

# MC3405

## Dual Operational Amplifier and Dual Comparator

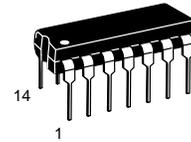
The MC3405 contains two differential-input operational amplifiers and two comparators, each set capable of single supply operation. This operational amplifier-comparator circuit fulfills its applications as a general purpose product for automotive and consumer circuits as well as an industrial building block.

The MC3405 is specified over the commercial operating temperature range of 0° to +70°C.

- Operational Amplifier Equivalent in Performance to MC3403
- Comparator Similar in Performance to LM339
- Single Supply Operation: 3.0 V to 36 V
- Split Supply Operation:  $\pm 1.5$  V to  $\pm 18$  V
- Low Supply Current Drain
- Operational Amplifier is Internally Frequency Compensated
- Comparator TTL and CMOS Compatible

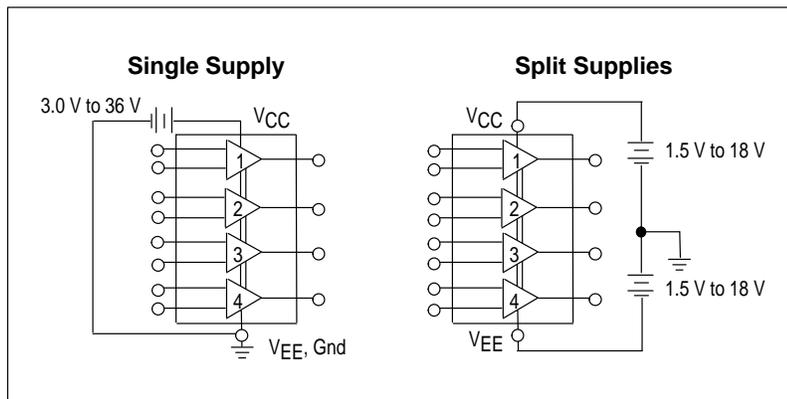
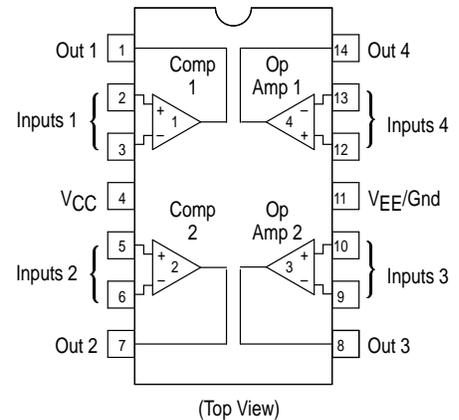
### DUAL OPERATIONAL AMPLIFIER / DUAL VOLTAGE COMPARATOR

#### SEMICONDUCTOR TECHNICAL DATA



**P SUFFIX**  
PLASTIC PACKAGE  
CASE 646

#### PIN CONNECTIONS



#### ORDERING INFORMATION

Device	Operating Temperature Range	Package
MC3405P	$T_A = 0^\circ$ to $+70^\circ\text{C}$	Plastic DIP

# MC3405

## OPERATIONAL AMPLIFIER SECTION

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage – Single Supply Split Supplies	$V_{CC}$ $V_{CC}, V_{EE}$	36 $\pm 18$	Vdc
Input Differential Voltage Range	$V_{IDR}$	$\pm 36$	Vdc
Input Common Mode Voltage Range	$V_{ICR}$	$\pm 18$	Vdc
Operating Ambient Temperature Range	$T_A$	0 to +70	°C
Storage Temperature Range	$T_{stg}$	-55 to +125	°C
Operating Junction Temperature Range	$T_J$	150	°C

### ELECTRICAL CHARACTERISTICS ( $V_{CC} = 5.0$ V, $V_{EE} = \text{Gnd}$ , $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Input Offset Voltage	$V_{IO}$	–	2.0	10	mV
Input Offset Current	$I_{IO}$	–	30	50	nA
Input Bias Current	$I_{IB}$	–	-200	-500	nA
Large-Signal, Open Loop Voltage Gain ( $R_L = 2.0$ k $\Omega$ )	$A_{VOL}$	20	200	–	V/mV
Power Supply Rejection	PSR	–	–	150	$\mu\text{V/V}$
Output Voltage Range (Note 1) ( $R_L = 10$ k $\Omega$ , $V_{CC} = 5.0$ V) ( $R_L = 10$ k $\Omega$ , $5.0$ V $\leq V_{CC} \leq 30$ V)	$V_{OR}$	3.3 $V_{CC} - 2.0$	3.5 $V_{CC} - 1.7$	– –	$V_{pp}$
Power Supply Current (Notes 2 and 3)	$I_{CC}$	–	2.5	7.0	mA
Channel Separation, $f = 1.0$ kHz to 20 kHz (Input Referenced)	–	–	-120	–	dB

### ELECTRICAL CHARACTERISTICS ( $V_{CC} = +15$ V, $V_{EE} = -15$ V, $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ( $T_A = T_{low} + T_{high}$ ) (Note 4)	$V_{IO}$	– –	2.0 –	10 12	mV
Average Temperature Coefficient of Input Offset Voltage	$\Delta V_{IO}/\Delta T$	–	15	–	$\mu\text{V}/^\circ\text{C}$
Input Offset Current ( $T_A = T_{low}$ to $T_{high}$ ) (Note 4)	$I_{IO}$	– –	– –	50 200	nA
Input Bias Current ( $T_A = T_{low}$ to $T_{high}$ ) (Note 4)	$I_{IB}$	– –	-200 –	-500 -800	nA
Input Common Mode Voltage Range	$V_{ICR}$	+13 $-V_{EE}$	–	–	Vdc
Large Signal, Open Loop Voltage Gain ( $V_O = \pm 10$ V, $R_L = 2.0$ k $\Omega$ ) ( $T_A = T_{low}$ to $T_{high}$ ) (Note 4)	$A_{VOL}$	20 15	200 100	– –	V/mV
Common Mode Rejection	CMR	70	90	–	dB
Power Supply Rejection Ratio	PSRR	–	30	150	$\mu\text{V/V}$
Output Voltage ( $R_L = 10$ k $\Omega$ ) ( $R_L = 2.0$ k $\Omega$ ) ( $R_L = 2.0$ k $\Omega$ , $T_A = T_{low}$ to $T_{high}$ ) (Note 4)	$V_O$	$\pm 12$ $\pm 10$ $\pm 10$	$\pm 13.5$ $\pm 13$ –	– – –	Vdc
Output Short Circuit Current	$I_{SC}$	$\pm 10$	$\pm 20$	$\pm 45$	mA
Power Supply Current (Notes 2 and 3)	$I_{CC}, I_{EE}$	–	2.8	7.0	mA
Phase Margin	$\phi_m$	–	60	–	Degrees
Small-Signal Bandwidth ( $A_V = 1$ , $R_L = 10$ k $\Omega$ , $V_O = 50$ mV)	BW	–	1.0	–	MHz

- NOTES:**
- Output will swing to ground.
  - Not to exceed maximum package power dissipation.
  - For operational amplifier and comparator.
  - $T_{low} = 0^\circ\text{C}$ ,  $T_{high} = +70^\circ\text{C}$

# MC3405

## ELECTRICAL CHARACTERISTICS ( $V_{CC} = +15\text{ V}$ , $V_{EE} = -15\text{ V}$ , $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Power Bandwidth ( $A_V = 1$ , $R_L = 2.0\text{ k}\Omega$ , $V_O = 20\text{ V}_{pp}$ , THD = 5%)	BWp	–	9.0	–	kHz
Rise Time/Fall Time	$t_{TLH}$ , $t_{THL}$	–	0.35	–	$\mu\text{s}$
Overshoot ( $A_V = 1$ , $R_L = 10\text{ k}\Omega$ , $V_O = 50\text{ mV}$ )	os	–	20	–	%
Slew Rate	SR	–	0.6	–	$\text{V}/\mu\text{s}$

## COMPARATOR SECTION

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage – Single Supply Split Supplies	$V_{CC}$ $V_{CC}$ , $V_{EE}$	36 $\pm 18$	Vdc
Input Differential Voltage Range	$V_{IDR}$	$\pm 36$	Vdc
Input Common Mode Voltage Range	$V_{ICR}$	–0.3 to +36	Vdc
Sink Current	$I_{Sink}$	20	mA
Operating Ambient Temperature Range	$T_A$	0 to +70	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	–55 to +125	$^\circ\text{C}$
Operating Junction Temperature Range	$T_J$	150	$^\circ\text{C}$

## ELECTRICAL CHARACTERISTICS ( $V_{CC} = 5.0\text{ V}$ , $V_{EE} = \text{Gnd}$ , $T_A = 25^\circ\text{C}$ , unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
Input Offset Voltage ( $T_A = T_{low}$ to $T_{high}$ ) (Notes 1 and 2)	$V_{IO}$	– –	2.0 –	10 12	mV
Average Temperature Coefficient of Input Offset Voltage	$\Delta V_{IO}/\Delta T$	–	15	–	$\mu\text{V}/^\circ\text{C}$
Input Offset Current ( $T_A = T_{low}$ to $T_{high}$ ) (Note 1)	$I_{IO}$	– –	50 –	100 200	nA
Input Bias Current ( $T_A = T_{low}$ to $T_{high}$ ) (Note 1)	$I_{IB}$	– –	–125 –	–500 –800	nA
Input Common Mode Voltage Range ( $T_A = T_{low}$ to $T_{high}$ ) (Note 1)	$V_{ICR}$	0 0	$V_{CC} - 1.5$ $V_{CC} - 1.7$	$V_{CC} - 1.7$ $V_{CC} - 2.0$	Vpp
Input Differential Voltage (All $V_{in} \geq 0\text{ Vdc}$ )	$V_{ID}$	–	–	36	V
Large-Signal, Open Loop Voltage Gain ( $R_L = 15\text{ k}\Omega$ )	$A_{VOL}$	–	200	–	$\text{V}/\text{mV}$
Output Sink Current ( $-V_{in} \geq 1.0\text{ Vdc}$ , $+V_{in} = 0$ , $V_O \leq 1.5\text{ V}$ )	$I_{Sink}$	6.0	16	–	mA
Low Level Output Voltage ( $+V_{in} = 0\text{ V}$ , $-V_{in} = 1.0\text{ V}$ , $I_{Sink} = 4.0\text{ mA}$ ) ( $T_A = T_{low}$ to $T_{high}$ ) (Note 1)	$V_{OL}$	– –	350 –	500 700	$\mu\text{A}$
Output Leakage Current ( $+V_{in} \geq 1.0\text{ Vdc}$ , $-V_{in} = 0$ , $V_O = 5.0\text{ Vdc}$ ) ( $T_A = T_{low}$ to $T_{high}$ ) (Note 1)	$I_{OL}$	– –	0.1 0.1	1.0 1.0	$\mu\text{A}$
Large-Signal Response	–	–	300	–	ns
Response Time (Note 3) ( $V_{RL} = 5.0\text{ Vdc}$ , $R_L = 5.1\text{ k}\Omega$ )	–	–	1.3	–	$\mu\text{s}$

- NOTES:** 1.  $T_{low} = 0^\circ\text{C}$ ,  $T_{high} = +70^\circ\text{C}$   
 2.  $V_O \cong 1.4\text{ V}$ ,  $R_S = 0\ \Omega$  with  $V_{CC}$  from 5.0 Vdc to 30 Vdc, and over the input common mode range 0 to  $V_{CC} - 1.7\text{ V}$ .  
 3. The response time specified is for a 100 mV input step with 5.0 mV overdrive. For larger signals 300 ns is typical.