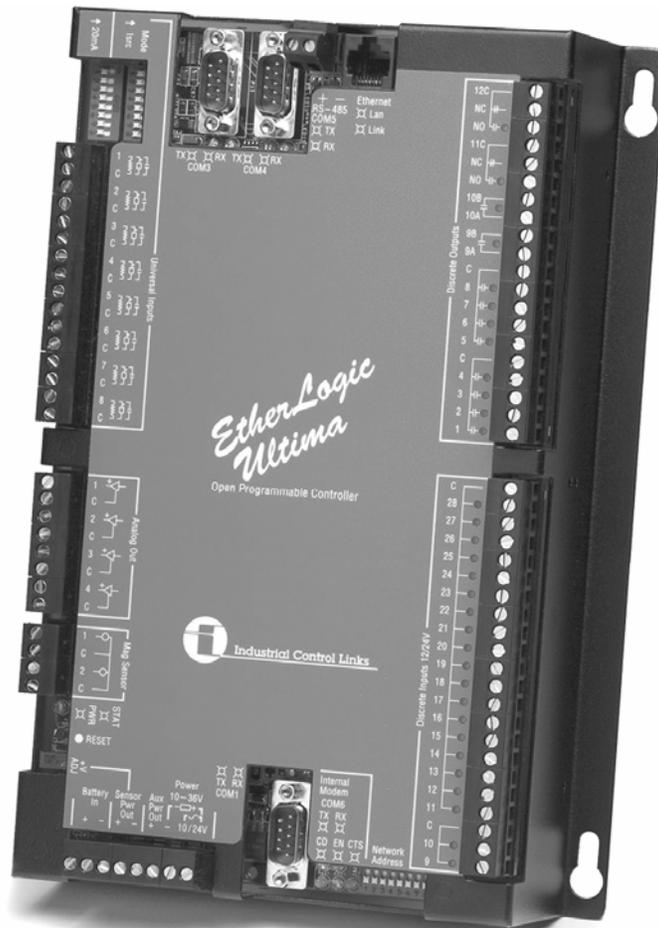


EtherLogic Ultima

Ethernet Programmable Controller

- ◆ Internal I/O:
 - 8 Universal (Analog/Sensor/Discrete) Inputs
 - 4 Analog Outputs
 - 20 Discrete Inputs (2 high-speed)
 - 12 Discrete (relay) Outputs
 - 2 Low-level high-speed Pulse Inputs (Magnetic Pickup)
- ◆ High Speed Ethernet,
- ◆ 4 Serial Ports plus Internal Radio/Telephone Modem/RS-232 & RS-485 Port Option
- ◆ Built-in battery backup charger/controller
- ◆ IEC 61131-3 Programming
- ◆ 32-bit Integer, 64-bit Floating Point Math
- ◆ Built-in HMI/MMIs. text and graphical, serial or Ethernet
- ◆ PID Control
- ◆ Web Server
- ◆ Data Logging
- ◆ Data Concentration
- ◆ Alarm Logging and Paging
- ◆ Alarm Dialing with Voice
- ◆ Remote Program Updates
- ◆ Email with File Attachments
- ◆ Programmable Power Management
- ◆ -40°C to +75°C Operating Temperature Range
- ◆ Modular I/O Expansion to 8000 points over 5,000ft.
- ◆ 3-year factory warranty



Etherlogic Ultima

Technical Reference Manual

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Acknowledgments

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In This Manual...

This manual provides the technical hardware information required for system design and installation of an EtherLogic Ultima controller.

If you have just purchased an Ultima controller, we hope that you are as pleased using it as we have been developing it.

If you are reading this manual looking at a future purchase, we hope that you will consider an EtherLogic when you have an application that needs a rugged controller that goes beyond simple relay logic replacement.

Support

If you have questions or need help with an application, we hope that you'll take advantage of our free technical support. Simply call us at:

(800) 888-1893

If you need to send us a fax, use either:

(530) 888-1300 or (530) 888-7017

If you prefer e-mail (we do), especially if you want to send us a sample of a program or other files, you can e-mail us at:

support@iclinks.com

For additional technical information including datasheets, manuals and software, visit our web site at:

www.iclinks.com

Certifications

EtherLogic Controllers are tested to the following certifications:

North America:



UL 508, CSA 142, ANSI/ISA-12.12.01-2000: April, CSA-C22.2 NO. 213-MI987 (R 1999); Class I Division 2 Groups A, B, C, and D: by INTERTEK.

European Union:



EN 60079-15: Sept 2003 ATEX Group II Category 3 Gas Vapor or Mist Explosion protection

Protection Type nA: In normal and some abnormal conditions, the equipment is not capable of igniting an explosive gas atmosphere.

All certified Etherlogic models come with the following compliance marking tag

ATEX Explosion protection Group II Category 3, Gas Vapor or mist (not suitable for incendiary dust environments)

"X" Device must be installed within an IP56, IP54, Nema 4, or Nema 4x enclosure. External surge suppression must be installed externally to limit input voltage to 140% of operating voltages.

CE Certification Marking

Class 1 Div 2 Compliance

Class 1 Div 2 Warning

ATEX Warning

CE

Ex II 3 G

EEx nA T4 X

Tamb -40°C to 75°C

"T4" Rating to 135°C Maximum Surface Temperature

Ambient Operating Temperature

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2;

WARNING - DO NOT REMOVE OR REPLACE ANY CONNECTORS OR FUSES OR OPERATE DIP SWITCHES WHILE CIRCUITS ARE LIVE UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRATIONS OF FLAMMABLE GASSES OR VAPORS.

AVERTISSEMENT - RISQUE D'EXPLOSION - COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX AVANT DE REPLACER LE COMPOSANTS

Contents

EtherLogic Ultima	1
In This Manual.....	3
Support.....	3
Certifications	5
North America:	5
European Union:	5
Contents	6
Etherlogic Ultima Overview.....	9
Introduction.....	9
Networking	9
Serial Communications.....	9
ScadaWorks IEC 61131-3 Programmable Logic.....	9
Internal I/O & I/O Processor.....	10
Internal Spread Spectrum Radio Option.....	10
Cellular Modem Option.....	10
Internal 56K baud Telephone Modem Option.....	10
EtherLogic Ultima Controller Architecture.....	11
I/O Processor.....	11
Main CPU	11
EtherLogic Ultima Controller - Front	13
Etherlogic Ultima Controller – Rear.....	16
Etherlogic Ultima Controller – Options	17
Status LED Indicators	18
POWER Status LED	18
CPU Status LED	18
Reset Pushbutton.....	18
Network Address/Option Switches.....	18
Installation	19
Mechanical Installation	19
North America:	19
European Union:	19
Electrical Installation.....	20
Class 1 Division 2 Group A, B, C, and D Requirements.....	20
Grounding	21
EtherLogic Ultima Analog & Discrete I/O	22
Universal Inputs	22
Signal Types and Levels	23
RAW Mode.....	23
5Vdc Mode.....	24
20mA Mode	24
Resistance Type Sensors.....	25
Resistance Mode	25

Thermistor Modes	25
RTD Mode	26
Millivolt Mode	28
Thermocouple Modes	28
Contact Closure and Logic Level Discrete Inputs	29
Field Wiring	31
Internal Analog Inputs	31
Input_Voltage	32
Battery_Voltage	32
Sensor_Pwr	32
Cold_Junct_Temp	32
Discrete Inputs	32
Signal Types and Levels	33
I/O Processor Functions	33
Pulse Totalization	33
Rate Calculation	34
Quadrature	34
Field Wiring - 12/24V Ultima Controllers	35
Field Wiring - 120V/240V Ultima Controllers	36
Internal Discrete Inputs	36
Power_Fail	37
Battery_Voltage	37
Sensor_Overload	37
Discrete Outputs	37
Field Wiring	37
Internal Discrete Outputs	39
Sensor_Pwr_Dsbl	39
Modem_Pwr_Dsbl	39
Status-Led_Dsbl	40
Analog Outputs	40
Signal Types and Levels	40
Output Scaling	41
Field Wiring	41
High-speed Pulse Inputs	41
Signal Types and Levels	42
Pulse Totalization & Rate Calculation	43
Field Wiring	43
Ethernet	43
Serial Communications	45
Serial Communications	46
RS-232 Serial Communications Interfaces	46
RS-485 Serial Communications Interface	47
Power	47
Powering the Controller	48
AC Power Wiring	48
DC Power Wiring	49

Etherlogic Ultima

Auxiliary DC Output Power Wiring	49
Battery Power Wiring	50
Sensor Power Output Wiring and Level Setting.....	50
Maintenance	52
Clock/Calendar/NV RAM Battery.....	52
Time & Date	53
Calibration.....	53
Software and Firmware Updates.....	53
Internal Telephone Modem Option.....	53
Internal Spread Spectrum Radio Option	54
Radio Installation	55
Radio Configuration.....	56
Radio Configuration - MAIN MENU.....	56
Radio Configuration - SET OPERATION MODE.....	57
Radio Configuration - SET BAUD RATE	58
Radio Configuration - EDIT RADIO PARAMETERS.....	59
Radio Configuration - SHOW RADIO STATISTICS.....	60
Radio Configuration - EDIT MULTIPOINT PARAMETERS	61
Internal Extra RS-232/RS-485 Port Option	62
Specifications	63
UNIVERSAL INPUTS	63
ANALOG OUTPUTS.....	64
DISCRETE INPUTS	64
LOW-LEVEL PULSE INPUTS	64
DISCRETE OUTPUTS	64
COMMUNICATIONS	65
COMMUNICATIONS OPTIONS (one only per controller)	65
CONTROL & COMMUNICATIONS PROCESSOR.....	65
GENERAL SPECIFICATIONS	65
SOFTWARE	66

Etherlogic Ultima Overview

Introduction

EtherLogic Ultima is a programmable controller, and much more.

EtherLogic Ultima combines the programmability of a Programmable Logic Controller (PLC), the communications capabilities of an advanced Remote Terminal Unit (RTU), the alarm notification capabilities of an alarm dialer, the data storage and retrieval capabilities of a Data Logger, and the power monitoring and protection facilities of an Uninterruptible Power Supply (UPS). By taking advantage of the capabilities of four separate instruments and a UPS, EtherLogic Ultima increases reliability while reducing configuration and programming time, cost and headaches.

Networking

EtherLogic Ultima comes with a built-in Ethernet Port with support for the standard Ethernet and Internet protocols for file transfer, e-mail, web serving and terminal access as well as standard industrial Ethernet compatible protocols such as Modbus TCP/IP. The built-in Ethernet capability is compatible with the latest generation of Wireless Ethernet modems including 802.11 type devices and GSM, GPRS and CDMA cellular systems.

EtherLogic Ultima comes with an RS-485 compatible serial communications port for low-cost 2-wire networking. RS-485 is used for I/O expansion as well as interfacing to intelligent industrial devices including loop controllers, variable speed drives and other PLCs/RTUs.

Serial Communications

In addition to the RS-485 port, EtherLogic Ultima has 3 RS-232 serial ports plus an internal port for a 56K baud telephone modem, a 900MHz or 2.4GHz spread spectrum radio, a cellular modem, or another RS-232/RS-485 port. When outfitted with a telephone modem, the Ultima Controller supports alarm dial-out and remote dial-in with voice alarm annunciation and touchtone/voice access to internal register setpoints, process variables and I/O control.

ScadaWorks IEC 61131-3 Programmable Logic

ScadaWorks is the software used to program Ultima controllers. It combines ISaGRAF IEC 61131-3 standard programming tools with ICLs ScadaBuilder software for communications, networking, alarm annunciation and data logging. Together they form the ScadaWorks Programming Suite.

IEC 61131-3 is the international open systems standard for industrial control programming, incorporating 6 different languages including ladder logic. Every EtherLogic Ultima controller includes an ISaGRAF runtime license.

Etherlogic Ultima

Closely integrated with the ISaGRAF IEC 61131-3 software is ScadaBuilder, ICL's Windows based software for configuring all of the non-logic operating features of the EtherLogic Ultima controller. ScadaBuilder makes it easy to setup Ethernet, Internet and serial networking and communications with multiple protocols on individual ports, configuring alarm handling and annunciation including voice and setting up multiple simultaneous data and alarm logs along with a choice of three different types of HMIs.

By combining IEC 61131-3 control with communications, alarming and data logging, common resources such as tag names are shared, significantly reducing the time required to build a SCADA system.

Internal I/O & I/O Processor

The EtherLogic Ultima controller has a rich compliment of built-in analog and discrete I/O:

- ◆ 8 16-bit Universal Inputs (5Vdc, 20mA, +/- 300mV, 10K thermistor, 10, 100 and 1000 ohm RTDs, ohms, J, K, T, E, R, S, B and N thermocouple, and contact closure)
- ◆ 3 20mA Analog Outputs
- ◆ 16 Discrete Inputs (including 2 very high-speed high-level pulse inputs)
- ◆ 12 10 amp Relay Outputs
- ◆ 2 Low-level high-speed Pulse Inputs (Magnetic Pickup)

A dedicated I/O microprocessor relieves the main CPU of performing real-time I/O tasks, including signal filtering and conditioning, sensor compensation and linearization, and totalization and rate computation.

Internal Spread Spectrum Radio Option

The EtherLogic Ultima controller is available with an internal 900MHz or 2.4GHz Spread Spectrum radio. Three brands of 900MHz radios are available, offering a choice of price and performance.

Cellular Modem Option

The cellular telephone network provides a convenient means of connecting an Ultima controller to the internet in remote locations. Ultima offers both GSM/GPRS and CDMA modems, compatible with all major carriers.

Internal 56K baud Telephone Modem Option

The EtherLogic Ultima controller is available with a high-speed telephone modem built onto the motherboard. With the telephone modem option installed, the controller can dial out to annunciate alarms, initiate numeric or alphanumeric pages, perform remote FTP file transfers, and send e-mails. Likewise, the controller can be dialed into to access register data and process variables, exchange files as well as download data logs and upload program revisions. A 2nd internal telephone modem with the same capabilities can be installed for in the internal modem/radio slot.

EtherLogic Ultima Controller Architecture

The EtherLogic Ultima controller has dual CPUs:

- ◆ an 8-bit Reduced Instruction Set CPU (RISC) for I/O processing
- ◆ a powerful 32-bit 386EX processor for communications and logic processing

The two processors communicate with each other using an internal communications link.

I/O Processor

The I/O processor is pre-programmed to continually scan the eight universal input points, and based upon settings in configuration and calibration registers, interprets the analog values as voltage (5Vdc or +/-300mV), current, temperature (J, K, T, E, R, S thermocouples, 1000 ohm RTDs and 10,000 ohm thermistors), resistance (up to 65,000 ohms), or contact closure.

Likewise, the twenty discrete inputs are scanned and their states stored for use by a controller program. Eight of the discrete inputs are totalized by the I/O processor. Two of these discrete inputs have software configurable filtering, that when minimized, allows the inputs to support very high speed counting and rate computation. Typical uses for these high-speed inputs include totalizing flow and indicating flow rate for a turbine flow meter, or measuring machinery operating speeds.

The I/O processor also monitors registers that contain analog and discrete output values and periodically refreshes the eight discrete outputs and three analog outputs.

Like the two high-speed discrete inputs, the I/O processor also supports two high-speed low-level pulse inputs typically for use with magnetic pickup type sensors. These inputs support both totalization and rate computation.

The Main CPU reads and writes the I/O processor registers over an internal high-speed communications link. The I/O information that the Main CPU reads is always filtered, linearized and calibrated (using factory stored calibration values in nonvolatile memory) so that the Main CPU needs to perform little or no additional processing except for optionally scaling analog values to “engineering units”.

A watchdog timer in the I/O CPU continually monitors the communications activity between the I/O CPU and the Main CPU. If the Main CPU stops “talking” to the I/O CPU for a preset time period, all of the discrete and analog outputs are automatically turned OFF for “fail-safe” operation. This feature can be disabled if desired.

Main CPU

The Main CPU has a total of five serial ports available to the user; three external RS-232 ports and one external RS-485 port, and an internal modem/radio port. RS-232 connections are standard for most serial communications devices, but are limited to short (<100 ft.) cable runs.

EtherLogic Ultima

RS-485 supports networking of up to 256 parallel devices over a distance of up to 5,000ft. (the EtherLogic Ultima Controller has a special interface design that extends the normal 32 device limit of the RS-485 standard to 256 devices).

The EtherLogic Ultima Controller has a built-in 10Mb/s twisted pair Ethernet port. The Ethernet Port provides high speed communications and is recommended for linking controllers with each other as well as with other system components such as PCs or the Internet.

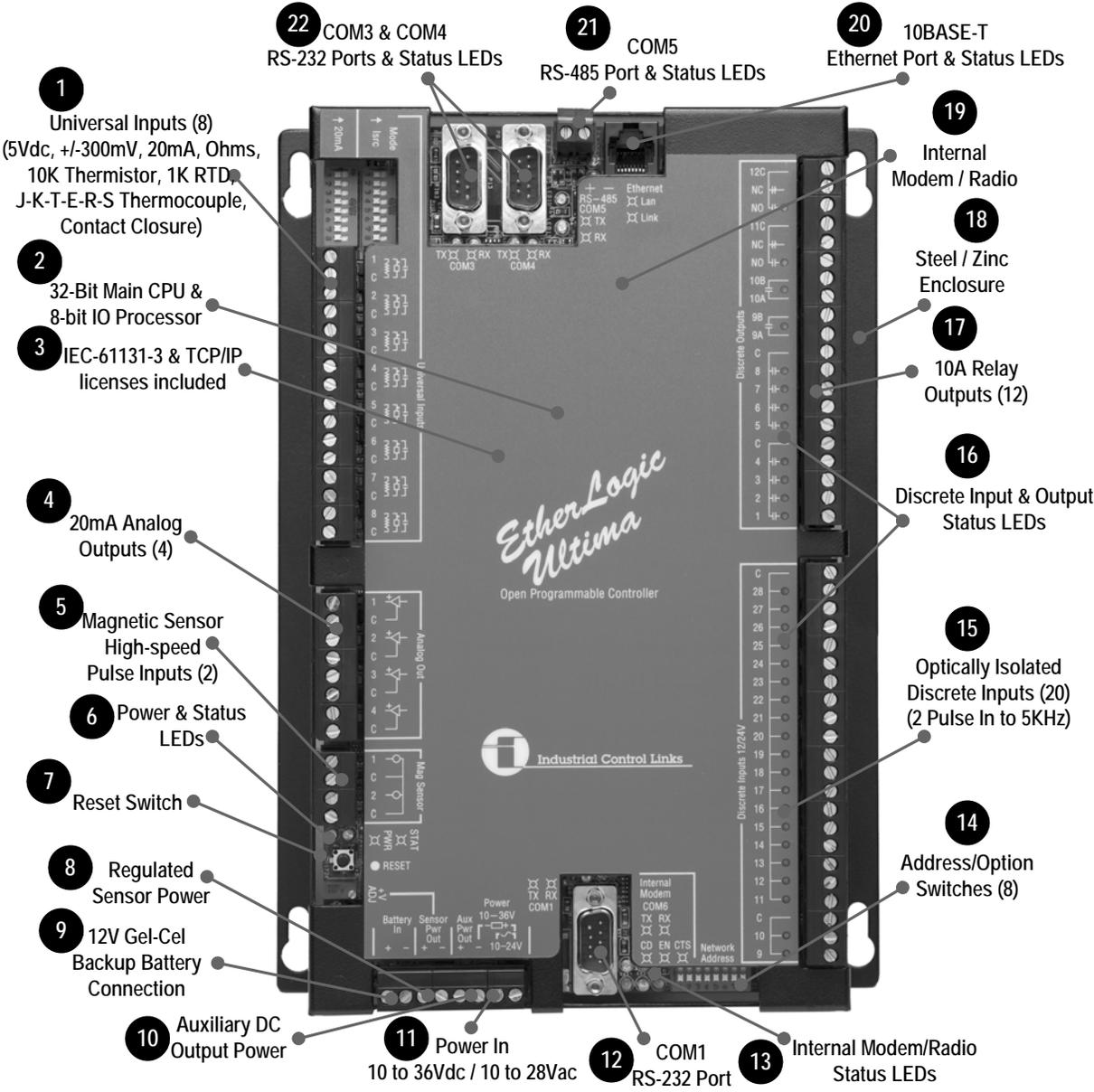
EtherLogic Ultima controllers are like desktop PC computers in many ways:

- they use an Intel x86 computer chip.
- they store programs in nonvolatile “disk” memory (solid state flash memory in EtherLogic Ultima controllers).
- they run programs in RAM memory loaded from the “disk”.
- they have a battery-backed real time clock for data and alarm log time-stamping and real-time based control.
- they can run multiple programs or “threads” simultaneously.
- they communicate easily with other computers over networks and a variety of physical mediums including twisted pair wiring, radios and telephone lines.

EtherLogic Ultima controllers differ from desktop PCs in that they have:

- no moving parts. For example, their “disk” is solid-state Flash memory.
- very wide operating temperature range; -40oC to +75oC (-40oF to 167oF).
- no display, keyboard or mouse is required. They’re designed for both stand-alone operation as well as remote control operation over a network.
- they have specially designed software to simplify and speed the development of industrial control applications, alarming and data logging applications.
- very wide operating temperature range; -40°C to +75°C (-40°F to 167°F).
- no display, keyboard or mouse is required. They’re designed for both stand-alone operation as well as remote control operation over a network.
- they have specially designed software to simplify and speed the development of industrial control applications, alarming and data logging applications.
- they come with a 3-year warranty.

EtherLogic Ultima Controller - Front



- 1 Universal Inputs**
 Eight (8) combination analog and discrete inputs - accepts 5Vdc, +/-300mV, 20mA, resistance (ohms), 10K thermistor, 1K RTD, J-K-T-E-R-S thermocouples, and contact closure sensor inputs.
- 2 32-bit Main CPU and 8-bit I/O processor**

Etherlogic Ultima

Powerful 32-bit Logic and Communications processor with floating point math, 8MB flash disk, 1MB RAM and Real Time Clock, and a dedicated 8-bit I/O processor for high-speed counting, signal conditioning & linearization.

- 3 IEC 61131-3 and TCP/IP licenses included**
Includes IEC61131-3 programming and TCP/IP (Ethernet & Internet access) licenses - no hidden software license fees
 - 4 20mA Analog Outputs**
Four (4) 20mA Analog Outputs for variable speed drives, dampers, positioners, etc. Frequently used for PID control.
 - 5 High-speed pulse/ Magnetic Sensor inputs**
Use low-cost flow sensors and tachometers without the cost of conditioning modules or transmitters
 - 6 Power and Status LEDs**
Power and Status LEDs - local status indication of CPU running and battery/power status
 - 7 Reset Switch**
Same functionality as "power-on" reset
 - 8 Sensor DC Power - Regulated and Program Controlled**
7 to 32Vdc analog loop/sensor power, program controlled for energy savings. Output is independent of the input voltage.
 - 9 Battery Backup - Charger and Battery Management**
A built-in UPS. Just hook up a 12V gel-cel battery! Microprocessor controlled charging and battery monitoring.
 - 10 Auxiliary DC Power**
Power your other equipment (such as an external radio), up to 3 amps, complete with battery backup.
 - 11 Power - 8 to 36Vdc, 10 to 24 Vac**
Very wide range of AC or DC power - starting at less than a watt (depending on power saver configuration and options).
 - 12 COM1 RS-232 Serial Port**
Primary "console" port for diagnostics and local operator interface.
 - 13 Internal Modem/Radio Status LEDs**
Communications status indicators for the optional internal modem or radio.
 - 14 Address/Options Switches**
8 "DIP" switches that the software can use as a Node Address, lower portion of an IP address or to select program options.
 - 15 20 Optically Isolated Discrete Inputs**
20 discrete inputs, 8 with 40Hz counting, 2 with 40Hz / 5KHz counting (software configurable) independent of program scan.
- Error! Objects cannot be created from editing field codes. **Discrete I/O Status LEDs**
Bright status indicators, right next to their respective wiring terminals. Program controllable for power savings.
- 17 10A Relay Outputs (3A for NC contacts)**
10 Form A and 2 Form C sets of relay contacts w/built-in snubbers - no interposing relays required.
 - 18 Powder-coated Steel/Zinc Enclosure**
Sturdy zinc impregnated steel enclosure, powder coated for super tough protection.

19

Internal Modem or Radio (3rd serial port)

Internal spread spectrum radio, cellular modem, 56K telephone modem, or an extra internal serial port. Telephone modem includes voice alarming and touchtone control support as well as PPP/SLIP remote serial Ethernet/Internet access.

20

10BASE-T Ethernet Port and Status LEDs

10Mb/s Ethernet Port with standard RJ-45 connector. LEDs show connection status (LINK) and data activity (LAN).

21

COM5 RS-485 Serial Port and Status LEDs

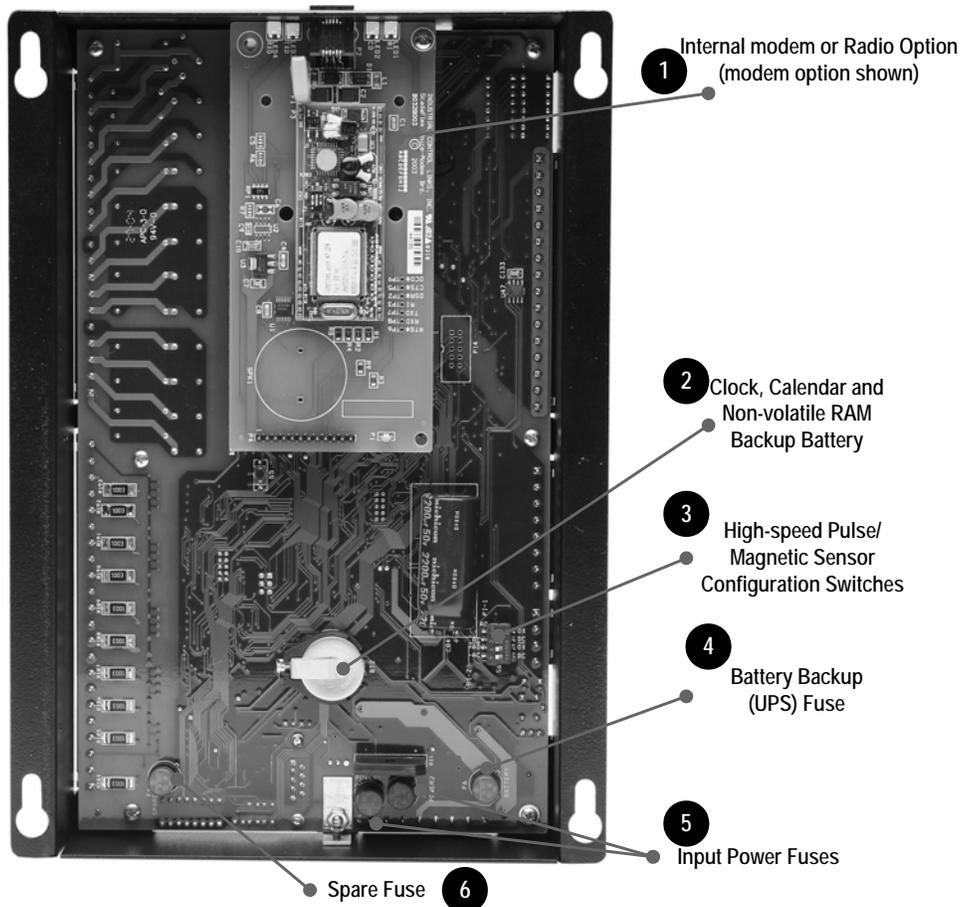
Low-cost RS-485 networking to 5000ft. for I/O expansion and direct digital interface to VFDs, loop controllers and PLCs.

22

COM3 and COM4 RS-232 Ports and Status LEDs

Connectivity to radios, modems, operator interfaces, GPS receivers and PC computers.

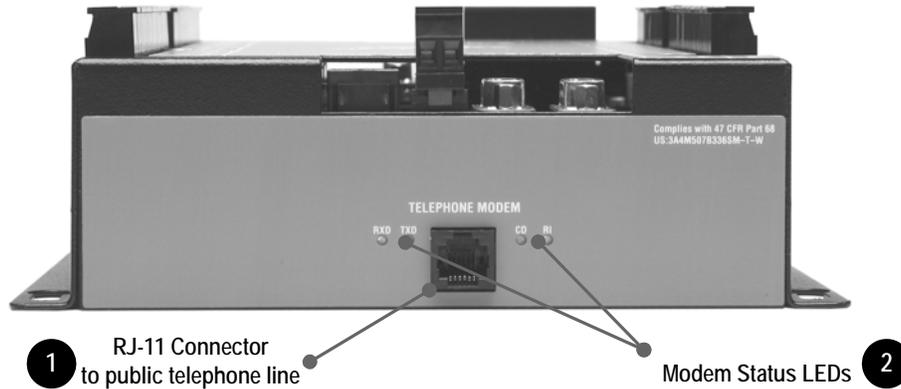
Etherlogic Ultima Controller – Rear



- 1** **Internal Modem or Radio Option**
The Ultima controller can have a built-in telephone modem or radio installed here. Saves cost and panel space.
- 2** **Removable Lithium backup Battery**
Provides backup power for internal clock, calendar and high-speed non-volatile register memory.
- 3** **High-speed pulse / Magnetic Pickup Configuration Switches**
Selects coupling and thresholding modes for both low-level high-speed pulse inputs.
- 4** **Battery Backup (UPS) Fuse**
5A fuse to protect battery and charger circuits that make up controllers built-in DC backup power supply.
- 5** **Input Power Fuses**
5A fuses to protect both main power inputs (2 redundant DC power inputs or both sides of AC power input).
- 6** **Spare Fuse**
Spare fuse, in case you're caught out in the field without one.

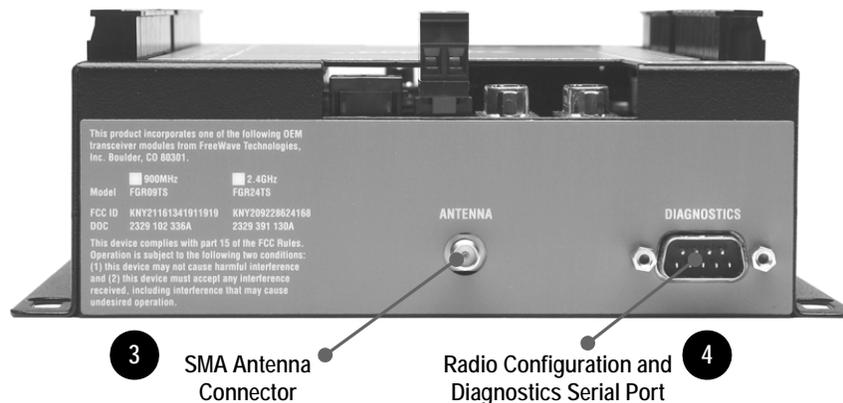
Etherlogic Ultima Controller – Options

(optional telephone modem and spread spectrum radios)



- 1 Telephone Modem Option: RJ-11 Connector to Public Telephone Line
Standard interface connector to a “normal” public telephone line.
- 2 Telephone Modem Option: Modem Status LEDs
LED indicators that show the current state of the Transmit & Receiver Data, Carrier Detect, and Ring Indicator signals.

Etherlogic Ultima Controller with optional Freewave Spread Spectrum Radio installed



- 3 Freewave Spread Spectrum Radio Option: SMA Antenna Connector
Standard SMA antenna connector for 900MHz (all) and 2.4GHz (military and non-US, Reverse SMA for 2.4 GHz in the USA).
- 4 Freewave Spread Spectrum Radio Option: Configuration and Diagnostics Connector
Second RS-232 port for configuration of Freewave Spread Spectrum radio as well as on-line diagnostics.

Status LED Indicators

EtherLogic Ultima controllers have two LED status indicators located near the reset switch.

POWER Status LED

The indicator labeled “POWER” is a bicolor (Red/Green) LED that indicates the current power state of the controller as follows:

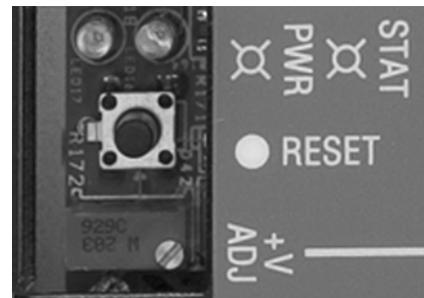
LED Status	Power Status	Battery Status
SOLID GREEN	Input power OK	battery charged
FLASHING GREEN	Input power OK	battery low (< 12.0V) or disconnected
SOLID RED	Input power failed	running on battery battery OK (> 10.5V)
FLASHING RED	Input power failed	running on battery battery low (< 10.5V)
OFF	Controller powered OFF	

CPU Status LED

The indicator labeled “STATUS” is a Green LED that flashes approximately twice a second when an ISaGRAF program is running. The LED can also be configured to operate under the control of a user’s program.

Reset Pushbutton

Pressing the “Reset” pushbutton is equivalent to powering the controller OFF and then ON. This will cause the controller to re-initialize and restart its operating program.



Network Address/Option Switches

EtherLogic Ultima controllers have a bank of 8 “DIP” switches that can be read by a user program. These switches can be used to set a network address in the field without requiring a laptop computer. Depending on how they are configured, the switches can represent a 1 in 256 address directly, such as for a Modbus Slave, or they can represent the lower “octet” of a TCP/IP Ethernet address. If the switches are not used for addressing, they may be used to select runtime options in a users program.

Additional information on using these switches is contained in the ScadaWorks/ScadaBuilder manual and Help files.

Installation

Mechanical Installation

EtherLogic controllers are designed to be installed in a protective enclosure with the appropriate NEMA rating for the environment that the controller will be used. Typical NEMA ratings are as follows:

North America:

Indoor applications only: NEMA 1 Indoor or Outdoor applications: NEMA 4, 4X or 12 rated enclosures.

European Union:

Must be installed inside IP54 or IP56 rated enclosures.

Transient suppression must be supplied externally for each active signal for the following circuits:

<i>Signal(s)</i>	<i>Maximum Operating Voltage</i>	<i>140% Transient Suppression Level.</i>	<i>Circuit Connection</i>
Digital Inputs 5 through 12 120 VAC RMS/DC	300V	420VAC RMS or 420VDC	DI to DI Common
Digital Inputs 5 through 12 12/24V AC DC	50V	70VAC RMS or 70VDC	DI to DI Common
Pulse Inputs	108 Vpp	152Vpp	PI to PI Common
RS 232 Signals (DTR, CD, RTS, CTS, RX, and TX) *	+/-12VDC	+/- 16.8VDC	Signal to RS 232 Common

** Different RS-232 ports support different signal configurations. Some signals may not be available on some ports and therefore do not need transient protection. Refer to the RS-232 pin out table later in this document for details.*

The enclosure material must be a minimum of 1.14mm (0.045”) thick. Typically, the controller is mounted vertically in such an enclosure on a steel backplate. If an alternative mounting scheme is used, it is recommended that the controller be mounted on a noncombustible surface.

External surge suppression must be installed to limit all operating voltages to within 140% of signal voltage. This includes all RS-232 signals, Digital Input, and Pulse Input terminals.

CAUTION: If the controller is mounted on or above a combustible surface (such as a wood backboard), a plate of at least 1.43mm (0.056”) galvanized or 1.6mm (0.063”) uncoated steel extending at least 150mm (5.9”) beyond the controller on all sides must be installed.

The controller is designed to be secured to a mounting surface with four #10 screws in a 6.75" x 6.5" rectangular pattern. A scale mounting template is included on the inside of the back cover of this manual.

Electrical Installation

All field wiring connections to and from the EtherLogic controller, except for RS-232 and Ethernet communications are made via removable terminal blocks.

Class 1 Division 2 Group A, B, C, and D Requirements

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C, D OR NON-HAZARDOUS LOCATIONS ONLY.

WARNING - EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2;

AVERTISSEMENT - RISQUE D'EXPLOSION – LA SUBSTITUTION DECOMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMBLEMES DE CLASSE I, DIVISION 2;

WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS;

AVERTISSEMENT - RISQUE D'EXPLOSION - AVANT DE DÉCONNECTER L'EQUIPEMENT, COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX.

WARNING - EXPLOSION HAZARD – BATTERIES MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NON-HAZARDOUS.

AVERTISSEMENT- RISQUE D'EXPLOSION –AFIN D'ÉVITER TOUT RISQUE D'EXPLOSION, S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX AVANT DE CHANGER LA BATTERIE.

WARNING - DO NOT REMOVE OR REPLACE ANY CONNECTORS OR FUSES OR OPERATE DIP SWITCHES WHILE CIRCUITS ARE LIVE UNLESS THE AREA IS KNOWN TO BE FREE OF IGNITABLE CONCENTRATIONS OF FLAMMABLE GASSES OR VAPORS.

AVERTISSEMENT - RISQUE D'EXPLOSION - COUPER LE COURANT OU S'ASSURER QUE L'EMPLACEMENT EST DÉSIGNÉ NON DANGEREUX AVANT DE REPLACER LE COMPOSANTS

Battery type: Lithium Coin Battery, Renata CR2032

NOTE: The terminal block screws must be tightened to 7 lb-in.

Diagrams in the following sections provide examples for analog and discrete I/O and power wiring. The following wiring guidelines must be followed:

- **Stranded conductors from #14 to #26 AWG, or solid conductors from #12 to #26AWG consisting of either copper or copper-clad aluminum is permitted.**
- **Wires must be rated for 240V, 90°C and suitably current rated.**
- **Wire insulation must be a minimum of 0.9mm (0.031”) thick if subjected to movement, flexing or handling during use or maintenance.**
- **Wires shall be routed away from sharp edges, screw threads, burrs, fins, moving parts, drawers, and the like.**
- **Clamps and guides, if used, shall be provided with smooth, well-rounded edges.**
- **Wiring that is subject to flexing during servicing such as that from a stationary part to a part mounted on a hinged door shall be provided with additional insulation at any point where flexed.**
- **Additional insulation, if used, shall be insulating tubing, or a wrapping of not less than two layers of insulating tape. All must be minimum of 90°C and 240V.**
- **All splices and connections must be mechanically secure and provide electrical continuity**
- **Conductors are also not to be grouped.**

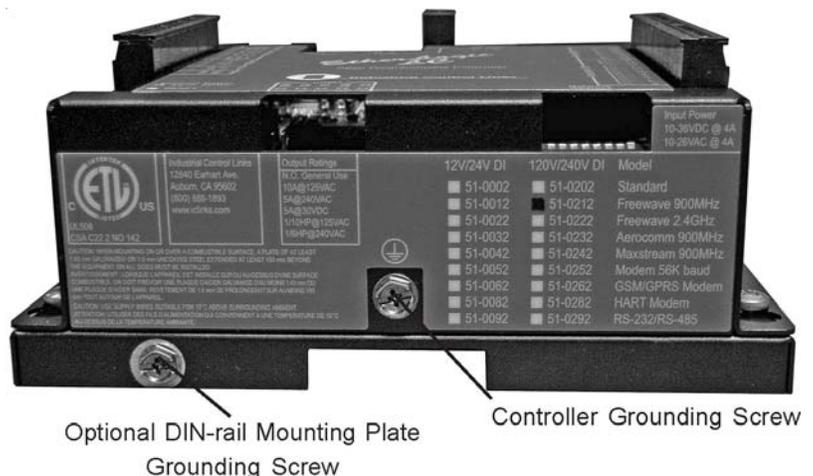
CAUTION: Use supply wires suitable for 15°C above surrounding ambient

ATTENTION: Utiliser des fils d'alimentation qui conviennent a une temperature de 15°C au-dessus de la temperature ambiante.

Grounding

The steel enclosure of the EtherLogic Advanta controller must have a bonding conductor (14AWG or heavier copper wire) that connects the controller case to the enclosure with less than 0.1 ohms of resistance. A green #10 grounding screw is provided on the end of the controller for attaching the bonding conductor.

If a DIN-rail mounting plate (option) is used, that plate must also have a bonding conductor attaching it to the equipment enclosure. A green #10 screw is provided on the mounting plate for this purpose.



EtherLogic Ultima Analog & Discrete I/O

The EtherLogic Ultima controller includes a full compliment of analog and discrete I/O:

- 8 Universal (Analog/Sensor/Discrete) Inputs
- 4 Analog Outputs
- 20 Discrete Inputs (2 include high-speed counting & quadrature support)
- 12 Discrete (relay) Outputs
- 2 Low-level High-Speed Pulse Inputs with magnetic pickup signal conditioning

Universal Inputs handle nearly any type of analog signal or sensor with no external signal conditioners required. Ultima supports standard 20mA and 5Vdc process signals to temperature sensors like thermocouples, thermistors and 2-wire RTDs. The Universal Inputs can also accept contact closure and logic-level discrete input signals.

Analog Outputs provide 20mA current loop control signals, or with a single resistor, 0 to 5 or 0 to 10V voltage control signals.

Discrete Inputs are optically isolated input points for sensing switch and contact closures from on/off sensors. Ultimas are ordered as “12/24V” or “120V” models depending on the signal levels of the Discrete Inputs.

Discrete Outputs provide contact closure signals to operate on/off type control devices. The Ultimas discrete outputs are heavy duty relays with contacts rated to switch up to 10 amps.

High-speed Pulse Inputs accept low-level fast pulse signals, typically from magnetic pickups. Even though some of the Discrete Inputs can also handle high speed pulses, these particular inputs can do so with signals that drop to much lower levels and have no signal conditioning.

I/O Expansion: Additional I/O capacity is supported with a family of expansion modules that connect to the controller via a high-speed 2-wire serial interface. This provides the additional benefit of a distributed I/O system. Wiring cost is reduced by enabling the I/O modules to be placed up to 5,000 feet away from the controller and close to the sensors and control devices, thereby minimizing the distances for field wiring runs.

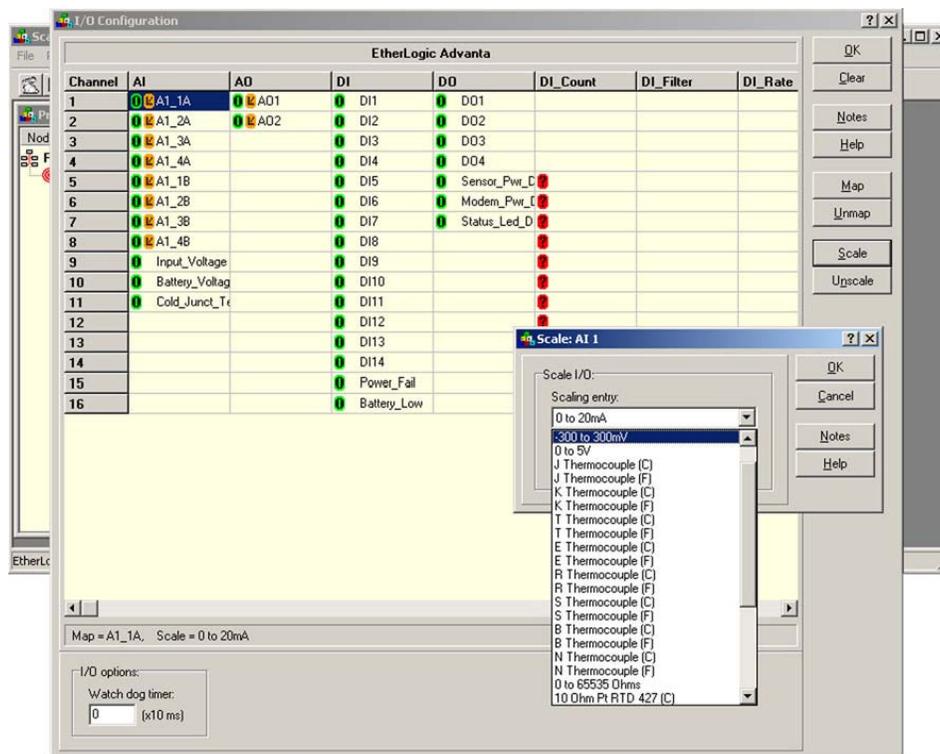
Universal Inputs

The EtherLogic Ultima Controller has eight Universal Inputs. The Universal Inputs accept both analog input and discrete input signals including signals from sensors that monitor levels, flows, temperatures, pressure, etc. as well as discrete input devices such as switches and relays contacts. Built-in signal conditioning eliminates the need for most external signal converters.

Each Universal Input channel has two inputs; one for voltage, millivolt and current sensors, the other for resistance sensors such as thermistors, RTDs and potentiometers. The two inputs may be used independently except for 3-wire RTD sensors which require both inputs for a single sensor.

Signal Types and Levels

The EtherLogic Ultima universal inputs may be configured to accept standard 20mA or 5V process control signals, thermocouples, low-level millivolt sensors, resistive sensors such as thermistors, RTDs and potentiometers, and contact closures. With a pair of external resistors, the inputs can be configured for higher voltages of either polarity (i.e +/-10Vdc). The input mode and sensor type are determined by settings in the I/O Section of the ScadaBuilder software (I/O|Configuration and I/O|Scaling).



The controller's main CPU downloads this information to the I/O processor on start-up so that the I/O processor can set up the input gain and calibration tables for processing analog input conversion data for each channel.

RAW Mode

Raw mode bypasses all scaling and calibration in the I/O processor, providing "raw" 16-bit readings from the A/D converter. A full scale reading of 65535 represents an input of approximately 5Vdc. If the current configuration switches are enabled, the input current can be calculated as the voltage drop read across a precision 121ohm resistor, or just over 40mA for a full scale readings of 65,535. The calculation is:

Etherlogic Ultima

$$\text{A/D Reading} = (65535 * \text{mA} * 121) / 5$$

If the current sources are enabled (for resistance measurements), the RAW readings are the ratiometric values read across the input resistance in series (bottom portion of a voltage divider) with a precision 10,000 ohm 0.1% low-drift resistor connected to the A/D reference. The calculation is:

$$\text{A/D Reading} = 65535 * R / (R + 10,000)$$

where R is the input resistance being measured. For example, a 10,000 resistor will read approximately 32767 counts:

$$65535 * 10,000 / (10,000 + 10,000) = 32767$$

5Vdc Mode

Voltage sensors are connected between the V/I and C terminals of a Universal Input channel.

When configured for voltage measurements, the Ultima controller measures signals from 0 to 5.6 volts (5 volts plus 12% over-range) with a resolution of just over 16-bits. There's no loss of accuracy in this over-range area, so it's possible to accurately read the signal levels from slightly misadjusted sensors that run "a little hot". It's also possible to distinguish between a sensor output that is at full scale versus over-range.

The I/O processor scales and performs calibration correction on the readings, so that a full scale reading of 5.6Vdc is presented to the main CPU as a value of 56000 (10,000 counts per volt). This provides readings that without further scaling, read out directly in 100uV increments (imagine a decimal point 4 places from the right to interpret the readings in volts). The Scaling section of ScadaBuilder can be used to change this scaling to more meaningful engineering units.

20mA Mode

Current loop sensors are connected between the V/I and C terminals of a Universal Input channel. If the devices are not self-powered, an external loop supply will be required.

When configured for milliamp measurements, the Ultima controller measures signals from 0 to just over 40mA (200% over-range for "standard" 20mA signals). The I/O processor scales and performs calibration correction on the readings, so that a full scale reading of 40mA is presented to the main CPU as a value of 40000 (1,000 counts per milliamp). The milliamp mode is typically used to measure the output of 4 to 20mA sensors. The readings from these sensors will come into the Main CPU as 4000 for 4mA and 20,000 for 20mA.

Current is measured by reading the voltage drop across a 121 ohm precision resistor through which the current is flowing. Besides setting the input mode in the ScadaBuilder software, current loops require that the current sense resistors be enabled by setting a DIP switch (labeled 20mA) above the input connector. There is a separate switch for each input.

Resistance Type Sensors

Resistance measurements and resistive type sensors such as thermistors, RTDs and pots require a current source. A separate set of switches next to the current loop switches (labeled “ISrc”) enables the internal current source for each individual input. **Be sure that the current loop switch and the current source switch for a channel are not turned ON at the same time.**

Resistance Mode

Resistance sensors are connected between the R and C terminals of a Universal Input channel.

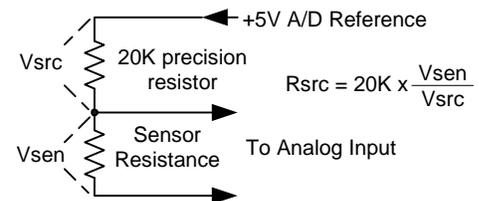
The Ultima controller can measure resistance from 0 to 65,535 ohms. The resolution is 1 ohm below 20,000 ohms and several ohms towards the top of the range. The readings can be scaled by ScadaBuilder from ohms to any set of engineering units. The resistance mode is typically used to read to resistance of potentiometer sensors that indicate position or rotation.

Resistance is measured by sourcing current through a precision 20,000 ohm reference resistor that is in series with the sensor. The I/O processor measures the voltage drop at the junction of the reference resistor and the sensor and compares it to the reference voltage. The I/O processor is then able to ratio metrically calculate the sensor resistance.

Set these switches ON for current loop inputs.



Set these switches ON for resistance, thermistors, RTDs and contact closures.



Thermistor Modes

Thermistors are temperature sensors that are popular for use in HVAC, building monitoring and automotive applications. The resistance of a thermistor varies non-linearly with temperature, so the I/O processor automatically corrects for the non-linearity and provides a calibrated reading in degrees C or F to the controller.

The resistance of a thermistor varies non-linearly with temperature, so the I/O processor automatically corrects for the non-linearity and provides a calibrated reading in degrees C or F to the controller. Ultima controllers support Type II and III 10K ohm thermistors (resistance is 10,000 ohms at 25°C/77°F). The supported temperature ranges and corresponding readings from the I/O processor are:

Sensor Mode	Temperature	From I/O processor
Type II - Deg C	-40.1°C to 203.4°C	-401 to 2034
Type II - Deg F	-40.1°F to 398.1°F	-400 to 3981
Type III - Deg C	-40.1°C to 201.1°C	-401 to 2011
Type III - Deg F	-40.1°F to 393.9°F	-400 to 3939

Deg C	Deg F	10K Type II - ohms	10K Type III - ohms
-40	-40	335,671	239,831
-35	-31	242,195	179,280
-30	-22	176,683	135,233
-25	-13	130,243	102,890
-20	-4	96,974	78,930
-15	5	72,895	61,030
-10	14	55,298	47,549
-5	23	42,314	37,316
0	32	32,650	29,490
5	41	25,395	23,462
10	50	19,903	18,787
15	59	15,714	15,136
20	68	12,493	12,268
25	77	10,000	10,000
30	86	8,056	8,197
35	95	6,530	6,754
40	104	5,324	5,594
45	113	4,366	4,656
50	122	3,601	3,893
55	131	2,985	3,271
60	140	2,487	2,760
65	149	2,082	2,339
70	158	1,751	1,990
75	167	1,480	1,700
80	176	1,256	1,458
85	185	1,070	1,255
90	194	916	1,084
150	302	185	238

Other thermistor types and ranges can be supported by reading the sensor resistance and using an ISaGRAF “CHARCTRZ” block for linearization.

RTD Mode

RTDs are another form of resistance temperature sensor. They are frequently used in HVAC and refrigeration applications. 1000 ohm RTDs are connected between the R and C terminals of a Universal Input channel. 10 and 100 ohm RTDs are connected to all three terminals. Although the relationship between resistance of an RTD and temperature is considerably more linear than thermistors, the I/O processor must still linearize the readings to provide accurate calibrated values to the controller.

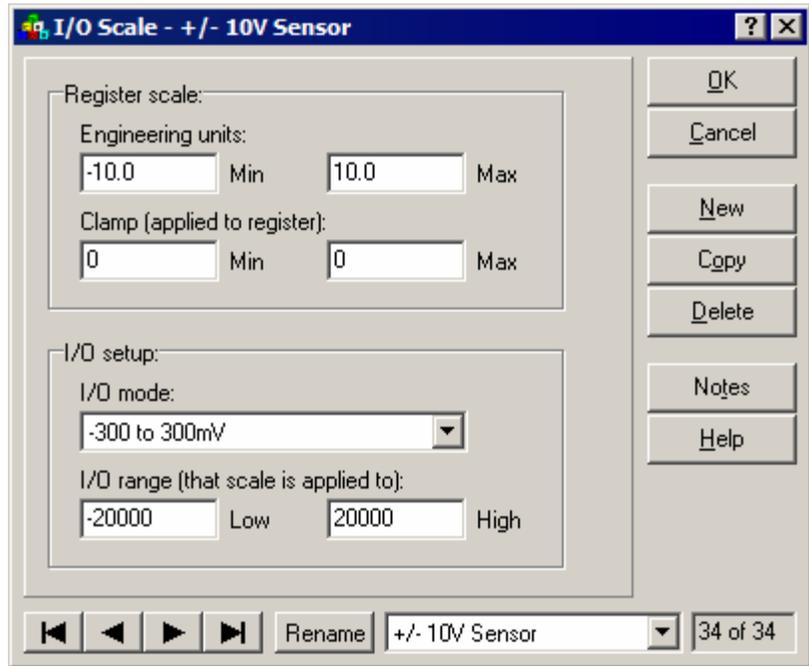
The EtherLogic Ultima controller supports 10 ohm copper and 100 3-wire RTDs, and 1000 ohm 2-wire RTDs. 10 ohm and 100 ohm RTDs use both inputs of a Universal Input channel. The supported temperature ranges and corresponding readings from the I/O processor are:

Sensor Mode	Temperature	From I/O Processor
10 ohm RTD	-190°C to 250°C -310°F to 482°F	-1900 to 2500 -3100 to 4820
100/1000 ohm RTDs	-198.9°C to 869.4°C	-1989 to 8694

Deg C	Deg F	10 ohm RTD	100 ohm RTD	1K ohm RTD
-40	-40	7.490	84.7	847
-30	-22	7.876	88.5	885
-20	-4	8.263	92.2	922
-10	14	8.649	96.1	961
0	32	9.035	100.0	1000
10	50	9.421	103.9	1039
20	68	9.807	107.8	1078
30	86	10.194	111.7	1117
40	104	10.580	115.5	1155
50	122	10.966	119.4	1194
60	140	11.352	123.2	1232
70	158	11.738	127.1	1271
80	176	12.124	130.9	1309
90	194	12.511	134.7	1347
100	212	12.897	138.5	1385
120	248	13.669	146.1	1461
140	284	14.442	153.6	1536
160	320	15.217	161.0	1610
180	356	15.996	168.5	1685
200	392	16.776	175.8	1758
220	428	17.555	180.9	1809
240	464	18.335	188.0	1880
250	482	18.726	191.5	1915

Millivolt Mode

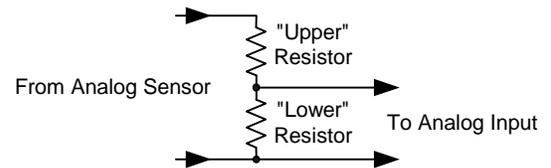
The Ultima controller can accurately measure very small signal levels like those from “bridge” type pressure transducers and low power devices such a solar radiation sensors. In the millivolt mode, the controller has a full scale measurement range of +/- 300mV. The I/O processor scales and performs calibration correction on the low-level readings, so that a full-scale reading of +/- 300mV is presented to the main CPU as a value of +/-30,000 (10,000 counts per 100mV).



Besides reading the output of low-level sensors, this mode is useful for creating custom input voltage ranges using an external resistor voltage divider. Typical custom ranges and their corresponding divider values are listed below (these allow for 150% over-range capacity and >10K ohm load).

Range	“Upper” resistor	“Lower” resistor
+/-1Vdc	8.06K ohm 1%	2.0K ohm 1%
+/-5Vdc	12.1K ohm 1%	499 ohm 1%
+/-10Vdc	24.3K ohm 1%	499 ohm 1%

Using the Scaling section of ScadaBuilder, the +/- 20000 (+/- 200.00mV) readings from the I/O processor can be easily converted to scaled values and/ or engineering units. In this example, the readings are converted to +/-10.000 which would be appropriate for a 10V divider. Note that if the input level exceeds 200mV, the scaled readings will exceed 10.000V unless clamping values are entered.



Changing the “Engineering Units” will cause the sensor readings to be converted linearly to any desired range of integer or real (floating point) values.

Thermocouple Modes

The Ultima Controller directly supports temperature measurements using thermocouple sensors. No external signal conditioners are needed for any combination of type J, K , T , E, R and S thermocouples.

Only use ungrounded type thermocouples (electrically isolated junction).

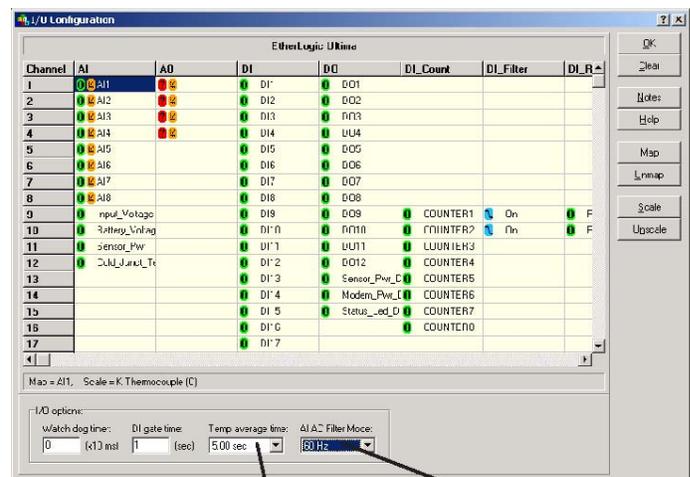
The I/O processor in the Ultima controller automatically performs linearization and cold-junction compensation to the thermocouple readings. The inputs have upscale burnout protection, forcing a maximum temperature reading for an open thermocouple sensor. The supported temperature ranges and corresponding readings from the I/O processor are listed below:

Thermocouple	Temperature Range	From I/O Processor
Type J	Deg C -240.7°C to 1199.0°C	-2407 to 11990
Type J	Deg F -401.2°F to 2190.2°F	-4012 to 21902
Type K	Deg C -261.2°C to 1369.5°C	-2612 to 13695
Type K	Deg F -438.1°F to 2497.1°F	-4381 to 24971
Type T	Deg C -263.2°C to 398.8°C	-2632 to 3988
Type T	Deg F -441.7°F to 749.8°F	-4417 to 7498
Type E	Deg C -267.4°C to 999.0°C	-2674 to 9990
Type E	Deg F -449.3°F to 1830.2°F	-4493 to 18302
Type R	Deg C -43.1°C to 1759.8°C	-431 to 17598
Type R	Deg F -45.5°F to 3199.6°F	-455 to 31996
Type S	Deg C -41.3°C to 1759.1°C	-413 to 17591
Type S	Deg F -42.3°F to 3198.3°F	-423 to 31983
Type B	Deg C 253.4°C to 1792.1°C	2534 to 17921
Type B	Deg F 488.1°F to 3257.8°F	4881 to 32578
Type N	Deg C -255.4°C to 1296.8°C	-2554 to 12968
Type N	Deg F -427.7°F to 2366.2°F	-4277 to 23662

Low-level thermocouple signals can be susceptible to noise. In the I/O Section of ScadaBuilder, the I/O processor can be set to average 1 to 8 readings at a time to reduce noise. Since temperatures normally change slowly, averaging can be used to smooth out noisy readings. There is also a power-line frequency setting to optimize 50/60Hz noise rejection, depending of the final equipment installation location.

Contact Closure and Logic Level Discrete Inputs

In addition to analog type sensors, the Universal Inputs of the Ultima controller can accept simple discrete input signals in the form of contact closures and low-level logic signals. Unlike the controller’s other discrete inputs, the universal inputs can use the built-in current sources available for resistance measurements so that no external “wetting” current is required for contact closure type sensors (switches, relay contacts, etc.). The inputs are also more sensitive so they are capable of accepting TTL and CMOS logic levels which typical run between 3 and 5Vdc (the minimum



Signal Averaging

AC Line Filtering

Etherlogic Ultima

ON voltage of the “normal” discrete inputs is 9Vdc). Do NOT apply any voltage in excess of 5.5Vdc to a Universal Input, otherwise the overload protection circuitry will take over and clamp the input to approximately 6Vdc.

The I/O processor actually processes a discrete sensor on a Universal Input like any other analog sensor, so the inputs are heavily filtered and respond much more slowly than the conventional discrete inputs. Do not use these inputs if you require response times faster than 1 second!

The Universal Input signals are brought into the controller as DI1 through DI8. No mode configuration is required to use a Universal Input as a discrete input. If the voltage level on an input is HIGH (a voltage of 2.50Vdc or greater), it is considered OFF. A LOW (any voltage level below 2.50Vdc) is considered to be ON. If a contact closure type sensor is to be used, the “Isrc” switch for that channel should be turned ON, pulling the input HIGH until the switch closes to ground. If a low-level logic signal is used, leave the current source resistor OFF.

The On/OFF “polarity” of any of the Discrete Inputs, including the Universal inputs, can be inverted, either in the I/O Section of ScadaBuilder, or in an ISaGRAF control logic program.

Field Wiring

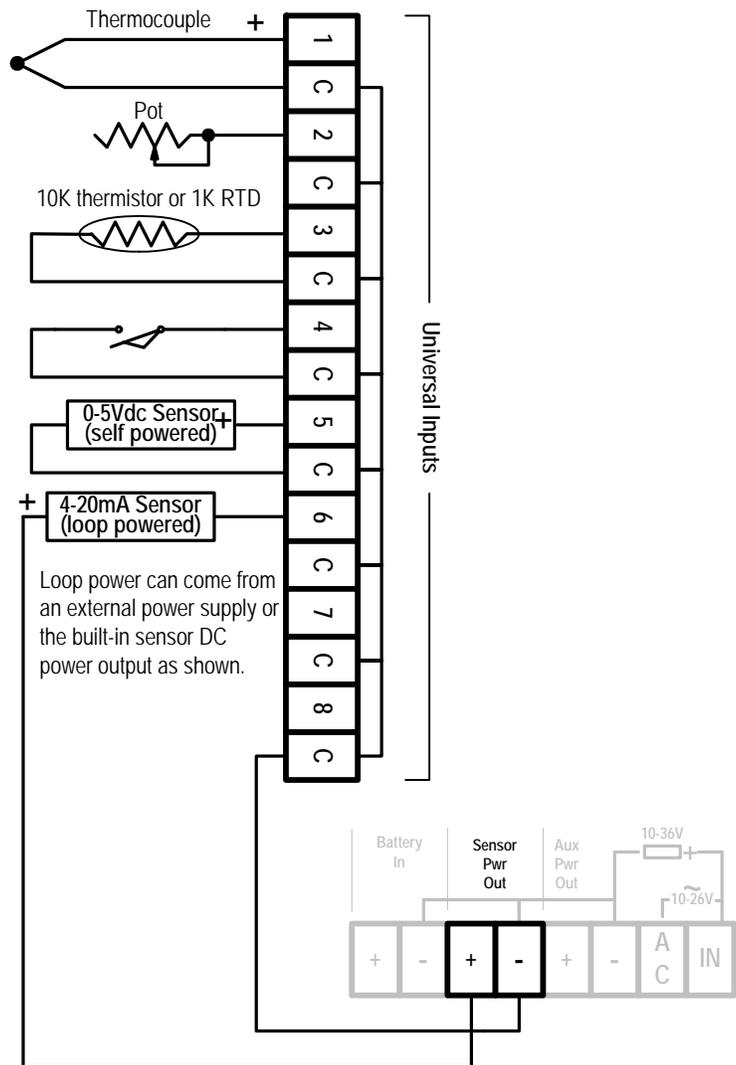
The universal input connections come into the Controller on a 16 position removable terminal block. There are 8 sensor input connections and 8 common connections, one per input channel. The common connections are electrically tied together, but isolated from the rest of the Controller and other types of I/O.

For 20mA or 5 volt sensors, the universal inputs are passive, requiring an active signal source. 20mA current loop devices must either have their own internal loop power supplies, or an external supply must be used (such as the Auxiliary Power Output built into the EtherLogic Ultima as shown below). Voltage type sensors are typically self-powered anyway. It is best if self-powered devices are isolated to avoid ground loops.

Thermocouples **MUST** be non-grounded type (electrically isolated) to avoid ground loops.

Thermistors, RTDs and other resistive sensors are isolated by design, so no special precautions are required.

Typical wiring to the universal inputs is shown here:



NOTE: The terminal block screws must be tightened to 7 lb-in. Please refer to the preceding installation section for additional electrical wiring requirements.

Internal Analog Inputs

The Ultima Controller has 4 internal analog inputs used to monitor operating voltages and temperature. Each of these can be read as an integer register value. ScadaBuilder automatically sets up the default names shown below when a new node (controller) is created, but these can be changed at any time. All voltages are in tenths of a volt (i.e. 254 = 25.4 volts). Temperature is in tenths of a degree C (i.e. 282 = 28.2°C)

Input_Voltage

This register represents the current external DC or rectified AC input voltage (power) to the controller. Since the controller can operate on battery backup power, it is entirely possible for this value to read 0 and still be functioning under battery power!

Battery_Voltage

This register represents the current backup battery voltage level. This is an actual battery voltage under a light load. The controller periodically turns off the internal charging circuitry and measures the battery voltage with a load resistor attached. A fully charged battery should read approximately 13.7Vdc to 13.9Vdc.

Sensor_Pwr

This register represents the current output voltage of the regulated sensor power supply. There is a separate ON/OFF control bit for this power source, so if the program shuts this supply off, this register will read 0. The sensor power supply is overload protected. If an external source begins to draw more than 300mA, the power supply output is automatically reduced. Besides triggering a Sensor Power Overload warning bit (see DIs), the sensor power level will be seen to drop in this register. There is a protection diode between where the sensor power is measured and the terminal block connection. Under load, the sensor power level can be as much as 0.7 volts LOWER than the indicated level because of the voltage drop in this diode. Lighter loads will experience less drop. The sensor power is user settable from approximately 7Vdc and 32Vdc.

Cold_Junct_Temp

This register represents the current temperature of the Universal Input terminals. Although this is primarily used for cold junction compensation of thermocouple sensor readings, the temperature generally represents the internal temperature of the controller. This sensor is purposely located away from heat generating components, so there may be certain locations in the controller that run somewhat warmer than the indicated temperature. Use this value as an average internal temperature indication. The maximum recommended operating temperature of the controller is 75°C.

Discrete Inputs

EtherLogic Ultima discrete inputs are used to monitor the state of switches, relays contacts, motor starter auxiliary contacts and any other on/off type signals. The inputs are optically isolated to avoid ground loop effects and prevent damage from transients and power surges on the input lines. The EtherLogic Ultima controller has 20 of this type of discrete inputs. The inputs are labeled DI9 though DI28 (the first 8 “discrete inputs” are actually part of the Universal Inputs that accept only contact closures and low-voltage input signals).

Signal Types and Levels

The Ultima's discrete inputs have a unique design that accepts both AC and DC signals. The inputs are not sensitive to signal polarity, supporting DC sensors with either "sinking" or "sourcing" output configurations as well as switch contacts with AC or DC signals.

The discrete input circuitry of the Ultima controller is purposely designed to respond to DC signals (that do not cross through 0 volts) faster than AC signals. This provides better noise rejection in systems with 50/60Hz control power, but allows for a little faster response times in machine control applications that typically use DC photoeyes and proximity switches.

The standard EtherLogic Ultima discrete inputs are designed to operate in 12 and 24 volt control systems or 120V and 240V control systems depending on the model number ordered. The guaranteed ON and OFF threshold and maximum input rating are:

The Ultima discrete inputs have hysteresis in order to improve their noise rejection. The hysteresis ensures that the voltage at which an input turns ON is higher than the voltage at which the input will turn OFF. Once the input signal reaches the ON threshold, it must drop down below the OFF threshold for the input to turn OFF. This feature combined with normal component tolerances defines the difference between the "guaranteed" OFF and "Guaranteed" ON thresholds in the table above.

I/O Processor Functions

The Ultima's I/O processor performs pulse totalization, rate calculation and quadrature counting (for encoders), helping to off-load menial I/O tasks from the main CPU and improve system performance. These features are only available on specific discrete inputs configured in the I/O section of ScadaBuilder

Feature	Qty.	Inputs	Rate Calc	Quadrature
High Speed (5KHz) Totalizers	2	DI9, DI10	Yes	Yes
Medium Speed (40Hz) Totalizers	6	DI11 to DI16	No	No

Model Type	OFF Threshold	ON Threshold	Maximum Input
12 / 24V	6 Vdc/Vac	9 Vdc/Vac	50 Vdc/Vac
120V/240V	50 Vdc/Vac	75 Vdc/Vac	300 Vdc/Vac

Pulse Totalization

The Ultima I/O processor counts ON transitions on 8 discrete inputs, providing reliable fast pulse totalization that is not sensitive to program scan time. All of the Discrete Inputs have noise filtering. On DI5 and DI6, the filtering may be reduced under software control for high-speed counting. With filtering in place, the input counting rate is limited to 40Hz (DC pulse) or 10Hz (switched AC). On DI5 and DI6, with filtering turned OFF, the inputs can count at rates exceeding 5KHz. The pulse totalizers are 32-bit counters, meaning that the totalizers count up to

Etherlogic Ultima

4,294,836,225 ON transitions before they “roll over” to zero again. The counters can be reset to zero at any time under program control by writing a 0 to the register. Like any other registers, totalizer registers can be declared as “retentive” (nonvolatile) so that the accumulated values will be remembered through a power failure. The built-in counting features can be used for very accurate flow and wattage totalization, including monitoring flow rates high-speed turbine flow meters.

Rate Calculation

On DI9 and DI10, the I/O processor also computes the incoming pulse rate based on a user settable “Gate” (sampling) time. The sampling time is set in 1 second increments in the I/O section of ScadaBuilder. Choosing a smaller (1 second) gate time causes the rate value to be updated more frequently. Choosing a longer gate time reduces the update rate but increases the measurement resolution since more input pulses are sampled over the longer time period.

Quadrature

In 12/24V Ultima controllers, DI9 and DI10 can be configured (in the I/O section of ScadaBuilder) to support a quadrature output shaft encoder. In this mode, the I/O processor keeps track of the distance (number of pulses) traveled in a 32-bit signed integer register. In a second signed register, the I/O processor shows a 1 or -1 to indicate the current direction of movement, or a 0 for no movement. This feature is typically used to keep track of the movement and position of vehicles, cranes and robotic equipment.

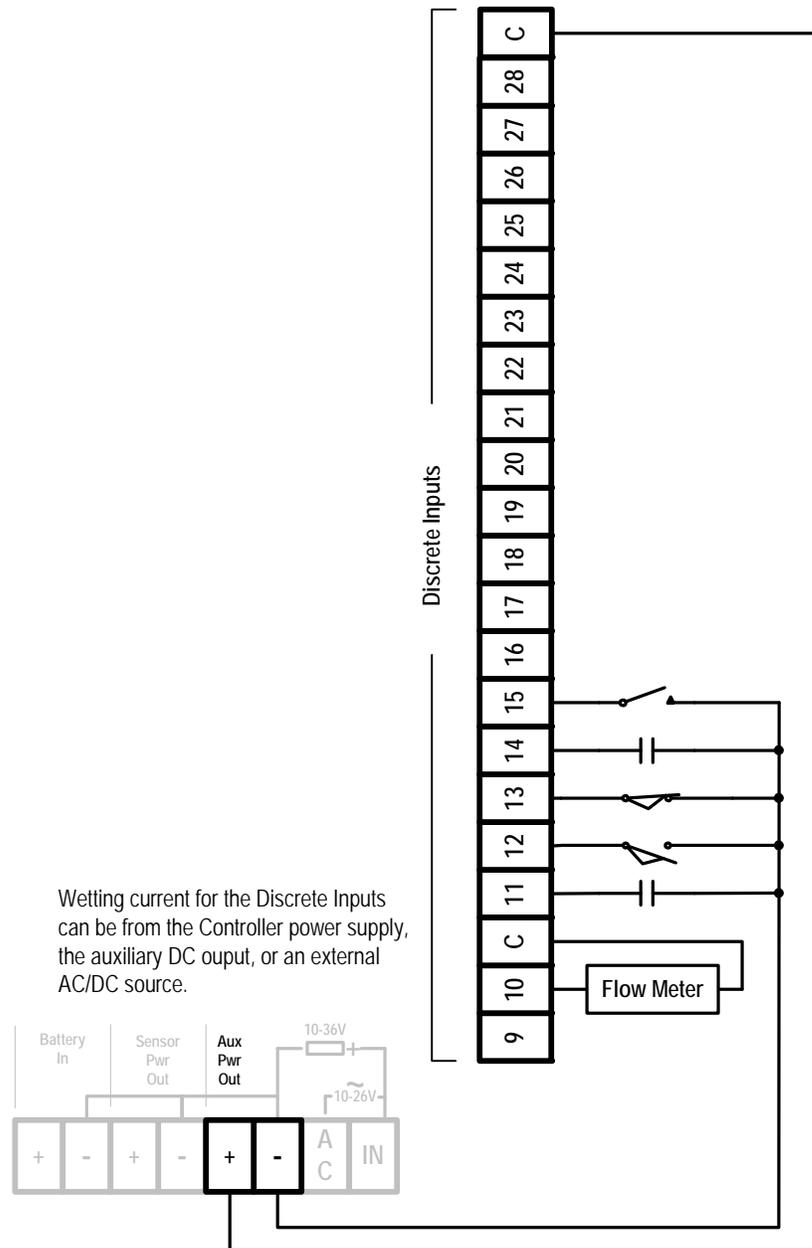
Field Wiring - 12/24V Ultima Controllers

Discrete input signals DI9 through DI28 come into the controller on a 22 position removable terminal block (DI1 through DI8 are Universal Inputs) with a shared common.

Discrete inputs DI9 through DI28 are passive and require an active voltage to be switched between input signal connections and their common connections to complete the input circuits. The inputs are isolated from the rest of the controller electronics.

The discrete inputs are not sensitive to polarity, so the power lead connected to the field sensors can be either the negative or the positive side of a DC power source, or either side of an AC power source.

For low-power applications, the input current at 12Vdc is approximately 1mA, sufficient for contact “wetting”, but low enough for practical use in solar and battery-backed applications. At 24V in, the input current rises to about 2.25mA for each input.



NOTE: The terminal block screws must be tightened to 7 lb-in.
Please refer to the preceding installation section for additional electrical wiring requirements.

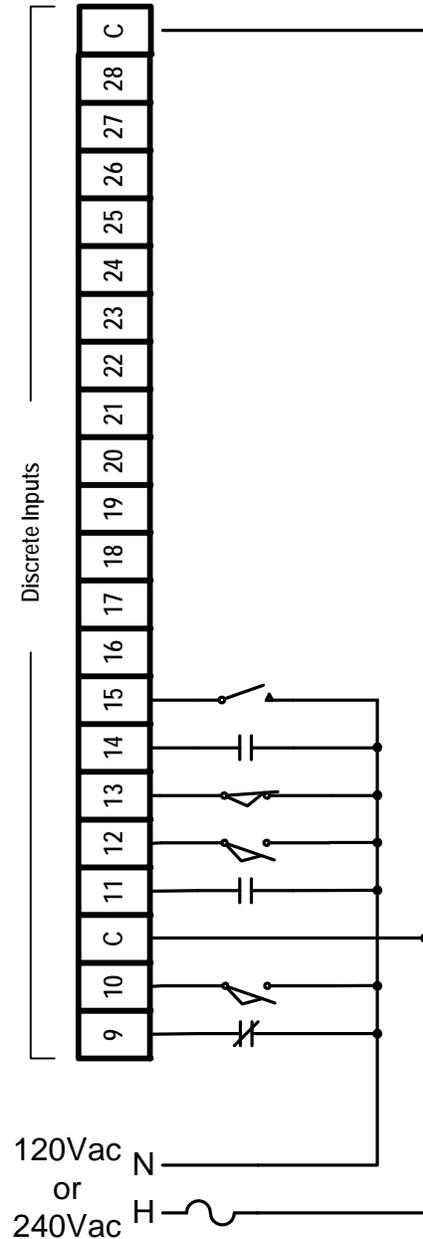
Field Wiring - 120V/240V Ultima Controllers

In 120V/240V models of the Ultima controller, ALL Discrete Inputs are designed to accept high-voltage (120V/240V) levels. This includes DI9 and DI10, which in the low-voltage models, support high-speed pulse signals. In all Ultimas, there are two other high-speed pulse inputs available (low-level/magnetic pickup inputs) that may be used with most types of pulse sensors, so typically, the loss of these inputs for high-speed pulse totalization and rate monitoring is not a problem.

Like their low-voltage counterparts, on 120V/240V Ultimas, discrete input signals DI1 through DI22 come into the controller on an 18-position removable terminal block (DI1 through DI8 are Universal Inputs). The input connections are arranged in groups of 2 and 18 inputs with separate commons for each group.

All of the discrete inputs are passive and require an active voltage to be switched between input signal connections and their common connections to complete the input

For 120V/240V Ultima controllers, wetting current for the Discrete Inputs typically comes from the incoming AC power line through a protective fuse.



NOTE: The terminal block screws must be tightened to 7 lb-in. Please refer to the preceding installation section for additional electrical wiring requirements.

Internal Discrete Inputs

Ultima controllers have three internal discrete inputs used to monitor incoming power, battery power and sensor power status. All of these can be read as a boolean values by a logic program. ScadaBuilder automatically sets up the default names shown below when a new node (controller) is created, but these can be changed at any time.

Power_Fail

This alarm bit is set whenever incoming power drops below 9.5 volts. The bit will remain set until the incoming power rises above 10.0 volts or the controller is reset (full power cycle).

Battery_Voltage

This alarm bit has slightly different setpoints depending on whether incoming power is present or if the controller is running off of backup battery power.

When incoming power is present, this bit set whenever the backup battery voltage is less than 11.8 volts. It is turned off when the battery charges up to at least 12.5 volts. This provides an indication of the charging state of the backup battery.

When incoming power is NOT present (controller is running on backup battery power), this bit is set when the battery voltage drops below 10.5 volts. This serves as a warning, since the power from the battery will be automatically disconnected (controller shut off) when the battery voltage drops below 9.8 volts in order to avoid deep discharge damage to the battery. The alarm bit is reset when the battery rises up to at least 12.0 volts or incoming power is restored above the thresholds described previously.

Sensor_Overload

This alarm bit is set whenever the sensor power supply is being required to supply in excess of 300mA. The power supply is designed to power up to 12 20mA current loops (8 Analog Inputs and 4 Analog Outputs = 240mA). If excess current is being drawn from the sensor power supply, the supply will respond by reducing the output voltage until the current drops below 300mA. This bit serves as a warning of the overload, and indicates that there may no longer be sufficient voltage powering the loop devices because of the overload.

Discrete Outputs

The discrete relay outputs of EtherLogic Ultima controllers are used to operate motor starters, lights, annunciators and any other type of on/off control device. The discrete outputs are 10 amp “dry” relay contacts (refer to load ratings below). The contacts have built-in snubbers to reduce arcing and radiated electrical interference. The outputs can switch both low-voltage (12/24V) and high voltage (120V/240Vac), AC or DC loads, regardless of the Ultima controller model (12/24V models can also switch 120V/ 240Vac loads).

Field Wiring

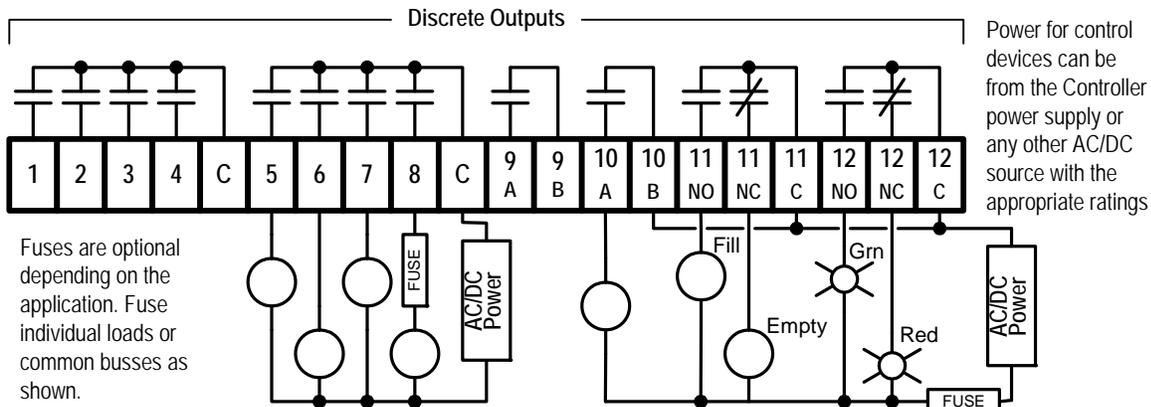
The EtherLogic Ultima controller has twelve discrete relay outputs. Two of the twelve relay outputs provide a set of “Form C” contacts (one normally closed and one normally open). The other ten relay outputs are “Form A” type with a single normally open contact each.

Etherlogic Ultima

To simplify field wiring, eight of the discrete outputs are grouped into two sets of four outputs. Each set has a pre-wired common. Two of the Form A outputs and the two Form C outputs have no shared common so that they can be inserted in the “middle” of external control circuits. The Discrete Outputs from the controller connect to their field wiring via a 20-position removable terminal block.

The discrete outputs are passive “dry” relay contacts that require an active supply voltage on one side of the load, while the relay output from the controller switches the other side of the load to the opposite supply leg. The relays may be used to switch AC or DC signals and power. The relays are rated to switch up to 10A (refer to load ratings below). Typical Discrete Output wiring is shown below:

Even though each of the normally open relay contacts are rated to switch up to 10-amps (up to 3-amps for normally closed contacts), the switching capacity of outputs that share a common is limited to the 15-amp rating of the common terminal block terminal. For example, if you are switching an 8 amp load on one of the outputs with a shared common, the sum of all of the other loads sharing that common must not exceed 7 amps, for a total of 15 amps. The 15A limit applies to both AC and DC circuits.



NOTE: The terminal block screws must be tightened to 7 lb-in. Please refer to the preceding installation section for additional electrical wiring requirements.

No fusing or overload protection for the discrete outputs is provided within the controller. External protection should be included in the output circuits to protect both the controller output contacts and the loads that they drive. Typically, large loads are fused individually, while smaller loads can share a fused line.

The Ultima relay outputs have built-in snubber protection across the contacts to reduce arcing that degrades the contacts and can cause premature relay failure, especially with inductive loads such as relays and motor starters. Even with snubber protection, some people choose to incorporate the added protection of transient suppression diodes across DC coils, and MOVs or other clamping devices across AC coils. When using Relay diodes (DC circuits), be sure Output to observe the diode polarity. A reversed connection will cause a short circuit! Metal Oxide Varistors (MOVs) may be used for AC and DC circuits and are not polarity sensitive.

Internal Discrete Outputs

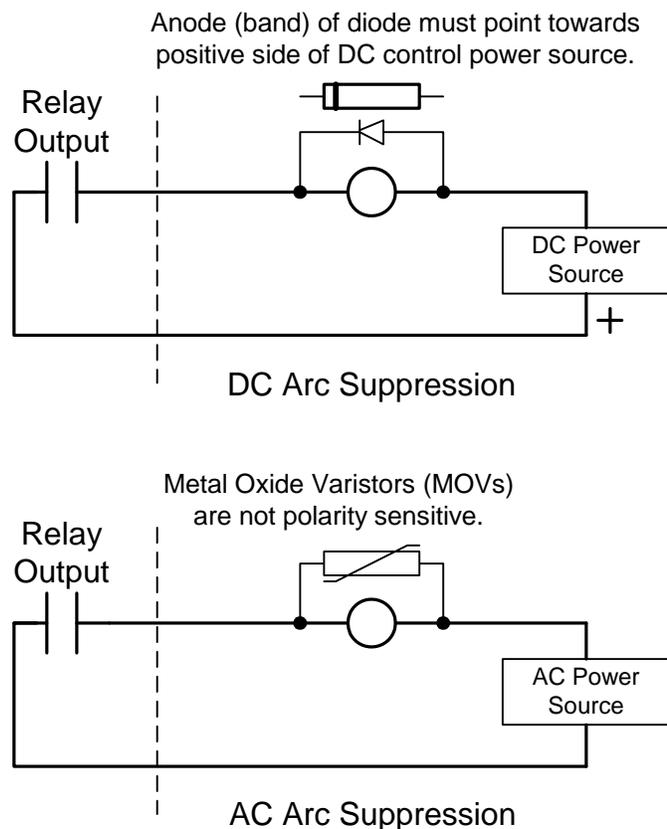
Ultima Controllers have 3 internal discrete outputs used to control power consumption for low-power applications. Each of these can be read or written as a boolean value by a logic program. ScadaBuilder automatically sets up the default names shown below when a new node (controller) is created, but these can be changed at any time.

Sensor_Pwr_Dsbl

Settings this control bit disables the sensor power supply. The primary purpose of the Sensor Power Supply is to provide regulated, and in most cases, boosted power for 20mA current loop devices. In battery powered applications, significant power can be saved by only powering 20mA sensors when a reading is about to be taken. For example, a tank level might only be sampled every 10 minutes, so power usage can be reduced by 95% if the tank sensor is only powered ON 30 seconds out of every 10 minutes. If the loop is being powered by 24V, then the power consumed by the loop is $24V \times 20mA = 0.48W$. This is nearly the power required to operate the entire controller (when configured for reduced power operation). Controlling the sensor power supply and reducing the power required by 20mA loop devices can be significant in solar powered and battery backed systems.

Modem_Pwr_Dsbl

Setting this control bit disables power to the internal modem or radio. Depending on the internal modem or radio being used, even the quiescent or standby current can be significant and an unnecessary waste. For example, if a telephone modem is going to only be used for dialout



Etherlogic Ultima

alarming, the program in the controller can power the modem on only when an alarm event occurs. Otherwise, modem power can be left off, saving over 0.5W of power that would otherwise be wasted.

Status-Led_Dsbl

Setting this control bit disables power to the Discrete Input and Output Status LEDs. Since these LEDs are normally only used when someone has the cabinet open and is working on the system, the DIO status LEDs can be powered off most of the time (if all 14 status DIO LEDs are turned ON, they require a total of nearly 0.4 watt of power!). Even if the LEDs are not turned off completely, power usage can be reduced significantly by simply modulating the LED power control. For example, toggling the status LED power control bit alternately every time through a program scan will result in slightly dimmer LEDs and a 50% reduction in LED power consumption.

Analog Outputs

Analog outputs are used to control variable speed drives, valves, positioners and dampers as well as chart recorders and digital displays. The EtherLogic Ultima controller has four 12-bit analog outputs.

Signal Types and Levels The resistor values required for common voltage ranges are:

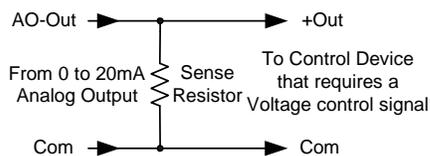
Signal Types and Levels

The four analog outputs produce 0 to 20mA control signals. The common 4 mA offset required by 4 to 20mA control devices and indicators can be set up in the scaling portion of the ScadaBuilder software.

With the addition of a single external resistor (per channel), the outputs can be converted to voltage outputs (i.e 0 to 5Vdc or 0 to 10Vdc).

The resistor value can be calculated as: $R_{sense} = V_{out} / 0.02$

The resistor values required for common voltage ranges are:



Output Range	Sense Resistor Values
0 to 1VDC	50 Ohms (1/8 Watt or more)
0 to 5VDC	250 Ohms (1/8 Watt or more)
0 to 10VDC	500 Ohms (1/8 Watt or more)

Common 1% values of 49, 249 and 499 ohms may be substituted for the “ideal” values listed above.

The Ultima analog outputs source current from the controller power supply, or the sensor (boost) power supply, whichever one has the highest output voltage. The common of the analog

outputs are connected to the controllers power supply common. Control devices connected to these four outputs should be isolated to avoid unforeseen ground loops.

Output Scaling

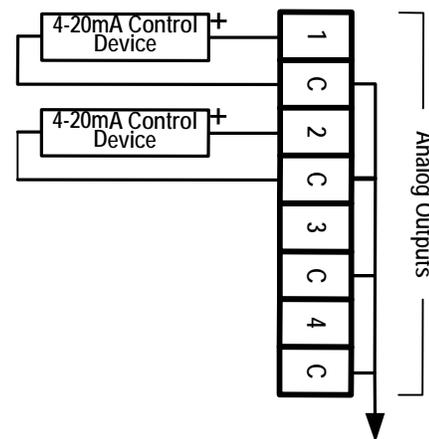
The EtherLogic Ultima Analog Outputs are scaled to provide a 0 to 20mA output signal with output values of 0 to 20,000 (1 count = 1uA). The outputs have an additional 5% or so of headroom, so it's possible to use values greater than 20,000 to get output levels slightly higher than 20mA. Note that since the outputs have an actual resolution of 12-bits (a range of 0 to 20,000 would require in excess of 14 bits), it will require an increase or decrease of several counts in the analog output value to cause a change in the actual current output. The 0 to 20,000 scaling is simply done for the convenience of system setup. If desired, the analog outputs can be rescaled by changing or adding a scaling record in the I/O section of Scadabuilder.

Field Wiring

The Analog Outputs from the Ultima Controller are connected to field devices via an 8-position removable terminal block on the left-hand side of the controller (4 signals and 4 commons).

Typical wiring to the Analog Outputs is shown in the diagram to the right. Note that no external loop power supply is required. The incoming DC or rectified AC power (or battery power) is used to power the Analog Outputs.

NOTE: The terminal block screws must be tightened to 7 lb-in. Please refer to the preceding installation section for additional electrical wiring requirements.



Analog Outputs - Field Wiring Example

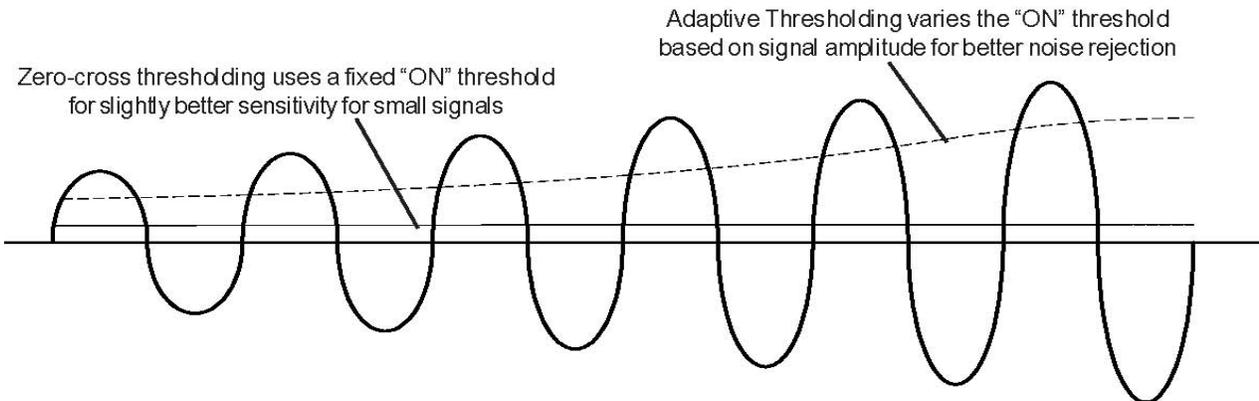
High-speed Pulse Inputs

The Ultima Controller can accept both conditioned and unconditioned high-speed pulse signals, typically indicating some sort of flow or movement. Conditioned signals come from electronic devices that provide a high-level digital signal that is compatible with the “normal” Discrete Inputs. The Ultimas DI9 and DI10 inputs are ideal for these types of signals. Unconditioned signals come directly for a sensor with no electronic conditioning. These are typically magnetic pickups or miniature “generators” whose output signal varies from millivolts to volts AC (the low-level pulse inputs support from 50mV to 108Vpp). In addition, some types of equipment provide logic-level signals (otherwise known as TTL or CMOS levels) that do not have sufficient amplitude to drive the DI9 and DI10 discrete inputs. These later two types of signals can be handled by either of the Ultimas two low-level high-speed pulse inputs.

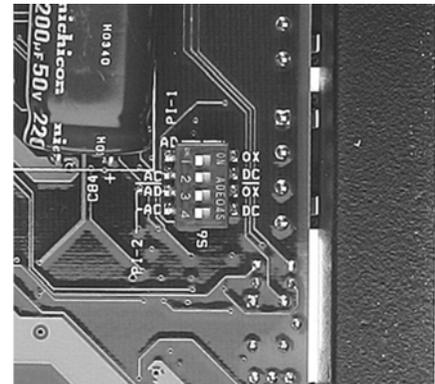
Signal Types and Levels

The low-level high-speed pulse inputs are configurable by DIP switches on the bottom side of the controller. There are two switches per input. For each input, one is marked AC/DC (AC/DC coupling), the second is marked AD/0X (Adaptive or zero-cross thresholding).

For proper operation, the pulse input signal must traverse above and below 0 volts. The AC signals from magnetic pickups operate this way, so they can be accepted directly (DC coupled)



into the pulse inputs. Logic signals transition from 0 to between 3 and 5 volts, so they don't meet this requirement and must be AC coupled into the pulse inputs. In summary, set the coupling DIP switches as follows:



Signal Type	Coupling
AC signals such as Magnetic Pickups	DC coupling
DC Logic and conditioned signals	AC coupling

The Pulse Inputs support a choice of adaptive or zero-cross thresholding on each input. Adaptive thresholding constantly adjusts the "ON" threshold based on the input amplitude, increasing noise rejection as the signal amplitude increases. The signal is considered to be OFF when the input goes below 0 volts and must go back above the variable ON threshold to be "ON" again. Zero-cross thresholding simply looks for the signal to go above or below 0 volts by about +/- 25mV. Adaptive thresholding provides better noise rejection but slightly worse sensitivity (+/- 75mV) than Zero-Cross detection (+/- 25mV).

For most applications, adaptive thresholding is recommended. Set the switches to "AD". For zero-cross thresholding, set the switches to "0X".

Pulse Totalization & Rate Calculation

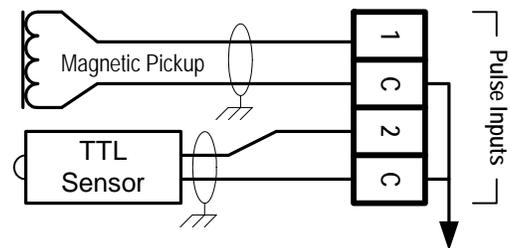
The Ultima I/O processor counts ON transitions on both of the low-level high-speed Pulse Inputs, providing reliable pulse totalization in excess of 5KHz that is not sensitive to program scan time. The pulse totalizers are 32bit counters, meaning that the totalizers count up to 4,294,836,225 ON transitions before they “roll over” to zero again. The counters can be reset to zero at any time under program control.

The I/O processor also computes the incoming pulse rate based on a user settable “Gate” (sampling) time. The sampling time is set in 1 second increments in the I/O section of ScadaBuilder. Choosing a smaller (1 second) gate time causes the rate value to be updated more frequently. Choosing a longer gate time reduces the update rate but increases the measurement resolution since more input pulses are sampled over the longer time period.

Field Wiring

The Pulse inputs are passive. The signal sources are self-powered and drive the inputs directly. A simple 2-wire connection per sensor is all that’s required.

Shielded cable, with the shield bonded at the controller end to earth ground, is recommended.



Ethernet

EtherLogic Ultima controllers come with an Ethernet port, providing higher speeds and more connectivity features than serial ports. The Ethernet Port can be used as a high-speed point-to-point connection to a single PC, connected in a wired or wireless network of controllers and PCs, or connected to the Internet via a DSL or cable modem.



Ethernet connectors look very similar to standard telephone connectors. Be sure that a “normal” telephone line is NEVER plugged into the Ethernet connector. Although it most likely will not damage the EtherLogic Ultima controller, it will probably disrupt normal telephone operation.

Ethernet has several different standards for the type of media or wiring that it uses to interconnect devices. EtherLogic Ultima controllers support the more common 10BASE-T unshielded twisted-pair standard.

10BASE-T differs from other Ethernet topologies. Instead of tapping off one long cable, each Ethernet device has a point-to-point connection with either a hub or a switch. In some systems, a switch will provide improved performance over a hub, but with EtherLogic Ultima, there is very little difference and hubs are generally cheaper than switches. One exception: a single PC can be

Etherlogic Ultima

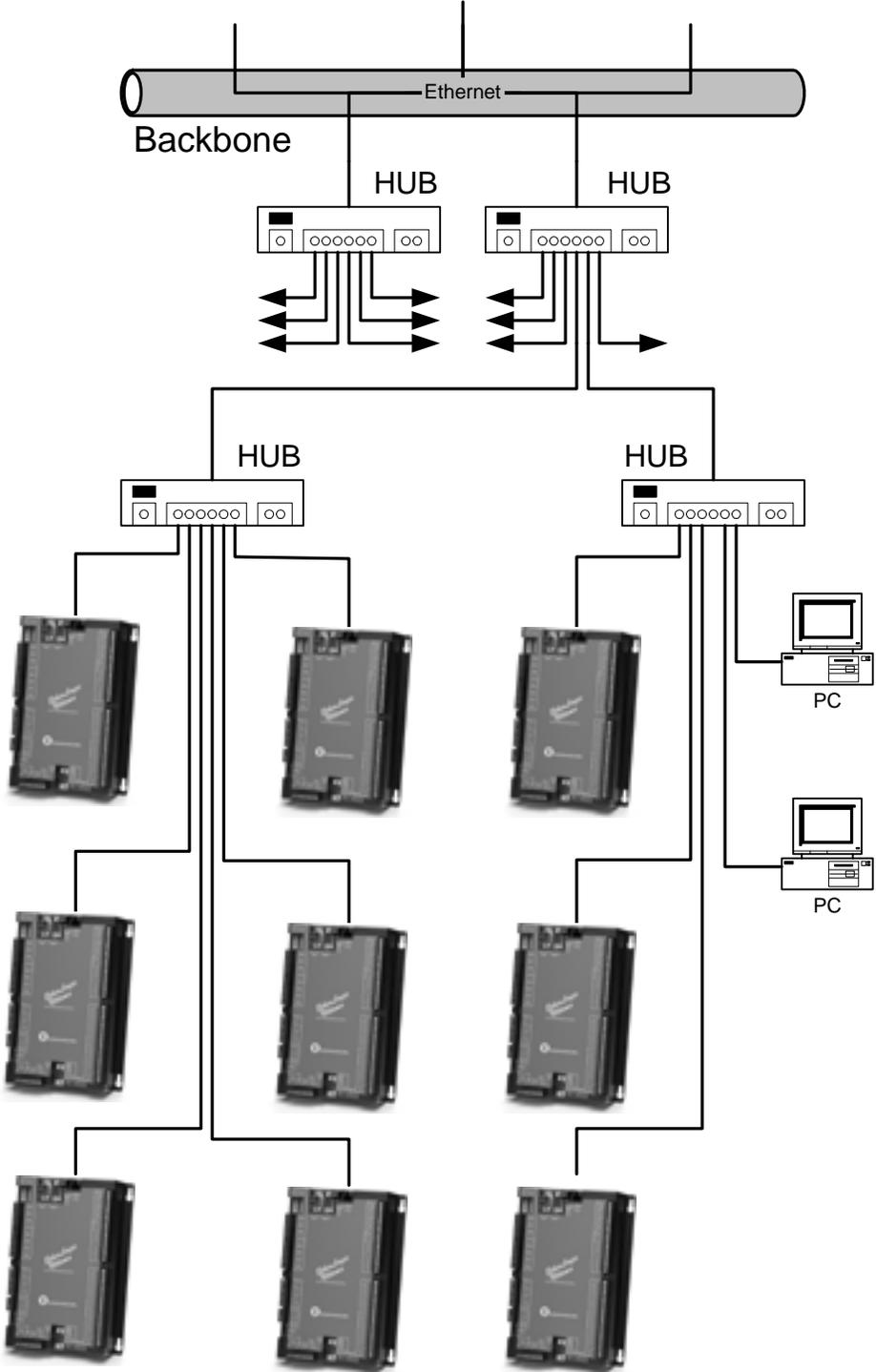
connected to a single controller using a “crossover” cable without using a hub. Use pre-made (and tested) “CAT5” patch cables to connect EtherLogic Ultima controllers to hubs or switches.

One big Advantage of using 10BASE-T is that each Ethernet device is isolated from the other devices on the network. When common wiring errors occur (such as shorts) , the problem will only affect a single device on the network without bringing down the entire network.

The 10BASE-T specification limits the wiring distance between EtherLogic Ultima controllers and a hub or switch to 328ft. (100meters). Hubs and switches act as buffers, extending the reach of networks. There is a limit of up to 4 hubs that may be used in one chain.

Frequently, a large Ethernet network consists of a main high-speed “backbone” with taps to switches or hubs that then feed down to devices like Ultima controllers. Because of the 100 meter/link and 4 hub limits, Ultima controllers can be up to 1,300 ft. away from the “backbone” without resorting to other buffering techniques.

As an alternative, some or all of the hubs and wiring can be replaced by fiber optic links and/or Ethernet radios, allowing the same connectivity features distributed over an even wider area than what is allowed by hardwired copper lines.



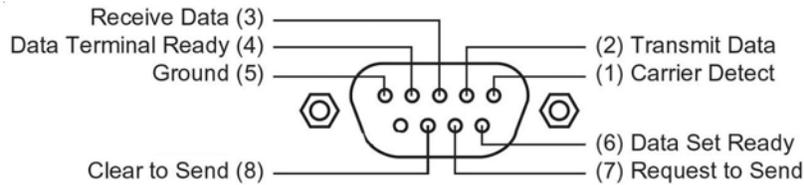
Serial Communications

The most common serial communications standard in SCADA and industrial control systems are RS-232 for short point-to-point connections, and RS-485 for longer point-to-point and networked communications. The EtherLogic Ultima Controller has 1 RS-232 serial port and one combination RS-232/ RS-485 serial port.

RS-232 Serial Communications Interfaces

Both external serial communications ports are RS-232 compatible. Both ports are designed for high-speed communications to 115K baud, although the second port has additional buffering and should be used for extremely high-speed communications if needed. The first port (COM1), typically used as a console and diagnostic port, is the simplest and has no modem control lines associated with it. The second port has nearly all modem control lines, ideal for external radio and telephone modems. Both serial ports use 9-pin male “D” connectors in exactly the same configuration and pinout as an IBM/PC compatible computer so you can you low-cost easy-to-find cables.

The RS-232 connector pin assignments and supported signals on each RS232 port are detailed below:



Signal	Name	Pin	COM1	COM3	COM4	COM6 (Internal)
Carrier Detect	DCD	1	◆	-	◆	◆
Receive Data	RXD	2	◆	◆	◆	◆
Transmit Data	TXD	3	◆	◆	◆	◆
Data Terminal Ready	DTR	4	◆	Always ON	◆	◆
Ground	GND	5	◆	◆	◆	◆
Data Set Ready	DSR	6	-	-	◆	-
Request to Send	RTS	7	Always ON	Always ON	◆	◆
Clear to Send	CTS	8	-	-	◆	◆
Ring Indicator	RI	9	-	-	-	-

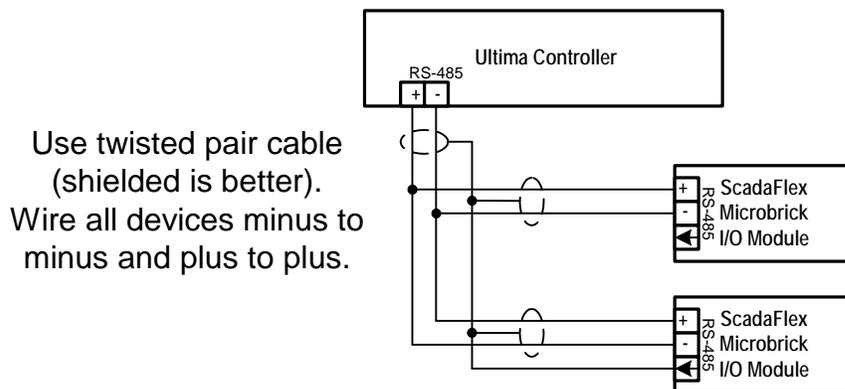
RS-485 Serial Communications Interface

RS-485 is a 2-wire communications interface designed to span distances of up to 5,000 ft. and supporting networked operation. The EtherLogic Ultima's RS-485 port (COM4) is typically used for I/O expansion using MAXIO or ScadaFlex MicroBrick and PicoBrick Distributed I/O modules, although many types of industrial equipment have an RS-485 interface and can be used with the EtherLogic Ultima controller. An optional communications card that plugs into the internal modem/radio port may be used to provide an additional RS-485 port.

Although the original RS-485 standard allowed for only 32 devices on a network, the RS-485 interfaces in Ultima controllers and ICL's Distributed I/O modules are specially designed to allow up to 256 devices to share the same network.

The Ultima's RS-485 connector is a 2-pin removable terminal block. The RS-485 interface has significant transient and overload protection with self-resetting polymer fuses. The protection circuits shunt overload current to the power supply ground connection.

Traditionally, RS-485 networks use a 100Ω resistor termination at each end of the network. This technique does not work well with certain protocols such as Modbus that do not have a lead-in message header to eliminate garbage on the beginning of a message. ICL controllers and I/O modules have series termination resistors that eliminate this problem. In most cases, even on longer networks, separate termination is not required. If termination is used, it should be AC coupled. Call ICL technical support for additional information if you think that you need additional network termination.



RS-485 - Field Wiring Example

Power

EtherLogic Ultima controllers are designed to operate from either AC or DC power. They are typically powered from a 12, 15 or 24 volt DC or 12 or 24 volt AC power sources, although they are rated to operate over an even wider range of 10 to 36Vdc or 10 to 24Vac. Ultima controllers have the ability to accept power from two independent DC power supplies in critical applications that have redundant DC power sources. The incoming voltage level can be read by a controller program.

Etherlogic Ultima

Ultimas have built-in UPS (battery backup) circuitry to support operation with an external 12 volt lead-acid or “gel-cel” battery. The I/O processor manages all battery charging and monitoring functions, and provides battery charge level and input power level monitoring information back to a control program as well as a bicolor LED status indicator.

Ultima controllers have a set of auxiliary DC output terminals to power external equipment. The output supplies DC power regardless of whether the input power is AC or DC. The output will provide up to 3 amps at approximately the same DC or ACrms level as the controller input power. When a lead-acid battery is connected to the controller, the auxiliary power output is battery backed, providing a 10 to 13.5 volt DC output in the absence of incoming power, depending on the battery charge level.

Ultima controllers have a regulated 24V Sensor Power Supply whose output can be turned on and off under program control for power management. The Sensor Power Supply provides a constant low-noise battery backed power source (when an external battery is connected) to supply Analog Input and Output 20mA current loops. The controllers Analog Outputs are powered from either the controller input power or the Sensor Power Supply, whichever has a higher voltage level.

The Sensor Power Supply has electronic overload protection. The output current is automatically limited to no more than 300mA (sufficient to power 6 input loops and 4 output loops with headroom). A current limit alarm bit as well as the Sensor Power Supply voltage level can be read by a controller program.

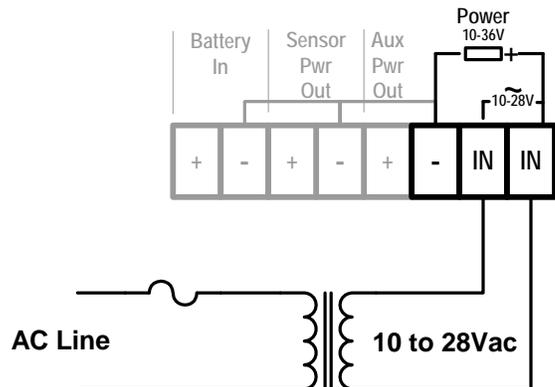
The power consumption of Ultima controllers is very low; typically less than 1.5 watts with the internal radio/modem and sensor power supply are turned off and the controller is not charging a battery. When power saving features are enabled that reduce the CPU speed and turn off unused hardware, the power draw can be reduced to as little as 0.75 watts under these same conditions. Because of their low power consumption and wide input power range, they are ideal for solar or battery backed applications.

Powering the Controller

The Ultima controller can be operated from either AC power (10 to 26Vac) or DC power (10 to 36Vdc). If the battery backup feature of the controller is to be used, the minimum input power is 12Vac or 15Vdc. At lower input voltages, complete charging of the lead-acid battery is not guaranteed.

AC Power Wiring

The Ultima controller can be powered directly from a low-voltage (12 or 24V) transformer. This is typically the lowest cost installation. Using the Recommended AC Power wiring configuration, the secondary of the AC transformer feeds a bridge rectifier circuit within the controller.

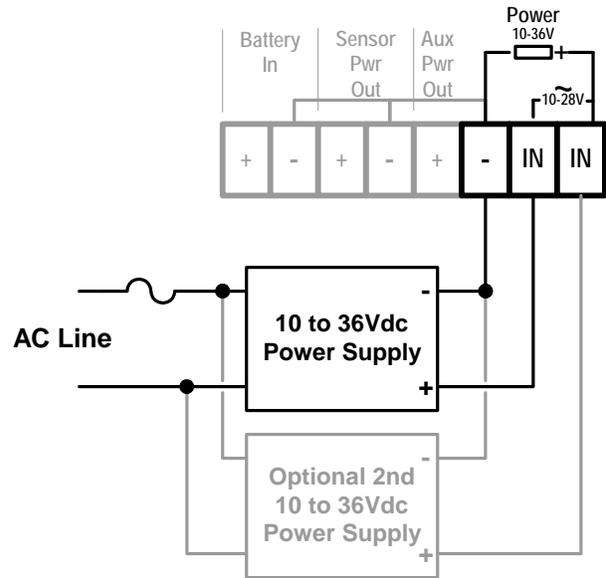


In this configuration, do not connect either leg of the transformer secondary to any other devices in the system unless they are completely isolated.

In systems that require grounding one side of the transformer secondary (such as HVAC systems), use the lower wiring diagram. This connects the transformer secondary to the controller's power ground. This is less efficient than the upper configuration and requires derating of the Auxiliary Output current.

DC Power Wiring

The Ultima controller can also be powered from a DC power source. The input power does not need to be regulated as long as it doesn't drop below 10Vdc or rise above 36Vdc. If a single DC power supply is used, it may be connected between the "-" input and either "IN" terminal as shown. If dual (redundant) DC power supplies are used, they will share the "-" terminal and each supply should be connected to its own "IN" terminal.



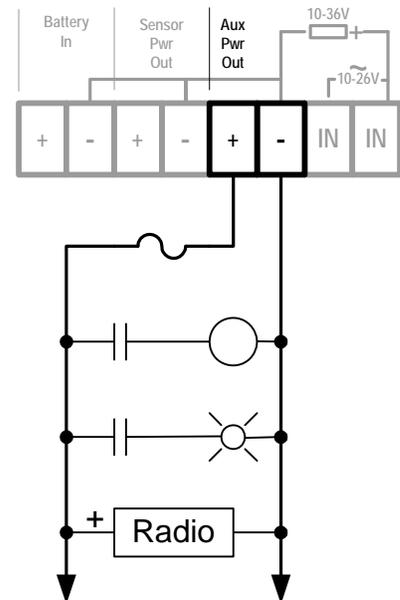
In the dual configuration, the power supply with the highest output voltage will supply power to the controller, but if it fails, the other supply will take over.

Auxiliary DC Output Power Wiring

The Ultima controller provides a non-regulated DC output to power auxiliary equipment such as relays, panel lights, annunciators, radios and modems. This is especially useful in AC powered systems. The auxiliary output has a current capacity of up to 3 amps (2 amps when a grounded AC power source is used. See the preceding AC Power wiring section).

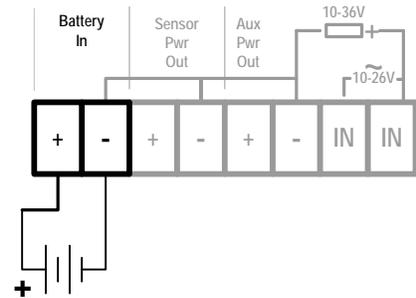
If a battery is connected to the UPS section of the controller, the auxiliary output will be battery backed. Under battery power, the output voltage will be approximately 0.5 to 1V below the battery voltage.

External fusing of devices connected to the auxiliary output are recommended, otherwise an overload on the auxiliary output will open one of the controller's internal main power fuses and/or the battery fuse.



Battery Power Wiring

With an external 12 volt lead-acid connected, the Ultima controller supports battery backup for itself as well as external equipment connected to the auxiliary DC output. With incoming power of at least 15Vdc or 12Vac, the Ultima will charge the battery with a charging current of approximately 500mA and then reduce the charging current to a maintenance trickle charge at approximately 13.7 volts. When the incoming power fails, the Ultima automatically switches over to battery power without glitches or dropouts. The I/O processor constantly monitors the battery level while charging and discharging, and provides both analog levels and status bits.



Nearly any lead-acid battery may be used, but gelled electrolyte (“gel-cel”) batteries are preferred because they are sealed. Capacities of 7AH to 12AH are typically used depending on the required backup time and loads. Batteries with a capacity of more than 20AH can be used but are not generally recommended.

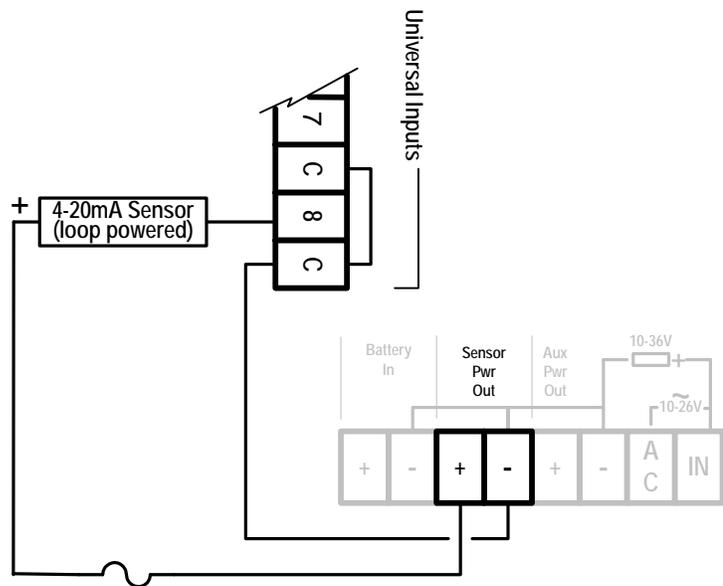
Connect the battery to the power connector as shown. Short runs of 16, 14 or 12 gauge wires are recommended to minimize voltage drops.

Be sure to observe the battery polarity.

Sensor Power Output Wiring and Level Setting

The Ultima controller provides a regulated, overload protected output designed to power 20mA analog sensors and control loops. The output is rated to continuously supply over 250mA and is electronically limited to approximately 300mA.

The Sensor Power Output is internally connected to the Analog Outputs so that if it is set higher than the input power, the outputs will be powered from the boosted Sensor Supply. Because the Ultima’s Universal Inputs are isolated from the controller, if you wish to use the Sensor Power Supply to power loop devices connected to the Universal Inputs, you must connect the “-” output to the Analog Input common and the “+” output to the “+” side of the loop devices as shown.



The voltage level of the Sensor Power Output is adjustable from approximately 7Vdc to 32Vdc by setting a 25-turn potentiometer located next to the pushbutton reset switch.

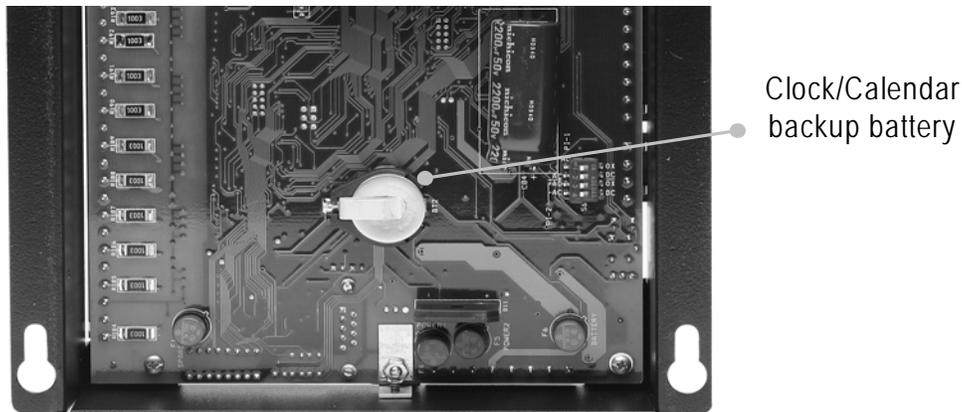
The Sensor Power Output voltage should be set high enough to accommodate all of the devices in the analog loops plus 5Vdc for the controllers output driver and headroom. The higher the voltage setting though, the greater the controllers input power draw. In solar and battery backed system, minimizing the loop voltage will help extend the operating time under battery power.

Maintenance

EtherLogic Ultima controllers are designed for long-term maintenance-free operation. The only maintenance items typically required by the controller are occasional replacement of a clock battery, setting the time and date, analog calibration and possible software and firmware updates.

Clock/Calendar/NV RAM Battery

The internal Real Time Clock, Calendar and nonvolatile register memory have a small lithium “coin” style battery that keeps these circuits running when there is no power to the controller. The battery is retained in a holder that is accessible from the bottom of the controller.



Depending on the ambient temperature and how often and long the controller is left powered off, the battery will need to be replaced every two to five years. A boolean bit may be assigned to an internal battery monitor circuit that monitors the battery condition. If this feature is taken advantage of, a controller program can annunciate an alarm to provide an early warning that the battery will need replacement soon.

The replacement battery is a Renata/Rayovac CR2032. When you replace the battery, be sure to pay attention to the batteries polarity. A large “+” sign should be readily visible on the top of the battery.



Do not incinerate or dispose of lithium batteries in general trash collection. They may explode or rupture violently. Check state and local regulations dealing with the disposal of these materials. You are legally responsible for hazards created while your battery is being disposed.

Time & Date

Using a PC running a terminal emulation program such as HyperTerminal (supplied with Windows) or ScadaBuilder, the Time and Date can be viewed and set from the “C>” prompt when the PC is connected to COM1 of the controller. To get to a “C>” prompt, cycle the controllers power or press the “Reset” button, then press the Escape key on your computers keyboard several times while the controller is just starting to “boot”. Type “TIME” followed by a carriage Return to View the current time setting. Do the same with the DATE. To change the Time or Date, enter a new value when prompted.

Calibration

The calibration of analog inputs and outputs should be checked typically once a year. The calibration values for the EtherLogic Ultima controller are retained in nonvolatile EEROM memory, and may be viewed and changed using a ScadaBuilder application available from Industrial Control Links. Please contact technical support for a copy, along with the recommended field calibration procedure. A backup copy of all calibration values, as determined by an automated test system in the factory, is always retained separately in another area of nonvolatile memory, “just in case”. The same ScadaBuilder application can restore the factory calibration values if needed.

Software and Firmware Updates

Controller software is easily and quickly updated using ICLs ScadaBuilder software with it’s built-in Kernel and Configuration update functions. In addition, the I/O processors firmware can be “drag and dropped” into the terminal window which automatically transfers it to the flash “disk” on the controller. The new firmware can then be installed using a Bootloader program shipped with the controller or available from the ICL web site (Note: the “drag and drop” mechanism can be used with any files to be sent to the controller). Please refer to the ScadaBuilder documentation for more information.

Internal Telephone Modem Option

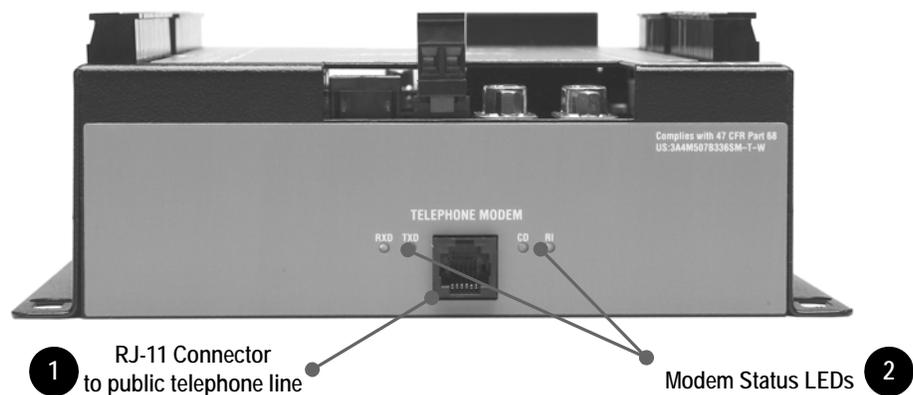
EtherLogic Ultima controllers can be ordered with an internal 56K baud dial-up telephone modem. Typical applications are for systems that require simultaneous voice/alarm dialing and data access using two phone lines. With the internal telephone modem option, the controller can dial out to announce an alarm with synthesized voice (including “real-time” process variables), send a message to a numeric or alphanumeric pager, send a text message to a cell phone, or send an e-mail (with file attachments such as data logs). The Ultima controller can also be configured to accept incoming calls for remote PC or touchtone voice-prompted access to process variables, and to make password protected register and I/O changes, as well as for remote program debugging and updates.

The internal Ultima telephone modem is functionally similar to the high-speed modems used in PC computers, except that the Ultima internal modem has the following additional features:

Etherlogic Ultima

- supports voice synthesis for alarm dialing
- supports touchtone tone recognition for remote dial-in and control
- operates over the full controller temperature rating (-40°C to +75°C).
- requires no additional panel space
- is an additional com port, freeing up an external RS-232/RS-485 port
- runs off of internal DC power from the controller, making it easy to provide long-lasting uninterruptable battery backed operation.

The modem telephone connector and status lights are built into the upper end of the controller (a duplicate set of LED indicators is visible on the front of the controller). The connector accepts a standard 6-pin modular telephone plug, of which only the center two pins are used for the telephone line connection (standard telephone wiring configuration).



Internal Spread Spectrum Radio Option

Ultima controllers are available with internal Spread Spectrum Radios, requiring no license and communicating at rates of up to 115K baud.

The spread spectrum radios used in Ultimas may be ordered for operation in either one of two bands designated by the Federal Communications Commission (FCC); 900 MHz (902 to 928MHz) and 2.4GHz ((2.400 to 2.4835MHz). Unlike conventional radio systems that transmit and receive on fixed frequencies, spread spectrum radios “hop” periodically from one frequency to another in a pseudo random pattern. The hopping pattern is user settable, and all radios that are configured to talk to each other follow this pattern, changing frequencies up to 100 times per second. The radios can utilize a total of 112 different frequencies.

Spread spectrum radios tend to be less affected by outside interference and are more secure than conventional radios because they are constantly changing operating frequency. If a spread spectrum radio encounters interference at a particular frequency, it simply picks up where it left off after hopping to the next frequency a few milliseconds later. The radios offer very high data reliability, utilizing a unique 32-bit error detection and correction scheme to ensure that corrupted data is never passed to the controller. This protection is above and beyond the protocol level error handling.

The radio embedded in Ultimas can deliver up to one watt of RF power, the maximum allowed by law in these frequency bands. This is a lower power than other types of radios operating at fixed licensed frequencies, but these spread spectrum radios can have a range of up to 60 miles in an open area. The radios have a built-in repeater function, so that each radio can serve as a

repeater to relay the messages of other radios located farther out as well as communicating the data from the controller. There is no limit, other than transmission time, to the number of repeater hops used, so spread spectrum radio networks can provide hundreds of miles of coverage.

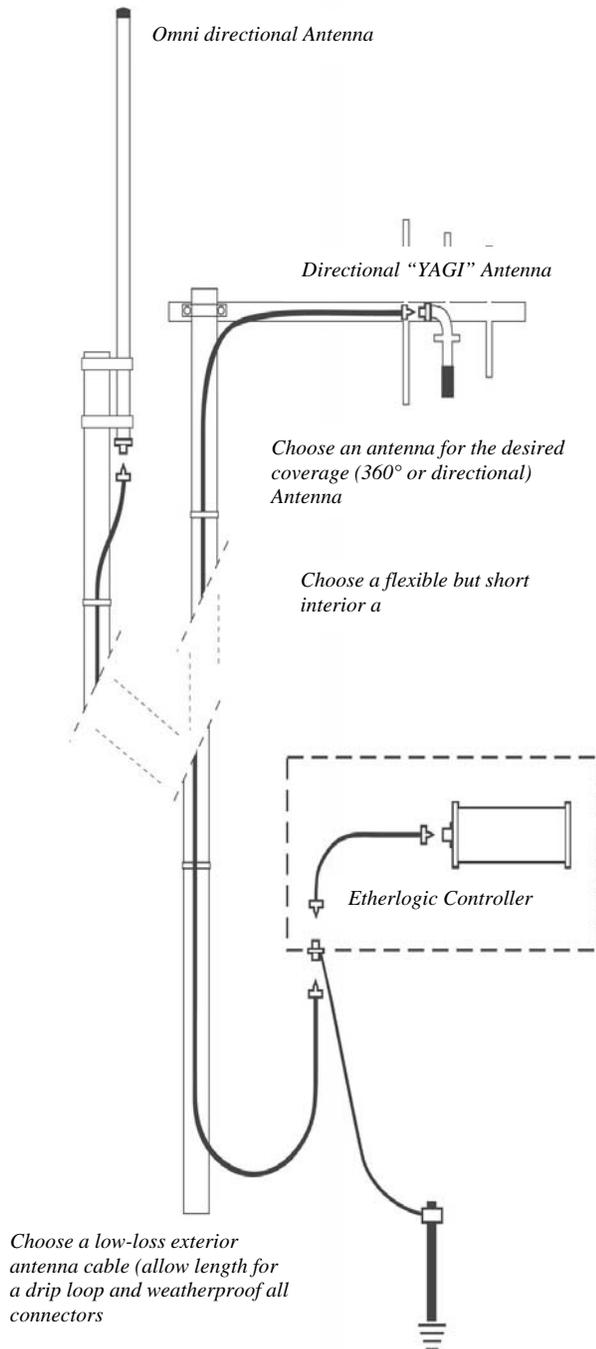
The EtherLogic Ultima radios support real-time on-line diagnostics that enable a single Ultima controller to serve as a central point to examine the status of any other radio and radio link in the network while communicating. The radios can be remotely configured and can even have the microprocessor firmware updated from this Master station. The remote diagnostics capability provides immediate status information for any segment of the radio network, including repeater links. This data can include Average signal strength and noise levels, as well as specific signal and noise levels for each of the 112 hopping frequencies. Additional information such as antenna reflections (SWR), operating temperature, and data error rates are available to analyze the performance of each portion of the radio network.

Radio Installation

The EtherLogic Ultima radio option uses a female “SMA” type antenna connector. The antenna connector and the radio status lights are located on upper side of the controller (see below).

Typically, a short, lightweight cable (such as RG-223 or LMR-200) connects between the radio antenna connector and a lightning

arrester in the panel. A lightning arrester with dedicated ground rod is required for any outdoor installation. The lightning arrester can also serve as a bulkhead connector to pass through the cabinet wall and transition to heavier, lower-loss type exterior antenna cables such as LMR-400 and LMR-600. These cables then connect to Yagi (directional) or Omni (Omni directional)



Etherlogic Ultima

antennas. LMR-600 cable has lower loss for longer runs. LMR-400 is cheaper and more flexible, but less than 100ft. of cable can cut the signal strength in half! Heliax has the lowest loss, but is stiff and hard to work with.

Radio Configuration

The spread spectrum radio option is automatically connected to an extra serial port (COM6) within the controller. The port can be configured like any other serial port including parameters such as baud rate, parity, etc. Like any other serial link, the radios operating parameters must be set to match those of the attached serial port in the EtherLogic Ultima

controller. While the radio serial port parameters are set using ICLs ScadaBuilder software on a PC, the radio is configured using a PC computer connected to the radio diagnostic serial port close to the antenna connector. Use a “straight through” serial cable. Communicating with the radio requires a terminal emulation program. This can be either the terminal emulator built into ScadaBuilder software, or the HyperTerminal software that comes with Windows, or similar alternative software. Set the terminal emulation configuration to:

19,200 baud, no parity, 8 data bits and NO flow control

The configuration menus in the radio are accessed by typing “Shift U” (be sure that “Caps Lock” is OFF, then while holding down the Shift key, press the U key). You should see the menu pictured below and the three internal radio status lights near the COM1 connector should be GREEN. Pressing the Escape key several times will cause the radio to return to normal operation.

Radio Configuration - MAIN MENU

When the radio has been placed into configuration mode, the radio status lights will glow green and the Main Menu screen will be displayed:



*SMA Antenna Connector
on side of Etherlogic*

```
MAIN MENU
Version 2.23 11-21-2002
Standard Hop Table
Modem Serial Number 911-8743

(0) Set Operation Mode
(1) Set Baud Rate
(2) Edit Call Book
(3) Edit Radio Transmission Characteristics
(4) Show Radio Statistics
(5) Edit MultiPoint Parameters
(6) TDMA Menu
```

Radio Configuration - SET OPERATION MODE

The “Set Operation Mode” screen is selected by pressing “0” at the Main Menu. In this screen, the radios basic operating mode is chosen. The screen is depicted below:

```
SET MODEM MODE
Modem Mode is 2

(0) Point to Point Master
(1) Point to Point Slave
(2) Point to MultiPoint Master
(3) Point to MultiPoint Slave
(4) Point to Point Slave/Repeater
(5) Point to Point Repeater
(6) Point to Point Slave/Master Switchable
(7) Point to MultiPoint Repeater
(F) Ethernet Options
(Esc) Exit to Main Menu

Enter Choice
```

The current operating mode for the radio is always shown at the top of this screen just under the title header.

Of the 9 available operating modes, only three of the modes are typically used with the Ultima controllers. These three modes are the “Point to Multipoint” operating modes:

Point to Multipoint Master

In this mode, there must be one, and only one Master radio in a system. All of the other radios in the network will operate as slaves to the Master. Designate one radio as the Master using selection #2 in the menu.

Point to Multipoint Slave

After a single radio has been designated as the Master, the remaining radios in the network must be set as “Slaves” using selection #3 in the menu.

Etherlogic Ultima

Point to Multipoint Slave/Repeater

To reach outlying areas in the network, the Slave radios can act as repeaters. Slave radios that will also act as repeaters are configured using selection #7 (Point to MultiPoint Repeater) in the menu. Be sure to also enable Slave/Repeater operation in Menu #5.

Return to the Main Menu

Once a radios mode has been set, press the ESC (escape key to get back to the Main Menu (only press once, or else you will end up back at the “C>” prompt).

Radio Configuration - SET BAUD RATE

The “Set Baud Rate” screen is selected by pressing “1” at the Main Menu. In this screen, the radios basic serial communication parameters are chosen. The screen is depicted below:

```
                SET BAUD RATE
                Modem Baud is 115200

(0)  230,400
(1)  115,200
(2)  76,800
(3)  57,600
(4)  38,400
(5)  19,200
(6)  9,600
(7)  4,800
(8)  2,400
(9)  1,200
(A)  Data, Parity      0
(B)  Modbus RTU       1
(C)  RS232/485        0
(D)  Setup Port       3
(E)  Turn Off Delay   0      Turn On Delay      0
(F)  Flow Control     0
(Esc) Exit to Main Menu
Enter Choice
```

The current communications speed (baud rate) setting for the radio is always shown at the top of this screen, just under the title header. The baud rate can be set to any one of ten standard speeds by simply typing a 0 through 9 corresponding to baud rates of 1,200 baud to 230,400. Any of these speeds may be used with the EtherLogic Ultima controller. The speed selected MUST match the port speed selected using the ScadaBuilder configuration software for the controller.

Parity

The radio supports the standard “Odd, Even or None” parity selections. For most applications including those using Modbus, 0 or “None” should be used.

Modbus RTU

This parameter should normally be set to “1” (enabled), forcing the radio to keep the integrity of a single message as one packet instead of using multiple packets which does not meet Modbus standard timing requirements.

RS-232/485, Turn Off Delay, Turn On Delay and Flow Control

These are not used in the Ultima controller and must be set to “0”.

Setup Port

Set this parameter to 3. This enables both radio ports for configuration.

Radio Configuration - EDIT RADIO PARAMETERS

The “Edit Radio Transmission Characteristics” screen is selected by pressing “3” at the Main Menu. The screen, with typical settings for an Ultima based SCADA system, is depicted below:

```

                                RADIO PARAMETERS

WARNING: Do not change parameters without reading manual

(0)   FreqKey           5
(1)   Max Packet Size  8
(2)   Min Packet Size  9
(3)   Xmit Rate        1
(4)   RF Data Rate     3
(5)   RF Xmit Power    10
(6)   Slave Security   0
(7)   RTS to CTS      0
(8)   Retry Time Out  255
(9)   Low power Mode   0
(A)   High Noise       0
(B)   MCU Speed        0
(C)   Remote LED       1
(Esc) Exit to Main Menu

Enter Choice

```

The parameters in this menu are geared towards handling special circumstances and should normally be left as shipped from the factory. One item though; “Remote LEDs”, must be turned on in order to enable the status LEDs located between the COM1 connector and the address switches. Be sure this parameter is set to a 1.

Most of the other parameters in this screen are used to optimize the radios operation in the event of problems in the field. They improve the operation of the radio in close proximity with other radio networks, in high (radio) noise environments, or to optimize the operation of the radio for certain mixes of data or types of protocols. In general, the radios are plug-and-play and these parameters are best left at the factory settings unless a technical support person recommends changing them. Typically, your radio setup should match the screen pictured above.

Radio Configuration - SHOW RADIO STATISTICS

The “Show Radio Statistics” screen is selected by pressing “4” at the Main Menu. The screen is depicted below:

```
                                MODEM STATISTICS

Master-Slave Distance (m) 0083200

Number of Disconnects      0
Radio Temperature          0
Antenna Reflected Power   0
Transmit Current (mA)      0000
                                Local  Remote1  Remote2  Remote3
Average Noise Level        12
Average Signal Level       0
Overall Rcv Rate (%)       0
C086EF

Press <ret> for Freq Table, <Esc> to return to main menu
```

The radio statistics screen shows an accumulated history of information regarding the performance of the radio and the quality of the radio link. Unlike the “real-time” updated information available at the Master, this information is a snapshot that can only be viewed while not operating, but it does provide a local tool to analyze the performance of a radio link.

Master-Slave Distance (m)

This value in meters is valid for distances over 1 Km (0.6 miles)

Radio Temperature

Should be 75 (°C) or less.

Average Noise and Signal Levels

These values are an average across all frequencies. Detailed information by frequency is available by displaying the Frequency Table accessed from this screen (see lower prompt line). Ideally, the noise level should be below “30” and the signal level should be at least “15” more than the noise. Note that this is NOT in dB, but arbitrary units to provide a relative signal strength and noise measurement.

Overall Rcv Rate (%)

This value provides an indication of the quality of the radio link and the impact on data throughput. A good quality link will have an Overall Receive Rate of 75% or better. The radio will not pass erroneous data, but a lower Overall Receive Rate indicates that data throughput might be affected at higher data rates, such as 115,200 baud.

Radio Configuration - EDIT MULTIPOINT PARAMETERS

The “Editing MultiPoint Parameters” screen is selected by pressing “5” at the Main Menu. The screen, with typical settings for the EtherLogic Ultima, is depicted below:

```

                                MULTIPOINT PARAMETERS

(0)   Number Repeaters           1
(1)   Master Packet Repeat       3
(2)   Max Slave Retry            9
(3)   Retry Odds                 9
(4)   DTR Connect                0
(5)   Repeater Frequency         0
(6)   Network ID                 30
(7)   Reserved
(8)   MAdvantaster Sync          0
(9)   1 PPS Enable/Delay        255
(A)   Slave/Repeater             0
(B)   Diagnostics                0
(C)   SubNet ID                  Disabled
(D)   Radio ID                   Not Set
(Esc) Exit to Main Menu

Enter Choice

```

Number of Repeaters

Repeaters extend the range of a radio network at the expense of speed. Any radio can also serve as a repeater. Set this parameter to 1 if you are using ANY repeaters. All radios in the network must have the same setting.

Master Packet Repeat

With a high quality link, set to 0 or 1 for maximum throughput. With a poor quality link, a higher number will improve getting individual messages though at the expense of speed and throughput. For Modbus networks, this value must be set to 3.

Network ID

This parameter helps avoid conflicts with other radio networks. All radios in the network should be set to the same ID value. Other networks must use a different value. Set this to any value below 4095, except the default (255).

Slave/Repeater

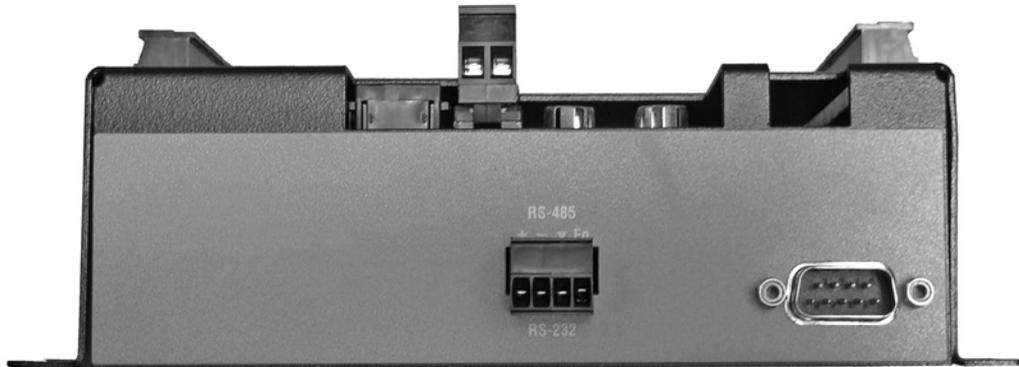
Set to 1 if this radio is a repeater as well as a node on the network. Be sure to set the Modem Mode (Menu #2) to (7) Multipoint Repeater also.

Diagnostics

Set to 1 for this radio to provide diagnostic data back to the Master.

Internal Extra RS-232/RS-485 Port Option

When an internal radio or telephone modem is not required, the internal serial port can be brought out as an extra RS-232 or RS-485 compatible interface with the addition of an optional communications card. A control relay output is provided for power management of the external serial device.

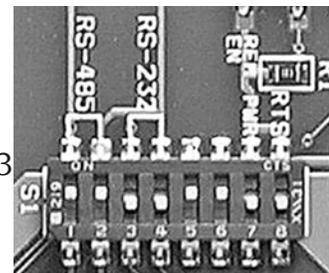


RS-232 Signal	DB 9 Connection	Terminal Block
Carrier Detect	1	
Receive Data	2	2
Transmit Data	3	1
Data Terminal Ready	4	
Ground	5	3
Data Set Ready	6	
Request To Send	7	
Clear to send	8	
RS-485 +		1
RS-485 -		2
Power Control		4

30V 6A FET - ON = Ground, OFF= OPEN

A bank of DIP switches is used to configure the RS-232/RS-485 option. The switches configure the interface signals brought out on the terminal block (RS-232 or RS-485) and select the control signal that operates the power control relay. The switches are accessed via the back controller.

- RS-232 on terminal block Switches 1 & 2 OFF, switches 3 & 4 ON
- RS-485 on terminal block Switches 1 & 2 ON, switches 3 & 4 OFF
- Internal Power control Switch 7 ON and switch 8 OFF
- RTS Power Control Switch 8 ON and switch 7 OFF



Specifications

UNIVERSAL INPUTS

Quantity, Resolution	8 total, 20 bits (1 part in 1,048,560)		
Maximum Reading	16 bits (1 part in 65,536)		
Resolution			
Converter Type	Delta-Sigma		
Input Resistance	voltage and thermocouple inputs	>1Megohm	
	Current mode (mA)	121 ohms	
	resistance sensors & contact closures	10,000 ohms	
Signal Input Ranges	Range	Minimum	Maximum
	4 to 20mA	0mA	46mA
	0 to 5Vdc	0Vdc	5. 625Vdc
	+/-_300mV	-300mV	+300mV
	resistance (ohms)	0 ohms	65,535 ohms
	Type J Thermocouple	-240.7°C	1199.0°C
	Type K Thermocouple	-261.2°C	1369.5°C
	Type T Thermocouple	-263.2°C	398.8°C
	Type E Thermocouple	-267.4°C	999.0°C
	Type R Thermocouple	-43.1°C	1759.8°C
	Type S Thermocouple	-41.3°C	1759.1°C
	Type B Thermocouple	253.4°C	1792.1°C
	Type N Thermocouple	-255.4°C	1296.8°C
	10K Thermistor, Type II	-40.1°C	203.4°C
	10K Thermistor, Type III	-40.1°C	201.1°C
	10 ohm .00427 RTD	-190.0°C	259.0°C
	100 ohm .00385 RTD	-198.9°C	869.4°C
	100 ohm .00392 RTD	-198.9°C	869.4°C
	1,000 ohm .00385 RTD	-198.9°C	869.4°C
	1,000 ohm .00392 RTD	-198.9°C	869.4°C
	Contact Closure (DI)	0	18,000 ohms
	Logic Level (DI)	0	5Vdc
Accuracy @ 25oC (% of Full Scale)	Voltage:	+/- 0.005%	
	mV, mA, Ohms, Thermistor & 100/1000 ohm RTD	+/- 0.01%	
	10 ohm RTD	+/- 0.5%	
	Thermocouple	+/- 0.03% +/- 1oC(CJ)	
Temperature Coefficient	voltage & thermocouples:	+/-5ppm/oC maximum	
	current	+/-30ppm/oC maximum	
	thermistor, RTD & ohms	+/-25ppm/oC maximum	
Input Overload Tolerance	Input current limited to 50mA, Input Voltage limiting at 6Vdc		
Overload / Transient Protection	Transorb/Self Resetting Polyfuse		

ANALOG OUTPUTS

Quantity	4
Output Type	0 or 4 to 20mA
Convertor	High-Frequency PWM
Resolution	12 bits (1 part in 4,096)
Maximum Load Resistance	250 ohms @10Vdc Loop Power 500 ohms @15Vdc Loop Power 750 ohms @20Vdc Loop Power 1,000 ohms @25Vdc Loop Power
Accuracy @ 25oC (% of Full Scale)	+/- 0.1%
Temperature Coefficient	+/-75ppm/oC maximum
Ripple & Noise	.01% maximum

DISCRETE INPUTS

Quantity	20		
Input type	Optically isolated with shared isolated commons, AC or DC		
Signal Input Ranges	Range	ON Minimum	OFF Maximum
	12/24V models	9Vac/Vdc	6Vac/Vdc
	120V/240V models	75Vac/Vdc	50Vac/Vdc
Maximum input level	50 Vac/Vdc (12/24V models), 300Vac (120V/240V models)		
DI Counting Rate	up to 40Hz (DC Pulse 50% Duty cycle), up to 10Hz (AC switched, 50/60Hz)		

LOW-LEVEL PULSE INPUTS

Quantity	2	
Signal Input Ranges	Minimum Signal	Maximum Signal
Adaptive Thresholding	+/- 75mV (150mVpp)	+/- 54V (108Vpp)
Zero-Cross Thresholding	+/- 25mV (150mVpp)	+/- 54V (108Vpp)
DI Pulse Counting Rate	>5KHz	

DISCRETE OUTPUTS

Quantity	12
Output type	Relay Contact
Output Configuration	10 x Form A (Normally Open), 2 x Form C (Normally Open/Normally Closed)
Output Rating and Contact Life	
General Use (Resistive Loads)	10Amps @125Vac, 5 Amps @250Vac or 30Vdc - 100,000 cycles
Inductive Loads	10Amps @ 277Vac - 10,000 cycles (COS=0.4) 1/10HP @125Vac, 1/6HP @250Vac -100,000 cycles
Contact Protection	RC Snubber

COMMUNICATIONS

Serial Ports	4 (+ 1 optional internal telephone modem + 1 optional internal 2nd modem/radio)
Communications Baud Rates	300 baud to 230,400 baud
Serial Port Interfaces	COM #1 RS-232, 9 pin D Male COM #3 RS-232, 9 pin D Male COM #4 RS-232, 9 pin D Male COM #5 RS-485, Removable Terminal Block, #14 to 26 stranded
Ethernet Port	10Base-T (10 Mb/sec), RJ-45

COMMUNICATIONS OPTIONS (one only per controller)

Internal Spread Spectrum Radios	900MHz, 1W, up to 115Kbaud 2.4GHz, 0.5W, up to 115Kbaud
Telephone modem w/voice	56K Baud, PC compatible
Serial Comm. Option	RS-232/RS-485 Add-on Port
Cellular Modem	GSM/GPRS Cell Modem

CONTROL & COMMUNICATIONS PROCESSOR

CPU	Intel 386EX
Memory	8MB Flash, 1MB RAM
Real Time Clock	Dallas DS1689S (IBM/PC comp.)

GENERAL SPECIFICATIONS

Field I/O Wiring Terminations	Removable Terminal Blocks Wire Size, #14 to #26 stranded or solid, #12 stranded only
Dimensions	7.0" W x 6.0" L x 2.5" D (178mm x 152mm x 64mm)
Power	10 to 26Vac, 10 to 36Vdc
Standard operation, No Options, Ethernet ON	1.5 Watts typical @ 12vdc (140mA) (No Battery Charging, All DO Off, All AO OFF, No Aux Power Load)
Low Power operation, No Options, Ethernet OFF	0.8 Watts typical @ 12vdc (140mA) (No Battery Charging, All DO Off, All AO OFF, No Aux Power Load)
Add per DO ON	225mW
Operating Temperature	-40°C to 75°C (-40°F to 167°F)
Humidity	5 to 85% RH (non-condensing)

SOFTWARE

IEC 61131-3 (ISaGRAF)

Ladder Diagram (LD)
Structured Text (ST)
Sequential Function Chart (SFC)
Function Block Diagram (FBD)
Instruction List (IL)
Flow Chart

SCADABUILDER

Serial Communications

Point-and-Click configuration of:
Modbus RTU/ASCII (Master or Slave)
DF1 (Master or Slave)
Bricknet (Peer-to-peer SCADA)
HART
NMEA-0183 (GPS)
PPP

Ethernet Communications

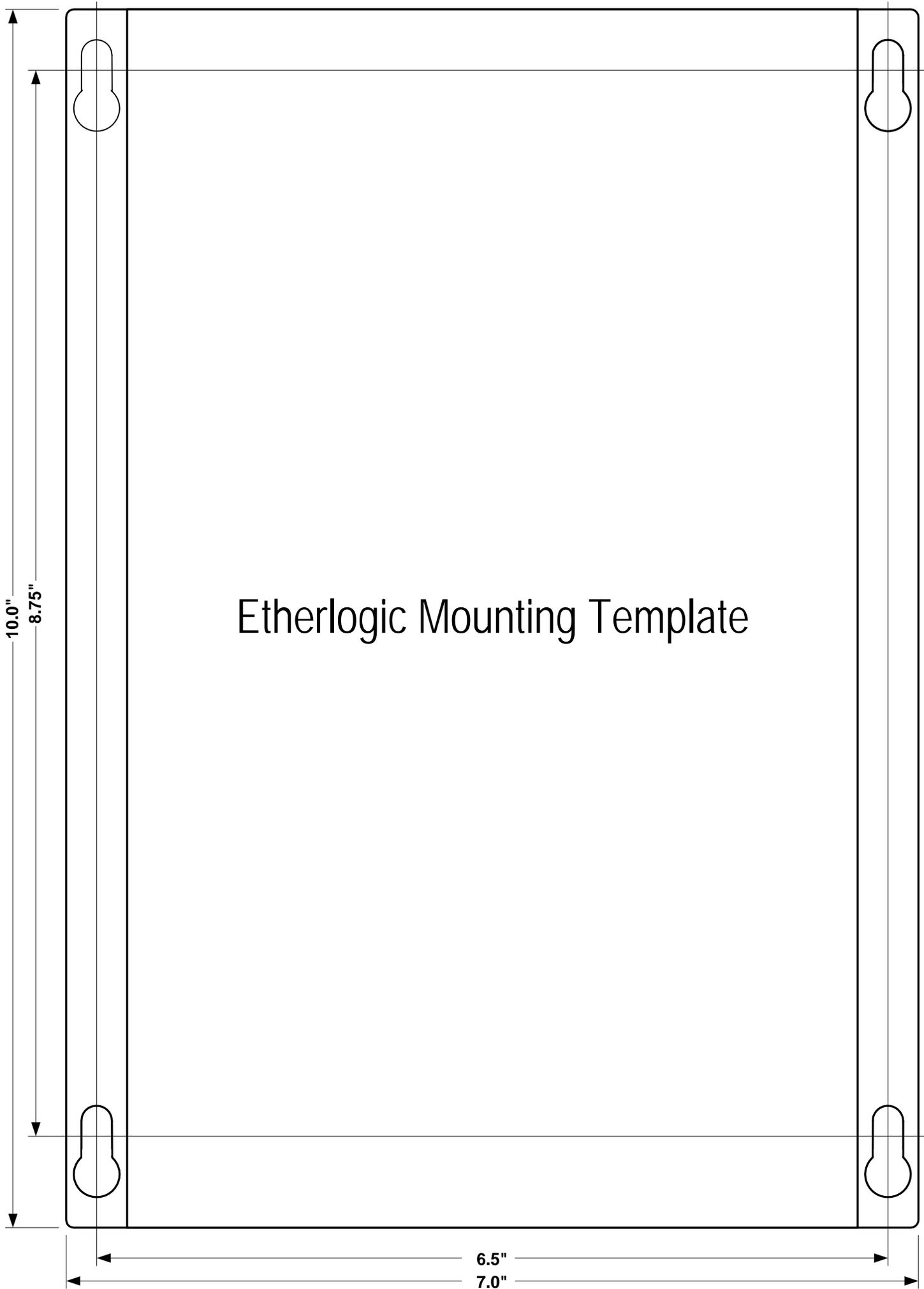
Simple HMI

Web Server HMI

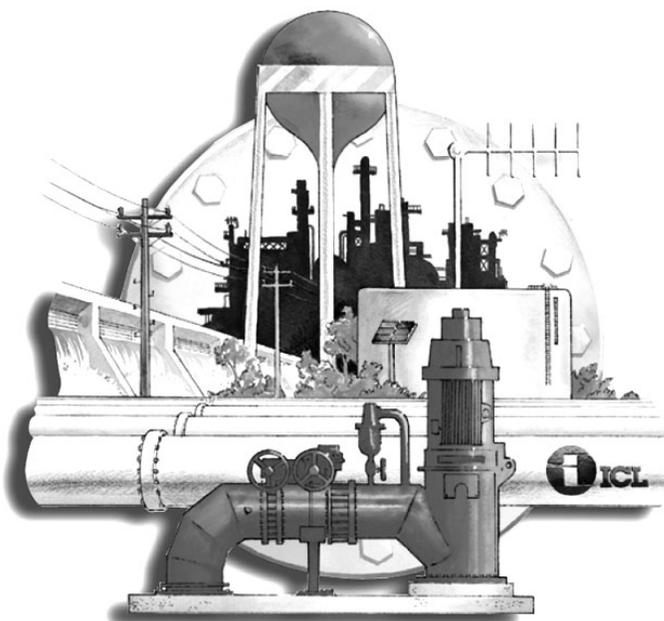
Data and Alarm Logging

Alarm Dialing

TAP (alphanumeric pager)
Modbus TCP/IP, HTTP, FTP, TELNET,SMTP
ANSI/VT100 - serial data links, Telnet over Ethernet
ErgoView - Java based
up to approximately 7MB
up to 100 tel. # lists, 256 #s/list
w/pager Numeric or alphanumeric pager
w/Voice over 14 minutes message capacity



Etherlogic Mounting Template



Industrial Control Links, Inc.
12840 Earhart Ave.
Auburn, CA 95602

USA/Canada: (800) 888-1893
International: (530) 888-1800

Fax: (530) 888-1300
(530) 888-7017

E-mail: support@iclinks.com
Web-site: www.iclinks.com

Doc# 60600003 (Rev. C)