

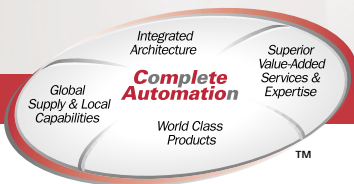
*Integrated
Architecture*

**Complete
Automation**

*Global
Supply & Local
Capabilities*

*World Class
Products*

*Superior
Value-Added
Services &
Expertise*



WELCOME TO THE WORLD OF COMPLETE AUTOMATION

Digital Servo Drive Power and Flexibility



Ultra Family Servo Drives



Bringing Together Leading Brands in Industrial Automation

Ultra Family Drives – A Broad Range of Power and Flexibility

The new Ultra Family creates a comprehensive set of servo drive products that range from simple analog command control to state-of-the-art, single-axis intelligent position control. Three Ultra Family drives provide this range of features. The Ultra3000 is a high-performance, digital servo drive that provides analog command control, preset speed and torque control, as well as master/follower operation.

The Ultra3000i digital servo drive with indexing adds basic position control capability to the Ultra3000 feature set.

The Ultra5000 drive is a flexible, powerful, C-programmable intelligent positioning drive.



Ultra Family

The entire Ultra Family is configured and programmed using Ultraware software. Ultraware provides a rich, intuitive tool set that includes sophisticated digital storage scope capability, a comprehensive array of diagnostics, and a file management system that helps organize multiple configuration files and motion programs.

To complete your system, the entire Ultra Family will operate a wide variety of Allen-Bradley high-performance rotary servomotors. The Ultra Family also offers seamless support of high-performance linear motors for your most demanding linear motion applications.

How Much Sophistication Does Your Application Require?

With the Ultra Family of drives, you can use the product that is the right fit for your application.

Ultra5000 Intelligent Positioning Drive

- When your application demands extremely high performance and flexibility, the Ultra5000 will provide you with an unprecedented level of performance at a reasonable price.
- High-speed digital signal processor technology, combined with C programmability, allows the Ultra5000 to accommodate the most demanding applications and execute motion programs extremely fast.
- High-speed applications such as labelers, smart belts, and flying cutoff systems will benefit from the Ultra5000's flexibility and performance.
- Because the Ultra5000 uses the standard ANSI C library of functions, it provides a rich set of math, string, and array commands that are not usually available on intelligent positioning drives.

Ultra3000 Digital Servo Drive

- Use the Ultra3000 with PLC, PC-based and stand-alone motion controllers that generate analog torque and velocity commands. Digital velocity and current loops in the Ultra3000 provide excellent, stable performance, and the Ultraware software makes them easy to set up.
- If your application requires accurate velocity control, the 8 preset velocities available on the Ultra3000 allow several speeds to be selected using the drive's digital inputs.
- The Ultra3000's flexible master/follower mode allows 8 different master/follower ratios to be selected using the drive's digital inputs.

Ultra3000i Digital Servo Drive with Indexing

- The Ultra3000i drive provides an economical solution to applications that require simple position control by eliminating an external motion controller or PLC card. Using the Ultra3000i's digital inputs or DeviceNet, 64 stored indexes can be selected. Indexes can be absolute positions, incremental distances, and even registration sensor-based moves. Also, multiple indexes can be linked together to form complex motion sequences, and blended indexes can be used to create complex profiles.

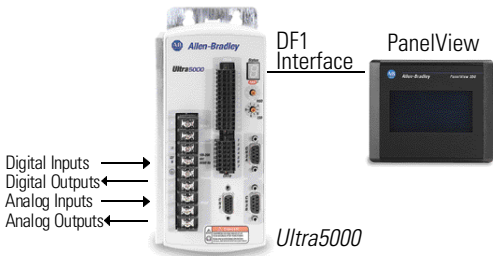
Platform Integration or Stand-Alone Flexibility

Motion control is the most important component to reducing cycle time in many applications. For higher performance and lower overall automation system costs, users now expect systems where multiple control functions, such as motion control and sequential control, integrate on single platforms for a single point of programming.

The Allen-Bradley Ultra Family is designed to provide OEM machine builders the flexibility of distributed, stand-alone component integration or broader integration into any machine architecture including Allen-Bradley's ControlLogix platform via analog command signals or direct SERCOS digital interfaces. ControlLogix technology integrates motion and sequential control functionality into a single multitasking controller platform that results in higher system performance, faster application development, easier maintenance, lower system costs, and simplified system installation.

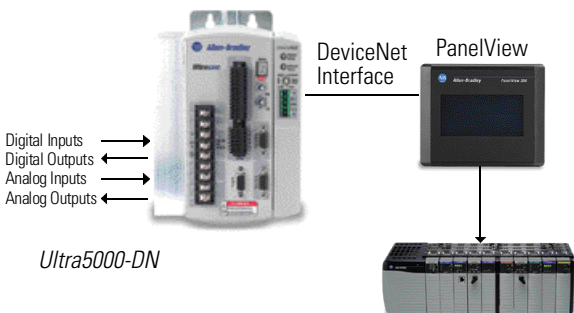
Ultra5000 Intelligent Positioning Drive

The Ultra5000 Intelligent Positioning Drive combines a high performance motion controller and a single axis servo drive into a single, cost-effective package.



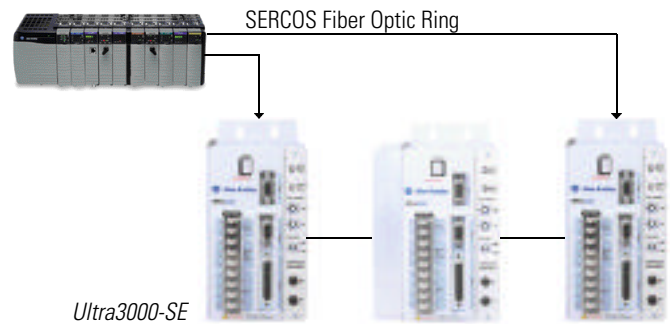
Ultra5000 with DeviceNet

The Ultra5000 and DeviceNet network combine to provide high-performance motion control capabilities with the versatility of network communications.

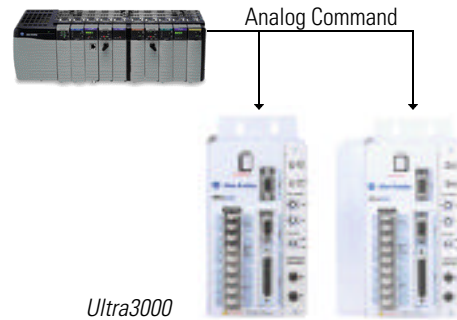


Ultra3000 with ControlLogix

The Ultra3000 can be used with Allen Bradley's ControlLogix PLC platform in a variety of ways. For the most complete integration, the 1756-M08SE and Ultra3000 with SERCOS interface provide OEM's with a high performance, single point commissioning system.

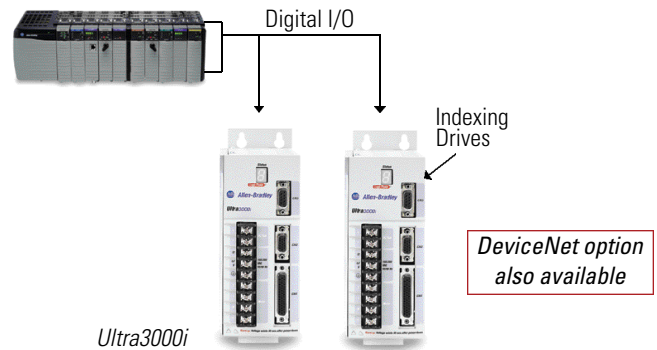


Using the ControlLogix 1756-M02AE analog card with the Ultra3000 provides a traditional motion solution for multi-axis applications.



Ultra3000i Indexing Servo Drive and ControlLogix

The Ultra3000i's indexing capability can often eliminate the need for a PLC motion card in applications where point-to-point positioning is required in a cost effective package.



Key Benefits of the Ultra5000 Intelligent Servo Drive

- ❖ Fully programmable integrated motion controller and drive to provide advanced motion control functions to any single axis application
- ❖ High-speed processing for increased axis performance and control capabilities
- ❖ Integrated drive, controller and I/O packaging eliminates system components, connections and cost
- ❖ Motion programs are created in ANSI C for fast code execution, compact code and standard development environment.
- ❖ Increased machine reliability by incorporating a proven power architecture
- ❖ Cost effective and seamless integration into stand-alone or control system topologies
- ❖ Standard DF-1 Interface for stand-alone applications, optional DeviceNet communication interface for supervisory control communications.

Ultra5000 Features

Each intelligent positioning drive features:

- ❖ 100-240V AC, single phase input
- ❖ Standard high-density D-Shell connectors for encoder feedback connections
- ❖ Pluggable spring clamp terminals for ease of wiring I/O and auxiliary feedback
- ❖ Sixteen general purpose digital inputs and eight general purpose digital output
- ❖ Two general purpose analog inputs and outputs
- ❖ Support for incremental, high resolution and multi-turn absolute feedback, including Stegmann Hiperface and sine/cosine encoders
- ❖ Automatic motor recognition capability with intelligent feedback devices, eliminating the need to configure motor parameters.
- ❖ CE compliance and UL listing

Ultra5000 Family



0.5 kWDrive



1.0 kWDrive



2.0 kWDrive

Key Benefits of the Ultra3000 Digital Servo Drive

- ❖ The Ultra3000 provides simple integration into Allen-Bradley machine control architectures. It accepts analog 0-10V, step/direction and master following command sources along with SERCOS and DeviceNet connectivity across the entire Ultra3000 family.
- ❖ Optimized motor/drive combinations are available for each application. The Ultra3000 can operate a wide variety of brushless servo motors, including the Allen-Bradley Y-, LD-, N-, H-, F-, W- and MP-Series motors along with linear and third-party motors.
- ❖ To eliminate costly and time consuming machine homing cycles, the Ultra3000 has built-in support for multi-turn absolute encoders or an option to supply external logic power to maintain position during power loss.
- ❖ Ultraware software is a powerful commissioning and diagnostic tool designed to increase your productivity and allows you to optimize your system's performance quickly and easily.

- ❖ The Ultra3000 incorporates application proven designs, tested individually and within overall architectures, to provide world class reliability and increase your machine productivity.
- ❖ The Ultra3000 can reduce cost and components. Using the Ultra3000i's built-in indexing capability can eliminate the need for a motion controller or PLC card for point to point positioning moves.

Ultra3000 Drive Features

Each standard Ultra3000 digital servo drive features:

- ❖ 100-240V AC, single and three phase input
- ❖ Standard high-density D-Shell connectors
- ❖ Field programmable flash memory firmware storage
- ❖ Seven segment LED for status and error codes
- ❖ Eight selectable general purpose inputs
- ❖ Four selectable general purpose outputs and one relay output
- ❖ Serial port for RS-232/RS-485 communications
- ❖ CE compliance and UL listed to U.S. and Canadian safety standards

Ultra3000 Family



0.5 kW Drive



1.0 kW Drive



2.0 kW Drive



3 kW Drive
with DeviceNet



7.5 kW Drive
with DeviceNet



15 kW Drive
with SERCOS

Ultraware Software – Pure Productivity

When you use the Ultra Family servo drives, you find just how easy they are to operate. Ultraware is a Windows-based interface with an intuitive object-oriented tree structure. With online help and quick startup windows, setup is simple.

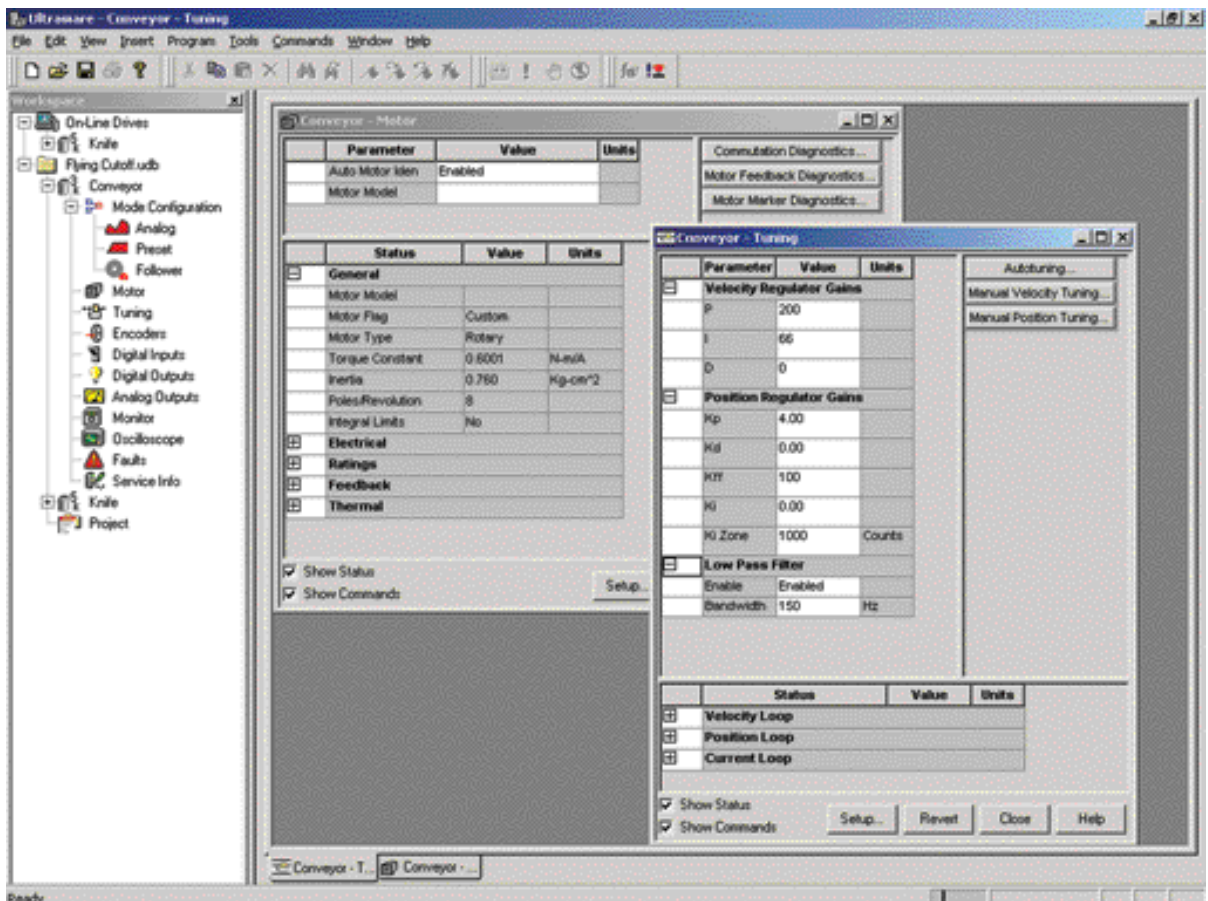
But Ultraware is more than just a configuration tool. It also comes with powerful, field-tested productivity tools such as:

- On-screen digital oscilloscope for fast tuning and diagnosis
- A full array of on-screen meters and other software tools for rapid debugging and measurement
- Instant access to critical information with complete online help
- Diagnostic and setup tools to make system integration a snap



Ultra Family drives keep error messages in nonvolatile message buffers, so tracking down problems is easier.

Ultraware software helps you save time, reduce your learning curve, and simplify the integration and debugging of your system because the same software is used for the entire Ultra Family. That means fewer maintenance headaches, less downtime, and a lower life cycle cost for all your drives.



Ultraware Software

Ultraware C Programming Environment for the Ultra5000

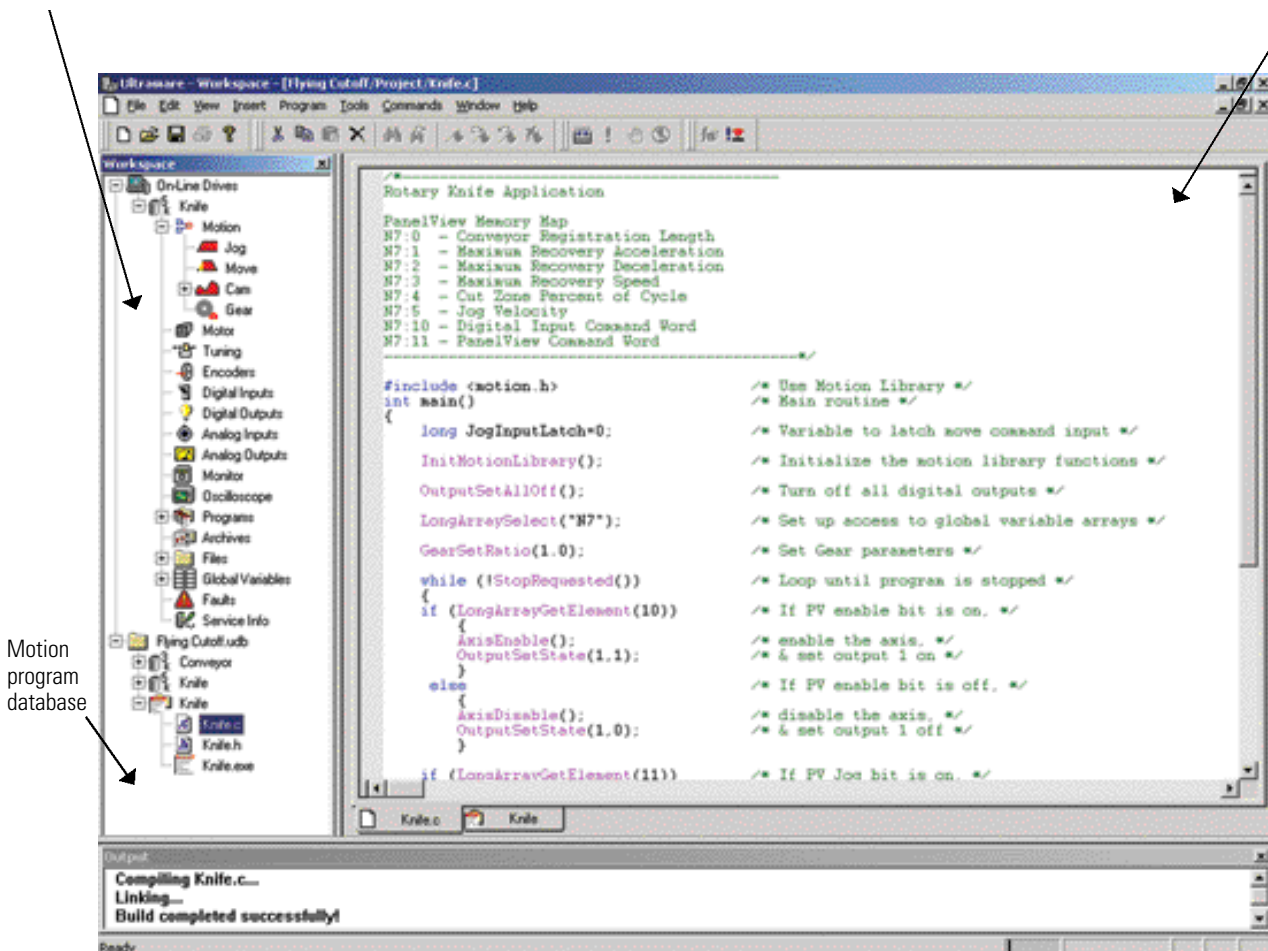
Ultra5000 Intelligent Positioning Drive programs are created using motion commands within an ANSI C format. The Ultra5000 is the first intelligent positioning drive to leverage the power and flexibility of the standard ANSI C language. Furthermore, adopting ANSI C as the programming language for the Ultra5000 provides the following benefits:

- Excellent capability to handle arrays, strings, numeric conversions, and math operations
- A rich set of iteration and selection structures such as If-Then, While, Do-While, For, and Switch operations
- Well-known syntax
- Greater speed and code compactness
- Convenient methods to add custom functions like rotary-knife, smart-belt, etc.

The Ultraware software used to configure the Ultra5000 includes a full-featured, color-syntax editor that provides access to the C programming environment.

Drive configuration and diagnostics controls

C Motion Program and Editor



Ultraware Software with C Editor

Ultra3000 Indexing – Cost-Reduce and Simplify Your Solution

Indexing functionality allows the drive to execute up to 64 different trapezoidal position moves initiated by the use of the digital I/O, MMI, or an unlimited number of indexes through the use of the host command language.

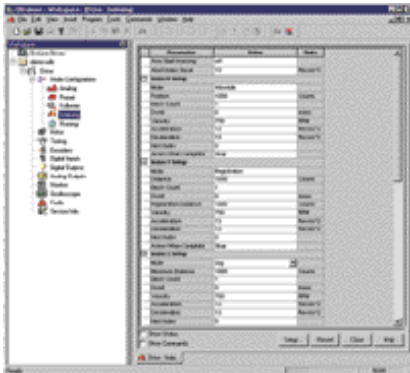
The benefit of indexing is the ability to obtain the position-control performance and flexibility in applications where electronic motion control systems were not cost-effective in the past. And the indexing drives simplify, as well as cost-reduce, many existing motion control systems by eliminating the need for the command source typically provided by motion controllers, stepper controllers, and PLC servo and stepper cards.

The indexing drives support four different types of index moves:

- Incremental – distance move that executes relative to current position
- Absolute – position move executed in reference to the home position
- Jog – input level sensitive move executed while input remains high
- Registration – distance move that executes relative to the registration sensor digital input

The Ultra 3000i indexing drive provides maximum flexibility by allowing you to define the following parameters for each individual index profile:

- Index Type
- Distance (Position)
- Batch Count
- Action when Complete
- Registration Distance
- Velocity
- Acceleration
- Deceleration
- Dwell Time
- Next Index

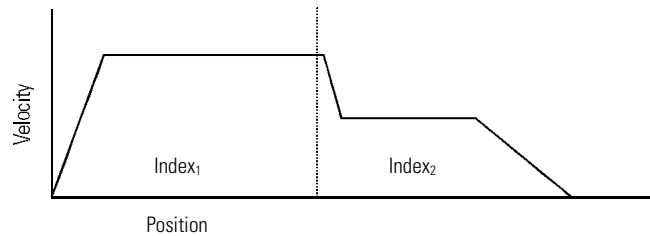


Ultra3000i Indexing with Ultraware

Blended Moves

Blended moves extend the positioning capability of the Ultra3000i by allowing it to finish an index move at a nonzero velocity and immediately begin the next specified move.

As the picture illustrates, one index can immediately lead to a second without stopping.



One of the many ways this feature can be useful includes making the high-velocity move of Index₁ to a defined point, then immediately blending it with Index₂ to the desired position, using a lower velocity. This allows product to be gently positioned without sacrificing cycle times.

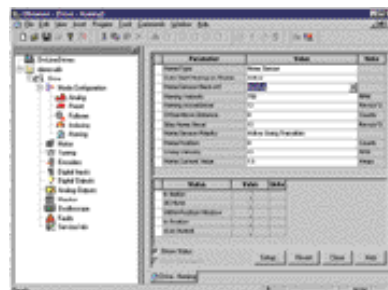
Alternatively, an application may require the use of a registration mark to define position. An index move to the zone where the registration mark is anticipated, immediately blended to a second index move that uses the mark for positioning, will result in accurate position registration.

Blended indexes are easily set up in Ultraware.

Home Routines

The Ultra 3000i offers a user-defined home routine, which allows you to home the axis without the aid of any other device. Using Ultraware, you can select one of the following different home routines to match your motion application:

- Home-to-sensor-to-marker
- Home-to-marker
- Home-to-sensor
- Home-to-current value
- Home-to-current value-to-marker



Ultra3000i Homing with Ultraware

MP-Series – New Low-Inertia Brushless Servomotors with Absolute Feedback

MP-Series features a newly engineered construction that reduces motor size while delivering significantly higher torque. A segmented core stator design, improved thermal management, along with multiple electronic configurations available create a motor with optimal performance characteristics. Easily reversible motor connectors and several feedback options including absolute and high resolution add to the versatility and capability of the MP-Series motor. Available in three frame sizes and growing, the MP-Series motors range in continuous torque capability from 0.79 to 10.20 Nm (7 to 90 lb-in) and speeds up to 5000 rpm. Feedback options for the MP-Series motor include a 2000-line, high-performance encoder that delivers 8,000 counts per revolution for precise position feedback.



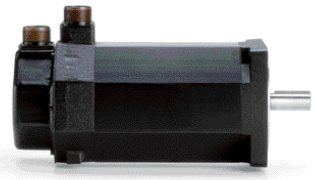
H-Series – Low-Inertia Brushless Servomotors

H-Series motors provide low inertia and high acceleration. Available in five frame sizes, the H-Series motors range in continuous torque capability from 0.5 to 50 Nm (5 to 450 lb-in) and speeds to 6000 rpm. The H-Series motors use an optical 2000-line incremental encoder with the 5000-line option for superior low-speed performance with the Ultra Family.



F-Series – Medium-Inertia Brushless Servomotors

F-Series motors, mechanically interchangeable with the H-Series, use a ferrite magnet that provides nearly four times greater inertia than the H-Series family for matching larger-load inertias. Available in two frame sizes, the F-Series motors range in continuous torque capability from 3.5 to 28 Nm (31 to 245 lb-in) and speeds to 4000 rpm. The F-Series motors use an optical 2000-line incremental encoder with a 5000-line option for superior low-speed performance with the Ultra Family.



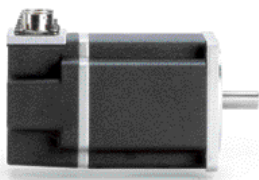
Y-Series – Small, Low-Inertia Brushless Servomotors

Y-Series motors, available in either 115V or 230V windings, use a high-energy neodymium magnet that provides low inertias for fast acceleration. Available in three popular metric frame sizes, the Y-Series motors range in continuous torque capability from .17 to 2.5 Nm (1.5 to 22 lb-in) and speeds up to 4500 rpm. Their outstanding torque-to-size ratios make the Y-Series a powerful combination with the Ultra Family drives.



N-Series – NEMA-Style Brushless Servomotors

N-Series motors use a high-energy ring magnet rotor construction for outstanding torque-to-size ratio. Available in four common NEMA-style frame sizes, N-Series motors matched with an Ultra Family drive create a high-performance alternative to stepper systems. They range in continuous torque capability from .18 to 5.3 Nm (1.6 to 47 lb-in) and speeds up to 7000 rpm.



Cables and Accessories

When it comes to motion control systems, efficient commissioning and superior uptime are a direct result of simple, easy-to-understand interconnects and integrity in every component. You'll find that using the standardized cables and accessories designed specifically for the Ultra Family means fewer problems, more efficient operation, less downtime, and quicker troubleshooting. We've taken great care to ensure that Ultra Family accessories provide unquestionably sound connections, long life, and superior performance.



Ultra5000 Intelligent Positioning Drive Specifications

GENERAL	2098-IPD-005 2098-IPD-005-DN	2098-IPD-010 2098-IPD-010-DN	2098-IPD-020 2098-IPD-020-DN
Peak Output Current (Amps)	7.5	15	30
Continuous Output Current (Amps)	2.5	5	10
Continuous Output Power (kW)	0.5	1	2
Continuous Shunt Power Internal	N/A	N/A	N/A
Peak Shunt Power Internal	N/A	N/A	N/A
Continuous Shunt Power w/External Kit	300 Watts	300 Watts	300 Watts
Peak Shunt Power External	4 kW	4 kW	4 kW
INPUT			
Continuous Input Current	5	9	18
Input Voltage	100-240 volts AC Single-Phase		
Input Frequency	47-63 Hz		
USER PROGRAMMING			
Language	Compiled ANSI C with Library of Motion Commands		
Programming Environment	Full-featured Color Syntax Editor and "C" Compiler Integrated with Ultraware Software		
Operating System	Real-time multitasking, Flash-upgradeable		
User Program Memory Capacity	512 Kbytes		
User Program Memory Storage Medium	Flash Memory, 100,000 Write Cycles		
Nonvolatile Memory Capacity	32 Kbytes (approximately 8000 nonvolatile user variables)		
Nonvolatile Memory Storage Medium	nvSRAM (high-speed SRAM/EEPROM)		
CONTROLLER			
Processor	Texas Instruments IMS320C32 32-Bit Floating Point Digital Signal Processor		
Clock Speed	60 MHz		
Commutation	3-Phase Sinusoidal Space Vector Modulated PWM		
Current Loop	Digital PI - 125 µsec update rate		
Velocity Loop	Digital PI - 250 µsec update rate		
Position Loop	Digital PI - 500 µsec update rate		
Position Range	32-bit signed		
Velocity Range	32-bit floating point		
Acceleration Range	32-bit floating point		
Electronic Gearing	64-bit signed		
INPUTS/OUTPUTS			
General-Purpose Digital Inputs	16 Optically Isolated 12-24 volt inputs		
Inputs/Outputs - Sinking/Sourcing Selection	Software Selectable as a Group to be Active High, Current Sinking or Active Low, Current Sourcing		
General-Purpose Digital Outputs	7 Optically Isolated 12-24 Volt Outputs – 50 Milliampers Maximum		
General-Purpose Relay Output	1 Normally Open Relay – 30 Volts DC Maximum Voltage, 1 Ampere Maximum Current		
General-Purpose I/O Response	100 µsec		
High-Speed Input Response	<1 µsec (Inputs 1 and 2)		
Position Capture Response	<1 µsec (Input 1, Input 2, Motor Encoder Index, and Auxiliary Encoder Index)		
General-Purpose Analog Inputs	2 12-bit Analog-to-Digital Converters (+/- 10v, single-ended)		
General-Purpose Analog Outputs	2 12-bit Digital-to-Analog Converters (+/- 10v, +/- 2ma, single-ended)		
COMMUNICATIONS			
Serial	2 Independent RS-232/RS-422/RS-485 Ports, 1200-38,400 Baud		
Networking	DeviceNet DF-1 Point-to-Point standard, DeviceNet optional.		
MOTOR FEEDBACK			
Input Modes	Incremental with Index, Sine/cosine High Resolution Absolute (Single and Multi-turn)		
Maximum Input Frequency	2.5 MHz (Encoder Lines), Over 1 million counts/rev (High Resolution)		
Commutation Startup	Hall Sensor		
AUXILIARY FEEDBACK			
Operation	Auxiliary Feedback Input		
Input Modes	A quad B		
Input Type	Line Receiver		
Maximum Input Frequency	2.5 MHz (Encoder Lines)		
MOTION			
Acceleration Types	Linear, S-Curve		
Auxiliary Encoder Follower Modes	Bidirection, Single-Direction, Buffered (Ratchet Mode)		
Electronic Cam	User-Generated Point Pair Table, Polynomial Interpolated Point Pairs		
CONNECTORS			
Digital I/O Connector CN1A	28-Position Pluggable Spring-Clamp Terminal Block		
Auxiliary Feedback/Analog I/O Connector CN1B	14-Position Pluggable Spring-Clamp Terminal Block		
Motor Feedback Connector CN2	15-Position High-Density Female D-Sub Connector		
Serial Port Connectors CN3A and CN3B	9-Position Female D-Sub Connector		
Main AC, Motor Power, and DC Bus Connector	9-Position Screw Terminal Block		
ENVIRONMENTAL			
Storage Temperature	-40°C to 70°C (-40°F to 158°F)		
Operating Temperature	0°C to 55°C (32°F to 131°F)		
Humidity	5% to 90% noncondensing		
Altitude	1500m/5000ft (derate 3% per 300m above 1500m)		
Vibration	10 to 2000 Hz at 2g		
Shock	15 g 11 msec half sine		
Weight	2098-IPD-005 3.9 lbs (1.77 kg)	2098-IPD-005-DN 4.7 lbs (2.11 kg)	2098-IPD-010 4.55 lbs (2.07 kg)
			2098-IPD-010-DN 5.3 lbs (2.41 kg)
			2098-IPD-020 4.51 lbs (2.05 kg)
			2098-IPD-020-DN 5.3 lbs (2.39 kg)

Ultra3000 and Ultra3000i Digital Servo Drive Specifications

ELECTRICAL CHARACTERISTICS	2098-DSD-005	2098-DSD-010	2098-DSD-020	2098-DSD-030
	2098-DSD-005X	2098-DSD-010X	2098-DSD-020X	2098-DSD-075 2098-DSD-150
Peak Output Current (Amps)	7.5	15	30	30/75/150
Continuous Output Current (Amps)	2.5	5	10	15/35/65
Continuous Output Power (kW)	0.5	1	2	3/7.5/15
Continuous Shunt Power Internal	N/A	N/A	N/A	50/180
Peak Shunt Power Internal	N/A	N/A	N/A	4.5/10/18
Continuous Shunt Power External (kW)	300 Watts	300 Watts	300 Watts	2.4/4/8
Peak Shunt Power External	4 kW	4 kW	4 kW	6/10/19
INPUT				
Continuous Input Current (Amps RMS)	5	9	18	28/30/46
Input Voltage	100-240 Volt AC Single-Phase (Three-Phase for -075 and -150)			12-24 VDC required for Digital I/O
Input Frequency	Optional 5 VDC external logic power 47-63 Hz			
OPERATING MODES AND COMMAND SOURCES				
Ultra3000				
Analog Velocity/Current Mode	+/- 10 Volt input			
Preset Velocity, Current, and Follower Ratios	8 presets, binary selection by digital inputs or serial commands, electronic gearing			
Step and Direction, Step Up/Step Down	2.5 MHz maximum frequency, Differential or single-ended input			
Master Encoder Following	2.5 MHz maximum line frequency, Differential or single-ended input			
Digital Serial Commands	Via serial port and 7-bit ASCII protocol			
Ultra3000i				
Indexing	64 configurable indexes, selectable by digital inputs or serial commands			
Positioning Types	Blended moves at a nonzero velocity, Jogging, Stop Index via digital input or serial command			
Home Routines	Absolute, Incremental, Registration, Jog Home-to-sensor, home-to-marker, home-to-sensor/marker, or home-to-current-value			
INPUTS/OUTPUTS				
General-Purpose Digital Inputs	8 Optically Isolated 12-24 Volt, Active High Inputs - Assignable to one or more selections			
General-Purpose Input Selections	Drive Enable, Disable Serial Communications, Pause Index, Stop Index, Pause Homing, Stop Homing, Preset Select, Set Preset Position, Integrator Inhibit, Follower Enable, Forward Enable, Reverse Enable, Operation Mode Override, Position Strobe, Home Sensor, Start Index, Define Home, Registration Sensor, Remove Command Offsets, Start Homing, Fault Reset			
General-Purpose Digital Outputs	4 Optically Isolated 12-24 volt Outputs, 50 Milliampere Maximum			
General-Purpose Output Selections	In-Position, Within Position Window, Zero Speed, Within Speed Window, Up to Speed Drive Enabled, DC Bus Charged, Ready, In Motion, In Dwell, Tracking, End of Sequence, Current Limiting, Registered, At Home, Axis Homed, Start Up Commutation Done, Brake Fault Disable, Fault Decel/Disable, Fault Ignore, Fault Indicate, Overtravel Exceeded			
General-Purpose Relay Output	1 Normally Open Relay, 30 volts DC Maximum Voltage, 1 Ampere Maximum Current			
Registration Input Capture Response	<100 µseconds			
Analog Command Input	1 14-Bit Analog-to-Digital Converter (+/- 10v, Differential)			
General-Purpose Analog Output	1 8-Bit Digital-to-Analog Converter (+/- 10v, +/- 2ma, single-ended)			
COMMUNICATIONS				
Serial	1 port with RS-232/RS-422/RS-485 at 1200-57,600 baud			
Networking	DeviceNet, SERCOS			
CONTROL LOOPS				
Modes	Current, Velocity, Position control			
Types	All loops digital			
PWM	8 kHz, Space Vector Modulation			
Velocity Loop Bandwidth	300 Hz			
MOTOR FEEDBACK				
Input Modes	Incremental with Index, Sine/cosine High Resolution Absolute (Single and Multi-turn)			
Maximum Input Frequency	2.5 MHz (Encoder Lines), Over 1 million counts/rev (High Resolution)			
Commutation Startup	Hall Sensor			
AUXILIARY FEEDBACK				
Operation	Auxiliary Position Loop Feedback Input			
Input Modes	A quad B			
Input Type	Line Receiver			
Maximum Input Frequency	2.5 MHz (Encoder Lines)			
CONNECTORS				
Control Connector CN1	44-Position High-Density Female D-Shell Connector			
Motor Feedback Connector CN2	15-Position High-Density Female D-Shell Connector			
Serial Port Connector CN3	9-Position Female D-Shell Connector			
Main AC, Motor Power, and DC Bus Connector	9-Position Screw Terminal Block			
ENVIRONMENTAL				
Storage Temperature	-40°C to 70°C (-40°F to 158°F)			
Operating Temperature	0°C to 55°C (32°F to 131°F)			
Humidity	5% to 90% noncondensing			
Altitude	1500m/5000ft (derate 3% per 300m above 1500m)			
Vibration	10 to 2000 Hz at 2g			
Shock	15g 11 msec half sine			
Weight	2098-DSD-005 2098-DSD-005X	2098-DSD-010 2098-DSD-010X	2098-DSD-020 2098-DSD-020X	2098-DSD-030 2098-DSD-075 2098-DSD-150
	3.7 lbs (1.68 kg)	4.47 lbs (2.03 kg)	4.41 lbs (2.0 kg)	(-030) 13.64 lbs (6.19 kg) (-075) 20.64 lbs (9.36 kg) (-150) 13.64 lbs (6.19 kg)