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TURCK

Absolute Multiturn Encoders
Modbus
RM-105/106

Manual

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Contents

1 Technical encoders specification

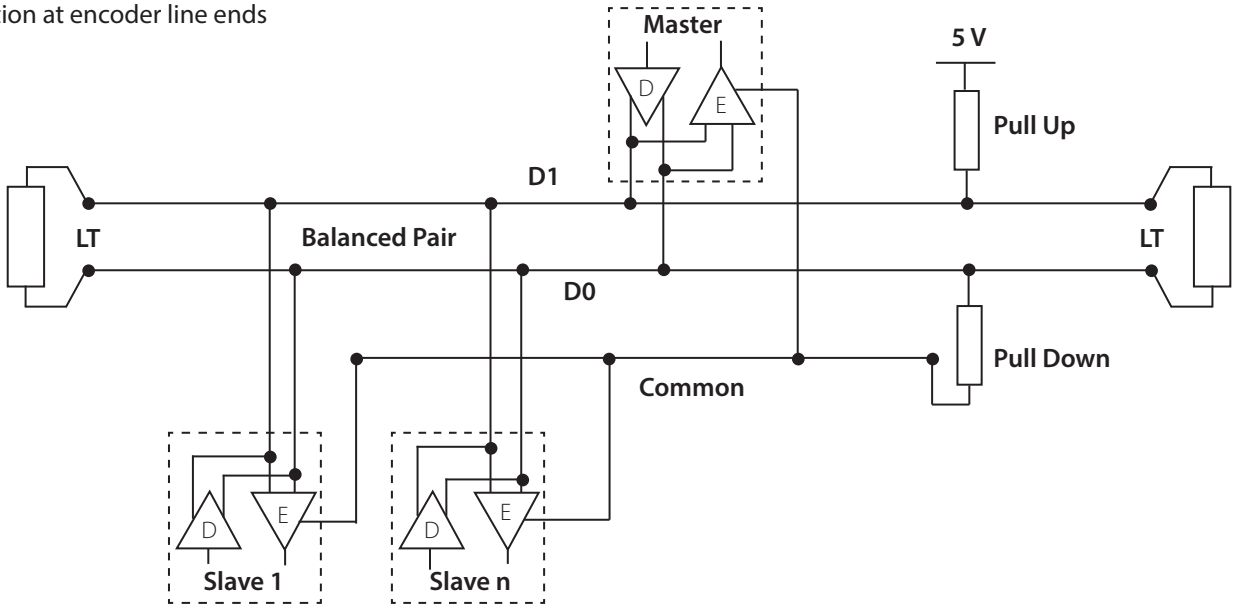
Electrical encoder feature
The RM-105/RM-106 multiturn is a particularly high resolution optical multiturn encoder without gears and with 100 percent magnetic insensitivity.

Absolute encoder system:	Singleturn with optical disk Multiturn with backup-battery
Output:	Modbus protocol RTU
Communication:	Default: 9600 Baud, 8 Data Bits, No parity, 1 Stopbit
Display:	no LED's
Interface:	RS-485 for Modbus
Connector system:	1 or 2 M12
Sensor:	contactless optical interface
Resolution:	65536 steps/per revolution
Revolution:	65536 turns
Default scaling:	32-Bit resolution Scaling off
Supply voltage:	10…30 VDC max. 80 mA

Reliable and insensitive
- Sturdy bearing construction for resistance against vibration and installation errors
- Ideal for use in a wide temperature range from -40°C up to +80°C [-40°F up to 176°F]
- All singleturn and multiturn functions on one single OptoASIC - offering the highest reliability, a high resolution up to 32 bits and 100% magnetic field insensitivity.

2 Modbus accesspoint

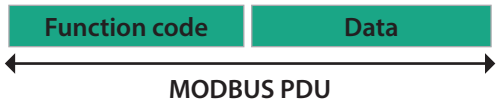
Termination at encoder line ends



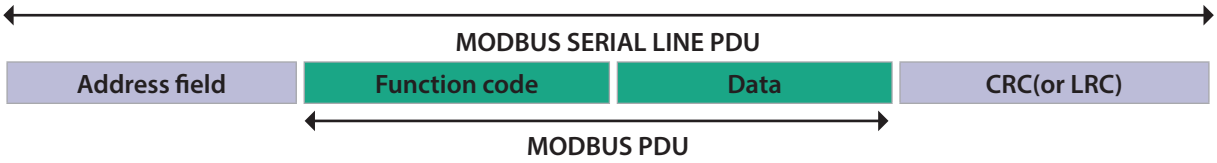
The bus termination is software configured by means of a register value. Once the Modbus has been looped through, it must be terminated between D0 and D1 at both ends using 120 ohm bus termination resistors on the last device.

3 Operating modes

The MODBUS application protocol [1] defines a simple Protocol Data Unit (PDU) independent of the underlying communication layers:



The mapping of MODBUS protocol on a specific bus or network introduces some additional fields on the Protocol Data Unit. The client that initiates a MODBUS transaction builds the MODBUS PDU, and then adds fields in order to build the appropriate communication PDU.



4 Modbus message RTU framing

In RTU mode, messages start with a silent interval of at least 3.5 character times.

MODBUS message

Start	Address	Function	Data	CRC Check	End
≥3.5 char	8 bits	8 bits	N x 8 bits	16 bits	≥3.5 char

This is most easily implemented as a multiple of character times at the baudrate that is being used on the network. The first field then transmitted is the device address in the range of 01…0xF7 (247) (248-255 reserved by Modbus). The allowable characters transmitted for all fields are hexadecimal 0–9, A–F.

Networked devices monitor the network bus continuously, including during the 'silent' intervals. When the first field (the address field) is received, the encoder decodes it to find out if it is the addressed device.
Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval.

The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message.

Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages.

5 RTU transmission mode

In RTU mode, messages start with a silent interval of at least 3.5 character times. This is most easily implemented as a multiple of character times at the baud rate that is being used on the network (shown as T1–T2–T3–T4 in the figure below). The first field then transmitted is the device address.
The allowable characters transmitted for all fields are hexadecimal 0–9, A–F. Networked devices monitor the network bus continuously, including during the 'silent' intervals. When the first field (the address field) is received, each device decodes it to find out if it is the addressed device.
Following the last transmitted character, a similar interval of at least 3.5 character times marks the end of the message. A new message can begin after this interval. The entire message frame must be transmitted as a continuous stream. If a silent interval of more than 1.5 character times occurs before completion of the frame, the receiving device flushes the incomplete message and assumes that the next byte will be the address field of a new message. Similarly, if a new message begins earlier than 3.5 character times following a previous message, the receiving device will consider it a continuation of the previous message. This will set an error, as the value in the final CRC field will not be valid for the combined messages. A typical message frame is shown below.

START	ADDRESS	FUNCTION	DATA	CRC CHECK	END
T1-T2-T3-T4	8 BITS	8 BITS	*n* x 8 BITS	16 BITS	T1-T2-T3-T4

6 Modbus node number

Node number 0 is reserved and must not be used by any node.
The resulting node numbers lie in the range 1...F7h hexadecimal (1...247 decimal, 248-255 reserved).

Encoder default: 0x3F

7 Data model

MODBUS bases its data model on a series of tables that have distinguishing characteristics. The four primary tables are:

Primary tables	Object type	Type of	Comments
Discrete Input	Single bit	Read-Only	This type of data can be provided by an I/O system.
Coils	Single bit	Read-Write	This type of data can be alterable by an application program
Input Registers	16-bit word	Read-Only	This type of data can be provided by an I/O system
Holding Registers	16-bit word	Read-Write	This type of data can be alterable by an application program

The distinctions between inputs and outputs, and between bit-addressable and word-addressable data items, do not imply any application behavior.

8 Data addresses in Modbus messages

All data addresses in Modbus messages are referenced to zero. The first occurrence of a data item is addressed as item number zero. For example:

- Holding register 40001 is addressed as register 0000 in the data address field of the message. The function code field already specifies a 'holding register' operation. Therefore the '4XXXX' reference is implicit. The CAN baud rate
- Holding register 40004 is addressed as register 0003 hex (3 decimal).

9 General Modbus register mapping

Read holding register mapping

Reads the binary contents of holding registers (4XXXX references) in the encoder slave.
Broadcast is not supported.

Register	Data Name	Order	ATT	Value	Register	Mandatory
40002	POSITION UPPER VALUE	00001	MSB	Position Value Bit 17-32	16-Bit	Yes
40003	POSITION LOWER VALUE	00002	LSB	Position Value Bit 1-16	16-Bit	Yes
40004	REVERSE STATE	00003	MSB	Acutal State CW = 2, CCW = 1	16-Bit	Yes
40005	TERMINATION STATE	00004	MSB	Termination on = 1, off = 0	16-Bit	Yes
40006	COMMISION. DIAG.	00005	MSB	Diagnostic / Error Result	16-Bit	NO
40007	COMPARE STATE	00006	MSB	0 = inside, 1 < Lowerlimit, 2 > Upperlimit	16-Bit	NO
40008	BATTERY VOLTAGE	00007	MSB	Actual Battery Voltage in VDC	16-Bit	NO
40009	SENSOR TEMPERATURE	00008	MSB	Actual Sensor temperature °C	16-Bit	NO
40010	MEASURING UNITS (MUR)	00009	MSB	Measuring Units / REv	16-Bit	NO
40011	MEASURING UNITS (MUR)	00010	LSB	Measuring Units / REv	16-Bit	NO
40012	TOTAL MEASURING RANGE	00011	MSB	Total Measuring Range (TMR)	16-Bit	NO
40013	TOTAL MEASURING RANGE	00012	LSB	Total Measuring Range (TMR)	16-Bit	NO
40014	SCALING FUNCTION	00013	MSB	Scaling active = 1, off = 0	16-Bit	NO
40015	SERIAL NUMBER	00014	MSB	Serial Number	16-Bit	NO
40016	SERIAL NUMBER	00015	LSB	Format YYDDDNNNNN	16-Bit	NO
40017	FIRMWARE	00016	MSB	Checksum Firmware	16-Bit	NO

10 Write holding register mapping

Description
Write values into a sequence of holding registers (4XXXX references). When broadcast, the function presets the same register references in all attached encoder slaves.

Note:
The function will override the encoder memory protect state.
The programmed values will remain valid in the registers during the complete power-cycle and some functions will achieve immediately.
All green tagged values need a power off/on cycle before they are valid and as of now the encoder works with the new register contents. The blue tagged values will achieve immediately after a valid update command (preset, Count direction, termination).
The register values will remain and stored in a non volatile memory, independent if they are not programmed in the controller's logic.

Register	Data Name	Int Reg.	Order	Attrib	Value	Defaults
40257	BAUDRATE	256	MSB	W	Baudrate 1 = 9600, 2 = 19200, 3 = 38400, 4 = 57600, 5 = 115200	01
	NUMBER DATA	257	MSB	W	Number of Data 2 = 8 Bit	02
	PARITY	258	MSB	W	Parity 1 = No, 2 = Even, 3 = Odd	01
	STOPBITS	259	MSB	W	Stopbits 1=1 Stop, 3=2 Stop	01
40261	COMM UPDATE	260	MSB	W	Communication Update 1 = execute	0
40262	NODE ADDRESS	261	MSB	W	Node-ID 1…247 (1..0 x F7)	0 x 3F
40263	NODE UPDATE	262	MSB	W	Node-ID Update 1 = execute	0
40264	PRESETVALUE	263	MSB	W	Preset High Word MSB	0x0000, 0xFFFF
	PRESETVALUE	264	LSB	W	PresetLow Word LSB	0x0000, 0xFFFF

40266	PRESET UPDATE	265	MSB	W	Preset Update 1 = execute	0
40267	COUNT DIRECT	266	MSB	W	Count Direction CCW = 1, CW = 2	2
40268	COUNT UPDATE	267	MSB	W	Count Direction Update 1 = execute	0
40269	TERMINATION	268	MSB	W	Termination Modbus off = 0, on = 1	0
40270	TERM UPDATE	269	MSB	W	Termination Update 1 = execute	0
40271	SERIAL NUMBER[2]	270	MSB	W	Serial Number High Word	130000
40272	SERIAL NUMBER[2]	271	LSB	W	Serial NumberLow Word	123456
40273	SERIAL UPDATE[2]	272	MSB	W	Serial Number Update 1 = execute	0
40274	SENSOR DIAG[2]	273	MSB	W	Sensor Diagnostic (internal Register val)	0
40275	LOWER LIMIT	274	MSB	W	Lower Limit Value	0
40276	UPPER LIMIT	275	MSB	W	Upper Limit Value	28 Bit-1
40277	COMPARE ACTIV.	276	MSB	W	Compare active = 1, 0 = no comparison	0
40278	MUR (MSB)	277	MSB	W	Measuring Units/REV MSB Word	0x0001
40279	MUR (LSB)	278	LSB	W	Measuring Units/REV LSB Word	0x0000
40280	TMR (MSB)	279	MSB	W	Total Measuring Range MSB Word	0x1000
40281	TMR (LSB)	280	LSB	W	Total Measuring Range LSB Word	0x0000
40282	SCALING FUNCTION	281	MSB	W	Scaling inactive = 0, Scaling Active = 1	0
40283	DELAY PRESCALER	282	MSB	W	Delay after t3.5 (1…32 * t3.5)	1

Note:
All additional holding registers have an additional functionality and are not for general use.

11 Supported Modbus function codes in project

Function 03 read holding registers general description

Query
The query message specifies the starting register and quantity of registers to be read. Registers are addressed starting at zero: registers 1–16 are addressed as 0–15. Here is an example of a request to read registers 40108–40110 from slave device.

QUERY

Field Name	Example (Hex)
Slave Address	11
Function	03
Starting Address Hi	00
Starting Address Lo	6B
No. of Points Hi	00
No. of Points Lo	03
Error Check (LRC or CRC)	—

Response
The register data in the response message are packed as two bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits. The response is returned when the data is completely assembled. Here is an example of a response to the query shown above:

RESPONSE

Field Name	Example (Hex)
Slave Address	11
Function	03
Byte Count	06
Data Hi (Register 40108)	02
Data Lo (Register 40108)	2B
Data Hi (Register 40109)	00
Data Lo (Register 40109)	00
Data Hi (Register 40110)	00
Data Lo (Register 40110)	64
Error Check (LRC or CRC)	—

12 Function 16 (10 Hex) preset multiple registers

Query
The query message specifies the register references to be preset. Registers are addressed starting at zero: register 1 is addressed as 0. Here is an example of a request to preset two registers starting at 40002 to 00 0A and 01 02 hex, in slave device 17 (0x11):

Response

QUERY

Field Name	Example (Hex)
Slave Address	11
Function	10
Starting Address Hi	00
Starting Address Lo	01
No. of Registers Hi	00
No. of Registers Lo	02
Byte Count	04
Data Hi	00
Data Lo	0A
Data Hi	01
Data Lo	02
Error Check (LRC or CRC)	—

The normal response returns the slave address, function code, starting address, and quantity of registers preset. Here is an example of a response to the query shown above.

RESPONSE

Field Name	Example (Hex)
Slave Address	11
Function	10
Starting Address Hi	00
Starting Address Lo	01
No. of Registers Hi	00
No. of Registers Lo	02
Error Check (LRC or CRC)	—

13 Function 03 Read holding registers

Description
Reads the binary contents of holding registers (4X references) in the slave.
Broadcast is not supported.

Register	Data Name	Order	ATT	Value	Register	Mandatory
40002	POSITION	00001	MSB	Position Value Bit 17-32	16-Bit	Yes
40003	POSITION	00002	LSB	Position Value Bit 1-16	16-Bit	Yes
40004	REVERSE STATE	00003	MSB	Actual State CW = 2,CCW = 1	16-Bit	Yes
40005	TERMINATION STATE	00004	MSB	Termination on = 1 ,off = 0	16-Bit	Yes
40006	COMMISION. DIAG	00005	MSB	Diagnostic /Error Result	16-Bit	NO
40007	COMPARE STATE	00006	MSB	0=inside, 1<Lowerlimit, 2> Upperlimit	16-Bit	NO
40008	BATTERY VOLTAGE	00007	MSB	Actual Battery Voltage in VDC	16-Bit	NO
40009	SENSOR TEMPERATURE	00008	MSB	Actual Sensor temperature °C	16-Bit	NO
40010	MEASURING UNITS (MUR)	00009	MSB	Measuring Units/REv	16-Bit	NO
40011	MEASURING UNITS (MUR)	00010	LSB	Measuring Units/REv	16-Bit	NO
40012	TOTAL MEASURING RANGE	00011	MSB	Total Measuring Range (TMR)	16-Bit	NO
40013	TOTAL MEASURING RANGE	00012	LSB	Total Measuring Range (TMR)	16-Bit	NO
40014	SCALING FUNCTION	00013	MSB	Scaling active =1, off = 0	16-Bit	NO
40015	SERIAL NUMBER	00014	MSB	Serial Number	16-Bit	NO
40016	SERIAL NUMBER	00015	LSB	Format YYDDDNNNNN	16-Bit	NO
40017	FIRMWARE	00016	MSB	Checksum Firmware	16-Bit	NO

Note:
All holding registers in red have an additional functionality and are not for general use.

Position value query register 40002 (16 or 32-bit access)
Expected value range

Position values depending on the adjusted scaling factor.

Singleturn resolution	16 bit:	0..0xFFFF (0..65535)	CW
		0xFFFF…0	CCW
Multiturn resolution	16+16 bit:	$0..2^{32}$	CW
		2^{32}… 0	CCW

Deterministic position delay time:	40µs
Position jitter:	+/- 1µs
Total response delay for position values:	40µs + process time for response frame
Estimated response delay for position:	100µs
Minimum cycle time for position update:	2ms (timeout t3.5 + 300µs)

Calculation example in practice:

Velocity from encoder:	1000 rpm
Calculated position delay:	1000/60 sec = 16.67 rpm/sec
Factor /100µs:	$16.67 / 100 * 10^{-6} = 0{,}001667$
Total steps in 100µs at 14 bit resolution	0,001667 * 16384 (14bit) = 27 steps
Velocity from encoder:	100 rpm
Total steps in 100µs at 14 bit resolution	0,0001667 * 16384 (14bit) = 3 steps

Conclusion
After reading the position value, the actual position has a deterministic delay which depends on the velocity of the encoder.

Actual reverse state query register 40004
Expected value in project:

Allowed count direction values:

Counterclockwise CCW = 1
Clockwise CW = 2

Default:	Clockwise CW = 2
Estimated response delay for reverse state:	10µs + process time for response frame
Minimum cycle time for actual reverse update:	2ms

Actual bus termination state query register 40005
Expected value in project:

Allowed bus termination values:
Bus termination off = 0
Bus termination on = 1

Estimated response delay for termination state:	10µs + process time for response frame
Minimum cycle time for actual termination update:	2ms

Actual commissioning diag state query register 40006:
Expected values for project:

Stored values:	Actual result of internal diagnostic test routines
Default:	COMM_NULL_ERR 0x0000 COMM_BATTERY_LOW 0x8001 COMM_INIT_FAULT 0x8002 COMM_ICLG_TEMP 0x8003 COMM_ICLG_OPTIC_FAIL 0x8004 COMM_FLASH_MODE 0x8005
Response delay after Execute diag command:	200µs

Read actual compare state register 40007
Expected values for project:

Compare values:	0 = inside values , 1 < lowerlimit, 2 > upperlimit
Default:	0 (inside) and comparison off
Response delay after Execute velocity command:	200µs

Read actual battery voltage of encoder register 40008 (only multiturn)
Expected values for project:

Battery values:	in Volt DC
Default:	350 … 365 -> 3.50 … 3.65 VDC
Singleturn:	0
Battery 1. warning level	2.6 VDC
Battery critical level	2.2 VDC
Singleturn value	0
Update Rate:	6 min

Read actual sensor temperature register 40009
Expected values for project:

Sensor temperature values:	in °C
Default:	25 °C (ambient temperature)
Temperature range	-40°C … 80°C [-40°F … 176°F]
Temperature critical level	100°C
Response delay after Update rate:	60 sec

Scaling parameters register (16 or 32-bit access)
MUR measuring units per revolution 40010
TMR total measuring range 40012
Expected value range:

Position values depending on the adjusted scaling factor.

MUR 16 bit:	0..0xFFFF (0..65535)	CW
	0xFFFF…0	CCW
TMR 16+16 bit:	$0..2^{32}$	CW
	2^{32}… 0	CCW

Deterministic position delay time:	40µs
Position jitter:	+/- 1µs
Total response delay for position values:	40µs + process time for response frame
Estimated response delay for position:	100µs
Minimum cycle time for position update:	2ms (timeout t3.5 + 300µs)

Scaling active state query register 40014
Expected value in project:

Scaling values:

Scaling off = 0
Scaling on = 1

Estimated response delay for termination state:	10µs + process time for response frame
Minimum cycle time for actual termination update:	2ms

Serial number register 40015/16 (32-bit access)
Expected value range

Allowed values:	Actual serial number in following format	
	0xYYDDDNNNNN	
	0xYY	year (last 2 digits)
	0xDDD	actual day of the year (1..365)

40015	SERIAL NUMBER	MSB	W	Serial Number High Word	0xYYDDD

Low word SN number	0xNNNNN	continuously number 1…65535

40016	SERIAL NUMBER	LSB	W	Serial NumberLow Word	0xNNNNN

Response delay after Execute SN update command:	15 ms (t.b.d) needed for storage operation

Read actual firmware release register 400017
Expected values for project:

Stored values:	Actual firmware release checksum
Default:	0xXXXX
Response delay after Execute firmware command:	200µs

14 Function 16 (10 Hex) write multiple registers

Multiturn encoder

Register	Data Name	Int Reg.	Order	Attrib	Value	Defaults
40257	BAUDRATE	256	MSB	W	Baudrate 1 = 9600, 2 = 19200, 3 = 38400, 4 = 57600, 5 = 115200	01
	NUMBER DATA	257	MSB	W	Number of Data 2=8Bit	02
	PARITY	258	MSB	W	Parity 1= No, 2=Even, 3=Odd	01
	STOPBITS	259	MSB	W	Stopbits 1=1 Stop, 3= 2Stop	01
40261	COMM UPDATE	260	MSB	W	Communication Update 1= execute	0
40262	NODE ADDRESS	261	MSB	W	Node-ID 1…247 (1..0xF7)	0x3F
40263	NODE UPDATE	262	MSB	W	Node ID Update 1= execute	0
40264	PRESETVALUE	263	MSB	W	Preset High Word MSB	0x0000
	PRESETVALUE	264	LSB	W	PresetLow Word LSB	0x0000
40266	PRESET UPDATE	265	MSB	W	Preset Update 1= execute	0
40267	COUNT DIRECT	266	MSB	W	Count Direction CCW = 1,CW = 2	2
40268	COUNT UPDATE	267	MSB	W	Count Direction Update 1= execute	0
40269	TERMINATION	268	MSB	W	Termination Modbus off = 0, on = 1	0
40270	TERM UPDATE	269	MSB	W	Termination Update 1= execute	0
40275	LOWER LIMIT	274	MSB	W	Lower Limit Value	0
40276	UPPER LIMIT	275	MSB	W	Upper Limit Value	0
40277	COMPARE ACTIV.	276	MSB	W	Compare active = 1 , 0 = no comparison	0
40278	MUR (MSB)	277	MSB	W	Measuring Units/REV MSB Word	0x0001
40279	MUR (LSB)	278	LSB	W	Measuring Units/REV LSB Word	0x0000
40280	TMR (MSB)	279	MSB	W	Total Measuring Range MSB Word	0x1000
40281	TMR (LSB)	280	LSB	W	Total Measuring Range LSB Word	0x0000
40282	SCALING FUNCTION	281	MSB	W	Scaling inactive = 0 , Scaling Active = 1	0
40283	DELAY PRESCALER	282	MSB	W	Delay after t3.5 (1 …32 * t3.5)	1

Note:
All holding registers in green need a power off/on cycle.

Note:
All input values for communication and other functionality will be checked on plausibility.
Other values as defined are not allowed and will cause an error message.

Note:
All write-cycles and update commands have different storage times.
Please adjust the command response timeout to max. of 2 seconds.

Write communication parameters (Register 40257)
Execute communication preset (Register 40261)
Default communication values for project:

Note:
After a communication update all communication parameters will not be valid until a complete power off/on cycle. The new values will be stored and executed only after a new power-on cycle.

Singleturn PARAMETERS:	9600 Baud, 8Data, No parity, 1Stop[3]
Multiturn PARAMETERS:	9600 Baud, 8Data, No parity, 2Stop[3]
	[3]Remark : the use of no parity and 115kb requires 2 stop bits.
Response delay after Execute comm update command:	15 ms needed for storage operation

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Write Node-ID (Register 40262)
Write Node-ID Update (Register 40263)
Default Node-ID values for project:

Valid Node ID's are in the range 0x01…0xF7 (0x00 is reserved for plc, 248 ..255 reserved)

Note:
After a Node-ID update the new Node-ID will not be valid until a complete power off/on cycle. The new Node-ID will be stored and executed only after a new power-on cycle.

Write position preset value (Register 40264)
Write position preset update (Register 40266)
Preset values for project:

The actual position value of the encoder will be set immediately to the programmed preset value after a valid update command. This allows, for example, for the encoder's zero position to be compared with the application zero position. After transmission of preset values a range checking is initiated. Only allowed in encoder stillstand.

Singleturn preset	0x0000
Multiturn preset	0x0000
Preset range singleturn	0….65535 (16 bit)
Preset range multiturn	0…2^{32} -1 (32 bit)
Preset delay time:	100µs
Verification of position after preset:	yes (internal)
Response delay after Execute preset update command:	20ms needed for storage operation

Write count direction value (Register 40267)
Write count direction update (Register 40268)
Default value for project:

Allowed count direction values :
Counterclockwise CCW = 1
Clockwise CW = 2

Default:	Clockwise CW = 2
Response delay after Execute reverse update command:	15 ms needed for storage operation

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Write termination Modbus (Register 40269)
Write termination update (Register 40270)
Default value for project:

The bus termination is software configured by means of the register 40269 value. Once the Modbus has been looped through, it must be terminated between D0 and D1 at the last encoder end.

Allowed values:	Termination off = 0, Termination on = 1
Default multiturn	Termination on = 1 (on)
Response delay after Execute termination update command:	15 ms needed for storage operation

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Write lower limit value (Register 40275)
Write upper limit value (Register 40276)
Preset limit values for project:

The actual position value of the encoder will immediately be compared with the programmed limit value after a valid update command. This allows, for example, for the encoder's position to be compared with the application position. After transmission of preset values a range checking is initiated.

Lower limit preset	0x0000 ..0xFFFF
Upper limit preset	0x0000…0xFFFF
Preset delay time:	100µs
Verification of position after preset:	yes (internal)
Response delay after Execute preset update command:	15 ms needed for storage operation

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Write compare update (Register 40277)
Preset scaling update for project:

Compare active	0=off, 1=on, Default = off
Delay time:	100µs
Verification of position after preset:	yes (internal)
Response delay after Execute preset update command:	15 ms needed for storage operation

Write MUR value (Register 40278)
Write TMR value (Register 40280)
Preset scaling values for project:

The actual position value of the encoder will immediately be compared with the programmed limit value after a valid update command. This allows, for example, for the encoder's position to be compared with the application position. After transmission of preset values a range checking is initiated.

MUR
This parameter configures the desired resolution per revolution. The encoder itself then internally calculates the appropriate scale factor. The calculated scaling factor MURF (by which the physical position value will be multiplied) is worked out according to the following formula:

MURF = Measuring steps per revolution (40278) / phys. resolution singleturn (65536)

Range of values:	1…maximum physical resolution (65536) 16-bit
Default setting:	65536 multiturn

TMR
This parameters configures the total number singleturn and multiturn measuring steps. A factor will be applied to the maximum physical resolution. The factor is always < 1. After the stated number of measuring steps, the encoder will reset itself to zero (notice limitations)*

TMR = ((phys.total measuring range / phys. singleturn resolution) * MURF)

Range of values:	TMR 1…maximum physical resolution (4294967296) 32-bit
Default setting:	33554432 (25-bit)

Write scaling update (Register 40281)
Preset scaling update for project:

Scaling active	0=off, 1=on, Default = OFF
Preset delay time:	100µs
Verification of position after preset:	yes (internal)
Response delay after Execute preset update command:	15 ms needed for storage operation

---

Write delay prescaler after request from PLC (Register 40282)
Preset delay prescaler value:

Allowed delay prescaler values active	1 …32
Preset delay time:	1 = (1*t3.5) = 1750µs 2 = (2*t3.5) = 3,5ms …
Max. delay time	32 = (32*t3.5) = 56 ms at baudrate > 9600 128ms at baudrate 9600
Verification of position after preset:	yes (internal)
Response delay after Execute preset update command:	15 ms needed for storage operation

15 Unsupported Modbus function codes

Not part of the implementation are following function codes:
01 Read Coil Status
02 Read Input Status
04 Read Input Registers
05 Force Single Coil
06 Preset Single Register
07 Read Exception Status
11 (0B Hex) Fetch Comm Event Ctr
12 (0C Hex) Fetch Comm Event Log
15 (0F Hex) Force Multiple Coils
20 (14Hex) Read General Reference
21 (15Hex) Write General Reference
22 (16Hex) Mask Write 4X Register
23 (17Hex) Read/Write 4X Registers
24 (18Hex) Read FIFO Queue

16 Additional supported Modbus function codes

17 (11 Hex) report slave ID

Description
Returns a description of the type of encoder present at the slave address, the current status of the slave run indicator, and other information specific to the slave device. Broadcast is not supported.

Query
Here is an example of a request to report the ID and status of slave device 17:

QUERY

Field Name	Example (Hex)
Slave Address	11
Function	11
Error Check (LRC or CRC)	—

Response
The format of a normal response is shown below. The data contents are specific to each type of encoder. They are listed on the following pages.

A Summary of slave IDs

These are the slave ID codes returned by Turck encoder in the first byte of the data field:

The Turck Modbus encoder returns a byte count of 31 as follows:

Byte contents
1 Slave address (actual encoder)
2 Function code
3 Byte length
4 Slave ID encoder
5 RUN indicator status (0 = Modbus OFFline (diagnostic), 0xFF = Modbus operational)
6-27 System information encoder type, company name, SW-version (ASCII format)
28,29 Error counter
30,31 CRC

4 Slave ID encoder
Singleturn encoder 1
Multiturn encoder 2

6..27 21 byte ASCII-Format "Turck RM-105/RM-106 Modbus"

17 Modbus exception codes

Code name meaning

01 ILLEGAL FUNCTION
The function code received in the query is not an allowable action for the slave. If a Poll Program Complete command was issued, this code indicates that no program function preceded it.

02 ILLEGAL DATA ADDRESS
The data address received in the query is not an allowable address for the slave.

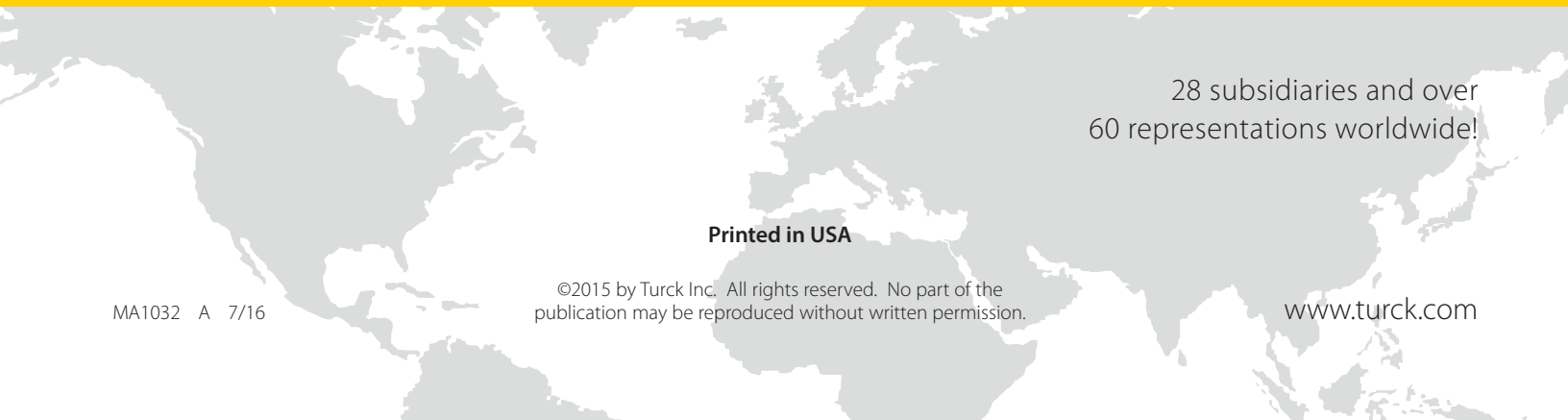
03 ILLEGAL DATA VALUE
A value contained in the query data field is not an allowable value for the slave.

04 SLAVE DEVICE FAILURE
An unrecoverable error occurred while the slave was attempting to perform the requested action.

05 ACKNOWLEDGE
The slave has accepted the request and is processing it, but a long duration of time will be required to do so. This response is returned to prevent a timeout error from occurring in the master. The master can next issue a Poll Program Complete message to determine if processing is completed.

06 SLAVE DEVICE BUSY
The slave is engaged in processing a long–duration program command. The master should retransmit the message later when the slave is free.

TURCK



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