

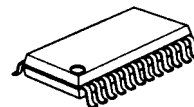
AM / FM RADIO

■ 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

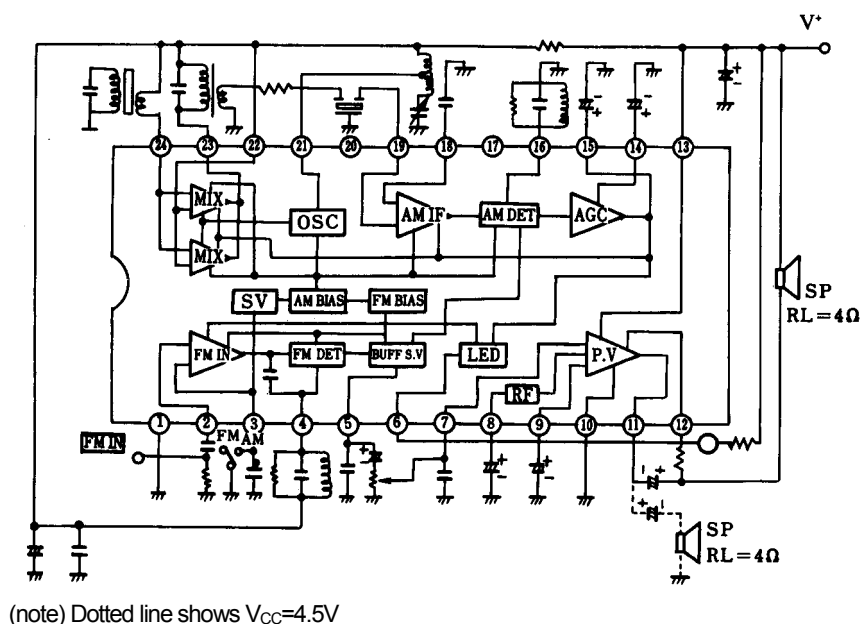


NJM2241M

■ 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



NJM2241

■ 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)

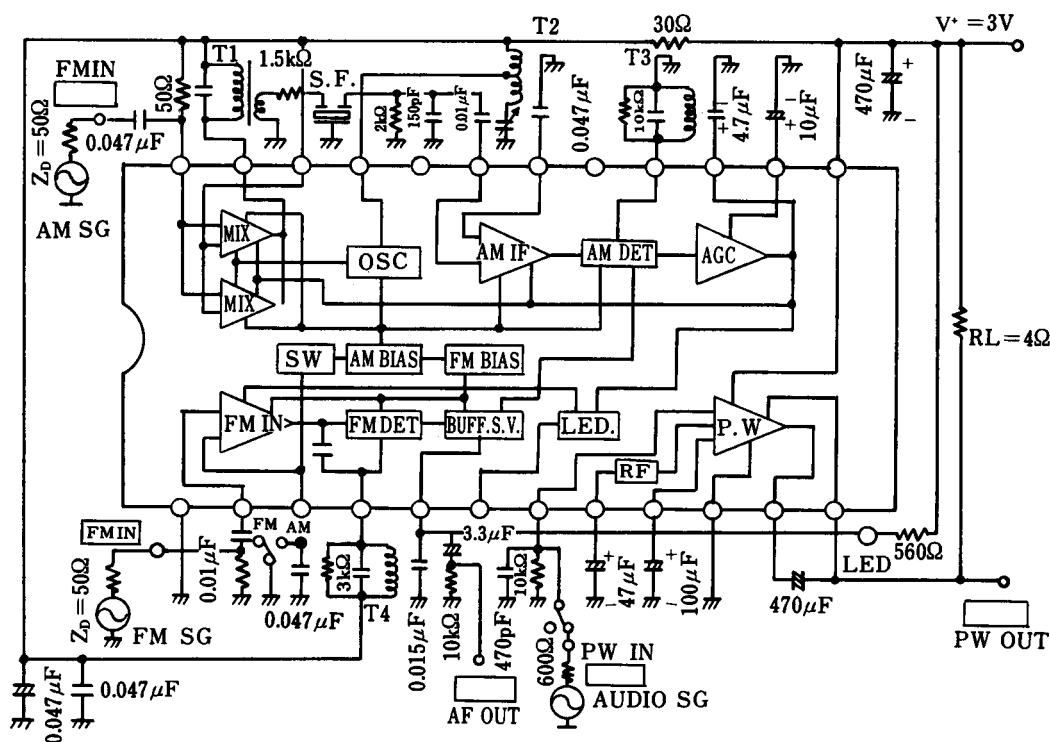
CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Operating Current	I _{CC (FM)}	V _{IN} =0	-	15	20	mA
	I _{CC (AM)}	V _{IN} =0	-	15	20	
-3dB Limiting Sensitivity	V _{IN (lim)}		-	36	42	dBμ
Detection Output Voltage	V _{OD}	V _{IN} =80dBμ	22	31	44	mVrms
Signal to Noise Ratio	S / N	V _{IN} =80dBμ	-	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
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	THD 1	V _{IN} =66dBμ	-	1.5	-	%
	THD 2	V _{IN} =106dBμ	-	4.0	-	
Local OSC Stop Voltage	V _{stop}	V _{OSC} -6dB	-	1.0	1.5	V
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	20	%
Output Noise Voltage	V _{NO}	R _O =10kΩ, R _L =4Ω BW=30Hz to 20kHz	-	0.18	-	mVrms

■ TERMINAL VOLTAGE AT NO SIGNAL

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

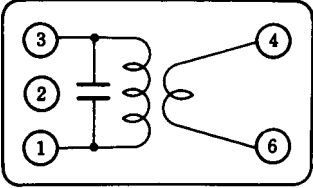
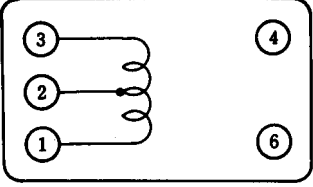
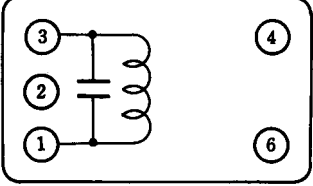
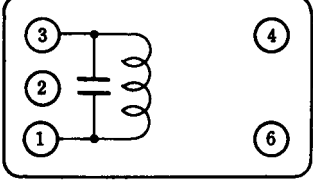
CHARACTERISTICS		SYMBOLS	TYPICAL VALUES		UNIT
PIN NO	FUNCTION		AT AM	AT FM	
1	GND	V_1	0	0	V
2	FM IF IN	V_2	2.4	2.0	V
3	FM / AM Switch	V_3	0	2.0	V
4	FM DET	V_4	2.9	2.9	V
5	DET OUT	V_5	0.4	0.7	V
6	LED DRIVER	V_6	-	-	V
7	PW IN	V_7	0	0	V
8	PW REF	V_8	1.35	1.35	V
9	PW Bypass	V_9	0.6	0.6	V
10	PW GND	V_{10}	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



NJM2241

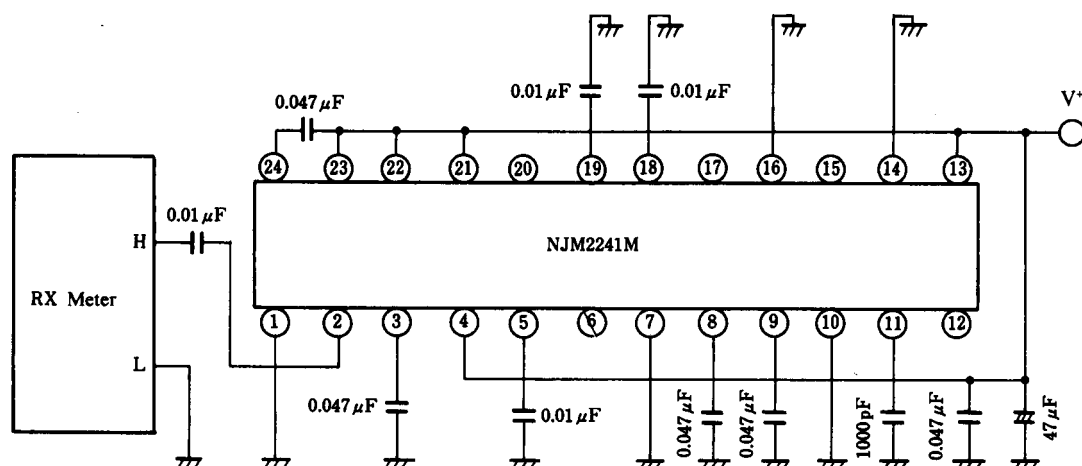
■ TEST CIRCUIT COIL DATA

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

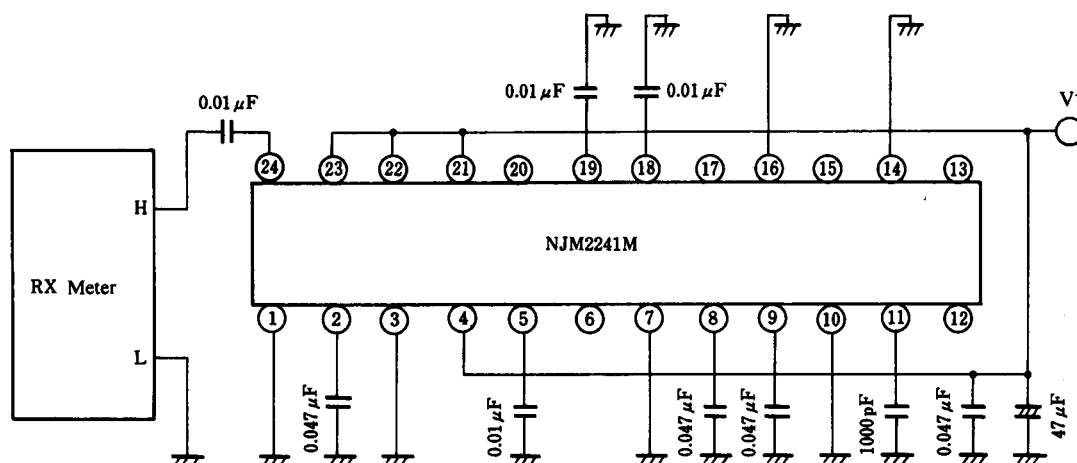
■ INPUT OUTPUT IMPEDANCE

CHARACTERISTICS	SYMBOLS	CIRCUITS	TEST CONDITIONS	TYP.	UNIT
Pin 2 Input Impedance (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)

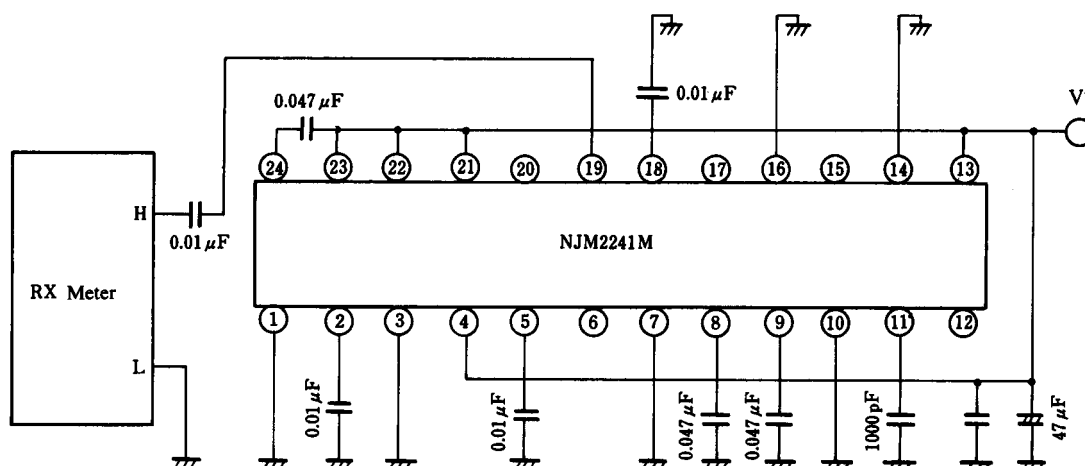


■ TEST CIRCUIT 2 (Pin 24 AM Input Resistance, Capacitance)

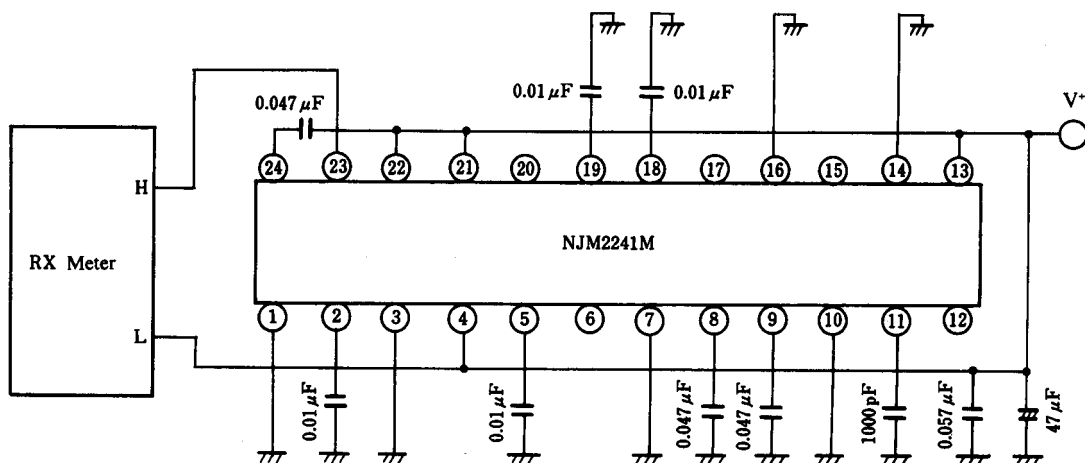


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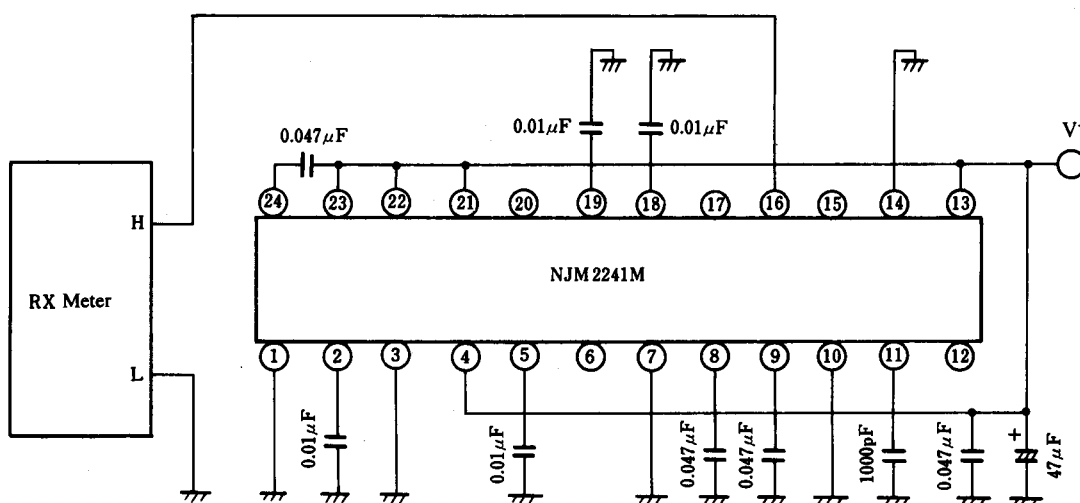
■ TEST CIRCUIT 3 (Pin 19 AM IF Input Resistance, Capacitance)



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



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



■ NOTES

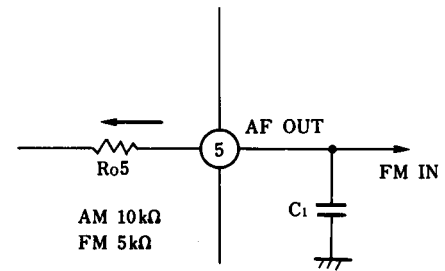
1. The frequency characteristics AM and FM mode

The output impedance of pin 5 (R_{O5}) and external capacitor C_1 decide frequency characteristics.

The value of R_{O5} turns to $10k\Omega$ at AM mode and $5k\Omega$ at FM mode.

Accordingly should consider above, trim C_1 to get proper frequency response.

Besides should design the location of C_1 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 pin 9 (PW OUT) and (GND) through a coupling capacitor.

3. Termination to the power stage

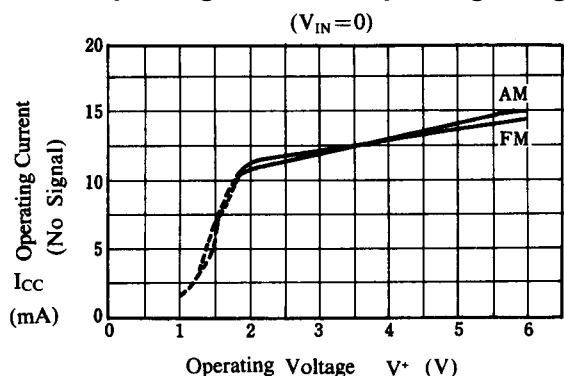
The audio signal of output pin 5 includes carrier component slightly, therefore a capacitor between pin and GND have to be connected to decrease carrier component.

4. Supply voltage start-up

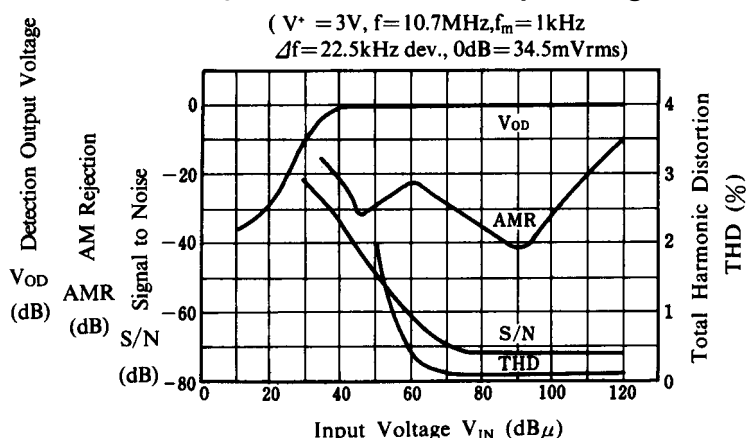
The supply voltage of radio circuit block should not start up before power stage start up.

■ TYPICAL CHARACTERISTICS

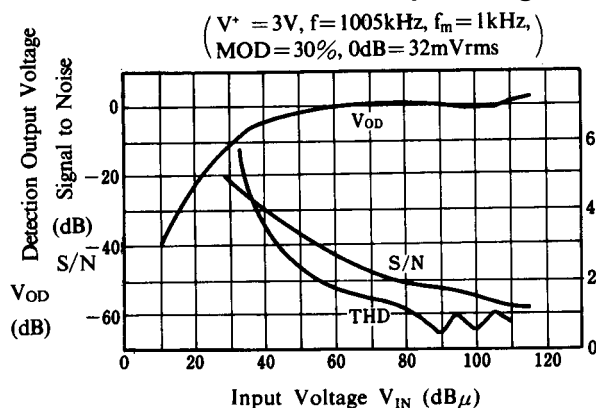
Operating Current vs. Operating Voltage



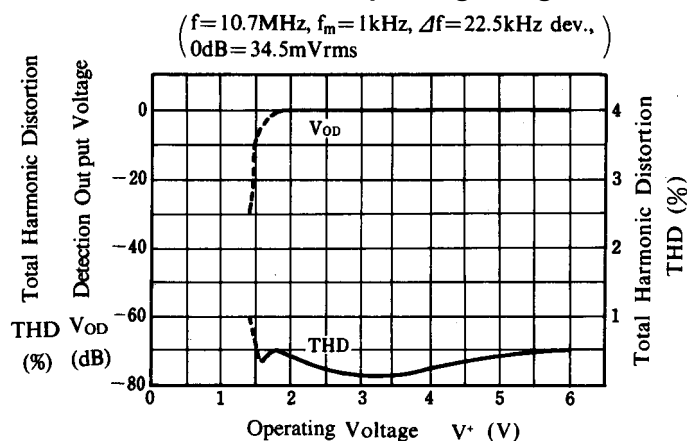
V_{OD} , AMR, S/N THD vs. Input Voltage



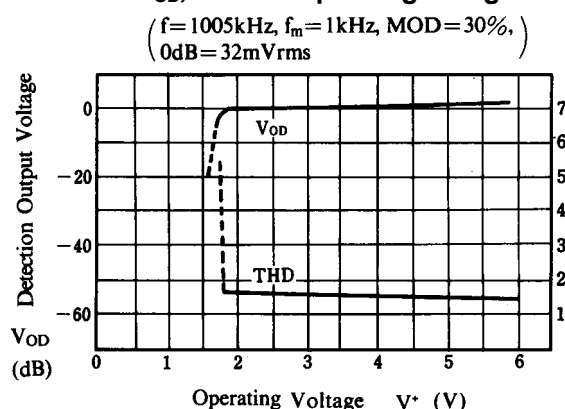
V_{OD} , S/N, THD vs. Input Voltage



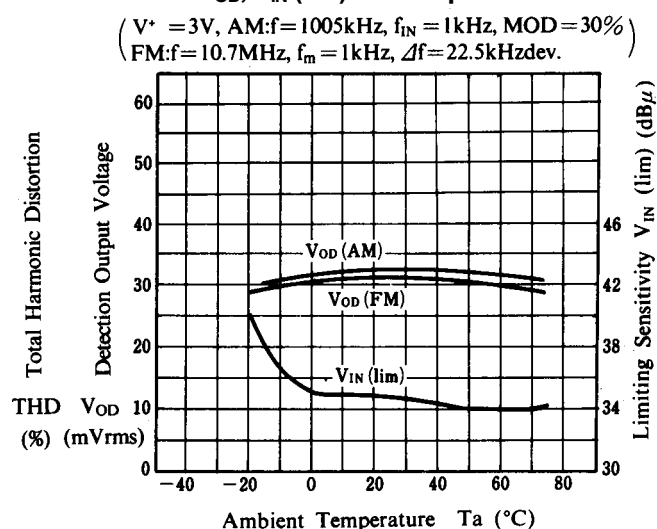
V_{OD} , THD vs. Operating Voltage



V_{OD} , THD vs. Operating Voltage



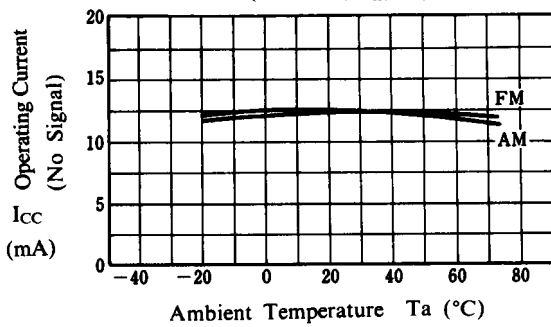
V_{OD} , V_{IN} (lim) vs. Temperature



■ TYPICAL CHARACTERISTICS

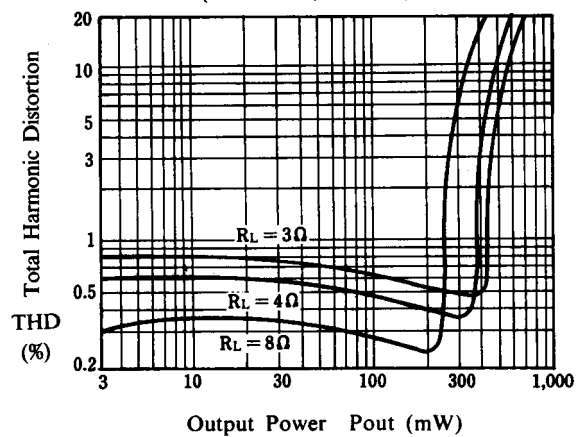
Operating Voltage vs. Temperature

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



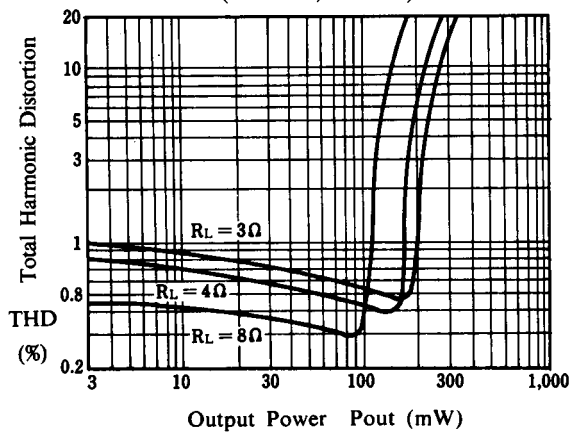
Total Harmonic Distortion vs. Output Power

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



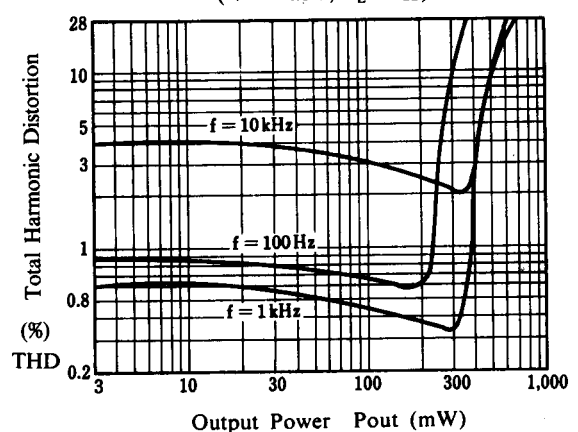
Total Harmonic Distortion vs. Output Power

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



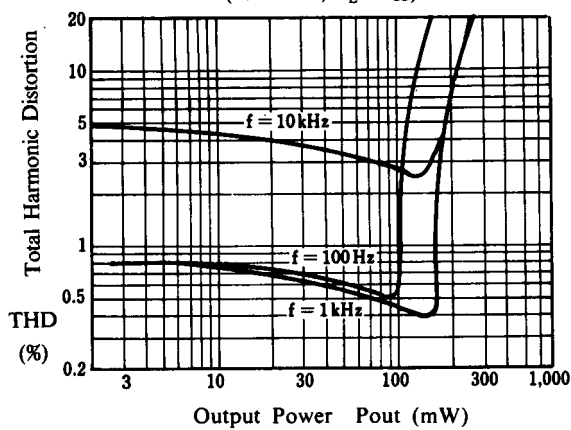
Total Harmonic Distortion vs. Output Power

($V^+ = 4.5V$, $R_L = 4\Omega$)



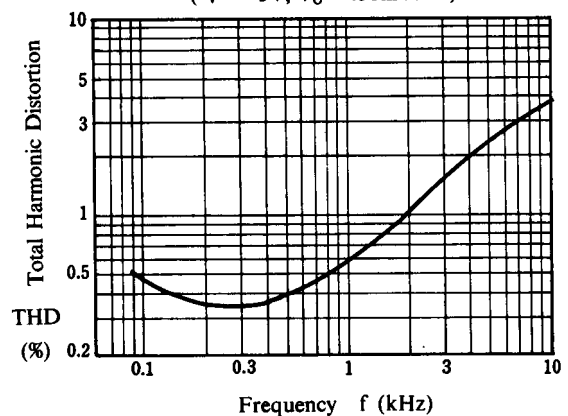
Total Harmonic Distortion vs. Output Power

($V^+ = 3V$, $R_L = 4\Omega$)



Total Harmonic Distortion vs. Frequency

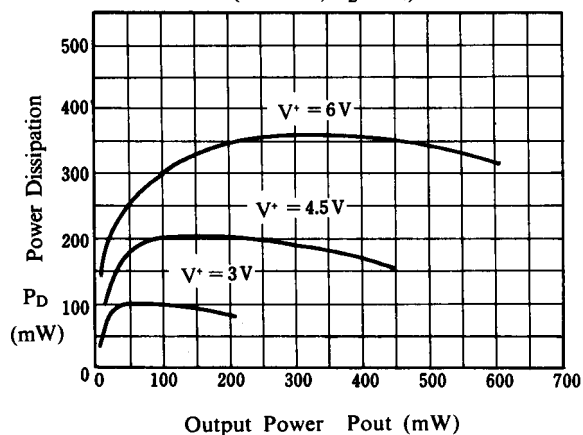
($V^+ = 3V$, $V_O = 450mV_{rms}$)



■ TYPICAL CHARACTERISTICS

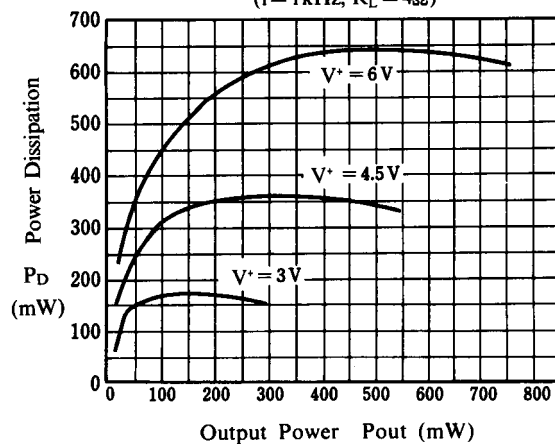
Power Dissipation vs. Output Power

($f=1\text{kHz}$, $R_L=8\Omega$)



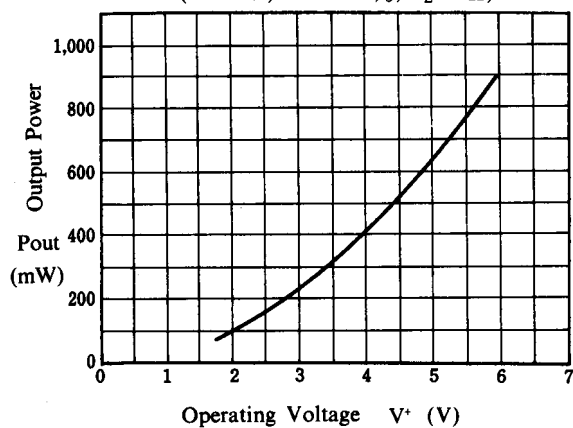
Power Dissipation vs. Output Power

($f=1\text{kHz}$, $R_L=4\Omega$)



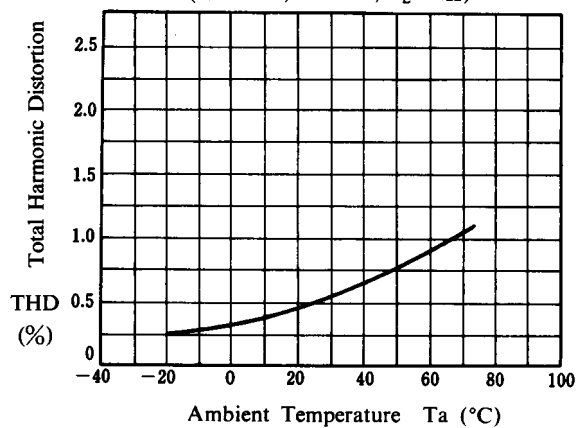
Output power vs. Operating Voltage

($f=1\text{kHz}$, $\text{THD}=10\%$, $R_L=4\Omega$)

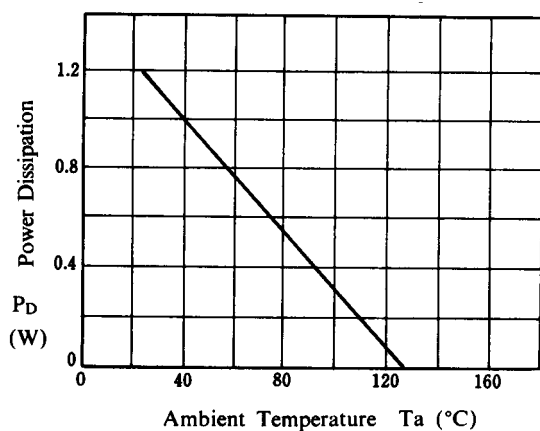


Total Harmonic Distortion vs. Temperature

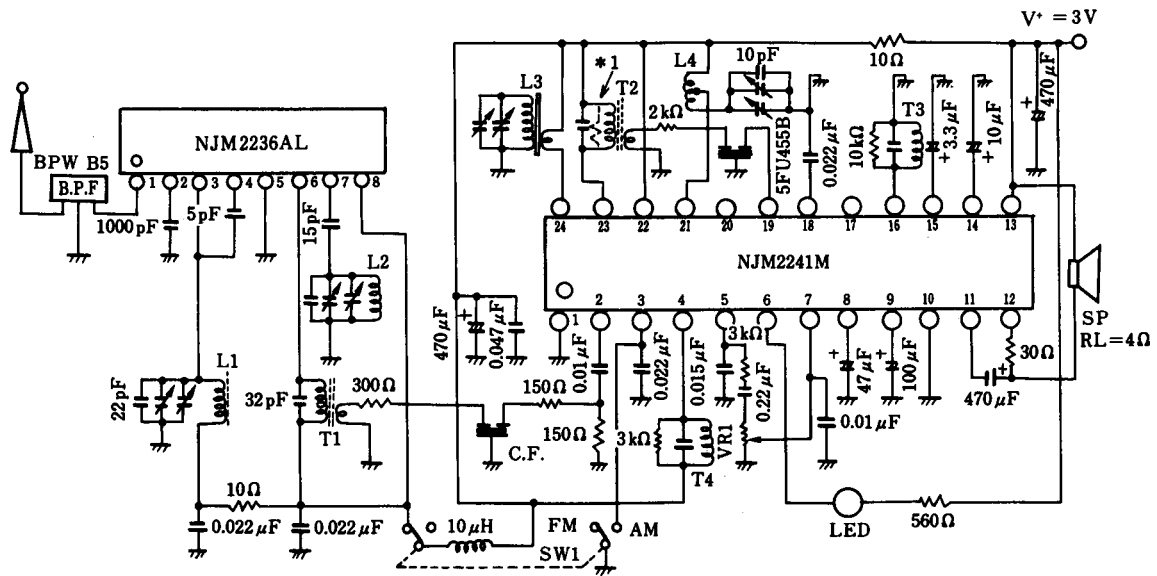
($V^*=3\text{V}$, $f=1\text{kHz}$, $R_L=4\Omega$)



Power Dissipation vs. Temperature

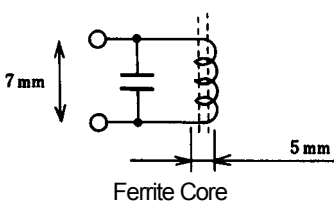
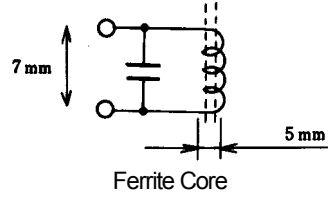
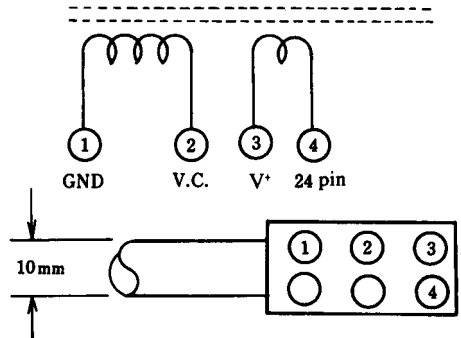
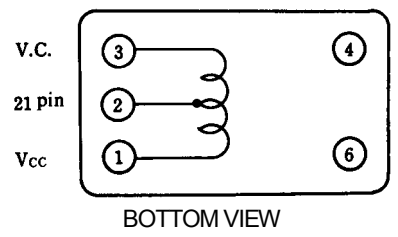


■ FM / AM RADIO APPLICATION CIRCUIT



Resistor 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.)	
L ₂ : OSC Coil	100MHz	100	0.7mmφ 2 $\frac{1}{2}$ T SUMIDA 0295 - 056	30pF (ext.)	
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	-	
L ₄ : AM OSC	796kHz	①-③ 125	①-② 15T ②-③ 89T Wire : 0.06mmφ UEW SUMIDA 2157 - 2239 - 213A	-	

■ 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

[CAUTION]

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