Instruction Bulletin
VD0C06S308
August 1996

PCMCIA Communication Card Kit

UNI-TELWAY, MODBUS/JBUS Protocols

VW3A66301U

User's Manual

Telemecanique

SQUARE D

⚠ DANGER

HAZARDOUS VOLTAGE

- Read and understand this bulletin in its entirety before installing PCMCIA card or operating ALTIVAR 66 drive controller with PCMCIA card installed. Installation, adjustment, repair and maintenance of these drive controllers must be performed by qualified personnel.
- Disconnect all power before servicing drive controller. WAIT ONE MINUTE until DC bus capacitors discharge, then measure DC bus capacitor voltage between PA and (-) terminals to verify DC voltage is less than 45 V. The DC bus LED is not an accurate indication of the absence of DC bus voltage.
- DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Install all covers and close door before applying power or starting and stopping the drive controller.
- User is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Before servicing drive controller:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on drive controller disconnect.
- Lock disconnect in open position.

Failure to follow these instructions will result in death or serious injury.

INTRODUCTION

The VW3A66301U Communication Card Kit allows you to connect an ALTIVAR 66 drive controller to multipoint networks using the following protocols:

- UNI-TELWAY
- MODBUS RTU / JBUS
- MODBUS ASCII

The VW3A66301U Communication Card Kit consists of a Type 3 Personal Computer Memory Card International Association (PCMCIA) card, a captive 3 m (9.84 ft) cable, and a SUB-D 15-pin connector.

The ALTIVAR 66 drive controller must be equipped with one of the following option modules:

- I / O Extension Module VW3A66201T or VW3A66202T or
- Communication Carrier Module VW3A66205

As a node on a network, the ALTIVAR 66 drive controller can receive and respond to data messages. The data exchange allows use of ALTIVAR 66 functions:

- Downloading of adjustment parameters
- Command and control
- Monitoring
- Diagnostics

SYSTEM SAFETY CONSIDERATIONS

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are Emergency Stop and Overtravel Stop. Separate or redundant control paths must be provided for critical control functions.
- The control paths of a system may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.

Failure to follow these instructions can result in death, serious injury, or equipment damage.[1]

1. For additional information, refer to NEMA ICS 1.1-1984, “Safety Guidelines for the application, Installation, and Maintenance of Solid State Control” and to NEMA ICS7.1-1995, “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.”

USING THIS MANUAL

This manual applies to ALTIVAR 66 drive controllers equipped with software version 3.0 or later. It consists of four sections:

- **Section 1: Installation and Configuration (page 3)** — describes how to install the PCMCIA Communication Card Kit and contains wiring information and procedures for connecting the drive controller to a UNI-TELWAY or MODBUS bus.
- **Section 2: Register Description (page 23)** — describes in detail the ALTIVAR 66 registers, including information such as range, units and factory settings.
- **Section 3: UNI-TELWAY Protocol (page 39)** — contains communication conventions for UNI-TELWAY protocol.
- **Section 4: MODBUS Protocol (page 45)** — contains communication conventions for MODBUS protocol.

Appendix A (page 57) contains a list of registers in numerical order with page references back to the descriptions in Section 2.

For more information about specific parameters, refer to the following ALTIVAR 66 documentation:

- Level 1 and 2 Configuration manual, VD0C06S305_
- I/O Extension Module and Level 3 Configuration manual VD0C06T306_.

Other documentation available:

- Receiving, Installation & Start-Up manual, VD0C06S304_
- Communication Carrier Module manual VD0C06N915_.
- Catalog, VD0C06S201_

Additional documentation is provided with the optional peripherals.

REVISION LEVEL

This is a new document. It is intended for use with ALTIVAR 66 drive controllers equipped with software version 3.0 or later.

SECTION 1: INSTALLATION AND CONFIGURATION

RECEIVING

Remove the Communication Card Kit from its packaging and visually inspect the exterior for shipping damage. If any damage is found, notify the carrier and your local representative. Do not install a damaged card. If the communication card is to be stored after receipt, replace it in its original packing material and store at -40 to +185 °F (-40 to +85 °C).

The following specifications apply to the communication interface of the Communication Card Kit:

- Isolation (network to drive controller): Galvanically isolated for 30 V RMS, 50 V peak
- Isolation (cable jacket to ground): 300 V RMS
- Captive cable termination: 15-pin, male D-shell
- Electrical interface: RS-232, RS-422, RS-485 (selectable by connection)

INSTALLATION

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

Read and understand this document, VD0C06S304_, VD0C06S305_, and the applicable option card manual before operating the drive controller.

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

Before installing, removing, or replacing the PCMCIA Communication Card Kit, remove all power from the drive controller, including external control power which may be present on the option module, and perform the bus voltage measurement procedure on page 4.

Bus Voltage Measurement Procedure

⚠ DANGER

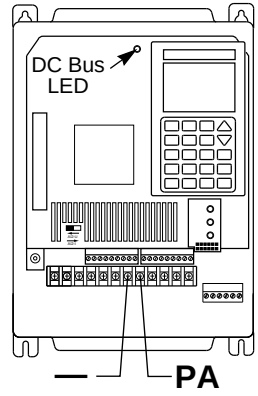
HAZARDOUS VOLTAGE

- This product contains energy storage devices. Read and understand the Bus Voltage Measurement Procedure before installing the PCMCIA Communication Card Kit. Measurement of DC bus capacitor voltage must be performed by qualified personnel.
- DC bus LED is not an accurate indication of absence of DC bus voltage.
- DO NOT short across capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

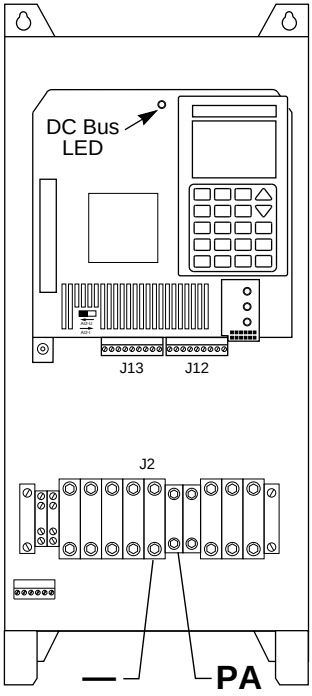
Failure to follow these instructions will cause shock or burn, resulting in death or serious injury.

The PA and - terminals are located inside the drive controller (see Figure 1). To measure bus capacitor voltage:

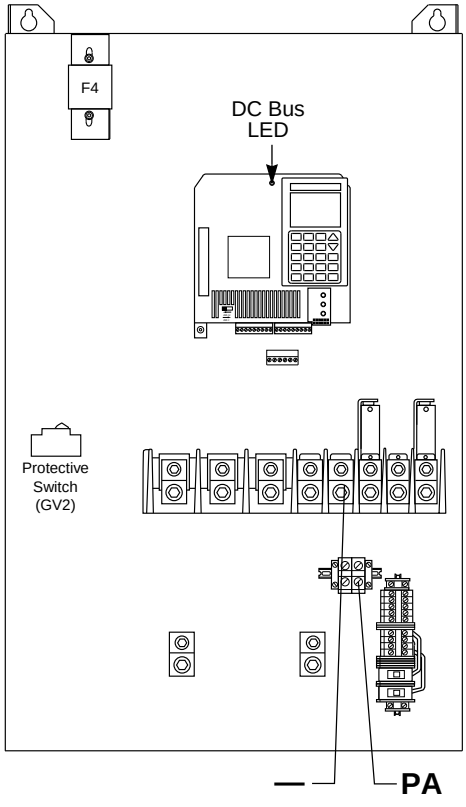
1. Disconnect all power from the drive controller.
2. Wait 1 minute to allow the DC bus to discharge.
3. Open the front cover of the drive controller.
4. Set the voltmeter to the 1000 VDC scale. Measure the bus capacitor voltage between the PA and - terminals to verify that the DC voltage is less than 45 V. **Do not short across capacitor terminals with voltage present!**
5. If the bus capacitors are not fully discharged, contact your local representative. **Do do not operate the drive controller.**



ATV66U41N4 to D12N4 and
ATV66U41M2 to U90M2



ATV66D16N4 to D79N4 and
ATV66D12M2 to D46M2



ATV66C10N4 to C19N4

Figure 1: Location of PA and - Terminals: ATV66U41N4 to C19N4 and ATV66U41M2 to D46M2

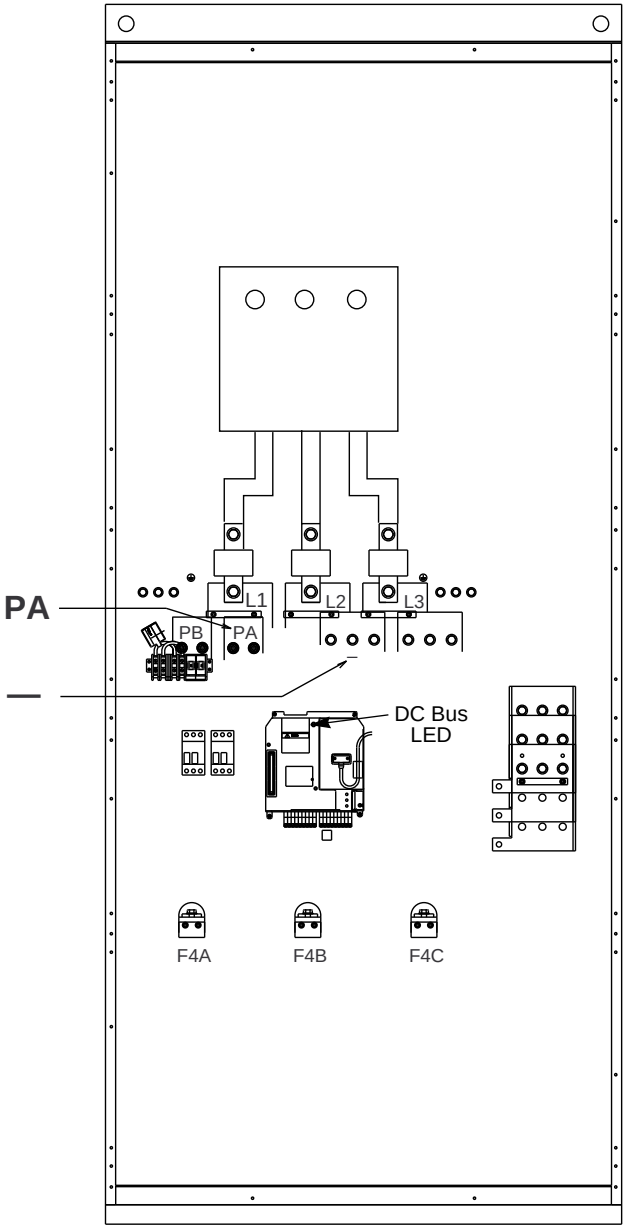


Figure 2: Location of PA and - Terminals: ATV66C23N41 to C31N41

Installing the PCMCIA Communication Card Kit

To install the PCMCIA Communication Card Kit into drive controller:

1. Open the drive controller door.
2. On models ATV66U41N4 to D23N4 and ATV66U41M2 to U90M2, remove plastic knockout from top of drive controller cover.
   NOTE: The drive controller enclosure Type rating will change from Type 1 to Open when the knockout is removed.
3. Insert the PCMCIA card 68-pin connector into the PCMCIA slot on top of option card with the “Insert” arrows facing towards the front of drive controller (see Figure 3).
4. For models ATV66U41N4 to D12N4 and ATV66U41M2 to U90M2: the PCMCIA captive cable must be routed through the knockout and outside the drive controller enclosure. For all other models, route the captive cable inside the drive controller enclosure, along with the control conductors connected to J12 and J13 of the drive controller main control board.
   NOTE: The 15-pin D-shell connector of the PCMCIA captive cable has exposed metal parts. The cable must be routed and anchored so that the connector avoids contact with live conductors within the drive controller.
5. For models ATV66D16N4 to D79N4 and ATV66D12M2 to D46M2: provisions in the bottom plastic plate allow the PCMCIA captive cable connector to exit through the bottom of the drive controller enclosure.
   NOTE: If the captive cable and connector of the PCMCIA card exit the drive controller enclosure, additional mechanical and environmental protection of the cable and connector may be required.

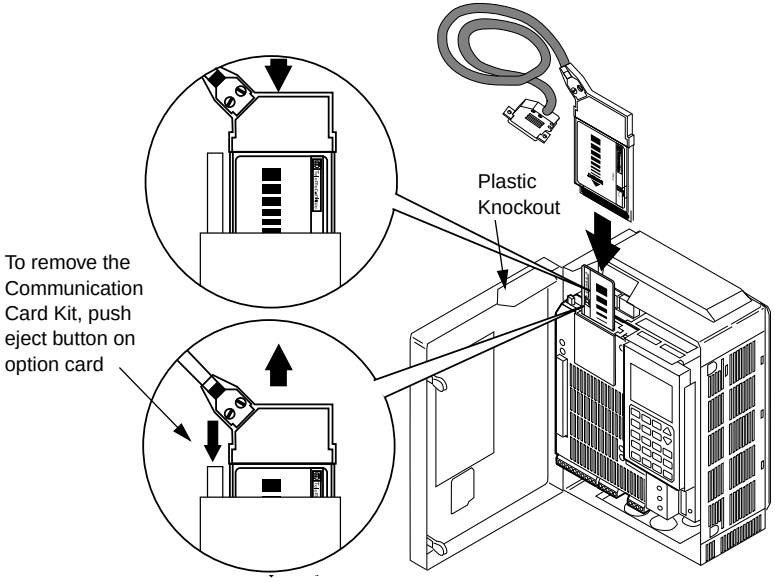
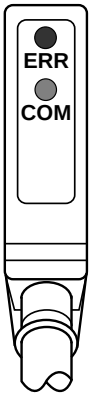


Figure 3: Mounting and Removing PCMCIA Communication Card Kit

Diagnostics

There are two LEDs on top of the PCMCIA interface card: a green “COM” LED and a red “ERR” LED. Status is indicated when the LEDs flash the patterns described in Figure 4.



Green COM LED	Red ERR LED	Probable Causes	Corrective Action
Illuminated	Off	Normal operation	
Flashing	Off	• Incorrect communication configuration • ALTIVAR 66 communication fault	• Check configuration • Check software compatibility
Off	Illuminated	Communication fault on the bus	• Check the switch positions on the TSX-SCA62 connector, if present. • Check for presence of master device and its proper link, configuration, and operation.
Off	Off	PCMCIA card or drive controller fault	Check the drive controller by removing the PCMCIA card. Replace the drive controller or the card.

Figure 4: PCMCIA LEDs — LED Status Indication

CONFIGURING THE COMMUNICATION FUNCTIONS

First Power Up

For a good understanding of access to the different menus, see the Level 1 & 2 Configuration manual, VD0C06S305_, and (if an I/O Extension Module is installed) the I/O Extension Module & Level 3 Configuration manual, VD0C06T306_.

Figure 5: First Power Up

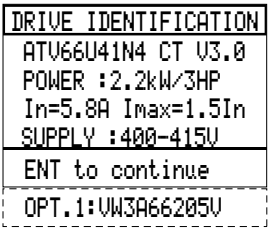
At first power up, a message appears on the keypad display to allow identification of the option. After OPT, the catalog number of the selected card is shown. Press ENT. This will reconfigure the drive controller to factory settings.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

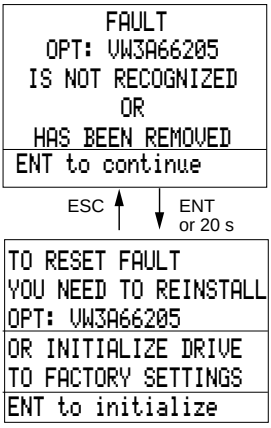
- Installation of an option module will reset all drive controller parameters, including I/O assignments, to factory default settings.
- Before installing an option module, record all existing settings of the drive controller.
- After installing the option module, reset drive controller back to recorded values.

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



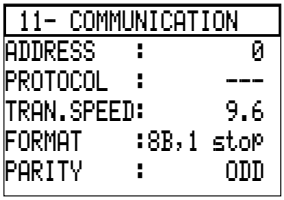
In the Drive Identification menu, you can check the catalog number of the option installed by pressing the ▲▼ keys.

Figure 6: Drive Identification



When the drive controller is powered up, if the option has been removed after being configured, the fault screen appears. The option must be reinstalled, or the drive controller settings must be reset to factory preset values.

Figure 7: Fault Screen



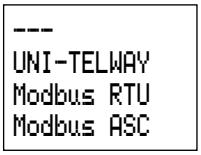
Select the 11→Communication menu to access the configuration parameters of the PCMCIA Communication Card Kit. This menu contains four submenus for configuring protocol, transmission speed, network format, and parity. Drive address is entered directly on the Communication menu from the keypad.

Figure 8: Communication Menu

Address

The address varies with the protocol selected and is configurable. Factory setting is 0. Maximum value is 31.

Protocol



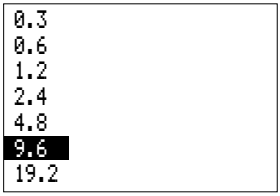
The VW3A66301U PCMCIA Communication Card Kit supports three protocols:

- UNI-TELWAY
- MODBUS RTU
- MODBUS ASCII

Figure 9: Protocol Menu

Factory setting is – – – (no protocol selected). Select the protocol appropriate for your network.

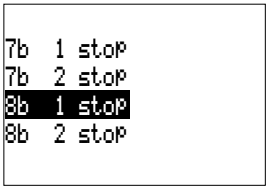
Transmission Speed



Network transmission speed is selectable from 300 to 19,200 baud. The factory preset transmission speed is 9,600 baud.

Figure 10: Transmission Speed Menu

Data Format



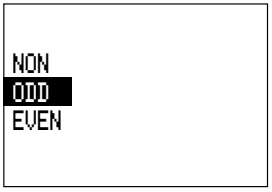
Depending on protocol selected, one or both of the following data formats are available:

- 7 bits with 1 or 2 stop bits (MODBUS ASCII only)
- 8 bits with 1 or 2 stop bits

Factory setting is 8 bits with 1 stop bit.

Figure 11: Data Format Menu

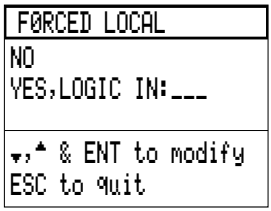
Parity



Set parity as none, even or odd. Factory setting is odd.

Figure 12: Parity Menu

Forced Local



A forced local logic input can be defined in the 7.2→Application Functions menu. This logic input returns control to the terminal strip or keypad if in Serial Link Command Mode (W2020, 1 [DLI] and W2020, 2 [FLI] set to 1; see page 24.)

Figure 13: Forced Local Menu

Forced local can also be selected in the 5→Keypad Configuration menu and assigned to the F1 function key. The F1 function key can be used to toggle between Local (Keypad or Terminal Command, depending on the setting of T/K) and Remote (Serial Link Command).

WIRING

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are Emergency Stop and Overtravel Stop. Separate or redundant control paths must be provided for critical control functions.
- The control paths of a system may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.

Failure to follow these instructions can result in death, serious injury, or equipment damage.[1]

1. For additional information, refer to NEMA ICS 1.1-1984, “Safety Guidelines for the application, Installation, and Maintenance of Solid State Control” and to NEMA ICS7.1-1995, “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.”

Connection to Multidrop Bus

Electrical Interface

The electrical interface of the VW3A66301U PCMCIA Communication Card Kit is selectable as either RS-485, RS-422, or RS-232C.

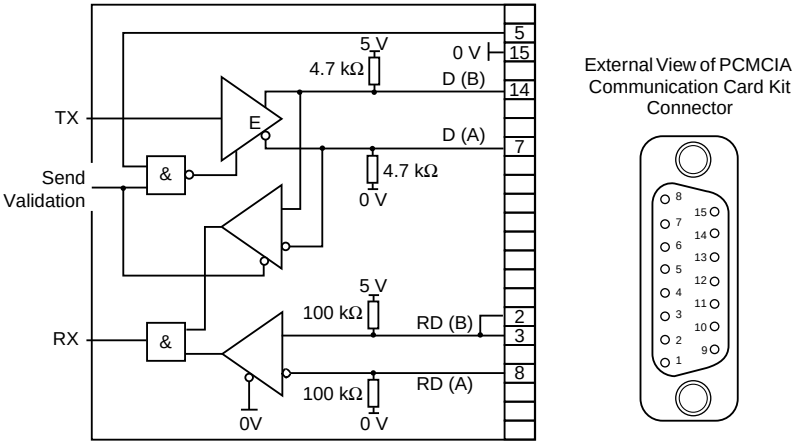


Figure 14: Electrical Interface

The electrical interface is isolated from the drive controller. It is supplied on a Sub D 15-pin connector. Figure 15 illustrates the RS-485 interface (seen from the external contact side), Figure 16 illustrates the RS-232C interface, and Figure 17 illustrates the RS-422 interface.

PCMCIA Card D-Shell Electrical Interface (RS-485)

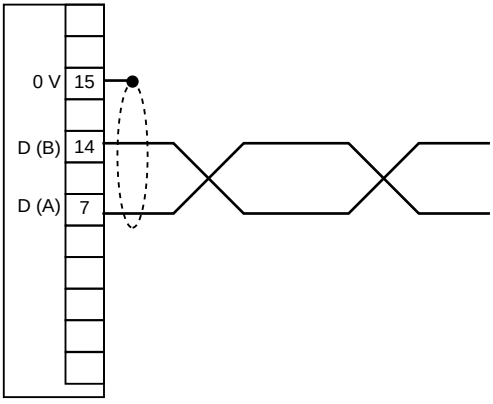
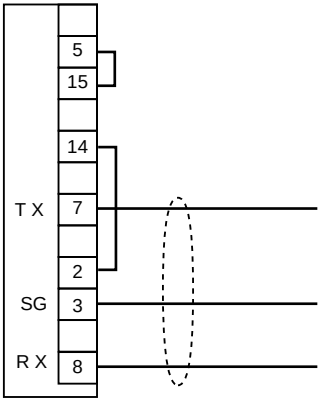


Figure 15: RS-485 Interface

PCMCIA Card D-Shell Electrical Interface (RS-232C)



NOTE: Shield connected to ground at other end

Figure 16: RS-232C Interface

PCMCIA Card D-Shell Electrical Interface (RS-422)

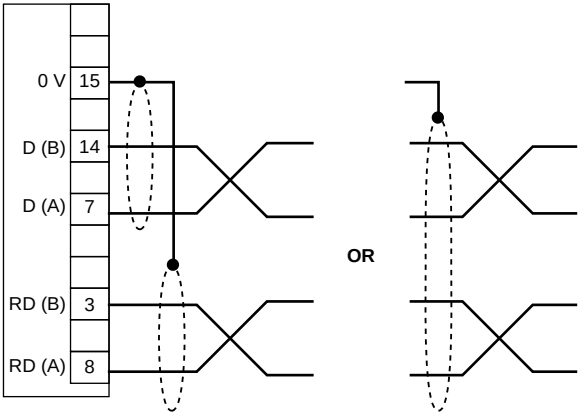


Figure 17: RS-422 Interface

When wiring ALTIVAR 66 drive controllers equipped with PCMCIA communication cards to a multidrop bus, follow the wiring practices required by national and local electrical codes in addition to the following:

- Use metallic conduit for all drive controller wiring. Do not run multidrop cable and power wiring in the same conduit.
- Metallic conduit carrying power wiring must be separated from metallic conduit containing the multidrop cable by at least 8 cm (3 in).
- Non-metallic conduit or cable trays used to carry power wiring must be separated from metallic conduit containing multidrop cable by at least 30.5 cm (12 in).
- Whenever power wiring and multidrop cable cross, the metallic conduit and non-metallic conduit or trays must cross at right angles.
- For the multidrop cable, use shielded cable with one or two pairs of twisted conductors. Use the cable recommended for each multidrop bus system shown.
- Connect the multidrop cable shield as shown in Figure 15, 16, or 17, in order to equalize the voltage potential at each PCMCIA Communication Card. Ground the shield only at one point.
- The maximum total cable length allowed is 1,000 m (3,281 ft).

Connection to UNI-TELWAY Bus with Telemecanique PLC

General

You must follow these rules when constructing a UNI-TELWAY multidrop network:

- Limit the number of nodes on the network to 28.
- Limit the stub cable length at each junction to 20 m (66 ft).
- Terminate each end of each twisted pair of the multidrop cable as shown in Figure 18.

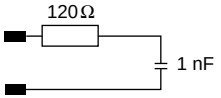


Figure 18: Zt Termination Device

Connection Accessories

To facilitate connection of the drive controller to the multidrop bus, the following accessories are available from the Telemecanique catalog.

Cable for connections to the bus is supplied in 3 different lengths:

- TSX-CSA 100: length 100 m (328 ft)
- TSX-CSA 200: length 200 m (656 ft)
- TSX-CSA 500: length 500 m (1,640 ft)

The TSX-SCA62 terminal block (Figure 19) is a passive unit featuring a printed circuit board fitted with screw terminals for enabling two pieces of equipment to be connected to the bus. It includes an end-of-line terminator, which is a jumper inside the box. The drive controller address is coded by setting the microswitches on the printed circuit board inside the box. For more information, refer to the documentation shipped with the Telemecanique equipment.

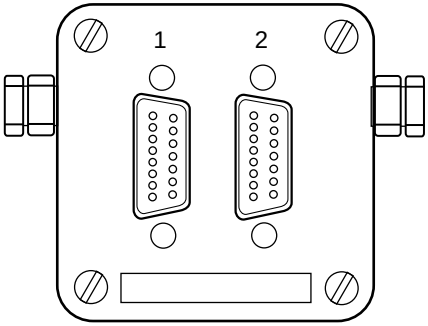


Figure 19: TSX-SCA62 Connector

Sample Network Layout

Figure 20 illustrates one possible system configuration involving multiple ALTIVAR 66 drive controllers connected to a UNI-TELWAY bus.

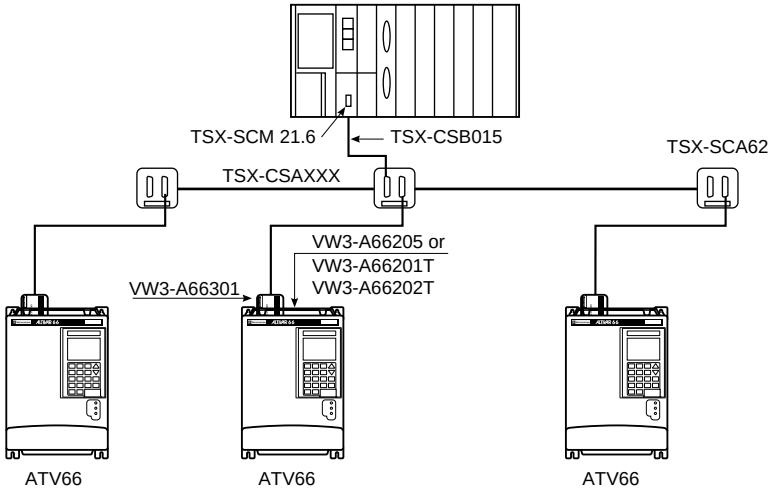


Figure 20: System Configuration: Multiple Drives on UNI-TELWAY Bus

NOTE: The ground connections between the TSX-SCA62 box and the ALTIVAR 66 drive controller must be made for good system operation. Connections should be as short as possible.

Connection to MODBUS Bus with MODICON PLC

General

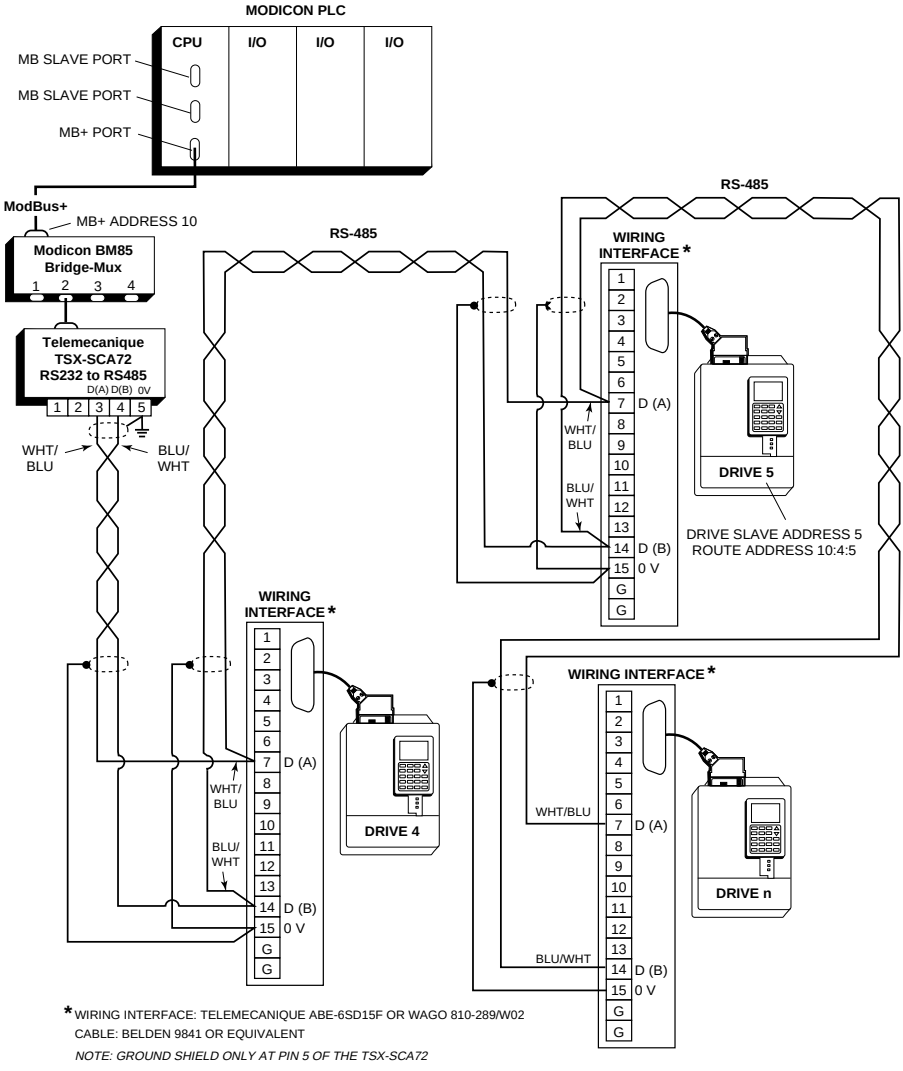
You must follow these rules when constructing a MODBUS multidrop network:

- Limit the number of nodes on the network to 32.
- Daisy-chain the multidrop cable as illustrated in Figure 21. Do not use stub connections.

Connection Accessories

Many Modicon PLCs cannot initiate messages from a MODBUS port because they were intended to be used as slave devices only. Therefore, when using a Modicon PLC, the Modicon BM85 Bridge Mux must be connected to the MODBUS Plus port. For multiple drives, a Telemecanique TSX-SCA 72 RS-232C to RS-485 converter must be used. Figure 21 shows system configuration involving multiple ALTIVAR 66 drive controllers connected to a MODBUS bus, using a Modicon PLC.

NOTE: Your MODBUS device or PLC may be capable of initiating a message directly from a MODBUS port (it must be a master port). Consult Modicon for more information if this is the case.



* WIRING INTERFACE: TELEMECANIQUE ABE-6SD15F OR WAGO 810-289/W02
CABLE: BELDEN 9841 OR EQUIVALENT
NOTE: GROUND SHIELD ONLY AT PIN 5 OF THE TSX-SCA72

Figure 21: MODBUS Network Diagram

PRINCIPLE OF COMMUNICATION

Data Structures

ALTIVAR 66 drive controllers are adjusted, controlled and monitored through data stored in drive controller memory. The data consists of bits and words.

Words consist of 16 bits and are designated Wx, where x indicates word number. Words are used for saving either numerical values (e.g., -32768 to +32767) or 16 independent logic states. The latter are also called registers.

For example, W2021 saves a numerical value for frequency reference and W2040 is a register consisting of 16 state bits. The notation W2040,2 designates bit 2 of register W2040.

Access to Data

The tables in Section 2 “Register Description” (pages 23-38) list drive controller parameters accessible by communication. The exact function of each parameter and how it affects drive controller operation are explained in instruction bulletins VD0C06S305_ and VD0C06T306_.

Data such as fault and monitoring information can only be read. Any attempt to write to this data will be refused. The bits and words corresponding to the adjustment, frequency reference, and command of the drive controller can be written to as well as read.

Units

Words are always expressed in signed (-32768 to +32767) or unsigned (0 to 65535) units. In the tables in Section 2 (pages 23-38), the units of each word are shown. For example, W2002 (Acceleration 1 time) is in units of 0.1 seconds. Therefore, a value of 60 corresponds to an acceleration time of 6 s.

Range

The allowable range is specified for each parameter. If a value outside of the range is written, the parameter will be set either to the range limit or to the factory default value.

Values at Power Up

At each power up, the ALTIVAR 66 drive controller is initialized with the configuration and adjustments saved in its EEPROM. W2021 and all of the bits in W2020 and W2031 are set to 0 and W2024 and W2028 are set to their factory default values. Also at power up, the drive controller is systematically placed in Local command (terminal strip or keypad command). To control via a multipoint bus, you must set the drive controller to Serial Link command by setting W2020,1 (DLI) and W2020,2 (FLI) to 1. See pages 24 and 25 for more information on these registers.

Parameter Types

There are several different types of parameters:

- Adjustment parameters — can be written and read while the drive controller is running or stopped.
- Command parameters — used to enable and disable Serial Link Command mode, start and stop the drive controller, and command the general operation of the drive controller.
- Display parameters — read-only parameters for monitoring.

Table 1 shows which adjustment parameters are available as a function of Control Type.

Table 1: Adjustment Parameter Setting Menu

Constant Torque			Variable Torque or Variable Torque Low Noise	
Normal	**High Torque**	**Special**	**Normal**	**NOLD**
Low Speed	Low Speed	Low Speed	Low Speed	Low Speed
High Speed	High Speed	High Speed	High Speed	High Speed
Acceleration	Acceleration	Acceleration	Acceleration	Acceleration
Deceleration	Deceleration	Deceleration	Deceleration	Deceleration
Acceleration 2 [1]	Acceleration 2 [1]	Acceleration 2 [1]	Acceleration 2 [1]	Acceleration 2 [1]
Deceleration 2 [1]	Deceleration 2 [1]	Deceleration 2 [1]	Deceleration 2 [1]	Deceleration 2 [1]
Damping	Damping	Damping	Damping	Damping
Motor Overload	Motor Overload	Motor Overload	Motor Overload	Motor Overload
Slip Compensation [2]	Slip Compensation [2]	Slip Compensation [2]	Profile	
IR Compensation	IR Compensation	IR Compensation		
	Voltage Boost	Voltage Boost		
	Bandwidth			

[1] Only effective if Alternate Ramps has been selected via the keypad or PC software.
[2] Only effective if Slip Compensation has been set to Manual via the keypad or PC software.

Priority of Treating Data

When several types of parameters are written in the same request, they are treated in the following order:

1. Writing bits W2020,1 and W2020,2 (DLI and FLI) to 1
2. Adjustment parameters
3. Command parameters (except W2020,1 and W2020,2)

Access Protection by Forced Local

All writing is blocked during Forced Local.

Command Mode Transitions

Wire the drive controller as shown in the Receiving, Installation, and Start-Up manual (VD0C06S304_). When transitioning between Serial Link command, Terminal strip command, and Keypad command, the drive controller behaves as shown in Table 2. There are two ways to transition between states: by a change in state of Forced Local (by logic input or keypad function key), or by a change in state of the DLI / FLI bits in W2020.

Table 2: Transition Between Command States

DLI/ FLI	SLC Run	Forced Local	0	0	0	0	1	1	1	1
			0	0	1	1	0	0	1	1
			0	1	0	1	0	1	0	1
0	0	0		No Change	No Change	Not Possible	SLC (Stop)	Not Possible	SLC (Run)	Not Possible
0	0	1	No Change		Not Possible	No Change	Not Possible	No Change	Not Possible	No Change
0	1	0	No Change	Not Possible		No Change	SLC (Stop)	Not Possible	SLC (Run)	Not Possible
0	1	1	Not Possible	No Change	No Change		Not Possible	No Change	Not Possible	No Change
1	0	0	Local 2	Not Possible	Local 2	Not Possible		Local 2	SLC (Run)	Not Possible
1	0	1	Not Possible	No Change	Not Possible	No Change	SLC (Stop)		Not Possible	No Change
1	1	0	Local 1	Not Possible	Local 1	Not Possible	SLC (Stop)	Not Possible		Local 2
1	1	1	Not Possible	No Change	Not Possible	No Change	Not Possible	No Change	SLC (Run)[1]	

[1] Local Command mode speed and direction are copied to W2021 and W2040,9 respectively.

SLC: Serial Link Command

Local 1: When transferring to Keypad command mode, the drive controller stops. When transferring to Terminal command mode, the drive controller stops unless a terminal command is present (direction and speed coming from the terminal strip).

Local 2:When transferring to Keypad command mode, there is no change in the drive controller state. When transferring to Terminal command mode, the drive controller stops unless a terminal command is present (direction and speed coming from the terminal strip).

Serial Link Fault Protection

The PCMCIA communication card continuously monitors the status of the serial link messaging while in Serial Link Command mode. This is in addition to the diagnostic checks described on page 8. The PCMCIA card must see a communication to the drive controller at least every 10 seconds or a communication fault will result.

⚠ WARNING

LOSS OF CONTROL

Setting W2020,4 (NTO) to 1 disables serial link fault protection. Provide alternate control paths when disabling the serial link fault protection.

Disabling the serial link fault protection can result in loss of control and can result in death, serious injury, or equipment damage.

If W2020,4 is set to 1, the PCMCIA communication card will not monitor the frequency of the messaging on the serial link. Operation with 2020,4 set to 1 is useful during certain diagnostic and commissioning procedures. W2020,4 should be set to 0 for normal Serial Link Command mode operation.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are Emergency Stop and Overtravel Stop. Separate or redundant control paths must be provided for critical control functions.
- The control paths of a system may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.

Failure to follow these instructions can result in death, serious injury, or equipment damage.[1]

1. For additional information, refer to NEMA ICS 1.1-1984, “Safety Guidelines for the application, Installation, and Maintenance of Solid State Control” and to NEMA ICS7.1-1995, “Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.”

Compatibility of Application Functions

Some Local Command mode (keypad or terminal strip) functions, as well as certain application functions of the ALTIVAR 66 drive controller, are not active in Serial Link Command mode. Table 3 shows which functions are active in Serial Link Command mode.

Table 3: Compatibility of Application Functions

Function programmed in Local Command mode	Active in Serial Link Command mode
Stop (Run Enable)	Yes
Run Forward	No
Run Reverse	No
Jog	No
+Speed/-Speed	No
Setpoint Memory	No
Preset Speeds	No
Speed Reference	No
Auto/Manual	No
Controlled Stop by LI	No
Controlled Stop by Freq.	Yes
Shutdown	Yes
Bypass	Yes
Brake Sequence	Yes
Cycles	No
Orient	No
Forced Local	Yes
Current Limit by LI	No
Voltage Reduction by LI	No

SECTION 2: REGISTER DESCRIPTION

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

- Writing to registers that are designated as reserved may cause unintended equipment operation.
- DO NOT write data to registers unless the function to be performed is completely understood. Consult the appropriate drive controller manual for additional details.

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

ADJUSTMENT WORDS (Read and Write)

These parameters can be adjusted when the motor is stopped or running.

Word	Range	Units	Description	Factory Setting
W2000	W2001 to Max. Freq. (set via keypad in Menu 7.12 or PC software)	0.1 Hz	High speed	50 Hz for 50 Hz input power 60 Hz for 60 Hz input power
W2001	0 to W2000	0.1 Hz	Low speed	0 Hz
W2002	1 to 9999	0.1 s	Accel 1	3 s
W2003	1 to 9999	0.1 s	Decel 1	3 s
W2004	1 to 9999	0.1 s	Accel 2 [1]	5 s
W2005	1 to 9999	0.1 s	Decel 2 [1]	5 s
W2006	1 to 100	0.1 Hz	Slip compensation [2]	3 Hz
W2007	0 to 800 [3]	1%	IR compensation	100%
W2008	0 to 100	1%	Profile	20%
W2009	0 to 100	1%	Voltage boost	20%
W2010	0 to 800 [3]	1%	Damping	20%
W2011	0 to 100	0.1%	Bandwidth	20%
W2012	45% In to 115% In	0.1 A	Motor overload	0.9 x In

[1] These registers are only effective if Alternate Ramps has been selected via the keypad or PC software.

[2] This register is only effective if Slip Compensation has been set to Manual via the keypad or PC software.

[3] Depends on torque type: High torque = 150; Special = 800; Other = 100.

COMMAND WORDS (Read and Write)

Word	Description	Possible Values
W2020	Drive reset	W2020,0 = 0 No reset W2020,0 = 1 Reset (must be in Serial Link Command [SLC] mode for reset to take effect)
	Assignment of logic commands over link (DLI) [1]	W2020,1 = 0 No logic commands over link W2020,1 = 1 Logic commands over link
	Assignment of references over link (FLI) [1]	W2020,2 = 0 No references over link W2020,2 = 1 References over link
	Alternate ramps (Ramp 2)	W2020,3 = 0 Ramp 1 W2020,3 = 1 Ramp 2

⚠ WARNING

LOSS OF CONTROL

Setting W2020,4 (NTO) to 1 disables serial link fault protection. Provide alternate control paths when disabling the serial link fault protection.

Disabling the serial link fault protection can result in loss of control and can result in death, serious injury, or equipment damage.

Suppression of communication control (NTO)	W2020,4 = 0 Monitor communication fault W2020,4 = 1 Do not monitor communication fault (no time-out)
Run/Stop command [2]	W2020,5 = 0 Stop W2020,5 = 1 Run
Braking by DC injection (DCB)	W2020,6 = 0 No command to inject DC W2020,6 = 1 Command to inject DC
Reserved	W2020,7
Freewheel stop	W2020,8 See table below
Fast stop	W2020,9 See table below
Reserved	W2020,10
Reserved	W2020,11
Reserved	W2020,12
Reserved	W2020,13
Command of external fault (EFL)	W2020,14 = 0 No external fault W2020,14 = 1 External fault present [3]

[1] Split control via DLI and FLI is not available. Setting only one bit active will cause the drive controller to set both bits active. Always write both bits to the same state.

Note: for operation in Serial Link Command (SLC) mode, both DLI and FLI must be set to 1 and LI1 must be active.

[2] Simultaneously writing W2020, 1, W2020,2 and W2020,5 to zero while the drive controller is running in SLC mode will transfer control to Local Command mode (either terminal or keypad). The drive controller will respond as indicated in Table 2 on page 20. However W2020,5 will remain active.

[3] Allows drive controller to fault upon external fault when in SLC mode when LIx is set for customer fault. If W2020,14 = 0, the drive controller ignores LIx, even if LIx was configured in Local Command mode (Keypad or Terminal strip).

Freewheel and Fast Stop

Freewheel Stop W2020,8	Fast Stop W2020,9	Stop Type
0	0	Normal stop
1	1	Freewheel stop
1	0	Freewheel stop
0	1	Fast stop

COMMAND WORDS (Read and Write)

Additional Command Register

Word	Description	Possible Values
W2031	Reserved	W2031,0
	Run direction	W2031,1 = 0 Forward W2031,1 = 1 Reverse
	Reserved	W2031,2

Word	Range	Description	Remarks
W2021	-32767 to 32767	Reference frequency	26478 = 400 Hz -26478 = -400 Hz Loss of all power to drive controller [1] resets W2021 to factory default of 0 (0 Hz).
W2024	40 to 150%	% of current limit % of motor In (1% steps)	Value is valid only when in SLC mode. Loss of all power to drive controller [1] resets W2024 to factory default of 150% (CT @ 60 Hz), 135% (CT @ 50 Hz), or 110% (VT).
W2028	20 to 100%	% of voltage reduction (1% steps)	Value is valid only when in SLC mode. Loss of all power to drive controller [1] resets W2028 to factory default of 100%.

[1] Control logic inactive, green LED on front of drive controller Off.

DISPLAY WORDS (Read Only)

Word	Range	Units	Description	Possible Values
W2044	0 to 100	1%	Value of analog input AI1	0% for 0 V and 100% for 10 V
W2063	0 to 100	1%	Value of analog input AI2	0% for 0 mA and 100% for 20 mA
W2064	0 to 100	1%	Value of analog input AI3	0% for 0 V and 100% for 10 V
W2065	0 to 100	1%	Value of analog input AI4	0% for 0 mA and 100% for 20 mA
W2100			Assignment of AI1	= 0 Not assigned = 1 Current limit = 2 Voltage reduction = 3 Speed Ref. 1 **[1]** = 4 Speed Ref. 2 = 5 Speed Ref. 3
W2101			Assignment of AI2	= 0 Not assigned = 1 Current limit = 2 Voltage reduction = 3 Speed Ref. 1 = 4 Speed Ref. 2 **[1]** = 5 Speed Ref. 3
W2102			Assignment of AI3	= 0 Not assigned **[1]** = 1 Current limit = 2 Voltage reduction = 3 Speed Ref. 1 = 4 Speed Ref. 2 = 5 Speed Ref. 3 = 6 Tach feedback
W2103			Assignment of AI4	= 0 Not assigned **[1]** = 1 Current limit = 2 Voltage reduction = 3 Speed Ref. 1 = 4 Speed Ref. 2 = 5 Speed Ref. 3

[1] Factory setting.

DISPLAY WORDS (Read Only)

Word	Range	Units	Description	Remarks / Possible Values
W2052		0.1 kW	Output power	Function of hp
W2053	0 to Nominal motor voltage	1 V	Output voltage	Function of drive controller voltage range
W2054	0 to Max. [1]	1 V	Mains voltage	Function of drive controller voltage range
W2055	0 to Max. [2]	1 V	Bus voltage	Function of drive controller voltage range
W2071	0 to 3		Nominal motor voltage range	= 0 208–240 V = 1 380–415 V = 2 440–460 V
W2202	0 to 3		Drive controller voltage range	= 0 Not used = 1 208–240 V = 2 380–460 V
W2056	0 to 199	1%	Motor thermal state value	
W2057	0 to 125	1%	Drive controller thermal state value	For kW > 7.5 kW

[1] Maximum depends on mains: 264 V for ATV66•••M2; 460 V for 50 Hz mains (ATV66•••N4); 529 V for 60 Hz mains (ATV66•••N4).

[2] Maximum depends on mains: 374 V for ATV66•••M2; 651 V for 50 Hz mains (ATV66•••N4); 748 V for 60 Hz mains (ATV66•••N4).

Word	Range	Unit	Description	Remarks / Possible Values
W2203			Mains frequency recognized	= 0 Unknown = 1 50 Hz = 2 60 Hz
W2041	-26478 to 26478		Output frequency	400 Hz = 26478
W2205		0.1 A	Drive controller nominal current	Function of hp, mains voltage, and torque type
W2206		0.1 A	Drive controller maximum current	Function of hp, mains voltage, and torque type
W2042		0.1 A	Output current	Function of hp and mains voltage

DISPLAY WORDS (Read Only)

Word	Description	Possible Values
W2040	Mode in which all commands are assigned	W2040,0 = 0 Commands assigned by link (SLC mode) W2040,0 = 1 Commands assigned by terminal or keypad (local mode)
	Drive controller ready (RDY or SLC)	W2040,1 = 0 Drive controller not ready W2040,1 = 1 Drive controller ready
	Fault (FLT)	W2040,2 = 0 No fault W2040,2 = 1 Drive controller faulted
	Reset authorized	W2040,3 = 0 Reset not authorized W2040,3 = 1 Reset authorized
	Brake engage relay state	W2040,4 = 0 Brake set (relay deenergized) W2040,4 = 1 Brake released (relay energized)
	Forced local	W2040,5 = 0 Drive controller not forced to local W2040,5 = 1 Drive controller forced to local
	NTO	W2040,6 = 0 Time-out fault W2040,6 = 1 No time-out fault
	Resettable fault	W2040,7 = 0 Non-resettable fault W2040,7 = 1 Resettable fault
	Motor running	W2040,8 = 0 Motor stopped W2040,8 = 1 Motor running
	Actual rotation direction	W2040,9 = 0 Forward W2040,9 = 1 Reverse
	DC injection braking	W2040,10 = 0 No current injected W2040,10 = 1 DC being injected
	Steady state	W2040,11 = 0 Drive controller not in steady state W2040,11 = 1 Drive controller in steady state
	Motor thermal overload alarm	W2040,12 = 0 Drive controller not in motor overload W2040,12 = 1 Drive controller in motor overload
	Reserved	W2040,13
	Current limit	W2040,14 = 0 Drive controller not in current limit W2040,14 = 1 Drive controller in current limit
	No line power (NLP)	W2040,15 = 0 Drive controller not faulted on mains phase loss W2040,15 = 1 Drive controller faulted on mains phase loss

DISPLAY WORDS (Read Only)

Word	Description	Possible Values
W2047	Local command mode T/K	W2047,0 = 0 Terminal command W2047,0 = 1 Keypad command
	Logic commands over link (DLI)	W2047,1 = 0 Not activated W2047,1 = 1 Activated
	Reference commands over link (FLI)	W2047,2 = 0 Not activated W2047,2 = 1 Activated
	Dynamic braking	W2047,3 = 0 Dynamic braking not active W2047,3 = 1 Dynamic braking in progress
	Fast stop	W2047,4 = 0 Fast stop not active W2047,4 = 1 Fast stop in progress
	Power loss, ramp stop	W2047,5 = 0 Not active W2047,5 = 1 Ramp stop in progress
	Gating state	W2047,6 = 0 Drive controller gating W2047,6 = 1 Drive controller not gating
	Orient complete	W2047,7 = 0 Orient stop not active W2047,7 = 1 Orient stop complete (200 ms pulse)
	Deceleration (DEC)	W2047,8 = 0 Drive controller not in deceleration W2047,8 = 1 Drive controller in deceleration
	Acceleration (ACC)	W2047,9 = 0 Drive controller not in acceleration W2047,9 = 1 Drive controller in acceleration
	Reserved	W2047,10
	Reserved	W2047,11
	Reserved	W2047,12
	Drive controller thermal fault	W2047,13 = 0 Drive controller not in thermal overload fault W2047,13 = 1 Drive controller in thermal overload fault
	Reserved	W2047,14
	Stopping by the keypad	W2047,15 = 0 Not active W2047,15 = 1 Drive controller stopped by keypad (latched until next start)

DISPLAY WORDS (Read Only)

Word	Description	Possible Values
W2048	Jog	W2048,0 = 0 Jog not in progress W2048,0 = 1 Jog in progress
	Reserved	W2048,1
	Cycle complete	W2048,2 = 0 Cycle not complete W2048,2 = 1 Cycle complete (200 ms pulse)
	Alternate ramp	W2048,3 = 0 Ramp 1 W2048,3 = 1 Ramp 2
	Auto/Manual	W2048,4 = 0 Manual activated W2048,4 = 1 Auto activated
	Frequency level attained	W2048,5 = 0 Freq. level not attained W2048,5 = 1 Freq. level attained
	Frequency Level 2 attained	W2048,6 = 0 Freq. level 2 not attained W2048,6 = 1 Freq. level 2 attained
	Reserved	W2048,7
	Reserved	W2048,8
	Thermal level attained	W2048,9 = 0 Thermal level not attained W2048,9 = 1 Thermal level attained
	Thermal Level 2 attained	W2048,10 = 0 Thermal level 2 not attained W2048,10 = 1 Thermal level 2 attained
	No Ramp Follow	W2048,11 = 0 Not active W2048,11 = 1 Active
	Run output command (Bypass)	W2048,12 = 0 Not active W2048,12 = 1 Active
	Rotation direction	W2048,13 = 0 Running in forward W2048,13 = 1 Running in reverse

Word	Range	Description	Remarks
W2075	1 to 8	Cycles step # that is in progress	
W2076	0 to 7	Preset speed # that is in progress	

DISPLAY WORDS (Read Only)

Word	Range	Description	Remarks
W2200	0 to 22	Drive controller horsepower	= 0 Not used = 1 Reserved = 2 Reserved = 3 2.2 kW, 3 hp = 4 3 kW = 5 4 kW, 5 hp = 6 5.5 kW, 7.5 hp = 7 7.5 kW, 10 hp = 8 11 kW, 15 hp = 9 15 kW, 20 hp = 10 Reserved = 11 22 kW, 30 hp = 12 30 kW, 40 hp = 13 37 kW, 50 hp = 14 45 kW, 60 hp = 15 55 kW, 75 hp = 16 75 kW, 100hp = 17 90 kW, 125 hp = 18 110 kW, 150 hp = 19 132 kW, 200 hp
W2201	0 to 22	Drive controller horsepower	Same as above with: = 1 0.75 kW, 1 hp = 2 1.5 kW, 2 hp = 10 18.5 kW, 20 hp

Word	Range	Units	Description	Possible Values
W2207			Software version	In BCD code
W2209	0 to 1		Software type	0 = Not used 1 = Standard software
W2210			Reserved	
W2211	0 to 1		Memory card option	= 0 Memory card not installed = 1 Memory card installed
W2212	0 to 1		Communication carrier option	= 0 Communication carrier module not installed = 1 Communication carrier module installed
W2213	0 to 1		Presence of keypad	= 0 Keypad not present = 1 Keypad installed
W2214	0 to 1		I/O Extension option module	= 0 I/O Extension module not installed = 1 24 V I/O Extension installed = 2 115 V I/O Extension installed
W2216	0 to 1		PCMCIA communication card	= 0 No PCMCIA communication card installed = 1 UNI-TELWAY/MODBUS/Jbus PCMCIA communication card installed

DISPLAY WORDS (Read Only)

Word	Range	Units	Description	Possible Values
W2058		H	Elapsed time (hours)	Total time W2058 + W2059
W2059		min	Elapsed time (minutes)	
W2060		RPM	Output speed	
W2061		User defined	Machine frequency reference (customer units)	Frequency times scaling factor
W2062		User defined	Machine frequency (customer units)	Frequency times scaling factor

Word	Range	Description	Possible Values
W2066		Reserved	
W2067		Reserved	
W2068		Reserved	
W2104		Assignment of analog output AO1	= 0 Not assigned = 1 Motor current = 2 Motor frequency [1] = 3 Output power = 4 Motor torque = 5 Output voltage = 6 Motor thermal state = 7 Ramp output = 8 Reserved
W2105		Assignment of analog output AO2	= 0 Not assigned = 1 Motor current [1] = 2 Motor frequency = 3 Output power = 4 Motor torque = 5 Output voltage = 6 Motor thermal state = 7 Ramp output = 8 Reserved
W2106		Assignment of analog output AO3	= 0 Not assigned [1] = 1 Motor current = 2 Motor frequency = 3 Output power = 4 Motor torque = 5 Output voltage = 6 Motor thermal state = 7 Ramp output = 8 Reserved

[1] Factory setting.

DISPLAY WORDS (Read Only)

Word	Description	Possible Values
W2043	Display of LI1 activation	W2043,1 = 0 Input not active W2043,1 = 1 Input active
	Display of LI2 activation	W2043,2 = 0 Input not active W2043,2 = 1 Input active
	Display of LI3 activation	W2043,3 = 0 Input not active W2043,3 = 1 Input active
	Display of LI4 activation	W2043,4 = 0 Input not active W2043,4 = 1 Input active
	Display of LI5 activation	W2043,5 = 0 Input not active W2043,5 = 1 Input active
	Display of LI6 activation	W2043,6 = 0 Input not active W2043,6 = 1 Input active
	Display of LI7 activation	W2043,7 = 0 Input not active W2043,7 = 1 Input active
	Display of LI8 activation	W2043,8 = 0 Input not active W2043,8 = 1 Input active
	Display of LO1 activation	W2043,9 = 0 Output not active W2043,9 = 1 Output active
	Display of LO2 activation	W2043,10 = 0 Output not active W2043,10 = 1 Output active
	Display of R1 activation	W2043,11 = 0 Output not active W2043,11 = 1 Output active
	Display of R2 activation	W2043,12 = 0 Output not active W2043,12 = 1 Output active
	Display of R3 activation	W2043,13 = 0 Output not active W2043,13 = 1 Output active
	Display of R4 activation	W2043,14 = 0 Output not active W2043,14 = 1 Output active

DISPLAY WORDS (Read Only)

Word	Description	Possible Values
W2107	Assignment of LO1; Factory setting: At speed	= 0 No assignment = 1 Ready state = 2 Running state = 3 At speed = 4 Forward direction = 5 Reverse direction = 6 Terminal/Keypad = 7 Auto/Manual = 8 Current limit = 9 Torque limit = 10 Fault State = 11 Drive controller thermal alarm = 12 Loss of follower = 13 No ramp follow = 14 Feedback loss = 15 Overspeed = 16 Frequency level = 17 Frequency level 2 = 18 Current level = 19 Current level 2 = 20 Thermal level = 21 Thermal level 2 = 22 Reserved = 23 Brake release = 24 Shutdown complete = 25 Orient complete = 26 Cycle complete = 27 Cycle fault = 28 Run output command (Bypass) = 29 Jog enabled
W2108	Assignment of LO2; Factory setting: Current limit	
W2111	Assignment of R1; Factory setting: Fault	
W2112	Assignment of R2; Factory setting: Running state	
W2113	Assignment of R3; Factory setting: Thermal level	
W2114	Assignment of R4; Factory setting: Ready state	

DISPLAY WORDS (Read Only)

Display of Logic Input Assignments

Word	Description	Possible Values
W2115	Assignment of LI1: Stop (3-wire control) or Run Enable (2-wire control) (not reconfigurable)	= 0 Not assigned = 1 Stop (3-wire control) = 2 Run Enable (2-wire control) = 3 Forward = 4 Reverse = 5 Current limit = 6 Voltage reduction = 7 Alternate ramps = 8 Jog = 9 +Speed = 10 -Speed = 11 Controlled stop = 12 Start cycle (Cycles) = 13 Reset cycle (Cycles) = 14 Step locking (Cycles) = 15 Next step (Cycles) = 16 Setpoint memory = 17 Preset speed a = 18 Preset speed b = 19 Preset speed c = 20 Orient command = 21 Orient pulses = 22 Forced local = 23 Auto/Manual = 24 Terminal/Keypad = 25 Process input (Bypass) = 26 Sequence input (Bypass) = 27 Reserved = 28 Reserved = 29 Customer fault = 30 Reset fault = 31 Auto run
W2116	Assignment of LI2: Forward (not reconfigurable)	
W2117	Assignment of LI3: Reverse (factory setting)	
W2118	Assignment of LI4: Jog (factory setting)	
W2119	Assignment of LI5: Preset speed a	
W2120	Assignment of LI6: Preset speed b	
W2121	Assignment of LI7: Preset speed c	
W2122	Assignment of LI8: Reset fault	

DISPLAY WORDS (Read Only)

Display of Fault Register (Fault that Caused Drive Controller to Trip)

Word	Possible Values
W2050	= 0 No fault = 1 AC line overvoltage = 2 DC bus overvoltage = 3 DC bus undervoltage = 4 Ground fault = 5 Short circuit between phases (Desat) = 6 ±15 V input = 7 Horsepower not recognized = 8 Input phase loss = 9 Motor overload = 10 Customer fault = 11 Drive Overtemperature = 12 Overspeed (with tachometer) = 13 Feedback loss = 14 Serial link fault = 15 Loss of follower = 16 Memory failure = 17 Precharge failure = 18 Sequence time-out fault (Bypass) = 19 Process time-out fault (Bypass) = 20 Dynamic brake fault = 21 DB resistor thermal fault = 22 Transistor short circuit = 23 Open transistor = 24 Output phase loss = 25 Control supply = 26 Short circuit on motor (LIC exceeded) = 27 Reserved = 28 Reserved = 29 Overspeed (without tachometer)

DISPLAY WORDS (Read Only)

Display of Present Faults Register (Fault Present if bit = 1)

Word	Possible Values	
W2051	W2051,0	Internal fault or other ALTIVAR 66 drive controller fault not listed
	W2051,1	Serial link fault
	W2051,2	Reserved
	W2051,3	Reserved
	W2051,4	DC bus undervoltage
	W2051,5	AC line overvoltage
	W2051,6	Input phase loss
	W2051,7	Drive Overtemperature
	W2051,8	No feedback, overspeed
	W2051,9	Short circuit between phases or to ground
	W2051,10	DC bus overvoltage
	W2051,11	Non-resettable bus overvoltage
	W2051,12	Motor overload
	W2051,13	Output phase loss
	W2051,14	Reserved
	W2051,15	Precharge failure

DISPLAY WORDS (Read Only)

Fault History

Word	Description	Possible Values
W2140	Indicates the position of marker on 1 of 8 past faults	
W2141	Past fault 1: drive controller state	= 0 No fault = 1 Acceleration = 2 Deceleration = 3 Steady state (Run) = 4 Dynamic braking = 5 Ready = 6 DC injection = 7 Current limit = 8 Auto test = 9 Configuration = 10 No run permissive
W2143	Past fault 2: drive controller state	
W2145	Past fault 3: drive controller state	
W2147	Past fault 4: drive controller state	
W2149	Past fault 5: drive controller state	
W2151	Past fault 6: drive controller state	
W2153	Past fault 7: drive controller state	
W2155	Past fault 8: drive controller state	
W2142	Past fault 1: name of fault	= 0 No fault = 1 AC line overvoltage = 2 DC bus overvoltage = 3 DC bus undervoltage = 4 Ground fault = 5 Short circuit between phases (Desat) = 6 ±15 V input = 7 Horsepower not recognized = 8 Input phase loss = 9 Motor overload = 10 Customer fault = 11 Drive Overtemperature = 12 Overspeed (with tachometer) = 13 Feedback loss = 14 Serial link fault = 15 Loss of follower = 16 Memory failure = 17 Precharge failure = 18 Sequence time-out fault (Bypass) = 19 Process time-out fault (Bypass) = 20 Dynamic brake fault = 21 DB resistor thermal fault = 22 Transistor short circuit = 23 Open transistor = 24 Output phase loss = 25 Control supply = 26 Short circuit on motor (LIC exceeded) = 27 Reserved = 28 Reserved = 29 Overspeed (without tachometer)
W2144	Past fault 2: name of fault	
W2146	Past fault 3: name of fault	
W2148	Past fault 4: name of fault	
W2150	Past fault 5: name of fault	
W2152	Past fault 6: name of fault	
W2154	Past fault 7: name of fault	
W2156	Past fault 8: name of fault	

SECTION 3: UNI-TELWAY PROTOCOL

LIST OF REQUESTS

Table 4 describes the UNI-TELWAY requests accepted by the ALTIVAR drive controllers and their limits. Detailed information on coding the requests is given in the UNI-TELWAY reference manual, TSX D24 004.

Table 4: List of Requests

Request	**Code** (Hexadecimal Format)	**ALTIVAR 66 Drive Controller**
Identification Protocol version Status Mirror Read error counter Counter reset	H'0F' H'30' H'31' H'FA' H'A2' H'A4'	Yes Yes Yes Yes Yes Yes
Read one Bit Write one Bit	H'00' H'10'	Yes Yes
Read one Word Write one Word	H'04' H'14'	Yes Yes
Read objects Write objects	H'36' H'37'	63 Words Max 60 Words Max
Event data		Yes 2 Words
Specific	H'F2'	See Table 8

Identification Request

Table 5: Identification Request

Request	**Code** (Hexadecimal Format)
Answer code	H'3F'
Product type	H'14' for ALTIVAR
Sub-type	H'66' for ATV66
Product version	H'xx' [1]
ASCII string [2]	Catalog number (e.g. ATV66U29N4)

[1] xx stands for software version. For example, enter H'30' for V3.0.

[2] The first byte of an ASCII string always corresponds to the length of the string.

Status Request

Table 6: Status Request

Request	Code (Hexadecimal Format)
Answer code	H'61'
Current state	H'xx' Bit 0: Internal fault Bit 1: Correctable fault Bit 2: Uncorrectable fault Bit 3: Not used Bit 4: Not used Bit 5: Not used Bit 6: Drive controller at standstill (RDY, SLC, or fault) Bit 7: Drive controller in Local control
State mask	H'C7' indicates the significant bits for the current state

Read and Write Objects Requests

Read and Write requests allow access to several words within the limits described in Table 4. They may be coded as set out in Table 7.

Table 7: Read and Write Objects Requests

Request	Code (Hexadecimal Format)
Question Code (TxTi,C)	H'36' (Read) or H'37' (Write)
Category	0 to 7
Segment	H'68' (internal word)
Object type	H'06' for reading a byte (8 bits) or H'07' for reading or writing a Word (16 bits)
Object address	H'xxxx'

The answer to the “Write Objects” request is accepted if at least one word is written.

The following examples give typical Read requests for the TSX7 programmable controller using text block. The examples read words W2020 to W2023 of the drive controller memory, first using word object types (Example 1) then using byte object types (Example 2).

Example 1: Word Object Type

The transmission text block in Figure 22 illustrates a Read request using the word object type (H'07'). In the example:

- TxTi,C=H'0736' (category + request)
- TxTi,L=6
- + Transmission Table

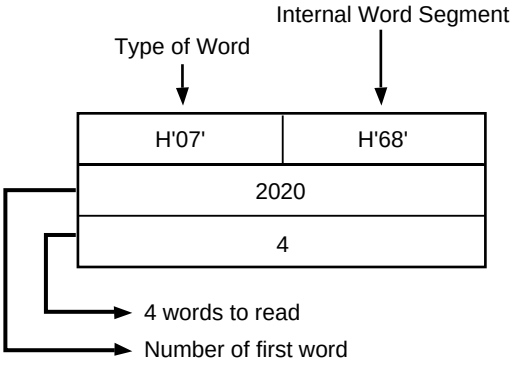


Figure 22: Reading Words W2020 to W2023: Transmission Text Block

Figure 23 illustrates the reception text block associated with the Read request in Figure 22. In the example:

- TxTi,V=H'66' (report)
- TxTi,S=9 (9 bytes received)
- + Reception Table

The data received in the reception table is offset by one byte. The application program must correct the data (by successive offsets, for example) before it is used.

W2020 (least sig.)	H'07'
W2021 (least sig.)	W2020 (most sig.)
W2022 (least sig.)	W2021 (most sig.)
W2023 (least sig.)	W2022 (most sig.)
	W2023 (most sig.)

Figure 23: Reading Words W2020 to W2023: Reception Text Block

Example 2: Byte Object Type

The transmission text block in Figure 24 illustrates a Read request using the byte object type (H'06'). In the example:

- TxTi,C=H'0736' (category + request)
- TxTi,L=6
- + Transmission Table

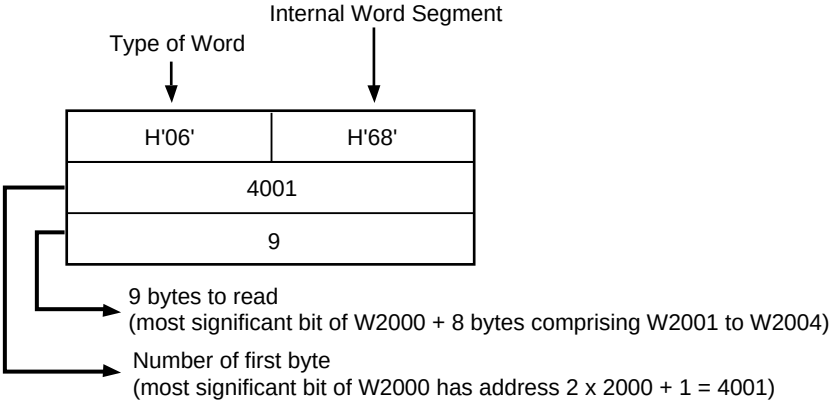


Figure 24: Reading Words W2001 to W2004: Transmission Text Block

Figure 25 illustrates the reception text block associated with the Read request in Figure 24. In the example:

- TxTi,V=H'66' (report)
- TxTi,S=10 (10 bytes received)
- + Reception Table
- The programming in Figure 24 enables the words to be correctly registered in the reception table.

W3019 (most sig.)	H'06'
W3020	
W3021	
W3022	
W3023	

Figure 25: Reading Words W3020 to W3023: Reception Text Block

Event Data

The drive controller transmits event data on its own initiative to the UNI-TELWAY link master without having first received a question. This data is sent via the “unrequested data” request and does not require an answer from the receiver.

Event data is sent in the following two cases:

- When a fault appears or disappears (change of state of W2040, bit 2 of state register)
- When the drive controller is forced to local control by one of its logic inputs (change of state of the input), if an input has been assigned to this function; or by a function key on the keypad, if one has been assigned to this function.

Event data consists of 2 words of 16 bits transmitted in the following order:

- STR state register (W2040)
- FLT fault register (W2051)

Using event data with the TSX programmable controller requires the following:

- Correct configuration of the master coupler for the UNI-TELWAY link
- Regular monitoring of the indicators which display changes in the value of the data
- Assignment of the data via the Read request of the event data

Specific Control Requests

Specific control requests enable the drive controller command to be carried out and to obtain in return information required to control the drive controller.

Table 8: Specific Control Request Format

Request code	byte	H'F2'
Category	byte	0...7
Specific request code	byte	0
Reserved	byte	0
Command	word	COM
Reference	word	FRH
Acceleration	word	ACC
Deceleration	word	DEC

Table 9: Specific Control Report Format

Answer code	byte	H'F2'
Specific answer code	byte	H'30'
Reserved	byte	0
Reference	word	FRH
State register	word	STR
Fault register	word	FLT
Motor current	word	LCR

Table 10: Negative Answer

Answer code	byte	H'FD'
Cause: Incorrect number of parameters		

REGISTER UPDATE TIMES

The maximum register update times for a single ALTIVAR drive controller using UNI-TELWAY are listed in Table 11. These times assume a baud rate of 9600 and no communication errors.

Table 11: Maximum Register Update Times

Number of Registers Transferred	**Read Time** [1] (msec)	**Write Time** [2] (msec)
1	44.7	43.5
10	65.3	64.2
20	88.2	87.1
50	157.0	155.8

[1] Read is by Read Object (36H) request. Values shown include query time, master processing time, and acknowledge (ACK) time.

[2] Write is by Write Object (37H) request. Values shown include query time, master processing time, and acknowledge (ACK) time.

SECTION 4: MODBUS PROTOCOL

The exchange of data between computer systems, programmable controllers and other intelligent systems must be carried out in a common language. This language must be simple and easily understood, however it must be possible to check each exchange in order to verify the correctness of transferred data. The variables exchanged are therefore carried in a frame composed of the following elements:

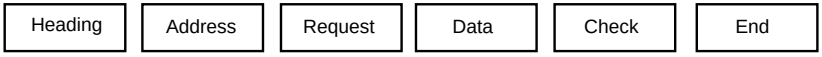


Figure 26: Variable Frames

This frame structure allows definition of the beginning and length of messages, the system to which the messages are addressed, the type of function requested, the variables themselves, a control parameter and an end code which validates the entire message.

MODBUS FRAMES

MODBUS frames consist of two transmission modes, RTU and ASCII. The frame defined for the RTU mode, illustrated in Figure 27, includes neither heading bytes nor end bytes. The data is transmitted in binary format and “CRC16” is a cyclical redundancy check. The end of the frame is detected by a silence ≥ 3 characters.

Figure 27: RTU Frames

The ASCII frame, illustrated in Figure 28, contains all the possible frame elements:

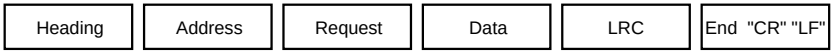


Figure 28: ASCII Frames

ASCII frames have the following characteristics:

- Heading=”:”(H'3A).
- The data is encoded in ASCII. Each byte is divided into 2 four-bit bytes, each of which is encoded by an ASCII character 0 to F.
- LRC: longitudinal redundancy check.
- End: “CR”, “LF” (H'0D and H'0A).

PRINCIPLE OF COMMUNICATION

MODBUS is a dialog protocol which creates a hierarchical structure between a master device and one or several slave devices. The drive controller is always a slave device. MODBUS protocol enables the master device to interrogate one or several of the drive controllers. A multidrop link connects the master device and drive controllers to each other.

Two types of dialog are possible between master device and drive controller:

- The master device communicates to the drive controller and waits for a response.
- The master device talks to a group of drive controllers without waiting for a response (broadcast messages).

The drive controller number can be between 1 and 31. The number 0 is reserved for a broadcast message.

In either case, the master device initiates and controls all exchanges with the drive controllers. If an erroneous exchange occurs, the master device reiterates the exchange and declares the drive controller absent if no answer is received after a given time has elapsed. Only one group may transmit on line at any time. No drive controller may initiate an exchange and lateral communication (drive controller to drive controller) is not possible. The master device's programming must therefore be designed to interrogate a drive controller and send the data received to another drive controller.

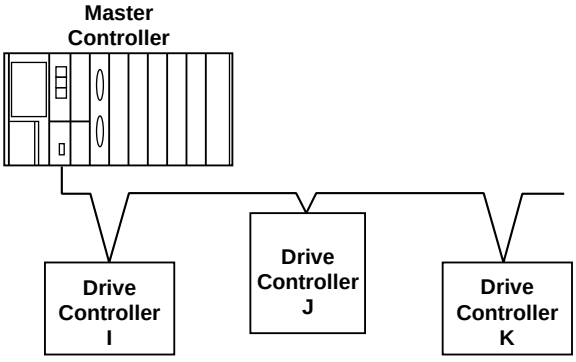


Figure 29: MODBUS Protocol

Accessible Data

MODBUS protocol enables data (bits and words) to be exchanged between master device and drive controller. In each drive controller, there are two types of data objects, input objects (bits and words) and output objects (bits and words). Input objects may be read only, whereas output objects may be read or written.

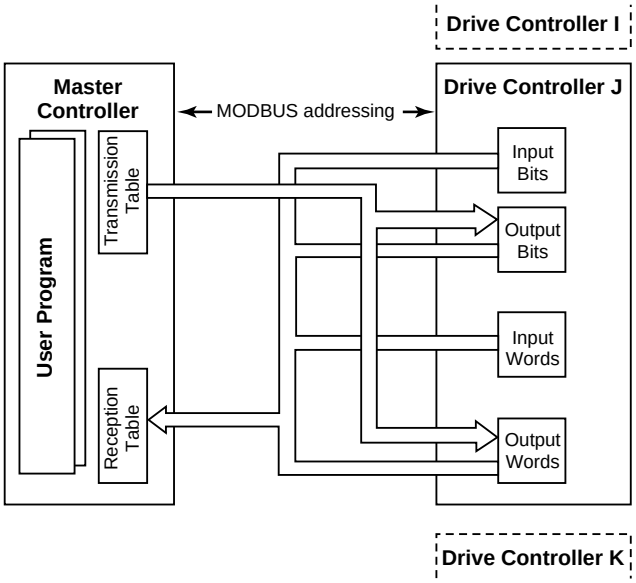


Figure 30: Input and Output Data Objects

Exchanges

The master device always initiates data exchanges. The master device addresses a drive controller by supplying it with four types of data:

- The drive controller's address
- The function required of the drive controller
- The data area (as a function of the request)
- The exchange check

The master device waits for the drive controller's answer before transmitting the next message, thus avoiding any conflict on the line. Operation in half-duplex is therefore authorized.

Checking and Supervision

All control of exchanges between two entities communicating via asynchronous serial link naturally includes exception messages when exchange faults occur. When a drive controller receives an incoherent message it reports an exchange fault to the master device, which in turn determines whether or not to repeat the exchange. The master device has access to a certain amount of data stored and controlled by the drive controller. The master device gains access to this data by special function codes.

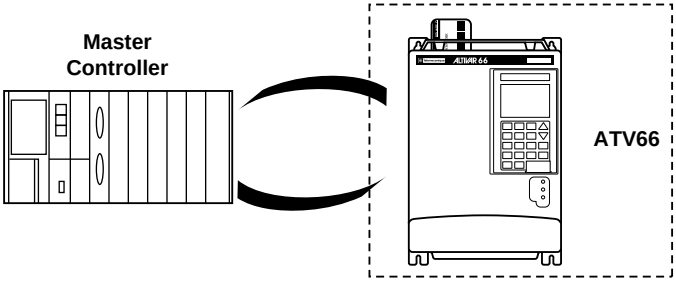


Figure 31: Communicating Exchange Faults

MODBUS FUNCTIONS

MODBUS functions are of two types:

- Functions which enable data exchange and
- Complementary functions for exchange diagnostics

Table 12 lists the functions controlled by the communication option for the ATV 66 and specifies its limits. Answer messages are never returned.

Table 12: MODBUS Functions

Code	Nature of Function	Drive Controller
01	Read N output bits. Allows reading of output bits (bits in the drive controller that can be written or read by the master).	Max 1
02	Read N input bits. Allows reading of input bits (bits that the master can only read).	Max 1
03	Read N output words. Allows reading of output words (words in the drive controller that can be written or read by the master).	Max 63
04	Read N input words. Allows reading of input words (words that the master can only read).	Max 63
05 [1]	Write one output bit (Used to set an output bit to 0 or 1)	Yes
06 [1]	Write one output word (Used to write a 16-bit output word)	Yes

[1] Used in broadcast messages and therefore must specify drive controller number as 0 in the message transmitted by the master device.

Table 12: MODBUS Functions (Continued)

Code	Nature of Function	Drive Controller
08	Diagnostic Function always accompanied by a sub-code: **08/00**: Echo. Tells drive controller to return full message sent by master device. **08/01**: Channel reinitialization. Reinitializes drive controller's communication so that it leaves Listen Only Mode (LOM) by sending the data H'0000 or H'FF00. **08/03**: Change of ASCII delimiter. In ASCII mode, messages are delimited by the line feed character (LF=H'0A). This function allows this character to be changed. **08/04**: Change to LOM mode. Used to set drive controller to Listen Only Mode (LOM). In LOM the drive controller does not process the messages addressed to it, and never transmits an answer except when the channel is reinitialized. **08/0A**: Counter Reset. Resets to zero all counters monitoring the exchanges of a drive controller. **08/0B**: Number of messages detected on the line without CRC or checksum error. Reads 16-bits (incremented from 0 to H'FFFF) to a counter that totals the messages detected on the line and processed by the drive controller. **08/0C**: Number of messages received with checksum error (reading a 16-bit counter). **08/0D**: Number of exception answers. Reading a 16-bit counter which totals the number of exception messages transmitted to the master device by a drive controller (following an incorrect frame). **08/0E**: Number of messages addressed to a drive controller, except broadcast messages. Reading a 16-bit counter that totals all the messages addressed to the drive controller, except broadcast messages. **08/0F**: Number of broadcast messages received. Reading a 16-bit counter that totals all of the broadcast messages addressed to the drive controller. **08/10**: Reading the number of NACK responses. The value read is always 0. **08/11**: Reading the number of responses from a drive controller that is not ready. The value read is always 0. **08/12**: Reading the number of erroneous characters.	Yes

[1] Used in broadcast messages and therefore must specify drive controller number as 0 in the message transmitted by the master device.

Table 12: MODBUS Functions (Continued)

Code	Nature of Function	Drive Controller
11	Read event counter •A status (always zero) •A counter that is incremented each time a correct message is received by the drive controller, except for the exception responses.	Yes
16 [1]	Write N output words This function enables the master device to write output words to the drive controller.	Max 60

[1] Used in broadcast messages and therefore must specify drive controller number as 0 in the message transmitted by the master device.

Frame Details RTU Mode

Figure 32 through Figure 49 illustrate example frames for the MODBUS functions listed in Table 12.

Read N Bits: Function 1 or 2

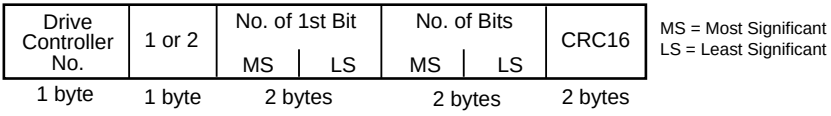


Figure 32: Read N Bits: Question Format

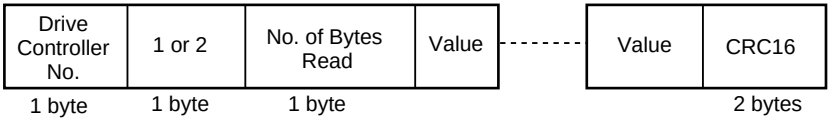


Figure 33: Read N Bits: Answer Format

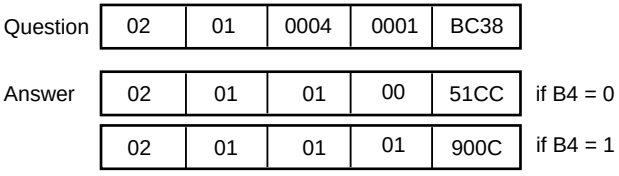


Figure 34: Example: Read Bit B4 of Drive Controller 2

Read N Words: Function 3 or 4

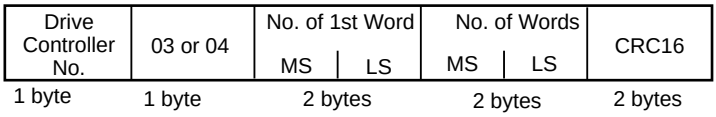


Figure 35: Read N Words: Question Format

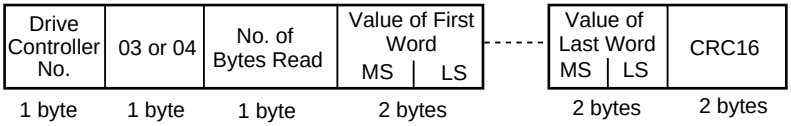


Figure 36: Read N Words: Answer Format

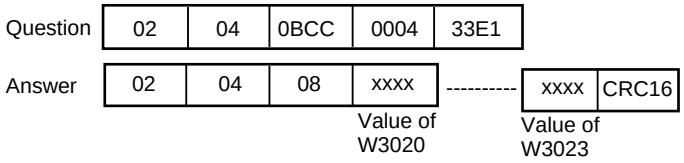


Figure 37: Example: Read Words W3020 to W3023 of Drive Controller 2

Write One Output Bit: Function 5

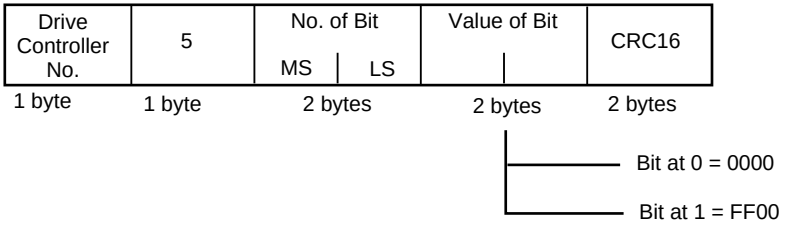


Figure 38: Write One Output Bit: Question Format

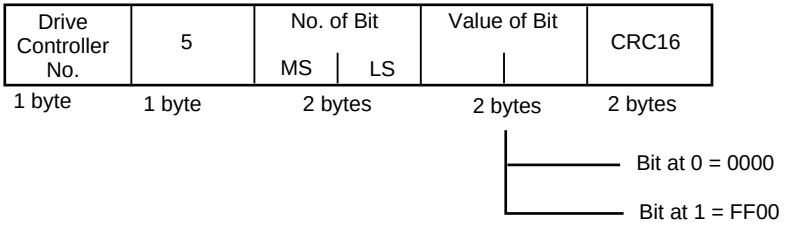


Figure 39: Write One Output Bit: Answer Format

Question and Answer	02	05	0003	FF00	7C09

Figure 40: Example: Write a Value of 1 in Bit B3 of Drive Controller 2

Write One Output Word: Function 6

Drive Controller No.	06	No. of Word		Value of Word		CRC16
		MS	LS	MS	LS	
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Figure 41: Write One Output Word: Question Format

Drive Controller No.	06	No. of Word		Value of Word		CRC16
		MS	LS	MS	LS	
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Figure 42: Write One Output Word: Answer Format

Question and Answer	02	06	0BCE	0315	2B1D

Figure 43: Example: Write a Value of H'0315' = 789 in W3022 of Drive Controller 2 (ACC = 78.9 s)

Diagnostic: Function 8

Drive Controller No.	08	Sub-code	Data	CRC16
1 byte	1 byte	2 bytes	2 bytes	2 bytes

Figure 44: Diagnostic: Question and Answer Format

Table 13: Diagnostic Question/Answer Data

Sub-Code	Question Data	Answer Data	Function Carried Out
00	XX YY	XX YY	Echo
01	00 00	00 00	Reinitialization
03	XX 00	XX 00	XX = new delimiter
04	00 00	No answer	Change to LOM Mode
0A	00 00	00 00	Counters reset to 0
0B	00 00	XX YY	XX YY = counter value
0C	00 00	XX YY	XX YY = counter value
0D	00 00	XX YY	XX YY = counter value
0E	00 00	XX YY	XX YY = counter value

Read Event Counter: Function 11 (H'0B')

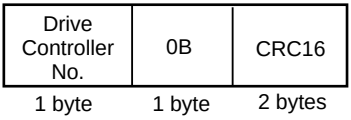


Figure 45: Read Event Counter: Question Format

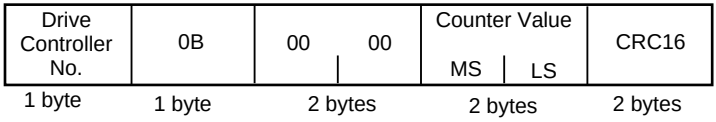


Figure 46: Read Event Counter: Answer Format

Write N Output Words: Function 16 (H'10')

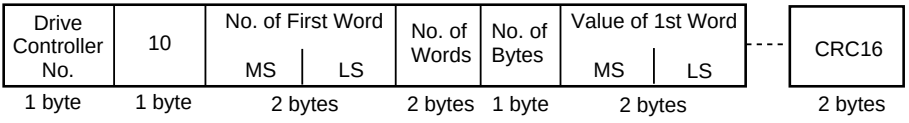


Figure 47: Write N Output Words: Question Format

Drive Controller No.	10	No. of First Word		No. of Words		CRC16
		MS	LS	MS	LS	
1 byte	1 byte	2 bytes		2 bytes		2 bytes

Figure 48: Write N Output Words: Answer Format

Question	02	10	0BCE	0002	04	0002	0003	E3C6
Answer	02	10	0BCE	0002	2220			

Figure 49: Example: Write Values of 2 and 3 in Words W3022 and 3023 of Drive Controller 2

Exception Answers

An exception answer is given by a drive controller when it is unable to carry out the request which has been given to it.

Drive Controller No.	Answer Code	Error Code	CRC16
1 byte	1 byte	1 byte	2 bytes

Figure 50: Exception Answer Format

The answer code consists of the function code of the request plus H'80 (the most significant bit is set at 1).

The error codes are as follows:

- 1 = Function requested is not recognized by the drive controller.
- 2 = Addresses of bits and words indicated in request are not valid in the drive controller.
- 3 = Values of bits and words indicated in request are not valid in the drive controller.
- 4 = Drive controller has started carrying out request but cannot process it completely.

CRC16 Calculation

The CRC16 is calculated based on all the message bytes by applying the following method:

1. Initialize the CRC (16-bit register) to H'FFFF'.
2. Enter the first to the last byte of the message:

```
CRC     XOR          <byte>–>CRC
Enter   8 times
        Move the CRC one bit to the right
        If the output bit=1, enter CRC XOR H'A001–>CRC
End Enter
End Enter
```

The CRC obtained will be transmitted least significant first, most significant next. *Note: XOR = exclusive OR.*

Frame Details ASCII Mode

In ASCII mode, the MODBUS frame has the following structure:

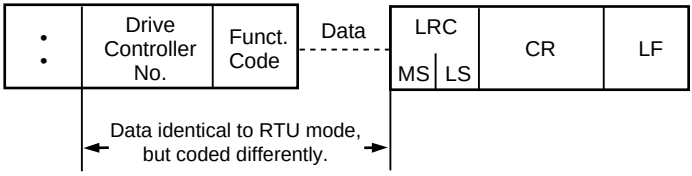


Figure 51: MODBUS ASCII Frame

The delimiters are as follows:

- ":"=H'3A'
- CR=H'0D'
- LF=H'0A'

The data field is similar to that of the RTU frames, but coded in ASCII characters. Each byte is divided into two four-bit bytes each of which is coded by its ASCII equivalent. For example, the byte containing the drive controller number 06 will be coded by the two ASCII characters "0" and "6", i.e. by H'30' and H'36'.

LRC (longitudinal redundancy check) is calculated by summing up, modulo 256, the values of the bytes of the contents of the frame (without the delimiters) then calculating the hexadecimal representation of the 2's-complement negation of the sum. This value is then coded as two ASCII characters as described above.

Example: Writing a value of 1 in bit B3 of drive controller 2

Question and answer

in Hexadecimal:

3A	30 32	30 35	30303033	46463030	4637	0D	0A

in ASCII:

:	02	05	0003	FF00	F7	CR	LF

Calculation of the LRC

Sum of the frame bytes:

H'02' + H'05' + H'00' + H'03' + H'FF' + H'00' = H'109' = 265

Modulo 256 Sum:

H'09' = 9

2's complement of the modulo 256 Sum:

H'100' - H'09' = 256' - 9 = 247 = H'F7'

Register Update Times

The maximum register update times for a single ALTIVAR drive controller using MODBUS protocol are listed in Table 14. These times assume a baud rate of 9600 and no communication errors.

Table 14: Maximum Register Update Times

Number of Registers Transferred	MODBUS ASCII		MODBUS RTU	
	Read Time [1] (msec)	Write Time [2] (msec)	Read Time [1] (msec)	Write Time [2] (msec)
1	68	59	61	52
10	106	97	82	73
20	148	138	105	96
50	273	263	174	165

[1] Function code = 03. Values shown include query time, master processing time, and acknowledge (ACK) time.

[2] Function code = 16. Values shown include query time, master processing time, and acknowledge (ACK) time.

APPENDIX A: ADDRESS DESCRIPTIONS & INDEX

Address	Description	Page
W2000	High speed	23
W2001	Low speed	23
W2002	Accel 1	23
W2003	Decel 1	23
W2004	Accel 2	23
W2005	Decel 2	23
W2006	Slip compensation	23
W2007	IR compensation	23
W2008	Profile	23
W2009	Voltage boost	23
W2010	Damping	23
W2011	Bandwidth	23
W2012	Motor overload	23
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GROUPE SCHNEIDER

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VD0C06S308 August 1996 Printed in USA FPC 8/96

Addendum to Instruction Bulletin VD0C06S308

INTRODUCTION

This document is an addendum to bulletin VD0C06S308 (dated August, 1996).

The VW3A66301U UNI-TELWAY, MODBUS / JBUS PCMCIA Communication Card Kit is only compatible with V3.0 drive controller software. If you are not sure which version of software is in your drive controller, use the procedure below. If the drive controller contains a version of software other than V3.0, contact your local field sales office for software upgrade information.

IDENTIFYING THE SOFTWARE VERSION

⚠ DANGER

HAZARDOUS VOLTAGE

- This product contains energy storage devices. Read, understand, and perform "Bus Voltage Measurement Procedure" in Section 1 of VD0C06S308 before identifying the software version. Measurement of DC bus capacitor voltage must be performed by qualified personnel.
- The DC bus LED is not an accurate indication of absence of DC bus voltage.
- DO NOT short across capacitors or touch unshielded components or terminal strip screw connections with voltage present.
- Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Failure to follow these instructions will cause death or serious injury.

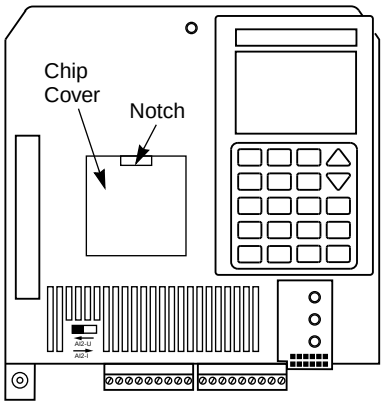

Figure 1: Main Control Board – Location of Chip Cover

1. Disconnect and verify that all power is removed from the drive controller (including any power present on J22, J23 & J24 terminals of the I / O extension module, if installed).
2. Wait 1 minute to allow the DC bus to discharge.
3. Perform the Bus Voltage Measurement Procedure (refer to Section 1 of the PCMCIA Communication Card Kit manual, VD0C06S308).
4. Insert a small, electrically insulated screw driver in the notch of the software chip cover. Apply slight upward pressure and pull out to remove the cover. See Figure 1.

   Note: If the drive controller is already equipped with an I/O extension module or communication carrier module, first remove the module by loosening the two mounting screws. (On the I/O extension module, also unplug the separable connectors – J22, J23 & J24 – from the bottom of the module.)
5. If the software version is not V3.0, contact your local field sales office for software upgrade information.
6. Replace the plastic cover over the software chip.
7. Reinstall the module (as required, see note in Step 4).
8. Close the drive controller cover.

FUNCTIONALITY

Table 1 lists the differences between the functionality described in the PCMCIA Communication Card Kit manual (bulletin no. VD0C06S308), and the actual operation of the card.

Table 1: Software V3.0 IE31 Exceptions

Page	Register	Function	Description
24	W2020,4	Suppression of communication control (NTO)	Communication time-out cannot be disabled.