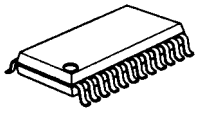
AM / FM RADIO

■ 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 tuning / indicator, AM AGC circuit, Audio Power amplifier.

■ PACKAGE OUTLINE

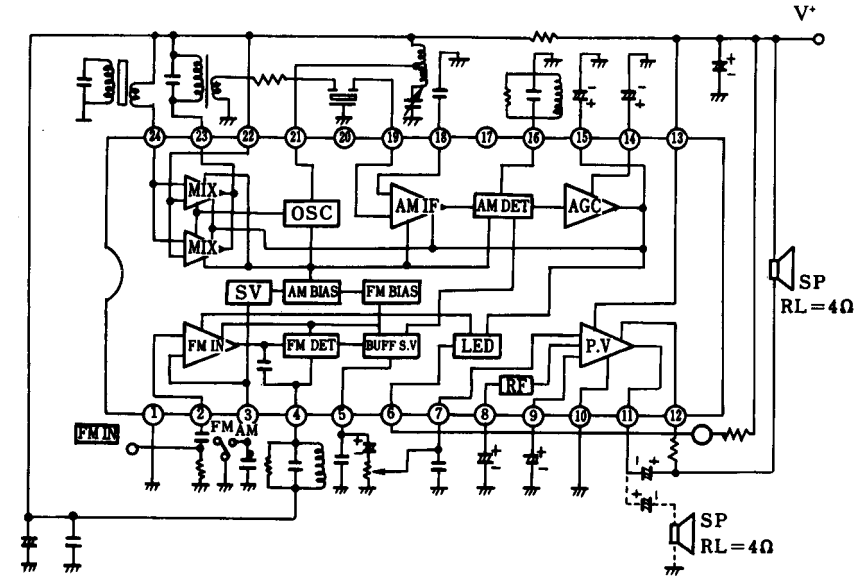


NJM2241M

■ FEATURES

- Wide Operating Voltage (1.8 to 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 (T_a=25°C)

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 to +75	°C
Storage Temperature Range	T_{stg}	-40 to +125	°C

■ ELECTRICAL CHARACTERISTICS

(V^+=3V, T_a=25°C, FM:f=10.7MHz, Δf=22.5kHz dev., fm=1kHz,
AM:f=1MHz, Mod=30%, fm=1kHz, Unless otherwise noted)

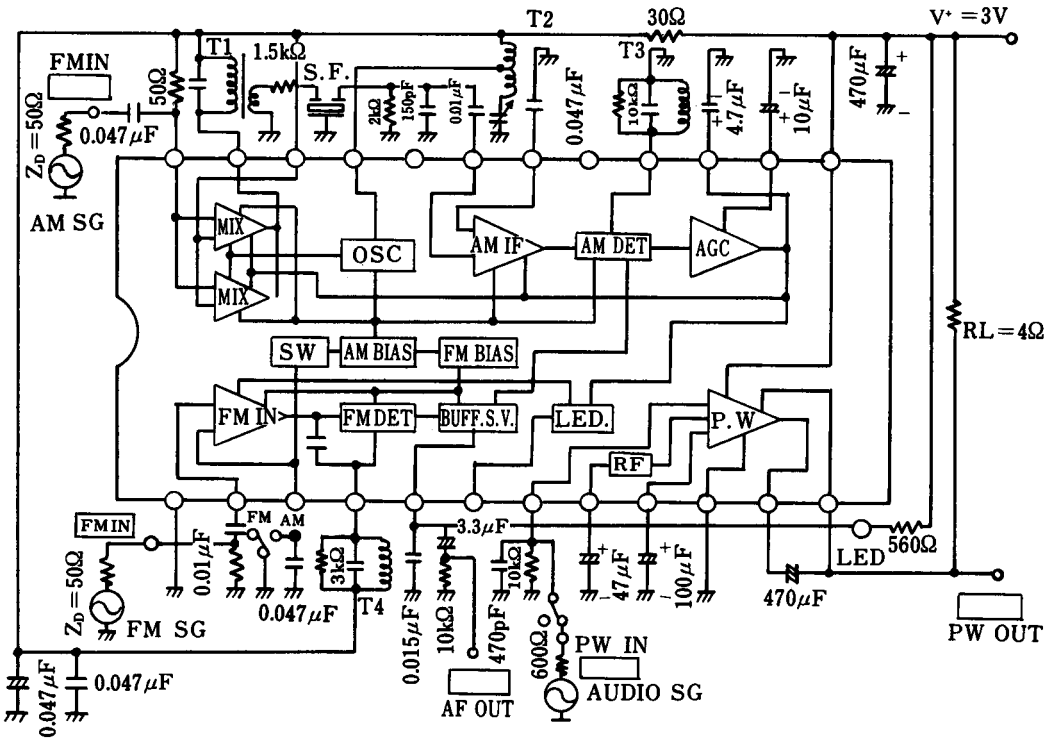
	CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
	Operating Current	I_{CC} (FM)	V_{IN}=0	-	15	20	mA
		I_{CC} (AM)	V_{IN}=0	-	15	20	
FM	-3dB Limiting Sensitivity	V_{IN} (lim)		-	36	42	dBμ
FM	Detection Output Voltage	V_{OD}	V_{IN}=80dBμ	22	31	44	mVrms
FM	Signal to Noise Ratio	S / N	V_{IN}=80dBμ	-	70	-	dB
FM	Total Harmonic Distortion	THD	V_{IN}=80dBμ	-	0.3	-	%
FM	Am Rejection	AMR	V_{IN}=80dBμ	-	33	-	dB
FM	Lamp Lighting Sensitivity	V_L		-	47	55	dBμ
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	THD 1	V_{IN}=66dBμ	-	1.5	-	%
AM		THD 2	V_{IN}=106dBμ	-	4.0	-	
AM	Local OSC Stop Voltage	V_{stop}	V_{OSC} -6dB	-	1.0	1.5	V
AM	Lamp Lighting Sensitivity	V_L		-	30	-	dBμ
PW	Voltage Gain	G_V	f=1kHz, RL=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, Po=50mW	-	0.5	20	%
PW	Output Noise Voltage	V_{NO}	R_O=10kΩ, R_L=4Ω BW=30Hz to 20kHz	-	0.18	-	mVrms

■ TERMINAL VOLTAGE AT NO SIGNAL

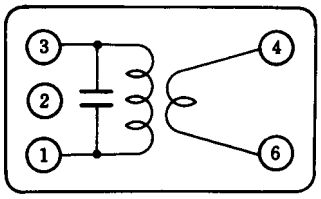
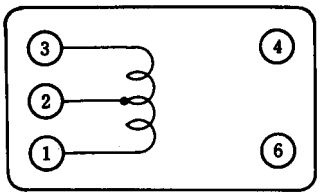
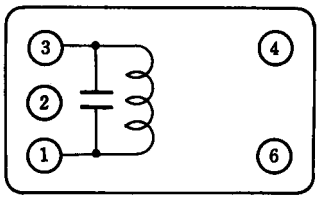
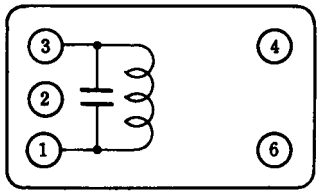
(V^+=3V, T_a=25°C)

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 Bipass	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 Bipass	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



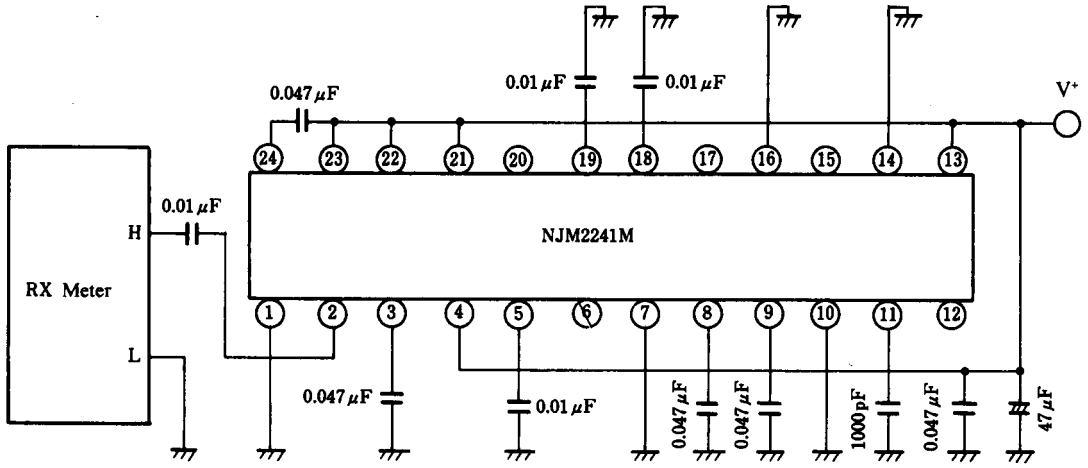
■ TEST CIRCUIT COIL DATA

COIL NO.	F_0	Q_0	TURNS	C_0	
T_1 : AM IFT (MIX OUT)	455kHz	①－③ 80	①－③ 60T ④－⑥ 16T Wire : 0.09mmφ UEW SUMIDA 2510－2173－302	①－③ 1500pF	 Bottom View
T_2 : AM OSC	796kHz	①－③ 125	①－② 15T ②－③ 89T Wire : 0.06mmφ UEW SUMIDA 2517－2239－213A	-	 Bottom View
T_3 : AM DET	455kHz	①－③ 105	①－③ 127T Wire : 0.06mmφ UEW SUMIDA 2510－2083－061	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

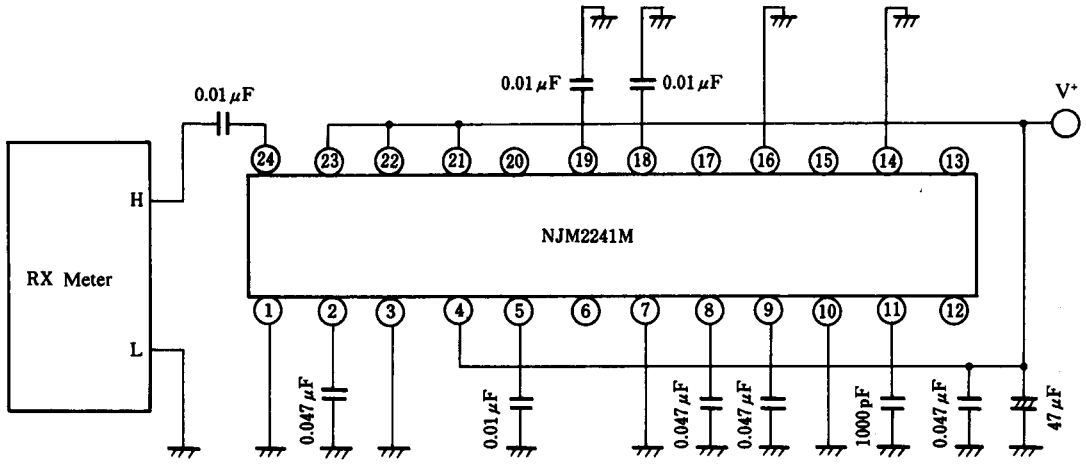
■ INPUT OUTPUT IMPEDANCE

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

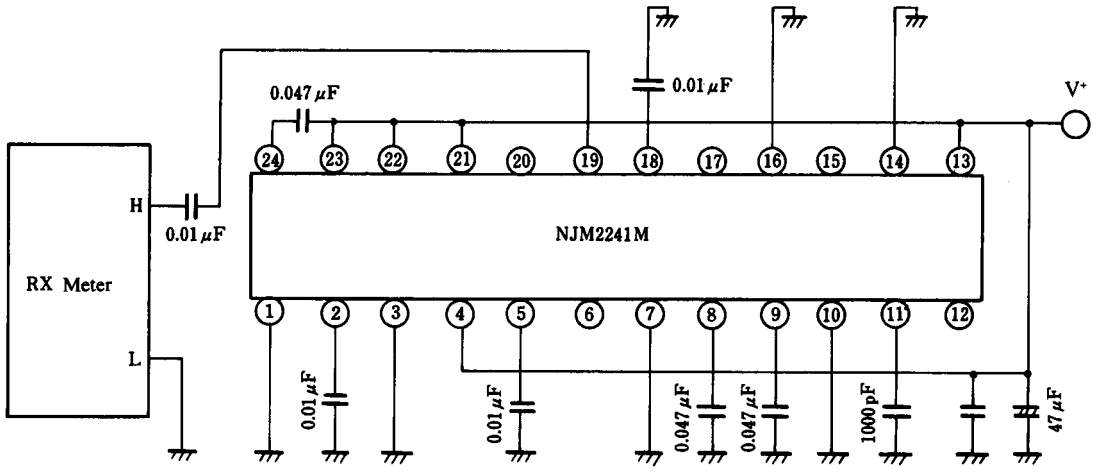
■ **TEST CIRCUIT 1** (Pin 2 FM Input Resistance, Capacitance)



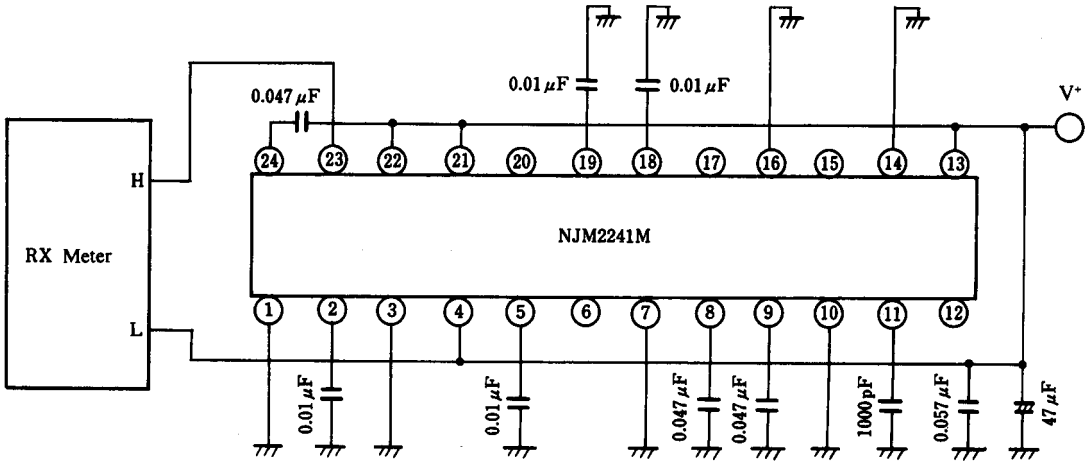
■ **TEST CIRCUIT 2** (Pin 24 AM Input Resistance, Capacitance)



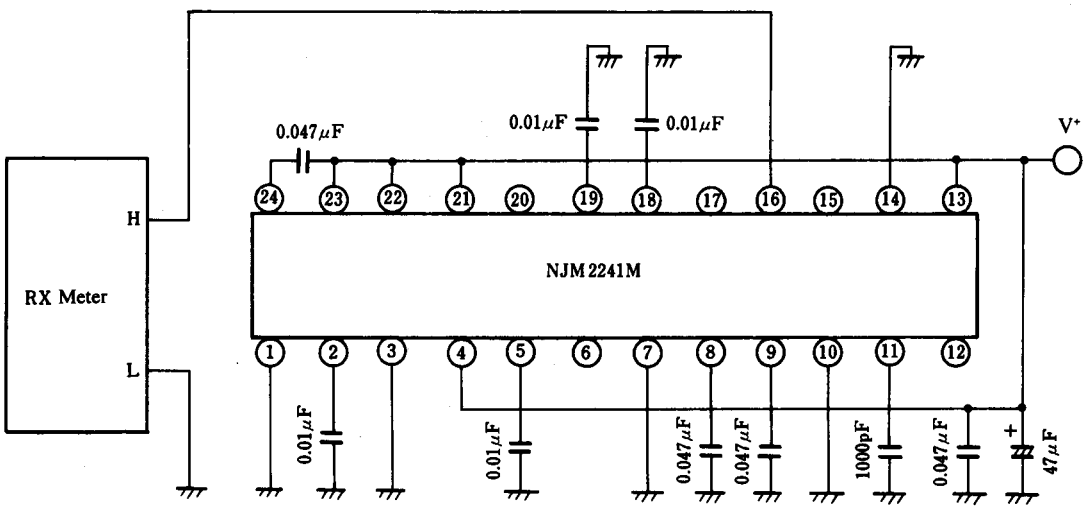
■ **TEST CIRCUIT 3** (Pin 19 AM IF Input Resistance, Capacitance)



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



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



■ **NOTES**

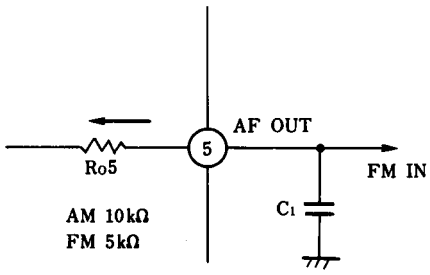
1. The frequency characteristics AM and FM mode

The output impedance of pin 5 (R_O5) and external capacitor C_1 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 pin 1 (GND) to get low tweet.



2. Loading speaker

Recommend to connect the speaker between pin 11 (V_{CC}) and pin 10 (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

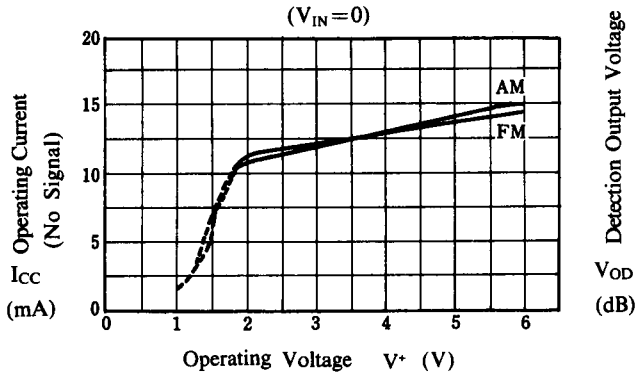
The audio signal of output pin5 includes carrier component slightly, therefore a capacitor between pin and GND have to be connected to decrease carrier component.

4. Supply voltage start-up

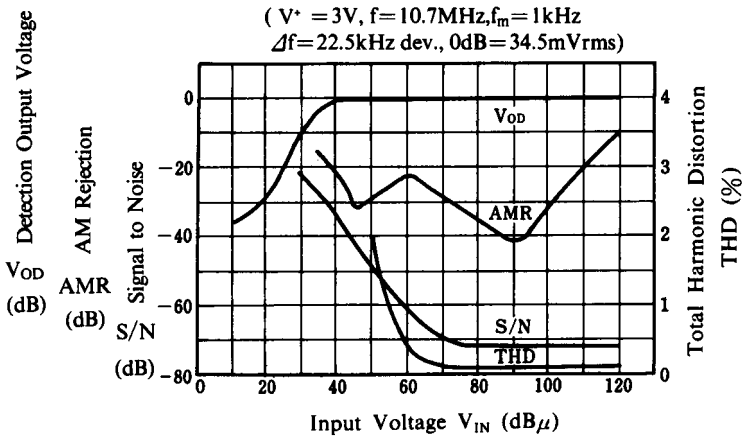
The supply voltage of radio circuit block should not start up before power stage start up.

■ TYPICAL CHARACTERISTICS

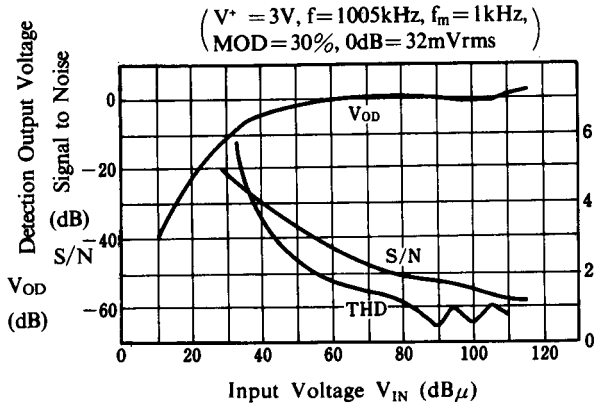
Operating Current vs. Operating Voltage



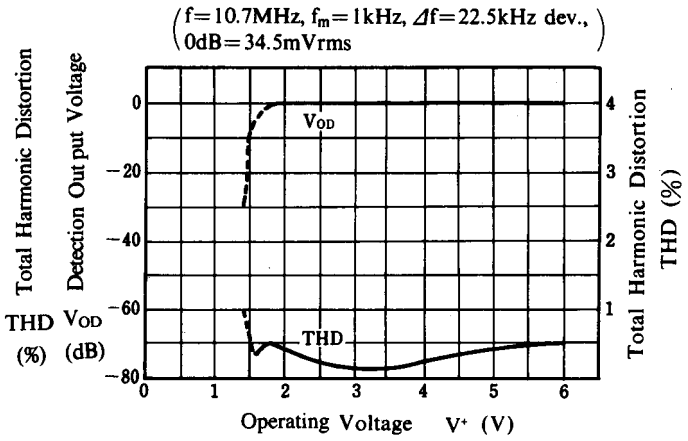
V_{OD}, AMR, S / N THD vs. Input Voltage



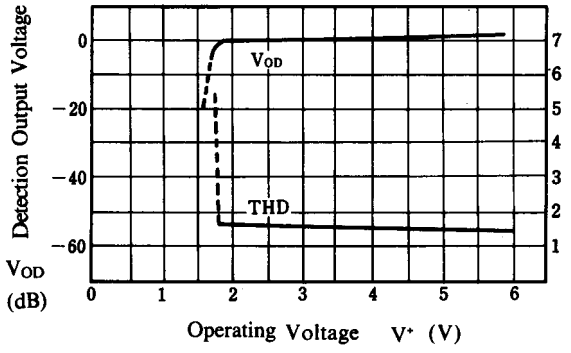
V_{OD}, S / N, THD vs. Input Voltage



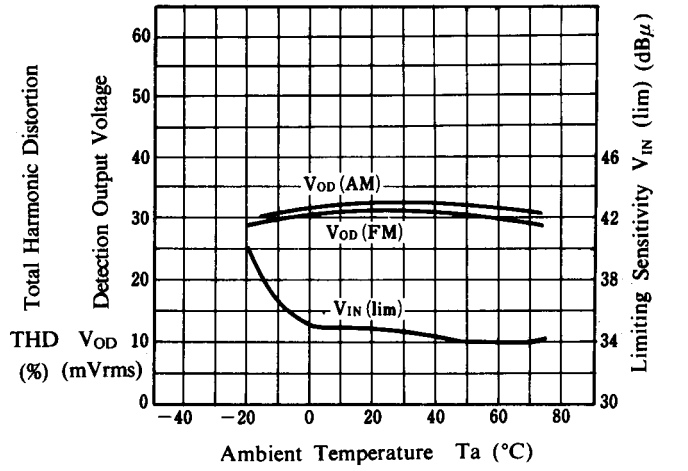
V_{OD}, THD vs. Operating Voltage



V_{OD}, THD vs. Operating Voltage



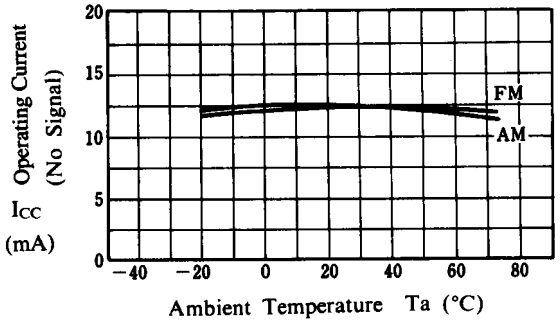
V_{OD}, V_{IN} (lim) vs. Temperature



■ TYPICAL CHARACTERISTICS

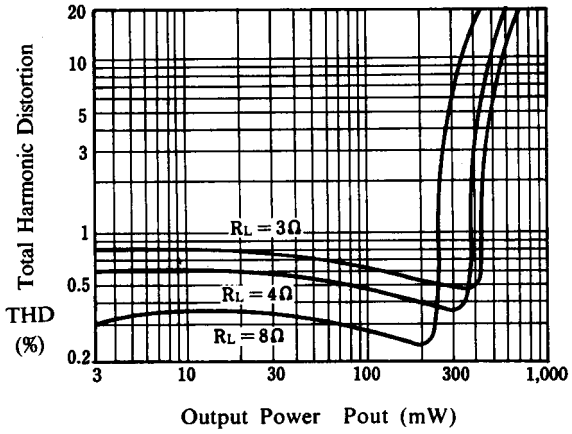
Operating Voltage vs. Temperature

(V^+ =3V, V_{IN}=0)



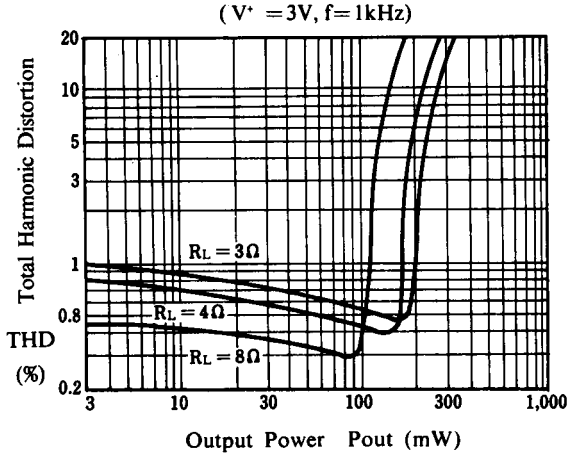
Total Harmonic Distortion vs. Output Power

(V^+ =4.5V, f=1kHz)



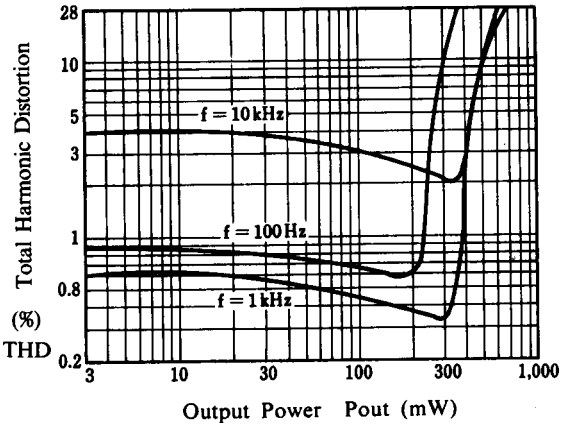
Total Harmonic Distortion vs. Output Power

(V^+ =3V, f=1kHz)



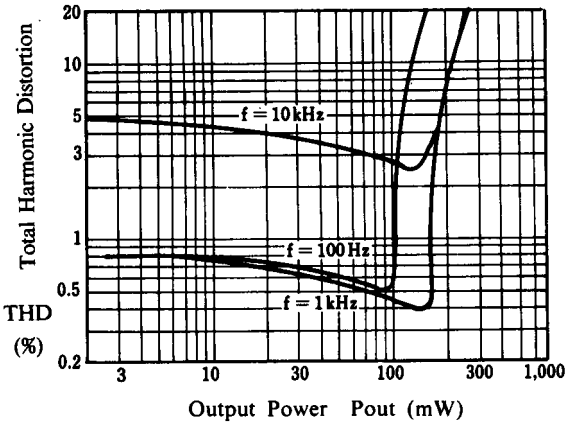
Total Harmonic Distortion vs. Output Power

(V^+ =4.5V, R_L=4Ω)



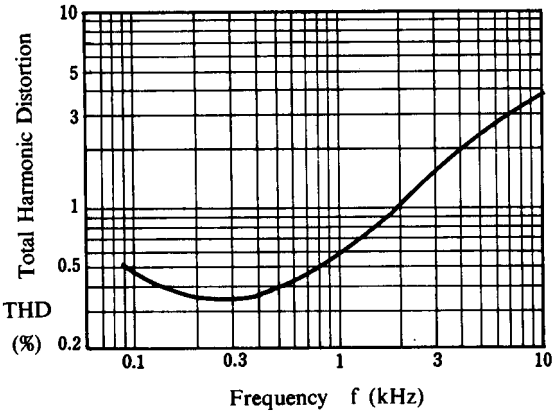
Total Harmonic Distortion vs. Output Power

(V^+ =3V, R_L=4Ω)



Total Harmonic Distortion vs. Frequency

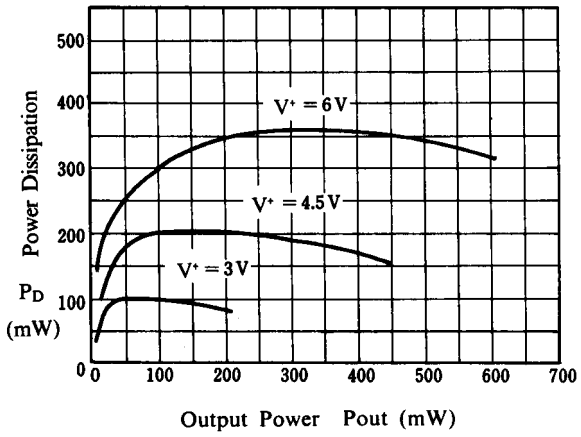
(V^+ =3V, V_O=450mVrms)



■ TYPICAL CHARACTERISTICS

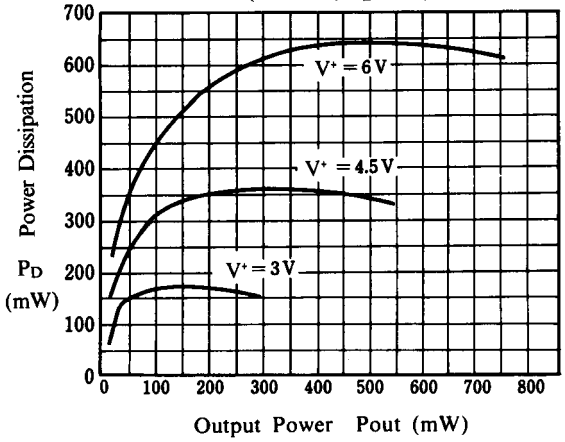
Power Dissipation vs. Output Power

(f=1kHz, R_L=8Ω)



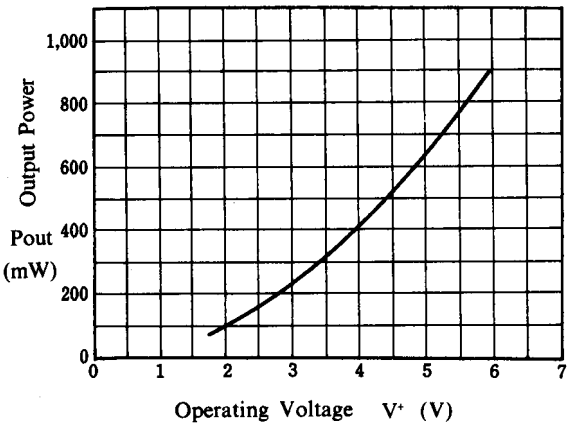
Power Dissipation vs. Output Power

(f=1kHz, R_L=4Ω)



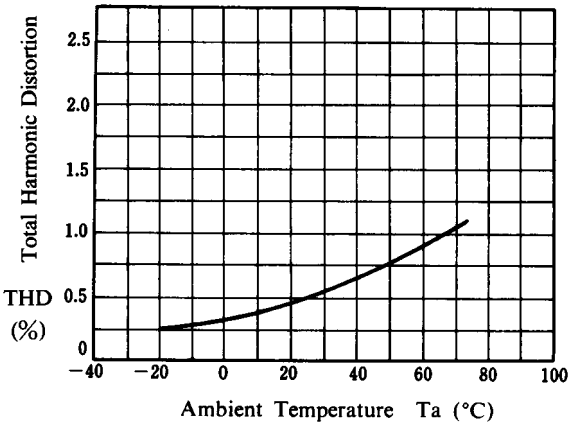
Output power vs. Operating Voltage

(f=1kHz, THD=10%, R_L=4Ω)

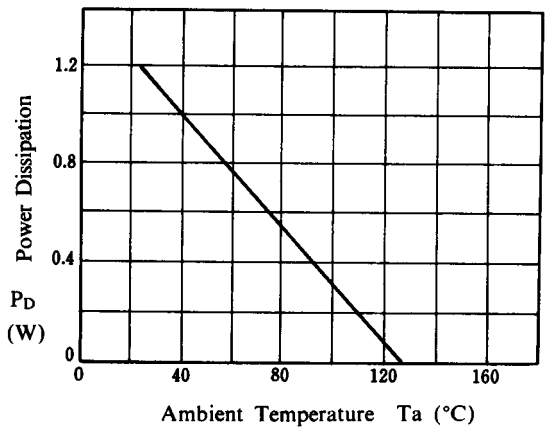


Total Harmonic Distortion vs. Temperature

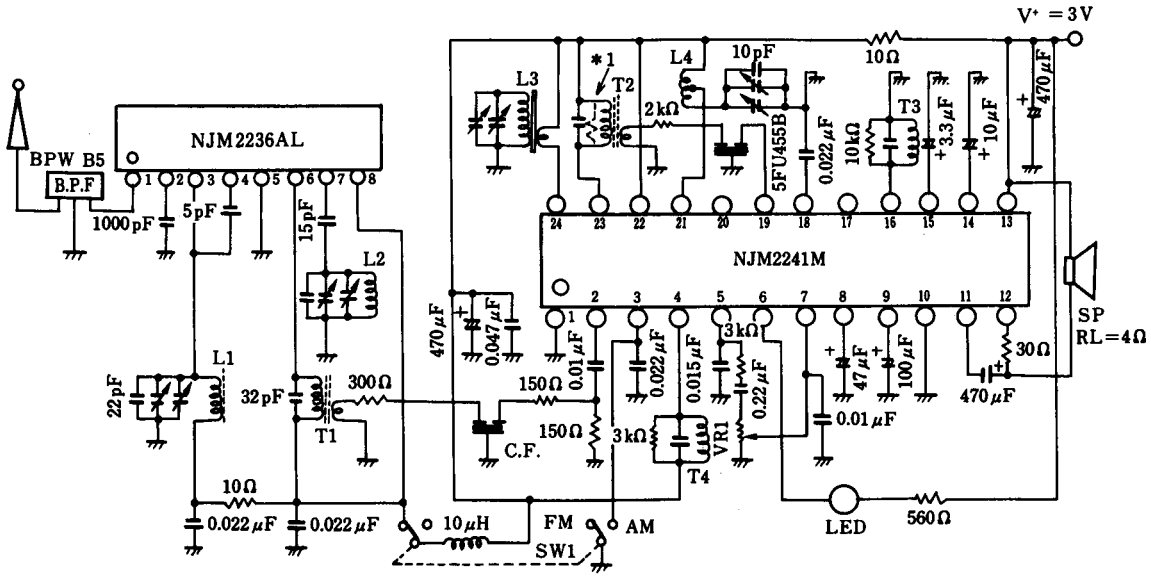
(V^+ =3V, f=1kHz, R_L=4Ω)



Power Dissipation vs. Temperature

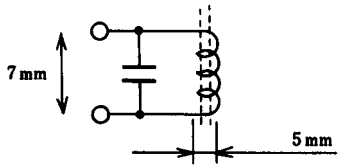
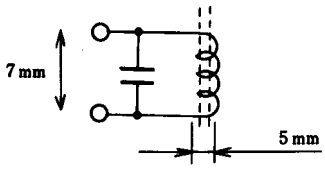
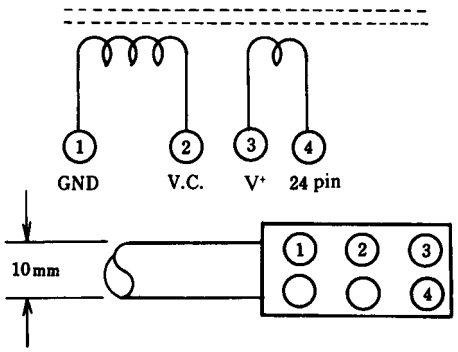
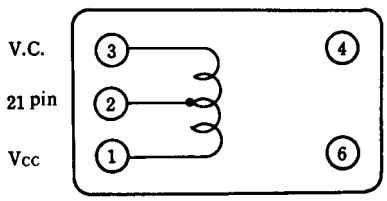


■ FM / AM RADIO APPLICATION CIRCUIT

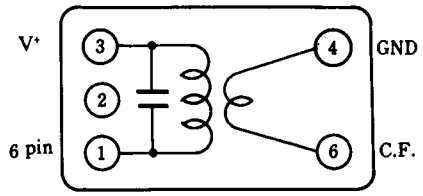
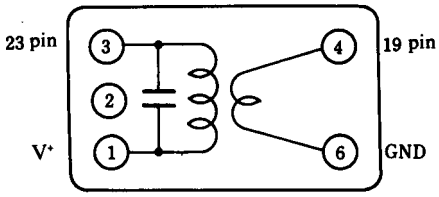
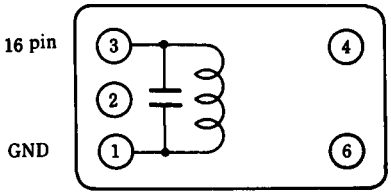
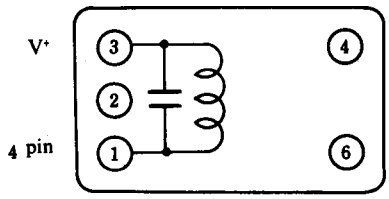


Resister should be located at * 1
if the Trans (T2) is high Q

■ 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 100T L = 600μH ③–④ 17T Wire : 4/0.07mm UATC Core : 10mmφ × 80mm MITSUMI Y1 – 7160 – 1	-	 BOTTOM VIEW
L_4 :AM OSC	796kHz	①–③ 125	①–② 15T ②–③ 89T 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 11T ④−⑥ 2T Wire : 0.12mmφ UEW SUMIDA 2153 – 414 – 041	①−③ 82pF	 Bottom View
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	 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