INTEGRATED AM UPCONVERSION RECEIVER

GENERAL DESCRIPTION

The TEA6200 is an integrated AM upconversion receiver circuit with an IF of 10.7 MHz. Because of the high dynamic range of the RF prestage there is no tuned prestage. The whole selectivity is provided by crystal filters. The circuit is intended for use in AM radios with synthesizer tuning.
The TEA6200 can handle RF signals up to 2 V RMS.

Features

- No pre-tuned selection is required
- No LW/MW switching
- RF input is protected from static discharge from the aerial
- Electronic standby switch
- Voltage controlled oscillator for synthesizer tuning
- IF output providing level information for search tuning.
- No alignment required.

QUICK REFERENCE DATA

parameter	symbol	min.	typ.	max.	unit
Supply voltage range	V_P	7.6	8.5	9.4	V
Supply current range	I_P	–	50	70	mA
AF output voltage with: RF at 1 MHz and 10 mV f_m at 400 Hz and 30%	V_{af}	–	350	–	mV
AGC start	V_{rf}	30	50	80	μV
AGC range	ΔV_{rf}	–	95	–	dB

PACKAGE OUTLINE

20-lead dual in line; plastic (SOT146).

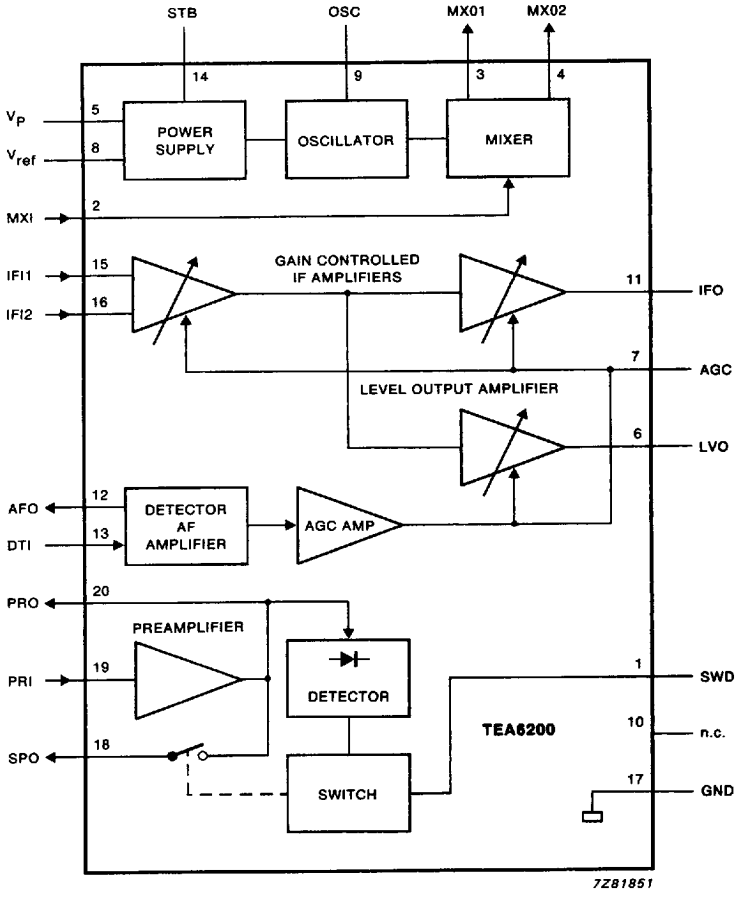


Fig. 1 Block diagram.

PINNING

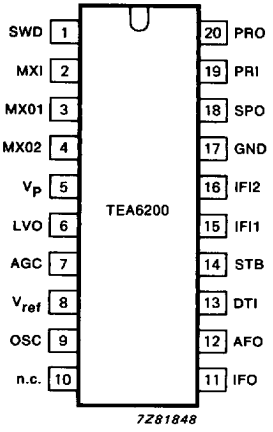


Fig. 2 Pinning diagram.

1	SWD	switching delay
2	MXI	mixer input
3	MXO1	mixer output 1
4	MXO2	mixer output 2
5	V_P	supply voltage
6	LVO	level output
7	AGC	AGC time constant
8	V_{ref}	reference voltage
9	OSC	oscillator
10	n.c.	not internally connected*
11	IFO	IF output
12	AFO	AF output
13	DTI	detector input
14	STB	standby switch
15	IFI1	IF input 1
16	IFI2	IF input 2
17	GND	ground
18	SPO	switched prestage output
19	PRI	prestage input
20	PRO	prestage output

* Pin 10 must be connected to pin 5, 8 or 17.

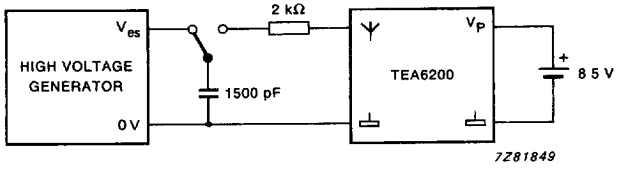
RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

parameter	symbol	min.	max.	unit
Supply voltage	V_P	–	12	V
Supply current	I_P	–	70	mA
Total power dissipation	P_{tot}	–	850	mW
Operating ambient temperature range	T_{amb}	−30	+ 85	°C
Storage temperature range	T_{stg}	−40	+ 150	°C
Electrostatic discharge voltage	$\pm V_{es}$	–	10	kV

THERMAL RESISTANCE

From junction to ambient $R_{th\ j\text{-}a}$ = 80 K/W



Will tolerate discharge between −10 kV and + 10 kV.

Fig. 3. Test circuit in accordance with IEC 315-1 clause 25.

DC CHARACTERISTICS

V_P = 8.5 V; V_{14} = V_P; Signal in OFF condition; all voltages referenced to ground unless otherwise specified.

parameter	conditions	symbol	min.	typ.	max.	unit
Mixer input		V_I	–	4.0	–	V
Mixer output 1		V_O	–	8.5	–	V
Mixer output 2		V_O	–	8.5	–	V
Level output		V_O	–	8.5	–	V
AGC voltage		V_{AGC}	–	0.65	–	V
Reference voltage		V_{ref}	–	4.0	–	V
Oscillator DC voltage		V_{OSC}	–	4.0	–	V
Prestage input		V_I	–	1.2	–	V
Prestage output		V_O	–	3.2	–	V

CHARACTERISTICS

V_P = 8.5 V; T_{amb} = 25 °C; f_{RF} = 1 MHz at 10 mV RMS; Q_{OSC} = 50; modulation = 400 Hz at 30%; insertion loss of filters: crystal filter = 1 dB; ceramic filter = 4 dB, all voltages referenced to ground unless otherwise specified.

parameter	conditions	symbol	min.	typ.	max.	unit
Supply						
Supply voltage range		V_P	7.6	8.5	9.4	V
Supply current range		I_P	–	50	70	mA
Guaranteed operating voltage		V_P	7.0	–	10.0	V
Standby switch						
ON voltage		V_{14}	3.2	–	V_P	V
OFF voltage		V_{14}	0	–	1	V
ON current		$\|I_{14}\|$	–	–	10	μA
OFF current		$-I_{14}$	–	–	0.5	mA
Supply current	device OFF	I_P	–	–	10	mA
Prestage	note 1					
Switching threshold	modulation = 80%	V_{rf}	–	320	–	mV
Hysteresis		V_{rf}	1.5	3.5	5.5	dB

CHARACTERISTICS (continued)

parameter	conditions	symbol	min.	typ.	max.	unit
Oscillator						
Frequency range		f_{osc}	10.8	–	17.8	MHz
Oscillator amplitude		V_{osc}	200	420	–	mV
Tuned circuit selectivity		Q_{OSC}	20	50	–	–
Mixer						
Input capacitance		$C_{2\text{-}8}$	–	5	10	pF
Input impedance		$Z_{2\text{-}8}$	10	40	–	kΩ
Conversion transconductance		$I_{3\text{-}4}/V_{2\text{-}8}$	–	3.8	–	S
IF amplifier						
Input impedance		$R_{16\text{-}15}$	10	–	–	kΩ
Input capacitance		$C_{16\text{-}15}$	–	–	5	pF
Output impedance		Z_{11}	230	330	430	Ω
Detector	note 2					
Input impedance		Z_{13}	265	380	500	Ω
Output impedance		Z_{12}	7	10	14	kΩ
Output level		V_{af}	250	350	500	mV
Reference voltage						
Voltage	V_P = 8.5 V	V_8	3.8	4.0	4.2	V
Output impedance		Z_8	–	20	–	Ω
Ripple rejection		$\frac{\Delta V_P}{\Delta V_8}$	40	–	–	dB
Level output pin 6	see Fig. 5					
Output impedance		Z_6	–	1	–	kΩ
Output voltage	V_{rf} = 70 μV	V_6	0.5	0.7	1.0	mV
Output voltage	V_{rf} = 2 mV	V_6	–	15	–	mV

parameter	conditions	symbol	min.	typ.	max.	unit
RF sensitivity						
RF input	(S + N)/N = 6 dB	V_{rf}	–	11	20	μV
	(S + N)/N = 26 dB	V_{rf}	–	110	150	μV
	(S + N)/N = 46 dB	V_{rf}	–	1100	2000	μV
	RF = 150 kHz (S + N)/N = 26 dB	V_{rf}	–	200	–	μV
Output signal						
AF output voltage	V_{rf} = 10 mV	V_{af}	250	350	500	mV
	V_{rf} = 20 μV	V_{af}	–	100	–	mV
Total distortion	V_{rf} = 1 mV; modulation = 80%	d_{tot}	–	3	5	%
Signal plus noise-to-noise ratio	RF = 10 mV to 1 V	(S+N)/N	53	57	–	dB
Ripple rejection	V_P = 8.5 V + V_r 20 Hz < fR < 20 kHz V_{rms} = 40 mV	$\frac{\Delta V_P}{\Delta V_{af}}$	20	–	–	dB
Large signal handling						
Aerial input voltage	THD = 10%; modulation = 80%	V_{rf}	2	3	–	V
AGC range of preamplifier switch			–	12	–	dB
Switching threshold	modulation = 80%	V_{rf}	–	320	–	mV
Hysteresis	modulation = 80%	V_{rf}	1.5	3.5	5.5	dB
Ripple rejection of preamplifier	20 Hz < f_R < 1.5 MHz	$\frac{\Delta V_P}{\Delta V_{20}}$	–	40	–	dB
AGC						
AGC range			–	95	–	dB
Change of V_{af}	100 μV < V_{rf} < 2 V		–	2	3	dB
AGC start		V_{rf}	30	50	80	μV
Intermodulation free dynamic range						
Long wave second order	350/250 kHz input noise level = −99 dBm	IMFDR 2	72	82	–	dB
third order	input noise level = −99 dBm	IMFDR 3	–	86	–	dB
Medium wave second order	650/1550 kHz input noise level = −104 dBm	IMFDR 2	74	84	–	dB
third order	1.25/1.4 MHz input noise level = −104 dBm	IMFDR 3	–	90	–	dB

Notes to the characteristics

1. The prestage is connected to the aerial by a 6 MHz low-pass filter that decouples unwanted aerial cable resonance frequencies. The large dynamic range of the prestage is achieved by use of a transimpedance amplifier with a feedback loop consisting of an equivalent aerial capacitance and a feedback capacitor. When large RF signals are received the feedback capacitance in the loop is increased and the gain subsequently reduced, (see Fig. 4).

   Voltage gain for small signals $G_V = V_{rf} \times \frac{C_{ae}}{C_1}$

   Voltage gain for large signals $G_V = V_{rf} \times \frac{C_{ae}}{C_1 + C_2}$

2. To protect the demodulator and the AGC circuitry, against parasitic oscillation in the IF section, a ceramic filter is connected between the IF output and detector input.

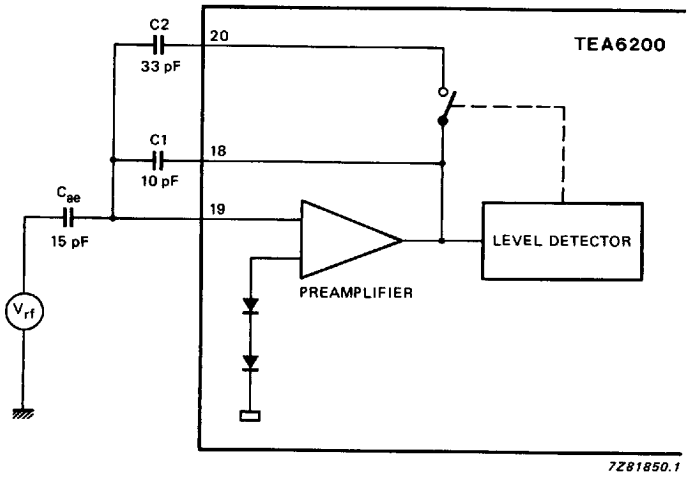


Fig. 4 Prestage circuit.

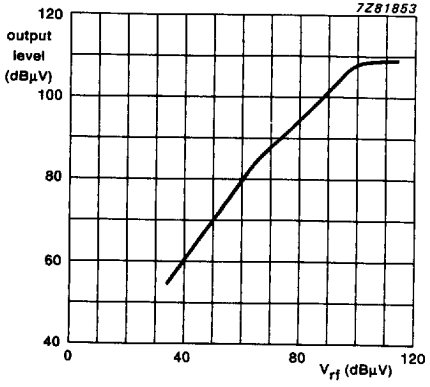


Fig. 5 IF output level.

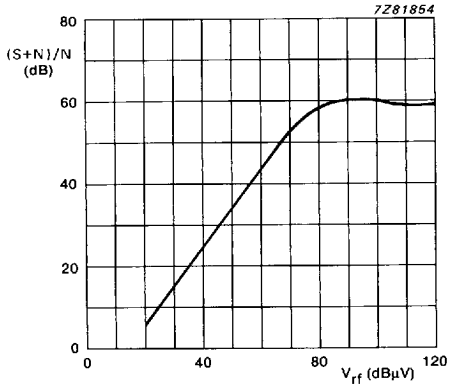


Fig. 6 Signal plus noise-to-noise ratio.

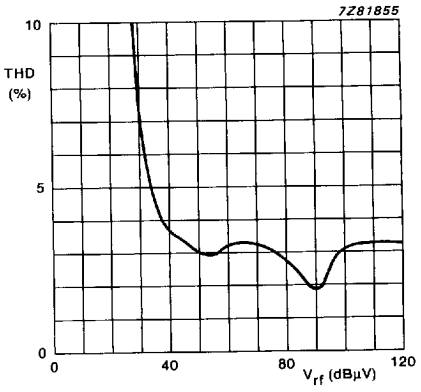


Fig. 7 Total harmonic distortion.

APPLICATION INFORMATION

Notes Fig. 8.

	Component	Circuit identity	Supplier reference
(1)	Crystal filters	XTAL	NDK 10T 7 BA
(2)	Ceramic filter	SFE	Murata E 10 7 S
(3)	Transformer	T1	Toko 7PS-1078 JK
(4)	Variable capacitance diode.	D1	BB609, BB809 or BBY40
(5)	Oscillator coil	L1	Toko 7PS-1077 X

APPLICATION INFORMATION

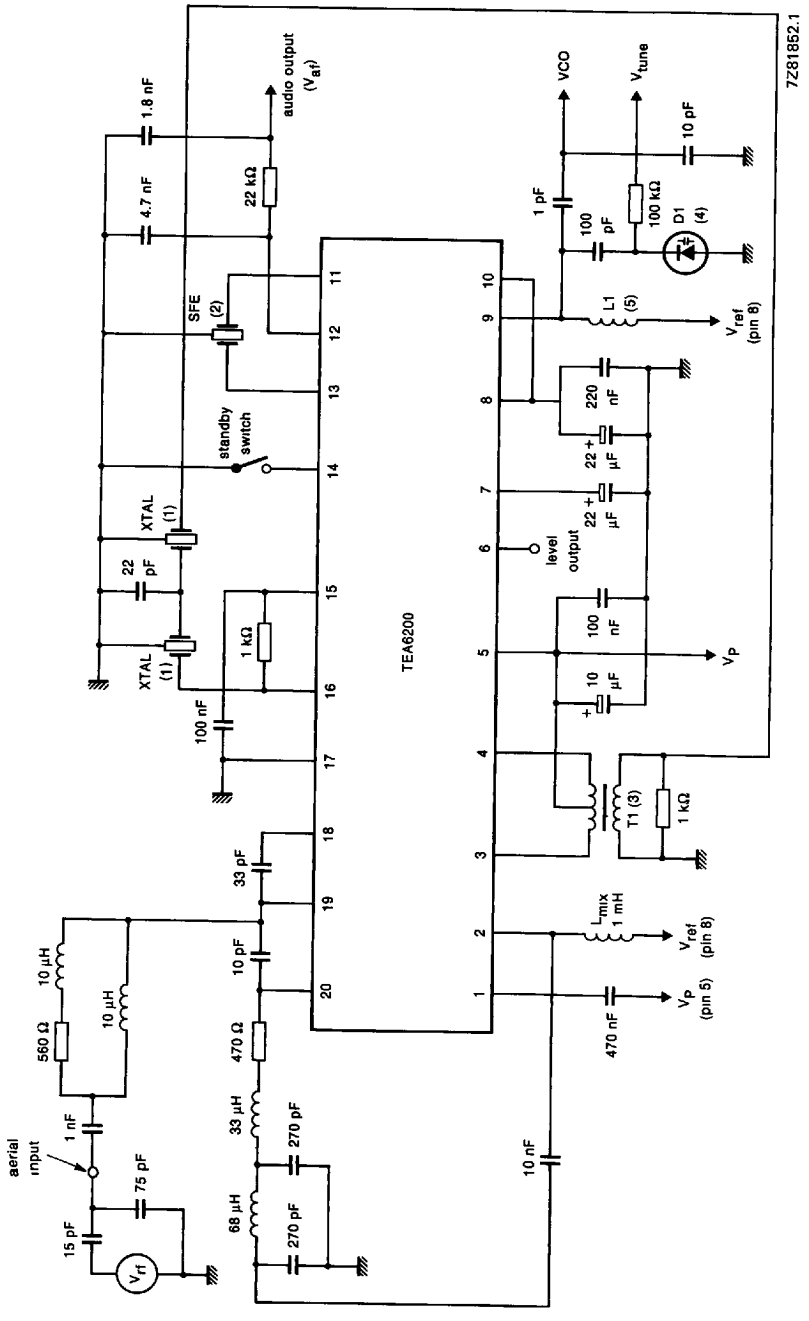


Fig. 8 Application diagram.