
Warning output upper limit value	SD6191
Warning output lower limit value	SD6192
D/A conversion latest alarm code	SD6218
D/A conversion latest error code	SD6219

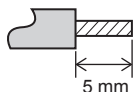
Wire end treatment

Treat stranded and solid wires as they are or use wire ferrules with insulation sleeves for wiring terminals.

■When stranded and solid wires are treated as they are

- Twist the end of stranded wires and make sure that there are no loose wires.
- Do not solder-plate the electric wire ends.

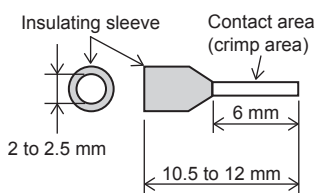
Stripping dimensions of electric wire ends



■When wire ferrules with insulation sleeves are used

Depending on the thickness of a wiring sheath used, it may be difficult to insert the sheath into an insulation sleeve. Refer to the external dimensions as a reference to select wires.

External dimension of wire ferrules with insulation sleeves



<Reference>

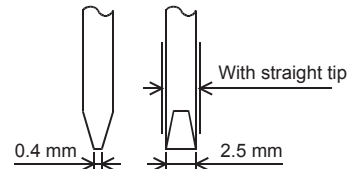
Manufacturer	Model	Crimp tool
Phoenix Contact GmbH & Co. KG	AI 0.5-6 WH	CRIMPFOX 6 CRIMPFOX 6T-F

■Tool

For tightening terminals, use a small, commercially-available screwdriver with a straight tip. The recommended shape is shown in the figure on the right.

■Precautions

When a precision screwdriver with a small grip is used, the specified tightening torque cannot be obtained. Use the following screwdriver or equivalent product (grip diameter: 25 mm) to obtain the tightening torque specified above.

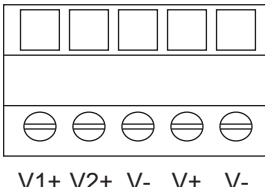


<Reference>

Manufacturer	Model
Phoenix Contact GmbH & Co. KG	SZS 0.4 × 2.5

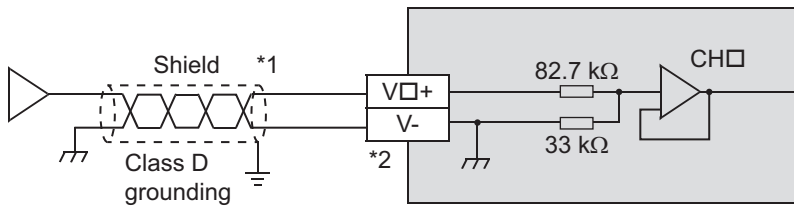
Terminal layout

The following table shows the terminal layout.

Terminal block	Signal name		Function	
 V1+ V2+ V- V+ V- Analog input Analog output	Analog input	V1+	CH1	Voltage input (+)
		V2+	CH1	Voltage input (+)
		V-	CH1/CH2	Voltage input (-)
	Analog output	V+	CH1	Voltage output (+)
		V-	CH1	Voltage output (-)

Analog input wiring

The following figures show wiring of the analog input.

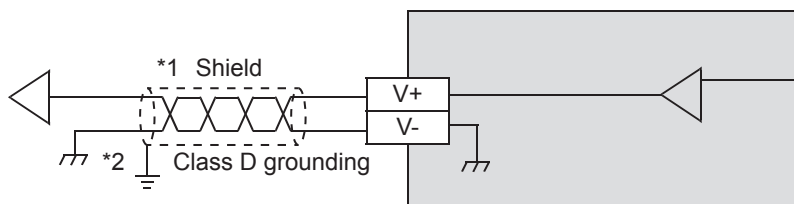


V□+, CH□: □ represents the channel number.

- *1 For analog input wiring, use shielded twisted-pair cables (double-core type). Separate them from other power lines or lines which can be induced by others.
- *2 For unused channels, short-circuit the "V□+" and "V-" terminals.

Analog output wiring

The following figures show wiring of the analog output.



- *1 For analog output wiring, use shielded twisted-pair cables (double-core type). Separate them from other power lines or lines which can be induced by others.
- *2 Ground a shielded cable at one point on the signal receiving side.

Grounding

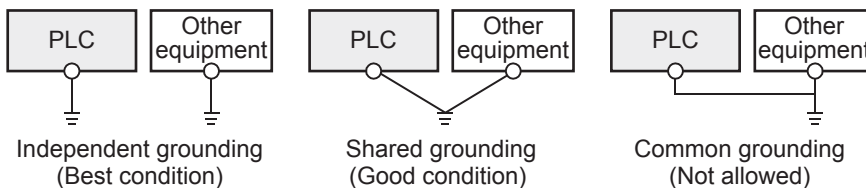
Perform the following.

- Perform class D grounding (Grounding resistance: 100 Ω or less).
- Ground the PLC independently when possible.

If the PLC cannot be grounded independently, perform the "Shared grounding" shown below.

For the details, refer to the following manual.

📖 MELSEC iQ-F FX5U User's Manual (Hardware)



- Use a grounding wire with thickness of AWG 14 (2 mm²) or thicker.
- Bring the grounding point close to the PLC as much as possible so that the ground cable can be shortened.

6.7 Parameter Setting

Set the parameters of each channel.
Setting parameters here eliminates the need to program them.

Point

Parameters are enabled when the CPU module is powered ON or after a reset. In addition, operations different from the parameter settings are possible by transferring values to special relays and special registers while changing these values in the program.
Refer to Page 295 List of Special Relays or Page 296 List of Special Registers for details on the special relays and special registers.

Basic settings (Analog input)

Setting procedure

Open "Basic Settings" of the GX Works3.

1. Start Module parameter.
- Navigation window ⇒ [Parameter] ⇒ [FX5UCPU] ⇒ [Module Parameter] ⇒ [Analog Input] ⇒ "Basic Settings"

Window

Item	CH1	CH2
A/D Conversion Enable/Disable Setting Function	Set AD conversion control method.	
A/D Conversion Enable/Disable Setting	Disable	Disable
A/D Conversion Method	Set AD conversion control method.	
Average Processing Specify	Sampling	Sampling
Time Average Counts Average Moving Average	0 Times	0 Times

Displayed items

Item	Description	Setting range	Default
A/D Conversion Enable/Disable Setting	Set whether to "enable" or "disable" A/D conversion value output.	• Enable • Disable	Disable
Average Processing Specify	Execute whether to set "average process" or "sampling processing".	• Sampling • Time Average • Count Average • Moving average	Sampling
Time Average Counts Average Moving average	Set time average, count average, moving average counts during specifying average process for each channel.	User-defined value for the allowable setting range	0

2. Click the item to be changed to enter the setting value.
- Item where a value is selected from the pull-down list
- Click button of the item to be set, and from the pull-down list that appears, select the value.
- Item where a value is entered into the text box
- Double-click the item to be set to enter the numeric value.

Application setting (Analog input)

Setting procedure

Open "Application Settings" of the GX Works3.

1. Start Module parameter.

Navigation window ⇒ [Parameter] ⇒ [FX5UCPU] ⇒ [Module Parameter] ⇒ [Analog Input] ⇒ "Application settings"

Window

Item	CH1	CH2
Warning Output Function	Execute the setting related to warning at A/D conversion.	
Process Alarm Warning Setting	Disable	Disable
Process Alarm Upper Upper Limit Value	0	0
Process Alarm Upper Lower Limit Value	0	0
Process Alarm Lower Upper Limit Value	0	0
Process Alarm Lower Lower Limit Value	0	0
Over Scale Detection	Execute the setting related to analog input value detection which exceeds the setting ra	
Over Scale Detection Enable/Disable	Enable	Enable
Scaling Setting	Execute the setting related to scaling at A/D conversion.	
Scaling Enable/Disable	Disable	Disable
Scaling Upper Limit Value	0	0
Scaling Lower Limit Value	0	0
Shift Function	Execute the setting related to shift function at A/D conversion.	
Shifting Amount	0	0
Digital Clip Setting	Execute the setting related to digital clip function at A/D conversion.	
Digital Clip Enable/Disable	Disable	Disable

Displayed items

Item	Description	Setting range	Default
Process Alarm Warning Setting	Set whether to "enable" or "disable" process alarm warning.	• Enable • Disable	Disable
Process Alarm Upper Upper Limit Value	Set upper upper limit value of digital output value.	-32768 to +32767	0
Process Alarm Upper Lower Limit Value	Set upper lower limit value of digital output value.	-32768 to +32767	0
Process Alarm Lower Upper Limit Value	Set lower upper limit value of digital output value.	-32768 to +32767	0
Process Alarm Lower Lower Limit Value	Set lower lower limit value of digital output value.	-32768 to +32767	0
Over Scale Detection Enable/Disable	Set whether to "enable" or "disable" over scale detection.	• Enable • Disable	Enable
Scaling Enable/Disable	Set whether to "enable" or "disable" scaling.	• Enable • Disable	Disable
Scaling Upper Limit Value	Set scaling conversion upper limit value.	-32768 to +32767	0
Scaling Lower Limit Value	Set scaling conversion lower limit value.	-32768 to +32767	0
Shifting Amount	Set shifting amount for shifting function.	-32768 to +32767	0
Digital Clip Enable/Disable	Whether to "enable" or "disable" the digital clip.	• Enable • Disable	Disable

2. Click the item to be changed to enter the setting value.

- Item where a value is selected from the pull-down list

Click [▼] button of the item to be set, and from the pull-down list that appears, select the value.

- Item where a value is entered into the text box

Double-click the item to be set to enter the numeric value.

Basic settings (Analog output)

Setting procedure

Open "Basic settings" of the GX Works3.

1. Start Module parameter.

Navigation window ⇒ [Parameter] ⇒ [FX5UCPU] ⇒ [Module Parameter] ⇒ [Analog Output] ⇒ "Basic Settings"

Window

Item	CH
☒ D/A Conversion Enable/Disable Setting Function	Set D/A conversion control method.
D/A Conversion Enable/Disable Setting	Disable
☒ D/A Output Enable/Disable Setting	Set D/A output conversion control method.
D/A Output Enable/Disable Setting	Disable

Displayed items

Item	Description	Setting range	Default
D/A Conversion Enable/Disable Setting	Set whether to "enable" or "disable" D/A conversion.	• Enable • Disable	Disable
D/A Output Enable/Disable Setting	Set whether to "enable" or "disable" D/A output.	• Enable • Disable	Disable

2. Click the item to be changed to enter the setting value.

- Item where a value is selected from the pull-down list

Click [▼] button of the item to be set, and from the pull-down list that appears, select the value.

- Item where a value is entered into the text box

Application setting (Analog output)

Setting procedure

Open "Application settings" of the GX Works3.

1. Start Module parameter.

Navigation window ⇒ [Parameter] ⇒ [FX5UCPU] ⇒ [Module Parameter] ⇒ [Analog Output] ⇒ "Application settings"

Window

Item	
Warning Output Function	Execute the setting related to warning at D/A conversion.
Warning Output Setting	Disable
Warning Upper Limit Value	0
Warning Lower Limit Value	0
Scaling Setting	Execute the setting related to scaling at D/A conversion.
Scaling Enable/Disable	Disable
Scaling Upper Limit Value	0
Scaling Lower Limit Value	0
Shift Function	Execute the setting related to shift function at D/A conversion.
Shift Value to Conversion Value	0
Analog Output HOLD/CLEAR Setting	It can be set whether to HOLD the last value, setting value or C
HOLD/CLEAR Setting	CLEAR
HOLD Setting Value	0

Displayed items

Item	Description	Setting range	Default
Warning Output Setting	Set whether to "enable" or "disable" warning output.	• Enable • Disable	Disable
Warning Upper Limit value	Set upper limit value of digital input value for warning output.	-32768 to +32767	0
Warning Lower Limit value	Set lower limit value of digital input value for warning output.	-32768 to +32767	0
Scaling Enable/Disable	Set whether to "enable" or "disable" scaling.	• Enable • Disable	Disable
Scaling Upper Limit Value	Set scaling conversion upper limit value.	-32768 to +32767	0
Scaling Lower Limit Value	Set scaling conversion lower limit value.	-32768 to +32767	0
Shift Value to Conversion Value	Set shifting amount for shifting function.	-32768 to +32767	0
HOLD/CLEAR Setting	Set output status at CLEAR or HOLD.	• CLEAR • Previous Value (Hold) • Setting Value	CLEAR
HOLD Setting Value	Set digital value that output at HOLD when "setting value" is selected in "HOLD/CLEAR Setting".	-32768 to +32767	0

2. Click the item to be changed to enter the setting value.

- Item where a value is selected from the pull-down list

Click [▼] button of the item to be set, and from the pull-down list that appears, select the value.

- Item where a value is entered into the text box

6.8 List of Error Code

The following table shows the error codes stored.

Analog input

□: This symbol indicates the number of the channel where a error has occurred. (1: CH1 to 2: CH2)

Error code	Error name	Description and cause	Action
0000H	—	There is no error.	—
1A0□H	Averaging process specification setting range error	A value other than 0 to 3 is set in CH□ Averaging process specification.	Set CH□ Averaging process specification to 0 to 3.
1A1□H	Time average setting range error	When the time average is selected in CH□ Averaging process specification, a value other than 1 to 10000 is set in CH□ Time average/Count average/Moving average setting.	Set CH□ Time average/Count average/Moving average setting to 1 to 10000.
1A2□H	Count average setting range error	When the count average is selected in CH□ Averaging process specification, a value other than 4 to 32767 is set in CH□ Time average/Count average/Moving average setting.	Set CH□ Time average/Count average/Moving average setting to 4 to 32767.
1A3□H	Moving average count setting range error	When the moving average is selected in CH□ Averaging process specification, a value other than 2 to 64 is set in CH□ Time average/Count average/Moving average setting.	Set CH□ Time average/Count average/Moving average setting to 2 to 64.
1A4□H	Process alarm upper lower limit value setting range error	The values set in CH□ Process alarm upper upper limit value to CH□ Process alarm lower lower limit value do not satisfy the following condition: Upper upper limit value ≥ Upper lower limit value ≥ Lower upper limit value ≥ Lower lower limit value	Set CH□ Process alarm upper upper limit value to CH□ Process alarm lower lower limit value so that the values satisfy the following condition: Upper upper limit value ≥ Upper lower limit value ≥ Lower upper limit value ≥ Lower lower limit value
1A7□H	Scaling upper and lower limit value setting error	CH□ Scaling upper limit value and CH□ Scaling lower limit value are equal.	Reset CH□ Scaling upper limit value or CH□ scaling lower limit value such that Scaling upper limit value ≠ Scaling lower limit value.

Analog output

Error code	Error name	Description and cause	Action
0000H	—	There is no error.	—
1B01H	Scaling upper/lower limit value setting error	Values that do not satisfy the following relation are set in warning output upper limit value and warning output lower limit value: Upper limit value > Lower limit value	Set the warning output upper limit value and warning output lower limit value so that upper limit value > lower limit value.
1B11H	HOLD output state setting range error	A value other than 0, 1 or, 2 is set to the HOLD output state setting.	Set a value between 0 and 2 to the HOLD output state setting.
1B21H	HOLD output set value range error	The HOLD output set value is outside the range between the scaling lower limit value and scaling upper limit value.	Specify the HOLD output set value to fall within the range between the scaling lower limit value and scaling upper limit value.
1B71H	Scaling upper and lower limit value setting error	Scaling upper limit value and Scaling lower limit value are equal.	Reset Scaling upper limit value or scaling lower limit value such that Scaling upper limit value ≠ Scaling lower limit value.

6.9 List of Alarm Code

The following table shows the list of the alarm codes stored.

Analog input

□: This symbol indicates the number of the channel where an alarm has occurred. (1: CH1 to 2: CH2)

Alarm code	Alarm name	Description and cause	Action
080□H	Process alarm (upper limit)	The process alarm (upper limit) has occurred in CH□.	When the digital operation value returns from the warning output range, the warning output flag automatically changes to "0: Normal". Afterwards, alarm can be cleared by turning ON the alarm clear request.
081□H	Process alarm (lower limit)	The process alarm (lower limit) has occurred in CH□.	
090□H	Over-limit detection flag	An over-limit has occurred in CH□.	If the alarm clear request is turned ON after the analog input value falls within the set range, all the over-limit detection flags are set to "0: Normal" and the alarm code in the A/D conversion latest alarm code is cleared.
0F0□H	Changing the setting with setting change not allowed	The setting was changed when setting change was not allowed.	Change the setting with setting change allowed.

Analog output

Alarm code	Alarm name	Description and cause	Action
0801H	Warning output alarm (upper limit)	The warning output alarm (upper limit) has occurred.	When the digital operation value returns from the warning output range, the warning output flag automatically changes to "0: Normal". Afterwards, alarm can be cleared by turning ON the alarm clear request.
0811H	Warning output alarm (lower limit)	The warning output alarm (lower limit) has occurred.	
0F01H	Changing the setting with setting change not allowed	The setting was changed when setting change was not allowed.	Change the setting with setting change allowed.

6.10 List of Special Relays

This section describes the special relays used for analog input and output.

Special relays for analog input

Special relays		Description	R/W
CH1	CH2		
SM6020	SM6060	A/D conversion completed flag	R
SM6021	SM6061	A/D conversion enable/disable setting	R/W
SM6022	SM6062	Scaling over detection flag	R
SM6024	SM6064	Over scale detection enable/disable setting	R/W
SM6025	SM6065	Maximum value/minimum value reset completed flag	R
SM6026	SM6066	Maximum value reset request	R/W
SM6027	SM6067	Minimum value reset request	R/W
SM6028	SM6068	Scaling enable/disable setting	R/W
SM6029	SM6069	Digital clipping enable/disable setting	R/W
SM6031	SM6071	Warning output flag (process alarm upper limit)	R
SM6032	SM6072	Warning output flag (process alarm lower limit)	R
SM6033	SM6073	Warning output setting (process alarm)	R/W
SM6057	SM6097	A/D conversion alarm clear request	R/W
SM6058	SM6098	A/D conversion alarm flag	R
SM6059	SM6099	A/D conversion error flag	R

R/W: Read/Write

R: Read only

Special relays for analog output

Special relays		Description	R/W
SM6180		D/A conversion enable/disable setting	R/W
SM6181		D/A output enable/disable setting	R/W
SM6188		Scaling enable/disable setting	R/W
SM6191		Warning output upper limit value flag	R
SM6192		Warning output lower limit value flag	R
SM6193		Warning output setting	R/W
SM6217		D/A conversion alarm clear request	R/W
SM6218		D/A conversion alarm flag	R
SM6219		D/A conversion error flag	R

R/W: Read/Write

R: Read only

6.11 List of Special Registers

This section describes the special registers used for analog input and output.

Special registers for analog input

Special registers		Description	R/W
CH1	CH2		
SD6020	SD6060	Digital output value	R
SD6021	SD6061	Digital operation value	R
SD6022	SD6062	Analog input voltage monitor	R
SD6023	SD6063	Average processing specify	R/W
SD6024	SD6064	Time Average/Count Average/Moving Average setting	R/W
SD6026	SD6066	Maximum value	R
SD6027	SD6067	Minimum value	R
SD6028	SD6068	Scaling upper limit value	R/W
SD6029	SD6069	Scaling lower limit value	R/W
SD6030	SD6070	Conversion value shift amount	R/W
SD6031	SD6071	Process alarm upper upper limit value	R/W
SD6032	SD6072	Process alarm upper lower limit value	R/W
SD6033	SD6073	Process alarm lower upper limit value	R/W
SD6034	SD6074	Process alarm lower lower limit value	R/W
SD6058	SD6098	A/D Conversion latest alarm code	R
SD6059	SD6099	A/D Conversion latest error code	R

R/W: Read/Write

R: Read only

Special registers for analog output

Special registers	Description	R/W
SD6180	Digital value	R/W
SD6181	Digital operation value	R
SD6182	Analog output voltage monitor	R
SD6183	HOLD/CLEAR function setting	R/W
SD6184	HOLD setting value	R/W
SD6188	Scaling upper limit value	R/W
SD6189	Scaling lower limit value	R/W
SD6190	Input value shift amount	R/W
SD6191	Warning output upper limit value	R/W
SD6192	Warning output lower limit value	R/W
SD6218	D/A conversion latest alarm code	R
SD6219	D/A conversion latest error code	R

R/W: Read/Write

R: Read only

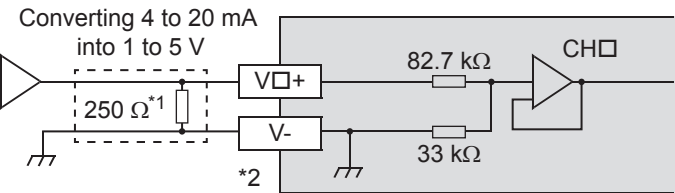
6.12 How to use analog inputs built in CPU module for current inputs

The analog input of the built-in analog can be used as the current input (4 to 20 mA DC) for the FX5U CPU module.

Method of using the FX5U CPU module for current inputs (4 to 20 mA DC)

The FX5U CPU module is designed to handle only voltage inputs. However, the FX5U CPU module can be used for current inputs by connecting a 250 Ω resistor (Precise resistance: 0.5%) between the V $\square$ + terminal and the V- terminal.

Example of wiring



CH No. goes in $\square$ of V $\square$ +, CH $\square$.

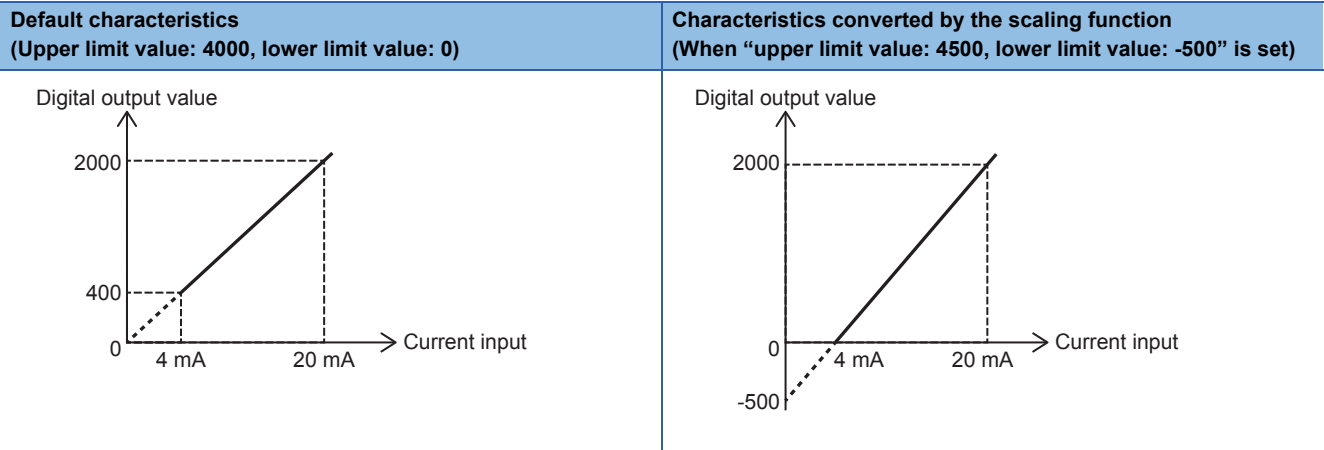
- *1 Instead of a 250 Ω resistor, a 500 Ω resistor can be connected in parallel. When selecting a resistor, consider the maximum input current.
- *2 For unused channels, short-circuit the "V $\square$ +" and "V-" terminals.

Specifications

Item	Specifications
Analog input	4 to 20 mA DC
Digital output	400 to 2000 ^{*1}
Resolution	10 μ A
Absolute maximum input	-2 mA, +60 mA

- *1 The digital output value can be changed using the scaling function.

Example of using the scaling signal



For details of the scaling function, refer to [Page 274 Scaling Function](#).