

# 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, and low cost monolithic operational amplifiers. These devices consume only 7mA of supply current per amplifier to achieve the performance of unity gain stable, 270V/ $\mu$ s slew rate and 60 MHz gain- bandwidth product.

The power supply operating range is from  $\pm 18V$  down to as low as  $\pm 2V$ . 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  $\pm 13.8V$  with  $V_S = \pm 15V$  and  $R_L = 1000\Omega$ . Furthermore, for single-supply operation at +5V, output voltage swing is from 0.2V to 3.9V with  $R_L = 500\Omega$ .

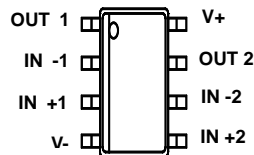
### FEATURES

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

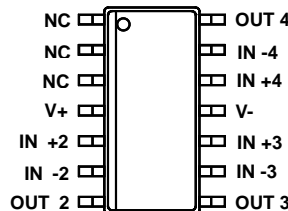
### APPLICATIONS

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

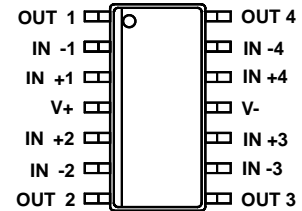
### PACKAGE PIN OUT



**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)



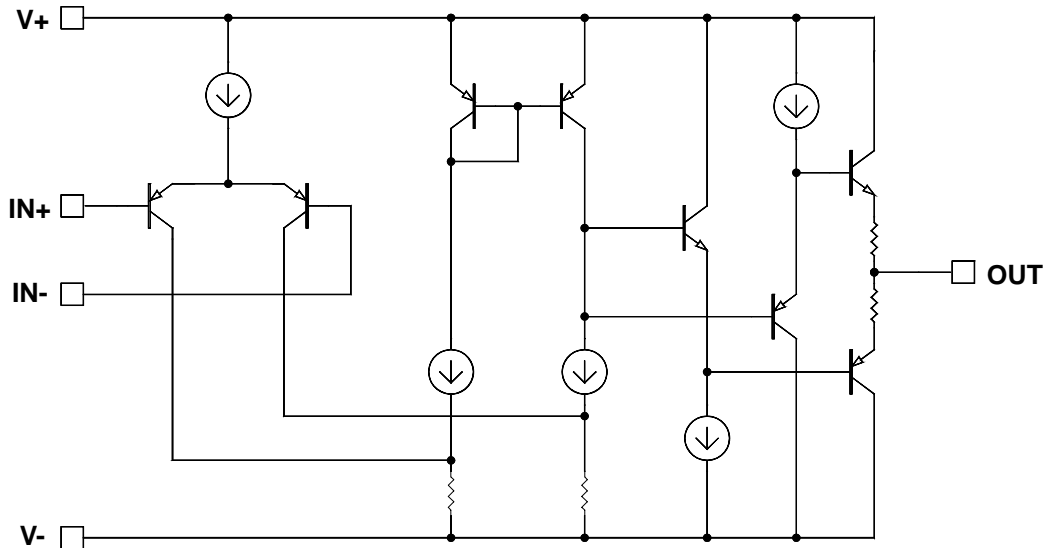
**AMC2444 (Quad)**  
14-Pin DIP /  
14-Pin S.O.I.C.  
(Top View)

### ORDER INFORMATION

T <sub>A</sub> (°C)	M	Plastic DIP	DM	Plastic S.O.I.C.	N	Plastic DIP	DM	Plastic S.O.I.C.
		8-Pin		8-Pin		14-Pin		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, $V_S$	$\pm 18V$ or $36V$
Input Voltage, $V_{IN}$	$\pm V_S$
Differential Input Voltage, $d V_{IN}$	$\pm 10V$
Operating Junction Temperature Range, $T_J$ (max)	$150^\circ C$
Storage Temperature Range	$-65^\circ C$ to $150^\circ C$
Lead Temperature (soldering, 10 seconds)	$260^\circ C$
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**

<b>M PACKAGE:</b>	
Thermal Resistance-Junction to Ambient, $\theta_{JA}$	$95^\circ C / W$
<b>DM PACKAGE:</b>	
Thermal Resistance-Junction to Tab, $\theta_{JT}$	$125^\circ C / W$
<b>N PACKAGE:</b>	
Thermal Resistance-Junction to Ambient, $\theta_{JA}$	$70^\circ C / W$
<b>D PACKAGE:</b>	
Thermal Resistance-Junction to Tab, $\theta_{JT}$	$110^\circ C / W$
Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$ .	
The $\theta_{JA}$ 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  $T_A = 25^\circ\text{C}$ ,  $V_S = \pm 15\text{V}$ ,  $R_L = 1000\Omega$ .

Parameter	Symbol	Test Conditions	AMC2244/2344/2444			Units
			Min	Typ	Max	
Input Offset Voltage	$V_{OS}$			0.5	4.0	mV
		$T_A = 0^\circ\text{C} - 70^\circ\text{C}$ (Note 1)			9.0	
Average Offset Voltage Drift	$TCV_{OS}$			10.0		$\mu\text{V}/^\circ\text{C}$
Input Bias Current	$I_B$	$V_S = \pm 15\text{V}$		2.4	8.2	$\mu\text{A}$
		$V_S = \pm 5\text{V}$		2.4		
Input Offset Current	$I_{OS}$	$V_S = \pm 15\text{V}$		50	300	nA
		$V_S = \pm 5\text{V}$			500	
Average Offset Current Drift	$TCI_{OS}$			0.3		$\text{nA}/^\circ\text{C}$
Open-Loop Gain	$A_{VOL}$	$V_S = \pm 15\text{V}$ , $V_{OUT} = \pm 10\text{V}$ , $R_L = 1000\Omega$	800	1500		V/V
		$V_S = \pm 5\text{V}$ , $V_{OUT} = \pm 2.5\text{V}$ , $R_L = 500\Omega$		1200		
		$V_S = \pm 5\text{V}$ , $V_{OUT} = \pm 2.5\text{V}$ , $R_L = 150\Omega$		1000		
Power Supply Rejection Ratio	PSRR	$V_S = \pm 5\text{V}$ to $\pm 15\text{V}$	60	80		dB
Common Mode Rejection Ratio	CMRR	$V_{CM} = \pm 12\text{V}$ , $V_{OUT} = 0\text{V}$	70	90		dB
Common Mode Input Rang	CMIR	$V_S = \pm 15\text{V}$		$\pm 14.0$		V
		$V_S = \pm 5\text{V}$		$\pm 4.2$		
		$V_S = +5\text{V}$		4.2/0.1		
Output Voltage Swing	$V_{OUT}$	$V_S = \pm 15\text{V}$ , $R_L = 1000\Omega$	$\pm 13.4$	$\pm 13.8$		V
		$V_S = \pm 15\text{V}$ , $R_L = 500\Omega$	$\pm 12.2$	$\pm 13.6$		
		$V_S = \pm 5\text{V}$ , $R_L = 500\Omega$	$\pm 3.4$	$\pm 3.9$		
		$V_S = \pm 5\text{V}$ , $R_L = 150\Omega$		$\pm 3.6$		
		$V_S = +5\text{V}$ , $R_L = 500\Omega$	3.6/0.4	3.9/0.2		
Output Short Circuit Current	$I_{SC}$		40	75		mA
		$T_A = 0^\circ\text{C} - 70^\circ\text{C}$ (Note 1)	35			
Supply Current	$I_S$	$V_S = \pm 15\text{V}$ , No Load		7.0	8.2	mA
		$V_S = \pm 5\text{V}$ , No Load		5.6		
Input Resistance	$R_{IN}$	Differential		150		k $\Omega$
		Common-Mode		15		M $\Omega$
Input Capacitance	$C_{IN}$	$A_V = +1$ @ 10MHz		1.0		pF
Output Resistance	$R_{OUT}$	$A_V = +1$		50		m $\Omega$
Power Supply Operating Range	PSOR	Dual Supply	$\pm 2.0$		$\pm 18.0$	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  $T_A = 25^\circ\text{C}$ ,  $V_S = \pm 15\text{V}$ ,  $A_V = +1$ ,  $R_L = 1000\Omega$ .

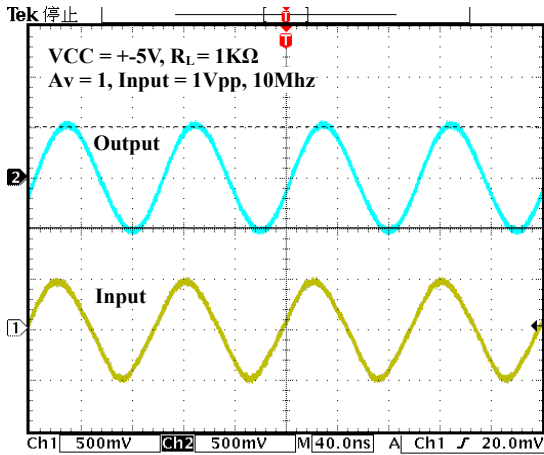
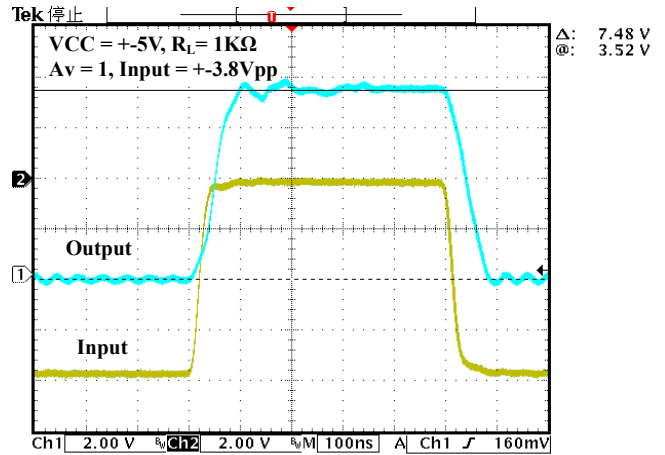
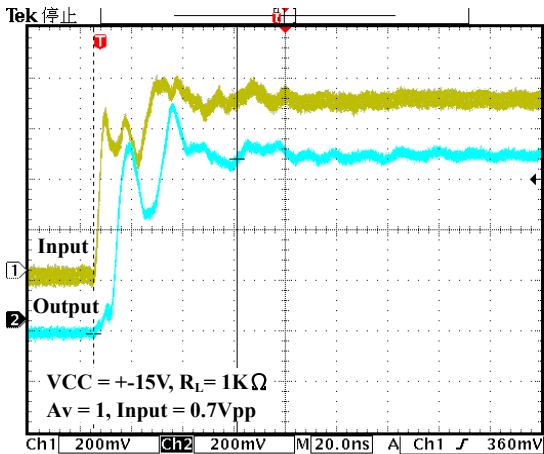
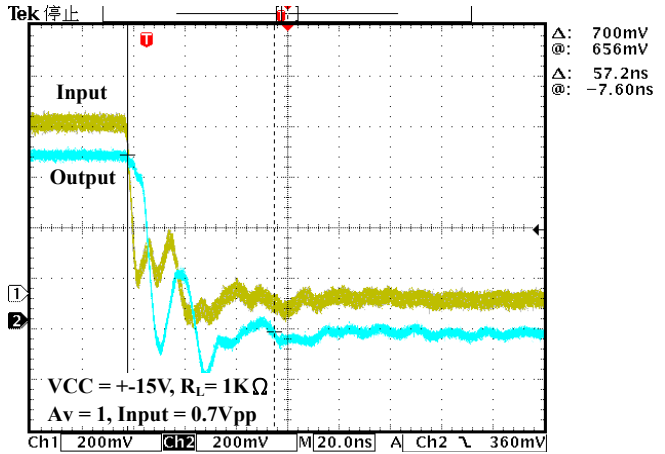
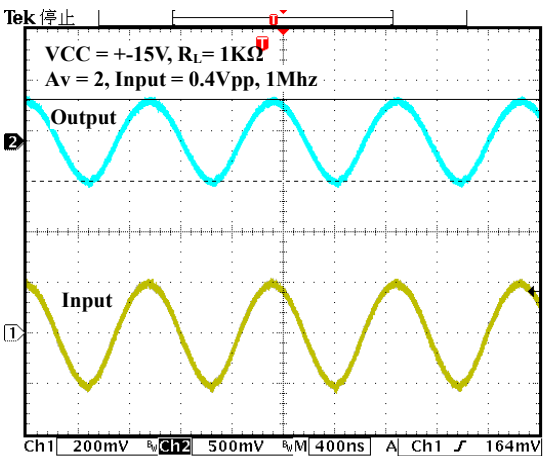
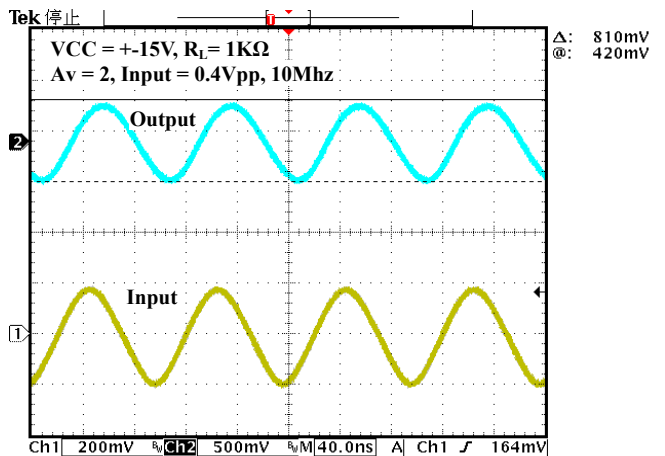
Parameter	Symbol	Test Conditions	AMC2244/2344/2444			Units	
			Min	Typ	Max		
-3dB Bandwidth ( $V_{OUT} = 0.4\text{V}$ )	BW	$V_S = \pm 15\text{V}$ ,	$A_V = +1$		120		MHz
			$A_V = -1$		60		
			$A_V = +2$		60		
			$A_V = +5$		12		
			$A_V = +10$		6		
		$V_S = \pm 5\text{V}$ ,	$A_V = +1$		80		
Gain Bandwidth Product	GBWP	$V_S = \pm 15\text{V}$		60		MHz	
		$V_S = \pm 5\text{V}$		45			
Phase Margin	PM	$R_L = 1\text{ k}\Omega$ , $C_L = 10\text{ pF}$		50		$^\circ$	
Channel Separation		$f = 5\text{ MHz}$		85		dB	
Slew Rate (Note 1)	SR	$V_S = \pm 15\text{V}$ , $R_L = 1000\Omega$	208	270		V/ $\mu\text{s}$	
		$V_S = \pm 5\text{V}$ , $R_L = 500\Omega$		166			
Full Power Bandwidth (Note 3)	FPBW	$V_S = \pm 15\text{V}$	3.33	4.3		MHz	
		$V_S = \pm 5\text{V}$ (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%, $A_V = +1$ )	$t_s$	$V_S = \pm 15\text{V}$ , 10V Step		80		ns	
		$V_S = \pm 5\text{V}$ , 5V Step		60			
Differential Gain (Note 2, 4)	dG	NTSC/PAL		0.04		%	
Differential Phase (Note 2, 4)	dP	NTSC/PAL		0.15		$^\circ$	
Input Noise Voltage (Note 2)	eN	10kHz		15.0		nV/ $\sqrt{\text{Hz}}$	
Input Noise Current (Note 2)	iN	10kHz		1.5		pA/ $\sqrt{\text{Hz}}$	

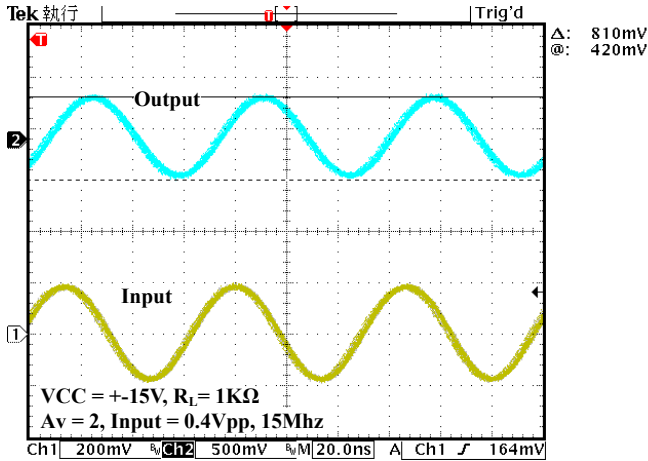
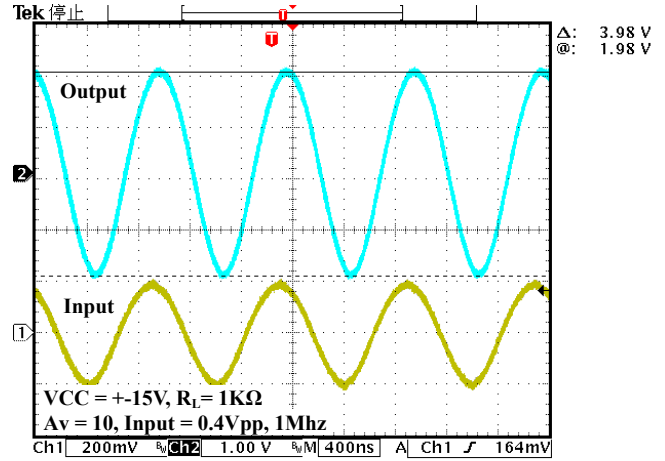
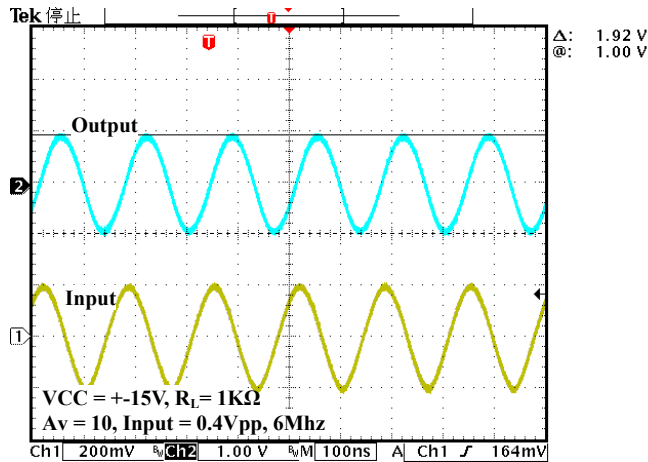
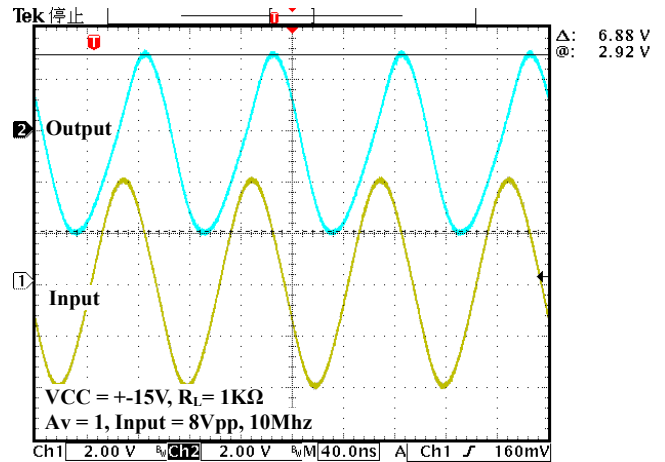
Note 1: Slew rate is measured on rising edge.

Note 2: The parameter is guaranteed (but not tested) by design and characterization data.

Note 3: For  $V_S = \pm 15\text{V}$ ,  $V_{OUT} = 20\text{ VPP}$ . For  $V_S = \pm 5\text{V}$ ,  $V_{OUT} = 5\text{ VPP}$ . Full power bandwidth is based on slew rate measurement using:  $\text{SR}/(2\pi \times V_{PEAK})$

Note 4: Video performance measured at  $V_S = \pm 15\text{V}$ ,  $A_V = +2$  with 2 times normal video level across  $R_L = 150\Omega$ . This corresponds to standard video levels across a back-terminal  $75\Omega$  load.

**CHARACTERIZATION CURVES**

**Unit Gain Stable Performance**

**Output Voltage Swing at +5V VCC**

**Output Rising Edge Performance**

**Output Falling Edge Performance**

**Output Swing at 1Mhz,  $A_v=2$** 

**Output Swing at 10Mhz,  $A_v=2$**

**CHARACTERIZATION CURVE**

**Output Swing at 15Mhz,  $A_v=2$** 

**Output Swing at 1Mhz,  $A_v=10$** 

**Output Swing at 6Mhz,  $A_v=10$** 

**Large signal Output Swing at 10Mhz,  $A_v=1$**

## 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:

$$T_{Jmax} = T_{max} + (\theta_{JA} \times PD_{maxtotal})$$

Where  $PD_{maxtotal}$  is the sum of the maximum power dissipation of each amplifier in the package ( $PD_{max}$ ).

$PD_{max}$  for each amplifier can be calculated as follows :

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

where:

$T_{max}$  = Maximum Ambient Temperature

$\theta_{JA}$  = Thermal Resistance of the Package

$PD_{max}$  = 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  $T_{Jmax} = 150^\circ\text{C}$ ,  $T_{max} = 75^\circ\text{C}$ ,  $I_{Smax} = 8.2 \text{ mA}$ , and the package  $\theta_{JA}$ 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  $R_L = 150\Omega$ , giving the results seen in Table 1.

**Table 1**

Device	Package	$\theta_{JA}$	$PD_{max} @ T_{max}$	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

**APPLICATION INFORMATION (CONTD.)****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  $R_L = 500\Omega$ , 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<sub>pp</sub>.

**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 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<sub>pp</sub> 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.

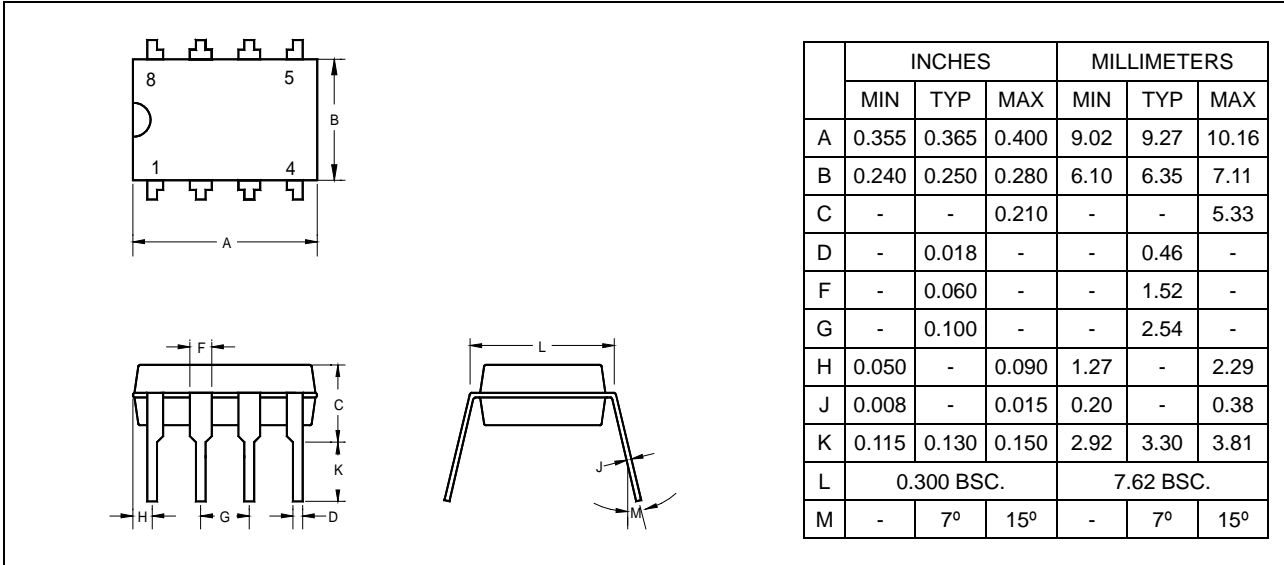
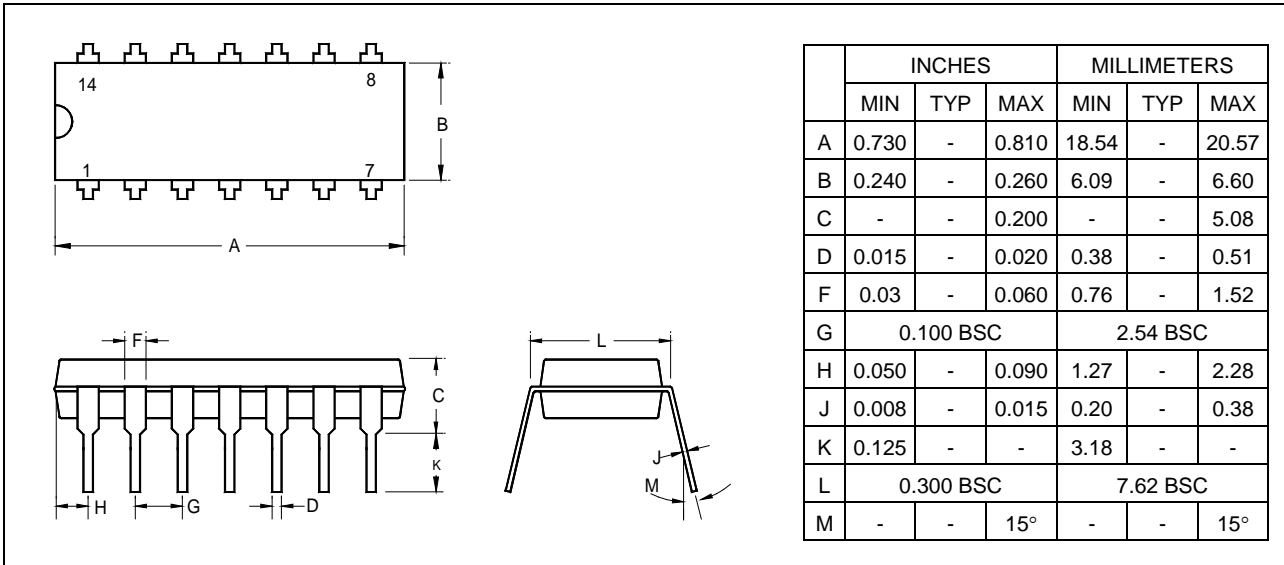
**Capacitive Loads**

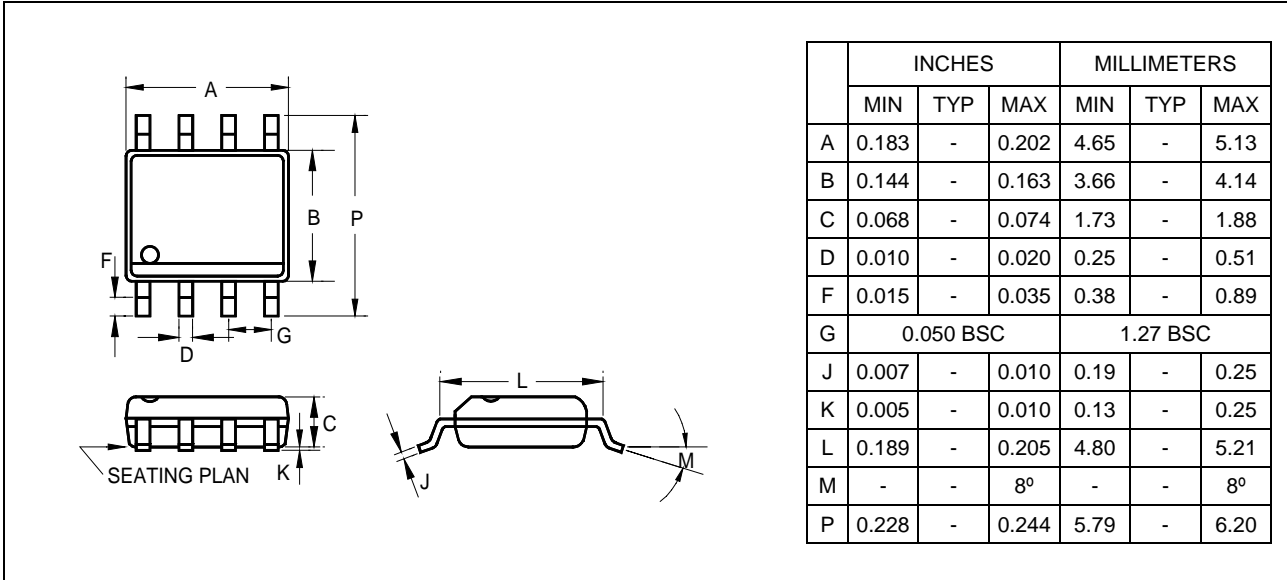
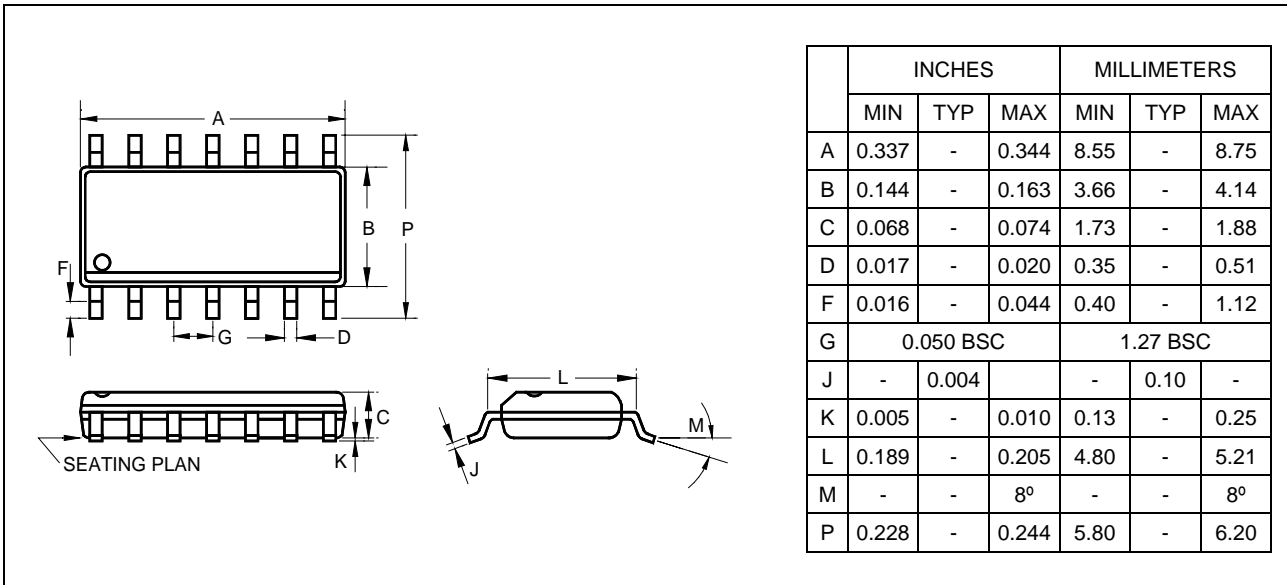
While driving the capacitive loads, the AMC2244/AMC2344/AMC2444 remain stable by automatically reducing their gain-bandwidth product as capacitive load increases. Therefore, for maximum bandwidth, capacitive loads should be reduced as much as possible or isolated via a series output resistor ( $R_S$ ). 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 kept under 5 KΩ because 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 for best performance.



**PACKAGE**
**8-Pin Plastic DIP**

**14-Pin Plastic DIP**


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

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


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