

Connecting Unitronics PLCs to Danfoss VLT Frequency Converters

Introduction

This document, together with the VisiLogic sample application Danfoss Drive Protocol.vlp shows you how to establish communications between a Unitronics Vision PLC and Danfoss Drive VLT Frequency Converter from series 2800/5000/6000.

The application Danfoss Drive Protocol.vlp includes a subroutine, Danfoss Handler, which implements the Danfoss communication protocol.

The following operands are used in the Danfoss Handler subroutine. Do not use these operands in other parts of the application, and avoid overwriting them.

MI550, MI551.

MI598 - MI700.

MB550 -MB553.

MB600 – MB610.

About the DanFoss Serial Communication Protocol

The protocol is detailed in pages 92-110 in the document Danfoss VLT 5000 Design Guide.pdf.

In general, all messages, or ‘telegrams’ communicated between the PLC and the Frequency Converter contain a ‘Process Block’

A telegram sent from the PLC to the Frequency Converter contains the Control Word and the Serial Communication Reference Word. The 16 bits of the Control Word provide a bitmap, The status of these bits sets a particular parameter in the Frequency Converter, according to the tables shown in the Danfoss VLT 5000 Design Guide.pdf.

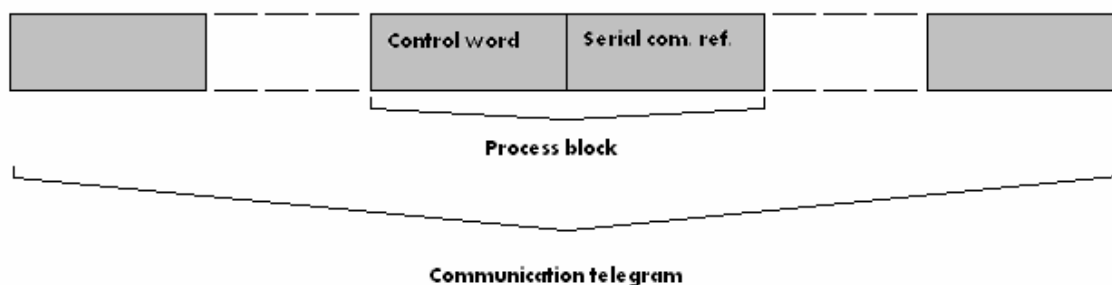


Figure 1. PLC to Frequency Converter

When the Danfoss Frequency Converter answers, the Process Block contains the Status Word and the Output Frequency Word. The bit status within the Status Word gives the PLC data regarding the Frequency Converter's mode.

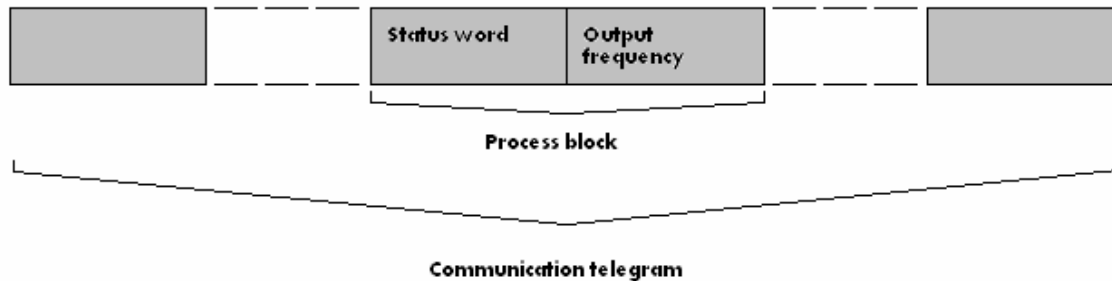


Figure 2. Frequency Converter to PLC

To learn more about the protocol and block structures, refer to the Danfoss VLT 5000 Design Guide.pdf:

- Control Word, pages 97-98
- Status Word, pages 99-100
- Serial Communication Reference Word, p102
- Present Output Frequency, p103

Note that the Serial Communication Reference Word is an integer (± 32767), which in turn corresponds to $\pm 200\%$ of the reference range. The minimum and maximum reference are stored in parameters 204 and 205 respectively. If, for example, the minimum is set to 0[Hz] and the maximum to 50[Hz], while the Serial Communication Reference Word is set to 2000[Hex], the motor will run with a frequency of approximately 25[Hz] ($\pm$ slip compensation). If other references are active, such as the analog reference, this will be added to the serial reference.

The user assigns an integer decimal value in the Serial Communication Reference Word while any conversions needed are implemented by the subroutine.

The value of the Frequency Converter's current output frequency is transferred as an integer value (± 32767), which in turn corresponds to $\pm 200\%$ of its range.

In order to change the direction of rotation, assign the Serial Communication Reference Word a negative value, while the two's complement conversion is automatically being dealt with in the Danfoss Handler subroutine..

Please refer to Danfoss VLT 5000 Design Guide.pdf regarding parameters 201 and 202 (Output frequency low limit and output frequency high limit).

Two types of operations can be associated with the Process Block:

- Using the process words (Control Word and Serial Communication Reference) in all telegrams, in the Read\Write parameter telegrams and obviously in the Process Block telegrams. If this method is chosen, all transmissions must explicitly define the value of the Process Block word (control word + serial communication reference word). In addition note that MB503 must be **set** as shown in the VisiLogic application.
- Recommended - Omitting the process word data by zeroing the Process Block word (= resetting MB510-MB525 and setting the appropriate serial com. Ref. word to 0). Note that in this case MB503 must be **reset** as shown in the VisiLogic application.

Since all Process Block related commands are implemented according to the Danfoss FC profile, parameter 512 – Telegram Profile, must be set to FC protocol [1].

Note

All read and write parameters must be pre-calculated (write) and post-calculated (read) according to the conversion factors explained in the Danfoss Design Guide.

Hardware connection

The communication physical layer is RS485. To learn about Vision controller serial communication options, please refer to the Visilogic help files.

The PLC RS485 TX\RX+ signal needs to be connected to the Danfoss RS485 positive signal (e.g. pin #68 over the VLT2800 platform) , while the PLC RS485 TX\RX- signal must be connected to the Danfoss RS485 negative signal (e.g. pin #69 over the VLT2800 platform).

Note that both the PLC and Frequency Converter must use identical serial communication parameters (baud rate, parity, data bits, stop bit).

In the VisiLogic Ladder application, the Vision COM port is initialized to the desired parameters via a COM Init function (see Appendix A). To learn how to set the Danfoss Frequency Converter communication parameters, please refer to the Danfoss Design Guide.

Communication options (Commands)

The VisiLogic Danfoss Handler subroutine runs three communication commands:

- Read Parameter – used to read the Frequency Converter’s parameter values.
- Write Parameter – used to write (modify) to the Frequency Converter’s parameter values.
- Process Block – used to control the Frequency Converter and receive the Process Block returned data (status and output frequency) from the Frequency Converter.

Note that the Read\Write parameter commands can also be used to control the drive. These commands also contain the Process Block data, and receive the Process Block returned data.

Read Parameter

The sample VisiLogic application sends a Read Parameter request, or telegram, to the Frequency Converter. In the VisiLogic application, the values from the controller's memory operands are stored into the parameters for the Read Parameter command as listed below:

1. Read parameter drive ID (stored in MI500)
As a device within the RS485 network, the Frequency Converter must be assigned a unique ID number.
The range of possible address is 1 to 31.
2. Read enumeration (stored in MI501)
This must be set to 1 in order to read a parameter value.
3. Read parameter number (stored in MI503)
This is the number of the parameter value to be read, for example 520, motor current.
4. Read parameter index (stored in MI504)
Some parameters have an index, for example parameter 615 (Error code) can be set to read the first error code, by setting the index register to 1.
5. Read parameter timeout (stored in MI505)
The Read parameter command timeout is set in units of 100mS. For example, to set the time out to a value of 1 second, the timeout register must have the value of 10.
Note that the Default timeout value is set by the subroutine to $10 \times 100\text{mS} = 1 \text{ second}$.
6. Read parameter retries (stored in MI506)
The number of retries that will be made if no response is received from the Frequency Converter.
Note that the Default retries value is set by the subroutine to 3.
7. Read parameter Control Word (MB510 – MB525)
The control word is constructed by the subroutine according to the bits order and values of MB510 to MB525. Please refer to the Danfoss VLT 5000 Design Guide.pdf, pages 97-98 for a full explanation of the Control Word.
8. Read parameter serial communication reference word (stored in MI511)
The serial communication reference is an integer (+/-32767) which in turn corresponds to +/-200% of the reference range.

After assigning values to all of the Read parameters, MB500 must be set for the telegram to be sent. MB500 is automatically reset by the subroutine when the communication session ends.

Read Parameter response from the Frequency Converter

When the controller receives a response from the Frequency Converter, or when the timeout time and number of retries has been exceeded, the subroutine will return the following operand values:

1. Read parameter result code (stored in MI507)
The result code indicates the success or failure of the communication session.
Possible values:
1000 – The Frequency Converter responded, but without a response indication.
2000 – Transmission was successful. In this case, the required parameter value is stored in the Read parameter response (LOW) word (MI508) and in Read parameter respond (HIGH) word (MI509) according to the parameter format, word\double word.

Also, the status word and the output frequency can be referred to as valid values.
3000 – No response from the Frequency Converter. Please refer to Appendix B – troubleshooting.

Fault codes include:

0,1,2,3,4,5,17,130,131 – please refer to the Danfoss Design Guide, page 94.

2. Read parameter response (LOW) & Read parameter response (HIGH) (stored in MI508 & MI 509): When transmission is successful (result code = 2000), the parameter value will be stored here, according to the parameter format, word\double word.
3. Read parameter status word (stored in MB530 – MB545)
The status word gives the user some indication of the Frequency Converter's status. For information about the status word, please refer Danfoss Design Guide, page 100.
4. Read parameter output frequency (stored in MI512)
The value of the Frequency Converter's current output frequency is transferred as an integer value (+\-32767), which in turn corresponds to +\ -200% of its range.

Write Parameter

The sample VisiLogic application sends a write Parameter request, or telegram, to the Frequency Converter. In the VisiLogic application, the values from the controller's memory operands are stored into the parameters for the Read Parameter command as listed below:

1. Write parameter drive ID (stored in MI500)
As a device within the RS485 network, the Frequency Converter must be assigned a unique ID number.
The range of possible address is 1 to 31.
2. Write Broadcast (stored in MI521)
The PLC can broadcast a write parameter telegram simultaneously to all networked Frequency converters. In order to send a Broadcast telegram, MI521 must contain the value 1.
Note that when a broadcast message is received by the Frequency Converters, they do not send a response to the PLC.
3. Write enumeration (stored in MI522)
The write enumeration register must be assigned one of the following values:
2 – Write parameter value in RAM (word).
3 - Write parameter value in RAM (double word).
13 – Write parameter value in RAM and EEPROM (double word).
14 – Write parameter value RAM and EEPROM (word).
4. Write parameter number (stored in MI523)
The number of the required parameter value, for example 202, output frequency high limit.
5. Write parameter index (stored in MI524)
If the parameter to write to is indexed, the parameter index register must be assigned.
6. Write parameter timeout (stored in MI525)
The read parameter command timeout is set in units of 100mS, for example to set the time out to a value of 1 second the timeout register must have the value of 10.
Default timeout value is set by the subroutine to 10 x 100mS = 1 second.

7. Write parameter retries (stored in MI526): the amount of retries up on no respond from the drive.
Default retries value is set by the subroutine to 3.
8. Write parameter value (Low word) & Write parameter value (High word) (stored in MI530 & MI531 respectively)
The value to be sent to the VLT parameter, ex. writing the value 1000 to parameter 202, 1000 decimal must be assigned to MI530.
9. Write parameter control word (MB510 – MB525)
The control word is constructed by the subroutine according to the bits order and values of MB510 to MB525.
Please refer to the Danfoss VLT 5000 Design Guide.pdf, pages 97-97 for a full explanation of the Control Word.
10. Write parameter serial communication reference word (stored in MI533): Please refer to the Serial Communication Reference explanation above.

After assigning values to all of the Write parameters, MB501 must be set in order to send the telegram to the Frequency Converter. MB501 will be automatically reset by the subroutine after the end of the communication session.

Write Parameter response from the Frequency Converter

When the controller receives a valid response from the Frequency Converter or in case of timeout x retries time expiration, the subroutine will return the following operand values:

1. Write parameter result code (stored in MI527)
The result code indicates the success or failure of the communication session.
Possible values:
1000 – The Frequency Converter responded, but without a response indication.
2000 – Transmission was successful.
In this case, the Write parameter response (LOW) word (MI528) and the Write parameter respond (HIGH) word (MI529) will contain the values of the Write parameter value (Low word) & Write parameter value (High word) respectively. Note that the status word and the output frequency can be referred to as valid values.
3000 – No response from the Frequency Converter. Please refer to Appendix B – Troubleshooting.
0,1,2,3,4,5,17,130,131 – in some cases the VLT might respond with fault code values. For information, please refer to the Danfoss Design Guide, page 94.
2. Write parameter status word (stored in MB530 – MB545):
The status word indicates the status of the Frequency Converter.
For information about the status word, please refer to the Danfoss Design Guide, page 100.
3. Write parameter output frequency (stored in MI535):
Please refer to the explanation above.

The Process Block

When the Process Block is sent from the controller to the Frequency Converter, the VisiLogic application stores operand values into the Process Block's parameters.

1. Write parameter drive ID (stored in MI540)
As a device within the RS485 network, the Frequency Converter must be assigned a unique ID number.
The range of possible address is 1 to 31.
2. Process Block Broadcast (stored in MI541)
The PLC can broadcast a write parameter telegram simultaneously to all networked Frequency converters. In order to send a Broadcast telegram, MI541 must contain the value 1.
Note that when a broadcast message is received by the Frequency Converters, they do not send a response to the PLC.
3. Process Block timeout (stored in MI546)
The read parameter command timeout is set in units of 100mS, for example to set the time out to a value of 1 second, the timeout register must have the value of 10.
Default timeout value is set by the subroutine to $10 \times 100\text{mS} = 1 \text{ second}$.
4. Process Block retries (stored in MI547)
The number of retries that will be made if no response is received from the Frequency Converter.
Note that the Default retries value is set by the subroutine to 3.
5. Process Block Control Word (MI 542)
The control word is constructed by the subroutine according to the bits order and values of MB510 to MB525. Please refer to the Danfoss VLT 5000 Design Guide.pdf, pages 97-98 for a full explanation of the Control Word.
6. Process Block serial communication reference word (stored in MI543)
The serial communication reference is an integer (+\ -32767) which in turn corresponds to +\ -200% of the reference range.

Process Block Frequency Converter response

When the controller receives a response from the Frequency Converter, or when the timeout time and number of retries has been exceeded, the subroutine will return the following operand values:

1. Process Block result code (stored in MI548)
The result code indicates the success or failure of the communication session.
Possible values:
2000 – Transmission was successful. The status word and the output frequency can be referred to as valid values.
3000 – No response from the Frequency Converter. Please refer to Appendix B – troubleshooting.
2. Process Block status word (stored in MB530 – MB545)
The status word gives the user some indication of the Frequency Converter's status. For information about the status word, please refer Danfoss Design Guide, page 100.
3. Process Block output frequency word (stored in MI545)
Please refer to the explanation above.

Appendix A

Setting the Unitronics PLC Communication Port Parameters

To initialize the Vision PLC communication port, include a COM Init function, located on the Communication menu, in your VisiLogic application as shown below. For more information, please refer to the VisiLogic Help file topic 'COM Port: Init'.

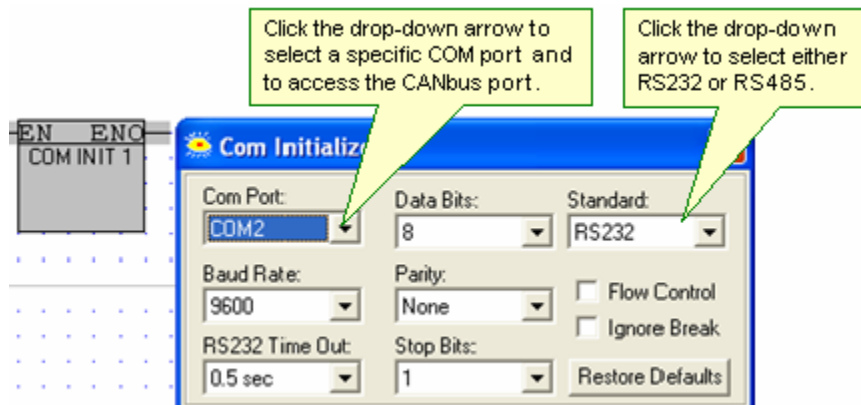


Figure 3. COM Port Initialization

Appendix B

Troubleshooting

If the Frequency Converter does not send a response, the Process Block result code will be 3000. In this case, please check the factors listed below.

- The RS485 two-wire connection is as described in Hardware connection, page 3.
- The PLC is sending to the correct Frequency Converter network ID number.
- All serial communication parameters (baud rate , parity , stop bit , data bits) are identical at both the PLC and the Frequency Converter.
- If the PLC is connected directly to the Frequency Converter via its RS485 port signals, and not via an RS485\RS232 converter, the COM Init function must be set to RS485 as shown below.

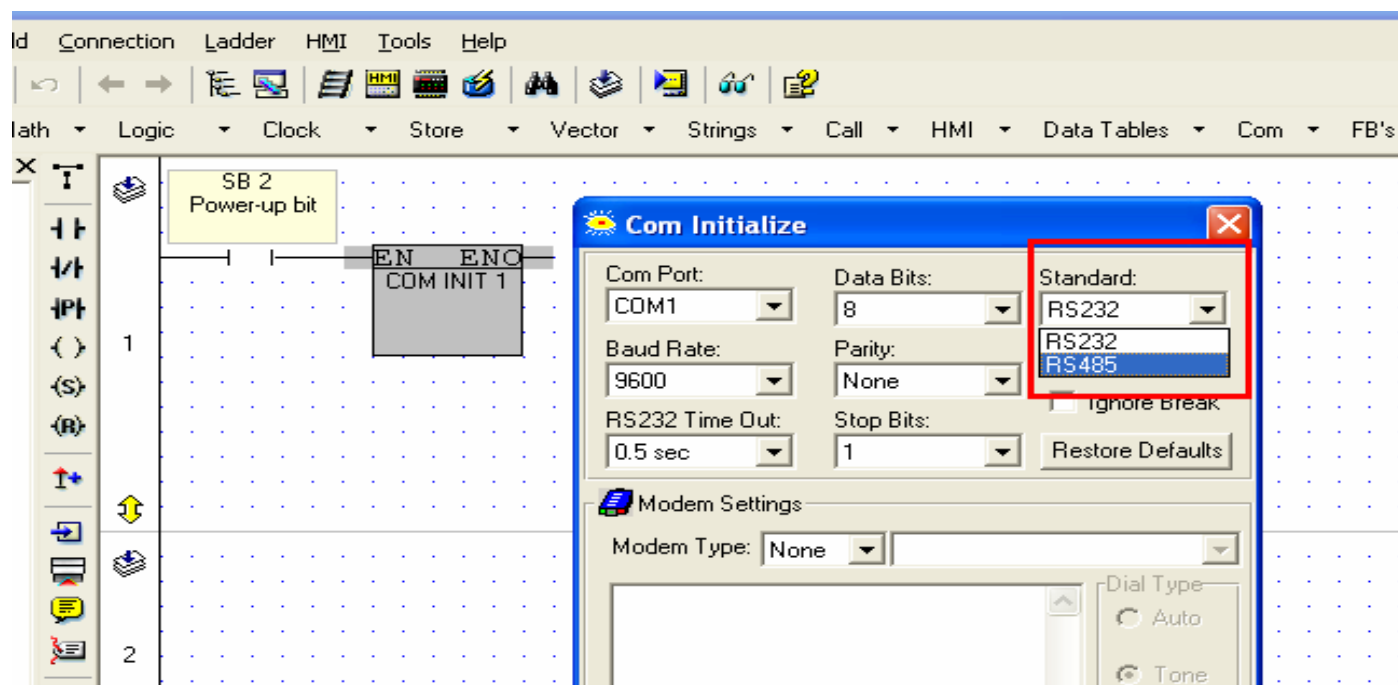


Figure 4. COM Port Initialization

- You may also try increasing the command timeout and retries, for example, setting Timeout = 30 (3 second) , retries = 5.