M5229P/FP

Hi-Fi 7-ELEMENT GRAPHIC EQUALIZER IC

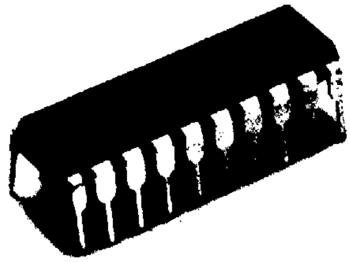
DESCRIPTION

The M5229 is a 7-element graphic equalizer IC best suited to Hi-Fi audio systems. It has 7-element resonance circuits with OP amp system and an output OP amp.

The IC can be used in compact sets of high-density assemblies, modules, and hybrid ICs. Its applications cover Hi-Fi stereo sets, radio cassette tape players, car audio systems, music centers, and electronic instruments.

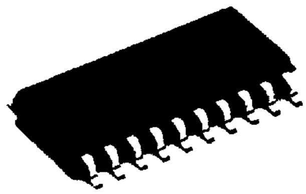
FEATURES

- High withstand voltage and wide supply voltage range ···························· V_{CC} = ± 2 to ± 18V(4 to 36V)
- Low distortion ································THD = 0.002 %(typ) (@f = 1kHz, Flat, V_O = 5Vrms)
- Low noise ·································· V_{NO} = 9 μ Vrms(typ) (@Flat, input short)
- Variable Gv by external resistance······· Gv = ± 12dB(typ)
- Single power (use GND pin ⑲ for Vcc/2 pin)
- Large allowable input voltage ············ V_{IM} = 9.5Vrms(typ) (@f = 1kHz, THD = 1 %, Flat)



Outline 20P4(P)

2.54mm pitch 300mil DIP (6.3mm × 24.0mm × 3.3mm)



Outline 20P2N-A(FP)

1.27mm pitch 300mil SOP (5.3mm × 12.6mm × 1.8mm)

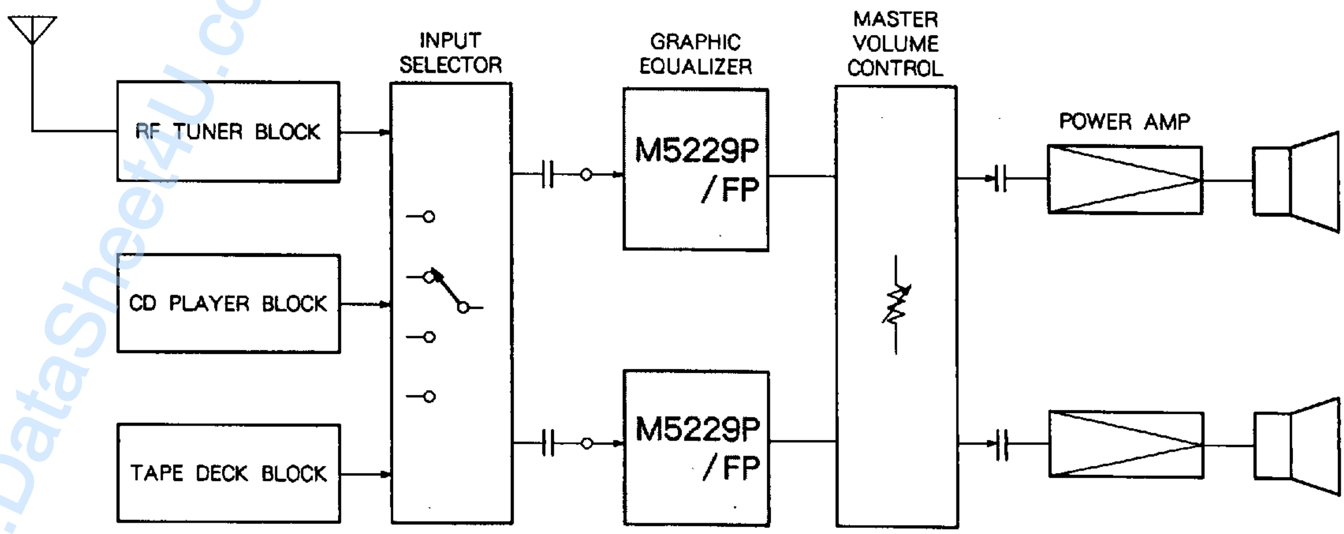
RECOMMENTED OPERATING CONDITIONS

Supply voltage range···················· V_{CC}, V_{EE} = ± 2 to ± 18V
or V_{CC} = 4 to 36V

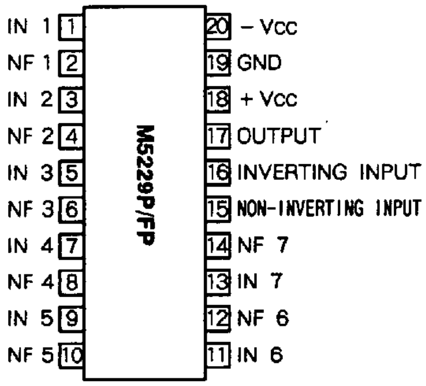
Rated supply voltage········· V_{CC}, V_{EE} = ± 15V or V_{CC} = 30V

Rated power dissipation ···························· 1000mW(DIP)
550mW(FP)

SYSTEM CONFIGURATION

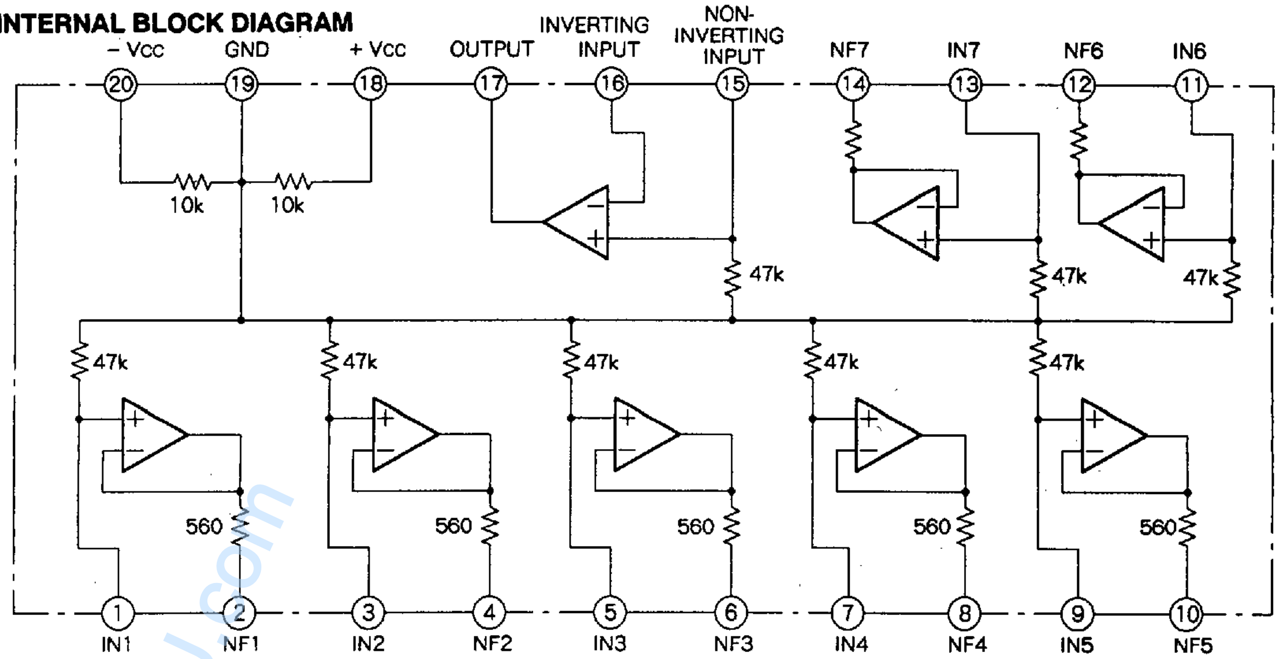


PIN CONFIGURATION (TOP VIEW)



Outline 20P4(P)
20P2N-A(FP)

IC INTERNAL BLOCK DIAGRAM



Unit Resistance : Ω

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HI-FI 7-ELEMENT GRAPHIC EQUALIZER IC

ABSOLUTE MAXIMUM RATINGS (Ta = 25℃, unless otherwise noted)

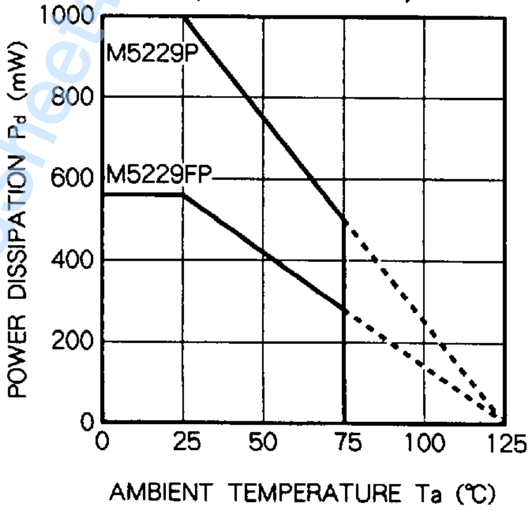
Symbol	Parameter	Ratings	Unit
V_{CC}	Supply voltage	36 (± 18)	V
I_{LP}	Load current	50	mA
P_d	Power dissipation	1000(P)/550(FP)	mW
T_{opr}	Operating temperature	− 20 to + 75	℃
T_{stg}	Storage temperature	− 55 to + 125	℃

ELECTRICAL CHARACTERISTICS (Ta = 25℃, Vcc = ± 15V)

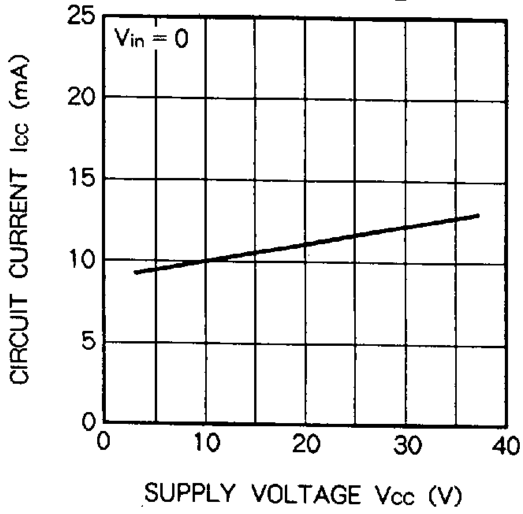
Symbol	Parameter		f (Hz)	Test conditions	Limit Min	Limit Typ	Limit Max	Unit
I_{CC}	Ciucuit current		−	V_{in} = 0	8	12	16	mA
$G_{V\,(FLAT)}$	Voltage Gain	Flat	1k	V_{in} = − 10dBm	− 2.3	− 0.3	+ 1.7	dB
$G_{V(BOOST)}$	Voltage Gain	Boost (Response)	60	V_{in} = − 10dBm, $V_{O\,(FLAT)}$ = 0dB	9.0	12.0	14.0	dB
			120		9.0	12.0	14.0	
			360		9.0	12.0	14.0	
			1k		9.0	12.0	14.0	
			2.5k		9.0	12.0	14.0	
			6.7k		9.0	12.0	14.0	
			15.7k		9.0	12.0	14.0	
$G_{V\,(CUT)}$	Voltage Gain	Cut (Response)	60	V_{in} = − 10dBm, $V_{O\,(FLAT)}$ = 0dB	−14.0	−12.0	− 9.0	dB
			120		−14.0	−12.0	− 9.0	
			360		−14.0	−12.0	− 9.0	
			1k		−14.0	−12.0	− 9.0	
			2.5k		−14.0	−12.0	− 9.0	
			6.7k		−14.0	−12.0	− 9.0	
			15.7k		−14.0	−12.0	− 9.0	
V_{OM}	Maximum output voltage		1k	THD = 1 %, Flat	7	9.5	−	Vrms
THD	Distortion ratio		1k	Vo = 5Vrms, Flat	−	0.002	0.1	%
V_{NO}	Output noise voltage		Input short BM : 10Hz to 30kHz, Flat		−	9	35	μVrms

TYPICAL CHARACTERISTICS

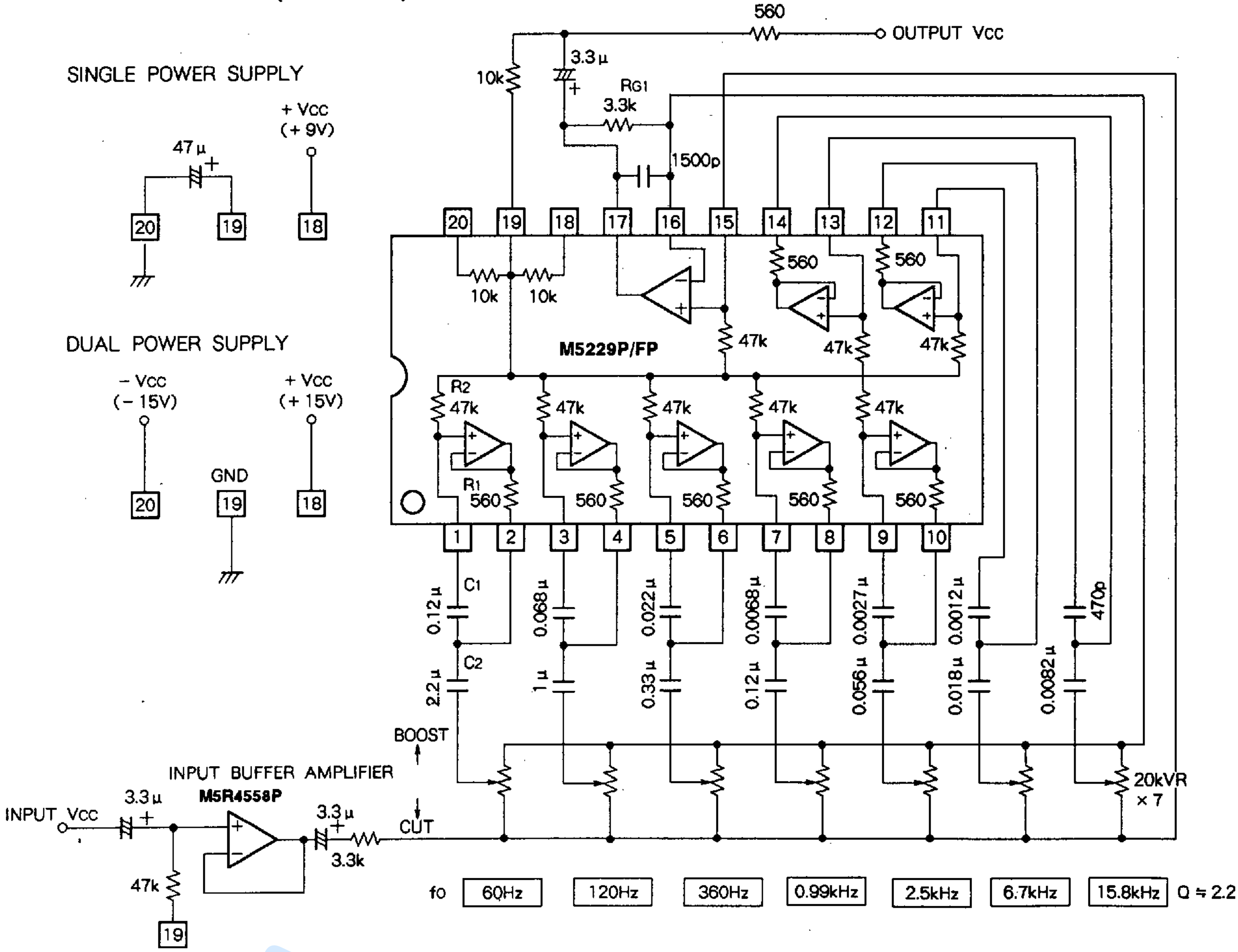
THERMAL DERATING (MAXIMUM RATING)



CIRCUIT CURRENT VS. SUPPLY VOLTAGE



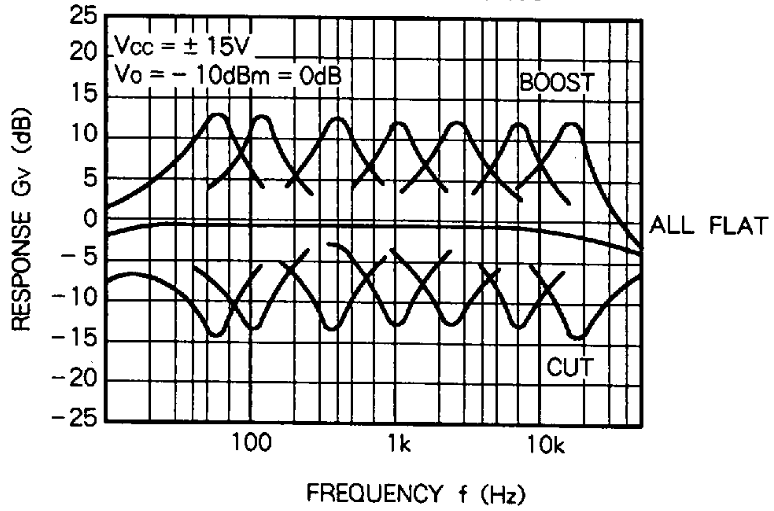
APPLICATION EXAMPLE (STANDARD)



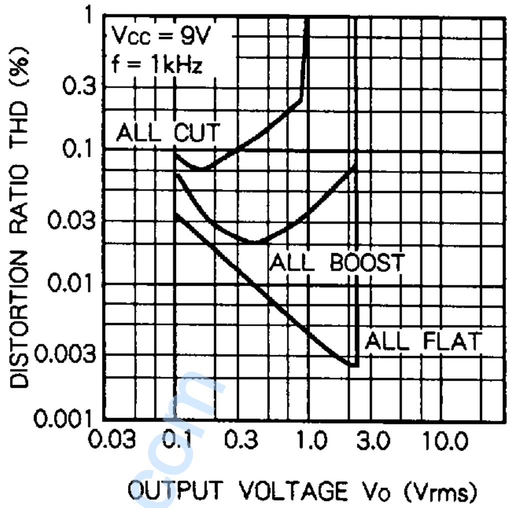
RESONANCE FREQUEQY $fo = \frac{1}{2\pi\sqrt{C1 \cdot C2 \cdot R1 \cdot R2}}$ [Hz] $\quad Q = \sqrt{C1 \cdot R2 / C2 \cdot R1}$

Units Resistance : Ω
Capacitance : F

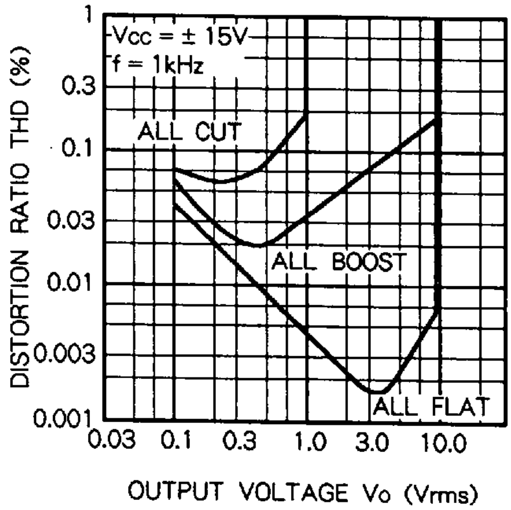
FREQUENCY CHARACTERISTICS



THD-Vo



THD-Vo

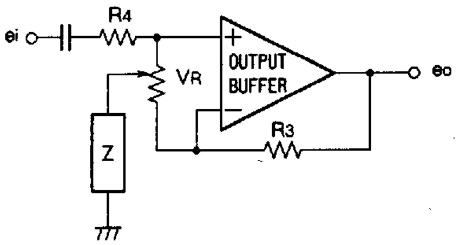


OPERATION DESCRIPTION

The M5229 consists of 7 resonance circuits and an output amplifier, and can also form a graphic epualizer, which has optional resonance frequency, fo, by the externally connecting condensor C_1, C_2 of variable resistance and a resonance circuit. The impedance is minimized by resonating and the semiconductor inductor, which is adopted in the resonance circuit, can therefore vary the frequency gain.

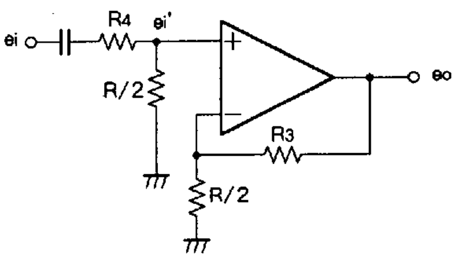
1. Flat boost cut

The resonance frequency gain can be altered by varying the external variable register.

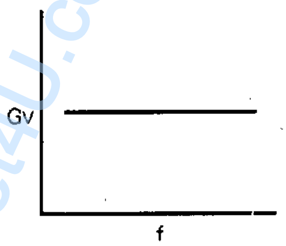


Z is an impedance in the resonance circuit

(1) Flat



R/2 is resistance at the center of VR



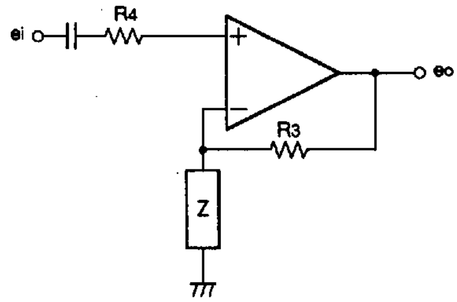
When the variable register is in center position, the equivalant circuit as in the above diagram can be obtained. At this stage if R_3, R_4 are set at the same level of resistance, then

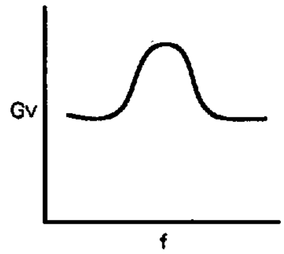
$$e_i' = \frac{R/2}{R_4 + R/2} \cdot e_i, \qquad Av = \frac{R_3 + R/2}{R/2}$$

$$e_o = Av \cdot e_i' = e_i$$

and, the frequency characteristics will be level regardless of the resonance circuit.

(2) Boost





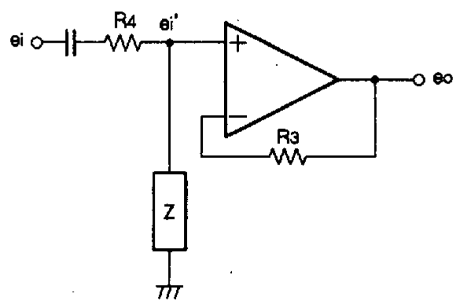
When the variable register is in boost position, the resonance circuit is connected to the NF loop of the output buffer amplifier. At this stage, R is much smaller than R_3, R_4, so it can be disregarded.

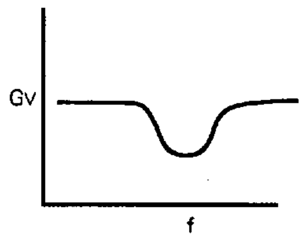
The gain Av is $Av = \dfrac{R_3 + Z}{Z}$ and,

the output voltage eo is $e_o = Av \cdot e_i = \dfrac{R_3 + Z}{Z} \cdot e_i$

When Z is smallest, the gain in resonance is the greatest, and the optional frequency is then boosted.

(3) Cut





When the variable register is in cut position, the resonance circuit is connected to the input side of the output buffer amplifier. When R is disregarded as the boost,

$$e_i' = \frac{Z}{R_4 + Z} \cdot e_i \cdot Av = 1 \text{ and,}$$

the output voltage e_o is $e_o = Av \cdot e_i' = \frac{Z}{R_4 + Z} \cdot e_i$

When Z is smallest, the gain in resonance is the greatest, and the optional frequency is then cut.

2. Resonance circuit

The semiconductor inductor converts L in the R, L, C serial resonance circuit into a CR pin by the buffer functions of active pins such as registers, Operational amplifiers, and works in a almost the same way as the R, L, C serial resonance circuit.

The R, L, C resonance frequency fo is

$f_o = 1/2\pi\sqrt{LC}$ ·······················Equation No.1

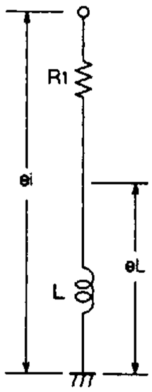


Fig. 1

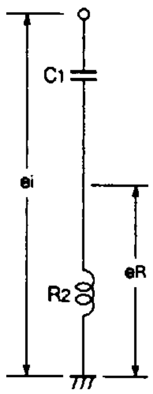


Fig. 2

When the voltage e_i is supplied to the resonance circuit as shown in Fig. 1.

$$e_L = j\omega L \cdot e_i / (R_1 + j\omega L)$$

If e_i is then supplied to the pins C_1, R_2 as shown in Fig.2,

$$e_R = e_i \cdot j\omega C_1 \cdot R_2/C_1 + j\omega C_1 \cdot R_2$$
$$= j\omega C_1 \cdot R_1 \cdot R_2/CR_1 + j\omega C_1 \cdot R_1 \cdot R_2$$

When $e_L = e_R$, $L = C_1 \cdot R_1 \cdot R_2$······Equation No.2

But if e_R is replaced by L of the R and L serial circuit, R_1 and C_1 are automatically connected in a parallel manner, and the value of e_R will be changed. So, in order to keep the value of e_R stable, a buffer amplifier should be used. The buffer amplifier is equivalent to an impedance.

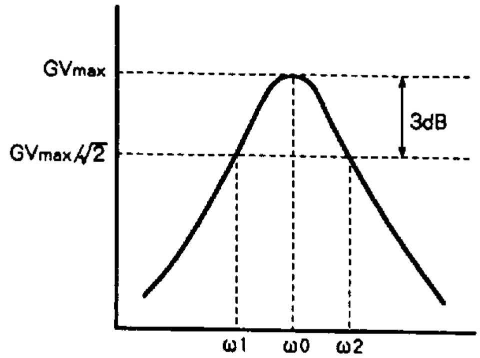
By epuations 1 and 2, the resonance frequency, fo is

$f_o = 1/2\pi\sqrt{C_1 \cdot C_2 \cdot R_1 \cdot R_2}$

The buffer amplifier in the resonance circuit of the M5229 is composed of operational amplifiers.

3. Angle of maximum resonance

The angle of maximum resonance, Q, is defined by the ratio of ω_o ($\omega_o = 2$ fo) and the frequency band width, ω_2-ω_1, ($Gmax/\sqrt{2}$)



The value of Q is found by the following equation ;

$Q = \sqrt{C_1 \cdot R_2 / C_2 \cdot R_1}$

The greater the value of Q, the narrower the frequency band width, and vice versa.

The M5229 is composed of R_1, R_2, so Q is defined by selecting the external condensor.