

LAFERT MODBUS ON RS485 MANUAL



Release 1.1

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REFERENCE DOCUMENTS:

- Lafert User Guide

TERMS AND ABBREVIATIONS

EMCY	Emergency Parameter.
EMC	Electromagnetic compatibility.
HMI	Human Machine Interface.
I/O	Input/output.

LSB	Least significant bit/byte.
LSD	Lafert Servo Drives.
MASTER	It is a device that controls and communicates with drive.
MSB	Most significant bit/byte.
MSM	Macro State Machine of Lafert Servo Drives.
IdNode	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 Drive and received by Main Control Box

FIRMWARE AND MANUAL RELEASED

This table shows the correlation between firmware and Modbus Manual.

Lafert Servo Drive	Firmware Released	Modbus Manual
SMARTRIS	2.2.5	1.1

1. | MODBUS OPERATION

1.1 RS485 - Modbus Communication Settings

WRITE SINGLE HOLDING REGISTER (0x06) / READ HOLDING REGISTERS (0x03)

Physical Address

Variable	Address (WR)	Default Value	Choice
Address	0x0028	1	1 ÷ 247

Baud Rate

Variable	Address (WR)	Default Value	Choice
BaudRate	0x0035	192 → 19200	96 → 9600
			192 → 19200
			384 → 38400
			576 → 57600
			1152 → 115200

COM Settings

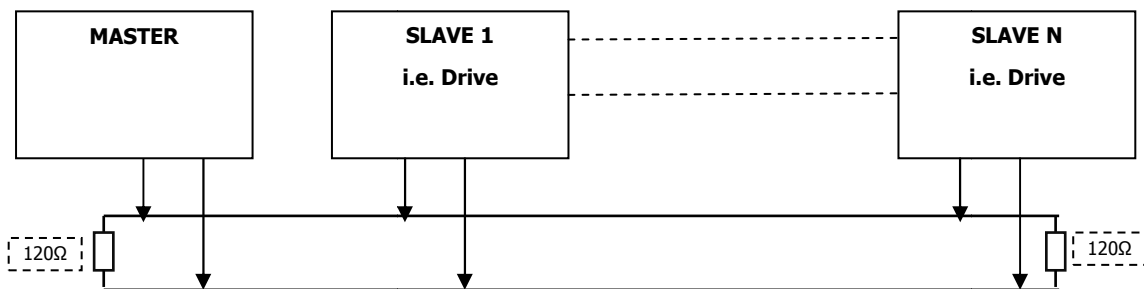
Variable	Address (WR)	Default Value	Choice
Parity/ Stop Bits / Data Bits	0x002B	0 → NO Parity / 2 Stop Bits / 8 Data Bits	0 → NO Parity / 2 Stop Bits / 8 Data Bits
			1 → ODD Parity / 1 Stop Bit / 8 Data Bits
			2 → EVEN Parity / 1 Stop Bit / 8 Data Bits



Warning

The Modbus Address is the physical address and depends if there are more devices together.

WARNING: The modifies of Baudrate or Parity can cause communication issues. They depend to Hardware connection. In case of sending different value drive gives the Exception Code 0x03



Picture 1 – Modbus Connection



Warning

Lafert Drive is always set as a slave

2. | READ INPUT REGISTERS (0X04)

2.1 List of Read Input Registers

READ FROM DRIVE (0x04)		UNIT
HEX	DEC	
0x0042	66	SPEED SETPOINT [RPM]
0x0047	71	CURRENT TORQUE SETPOINT [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	BUS DC LINK [V / 100]
0x0065	101	MOTOR TEMPERATURE [°C / 10]
0x0066	102	HEAT-SINK TEMPERATURE [°C / 10]
0x0067	103	BOARD TEMPERATURE [°C / 10]
0x0068	104	MOTOR SPEED [RPM]
0x0069	105	TORQUE CURRENT [A / 100]
0x006A	106	I2T ENERGY VALUE [%]
0x006B	107	AXIS POSITION LOW [Pulse]
0x006C	108	AXIS POSITION HIGH [Pulse]
0x006D	109	IMPULSES [Pulse]

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

2.2 Description of Read Input Registers

SPEED SETPOINT [rpm]

PDU Address (HEX)	Description
0x0042	SPEED SETPOINT i.e. 0x0042 = 0x64 (100) → Speed Motor = 100 rpm 0x0042 = 0xF448 (62536 = -3000) → Speed Motor = -3000 rpm

CURRENT TORQUE SETPOINT

PDU Address (HEX)	Description
0x0047	Current SETPOINT i.e. 0x0047 = 0xC8 (200) → 2 Arms

0x0047 = 0xFF38 (65336 = -200) → - 2 Arms

DIGITAL INPUTS

PDU Address (HEX)	Description															
0x005E	Reads DIGITAL INPUTS The default DIGITAL INPUT configuration in Modbus Command Mode is: - DIGIN1 = DCW - DIGIN2 = DCCW - DIGIN3 = EMERGENCY INPUT ENABLE - DIGIN4 = RESET (see table below for further informations about digital inputs configurations) <table><tr><td>0x005E</td><td>DIG IN 4</td><td>DIG IN 3</td><td>DIG IN 2</td><td>DIG IN 1</td></tr><tr><td>0x0001</td><td>0</td><td>0</td><td>0</td><td>1</td></tr><tr><td>0x000F</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table>	0x005E	DIG IN 4	DIG IN 3	DIG IN 2	DIG IN 1	0x0001	0	0	0	1	0x000F	1	1	1	1
0x005E	DIG IN 4	DIG IN 3	DIG IN 2	DIG IN 1												
0x0001	0	0	0	1												
0x000F	1	1	1	1												

Contact Manufacturer to modify program of Digital Inputs

Bit	Configuration
0	"RUN" (used only in Analog Mode): this input is the command to move the drive in RUN state.
1	"STOP" (used only in Analog Mode): this input is the command to move the drive in STOP state
2	"EMERGENCY INPUT ENABLE": when the option of digital input 3 is defined "Emergency Input Enable" this input is the command to move the drive in STANDBY state.
3	"RESET": when this function is enabled the input configured can put the drive in reset (it is an hardware reset). If the digital input is configured as reset, the reset has a filter with 100ms.
4	"DCW": this function is to configure the input with an actuator for clockwise. If the input state is 1 the drive goes in STOP state.
5	"DCCW": this function is to configure the input with an actuator for counter clockwise. If the input state is 1 the drive goes in STOP state
6	"SETVEL1" (used only in Analog Mode): This function is to configure the Set Point value defined by "File Parameters". If the digital inputs are set with this function, then the Set Points available are 2.
7	"SETVEL2" (used only in Analog Mode): This function is to configure the Set Point value defined by "File Parameters". If the digital inputs are set with the functions "SETVEL1" and "SETVEL2", then the Set Points available are 4.
8	"SETVEL3" (used only in Analog Mode): This function is to configure the Set Point value defined by "File Parameters". If the digital inputs were set with the functions "SETVEL1", "SETVEL2" and "SETVEL3", then the Set Points available are 8.
9	"SETVEL4" (used only in Analog Mode): This function is to configure the Set Point value defined by "File Parameters". If the digital inputs were set with the functions "SETVEL1", "SETVEL2", "SETVEL3" and "SETVEL4", then the Set Points available are 15. If this function is set then all digital inputs are used. When all digital inputs are 0 the drive is in STANDBY, to have the RUN function it needs to have at least one digital input as 1.
10	"VEL/CUR" (used only in Analog Mode): If the digital Input is selected with this function then the drive change the mode operation (Velocity Profile and Torque Profile), the function can be used only in standby state.
11	"DIR" (used only in Analog Mode): This function changes the direction of the motor. The set point changes the polarity.

Table 1 – Programmable Inputs

DIGITAL OUTPUTS

PDU Address (HEX)	Description				
0x005F	Reads DIGITAL OUTPUTS				
	DIG-OUT1: shows if the drive is:				
	• '1' = Drive OK • '0' = Drive in FAULT				
	DIG-OUT2 Warning				
	DIG-OUT3 is free and programmable				
0x005F	DIG-OUT4 shows the BRAKE status:				
	• '1' = brake released, motor axis free • '0' = brake active, motor blocked				
	i.e. 0x005F = 0x0001 → Drive OK is ON, the drive doesn't have alarm				
	0x005E	DIG OUT 4	DIG OUT 3	DIG OUT 2	DIG OUT 1
	0x0001	0	0	0	1
0x000F	1	1	1	1	

DRIVE STATUS

PDU Address (HEX)	Description
0x0060	Status of the drive: 0x0001 – Run in Velocity mode 0x0002 – Drive in StandBy 0x0004 – Drive in STOP 0x0008 – reserved 0x0010 – Drive in Alarm (see Error code) 0x0020 – Run in Torque mode 0x0040 – Drive in Init state (CANOpen) 0x0080 – Drive in SAFE (STO active) 0x0100 – reserved i.e. 0x0060 = 0x0002: the drive is ready in standby

WARNING CODE LOW

PDU Address (HEX)	Bit	Warning	Warning description
0x0061	0-7	free	
	8	Heat Sink Temperature	Warning Heat Sink Temperature
	9	Logic Board Temperature	Warning Logic Board Temperature
	10	Motor Temperature	Warning Motor Temperature
	14-15	free	

WARNING CODE HIGH

PDU Address (HEX)	Bit	Warning	Warning description
0x0062	0-15	free	

ERROR CODE

PDU Address (HEX)	Bit	Error Code	Error description
0x0063	0	See table below	See table below

Error	Error Code	Description	Meaning	F W	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 (I2t, thermal state)	Alarm Over Current with integral i^2t (Over Load)	F	5,2
	0x2352	Load Level (i2t) not rearmed	Alarm Over Current with integral i^2t (Over Load) not Rearmed	F	5,2
ALARM VOLTAGE					
OVER VOLTAGE	0x3210	DC link over-voltage	Over Voltage alarm has been occurred	F	4,2
DC LINK UNDER VOLTAGE	0x3220	DC link under-voltage	Under Voltage alarm has been occurred	F	4,1
ALARM TEMPERATURE					
TEMPERATURE DRIVE	0x4300	Temperature Drive	Over Temperature Heat Sink (value depends by Manufacturer)	F	1,1
	0x4301	Warning temperature drive	Warning temperature drive (value depends by Manufacturer)	W	-
	0x4310	Excess temperature drive	Heat Sink Temperature too high of max Range	F	1,3
	0x4320	Too low temperature drive	Heat Sink Temperature too low of minimum Range	F	1,3
TEMPERATURE INT 1 – BOARD	0x4500	Temperature Logic Board	Over Board Temperature (> 68°C)	F	1,4
	0x4501	Warning Logic Board temperature	Warning Logic Board temperature (> 63°C)	W	-
	0x4510	Excess Logic Board temperature	Board Temperature too high of maximum Range	F	1,5
	0x4520	Too low Logic Board temperature	Board Temperature too low of minimum Range	F	1,5
TEMPERATURE EXT 1 - MOTOR	0x4A00	Temperature Motor	Over Motor Temperature (> 140°C)	F	1,10
	0x4A01	Warning temperature Motor	Warning Motor Temperature (> 130°C)	W	-
	0x4A10	Excess temperature Motor	Motor Temperature too high of maximum Range	F	1,6
	0x4A20	Too low temperature Motor	Motor Temperature too low of minimum Range	F	1,6
ALARM HARDWARE					
INPUT STAGES	0x5431	Offset Sensor	Offset Sensor	F	3,10
HARDWARE MEMORY	0x5501	HardwareError Write EEprom: Vbus too Low	Write is not possible because the Bus Voltage is too low to guarantee the writing complete	F	5,3

HW MEMORY E²PROM - USER	0x5530	E²PROM	Generic Error E ² prom	F	6,1
	0x5531	E ² prom General Error	Generic Error E ² prom Writing	F	6,1
	From 0x5532 to 0x556F	E ² prom Error Parameter 1 - 61	Error Writing E ² prom Parameters (contact Manufacturer)	F	6,1
HW MEMORY E²PROM - FACTORY PARAMETERS	0x5A02	Error Data Golden Image	Data Golden Image is not written	F	8,1
ALARM PARAMETERS					
DATA SET	0x6300	Data Set Parameters Table	Data Set Programming Error	F	7,1
	From 0x6301 To 0x6409	Data record no. 1 - 24	Programming Error Data Set (contact Manufacturer)	F	7,1
PARAMETER ERROR	0x6320	Parameter Error	Generic Parameter Error	F	6,4
	0x6321	Incongruity Data Configuration 1	Configuration Error (contact Manufacturer)	F	6,4
	0x6322	Incongruity Data Configuration 2	Configuration Error (contact Manufacturer)	F	6,4
ALARM ADDITIONAL MODULE					
ENCODER SINCOS	0x7350	Encoder SinCos	Error Generic Encoder SinCos	F	2,6
	0x7351	Rx Error	Error Message Received	F	2,6
	0x7352	Tx Error	Error Message Transmitted	F	2,6
	0x7353	Comand Read Position Error	Error Read Position	F	2,6
	0x7354	Comand Status Error	Error Status Encoder SinCos	F	2,6
	0x7355	Comand Type Error	Error Type Encoder SinCos	F	2,6
	0x7356	Comand Init Timeout	Error Timeout during Initialization SinCos	F	2,6
CONVERTER SINCOS	0x7360	Converter Sin/Cos	Error Generic Converter Sin/Cos	F	6,3
	0x7361	E ² prom Ext	First programming E ² prom external, we must reset the driver	F	6,3
	0x7362	Nerr Signal Amp	Fault has been occurred: Amplitude Error	F	6,3
	0x7363	Nerr Signal Freq	Fault has been occurred: Frequency Error	F	6,3
	0x7364	Nerr Signal Other	Fault has been occurred: configuration or Under voltage or System Error	F	6,3
	0x7365	Error Gen	General Error	F	6,3
RESOLVER	0x7374	Resolver Initialization	Resolver Fault Initialization has been occurred		2,4
	0x7375	Resolver Hardware Fault LOS (Loss of Signal)	Manufacturer specific value describes the cause of the triggering of the fault detection output pins	F	2,10
	0x7376	Resolver Hardware Fault DOS (Degradation of Signal)	Manufacturer specific value describes the cause of the triggering of the fault detection output pins	F	2,10
	0x7377	Resolver Hardware Fault LOT (Loss of Tracking)	Manufacturer specific value describes the cause of the triggering of the fault detection output pins	F	2,10
	0x7378	Resolver Hardware Fault LOS, DOS, LOT during phasing initialisation	Manufacturer specific value describes the cause of the triggering of the fault detection output pins	F	2,10
INCR ENCODER	0x7390	Incremental Encoder	Error Generic Incremental Encoder	F	2, 5
	0x7391	Encoder error init	Encoder has initialization error due to sequence Hall or value null	F	2, 1
	0x7392	Encoder error congruence	Encoder has congruence error between Hall	F	2, 2

	0x7393	Encoder error phasing	Encoder has phasing error	F	2, 3
	0x7394	Encoder error Distance	Encoder Error Distance Hall	F	2, 4
COMMUNICATION	0x7520	MODBUS	Modbus Generic Error	F	9,1
	0x7521	Modbus Communication Lost	The drive didn't receive any valid message during the Communication Loss Timer (see Modbus func. 03 or 06 - addr.0x0036).	F	9,1
ALARM PROTOCOL					
TORQUE PROFILE CONTROL	0x8300	Torque control	General Error for Profile Torque Controller	F	6,6
	0x8341	Torque Type	Error type selected is not managed	F	6,6
	0x8351	Torque Dynamic Brake	Error Dynamic Brake is not implemented	F	6,6
VELOCITY SPEED CONTROLLER	0x8400	Velocity speed controller	General Error for Profile Velocity Controller	F	6,7
	0x8410	Following error Current Mode	The difference between the velocity command and the actual velocity is greater than the value that is set in maximum velocity error. The drive is in Torque Profile	F	5,10
	0x8411	Following error Velocity Mode	The difference between the velocity command and the actual velocity is greater than the value that is set in maximum velocity error. The drive is in Velocity Profile	F	5,10
	0x8412	Over Speed	Actual speed exceeds the velocity over speed value	F	5,8
	0x8611	Following error	The difference between the position command and the actual position is greater than the value that is set in maximum position error	F	-
EEPROM	0x8B00 0x8B02	Store and Restore Process	General Error for Store and Restore Process	F	8,2

Table 2 - Error code Description



Warning

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

BUS DC LINK

PDU Address (HEX)	Description
0x0064	Bus Dc Link [V / 100] i.e. 0x0064 = 0x1356 (4950) → Bus Dc Link = 49.5 Vdc

MOTOR TEMPERATURE

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

HEAT-SINK TEMPERATURE

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

BOARD TEMPERATURE

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

MOTOR SPEED

PDU Address (HEX)	Description
0x0068	Motor Speed in rpm i.e. 0x0068 = 0x01F4 (500) → Motor is running at 500 rpm 0x0068 = 0xFC18 (64536 = -1000) → Motor Speed = -1000 rpm

TORQUE CURRENT

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

I2T ENERGY VALUE

PDU Address (HEX)	Description
0x006A	I2T Energy Level [% of nominal current] i.e. 0x006A = 0x0032 (50) → Torque current = 50% of nominal current 0x006A = 0x0096 (150) → Torque current = 150% of nominal current – drive it could goes in alarm

AXIS POSITION LOW

PDU Address (HEX)	Description
0x006B	Low part of axis position [lower 16 bit of total 32 bit] i.e. Position axes = 1000000 / 0x000F4240 0x006B = 0x4240

AXIS POSITION HIGH

PDU Address (HEX)	Description
0x006C	High part of axis position [higher 16 bit of total 32 bit] i.e. Position axes = 1000000 / 0x000F4240 0x006C = 0xF

IMPULSES

PDU Address (HEX)	Description
0x006D	Electrical impulse read – Electrical gear Value depends of feedback resolutions: for a feedback with 14 bits the range value is [0:16384] i.e. 0x006D = 0x1000 → the motor axis is at position 4096/16384 → it is at 90°

3. | READ HOLDING REGISTERS (0X03)

3.1 List of Read Holding Registers

READ ONLY (0x03)		UNIT
HEX	DEC	
0x0001	1	CONTROL WORD
0x0003	3	FULL SCALE VELOCITY [RPM]
0x0028	40	MODBUS ADDRESS
0x002B	43	COM SETTINGS
0x0035	53	MODBUS BAUD RATE
0x0036	54	COMMUNICATION LOSS TIME
0x003C	60	PID VELOCITY KP [IU]
0x003D	61	PID VELOCITY KI [IU]
0x003E	62	PID VELOCITY KW [IU]
0x003F	63	SPEED RAMP STATE
0x0040	64	SPEED RAMP UP [ms]
0x0041	65	SPEED RAMP DOWN [ms]
0x0043	67	SPEED POLARITY
0x0044	68	LIMIT TORQUE POSITIVE [%]
0x0045	69	LIMIT TORQUE NEGATIVE [%]
0x0046	70	SLOPE RAMP (TORQUE) [peak current / (1000 * s)]
0x004E	78	BRAKE MANAGED
0x004F	79	BRAKE MODE
0x0050	80	BRAKE TYPE
0x01FF	511	FW RELEASE CUSTOMER
0x0201	513	HW RELEASE
0x0202	514	PARAMETER RELEASE
0x0203	515	MOTOR TYPE
0x0204	516	STO CHECK
0x0205	517	FEEDBACK
0x0207	519	OPERATION MODE

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

3.2 Description of Read Holding Registers

CONTROL WORD

PDU Address (HEX)	Description
0x0001	Reads CONTROL WORD bits status: 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 Warning: BRAKE bit is a DON'T CARE bit if the brake is NOT ACTIVE and is set to AUTO. Brake can be managed by modbus address 0x004E Brake mode (manual/auto) can be changed by modbus address 0x004F

FULL SCALE VELOCITY

PDU Address (HEX)	Description
0x0003	Velocity Full Scale [rpm] i.e. if the motor is 4500 rpm 0x0003 = 0x1194 (4500) → Velocity Full Scale = 4500 rpm

MODBUS ADDRESS

PDU Address (HEX)	Description
0x0028	Modbus Address i.e. 0x0028 = 1 → Modbus Address = 1

COM SETTINGS

PDU Address (HEX)	Description
0x002B	COM Settings - Modbus COM 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

MODBUS BAUD RATE

PDU Address (HEX)	Description
0x0035	Modbus Baud Rate i.e. 0x0035 = 0x00C0 (192) → ModBus Baud Rate = 19200

COMMUNICATION LOSS TIME

PDU Address (HEX)	Description
0x0036	Reads the timer that is set to recognize modbus communication loss when the motor is running. If the value is equal to 0, the timer is disabled.

PID VELOCITY KP

PDU Address (HEX)	Description
0x003C	Proportional PID Velocity -The parameter controls equivalent of PID speed parameters. i.e. The PID are defined by application It is possible to change the Speed Pid in run time.

PID VELOCITY KI

PDU Address (HEX)	Description
0x003D	Integral PID Velocity -The parameter controls equivalent of PID speed parameters. i.e. The PID are defined by application It is possible to change the Speed Pid in run time.

PID VELOCITY KW

PDU Address (HEX)	Description
0x003E	Parameter PID Velocity -The parameter controls equivalent of PID speed parameters. i.e. The PID are defined by application. It is possible to change the Speed Pid in run time.

RAMP STATE

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

SPEED RAMP UP

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

SPEED RAMP DOWN

PDU Address (HEX)	Description
0x0041	Speed ramp down in ms i.e. 0x0040 = 1000 : Speed ramp down from max velocity to 0 = 1 sec

SPEED POLARITY

PDU Address (HEX)	Description
0x0043	Polarity of Speed/Torque setpoint - range [-Full scale velocity: Full scale velocity] 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 = 3.000 rpm, sending 0x0043 = 1 the motor begin to run at -3000 rpm

TORQUE LIMIT POSITIVE

PDU Address (HEX)	Description
0x0044	Torque limit positive This parameter shall indicate the configured maximum 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 maximum torque positive is 50% of rated current

TORQUE LIMIT NEGATIVE

PDU Address (HEX)	Description
0x0045	Torque limit negative This parameter shall indicate the configured maximum 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 maximum torque negative is 50% of rated current

SLOPE RAMP (TORQUE)

PDU Address (HEX)	Description
0x0046	Slope Torque Ramp [peak 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 messages with Emergency Protocol. i.e. 0x0046 = 0x03E8 (1000) → Torque ramp up from 0 to rated current = 1 sec

BRAKE MANAGED

PDU Address (HEX)	Description
0x004E	Brake Managed (value admitted 0/1) i.e. 0x004E = 1 → Brake managed 0x004E = 0 → NO Brake

BRAKE MODE

PDU Address (HEX)	Description
0x004F	Brake Mode Manual/Automatic (value admitted 0/1) i.e. 0x004F = 1 → Manual Brake enabled 0x004F = 0 → Automatic Brake enabled

BRAKE TYPE

PDU Address (HEX)	Description
0x0050	Selection of type of brake (in case of brake enabled) (value admitted 0/1): i.e. 0x004F = 1 → Magnetic Brake 0x004F = 2 → Spring Brake

FIRMWARE RELEASE CUSTOMER

PDU Address (HEX)	Description
0x01FF	Read the device firmware version i.e. 0x0054 = 0x00E1 (225) → Firmware release 2.2.5

HARDWARE RELEASE

PDU Address (HEX)	Description
0x0201	Read the device hardware version i.e. 0x0053 = 0x000B (11) → Hardware release 1.1

PARAMETER RELEASE

PDU Address (HEX)	Description
0x0202	Read parameter release: i.e. 0x0052 = 0x0136 (310) → Parameter release 3.1.0

MOTOR TYPE

PDU Address (HEX)	Description
0x0203	Read motor type: • 0 = None, • 1 = B40, • 2 = B63, • 3 = B71, • 100 = TCF i.e. 0x0051 = 1 → Selected Motor Type S

STO CHECK

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

FEEDBACK TYPE

PDU Address (HEX)	Description
0x0205	Reads what type of feedback control has the drive • 0x0205 = 0 → Resolver • 0x0205 = 1 → Incremental Encoder • 0x0205 = 2 → SinCos Encoder

OPERATION MODE

PDU Address (HEX)	Description
0x0207	Reads operation Mode: • 0x0207 = 0 → No Operation mode • 0x0207 = 1 → Torque mode • 0x0207 = 2 → Velocity mode

4. | WRITE SINGLE HOLDING REGISTER (0X06)

4.1 List of Write Single Holding Registers

WRITE PARAMETERS (0x06)		UNIT
HEX	DEC	
0x0000	0	STORE E2PROM
0x0001	1	CONTROL WORD
0x0028	40	MODBUS ADDRESS
0x002B	43	COM SETTINGS
0x0035	53	MODBUS BAUD RATE
0x0036	54	COMMUNICATION LOSS TIME
0x003C	60	PID VELOCITY KP
0x003D	61	PID VELOCITY KI
0x003E	62	PID VELOCITY KW
0x003F	63	RAMP ENABLE
0x0040	64	SPEED RAMP UP TIME
0x0041	65	SPEED RAMP DOWN TIME
0x0042	66	SPEED SETPOINT
0x0043	67	SPEED POLARITY
0x0044	68	LIMIT TORQUE POSITIVE
0x0045	69	LIMIT TORQUE NEGATIVE
0x0046	70	SLOPE RAMP (TORQUE)
0x0047	71	CURRENT TORQUE SETPOINT
0x004E	78	BRAKE MANAGE
0x004F	79	BRAKE MODE
0X0207	519	OPERATION MODE
0x5A5A	23130	RESTORE MANUFACTURER DATA
0xA5A5	42405	RESET DRIVE

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



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 E2PROM)
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	COM SETTINGS
0x0035	53	MODBUS BAUD RATE
0X0207	519	OPERATION MODE

4.2 Description of Write Single Holding Registers

STORE E2PROM DATA

PDU Address (HEX)	Description
0x0000	Command to store data on E2prom. Not need to send parameters i.e. 0x0000 → Store the parameters in E2prom

CONTROL WORD

PDU Address (HEX)	Description
0x0001	CONTROL WORD bits status: - 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 Warning: BRAKE bit is a DON'T 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 value it is out of range [0:7] the drive gives the Exception Code 0x03



Warning

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



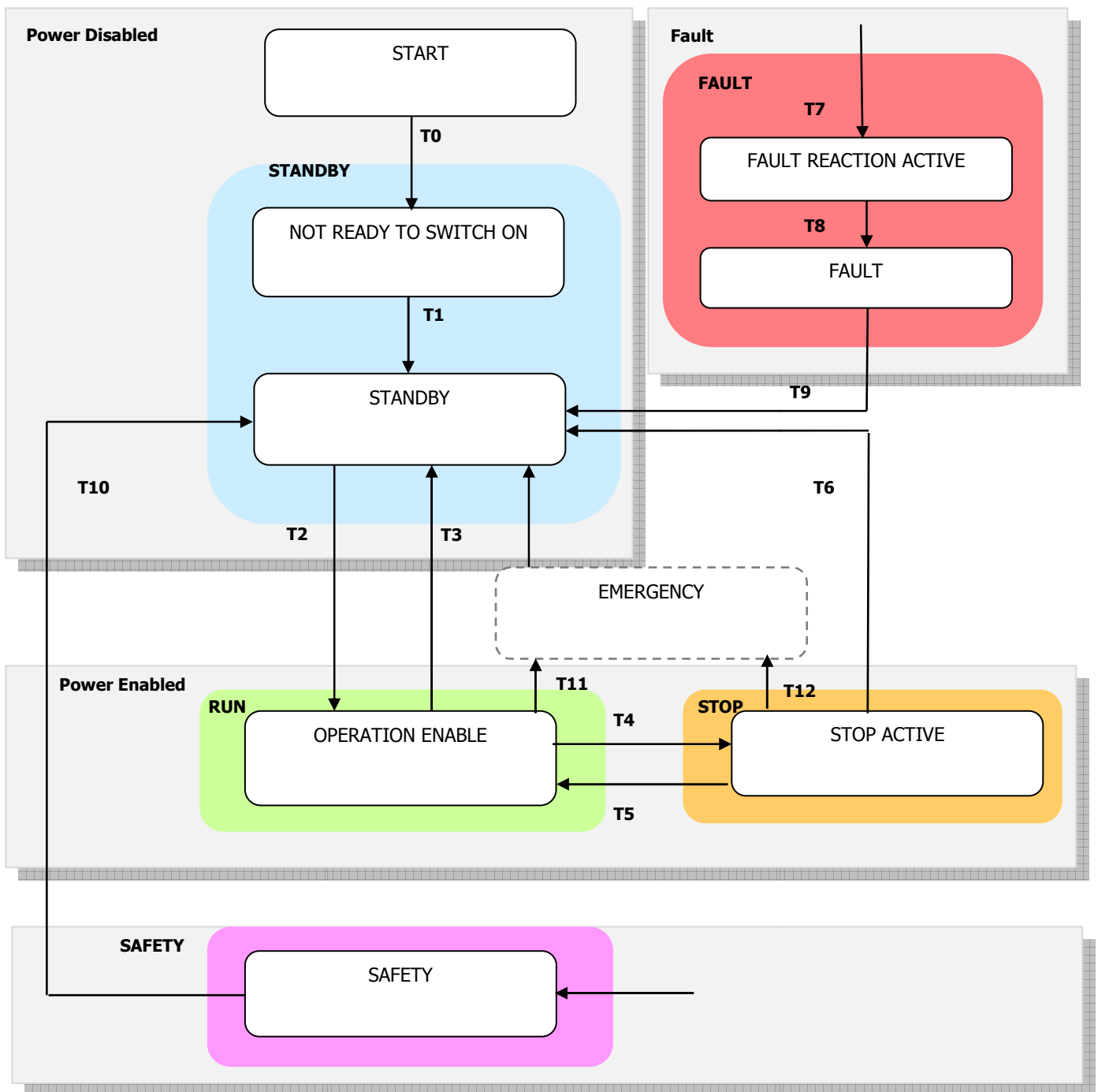
Warning

In case of Run/Stop state if is given an *Emergency Command* (Digital Input - **not Safety input**) the drive state goes to standby (T11/T12). Then if you need to give a run command (or stop command) is necessary the transition of command SAFETY → STANDBY → RUN



Warning

In case of Run/Stop state if is given an *STO Command* (**Safety input**) the drive state goes to standby (T11/T11a). Then if you need to give a run command (or stop command) is necessary the transition of command SAFETY → STANDBY → RUN



Picture 2 - State Machine Modbus Mode with Safety State

4.2.1 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



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 E2PROM Data and then reset drive with command [func.06 – addr.0xA5A5] System Reset.

- 4) Verify that the Smartris Drive is in SWITCHED ON
- 5) Set **OPERATION ENABLED** State : write [0x06] Control Word → 0x0001 = 0x0003 [**T2**]
- 6) Verify LED STATUS ENABLED
 - Verify by read [func. 0x03 - addr.0x0060], that the Smartris Drive is in ENABLED [Drive Status = 0x0001 → RUN]]
 - Verify that the brake is released
- 7) 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)
- 8) 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
- 9) 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's equal to a QUICK 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 [**T4**] – Drives goes in Standby state.

Transitions:

Transition	Description	Transition	
T0	Switch ON – Supply to drive	T7	Fault reaction active
T1	Drive after init – 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 decrement speed with a programmed ramp
T5	Run command–Drive Enabled Stop→Run		
T6	Standby command – Stop→Standby	T12	Emergency (If active)

Table 3 – Transition Description – State machine

NOTES:

- The STO (**SAFETY**) command may can stop the running command immediately
- The **Stop** Command can stop the running command immediately
- A **FAULT** (see table in Diagnostic) can stop the running command immediately

MODBUS ADDRESS

PDU Address (HEX)	Description
0x0028	Modbus Address. [1:247] i.e. 0x0028 = 1 → Modbus Address = 1 To change MODBUS ADDRESS is necessary save to E2prom and give a reset command If value it is out of range the drive gives the Exception Code 0x03

COM SETTINGS

PDU Address (HEX)	Description
0x002B	COM Settings. Modbus COM 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 COM SETTINGS is necessary save to E2prom and give a reset command If value it is out of range the drive gives the Exception Code 0x03

MODBUS BAUD RATE

PDU Address (HEX)	Description
0x0035	Modbus Baud Rate (Default 19200) 0x0035 = 96 → 9600 0x0035 = 192 → 19200 0x0035 = 384 → 38400 0x0035 = 576 → 57600 0x0035 = 1152 → 115200 i.e. 0x0035 = 0x00C0 (192) → ModBus Baud Rate = 19200 To change MODBUS BAUD RATE is necessary save to E2prom and give a reset command If value it is out of range the drive gives the Exception Code 0x03

COMMUNICATION LOSS TIME

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

PID VELOCITY KP

PDU Address (HEX)	Description
0x003C	Proportional PID Velocity -The parameter controls equivalent of PID speed parameters. i.e. The PID are defined by application. It is possible to change the Speed Pid in run time. If value it is negative the drive gives the Exception Code 0x03

PID VELOCITY KI

PDU Address (HEX)	Description
0x003D	Integral PID Velocity -The parameter controls equivalent of PID speed parameters. i.e. The PID are defined by application. It is possible to change the Speed Pid in run time. If value it is negative the drive gives the Exception Code 0x03

PID VELOCITY KW

PDU Address (HEX)	Description
0x003E	Parameter PID Velocity -The parameter controls equivalent of PID speed parameters. i.e. The PID are defined by application. It is possible to change the Speed Pid in run time. If value it is negative the drive gives the Exception Code 0x03

RAMP ENABLE

PDU Address (HEX)	Description
0x003F	Reads if the ramps (torque and speed ramps) are enabled or not. i.e. 0x003F = 1 : Speed ramp enabled 0x003F = 0 : Speed ramp disabled To change RAMP STATE is necessary save to E2prom and give a reset command If value it is different from 0/1 the drive gives the Exception Code 0x03

SPEED RAMP UP

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

SPEED RAMP DOWN

PDU Address (HEX)	Description
0x0041	Speed ramp down in ms

	i.e. 0x0040 = 0x03E8 (1000) → Speed ramp down from max velocity to 0 = 1 sec If value it is negative the drive gives the Exception Code 0x03
--	---

SPEED SET POINT

PDU Address (HEX)	Description
0x0042	Speed setpoint - range [-Full scale velocity: Full scale velocity] The speed setpoint is available in range of - Full scale velocity Full scale velocity Considering a drive with Full scale velocity = 3.000 rpm Speed SetPoint (Write to VFD Function 0x06) has a range [-3000:3000] rpm i.e. 0x0042 = 0x0BB8 (3.000) is requested speed → Speed Motor = 3000 rpm 0x0042 = 0xF448 (-3.000) → Speed Motor = -3000 rpm If value it is out of range the drive gives the Exception Code 0x03

SPEED POLARITY

PDU Address (HEX)	Description
0x0043	Polarity of Speed/Torque/Position setpoint - range [-Full scale velocity: Full scale velocity] 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 = 3.000 rpm, sending 0x0043 = 1 the motor begin to run at -3000 rpm If value it is different to 0/1 the drive gives the Exception Code 0x03

LIMIT TORQUE POSITIVE

PDU Address (HEX)	Description
0x0044	Torque limit positive [0:100] This parameter shall indicate the configured maximum 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 maximum torque positive is 50% of rated current If value it is out of range the drive gives the Exception Code 0x03

LIMIT TORQUE NEGATIVE

PDU Address (HEX)	Description
0x0045	Torque limit negative [0:100] This parameter shall indicate the configured maximum 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 maximum torque negative is 50% of rated current

	If value it is out of range the drive gives the Exception Code 0x03
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SLOPE RAMP (TORQUE)

PDU Address (HEX)	Description
0x0046	Slope Torque Ramp [peak 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 peak 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 messages with Emergency Protocol. i.e. 0x0046 = 0x01F4 (500) → Torque ramp up from 0 to peak current in (1000 / 500) secs = 2 sec If value it is negative the drive gives the Exception Code 0x03 If Operation Mode is set on Velocity drive gives the Exception Code 0x03

CURRENT TORQUE SETPOINT

PDU Address (HEX)	Description
0x0047	Torque Setpoint [Arms / 100] in Torque Control Mode. [-peak current, peak current] Torque Setpoint range: [-Peak Current; Peak Current] i.e. 0x0047 = 0xC8 (200) → 2 Arms 0x0047 = 0xFF38 (65335 = -200) → - 2 Arms If value it is out of range the drive gives the Exception Code 0x03

BRAKE MANAGE

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

BRAKE MODE

PDU Address (HEX)	Description
0x004F	Set brake mode (Auto / Manual) 0x004F = 1 → Manual Brake 0x004F = 0 → Automatic Brake If value it is different to 0/1 the drive gives the Exception Code 0x03

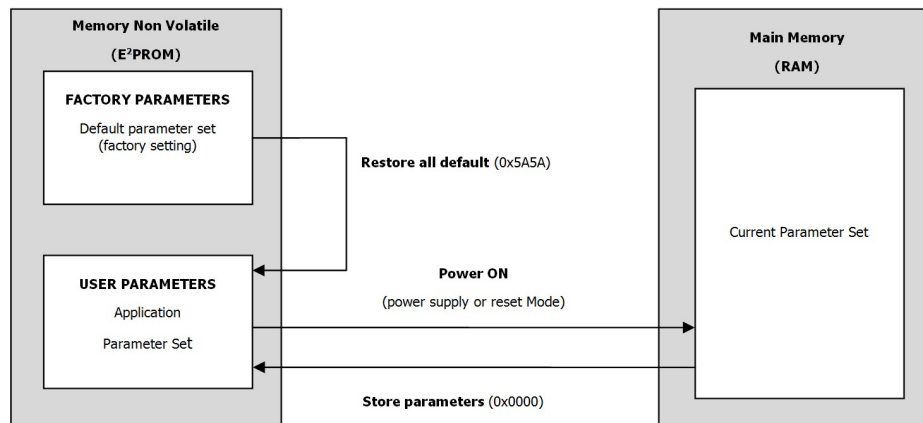
OPERATION MODE

PDU Address (HEX)	Description
0x0207	Reads operation Mode: 0x0207 = 1 → Torque mode

	0x0207 = 2 → Velocity mode To change OPERATION MODE is necessary save to E2prom and give a reset command If value it is different from 1/2 the drive gives the Exception Code 0x03
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RESTORE MANUFACTURER DATA

PDU Address (HEX)	Description
0x5A5A	Command to restore Manufacturer data on E2prom. Not need to send parameters



Picture 3 - Store - Restore Function

SYSTEM RESET

PDU Address (HEX)	Description
0xA5A5	Active if the control board is on error or want to make effective changes after a save in EEPROM: not need to send parameters Drive respond to PLC, after the drive is reset wait about 2 sec for new communication.

5. | DIAGNOSTIC

MACRO DRIVE STATE	Modbus STATE	STATUS 1 LED GREEN	STATUS 2 LED YELLOW	LED VIEW
INIT	Not Ready To Switch On	"BLINK" simultaneously	"BLINK" simultaneously	 1 simultaneously  2 simultaneously
	Switch On Disabled Ready to Switch On	"BLINK" alternately	"BLINK" alternately	 1 alternately  2 alternately
STANDBY	Switched On	"BLINK"	OFF	 1 BLINK 50%  2 OFF
FAULT	Fault Fault reaction fault	"BLINK" [x]	"BLINK" [y]	 1 see fault  2 chapter
RUN (RUNV / RUNC)	Operation Enabled	ON	OFF	 1 ON  2 OFF
STOP	Quick Stop Active	ON	ON	 1 ON  2 ON
SAFETY	-	OFF	"BLINK"	 1 OFF  2 BLINK

Table 4 - Led Status

Alarm	STATUS 1 CODE	STATUS 2 CODE	Alarm Description
	LED GREEN	LED YELLOW	
	 1st Code	 2nd Code	
A Group: (Temperature)			
Motor Over Temperature	1	10	Motor Temperature over threshold. Motor has reached a too high temperature for correct operation.
Heat Sink Over Temperature	1	1	Heat Sink Temperature over threshold. Heat Sink reached a too high temperature for correct operation.
Heat Sink Temp Out Of Range	1	3	Heat Sink Temperature Sensor is out of range. Potential malfunction of the temperature sensor. ¹
Board Over Temperature	1	4	Internal Board Temperature over threshold. Too high a temperature for correct operation inside the drive.
Board Temp Out Of Range	1	5	Internal Temperature Sensor out of range. Potential malfunction of the temperature sensor. ¹
Motor Temp Out Of Range	1	6	Motor Temperature Sensor is out of range. Potential malfunction of the temperature sensor. ¹
B Group: (Feedback)			
Resolver	2	10	Check resolver connections,connectors and wiring of both sides.
Encoder init	2	1	Encoder initialization error due to sequence Hall or value null
Enc congruence	2	2	Encoder has congruence error between Hall
Encoder phasing	2	3	Encoder has phasing error

Alarm	STATUS 1 CODE LED GREEN	STATUS 2 CODE LED YELLOW	Alarm Description
	 1st Code	 2nd Code	
Enc Distance	2	4	Encoder Error Distance Hall
Resolver Init	2	4	Initialization Fault for Resolver Device. ¹
Encoder	2	5	Incremental Encoder Fault
SinCos Fault	2	6	SinCos Encoder Fault
Hall	2	7	Hall Sensors Fault
Distance Hall	2	8	Hall Sensors Fault
C Group: (Current)			
Offset Current Sensor	3	10	Offset current sensor is out of range. ¹
Over Current	3	1	The current absorbed by the motor is beyond the set limit. Check Phase Motor connection and wire. Look for any short circuits.
D Group: (Voltage)			
Under Voltage	4	1	DC Bus voltage value lower than the limit threshold. Check mains voltage at terminals +, -.
Over Voltage	4	2	DC Bus voltage value higher than the limit threshold. Check mains voltage at terminals +, -
E Group: (Functionality)			
Velocity Fault	5	10	The actual speed differs from the target Speed.
I ² T Overload Protection	5	2	I2T overload motor protection reached.
Hardware	5	3	Error Hardware ¹
External HW	5	4	Error CAN Interface ¹
OverSpeed	5	8	Overspeed error - CAN
F Group: (Communication)			
E ² prom	6	1	Parameter Fault stored in E2prom.
CanOpen	6	2	Communication Fault with CANOpen
Sincos Fault	6	3	Internal Communication Fault ¹
Configuration Parameters	6	4	Configuration Parameters Fault ¹
Profile Generic	6	5	Error Configuration Profile: Mode Of Operation
Torque Profile	6	6	Error Torque Profile
Velocity Profile	6	7	Error Velocity Profile
Homing Profile	6	8	Error Homing Profile
Configuration Parameters			
Program Fault	7	X	Code Programming Fault ¹ (Contact the Manufacturer).
Manufacturer	8	1	Data Manufacturer image is not written
Store/Restore	8	2	General Error for Store and Restore Process

Alarm	STATUS 1 CODE	STATUS 2 CODE	Alarm Description
	LED GREEN	LED YELLOW	
	 1st Code	 2nd Code	
Modbus Error	9	1	Communication Fault with Modbus

Table 5 - Diagnostic

REVISION HISTORY

Rel.	Date	Description
1.0	30/04/2021	First Emission of Modbus Manual
1.0	07/06/2021	Added new Modbus Commands
1.1	29/06/2021	Manual Review