

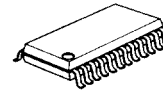
AM/FM RADIO

■ GENERAL DESCRIPTION

The NJM2241 is monolithic integrated circuit in a 24-lead small outline 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, FM/AM detector, FM/AM tuning/indicator, AM AGC circuit, Audio Power amplifier.

■ PACKAGE OUTLINE

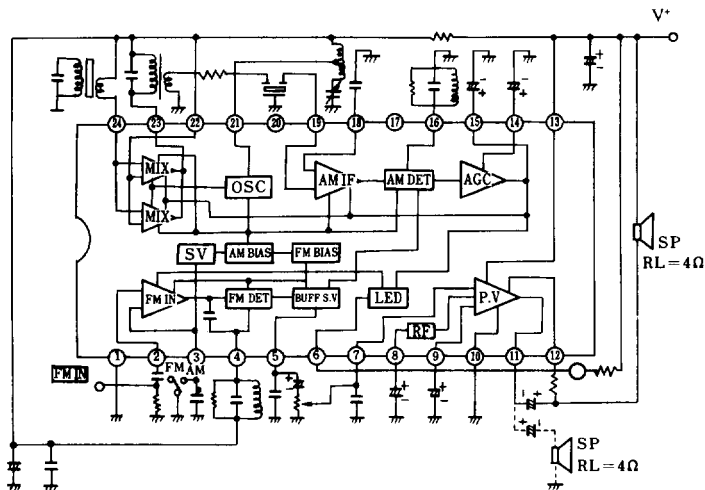


NJM 2241 M

■ FEATURES

- Wide Operating Voltage (1.8 ~ 6.0V)
- Tuning Indicator LED direct drive (10mA Max.)
- 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 DMP24
- Bipolar Technology

■ BLOCK DIAGRAM



(note) Dotted line shows $V_{CC}=4.5V$



■ **ABSOLUTE MAXIMUM RATINGS**

(Ta=25℃)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V ⁻	8	V
Lamp Current	I _{Lamp(Max)}	10	mA
Output Current	I _{O(peak)}	550	mA
Power Dissipation	P _D	700	mW
Operating Temperature Range	T _{opr}	-20 ~ +75	℃
Storage Temperature Range	T _{stg}	-40 ~ +125	℃

■ **ELECTRICAL CHARACTERISTICS**

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

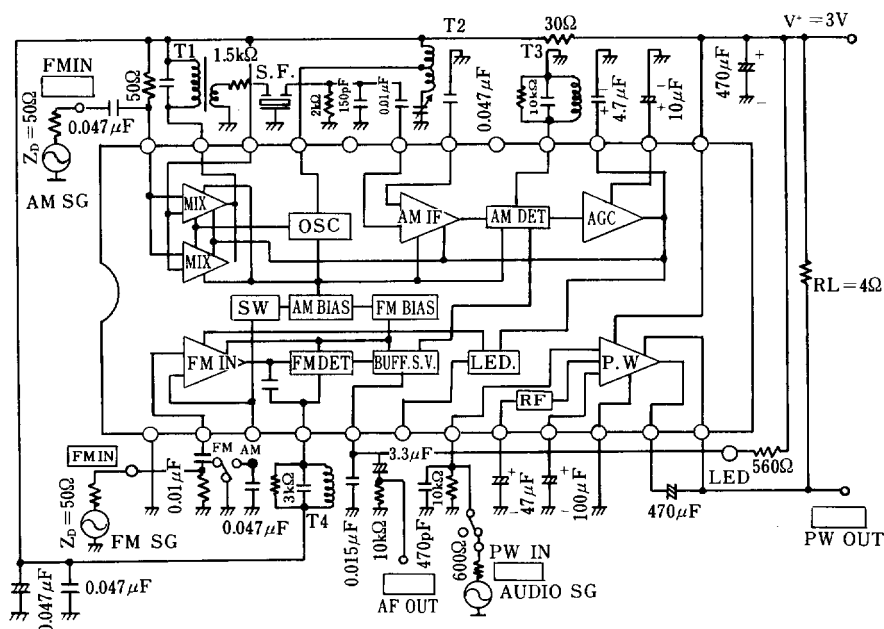
AM: f=1MHz, Mod=30%, fm=1kHz Unless otherwise noted)

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 M	-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
	Total Harmonic Distortion	THD	V _{IN} =80dBμ	—	0.3	—	%
	Am Rejection	AMR	V _{IN} =80dBμ	—	33	—	dB
	Lamp Lighting Sensitivity	V _L		—	47	55	dBμ
A M	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
	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 W	Lamp Lighting Sensitivity	V _L		—	30	—	dBμ
	Voltage Gain	G _V	f=1kHz, R _L =4Ω	37	40	43	dB
	Output Power	P _{OD1}	f=1kHz, R _L =4Ω, THD=10%	180	220	—	mW
		P _{OD2}	V ⁺ =4.5V f=1kHz, R _L =4Ω, THD=10%	—	500	—	
	Total Harmonic Distortion	THD	f=1kHz, R _L =4Ω, P _O =50mW	—	0.5	2.0	%
	Output Noise Voltage	V _{NO}	R _O =10kΩ, R _L =4Ω BW=30Hz~20kHz	—	0.18	—	mVrms

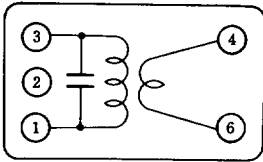
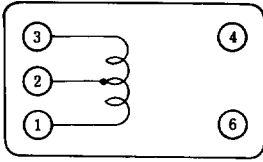
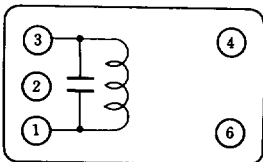
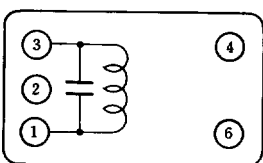
($V^+=3V$, $T_a=25^\circ\text{C}$)

CHARACTERISTICS		SYMBOLS	TYPICAL VALUES		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	LED DRIVER	V ₆	—	—	V
7	PW IN	V ₇	0	0	V
8	PW REF	V ₈	1.35	1.35	V
9	PW Bypass	V ₉	0.6	0.6	V
10	PW GND	V ₁₀	0	0	V
11	PW OUT	V ₁₁	1.5	1.5	V
12	PW Bootstrap	V ₁₂	2.8	2.8	V
13	V* 1	V ₁₃	3.0	3.0	V
14	AGC1	V ₁₄	0.6	0	V
15	AGC2	V ₁₅	0.6	0	V
16	AM DET	V ₁₆	0	0	V
17	Not Use	—	—	—	—
18	AM Bypass	V ₁₈	1.3	0	V
19	AM IF IN	V ₁₉	1.3	0	V
20	Not Use	—	—	—	—
21	AM Osc	V ₂₁	2.9	2.9	V
22	V* 2	V ₂₂	2.9	2.9	V
23	AM MIX OUT	V ₂₃	2.9	2.9	V
24	AM RF IN	V ₂₄	2.9	2.9	V

■ TEST CIRCUIT



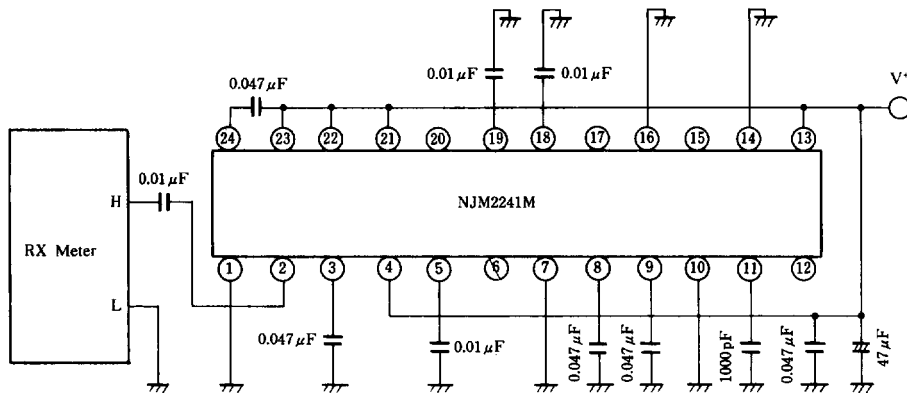
■ TEST CIRCUIT COIL DATA

COIL NO.	F ₀	Q ₀	TURNS	C ₀	
T ₁ : AM IFT (MIX OUT)	455kHz	①-③ 80	①-③ 60 T ④-⑥ 16 T Wire : 0.09mmφ UEW SUMIDA 2150-2173-302	①-③ 1500pF	 Bottom View
T ₂ : AM OSC	796kHz	①-③ 125	①-② 15 T ②-③ 89 T Wire : 0.06mmφ UEW SUMIDA 2157-2239-213 A	—	 Bottom View
T ₃ : AM DET	455kHz	①-③ 105	①-③ 127 T Wire : 0.06mmφ UEW SUMIDA 2150-2083-061	①-③ 330pF	 Bottom View
T ₄ : FM DET	10.7MHz	①-③ 100	①-③ 10 T Wire : 0.12mmφ UEW SUMIDA 2153-4095-331	①-③ 150pF	 Bottom View

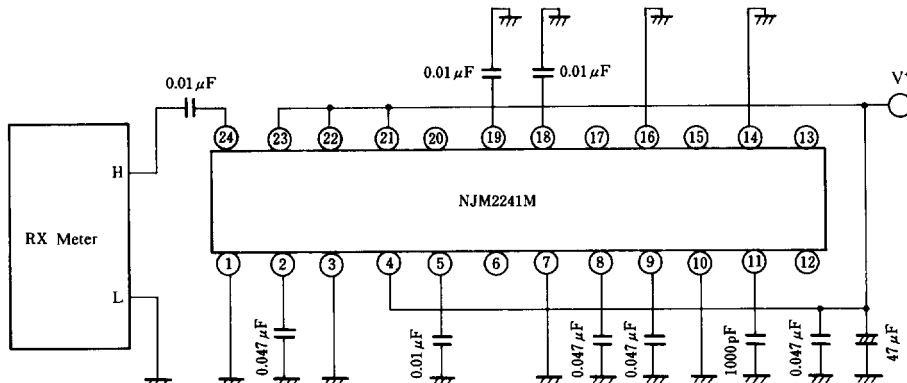
■ INPUT OUTPUT IMPEDANCE

CHARACTERISTICS	SYMBOLS	CIRCUITS	TEST CONDITIONS	TYP.	UNIT
Pin 2 Input Impedance (FM)	RIN2 CIN2	1	f=10.7MHz	4.6 5.0	kΩ pF
Pin 24 Input Impedance (AM)	RIN24 CIN24	2	f=1kHz	20 11	kΩ pF
Pin 19 Input Impedance (AM)	RIN19 CIN19	3	f=455kHz	6 3.7	kΩ pF
Pin 23 Output Impedance (AM)	RO23 CO23	4	f=455kHz	2.5 5.5	kΩ pF
Pin 16 Output Impedance (AM)	RO16 CO16	5	f=455kHz	100 5.0	kΩ pF

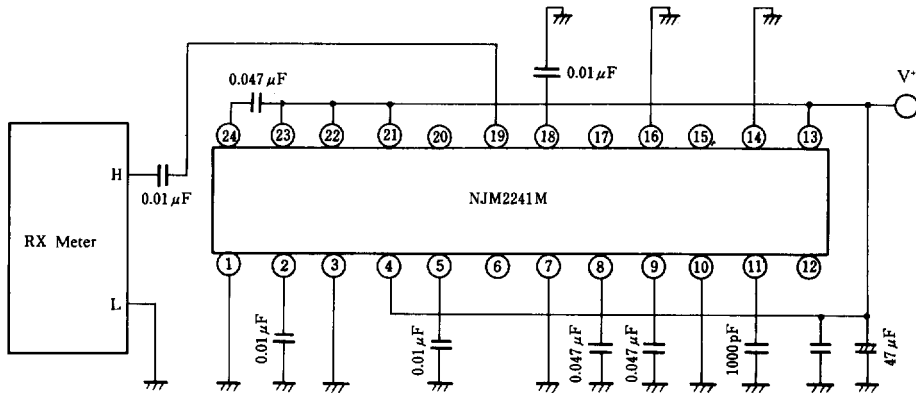
■ **TEST CIRCUIT 1** (Pin 2 FM Input Resistance, Capacitance)



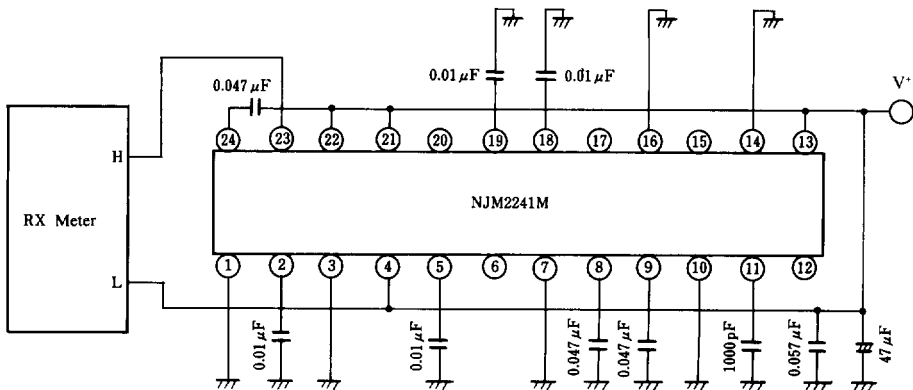
■ **TEST CIRCUIT 2** (Pin 24 AM Input Resistance, Capacitance)



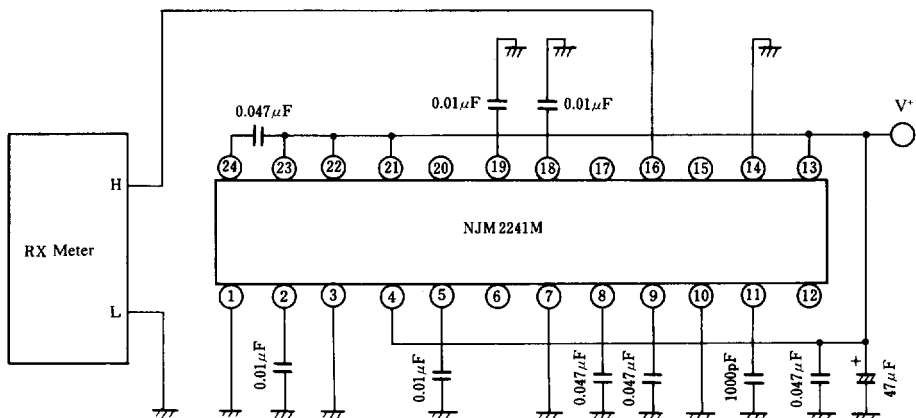
■ **TEST CIRCUIT 3** (Pin 19 AM IF Input Resistance, Capacitance)



■ **TEST CIRCUIT 4** (Pin 23 AM Mix Output Resistance, Capacitance)



■ **TEST CIRCUIT 5** (Pin 16 AM DET Output Resistance, Capacitance)





■ NOTES

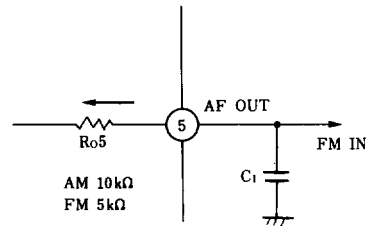
1. The frequency characteristics AM and FM mode

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 (Vcc) 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

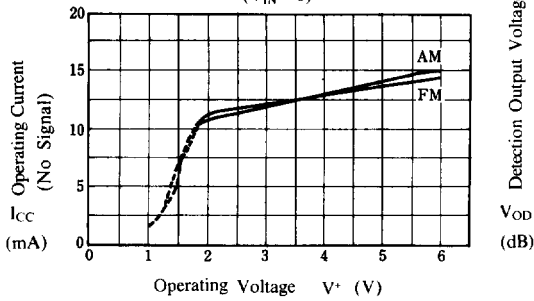
The audio signal of output pin5 includes carrier component slightly, therefore a capacitor between pin and GND have to be connected to decrease carrier component.

4. Supply voltage start-up

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

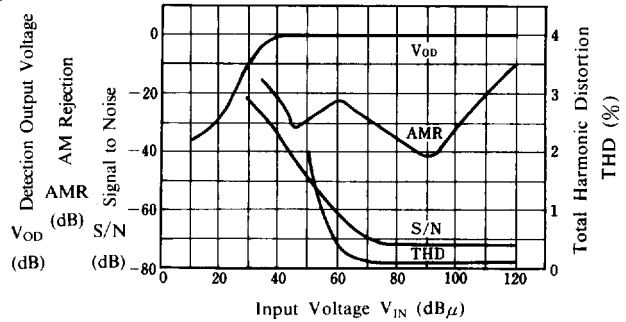
■ TYPICAL CHARACTERISTICS

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



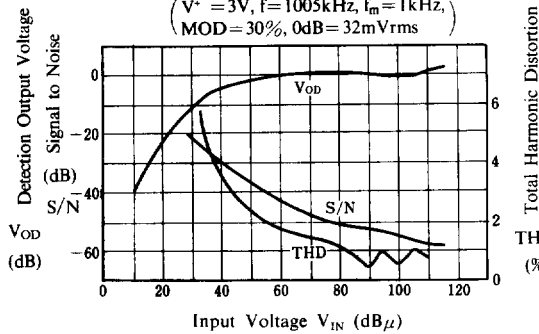
V_{OD} , AMR, S/N, THD vs. Input Voltage

($V^* = 3V$, $f = 10.7MHz$, $f_m = 1kHz$,
 $\Delta f = 22.5kHz$ dev., $0dB = 34.5mVrms$)



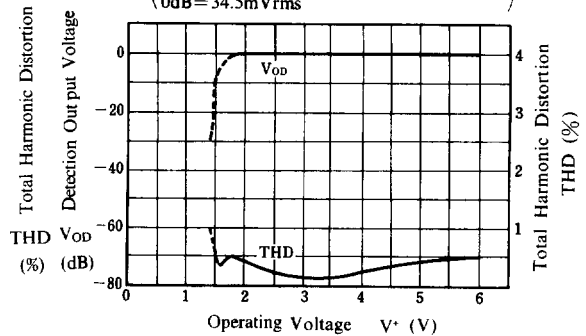
V_{OD} , S/N, THD vs. Input Voltage

($V^* = 3V$, $f = 1005kHz$, $f_m = 1kHz$,
 $MOD = 30\%$, $0dB = 32mVrms$)



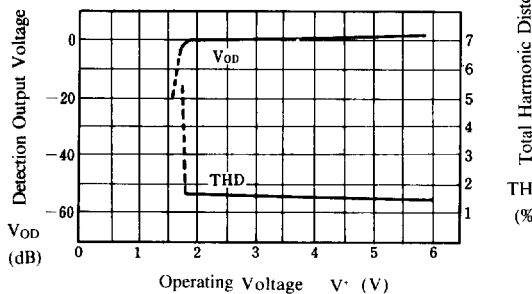
V_{OD} , THD vs. Operating Voltage

($f = 10.7MHz$, $f_m = 1kHz$, $\Delta f = 22.5kHz$ dev.,
 $0dB = 34.5mVrms$)



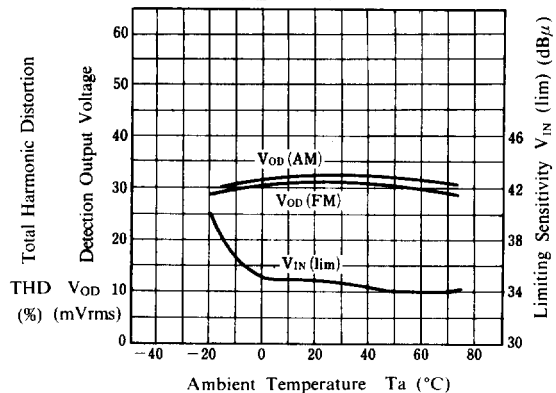
V_{OD} , THD vs. Operating Voltage

($f = 1005kHz$, $f_m = 1kHz$, $MOD = 30\%$,
 $0dB = 32mVrms$)



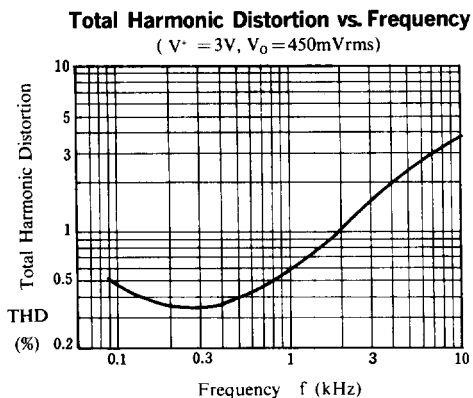
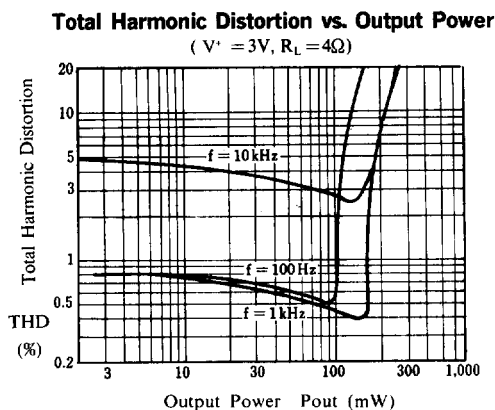
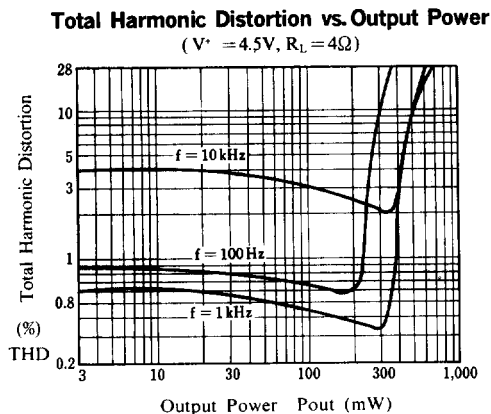
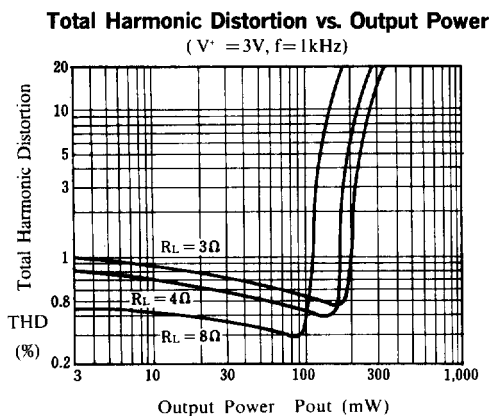
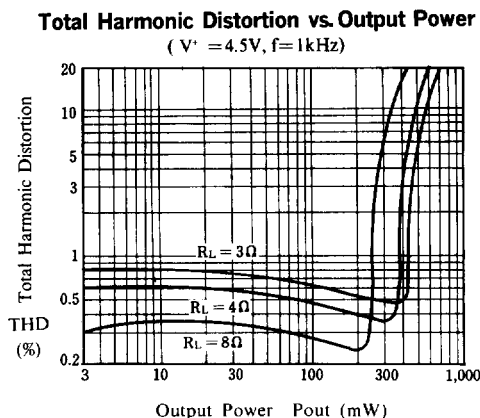
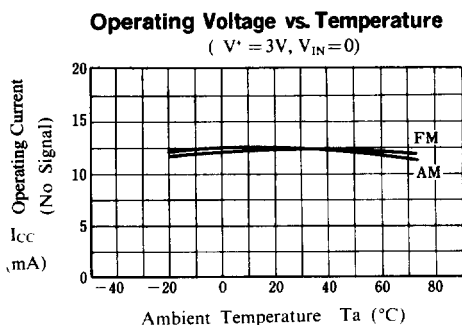
V_{OD} , $V_{IN}(lim)$ vs. Temperature

($V^* = 3V$, AM: $f = 1005kHz$, $f_m = 1kHz$, $MOD = 30\%$,
FM: $f = 10.7MHz$, $f_m = 1kHz$, $\Delta f = 22.5kHz$ dev.)

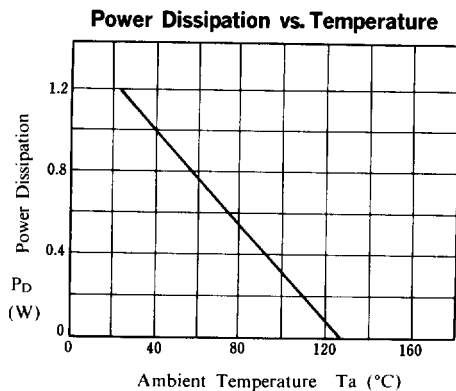
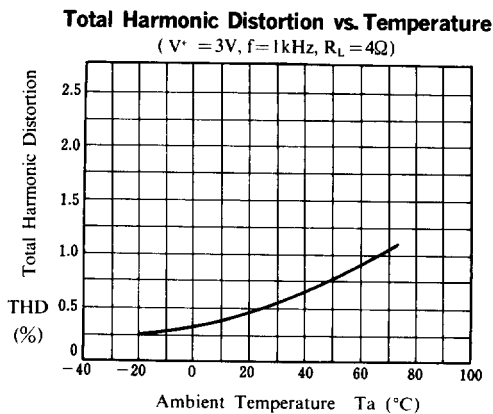
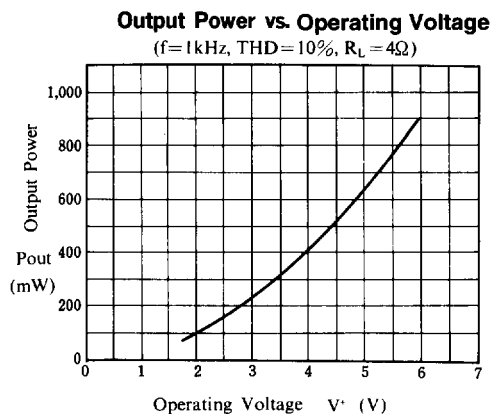
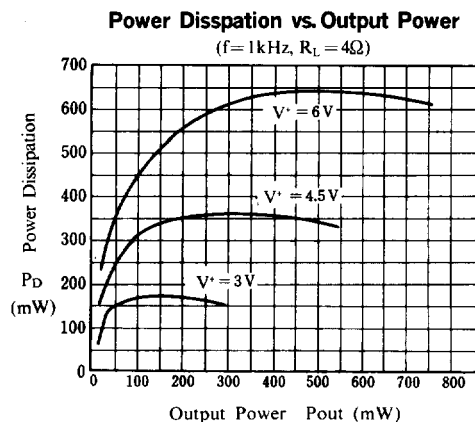
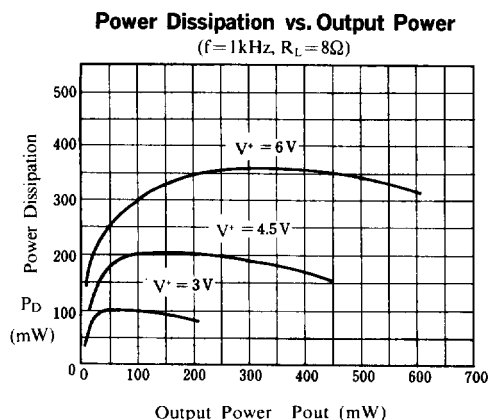


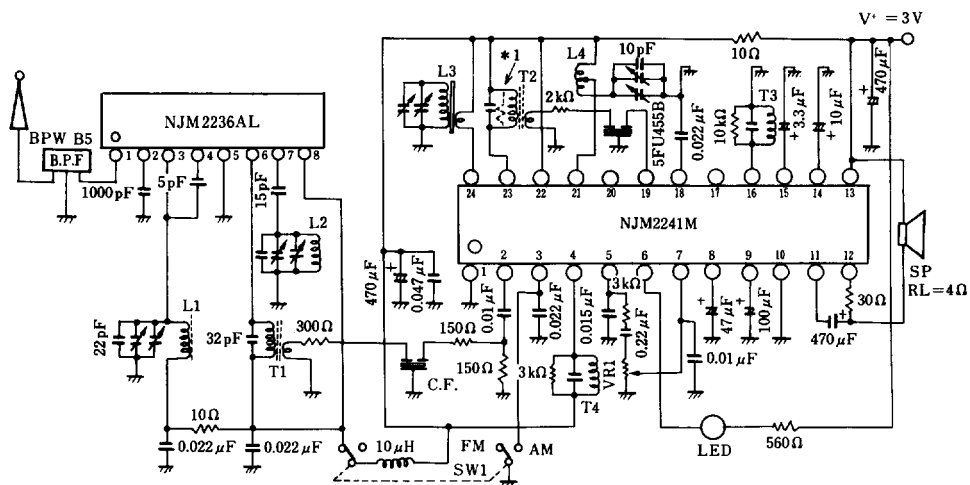


TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS

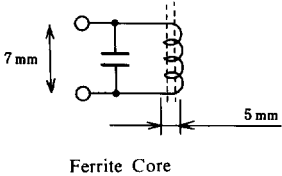
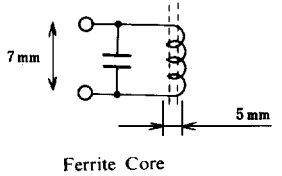
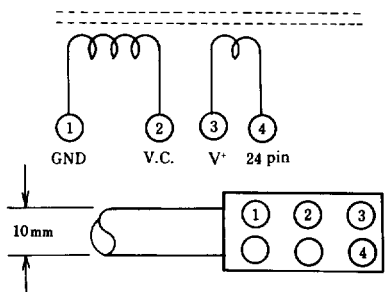
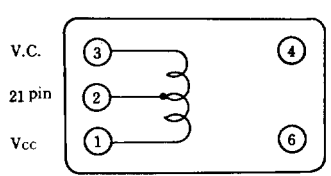




Resister should be located at *1
if the Trans (T2) is high Q



■ FM/AM RADIO APPLICATION CIRCUIT

COIL NO.	F ₀	Q ₀	TURNS	C ₀	
L ₁ : RF Coil	100MHz	100	0.7mmφ 2 $\frac{1}{4}$ T SUMIDA 0295-057	22pF (ext.)	 Ferrite Core
L ₂ : OSC Coil	100MHz	100	0.7mmφ 2 $\frac{1}{2}$ T 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



■ FM/AM RADIO APPLICATION CIRCUIT

COIL NO.	F ₀	Q ₀	TURNS	C ₀	BOTTOM VIEW
T ₁ : FM IFT	10.7MHz	①-③ 90	①-③ 11 T 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 60T 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 330pF	
T ₄ : FM DET	10.7MHz	①-③ 100	①-③ 10 T Wire : 0.12mmφ UEW SUMIDA 2153-4095-331	①-③ 150pF	