Modicon M241 Logic Controller

System Functions and Variables PLCSystem Library Guide

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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

This document will acquaint you with the system functions and variables offered within the Modicon M241 Logic Controller. The M241 PLCSystem library contains functions and variables to get information from and send commands to the controller system.

This document describes the data type functions and variables of the M241 PLCSystem library.

The following knowledge is required:

- Basic information on the functionality, structure, and configuration of the M241 Logic Controller.
- Programming in the FBD, LD, ST, IL, or CFC language.
- system variables (global variables).

Validity Note

This document has been updated with the release of SoMachine V4.1.

Related Documents

Title of Documentation	Reference Number
SoMachine Programming Guide	EIO0000000067 (ENG); EIO0000000069 (FRE); EIO0000000068 (GER); EIO0000000071 (SPA); EIO0000000070 (ITA); EIO0000000072 (CHS)
Modicon M241 Logic Controller Hardware Guide	EIO0000001456 (ENG); EIO0000001457 (FRE); EIO0000001458 (GER); EIO0000001459 (SPA); EIO0000001460 (ITA); EIO0000001461 (CHS)
Modicon M241 Logic Controller Programming Guide	EIO0000001432 (ENG); EIO0000001433 (FRE); EIO0000001434 (GER); EIO0000001435 (SPA); EIO0000001436 (ITA); EIO0000001437 (CHS)

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Product Related Information

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Chapter 1
M241 System Variables

Overview

This chapter:

- gives an introduction to the system variables *(see page 12)*
- describes the system variables *(see page 18)* included with the M241 PLCSystem library

What Is in This Chapter?

This chapter contains the following sections:

Section 1.1
System Variables: Definition and Use

Overview

This section defines system variables and how to implement them in the Modicon M241 Logic Controller.

What Is in This Section?

This section contains the following topics:

Understanding System Variables

Introduction

This section describes how system variables are implemented. System variables:

- allow you to access general system information, perform system diagnostics, and command simple actions.
- are structured variables conforming to IEC 61131-3 definitions and naming conventions. You can access the system variables using the IEC symbolic name `PLC_GVL`. Some of the `PLC_GVL` variables are read-only (for example, `PLC_R`) and some are read/write (for example, `PLC_W`).
- are automatically declared as global variables. They have system-wide scope and they can be accessed by any Program Organization Unit (POU) in any task.

Naming Convention

The system variables are identified by:

- a structure name that represents the category of system variable. For example, `PLC_R` represents a structure name of read-only variables used for the controller diagnosis.
- a set of component names that identifies the purpose of the variable. For example, `i_wVendorID` represents the controller vendor ID.

You can access the system variables by typing the structure name of the variables followed by the name of the component.

Here is an example of system variable implementation:

```
VAR
    myCtr_Serial : DWORD;
    myCtr_ID : DWORD;
    myCtr_FramesRx : UDINT;
END_VAR

myCtr_Serial := PLC_R.i_dwSerialNumber;
myCtr_ID := PLC_R.i_wVendorID;
myCtr_FramesRx := SERIAL_R[0].i_udiFramesReceivedOK;
```

NOTE: The fully qualified name of the system variable in the example above is `PLC_GVL.PLC_R.i_wVendorID`. The `PLC_GVL` is implicit when declaring a variable using the **Input Assistant**, but it may also be entered in full. Good programming practice often dictates the use of the fully qualified variable name in declarations.

System Variables Location

2 kinds of system variables are defined for use when programming the controller:

- located variables
- unlocated variables

The located variables:

- have a fixed location in a static %MW area: %MW60000 to %MW60199 for read-only system variables.
- are accessible through Modbus TCP, Modbus serial, and EtherNet/IP requests both in RUNNING and STOPPED states.
- are used in SoMachine programs according to the `structure_name.component_name` convention explained previously. %MW addresses from 0 to 59999 can be accessed directly. Addresses greater than this are considered out of range by SoMachine and can only be accessed through the `structure_name.component_name` convention.

The unlocated variables:

- are not physically located in the %MW area.
- are not accessible through any fieldbus or network requests unless you locate them in the relocation table, and only then these variables can be accessed in RUNNING and STOPPED states. The relocation table uses the following dynamic %MW areas:
  - %MW60200 to %MW61999 for read-only variables
  - %MW62200 to %MW63999 for read/write variables
- are used in SoMachine programs according to the `structure_name.component_name` convention explained previously. %MW addresses from 0 to 59999 can be accessed directly. Addresses greater than this are considered out of range by SoMachine and can only be accessed through the `structure_name.component_name` convention.

Using System Variables

Introduction

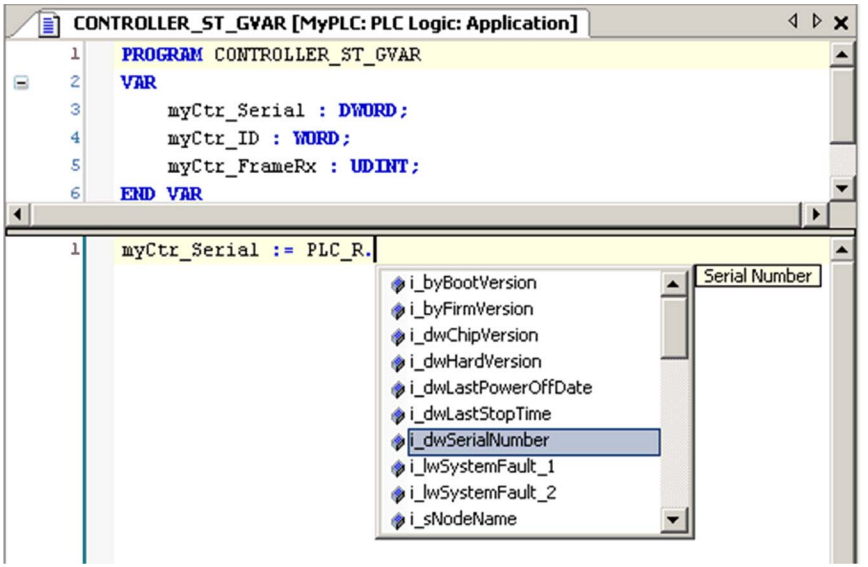
This section describes the steps required to program and to use system variables in SoMachine.

System variables are global in scope, and you can use them in all the Program Organization Units (POUs) of the application.

System variables do not need to be declared in the Global Variable List (GVL). They are automatically declared from the controller system library.

Using System Variables in a POU

SoMachine has an auto-completion feature. In a **POU**, start by entering the system variable structure name (`PLC_R`, `PLC_W`...) followed by a dot. The system variables appear in the **Input Assistant**. You can select the desired variable or enter the full name manually.



NOTE: In the example above, after you type the structure name `PLC_R.`, SoMachine offers a pop-up menu of possible component names/variables.

Example

The following example shows the use of some system variables:

```
VAR
    myCtr_Serial : DWORD;
    myCtr_ID : WORD;
    myCtr_FramesRx : UDINT;
END_VAR
myCtr_Serial := PLC_R.i_dwSerialNumber;
myCtr_ID := PLC_R.i_wVendorID;
myCtr_FramesRx := SERIAL_R[0].i_udiFramesReceivedOK;
```

Section 1.2
PLC_R and PLC_W Structures

Overview

This section lists and describes the different system variables included in the `PLC_R` and `PLC_W` structures.

What Is in This Section?

This section contains the following topics:

PLC_R: Controller Read-Only System Variables

Variable Structure

This table describes the parameters of the PLC_R system variable (PLC_R_STRUCT type):

Modbus Address (1)	Var Name	Type	Comment
60000	i_wVendorID	WORD	Controller Vendor ID. 101A hex = Schneider Electric
60001	i_wProductID	WORD	Controller Reference ID. **NOTE:** Vendor ID and Reference ID are the components of the Target ID of the controller displayed in the communication settings view (Target ID = 101A XXXX hex).
60002	i_dwSerialNumber	DWORD	Controller Serial Number
60004	i_byFirmVersion	ARRAY[0..3] OF BYTE	Controller Firmware Version [aa.bb.cc.dd]: ● i_byFirmVersion[0] = aa ● ... ● i_byFirmVersion[3] = dd
60006	i_byBootVersion	ARRAY[0..3] OF BYTE	Controller Boot Version [aa.bb.cc.dd]: ● i_byBootVersion[0] = aa ● ... ● i_byBootVersion[3] = dd
60008	i_dwHardVersion	DWORD	Controller Hardware Version.
60010	i_dwChipVersion	DWORD	Controller Coprocessor Version.
60012	i_wStatus	PLC_R_STATUS *(see page 65)*	State of the controller.
60013	i_wBootProjectStatus	PLC_R_BOOT_PROJECT_STATUS *(see page 62)*	Returns information about the boot application stored in FLASH memory.
60014	i_wLastStopCause	PLC_R_STOP_CAUSE *(see page 66)*	Cause of the last transition from RUN to another state.
60015	i_wLastApplicationError	PLC_R_APPLICATION_ERROR *(see page 61)*	Cause of the last controller exception.

Modbus Address (1)	Var Name	Type	Comment
60016	i_lwSystemFault_1	LWORD	Bit field FFFF FFFF FFFF FFFF hex indicates no error detected. A bit at low level means that an error has been detected: ● bit 0 = Expert I/O error detected ● bit 1 = TM3 error detected ● bit 2 = Ethernet IF1 error detected ● bit 3 = Ethernet IF2 error detected ● bit 4 = Serial 1 in overcurrent error detected ● bit 5 = Serial 2 error detected ● bit 6 = CAN 1 error detected ● bit 7 = Cartridge 1 error detected ● bit 8 = Cartridge 2 error detected ● bit 9 = TM4 error detected ● bit 10 = SD Card error detected ● bit 11 = Firewall error detected
60020	i_lwSystemFault_2	LWORD	Bit field FFFF hex indicates no error detected. If i_wIOStatus1 = PLC_R_IO_SHORTCUT_FAULT, the meaning of i_lwSystemFault_2 is: ● bit 0 = 0: short-circuit detected in PTO0 block ● bit 1 = 0: short-circuit detected in PTO1 block ● bit 2 = 0: short-circuit detected in Output Group1 ● bit 3 = 0: short-circuit detected in Output Group2 ● bit 4 = 0: short-circuit detected in Output Group3
60024	i_wIOStatus1	PLC_R_IO_STATUS *(see page 63)*	Embedded Expert I/O status.
60025	i_wIOStatus2	PLC_R_IO_STATUS *(see page 63)*	TM3 I/O status.
60026	i_wClockBatterystatus	WORD	Status of the battery of the RTC: ● 0 = Battery change needed ● 100 = Battery fully charged Other values (1...99) represents the percentage of charge. For example, if the value is 75, it represents that the battery charge is 75%.

Modbus Address (1)	Var Name	Type	Comment
60028	i_dwAppliSignature1	DWORD	First DWORD of 4 DWORD signature (16 bytes total). The application signature is generated by the software during build.
60030	i_dwAppliSignature2	DWORD	Second DWORD of 4 DWORD signature (16 bytes total). The application signature is generated by the software during build.
60032	i_dwAppliSignature3	DWORD	Third DWORD of 4 DWORD signature (16 bytes total). The application signature is generated by the software during build.
60034	i_dwAppliSignature4	DWORD	Fourth DWORD of 4 DWORD signature (16 bytes total). The application signature is generated by the software during build.
(1) Not accessible through the application.			

n/a	i_sVendorName	STRING(31)	Name of the vendor: “Schneider Electric”.
n/a	i_sProductRef	STRING(31)	Reference of the controller.
n/a	i_sNodeName	STRING(99)	Node name on SoMachine Network.
n/a	i_dwLastStopTime	DWORD	The time of the last detected STOP in seconds beginning with January 1, 1970 at 00:00 UTC.
n/a	i_dwLastPowerOffDate	DWORD	The date and time of the last detected power off in seconds beginning with January 1, 1970 at 00:00 UTC. **NOTE:** Convert this value into date and time by using the function SysTimeRtcConvertUtcToDate. For more information about Time and Date conversion, refer to the Systime Library Guide *(see SoMachine, Getting & Setting Real Time Clock, SysTime Library Guide)*.
n/a	i_uiEventsCounter	UINT	Number of external events detected on inputs configured for external event detection since the last cold start. Reset by a Cold Start or by the PLC_W.q_wResetCounterEvent command.

n/a	i_wTerminalPortStatus	PLC_R_TERMINAL_PORT_STATUS *(see page 67)*	Status of the USB Programming Port (USB Mini-B).
n/a	i_wSdCardStatus	PLC_R_SDCARD_STATUS *(see page 64)*	Status of the SD card.
n/a	i_wUsrFreeFileHdl	WORD	Number of available File Handles. A File Handle is the resource allocated by the system when you open a file.
n/a	i_udiUsrFsTotalBytes	UDINT	User FileSystem total memory size (in bytes). It is the size of the flash memory for the directory "/usr/".
n/a	i_udiUsrFsFreeBytes	UDINT	User FileSystem free memory size (in bytes).
n/a	i_uiTM3BusState	PLC_R_TM3_BUS_STATE *(see page 68)*	TM3 bus state. i_uiTM3BusState can have the following values: ● 1: TM3_CONF_ERROR Configuration mismatch between physical configuration and SoMachine configuration. ● 3: TM3_OK Physical configuration matches SoMachine configuration. ● 4: TM3_POWER_SUPPLY_ERROR TM3 bus is not powered (for example when the Logic Controller is powered by USB).
n/a	i_ExpertIO_RunStop_Input	BYTE	Run/Stop input location is: ● 16...FF hex if the expert I/O is not configured ● 0 for %IX0.0 ● 1 for %IX0.1
n/a	i_x10msClk	BOOL	TimeBase bit of 10 ms. This variable is toggling On/Off with period = 10 ms. The value toggles when the logic controller is in Stop and in Run state.
n/a	i_x100msClk	BOOL	TimeBase bit of 100 ms. This variable is toggling On/Off with period = 100 ms. The value toggles when the logic controller is in Stop and in Run state.
n/a	i_x1sClk	BOOL	TimeBase bit of 1 s. This variable is toggling On/Off with period = 1 s. The value toggles when the logic controller is in Stop and in Run state.

NOTE: n/a means that there is no pre-defined Modbus address mapping for this system variable.

PLC_W: Controller Read/Write System Variables

Variable Structure

This table describes the parameters of the PLC_W system variable (PLC_W_STRUCT type):

%MW	Var Name	Type	Comment
n/a	q_wResetCounterEvent	WORD	Transition from 0 to 1 resets the events counter (PLC_R.i_uiEventsCounter). To reset the counter again, it is necessary to write this register to 0 before another transition from 0 to 1 can take place.
n/a	q_uiOpenPLCControl	UINT	When Value passes from 0 to 6699, the command previously written in the following PLC_W.q_wPLCControl is executed.
n/a	q_wPLCControl	PLC_W_COMMAND *(see page 69)*	Controller RUN / STOP command executed when the system variable PLC_R.q_uiOpenPLCControl value passes from 0 to 6699.

NOTE: n/a means that there is no pre-defined %MW mapping for this system variable.

Section 1.3
SERIAL_R and SERIAL_W Structures

Overview

This section lists and describes the different system variables included in the `SERIAL_R` and `SERIAL_W` structures.

What Is in This Section?

This section contains the following topics:

SERIAL_R[0...1]: Serial Line Read-Only System Variables

Introduction

SERIAL_R is an array of 2 SERIAL_R_STRUCT type. Each element of the array returns diagnostic system variables for the corresponding serial line.

For the M241 Logic Controller:

- Serial_R[0] refers to the serial line 1
- Serial_R[1] refers to the serial line 2

Variable Structure

This table describes the parameters of the SERIAL_R[0...1] system variables:

%MW	Var Name	Type	Comment
Serial Line			
n/a	i_udiFramesTransmittedOK	UDINT	Number of frames successfully transmitted.
n/a	i_udiFramesReceivedOK	UDINT	Number of frames received without any errors detected.
n/a	i_udiRX_MessagesError	UDINT	Number of frames received with errors detected (checksum, parity).
Modbus Specific			
n/a	i_uiSlaveExceptionCount	UINT	Number of Modbus exception responses returned by the logic controller.
n/a	i_udiSlaveMsgCount	UINT	Number of messages received from the Master and addressed to the logic controller.
n/a	i_uiSlaveNoRespCount	UINT	Number of Modbus broadcast requests received by the logic controller.
n/a	i_uiSlaveNakCount	UINT	Not used
n/a	i_uiSlaveBusyCount	UINT	Not used
n/a	i_uiCharOverrunCount	UINT	Number of character overruns.

n/a means that there is no predefined %MW mapping for this system variable.
Not used means that the variable is not maintained by the system, and that if the value of the variable is non-zero, it should be considered extraneous.

The SERIAL_R counters are reset on:

- Download.
- Controller reset.
- SERIAL_W[x].q_wResetCounter command.
- Reset command by Modbus request function code number 8.

SERIAL_W[0...1]: Serial Line Read/Write System Variables

Introduction

SERIAL_W is an array of 2 SERIAL_W_STRUCT type. Each element of the array resets the SERIAL_R system variables for the corresponding serial line to be reset.

For the M241 Logic Controller:

- Serial_W[0] refers to the serial line 1
- Serial_W[1] refers to the serial line 2

Variable Structure

This table describes the parameters of the SERIAL_W[0...1] system variable:

%MW	Var Name	Type	Comment
n/a	q_wResetCounter	WORD	Transition from 0 to 1 resets all SERIAL_R[0...1] counters. To reset the counters again, it is necessary to write this register to 0 before another transition from 0 to 1 can take place.

NOTE: n/a means that there is no predefined %MW mapping for this system variable.

Section 1.4
ETH_R and ETH_W Structures

Overview

This section lists and describes the different system variables included in the `ETH_R` and `ETH_W` structures.

What Is in This Section?

This section contains the following topics:

ETH_R: Ethernet Port Read-Only System Variables

Variable Structure

This table describes the parameters of the ETH_R system variable (ETH_R_STRUCT type):

%MW	Var Name	Type	Comment
60050	i_byIPAddress	ARRAY[0..3] OF BYTE	IP address [aaa.bbb.ccc.ddd]: ● i_byIPAddress[0] = aaa ● ... ● i_byIPAddress[3] = ddd
60052	i_bySubNetMask	ARRAY[0..3] OF BYTE	Subnet Mask [aaa.bbb.ccc.ddd]: ● i_bySub-netMask[0] = aaa ● ... ● i_bySub-netMask[3] = ddd
60054	i_byGateway	ARRAY[0..3] OF BYTE	Gateway address [aaa.bbb.ccc.ddd]: ● i_byGateway[0] = aaa ● ... ● i_byGateway[3] = ddd
60056	i_byMACAddress	ARRAY[0..5] OF BYTE	MAC address [aa.bb.cc.dd.ee.ff]: ● i_byMACAddress[0] = aa ● ... ● i_byMACAddress[5] = ff
60059	i_sDeviceName	STRING(15)	Name used to get IP address from server.
n/a	i_wIpMode	ETH_R_IP_MODE *(see page 76)*	Method used to obtain an IP address.
n/a	i_byFDRServerIPAddress	ARRAY[0..3] OF BYTE	The IP address [aaa.bbb.ccc.ddd] of the DHCP or BootP server: ● i_byFDRServerIPAddress[0] = aaa ● ... ● i_byFDRServerIPAddress[3] = ddd Equals 0.0.0.0 if Stored IP or Default IP used.
n/a	i_udiOpenTcpConnections	UDINT	Number of open TCP connections.
n/a means that there is no predefined %MW mapping for this system variable.			

%MW	Var Name	Type	Comment
n/a	i_udiFramesTransmittedOK	UDINT	Number of frames successfully transmitted. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiFramedReceivedOK	UDINT	Number of frames successfully received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiTransmitBufferErrors	UDINT	Numbers of frames transmitted with detected errors. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiReceiveBufferErrors	UDINT	Numbers of frames received with detected errors. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_wFrameSendingProtocol	ETH_R_FRAME_PROTOCOL *(see page 75)*	Ethernet protocol configured for frames sending (IEEE 802.3 or Ethernet II).
n/a	i_wPortALinkStatus	ETH_R_PORT_LINK_STATUS *(see page 79)*	Link of the Ethernet Port (0 = No Link, 1 = Link connected to another Ethernet device).
n/a	i_wPortASpeed	ETH_R_PORT_SPEED *(see page 80)*	Ethernet Port network speed (10Mb/s or 100Mb/s).
n/a	i_wPortADuplexStatus	ETH_R_PORT_DUPLEX_STATUS *(see page 77)*	Ethernet Port duplex status (0 = Half or 1 = Full duplex).
n/a	i_udiPortACollisions	UDINT	Number of frames involved in one or more collisions and subsequently transmitted successfully. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
Modbus TCP/IP Specific			
n/a	i_udiModbusMessageTransmitted	UDINT	Number of Modbus messages transmitted. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a means that there is no predefined %MW mapping for this system variable.			

%MW	Var Name	Type	Comment
n/a	i_udiModbusMessageReceived	UDINT	Number of Modbus messages received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiModbusErrorMessage	UDINT	Modbus detected error messages transmitted and received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a means that there is no predefined %MW mapping for this system variable.			

%MW	Var Name	Type	Comment
EtherNet/IP Specific			
n/a	i_udiETHIP_IOMessagingTransmitted	UDINT	EtherNet/IP Class 1 frames transmitted. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiETHIP_IOMessagingReceived	UDINT	EtherNet/IP Class 1 frames received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiUCMM_Request	UDINT	EtherNet/IP Unconnected Messages received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiUCMM_Error	UDINT	EtherNet/IP invalid Unconnected Messages received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_udiClass3_Request	UDINT	EtherNet/IP Class 3 requests received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a means that there is no predefined %MW mapping for this system variable. **Not used** means that the variable is not maintained by the system, and that if the value of the variable is non-zero, it should be considered extraneous.			

%MW	Var Name	Type	Comment
n/a	i_udiClass3_Error	UDINT	EtherNet/IP invalid class 3 requests received. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_uiAssemblyInstanceInput	UINT	Input Assembly Instance number. See the appropriate Programming Guide of your controller for more information.
n/a	i_uiAssemblyInstanceInputSize	UINT	Input Assembly Instance size. See the appropriate Programming Guide of your controller for more information.
n/a	i_uiAssemblyInstanceOutput	UINT	Output Assembly Instance number. See the appropriate Programming Guide of your controller for more information.
n/a	i_uiAssemblyInstanceOutputSize	UINT	Output Assembly Instance size. See the appropriate Programming Guide of your controller for more information.
n/a	i_uiETHIP_ConnectionTimeouts	UINT	Number of connection timeouts. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_ucEipRunIdle	ETH_R_RUN_IDLE *(see page 81)*	Run (value = 1)/Idle(value = 0) flag for EtherNet/IP class 1 connection.
n/a	i_byMasterIpTimeouts	BYTE	Ethernet Modbus TCP Master timeout events counter. Reset at Power ON or with reset command ETH_W.q_wResetCounter.
n/a	i_byMasterIpLost	BYTE	Ethernet Modbus TCP Master link status: 0 = link OK, 1 = link lost.
n/a	i_wPortAIpStatus	ETH_R_PORT_IP_ STATUS *(see page 78)*	Ethernet TCP/IP port stack status.
n/a	i_byIPAddress_If2	ARRAY[0..3] OF BYTE	Not used.

n/a means that there is no predefined %MW mapping for this system variable.
Not used means that the variable is not maintained by the system, and that if the value of the variable is non-zero, it should be considered extraneous.

%MW	Var Name	Type	Comment
n/a	i_bySubNetMask_If2	ARRAY[0..3] OF BYTE	Not used.
n/a	i_byGateway_If2	ARRAY[0..3] OF BYTE	Not used.
n/a	i_byMACAddress_If2	ARRAY[0..5] OF BYTE	Not used.
n/a	i_sDeviceName_If2	STRING(15)	Not used.
n/a	i_wIpMode_If2	ETH_R_IP_MODE *(see page 76)*	Not used.
n/a	i_wPortALinkStatus_If2	ETH_R_PORT_LINK_ STATUS *(see page 79)*	Not used.
n/a	i_wPortASpeed_If2	ETH_R_PORT_ SPEED *(see page 80)*	Not used.
n/a	i_wPortADuplexStatus_If2	ETH_R_PORT_ DUPLEX_STATUS *(see page 77)*	Not used.
n/a	i_wPortAIpStatus_If2	ETH_R_PORT_IP_ STATUS *(see page 78)*	Not used.

n/a means that there is no predefined %MW mapping for this system variable.
Not used means that the variable is not maintained by the system, and that if the value of the variable is non-zero, it should be considered extraneous.

NOTE: n/a means that there is no predefined %MW mapping for this system variable.

ETH_W: Ethernet Port Read/Write System Variables

Variable Structure

This table describes the parameters of the ETH_W system variable (ETH_W_STRUCT type):

%MW	Var Name	Type	Comment
n/a	q_wResetCounter	WORD	Transition from 0 to 1 resets all ETH_R counters. To reset again, it is necessary to write this register to 0 before another transition from 0 to 1 can take place.

NOTE: n/a means that there is no predefined %MW mapping for this system variable.

Section 1.5
TM3_MODULE_R Structure

TM3_MODULE_R[0...13]: TM3 Modules Read-Only System Variables

Introduction

The TM3_MODULE_R is an array of 14 TM3_MODULE_R_STRUCT type. Each element of the array returns diagnostic system variables for the corresponding TM3 expansion module.

For the Modicon M241 Logic Controller:

- TM3_MODULE_R[0] refers to the TM3 expansion module 0
- ...
- TM3_MODULE_R[13] refers to the TM3 expansion module 13

Variable Structure

The following table describes the parameters of the TM3_MODULE_R[0...13] system variable:

%MW	Var Name	Type	Comment
n/a	i_wProductID	WORD	TM3 expansion module ID.
n/a	i_wModuleState	TM3_MODULE_STATE *(see page 85)*	Describes the state of the TM3 module.

NOTE: n/a means that there is no predefined %MW mapping for this system variable.

Section 1.6
PROFIBUS_R Structure

PROFIBUS_R: PROFIBUS Read-Only System Variables

Variable Structure

This table describes the parameters of the `PROFIBUS_R` system variable (`PROFIBUS_R_STRUCT` type):

%MW	Var Name	Type	Comment
n/a	`i_wPNOIdentifier`	`WORD`	Slave identification code.
n/a	`i_wBusAdr`	`UINT`	PROFIBUS slave address.
n/a	`i_CommState`	`UDINT`	Value representing the state of the PROFIBUS module: • 0x00: Unknown • 0x01: Not configured • 0x02: Stop • 0x03: Idle • 0x04: Operate
n/a	`i_CommError`	`UDINT`	Communication error code.
n/a	`i_ErrorCount`	`UDINT`	Communication error counter.

NOTE: n/a means that there is no predefined %MW mapping for this system variable.

Section 1.7
CART_R Structure

CART_R_STRUCT: Cartridge Read-Only System Variables

Variable Structure

The following table describes the parameters of the `CART_R_STRUCT` system variable:

%MW	Var Name	Type	Comment
n/a	`i_uiModuleId`	CART_R_MODULE_ID *(see page 88)*	Module ID
n/a	`i_uifirmwareVersion`	`UINT`	Firmware version
n/a	`i_udiCartState`	CART_R_STATE *(see page 89)*	Cartridge state

NOTE: n/a means that there is no predefined %MW mapping for this system variable.

Chapter 2
M241 System Functions

Overview

This chapter describes the system functions included in the M241 PLCSystem library.

What Is in This Chapter?

This chapter contains the following sections:

Section 2.1
M241 Read Functions

Overview

This section describes the read functions included in the M241 PLCSystem library.

What Is in This Section?

This section contains the following topics:

GetImmediateFastInput: Read Input of an Embedded Expert I/O

Function Description

This function returns the current physical value of the input, which may be different from the current logical value of that input. The value is read immedialely from the hardware at function call time. Only I0 to I7 can be accessed through this function.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variable Description

The following table describes the input variables:

Input	Type	Comment
Block	INT	Not used.
Input	INT	Input Index to read from 0...7.

The following table describes the output variable:

Output	Type	Comment
GetImmediateFastInput	BOOL	Value of the input <Input> – FALSE/TRUE.

The following table describes the input/output variables:

Input/Output	Type	Comment
Error	BOOL	FALSE= operation is okay. TRUE= operation error, the function returns an invalid value.
ErrID	IMMEDIATE_ERR_TYPE *(see page 91)*	Operation error code when Error is TRUE.

GetRtc: Get Real Time Clock

Function Description

This function returns RTC time in seconds in UNIX format (time expired in seconds since January 1, 1970 at 00:00 UTC).

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variable Description

The following table describes the I/O variable:

Output	Type	Comment
GetRtc	DINT	RTC in seconds in UNIX format.

Example

The following example describes how to get the RTC value:

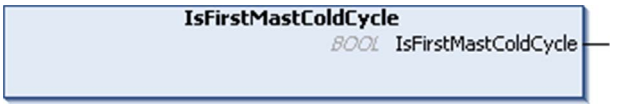
```
VAR
    MyRTC : DINT := 0;
END_VAR
MyRTC := GetRtc();
```

IsFirstMastColdCycle: Indicates if Cycle is the First MAST Cold Start Cycle

Function Description

This function returns TRUE during the first MAST cycle after a cold start (first cycle after download or reset cold).

Graphical Representation



IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variable Description

The table describes the output variable:

Output	Type	Comment
IsFirstMastColdCycle	BOOL	TRUE during the first MAST task cycle after a cold start.

Example

Refer to the function IsFirstMastCycle *(see page 42)*.

IsFirstMastCycle: Indicates if Cycle is the First MAST Cycle

Function Description

This function returns TRUE during the first MAST cycle after a start.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variable Description

Output	Type	Comment
IsFirstMastCycle	BOOL	TRUE during the first MAST task cycle after a start.

Example

This example describes the three functions IsFirstMastCycle, IsFirstMastColdCycle and IsFirstMastWarmCycle used together.

Use this example in MAST task. Otherwise, it may run several times or possibly never (an additional task might be called several times or not called during 1 MAST task cycle):

```
VAR
MyIsFirstMastCycle : BOOL;
MyIsFirstMastWarmCycle : BOOL;
MyIsFirstMastColdCycle : BOOL;
END_VAR

MyIsFirstMastWarmCycle := IsFirstMastWarmCycle();
MyIsFirstMastColdCycle := IsFirstMastColdCycle();
MyIsFirstMastCycle := IsFirstMastCycle();

IF (MyIsFirstMastWarmCycle) THEN

(*This is the first Mast Cycle after a Warm Start: all variables are set
to their initialization values except the Retain variables*)

(*=> initialize the needed variables so that your application runs as
expected in this case*)

END_IF;
```

```
IF (MyIsFirstMastColdCycle) THEN
(*This is the first Mast Cycle after a Cold Start: all variables are set
to their initialization values including the Retain Variables*)
(*=> initialize the needed variables so that your application runs as
expected in this case*)
END_IF;
IF (MyIsFirstMastCycle) THEN
(*This is the first Mast Cycle after a Start, i.e. after a Warm or Cold
Start as well as STOP/RUN commands*)
(*=> initialize the needed variables so that your application runs as
expected in this case*)
END_IF;
```

IsFirstMastWarmCycle: Indicates if Cycle is the First MAST Warm Start Cycle

Function Description

This function returns TRUE during the first MAST cycle after a warm start.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variable Description

This table describes the output variable:

Output	Type	Comment
IsFirstMastWarmCycle	BOOL	TRUE during the first MAST task cycle after a warm start.

Example

Refer to the function IsFirstMastCycle *(see page 42)*.

Section 2.2
M241 Write Functions

Overview

This section describes the write functions included in the M241 PLCSystem library.

What Is in This Section?

This section contains the following topics:

PhysicalWriteFastOutputs: Write Fast Output of an Embedded Expert I/O

Function Description

This function writes a physical state to the Q0 to Q3 outputs at function call time.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation (see page 95)*.

I/O Variable Description

The following table describes the input variables:

Input	Type	Comment
Q0Value	BOOL	Requested value for the output 0.
Q1Value	BOOL	Requested value for the output 1.
Q2Value	BOOL	Requested value for the output 2.
Q3Value	BOOL	Requested value for the output 3.

The following table describes the output variable:

Output	Type	Comment
PhysicalWriteFastOutputs	WORD	Output value of the function.

NOTE: Only the first 4 bits of the returned value are significant and used as a bit field to indicate if the output is written.

NOTE: If the bit corresponding to the output is 1, the output is written successfully.

NOTE: If the bit corresponding to the output is 0, the output is not written because it is already used by an expert function.

NOTE: If the bit corresponding to the output is 0b1111, all of the 4 outputs are written correctly.

NOTE: If the bit corresponding to the output is 0b1110, Q0 is not written because it is used by a frequency generator.

SetRTCDrift: Set Compensation Value to the RTC

Function Description

This function accelerates or slows down the frequency of the RTC to give control to the application for RTC compensation, depending on the operating environment (temperature, …). The compensation value is given in seconds per week. It can be positive (accelerate) or negative (slow down).

NOTE: The `SetRTCDrift` function must be called only once. Each new call replaces the compensation value by the new one. The value is kept in the logic controller hardware while the RTC is powered by the main supply or by the battery. If both battery and power supply are removed, the RTC compensation value is not available.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variables Description

This table describes the input parameters:

Inputs	Type	Comment
`RtcDrift`	`SINT(-29..29)`	Correction in seconds per week (-29 ... +29).

NOTE: The parameters `Day`, `Hour`, and `Minute` are used only to ensure backwards compatibility.

NOTE: If the value entered for `RtcDrift` exceeds the limit value, the logic controller firmware sets the value to its maximum value.

This table describes the output variable:

Output	Type	Comment
`SetRTCDrift`	RTCSETDRIFT_ERROR *(see page 92)*	Returns `RTC_OK` (00 hex) if command is correct otherwise returns the ID code of the detected error.

Example

In this example, the function is called only once during the first MAST task cycle. It accelerates the RTC by 4 seconds a week (18 seconds a month).

```
VAR
    MyRTCDrift : SINT (-29..29) := 0;
    MyDay : DAY_OF_WEEK;
    MyHour : HOUR;
    MyMinute : MINUTE;
END_VAR
```

```
IF IsFirstMastCycle() THEN
    MyRTCDrift := 4;
    MyDay := 0;
    MyHour := 0;
    MyMinute := 0;
    SetRTCDrift(MyRTCDrift, MyDay, MyHour, MyMinute);
END_IF
```

Section 2.3
M241 User Functions

Overview

This section describes the `DataFileCopy` and `ExecuteScript` functions included in the M241 PLCSystem library.

What Is in This Section?

This section contains the following topics:

DataFileCopy: Copy File Commands

Function Description

This function copies memory data to a file and vice versa. The file is located either within the internal file system or an external file system (SD card).

The `DataFileCopy` function block can:

- Read data from a formatted file or
- Copy data from memory buffer to a formatted file. For further information, refer to Flash Memory Organization *(see Modicon M241 Logic Controller, Programming Guide)*.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation (see page 95)*.

I/O Variable Description

This table describes the input variables:

Input	Type	Comment
xExecute	BOOL	On rising edge, starts the function block execution. On falling edge, resets the outputs of the function block when its execution terminates.
sFileName	STRING	File name without extension (the extension *.DTA* is automatically added). Use only a...z, A...Z, 0...9 alphanumeric characters.
xRead	BOOL	TRUE: copy from file to memory. FALSE: copy from memory to file.
xSecure	BOOL	TRUE: The MAC address is always stored in the file. Only a controller with the same MAC address can read from the file. FALSE: Another controller with the same type of memory can read from the file.
iLocation	INT	0: the file location is */usr/DTA* in internal file system. 1: the file location is */usr/DTA* in external file system (SD card).

uiSize	UINT	Indicates the size in bytes. Maximum is 65534 bytes.
		Only use addresses of variables conforming to IEC 6113-1 (variables, arrays, structures), for example:
		`Variable : int;`
		`uiSize := SIZEOF (Variable);`

dwAdd	DWORD	Indicates the address in the memory.
		Only use addresses of variables conforming to IEC 6113-1 (variables, arrays, structures), for example:
		`Variable : int;`
		`dwAdd := ADR (Variable);`

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Verify that the memory location is of the correct size and the file is of the correct type before copying the file to memory.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This table describes the output variables:

Output	Type	Comment
xDone	BOOL	TRUE = indicates that the action is successfully completed.
xBusy	BOOL	TRUE = indicates that the function block is running.
xError	BOOL	TRUE = indicates that an error is detected and the function block aborted the action.
eError	DataFileCopyError *(see page 71)*	Indicates the type of the data file copy detected error.

NOTE: If you write to memory variable within the area of the file write, you generate a CRC detected error.

Example

This example describes how to copy file commands:

```
VAR
LocalArray : ARRAY [0..29] OF BYTE;
myFileName: STRING := 'exportfile';
EXEC_FLAG: BOOL;
DataFileCopy: DataFileCopy;
END_VAR
DataFileCopy(
xExecute:= EXEC_FLAG,
sFileName:= myFileName,
xRead:= FALSE,
xSecure:= FALSE,
iLocation:= DFCL_INTERNAL,
dwSize:= SIZEOF(LocalArray),
dwAdd:= ADR(LocalArray),
xDone=> ,
xBusy=> ,
xError=> ,
eError=> );
```

ExecuteScript: Script Commands

Function Description

This function can run the following SD card script commands:

- Download
- Upload
- SetNodeName
- Delete
- Reboot

Use the same syntax as the USB script to run these commands (case sensitive). Refer to Script and Files Generation with SD Card Mass Storage *(see Modicon M241 Logic Controller, Programming Guide)*.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation (see page 95)*.

I/O Variable Description

This table describes the input variables:

Input	Type	Comment
xExecute	BOOL	On rising edge, starts the function block execution. On falling edge, resets the outputs of the function block when its execution terminates.
sCmd	STRING	SD card script command syntax. Simultaneous command executions are not allowed: if a command is being executed from another function block or from an SD card script then the function block queues the command and does not execute it immediately. **NOTE:** An SD card script executed from an SD card is considered as being executed until the SD card has been removed.

This table describes the output variables:

Output	Type	Comment
xDone	BOOL	TRUE = indicates that the action is successfully completed.
xBusy	BOOL	TRUE = the function block is running.
xError	BOOL	TRUE = indicates error detection and the function block aborts the action.
eError	ExecuteScriptError *(see page 73)*	Indicates the type of the execute script detected error.

Example

This example describes how to execute a script command:

```
VAR
EXEC_FLAG: BOOL;
ExecuteScript: ExecuteScript;
END_VAR
ExecuteScript(
xExecute:= EXEC_FLAG,
sCmd:= 'Upload "/usr/Syslog/*"',
xDone=> ,
xBusy=> ,
xError=> ,
eError=> );
```

Section 2.4
TM3 Read Functions

Overview

This section describes the TM3 read functions included in the M241 PLCSystem library.

What Is in This Section?

This section contains the following topics:

TM3_GetModuleBusStatus: Get TM3 Module Bus Status

Function Description

This function returns the bus status of the module. The index of the module is given as an input parameter.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variable Description

The following table describes the input variable:

Input	Type	Comment
ModuleIndex	BYTE	Index of the module (0 for the first expansion, 1 for the second, and so on).

The following table describes the output variable:

Output	Type	Comment
TM3_GetModuleBusStatus	TM3_ERR_CODE *(see page 83)*	Returns TM3_OK (00 hex) if command is correct otherwise returns the ID code of the detected error.

TM3_GetModuleInternalStatus: Get TM3 Module Internal Status

Function Description

This function fills the pStatusBuffer with the status table of the module ModuleIndex.

Graphical Representation

IL and ST Representation

To see the general representation in IL or ST language, refer to the chapter *Function and Function Block Representation* *(see page 95)*.

I/O Variable Description

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Ensure that the pStatusBuffer is allocated.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following table describes the input variables:

Input	Type	Comment
ModuleIndex	BYTE	Index of the module (0 for the first expansion, 1 for the second, and so on).
StatusOffset	BYTE	Offset of the first status to be read in the status table.
StatusSize	BYTE	Number of bytes to be read in the status table.
pStatusBuffer	POINTER TO BYTE	Buffer containing the read status table.

The following table describes the output variable:

Output	Type	Comment
TM3_GetModuleInternalStatus	TM3_ERR_CODE *(see page 83)*	Returns TM3_OK (00 hex) if command is correct otherwise returns the ID code of the error.

Example

The following example describes how to get the module internal status:

```
VAR
AMM3HT_Channel1_Input_Status: BYTE;
END_VAR
TM3_GetModuleInternalStatus(0, 1, 1, ADR(AMM3HT_Channel1_Input_Status));
```

Chapter 3
M241 PLCSystem Library Data Types

Overview

This chapter describes the data types of the M241 PLCSystem Library.

There are 2 kinds of data types available:

- System variable data types are used by the system variables *(see page 11)* of the M241 PLCSystem Library (PLC_R, PLC_W,...).
- System function data types are used by the read/write system functions *(see page 37)* of the M241 PLCSystem Library.

What Is in This Chapter?

This chapter contains the following sections:

Section 3.1
PLC_R/W System Variables Data Types

Overview

This section lists and describes the system variable data types included in the `PLC_R` and `PLC_W` structures.

What Is in This Section?

This section contains the following topics:

PLC_R_APPLICATION_ERROR: Detected Application Error Status Codes

Enumerated Type Description

The PLC_R_APPLICATION_ERROR enumeration data type contains the following values:

Enumerator	Value	Comment
PLC_R_APP_ERR_UNKNOWN	FFFF hex	Undefined error detected.
PLC_R_APP_ERR_NOEXCEPTION	0000 hex	No error detected.
PLC_R_APP_ERR_WATCHDOG	0010 hex	Application watchdog of task expired.
PLC_R_APP_ERR_HARDWAREWATCHDOG	0011 hex	Hardware watchdog expired.
PLC_R_APP_ERR_IO_CONFIG_ERROR	0012 hex	Incorrect I/O configuration parameters detected.
PLC_R_APP_ERR_UNRESOLVED_EXTREFS	0018 hex	Undefined functions detected.
PLC_R_APP_ERR_IEC_TASK_CONFIG_ERROR	0025 hex	Incorrect Task configuration parameters detected.
PLC_R_APP_ERR_ILLEGAL_INSTRUCTION	0050 hex	Undefined instruction detected.
PLC_R_APP_ERR_ACCESS_VIOLATION	0051 hex	Attempted access to reserved memory area.
PLC_R_APP_ERR_DIVIDE_BY_ZERO	0102 hex	Integer division by zero detected.
PLC_R_APP_ERR_PROCESSORLOAD_WATCHDOG	0105 hex	Processor overloaded by Application Tasks.
PLC_R_APP_ERR_DIVIDE_REAL_BY_ZERO	0152 hex	Real division by zero detected.
PLC_R_APP_ERR_EXPIO_EVENTS_COUNT_EXCEEDED	4E20 hex	Too many events on expert I/Os are detected. Reduce the Event Tasks.
PLC_R_APP_ERR_APPLICATION_VERSION_MISMATCH	4E21 hex	Mismatch in the application version detected.

PLC_R_BOOT_PROJECT_STATUS: Boot Project Status Codes

Enumerated Type Description

The PLC_R_BOOT_PROJECT_STATUS enumeration data type contains the following values:

Enumerator	Value	Comment
PLC_R_NO_BOOT_PROJECT	0000 hex	Boot project does not exist in Flash memory.
PLC_R_BOOT_PROJECT_CREATION_IN_PROGRESS	0001 hex	Boot project is being created.
PLC_R_DIFFERENT_BOOT_PROJECT	0002 hex	Boot project in Flash is different from the project loaded in RAM.
PLC_R_VALID_BOOT_PROJECT	FFFF hex	Boot project in Flash is the same as the project loaded in RAM.

PLC_R_IO_STATUS: I/O Status Codes

Enumerated Type Description

The PLC_R_IO_STATUS enumeration data type contains the following values:

Enumerator	Value	Comment
PLC_R_IO_OK	FFFF hex	Inputs/Outputs are operational.
PLC_R_IO_NO_INIT	0001 hex	Inputs/Outputs are not initialized.
PLC_R_IO_CONF_FAULT	0002 hex	Incorrect I/O configuration parameters detected.
PLC_R_IO_SHORTCUT_FAULT	0003 hex	Inputs/Outputs short-circuit detected.
PLC_R_IO_POWER_SUPPLY_FAULT	0004 hex	Inputs/Outputs power supply error detected.

PLC_R_SDCARD_STATUS: SD Card Slot Status Codes

Enumerated Type Description

The `PLC_R_SDCARD_STATUS` enumeration data type contains the following values:

Enumerator	Value	Comment
`NO_SDCARD`	0000 hex	No SD card detected in the slot or the slot is not connected.
`SDCARD_READONLY`	0001 hex	SD card is in read-only mode.
`SDCARD_READWRITE`	0002 hex	SD card is in read/write mode.
`SDCARD_ERROR`	0003 hex	Error detected in the SD card.

PLC_R_STATUS: Controller Status Codes

Enumerated Type Description

The PLC_R_STATUS enumeration data type contains the following values:

Enumerator	Value	Comment
PLC_R_EMPTY	0000 hex	Controller does not contain an application.
PLC_R_STOPPED	0001 hex	Controller is stopped.
PLC_R_RUNNING	0002 hex	Controller is running.
PLC_R_HALT	0004 hex	Controller is in a HALT state. (see the controller state diagram in your controller *programming guide*).
PLC_R_BREAKPOINT	0008 hex	Controller has paused at a breakpoint.

PLC_R_STOP_CAUSE: From RUN State to Other State Transition Cause Codes

Enumerated Type Description

The PLC_R_STOP_CAUSE enumeration data type contains the following values:

Enumerator	Value	Comment
PLC_R_STOP_REASON_UNKNOWN	00 hex	Initial value or stop cause is undefined.
PLC_R_STOP_REASON_HW_WATCHDOG	01 hex	Stopped after hardware watchdog timeout.
PLC_R_STOP_REASON_RESET	02 hex	Stopped after reset.
PLC_R_STOP_REASON_EXCEPTION	03 hex	Stopped after exception.
PLC_R_STOP_REASON_USER	04 hex	Stopped after a user request.
PLC_R_STOP_REASON_IECPROGRAM	05 hex	Stopped after a program command request (for example: control command with parameter PLC_W.q_wPLCControl:=PLC_W_COMMAND.PLC_W_STOP;).
PLC_R_STOP_REASON_DELETE	06 hex	Stopped after a remove application command.
PLC_R_STOP_REASON_DEBUGGING	07 hex	Stopped after entering debug mode.
PLC_R_STOP_FROM_NETWORK_REQUEST	0A hex	Stopped after a request from the network, SD card, or PLC_W command.
PLC_R_STOP_FROM_INPUT	0B hex	Stop required by a controller input.
PLC_R_STOP_FROM_RUN_STOP_SWITCH	0C hex	Stop required by the controller switch.
PLC_R_STOP_REASON_RETAIN_MISMATCH	0D hex	Stopped after an unsuccessful check context test during rebooting.
PLC_R_STOP_REASON_BOOT_APPLI_MISMATCH	0E hex	Stopped after an unsuccessful compare between the boot application and the application that was in the memory before rebooting.
PLC_R_STOP_REASON_POWERFAIL	0F hex	Stopped after a power interruption.

For more information for reasons the controller has stopped, refer to the Controller State Description.

PLC_R_TERMINAL_PORT_STATUS: Programming Port Connection Status Codes

Enumerated Type Description

The PLC_R_TERMINAL_PORT_STATUS enumeration data type contains the following values:

Enumerator	Value	Comment
TERMINAL_NOT_CONNECTED	00 hex	No PC is connected to the programming port.
TERMINAL_CONNECTION_IN_PROGRESS	01 hex	Connection is in progress.
TERMINAL_CONNECTED	02 hex	PC is connected to the programming port.
TERMINAL_ERROR	0F hex	Error detected during connection.

PLC_R_TM3_BUS_STATE: TM3 Bus Status Codes

Enumerated Type Description

The `PLC_R_TM3_BUS_STATE` enumeration data type contains the following values:

Enumerator	Value	Comment
`TM3_CONF_ERROR`	01 hex	Error detected due to mismatch in the physical configuration and the configuration in SoMachine.
`TM3_OK`	03 hex	The physical configuration and the configuration in SoMachine match.
`TM3_POWER_SUPPLY_ERROR`	04 hex	Error detected in power supply.

PLC_W_COMMAND: Control Command Codes

Enumerated Type Description

The PLC_W_COMMAND enumeration data type contains the following values:

Enumerator	Value	Comment
PLC_W_STOP	0001 hex	Command to stop the controller.
PLC_W_RUN	0002 hex	Command to run the controller.
PLC_W_RESET_COLD	0004 hex	Command to initiate a Controller cold reset.
PLC_W_RESET_WARM	0008 hex	Command to initiate a Controller warm reset.

Section 3.2
DataFileCopy System Variables Data Types

Overview

This section lists and describes the system variable data types included in the `DataFileCopy` structures.

What Is in This Section?

This section contains the following topics:

DataFileCopyError: Detected Error Codes

Enumerated Type Description

The `DataFileCopyError` enumeration data type contains the following values:

Enumerator	Value	Description
`ERR_NO_ERR`	00 hex	No error detected.
`ERR_FILE_NOT_FOUND`	01 hex	The file does not exist.
`ERR_FILE_ACCESS_REFUSED`	02 hex	The file cannot be opened.
`ERR_INCORRECT_SIZE`	03 hex	The request size is not the same as size read from file.
`ERR_CRC_ERR`	04 hex	The CRC is not correct and the file is assumed to be corrupted.
`ERR_INCORRECT_MAC`	05 hex	The controller attempting to read from the file does not have the same MAC address as that contained in the file.

DataFileCopyLocation: Location Codes

Enumerated Type Description

The `DataFileCopyLocation` enumeration data type contains the following values:

Enumerator	Value	Description
`DFCL_INTERNAL`	00 hex	Data file with DTA extension is located in */usr/Dta* directory.
`DFCL_EXTERNAL`	01 hex	Data file with DTA extension is located in */sd0/usr/Dta* directory.
`DFCL_TBD`	02 hex	Not used.

Section 3.3
ExecScript System Variables Data Types

ExecuteScriptError: Detected Error Codes

Enumerated Type Description

The `ExecuteScriptError` enumeration data type contains the following values:

Enumerator	Value	Description
`CMD_OK`	00 hex	No error detected.
`ERR_CMD_UNKNOWN`	01 hex	The command is not recognized.
`ERR_SD_CARD_MISSING`	02 hex	SD card is not present.
`ERR_SEE_FWLOG`	03 hex	There was an error detected during command execution, see `FwLog.txt`. For more information, refer to File Type *(see Modicon M241 Logic Controller, Programming Guide)*.
`ERR_ONLY_ONE_COMMAND_ALLOWED`	04 hex	An attempt was made to execute several scripts simultaneously.
`CMD_BEING_EXECUTED`	05 hex	A script is already in progress.

Section 3.4
ETH_R/W System Variables Data Types

Overview

This section lists and describes the system variable data types included in the `ETH_R` and `ETH_W` structures.

What Is in This Section?

This section contains the following topics:

ETH_R_FRAME_PROTOCOL: Frame Transmission Protocol Codes

Enumerated Type Description

The `ETH_R_FRAME_PROTOCOL` enumeration data type contains the following values:

Enumerator	Value	Comment
`ETH_R_802_3`	00 hex	The protocol used for frame transmission is IEEE 802.3.
`ETH_R_ETHERNET_II`	01 hex	The protocol used for frame transmission is Ethernet II.

ETH_R_IP_MODE: IP Address Source Codes

Enumerated Type Description

The `ETH_R_IP_MODE` enumeration data type contains the following values:

Enumerator	Value	Comment
`ETH_R_STORED`	00 hex	Stored IP address is used.
`ETH_R_BOOTP`	01 hex	Bootstrap protocol is used to get an IP address.
`ETH_R_DHCP`	02 hex	DHCP protocol is used to get an IP address.
`ETH_DEFAULT_IP`	FF hex	Default IP address is used.

ETH_R_PORT_DUPLEX_STATUS: Transmission Mode Codes

Enumerated Type Description

The `ETH_R_PORT_DUPLEX_STATUS` enumeration data type contains the following values:

Enumerator	Value	Comment
`ETH_R_PORT_HALF_DUPLEX`	00 hex	Half duplex transmission mode is used.
`ETH_R_FULL_DUPLEX`	01 hex	Full duplex transmission mode is used.
`ETH_R_PORT_NA_DUPLEX`	03 hex	No duplex transmission mode is used.

ETH_R_PORT_IP_STATUS: Ethernet TCP/IP Port Status Codes

Enumerated Type Description

The ETH_R_PORT_IP_STATUS enumeration data type contains the following values:

Enumerator	Value	Comment
WAIT_FOR_PARAMS	00 hex	Waiting for parameters.
WAIT_FOR_CONF	01 hex	Waiting for configuration.
DATA_EXCHANGE	02 hex	Ready for data exchange.
ETH_ERROR	03 hex	Ethernet TCP/IP port error detected (cable disconnected, invalid configuration, and so on).
DUPLICATE_IP	04 hex	IP address already used by another equipment.

ETH_R_PORT_LINK_STATUS: Communication Link Status Codes

Enumerated Type Description

The `ETH_R_PORT_LINK_STATUS` enumeration data type contains the following values:

Enumerator	Value	Comment
`ETH_R_LINK_DOWN`	00 hex	Communication link not available to another device.
`ETH_R_LINK_UP`	01 hex	Communication link available to another device.

ETH_R_PORT_SPEED: Communication Speed of the Ethernet Port Codes

Enumerated Type Description

The `ETH_R_PORT_SPEED` enumeration data type contains the following values:

Enumerator	Value	Comment
`ETH_R_SPEED_NA`	0 dec	Network speed is 0 megabits per second.
`ETH_R_SPEED_10_MB`	10 dec	Network speed is 10 megabits per second.
`ETH_R_100_MB`	100 dec	Network speed is 100 megabits per second.

ETH_R_RUN_IDLE: Ethernet/IP Run and Idle States Codes

Enumerated Type Description

The `ETH_R_RUN_IDLE` enumeration data type contains the following values:

Enumerator	Value	Comment
`IDLE`	00 hex	EtherNet/IP connection is idle.
`RUN`	01 hex	EtherNet/IP connection is running.

Section 3.5
TM3_MODULE_R System Variables Data Types

Overview

This section lists and describes the system variable data types included in the `TM3_MODULE_R` structure.

What Is in This Section?

This section contains the following topics:

TM3_ERR_CODE: TM3 Expansion Module Detected Error Codes

Enumerated Type Description

The TM3_ERR_CODE enumeration data type contains the following values:

Enumerator	Value	Comment
TM3_NO_ERR	00 hex	Last bus exchange with the expansion module was successful.
TM3_ERR_FAILED	01 hex	Error detected due to the last bus exchange with the expansion module was unsuccessful.
TM3_ERR_PARAMETER	02 hex	Parameter error detected in the last bus exchange with the module.
TM3_ERR_COK	03 hex	Temporary or permanent hardware error detected on one of the TM3 expansion modules.
TM3_ERR_BUS	04 hex	Bus error detected in the last bus exchange with the expansion module.

TM3_MODULE_R_ARRAY_TYPE: TM3 Expansion Module Read Array Type

Description

The `TM3_MODULE_R_ARRAY_TYPE` is an array of 0...13 `TM3_MODULE_R_STRUCT`.

TM3_MODULE_STATE: TM3 Expansion Module State Codes

Enumerated Type Description

The `TM3_MODULE_STATE` enumeration data type contains the following values:

Enumerator	Value	Comment
`TM3_EMPTY`	00 hex	No module.
`TM3_CONF_ERROR`	01 hex	Physical expansion module does not match with the one configured in SoMachine.
`TM3_BUS_ERROR`	02 hex	Bus error detected in the last exchange with the module.
`TM3_OK`	03 hex	Last bus exchange with this module was successful.

Section 3.6
Cartridge System Variables Data Types

Overview

This section lists and describes the system variable data types included in the `Cartridge` structure.

What Is in This Section?

This section contains the following topics:

CART_R_ARRAY_TYPE: Cartridge Read Array Type

Description

The `CART_R_ARRAY_TYPE` is an array of 0..1 `CART_R_STRUCT`.

CART_R_MODULE_ID: Cartridge Read Module Identifier

Enumerated Type Description

The CART_R_MODULE_ID enumeration data type contains the following values:

Enumerator	Value	Description
CART_R_MODULE_ID	40 hex	TMC4AI2
CART_R_MODULE_ID	41 hex	TMC4AQ2
CART_R_MODULE_ID	42 hex	TMC4TI2
CART_R_MODULE_ID	48 hex	TMC4HOIS01
CART_R_MODULE_ID	49 hex	TMC4PACK01
CART_R_MODULE_ID	FF hex	None

CART_R_STATE: Cartridge Read State

Enumerated Type Description

The CART_R_STATE enumeration data type contains the following values:

Enumerator	Value	Comment
CONFIGURED	00 hex	Cartridge is configured.
INITIALIZED_NOT_CONFIGURED	01 hex	Cartridge is initialized but not configured.
NOT_INITIALIZED	02 hex	Cartridge is not initialized.

Section 3.7
System Function Data Types

Overview

This section describes the different system function data types of the M241 PLCSystem library.

What Is in This Section?

This section contains the following topics:

IMMEDIATE_ERR_TYPE: `GetImmediateFastInput` Read Input of Embedded Expert I/O Codes

Enumerated Type Description

The enumeration data type contains the following values:

Enumerator	Type	Comment
IMMEDIATE_NO_ERROR	Word	No errors detected.
IMMEDIATE_UNKNOWN	Word	The reference of `Immediate` function is incorrect or not configured.
IMMEDIATE_UNKNOWN_PARAMETER	Word	A parameter reference is incorrect.

RTCSETDRIFT_ERROR: SetRTCDrift Function Detected Error Codes

Enumerated Type Description

The RTCSETDRIFT_ERROR enumeration data type contains the following values:

Enumerator	Value	Comment
RTC_OK	00 hex	RTC drift correctly configured.
RTC_BAD_DAY	01 hex	Not used.
RTC_BAD_HOUR	02 hex	Not used.
RTC_BAD_MINUTE	03 hex	Not used.
RTC_BAD_DRIFT	04 hex	RTC Drift parameter out of range.
RTC_INTERNAL_ERROR	05 hex	RTC Drift settings rejected on internal error detected.

Appendices

Appendix A
Function and Function Block Representation

Overview

Each function can be represented in the following languages:

- IL: Instruction List
- ST: Structured Text
- LD: Ladder Diagram
- FBD: Function Block Diagram
- CFC: Continuous Function Chart

This chapter provides functions and function blocks representation examples and explains how to use them for IL and ST languages.

What Is in This Chapter?

This chapter contains the following topics:

Differences Between a Function and a Function Block

Function

A function:

- is a POU (Program Organization Unit) that returns one immediate result.
- is directly called with its name (not through an instance).
- has no persistent state from one call to the other.
- can be used as an operand in other expressions.

Examples: boolean operators (`AND`), calculations, conversion (`BYTE_TO_INT`)

Function Block

A function block:

- is a POU (Program Organization Unit) that returns one or more outputs.
- needs to be called by an instance (function block copy with dedicated name and variables).
- each instance has a persistent state (outputs and internal variables) from one call to the other from a function block or a program.

Examples: timers, counters

In the example, `Timer_ON` is an instance of the function block `TON`:

```
PROGRAM MyProgram_ST
VAR
    Timer_ON: TON;  // Function Block Instance
    Timer_RunCd: BOOL;
    Timer_PresetValue: TIME := T#5S;
    Timer_Output: BOOL;
    Timer_ElapsedTime: TIME;
END_VAR
```

```
Timer_ON(
    IN:=Timer_RunCd,
    PT:=Timer_PresetValue,
    Q=>Timer_Output,
    ET=>Timer_ElapsedTime);
```

How to Use a Function or a Function Block in IL Language

General Information

This part explains how to implement a function and a function block in IL language.

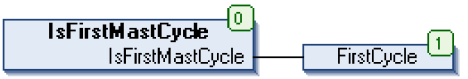
Functions `IsFirstMastCycle` and `SetRTCDrift` and Function Block `TON` are used as examples to show implementations.

Using a Function in IL Language

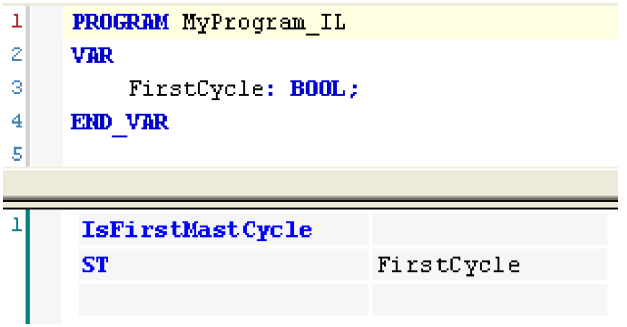
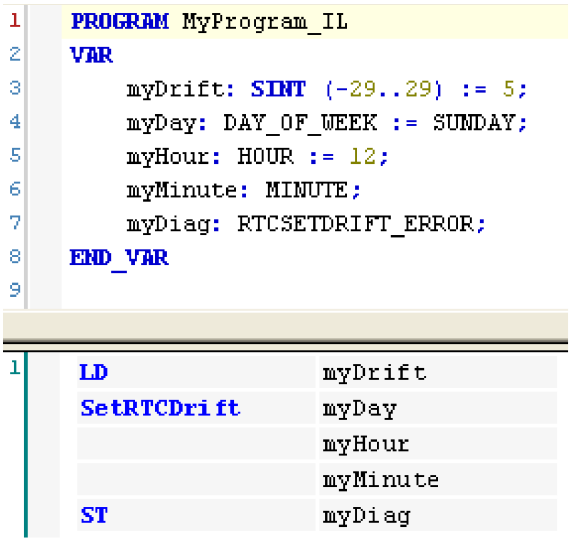
This procedure describes how to insert a function in IL language:

Step	Action
1	Open or create a new POU in Instruction List language. **NOTE:** The procedure to create a POU is not detailed here. For more information, refer to Adding and Calling POUs *(see SoMachine, Programming Guide)*.
2	Create the variables that the function requires.
3	If the function has 1 or more inputs, start loading the first input using LD instruction.
4	Insert a new line below and: ● type the name of the function in the operator column (left field), or ● use the **Input Assistant** to select the function (select **Insert Box** in the context menu).
5	If the function has more than 1 input and when Input Assistant is used, the necessary number of lines is automatically created with `???` in the fields on the right. Replace the `???` with the appropriate value or variable that corresponds to the order of inputs.
6	Insert a new line to store the result of the function into the appropriate variable: type ST instruction in the operator column (left field) and the variable name in the field on the right.

To illustrate the procedure, consider the Functions `IsFirstMastCycle` (without input parameter) and `SetRTCDrift` (with input parameters) graphically presented below:

Function	Graphical Representation
without input parameter: `IsFirstMastCycle`	
with input parameters: `SetRTCDrift`	

In IL language, the function name is used directly in the operator column:

Function	Representation in SoMachine POU IL Editor
IL example of a function without input parameter: `IsFirstMastCycle`	
IL example of a function with input parameters: `SetRTCDrift`	

Using a Function Block in IL Language

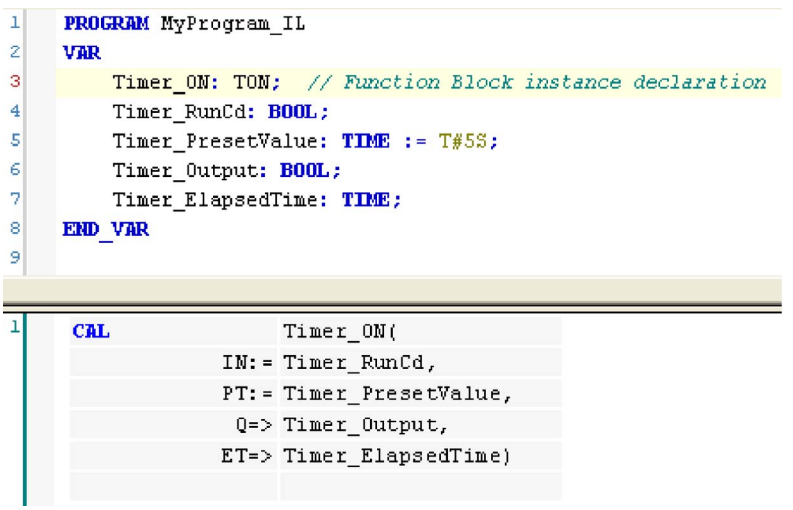
This procedure describes how to insert a function block in IL language:

Step	Action
1	Open or create a new POU in Instruction List language. **NOTE:** The procedure to create a POU is not detailed here. For more information, refer to Adding and Calling POUs *(see SoMachine, Programming Guide)*.
2	Create the variables that the function block requires, including the instance name.
3	Function Blocks are called using a `CAL` instruction: ● Use the **Input Assistant** to select the FB (right-click and select **Insert Box** in the context menu). ● Automatically, the `CAL` instruction and the necessary I/O are created. Each parameter (I/O) is an instruction: ● Values to inputs are set by ":=". ● Values to outputs are set by "=>".
4	In the `CAL` right-side field, replace `???` with the instance name.
5	Replace other `???` with an appropriate variable or immediate value.

To illustrate the procedure, consider this example with the `TON` Function Block graphically presented below:

Function Block	Graphical Representation
`TON`	

In IL language, the function block name is used directly in the operator column:

Function Block	Representation in SoMachine POU IL Editor
TON	

```
PROGRAM MyProgram_IL
VAR
    Timer_ON: TON;  // Function Block instance declaration
    Timer_RunCd: BOOL;
    Timer_PresetValue: TIME := T#5S;
    Timer_Output: BOOL;
    Timer_ElapsedTime: TIME;
END_VAR
```

```
CAL          Timer_ON(
        IN:= Timer_RunCd,
        PT:= Timer_PresetValue,
         Q=> Timer_Output,
        ET=> Timer_ElapsedTime)
```

How to Use a Function or a Function Block in ST Language

General Information

This part explains how to implement a Function and a Function Block in ST language.

Function `SetRTCDrift` and Function Block `TON` are used as examples to show implementations.

Using a Function in ST Language

This procedure describes how to insert a function in ST language:

Step	Action
1	Open or create a new POU in Structured Text language. **NOTE:** The procedure to create a POU is not detailed here. For more information, refer to Adding and Calling POUs *(see SoMachine, Programming Guide)*.
2	Create the variables that the function requires.
3	Use the general syntax in the **POU ST Editor** for the ST language of a function. The general syntax is: `FunctionResult:= FunctionName(VarInput1, VarInput2,.. VarInputx);`

To illustrate the procedure, consider the function `SetRTCDrift` graphically presented below:

Function	Graphical Representation
`SetRTCDrift`	

The ST language of this function is the following:

Function	Representation in SoMachine POU ST Editor

`SetRTCDrift`	`PROGRAM MyProgram_ST`
	`VAR myDrift: SINT(-29..29) := 5;`
	`myDay: DAY_OF_WEEK := SUNDAY;`
	`myHour: HOUR := 12;`
	`myMinute: MINUTE;`
	`myRTCAdjust: RTCDRIFT_ERROR;`
	`END_VAR`
	`myRTCAdjust:= SetRTCDrift(myDrift, myDay, myHour, myMinute);`

Using a Function Block in ST Language

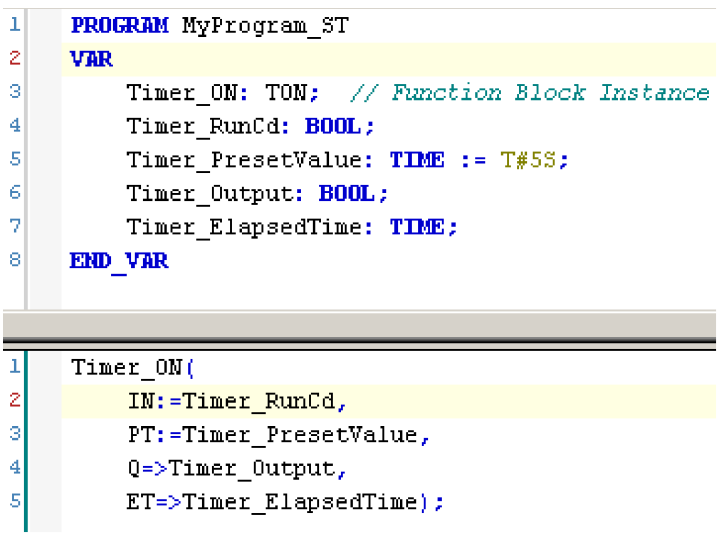
This procedure describes how to insert a function block in ST language:

Step	Action
1	Open or create a new POU in Structured Text language. **NOTE:** The procedure to create a POU is not detailed here. For more information on adding, declaring and calling POUs, refer to the related documentation *(see SoMachine, Programming Guide)*.
2	Create the input and output variables and the instance required for the function block: ● Input variables are the input parameters required by the function block ● Output variables receive the value returned by the function block
3	Use the general syntax in the **POU ST Editor** for the ST language of a Function Block. The general syntax is: `FunctionBlock_InstanceName(Input1:=VarInput1, Input2:=VarInput2,... Ouput1=>VarOutput1, Ouput2=>VarOutput2,...);`

To illustrate the procedure, consider this example with the `TON` function block graphically presented below:

Function Block	Graphical Representation
`TON`	

This table shows examples of a function block call in ST language:

Function Block	Representation in SoMachine POU ST Editor
TON	

```
PROGRAM MyProgram_ST
VAR
    Timer_ON: TON;  // Function Block Instance
    Timer_RunCd: BOOL;
    Timer_PresetValue: TIME := T#5S;
    Timer_Output: BOOL;
    Timer_ElapsedTime: TIME;
END_VAR
```

```
Timer_ON(
    IN:=Timer_RunCd,
    PT:=Timer_PresetValue,
    Q=>Timer_Output,
    ET=>Timer_ElapsedTime);
```

Glossary

0-9

%MW

According to the IEC standard, %MW represents a memory word register (for example, a language object of type memory word).

A

application

A program including configuration data, symbols, and documentation.

ARRAY

The systematic arrangement of data objects of a single type in the form of a table defined in logic controller memory. The syntax is as follows: `ARRAY [<dimension>] OF <Type>`

Example 1: `ARRAY [1..2] OF BOOL` is a 1-dimensional table with 2 elements of type `BOOL`.

Example 2: `ARRAY [1..10, 1..20] OF INT` is a 2-dimensional table with 10 x 20 elements of type `INT`.

B

BOOL

(*boolean*) A basic data type in computing. A `BOOL` variable can have one of these values: 0 (`FALSE`), 1 (`TRUE`). A bit that is extracted from a word is of type `BOOL`; for example, `%MW10.4` is a fifth bit of memory word number 10.

Boot application

(*boot application*) The binary file that contains the application. Usually, it is stored in the PLC and allows PLC to boot on the application that the user has generated.

BOOTP

(*bootstrap protocol*) A UDP network protocol that can be used by a network client to automatically obtain an IP address (and possibly other data) from a server. The client identifies itself to the server using the client MAC address. The server, which maintains a pre-configured table of client device MAC addresses and associated IP addresses, sends the client its pre-configured IP address. BOOTP was originally used as a method that enabled diskless hosts to be remotely booted over a network. The BOOTP process assigns an infinite lease of an IP address. The BOOTP service utilizes UDP ports 67 and 68.

byte

A type that is encoded in an 8-bit format, ranging from `16#00` to `16#FF` in hexadecimal representation.

C

CFC

(*continuous function chart*) A graphical programming language (an extension of the IEC 61131-3 standard) based on the function block diagram language that works like a flowchart. However, no networks are used and free positioning of graphic elements is possible, which allows feedback loops. For each block, the inputs are on the left and the outputs on the right. You can link the block outputs to the inputs of other blocks to create complex expressions.

configuration

The arrangement and interconnection of hardware components within a system and the hardware and software parameters that determine the operating characteristics of the system.

controller

Automates industrial processes (also known as programmable logic controller or programmable controller).

CRC

(*cyclical redundancy check*) A method used to determine the validity of a communication transmission. The transmission contains a bit field that constitutes a checksum. The message is used to calculate the checksum by the transmitter according to the content of the message. Receiving nodes, then recalculate the field in the same manner. Any discrepancy in the value of the 2 CRC calculations indicates that the transmitted message and the received message are different.

D

DHCP

(*dynamic host configuration protocol*) An advanced extension of BOOTP. DHCP is more advanced, but both DHCP and BOOTP are common. (DHCP can handle BOOTP client requests.)

DWORD

(*double word*) Encoded in 32-bit format.

E

element

The short name of the ARRAY element.

equipment

A part of a machine including sub-assemblies such as conveyors, turntables, and so on.

Ethernet

A physical and data link layer technology for LANs, also known as IEE 802.3.

EtherNet/IP

(*Ethernet industrial protocol*) An open communications protocol for manufacturing automation solutions in industrial systems. EtherNet/IP is in a family of networks that implement the common industrial protocol at its upper layers. The supporting organization (ODVA) specifies EtherNet/IP to accomplish global adaptability and media independence.

F

FB

(*function block*) A convenient programming mechanism that consolidates a group of programming instructions to perform a specific and normalized action, such as speed control, interval control, or counting. A function block may comprise configuration data, a set of internal or external operating parameters and usually 1 or more data inputs and outputs.

firmware

Represents the BIOS, data parameters, and programming instructions that constitute the operating system on a controller. The firmware is stored in non-volatile memory within the controller.

flash memory

A non-volatile memory that can be overwritten. It is stored on a special EEPROM that can be erased and reprogrammed.

function

A programming unit that has 1 input and returns 1 immediate result. However, unlike FBs, it is directly called with its name (as opposed to through an instance), has no persistent state from one call to the next and can be used as an operand in other programming expressions.

Examples: boolean (AND) operators, calculations, conversions (BYTE_TO_INT)

function block

A programming unit that has 1 or more inputs and returns 1 or more outputs. FBs are called through an instance (function block copy with dedicated name and variables) and each instance has a persistent state (outputs and internal variables) from 1 call to the other.

Examples: timers, counters

function block diagram

One of the 5 languages for logic or control supported by the standard IEC 61131-3 for control systems. Function block diagram is a graphically oriented programming language. It works with a list of networks where each network contains a graphical structure of boxes and connection lines representing either a logical or arithmetic expression, the call of a function block, a jump, or a return instruction.

G

GVL

(*global variable list*) Manages global variables that can be passed between controllers on an Ethernet TCP/IP Modbus network.

H

hex

(*hexadecimal*)

I

I/O

(*input/output*)

ID

(*identifier/identification*)

IEC

(*international electrotechnical commission*) A non-profit and non-governmental international standards organization that prepares and publishes international standards for electrical, electronic, and related technologies.

IEC 61131-3

Part 3 of a 3-part IEC standard for industrial automation equipment. IEC 61131-3 is concerned with controller programming languages and defines 2 graphical and 2 textual programming language standards. The graphical programming languages are ladder diagram and function block diagram. The textual programming languages include structured text and instruction list.

IEEE 802.3

A collection of IEEE standards defining the physical layer, and the media access control sublayer of the data link layer, of wired Ethernet.

IL

(*instruction list*) A program written in the language that is composed of a series of text-based instructions executed sequentially by the controller. Each instruction includes a line number, an instruction code, and an operand (refer to IEC 61131-3).

INT

(*integer*) A whole number encoded in 16 bits.

IP

(*Internet protocol* Part of the TCP/IP protocol family that tracks the Internet addresses of devices, routes outgoing messages, and recognizes incoming messages.

L

LD

(*ladder diagram*) A graphical representation of the instructions of a controller program with symbols for contacts, coils, and blocks in a series of rungs executed sequentially by a controller (refer to IEC 61131-3).

LWORD

(*long word*) A data type encoded in a 64-bit format.

M

MAC address

(*media access control address*) A unique 48-bit number associated with a specific piece of hardware. The MAC address is programmed into each network card or device when it is manufactured.

MAST

A processor task that is run through its programming software. The MAST task has 2 sections:

- **IN:** Inputs are copied to the IN section before execution of the MAST task.
- **OUT:** Outputs are copied to the OUT section after execution of the MAST task.

N

network

A system of interconnected devices that share a common data path and protocol for communications.

P

PLC

(*programmable logic controller*) An industrial computer used to automate manufacturing, industrial, and other electromechanical processes. PLCs are different from common computers in that they are designed to have multiple input and output arrays and adhere to more robust specifications for shock, vibration, temperature, and electrical interference among other things.

POU

(*program organization unit*) A variable declaration in source code and a corresponding instruction set. POUs facilitate the modular re-use of software programs, functions, and function blocks. Once declared, POUs are available to one another.

program

The component of an application that consists of compiled source code capable of being installed in the memory of a logic controller.

protocol

A convention or standard definition that controls or enables the connection, communication, and data transfer between 2 computing system and devices.

R

run

A command that causes the controller to scan the application program, read the physical inputs, and write to the physical outputs according to solution of the logic of the program.

S

ST

(*structured text*) A language that includes complex statements and nested instructions (such as iteration loops, conditional executions, or functions). ST is compliant with IEC 61131-3.

STOP

A command that causes the controller to stop running an application program.

string

A variable that is a series of ASCII characters.

system variable

A variable that provides controller data and diagnostic information and allows sending commands to the controller.

T

task

A group of sections and subroutines, executed cyclically or periodically for the MAST task or periodically for the FAST task.

A task possesses a level of priority and is linked to inputs and outputs of the controller. These I/O are refreshed in relation to the task.

A controller can have several tasks.

TCP

(*transmission control protocol*) A connection-based transport layer protocol that provides a simultaneous bi-directional transmission of data. TCP is part of the TCP/IP protocol suite.

U

UDINT

(*unsigned double integer*) Encoded in 32 bits.

UINT

(*unsigned integer*) Encoded in 16 bits.

unlocated variable

A variable that does not have an address (refer to *located variable*).

V

variable

A memory unit that is addressed and modified by a program.

W

watchdog

A watchdog is a special timer used to ensure that programs do not overrun their allocated scan time. The watchdog timer is usually set to a higher value than the scan time and reset to 0 at the end of each scan cycle. If the watchdog timer reaches the preset value, for example, because the program is caught in an endless loop, a fault is declared and the program stopped.

WORD

A type encoded in a 16-bit format.

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