

# IM2000

## HIGH PERFORMANCE MICROSTEPPING CONTROLLER

### FEATURES

- COMPLETE MICROSTEPPING CONTROL SYSTEM IN A 68 PIN PLCC or 80 PIN QFP
- UP TO 10 MHz STEP CLOCK RATE
- INTERNAL SINE/COSINE GENERATOR
- PWM PHASE CURRENT CONTROL
- MINIMAL EXTERNAL COMPONENTS
- AUTOMATIC CURRENT REDUCTION
- 14 SELECTABLE RESOLUTIONS — BOTH IN DECIMAL AND BINARY
- NUMBER OF MICROSTEPS PER STEP CAN BE CHANGED ON-THE-FLY WITHOUT MOTOR MOVEMENT INTERRUPTION
- UP TO 51,200 STEPS/REV
- STAND ALONE OR BUSS MODES
- SINGLE 5V POWER SUPPLY
- SHORT CIRCUIT AND OVER TEMPERATURE PROTECTION INPUTS
- FAULT OUTPUT
- ON FULL STEP OUTPUT
- ANTI-RESONANCE

### DESCRIPTION

The IM2000 is a high performance microstepping controller that incorporates a sine/cosine signal generator, anti-resonance circuitry, PWM current control and much

more in one monolithic IC. The IM2000 combines hardware intense functions together with innovative features to provide designers with a powerful yet simple solution for their high volume OEM products.

Never before has any motion product integrated all the digital control into one monolithic IC. This high degree of integration can significantly reduce design time as well as driver size.

Beyond the integration of a complete microstepping control system, the IM2000 has unique features that give designers unprecedented control over motor movement. These features include 14 selectable resolutions (in both decimal and binary) that can be changed at any time without motor movement interruption. There is no need to reset the controller. This allows the user to rapidly move long distances, yet precisely position the motor at the end of travel without the need or expense of a complex controller.

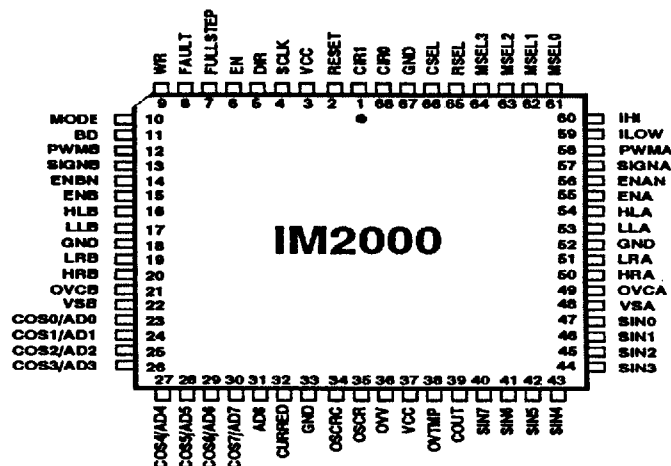
Another valuable feature is an "On-Full Step" output which indicates when the motor is at an electrical full step. This output can be used to reduce the overhead needed to track position when making long moves.

The development of proprietary circuits has minimized ripple current, while maintaining a 20 KHz chopping rate. This prevents additional motor heating that is common with drivers requiring higher chopping rates. Now low inductance stepper motors can be used to improve high speed performance and peak system efficiency.

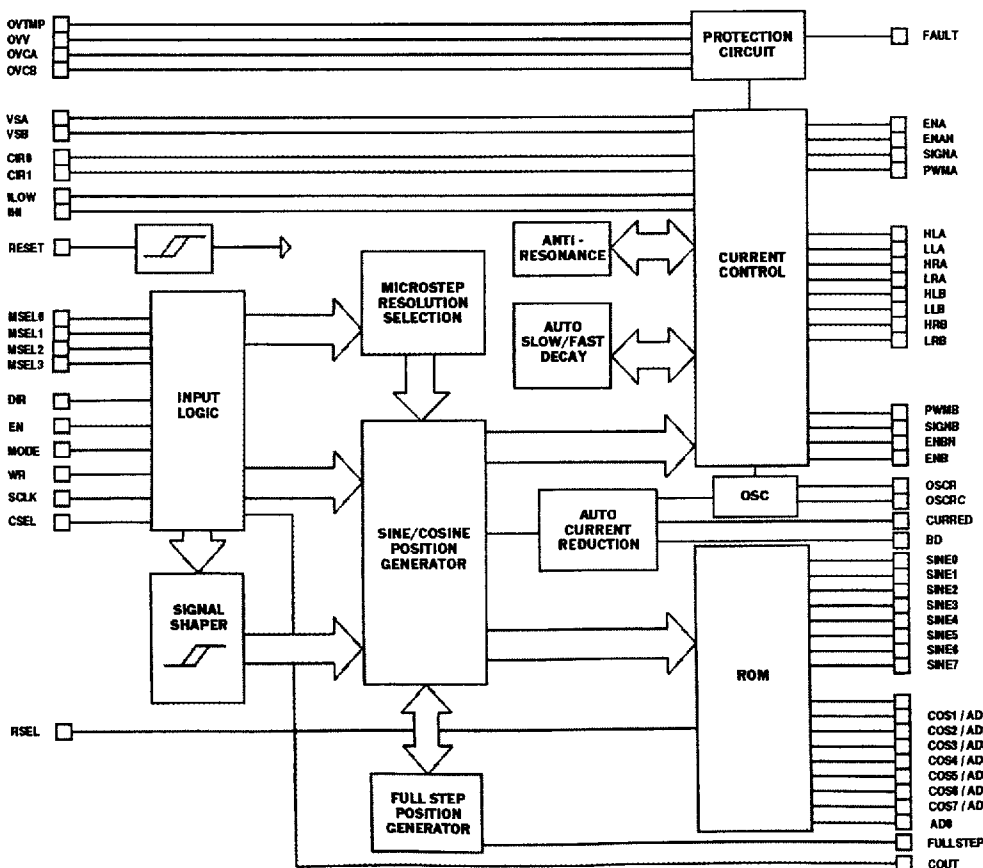
The IM2000 needs only clock and direction inputs to control the motor and will interface directly to discrete bridges or common monolithic bridge ICs.

Designers can now place drivers directly on their PC boards with all the necessary control in one single 68 pin PLCC package or optional 80 pin QFP package.

Size, price, and time-to-market are three crucial aspects in today's competitive markets and the IM2000 offers the ability to reduce all three.



68 PIN PLCC



## PIN DESCRIPTION

| 80<br>PIN #       | 68<br>PIN #    | NAME                  | FUNCTION                                                                                                                                                                                                                                                                                                           |
|-------------------|----------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 56                | 4              | SCLK                  | Step clock input. A positive going edge on this input will advance the motor one increment (the size of the increment is dependent on the microstep select inputs).                                                                                                                                                |
| 48                | 65             | RSEL                  | ROM Select Input. When low this input selects the internal sine/cosine ROM. When high ADO-AD8 are selected for use with an external lookup table.                                                                                                                                                                  |
| 54                | 2              | RESET                 | Reset input. When low this input will reset the IM2000 (PWM, Enable, and Full Bridge outputs will be disabled) when released the controller will be at its initial state (sine at 0, cosine at peak)                                                                                                               |
| 57                | 5              | DIR                   | Direction input. This input is used to change the direction of the motor. Physical direction also depends on the connection of the motor windings.                                                                                                                                                                 |
| 49                | 66             | CSEL                  | Clock Select Input. When low the SCLK input will be directed to the internal sine/cosine generator independent of the level of the EN input. When high the SCLK input will be directed to the COUT output when the EN input is low and conversely to the internal sine/cosine generator when the EN input is high. |
| 58                | 6              | EN                    | Enable input. When low this input will enable/disable the PWM and full bridge output signals.                                                                                                                                                                                                                      |
| 59                | 7              | FULLSTEP              | On fullstep output signal. This active low output indicates when the IM2000's sine & cosine outputs are positioned on a full step.                                                                                                                                                                                 |
| 61                | 8              | FAULT                 | Fault output signal. This active high output indicates when a fault has occurred. It will stay active until the IM2000 is reset.                                                                                                                                                                                   |
| 62                | 9              | WR                    | Write input. When the IM2000 is configured in the buss mode, this input is used to latch in the microstep select, enable, and direction inputs.                                                                                                                                                                    |
| 63                | 10             | MODE                  | Mode select input. This input is used to configure the IM2000 in a stand alone or buss modes.                                                                                                                                                                                                                      |
| 40,65             | 58,12          | PWMA,PWMB             | Phase A and Phase B pulse width modulated output signals. These outputs can be used to control the phase currents in common PWM type power sections.                                                                                                                                                               |
| 38,67             | 57,13          | SIGNA, SIGNB          | Sign of A and sign of B output signals. These outputs indicate the sign of the sine and the sign of the cosine.                                                                                                                                                                                                    |
| 36,69             | 55,15          | ENA, ENB              | Phase A and Phase B enable output signals. These active high outputs, which work in conjunction with the enable input of PIN 6, can be used to enable/disable the power section of the driver.                                                                                                                     |
| 37,68             | 56,14          | ENAN, ENBN            | Phase A and Phase B enable NOT output signals. These active low outputs, which work in conjunction with the enable input of PIN 6, can be used to enable/disable the power section of the driver.                                                                                                                  |
| 30,31<br>34,35    | 50,51<br>53,54 | HRA, LRA,<br>LLA, HLA | Phase A high side and low side full bridge control signals These outputs can be used to control discrete P-N or N-N full bridge power sections or half and full bridge IC's.                                                                                                                                       |
| 70,71<br>74,75    | 16,17<br>19,20 | HLB, LLB,<br>LRB, HRB | Phase B high side and low side full bridge control signals. These outputs can be used to control discrete P-N or N-N full bridge power sections or half and full bridge IC's.                                                                                                                                      |
| 78,80<br>1-4,6,7  | 23-30          | COS0-COS7             | Cosine waveform output signals for Phase B.                                                                                                                                                                                                                                                                        |
| 18,19<br>21-25,27 | 40-47          | SIN7-SIN0             | Sine waveform output signals for Phase A.                                                                                                                                                                                                                                                                          |
| 42                | 60             | IHI                   | Polarity select input for active high or active low high side full bridge control outputs.                                                                                                                                                                                                                         |
| 41                | 59             | ILOW                  | Polarity select input for active high or active low low side full bridge control outputs.                                                                                                                                                                                                                          |
| 28,77             | 48,22          | VSA,VSB               | Phase A and Phase B current sense inputs.                                                                                                                                                                                                                                                                          |
| 29,76             | 49,21          | OVCA, OVCB            | Phase A and Phase B over current/short circuit protection inputs.                                                                                                                                                                                                                                                  |
| 9                 | 32             | CURRED                | Automatic current reduction output signal. This active high output is used to automatically reduce the driver output current 1 sec. after the last step clock input.                                                                                                                                               |
| 11,12             | 34,35          | OSCR0,OSCR            | Resistor/capacitor inputs for on board PWM oscillator.                                                                                                                                                                                                                                                             |
| 14                | 36             | OVV                   | Over voltage protection input.                                                                                                                                                                                                                                                                                     |
| 16                | 38             | OVTMP                 | Over temperature protection input.                                                                                                                                                                                                                                                                                 |
| 15,55             | 3,37           | VCC                   | Supply Voltage                                                                                                                                                                                                                                                                                                     |
| 10,32,<br>50,72   | 18,33<br>52,67 | GND                   | Ground                                                                                                                                                                                                                                                                                                             |
| 43,44,<br>46,47   | 61-64          | MSEL0-MSEL3           | Microstep resolution select inputs. These inputs are used to select the number of microsteps per full step. The available resolutions (microsteps/step) are: 2, 4, 5, 8, 10, 16, 25, 32, 50, 64, 125, 128, 250, 256.                                                                                               |
| 78,80<br>1-4,6-8  | 23-31          | ADO-AD8               | Address 0 - Address 8. These outputs are used in conjunction with external lookup tables for user supplied sine and cosine curves.                                                                                                                                                                                 |
| 17                | 39             | COUT                  | SCLK Output. This output is dependent on the CSEL and EN inputs.                                                                                                                                                                                                                                                   |
| 51,52             | 68,1           | CIR0, CIR1            | PWM Circulation Select Inputs. These inputs are used to select whether or not the PWM will be in a recirculating or a non-recirculating mode or an automatic recirculating and non-recirculating mode.                                                                                                             |
| 64                | 11             | BD                    | Binary/Decimal Select Output. This output is used in conjunction with ADO-AD8 when using outside lookup tables. This output is used to choose between binary or decimal encoded tables.                                                                                                                            |

## ABSOLUTE MAXIMUM RATINGS

| Parameter         | Symbol    | Limits                           | Units |
|-------------------|-----------|----------------------------------|-------|
| DC Supply Voltage | $V_{DD}$  | $V_{SS} - 0.3$ to $+7.0$         | V     |
| Input Voltage     | $V_{IN}$  | $V_{SS} - 0.3$ to $V_{DD} + 0.3$ | V     |
| Output Voltage    | $V_{OUT}$ | $V_{SS} - 0.3$ to $V_{DD} + 0.3$ | V     |
| Storage Temp.     | $T_{STG}$ | $-65$ to $+150$                  | °C    |

## RECOMMENDED OPERATING CONDITIONS

| Parameter         | Symbol           | Min.            | Typ | Max             | Units |
|-------------------|------------------|-----------------|-----|-----------------|-------|
| DC Supply Voltage | V <sub>DD</sub>  | 4.5             | 5.0 | 5.5             | V     |
| Input Voltage     | V <sub>IN</sub>  | V <sub>SS</sub> |     | V <sub>DD</sub> | V     |
| Operating Temp.   | T <sub>OPR</sub> | − 20            |     | 85              | °C    |

## ELECTRICAL CHARACTERISTICS

$$V_{DD} = +5.0 \pm 10\% \quad T_{OPR} = 25^\circ\text{C}$$

## DC ELECTRICAL CHARACTERISTICS

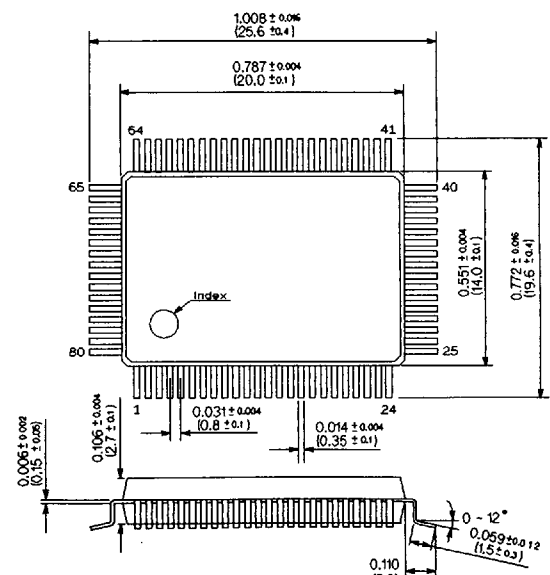
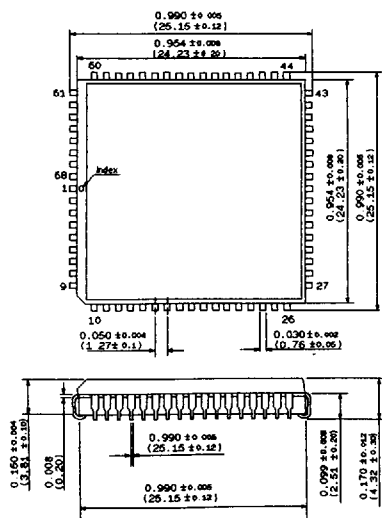
| SYMBOL   | PARAMETER                                        | CONDITIONS        | MIN            | TYP | MAX            | UNITS   |
|----------|--------------------------------------------------|-------------------|----------------|-----|----------------|---------|
| $V_{IL}$ | Low level input voltage                          |                   |                |     | 0.8            | V       |
| $V_{IH}$ | High level input voltage                         |                   | 2.0            |     |                | V       |
| $V_{T+}$ | Schmitt trigger positive going threshold voltage | $V_{DD} = 5.0$    |                | 3.0 |                | V       |
| $V_{T-}$ | Schmitt trigger negative going threshold voltage | $V_{DD} = 5.0$    | 0.6            |     |                | V       |
| $V_H$    | Schmitt trigger hysteresis voltage               | $V_{DD} = 5.0$    | 0.1            |     |                | V       |
| $I_{IL}$ | Low level input current                          | $V_{IN} = V_{SS}$ |                |     | 1.0            | $\mu A$ |
| $I_{IH}$ | High level input current                         | $V_{IN} = V_{DD}$ |                |     | 1.0            | $\mu A$ |
| $V_{OL}$ | Low level output voltage                         |                   |                |     | $V_{SS} + 0.4$ | V       |
| $V_{OH}$ | High level output voltage                        |                   | $V_{DD} - 0.4$ |     |                | V       |
| $I_{OL}$ | Low level output current                         |                   |                |     | - 6.0          | mA      |
| $I_{OH}$ | High level output current                        |                   |                |     | 3.0            | mA      |
| $I_{CC}$ | Supply current                                   |                   |                |     |                | mA      |

## AC ELECTRICAL CHARACTERISTICS

| SYMBOL    | PARAMETER               | CONDITIONS | MIN | TYP | MAX | UNITS |
|-----------|-------------------------|------------|-----|-----|-----|-------|
| $t_{RW}$  | RESET pulse width       |            | 200 |     |     | nS    |
| $t_S$     | MSEL, SCLK setup time   |            |     | 100 |     | nS    |
| $t_{SW}$  | SCLK pulse width        |            |     | 10  |     | nS    |
| $t_{WR}$  | WR pulse width          |            |     | 20  |     | nS    |
| $t_{WH}$  | Data hold time after WR |            | 0   |     |     | nS    |
| $f_{PWM}$ | PWM chopping frequency  |            |     | 20  |     | KHz   |
| $f_{CLK}$ | SCLK input frequency    |            |     | 10  |     | MHz   |

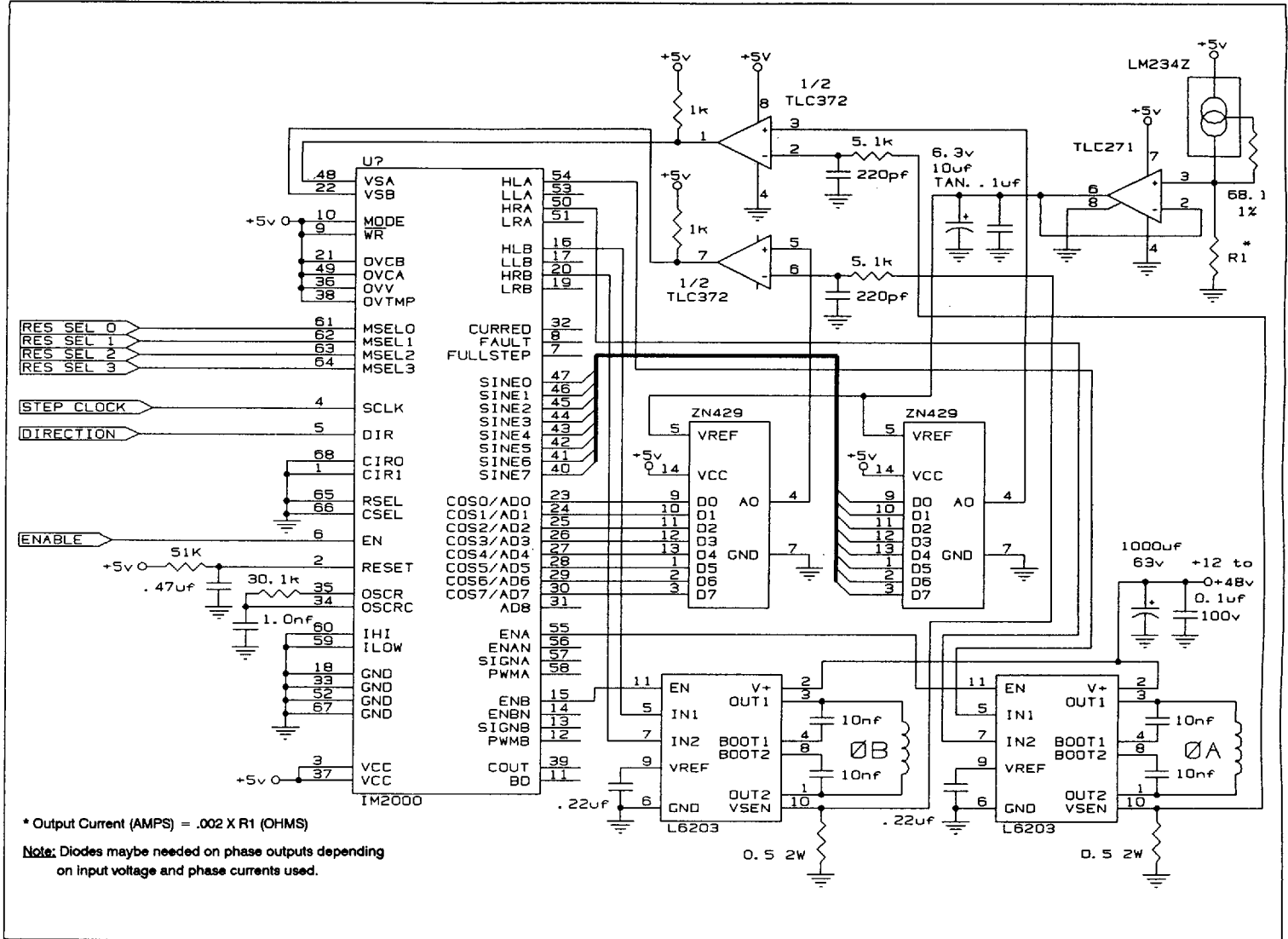
## PACKAGING INFORMATION

unit : inch  
(mm)



# TYPICAL APPLICATION

FIG. 1  
48V, 3 AMPS (RMS)/PHASE MICROSTEPPING DRIVER



The information contained herein has been carefully checked and is believed to be accurate; however, no responsibility is assumed for information inaccuracies. Specifications are subject to change without notice.

# IMS<sup>TM</sup>

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