PROTOBYTE

# PRODRIVE-2000

**80VDC / 7AMP**

**Microstepping Driver**

JANUARY 2004

**FEATURES –**

- Wide Operating Voltage
- Programmable Phase Current
- High Stepping Rate
- Smooth Performance / 10-Microsteps
- Anti-Resonance / Mid-Band Stabilization
- Automatic *STANDBY* Current Reduction
- Optically-Isolated Step and Direction
- Disable Command Tri-States Phase Outputs
- High-Efficiency *MOSFET* / Low Dissipation
- Open-Frame / Extruded Aluminum Chassis
- Removable Terminal Blocks / 5mm Pitch
- QS9000 Compliant Manufacturing

**APPLICATIONS –**

- Industrial Automation
- Computer Numeric Control
- Robotics
- Medical Products
- Labeling / Conveying Equipment
- Packaging Systems

**DESCRIPTION –**

The ProDrive-2000 *Microstepper* is quite universal and well suited for driving NEMA 17 to 42 frame, 2-phase stepper motors. It provides sinusoidal phase currents optimized for 10-microsteps per full motor step and transitions to quadrature phase currents as motor speed increases beyond the point where microstepping is no longer beneficial. Bipolar phase current regulation is achieved through PWM *chopping* at 20kHz., promoting inaudible switching. Phase currents are programmed using an external resistance, which may be fixed or dynamic, with provision for trimming. Automatic phase current reduction to 1/3$^{rd}$ the programmed value is enabled by default and occurs after one-second of stepping inactivity. Additional power conservation can be realized through use of the non-isolated disable command, which inhibits MOSFET gate drive, causing phase outputs to assume a high-impedance state. The anti-resonance circuit provides damping of motor oscillations by leading or lagging the torque wave, resulting in maximum usable motor torque.

**TYPICAL CONFIGURATION –**

Components that are necessary for a typical configuration are shown in *Figure-1*. While these are the "minimum" required to operate the ProDrive-2000, other configurations can result in added flexibility. Including, a user defined *Standby* current and programming of phase currents "on-the-fly". Emergency stop is easily implemented through a single switched contact or an optically-isolated solid-state-relay.

Operating power for the ProDrive-2000 is sourced entirely from *VDD*, which should be situated in close proximity to the ProDrive-2000, otherwise an external capacitance is required. High-side fusing is recommended if *VDD* lacks internal over-current and short-circuit protection. Optically-isolated "Step" and "Direction" commands use *VCC* as the source for common-anode LED's. A pulse-generator, indexer or controller provides *VCC* and must include a means for sinking return currents, as depicted in *Figure-1*. A *VCC* higher than 5volts can be used with the proper series-limiting resistors.

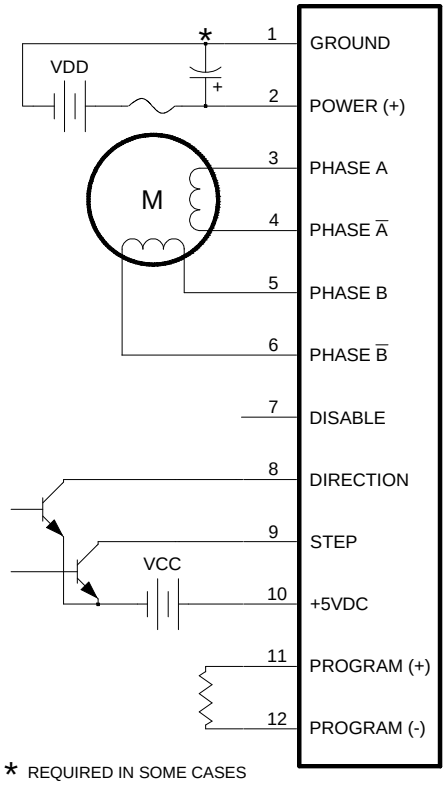


*Figure-1*





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**ABSOLUTE MAXIMUM RATINGS –**

Power Source Voltage / *VDD* .....100V (NOTE-1)
Phase Output Voltage ..... 100V (NOTE-2)
Opto-Coupler Source Voltage / *VCC* ..... 7V (NOTE-3)
Opto-Coupler LED Forward Current ..... 25mA (NOTE-4)
Opto-Coupler LED Reverse Voltage ..... 6V (NOTE-5)
Chassis Base Plate Temperature .....85°C (NOTE-6)

- *EXCEEDING MAXIMUM RATINGS WILL CAUSE FAILURE* -

**RECOMMENDED CONDITIONS –**

| PARAMETER | MINIMUM | TYPICAL | MAXIMUM | UNITS |
|---|---|---|---|---|
| *VDD* Power Source | 24 | - | 80 | V |
| Phase Current | 1 | - | 7 | A |
| Phase Inductance | 500 | - | - | uH |
| *VCC* Opto-Coupler Source (NOTE-7) | 4.75 | 5.00 | 5.25 | V |
| Step-Direction Sink Current | 16 | - | 20 | mA |
| Step-Direction Saturation (NOTE-8) | - | 0.2 | 0.5 | V |
| Step-Direction ∇ Transition | - | - | 100 | nsec |
| Step " LOW " Pulse-Width | 0.5 | - | ∞ | usec |
| Step " HIGH " Pulse-Width | 4 | - | ∞ | usec |
| Step Period Irregularity | -30 | 0 | +30 | % |
| Direction Change - Step ∇ (NOTE-9) | -1 | - | 1 | usec |
| Ambient Temperature | 0 | 25 | 50 | °C |
| Chassis Base Plate Temperature | 0 | 50 | 70 | °C |
| Relative Humidity (NOTE-10) | 0 | - | 95 | % |

Notes:

1) Peak operating voltage, including ripple, spikes and regenerated voltages in excess of the *VDD* power source.
2) Peak phase voltage, referenced to *VDD* ground. Including voltage generated while manually rotating the motor.
3) Maximum continuous *VCC* without external series-limiting resistors.
4) Maximum average forward current per channel at 25°C ambient.
5) > 5mA reverse current will drop voltage sufficient for reverse-breakdown of the LED.
6) Thermal probe contacting chassis ( *HEATSINK* ) at center of bottom surface.
7) Pulse generators having a higher *VCC* (12-24Vdc), require use of external series-limiting resistors.
8) Voltage drop measured from *STEP* or *DIRECTION* terminal to *VCC* ground, when active "LOW ".
9) Direction change should occur on the *STEP* falling-edge, within the min-max window.
10) Non-condensing.



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**PERFORMANCE CHARACTERISTICS –** $T_A$ = 25°C (unless otherwise stated)

| PARAMETER | MINIMUM | TYPICAL | MAXIMUM | UNITS |
|---|---|---|---|---|
| *VDD* Power to PWM Delay (NOTE-1) | - | 30 | - | msec |
| Step Propagation Delay (NOTE-2) | 5 | - | 100 | usec |
| Disable Propagation Delay (NOTE-3) | - | 560 | 620 | nsec |
| Step Frequency | 0 | - | 200 | kHz. |
| PWM Frequency | - | 20 | - | kHz. |
| Sine/Cosine to Quadrature Crossover | - | 15.5 | - | kHz. |
| Low Level Operating Current | 13.35 | - | 19.75 | mA |
| Disable Voltage (NOTE-4) | - | 5.8 | - | V |
| Disable Sink Current (NOTE-5) | 550 | 580 | 610 | uA |
| Dielectric Breakdown (NOTE-6) | - | 5500 | - | V |
| Continuous Phase Current (NOTE-7) | - | 4 | - | A |
| PCB; Excluding Chassis | - | 48 | - | V |
| Continuous Phase Current (NOTE-8) | - | 6 | - | A |
| PCB; Including Chassis | - | 60 | - | V |

Notes:

1) *VDD* rising through half-bridge driver under-voltage lockout, until start-up of phase modulation.
2) Internal timing delay from *STEP* active " LOW " edge until *STEP* commanded at the H-Bridges.
3) Includes contact closure activating *DISABLE*, half-bridge driver fall-time and MOSFET fall-time.
4) Internally pulled-up through 40k-ohm/2 divider.
5) Continuous current through mechanical or solid-state contact while holding *DISABLE* active.
6) MOSFET Drain to Chassis, per ASTM D149.
7) Typical at 22°C ambient. TO-220 cases: <55°C rise over ambient. No additional heat-sinking.
8) Typical at 22°C ambient. Chassis plate: <35°C rise over ambient. No additional heat-sinking.

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**PROGRAM RESISTOR SELECTION –**

*Use the Formula…*

$$47\left(\frac{\text{PHASE CURRENT}}{7 - \text{PHASE CURRENT}}\right) = \text{K-OHMS}$$

(*0.250 W 5%*)

*or*

*Use the Table…*

| PHASE CURRENT (A) | PROGRAM RESISTOR |
|---|---|
| 1.0 | 8.2k |
| 1.5 | 13k |
| 2.0 | 18k |
| 2.5 | 27k |
| 3.0 | 36k |
| 3.5 | 47k |
| 4.0 | 62k |
| 4.5 | 82k |
| 5.0 | 120k |
| 5.5 | 180k |
| 6.0 | 270k |
| 6.5 | 620k |
| 7.0 | OPEN |





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**TERMINAL / FEATURE LOCATION –**

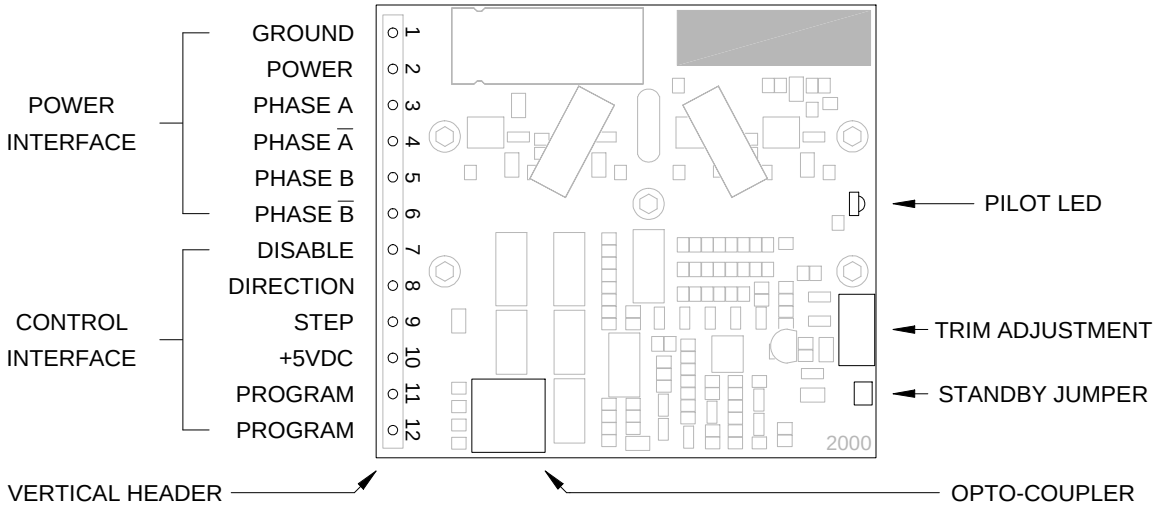


*Figure-2*

Interfacing consist of a power and control section, as shown in *Figure-2*. Two (6-position) terminal blocks are removable from the vertical header, with terminals numbered on the printed-circuit board. An opto-coupler socket simplifies its' replacement or addition of *optional* circuits. With a right-angle "*Pilot LED* " the power status and *Trim Adjustment* are accessible through a common window in the users' enclosure. A "solder-bump" jumper defeats the phase current reduction feature (*Standby*), when bridged.

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**PHYSICAL CHARACTERISTICS –**

- *CHASSIS…*

TYPE= EXTRUSION
ALLOY= ALUMINUM; 6063 T-5
COATING= ANODIZED; BLACK; TYPE-II, CLASS-I

- *PC-BOARD…*

TYPE= FR-4; 6-LAYER
RATING= UL-94V0

- *ASSEMBLY…*

WEIGHT= 5.3 ounces ( 150.25 grams)



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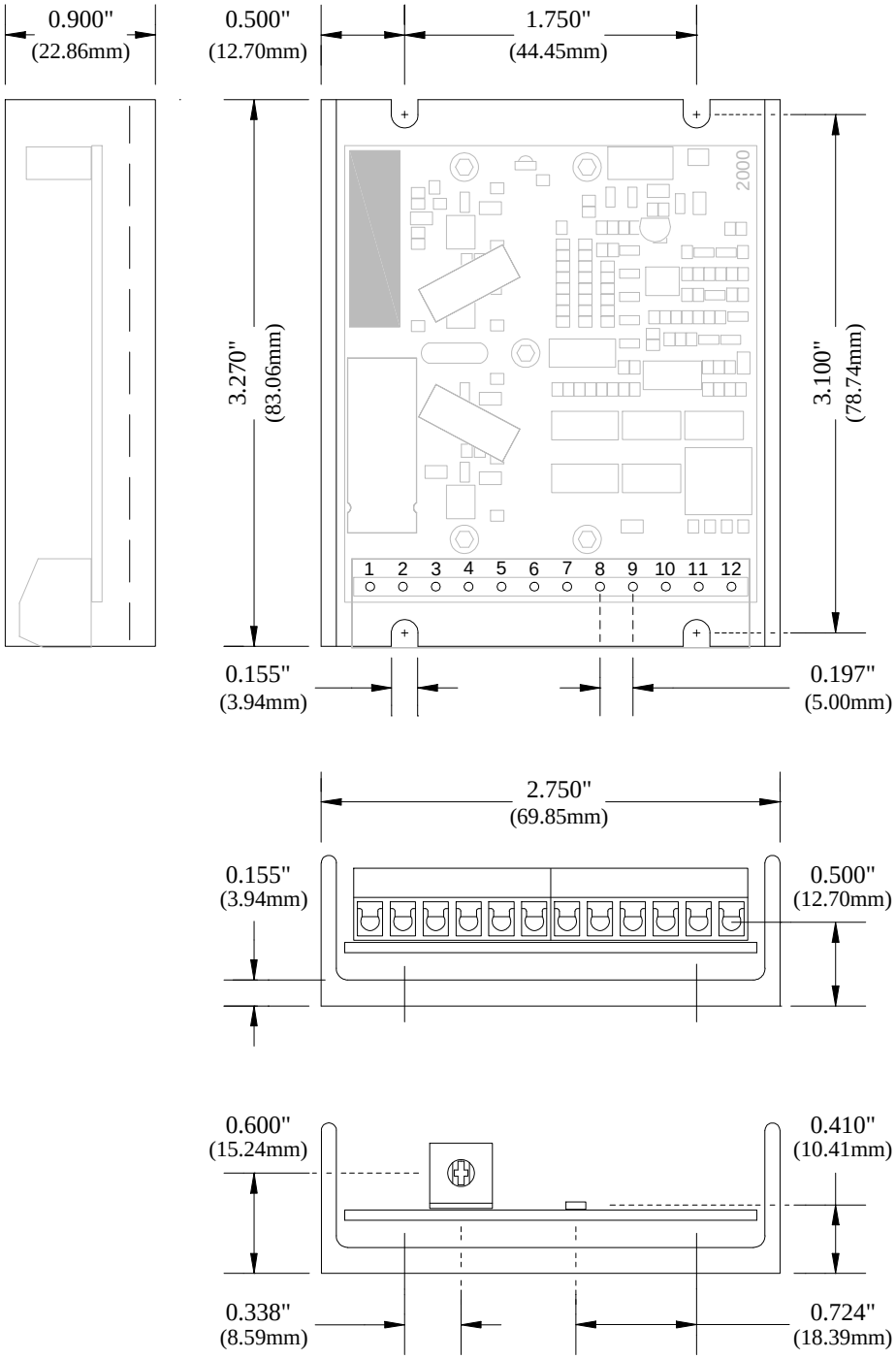
**DIMENSIONS –**




*OUTLINE TOLERANCE +/- 0.010" (0.25mm)*
*MILLING TOLERANCE +/- 0.005" (0.13mm)*





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