

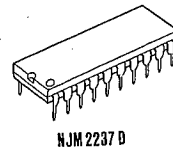
AM/FM RADIO

■ GENERAL DESCRIPTION

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

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

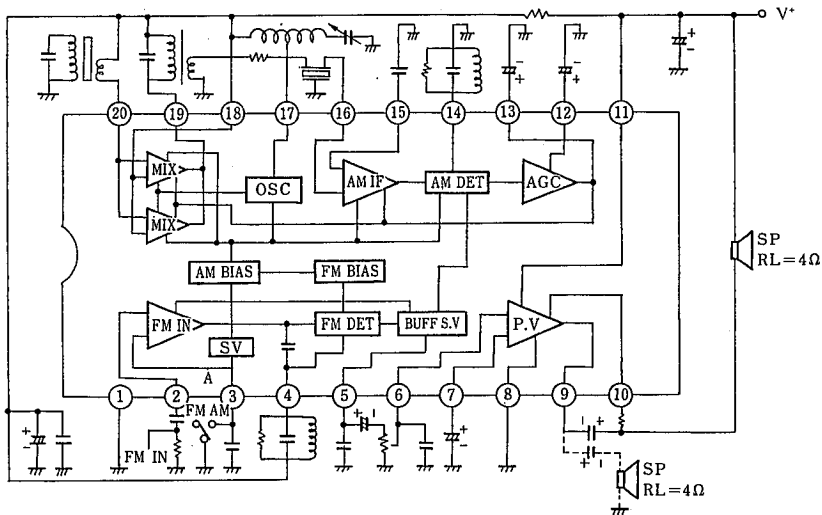
■ PACKAGE OUTLINE



■ FEATURES

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

■ BLOCK DIAGRAM



(note) Dotted line shows $V^* = 4.5V$

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

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	°C
Storage Temperature Range	T _{stg}	-40~125	°C

■ ELECTRICAL CHARACTERISTICS

(V⁺=3V, Ta=25°C, FM: f=10.7MHz, Δf=22.5kHz dev., fm=1kHz

AM: f=1MHz, Mod=30%, fm=1kHz Unless otherwise noted)

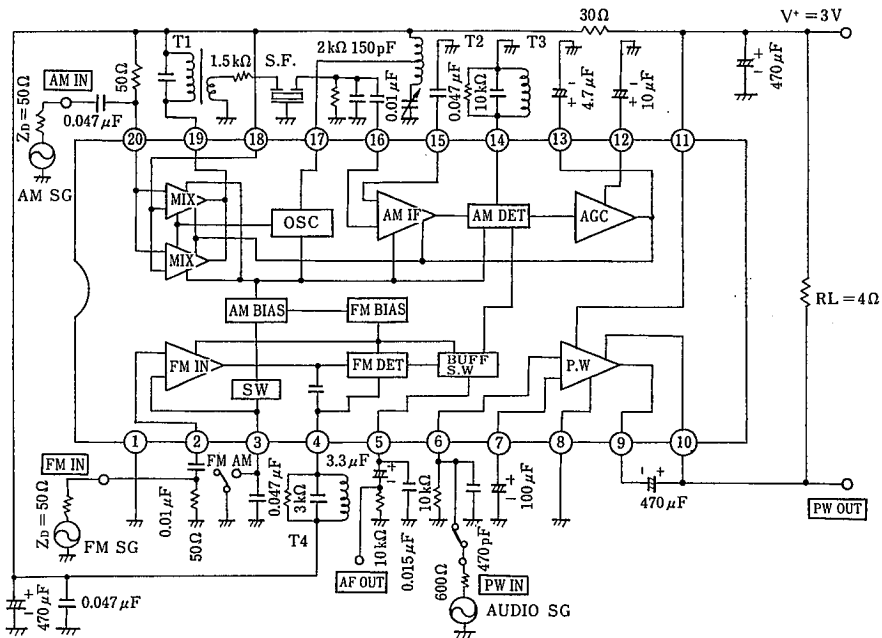
CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
Operating Current	I _{CC} (FM)	V _{IN} =0	—	15	20	mA	
	I _{CC} (AM)	V _{IN} =0	—	15	20		
F	-3dB Limiting Sensitivity	V _{IN(lim)}	—	36	42	dBμ	
	Detection Output Voltage	V _{OD}	V _{IN} =80dBμ	22	31	44	mVrms
	Signal to Noise Ratio	S/N	V _{IN} =80dBμ	—	70	—	dB
M	Total Harmonic Distortion	THD	V _{IN} =80dBμ	—	0.3	—	%
	Am Rejection Ratio	AMR	V _{IN} =80dBμ	—	33	—	dB
A	Voltage Gain	G _V	V _{IN} =30dBμ	5	11	17	mVrms
	Detection Output Voltage	V _{OD}	V _{IN} =66dBμ	22	31	44	mVrms
	Signal to Noise Ratio	S/N	V _{IN} =66dBμ	—	46	—	dB
M	Total Harmonic Distortion	THD1	V _{IN} =66dBμ	—	1.5	—	%
		THD2	V _{IN} =106dBμ	—	4.0	—	
	Local OSC Stop Voltage	V _{STOP}	V _{osc} -6dB	—	1.0	1.5	V
P	Voltage Gain	G _V	f=1kHz, R _L =4Ω	37	40	43	dB
		P _{OD1}	f=1kHz, R _L =4Ω, THD=10%	180	220	—	
	Output Power	P _{OD2}	V ⁺ =4.5V f=1kHz, R _L =4Ω, THD=10%	—	500	—	mW
W	Total Harmonic Distortion	THD	f=1kHz, R _L =4Ω, P _O =50mW	—	0.5	20	%
	Output Noise Voltage	V _{NO}	R _O =10kΩ, R _L =4Ω BW=30Hz~20kHz	—	0.18	—	mVrms

■ TERMINAL VOLTAGE AT NO SIGNAL

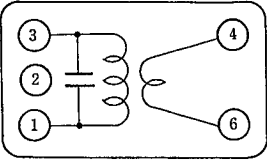
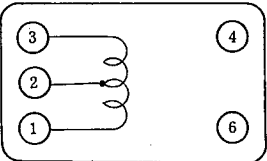
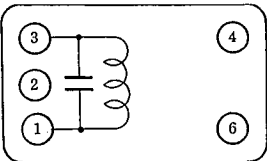
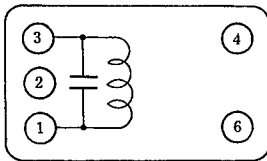
(V* = 3V, T_a = 25°C)

PIN NO	CHARACTERISTICS FUNCTION	SYMBOLS	TYPICAL VALUE.		UNIT.
			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 Bypass	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 Bypass	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



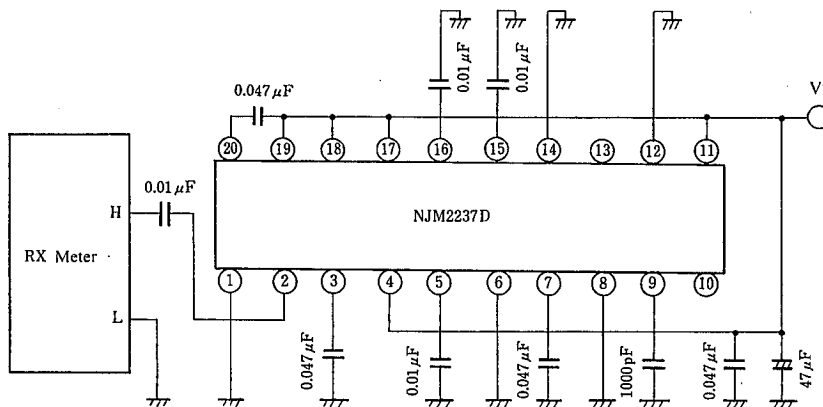
■ TEST CIRCUIT COIL DATA

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

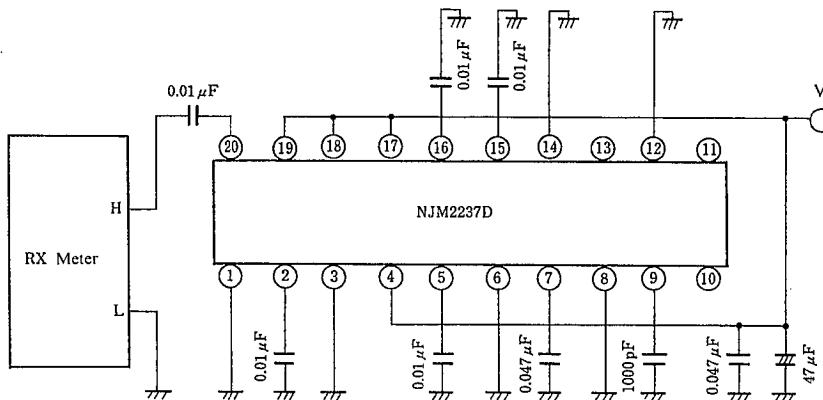
■ INPUT OUTPUT IMPEDANCE

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

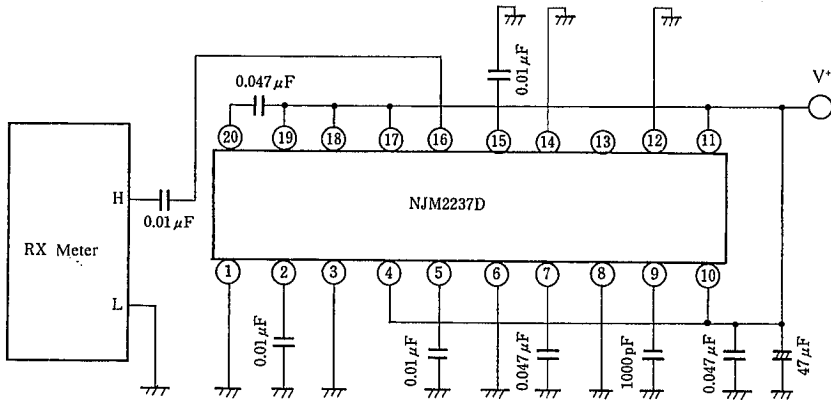
■ TEST CIRCUIT 1 (Pin 2 FM Input Resistance, Capacitance)



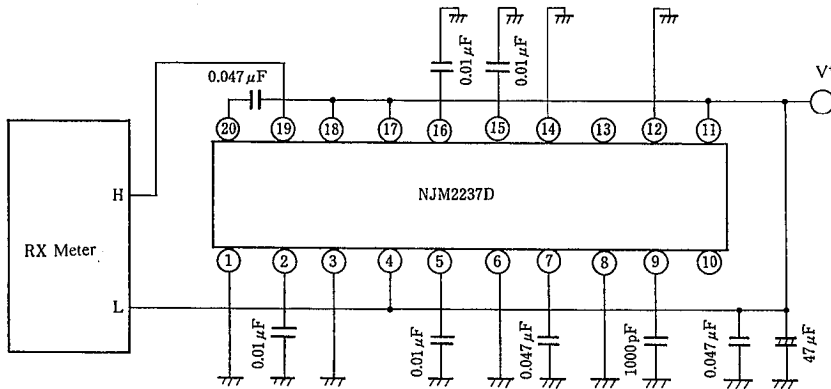
■ TEST CIRCUIT 2 (Pin 20 AM Input Resistance, Capacitance)



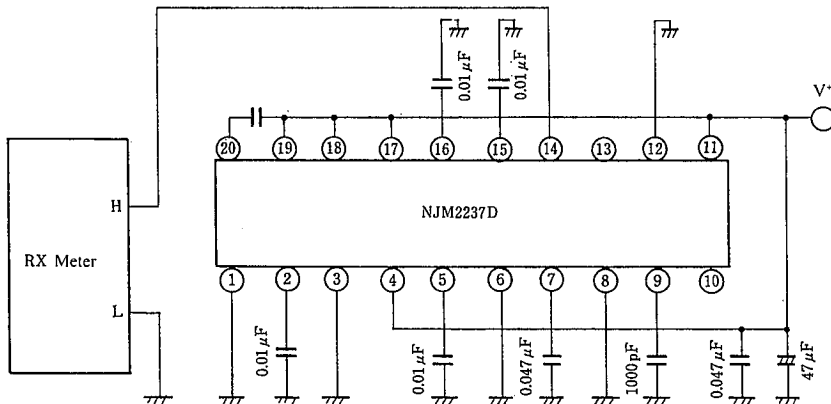
■ TEST CIRCUIT 3 (Pin 16 AM IF Input Resistance, Capacitance)



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



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



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■ NOTES

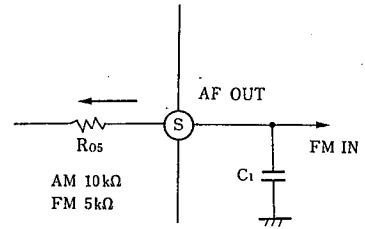
1. The frequency characteristics at AM and FM mode

The output impedance of pin5 (Ro5) and external capacitor C1 decide frequency characteristics.

The value of Ro5 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 V_{cc} 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.

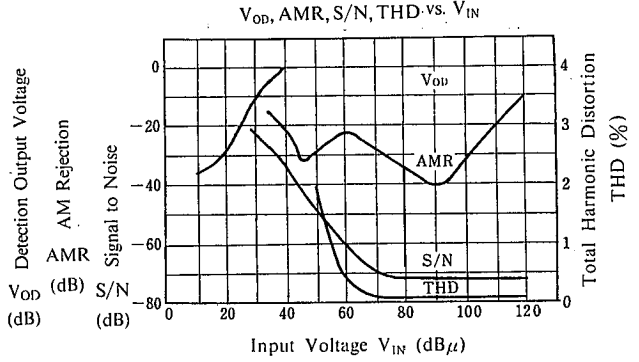
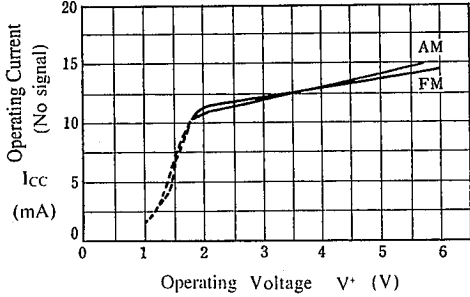
4. Supply voltage start-up

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

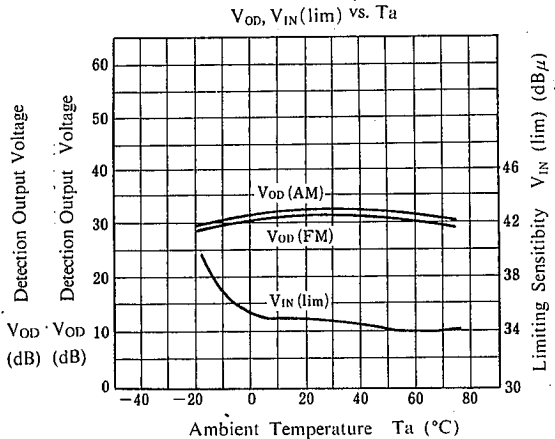
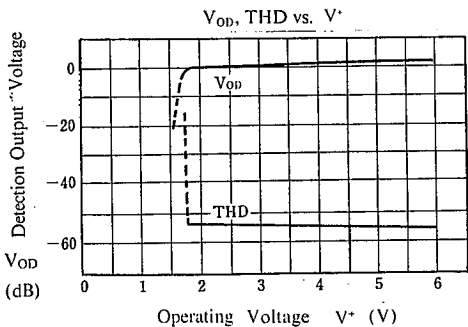
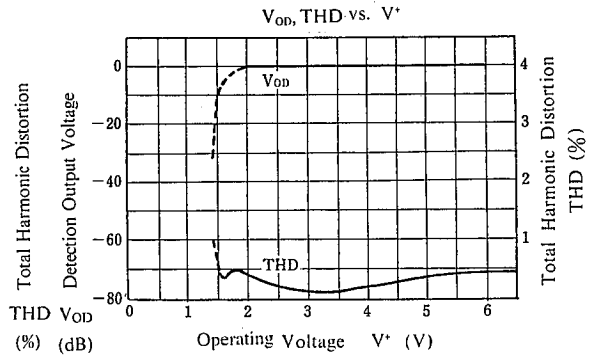
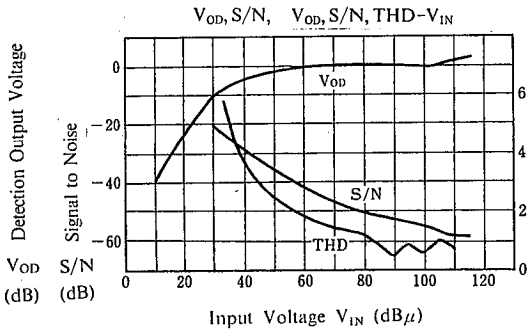
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■ TYPICAL CHARACTERISTICS

Operating Current vs. Operating Voltage
($V_{IN}=0$)

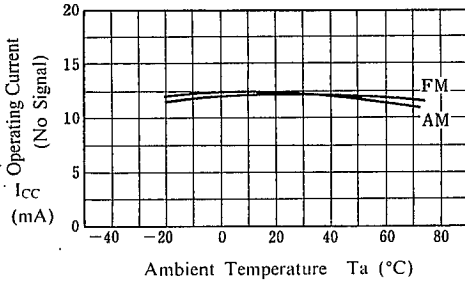


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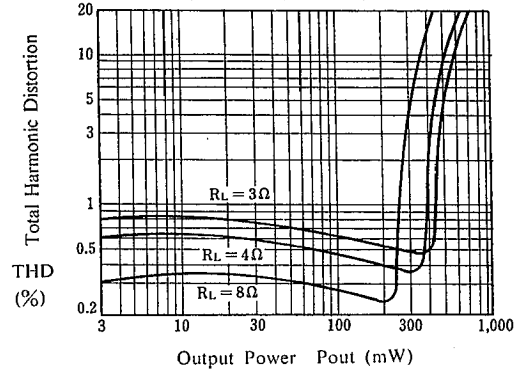


■ TYPICAL CHARACTERISTICS

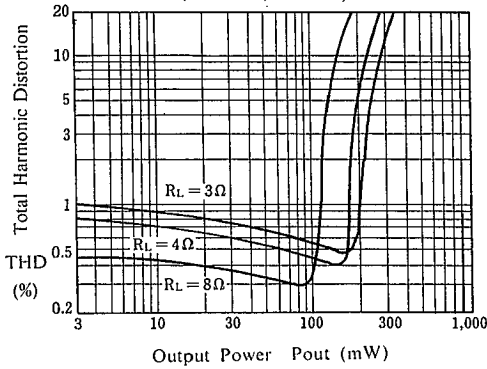
Operating Current vs. Temperature
($V^* = 3V, V_{IN} = 0$)



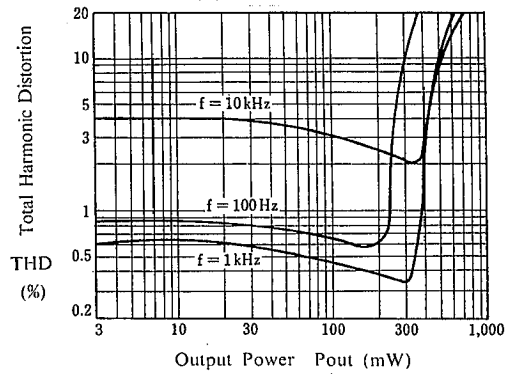
Total Harmonic Distortion vs. Output Power
($V^* = 4.5V, f = 1kHz$)



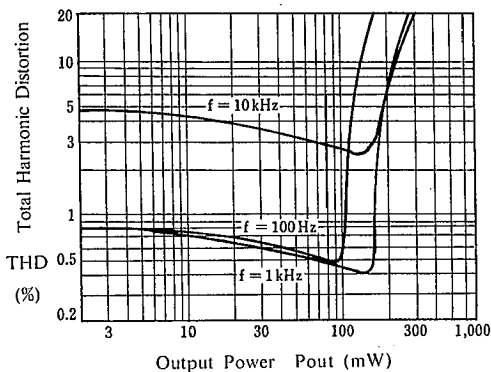
Total Harmonic Distortion vs. Output Power
($V^* = 3V, f = 1kHz$)



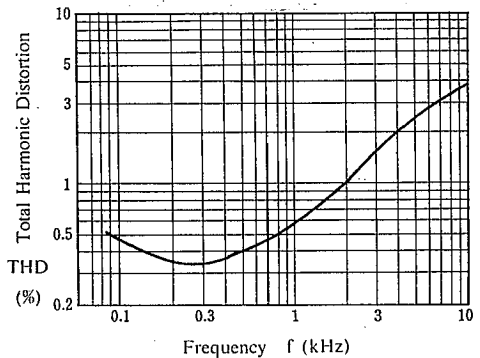
Total Harmonic Distortion vs. Output Power
($V^* = 4.5V, R_L = 4\Omega$)



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



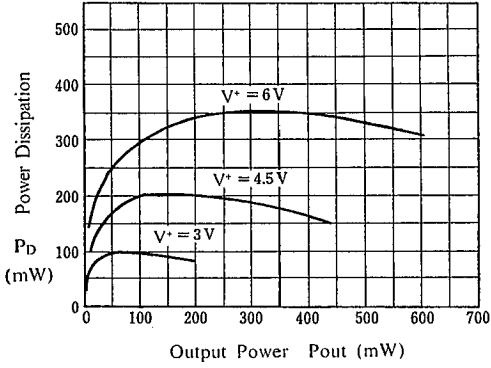
Total Harmonic Distortion vs. Frequency
($V^* = 3V, V_O = 450mV_{rms}$)



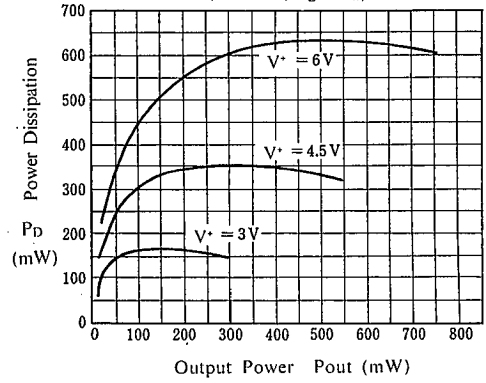
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TYPICAL CHARACTERISTICS

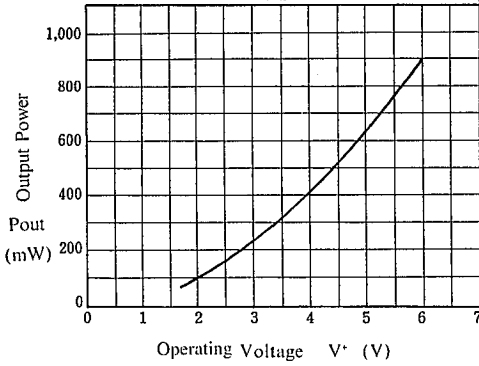
Power Dissipation vs. Output Power
($f=1\text{kHz}$, $R_L=8\Omega$)



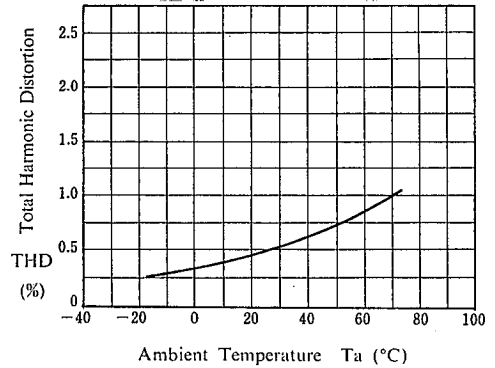
Power Dissipation vs. Output Power
($f=1\text{kHz}$, $R_L=4\Omega$)



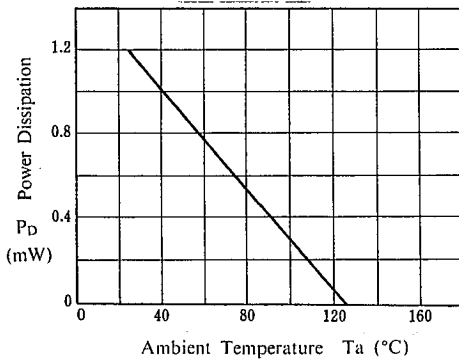
Output Power vs. Operating Voltage
($f=1\text{kHz}$, $\text{THD}=10\%$, $R_L=4\Omega$)



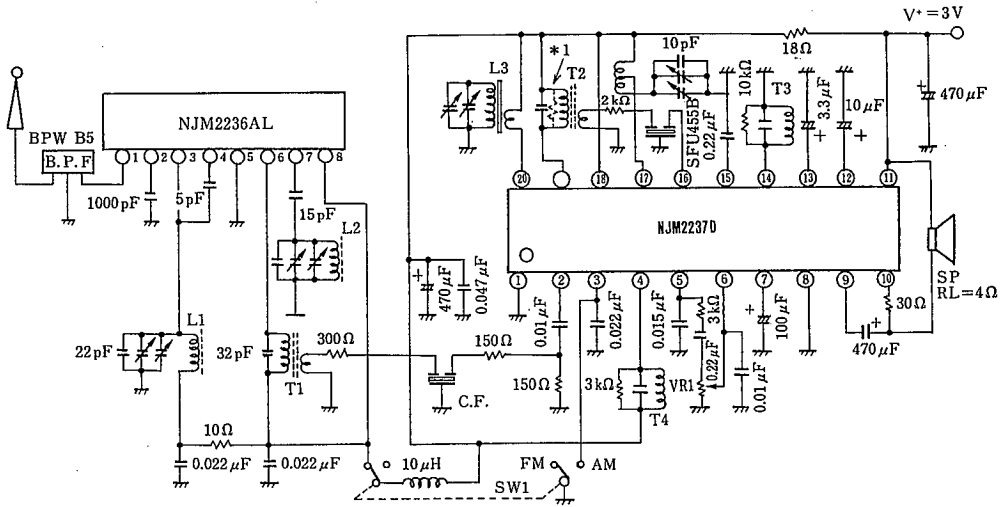
Total Harmonic Distortion vs. Temperature
($V^*=3\text{V}$, $f=1\text{kHz}$, $R_L=4\Omega$)



Power Dissipation vs. Temperature

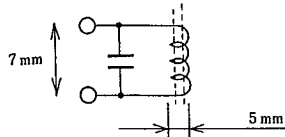
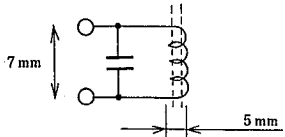
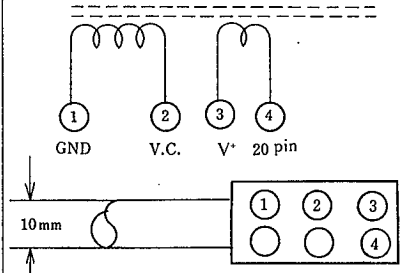
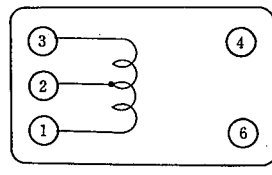


■ FM/AM RADIO APPLICATION CIRCUIT



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■ 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.)	 <p>Ferrite Core</p>
L ₂ : OSC Coil	100MHz	100	0.7mmφ 2 $\frac{1}{2}$ T (Japan Band) SUMIDA 0295-056	30pF (ext.)	 <p>Ferrite Core</p>
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	-	 <p>BOTTOM VIEW</p>
L ₄ : AM OSC	796kHz	①-③ 125	①-② 15 T ②-③ 89 T Wire: 0.06mmφ UEW SUMIDA 2157-2239-213A	-	 <p>BOTTOM VIEW</p>

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 2T Wire : 0.12mmφ UEW SUMIDA 2153-414-041	①-③ 82pF	
T ₂ : AM IFT	455kHz	①-③ 80	①-③ 60T ④-⑥ 16T Wire : 0.09mmφ UEW SUMIDA 2150-2173-302	①-③ 1500pF	
T ₃ : AM DET	455kHz	①-③ 105	①-③ 127T Wire : 0.06mmφ UEW SUMIDA 2150-2083-061	①-③ 3330pF	
T ₄ : FM DET	10.7MHz	①-③ 100	①-③ 10T Wire : 0.12mmφ UEW SUMIDA 2153-4095-331	①-③ 150pF	

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MEMO

[CAUTION]

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