Programmable Quad Operational Amplifiers

GENERAL DESCRIPTION

The XR-146 family of quad operational amplifiers contain four independent high-gain, low-power, programmable op-amps on a monolithic chip. The use of external bias setting resistors permit the user to program gain-bandwidth product, supply current, input bias current, input offset current, input noise and the slew rate.

The basic XR-146 family of circuits offer partitioned programming of the internal op-amps where one setting resistor is used to set the bias levels in the three op-amps, and a second bias setting is used for the remaining op-amp. Its modified version, the XR-346-2 provides a separate bias setting resistor for each of the two op-amp pairs.

FEATURES

Programmable
Micropower operation
Low noise
Wide power supply range
Class AB output
Ideal pin out for biquad active filters
Overload protection for input and output
Internal frequency compensation

APPLICATIONS

Total Supply Current = 1.4 mA (I_{SET}/10 μA)
Gain Bandwidth Product = 1 MHz (I_{SET}/10μA)
Slew Rate = 0.4V/μs (I_{SET}/10 μA)
Input Bias Current $\cong$50 nA (I_{SET}/10 μA)

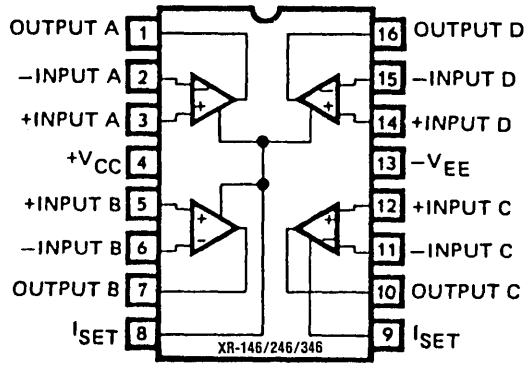
I_{SET} = Current into pin 8, pin 9 (see schematic)

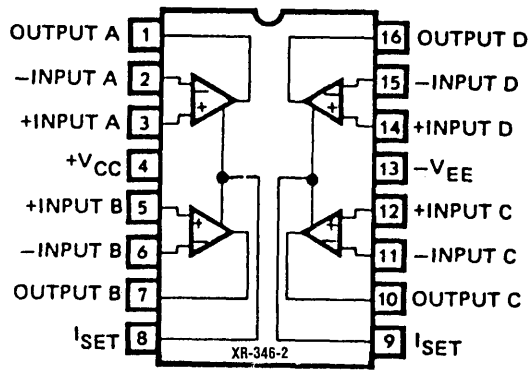
$$I_{SET} = \frac{V+ - V- - 0.6V}{R_{SET}}$$

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	
XR-146	±22V
XR-246/346	±18V
Differential Input Voltage (Note 1)	
XR-146/246/346	±30V
Common Mode Input Voltage (Note 1)	
XR-146/246/346	±15V
Power Dissipation (Note 2)	
XR-146	900 mW
XR-246/346	500 mW
Output Short Circuit Duration (Note 3)	
XR-146/246/346	Indefinite
Maximum Junction Temperature	
XR146	150°C
XR-246	110°C
XR-346	100°C

FUNCTIONAL BLOCK DIAGRAMS





ABSOLUTE MAXIMUM RATINGS (continued)

Storage Temperature Range	
XR-146/246/346	−65°C to +150°C

ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-146M	Ceramic	−55°C to +125°C
XR-246N	Ceramic	−25°C to +85°C
XR-246P	Plastic	−25°C to +85°C
XR-346/ 346-2CN	Ceramic	0°C to +70°C
XR-346/ 346-2CP	Plastic	0°C to +70°C

ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_S = ±15V, I_{SET} = 10 μA)

PARAMETERS	XR-146			XR-246/346			UNITS	CONDITIONS
	MIN	TYP	MAX	MIN	TYP	MAX		
Input Offset Voltage		0.5	5		0.5	6	mV	V_{CM} = 0V, $R_S \leq 50\Omega$
Input Offset Current		2	20		2	100	nA	V_{CM} = 0V
Input Bias Current		50	100		50	250	nA	V_{CM} = 0V
Supply Current (4 Op-Amps)		1.4	2.0		1.4	2.5	mA	
Large Signal Voltage Gain	100	1000		50	1000		V/mV	R_L = 10 kΩ, ΔV_{OUT} = ±10V
Input CM Range	±13.5	±14		±13.5	±14		V	
CM Rejection Ratio	80	100		70	100		dB	$R_S \leq$ 10 kΩ
Power Supply Rejection Ratio	80	100		74	100		dB	$R_S \leq$ 10 kΩ
Output Voltage Swing	±12	±14		±12	±14		V	$R_L \leq$ 10 kΩ
Short-Circuit Current	5	20	30	5	20	30	mA	
Gain Bandwidth Product	0.8	1.2		0.5	1.2		MHz	
Phase Margin		60			60		Deg	
Slew Rate		0.4			0.4		V/μs	
Input Noise Voltage		28			28		nV/√Hz	f = 1 kHz
Channel Separation		120			120		dB	R_L = 10 kΩ, ΔV_{OUT} = 0V to +12V
Input Resistance		1.0			1.0		MΩ	
Input Capacitance		2.0			2.0		pF	

The following specifications apply over the Maximum Operating Temperature Range

Input Offset Voltage		0.5	6		0.5	7.5	mV	V_{CM} = 0V, $R_S \leq 50\Omega$
Input Offset Current		2	25		2	100	nA	V_{CM} = 0V
Input Bias Current		50	100		50	250	nA	V_{CM} = 0V
Supply Current (4 Op-Amps)		1.5	2.0		1.5	2.5	mA	
Large Signal Voltage Gain	50	1000		25	1000		V/mV	R_L = 10 kΩ, ΔV_{OUT} = ±10V
Input CM Range	±13.5	±14		±13.5	±14		V	
CM Rejection Ratio	70	100		70	100		dB	$R_S \leq 50\Omega$
Power Supply Rejection Ratio	76	100		74	100		dB	$R_S \leq 50\Omega$
Output Voltage Swing	±12	±14		±12	±14		V	$R_L \geq$ 10 kΩ

ELECTRICAL CHARACTERISTICS (T_A = 25°C, V_S = ±15V, I_{SET} = 1 μA)

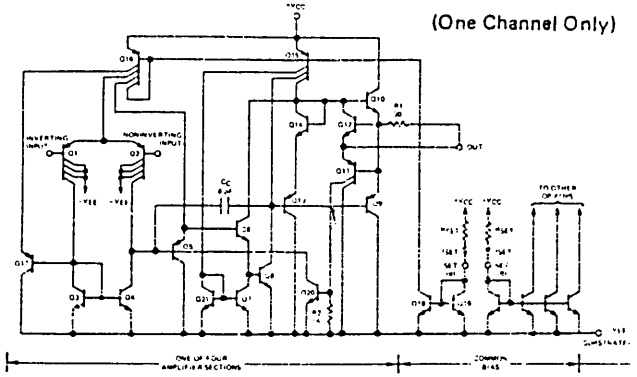
Input Offset Voltage		0.5	5		0.5	6	mV	V_{CM} = 0V, $R_S \leq 50\Omega$
Input Bias Current		7.5	20		7.5	100	nA	V_{CM} = 0V
Supply Current (4 Op-Amps)		140	250		140	300	μA	
Gain Bandwidth Product	80	100		50	100		kHz	

ELECTRICAL CHARACTERISTICS (T_A = +25°C, V_S = ±1.5V, I_{SET} = 10 μA)

Input Offset Voltage		0.5	5		0.5	7	mV	V_{CM} = 0V, $R_S \leq 50\Omega$
Input CM Range	±0.7			±0.7			V	
CM Rejection Ratio		80			80		dB	$R_S \leq 50\Omega$
Output Voltage Swing	±0.6			±0.6			V	$R_L \geq$ 10 kΩ

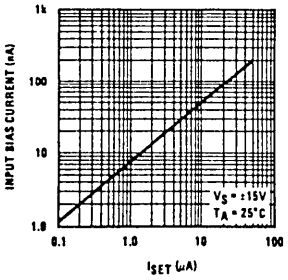
EQUIVALENT SCHEMATIC DIAGRAM

(One Channel Only)

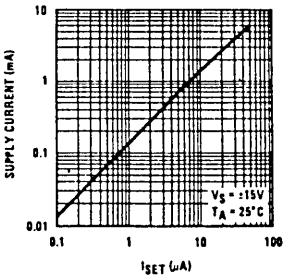


TYPICAL PERFORMANCE CHARACTERISTICS

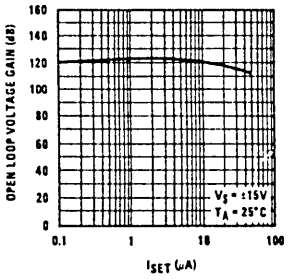
Input Bias Current vs I_{SET}



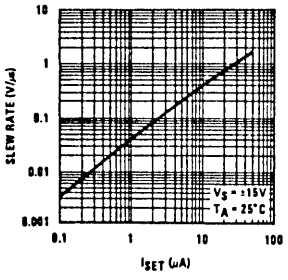
Supply Current vs I_{SET}



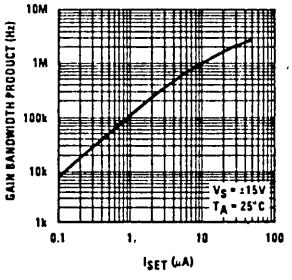
Open Loop Voltage Gain vs I_{SET}



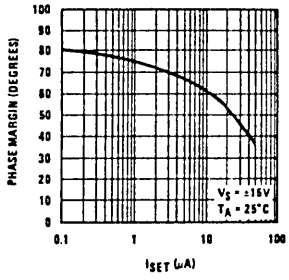
Slew Rate vs I_{SET}



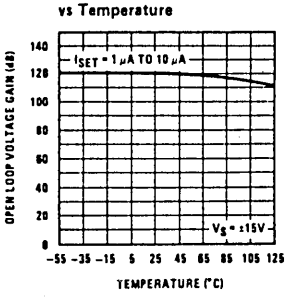
Gain Bandwidth Product vs I_{SET}



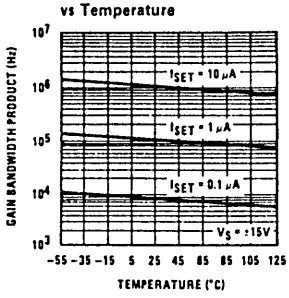
Phase Margin vs I_{SET}



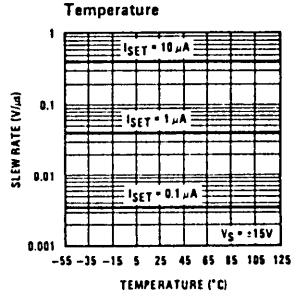
Open Loop Voltage Gain vs Temperature



Gain Bandwidth Product vs Temperature

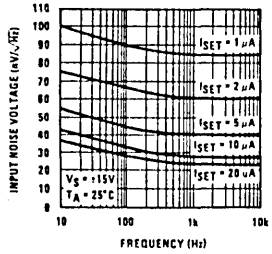


Slew Rate vs Temperature

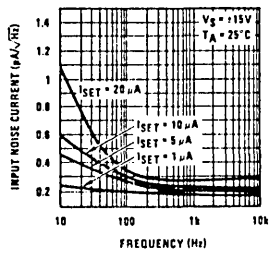


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

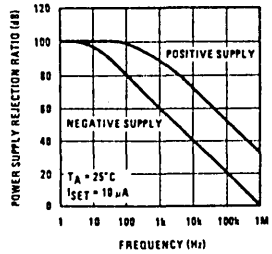
Input Noise Voltage vs Frequency



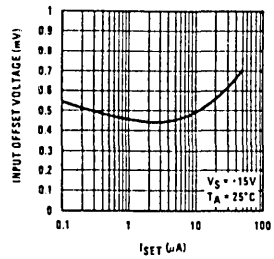
Input Noise Current vs Frequency



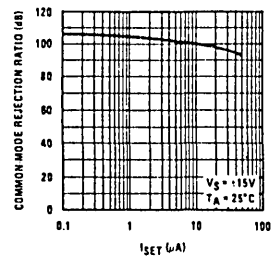
Power Supply Rejection Ratio vs Frequency



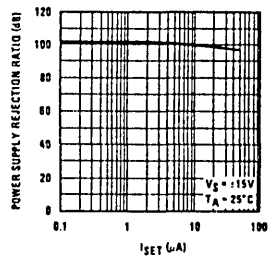
Input Offset Voltage vs I_{SET}



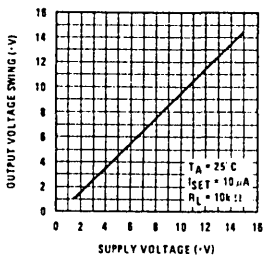
Common-Mode Rejection Ratio vs I_{SET}



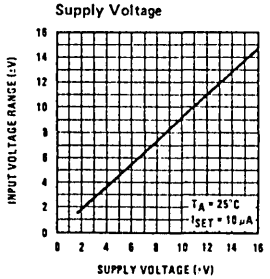
Power Supply Rejection Ratio vs I_{SET}



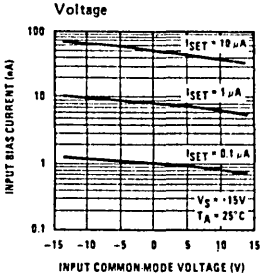
Output Voltage Swing vs Supply Voltage



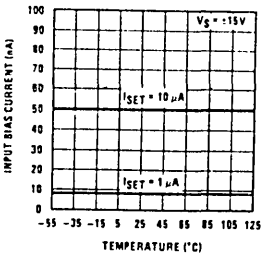
Input Voltage Range vs Supply Voltage



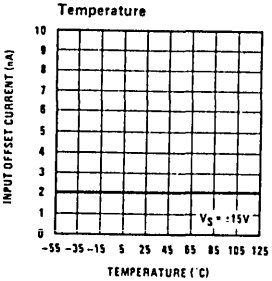
Input Bias Current vs Input Common-Mode Voltage



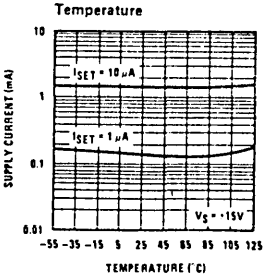
Input Bias Current vs Temperature



Input Offset Current vs Temperature



Supply Current vs Temperature



Note 1: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 2: The maximum power dissipation for these devices must be derated at elevated temperatures and is dictated by T_{jMAX}, θjA, and the ambient temperature, T_A. The maximum available power dissipation at any temperature is $P_d = (T_{jMAX} - T_A)/\theta jA$ or the 25°C P_{dMAX}, whichever is less.

Note 3: Any of the amplifier outputs can be shorted to ground indefinitely; however, more than one should be simultaneously shorted as the maximum junction temperature will be exceeded.