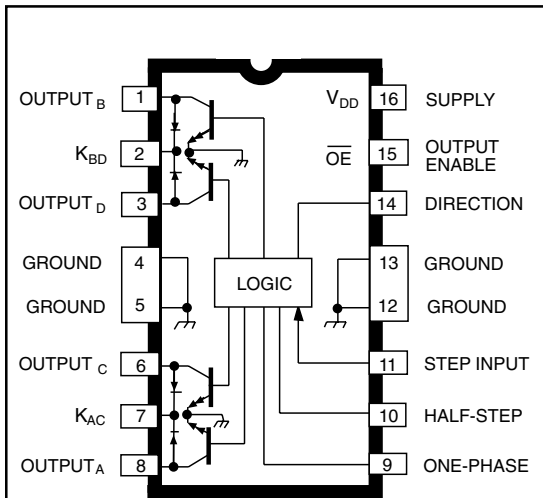


# 5804

## BiMOS II UNIPOLAR STEPPER-MOTOR TRANSLATOR/DRIVER



Dwg. W-194

Note that the UCN5804B (dual in-line package) and UCN5804LB (small outline IC package) are electrically identical and share a common terminal number assignment.

### ABSOLUTE MAXIMUM RATINGS

Output Voltage, $V_{CE}$ .....	50 V
Output Sustaining Voltage, $V_{CE(sus)}$ .....	35 V
Output Sink Current, $I_{OUT}$ .....	1.5 A
Logic Supply Voltage, $V_{DD}$ .....	7.0 V
Input Voltage, $V_{IN}$ .....	7.0 V
Package Power Dissipation, $P_D$ .....	See Graph
Operating Temperature Range, $T_A$ .....	-20°C to +85°C
Storage Temperature Range, $T_S$ .....	-55°C to +150°C

Combining low-power CMOS logic with high-current and high-voltage bipolar outputs, the UCN5804B and UCN5804LB BiMOS II translator/drivers provide complete control and drive for a four-phase unipolar stepper-motor with continuous output current ratings to 1.25 A per phase (1.5 A startup) and 35 V.

The CMOS logic section provides the sequencing logic, DIRECTION and OUTPUT ENABLE control, and a power-on reset function. Three stepper-motor drive formats, wave-drive (one-phase), two-phase, and half-step are externally selectable. The inputs are compatible with standard CMOS, PMOS, and NMOS circuits. TTL or LSTTL may require the use of appropriate pull-up resistors to ensure a proper input-logic high.

The wave-drive format consists of energizing one motor phase at a time in an A-B-C-D (or D-C-B-A) sequence. This excitation mode consumes the least power and assures positional accuracy regardless of any winding imbalance in the motor. Two-phase drive energizes two adjacent phases in each detent position (AB-BC-CD-DA). This sequence mode offers an improved torque-speed product, greater detent torque, and is less susceptible to motor resonance. Half-step excitation alternates between the one-phase and two-phase modes (A-AB-B-BC-C-CD-D-DA), providing an eight-step sequence.

The bipolar outputs are capable of sinking up to 1.5 A and withstanding 50 V in the off state (sustaining voltages up to 35 V). Ground-clamp and flyback diodes provide protection against inductive transients. Thermal protection circuitry disables the outputs when the chip temperature is excessive.

Both devices are rated for operation over the temperature range of -20°C to +85°C. The UCN5804B is supplied in a 16-pin dual in-line plastic batwing package with a copper lead frame and heat-sinkable tabs for improved power dissipation capabilities; the UCN5804LB is supplied in a 16-lead plastic SOIC batwing package with a copper lead frame and heat-sinkable tabs.

### FEATURES

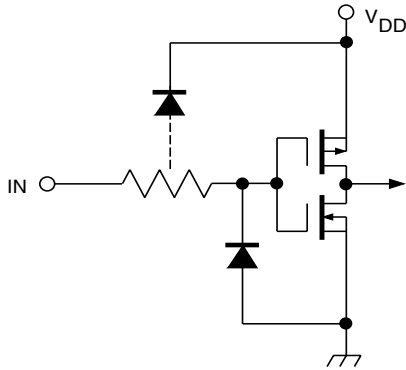
- 1.5 A Maximum Output Current
- 35 V Output Sustaining Voltage
- Wave-Drive, Two-Phase, and Half-Step Drive Formats
- Internal Clamp Diodes
- Output Enable and Direction Control
- Power-On Reset
- Internal Thermal Shutdown Circuitry

Always order by complete part number, e.g., **UCN5804B**.

# 5804

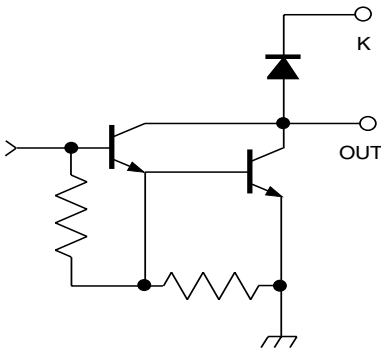
## BiMOS II UNIPOLAR STEPPER-MOTOR TRANSLATOR/DRIVER

### TYPICAL INPUT CIRCUIT

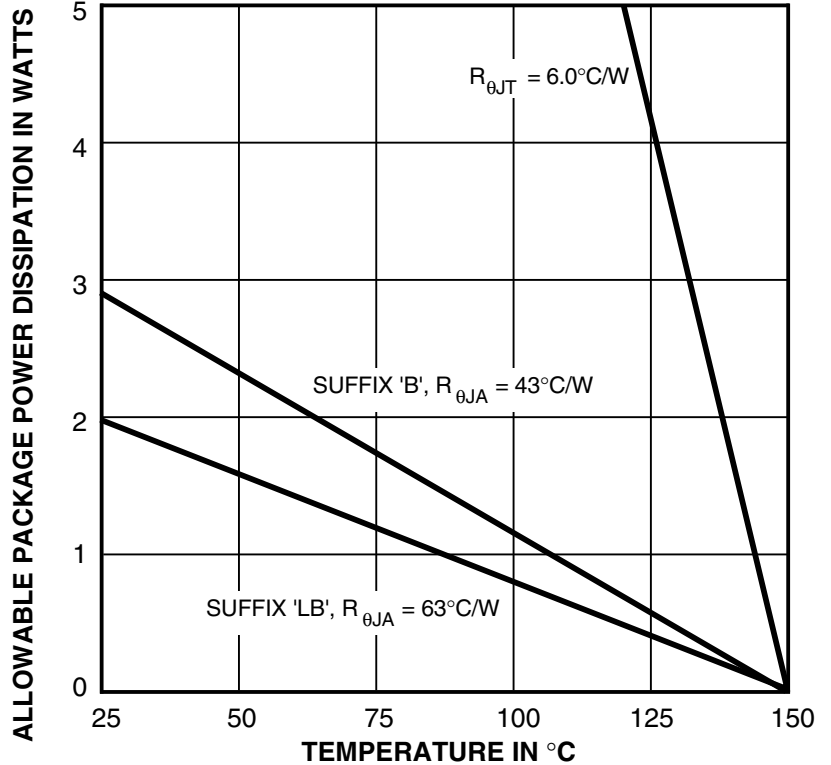


Dwg. EP-010-5

### TYPICAL OUTPUT DRIVER



Dwg. EP-021-4



Dwg. GP-049-2A

### TRUTH TABLE

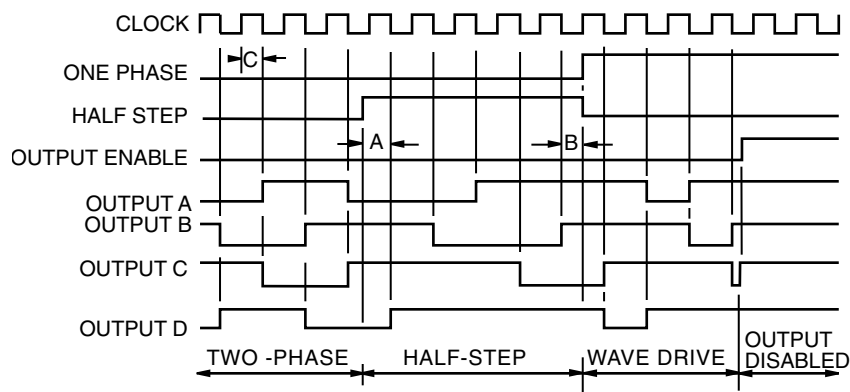
Drive Format	Pin 9	Pin 10
Two-Phase	L	L
One-Phase	H	L
Half-Step	L	H
Step-Inhibit	H	H

# 5804 BiMOS II UNIPOLAR STEPPER-MOTOR TRANSLATOR/DRIVER

**ELECTRICAL CHARACTERISTICS** at  $T_A = 25^\circ\text{C}$ ,  $T_J \leq 150^\circ\text{C}$ ,  $V_{DD} = 4.5\text{ V to }5.5\text{ V}$   
(unless otherwise noted).

Characteristic	Symbol	Test Conditions	Limits			Units
			Min.	Typ.	Max.	
Output Leakage Current	$I_{CEX}$	$V_{OUT} = 50\text{ V}$	—	10	50	$\mu\text{A}$
Output Sustaining Voltage	$V_{CE(sus)}$	$I_{OUT} = 1.25\text{ A}$ , $L = 3\text{ mH}$	35	—	—	V
Output Saturation Voltage	$V_{CE(SAT)}$	$I_{OUT} = 700\text{ mA}$	—	1.0	1.2	V
		$I_{OUT} = 1\text{ A}$	—	1.1	1.4	V
		$I_{OUT} = 1.25\text{ A}$	—	1.2	1.5	V
Clamp Diode Leakage Current	$I_R$	$V_R = 50\text{ V}$	—	10	50	$\mu\text{A}$
Clamp Diode Forward Voltage	$V_F$	$I_F = 1.25\text{ A}$	—	1.5	3.0	V
Input Current	$I_{IN(1)}$	$V_{IN} = V_{DD}$	—	0.5	5.0	$\mu\text{A}$
	$I_{IN(0)}$	$V_{IN} = 0.8\text{ V}$	—	-0.5	-5.0	$\mu\text{A}$
Input Voltage	$V_{IN(1)}$	$V_{DD} = 5\text{ V}$	3.5	—	5.3	V
	$V_{IN(0)}$		-0.3	—	0.8	V
Supply Current	$I_{DD}$	2 Outputs ON	—	20	30	mA
Turn-Off Delay	$t_{ON}$	50% Step Inputs to 50% Output	—	—	10	$\mu\text{s}$
Turn-On Delay	$t_{OFF}$	50% Step Inputs to 50% Output	—	—	10	$\mu\text{s}$
Thermal Shutdown Temperature	$T_J$		—	165	—	$^\circ\text{C}$

## TIMING CONDITIONS



Dwg. W-110A

- A. Minimum Data Set Up Time . . . . . **100 ns**
- B. Minimum Data Hold Time . . . . . **100 ns**
- C. Minimum Step Input Pulse Width . . . . . **3.0  $\mu\text{s}$**

# 5804

## *BiMOS II UNIPOLAR STEPPER-MOTOR TRANSLATOR/DRIVER*

### APPLICATIONS INFORMATION

Internal power-on reset (POR) circuitry resets OUTPUT<sub>A</sub> (and OUTPUT<sub>D</sub> in the two-phase drive format) to the on state with initial application of the logic supply voltage. After reset, the circuit then steps according to the tables.

The outputs will advance one sequence position on the high-to-low transition of the STEP INPUT pulse. Logic levels on the HALF-STEP and ONE-PHASE inputs will determine the drive format (one-phase, two-phase, or half-step). The DIRECTION pin determines the rotation sequence of the outputs. Note that the STEP INPUT must be in the low state when changing the state of ONE-PHASE, HALF-STEP, or DIRECTION to prevent erroneous stepping.

All outputs are disabled (off) when OUTPUT ENABLE is at a logic high. If the function is not required, OUTPUT ENABLE should be tied low. In that condition, all outputs depend only on the state of the step logic.

During normal commutation of a unipolar stepper motor, mutual coupling between the motor windings can force the outputs of the UCN5804B below ground. This condition will cause forward biasing of the collector-to-substrate junction and source current from the output. For many L/R applications, this substrate current is high enough to adversely affect the logic circuitry and cause misstepping. External series diodes (Schottky are recommended for increased efficiency at low-voltage operation) will prevent substrate current from being sourced through the outputs. Alternatively, external ground clamp diodes will provide a preferred current path from ground when the outputs are pulled below ground.

Internal thermal protection circuitry disables all outputs when the junction temperature reaches approximately 165°C. The outputs are enabled again when the junction cools down to approximately 145°C.

### WAVE-DRIVE SEQUENCE

Half Step = L, One Phase = H				
Step	A	B	C	D
POR	ON	OFF	OFF	OFF
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	ON

### TWO-PHASE DRIVE SEQUENCE

Half Step = L, One Phase = L				
Step	A	B	C	D
POR	ON	OFF	OFF	ON
1	ON	OFF	OFF	ON
2	ON	ON	OFF	OFF
3	OFF	ON	ON	OFF
4	OFF	OFF	ON	ON

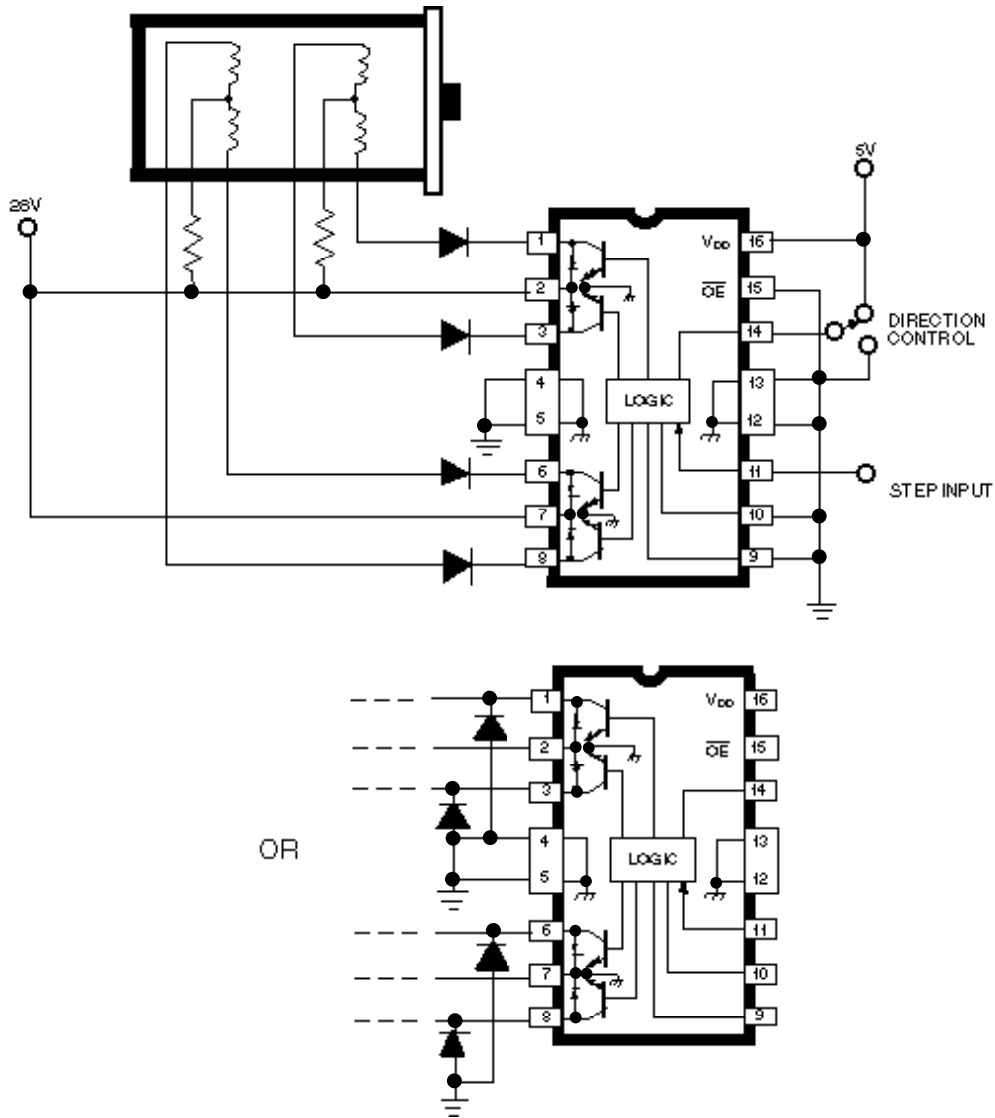
### HALF-STEP DRIVE SEQUENCE

Half Step = H, One Phase = L				
Step	A	B	C	D
POR	ON	OFF	OFF	OFF
1	ON	OFF	OFF	OFF
2	ON	ON	OFF	OFF
3	OFF	ON	OFF	OFF
4	OFF	ON	ON	OFF
5	OFF	OFF	ON	OFF
6	OFF	OFF	ON	ON
7	OFF	OFF	OFF	ON
8	ON	OFF	OFF	ON



# 5804 BiMOS II UNIPOLAR STEPPER-MOTOR TRANSLATOR/DRIVER

## TYPICAL APPLICATION L/R Stepper-Motor Drive



*The products described here are manufactured under one or more U.S. patents or U.S. patents pending.*

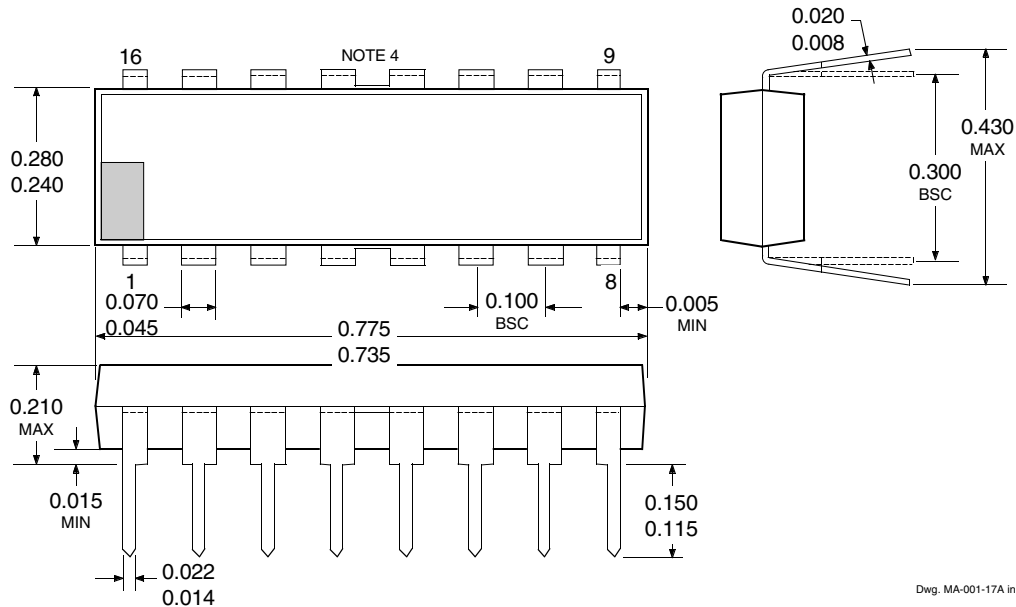
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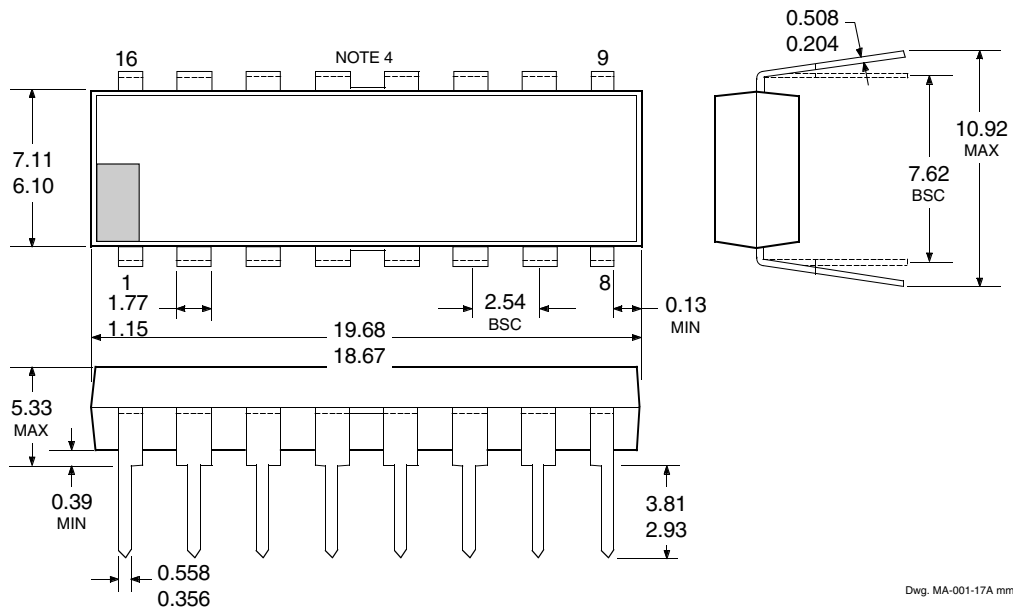
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**5804**  
**BiMOS II UNIPOLAR**  
**STEPPER-MOTOR**  
**TRANSLATOR/DRIVER**

**UCN5804B**  
**Dimensions in Inches**  
**(controlling dimensions)**



**Dimensions in Millimeters**  
**(for reference only)**



- NOTES: 1. Exact body and lead configuration at vendor's option within limits shown.  
 2. Lead spacing tolerance is non-cumulative.  
 3. Lead thickness is measured at seating plane or below.  
 4. Webbed lead frame. Leads 4, 5, 12, and 13 are internally one piece.  
 5. Supplied in standard sticks/tubes of 25 devices.



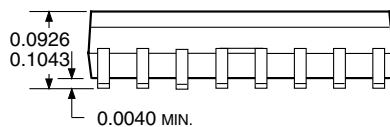
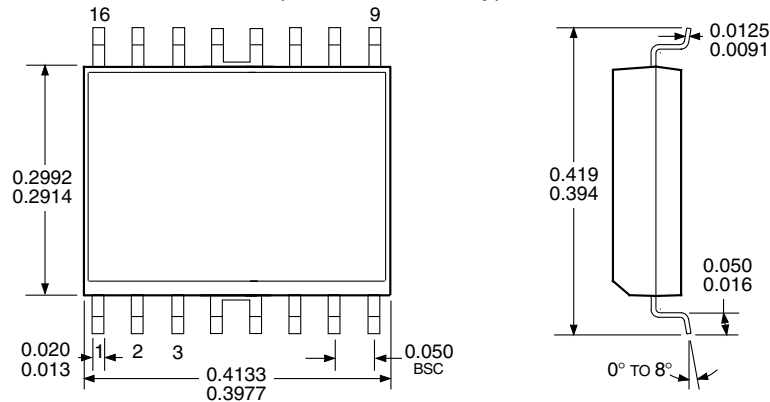
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 Worcester, Massachusetts 01615-0036 (508) 853-5000

# 5804 BiMOS II UNIPOLAR STEPPER-MOTOR TRANSLATOR/DRIVER

## UCN5804LB

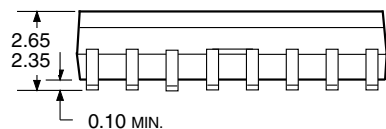
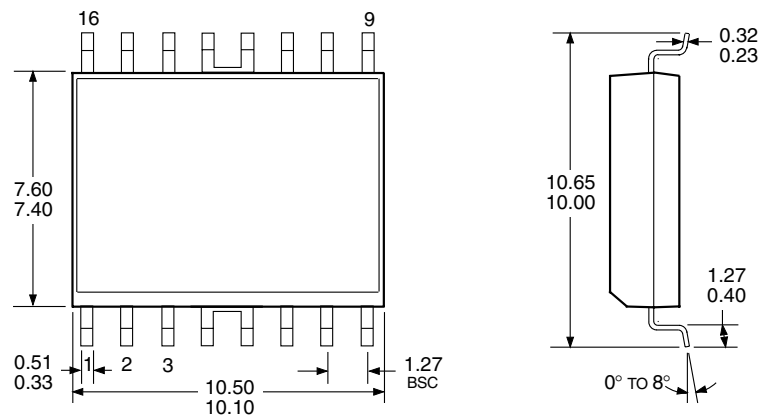
(add "TR" to part number for tape and reel)

**Dimensions in Inches**  
(for reference only)



Dwg. MA-008-17A in

**Dimensions in Millimeters**  
(controlling dimensions)



Dwg. MA-008-17A mm

- NOTES: 1. Exact body and lead configuration at vendor's option within limits shown.  
 2. Lead spacing tolerance is non-cumulative.  
 3. Lead thickness is measured at seating plane or below.  
 4. Webbed lead frame. Leads 4, 5, 12, and 13 are internally one piece.  
 5. Supplied in standard sticks/tubes of 47 devices or add "TR" to part number for tape and reel.

**5804**  
**BiMOS II UNIPOLAR**  
**STEPPER-MOTOR**  
**TRANSLATOR/DRIVER**

**MOTOR DRIVERS**

Function	Output Ratings*		Part Number†
<b>INTEGRATED CIRCUITS FOR BRUSHLESS DC MOTORS</b>			
3-Phase Power MOSFET Controller	—	28 V	3933
3-Phase Power MOSFET Controller	—	50 V	3932
3-Phase Power MOSFET Controller	—	50 V	7600
2-Phase Hall-Effect Sensor/Driver	400 mA	26 V	3626
Bidirectional 3-Phase Back-EMF Controller/Driver	±600 mA	14 V	8906
2-Phase Hall-Effect Sensor/Driver	900 mA	14 V	3625
3-Phase Back-EMF Controller/Driver	±900 mA	14 V	8902–A
3-Phase Controller/Drivers	±2.0 A	45 V	2936 & 2936-120
<b>INTEGRATED BRIDGE DRIVERS FOR DC AND BIPOLAR STEPPER MOTORS</b>			
Dual Full Bridge with Protection & Diagnostics	±500 mA	30 V	3976
PWM Current-Controlled Dual Full Bridge	±650 mA	30 V	3966
PWM Current-Controlled Dual Full Bridge	±650 mA	30 V	3968
PWM Current-Controlled Dual Full Bridge	±750 mA	45 V	2916
PWM Current-Controlled Dual Full Bridge	±750 mA	45 V	2919
PWM Current-Controlled Dual Full Bridge	±750 mA	45 V	6219
PWM Current-Controlled Dual Full Bridge	±800 mA	33 V	3964
PWM Current-Controlled Full Bridge	±1.3 A	50 V	3953
PWM Current-Controlled Dual Full Bridge	±1.5 A	45 V	2917
PWM Current-Controlled Microstepping Full Bridge	±1.5 A	50 V	3955
PWM Current-Controlled Microstepping Full Bridge	±1.5 A	50 V	3957
PWM Current-Controlled Dual DMOS Full Bridge	±1.5 A	50 V	3972
Dual Full-Bridge Driver	±2.0 A	50 V	2998
PWM Current-Controlled Full Bridge	±2.0 A	50 V	3952
DMOS Full Bridge PWM Driver	±2.0 A	50 V	3958
Dual DMOS Full Bridge	±2.5 A	50 V	3971
<b>UNIPOLAR STEPPER MOTOR &amp; OTHER DRIVERS</b>			
Voice-Coil Motor Driver	±500 mA	6 V	8932–A
Voice-Coil Motor Driver	±800 mA	16 V	8958
Unipolar Stepper-Motor Quad Drivers	1 A	46 V	7024 & 7029
Unipolar Microstepper-Motor Quad Driver	1.2 A	46 V	7042
Unipolar Stepper-Motor Translator/Driver	1.25 A	50 V	5804
Unipolar Stepper-Motor Quad Driver	1.8 A	50 V	2540
Unipolar Stepper-Motor Quad Driver	1.8 A	50 V	2544
Unipolar Stepper-Motor Quad Driver	3 A	46 V	7026
Unipolar Microstepper-Motor Quad Driver	3 A	46 V	7044

\* Current is maximum specified test condition, voltage is maximum rating. See specification for sustaining voltage limits or over-current protection voltage limits. Negative current is defined as coming out of (sourcing) the output.

† Complete part number includes additional characters to indicate operating temperature range and package style.

Also, see 3175, 3177, 3235, and 3275 Hall-effect sensors for use with brushless dc motors.



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