MC33171, MC33172, MC33174, NCV33172

Single Supply 3.0 V to 44 V, Low Power Operational Amplifiers

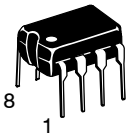
ON Semiconductor®

Quality bipolar fabrication with innovative design concepts are employed for the MC33171/72/74 series of monolithic operational amplifiers. These devices operate at 180 μA per amplifier and offer 1.8 MHz of gain bandwidth product and 2.1 V/μs slew rate without the use of JFET device technology. Although this series can be operated from split supplies, it is particularly suited for single supply operation, since the common mode input voltage includes ground potential (V_{EE}). With a Darlington input stage, these devices exhibit high input resistance, low input offset voltage and high gain. The all NPN output stage, characterized by no deadband crossover distortion and large output voltage swing, provides high capacitance drive capability, excellent phase and gain margins, low open loop high frequency output impedance and symmetrical source/sink AC frequency response.

The MC33171/72/74 are specified over the industrial/automotive temperature ranges. The complete series of single, dual and quad operational amplifiers are available in plastic as well as the surface mount packages.

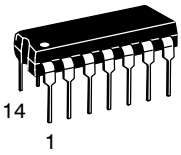
Features

- Low Supply Current: 180 μA (Per Amplifier)
- Wide Supply Operating Range: 3.0 V to 44 V or ±1.5 V to ±22 V
- Wide Input Common Mode Range, Including Ground (V_{EE})
- Wide Bandwidth: 1.8 MHz
- High Slew Rate: 2.1 V/μs
- Low Input Offset Voltage: 2.0 mV
- Large Output Voltage Swing: −14.2 V to +14.2 V (with ±15 V Supplies)
- Large Capacitance Drive Capability: 0 pF to 500 pF
- Low Total Harmonic Distortion: 0.03%
- Excellent Phase Margin: 60°
- Excellent Gain Margin: 15 dB
- Output Short Circuit Protection
- ESD Diodes Provide Input Protection for Dual and Quad
- Pb−Free Packages are Available
- NCV Prefix for Automotive and Other Applications Requiring Site and Control Changes

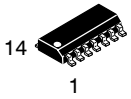


PDIP−8
P SUFFIX
CASE 626

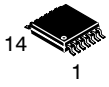
SO−8
D, VD SUFFIX
CASE 751



PDIP−14
P, VP SUFFIX
CASE 646



SO−14
D, VD SUFFIX
CASE 751A



TSSOP−14
DTB SUFFIX
CASE 948G

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

DEVICE MARKING INFORMATION

See general marking information in the device marking section on page 10 of this data sheet.

Publication Order Number:
MC33171/D

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}/V_{EE}	±22	V
Input Differential Voltage Range	V_{IDR}	(Note 1)	V
Input Voltage Range	V_{IR}	(Note 1)	V
Output Short Circuit Duration (Note 2)	t_{SC}	Indefinite	sec
Operating Ambient Temperature Range	T_A	(Note 3)	°C
Operating Junction Temperature	T_J	+150	°C
Storage Temperature Range	T_{stg}	−65 to +150	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

DC ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = −15 V, R_L connected to ground, T_A = +25°C, unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Input Offset Voltage (V_{CM} = 0 V)	V_{IO}				mV
V_{CC} = +15 V, V_{EE} = −15 V, T_A = +25°C		–	2.0	4.5	
V_{CC} = +5.0 V, V_{EE} = 0 V, T_A = +25°C		–	2.5	5.0	
V_{CC} = +15 V, V_{EE} = −15 V, T_A = T_{low} to T_{high} (Note 3)		–	–	6.5	
Average Temperature Coefficient of Offset Voltage	$\Delta V_{IO}/\Delta T$	–	10	–	μV/°C
Input Bias Current (V_{CM} = 0 V)	I_{IB}				nA
T_A = +25°C		–	20	100	
T_A = T_{low} to T_{high} (Note 3)		–	–	200	
Input Offset Current (V_{CM} = 0 V)	I_{IO}				nA
T_A = +25°C		–	5.0	20	
T_A = T_{low} to T_{high} (Note 3)		–	–	40	
Large Signal Voltage Gain (V_O = ±10 V, R_L = 10 k)	A_{VOL}				V/mV
T_A = +25°C		50	500	–	
T_A = T_{low} to T_{high} (Note 3)		25	–	–	
Output Voltage Swing	V_{OH}				V
V_{CC} = +5.0 V, V_{EE} = 0 V, R_L = 10 k, T_A = +25°C		3.5	4.3	–	
V_{CC} = +15 V, V_{EE} = −15 V, R_L = 10 k, T_A = +25°C		13.6	14.2	–	
V_{CC} = +15 V, V_{EE} = −15 V, R_L = 10 k, T_A = T_{low} to T_{high} (Note 3)		13.3	–	–	
V_{CC} = +5.0 V, V_{EE} = 0 V, R_L = 10 k, T_A = +25°C	V_{OL}	–	0.05	0.15	
V_{CC} = +15 V, V_{EE} = −15 V, R_L = 10 k, T_A = +25°C		–	−14.2	−13.6	
V_{CC} = +15 V, V_{EE} = −15 V, R_L = 10 k, T_A = T_{low} to T_{high} (Note 3)		–	–	−13.3	
Output Short Circuit (T_A = +25°C)	I_{SC}				mA
Input Overdrive = 1.0 V, Output to Ground					
Source		3.0	5.0	–	
Sink		15	27	–	
Input Common Mode Voltage Range	V_{ICR}				V
T_A = +25°C		V_{EE} to (V_{CC} −1.8)			
T_A = T_{low} to T_{high} (Note 3)		V_{EE} to (V_{CC} −2.2)			
Common Mode Rejection Ratio (R_S ≤ 10 k), T_A = +25°C	CMRR	80	90	–	dB
Power Supply Rejection Ratio (R_S = 100 Ω), T_A = +25°C	PSRR	80	100	–	dB
Power Supply Current (Per Amplifier)	I_D				μA
V_{CC} = +5.0 V, V_{EE} = 0 V, T_A = +25°C		–	180	250	
V_{CC} = +15 V, V_{EE} = −15 V, T_A = +25°C		–	220	250	
V_{CC} = +15 V, V_{EE} = −15 V, T_A = T_{low} to T_{high} (Note 3)		–	–	300	

1. Either or both input voltages must not exceed the magnitude of V_{CC} or V_{EE}.
2. Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded.
3. MC3317x T_{low} = −40°C T_{high} = +85°C
   MC3317xV, NCV33172 T_{low} = −40°C T_{high} = +125°C

AC ELECTRICAL CHARACTERISTICS (V_{CC} = +15 V, V_{EE} = −15 V, R_L connected to ground, T_A = +25°C, unless otherwise noted.)

Characteristics	Symbol	Min	Typ	Max	Unit
Slew Rate (V_{in} = −10 V to +10 V, R_L = 10 k, C_L = 100 pF) A_V +1 A_V −1	SR	 1.6 –	 2.1 2.1	 – –	V/μs
Gain Bandwidth Product (f = 100 kHz)	GBW	1.4	1.8	–	MHz
Power Bandwidth A_V = +1.0 R_L = 10 k, V_O = 20 V_{pp}, THD = 5%	BWp	 –	 35	 –	kHz
Phase Margin R_L = 10 k R_L = 10 k, C_L = 100 pF	ϕ_m	 – –	 60 45	 – –	Deg
Gain Margin R_L = 10 k R_L = 10 k, C_L = 100 pF	A_m	 – –	 15 5.0	 – –	dB
Equivalent Input Noise Voltage R_S = 100 Ω, f = 1.0 kHz	e_n	–	32	–	$nV/\sqrt{Hz}$
Equivalent Input Noise Current (f = 1.0 kHz)	I_n	–	0.2	–	$pA/\sqrt{Hz}$
Differential Input Resistance V_{cm} = 0 V	R_{in}	 –	 300	 –	MΩ
Input Capacitance	C_{in}	–	0.8	–	pF
Total Harmonic Distortion A_V = +10, R_L = 10 k, 2.0 $V_{pp} \le V_O \le$ 20 V_{pp}, f = 10 kHz	THD	 –	 0.03	 –	%
Channel Separation (f = 10 kHz)	CS	–	120	–	dB
Open Loop Output Impedance (f = 1.0 MHz)	z_o	–	100	–	Ω

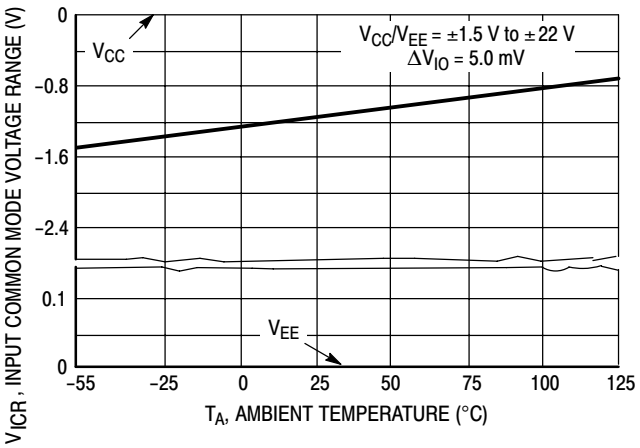


Figure 2. Input Common Mode Voltage Range versus Temperature

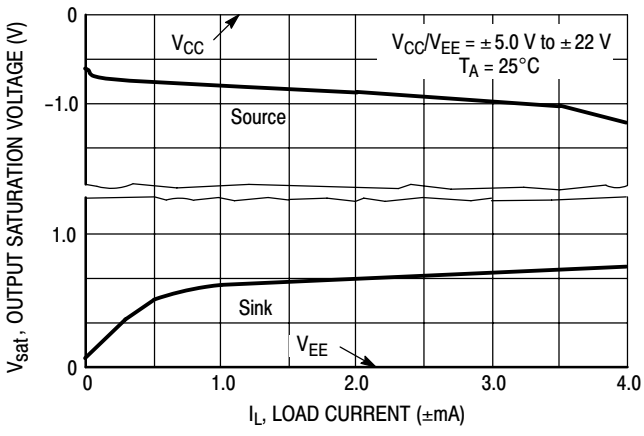


Figure 3. Split Supply Output Saturation versus Load Current

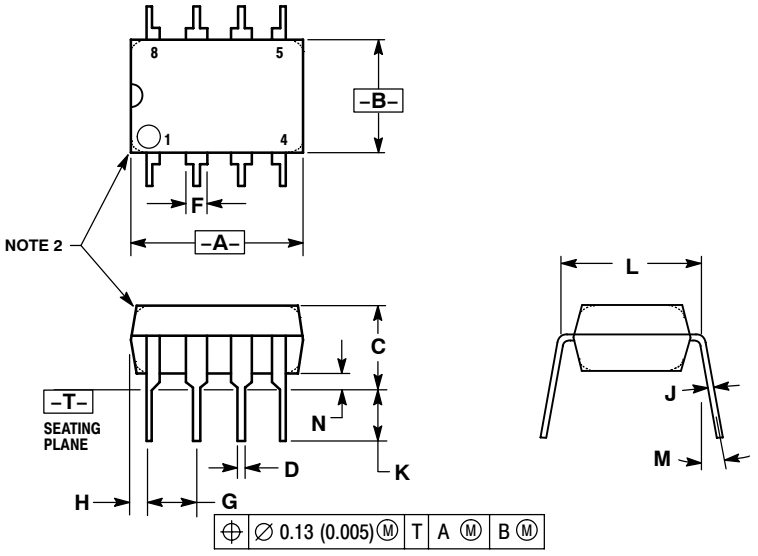
ORDERING INFORMATION

Op Amp Function	Device	Operating Temperature Range	Package	Shipping†
Single	MC33171D	T_A = −40° to +85°C	SO−8	98 Units/Rail
	MC33171DG		SO−8 (Pb−Free)	
	MC33171DR2		SO−8	2500 / Tape & Reel
	MC33171DR2G		SO−8 (Pb−Free)	
	MC33171P		Plastic DIP	50 Units/Rail
	MC33171PG		Plastic DIP (Pb−Free)	
Dual	MC33172D	T_A = −40° to +85°C	SO−8	98 Units/Rail
	MC33172DG		SO−8 (Pb−Free)	
	MC33172DR2		SO−8	2500 / Tape & Reel
	MC33172DR2G		SO−8 (Pb−Free)	
	MC33172P		Plastic DIP	50 Units/Rail
	MC33172PG		Plastic DIP (Pb−Free)	
	MC33172VD	T_A = −40° to +125°C	SO−8	98 Units/Rail
	MC33172VDG		SO−8 (Pb−Free)	
	MC33172VDR2		SO−8	2500 / Tape & Reel
	MC33172VDR2G		SO−8 (Pb−Free)	
	NCV33172DR2**		SO−8	2500 / Tape & Reel
Quad	MC33174D	T_A = −40° to +85°C	SO−14	55 Units/Rail
	MC33174DG		SO−14 (Pb−Free)	
	MC33174DR2		SO−14	2500 / Tape & Reel
	MC33174DR2G		SO−14 (Pb−Free)	
	MC33174DTB		TSSOP−14*	96 Units/Rail
	MC33174DTBG		TSSOP−14*	
	MC33174DTBR2		TSSOP−14*	2500 / Tape & Reel
	MC33174DTBR2G		TSSOP−14*	
	MC33174P		Plastic DIP	25 Units/Rail
	MC33174PG		Plastic DIP (Pb−Free)	
	MC33174VDR2	T_A = −40° to +125°C	SO−14	2500 / Tape & Reel
	MC33174VDR2G		SO−14 (Pb−Free)	
	MC33174VP		Plastic DIP	25 Units/Rail
	MC33174VPG		Plastic DIP (Pb−Free)	

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*This package is inherently Pb−Free.
**NCV prefix for automotive and other applications requiring site and control changes.

PACKAGE DIMENSIONS

PDIP−8
P SUFFIX
CASE 626−05
ISSUE L



NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	---	10°	---	10°
N	0.76	1.01	0.030	0.040