

Chapter 5 MODBUS /OMRON Protocols Support

The T100M+ PLC supports a subset of the OMRON™ and MODBUS™ (Both ASCII and RTU modes are now supported) compatible communication protocols so that it can be easily linked to third-party control software/hardware products such as SCADA software, touch panels etc. The PLC automatically recognizes the type of command format and will respond with the correct response. These are accomplished without any user intervention and without any need to configure the PLC at all!

Both MODBUS and Omron protocols use the same **device ID address** (00 to FF) as the native protocol described in Chapter 3. Since the addresses of I/O and internal variables in the T100M+ PLC are organized very differently from the OMRON or Modicon PLCs, we need to map these addresses to the corresponding memory areas in the other PLCs so that they can be easily accessed by their corresponding protocols. All I/Os, timers, counters, internal relays and data memory DM[1] to DM[4000] are mapped as shown in table 5.1. However, 32 bit variables and string variables are not mapped since they are fundamentally quite different in their implementation among different PLCs. Internal variables which are not mapped can be still be accessed by copying the contents of these variables to unused data memory DM[n] (these can be easily accomplished within a CusFn) so that they can be accessed by these third party protocols.

For normal application Table 5.1 may be all that you need to interface to third party control products such as a touch screen LCD panel.

5.1 MODBUS ASCII Protocol Support

T100M+ supports MODBUS ASCII protocols with the following command and response format:

START	Address	Function	Data	LRC Check	CRLF
:	2 chars	2 chars	# chars	2 chars	2 chars

The following Function Codes are supported:

02	Read Input Status
03	Read Holding Registers
05	Force Single Coil. Coil #1 = 40001.1, Coil #2 = 40001.2 Coil # 17 = 40002.1 and so on.
06	Preset Single Register
16	Preset Multiple Registers

Please refer to the MODBUS protocol published by Groupe Schneider at <http://www.modicon.com> to find out the exact address and data format of the MODBUS command and response.

Table 5.1: Memory Mapping of T100M+ to other PLCs

T100M+ I/O #		OMRON	MODBUS Word Addr. mapping	MODBUS Bit Addr. Mapping
Input	n			n
	1 to 16	IR00.0 to IR00.15	40001.1 to 40001.16	1 to 16
	17 to 32	IR01.0 to IR01.15	40002.1 to 40002.16	17 to 32
	33 to 48	IR02.0 to IR02.15	40003.1 to 40003.16	33 to 48
	49 to 64	IR03.0 to IR03.15	40004.1 to 40004.16	49 to 64
	65 to 80	IR04.0 to IR04.15	40005.1 to 40005.16	65 to 80
	81 to 96	IR05.0 to IR05.15	40006.1 to 40006.16	81 to 96
Output	n			256 + n
	1 to 16	IR16.0 to IR16.15	40017.1 to 40017.16	257 to 272
	17 to 32	IR17.0 to IR17.15	40018.1 to 40018.16	273 to 288
	33 to 48	IR18.0 to IR18.15	40019.1 to 40019.16	289 to 304
	49 to 64	IR19.0 to IR19.15	40020.1 to 40020.16	305 to 320
	65 to 80	IR20.0 to IR20.15	40021.1 to 40021.16	321 to 336
	81 to 96	IR21.0 to IR21.15	40022.1 to 40022.16	337 to 352
Timer	n			512+n
	1 to 16	IR32.0 to IR32.15	40033.1 to 40033.16	513 to 528
	17 to 32	IR33.0 to IR33.15	40034.1 to 40034.16	529 to 544
	33 to 48	IR34.0 to IR34.15	40035.1 to 40035.16	545 to 560
	49 to 64	IR35.0 to IR35.15	40036.1 to 40036.16	561 to 576
Counter	n			768 + n
	1 to 16	IR48.0 to IR48.15	40049.1 to 40049.16	769 to 784
	17 to 32	IR49.0 to IR49.15	40050.1 to 40050.16	785 to 800
	33 to 48	IR50.0 to IR50.15	40051.1 to 40051.16	801 to 816
	49 to 64	IR51.0 to IR51.15	40052.1 to 40052.16	817 to 832
Relay	n			1024 + n
	1 to 16	IR64.0 to IR64.15	40065.1 to 40065.16	1025 to 1040
	17 to 32	IR65.0 to IR65.15	40066.1 to 40066.16	1041 to 1056
	33 to 48	IR66.0 to IR66.15	40067.1 to 40067.16	1057 to 1072
	49 to 64	IR67.0 to IR67.15	40068.1 to 40068.16	1073 to 1088
	65 to 80	IR68.0 to IR68.15	40069.1 to 40069.16	1089 to 1104
	81 to 96	IR69.0 to IR69.15	40070.1 to 40070.16	1105 to 1120
	97 to 112	IR70.0 to IR70.15	40071.1 to 40071.16	1121 to 1136
	113 to 128	IR71.0 to IR71.15	40072.1 to 40072.16	1137 to 1152
	129 to 144	IR72.0 to IR72.15	40073.1 to 40073.16	1153 to 1168
	145 to 160	IR73.0 to IR73.15	40074.1 to 40074.16	1169 to 1184
	161 to 176	IR74.0 to IR74.15	40075.1 to 40075.16	1185 to 1200
	177 to 192	IR75.0 to IR75.15	40076.1 to 40076.16	1201 to 1216
	193 to 208	IR76.0 to IR76.15	40077.1 to 40077.16	1217 to 1232
	209 to 224	IR77.0 to IR77.15	40078.1 to 40078.16	1233 to 1248
..	
497 to 512	IR96.0 to IR96.15	40097.1 to 40097.16	1521 to 1536	

* MODBUS is a registered trademark of Groupe Schneider.

OMRON is a registered trademark of OMRON Corporation.

T100M+ Variables		OMRON	MODBUS
Timer Present Values	1 to 64	IR128 to IR191	40129 to 40192
Counter Present Values	1 to 64	IR256 to IR319	40257 to 40320
Clock	TIME[1] TIME[2] TIME[3]	IR512 IR513 IR514	40513 40514 40515
Date	DATE[1] DATE[2] DATE[3] DATE[4]	IR516 IR517 IR518 IR519	40517 40518 40519 40520
Data Memory	DM[1] DM[2] DM[4000]	DM[1] DM[2] DM[4000]	41001 41002 45000

5.2 MODBUS RTU Protocol Support

The new Rev D of the T100MD+ or T100MX+ PLCs also supports the MODBUS RTU protocol. The difference between the ASCII and RTU protocols is that the latter transmits binary data directly instead of converting one byte of binary data into two ASCII characters. A message frame is determined by the silent interval of 3.5 character times between characters received at the COMM port. Other than that, the function codes and memory mappings are identical to the MODBUS ASCII protocol. Table 5.1 therefore applies to MODBUS RTU protocol as well.

MODBUS RTU has following command and response format:

Start	Address	Function	Data	CRC 16	END
Silence of 3.5 char times	1 byte	1 byte	# byte	2 bytes	Silence of 3.5 char times

The following Function Codes are supported:

02	Read Input Status
03	Read Holding Registers
05	Force Single Coil. Coil #1 = 40001.1, Coil #2 = 40001.2 Coil # 17 = 40002.1 and so on.
06	Preset Single Register
16	Preset Multiple Registers

5.3 OMRON Host Link Command Support

Command Type	Header	Level of Support
a) TEST	TS	Full support
b) STATUS READ	MS	Full support
c) ERROR Read	MF	Dummy (always good)
d) IR Area READ	RR	Full support (0000 to 1000)
e) HR, AR, LR Area & TC Status READ	RH	Dummy (always returns "0000")
f) DM AREA READ	RD	Full support
g) PV READ	RC	Dummy (always returns "0000")
h) Status Write	SC	Dummy (always OK)
i) IR Area WRITE	WR	Full Support
j) HR, AR, LR Area & TC Status WRITE	WH, WJ, WL, WG	Dummy (always OK)
k) DM Area WRITE	WD	Full Support (from DM0001-DM4000)
l) FORCED SET	KSCIO KRCIO	Full Support for IR Area only Dummy for other areas.
m) Registered I/O Read for Channel or Bit	QQMR/ QQIR	Full Support for IR and DM only Dummy for other areas (always 0000)

For detailed description of the command and response formats for each OMRON Host Link Commands, please refer to C20H/C28H/C40H PLC Operation manual published by OMRON Corporation.

5.4 Application Example: Interfacing to SCADA Software

SCADA software or MMI systems (also known as LCD Touch Panels) normally use object-oriented programming method. Graphical objects such as switches indicator lights or meters, etc., are picked from the library and then assigned to a certain I/O or internal data address of the PLC. When designing a SCADA system, first you need to define the PLC type. You can choose the MODBUS ASCII, MODBUS RTU or OMRON C20H. Once a graphical object has been created, you will need to edit its connection and at this point you will be presented with a selection table that correspond to the memory map of that PLC type.

Example 1: To connect an indicator lamp to Input #9 of the PLC.

You will need to program the switch to connect to IR00.8 for OMRON protocol. However, If you have defined the PLC as MODBUS type then this indicator lamp should be connected to address 40001.9. (See Table 5.1). In either case there is no need to learn about the actual command format of the protocol itself, as the SCADA software will automatically generate the required commands to access the input address that has been chosen for the object.

Example 2: To display reading from ADC #3 as a bar graph on SCADA.

Since the data from ADC #3 is not directly mapped to MODBUS or OMRON in Table 5.1, you need to add a statement in the custom function that reads the ADC #3 and copy it into a data memory, e.g.,

DM[100] = ADC(3)

Now you can program the bar graph on the SCADA screen to be connected to DM[100] if you use OMRON protocol. For MODBUS protocol the object should be connected to the address: 41100 as can be seen from Table 5.1.

5.5 Using The T100M+ PLC as MODBUS Master

The T100M+ PLCs supports for MODBUS protocol goes beyond being a MODBUS slave only. You can use the TBASIC READMODBUS and WRITEMODBUS commands to send out MODBUS ASCII commands to access any other T100M+ PLC or any third party MODBUS slave devices.

Note that when using READMODBUS or WRITEMODBUS command, the 40001 address stated in Table 5.1 should be interpreted as address 0000, and 40002 as address 0001 41001 as address 1000, etc. This is in accordance with the specifications stated in MODBUS protocols. MODICON defined zero offset address for the MODBUS command, yet in their I/O definition the I/O channels are supposed to start from address 40001. Hence the unusual correspondence. But to maintain compatibility with the MODBUS specifications we have to adhere to their definitions.

M+ PLC As MODBUS RTU Master

The new Rev. D T100M+ PLC can also act as a MODBUS RTU master! The same READMODBUS and WRITEMODBUS commands can be used to send and receive MODBUS RTU commands. What you need to do is to add 10 (decimal) to the COMM port number to signal to the processor that you wish to use MODBUS RTU instead of ASCII to talk to the slaves. I.e. you should specify port #11 to use RTU commands on COMM1, and specify port #13 to use RTU commands on COMM3. E.g. the statement DM[10] = READMODBUS (13, 8, 16) will access via COMM3 the slave with ID = 08 and read the content of register #16. This register corresponds to MODICON address 40017 and is the OUTPUT[1] of the slave PLC.

The ability to speak MODBUS RTU greatly extend the type of peripherals which can be used with a T100M+ PLC. You can now make use of many off-the-shelf, third party RTU devices to extend the PLC capability, making the M-series truly super PLCs!