Schneider Electric

AB DF1 Protocol
XBT N/R/RT

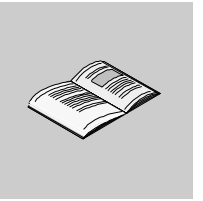
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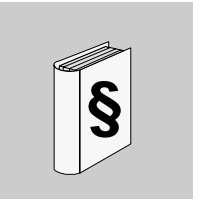
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Safety Information



Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

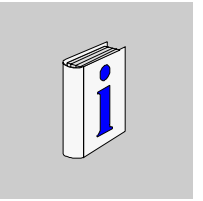
⚠ CAUTION
CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

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About the Book



At a Glance

Document Scope

This document describes communication between automation systems and the XBT N/R/RT product range using the AB DF1 protocol.

Validity Note

The data and illustrations found in this document are not binding. We reserve the right to modify our products in line with our policy of continuous product development. The information in this document is subject to change without notice and should not be construed as a commitment by Schneider Electric.

Related Documents

Title of Documentation	Reference Number
XBT N/R/RT Instruction sheet	W916810140111 A07
XBT N/R/RT User Manual	33003962
Vijeo-Designer Lite	Online help

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Product Related Information

Schneider Electric assumes no responsibility for any errors that may appear in this document. If you have any suggestions for improvement or amendments or have found errors in this publication, please notify us.

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All pertinent state, regional and local safety regulations must be observed when installing and using this product. For reasons of safety and to ensure compliance with documented system data, only the manufacturer should perform repairs to components.

Since the XBT N/R/RT terminals are not designed to pilot safety critical processes, no specific instructions apply in this context.

User Comments

We welcome your comments about this document. You can reach us by e-mail at techcomm@schneider-electric.com.

Compatibility

1

Compatibility

Overview

The DF1 protocol available for XBT terminals can be used to communicate with the following Allen Bradley process controllers:

- SLC-500
- Micrologix 1000
- Micrologix 1200
- Micrologix 1500

Operating Principle

2

Overview

This chapter describes the operating principle of XBT terminals in applications using the AB DF1 protocol.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop.
- Separate or redundant control paths must be provided for critical for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.*
- Each implementation of a Magelis XBT N/R/RT must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

*For additional information, refer to NEMA ICS 1.1 (latest edition), *Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control*

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
General Information on Bus Communications	13
Master / Slave Communication Principle	14
Communication of XBT Terminals with Allen Bradley PLCs	16

General Information on Bus Communications

Overview

The XBT terminals can be connected to PLCs using different protocols. This document describes the communication using the DF1 protocol with the XBT terminal acting as master.

Roles of XBT Terminals

The terminals are usually connected to a communication equipment (PLC or other) via a field bus. The XBT and the PLCs work autonomously of each other.

XBT terminals perform the following functions:

- monitoring function: XBT terminals visualize the processes that are active in the PLCs and indicate alarm states
- command function: XBT terminals send information to the PLC upon user request

Roles of Buses

A bus system provides the possibility to connect different devices via a unique cabling.

Roles of Protocols

The protocol defines the language that is used by all the equipment connected to the bus.

Master / Slave Communication Principle

Overview

DF1 communications are performed according to the master / slave principle that is described in the following.

Characteristics of the Master / Slave Principle

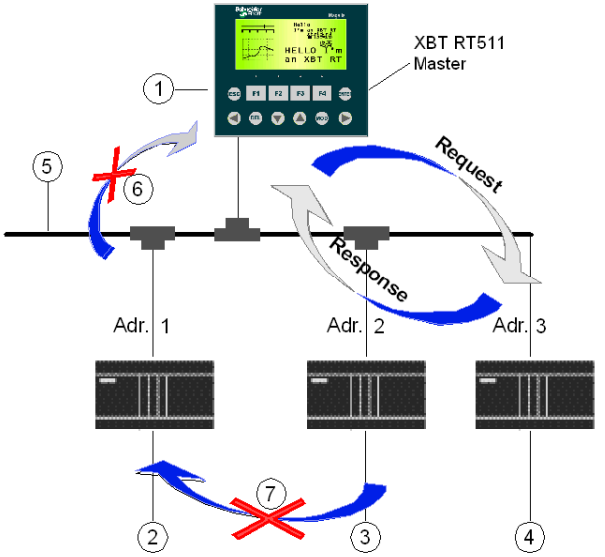
The master / slave principle is characterized as follows:

- Only one master is connected to the bus at a time.
- One or several slaves can be connected to the same serial bus.
- Only the master is allowed to initiate communication, i.e. to send requests to the slaves.
- In DF1 communications, the master can only initiate one DF1 transaction at the same time.
- The slaves can only answer requests they received from the master.
- The slaves are not allowed to initiate communication, neither to the master nor to any other slave.
- In DF1 communications, the slaves generate an error message and send it as response to the master if an error occurred in receipt of the message or if the slave is unable to perform the requested action.

Terminals acting as Master in DF1 Applications

In DF1 applications, the XBT terminal acts as master, whereas the PLCs act as slaves.

Master / Slave communication



1 XBT RT511
2 SLC–500 / Micrologix
3 SLC–500 / Micrologix
4 SLC–500 / Micrologix
5 DF1 bus
6 Slaves cannot initiate the communication
7 Slaves cannot communicate with other slaves

Communication of XBT Terminals with Allen Bradley PLCs

Overview

The XBT terminal is master.

The DF1 protocol is the communication protocol for Allen Bradley process controllers.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

The protocol must be installed and used by authorized and properly trained personnel.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Depending on the type of process controllers in the range, the dialog will be supported by different types of frames:

Type of Frame	Comment
specific ● SLC-500 or ● Micrologix 1000 / Micrologix 1200 / Micrologix 1500	If only SLC-500 or Micrologix 1000 / Micrologix 1200 / Micrologix 1500 process controllers communicate with the XBT terminal.
"BASIC COMMAND SET" generic frames	If different types of equipment such as SLC-500, Micrologix 1000 / Micrologix 1200 / Micrologix 1500 communicate with the XBT terminal.

Certain restrictions will apply to the access to the process controller data depending on the type of frame selected (see *Variable Types Supported, page 29*).

The dialog between the XBT terminal as master (requester of the exchange), and the equipment as slaves is of question/reply type.

Half/Full Duplex Link

The terminal automatically detects whether the link is of half duplex or full duplex type.

The XBT can be connected in point-to-point mode, or the network of 254 possible PLCs can be used via the polling system. This characteristic is transparent to the user and the XBT functions remain the same except for addressing which in the case of a point-to-point link is limited to the directly connected process controller.

Automatic Detection of Full Duplex

NOTE: It is important to note that the XBT should be connected to the network before turning on the power supply.

The polling detection mechanism is switched on when the XBT is powered on and switches off after about 30 s. This is why if the XBT is connected to the network when the mechanism is switched off, the controller will be automatically considered to be configured in Full Duplex and the XBT will behave as such.

Software Configuration

3

Overview

This chapter contains the protocol parameters you must configure in the Vijeo-Designer Lite software for operating XBT terminals in applications using the DF1 protocol.

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
Vijeo-Designer Lite	20
Protocol - AB DF1 Dialog Box	22
Configuring Equipment Addresses	24
DF1 Equipment Address Dialog Box	26

Vijeo-Designer Lite

Overview

Use the Vijeo-Designer Lite software to configure your XBT terminal for DF1 protocol applications.

⚠ WARNING

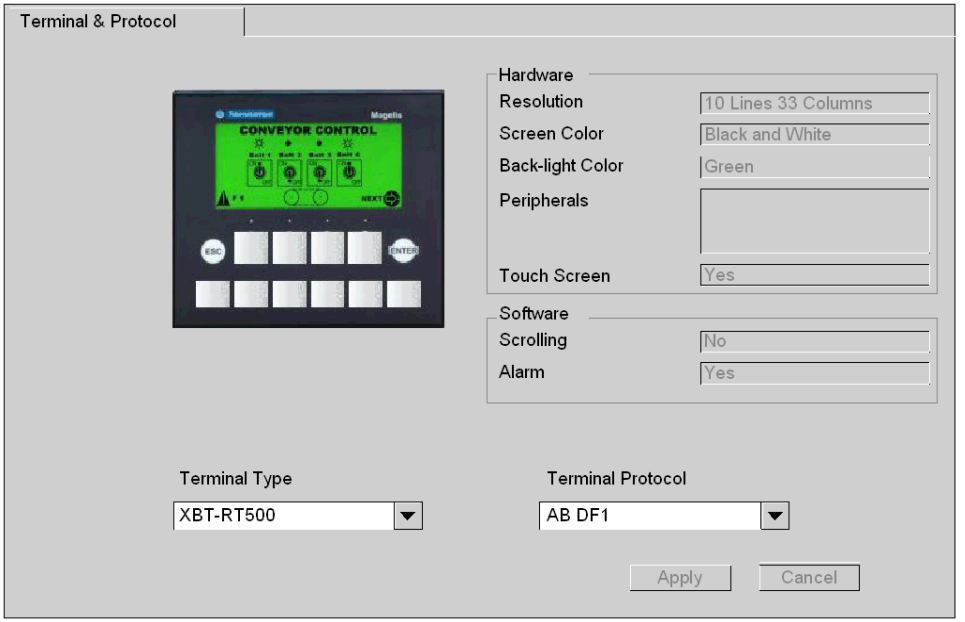
INCOMPATIBLE SOFTWARE

Use only Schneider Electric manufactured or approved software to program hardware.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Opening the Protocol - AB DF1 Dialog Box

To open the **Protocol - AB DF1** dialog box in Vijeo-Designer Lite for setting the protocol parameters, proceed as follows:

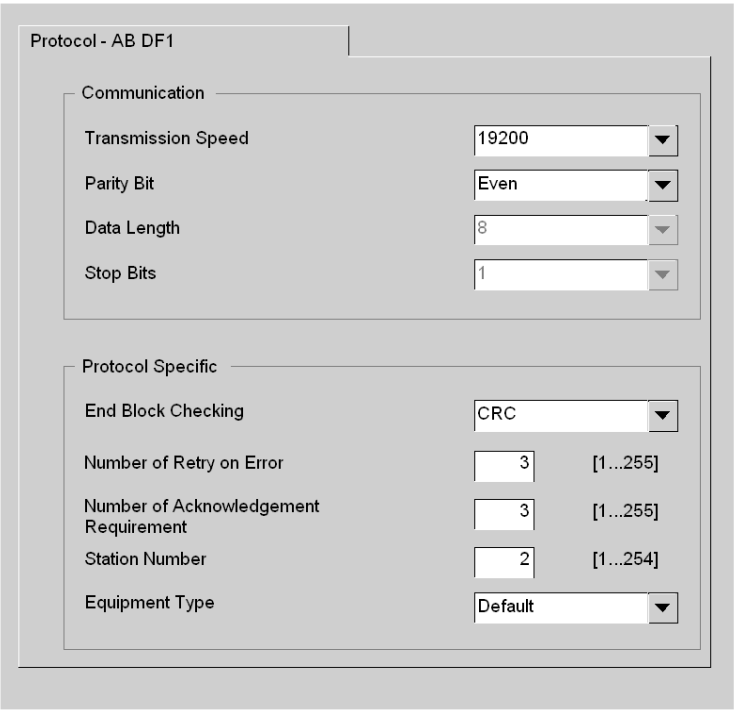
Step	Action
1	Start Vijeo-Designer Lite. To create a new application, continue with step 2, if you have already created a DF1 application, skip steps 2 and 3 and execute step 4.
2	From the application browser on the left-hand side of the Vijeo-Designer Lite window select the item **Configuration →Terminal & Protocol**. **Result**: The following dialog box will be displayed on the right-hand side of the Vijeo-Designer Lite window. 
3	From the **Terminal Protocol** list in the lower right corner select the item **AB DF1** and click **Apply**.
4	Select from the application browser the item **Protocol - AB DF1**. **Result**: The dialog box **Protocol - AB DF1** will be displayed on the right-hand side of the Vijeo-Designer Lite window where you can configure the protocol parameters for DF1 communication.

Protocol - AB DF1 Dialog Box

Purpose

Use this dialog box to configure the protocol parameters for DF1 communication.

Representation



Elements of the dialog box

Element	Description
Communication	
Transmission Speed	Select the transmission speed (in bit/s) on your DF1 bus from the list. Make sure to configure the same transmission speed for all devices connected to the bus.
Parity Bit	Select either even, odd or no parity. Make sure to configure the same parity value for all devices connected to the bus.
Data Length	You cannot edit this parameter because in DF1 communications the length of user data is always 8 bits.
Stop Bits	You cannot edit this parameter because in DF1 communications always 1 stop bit is used.
Protocol Specific	
End Block Checking	Select the detected error checking method (BCC or CRC) that should be executed. ● Select **BCC** (Block Check Character) for rapid, 8-bit format detected error checking. ● Select **CRC** (Cyclic Redundancy Checking) for less rapid but more reliable, 16-bit format detected error checking.
Number of Retry on Error	Enter the number of times the XBT terminal should resend a message to an equipment after it received a negative response from it.
Number of Acknowledgement Requirement	Enter the number of times the XBT terminal should request an acknowledgement from the equipment after a receive time out has been exceeded.
Station Number	Enter the unique address (between 1 and 254) of the XBT terminal in the network.
Equipment Type	Select the type of Allen Bradley PLC that should be addressed by the XBT terminal. If the XBT terminal should address different types of Allen Bradley PLCs, select the value **Default**.

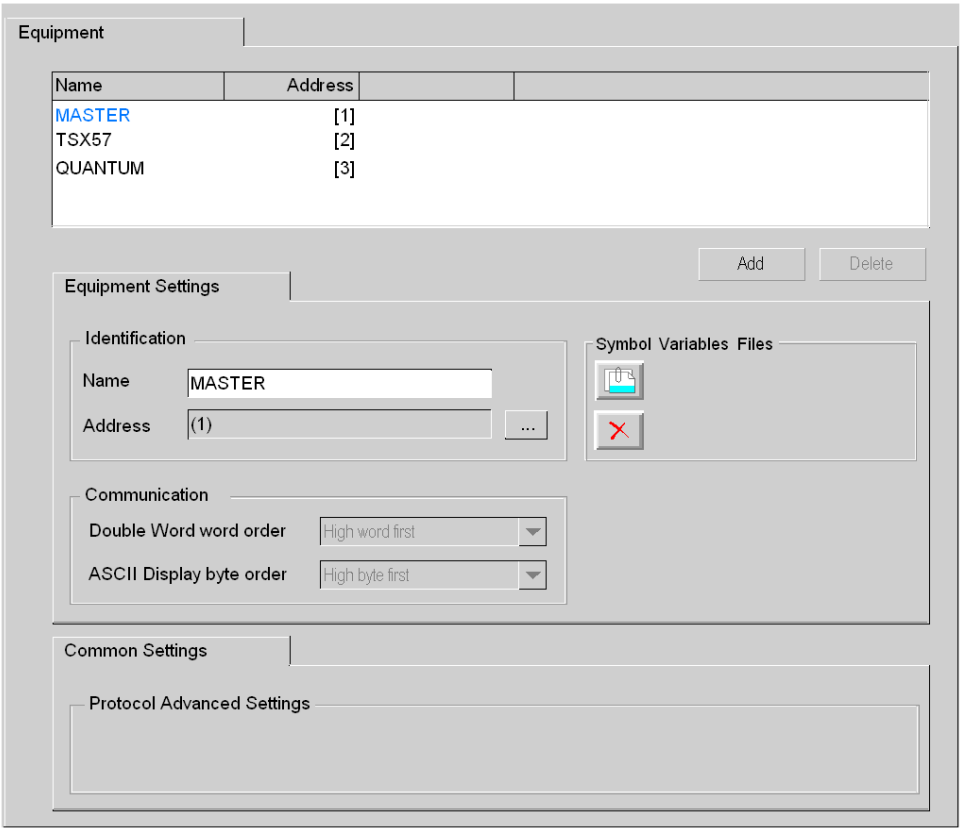
Configuring Equipment Addresses

Overview

Use the Vijeo-Designer Lite software to configure addresses for the equipment your XBT terminal should communicate with.

Opening the Equipment Address Dialog Box

To open the **Equipment Address** dialog box in Vijeo-Designer Lite for configuring AB DF1 equipment addresses, proceed as follows:

Step	Action
1	Start Vijeo-Designer Lite.
2	From the application browser on the left-hand side of the Vijeo-Designer Lite window select the item **Equipments**. **Result**: The following dialog box will be displayed on the right-hand side of the Vijeo-Designer Lite window. 
3	In the **Equipments** dialog box select a slave device from the list.
4	In the **Equipment Settings** →**Identification** box below click the **...** button right to the **Address** text box. **Result**: The dialog box **Equipment Address** will be displayed where you can configure an address for the selected equipment.

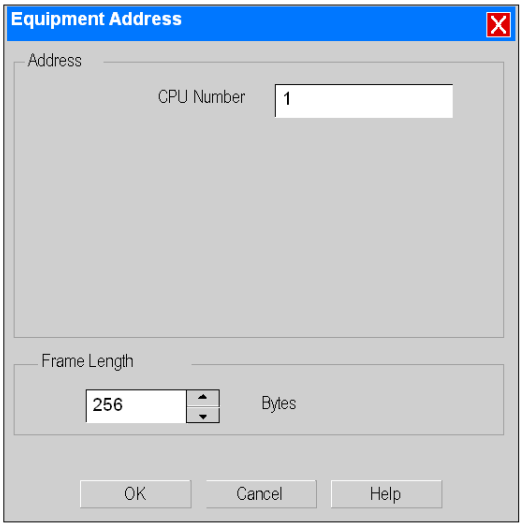
DF1 Equipment Address Dialog Box

Purpose

Use this dialog box to configure the address of equipments connected to the network.

Representation

DF1 equipment address



Elements of the dialog

Element	Description
CPU Number	Enter the CPU number (between 1 and 254) for the selected equipment.
Frame Length	Enter a value for the length of the frame (in bytes)
OK button	Click the **OK** button to assign the entered address to the selected equipment.
Cancel button	Click the **Cancel** button to discard the changes and to close the dialog box.
Help button	Click the **Help** button to open the Vijeo-Designer Lite online help.

NOTE: For the parameter **Frame Length** select a value that is at least equal to the largest variable length expected. If the value of the parameter **Frame Length** is smaller than the variable length the following errors will occur:

- PLC read/write operations will fail
- question marks will be displayed on the XBT terminals instead of values

Variable Types Supported

4

Variable Types Supported

Table of Variable Types Supported by the XBT

The following table lists all DF1 variables XBT terminals can access.

Variable Type Supported	DF1 Syntax
Bit	Nf:i/j
Word	Nf:i
Double Word	= word
Floating	Ff:i
String	= word

Identifiers

- f : 7...255
- i : 0...255
- j : 0...15

File Number f

Indicates the number of the file in the process controller that the operator wishes to access.

Depending on the choice of process controller type, the possible file number will be:

Process Controller Type	File Number
Default (Basic Command Set)	• for an SLC-500 use 9 • for a PLC-5 this number corresponds to the transmitter's network address
PLC-5	between 9 and 255
SLC-500	between 9 and 255
• Micrologix 1000 • Micrologix 1200 • Micrologix 1500	7

Index i

Indicates the item number in the selected file.

NOTE: If you use the Basic Command Set this item number may be interpreted differently according to the type of process controller. For further information refer to your process controller's technical documentation.

Index j

It will only be possible to access this field if the selected data type is Nf:i/j.

It indicates the bit's row in the word (selected by means of the i field).

Cables and Connectors

5

Overview

This chapter specifies the cables and connectors required for XBT terminals in DF1 applications.

What's in this Chapter?

This chapter contains the following topics:

Topic	Page
Cables	32
SUB-D 25 Pin Connections	33

Cables

Technical Data

The following table lists the cables required to connect XBT terminals to the different Allen Bradley devices.

Connected Device	XBT Type	Cable Reference	Length and Type
SLC–5	XBT N401/N410 XBT R410/R411 XBT RT500/RT511	XBT Z9730*	2.5 m (98.45 in.) (SUB-D25 <--> SUB-D9)
Micrologix	XBT N401/N410 XBT R410/R411	XBT Z9731	2.5 m (98.45 in.) (SUB-D25 <--> Micrologix 1000)
	XBT RT500/RT511	XBT Z9733**	2.5 m (98.45 in.) (RJ45 <--> Micrologix 1000)

*

- **XBT RT 511**: you must add a XBT ZG939 cable adapter (SUB-D25 <-> RJ45)
- **XBT RT 500**: you must add a XBT ZG939 cable adapter (SUB-D25 <-> RJ45) and a XBT ZRTPW for power supply.

** **XBT RT 500**: you must add a XBT ZG939 cable adapter for power supply.

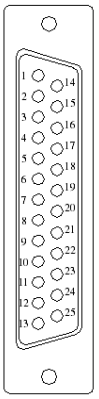
SUB-D 25 Pin Connections

Overview

The following XBT terminals provide a SUB-D25 connector on their rear panels:

- XBT N401
- XBT N410
- XBT R410
- XBT R411

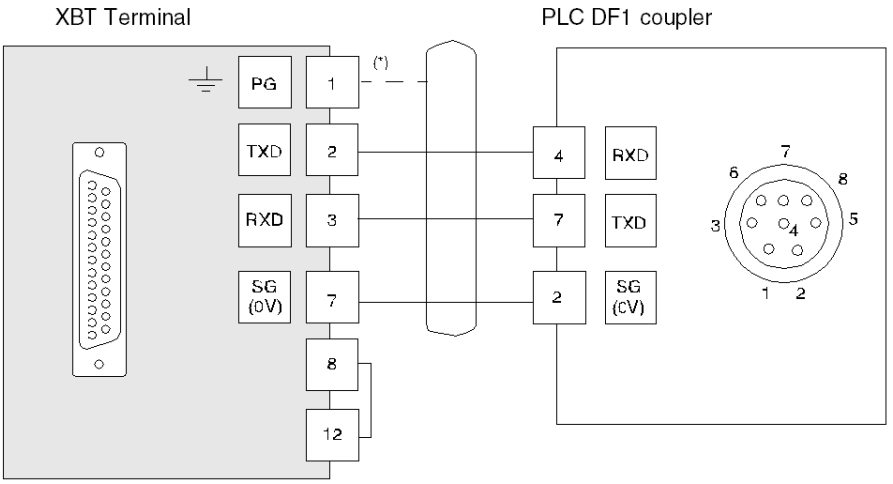
The SUB-D25 connector supports RS232 lines for connections to Allen Bradley PLCs. The pin assignment is shown in the following figure.



1	⏚
2	TXD
3	RXD
4	0
5	1
6	
7	0V iso
8	COM
9	
10	
11	
12	IN2
13	IN1
14	B0
15	B1
16	B2
17	B3
18	
19	B4
20	
21	
22	0V iso
23	
24	PAR
25	

Connection to Micrologix 1000, 1200 and 1500 via XBT Z9731

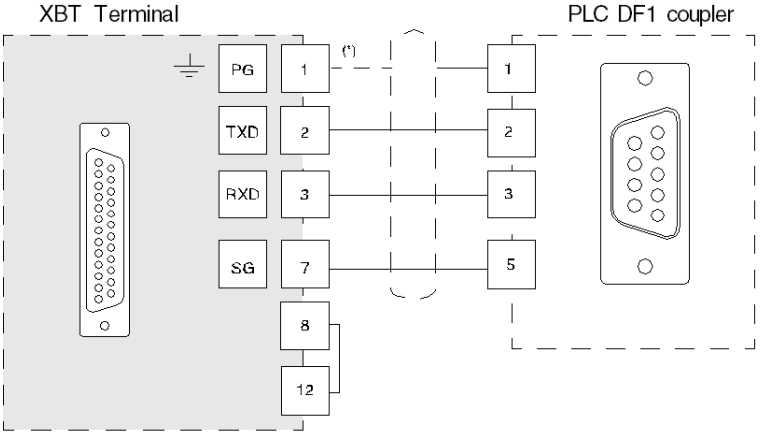
The illustration below shows the cabling for Micrologix 1000, 1200 and 1500 using cable XBT Z9731.



(*) Connection of the shielding at both ends depends on any electrical restrictions affecting the installation.

Connection to SLC–500 via XBT Z9730

The illustration below shows the cabling for SLC–500 using cable XBT Z9730.



(*) Connection of the shielding at both ends depends on any electrical restrictions affecting the installation.

Diagnostics

6

XBT Detected Error Indication

Overview

XBT terminals indicate detected errors in different ways

- by displaying question marks ?????? in alphanumerical fields
- by displaying crosses for graphic objects
- by displaying hash characters in alphanumerical fields
- by blinking alphanumerical fields
- by issuing system error messages

The following paragraphs list these three detected errors and their possible reasons.

Question Marks and Crosses

When question marks ?????? and crosses XXXXXX are displayed on the display of your XBT terminal, a transmission error has occurred. To correct this, check the following:

If...	**Then ...**
question marks are displayed	verify that all cables are correctly connected.
question marks are displayed	verify that the communication parameters set in the **Protocol - AB DF1** dialog box are identical for all equipment connected to the bus i.e. same transmission speed, same use of parity.
question marks are displayed	the XBT terminal may have received no response from the PLC.
question marks are displayed	the XBT terminal may have received an exception response from the PLC.

Hash Characters

Hash characters displayed in alphanumerical fields on your XBT terminal indicate that the value to be displayed is too long for this alphanumerical field and cannot completely be displayed. The value `100` can, for example, not be displayed in a 2-digit alphanumerical field. To correct this problem, enter a shorter value or adapt the size of the alphanumerical field so that it can display any of the possible values of the PLC variable.

Blinking Alphanumerical Fields

Blinking alphanumerical fields on your XBT terminal indicate that the value of this field has exceeded or fallen below a user-defined threshold.

System Error Messages

A variety of system error messages is by default configured for the terminals. All these standard system messages are assigned a panel number 200+x. A distinction is made between system error messages indicating communication interruptions and status messages provoked by inputs at the terminal.

These 2 message types differ by the numbers they are assigned and by the way they are displayed at the terminal as shown in the list below:

System Error Message Caused by:	System Error Message Numbers	Display Mode
Communication Interruptions	201– 204	To indicate that a communication interruption has occurred, the message is displayed in a popup dialog box every 10 seconds.
Input at Terminal	241 – 258	The status message is displayed as a response to user input at the terminal.

Messages Caused by Communication Interruptions

Messages 201 to 204 are issued by the terminal to indicate that a communication interruption has occurred. They are displayed in a popup dialog every 10 seconds.

If...	Then ...
message `201: DIALOG TABLE AUTHORIZATION INCORRECT` is displayed	the authorization word in the dialog table does not have the expected value. (Refer to the Vijeo-Designer Lite online help for information on how this word is working.) To correct this problem verify that:. ● you are connected to the right PLC ● the memory of your PLC is not corrupted ● the correct value is saved on the PLC
message `202: DIALOG TABLE WRITING IMPOSSIBLE` is displayed	the write cycle to the dialog table of the PLC could not be ended. This condition may have the following causes: ● too much load on the communication bus ● EMC disturbances on the communication bus
message `203: DIALOG TABLE READING IMPOSSIBLE` is displayed	the read cycle from the dialog table of the PLC could not be ended. This condition may have the following causes: ● too much load on the communication bus ● EMC disturbances on the communication bus

Messages Caused by Input at the Terminal

Messages 242 to 254 issued by the XBT as a response to user input at the terminal. These messages are displayed directly after the operator has sent an incorrect command to the terminal and will persist until the user has corrected the entered command or value. Messages 255 to 258 are status messages displayed after the user has initiated an operation at the terminal to indicate that it has (or has not) been accepted and is in progress.

If...	Then ...
message `241: IMPOSSIBLE TO READ VARIABLE` is displayed	the terminal has attempted to read a variable and could not retrieve its value. This condition may have the following causes: ● too much load on the communication bus ● EMC disturbances on the communication bus
message `242: IMPOSSIBLE TO WRITE VARIABLE` is displayed	the terminal has attempted to write in a memory area of the equipment and has received a negative acknowledgement or no acknowledgement at all. This condition may have the following causes: ● too much load on the communication bus ● EMC disturbances on the communication bus

If...	Then ...
messages 243 to 249 are displayed	correct the value or command you have entered as indicated.
message 250: LANGUAGE IMPOSED BY PLC is displayed	the PLC forces the terminal to use a language. This language cannot be changed by the operator. For more information see the Vijeo-Designer Lite online help, functions of the dialog table.
messages 251 or 252 are displayed	correct the value or command you have entered as indicated.
message 253: PASSWORD IMPOSED BY PLC is displayed	you cannot change the password at the terminal because it is forced by the PLC. For more information see the Vijeo-Designer Lite online help, functions of the dialog table.
message 254: PROTECTED ACCESS PAGE is displayed	you are trying to access a page that is password protected but you do not have the required authorization level.
messages 255 to 258 are displayed	the commands you entered at the terminal are executed or not executed, as indicated in these status messages.

Diagnosis Counters

3 diagnosis counters can be displayed on the protocol's system page (line parameters):

Number	Meaning
1	number of responses received without any FCS error
2	number of responses received with any FCS error
3	number of requests that have not been answered

NOTE: The counters no. 4...8 are not used and remain at 0.

Appendices



RS232/RS485 Recommendations

A

Overview

This chapter decribes the RS232/RS485 recommendations.

What's in this Chapter?

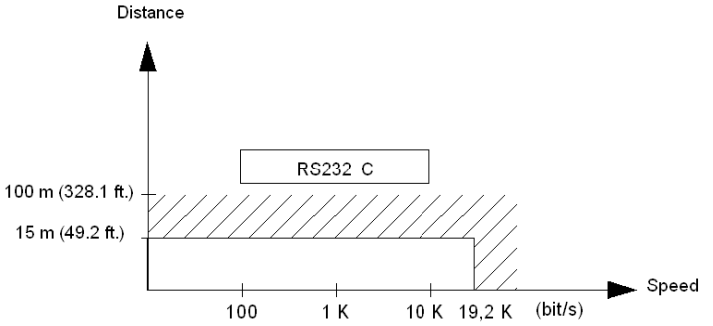
This chapter contains the following topics:

Topic	Page
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RS232 Recommendations

Diagrams for RS232C Link

RS232C link



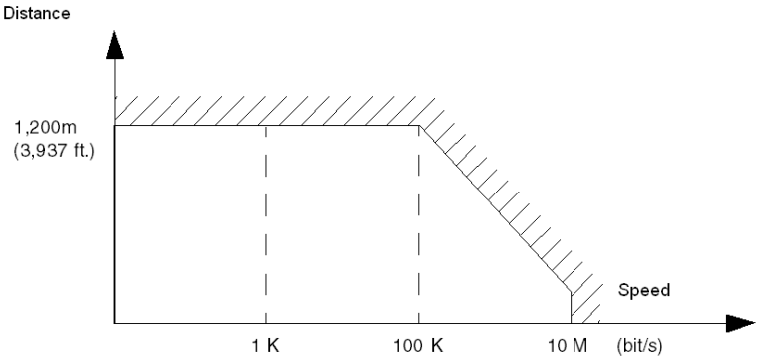
- Maximum length for the link is 15 m (49.2 ft.).
- Wiring = 3 shielded wires with a minimum cross-section of 0.6 mm^2 (AWG22)

NOTE: The maximum length including the RS232 link is 15 m (49.21 ft.), provided that the equipment connected to the XBT terminal is not subject to more stringent restrictions (refer to connected devices instruction sheet) and for XBT RT500 provided that the length of the cable is below 10 m (32.8 ft.) (because power is also supplied by this cable).

RS485 Recommendations

Diagrams for RS485 Link

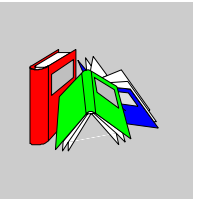
RS485 link



- Maximum length for the link is 1,200 m (3,937 ft.).
- Wiring = 2 shielded twisted wires with a minimum cross-section of 0.6 mm^2 (AWG22) and one 0 V wire

NOTE: The maximum length including the RS485 link is 1,200 m (3,937 ft.), provided that the equipment connected to the XBT terminal is not subject to more stringent restrictions (refer to connected devices instruction sheet) and for XBT RT500 provided that the length of the cable is below 10 m (32.8 ft.) (because power is also supplied by this cable).

Glossary



A

AWG

American wire gauge (wire diameter)

F

FCS

frame check sequence

M

Magelis

Generic commercial name of the range of Schneider HMI terminals.

P

PLC

programmable logic controller

R

RS232

recommended standard for connecting serial devices = EIA/TIA 232

RS422

recommended standard for connecting serial devices = EIA/TIA 422

V

Vijeo-Designer Lite

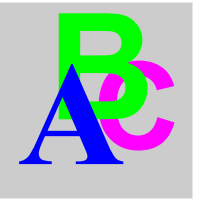
Configuration software for the low end Magelis range. It replaces the XBT-L1000 software.

X

XBT

Any HMI terminal (when it is not necessary to make a distinction).

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