

BACnet®

CFW900-IOS

User's Guide

User's Guide

CFW900-IOS

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SUMMARY OF REVISIONS

The information below describes the reviews made in this manual.

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1 ABOUT THE MANUAL

This manual supplies the necessary information for the operation of the CFW900 frequency inverter using the BACnet protocol. This manual must be used together with the CFW900 user's manual and programming manual.

1.1 ABBREVIATIONS AND DEFINITIONS

ASCII	American Standard Code for Information Interchange
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
BACnet	Building Automation and Control Network
B-ASC	BACnet Application Specific Controller
BIBBs	BACnet Interoperability Building Blocks
CRC	Cyclic Redundancy Check
HVAC	Heating, Ventilation and Air Conditioning
ISO	International Organization for Standardization
MS/TP	Master-Slave/Token-Passing

1.2 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.

1.3 DOCUMENTS

The BACnet protocol was developed based on the following specifications and documents:

Document	Version	Source
ANSI/ASHRAE Standard 135-2004	V1.0	ANSI/ASHRAE/ISO

For this documentation, consult BACnet Committee, organization that develops and maintains BACnet standard.

1.4 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.

1.5 TRADEMARKS

BACnet[®] is a registered trademark of ASHRAE.

All other trademarks are the property of their respective holders.

2 RS-485 INTERFACE DESCRIPTION

The RS-485 serial interface is available on the CFW900-IOS accessory, which is supplied as standard with the product.

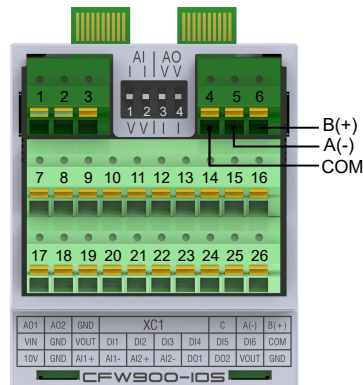


Figure 2.1: RS-485 interface on CFW900-IOS

The interface connection is made according to the pinout shown in the table below:

Table 2.1: RS-485 interface pinout

Pin	Name	Function
4	C	0 V Reference
5	A(-)	RS-485 (Terminal A)
6	B(+)	RS-485 (Terminal B)

2.1 Interface characteristics

- The interface follows the EIA/TIA-485 standard.
- It allows bit rate communication from 9600 up to 76800 bps.
- 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 repeaters¹.
- A maximum bus length of 1000 m.

2.2 Indications

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

2.3 Connection to the 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 (C signal). In case the cable does not have the additional wire, the reference signal must be left disconnected.
- 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 terminating resistors only at two points, at the extremes of the main bus, even if there are derivations from the bus.

¹The maximum number of devices that can be connected on the network depends on the protocol used.

3 BACNET NETWORK INSTALLATION

The following points must be observed when using the RS-485 interface.

3.1 COMMUNICATION RATE

The table below shows the permitted rates for the RS-485 interface.

Table 3.1: Supported bit rates

Bit rate
9600 bit/s
19200 bit/s
38400 bit/s
57600 bit/s
76800 bit/s

BACnet sets the default rate at 19200 bps.



NOTE!

All network equipment must use the same bit rate.

3.2 ADDRESSING

Every device on the BACnet network must have a unique address. The addressing rules are given in section 4.2.

3.3 TERMINATING RESISTOR

The use of terminating resistors at the ends of the bus is essential to avoid line reflection, which can impair the signal and cause communication errors. Terminating resistors of 120 Ω | 0.25 W must be connected between the signals B(+) and A(-) at the ends of the main bus.

It worth to mention that, in order to allow the disconnection of the element from the network without damaging the bus, it is interesting to put active terminations, which are elements that only play the role of the termination. Thus, any equipment in the network can be disconnected from the bus without damaging the termination.

3.4 CABLING

Recommended characteristics of the cable used in the installation:

- It is recommended the use of a shielded cable with a twisted pair for the signals B(+) and A(-), 24 AWG minimum.
- It is also recommended that the cable has one more wire for the interconnection of the 0V reference signal.
- Maximum length for connection between devices: 1000 m.

To perform the installation, it is recommended the use of shielded cables specific for use in industrial environment.

3.5 CONNECTION ON THE NETWORK

In order to interconnect the several network nodes, it is recommended to connect the equipment directly to the main line without using derivations. During the cable installation the passage near to power cables must be avoided, because, due to electromagnetic interference, this makes the occurrence of transmission errors possible.

BACNET NETWORK INSTALLATION

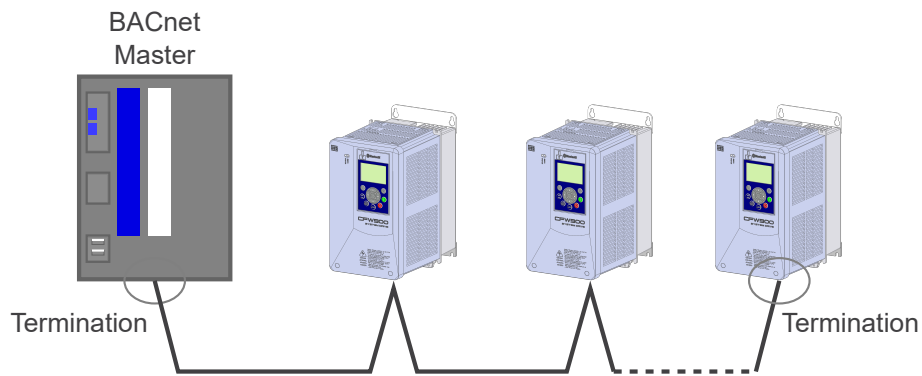


Figure 3.1: BACnet network installation example

In order to avoid problems with current circulation caused by difference of potential among ground connections, it is necessary that all the devices be connected to the same ground point.

The maximum number of devices connected to a single segment of the network is limited to 32. Repeaters can be used for connecting a bigger number of devices.

4 OVERVIEW OF THE BACNET NETWORK

BACnet, acronym for “Building Automation and Control Network”, is an open protocol defined by the ANSI/ASHRAE/ISO Standard 135-2004. The protocol establishes a model for building automation and control network used mainly in HVAC, describing the interaction between devices and systems. It defines:

- Data and commands structured in an object-oriented model.
- Services that describe data access.
- A flexible network architecture.

The BACnet standard defines six types of communication networks for transporting BACnet messages, as showed in the figure 4.1. The type of network defines the physical and data link layers. The six types of networks are:

- BACnet ARCNET
- BACnet Ethernet (ISO 8802-3)
- BACnet LonTalk
- BACnet MS/TP
- BACnet Point-To-Point
- BACnet/IP

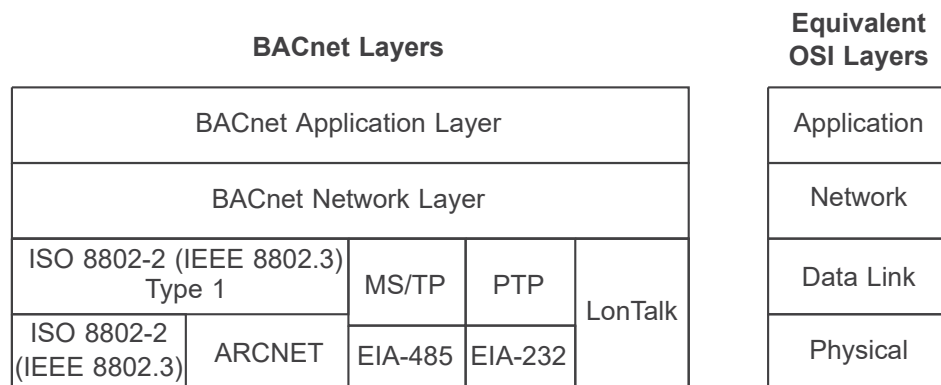


Figure 4.1: BACnet protocol architecture

A BACnet equipment has a collection of data elements defined as objects and properties.

A BACnet object represents physical or virtual information of the equipment, as a digital or analog input, control variables and parameters. The BACnet standard defines 25 types of objects. Each object is identified by a property called Object Identifier, which codifies the object instance type in a 32-bit binary number.

A BACnet property represents characteristics or information of a BACnet object. It is through the properties that other elements can access the equipment information. The property access can be defined as read-only or read/write. BACnet specification defines the following category of services:

- Object Access Services
- Remote Device Management Services
- Alarm and Event Services
- File Access Services
- Virtual Terminal Services
- Security Services

OVERVIEW OF THE BACNET NETWORK

BACnet equipment can be classified in six different profiles according to the set of services made available:

- BACnet Operator Workstation (B-OWS)
- BACnet Building Controller (B-BC)
- BACnet Advanced Application Controller (B-AAC)
- BACnet Application Specific Controller (B-ASC)
- BACnet Smart Actuator (B-AS)
- BACnet Smart Sensor (B-SS)

4.1 BACnet MS/TP

BACnet protocol implemented in the CFW900 uses RS-485 standard for the physical and data link layers, and it is called BACnet MS/TP (Master-Slave/Token-Passing). It can be divided in two groups, master and slave nodes, according to the node address range.

Medium access control is performed in two ways:

- **Master-Slave (MS):** It is used in the communication between a master node and a slave node.
- **Token-Passing (TP):** Communication only among master nodes. A logical ring is defined and the master that has the token can establish communication with slave nodes and other masters.

In a BACnet MS/TP network, nodes are initialized and enter the IDLE state, waiting for the arrival of a telegram, which can be:

- ReceivedInvalidFrame: remains in IDLE.
- ReceivedUnwantedFrame: remains in IDLE.
- ReceivedToken: enters the USE_TOKEN state, executes the necessary communication (with slaves or other masters) and passes the token to the next node.
- PollForMaster: sends a telegram to the node with the address in the Source Address field.
- ReceivedDataNoReply: signals the reception to the higher layers.
- ReceivedDataNeedingReply: signals the reception to the higher layers and sends the requested response.

4.1.1 BACnet MS/TP Message Structure

BACnet specification defines that the frame can have from 0 up to 501 bytes (octets), and that each byte is composed by 8 bits without parity, with start and stop bits, as shown in figure 4.2.

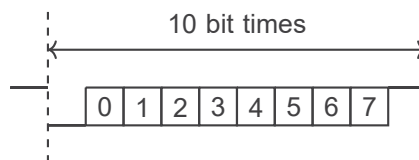


Figure 4.2: Byte structure

- **Reception (RX):** Maximum time between bytes ($T_{framegap}$) is of 20-bit times, and the minimum time between frames ($T_{turnaround}$) after the last byte stop bit is of 40-bit times, according to figure 4.3.
- **Transmission (TX):** RTS signal must be disabled after the end of the stop bit time ($T_{postdrive}$), which is of 15-bit times.

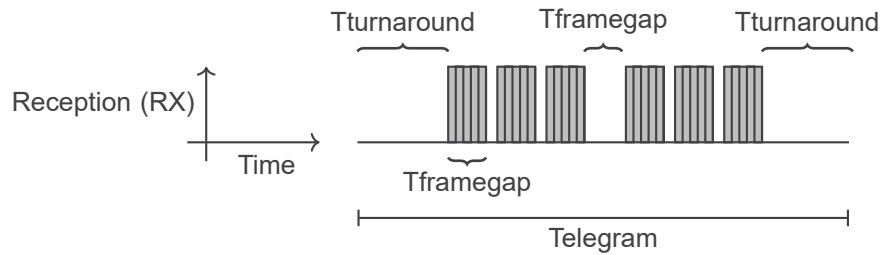


Figure 4.3: BACnet data reception

BACnet data frame consists of a header and data, as shown in table 4.1.

Table 4.1: BACnet frame

HEADER							DATA		
0x55	0xFF	Frame Type	Destination Address	Source Address	Length	CRC	Data	CRC-	CRC+

Preamble: Formed by two bytes with the 55h and FFh values, respectively.

Frame Type: Specification defines eight frame types, from 0 to 7. Frame types 8 through 127 are reserved by ASHRAE, and from 128 to 255 are available to vendors for proprietary (non-BACnet) frames. The defined types are:

- 00 Token
- 01 Poll For Master
- 02 Reply To Poll For Master
- 03 Test_Request
- 04 Test_Response
- 05 BACnet Data Expecting Reply
- 06 BACnet Data Not Expecting Reply
- 07 Reply Postponed

Frame Type 00: Token

The Token frame is used to pass network mastership to the destination node. There is no data in Token frames.

Frame Type 01: Poll For Master

The Poll For Master frame is transmitted by master nodes during configuration and periodically during normal network operation. It is used to discover the presence of other master nodes on the network and to determine a successor node in the token ring. There are no data in Poll For Master frames.

Frame Type 02: Reply To Poll For Master

This frame is transmitted as a reply to the Poll For Master frame. It is used to indicate that the node sending the frame wishes to enter the token ring. There are no data in Reply To Poll For Master frames.

Frame Type 03: Test_Request

This frame is used to initiate a loopback test of the MS/TP to MS/TP transmission path.

Frame Type 04: Test_Response

This frame is used to reply to Test_Request frames. The data, if present, shall be that which was present in the initiating Test_Request.

Frame Type 05: BACnet Data Expecting Reply

OVERVIEW OF THE BACNET NETWORK

This frame is used by master nodes to convey the data parameter of a DL-UNITDATA.request whose DER (data_expecting_reply) is true. This is a service primitive with the following semantics:

DL-UNITDATA.request(source_address, destination_address, data, priority, data_expecting_reply)

Frame Type 06: BACnet Data Not Expecting Reply

This frame is used by master nodes to convey the data parameter of a DL-UNITDATA.request whose DER (data_expecting_reply) is false.

Frame Type 07: Reply Postponed

This frame is used by master nodes to defer sending a reply to a previously receive BACnet Data Expecting Reply frame. There are no data in Reply Postponed frames.

Destination and Source addresses: Formed by two bytes, destination and source address, respectively.

Length: Formed by two bytes that inform the number of data bytes in the message.

Header CRC: For checking header transmission errors. Used method is CRC-8.

Data: From 0 to 501 bytes, conforme especificação BACnet. In the CFW900 data field can contain up to 480 bytes.

Data CRC: For checking data transmission errors. Used method is CRC-16.

4.2 ADDRESS

Node address varies according to the station type, where:

- Addresses 0 to 127 are valid for both master or slave nodes.
- Addresses 128 to 254 are valid only for slave nodes.
- Source address of 255 is not allowed.²

In the CFW900, address is set using parameter C9.3.2.

4.3 BACNET PROFILE

The profile developed for CFW900 is the B-ASC, with communication management services and data sharing that provide the following BACnet Interoperability Building Blocks (BIBBs):

- Data Sharing:
 - DS-RP-B: ReadProperty-B
 - DS-RPM-B: ReadPropertyMultiple-B
 - DS-WP-B: WriteProperty-B
- Device e Network Management:
 - DM-DDB-B: Who-Is / I-Am
 - DM-TS-B: Device Management-TimeSynchronization-B
 - DM-RD-B: Device Management-ReinitializeDevice-B

4.3.1 ReadProperty (DS-RP-B)

A BACnet client (node performing a request to a server node) uses the ReadProperty service to obtain a BACnet object property value. This service allows reading access to the properties that have the R (reading) access type.

²A destination address of 255 (FFh) denotes broadcast.

4.3.2 ReadPropertyMultiple (DS-RPM-B)

A BACnet client uses the ReadPropertyMultiple service to obtain multiple property values from multiple BACnet objects. This service allows reading access to the properties that have the R (reading) access type.

4.3.3 WriteProperty (DS-WP-B)

A BACnet client uses the WriteProperty service to modify the value of a specific BACnet object property. This service allows writing access to the properties that have the W (writing) or C (commandable) access type.

4.3.4 Who-Is / I-Am (DM-DDB-B)

The Who-Is / I-Am service is used to identify the devices connected to the network. The Who-Is message is sent by the BACnet controller, and the nodes respond with an I-Am message, informing their Object Identifier and address. The I-Am message is broadcast, and can be transmitted during initialization or periodically, according to the parameter C9.11.5.

4.3.5 Device Management-TimeSynchronization-B (DM-TS-B)

The TimeSynchronization service implemented in the CFW900 synchronizes local date and time with the date and time received from the controller.

4.3.6 Device Management-ReinitializeDevice-B (DM-RD-B)

The ReinitializeDevice service is used to remotely reinitialize the equipment. Supported reset modes are COLD and WARM. BACnet standard defines that a password must be used to validate this service execution. This password is a string (set of ASCII characters) with up to 20 positions.

Password used for remote reinitialization in the CFW900 is a number between 0000 and 9999, which in BACnet network, is converted to 4 ASCII characteres between "0000" and "9999".

If, for instance, we consider CFW900's standard password is 5 (C9.11.6 = 5), remote device reinitialization will be performed only if received password is "5".

5 SUPPORTED BACNET OBJECTS

A BACnet object represents a physical or virtual equipment information, as a digital input or parameters. The CFW900 supports the following object types:

- Analog Input
- Analog Output
- Analog Value
- Binary Input
- Binary Output
- Binary Value
- Device
- Network Port

Each object type defines a data structure composed by properties that allow the access to the object information. Below table shows implemented properties for each CFW900 object type.

Table 5.1: Properties of the BACnet objects

Property	Device	Analog Input	Analog Output	Analog Value	Binary Input	Binary Output	Binary Value
Object_Identifier	X	X	X	X	X	X	X
Object_Name	X	X	X	X	X	X	X
Object_Type	X	X	X	X	X	X	X
System_Status	X						
Vendor_Name	X						
Vendor_Identifier	X						
Model_Name	X						
Firmware_Revision	X						
Application_Software_Version	X						
Description	X						
Protocol_Version	X						
Protocol_Revision	X						
Protocol_Services_Supported	X						
Protocol_Object_Types_Supported	X						
Object_List	X						
Max_APDU_Length_Accepted	X						
Segmentation_Supported	X						
APDU_Timeout	X						
Number_Of_APDU_Retries	X						
Max_Master	X						
Max_Info_Frames	X						
Device_Address_Binding	X						
Database_Revision	X						
Present_Value		X	X	X	X	X	X
Status_Flags		X	X	X	X	X	X
Event_State		X	X	X	X	X	X
Out_Of_Service		X	X	X	X	X	X
Units		X	X	X	X	X	X
Min_Pres_Value			X				
Max_Pres_Value			X				
Priority_Array			X	X		X	X
Relinquish_Default			X	X		X	X
Polarity					X	X	

SUPPORTED BACNET OBJECTS



NOTE!

Priority_Array and Relinquish_Default properties are available for objects with type C (commandable) access only.

Each object presents an identifier unique in the network, called Object Identifier. The Object Identifier property is composed by two parts:

Object Type - 10 bits	Object Instance - 22 bits
-----------------------	---------------------------

Each object has one of the following access types:

- R Readable
- W Writable
- C Commandable (writable with priority)

The commandable (C) access type consists of a 16-level priority array, where priority 1 is the highest and 16 the lowest. If all the priorities are disabled (NULL), the value of the Relinquish Default property is given to the Present Value property.

5.1 Analog Input (AI) Object

The Analog Input object type defines a standardized object whose properties represent the externally visible characteristics of an analog input. Present Value property indicates the current value, and are of type REAL.

Table 5.2: Analog Input Object

Object Instance	Object Name	Description	Unit	Access Type
AI0	AI1	Indicates the level of parameter S3.1.1.1	%	R
AI1	AI2	Indicates the level of parameter S3.1.1.2	%	R



NOTE!

Only the analog inputs available on the CFW900-IOS accessory, which comes standard with the product, are accessible on the BACnet network.

5.2 Analog Output (AO) Object

The Analog Output object type defines a standardized object whose properties represent the externally visible characteristics of an analog output. Present Value (commandable) property indicates the current value, and are of type REAL.

Table 5.3: Analog Output Object

Object Instance	Object Name	Description	Unit	Access Type
AO0	AO1	Controls the level of parameter S3.1.2.2	%	C
AO1	AO2	Controls the level of parameter S3.1.2.5	%	C



NOTE!

Only the analog outputs available on the CFW900-IOS accessory, which comes standard with the product, are accessible on the BACnet network.

5.3 Analog Value (AV) Object

The Analog Value object type defines a standardized object whose properties represent the externally visible characteristics of an analog value. An analog value is a control system parameter residing in the memory of

the CFW900. Present Value (readable or commandable) property indicates the current value, and are of type REAL.

Table 5.4: Analog Value Object

Object Instance	Object Name	Description	Unit	Access Type
AV0	Motor Speed	S2.1.3 Actual Value	rpm	R
AV1	Motor Current	S2.3.1 Current	A	R
AV2	DC Link Voltage (Ud)	S2.7.1 Voltage	V	R
AV3	Motor Frequency	S2.3.3 Frequency	Hz	R
AV4	Motor Voltage	S2.3.2 Voltage	V	R
AV5	Motor Torque	S2.2.3 Estimated Value	%	R
AV6	Output Power	S2.3.5 Power	kW	R
AV7	Internal Air Temperature	S2.5.3 Control	° C	R
AV8	Time Powered	D3.1 Time Powered	hours	R
AV9	Time Enabled	D3.2 Hours Enabled	hours	R
AV10	kWh Output Energy	S2.3.8 Energy kWh	kWh	R
AV11	Current Alarm	D2.1.1 Alarm 1	-	R
AV12	Current Fault	D1.1.1 Fault 1	-	R
AV13	Ramp Acceleration Time 1	C6.1.1 Acceleration Time	s	C
AV14	Ramp Deceleration Time 1	C6.1.2 Deceleration Time	s	C
AV15	Speed (%)	S5.1.2 Speed	%	R
AV16	Speed Reference (%)	S5.2.3 Speed Reference	%	C
AV17	PID Automatic Setpoint	A2.2.1.1 Automatic Mode	-	C
AV18	PID Manual Setpoint	A2.2.1.2 Manual Mode	rpm	C
AV19	PID Process Variable	A2.1.3 Process Variable	-	R
AV20	PID Controller Output	A2.1.5 Controller Output	rpm	R

Detailed description of each parameter is provided in the product's programming manual.

5.4 Binary Input (BI) Object

The Binary Input object type defines a standardized object whose properties represent the externally visible characteristics of a binary input. A binary input is a physical device or hardware input that can be in only one of two distinct states, on/active or off/inactive. Present Value property indicates the current value, and are of type BOOL.

Table 5.5: Binary Input Object

Object Instance	Object Name	Description	Status	Access Type
BI0	DI1	S3.1.3.1 DI - Bit 0	on/off	R
BI1	DI2	S3.1.3.1 DI - Bit 1	on/off	R
BI2	DI3	S3.1.3.1 DI - Bit 2	on/off	R
BI3	DI4	S3.1.3.1 DI - Bit 3	on/off	R
BI4	DI5	S3.1.3.1 DI - Bit 4	on/off	R
BI5	DI6	S3.1.3.1 DI - Bit 5	on/off	R



NOTE!

Only the binary inputs available on the CFW900-IOS accessory, which comes standard with the product, are accessible on the BACnet network.

5.5 Binary Output (BO) Object

The Binary Output object type defines a standardized object whose properties represent the externally visible characteristics of a binary output. A binary output is a physical device or hardware output that can be in only one of two distinct states, on/active or off/inactive. Present Value property indicates the current value, and are of type BOOL.

SUPPORTED BACNET OBJECTS

Table 5.6: Binary Output Object

Object Instance	Object Name	Description	Status	Access Type
BO0	DO1	S3.1.4.2 DO Network - Bit 0	on/off	C
BO1	DO2	S3.1.4.2 DO Network - Bit 1	on/off	C
BO2	DO3	S3.2.4.2 DO Network - Bit 0	on/off	C
BO3	DO4	S3.2.4.2 DO Network - Bit 1	on/off	C
BO4	DO5	S3.2.4.2 DO Network - Bit 2	on/off	C



NOTE!

Digital outputs DO3, DO4 and DO5 will only be available if the CFW900-REL-01 accessory is installed in slot A. For the BACnet controller to activate these digital outputs, network mode must be selected in parameters C5.2.4.1, C5.2.4.2 and C5.2.4.3.

5.6 Binary Value (BV) Object

The Binary Value object type defines a standardized object whose properties represent the externally visible characteristics of a binary value. A binary value is a control system parameter residing in the memory of the CFW900. Present Value (readable or commandable) property indicates the current value, and are of type BOOL.

Table 5.7: Binary Value Object

Object Instance	Object Name	Description	Status	Access Type
BV0	STO	Status Word 1 - Bit 0	on/off	R
BV1	Run Command	Status Word 1 - Bit 1	on/off	R
BV2	Local	Status Word 1 - Bit 2	on/off	R
BV3	Reserved	Status Word 1 - Bit 3	on/off	R
BV4	No Quick Stop	Status Word 1 - Bit 4	on/off	R
BV5	2nd Ramp	Status Word 1 - Bit 5	on/off	R
BV6	Config Mode	Status Word 1 - Bit 6	on/off	R
BV7	Alarm	Status Word 1 - Bit 7	on/off	R
BV8	Running	Status Word 1 - Bit 8	on/off	R
BV9	Enabled	Status Word 1 - Bit 9	on/off	R
BV10	Reverse	Status Word 1 - Bit 10	on/off	R
BV11	JOG	Status Word 1 - Bit 11	on/off	R
BV12	Remote 2	Status Word 1 - Bit 12	on/off	R
BV13	Undervoltage	Status Word 1 - Bit 13	on/off	R
BV14	Reserved	Status Word 1 - Bit 14	on/off	R
BV15	Fault	Status Word 1 - Bit 15	on/off	R
BV16	Enable Ramp	Control Word Serial - Bit 0	on/off	C
BV17	General Enable	Control Word Serial - Bit 1	on/off	C
BV18	Run Reverse	Control Word Serial - Bit 2	on/off	C
BV19	Enable JOG	Control Word Serial - Bit 3	on/off	C
BV20	R1/R2 Mode	Control Word Serial - Bit 4	on/off	C
BV21	2nd Ramp	Control Word Serial - Bit 5	on/off	C
BV22	No Quick Stop	Control Word Serial - Bit 6	on/off	C
BV23	Fault Reset	Control Word Serial - Bit 7	on/off	C

5.7 Device Object

The Device object type defines a standardized object whose properties represent the externally visible characteristics of a BACnet device. Properties of this object are summarized in the Device column of the table 5.1.

5.8 Network Port Object

The Network Port object provides access to the configuration and properties of network ports of a device.

6 S STATUS

This menu contains the status information of the inverter, motor, control accessories and networks. It is also possible to access information related to the functional safety of the inverter. It allows viewing the reading variables of the CFW900.



NOTE!

All parameters present in this menu can only be seen on the HMI display and cannot be changed by the user unless they are linked to the parameters of the **Configurations** menu.

S5 Communications

It allows viewing the parameters used for monitoring and controlling the CFW900 inverter using communication interfaces.

S5.1 Status and Commands

It allows viewing the CFW900 logical status and commands.

S5.1 Status and Commands

.1 Status Word 1	0 ... 15 Bit
.2 Speed	-200.00 ... 200.00 %
.3 Status Word 2	0 ... 15 Bit
.4 Status Word 3	0 ... 4 Bit

.1 Status Word 1 It indicates the operating status of the inverter. Each bit represents a status.

Bit	Value/Description
Bit 0 STO	0 = No: STO function is inactive (inverter operational). 1 = Yes: STO function is active (inverter locked).
Bit 1 Run Command	0 = No: no run command active. 1 = Yes: run command active.
Bit 2 Local	0 = No: inverter in Remote command mode. 1 = Yes: inverter in Local command mode (via HMI).
Bit 3 Fire Mode	0 = No: The Fire Mode function is disabled. 1 = Yes: The Fire Mode function is enabled.
Bit 4 No Quick Stop	0 = No: quick stop command active. 1 = Yes: no quick stop command active.
Bit 5 2nd Ramp	0 = No: 1st acceleration and deceleration ramp by C6.1.1 and C6.1.2. 1 = Yes: 2nd acceleration and deceleration ramp by C6.1.4 and C6.1.5.
Bit 6 Config. Mode	0 = No: inverter in normal operation. 1 = Yes: inverter in configuration state. It indicates a special condition in which the inverter cannot be enabled.
Bit 7 Alarm	0 = No: without alarm. 1 = Yes: with alarm active.
Bit 8 Running	0 = No: motor is stopped. 1 = Yes: motor is running according to reference and command.
Bit 9 Enabled	0 = No: inverter is general disabled. 1 = Yes: inverter is general enabled.
Bit 10 Reverse	0 = No: motor running in the forward direction. 1 = Yes: motor running in the reverse direction.
Bit 11 JOG	0 = No: no JOG command active. 1 = Yes: JOG command is active.
Bit 12 Remote 2	0 = No: inverter in Remote 1 command mode. 1 = Yes: inverter in Remote 2 command mode.
Bit 13 Undervoltage	0 = No: without undervoltage. 1 = Yes: with undervoltage.
Bit 14 Not used	Not used.

S STATUS

Bit	Value/Description
Bit 15 Fault	0 = No: normal operation. 1 = Yes: fault acting.



NOTE!

Bit 3 associated with the Fire Mode status is updated according to the command to enable the function (digital input configured in C13.3 with logic level "0" (0 V)), and not according to the inverter status (S1.1.1) being in Fire Mode.

.2 Speed It indicates the actual speed of the motor driven by the inverter in percentage of the maximum speed.

■ S5.1.2 = 0,00 % $\Rightarrow$ motor speed = 0 rpm

■ S5.1.2 = 100,00 % $\Rightarrow$ motor speed = C4.3.1.1.2

Intermediate or higher speed values can be obtained by using this scale. For example, if the value read is 25.0 %, considering C4.3.1.1.2 = 1800 rpm, to obtain the value in rpm you must calculate:

100,00 % : 1800 rpm

25,00 % : Speed

$$\text{Speed} = \frac{25,00 \times 1800}{100,00}$$

Speed = 450 rpm

Negative values indicate motor running in the reverse direction of rotation.

.3 Status Word 2 It indicates other status of the inverter functions. Each bit represents a status.

Bit	Value/Description
Bit 0 Self-tuning	0 = No: inverter is not running the Self-tuning routine. 1 = Yes: inverter is running the Self-Tuning routine to estimate the motor parameters.
Bit 1 Field Weakening	0 = No: Control is not in the field weakening region. 1 = Yes: Control is in the field weakening region.
Bit 2 Pre-Charge OK	0 = No: pre-charge of the DC link capacitors not completed. 1 = Yes: pre-charge of the DC link capacitors completed.
Bit 3 Not used	Not used.
Bit 4 Zero Speed	0 = No: the inverter is not disabled by zero speed. 1 = Yes: the inverter is disabled by zero speed.
Bit 5 Decel. Ramp	0 = No: no deceleration. 1 = Yes: inverter decelerating.
Bit 6 Acc. Ramp	0 = No: no acceleration. 1 = Yes: inverter accelerating.
Bit 7 Ramp Hold	0 = No: ramp operating in normal conditions. 1 = Yes: the path of the ramp is frozen by some command source or internal function.
Bit 8 Setpoint OK	0 = No: motor speed has not reached the reference yet. 1 = Yes: motor speed has reached the reference.
Bit 9 DC Voltage Limitation	0 = No: DC link limitation or Dynamic Braking inactive. 1 = Yes: DC link limitation or Dynamic Braking active.
Bit 10 Current Limitation	0 = No: current limitation inactive. 1 = Yes: current limitation active.
Bit 11 Torque Limitation	0 = No: torque limitation inactive. 1 = Yes: torque limitation active.
Bit 12 Ride-Through	0 = No: Ride-through not running. 1 = Yes: Ride-through running.
Bit 13 Flying Start	0 = No: Flying start not running. 1 = Yes: Flying start running.
Bit 14 DC Braking	0 = No: DC braking inactive. 1 = Yes: DC braking active.

Bit	Value/Description
Bit 15 PWM pulses	0 = No: PWM voltage pulses at the output disabled. 1 = Yes: PWM voltage pulses at the output enabled.

.4 Status Word 3 It indicates other status of the inverter functions. Each bit represents a status.

Bit	Value/Description
Bit 0 SD Card	SD card is only detected during the inverter initialization, so the inverter will not detect SD card disconnection during operation. 0 = No: SD card not connected. 1 = Yes: SD card connected.
Bit 1 Not used	Not used.
Bit 2 Param. Storage	Indicates the status of the storage memory for user parameter setting. When the memory reaches its maximum capacity, new parameter changes may not be retained after the inverter is restarted. The next time the product is powered on, a message will be displayed on the HMI, and memory space will be freed up to allow new parameter settings. The inverter operation is not affected when storage space is exhausted. 0 = Free: There is space available in the memory to store user parameters. 1 = Limit: The memory for storing user parameters has reached its maximum capacity.
Bit 3 Limited Speed Ref.	0 = No: The value of S2.1.1 is being updated with the effective value of the speed reference source. 1 = Yes: The effective value of the speed reference source is greater than the value of S2.1.6. In this situation, the inverter limits the value of S2.1.1 to the value of S2.1.6.
Bit 4 Max. Freq. Limit	0 = Limited (599 Hz): The maximum output frequency of the inverter is limited to 599 Hz. 1 = Not Limited: No limitation on the maximum output frequency of the inverter.



NOTE!

Excessive changes to configuration parameters via HMI, WPS, communication networks, SoftPLC application or downloads of SoftPLC user parameter settings may lead to the storage limit exhaustion. To avoid that, it is recommended to use cyclical writing methods via communication networks, as such methods write the values in a non-retentive way. Additionally, configure SoftPLC user parameters as non-retentive and use retentive markers to copy data to these parameters.

S5.2 Serial RS-485

It allows viewing the status of the RS485 serial interface and the commands received by this interface.

S5.2 Serial RS-485

.1 Interface Status	0 ... 2
.2 Control Word	0 ... 7 Bit
.3 Speed Reference	-200.00 ... 200.00 %
.5 Received Telegrams	0 ... 65535
.6 Transmitted Telegrams	0 ... 65535
.7 Telegrams with Error	0 ... 65535
.8 Reception Errors	0 ... 65535

.1 Interface Status It indicates the status of the RS-485 serial interface.

Indication	Description
0 = Inactive	Not used.
1 = Active	Serial interface active.
2 = Timeout Error	It indicates that the CFW900 did not receive valid telegrams for a time longer than the limit set.

.2 Control Word It indicates the status of the control word via RS-485 serial interface. This parameter can only be changed via RS-485 serial interface. For other sources, only read access is allowed.

S STATUS

For the commands written in this parameter to be executed, the inverter must be programmed to be commanded via Serial. This programming is done through menu C4.

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

Bit	Value/Description
Bit 0 Enable Ramp	0 = No: stops the motor by deceleration ramp. 1 = Yes: the motor turns according to the acceleration ramp until reaching the speed reference value.
Bit 1 General Enable	0 = No: disables the inverter completely, interrupting the motor power supply. 1 = Yes: enables the inverter completely, allowing the operation of the motor.
Bit 2 Run Reverse	0 = No: runs the motor in the direction of the reference signal (forward). 1 = Yes: runs the motor in the opposite direction of the reference signal (reverse).
Bit 3 Enable JOG	0 = No: disables the JOG function. 1 = Yes: enables the JOG function.
Bit 4 R1/R2 Mode	0 = R1: selects the Remote 1 command mode. 1 = R2: selects the Remote 2 command mode.
Bit 5 2nd Ramp	0 = No: 1st ramp acceleration and deceleration according to parameters C6.1.1 and C6.1.2. 1 = Yes: 2nd ramp acceleration and deceleration according to parameters C6.1.4 and C6.1.5.
Bit 6 No Quick Stop	0 = No: enables quick stop. 1 = Yes: disables quick stop.
Bit 7 Fault Reset	0 = No: not used. 1 = Yes: in the transition, if in a fault state, it resets the fault.

.3 Speed Reference It indicates the speed reference sent via RS-485 Serial interface to the motor driven by the inverter in percentage of the maximum speed. This parameter can only be changed via RS-485 serial interface. For other sources, only read access is allowed.

For the reference written in this parameter to be used, the inverter must be programmed to use the speed reference via Serial. This programming is done through menu C4.

- S5.2.3 = 0,00 % $\Rightarrow$ speed reference = 0 rpm
- S5.2.3 = 100,00 % $\Rightarrow$ speed reference = C4.3.1.1.2

Intermediate or higher speed values can be obtained by using this scale. For example, if the desired value for the reference is 900 rpm, considering C4.3.1.1.2 = 1800 rpm, it should be calculated:

100,00 % : 1800 rpm
Reference % : 900 rpm

$$\text{Reference \%} = \frac{900 \times 100,00}{1800}$$

Reference % = 50 %

Negative values can be used to reverse the direction of rotation of the motor. The direction of rotation of the motor, however, also depends on the value of the rotation direction command bit in S1.6.1:

- Bit Direction of Rotation = 1 and S5.2.3 > 0: reference for the forward direction
- Bit Direction of Rotation = 1 and S5.2.3 < 0: reference for the reverse direction
- Bit Direction of Rotation = 0 and S5.2.3 > 0: reference for the reverse direction
- Bit Direction of Rotation = 0 and S5.2.3 < 0: reference for the forward direction

.5 Received Telegrams It indicates the number of telegrams received.

.6 Transmitted Telegrams It indicates the number of telegrams transmitted.

.7 Telegrams with Error It indicates the number of telegrams received with errors (CRC, Checksum).

.8 Reception Errors It indicates the number of bytes received with errors.

**NOTE!**

The counters are cyclic, that is, when it reaches 65535, it returns to 0.

**NOTE!**

These counters start at 0 whenever the product is powered on. They also return to 0 whenever the maximum limit of the parameter is reached.

7 C CONFIGURATIONS

It allows changing the CFW900 configuration parameters. Depending on the parameter property, it is possible to set its value according to the table below.

Property	Description
Stopped	Parameter can only be changed with the motor stopped.
Model	Default value may change according to inverter model.



NOTE!

Parameter options with the description "Not used" are for WEG's exclusive use.

C9 COMMUNICATIONS

It sets the CFW900 to exchange information via communication network.

C9.1 Communication Errors

It allows setting the operation of the fault for the communication interfaces and related protocols.

C9.1.1 Master Offline

Communication interruption fault with the network master.

If for some reason the communication between the product and the network master is interrupted, a communication error will be issued, an alarm or fault will be displayed on the HMI, depending on the programming of this menu.

It only occurs after the device is online.

C9.1.1 Master Offline

C9.1.1.1 Mode

Range: 0 ... 2

Default: 2

Properties:

Description:

It allows configuring the fault tripping mode against interruption in the communication with the network master.

Indication	Description
0 = Inactive	Alarm and fault disabled.
1 = Fault	Only fault enable. It disables the motor.
2 = Alarm	Alarm enabled. It actuates as described in C9.1.1.2.

C9.1.1 Master Offline

C9.1.1.2 Alarm Action

Range: 0 ... 4

Default: 2

Properties:

Description:

Action for offline communication alarm, for any network interface - A128, A129, A130, A133, A134, A135, A137, A147 and A149.

The actions described in this parameter are performed by writing the respective bits in the control word of the communication/interface protocol. Thus, for the commands to take effect, the equipment must be programmed to be controlled by the network interface used. This programming is done through menu C4.

C CONFIGURATIONS

Indication	Description
0 = Off	No action is taken; the equipment remains in the current status.
1 = Stop by Ramp	The ramp to stop command is executed, and the motor stops according to the programmed deceleration ramp.
2 = General Disable	The equipment is general disabled and the motor coasts to stop.
3 = Go to R1	The equipment is commanded to the remote 1 status.
4 = Go to R2	The equipment is commanded to the remote 2 status.



NOTE!

The alarm action will only have a function if the error tripping mode in C9.1.1.1 is programmed for Alarm.

C9.1.2 Master Idle/Prog

Network master status fault.

If there is a transition of the network master status from the operation mode (Run) to the configuration mode (Idle/Prog), a communication error will be issued, an alarm or fault will be displayed on the HMI, depending on the programming made in this menu.

It only occurs after the network master Run mode is detected. The way to detect this condition depends on the communication protocol and the network master.

C9.1.2 Master Idle/Prog

C9.1.2.1 Mode

Range: 0 ... 2

Default: 2

Properties:

Description:

It allows configuring the fault tripping mode when the network master is placed in programming mode (Idle/Prog).

Indication	Description
0 = Inactive	Alarm and fault disabled.
1 = Fault	Only fault enable. It disables the motor.
2 = Alarm	It acts as an alarm. Action described in C9.1.2.2.

C9.1.2 Master Idle/Prog

C9.1.2.2 Alarm Action

Range: 0 ... 4

Default: 2

Properties:

Description:

Action for the master alarm in programming mode (Idle/Prog) - A136.

The actions described in this parameter are performed by writing the respective bits in the control word of the communication/interface protocol. Thus, for the commands to take effect, the equipment must be programmed to be controlled by the network interface used. This programming is done through menu C4.

Indication	Description
0 = Off	No action is taken; the equipment remains in the current status.
1 = Stop by Ramp	The ramp to stop command is executed, and the motor stops according to the programmed deceleration ramp.
2 = General Disable	The equipment is general disabled and the motor coasts to stop.
3 = Go to R1	The equipment is commanded to the remote 1 status.
4 = Go to R2	The equipment is commanded to the remote 2 status.

**NOTE!**

The alarm action will only have a function if the error tripping mode in C9.1.2.1 is programmed for Alarm.

C9.3 Serial RS-485

Configuration for the RS485 communication interface and the protocols that use this interface.

C9.3 Serial RS-485**C9.3.1 Protocol**

Range:	0 ... 3	Default: 2
Properties:	Stopped	

Description:

It selects the desired protocol for the RS-485 serial interface.

Indication	Description
0 = Not used	Not used.
1 = Modbus RTU Client	Modbus RTU client serial protocol.
2 = Modbus RTU Server	Slave Modbus RTU serial protocol.
3 = BACnet MS/TP	Slave BACnet MS/TP serial protocol.

**NOTE!**

After changing this property, the device must be turned off and back on to effect the modifications.

C9.3 Serial RS-485**C9.3.2 Address**

Range:	0 ... 255	Default: 1
Properties:	Stopped	

Description:

It selects the address used for the serial communication.

It is necessary that each device in the network have an address different from all the others.

**NOTE!**

After changing this property, the device must be turned off and back on to effect the modifications.

C9.3 Serial RS-485**C9.3.3 Baud Rate**

Range:	0 ... 5	Default: 1
Properties:	Stopped	

Description:

It selects the desired value for the baud rate of the serial interface in bits per second. This rate must be the same for all devices connected to the network.

Indication	Description
0 = 9600 bit/s	Rate of 9600 bits per second.
1 = 19200 bit/s	Rate of 19200 bits per second.
2 = 38400 bit/s	Rate of 38400 bits per second.
3 = 57600 bit/s	Rate of 57600 bits per second.
4 = 76800 bit/s	Rate of 76800 bits per second.

C CONFIGURATIONS

Indication	Description
5 = Not used	Not used.

C9.3 Serial RS-485

C9.3.4 Bytes Configuration

Range:	0 ... 5	Default: 1
Properties:	Stopped	

Description:

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



NOTE!

For BACnet, the only valid option is 0 = 8-bits, no, 1.

Indication	Description
0 = 8-bits, no, 1	8 bits, no parity, 1 stop bit.
1 = 8-bits, even, 1	8 bits, with even parity, 1 stop bit.
2 = 8-bits, odd, 1	8 bits, with odd parity, 1 stop bit.
3 = 8-bits, no, 2	8 bits, no parity, 2 stop bits.
4 = 8-bits, even, 2	8 bits, with even parity, 2 stop bits.
5 = 8-bits, odd, 2	8 bits, with odd parity, 2 stop bits.

C9.3 Serial RS-485

C9.3.5 RS-485 Timeout

Range:	0.0 ... 999.0 s	Default: 0.0 s
Properties:	Stopped	

Description:

Maximum time without communication.

C9.11 BACnet

Allows programming the BACnet network protocol settings using the built-in RS-485 serial port of the CFW900.

C9.11 BACnet

C9.11.1 BACnet Instance - High

Range:	0 ... 419	Default: 0
Properties:		

Description:

Defines the high part of the BACnet device instance.



NOTE!

After changing this property, the device must be turned off and back on to effect the modifications.

C9.11 BACnet

C9.11.2 BACnet Instance - Low

Range:	0 ... 9999	Default: 0
Properties:		

Description:

Defines the low part of the BACnet device instance.

The BACnet standard requires that the device instance be unique on the network and have a value between 0 and 4194304. The BACnet instance forms the Object Identifier property of the DEVICE object, which defines the device characteristics on the network. The BACnet instance can be set automatically or manually:

Automatically:

If the values of parameters C9.11.1 and C9.11.2 are 0 (factory default), the inverter automatically creates the BACnet instance based on the manufacturer's BACnet ID (WEG BACnet ID = 359) and on the serial address. In this configuration, the user only needs to enter the serial address in parameter C5.10.1. BACnet instance = BACnet ID + Serial Address

Example 1: serial address = 102

Instance = 359102

Example 2: serial address = 15

Instance = 359015

Manually:

The BACnet instance is defined using parameters C9.11.1 and C9.11.2. The content of the parameter C9.11.1 is multiplied by 10000 and added to the content of parameter C9.11.2.

Example 1: Instance = 542786

$542786 / 10000 = 54.2786$

C9.11.1 = 54 (integer part)

C9.11.2 = 2786 (decimal part)

Example 2: Instance = 66789

$66789 / 10000 = 6.6789$

C9.11.1 = 6 (integer part)

C9.11.2 = 6789 (decimal part)

Example 3: Instance = 35478

$35478 / 10000 = 3.5478$

C9.11.1 = 3 (integer part)

C9.11.2 = 5478 (decimal part)



NOTE!

After changing this property, the device must be turned off and back on to effect the modifications.

C9.11 BACnet

C9.11.3 Max BACnet Master

Range: 0 ... 127

Default: 127

Properties:

Description:

Defines the highest address used by the master.



NOTE!

After changing this property, the device must be turned off and back on to effect the modifications.

C CONFIGURATIONS

C9.11 BACnet

C9.11.4 Max Number of Frames

Range: 0 ... 255

Default: 1

Properties:

Description:

Defines the number of telegrams that the station can transmit when it receives the token. After that, it must transmit the token to the next station.



NOTE!

After changing this property, the device must be turned off and back on to effect the modifications.

C9.11 BACnet

C9.11.5 I Am Transmission

Range: 0 ... 1

Default: 0

Properties:

Description:

The I-Am telegram is used to identify the station on the BACnet network. When set to 1 (Continuous), the inverter transmits an I-Am telegram every 200 ms.

Indication	Description
0 = Power Up	The I-Am telegram is sent upon product power-up.
1 = Continuous	The I-Am telegram is sent continuously every 200ms.



NOTE!

After changing this property, the device must be turned off and back on to effect the modifications.

C9.11 BACnet

C9.11.6 BACnet Password

Range: 0 ... 9999

Default: 5

Properties:

Description:

Defines a password to validate the execution of the DM-RD-B service.



NOTE!

After changing this property, the device must be turned off and back on to effect the modifications.

C9.11 BACnet

C9.11.7 BACnet Device Name

Default: CFW900

Properties:

Description:

Configures the BACnet device name.

By default, the device name is CFW900.

The device name must consist of 1 to 15 alphanumeric characters.

**NOTE!**

After changing this property, the device must be turned off and back on to effect the modifications.

8 FAULTS AND ALARMS

Fault/Alarm	Description	Possible Causes
A128: Serial Communication Timeout	It indicates that the CFW900 stopped receiving telegrams on the serial interface for a period longer than the setting programmed in C9.3.5. Note: ■ Ensure that the master always sends telegrams to the equipment in a shorter time than that set in C9.3.5. ■ It can be disabled by setting C9.3.5=0.0 s.	■ Check the network installation for broken cables, faults, poor contact in the network connections and grounding.
F228: Serial Communication Timeout	It indicates that the CFW900 stopped receiving telegrams on the serial interface for a period longer than the setting programmed in C9.3.5. Note: ■ Ensure that the master always sends telegrams to the equipment in a shorter time than that set in C9.3.5. ■ It can be disabled by setting C9.3.5=0.0 s.	■ Check the network installation for broken cables, faults, poor contact in the network connections and grounding.



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