AMC Doc. #: AMC2X44_D (LF)
Dec 2004

ADD MICROTECH CORP.

AMC2244/AMC2344/AMC2444

DUAL/Triple/QUAD LOW-POWER 60MHz UNITY-GAIN STABLE OP AMPLIFIERS

DESCRIPTION

The AMC2244/AMC2344/AMC2444 are dual, triple and quad versions of the high speed, low power, low cost monolithic operational amplifiers. These devices consume only 7mA of supply current per amplifier to achieve the performance of unity gain stable, 270V/µs slew rate and 60 MHz gain- bandwidth product.

The power supply operating range is from ±18V down to as low as ±2V. For single-supply operation, the AMC2244/AMC2344/AMC2444 operate from 36V down to 2.5V.

The AMC2244/AMC2344/AMC2444 also features an extremely wide output voltage swing. The maximum output voltage swing is ±13.8V with V_S = ±15V and R_L = 1000Ω. Furthermore, for single-supply operation at +5V, output voltage swing is from 0.2V to 3.9V with R_L = 500Ω.

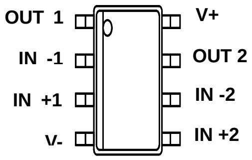
FEATURES

- **60MHz Gain-Bandwidth Product**
- **Low Supply Current, 7mA (per Amplifier) at V_S = ±15V**
- **Wide supply range, ±2V to ±18V dual-supply, 2.5V to 36V single-supply**
- **High slew rate = 270V/µs**
- **Fast Settling = 80 ns to 0.1 % for a 10V Step**
- **Low Differential Gain = 0.04% at A_V = +2, R_L = 150Ω**
- **Low Differential Phase = 0.15° at A_V = +2, R_L = 150Ω**
- Stable with unlimited capacitive load
- Wide output voltage swing, ±13.8V with V_S = ±15V, R_L = 1000Ω, and 3.9V/0.2V with V_S = +5V, R_L =500Ω
- Low cost, enhanced pin-pin Compatible to the **AD827/AD828/AD8073, EL2244/EL2444C & TSH72/TSH74/TSH112/TSH114 LT1229/LT1230**

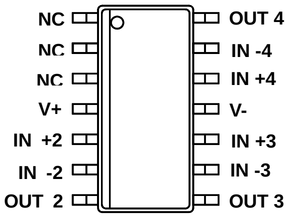
APPLICATIONS

- High Speed Sample-and-Hold
- High Speed Signal Processing
- ADC/DAC Buffer
- Video Amplifiers
- Active Filters/Integrators
- Pulse/RF Amplifiers
- STB(Set-up Box)

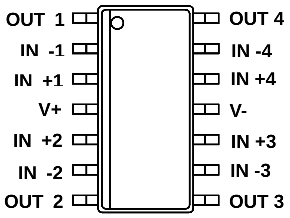
PACKAGE PIN OUT



AMC2244 (Dual)
8-Pin DIP /
8-Pin S.O.I.C.
(Top View)



AMC2344 (Triple)
14-Pin DIP /
14-Pin S.O.I.C.
(Top View)



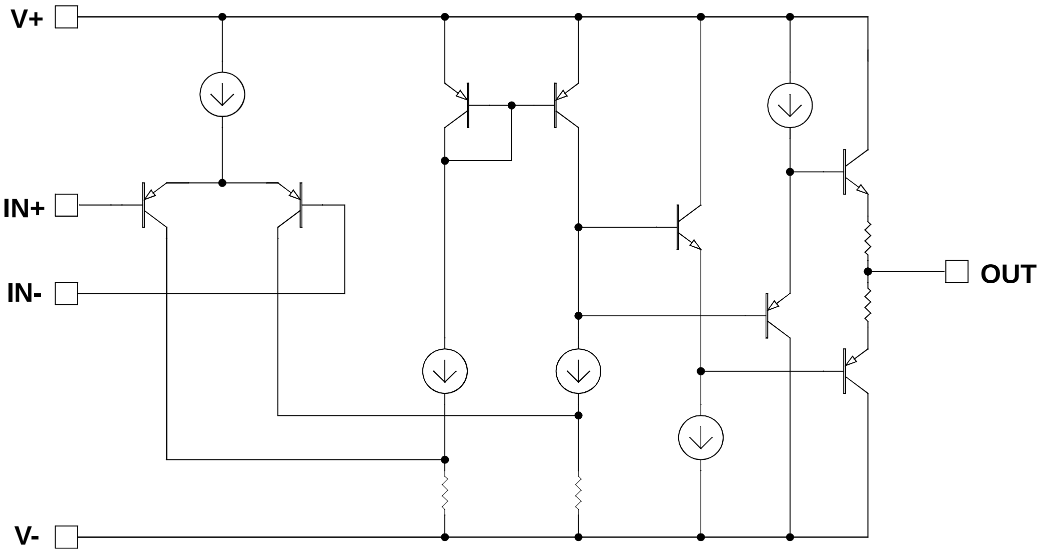
AMC2444 (Quad)
14-Pin DIP /
14-Pin S.O.I.C.
(Top View)

ORDER INFORMATION

T_A (°C)	**M**	Plastic DIP 8-Pin	**DM**	Plastic S.O.I.C. 8-Pin	**N**	Plastic DIP 14-Pin	**DM**	Plastic S.O.I.C. 14-Pin
0 to 70	**AMC2244M**		**AMC2244DM**		**AMC2344N/AMC2444N**		**AMC2344DM/AMC2444DM**	
	AMC2244MF(Lead Free)		**AMC2244DMF(Lead Free)**		**AMC2344NF(Lead Free)**		**AMC2344DMF/AMC2444DMF (Lead Free)**	

Note: 1.All surface-mount packages are available in Tape & Reel. Append the letter “T” to part number (i.e. AMC2244DMT、AMC2344DMT or AMC2444DMT).
2.The letter “F” is marked for Lead Free process as AMC2444NF、AMC2444DMF(Lead Free).

SIMPLIFIED SCHEMATIC (PER AMPLIFIER)



ABSOLUTE MAXIMUM RATINGS (Note 1)	
Supply Voltage, V_S	± 18V or 36V
Input Voltage, V_{IN}	± V_S
Differential Input Voltage, d V_{IN}	± 10V
Operating Junction Temperature Range, T_J (max)	150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (soldiering, 10 seconds)	260°C

Note 1: Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground. Currents are positive into, negative out of the specified terminal.

THERMAL DATA	
M PACKAGE:	
Thermal Resistance-Junction to Ambient, θ_{JA}	95°C /W
DM PACKAGE:	
Thermal Resistance-Junction to Tab, θ_{JT}	125°C /W
N PACKAGE:	
Thermal Resistance-Junction to Ambient, θ_{JA}	70°C /W
D PACKAGE:	
Thermal Resistance-Junction to Tab, θ_{JT}	110°C /W

Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
The θ_{JA} numbers are guidelines for the thermal performance of the device/pc-board system.
All of the above assume no ambient airflow.

DC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, these specifications apply the operating ambient temperatures T_A = 25°C, V_S = ± 15V, R_L = 1000Ω.

Parameter	Symbol	Test Conditions	AMC2244/2344/2444			Units
			Min	Typ	Max	
Input Offset Voltage	V_{OS}			0.5	4.0	mV
		T_A = 0°C - 70°C (Note 1)			9.0	
Average Offset Voltage Drift	TCV_{OS}			10.0		µV/°C
Input Bias Current	I_B	V_S = ± 15V		2.4	8.2	µA
		V_S = ± 5V		2.4		
Input Offset Current	I_{OS}	V_S = ± 15V		50	300	nA
		V_S = ± 5V			500	
Average Offset Current Drift	TCI_{OS}			0.3		nA/°C
Open-Loop Gain	A_{VOL}	V_S = ± 15V, V_{OUT} = ± 10V, R_L = 1000Ω	800	1500		V/V
		V_S = ± 5V, V_{OUT} = ± 2.5V, R_L = 500Ω		1200		
		V_S = ± 5V, V_{OUT} = ± 2.5V, R_L = 150Ω		1000		
Power Supply Rejection Ratio	PSRR	V_S = ± 5V to ± 15V	60	80		dB
Common Mode Rejection Ratio	CMRR	V_{CM} = ± 12V, V_{OUT} = 0V	70	90		dB
Common Mode Input Rang	CMIR	V_S = ± 15V		± 14.0		V
		V_S = ± 5V		± 4.2		
		V_S = + 5V		4.2/0.1		
Output Voltage Swing	V_{OUT}	V_S = ± 15V, R_L = 1000Ω	± 13.4	± 13.8		V
		V_S = ± 15V, R_L = 500Ω	± 12.2	± 13.6		
		V_S = ± 5V, R_L = 500Ω	± 3.4	± 3.9		
		V_S = ± 5V, R_L = 150Ω		± 3.6		
		V_S = + 5V, R_L = 500Ω	3.6/0.4	3.9/0.2		
Output Short Circuit Current	I_{SC}		40	75		mA
		T_A = 0°C - 70°C (Note 1)	35			
Supply Current	I_S	V_S = ± 15V, No Load		7.0	8.2	mA
		V_S = ± 5V, No Load		5.6		
Input Resistance	R_{IN}	Differential		150		kΩ
		Common-Mode		15		MΩ
Input Capacitance	C_{IN}	A_V = + 1 @ 10MHz		1.0		pF
Output Resistance	R_{OUT}	A_V = + 1		50		mΩ
Power Supply Operating Range	PSOR	Dual Supply	± 2.0		± 18.0	V
		Single Supply	2.5		36.0	

Note1: The parameter is guaranteed (but not tested) by design and characterization data.

AC ELECTRICAL CHARACTERISTICS

Unless otherwise specified, these specifications apply the operating ambient temperatures $T_A = 25°C$, $V_S = \pm 15V$, $A_V = +1$, $R_L = 1000\Omega$.

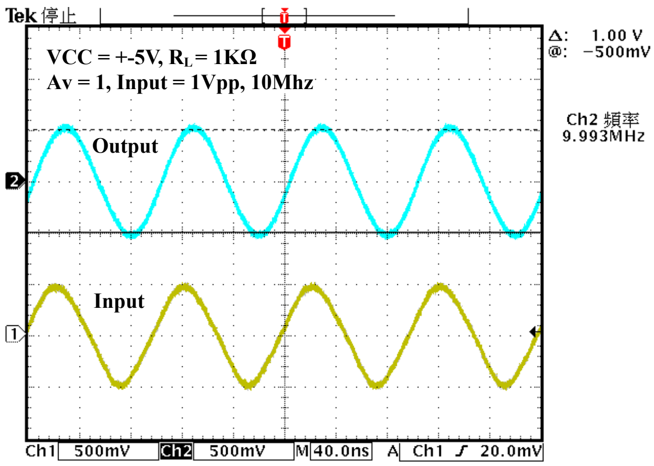
Parameter	Symbol	Test Conditions		AMC2244/2344/2444			Units
				Min	Typ	Max	
-3dB Bandwidth ($V_{OUT} = 0.4V$)	BW	$V_S = \pm 15V$,	$A_V = +1$		120		MHz
			$A_V = -1$		60		
			$A_V = +2$		60		
			$A_V = +5$		12		
			$A_V = +10$		6		
		$V_S = \pm 5V$,	$A_V = +1$		80		
Gain Bandwidth Product	GBWP	$V_S = \pm 15V$			60		MHz
		$V_S = \pm 5V$			45		
Phase Margin	PM	$R_L = 1\ k\Omega$, $C_L = 10\ pF$			50		°
Channel Separation		f = 5 MHz			85		dB
Slew Rate (Note 1)	SR	$V_S = \pm 15V$, $R_L = 1000\Omega$		208	270		V/μs
		$V_S = \pm 5V$, $R_L = 500\Omega$			166		
Full Power Bandwidth (Note 3)	FPBW	$V_S = \pm 15V$		3.33	4.3		MHz
		$V_S = \pm 5V$ (Note 2)			10.6		
Rise Time, Fall Time	t_r, t_f	0.1V Step			3.0		ns
Overshoot		0.1V Step			20		%
Propagation Delay	t_{PD}				2.5		ns
Settling Time (to 0.1%, $A_V = +1$)	t_s	$V_S = \pm 15V$, 10V Step			80		ns
		$V_S = \pm 5V$, 5V Step			60		
Differential Gain (Note 2, 4)	dG	NTSC/PAL			0.04		%
Differential Phase (Note 2, 4)	dP	NTSC/PAL			0.15		°
Input Noise Voltage (Note 2)	eN	10kHz			15.0		nV/√Hz
Input Noise Current (Note 2)	iN	10kHz			1.5		pA/√Hz

Note 1: Slew rate is measured on rising edge.
Note 2: The parameter is guaranteed (but not tested) by design and characterization data.
Note 3: For $V_S = \pm 15V$, $V_{OUT} = 20\ V_{PP}$. For $V_S = \pm 5V$, $V_{OUT} = 5\ V_{PP}$. Full power bandwidth is based on slew rate measurement using: $SR/(2\pi \times V_{PEAK})$
Note 4: Video performance measured at $V_S = \pm 15V$, $A_V = +2$ with 2 times normal video level across $R_L = 150\Omega$. This corresponds to standaard video levels across a back-terminal 75Ω load.

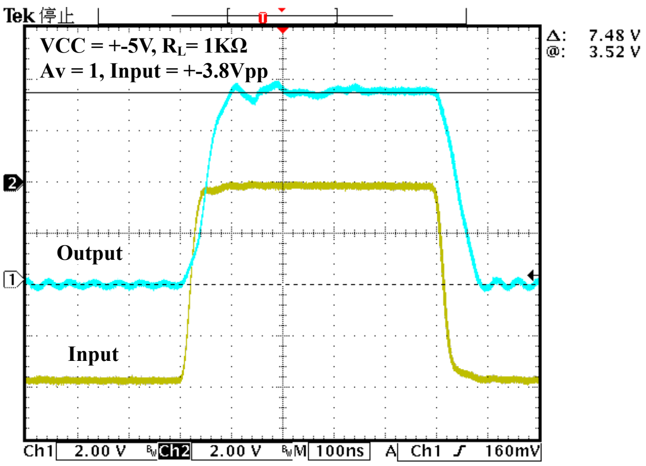
AMC2244/AMC2344/AMC2444

DUAL/TRIPLE/QUAD LOW-POWER 60MHz UNITY-GAIN STABLE OP AMPLIFIERS

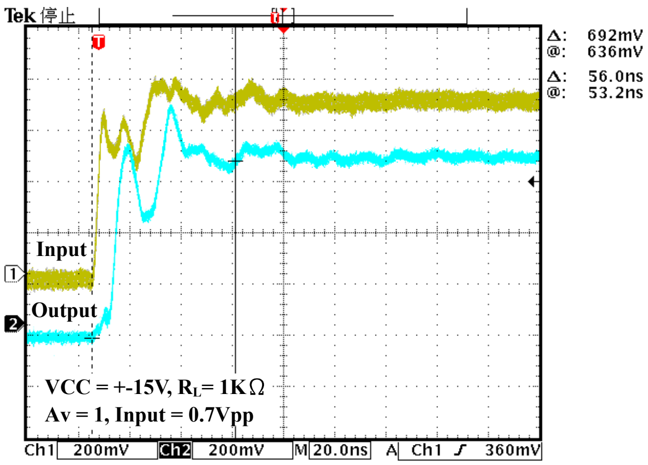
CHARACTERIZATION CURVES



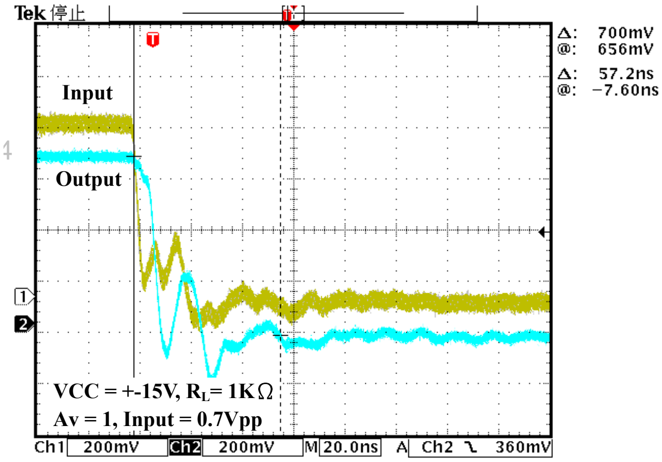
Unit Gain Stable Performance



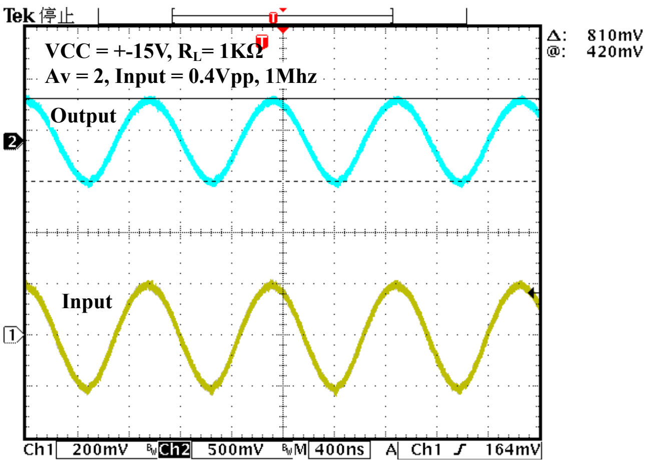
Output Voltage Swing at +-5V VCC



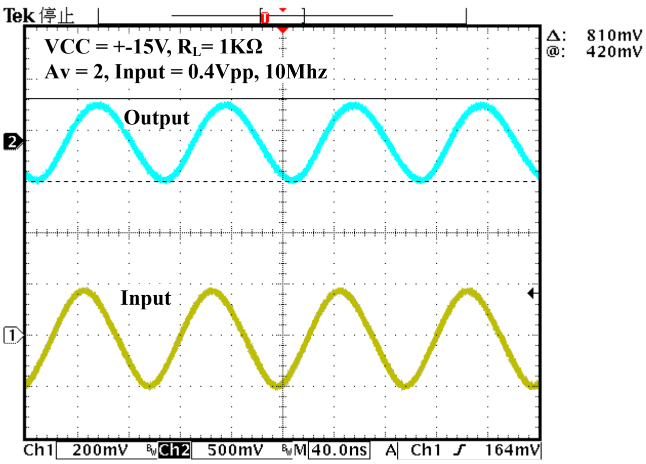
Output Rising Edge Performance



Output Falling Edge Performance

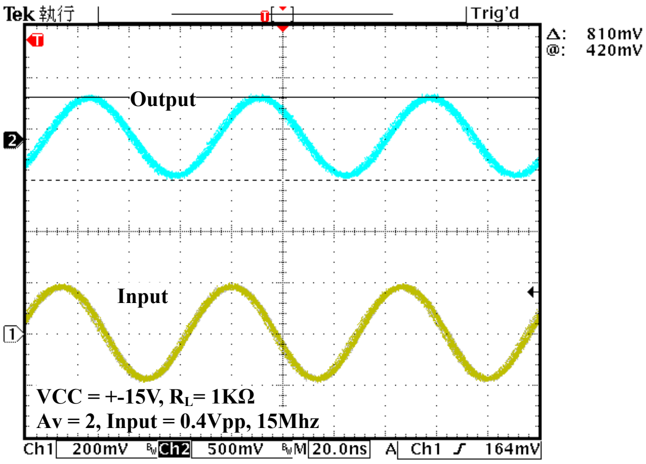


Output Swing at 1Mhz, Av=2

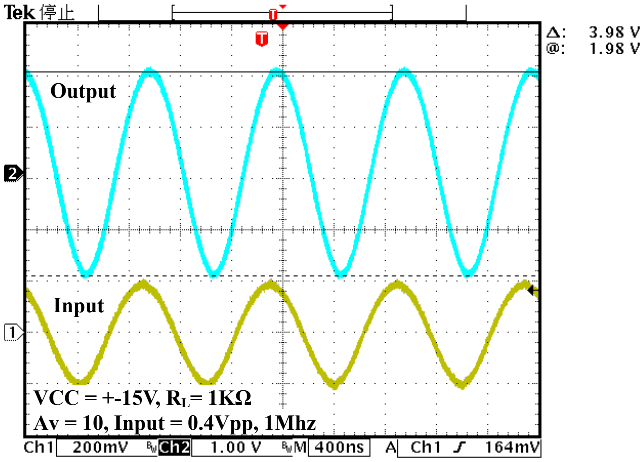


Output Swing at 10Mhz, Av=2

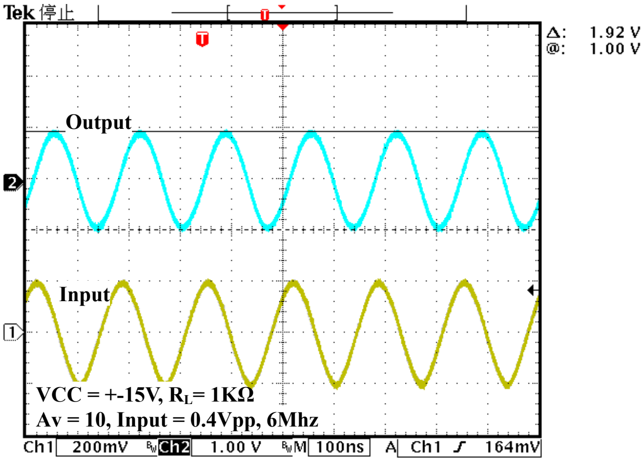
CHARACTERIZATION CURVE



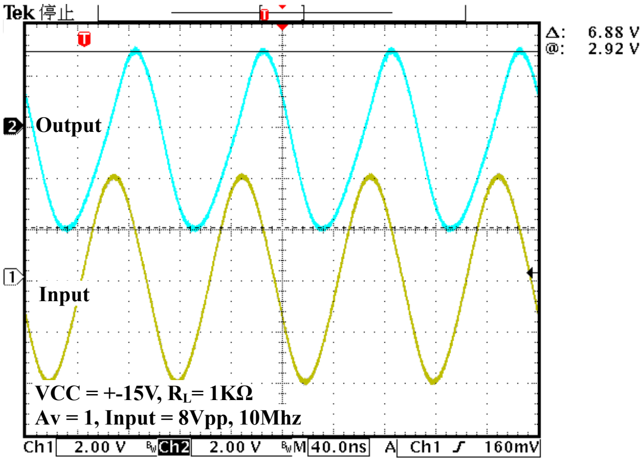
Output Swing at 15Mhz, Av=2



Output Swing at 1Mhz, Av=10



Output Swing at 6Mhz, Av=10



Large signal Output Swing aat 10Mhz, Av=1

APPLICATION INFORMATION

Product Description

The AMC2244/AMC2344/AMC2444 are low-power wideband monolithic operational amplifiers implemented with a classical voltage-feedback topology. This allows them to be used in a variety of applications where current-feedback amplifiers are not appropriate. For example, a capacitor to be placed in the feedback path, making it an excellent choice for applications such as active filters, sample-and-holds, or integrators. Similarly, because of the ability to use diodes in the feedback network, the AMC2244/AMC2344/AMC2444 are an excellent choice for applications such as fast log amplifiers.

Power Dissipation

In order to prevent the junction temperature to exceed 150°C , it is important to calculate the maximum junction temperature (T_{Jmax}) for all applications to determine if power-supply voltages, load conditions, or package type need to be modified such that the AMC2244/AMC2344/AMC2444 remain in the safe operating area. These parameters are related as follows:

$$T_{Jmax} = T_{max} + (\theta_{JA} \times \text{PDmaxtotal})$$

Where PDmaxtotal is the sum of the maximum power dissipation of each amplifier in the package (PDmax). PDmax for each amplifier can be calculated as follows :

$$\text{PDmax} = (2 \times V_S \times I_{Smax} + (V_S - V_{outmax}) \times (V_{outmax} / R_L))$$

where:
T_{max} =Maximum Ambient Temperature
θ_{JA} = Thermal Resistance of the Package
PDmax = Maximum Power Dissipation of 1 Amplifier
V_S = Supply Voltage
I_{Smax} = Maximum Supply Current of 1 Amplifier
V_{outmax} = Maximum Output Voltage Swing of the Application
R_L = Load Resistance

To serve as a guide for the user, we can calculate maximum allowable supply voltages for the example of the video cable-driver below since we know that T_{Jmax} = 150°C, T_{max} = 75°C, I_{Smax} = 8.2 mA, and the package θ_{JA}s are shown in Table 1. If we assume (for this example) that we are driving a back-terminated video cable, then the maximum average value (over duty-cycle) of V_{outmax} is 1.4V, and R_L = 150Ω, giving the results seen in Table 1.

Device	Package	θ_{JA}	PDmax @ T_{max}	Max V_S
AMC2244M	8P DIP	95°C /W	0.789W @ 75°C	±16.6V
AMC2244DM	8P SOIC	125°C /W	0.600W @ 75°C	±12.1V
AMC2344N/AMC2444N	14P DIP	70°C /W	1.071W @ 75°C	±11.5V
AMC2344D/AMC2444D	14P SOIC	110°C /W	0.682W @ 75°C	±7.5V

Table 1

Single Supply Operation

The AMC2244/AMC2344/AMC2444 have been designed to operate over a wide input and output voltage range. However, the AMC2244/AMC2344/AMC2444 are also suitable for single-supply operation. With a 5V supply and R_L = 500Ω, the output voltage swing is from 200mV to 3.9V, this results in a 3.7V output swing on a single 5V supply. The single supply operation range is from as high as 36V to 2.5V. For a single 2.5V supply application, the output swing can still have $1V_{PP}$.

Gain-Bandwidth Product and the-3 dB Bandwidth

The gain-bandwidth product of AMC2244/AMC2344/AMC2444 is 60 MHz while using only 7mA of supply current per amplifier. For gains greater than 4, their closed-loop –3 dB bandwidth is approximately equal to the gain-bandwidth

APPLICATION INFORMATION (CONTD.)

product divided by the noise gain of the circuit. For gains less than 4, higher-order poles in the amplifiers' transfer function contribute to even higher closed loop bandwidths. For example, the –3 dB bandwidth is 120 MHz at a gain of + 1, dropping to 60 MHz at a gain of +2.

Output Drive Capability

The AMC2244/AMC2344/AMC2444 have been designed to drive low impedance loads. The output swing can easily reach $6V_{PP}$ into a 150Ω load. This features the AMC2244/AMC2344/AMC2444 in the field of RF, IF and video applications. Furthermore, even at low temperatures, the current drive still remains a minimum of 35mA.

For signal transmission and distribution, a back-terminated cable (75Ω in series at the drive end, and 75Ω to ground at the receiving end) is preferred since the impedance match at both ends will absorb any reflections. However, when double termination is used, the received signal is halved; therefore a gain of 2 configuration is typically used to compensate for the attenuation.

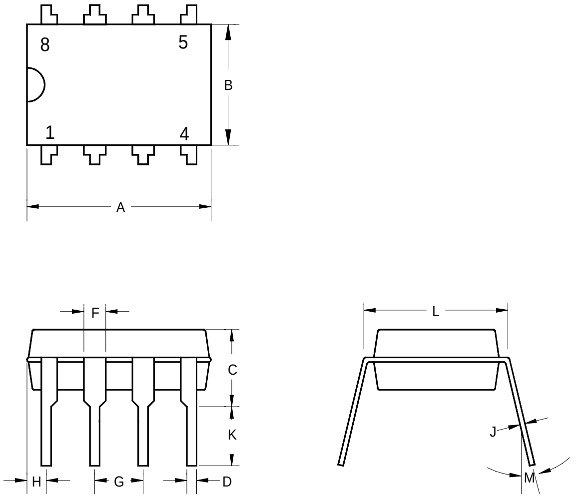
Capacitive Loads

While driving the capacitive loads, the AMC2244/AMC2344/AMC2444 remain stable by automatically reducing their gain-bandwidth product as capacitive load increases. Therefore, for maximum bandwidth, capacitive loads should be reduced as much as possible or isolated via a series output resistor (R_S). Similarly, coax lines can be driven, but best AC performance is obtained when they are terminated with their characteristic impedance so that the capacitance of the coaxial cable will not add to the capacitive load seen by the amplifier. Although stable with all capacitive loads, some peaking still occurs as load capacitance increases. A series resistor at the output can be used to reduce this peaking and further improve stability.

Printed-Circuit Layout

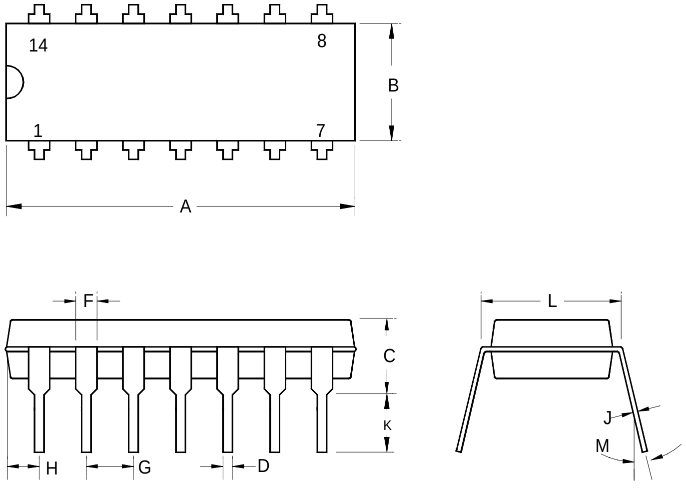
In most applications, good PCB layout is necessary for optimum performance. Ground-plane construction is highly recommended for good power supply bypassing. A 0.1 µF ceramic capacitor is recommended for bypassing both supplies. Lead lengths should be as short as possible, and bypass capacitors should be placed as close to the device pins as possible. For good AC performance, parasitic capacitances should be kept to a minimum at both inputs and at the output. Resistor values should be dept under 5 KΩbecause of the RC time constants associated with the parasitic capacitance. Metal-film and carbon resistors are both acceptable, use of wire-wound resistors is not recommended because of their parasitic inductance. Similarly, capacitors should be low-inductance foe best performance.

8-Pin Plastic DIP



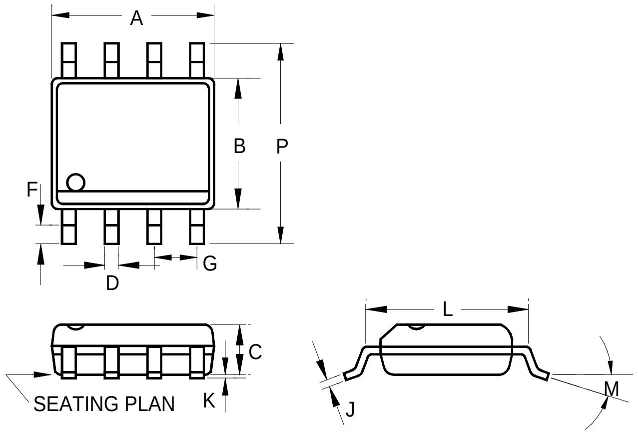
	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.355	0.365	0.400	9.02	9.27	10.16
B	0.240	0.250	0.280	6.10	6.35	7.11
C	-	-	0.210	-	-	5.33
D	-	0.018	-	-	0.46	-
F	-	0.060	-	-	1.52	-
G	-	0.100	-	-	2.54	-
H	0.050	-	0.090	1.27	-	2.29
J	0.008	-	0.015	0.20	-	0.38
K	0.115	0.130	0.150	2.92	3.30	3.81
L	0.300 BSC.			7.62 BSC.		
M	-	7º	15º	-	7º	15º

14-Pin Plastic DIP



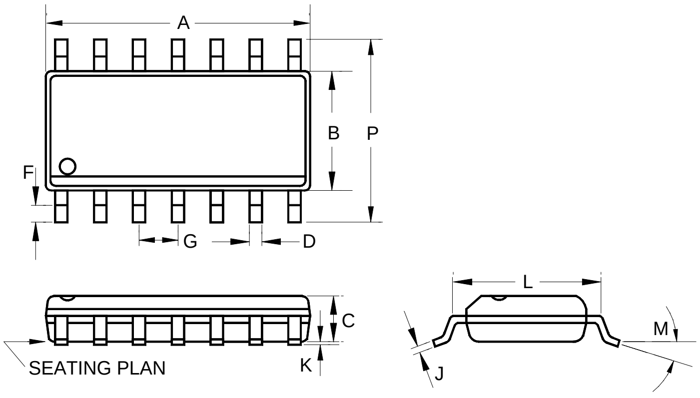
	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.730	-	0.810	18.54	-	20.57
B	0.240	-	0.260	6.09	-	6.60
C	-	-	0.200	-	-	5.08
D	0.015	-	0.020	0.38	-	0.51
F	0.03	-	0.060	0.76	-	1.52
G	0.100 BSC			2.54 BSC		
H	0.050	-	0.090	1.27	-	2.28
J	0.008	-	0.015	0.20	-	0.38
K	0.125	-	-	3.18	-	-
L	0.300 BSC			7.62 BSC		
M	-	-	15°	-	-	15°

8-Pin Plastic S.O.I.C.



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.183	-	0.202	4.65	-	5.13
B	0.144	-	0.163	3.66	-	4.14
C	0.068	-	0.074	1.73	-	1.88
D	0.010	-	0.020	0.25	-	0.51
F	0.015	-	0.035	0.38	-	0.89
G	0.050 BSC			1.27 BSC		
J	0.007	-	0.010	0.19	-	0.25
K	0.005	-	0.010	0.13	-	0.25
L	0.189	-	0.205	4.80	-	5.21
M	-	-	8º	-	-	8º
P	0.228	-	0.244	5.79	-	6.20

14-Pin Plastic S.O.I.C.



	INCHES			MILLIMETERS		
	MIN	TYP	MAX	MIN	TYP	MAX
A	0.337	-	0.344	8.55	-	8.75
B	0.144	-	0.163	3.66	-	4.14
C	0.068	-	0.074	1.73	-	1.88
D	0.017	-	0.020	0.35	-	0.51
F	0.016	-	0.044	0.40	-	1.12
G	0.050 BSC			1.27 BSC		
J	-	0.004		-	0.10	-
K	0.005	-	0.010	0.13	-	0.25
L	0.189	-	0.205	4.80	-	5.21
M	-	-	8º	-	-	8º
P	0.228	-	0.244	5.80	-	6.20

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