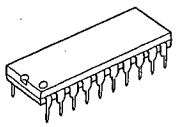
AM/FM RADIO

■ GENERAL DESCRIPTION

The NJM2237 is monolithic integrated circuit in a 20-lead dual in-line plastic package designed for use in 3-6V protable AM/FM radio receivers.

The functions incorporated are AM RF amplifier, AM mixer, FM/AM IF amplifier, FM/AM detecter, AM AGC circuit Audio Power amplifier.

■ PACKAGE OUTLINE

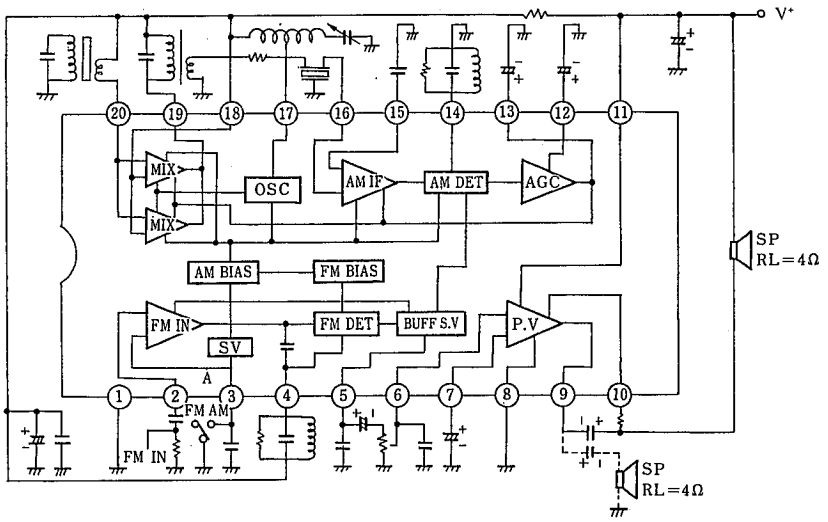


NJM2237D

■ FEATURES

- Wide Operating Voltage (1.8~6.0V)
- Very Simple DC switching of FM/AM
- High AM signal handling
- 4Ω speaker direct drive
- Low tweet
- Most suitable to use with NJM2236
- Package Outline DIP20
- Bipolar Technology

■ BLOCK DIAGRAM



(note) Dotted line shws V^+ =4.5V

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	8	V
Output Current	$I_{O(peak)}$	550	mA
Power Dissipation	P_D	1.2	W
Operating Temperature Range	T_{opr}	−20～75	℃
Storage Temperature Range	T_{stg}	−40～125	℃

■ ELECTRICAL CHARACTERISTICS

(V^+=3V, Ta=25℃, FM: f=10.7MHz, △f=22.5kHz dev., fm=1kHz
AM: f=1MHz, Mod=30%, fm=1kHz Unless otherwise noted)

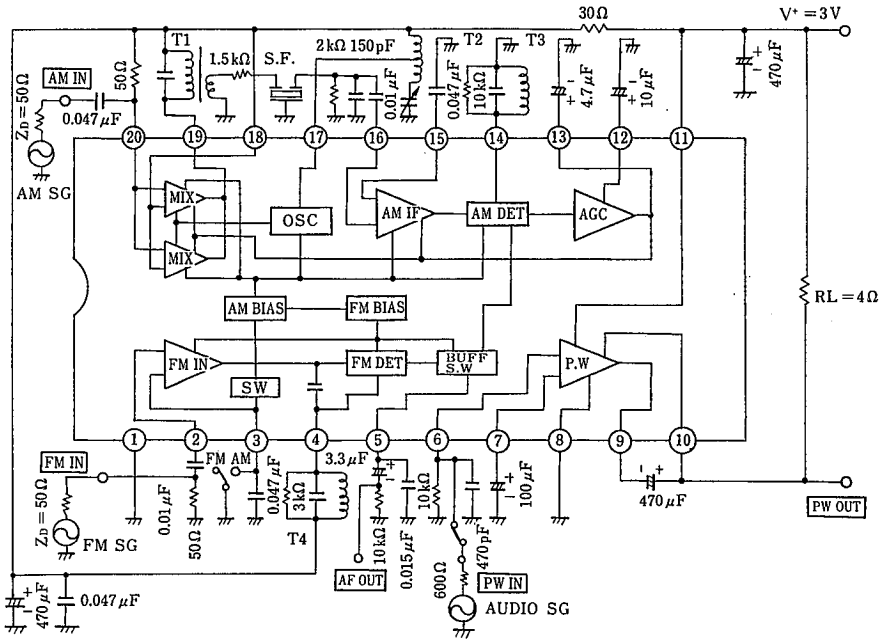
	CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
	Operating Current	I_{CC} (FM)	V_{IN}=0	—	15	20	mA
		I_{CC} (AM)	V_{IN}=0	—	15	20	
FM	−3dB Limiting Sensitivity	$V_{IN(lim)}$		—	36	42	dBμ
FM	Detection Output Voltage	V_{OD}	V_{IN}=80dBμ	22	31	44	mVrms
FM	Signal to Noise Ratio	S/N	V_{IN}=80dBμ	—	70	—	dB
FM	Total Harmonic Distortion	THD	V_{IN}=80dBμ	—	0.3	—	%
FM	Am Rejection Ratio	AMR	V_{IN}=80dBμ	—	33	—	dB
AM	Voltage Gain	G_V	V_{IN}=30dBμ	5	11	17	mVrms
AM	Detection Output Voltage	V_{OD}	V_{IN}=66dBμ	22	31	44	mVrms
AM	Signal to Noise Ratio	S/N	V_{IN}=66dBμ	—	46	—	dB
AM	Total Harmonic Distortion	THD1	V_{IN}=66dBμ	—	1.5	—	%
AM		THD2	V_{IN}=106dBμ	—	4.0	—	
AM	Local OSC Stop Voltage	V_{STOP}	V_{OSC}−6dB	—	1.0	1.5	V
PW	Voltage Gain	G_V	f=1kHz, R_L=4Ω	37	40	43	dB
PW	Output Power	$P_{OD}1$	f=1kHz, R_L=4Ω, THD=10%	180	220	—	mW
PW		$P_{OD}2$	V^+=4.5V f=1kHz, R_L=4Ω, THD=10%	—	500	—	
PW	Total Harmonic Distortion	THD	f=1kHz, R_L=4Ω, P_O=50mW	—	0.5	20	%
PW	Output Noise Voltage	V_{NO}	R_O=10kΩ, RL=4Ω BW=30Hz～20kHz	—	0.18	—	mVrms

■ TERMINAL VOLTAGE AT NO SIGNAL

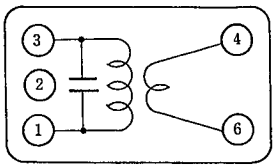
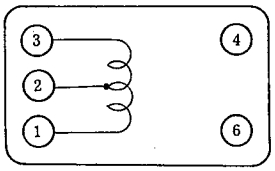
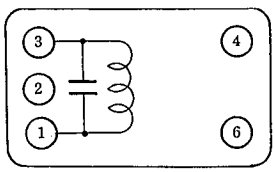
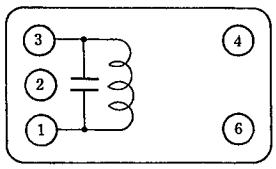
(V⁺=3V, Ta=25℃)

CHARACTERISTICS		SYMBOLS	TYPICAL VALUE.		UNIT.
PIN NO	FUNCTION		AT AM	AT FM	
1	GND	V_1	0	0	V
2	FM IF IN	V_2	2.4	2.0	V
3	FM/AM Switch	V_3	0	2.0	V
4	FM DET	V_4	2.9	2.9	V
5	DET OUT	V_5	0.4	0.7	V
6	PW IN	V_6	0	0	V
7	PW Bipass	V_7	0.6	0.6	V
8	PW GND	V_8	0	0	V
9	PW OUT	V_9	1.5	1.5	V
10	PW Bootstrap	V_{10}	2.8	2.8	V
11	V⁺ 1	V_{11}	3.0	3.0	V
12	AGC1	V_{12}	0.6	0	V
13	AGC2	V_{13}	0.6	0	V
14	AM DET	V_{14}	0	0	V
15	AM Bipass	V_{15}	1.3	0	V
16	AM IF IN	V_{16}	1.3	0	V
17	AM Osc	V_{17}	2.9	2.9	V
18	V⁺ 2	V_{18}	2.9	2.9	V
19	AM MIX OUT	V_{19}	2.9	2.9	V
20	AM RF IN	V_{20}	2.9	2.9	V

■ TEST CIRCUIT



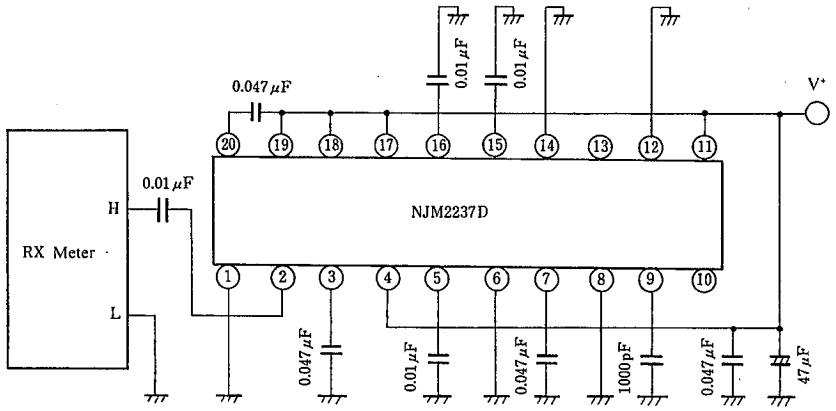
■ TEST CIRCUIT COIL DATA

COIL NO.	F_0	Q_0	TURNS	C_0	BOTTOM VIEW
T_1 : FM IFT (MIX OUT)	455kHz	①–③ 80	①–③ 60T ④–⑥ 16T Wire : 0.09mmϕ UEW SUMIDA 2150–2173–302	①–③ 1500pF	 Bottom View
T_2 : AM OSC	796kHz	①–③ 125	①–② 15T ②–③ 89T Wire : 0.06mmϕ UEW SUMIDA 2157–2239–213A	–	 Bottom View
T_3 : AM DET	455kHz	①–③ 105	①–③ 127T Wire : 0.06mmϕ UEW SUMIDA 2150–2083–061	①–③ 330pF	 Bottom View
T_4 : FM DET	10.7MHz	①–③ 100	①–③ 10T Wire : 0.12mmϕ UEW SUMIDA 2153–4095–331	①–③ 150pF	 Bottom View

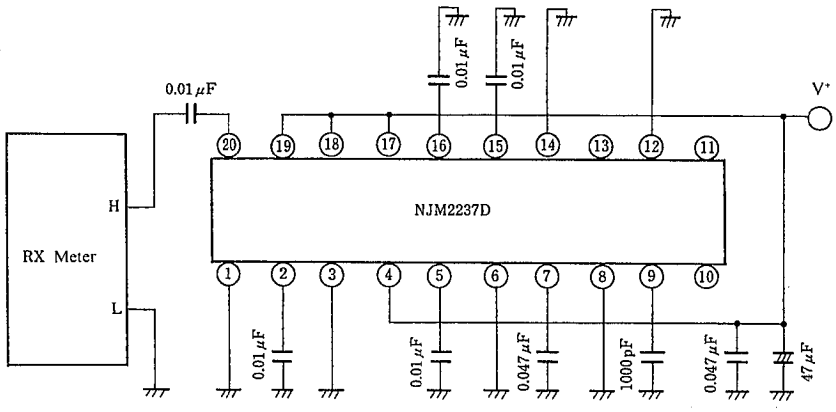
■ INPUT OUTPUT IMPEDANCE

CHARACTERISTIC	SYMBOL	CIRCUIT	TEST CONDITION	TYP.	UNIT
Pin 2 Input Impedance (FM)	R_{IN2} C_{IN2}	1	f=10.7MHz	4.6 5.0	kΩ pF
Pin 20 Input Impedance (AM)	R_{IN20} C_{IN20}	2	f=1MHz	20 11	kΩ pF
Pin 16 Input Impedance (AM)	R_{IN16} C_{IN16}	3	f=455kHz	6 3.7	kΩ pF
Pin 19 Output Impedance (AM)	R_{O19} C_{O19}	4	f=455kHz	2.5 5.5	kΩ pF
Pin 14 Output Impedance (AM)	R_{O14} C_{O14}	5	f=455kHz	100 5.0	kΩ pF

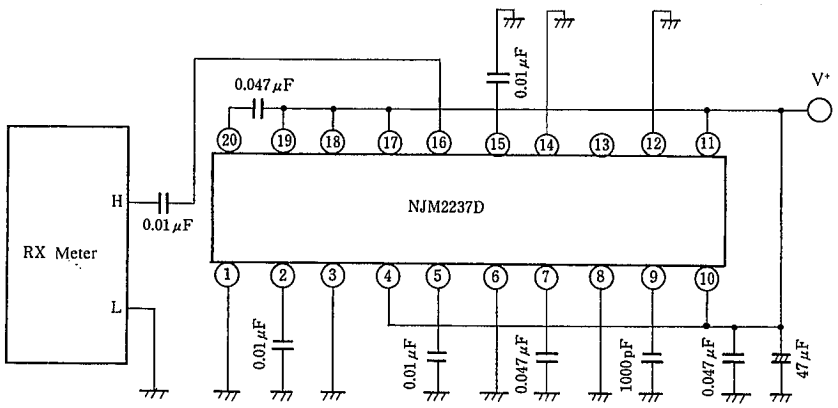
■ TEST CIRCUIT 1 (Pin 2 FM Input Resistance, Capacitance)



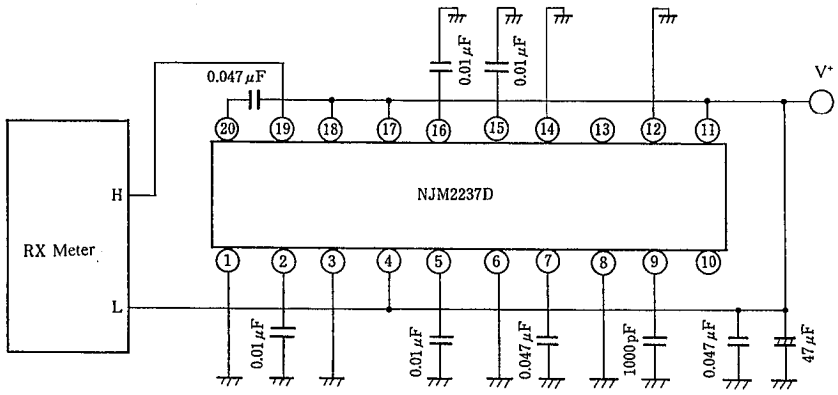
■ TEST CIRCUIT 2 (Pin 20 AM Input Resistance, Capacitance)



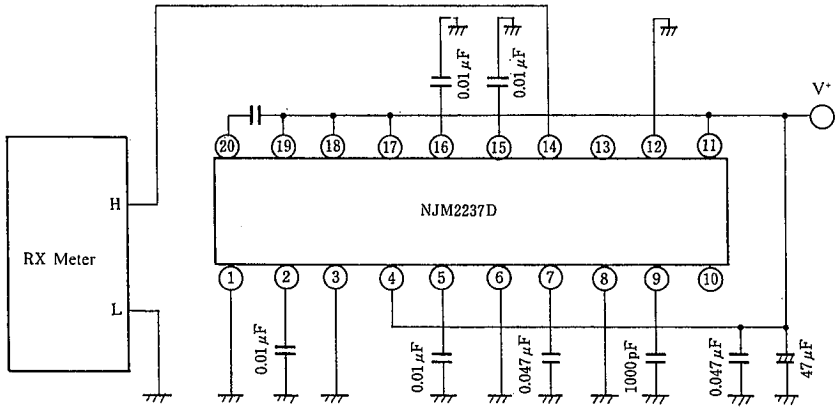
■ **TEST CIRCUIT 3** (Pin 16 AM IF Input Resistance, Capacitance)



■ **TEST CIRCUIT 4** (Pin 19 AM Mix Output Resistance, Capacitance)



■ **TEST CIRCUIT 5** (Pin 14 AM DET Output Resistance, Capacitance)



■ NOTES

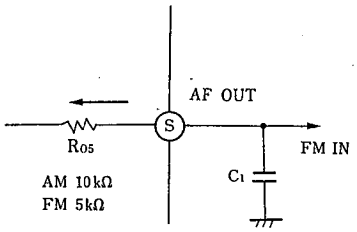
1. The frequency characteristics at AM and FM mode

The output impedance of pin5 (R_{O5}) and external capacitor C1 decide frequency characteristics.

The value of R_{O5} turns to 10kΩ at AM mode and 5kΩ at FM mode.

Accordingly should consider above, trim C1 to get proper frequency response.

Besides should design the location of C1 closer to pin1 (GND) to get low tweet.



2. Loading speaker

Recommend to connect the speaker between pin11 (V^+) and pin10 (bootstrap) at $V^+ = 3V$ for better low supply to voltage operation.

When Vcc is above 4.5V, recommend the speaker connection between pin9 (PW OUT) and (GND) through a coupling capacitor.

3. Termination to the power stage

The audio signal of output pin5 includes carrier component slightly, therefore a capacitor between pin6 and GND have to be connected to decrease carrier component.

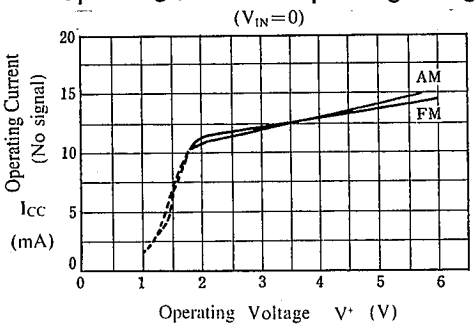
4. Supply voltage start-up

The supply voltage of radio circuit block should not start up before power stage start-up.

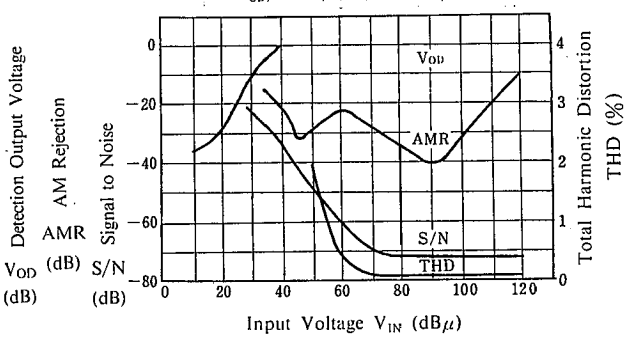
4

■ TYPICAL CHARACTERISTICS

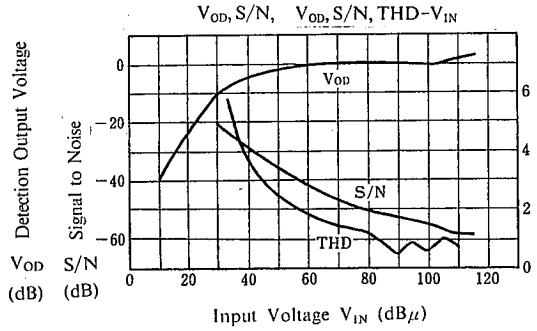
Operating Current vs. Operating Voltage



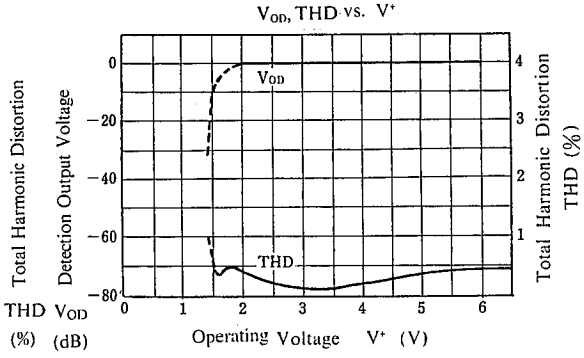
V_{OD}, AMR, S/N, THD vs. V_{IN}



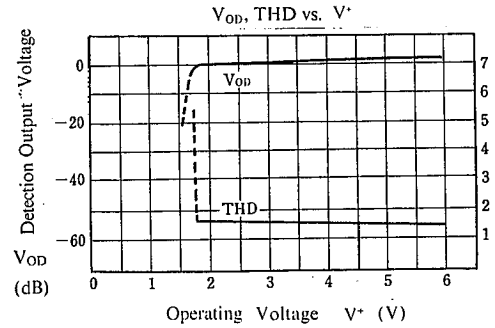
V_{OD}, S/N, V_{OD}, S/N, THD-V_{IN}



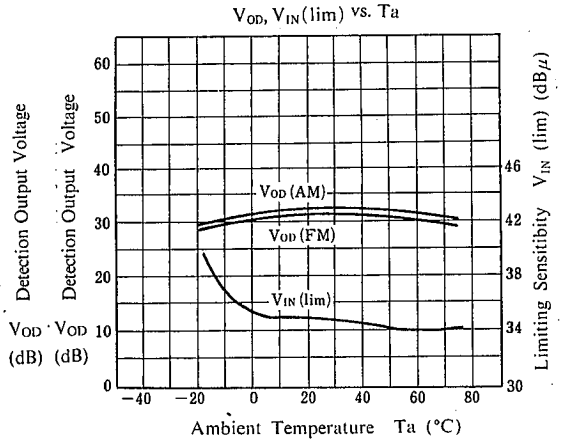
V_{OD}, THD vs. V+



V_{OD}, THD vs. V+

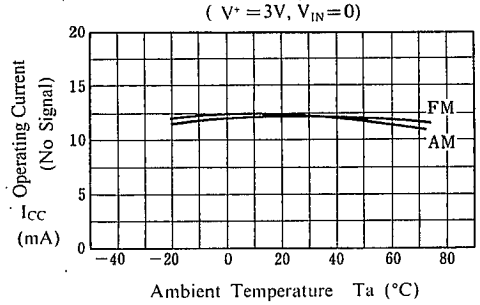


V_{OD}, V_{IN}(lim) vs. Ta

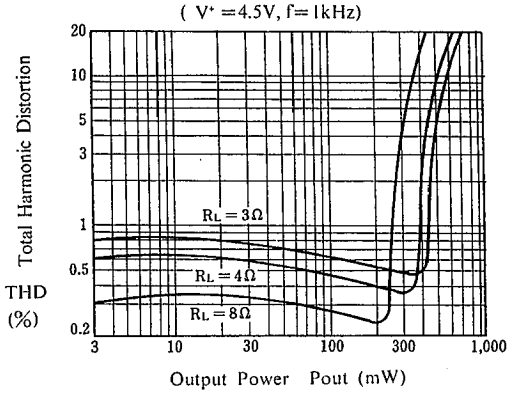


■ TYPICAL CHARACTERISTICS

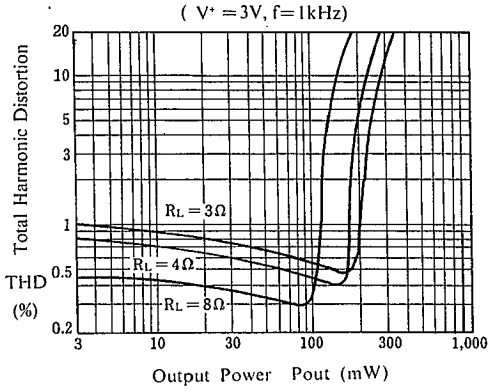
Operating Current vs. Temperature
($V^+ = 3V$, $V_{IN} = 0$)



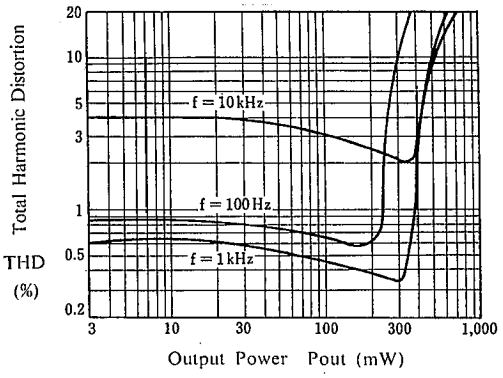
Total Harmonic Distortion vs. Output Power
($V^+ = 4.5V$, f = 1kHz)



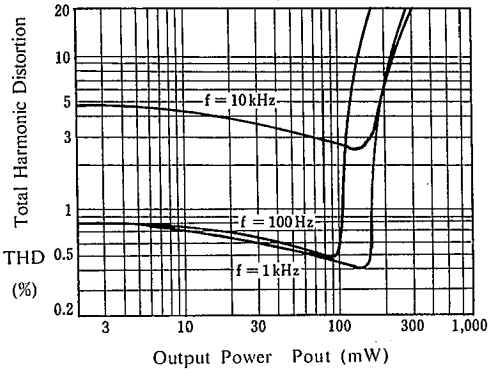
Total Harmonic Distortion vs. Output Power
($V^+ = 3V$, f = 1kHz)



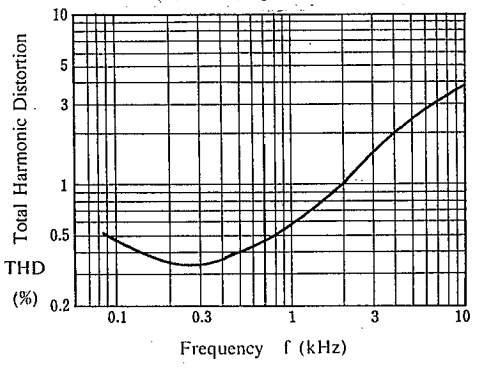
Total Harmonic Distortion vs. Output Power
($V^+ = 4.5V$, $R_L = 4\Omega$)



Total Harmonic Distortion vs. Output Power
($V^+ = 3V$, $R_L = 4\Omega$)

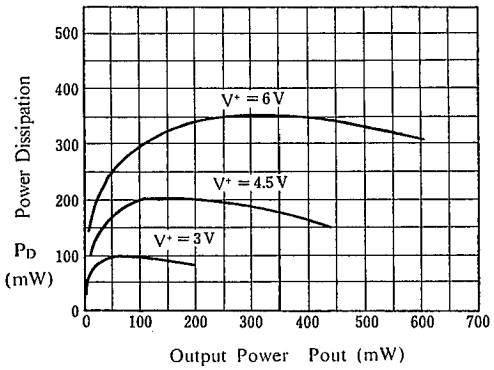


Total Harmonic Distortion vs. Frequency
($V^+ = 3V$, $V_O = 450mVrms$)

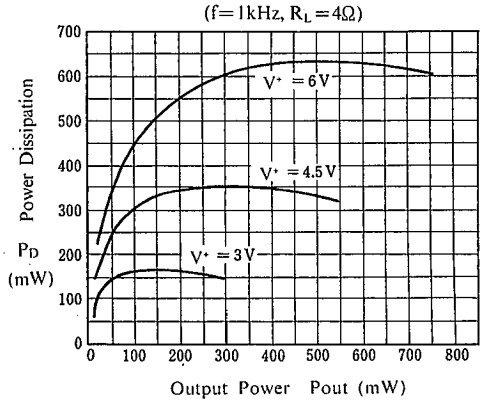


■ TYPICAL CHARACTERISTICS

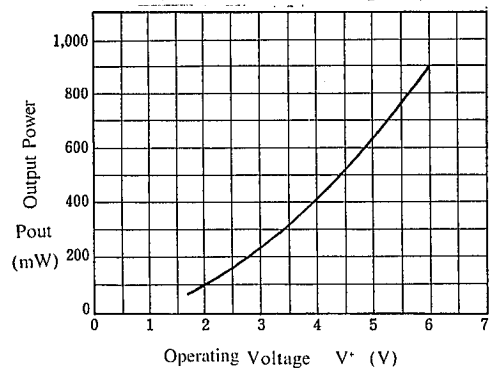
Power Dissipation vs. Output Power
(f=1kHz, R_L=8Ω)



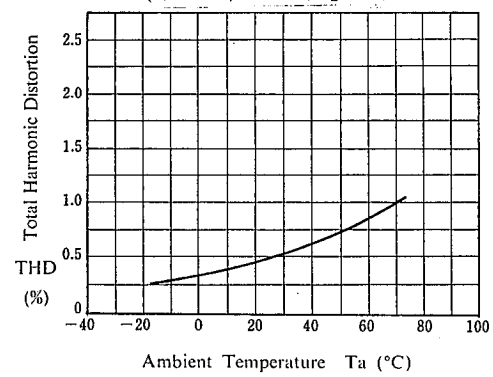
Power Dissipation vs. Output Power
(f=1kHz, R_L=4Ω)



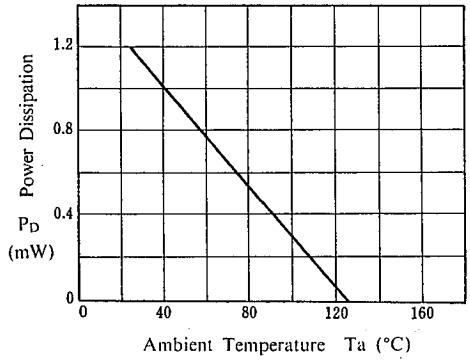
Output Power vs. Operating Voltage
(f=1kHz, THD=10%, R_L=4Ω)



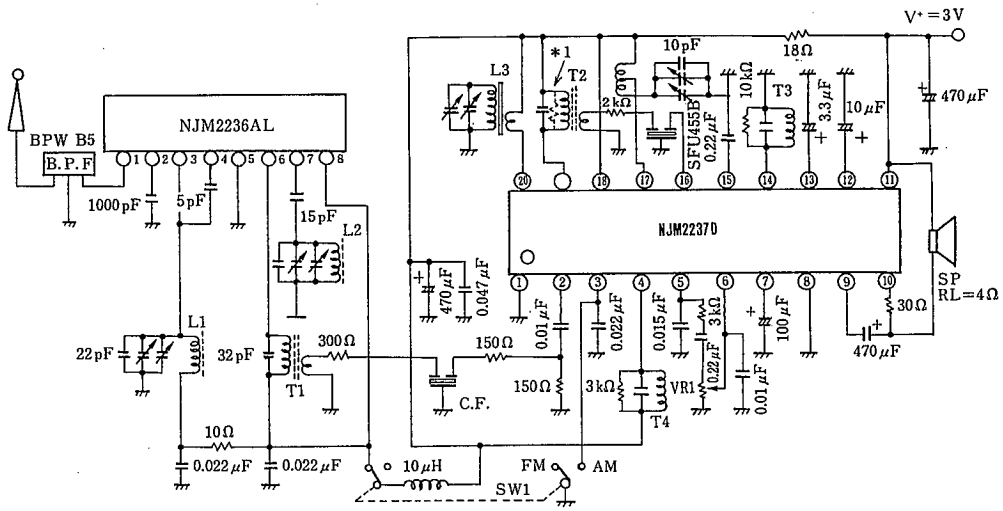
Total Harmonic Distortion vs. Temperature
(V^+ =3V, f=1kHz, R_L=4Ω)



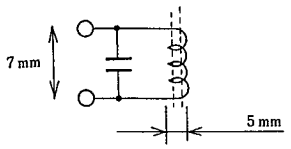
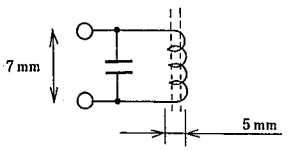
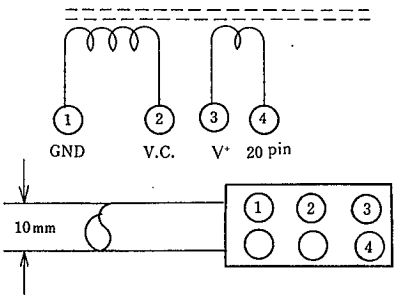
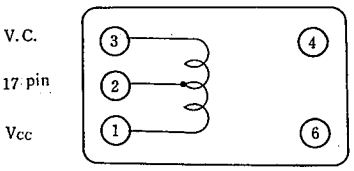
Power Dissipation vs. Temperature

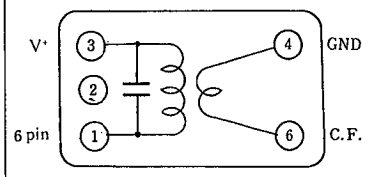
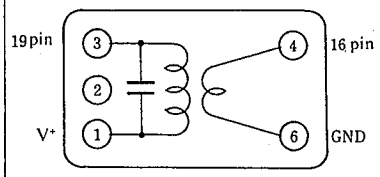
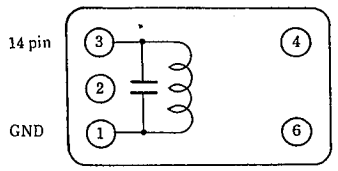
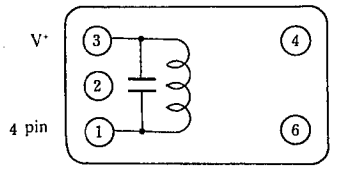


■ FM/AM RADIO APPLICATION CIRCUIT



■ FM/AM RADIO APPLICATION CIRCUIT

COIL NO.	F_0	Q_0	TURNS	C_0	BOTTOM VIEW
L_1 : RF Coil	100MHz	100	0.7mmφ $2\frac{1}{4}$ T (Japan Band) SUMIDA 0295−057	22pF (ext.)	 Ferrite Core
L_2 : OSC Coil	100MHz	100	0.7mmφ $2\frac{1}{2}$ T (Japan Band) SUMIDA 0295−056	30pF (ext.)	 Ferrite Core
L_3 : AM ANT	796kHz	①−② 200	①−② 100 T L=600μH ③−④ 17 T Wire : 4/0.07mm UATC Core : 10mmφ×80mm MITUMI YI−7160−1	—	 BOTTOM VIEW
L_4 : AM OSC	796kHz	①−③ 125	①−② 15 T ②−③ 89 T Wire : 0.06mmφ UEW SUMIDA 2157−2239−213A	—	 BOTTOM VIEW

COIL NO.	F_0	Q_0	TURNS	C_0	BOTTOM VIEW
T_1 : FM IFT	10.7MHz	①−③ 90	①−③ 11T ④−⑥ 2 T Wire : 0.12mmφ UEW SUMIDA 2153−414−041	①−③ 82pF	
T_2 : AM IFT	455kHz	①−③ 80	①−③ 60 T ④−⑥ 16 T Wire : 0.09mmφ UEW SUMIDA 2150−2173−302	①−③ 1500pF	
T_3 : AM DET	455kHz	①−③ 105	①−③ 127 T Wire : 0.06mmφ UEW SUMIDA 2150−2083−061	①−③ 3330pF	
T_4 : FM DET	10.7MHz	①−③ 100	①−③ 10 T Wire : 0.12mmφ UEW SUMIDA 2153−4095−331	①−③ 150pF	

MEMO