ANALOG DEVICES

# Quad Low Power, Precision Comparator

CMP04

FEATURES
High Gain: 200 V/mV Typ
Single- or Dual-Supply Operation
Input Voltage Range Includes Ground
Low Power Consumption (1.5 mW/Comparator)
Low Input Bias Current: 100 nA Max
Low Input Offset Current: 10 nA Max
Low Offset Voltage: 1 mV Max
Low Output Saturation Voltage: 250 mV @ 4 mA
Logic Output Compatible with TTL, DTL, ECL, MOS,
  and CMOS
Directly Replaces LM139/LM239/LM339 Comparators

PIN CONNECTIONS

14-Lead SOIC

OUT 2	1	14 OUT 3
OUT 1	2	13 OUT 4
V+	3	12 GND
IN 1–	4	11 IN 4+
IN 1+	5	10 IN 4–
IN 2–	6	9 IN 3+
IN 2+	7	8 IN 3–
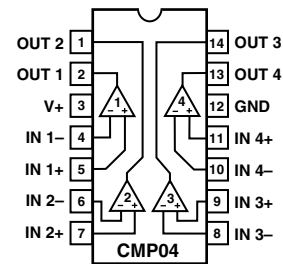
CMP04

GENERAL DESCRIPTION
Four precision independent comparators comprise the CMP04. Performance highlights include a very low offset voltage, low output saturation voltage, and high gain in a single-supply design. The input voltage range includes ground for single-supply operation and V– for split supplies. A low power supply current of 2 mA, which is independent of supply voltage, makes this the preferred comparator for precision applications requiring minimal power consumption. Maximum logic interface flexibility is offered by the open-collector TTL output.
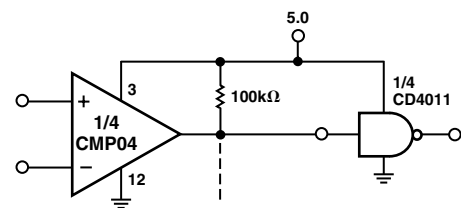
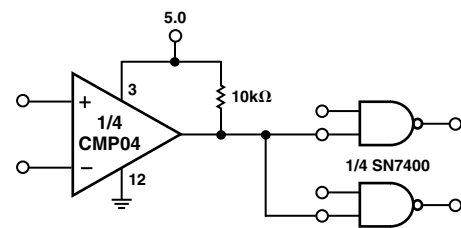## TYPICAL INTERFACE

Figure 2a. Driving CMOS
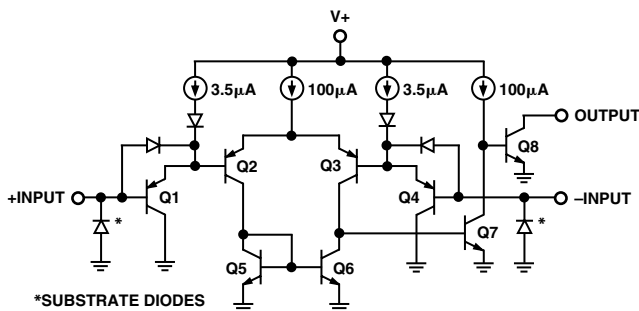
Figure 2b. Driving TTL

Figure 1. Simplified Schematic (1/4 CMP04)

REV. D

CMP04–SPECIFICATIONS

ELECTRICAL CHARACTERISTICS (@ V+ = 5 V, T_A = 25°C, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Offset Voltage	V_{OS}	R_S = 0 Ω, R_L = 5.1 kΩ, V_O = 1.4 V[1]		0.4	1	mV
Input Offset Current	I_{OS}	$I_{IN}(+) - I_{IN}(-)$, R_L = 5.1 kΩ, V_O = 1.4 V		2	10	nA
Input Bias Current	I_B	$I_{IN}(+)$ or $I_{IN}(-)$		25	100	nA
Voltage Gain	A_V	R_L ≥ 15 kΩ, V+ = 15 V[2]	80	200		V/mV
Large Signal Response Time	t_r	V_{IN} = TTL Logic Swing, V_{REF} = 1.4 V[3]				
		V_{RL} = 5 V, R_L = 5.1 kΩ		300		ns
Small Signal Response Time	t_r	V_{IN} = 100 mV Step[3], 5 mV Overdrive				
		V_{RL} = 5 V, R_L = 5.1 kΩ		1.3		µs
Input Voltage Range	CMVR	Note 4	0		V+ – 1.5	V
Common-Mode Rejection Ratio	CMRR	Notes 2, 5	80	100		dB
Power Supply Rejection Ratio	PSRR	V+ = 5 V to 18 V[2]	80	100		dB
Saturation Voltage	V_{OL}	$V_{IN}(-)$ ≥ 1 V, $V_{IN}(+)$ = 0, I_{SINK} ≤ 4 mA		250	400	mV
Output Sink Current	I_{SINK}	$V_{IN}(-)$ ≥ 1 V, $V_{IN}(+)$ = 0, V_O ≤ 1.5 V	6	16		mA
Output Leakage Current	I_{LEAK}	$V_{IN}(+)$ ≥ 1 V, $V_{IN}(-)$ = 0, V_O = 30 V		0.1	100	nA
Supply Current	I+	R_L = ∞, All Comps V+ = 30 V		0.8	2.0	mA

NOTES
[1]At output switch point, V_O = 1.4 V, R_S = 0 Ω with V+ from 5 V, and over the full input common-mode range (0 V to V+ – 1.5 V).
[2]Guaranteed by design.
[3]Sample tested.
[4]The input common-mode voltage or input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is V+ – 1.5 V, but either or both inputs can go to 30 V without damage.
[5]R_L ≥ 15 kΩ, V+ = 15 V, V_{CM} = 1.5 V to 13.5 V.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]
Supply Voltage . . . . +36 V or ±18 V
Differential Input Voltage . . . . 36 V dc
Input Voltage . . . . –0.3 V to +36 V
Operating Temperature Range
  CMP04FS . . . . –40°C to +85°C
Junction Temperature (T_J) . . . . –65°C to +150°C
Storage Temperature Range . . . . –65°C to +150°C
Input Current (V_{IN} < –3.0 V) . . . . 50 mA
Output Short Circuit to GND . . . . Continuous
Lead Temperature (Soldering, 60 sec) . . . . 300°C

Package Type	θ_{JA}[2]	θ_{JC}	Unit
14-Lead SOIC	120	36	°C/W

NOTES
[1]Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted. Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
[2]θ_{JA} is specified for worst-case mounting conditions, i.e., θ_{JA} is specified for device soldered to printed circuit board for SOIC package.

ORDERING GUIDE

Model	T_A = 25°C V_{OS}	Temperature Ranges	Package Descriptions	Package Options
CMP04FS	1 mV	–40°C to +85°C	14-Lead SOIC	R-14

REV. D

ELECTRICAL CHARACTERISTICS (@ V+ = 5 V, −40°C ≤ T_A ≤ +85°C for CMP04FS, unless otherwise noted.)

Parameter	Symbol	Conditions	Min	CMP04F[1] Typ	Max	Unit
Input Offset Voltage	V_{OS}	$R_S = 0\ \Omega$, $R_L = 5.1\ k\Omega$		1	2	mV
		$V_O = 1.4\ V$[2]		1	2	mV
Input Offset Current	I_{OS}	$I_{IN}(+) - I_{IN}(-)$		4	20	nA
		$R_L = 5.1\ k\Omega$		4	20	nA
		$V_O = 1.4\ V$		4	20	nA
Input Bias Current	I_B	$I_{IN}(+)$ or $I_{IN}(-)$		40	200	nA
Voltage Gain	A_V	$R_L \geq 15\ k\Omega$, V+ = 15 V[3]	70	125		V/mV
Large Signal Response Time	t_r	V_{IN} = TTL Logic Swing		300		ns
		$V_{REF} = 1.4\ V$[4]		300		ns
		$V_{RL} = 5\ V$, $R_L = 5.1\ k\Omega$		300		ns
Small Signal Response Time	t_r	V_{IN} = 100 mV Step[4]		1.3		µs
		5 mV Overdrive		1.3		µs
		$V_{RL} = 5\ V$, $R_L = 5.1\ k\Omega$		1.3		µs
Input Voltage Range	CMVR	Note 5	0		V+ − 1.5	V
Common-Mode Rejection Ratio	CMRR	Notes 1, 3	60	100		dB
Power Supply Rejection Ratio	PSRR	V+ = 5 V to 18 V	80	100		dB
Saturation Voltage	V_{OL}	$V_{IN}(-) \geq 1\ V$, $V_{IN}(+) = 0$,		250	700	mV
		$I_{SINK} \leq 4\ mA$		250	700	mV
Output Sink Current	I_{SINK}	$V_{IN}(-) \geq 1\ V$,	5	16		mA
		$V_{IN}(+) = 0$, $V_O \leq 1.5\ V$	5	16		mA
Output Leakage Current	I_{LEAK}	$V_{IN}(+) \geq 1\ V$,		0.1	200	nA
		$V_{IN}(-) = 0$, $V_O = 30\ V$		0.1	200	nA
Supply Current	I+	$R_L = \infty$, All Comps		1.2	3.0	mA
		V+ = 30 V		1.2	3.0	mA

NOTES

[1]$R_L \geq 15\ k\Omega$, V+ = 15 V, V_{CM} = 1.5 V to 13.5 V.

[2]At output switch point, $V_O = 1.4\ V$, $R_S = 0\ \Omega$ with V+ from 5 V; and over the full input common-mode range (0 V to V+ −1.5 V).

[3]Guaranteed by design.

[4]Sample tested.

[5]The input common-mode voltage or input signal voltage should not be allowed to go negative by more than 0.3 V. The upper end of the common-mode voltage range is V+ − 1.5 V, but either or both inputs can go to +30 V without damage.

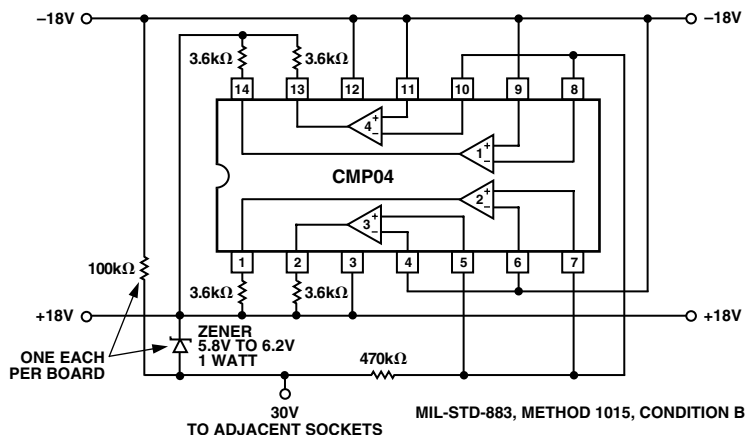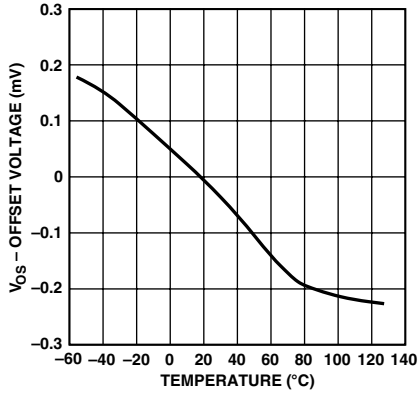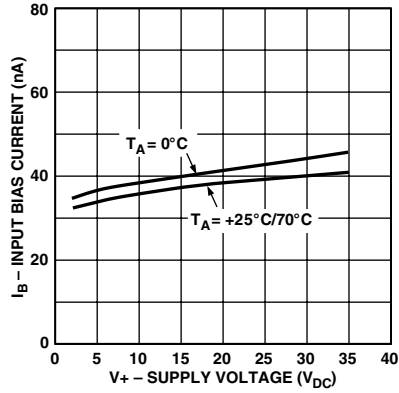Specifications subject to change without notice.
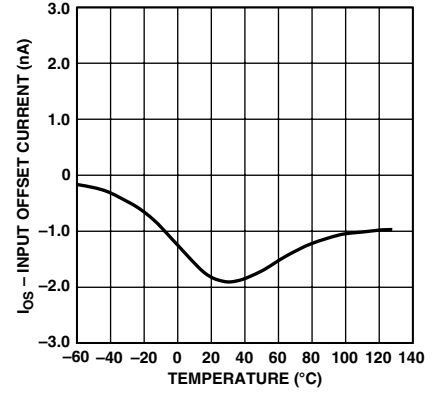

Figure 3. Burn-In Circuit

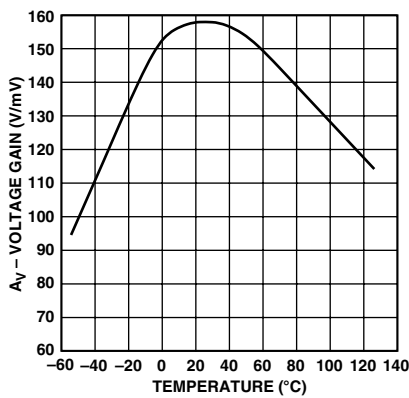# CMP04–Typical Performance Characteristics
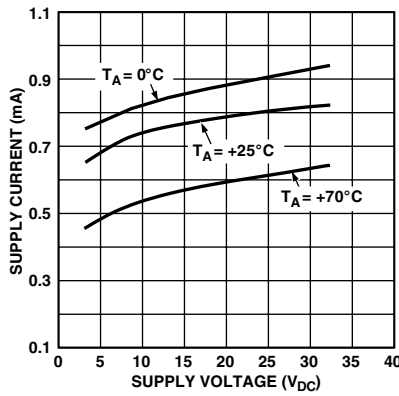

TPC 1. Offset Voltage vs. Temperature

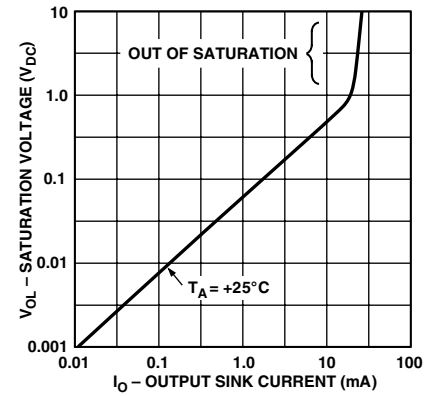TPC 2. Input Bias Current vs. V+ and Temperature

TPC 3. Input Offset Current vs. Temperature
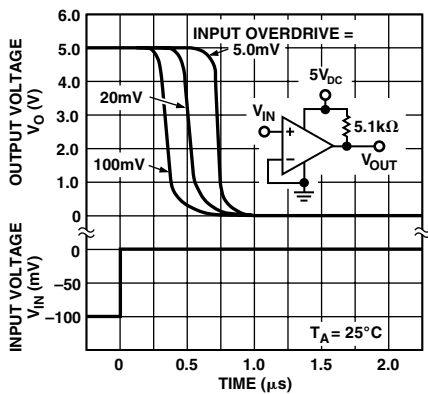

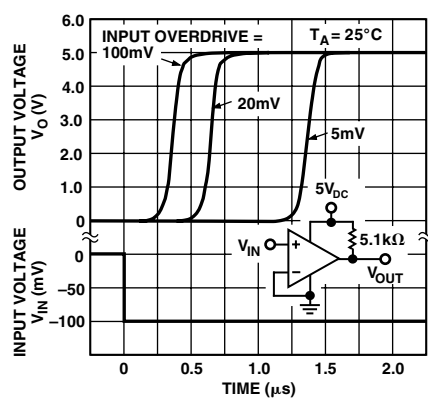TPC 4. Voltage Gain vs. Temperature

TPC 5. Supply Current vs. Supply Voltage

TPC 6. Output Voltage vs. Output Current and Temperature

TPC 7. Response Time for Various Input Overdrives—Negative Transition

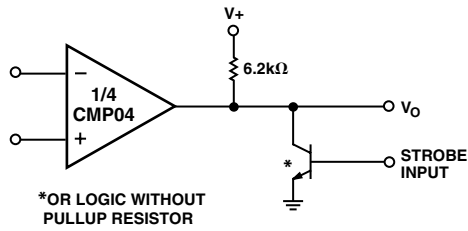

TPC 8. Response Time for Various Input Overdrives—Positive Transition

–4–

TYPICAL APPLICATIONS

Figure 4. Output Strobing
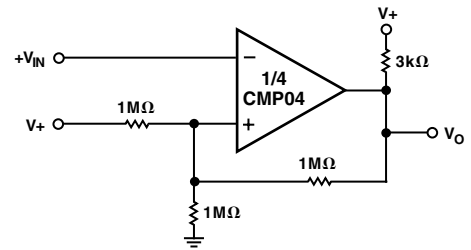
Figure 7. Inverting Comparator with Hysteresis
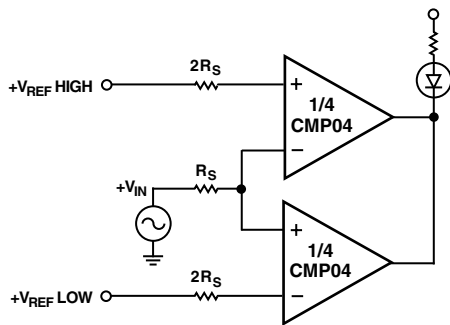
Figure 5. Limit Comparator
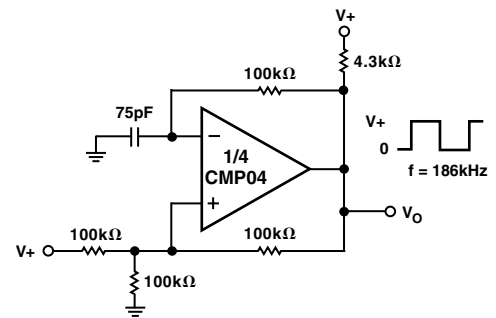
Figure 8. Square Wave Oscillator
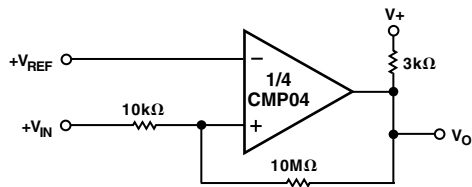
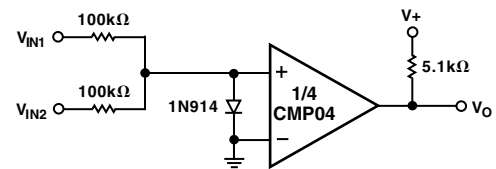Figure 6. Noninverting Comparator with Hysteresis

Figure 9. Comparing Input Voltages of Opposite Polarity
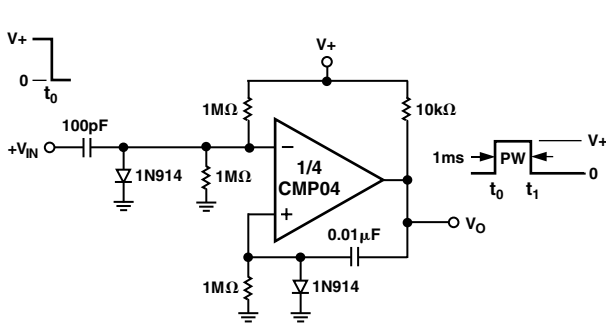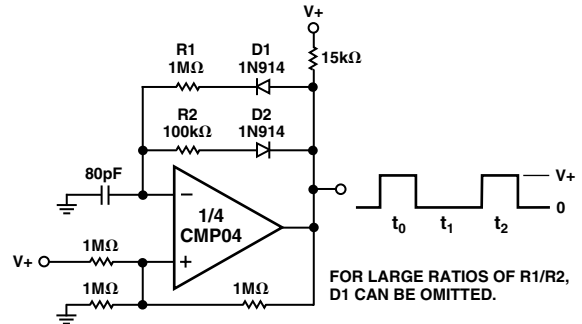
CMP04

Figure 10. One-Shot Multivibrator
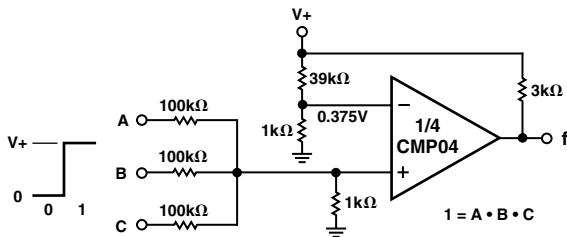

Figure 12. Pulse Generator

Figure 11. AND Gate
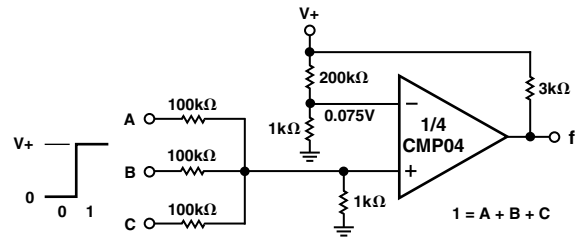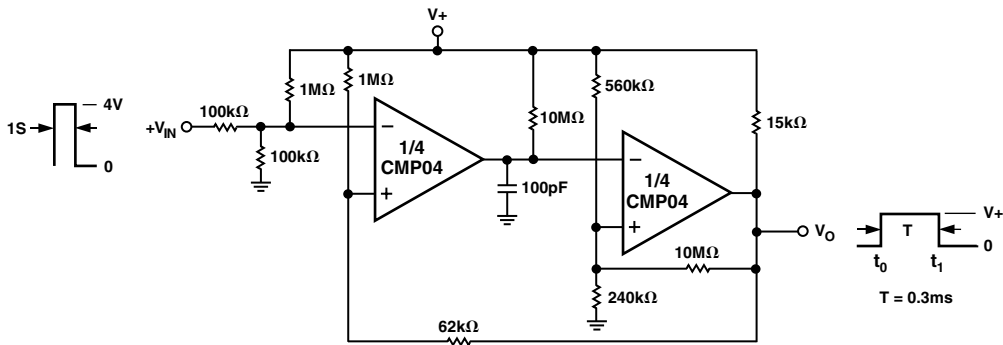

Figure 13. OR Gate

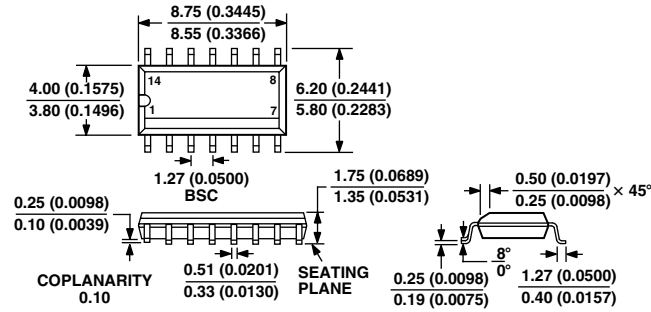Figure 14. One-Shot Multivibrator with Input Lockout
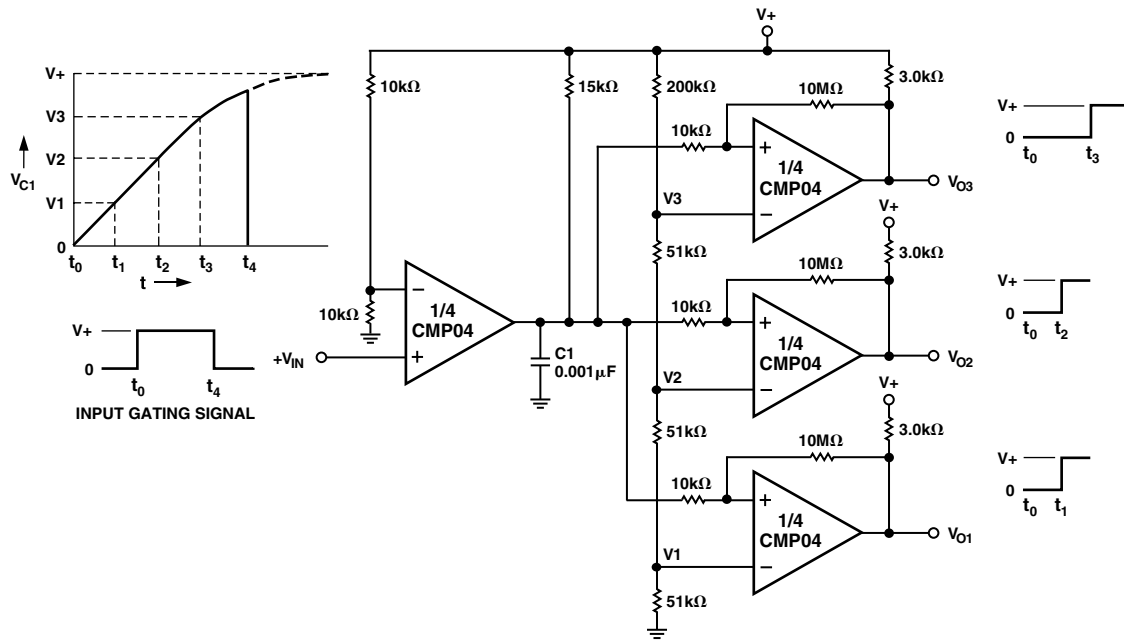
Figure 15. Time Delay Generator

CMP04

OUTLINE DIMENSIONS

14-Lead Standard Small Outline Package [SOIC]
Narrow Body
(R-14)
Dimensions shown in millimeters and (inches)

8.75 (0.3445)
8.55 (0.3366)

4.00 (0.1575)
3.80 (0.1496)

14   8

1   7

6.20 (0.2441)
5.80 (0.2283)

1.27 (0.0500)
BSC

1.75 (0.0689)
1.35 (0.0531)

0.50 (0.0197)
0.25 (0.0098) × 45°

0.25 (0.0098)
0.10 (0.0039)

COPLANARITY
0.10

0.51 (0.0201)
0.33 (0.0130)

SEATING
PLANE

0.25 (0.0098)
0.19 (0.0075)

8°
0°

1.27 (0.0500)
0.40 (0.0157)

COMPLIANT TO JEDEC STANDARDS MS-012AB
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS
(IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR
REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Revision History

REV. D