

6427525 N E C ELECTRONICS INC

05E 22688 D

**BIPOLAR ANALOG INTEGRATED CIRCUIT**

**$\mu$ PC1213C**

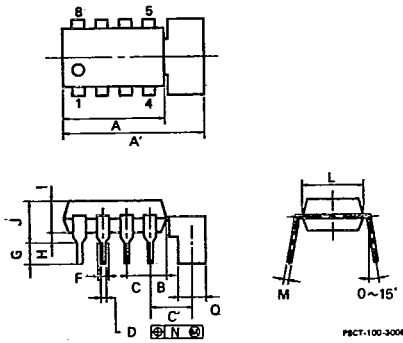
T-74-05-01

**AUDIO POWER AMPLIFIER**

**DESCRIPTION**

The  $\mu$ PC1213C is a silicon monolithic integrated circuit designed for an audio power amplifier used in a portable radio receiver or a portable cassette tape recorder which works at 9-volt power supply. The  $\mu$ PC1213C is encapsulated in an 8-pin dual in-line plastic package with a tab.

**8 PIN PLASTIC DIP WITH TAB (300 mil)**



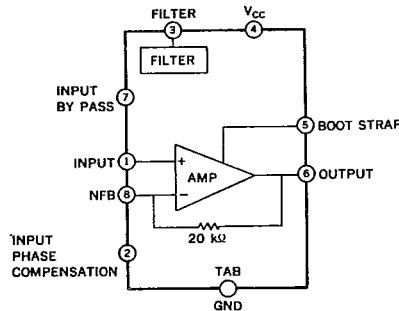
ITEM	MILLIMETERS	INCHES
A	12.70 MAX.	0.500 MAX.
A'	14.80 MAX.	0.571 MAX.
B	2.54 MAX.	0.100 MAX.
C	2.54 (T.P.)	0.100 (T.P.)
C'	3.85	0.144
D	0.50 $\pm$ 0.10	0.020 $\pm$ 0.004
F	1.1 MIN.	0.043 MIN.
G	3.5 $\pm$ 0.3	0.138 $\pm$ 0.012
H	0.51 MIN.	0.020 MIN.
I	4.31 MAX.	0.170 MAX.
J	5.08 MAX.	0.200 MAX.
L	6.4	0.252
M	0.30 $\pm$ 0.04	0.012 $\pm$ 0.002
N	0.25	0.01
Q	2.62 $\pm$ 0.30	0.103 $\pm$ 0.020

**NOTE**  
1) Each lead centerline is located within 0.25 mm (0.01 inch) of its true position (T.P.) at maximum material condition.

**FEATURES**

- High output power.  
 $P_o = 2.4$  W (TYP.)  
at  $V_{CC} = 9$  V,  $R_L = 4 \Omega$ , T.H.D. = 10 %
- Wide operating voltage range.  
 $V_{CC} = 4.5$  to 9 to 11 V
- High ripple rejection ratio.  
R.R.R. = 55 dB (TYP.)
- Soft clipping waveform.
- Have a muting circuit so that no shock noise at power supply switch on and off.
- Have a terminal to reject interference noise in strong electric field. (pin 2)

**BLOCK DIAGRAM**



**CONNECTION DIAGRAM**

No.	CONNECTION	No.	CONNECTION
1	INPUT	5	BOOTSTRAP
2		6	OUTPUT
3	FILTER	7	FILTER
4	$V_{CC}$	8	N. F. B.
TAB	GND		

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**ABSOLUTE MAXIMUM RATINGS (T<sub>a</sub> = 25 °C)**

Supply Voltage	V <sub>CC1</sub>	(No Signal)	16	V
Supply Voltage	V <sub>CC2</sub>	(Operating)	11	V
Allowable Power Dissipation	P <sub>d</sub>	*	2.4	W
Operating Temperature	T <sub>opt</sub>		-20 to 70	°C
Storage Temperature	T <sub>stg</sub>		-40 to 150	°C

\* 50 x 50 x 0.035 mm<sup>3</sup> copper heat sink on P.C.B.

**RECOMMENDED CONDITIONS (T<sub>a</sub> = 25 °C)**

Supply Voltage	V <sub>CC</sub> = 4.5 to 9 to 11 V
Load Impedance	R <sub>L</sub> = 4 Ω

**ELECTRICAL CHARACTERISTICS (T<sub>a</sub> = 25 °C)**

(V<sub>CC</sub> = 9 V, R = 4Ω, f = 1 kHz, Refer to the test circuit  
50 x 50 x 0.035 mm<sup>3</sup> copper heat sink on P.C.B. unless otherwise specified)

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITION
Quiescent Circuit Current	I <sub>CC</sub>	8	15	25	mA	No Signal
Open Loop Voltage Gain	A <sub>vo</sub>	55	65		dB	P <sub>O</sub> = 0.25 W
Voltage Gain (Closed Loop)	A <sub>v</sub>	41	45	48	dB	R <sub>f</sub> = 100 Ω
			34			R <sub>f</sub> = 360 Ω
Output Power	P <sub>O</sub>	1.8	3.6		W	T.H.D. = 10 %
			2.2			R <sub>f</sub> = 100 Ω
			2.4			V <sub>CC</sub> = 11 V, R <sub>L</sub> = 4 Ω
			1.3			V <sub>CC</sub> = 11 V, R <sub>L</sub> = 8 Ω
			1.0			V <sub>CC</sub> = 9 V, R <sub>L</sub> = 4 Ω
			0.54			V <sub>CC</sub> = 9 V, R <sub>L</sub> = 8 Ω
Input Sensitivity	V <sub>i(rms)</sub>		19.5		mV	P <sub>O</sub> = 2.4 W
			47.3			R <sub>L</sub> = 4 Ω
						R <sub>f</sub> = 100 Ω (A <sub>v</sub> = 45 dB)
Input Sensitivity	V <sub>i(rms)</sub>		2.5		mV	P <sub>O</sub> = 50 mW
			8.9			R <sub>L</sub> = 4 Ω
						R <sub>f</sub> = 100 Ω (A <sub>v</sub> = 45 dB)
Total Harmonic Distortion	T.H.D.		0.4	1.5	%	P <sub>O</sub> = 0.25 W
Output Noise Voltage	NL		0.2	0.8	mV <sub>r.m.s.</sub>	R <sub>G</sub> = 0
Supply Voltage Rejection Ratio	S.V.R.	40	55		dB	R <sub>G</sub> = 0, f <sub>ripple</sub> = 100 Hz V <sub>ripple</sub> = 0.3 V <sub>r.m.s.</sub>
Input Impedance	R <sub>i</sub>	10	20		kΩ	

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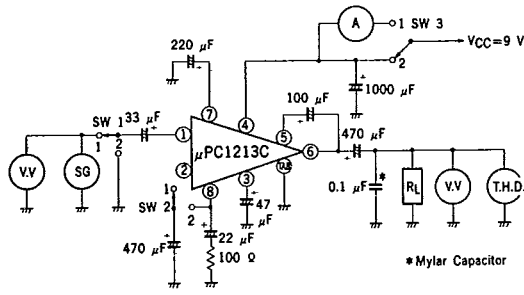
NOTE: In case that only a TYP. value is specified, this specification is for helping to design.

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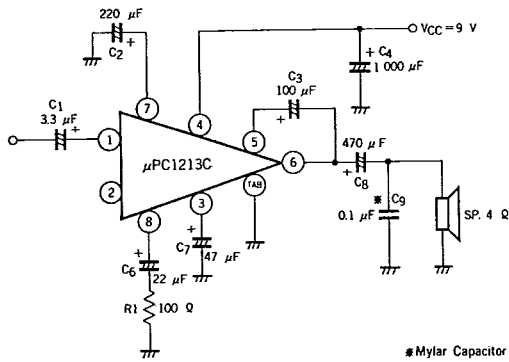
TEST CIRCUIT  
Fig. 1 TEST CIRCUIT



SWITCH POSITION

		SWITCH		
ITEM		SW1	SW2	SW3
Circuit Current	$I_{CC}$	2	1	1
Open Loop Voltage Gain	$A_{VO}$	1	2	2
Voltage Gain	$A_V$	1	1	2
Output Power	$P_O$	1	1	2
Total Harmonic Distortion	T.H.D.	1	1	2
Output Noise Voltage	NL	2	1	2

TYPICAL APPLICATION  
Fig. 2 SINGLE OPERATION



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Fig. 3 BTL OPERATION

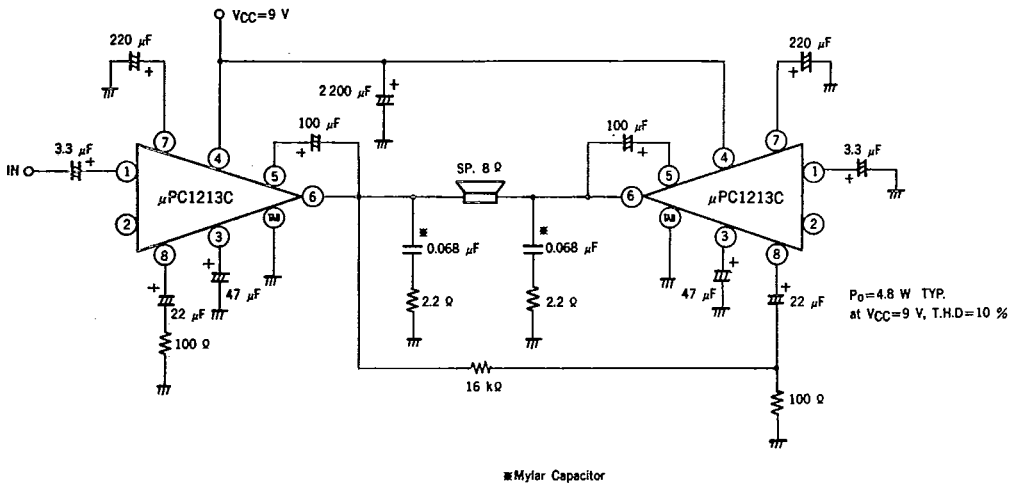
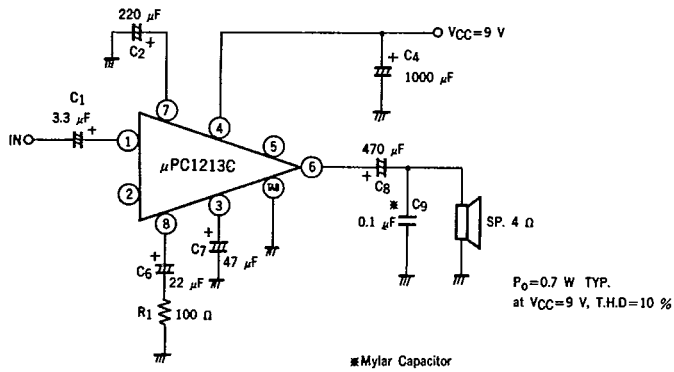


Fig. 4 SINGLE OPERATION WITHOUT BOOTSTRAP



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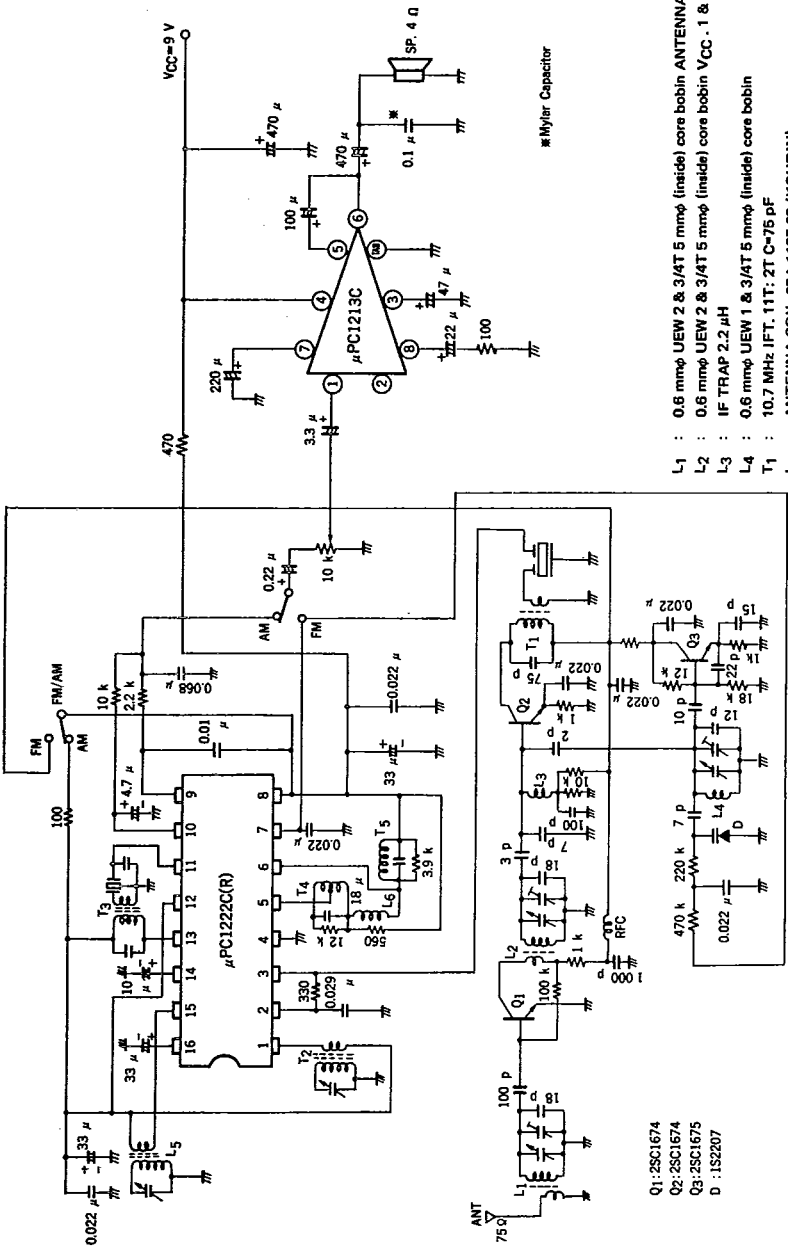
**NOTE FOR USE**

- (1) Capacitor C<sub>9</sub> is for preventing the parasitic oscillation. A mylar capacitor is recommended for this position.
- (2) The ground side of C<sub>4</sub>, C<sub>9</sub> and the loud speaker should be attached at the place of the copper foil close to the tab of  $\mu$ PC1212C.
- (3) Interference noise rejection in a strong electric field can be achieved by adding a capacitor (about 1 000 pF) between pin 1 and pin 2.

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- L1 : 0.6 mmφ UEW 2 & 3/AT 5 mmφ (inside) core bobbin ANTENNA 3/4T
- L2 : 0.6 mmφ UEW 2 & 3/AT 5 mmφ (inside) core bobbin VCC .1 & 3/4T
- L3 : IF TRAP 2.2 μH
- L4 : 0.6 mmφ UEW 1 & 3/AT 5 mmφ (inside) core bobbin
- T1 : 10.7 MHz IFT. 11T. 2T C-75 pF
- L5 : ANTENNA COIL. 25A-1195-08 (KOHRI)
- T2 : AM OSC 26-1791-13 (KOHRI)
- T3 : AM IFT CFZ-455C (TOKO)
- T4 : AM DET. 5251 (TOKO)
- T5 : FM DET. 12747 (TOKO)
- L6 : PHASE SHIFT COIL 7BA180JH (TOKO)

\*Mylar Capacitor

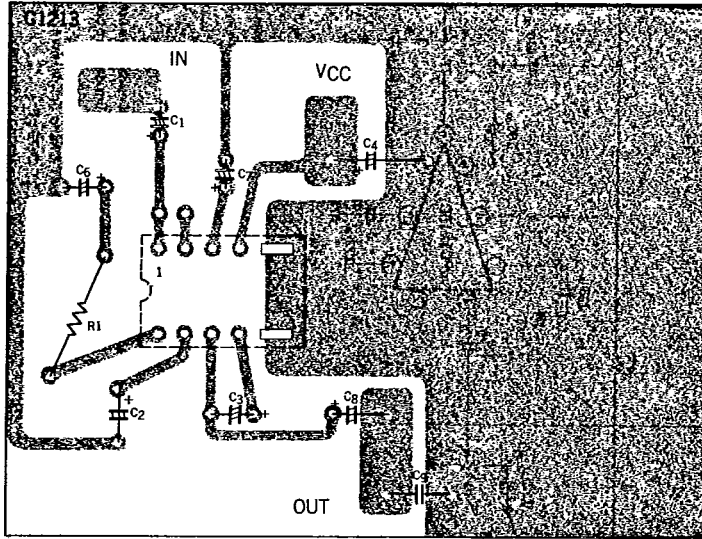
APPLICATION INFORMATION  
Fig. 5 LOW COST FM-AM RADIO WITH 2.4 W OUTPUT POWER (V<sub>CC</sub> = 9 V)

- Q1: 2SC1674
- Q2: 2SC1674
- Q3: 2SC1675
- D : 1S2207

UNIT : Capacitance F  
Resistance Ω

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P.C. BOARD PATTERN (COPPER SIDE)

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$\mu$ PC1213C

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TYPICAL CHARACTERISTICS ( $T_a = 25^\circ\text{C}$ )

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Fig. 6 OUTPUT POWER vs. SUPPLY VOLTAGE

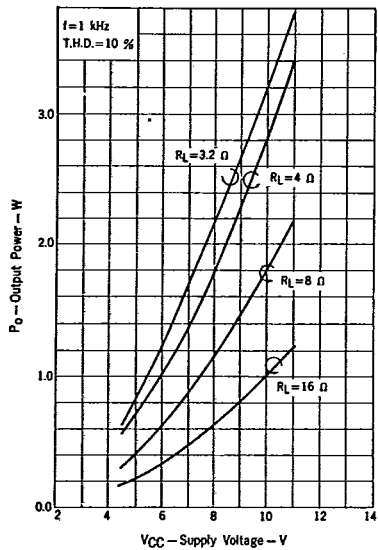


Fig. 7 TOTAL HARMONIC DISTORTION vs. OUTPUT POWER

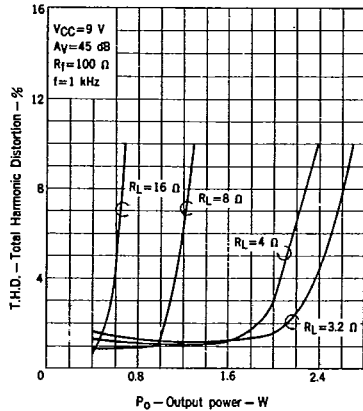
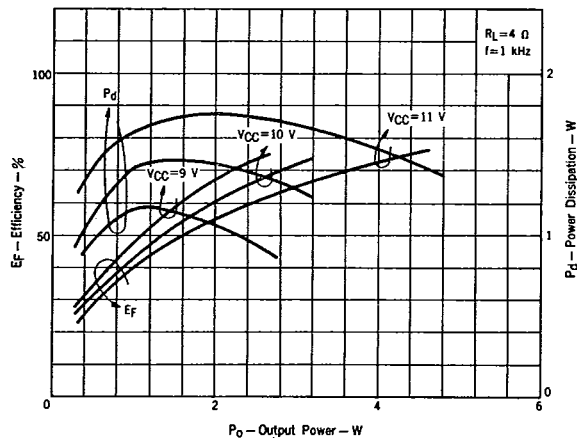


Fig. 8 POWER DISSIPATION AND EFFICIENCY vs. OUTPUT POWER



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Fig. 10 QUIESCENT OUTPUT VOLTAGE AT PIN 6 vs. SUPPLY VOLTAGE

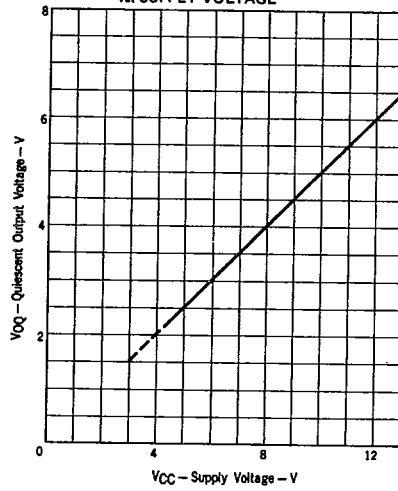


Fig. 9 VOLTAGE GAIN (CLOSED LOOP) vs. R<sub>f</sub>

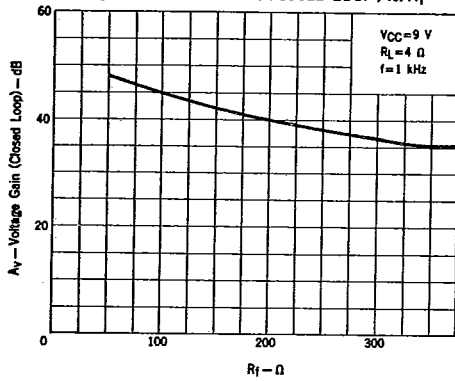


Fig. 11 INPUT SENSITIVITY vs. R<sub>f</sub>

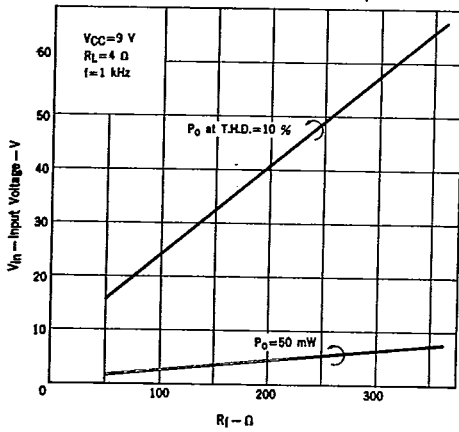
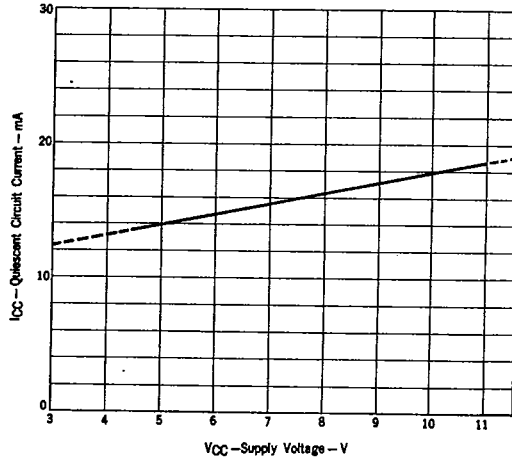


Fig. 12 QUIESCENT CIRCUIT CURRENT vs. SUPPLY VOLTAGE



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Fig. 13 OPEN LOOP VOLTAGE GAIN, VOLTAGE GAIN vs. FREQUENCY

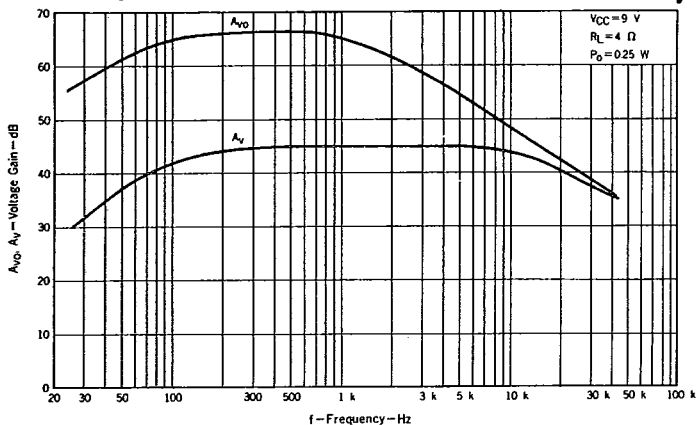


Fig. 14 TOTAL HARMONIC DISTORTION vs. FREQUENCY

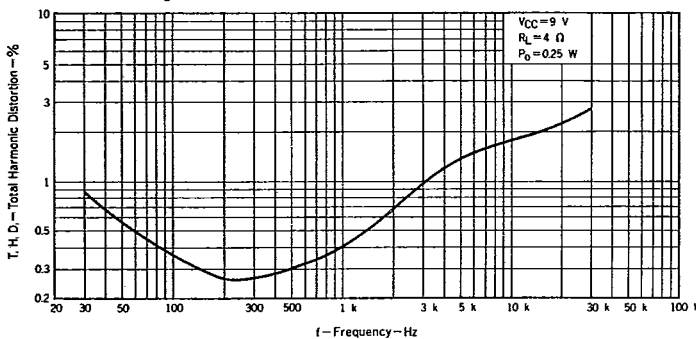


Fig. 15 TOTAL HARMONIC DISTORTION vs. OUTPUT POWER

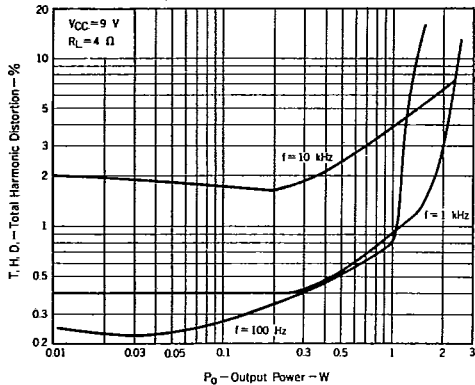


Fig. 16 THERMAL CHARACTERISTICS

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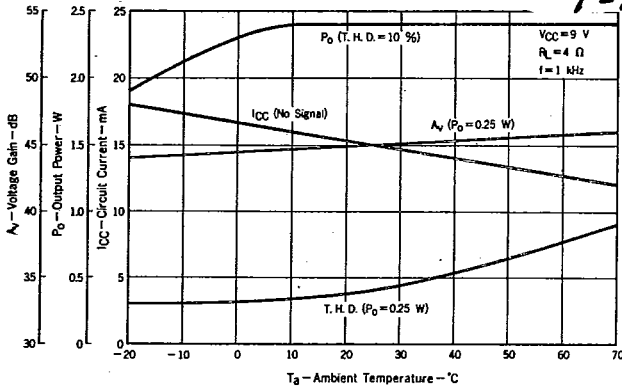


Fig. 17 OPEN LOOP VOLTAGE GAIN, VOLTAGE GAIN vs. SUPPLY VOLTAGE

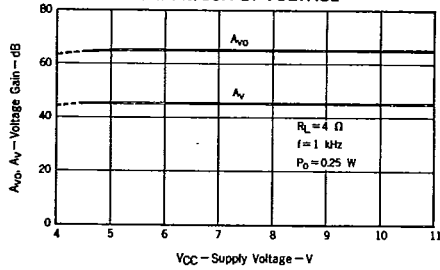
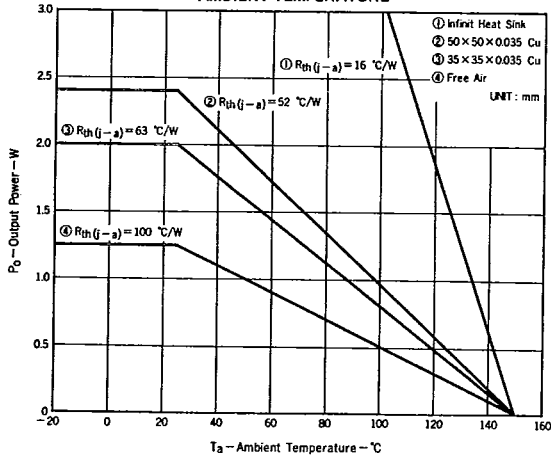


Fig. 18 AVAILABLE POWER DISSIPATION vs. AMBIENT TEMPERATURE



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## DESIGN OF HEAT SINK

Keep much margin at the design of heat sink.

The heat sink shown the folling sentence is nessesary when the  $\mu$ PC1213C is operated under next conditions.

Conditions : Maximum Operating Voltage 10 V  
 Maximum Ambient Temperature 70 °C  
 Load Impedance 4  $\Omega$

There is the equation between junction temperature and thermal resistance.

$$T_j = T_a + R_{th(j-a)} \times P_d \quad (1)$$

$T_j$  : Junction Temperature

$T_a$  : Ambient Temperature

$R_{th(j-a)}$  : Thermal Resistance (Junction to Ambient)

$P_d$  : Power Dissipation

According to Fig. 8,  $P_d(\text{MAX.}) = 1.42 \text{ W}$  at  $V_{CC} = 10 \text{ V}$

And absolute maximum rating shows,  $T_j < 150 \text{ }^\circ\text{C}$

From the equation (1) and those values,

$$R_{th(j-a)} < 56.3 \text{ }^\circ\text{C/W} \quad (2)$$

According to Fig. 18, copper size on P.C.B. satisfying the inequality (2) is  $50 \times 50 \times 0.035 \text{ mm}^3$ .