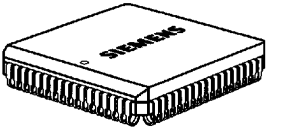
SIEMENS

One-Chip Car Radio **TUA 4300P**

1 Overview

1.1 Application

The TUA 4300P is a one-chip car radio system consisting of AM/FM receiver, AM-up/down conversion, AGC amplifier/demodulator, FM-IF limiter amplifier/demodulator and stereo decoder/noiseblanker.



P-LCC-68-1

1.1.1 AM/FM Receiver

The TUA 4300P is an integrated combined AM-FM receiver with strictly symmetrical RF parts for use in car radios.

1.1.1.1 Features

- High flexibility with an external preamplifier stage for AM and FM
- Strictly symmetrical RF parts
- Separate mixers for AM- and FM-mode
- Sym. or asym. mixer inputs
- Only one 2-pin oscillator for the 1st LO (in AM mode the oscillator frequency is divided by 8 or 10)
- 1st LO with LC tank circuit
- 1st LO at 100 MHz range
- 1st LO decoupled counter output
- 1st LO decoupled divided counter output
- Low-phase noise
- FM/AM field strength output combined

Type	Ordering Code	Package
TUA 4300P	Q67101-A5213	P-LCC-68-1

8235605 0088052 385

1.2 FM Mode

1.2.1 FM Receiver

In this mode, the receiverpart is comprised of a mixer, an oscillator, a prestage control and an IF post amplification.

1.2.1.1 Features

- Integrated AGC generation for PIN diodes and MOSFETs
- High-level mixer input
- High-input/output 3. order interceptpoint

1.2.2 FM-IF Demodulator

The FM-IF-demodulator has been developed especially for car radio applications.

1.2.2.1 Features

- 7-stage limiter amplifier
- Coincidence demodulator
- Field strength output (combined with AM)
- Fixed mute depth (with full muting typ. 80 dB)
- Multipath detector with analog output

1.3 Stereo Decoder

This part provides the stereo decoder function and noise blanking for FM car radio applications.

1.3.1 Features

- Internal reference voltage source
- Adjustment free oscillator with ceramic resonator 456 kHz
- Pilot dependent mono/stereo switching with hysteresis
- Stereo indicator output
- Analog mono/stereo blend control (stereo noise control, SNC)
- Pilot canceller (19 kHz)
- Adjacent channel noise suppression (114 kHz)
- Mute facility
- Analog deemphasis control (high-cut control, HCC)
- Interference noise detector with integrated high-pass filter (IF level signal or MPX input)
- MPX input low-pass filter
- Noise blanking at MPX demodulator outputs
- L-, R- audio is common to AM

1.4 AM Mode

In this mode, the IC is comprised of a mixer, an oscillator with a divider by 8 or 10, a prestage control, an IF post amplification, 2nd mixer with AGC to convert the 1st IF to the 2nd IF, 2nd local oscillator (buffer for external source), automatic gain controlled amplifier and quasisynchronous demodulator. The same oscillator is used in AM- and FM-mode.

1.4.1 Features

- 2nd mixer with AGC
- 1st IF amp; use of CER filter or crystal filter possible
- 2nd LO with input for external source
- Output for 2nd IF carrier (AM stereo)
- Output for AM-IF counter
- Wide range 2nd IF AGC amplifier
- Quasi synchronous demodulator for AM mode
- Fast AM search tuning stop feature
- HCC for AM

2 Circuit Description

2.1 AM/FM Receiver

The AM/FM receiver part includes a 2-pin varactor tuned oscillator. In the FM mode the direct oscillator frequency is fed into the double balanced FM mixer, in the AM mode the divided by 8 or 10 oscillator frequency is fed into the AM mixer.

The two separate symmetrical input stages of the IC, one optimized for FM-, the other for AM mode allow symmetrical and unsymmetrical prestage configuration.

The AM- and FM- input frequencies are converted to a fix 1st IF in the 10.7 MHz range. The separate output stages allow optimized output circuits for AM- and FM-mode. For low-cost applications it is possible to connect both sym. outputs to one tank circuit. The IF is post-amplified in separate IF amplifiers, one optimized for FM, the other for AM. Using of a CER filter or crystal filter is possible.

The TUA 4300P has been designed to work with a PLL in the 100 MHz range in both modes or in the AM mode with the divided frequency.

Depending on the input signal strength, the integrated AGC stage for prestage control drives PIN diodes as well as MOSFETs.

2.2 FM MODE

FM-IF Demodulator

The FM-IF amplifier includes a 7-stage capacitive coupled-limiter amplifier with coincidence demodulator and AF output. The AF output signal can be continuously attenuated to decrease the noise.

There is a field strength output (with typ 75 dB dynamic range, typ. ± 1 dB nonlinearity and typ. ± 3 dB temperature drift) and a fixed muting (with full muting typ. 80 dB).

A multipath detector with analog output is available. Its input signal is fed from the high-pass filter of the stereo-decoder/noiseblanker and a second 225 kHz 2-pole high-pass filter.

2.3 Stereo Decoder

Power Supply, Reference Current

A temperature-stable, low-noise reference voltage generator is used for better ripple rejection and to generate a reference current. This current is used as a time base for the deemphasis, the gate time of the pulse former, and the pilot cancellation, avoiding temperature and tolerance effects.

MPX Input, MPX Filter

A 4-pole low-pass filter determines the bandwidth of the MPX signal.

Voltage Controlled Oscillator, Phase Detector

The 456 kHz oscillator and the frequency dividers are used as walsh function generators (suppression of 3rd order harmonics) for:

- 38 kHz for the stereo decoder
- 19 kHz inphase for phase detector and pilot cancellation
- 19 kHz quadrature for the phase detector.

The phase detector locks the on-chip 19 kHz signal to the pilot tone in the MPX signal at 90° phase.

Pilot Detector, Pilot Indicator, Pilot Cancellation

The voltage at the pilot detector output is proportional to the pilot tone input level. If that level is high enough, the pilot indicator output is activated and the pilot cancellation turned on: a 19 kHz signal proportional to the voltage at the pilot detector output is added to the MPX signal with inverse polarity, cancelling the 19 kHz pilot tone.

Interference Detector, Noise Detector, Pulse Former

The signal from the interference input (MPX or field strength signal) passes a 4-pole high-pass to the noise blanking circuitry. The average noise level is stored on an external capacitor. The interference detector compares the actual noise level with that stored on the capacitor and triggers the pulse former if there is a significant difference. The pulse former generates a gate pulse for the HCC block. During that pulse time the outputs of the deemphasis circuit are switched to hold mode.

2.4 AM Mode

In the AM mode the 1st IF is converted by the 2nd mixer into the 2nd IF in the 450 kHz range. Therefore a 2nd LO, which is used as a buffer for external sources, is part of the IC. An AGC in this mixer increases sensitivity. The 2nd IF signal passes an automatic gain controlled IF amplifier and is then demodulated to the AF in a quasisynchronous demodulator. Switching to seek mode, the AGC time constant is reduced by a factor of 5, the 2nd mixer AGC is forced to high gain, the AM-IF counter output is switched on and the AF is muted. For AM stereo demodulation an AM-IF output is available. The AGC voltage is used as AM field strength and is fed to the combined field strength output.

2.5 Pin Configuration
(top view)

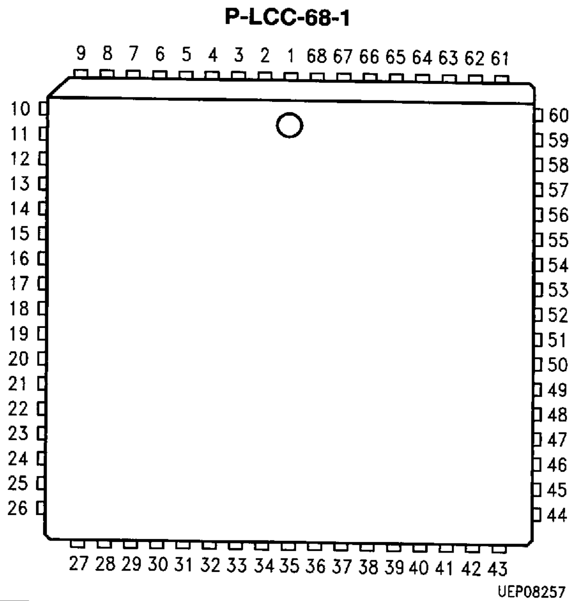


Figure 1

2.6 Pin Definitions and Functions

Pin No.	Symbol	Function
1	MPX signal output	FM MPX signal and AM demodulator signal output
2	Mute FM	Dynamic FM mute control blocking capacitor
3	Mute depth	Mute depth control, default value overriding possible
4	Demodulator circuit FM	Demodulator circuit FM
5	Demodulator circuit FM	Demodulator circuit FM
6	+ V_{SIF}	Supply voltage IF and stereo decoder section
7	Fieldstrength output	AM/FM fieldstrength combined output
8	V_{REF} FM	Reference voltage FM-IF section (4.8 V)
9	Multipath det. input	Auxiliary multipath detector input (in parallel to internal connection)
10	Multipath det. cap.	Multipath detector rectifier capacitor
11	Multipath det. output	Analog multipath detector output

2.6 Pin Definitions and Functions (cont'd)

Pin No.	Symbol	Function
12	AM seek mode switch	AM seek mode switch; AM-IF counter 'ON', 2nd mixer gain 'HIGH', AM-AGC 'FAST' and AM-AF 'MUTE'
13	AM-IF counter 'OUT'	AM-IF counter output for search tuning
14	AM stereo 'OUT' GND	Analog AM-IF output for AM stereo
15	GND_{IF}	Ground IF and stereo decoder section
16	FM-IF input	FM limiter input bias decoupling capacitor
17	FM-IF input	FM limiter input
18	AM-IF bias	AM-AGC amplifier bias decoupling capacitor
19	AM-IF input	AM-AGC amplifier input
20	AM-IF bias	AM-AGC amplifier bias decoupling capacitor
21	2nd mixer 'OUT'	2nd AM mixer outputs (open collector)
22	2nd mixer 'OUT'	2nd AM mixer outputs (open collector)
23	AM-IF AGC cap.	AM-AGC amplifier time constant capacitor
24	2nd LO quartz	Force frequency input for 2nd AM mixer
25	2nd mixer input	2nd AM mixer bias decoupling capacitor
26	2nd mixer input	2nd AM mixer input
27	IF amp. 'OUT' AM	10.7 MHz IF amplifier output AM (open collector)
28	IF amp. 'OUT' FM	10.7 MHz IF amplifier output FM
29	$V_{Prestage}$ AGC AM	AM prestage AGC buffered voltage output with fast attack, slow decay feature
30	$I_{Prestage}$ AGC FM	FM prestage AGC current output for PIN diode
31	IF amp. input bias	10.7 MHz IF amplifier operation point
32	AM-IF amp. input	10.7 MHz IF amplifier input AM
33	FM-IF amp. input	10.7 MHz IF amplifier input FM
34	SEL 8/10	AM 1st local oscillator divider control for dividing by 10 for long wave and medium wave receiving or dividing by 8 for short wave receiving
35	+ VS RF	Supply voltage RF section
36	GND	Ground RF section
37	V_{REF} AM	Reference voltage AM-IF section (4.8 V)
38	FM mixer output	FM mixer outputs (open collector)
39	FM mixer output	FM mixer outputs (open collector)
40	AM mixer output	AM mixer outputs (open collector)
41	AM mixer output	AM mixer outputs (open collector)

8235605 0088058 8T3

2.6 Pin Definitions and Functions (cont'd)

Pin No.	Symbol	Function
42	Prestage AGC cap. AM	AM prestage AGC time constant capacitor
43	Prestage AGC cap. FM	FM prestage AGC time constant capacitor; output for MOS FET Tetrode Gate 2
44	RF input AM	AM 1st mixer symmetrical inputs
45	RF input AM	AM 1st mixer symmetrical inputs
46	RF input FM	FM 1st mixer symmetrical inputs
47	RF input FM	FM 1st mixer symmetrical inputs
48	V_{REF} RF	Reference voltage RF section (4.8 V)
49	RF oscillator	1st local AM/FM oscillator circuit
50	RF oscillator	1st local AM/FM oscillator circuit
51	Divided counter 'OUT'	1st local oscillator divided by 8/10 counter output (disabled in FM mode)
52	Direct counter 'OUT'	1st local oscillator counter output
53	2nd mixer AGC cap.	2nd AM mixer AGC time constant capacitor
54	Noise gate cap./AM-FM	Timing capacitor for noisedetector monoflop (gate time) AM/FM mode control; low-voltage activates AM section and disables stereo decoder VCO, phase detector, pilot detector, SNC and FM section
55	Noise level cap.	Hold capacitor for noise detector average level low voltage applied mutes the stereo decoder outputs
56	Deemphasis right	HCC timing/hold capacitor, deemphasis right
57	Deemphasis left	HCC timing/hold capacitor, deemphasis left
58	AF output left	AF output left
59	AF output right	AF output right
60	Filtered fieldstrength	Filtered AM/FM fieldstrength
61	Control voltage SNC	Control voltage SNC (stereo noise control), external decreasing of stereo separation possible
62	Pilot indicator output	Pilot indicator output, active 'HIGH' (open collector)
63	Pilot detector cap.	Pilot detector capacitor, low-voltage activates mono state
64	MPX signal input	Stereo decoder MPX signal input
65	Stereo PLL	Stereo decoder PLL phase detector, loop filter
66	Stereo oscillator	VCO pin for ceramic resonator
67	I_{REF} stereo	Reference current pin, external reference resistor
68	Noise detector input	Noise detector input

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2.7 Functional Block Diagrams

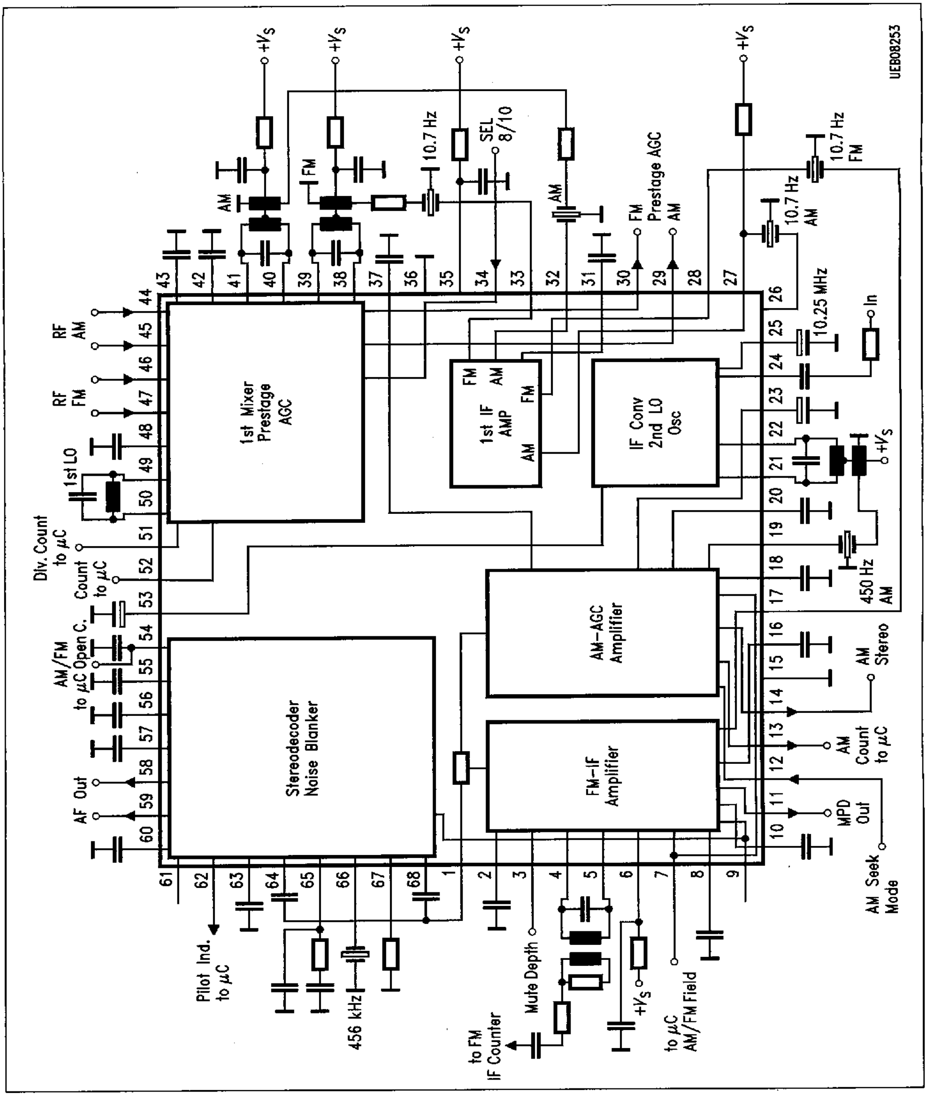

Figure 2
Block Diagram

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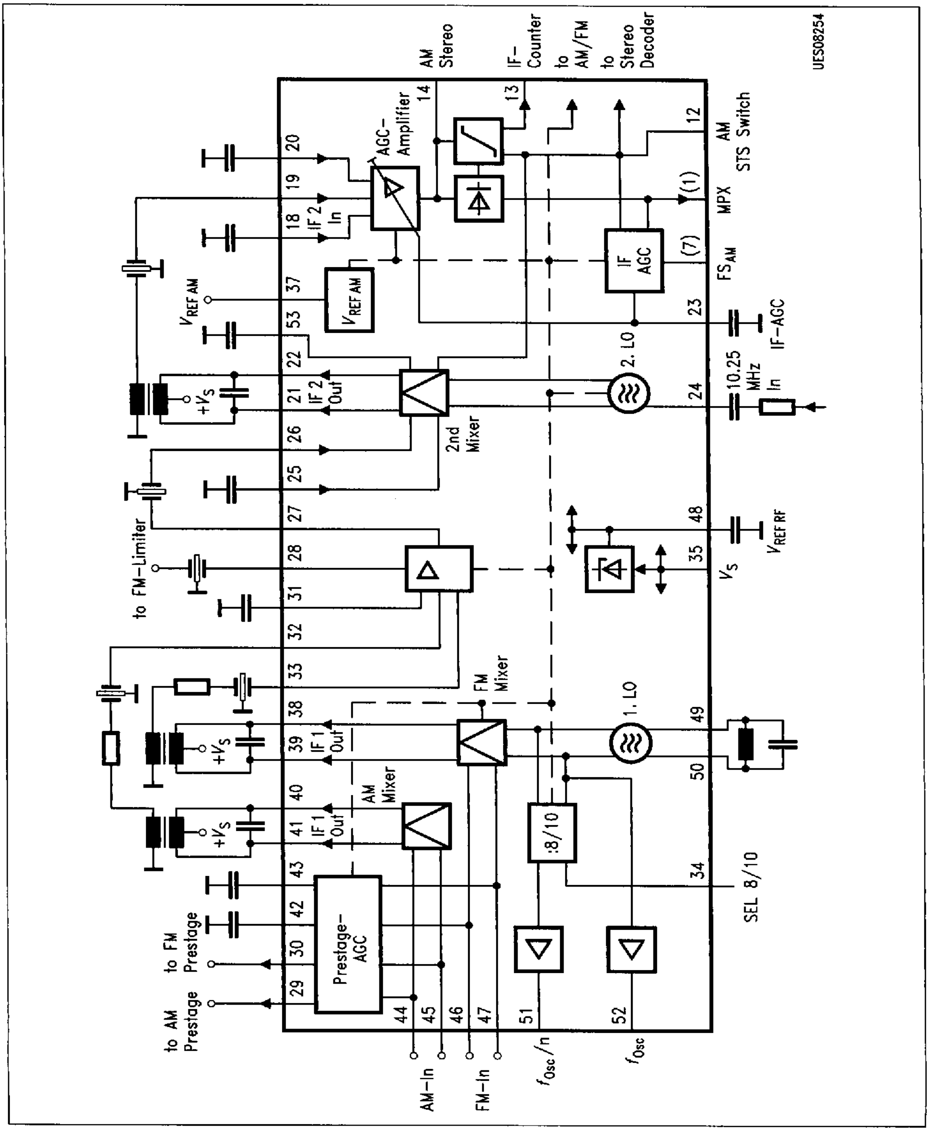

Figure 3
Block Diagram AM/FM Receiver

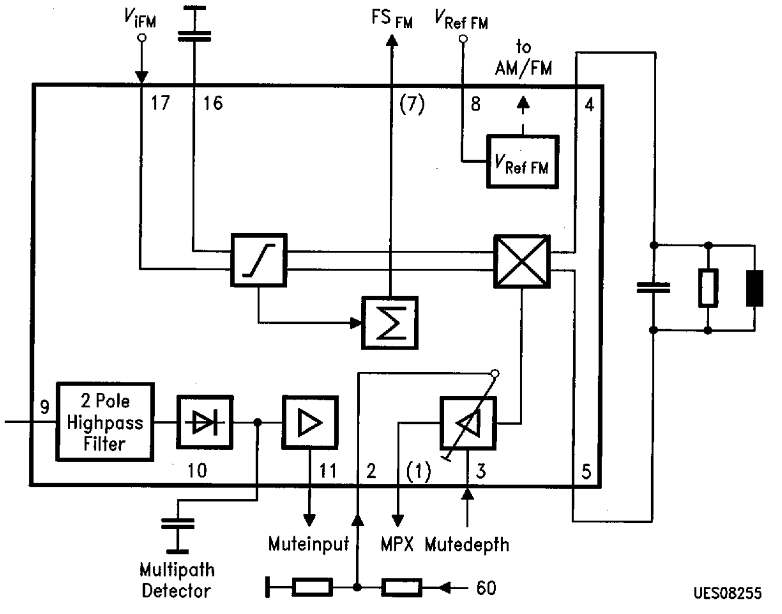

Figure 4
Block Diagram FM-IF Amplifier

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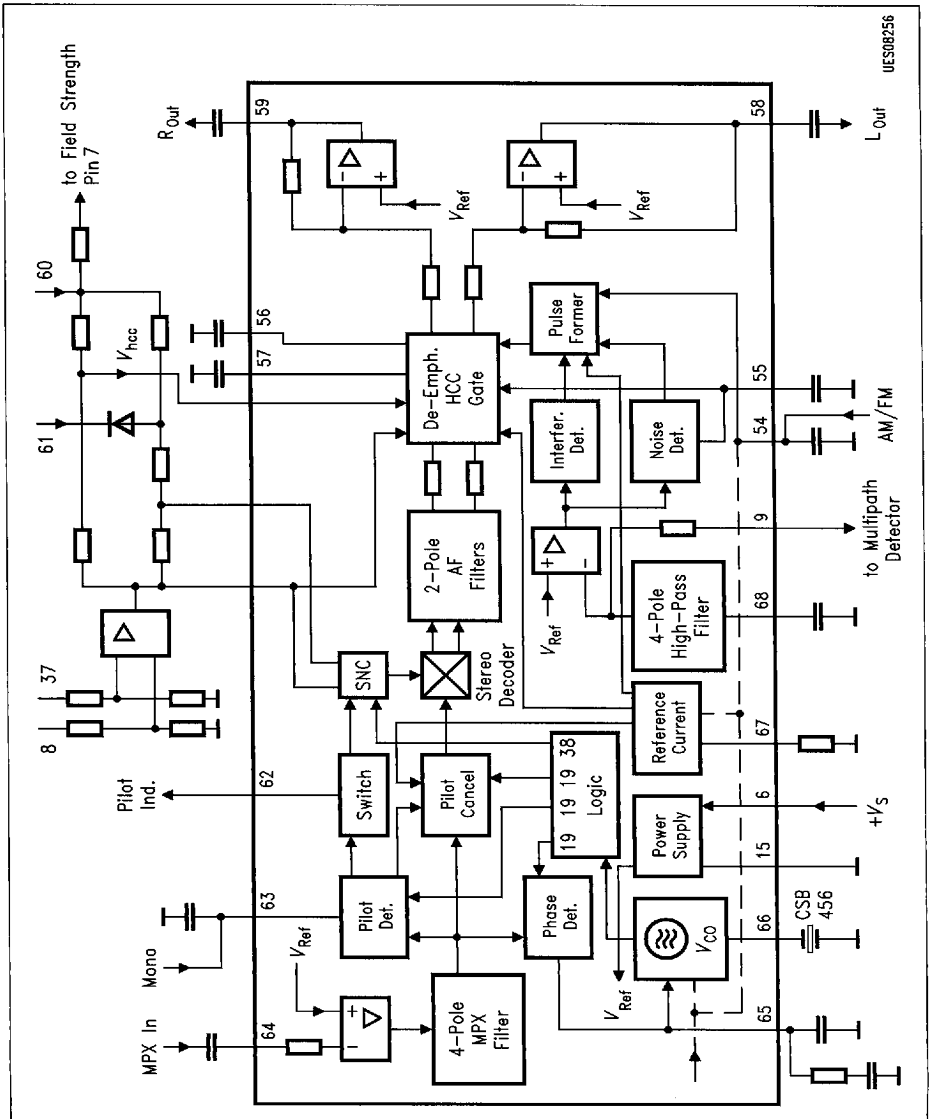

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Figure 5
Block Diagram Stereo Decoder/Noiseblanker

3 Electrical Characteristics

3.1 Absolute Maximum Ratings

T_A = – 40 °C to 85 °C

Parameter	Symbol	Limit Values		Unit	Remarks
		min.	max.		
Junction temperature	T_j	– 40	150	°C	
Storage temperature	T_S	– 40	125	°C	
Thermal resistance	$R_{th\ SA}$		42	K/W	
ESD voltage, HBM	V_{ESD}	– 4	4	kV	100 pF, 1500 Ω

Note: Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

3.2 Operating Range

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Supply voltage	V_S	8	11	V
Ambient temperature	T_A	– 40	85	°C

Note: In the operating range the functions given in the circuit description are fulfilled.

8235605 0088064 0T7

3.3 AC/DC Characteristics

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Current consumption	$I_{S\,FM}$ $I_{S\,AM}$	80 76	100 95	120 114	mA mA	FM mode AM mode	1 1

1. AM/FM Receiver

1st LO

Frequency range	$f_{1st\,LO}$	80		140	MHz		1
Frequency range	$f_{1st\,LO}$	50		150	MHz	$Q_{factor\,of\,coil}$ > 90	Lab
Counter output	V_{52}	100	130		mVrms	R_{L52} = 330 Ω	1
Divided counter output	V_{51}	100	130		mVrms	R_{L51} = 330 Ω	1
Output impedance	R_{51}	0.8	1	1.2	kΩ		Lab
Output impedance	R_{52}	240	300	360	Ω		Lab
Frequency	$f_{1st\,LO}$	t.b.d.			MHz	V_{tuning} = 0 V	

10.7 MHz IF Amplifier[1]

DC input voltage	$V_{32,\,33}$	4.4	4.7	5.0	V		1
Input resistance	R_{32}	1.45	1.8	2.2	kΩ	AM	1
Input resistance	R_{33}	265	330	396	Ω	FM	1
Output resistance	R_{27}	100			kΩ	Open collector	1
Output resistance	R_{28}	265	330	396	Ω		1
Voltage gain	$A_{33\text{-}28}$	24	27	30	dB	FM, R_{28} = 330 Ω	Lab
Voltage gain	$A_{32\text{-}27}$	8	11	14	dB	AM, R_{27} = 165 Ω	Lab
Noise figure	F_{AM}		6		dB	R_G = 330 Ω	Lab
Noise figure	F_{FM}		7		dB	R_G = 330 Ω	Lab
Reference voltage	V_{48}	4.5	4.8	5.1	V		1
Output current	I_{48}			1	mA		1

[1] $f_{IF\,1}$ = 10.7 MHz

8235605 0088065 T33

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
AM Mode[1]							
Mixer 1							
Interceptpoint 3rd order	I_{P3}		134		dBµV	$V_{44,45}$ ≥ 100 mVrms special test circuit necessary	Lab
Mixer gain	A_{M1}		– 2		dB	$V_{44,45}$ = 80 mVrms; $V_{out} = V_{32}$ (X_F = 1k5//5p; a_F = – 2 dB)	Lab
Over all gain	$A_{M\ IF}$	1	5	9	dB	$V_{44,45}$ = 80 mVrms; $V_{out} = V_{IF\ 10.7}$	1
Max. input voltage	$V_{44,45}$	1100	1400		mVpp	SINAD > 34 dB; m = 80 %	1
Noise figure (10 MHz)	F		7		dB	$R_{g\ opt}$ = 700 Ω	Lab
Input impedance	$R_{44,45}$	3.2	4	4.8	kΩ	Sym.	Lab
Input impedance	$C_{44,45}$	1.6	2	2.4	pF	Sym.	Lab
Input impedance	$R_{44,45}$	1.6	2	2.4	kΩ	Asym.	Lab
Input impedance	$C_{44,45}$	3.2	4	4.8	pF	Asym.	Lab
1st LO divided by 8	$V_{34\ Low}$	0		0.7	V		1
1st LO divided by 10	$V_{34\ High}$	2.4		5	V	Or open	1
Prestage AGC Output							
AGC voltage AM	V_{29}	6	7		V	$V_{44,45}$ = 50 mVrms	1
AGC voltage AM	V_{29}	0		0.5	V	$V_{44,45}$ = 200 mVrms	1
AGC voltage FM	V_{43}	0		0.1	V	$V_{44,45}$ = 50 mVrms	1
AGC current FM	I_{30}	0		0.1	mA	$V_{44,45}$ = 50 mVrms	1

[1] f_{IF1} = 10.7 MHz, f_{IF2} = 450 kHz, $f_{44,45}$ = 1 MHz, V_{54} = 1 V

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Integrator current	I_{42}[1]	– 30	– 38	– 49	µA	$V_{44,45}$ = 50 mVrms V_m = 3 V	1
Integrator current	I_{42}[1]	32	40	51	µA	$V_{44,45}$ = 200 mVrms V_m = 3 V	1

2nd AM IF Section

Mixer 2

Parameter	Symbol	min.	typ.	max.	Unit	Test Condition	Test Circuit
Max. mixer gain	A_{M2}	17	20	23	dB	V_{26} = 1 mV; V_{out} = $V_{IF\,450}$ f_{26} = 10.7 MHz; f_{24} = 10.25 MHz	1
Mixer AGC range	ΔA	17	20	23	dB	ΔA = $A_{V26=1\,mV} - A_{V26=100\,mV}$	1
Mixer gain seek mode ON		17	20	23	dB	V_{26} = 1 mV; V_{12} = 0.7 V	1
Noise figure	F		10		dB		Lab
Integrator current	I_{53}[1]	80	150	230	µA	V_{26} = 0 V_m = 3 V	1
Integrator current	I_{53}[1]	– 190	– 270	– 380	µA	V_{26} = 100 mVrms V_m = 3 V	1

2nd LO

Parameter	Symbol	min.	typ.	max.	Unit	Test Condition	Test Circuit
Operational frequency	f_{24}	9.25	10.25	11.25	MHz		1
External force voltage	V_{24}	30			mVrms	R_g = 600 Ω; C_k = 100 pF	1

[1] Integrator currents are measured between the output pin (– pole of the measurement equipment) and a voltage source V_m (+ pole).

8235605 0088067 806

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
FM Mode[1]							
Mixer 1							
Interceptpoint 3rd order	I_{P3}		125		dBµV	$V_{46,47} \geq$ 100 mVrms special testcircuit necessary	Lab
Noise figure (10 MHz)	F		6		dB	$R_{g\,opt}$ = 500 Ω	Lab
Mixer gain	A_{M1}		9		dB	$V_{46,47}$ = 10 mVrms; $V_{out} = V_{33}$ (R_F = 330 Ω; a_F = – 4 dB)	Lab
Over all gain	$A_{M\,IF}$	26	32	38	dB	$V_{46,47}$ = 10 mVrms; $V_{out} = V_{IF\,10.7}$	1
Input impedance	$R_{46,47}$	3.2	4	4.8	kΩ	Sym.	Lab
Input impedance	$C_{46,47}$	1.6	2	2.4	pF	Sym.	Lab
Input impedance	$R_{46,47}$	1.6	2	2.4	kΩ	Asym.	Lab
Input impedance	$C_{46,47}$	3.2	4	4.8	pF	Asym.	Lab
Prestage AGC Output							
AGC voltage FM	V_{43}	5.6	6.4	7.2	V	$V_{46,47}$ = 0 mVrms	1
AGC voltage FM	V_{43}	0		0.1	V	$V_{46,47}$ = 50 mVrms	1
AGC current FM	I_{30}	9.5	12	14.5	mA	$V_{46,47}$ = 0 mVrms	1
AGC current FM	I_{30}	0		0.1	mA	$V_{46,47}$ = 50 mVrms	1
AGC voltage AM	V_{29}	0		0.5	V	$V_{46,47}$ = 0	1
Integrator current	I_{43}[2]	– 12	– 25	– 46	µA	V_{46} = 0, V_m = 4.8 V	1
Integrator current	I_{43}[2]	42	60	81	µA	V_{46} = 100 mVrms; V_m = 4.8 V	1

[1] f_{IF} = 10.7 MHz, $f_{46,47}$ = 100 MHz, V_{54} = open
[2] Integrator currents are measured between the output pin (– pole of the measurement equipment) and a voltage source V_m (+ pole).

8235605 0088068 742

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
2. FM Demodulator[1]							
Field strength output	V_7						
– dynamic range		66	72		dB	see diagram D1	1
– nonlinearity			± 1	± 3	dB	see diagram D2	1
– temperature drift				± 3	dB	see diagram D3	1
– load capacitance				50	pF		
– load resistance		1			kΩ		
	V_7	4	4.6	5.2	V	V_{17} = 200 mVrms	1
	V_7	1.5	1.9	2.3	V	V_{17} = 1 mVrms	1
	V_7	0		1	V	V_{17} = 0 mVrms	1
AF output voltage	$V_{1\,FM}$	400	500	600	mVrms	R_L > 10 kΩ; deemph. = 100 µs	1
AF output voltage	$V_{1\,FM}$		600		mVrms	R_L > 10 kΩ; no deemph.	Lab
Input voltage for limiter threshold	V_{17}		33	42	µVrms	$V_1 = V_{1\,FM} - 3$ dB	1
Total harmonic distortion	THD_1			1.2	%		1
AM suppression	a_{AM}	70	80		dB	m = 30 %	1
Signal-to-noise ratio	$a_{S/N}$	72	80		dB		1
AF mute	a_{AF}	10	12	14	dB	V_3 = open, V_2 = 0	1
Reference voltage	V_8	4.6	4.9	5.2	V		1
Output current	I_8			1.0	mA		1
Multipath Detector[2]							
Attack current	I_{10}[3]	600	800	1000	µA	$V_{64\,AC}$ = 1 Vpp, V_m = 4.8 V	1
Recovery current	I_{10}[3]	– 6	– 9	– 12	µA	$V_{64\,AC}$ = 0, V_m = 3.8 V	1
Start voltage	$V_{11\,Def}$	4.4	4.7		V	$V_{64\,AC}$ = 0 V	1

[1] Measuring condition: f_{IF} = 10.7 MHz; Δf = ± 75 kHz; f_{mod} = 1 kHz; V_{17} = 10 mVrms; V_{54} = open; deemphasis = 100 µs.
[2] f_{68} = 400 kHz
[3] Integrator currents are measured between the output pin (– pole of the measurement equipment) and a voltage source V_m (+ pole).

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Detector characteristic	V_{11}	$V_{11\,Def}$ – 0.14 V	$V_{11\,Def}$ – 0.1 V	$V_{11\,Def}$ – 0.07 V	V	f_{68} = 75 kHz; V_{68} = 100 mVpp	1
Detector characteristic	V_{11}	$V_{11\,Def}$ – 1.8 V	$V_{11\,Def}$ – 1.6 V	$V_{11\,Def}$ – 1.4 V	V	f_{68} = 400 kHz; V_{68} = 100 mVpp	1

3. Stereo Decoder[1)]

Total harmonic distortion	$THD_{58,\,59}$		0.1	0.3	%	f = 1 kHz	1
Signal to noise ratio	$S/N_{58,\,59}$	65	75		dB	Stereo	1
Channel separation	a_{Sep}	28	40		dB		1
AF output voltage	$V_{58,\,59}$	310	390	470	mVrms	Stereo	1
Overdrive margin	$V_{58,\,59\,max}$	4	8		dB	THD = 1 %	1
AF output DC voltage	$V_{DC\,58,\,59}$	2.5	3	3.5	V		1
Difference of output voltage levels	$\Delta V_{58,\,59}$			2	dB		1
Muting depth	$A_{58,\,59}$	70	75		dB	V_{55} = 0	1
Muting depth	$A_{58,\,59}$	70	75		dB	V_{12} = 0.7 V	1
DC offset at mute	$\Delta_{DC\,58,\,59}$	– 100	0	100	mV		1
DC offset stereo ON/OFF	$\Delta_{DC\,58,\,59}$	– 100	0	100	mV		1
Pop noise	$V_{PN\,58,\,59}$		t.b.d.		µV	Stereo	1

Carrier and Harmonic Suppression (referenced to $V_{47,48}$ = 390 mVrms)

Pilotsignal[2)] (f = 19 kHz)	a_{19}	40	45		dB		1
subcarrier[2)] (f = 38 kHz)	a_{38}	40	50		dB		1
(f = 57 kHz)	a_{57}	40	50		dB		1

1) Measuring condition: V_{64} = 600 mVrms; f = 1 kHz; 15 kHz LP with 19 kHz notch; see **diagram 4page 253**.
2) Intermodulation performance see **chapter 3.5**.

8235605 0088070 3T0

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Mono/Stereo Control							
Pilot Threshold Voltage							
For stereo ON	$V_{PIL\ on}$		20	30	mVrms		1
For stereo OFF	$V_{PIL\ off}$	5	14		mVrms		1
Hysteresis			3		dB	$V_{PIL\ on}/V_{PIL\ off}$	1
Stereo Indicator Output							
Pilot OFF	$V_{62\ off}$			0.5	V	I_{62} = 1 mA	
Pilot ON	$I_{62\ on}$			10	µA	V_{62} = 8 V	
External Control Voltages (active low)							
Operational voltage for external mono control pin (pin 63)	$V_{63\ thr}$			1	V		1
Operational voltage for AM/FM (pin 54)	$V_{54\ thr}$			1	V	AM ON	1
Deemphasis[1]							
Minimum FM	$A_{min\ FM}$	6.6	7.8	9	dB	$V_{60} \geq 4.4$ V; f_m = 5 kHz	1
Maximum FM	$A_{max\ FM}$	13	16	19	dB	V_{60} = 0 V; f_m = 5 kHz	1
Minimum AM	$A_{min\ AM}$	6.6	7.8	9	dB	$V_{60} \geq 3.4$ V; f_m = 5 kHz	1
Maximum AM	$A_{max\ AM}$	11.5	14.5	17.5	dB	V_{60} = 0 V; f_m = 5 kHz	1
Stereo/Mono Blend Control							
Channel separation	a_{Sep}	10	13	16	dB	V_{60} = 2.5 V	1
Channel separation	a_{Sep}	1	2	3	dB	V_{60} = 1.7 V	1

[1] Reference frequency = 400 Hz; C_{deemph} = 10 nF; τ_{nom} = 75 µs

8235605 0088071 237

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Oscillator							
Max. osc. frequency	$f_{osc\ max}$	0.7	1.0	2.0	%	100 % × (f_{max}/456 kHz – 1)	1
Min. osc. frequency	$f_{osc\ min}$	– 2.0	– 1.0	– 0.7	%	100 % × (f_{max}/456 kHz – 1)	1
VCO gain	$\Delta f/\Delta V_{65}$	– 12	– 8	– 4	kHz/V		1
Oscillator voltage	$V_{66\ DC}$	2.5	4	5.5	V		1
Oscillator swing	$V_{66\ AC}$	260	370	470	mVrms		1
PLL							
PD gain	$\Delta i/\Delta\Phi$	6.0	8.2	10.2	µA/rad	V_{pilot} = 54 mVrms	See **fig. 8**
Noise Detector							
Input resistance	R_{68}	80	99	120	kΩ		1
Input high-pass filter	$f_{in\ 68}$	80	100	120	kHz	– 3 dB	Lab
Trigger threshold	$V_{68\ min}$		30	50	mVrms	$V_{55} = V_{55}$ ($V_{68\ mean}$ = 0) f_{68} = 200 kHz	1
Trigger threshold	$V_{68\ dyn}$	130	170	210	mVrms	$V_{55} = V_{55}$ ($V_{68\ mean}$ = 50 mVrms) f_{68} = 200 kHz	1
Maximum noise mean value[1]	$V_{68maxmean}$	65	80	115	mVrms	f_{68} = 200 kHz	1
Suppression pulse duration		34	40	46	µs		1
Input offset current	$I_{56,\ 57}$	– 50	0	50	nA		Lab

[1] The trigger threshold is adapted to the input noise. If max. noise mean value is exceeded, threshold is too high for any trigger of the noise blanker.

8235605 0088072 173

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			

4. AM Mode

AGC Amplifier[1]

Parameter	Symbol	min.	typ.	max.	Unit	Test Condition	Test Circuit
AGC range	ΔA	70	80		dB	$V_1 = V_{1\,AM} \pm 3$ dB	1
Reg. output voltage	V_{14}		75		mVrms	AM stereo, $R_L > 1$ MΩ, $C_L < 2$pF	1
Input sensitivity	V_{19}		30		µVrms	$V_1 = V_{1\,AM} - 3$ dB	1
AGC time seek mode ON	$V_{12\,L}$	0		0.7	V		1
AGC time seek mode OFF	$V_{12\,H}$	2.4		5	V		1
Integrator current	I_{23}[2]	80	100	120	µA	$V_{19} = 0$; $V_m = 3$ V	1
Integrator current	I_{23}[2]	– 80	– 100	– 120	µA	$V_{19} = 200$ mVrms; $V_m = 3$ V	1
Integrator current	I_{23}[2]	520	650	780	µA	$V_{19} = 0$; $V_m = 3$ V; $V_{12} = 0.7$ V	1
Integrator current	I_{23}[2]	– 520	– 650	– 780	µA	$V_{19} = 200$ mVrms; $V_m = 3$ V; $V_{12} = 0.7$ V	1
Field strength output	V_7	0	0.3	0.6	V	$V_{19} = 0$ mV; seek mode OFF	1
	V_7	1.4	1.7	2.1	V	$V_{19} = 100$ µV; seek mode OFF	1
	V_7	2.4	2.7	3.0	V	$V_{19} = 500$ µV; seek mode OFF	1
	V_7	3.5	4.1	4.7	V	$V_{19} = 5$ mV; seek mode OFF	1
	V_7	4.0	4.6	5.1	V	$V_{19} = 30$ mV; seek mode OFF	1
Reference voltage	V_{37}	4.5	4.8	5.1	V		1
Output current	I_{37}			1.0	mA		1

[1] Measuring condition: $f_{IF} = 450$ kHz; $f_{mod} = 1$ kHz; $V_{19} = 10$ mVrms, deemphasis = 100 µs
[2] Integrator currents are measured between the output pin (– pole of the measurement equipment) and a voltage source V_m (+ pole).

8235605 0088073 00T

3.3 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = 25 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Demodulator							
AF output voltage	$V_{1\,AM}$	360	480	600	mVrms	m = 0.8	1
AF output voltage	$V_{1\,AM}$	305	406	480	mVrms	m = 0.8; deemph. = 100 µs	1 Lab
Total harm. distortion	THD_{64}		0.7	2	%	m = 0.8	1
(S + N)/N			30		dB	m = 0.8; V_{19} = 20 µV	1
(S + N)/N			50		dB	m = 0.8; V_9 = 200 µV	1
(S + N)/N			66		dB	m = 0.8; V_{19} = 100 mVrms	1
AF linearity	ΔV_1			3	dB	V_{19} = 100 µV/50 mV	1
IF peak	V_{14pp}		1	1.5	Vpp	V_{23} shorted to GND	Lab
IF Counter							
IF counter output voltage	V_{13}	320	400	480	mVrms	R_L > 1 MΩ	1
IF counter output voltage	V_{13}			1	V_{DC}	V_{12} = 2.4 V	1
IF counter output voltage	$V_{13\,AC}$			1	mVrms	V_{12} = 2.4 V	1

Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at T_A = 25°C and the given supply voltage.

3.4 AC/DC Characteristics

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Current consumption	$I_{S\ FM}$ $I_{S\ AM}$	70 66	100 95	130 124	mA mA	FM mode AM mode	1 1

1. AM/FM Receiver

1st LO

Frequency range	$f_{1st\ LO}$	80		140	MHz		1
Frequency range	$f_{1st\ LO}$	50		150	MHz	$Q_{factor\ of\ coil}$ > 90	Lab
Counter output	V_{52}	90	130		mVrms	$R_{L\ 52}$ = 330 Ω	1
Divided counter output	V_{51}	90	130		mVrms	$R_{L\ 51}$ = 330 Ω	1
Output impedance	R_{51}	0.7	1	1.3	kΩ		Lab
Output impedance	R_{52}	210	300	390	Ω		Lab
Frequency	$f_{1st\ LO}$				MHz	V_{tuning} = 0 V	

10.7 MHz IF Amplifier[1)]

DC input voltage	$V_{32,\ 33}$	4.3	4.7		V		1
Input resistance	R_{32}	1.3	1.8	2.35	kΩ	AM	1
Input resistance	R_{33}	230	330	430	Ω	FM	1
Output resistance	R_{27}	100			kΩ	Open collector	1
Output resistance	R_{28}	230	330	430	Ω		1
Voltage gain	$A_{33\text{-}28}$	22	27	32	dB	FM, R_{28} = 330 Ω	Lab
Voltage gain	$A_{32\text{-}27}$	6	11	16	dB	AM, R_{27} = 330 Ω	Lab
Noise figure	F_{AM}		6		dB	R_G = 330 Ω	Lab
Noise figure	F_{FM}		7		dB	R_G = 330 Ω	Lab
Reference voltage	V_{48}	4.4	4.8	5.2	V		1
Output current	I_{48}			1	mA		1

1) $f_{IF\ 1}$ = 10.7 MHz

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			

AM Mode[1)]

Mixer 1

Parameter	Symbol	min.	typ.	max.	Unit	Test Condition	Test Circuit
Interceptpoint 3rd order	I_{P3}		134		dBµV	$V_{44,45}$ ≥ 100 mVrms special testcircuit necessary	Lab
Mixer gain	A_{M1}		– 2		dB	$V_{44,45}$ = 80 mVrms; $V_{out} = V_{32}$ (X_F = 1k5//5p; a_F = – 2 dB)	Lab
Over all gain	$A_{M\,IF}$	– 1	5	11	dB	$V_{44,45}$ = 80 mVrms; $V_{out} = V_{IF\,10.7}$	1
Max. input voltage	$V_{44,45}$	1100	1400		mVpp	SINAD > 34 dB; m = 80 %	1
Noise figure (10 MHz)	F		7		dB	$R_{g\,opt}$ = 700 Ω	Lab
Input impedance	$R_{44,45}$	3.1	4	4.9	kΩ	Sym.	Lab
Input impedance	$C_{44,45}$	1.5	2	2.5	pF	Sym.	Lab
Input impedance	$R_{44,45}$	1.5	2	2.5	kΩ	Asym.	Lab
Input impedance	$C_{44,45}$	3.1	4	4.9	pF	Asym.	Lab
1st LO divided by 8	$V_{34\,Low}$	0		0.7	V		1
1st LO divided by 10	$V_{34\,High}$	2.4		5	V	Or open	1

Prestage AGC Output

Parameter	Symbol	min.	typ.	max.	Unit	Test Condition	Test Circuit
AGC voltage AM	V_{29}	5.5	7		V	$V_{44,45}$ = 50 mVrms	1
AGC voltage AM	V_{29}	0		0.7	V	$V_{44,45}$ = 200 mVrms	1
AGC voltage FM	V_{43}	0		0.5	V	$V_{44,45}$ = 50 mVrms	1
AGC current FM	I_{30}	0		0.5	mA	$V_{44,45}$ = 50 mVrms	1

1) $f_{IF\,1}$ = 10.7 MHz, $f_{IF\,2}$ = 450 kHz, $f_{44,45}$ = 1 MHz, V_{54} = 1 V

8235605 0088076 819

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Integrator current	I_{42}[1]	– 28	– 38	– 53	µA	$V_{44,45}$ = 50 mVrms V_m = 3 V	1
Integrator current	I_{42}[1]	30	40	55	µA	$V_{44,45}$ = 200 mVrms V_m = 3 V	1

2nd AM IF Section

Mixer 2

Parameter	Symbol	min.	typ.	max.	Unit	Test Condition	Test Circuit
Max. mixer gain	A_{M2}	15	20	25	dB	V_{26} = 1 mV; $V_{out} = V_{IF\,450}$ f_{26} = 10.7 MHz; f_{24} = 10.25 MHz	1
Mixer AGC range	ΔA	15	20	25	dB	ΔA = $A_{V26\,=\,1\,mV} - A_{V26\,=\,100\,mV}$	1
Mixer gain seek mode ON		15	20	25	dB	V_{26} = 1 mV; V_{12} = 0.7 V	1
Noise figure	F		10		dB		Lab
Integrator current	I_{42}[1]	70	150	250	µA	V_{26} = 0 V_m = 3 V	1
Integrator current	I_{42}[1]	– 180	– 270	– 400	µA	V_{26} = 100 mVrms V_m = 3 V	1

2nd LO

Parameter	Symbol	min.	typ.	max.	Unit	Test Condition	Test Circuit
Operational frequency	f_{24}	9.25	10.25	11.25	MHz		1
External force voltage	V_{24}	30			mVrms	R_g = 600 Ω; C_k = 100 pF	1

[1] Integrator currents are measured between the output pin (– pole of the measurement equipment) and a voltage source V_m (+ pole).

8235605 0088077 755

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
FM Mode[1]							
Mixer 1							
Interceptpoint 3rd order	I_{P3}		125		dBµV	$V_{46,47} \geq$ 100 mVrms special testcircuit necessary	Lab
Noise figure (10 MHz)	F		6		dB	$R_{g\,opt}$ = 500 Ω	Lab
Mixer gain	A_{M1}		9		dB	$V_{46,47}$ = 10 mVrms; $V_{out} = V_{33}$ (R_F = 330 Ω; a_F = – 4 dB)	Lab
Over all gain	$A_{M\,IF}$	25	32	39	dB	$V_{46,47}$ = 10 mVrms; $V_{out} = V_{IF\,10.7}$	1
Input impedance	$R_{46,47}$	3.1	4	4.9	kΩ	Sym.	Lab
Input impedance	$C_{46,47}$	1.5	2	2.5	pF	Sym.	Lab
Input impedance	$R_{46,47}$	1.5	2	2.5	kΩ	Asym.	Lab
Input impedance	$C_{46,47}$	3.1	4	4.9	pF	Asym.	Lab
Prestage AGC Output							
AGC voltage FM	V_{43}	5.2	6.4	7.7	V	$V_{46,47}$ = 0 mVrms	1
AGC voltage FM	V_{43}	0		0.2	V	$V_{46,47}$ = 50 mVrms	1
AGC current FM	I_{30}	8.5	12	15.5	mA	$V_{46,47}$ = 0 mVrms	1
AGC current FM	I_{30}	0		0.2	mA	$V_{46,47}$ = 50 mVrms	1
AGC voltage AM	V_{29}	0		1	V	$V_{46,47}$ = 0	1
Integrator current	I_{43}[2]	– 10	– 25	– 50	µA	V_{46} = 0 V_m = 4.8 V	1
Integrator current	I_{43}[2]	40	60	85	µA	V_{46} = 100 mVrms; V_m = 4.8 V	1

[1] f_{IF} = 10.7 MHz, $f_{46,47}$ = 100 MHz, V_{54} = open
[2] Integrator currents are measured between the output pin (– pole of the measurement equipment) and a voltage source V_m (+ pole).

8235605 0088078 691

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
2. FM Demodulator[1]							
Field strength output	V_7						
– dynamic range		63	72		dB	See diagram D1	1
– nonlinearity			± 1		dB	see diagram D2	1
– temperature drift				± 3	dB	see diagram D3	1
– load capacitance				50	pF		
– load resistance		1			kΩ		
	V_7	4	4.6	5.2	V	V_{17} = 200 mVrms	1
	V_7	1.4	1.9	2.4	V	V_{17} = 1 mVrms	1
	V_7	0		1.5	V	V_{17} = 0 mVrms deemph = 100 µs	1
AF output voltage	$V_{1\ FM}$	350	500	650	mVrms	R_L > 10 kΩ; deemph. = 100 µs	1
AF output voltage	$V_{1\ FM}$		600		mVrms	R_L > 10 kΩ; no deemph.	Lab
Input voltage for limiter threshold	V_{17}		33	45	µVrms	$V_1 = V_{1\ FM}$ – 3 dB	1
Total harmonic distortion	THD_1			1.2	%		1
AM suppression	a_{AM}	70	80		dB	m = 30 %	1
Signal-to-noise ratio	$a_{S/N}$	72	80		dB		1
AF mute	a_{AF}	9	12	15	dB	V_3 = open; V_2 = 0	1
Reference voltage	V_8	4.4	4.8	5.2	V		1
Output current	I_8			1.0	mA		1
Multipath Detector[2]							
Attack current	I_{10}[3]	500	800	1100	µA	$V_{68\ AC}$ = 1 Vpp, V_m = 4.8 V	1
Recovery current	I_{10}[3]	– 3	– 9	– 14	µA	$V_{68\ AC}$ = 0, V_m = 3.8 V	1
Start voltage	$V_{11\ Det}$	4.3	4.7		V	$V_{68\ AC}$ = 0 V	1

[1] Measuring condition: f_{IIF} = 10.7 MHz; Δf = ± 75 kHz; f_{mod} = 1 kHz; V_{17} = 10 mVrms; V_{54} = open; deemphasis = 100 µs
[2] f_{68} = 400 kHz
[3] Integrator currents are measured between the output pin (– pole of the measurement equipment) and a voltage source V_m (+ pole).

8235605 0088079 528

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Detector characteristic	V_{11}	$V_{11\ Def}$ – 0.15 V	$V_{11\ Def}$ – 0.1 V	$V_{11\ Def}$ – 0.05 V	V	f_{68} = 75 kHz; V_{68} = 100 mVpp	1
Detector characteristic	V_{11}	$V_{11\ Def}$ – 2.0 V	$V_{11\ Def}$ – 1.6 V	$V_{11\ Def}$ – 1.2 V	V	f_{68} = 400 kHz; V_{68} = 100 mVpp	1

3. Stereo Decoder[1]

Total harmonic distortion	$THD_{58,\ 59}$		0.1	0.5	%	f = 1 kHz	1
Signal to noise ratio	$S/N_{58,\ 59}$	65	75		dB	Stereo	1
Channel separation	a_{Sep}	26	40		dB		1
AF output voltage	$V_{58,\ 59}$	300	390	500	mVrms	Stereo	1
Overdrive margin	$V_{58,\ 59\ max}$	3	8		dB	THD = 1 %	1
AF output DC voltage	$V_{DC\ 58,\ 59}$	2.3	3	3.7	V		1
Difference of output voltage levels	$\Delta V_{58,\ 59}$			2	dB		1
Muting depth	$A_{58,\ 59}$	70	75		dB	V_{55} = 0	1
Muting depth	$A_{58,\ 59}$	70	75		dB	V_{12} = 0.7 V	1
DC offset at mute	$\Delta_{DC\ 58,\ 59}$	– 100	0	100	mV		1
DC offset stereo ON/OFF	$\Delta_{DC\ 58,\ 59}$	– 100	0	100	mV		1
Pop noise	$V_{PN\ 58,\ 59}$		t.b.d.		µV	Averaging	1

Carrier and Harmonic Suppression (referenced to $V_{58,\ 59}$ = 390 mVrms)

Pilotsignal[2] (f = 19 kHz)	a_{19}	40	45		dB		1
subcarrier[2] (f = 38 kHz)	a_{38}	40	50		dB		1
(f = 57 kHz)	a_{57}	40	50		dB		1

[1] Measuring condition: V_{64} = 600 mVrms; f = 1 kHz; 15 kHz LP with 19 kHz notch; see **diagram page 253**.
[2] Intermodulation performance see **chapter 3.5**.

8235605 0088080 24T

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Mono/Stereo Control							
Pilot Threshold Voltage							
For stereo ON	$V_{PIL\ on}$		20	40	mVrms		1
For stereo OFF	$V_{PIL\ off}$	2	15		mVrms		1
Hysteresis			3		dB	$V_{PIL\ on}/V_{PIL\ off}$	1
Stereo Indicator Output							
Pilot OFF	$V_{62\ off}$			0.5	V	I_{62} = 1 mA	
Pilot ON	$I_{62\ on}$			10	µA	V_{62} = 11 V	
External Control Voltages (active low)							
Operational voltage for external mono control pin (pin 63)	$V_{63\ thr}$			1	V		1
Operational voltage for AM/FM (pin 54)	$V_{54\ thr}$			1	V	AM ON	1
Deemphasis[1]							
Minimum FM	$A_{min\ FM}$	5.5	7.8	10.2	dB	$V_{60} \geq 4.4$ V; f_m = 5 kHz	1
Maximum FM	$A_{max\ FM}$	11.5	16	20.5	dB	V_{60} = 0 V; f_m = 5 kHz	1
Minimum AM	$A_{min\ AM}$	5.5	7.8	10.2	dB	$V_{60} \geq 3.4$ V; f_m = 5 kHz	1
Maximum AM	$A_{max\ AM}$	10	14.5	19	dB	V_{60} = 0 V; f_m = 5 kHz	1

[1] Reference frequency = 400 Hz; C_{deemph} = 10 nF; τ_{nom} = 75 µs

8235605 0088081 186

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Stereo/Mono Blend Control							
Channel separation	a_{Sep}	7	13	19	dB	V_{60} = 2.5 V	1
Channel separation	a_{Sep}	1	2	5	dB	V_{60} = 1.7 V	1
Oscillator							
Max. osc. frequency	$f_{osc\ max}$	0.7	1.0	2.0	%	100 % × (f_{max}/456 kHz – 1)	1
Min. osc. frequency	$f_{osc\ min}$	– 2.0	– 1.0	– 0.7	%	100 % × (f_{max}/456 kHz – 1)	1
VCO gain	$\Delta f/\Delta V_1$	– 13	– 8	– 3	kHz/V		1
Oscillator voltage	$V_{66\ DC}$	2	4	6	V		1
Oscillator swing	$V_{66\ AC}$	240	370	490	mVrms		1
PLL							
PD gain	$\Delta i/\Delta \Phi$	5	8.2	11.2	µA/rad	V_{pilot} = 54 mVrms	See **fig. 8**
Noise Detector							
Input resistance	R_{68}	70	99	130	kΩ		Lab
Input high-pass filter	$f_{in\ 68}$	70	100	130	kHz	– 3 dB	Lab
Trigger threshold	$V_{68\ min}$		30	60	mVrms	$V_{55} = V_{55}$ ($V_{68\ mean}$ = 0) f_{68} = 200 kHz	1
Trigger threshold	$V_{68\ dyn}$	110	170	260	mVrms	$V_{55} = V_{55}$ ($V_{68\ mean}$ = 50 mVrms) f_{68} = 200 kHz	1
Maximum noise mean value[1]	$V_{68maxmean}$	60	80	120	mVrms	f_{68} = 200 kHz	1

[1] The trigger threshold is adapted to the input noise. If max. noise mean value is exceeded, threshold is too high for any trigger of the noise blanker.

8235605 0088082 012

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Suppression pulse duration		30	40	50	µs		1
Input offset current	$I_{56, 57}$	– 50	0	50	nA		Lab

4. AM Mode

AGC Amplifier[1]

AGC range	ΔA	64	80		dB	$V_1 = V_{1\,AM} \pm 3$ dB	1
Reg. output voltage	V_{14}	50	75	105	mVrms	$V_1 = V_{1\,AM} - 3$ dB	1
Input sensitivity	V_{19}		30		µVrms	$V_{58} = V_{58\,AM} - 3$ dB	1
AGC time seek mode ON	$V_{12\,L}$	0		0.7	V		1
AGC time seek mode OFF	$V_{12\,H}$	2.4		5	V		1
Integrator current	I_{23}[2]	70	100	130	µA	$V_{19} = 0$; $V_m = 3$ V	1
Integrator current	I_{23}[2]	– 70	– 100	– 130	µA	$V_{19} = 200$ mVrms; $V_m = 3$ V	1
Integrator current	I_{13}[2]	450	650	845	µA	$V_{19} = 0$; $V_m = 3$ V; $V_3 = 0.7$ V	1
Integrator current	I_{23}[2]	– 450	– 650	– 845	µA	$V_{19} = 200$ mVrms; $V_m = 3$ V; $V_3 = 0.7$ V	1
Field strength output	V_7	0	0.3	0.8	V	$V_{19} = 0$ mV; seek mode OFF	1
	V_7	1.2	1.7	2.3	V	$V_{19} = 100$ µV; seek mode OFF	1
	V_7	2.2	2.7	3.2	V	$V_{19} = 500$ µV; seek mode OFF	1
	V_7	3.3	4.1	4.9	V	$V_{19} = 5$ mV; seek mode OFF	1
	V_7	3.8	4.6	5.4	V	$V_{19} = 30$ mV; seek mode OFF	1

[1] Measuring condition: f_{IF} = 10.7 MHz; Δf = ± 75 kHz; f_{mod} = 1 kHz; V_{19} = 10 mVrms; V_{54} = open; deemphasis = 100 µs
[2] The trigger threshold is adapted to the input noise. If max. noise mean value is exceeded, threshold is too high for any trigger of the noise blanker.

3.4 AC/DC Characteristics (cont'd)

V_S = 9.5 V, T_A = – 40 to + 85 °C

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Reference voltage	V_{37}	4.4	4.8	5.2	V		1
Output current	I_{37}			1	mA		1
Demodulator							
AF output voltage	$V_{1\,AM}$	335	480	650	mVrms	m = 0.8	1
AF output voltage	$V_{1\,AM}$	283	406	550	mVrms	m = 0.8; deemph. = 100 µs	1 Lab
Total harm. distortion	THD_1		0.7	2	%	m = 0.8	1
(S + N)/N		20	30		dB	m = 0.8; V_{19} = 20 µV	1
(S + N)/N		40	50		dB	m = 0.8; V_{19} = 200 µV	1
(S + N)/N		56	66		dB	m = 0.8; V_{19} = 100 mVrms	1
AF linearity	ΔV_1			3	dB	V_{19} = 100 µV/50 mV	1
IF peak	ΔV_{14pp}		1	1.5	Vpp	V_{23} shorted to GND	Lab
IF Counter							
IF counter Output voltage	V_{13}	285	400	580	mVrms	R_L > 1 MΩ; C_L < 2 pF V_{12} = 0.7 V	1
IF counter Output voltage	V_{13}			1	V_{DC}	V_{12} = 2.4 V	1
IF counter Output voltage	$V_{13\,AC}$			2	mVrms	V_{12} = 2.4 V	1

Note: The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at T_A = 25 °C and the given supply voltage.

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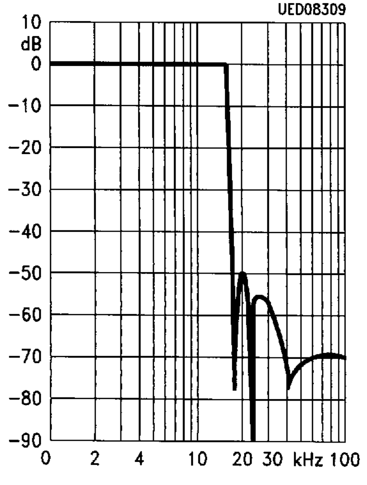
3.5 Intermodulation Behaviour Stereo Decoder Section

Referenced to $V_{47,48}$ = 390 mVrms.

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
f_{mod} = 10 kHz	a_2		60			$f_S = 2 \times 10$ kHz … 19 kHz; 91 % Mono, 9 % Pilot f_S = 1 kHz	Lab
f_{mod} = 13 kHz	a_3		70			$f_S = 2 \times 13$ kHz … 38 kHz; 91 % Mono, 9 % Pilot f_S = 1 kHz	Lab
f = 57 kHz	a_{57}		70			f_S = 1 kHz ± 23 Hz; 91 % Mono, 9 % Pilot, f_m = 1 kHz, 5 % Traffic Radio Carrier (f = 57 kHz; f_m = 23 Hz; m = 60 %)	Lab

Low-Pass Filter with 19 kHz Notch



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Test Circuit

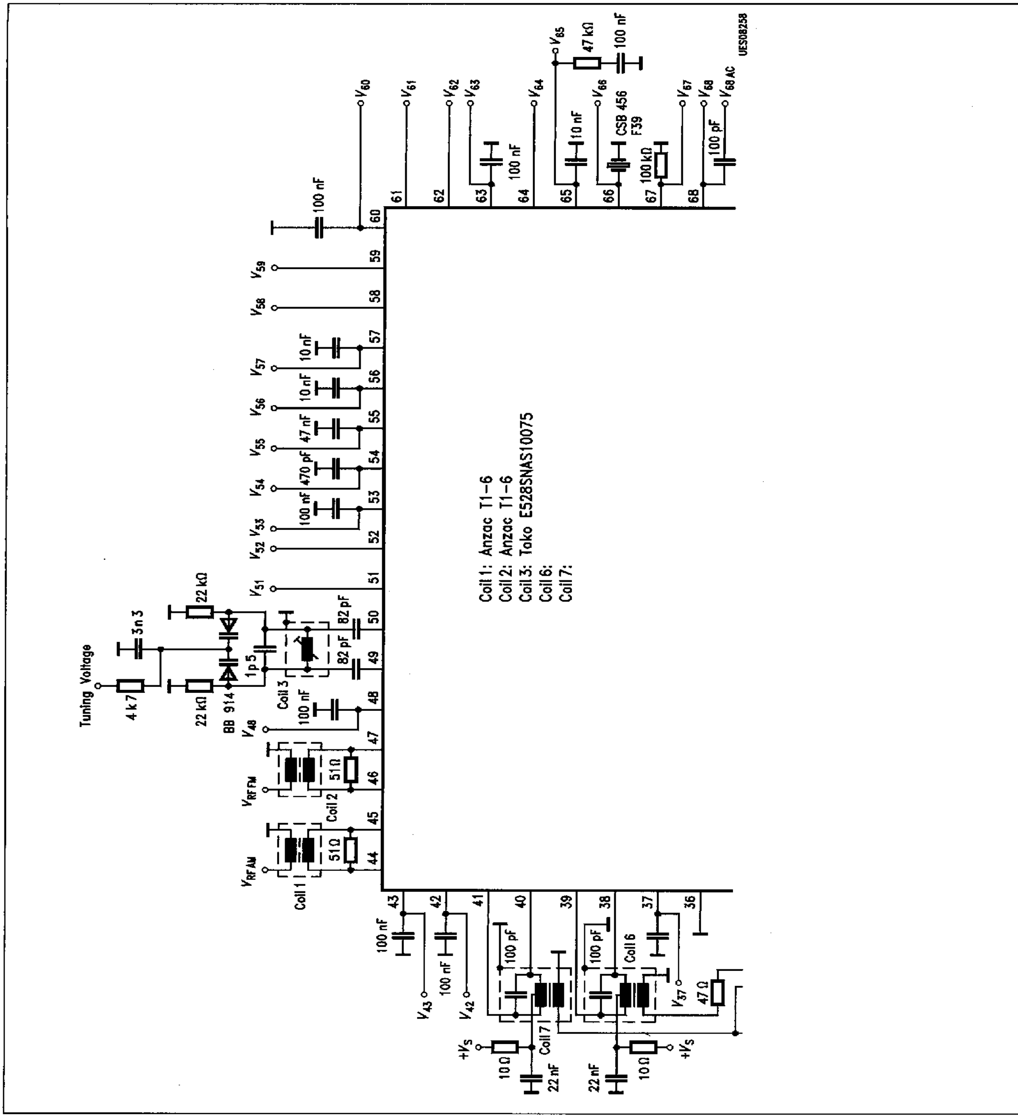

Figure 6a

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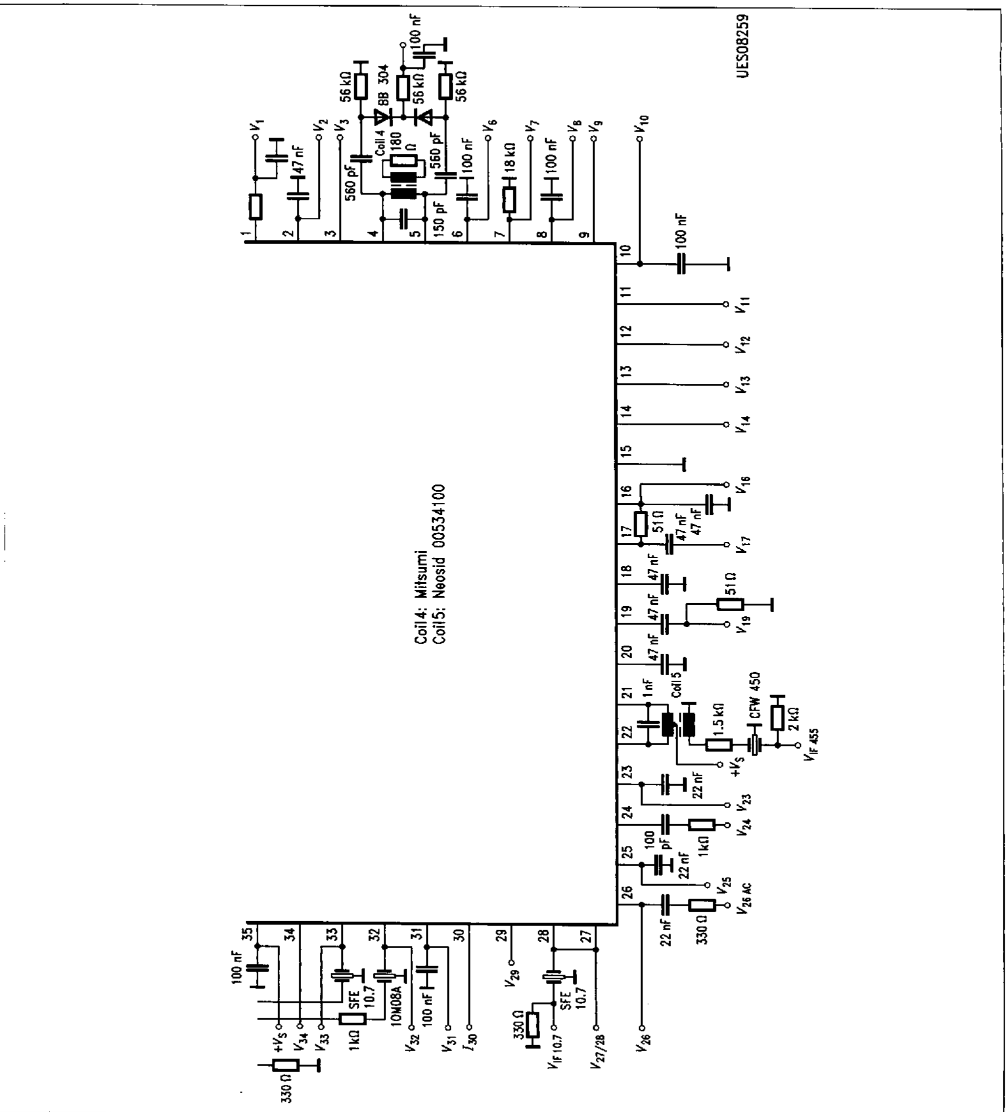

Figure 6b

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Application Circuit

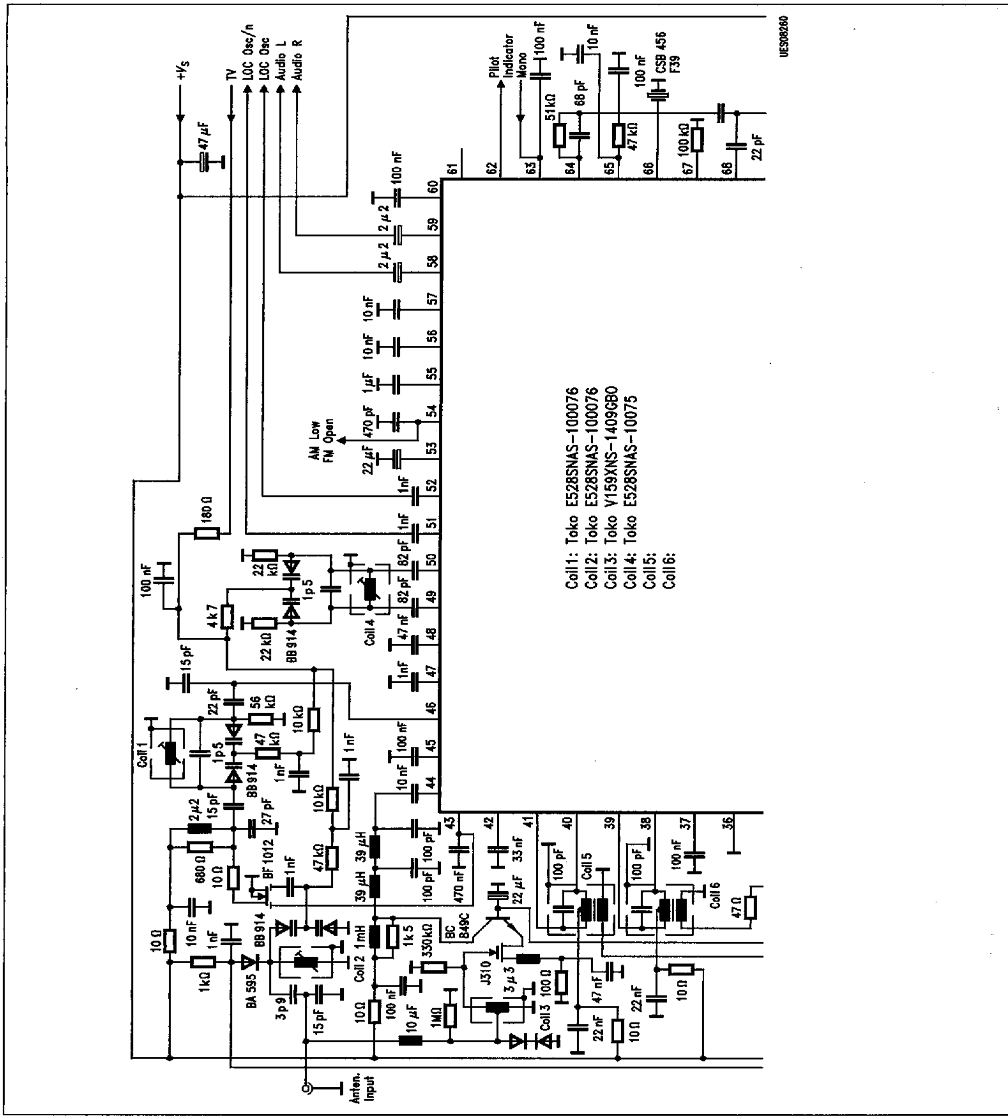

Figure 7a

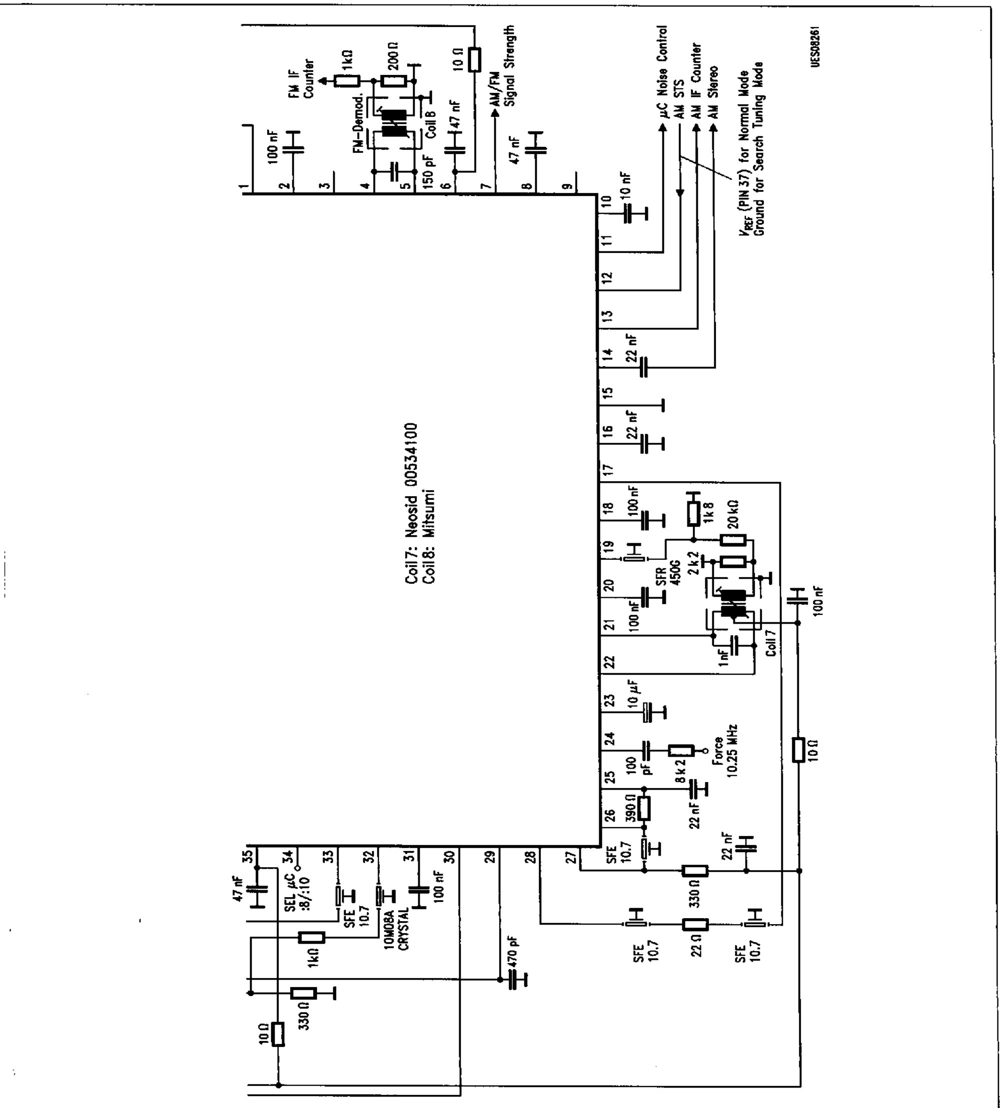

Figure 7b

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Diagrams

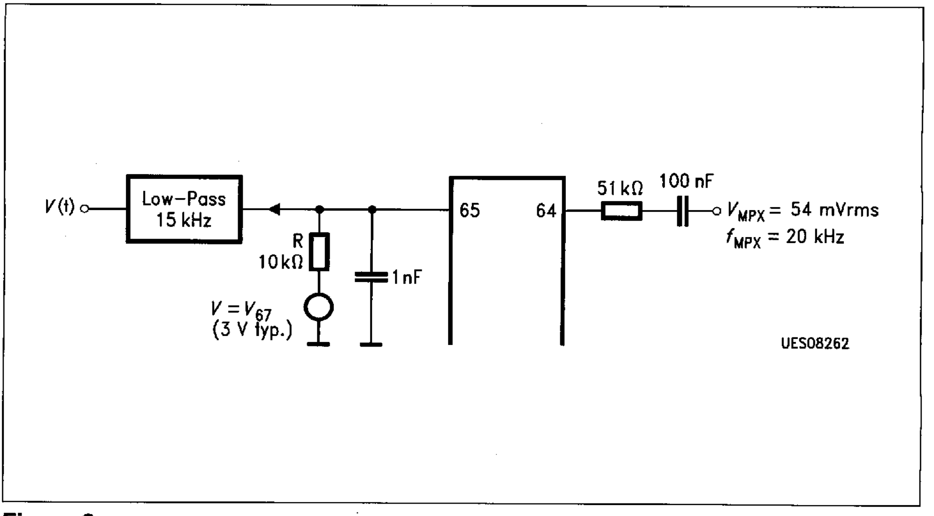


Figure 8
Definition of Phase Detector Gain

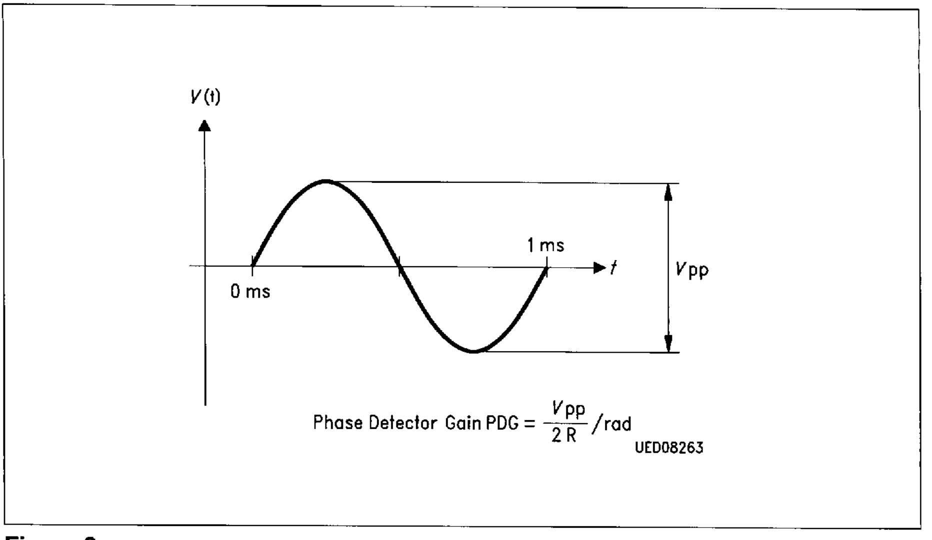
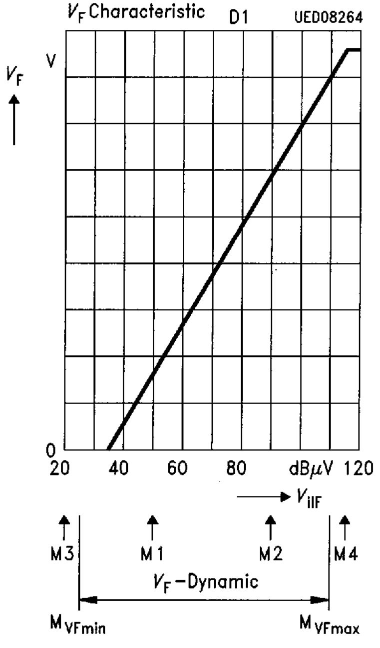


Figure 9
Phase Detector Gain

Diagram D1



V_F Dynamics

The dynamic range of V_F voltage is determined by the test points M1 through M4 as follows:

M1: test point (at V_{iIF} = 50 dBµV) supplies $V_{F(M1)}$

M2: test point (at V_{iIF} = 90 dBµV) supplies $V_{F(M2)}$

M3: test point (at V_{iIF} = 20 dBµV) supplies $V_{F(M3)}$

M4: test point (at V_{iIF} = 120 dBµV) supplies $V_{F(M4)}$

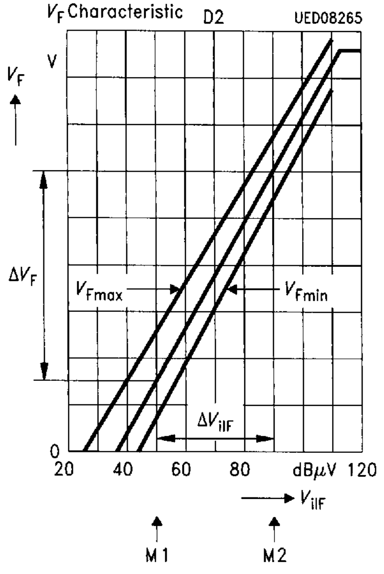
Hence follows:

$M_{VF\,max}$:= 90 dBµV + $(V_{F(M4)} - V_{F(M2)}) / (V_{F(M2)} - V_{F(M1)}) \times 40$ dB

$M_{VF\,min}$:= 50 dBµV – $(V_{F(M1)} - V_{F(M3)}) / (V_{F(M2)} - V_{F(M1)}) \times 40$ dB

$V_{F\,Dynamics} = M_{VF\,max} - M_{VF\,min}$

Diagram D2



Test points to determine V_F linearity:

V_F is determined at 25 °C

Slope: $m = (V_{F(M2)} - V_{F(M1)})/40$ dB.

The tolerance range of the V_F-linearity is determined by two parallel lines:

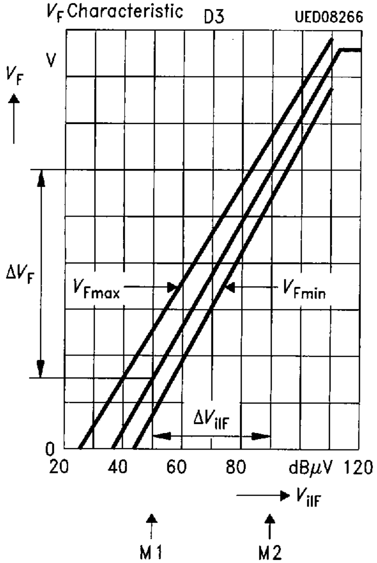
$V_{F\,max} = V_{F(M1)} + m(\text{M} + 60\text{ dB} + 1\text{ dB})$

$V_{F\,min} = V_{F(M1)} + m(\text{M} + 60\text{ dB} - 1\text{ dB})$

The V_F values within the V_F dynamic range ($M_{VF\,min} \leq M \leq M_{VF\,min}$) must be inside the predetermined tolerance range:

$$V_{F\,min} \leq V_{F(M)} \leq V_{F\,max}$$

Diagram D3



Test points to determine V_F drift:

V_F-temperature drift: it is determined within – 40 to + 85 °C.

Slope: $m = (V_{F(M2)} - V_{F(M1)})/40$ dB (at 25 °C).

The tolerance range of the V_F-temperature is determined by two parallel lines:

$V_{F\,max} = V_F(M1) + m(M + 60\text{ dB} + 3\text{ dB})$

$V_{F\,min} = V_F(M1) + m(M + 60\text{ dB} - 3\text{ dB})$

The V_F values for temperatures between – 40 to + 85 °C within the V_F dynamic range ($M_{VF\,min} \leq V_F \leq M_{VF\,min}$) must be inside the predetermined tolerance field:

$$V_{F\,min} \leq V_F(M) \leq V_{F\,max}$$

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Application Hints

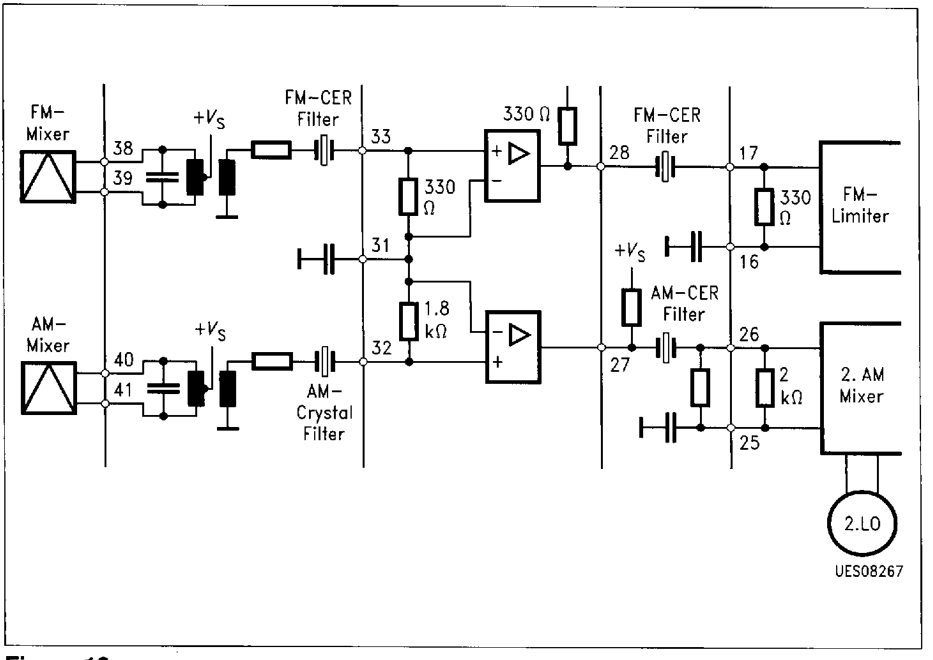


Figure 10
High Performance Application

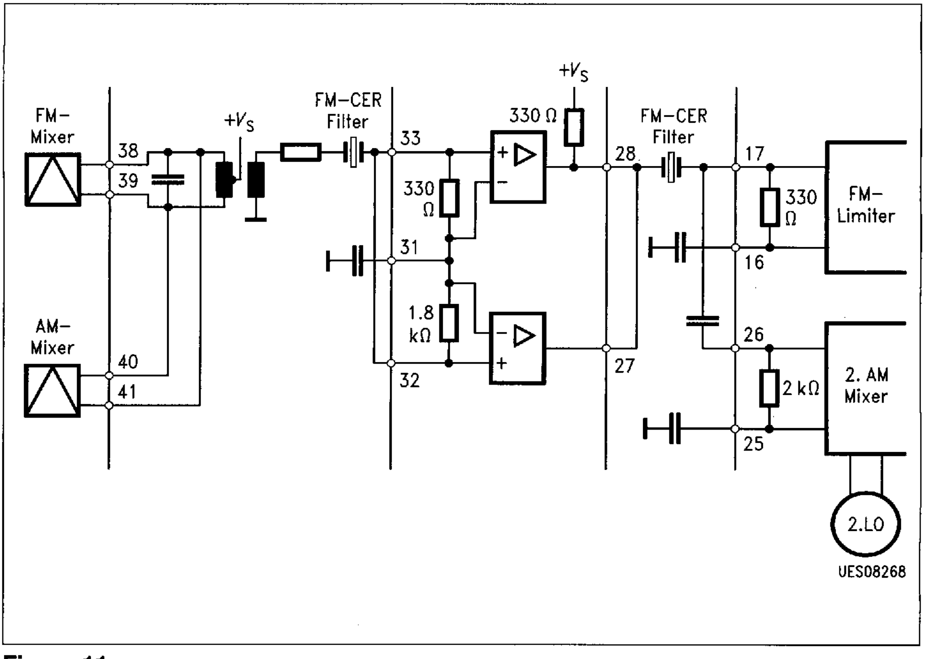
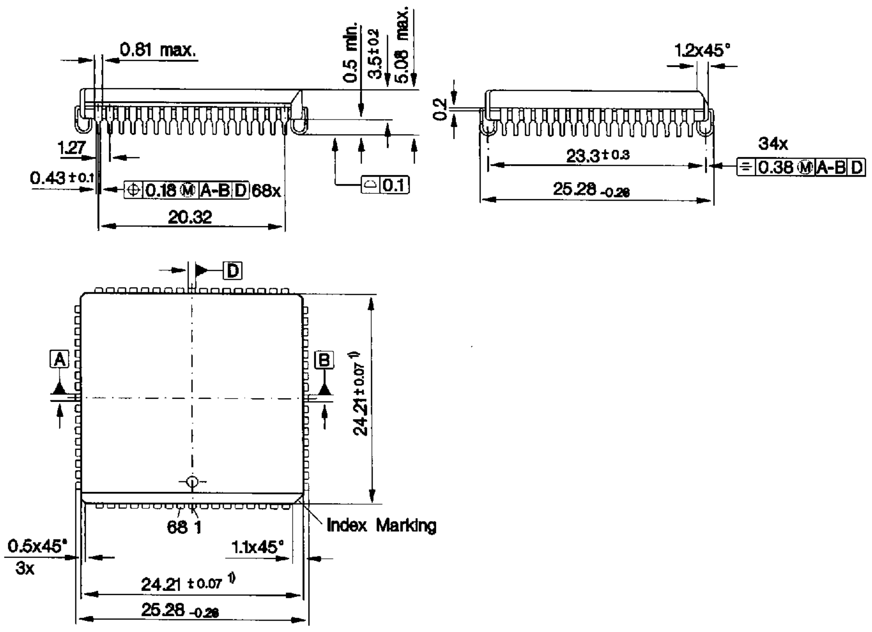


Figure 11
Low Cost Application

4 Package Outlines

P-LCC-68-1
(Plastic Leaded Chip Carrier)



1) Does not include plastic or metal protrusion of 0.15 max. per side

GPL05099

Sorts of Packing
Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".
SMD = Surface Mounted Device

Dimensions in mm