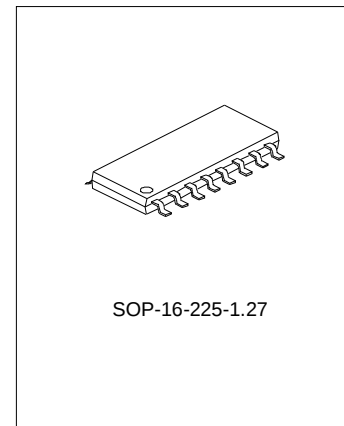


FM RADIO RECEIVER FOR PORTABLE SYSTEM

DESCRIPTION

The SA1021 integrated radio receiver circuit is for portable radios, stereo as well as mono, where a minimum of periphery is important in terms of small dimensions and low cost. It is fully compatible for applications using the low-voltage micro tuning system (MTS). The IC has a frequency locked loop (FLL) system with an intermediate frequency of 76kHz. The selectivity is obtained by active RC filters. The only function to be tuned is the resonant frequency of the oscillator. Interstation noise as well as noise from receiving weak signals is reduced by a correlation mute system.

Special precautions have been taken to meet local oscillator radiation requirements. Because of the low intermediate frequency, low pass filtering of the MUX signal is required to avoid noise when receiving stereo. 50kHz roll-off compensation, needed because of the low pass characteristic of the FLL, is performed by the integrated LF amplifier. For mono application this amplifier can be used to directly drive an earphone. The field-strength detector enables field-strength dependent channel separation control.



SOP-16-225-1.27

ORDERING INFORMATION

Part No.	Package
SA1021	SOP-16-225-1.27

- * Mixer
- * IF amplifier/limiter
- * Mute circuit
- * Loop amplifier
- * LF amplifier for mono earphone amplifier or MUX filter

FEATURES

- * RF input stage
- * Local oscillator
- * Frequency detector
- * MTS compatible
- * Internal reference circuit
- * Field-strength dependent channel separation control facility.

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BLOCK DIAGRAM

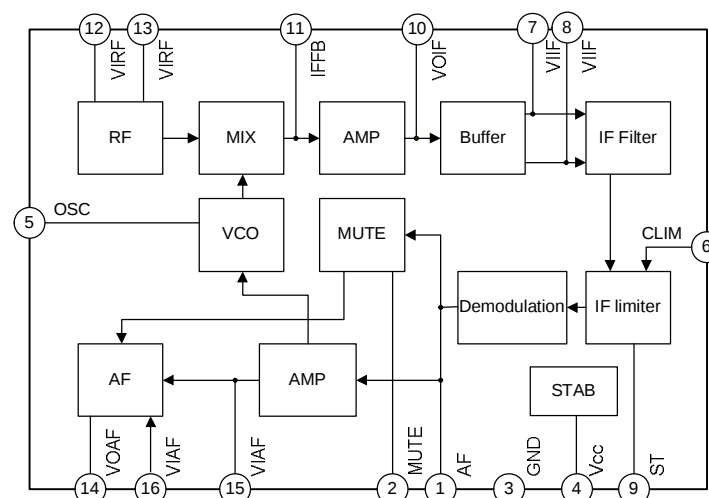


Fig.1 Block diagram

ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Min.	Max.	Unit
Supply Voltage(pin 4)	$V_p = V_{4-3}$	--	7.0	V
Oscillator Voltage	V_{5-4}	$V_{p-0.5}$	$V_{p+0.5}$	V
Operating Ambient Temperature Range	T_{amb}	-10	+70	°C
Storage Temperature Range	T_{stg}	-55	+150	°C

QUICK REFERENCE DATA

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage (pin 4)	$V_p = V_{4-3}$	$V_p = 3V$ Source impedance=75Ω; Mute disabled Source impedance=75Ω	1.8	--	6.0	V
Supply Current	I_4		--	6.3	--	mA
RF Input Frequency	f_{rf}		1.5	--	110	MHz
Sensitivity (e.m.f.) for -3 dB Limiting	EMF		--	4	--	μV
Signal Handling (e.m.f.)	EMF		--	200	--	mV
AF Output Voltage	V_o		--	90	--	mV

THERMAL RESISTANCE

From junction to ambient

 $R_{th\ j-a}$ 300 K/W**DC ELECTRICAL CHARACTERISTICS** ($T_{amb}=25^{\circ}C$, $V_p=3V$, Unless otherwise specified)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Supply Voltage(pin 4)	$V_p = V_{4-3}$	--	1.8	3.0	6.0	V
Supply Current	I_4	$V_p = 3V$	--	6.3	--	mA
Oscillator current	I_5	--	--	250	--	μA
Voltage at Pin 13	V_{13-3}	--	--	0.9	--	V
Output Voltage(pin 14)	V_{14-3}	--	--	1.3	--	V

AC ELECTRICAL CHARACTERISTICS(MONO OPERATION) $T_{amb}=25^{\circ}C$, $V_p=3V$, measured in Fig.5, $f_{rf}=96MHz$ modulated with $\Delta f=\pm 22.5kHz$, $f_m=1kHz$, $EMF=0.3mV$ (e.m.f. at a source impedance of 75Ω), r.m.s. noise voltage measured unweighted ($f=300Hz$ to 20kHz), Unless otherwise specified

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
Sensitivity (e.m.f.)	for -3 dB limiting	See Fig.3 Muting disabled	--	4.0	--	μV
	for -3 dB muting		--	5.0	--	μV
	for (S+N)/N=26dB		--	7.0	--	μV
Signal Handling (e.m.f.)	EMF	THD<10%, $\Delta f=\pm 75kHz$	--	200	--	mV
Signal-to-noise Ratio	(S+N)/N	--	--	60	--	dB
Total Harmonic Distortion	THD	$\Delta f=22.5kHz$	--	0.7	--	%
		$\Delta f=\pm 75kHz$	--	2.3	--	%

(To be continued)

(continued)

Characteristics	Symbol	Test conditions	Min.	Typ.	Max.	Unit
AM Suppression of Output Voltage	AMS	Ratio of AM signal (fm=1kHz; m=80%) to FM signal (fm=1kHz; Δf=±75kHz)	--	50	--	dB
Ripple Rejection	RR	ΔVp=100mV, f=1kHz	--	30	--	dB
Oscillator Voltage (r.m.s. value)	V5-4(rms)	--	--	250	--	mV
Variation of Oscillator Frequency with Temperature	Δfosc/ΔTamb	Vp= 1V	--	5	--	KHz/°C
Selectivity	S+300	see Fig.9	--	46	--	dB
	S-300	no modulation	--	30	--	dB
AFC Range	±Δfrf	--	--	160	--	kHz
Mute Range	±Δfrf	--	--	120	--	kHz
Audio Bandwidth	B	ΔVo=3dB, measured with 50μs pre-emphasis	--	10	--	kHz
AF Output Voltage(r.m.s. value)	Vo(rms)	RL(pin 14)=100Ω	--	90	--	mV
AF Output	Max.d.c. load	Io(dc)	-100	--	+100	μA
	Max.a.c. load (peak value)	Io(ac)	--	3	--	mA

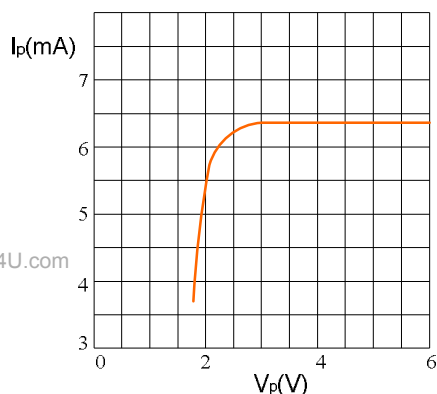


Fig.2 Supply current as a function of the supply voltage

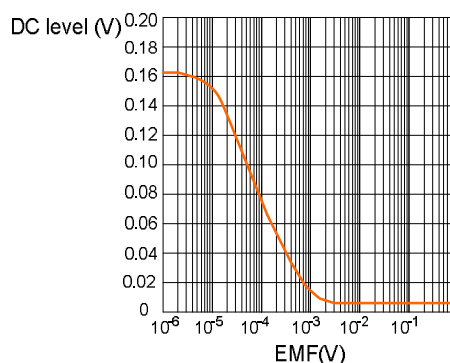


Fig.3 Field strength voltage (V9-3) at Rsource=1kΩ; f=96.75MHz; Vp=3V

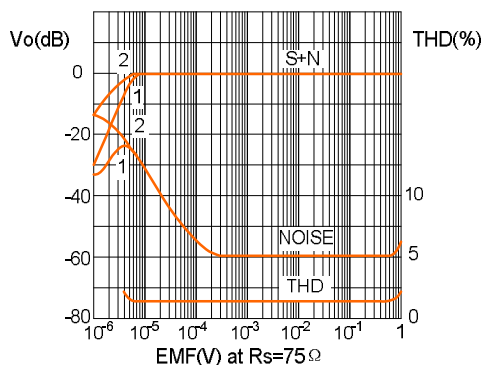


Fig.4 Mono operation: AF output voltage (Vo) and total harmonic distortion (THD) as functions of input e.m.f. (EMF); Rsource=75Ω; frf=96MHz; 0dB=90mV. For S+N and noise curves (1) is with muting enabled and (2) is with muting disabled; signal Δf=±22.5kHz and fm=1kHz. For THD curve, Δf=±75kHz and fm=1kHz.

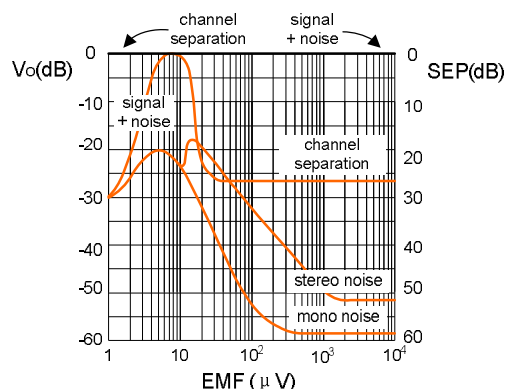


Fig.6 Stereo operation: signal/noise and channel separation of SA1021 when used in the circuit of Fig.8.

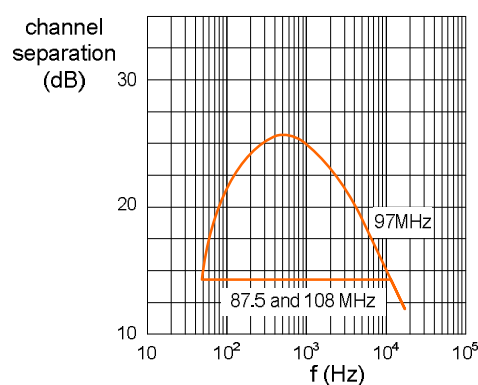


Fig.7 Stereo operation: channel separation as a function of audio frequency in the circuit of Fig.8.

TEST AND APPLICATION CIRCUITS

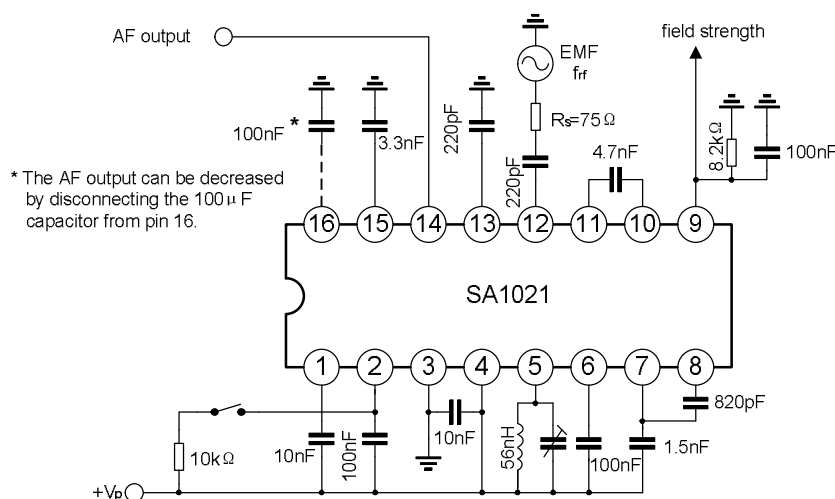


Fig.5 Test circuit for mono operation.

AC ELECTRICAL CHARACTERISTICS(STEREO OPERATION) $T_{amb}=25^{\circ}C$; $V_p=3V$; measured in Fig.8; $f_{rf}=96MHz$ modulated with pilot $\Delta f=\pm 6.75kHz$ and AF signal $\Delta f=\pm 22.5kHz$; $f_m=1kHz$; $EMF=1mV$ (e.m.f. at a source impedance of 75Ω); r.m.s. noise voltage measured unweighted ($f=300Hz$ to $20kHz$); Unless otherwise specified.

Characteristics	Symbol	Test conditions		Min.	Typ.	Max.	Unit
Sensitivity (e.m.f.) for $(S+N)/N=26dB$	EMF	See Fig.8, pilot off		--	11	--	μV
Selectivity	S+300	See Fig.9.no modulation		--	40	--	dB
	S-300			--	22	--	dB
Signal-to-noise Ratio	$(S+N)/N$	--		--	50	--	dB
Channel Separation	α	$V_i=L$ -signal; $f_m=1kHz$, pilot on:	at $f_{rf}=97MHz$	--	26	--	dB
	α		at $f_{rf}=87.5MHz$ and $108MHz$	--	14	--	dB

TEST AND APPLICATION CIRCUIT

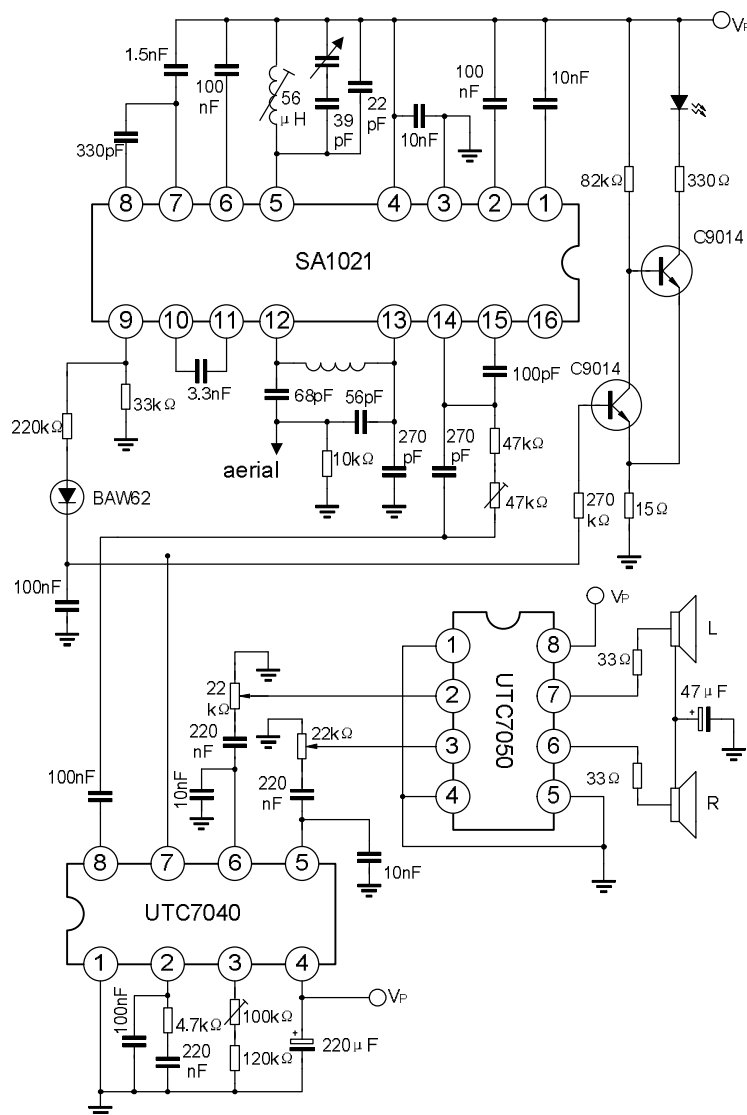


Fig.8: Stereo application in combination with a low voltage PLL stereo decoder (UTC7040) and a low voltage Mono/stereo power amplifier (UTC7050).

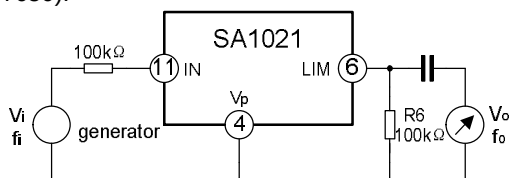


Fig.9 test set-up; $V_i=30\text{mV}$; $f_i=76\text{kHz}$; selective voltmeter at output has $R_i \geq 1\text{M}\Omega$ and $C_i \leq 8\text{pF}$; $f_o=f_i$.

This test set-up is to incorporate the circuit of Fig.5 for mono operation or the circuit of Fig.8 for stereo operation.

For either circuit, replace the $100\mu\text{F}$ capacitor at pin 6 with $R_6(100\text{k}\Omega)$ as shown above.

SELECTIVITY

$$S+300=20 \frac{V_o | (300\text{kHz} - f_i)}{V_o | f_i}$$

$$S-300=20 \frac{V_o | (300\text{kHz} + f_i)}{V_o | f_i}$$

PACKAGE OUTLINE

SOP-16-225-1.27

UNIT: mm

