SGS-THOMSON MICROELECTRONICS

TDA7220

VERY LOW VOLTAGE AM-FM RADIO

- OPERATING SUPPLY VOLTAGE: 1.5 to 6V
- HIGH SENSITIVITY AND LOW NOISE
- LOW BATTERY DRAIN
- VERY LOW TWEET
- HIGH SIGNAL HANDLING
- VERY SIMPLE DC SWITCHING OF AM-FM
- AM SECTION OPERATES UP TO 30 MHz

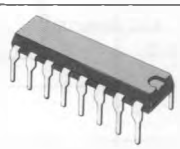
The TDA 7220 is a monolithic integrated circuit in a 16-lead dual in-line plastic package designed for use in 3V, 4.5V and 6V portable AM-FM radio receivers.
The functions incorporated are:

AM SECTION

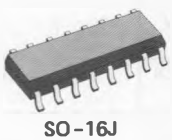
- Preamplifier and double balanced mixer with AGC
- On pin local oscillator
- IF amplifier with internal AGC
- Detector and audio preamplifier

FM SECTION

- IF amplifier and limiter
- Quadrature detector
- Audio preamplifier



DIP-16 Plastic (0.25)



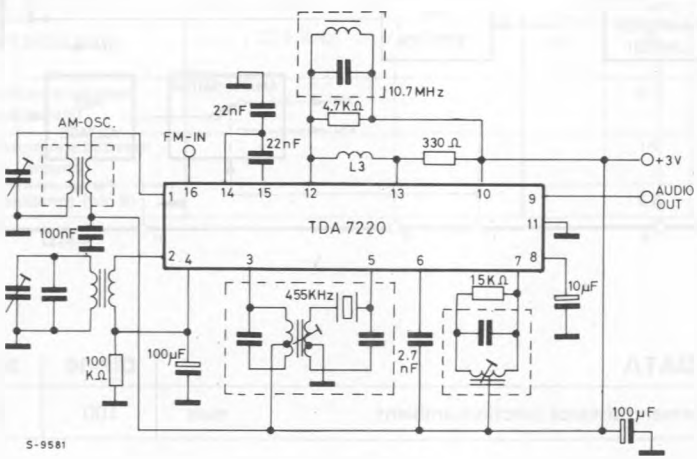
SO-16J

ORDERING NUMBERS: TDA7220 (DIP-16)
TDA7220D (SO-16)

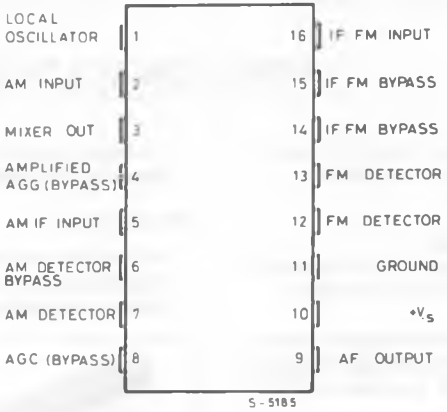
ABSOLUTE MAXIMUM RATINGS

V_s	Supply voltage	6.5	V
P_{tot}	Total power dissipation at $T_{amb} < 110°C$ (DIP-16)	400	mW
T_{op}	Operating temperature	-20 to 85	°C
T_{stg}, T_j	Storage and junction temperature	-55 to 150	°C

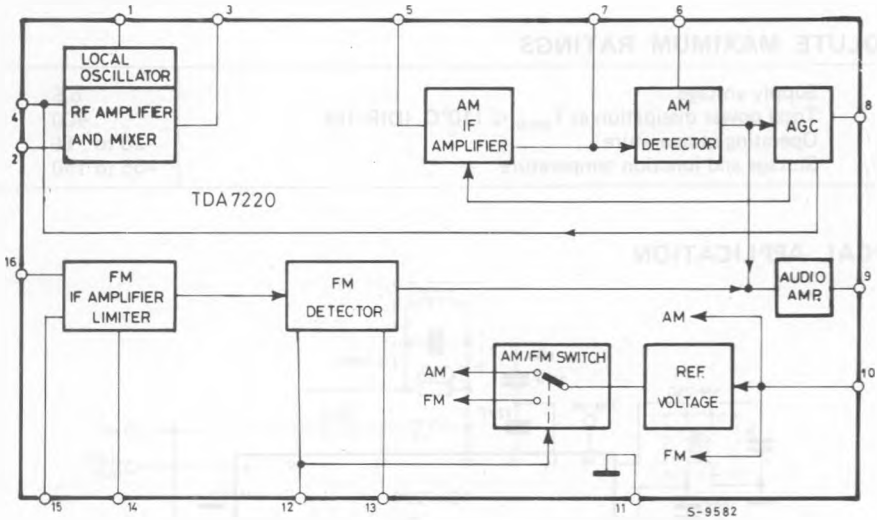
TYPICAL APPLICATION



CONNECTION DIAGRAM



BLOCK DIAGRAM



THERMAL DATA

			DIP-16	SO-16	
$R_{th\ j\text{-}amb}$	Thermal resistance junction-ambient	max	100	200	°C/W

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, V_s = 3V unless otherwise specified, refer to test circuit)

	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_d	Drain current	AM section		11	18	mA
		FM section		10	15	mA

AM SECTION (f_o = 1 MHz; f_m = 1 KHz)

V_I	Input sensitivity	S/N = 26 dB	m = 0.3		12	25	μV
S/N	Signal to noise	V_I = 1 mV	m = 0.3	40	50		dB
ΔV_I	AGC range	ΔV_{out} = 10 dB	m = 0.8	90			dB
V_o	Recovered audio signal (pin 9)	V_i = 1 mV	m = 0.3	40	80	110	mV
d	Distortion				0.6		%
V_H	Max input signal handling capability	m = 0.8	d < 10%	0.5			V
R_i	Input resistance between pins 2 and 4	m = 0			7.5		KΩ
C_i	Input capacitance between pins 2 and 4	m = 0			18		pF
R_o	Output resistance (pin 9)				4.5		KΩ
	Tweet 2 IF	m = 0.3	V_i = 1 mV		40		dB
	Tweet 3 IF				55		dB

FM SECTION (f_o = 10.7 MHz; f_m = 1 KHz)

V_i	Input limiting voltage	-3 dB limiting point			33	80	μV
AMR	Amplitude modulation rejection	Δf = ± 22.5 KHz V_i = 3 mV	m = 0.3		40		dB
S/N	Signal to noise	Δf = ± 22.5 KHz	V_i = 1 mV	50	65		dB
d	Distortion	Δf = ± 22.5 KHz	V_i = 1 mV		0.3		%
		Δf = ± 75 KHz			1.1	1.5	%
V_o	Recovered audio signal (pin 9)	Δf = ± 22.5 KHz	V_i = 1 mV	40	70	90	mV
R_i	Input resistance between pin 16 and ground				6.5		KΩ
C_i	Input capacitance between pin 16 and ground				14		pF
R_o	Output resistance (pin 9)				4.5		KΩ

ELECTRICAL CHARACTERISTICS (T_{amb} = 25°C, V_s = 1.6V unless otherwise specified, refer to test circuit)

Parameter		Test conditions		Min.	Typ.	Max.	Unit
I_d	Drain current	AM section			8	15	mA
		FM section			7	13	mA
AM SECTION (f_o = 1 MHz; f_m = 1 KHz)							
V_i	Input sensitivity	S/N = 26 dB	m = 0.3		15	25	μV
S/N	Signal to noise	V_i = 1 mV	m = 0.3	40	48		dB
V_i	AGC range	ΔV_{out} = 10 dB	m = 0.8	90			dB
V_o	Recovered audio signal (pin 9)	V_i = 1 mV	m = 0.3	40	75		mV
d	Distortion				0.5		%
V_H	Max input signal handling capability	m = 0.8	d < 10%	0.5			V
R_i	Input resistance between pins 2 and 4	m = 0			7.5		KΩ
C_i	Input capacitance between pins 2 and 4	m = 0			18		pF
R_o	Output resistance (pin 9)				4.5		KΩ
	Tweet 2 IF	m = 0.3	V_i = 1 mV		40		dB
	Tweet 3 IF				55		dB
FM SECTION (f_o = 10.7 MHz; f_m = 1 KHz)							
V_i	Input limiting voltage	-3 dB limiting point			50		μV
AMR	Amplitude modulation rejection	Δf = ± 22.5 KHz V_i = 3 mV	m = 0.3		34		dB
S/N	Ultimate quieting	Δf = ± 22.5 KHz	V_i = 1 mV		55		dB
d	Distortion	Δf = ± 22.5 KHz	V_i = 1 mV		0.6		%
V_o	Recovered audio signal (pin 9)	Δf = ± 22.5 KHz	V_i = 1 mV		55		mV
R_i	Input resistance between pin 16 and ground				6.5		KΩ
C_i	Input capacitance between pin 16 and ground				14		pF
R_o	Output resistance (pin 9)				4.5		KΩ

Fig. 1 – Test circuit

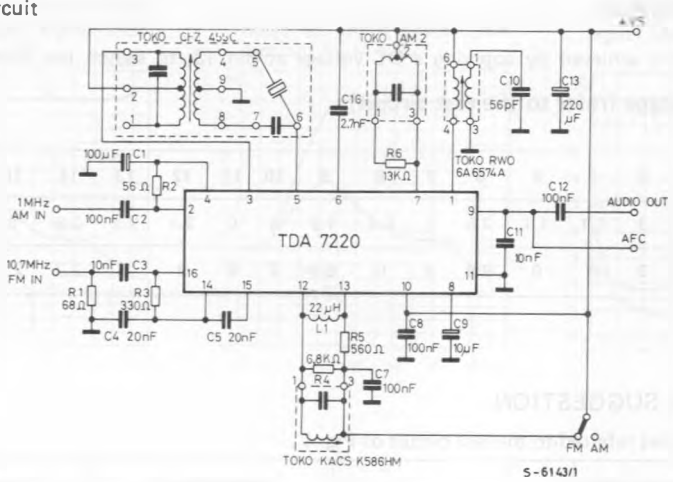
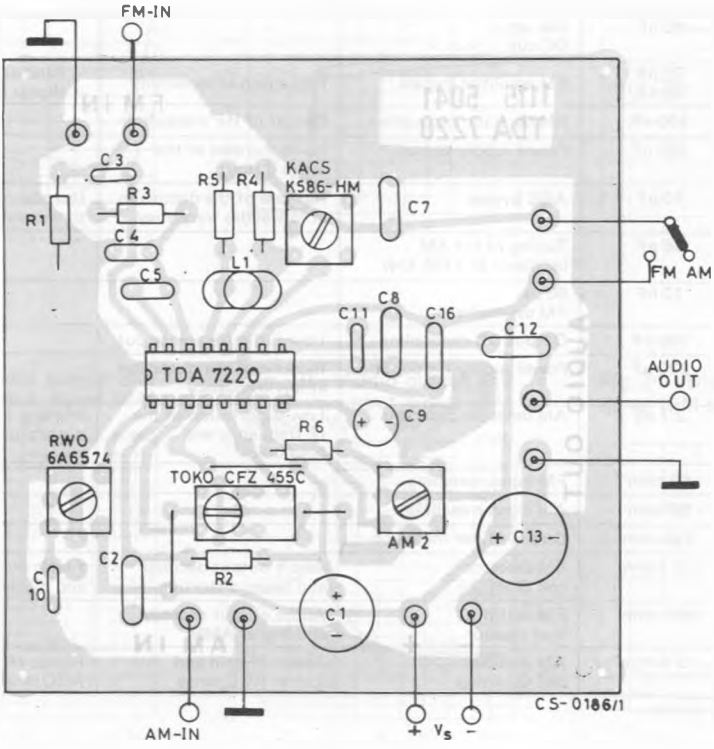


Fig. 2 – PC board and component layout (1:1 scale) of the test circuit



AM-FM SWITCHING

AM-FM switching is achieved by applying a DC voltage at pin 13, to switch the internal reference.

Typical DC voltage (refer to the test circuit)

Pins	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Unit
AM	3	1.1	3	1.1	1.1	2.5	3	0.7	1.2	3	0	2.1	2.1	2.9	3	2.9	V
FM	3	0	3	0	0	2.4	3	0	0.9	3	0	3	3	2.7	2.7	2.7	V

APPLICATION SUGGESTION

Recommended values referred to the test circuit of Fig. 1

Part number	Recommended value	Purpose	Smaller than recommended value	Larger than recommended value
C1	100 µF	AGC bypass	Increase of the distortion at low audio frequency	Increase of the AGC time constant
C2 (*)	100 nF	AM input DC cut		
C3 (*)	10 nF	FM input DC cut		
C4 C5	20 nF 20 nF	FM amplifier bypass	Reduction of sensitivity	– Bandwidth increase – Higher noise
C7	100 nF	FM detector decoupling	Danger of RF irradiation	
C8	100 nF	Power supply bypass	Noise increase of the audio output	
C9	10 µF	AGC bypass	Increase of the distortion at low audio frequency	Increase of the AGC time constant
C10 (*)	56 pF	Tuning of the AM oscillator at 1455 KHz		
C11	10 nF	50 µs FM de-enphasis		
C12	100 nF	Output DC decoupling	Low audio frequency cut	
C13	220 µF	Power supply decoupling	Increase of the distortion at low frequency	
C16	2.7 nF	AM detector capacitor	Low suppression of the IF frequency and harmonics	Increase of the audio distortion
R1 (*)	68 ohm	FM input matching		
R2 (*)	56 ohm	AM input matching		
R3	330 ohm	Ceramic filter matching		
R4	6.8 Kohm	FM detector coil Q setting	Audio output decrease and lower distortion	Audio output increase and higher distortion
R5	560 ohm	FM detector load resistor	Audio output decrease and higher AMR	
R6	13 Kohm	AM detector coil Q setting	Lower IF gain and Lower AGC range	Higher IF gain and lower AGC range

(*) Only for test circuit.

Fig. 3 - Audio output and noise vs. input signal (AM section) $V_s = 3V$

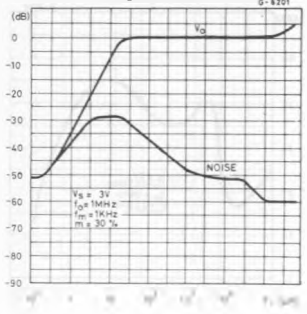


Fig. 4 - Audio output and noise vs. input signal (AM section) $V_s = 1.6V$

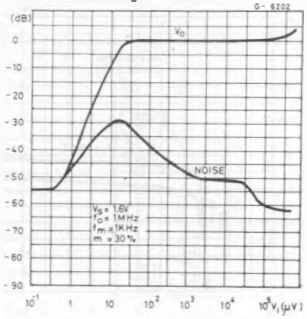


Fig. 5 - Distortion vs. input signal (AM section) $V_s = 3V$

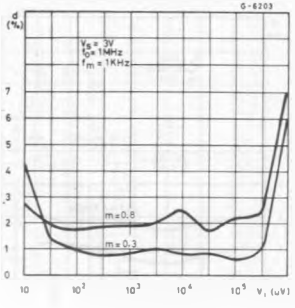


Fig. 6 - Distortion vs. input signal (AM section) $V_s = 1.6V$

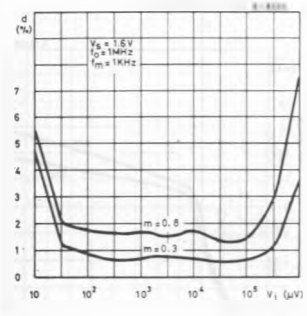


Fig. 7 - Audio output vs. supply voltage (AM section)

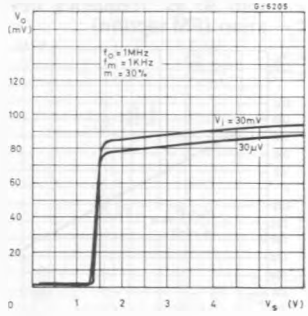


Fig. 8 - Amplified AGC voltage (pin 4) vs. input signal (AM section)

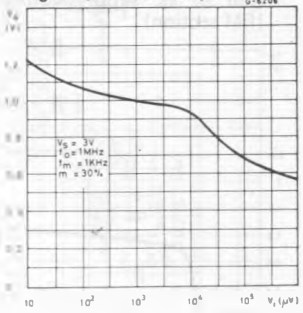


Fig. 9 - Audio output and noise vs. input signal (FM section) $V_s = 3V$

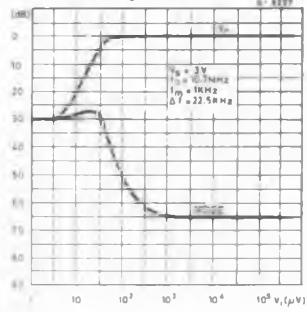


Fig. 10 - Audio output and noise vs. input signal (FM section) $V_s = 1.6V$

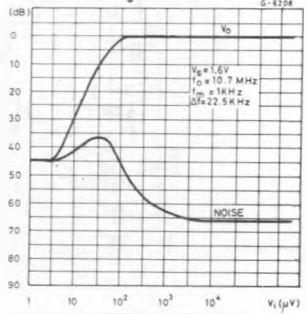


Fig. 11 - Distortion vs. input signal (FM section) $V_s = 3V$

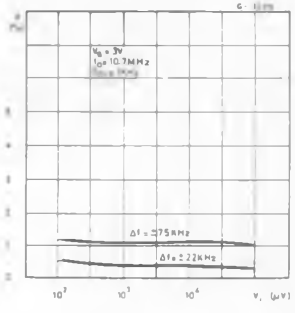


Fig. 12 - Distortion vs. input signal (FM section) $V_s = 1.6V$

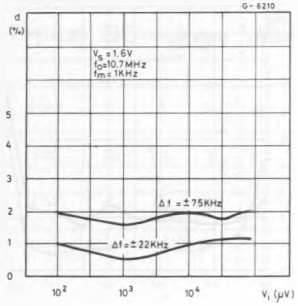


Fig. 13 - Audio output vs. supply voltage (FM section)

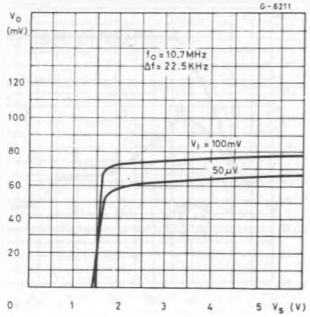


Fig. 14 - Amplitude modulation rejection vs. input signal (FM section)

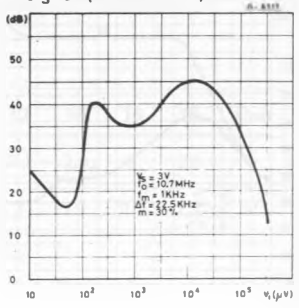


Fig. 15 - DC output voltage (pin 9) vs. supply voltage (FM section)

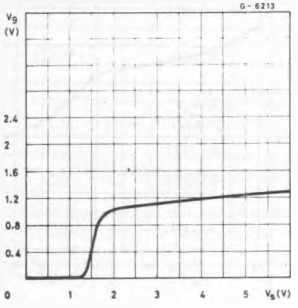


Fig. 16 - AFC output voltage (pin 9) vs. frequency deviation (FM section)

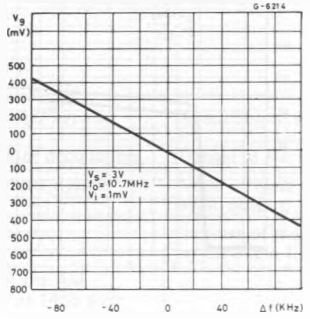
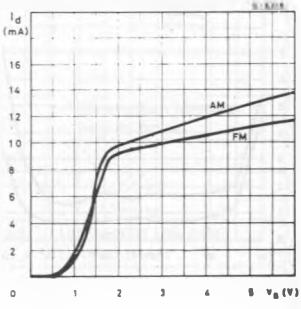
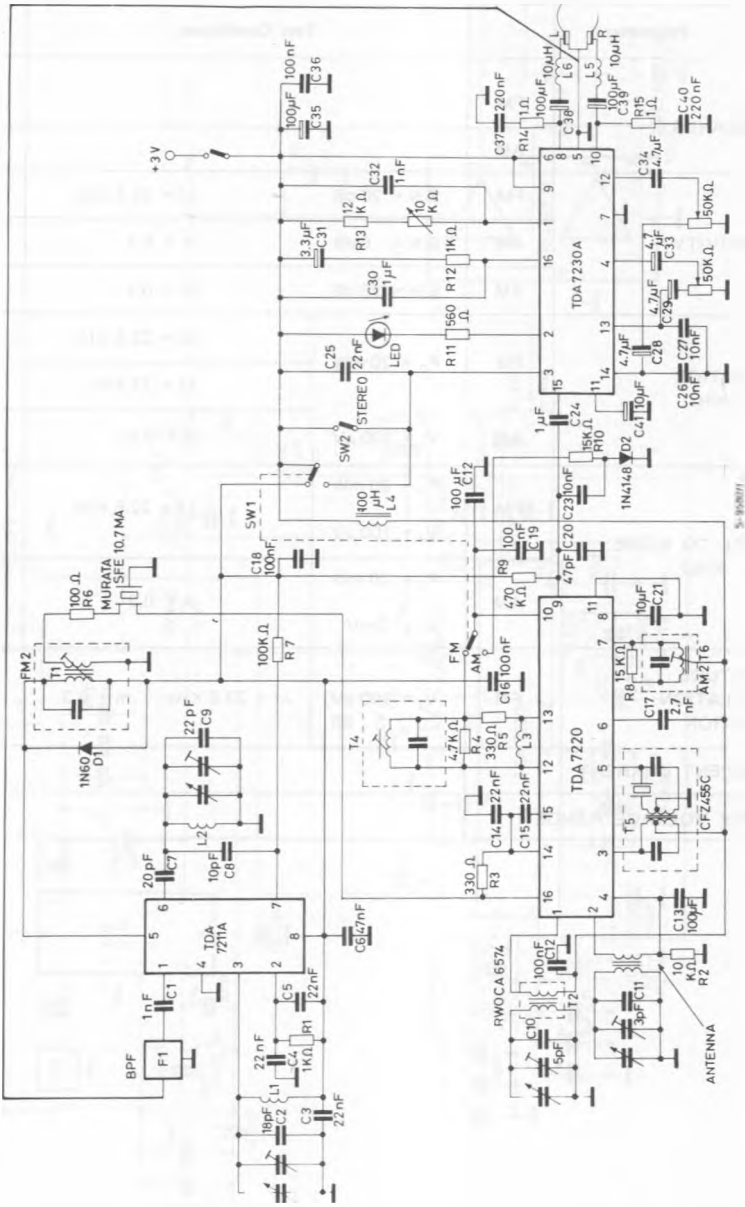


Fig. 17 - Drain current vs. supply voltage



APPLICATION INFORMATION

Fig. 18 - Stereo AM/FM miniradio



APPLICATION INFORMATION (continued)

Typical performance of the radio receiver of fig. 18 (V_s = 3V, R_L = 32Ω)

Parameter		Test Conditions		Value
WAVEBANDS	FM			87.5 to 108 MHz
	AM			510 to 1620 KHz
SENSITIVITY	FM	S/N = 26 dB	Δf = 22.5 KHz	3 μV
	AM	S/N = 6 dB	m = 0.3	2 μV
	AM	S/N = 26 dB	m = 0.3	10 μV
DISTORTION (fm = 1 KHz)	FM	P_o = 20 mW	Δf = 22.5 KHz	0.5%
			Δf = 75 KHz	1.8%
	AM	V_i = 100 μV	m = 0.8	1.1%
SIGNAL TO NOISE (fm = 1 KHz)	FM	P_o = 20 mW V_i = 100 μV	Δf = 22.5 KHz	60 dB
	AM	P_o = 20 mW V_i = 1 mV	m = 0.3	45 dB
AMPLITUDE MODULATION REJECTION	FM	V_i = 100 μV	Δf = 22.5 KHz m = 0.3	40 dB
QUIESCENT CURRENT				16 mA
SUPPLY VOLTAGE RANGE				1.6 to 3V

APPLICATION INFORMATION (continued)

Fig. 19 - 0.3W AM/FM Mono-Radio