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# Ndrive Linear Series

## *Digital Servo Amplifiers – Linear*

- Output power range of 10 or 20 A peak with ±10 to ±80 VDC bus
- 2- or 3-phase AC line input or DC input
- CE approval
- Linear power stages
- Digital current, velocity, and position loops for improved motion stability
- Optional integrated encoder multiplier for higher throughput and reduced wiring
- Flexible design provides ability to drive brushless and DC brush-type servomotors as well as stepping motors
- Encoder or resolver feedback



*Ndrive HLe* *Ndrive CL* *Ndrive ML*

The Ndrive® family of digital servo amplifiers are high performance discrete drives used with the Automation 3200 motion controller. These drives are capable of controlling brushless, DC brush, and stepper motors over a wide range of operating voltages and currents. Based on a common architecture, Ndrive amplifiers perform both current- and position-loop closures digitally.

The use of high-performance double-precision processors allows these drives to generate ultra-smooth motion profiles. Servo system response is optimized with the use of up to eight second-order loop-shaping filters, precise time-aligned feed-forward and other proprietary techniques with loop closure rates up to 20 kHz.

The Ndrive family includes several versions of low noise, ultra-high-performance linear drives. The Ndrive series provides high bandwidth and superb linearity required for the ultimate in velocity regulation as well as positional stability. The HLe offers the ability to use resolver or inductosyn sensors and provides the highest level of encoder interpolation. The Ndrive CL is available for applications requiring low noise and is optimized for cost sensitive, lower-power applications. For low-power, high precision systems use the Ndrive ML.

Options for the Ndrive family include integral encoder interpolation, one- to three-axis position synchronized output (PSO), automatic brake control, digital and analog I/O expansion, absolute encoder interface, and one- or two-channel resolver interfaces. An optional dedicated ethernet port is available on the HLe drives for connection to third-party I/O expansion devices. This provides the potential to connect to a large number of I/O points typically required for PLC-type applications.

Any combination of Ndrive amplifiers may be connected to the Automation 3200 FireWire® network, allowing the system to be customized as needed.



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## Ndrive Series COMPARISON



***Ndrive HLe***
*Width: 206.9 mm*
*Height: 234.3 mm*



***Ndrive CL***
*Width: 103.7 mm*
*Height: 265.2 mm*



***Ndrive ML***
*Width: 92.1 mm*
*Height: 141.0 mm*

| Ndrive Comparison Chart | Ndrive HLe | Ndrive CL | Ndrive ML |
|---|---|---|---|
| **PC Interface** | FireWire® | FireWire® | FireWire® |
| **Current Output, Peak(1)** | 10-20 A(2) | 10 A(2) | 10 A(2) |
| **Current Output, Continuous(1)** | 5-10 A(2) | 5 A(2) | 5 A(2) |
| **Bus Voltage** | ±40-80 VDC(3) | ±40 VDC(3) | ±40 VDC(3) |
| **Amplifier Type** | Linear | Linear | Linear |
| **Motor Supply Voltage** | 2 Phase AC | 2 Phase AC(4) | DC |
| **Standard I/O(5)** | 4-DO/6-DI<br>1-AO/1-AI | 4-DO/6-DI<br>1-AO/1-AI | 1-AI |
| **Expansion I/O(5) (Additional to Base I/O)** | 16-DO/16-DI<br>3-AO/3-AI | 16-DO/16-DI<br>1-AO/1-AI | 8-DO/8-DI<br>1-AO/1-AI |
| **Single Axis PSO(6)** | Yes | Yes | Yes |
| **Dual Axis PSO(6)** | Yes | No | No |
| **Triple Axis PSO(6)** | Yes | No | No |
| **Ethernet Capable for Third-Party I/O** | Yes | No | No |

Notes:
1. Peak value of the sine wave; rms current for AC motors is 0.707 * $A_{pk}$.
2. Load dependent.
3. Output voltage is load dependent.
4. External transformer required.
5. DO = Digital Output; DI = Digital Input; AO = Analog Output; AI = Analog Input.
6. PSO not available on Ndrive CL/ML when using integral MXU.


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## Ndrive HLe SPECIFICATIONS

| Ndrive HLe | Units | 10-40 | 20-40 | 10-80 |
|---|---|---|---|---|
| **Motor Style** | | Brush, Brushless, Stepper, Voice Coil | | |
| **Motor Supply** | VAC | 115/230; 50/60 Hz; Factory Configured | | |
| **Control Supply**[1] | VAC | 85-240; 50/60 Hz | | |
| **Bus Voltage**[2] | VDC | ±40 | ±40 | ±80 |
| **Peak Output Current (1 sec)**[3,4] | $A_{pk}$ | 10 | 20 | 10 |
| **Continuous Output Current**[3,4] | $A_{pk}$ | 5 | 10 | 5 |
| **Digital Inputs** | — | 6 Optically-Isolated (2 High Speed) | | |
| **Digital Outputs** | — | 4 Optically-Isolated | | |
| **Analog Inputs** | — | One 16-bit Differential; ±10 V | | |
| **Analog Outputs** | — | One 16-bit Single-Ended | | |
| **Dedicated Axis I/O on Feedback Connector** | | Three Limit Inputs (CW, CCW, Home); Three Hall Effect Inputs (A, B, C); Three High-Speed differential Inputs (sin, cos, mkr for encoder); Motor Over-Temperature Input | | |
| **Dedicated I/O on Auxiliary Feedback Connector** | | sin, cos, mkr for Aux Enc; Aux Enc can be used for PSO Output | | |
| **I/O Expansion Board**[5] | — | 16/16 Digital Opto-Isolated; 3 Analog In (±10 V, 16-bit Differential); 3 Analog Out (±10 V, 16-bit) | | |
| **High Speed Data Capture** | | Yes (50 ns Latency) | | |
| **Automatic Brake Control** | — | Standard; 24 V @ 1 A | | |
| **Emergency Stop Sense Input (ESTOP)**[6] | — | Standard; 24 V Opto-Isolated | | |
| **Position Synchronized Output (PSO)** | — | Single Axis Standard, Two/Three Axis Optional | | |
| **Can Output Multiplied Encoder** | | Yes | | |
| **Can Output Square Wave Encoder** | | Yes | | |
| **Primary Encoder Input Frequency** | | 32 MHz Square Wave Standard; 500 kHz Sine Wave (MXH) | | |
| **Secondary Encoder Input Frequency** | | 32 MHz Square Wave | | |
| **Encoder Multiplication** | — | Up to x65536 with Quadrature Output (MXH) | | |
| **Absolute Encoder** | | Renishaw Resolute BiSS; EnDat 2.1; EnDat 2.2 | | |
| **Resolver Interface** | — | Optional; 1 or 2 Channel; 16-bit | | |
| **Internal Shunt Resistor** | | N/A | | |
| **External Shunt** | | N/A | | |
| **Ethernet** | — | Optional | | |
| **USB** | | No | | |
| **RS-232** | | No | | |
| **FireWire** | | Yes | | |
| **Fieldbus** | | Modbus TCP on PC | | |
| **Current Loop Update Rate** | kHz | 20 | | |
| **Servo Loop Update Rate** | kHz | 8 | | |
| **Power Amplifier Bandwidth** | kHz | Selectable Through Software | | |
| **Minimum Load Inductance** | mH | 0 | | |
| **Operating Temperature** | °C | 0 to 50 | | |
| **Storage Temperature** | °C | -30 to 85 | | |
| **Weight** | kg (lb) | 10.36 (22.8) | | |

Notes:
1. "Keep Alive" supply.
2. Output voltage is load dependent.
3. Peak value of the sine wave; rms current for AC motors is 0.707 * $A_{pk}$.
4. Load dependent.
5. Requires IO option.
6. Requires external relay to remove motor supply power.



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## Ndrive CL SPECIFICATIONS

| Ndrive CL | Units | |
|---|---|---|
| **Motor Style** | | Brush, Brushless, Stepper, Voice Coil |
| **Motor Supply** | VAC | 56 (center tapped transformer; two 28 VAC windings); Max |
| **Control Supply**(1) | VAC | 85-240; 50/60 Hz |
| **Bus Voltage**(2) | VDC | ±40 |
| **Peak Output Current (1 sec)**(3,4) | $A_{pk}$ | 10 |
| **Continuous Output Current**(3,4) | $A_{pk}$ | 5 |
| **Digital Inputs** | — | 6 Optically-Isolated (2 High Speed) |
| **Digital Outputs** | — | 4 Optically-Isolated |
| **Analog Inputs** | — | One 16-bit Differential; ±10 V |
| **Analog Outputs** | — | One 16-bit Single-Ended |
| **Dedicated Axis I/O on Feedback Connector** | | Three Limit Inputs (CW, CCW, Home); Three Hall Effect Inputs (A, B, C); Three High-Speed differential Inputs (sin, cos, mkr for encoder); Motor Over-Temperature Input |
| **Dedicated I/O on Auxiliary Feedback Connector** | | sin, cos, mkr for Aux Enc; Aux Enc can be used for PSO Output |
| **I/O Expansion Board**(5) | — | 16/16 Digital Opto-Isolated;1 Analog In (±10 V, 12-bit Differential); 1 Analog Out (±10 V, 12-bit) |
| **High Speed Data Capture** | | Yes (50 ns Latency) |
| **Automatic Brake Control** | — | Optional |
| **Emergency Stop Sense Input (ESTOP)**(6) | — | Standard; 24 V Opto-Isolated |
| **Position Synchronized Output (PSO)** | — | Single Axis Only |
| **Can Output Multiplied Encoder** | | No |
| **Can Output Square Wave Encoder** | | Yes |
| **Primary Encoder Input Frequency** | | 32 MHz Square Wave Standard; 400 kHz Sine Wave (MXU) |
| **Secondary Encoder Input Frequency** | | 32 MHz Square Wave |
| **Encoder Multiplication** | — | Up to x65536 (MXU) |
| **Resolver Interface** | — | N/A |
| **Internal Shunt Resistor** | | N/A |
| **External Shunt** | | N/A |
| **Ethernet** | — | N/A |
| **USB** | | No |
| **RS-232** | | No |
| **FireWire** | | Yes |
| **Fieldbus** | | Modbus TCP on PC |
| **Current Loop Update Rate** | kHz | 20 |
| **Servo Loop Update Rate** | kHz | 8 |
| **Power Amplifier Bandwidth** | kHz | Selectable Through Software |
| **Minimum Load Inductance** | mH | 0 |
| **Operating Temperature** | °C | 0 to 50 |
| **Storage Temperature** | °C | -30 to 85 |
| **Weight** | kg (lb) | 3.54 (7.8) |

Notes:
1. "Keep Alive" supply.
2. Output voltage is load dependent.
3. Peak value of the sine wave; rms current for AC motors is 0.707 * $A_{pk}$.
4. Load dependent.
5. Requires IO option.
6. Requires external relay to remove motor supply power.


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## Ndrive ML SPECIFICATIONS

| Ndrive ML | Units | |
|---|---|---|
| **Motor Style** | | Brush, Brushless, Stepper, Voice Coil |
| **Motor Supply** | VDC | ±40 max |
| **Control Supply**(1) | VDC | 18-36 VDC |
| **Bus Voltage**(2) | VDC | ±40 |
| **Peak Output Current (1 sec)**(3,4) | $A_{pk}$ | 10 |
| **Continuous Output Current**(3,4) | $A_{pk}$ | 5 |
| **Digital Inputs** | — | N/A |
| **Digital Outputs** | — | N/A |
| **Analog Inputs** | — | One 16-bit Differential; ±10 V |
| **Analog Outputs** | — | N/A |
| **Dedicated Axis I/O on Feedback Connector** | | Three Limit Inputs (CW, CCW, Home); Three Hall Effect Inputs (A, B, C); Three High-Speed differential Inputs (sin, cos, mkr for encoder); Motor Over-Temperature Input |
| **Dedicated I/O on Auxiliary Feedback Connector** | | N/A |
| **I/O Expansion Board**(5) | — | 8/8 Digital Opto-Isolated; 1 Analog In (±10 V, 16-bit Differential); 1 Analog Out (±5 V, 16-bit); sin, cos, mkr for Aux Enc; Aux Enc can be used for PSO Output |
| **High Speed Data Capture** | | Yes (50 ns Latency) |
| **Automatic Brake Control** | — | Optional |
| **Emergency Stop Sense Input (ESTOP)**(6) | — | Standard; 24 V Opto-Isolated |
| **Position Synchronized Output** | — | Single Axis Only |
| **Can Output Multiplied Encoder** | | Yes (MXH Only) |
| **Can Output Square Wave Encoder** | | Yes |
| **Primary Encoder Input Frequency** | | 32 MHz Square Wave Standard; 2 MHz Sine Wave (MXU or MXH) |
| **Secondary Encoder Input Frequency** | | 32 MHz Square Wave |
| **Encoder Multiplication** | — | Up to x4096 (MXU); Up to x65536 with Quadrature Output (MXH) |
| **Resolver Interface** | — | N/A |
| **Internal Shunt Resistor** | | N/A |
| **External Shunt** | | N/A |
| **Ethernet** | — | N/A |
| **USB** | | No |
| **RS-232** | | No |
| **FireWire** | | Yes |
| **Fieldbus** | | Modbus TCP on PC |
| **Current Loop Update Rate** | kHz | 20 |
| **Servo Loop Update Rate** | kHz | 8 |
| **Power Amplifier Bandwidth** | kHz | Selectable Through Software |
| **Minimum Load Inductance** | mH | 0 |
| **Operating Temperature** | °C | 0 to 50 |
| **Storage Temperature** | °C | -30 to 85 |
| **Weight** | kg (lb) | 0.45 (1.0) |

Notes:
1. "Keep Alive" supply.
2. Output voltage is load dependent.
3. Peak value of the sine wave; rms current for AC motors is 0.707 * $A_{pk}$.
4. Load dependent.
5. Requires IO option.
6. Requires external relay to remove motor supply power.



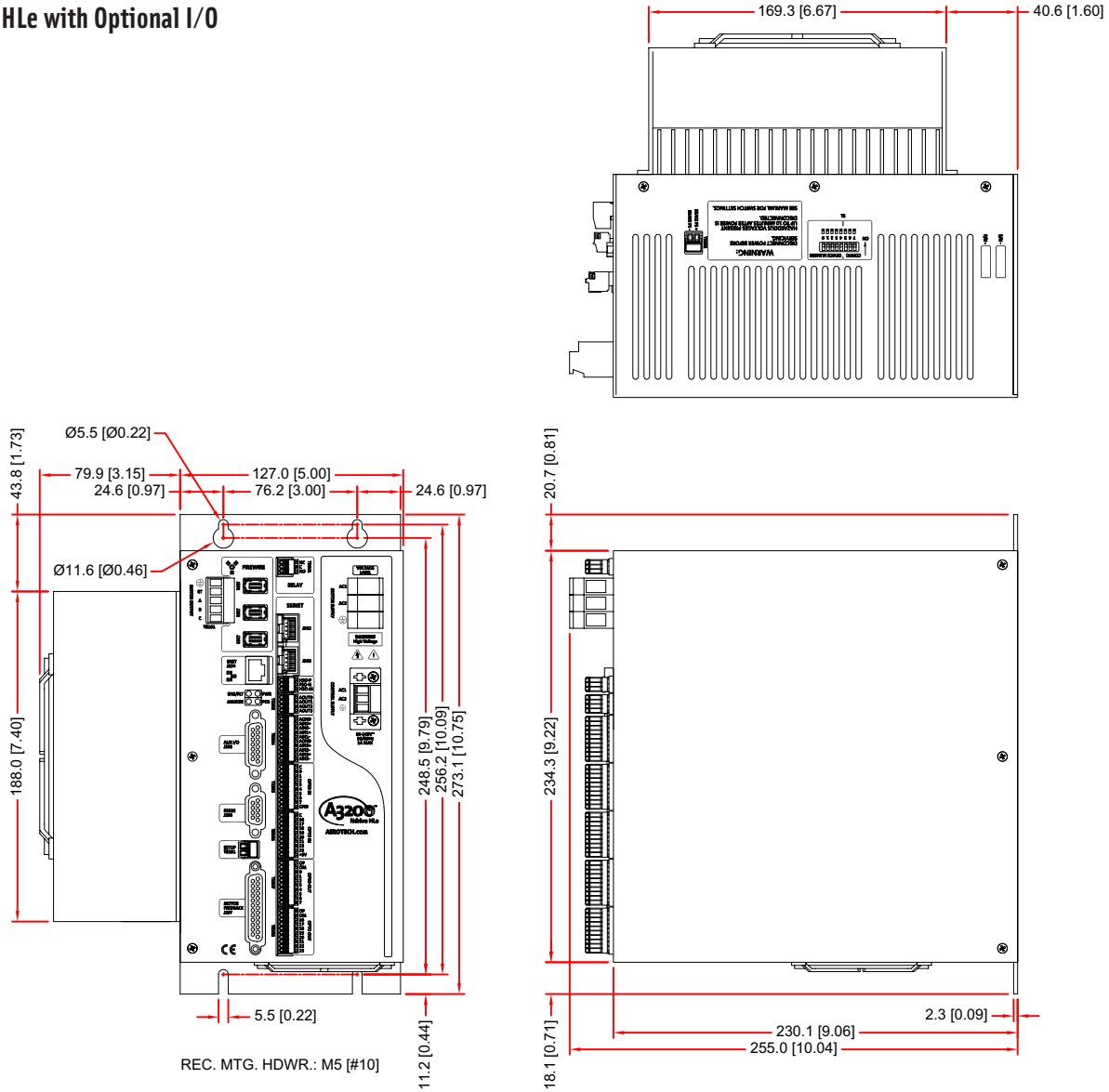
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## Ndrive HLe DIMENSIONS

### Ndrive HLe with Optional I/O



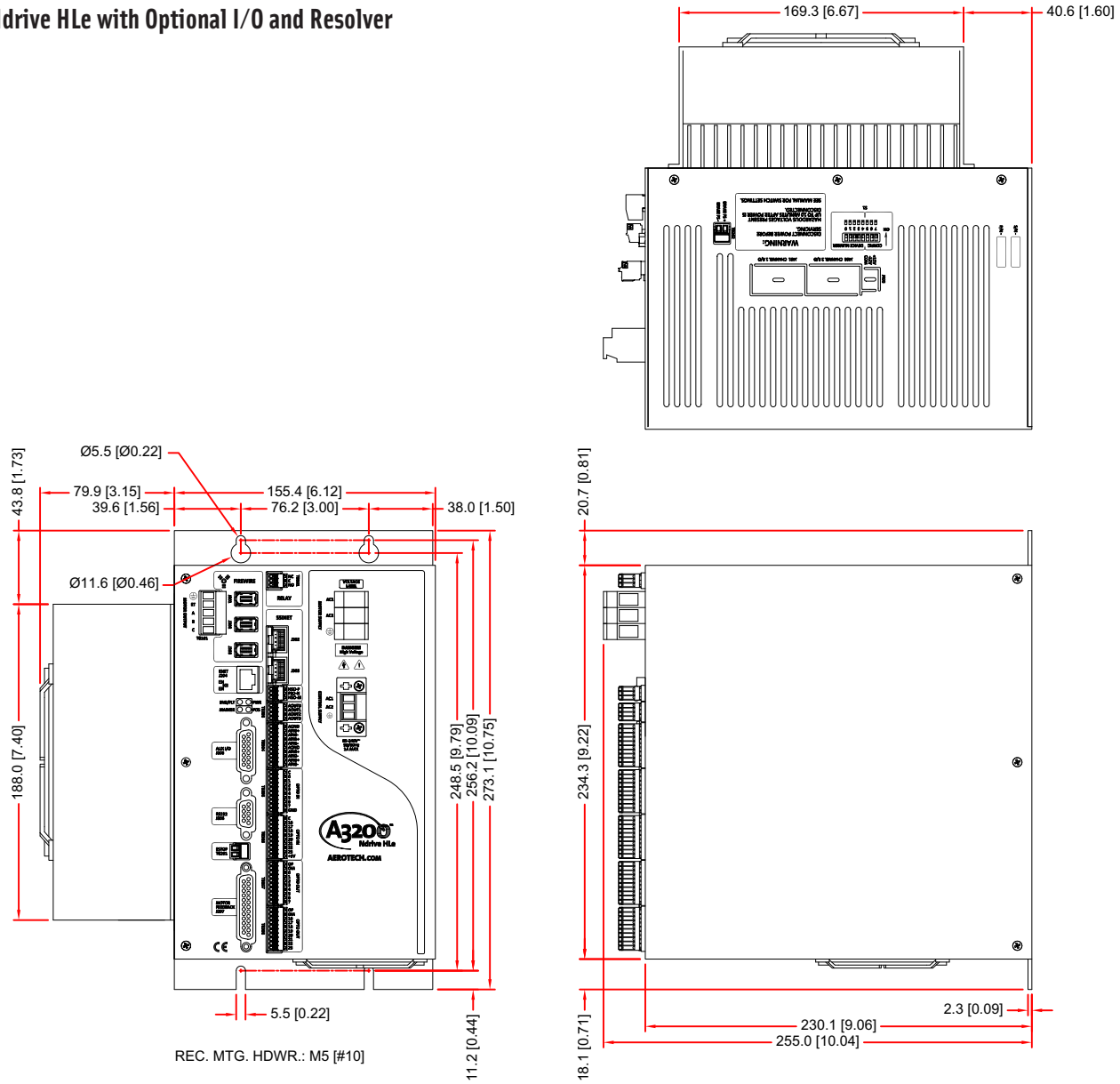



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## Ndrive HLe DIMENSIONS

### Ndrive HLe with Optional I/O and Resolver






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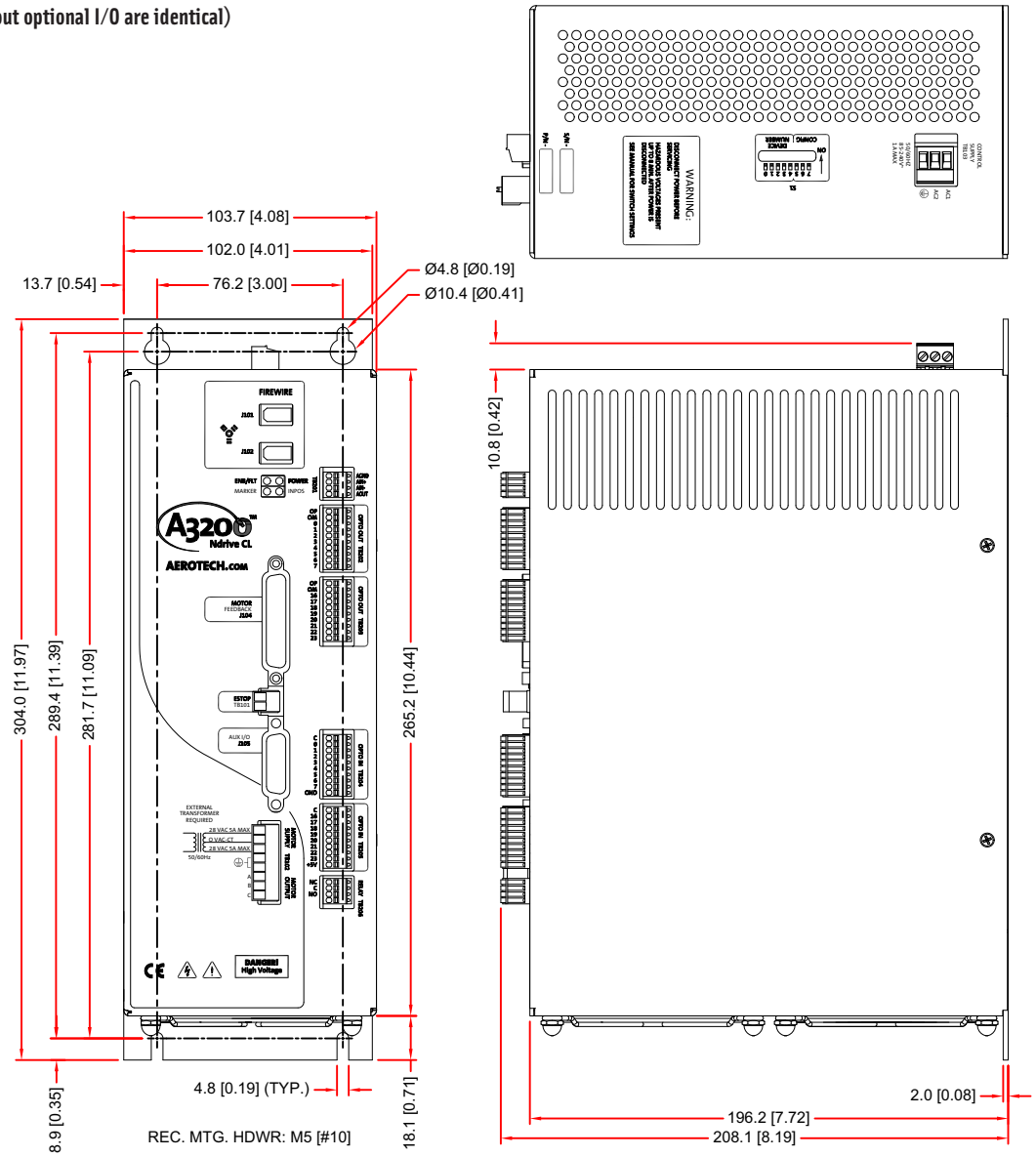


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## Ndrive CL DIMENSIONS

### Ndrive CL with Optional I/O

(Dimensions without optional I/O are identical)





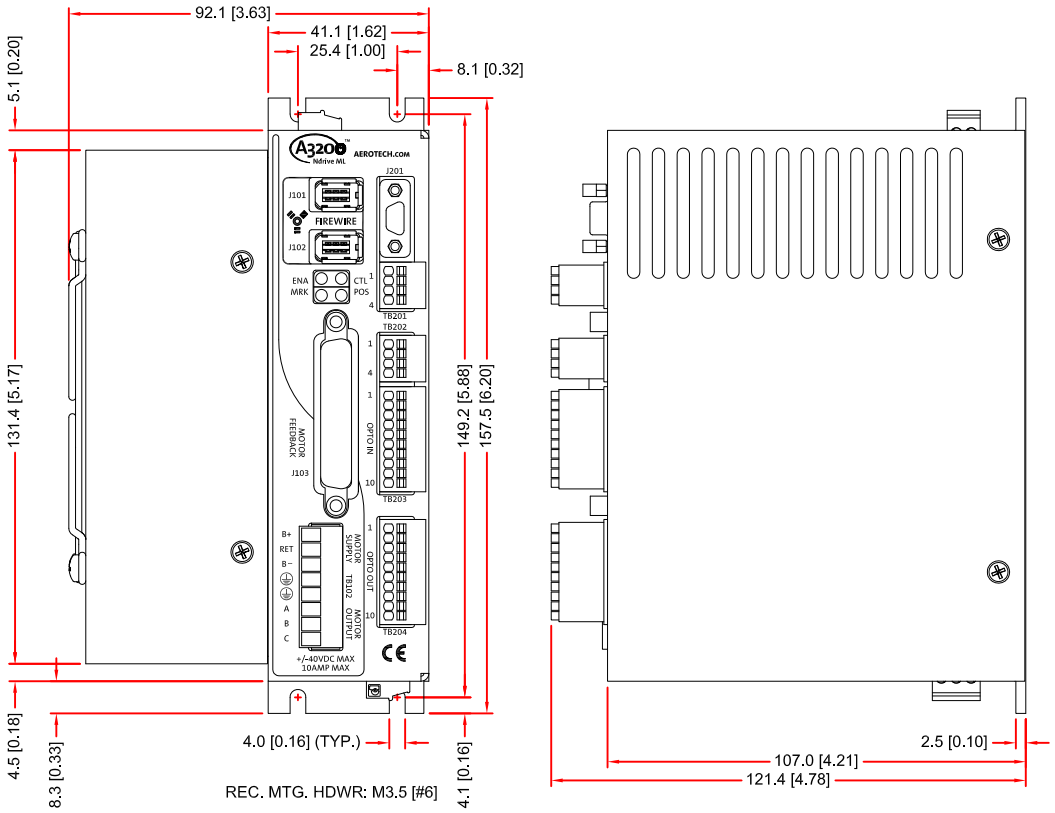

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## Ndrive ML DIMENSIONS

### Ndrive ML with Optional I/O

**(Dimensions without optional I/O are identical)**






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## Ndrive Series ORDERING INFORMATION

### Ordering Example

| Ndrive HLe | 20-40-X | -ENET | RDP1-10K |
|---|---|---|---|
| **Base** | **Output Current** | **Control Option** | **Resolver Options** |
| Ndrive HLe | 10-40-X<br>20-40-X<br>10-80-X | -IO<br>-DUALPSO<br>-TRIPLEPSO<br>-PSOPTO2<br>-PSOPTO3<br>-PSOPTO4<br>-PSOAH<br>-MXH<br>-ENET | RDP1-10K<br>RDP1-7.5K<br>RDP1-5K<br>RDP2-10K<br>RDP2-7.5K<br>RDP2-5K |
| Ndrive CL | 10-40 | -IO<br>-MXU | |
| Ndrive ML | 10-40 | -IO<br>-MXU<br>-MXH | |

### NDRIVE HLe (Linear)

| | |
|---|---|
| NDRIVE HLe10-40-x | 10 A peak/5 A continuous (load dependent), ±40 VDC bus, 115/230 VAC control supply input to power logic circuitry; supports brushless, brush, and stepper motors; includes: 4 opto-isolated digital inputs (sinking or sourcing), 2 high-speed digital inputs, 4 opto-isolated digital outputs (sinking or sourcing), 1 16-bit analog output, 1 16-bit differential analog input, single-axis PSO capability, 2 quadrature encoder input channels, ESTOP sense input |
| NDRIVE HLe20-40-x | 20 A peak/10 A continuous (load dependent), ±40 VDC bus, 115/230 VAC control supply input to power logic circuitry; supports brushless, brush, and stepper motors; includes: 4 opto-isolated digital inputs (sinking or sourcing), 2 high-speed digital inputs, 4 opto-isolated digital outputs (sinking or sourcing), 1 16-bit analog output, 1 16-bit differential analog input, single-axis PSO capability, 2 quadrature encoder input channels, ESTOP sense input |
| NDRIVE HLe10-80-x | 10 A peak/5 A continuous (load dependent), ±80 VDC bus, 115/230 VAC control supply input to power logic circuitry; supports brushless, brush, and stepper motors; includes: 4 opto-isolated digital inputs (sinking or sourcing), 2 high-speed digital inputs, 4 opto-isolated digital outputs (sinking or sourcing), 1 16-bit analog output, 1 16-bit differential analog input, single-axis PSO capability, 2 quadrature encoder input channels, ESTOP sense input |

### NDRIVE HLe Line Voltage (-x) Options

| | |
|---|---|
| -A | 115 VAC input |
| -B | 230 VAC input |
| -C | 100 VAC input |
| -D | 200/208 VAC input |

### NDRIVE HLe Control Options

| | |
|---|---|
| -I/O | Expansion board with 16 opto-isolated inputs (sinking or sourcing); 16 outputs (sinking or sourcing); 3 16-bit analog inputs; 3 16-bit analog outputs; brake relay |
| -DUALPSO | Two-axis PSO firing; second encoder input through AUX connection on Ndrive or through SSINET on I/O board, includes HCPL2601 opto-isolator |
| -TRIPLEPSO | Three-axis PSO firing; requires I/O option to provide connections for three axes of encoder feedback; includes HCPL2601 opto-isolator |
| -PSOPTO2 | Opto-isolator for PSO; requires IOx option (<+15 V, high speed, low current, 6N136) |
| -PSOPTO3 | Opto-isolator for PSO; requires IOx option (<+30 V, low speed, high current, 4N33) |
| -PSOPTO4 | Opto-isolator for PSO; requires IOx option (TIL117-M, 40 kHz, 5-25 VDC, 50 mA) |
| -PSOAH | Active-high PSO output |
| -MXH | Programmable encoder multiplier up to x65536 with real-time encoder quadrature output |
| -ENET | 10/100 BASE-T Ethernet port |


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# Ndrive Series ORDERING INFORMATION

## NDRIVE HLe Resolver Options

| | |
|---|---|
| RDP1-10K | Ndrive 1-channel resolver to digital feedback card with dynamic resolution switching capability; 10 kHz carrier frequency |
| RDP1-7.5K | Ndrive 1-channel resolver to digital feedback card with dynamic resolution switching capability; 7.5 kHz carrier frequency |
| RDP1-5K | Ndrive 1-channel resolver to digital feedback card with dynamic resolution switching capability; 5 kHz carrier frequency |
| RDP2-10K | Ndrive 2-channel resolver to digital feedback card with dynamic resolution switching capability; 10 kHz carrier frequency |
| RDP2-7.5K | Ndrive 2-channel resolver to digital feedback card with dynamic resolution switching capability; 7.5 kHz carrier frequency |
| RDP2-5K | Ndrive 2-channel resolver to digital feedback card with dynamic resolution switching capability; 5 kHz carrier frequency |

## NDRIVE CL

| | |
|---|---|
| NDRIVE CL10-40 | 10 A peak/5 A continuous (load dependent), ±40 VDC bus, 85-240 VAC control supply input to power logic circuitry; supports brush and brushless motors; includes: 4 opto-isolated digital outputs (sinking or sourcing); 6 opto-isolated digital inputs (sinking or sourcing); 1 16-bit analog output; 1 16-bit differential analog input; single-axis PSO capability; 2 quadrature encoder input channels; ESTOP sense input |

## NDRIVE CL Control Options

| | |
|---|---|
| -I/O | Expansion board with 16 opto-isolated inputs (sinking or sourcing); 16 outputs (sinking or sourcing); 1 12-bit analog input; 1 16-bit analog output; brake relay |
| -MXU | Programmable encoder multiplier up to x65536; no real-time encoder quadrature output |

## NDRIVE ML

| | |
|---|---|
| NDRIVE ML10 | 10 A peak/5 A continuous (load dependent), ±40 VDC bus, 18-36 VDC control supply input to power logic circuitry; supports brush and brushless motors; includes: 1 16-bit differential analog input; single-axis PSO capability; 1 quadrature encoder input channel; ESTOP sense input |

## NDRIVE ML Control Options

| | |
|---|---|
| -I/O | Expansion board with 8 opto-isolated inputs (sinking or sourcing); 8 outputs (sinking or sourcing); 1 16-bit analog input; 1 16-bit analog output; brake relay |
| -MXU | Programmable encoder multiplier up to x4096; no real-time encoder quadrature output |
| -MXH | Programmable encoder multiplier up to x65536 with real-time encoder quadrature output |



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