FR-E500

Frequency Inverter

Instruction Manual

OI-FR-E5NCO
CANopen Communications Option Unit

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Specifications subject to change without notice.

Warning symbols

For your own safety, please pay special attention to instructions containing the following symbol:

This warning symbol indicates the presence of dangerous voltage. It informs you of high voltage conditions, situation and locations that may cause death or serious injury if you do not follow precautions.

NOTES inform you of situations or conditions which will damage machinery or cause additional motor-operation downtime if you do not take suggested steps to correct or address such situations or conditions.

Thank you for choosing this option unit for the Mitsubishi FR-E500 Series transistorized frequency inverters. Please read this manual carefully before using this option unit.

This instruction manual gives handling information and precautions for use of this product. Incorrect handling might cause an unexpected fault. Before using the equipment, please read this manual carefully to use it to its optimum.

Please forward this manual to the end user.

CANopen Communications Option Unit

This option allows the inverter to be connected to a network adhering to the CANopen communications protocol. Some important features are highlighted below.

- Data rates of 20K baud, 50K baud, 62.5K baud, 100K baud, 125K baud, 250K baud, 500Kbaud, and1M baud are selectable.
- Up to 99 stations supported on a single network.
- Ability to add or remove stations without disrupting network operation.
- Network access to all inverter parameters, Start/Stop commands, and monitor data.

Safety Instructions

Do not attempt to install, operate, maintain or inspect this product until you have read through this instruction manual and appended documents carefully and can use the equipment correctly. Do not use this product until you have a full knowledge of the equipment, safety information and instructions.

In this manual, the safety instruction levels are classified into **"WARNING"** and **"CAUTION".**

Denotes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.

Denotes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that even the **CAUTION** level may lead to a serious consequence under some circumstances. Please follow the instructions of both levels as they are important to personnel safety.

SAFETY INSTRUCTIONS

1. Electric Shock Prevention

⚠ WARNING

- While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals and charging part and get an electric shock.
- If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage with a tester or the like.
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the option unit before wiring. Otherwise, you may get an electric shock or be injured.
- Operate the switches with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.

2. Injury Prevention

⚠ CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent damage, etc.
- Ensure that the cables are connected to the correct terminals. Otherwise damage, etc. may occur.
- Always make sure that polarity is correct to prevent damage, etc.
- While power is on or for some time after power-off, do not touch the inverter as it is hot and you may get burnt.

3. Additional Instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.

(1) Transportation and installation

⚠ CAUTION
• Do not install or operate the option unit if it is damaged or has parts missing. • Do not stand or rest heavy objects on top of the product. • Check that the mounting orientation is correct. • Prevent screws, metal fragments, conductive bodies, oil or other flammable substance from entering the inverter.

(2) Test operation and adjustment

⚠ CAUTION
• Before starting operation, confirm and adjust the parameters. A failure to do so may cause some machines to make unexpected motions.

(3) Usage

⚠ WARNING
• Do not modify the equipment.

⚠ CAUTION
• When parameter clear or all parameter clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation. • For prevention of damage due to static electricity, touch nearby metal before touching this product to eliminate static electricity from your body.

(4) Maintenance, inspection and parts replacement

⚠ CAUTION
• Do not test the equipment with a megger(measure insulation resistance).

(5) Disposal

⚠ CAUTION
• Dispose of this product as general industrial waste.

(6) General information

All illustrations given in this manual may have been drawn with covers or safety guards removed to provide in-depth description. Before starting operation of the product, always return the covers and guards into original positions as specified and operate the equipment in accordance with the manual.

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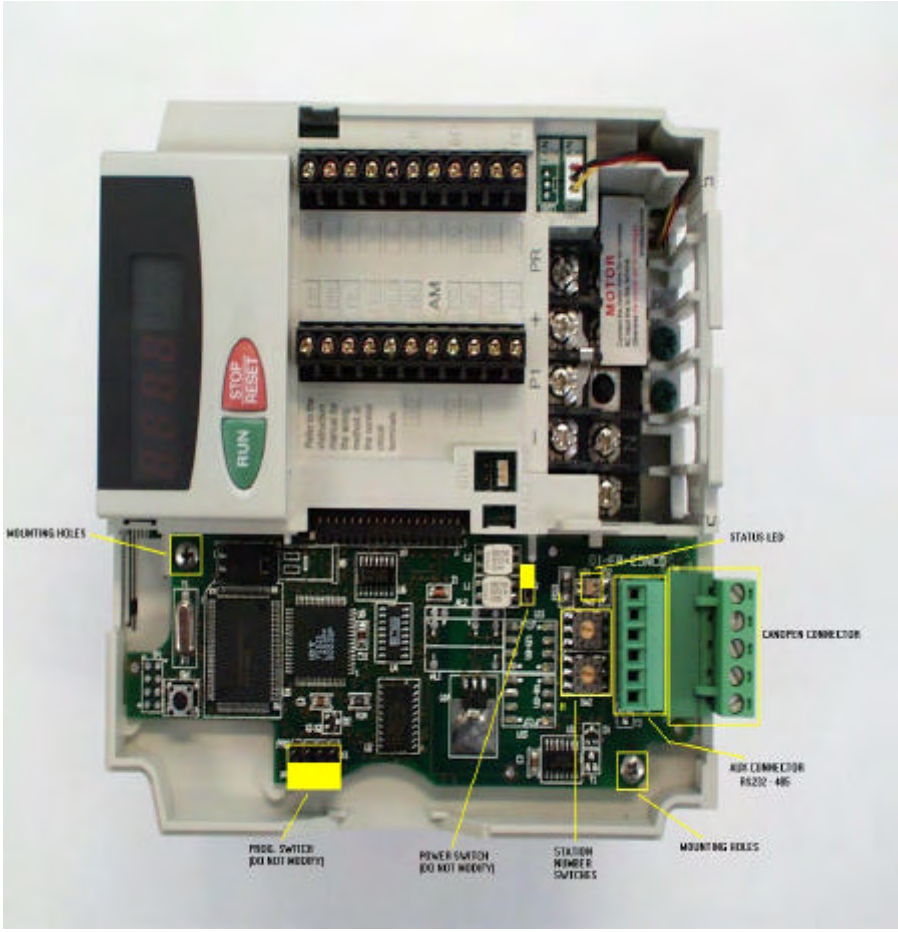
1. STRUCTURE


STOP RESET
RUN
MOTOR
MOUNTING HOLES
STATUS LED
CANOPEN CONNECTOR
AUX CONNECTION RS232 - 485
MODE SWITCH (DO NOT MODIFY)
POWER SWITCH (DO NOT MODIFY)
STATION NUMBER SWITCHES
MOUNTING HOLES

2. INSTALLATION

Remove the inverter cover following the inverter instruction manual and install the option unit using the following procedure:

2.1. Pre-Installation Checks

(1) Check the inverter type.
This option unit may only be used with the FR-E500 series inverters and must not be used with any other series (e. g. A100, A200, Z, and Fseries). These models have a different option connector to prevent connecting by mistake; however, if the user forces the connector, the inverter may be damaged.

(2) Make sure that the inverter input power is off.
The inverter may be damaged if the option unit is installed with the input power on. The inverter executes an initialization procedure at power on that includes checking the option port. Adding the option later causes a hardware conflict which may damage the inverter or option unit and result in the alarm "E. OP3".

(3) Ensure that the following items are supplied with the option package:
- FR-E5ND option unit
- 2 Mounting Machine nylon Screws M3 x 8
- Instruction Manual

2.2. Installation Procedure

(1) Carefully insert the connector of the option unit into the connector of the inverter. Use the two mounting holes and the guide hole to align the bottom board with the matching machine screw inserts and the plastic guide pin on the inverter. Make sure that the inverter option is firmly seated in the inverter and the connector is fully plugged in.

(2) Secure the option unit to the inverter with the two mounting screws. If the screw holes in the option unit do not line up with the inverter mounting holes, check that the connectors have been fitted correctly.

Note:	Make sure that the FR-E5ND option unit is snugly inserted into the inverter and the option to inverter connector is fully and firmly inserted.

2.3. Connection To Network

(1) Upon completion of the installation procedure, the inverter should be at rest with the power off. The option unit is mounted in the inverter with the drop cable connected to the terminal block, but unconnected to the network trunk cable. Set the node address on the two switches to a number between 1 and 99. SW1(h) is the tens digit and SW2(l) is the ones digit. Ensure that the number chosen is not already being used by another station on the network including a master station.

(2) Make sure that a **terminating resistor** is installed at **each end** of the **trunk** cable. These resistors must meet the following requirements: R=**120** Ohms, **1%** Metal Film, and **0.25** Watts.

Note:	The state of the Node Address switches are sampled once at power on. Changing the Node Address later on will have no effect and the software will keep the number read at power on. Turn power off, readjust the switches, and turn power back on to change the node address.

2.4. LED Status Indicator

LED Condition	Notes
Flashing Green 1Hz	The initialization of the Node is finished and the CAL 'Pre_operational' state has been achieved.
Green	The CAL 'OPERATIONAL' state has been achieved.
Red	Irrecoverable Error (failure)
Flashing Red 1Hz	The CAL 'STOPPED' state has been achieved.

3. GETTING STARTED

3.1. Node Address And Baud Rate

The baud rate is also available in Pr.346 (see section 5.1 Parameters 345 and 346).

To change the baudrate manually via the parameter unit, refer to the description of Prs.345 and 346.

3.2. Net Mode and Parameter Setup

(1) The inverter must be in Net Mode for motor control operations through the network. Drive mode is controlled automatically by the FR-E5NCO option card (cal-OPERATIONAL).

4. OPERATION

Operation of the E500 changes slightly when the FR-E5NCO is installed, and those changes are described here. Parameter definitions including newly created parameters, as well as operation with the FR-E5NCO installed are described.

4.1. Operation Modes

4.1.1. PU operation mode

Control of the inverter is from the parameter unit (PU).

4.1.2. External operation mode

Control of the inverter is by external signals connected to the inverter's terminal block.

4.1.3. Network (computer link) operation mode

Control of the inverter is via commands from a CANopen master.

4.2. Operation Mode Selection

The following table describes the required actions to change the operation mode.

mode change	Required action
External operation → PU operation	Press PU key on parameter unit
PU operation → external operation	Press EXT key on parameter unit
External operation → network operation	Send a CANopen OPERATIONAL command
Network operation → external operation	Send a CANopen NMT command different from the OPERATIONAL

The following conditions must also be met before a mode change can be effected:

- inverter is stopped
- forward and reverse commands are off

Parameter 340 allows selection of network operation mode on power up and after a drive reset.

5. FR-E5ND SPECIFIC PARAMETERS

There are several parameters which are used only when the E5ND is installed in the E500. The following sections describe these parameters.

5.1. Parameters 345 and 346

To support the FR-E5ND, two new parameters were created, Prs.345 & 346. They are described below. Use them to override DIP Switch settings, i.e., to do software reset of MAC ID.

Pr. No.	Function	Setting Range	Minimum Increment	Default Setting
345	Canopen Address Startup Data	0 to 255	1	63 (3FH)
346	Canopen baudrate Startup Data	0 to 255	1	123 (84H)

Pr345 and 346 is a bitmapped parameter. The definition is as follows:

Parameter 345 function:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				CANopen node address (1-100)			

If P345=100 the node no. is taken from dip switches, otherwise the node no. is the one set in P345 (1-99).

Parameter 346 function:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
				Baud rate			

N.B. After modification of Pr.345 and 346 it is necessary to switch off the inverter in order to make the modifications active.

Allowed Baud rates:

Baud rates	**Bits 3,2,1,0 values**
1M	0001 (1)
500K	0010 (2)
250K	0011 (3)
125K	0100 (4)
100K	0101 (5)
62.5K	0110 (6)
50K	0111 (7)
20K	1000 (8)

Note: Do not modify the value of Pr.17 during operation, the inverter modifies the state of MRS signal only when inverter is idle and without active commands.

6. CANopen communication profile

CANopen Communication Profile has been developed according to DS 301, Version 1.1 by CiA (CAN in Automation).

These manufacturer functionalities are available:

- parameters reading
- parameters writing
- alarms buffer reading
- inverter monitoring (measures)
- sending of commands to the inverter (Step Fwd, Step Rev, Stop …)
- inverter status reading
- speed setting in hundredths of Hz
- speed setting in rpm
- speed setting through analog input
- alarms buffer reset
- inverter reset (in case of alarm)

6.1. Service Data Object (SDO)

SDO are supported only in expedited modality; both upload and download operation are implemented.

In case of operation fault, an Abort SDO is returned; the following table reports possible abort codes:

Abort Code	**Description**
0602 0000	Object does not exist in the object dictionary
0609 0011	Sub-index does not exist
0607 0010	Data type does not match, length of service parameter does not match
0601 0002	Attempt to write a read-only object
0601 0001	Attempt to read a write-only object
0800 0000	General error
0800 0022	Data cannot be transferred or stored to the application because of the present device state

0606 0000	Access failed due to an hardware error
0604 0041	Object cannot be mapped to the PDO
0604 0042	The number and length of the objects to be mapped would exceed PDO length
0609 0030	Value range of parameter exceeded (only for write access)
0800 0021	Data cannot be transferred or stored to the application because of local control

6.2. Object Dictionary Entries supported

The following table reports an overview of the Object Dictionary entries implemented in the communication profile area:

Index	Subindex	R/W Flag	Description
0006H	0H	RO	Deftype UNSIGNED16
1000H	0H	RO	Device type
1001H	0H	RO	Error register (Flags)
1002H	0H	RO	Manufacturer status register
1005H	0H	RW	COB-ID SYNCH
1008H	0H	RO	Manufacturer device name
1009H	0H	RO	Manufacturer hardware version
100AH	0H	RO	Manufacturer software version
100BH	0H	RO	Node-ID
100CH	0H	RW	Guard time
100DH	0H	RW	Life Time Factor
1011H	0H	RW	Restore default parameter
1014H	0H	RW	COB-ID EMCY
1400H-1403H	0H-2H	RW	RxPDO Communication parameter
1600H-1603H	0H-4H	RW	RxPDO Mapping
1800H-1803H	0H-5H	RW	TxPDO Communication parameter
1A00H-1A03H	0H-4H	RW	TxPDO Mapping
2000H-2002H	0H	RO	Monitor data
2106H	0H	WO	Alarms buffer clear
2107H	0H	WO	Inverter reset
3000H–33E7H	0H	RW	Inverter parameters (3000H + nr.parameter)
3400H-3403H	0H	RO	Alarms buffer (last 8 alarms)
4000H	0H	RW	Inverter command
4001H	0H	RW	Inverter speed Hz xxx.xx
4001H	1H	RW	Inverter speed Rpm
4001H	2H	WO	Inverter speed to analog input

6.2.1. Objects 2000H-2002H

Starting from address 2000H to address 2002H, the following monitors are available:

Index	Monitor no.	Description
2000+0H	Monitor No 1	Output frequency
1H	Monitor No 2	Output current
2H	Monitor No 3	Output voltage

6.2.2. Objects 3000H-33E7H

Object dictionary indexes ranging from 3000H to 33E7H are associated to inverter parameters. Most of inverter parameters are internally defined as 1 WORD, but there are some parameters that require more than one WORD. These parameters can't be mapped with only one object dictionary, so sub-indexes are used to access each WORD.

6.2.2.1. Parameters 902-905

These parameters are defined from index 3386H (parameter 902) to index 3089H (parameter 905); they store respectively "frequency setting voltage bias", "frequency setting voltage gain", "frequency setting current bias" and "frequency setting current gain". Bias and gain are used to adjust the relationship between the input signal entered from outside the inverter to set up the output frequency and the output frequency.
Each parameter is made of two sub-parameters, the first contain a frequency output value, the second the corresponding analog input value, expressed in per cents of its full scale value.
Object dictionary index is used to identify the parameter, while sub-indexes are used to identify its sub-parameters.
Sub-index 0H contains the number of valid entries within the record (2 valid entries), other sub-indexes are associated to sub-parameters as shown in the following table:

Sub-Index	Type	R/W Flag	Description
00H	UNSIGEND8	RO	number of valid entries within the record
01H	UNSIGNED16	RW	output frequency value
02H	UNSIGNED16	RW	analog input value (per cent of its full scale)

For example the “frequency” value associated to parameter 904 is identified with index 3388H (3000H+904=3000H+388H) and sub-index 01H.

6.2.2.2. Other parameters

Other parameters are identified only with an object dictionary index, using the relation:

index= 3000H + parameter no.

For example the corresponding index of parameter 244 is 30F4H = 3000H + 244= 3000H + F4H

6.2.3. Objects 3400H – 3403H subindex 0H

These four object reports the eight latest alarms; object 3400H reports the newest alarm, as well as object 3403H reports the oldest alarms.

3400H newest alarms
3401H
3402H
3403H oldest alarms

6.2.4. Object 4000H subindex 0H

Object at index 4000H, sub-index 0H allows users to set inverter command (SDO download) and returns inverter status (SDO upload).

6.2.4.1. Inverter command

Inverter command consists of one word, whose bits have the following meaning:

Bit	Meaning	Bit	Meaning
15	-	07	-
14	-	06	-
13	-	05	RL
12	-	04	RM
11	-	03	RH
10	MRS	02	STR
09	-	01	STF
08	-	00	STOP

STF: Run forward
STR: Run reverse
RH: Speed selection – high
RM: Speed selection – middle
RL: Speed selection - low
MRS: output stop

6.2.4.2. Inverter Status

Reading inverter status a word is reported; its bits have the following meaning:

Bit	Meaning	Bit	Meaning
15	-	07	ALARM/ERROR
14	-	06	FU
13	-	05	IPF (?)
12	-	04	OL
11	-	03	SU
10	-	02	RUN RW
09	-	01	RUN FW
08	-	00	RUN

RUN: inverter running
FWD: forward running
REV: reverse running
SU: up to frequency
OL: over load
IPF: instantaneous power failure

FU: frequency detection
ALARM/ERROR: alarm condition

*6.2.5. **Object 4001H subindex 0H***

This object implements the setting (download) and the reading (upload) of inverter speed in hundredths of hertz. When reading, inverter output frequency is returned (Monitor 1).

6.2.6. Object 4001H subindex 1H

This object implements the setting (download) and the reading (upload) of inverter speed in rpm. When reading inverter output frequency converted in rpm is returned (Monitor 1 converted in rpm).

6.3. Emergency object

Emergency objects are triggered by the occurrence of a device internal error situation. This object eight's byte have the following meaning:

Byte	Meaning
0-1	Emergency error code
2	Object 1001H
3	System error (manufacturer error code) • 21 = Command error (command not accepted) • 31 = Lifetime expired • 42 = Synchronous error (pdo) • 44 = Synchronous error (pdo) • 62 = Error storing parameter
4	Canopen alarm or command error: • 11H =Outside range • 12H =External operation • 13H =Operational • 14H =Parameter read only • 16H =No parameter • 19H =Data usage error • 21H =Now in operating mode (actual operating) • 22H =STF • 23H =STR • 24H =Operating mode set
5	Actual canopen status • 5 = OPERATIONAL • 127= PRE_OPERATIONAL • 4 = STOPPED
6	0
7	0

In case of an emergency due to an inverter alarm the master can reset the inverter via SDO (Index 2107H, sub-index 0H).

Note:

The latest alarm can be read with an SDO upload at index 3400H, sub-index 0H.

6.4. Node guarding protocol

Node Guarding Protocol is supported, according to CiA specifications. Object at index 100CH, sub-index 0 defines the guard time and object at index 100DH, sub-index 0H defines the life time factor.

When the node doesn't receive the polling from the master it sends an emergency message; the motor can be stopped, left free to rotate, …, according to object 6007H/0H value.

6.5. Default PDO definition

6.5.1. Receive PDO1

Receive PDO1 is default defined as an asynchronous PDO. Its eight data bytes are mapped with these objects:

Bytes	**Object Mapped**	**Index**	**Sub-Index**
0,1	Inverter Command	4000H	0H
2,3	Inverter Frequency set	4001H	0H
4,5	Not used	-	-
6,7	Not used	-	-

Examples:

Inverter run + setting speed 50Hz
Word 0 – 4 = 0002H, 1388H, 0H, 0H

Inverter stop
Word 0 – 4 = 0001H, 0H, 0H, 0H

6.5.2. Transmit PDO1

Receive PDO1 is default defined as an RTR PDO. Its eight data bytes are mapped with these objects:

Bytes	Object Mapped	Index	Sub-Index
0,1	Inverter Status	4000H	0H
2,3	Inverter Output Frequency	4001H	0H
4,5	Output current	2001H	0H
6,7	The latest two alarms	3400H	0H

6.5.3. Other Receive and Transmit PDO

Receive PDO 2,3,4 and Transmit PDO 2,3,4 are not mapped.

7. CANopen DEVICE PROFILE

CANopen Device Profile has been developed according to DPS 402 Version 1.1 by CiA (CAN in Automation), designed for Drives and Motion Control.

Modes of Operation supported:
- Velocity Mode (only mandatory objects supported)

Objects supported:
- Emergency messages with Error Code referred to Device Profile
- Global Mandatory object related to Device Profile for Drives and Motion Control
- Mandatory objects related to “Velocity mode”

Index	Sub Index	R/W FLAG	Description
1000H	00H	RO	device type
1001H	00H	RO	error register
6007H	00H	RW	abort_connection_option_code
6040H	00H	RW	controlword
6041H	00H	RO	statusword
6042H	00H	RW	vl_target_velocity
6043H	00H	RO	vl_velocity_demand
6044H	00H	RO	vl_control_effort
6046H	00H	RO	n. sub-index of vl_velocity_min_max_amount
6046H	01H	RW	vl_velocity_min_amount
6046H	02H	RW	vl_velocity_max_amount
6048H	00H	RO	n. sub-index of vl_velocity_acceleration
6048H	01H	RW	delta_speed (vl_velocity_acceleration)
6048H	02H	RW	delta_time (vl_velocity_acceleration)
6049H	00H	RO	n. sub-index of vl_velocity_deceleration
6049H	01H	RW	delta_speed (vl_velocity_deceleration)
6049H	02H	RW	delta_time (vl_velocity_deceleration)
604AH	00H	RO	n. sub-index of vl_velocity_quick_stop
604AH	01H	RW	delta_speed (vl_velocity_quick_stop)
604AH	02H	RW	delta_time (vl_velocity_quick_stop)
6060H	00H	WO	modes of operation
6061H	00H	RO	modes of operation display
67FFH	00H	RO	single device type

7.1. Emergency Error Code

Emergency message contains a field named “Error Code” that describe the type of error reported. Error Code is of Unsigned16 type; the high byte defines an error classification while the low byte contains the error number for this class.

Relationship between “Emergency Error Code” and “Inverter alarm code”:

Error Code	Meaning	Inverter alarm code
2213H	over-current in ramp function	E.OC1, E.OC3
2214H	over-current in the sequence	E.OC2
2300H	current on device output side	E.THT, E.OLT
2330H	earth leakage	E.GF
3210H	DC link over voltage	EOV1,EOV2,EOV3
4310H	excess temperature drive	E.FIN
5000H	device hardware	E.OPT, E.CPU
5112H	supply U2=supply +24V	EP.24
5410H	output stages	E.LF
5530H	data storage EEPROM	E.PE
6000H	device software	E0..E15
7110H	brake chopper	E.BE
7510H	communication serial interface No. 1	E.PUE, E.CTE

Note:

Other inverter alarms, not reported in this table, are classified as generic error (Error Code = 1000H).

7.1.1. Restrictions

- Alarm codes are available only after 40 msec the alarm is detected; emergency objects are sent after this time has elapsed.

7.2. Object 1000H (Device Type)

Object 1000H describes the type of a device and its functionality; it is of Unsigned32 type and it reports three data:

- device profile number (bit 0..15)
- type (bit 16..23)
- mode bit (bit 24..31)

Device profile number is set to 402, type is equal to 1 (frequency converter) and mode bits are set to 0; in response to a SDO request the value 00010192H is reported.

7.3. Object 1001H (Error register)

Error register bits are valorized in function of the alarm that has been detected.

7.4. Object 6007H (abort connection option code)

The content of this objects selects the function to be performed when the connection to the network is lost.

Possible values are the following:

0: No action
2: Device control command “disable_voltage”
3: Device control command “quick_stop”

7.5. Object 6040H (controlword)–6041H (statusword)

The *controlword* object control the state of the drive, as well as the *statusword* reports the state of the drive.
The statemachine describes the device status and the possible control sequence of the drive.

States “Start”, “Not Ready to Switch On” and “Fault Reaction Active” are not implemented, other states are available.

7.5.1. Restrictions

After inverter is turned on power is directly applied to the DC link; it is not possible to separate states in which power is disabled and states in which power is enabled.
Statemachine is software implemented; states are only logical states, and they do not reflect an inverter state.

Bit N. 11 of the status word has not been implemented.

7.6. Object 6042H (vl_target_velocity)

The *vl_target_velocity* is the required velocity of the system and it is defined in rpm (object *vl_dimension_factor* has not been implemented).

7.7. Object 6043H (vl_velocity_demand)

The *vl_velocity_demand* is the instantaneous velocity provided by the ramp generator, its units are rpm.

7.8. Object 6044H (vl_control_effort)

In closed loop systems this object reports motor speed, in open loop systems it reports the instantaneous velocity provided by the ramp generator. Units are the same of other objects that return a speed (rpm).
FRE inverter can be used only in open loop modality.

7.9. Object 6046H (vl_velocity_min_max_amount)

This parameter is composed of the *vl_velocity_min_amount* and *vl_velocity_max_amount* subparameter, that represent the minimum and maximum speed provided by the driver. These velocities are defined in rpm.

7.10. Object 6048H (vl_velocity_acceleration)

This parameter specifies the slope of the acceleration ramp; it is calculated as the quotient of *delta_speed* and *delta_time*, that are respectively defined in rpm and seconds.

7.10.1. Restrictions

Device Profile defines a *delta_speed* parameter for *vl_velocity_acceleration*, *vl_velocity_deceleration* and *vl_velocity_quick_stop*. These parameters are internally mapped in a

unique inverter parameter, thus, changing *delta speed* of *vl_velocity_acceleration* , results in an undesired change of the *delta_speed* parameter of *vl_velocity_deceleration* and *vl_velocity_quick_stop*.

7.11. Object 6049H (vl_velocity_deceleration)

This parameter specifies the slope of the deceleration ramp; it is calculated as the quotient of *delta_speed* and *delta_time*, that are respectively defined in rpm and seconds.

7.11.1. Restrictions

Device Profile defines a *delta_speed* parameter for *vl_velocity_acceleration*, *vl_velocity_deceleration* and *vl_velocity_quick_stop*. These parameters are internally mapped in a unique inverter parameter, thus, changing *delta speed* of *vl_velocity_deceleration* , results in an undesired change of the *delta_speed* parameter of *vl_velocity_acceleration* and *vl_velocity_quick_stop*.

7.12. Object 604AH (vl_velocity_quick_stop)

This parameter specifies the slope of the deceleration ramp used in quick stop function; it is calculated as the quotient of *delta_sp*eed and *delta_time*, that are respectively defined in rpm and seconds.

7.12.1. Restrictions

Device Profile defines a *delta_speed* parameter for *vl_velocity_acceleration*, *vl_velocity_deceleration* and *vl_velocity_quick_stop*. These parameters are internally mapped in a unique inverter parameter, thus, changing *delta speed* of *vl_velocity_quick_stop* , results in an undesired change of the *delta_speed* parameter of *vl_velocity_acceleration* and *vl_velocity_deceleration*.

7.12.2.Note

Quick stop is obtained using an internal inverter command, the “second function”. In order to enable this functionality it is necessary to program terminal RL as input for second function; this is obtained setting parameter 180 equal to 3.

7.13. Object 6060H (modes of operation)

Parameter “modes of operation” defines the actual operation-mode. Since only “Velocity mode” is supported, it is not possible to change the value of this parameter.

7.14. Object 6061H (modes of operation display)

This parameter shows the current mode of operation. Since only “Velocity mode” is supporter, the value returned by this objects is fixed to 2 (Velocity Mode).

7.15. Object 6FFFH (Single Device Type)

Inverter is a single device module; this object is equivalent to Object 1000H.

8. MODBUS Protocol

8.1. Introduction

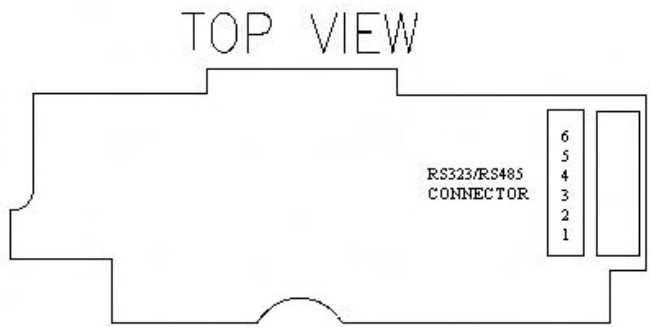
This option allows to communicate with the inverter via MODBUS protocol through a RS232 port or a RS485 port. Data writing towards the inverter is implemented through the MODBUS functionality of "writing 1 WORD", whereas data reading from the inverter is realized through the "reading of N WORDS".

These functionalities are available:

- parameter reading
- parameter writing
- alarms buffer reading
- inverter monitoring (measures)
- sending of commands to the inverter (Step Fwd, Step Rev, Stop …)
- inverter status reading
- speed setting in hundredths of Hz
- speed setting in rpm
- speed setting through analog input
- alarms buffer reset
- inverter reset (in case of alarm)
- inverter NET modality setting (to enable inverter to receive commands through the option)
- SW version reading

8.2. Connection diagram

Connections regarding ports 232 and 485 are available on the 6 pin type connector (X6) placed in the upper part of the option; its pin configuration is the following:



Pin	Description
1	Not used
2	Rx (RS232)
3	Tx (RS232)
4	A (RS485)
5	B (RS485)
6	GND

In addition it is necessary to set the 2 jumper X2 and X3 as regards the port (RS232 or RS485) used.

Example of connection between Personal Computer and option through the port RS232

PC Connector		**Option Connector**
Pin 2 (Rx)	----------	Pin 3 (Tx)
Pin 3 (Tx)	----------	Pin 2 (Rx)
Pin 5 (GND)	----------	Pin 6 (GND)

8.3. Communication parameters

It is possible to configure the serial communication by setting the following parameters:

- baudrate (1200 bps, 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps)
- parity type (even, odd or none)
- waiting time for answer sending
- sending the answer frame immediately after receipt of the writing frame or after the command has been accepted by the inverter

The number of data bit is fixed at 8 and the number of stop bit at 1.

The configuration of the port is determined through the parameter 347 (available only if the option is connected to the inverter), whose 8 bits take the following meaning:

bit 07: answer not immediate (0) /immediate answer (1)
bit 06-05: setting the waiting time before sending the answer
bit 04 : disabled parity(0) / enabled parity(1)
bit 03 : odd parity (0) / even parity (1)
bit 02-01-00: baudrate

8.3.1. Baudrate setting

The allowed baudrates and the corresponding values to be set in the bit 2, 1 and 0 are the following:

b2	b1	b0	Baudrate
0	0	1	1200 bps
0	1	0	2400 bps
0	1	1	4800 bps
1	0	0	9600 bps
1	0	1	19200 bps
1	1	0	38400 bps

8.3.2. Parity setting

Parity type is defined through bit 3 and 4, that take the following meaning:

b4	b3	Parity
0	0	No parity
0	1	No parity
1	0	Odd parity
1	1	Even parity

8.3.3. Waiting time setting

The setting of the waiting time allows to postpone the inverter answer after a time of 0, 1,2 or 3 ms. This chance is useful, for instance, in the case a device connected to the line keeps the line busy for a certain time after having sent a frame (for example some RS232/RS485 converters). If the inverter answer was immediate, part of the answer would be lost because of the device behaviour. Setting a waiting time, therefore, the option does not send the answer immediately, and thus the conflict with the device that keeps the line busy, can be avoided. The bit interested are the 6 and the 5, to which the following delays correspond:

b6	b5	Delay
0	0	No delay
0	1	1 ms
1	0	2 ms
1	1	3 ms

8.3.4. Immediate/Not immediate answer

The sending of a MODBUS command to the option ends up in the writing of the command itself in the DUAL-RAM, so that it is interpreted by the inverter, and - once interpreted - the result of this operation is sent back in DUAL-RAM. For some commands, a time interval of some tenths msec can elapse between the sending of the command in DUAL-RAM and the answer of the inverter. Through this setting it is possible to choose whether the MODBUS answer frame must be sent immediately when the command is

sent to the inverter, or after that the command has been accepted and processed by the inverter; in the first case an answer of accepted command will always be sent, whereas in the second case a frame could be sent, indicating that the command has not been accepted, in the case that the command would actually be rejected by the inverter. The bit involved is the 7 and its valorization has the following meanings:

b7	Answer
0	After acceptance from inverter
1	Immediate

8.3.5. Example of parameter 347 setting (1)

Baudrate: 9600 bps
Parity: none
Waiting time: none
Immediate/Not immediate answer: not immediate

Bit	Value
07	0
06	0
05	0
04	0
03	0
02	1
01	0
00	0

Value of parameter: 04H = 4. Therefore 4 must be set as value.

8.3.6. Example of parameter 347 setting (2)

Baudrate: 19200 bps
Parity: even
Waiting time: 2 msec
Immediate/Not immediate answer: immediate

Bit	Value
07	1
06	1
05	0
04	1
03	1
02	1
01	0
00	1

Value of parameter: DDH = 221

8.3.7. Example of parameter 347 setting (3)

Baudrate: 9600 bps
Parity: odd
Waiting time: 3 msec
Immediate/Not immediate answer: not immediate

Bit	Value
07	0
06	1
05	1
04	1
03	0
02	1
01	0
00	0

Value of parameter: 74H = 116

8.4. Node identification

The number of the node can be set in the following two ways:

- valorizing the parameter 345 with the node identification reference
- through the dip-switch available on the option setting the parameter 345 at 100

8.5. N words Reading

"N" consecutive words can be read, for example to read more consecutive parameters or to read all the alarms buffer or to read more consecutive measures.
The result of the reading is sent by giving the word to the address indicated, that to the subsequent address and so on; of each word the most significantive byte is first sent, and then the least significative one.

8.5.1. Example of N WORDS reading

Request of 2 words starting from the address 20000 (4E20H) (Parameter 0 and parameter 1 are returned):

Node:	25	
Parameter:	0	
Value:	50	(003CH)
Parameter:	1	
Value:	11984	(2ED0H)

Frame to be sent:	19 03 4E 20 00 02 D1 31
Answer frame	19 03 04 00 3C 2E D0 BE 02

The answer frame reports the byte in the sequence: 00, 3C, 2E, D0.

8.6. One word writing

The setting of parameters, the reset of the inverter … are implemented by writing one word.

8.6.1. Example of 1 WORD writing:

Node:	25 (19H)
Address:	26000 (6590H)
Value written:	1

Frame to be sent: 19 06 65 90 00 01 D5 CE
Answer frame: 19 06 65 90 00 01 D5 CE

8.7. MODBUS Commands recognized by the inverter

Description	Address	Writing/reading	Range
Parameters 0-999	20000-21998	RW	0-65535
Alarms buffer 0-3	23000-23006	RO	0-65535
Measures 0-24	23100-23104	RO	0-65535
Command setting	24000	WO	0-65535
Inverter status	24000	RO	0-65535
Speed [Hz]	24002	RW	0-65535
Speed[rpm]	24004	RW	0-65535
Analog input speed	24006	WO	0-255
Alarms buffer reset	25000	WO	0-0
Inverter reset	25002	WO	0-0
Inverter NET ON/OFF	26000	WO	0-1
SW version	27000-27016	RO	0-65535

Note:

Before sending any other command to the inverter it is necessary to launch the command for setting of the NET modality.

8.7.1. Parameters 0-999

Inverter parameters are codified starting from address 20000 up to address 21998: 1000 addresses are available because only the even addresses are used, since the dimension of each parameter is 1 WORD.

Parameter 0:	20000
Parameter 1:	20002
……	
Parameter 999:	21998

Reading/Writing of parameters containing sub-parameters, like parameters ranging 902 to 905 is not allowed.

8.7.1.1. Example of writing of 1 parameter

Node:	25 (19H)
Parameter:	7
Address:	20014 (4E2EH)
Value:	100

Frame to be sent:	19 06 4E 2E 00 64 FC D8
Answer frame:	19 06 4E 2E 00 64 FCD8

8.7.1.2. Example of reading of 1 parameter

Node:	25 (19H)
Parameter:	7
Address:	20014 (4E2EH)
Value:	100 (64H)

Frame to be sent:	19 03 4E 2E 00 01 F0 F3
Answer frame:	19 03 02 00 64 99 AD

8.7.2. Alarms buffer

Alarms buffer contains the last 8 alarms, each codified with 1 byte, that are available starting from the address 23000 to the address 23006. 4 addresses are available; each reading reports one pair of alarm codes. Only the even addresses are used, since the dimension of each parameter is of 2 byte.

Alarm 0,1: 23000
Alarm 2,3: 23002
Alarm 4,5: 23004
Alarm 6,7: 23006

Alarm 0 is the most recent and is reported in the less significant part of the WORD.

8.7.2.1. Example of alarms buffer reading

Node: 25 (19H)
Alarms: 0,1
Address: 23000 (59D8H)
Alarms: 1 only alarm with code A3

Frame to be sent: 19 03 59 D8 00 01 15 75
Answer frame: 19 03 02 00 A3 D8 3F

The alarm code is reported in the least significative byte of the WORD in answer.

Node: 25 (19H)
Alarms: 0,1
Address: 23000 (59D8H)
Alarms: 2 alarms present, the most recent with the B1 code and the previous with A3 code.

Frame to be sent: 19 03 59 D8 00 01 15 75
Answer: 19 03 02 A3 B1 20 C2

8.7.3. Measures

Measures are codified starting from address 23100 to address 23104, therefore 3 addresses are at disposal. Only the even addresses are used because the size of each measure is of 2 byte.

Address	Progressive	Description
23100	Monitor No 1	Output frequency
23102	Monitor No 2	Output current
23104	Monitor No 3	Output voltage

8.7.3.1. Example of reading of 1 measure

Node: 25 (19H)
Measure: 0 (current speed in hundredths of Hz)
Address: 23100 (5A3CH)
Value : 5000 (50.00 Hz) (1388H)

Frame to be sent: 19 03 5A 3C 00 01 55 06
Answer frame: 19 03 02 13 88 95 10

8.7.4. Command setting

The address to which is assigned the setting of command to the inverter is 24000. The command consists of one word, whose bits have the following meaning:

Bit	Meaning	Bit	Meaning
15	-	07	-
14	-	06	-
13	-	05	RL
12	-	04	RM
11	-	03	RH
10	MRS	02	STR
09	-	01	STF
08	-	00	STOP

STF: Run forward

STR: Run reverse
RH: Speed selection – high
RM: Speed selection – middle
RL: Speed selection - low
MRS: output stop

8.7.4.1. Example of command setting

Node: 25 (19H)
Address: 24000 (5DC0H)
STF command (step forward)

Frame to be sent: 19 06 5D C0 00 02 18 43
Answer frame: 19 06 5D C0 00 02 18 43

8.7.5. Inverter status

Inverter status can be read at the address 24000. A WORD is reported whose bits have the following meaning:

Bit	Meaning	Bit	Meaning
15	-	07	ALARM/ERROR
14	-	06	FU
13	-	05	IPF(?)
12	-	04	OL
11	-	03	SU
10	-	02	RUN RW
09	-	01	RUN FW
08	-	00	RUN

RUN: inverter running
FWD: forward running
REV: reverse running
SU: up to frequency
OL: over load
IPF: instantaneous power failure
FU: frequency detection
ALARM/ERROR: alarm condition

8.7.5.1. Example of reading of inverter status

Node: 25 (19H)
Address: 24000 (5DC0H)

Frame to be sent: 19 03 5D C0 00 01 94 42
Answer frame: 19 03 02 80 4B B9 B1

8.7.6. Setting/reading of speed in hundredths of Hz

Speed can be set and read at the address 24002, the value read or set is in hundredths of Hz.

8.7.6.1. Example of speed setting in hundredths of Hz:

Node: 25 (19H)
Address: 24002 (5DC2H)
Speed: 100.00 Hz (10000=2710H)

Frame to be sent: 19 06 5D C2 27 10 22 7E
Answer frame: 19 06 5D C2 27 10 22 7E

8.7.6.2. Example of reading of speed in hundredths of Hz:

Node: 25 (19H)
Address: 24002 (5DC2H)
Speed: 60.00 Hz (6000=1770H)

Frame to be sent: 19 03 5D C2 00 01 35 82
Answer frame: 19 03 02 17 70 96 52

8.7.7. Speed setting/reading in rpm

Speed can be set and read in rpm at the address 24004. Inside the inverter speed is anyhow defined in hundredths of Hz; the option executes the conversion from rpm supplied to Hz in the following modality:

number of poles = parameter 144

speed [Hz] = speed [rpm] * ((10*number_poles)/4)) / 3;

8.7.7.1. Example of speed setting in rpm:

Node: 25 (19H)
Address: 24004 (5DC4H)
Speed: 100 rpm (100=64H)

Frame to be sent: 19 06 5D C4 00 64 D9 A8
Answer frame: 19 06 5D C4 00 64 D9 A8

8.7.7.2. Example of speed reading in rpm:

Node: 25 (19H)
Address: 24004 (5DC4H)
Speed: 50 rpm (50=32H)

Frame to be sent: 19 03 5D C4 00 01 D5 83
Answer frame: 19 03 02 00 32 19 93

8.7.8. Setting/reading the speed through analog input

The speed in analogue can be set at the address 24006, the read or set value is a byte, since the D/A converter used is a 8 bit D/A.
The value sent is the value that is converted directly to the DA converter present on the option.

Value=0 speed set=0
Value=255 speed set= max.speed

In order that speed could be set through this command, it is necessary to carry out the following settings:

- Set parameter 339=1 so that speed is set by the analogue input
- Set the parameters 38 and 903, which establish the full scale value

- Set the parameter 73 which indicates the input full scale voltage 5V, 10V .. (set to 5V)

8.7.9. Example of DA speed setting:

Node: 25 (19H)
Address: 24006 (5DC6H)
Set speed: 120

Frame to be sent: 19 06 5D C6 00 78 79 A1
Answer: 19 06 5D C6 00 78 79 A1

8.7.10.Alarms buffer reset

The command of alarms buffer reset is mapped at the address 25000; the buffer of the alarms is reset by writing at the address 25000 the value 0, the writing of other values involves rejection of the command.

8.7.10.1.Example of alarms reset (correct)

Node: 25 (19H)
Address: 25000 (61A8H)
Value: 0

Frame to be sent: 19 06 61 A8 00 00 14 0E
Answer frame: 19 06 61 A8 00 00 14 0E

8.7.10.2.Example of alarms reset (not correct)

Node: 25 (19H)
Address: 25000 (61A8H)
Value: 50

Frame to be sent: 19 06 61 A8 0032 95DB
Answer frame: 19 86 03 82 66

8.7.11. Inverter reset

The command of inverter reset is mapped at the address 25002; the inverter is reset by writing at the address 25002 the value 0, the writing of other values involves rejection of the command.

8.7.11.1.Example of inverter reset (correct)

Node: 25 (19H)
Address: 25002 (61AAH)
Value: 0

Frame to be sent: 19 06 61 AA 00 00 B5 CE
Answer frame: 19 06 61 AA 00 00 B5 CE

8.7.11.2.Example of inverter reset (not correct)

Node: 25 (19H)
Address: 25002 (61AAH)
Value: 54

Frame to be sent: 19 06 61 AA 00 36 35 D8
Answer frame: 19 86 03 82 66

8.7.12.Setting/removal of NET modality

In order that the inverter accepts commands it is necessary to set it in the NET modality. Writing at the address 26000 the value 1 the inverter enters the NET modality, writing 0 the NET modality is removed.
Before sending any other command to the inverter it is necessary to launch the command for setting of the NET modality.

8.7.12.1.Example of setting of NET modality

Node: 25 (19H)
Address: 26000 (6590H)
Value: 1

Frame to be sent: 19 06 65 90 00 01 55 33
Answer frame: 19 06 65 90 00 01 55 33

8.7.12.2.Example of removal of NET modality

Node: 25 (19H)
Address: 26000 (6590H)
Value: 0

Frame to be sent: 19 06 65 90 00 00 94 F3
Answer frame: 19 06 65 90 00 00 94 F3

8.7.13. SW Version

Starting from the address 27000 up to the address 27016 some informations are present regarding the software version installed on the option:

the SW version is expressed in the format:

xxxx.yy.zz and followed by the date and the hour of creation of the software

27000: xxxx
27002: yy
27004: zz
27006: Day
27008: Month
27010: Year
27012: Hours
27014: Minutes
27016: Seconds

All these informations are reported in hexadecimal format; for example for the day 13 the value 0013H will be reported.

8.7.13.1.Example of info reading of the version

Node: 25 (19H)
Address: 27000-27016
Values:

xxxx	0043H
yy	00H
zz	01H
day	13H
month	02H
year	01H
hours	16H
minutes	21H
seconds	58H

Frame to be sent: 19 03 69 78 00 01 1A 57
Answer frame: 19 03 02 00 43 D9 B7

Frame to be sent: 19 03 69 7A 00 01 BB 97
Answer frame: 19 03 02 00 00 98 46

Frame to be sent:: 19 03 69 7C 00 01 5B 96
Answer frame: 19 03 02 00 01 59 86

Frame to be sent: 19 03 69 7E 00 01 FA 56
Answer frame: 19 03 02 00 13 D9 8B

Frame to be sent: 19 03 69 80 00 01 9B A6
Answer frame: 19 03 02 00 02 19 87

Frame to be sent: 19 03 69 82 00 01 3A 66
Answer frame: 19 03 02 00 01 59 86

Frame to be sent: 19 03 69 84 00 01 DA 67
Answer frame: 19 03 02 00 16 19 88

Frame to be sent: 19 03 69 86 00 01 7B A7
Answer frame: 19 03 02 00 21 58 5E

Frame to be sent: 19 03 69 88 00 01 1A 64

Answer frame: 19 03 02 00 58 99 BC

8.8. Error codes

If one frame is received and the CRC is incorrect no answer is sent, if - on the other hand - the frame received is correct and the data supplied are not coherent, one frame is sent containing one of the possible error codes:

- Function code unknown 01H
- Address not correct 02H
- Data not correct 03H
- PLC not ready 04H
- Error in the writing 05H
- Overlap with memory zones 06H

8.8.1. Example of error (address not correct)

Reading of 1 WORD at the address 30000.

Node: 25 (19)
Address: 30000 (7530)
Value: 1

Frame to be sent: 19 03 75 30 00 01 9D D1
Answer frame: 19 83 02 40 F6

8.8.2. Example of error (data incorrect)

Writing the value 3 to the address 26000, when only the values 0 and 1 are allowed.

Node: 25 (19H)
Address: 30000 (6590H)
Value: 3

Frame to be sent: 19 06 65 90 00 03 D4 F2
Answer frame: 19 86 03 82 66

9. SPECIFICATIONS

1) Power supply
   - Control power: supplied by the inverter.
   - Communication power: supplied by CAN open supply, 11 to 28 V with a 10 A capacity.
2) Standard
   - According to Bottero CANopen specifications
   - CAN transceiver and CAN controller as specified in ISO 11898.
3) Maximum cable distance
   - 500m at 125k baud with thick cable (see CANopen phl specification for details on maximum cable distance for different baud rates)
4) Transmission speed
   - 125kbps, 250kbps, 500kbps
5) Number of inverters connectable
   - 63 inverters with minimum of one node as a master
6) Supported inverters
   - FR-A500
7) Dimension
   - 96 x 49 x 33 mm

10) Environmental

Ambient temperature	-10 to 50ºC (non-condensing)
Ambient humidity	90% or less (non-condensing)
Vibration	0.6G or less, conforming to JIS-C0912
Protective structure	Open type (IP00), JEM1030

10. References

Mitsubishi FR-E500 Inverter Instruction Manual
Document# IB (NA) 66790 (?)

Mitsubishi Electronic Data Sheet Instruction Manual
Document# VC7BNA00011 (?)

CIA CANopen application layer and communication profile
Draft standard 301 V 4.0

CiA CANopen Device Profile – Drives and Motion Control
Draft Standard Proposal 402 V 1.1

11. Appendix A

11.1. Summary of CANopen communication objects

Index	Subindex	R/W Flag	Description
0006H	0H	RO	Deftype UNSIGNED16
1000H	0H	RO	Device type
1001H	0H	RO	Error register (Flags)
1002H	0H	RO	Manufacturer status register
1005H	0H	RW	COB-ID SYNCH
1008H	0H	RO	Manufacturer device name
1009H	0H	RO	Manufacturer hardware version
100AH	0H	RO	Manufacturer software version
100BH	0H	RO	Node-ID
100CH	0H	RW	Guard time
100DH	0H	RW	Life Time Factor
1011H	0H	RW	Restore default parameter
1014H	0H	RW	COB-ID EMCY
1400H-1403H	0H-2H	RW	RxPDO Communication parameter
1600H-1603H	0H-4H	RW	RxPDO Mapping
1800H-1803H	0H-5H	RW	TxPDO Communication parameter
1A00H-1A03H	0H-4H	RW	TxPDO Mapping
2000H-2002H	0H	RO	Monitor data
2106H	0H	WO	Alarm clear
2107H	0H	WO	Inverter reset
3000H–33E7H	0H	RW	Param. 0 (3000H + nr.parameter)
3400H-3403H	0H	RO	Alarm buffer (last 8 alarms)
4000H	0H	RW	Inverter command
4001H	0H	RW	Inverter speed Hz xxx.xx
4001H	1H	RW	Inverter speed Rpm
4001H	2H	WO	Inverter speed to analog input

11.2. Summary of CANopen Device Profile objects

Index	Sub Index	R/W FLAG	Description
1000H	00H	RO	device type
1001H	00H	RO	error register
6007H	00H	RW	abort_connection_option_code
6040H	00H	RW	controlword
6041H	00H	RO	statusword
6042H	00H	RW	vl_target_velocity
6043H	00H	RO	vl_velocity_demand
6044H	00H	RO	vl_control_effort
6046H	00H	RO	n. sub-index of vl_velocity_min_max_amount
6046H	01H	RW	vl_velocity_min_amount
6046H	02H	RW	vl_velocity_max_amount
6048H	00H	RO	n. sub-index of vl_velocity_acceleration
6048H	01H	RW	delta_speed (vl_velocity_acceleration)
6048H	02H	RW	delta_time (vl_velocity_acceleration)
6049H	00H	RO	n. sub-index of vl_velocity_deceleration
6049H	01H	RW	delta_speed (vl_velocity_deceleration)
6049H	02H	RW	delta_time (vl_velocity_deceleration)
604AH	00H	RO	n. sub-index of vl_velocity_quick_stop
604AH	01H	RW	delta_speed (vl_velocity_quick_stop)
604AH	02H	RW	delta_time (vl_velocity_quick_stop)
6060H	00H	WO	modes of operation
6061H	00H	RO	modes of operation display
67FFH	00H	RO	single device type

11.3. Summary of MODBUS commands

Address	R/W Flag	Description	Range
20000-21998	RW	Parameters 0-999	0-65535
23000-23006	RO	Alarms buffer 0-3	0-65535
23100-23104	RO	Measures 0-24	0-65535
24000	WO	Command setting	0-65535
24000	RO	Inverter status	0-65535
24002	RW	Speed [Hz]	0-65535
24004	RW	Speed[rpm]	0-65535
24006	WO	Analog input speed	0-255
25000	WO	Alarms buffer reset	0-0
25002	WO	Inverter reset	0-0
26000	WO	Inverter NET ON/OFF	0-1
27000-27016	RO	SW version	0-65535

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