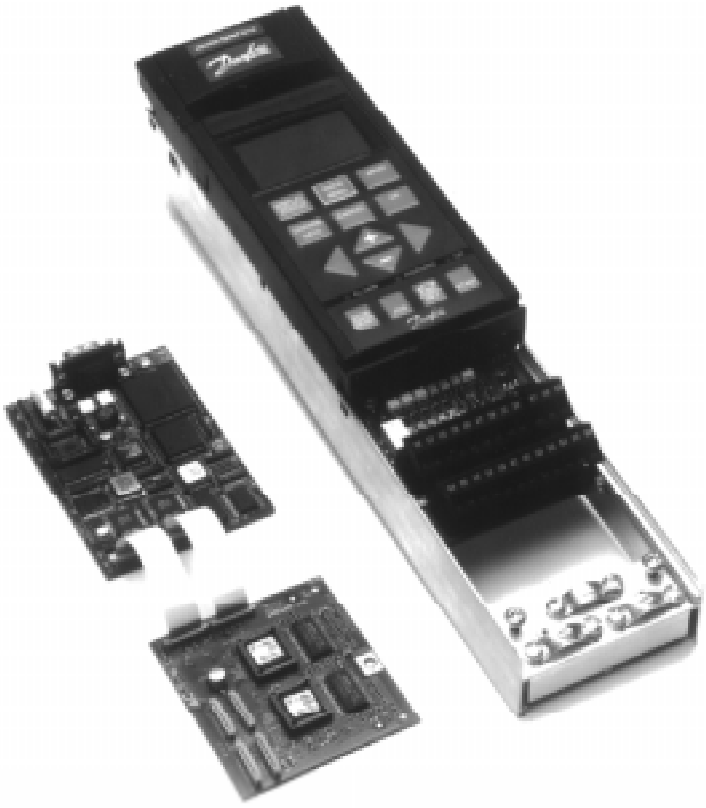
Drives and Controls

Danfoss

Modbus Plus



VLT® 5000 Series
Modbus Plus Option Card
Installation & Operation Manual

VLT® 5000 Series

The Modbus Plus Option Card Manual

Contents

Product Overview

Introduction

The documentation in this manual is intended to provide you with comprehensive information on how to set up your Modbus Plus Option Card for communication over a Modbus Plus communication link.

About this manual

This manual is intended to be used both as an instructional and a reference manual. It only briefly touches on the basics of the Modbus Plus protocol whenever it is necessary for gaining an understanding of the Modbus Plus Option Card for the Danfoss VLT 5000 Series.

This manual is also intended to serve as a guideline when you specify and optimize your communication system. The list of contents is also a decision route that will guide you through the decisions you have to make before you set up your system.

Even if you are an experienced Modbus Plus programmer, we suggest that you read this manual in its entirety before you start programming, since important information can be found in all sections.

Assumptions

This manual assumes that you are using a Modbus Plus Option Card in conjunction with a Danfoss VLT 5000 Series Drive. It is also assuming that you as a master, are using a PLC or PC that is equipped with a serial communication card supporting all the Modbus Plus communication services required by your application. Also all requirements stipulated in the Modbus Plus standard as well as well as those pertaining to the VLT Variable Speed Drive, are strictly observed as well as all limitations therein fully respected.

What you should already know

The Danfoss Modbus Plus Option Card is designed to communicate with any master abiding by the Modbus Plus standard. It is therefore assumed that you have full knowledge of the PC or PLC you intend to use as a master in your system.

Agency Approval

The Modbus Plus Option Card is UL listed and cUL approved.

The Modbus Plus Option card is CE pending, consult factory.

Danfoss is a Modconnect partner.

Modbus Plus Part Numbers

Style Enclosure	VLT 5000 Description	Modbus Order No. with memory card	Modbus Order No. without memory card
Bookstyle	5001-5006, 200-240V 5001-5011, 380-500V	176F1550	176F1558
Compact Chassis	5001-5027, 200-240V 5001-5052, 380-500V	176F1551	176F1559
Compact NEMA 12	5001-5027, 200-240V 5001-5052, 380-500V	176F1550	176F1558
Compact Chassis	5032-5052, 200-240V 5060-5250, 380-500V	176F1551	176F1559
Compact NEMA 12	5032-5052, 200-240V 5060-5250, 380-500V	176F1551	176F1559

Additional Reference Literature

175R5285 - Option Card Installation Instructions
175R5271 - VLT 5000 Series Adjustable Frequency Drive Instruction Manual

(Contact Danfoss for these manuals.)

GM-MBL-001 Rev D - MODICON Modbus Plus Network Planning and Installation Guide.

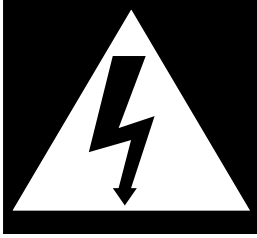
Appropriate "Modicon Programmable Controller Systems" manual for your equipment.

(Contact MODICON for these manuals.)

Installation

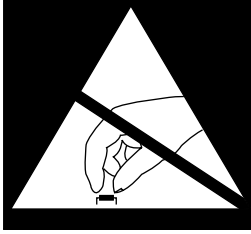
The following installation section is specific to the Modbus Plus option card. For more specific information on installation and operation of the VLT 5000 refer to the VLT 5000 Series Adjustable Frequency Drive Instruction Manual 175R5271.

WARNING:



The VLT Adjustable Frequency Drive contains dangerous voltages when connected to line voltage. After disconnecting from the line wait at least 15 minutes before touching any electrical components. Only a competent electrician should carry out the electrical installation. Improper installation of the motor or the VLT may cause equipment failure, serious injury or death. Follow this manual and National Electrical Codes and local safety codes.

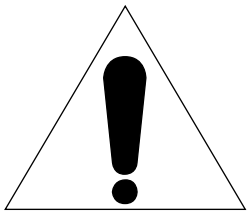
WARNING:



Electrostatic Precaution; Electrostatic discharge (ESD). Many electronic components are sensitive to static electricity. Voltages so low that they cannot be felt, seen or heard, can reduce the life, affect performance, or completely destroy sensitive electronic components.

When performing service, proper ESD equipment should be used to prevent possible damage from occurring.

CAUTION:

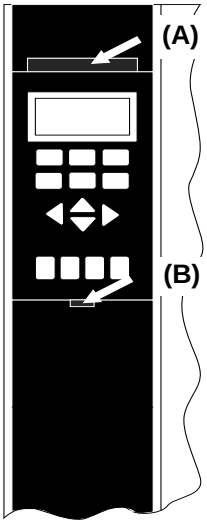


It is the responsibility of the user or the person installing the VLT to provide proper grounding, as well as motor overload and branch circuit protection according to the National Electrical Code and local codes.

Installation for Bookstyle Units

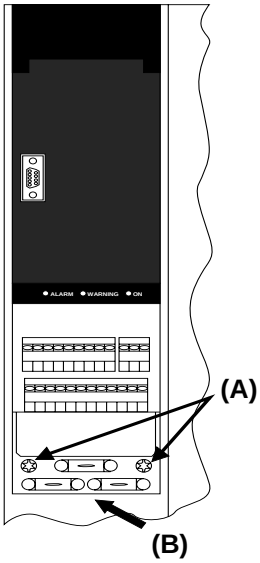
1. Access to Control Card Cassette

- To remove the Local Control Panel (LCP) pull at the top of display (A).
- To remove the protective cover gently pry at the notch (B).



2. Removing Cassette

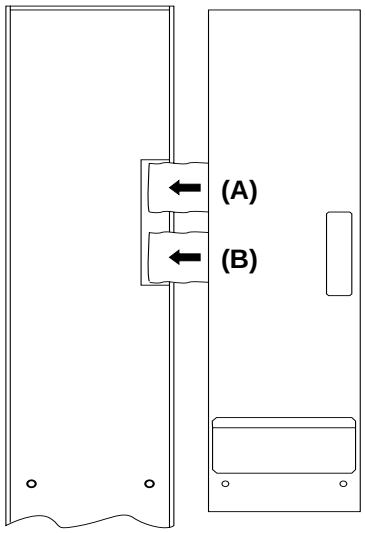
- Remove any control wiring by unplugging the terminals and removing the ground clamps.
- Unscrew the two captive screws (A) securing the cassette to the Chassis.
- Lift at the bottom of the cassette (B) and unhinge at the top.



3. Removing Ribbon Cables

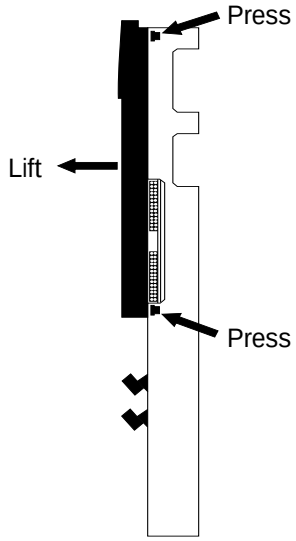
- Unplug the two ribbon cables (A) and (B) from the control.

NOTE: The ribbon cables will need to be replaced on the same connections from which they were removed.



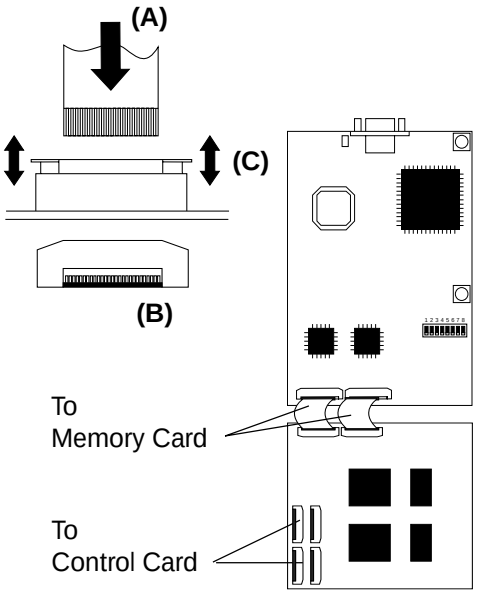
4. Removing LCP Cradle.

- Carefully push in at the right side corners of the LCP cradle to release clips, and gently pull out to release clips at left side.



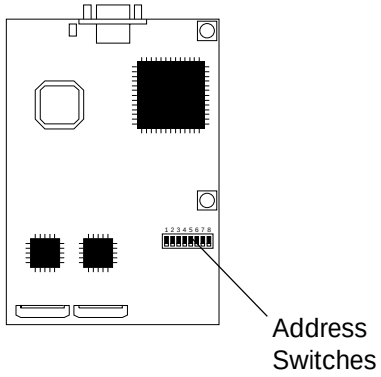
5. Ribbon Cable Installation on Option Cards

- Be sure that the exposed wire portion of the ribbon cable (A) is facing the front of the socket (B).
- Pull up the collar (C) of the ribbon cable socket, insert the cable and push the collar closed.
- Repeat for all ribbon cables.



6. Modbus Plus Address Switch

NOTE: Address switch settings need to be made prior to option card installation. Refer to "Understanding Module Address Switches" section in this manual.



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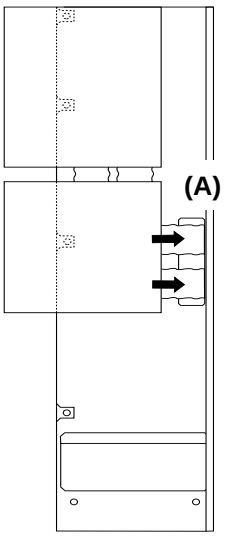
7. Ribbon Cable Routeing

- Carefully route cables through the opening in the back of cassette (A).



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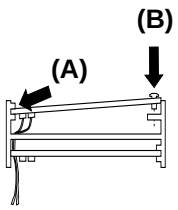
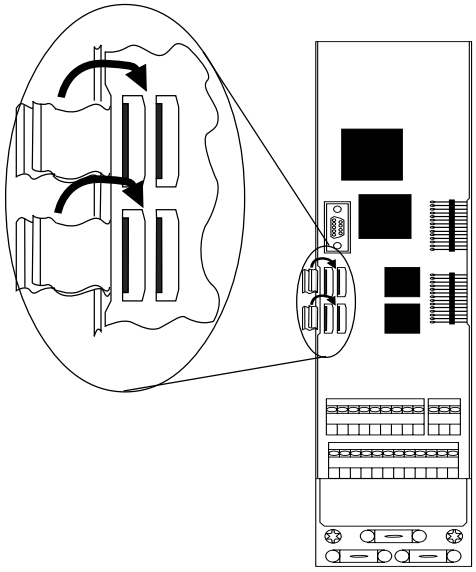
8. Securing Option Card

- Slide the edge of the option card into the slot in the side of the cassette (A).
- Secure the other edge of the option card with the self-tapping screws provided (B) torque the screws to 7.1 LB • IN.



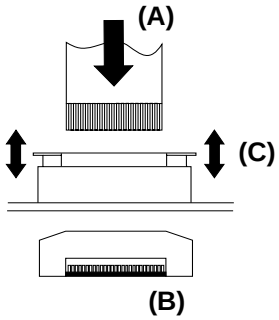
9. Ribbon cable installation on Control Card

- Be sure not to twist cables.
- Insert cables in corresponding sockets.



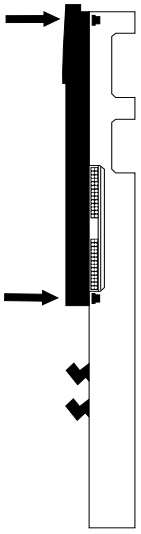
10. Ribbon cable installation on Control Card

- Be sure that the exposed wire portion of the ribbon cable (A) is facing the front of the socket (B).
- Pull up the collar (C) of the ribbon cable socket, insert the cable and push the collar closed.
- Repeat for all ribbon cables.



11. Replace the LCP Cradle

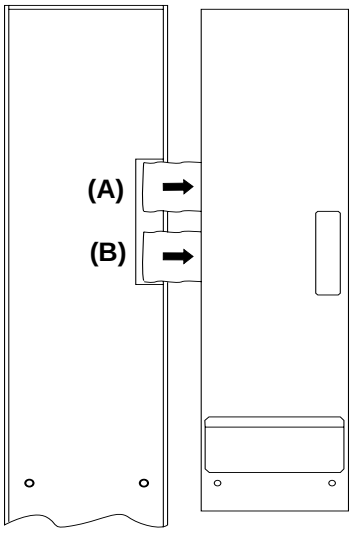
- Insert the right side clips first.
- Push down on the right side to snap into place.



12. Replacing the Cassette

- Re-connect the ribbon cables A and B.

NOTE: The ribbon cables will need to be replaced on the same connections from which they were removed.



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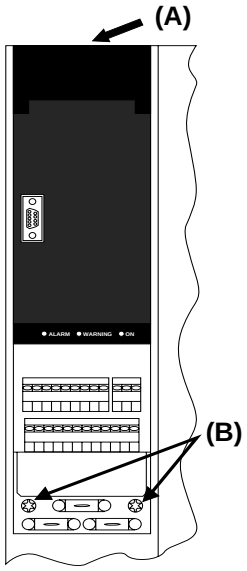
13. Replacing the Cassette

- Hinge the control card cassette at the top of the drive (A) and tighten the two screws (B) to 7.9 LB • IN
- Replace the LCP, control signal wiring and protective cover.



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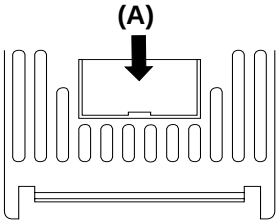
14. Network Connector

- Network connector installs through the top of the control card cassette.
- Remove connector access knock-out (A) in top cover of drive.



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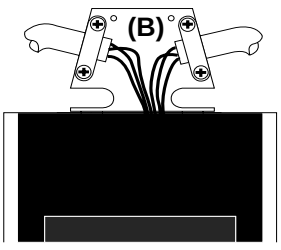
15. Wiring Bracket

- Mount wiring bracket (B) to the top of the drive and torque screws to 10.6 LB • IN.

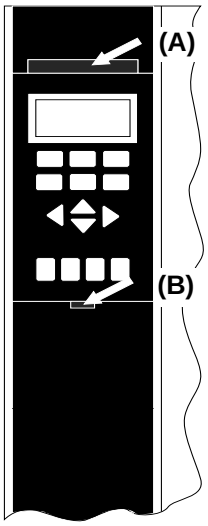
NOTE: Cable clamps are to be placed over the wire insulation for strain relief only. DO NOT ground the cable shield.



Installation for Compact Chassis & NEMA 1 Units

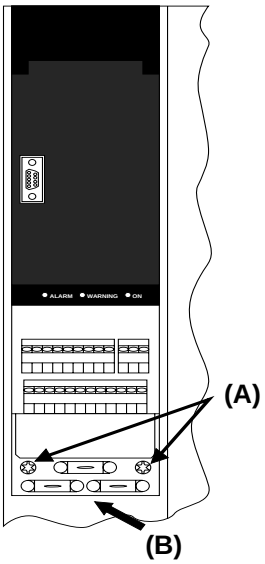
1. Access to Control Card Cassette

- To remove the Local Control Panel (LCP) pull at the top of display (A).
- To remove the protective cover gently pry at the notch (B).



2. Removing Cassette

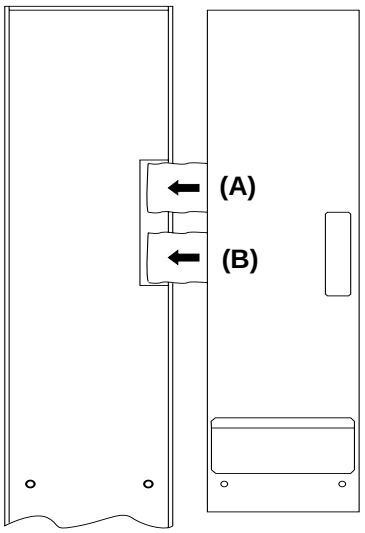
- Remove any control wiring by unplugging the terminals and removing the ground clamps.
- Unscrew the two captive screws (A) securing the cassette to the Chassis.
- Lift at the bottom of the cassette (B) and unhinge at the top.



3. Removing Ribbon Cables

- Unplug the two ribbon cables (A) and (B) from the control.

NOTE: The ribbon cables will need to be replaced on the same connections from which they were removed.



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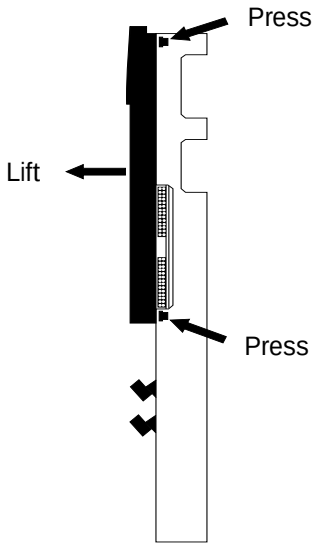
4. Removing LCP Cradle.

- Carefully push in at the right side corners of the LCP cradle to release clips, and gently pull out to release clips at left side.



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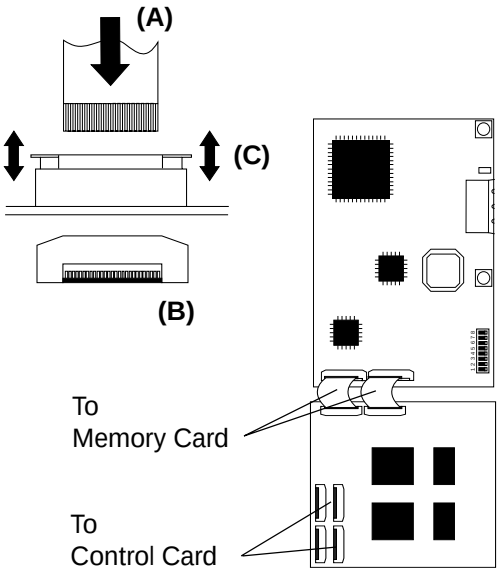
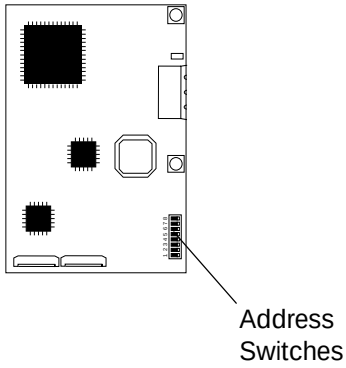
5. Ribbon Cable Installation on Option Cards

- Be sure that the exposed wire portion of the ribbon cable (A) is facing the front of the socket (B).
- Pull up the collar (C) of the ribbon cable socket, insert the cable and push the collar closed.
- Repeat for all ribbon cables.



6. Modbus Plus Address Switch

NOTE: Address switch settings need to be made prior to option card installation. Refer to "Understanding Module Address Switches" section in this manual.



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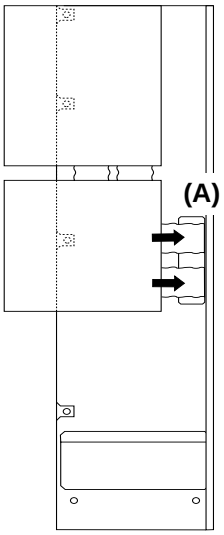
7. Ribbon Cable Routeing

- Carefully route cables through the opening in the back of cassette (A).



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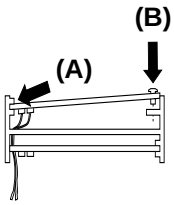
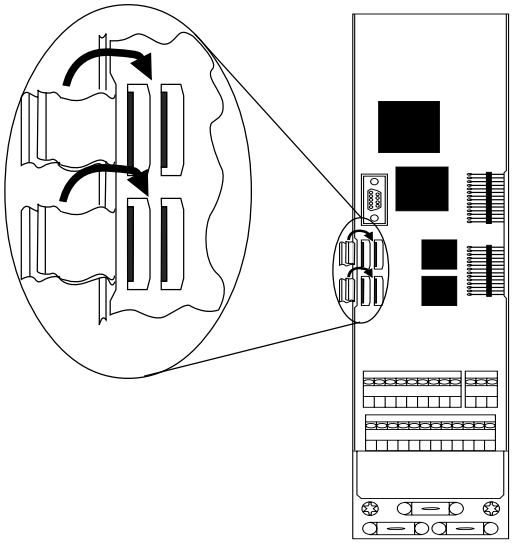
8. Securing Option Card

- Slide the edge of the option card into the slot in the side of the cassette (A).
- Secure the other edge of the option card with the self-tapping screws provided (B) torque the screws to 7.1 LB • IN.



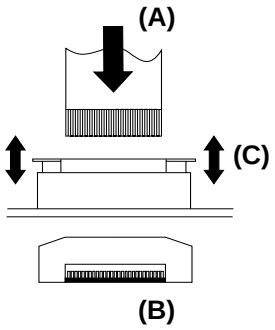
9. Ribbon cable installation on Control Card

- Be sure not to twist cables.
- Insert cables in corresponding sockets.



10. Ribbon cable installation on Control Card

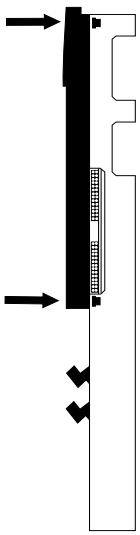
- Be sure that the exposed wire portion of the ribbon cable (A) is facing the front of the socket (B).
- Pull up the collar (C) of the ribbon cable socket, insert the cable and push the collar closed.
- Repeat for all ribbon cables.



11. Replace the LCP Cradle

- Insert the right side clips first.
- Push down on the right side to snap into place.

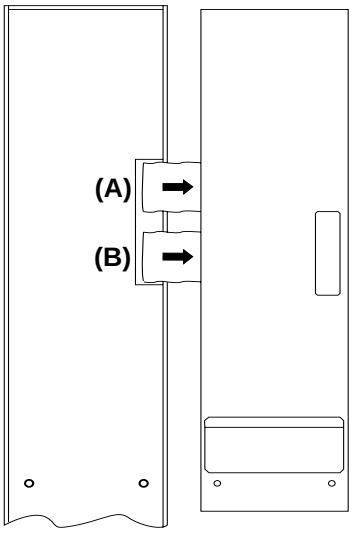
NOTE: Before re-installing the control card cassette on Compact Chassis and NEMA 1 units 5008-5027, 200V and 5016-5052, 380-500V, two cable tie anchors will need to be installed. Refer to the Network Cable Installation (Step 18).



12. Replacing the Cassette

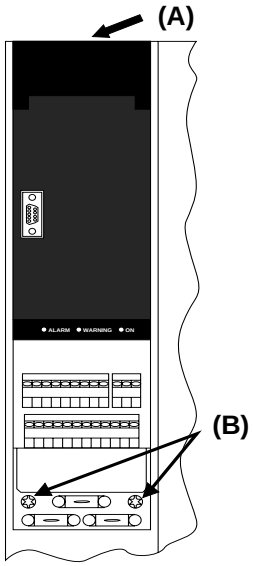
- Re-connect the ribbon cables A and B.

NOTE: The ribbon cables will need to be replaced on the same connections from which they were removed.



13. Replacing the Cassette

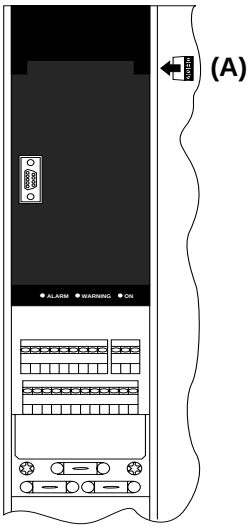
- Hinge the control card cassette at the top of the drive (A) and tighten the two screws (B) to 7.9 LB • IN
- Replace the LCP, control signal wiring and protective cover.



14. Network Connector

- Network connector (A) installs through the right side of the control card cassette.

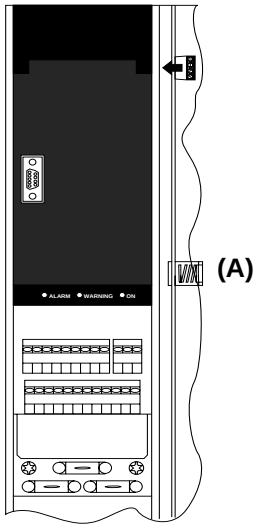
NOTE: Refer to the Network Cable Installation step for your particular drive.



15. Spring Tension Clip

NOTE: Cable clamps are to be placed over the wire insulation for strain relief only. DO NOT ground the cable shield.

The spring tension clip (A) mounted in the chassis is used as a cable strain relief.



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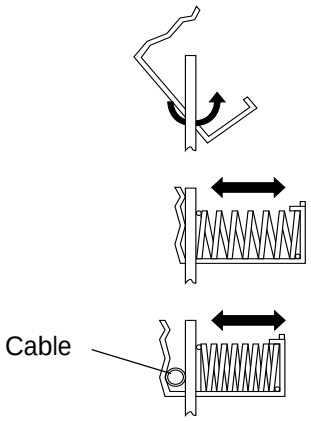
16. Install Spring Tension Clip

- Insert the clip through inner wall of the VLT.
- Compress the spring into the clip.
- Cable is to be inserted between the inner wall and the clip.



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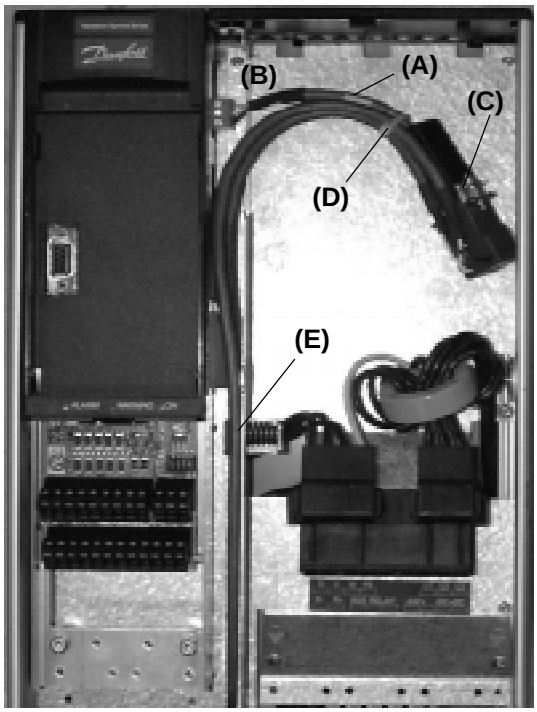
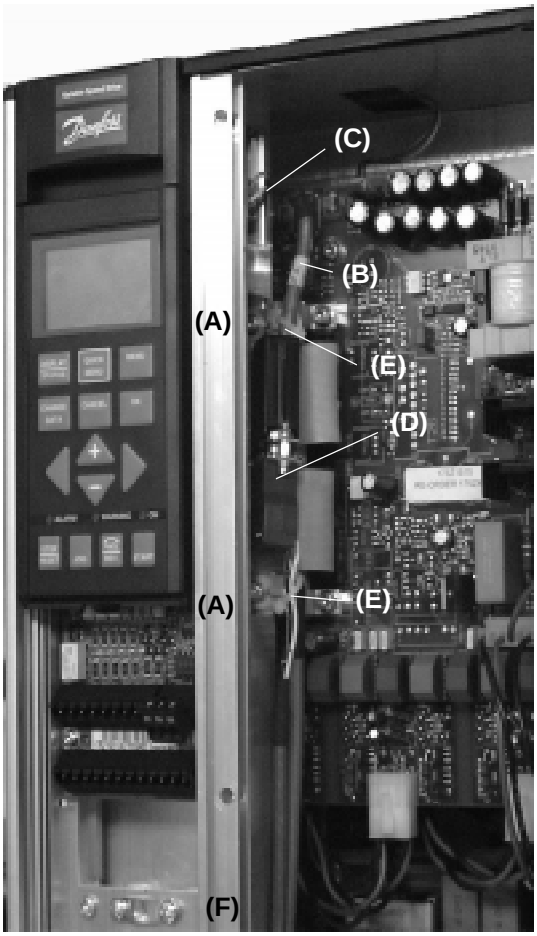
17. Network Cable Installation for Compact Chassis and NEMA 1 Units 5001-5006, 200V 5001-5011, 380-500V

- After re-installing the control card cassette, install adapter cable 190703 (A) into the side access option (B).
- Attach the Modicon connector to the adapter (C), secure hardware, and tie wrap (D).
- Verify the metal hardware of the adapter plug – network cable interface is secure from contact with circuitry or circuit connections.
- Route the insulated network cable between the inner wall and the spring clip (E).



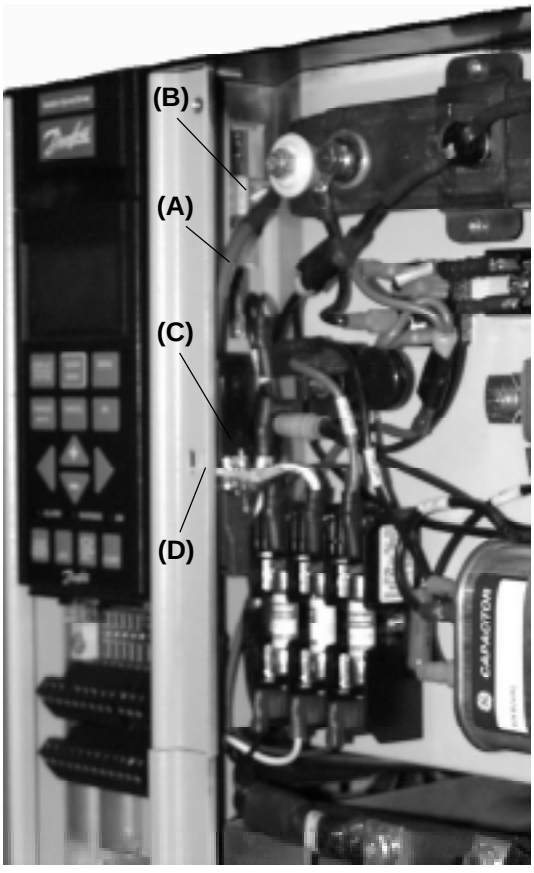
18. Network Cable Installation for Compact Chassis and NEMA 1 Units 5008-5027, 200V 5016-5052, 380-500V

- Before re-installing the control card cassette, install two cable tie anchors (A), included with the adapter cable, on the inner wall of the VLT 5000.
- After re-installing the control card cassette, install adapter cable 190703 (B) into the side access option (C).
- Attach the Modicon connector to the adapter (D), secure hardware, and tie wrap (E).
- Verify the metal hardware of the adapter plug – network cable interface is secure from contact with circuitry or circuit connections.
- Route the insulated network cable between the inner wall and the spring clip (F).



19. Network Cable Installation for Compact Chassis and NEMA 1 Units 5060-5250

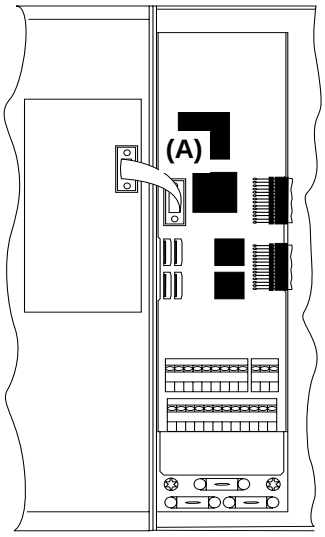
- After re-installing the control card cassette, install adapter cable 190703 (A) into the side access option (B).
- Attach the Modicon connector to the adapter (C), secure hardware, and tie wrap (D).
- Verify the metal hardware of the adapter plug – network cable interface is secure from contact with circuitry or circuit connections.



Installation for Compact NEMA 12 Units

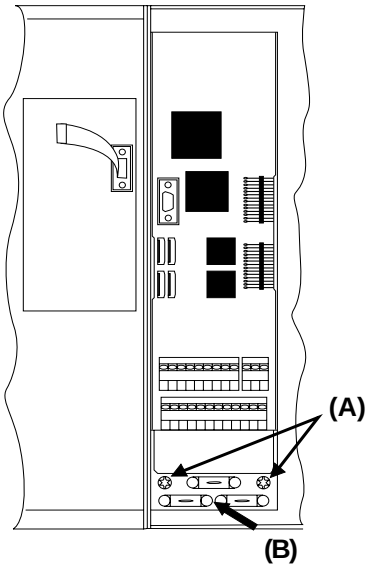
1. Unplug the Control Card Cassette

- Remove any control wiring by unplugging the terminals and removing the ground clamps.
- Unplug the LCP cable (A).



2. Removing Control Card Cassette

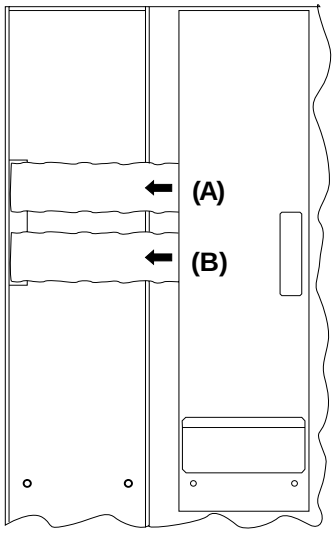
- Unscrew the two captive screws (A) securing the cassette to the Chassis.
- Lift up at the bottom of the cassette (B) and unhinge at the top.



3. Removing Ribbon Cables

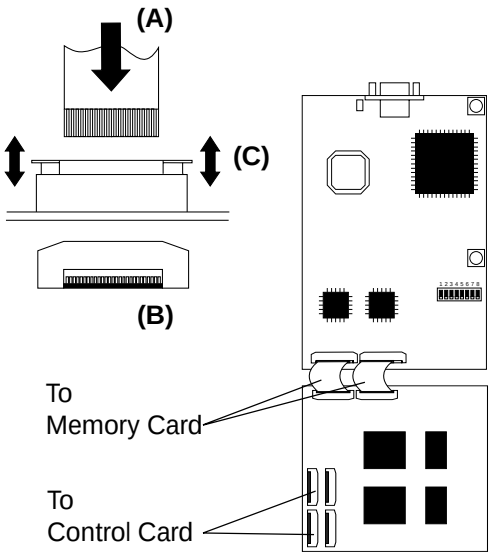
- Unplug the two ribbon cables (A) and (B) from the control card.

NOTE: The ribbon cables will need to be replaced on the same connections from which they were removed.



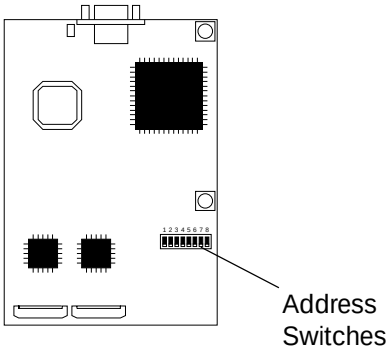
4. Ribbon Cable Installation on Option Cards

- Be sure that the exposed wire portion of the ribbon cable (A) is facing the front of the socket (B).
- Pull up the collar (C) of the ribbon cable socket, insert the cable and push the collar closed.
- Repeat for all ribbon cables.



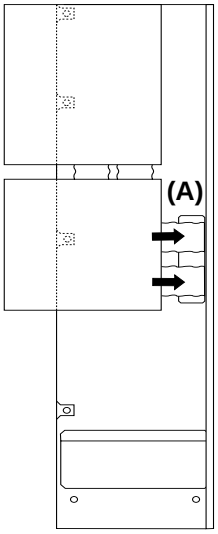
5. Modbus Plus Address Switch

NOTE: Address switch settings need to be made prior to option card installation. Refer to "Understanding Module Address Switches" section in this manual.



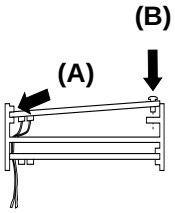
6. Ribbon Cable Routeing

- Carefully route cables through the opening in the back of cassette (A).



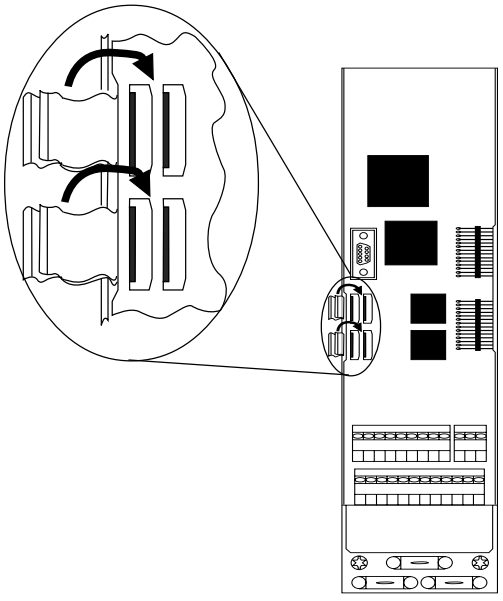
7. Securing Option Card

- Slide the edge of the option card into the slot in the side of the cassette (A).
- Secure the other edge of the option card with the self-tapping screws provided (B) torque the screws to 7.1 LB • IN.



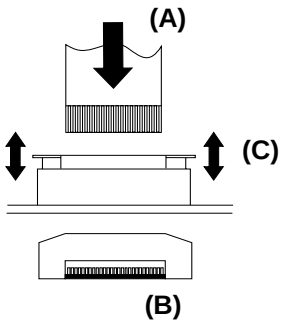
8. Ribbon cable installation on Control Card

- Be sure not to twist cables.
- Insert cables in corresponding sockets.



9. Ribbon cable installation on Control Card

- Be sure that the exposed wire portion of the ribbon cable (A) is facing the front of the socket (B).
- Pull up the collar (C) of the ribbon cable socket, insert the cable and push closed the collar.
- Repeat for all ribbon cables.



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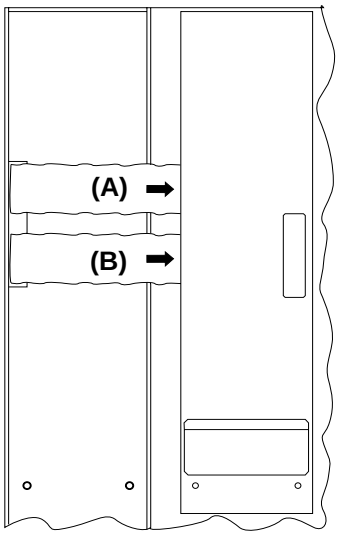
10. Replacing the Cassette

- Re-connect the ribbon cables A and B.

NOTE: The ribbon cables will need to be replaced on the same connections from which they were removed.



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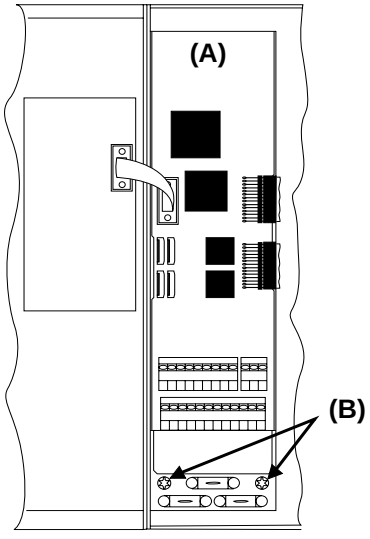
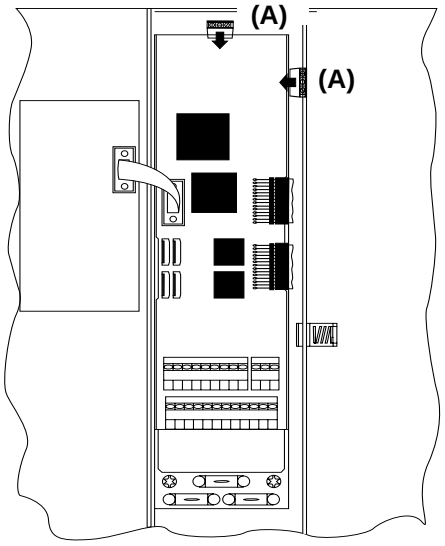
11. Replacing the Cassette

- Hinge the control card cassette at the top of the drive (A) and tighten the two screws (B) to 7.9 LB • IN
- Replace the LCP cable and control signal wiring.



12. Network Connector

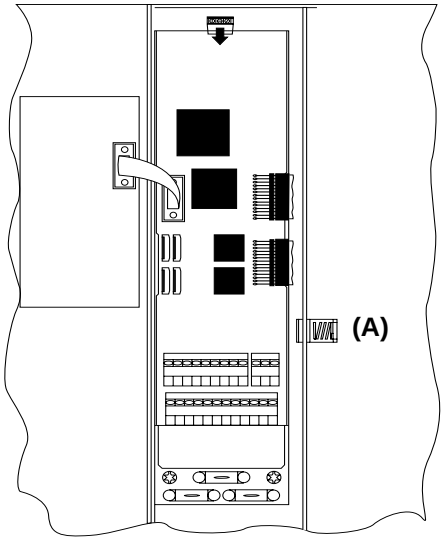
- For Compact NEMA 12 units 5001-5027, 200-240V and 5001-5052, 380-500V, the network connector (A) installs through the top of the control card cassette.
- For Compact NEMA 12 units 5032-5052, 200-240V and 5060-5250, 380-500V, the network connector (A) installs through the right side of the control card cassette.



13. Spring Tension Clip

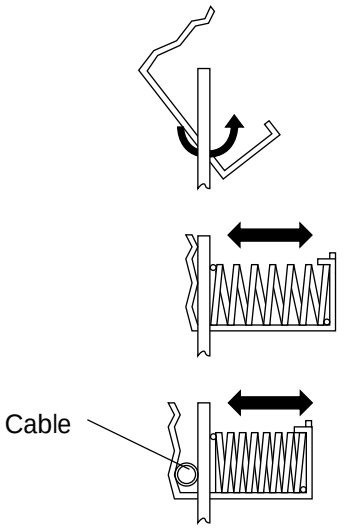
NOTE: Cable clamps are to be placed over the wire insulation for strain relief only. DO NOT ground the cable shield.

The spring tension clip (A) mounted in the chassis is used as a cable strain relief.



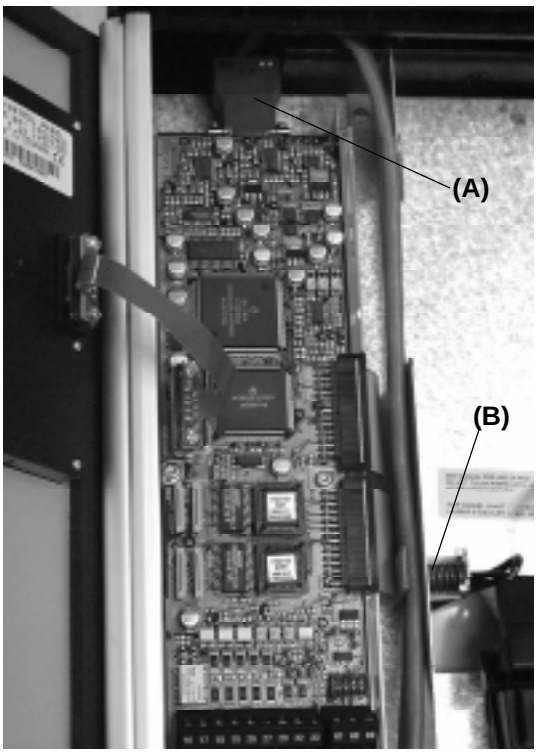
14. Install Spring Tension Clip

- Insert the clip through inner wall of the VLT.
- Compress the spring into the clip.
- Cable is to be inserted between the inner wall and the clip.



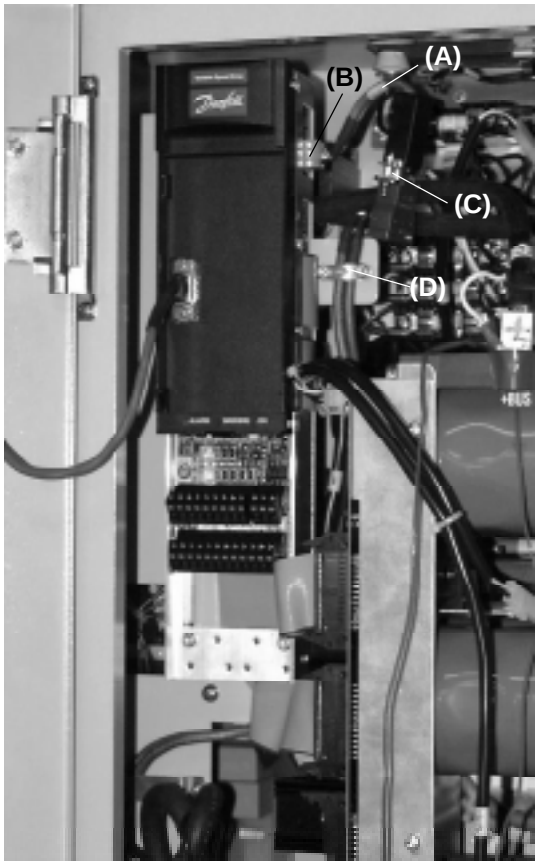
15. Network Cable Installation for Compact NEMA 12 Units 5001-5027, 200-240V and 5001-5052, 380-500V

- After re-installing the control card cassette, the network connector (A) installs through the top side of the control card cassette.
- Verify the hardware of the network cable interface is secure from contact with circuitry or circuit connections.
- Route the insulated network cable between the inner wall and the spring clip (B).



16. Network Cable Installation for Compact NEMA 12 Units 5032-5052, 200-240V and 5060-5250, 380-500V

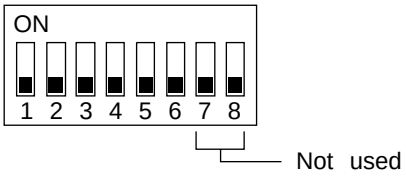
- After re-installing the control card cassette, install adapter cable 190703 (A) into the side access option (B).
- Attach the Modicon connector to the adapter (C), secure hardware, and tie wrap (D).
- Verify the metal hardware of the adapter plug – network cable interface is secure from contact with circuitry or circuit connections.



Understanding Module Address Switches

The Modbus Plus Communication module's Address switch settings determine Modbus Plus node address.

DIP Switch ON = 0
Factory Settings OFF = 1



NOTE: The Address switches on the Modbus Plus option card need to be set prior to re-installing the Control Card Assembly into the VLT 5000.

ATTENTION:

Changes in switch settings are only active after cycling power.

When you make changes to the switch settings, use a pointed instrument such as a ball point pen. DO NOT use a pencil because damage may occur.

Unpredictable operation may occur if you fail to check connections and DIP switch settings for compatibility with your application. Unpredictable operation may result in death, personal injury, and equipment damage.

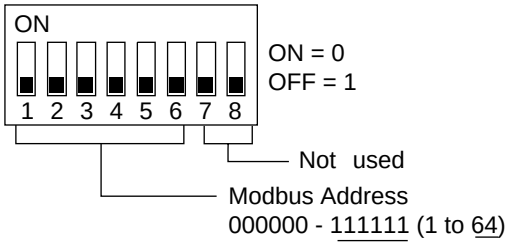
Hazard of injury or equipment damage may occur due to unintended or incorrect machine motion. When a system is configured for the first time, the motor must be disconnected from the machine or process during initial system testing.

NOTE: When setting the Communication Module's addressing DIP switches, you must ensure that each serial device on the network has a unique address.

Setting the Modbus Plus Node Address

Set switches 1 - 6 to the address in your application. Switches 7 and 8 are not used. Each node must have a unique address. NOTE: The address will be one higher than the binary value you set into the switches.

It is recommended that you reserve address 64 for future network maintenance. It is also recommended that you do not use address 1, to avoid possible confusion when using a local default address of 1 at a controller node's programming panel.



NOTE: Changes in switch settings are only active after cycling power.

Modbus Address	Switch Settings 1 → 6	Modbus Address	Switch Settings 1 → 6	Modbus Address	Switch Settings 1 → 6	Modbus Address	Switch Settings 1 → 6
1	000000	17	000010	33	000001	49	000011
2	100000	18	100010	34	100001	50	100011
3	010000	19	010010	35	010001	51	010011
4	110000	20	110010	36	110001	52	110011
5	001000	21	001010	37	001001	53	001011
6	101000	22	101010	38	101001	54	101011
7	011000	23	011010	39	011001	55	011011
8	111000	24	111010	40	111001	56	111011
9	000100	25	000110	41	000101	57	000111
10	100100	26	100110	42	100101	58	100111
11	010100	27	010110	43	010101	59	010111
12	110100	28	110110	44	110101	60	110111
13	001100	29	001110	45	001101	61	001111
14	101100	30	101110	46	101101	62	101111
15	011100	31	011110	47	011101	63	011111
16	111100	32	111110	48	111101	64	111111

Network Installation

Network planning and installation is described in the MODICON Modbus Plus Network Planning and Installation Guide, MODICON P/N GM-MBL-001 Rev D (contact MODICON for this guide). The Danfoss VLT is considered a "Host Device" by MODICON.

The Modbus Plus option is not shipped with any mating network connectors for two (2) reasons:

A. Consistency with the way MODICON ships its products.
B. A choice must be made between an in-line connector or a terminating connector depending on network configuration.

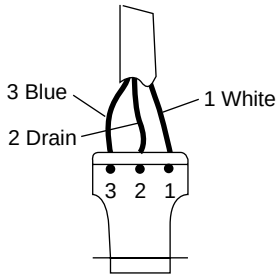
Mating network connectors should be ordered from MODICON:
P/N AS-MBKT-085, (1) in-line connector
P/N AS-MBKT-185, (2) terminating connectors

The recommended Modbus Plus cable is Belden 9841, shielded twisted pair. Minimum length between nodes is 10 ft. (3m) Maximum length without repeaters is 1500 ft (450m).

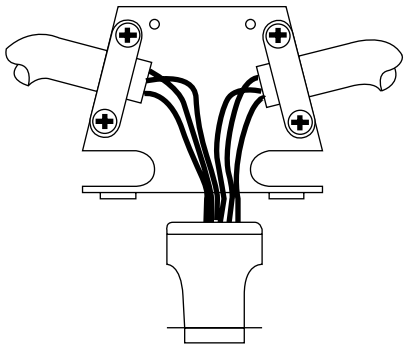
Network Cable Connection

All three conductors of the cable (signal wires and shield) should remain isolated from the panel grounding connection at each drop location. Grounding systems should connect to the network device, not to the network cable.

If the network devices are installed, make sure each one has its grounding terminal and frame properly connected to the plant grounding system. The grounding path should be separate from paths used for motors, generators, welders, and other high-current industrial devices.



NOTE: Drain wire and shield should be insulated.



Example of Bookstyle Connection

Ground Connection

It is important that all VLT 5000s and other devices connected to the Modbus Plus network are connected to the same ground potential. The ground connection must have a low HF (high frequency) impedance. This can be achieved by connecting a large surface area of the cabinet to ground, for example by mounting the VLT 5000 Series on a conductive rear plate.

When having long distances between the stations in a Modbus Plus network it can be necessary to use additional potential equalizing cables, connecting the individual stations to the same ground potential.

Bus Termination

It is essential that the bus line be terminated properly. A mismatch of impedance may result in reflections on the line that will corrupt data transmission.

The Modbus Plus Option Card is provided with a pluggable screw connector for 176F1551 and a DB9 connector for 176F1550.

An adaptor cable number 190703 is required for use with 176F1551.

NOTE:
Relevant national and local regulations regarding protective ground connection, must be observed.

Cable Routing

The Modbus Plus communication cable must be kept away from motor and brake resistor cables to avoid coupling of high frequency noise from one cable to the other. Normally a distance of 8 inches (200 mm) is sufficient, but it is generally recommended to keep the greatest possible distance between the cables, especially where cables are running in parallel over long distances.

If the Modbus Plus cable has to cross a motor and brake resistor cable they must cross each other at an angle of 90°.

Modbus Plus Communication

PLC Commands

1. MSTR Block Overview

All MODICON PLCs have a special master (MSTR) instruction with which nodes on the network can initiate message transactions. The MSTR function allows you to initiate one of eight possible operations over the Modbus Plus network:

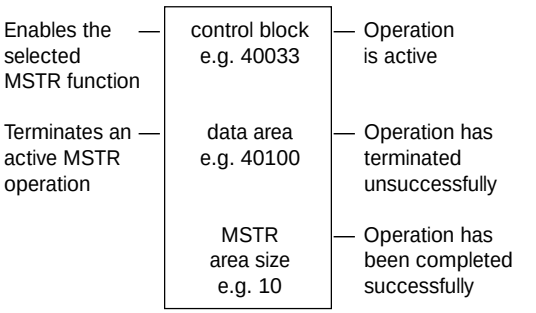
MSTR Function	Code
Write data	1
Read data	2
Get local statistics	3*
Clear local statistics	4*
Write global database	5
Read global database	6
Get remote statistics	7*
Clear remote statistics	8*

**Refer to Modbus Plus manual for details.*

MSTR blocks may be simultaneously active in a ladder logic program.

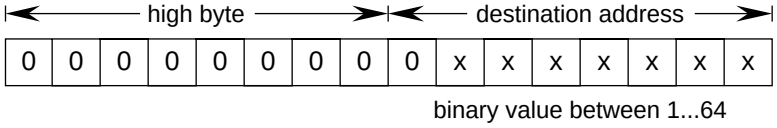
Refer to the PLC manual to determine the number of active blocks that can be used.

The MSTR instruction is a three-node function block:



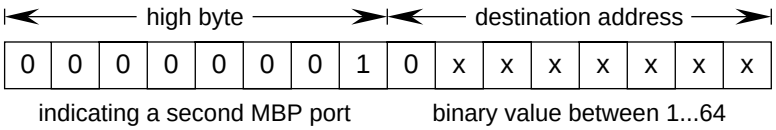
The top node of the MSTR function block, which must be a 4x register, is the first of nine consecutive holding registers that form the MSTR *control block*:

4x	Identifies one of the eight MSTR operations
4x + 1	Displays error status
4x + 2	Displays length
4x + 3	Displays MSTR function-dependent information
4x + 4	The Routing 1 register, uses the bit value of the low byte to designate the address of the destination device; if you are using a controller with just one Modbus Plus port, the value of the high byte should be set to 0:



MSTR Block Overview (continued)

If you are using a controller with two Modbus Plus ports—e.g., using two S985 cards in a chassis mount controller—the value of the high byte for one port must be set to 0 and the high byte for the other port must be set to 1, leaving an offset of 256 between the destination node address and the register value:



4x + 5 The Routing 2 register
4x + 6 The Routing 3 register
4x + 7 The Routing 4 register
4x + 8 The Routing 5 register

The middle node from the MSTR function block, which must be a 4x register, designates the first register in the *data area*. For operations that provide the communication processor with data—such as a Write operation—the *data area* is the source of the data. For operations that acquire data from the communication processor—such as a Read operation—the *data area* is the destination of the data.

The bottom node from the MSTR function block indicates that this is an MSTR function and specifies the maximum number of registers in the data area; area size must be a constant value ranging from 1 ... 100 for write operation and 1 ... 125 for read operations.

NOTE: Refer to PLC manual for PLC data area size.

2. MSTR Function Error Codes

If an error occurs during any one of the eight MSTR operations, a hexadecimal error code will be displayed in register 4x + 1 in the control block.

The form of the code is Mmss, where
- M represents the major code
- m represents the minor code
- ss represents a subcode

Hex Error Code	Meaning
1001	User-initiated abort
2001	Invalid operation type
2002	User parameter changed
2003	Invalid length
2004	Invalid offset
2005	Invalid length + offset
2006	Invalid slave device data area
2007	Invalid slave device network area
2008	Invalid slave device network routing
2009	Route equal to your own address
200A	Attempting to obtain more global data words than available
30ss*	Modbus slave exception response
4001	Inconsistent Modbus slave response
5001	Inconsistent network response
6mss**	Routing failure

* The ss subfield in error code 30ss is described in the following table:

** The m subfield in error code 6mss is an index into the routing information indicating where an error has been detected—a value of 0 indicates the local node, a 2 the second device on the route, etc.

MSTR Function Error Codes (continued)

30ss Hex Value	Modbus Slave Exception
01	Slave device does not support the requested operation
02	Nonexistent slave device registers requested
03	Invalid data value requested
04	Unassigned
05	Slave has accepted long-duration program command
06	Function can't be performed now—a long duration command in effect
07	Slave rejected long-duration program command
85 *	Data type false
86 *	Cannot be set by user
8A *	Access group
8B *	No parameter write access
92 *	Other fault
08 ... 255	Unassigned except where shown above

* These were assigned by Danfoss.

See the table below for the ss subfield in error code 6mss:

6mss** Hex value	Routing Failure
01	No response received
02	Program access denied
03	Node off-line and unable to communicate
04	Exception response received
05	Router node data paths busy
06	Slave device down
07	Bad destination address
08	Invalid node type in routing path
10	Slave has rejected the command
20	Initiated transaction forgotten by slave device
40	Unexpected master output path received
80	Unexpected response received

** The m subfield in error code 6mss is an index into the routing information indicating where an error has been detected—a value of 0 indicates the local node, a 2 the second device on the route, etc.

3. Read and Write MSTR Functions

An MSTR Write function transfers data from a master source device to a specified slave (VLT) destination device on the network. An MSTR Read function transfers data from a specified slave source device to a master destination device on the network. Read and Write use one data master transaction path and may be completed over multiple scans.

a. Control Block Utilization

The contents of the nine registers in the top node of the MSTR block contain the following information when you implement a Read or Write function:

Control Block Register	MSTR Function	Register Content
4x	Operation type	1 = Write 2 = Read
4x + 1	Error status	Displays a hex value indicating an MSTR error, when relevant (see MSTR Function Error Codes).
4x + 2	Length	Write = number of registers to be sent to slave (VLT) Read = number of registers to be read from slave (VLT)
4x + 3	Slave device data area	Specifies starting 4x register in the slave (VLT) to be read from or written to (1 = 40001, 49 = 40049)
4x + 4, + 5, +6, +7, +8	Routing 1, 2, 3, 4,5	Designates the first through fifth routing path addresses.

If you attempt to program the MSTR function to Read or Write its own station address, an error will be generated in the second register of the MSTR control block. It is possible to attempt a Read/Write operation to a nonexistent register in the slave device. The slave will detect this condition and report it—this may take several scans.

NOTE: You need to understand Modbus Plus routing path procedures before programming an MSTR block.

4. Write Global Data MSTR Function

The Write global data function transfers data to the comm processor in the current node so that it can be sent over the network when the node gets the token. All nodes on the local network link can receive this data. This operation takes one scan to complete and does not require a data master transaction path.

Control Block Register	MSTR Function	Register Content
4x	Operation type	5
4x + 1	Error status	Displays a hex value indicating an MSTR error, when relevant (see MSTR Function Error Codes).
4x + 2	Length	Specifies the number of registers from the data area to be sent to the comm processor; the value of the length must be les than or equal to 32 and must not exceed the size of the data area
4x + 4	Routing 1	If this is the second of two local nodes, set the high byte to a value of 1 (PLC Node number).

a. Control Block Utilization

5. Read Global Data MSTR Function

The Read global data function gets data from the comm processor in any node on the local network link that is providing global data. This operation may require multiple scans to complete if no global data are currently available from the requested node; if global data are currently available, the operation completes in a single scan. No master transaction path is required.

a. Control Block Utilization

Control Block Register	MSTR Function	Register Content
4x	Operation type	6
4x + 1	Error status	Displays a hex value indicating an MSTR error, when relevant (see MSTR Function Error Codes).
4x + 2	Length	Specifies the number of words of global data to be requested from the comm processor designated by the routing 1 parameter; the value of the length must be greater than 0 and less than or equal to 32 and must not exceed the size of the data area
4x + 3	Available words	Contains the number of words available from the VLT 5000; the value is automatically updated by internal software
4x + 4	Routing 1	The low byte specifies the address of the VLT 5000 whose global data are to be returned (a value between 1 ... 64); if this is the second of two local nodes, set the high byte to a value of 1

Drive Configuration

The Global Data communications capabilities are controlled by a fixed block of Holding Registers (40500-40565) located in each Modbus Plus serial communication card. It is possible to "write to" and "read from" the VLT up to 32 drive parameters, in any order, as specified by the user.

As the unit is delivered from the factory, Holding Registers 40500-40565 are all set to the value 0. This effectively disables the Global Data read/write functions.

Holding Registers 40500-40565 are located within the Modbus Plus Option Card, and cannot be displayed or accessed by the VLT LCP screen. All read/write, setup/ configuration of these Holding Registers must be performed over the Modbus Plus network.

Global Data, is the fastest way to communicate with the VLT over the Modbus Plus Network, however, there is no mechanism by which errors such as data over/under range etc. can be reported back to the master when writing data to the VLT.

Global Data Write Function

Writing from the PLC (Local Master) to the VLT 5000 is controlled by Holding Registers 40500-40533. Two Holding Registers 40500 and 40501 are used to enable the Global Data write function, while Holding Registers 40502 through 40533 are used to "map' the PLC Global Data to the VLT 5000 parameters.

- 40500 "online": Acceptable data values for this register are 0, 1 and 2.
  0: Writing to the VLT 5000 via Global Data is disabled.
  1: Writing to the VLT 5000 via Global Data enabled. This register will automatically be reset to 0 upon Bus Timeout, or power cycling of the VLT 5000.
  2: Writing to the VLT 5000 via Global Data is enabled. This register will NOT be reset to 0 upon Bus Timeout, or power cycling of the VLT 5000.

All other data values will be treated in the same manner as 1.

- 40501 "Local Master Node": Acceptable data values for this register are 1 through 64.

The node number placed in this register is regarded as the node number of the PLC which is writing to the VLT 5000 via global data. The Modbus Plus Option Card will monitor the Global Data of this node. When new Global Data is available, it will be written to the VLT 5000 parameters as mapped by the Holding Registers 40502 through 40533.

Holding Register	Description
40500	Online (0...2)
40501	Local Master Node (1...64)
40502	GD_Write1
40503	GD_Write2
40504	GD_Write3
40505	GD_Write4
40506	GD_Write5
40507	GD_Write6
40508	GD_Write7
40509	GD_Write8
40510	GD_Write9
40511	GD_Write10
40512	GD_Write11
40513	GD_Write12
40514	GD_Write13
40515	GD_Write14
40516	GD_Write15
40517	GD_Write16
40518	GD_Write17
40519	GD_Write18
40520	GD_Write19
40521	GD_Write20
40522	GD_Write21
40523	GD_Write22
40524	GD_Write23
40525	GD_Write24
40526	GD_Write25
40527	GD_Write26
40528	GD_Write27
40529	GD_Write28
40530	GD_Write29
40531	GD_Write30
40532	GD_Write31
40533	GD_Write32

Global Data Write Function (continued)

The Modbus Plus Option Card will test to determine if the Local Master Node is present in the network. If the Local Master Node is not present, all writing to the VLT 5000 via Global Data will be disabled. A Bus Timeout will then occur if enabled through VLT 5000 parameters 803 and 804. When the Local Master Node is again present in the network, and new Global Data is available, the Bus Timeout condition will return to normal operation, with control of writing via Global Data responding as programmed in Holding Register 40500 "online".

If the Local Master Node is programmed with a data value that is equal to the VLT 5000's own node number, writing via Global Data is disabled.

- 40502 through 40533 GD_ Write1 .... GD_Write32::

These registers are used to map the PLC's 32 words of Global Data to the VLT 5000's parameters. Data values placed in these registers are the (4X) Holding Register number of the VLT 5000 parameter being written to.

For example, the PLC Global Word 1 will be written to the VLT 5000 Holding Register programmed in 40502. The PLC Global Word 32 will be written to the VLT Holding Register programmed in 40533.

A placeholder data value of 0 may be programmed in registers 40502 through 40533 for use in the case when multiple drives are being written to via Global Data. If the PLC Global Data Word is mapped to a VLT 5000 Holding Register containing a value of 0, it will not be written to the VLT 5000. The Global Word is essentially "skipped over" by this node.

Holding Register	Description
40500	Online (0...2)
40501	Local Master Node (1...64)
40502	GD_Write1
40503	GD_Write2
40504	GD_Write3
40505	GD_Write4
40506	GD_Write5
40507	GD_Write6
40508	GD_Write7
40509	GD_Write8
40510	GD_Write9
40511	GD_Write10
40512	GD_Write11
40513	GD_Write12
40514	GD_Write13
40515	GD_Write14
40516	GD_Write15
40517	GD_Write16
40518	GD_Write17
40519	GD_Write18
40520	GD_Write19
40521	GD_Write20
40522	GD_Write21
40523	GD_Write22
40524	GD_Write23
40525	GD_Write24
40526	GD_Write25
40527	GD_Write26
40528	GD_Write27
40529	GD_Write28
40530	GD_Write29
40531	GD_Write30
40532	GD_Write31
40533	GD_Write32

Global Data Read Function

Reading data from the VLT 5000 parameters, and placing the data in the VLT 5000's Global Data is controlled by Holding Registers 40534-40565. These registers map the VLT 5000 parameters to the Global Data, words 1 -32 of the VLT 5000 node.

- 40534 through 40565 GD_Read1 ... GD_Read 32:

Data values placed in these registers are the (4X) Holding Register numbers of the VLT 5000 parameters being read.

For example, data placed in the VLT 5000 Global Data word 1 will be read from the VLT 5000 Holding Register programmed in 50534. Data placed in the VLT 5000 Global Word 32 will be read from the VLT 5000 Holding Register programmed in 40565.

The Global Data Read Function is always active, and is not influenced by "online" (40500) or Local Master Node (40501) Holding Registers. An "end of table marker" data value of 0 may be programmed in registers 40534 through 40565. The "end of table marker" should be used when less than 32 words of Global Data are required from the VLT 5000. The Modbus Plus Option Card will step through the registers 40534-40565 reading the corresponding VLT 5000 parameter and placing the data in the VLT 5000's Global Data, until an end of table marker (0) is encountered or the end of the table (40565) is reached. The process repeats over and over, while the VLT 5000 is powered.

To disable the Global Data Read Function, place an end of table marker (0) in register 40534, GD_Read1.

If an invalid VLT Holding Register Number is programmed in 40534-40565, a data value of 0 will be placed in the corresponding Global Data Word.

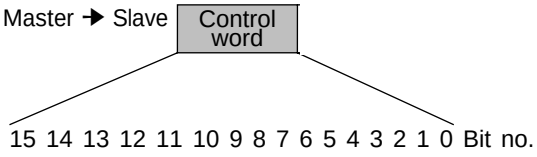
Holding Register	Description
40534	GD_Read1
40535	GD_Read2
40536	GD_Read3
40537	GD_Read4
40538	GD_Read5
40539	GD_Read6
40540	GD_Read7
40541	GD_Read8
40542	GD_Read9
40543	GD_Read10
40544	GD_Read11
40545	GD_Read12
40546	GD_Read13
40547	GD_Read14
40548	GD_Read15
40549	GD_Read16
40550	GD_Read17
40551	GD_Read18
40552	GD_Read19
40553	GD_Read20
40554	GD_Read21
40555	GD_Read22
40556	GD_Read23
40557	GD_Read24
40558	GD_Read25
40559	GD_Read26
40560	GD_Read27
40561	GD_Read28
40562	GD_Read29
40563	GD_Read30
40564	GD_Read31
40565	GD_Read32

Process Control and Status

NOTE: The VLT 5000 supports two different formats for Control Word and Status Word. The format is changed via parameter 512.

Danfoss Control Word

Control word as per VLT standard (parameter 512 = DANFOSS)
The control word is used for sending commands from a master (e.g. a PC) to a slave (VLT 5000 Series).



Bit	Bit = 0	Bit = 1
00	Preset ref. choice lsb	
01	Preset ref. choice msb	
02	DC brake	Ramp
03	Coasting	Enable
04	Quick-stop	Ramp
05	Freeze Output Freq.	Ramp enable
06	Ramp stop	Start
07	No function	Reset
08	No function	Jog
09	Ramp 1	Ramp 2
10	Data not valid	Valid
11	No function	Relay 01 active
12	No function	Relay 04 active
13	Choice of Setup lsb	
14	Choice of Setup msb	
15	No function	Reversing

Bit 00/01:
Bits 00 and 01 are used for choosing among the four pre-programmed references (parameters 215-218) in accordance with the following table:

Preset ref.	Parameter	Bit 01	Bit 00
1	215	0	0
2	216	0	1
3	217	1	0
4	218	1	1

NOTE: Parameter 508 is where to choose the way bits 00/01 are to be combined (gated) with the corresponding function on the digital inputs.

Bit 02, DC Brake:
Bit 02 = "0" leads to DC braking and stop. Braking current and duration are set in parameters 125 and 126. Bit 02 = "1" leads to ramping.

Bit 03: Coasting/Enable
Bit 03 = "0" causes the drive to release control of the motor and coast to a stop. Bit 03 = "1" means that the adjustable frequency drive is able to start provided the other conditions for starting are fulfilled. Parameter 502 is used to determine the gating between bus and digital control of coasting.

Bit 04: Quick-stop
Bit 04 = "0" causes the motor to quick- stop using the ramp programmed in parameter 503. Bit 04 = "1" means that the adjustable frequency drive is able to start, provided the other conditions for starting are fulfilled. Parameter 503 is used to determine the gating between bus and digital control of quick-stop.

Bit 05, Freeze output frequency/ramp enable:
Bit 05 = "0" will cause the output frequency to be maintained even if the reference signal is changed. Bit 05 = "1" will allow the adjustable frequency drive to again regulate the output frequency to the given reference.

Bit 06: Ramp Stop/Start
Bit 06 = "0" causes a ramped stop using either ramp-down 1 (parameter 208) or ramp-down 2 (parameter 210). When Bit 06 = '1" the motor will begin accelerating using either ramp-up 1 (parameter 207) or ramp-up 2 (parameter 209) provided the other conditions for starting have been fulfilled. Parameter 505 is used to determine the gating between bus and digital control of ramp start/stop. In addition, Relay 01 and 04 will be activated when the output frequency is 0 Hz, provided Relay 123 has been selected in parameter 323 or 326.

Bit 07: No function/reset
Bit 07 = "0" will cause no reset. Setting Bit 07 = "1" will cause a trip to be reset.

Bit 08, Activation of Jog speed in parameter 213:
Bit 08 = "0": Jog speed not activated. Bit 08 = "1" means that the motor is running at Jog speed.

Bit 09, Choice of ramp 1/2:
Bit 09 = "0" means that ramp 1 is active (parameters 207/208). Bit 09 = "1" means that ramp 2 (parameters 209/210) is active.

Bit 10, Data not valid/Valid:
This bit is used to determine if the VLT 5000 will respond to the control word. Bit 10 = "0" will cause the control word to be ignored. Bit 10 = "1" will allow the control word to be used. This function is important because the control word is always contained in the telegram. With this bit it is possible to disable the control word if it is not to be used, for example if the telegram is used just for read/writing a parameter.

Bit 11, Relay 01:
Bit 11 = "0": Relay 01 not activated. Bit 11 = 1: Relay 01 activated, provided "Control word bit" [33] has been chosen in parameter 323.

Bit 12, Relay 04:
Bit 12 = "0": Relay 04 not activated. Bit 12 = "1": Relay 04 activated, provided Control word bit [33] has been chosen in parameter 326.

Bits 13/14, Choice of Setup:
Bits 13 and 14 are used for choosing among the four menu setups in accordance with:

Setup	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

This function is only possible if "Multi-Setups" [5] have been selected in parameter 004.

NOTE: Parameter 507 is used for choosing how bits 13/14 are to be combined (gated) with the corresponding function on the digital inputs.

Bit 15, No function/reversing:
Reversing of the direction of rotation of the motor. Bit 15 = "0" leads to no reversing, bit 15 = "1" leads to reversing.

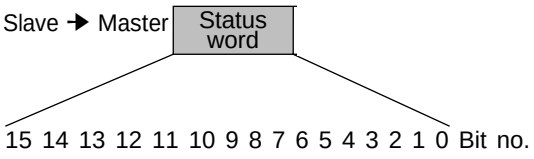
Note factory selection of reversing has been set as "Digital" in parameter 506. Bit 15 only leads to reversing if *"bus"*, *"logical" or* or *"logical and"* has been selected.

NOTE: Unless otherwise mentioned, the control word bit is combined (gated) with the corresponding function on the digital inputs as a logical "or" function.

Danfoss Status Word

Status word as per VLT standard (parameter 512 = DANFOSS)

The status word is used for informing the master (e.g. a PC) about the condition of the slave (VLT 5000 Series).



Bit	Bit = 0	Bit = 1
00	Control not ready	Ready
01	VLT not ready	Ready
02	Coasting	Enable
03	No fault	Trip
04	Reserved	
05	Reserved	
06	Reserved	
07	No warning	Warning
08	Speed ≠ reference	Speed = ref.
09	Local control	Bus control
10	Out of range	Frequency OK
11	Not running	Running
12	VLT OK	Stalling, auto-start
13	Voltage OK	Above limit
14	Torque OK	Above limit
15	Timer OK	Above limit

Bit 00, Control not ready/ready:
Bit 00 = "0" means that the adjustable frequency drive has tripped.
Bit 00 = "1" means that the adjustable frequency drive controls are ready, but the mains power is not applied (External 24V operation).

Bit 01, VLT not ready/ready:
Same meaning as bit 00; however, there is also a supply to the mains component, and the adjustable frequency drive is ready to run when it receives the necessary start signals.

Bit 02, Coasting/enable:
Bit 02 = "0" means that the control word bit 03 is "0" (Coasting) or that VLT 5000 Series has tripped.
Bit 02 = "1" means that control word bit 03 is "1" and that VLT 5000 Series has not tripped.

Bit 03, No fault/trip:
Bit 03 = "0" means that VLT 5000 Series is not in a fault condition. Bit 03 = "1" means that VLT 5000 Series has tripped and needs a reset signal in order to run.

Bit 07, No warning/warning:
Bit 07 = "0" means that there is no unusual situation. Bit 07 = "1" means that an abnormal condition has arisen for the VLT 5000 Series. All warnings described in the VLT 5000 instruction manual will set bit 07 to "1".

Bit 08, Speed ≠ ref/speed. = ref.:
Bit 08 = "0" means that the actual motor speed is different from the speed reference setpoint. This can be the case while the speed is ramped up/down during start/stop. Bit 08 = "1" means that the present motor speed equals the speed reference set point.

Bit 09, Local control/Bus control:
Bit 09 = "0" means that VLT 5000 Series has been stopped by means of the stop key on the control panel, or that Local operation has been selected in parameter 002. Bit 09 = "1" means that it is possible to control the adjustable frequency drive via the DeviceNet option card.

Bit 10, Out of operating range/Freq. limit OK:
Bit 10 = "0" means that the output frequency is out of the range set in parameter 225 (Warning: Low frequency) and parameter 226 (Warning: High frequency). Bit 10 = "1" means that the output frequency lies within the mentioned range.

Bit 11, Does not run/runs:
Bit 11 = "0" means that the motor is not running. Bit 11 = "1" means that VLT 5000 Series has a start signal of that the output frequency is greater than 0 Hz.

Bit 12, VLT OK/stalling, autostart:
Bit 12 = "0" means that there is no temporary overtemperature on the inverter. Bit 12 = '1" means that the inverter has stopped because of overtemperature, but that the unit has not tripped and will continue, once the overtemperature stops.

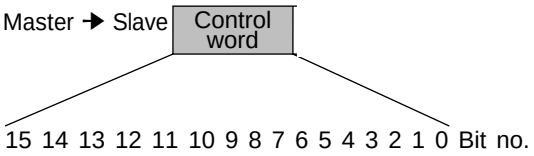
Bit 13, Voltage OK/above limit:
Bit 13 = "0" means that the voltage limits of VLT 5000 Series have not been exceeded. Bit 13 = "1" means that the DC voltage of the VLT 5000 Series intermediate circuit is too low or too high.

Bit 14, Torque OK/above limit:
Bit 14 = "0" means that the motor current is lower than the torque limit selected in parameter 221. Bit 14 = "1" means that the torque limit in parameter 221 has been exceeded.

Bit 15, Timers OK/above limit:
Bit 15 = "0" means that the timers for the motor thermal protection and VLT thermal protection, respectively, have not exceeded 100%. Bit 15 = "1" means that one of the timers has exceeded 100%.

Profidrive Control Word

Control word as per Profidrive standard
(parameter 512 = PROFIDRIVE)
The control word is used for transmitting commands from a master (e.g. a PC) to a slave (VLT 5000 Series).



Bit	Bit = 0	Bit = 1
00	OFF 1	ON 1
01	OFF 2	ON 2
02	OFF 3	ON 3
03	Motor coasting	Enable
04	Quick-stop	Ramp
05	Freeze output freq	Ramp enable
06	Ramp stop	Start
07	No function	Reset
08	Jog 1 OFF	ON
09	Jog 2 OFF	ON
10	Data not valid	Valid
11	No function	Slow down
12	No function	Catch
13	Choice of Setup 1 (lsb)	
14	Choice of Setup 2 (msb)	
15	No function	Reversing

Bit 00, OFF1/ON1:
An ordinary ramp stop which uses the ramp time in parameters 207/208 or 209/210. Bit 00 = "0" leads to a stop, and output relay 01 or 04 being activated, the output frequency is 0 Hz, provided "Relay 123" [31] has been selected in parameter 323 or 326. Bit 00 = "1" means that the adjustable frequency drive will be able to start if the other conditions for starting have been fulfilled.

Bit 01, OFF2/ON2:
Coasting stop. Bit 01 = "0" leads to a coasting stop, and output relay 01 or 04 being activated, when the output frequency is 0 Hz, provided "Relay 123" [31] has been selected in parameter 323 or 326. Bit 01 = "1" means that the adjustable frequency drive is able to start provided the other conditions for starting are fulfilled.

Bit 02, OFF3/ON3:
Quick-stop, which uses the ramp time set in parameter 212. Bit 02 = "0" leads to a quick stop and output relay 01 or 04 being activated, when the output frequency is 0 Hz, provided "Relay 123" [31] has been selected in parameter 323 or 326. Bit 02 = "1" means that the adjustable frequency drive is able to start, provided the other conditions for starting are fulfilled.

Bit 03, Coasting/enable:
Coasting stop. Bit 03 = "0" leads to a stop. Bit 03 = "1" means that the adjustable frequency drive is able to start, provided the other conditions for starting are fulfilled. Note: in parameter 502 the choice is made as to how bit 03 is to be combined (gated) with the corresponding function on the digital inputs.

Bit 04, Quick-stop/ramp:
Quick-stop which uses the ramp time in parameter 212. Bit 04 = "0" leads to a quick-stop. Bit 04 = "1" means that the adjustable frequency drive is able to start, provided the other conditions for starting are fulfilled. Note: In parameter 503 the choice is made as to how bit o4 is to be combined (gated) with the corresponding function on the digital inputs.

Bit 05, Freeze output frequency/ramp enable:
Bit 05 = "0" means that the current output frequency is maintained even if the reference is changed. Bit 05 = "1" means that the adjustable frequency drive is again able to regulate, and the given reference is followed.

Bit 06, Ramp stop/start:
An ordinary ramp stop that uses the ramp time in parameters 207/208 or 209/210. Bit 06 = "0" leads to a stop. Bit 06 = '1" means the adjustable frequency drive is able to start, provided the other conditions for starting are fulfilled. In parameter 505 the choice is made as to how bit 06 is to be combined (gated) with the corresponding function on the digital inputs.

Bit 07, No function/reset
Reset of trip. Bit 07 = "0" means that there is no reset. Bit 07 = "1" means that a trip is reset.

Bit 08, Jog 1 OFF/ON:
Activation of pre-programmed speed in parameter 509 (Bus Jog 1). JOG 1 is only possible when Bit 04 = "0" and bit 00-03 = "1".

Bit 09, Jog 2 OFF/ON:
Activation of pre-programmed speed in parameter 510 (Bus Jog 2). JOG 2 is only possible when Bit 04 = "0" and bits 00-03 = "1". If both JOG 1 and JOG 2 are activated (bits 08 and 09 = "1"), JOG 1 has the higher priority, which means that the speed programmed in parameter 509 will be used.

Bit 10, Data not valid/valid:
Used for telling VLT 5000 whether the control word is to be used or ignored. Bit 10 = "0" means that the control word is ignored. Bit 10 = "1" means that the control word is used.

Bit 11, No function/slow down:
Used for reducing the speed reference by the value in parameter 219. Bit 11 = "0" means that there is no change of the reference. Bit 11 = "1" means that the reference is reduced.

Bit 12, No function/catch-up:
Used for increasing the speed reference by the value of parameter 219. Bit 12 = "0" means that the reference is increased. If both slow down and catch-up are activated (bits 11 and 12 = "1"), slow down has the higher priority, i.e. the speed reference is reduced.

Bits 13/14, Choice of Setup:
Bits 13 and 14 are used for choosing among the four menu setups in accordance with:

Setup	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

This function is only possible if "Multi-Setups" [5] have been selected in parameter 004.

NOTE: Parameter 507 is used for choosing how bits 13/14 are to be combined (gated) with the corresponding function on the digital inputs.

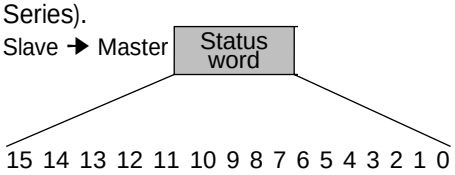
Bit 15, No function/reversing:
Reversing of the direction of rotation of the motor. Bit 15 = "0" leads to no reversing, bit 15 = "1" leads to reversing.

Note factory selection of reversing has been selected as Digital in parameter 506. Bit 15 only leads to reversing if *"bus"*, *"logical or"* or *"logical and"* has been selected.

NOTE: Unless otherwise mentioned, the control word bit is combined (gated) with the corresponding function on the digital inputs as a logical "or" function.

Profidrive Status Word

Status word (according to Profidrive standard)
(parameter 512 = PROFIDRIVE)
The status word is used for informing the master (e.g. a PC) of the condition of a slave (VLT 5000 Series).



Bit	Bit = 0	Bit = 1
00	Control not ready	Ready
01	VLT not ready	Ready
02	Motor coasting	Enable
03	No fault	Trip
04	ON 2	OFF 2
05	ON 3	OFF 3
06	Start enable	Start disable
07	No warning	Warning
08	Speed ≠ reference	Speed = ref.
09	Local control	Bus control
10	Out of range	Freq. limit OK
11	Not running	Running
12	VLT OK	Stalling, auto-start
13	Voltage OK	Above limit
14	Torque OK	Above limit
15	Timer OK	Above limit

Bit 00, Control not ready/ready:
Bit 00 = "0" means that bit 00, 01 or 02 of the control word is "0" (OFF1, OFF2 or OFF3), or that the adjustable frequency drive has tripped. Bit 00 = "1" means that the adjustable frequency drive is ready, but the mains power is not applied (external 24V operation).

Bit 01, VLT not ready/ready:
Same meaning as bit 00; however, the mains power is applied, and the adjustable frequency drive is ready to run when it receives the necessary start signals.

Bit 02, Coasting/enable:
Bit 02 = "0" means that the control word bit 00, 01, 02 or 03 is "0" (OFF1, OFF2, OFF3 or Coasting), or the VLT 5000 Series unit has tripped. Bit 02 = "1" means that the control word bits 00, 01, 02 or 03 are "1" and that VLT 5000 Series has not tripped.

Bit 03, No fault/trip:
Bit 03 = "0" means that VLT 5000 Series is not in a fault condition. Bit 03 = "1" means that VLT 5000 Series has tripped and needs a reset signal in order to run.

Bit 04, ON2/OFF2:
Bit 04 ="0" means that control word bit 01 ="1".
Bit 04 ="1" means that control word bit 01 ="0".

Bit 05, ON3/OFF3:
Bit 05 ="0" means that control word bit 02 ="1".
Bit 05 -"1" means that control word bit 02 ="0".

Bit 06, Start enable/start disable:
Bit 06 is always "0" if Danfoss has been selected in parameter 512. If Profidrive has been selected in parameter 512, bit 06 will be "1" after reset of a trip, after activation of OFF2 or OFF3 and after connection of mains voltage. Start disable = 0 after, setting control word bit 00 to "0" and bits 01, 02 and 10 to "1".

Bit 07, No warning/warning:
Bit 07 = "0" means that there is no unusual situation. Bit 07 = "1" means that an abnormal condition has arisen for the VLT 5000 Series. All warnings described in the VLT 5000 instruction manual will set bit 07 to "1".

Bit 08, Speed ≠ ref/speed. = ref.:
Bit 08 = "0" means that the actual motor speed is different from the speed reference setpoint. This can be the case while the speed is ramped up/down during start/stop. Bit 08 = "1" means that the present motor speed equals the speed reference setpoint.

Bit 09, Local control/Bus control:
Bit 09 = "0" means that VLT 5000 Series has been stopped by means of the stop key on the control panel, or that Local operation has been selected in parameter 002. Bit 09 = "1" means that it is possible to control the adjustable frequency drive via the DeviceNet option card.

Bit 10, Out of operating range/Freq. limit OK:
Bit 10 = "0" means that the output frequency is out of the range set in parameter 225 (Warning: Low frequency) and parameter 226 (Warning: High frequency). Bit 10 = "1" means that the output frequency lies within the mentioned range.

Bit 11, Not running/running:
Bit 11 = "0" means that the motor is not running. Bit 11 = "1" means that VLT 5000 Series has a start signal of that the output frequency is greater than 0 Hz.

Bit 12, VLT OK/stalling, autostart:
Bit 12 = "0" means that the VLT is OK. Bit 12 = '1" means that the inverter has stopped because of overtemperature, but that the unit has not tripped and will restart, once the overtemperature condition is resolved.

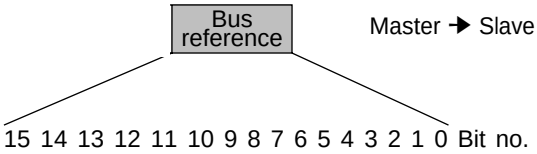
Bit 13, Voltage OK/above limit:
Bit 13 = "0" means that the voltage limits of VLT 5000 Series have not been exceeded. Bit 13 = "1" means that the DC voltage of the VLT 5000 Series intermediate circuit is too low or too high.

Bit 14, Torque OK/above limit:
Bit 14 = "0" means that the motor torque is lower than the torque limit selected in parameter 221. Bit 14 = "1" means that the torque limit in parameter 221 has been exceeded.

Bit 15, Timers OK/above limit:
Bit 15 = "0" means that the timers for the motor thermal protection and VLT thermal protection, respectively, have not exceeded 100%. Bit 15 = "1" means that one of the timers has exceeded 100%.

Bus Reference

Bus reference value:



The frequency reference value is transmitted to the adjustable frequency drive in the form of a 16-bit word. The value is transmitted as a whole number (0-32767). 16384 (4000 Hex) corresponds to 100%. (Negative figures are represented by 2's complement.)

The bus reference has the following format:
Parameter 203 = "0"

"ref_{MIN} – ref_{MAX}"

0-16384 (4000 Hex) ~ 0-100% ~ ref_{MIN} - ref_{MAX}

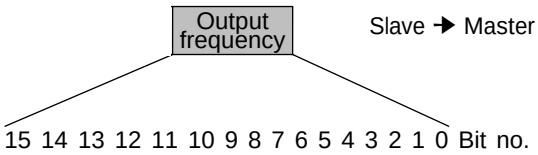
Parameter 203 = "1"

$–ref_{MAX}$ - $+ref_{MAX}$

–16384 (C000 Hex) - +16384 (4000 Hex) ~
–100 - +100% ~ $–ref_{MAX}$ - $+ref_{MAX}$

Output Percentage

Actual output frequency



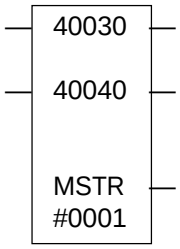
The value of the actual output frequency of the adjustable frequency drive is transmitted in the form of a 16-bit word. The value is transmitted as a whole number (0-32767). 16384 (4000 Hex) corresponds to 100%. (Negative figures are formed by means of 2's complement).

Examples Section

Example 1: Read VLT 5000 Parameter 200

Example 1: Read VLT 5000 parameter 200.
The Modbus Plus controller is at address 7 and the VLT 5000 is at address 4.
MSTR control block at address 40030.
MSTR data area at address 40040.

Set up the MSTR block as follows:

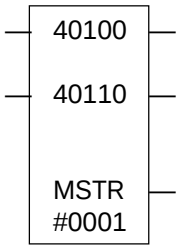


40030	2	Read command
40031	0000 hex	Error response code is placed here
40032	1	Number of registers to read
40033	55	40055 is the holding register that corresponds to VLT 5000 parameter number 200.
40034	4	VLT 5000 address
40035	1	Data slave path 1 (can be 1 through 8)
40036	0	
40037	0	
40038	0	
40040	0	132 Hz clockwise

Example 2: Write to the VLT 5000 Control Word

Example 2: Write 047C hex to the VLT 5000 control word (PNU 967) to start the VLT 5000. The Modbus Plus controller is at address 7 and the VLT 5000 is at address 4.
MSTR control block at address 40100.
MSTR data area at address 40110.

Set up the MSTR block as follows:



40100	1	Write command
40101	0000 hex	Error response code is placed here
40102	1	Number of registers to write
40103	254	40254 is mapped to the VLT 5000 control register (PNU 967)
40104	4	VLT 5000 address
40105	2	Data slave path 2 (can be 1 through 8)
40106	0	
40107	0	
40108	0	

40110 047C hex Data to write to the VLT 5000 is placed here.

VLT Control Word for Example 2:

0				4				7				C			
0	0	0	0	0	1	0	0	0	1	1	1	1	1	0	0
					Valid Control Word				Start	Ramp Enable	Ramp	Enable	Ramp		

Refer to "Danfoss Control Word" in the Process Control and Status section of the manual.

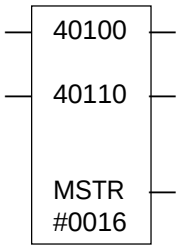
NOTE: This example assumes that parameter 502 is set to Serial Port or a jumper has been placed between terminals 12 and 27.

Example 3: Monitoring VLT 5000 Parameters Using Global Data Read

Example 3: Using global data reads, monitor VLT 5000 parameters 200 through 215. The Modbus Plus controller is at address 7 and the VLT 5000 is at address 4.

First, set up a MSTR block to set the global data read registers to the register numbers corresponding to the VLT 5000 parameters 200 through 215.

Set up the MSTR block as follows:

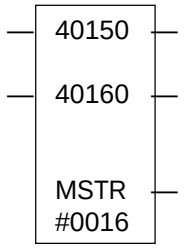


40100	1	Write command
40101	0000 hex	Error response code is placed here
40102	16	Number of registers to write
40103	534	40534 is the start of the global data read area
40104	4	VLT 5000 address
40105	2	Data slave path 2 (can be 1 through 8)
40106	0	
40107	0	
40108	0	

40110	55	Data to write to global data read register 1 (55 → VLT PNU 200)
40111	56	Data to write to global data read register 2 (56 → VLT PNU 201)
40112	57	Data to write to global data read register 3 (57 → VLT PNU 202)
40113	58	Data to write to global data read register 4 (58 → VLT PNU 203)
40114	59	Data to write to global data read register 5 (59 → VLT PNU 204 HIGH)
40115	60	Data to write to global data read register 6 (60 → VLT PNU 204 LOW)
40116	61	Data to write to global data read register 7 (61 → VLT PNU 205 HIGH)
40117	62	Data to write to global data read register 8 (62 → VLT PNU 205 LOW)
40118	63	Data to write to global data read register 9 (63 → VLT PNU 206)
40119	64	Data to write to global data read register 10 (64 → VLT PNU 207 HIGH)
40120	65	Data to write to global data read register 11 (65 → VLT PNU 207 LOW
40121	66	Data to write to global data read register 12 (66 → VLT PNU 208 HIGH)
40122	67	Data to write to global data read register 13 (67 → VLT PNU 208 LOW)
40123	68	Data to write to global data read register 14 (68 → VLT PNU 209 HIGH)
40124	69	Data to write to global data read register 15 (69 → VLT PNU 209 LOW)
40125	70	Data to write to global data read register 16 (70 → VLT PNU 210 HIGH)

Example 3: Monitoring VLT 5000 Parameters Using Global Data Read (continued)

Next, set up the MSTR block for the global data read:



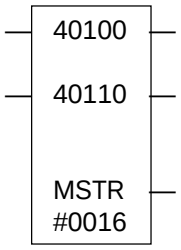
40150	6	Global data read command	
40151	0000 hex	Error response code is placed here	
40152	16	Number of words of global data to be requested	
40153	16	Number of available global data words	
40154	4	VLT 5000 address	
40160	0	Returned global data word 1 (VLT PNU 200)	132 Hz clockwise
40161	0	Returned global data word 2 (VLT PNU 201)	0 Hz
40162	1320	Returned global data word 3 (VLT PNU 202)	132 Hz
40163	0	Returned global data word 4 (VLT PNU 203)	Min-Max
40164	0	Returned global data word 5 (VLT PNU 204 HIGH)	0.000 Hz
40165	0	Returned global data word 6 (VLT PNU 204 LOW)	
40166	0	Returned global data word 7 (VLT PNU 205 HIGH)	50.000 Hz
40167	50000	Returned global data word 8 (VLT PNU 205 LOW)	
40168	0	Returned global data word 9 (VLT PNU 206)	Linear
40169	0	Returned global data word 10 (VLT PNU 207 HIGH)	1.00 sec
40170	100	Returned global data word 11 (VLT PNU 207 LOW)	
40171	0	Returned global data word 12 (VLT PNU 208 HIGH)	1.00 sec
40172	100	Returned global data word 13 (VLT PNU 208 LOW)	
40173	0	Returned global data word 14 (VLT PNU 209 HIGH)	1.00 sec
40174	100	Returned global data word 15 (VLT PNU 209 LOW)	
40175	0	Returned global data word 16 (VLT PNU 210 HIGH)	

Example 4: Write to the VLT 5000 Parameters Using Global Data Writes

Example 4: Using global data writes, change VLT 5000 parameters 207 (Ramp up time #1) to 10.00 sec. (1000).
The Modbus Plus controller is at address 7 and the VLT 5000 is at address 4.

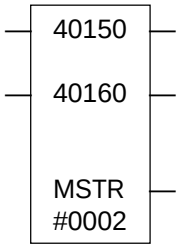
First, set up a MSTR block to set the global data write registers to the register numbers corresponding to the VLT 5000 parameter 207.

Set up the MSTR block as follows:



40100	1	Write command
40101	0000 hex	Error response code is placed here
40102	4	Number of registers to write
40103	500	40502 is the start of the global data write area
40104	4	VLT 5000 address
40105	2	Data slave path 2 (can be 1 through 8)
40106	0	
40107	0	
40108	0	
40110	2	Set online flag to auto online
40111	7	Set PLC master node
40112	64	Data to write to global data read register 1 (64 → VLT PNU 207 HIGH)
40113	65	Data to write to global data read register 2 (65 → VLT PNU 207 LOW)

Next, set up the MSTR block for the global data write:



40150	5	Global data write command
40151	0000 hex	Error response code is placed here
40152	2	Number of words of global data to write
40153	0	No routing information needed
40154	0	Only 1 local node on the network
40160	0	Global data 1 to write to VLT PNU 207 HIGH
40161	1000	Global data 2 to write to VLT PNU 207 LOW

Parameters

Modbus Plus Specific Parameter Descriptions

Parameter 803

803 Bus time out
(BUS TIME OUT)

Selection:

1 - 99 sec	★ 1 sec

Function:
This parameter selects the maximum time expected to pass between valid control words received by the VLT via Global Data. If this time is exceeded, the Modbus Plus link to the Local Master Node is assumed to be disconnected. The desired VLT 5000 reaction is set up through parameter 804.

Parameter 804

804 Bus time out function
(BUS TIME OUT FUNCT.)

Selection:

★ Off (OFF)	[0]
Freeze output frequency (FREEZE OUTPUT)	[1]
Stop with auto restart (STOP)	[2]
Output frequency = JOG freq. (JOGGING)	[3]
Output freq, = Max. freq. (MAX SPEED)	[4]
Stop with trip (STOP AND TRIP)	[5]
Control without Modbus Plus (NO MODBUS PLUS CONTROL)	[6]
Select set up 4 (SELECT SET UP 4)	[7]

Function:

The time out counter is triggered at the first reception of a valid control word i.e. bit 10 = ok.
The *time out* function can be activated in two different ways:

1. CTW (Control Word) is not updated within the specified time
2. Parameter 805 = "bit 10 = 0 → time out" and bit 10 = "0"

The VLT remains in time out state until one of the following four conditions is true:

1. Valid control word (Bit 10 = ok) is received and reset (Bus, terminals or local control panel) is activated (reset is only necessary when the time out function *Stop w/trip* is selected) → control via MODBUS PLUS is resumed with the actual control word.
2. Parameter 002 = *Local* → Local control via local control panel is enabled.
3. Parameter 928 = *Disabled* → Normal control via terminals and RS485 is enabled.

NOTE: The time out counter is reset and must be triggered by a valid control word before a new time out can be activated.

4. Parameter 804 = Off ' control via MODBUS PLUS is resumed and the most recent control word is used.

Description of selections:

- *Freeze output frequency*: Freeze output frequency until communication is resumed.
- *Stop with auto restart*: Stop with auto restart when communication is resumed.
- *Output frequency* = *JOG freq*.: Motor will run at JOG frequency until communication is resumed.
- *Output frequency* = *Max. freq*.: Motor will run at max. frequency until communication is resumed.
- Stop with trip: Motor is stopped, reset needed for restart, see explanation above.
- Control without MODBUS PLUS: Control via MODBUS PLUS is disabled and control is possible via terminals and/or standard RS485 interface, until communication is resumed.
- Select set up 4: Set up 4 is elected in parameter 004 and the settings of set up 4 will be used. Parameter 004 is not reset to the original value when communication is resumed.

★ Factory setting

Parameter 805

805 Function of control word bit 10 (Bit 10 function)

Selection:

	No function (NO FUNCTION)	[0]
★	Bit 10 = 1 → CTW active (BIT 10 = 1 → CTW ACTIVE)	[1]
	Bit 10 = 0 → CTW active (BIT 10 = 0 → CTW ACTIVE)	[2]
	Bit 10 = 0 → time out (BIT 10 = 0 → TIME OUT)	[3]

Function:

The control word and speed reference will be ignored if bit 10 of the control word is *0*, but parameter 805 lets the user change the function of bit 10. This is some times necessary as some masters are setting all bits to *0* in various fault situations. In these cases it makes sense to change the function of bit 10 so that the VLT is commanded to stop (coast) when all bits are *0*.

Description of selections:

- No function: Bit 10 is ignored, i.e. control word and speed reference is always valid.
- *Bit 10 = 1 → CTW active*: Control word and speed reference is ignored if bit 10 = *0*.
- *Bit 10 = 0 → CTW active*: Control word and speed reference is ignored if bit 10 = *1*. If all bits of the control word are 0 the VLT reaction will be coasting.
- *Bit 10 = 0 → time out*: The time out function selected in parameter 804 is activated when bit 10 is *0*.

NOTE: Changes in parameter 805 executed after cycling power.

Parameter 927

927 Parameter edit

Selections:

	Disabled	[0]
★	Enabled	[1]

Function:

Editing parameters is possible via either MODBUS PLUS or standard RS485 serial port (accessed using VLT Dialog 5000), but not both at the same time. Parameter read is always possible via the local control panel.

Description of selections:

- *Disabled*: Parameter edit via MODBUS PLUS is disabled. Parameter edit via standard RS485 serial port is possible.
- *Enabled*: Parameter edit via MODBUS PLUS is enabled. Parameter edit via standard RS485 serial port is blocked.

Parameter 928

928 Process control

Selections:

	Disabled	[0]
★	Enabled	[1]

Function:

Process control (setting of control word and speed reference) is possible via either MODBUS PLUS or the standard RS485 serial port, but not both at the same time. Local control is always possible via the local control panel. Control via control card terminals is possible with bus depending on the setting of parameters 502-508.

Description of selections:

- *Disabled*: Process control via MODBUS PLUS is disabled. Process control via standard RS485 serial port is possible.
- *Enabled*: Process control via MODBUS PLUS is enabled. Process control via standard RS485 serial port is blocked.

NOTE: the motor may start without notice when parameter 928 is changed and start commands are present.

★ Factory setting

Parameter 967

967 Control word

Selections:

16 bits binary code

No LCP access

Function:

Parameter 967 is devoted to sending a control word to the VLT.

Parameter 968

968 Status word

Selections:

Read only

No LCP access

Function:

Parameter 968 is devoted to reading the status word from the VLT.

Parameter 970

970 Edit set up selection (EDIT SETUP SELECT)

Selection:

Factory set up (FACTORY SET UP)	[0]
Set up 1 (SET UP 1)	[1]
Set up 2 (SET UP 2)	[2]
Set up 3 (SET UP 3)	[3]
Set up 4 (SET UP 4)	[4]
★ Active set up (ACTIVE SET UP)	[5]

Function:

As parameter 005, described in VLT 5000 Series Instruction Manual 175R5271.

Parameter 971

971 Store data values (STORE DATA VALUE)

Selection:

★ No action (NO ACTION)	[0]
Store data values (STORE DATA VALUES)	[1]

Function:

Parameter values changed via MODBUS PLUS is only stored in RAM meaning that the changes are lost at power down. This parameter is used to activate a function that stores all parameter values in the EEPROM thus retaining changed parameter values at power down.

Description of selections:

No action: The store function is inactive.
Store data values: All parameter values will be stored in the EEPROM. The value returns to *No action* when all parameter values have been stored.

★ Factory setting

VLT 5000 Parameter Listing

Group 0, Operation & Display

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40001	001	Language	English	0	R/W
40002	002	Local/remote control	Remote control	0	R/W
40003	003	Local reference, high word	000.000	–3	R
40004	003	Local reference, low word	000.000	–3	R
40005	004	Active setup	Setup 1	0	R/W
40006	005	Programming setup	Active setup	0	R/W
40007	006	Copying of setups	No copying	0	R/W
40008	007	LCP copy	No copying	0	R
40009	008	Display scaling of motor frequency	1	-2	R/W
40010	009	Display line 2	Frequency [x Scale]	0	R/W
40011	010	Display line 1.1	Reference [%]	0	R/W
40012	011	Display line 1.2	Motor current [A]	0	R/W
40013	012	Display line 1.3	Power [kW]	0	R/W
40014	013	Local control/configuration	LCP control/as parameter 100	0	R/W
40015	014	Local stop	Possible	0	R/W
40016	015	Local jog	Not possible	0	R/W
40017	016	Local reversing	Not possible	0	R/W
40018	017	Local reset of trip	Possible	0	R/W
40019	018	Lock for data change	Not locked	0	R/W
40020	019	Operating state at power-up, local control	Forced stop, use saved ref.	0	R/W

Group 1, Load & Motor

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40021	100	Configuration	Speed, open loop mode	0	R/W
40022	101	Torque characteristics	High - constant torque	0	R/W
40023	102	Motor power	Depends on unit	1	R/W
40024	103	Motor voltage	Depends on unit	0	R/W
40025	104	Motor frequency	50 Hz	0	R/W
40026	105	Motor current, high word	Depends on motor	–2	R/W
40027	105	Motor current, low word			
40028	106	Rated motor speed	Depends on motor	0	R/W
40029	107	Automatic motor adaptation	Adaptation off	0	R/W
40030	108	Stator resistance, high word	Depends on motor	–4	R/W
40031	108	Stator resistance, low word			
40032	109	Stator reactance, high word	Depends on Motor	–2	R/W
40033	109	Stator reactance, low word			
40034	110	Motor magnetizing, 0 rpm	100%	0	R/W

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 1, Load & Motor (continued)

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40035	111	Min. frequency normal magnetizing	1.0 Hz	–1	R/W
40036	113	Load compensation at low speed	100 %	0	R/W
40037	114	Load compensation at high speed	100 %	0	R/W
40038	115	Slip compensation	100 %	0	R/W
40039	116	Slip compensation time constant	0.50 sec	–2	R/W
40040	117	Resonance dampening	100 %	0	R/W
40041	118	Resonance dampening time constant	5 ms	–3	R/W
40042	119	High starting torque	0.0 sec	–1	R/W
40043	120	Start delay	0.0 sec	–1	R/W
40044	121	Start function	Coasting in start delay time	0	R/W
40045	122	Function at stop	Coasting	0	R/W
40046	123	Min. frequency for activating function at stop	0.0 Hz	–1	R/W
40047	124	DC holding current	50 %	0	R/W
40048	125	DC braking current	50 %	0	R/W
40049	126	DC braking time	10.0 sec	–1	R/W
40050	127	DC brake cut-in frequency	0.0 Hz	–1	R/W
40051	128	Motor thermal protection	No protection	0	R/W
40052	129	External motor fan	No	0	R/W
40053	130	Start frequency	0.0 Hz	–1	R/W
40054	131	Initial voltage	0.0 V	–1	R/W

Group 2, References & Limits

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40055	200	Output frequency range/direction	0-132 Hz	0	R/W
40056	201	Output frequency low limit	0.0 Hz	–1	R/W
40057	202	Output frequency high limit	132 Hz	–1	R/W
40058	203	Reference/feedback area	Min-Max	0	R/W
40059	204	Minimum reference, high word	0.000	–3	R/W
40060	204	Minimum reference, low word			
40061	205	Maximum reference, high word	Depends on unit	–3	R/W
40062	205	Maximum reference, low word			
40063	206	Ramp type	Linear	0	R/W
40064	207	Ramp-up time 1, high word	Depends on unit	–2	R/W
40065	207	Ramp-up time 1, low word			
40066	208	Ramp-down time 1, high word	Depends on unit	–2	R/W
40067	208	Ramp-down time 1, low word			

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 2, References & Limits (continued)

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40068	209	Ramp-up time 2, high word	Depends on unit	–2	R/W
40069	209	Ramp-up time 2, low word			
40070	210	Ramp-down time 2, high word	Depends on unit	–2	R/W
40071	210	Ramp-down time 2, low word			
40072	211	Jog ramp time, high word	Depends on unit	–2	R/W
40073	211	Jog ramp time, low word			
40074	212	Quick stop ramp-down time, high word	Depends on unit	–2	R/W
40075	212	Quick stop ramp-down time, low, word			
40076	213	Jog frequency	10.0 Hz	–1	R/W
40077	214	Reference function	Sum	0	R/W
40078	215	Preset reference 1	0.00 %	–2	R/W
40079	216	Preset reference 2	0.00 %	–2	R/W
40080	217	Preset reference 3	0.00 %	–2	R/W
40081	218	Preset reference 4	0.00 %	–2	R/W
40082	219	Catch up/slow down value	0.00 %	–2	R/W
40083	221	Torque limit for motor mode	160 % of $T_{M,N}$	–1	R/W
40084	222	Torque limit for regenerative operation	10 %	–1	R/W
40085	223	Warning: Low current	0.0 A	–1	R/W
40086	224	Warning: High current	$I_{VLT,MAX}$	–1	R/W
40087	225	Warning: Low frequency	0.0 Hz	–1	R/W
40088	226	Warning: High frequency	132.0 Hz	–1	R/W
40089	227	Warning: Low feedback, high word	–4000.000	–3	R/W
40090	227	Warning: Low feedback, low word			
40091	228	Warning: High feedback, high word	4000.000	–3	R/W
40092	228	Warning: High feedback, low word			
40093	229	Frequency bypass bandwidth	0 (OFF) %	0	R/W
40094	230	Frequency bypass 1	0.0 Hz	–1	R/W
40095	231	Frequency bypass 2	0.0 Hz	–1	R/W
40096	232	Frequency bypass 3	0.0 Hz	–1	R/W
40097	233	Frequency bypass 4	0.0 Hz	–1	R/W
40098	298	Factory reserved			
40099	299	Factory reserved			

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 3, Inputs & Output

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40100	300	Terminal 16, input	Reset	0	R/W
40101	301	Terminal 17, input	Freeze reference	0	R/W
40102	302	Terminal 18 Start, input	Start	0	R/W
40103	303	Terminal 19, input	Reversing	0	R/W
40104	304	Terminal 27, input	Coasting stop, inverse	0	R/W
40105	305	Terminal 29, input	Jog	0	R/W
40106	306	Terminal 32, input	Choice of setup, msb/speed up	0	R/W
40107	307	Terminal 33, input	Choice of setup, lsb/speed down	0	R/W
40108	308	Terminal 53, analog input voltage	Reference	0	R/W
40109	309	Terminal 53, min. scaling	0.0 V	–1	R/W
40110	310	Terminal 53, max. scaling	10.0 V	–1	R/W
40111	311	Terminal 54, analog input voltage	No operation	0	R/W
40112	312	Terminal 54, min. scaling	0.0 V	–1	R/W
40113	313	Terminal 54, max. scaling	10.0 V	–1	R/W
40114	314	Terminal 60, analog input current	Reference	0	R/W
40115	315	Terminal 60, min. scaling	0.0 mA	–4	R/W
40116	316	Terminal 60, max, scaling	20.0 mA	–4	R/W
40117	317	Time out	10 sec	0	R/W
40118	318	Function after time out	Off	0	R/W
40119	319	Terminal 42, output	$0\text{-}I_{MAX}$ = 0-20 mA	0	R/W
40120	320	Terminal 42, output, pulse scaling	5000 Hz	0	R/W
40121	321	Terminal 45, output	$0\text{-}f_{MAX}$ = 0-20 mA	0	R/W
40122	322	Terminal 45, output, pulse scaling	5000 Hz	0	R/W
40123	323	Relay 01, output	Ready - no thermal warning	0	R/W
40124	324	Relay 01, ON delay	0.00 sec	–2	R/W
40125	325	Relay 01, OFF delay	0.00 sec	–2	R/W
40126	326	Relay 04, output	Ready - remote control	0	R/W
40127	327	Pulse reference, max. frequency	5000 Hz	0	R/W
40128	328	Pulse feedback, max. frequency	25000 Hz	0	R/W
40129	329	Encoder feedback pulse/rev.	1024 pulses/rev.	0	R/W

Group 4, Special functions

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40130	400	Brake function	Off	0	R/W
40131	401	Brake resistor, ohm	Depends on unit	–1	R/W
40132	402	Brake power limit, kW	Depends on unit	2	R/W
40133	403	Power monitoring	On	0	R/W
40134	404	Brake check	Off	0	R/W

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 4, Special functions (continued)

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40135	405	Reset function	Manual reset	0	R/W
40136	406	Automatic restart time	5 sec	0	R/W
40137	407	AC line failure	No function	0	R/W
40138	408	Quick discharge	Not possible	0	R/W
40139	409	Trip delay torque	Off	0	R/W
40140	410	Trip-delay inverter	Depends on unit	0	R/W
40141	411	Switching frequency	Depends on unit output	2	R/W
40142	412	Output frequency dependent switching frequency	Not possible	0	R/W
40143	413	Overmodulation function	On	–1	R/W
40144	414	Minimum feedback, high word	0.000	–3	R/W
40145	414	Minimum feedback, low word			
40146	415	Maximum feedback, high word	1500.000	–3	R/W
40147	415	Maximum feedback, low word			
40148	416	Process unit	%	0	R/W
40149	417	Speed PID proportional gain	0.015	–3	R/W
40150	418	Speed PID integral time, high word	8 ms	–4	R/W
40151	418	Speed PID integral time, low word			
40152	419	Speed PID differential time	30 ms	–4	R/W
40153	420	Speed PID D-gain limit	5.0	–1	R/W
40154	421	Speed PID lowpass filter time	10 ms	–4	R/W
40155	422	U 0 voltage at 0 Hz	20.0 V	–1	R/W
40156	423	U 1 voltage	parameter 103	–1	R/W
40157	424	F 1 frequency	parameter 104	–1	R/W
40158	425	U 2 voltage	parameter 103	–1	R/W
40159	426	F2 frequency	parameter 104	–1	R/W
40160	427	U 3 voltage	parameter 103	–1	R/W
40161	428	F 3 frequency	parameter 104	–1	R/W
40162	429	U 4 voltage	parameter 103	–1	R/W
40163	430	F 4 frequency	parameter 104	–1	R/W
40164	431	U 5 voltage	parameter 103	–1	R/W
40165	432	F 5 frequency	parameter 104	–1	R/W
40166	433	Torque proportional gain	100 %	0	R/W
40167	434	Torque integral time, high word	0.02 sec	–3	R/W
40168	434	Torque integral time, low word			
40169	437	Process PID Normal/inverse control	Normal	0	R/W
40170	438	Process PID anti windup	On	0	R/W
40171	439	Process PID start frequency	parameter 201	0	R/W
40172	440	Process PID proportional gain	0.01	0	R/W

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 4, Special functions (continued)

Holding Register	Parameter Number	Parameter Description	Factory Setting	Conversion Index	Read/ Write
40173	441	Process PID integral time, high word	Off	4	R/W
40174	441	Process PID integral time, low word			
40175	442	Process PID differentiation time	0.00 sec (Off)	4	R/W
40176	443	Process PID differentiation gain limit	5.0	0	R/W
40177	444	Process PID lowpass filter time	0.01	4	R/W
40178	445	Flying start	Off	0	R/W
40179	446	Switching pattern	Automatic	0	R/W
40180	447	Torque compensation	100%	0	R/W
40181	448	Gear ratio, high word	1	–2	R/W
40182	448	Gear ratio, low word			
40183	449	Friction loss	0%	–2	R/W
40184	450	Mains failure voltage	Depends on unit	0	R/W

Group 5, Serial Communication

Holding Register	Parameter Number	Parameter Description Index	Factory Setting	Conversion Index	Read/ Write
40185	500	Address	1	0	R/W
40186	501	Baudrate	9600 Baud	0	R/W
40187	502	Coasting	Logic or	0	R/W
40188	503	Quick-stop	Logic or	0	R/W
40189	504	DC-brake	Logic or	0	R/W
40190	505	Start	Logic or	0	R/W
40191	506	Reversing	Logic or	0	R/W
40192	507	Selection of setup	Logic or	0	R/W
40193	508	Selection of speed	Logic or	0	R/W
40194	509	Bus jog 1	10.0 Hz	–1	R/W
40195	510	Bus jog 2	10.0 Hz	–1	R/W
40196	512	Telegram profile	Danfoss	0	R/W
40197	513	Bus time interval	1 sec	0	R/W
40198	514	Bus time interval function	Off	0	R/W
40199	515	Data read-out: Reference %		–1	R
40200	516	Data read-out: Reference unit, high word			
40201	516	Data read-out: Reference unit, low word		–3	R
40202	517	Data read-out: Feedback, high word		–3	R
40203	517	Data read-out: Feedback, low word			

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 5, Serial Communication (continued)

Holding Register	Parameter Number	Parameter Description Index	Factory Setting	Conversion Index	Read/ Write
40204	518	Data read-out: Frequency		–1	R
40205	519	Data read-out Frequency x Scaling, high word		–2	R
40206	519	Data read-out Frequency x Scaling, low word			
40207	520	Data read-out: Current, high word		–2	R
40208	520	Data read-out: Current, low word			
40209	521	Data read-out: Torque		–1	R
40210	522	Data read-out: Power kW high word		–1	R
40211	522	Data read-out: Power kW low word			
40212	523	Data read-out: Power HP, high word		–2	R
40213	523	Data read-out: Power HP, low word			
40214	524	Data read-out: Motor voltage		–1	R
40215	525	Data read-out: DC link voltage		0	R
40216	526	Data read-out: Motor temperature		0	R
40217	527	Data read-out: VLT temp.		0	R
40218	528	Data read-out: Digital input		0	R
40219	529	Data read-out: Terminal 53, analog input		–1	R
40220	530	Data read-out: Terminal 54, analog input		–1	R
40221	531	Data read-out: Terminal 60, analog input		–4	R
40222	532	Data read-out: Pulse reference, high word		–1	R
40223	532	Data read-out: Pulse reference, low word			
40224	533	Data read-out: External reference %		–1	R
40225	534	Data read-out: Status word, binary		0	R
40226	535	Data read-out: Brake power/2 min.		2	R
40227	536	Data read-out: Brake power/sec.		2	R
40228	537	Data read-out: Heat sink temperature		0	R
40229	538	Data read-out: Alarm word binary, high word		0	R
40230	538	Data read-out: Alarm word binary, low word			
40231	539	Data read-out: VLT control word, binary		0	R
40232	540	Data read-out: Warning word 1, high word		0	R
40233	540	Data read-out: Warning word 1, low word			

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 5, Serial Communication (continued)

Holding Register	Parameter Number	Parameter Description Index	Factory Setting	Conversion Index	Read/ Write
40234	541	Data read-out: Warning word 2, high word		0	R
40235	541	Data read-out: Warning word 2, low word			

Group 6, Technical Functions

Holding Register	Parameter Number	Parameter Description Index	Factory Setting	Conversion Index	Read/ Write
40236	600	Operating data: Operating hours, high word		–1	R
40237	600	Operating data: Operating hours, low word			
40238	601	Operating data: Hours run, high word		–1	R
40239	601	Operating data: Hours run, low word			
40240	602	Operating data: kWh counter, high word		2	R
40241	602	Operating data: kWh counter, low word			
40242	603	Operating data: Number of power-ups		0	R
40243	604	Operating data: Number of overtemperatures		0	R
40244	605	Operating data: Number of overvoltages		0	R
	606 - 617	Unsupported array values			
40245	618	Reset of kWh counter		0	R/W
40246	619	Reset of hours-run counter		0	R/W
40247	620	Operating mode Normal function		0	R/W
	621 - 631	Unsupported text values			
40248	699	Service reset		0	R/W

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Group 8 and 9, Technical Functions

Holding Register	Parameter Number	Parameter Description Index	Factory Setting	Conversion Index	Read/ Write
40249	803	Bus time out		–1	R/W
40250	804	Bus time out function		–1	R/W
40251	805	Bit 10 function		–1	R/W
40252	927	Parameter edit		0	R/W
40253	928	Process control		0	R/W
40254	967	Control word		0	R/W
40255	968	Status word		0	R
40256	970	Edit setup		0	R/W
40257	971	Store data values		0	R/W
40298 * †		Bus Reference		0	R/W
40299 *		Output Frequency		0	R

* Accessible through global transfer only.

† The control word must be written before bus reference can be written.

NOTE: 4xxxx, the leading 4 is implied and should not be entered when programming the PLC.
Conversion index: Decimal point placement (e.g. –3 = value x 10^{-3})

Troubleshooting

VLT 5000 Modbus Plus Troubleshooting

If problems are encountered during set-up or operation, there is a Modbus Plus LED and VLT 5000 warnings and alarms to assist in finding the source of the problem. The VLT 5000 Local Control Panel (LCP) will indicate drive and communication warnings and alarms.

Warning and Alarm Messages

There is a clear distinction between alarms and warnings. In the case of an alarm, The VLT will enter a fault condition. After the cause for the alarm has been cleared, the master will have to acknowledge the alarm message for the VLT to start operating again. A warning on the other hand may come when a warning condition appears, and disappear when conditions return to normal without interfering with the process.

Warnings

Any warning within the VLT is represented by a single bit within a warning word. A warning word is always an action parameter. Bit status FALSE [0] means no warning, while bit status TRUE [1] means warning.

In addition to the warning word message the master will also be notified through a change of bit 7 in the Status Word.

Alarms

Following an Alarm message the VLT will enter Fault condition. Only after the fault has been cleared and the master has acknowledged the alarm message by setting bit 7 in the Control Word, can the VLT resume operation.

Any alarm within the VLT is represented by a single bit within the alarm word. The alarm word is always an action parameter. Bit status FALSE [0] means no fault, while bit status TRUE [1] means fault.

Alarms & Warnings Descriptions

Refer to the VLT 5000 Series Adjustable Frequency Drive Instruction Manual No. 175R5271 for complete descriptions of all Warnings and Alarms.

Field Bus Card Specific Alarms & Warnings

The warnings and alarms listed below are specific to operation with a field bus card.

Warning 18: HPFB Timeout
A High Performance Field Bus Time-out will only occur if communication using global data tables is interrupted for longer than the time programmed in VLT 5000 Parameter 803 and VLT 5000 Parameter 804 is not programmed to OFF.

Alarm 34: Option Communication Fault
This alarm indicates a problem in the Modbus Plus Option Card Alarm can be triggered by excessive Network cable noise of improper network termination.

Appl Error: T0 exp, T1 exp
These errors indicate an internal loss of communication between the Modbus Plus Option Card, Memory Card and the VLT 5000 Control Card. Typically caused by loose ribbon cable connections.

NOTE:
If a single dot is displayed in the top left corner of the LCP after installation, check alll ribbon cable connections. This indicates that the microprocessor on the VLT 5000 Control Card did not initialize.

Network LED Indicator

Modbus Plus status is shown by flashing a repetitive pattern on the network indicator (green LED). The patterns are:

- Six flashes per second;
  The node's normal operating state. The node is successfully receiving and passing the token. All nodes on the network should be flashing this pattern.

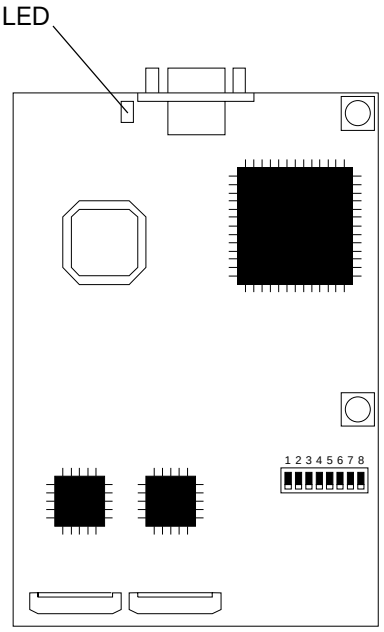
- One flash per second;
  The node is off-line after just being powered up, or after exiting the four flashes per second mode.

- Two flashes, then OFF for two seconds;
  The node is hearing the token being passed among other nodes, but is never receiving the token. Check the network for an open circuit or defective termination.

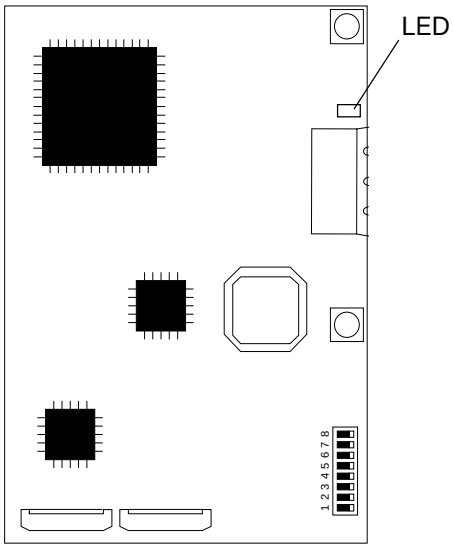
- Three flashes, then OFF for 1.7 seconds;
  The node is not hearing any other nodes. It is periodically claiming the token, but finding no other node to which to pass it. Check the network for an open circuit or defective termination.

- Four flashes, then OFF for 1.4 seconds;
  The node has heard a valid message from another node that is using the same address as this node. The node remains in this state as long as it continues to hear the duplicate address. If the duplicate address is not heard for five seconds, the node then changes to the pattern of one flash every second.

NOTE: LED patterns other than those shown above indicate a possible hardware problem.



Part # 175F1550



Part # 175F1551

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