

# M5238AL/P/FP

## DUAL LOW-NOISE J-FET INPUT OPERATIONAL AMPLIFIERS

### DESCRIPTION

The M5238 is a semiconductor integrated circuit designed as a low-noise Bi-FET operational amplifier which adopts J-FETs in the input stage. Noise reduction characteristic in the input stage has been improved by 3 - 4dB, when compared with the M5221 general-purpose Bi-FET operational amplifier, and two circuits for yielding a high input impedance, high slew rate and low bias current and other excellent characteristics, are housed in an 8-pin SIP, DIP or FP.

It can be widely used as a general-purpose operational amplifier in stereo equipment, tape decks, digital audio disc players and other similar products as well as in VCRs, video disc players and video related players.

### FEATURES

- Low noise, input-referred noise .....  $V_{NI}=1.9\mu\text{Vrms}(\text{typ.})$   
 ( $R_S=100\text{k}\Omega$  BW10Hz~30kHz FLAT)  
 S/N=73dB(typ.)  
 (Shorted input, RIAA, IHF-A network, PHONO 2.5mVrms)
- High input impedance due to J-FET input  
 .....  $R_i=1000\text{M}\Omega(\text{typ.})$
- High slew rate .....  $S_R=20\text{V}/\mu\text{s}(\text{typ.})$
- High gain, low distortion  
 .....  $G_{VO}=100\text{dB}(\text{typ.})$ , THD=0.002%  
 ( $G_V=35.6\text{dB}$ , RIAA,  $V_O=5\text{Vrms}$ )
- Large load current and allowable current  
 .....  $I_{LP}=\pm 50\text{mA}$ ,  $P_d=800\text{mW}(\text{SIP})$   
 $P_d=625\text{mW}(\text{DIP})$ ,  $P_d=440\text{mW}(\text{FP})$

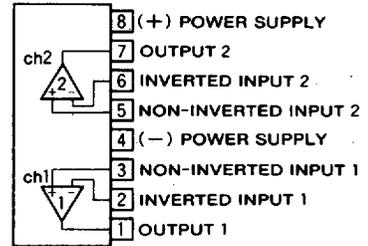
### APPLICATION

General purpose preamplifier in stereo equipment, tape decks and digital audio disc players, VCRs and video disc players.

### RECOMMENDED OPERATING CONDITION

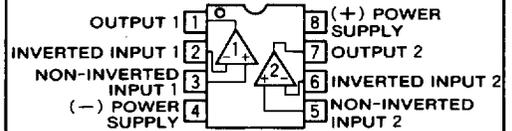
- Supply voltage range .....  $\pm 5 \sim \pm 15\text{V}$
- Rated supply voltage .....  $\pm 15\text{V}$

### PIN CONFIGURATION (TOP VIEW)



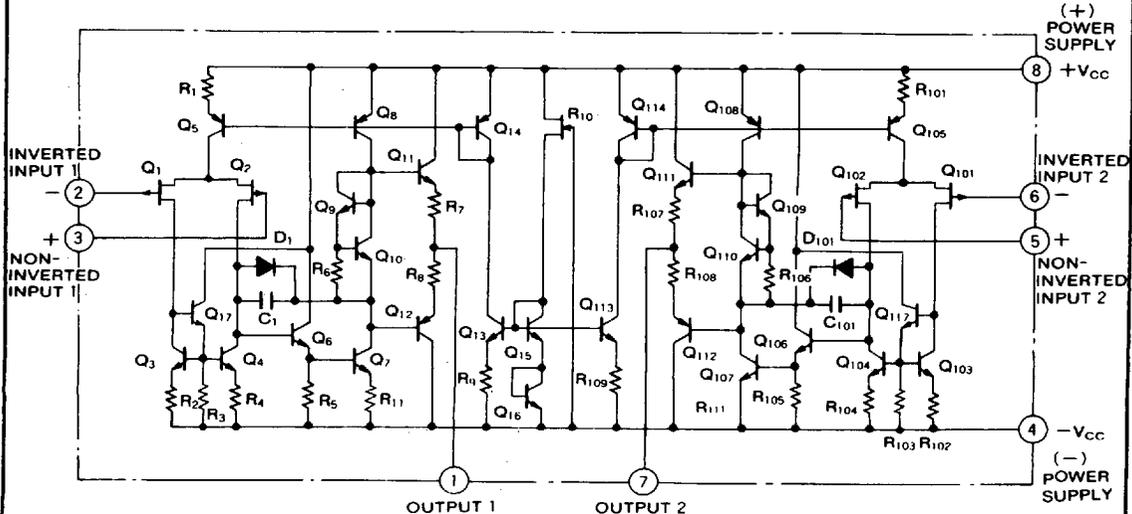
Outline 8P5 (AL)

DIP, MINI FLAT



Outline 8P4 (AP)  
8P2S-A (AFP)

### BLOCK DIAGRAM



MITSUBISHI ICs (AV COMMON)  
**M5238AL/P/FP**

**DUAL LOW-NOISE J-FET INPUT OPERATIONAL AMPLIFIERS**

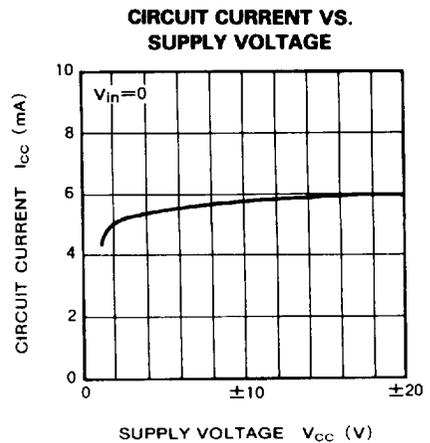
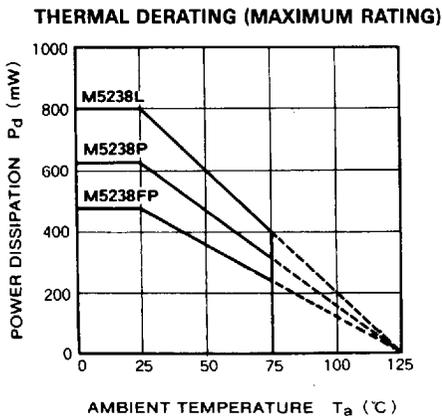
**ABSOLUTE MAXIMUM RATINGS** ( $T_a=25^\circ\text{C}$ , unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
$V_{CC}$	Supply voltage		$\pm 18$	V
$I_{LP}$	Load current		$\pm 50$	mA
$V_{ID}$	Differential input voltage		$\pm 30$	V
$V_{IC}$	Common input voltage		$\pm 15$	V
$P_d$	Power dissipation		800(SIP)/625(DIP)/440(FP)	mW
$K_\theta$	Thermal derating	$T_a \geq 25^\circ\text{C}$	8(SIP)/6.25(DIP)/4.4(FP)	mW/ $^\circ\text{C}$
$T_{opr}$	Ambient temperature		$-20 \sim +75$	$^\circ\text{C}$
$T_{stg}$	Storage temperature		$-55 \sim +125$	$^\circ\text{C}$

**ELECTRICAL CHARACTERISTICS** ( $T_a=25^\circ\text{C}$ ,  $V_{CC}=\pm 15\text{V}$ )

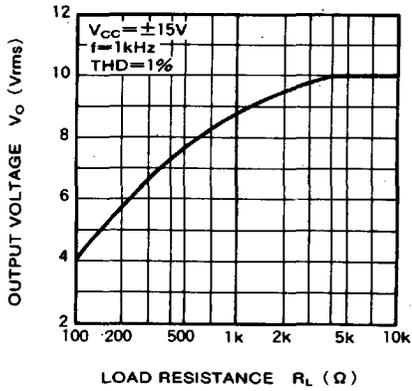
Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
$I_{CC}$	Circuit current	$V_{in}=0$		5.8	9.0	mA
$V_{IO}$	Input offset voltage	$R_s \leq 10\text{k}\Omega$		2.0	10.0	mV
$I_{IO}$	Input offset current			5	200	pA
$I_{IB}$	Input bias current			30	400	pA
$R_{in}$	Input resistance			$10^3$		M $\Omega$
$G_{VO}$	Open loop voltage gain	$R_L \geq 2\text{k}\Omega$ , $V_o = \pm 10\text{V}$	86	106		dB
$V_{OM}$	Maximum output voltage	$R_L \geq 10\text{k}\Omega$	$\pm 12$	$\pm 14$		V
		$R_L \geq 2\text{k}\Omega$	$\pm 10$	$\pm 13$		
$V_{CM}$	Common input voltage width		$\pm 10$	$\pm 12$		V
CMRR	Common mode rejection ratio	$R_s \leq 10\text{k}\Omega$	70	76		dB
SVRR	Supply voltage rejection ratio	$R_s \leq 10\text{k}\Omega$		30	150	$\mu\text{V/V}$
$P_d$	Power dissipation			174	270	mW
SR	Slew rate	$G_v=0\text{dB}$ , $R_L=2\text{k}\Omega$		20		V/ $\mu\text{s}$
$f_T$	Gain bandwidth product			6		MHz
$V_{NI}$	Input referred noise voltage	$R_s=100\Omega$ , BW=10Hz~30kHz		1.9		$\mu\text{Vrms}$

**TYPICAL CHARACTERISTICS**

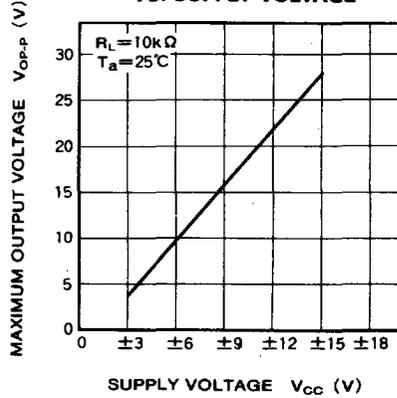


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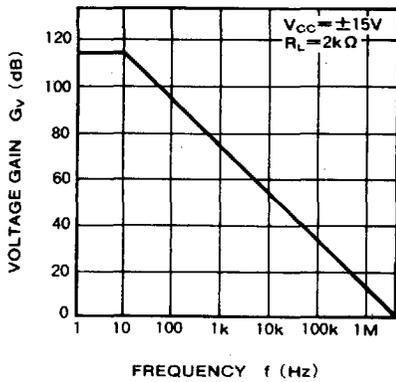
OUTPUT VOLTAGE VS. LOAD RESISTANCE



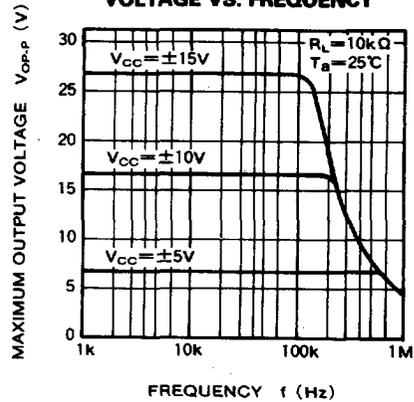
MAXIMUM OUTPUT VOLTAGE VS. SUPPLY VOLTAGE



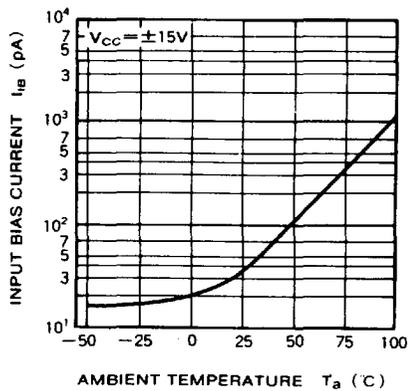
VOLTAGE GAIN VS. FREQUENCY RESPONSE



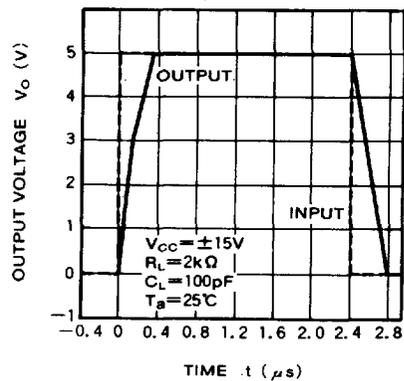
MAXIMUM OUTPUT VOLTAGE VS. FREQUENCY



INPUT BIAS CURRENT VS. AMBIENT TEMPERATURE



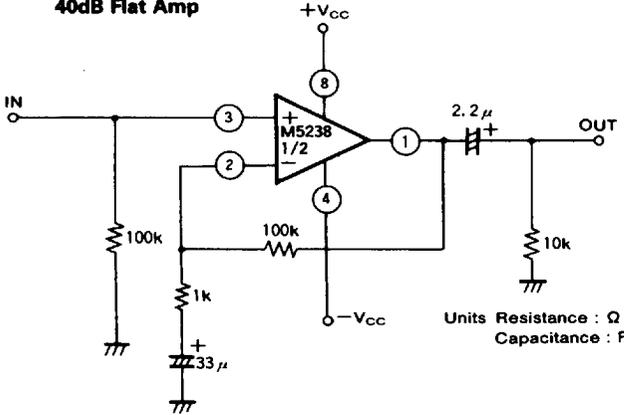
SLEW RATE (SR) CHARACTERISTICS



**DUAL LOW-NOISE J-FET INPUT OPERATIONAL AMPLIFIERS**

**APPLICATION CIRCUIT 1**

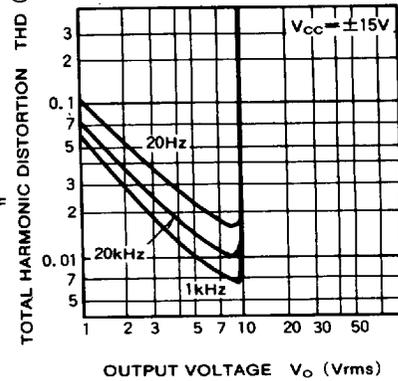
**40dB Flat Amp**



**TYPICAL CHARACTERISTICS**

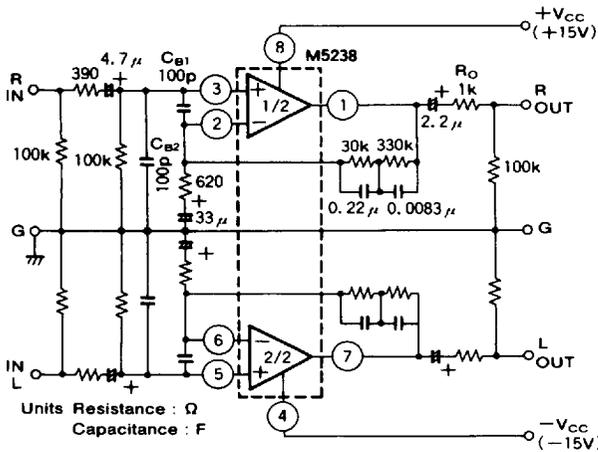
- $V_{CC} = \pm 15V$
- $G_v = 40dB (f = 1kHz)$
- $V_o = 9.5V_{rms} (f = 1kHz, THD = 0.1\%)$
- $THD = 0.007\% (f = 1kHz, V_o = 7V_{rms})$

**TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE**



**APPLICATION CIRCUIT 2**

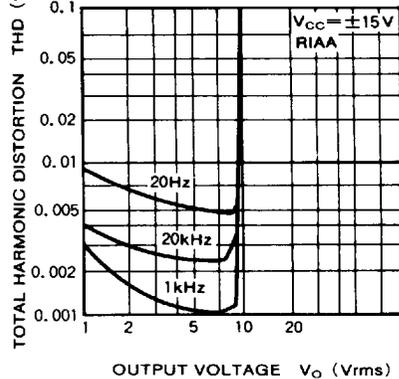
**Stereo equalizer amplifier circuit**



**TYPICAL CHARACTERISTICS** ( $V_{CC} = \pm 15V, RIAA$ )

- $G_v = 35.6dB (f = 1kHz)$
- $V_{in} = 1.9\mu V_{rms} (R_s = 100\Omega, BW = 20Hz \sim 30kHz)$
- $S/N = 73dB$  (IHF-A network, shorted input, 2.5mVrms input sensitivity)
- $THD = 0.001\% (f = 1kHz, V_o = 7V_{rms})$

**TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE**



$L_{ch}$  circuit constants are identical to those of  $R_{ch}$ .

$C_{B1}, C_{B2}$ : Capacitors for buzz prevention, use if required.

$R_o$ : Resistor used to prevent parasitic oscillation for capacitive loads and current limiting with shorted and other abnormal load conditions.