Solenoid and Motor Driver (1/2 H Driver)

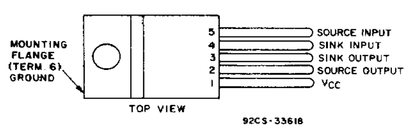
Features:
- *Chip encapsulated in a 5-lead plastic TO-220-style package (VERSA-VI)*
- *Output short-circuit protection*
- *Thermal overload protection*
- *Solenoid inductive "kick" protection with internal-clamp diodes*
- *Output sink and source capacity of 600-mA minimum overtemperature*
- *Horizontal and vertical mounting packages available*
- *Separate sink circuit and source circuit, each individually controlled*
- *Inputs can be driven by TTL logic levels and CMOS logic levels*
- *Low V_{CE}(sat)*

The RCA-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 non-latching), 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.

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*



TERMINAL ASSIGNMENT

File Number **1277**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

SUPPLY VOLTAGE (Pin 1 to GND) .... Positive . . .41 V DC
Negative . . .1.4 V DC
SINK CURRENT .... 1.9 A
SOURCE CURRENT .... Controlled by Internal Current Limiting

INPUT VOLTAGE:
SINK INPUT (Pin 4 to GND) .... 17 V
SOURCE INPUT (Pin 5 to GND) .... 17 V
MAXIMUM FORWARD CURRENT—Diode D1 .... 2.5 A
MAXIMUM FORWARD CURRENT—Diode D2 .... 3 A
POWER DISSIPATION, P_D at T_A=90°C .... 15 W
THERMAL RESISTANCE, JUNCTION TO CASE .... 4°C/W
JUNCTION TEMPERATURE .... 150°C
OPERATING TEMPERATURE .... -40° to +85°C
STORAGE TEMPERATURE .... -55° to +150°C
LEAD TEMPERATURE (DURING SOLDERING):
At distance 1/16 ± 1/32 in. (1.59 ± 0.79 mm) from case for 10 s max. .... 265°C

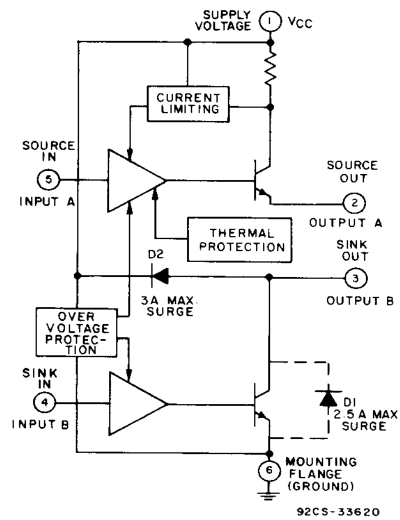
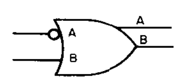


Fig. 1 - 1/2 H driver function diagram.

TRUTH TABLE FOR SOLENOID DRIVER
TTL Logic Conditions: $0 \le V_L \le 0.8$, $1.9 \le V_H \le 5.5$

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)



ELECTRICAL CHARACTERISTICS at T_A=25°C, V_{CC}=10.5 V to 18 V
Unless otherwise specified

CHARACTERISTIC	TEST CONDITIONS	LIMITS Min.	Typ.	Max.	UNITS
Output Leakage Current, Pin 2 See Fig. 6	Inputs Open V_{CC}=4 V to 18 V Source and Sink Loads=20 Ω	-110	±0.5	110	μA
Output Leakage Current, Pin 3 See Fig. 6	Inputs Open V_{CC}=4 V to 18 V Source and Sink Loads=20 Ω	-110	±0.5	110	μA
Thermal Resistance, Junction to Case θ_{JC}		—	3	4	°C/W
Quiescent Current, Pin 1 See Fig. 5	Device "ON" Input Terminals Shorted, V_{CC}=14 V	—	**70**	**100**	mA
Quiescent Current, Pin 1 See Fig. 4	Device "OFF" Input Terminals Open, V_{CC}=14 V	—	17	40	mA
Thermal Shutdown Temperature	R_L=Short Circuit	128	140	162	°C
Overvoltage Shutdown-Circuit Upper Trip Point, Pin 1 Voltage See Fig. 8	R_L=20 Ω	20	25	27	V
Overvoltage Shutdown-Circuit Lower Trip Point, Pin 1 Voltage See Fig. 8	R_L=20 Ω	18	21.4	23	V
Input Logic Levels; Source Input - Pin 5, Sink Input - Pin 4					
Input Low Threshold Sink or Source V_{IL}	V_{CC}=14 V **See Note 1**	—	0.4	0.8	V
Input High Threshold Sink or Source V_{IH}	V_{CC}=14 V **See Note 2**	1.9	2.4	—	V
Input Low Current Sink or Source I_{LL}	$V_{IN} \leq 0.4$ V	−0.9	−0.3	—	mA
Input High Current Sink or Source I_{IH}	$V_{IN} \leq 5.5$ V	−110	−23	110	μA

NOTE 1: I_{SOURCE} or $I_{SINK} \leq 600$ mA, $V_{OS} \leq 1.5$ V, $V_{SINK} \leq 0.75$ V.
NOTE 2: I_{SOURCE} or $I_{SINK} \leq 100$ μA, V_{SOURCE} = GND, for V_{SINK} 20 Ω to V_{CC}.

ELECTRICAL CHARACTERISTICS (Cont'd)

CHARACTERISTIC	TEST CONDITIONS	LIMITS			UNITS
		Min.	Typ.	Max.	
Source Outputs					
Output Voltage, V_{OS} Pin 2 **See Note 3** See Fig. 7	Referenced to V_{CC} with I_{SOURCE}= 600 mA	—	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 pF, R_L=33 Ω	—	0.45	5.6	μs
Turn-Off Delay to Output-Off Pin 2	C_L=100 pF, R_L=33 Ω	—	5	55	
Sink Outputs					
Output Saturation Voltage V_3 **See Note 3** See Fig. 10	I_{SINK}=600 mA, $V_{IN} \leq 0.4$ V	—	0.3	0.85	V
Output Saturation Voltage V_3 **See Note 3** See Fig. 10	I_{SINK}=1000 mA $V_{IN} \leq 0.4$ V	—	0.8	1.65	
Turn-On Delay to Output-On Pin 3 (T_{ON})	C_L=100 pF, R_L=33 Ω to V_{CC}	—	0.45	5.6	μs
Turn-Off Delay to Output-Off Pin 3 (T_{OFF})	C_L=100 pF, R_L=33 Ω to V_{CC}	—	0.95	25	

NOTE 3: Measured over temperature range of −40° C to 85° C.

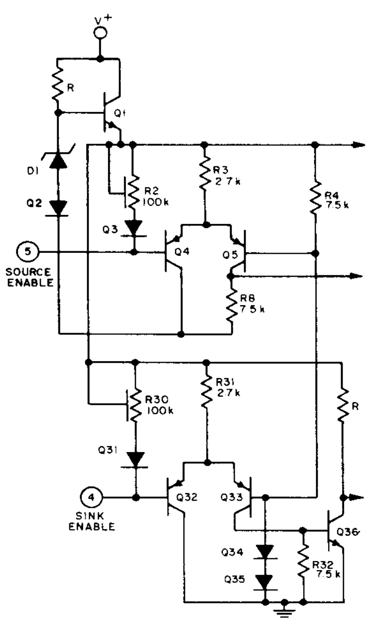


Fig. 2 - Detailed schematic of the input circuit for CA3169.

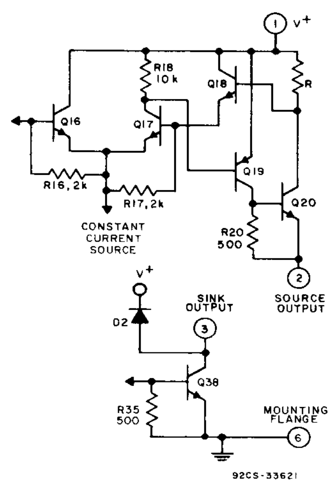


Fig. 3 - Detailed schematic of the output circuit for CA3169.

TEST CIRCUITS
(V_{CC} = V_{IN} = PIN 1 VOLTAGE)

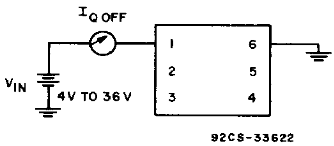


Fig. 4 - Quiescent current device "OFF"

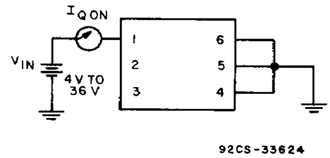


Fig. 5 - Quiescent current device "ON".

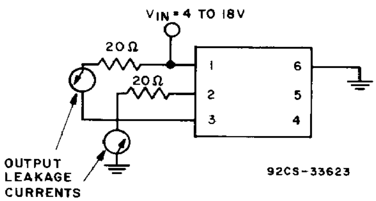


Fig. 6 - Output leakage currents.

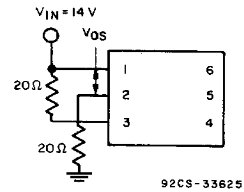
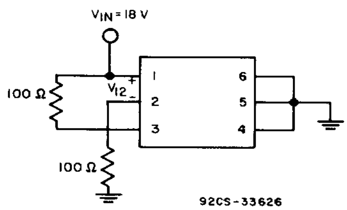


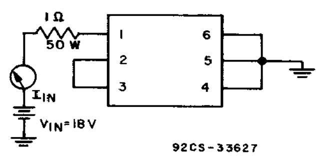
Fig. 7 - Output source voltage (referenced to V_{CC}).



PROCEDURE

1. Measure V_{12}.
2. Increase V_{CC} until $V_{12} \geq 2$ V.
3. Measure V_{CC}; 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 V_{CC} until pin 3 switches, i.e., ≤ 18 V. The supply voltage will be the low trip point voltage.

Fig. 8 - Overvoltage protection.



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

Fig. 9 - Thermal shutdown.

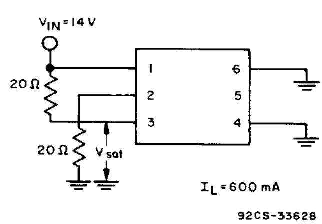
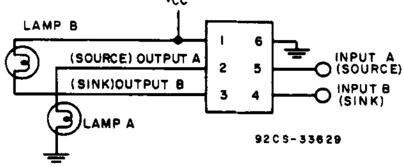


Fig. 10 - Output saturation voltage.

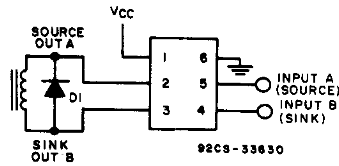
CA3169

TYPICAL APPLICATIONS



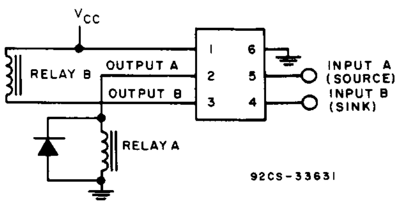
When input A goes low, lamp A will light.
When input B goes low, lamp B will light.

Fig. 11 - Lamp driver.



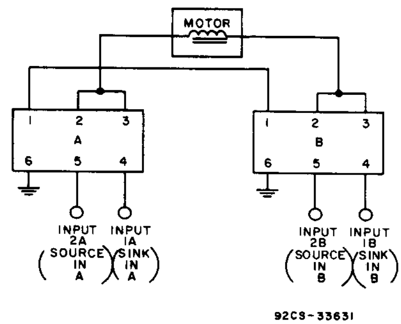
Input A and input B must both be low for the solenoid to switch.

Fig. 12 - Non-latching solenoid.



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

Fig. 13 - 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.

Fig. 14 - Motor driver or latching solenoid driver.