TOSHIBA

UG-TS02***-E022

PROGRAMMABLE CONTROLLERS

PROSEC **T2-Series**

USERS MANUAL

– Modbus Module –

PRELIMINARY

TOSHIBA CORPORATION

Important Information

Misuse of this equipment can result in property damage or human injury.
Because controlled system applications vary widely, you should satisfy yourself as to the acceptability of this equipment for your intended purpose.
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Safety Precautions

This application guide is prepared for users of Toshiba programmable controller PROSEC T2-Series and EX100 Series (hereafter called T2).

Read this guide and your PLC's manual thoroughly to use the PLC system safely.

Hazard Classifications

In this guide, the following two hazard classifications are used to explain the safety precautions.

⚠ WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Even if a precaution is classified as CAUTION, it may cause serious results depending on the situation. Observe all the safety precautions described on this guide.

Safety Precautions

⚠ CAUTION

- Read the Safety Precautions described in your PLC's User's Manual before using the PLC.
- Carefully design a fail-safe system in order to avoid an unsafe situation caused by PLC failure. When the PLC detects an error in its self-diagnostics, the PLC goes into the error mode. In the error mode, all the PLC outputs turn OFF and the analog outputs go to 0 (zero).

About This Guide

This guide describes how to setup and use the Toshiba EX10-MML11 Modbus module. When used in a Modbus network, the EX10-MML11 module allows any Modbus master to write to/read from the registers in an EX100 or T2 PLC using standard Modbus RTU protocol.

Contents

1. Overview

The Modbus module (ML11) is used to connect T2E, T2N, or EX100 PLCs to a Modbus Master. The addition of the EX10-MML11 (MODBUS Module) allows the T2E, T2N or EX100 PLC to communicate via standard MODBUS RTU protocol. This allows quick and easy access to the PLC registers by a standard MODBUS Master.

Using the ML11 Modbus module any Modbus Master can read the status of registers in the PLC and write to registers in the PLC. This allows the Modbus Master to know the status of inputs to the PLC (both digital and analog) and to control the outputs of the PLC (also both digital and analog).

The ML11 Modbus module cannot be a Modbus master, only a modbus slave. It has one RS485 port for connection to the Modbus master. The preferred location of the EX10-MML11 is next to the CPU. However, the module may be located in any slot to the right of the CPU.

The CPU module can be any of the following:

EX10-MPU11	EX100 CPU, now obsolete
EX10-MPU12A	EX100 CPU, now obsolete
TPU215—S	T2 CPU now obsolete
TPU224--S	T2 CPU, now obsolete
TPU234E-S	T2E CPU (replaces all obsolete CPUs)
TPU215N-S	T2N CPU, basic
TPU235N-S	T2N CPU, with Ethernet
TPU245N-S	T2N CPU, with Ethernet and Tosline S20

The ML11 Modbus module is also used to connect a T2 or EX100 PLC into the Toshiba ECBUS. The ECBUS allows the PLCs to share data with Toshiba's EC300 series loop controllers. The ECBUS is a LAN (local area network) which allows multiple EC300s and T2/EX100 PLCs to share data. For more information on the ECBUS, please refer to ECBUS Transmission Interface Manual, see Additional References.

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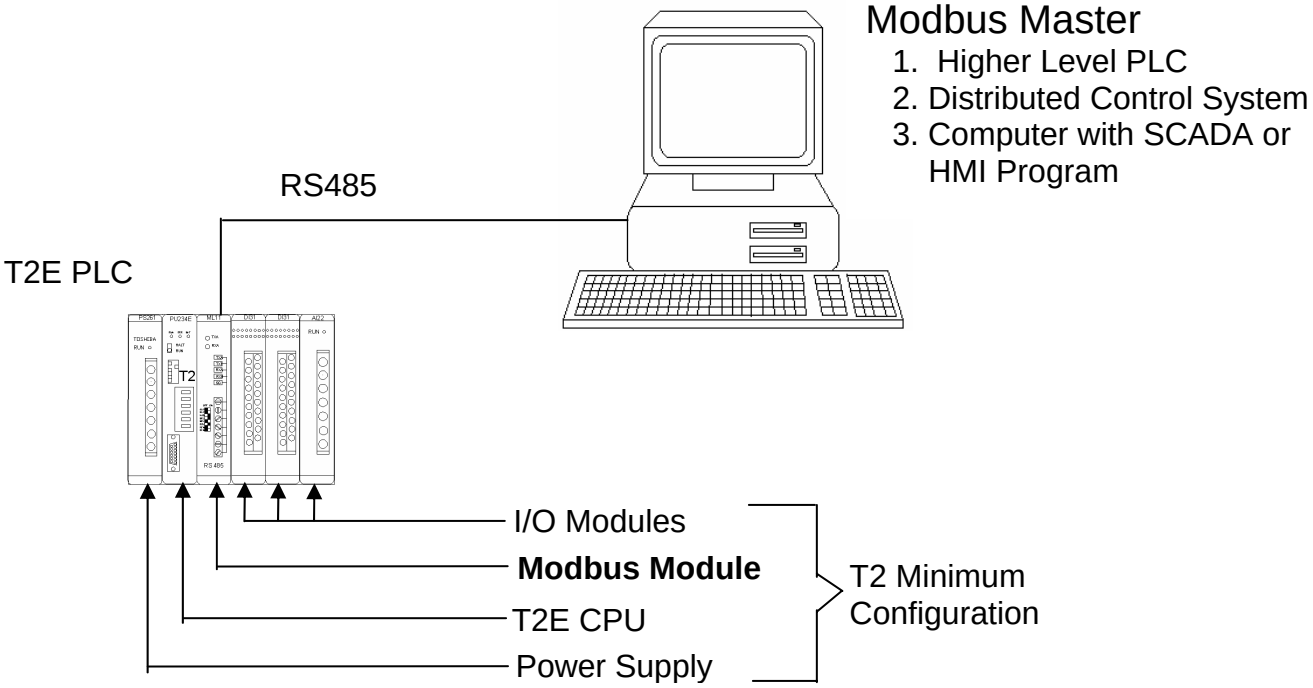
2. System Configuration

From 1 to 32 T2E or T2N PLCs can be connected to a Modbus master using the Modbus module.

1 to 1 Configuration



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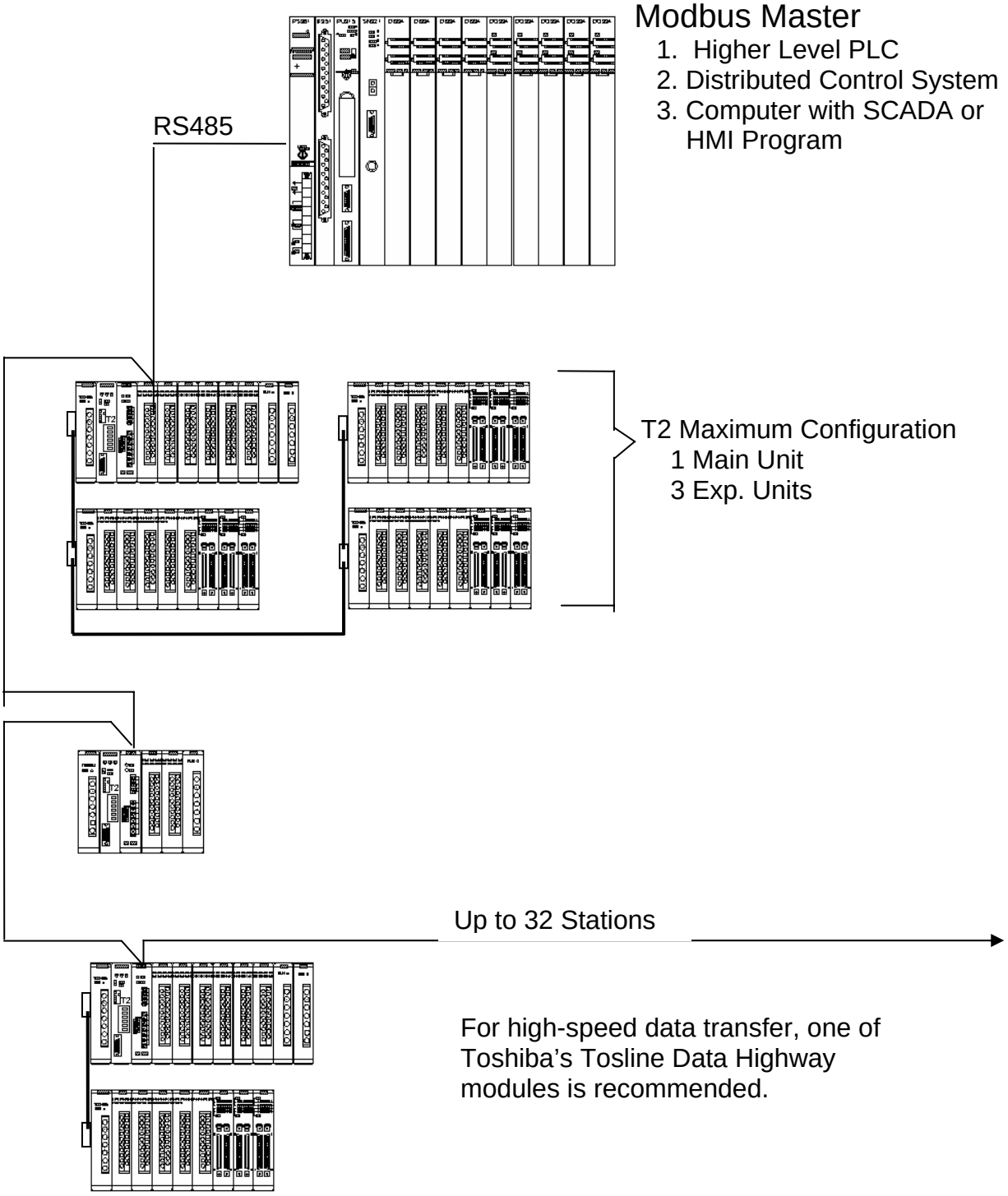
1 to N Configuration



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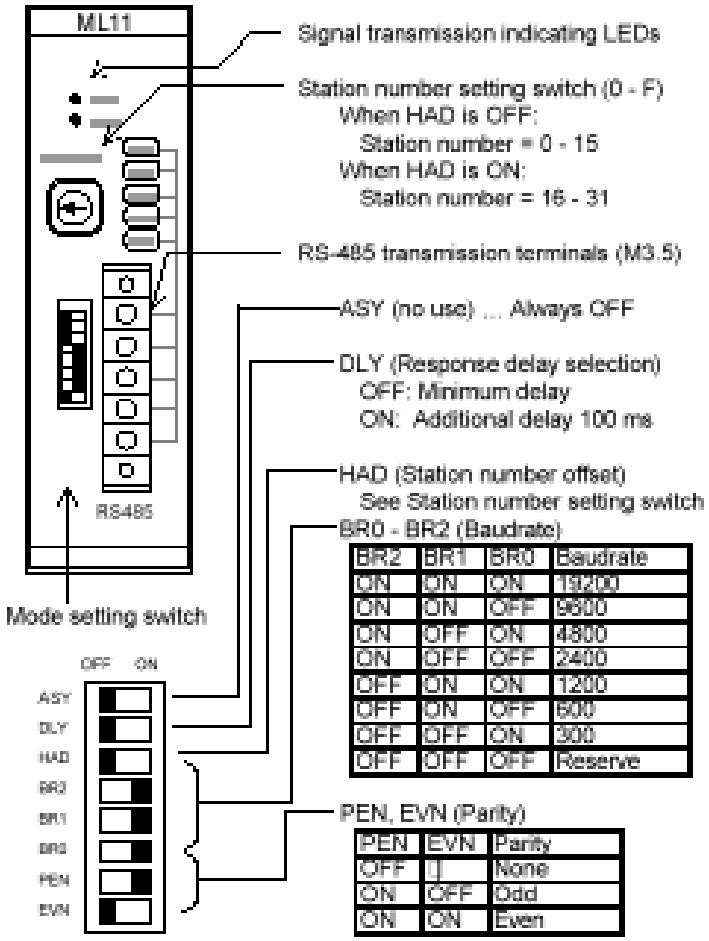
3. External Features and Switch Settings



BR2	BR1	BR0	Baudrate
ON	ON	ON	19200
ON	ON	OFF	9600
ON	OFF	ON	4800
ON	OFF	OFF	2400
OFF	ON	ON	1200
OFF	ON	OFF	600
OFF	OFF	ON	300
OFF	OFF	OFF	Reserve

PEN	EVN	Parity
OFF	[]	None
ON	OFF	Odd
ON	ON	Even

4. Specifications

ITEM	SPECIFICATION
INTERFACE	TERMINAL BLOCK
COMMUNICATION STYLE	HALF-DUPLEX
SIGNAL CONFIGURATION	TXA/RXA TXB/RXB
SYNCHRONIZATION	START-STOP
NETWORK TOPOLOGY	PARTY LINE (MULTIDROP)
COMMUNICATION SPEED	300, 600, 1200, 2400, 4800, 9600, 19200 bps
TRANSMISSION DISTANCE	1 KM MAX
COMMUNICATION MODE	RTU MODE
DATA LENGTH	8 BITS
STOP BITS	1 BIT
PARITY	EVEN, ODD, NONE
STATION NUMBER	1 TO 31 (DO NOT SELECT 0 OR 32)
ERROR CHECK	PARITY CRC
NUMBER OF CHANNELS	1 CHANNEL

5. Modbus Module Operation

5.1. Modbus Commands

When a MODBUS command is used, the Modbus module translates it to the corresponding T2 register access protocol.

MODBUS FUNCTION CODE	T2 COMMAND
01 Read Coil Status	DR Read Device/Register
02 Read Input Status	DR Read Device/Register
03 Read Holding Register	DR Read Device/Register
04 Read Input Register	DR Read Device/register
05 Force Single Coil	DW Write Device Register
06 Force Single Register	DW Write Device/Register
08 Loop Back Diagnostic test	**** Not Supported by EX10-MML11
15 Force Multiple Coils	DW Write Device/register
16 Preset Multiple Registers	DW Write Device/register

For more information on the Modbus protocol, please refer to the Modbus Protocol Reference Guide, see Additional References.

For more information on the T2 register access protocol, please refer to the Computer Link Function Operation Manual, see Additional References.

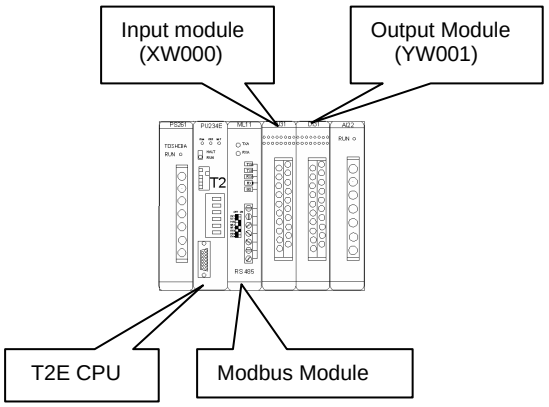
5.2. Modbus Data Types and T2 Register Mapping

This table shows how the different Modbus data types are mapped into T2 registers. In other words, a Modbus master would reference the following Modbus register ranges to access the corresponding T2 PLC registers.

For example, Modbus Holding Register 4352 will map to T2 register D000, and Input Register 0000 will map to XW00.

Data Type	Attribute	Modbus No.	Offset	Reg/Device	Address (T2)
Coils	Read/Write	0****	0000 to 0511 0512 to 4095 4096 to 5112 7936 to 8447	Y R Z	Y000 to Y31F Y320 to Y63F R000 to R63F Z000 to Z31F
Input Status	Read only	1****	0000 to 0511 0512 to 4095	X	X000 to X31F X320 to X63F
Input Register	Read only	3****	0000 to 0063	XW	XW00 to XW63
Holding Registers	Read/Write	4****	0000 to 0063 0768 to 0831 1280 to 1311 3328 to 3455 3840 to 3967 4352 to 5887	YW RW ZW T C D	YW00 to YW63 RW00 to RW63 ZW00 to ZW31 T000 to T127 C000 to C095 D000 to D1405

Modbus – T2 Address mapping Example:



In this example, the T2 is being used As a Modbus Remote Terminal Unit slave. A Modbus master can access The I/O or data registers in the T2. See the following table for a Modbus to T2 address mapping example.

Modbus Address	T2 Address	T2 Data Type
30000	XW000	Input Register
40001	YW001	Output Register
44352	D0000	Data Register

Note: When dealing with I/O registers, make sure that the Modbus master is attempting to access only the I/O points that physically exist in the T2 system. For example, Holding Register 0 (40000) does not exist in the above example because there is no YW000 in the T2 system. In the above system, only have Holding Register 1 (40001) exists.

5.3. Restricted Registers

Registers D1406 to D1535 are reserved for “raw” data transmission with the EC300 loop controllers on the ECBUS network. These registers are not available when the EX10-MML11 is used as a Modbus slave module. Do not use these registers.

6. Modbus Module Setup

The Toshiba Modbus module has been used reliably as a Modbus slave for several years. First it was used on Toshiba's EX100 Series PLCs and now on the T2 Series PLCs. Before it can function as intended however, all the DIP switches must be properly set and all wiring connections must be correct.

6.1. Modbus Module DIP Switch Settings

The following items are setup by DIP switches on the Modbus module:

- Station number
- Transmission rate (Baud rate)
- Parity

Station Number:

The station numbers identify the controllers and must be different from each other in the network. If the EX10-MML11 address is less than 15, then set the third switch (HAD) to the "off" position. If the EX10-MML11 address is higher than 16, set the switch to the "on" position. Using the "STATION" dial switch (numbered in hexadecimal) carefully set the station number. Do not set the dial switch to 0 with the HAD switch off.

Transmission Rate (Baud Rate):

Select the combination of the three switches "BR2", "BR1", and "BRO" for the desired communication speed. These are the 4th, 5th, and the 6th switches.

Baud Rate	BR2	BR1	BR0
19200	ON	ON	ON
9600	ON	ON	OFF
4800	ON	OFF	ON
2400	ON	OFF	OFF
1200	OFF	ON	ON
600	OFF	ON	OFF
300	OFF	OFF	ON
RESERVED	OFF	OFF	OFF

Parity Check:

Select the parity check as odd, even or none. Use switches 7 and 8 to set the parity.

PARITY	PEN (7)	EVN (8)
NONE	OFF	----
ODD	ON	OFF
EVEN	ON	ON

ASY and DLY switches:

The ASY and DLY switches are not used on the EX10-MML11, and should be set to the “Off” position.

Example Configuration Settings:

This section shows how to set the card up for network station address 2, 9600 baud, and no parity.

1) “ASY and DLY”

Set these to the **Off** position.

2) "Station Address"

- Set the **Station number** on the rotary switch to **2**.
- Set the **HAD** switch to **OFF** because our address is less than 16.

3) "Communication speed"

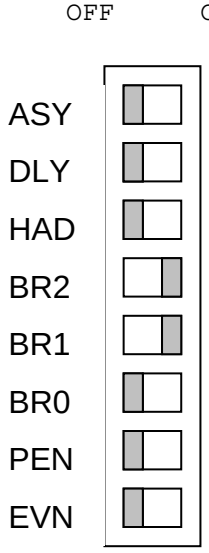
For 9600 baud, the following settings are required.

- **BR2** is on
- **BR1** is on
- **BR0** is off

4) "Parity check"

For No Parity, the following settings are required.

- **PEN** is off.
- **EVN** is off.



Switch settings for 9600 baud, no parity, and address less than 16.

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6.2. Wiring Connection to the Modbus Module

Sometimes it is necessary to convert from the standard RS485 to RS232 for connection to a Personal Computer. The wiring between the Modbus module and the converter must be set as follows:

RS485 Converter	Modbus Module
TXA	RXA
RXA	TXA
TXB	RXB
RXB	TXB
SG	SG

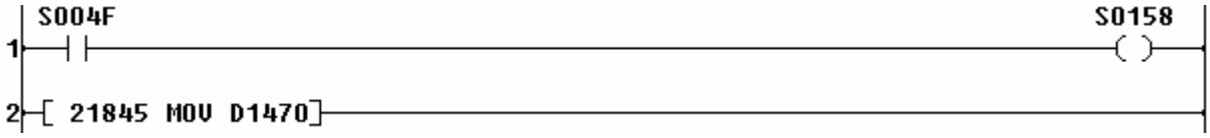
Note: Different RS485 converters have different connections. For example, when one commonly available converter is used, TXA connects to RXB, TXB connects to RXA, etc. Please refer to the converter manufacturer's instructions.

7. CPU Setup for the Modbus Module

Two lines of ladder logic are necessary to configure a T2 CPU for use with the Modbus module.

1 Communications Priority: To insure uninterrupted communications between the CPU and the Modbus module, the communications priority bit S0158 must be set ON.

2. Initialization: To initialize the Modbus module, write the initialization parameter into data register D1470. Register **D1470** must be set to **H5555** (21845 Decimal) before the Modbus module will start communicating.



When using the Modbus module, the above logic should be placed in Block 1, Rung 1 and Rung 2 of the PLC program.

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8. Trouble Shooting

The communication status LEDs can be used to verify correct operation of the Modbus module. During normal operation, the LED indicators flash as follows:

- **RXD LED**: Flashes when the Modbus master sends a message to the EX10 -MML11. On a multi slave network, this can also flash when when the master polls other slaves, or when other slaves respond to the master. In general, it indicates activity on the network.

- **TXD LED**: Flashes when that specific EX10-MML11 responds to the master. This LED is only relevant to the module on which it is being viewed, regardless of how many slaves are on the network. It indicates that the module has received a message that is uniquely addressed to it, and the EX10-MML11 is responding. This LED is usually on longer than the RXD LED because the responses have more data than the requests.

If the LED indicators are not flashing, check the following:

1) Wiring connections
2) Resistance at terminals
3) Baud rate setting
4) Station Number
5) HAD Switch
6) Parity selection
7) Modbus master is using standard Modbus RTU format

If the LED indicators are on solid:

The polarity has been reversed on the network wiring. For example, the “A” terminals are wired to the “B” lines, the “+” terminals are wired to the “-“ lines, etc. Correct the connections to the EX10-MML11.

9. Additional References

Toshiba Corporation, *Instruction Manual - EC300 Series Controller – ECBUS Transmission Interface Module – ML11*. 6F8A0613 4th ed. Feb 1995. Tokyo, Japan.

Toshiba Corporation, *Computer Link Function Operation Manual*. UM-TS03-E008, 3rd ed. Aug. 1977. Tokyo, Japan.

Gould Modicon, *Modbus Protocol Reference Guide*. PI-MBUS-300 Rev B. Jan 1985. Andover, MA.

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