Using The ELC-AN06AANN Expansion Analog I/O Card with The C445 Motor Management Relay

Introduction

The purpose of this application note is to demonstrate how a single analog I/O card can be added to a C445 Motor Management Relay. For this example, the 4 input / 2 output analog card is used, part number: ELC-AN06AANN. Any of the available ELC analog cards along with the 4-input Thermocouple card and 4-input RTD card can be used as a stand-alone I/O card with the C445.

When using a single analog card with the C445, the ELC-CARS485 Modbus adapter module is not needed. This allows a single analog card to be used so the MCC bucket size for all C445 relays can remain the standard size. A larger bucket is not required. The analog card does require 24vdc power, but it will communicate directly with the C445.

When used in this way, a logic program is required in the C445 to exchange configuration and analog data with the analog card. This application note will demonstrate this functionality. A sample logic program is also included in the zip file with this application note.

This example uses the ELC-AN06AANN card so an analog output can be wired to analog input to demonstrate writing to an output and reading the corresponding analog input data.

System Overview

The devices used for this application example are as follows:

1. C445 overload relay including a Base Control Module, a Measurement Module and a User Interface module.

2. ELC-AN06AANN, 4-input, 2-output analog module
Power Xpert inControl Software. This includes the Logic Engine Programming Software

The Power Xpert Logic Engine software will communicate with the C445 to download and monitor the program to the C445 using a USB/Micro USB cable. The C445 will communicate Modbus RTU to the ELC analog card.

Configuring the RS-485 Modbus Port on the ELC Analog Card

The ELC Analog card must be configured to communicate with the C445. The default communication settings for the RS-485 port on the analog card are:

9600 baud, ASCII mode, 7 bits/byte, even parity and 1 stop bit

These settings will be changed to the following:

115200 baud, RTU mode, 8 bits/byte, even parity and 1 stop bit

To change the configuration of the RS-485 port on the ELC analog card, a USB/RS-485 cable will be needed along with Modbus master software such as Modscan. Modscan is third-party, readily available software that can be downloaded at a minimal cost. This application note will demonstrate changing the settings of the RS-485 port on the ELC analog card using Modscan. If the USB/RS-485 cable from Eaton is used (part number C445XS-USBLEADS), then the USB driver is installed with the Power Xpert inControl software. In that case, the cable will work with no other action required. If a third-party cable is used, the USB driver for it will need to be obtained from that third-party and installed per their instructions.

Connect the USB end of the cable to the computer and wire the open leads end to the green RS-485 connector on the bottom of the ELC analog card per the following. This wiring diagram assumes the C445XS-USBLEADS cable is being used.

The C445XS-USBLEADS cable has a label that shows which wire is D0 and which is D1.

<table>
<thead>
<tr>
<th>Cable Leads</th>
<th>ELC Analog card connector</th>
</tr>
</thead>
<tbody>
<tr>
<td>D0</td>
<td>--------------------------</td>
</tr>
<tr>
<td>D1</td>
<td>--------------------------</td>
</tr>
</tbody>
</table>

Once the cable is connected and the analog module is powered, check Device Manager on your computer to see which virtual COM Port has been assigned to the USB cable. For this example, COM1 has been assigned.

Start the Modscan software. The Modscan screen should look like the following:
Since by default, the ELC analog card is configured for 9600 baud, ASCII mode, 7 bits/byte, even parity and 1 stop bit, Mosdscan must be initially configured the same to communicate with the card. By default, the Modbus node address is 1 for the analog card.

The following steps will take you through configuring the analog card with Modscan.

1. Under the “Setup” drop down menu, “Display Options” select only the following so a check mark is displayed next to each:
   - Show Data
   - Hex
   - Hex Address

2. Change the command settings on the main screen to match the following:

3. Select the “Connection” drop down menu, then select “Connect” and the following window will be displayed:
4. Change the settings to match the default settings of the analog card as shown below. Be sure to select the correct COM port.
5. Before leaving this screen, select the “Protocol Selections” button and change the “Transmission Mode / Standard” to ASCII as shown below.
6. Select OK to close this screen then select OK on the Connection Details screen to close it. The Modscan software should now be reading Modbus address 4021 from the analog card, which are the present interface settings. Per below, the value of 2 being read represents 9600 baud, ASCII mode, 7 bits/byte, even parity and 1 stop bit.

Note, the IL for the ELC-AN06AANN card shows the interface parameters register to be 40e8. Like many Modbus devices, a 1 must be added to that address to access it properly.

7. Next, send a Write command to the analog card to change the interface parameters to 115200 baud, RTU mode, 8 bits/byte, even parity and 1 stop bit.

8. Select “Setup”/“Extended”/“Preset Regs”. The following screen will be displayed. The address 16617 is the decimal equivalent to 40e9 Hex.

9. Select OK and the following will be displayed. Change the data window as shown to C020. This is the Hex code that represents the new interface parameters for the analog card.
10. Note that there are no longer any responses being received. That’s because the interface parameters for the analog card have been changed. Change them to the following to begin successfully reading the new hex code, C020 from register 40e9.

Under “Connection” select “disconnect”
Under “Connection” select “Connect”
Change the values per the following two screens
11. Modscan should now be communicating with the analog card at the new interface parameters, 115200 baud, RTU mode, 8 bits/byte, even parity and 1 stop bit as shown below.
Configuring the RS-485 Port on the C445 to communicate with the ELC Analog Card

Using the C445 User Interface, set the following parameter as shown below:

9. Communications / 1. Modbus / 1. Base Ctrl Module 485 Port mode: Edit, then select “Generic Master” with the up/down arrows and be sure to Save.

Also using the User Interface, change the External I/O configuration per below. Use the Mode/Back button to back out to the main configuration menu (Communications).

The use the down arrow button to scroll to: 15. External I/O.

Select OK, then scroll to: 2. Ext IO Comm Config and press the OK button. Configure each parameter under EXT IO Comm Config as shown below. Use the OK, EDIT, SAVE and UP/DOWN arrow buttons as needed.

1. ELC IO Modbus Address: 1
2. Ext IO Modbus Baud Rate: 4, 115200
3. Ext IO Modbus Parity and Stop Bits: 0, Even Parity – 1 Stop Bit

The C445 is now properly configured to communicate with the ELC analog card.

Connecting the C445 to the ELC Analog Card

The 3-position black RS-485 connector on the bottom of the C445 Base Control Module is connected to the green 2-position RS-485 connector on bottom of the ELC analog card as shown below.
C445 Base Control Module Connector | ELC-AN06AANN Connector

<table>
<thead>
<tr>
<th>D0</th>
<th>D1</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>+</td>
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Connecting the USB port on the computer to the Micro USB port on the C445 Base Control Module

The USB driver for the USB/Micro USB cable from Eaton, part number C445XS-USBMICRO is included when the Power Xpert inControl software is installed on the computer. Simply connect the USB end of the cable to a USB port on the computer and the Micro USB end of the cable to the Micro USB port on the front of the C445 Base Control Module. If a third-party USB/Micro USB cable is used, the driver will need to be obtained from the cable manufacturer and installed on your computer per their instructions. This connection will be used to download the Logic program and monitor the execution of the program.

Refer to the C445 User manual, publication MN042003EN for information on wiring and configuring the C445 system.

Powering the Analog Module

The ELC analog card comes with a special connector with a red, a white wire and a green wire. The connector plugs into the bottom of the analog card. The red, white and green open leads of this cable need to be connected to a 24vdc power supply as follows:

Red wire: +24vdc
Black wire: 0 vdc or common
Green wire: power supply ground connection

Wiring the Analog I/O module to work with the program included with this application note

The program included with this application note assumes that the second analog output (CH6) is wired to the second analog input (CH2) using current mode for each analog point. Both I/O points will be configured for 0-20ma. Scaling is used in the logic to make the analog signal 4-20ma. Average Current of the motor the C445 is controlling and protecting is the value scaled to the 4-20ma output signal. The program will be more thoroughly described later in this document.

Wire CH6 to CH2 on the analog I/O card as follows:
For current mode on the analog input CH2, V+ must be jumpered to I+ as shown. The Instruction Leaflet for the ELC-AN06AANN card, IL05003003E is also included in the zip file with this application note and the Logic Program.

The Logic Program Description

Once all the wiring is complete, the Power Xpert Logic Engine software can be opened and downloaded to the C445 using the PowerXpert inControl Logic Engine software. The following is a description of each portion of the logic program.

Delay Logic

The function blocks shown below provide a 5 second delay at power up to make sure the ELC analog card is ready to receive messages. This is to avoid faulting the C445 when it attempts to send Modbus messages to the analog card. The LBL is at the end of the logic. The numbers in each function block represent the execution order. They are added after compile.
ELC Analog Configuration

The following function blocks write the analog channel configuration to the analog card and read it back to verify it. The decimal value 49176 represents C018 hex. In binary, this is 1100000000011000. Per the attached ELC-AN06AANN IL, this configures analog input channel 2 for +/-20ma and analog output channel 6 for 0-20ma.

Writing Average Current from the C445 to the ELC analog output channel 6

The following logic performs the following functions:

1. The TYPECONV function block converts the UINT Average current value from the C445 to an INT for the REFSCALE function block.
2. The C445 Measurement module for this example is a 0-5A unit. The C445 scales it based on the current scale factor, which is 1000 for this measurement module. The decimal range of the 0-20ma analog output (CH6) is 0-4000. Since it is assumed for this example that a 4-20ma signal is required for CH6, the 0-5A current (0-5000) is scaled to the decimal range 800-4000.
3. The MBUS_DATA_OUT function block sends a Modbus command to the analog card with a decimal value in the range of 800-4000 decimal which represents 4-20ma which in turn represents 0-5000 for scaled current.
Reading Average current from the ELC analog input channel 2

The following logic performs the following functions:

1. The MBUS_DATA_IN function block reads the analog input channel 2 data and converts it to the 200-1000 decimal range, which represents 4-20ma.
2. The REFSCALE function block converts the 200-1000 decimal range values which represent 4-20ma to 0-5000 which is the average scaled current.
3. The TYPCONV function block converts the average scaled current from INT to REAL. This is so the DIV function block can convert the average scaled current to amps without losing resolution.
4. The DIV function block converts the average scaled current to amps as a REAL (floating point) value.
Downloading the Logic Program provided with this application example

The Power Xpert Logic Engine software is included with the installation of the Power Xpert inControl OneInstaller software. The Logic Engine is a separate package with a separate icon placed on the desktop. This icon is called Power Xpert inControl Logic Engine.

Double click the Logic Engine icon to open the software. The following screen will be displayed.

1. Under the File drop down menu, select Open.
2. Browse for the program saved to your hard drive that was provided in the zip file with this application note. The name of the program is: Analog_AN06_Program.txt.
3. Open the program and the software screen will look like the following.
Downloading the program using the USB/micro USB cable

1. Connect the USB end of the cable to a USB port on your computer and the micro USB end to the C445 Base Control module. If the C445XS-USBMICRO cable from Eaton is used, the USB driver for it is installed with the Power Xpert inControl software. So, the cable will immediately work.
2. Verify the virtual COM port assigned to the USB cable with Device Manager.
3. On the row of icons at the top of the screen, select the “gear”, which is the third icon from the right ( ). The following window will open.
4. When using the USB cable, Modbus RTU is the protocol. Select RTU under Port and select the virtual COM port your computer assigned to the USB cable. The interface parameters should be left at their defaults per the screen shot below. Then select OK.

5. Open the Output window at the bottom of the screen by grabbing and dragging its upper edge as shown below.
6. Click the compile icon at the top of the screen: and compile success should be displayed in the Output section as shown below.

7. Click the Connect icon which is the second icon from the right ( ) and the following should be displayed in the Output window:

8. Click the download icon ( ) to download the program to the C445. The Output window will display progress. There is also a green progress bar displayed during the download. It’s located at the bottom right of the screen.
9. When the download is complete, you will be asked if you want to put the logic into the Run mode. Select Yes.
10. Test the program. This is accomplished by selecting the Online Debug mode icon ( ). Values will be displayed at the inputs and outputs of the function blocks. The current in amps will be displayed at the output of the DIV function block at the bottom of the program. It will display 0 amps when the motor is not running and the average current in amps when the motor is running. This value is a Real or floating point value to retain resolution.

**Conclusion**

This application example demonstrates all aspects of the following when using single analog cards communicating directly with the C445.

1. Configuring the analog card to communicate with the C445 using Modscan.
2. Configuring the C445 to communicate with the ELC analog card
3. Configuring the analog module’s analog channels
4. Wiring an analog output to as analog input to demonstrate both functions
5. Writing analog data to analog module channels
6. Reading analog data from analog module channels
7. Scaling analog data
8. Converting data types
9. Connecting to the C445 and downloading and viewing logic programs with the Power Xpert Logic Engine software
10. Debugging and viewing program execution online with the logic
References

C445 User Manual, Publication MN042003EN
ELC-AN06AANN Instruction Leaflet, Publication IL05003003E

The Power Xpert inControl configuration software and the Power Xpert inControl Logic Engine programming software are both downloaded with the Power Xpert inControl One Installer Package located on the C445 website: www.eaton.com/c445 (under Resources, then Software, Firmware, and Applications).
Additional Help

In the US or Canada: please contact the Technical Resource Center at 1-877-ETN-CARE or 1-877-386-2273 option 2. Or, email: TRCAutomation@eaton.com

All other supporting documentation is located on the Eaton web site at www.eaton.com/C445