



MICRO POWER SYSTEMS INC

QUAD MATCHED OPERATIONAL AMPLIFIER, 741-TYPE

MPOP09 / OP11

FEATURES

- Guaranteed V_{OS} , 500 μ V max.
- Guaranteed Matched CMRR, 94 dB min.
- Guaranteed Matched V_{OS} , 750 μ V max.
- Internal Frequency Compensation
- Low Crossover Distortion
- Continuous Short Circuit Protection
- Low Input Bias Current
- LM148/LM348 Direct Replacements
- RM4136/RC4136 Direct Replacements
- Low Noise

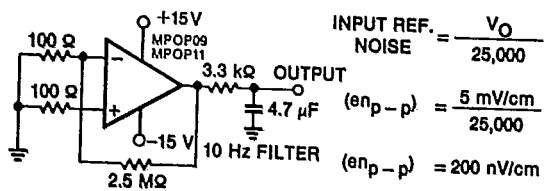
GENERAL DESCRIPTION

T-79-05-40

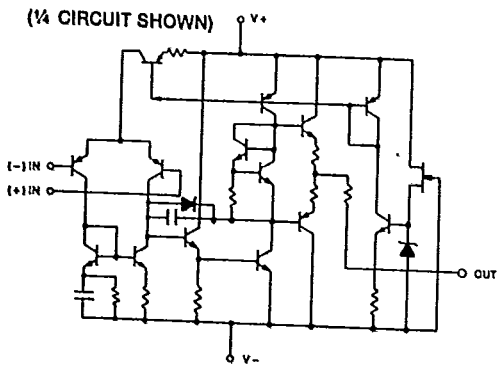
The MPOP09/MPOP11 is a quad matched amplifier set (741-type) in a single 14-pin DIP package. The MPOP11 is a plug-in replacement for the OP11, LM348, and LM148 amplifiers while the MPOP09 is a plug-in replacement for OP09, RC4136, and RM4136 amplifiers. Matched parameters include offset voltage and common mode rejection ratio — important considerations for instrumentation amplifiers. Also, for good audio system performance, the amplifiers have been designed to have equal positive and negative slew rates.

Incorporated into each of the amplifiers are the MPOPO2 advantages of low drift and noise. Micro Power Systems' "Silicon Nitride Passivation" provides long-term stability, reduced "popcorn noise" and maximum reliability. For designs requiring minimum space and cost, the MPOP09 and MPOP11 amplifiers are ideal. The MPOP09 and MPOP11 are a good choice in circuits requiring MP5502-type performance in quad configuration.

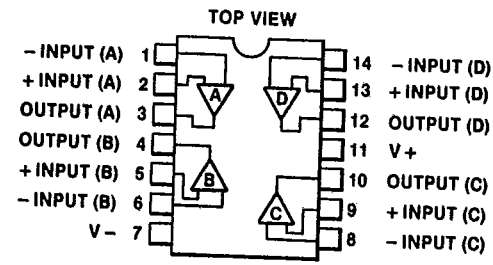
LOW FREQUENCY NOISE TEST CIRCUIT



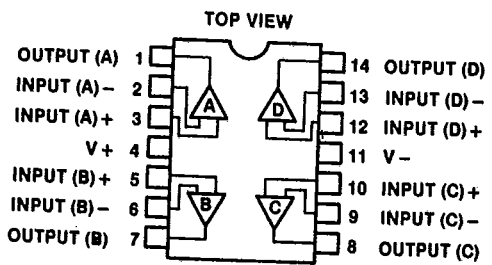
EQUIVALENT SCHEMATIC



PIN CONNECTIONS, MPOP09



PIN CONNECTIONS, MPOP11



See Section 7 for Ordering Information

MPOP09 / OP11

ABSOLUTE MAXIMUM RATINGS

Supply Voltage	± 22 V
Internal Power Dissipation (Note 1)	800 mW
Differential Input Voltage	± 30 V
Input Voltage	Supply Voltage
Output Short Circuit Duration	Continuous (One Amplifier Only)
Storage Temperature Range	-65° to +150°C
Lead Temperature Range (Soldering, 60 sec)	300°C
Operating Temperature Range	
MPOP09A, MPOP09B	-55°C to +125°C
MPOP09E, MPOP09F	0°C to +70°C
MPOP11A, MPOP11B, MPOP11C	-55°C to +125°C
MPOP11E, MPOP11F, MPOP11G	0°C to +70°C

NOTES TO ABSOLUTE MAXIMUM RATINGS

- For supply voltages less than ± 22 V, the absolute maximum input voltage is equal to the supply voltage.
- Maximum power dissipation vs ambient temperature:

Package	Max. Ambient Temp. For Rating	Derate Above Max. Ambient Temp.
DIP (Y) (ceramic)	100°C	10.0 mW/°C
DIP (P) (plastic)	70°C	8.3 mW/°C

MATCHING CHARACTERISTICS

At $V_S = \pm 15V$, $T_A = +25^\circ C$, $R_S \leq 100\Omega$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-09A, OP-09E OP-11A, OP-11E			OP-09B, OP-09F OP-11B, OP-11F			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage Match	ΔV_{OS}		-	0.5	0.75	-	0.8	2.0	mV
Common-Mode Rejection Ratio Match	$\Delta CMRR$	$V_{CM} = \pm 12V$	-	1	20	-	1	20	$\mu V/V$
		$V_{CM} = \pm 12V$	94	120	-	94	120	-	dB

MATCHING CHARACTERISTICS

At $V_S = \pm 15V$, $-55^\circ C \leq T_A \leq +125^\circ C$ for OP-09A, OP-09B, OP-11A and OP-11B, $0^\circ C \leq T_A \leq +70^\circ C$ for OP-09E, OP-09F, OP-11E and OP-11F, $R_S \leq 100\Omega$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-09A, OP-09E OP-11A, OP-11E			OP-09B, OP-09F OP-11B, OP-11F			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage Match	ΔV_{OS}		-	0.6	1.0	-	1.0	2.5	mV
Common-Mode Rejection Ratio Match	$\Delta CMRR$	$V_{CM} = \pm 12V$	-	3.2	20	-	3.2	20	$\mu V/V$
		$V_{CM} = \pm 12V$	94	110	-	94	110	-	dB

MATCHING PARAMETER DEFINITIONS

Common Mode Rejection Ratio Match ($\Delta CMRR$). The difference between the common-mode rejection ratios of side A and side B. $\Delta CMRR$ in dB = $-20 \log_{10}$. Match exists between any two amplifiers.

Input Offset Voltage Match (ΔV_{OS}). The difference between the offset voltages of side A and side B. ($V_{OSA} - V_{OSB}$). Using amplifier A as reference, then $\Delta V_{OS} = V_{OSN} - V_{OSA}$.

DEFINITIONS FOR MPOP09 & MPOP11

Input Offset Voltage (V_{OS}). The voltage required at either input to drive the output to zero volts in a closed loop condition.

Input Noise Voltage (e_{n_p-p}). The peak-to-peak noise voltage for a defined bandwidth.

Input Bias Current (I_B). The average current needed at both input terminals to obtain zero volts at the output.

Common Mode Rejection Ratio (CMRR). The ratio of the common mode voltage at the inputs to the resulting voltage error at the output.

MICRO POWER SYSTEMS, INC

MPOP09 / OP11

ELECTRICAL CHARACTERISTICS

(Each Amplifier) at $V_S = \pm 15V$, $T_A = 25^\circ C$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-09A/E OP-11A/E			OP-09B/F OP-11B/F			OP-11C/G			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	V_{OS}	$R < 10k\Omega$	-	0.3	0.5	-	0.6	2.5	-	1.2	5.0	mV
Input Offset Current	I_{OS}		-	5.5	20	-	25	50	-	75	200	nA
Input Bias Current	I_B		-	180	300	-	300	500	-	300	500	nA
Input Resistance Differential Mode	R_{IN}	(Note 3)	0.2	0.4	-	0.2	0.4	-	0.2	0.4	-	MΩ
Input Voltage Range	IVR		±12	±13	-	±12	±13	-	±12	±13	-	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 12V$, $R_S \leq 10k\Omega$	100	120	-	100	120	-	70	100	-	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 5$ to $\pm 15V$, $R_S \leq 10k\Omega$	-	4	32	-	4	32	-	10	100	$\mu V/V$
Output Voltage Swing	V_O	$R_L \geq 2k\Omega$	±11	±13	-	±11	±13	-	±11	±13	-	V
Large-Signal Voltage Gain	A_{VO}	$R_L \leq 2k\Omega$, $V_O = \pm 10V$	100	650	-	100	650	-	50	500	-	V/mV
Power Consumption (Note 1)	P_d	$V_O = 0V$	-	105	180	-	123	180	-	210	340	mW
Input Noise Voltage	e_{npp}	0.1Hz to 10Hz	-	0.7	-	-	0.7	-	-	0.7	-	μV_{pp}
Input Noise Voltage Density	e_n	$f_O = 10Hz$ $f_O = 100Hz$ $f_O = 1000Hz$	-	18	-	-	18	-	-	18	-	nV/\sqrt{Hz}
Input Noise Current	i_{npp}	0.1Hz to 10Hz	-	17	-	-	17	-	-	17	-	pA_{pp}
Input Noise Current Density	i_n	$f_O = 10Hz$ $f_O = 100Hz$ $f_O = 1000Hz$	-	1.8	-	-	1.8	-	-	1.8	-	pA/\sqrt{Hz}
Channel Separation	CS		100	130	-	100	130	-	-	130	-	dB
Slew Rate (Note 3)	SR		0.7	1.0	-	0.7	1.0	-	0.7	1.0	-	V/ μs
Large-Signal Bandwidth (Note 3)		$V_O = 20V_{pp}$	11	16	-	11	16	-	11	16	-	kHz
Closed-Loop Bandwidth (Note 3)	BW	$A_{VCL} = +1.0$	1.5	2.0	-	1.5	2.0	-	1.5	2.0	-	MHz
Risetime (Note 2)	t_r	$A_V = +1$, $V_{IN} = 50mV$	-	80	120	-	80	120	-	80	120	ns
Overshoot (Note 2)	O_S		-	15	25	-	15	25	-	15	25	%

NOTES:

1. Total dissipation for all four amplifiers in package.
2. Sample tested.
3. Guaranteed by design.

ELECTRICAL CHARACTERISTICS(Each Amplifier) at $V_S = \pm 15V$, $-55^\circ C \leq T_A \leq +125^\circ C$, unless otherwise noted.**MPOP09 / OP11**

PARAMETER	SYMBOL	CONDITIONS	OP-09A OP-11A			OP-09B OP-11B			OP-11C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	V_{OS}	$R_S \leq 10k\Omega$	-	0.4	1.0	-	1.0	3.5	-	1.5	6.0	mV
Average Input Offset Voltage Drift (Note 2)	TCV_{OS}	$R_S \leq 10k\Omega$	-	2.0	10	-	4.0	15	-	4.0	-	$\mu V/^\circ C$
Input Offset Current	I_{OS}		-	20	40	-	40	80	-	250	300	nA
Average Input Offset Current Drift (Note 2)	TCI_{OS}		-	0.1	0.3	-	0.3	0.6	-	0.3	0.6	$nA/^\circ C$
Input Bias Current	I_B		-	200	375	-	400	650	-	400	800	nA
Input Voltage Range	IVR		± 12	± 13	-	± 12	± 13	-	± 12	± 13	-	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 12V$, $R_S \leq 10k\Omega$	100	120	-	100	120	-	70	100	-	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 5$ to $\pm 15V$, $R_S \leq 10k\Omega$	-	4	32	-	4	32	-	10	100	$\mu V/V$
Large-Signal Voltage Gain	A_{VO}	$R_L \geq 2k\Omega$, $V_O = \pm 10V$	50	250	-	50	250	-	25	100	-	V/mV
Output Voltage Swing	V_O	$R_L \geq 2k\Omega$	± 11	± 13	-	± 11	± 13	-	± 11	± 13	-	V
Power Consumption (Note 1)	P_d	$V_O = 0V$	-	115	200	-	115	200	-	250	400	mW

ELECTRICAL CHARACTERISTICS(Each Amplifier) at $V_S = \pm 15V$, $0^\circ C \leq T_A \leq +70^\circ C$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-09E OP-11E			OP-09F OP-11F			OP-11G			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage	V_{OS}	$R_S \leq 10k\Omega$	-	0.4	0.8	-	0.8	3.0	-	1.5	6.0	mV
Average Input Offset Voltage Drift	TCV_{OS}	$R_S \leq 10k\Omega$	-	2.0	10	-	4.0	15	-	4.0	-	$\mu V/^\circ C$
Input Offset Current	I_{OS}		-	14	30	-	40	60	-	250	300	nA
Average Input Offset Current Drift (Note 2)	TCI_{OS}		-	0.1	0.3	-	0.3	0.6	-	0.3	0.6	$nA/^\circ C$
Input Bias Current	I_B		-	200	350	-	400	550	-	400	800	na
Input Voltage Range	IVR		± 12	± 13	-	± 12	± 13	-	± 12	± 13	-	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 12V$, $R_S \leq 10k\Omega$	100	120	-	100	120	-	70	100	-	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 5$ to $\pm 15V$, $R_S \leq 10k\Omega$	-	4	32	-	4	32	-	10	100	$\mu V/V$
Large-Signal Voltage Gain	A_{VO}	$R_L \geq 2k\Omega$, $V_O = \pm 10V$	50	250	-	50	250	-	25	100	-	V/mV
Output Voltage Swing	V_O	$R_L \geq 2k\Omega$	± 11	± 13	-	± 11	± 13	-	± 11	± 13	-	V
Power Consumption (Note 1)	P_d	$V_O = 0V$	-	115	200	-	115	200	-	250	400	mW

NOTES:

- Total dissipation for all four amplifiers in package.
- Sample tested.