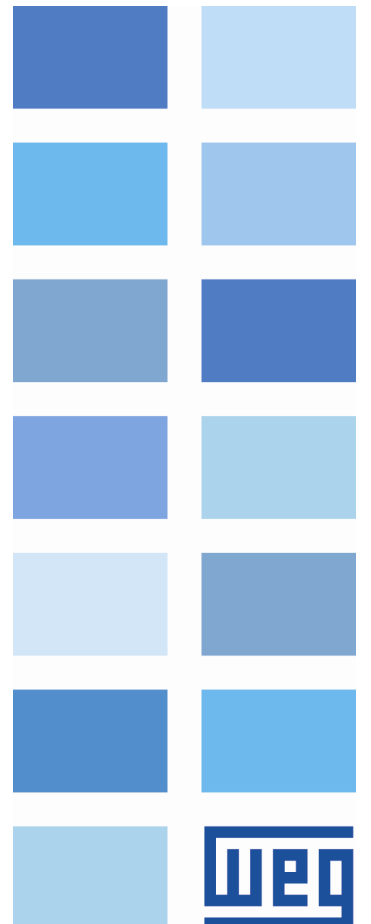


N2

CFW501

User's Manual





N2 User's Manual

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ABOUT THE MANUAL

This manual provides the necessary information for the operation of the CFW501 frequency inverter using the N2 protocol. This manual must be used together with the CFW501 user manual.

ABBREVIATIONS AND DEFINITIONS

ASCII American Standard Code for Information Interchange
PLC Programmable Logic Controller
HMI Human-Machine Interface
ro Read-only
rw Read/write

NUMERICAL REPRESENTATION

Decimal numbers are represented by means of digits without suffix. Hexadecimal numbers are represented with the letter 'h' after the number.

DOCUMENTS

The N2 protocol for the CFW501 was developed based on the following specifications and documents:

| Document | Version | Source |
|--------------------------------------|------------------|-----------------------|
| Metasys N2 Specification for Vendors | 04-3402-22 REV A | Jhonson Controls, Inc |

1 INTRODUCTION TO THE SERIAL COMMUNICATION

In a serial interface, the data bits are sent sequentially through a communication channel, or busbar. Several technologies use serial communication for data transfer, including the RS232 and RS485 interfaces.

The standards that specify the RS232 and RS485 interfaces, however, do specify neither the format nor the character sequence for data transmission and reception. In this sense, besides the interface, it is also necessary to identify the protocol used for the communication.

The N2 network using the RS485 interface as the physical layer to message exchange.

The characteristics of the RS485 serial interface available in the CFW501 frequency inverter, as well as the N2 protocol, will be presented next.

2 INTRODUCTION TO THE N2 COMMUNICATION

The N2 communication protocol was designed by Johnson Controls. The N2 uses the Master-Slave type communication configuration and it is possible to have up to 255 slaves in a network. All communication begins with the master sending a telegram to the slave and the slave answer the master what was requested.

The physical layer is RS485 compatible, half duplex, shielded twisted pair. The communication rate is 9600 bits/sec with 1 start bit, 8 bits for data and 1 stop bit, without parity.

The N2 protocol is an interface for accessing the existing data in the device. Every device connection to the N2 network can be thought of as a small data manager. This data base presents data structure that represents the device objects.

An N2 object represents physical or virtual information of the device, with one digital or analog input or output, control variables and parameters. A virtual object, made of a collection of N2 objects, is the N2 device model as presented at figure 2.1. The N2 specification is made up of:

- Analog Inputs.
- Binary Inputs.
- Analog Outputs.
- Binary Outputs.
- Float Internal Values.
- Integer Internal Values.
- Byte Internal Value.

Each device can show 256 objects of each type maximum.

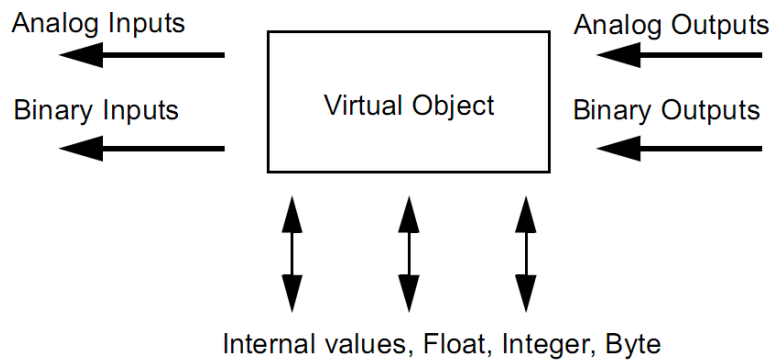


Figure 2.1: Virtual object

2.1 N2 MS/TP MESSAGES STRUCTURE

The Figure 2.2 shows the N2 data frame. The N2 data frame uses ASCII-hex characters.



Figure 2.2: Frame N2

- “>”: character for message starting - 1 byte.
- Address: address range – from 1 to 255.
- Data: device message.
- Checksum: used to test the accuracy and validity of the message.
- “CR”: end of message – 1 byte.

2.2 COMMANDS AND SUBCOMMANDS

The N2 device data are accessed by commands and subcommands. The first character of the data represents the command to be executed. Depending on the command it can present a subcommand, as shown in Table 2.1

Table 2.1: N2 Commands and subcommands

| Command | Subcommand | Description | Note |
|---------|------------|---------------------------------|----------|
| 0 | 0 | Time Update Message | |
| 0 | 1 | Read Memory Diagnostics Message | Optional |
| 0 | 4 | Poll Message No ACK | |
| 0 | 5 | Poll Message with ACK | |
| 0 | 8 | Warm Start Message | Optional |
| 0 | 9 | Status Update Message | Optional |
| 1 | 0 - FH | Read Field MSG | |
| 2 | 0 - FH | Write Field MSG | |
| 7 | 0 - FH | General Command Message | |
| 8 | 1 - 3H | Upload Messages | Optional |
| 9 | 1 - 3H | Download Message | Optional |
| F | - | MSG Identify Device | |

The CFW501 inverter presents the commands and subcommands described in table 2.2

Table 2.2: N2 Commands and subcommands for the CFW501 inverter

| Command | Subcommand | Description | Note |
|---------|------------|-----------------------------------|------|
| 0 | 0 | Time Update Message | |
| 0 | 4 | Poll Message No ACK | |
| 0 | 5 | Poll Message with ACK | |
| 1 | 0 - FH | Read Field MSG | |
| 2 | 0 - FH | Write Field MSG | |
| 7 | 2 | General Command Message: Override | |
| 7 | 3 | General Command Message: Release | |
| F | - | MSG Identify Device | |

2.3 POLLING MECHANISM

It is defined as an automatic communication mechanism performed by the master with the devices present in the N2 network. This allows the slaves to transmit the data that had their values changed from the last polling.

3 INTERFACE DESCRIPTION

The interfaces for serial communication RS232, RS485 or USB available for the CFW501 frequency inverter depend on the selected plug-in module for the product. Following are presented information about the connection and installation of the equipment, using different plug-in modules.

3.1 PLUG-IN MODULES WITH RS485 INTERFACE

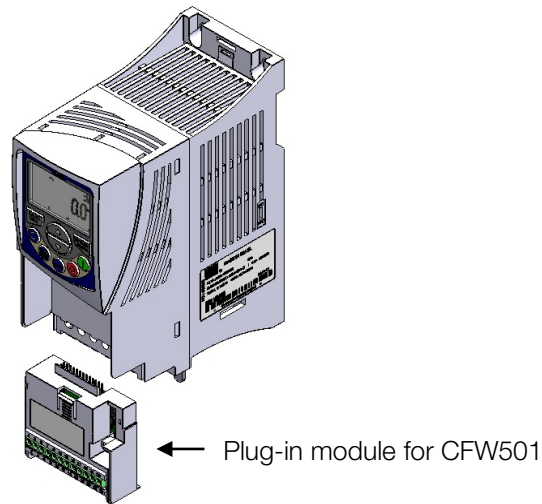


Figure 3.1: Example of CFW501 plug-in module

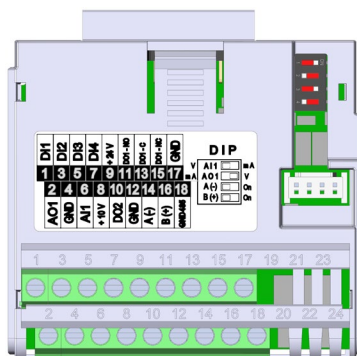
All plug-in modules for CFW501 frequency inverter have at least one standard RS485 interface, identified as Serial (1). This standard RS485 interface has two functions:

- Point to Point Connection with remote keypad.
- Connection via RS485 for network operation.

The selection of the function that will be used for the product is made using parameter P0312.

3.1.1 RS485 connector for the standard plug-in module (CFW500-IOS)

For the standard plug-in module, the connection to the RS485 interface is available via the control terminal using the following pin assignment:



| Pin | Name | Function |
|-----|------------|------------------------------------|
| 12 | A-Line (-) | RxD/TxD negative |
| 14 | B-Line (+) | RxD/TxD positive |
| 16 | GND | 0V isolated from the RS485 circuit |

Table 2.1: RS485 connector pinout for standard plug-in module (CFW500-IOS)

3.2 PLUG-IN MODULES WITH RS485 INTERFACE AND ADDITIONAL INTERFACE

Depending on the installed plug-in module, CFW501 has up to two serial interfaces simultaneously, but only one can be the source of commands or references, the other is necessarily inactive or remote keypad as the selection of P0312.

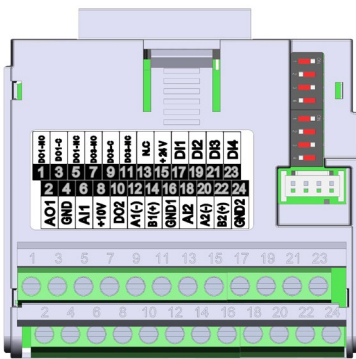
The Serial (1) Interface is the standard interface CFW501 and is present in all plug-in modules via the terminals of the standard RS485 port. The Serial (2) interface is present only in the plug-in modules described below:



NOTE!

It is not possible use the serial interfaces for communication with two different networks. The only allowed simultaneous operation is using Serial (1) connected to the remote keypad, and another programmed protocol to Serial (2).

3.2.1 Plug-in module with two RS485 interfaces (CFW500-CRS485-B)



| Pin | Name | Function |
|-----|------------|---------------------------------------|
| 12 | A-Line (-) | RxD/TxD negative – Serial (1) |
| 14 | B-Line (+) | RxD/TxD positive – Serial (1) |
| 16 | Ref. | 0V for the RS485 circuit – Serial (1) |

| Pin | Name | Function |
|-----|------------|---------------------------------------|
| 20 | A-Line (-) | RxD/TxD negative – Serial (2) |
| 22 | B-Line (+) | RxD/TxD positive – Serial (2) |
| 24 | Ref. | 0V for the RS485 circuit – Serial (2) |

Table 3.2: Plug-in module with additional RS485

For this plug-in module, besides the standard RS485 interface, a second RS485 interface is available. This accessory allows simultaneous connection of a remote HMI in the standard RS485 serial interface, plus a programmable RS485 interface.

3.2.2 Plug-in module with RS485 and USB interfaces (CFW500- CUSB)

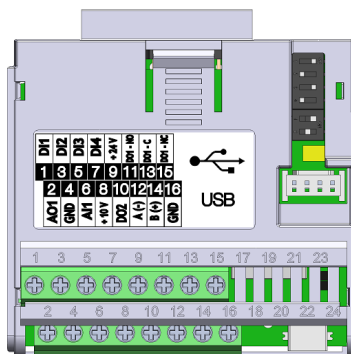


Figure 2.2: Plug-in module with USB connection

For this plug-in module, besides the standard RS485 interface, a USB interface with mini-USB connector is available. When connecting the USB interface, it will be recognized as a USB to serial converter, and a virtual COM port will be created¹. Thus communication is made with the drive via this COM port. The USB accessory also provides the connection to the remote keypad via standard RS485 interface.

¹ It is necessary to install the USB driver on the CD-ROM supplied with the product. The COM port number created depends on the availability in the operating system and, once connected, consult the hardware resources of the system to identify this port.

3.2.3 Plug-in module with RS485 and RS232 interfaces (CFW500-CRS232)

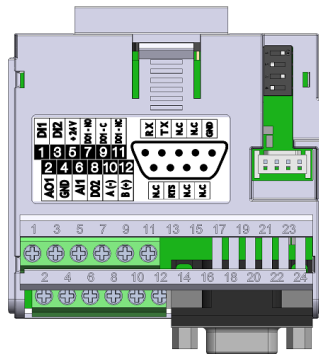


Figure 2.3: Plug-in module with RS232 connection

For this plug-in module, besides the standard RS485 interface, an RS232 interface is available. This accessory allows simultaneous connection of a remote HMI in the standard RS485 serial interface, plus a programmable RS232 interface.

3.3 RS485

3.3.1 RS485 Interface Characteristics

- The interface follows the EIA-485 standard.
- It allows communication baud rates from 9600 up to 38400 Kbit/s.
- The interface is electrically isolated and with differential signal, which grants more robustness against electromagnetic interference.
- It allows the connection of up to 32 devices to the same segment. More devices can be connected by using repeaters².
- A maximum bus length of 1000 meters.

3.3.2 Terminating resistor

It is necessary to enable a terminating resistor at both ends of the main bus for each segment of the RS485 network. There are switches in the CFW501 frequency inverter that can be activated to enable the terminating resistor. Refer to the plug-in installation guide for details.

3.3.3 Indications

Details on the alarms, communications failures and communication states are made through the keypad (HMI) and product parameters.

3.3.4 Connection with the RS485 Network

The following points must be observed for the connection of the device using the RS485 interface:

- It is recommended the use of a shielded cable with a twisted pair of wires.
- It is also recommended that the cable has one more wire for the connection of the reference signal (GND). In case the cable does not have the additional wire, then the GND signal must be left disconnected.

² The limit number of devices that can be connected to the network depends also on the used protocol.

- The cable must be laid separately (and far away if possible) from the power cables.
- All the network devices must be properly grounded, preferably at the same ground connection. The cable shield must also be grounded.
- Enable the termination resistors only at two points, at the extremes of the main bus, even if there are derivations from the bus.

4 PROGRAMMING

Next, the CFW501 frequency inverter parameters related to the N2 communication will be presented.

4.1 SYMBOLS FOR THE PROPERTIES DESCRIPTION

| | |
|-----|--|
| RO | Reading only parameter |
| CFG | Parameter that can be changed only with a stopped motor. |

P0105 – 1ST/2ND RAMP SELECTION

P0220 – LOCAL/REMOTE SELECTION SOURCE

P0221 – SPEED REFERENCE SELECTION – LOCAL SITUATION

P0222 – SPEED REFERENCE SELECTION – REMOTE SITUATION

P0223 – FORWARD/REVERSE SELECTION – LOCAL SITUATION

P0224 – RUN/STOP SELECTION – LOCAL SITUATION

P0225 – JOG SELECTION – LOCAL SITUATION

P0226 – FORWARD/REVERSE SELECTION – REMOTE SITUATION

P0227 – RUN/STOP SELECTION – REMOTE SITUATION

P0228 – JOG SELECTION – REMOTE SITUATION

These parameters are used in the configuration of the command source for the CFW501 frequency inverter local and remote situations. In order that the device be controlled through the N2 interface, the options 'serial' available in these parameters, must be selected.

The detailed description of these parameters is found in the CFW501 programming manual.

P0308 – SERIAL ADDRESS

| | | |
|-------------------------------|----------|-------------------|
| Range: | 0 to 255 | Default: 1 |
| Properties: | CFG | |
| Access groups via HMI: | NET | |

Description:

It allows programming the address used for the inverter serial communication. It is necessary that each device in the network has an address different from all the others. The valid addresses for this parameter depend on the protocol programmed in P0312:

- HMI → programming needn't address.
- Modbus RTU → valid addresses: 1 to 247.
- BACnet → valid addresses: 0 to 254.
- N2 → valid addresses: 1 to 255.
- SymbiNet → valid addresses: 1 to 63.

P0310 – SERIAL BAUD RATE

| | | |
|-------------------------------|---|-------------------|
| Range: | 0 = 9600 bits/s 1 = 19200 bits/s 2 = 38400 bits/s | Default: 1 |
| Properties: | CFG | |
| Access groups via HMI: | NET | |

Description:

It allows programming the baud rate for the serial communication interface, in bits per second. This baud rate must be the same for all the devices connected to the network.


NOTE!

To use the RS485 interface with the remote keypad it is not necessary to set the baud rate. This setting is necessary only with the other serial protocols, for both the standard interface (1) as the additional interface (2).


NOTE!

The option 0 must be selected for the N2 protocol.

P0311 – SERIAL INTERFACE BYTE CONFIGURATION

| | | |
|-------------------------------|---|-------------------|
| Range: | 0 = 8 data bits, no parity, 1 stop bit 1 = 8 data bits, even parity, 1 stop bit 2 = 8 data bits, odd parity, 1 stop bit 3 = 8 data bits, no parity, 2 stop bits 4 = 8 data bits, even parity, 2 stop bits 5 = 8 data bits, odd parity, 2 stop bits | Default: 1 |
| Properties: | CFG | |
| Access groups via HMI: | NET | |

Description:

It allows programming the number of data bits, parity and stop bits of the serial interface bytes. This configuration must be identical for all the devices connected to the network.


NOTE!

The option 0 must be selected for the BACnet and N2 protocol.


NOTE!

To use the RS485 interface with the remote keypad it is not necessary to set the byte configuration. This setting is necessary only with the other serial protocols, for both the standard interface (1) as the additional interface (2).

P0312 – SERIAL PROTOCOL

| | | |
|-------------------------------|--|-------------------|
| Range: | 0 = HMI (1) 1 = SymbiNet (1) 2 = Modbus RTU (1) 3 = BACnet (1) 4 = N2 (1) 5 = Master Modbus RTU (1) and Modbus RTU (2) 6 = HMI (1) and Modbus RTU (2) 7 = Modbus RTU (2) 8 = HMI (1) and BACnet (2) 9 = BACnet (2) 10 = HMI (1) and N2 (2) 11 = N2 (2) 12 = HMI (1) and Master Modbus RTU (2) 13 = Modbus RTU (1) and Master Modbus RTU (2) 14 = HMI (1) and SymbiNet (2) 15 = SymbiNet (2) | Default: 2 |
| Properties: | CFG | |
| Access groups via HMI: | NET | |

Description:

It allows selecting the desired protocol for the serial interface.

Table 4.1: P0312 options

| Option | Description |
|--|--|
| 0 = HMI (1) | For the standard RS485 interface (1), this option selects the remote HMI communication protocol. |
| 1 = SymbiNet (1) | For the standard serial interface (1), this option selects SymbiNet as the communication protocol. |
| 2 = Modbus RTU (1) | For the standard RS485 interface (1), this option selects Modbus RTU slave as the communication protocol. |
| 3 = BACnet (1) | For the standard RS485 interface (1), this option selects BACnet MS/TP the communication protocol. |
| 4 = N2 (1) | For the standard RS485 interface (1), this option selects N2 the communication protocol. |
| 5 = 5 = Master Modbus RTU (1) and Modbus RTU (2) | For the interface modules with more than one serial interface, this option allows to use the standard interface (1) as master Modbus RTU, and simultaneously to use the additional interface as slave Modbus RTU. |
| 6 = HMI (1)/Modbus RTU (2) | For the interface modules with more than one serial interface (example: CFW500-CUSB, etc.), this option allows to use the remote HMI connected to standard interface (1), and simultaneously, to use Modbus RTU slave protocol at the additional serial interface (2). |
| 7 = Modbus RTU (2) | For the additional RS485 interface (2), this option selects Modbus RTU slave communication protocol. The standard serial interface (1) remains disabled. |
| 8 = HMI (1)/BACnet (2) | For the interface modules with more than one serial interface (example: CFW500-CUSB, etc.), this option allows to use the remote HMI connected to standard interface (1), and simultaneously, to use BACnet MS/TP protocol at the additional serial interface (2). |
| 9 = BACnet (2) | For the additional RS485 interface (2), this option selects BACnet MS/TP communication protocol. The standard serial interface (1) remains disabled. |
| 10 = HMI (1)/N2 (2) | For the interface modules with more than one serial interface (example: CFW500-CUSB, etc.), this option allows to use the remote HMI connected to standard interface (1), and simultaneously, to use N2 protocol at the additional serial interface (2). |
| 11 = N2 (2) | For the additional RS485 interface (2), this option selects N2 communication protocol. The standard serial interface (1) remains disabled. |

| | |
|---|---|
| 12 = HMI (1) and Master Modbus RTU (2) | For the interface modules with more than one serial interface, this option allows to use the remote HMI connected to standard interface (1), and simultaneously to use the drive as Master Modbus RTU at the additional serial interface (2). |
| 13 = Modbus RTU (1) and Master Modbus RTU (2) | For the interface modules with more than one serial interface, this option allows to use the standard interface (1) as slave Modbus RTU, and simultaneously to use the drive as Master Modbus RTU at the additional serial interface (2). |
| 14 = HMI (1) and SymbiNet (2) | For the interface modules with more than one serial interface, this option allows to use the remote HMI connected to standard interface (1), and simultaneously to use the additional interface (2) as SymbiNet. |
| 15 = SymbiNet (2) | For the additional serial interface (2), this option selects SymbiNet communication protocol. The standard serial interface (1) remains disabled. |

P0313 – COMMUNICATION ERROR ACTION

| | |
|---|-------------------|
| Range: 0 = Inactive 1 = Disable via Run/Stop 2 = Disable via General Enable 3 = Change to Local 4 = Change to Local keeping commands and reference 5 = Causes a Fault Properties: CFG Access groups via HMI: NET | Default: 1 |
|---|-------------------|

Description:

It allows the selection of the action to be executed by the device, if it is controlled via network and a communication error is detected.

Table 4.2: P0313 options

| Options | Description |
|--|---|
| 0 = Inactive | No action is taken and the drive remains in the existing status. |
| 1 = Disable via Run/Stop | A stop command with deceleration ramp is executed and the motor stops according to the programmed deceleration ramp. |
| 2 = Disable via General Enable | The drive is disabled by removing the General Enabling and the motor coasts to stop. |
| 3 = Change to Local | The drive commands change to Local. |
| 4 = Change to Local keeping commands and reference | The drive commands change to Local, but the status of the enabling and speed reference commands received via network are kept, providing that the drive has been programmed to use in Local mode the commands via HMI, or 3-wire start/stop and speed reference via either HMI or electronic potentiometer. |
| 5 = Causes a Fault | Instead of an alarm, the communication error causes an drive fault, so that a drive fault reset becomes necessary in order to restore normal operation. |

The following events are considered communication errors:

Serial communication (RS485):

- A128 alarm/F228 fault: Serial communication timeout

The actions described in this parameter are executed by means of the automatic writing of the selected actions in the respective bits of the interface control words. Therefore, in order that the commands written in this parameter be effective, it is necessary that the device be programmed to be controlled via the used network interface (with exception of option “Causes a Fault”, which blocks the equipment even if it is not controlled by network). This programming is achieved by means of parameters P0220 to P0228.

P0314 – SERIAL WATCHDOG

| | | |
|-------------------------------|---------------|---------------------|
| Range: | 0.0 to 999.0s | Default: 0.0 |
| Properties: | CFG | |
| Access groups via HMI: | NET | |

Description:

It allows programming a time limit for the detection of serial interface communication error. If the frequency inverter remains without receiving valid telegrams longer than the time programmed in this parameter, it will be considered that a communication error has occurred, the alarm A128 will be showed on the HMI and the option programmed in P0313 will be executed.

After being powered up, the frequency inverter starts counting this time from the first received valid telegram. The value 0.0 disables this function.

P0316 – SERIAL INTERFACE STATUS

| | | |
|-------------------------------|--|-------------------|
| Range: | 0 = Inactive 1 = Active 2 = Watchdog error | Default: - |
| Properties: | RO | |
| Access groups via HMI: | NET | |

Description:

It allows identifying whether the RS485 serial interface board is properly installed, and whether the serial communication presents errors.

Table 4.3: P0316 options

| Options | Description |
|--------------------|---|
| 0 = Inactive | Inactive serial interface. It occurs when the device does not have the RS485 board installed. |
| 1 = Active | Installed and acknowledged RS485 interface board. |
| 2 = Watchdog error | The serial interface is active, but a serial communication error has been detected - A128 alarm/F228 fault. |

P0680 – STATUS WORD

| | | |
|-------------------------------|----------------|-------------------|
| Range: | 0000h to FFFFh | Default: - |
| Properties: | RO | |
| Access groups via HMI: | NET | |

Description:

It allows the device status monitoring. Each bit represents a specific status:

| Bits | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|-----------------|-----------------|--------------|---------|-----|-----------------|-----------------------|---------------|-----------------|-----------------------|-------------|-------------------|--------|-----------|-------------|----------|
| Function | Fault condition | (PID) Automatic | Undervoltage | LOC/REM | JOG | Speed direction | Active General Enable | Motor Running | Alarm condition | In configuration mode | Second ramp | Active quick stop | Bypass | Fire Mode | Run command | Reserved |

Table 4.4: P0680 parameter bit functions

| Bits | Values |
|--------------------------------|--|
| Bit 0 | Reserved. |
| Bit 1 Run command | 0: Run command is inactive. 1: Run command is active. This bit is mapped in the BI2 object |
| Bit 2 Fire Mode | 0: Drive is not in Fire Mode. 1: Drive is in Fire Mode. This bit is mapped in the BI3 object |
| Bit 3 Bypass | 0: Drive is not in Bypass mode. 1: Drive is in Bypass mode. This bit is mapped in the BI4 object |
| Bit 4 Active quick stop | 0: The fast stop command is not active. 1: The drive is executing the fast stop command. This bit is mapped in the BI5 object |
| Bit 5 Second ramp | 0: The drive is configured to use the first ramp values, programmed in P0100 and P0101, as the motor acceleration and deceleration ramp times. 1: The drive is configured to use the second ramp values, programmed in P0102 and P0103, as the motor acceleration and deceleration ramp times. This bit is mapped in the BI6 object |
| Bit 6 In configuration mode | 0: The drive is operating normally. 1: The drive is in the configuration mode. It indicates a special condition during which the drive cannot be enabled: Executing the self-tuning routine Executing the oriented start-up routine Executing the HMI copy function Executing the flash memory card self-guided routine There is a parameter setting incompatibility There is no power at the drive power section This bit is mapped in the BI7 object |
| Bit 7 Alarm condition | 0: The drive is not in alarm condition. 1: The drive is in alarm condition. Note: The alarm number can be read by means of the parameter P0048 – Present Alarm. This bit is mapped in the BI8 object |
| Bit 8 Motor Running | 0: The motor is stopped. 1: The drive is running the motor at the set point speed, or executing either the acceleration or the deceleration ramp. This bit is mapped in the BI9 object |
| Bit 9 Active General Enable | 0: General Enable is not active. 1: General Enable is active and the drive is ready to run the motor. This bit is mapped in the BI10 object |
| Bit 10 Speed direction | 0: The motor is running in the reverse direction. 1: The motor is running in the forward direction. This bit is mapped in the BI11 object |
| Bit 11 JOG | 0: Inactive JOG function. 1: Active JOG function. This bit is mapped in the BI12 object |
| Bit 12 LOC/REM | 0: Drive in Local mode. 1: Drive in Remote mode. This bit is mapped in the BI13 object |
| Bit 13 Undervoltage | 0: No Undervoltage. 1: With Undervoltage. This bit is mapped in the BI14 object |

| | |
|-----------------------------|---|
| Bit 14 Manual/ Automatic | 0: PID in manual mode. 1: PID in Automatic mode. This bit is mapped in the BI15 object |
| Bit 15 Fault condition | 0: The drive is not in a fault condition. 1: The drive has detected a fault. Note: The fault number can be read by means of the parameter P0049 – Present Fault. This bit is mapped in the BI16 object |

P0681 – MOTOR SPEED IN 13 BITS

| | |
|-----------------------------------|-------------------|
| Range: - 32768 to 32767 | Default: - |
| Properties: RO | |
| Access groups via HMI: NET | |

Description:

It allows monitoring the motor speed. This word uses 13-bit resolution with signal to represent the motor synchronous speed:

- P0681 = 0000h (0 decimal) → motor speed = 0
- P0681 = 2000h (8192 decimal) → motor speed = synchronous speed

Intermediate or higher speed values in rpm can be obtained by using this scale. E.g. for a 4 pole motor and 1800 rpm of synchronous speed if the value read is 2048 (0800h), then, to obtain the speed in rpm one must calculate:

| |
|---|
| 8192 => 1800 rpm 2048 => Speed in rpm |
| $\text{Speed in rpm} = \frac{1800 \times 2048}{8192}$ |
| Speed in rpm = 450 rpm |

Negative values in this parameter indicate that the motor is running in the reverse direction.

This parameter is mapped in the AI18 object.

P0682 – SERIAL CONTROL WORD

| | |
|-----------------------------------|-----------------------|
| Range: 0000h to FFFFh | Default: 0000h |
| Properties: - | |
| Access groups via HMI: NET | |

Description:

It is the device N2 interface control word. This parameter can only be changed via serial interface. For the other sources (HMI, etc.) it behaves like a read-only parameter.

In order to have those commands executed, it is necessary to program the equipment to be controlled via serial. This programming is achieved by means of parameters P0105 and P0220 to P0228.

Each bit of this word represents a command that can be executed.

| Bits | 15 | 14 | 13 | 13 to 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----------|---------------------------|---------------------|----------|-------------|------------|-------------|---------|-----|-----------------|----------------|----------|
| Function | Reserved | External PID controller 1 | Main PID controller | Reserved | Fault reset | Quick stop | Second ramp | LOC/REM | JOG | Speed direction | General enable | Run/Stop |

Table 4.5: P0682 parameter bit functions

| Bits | Values |
|-------------------------------------|---|
| Bit 0 Run/Stop | 0: It stops the motor with deceleration ramp. 1: The motor runs according to the acceleration ramp until reaching the speed reference value. This bit is mapped in the object BO1 |
| Bit 1 General enable | 0: It disables the drive, interrupting the supply for the motor. 1: It enables the drive allowing the motor operation. This bit is mapped in the object BO2 |
| Bit 2 Speed direction | 0: To run the motor in a direction opposed to the speed reference. 1: To run the motor in the direction indicated by the speed reference. This bit is mapped in the object BO3 |
| Bit 3 JOG | 0: It disables the JOG function. 1: It enables the JOG function. This bit is mapped in the object BO4 |
| Bit 4 LOC/REM | 0: The drive goes to the Local mode. 1: The drive goes to the Remote mode. This bit is mapped in the object BO5 |
| Bit 5 Second ramp | 0: The drive uses the first ramp values, programmed in P0100 and P0101, as the motor acceleration and deceleration ramp times. 1: The drive is configured to use the second ramp values, programmed in P0102 and P0103, as the motor acceleration and deceleration ramp times. This bit is mapped in the object BO6 |
| Bit 6 Quick stop | 0: It does not execute the quick stop command. 1: It executes the quick stop command. Note: This function is not allowed with control types (P0202) V/f or VVV. This bit is mapped in the object BO7 |
| Bit 7 Fault reset | 0: No function. 1: If in a fault condition, then it executes the reset. This bit is mapped in the object BO8 |
| Bits 8 to 12 | Reserved. |
| Bit 13 Main PID controller | 0: Automatic. 1: Manual. This bit is mapped in the object BO14 |
| Bit 14 External PID controller 1 | 0: Automatic. 1: Manual. This bit is mapped in the object BO15 |
| Bit 15 | Reserved. |

P0683 – SERIAL SPEED REFERENCE

| | | |
|-------------------------------|-----------------|-------------------|
| Range: | -32768 to 32767 | Default: 0 |
| Properties: | - | |
| Access groups via HMI: | NET | |

Description:

It allows programming the motor speed reference via the N2 interface. This parameter can only be changed via serial interface. For the other sources (HMI, etc.) it behaves like a read-only parameter.

In order that the reference written in this parameter be used, it is necessary that the drive be programmed to use the speed reference via serial. This programming is achieved by means of parameters P0221 and P0222.

This word uses a 13-bit resolution with signal to represent the motor synchronous speed.

- P0683 = 0000h (0 decimal) → speed reference = 0
- P0683 = 2000h (8192 decimal) → speed reference = synchronous speed

Intermediate or higher reference values can be programmed by using this scale. E.g. for a 4 pole motor and 1800 rpm of synchronous speed, to obtain a speed reference of 900 rpm one must calculate:

| |
|---|
| 1800 rpm => 8192 900 rpm => 13 bit reference |
| $13 \text{ bit reference} = \frac{900 \times 8192}{1800}$ |
| 13 bit reference = 4096 => Value corresponding to 900 rpm in a 13 bit scale |

This parameter also accepts negative values to revert the motor speed direction. The reference speed direction, however, depends also on the control word - P0682 - bit 2 setting:

- Bit 2 = 1 and P0683 > 0: reference for forward direction
- Bit 2 = 1 and P0683 < 0: reference for reverse direction
- Bit 2 = 0 and P0683 > 0: reference for reverse direction
- Bit 2 = 0 and P0683 < 0: reference for forward direction

This parameter is mapped in the AO3 object.

P0695 – DIGITAL OUTPUT SETTING

| | | |
|-------------------------------|----------------|-----------------------|
| Range | 0000h to 001Fh | Default: 0000h |
| Properties: | - | |
| Access groups via HMI: | NET | |

Description:

It allows the control of the digital outputs by means of the network interfaces. This parameter cannot be changed via HMI.

Each bit of this parameter corresponds to the desired value for one digital output. In order to have the correspondent digital output controlled according to this content, it is necessary that its function be programmed for "P0695 Content" at parameters P0275 to P0279.

| Bits | 15 to 5 | 4 | 3 | 2 | 1 | 0 |
|----------|----------|-------------|-------------|-------------|-------------|-------------|
| Function | Reserved | DO5 setting | DO4 setting | DO3 setting | DO2 setting | DO1 setting |

Table 4.6: P0695 parameter bit functions

| Bits | Values |
|----------------------|---|
| Bit 0 DO1 setting | 0: DO1 output open. 1: DO1 output closed. This bit is mapped in the BO17 object |
| Bit 1 DO2 setting | 0: DO2 output open. 1: DO2 output closed. This bit is mapped in the BO18 object |
| Bit 2 DO3 setting | 0: DO3 output open. 1: DO3 output closed. This bit is mapped in the BO19 object |
| Bit 3 DO4 setting | 0: DO4 output open. 1: DO4 output closed. This bit is mapped in the BO20 object |
| Bit 4 DO5 setting | 0: DO5 output open. 1: DO5 output closed. This bit is mapped in the BO21 object |
| Bits 5 to 15 | Reserved |


NOTE!

Some of the digital outputs may not be available depending on the plug-in module.

P0696 – VALUE 1 FOR ANALOG OUTPUTS
P0697 – VALUE 2 FOR ANALOG OUTPUTS
P0698 – VALUE 3 FOR ANALOG OUTPUTS

| | | |
|-------------------------------|-----------------|-------------------|
| Range: | -32768 to 32767 | Default: 0 |
| Properties: | - | |
| Access groups via HMI: | NET | |

Description:

They allow the control of the analog outputs by means of network interfaces. These parameters cannot be changed via HMI.

The value written in these parameters is used as the analog output value, providing that the function for the desired analog output be programmed for “P0696 / P0697 / P0698 value”, at the parameters P0251, P0254, P0257.

The value must be written in a 15-bit scale (7FFFh = 32767)³ to represent 100 % of the output desired value, i.e.:

- P0696 = 0000h (0 decimal) → analog output value = 0 %
- P0696 = 7FFFh (32767 decimal) → analog output value = 100 %

³ For the actual output resolution, refer to the product manual.

The showed example was for P0696, but the same scale is also used for the parameters P0697 / P0698. For instance, to control the analog output 1 via serial, the following programming must be done:

- Choose a parameter from P0696, P0697, P0698 to be the value used by the analog output 1. For this example, we are going to select P0696.
- Program the option "P0696 value" as the function for the analog output 1 in P0254.
- Using the network interface, write in P0696 the desired value for the analog output 1, between 0 and 100 %, according to the parameter scale.

N2 objects of the ANALOG OUTPUT type mold the analog outputs, where:

- AO4 - P0696.
- AO5 - P0697.
- AO6 - P0698.

**NOTE!**

For CFW501 frequency inverter, the analog output 3 represents the frequency output (FO).

5 N2 OBJECTS MODELING

An N2 object represents physical or virtual information of the equipment, such as a digital input or parameters. The CFW501 inverter presents the following object types:

- ANALOG INPUT.
- ANALOG OUTPUT.
- BINARY INPUT.
- BINARY OUTPUT.

5.1 N2 OBJECTS FOR THE CFW501

Table 5.1 shows the actions supported by each kind of object N2.

Table 5.1: Action for the objects N2

| Action | Analog Input | Binary Input | Analog Output | Binary Output |
|----------|--------------|--------------|---------------|---------------|
| Write | X | X | X | X |
| Read | X | X | X | X |
| Override | | | X | X |
| Release | | | X | X |

The CFW501 inverter parameters are mapped by N2 objects which are described below.



NOTE!

Refer to the description of the parameters associates with each object for more details about it.

5.1.1 ANALOG INPUT (AI) Object

It represents an analog input by which its value can be read by the network controller. The ANALOG INPUT object types for the CFW501 are described at table 5.2.

Table 5.2: ANALOG INPUT Object

| Object | Eng. Unit | Parameter | Description | Range | Access |
|--------|-----------|-----------|-----------------------|------------------|--------|
| AI1 | RPM | P0002 | Motor Speed | 0 – 18000 | R |
| AI2 | A | P0003 | Motor Current | 0.0 – 4500.0 | R |
| AI3 | V | P0004 | DC Link Voltage (Ud) | 0 – 2000 | R |
| AI4 | Hz | P0005 | Motor Frequency | 0.0 – 1020.0 | R |
| AI5 | V | P0007 | Motor Voltage | 0 – 2000 | R |
| AI6 | % | P0009 | Motor Torque | -1000.0 – 1000.0 | R |
| AI7 | kW | P0010 | Output Power | 0.0 – 6553.5 | R |
| AI8 | % | P0018 | AI1 Value | -100.00 – 100.00 | R |
| AI9 | % | P0019 | AI2 Value | -100.00 – 100.00 | R |
| AI10 | % | P0020 | AI3 Value | -100.00 – 100.00 | R |
| AI11 | °C | P0030 | Heatsink Temperature | -20.0 – 150.0 | R |
| AI12 | - | - | Reserved | - | - |
| AI13 | h | P0042 | Time Powered | 0 – 65535 | R |
| AI14 | h | P0043 | Time Enabled | 0.0 – 6553.5 | R |
| AI15 | kWh | P0044 | kWh Output Energy | 0 – 65535 | R |
| AI16 | - | P0048 | Present Alarm | 0 – 999 | R |
| AI17 | - | P0049 | Present Fault | 0 – 999 | R |
| AI18 | - | P0681 | Speed in 13 bits | -32768 – 32767 | R |
| AI19 | bar | P1015 | Main PID Feedback | -32768 – 32767 | R |
| AI20 | % | P1016 | Main PID Output | 0.0 – 100.0 | R |
| AI21 | °C | P1062 | External PID Feedback | -32768 – 32767 | R |
| AI22 | % | P1063 | External PID Output | 0.0 – 100.0 | R |

5.1.2 ANALOG OUTPUT (AO) Object

It represents an analog output by which its value can be read by the network controller. The ANALOG OUTPUT object types for the CFW501 are described at table 5.3.

Table 5.3: ANALOG OUTPUT Object

| Object | Eng. Unit | Parameter | Description | Range | Access |
|--------|-----------|-----------|----------------------------|----------------|--------|
| AO1 | s | P0100 | Acceleration Time | 0.0 – 999.0 | R/W |
| AO2 | s | P0101 | Deceleration Time | 0.0 – 999.0 | R/W |
| AO3 | - | P0683 | Serial/USB Speed Ref. | -32768 – 32767 | R/W |
| AO4 | - | P0696 | AOx Value 1 | -32768 – 32767 | R/W |
| AO5 | - | P0697 | AOx Value 2 | -32768 – 32767 | R/W |
| AO6 | - | P1012 | SoftPLC Parameter | 0 – 65535 | R/W |
| AO7 | - | P1013 | SoftPLC Parameter | 0 – 65535 | R/W |
| AO8 | - | P1025 | SoftPLC Parameter | 0 – 65535 | R/W |
| AO9 | bar | P1011 | Main PID Aut. Setpoint | -32768 – 32767 | R/W |
| AO10 | % | P1014 | Main PID Man. Setpoint | 0.0 – 100.0 | R/W |
| AO11 | °C | P1060 | External PID Auto Setpoint | -32768 – 32767 | R/W |
| AO12 | % | P1061 | External PID Man. Setpoint | 0.0 – 100.0 | R/W |

5.1.3 BINARY INPUT (BI) Object

It represents a physical digital input by which its status can be read by the network controller. The BINARY INPUT object types for the CFW501 are described at table 5.4.

Table 5.4: BINARY INPUT Object

| Object | Eng. Unit | Parameter | Bit | Description | Values (1 / 0) | Access |
|--------|-----------|-----------|-----|----------------|---------------------|--------|
| BI1 | - | P0680 | 0 | Not Used | - | - |
| BI2 | - | P0680 | 1 | Run Command | On / Off | R |
| BI3 | - | P0680 | 2 | Fire mode | On / Off | R |
| BI4 | - | P0680 | 3 | Bypass | On / Off | R |
| BI5 | - | P0680 | 4 | Quick Stop | Active / Inactive | R |
| BI6 | - | P0680 | 5 | 2nd Ramp | On / Off | R |
| BI7 | - | P0680 | 6 | Config. Mode | Config / Normal | R |
| BI8 | - | P0680 | 7 | Alarm | Alarm / No Alarm | R |
| BI9 | - | P0680 | 8 | Running | Running / Stopped | R |
| BI10 | - | P0680 | 9 | Enabled | Enabled / Disabled | R |
| BI11 | - | P0680 | 10 | Forward | Forward / Reverse | R |
| BI12 | - | P0680 | 11 | JOG | On / Off | R |
| BI13 | - | P0680 | 12 | Remote | Remote / Local | R |
| BI14 | - | P0680 | 13 | Subvoltage | Subvoltage / No Sub | R |
| BI15 | - | P0680 | 14 | Automatic(PID) | Auto / Manual | R |
| BI16 | - | P0680 | 15 | Fault | Fault / No Fault | R |
| BI17 | - | P0012 | 0 | DI1 | On / Off | R |
| BI18 | - | P0012 | 1 | DI2 | On / Off | R |
| BI19 | - | P0012 | 2 | DI3 | On / Off | R |
| BI20 | - | P0012 | 3 | DI4 | On / Off | R |
| BI21 | - | P0012 | 4 | DI5 | On / Off | R |
| BI22 | - | P0012 | 5 | DI6 | On / Off | R |
| BI23 | - | P0012 | 6 | DI7 | On / Off | R |
| BI24 | - | P0012 | 7 | DI8 | On / Off | R |

5.1.4 BINARY OUTPUT (BO) Object

It represents a physical digital output by which its status can be read by the network controller. The BINARY OUTPUT object types for the CFW501 are described at table 5.5.

Table 5.5: BINARY OUTPUT Objects

| Object | Eng. Unit | Parameter | Bit | Description | Values (1 / 0) | Access |
|--------|-----------|-----------|-----|----------------|-------------------|--------|
| BO1 | - | P0682 | 0 | Ramp Enable | Run / Stop | R/W |
| BO2 | - | P0682 | 1 | General Enable | Enable / Disable | R/W |
| BO3 | - | P0682 | 2 | Run Forward | Forward / Reverse | R/W |
| BO4 | - | P0682 | 3 | JOG Enable | On / Off | R/W |
| BO5 | - | P0682 | 4 | Remote | Remote / Local | R/W |
| BO6 | - | P0682 | 5 | 2nd Ramp | On / Off | R/W |
| BO7 | - | P0682 | 6 | Quick Stop | On / Off | R/W |
| BO8 | - | P0682 | 7 | Fault Reset | Reset / Off | R/W |
| BO9 | - | P0682 | 8 | Not Used | - | - |
| BO10 | - | P0682 | 9 | Not Used | - | - |
| BO11 | - | P0682 | 10 | Not Used | - | - |
| BO12 | - | P0682 | 11 | Not Used | - | - |
| BO13 | - | P0682 | 12 | Not Used | - | - |
| BO14 | - | P0682 | 13 | Intern PID | Manual / Auto | R/W |
| BO15 | - | P0682 | 14 | Extern PID | Manual / Auto | R/W |
| BO16 | - | P0682 | 15 | Not Used | - | - |
| BO17 | - | P0695 | 0 | DO1 | On / Off | R/W |
| BO18 | - | P0695 | 1 | DO2 | On / Off | R/W |
| BO19 | - | P0695 | 2 | DO3 | On / Off | R/W |
| BO20 | - | P0695 | 3 | DO4 | On / Off | R/W |
| BO21 | - | P0695 | 4 | DO5 | On / Off | R/W |

5.1.5 Control System Model DDL

 * WEG , CFW501 Variable Frequency Drive

CSMODEL "CFW501", "VND"
 AITITLE "Analog Inputs"
 BITITLE "Binary Inputs"
 AOTITLE "Analog Outputs"
 BOTITLE "Binary Outputs"

CSAI "AI1",N,N,"Motor Speed - P0002", "rpm"
 CSAI "AI2",N,N,"Motor Current - P0003", "A"
 CSAI "AI3",N,N,"DC Link Voltage (Ud) - P0004", "V"
 CSAI "AI4",N,N,"Motor Frequency - P0005", "Hz"
 CSAI "AI5",N,N,"Motor Voltage - P0007", "V"
 CSAI "AI6",N,N,"Motor Torque - P0009", "%"
 CSAI "AI7",N,N,"Output Power - P0010", "kW"
 CSAI "AI8",N,N,"AI1 Value - P0018", "%"
 CSAI "AI9",N,N,"AI2 Value - P0019", "%"
 CSAI "AI10",N,N,"AI3 Value - P0020", "%"
 CSAI "AI11",N,N,"Heatsink Temperature - P0030", "°C"
 CSAI "AI12",N,N,"Reserved", "-"
 CSAI "AI13",N,N,"Time Powered - P0042", "h"
 CSAI "AI14",N,N,"Time Enabled - P0043", "h"
 CSAI "AI15",N,N,"kWh Output Energy - P0044", "kWh"
 CSAI "AI16",N,N,"Present Alarm - P0048", ""
 CSAI "AI17",N,N,"Present Fault - P0049", ""
 CSAI "AI18",N,N,"Speed in 13 bits - P0681", ""
 CSAI "AI19",N,N,"Main PID Feedback - P1015", ""
 CSAI "AI20",N,N,"Main PID Output - P1016", "%"
 CSAI "AI21",N,N,"External PID Feedback - P1062", ""
 CSAI "AI22",N,N,"External PID Output - P1063", "%"

CSBI "BI1",N,N,"Not Used","Off","On"
 CSBI "BI2",N,N,"Run Command","Off","On"
 CSBI "BI3",N,N,"Fire mode","Off","On"
 CSBI "BI4",N,N,"Bypass","Off","On"
 CSBI "BI5",N,N,"Quick Stop","Inactive","Active"
 CSBI "BI6",N,N,"2nd Ramp","Off","On"
 CSBI "BI7",N,N,"Config. Mode","Normal","Config"
 CSBI "BI8",N,N,"Alarm","No Alarm","Alarm"
 CSBI "BI9",N,N,"Running","Stopped","Running"
 CSBI "BI10",N,N,"Enabled","Disabled","Enabled"
 CSBI "BI11",N,N,"Forward","Reverse","Forward"
 CSBI "BI12",N,N,"JOG","Off","On"
 CSBI "BI13",N,N,"Remote","Local","Remote"
 CSBI "BI14",N,N,"Subvoltage","No","Subvoltage"
 CSBI "BI15",N,N,"Automatic(PID)","Manual","Auto"
 CSBI "BI16",N,N,"Fault","No Fault","Fault"
 CSBI "BI17",N,N,"DI1","Off","On"
 CSBI "BI18",N,N,"DI2","Off","On"
 CSBI "BI19",N,N,"DI3","Off","On"
 CSBI "BI20",N,N,"DI4","Off","On"
 CSBI "BI21",N,N,"DI5","Off","On"
 CSBI "BI22",N,N,"DI6","Off","On"
 CSBI "BI23",N,N,"DI7","Off","On"
 CSBI "BI24",N,N,"DI8","Off","On"

CSAO "AO1",Y,Y,"Acceleration Time - P0100","s"
 CSAO "AO2",Y,Y,"Deceleration Time - P0101","s"
 CSAO "AO3",Y,Y,"Serial/USB Speed Ref. - P0683",""
 CSAO "AO4",Y,Y,"AOx Value 1 - P0696",""
 CSAO "AO5",Y,Y,"AOx Value 2 - P0697",""
 CSAO "AO6",Y,Y,"SoftPLC Parameter 3 - P1012",""
 CSAO "AO7",Y,Y,"SoftPLC Parameter 4 - P1013",""
 CSAO "AO8",Y,Y,"SoftPLC Parameter 16 - P1025",""
 CSAO "AO9",Y,Y,"Main PID Aut. Setpoint - P1011",""
 CSAO "AO10",Y,Y,"Main PID Man. Setpoint - P1014","%"
 CSAO "AO11",Y,Y,"External PID Auto Setpoint - P1060",""
 CSAO "AO12",Y,Y,"External PID Man. Setpoint - P1061","%"

CSBO "BO1",Y,Y,"Ramp Enable","Stop","Run"
 CSBO "BO2",Y,Y,"General Enable","Disable","Enable"
 CSBO "BO3",Y,Y,"Run Forward","Reverse","Forward"
 CSBO "BO4",Y,Y,"JOG Enable","Off","On"
 CSBO "BO5",Y,Y,"Remote","Local","Remote"
 CSBO "BO6",Y,Y,"2nd Ramp","Off","On"
 CSBO "BO7",Y,Y,"Quick Stop","Off","On"
 CSBO "BO8",Y,Y,"Fault Reset","Off","Reset"
 CSBO "BO9",Y,Y,"Not Used","Off","On"
 CSBO "BO10",Y,Y,"Not Used","Off","On"
 CSBO "BO11",Y,Y,"Not Used","Off","On"
 CSBO "BO12",Y,Y,"Not Used","Off","On"
 CSBO "BO13",Y,Y,"Not Used","Off","On"
 CSBO "BO14",Y,Y,"Intern PID","Auto","Manual"
 CSBO "BO15",Y,Y,"Extern PID","Auto","Manual"
 CSBO "BO16",Y,Y,"Not Used","Off","On"
 CSBO "BO17",Y,Y,"DO1","Off","On"
 CSBO "BO18",Y,Y,"DO2","Off","On"

CSBO "BO19",Y,Y,"DO3","Off","On"
CSBO "BO20",Y,Y,"DO4","Off","On"
CSBO "BO21",Y,Y,"DO5","Off","On"

6 FAULTS AND ALARMS RELATED TO THE N2 COMMUNICATION

A128/F228 – TIMEOUT FOR SERIAL COMMUNICATION

Description:

It is the only alarm/fault related to the serial communication indicates that the equipment stopped receiving valid serial telegrams for a period longer than the one programmed in P0314.

Operation:

The parameter P0314 allows programming a period of time during which the equipment must receive at least one valid telegram via the RS485 serial interface – with address and error-checking field correct – otherwise, it will be considered that there was any problem in the serial communication. The time counting initiates after the reception of the first valid telegram. This function can be used by any serial protocol supported by the equipment.

After the serial communication timeout has been identified, the A128 alarm or F228 fault message will be showed on the HMI, depending on the P0313 programming. For alarms, if the communication is reestablished and new valid telegrams are received, the alarm indication will be removed from the HMI.

Possible Causes/Correction:

- Verify factors that could cause failures in the communication (cables, installation, and grounding).
- Make sure that the master sends telegrams to the equipment in intervals shorter than the programmed in P0314.
- Disable this function at P0314.



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