



## QUAD PRECISION MICROPOWER CMOS VOLTAGE COMPARATOR WITH DRIVER

### GENERAL DESCRIPTION

The ALD4303A/ALD4303 is a precision monolithic high performance quad voltage comparator with open drain output built with advanced silicon gate CMOS technology. It features very high typical input impedance of  $10^{12}\Omega$ ; low input bias current of  $10\text{pA}$ ; very low power dissipation of  $7.5\mu\text{A}$  per comparator; micropower operation; high output drive and single (+5V) or dual ( $\pm 5\text{V}$ ) power supply operation.

The input voltage range includes ground, making this comparator ideal for single supply low level signal detection with high source impedance. The ALD4303A/ALD4303 can be used in connection with other voltage comparator circuits such as the ALD2301/ALD2302/ALD4302 voltage comparators. The outputs can be connected to a higher external voltage than  $V+$  and used in a wired-OR connection with other open drain circuits such as ALD2301/ALD2303. They can also be used with push-pull output types such as ALD2302/ALD4302 voltage comparators simultaneously with open drain comparators using a common  $V+$ . The ALD4303A/ALD4303 is ideal for a great variety of voltage comparator applications, especially micropower detection circuits requiring very low input currents, high output currents and low standby power.

### APPLICATIONS

- Sensor detection circuits
- PCMCIA instruments
- MOSFET driver
- High source impedance voltage comparison circuits
- Multiple limit window comparator
- Power supply voltage monitor
- Photodetector sensor circuit
- High speed LED driver
- Oscillators
- Battery operated instruments
- Remote signal detection
- Multiple relay drivers

### BENEFITS

- Extremely low power and high precision combination
- Built-in high input impedance buffer
- Built-in output driver with up to 60mA sink current

### ORDERING INFORMATION

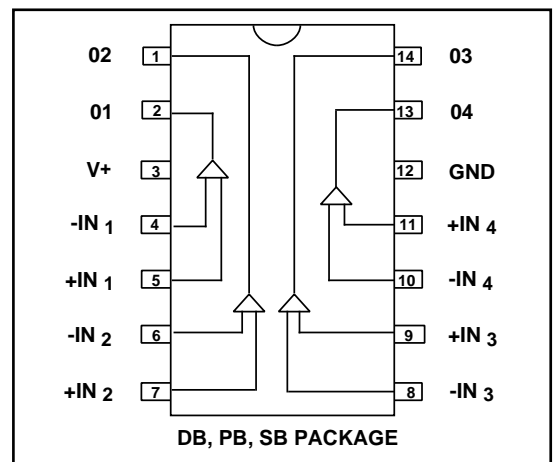
Operating Temperature Range *		
-55°C to +125°C	0°C to +70°C	0°C to +70°C
14-Pin CERDIP Package	14-Pin Small Outline Package (SOIC)	14-Pin Plastic Dip Package
ALD4303ADB	ALD4303ASB	ALD4303APB
ALD4303DB	ALD4303SB	ALD4303PB

\* Contact factory for industrial temperature range

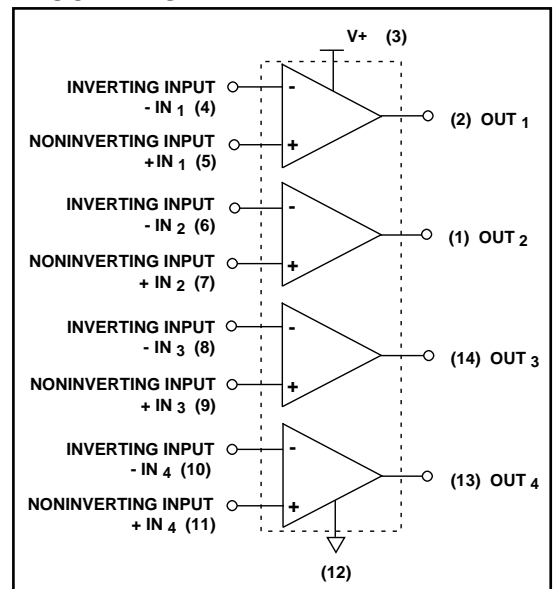
### FEATURES

- 3V, 5V and 12V supply
- Guaranteed to drive  $200\Omega$  loads
- Fanout of 30LS TTL loads
- Guaranteed maximum supply current of  $22\mu\text{A}$  per comparator
- Industry standard pinout of LM393 type
- Extremely low input bias currents --  $10\text{pA}$
- Virtually eliminates source impedance effects
- Single (+5V) and dual supply ( $\pm 5\text{V}$ ) operation
- CMOS, NMOS and TTL compatible
- Open drain wired-OR outputs
- Compatible with push-pull outputs
- High output sinking current -- 60mA
- Low supply current spikes
- High gain --  $100\text{V/mV}$

### PIN CONFIGURATION



### BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Supply voltage, V+	_____	13.2V	
Differential input voltage range	_____	-0.3V to V+ +0.3V	
Power dissipation	_____	600 mW	
Operating temperature range	PB, SB package	_____	0°C to +70°C
	DB package	_____	-55°C to +125°C
Storage temperature range	_____	-65°C to +150°C	
Lead temperature, 10 seconds	_____	+260°C	

## OPERATING ELECTRICAL CHARACTERISTICS

T<sub>A</sub> = 25°C V<sub>+</sub> = +5V unless otherwise specified

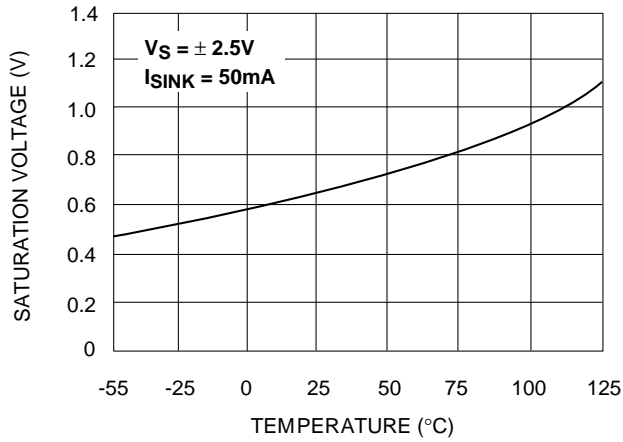
Parameter	Symbol	4303A			4303			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
Voltage Supply	V <sub>S</sub>	±1.5		±6	±1.5		±6	V	Dual Supplies
	V <sub>+</sub>	3		12	3		12	V	Single Supply
Supply Current	I <sub>S</sub>		50	90		50	90	µA	R <sub>LOAD</sub> = ∞ 4 comparators
Voltage Gain	A <sub>VD</sub>	10	100		10	100		V/mV	R <sub>LOAD</sub> ≥ 15KΩ
Input Offset Voltage	V <sub>OS</sub>		2	5.0 7.0		4	10.0 12.0	mV	R <sub>LOAD</sub> = 1.5KΩ 0°C ≤ T <sub>A</sub> ≤ 70°C
Input Offset Current <sup>1</sup>	I <sub>OS</sub>		0.1	30 800		0.1	30 800	pA	0°C ≤ T <sub>A</sub> ≤ 70°C
Input Bias Current <sup>1</sup>	I <sub>B</sub>		0.1	30 1000		0.1	30 1000	pA	0°C ≤ T <sub>A</sub> ≤ 70°C
Common Mode Input Voltage Range <sup>2</sup>	V <sub>ICR</sub>	-0.3		V+ -1.5	-0.3		V+ -1.5	V	
Low Level Output Voltage	V <sub>OL</sub>		0.18	0.4		0.18	0.4	V	I <sub>SINK</sub> = 12mA V <sub>INPUT</sub> = 1V Differential
Low Level Output Current	I <sub>OL</sub>	24	60		24	60		mA	V <sub>OL</sub> = 1.0V
High Level Leakage Current	I <sub>LH</sub>		0.1	20		0.1	20	nA	V <sub>OH</sub> = 5.0V
Response Time <sup>2</sup>	t <sub>RP</sub>		6.5			6.5		µs	R <sub>L</sub> = 50KΩ C <sub>L</sub> = 15pF 10mV Input Step/10mV Overdrive
			5			5		µs	R <sub>L</sub> = 50KΩ C <sub>L</sub> = 15pF TTL- Level Input Step

Notes: <sup>1</sup> Consists of junction leakage currents

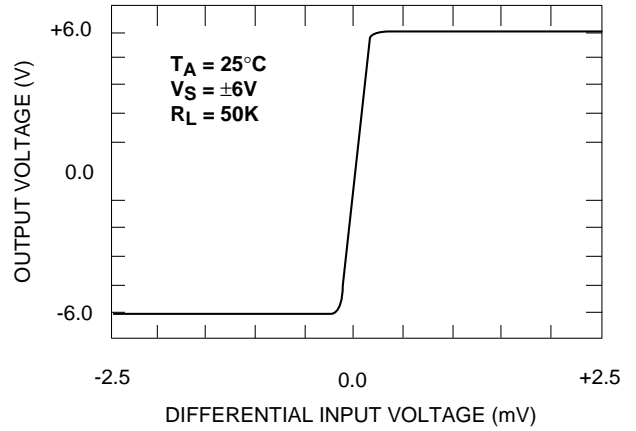
<sup>2</sup> Sample tested parameters

# TYPICAL PERFORMANCE CHARACTERISTICS

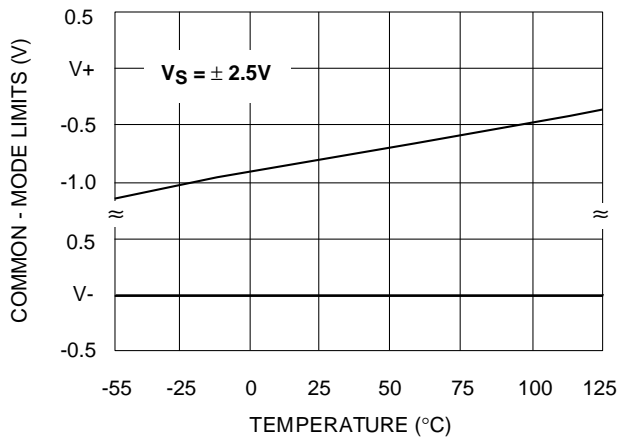
## SATURATION VOLTAGE vs. TEMPERATURE



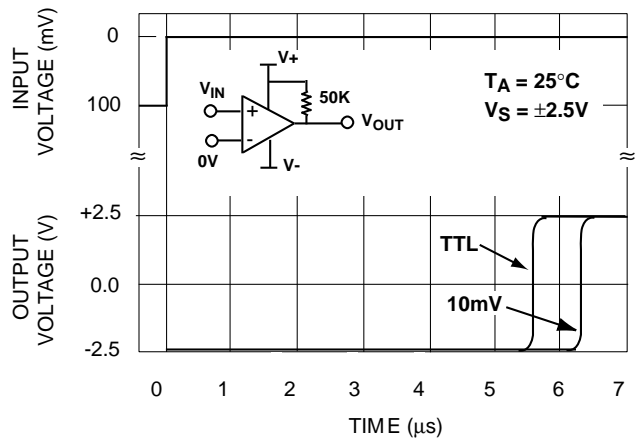
## TRANSFER FUNCTION



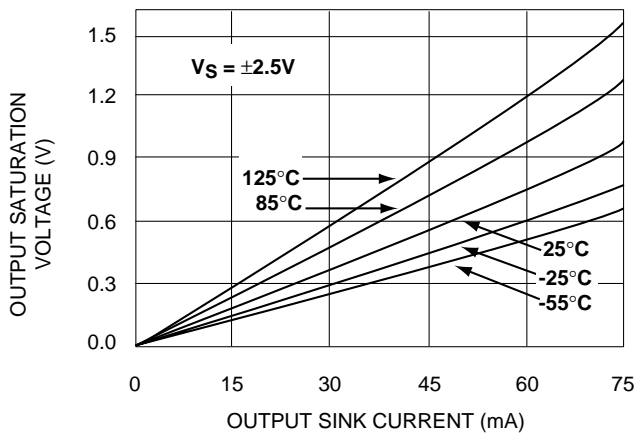
## COMMON - MODE VOLTAGE REFERRED TO SUPPLY VOLTAGE



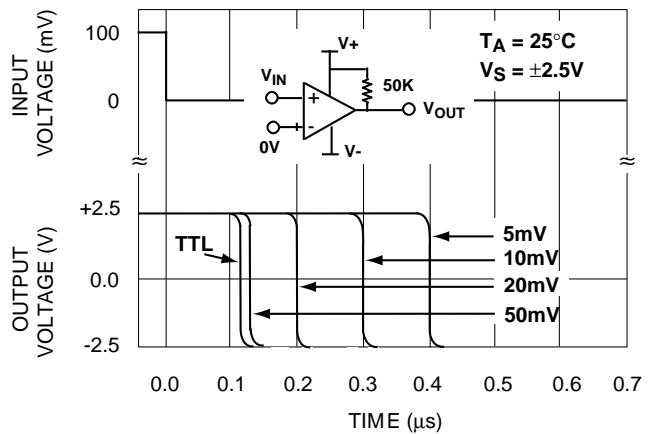
## RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES



## SATURATION VOLTAGE vs. SINK CURRENT

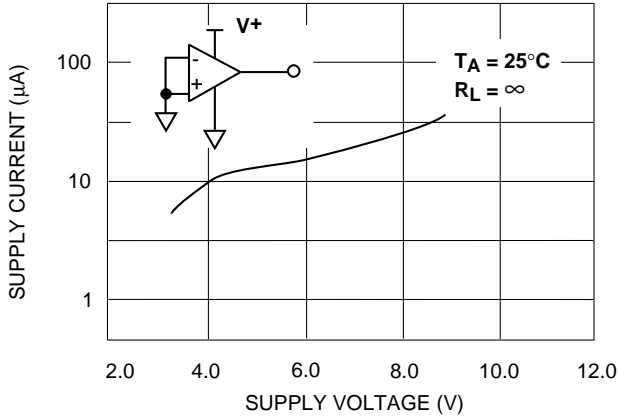


## RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES

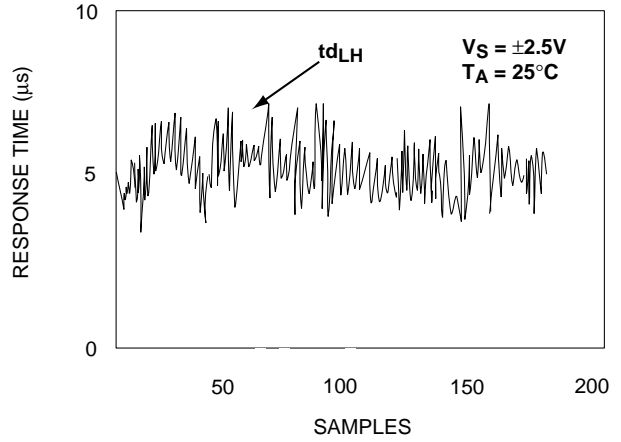


# TYPICAL PERFORMANCE CHARACTERISTICS

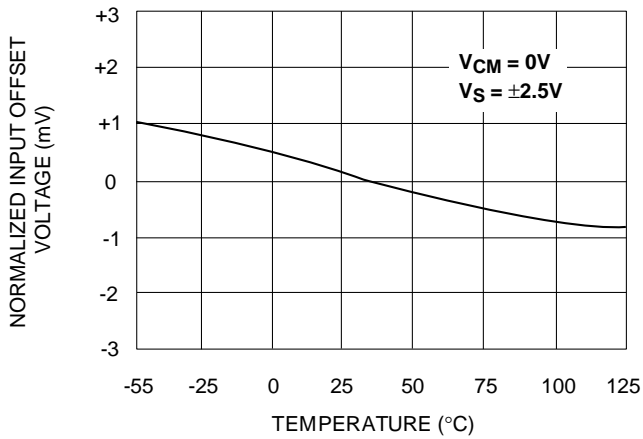
**TOTAL SUPPLY CURRENT vs. TOTAL SUPPLY VOLTAGE**



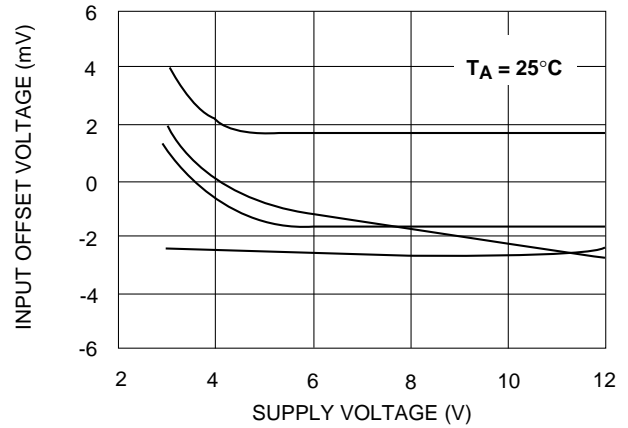
**RESPONSE TIME FOR REPRESENTATIVE SAMPLES**



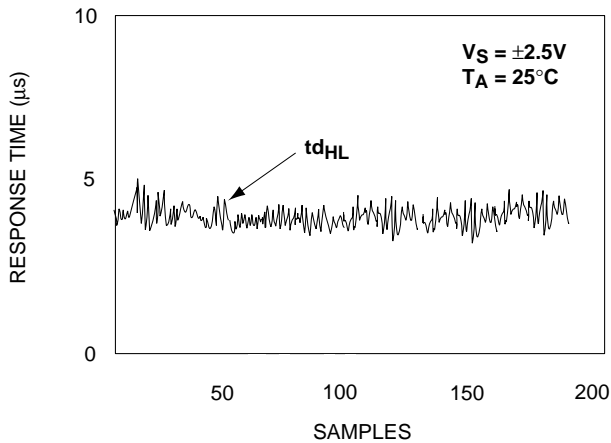
**NORMALIZED INPUT OFFSET VOLTAGE vs. TEMPERATURE**



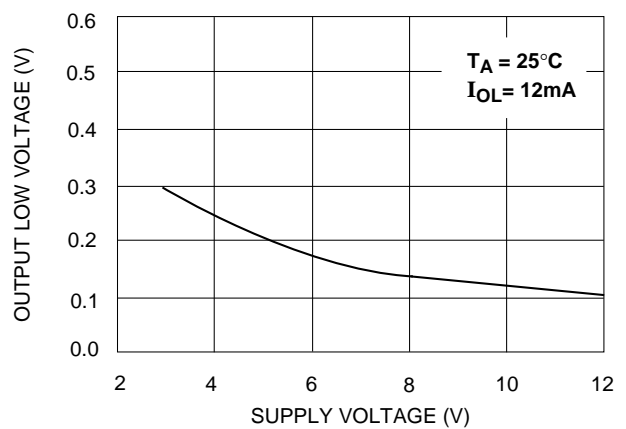
**INPUT OFFSET VOLTAGE vs. SUPPLY VOLTAGE REPRESENTATIVE SAMPLES**



**RESPONSE TIME FOR REPRESENTATIVE SAMPLES**

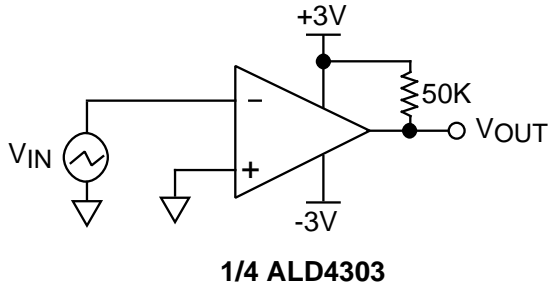


**OUTPUT LOW VOLTAGE vs. SUPPLY VOLTAGE**

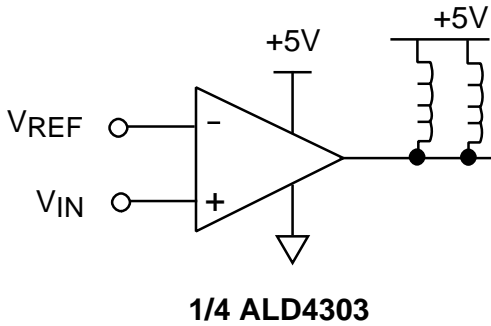


# TYPICAL APPLICATIONS

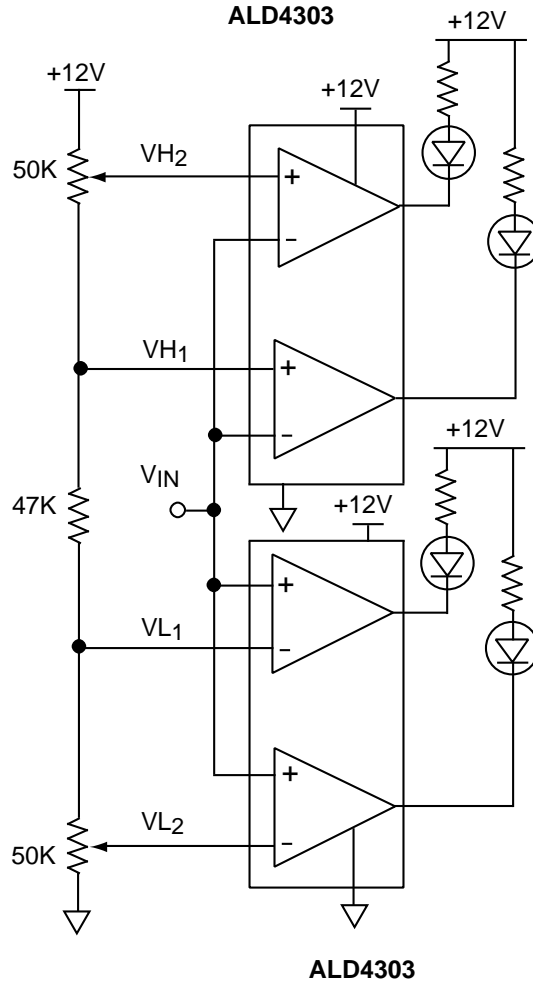
## ZERO CROSSING DETECTOR



## MULTIPLE RELAY DRIVE

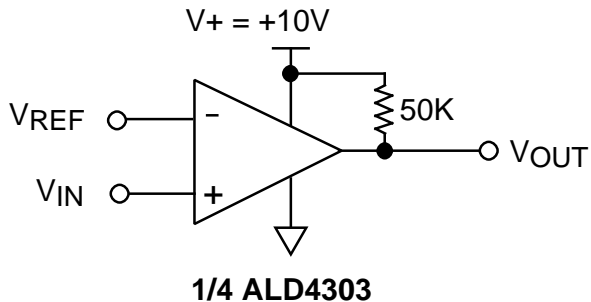


## DOUBLE QUAD LIMIT WINDOW COMPARATOR



VL<sub>1</sub> and VH<sub>1</sub> first limit window send warning  
 VL<sub>2</sub> and VH<sub>2</sub> second limit window execute system cutoff

## VOLTAGE LEVEL TRANSLATOR



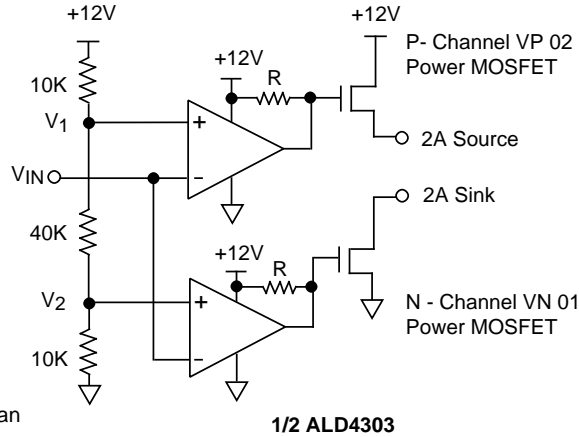
$V_{REF} = 1.4V$  for TTL input

$V_{REF} = \frac{V^+}{2}$  for CMOS input

Output  $V_{OUT}$  swings from rail-to-rail

# TYPICAL APPLICATIONS

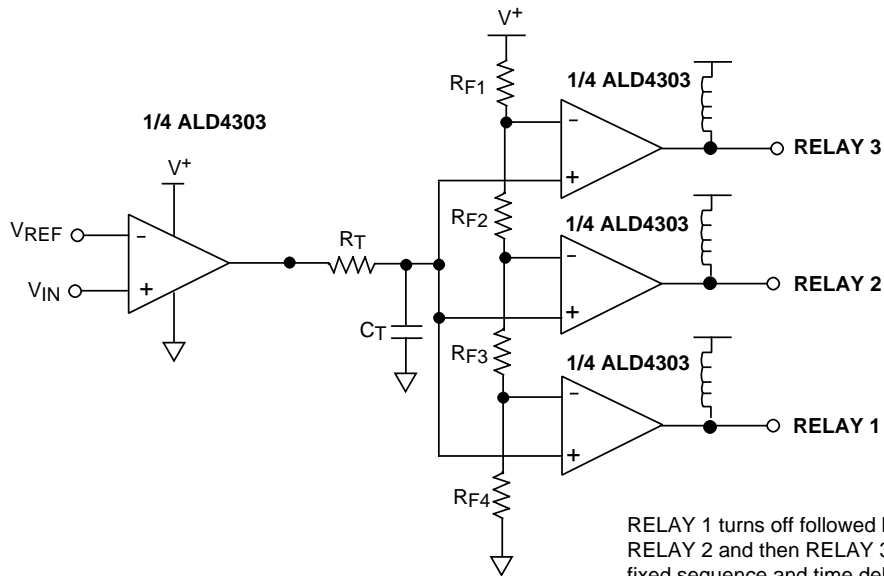
## PUSH-PULL COMPLEMENTARY POWER MOSFET DRIVER



$R \geq 50 \text{ K}\Omega$

This circuit eliminates crossover current in the complementary power transistors. The outputs can be used to source and sink different loads or tied together to provide push-pull drive of the same load.

## TIME DELAY GENERATOR



RELAY 1 turns off followed by RELAY 2 and then RELAY 3 with fixed sequence and time delays selected by ratios  $R_{F1}$ ,  $R_{F2}$ ,  $R_{F3}$  and  $R_{F4}$ .

### Design & Operating Notes:

1. In order to minimize stray oscillation, all unused inputs must be tied to ground.
2. The input bias and offset currents are essentially input protection diode reverse bias leakage currents, and are typically less than 1 pA at room temperature. These currents are a function of ambient temperature, and would have to be considered in applications where very high source impedance or high accuracy are involved.
3. The high output sinking current of 60mA for each output offers flexibility in many applications, as a separate buffer or driver would not be necessary to drive the intended load. However, as the circuit normally operates close to ambient temperature due to its very low power consumption, thermal effects caused by large output current transients must be considered in certain applications.