



smartris Modbus Communication



<Note>

- This product should be handled by only those who have been trained for the work.
Please read this manual carefully before use.
- Deliver this manual to the customer who will actually use the product.
- This instruction manual should be carefully stored.

Introduction: Safety Precautions


- Carefully read this maintenance manual and all accompanying documents before use (installation, operation, maintenance, inspection, etc.). Please use this product after thoroughly understanding the machine, information about safety, and all precautions for correct operation. After reading, retain this manual for future reference.
- Pay close attention to the "DANGER" and "CAUTION" warnings regarding safety and proper use.



Improper handling may result in physical damage, serious personal injury and / or death.



Improper handling may result in physical damage and/ or personal injury.

Matters described in  may lead to serious danger depending on the situation. Be sure to observe important matters described herein.



- Transport, installation, wiring, operation, maintenance, and inspections should be performed by trained technicians; otherwise, electric shock, injury, fire, or damage to the equipment may result.
- When the unit is to be used for the personnel transport vehicle, install a safety protecting device on the elevator side to prevent it from falling; otherwise, personal injury or damage to the equipment due to falling of hoisting equipment.

Introduction: Reading the Maintenance Manual, Table of Contents

This is the maintenance manual for Modbus communication for the smartris servo drive unit.^{Note}
Please refer to the maintenance manual for the smartris servo drive unit (No. DM1802E) regarding drive unit operations, or to the smartris gearmotor maintenance manual (No. DM1801E) regarding handling of motor and gear parts.

Note: 「RS-485 Modbus RTU Communication」 is written as 「Modbus Communication」.

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1-1 Purpose of This Document

This document describes the safe installation and operation of this product (smartris).

Please read this before using, and follow all safety warnings and cautions herein to ensure safe handling of this product.

Keep this document in a location where you can use it at any time.

CAUTION

- This document is a maintenance manual for qualified persons who will use this product.
- This document is the maintenance manual for Modbus.

This document is written under the following conditions and restrictions:

- This document contains proprietary information.
- Information related to Modbus networking is provided for servo drive users.
- Descriptions and figures contained in this document are for explanation and reference only.
- Company and individual names used in data and examples are fictitious unless any note is added.
- Note that the contents of this manual may change without notice.

1-2 Safety Precautions

Follow the safety procedures described in this document to ensure safe operation.

When operating this product and its peripheral devices, it is required to protect its operators and the surrounding area.

CAUTION

- It is necessary to confirm that all system switches are working properly and that there are no warning indicators.
- Before startup, check wiring and confirm that there is no damage to the drive unit.
- Applying more voltage than those specified or reversing the cable connections may cause faults in the drive unit.
- Do not connect or disconnect cables while the power is ON or during operation.
- Operators are responsible for performing safe installations in compliance with any applicable laws and standards.

Note: Thoroughly read this document before performing installation.

This product contains parts that are sensitive to static electricity; improper handling may result in faults.

To prevent electrostatic faults, avoid contact with highly insulating plastic films and synthetic fibers.

Place this product on a conductive material and ground it to discharge static electricity.

Keep covers and control panels closed to avoid worker injury and product faults.

1. Overview

DANGER

- Never connect or disconnect drive unit wiring when the power is ON; otherwise, faults or electrocution due to arcing discharge may occur.
- High voltage is applied to cables even when the motor is stopped. Never remove any cables.
- When disconnecting power connections after turning the power off, wait at least one minute before touching the device, because capacitors and contacts will remain charged. We recommend using an instrument to measure voltage before touching the device.

CAUTION

- The following are cautions for avoiding personal injury and faults in the product and other devices.
- Only apply DC power within the voltage specifications listed in this document.
 - When connecting power cables to this product, isolate it from dangerous high-voltage lines and conduct insulation that complies with safety standards.
 - Before operating this product, ensure it was installed according to the procedures in this manual.
 - Confirm proper operation before using the Safe Torque Off function.
 - If the device catches fire, never throw water directly on it to extinguish it.

CAUTION

- This is information for confirmation to ensure normal operation and understanding of the product.

Safety measures must be followed for workers and devices according to the appropriate standards.

1-3 Approval

(1) CE Conformity

This product is certified for the conformance with the following EC Directives by Certification Bodies.

- EMC Directive (2014/30/EU)
- RoHS Directive (2011/65/EU)
- WEEE Directive (2012/19/UE)

(2) Safety

This product is compliant with the following EN safety standards:

- **EN 61800-5-1** : Adjustable speed electrical power drive systems - Part 5-1: Safety requirements
 - Electrical, thermal and energy.

(3) EMC Requirements

This product satisfies the requirements for emission and immunity conditions of “type-2 environments” (industrial environments) category.

- **EN 61800-3** : Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods.

(4) Safety Conformity (STO)

This product is equipped with two-channel Safe Torque Off (STO) input compliant with safety functions. This function stops PWM output and safely stops torque of the drive unit.

The circuit designs have been tested and certified by TÜV SÜD.

STO safety function for circuit designs in this product are compliant with the following EN standards:

- **EN61508** : Functional safety of electrical/electronic/programmable electronic safety-related systems
- **EN61800-5-2** and category : Adjustable speed electrical power drive systems - Part 5-2: Safety requirements - Functional
- **EN ISO 13849-1:2015** : Safety of machinery - Safety-related parts of control systems - Part 1 : General principles for design.

Subsystems include safety conditions with the following characteristics:

EN 13849-1	EN 61508	PFHD [1/h]
PLe	SIL3	-

1-4 Startup

EMC directives forbid startup before confirmation that this product was installed in compliance with EC Directive standards.

(1) Proper Usage

This product can be applied to drive synchronous servomotors using permanent magnets (servomotors compatible with machine and system feedback systems).

This product is certified for use in industrial applications. Note that its use in residential areas requires additional EMC countermeasures.

The customer will need to prepare a risk analysis for the final product.

CAUTION

- Customers planning use for nonindustrial applications must first obtain our approval.

(2) Inappropriate Uses

This product is incompatible with motors other than synchronous servomotors. It also cannot be used in motors incompatible with feedback systems.

Note that installation in areas presenting the danger of flammable materials, flammable gases, dust, etc., can result in fire or explosion. Do not install the drive unit or motor of this product in such environments.

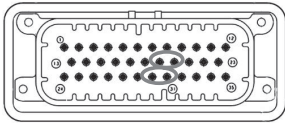
1. Overview

1-5 Terms and Abbreviations

Name	Description
EMCY	Emergency Object
EMC	Electromagnetic Compatibility
HMI	Human Machine Interface
I/O	Input/Output
LSB	Least Significant Bit/Byte
MASTER	It is a device that controls and communicates with drive.
MSB	Most Significant Bit/Byte
MSM	Macro State Machine
Node Id	Node address assigned to a device on the network.
PDS	Power Drive System.
REG	Register
RO	Denotes Read-Only access.
RW	Denotes Read Write access.
RX	Messages sent by Main Control Board and received by Drive.
STO	Safe Torque Off
TX	Messages sent by the drive and received by the main control box.
W/R	Write/Read

2. Modbus Communication

2-1 Connection for Modbus Communication



Connector X1

Table 2-1 Modbus Signals

Pin No.	Signal	Description
19	GND_CAN/GND_RS485	GND (CANopen or RS485 Modbus)
20	CAN_T/RS485_T	Termination resistor 120Ω (Connection for CAN_H/RS485+)
30	CAN_L/RS485-	Connection for CAN_L or RS485-
31	CAN_H/RS485+	Connection for CAN_H or RS485+

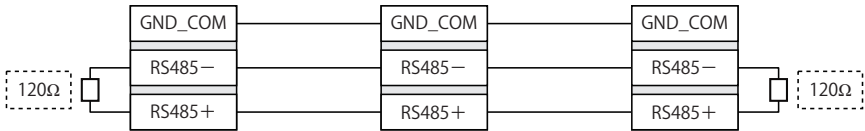


Fig. 2-1 Connection for Modbus Communication

The two ends of the CAN cables must be terminated by a resistor of 120Ω.

The CAN bus can be closed with a resistance terminator into to the drive using Pin 20. The CAN_T pin has to connect to CAN_H pin on Connector X1.

2-2 Modbus Communication Settings

Write Single Holding Resistors (0x06)/ Read Holding Resistors (0x03)

Physical Address

Variable	PDU Address (W/R)	Default Value	Choice
Modbus Address	0x0028	1	1 ~ 247

Baud Rate

Variable	PDU Address (W/R)	Default Value	Choice
Modbus Baud Rate	0x0035	192 → 19200	96 → 9600 b
			192 → 19200 b
			384 → 38400 b
			576 → 57600 b
			1152 → 115200 b

Communication Settings

Variable	PDU Address (W/R)	Default Value	Choice
Parity	0x002B	0	0 → NO parity/2 Stop Bits/8 Data Bits
Stop Bit			1 → ODD Parity/1 Stop bit/8 Data bits
Data Bit			2 → EVEN Parity/1 Stop Bit/8 Data Bits

⚠ WARNING

- The Modbus address is the physical address and depends if there are more devices together.
- The modifies of baud rate or parity can cause communication issues.
- They depend to hardware connection.
- In case of sending different value drive gives the Exception Code 0x03. (See chapter 7)
- The smartris drive is always set as a slave.

2. Modbus Communication

2-3 Example of Modbus Communication Settings

WARNING

Modbus does not allow more devices with same address.
To change address, it is mandatory connect one drive on the time with the master controller.

2-3-1 Change Modbus Address

In case of more devices connected it is necessary to change the address of devices (default value 1).
Insert silent interval (≥ 3.5 char) between each message frame.

Example: Change Modbus address (0x0028) from 1 (default) to 2

1. Connect the drive to change Modbus address and send the following command.

(PDU Address: 0x0028)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	00	28	00	02	88	03

2. Save to EEPROM (PDU Address: 0x0000)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	00	00	00	01	48	0A

3. System Reset (PDU Address: 0xA5A5)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	A5	A5	00	01	7A	E5

After this procedure the drive has Modbus address set at 2.

2-3-2 Change Modbus Baud Rate

Example: Change Modbus baud rate (0x0035) from 19200b (default) to 9600b (96 = 0x60)

1. Connect the drive to change baud rate and send the following command.

(PDU Address: 0x0035)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	00	35	00	60	99	EC

2. Save to EEPROM (PDU Address: 0x0000)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	00	00	00	01	48	0A

3. System Reset (PDU Address: 0xA5A5)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	A5	A5	00	01	7A	E5

After this procedure the drive has Modbus baud rate is set at 9600b.

2. Modbus Communication

2-3-3 Change Communication Settings

Example: Change the communication setting (0x002B) from 0 (default) to 1.

(1 ODD parity/ 1 Stop bit/ 8 Data bits)

1. Connect the drive to change communication settings and send the following command.

(PDU Address: 0x002B)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	00	2B	00	01	38	02

2. Save to EEPROM (PDU Address: 0x0000)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	00	00	00	01	48	0A

3. System Reset (PDU Address: 0xA5A5)

Address	Function Code	PDU Address (W/R)		Data		CRC (16 bit)	
01	06	A5	A5	00	01	7A	E5

After this procedure the drive has Modbus communication setting is set at 1.

(1 ODD Parity/ 1 Stop bit/ 8 Data bits)

3. Read Input Registers (0x04)

3-1 List of Read Input Registers

Read from Drive (0x04)			Default Value	Unit		
HEX	DEC	Name				
0x0042	66	Speed setpoint	0	RPM		
0x0047	71	Torque (Current) setpoint	0	Arms/100		
0x005E	94	Digital inputs	-	-		
0x005F	95	Digital outputs				
0x0060	96	Drive status				
0x0061	97	Warning code Low				
0x0062	98	Warning code High				
0x0063	99	Error code				
0x0064	100	DC Link voltage			-	V/100
0x0065	101	Motor temperature			-	°C/10
0x0066	102	Heat sink temperature				
0x0067	103	Board temperature				
0x0068	104	Motor speed	0	RPM		
0x0069	105	Torque current	0	A/100		
0x006A	106	I2T Energy value	0	%		
0x006B	107	Axis position Low	0	Pulse		
0x006C	108	Axis position High				
0x006D	109	Feedback pulse				
0x006E	110	Filtered velocity	0	RPM		

If it is written an address of not present in list above, the drive gives the Exception Code 0x02.

(See chapter 7)

3-2 Description of Read Input Registers

Message frame for query and response is as follows. Start and Stop bit as silent interval is omitted.

Insert silent interval (≥ 3.5 char) between each message frame.

- Message Frame Example (Query)

Send a request to read motor speed (0x0068) and torque current (0x0069) to the smartris for Modbus address 1.

Address	Function Code	PDU Address (W/R)		Resistor No. High	Resistor No. Low	CRC High	CRC Low
01	04	00	68	00	02	F0	17

- Message Frame Example (Response)

In case of motor speed (0x0068) 1000rpm and torque current (0x0069) 2000 mA to the smartris for Modbus address 1

Address	Function Code	Number of Data Bytes	0x0068 Data High	0x0068 Data Low	0x0069 Data High	0x0069 Data Low	CRC High	CRC Low
01	04	04	03	E8	07	D0	78	58

- Speed Setpoint

PDU Address (HEX)	Description	Default Value
0x0042	Speed setpoint - range [0 to \pm full scale velocity] 0x0042 = 0x64 (100) \rightarrow 100 rpm 0x0042 = 0xF448 (62536 = -3000) \rightarrow -3000 rpm	0

- Torque (Current) Setpoint

PDU Address (HEX)	Description	Default Value
0x0047	Torque (Current) setpoint: Unit is [A rms/100]. 0x0047 = 0xC8 (200) \rightarrow 2 A rms 0x0047 = 0xFF38 (65336 = -200) \rightarrow -2 A rms	0

3. Read Input Registers (0x04)

• Digital Inputs

PDU Address (HEX)	Description	Default Value																				
0x005E	<p>Reads digital Inputs state.</p> <p>The default digital input configuration in Modbus command mode is:</p> <ul style="list-style-type: none"> • DIG- IN1 = Reserved • DIG -IN2 = Reserved • DIG -IN3 = Emergency stop • DIG -IN4 = Reset <p>See table below for further information about digital inputs configurations.</p> <table border="1"> <thead> <tr> <th>0x005E</th> <th>DIG IN 4</th> <th>DIG IN 3</th> <th>DIG IN 2</th> <th>DIG IN 1</th> </tr> </thead> <tbody> <tr> <td>0x0001</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>to</td> <td colspan="4">to</td> </tr> <tr> <td>0x000F</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	0x005E	DIG IN 4	DIG IN 3	DIG IN 2	DIG IN 1	0x0001	0	0	0	1	to	to				0x000F	1	1	1	1	-
0x005E	DIG IN 4	DIG IN 3	DIG IN 2	DIG IN 1																		
0x0001	0	0	0	1																		
to	to																					
0x000F	1	1	1	1																		

• Digital Outputs

PDU Address (HEX)	Description	Default Value																				
0x005F	<p>Reads digital outputs state.</p> <ul style="list-style-type: none"> • DIG- OUT1 : Shows if drive is: 1= Drive OK 0= Drive in FAULT • DIG -OUT2 : Warning • DIG -OUT3 : Reserved • DIG -OUT4 : Shows the brake status: 1= Brake released, motor axis free 0= Brake active, motor axis locked <p>i.e. 0x005F = 0x0001 → Drive OK is ON, the drive does not have alarm.</p> <p>See table below for further information about digital outputs configurations.</p> <table border="1"> <thead> <tr> <th>0x005F</th> <th>DIG OUT4</th> <th>DIG OUT3</th> <th>DIG OUT 2</th> <th>DIG OUT 1</th> </tr> </thead> <tbody> <tr> <td>0x0001</td> <td>0</td> <td>0</td> <td>0</td> <td>1</td> </tr> <tr> <td>to</td> <td colspan="4">to</td> </tr> <tr> <td>0x000F</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	0x005F	DIG OUT4	DIG OUT3	DIG OUT 2	DIG OUT 1	0x0001	0	0	0	1	to	to				0x000F	1	1	1	1	-
0x005F	DIG OUT4	DIG OUT3	DIG OUT 2	DIG OUT 1																		
0x0001	0	0	0	1																		
to	to																					
0x000F	1	1	1	1																		

• Drive Status

PDU Address (HEX)	Description	Default Value
0x0060	<p>Status of the drive</p> <ul style="list-style-type: none"> • 0x0001: Run in velocity mode • 0x0002: Drive in standby • 0x0004: Drive in stop • 0x0008: Reserved • 0x0010: Drive in alarm (See table 3-1) • 0x0020: Run in torque mode • 0x0080: Drive in safe (STO active) • 0x0100: Reserved <p>i.e. 0x0060 = 0x0002: The drive is ready in standby.</p>	-

• Warning Code Low

PDU Address (HEX)	Bit	Warning	Warning Description	Default Value
0x0061	0 to 7	Reserved	-	-
	8	Heat sink temperature	Warning heat sink temperature	
	9	Logic board temperature	Warning logic board temperature	
	10	Motor temperature	Warning motor temperature	
	14 to 15	Reserved	-	

• Warning Code High

PDU Address (HEX)	Bit	Warning	Warning Description	Default Value
0x0062	0 to15	Reserved	-	-

• Error Code

PDU Address (HEX)	Bit	Error Code	Error Description	Default Value
0x0063	0	See table 3-1	See table 3-1	-

3. Read Input Registers (0x04)

Table 3-1 Description of Error Code

Error	Error Code	Description	Meanings	Fault Warning	LED Code
No Error	0x0000	No error	The Fault reset command has been executed or there was a reset with power cycle.	-	-
Alarm Current					
Short Circuit Motor	0x2340	Short circuit (motor side)	Alarm over current has been occurred.	F	3,1
Load Level Fault	0x2350	Load level fault (I ² t, thermal state)	Alarm over current with integral I2t (overload)	F	5,2
	0x2352	Waiting for overload timer to be canceled	Waiting for overload timer to be canceled after overload alarm was occurred. (1 minute)		
Alarm Voltage					
Over Voltage	0x3210	DC link over voltage	Over voltage alarm has been occurred.	F	4,2
Under Voltage	0x3220	DC link under voltage	Under voltage alarm has been occurred.	F	4,1
Alarm Temperature					
Drive Temperature Error Heat sink temperature	0x4300	Drive temperature error	Heat Sink over temperature	F	1,1
	0x4301	Drive temperature warning	Warning heat sink temperature	W	-
	0x4310	Excess drive temperature	Heat sink temperature too high of maximum range	F	1,3
	0x4320	Too low drive temperature	Heat sink temperature too low of minimum range		
Drive Temperature Error Logic board temperature	0x4500	Logic board temperature error	Over logic board temperature (> 68 °C)	F	1,4
	0x4501	Logic board Temperature warning	Warning logic board temperature (> 63 °C)	W	-
	0x4510	Excess logic board temperature	Logic board temperature too high of max. range (Temperature sensor error etc.)	F	1,5
	0x4520	Too low logic board temperature	Logic board Temperature too low of min. range (Temperature sensor error etc.)		
Motor Temperature Error	0x4A00	Motor temperature error	Over motor temperature (> 140 °C)	F	1,10
	0x4A01	Motor temperature warning	Warning motor temperature (> 130 °C)	W	-
	0x4A10	Excess motor Temperature	Motor temperature too high of max. range (Temperature sensor error etc.)	F	1,6
	0x4A20	Too low motor temperature	Motor temperature too low of min. range (Temperature sensor error etc.)		
Alarm Hardware					
Current Sensor Error	0x5431	Current sensor offset error	Error current sensor offset	F	3,10
EEPROM Hardware Error	0x5501	Hardware error write EEPROM: Bus voltage too low	Write is not possible because the bus voltage is too low to guarantee the writing complete.	F	5,3
EEPROM Error	0x5530	EEPROM error	Generic error EEPROM	F	6,1
	0x5531	EEPROM general error	Generic error EEPROM writing		
	0x5532 to 0x556F	EEPROM error (Parameter 1 to 61)	Error writing EEPROM parameters		
EEPROM Error Golden Image writing	0x5A02	Golden Image data error (Storage area for default value of parameters)	Golden image data is not written.	F	8,1
Alarm Parameters					
Data Set	0x6300	Data set parameters table	Data set programming error	F	7,1
	0x6301 to 0x6409	Data record No. 1 to 24	Programming error data set		
	0x6320	Parameter error	Generic parameter error		
Parameter Error	0x6321	Incongruity data configuration 1	Configuration error	F	6,4
	0x6322	Incongruity data configuration 2			

3. Read Input Registers (0x04)

Error	Error Code	Description	Meanings	Fault Warning	LED Code
Alarm Additional Modules					
Absolute Encoder	0x7350	Absolute encoder	Error generic absolute encoder	F	2,6
	0x7351	Rx error	Error message received		
	0x7352	Tx error	Error message transmitted		
	0x7353	Read position error	Error read position		
	0x7354	Status error	Error status absolute encoder		
	0x7355	Command type error	Error command type of absolute encoder		
	0x7356	Initial timeout error	Error timeout during initialization absolute encoder		
Resolver	0x7374	Resolver initialization	Show the cause of failure detection.	F	2,4
	0x7375	Resolver hardware fault LOS (Loss of Signal)	-0x01 (bit 0) : Parity error for composition -0x02 (bit 1) : Phase error is over phase lock range.	F	2,10
	0x7376	Resolver hardware fault DOS (Degradation of Signal)	-0x04 (bit 2) : Velocity is over max. racking rate.		
	0x7377	Resolver hardware fault LOT (Loss of Tracking)	-0x08 (bit 3) : Tracking error is over threshold of LOT.		
	0x7378	Resolver hardware fault LOS, DOS, LOT during phasing initialization	-0x10 (bit 4) : Sin/Cos input is not same as DOS.		
-0x20 (bit 5) : Sin/Cos input is over DOS threshold. -0x40 (bit 6) : Sin/Cos input is below LOS threshold. -0x80 (bit 7) : Sin/Cos input is clipped.					
Communication	0x7520	Modbus error	Modbus generic error	F	9,1
	0x7521	Modbus communication lost	The drive did not receive any valid message during the communication loss timer (see Modbus Func.03 or 06 - Addr.0x0036).		
Alarm Protocol					
Torque Profile	0x8300	Torque control	General error for profile torque controller	F	6,6
	0x8341	Torque type	Error type selected is not managed.		
	0x8351	Dynamic brake	Error dynamic brake is not implemented.		
Velocity Speed Controller	0x8400	Velocity speed controller	Error generic for profile velocity controller	F	6,7
	0x8411	Following error velocity mode	The difference between the velocity command and the actual velocity is greater than the value that is set in max. velocity error. The drive is in velocity profile.	F	5,10
			Over speed	Actual speed exceeds the velocity over speed value.	F
EEPROM	0x8B00 0x8B02	Store and restore process	General error for store and restore process	F	8,2

3. Read Input Registers (0x04)

⚠ WARNING

The alarm can be Fault (F) or warning (W), if it is a fault the drive will stop.

• DC Link Voltage

PDU Address (HEX)	Description	Default Value
0x0064	DC link voltage [V/100] i.e. 0x0064 = 0x1356 (4950) = 49.5 Vdc	-

• Motor Temperature

PDU Address (HEX)	Description	Default Value
0x0065	Temperature of motor [°C/10] i.e. 0x0065 = 0x0163 (355) = 35.5 °C	-

• Heat Sink Temperature

PDU Address (HEX)	Description	Default Value
0x0066	Heat sink drive temperature [°C/10] i.e. 0x0066 = 0x0163 (355) = 35.5 °C	-

• Board Temperature

PDU Address (HEX)	Description	Default Value
0x0067	Board (Internal drive) temperature [°C/10] i.e. 0x0067 = 0x0163 (355) = 35.5 °C	-

• Actual Velocity

PDU Address (HEX)	Description	Default Value
0x0068	Motor speed in rpm. Average value of speed Filter on speed was a mobile average of 512 samples. Variable suitable to monitor the motor speed i.e. 0x0068 = 0x01F4 (500) → Motor is running at 500 rpm 0x0068 = 0xFC18 (64536 = -1000) → Motor speed = -1000 rpm	0

• Torque Current

PDU Address (HEX)	Description	Default Value
0x0069	Torque current [Arms/100] i.e. 0x0069 = 0x01F4 (500) = 5 Arms 0x0069 = 0xFC18 (64536 = -1000) = -10 Arms	0

• I²T Energy Value

PDU Address (HEX)	Description	Default Value
0x006A	I ² T energy value [%] i.e. 0x006A = 0x0032 (50) → Torque current =50% of rated current 0x006A = 0x0096 (150) → Torque current =150% of rated current (Drive it could goes in alarm.) <Rated current for the drive model> ECO-S : 11.5A ECO-M, PRO-M : 25.8A PRO-L : 35.8A	0

• Axis Position Low

PDU Address (HEX)	Description	Default Value
0x006B	Show the low part of mechanical axis position [lower 16 bit of total 32 bit], accumulated according to the number of rotations. The sign of value obtained by direction of rotation and gear motor type of the smartris is different. ECO series: Looking the output shaft from load side, counter-clockwise ⇒ +, clockwise ⇒ - PRO series: counter-clockwise ⇒ -, clockwise ⇒ + The data process resolution per one rotation is 16384 (14bit) for the resolver and the absolute encoder. i.e. Motor axis position = 360° = 16384 = 0x00004000 0x006B = 0x4000 (0x006C = 0x0000) The output shaft position for the gear motor is 16384 (14 bit) multiplied by gear ratio to be 360° = one rotation. i.e. In case of gear ratio 21: 16384×21 = 344064 = 360° (Conversion of the output shaft position for the gear motor)	0

3. Read Input Registers (0x04)

• Axis Position High

PDU Address (HEX)	Description	Default Value
0x006C	<p>Show the high part of mechanical axis position [higher 16 bit of total 32 bit], accumulated according to the number of rotations. The sign of value obtained by direction of rotation and gear motor type of the smartris is different. ECO series: Looking the output shaft from load side, counter-clockwise $\Rightarrow +$, clockwise $\Rightarrow -$ PRO series: counter-clockwise $\Rightarrow -$, clockwise $\Rightarrow +$ The data process resolution per one rotation is 16384 (14bit) for the resolver and the absolute encoder. i.e. Motor axis position = $-180^\circ = -8192 = 0xFFFFE000$ $0x006C = 0xFFFF$ ($0x006B = 0xE000$) The output shaft position for the gear motor is 16384 (14 bit) multiplied by gear ratio to be $360^\circ = 1$ rotation. i.e. In case of gear ratio 21: $16384 \times 21 = 344064 = 360^\circ$ (Conversion of the output shaft position for the gear motor)</p>	0

⚠ WARNING

The (mechanical) Axis Position message is 32 bit data, while the Modbus parameters are 16 bit: the 32 bit are separated in 2 parameters of 16 bit, 0x006B contains the lower 16 bit, while 0x006C contains the higher part.
 The data range is [0x80000000 to 0x7FFFFFFF]. When data reaches upper limit or under limit, it returns 0x00000000.

• Feedback Pulse Value

PDU Address (HEX)	Description	Default Value
0x006D	<p>Feedback pulse read – Electrical angle (electrical position of axis) Data range is [-16384 to 16384] with increment units. The sign of value obtained by direction of rotation and gear motor type of the smartris is different. The relationship between direction of rotation and the sign of value is reversed with the axis position (0x006B, 0x006C). ECO series: Looking the output shaft from load side, counter-clockwise $\Rightarrow -$, clockwise $\Rightarrow +$ PRO series: counter-clockwise $\Rightarrow +$, clockwise $\Rightarrow -$ When data reaches to max. 16384 (0x4000) or min -16384 (0xBFFF), it returns to 0. The actual position of shaft depends on the number of motor pole pairs is one rotation when counted to upper limit (16384). ECO-S: 5 pole pairs, ECO-M, PRO-M, PRO-L: 4 pole pairs The data process resolution per electrical angle 360° is 16384 (14bit) for the resolver and the absolute encoder. i.e. $0x006D = 0x1000$ (4096) $\Rightarrow 4096/16384 \Rightarrow$ The motor axis position is 90° at electrical angle. The output shaft position for the gear motor is one rotation multiplied by gear ratio and the number of motor pole pairs, when counted to upper limit 16384. i.e. In case of gear ratio 21 for ECO-S: $21 \times (5 \text{ pole pairs}) = 105 \text{ counts} = 360^\circ$ (Conversion of the output shaft position for the gear motor)</p>	-

• Velocity Filtered

PDU Address (HEX)	Description	Default Value
0x006E	<p>This Parameter communicates the value of velocity filtered. The filter is a low pass one pole filter for velocity [Hz]. (default value is 50Hz.) Variable suitable for monitor the velocity feedback. i.e. $0x006E = 0x03E8 \rightarrow$ Actual average speed $\rightarrow 1000$ RPM</p>	0

4. Read Holding Registers (0x03)

4-1 List of Read Holding Registers

Read Only (0x03)			Default Value	Unit
HEX	DEC	Name		
0x0001	1	Controlword	-	-
0x0003	3	Full scale velocity	L=3000, M=4500, S=4500	RPM
0x0028	40	Modbus address	1	-
0x002B	43	Communication settings	0	
0x0035	53	Modbus baud rate	192	
0x0036	54	Communication loss time	0	
0x003C	60	PID velocity KP	L=300, M=200, S=70	i.u.
0x003D	61	PID velocity KI	L=700, M=400, S=300	
0x003E	62	PID velocity KV	L=1000, M=600, S=500	
0x003F	63	Speed ramp state	1: Ramp enable	-
0x0040	64	Speed ramp up time	2000	ms
0x0041	65	Speed ramp down time		
0x0043	67	Speed/Torque polarity	0	-
0x0044	68	Limit torque positive	100	%
0x0045	69	Limit torque negative		
0x0046	70	Slope ramp (Torque)	0	(Motor rated current/1000)/s
0x004E	78	Brake managed	1: Blake enable	-
0x004F	79	Brake mode	1: Manual brake enable	
0x0050	80	Brake type	Depend on brake type	
0x0051	81	Dynamic brake enable	1: Dynamic brake enable	
0x01FF	511	FW release customer	Depend on FW release	
0x0201	513	HW release	Depend on HW release	
0x0202	514	Parameter release	Depend on parameter release	
0x0203	515	Motor type	Depend on motor	
0x0204	516	STO check	Depend on drive	
0x0205	517	Feedback		
0x0207	519	Operation mode	-	

If it is written an address of not present in list above, the drive gives the Exception Code 0x02. (See chapter 7)

4-2 Description of Read Holding Registers

Message frame for query and response is as follows. Start and Stop bit as silent interval is omitted.

- Message Frame Example (Query)

Send a request to read baud rate (0x0035) to the smartris for Modbus address 10.

Address	Function Code	PDU Address (W/R)		Resistor No. High	Resistor No. Low	CRC High	CRC Low
0A	03	00	35	00	01	95	7F

- Message Frame Example (Response)

In case of baud rate (0x0035) 19200b to the smartris for Modbus address 10

Address	Function Code	Number of Data Bytes	0x0035 Data High	0x0035 Data Low	CRC High	CRC Low
0A	03	02	00	C0	1D	D5

4. Read Holding Registers (0x03)

- Ramp State

PDU Address (HEX)	Description	Default Value
0x003F	Reads if the ramps (torque and speed ramps) are enabled or not (default enabled). i.e. 0x003F = 1: Ramp enabled/ 0: Ramp disabled If the value is different to 0 or 1, the drive gives the Exception Code 0x03.	1

- Speed Ramp Up Time

PDU Address (HEX)	Description	Default Value
0x0040	Speed ramp up time in ms i.e. 0x0040 = 1000: Speed ramp up time from 0 to max. velocity = 1 sec	2000

- Speed Ramp Down Time

PDU Address (HEX)	Description	Default Value
0x0041	Speed ramp down time in ms i.e. 0x0041 = 1000: Speed ramp down time from max. velocity to 0 = 1 sec	2000

- Speed/Torque Polarity

PDU Address (HEX)	Description	Default Value
0x0043	Polarity of Speed/Torque setpoint The following value definition is valid: • bit value = 0: multiply the demand value by 1 • bit value = 1: multiply the demand value by -1 i.e. In case of speed setpoint = 3000 rpm, sending 0x0043 = 1 the motor begins to run at -3000 rpm.	0

- Torque Limit Positive

PDU Address (HEX)	Description	Default Value
0x0044	Torque limit positive [0 ~ 100%] The value shall be given percent of peak current. Positive torque takes effect in the case of motive operation is positive velocity or regenerative operation is negative velocity. This parameter is used also profile velocity. i.e. 0x0044 = 0x0032 (50), the max. torque positive is 50% of rated current. <Peak current of the drive model> ECO-S: 41.7A ECO-M, PRO-M: 96.3A PRO-L: 136.2A	100

- Torque Limit Negative

PDU Address (HEX)	Description	Default Value
0x0045	Torque limit negative [0 ~ 100%] The value shall be given percent of peak current. Negative torque takes effect in the case of motive operation is negative velocity or regenerative operation is negative velocity. This parameter is used also profile velocity. i.e. 0x0045 = 0x0032 (50), the max. torque negative is 50% of rated current. <Peak current of the drive model> ECO-S: 41.7A ECO-M, PRO-M: 96.3A PRO-L: 136.2A	100

- Slope Ramp (Torque)

PDU Address (HEX)	Description	Default Value
0x0046	Slope torque ramp [rated current/ (1000)/s] in torque control mode. This parameter shall indicate the configured rate of change of torque. The value shall be given in units of per thousand of rated torque per second. It is controlled by some limits of drive. If the value is not correct the drive sends an Abort Code. If the value is not correct during initialization the drive sends an error message with Emergency Protocol. i.e. 0x0046 = 0x03E8 (1000) → Torque ramp up from 0 to motor rated current = 1 sec 0x0046 = 0x01F4 (500) → Torque ramp up from 0 to motor rated current (1000/500) = 2 sec	1000

4. Read Holding Registers (0x03)

• Brake Managed

PDU Address (HEX)	Description	Default Value
0x004E	Brake managed (value admitted 0/1) i.e. 0x004E = 1: Brake managed/ 0: NO Brake	1

• Brake Mode

PDU Address (HEX)	Description	Default Value
0x004F	Brake mode Manual/Automatic (value admitted 0/1) i.e. 0x004F = 1: Manual brake enabled/ 0: Automatic brake enabled	1

• Brake Type

PDU Address (HEX)	Description	Default Value
0x0050	Selection of type of brake (in case of brake enabled) (value admitted 1/2) i.e. 0x0050 = 1: Magnetic brake/ 2: Spring brake	Depend on brake

• Dynamic Brake Enable

PDU Address (HEX)	Description	Default Value
0x0051	Dynamic brake (electronic controlled stop) enable (value admitted 0/1) i.e. 0x0051 = 1: Dynamic brake enabled/ 0: NO Dynamic brake	1

• Firmware Version

PDU Address (HEX)	Description	Default Value
0x01FF	Read the device firmware version. i.e. 0x01FF = 0x00E1 (225): Firmware release 2.2.5	Depend on FW ver.

• Hardware Version

PDU Address (HEX)	Description	Default Value
0x0201	Read the device hardware version. i.e. 0x0201 = 0x000B (11): Hardware release 1.1	Depend on HW ver.

• Parameter Release

PDU Address (HEX)	Description	Default Value
0x0202	Read parameter release. i.e. 0x0202 = 0x0136 (310): Parameter release 3.1.0	Depend on parameter

• Motor Type

PDU Address (HEX)	Description	Default Value
0x0203	Read motor type. • 0x0203 = 0: None/ 1: ECO-S/ 2: ECO-M or PRO-M/ 3: PRO-L/100: reserved i.e. 0x0203 = 1: Motor type 「ECO-S」	Depend on motor

• STO Check

PDU Address (HEX)	Description	Default Value
0x0204	Reads if the drive has STO (Safe Torque Off). i.e. 0x0204 = 1: STO present/ 2: NO STO	Depend on drive

• Feedback Type

PDU Address (HEX)	Description	Default Value
0x0205	Reads what type of feedback control has the drive. i.e. 0x0205 = 0: Resolver/ 2: Absolute encoder	Depend on drive

• Operation Mode

PDU Address (HEX)	Description	Default Value
0x0207	Reads operation mode. i.e. 0x0207 = 1: Torque mode/ 2: Velocity mode	-

5. Write Single Holding Registers (0x06)

5-1 List of Write Single Holding Registers

Write Parameters (0x06)			Default Value	Unit
HEX	DEC	Name		
0x0000	0	Store EEPROM	-	
0x0001	1	Controlword	0	
0x0028	40	Modbus address	1	-
0x002B	43	Communication settings	0	
0x0035	53	Modbus baud rate	192	
0x0036	54	Communication loss time	0	ms
0x003C	60	PID velocity KP	L=300, M=200, S=70	
0x003D	61	PID velocity KI	L=700, M=400, S=300	i.u.
0x003E	62	PID velocity KV	L=1000, M=600, S=500	
0x003F	63	Ramp enable	1: Ramp enable	-
0x0040	64	Speed ramp up time		
0x0041	65	Speed ramp down time	2000	ms
0x0042	66	Speed setpoint	0	RPM
0x0043	67	Speed/Torque polarity	0	-
0x0044	68	Limit torque positive		
0x0045	69	Limit torque negative	100	%
0x0046	70	Slope ramp (Torque)	1000	(Motor rated current/1000)/s
0x0047	71	Torque (Current) setpoint	0	Arms/100
0x004E	78	Brake managed	1: Brake enable	
0x004F	79	Brake mode	1: Manual brake enable	
0x0051	81	Dynamic brake enable	1: Dynamic brake enable	
0X0207	519	Operation mode		
0x5A5A	23130	Restore manufacturer data	-	
0xA5A5	42405	Reset drive		

If it is written an address of not present in list above, the drive gives the Exception Code 0x02.
(See chapter 7)

WARNING

Some commands need the following procedure to make the changes of their parameters effective:

- (1) Save in EEPROM (command [Func.06 – Addr:0x0000] STORE EEPROM)
- (2) Drive Reset (command [Func.06 – Addr:0xA5A5] RESET DRIVE)

List of Commands that need this procedure:

HEX	DEC	Command Name
0x0028	40	Modbus Address
0x002B	43	Communication Settings
0x0035	53	Modbus Baud Rate
0x0036	54	Communication Loss Time
0x003F	63	Ramp Enable
0x004F	79	Brake Mode
0X0207	519	Operation Mode.

5. Write Single Holding Registers (0x06)

5-2 Description of Write Single Holding Registers

Message frame for query and response is as follows. Start and Stop bit as silent interval is omitted.

- Message Frame Example (Query)

Send a request to write motor velocity command (0x0042) 1000rpm to the smartris for Modbus address 5.

Address	Function Code	PDU Address (W/R)		Write Value High	Write Value Low	CRC High	CRC Low
05	06	00	42	03	E8	28	E4

- Message Frame Example (Response)

Send a response to write motor velocity command (0x0042) 1000rpm to the smartris for Modbus address 5. (Message frame for response is same as query.)

Address	Function Code	PDU Address (W/R)		Write Value High	Write Value Low	CRC High	CRC Low
05	06	00	42	03	E8	28	E4

- Store EEPROM Data

PDU Address (HEX)	Description	Default Value
0x0000	Command to store data on EEPROM. Not need to send a specific value of parameter. i.e. 0x0000 → Store the parameters in EEPROM.	-

- Controlword

PDU Address (HEX)	Description	Default Value
0x0001	<p>Controlword bits status:</p> <ul style="list-style-type: none"> • Bit 0: RUN bit → 0: Run Disabled/ 1: Run Enabled • Bit 1: STOP bit → 0: Stop Enabled/ 1: Stop Disabled • Bit 2: BRAKE bit → 0: Brake can be disabled manually/ 1: Brake can be enabled manually. <p>Warning: Brake bit is a DO NOT CARE bit if the brake is NOT ACTIVE and is set to AUTO. Brake can be activated by Modbus address 0x004E. Brake mode (manual/auto) can be changed by Modbus address 0x004F. If the value is out of range [0:7], the drive gives the Exception Code 0x03.</p>	0

WARNING

The alarm can be Fault (F) or warning (W), if it is a fault the drive will stop.

5. Write Single Holding Registers (0x06)



In case of Run/Stop state:

(1) If it is given an Emergency Command (Digital Input - not Safety input), the drive state goes to standby.

- Dynamic brake is valid. (PDU address:0x0051=1)

The brake is activated after the motor ramp stop(4.5rpm/ms). If the motor fails to stop and the time brake timeout (3000ms) is over, then the brake will be activated immediately (see dashed line).

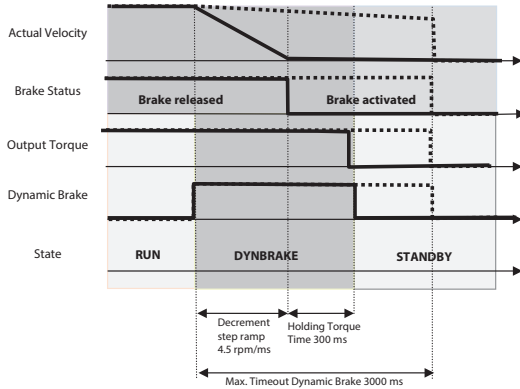


Fig. 5-1 Brake Operation with Dynamic Brake

- Dynamic brake is invalid. (PDU address:0x0051=0)

The motor will stop immediately at max. torque. The brake is activated when the velocity is lower than ± 5 rpm.

If the motor fails to stop and the time brake timeout (2000ms) is over, then the brake will be activated immediately (see dashed line).

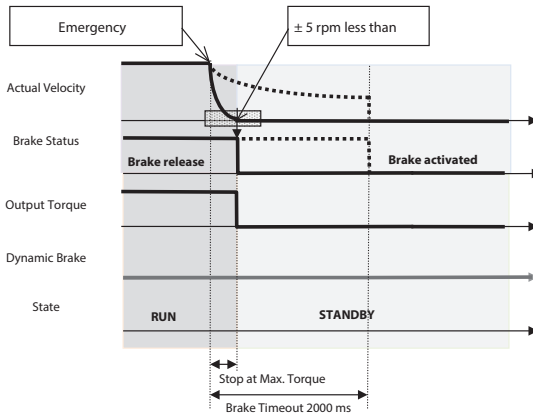


Fig. 5-2 Brake Operation without Dynamic Brake

5. Write Single Holding Registers (0x06)

⚠ WARNING

- (2) If it is given an STO Command (Safety input), the drive state goes to standby. The motor will stop for inertia when the velocity is lower ± 5 rpm. When STO command is entered, dynamic brake will be invalid. If the motor fails to stop and the brake timeout (2000ms) is over, then the brake will be activated immediately (see dashed line).

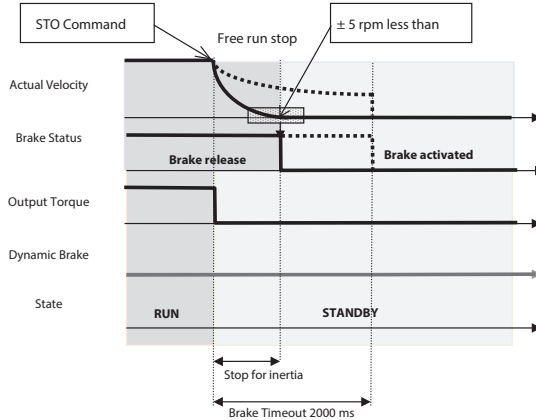


Fig. 5-3 Brake Operation without Dynamic Brake (STO Command)

5. Write Single Holding Registers (0x06)

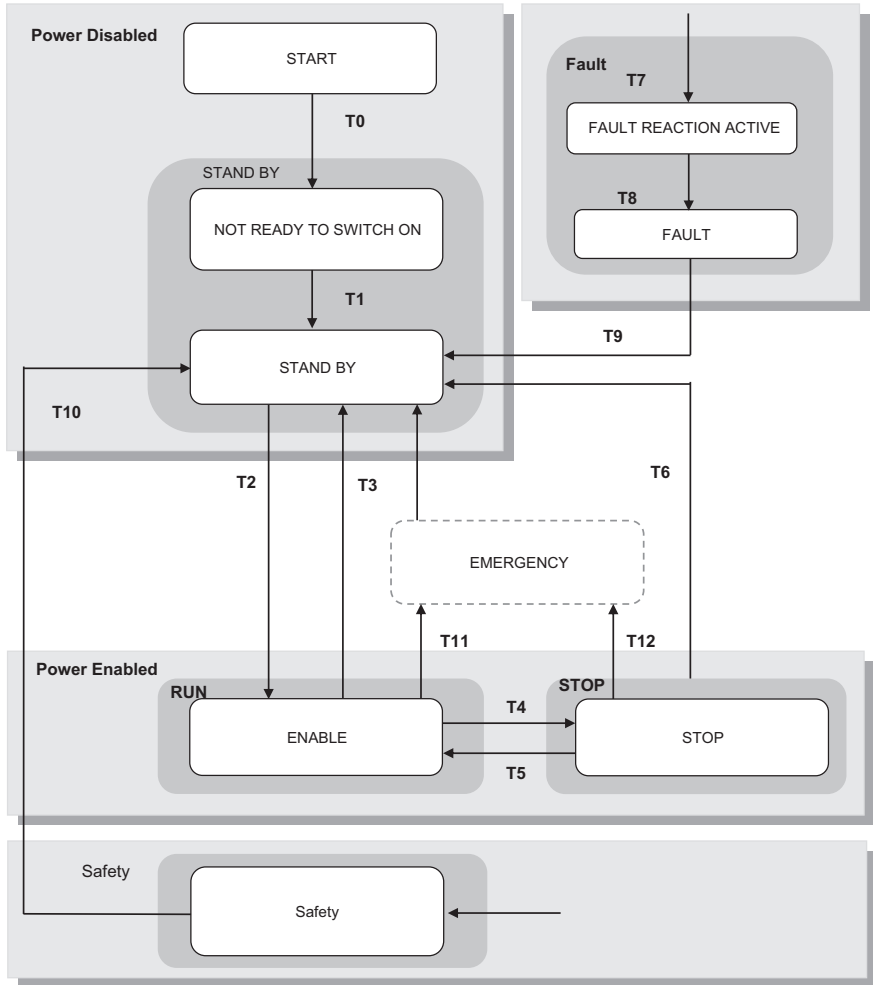


Fig. 5-4 Modbus State Machine (With Safety State)

Run Sequence

- (1) Switch ON Power Supply [T0]
- (2) Wait Standby (SWITCHED ON) State [T1]
- (3) Verify Operation Mode by reading [Func. 0x03 – Addr. 0x0207] Operation Mode:
 - Value equal to 1 → Torque mode
 - Value equal to 2 → Velocity mode

5. Write Single Holding Registers (0x06)

⚠ WARNING

If the customer wants to switch from Torque Mode to velocity Mode or vice-versa he must set it by write to [Func.06 – Addr.0x0207] Operation Mode.

To make changes effective, the customer must first save to memory with command [Func.06 – Addr. 0x0000] Store EEPROM Data and then reset drive with command [Func.06 – Addr.0xA5A5] System Reset.

- (4) Verify that the smartris drive is in SWITCHED ON. (See chapter 9)
- (5) Set OPERATION ENABLED State : write [0x06] Controlword → 0x0001 = 0x0003 [T2]
- (6) Verify that the brake is released.
- (7) Verify LED STATUS ENABLED. (See chapter 9)
 - Verify by read [Func. 0x03 - Addr. 0x0060], that the Smartris Drive is in ENABLED [Drive Status = 0x0001 → RUN])
- (8) Set velocity or torque command and drive the motor.
 - If [Func. 0x06 - Addr. 0x0207] - Operation Mode = 2 – Velocity mode → Write to [Func.0x06 – Addr. 0x0042] Speed Set Point → i.e. 0x03e8 (1000 → 1000 rpm)
 - If [Func. 0x06 - Addr. 0x0207] - Operation Mode = 1 – Torque mode → Write to [Func.0x06 – Addr. 0x0047] Torque Set Point → i.e. 0x03e8 (1000 → 10 Arms)
- (9) Verify if the motor is running
 - Verify the motor speed (after ramp) by read to [Func. 0x04 – Addr. 0x0068] Motor Speed.
 - Verify the motor current by read to [Func. 0x04 – Addr. 0x0069] Torque Current.
- (10) Stop the motor with Stop Command → write to [Func. 0x06 - Addr. 0x0001] - Control Word → 0x0001 [T4] – Drive goes immediately in Stop state with MAX torque (it is equal to a STOP command).
 - If you want to Stop the motor with ramp, just write to [Func.06 – Addr.0x0042] Speed Set Point the value 0 (0 rpm).
 - Stop the motor with Standby Command → write to [Func. 0x06 - Addr. 0x0001] - Control Word → 0x0002 [T3] – The motor brake is ON after the motor ramp stop, Drive goes in Standby state.

Table 7-2 Transfer Description - State Machine

Transfer	Description	Transfer	Description
T0	Switch ON – Supply to drive	T7	Fault reaction active
T1	Standby – No Alarm	T8	Fault - Drive in Alarm
T2	Run command – Drive Enabled Standby - Run	T9	Reset command Fault - Standby
T3	Standby command – Drive Disabled	T10	STO (SAFETY) Command
T4	Stop command – Drive Run - Stop	T11	Emergency (If active) - the motor will decelerate speed with a programmed ramp.
T5	Run command - Drive Enabled Stop - Run		
T6	Standby command – Stop - Standby	T12	Emergency (If active)

Note: The STO (SAFETY) and the stop command may can stop the running command immediately.

A FAULT (see table in Diagnostic) can stop the running command immediately.

5. Write Single Holding Registers (0x06)

- Modbus Address

PDU Address (HEX)	Description	Default Value
0x0028	Modbus address [1 to 247]: The drive that can be connected at the same time is max. 32. i.e. 0x0028 = 1 → Modbus address: 1 To change Modbus address is necessary save to EEPROM and give a reset command. If the value is out of range, the drive gives the Exception Code 0x03.	1

- Communication Settings

PDU Address (HEX)	Description	Default Value
0x002B	Modbus communication settings related to parity, stop bits and data bits: • 0: No Parity, 2 stop bits • 1: Odd Parity, 1 stop bit • 2: Even Parity 1 stop bit To change communication settings is necessary save to EEPROM and give a reset command. If the value is out of range the drive gives the Exception Code 0x03.	0

- Modbus Baud Rate

PDU Address (HEX)	Description	Default Value
0x0035	Modbus baud rate • 0x0035 = 96 → 9600 b/ 192 → 19200 b/384 → 38400 b/ 576 → 57600 b/ 1152 → 115200 b To change Modbus baud rate is necessary save to EEPROM and give a reset command. If the value is out of range, the drive gives the Exception Code 0x03.	192

- Communication Loss Time

PDU Address (HEX)	Description	Default Value
0x0036	Communication loss time [ms] i.e. 0x0036 = 0x03B8 (1000) → Loss time = 1000 ms 0x0036 = 0 → Communication loss time disabled If the value is out of range [0:32000], the drive gives the Exception Code 0x03.	0

- PID Velocity KP

PDU Address (HEX)	Description	Default Value
0x003C	Proportional PID velocity The parameter controls equivalent of PID speed parameters. The PID are defined by application. It is possible to change the speed PID in run time. If the value is negative, the drive gives the Exception Code 0x03.	Depend on motor L=300 M=200 S=70

- PID Velocity KI

PDU Address (HEX)	Description	Default Value
0x003D	Integral PID velocity The parameter controls equivalent of PID speed parameters. The PID are defined by application. It is possible to change the speed PID in run time. If the value is negative, the drive gives the Exception Code 0x03.	Depend on motor L=700, M=400 S=300

- PID Velocity KV

PDU Address (HEX)	Description	Default Value
0x003E	Parameter PID velocity The parameter controls equivalent of PID speed parameters. The PID are defined by application. It is possible to change the speed PID in run time. If the value is negative, the drive gives the Exception Code 0x03.	Depend on motor L=1000 M=600 S=500

- Ramp Enable

PDU Address (HEX)	Description	Default Value
0x003F	Reads if the ramps (torque and speed ramps) are enabled or not. i.e. 0x003F = 1: Speed ramp enabled/ 0: Speed ramp disabled To change ramp state is necessary save to EEPROM and give a reset command. If value is different from 0/1, the drive gives the Exception Code 0x03.	1

5. Write Single Holding Registers (0x06)

- Ramp Enable

PDU Address (HEX)	Description	Default Value
0x003F	Reads if the ramps (torque and speed ramps) are enabled or not. i.e. 0x003F = 1: Speed ramp enabled/ 0: Speed ramp disabled To change ramp state is necessary save to EEPROM and give a reset command. If value is different from 0/1, the drive gives the Exception Code 0x03.	1

- Speed Ramp Up Time

PDU Address (HEX)	Description	Default Value
0x0040	Speed ramp up time in ms i.e. 0x0040 = 0x03E8 (1000) → Speed ramp up time from 0 to max. velocity = 1 sec If value is negative the drive, gives the Exception Code 0x03.	2000

- Speed Ramp Down Time

PDU Address (HEX)	Description	Default Value
0x0041	Speed ramp down time in ms i.e. 0x0041 = 0x03E8 (1000) → Speed ramp down time from max. velocity to 0 = 1 sec If value is negative the drive, gives the Exception Code 0x03.	2000

- Speed Setpoint

PDU Address (HEX)	Description	Default Value
0x0042	Speed setpoint - range [0 to \pm full scale velocity] 0x0042 = 0x64 (100) → 100 rpm 0x0042 = 0xF448 (62536 = -3000) → -3000 rpm i.e. 0x0042 = 0x0BB8 (3000) is requested speed → Motor speed = 3000 rpm 0x0042 = 0xF448 (-3000) → Motor speed = -3000 rpm If value is out of range, the drive gives the Exception Code 0x03.	0

- Speed/Torque Polarity

PDU Address (HEX)	Description	Default Value
0x0043	Polarity of Speed/Torque setpoint The following value definition is valid: • bit value = 0: multiply the demand value by 1/ 1: multiply the demand value by -1 i.e. In case of speed setpoint = 3000 rpm, sending 0x0043 = 1 the motor begins to run at -3000 rpm If value is different to 0/1, the drive gives the Exception Code 0x03.	0

- Limit Torque Positive

PDU Address (HEX)	Description	Default Value
0x0044	Torque limit positive [0:100] This parameter shall indicate the configured max. positive torque in the motor. The value shall be given percent of rated current. Positive torque takes effect in the case of motive operation is positive velocity or regenerative operation is negative velocity. This parameter is used also profile velocity. i.e. 0x0044 = 0x0032 (50), the max. torque positive is 50% of rated current If value is out of range, the drive gives the Exception Code 0x03. <Peak current of the drive model> ECO-S: 41.7A ECO-M, PRO-M: 96.3A PRO-L: 136.2A	100

- Limit Torque Negative

PDU Address (HEX)	Description	Default Value
0x0045	This parameter shall indicate the configured max. negative torque in the motor. The value shall be given percent of rated current. Negative torque takes effect in the case of motive operation is negative velocity or regenerative operation is negative velocity. This parameter is used also profile velocity. i.e. 0x0045 = 0x0032 (50), the max. torque negative is 50% of rated current If value is out of range, the drive gives the Exception Code 0x03. <Peak current of the drive model> ECO-S: 41.7A ECO-M, PRO-M: 96.3A PRO-L: 136.2A	100

5. Write Single Holding Registers (0x06)

- Slope Ramp

PDU Address (HEX)	Description	Default Value
0x0046	Slope torque ramp [rated current/ (1000*s)] in torque control mode This parameter shall indicate the configured rate of change of torque. The value shall be given in units of per thousand of rated torque per second. It is controlled by some limits of drive. If the value is not correct the drive sends an Abort Code. If the value is not correct during initialization the drive sends an error message with Emergency Protocol. i.e. 0x0046 = 0x03E8 (1000) → Torque ramp up from 0 to rated current in 1sec i.e. 0x0046 = 0x01F4 (500) → Torque ramp up from 0 to rated current in (1000/500) secs = 2 sec If the value is negative or operation mode is set on velocity, the drive gives the Exception Code 0x03.	1000

- Torque (Current) Setpoint

PDU Address (HEX)	Description	Default Value
0x0047	Torque setpoint [Arms/100] in torque control mode Torque Setpoint range: [0 to ±peak current] i.e. 0x0047 = 0xC8 (200) → 2 Arms 0x0047 = 0xFF38 (65335 = -200) → - 2 Arms If the value is out of range, the drive gives the Exception Code 0x03.	0

- Brake Managed

PDU Address (HEX)	Description	Default Value
0x004E	Enable/Disable Brake manage • 0x004E = 1: Brake ON • 0x004E = 0: Brake OFF If the value is different to 0/1, the drive gives the Exception Code 0x03.	1

- Brake Mode

PDU Address (HEX)	Description	Default Value
0x004F	Set brake mode (Auto/Manual). • 0x004F = 1: Manual brake • 0x004F = 0: Automatic brake If the value is different to 0/1, the drive gives the Exception Code 0x03.	1

- Dynamic Brake Enable

PDU Address (HEX)	Description	Default Value
0x0051	Dynamic Brake (electronic controlled stop) Enable (value admitted 0/1) • 0x0051 = 1: Dynamic brake enabled • 0x0051 = 0: NO Dynamic brake If the value is different to 0/1, the drive gives the Exception Code 0x03.	1

- Operation Mode

PDU Address (HEX)	Description	Default Value
0x0207	Set operation mode. • 0x0207 = 1: Torque mode/ 2: Velocity mode To change operation mode is necessary save to EEPROM and give a reset command. If the value is different to 1/2, the drive gives the Exception Code 0x03.	-

- Restore Manufacturer Data

PDU Address (HEX)	Description	Default Value
0x5A5A	Command to restore manufacturer data on EEPROM. Not need to send a specific value of parameter.	-

5. Write Single Holding Registers (0x06)

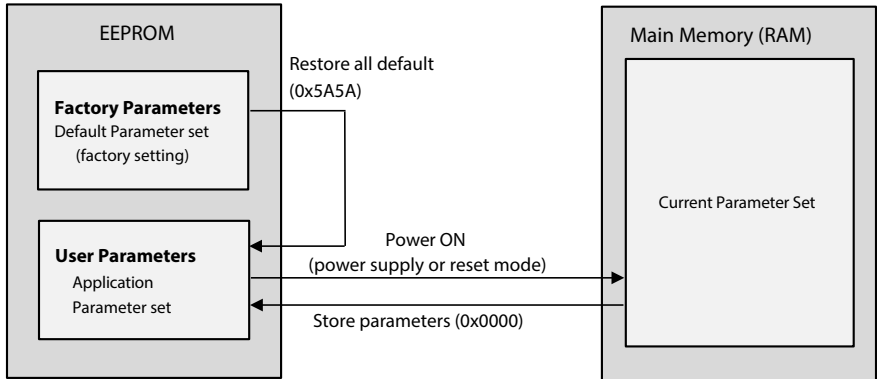


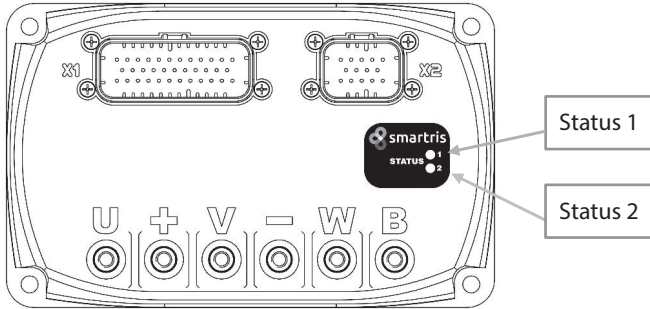
Fig. 5-5 Parameter Store, Restore Function

- System Reset

PDU Address (HEX)	Description	Default Value
0x5A5A	This command gives to drive a system reset: sending this parameter the drive reset to reboot it. It is useful if the drive is on error or to make effective changes after a save in EEPROM: not need to send a specific value of parameter. Drive responds to PLC, after the drive is reset wait about 2 sec for new communication.	-

6. Diagnostic

6-1 Diagnostic



- LEDs 1 and 2 on the right side of the main unit show the drive status; the green LED shows status 1, and the yellow LED shows status 2

Table 6-1 Status LEDs

Drive State	CANopen Status	Status 1 LED (Green)	Status 2 LED (Yellow)	LED Display
INIT	Not ready to switch ON	"Blink"	"Blink"	<ul style="list-style-type: none"> ● 1 Simultaneously blink ● 2 Simultaneously blink
	Not ready to switch ON Switch ON disabled Ready to switch ON	Alternately "Blink"	Alternately "Blink"	<ul style="list-style-type: none"> ● 1 Alternately blink ● 2 Alternately blink
STANDBY	Switched ON	"Blink"	OFF	<ul style="list-style-type: none"> ● 1 Blink 50% ● 2 OFF
FAULT	Fault Fault reaction fault	"Blink" Code [x]	"Blink" Code [y]	<ul style="list-style-type: none"> ● 1 See Fig. 8-2 ● 2
RUN	Operation enabled	ON	OFF	<ul style="list-style-type: none"> ● 1 ON ● 2 OFF
STOP	Quick stop active	ON	ON	<ul style="list-style-type: none"> ● 1 ON ● 2 ON
SAFETY	-	OFF	"Blink"	<ul style="list-style-type: none"> ● 1 OFF ● 2 Blink

6. Diagnostic

Table 6-2 List of Alarms

Category	Alarm	Status 1	Status 2	Alarm Description
		LED (Green) Code [x]	LED (Yellow) Code [y]	
A Temperature	Motor over temperature	1	10	Motor temperature exceeds the temperature setting. Operation is impossible due to high motor temperature.
	Heat sink over temperature		1	Heat sink temperature exceeds the temperature setting. Operation is impossible due to high heat sink temperature.
	Heat sink temperature out of range		3	Heat sink temperature is beyond range of the temperature sensor. Temperature sensor malfunction
	PCB over temperature		4	PCB temperature exceeds the temperature setting. Operation is impossible due to high PCB temperature.
	PCB temperature out of range		5	PCB temperature is beyond range of the temperature sensor. Temperature sensor malfunction
	Motor temperature out of range		6	Motor temperature sensor is out of range. Temperature sensor malfunction
B Feedback	Resolver	2	10	Check resolver connector and wiring.
	Resolver initialization		4	Resolver initialization error
	Absolute encoder		6	Absolute encoder fault
C Current	Current sensor offset	3	10	Current sensor offset is out of range.
	Overcurrent		1	Motor overcurrent Check motor wiring for shorts.
D Voltage	Undervoltage	4	1	DC bus voltage is below set value. Check +/- power terminal voltages.
	Oversvoltage		2	DC bus voltage exceeds set value. Check +/- power terminal voltages.
E Functionality	Speed fault	5	10	Large error between commanded speed and actual speed
	Overload protection (I ² T)		2	Motor overload protection (I ² T)
	Hardware		3	Hardware fault
	External hardware		4	CANopen interface fault
	Overspeed		8	CANopen overspeed fault
F Communication	EEPROM	6	1	Erroneous parameter stored in EEPROM
	Canopen		2	Canopen communication fault
	Absolute fault		3	Internal communication fault
	Parameter initialization		4	Parameter initialization fault
	Profile		5	Profile setting fault
	Torque profile		6	Torque profile fault
	Velocity profile		7	Velocity profile fault
G Configuration	Program fault	7	x	Code Programming Fault
	Manufacturer	8	1	Data Manufacturer image is not written.
	Store/Restore		2	General Error for Store and Restore Process
	Modbus error	9	1	Communication Fault with Modbus

7. Exception Code

Following a request, there are 4 possible outcomes from the slave.

- (1) The request is successfully processed by the slave and a valid response is sent.
- (2) The request is not received by the slave therefore no response is sent.
- (3) The request is received by the slave with a parity, CRC error. The slave ignores the request and sends no response.
- (4) The request is received without an error but cannot be processed by the slave for another reason.

The slave replies with an exception response.

In a normal response, the slave echoes the function code. The first sign of an exception response is that the function code is shown in the echo with its highest bit set. All function codes have 0 for their most significant bit. Therefore, setting this bit to 1 is the signal that the slave cannot process the request.

Following the function code is the exception code. The exception code gives an indication of the nature of the problem. The possible codes are shown in the table below.

The exception code shown above 0x02 is an indication that parameter has an illegal address in the slave.

Table 7-1 List of Exception Code

Exception Code on Modbus Communication		
Exception Code	Name	Description
0x01	Illegal Function	The function code received in the request is not an authorized action for the slave. The slave may be in the wrong state to process a specific request.
0x02	Illegal Data Address	The data address received by the slave is not an authorized address for the slave.
0x03	Illegal Data Value	The value in the request data field is not an authorized value for the slave.

8. Warranty

The scope of warranty of our delivered products is limited only to what we manufactured.

Warranty (period and description)

Period	The warranty period applies only to new products and represents 18 months after the shipment or 12 months after the actual operation, whichever is shorter.
Description	<p>If the product failed within the warranty period, in the case where mounting is done properly, connection and maintenance & administration are followed according to the maintenance manual, and the product is properly run based on the specification on the catalog or under conditions agreed between us, we will repair or provide an alternative product at our discretion for free of charge, except the exclusions below.</p> <p>However, as far as the product is connected with customers' other devices, we will not indemnify those expenses on dismantling from/mounting on the devices, etc. and other associated construction expenses, transportation expenses and opportunity loss and operation loss the customers suffered from, and other indirect damages.</p>
Exclusion from the warranty	<p>The following items will be excluded from the warranty:</p> <ol style="list-style-type: none"> 1. A breakdown resulting from defects in the mounting of the product and connection with other devices, etc. 2. A breakdown resulting from insufficient maintenance & administration and improper handling of the product, including a case that the product is not stored according to our defined storage manual. 3. A breakdown resulting from operation which does not fall within our specification and other operation conditions and use status we hardly can know or a failure caused by the use of lubricant which we do not recommended. 4. A breakdown resulting from defects, special specification, etc of device prepared and connected by customer. 5. A breakdown resulting from modification or reconstruction of the product. 6. A secondary breakdown occurring in our product due to defects in sequence circuits. 7. A breakdown resulting from defects in parts supplied or specified by customers. 8. A breakdown caused by inevitable force including earthquake, fire, flood disaster, salt damage, gas damage, and lightning strike, etc. 9. Warranty of natural wear and tear, abrasion, and deterioration of consumable parts such as Aluminum electrolytic capacitor etc. under normal usage. 10. A breakdown caused for reasons not attributable to each of the above item.

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