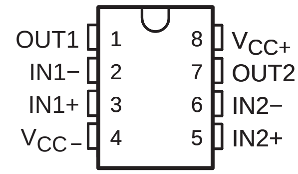
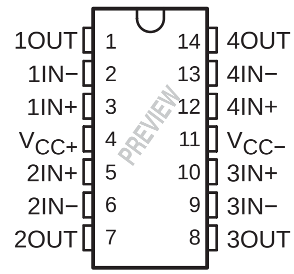
- **Dual-Supply Operation . . . ±5 V to ±18 V**
- **Low Noise Voltage . . . 4.5 nV/√Hz**
- **Low Input Offset Voltage . . . 0.15 mV**
- **Low Total Harmonic Distortion . . . 0.002%**
- **High Slew Rate . . . 7 V/μs**
- **High-Gain Bandwidth Product . . . 16 MHz**
- **High Open-Loop AC Gain . . . 800 @ 20 kHz**
- **Large Output-Voltage Swing . . . 14.1 V to −14.6 V**
- **Excellent Gain and Phase Margins**

MC33078 . . . D (SOIC), DGK (MSOP), OR P (PDIP) PACKAGE
(TOP VIEW)



MC33079 . . . D (SOIC) OR P (PDIP) PACKAGE
(TOP VIEW)



description/ordering information

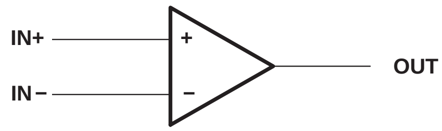
The MC33078 and MC33079 are bipolar dual/quad operational amplifiers with high-performance specifications for use in quality audio and data-signal applications. These devices operate over a wide range of single- and dual-supply voltages and offer low noise, high-gain bandwidth, and high slew rate. Additional features include low total harmonic distortion, excellent phase and gain margins, large output voltage swing with no deadband crossover distortion, and symmetrical sink/source performance.

ORDERING INFORMATION

T_A	PACKAGE†			ORDERABLE PART NUMBER	TOP-SIDE MARKING
−40°C to 85°C	Dual	PDIP (P)	Tube of 50	MC33078P	MC33078P
		SOIC (D)	Tube of 75	MC33078D	M33078
			Reel of 2500	MC33078DR	
		VSSOP/MSOP (DGK)	Reel of 2500	MC33078DGKR	PREVIEW
			Reel of 250	MC33078DGKT	
	Quad	PDIP (P)	Tube of 50	MC33079P	PREVIEW
		SOIC (D)	Tube of 75	MC33079D	PREVIEW
			Reel of 2500	MC33079DR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

symbol (each amplifier)



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC+} (see Note 1) . . . . 18 V
Supply voltage, V_{CC-} (see Note 1) . . . . −18 V
Supply voltage, (V_{CC-} to V_{CC+}) . . . . 36 V
Input voltage, either input (see Notes 1 and 2) . . . . V_{CC-} or V_{CC+}
Input current (see Note 3) . . . . ±10 mA
Duration of output short circuit (see Note 4) . . . . Unlimited
Package thermal impedance, θ_{JA} (see Notes 5 and 6): D package . . . . 97°C/W
DGK package . . . . 172°C/W
P package . . . . 85°C/W
Operating virtual junction temperature, T_J . . . . 150°C
Storage temperature range, T_{stg} . . . . −65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES:
1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-}.
2. The magnitude of the input voltage must never exceed the magnitude of the supply voltage.
3. Excessive input current will flow if a differential input voltage in excess of approximately 0.6 V is applied between the inputs, unless some limiting resistance is used.
4. The output may be shorted to ground or either power supply. Temperature and/or supply voltages must be limited to ensure the maximum dissipation rating is not exceeded.
5. Maximum power dissipation is a function of T_J(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
6. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

		MIN	MAX	UNIT
V_{CC-}	Supply voltage	−5	−18	V
V_{CC+}	Supply voltage	5	18	V
T_A	Operating free-air temperature range	−40	85	°C

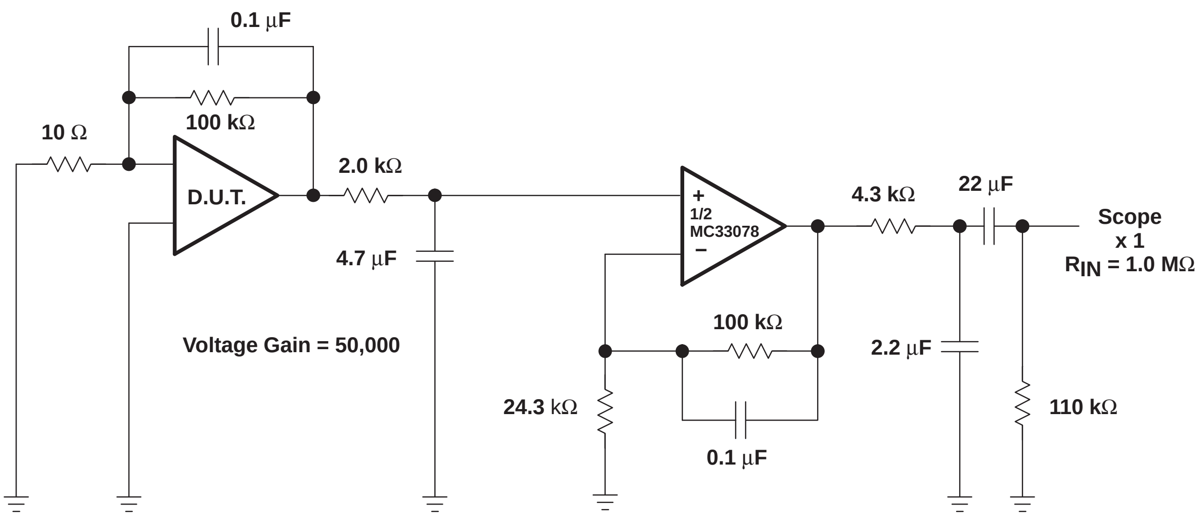
electrical characteristics, V_{CC-} = −15 V, V_{CC+} = 15 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
V_{IO}	Input offset voltage	V_O = 0, R_S = 10 Ω, V_{CM} = 0		T_A = 25°C		0.15	2	mV
				T_A = −40°C to 85°C			3	
αV_{IO}	Input offset voltage temperature coefficient	V_O = 0, R_S = 10 Ω, V_{CM} = 0		T_A = −40°C to 85°C		2		µV/°C
I_{IB}	Input bias current	V_O = 0,	V_{CM} = 0	T_A = 25°C		300	750	nA
				T_A = −40°C to 85°C			800	
I_{IO}	Input offset current	V_O = 0,	V_{CM} = 0	T_A = 25°C		25	150	nA
				T_A = −40°C to 85°C			175	
V_{ICR}	Common-mode input voltage range	ΔV_{IO} = 5 mV,	V_O = 0		±13	±14		V
A_{VD}	Large-signal differential voltage amplification	$R_L \geq$ 2 kΩ, V_O = ±10 V		T_A = 25°C	90	110		dB
				T_A = −40°C to 85°C	85			
V_{OM}	Maximum output voltage swing	V_{ID} = ±1 V	R_L = 600 Ω	V_{OM+}		10.7		V
				V_{OM-}		−11.9		
			R_L = 2k Ω	V_{OM+}	13.2	13.8		
				V_{OM-}	−13.2	−13.7		
			R_L = 10k Ω,	V_{OM+}	13.5	14.1		
				V_{OM-}	−14	−14.6		
CMMR	Common-mode rejection ratio	V_{IN} = ±13 V			80	100		dB
k_{SVR}†	Supply-voltage rejection ratio	V_{CC+} = 5 V to 15 V, V_{CC-} = −5 V to −15 V			80	105		dB
I_{OS}	Output short-circuit current	$\lvert V_{ID} \rvert$ = 1 V, Output to GND		(Source current)	15	29		mA
				(Sink current)	−20	−37		
I_{CC}	Supply current (per channel)	V_O = 0		T_A = 25°C		2.05	2.5	mA
				T_A = −40°C to 85°C			2.75	

† Measured with $V_{CC\pm}$ differentially varied at the same time

operating characteristics, V_{CC-} = −15 V, V_{CC+} = 15 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS			MIN	TYP	MAX	UNIT
SR	Slew rate at unity gain	A_{VD} = 1, V_{IN} = −10 V to 10 V, R_L = 2 kΩ, C_L = 100 pF			5	7		V/µs
GBW	Gain bandwidth product	f = 100 kHz			10	16		MHz
B_1	Unity gain frequency	open loop				9		MHz
	Gain margin	R_L = 2 kΩ	C_L = 0 pF			−11		dB
			C_L = 100 pF			−6		
ϕ_m	Phase margin	R_L = 2 kΩ	C_L = 0 pF			55		deg
			C_L = 100 pF			40		
	Amp-to-amp isolation	f = 20 Hz to 20 kHz				−120		dB
	Power bandwidth	V_O = 27 $V_{(PP)}$,	R_L = 2 kΩ,	THD ≤ 1%		120		kHz
THD	Total harmonic distortion	V_O = 3 V_{rms}, A_{VD} = 1, R_L = 2 kΩ, f = 20 Hz to 20 kHz				0.002		%
z_o	Open-loop output impedance	V_O = 0,	f = 9 MHz			37		Ω
r_{id}	Differential input resistance	V_{CM} = 0				175		kΩ
C_{id}	Differential input capacitance	V_{CM} = 0				12		pF
V_n	Equivalent input noise voltage	f = 1 kHz,	R_S = 100 Ω			4.5		nV/√Hz
I_n	Equivalent input noise current	f = 1 kHz				0.5		pA/√Hz



NOTE: All capacitors are non-polarized.

Figure 1. Voltage Noise Test Circuit (0.1 Hz to 10 Hz_{p-p})

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/Ball Finish	MSL Peak Temp [3]
MC33078D	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078DE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078DGKR	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078DGKRG4	ACTIVE	MSOP	DGK	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078DGKT	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078DGKTG4	ACTIVE	MSOP	DGK	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078DR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078DRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
MC33078P	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC33078PE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
MC33079D	PREVIEW	SOIC	D	14	50	TBD	Call TI	Call TI
MC33079DR	PREVIEW	SOIC	D	14	2500	TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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