# M5210L, P, FP

## DUAL HIGH-VOLTAGE,HIGH S/N OPERATIONAL AMPLIFIERS (DUAL POWER SUPPLY TYPE)

## DESCRIPTION

The M5210 is a semiconductor integrated circuit designed for a preamplifier in audio equipment of stereo and cassette tape decks.

Two low-noise operational amplifier circuits displaying internal phase-compensated high gain and low distortion are contained in a 8-pin (SIP, DIP), suitable for application as a microphone and tone control amplifier of stereo equipment and cassette tape decks.

The unit can also be used as a general-purpose amplifier in portable equipment such as a stereo cassette tape recorder of a single power supply type as it operates at a low supply voltage.

## FEATURES

- Low noise ····· $V_{NI}$=1.0$\mu$Vrms typ.($R_g$=2.2k$\Omega$, FLAT)
  S/N=66dB typ.($R_g$=600$\Omega$, IHF-A network)
  (microphone amplifier, fererence input=−60dBm)
  Higher S/N ratio by 10dB when compared to ordinary operational amplifiers
- High voltage ····· $V_{CC}$=±25V(50V)
- Low maximum input voltage ····· $V_i$=140mVrms(typ.)
  ($V_{CC}$=±22.5V, $G_V$=40dB)
- High gain, low distortion
  ····· $G_{VO}$=113dB, THD=0.002%(typ.)
- High slew rate ····· SR=6.5V/$\mu$s(typ.)
- High load current, high power dissipation
  ····· $I_{LP}$=±50mA, $P_d$=800mW(SIP)
  $P_d$=625mW(DIP), $P_d$=440mW(FP)

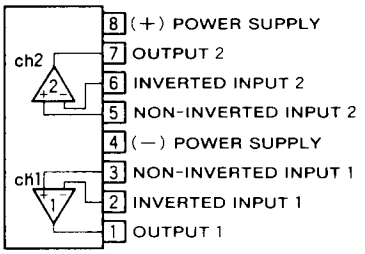
## APPLICATION

General-purpose preamplifier in stereo equipment, tape decks and radio stereo cassette recorders

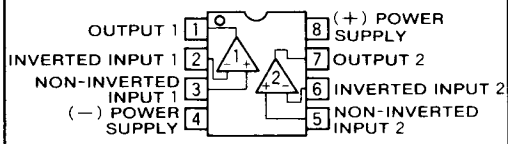
## RECOMMENDED OPERATING CONDITIONS

Supply voltage range ····· ±2~±22.5V
Rated supply voltage ····· ±22.5V

## PIN CONFIGURATION (TOP VIEW)

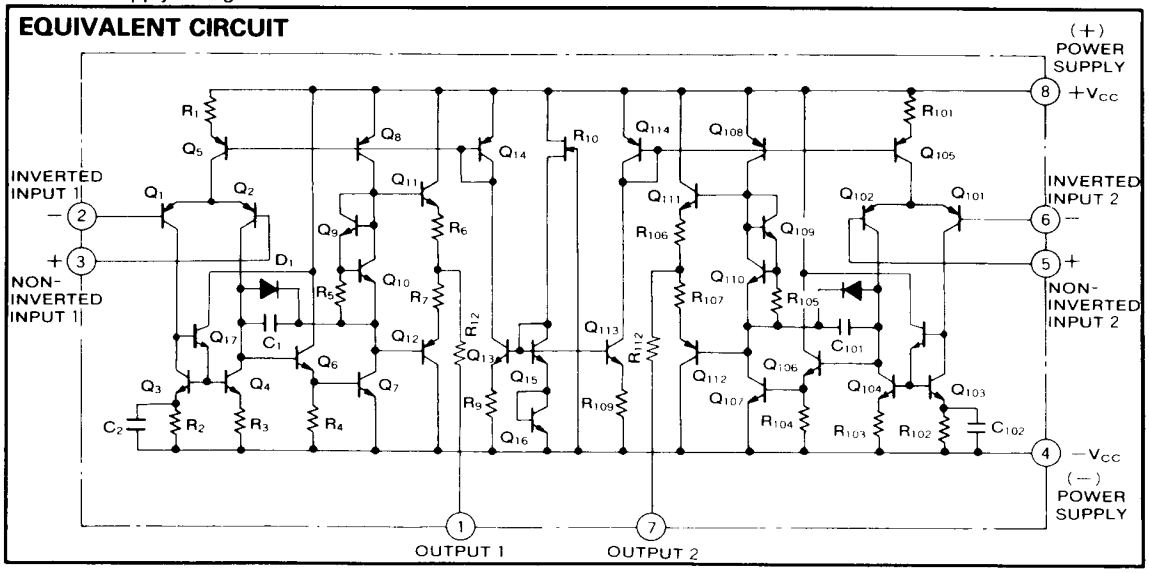



Outline 8P5 (M5210L)




Outline 8P4 (M5210P)
8P2S (M5210FP)

## EQUIVALENT CIRCUIT






MITSUBISHI ELECTRIC

## DUAL HIGH-VOLTAGE,HIGH S/N OPERATIONAL AMPLIFIERS (DUAL POWER SUPPLY TYPE)

### ABSOLUTE MAXIMUM RATINGS ($T_a$=25℃, unless otherwise noted)

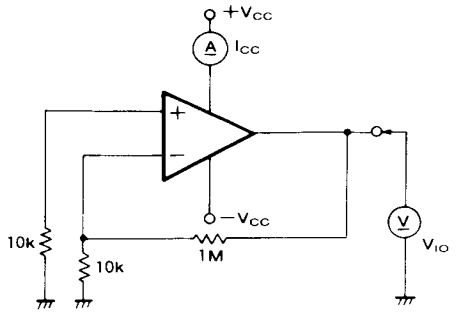
| Symbol | Parameter | Conditions | Ratings | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply voltage | | ±25(50) | V |
| $I_{LP}$ | Load current | | ±50 | mA |
| $V_{id}$ | Differential input voltage | | ±30 | V |
| $V_{ic}$ | Common input voltage | | ±22.5 | V |
| $P_d$ | Power dissipation | | 800(SIP)/625(DIP)/440(FP) | mW |
| $K_\theta$ | Thermal derating | $T_a$≧25℃ | 8(SIP)/6.25(DIP)/4.4(FP) | mW/℃ |
| $T_{opr}$ | Operating temperature | | −20～+75 | ℃ |
| $T_{stg}$ | Storage temperature | | −55～+125 | ℃ |

### ELECTRICAL CHARACTERISTICS ($T_a$=25℃, $V_{CC}$=±22.5V)

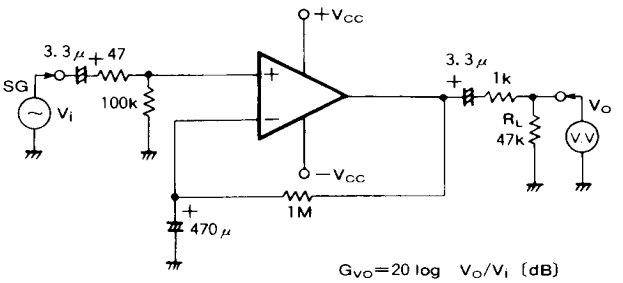
| Symbol | Parameter | Test conditions | Limits | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| $I_{CC}$ | Circuit current | $V_{in}$=0 | 2.0 | 4.0 | 8.0 | mA |
| $V_{IO}$ | Input offset voltage | $R_S$≦10kΩ | | 0.5 | 6.0 | mV |
| $I_{IB}$ | Input bias current | | | 0.7 | | μA |
| $G_{VO}$ | Open loop voltage gain | f=100Hz, $R_L$=47kΩ, $C_{NF}$=470μF | 90 | 113 | | dB |
| $V_{OM}$ | Maximum output voltage | f=1kHz, THD=0.1%, $R_L$=47kΩ, FLAT | 12.5 | 14.2 | | Vrms |
| THD | Total harmonic distortion | f=1kHz, $V_O$=10Vrms, $R_L$=47kΩ, FLAT | | 0.002 | | % |
| $V_{NI}$ | Input-referred noise voltage | $R_g$=2.2kΩ, BW=10Hz～30kHz, FLAT | | 1.0 | 1.5 | μVrms |
| S/N | Signal to noise ratio | $R_g$=600Ω, $G_V$=40dB, IHF-A network<br>Reference input −60dBm (microphone) | | 66 | | dB |

### TEST CIRCUITS

(a) $I_{CC}$, $V_{IO}$

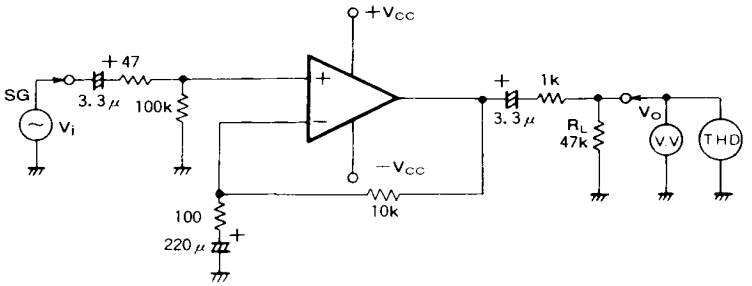



(b) $G_{VO}$




$G_{VO}$=20 log $V_O/V_i$ (dB)

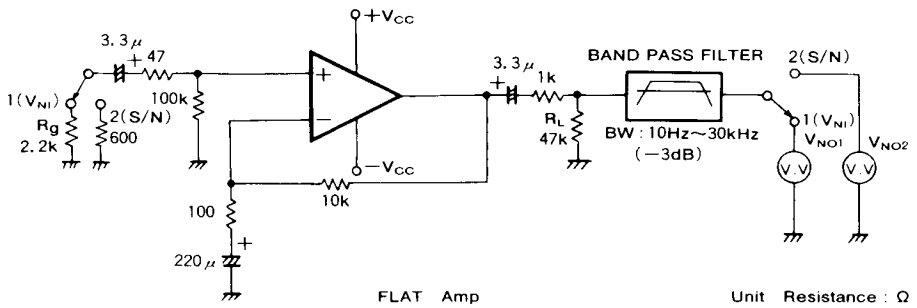
(c) $V_{OM}$, THD




Unit Resistance : Ω
Capacitance : F

## TEST CIRCUIT

(d) $V_{NI}$, S/N



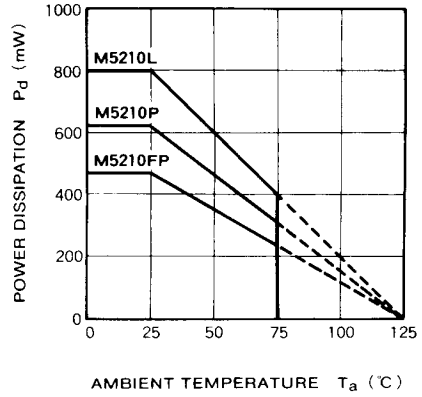

FLAT Amp
$G_V$=40dB=100 TIMES (@f=1kHz)

Unit Resistance : Ω
Capacitance : F

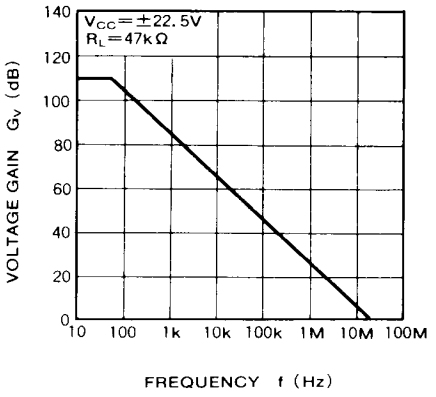
1. $V_{NI}=V_{NO1}/100$ ($\mu$Vrms)
2. S/N=20 log [775$\mu$Vrms/($V_{NO2}$/100)] (dB) 775$\mu$Vrms=−60dBm(microphone reference input voltage)
   * An AC voltmeter V.V with a built-in fHF-A network filter should be used for measuring the S/N ratio.

## TYPICAL CHARACTERISTICS

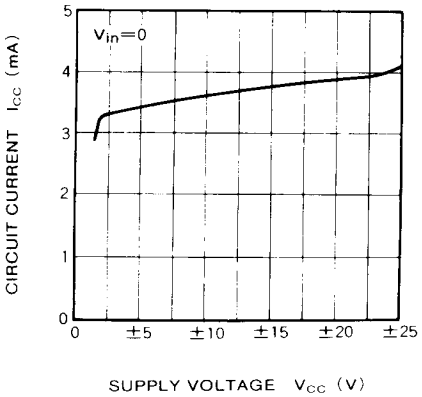
### THERMAL DERATING (MAXIMUM RATING)



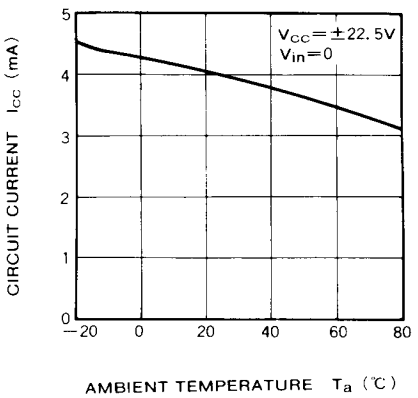

### VOLTAGE GAIN VS. FREQUENCY RESPONSE




### CIRCUIT CURRENT VS. SUPPLY VOLTAGE

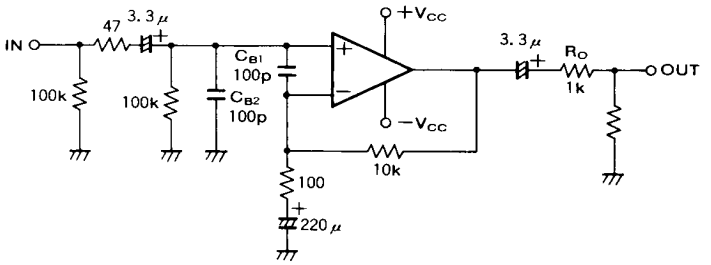



### CIRCUIT CURRENT VS. AMBIENT TEMPERATURE



## APPLICATION EXAMPLES

**(1) Stereo FLAT (microphone) amplifier circuit**




Units Resistance : Ω
Capacitance : F

**TYPICAL CHARACTERISTICS** ($V_{CC}$=±22.5V, FLAT)

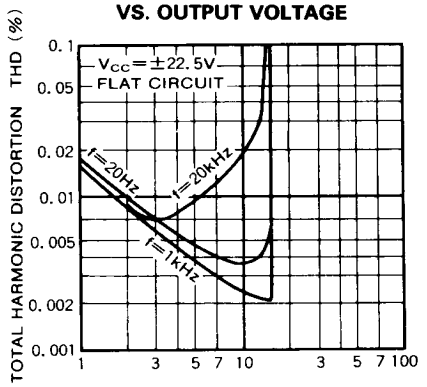
- $G_V$=40dB (f=1kHz)
- $V_{NI}$=1.0μVrms($R_g$=2.2kΩ, BW=10Hz~30kHz)
- S/N=66dB (IHF-A network, $R_g$=600Ω, −60dBm input sensitivity)
- THD=0.002%(f=1kHz、$V_O$=10Vrms)

Left channel circuit constants are identical to those of right channel

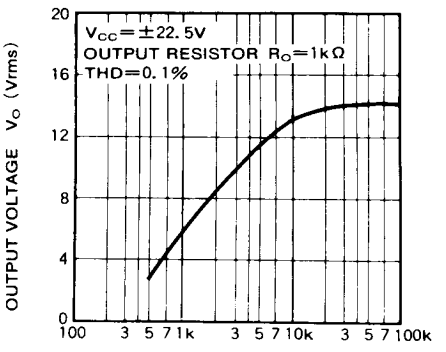
$C_{B1}$, $C_{B2}$ : Capacitors for buzz prevention, use if required.

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

**TOTAL HARMONIC DISTORTION VS. OUTPUT VOLTAGE**




**OUTPUT NOISE VOLTAGE VS. LOAD RESISTANCE**




**SIGNAL-TO-NOISE RATIO VS. SIGNAL SOURCE RESISTANCE**