

# The MultiPro Family of Automation Controllers



\* Compact: Measures only 5.9" high x 5.3" wide

## Impressive Features to Tackle Demanding Applications

### Features / Applications

MULTITASKING & INTEGRATION OF DIGITAL, ANALOG & MOTION CONTROL	Web Handling
HIGH-PERFORMANCE QUAD SERVO CONTROL	X-Y Table Positioning
POWERFUL QUAD STEPPER CONTROL	Tensioning Systems
ELECTRONIC GEARING, RATIOMETRIC CONTROL	Edge Guiding
HIGH-RESOLUTION ANALOG I/O FUNCTIONS	Winding Systems
AXIS FOLLOWER CONTROL & REGISTRATION MARK SENSING	Cut-to-Length
CONTROL TUNED BY PID OR PAVIF ALGORITHMS	Ratiometric Dispensing
UP TO 64 I/O POINTS PER UNIT	Motor Conveyor Systems
FULL-FEATURED PROGRAMMING & DEBUGGING	Robot Handling Systems
ETHERNET, SERIAL & DEVICENET COMMUNICATIONS	Packaging
	Material Handling
	Tapping Systems
	Hydraulic Motor Control
	Press-Brake Feed Systems

## Powerful Integrated Control in a Compact\* Package

- Extensive Multitasking Capability
- Advanced Motion Control
- Extensive Toolset for Control Applications
- Ethernet/DeviceNet Communications
- High-Speed Processing for Demanding Applications



Control Technology Corporation  
 25 South Street, Hopkinton MA 01748-2217  
 508.435.9595 • 800.282.5008 • Fax: 508.435.2373  
 info@ctc-control.com • www.ctc-control.com

# Tailored to Fulfill Multiple, Application-Specific, Totally-Integrated Machine Control Functions

## Powerful Features, Small Footprint and Increased Processing Speed for Demanding Applications

Master your machine automation projects faster and better with the powerful MultiPro™ family of stand-alone, +24 VDC powered automation controllers. Processing speeds have been increased by a factor of three over earlier models, delivering impressive response times. All models have two RS-232 ports, providing simultaneous operator interface, programming and diagnostics. MultiPro's impressive set of automation features simplifies and accelerates development where you need to integrate analog, digital and motion control. Compact size, choice of communications and pricing make the MultiPro easy to design into applications where space and budget are constrained.

## True Multiprocessing for High Performance

MultiPro delivers high-performance control by dedicating individual CPUs to the analog I/O subsystem, motion controller, communications processor, and the main controller. MultiPro's efficient hardware design enables you to achieve high-performance machine control without endless hours of software optimization. Individual processors deliver repeatable, high-precision results, while the overall control strategy is orchestrated by your Quickstep control program, which is capable of performing up to 28 simultaneous tasks.

## Software to Accelerate Implementation Time

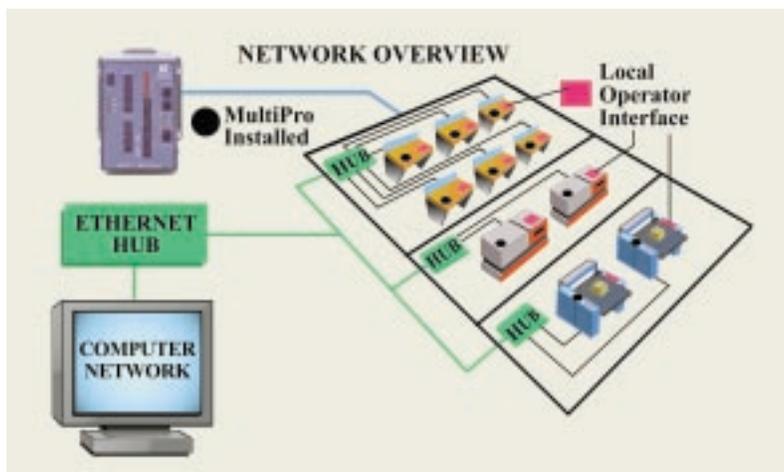
Your control strategy will quickly become reality with the Quickstep for Windows State Language. With less than a day's training, engineers are able to begin working productively on their automation projects! Quickstep combines an intuitive language structure with powerful diagnostic tools developed specifically for integrated machine automation. All analog and digital I/O control, motion control and communications functions are implemented using the easy to understand English-like instructions of this single language.



*The Quickstep™ for Windows™ State Language is designed to integrate the control of servos, stepping motors, analog I/O and digital sequencing. It features fully integrated communications and ultra fast design setup. Its development tools save design/debug time. Add this to the use of helpful descriptive names for all your I/O and registers, and an instruction set that includes motion control and other high-level instructions, and you'll never want to see a rung of ladder logic again.*

*Quickstep for Windows is a unique modular programming language that enables you to define your control strategy with easy-to-learn English-like syntax. You build your control strategy as a series of steps, each of which corresponds to a process event. Each step has four parts:*

- 1. A step name that identifies the step for use elsewhere in the program.*
- 2. A comment section that holds description or explanation of the step.*
- 3. An output section that defines any outputs to the process that should occur during that step.*
- 4. A statement section that lists all logic, monitoring, calculations, commands and other programming that should occur during that step.*



*MultiPro provides a fast track from development to production. Communications capabilities are in place for process validation and overall system monitoring.*

Step Name	[5] Stamp_Part
Comment	;;;While the pusher holds the part in place, the stamp ;;;is turned on to stamp the part. Once the stamp has ;;;fully extended we go to Retract Stamp and Pusher
Output	Stamp_On
Statements	monitor Stamp_Extended goto Retract_Stamp_and_Pusher

## Intelligent Communications

MultiPro communications ports provide the flexibility to



integrate with host computers, operator interfaces or external devices. Any of the MultiPro controller's internal registers, flags, and other resources can be monitored or changed from an RS-232 or Ethernet communications port, using CTC's 32-bit DLL or via HMI drivers. MultiPro+ controllers are programmed and debugged over RS-232 or Ethernet connections (RS-232 only for "non-plus" models).

Several off-the-shelf software interface tools are available for use in Windows-based operator interfaces, or to interface with external devices such as bar code readers, weigh scales, or host computers.

Ethernet communications also provide fast networking to host computers, and peer-to-peer networking between MultiPro+ controllers on the same network. MultiPro controllers may be configured as masters, slaves, or both on DeviceNet™ networks, and support Bit-Strobe, Poll, Change-of-State, Cyclic and Explicit messaging.

## Advanced Servo Motor Control



The MultiPro is suitable for use in a wide variety of demanding servo applications. Up to four axes of high-performance servo motor control is readily accomplished with the MultiPro due to its extensive range of capabilities—including ratiometric operation, registration sensing, multiple compensation modes and multi-step home sensing. Each servo axis supports operations at rates up to 4,000,000 counts per second, accelerating at rates up to 130,000,000 counts/sec<sup>2</sup>. Velocities may be set to a resolution of 1 count/sec. Smooth performance throughout a motion profile is provided by 13-bit analog outputs, isolated from controller logic. Six control inputs per axis perform a number of useful functions, including home position sensing and detecting forward and reverse limits.

## Choice of Compensation Techniques

Two filter modes are available to resolve difficult stability problems:

- PID, the traditional Proportional-Integral-Derivative compensation filter
- PAVff, Proportional with Acceleration and Velocity feed forward terms

MultiPro servo models also support direct (non-filtered) control of the command output for open loop velocity control.

## Special Software Functions

Motor tuning may be accomplished in minutes using CTCMON, a separate program included with Quickstep, with its register monitoring and modification capabilities. A special feature of the MultiPro servo models is automatic ratio control of two axes (electronic gearing), where one axis is under program control and the other follows it via a programmable ratio.

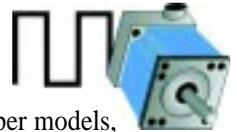
The MultiPro+ 1.5 Servo and Cam Servo models provide a unique feature called axis-follower control. In this mode, a second encoder input is used to monitor an externally driven encoder. The servo axis automatically follows this position via a programmable ratio.

The high-speed registration input allows the MultiPro controller to "see" a registration mark within  $\pm 1$  encoder count up to the maximum input of four million counts per second! Two modes of registration are thereby supported. In the first mode, the servo position can be stored at registration to allow position compensation or adjustment for the servo axis. In the second mode, a pre-set move distance from the registration mark can be achieved, providing extremely fast, accurate and repeatable registration control.

## Programmable Limit Switch Capability

All MultiPro servo models support PLS (Programmable Limit Switch) control. The PLS is configured with special purpose registers as well as with the Data Table. The registers provide configuration and control, while the Data Table contains the image of transition points and output states.

## Powerful Stepper Motor Control



With the MultiPro Stepper models, a high maximum step rate lets you control microstepping devices as well as half- and full-step drives. In addition, the stepper capabilities are implemented using the powerful servo command set of the Quickstep language. These commands enable you to execute continuous velocity-based moves in addition to absolute and relative positioning commands.

Velocity may be reprofiled on the fly and the motor's current theoretical velocity and position may be read at any time. Motion parameters can be derived from any other controller resource. This flexibility provides:

- Local or network-based operator control derived from many different input devices, including computer programs and touch screens. The controller can also make automatic adjustments based on any condition it can sense.
- Derived motion parameters from a Data Table stored with your program—with the table row being selected based on the product currently being manufactured.

## Axis Control Inputs

Six dedicated inputs perform several useful functions: jogging (clockwise or counterclockwise), home position sensing, detecting forward and reverse limits, and soft stop. The soft stop input not only decelerates the motor to a stop, but also captures the position at which the input occurred, enabling accurate synchronization of the axis to registration marks on a workpiece or machine.

## High-Resolution Analog I/O



High-performance, high-resolution analog capabilities are provided with the MultiPro MC machine controller models. The analog subsystem supports eight differential analog inputs, eight analog outputs, and eight digital outputs. Bipolar ( $\pm 10V$ ) analog inputs offer 15-bit resolution, and may be individually

# Choose from 13 Ready-to-Use Controller Configurations...

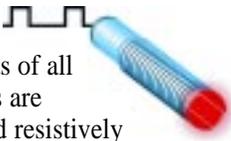
programmed to digitally filter the incoming signal, providing increased stability. From 2 to 256 analog samples may be continuously averaged at an update rate of 2.083 milliseconds.

Eight bipolar analog outputs have 13-bit resolution and an output range of  $\pm 10V$ . Eight open-collector outputs are also available for driving DC loads. Each output handles up to a 0.5A load and provides over-current and short circuit protection. These inputs are typically used for thresholding triggering on the analog inputs. Each I/O point is refreshed every 2.083 milliseconds and made available to the main CPU via dual-port RAM technology. Therefore, your Quickstep application program is free to interrogate analog inputs and write to the outputs at any time without injecting lengthy conversion delays into the execution time.

## Input Threshold Triggering

A special feature of the analog models is Input Threshold Triggering. This capability enables each analog input to be locally configured to control an associated digital output upon reaching a predefined setpoint. A setpoint can be dynamically adjusted from the master control program. Threshold sensing is handled by the dedicated analog subsystem CPU and is repeatable to within 2.25 milliseconds.

## Digital I/O



The digital inputs of all MultiPro models are self-powered and resistively “pulled up” to an external +24 VDC supply. Actuating an input merely requires closing an external switch to the power supply’s return, or common.

Open-collector digital outputs provide great flexibility, enabling many types of 24 VDC load devices to be accommodated. Loads such as solenoid valves, indicator lights, small motors and motor starters may be easily interfaced, up to current levels of 500 mA per output (a total of 5 Amps per output module also applies).

*To find the ideal MultiPro model for you, refer to the handy specification/price chart on the next page* ►



## The Economy Series: powerful control for less than \$2000

- Model 2648 MultiPro Dual Servo
- Model 2649 MultiPro 64 I/O Dual Servo
- Model 2652 MultiPro Dual Stepper
- Model 2655 MultiPro 64 I/O Dual Stepper



## The Ethernet Network Family: remote control of the enterprise

- Model 2644 MultiPro+ MC
- Model 2645 MultiPro+ Dual Stepper
- Model 2647 MultiPro+ Dual Servo
- Model 2647-1.5 MultiPro+ 1.5 Servo
- Model 2647-1CF MultiPro+ Cam Servo



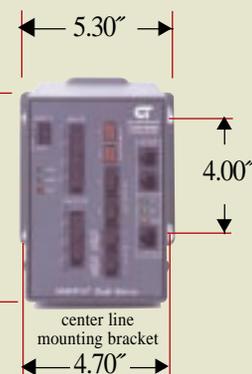
## Advanced Integration Series: for your most demanding applications

- Model 2646 MultiPro MC Dual Servo
- Model 2650 MultiPro Quad Servo
- Model 2651 MultiPro Dual Servo with DeviceNet
- Model 2654 MultiPro 32 I/O Quad Stepper

## Extreme versatility in a small package... under one programming environment

*The small footprint, only 5.9" high by 5.3" overall width by 5.5" deep, makes the MultiPro family a uniquely compact series of powerful machine controllers.*

*Designed for industrial environments, the units are rugged and components have been selected for their reliability under factory conditions.*



*The small footprint of the MultiPro makes it ideal for applications where space is limited.*

### Specifications for the MultiPro Controller Family

Model Number	Description	Digital Inputs	Digital Outputs	Analog Inputs	Analog Outputs	Servo Axes	PLS	Registration	Cam Following	Axis Following	Stepping Motor Axes	RS-232 Ports	Network Support	Price
2644	MultiPro+ MC	16	24	8	8	N/A	N/A	N/A	N/A	N/A	N/A	2	Ethernet	\$2490
2645	MultiPro+ Dual Stepper	16	16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2	2	Ethernet	\$2200
2646	MultiPro MC Dual Servo	16	24	8	8	2	16	2	N/A	1	N/A	2	N/A	\$2490
2647	MultiPro+ Dual Servo	16	16	N/A	N/A	2	16	2	N/A	1	N/A	2	Ethernet	\$2490
2647-1.5	MultiPro+ 1.5 Servo	16	16	N/A	N/A	1.5	16	1	N/A	1	N/A	2	Ethernet	\$2395
2647-1CF	MultiPro+ Cam Servo	16	16	N/A	N/A	1	16	1	1	1	N/A	2	Ethernet	\$2450
2648	MultiPro Dual Servo without Ethernet	16	16	N/A	N/A	2	16	2	N/A	1	N/A	2	N/A	\$1850
2649	MultiPro 64 I/O Dual Servo	32	32	N/A	N/A	2	16	2	N/A	1	N/A	2	N/A	\$1995
2650	MultiPro Quad Servo	16	16	N/A	N/A	4	16	4	N/A	2	N/A	2	N/A	\$2495
2651	MultiPro Dual Servo with DeviceNet	16	16	N/A	N/A	2	16	2	N/A	1	N/A	2	DeviceNet	\$2495
2652	MultiPro Dual Stepper	16	16	N/A	N/A	N/A	N/A	2	N/A	N/A	2	2	N/A	\$1595
2654	MultiPro 32 I/O Quad Stepper	16	16	N/A	N/A	N/A	N/A	4	N/A	N/A	4	2	N/A	\$2195
2655	MultiPro 64 I/O Dual Stepper	32	32	N/A	N/A	N/A	N/A	2	N/A	N/A	2	2	N/A	\$1775

### What our customers say about their recent projects...

*“Start-up time was far less than with other controllers because MultiPro is so easy to use.”*

*“MultiPro gives you 50 pounds of technology in a two pound box.”*

*“Amazing! Motion, I/O, Networking and Communications, all in one package... and I can hold it in one hand!”*

*“We chose MultiPro because it was a great value for this application and Quickstep was easy to use.”*

# • Specifications for the MultiPro Family of Controllers

## Controller Characteristics

Specifications	Min	Typ	Max	Unit	Typical Performance Specifications	Typ	Unit
Ambient Temperature					Sense input, jump to new step, change output	.5	ms
Operating	0		50	°C	Perform multiplication (between volatile registers)	.3	ms
Storage	-20		80	°C	Change servo profile	1.0	ms
Power Input Range	22	24	27	VDC	Time delay duration, 10 ms programmed	10.08	ms
Current Requirement at 24VDC		.45	.6	Amp	Time delay duration, 1 sec programmed	1.001	sec
User Memory Capacity (4 yr. Lithium-cell RAM)		32K		Bytes	Software Counters	750	Hz

The Main CPU is a Hitachi SH2 processor running at 24.576 MHz

All specifications shown are at 25°C unless otherwise noted.

## Analog I/O Characteristics

Absolute Maximum Ratings	Min	Max	Unit	Input Resolution (15-bit)	.00305	%FS		
Maximum Analog Input Voltage		±15	VDC	Input Accuracy (25°C, 8-sample Filtering)	.00305	%FS		
Minimum Analog Output Load Resistance	2.0		kΩ	Input Conversion Time (asynchronous)	2.083	ms		
Maximum Output Current				Input Filter Settings (Default = 1 Sample)	2.083	533.248 ms		
Precision 10 Volt Reference Output		25	mA	Threshold Triggering Response (Analog Input to Digital Output Response)	2.25	ms		
Digital Outputs (per Output)		500	mA					
Analog Isolation - Voltage Withstand (one minute duration max.)		1500	volts					
<b>Analog Output Specifications</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Unit</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Unit</b>
Output Voltage Range	-10.000		10.000	VDC	On Voltage (I <sub>o</sub> = 500 mA)	.6	1.2	VDC
Output Resolution		2.44		mV	Off Leakage (applied V = 24 VDC)	1	100	µA DC
Output Settling Time					Maximum Output Current*		500	mA DC
-10.000 to +10.000 V		.2		ms				
0 to 5.000 V		.1		ms				
<b>Analog Input Specifications</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Unit</b>				
Differential Input Range	-10.000000		+10.000000	VDC				
Common Mode Voltage Range	-10		+10	VDC				
Input Resistance		10		MΩ				

\*All digital outputs are short circuit and over-current protected.

## Stepper Motor Controller Characteristics

Absolute Maximum Ratings	Min	Max	Unit	Notes:
+5 V. Supply Output Current - Note 2 (for powering external drive inputs)		96	mA	1. Specifications shown are at 25°C, unless otherwise noted.
Ambient Temperature (operating)	0	50	°C	2. Powered from the controller's 24 V supply.
<b>Specifications</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Unit</b>
<b>Pulse and Direction Outputs</b>				
Low V <sub>OL</sub> (I <sub>OL</sub> = 24 mA)	0.36		0.44	VDC
High V <sub>OH</sub> (I <sub>OH</sub> = 24 mA)	4.44		5.25	VDC
<b>Pulse Width (jumper configurable)</b>				
For microstepping drives		1.3		ms
For half- and full-step drives		34		ms
<b>Axis Control Inputs</b>				
Off Voltage (I <sub>i</sub> = 0 mA) - Note 3		24.0	26.4	VDC
On Current (V <sub>i</sub> = 0 V)		2.1	2.5	mA
Threshold				
Low-to-High		8.5		VDC
High-to-Low		7.5		VDC
<b>Performance Specifications</b>	<b>Min</b>	<b>Typ</b>	<b>Max</b>	<b>Unit</b>
Maximum Velocity Setting	1		250,000	Steps/sec
Resolution of Max. Velocity Setting		3.9		Steps/sec
Accel. and Decel. Settings			130,000,000	Steps/sec <sup>2</sup>
Resolution of Accel/Decel Setting		15.3		Steps/sec <sup>2</sup>
Position Range (Absolute Mode)	-2,147,483,648		2,147,483,647	Steps
Relative Motion Command Range	-2,147,483,648		2,147,483,647	Steps

### Notes:

- Specifications shown are at 25°C, unless otherwise noted.
- Powered from the controller's 24 V supply.
- Dependent on the controller's auxiliary supply voltage (24 V typ).

### Commands

For programming flexibility the MultiPro Dual and Quad Stepper use Quickstep™ servo commands: Profile Servo, Turn Servo, Stop Servo, Search and Zero Servo, Zero Servo, Monitor Servo, If Servo, and Store Servo.

The MultiPro Dual and Quad Steppers also support commands for three modes of operation: absolute positioning, relative positioning and velocity (continuous). Automatic home-seeking modes are also supported.

Each axis provides six axis control inputs, for performing the following functions:

**SOFT STOP** – stops motor motion.

**FWD-LIM** – inhibits motion in the forward direction.

**REV-LIM** – inhibits motion in the reverse direction.

**HOME** – establishes a home (zero) reference point for absolute positioning.

**JOG CW** and **JOG CCW** – turns the motor cw or ccw at the programmed rate.

**START** – A programmable option replacing JOG CW that allows a motion to wait for this input.

# Exceeding Your Performance Expectations... in a Small Package

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## Digital I/O Characteristics

Absolute Maximum Ratings	Min	Max	Unit
Applied Input Voltage – Note 1	0	27.0	VDC
Applied Output Voltage – Note 2	0	24.0	VDC
Output Current			
Single Output		500	mA
Total Module Limit		5	Amps
Digital Output Specifications	Typ	Max	Unit
Output On Voltage ( $I_o = 500$ mA)	0.8	1.8	VDC
Output Off Leakage (applied V = 24 V) – Note 3	0.01	0.75	$\mu$ A

Digital Input Specifications	Typ	Max	Unit
Input Off Voltage ( $I_i = 0$ mA)	24.0	26.4	VDC
Input On Current ( $V_i = 0$ V)	-2.10	-2.85	mA
Input On Current Threshold ( $V_i = 8$ V typ)	-1.0	-1.85	mA
Input Off Current (typ leakage current allowable)		-250	$\mu$ A

### Notes:

- Under normal operation, no external input voltage is applied – inputs should be externally switched to the input common.
- An on-board protection diode returns to +24 V from each output.
- In the off state, unconnected outputs are internally pulled to +5 V through a diode and an LED indicator.

## Servo Motor Controller Characteristics

Absolute Maximum Ratings	Min	Max	Unit	
Command Load Resistance	2		k $\Omega$	
Encoder Input Voltage	0.0	+5.0	VDC	
Encoder (+5 V) Supply Output Current (total for each pair of axes)		500	mA	
Specifications	Min	Typ	Max	Unit
Command Outputs				
Nominal Voltage Range	-10.0		+10.0	VDC
Differential Encoder Inputs				
Nominal Input Range	0.0		+5.0	VDC
Open-circuit Voltage ( $I_i = 0$ mA)		5.0	5.38	VDC
Logic-low Current ( $V_i = 0$ V)		1.1	1.2	mA
Axis Control Inputs (except Registration)				
Off Voltage ( $I_i = 0$ mA) - Note 1		24.0	26.4	VDC
On Current ( $V_i = 0$ V)		2.12		mA
Threshold				
Low-to-High		5.1		VDC
High-to-Low		4.9		VDC
Registration Auxiliary Input				
Off Voltage ( $I_i = 0$ mA)		24.0	26.4	VDC
On Current ( $V_i = 0$ V)		2.28		mA
Threshold				
Low-to-High		5.1		VDC
High-to-Low		4.9		VDC
Performance Specifications	Min	Typ	Max	Unit
Maximum Velocity Setting	1		4,000,000	Steps/sec
Resolution of Max. Velocity Setting		1		Steps/sec
Accel. and Decel. Settings	1		130,000,000	Steps/sec <sup>2</sup>
Resolution of Accel/Decel Setting		1		Steps/sec <sup>2</sup>
Position Range (Absolute Mode)	-2,147,483,648		2,147,483,647	Steps
Relative Motion Command Range	-2,147,483,648		2,147,483,647	Steps
Position Registration Accuracy		$\pm 1$		Count

### Notes:

- Dependent on controller auxiliary supply voltage (24 V. typ).
- PID parameters are programmed as relative values in the range of 0 to 255. Acceleration ( $A_{ff}$ ) and Velocity feedforward ( $V_{ff}$ ) range from 0 to 32767.
- In Performance Specifications, the term *Step* refers to one edge transition on either encoder input for that axis.
- Ratio Range for both axis following and ratio control is  $\pm 1$ : 32767 minimum and  $\pm 32767$ : 1 maximum. Depending on the application, high ratios may result in instability.

### Commands

Commands are supported for three modes of operation: absolute positioning, relative positioning and velocity (continuous) mode operation. Automatic home-seeking modes are also supported.

Instantaneous position and error data may be obtained at any time, allowing implementation of self-teaching and fault monitoring programs.

Each axis provides six axis control inputs, for performing the following functions:

**KILL** – commands the processor to disable servo output (note: in critical or dangerous applications, external means should be used to implement an E-STOP function!).

**FWD-LIM** – inhibits motion in the forward direction.

**REV-LIM** – inhibits motion in the reverse direction.

**HOME** – used to establish a home (zero) reference point for absolute positioning.

**START** – any motion may, optionally, be programmed to wait for this input.

**REGISTRATION** – accurately captures the servo position and, if desired, can alter the move.

## Communications Characteristics

Specifications	Min	Typ	Max	Units
<b>RS-232 Communications</b>				
RS-232 Transmitters		$\pm 9$	$\pm 12$	VDC
RS-232 Receivers	$\pm 3$		$\pm 12$	VDC
<b>Ethernet Communications</b>				
Transceivers 10 Megabit / sec conforming to IEEE 802.3 standard			1.5	AC PP
Total Nodes Supported		999		Nodes
Total Nodes per Segment		30		Nodes
Cable Length per Segment		185		Meters
Cable Length per Network		925		Meters

Specifications	Min	Typ	Max	Unit
<b>DeviceNet Communications</b>				
DeviceNet Power		11	24	VDC
DeviceNet Load		100	150	mA

### Network Performance Considerations

Host Communications	Typ	Max	Unit
16-Register Read		9-12	ms
50-Register Read		10-13	ms

# About Control Technology Corporation

CTC manufactures automation controllers that are uniquely efficient at integrating high-performance servo control, stepping motor control, analog sensing, communications and, of course, conventional I/O into a single architecture. Since 1975, our controllers and programming languages have been used by thousands of automation control engineers throughout the world for fast implementation of factory integration.

Our business is focused on making automated machines work smarter and faster, and offering our customers superior tools to master their machine control projects. Unlike many controls suppliers, we design and manufacture most of the products we sell, providing our customers with exceptional value and support.

Our products serve as the brain and nervous system of the automated machines developed by our customers. Our purpose is to provide the tools for accomplishing more with considerably less effort. This philosophy extends to our own employees, to the control engineers who use our products and to the operators who ultimately run the automated systems.

At our headquarters in Hopkinton, Massachusetts, we maintain a senior staff with advanced developmental expertise in motion control, analog circuit design, control software engineering, language technology and user interface design. We are dedicated not merely to innovation, but to state-of-the-industry invention across a broad spectrum of technologies. Our efforts result in highly-integrated products for diverse applications in machine and process control, data acquisition and communications, medical instrumentation, scientific test and measurement, and more.

CTC manufacturing facilities incorporate many of the advanced techniques used in precision printed circuit board design and assembly. To ensure a quality product we do the following:

- maintain our own automated surface mount assembly equipment
- use advanced CAD software for all mechanical and electronic design
- inspect components, burn-in and 100% test finished products

## Technology Centers and Local Support

CTC maintains modern Technology Centers in Hopkinton, Massachusetts, Mequon, Wisconsin and Fremont, California. Each is equipped as a training and support facility for customers in the region. A variety of automation seminars and workshops are conducted at these offices and customers are sent technical updates to ensure that current information is available to all design and engineering personnel who work with CTC controllers and software. In addition, a field force comprised of factory trained sales representatives and distributors provide fast turnaround for products and technical services, and offer training on a local basis.



**Control Technology Corporation**  
25 South Street, Hopkinton MA 01748-2217  
508.435.9595 • 800.282.5008 • Fax: 508.435.2373  
info@ctc-control.com • www.ctc-control.com