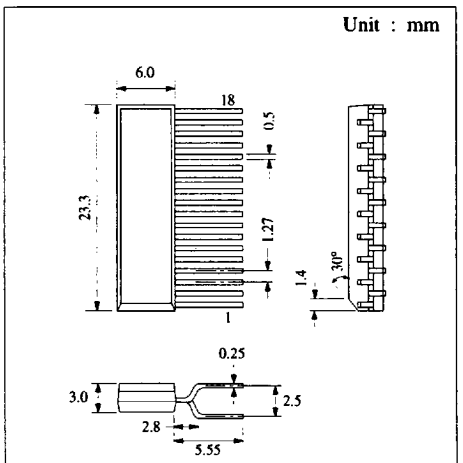
AN7024

AM Tuner, FM-IF + MPX IC for Radio, Radio Cassette Recorder

■ Description

The AN7024 is a monolithic integrated circuit incorporating AM-Tuner, FM-IF, FM-MPX and demodulation circuit which is most suitable for radio cassette recorder. Integration into 18-pin ZIL package makes possible to reduce external parts. (7 pieces reduced by in-house comparsion)

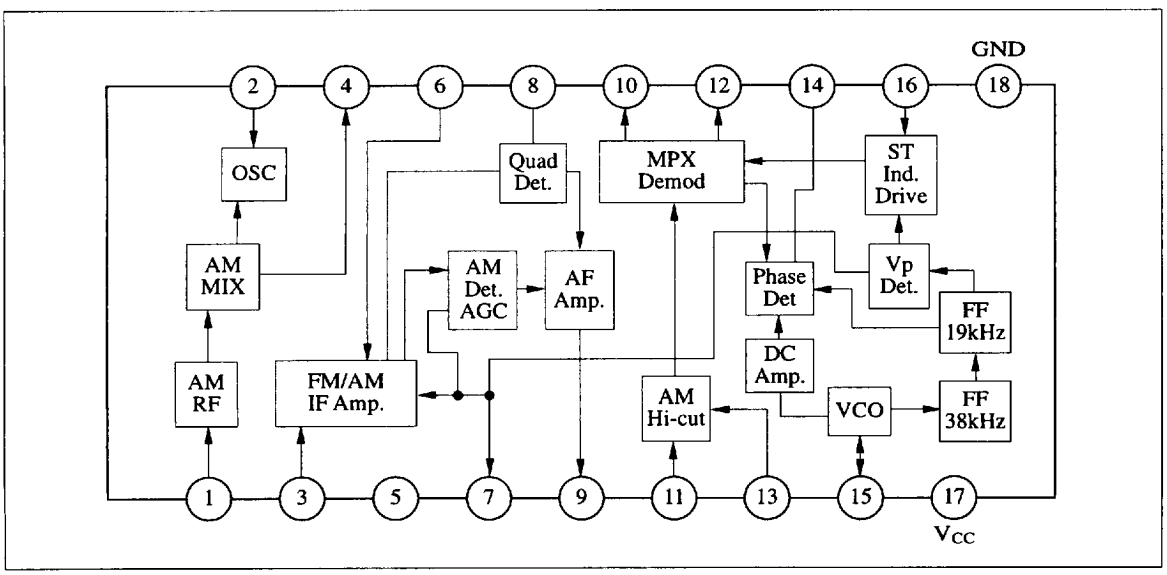


18-Lead ZSIL Plastic Package (18-ZSIP)

■ Features

- Incorporating on a single chip (AM Tuner, FM-IF, FM-MPX)
- Fewer external parts
- Built-in stereo indicator
- V_{CC} range: V_{CC} = 3V ~ 7V

■ Block Diagram



■ Absolute Maximum Ratings (Ta=25°C)

Item	Symbol	Rating	Unit
Supply Voltage	V_{CC}	7	V
Supply Current	I_{CC}	30	mA
Power Dissipation	P_D	210	mW
Operating Ambient Temperature	Topr	-20 ~ +70	°C
Storage Temperature	Tstg	-55 ~ +150	°C

Operating Supply Voltage Range: V_{CC} = 3.0V ~ 7.0V

■ Electrical Characteristics (V_{CC}=5V, Ta=25°C)

Item	Symbol	Condition	min.	typ.	max.	Unit
FM						
Total Circuit Current	$I_{tot(FM)}$	Stereo no input		14		mA
Signal to Noise Ratio	$S/N_{(FM)}$	V_{in} = 80dBμ, Stereo		66		dB
Detection Output Voltage	$V_{O(FM)}$	V_{in} = 80dBμ, Monaural	67	89	119	mV
Limiting Sensitivity	$V_{L(FM)}$	Input which $V_{O(FM)}$ decreases by 3dB, Monaural	31	34	37	dBμ
AM						
Detection Output Voltage	$V_{O(AM)}$	V_{in} = 60dBμ	47	63	84	mV
Sensitivity	V_G	$V_{o(AM)}$ = 20mV	2.5	8	13.5	dBμ
Total Circuit Current	$I_{tot(AM)}$	No input		11		mA
Signal to Noise Ratio	$S/N_{(AM)}$	V_{in} = 60dBμ		44		dB
MPX						
Channel Balance	CB	V_{in} = 80dBμ, Monaural		0		dB
Stereo Separation	Sep	V_{in} = 80dBμ, Stereo	36	46		dB
Total Harmonic Distortion	THD	V_{in} = 80dBμ, Stereo		0.5	1.5	%
Stereo Lamp ON Level	$V_{P(ON)}$	V_{in} = 80dBμ, Modulation indication		4.2	8.0	%
Stereo Lamp OFF Level	$V_{P(OFF)}$	V_{in} = 80dBμ, Modulaton indication	0.9	2.3		%

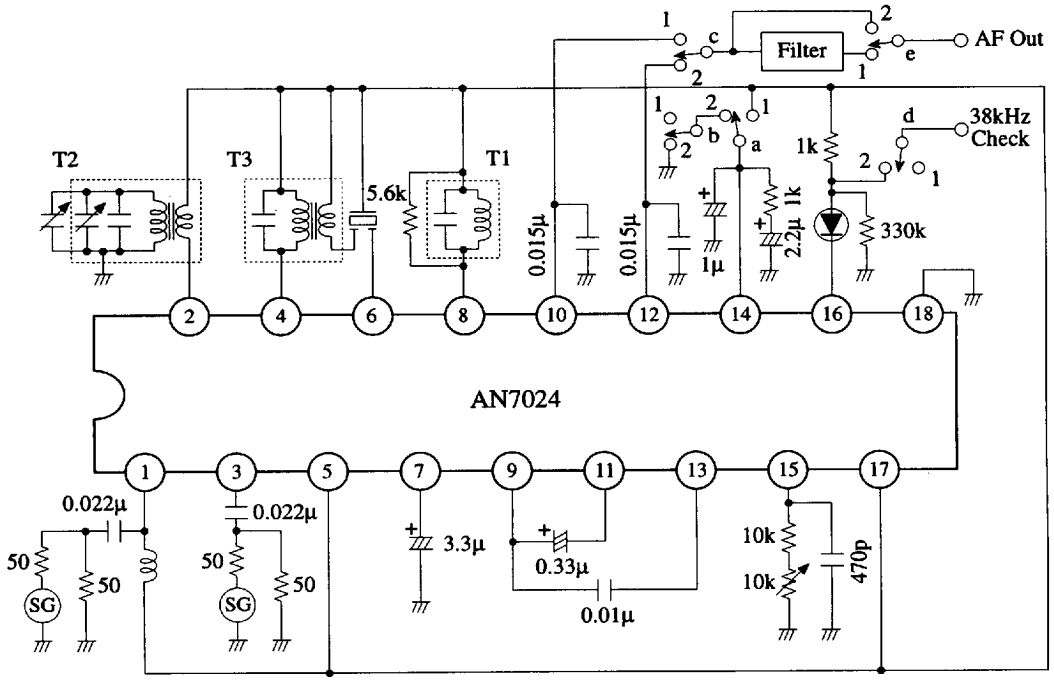
Note) Unless otherwise specified,

FM: monaural; f_{in} = 10.7MHz, 1kHz 30% modulation

Stereo; f_{in} = 10.7MHz, 1kHz 100% modulation (L + R = 90%, pilot 10%).

AM: ----------; f_{in} = 1MHz, 400Hz 30% modulation

■ Explanation of Test Circuit and Test Methods



Switch

a ··· 1 AM
2 FM

b ··· 1 Stereo
2 Forced Mono

c ··· 1 R-channel Output
2 L-channel Output

d ··· 1 AM
2 FM 38kHz Check

e ··· 1 Stereo Signal Output
2 Mono Signal Output

Note :

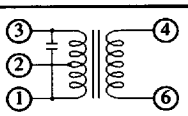
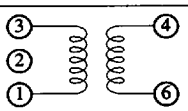
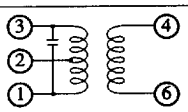
(1) Free-running must be adjusted to 38kHz ± 100Hz

(2) 470pF Styrole or Polyster Capacitor

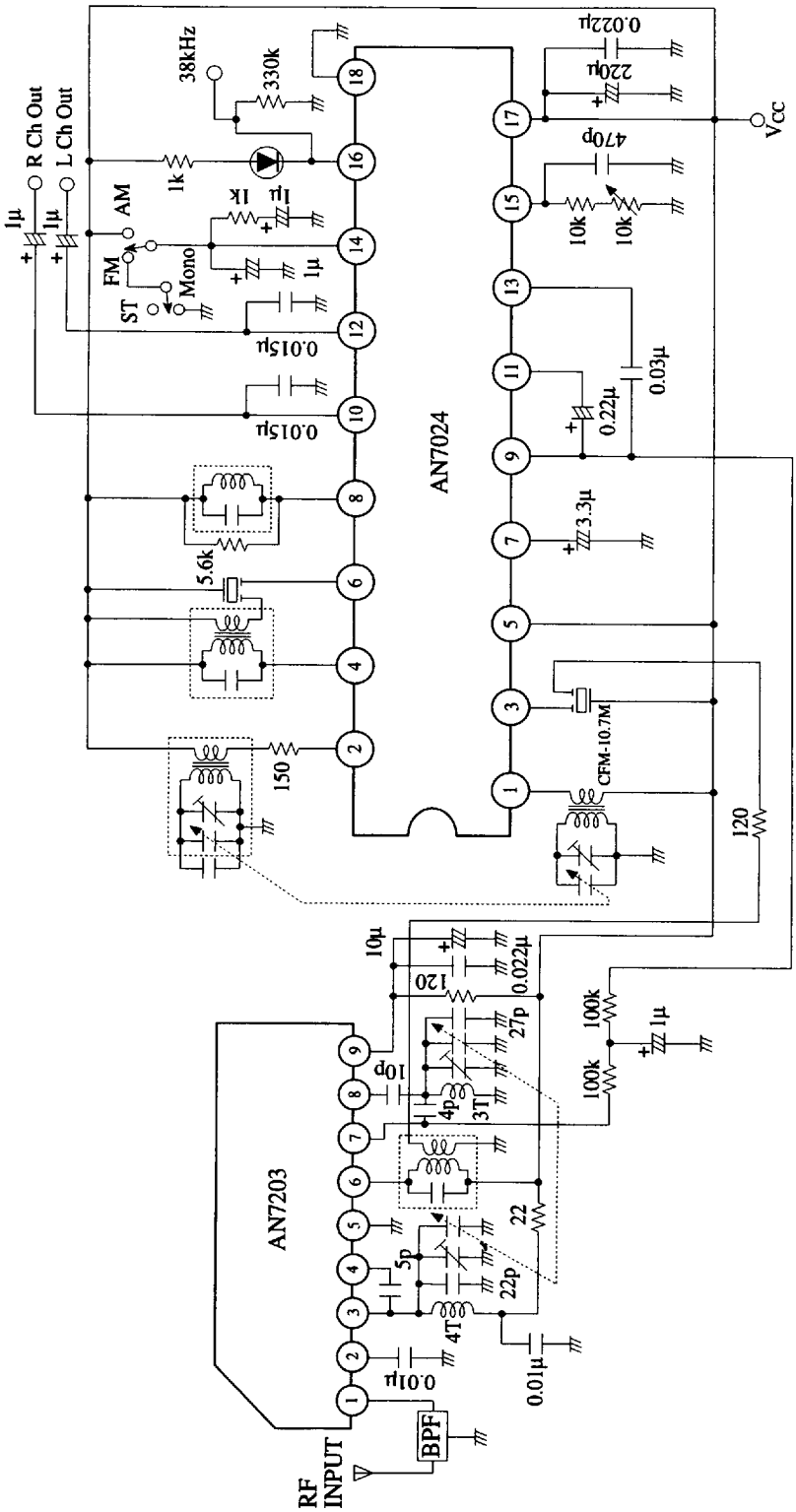
(3) Low Pass Filter used for BL-13 or BL-14

(4) Stereo output signal is external modulated to FM-SG

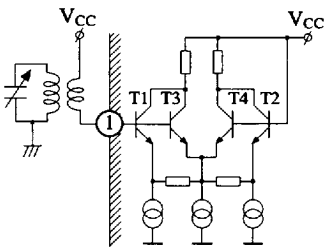
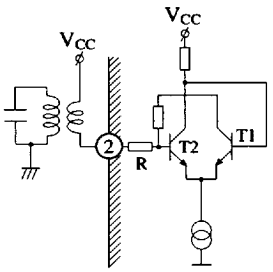
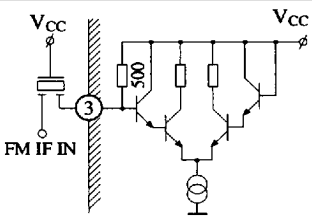
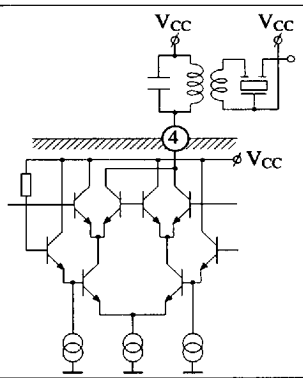
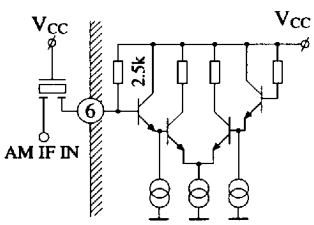
■ Coil Specifications

Symbol	Use, Freq.	Type No.	Maker	Connection Diagram	Number of Turns	Tuning Cap.	Unloaded Q
T1	FM Quad Coil 10.7MHz	IFT-41K9	MITSUMI		①···② 7T ②···③ 4T ④···⑥ 2T	100pF	90±20%
T2	AM MW Osc. Coil	L-5K7-H4	MITSUMI		①···③ 87T ④···⑥ 6T	..	100±20%
T3	AM MIX Output 455kHz	IFT-21K7 H-4	MITSUMI		①···② 10T ②···③ 43T ④···⑥ 14T	1500pF	130±20%

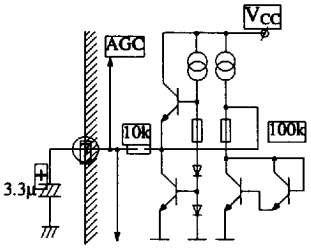
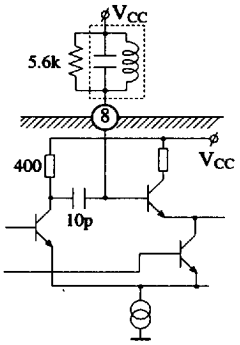
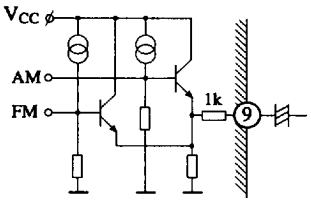
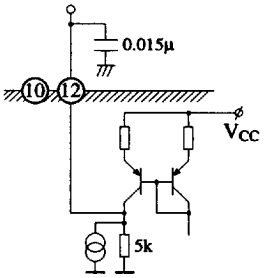
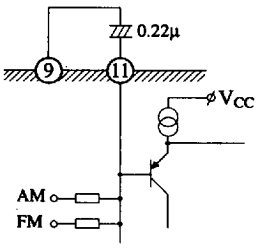
■ Application Circuit of AN7203 and AN7024



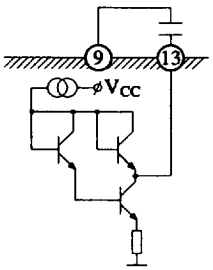
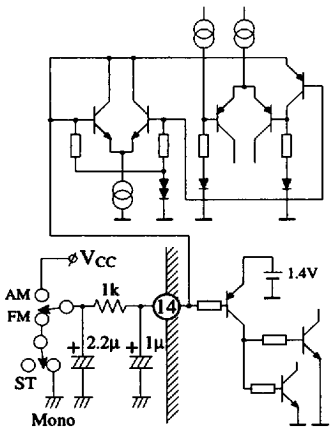
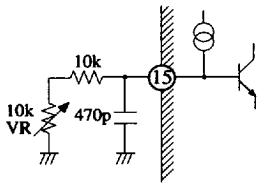
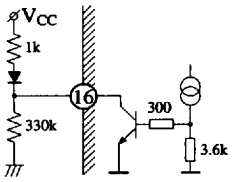
■ Pin Descriptions

Pin No.	Pin Name	DC Voltage	Equivalent Circuit	Description
1	AM RF Input	5V		Configuration of RF amp is differential amp. Input of base T1 & T3 need dc bias via external coil to V_{CC}. Usable sensitivity is better if antenna coil is used. AGC operates when T1 & T2 are off, T3 & T4 are on, becoming differential amp for small signal. On the other hand, when T1 & T2 are on, T3 & T4 are off, becoming differential for large signal.
2	AM Oscillator	5V		Configuration of OSC circuit is a differential amp. Note that OSC stops when Q factor of external coil is low. To test for OSC stop, use bare hand to touch on the secondary coil pins. In good case, when hand is removed, OSC restarts. Resistor R is for the prevention of stop OSC. If R=0, then at V_{CC} "ON", there is no DC loading and T1 & T2 are not "ON", there will be no oscillation. Level at pin 2 is 120mV.
3	FM IF IN	5V		Input impedance decided by 500Ω internal resistor. Limiting amp configuration is a 5-stages differential amp. The total gain is 60dB.
4	AM MIX OUT	5V		Mixer configuration is double-balanced mixer. Oscillation leakage is minimized.
6	AM IF IN	5V		AGC operates by controlling the emitter current of first stage IF amp. Input impedance decided by 2.5kΩ resistor. AM IF amp configuration is 3-stages differential amp. The total gain is 60dB.

■ Pin Descriptions (Continue)

Pin No.	Pin Name	DC Voltage	Equivalent Circuit	Description
7	AGC & MPX Pilot Signal Detector	1.4V		AGC output impedance is 110kΩ. Phase detector LPF output impedance is 10kΩ. Common value 3.3µF capacitor at pin 7. Cannot connect low impedance circuit to pin 7.
8	FM Detector	5V		FM detector configuration is quadrature detector. Phase shift capacitor is located internally. 5.6kΩ resistor affects detector output level & harmonic distortion.
9	Detector Output	AM 0.3V FM 0.7V		Common for both AM & FM. Output impedance is 1kΩ.
10 12	MPX Output	1.2V		Output circuit configuration is a current mirror. Output impedance is 5kΩ. Time constant & de-emphasis is 75µs, determined by external capacitor 0.015µF. Output dynamic range is fixed at 800mV. No effect by V_{CC}.
11	MPX IN	0.7V		Input impedance is 30kΩ in AM mode & 100kΩ in FM mode. The input coupling capacitor is 0.22µF. Cutoff frequency is 55Hz for AM & 7Hz for FM.

■ Pin Descriptions (Continue)

Pin No.	Pin Name	DC Voltage	Equivalent Circuit	Description
13	AM Hi-Cut	0.4V		Capacitor at pin 13 and output impedance of pin 9 decides the input impedance of pin 13. Pin 13 is joined to GND by low impedance in AM mode. High-cut frequency is 4.8kHz. In FM mode, pin 13 is high impedance.
14	MPX Phase Detector LPF	AM 5V FM 1.4V (Stereo) FM 0V (Mono)		Used as switch for FM/AM & force mono. Please use discrete parts for LPF. If discrete parts are not used, the characteristics for THD & S/N in stereo mode will be poor. When switch is open, FM stereo mode. When switch is GND, FM mono mode. When switch is V_{CC}, AM Mode. Please maintain this switching condition at 0.5V & below for FM mono mode. For AM, use 2.5V & above. Current in AM mode from V_{CC} to pin 14 is 800μA. When pin 14 is switched to GND, there is no current.
15	VCO	AM 0V FM 76kHz Oscillation		Oscillation of this circuit is 76kHz, determined by external resistor & capacitor. For VCO adjustment, please join 330kΩ between pin 16 & GND. Adjust VCO range to 38kHz±100Hz. The 470pF is a styrole/polypropylene film capacitor for guarantee of temperature characteristics & limits.
16	Stereo LED Driver and VCO monitor	AM 3.3V FM 0.13V (Stereo) FM 4.2V (Mono)		Current capability is 30mA maximum. Usable LED current is 4mA. For VCO monitor, please join 330kΩ resistor to GND. Only this pin can be connected to 12V via 1kΩ pull-up resistor.
5	V_{CC}			V_{CC} for FM stage Connect centre pin of ceramic filter to this pin.
17	V_{CC}	5V		
18	GND	0V		