Selecting Other System Components

This chapter reviews the ULTRA 100 Series 1398-DDM-005 and -005X, 1398-DDM-009 and -009X, 1398-DDM-019 and -019X drives, command sources and interfaces for the drives, and complementary motors and accessory equipment. Selection of complementary servo components allows you to efficiently connect other devices to your microdrive. Pertinent information about each is provided to assist you in planning your servo system.

ULTRA 100 Series Overview

The ULTRA 100 Series drives are part of a family of universal digital drives. ULTRA 100 Series drives use microcontrollers to digitally manage the current, velocity, and position. All system and application parameters are set in software, which ensures repeatability of all functions and prevents element drift.

A single unit fully encloses all electronics. An external transformer is *not* required on the power line. All connectors and indicators are accessible and clearly marked on the front panel.

ULTRA 100 Series Features

Drive Power Ratings

Several power levels of ULTRA 100 Series drives are available. All models have integral power supplies[1] and use a single phase power source. They differ only in physical size, indexing capability and output power:

- 1398-DDM-005 and -005X with continuous output power of 500 Watts.
- 1398-DDM-009 and -009X with continuous output power of 1000 Watts.
- 1398-DDM-019 and -019X with continuous output power of 2000 Watts.

The ULTRA 100 Series drives, when combined with brushless servo motors, provide continuous torque ranging from 0.17 Nm to 2.5 Nm (1.5 to 22.5 lb-in) and peak torque ranging from 0.48 Nm to 7.12 Nm (4.3 lb-in to 63 lb-in).

1. 1398-DDM-005 and -005X, 1398-DDM-009 and -009X, 1398-DDM-019 and -019X require an external 12-24VDC power source for I/O.

High Performance Microcontroller Technology

All digital current, velocity and position loop calculations as well as the motor commutation calculation are performed by a microcontroller.

IPM Technology

IPM (Intelligent Power Module) technology in the output stage provides a high frequency, digital PWM (Pulse Width Modulation) sine wave that controls the current loop, including overcurrent, short circuit and overtemperature protection.

Analog and Digital Interfaces

All ULTRA 100 Series drives allow the user to select one of the following analog or digital command interfaces:

- ±10 Volt analog interface - velocity or torque control
- Presets (from one to eight binary inputs) - torque or velocity control
- Quadrature encoder digital interface - electronic gearing position follower
- Step/Direction digital interface - position control
- CW/CCW (step up/step down) interface - position control
- Indexing - position control from a single point in one of three ways
- Operating mode override - alternate movement interface

Encoder Control

A single, motor mounted encoder provides complete commutation information and velocity feedback. Low velocity regulation is enhanced by the use of a 5000 PPR (pulses per revolution) incremental encoder.

Encoder Output

A selectable output allows the encoder resolution to be specified for maximum performance without added circuitry. Outputs are differential line drivers capable of dividing the motor encoder signal by a factor of 1, 2, 4 or 8.

Digital I/O

Digital I/O channels allow the user to program the drive to fit the specific application. Power for the I/O must be supplied by an 12-24 VDC external I/O power source. Selections include:

- Four selectable (INPUT1, INPUT2, INPUT3 and FAULT RESET), optically isolated, active high inputs.

- One dedicated, control (ENABLE), optically isolated, active high input.
- Two selectable, optically isolated and short circuit protected, active high outputs.
- Two dedicated (BRAKE/DRIVE ENABLED and DRIVE READY), normally open relay outputs.

Analog I/O

A dedicated analog input provides current limiting capabilities, while the analog output can be customized to fit the application:

- One dedicated 0 - 10 Volt, analog input (EXTERNAL CURRENT LIMIT)
- One selectable, ±10 Volt analog output.

AC Input Power

ULTRA 100 Series drives covered by this manual are powered directly from a main 100-240 VAC single phase line.

Personality Module

EEPROM (electrically erasable programmable read only memory) stores both motor and application specific settings and parameters for the drive.

Multiple Protection Circuits

Device and circuit protection, and diagnostic information is provided by:

- Bi-color single point LED
- Overtemperature, short circuit and overcurrent protection for the power output
- I^2T (power-time) protection for the motor and the power drive
- Bus Overvoltage
- Bus Undervoltage
- Overspeed
- Fault diagnostics
- Watchdog timers provide fail-safe operation.

Command Sources

Serial Command Sources

ULTRA 100 Series drives are configured and controlled via a serial communication link. Commands may be issued from a variety of sources through a serial communications port. Possible command sources include:

- Personal computers

- Host computers
- Programmable Logic Controllers
- Motion controllers
- TouchPad.

The serial communication interface for the ULTRA 100 Series supports:

- RS-232 and the four wire RS-485 communications standards
- NRZ (non-return to zero) asynchronous serial format
- Baud rates: 1200, 2400, 4800, 9600 and 19200
- Parity generation and checking: Even, Odd or None.

Connection of communication cables between the drive and user-supplied equipment is described in the following sections:

- One ULTRA 100 Series drive - “Single Axis RS-232 Set Up” on page 6-34
- Multiple ULTRA 100 Series drives - “Multiple Axes Four-wire RS-485 Communications” on page 6-35.

Analog Command Sources

In the analog mode of operation, the ULTRA 100 Series drive requires a variable ±10 Volt DC external analog signal capable of driving the servo regulator’s command input at an input impedance of 13.3 kOhms. Choose a source such as a PLC (programmable logic controller), the DAC (digital-to-analog converter) of a computer, or a motion controller that meets this requirement.

Differential or single-ended line drivers may supply the signals for the auxiliary encoder inputs, step and direction inputs, and step up/down inputs. The differential signal must be capable of supplying at least 5 mA with 2.0 Volts across the + and - inputs. A differential signal source provides the best noise margin of all the interface circuit options. Single-ended signals from TTL drivers must be capable of sourcing or sinking 5 mA.

In preset mode, the controlling device should be able to source 10 mA into the digital inputs.

I/O Interface

Analog Input

One analog input channel is accessible to the user. The analog input limits the peak current available from the drive.

- I LIMIT (current limit)

The analog signal must be within 0-10 Volt range and single-ended.

Options and Accessories

ULTRA 100 Series drives conformance to the European Union Directives is contingent on:

1. Installation of AC line filters between the power source and the drive, and
2. Use of factory supplied cables to connect F-, H-, LD- N-, S-, W- or Y-Series motors to a drive. Diagrams and schematics for all Rockwell Automation cables are shown in Cable Diagrams, Schematics and Examples, beginning on page B-1.

ULTRA 100 Series Drives

	Description
1398-DDM-005	500 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-005X	500 Watt Universal Indexing Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-009	1000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-009X	1000 Watt Universal Indexing Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-019	2000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-019X	2000 Watt Universal Indexing Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-010	1000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-020	2000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-030	3000 Watt Universal Drive, single phase 100-240 VAC @ 50/60 Hz
1398-DDM-075	7500 Watt Universal Drive, single or three phase 100-240 VAC @ 50/60 Hz

Fuses

Description	Part Number
1 Ampere, fast acting, inline for 1398-DDM-010, -020, -030 or -075 (Littelfuse R451001, or equivalent)	0006-9071-001
Fuse for 1398-DDM-010, -020, -030 or -075 External Shunt Resistor (Littelfuse CCMR-4.5 or equivalent)	0006-9070-001

Interface Cables

Diagrams and schematics for these cables are shown beginning on page B-3.

	Digital Outputs
Selectable (2)	12-24 Volt, Short Circuit Protected, Optically Isolated, Single-ended, Active High, 50 mA maximum
BRAKE	Normally Open Relay, 1 A
READY	Normally Open Relay, 100 mA
Digital I/O Power Supply	User supplied 12 to 24 VDC
	Analog Inputs
Current Limit (I LIMIT)	0 to 10 Volt, single-ended, 5 kOhm input Impedance
COMMAND	±10 Volt, Differential, 13 kOhm input Impedance, offset software adjustable
	Analog Outputs
ANALOG1	0 to 10 Volt, 8 bits, 2 mA maximum
	Auxiliary Encoder Input
Auxiliary Encoder Signal Input	26LS33 Input, 4 MHz Count Frequency Differential/Single-ended A/B Step/Direction CW/CCW
	Motor Encoder Output
Motor Encoder Output	AM26C31 or AM26LS31 Differential Driver, Divide by 1, 2, 4, or 8 Differential output is 2.0 Vdc across a 100 Ohm load
	Memory
Parameter Data Retention	20 years
	Motor Protection
Motor Overload Protection	The drive utilizes solid state motor overload protection which operates: • within 8 minutes at 200% overload • within 20 seconds at 600% overload
	Speed Regulation
Type	Digital, PI
-3dB Bandwidth	300 Hz
-45° Bandwidth	50 Hz
Ripple	±0.44 rpm with 5000 line encoder
Speed Range	1:8000 rpm
	Position Regulation
Type	Digital, PI with Feedforward
	Filters
Low Pass	Digital, 0 - 1000 Hz, -3 dB Bandwidth, Selectable

Power

	1398-DDM-005 & 1398-DDM-005X	1398-DDM-009 & 1398-DDM-009X	1398-DDM-019 & 1398-DDM-019X
AC Input Voltage and Frequency	100-240 Vac_{rms} nominal Single Phase 47 - 63 Hz	100-240 Vac_{rms} nominal Single Phase 47 - 63 Hz	100-240 Vac_{rms} nominal Single Phase 47 - 63 Hz
AC Input Current	5 A_{rms}	9 A_{rms}	18 A_{rms}
Bus Voltage	141-339 Vdc	141-339 Vdc	141-339 Vdc
Output Peak Current	7.5 Amps	15 Amps	30 Amps
Continuous Output Current (peak)	2.5 Amps	5 Amps	10 Amps
Bus Capacitance Energy Absorption (from 325-400 Vdc Bus)[a]	38 Joules C=1410uF	51 Joules C=1880uF	51 Joules C=1880uF
Peak Power Output[b]	120 Vac 0.9 kWatts 240 Vac1.8 kWatts	120 Vac 1.3 kWatts 240 Vac 2.7 kWatts	120 Vac 2.7 kWatts 240 Vac 5.5 kWatts
Continuous Power Output[b]	120 Vac 0.3 kWatts 240 Vac 0.6 kWatts	120 Vac 0.6 kWatts 240 Vac 1.2 kWatts	120 Vac 1.2 kWatts 240 Vac 2.5 kWatts

a. Bus capacitance energy absorption is based on the following equations:

$$\varepsilon = \frac{1}{2}C(V^2_f) - \frac{1}{2}C(V^2_i)$$

$$\varepsilon = \frac{1}{2}C(420)^2 - \frac{1}{2}C(325)^2$$

$$\frac{1}{2}C \cdot (420^2 - 325^2) = C(35387)$$

$$\text{if} C = 17 \times 470\text{uF, E} = 282$$

b. Power outputs are based on the following equation:

$$\text{kWatts} = \left(\text{VAC} \times \frac{I_{Rmax}}{\sqrt{2}} \times \sqrt{3}\right) \times 0.85$$

Power Dissipation

ULTRA 100 Series drives dissipate power that results in cabinet heating. The following table lists power dissipation values. Calculate the cabinet cooling requirements using the power dissipation information and formulas below.

Current as % of Rated Continuous Current	1398-DDM-005 & 1398-DDM-005X	1398-DDM-009 & 1398-DDM-009X	1398-DDM-019 & 1398-DDM-019X
100	48 W	48 W	50 W
NOTE: These values do *not* include external shunt regulator power (regenerated power).			

Maximum power losses are shown to help size a NEMA 12 or equivalent enclosure and to ensure the required ventilation. Typical power losses are about one-half maximum power losses.

When sizing an enclosure with no active method of heat dissipation, the following equation approximates the size of enclosure necessary: