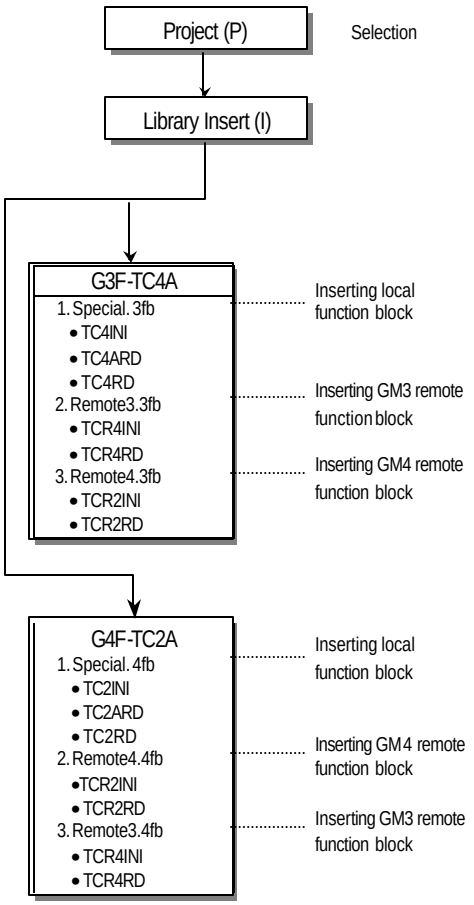
Chapter 4. FUNCTION BLOCKS

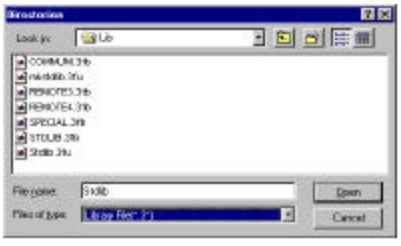
The followings explain the function blocks for the thermocouple input module used on the GMWIN
The types of function block are given here.

No	G3F-TC4A		G4F-TC2A		G6F-TC2A		Function
	Local	Remote	Local	Remote	Local	Remote	
1	TC4INI	TCR4INI	TC2INI	TCR2INI	TC2INI	TCR62INI	Module Initialization
2	TC4ARD	TCR4RD	TC2ARD	TCR2RD	TC2ARD	TCR62RD	Reading the temperature conversion value (Array type)
3	TC4RD	-	TC2RD	-	TC2RD	-	Reading the temperature conversion value (Single type)

4.1 Insertion of the Function Blocks for the Thermocouple Input Module on the GMWIN.

Function blocks can be registered with the following procedure while the GMWIN is running.
Insertion of the function blocks is only possible when a project is open.

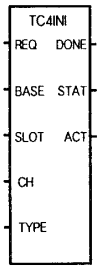
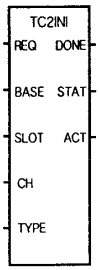




4.2 Local Function Block

4.2.1 Module Initialization (G3F-TC4A: TC4INI, G4F-TC2A/G6F-TC2A:TC2INI)

Module initialization function block specifies thermocouple input module base location, slot location, run channel enable/disable and the type of thermocouple for use in program.

Function Block	I/O	Variable	Data Type	Description
G3F – TC4A  G4F-TC2A/ G6F-TC2A  	I	REQ	BOOL	Function block execution request area - Used to request an execution of the initialization function block - If the conditions connected with this area are established and "0" changes into "1" while program is running, the initialization function block is executed
		BASE	USINT	Base location No. - Used to write the base No. where the thermocouple input module is mounted. - Setting range: GM1 series(0~31), GM2 series(0~7), GM3/4 series(0-3), GM6 series(0-1)
		SLOT	USINT	Slot location No. - Used to write the slot No. where the thermocouple input module is mounted. - Setting range: 0~7
		CH	BOOL [Array] *Note 1	Used channel enable/disable specification - Used to enable or disable a channel for run. - Specify "1" for enabling, and "0" for disabling
		TYPE	USINT [Array] *Note 1	Specifying the type of the sensor to be connected -
	O	DONE	BOOL	Function block finished execution status - "1" is output when the initialization function block is finished with no error and "1" remains until next execution. If an error occur, '0' is displayed and the operation enters into the stop state.
		STAT	USINT	Error status indication area - Used to output the error No. when it occurs during initialization function block execution. - For description of errors, refer to the Section 4.4
		ACT	BOOL [Array] *Note 1	Run channel status indication area - After the initialization function block is finished with no error, "1" is output if the channel is in normal state. But "0" is output for the disabled channels.

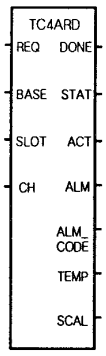
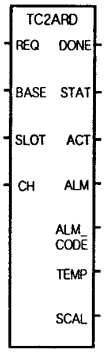
Input specification No.	Sensor type	Temperature range
0	K	-200.0 to 1200.0°C
1	J	-200.0 to 800.0°C
2	E	-150.0 to 600.0°C
3	T	-200.0 to 400.0°C
4	B	400.0 to 1800.0°C
5	R	0.0 to 1750.0℃
6	S	0.0 to 1750.0℃

REMARK

∗Note 1 [Array]
: The numbers of Array are 16 in G3F-TC4A, 4 in G4F-TC2A/G6F-TC2A.

4.2.2 Module Reading (Array type) (G3F-TC4A : TC4ARD, G4F-TC2A/G6F-TC2A : TC2ARD)

The Array type module reading function block executes all channels of the thermocouple input module in batch processing. If a channel is enabled then the function block outputs the temperature conversion value to the output value TEMP.

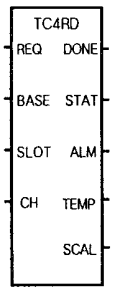
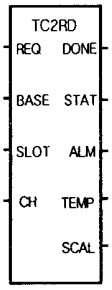
Function Block	I/O	Variable	Data Type	Description
G3F－TC4A  	I	REQ	BOOL	Function block execu tion request area - Used to request an execution of the reading function block - If the conditions connected with this area are established while the program is running and “0” changes into “1”, the reading function block is executed.
		BASE	USINT	Base location No. - Used to write the base No. where the thermocouple input module is mounted. - Setting range: GM1 series(0~31), GM2 series(0~7), GM3/4 series(0-3), GM6 series(0-1)
		SLOT	USINT	Slot location No. - Used to write the slot No. where the thermo couple input module is mounted. - Setting range: 0~7
		CH	BOOL [Array] *Note 1	Run channel enable/disable specification - Used to enable or disable a channel for run. - Specify “1” for enabling, and “0” for disabling
	O	DONE	BOOL	Function block finish ed execution status - “1” is output when the reading function block is finished with no error and “1” remains until next execution. If an error occur,‘0’ is displayed and the operation enters into the stop state.
		STAT	USINT	Error status indication a rea - Used to output the error No. when it occurs during reading function block execution. - For description of errors, refer to Section 4.4
		ACT	BOOL [Array] *Note 1	Run channel status indication area - After the reading function block is finished with no error, “1” is output if the channel is in normal state. But “0” is output for the disabled channels.
G4F-TC2A/ G6F-TC2A  		ALM	BOOL [Array] *Note 1	Run channel error indication area - “1” is outputted when error occurs for each run channel.
		ALM_ CODE	USINT [Array] *Note 1	Run channel error code area -Outputs the following code for each channel coded if error occurred. 0: Normal 16: Disconnection detected 17: Out-of-the-measuring-range error 18: Reference junction compensation device error
		TEMP	INT [Array] *Note 1	Temperature conversion value output area - The CPU module reads the temperature conversion value of the corresponding channel from the thermocouple input module and outputs it to this area. - The temperature conversion value of each channel is 10 times than the real temperature value. - (Example: Temperature conversion value 1234 → Real temperature value 123.4°C)
		SCAL	INT [Array] *Note 1	Digital conversion value output area - The CPU module reads the digital conversion value of the corresponding cha nnel from the thermocouple input module and outputs it to this area. - The temperature conversion value of each channel within its measuring temperature range is converted into a digital value within 0 to 16000 and it is outputted to this area. - The Value read from the output variable SCAL. $\frac{16000}{\text{Overall measuring temperature range}} \times (\text{Temperature conversion value} - \text{Minimum measuring temperature})$ - The output value through digital conversion can be used as a PV of the PID control module.

REMARK

∗Note 1: The numbers of Array are 16 in G3F-TC4A, 4 in G4F-TC2A/G6F-TC2A.

4.2.3 Module Reading (Stand-alone type)

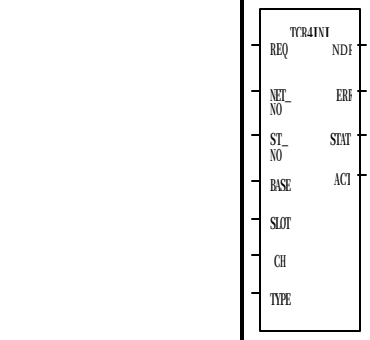
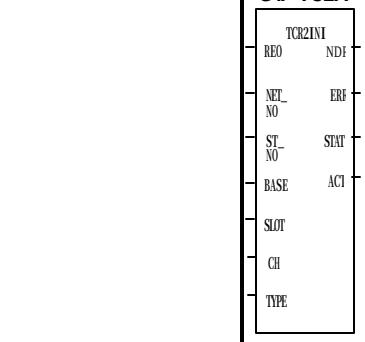
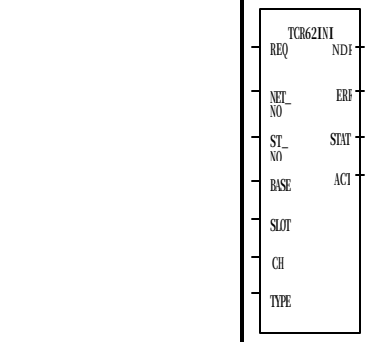
The stand-alone type module reading function block outputs the temperature conversion value to which each channel of the thermocouple input module is set to output variable TEMP.

Function Block	I/O	Variable	Data Type	Description
G3F－TC4A  	I	REQ	BOOL	Function block execution request area - Used to request an execution of the conversion value reading function block - If the conditions connected with this area are established and "0" changes into "1" while the program is running, the reading function block is executed.
		BASE	USINT	Base location No. - Used to write the base No. where the thermocouple input module is mounted. - Setting range: GM1 series(0~31), GM2 series(0~7), GM3/4 series(0-3) GM6 series(0-1)
		SLOT	USINT	Slot location No. - Used to write the slot No. where the thermocouple input module is mounted. - Setting range: 0~7
		CH	USINT	Specifying the use channel. Setting range : 0 to 15 (G4F-TC2A/G6F-TC2A: 0 to 3)
G4F-TC2A/ G6F-TC2A  	O	DONE	BOOL	Function block finished execution status - "1" is output when the reading function block is finished without error and "1" remains until next execution. If an error occur, '0' is output and the operation enters into the stop state.
		STAT	USINT	Error status indication area - Used to output the error No. when it occurs during reading function block execution. - For description of errors, refer to the Section 4.4
		ALM	BOOL	Run channel error indication area - "1" is output when error occurs for corresponding run channel.
		TEMP	INT	Temperature conversion value output area - The CPU module reads the temperature conversion value of the corresponding channel from the thermocouple-input module and outputs it to this area. - The temperature conversion value of corresponding channel is 10 times than the real temperature value. (Example: Temperature conversion value 1234 → Real temperature value 123.4℃)
		SCAL	INT	Digital conversion value output area - The CPU module reads the digital conversion value of the corresponding channel from the thermocouple input module and outputs it to this area. - The temperature conversion value of corresponding channel within its measuring temperature range is converted into a digital value within 0 to 16000 and it is outputted to this area. - The Value read from the output variable SCAL. $\frac{16000}{\text{Overall measuring temperature range}} \times (\text{Temperature conversion value} - \text{Minimum measuring temperature})$ - The output value through digital conversion can be used as a PV of the PID control module.

4.3 Remote Function Block

4.3.1 Module Initialization (G3F-TC4A : TCR4INI, G4F-TC2A :TCR2INI,G6F-TC2A :TCR62INI)

The module initialization function block specifies, for use in the program, the local communications module slot location No. of the thermocouple input module, and the station No., base No. and slot location No. of the communications module loaded in remote I/O station. And it specifies used channels and the type of the thermocouple.

Function Block	I/O	Variable	Data Type	Description
G3F-TC2A  **G4F-TC2A**  **G6F-TC2A**  	I	REQ	BOOL	Function block execution request area - Used to request an ex ecution of the writing function block - If the conditions connected with this area are established while the program is running and "0" changes into "1" (↑), the initialization function block is executed.
		NET_NO	USINT	Location No. of the slot where the local communication module to which the function block will be sent is mounted. - Setting range: 0 ~ 7
		ST-NO	USINT	Station No. of the communication module mounted in the remote I/O station. -Setting range: 0 ~ 63
		BASE	USINT	Base location No. - Used to write the base No. where the thermocouple input module is mounted. - Setting range: GM1 series(0~31), GM2 series(0~7), GM3/4 series(0-3) GM6 series(0-1)
		SLOT	USINT	Slot location No. - Used to write the slot No. where the thermocouple input module is mounted. - Setting range: 0~7
		CH	BOOL [Array] *Note 1	Used channel enable/disable specification - Used to enable or disable a channel for run. - Specify "1" for enabling, and "0" for disabling
		TYPE	USINT [Array] *Note 1	Specifying the type of used sensor - Used to specify the type of sensor used at each channel
	O	NDR	BOOL	"1" when the function block is finished without error. "1" remains during the scan where the execution condition is being satisfied and it changes into "0" at the next scan.
		ERR	BOOL	Error information indication area - If error occurs during initialization function block execution "1" is outputted and the module enter into the stop state. "1" remains during the scan where the execution condition is being satisfied and it changes into "0" at the next scan.
		STAT	USINT	Error status indication area - Used to output the error No. when it occurs during reading function block execution. - For description of errors, refer to the Section 4.4
		ACT	BOOL [Array] *Note 1	Run channel status indication area - After the initialization function block is finished without error, "1" is output if the channel is in normal state. But "0" is output for the disabled channels.

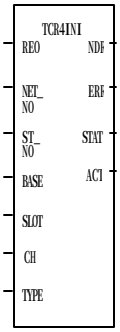
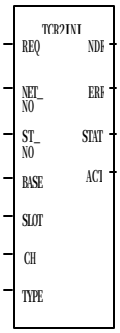
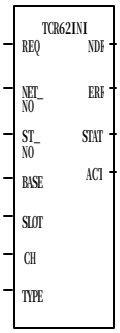
Input specification No.	Sensor type	Temperature range
0	K	-200.0 to 1200.0°C
1	J	-200.0 to 800.0°C
2	E	-150.0 to 600.0°C
3	T	-200.0 to 400.0°C
4	B	400.0 to 1800.0°C
5	R	0.0 to 1750.0°C
6	S	0.0 to 1750.0°C

REMARK

*Note 1: The numbers of Array are 16 in G3F-TC4A, 4 in G4F-TC2A/G6F-TC2A.

4.3.2 Module Reading (G3F-TC4A : TCR4RD, G4F-TC2A : TCR2RD, G6F-TC2A : TCR62RD)

The module reading function block processes all channels of the thermocouple input module in batch. The enabled channel outputs the temperature conversion value to the output variable TEMP.

Function Block	I/O	Variable	Data Type	Description
G3F-TC4A  **G4F-TC2A**  **G6F-TC2A** 	I	REQ	BOOL	Function block execution request area - Used to request an execution of the reading function block - If the conditions connected with this area are established while the program is running and "0" changes into "1" (↑), the module initialization function block is executed.
		NET_NO	USINT	Location No. of the slot where the local communication module to which the function block will be sent is mounted. - Setting range: 0 ~ 7
		ST_NO	USINT	Station No. of the communication module mounted in the remote I/O station. -Setting range: 0 ~ 63
		BASE	USINT	Base module location No. - Used to write the base No. where the thermocouple input module is mounted. - Setting range: GM1 series(0~31), GM2 series(0~7), GM3/4 series(0-3) GM6 series(0-1)
		SLOT	USINT	Slot location No. - Used to write the slot No. where the thermocouple input module is mounted. - Setting range: 0~7
		CH	BOOL [Array]	Used channel enable/disable specification - Used to enable or disable a channel for run. - Specify "1" for enabling, and "0" for disabling
	O	NDR	*Note1 BOOL	"1" when the function block is finished without error. "1" remains during the scan where the execution condition is being satisfied and changes into "0" at next scan.
		ERR	BOOL	Error information indication area - If error occurs during initialization function block execution "1" is outputted and the module enter into the stop state. "1" remains during the scan where the execution condition is being satisfied and it changes into "0" at the next scan.
		STAT	USINT	Error status indication area - Used to output the error No. when it occurs during reading function block execution. - For description of errors, refer to Section 4.4
		ACT	BOOL [Array] *Note 1	Run channel status indication area - After the initialization function block is finished with no error, "1" is output if the channel is in normal state. But "0" is output for the disabled channels.
		ALM	BOOL [Array] *Note 1	Run channel error indication area - "1" is outputted when error occurs for each run channel.
		ALM_CODE	USINT [Array] *Note 1	Run channel error code area -Outputs the following code for each channel coded if error occurred. 0: Normal 16: Disconnection detected 17: Out-of-the-measuring-range error 18: Reference junction compensation device error
		TEMP	INT [Array] *Note 1	Temperature conversion value output area - The CPU module reads the temperature conversion value of the corresponding channel from the thermocouple-input module and outputs it to this area. - The temperature conversion value of each channel is 10 times than the real temperature value. - (Example: Temperature conversion value 1234 → Real temperature value 123.4 °C)
		SCAL	INT [Array] *Note 1	Digital conversion value output area - The CPU module reads the digital conversion value of the corresponding channel from the thermocouple-input module and outputs it to this area. - The temperature conversion value of each channel within its measuring temperature range is converted into a digital value within 0 to 16000 and it is outputted to this area. - The Value read from the output variable SCAL. $\frac{16000}{\text{Overall measuring temperature range}} \times (\text{Temperature conversion value} - \text{Minimum measuring temperature})$ - The output value through digital conversion can be used as a PV of the PID control module.

REMARK

*Note 1: The numbers of Array are 16 in G3F-TC4A, 4 in G4F-TC2A/G6F-TC2A.

4.4 Errors Indicated During Execution of Function Block

4.4.1 Errors Indicated by the Output Variable, STAT

Errors indicated the output variable, STAT and their corrective actions are explained.

STAT No.	Item	Description	Function Block			Corrective Action
			Initiali-zation	Reading: Array	Reading: Stand alone	
0	Local	Normal run status	O	O	O	—
1		Base location No. outside the setting range	O	O	O	Adjust it within the setting range
2		The corresponding base unit hardware defect	O	O	O	Contact a service station
3		Slot location No. outside the setting range	O	O	O	Specify correctly the slot No. where the PID control module is mounted .
4		The specified slot has no thermocouple input module	O	O	O	Mount thermocouple input module on the specified slot.
5		A module other than thermocouple input module is loaded on.	O	O	O	Mount thermocouple input module on the specified slot.
6		Channel No. outside the setting range	—	—	O	Specify correctly the run channel.
7		Thermocouple input module hardware defect	O	O	O	Contact a service station.
8		Thermocouple input module memory defect	O	O	O	Contact a service station.
9		The run channel was not specified in the Initialization function block.	—	O	O	Specify correctly run channels in the initialization function block.
10		Disconnection detected at one or more of the use channels, or temperature outside the range.	—	O	—	See Section 9.2.4
16		A disconnection of thermocouple or compensating wire was detected at the use channels	—	—	O	Fix the disconnection of the thermocouple or compensating wire.
17		Out-of-the-range temperature was detected at the used channels	—	—	O	Check the specification of used thermocouple, and then use a temperature within the defined range.
18		Reference junction compensation device connection defect	—	—	O	Check the connection of the reference junction compensation device.
128	Remote	Remote communications module H/W defect	O	O		See Remote communications module User's Manual
129		Base location No. outside the setting range	O	O		Adjust it within the setting range
131		Slot location No. outside the setting range	O	O		Specify correctly the slot No. where thermocouple input module is mounted.
133		A module other than thermocouple input module is loaded on.	O	O		Mount thermocouple input module on the specified slot.
135		Thermocouple input module hardware defect	O	O	—	Contact a service station.
136		Thermocouple input module memory defect	O	O		Contact a service station.
137		The run channel was not specified in the initialization function block.	—	O		Specify correctly run channels in the initialization function block.
138		Disconnection detected at one or more of the use channels, or temperature outside the range.	—	O		See the Section 9.2.4

4.4.2 Errors indicated by the output variable, ALM_CODE in the array type temperature conversion value reading function block.
(G3F-TC4A : TC4ARD, TCR4RD. G4F-TC2A : TC2ARD, TCR2RD G6F-TC2A : TC2ARD, TCR62RD)

ALM_CODE No.	Description	Corrective Action
0	Normal run status	—
16	Disconnection of the thermocouple or compensating wire	Fix the disconnection between the thermocouple input module and the thermocouple
17	Out-of-the range temperature	Specify correctly the type of the thermocouple or use the temperature within defined range.
18	Reference junction compensation device connection defect	Check the connection of the reference junction compensation device.