

# 0.7 A Dual H-Bridge Motor Driver with 3.0V/5.0V Compatible Logic I/O

The 17529 is a monolithic dual H-Bridge power IC ideal for portable electronic applications containing bipolar step motors and/or brush DC-motors (e.g., cameras and disk drive head positioners).

The 17529 operates from 2.0 V to 6.8 V, with independent control of each H-Bridge via parallel MCU interface (3.0 V- and 5.0 V-compatible logic). The device features on-board charge pump, as well as built-in shoot-through current protection and an undervoltage shutdown function.

The 17529 has four operating modes: Forward, Reverse, Brake, and Tri-States (High Impedance). The 17529 has a low total  $R_{DS(ON)}$  of 1.2  $\Omega$  (max @ 25°C).

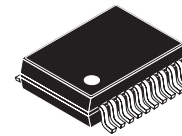
The 17529's low output resistance and high slew rates provide efficient drive for many types of micromotors.

## Features

- Low Total  $R_{DS(ON)}$  0.7  $\Omega$  (Typ), 1.2  $\Omega$  (Max) @ 25°C
- Output Current 0.7 A (DC), 1.4 A (Peak)
- Shoot-Through Current Protection Circuit
- 3.0 V/5.0 V CMOS-Compatible Inputs
- PWM Control Input Frequency up to 200 kHz
- Built-In Charge Pump Circuit
- Low Power Consumption
- Undervoltage Detection and Shutdown Circuit
- Pb-Free Packaging Designated by Suffix Code EV

**17529**

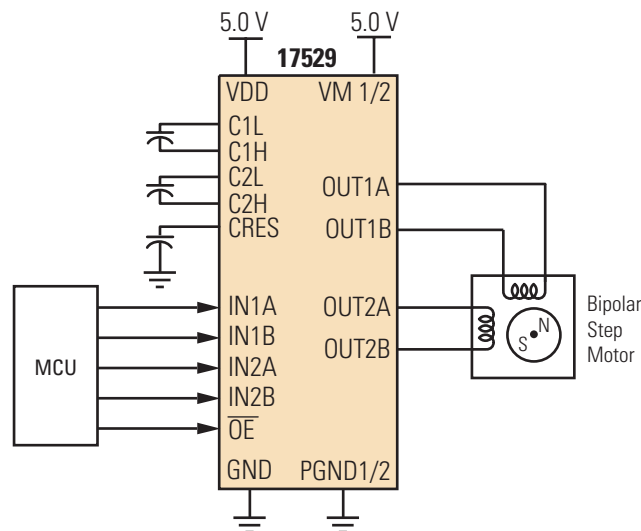
**DUAL H-BRIDGE**



**EV SUFFIX (PB-FREE)  
 98ASA10616D  
 20-TERMINAL VMFP**

## ORDERING INFORMATION

Device	Temperature Range ( $T_A$ )	Package
MPC17529EV/EL	-20°C to 65°C	20 VMFP



**Figure 1. 17529 Simplified Application Diagram**

\* This document contains certain information on a new product. Specifications and information herein are subject to change without notice.

### INTERNAL BLOCK DIAGRAM

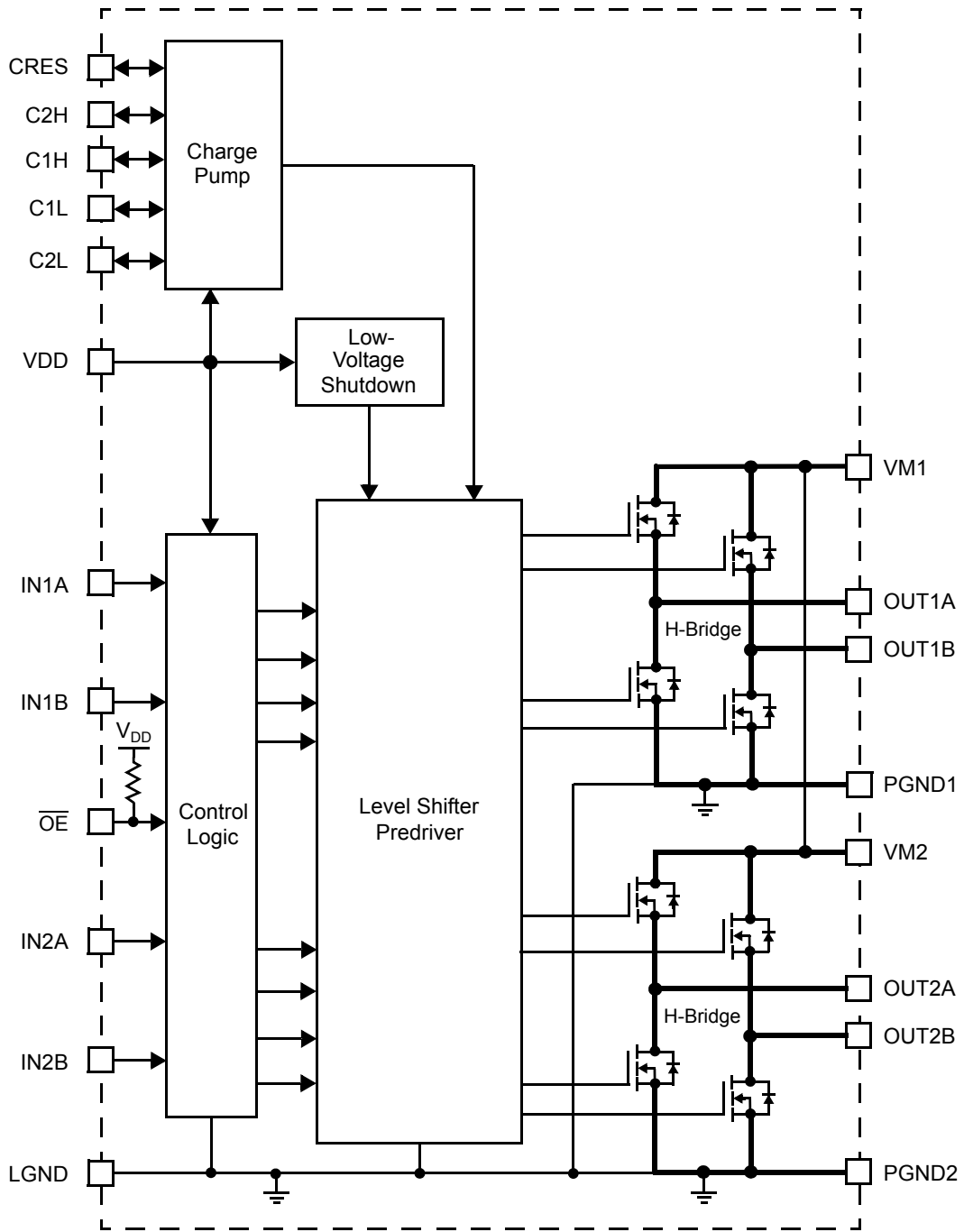


Figure 2. 17529 Simplified Internal Block Diagram

## TERMINAL CONNECTIONS

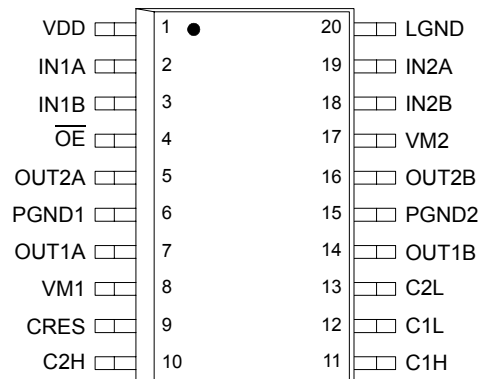


Figure 3. 17529 Terminal Connections

Table 1. Terminal Function Description

Terminal	Terminal Name	Formal Name	Definition
1	VDD	Control Circuit Power Supply	Positive power source connection for control circuit.
2	IN1A	Logic Input Control 1A	Logic input control of OUT1A (refer to <a href="#">Table 5, Truth Table</a> , page Z).
3	IN1B	Logic Input Control 1B	Logic input control of OUT1B (refer to <a href="#">Table 5, Truth Table</a> , page Z).
4	$\overline{OE}$	Output Enable	Logic output Enable control of H-Bridges (Low = True).
5	OUT2A	H-Bridge Output 2A	Output A of H-Bridge channel 2.
6	PGND1	Power Ground 1	High-current power ground 1.
7	OUT1A	H-Bridge Output 1A	Output A of H-Bridge channel 1.
8	VM1	Motor Drive Power Supply 1	Positive power source connection for H-Bridge 1 (Motor Drive Power Supply).
9	CRES	Predriver Power Supply	Internal triple charge pump output as predriver power supply.
10	C2H	Charge Pump 2H	Charge pump bucket capacitor 2 (positive pole).
11	C1H	Charge Pump 1H	Charge pump bucket capacitor 1 (positive pole).
12	C1L	Charge Pump 1L	Charge pump bucket capacitor 1 (negative pole).
13	C2L	Charge Pump 2L	Charge pump bucket capacitor 2 (negative pole).
14	OUT1B	H-Bridge Output 1B	Output B of H-Bridge channel 1.
15	PGND2	Power Ground 2	High-current power ground 2.
16	OUT2B	H-Bridge Output 2B	Output B of H-Bridge channel 2.
17	VM2	Motor Drive Power Supply 2	Positive power source connection for H-Bridge 2 (Motor Drive Power Supply).
18	IN2B	Logic Input Control 2B	Logic input control of OUT2B (refer to <a href="#">Table 5, Truth Table</a> , page Z).
19	IN2A	Logic Input Control 2A	Logic input control of OUT2A (refer to <a href="#">Table 5, Truth Table</a> , page Z).
20	LGND	Logic Ground	Low-current logic signal ground.

## MAXIMUM RATINGS

**Table 2. Maximum Ratings**

All voltages are with respect to ground unless otherwise noted. Exceeding the ratings may cause a malfunction or permanent damage to the device.

Rating	Symbol	Value	Unit
Motor Supply Voltage	$V_M$	-0.5 to 8.0	V
Charge Pump Output Voltage	$V_{CRES}$	-0.5 to 14	V
Logic Supply Voltage	$V_{DD}$	-0.5 to 7.0	V
Signal Input Voltage	$V_{IN}$	-0.5 to $V_{DD}+0.5$	V
Driver Output Current			A
Continuous	$I_O$	0.7	
Peak <sup>(1)</sup>	$I_{OPK}$	1.4	
ESD Voltage			V
Human Body Model <sup>(2)</sup>	$V_{ESD1}$	±1500	
Machine Model <sup>(3)</sup>	$V_{ESD2}$	±200	
Operating Junction Temperature	$T_J$	-20 to 150	°C
Operating Ambient Temperature	$T_A$	-20 to 65	°C
Storage Temperature Range	$T_{STG}$	-65 to 150	°C
Thermal Resistance <sup>(4)</sup>	$R_{\theta JA}$	120	°C/W
Power Dissipation <sup>(5)</sup>	$P_D$	1040	mW
Soldering Temperature <sup>(6)</sup>	$T_{SOLDER}$	260	°C

**Notes**

- $T_A = 25^\circ\text{C}$ , 10 ms pulse at 200 ms interval.
- ESD1 testing is performed in accordance with the Human Body Model ( $C_{ZAP} = 100 \text{ pF}$ ,  $R_{ZAP} = 1500 \ \Omega$ ).
- ESD2 testing is performed in accordance with the Machine Model ( $C_{ZAP} = 200 \text{ pF}$ ,  $R_{ZAP} = 0 \ \Omega$ ).
- Mounted on 37 x 50 Cu area (1.6 mm FR-4 PCB).
- $T_A = 25^\circ\text{C}$ .
- Soldering temperature limit is for 10 seconds maximum duration. Not designed for immersion soldering. Exceeding these limits may cause malfunction or permanent damage to the device.

## STATIC ELECTRICAL CHARACTERISTICS

**Table 3. Static Electrical Characteristics**

 Characteristics noted under conditions  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = V_M = 5.0\text{ V}$ ,  $\text{GND} = 0\text{ V}$  unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
<b>POWER (VM1, VM2, VDD)</b>					
Motor Supply Voltage	$V_M$	2.0	5.0	6.8	V
Logic Supply Voltage	$V_{DD}$	2.7	5.0	5.6	V
Driver Quiescent Supply Current (No Signal Input)	$I_{QM}$	–	–	1.0	$\mu\text{A}$
Logic Quiescent Supply Current (No Signal Input) <sup>(7)</sup>	$I_{QVDD}$	–	–	1.0	mA
Operating Power Supply Current					mA
Logic Supply Current <sup>(8)</sup>	$I_{DVDD}$	–	–	3.0	
Charge Pump Circuit Supply Current <sup>(9)</sup>	$I_{CRES}$	–	–	0.7	
Low $V_{DD}$ Detection Voltage <sup>(10)</sup>	$V_{DDDET}$	1.5	2.0	2.5	V
Driver Output ON Resistance <sup>(11)</sup>	$R_{DS(ON)}$	–	0.7	1.2	Ohms
<b>GATE DRIVE (C1L–C1H, C2L–C2H, CRES)</b>					
Gate Drive Voltage	$V_{CRES}$	12	13	13.5	V
Recommended External Capacitance (C1L–C1H, C2L–C2H, $C_{RES}$ –GND)	$C_{CP}$	0.01	0.1	1.0	$\mu\text{F}$
<b>CONTROL LOGIC (<math>\overline{\text{OE}}</math>, N1A, N1B, N2A, N2B)</b>					
Logic Input Voltage	$V_{IN}$	0.0	–	$V_{DD}$	V
Logic Inputs ( $2.7\text{ V} < V_{DD} < 5.7\text{ V}$ )					
High-Level Input Voltage	$V_{IH}$	$V_{DD} \times 0.7$	–	–	V
Low-Level Input Voltage	$V_{IL}$	–	–	$V_{DD} \times 0.3$	V
High-Level Input Current	$I_{IH}$	–	–	1.0	$\mu\text{A}$
Low-Level Input Current	$I_{IL}$	-1.0	–	–	$\mu\text{A}$
$\overline{\text{OE}}$ Terminal Input Current Low	$I_{OIL\overline{\text{OE}}}$	–	50	100	$\mu\text{A}$

**Notes**

7.  $I_{QVDD}$  includes the current to predriver circuit.
8.  $I_{VDD}$  includes the current to predriver circuit at  $f_{IN} = 100\text{ kHz}$ .
9. At  $f_{IN} = 20\text{ kHz}$ .
10. Detection voltage is defined as when the output becomes high-impedance after  $V_{DD}$  drops below the detection threshold. When the gate voltage  $V_{CRES}$  is applied from an external source,  $V_{CRES} = 7.5\text{ V}$ .
11. Source + sink at  $I_O = 0.7\text{ A}$ .

## DYNAMIC ELECTRICAL CHARACTERISTICS

**Table 4. Dynamic Electrical Characteristics**

Characteristics noted under conditions  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = V_M = 5.0\text{ V}$ ,  $\text{GND} = 0\text{ V}$  unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
<b>INPUT (IN1A, IN1B, OE, IN2A, IN2B)</b>					
Pulse Input Frequency	$f_{IN}$	–	–	200	kHz
Input Pulse Rise Time <sup>(12)</sup>	$t_R$	–	–	(13) 1.0	$\mu\text{s}$
Input Pulse Fall Time <sup>(14)</sup>	$t_F$	–	–	(13) 1.0	$\mu\text{s}$
<b>OUTPUT (OUT1A, OUT1B, OUT2A, OUT2B)</b>					
Propagation Delay Time <sup>(15)</sup>					$\mu\text{s}$
Turn-ON Time	$t_{PLH}$	–	0.1	0.5	
Turn-OFF Time	$t_{PHL}$	–	0.1	0.5	
Charge Pump Wake-Up Time <sup>(16)</sup>	$t_{VGON}$	–	1.0	3.0	ms
Low-Voltage Detection Time	$t_{VDDDET}$	–	–	10	ms

**Notes**

12. Time is defined between 10% and 90%.
13. That is, the input waveform slope must be steeper than this.
14. Time is defined between 90% and 10%.
15. Load of Output is  $8.0\ \Omega$  resistance.
16.  $C_{CP} = 0.1\ \mu\text{F}$ .

## TIMING DIAGRAMS

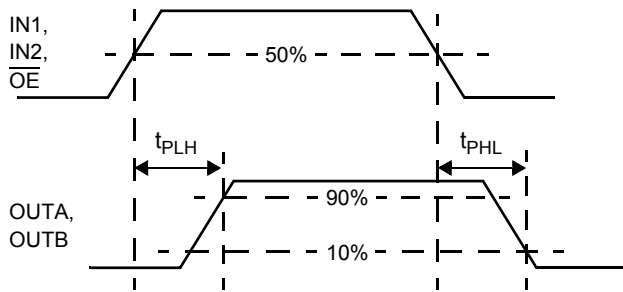
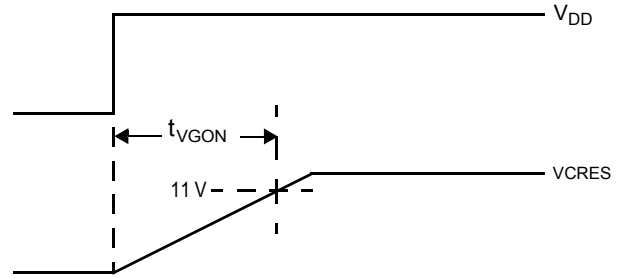
Figure 4.  $t_{PLH}$ ,  $t_{PHL}$ , and  $t_{PZH}$  Timing

Figure 6. Charge Pump Timing Diagram

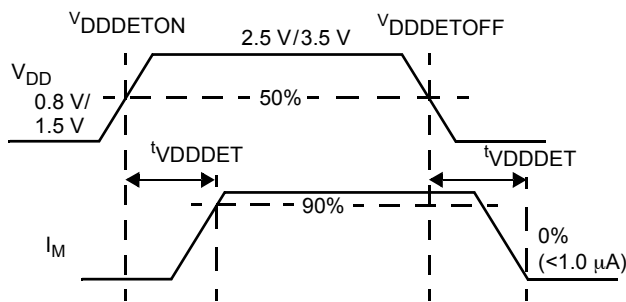


Figure 5. Low-Voltage Detection Timing Diagram

Table 5. Truth Table

INPUT			OUTPUT	
$\overline{OE}$	IN1A IN2A	IN1B IN2B	OUT1A OUT2A	OUT1B OUT2B
L	L	L	L	L
L	H	L	H	L
L	L	H	L	H
L	H	H	Z	Z
H	X	X	Z	Z

H = High.

L = Low.

Z = High impedance.

X = Don't care.

 $\overline{OE}$  terminal is pulled up to  $V_{DD}$  with internal resistance.

## SYSTEM/APPLICATION INFORMATION

### INTRODUCTION

The 17529 is a monolithic dual H-Bridge ideal for portable electronic applications to control bipolar step motors and brush DC motors such as those found in camera lens assemblies, camera shutters, optical disk drives, etc. The 17529 operates from 2.0 V to 6.8 V, providing dual H-bridge motor drivers with parallel 3.0 V- or 5.0 V-compatible I/O. The device features an on-board charge pump, as well as built-in shoot-through current protection and undervoltage shutdown.

The 17529 has four operating modes: Forward, Reverse, Brake, and Tri-States (High Impedance). The MOSFETs comprising the output bridge have a total source + sink  $R_{DS(ON)} \leq 1.2 \Omega$ .

The 17529 can simultaneously drive two brush DC motors or, as shown in the simplified application diagram on page 1, one bipolar step motor. The drivers are designed to be PWM'ed at frequencies up to 200 kHz.

### FUNCTIONAL TERMINAL DESCRIPTION

#### CONTROL CIRCUIT POWER SUPPLY (VDD)

The VDD terminal carries the logic supply voltage and current into the logic sections of the IC. VDD has an undervoltage threshold. If the supply voltage drops below the undervoltage threshold, the output power stage switches to a tri-state condition. When the supply voltage returns to a level that is above the threshold, the power stage automatically resumes normal operation according to the established condition of the input terminals.

#### LOGIC INPUT CONTROL (IN1A, IN1B, IN2A, AND IN2B)

These logic input terminals control each H-Bridge output. IN1A logic HIGH = OUT1A HIGH. However, if all inputs are taken HIGH, the outputs bridges are both tri-stated (refer to [Table 5, Truth Table](#), page 7).

#### OUTPUT ENABLE (OE)

The  $\overline{OE}$  terminal is a LOW = TRUE enable input. When  $\overline{OE}$  = HIGH, all H-Bridge outputs (OUT1A, OUT1B, OUT2A, and OUT2B) are tri-stated (high-impedance), regardless of logic input (IN1A, IN1B, IN2A, and IN2B) states.

#### H-BRIDGE OUTPUT (OUT1A, OUT1B, OUT2A, AND OUT2B)

These terminals provide connection to the outputs of each of the internal H-Bridges (see [Figure 2, 17529 Simplified Internal Block Diagram](#), page 2).

#### MOTOR DRIVE POWER SUPPLY (VM1 AND VM2)

The VM terminals carry the main supply voltage and current into the power sections of the IC. This supply then becomes controlled and/or modulated by the IC as it delivers the power to the loads attached between the output terminals. All VM terminals must be connected together on the printed circuit board.

#### CHARGE PUMP (C1L AND C1H, C2L AND C2H)

These two pairs of terminals, the C1L and C1H and the C2L and C2H, connect to the external bucket capacitors required by the internal charge pump. The typical value for the bucket capacitors is 0.1  $\mu\text{F}$ .

#### PREDRIVER POWER SUPPLY (C<sub>RES</sub>)

The C<sub>RES</sub> terminal is the output of the internal charge pump. Its output voltage is approximately three times the V<sub>DD</sub> voltage. The VCRES voltage is power supply for internal predriver circuit of H-Bridges.

#### POWER GROUND (PGND)

Power ground terminals. They must be tied together on the PCB.

#### LOGIC GROUND (LGND)

Logic ground terminal.



This paragraph is boilerplate - you may add to it but, can not change wording. You may change numeric values

## APPLICATIONS

### TYPICAL APPLICATION

Figure 7 shows a typical application for the 17529. When applying the gate voltage to the C<sub>RES</sub> terminal from an external source, be sure to connect it via a resistor equal to, or greater than,  $R_G = V_{CRES}/0.02 \Omega$ .

The internal charge pump of this device is generated from the VDD supply; therefore, care must be taken to provide sufficient gate-source voltage for the high-side MOSFETs when  $V_M \gg V_{DD}$  (e.g.,  $V_M = 5.0 \text{ V}$ ,  $V_{DD} = 3.0 \text{ V}$ ), in order to ensure full enhancement of the high-side MOSFET channels.

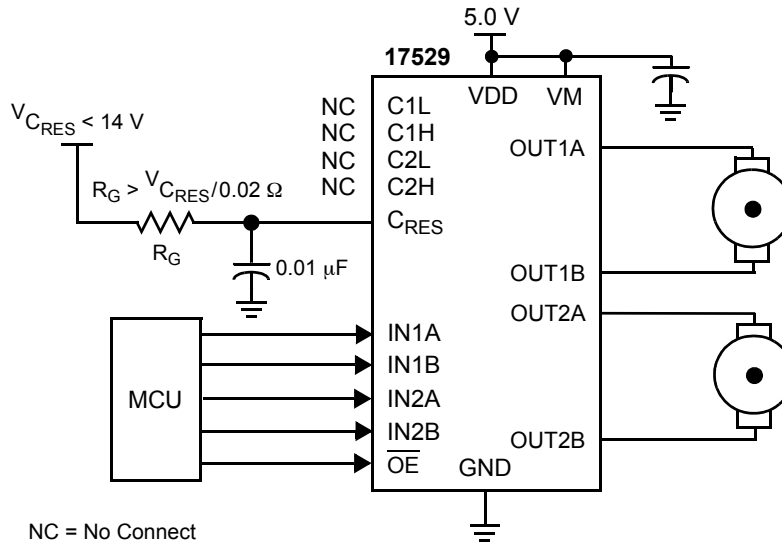


Figure 7. 17529 Typical Application Diagram

### CONDUCTED ELECTROMOTIVE FORCE (CEMF) SNUBBING TECHNIQUES

Care must be taken to protect the IC from potentially damaging CEMF spikes induced when commutating currents in inductive loads. Typical practice is to provide snubbing of voltage transients by placing a capacitor or zener at the supply terminal (VM) (see Figure 8).

### PCB LAYOUT

When designing the printed circuit board (PCB), connect sufficient capacitance between power supply and ground terminals to ensure proper filtering from transients. For all high-current paths, use wide copper traces and shortest possible distances.

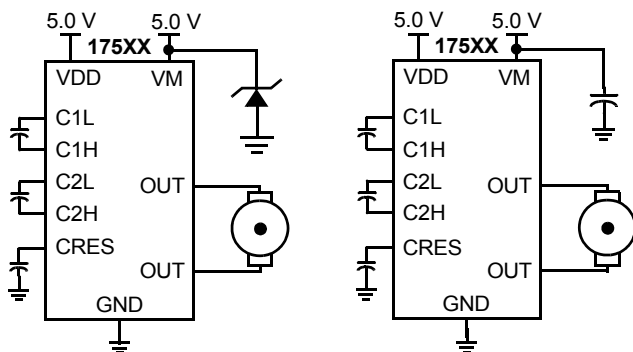
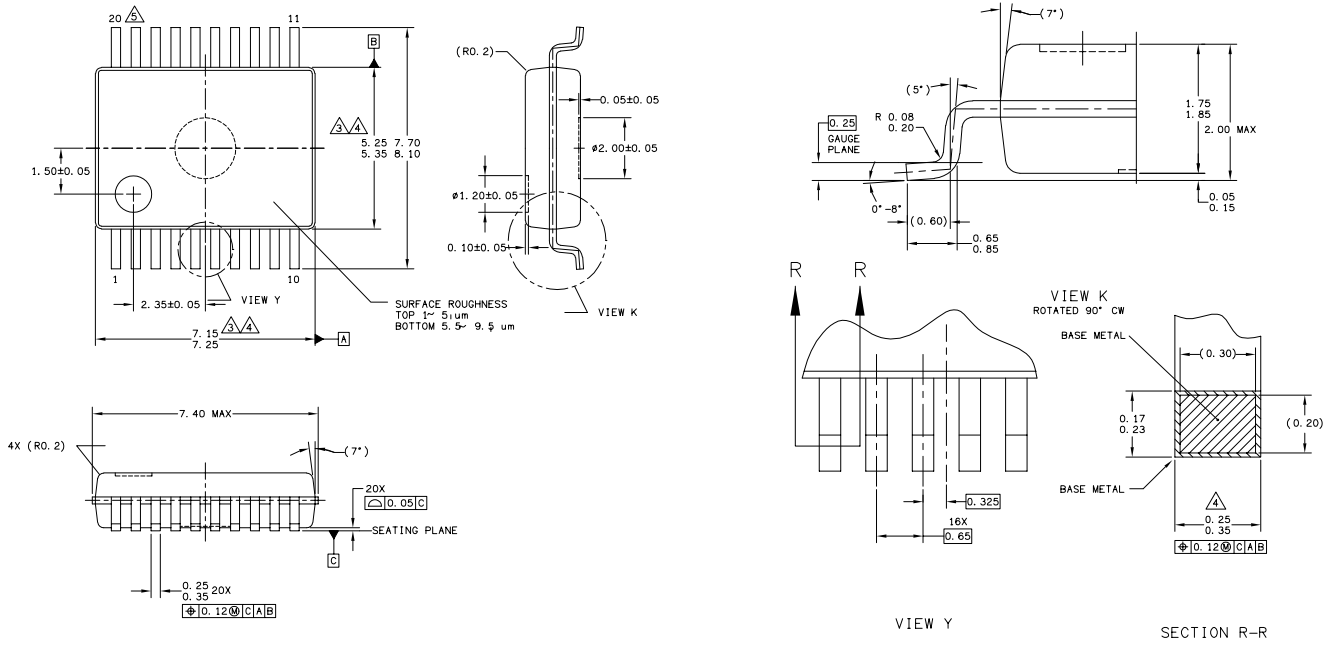


Figure 8. CEMF Snubbing Techniques

**PACKAGE DIMENSIONS**

For the most current package revision, visit [www.freescale.com](http://www.freescale.com) and perform a keyword search using the 98A listed below.



**EV (Pb-FREE) SUFFIX**  
20-LEAD VMFP  
PLASTIC PACKAGE  
98ASA10616D  
ISSUE A

## REVISION HISTORY

Revision	Date	Description of Changes
2.0	9/2005	<ul style="list-style-type: none"><li>• Implemented Revision History page</li><li>• Converted to Freescale format</li></ul>

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