

Control Techniques Variable-Speed Drive (VSD) Interface

Overview

The E2 RX, BX, and CX series of controllers features integration with several models of variable-speed drives (VSDs) manufactured by Control Techniques, a division of Emerson Industrial Automation. The E2 communicates with the VSD via an RS485 MODBUS network, which allows easier wiring setup and more detailed status and fault information to be communicated to the E2 than traditional VSDs driven with I/O points.

All E2 control applications that can use VSDs — such as variable-speed condenser fans, AHU fans, and VS compressors — support selection of Control Techniques drives, making software setup quicker and easier.

Cautions, Warnings, and Notices

WARNING! If an E2 has Commander SK variable speed drives configured, do NOT remotely upgrade this unit to 2.64F01 and above if the current version is earlier than 2.64F01. The E2 will lose communication with Commander SK drives when upgraded. A technician must be on-site to clean out the Commander SK and reprogram (follow the instructions in this document to program).

WARNING! Inhibit or disable the VSD before making programming changes. Refer to the VSD's manufacturer's instructions for information on inhibiting the drive.

Compatible Drives and E2 Versions

The E2 controller's RS485 MODBUS interface communicates with the following Controller Techniques VSD models:

- Commander SK - Requires E2 version 2.64F01 or above
- Commander SE - Requires E2 version 2.40F01 or above
- Unidrive SP - Requires E2 version 2.40F01 or above

Before Beginning Setup

The networking and configuration instructions in this technical bulletin assume the Control Techniques VSDs are properly installed, tuned, and programmed by the installer. It is **critical** that the proper filters, wiring, shielding, and grounding are done to minimize the EMI generated by these drives. The following is a list of items that **must** be addressed to insure proper system operation. Refer to the drive manual on how to do the following:

1. Fitting the correct RFI filter(s) at the power input to the drive,

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2. Mounting the drive against the surface of the RFI filter correctly, removing all paint or non-conducting coatings so that the drive and the RFI filter make good direct electrical contact,
3. Ensuring the filter is connected to the drive using only the wires provided (with no extensions),
4. Using a shielded (screened) or steel wire armored cable to connect the drive to the motor, with the shield connected to the drive gland plate by a good high-frequency connection (using either the conductive cable glands or the SE11 optional cable screen clamp kit),
5. Grounding the shield of the motor cable to the ground terminal of the motor frame using a link that is as short as possible and not exceeding 50 mm (2 in) in length (a full 360° termination of the shield to the motor terminal housing, if metal, is beneficial),
6. Ensuring the cables carrying the AC supply and the ground to the filter are at least 100 mm (4 in) from the drive and motor cable,
7. Avoiding locating noise-sensitive circuits in a zone extending 0.3m (12 inches) all around the drive, and
8. Ensuring the motor cables do NOT run in parallel with control signal cables.

Proper setting of the drive setpoints themselves, outside of what is needed for the VSDs to communicate with E2s, is beyond the scope of this document. For information about CT drive setpoints and their functions, consult the Commander SK, Commander SE, or Unidrive SP instructions.

VSD Input Wiring



WARNING! Keep the VSD disabled by leaving the ENABLE and FWD/RUN signals OPEN until the drive is ready for use.

If the VSD's drive speed will be controlled by a 0-10VDC analog output board point from a MultiFlex or 4AO board controlled by the E2, the point must be connected to the drive's speed input terminals. Commonly, the FWD/RUN and ENABLE inputs on the VSD are also be connected to relays on a MultiFlex board so the E2 may control the run and enable signals.

Figure 1 on page 3 shows wiring for the Commander SK for both 0-10VDC and MODBUS drive control. For analog control, use Belden 8761 or equivalent cable to connect the analog point to the T1 and T2 terminals on the Commander SK, and connect a relay point on a MultiFlex or 8RO board to terminals B2 and B5 to control the FWD/RUN signal.

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For both MODBUS and 0-10VDC, connect B2 and B4 terminals to a relay on a MultiFlex or 8RO board to control the ENABLE signal, or simply jumper B2 and B4 to enable the drive.

COMMANDER SK DRIVE WIRING

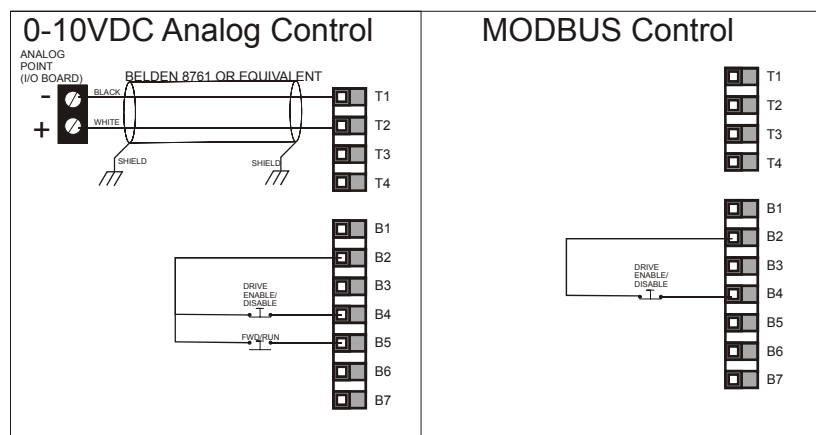


Figure 1 - Commander SK Drive Wiring (Analog and MODBUS)

For wiring information for Commander SE and Unidrive SP models of VSD, refer to the VSD documentation.

MODBUS Networking

Control Techniques drives connect to an E2 using an RS485 network. Multiple VSDs must be interconnected in a daisy-chain without branches or star configurations, as shown in Figure 2. Use only Belden 8761 shielded two-wire cable or equivalent.

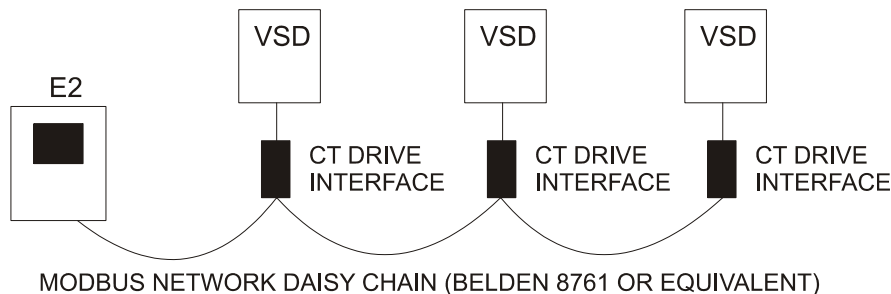


Figure 2 - MODBUS Daisy Chain for CT VSD Drives

Warning! Consult the Control Techniques technical manual for your drive(s) for proper wiring, grounding, and noise prevention. Failure to do so may result in excessive noise disrupting RS485 communication.

Warning! Use only Belden 8761 or equivalent for networking the VSDs. CAT5 cabling and other cable that typically uses RJ45 connectors like the one on the VSD are not rated for use with VSDs.

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Connection to E2

The E2 supports MODBUS on any of its RS485 serial ports. These include:

- **COM2** - The RS485 serial port onboard the E2 Power Interface Board (PIB). All E2 models have a COM2 port, which is typically used by the CPC I/O Network but may also be designated as a MODBUS port.
- **COM4** - The RS485 serial port on the RS485 COM Card (P/N 637-4890), a peripheral board that must be purchased separately.
- **COM6** - The RS485 serial port on the E2 Modem/Expansion COM Card (P/Ns 637-4871, 637-4872, and 637-4873), a peripheral board that must be purchased separately. MODBUS must be connected to the RS485 port as labeled in *Figure 3*.

The connectors for the COM2, COM4, and COM6 ports are shown in *Figure 3*. Note that the COM port assigned for use as MODBUS may not be used to communicate with CPC I/O boards or any other type of serial device - only MODBUS devices may be connected to the port.

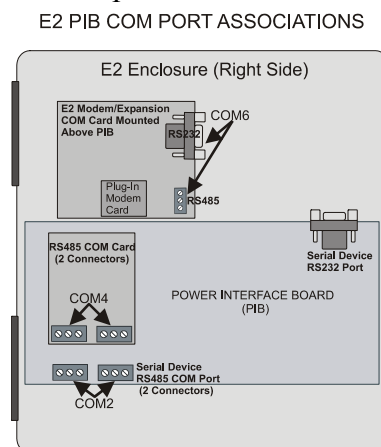


Figure 3 - E2 PIB COM Port Locations

Connection to VSDs and the CT Drive Interface

CPC requires that all MODBUS network connections to Control Techniques VSDs use a CT Drive Interface (P/N 535-2725). This assembly, which plugs into the RJ45 MODBUS jack on the VSD, provides the noise filtering circuitry recommended by Control Techniques, and it also provides a screw terminal connector for easier daisy chaining to the MODBUS network.

1. Using the shielded Ethernet cable included in the CT Drive Interface Kit, connect the CT Drive Interface box to the RJ45 jack on the VSD. Do not use any other Ethernet cable except the cable supplied in the CT Drive Interface kit.
2. Connect the MODBUS network cable to the RS485 network connector on the CT Drive Interface. Wire all 485+ terminals on the E2 and CT Drive Interfaces to the same wire color, and wire all 485- terminals to the other wire color. All bare shield wires should be connected to the 0V terminals. The 0V terminal must also be connected to earth ground with a 14AWG wire no longer than 6 inches. You may use the earth ground connection on the motor drive. Refer to *Figure 4*.
3. Terminate the two devices at the endpoints of the MODBUS daisy chain. For the E2, the termination jumpers will be next to the COM port connector. For the VSDs, use the termination jumpers on the CT Drive Interface. Set the jumpers of the end devices to the TERMINATED positions and all other devices to the UNTERMINATED position. Refer to *Figure 4*.

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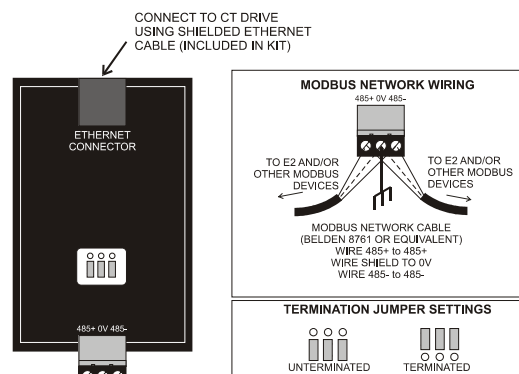


Figure 4 - CT Drive Interface Wiring and Termination Settings

Manually Configuring the VSDs to Enable MODBUS Communication

By default, a Control Techniques VSD is not configured with the right parameter settings to communicate via MODBUS. Before connecting to an E2, you must use the CT drive's own keypad interface to change serial networking parameter values. The list below shows the ID number of each parameter that must be changed for each model type. Refer to the drive manufacturer's instructions for more information about using the CT drive keypad interface.

Commander SE:

- 41 - SERIAL MODE: Change to "rtU"
- 42 - BAUD RATE: Recommended value is "19.2" for 19200 baud.
- 43 - SERIAL ADDRESS: Choose a unique MODBUS address number from 1 to 127. The SE drive displays MODBUS addresses with a decimal point (i.e. 10 is displayed as "1.0", and 2 is displayed as "0.2"). Ignore the decimal point.

Commander SK:

For the Commander SK, follow the steps below in order:

1. Inhibit or disable the drive.
2. Set access to Level 3 (set parameter 10 to "L3").
3. Reset the drive to USA defaults (set parameter 29 to "USA").
4. Set the Drive Config (parameter 5) to "Pr."
5. Set access to Level 3 (set parameter 10 to "L3").
6. Set the SERIAL COMMS BAUD RATE (parameter 43) to "19.2" (19200 baud).
7. Set the SERIAL COMMS ADDRESS (parameter 44) to a unique MODBUS address number from 1 to 127.
8. **Do not set any other parameters. Exit to save changes.**

Unidrive SP:

- 35 - SERIAL MODE: Change to "rtU"
- 36 - SERIAL COMMUNICATION BAUD RATE: Recommended value is "19.2" for 19200 baud.

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- 37 - SERIAL COMMUNICATIONS ADDRESS: Choose a unique MODBUS address number from 1 to 127.














Sharing the MODBUS Network with Other MODBUS Devices

Control Techniques VSDs may share the same network segment as other MODBUS devices communicating with the E2, provided:

- Each device, regardless of type, has a unique MODBUS address from 1 to 127. In other words, if there are two VSDs and five Control Link Case Displays (CL-CDs) on the MODBUS network, do not number the VSDs 1-2 and the Control Link Case Displays 1-5. You must either number the VSDs 1-2 and the CL-CDs 3-7, or the CL-CDs 1-5 and the VSDs 6-7.
- Each device uses the same baud rate and parity type.
- The number of total devices does not exceed 127.




Adding Control Techniques VSD Drives

Once the Control Techniques VSDs are networked properly, assign the E2 COM port to which the VSDs are connected as a MODBUS port, and specify the number of drives on the network.


1. Log in to the E2 controller with a username/password that has Level 4 (Administrator) access.
2. Press     (GENERAL CONTROLLER INFORMATION).
3. Port assignments are made in the “Serial” tab of the General Controller Information setup screens. Press   to navigate to the Serial Configuration screen.
4. In the COM Connection field that corresponds to the COM port number to which the VSDs are connected, press  - LOOK UP and select “MODBUS.”
5. After selecting “MODBUS,” four fields will appear below the COM Connection field. These fields define the format of the messages coming from the VSDs and must be set to the following values:
 - *Baud Rate* - To match the baud rate settings specified in the VSDs, set the baud rate to 19200.
 - *Data Size* - 8
 - *Parity* - None
 - *Stop Bits* - All CT VSD drives use 2 stop bits, but since all other MODBUS-enabled Emerson Climate Technologies devices use 1 stop bit, the E2 has been programmed to automatically use 2 stop bits in messaging to CT VSD devices only. Therefore it is recommended you leave the Stop Bits field set to 1.
6. When you have finished entering the MODBUS settings, press  to save changes and return to the System Information menu.
7. Press     (CONNECTED I/O BOARDS AND CONTROLLERS).
8. In the Connected I/O screen, locate the field in the ECT Devices box labeled “CT Drive.” Enter the total number of VSDs on the network in this field.
9. Press  to save changes and return to the Network Setup menu.

Commissioning the VSD

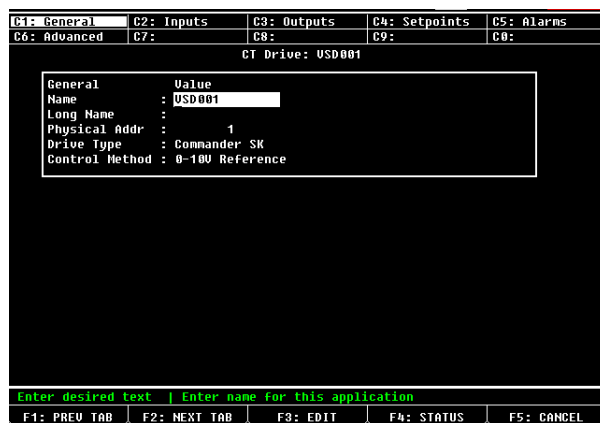
Once you have set the COM port for MODBUS and added a number of CT drives, the next step in VSD setup is to edit the application parameters in the E2 to set drive type, address, and control type:

1. Press   - Configured Applications
2. Use the arrow keys to highlight “CT Drive” in the Configured Apps menu. Press .

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3. If multiple CT drives are set up, highlight the name of the drive you wish to set up and press .
4. The CT Drive Status screen should be visible. From this screen, press **F5** to access the CT Drive setup screens. The first setup screen shown will be “General.”

Screen 1: General




General	Value
Name	: USD001
Long Name	:
Physical Addr	: 1
Drive Type	: Commander SK
Control Method	: 0-10V Reference

Enter desired text | Enter name for this application

F1: PREV TAB F2: NEXT TAB F3: EDIT F4: STATUS F5: CANCEL

Figure 5 - CT Screen 1: General

5. Enter a name for the VSD in the “Name” field.
6. Enter the MODBUS address for this drive in the “Physical Addr” field.
7. Choose the VSD model type (Commander SK, Commander SE, or Unidrive SP) in the Drive Type field.
8. In the Control Method field, select “0-10V Reference” if controlling drive speed from an analog point, or “MODBUS Network” if the E2 will control drive speed directly through the MODBUS interface.
9. Press  to save these changes and exit.
10. Remain on the CT Drive Status screen. You should see live values appearing in the “Current Conditions” status fields (such as Hz/RPM) as the E2 makes connections between the CT Drive application inputs and outputs and the VSD’s inputs and outputs. Remain on this status screen until the Setpt Status field shows either “In Sync” or “Sync/Error.” (Note: the screen may show Sync/Error even when no error is occurring - this is normal. Ignore this parameter until the drive is fully configured. See “Configuration and Synchronizing Configuration Between the E2 and Control Techniques VSDs” on page 9.)

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11. When the Setpt Status field shows “In Sync” or “Sync/Error,” press **F5** to return to the CT Drive setup screens. Complete the drive programming by setting the necessary setpoints in the Setpoints, Alarms, and Advanced tabs.

C1: General	C2: Inputs	C3: Outputs	C4: Setpoints	C5: Alarms
C6: Advanced	C7:	C8:	C9:	C0:


CT Drive: USD001

Setpoints	Value
Minimum Speed :	30.0
Maximum Speed :	60.0
Accel Rate :	30.0
Decel Rate :	60.0
Motor Current :	7.5
Motor Speed :	1800
Motor Voltage :	230.0
Motor pwr Factr:	0.85

Enter -3000 to 3000 Hz | Minimum drive speed (01)

F1: PREV TAB F2: NEXT TAB F3: EDIT F4: STATUS F5: CANCEL

Figure 6 - CT Drive Setpoints Tab

When finished programming, press  to save changes and exit. On the CT Drive status screen, you should see the Setpt Status field change to the value “In Sync.” The final step in CT Drive setup is to associate the VSD with the application that will be commanding it.




VSD Association With E2 Control Applications


Most E2 control applications that can use variable-speed drives may be associated with Control Techniques VSDs. They are:

- Suction Group and Enhanced Suction Group (for controlling variable-speed compressors)
- Condenser (for controlling variable-speed fans)
- AHU (for controlling variable-speed blowers)












To associate an application with a CT VSD, navigate to the application’s setup screens, locate the field that determines device type or fan type, and set that field to “CT Drive.”

Condenser & AHU

1. Press  **5** - Configured Applications.
2. Highlight either “Condenser” or “AHU” in the Configured Apps menu, and press .
3. If more than one application, highlight the name of the application you wish to set up in the Summary Screen and press .
4. From the status screen, press **F5** to access the application setup screens.
5. Locate the “Fan Type” field on screen C1: General. Highlight this field, press **F4**, and select “CT Drive” as the fan type.
6. Navigate to the screen where the advanced VS setup parameters are (screen C4: VS Setup for Condensers, screen C8: Adv Fan for AHU).
7. Locate the field named “CT Drive.” Highlight this field, press **F4**, and select the name of the CT Drive application you wish to assign to this application.

8. Press  to save changes and exit.

Suction Group & Enhanced Suction Group

1. Press   - Configured Applications.
2. Highlight either “Suction Group” or “Enhanced Suction Group” in the Configured Apps menu, and press .
3. If more than one application, highlight the name of the application you wish to set up in the Summary Screen and press .
4. From the status screen, press  to access the application setup screens.
5. In Screen 1: General, if you have not set up the total number of compressor stages in the rack, enter the correct number in the “Num of Stages” field. This will cause the “C6: Comp Setup” tab to be visible.
6. Press  +  to navigate to the Comp Outs screen.
7. For stage #1 in the Comp Outs screen, highlight the “TYPE” field and set this field to “CTdr” (CT Drive). This assigns stage 1 of the rack to be a VS compressor driven by a CT VSD.
8. Press  +  to navigate to the VS screen.
9. Locate the field named “CT Drive.” Highlight this field, press , and select the name of the CT Drive application you wish to assign to this application.
10. Press  to save changes and exit.

When a CT Drive application is associated with a control application, the E2 automatically connects all of the necessary inputs and outputs of the CT Drive to the inputs and outputs of the control application that are responsible for: controlling the drive’s forward/run (RUN) and variable speed percentage (VS); resetting the inverter (INV RST); reading the motor frequency (MOTOR FREQ); and reading the inverter’s alarm output state (ALARM OUT).

Configuration and Synchronizing Configuration Between the E2 and Control Techniques VSDs

The setpoints that determine how the VSD operates are kept and saved in the VSD’s own memory. When the VSD is connected to an E2, the E2 becomes the “master” of the VSD’s setpoints. This means:

- All permanent changes to CT Drive setpoints must be made through the E2’s CT Drive application. Changes made through the E2 are saved to the VSD as permanent.
- All changes made from the VSD’s front panel are temporary and will eventually be overwritten by the configuration in the CT Drive application. The E2 checks once daily for out-of-synch conditions between the setpoints in the CT Drive application and the VSD, and all setpoints that are different from the values stored in the CT Drive application will be overwritten.

Read Setpoints On Startup

If the VSD is a Commander SE or Unidrive SP, or if you are using a Commander SK drive and the E2 version is before version E2 2.64F01, when the E2 makes the connection between a VSD and a CT Drive application for the first time, the setpoints are read from the VSD and saved to the E2’s application configuration. When this occurs, the configurations between the E2 and VSD are considered “synchronized.” After the initial read from the

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VSD occurs, as long as the VSD is associated with a CT Drive application in the E2, the E2 will be considered the primary device when keeping the setpoints synchronized between the E2 and VSD.

When using a Commander SK drive with E2 version 2.64F01 or above, E2 will not read setpoints when first connected. Drive parameters will need to be programmed from the E2.