Profibus DP

CFW503

User's Guide

User’s Guide

CFW503

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The information below describes the reviews made in this manual.

Version	Revision	Description
-	R00	First edition.

CONTENTS

ABOUT THE MANUAL

This manual supplies the necessary information for the operation of the CFW503 frequency inverter using the Profibus DP protocol. This manual must be used together with the CFW503 user's manual and programming manual.

ABBREVIATIONS AND DEFINITIONS

DP Decentralized Periphery
EIA Electronic Industries Alliance
I/O Input/Output
ro Read only
rw Read/write
SAP Service Access Point

NUMERICAL REPRESENTATION

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

IMPORTANT NOTICE ABOUT CYBERSECURITY AND COMMUNICATIONS

This product/equipment can connect and exchange information through networks and communication protocols. It has been designed and subjected to tests to ensure correct operation with other automation systems using the protocols mentioned in this manual. Therefore, it is essential that the customer understands the responsibilities in connection with information and cybersecurity when using this equipment.

Consequently, it is the exclusive obligation of the customer to adopt in-depth defense strategies and implement policies and measures to ensure the security of the system as a whole, including with regard to communications sent and received by the equipment. Among such measures, we can point out the installation of firewalls, antivirus and malware protection applications, data encryption, authentication control and physical user access.

WEG and its affiliates take no liability for damages or losses arising from cybersecurity breaches, including, but not limited to, unauthorized access, intrusion, information, or data leak and/or theft, denial-of-service attacks, or any other form of security breach. Using this product under conditions for which it was not specifically designed is not recommended and may result in damage to the product, the network, and the automation system. Thus, it is essential that the customer understand that the external intervention by third-party software applications, such as sniffers or applications with similar actions, has the potential to cause interruptions or restrictions in the functionality of the equipment.

TRADEMARKS

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1 INTRODUCTION TO THE PROFIBUS DP PROTOCOL

A general overview of Profibus DP protocol, describing the main characteristics and functions, are presented next.

1.1 PROFIBUS DP NETWORK

The term Profibus is used to describe a digital communication system that can be used in several application areas. It is an open and standardized system, defined by the IEC 61158 and IEC 61784 standards, which comprises from the used physical medium to data profiles for certain sets of equipments. In this system, the DP communication protocol was developed with the purpose of allowing a fast, cyclic and deterministic communication between masters and slaves.

Among the several communication technologies that can be used in this system, the Profibus DP technology describes a solution that, typically, is composed by the DP protocol, RS485 transmission medium and application profiles, used mainly in applications and equipments with emphasis in manufacturing automation.

Nowadays, there is an organization named Profibus International, responsible for keeping, updating and publishing the Profibus technology among users and members. More information regarding the technology, as well as the complete protocol specification can be obtained with this organization or with one of the regional associations or competence centers associated to the Profibus International (http://www.profibus.com).

1.2 PROFIBUS DP PROTOCOL VERSIONS

The Profibus DP protocol defines a series of functions for exchanging data between master and slave. The set of functions can be divided in different functional levels, in the following versions:

- **DP-V0:** It is the first version of the protocol, which mainly defines functions to perform cyclic data exchange between master and slave.
- **DP-V1:** It is an extension of the functions defined in the first version; it defines particularly how to perform the exchange of acyclic data between master and slave, besides the cyclic data.
- **DP-V2:** It defines a set of advanced functions such as communication between slaves and isochronous communication mode.

The CFW503 frequency inverter supports the services of the DP-V0 and DP-V1 versions.

1.3 DEVICE TYPES IN A PROFIBUS DP NETWORK

Three different types of equipment are specified in a Profibus network:

- **Slaves:** They are passive stations in the network, which only answer to the requests made by the master.
- **Class 1 Master:** It is responsible for the cyclic data exchange. Typically represented by the PLC, or process or plant control software.
- **Class 2 Master:** It allows the communication in the Profibus DP network through acyclic messages. Typically represented by an engineering or configuration tool used for network commissioning or maintenance.

The CFW503 frequency inverter operates as a slave in the Profibus DP network.

1.4 PHYSICAL LAYER

There are different network transmission types to allow communication in a Profibus network, each one with suitable features according to the demands of different application types. The main transmission modes are:

- **RS485:** this is the most used transmission type for Profibus network. It provides high transmission rates, simple installation and low cost.
- **MBP:** this is specified mainly for applications in chemical and petrochemical industries, for communication in safety areas. The transmission rate is defined at 31.25 kbit/s with the possibility of feeding the devices from the communication bus.
- **Optical Fiber:** this is used mainly in applications where high electromagnetic interference immunity and/or great distances connections are required.

INTRODUCTION TO THE PROFIBUS DP PROTOCOL

The Profibus DP accessory of CFW503 frequency inverter provides an RS485 interface for network connection.

2 PROFIBUS DP COMMUNICATION INTERFACE

The following Profibus DP accessory is needed in order to enable the device communication in a Profibus DP network. Information about the installation of this module can be found in the guide that came with the accessory.

2.1 PLUG-IN MODULE

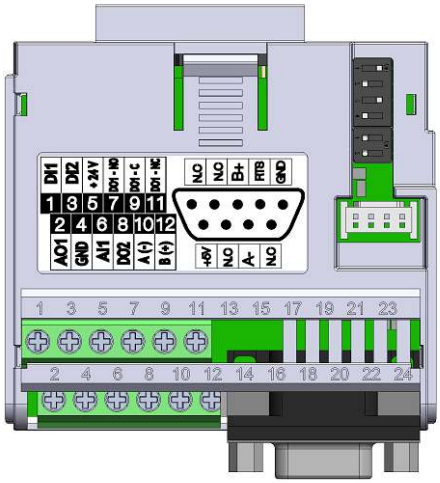


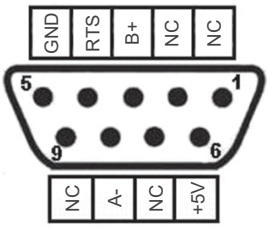
Figure 2.1: *CFW500-CPDP Accessory*

- WEG part number: 11769750.
- Composed by the Profibus DP-V1 communication module and an installation guide.
- It supports DP-V1 (acyclic messages).

2.2 CONNECTOR PINOUT

The Profibus DP-V1 communication module has two connectors to the Profibus network, each one with the following pinout:

Table 2.1: *Profibus female DB9 connector pinout (XC6)*

Connector	Pin	Name	Function
	1	NC	Not Connected
	2	NC	Not Connected
	3	B-Line (+)	RxD/TxD positive (red)
	4	RTS	Request To Send
	5	GND	0V isolated for the RS485 circuit
	6	+5V	+5V isolated for the RS485 circuit
	7	NC	Not Connected
	8	A-Line (-)	RxD/TxD negative (green)
	9	NC	Not Connected

NOTE!
The DB9 connector frame is connected to the CFW503 frequency inverter protective earth.

2.3 DIP SWITCHES

At each segment of the Profibus DP network, it is necessary to enable terminating resistors at both end points of the main bus. For this purpose, the Profibus DP communication module has two DIP switches that can be activated (both switches to the ON position) to enable the resistor. The DIP switches should not be activated if the network connector already has the terminating resistors.

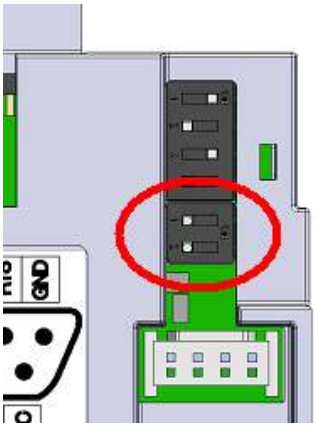


Figure 2.2: *Dip switches position to terminating resistor enable*

2.4 INDICATIONS

The alarms, faults and status indications are done through the device HMI and parameters of the CFW503 frequency inverter.

3 PROFIBUS DP NETWORK INSTALLATION

The Profibus DP network, such as several industrial communication networks, for being many times applied in aggressive environments with high exposure to electromagnetic interference, requires that certain precautions be taken in order to guarantee a low communication error rate during its operation. Recommendations to perform the product connection in this network are presented next.

3.1 BAUD RATE

The Profibus DP protocol defines several baud rates that can be used, from 9.6 kbit/s up to 12Mbit/s. The maximum allowed transmission line length depends on the used baud rate, and this correlation is showed on the Table 3.1 on page 3-1.

Table 3.1: *Supported baud rates and installation size*

Baud Rate	Cable Length
9.6 kbit/s	1200 m
19.2 kbit/s	1200 m
45.45 kbit/s	1200 m
93.75 kbit/s	1200 m
187.5 kbit/s	1000 m
500 kbit/s	400 m
1.5 Mbit/s	200 m
3.0 Mbit/s	100 m
6.0 Mbit/s	100 m
12.0 Mbit/s	100 m

All equipments in the network must use the same baud rate. The CFW503 frequency inverter Profibus DP interface has automatic baud rate detection, according to what has been configured for the network master, and therefore it is not necessary to configure this option.

It is possible to observe the baud rate detected by the board at the parameter P0963.

3.2 ADDRESS IN THE PROFIBUS DP NETWORK

Every device in a Profibus DP network, master or slave, is identified through a network address. This address must be different for each device. The CFW503 frequency inverter Profibus DP address is configured through the parameter P0918.

3.3 CABLE

It is recommended that the installation be carried out with a type A cable, whose characteristics are described in the Table 3.2 on page 3-1. The cable has a pair of wires that must be shielded and twisted, in order to guarantee higher immunity against electromagnetic interference.

Table 3.2: *Profibus DP cable characteristics*

Impedance	Capacitance	Resistance in Loop	Diameter of the Cable	Cross Section of the Wire
135 to 165 Ω	30 pf / m	110 Ω / km	> 0.64 mm	> 0.34 mm^2

3.4 CONNECTORS

Several connector types can be used for the network connection of the equipment, from simple screw connectors up to very specific connector types for the Profibus network. The connector used in the CFW503 frequency inverter Profibus DP accessory is presented at Section 2.2 CONNECTOR PINOUT on page 2-1.

3.5 CONNECTION IN THE NETWORK

The Profibus DP protocol, by using the RS-485 physical medium, allows the connection of up to 32 devices per segment without the use of repeaters. By using repeaters, up to 126 addressable equipments can be connected to the network. Each repeater must also be included as a device connected to the segment, even not occupying a network address.

It is recommended that the connection of all the devices present in the Profibus DP network be made coming from the main bus. Generally, the Profibus network connector itself has an input and an output for the cable, allowing the connection to be taken to the other network points. Derivations from the main bus are not recommended, especially for baud rates higher or equal to 1.5Mbits/s.

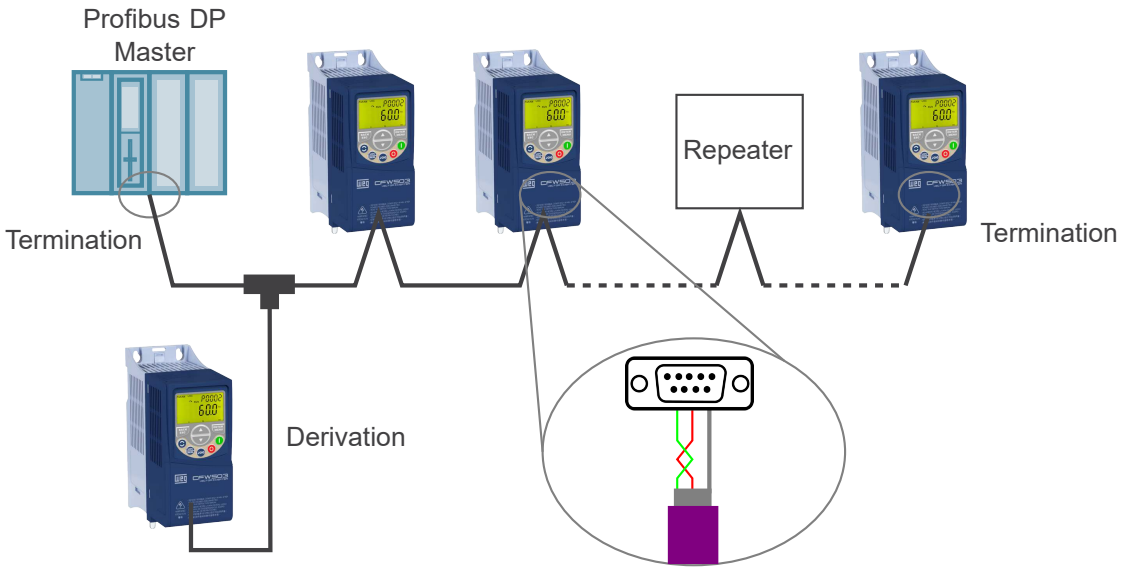


Figure 3.1: *Profibus DP network installation example*

The Profibus DP network cables must be laid separately (and far away if possible) from the power cables. All the drives must be properly grounded, preferably at the same ground point. The Profibus cable shield must also be grounded. The CFW503 Profibus board connector itself already has a connection with the protective ground and, therefore, makes the connection of the shield to the ground when the Profibus cable is connected to the drive. However a better connection, implemented by clamps that connect the shield to a ground point, is also recommended.

3.6 TERMINATION RESISTOR

At each segment of the Profibus DP network, it is necessary to enable a terminating resistor at the end points of the main bus. The use of specific Profibus network connectors with a switch to enable the resistor is recommended, which must only be enabled (ON position) if the equipment is the first or the last element of the segment. The DIP switches present in the communication module also can be used to enable the termination resistors.

It is important to emphasize that in order to be possible to disconnect the element from the network without impairing the bus, it becomes interesting the use of active terminations, which are elements that have only the termination function. Therefore, any drive of the network can be disconnected from the bus without impairing the termination.

3.7 GSD FILE

Each element of the Profibus DP network has an associated configuration file with the GSD extension. This file describes the characteristics of each equipment and it is used by the Profibus DP network master configuration tool. During the master configuration the GSD configuration file supplied with the equipment must be used.

4 PARAMETERS

Next, the frequency inverter CFW503 parameters related to the Profibus DP communication will be presented.

P0220 - LOC/REM Selection Src

Adjustable Range:	0 = Always LOC 1 = Always REM 2 = HMI Key LOC 3 = HMI Key REM 4 = DIx 5 = Serial/USB LOC 6 = Serial/USB REM 7 to 8 = Not Used 9 = CO/DN/PB/Eth LOC 10 = CO/DN/PB/Eth REM 11 = SoftPLC	**Factory Setting:**	2
Properties:	cfg		
Access Groups:	NET		

Description:

It defines the command source which will select between Local situation and Remote.

Table 4.1: *P0220 options*

Indication	Description
0 = Always LOC	Always in Local command mode.
1 = Always REM	Always in Remote command mode.
2 = HMI Key LOC	REM/LOC mode change via HMI key.
3 = HMI Key REM	REM/LOC mode change via HMI key.
4 = DIx	REM/LOC mode change via digital input command, as programmed in P0263 to P0270.
5 = Serial/USB LOC	REM/LOC mode change via serial control word - P0682.
6 = Serial/USB REM	REM/LOC mode change via serial control word - P0682.
7 ... 8 = Not Used	Reserved.
9 = CO/DN/PB/Eth LOC	REM/LOC mode change via CO/DN/PB/Eth control word - P0684.
10 = CO/DN/PB/Eth REM	REM/LOC mode change via CO/DN/PB/Eth control word - P0684.
11 = SoftPLC	Change via SoftPLC command.

P0221 - LOC Reference Sel.

P0222 - REM Reference Sel.

Adjustable Range:	0 = HMI Keys 1 = AI1 2 = AI2 3 = AI3 4 = FI 5 = AI1 + AI2 > 0 6 = AI1 + AI2 7 = E.P. 8 = Multispeed 9 = Serial/USB 10 = Not Used 11 = CO/DN/PB/Eth 12 = SoftPLC 13 = Not Used 14 = AI1 > 0 15 = AI2 > 0 16 = AI3 > 0 17 = FI > 0	**Factory Setting:**	0
Properties:	cfg		
Access Groups:	NET		

Description:

It defines the source of the frequency reference in the Local situation and Remote situation.

Table 4.2: *P0221 options*

Indication	Description
0 = HMI Keys	Reference via speed reference parameter HMI (P0121).
1 = AI1	Reference via analog input 1.
2 = AI2	Reference via analog input 2.
3 = AI3	Reference via analog input 3.
4 = FI	Reference via frequency input.
5 = AI1 + AI2 > 0	Combination of reference AI1 + AI2 when greater than 0.
6 = AI1 + AI2	Combination of reference AI1 + AI2.
7 = E.P.	Reference via electronic potentiometer.
8 = Multispeed	Configuration for predefined speeds.
9 = Serial/USB	Reference via serial - P0683.
10 = Not Used	Reserved.
11 = CO/DN/PB/Eth	Reference via CO/DN/PB/Eth - P0685.
12 = SoftPLC	Reference via SoftPLC.
13 = Not Used	Reserved.
14 = AI1 > 0	Condition for reference AI1 greater than 0.
15 = AI2 > 0	Condition for reference AI2 greater than 0.
16 = AI3 > 0	Condition for reference AI3 greater than 0.
17 = FI > 0	Condition for reference FI greater than 0.

P0223 - LOC Rotation Sel.

P0226 - REM Rotation Sel.

Adjustable Range:	0 = Clockwise 1 = Countclockwise 2 = HMI Key (FWD) 3 = HMI Key (REV) 4 = DIx 5 = Serial/USB (F) 6 = Serial/USB (R) 7 to 8 = Not Used 9 = CO/DN/PB/Et(F) 10 = CO/DN/PB/Et(R) 11 = Not Used 12 = SoftPLC	**Factory Setting:**	2
Properties:	cfg		
Access Groups:	NET		

Description:

It defines the source of the “Direction of Rotation” command in the Local and Remote situation.

Table 4.3: *P0223 options*

Indication	Description
0 = Clockwise	Direction of rotation in clockwise (H).
1 = Countclockwise	Direction of rotation in counterclockwise (AH).
2 = HMI Key (FWD)	Clockwise direction of rotation via HMI key.
3 = HMI Key (REV)	Counterclockwise direction of rotation via HMI key.
4 = DIx	Direction of rotation controlled by digital input, as programmed in P0263 to P0270.
5 = Serial/USB (F)	Clockwise direction of rotation via serial control word - P0682.
6 = Serial/USB (R)	Counterclockwise direction of rotation via serial control word - P0682.
7 ... 8 = Not Used	Reserved.
9 = CO/DN/PB/Et(F)	Clockwise direction of rotation via CO/DN/PB/Eth control word - P0684.
10 = CO/DN/PB/Et(R)	Counterclockwise direction of rotation via CO/DN/PB/Eth control word - P0684.
11 = Not Used	Reserved.
12 = SoftPLC	Direction of rotation controlled by SoftPLC.

P0224 - LOC Run/Stop Sel.

P0227 - REM Run/Stop Sel.

Adjustable Range:	0 = HMI Keys 1 = DIx 2 = Serial/USB 3 = Not Used 4 = CO/DN/PB/Eth 5 = SoftPLC	**Factory Setting:**	0
Properties:	cfg		
Access Groups:	NET		

Description:

It defines the source of the “Run/Stop” command in the Local and Remote situation. This command corresponds to the functions implemented in any of the command sources able to enable the motor movement, that is, General Enable, Ramp Enable, Forward Run, Reverse Run, Start, etc.

Table 4.4: P0224 options

Indication	Description
0 = HMI Keys	Reference via HMI key.
1 = DIx	Reference controlled by digital input, as programmed in P0263 to P0270.
2 = Serial/USB	Reference via serial control word - P0682
3 = Not Used	Reserved.
4 = CO/DN/PB/Eth	Reference via CO/DN/PB/Eth control word - P0684.
5 = SoftPLC	Reference controlled by SoftPLC.

P0225 - LOC JOG Selection

P0228 - REM JOG Selection

Adjustable Range:	0 = Disable 1 = HMI Keys 2 = DIx 3 = Serial/USB 4 = Not Used 5 = CO/DN/PB/Eth 6 = SoftPLC	**Factory Setting:**	1
Properties:	cfg		
Access Groups:	NET		

Description:

It defines the source of the JOG function in the Local and Remote situation. The JOG function means a Run/Stop command added to the reference defined by P0122. See the programming manual.

Table 4.5: P0225 options

Indication	Description
0 = Disable	Disabled.
1 = HMI Keys	Control via HMI key.
2 = DIx	Control via digital input, as programmed in P0263 to P0270.
3 = Serial/USB	Control via serial control word - P0682.
4 = Not Used	Reserved.
5 = CO/DN/PB/Eth	Control via CO/DN/PB/Eth control word - P0684.
6 = SoftPLC	Control via SoftPLC.

P0313 - Comm. Error Action

Adjustable Range:	0 = Inactive 1 = Ramp Stop 2 = General Disab. 3 = Go to LOC 4 = LOC Keep Enab. 5 = Cause Fault	**Factory Setting:**	1
Properties:			
Access Groups:	NET		

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.

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 are 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.

Table 4.6: *P0313 options*

Indication	Description
0 = Inactive	No action is taken and the drive remains in the existing status.
1 = Ramp Stop	A stop command with deceleration ramp is executed and the motor stops according to the programmed deceleration ramp.
2 = General Disab.	The drive is disabled by removing the General Enabling and the motor coasts to stop.
3 = Go to LOC	The drive commands change to Local.
4 = LOC Keep Enab.	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 = Cause Fault	Instead of an alarm, the communication error causes a drive fault, so that a drive fault reset becomes necessary in order to restore normal operation.

P0680 - Logical Status

Adjustable Range:	0 to FFFF (hexa) Bit 0 = STO Bit 1 = Run Command Bit 2 = Fire Mode Bit 3 = Reserved Bit 4 = Quick Stop Bit 5 = 2nd Ramp Bit 6 = Config. Mode Bit 7 = Alarm Bit 8 = Running Bit 9 = Enabled Bit 10 = Forward Bit 11 = JOG Bit 12 = Remote Bit 13 = Undervoltage Bit 14 = Automatic PID Bit 15 = Fault	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

The inverter status word is unique for all the sources and can only be accessed for reading. It indicates all the relevant operating status and modes of the inverter. The value of P0680 is indicated in hexadecimal. The function of each bit of P0680 is described in Table 4.7 on page 4-6.

Table 4.7: P0680 bits function

Bit	Value/Description
Bit 0 Reserved	Reserved.
Bit 1 Run Command	**0:** there was no Run command **1:** there was Run command
Bit 2 Fire Mode	**0:** fire Mode function inactive **1:** fire Mode function active
Bit 3 Reserved	Reserved.
Bit 4 Quick Stop	**0:** quick stop inactive **1:** quick stop active
Bit 5 2nd Ramp	**0:** 1st acceleration and deceleration ramp by P0100 and P0101 **1:** 2nd acceleration and deceleration ramp by P0102 and P0103
Bit 6 Config. Mode	**0:** inverter operating in normal conditions **1:** inverter in configuration state. It indicates a special condition in which the inverter cannot be enabled, because it has parameterization incompatibility
Bit 7 Alarm	**0:** inverter is not in alarm state **1:** inverter is in alarm state
Bit 8 Running	**0:** motor is stopped **1:** motor is running according to reference and command
Bit 9 Enabled	**0:** inverter is disabled **1:** inverter is enabled and ready to run the motor
Bit 10 Forward	**0:** motor is running in the reverse direction **1:** motor is running in the forward direction
Bit 11 JOG	**0:** JOG function inactive **1:** JOG function active
Bit 12 Remote	**0:** inverter in Local mode **1:** inverter in Remote mode
Bit 13 Undervoltage	**0:** no undervoltage **1:** with undervoltage
Bit 14 Automatic PID	**0:** in manual mode (PID function) **1:** in automatic mode (PID function)
Bit 15 Fault	**0:** inverter is not in fault state **1:** some fault registered by the inverter

P0681 - Speed at 13 bits

Adjustable Range:	-32768 to 32767	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

It defines the 13-bit speed reference. The 13-bit Frequency Reference is a scale based on the motor rated speed (P0402) or on the motor rated frequency (P0403). In the inverter, parameter P0403 is taken as the base to determine the frequency reference.

Thus, the 13-bit frequency value has a range of 16 bits with signal, that is, -32768 to 32767; however, the rated frequency in P0403 is equivalent to the value 8192. Therefore, the maximum value in the range 32767 is equivalent to four times P0403:

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

Intermediate or higher frequency values can be obtained by using this scale. E.g., for a 60Hz rated frequency motor, if the value read is 2048 (0800h), then, to obtain the value in Hz one must calculate:

8192 => 60 Hz
2048 => Frequency

$$\text{Frequency} = \frac{2048 \times 60}{8192}$$

Frequency = 15 Hz

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

NOTE!
The values transmitted over the network have a scale limitation, allowing a maximum of 4 times the rated frequency of the motor, with saturation in 32767 (or -32768).

P0684 - CO/DN/PB/Eth Control

Adjustable Range:	0 to FFFF (hexa) Bit 0 = Run/Stop Bit 1 = General Enable Bit 2 = Run Forward Bit 3 = JOG Enable Bit 4 = Remote Bit 5 = 2nd Ramp Bit 6 = Quick Stop Bit 7 = Fault Reset Bit 8 to 15 = Reserved	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

The inverter control word has read and write access only via network interface, but read only access is permitted for the other sources (keypad, SoftPLC). Each bit function is described as per Table 4.8 on page 4-8. The value of P0684 is indicated in hexadecimal.

Table 4.8: P0684 bits function

Bit	Value/Description
Bit 0 Run/Stop	**0**: stops the motor by deceleration ramp **1**: run the motor according to the acceleration ramp until reaching the speed reference value
Bit 1 General Enable	**0**: disables the inverter, interrupting the power supply to the motor **1**: enables the inverter, allowing the operation of the motor
Bit 2 Run Forward	**0**: run the motor in the opposite direction of the reference signal (reverse) **1**: run the motor in the direction of the reference signal (forward)
Bit 3 JOG Enable	**0**: disable JOG function **1**: enable JOG function
Bit 4 Remote	**0**: inverter goes into Local mode **1**: inverter goes into Remote mode
Bit 5 2nd Ramp	**0**: acceleration and deceleration ramp by P0100 and P0101 **1**: acceleration and deceleration ramp by P0102 and P0103
Bit 6 Quick Stop	**0:** disable quick stop **1:** enable quick stop
Bit 7 Fault Reset	**0**: no function **1**: if in fault state, reset the fault
Bit 8 … 15 Reserved	Reserved.

P0685 - CO/DN/PB/Eth SpeedRef

Adjustable Range:	-32768 to 32767	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

It allows programming the motor speed reference via communication interfaces only. For other sources (HMI, etc.), it behaves as a read-only parameter.

To enable the use of the reference written in this parameter, the product must be programmed to use the speed reference via communication network. This is programming is done using parameters P0221 and P0222.

This word uses a 13-bit resolution with signal to represent the motor rated frequency (P0403):

- P0683 = 0000h (0 decimal) → speed reference = 0.
  P0683 = 2000h (8192 decimal) → speed reference = rated frequency (P0403).
- P0685 = 0000h (0 decimal) → speed reference = 0.
  P0685 = 2000h (8192 decimal) → speed reference = rated frequency (P0403).

Intermediate or higher reference values can be programmed by using this scale. E.g. 60Hz rated frequency, to obtain a speed reference of 30 Hz one must calculate:

60 Hz => 8192
30 Hz => 13 bits reference

$$13 \text{ bits reference} = \frac{30 \times 8192}{60}$$

13 bits reference = 4096 => Value corresponding to 30 Hz 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 - P0684 bit 2 setting:

- Bit 2 = 1 and P0685 > 0: reference for forward direction

- Bit 2 = 1 and P0685 < 0: reference for reverse direction
- Bit 2 = 0 and P0685 > 0: reference for reverse direction
- Bit 2 = 0 and P0685 < 0: reference for forward direction

NOTE!
The values transmitted over the network have a scale limitation, allowing a maximum of 4 times the rated frequency of the motor, with saturation in 32767 (or -32768).

P0695 - DOx Value

Adjustable Range:	0 to 1F (hexa) Bit 0 = DO1 Bit 1 = DO2 Bit 2 = DO3 Bit 3 = DO4 Bit 4 = DO5	**Factory Setting:**	0
Properties:			
Access Groups:	NET		

Description:

It provides access for monitoring and controlling the inverter by using the communication interfaces. Each bit represents the value for a digital output. The value written in this parameter is used as the digital output value, providing that the function for the desired digital output be programmed for “P0695 value” at parameters P0275 to P0279.

Table 4.9: *P0695 bits function*

Bit	Value/Description
Bit 0 DO1	**0**: DO1 output open. **1**: DO1 output closed.
Bit 1 DO2	**0**: DO2 output open. **1**: DO2 output closed.
Bit 2 DO3	**0**: DO3 output open. **1**: DO3 output closed.
Bit 3 DO4	**0**: DO4 output open. **1**: DO4 output closed.
Bit 4 DO5	**0**: DO5 output open. **1**: DO5 output closed.

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

P0696 - AOx Value 1

P0697 - AOx Value 2

P0698 - AOx Value 3

Adjustable Range:	-32768 to 32767	**Factory Setting:**	0
Properties:			
Access Groups:	NET		

Description:

It provides access for monitoring and controlling the inverter by using the communication interfaces.

They allow the control of the analog outputs by means of network interfaces (Serial, CAN, etc.). 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.

The value must be written in a 15-bit scale (7FFFh = 32767) 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 %

The showed example was for P0696, but the same scale is also used for the parameters P0697 and 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.

NOTE!
For CFW503 frequency inverter, the analog output 3 represents the frequency output (FO).

P0740 - Profibus Comm. Status

Adjustable Range:	0 = Disabled 1 = Access Error 2 = Offline 3 = Config. Error 4 = Param. Error 5 = Clear Mode 6 = Online	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

It allows identifying if the Profibus DP interface board is properly installed, besides indicating the status of the communication with the network master.

Table 4.10: P0740 options

Indication	Description
0 = Disabled	The Profibus interface is not installed.
1 = Access Error	A problem was identified during the Profibus interface initialization.
2 = Offline	The Profibus interface is installed and properly configured, but no cyclic communication is established.
3 = Config. Error	Data received in the I/O configuration telegram are not in accordance with the configurations done through the parameter P0922.
4 = Param. Error	Data received in the parameterization telegram does not have valid format/values.
5 = Clear Mode	During data exchange with the master, the slave received a command to enter the clear mode.
6 = Online	I/O data exchange between the slave and Profibus network master is successfully running.

P0741 - Profibus Data Profile

Adjustable Range:	0 = PROFIdrive 1 = Manufacturer	**Factory Setting:**	1
Properties:			
Access Groups:	NET		

Description:

It configures the Profibus data profile.

Table 4.11: P0741 options

Indication	Description
0 = PROFIdrive	The control, status, speed reference and motor speed words have values and functions according to what is described by the PROFIdrive specification. The description of each word is done in the following parameters: ■ P0967: Control Word 1. ■ P0968: Status Word 1. The speed reference and motor speed words for this profile are described next.
1 = Manufacturer	The control, status, speed reference and motor speed words have values and functions specific for CFW503 frequency inverter. The description of each word is done in the following parameters: ■ P0680: Logical Status. ■ P0681: Speed at 13 bits. ■ P0684: CO/DN/PB/Eth Control. ■ P0685: CO/DN/PB/Eth SpeedRef.

P0742 - Profibus Read Word #3

P0743 - Profibus Read Word #4

P0744 - Profibus Read Word #5

P0745 - Profibus Read Word #6

P0746 - Profibus Read Word #7

P0747 - Profibus Read Word #8

Adjustable Range:	0 to 1199	**Factory Setting:**	0
Properties:			
Access Groups:	NET		

Description:

It allows programming the content of the input words 3 a 8 (input: drive sends to the master). By using these parameters it is possible to program the number of another parameter whose content must be made available at the network master input area.

If, for instance, one wants to read from the CFW503 frequency inverter the motor current in Amps, one must program the value 3 in one of these parameters, because the parameter P0003 is the one that contains this information. It is worthwhile to remind that the value read from any parameter is represented with a 16 bit word. Even if the parameter has decimal resolution, the value is transmitted without the indication of the decimal places. E.g., if the parameter P0003 has the value 4.7A, the value supplied via the network will be 47.

These parameters are used only if the equipment is programmed at the parameter P0922 to use the options 2 a 8 (configuration telegrams 103 a 108). Up to 8 words to be read by the network master can be made available, according to the selected option.

The first two input words are fixed and represent the status and the motor speed.

NOTE!
The value 0 (zero) disables the reading in the word. The number of input words, however, keeps the same as programmed at P0922.

P0750 - Profibus Write Word#3

P0751 - Profibus Write Word#4

P0752 - Profibus Write Word#5

P0753 - Profibus Write Word#6

P0754 - Profibus Write Word#7

P0755 - Profibus Write Word#8

Adjustable Range:	0 to 1199	**Factory Setting:**	0
Properties:			
Access Groups:	NET		

Description:

It allows programming the content of the output words 3 a 8 (output: master sends to the drive). Using these parameters, it is possible to program the number of another parameter whose content must be made available at the network master output area.

If, for instance, one wants to write the acceleration ramp value in the CFW503 frequency inverter, one must program the value 100 in one of these parameters, because the parameter P0100 is the one where this information is programmed. It is worthwhile to remind that the value written in any parameter is represented with a 16 bit word. Even if the parameter has decimal resolution, the value is transmitted without the indication

of the decimal places. E.g., if one wishes to program with the value 5.0s, the value programmed via the network must be 50.

These parameters are used only if the equipment is programmed at the parameter P0922 to use the options 2 a 8 (configuration telegrams 103 a 108). Up to 8 words to be written by the network master can be made available, according to the selected option.

The first two output words are fixed and represent the control and the speed reference.

NOTE!
- The value 0 (zero) disables the writing in the word. The number of input words, however, keeps the same as programmed at P0922.
- The written parameters using these words are not saved in non-volatile memory. Thus, if the equipment is turned off and on again, these parameters will return to their original value.

P0918 - Profibus Address

Adjustable Range:	1 to 126	**Factory Setting:**	1
Properties:			
Access Groups:	NET		

Description:

It allows programming the slave address in the Profibus DP network. It is necessary that each of the equipments in the network has an address different from the others.

NOTE!
If this parameter is changed, the slave will assume the new configuration only when there is no cyclic communication with the master.

P0922 - Profibus Teleg. Sel.

Adjustable Range:	2 = Std. Teleg. 1 3 = Telegram 103 4 = Telegram 104 5 = Telegram 105 6 = Telegram 106 7 = Telegram 107 8 = Telegram 108	**Factory Setting:**	2
Properties:			
Access Groups:	NET		

Description:

It allows selecting which configuration telegram is used by the drive during the Profibus DP network initialization. This telegram defines the format and quantity of input/output data exchanged with the network master.

Table 4.12: P0922 options

Indication	Description
2 = Std. Teleg. 1	Allows you to program 2 I/O words.
3 = Telegram 103	Allows you to program 3 I/O words.
4 = Telegram 104	Allows you to program 4 I/O words.
5 = Telegram 105	Allows you to program 5 I/O words.
6 = Telegram 106	Allows you to program 6 I/O words.
7 = Telegram 107	Allows you to program 7 I/O words.
8 = Telegram 108	Allows you to program 8 I/O words.

P0963 - Profibus Baud Rate

Adjustable Range:	0 = 9.6 kbit/s 1 = 19.2 kbit/s 2 = 93.75 kbit/s 3 = 187.5 kbit/s 4 = 500 kbit/s 5 = Not Detected 6 = 1500 kbit/s 7 = 3000 kbit/s 8 = 6000 kbit/s 9 = 12000 kbit/s 10 = Reserved 11 = 45.45 kbit/s	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

It is a Profibus DP communication specific parameter, defined by the PROFIdrive standard, to indicate the baud rate detected by the Profibus DP interface.

Table 4.13: P0963 options

Indication	Description
0 = 9.6 kbit/s	9600 bit per second.
1 = 19.2 kbit/s	19200 bit per second.
2 = 93.75 kbit/s	93750 bit per second.
3 = 187.5 kbit/s	187500 bit per second.
4 = 500 kbit/s	500000 bit per second.
5 = Not Detected	Not detected.
6 = 1500 kbit/s	1500000 bit per second.
7 = 3000 kbit/s	3000000 bit per second.
8 = 6000 kbit/s	6000000 bit per second.
9 = 12000 kbit/s	12000000 bit per second.
10 = Reserved	Reserved.
11 = 45.45 kbit/s	45450 bit per second.

P0967 - Control Word 1

Adjustable Range:	0 to FFFF (hexa) Bit 0 = ON Bit 1 = No Coast Stop Bit 2 = No Quick Stop Bit 3 = Enable Operation Bit 4 = Enable Ramp Generator Bit 5 = Reserved Bit 6 = Enable Setpoint Bit 7 = Fault Acknowledge Bit 8 = JOG 1 ON Bit 9 = Reserved Bit 10 = Control By PLC Bit 11 to 15 = Reserved	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

It is a Profibus DP communication specific parameter, defined by the PROFIdrive standard, with the inverter control word via the Profibus DP interface when the PROFIdrive data profile is selected at P0741. This parameter can only be changed via Profibus DP interface. For the other sources (HMI, CAN, etc.) it behaves like a read-only parameter.

In order that the commands written in this parameter be executed, it is necessary to program the drive to be commanded via CO/DN/PB/Eth. This programming is done by means of parameters P0220 to P0228.

The specific functions in this word follow the defined by the PROFIdrive specification. Each bit of this word corresponds to a command that can be executed by the drive.

Table 4.14: *P0967 bits function*

Bit	Value/Description
Bit 0 ON	**0:** OFF -> If enabled, it stops and disables the drive. **1:** ON -> It allows the inverter enabling.
Bit 1 No Coast Stop	**0:** Coast Stop -> It disables the drive. **1:** No Coast Stop -> It allows the drive enabling.
Bit 2 No Quick Stop	**0:** If enabled, it executes the Quick Stop command and disables the drive. **1:** It allows the inverter drive. Note: When the control type (P0202) is V/f or VVW, the use of this function is not recommended.
Bit 3 Enable Operation	**0:** It disables the drive. **1:** It enables the drive.
Bit 4 Enable Ramp Generator	**0:** It disables the drive via deceleration ramp. **1:** It enables the speed ramp for the drive.
Bit 5 Reserved	Reserved.
Bit 6 Enable Setpoint	**0:** It resets the speed reference. **1:** It uses the speed reference received via the Profibus DP network.
Bit 7 Fault Acknowledge	**0:** No function. **1:** If in a fault condition, it executes the fault reset.
Bit 8 JOG 1 ON	**0:** It disables the JOG function. **1:** It enables the JOG function.
Bit 9 Reserved	Reserved.
Bit 10 Control By PLC	**0:** The drive goes to the LOC mode. **1:** The inverter goes to the REM mode. Note: The local and remote command sources depend on the options programmed at the parameters P0220 to P0228.
Bit 11 … 15 Reserved	Reserved.

P0968 - Status Word 1

Adjustable Range:	0 to FFFF (hexa) Bit 0 = Ready To Swtich On Bit 1 = Ready To Operate Bit 2 = Operation Enabled Bit 3 = Fault Present Bit 4 = Coast Stop Not Active Bit 5 = Quick Stop Not Active Bit 6 = Switching On Inhibited Bit 7 = Warning Present Bit 8 = Reserved Bit 9 = Control Requested Bit 10 to 15 = Reserved	**Factory Setting:**	-
Properties:	ro		
Access Groups:	NET		

Description:

It is a Profibus DP communication specific parameter, defined by the PROFIdrive standard, with the drive status word via the Profibus DP interface when the PROFIdrive data profile is selected at P0741.

The specific functions in this word follow the defined by the PROFIdrive specification. Each bit of this word corresponds to one state.

Table 4.15: *P0968 bits function*

Bit	Value/Description
Bit 0 Ready To Swtich On	**0:** The drive cannot be enabled. **1:** Commands received from the master allow enabling the drive.
Bit 1 Ready To Operate	**0:** No commands received from the master to operate the equipment. **1:** Commands received from the master allow enabling the drive.
Bit 2 Operation Enabled	**0:** The drive is disabled. **1:** Drive enabled, and able to receive the command to release the ramp.
Bit 3 Fault Present	**0:** The drive is not in a fault condition. **1:** The drive is in a fault condition.
Bit 4 Coast Stop Not Active	**0:** The drive is disabled. **1:** The drive is enabled.
Bit 5 Quick Stop Not Active	**0:** The drive is with a Quick Stop command active. **1:** Quick Stop command is not active at the drive.
Bit 6 Switching On Inhibited	**0:** The drive enabling is allowed. **1:** The drive operation is blocked, indicating a special condition that prevents the equipment operation.
Bit 7 Warning Present	**0:** No alarm. **1:** The drive has an active alarm.
Bit 8 Reserved	Reserved.
Bit 9 Control Requested	**0:** The drive is operating in local mode. **1:** The drive is operating in local mode.
Bit 10 … 15 Reserved	Reserved.

5 PROFIBUS DP NETWORK OPERATION

The CFW503 frequency inverter with Profibus DP communication accessory operates as a slave in the network and supports the network services of DP-V0 and DP-V1 communication protocols. Information about the inverter operation using the services specified on these versions is presented bellow.

5.1 PROFIBUS DP-V0

5.1.1 Cyclic Data

The communication via cyclic data allows the data transfer in two directions:

- Input data: Data transmitted from the slave to the master, for monitoring the status and the variables of each slave.
- Output data: Data transmitted from the master to the slave, for control and transmission of operation data to the equipment.

These data are transmitted in regular time periods, defined by the baud rate, number of slaves in the network and the amount of data exchanged with each slave.

The number of input/output (I/O) words available for the CFW503 frequency inverter depends on the format of the configuration telegram, programmed through the parameter P0922. It is possible to exchange from 2 to 8 words (16 bits each), depending on the selected option. The contents of these words depend on the setting of the parameters P0742 to P0755.

Table 5.1: *Selection of the I/O words*

	Input (slave -> master)	Word	Output (master -> slave)	
Fixed	Status Word	#1	Control Word	2I/O
Fixed	Motor Speed	#2	Speed Reference	
Programable	Reading Profibus #3	#3	Writing Profibus #3	3I/O
Programable	Reading Profibus #4	#4	Writing Profibus #4	4I/O
Programable	Reading Profibus #5	#5	Writing Profibus #5	
Programable	Reading Profibus #6	#6	Writing Profibus #6	
Programable	Reading Profibus #7	#7	Writing Profibus #7	
Programable	Reading Profibus #8	#8	Writing Profibus #8	8I/O

NOTE!

- The format of the control, status, speed reference and motor speed words depends on the parameter P0741 programming.
- If this parameter is changed, the slave will assume the new configuration only when there is no cyclic communication with the master.

The same programming done at the parameter P0922 must also be configured at the network master, using a master configuration tool and the CFW503 GSD file, selecting one of the available modules described in the GSD file.

5.1.2 SYNC/FREEZE

The CFW503 frequency inverter supports the SYNC/UNSYNC and FREEZE/UNFREEZE commands. These are global commands that the master can send to all the network slaves, allowing simultaneous update of I/O data in the network equipments.

The SYNC/UNSYNC commands act on the master output data. When receiving a SYNC command, the command and speed reference values received by each slave are frozen. Values received later by the slave are stored, but will only be updated after the reception of a new SYNC command, or after the UNSYNC command, which cancels this function.

The FREEZE/UNFREEZE commands act in a similar form as the SYNC, but their action is associated to the master input data. When receiving a FREEZE command, variable and status values of each slave are frozen.

These values remain fixed until a new FREEZE command be received, or after the UNFREEZE command, which cancels this function.

5.2 PROFIBUS DP-V1

In addition to the services defined by the first version of the Profibus DP specification (DP-V0), where it is mainly defined how to perform the exchange of cyclic data for equipment control and monitoring, the CFW503 frequency inverter with the Profibus DP communication accessory also supports the DP-V1 additional services for acyclic communication. Using these services, it id possible to read/write drive parameters using DP-V1 acyclic function, both by the network master (class 1 master) and by a commissioning tool (class 2 master).

5.2.1 Available Services for Acyclic Communication

The device supports the following services for acyclic communication in the Profibus DP network:

- Communication between class 1 master and slave (MS1):
  - Data acyclic reading (DS_Read).
  - Data acyclic writing (DS_Write).
- Communication between class 2 master and slave (MS2):
  - Initiates the connection (Initiate).
  - Data acyclic reading (DS_Read).
  - Data acyclic writing (DS_Write).
  - Aborts the connection (Abort).

DP-V1 requests use an SD2 type Profibus DP telegram – with variable data length. This type of telegram has the following fields:

Telegram Header									Data Unit	Telegram End	
SD	LE	LEr	SD	DA	SA	FC	DSAP	SSAP	DU	FCS	ED
68h	xx	xx	68h	xx	xx	xx	xx	xx	xx ...	xx	16h

SD	Telegram start delimiter (Start Delimiter)
LE	Telegram length, from the DA field to the DU (Length)
LEr	Telegram length repetition (Length repeat)
DA	Destination Address
SA	Source Address
FC	Function Code
DSAP	Destination Service Access Point
SSAP	Source Service Access Point
DU	Data unit, size 1 to 244 (Data Unit for DP services)
FCS	Telegram checking byte (Frame Checking Sequence)
ED	Telegram end delimiter (End Delimiter)

In this telegram it matters to describe the data structure in the DU field, where the form to access the drive parameters is defined. The other fields follow the defined by the Profibus specification and, normally, are controlled by the network master.

5.2.2 Data Addressing

In the functions for reading and writing via acyclic data, these data are addressed with a numbering indicating which slot and index are being accessed. The slots can be used to address different physical segments of an equipment (a modular equipment for instance) or even logical segments inside a single equipment. The index indicates which data inside the segment is being accessed.

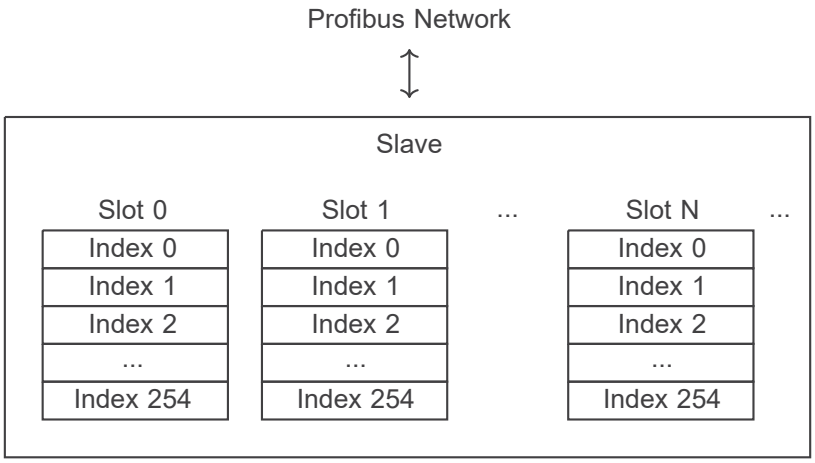


Figure 5.1: *Acyclic Data Addressing*

5.2.3 Reading/Writing DP-V1 Telegrams

In the Profibus DP protocol, the writing (DS_Write) and reading (DS_Read) DP-V1 telegrams used to access the parameters have the following structure:

Writing Telegram (DS_Write):

Request (master->slave)	**Header**	**Data Unit (DU)**					**End**
		Function 5Fh	Slot 0	Index 47	Size n	Request Data (n bytes)	
Positive Response (slave->master)	**Header**	**Data Unit (DU)**					**End**
		Function 5Fh	Slot 0	Index 47	Size 0		
Negative Response (slave -> master)	**Header**	**Data Unit (DU)**					**End**
		Function DFh	Error Decode 128	Error Code 1 xx	Error Code 2 xx		

Reading Telegram (DS_Read):

Positive Response (slave->master)	**Header**	**Data Unit (DU)**					**End**
		Function 5Eh	Slot 0	Index 47	Size 240		
Request (master->slave)	**Header**	**Data Unit (DU)**					**End**
		Function 5Eh	Slot 0	Index 47	Size n	Request Data (n bytes)	
Negative Response (slave -> master)	**Header**	**Data Unit (DU)**					**End**
		Function DEh	Error Decode 128	Error Code 1 xx	Error Code 2 xx		

Each telegram field can assume the following values:

Function	5Fh – Writing request, positive response for writing 5Eh – Reading request, positive response for reading DFh – Negative response for writing DEh – Negative response for reading
Slot	0 (It is the standard slot for accessing the drive parameters, according to PROFIdrive)
Index	47 (It is the standard index for accessing the drive parameters, according to PROFIdrive)
Size	Number of bytes for reading and writing. Writing request: 'n' bytes, according to the number of bytes in the request telegram. Positive response for writing: 0 bytes Reading request: 240 bytes (It requests the maximum number of reading bytes, because the size of the slave response is variable). Positive response for reading: 'n' bytes, according to the number of bytes in the response telegram.
Error Decode	128
Error Code 1	Error code, according to the problem found in the request: B0h: access error – invalid slot B2h: access error – invalid index B5h: access error – modification not allowed for the parameter B6h: access error – modification in read-only parameter B7h: access error – incorrect values for parameter access B8h: access error – invalid parameter number C3h: Resource error – Response not available for the reading request
Error Code 2	0
Request Data	Variable size field of the writing request (DS_Write), which contains the data for accessing the drive parameters.
Response Data	Variable size field of the reading response (DS_Read), which contains the result of the access to the drive parameters.

5.2.4 Data Structure for Parameter Access – WEG

Besides the structure for the access to the parameters according to the PROFIdrive specification, it is also possible to use a simplified structure for the access to the parameters through the following addressing:

- Slot 0.
- Index 48.

With the telegrams described in the Section 5.2.3 Reading/Writing DP-V1 Telegrams on page 5-3, it is possible to get access to the parameters using the following mechanism:

- Parameter modification: the modification of parameters is performed with a writing telegram (DS_Write), with 4 data bytes, were the two first represent the parameter number and the two last represent the parameter content, always with the most significant byte transmitted first. The response to the writing telegram indicates whether or not the modification was successful.
- Parameter reading: for the reading of parameters, first a writing telegram (DS_Write) with 2 data bytes representing the parameter number must be sent. After this telegram has been successfully sent, a reading telegram (DS_Read) must be sent, and the response will have 2 data bytes with the parameter content.

The reading telegrams as well as the writing telegrams are able to report errors in the parameter requests, according to the codes described for the Error Code 1 field.

The fields with the request and response data contain the structure where the parameters accessed at the drive are defined. In this access the request and response data have the following structure:

Table 5.2: *Request data structure*

Request data header	Request Reference	Request ID	
	DO-ID	Nr. of Parameters (n)	
Parameter address	Attribute	Nr. of Elements	Repeated 'n' times, according to the number of accessed parameters.
	Parameter Number		
	Sub-index		
	⋮		
Parameter value (only for parameter modification requests)	Format	Number of Values	Repeated 'n' times, according to the number of parameters in the header.
	Value 1		
	Value 2...		
	⋮		

Request Reference	A number between 1 and 255 that will be retransmitted in the response telegram.
Request ID	It represents the type of request made to the slave: 1 = Parameter reading 2 = Parameter modification
DO-ID	0
Nr. of Parameters	The number of parameters accessed in the request.
Attribute	10h (request of the parameter value)
Nr. of Elements	For parameters of the array type, it represents the number of elements accessed in the parameter. For the CFW503 only a few parameters specified by the PROFIdrive specification have this format, the other parameters are always formed by a single value, and therefore this field must be set in 0 or 1.
Parameter Number	The number of a drive valid parameter (the most significant byte is transmitted first).
Sub-index	For parameters of the array type, it represents the array element starting from which the access will be made (the most significant byte is transmitted first). For parameters formed by a single item, this field must be set in 0.
Format	It defines the format for the writing parameter. For the CFW503 parameters the value 42h (16 bit word) must be used.
Number of Values	The number of values to be written (defined in the number of elements).
Value	Value to write in the parameter (the most significant byte is transmitted first).

Table 5.3: *Response data structure*

Response data header	Request Reference mirror	Response ID	
	DO-ID mirror	Nr. of Parameters (n)	
Parameter value (only for parameter reading responses, or incase of error)	Format	Number of Values	Repeated 'n' times, according to the number of accessed parameters.
	Value 1 or error code		
	Value 2 or error code...		
	⋮		

Request Reference mirror	A mirror of the value received in the request telegram.
Response ID	It represents the type of response sent by the slave: 1 = Successful parameter reading 2 = Successful parameter modification 129 = Parameter reading with error 130 = Parameter modification with error
DO-Id Mirror	Mirror of the value received in the request telegram.
Nr. of Parameters (n)	The number of parameters accessed in the request.
Format	It defines the format of the accessed parameter: 42h = 16 bit word 44h = Parameter access error
Number of values	The number of values read from the parameter, or the number of error codes from the parameter access.
Value	Value read from the parameter (the most significant byte is transmitted first).
Error code	In case of parameter illegal access (error in reading or writing of any of the parameters), the code of the type of found error will be indicated: 0000h = parameter does not exist 0001h = modification of read-only parameter 0002h = parameter value out of the limits 0003h = indicated sub-index does not exist 0004h = parameter not of the array type 0005h = incorrect format for the parameter 0009h = description not available (only value) 000Fh = text not available (only value) 0016h = incorrect access to the parameter 0017h = unknown format 0018h = incorrect number of values

5.2.5 Example of Telegrams for Acyclic Access to the Parameters

Below are shown examples of sequences to access the parameters of the drive. As aforementioned, every access to the parameters is performed first with a writing telegram with the request, and then with a reading telegram to obtain the result of the request.

Example1: reading of the motor speed (P0002) and current (P0003) parameters.

Request (made by the master using the telegram DS_Write):

Byte Number	Field	Value	Description
1	Request Reference	1	
2	Request ID	1	Reading Request
3	DO-ID	0	
4	Number of Parameters	2	Reading of 2 Parameters
5	Attribute	10h	Reading of the parameter value
6	Number of Elements	1	Reading of only one value
7	Parameter number (byte + sig.)	0	Number of the first parameter read = P002
8	Parameter number (byte - sig.)	2	
9	Sub-index (high part)	0	Parameter has no sub-index
10	Sub-index (low part)	0	
11	Attribute	10h	Reading of the parameter value
12	Number of Elements	1	Reading of only one value
13	Parameter number (byte + sig.)	0	Number of the second parameter read = P003
14	Parameter number (byte - sig.)	3	
15	Sub-index (byte + sig.)	0	Parameter has no sub-index
16	Sub-index (byte - sig.)	0	

Positive response (sent by the slave in the response of telegram DS_Read)
Assuming P0002 = 100 rpm and P0003 = 5.0 A

Byte Number	Field	Value	Description
1	Request Reference	1	Copied from the request telegram
2	Request ID	1	Positive reading request
3	DO-ID	0	
4	Number of Parameters	2	Reading of 2 Parameters
5	Format	42h	WORD-type value (16 bits)
6	Number of values	1	Reading of only one value
7	Parameter value (byte + sig.)	0	P002 = 100 rpm
8	Parameter value (byte - sig.)	100	
9	Format	42h	WORD-type value (16 bits)
10	Number of values	1	Reading of only one value
11	Parameter value (byte + sig.)	0	P003 = 5.0 A
12	Parameter value (byte - sig.)	50	

Negative response (sent by the slave in the response of telegram DS_Read)
Assuming error in the reading of the second parameter

Byte Number	Field	Value	Description
1	Request Reference	1	Copied from the request telegram
2	Request ID	129	Negative reading request
3	DO-ID	0	
4	Number of Parameters	2	Reading of 2 Parameters
5	Format	42h	WORD-type value (16 bits)
6	Number of values	1	Reading of only one value
7	Parameter value (byte + sig.)	0	P002 = 100 rpm
8	Parameter value (byte - sig.)	100	
9	Format	44h	Reading error
10	Number of values	1	Only one value available
11	Error code (byte + sig.)	0	Error 0000h (assuming that the requested parameter
12	Error code (byte - sig.)	0	does not exist).

Example 2: change of the upper speed limit parameter (P0134).

Request (made by the master using the telegram DS_Write)
Assuming desired change to P0134 = 1000 rpm.

Byte Number	Field	Value	Description
1	Request Reference	1	
2	Request ID	2	Change request
3	DO-ID	0	
4	Number of Parameters	1	Change of one parameter
5	Attribute	10h	Change of the parameter value
6	Number of Elements	1	Change of only one value
7	Parameter number (byte + sig.)	0	Number of the changed parameter = P134
8	Parameter number (byte - sig.)	134	
9	Sub-index (high part)	0	Parameter has no sub-index
10	Sub-index (low part)	0	
11	Format	42h	WORD-type value (16 bits)
12	Number of values	1	Only one value changed
13	Parameter value (byte + sig.)	03h	P134 = 1000 rpm
14	Parameter value (byte - sig.)	E8h	

Positive response (sent by the slave in the response of telegram DS_Read):

Byte Number	Field	Value	Description
1	Request Reference	1	Copied from the request telegram
2	Request ID	2	Positive change request
3	DO-ID	0	
4	Number of Parameters	1	Change of one parameter

Negative response, assuming error in the change (sent by the slave in the response of telegram DS_Read):

Byte Number	Field	Value	Description
1	Request Reference	1	Copied from the request telegram
2	Request ID	130	Negative change request
3	DO-ID	0	
4	Number of Parameters	2	Change of one parameter
5	Format	44h	Error in the change
6	Number of values	1	Only one value available
7	Error code (byte + sig.)	0	Error 0002h (assuming the value for the parameter is off limits).
8	Error code (byte - sig.)	2	

6 STARTUP GUIDE

The main steps to start up the CFW503 frequency inverter in Profibus DP network are described below. These steps represent an example of use. Check out the specific chapters for details on the indicated steps.

6.1 INSTALLING THE ACCESSORY

1. Install the communication accessory, as indicated in the installation guide supplied with the accessory.
2. Observe the content of parameter P0027. Check if the module was recognized. The detection is done automatically and does not require the user's intervention.
3. Connect the cable to the accessory, considering the recommended instructions in network installation, as described in Section 3 PROFIBUS DP NETWORK INSTALLATION on page 3-1:
   - Use shielded cable.
   - Properly ground network equipment.
   - Avoid laying communication cables next to power cables.

6.2 CONFIGURING THE EQUIPMENT

1. Follow the recommendations described in the user manual to program the device parameters related to the motor parameterization, desired functions for the I/O signals, etc.
2. Program the command sources as desired for the application in (P0220 ... P0228).
3. Configure communication parameters, such as address and data profile in P0918 and P0741.
4. Program the desired action for the equipment in case of communication fault in parameter P0313.
5. Define which data will be read and written at frequency inverter CFW503 using Section 5 PROFIBUS DP NETWORK OPERATION on page 5-1.

6.3 CONFIGURING THE MASTER

The way the network configuration is done depends greatly on the used client and the configuration tool. It is essential to know the tools used to perform this activity. In general, the following steps are necessary to perform the network configuration.

1. Load the GSD file[1] to the list of devices in the network configuration tool.
2. Select CFW503 frequency inverter from the available list of devices on the network configuration tool. This can be done manually or automatically, if allowed by the tool.
3. During the configuration of the network, it is necessary to define the amount of I/O data communicated between frequency inverter CFW503 and the master, as described in Section 5 PROFIBUS DP NETWORK OPERATION on page 5-1. Among the main parameters that can be used to control the device, we can mention:
   - P0680 - Status word (read)
   - P0681 - Motor speed (read)
   - P0684 - Control word (write)
   - P0685 - Speed reference (write)

[1] The GSD file is available from WEG website (http://www.weg.net). It is important to note if the GSD configuration file is compatible with the firmware version of the CFW503 frequency inverter.

6.4 COMMUNICATION STATUS

Once the network is assembled and the client programmed, it is possible to use the parameters of the equipment to identify some status related to the communication.

- The parameter P0740 indicate the status of communication between the device and the network master.

Once configured, the network status P0740 indicates Online. It is in this condition that cyclic data exchange effectively occurs between the slave and the master of the network. The master of the network must also supply information about the communication with the slave.

6.5 OPERATION USING PROCESS DATA

Once the communication is established, the data mapped in the I/O area is automatically updated between master and slave.

It is important to know these parameters to program the master as desired for the application.

6.6 ACCESS TO PARAMETERS – ACYCLIC MESSAGES

Besides the I/O data (cyclic) communication, the DeviceNet protocol also defines a kind of acyclic telegram (*DS_Read* e *DS_Write*), used especially in asynchronous tasks, such as parameter setting and configuration of the equipment.

The GSD file provides the full parameter list of the equipment, which can be accessed via *DS_Read* and *DS_Write*. The Section 5.2.1 Available Services for Acyclic Communication on page 5-2 how to address the parameters of the frequency inverter CFW503 via acyclic messages.

7 QUICK REFERENCE OF ALARMS AND FAULTS

Fault / Alarm	Description	Possible Causes
F0031: Plug-in Comm Lost	Main control cannot establish the communication link with the communication acccessory.	■ Accessory damaged. ■ Poor connection of the accessory. ■ Problem in the identification of the accessory; refer to P0027.
A0138/ F0238: Clear Mode Profibus	It indicates that the inverter received the command from the Profibus DP network master to go into clear mode.	- Check the network master status, ensuring it is in the Run mode.
A0139/ F0239: Profibus Offline	It indicates interruption in the communication between the Profibus DP network master and the inverter. The Profibus DP communication interface went into offline status	- Check if the network master is correctly configured and operating properly. - Check for short-circuit or poor contact on the communication cables. - Check if the cables are not misconnected or inverted. - Check if the termination resistors with the right value were installed only at the end of the main bus. - Check the network installation in general – cabling, grounding.
A0140/ F0240: Access Error Prof.Interf.	It indicates error in the access to the Profibus DP communication module data.	- Check if the Profibus DP module is correctly fitted. - Hardware errors due to improper handling or installation of the accessory, for instance, may cause this error. If possible, carry out tests by replacing the communication accessory.

Fault and alarm operation:

- Faults operate by indicating their occurrence on the HMI, in the frequency inverter status word (P006), in the present fault parameter (P049) and disabling the motor. They can only be reset with a reset command or de-energizing the frequency inverter.
- Alarms operate by indicating their occurrence on the HMI and in the present alarm parameter (P048). They are automatically reset when the alarm condition ceases existing.

BRAZIL
WEG DRIVES & CONTROLS - AUTOMAÇÃO LTDA.
Av. Prefeito Waldemar Grubba, 3000
89256-900 - Jaraguá do Sul - SC
Phone: 55 (47) 3276-4000
Fax: 55 (47) 3276-4060
www.weg.net/br