

## Quad Operational Amplifiers

### GENERAL DESCRIPTION

The XR-3403 and XR-3503 are quad operational amplifiers specifically designed for single supply operation. All four amplifiers are similar in characteristics to industry standard op amps like the 741. The XR-3403 is available in both ceramic and plastic packages; the XR-3503 is available in a 14 pin ceramic package with guaranteed performances across the military temperature range.

### FEATURES

- Short Circuit Protected Outputs
- Class AB Output Stage for Minimal Crossover Distortion
- True Differential Input Stage
- Single Supply Operation: 3.0 to 36 Volts
- Split Supply Operation:  $\pm 1.5$  to  $\pm 18$  Volts
- Low Input Bias Currents: 500 nA Max
- Four Amplifiers per Package
- Internally Compensated
- Similar Performance to Popular 741
- Direct Pin-for-Pin Replacement for MC3403/3503, LM324 and RC4137

### APPLICATIONS

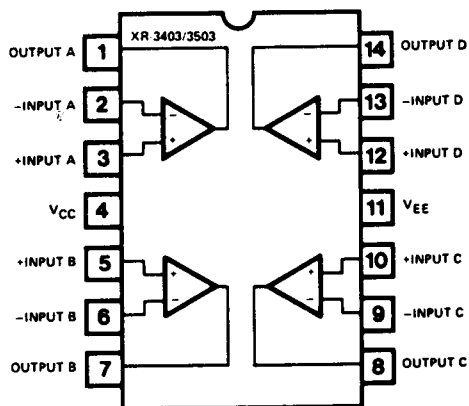
- Buffer Amplifiers
- Summing/Differencing Amplifiers
- Instrumentation Amplifiers
- Active Filters
- Signal Processing
- Sample and Differencing
- I to V Converters
- Integrators
- Simulated Components
- Analog Computers

### ABSOLUTE MAXIMUM RATINGS

Power Supply Voltages	
Single Supply	36V
Split Supplies	$\pm 18V$
Input Differential Voltage Range with Split Power Supply	$\pm 30V$
Input Common Mode Voltage Range*	$\pm 15V$
Package Power Dissipation:	
Plastic Package	625 mW
Derate above $T_A = +25^\circ C$	5.0 mW/ $^\circ C$
Ceramic Package	750 mW
Derate above $T_A = +25^\circ C$	6.0 mW/ $^\circ C$
Storage Temperature Range	$-65^\circ C$ to $+150^\circ C$

\*For Supply Voltage less than  $\pm 15V$ , the absolute maximum input voltage is equal to the supply voltage.

### FUNCTIONAL BLOCK DIAGRAM



### ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-3503M	Ceramic	$-55^\circ C$ to $+125^\circ C$
XR-3403CN	Ceramic	$0^\circ C$ to $+70^\circ C$
XR-3403CP	Plastic	$0^\circ C$ to $+70^\circ C$

### SYSTEM DESCRIPTION

The XR-3403 is an array of four independent operational amplifiers, each with true differential inputs. The device has electrical characteristics similar to the popular 741. However, the XR-3403 has several distinct advantages over standard operational amplifier types in single supply applications. The XR-3403 can operate at supply voltages as low as 3.0 volts or as high as 36 volts with quiescent currents about one-fifty of those associated with the 741 (on a per amplifier basis). The common mode input range includes the negative supply, thereby eliminating the necessity for external biasing components in many applications. The output voltage range also includes the negative power supply voltage.

# XR-3403/3503

## ELECTRICAL CHARACTERISTICS

Test Conditions:  $V_{CC} = +15V$ ,  $V_{EE} = 15V$ ,  $T_A = +25^\circ C$  unless otherwise noted.

PARAMETERS	XR-3503M			XR-3403C			UNITS	CONDITIONS
	MIN	TYP	MAX	MIN	TYP	MAX		
Input Offset Voltage		2.0	5.0 6.0		2.0	10 12	mV	$T_A = T_{high}$ to $T_{low}$ <sup>1</sup>
Input Offset Current		30	50 200		30	50 200	nA	$T_A = T_{high}$ to $T_{low}$
Large Signal Open-Loop Voltage Gain	50 25	200 300		20 15	200		V/mV	$V_O = \pm 10V$ $R_L = 2.0\text{ K}\Omega$ $T_A = T_{high}$ to $T_{low}$
Input Bias Current		-200 -300	-500 -1500		-200	-500 -800	nA	$T_A = T_{high}$ to $T_{low}$
Output Impedance		75			75		$\Omega$	$f = 20\text{ Hz}$
Input Impedance	0.3	1.0		0.3	1.0		M $\Omega$	$f = 20\text{ Hz}$
Output Voltage Swing	$\pm 12$ $\pm 10$ $\pm 10$	$\pm 13.5$ $\pm 13$		$\pm 12$ $\pm 10$ $\pm 10$	$\pm 13.5$ $\pm 13$		V	$R_L = 10\text{ K}\Omega$ $R_L = 2.0\text{ K}\Omega$ $R_L = 2.0\text{ K}\Omega$ $T_A = T_{high}$ to $T_{low}$
Input Common Mode Voltage Range	+13V- $V_{EE}$	+13.5V- $V_{EE}$		+13V- $V_{EE}$	+13.5V- $V_{EE}$		V	
Common Mode Rejection Ratio	70	90		70	90		dB	$R_S < 10\text{ K}\Omega$
Power Supply Current ( $V_O = 0$ )		2.8	4.0		2.8	7.0	mA	$R_L = \infty$
Individual Output Short-Circuit Current <sup>2</sup>	$\pm 20$	$\pm 30$	$\pm 45$	$\pm 10$	$\pm 20$	$\pm 45$	mA	
Positive Power Supply Rejection Ratio		30	150		30	150	$\mu V/V$	
Negative Power Supply Rejection Ratio		30	150		30	150	$\mu V/V$	
Average Temperature Coefficient of Input Offset Current		50			50		pA/ $^\circ C$	$T_A = T_{high}$ to $T_{low}$
Average Temperature Coefficient of Input Offset Voltage		10			10		$\mu V/^\circ C$	$T_A = T_{high}$ to $T_{low}$
Power Bandwidth		9.0			9.0		kHz	$A_V = 1$ , $R_L = 2.0\text{ K}\Omega$ $V_O = 20V$ (p-p) THD = 5%
Small Signal Bandwidth		1.0			1.0		MHz	$A_V = 1$ , $R_L = 10\text{ K}\Omega$ $V_O = 50\text{ mV}$
Slew Rate		0.6			0.6		V/ $\mu s$	$A_V = 1$ , $V_i = -10V$ to $+10V$
Rise Time		0.6			0.6		$\mu s$	$A_V = 1$ , $R_L = 10\text{ K}\Omega$ $V_O = 50\text{ mV}$
Fall Time		0.6			0.6		$\mu s$	$A_V = 1$ , $R_L = 10\text{ K}\Omega$ $V_O = 50\text{ mV}$
Overshoot		20			20		%	$A_V = 1$ , $R_L = 10\text{ K}\Omega$ $V_O = 50\text{ mV}$
Phase Margin		60			60		Degrees	$A_V = 1$ , $R_L = 2.0\text{ K}\Omega$ $C_L = 200\text{ pF}$
Crossover Distortion		1.0			1.0		%	( $V_{in} = 30\text{ mV p-p}$ $V_{out} = 2.0V\text{ p-p}$ $f = 10\text{ kHz}$ )

<sup>1</sup> $T_{high} = +125^\circ C$  for XR-3503M,  $+70^\circ C$  for XR-3403C  
 $T_{low} = -55^\circ C$  for XR-3503M,  $0^\circ C$  for XR-3403C

<sup>2</sup>Not to exceed maximum package power dissipation.  
<sup>3</sup>Output will swing to ground.

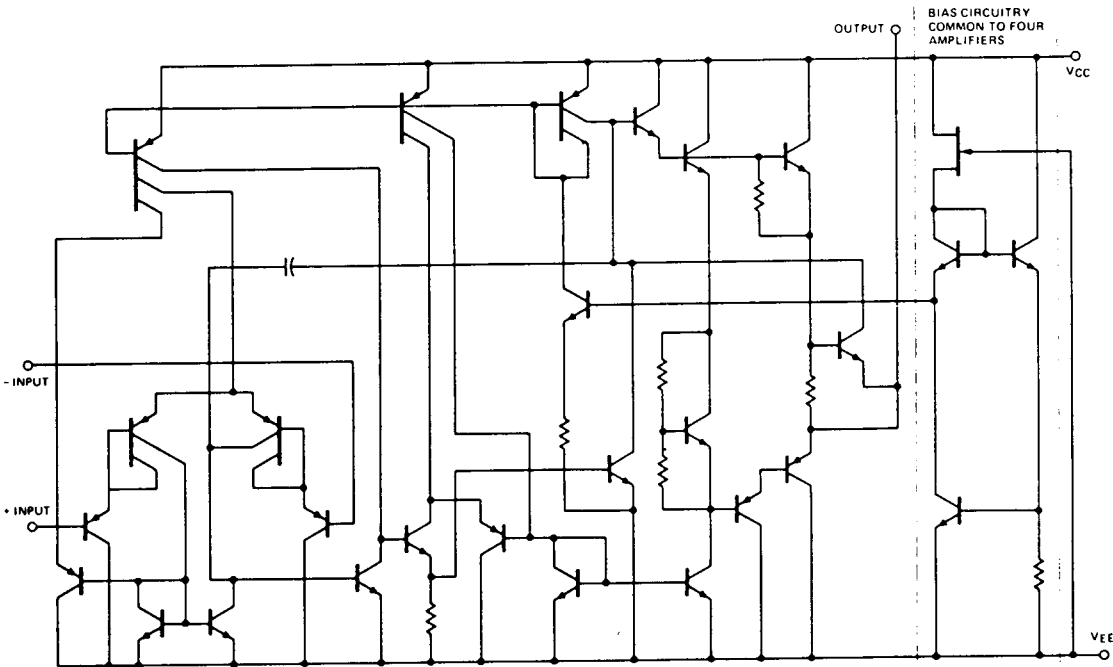
# XR-3403/3503

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## ELECTRICAL CHARACTERISTICS

Test Conditions:  $V_{CC} = 5.0V$ ,  $V_{EE} = \text{Grd}$ ,  $T_A = +25^\circ\text{C}$ , unless otherwise noted.

PARAMETERS	XR-3503M			XR-3403C			UNITS	CONDITIONS
	MIN	TYP	MAX	MIN	TYP	MAX		
Input Offset Voltage		2.0	5.0		2.0	10	mV	
Input Offset Current		30	50		30	50	nA	
Input Bias Current		-200	-500		-200	-500	nA	
Large Signal Open Loop Voltage Gain	20	200		20	200		V/mV	$R_L = 2.0\text{ K}\Omega$
Power Supply Rejection Ratio			150			150	$\mu\text{V/V}$	
Output Voltage Range <sup>3</sup>	3.5 $V_{CC} - 1.5V$			3.5 $V_{CC} - 1.5V$			Vp-p	$R_L = 10\text{ K}\Omega$ $V_{CC} = 5.0V$ $R_L = 10\text{ K}\Omega$ $5.0V \leq V_{CC} \leq 30V$
Power Supply Current		2.5	4.0		2.5	7.0	mA	
Channel Separation		-120			-120		dB	$f = 1.0\text{ kHz to }20\text{ kHz}$ (Input Referenced)



EQUIVALENT SCHEMATIC DIAGRAM

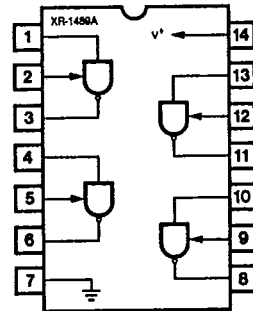
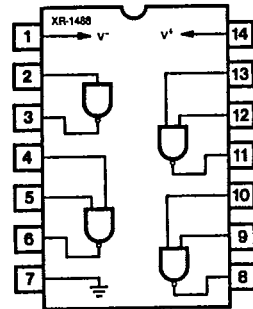
## Quad Line Driver/Receiver

### GENERAL DESCRIPTION

The XR-1488 is a monolithic quad line driver designed to interface data terminal equipment with data communications equipment in conformance with the specifications of EIA Standard No. RS232C. This extremely versatile integrated circuit can be used to perform a wide range of applications. Features such as output current limiting, independent positive and negative power supply driving elements, and compatibility with all DTL and TTL logic families greatly enhance the versatility of the circuit.

The XR-1489A is a monolithic quad line receiver designed to interface data terminal equipment with data communications equipment. The XR-1489A quad receiver along with its companion circuit, the XR-1488 quad driver, provide a complete interface system between DTL or TTL logic levels and the RS232C defined voltage and impedance levels.

### FUNCTIONAL BLOCK DIAGRAMS



### ABSOLUTE MAXIMUM RATINGS

Power Supply	
XR-1488	± 15 Vdc
XR-1489A	+ 10 Vdc
Power Dissipation	
Ceramic Package	1000 mW
Derate above +25°C	6.7 mW/°C
Plastic Package	650 mW/°C
Derate above +25°C	5 mW/°C

### ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-1488N	Ceramic	0°C to +70°C
XR-1488P	Plastic	0°C to +70°C
XR-1489AN	Ceramic	0°C to +70°C
XR-1489AP	Plastic	0°C to +70°C

### SYSTEM DESCRIPTION

The XR-1488 and XR-1489A are a matched set of quad line drivers and line receivers designed for interfacing between TTL/DTL and RS232C data communication lines.

The XR-1488 contains four independent split supply line drivers, each with a ± 10 mA current limited output. For RS232C applications, the slew rate can be reduced to the 30 V/μS limit by shunting the output to ground with a 410 pF capacitor. The XR-1489A contains four independent line receivers, designed for interfacing RS232C to TTL/DTL. Each receiver features independently programmable switching thresholds with hysteresis, and input protection to ±30 V. The output can typically source 3 mA and sink 20 mA.