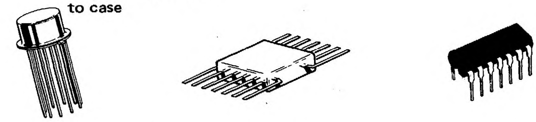
DUAL OPERATIONAL AMPLIFIERS

OPERATIONAL AMPLIFIERS

MC1435

. . . designed for use as summing amplifiers, integrators, or amplifiers with operating characteristics as a function of the external feedback components. Ideal for chopper stabilized applications where extremely high gain is required with excellent stability.

Lead 1 connected to case



CASE 71
"G" SUFFIX

CASE 83
(TO-86)
"F" SUFFIX

CASE 93
(TO-116)
"P" SUFFIX

Typical Amplifier Features:

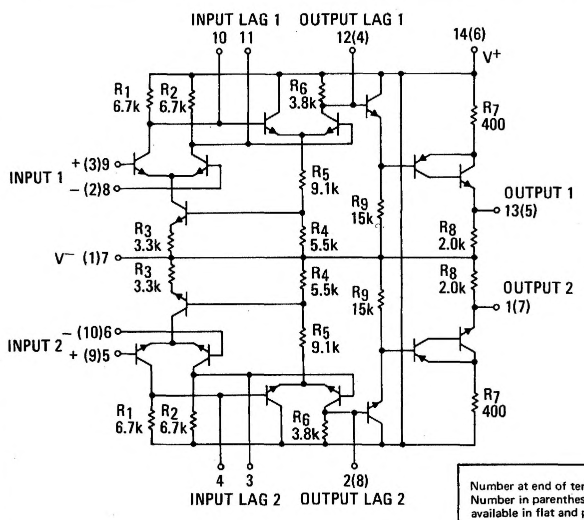
- High Open Loop Gain Characteristics — A_{VOL} = 7,000 typical
- Low Temperature Drift — ±10 μV/°C
- Large Output Voltage Swing — ±3.6 V typ @ ±6.0 V supply
- Low Input Offset Voltage — 1.0 mV
- Low Input Noise Voltage — 0.5 μV

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

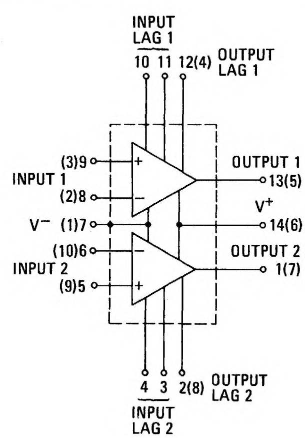
Rating	Symbol	Value	Unit
Power Supply Voltage	V^+ V^-	+9.0 -9.0	Vdc Vdc
Differential Input Signal	V_{in}	±5.0	Volts
Common Mode Input Swing	CMV_{in}	+5.0 -4.0	Volts
Output Short Circuit Duration	t_S	Continuous	
Power Dissipation (package limitation) Metal Can Derate above 25°C Flat Package Derate above 25°C Plastic Package Derate above 25°C	P_D	 680 4.6 500 3.3 400 3.3	 mW mW/°C mW mW/°C mW mW/°C
Operating Temperature Range*	T_A	0 to + 75	°C
Storage Temperature Range Metal Can and Flat Package Plastic Package	T_{stg}	 -65 to +150 -65 to +125	°C

*For full temperature range (-55°C to +125°C) and characteristic curves, see MC1535 data sheet.

CIRCUIT SCHEMATIC

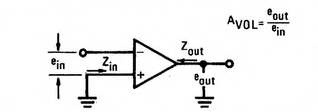
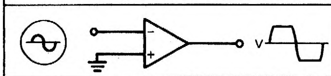
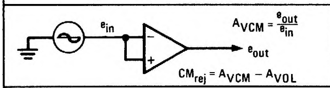
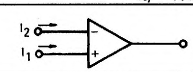
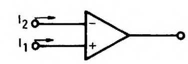
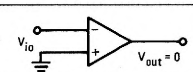
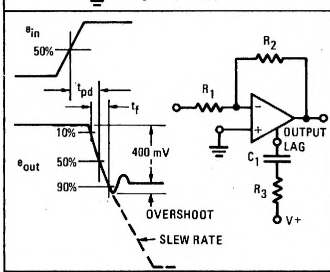
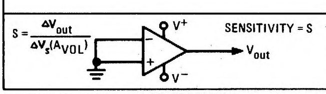


EQUIVALENT CIRCUIT



Number at end of terminal is pin number for both flat and plastic packages. Number in parenthesis is pin number for metal can package. Input lag available in flat and plastic packages.

ELECTRICAL CHARACTERISTICS (Each Amplifier) (V^+ = +6.0Vdc, V^- = −6.0Vdc, T_A = 25°C unless otherwise noted)

Characteristic Definitions (linear operations)	Characteristic	Symbol	Min	Typ	Max	Unit
	Open Loop Voltage Gain (T_A = 0°C to +75°C)	A_{VOL}	3,500 71	7,000 77	- -	V/V dB
	Output Impedance (f = 20 Hz)	Z_{out}	-	1.7	-	kΩ
	Input Impedance (f = 20 Hz)	Z_{in}	10	45	-	kΩ
	Output Voltage Swing (R_L = 10 kΩ)	V_{out}	5.0	7.0	-	V_{p-p}
	Input Common Mode Voltage Swing	CMV_{in}	+3.0 -2.0	+3.9 -2.7	- -	V_{peak}
	Common Mode Rejection Ratio	CM_{rej}	60	90	-	dB
	Input Bias Current $\left(I_b = \frac{I_1 + I_2}{2}\right)$, ($T_A$ = +25°C) (T_A = 0°C)	I_b	- -	1.2 3.6	5.0 10	μA
	Input Offset Current ($I_{io} = I_1 - I_2$) ($I_{io} = I_1 - I_2$, T_A = 0°C) ($I_{io} = I_1 - I_2$, T_A = +75°C)	I_{io}	- - -	0.05 - -	0.5 1.5 1.5	μA
	Input Offset Voltage (T_A = 25°C) R_S = 50Ω (T_A = 0°C to + 75°C)	V_{io}	- -	1.0 -	5.0 7.5	mV
	Step Response Gain = 100, 30% overshoot, R_1 = 4.7 kΩ, R_2 = 470 kΩ, R_3 = 150 Ω, C_1 = 1,000 pF	t_f t_{pd} dV_{out}/dt ①	- - -	0.8 0.1 7.0	- - -	μs μs V/μs
	Gain = 10, 10% overshoot, R_1 = 47 kΩ, R_2 = 470 kΩ, R_3 = 47 Ω, C_1 = 0.01 μF	t_f t_{pd} dV_{out}/dt ①	- - -	0.4 0.3 4.0	- - -	μs μs V/μs
	Gain = 1, 5% overshoot, R_1 = 47 kΩ, R_2 = 47 kΩ R_3 = 4.7 Ω, C_1 = 0.1 μF	t_f t_{pd} dV_{out}/dt ①	- - -	0.5 0.25 0.67	- - -	μs μs V/μs
	Average Temperature Coefficient of Input Offset Voltage (R_S = 50 Ω, T_A = 0°C to +75°C)	TC_{Vio}	-	3.0	-	μV/°C
	Average Temperature Coefficient of Input Offset Current (T_A = 0°C to +75°C)	TC_{Iio}		2.0		nA/°C
	DC Power Dissipation (Power Supply = ± 6.0 V, V_{out} = 0)	P_D	-	100	180	mW
	Positive Supply Sensitivity (V^- constant)	S^+	-	50	-	μV/V
	Negative Supply Sensitivity (V^+ constant)	S^-	-	100	-	μV/V

MATCHING CHARACTERISTICS

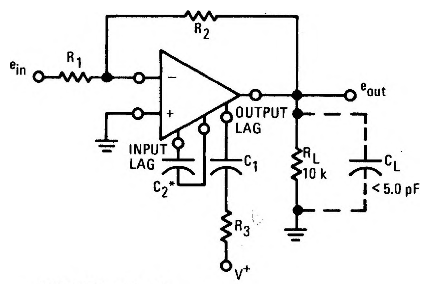
Same characteristic definitions as shown for each amplifier above.	Open Loop Voltage Gain	$A_{VOL1}-A_{VOL2}$	-	±1.0	-	dB
	Input Bias Current	$I_{b1}-I_{b2}$	-	±0.15	-	μA
	Input Offset Current	$I_{io1}-I_{io2}$	-	±0.02	-	μA
	Average Temperature Coefficient	$TC_{Iio1}-TC_{Iio2}$		±0.1		nA/°C
	Input Offset Voltage	$V_{io1}-V_{io2}$	-	±0.1	-	mV
	Average Temperature Coefficient	$TC_{Vio1}-TC_{Io2}$		±0.5		μV/°C
	Channel Separation (See Fig. 10) (f = 10 kHz)	$\frac{e_{out\,1}}{e_{out\,2}}$	-	-60	-	dB

① dV_{out}/dt = Slew Rate

TYPICAL OUTPUT CHARACTERISTICS

$V^+ = +6.0$ Vdc, $V^- = -6.0$ Vdc, $T_A = 25°C$

FIGURE 1 – TEST CIRCUIT



*MC1435 F and P only.

FIGURE NO.	CURVE NO.	VOLTAGE GAIN	TEST CONDITIONS R_1(Ω)	R_2(Ω)	C_1(pF)	R_3(Ω)	C_2(pF)	OUTPUT NOISE (mV rms)
2	1	100	4.7 k	470 k	1,000	150	0	1.7
	1A	or 100	4.7 k	470 k	0	∞	510	2.1
	2	10	47 k	470 k	10,000	47	0	1.0
	2A	or 10	47 k	470 k	0	∞	5,000	2.1
	3	1	47 k	47 k	100,000	4.7	0	0.12
	3A	or 1	47 k	47 k	0	∞	50,000	0.46
3	1	100	4.7 k	470 k	1,000	150	0	1.7
		or 100	4.7 k	470 k	0	∞	510	2.1
	2	10	47 k	470 k	10,000	47	0	1.0
		or 10	47 k	470 k	0	∞	5,000	2.1
	3	1	47 k	47 k	100,000	4.7	0	0.12
		or 1	47 k	47 k	0	∞	50,000	0.46
4	1	AVOL	100	∞	1,000	150	0	8.1
		or AVOL	100	∞	0	∞	510	8.1
	2	AVOL	100	∞	10,000	47	0	5.5
		or AVOL	100	∞	0	∞	5,000	5.5
	3	AVOL	100	∞	100,000	4.7	0	4.4
		or AVOL	100	∞	0	∞	50,000	4.4

FIGURE 2 – LARGE SIGNAL SWING versus FREQUENCY

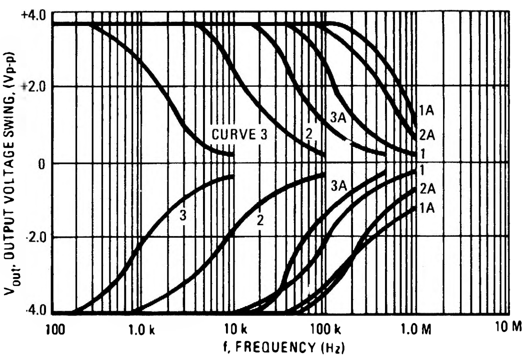


FIGURE 3 – VOLTAGE GAIN versus FREQUENCY

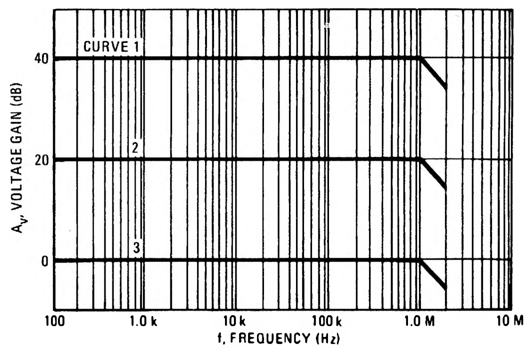


FIGURE 4 – OPEN LOOP VOLTAGE GAIN versus FREQUENCY

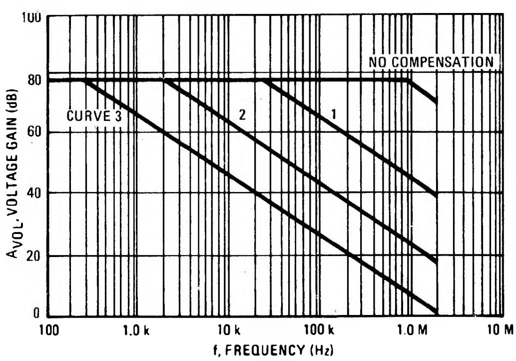


FIGURE 5 – INPUT OFFSET VOLTAGE versus TEMPERATURE

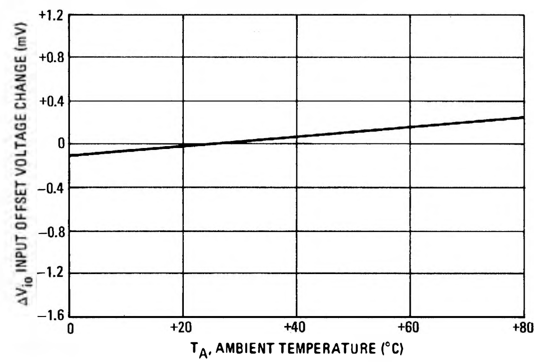


FIGURE 6 – VOLTAGE GAIN versus POWER SUPPLY VOLTAGE

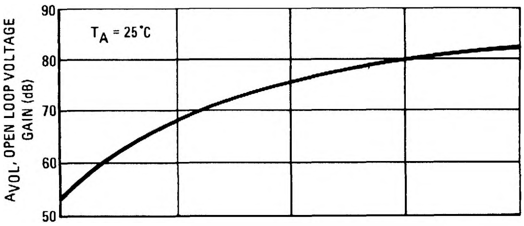


FIGURE 1 – COMMON MODE SWING versus POWER SUPPLY VOLTAGE

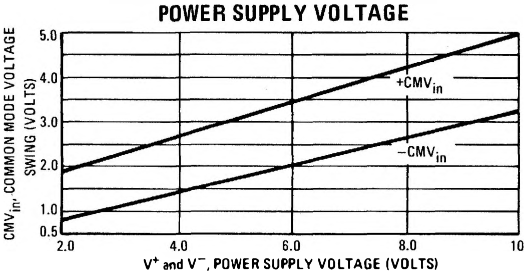


FIGURE 8 – POWER DISSIPATION versus POWER SUPPLY VOLTAGE

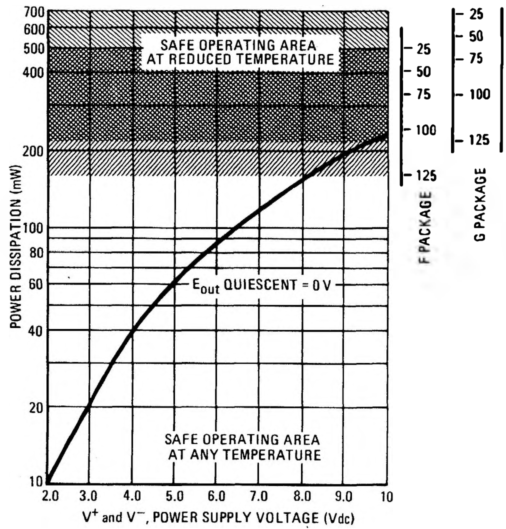
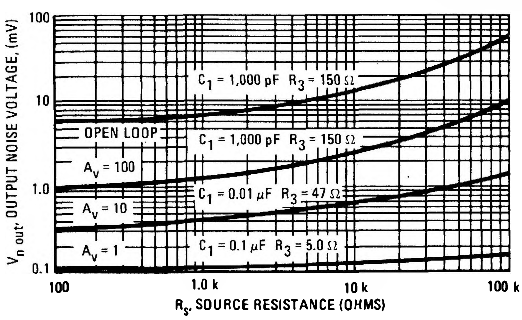


FIGURE 9 – OUTPUT NOISE VOLTAGE versus SOURCE RESISTANCE



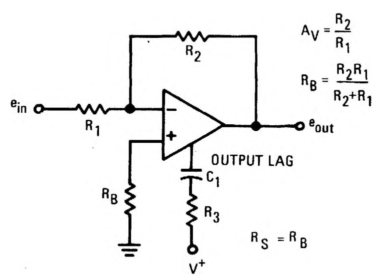
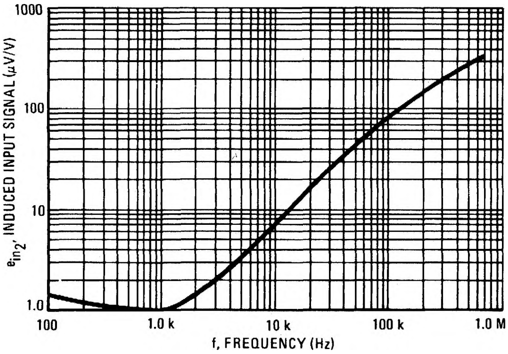
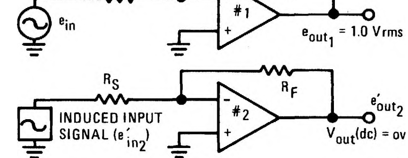


FIGURE 10 – INDUCED INPUT SIGNAL (CHANNEL SEPARATION) versus FREQUENCY





Induced input signal (µV of induced input signal in amplifier #2 per volt of output signal at amplifier #1)

$e'_{out_2} = e'_{in_2} \times \frac{R_F}{R_S}$, where e'_{out_2} is the component of e_{out_2} due only to lack of perfect separation between the two amplifiers.