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Chapter 11

Analog Expansion Units

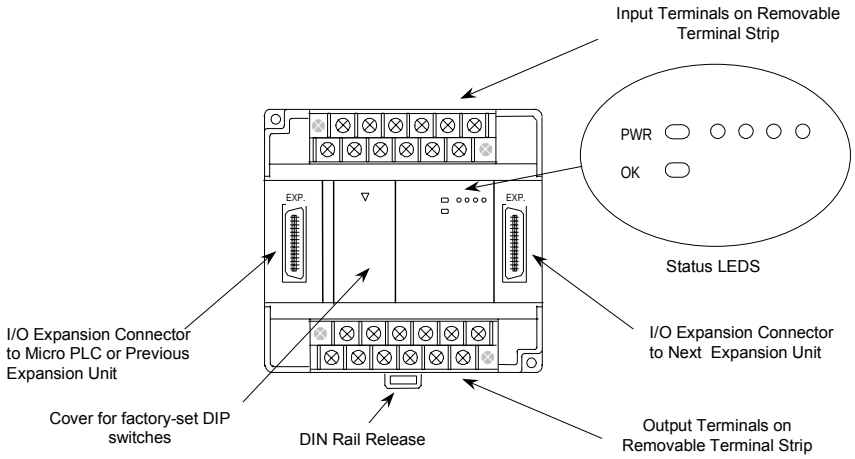
This chapter describes the following VersaMax Micro PLC Analog Expansion Units:

- IC200UEX616 — 6 Point Analog Expansion Unit, (4) Analog In and (2) Analog Out, 12 VDC Power Supply
- IC200UEX624 — 4 Point Analog Expansion Unit, (4) Analog In, 24 VDC Power Supply
- IC200UEX626 — 6 Point Analog Expansion Unit, (4) Analog In and (2) Analog Out, 24 VDC Power Supply
- IC200UEX636 — 6 Point Analog Expansion Unit, (4) Analog In and (2) Analog Out, 100/240 VAC Power Supply

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Features of Analog Expansion Units

Analog, Expansion Units have the features shown below. Expansion Units can be located up to 2 meters from the Micro PLC.



Removable Terminal Strips

The removable terminal assemblies are protected by hinged covers. After turning off power to the Expansion Unit, a terminal assembly and attached field wiring can be separated from the Expansion Unit by removing two screws.

Expansion Connector

The connector on the left side of the Expansion Unit is used to connect to the Micro PLC or to the outgoing connector on the previous Expansion Unit. The connector on the right side of the Expansion Unit can be used to attach to the next Expansion Unit.

Status LEDs

LEDs on the Expansion Unit provide quick visual verification of operating status. Expansion Unit LEDs indicate local Power and OK mode.

Cables

A 0.1 meter ribbon cable (IC200CBL501) is provided with each Expansion Unit. Cables are also available in 0.5 meter (IC200CBL505) and 1 meter (IC200CBL510) lengths.

Analog Expansion Unit Specifications

Module Dimensions	Height: 90mm (3.6 inches), Depth: 76mm (3.0 inches) Width: 150mm (6.0 inches)
Inputs	4 analog inputs
Outputs	2 analog outputs (all models except UEX624)

Power Specifications for Analog Expansion Units

	IC200UEX616	IC200UEX624, UEX626	IC200UEX636
Power voltage	12VDC	24VDC	100/110/120/200/210/ 220V (50/60Hz) VAC
Range	9.6VDC - 15VDC	19.2VDC to 30VDC	85 to 264VAC
Hold-up	10.1ms at 9.6V	24.5ms at 19.2V	223ms at 85V
Inrush Current/Time	0.9A / 1ms at 15V	2.5V / 1ms at 30V	4A / 5ms at 264V
Input Current	0.15A at 15V	0.1A at 30V	0.06A at 264V
Input Power Supply Rating	2.25W	3W	15VA

The DC power source must have enough transient current capability to support the inrush current of the power supply and to maintain the nominal voltage level.

Input and Output Specifications

*Analog Input Channels (IC200UEX6**)*	4, differential
Input ranges	0 to 10V (10.23V maximum) -10V to +10V (-10.23V min. and +10.23V max.) 0 to 20mA (20.47mA maximum) 4 to 20mA (20.47mA maximum)
Resolution	12 bits
Accuracy	±1% of full scale over full operating temperature range
Linearity	±3 LSB maximum
Isolation	non-isolated
Common mode voltage	±40 V maximum
Current input impedance	249 Ohms
Voltage input impedance	200 kOhms
Input filter time	20ms to reach 1% error for step input
Analog Output Channels	2, single-ended, non isolated
Output ranges	0 to 10V (10.23V maximum) 0 to 20mA (20.47mA maximum) 4 to 20mA (20.47mA maximum)
Resolution	12 bits
Accuracy	±1% of full scale over operating temperature range
Current: maximum terminal voltage user load range output load capacitance output load inductance	10V (at 20mA output) 10 to 500 ohms 2000 pF maximum 1 Henry maximum
Voltage: output loading output load capacitance	10 kOhm minimum at 10 volts 1 µF maximum

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Analog Operation

This section explains how a VersaMax Micro PLC Expansion Unit with analog channels processes analog data. Unlike discrete expansion units, if one analog unit fails all subsequent analog expansion units will stop communicating. However, expansion units before the failed unit continue to be available. If an analog expansion fails at power up, no expansion units (discrete or analog) will be functional.

Analog I/O Parameters

Each analog channel can be configured to operate in either voltage or current mode. If current mode operation is selected, the range can then be configured as either 4-20mA or 0-20mA. If voltage mode operation is selected (inputs only), the range can then be configured as either 0-10V or –10V to +10V.

Parameter	Choices	Default Value
Voltage or current mode	Voltage, Current	Voltage
Current range selection	4–20mA, 0–20mA	4–20mA
Voltage range selection (Inputs Only)	0-10V, -10-+10V	0-10V

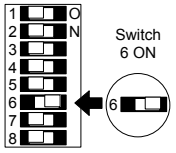
Input/Output Values Compared to Process Data

The Expansion Unit processes analog channels using fixed conversion values for both current and voltage mode operation. The table below shows the relationship between the analog input and output values used by the application program, and the actual analog input or output for each mode. These values include the automatic adjustments for gain.

In this Configured Mode:	This is the Analog Signal Range	This is the Equivalent Process Data %AI or %AQ Range	For the Default Calibration, the Value in the %AI or %AQ Reference Equals:
Voltage 0 to +10V	0 to 10,000mV	0 to 32000	3.2 x mV
Voltage –10 to +10V (Inputs Only)	-10,000mv to +10,0000mV	-32000 to 32000	3.2 x mV
Current 0 to 20mA	0 to 20,000µA	0 to 32000	1.6 x µA
Current 4 to 20mA	4,000 to 20,000µA	0 to 32000	2 x µA –8000

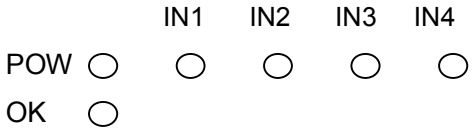
Count Resolution for Analog Expansion Units

For analog expansion units, count resolution is controlled by a dip switch setting on the module. Switch 6 should be set to ON by default. If unexpected results are observed, check the position of switch 6. If switch 6 is not ON, power down the system and set switch 6 to ON. Do NOT change any of the other switches.



LED Indications

The module's LEDs indicate the status of the module and of the analog inputs.

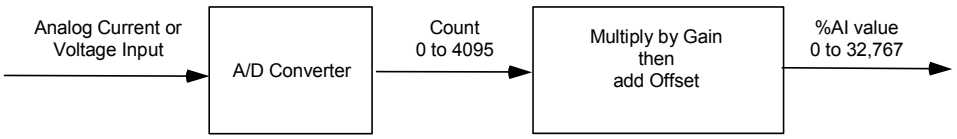


If an initialization error occurs, the OK LED blinks rapidly. During normal operation, the analog input LEDs should be off.

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Analog Input Processing

The Expansion Unit processes analog input channels with a 12-bit successive-approximation A/D converter. It converts the analog value into a digital count, calculates the %AI value as described below, then places the result into the appropriate %AI input reference (these references are described in chapter 21).



Automatic Conversion of Analog Voltage or Current to Counts

In voltage mode, the Expansion Unit first converts the 0 to 10,000mV input signal to a count in the range of 0 to 4,000 (or –10,000mV to 10,000mV signal to a range of –4,000 to 4,000). The fixed multiplier for this conversion is 2.5.

In current mode, the Expansion Unit first converts the 0 to 20,000µA input signal to a count value in the range of 0 to 4,000. The fixed multiplier for this conversion is 5. The conversion for both current modes (0-20mA and 4-20mA) is the same.

Automatic Gain and Offset Adjustment for Analog Inputs

The Expansion Unit then converts the A/D converter's input count value from the range of 0 to 4000 to a final %AI input value in the range of 0 to 32,000. It multiplies the count value by 8 (32000 / 4000) to get the final analog input ($AI):

(input count X 8) = %AI value

Any calculated value above 32,767 is clamped at that maximum value. Any calculated value less than 0 is clamped at 0.

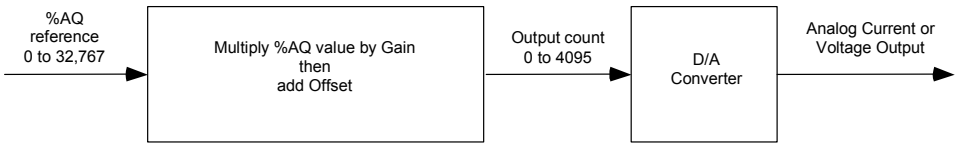
Analog Input Conversion Summary

The table below summarizes the conversion of voltage or current inputs to counts and then to %AI values.

Input Signal	Conversion Factor	A/D Converter VAlue	Gain Factor	%AI Range
Voltage Mode (0 to 10,000mV)	2.5	0–4000 counts	8	0–32,000
Voltage Mode (-10,000 to 10,000mV)	2.5	-4000 to 4000 counts	8	-32,000 to 32,000
Current Mode (0–20mA) or (4–20mA)	5	0–4000 counts	8	0–32,000

Analog Output Processing

To generate the analog output signal, the Expansion Unit converts the value in the %AQ output reference into a count value for the 12-bit D/A converter, which then drives the analog output.



Automatic Gain and Offset Adjustment for Analog Outputs

The application's %AQ output range of 0 to 32000 corresponds to the D/A converter's output count range of 0 to 4000. The Expansion Unit first multiplies the %AQ value from the program by .125 (4000 / 32000) to produce the count value for the D/A converter:

(%AQ X .125) = D/A count

Any calculated value that exceeds 4095 (2^{12}-1) is clamped at that maximum value. Any calculated value less than 0 is clamped at 0. The range 0 to 4095 corresponds to %AQ values between 0 and 32,767.

Automatic Conversion of Counts to Analog Voltage or Current

In voltage mode, the D/A converter then converts the count value in the range of 0 to 4,000 counts to an analog signal from 0 to 10,000mV. The output voltage gain (ratio) for this conversion is 2.5.

In current mode, the D/A converter converts the count value to an analog signal from 0 to 20,000µA. The output current gain for this conversion is 5. The conversion for both current modes (0-20mA and 4-20mA) is the same.

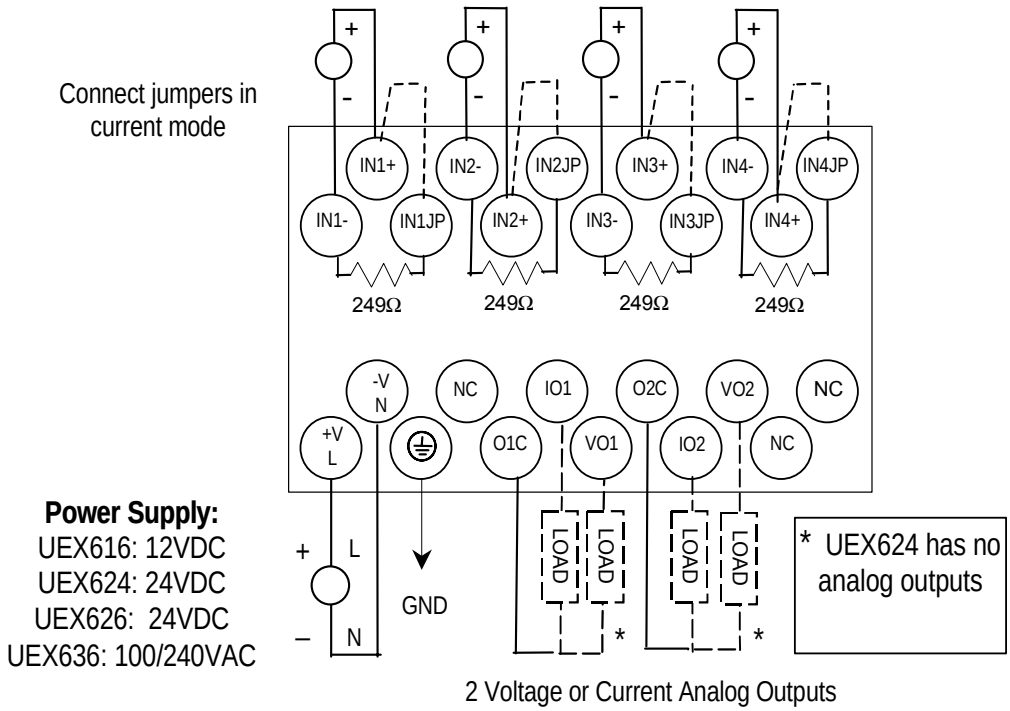
Analog Output Data Conversion Summary

The table below summarizes the conversion of %AQ values to counts and then to voltage or current levels.

%AQ Range	Gain, Factor	D/A Converter Range	Conversion Factor	Output Signal
0– 32,000	0.125	0–4,000 counts	2.5	Voltage Mode (0–10,000mV)
0–32,000	0.125	0–4,000 counts	5	Current Mode (0–20mA) or (4–20mA)

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Wiring Diagram



On modules IC200UEX616, UEX626 and UEX 636, voltage and current outputs are present on their respective output terminals at the same time. For proper module operation, only the output terminals that correspond to the voltage / current output configuration should be connected.

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