

## Solenoid and Motor Driver (1/2 H Driver)

April 1992

### Features

- Chip Encapsulated in a 5-Lead Plastic TO-220 Style Package (VERSA-VI)
- Output Short Circuit Protection
- Thermal Overload Protection
- Solenoid Inductive "Kick" Protection with Internal-Clamp Diodes
- Output Sink and Source Capacity of 600mA Minimum Overtemperature
- Horizontal and Vertical Mounting Packages Available
- Separate Sink Circuit and Source Circuit, Each Individually Controlled

### Applications

- Latching Solenoid Driver (Single and Multiple)
- Non-Latching Solenoid Driver
- Relay Driver
- Lamp Controller
- Lamp Driver
- Motor Controller (Forward and Reverse)
- Stepper Motor Controller
- On-Off Logic Controllers (TTL Logic)
- Intermediate Power Driver
- Triac, SCR, and Transistor Drivers

### Description

The CA3169 is a monolithic integrated circuit capable of driving lamps and other devices that can be changed between two states (on or off). Transistors, SCR's, and triacs are some of the solid state devices that can be controlled by the CA3169. This device can also control relays, solenoids (latching or nonlatching), motors (DC - forward and reverse) and DC stepping motors.

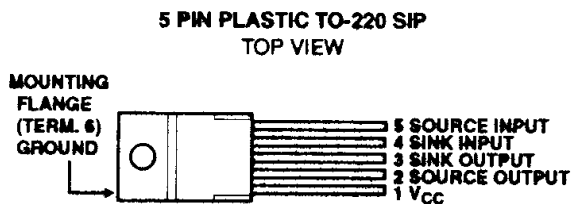
The CA3169 contains a separate source driver circuit with internal current limiting protection and a separate sink driver circuit. The sink driver contains an energy absorbing diode to protect the device against any inductive "kick" during state changes. The CA3169 is protected against overvoltage conditions on the output drivers and overtemperature conditions (thermal-shutdown protection).

The input operating levels are TTL compatible. The source and sink outputs are in their off condition (non-conducting) when their respective inputs are in a HI state, or open-circuited. The outputs are in their on state (conducting) when their respective inputs are LO. The VERSA-VI package is available with two lead configurations. The CA3169 has a vertical-mount lead form, and the CA3169M has a horizontal-mount lead form.

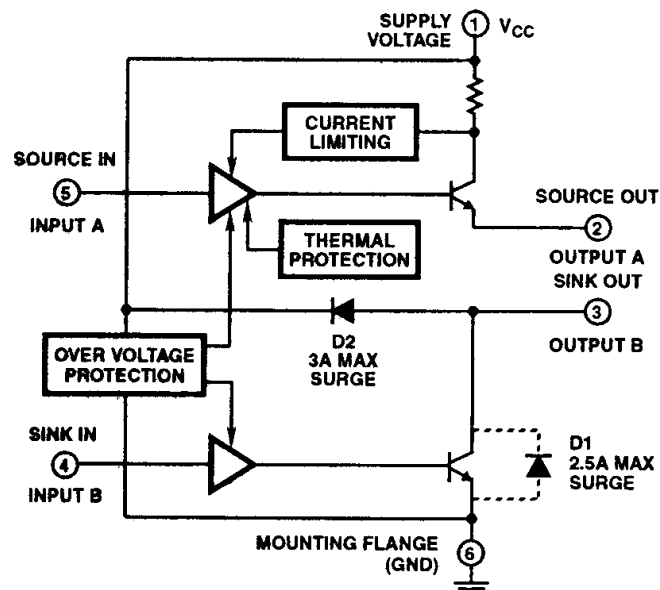
### Ordering Information

PART NUMBER	TEMPERATURE	PACKAGE
CA33169	-40°C to +85°C	5 Lead Plastic SIP Staggered Vertical
CA33169M	-40°C to +85°C	5 Lead Plastic SIP Surface Mount

### Pinout



### Functional Block Diagram



CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper I.C. Handling Procedures.

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## Specifications CA3169

### Absolute Maximum Ratings

Supply Voltage (Pin 1 to GND) Positive ..... 41V DC Negative ..... 1.4V DC Sink Current ..... 1.9A Source Current ..... Controlled by Internal Current Limiting Input Voltage: Sink Input (Pin 4 to GND) ..... 17V Source Input (Pin 5 to GND) ..... 17V Maximum Forward Current - Diode D1 ..... 2.5A Maximum Forward Current - Diode D2 ..... 3A	Power Dissipation, $P_D$ at $T_A = 90^\circ\text{C}$ ..... 15W Thermal Resistance, Junction to Case: ..... $4^\circ\text{C/W}$ Junction Temperature ..... $+150^\circ\text{C}$ Operating Temperature ..... $-40^\circ\text{C}$ to $+85^\circ\text{C}$ Storage Temperature ..... $-55^\circ\text{C}$ to $+150^\circ\text{C}$ Lead Temperature (During Soldering): At Distance $1/16 \pm 1/32$ in. ( $1.59 \pm 0.79\text{mm}$ ) from case for 10s max. .... $+265^\circ\text{C}$
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*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

### Electrical Specifications at $T_A = +25^\circ\text{C}$ , $V_{CC} = 10.5\text{V}$ to $18\text{V}$ Unless otherwise specified.

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output Leakage Current, Pin 2 See Figure 5		Inputs Open $V_{CC} = 4\text{V}$ to $18\text{V}$ Source and Sink Loads = $20\Omega$	-110	$\pm 0.5$	110	$\mu\text{A}$
Output Leakage Current, Pin 3 See Figure 5		Inputs Open $V_{CC} = 4\text{V}$ to $18\text{V}$ Source and Sink Loads = $20\Omega$	-110	$\pm 0.5$	110	
Thermal Resistance	$\theta_{JC}$		-	3	4	$^\circ\text{C/W}$
Quiescent Current, Pin 1 See Figure 4		Device "ON" Input Terminals Shorted, $V_{CC} = 14\text{V}$	-	70	100	mA
Quiescent Current, Pin 1 See Figure 3		Device "OFF" Input Terminals Open, $V_{CC} = 14\text{V}$	-	17	40	
Thermal Shutdown Temperature		$R_L = \text{Short Circuit}$	128	140	162	$^\circ\text{C}$
Overshoot Shutdown -Circuit Upper Trip Point, Pin 1 Voltage See Figure 7		$R_L = 20\Omega$	20	25	27	V
Overshoot Shutdown - Circuit Lower Trip Point, Pin 1 Voltage See Figure 7		$R_L = 20\Omega$	18	21.4	23	
<b>Input Logic Levels; Source Input - Pin 5, Sink Input - Pin 4</b>						
Input Low Threshold Sink or Source	$V_{IL}$	$V_{CC} = 14\text{V}$ (See Note 1)	-	0.4	0.8	V
Input High Threshold Sink or Source	$V_{IH}$	$V_{CC} = 14\text{V}$ (See Note 2)	1.9	2.4	-	
Input Low Current Sink or Source	$I_{LL}$	$V_{IN} \leq 0.4\text{V}$	-0.9	-0.3	-	mA
Input High Current Sink or Source	$I_{IH}$	$V_{IN} \leq 5.5\text{V}$	-110	-23	110	$\mu\text{A}$
Output Voltage, Pin 2 See Figure 6	$V_{OS}$	Referenced to $V_{CC}$ with $I_{SOURCE} = 600\text{mA}$ , See Note 3	-	1	1.6	V
Short-Circuit Current Limit, Pin 2 to Ground			0.65	1.11	2.6	A
Turn-On Delay to Output-On, Pin 2		$C_L = 100\text{pF}$ , $R_L = 33\Omega$	-	0.45	5.6	$\mu\text{s}$
Turn-Off Delay to Output-Off, Pin 2		$C_L = 100\text{pF}$ , $R_L = 33\Omega$	-	5	55	$\mu\text{s}$
<b>Sink Outputs</b>						
Output Saturation Voltage See Figure 9	$V_3$	$I_{SINK} = 600\text{mA}$ $V_{IN} \leq 0.4\text{V}$ See Note 3	-	0.3	0.85	V
Output Saturation Voltage See Figure 9	$V_3$	$I_{SINK} = 1000\text{mA}$ $V_{IN} \leq 0.4\text{V}$ See Note 3	-	0.8	1.65	

**Electrical Specifications** at  $T_A = +25^\circ\text{C}$ ,  $V_{CC} = 10.5\text{V}$  to  $18\text{V}$  Unless otherwise specified. (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Turn-On Delay to Output-On Pin 3	$T_{ON}$	$CL = 100\text{pF}$ , $RL = 33\Omega$ to $V_{CC}$	-	0.45	5.6	$\mu\text{s}$
Turn-Off Delay to Output-Off Pin 3	$T_{OFF}$	$CL = 100\text{pF}$ , $RL = 33\Omega$ to $V_{CC}$	-	0.95	25	

NOTES:

- $I_{SOURCE}$  or  $I_{SINK} \leq 600\text{mA}$ ,  $V_{OS} \leq 1.5\text{V}$ ,  $V_{SINK} \leq 0.75\text{V}$ .
- $I_{SOURCE}$  or  $I_{SINK} \leq 100\mu\text{A}$ ,  $V_{SOURCE} = \text{GND}$ , for  $V_{SINK} 20\Omega$  to  $V_{CC}$ .
- Measured over temperature range of  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$ .

**TRUTH TABLE FOR SOLENOID DRIVER**  
TTL Logic Conditions:  $0 \leq VL \leq 0.8$ ,  $1.9 \leq VH \leq 5.5$

INPUT A SOURCE IN	INPUT B SINK IN	OUTPUT A SOURCE OUT	OUTPUT B SINK OUT
$V_L$	$V_L$	HIGH (ON)	LOW (ON)
$V_L$	$V_H$	HIGH (ON)	(OFF)
$V_H$	$V_L$	(OFF)	LOW (ON)
$V_H$	$V_H$	(OFF)	(OFF)

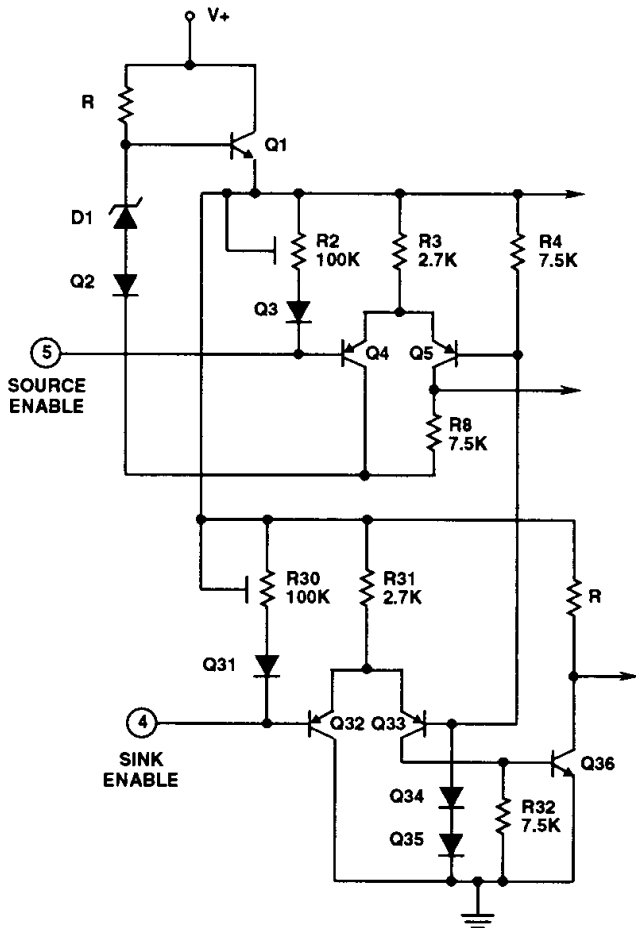
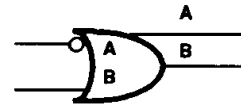


FIGURE 1. DETAILED SCHEMATIC OF THE INPUT CIRCUIT FOR CA3169.

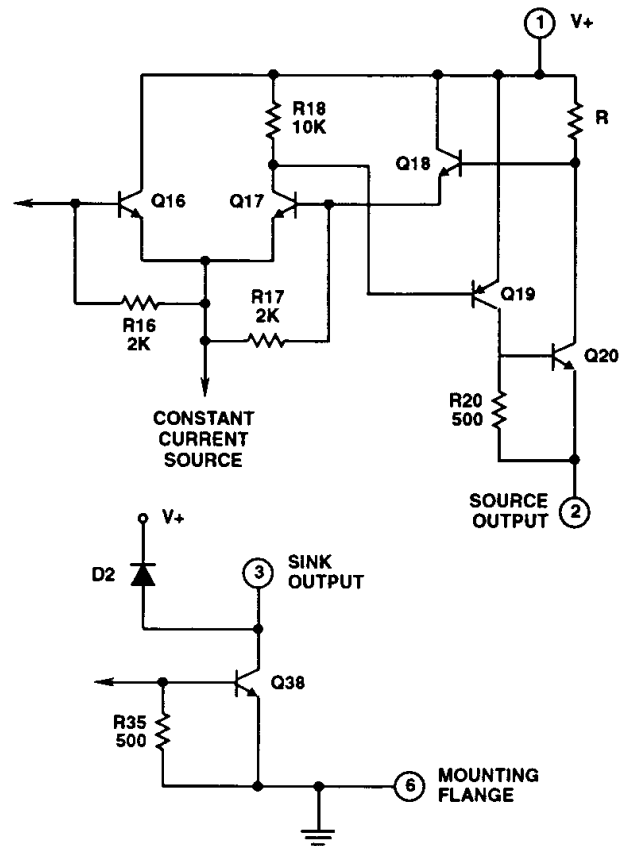


FIGURE 2. DETAILED SCHEMATIC OF THE OUTPUT CIRCUIT FOR CA3169.

Test Circuits

(VCC = VIN = PIN 1 VOLTAGE)

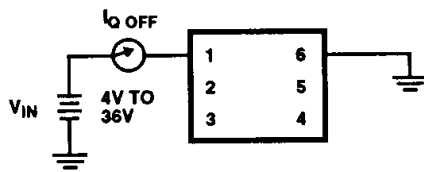


FIGURE 3. QUIESCENT CURRENT DEVICE "OFF".

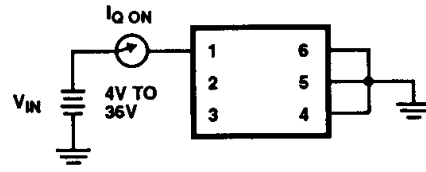


FIGURE 4. QUIESCENT CURRENT DEVICE "ON".

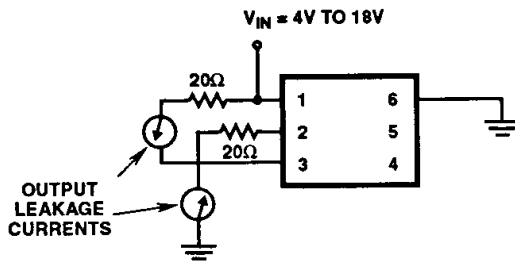


FIGURE 5. OUTPUT LEAKAGE CURRENTS.

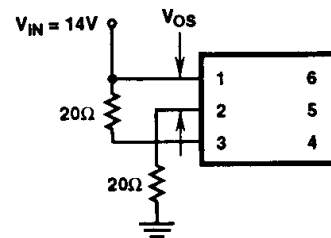
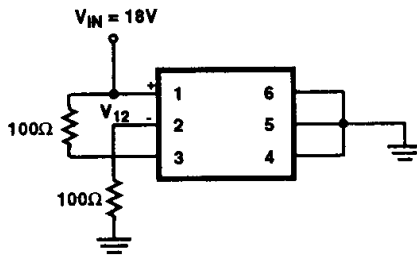


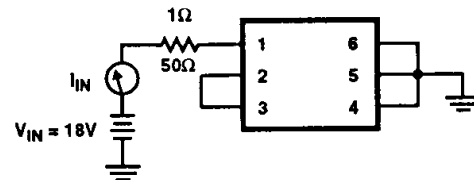
FIGURE 6. OUTPUT SOURCE VOLTAGE (REFERENCED TO VCC).



PROCEDURE

1. Measure V12.
2. Increase VCC until V12 ≥ 2V.
3. Measure VCC; this voltage is the high trip point. Pin 2 should be off; i.e., pin 3 should be high.
4. Observe and measure the voltage at pin 3.
5. Decrease VCC until pin 3 switches, i.e., ≤ 18V. The supply voltage will be the low trip point voltage.

FIGURE 7. OVERVOLTAGE PROTECTION.



When VCC is turned on, IIN should be equal to or greater than 1A. Thermal shutdown will operate properly if the input current drops below 0.5A (0.3A typ.) in 10 to 15 seconds. Cover the unit during this test in the event that the thermal shutdown is not operating properly.

FIGURE 8. THERMAL SHUTDOWN.

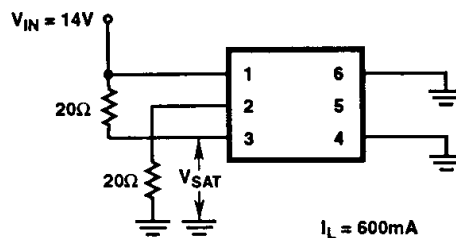
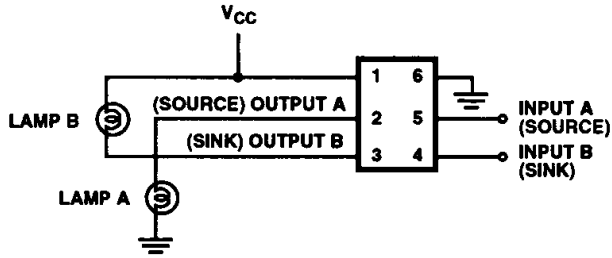


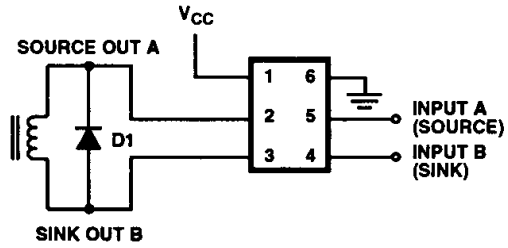
FIGURE 9. OUTPUT SATURATION VOLTAGE.

Typical Applications



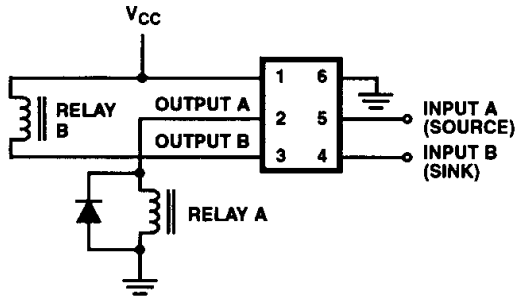
When input A goes low, lamp A will light.  
When input B goes low, lamp B will light.

FIGURE 10. LAMP DRIVER.



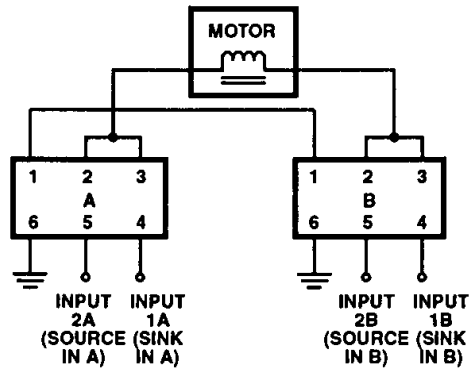
Input A and input B must both be low for the solenoid to switch.

FIGURE 11. NON-LATCHING SOLENOID.



Relay A will close when in input A goes low. Relay B will close when input B goes low. Both relays will close when both inputs go low.

FIGURE 12. RELAY DRIVER.



When opposing inputs go low, the motor will switch direction; if source input A and sink input B both go low, current will flow from A to B. If source input B and sink input A both go low, current will flow from B to A.

FIGURE 13. MOTOR DRIVER OR LATCHING SOLENOID DRIVER.