

User Manual

Modbus RTU Protocol for TID1

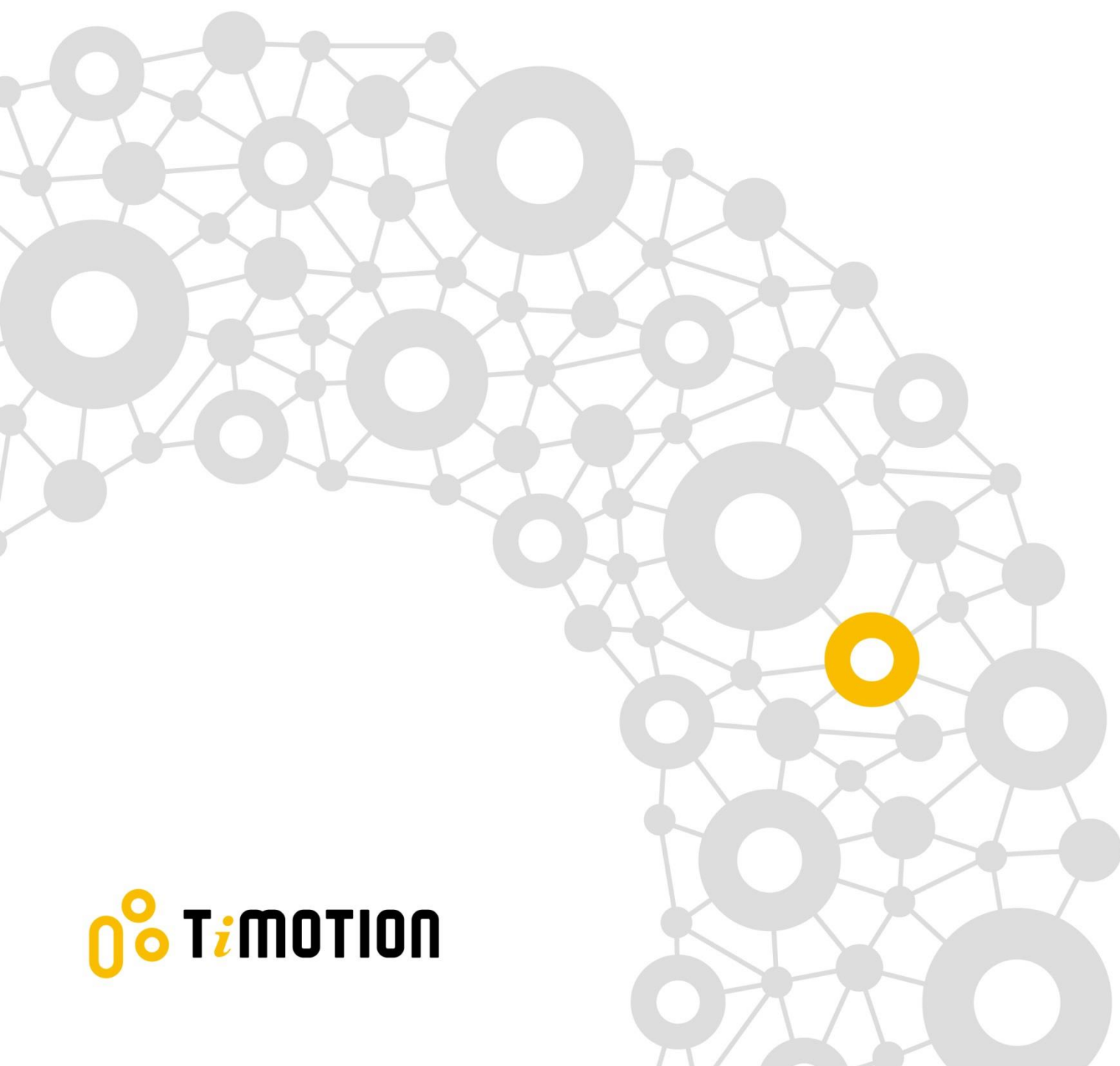


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1.Introduction

This user manual serves as a reference guide for users familiar with Modbus standards, providing information on TiMOTION T-Smart actuators compatible with Modbus RTU protocol.

2.Glossary

Alphanumeric Notation Guide:

Notation	Description	Format
nnnnb	Numbers followed by "b".	Binary
nnnnh or LLLLh	Numbers or Capital Letters (A, B, C, D, E, F) followed by "h".	Hexadecimal
nnnn	All other numbers.	Decimal

General: Modbus protocol utilizes a big-endian byte order.

SA	Slave Address
FC	Function Code
Data	Data Range
CRC	Cyclic Redundancy Check

Actuator

EOS	End of Stroke
POT	Potentiometer

3.Functional Description

3.1 Communication settings

This section provides information on the configuration settings for communication:

Configuration	Description	Register
Slave Address:	Allowed address: 1 to 246 (0 = Broadcast) Default: 247 (Unassigned)	1114h
Baud Rate:	Supported baud rate: 9600, 19200, 57600, 115200 Baud Default: 9600	1115h
Response Delay:	Configure inter-frame delay*, range: 3 to 100ms	1116h
Parity:	No parity	N/A
Stop Bit:	1 stop bit	N/A

[*Inter-frame delay is the interval between request and response.](#)

3.2 Function Codes and Descriptions

FC 3 (03h) - Read Holding Registers

The following section provides details on Modbus function codes, starting with FC 3 (03h), which pertains to the function of reading holding registers.

Request

Item	SA	FC	Data		CRC
			Start Address	Number of Registers	
Number of Bytes	1	1	2	2	2
Value		03h	0000h to FFFFh	1h to 32h	

Response

Item	SA	FC	Data		CRC
			Number of Bytes	Register Value	
Number of Bytes	1	1	1	2 x N [*]	2
Value		03h	2 x N [*]		

^{*}N = Number of registers

Error

Item	SA	Error code	Exception code	CRC
Number of bytes	1	1	1	2
Value		83h	01, 02, 03, 04	

FC 6 (06h)-Single Register Write

This section provides detailed explanations of Modbus function codes, commencing with FC 6 (06h) dedicated to the operation of writing a single register.

Request

Item	SA	FC	Data		CRC
			Register Address	Register Value	
Number of Bytes	1	1	2	2	2
Value		06h	0000h to FFFFh	0000h to FFFFh	

Response

Item	SA	FC	Data		CRC
			Register Address	Register Value	
Number of Bytes	1	1	2	2	2
Value		06h	0000h to FFFFh	0000h to FFFFh	

Error

Item	SA	Error Code	Exception Code	CRC
Number of bytes	1	1	1	2
Value		86h	01, 02, 03 ,04	

FC 16 (10h) - Write Multiple Registers

This section elucidates Modbus function codes, initiating with FC 16 (10h), focusing on the functionality of writing multiple registers.

Request

Item	SA	FC	Data				CRC
			Start Address	No. of Registers	No. of Bytes	Register Value	
No. of Bytes	1	1	2	2	1	2 x N*	2
Value		10h	0000h to FFFFh	0001h to 0032h	2 x N*		

*N = Number of registers

Response

Item	SA	FC	Data		CRC
			Start Address	Number of Registers	
Number of Bytes	1	1	2	2	2
Value		10h	0000h to FFFFh	0001h to 0032h	

Error

Item	SA	Error Code	Exception Code	CRC
Number of Bytes	1	1	1	2
Value		90h	01, 02, 03, 04	

3.3 Modbus Exception Codes

This section outlines Modbus Exception Codes, providing information on the associated codes, names, and their respective meanings:

Code	Name	Meaning
01	Illegal Function	The function code received in the request is not an allowable action.
02	Illegal Data Address	The data address received in the query is not an allowable address.
03	Illegal Data Value	A value contained in the request data field is not an allowable value.
04	Slave Device Failure	An unrecoverable error occurred when attempting to perform the requested action.

3.4 Actuator Movement Control

Control Register Details

Register Address: 1000h

bit 0 - 15	M1 Position	Resolution: 1mm Range: 0 – 65535 0: retract to lower limit 65534: extend to upper end 65535: no movement
		<ul style="list-style-type: none"> ♦ Absolute synchronization is based on M1 position. ♦ This section is designated for action commands ranging from 0Bh to 0Eh.

Register Address: 1001h

bit 0 - 15	M2 Position	Resolution: 1mm Range: 0 – 65535 0: retract to lower limit 65534: extend to upper end 65535: no movement
		<ul style="list-style-type: none"> ♦ This section is designated for action commands ranging from 0Bh to 0Eh.

Register Address: 1002h

bit 0 - 15	Action
00h:	M1 & M2 actuators stop
01h:	M1 extends
02h:	M1 retracts
03h:	M2 extends
04h:	M2 retracts
05h:	M1 & M2 extend (simultaneous movement)
06h:	M1 & M2 retract (simultaneous movement)
07h:	M1 & M2 extend (relative synchronization)
08h:	M1 & M2 retract (relative synchronization)
09h:	M1 & M2 extend (absolute synchronization)
0Ah:	M1 & M2 retract (absolute synchronization)
0Bh:	M1 runs to the specified position
0Ch:	M2 runs to the specified position
0Dh:	M1 & M2 run to the specified position
0Eh:	M1 & M2 run to the specified position (absolute synchronization)
0Fh:	M1 & M2 extend to upper limit*
010h:	M1 & M2 retract to lower limit*

*Action commands 0Fh & 010h are intended to reset the position of actuators.

Example (hex): Modbus CRC-16 (Big Endian)

M1 & M2 retract to lower limit:

Request

SA	FC	Data	CRC
05	06	10 02 00 10	2C 82

Response

SA	FC	Data	CRC
05	06	10 02 00 10	2C 82

M1 & M2 extend (absolute synchronization):

Request

SA	FC	Data	CRC
05	06	10 02 00 09	ED 48

Response

SA	FC	Data	CRC
05	06	10 02 00 09	ED 48

M1 & M2 run to the specified position (absolute synchronization):

1. Send the position command.

(The example here is 100mm)

Request

SA	FC	Data	CRC
05	06	10 00 00 64	8D 65

Response

SA	FC	Data	CRC
05	06	10 00 00 64	8D 65

2. Then send the action command.

Request

SA	FC	Data	CRC
05	06	10 02 00 0E	AC 8A

Response

SA	FC	Data	CRC
05	06	10 02 00 0E	AC 8A

4. Register Map

4.1 Actuator Command

This register map provides a comprehensive overview of key parameters and controls for the actuator. Below is a summary of significant registers:

Register	Name	Description	Data Type	Access
1103h	M1 current limit – extend	Unit: 0.1 A	U16	R, W
1104h	M1 current limit – retract	Unit: 0.1 A	U16	R, W
1105h	M1 PWM – extend		U16	R, W
1106h	M1 PWM – retract		U16	R, W
1107h	M1 stroke limit	Bit 0 = Virtual upper limit ON/OFF Bit 1 = Virtual lower limit ON/OFF	U16	R, W
1108h	M1 virtual upper limit	Unit: 0.1 mm	U16	R, W
1109h	M1 virtual lower limit	Unit: 0.1 mm	U16	R, W
110Ah	M1 soft start – extend	Unit: 0.1 second	U16	R, W
110Bh	M1 soft start – retract	Unit: 0.1 second	U16	R, W
110Ch	M1 soft stop – extend	Unit: 0.1 second	U16	R, W
110Dh	M1 soft stop – retract	Unit: 0.1 second	U16	R, W
110Eh	M1 Deceleration before stroke limit - Upper limit	Unit: 0.1 mm	U16	R, W
110Fh	M1 Deceleration before stroke limit - Lower limit	Unit: 0.1 mm	U16	R, W
1113h	Termination resistor	ON/OFF	U16	R, W
1114h	Slave address	Allowed address: 1 to 246 0 = Broadcast, 247= Unassigned Default: 247 (Unassigned)	U16	R, W
1115h	Baud rate	0 = 9600, 1 = 19200, 2 = 57600, 3 = 115200 Default: 9600	U16	R, W
1116h	Response delay	Configure inter-frame delay range: 3 to 100ms	U16	R, W
1120h	M2 Current limit – extend	Unit: 0.1 A	U16	R, W
1121h	M2 Current limit – retract	Unit: 0.1 A	U16	R, W
1122h	M2 PWM – extend		U16	R, W
1123h	M2 PWM – retract		U16	R, W

1124h	M2 Stroke limit	Bit 0 = Virtual upper limit ON/OFF Bit 1 = Virtual Down limit ON/OFF	U16	R, W
1125h	M2 Virtual upper limit	Unit: 0.1 mm	U16	R, W
1126h	M2 Virtual lower limit	Unit: 0.1 mm	U16	R, W
1127h	M2 Soft start – extend	Unit: 0.1 second	U16	R, W
1128h	M2 Soft start – retract	Unit: 0.1 second	U16	R, W
1129h	M2 Soft stop – extend	Unit: 0.1 second	U16	R, W
112Ah	M2 Soft stop – retract	Unit: 0.1 second	U16	R, W
112Bh	M2 Deceleration before stroke limit - Upper limit	Unit: 0.1 mm	U16	R, W
112Ch	M2 Deceleration before stroke limit - Lower limit	Unit: 0.1 mm	U16	R, W

4.2 Configurable Data

This section outlines the key parameters for configuring position signals and the control of actuators.

A summary of the significant details is provided below:

Register	Name	Description	Data Type	Access
A01Ch	M1 Resolution (pulse/mm) * 100	-	U16	R, W

Configure M1 real-time position signals & cut-off types

Real-time position signals

bit1 bit0	Details
0	none
1	Double Hall sensors
2	POT

A02Bh

Cut-off types

bit2	Details
0	Two limit switches cut off the actuator at EOS
1	Two limit switches send signals at EOS and TID1 cut off actuator

Default: 001b

(Double Hall sensors with Two limit switches cut off the actuator at EOS)

A031h	M2 Resolution (pulse/mm) * 100	-	U16	R, W
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Configure M2 real-time position signals & cut-off types

Real-time position signals

bit1 bit0	Details
0	none
1	Double Hall sensors
2	POT

A040h

-

U16 R, W

Cut-off types

bit2	Details
0	Two limit switches cut off the actuator at EOS
1	Two limit switches send signals at EOS and TID1 cut off actuator

Default: 001b

(Double Hall sensors with Two limit switches cut off the actuator at EOS)

4.3 Actuator Status

This Actuator Status section provides insights into various operational parameters and status indicators.

Here's a breakdown of the relevant registers:

Register Name		Description	Data Type	Access
1300h	Clear data	Write 1: Clear all data	-	R
1301h	Measured input voltage	Unit: 0.1 V	U16	R
1302h	M1 Measured current	Unit: 0.1 A	U16	R
1303h	M1 Position of actuator	Unit: 0.1 mm	U16	R
1304h	M1 Actuator status	Independent status bit-indicator (1 = T, 0 = F):		U16 R
		bit 0	Running in extend direction	
		bit 1	Running in retract direction	
		bit 2	Stop at upper stroke limit	
		bit 3	Stop at lower stroke limit	
		bit 4	Over temperature	
1305h	M2 Actuator status	bit 5	Over voltage	
		bit 6	Under voltage	
		bit 7	Over current	
		bit 8	Reserved	
		bit 9	Stall	
		Bit 10 – 15: Reserved		
1306h	Measured temperature – Driver	Unit: 1°C	S16	R
1307h	Reserved			

4.4 Service Data

This Service Data section presents essential operational statistics and recorded parameters for the actuator's service history. Here's an overview of the relevant registers:

Register	Name	Description	Data Type	Access
1308h 1309h	M1 Total counts of extension	-	U32	R
130Ah 103Bh	M1 Total counts of retraction	-	U32	R
130Ch 130Dh	M1 Total time of operation	-	U32	R
130Eh	Highest temperature recorded – Driver	Unit: 1° Celsius	S16	R
130Fh	Lowest temperature recorded – Driver	Unit: 1° Celsius	S16	R
1310h	Total counts of over temperature protection – Driver	-	U16	R
1314h	Total counts of over voltage protection	-	U16	R
1315h	Total counts of under voltage protection	-	U16	R
1316h	M1 Total counts of over current protection – extending	-	U16	R
1317h	M1 Total counts of over current protection – retracting	-	U16	R
1319h	M1 Total counts of actuator stall – extending	-	U16	R
131Ah	M1 Total counts of actuator stall – retracting	-	U16	R
131Bh 131Ch	M1 Total distance – extension & retraction (mm)	-	U32	R
131Dh	M1 Total counts of low temperature operation	-	U16	R
1322h 1323h	M2 Total counts of extension	-	U32	R
1324h 1325h	M2 Total counts of retraction	-	U32	R
1326h 1327h	M2 Total time of operation(S)	-	U32	R
1328h	M2 Total counts of Over current protection – extending	-	U16	R
1329h	M2 Total counts of Over current protection – retracting	-	U16	R
132Bh	M2 Total counts of actuator stall – extending	-	U16	R
132Ch	M2 Total counts of actuator stall – retracting	-	U16	R

132Dh	M2 Total distance – extension & retraction	-	U32	R
132Eh				
132Fh	M2 Total counts of low temperature operation	-	U16	R