

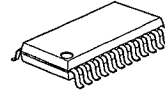
AM/FM RADIO

■ 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

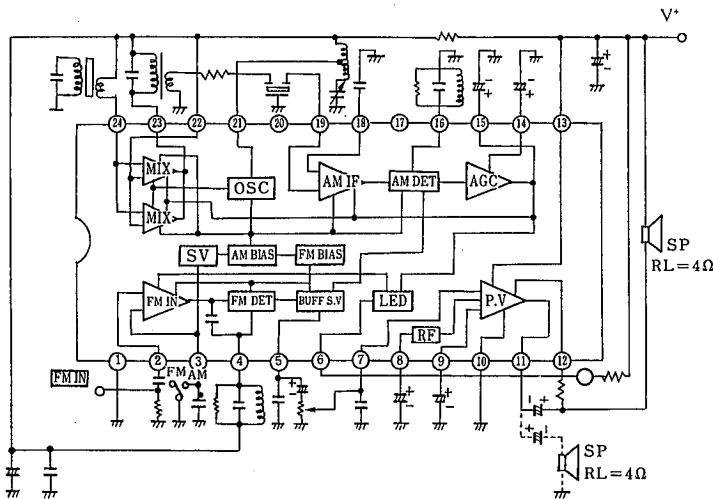


NJM 2241M

■ 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 tweeter
- Most suitable to use with NJM2236
- Package Outline DMP24
- Bipolar Technology

■ BLOCK DIAGRAM



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

4

■ ABSOLUTE MAXIMUM RATINGS

(Ta=25°C)

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V <sup>+</sup>	8	V
Lamp Current	I <sub>Lamp(Max)</sub>	10	mA
Output Current	I <sub>O(peak)</sub>	550	mA
Power Dissipation	P <sub>D</sub>	700	mW
Operating Temperature Range	T <sub>opr</sub>	-20~+75	°C
Storage Temperature Range	T <sub>stg</sub>	-40~+125	°C

■ ELECTRICAL CHARACTERISTICS

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

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

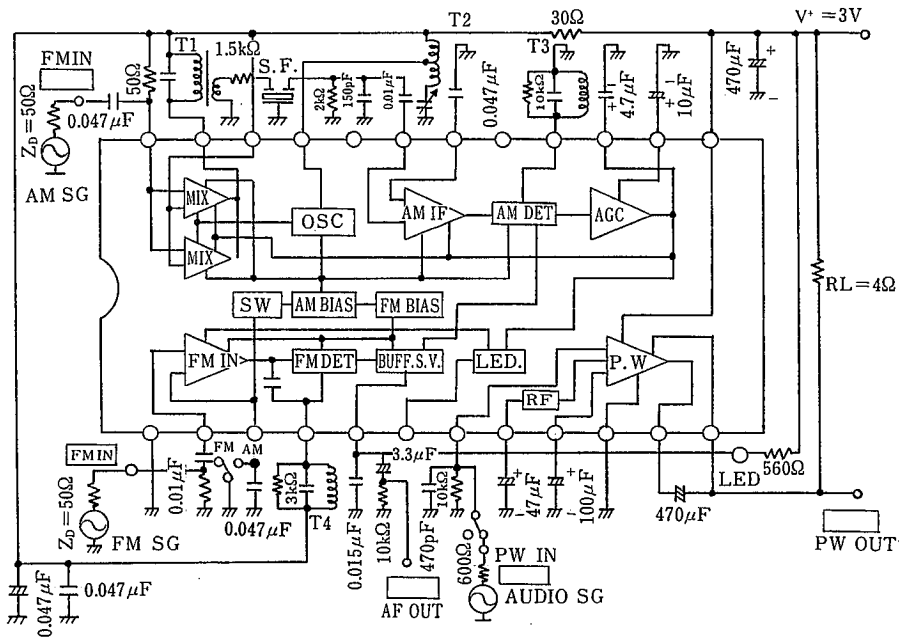
CHARACTERISTICS	SYMBOLS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT	
Operating Current	I <sub>CC</sub> (FM)	V <sub>IN</sub> =0	—	15	20	mA	
	I <sub>CC</sub> (AM)	V <sub>IN</sub> =0	—	15	20		
F M	-3dB Limiting Sensitivity	V <sub>IN(lim)</sub>	—	36	42	dBμ	
	Detection Output Voltage	V <sub>OD</sub>	V <sub>IN</sub> =80dBμ	22	31	44	mVrms
	Signal to Noise Ratio	S/N	V <sub>IN</sub> =80dBμ	—	70	—	dB
	Total Harmonic Distortion	THD	V <sub>IN</sub> =80dBμ	—	0.3	—	%
	Am Rejection	AMR	V <sub>IN</sub> =80dBμ	—	33	—	dB
	Lamp Lighting Sensitivity	V <sub>L</sub>		—	47	55	dBμ
A M	Voltage Gain	G <sub>V</sub>	V <sub>IN</sub> =30dBμ	5	11	17	mVrms
	Detection Output Voltage	V <sub>OD</sub>	V <sub>IN</sub> =66dBμ	22	31	44	mVrms
	Signal to Noise Ratio	S/N	V <sub>IN</sub> =66dBμ	—	46	—	dB
	Total Harmonic Distortion	THD1	V <sub>IN</sub> =66dBμ	—	1.5	—	%
		THD2	V <sub>IN</sub> =106dBμ	—	4.0	—	
	Local OSC Stop Voltage	V <sub>stop</sub>	V <sub>osc</sub> -6dB	—	1.0	1.5	V
Lamp Lighting Sensitivity	V <sub>L</sub>		—	30	—	dBμ	
P W	Voltage Gain	G <sub>V</sub>	f=1kHz, R <sub>L</sub> =4Ω	37	40	43	dB
	Output Power	P <sub>OD1</sub>	f=1kHz, R <sub>L</sub> =4Ω, THD=10%	180	220	—	mW
		P <sub>OD2</sub>	V <sup>+</sup> =4.5V f=1kHz, R <sub>L</sub> =4Ω, THD=10%	—	500	—	
	Total Harmonic Distortion	THD	f=1kHz, R <sub>L</sub> =4Ω, P <sub>O</sub> =50mW	—	0.5	2.0	%
Output Noise Voltage	V <sub>NO</sub>	R <sub>O</sub> =10kΩ, R <sub>L</sub> =4Ω BW=30Hz~20kHz	—	0.18	—	mVrms	

## ■ TERMINAL VOLTAGE AT NO SIGNAL

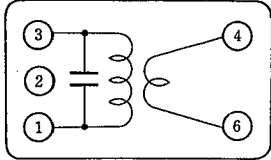
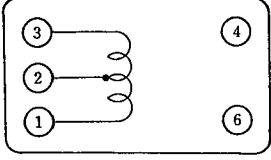
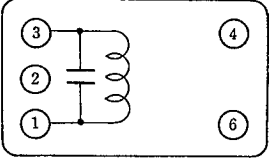
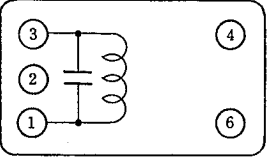
(V<sup>+</sup>=3V, T<sub>a</sub>=25°C)

CHARACTERISTICS		SYMBOLS	TYPICAL VALUES		UNIT
PIN NO	FUNCTION		AT AM	AT FM	
1	GND	V <sub>1</sub>	0	0	V
2	FM IF IN	V <sub>2</sub>	2.4	2.0	V
3	FM/AM Switch	V <sub>3</sub>	0	2.0	V
4	FM DET	V <sub>4</sub>	2.9	2.9	V
5	DET OUT	V <sub>5</sub>	0.4	0.7	V
6	LED DRIVER	V <sub>6</sub>	—	—	V
7	PW IN	V <sub>7</sub>	0	0	V
8	PW REF	V <sub>8</sub>	1.35	1.35	V
9	PW Bypass	V <sub>9</sub>	0.6	0.6	V
10	PW GND	V <sub>10</sub>	0	0	V
11	PW OUT	V <sub>11</sub>	1.5	1.5	V
12	PW Bootstrap	V <sub>12</sub>	2.8	2.8	V
13	V <sup>+</sup> 1	V <sub>13</sub>	3.0	3.0	V
14	AGC1	V <sub>14</sub>	0.6	0	V
15	AGC2	V <sub>15</sub>	0.6	0	V
16	AM DET	V <sub>16</sub>	0	0	V
17	Not Use	—	—	—	—
18	AM Bypass	V <sub>18</sub>	1.3	0	V
19	AM IF IN	V <sub>19</sub>	1.3	0	V
20	Not Use	—	—	—	—
21	AM Osc	V <sub>21</sub>	2.9	2.9	V
22	V <sup>+</sup> 2	V <sub>22</sub>	2.9	2.9	V
23	AM MIX OUT	V <sub>23</sub>	2.9	2.9	V
24	AM RF IN	V <sub>24</sub>	2.9	2.9	V

## ■ TEST CIRCUIT



■ TEST CIRCUIT COIL DATA

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

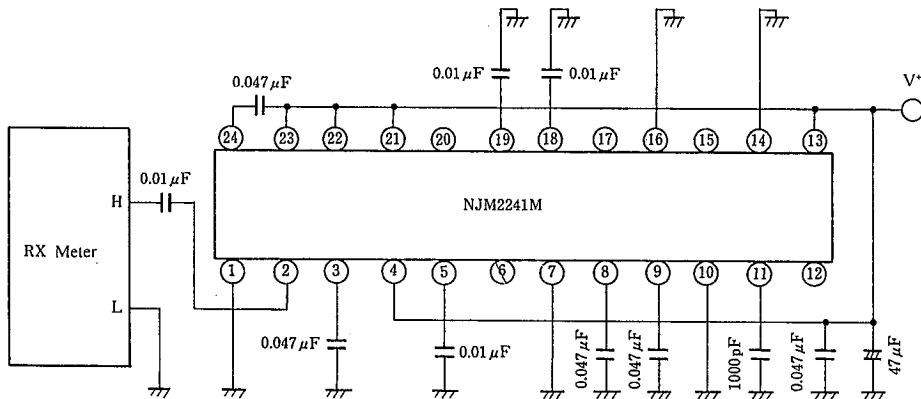
4

## INPUT OUTPUT IMPEDANCE

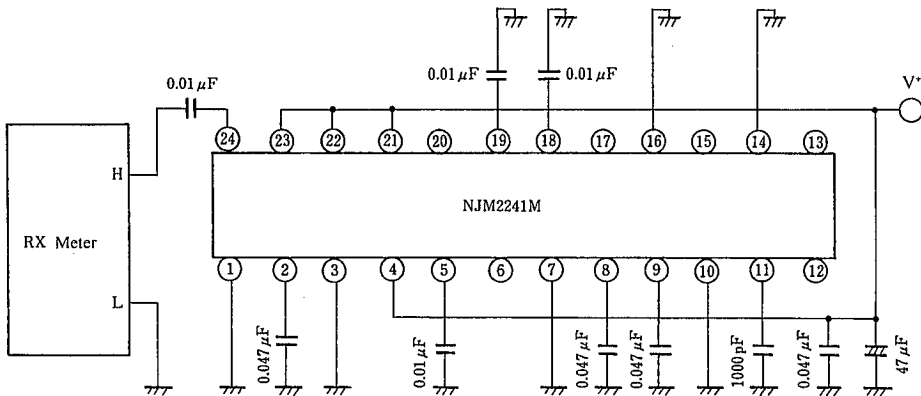
CHARACTERISTICS	SYMBOLS	CIRCUITS	TEST CONDITIONS	TYP.	UNIT
Pin 2 Input Impedance (FM)	RIN2	1	$f=10.7\text{MHz}$	4.6	$k\Omega$
	CIN2			5.0	$pF$
Pin 24 Input Impedance (AM)	RIN24	2	$f=1\text{kHz}$	20	$k\Omega$
	CIN24			11	$pF$
Pin 19 Input Impedance (AM)	RIN19	3	$f=455\text{kHz}$	6	$k\Omega$
	CIN19			3.7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

4

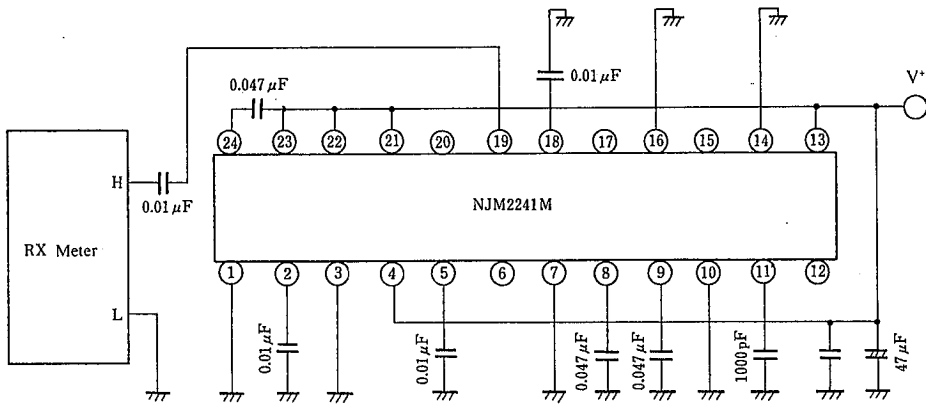
### TEST CIRCUIT 1 (Pin 2 FM Input Resistance, Capacitance)



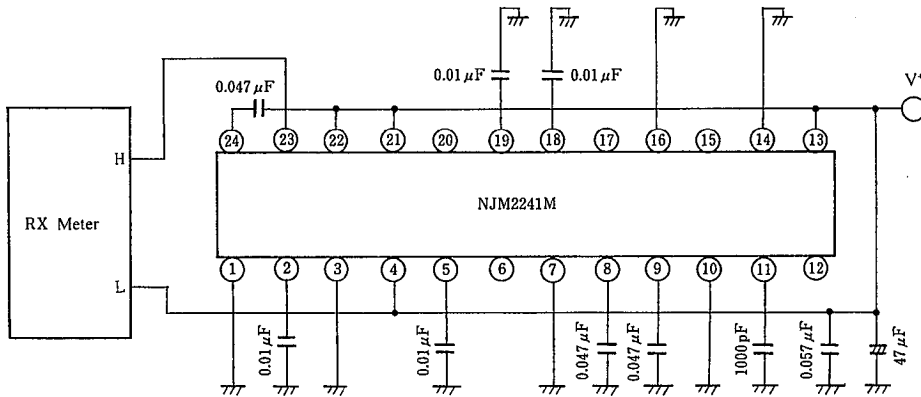
### TEST CIRCUIT 2 (Pin 24 AM Input Resistance, Capacitance)



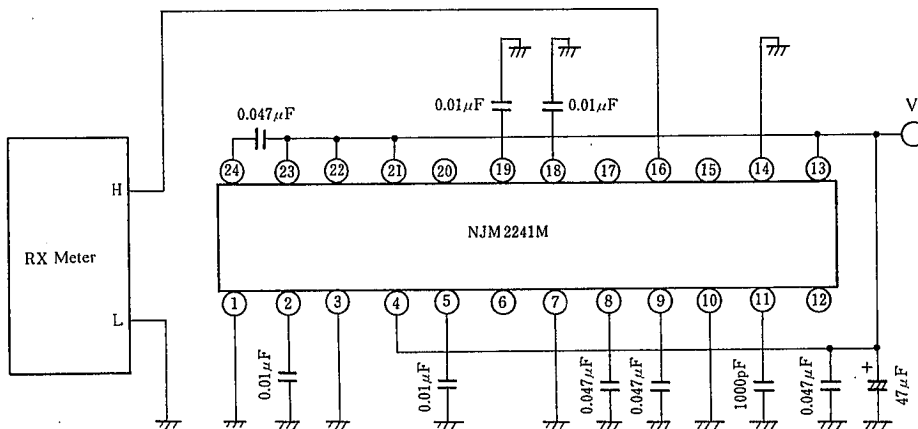
■ TEST CIRCUIT 3 (Pin 19 AM IF Input Resistance, Capacitance)



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



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



## ■ NOTES

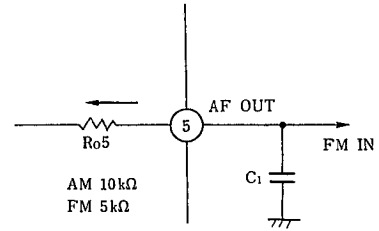
### 1. The frequency characteristics AM and FM mode

The output impedance of pin5 ( $R_{o5}$ ) and external capacitor C1 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 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 ( $V_{cc}$ ) and pin10 (bootstrap) at  $V_c = 3V$  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

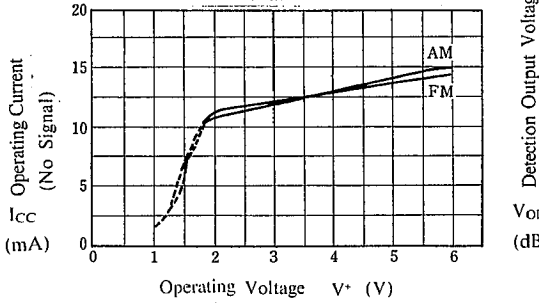
The audio signal of output pin5 includes carrier component slightly, therefore a capacitor between pin5 and GND have to be connected to decrease carrier component.

### 4. Supply voltage start-up

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

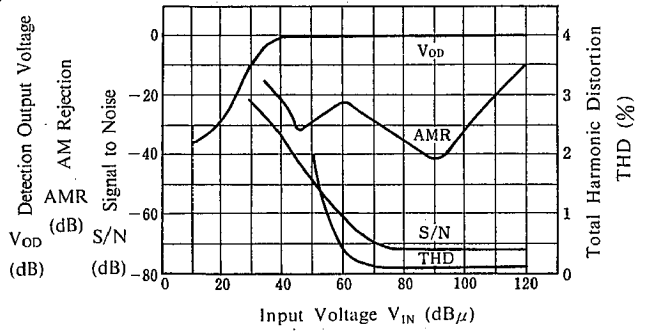
■ TYPICAL CHARACTERISTICS

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



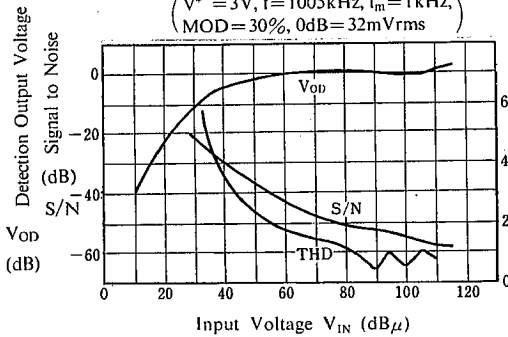
$V_{OD}, AMR, S/N, THD$  vs. Input Voltage

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



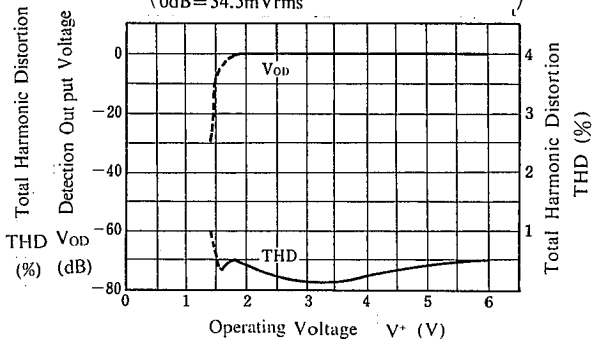
$V_{OD}, S/N, THD$  vs. Input Voltage

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



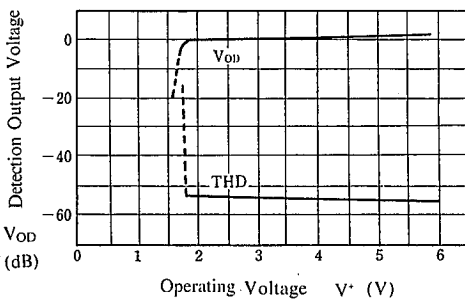
$V_{OD}, THD$  vs. Operating Voltage

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



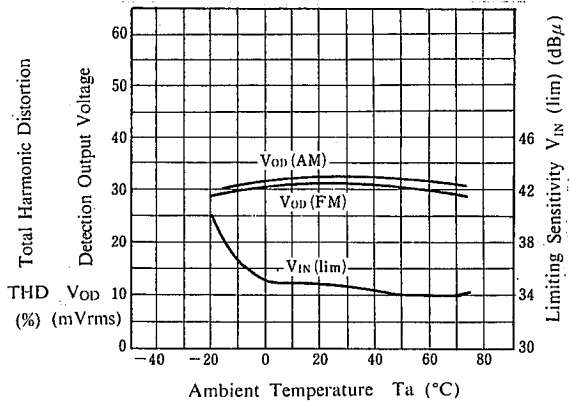
$V_{OD}, THD$  vs. Operating Voltage

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



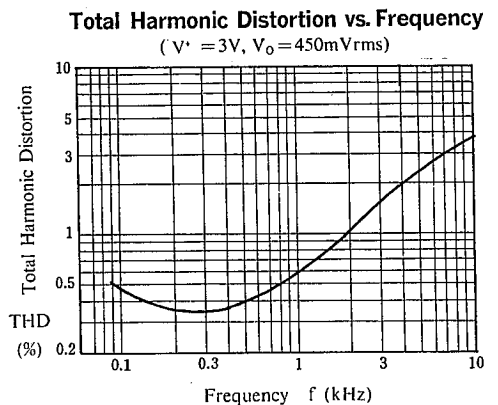
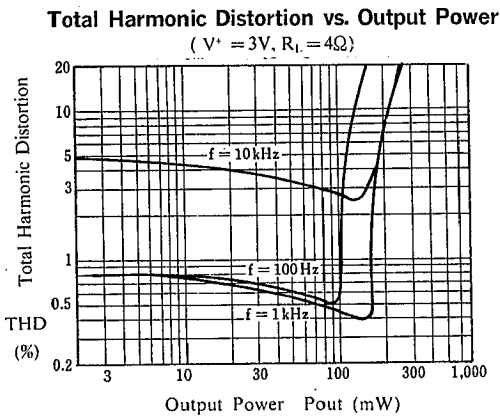
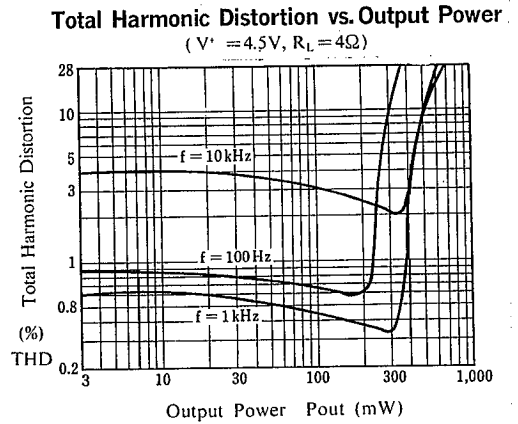
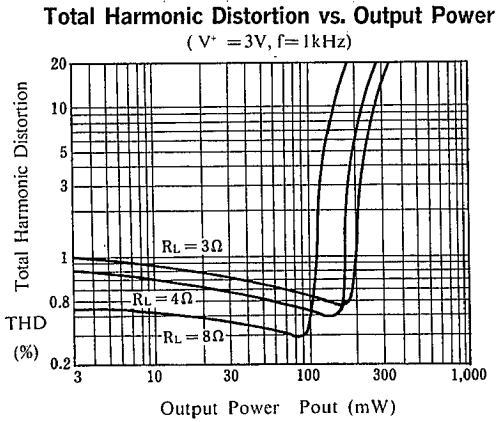
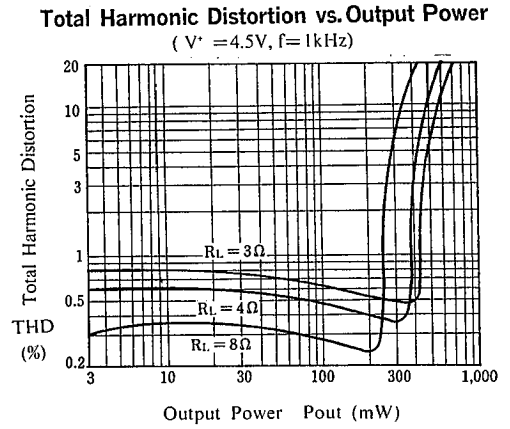
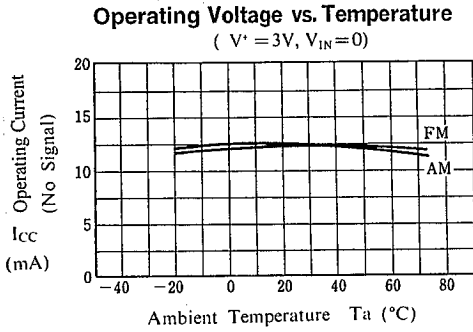
$V_{OD}, V_{IN}(lim)$  vs. Temperature

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



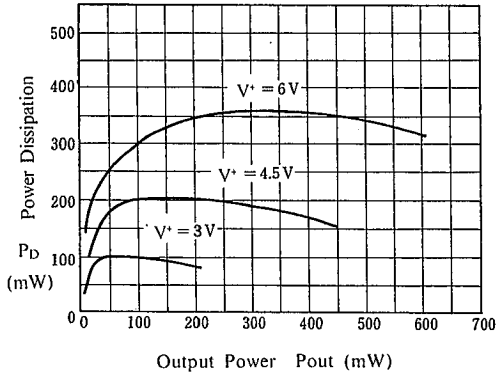


## ■ TYPICAL CHARACTERISTICS

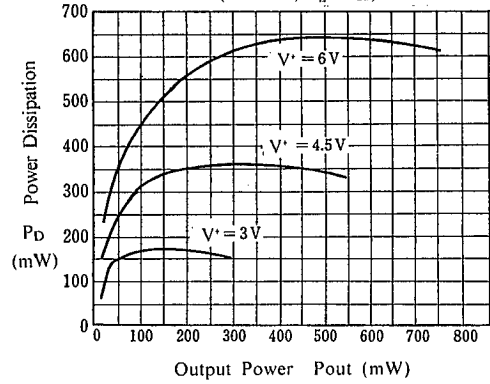


■ TYPICAL CHARACTERISTICS

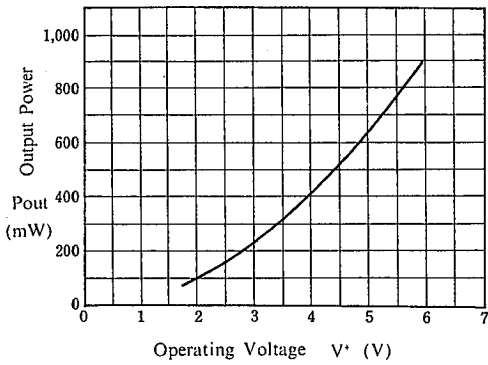
Power Dissipation vs. Output Power  
( $f=1\text{kHz}$ ,  $R_L=8\Omega$ )



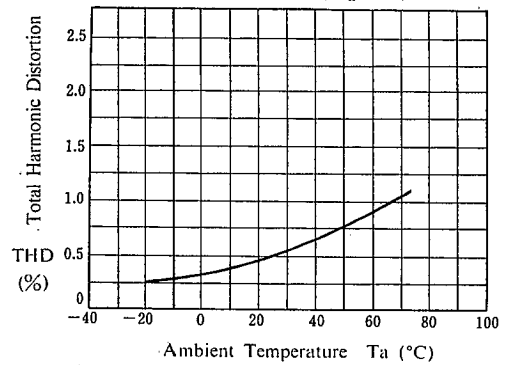
Power Dissipation vs. Output Power  
( $f=1\text{kHz}$ ,  $R_L=4\Omega$ )



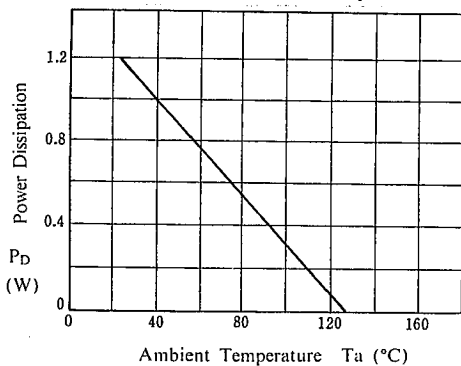
Output Power vs. Operating Voltage  
( $f=1\text{kHz}$ ,  $\text{THD}=10\%$ ,  $R_L=4\Omega$ )



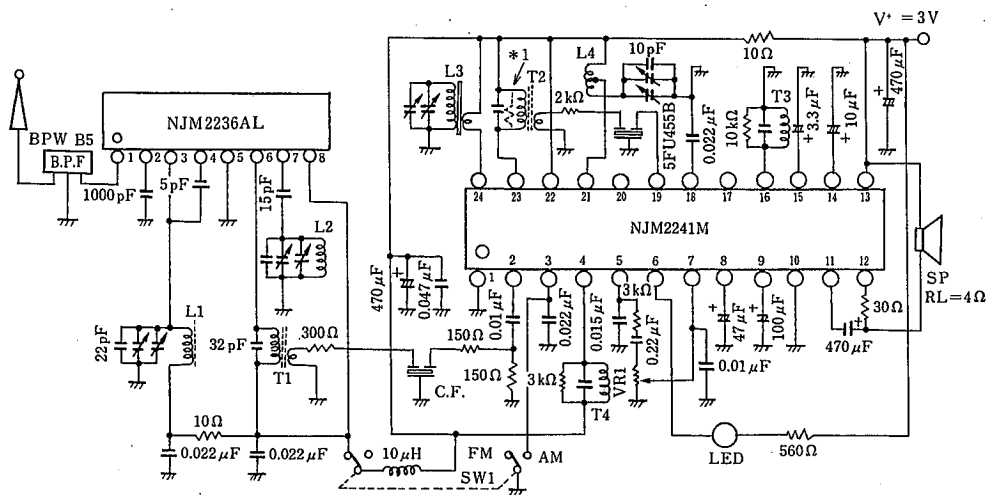
Total Harmonic Distortion vs. Temperature  
( $V^*=3\text{V}$ ,  $f=1\text{kHz}$ ,  $R_L=4\Omega$ )



Power Dissipation vs. Temperature

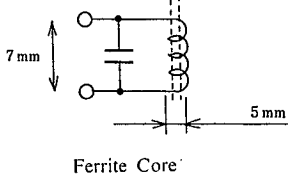
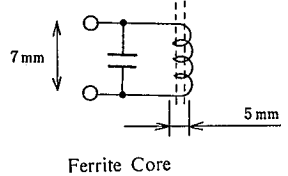
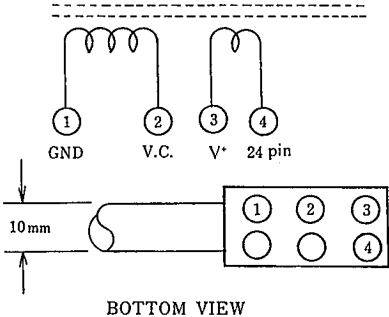
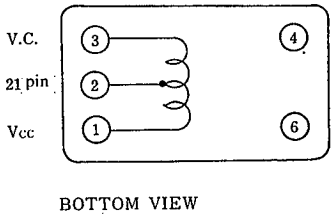


## ■ FM/AM RADIO APPLICATION CIRCUIT



Resistor should be located at # 1  
if the Trans (T2) is high Q

■ FM/AM RADIO APPLICATION CIRCUIT

COIL NO.	F <sub>0</sub>	Q <sub>0</sub>	TURNS	C <sub>0</sub>	
L <sub>1</sub> : RF Coil	100 MHz	100	0.7mmφ 2 1/4 T SUMIDA 0295-057	22 pF (ext.)	 <p>Ferrite Core</p>
L <sub>2</sub> : OSC Coil	100 MHz	100	0.7mmφ 2 1/2 T SUMIDA 0295-056	30 pF (ext.)	 <p>Ferrite Core</p>
L <sub>3</sub> : AM ANT	796 kHz	①-② 200	①-② 100 T L=600 μH ③-④ 17 T Wire : 4/0.07mm UATC Core : 10mmφ × 80mm MITUMI YI-7160-1	-	 <p>BOTTOM VIEW</p>
L <sub>4</sub> : AM OSC	796 kHz	①-③ 125	①-② 15 T ②-③ 89 T Wire : 0.06mmφ UEW SUMIDA 2157-2239-213A	-	 <p>BOTTOM VIEW</p>

4

## ■ FM/AM RADIO APPLICATION CIRCUIT

COIL NO.	F <sub>0</sub>	Q <sub>0</sub>	TURNS	C <sub>0</sub>	BOTTOM VIEW
T <sub>1</sub> : 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	<p>Bottom View</p>
T <sub>2</sub> : AM IFT	455kHz	①-③ 80	①-③ 60T ④-⑥ 16 T Wire: 0.09mmφ UEW SUMIDA 2150-2173-302	①-③ 1500pF	<p>Bottom View</p>
T <sub>3</sub> : AM DET	455kHz	①-③ 105	①-③ 127 T Wire: 0.06mmφ UEW SUMIDA 2150-2083-061	①-③ 330pF	<p>Bottom View</p>
T <sub>4</sub> : FM DET	10.7MHz	①-③ 100	①-③ 10 T Wire: 0.12mmφ UEW SUMIDA 2153-4095-331	①-③ 150pF	<p>Bottom View</p>

4

## MEMO

[CAUTION]

The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.