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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
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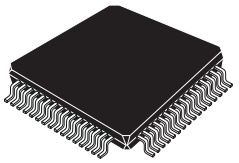
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

TDA7541B

AM/FM car radio tuner IC with stereo decoder and intelligent selectivity system

Features

- FM part
  - AGC generation by RF and IF detection
  - I/Q mixer for 1st IF 10.7 MHz with image rejection
  - Mixer for 2nd IF 450 kHz
  - Internal 450 kHz band pass filter with bandwidth control by ISS
  - Fully integrated FM demodulator with noise cancellation
- AM part
  - Wide and narrow AGC generation
  - Mixer for 1st IF 10.7 MHz, AM up conversion
  - Mixer for 2nd IF 450 kHz
  - Integrated AM-demodulator
  - AM IF noise blanking
- Stereo decoder
  - PLL with adjustment free, fully integrated VCO
  - Automatic pilot dependent MONO/STEREO switching
  - Programmable ROLL-OFF compensation
  - High cut and stereo blend-characteristics programmable
  - Dedicated RDS mute
  - Audio noise blanker
- Additional features
  - VCO for world tuning range



LQFP64

  - High performance fast PLL for RDS-System
  - IF counter for FM and AM with search stop signal
  - Quality detector for level, deviation, adjacent channel and multipath
  - ISS (Intelligent selectivity system) for cancellation of adjacent channel and noise influences
  - Adjacent channel mute
  - Fully electronic alignment
  - Independent weather band input
  - All functions I^2C bus controlled

Description

The TDA7541B is a high performance tuner circuit with stereo decoder for AM/FM car radio. It contains a mixer, IF amplifier, demodulator for AM and FM, stereo decoder, quality detection, ISS filter and PLL synthesizer with IF counter on a single chip. Use of BICMOS technology allows the implementation of several tuning functions and a minimum of external components.

Table 1. Device summary

Order code	Package	Packing
TDA7541B	LQFP64 (10 x 10 x 1.4 mm)	Tray
TDA7541BTR	LQFP64 (10 x 10 x 1.4 mm)	Tape and reel
TDA7541BW	LQFP64 (14 x 14 x 1.4 mm)	Tray
TDA7541BWTR	LQFP64 (14 x 14 x 1.4 mm)	Tape and reel

Contents

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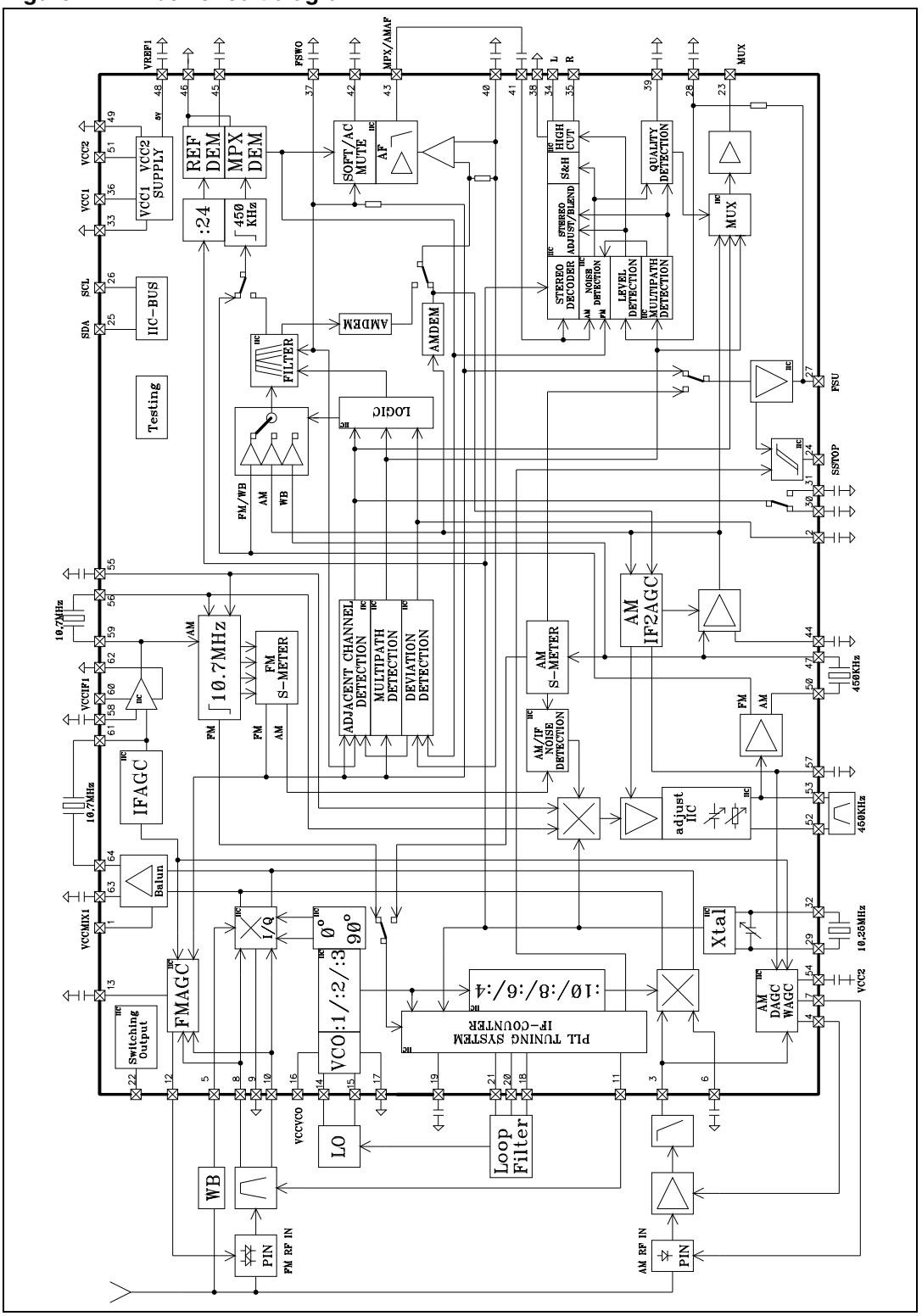
1 Block circuit diagram

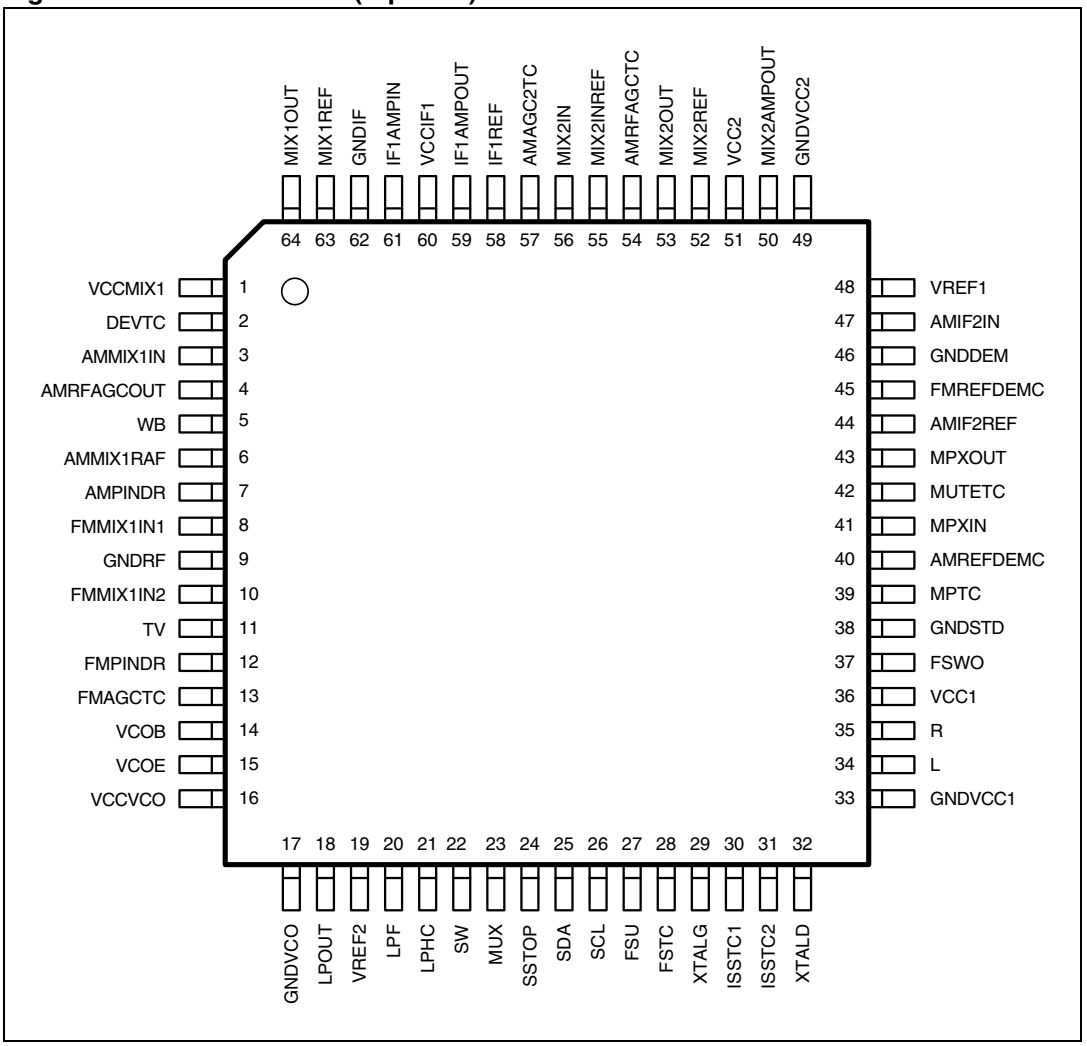
Figure 1. Block circuit diagram



2 Pin connection and pin description

2.1 Pin connection

Figure 2. Pin connection (top view)



2.2 Pin description

Table 2. Pin description

Pin No.	Pin name	Function
1	VCCMIX1	Mixer1 Supply
2	DEVTC	Deviation Detector Time Constant
3	AMMIX1IN	AM Mixer1 Input
4	AMRFAGCOUT	AM RF AGC Voltage Output
5	WB	Weather Band Input
6	AMMIX1REF	AM Mixer1 Reference
7	AMPINDR	AM Pin Diode Driver Output
8	FMMIX1IN1	FM Mixer1 Input1
9	GNDRF	RF Ground
10	FMMIX1IN2	FM Mixer1 Input2
11	TV	Tuning Voltage Preselection
12	FMPINDR	FM Pin Diode Driver Output
13	FMAGCTC	FM AGC Time Constant
14	VCOB	VCO Input Base
15	VCOE	VCO Output Emitter
16	VCCVCO	VCO Supply
17	GNDVCO	VCO Ground
18	LPOUT	OpAmp Output to PLL Loop Filter
19	VREF2	Voltage Reference for PLL OpAmp
20	LPF	OpAmp Input to PLL Loop Filter
21	LPHC	High Current PLL Loop Filter Input
22	SW	Free Programmable Switch Output
23	MUX	Multiplexer Output
24	SSTOP	Search Stop Output
25	SDA	I^2C Bus Data
26	SCL	I^2C Bus Clock
27	FSU	Unweighted Field Strength Output
28	FSTC	S-meter Filtering Capacitor
29	XTALG	Xtal Oscillator to MOS Gate
30	ISSTC1	ISS Filter Time Constant1 (slow)
31	ISSTC2	ISS Filter Time Constant2 (fast)
32	XTALD	Xtal Oscillator to MOS Drain
33	GNDVCC1	Digital Ground

Table 2. Pin description (continued)

Pin No.	Pin name	Function
34	L	Stereo Decoder Output Left
35	R	Stereo Decoder Output Right
36	VCC1	Digital Supply
37	FSWO	Weighted Field Strength Output
38	GNDSTD	Stereo Decoder Ground
39	MPTC	Multipath Detector Time Constant
40	AMREFDEMC	AM Demodulator Reference
41	MPXIN	Stereo Decoder Input
42	MUTETC	Weak Signal Mute Time Constant
43	MPXOUT	AM Audio / MPX Output
44	AMIF2REF	AM IF2 Amplifier Reference Voltage
45	FMREFDEMC	FM Demodulator Reference
46	GNDDEM	FM Demodulator Ground
47	AMIF2IN	AM IF2 Amplifier Input
48	VREF1	5V Reference
49	GNDVCC2	Analog Ground
50	MIX2AMPOUT	MIXER2 Amplifier Output
51	VCC2	Analog Supply
52	MIX2REF	Mixer2 Reference
53	MIX2OUT	Mixer2 Output
54	AMRFAGCTC	AM RF AGC Time Constant
55	MIX2INREF	Mixer2 Input Reference
56	MIX2IN	Mixer2 Input
57	AMAGC2TC	AM AGC2 Time Constant
58	IF1REF	IF1 Amplifier Reference
59	IF1AMPOUT	IF1 Amplifier Output
60	VCCIF1	IF1 Supply
61	IF1AMPIN	IF1 Amplifier Input
62	GNDIF1	IF1 Ground
63	MIX1REF	Mixer1 Reference
64	MIX1OUT	Mixer1 Output

3 Electrical specifications and characteristics

3.1 Thermal data

Table 3. Thermal data

Symbol	Parameter		Value	Unit
$R_{TH(j\text{-}amb)}$	Thermal resistance junction-to-ambient	Max.	70	°C/W

3.2 Absolute maximum ratings

Table 4. Absolute maximum ratings

Symbol	Parameter	Conditions	Value	Unit
V_S	Supply voltage	-	9.5	V
T_{amb}	Ambient temperature	-	-40 to 85	°C
T_{stg}	Storage temperature	-	-55 to +150	°C
V_{ESD}	ESD withstand voltage	Human Body Model	2	kV
		Machine Model	100	V
		Charged Device Model	300	V

3.3 Electrical characteristics

3.3.1 Globals

T_{amb} = 25 °C, $V_{CC1} = V_{CC2} = V_{CCMIX1} = V_{CCVCO} = V_{CCIF}$ = 8.5 V, f_{Xtal} = 10.25 MHz, in application circuit, unless otherwise specified.

Table 5. Globals

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
1. Supply							
1.1	V_{CC1}	Digital supply voltage	-	7.7	8.5	9	V
1.2	V_{CC2}	Analog supply voltage	-	7.7	8.5	9	V
1.3	V_{CCVCO}	VCO supply voltage	-	7.7	8.5	9	V
1.4	V_{CCMIX1}	Mixer1 supply voltage	-	7.7	8.5	9	V
1.5	V_{CCIF}	IF1 Supply Voltage	-	7.7	8.5	9	V
1.6	I_{CC1}	Supply current	FM ON	-	19	23	mA
1.7	I_{CC1}	Supply current	AM ON	-	21	25	mA
1.8	I_{CC2}	Supply current	FM ON	-	48	58	mA
1.9	I_{CC2}	Supply current	AM ON	-	37	44	mA

Table 5. Globals (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
1.10	I_{CCVCO}	Supply current	-	-	12	15	mA
1.11	I_{CCMIX1}	Supply current	FM ON	-	32	40	mA
1.12	I_{CCMIX1}	Supply current	AM ON	-	20	24	mA
1.13	I_{CCIF}	Supply current	-	-	4	5	mA
2. Reference voltages							
2.1	V_{REF1}	Internal reference voltage	I_{REF1} = 0mA	4.8	5	5.2	V
2.2	V_{REF2}	Internal reference voltage	I_{REF2} = 0mA	2.4	2.5	2.6	V
3. I^2C bus interface							
3.1	f_{SCL}	Clock frequency	-	-	-	400	kHz
3.2	V_{IL}	Input low voltage	-	-	-	1	V
3.3	V_{IH}	Input high voltage	-	2	-	-	V
3.4	I_{IN}	Input current	-	-5	-	5	µA
3.5	V_O	Output acknowledge voltage	I_O = 1.6mA	-	-	0.4	V

3.3.2 FM section

T_{amb} = 25 °C, $V_{CC1} = V_{CC2} = V_{CCMIX1} = V_{CCVCO} = V_{CCIF}$ = 8.5 V, f_{Xtal} = 10.25 MHz, f_{RF} = 98 MHz, dev = 40 kHz, f_{Mod} = 1 kHz, in application circuit, unless otherwise specified.

Table 6. FM section

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
4. Wide band RF AGC							
4.1	$V_{8\text{-}10}$	Lower threshold start	V_{13} = 2.5 V, RFK “0”	-	79	-	dBµV
4.2	$V_{8\text{-}10}$	Upper threshold start	V_{13} = 2.5 V, RFK”0”	-	93	-	dBµV
4.3	$\Delta V_{8\text{-}10}$	Control range RF KAGC	KAGC”000”, RFAGC”00”, V_{37} = 3.0….3.7 V, RFK”1”	5	8	11	-
5. Narrow band IF and keying AGC							
5.1	V_{61}	Lower threshold start	KAGC = off, $V_{8\text{-}10}$ = 0 mV_{RMS}	-	82	-	dBµV
5.2	V_{61}	Upper threshold start	KAGC = off, $V_{8\text{-}10}$ = 0 mV_{RMS}	-	94	-	dBµV
5.3	V_{61}	Max. IFAGC threshold with KAGC	KAGC”000”,IFAGC”00”, V_{37} = 3.0 V	-	97	-	dBµV
5.4	V_{37}	Start point KAGC	KAGC”000”,IFAGC”00”,	3.2	3.4	3.6	V
5.5	ΔV_{61}	Control range IF KAGC	KAGC”000”,IFAGC”00”, V_{37} = 3.2….3.9 V	12	15	18	dB
6. AGC time constant output							
6.1	V_{13}	Max. AGC output voltage	$V_{8\text{-}10}$= 0 mV_{RMS}	-	-	V_{REF1} +V_{BE}	V

Table 6. FM section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
6.2	V_{13}	Min. AGC output voltage	$V_{8\text{-}10}$ = 100 mV_{RMS}	-	-	0.5	V
6.3	I_{13}	Min. AGC charge current	$V_{8\text{-}10}$= 0 mV_{RMS},V_{13} = 2.5 V	-33	-25	-17.5	µA
6.4	I_{13}	Max. AGC discharge current	$V_{8\text{-}10}$ = 100 mV_{RMS},V_{13} = 2.5 V	1.7	2.5	3.3	mA
7. AGC PIN diode driver output							
7.1	I_{12}	AGC OUT, current min.	$V_{8\text{-}10}$ = 0 mV_{RMS}, V_{12} = 2.5V	15	25	35	µA
7.2	I_{12}	AGC OUT, current max.	$V_{8\text{-}10}$ = 50 mV_{RMS}, V_{12} = 2.5 V	-	-	-16	mA
8. FM I/Q Mixer1 (10.7 MHz)							
8.1	R_{IN}	Input resistance	Differential	8	10	12	kΩ
8.2	C_{IN}	Input capacitance	Differential	-	4	-	pF
8.3	R_{OUT}	Output resistance	-	530	660	790	Ω
8.4	$V_{8,11}$	Input DC bias	-	2.2	2.5	2.8	V
8.5	G	Gain	Unloaded	20	22	24	dB
8.6	G_I	Gain	With 330 Ω load	14	16	18	dB
8.7	INOISE	Equivalent input noise	-	-	3	-	nV/√Hz
8.8	CP_{1dB}	1dB compression point	Referred to diff. mixer input	-	100	-	dBµV
8.9	IIP3	3rd order intermodulation	-	-	119	-	dBµV
8.10	IQP	I/Q phase adjust	PH	-7	-	+8	DEG
8.11	IRR	Image rejection ratio	Ratio wanted/image	30	40	-	dB
8.12	IRR	Image rejection ratio	With phase adjust	40	46	-	dB
9. WB I/Q Mixer1 (10.7 MHz)							
9.1	R_{IN}	Input resistance	Single ended	1.7	2.5	3.3	kΩ
9.2	C_{IN}	Input capacitance	Single ended	-	3	-	kΩ
9.3	R_{OUT}	Output resistance	-	530	660	790	Ω
9.4	V_5	Input dc bias	-	2	2.3	2.6	V
9.5	G	Gain	unloaded	24	26	28	dB
9.6	INOISE	Equivalent Input noise	Source impedance 400 Ω	-	2.3	-	nV/√Hz
9.7	IIP3	3rd order intermodulation	-	-	113	-	dBµV
10. IF1 amplifier (10.7 MHz)							
10.1	R_{IN}	Input resistance	-	265	330	396	Ω
10.2	C_{IN}	Input capacitance	-	-	2.5	-	pF
10.3	V_{61}	DC input voltage	-	-	V_{CCIF1}/3	-	V
10.4	R_{OUT}	Output resistance	-	265	330	396	Ω
10.5	C_{OUT}	Output capacitance	-	-	2.5	-	pF

Table 6. FM section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
10.6	V_{59}	DC output voltage	-	-	$V_{CCIF1}/2$	-	V
10.7	G_{min}	Min. gain	IFG	-	9	-	dB
10.8	G_{max}	Max. gain	IFG	-	21	-	dB
10.9	INOISE	Equivalent input noise voltage	G_{max}, R_{gen}=330 Ω, R_L=330 Ω, noise of R_{gen} not included	-	3.2	-	nV/√Hz
10.10	CP_{1dB}	1 dB compression point	referred to 330 Ω input, G_{max}	-	99	-	dBµV
10.11	IIP3	3rd order Intermodulation	referred to 330 Ω input, G_{max}	-	130	-	dBµV
11. Mixer2 (450kHz)							
11.1	R_{IN}	Input resistance	Differential	240	300	360	Ω
11.2	C_{IN}	Input capacitance	-	-	2.5	-	pF
11.3	$V_{55.56}$	DC input voltage	-	3.7	4	4.3	V
11.4	R_{OUT}	Output resistance	-	100	-	-	kΩ
11.5	C_{OUT}	Output capacitance	-	-	2.5	-	pF
11.6	$V_{52,53}$	DC output voltage	-	3.7	4	4.3	V
11.7	g_m	Conversion transconductance	WB Mode; referred to MIX2OUT	-	126	-	µA/V
11.8	G	Gain	FM Mode, referred to MIX2OUT	-	16	-	dB
11.9	C_{step}	Min. cap. Step	IF2A	-	2.2	-	pF
11.10	C_{max}	Max. cap.	IF2A	-	33	-	pF
11.11	INOISE	Equivalent input noise voltage, including buffer mixer2	R_{gen} = 330 Ω, IF2Q"10" noise of R_{gen} not included	-	15	-	nV/√Hz
11.12	CP_{1dB}	1dB compression point	referred to 330 Ω input,IF2Q"10"	-	116	-	dBµV
11.13	IIP3	3rd order Intermodulation	referred to 330 Ω input,IF2Q"10"	-	132	-	dBµV
12. Demodulator, audio output							
12.1	THD	Total harmonic distortion	Dev.= 75 kHz, V_{56}= 100 dBµV, IF2Q"11"	-	0.1	0.3	%
12.2	a_{AM}	AM suppression	V_{56} =100 dBµ, Δf = 40 KHz, f_{mod} =1 kHz, f_{mod} =1 kHz@AM, m =0.3 %	40	60	-	dB
12.3	V_{MPX}	MPX output signal	Dev.= 75 kHz	440	500	560	mV_{RMS}
12.4	R_{OUT}	Output impedance	-	20	40	60	Ω
12.5	R_{LOAD}	Load resistance	-	10	-	-	kΩ

Table 6. FM section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
12.6	(S+N)/N	Signal plus noise-to-noise ratio at MPXOUT	Δf = 40 kHz, f_{mod} =1 kHz, V_{56} =100 dBµV, De-emphasis = 50 µs, B = 200 Hz to 15 kHz ISSENA = 0	70	-	-	dB
12.7	(S+N)/N	Signal plus noise-to-noise ratio In weatherband mode	Δf = 3.5 kHz, f_{mod} =1 kHz, V_{56} =100 dBµV, De-emphasis = 75 µs, setting see *Table 10*	40	-	-	dB
13. Quality detection							
	Unweighted field strength (FSU) and weighted field strength						
13.1	V_{37}	DC output voltage	V_{56} = 20 dBµV, FMON=1, FSWO = OFF	-	2.5	-	V
13.2	V_{37}	DC output voltage	V_{56} = 50 dBµV, FMON=1, FSWO = OFF	-	3	-	V
13.3	V_{37}	DC output voltage	V_{56} = 70 dBµV, FMON=1, FSWO = OFF	-	3.5	-	V
13.4	V_{37}	DC output voltage	V_{56} > 120 dBµV, FMON=1, FSWO = OFF	-	4.6	-	V
13.5	ΔV_{37}	Slope	-	-	25	-	mV/dB
13.6	ΔV_{37}	DC offset	-	-200	-	0	mV
13.7	R_{OUT}	Output impedance	FSWO	17	23.5	30	kΩ
13.8	V_{27}	DC output voltage	V_{56} = 20 dBµV, FMON=1, SL="101"	-	0.1	0.4	V
13.9	V_{27}	DC output voltage	V_{56} = 50 dBµV, FMON=1, SL="101"	-	1	-	V
13.10	V_{27}	DC output voltage	V_{56} = 70 dBµV, FMON=1, SL="101"	-	2	-	V
13.11	V_{27}	DC output voltage	V_{56} > 120 dBµV, FMON=1, SL="101"	4	-	-	V
13.12	ΔV_{27}	Slope	-	-	50	-	mV/dB
13.13	R_{OUT}	Output impedance	FSU	320	400	480	Ω
13.14	R_{load}	Load resistor	FSU	-	20	-	kΩ
13.15	V_{27}	DC output voltage AM	V_{47} = 20 dBµV, FMON = 0, SL= "010"	-	0.1	0.3	V
13.16	V_{27}	DC output voltage AM	V_{47} = 40 dBµV, FMON = 0, SL= "010"	-	1.25	-	V
13.17	V_{27}	DC output voltage AM	V_{47} = 60 dBµV, FMON = 0, SL= "010"	-	3.0	-	V
13.18	V_{27}	DC output voltage AM	V_{47} > 100 dBµV, FMON = 0, SL= "010"	4.5	-	-	V

Table 6. FM section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
13.19	ΔV_{27}	Slope AM	FMON=0	-	90	-	mV/dB
13.20	f_{LP}	-3 dB frequency low pass AM	FMON=0	-	40	-	kHz
	Adjacent channel gain						
13.21	G_{AC}	Gain	-	-	32	-	dB
	Adjacent channel filter						
13.22	f_{HP}	-3 dB frequency highpass	ACF=0	-	100	-	kHz
13.23	f_{-20dB}	Attenuation 20dB	-	-	70	-	kHz
13.24	f_{BP}	Centre frequency	ACF=1	-	100	-	kHz
	Multipath channel gain						
13.25	G_{MP}	Gain	-	-	12	-	dB
	Multipath bandpass filter						
13.26	f_C	Centre frequency	-	-	19	-	kHz
13.27	Q	Quality factor	-	5	8	10	-
14. ISS (intelligent selectivity system) filter 450kHz							
14.1	f_{centre}	Centre frequency	f_{REF_intern} = 450kHz		450		kHz
14.2	BW 3dB	Bandwidth, -3 dB	ISSBW = 1	70	80	90	kHz
14.3	BW 20dB	Bandwidth, -20 dB	ISSBW = 1	132	150	168	kHz
14.4	BW 3dB	Bandwidth, -3 dB	ISSBW = 0	106	120	135	kHz
14.5	BW 20dB	Bandwidth, -20 dB	ISSBW = 0	220	250	280	kHz
14.6	BW 3dB	Bandwidth weather band	WBON = 1	18	22	26	kHz
14.7	BW 20dB	-20dB weather band	WBON = 1	-	70	-	kHz
	Adjacent channel ISS filter threshold						
14.8	V_{THAC}	Internal low threshold	ACTH	-	2.75	-	V
14.9	V_{THAC}	Internal high threshold	ACTH	-	3.05	-	V
	Multipath threshold						
14.10	V_{THMP}	Internal low threshold	MPTH	-	0.50	-	V
14.11	V_{THMP}	Internal high threshold	MPTH	-	1.25	-	V
	ISS filter time constant						
14.12	$I_{30,31}$	Charge current low mid	TISS, BWDEF = 1	-89	-74	-59	µA
14.13	$I_{30,31}$	Charge current high mid	TISS, BWDEF = 1	-72	-60	-48	µA
14.14	$I_{30,31}$	Charge current low narrow	TISS, BWDEF = 1	-148	-124	-99	µA
14.15	$I_{30,31}$	Charge current high narrow	TISS, BWDEF = 1	-132	-110	-88	µA
14.16	$I_{30,31}$	Discharge current low	TISS, BWDEF = 0	0.5	1	1.5	µA

Table 6. FM section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
14.17	$I_{30,31}$	Discharge current high	TISS, BWDEF = 0	11	15	19	µA
14.18	$V_{30,31}$	Low voltage	BWDEF = 0	-	0.1	0.2	V
14.19	$V_{30,31}$	High voltage	BWDEF = 1	4.6	4.9	-	V
	ISS filter switch threshold						
14.20	$V_{30,31}$	Threshold ISS on	BWDEF = 0	-	3	-	V
14.21	$V_{30,31}$	Threshold ISS off	BWDEF = 0	-	1	-	V
14.22	$V_{30,31}$	Threshold ISS narrow on	BWDEF = 0	-	4	-	V
14.23	$V_{30,31}$	Threshold ISS narrow off	BWDEF = 0	-	2	-	V
	Deviation detection						
14.24	I_3	Charge current low	TDEV	-40	-32	-20	µA
14.25	I_3	Charge current high	TDEV	-48	-39	-30	µA
14.26	I_3	Discharge current low	TDEV	0.5	1	1.5	µA
14.27	I_3	Discharge current high	TDEV	5.5	8	10.5	µA
14.28	DEV_{WTH}	Internal low threshold	DWTH, I_3 = 1 µA	-	20	-	kHz
14.29	DEV_{WTH}	Internal high threshold	DWTH, I_3 = 1 µA	-	50	-	kHz
14.30	$RATIO_{min}$	Referred to threshold	DTH	-	1	-	
14.31	$RATIO_{max}$	Referred to threshold	DTH	-	1.5	-	
15. Weak signal mute							
15.1	V_{37}	Upper start point	WMTH = 0, WMD = 7, V_{IN}=V_{56}, AF = -3 dB	-	2.9	-	V
15.2	V_{37}	Lower start point	WMTH = 7, WMD = 7, V_{IN}=V_{56}, AF = -3 dB	-	2.7	-	V
15.3	a_{WMD}	Min. mute depth	WMD = 0, WMTH = 7, V_{56} =OFF	10	14	-	dB
15.4	a_{WMD}	Max. mute depth	WMD = 7, WMTH = 7, V_{56}=OFF	22	26	-	dB
15.5	a_{MTHISS}	Mute threshold below WMTH for ISS filter “ON”	WMD, WMTH, V_{IN}=V_{56}	-	1	-	dB
15.6	V_{ACMTH}	Internal AC mute threshold	ACMTH	40	-	260	mV
15.7	a_{ACMD}	AC mute depth	ACMD	3	-	8	dB
15.8	I_{42}	Charge current	-	-65	-47.5	-30	µA
15.9	I_{42}	Discharge current	-	1.5	2.5	4	µA
16. Multiplexer output							
16.1	V_{23}	Output voltage low	-	-	0.1	0.2	V
16.2	V_{23}	Output voltage high	-	4.6	4.9	-	V
16.3	R_{OUT}	Output resistance	-	200	250	300	Ω
16.4	R_{23load}	Load resistor	-	20	-	-	kΩ

3.3.3 AM section

T_{amb} = 25 °C, $V_{CC1} = V_{CC2} = V_{CCMIX1} = V_{CCVCO} = V_{CCIF}$ = 8.5 V, f_{Xtal} = 10.25 MHz, f_{RF} = 1 MHz, m = 30%, f_{mod} = 1 kHz, in application circuit, unless otherwise specified.

Table 7. AM section

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
17. Global							
17.1	V_{ANT_US}	Usable sensitivity (1)	(S+N)/N = 26 dB	-	19	25	dBµV
17.2	(S+N)/N	Signal to Noise Ratio	Ref.: V_3 = 80 dBµV	50	55	-	dB
17.3	a_{IF}	IF1 rejection	S/N = 26 dB, m = 30 %, f_{mod} = 1 kHz	70	80	-	dB
17.4	V_3	Min. RF AGC threshold	RFAGC	-	92	-	dBµV
17.5	V_3	Max. RF AGC threshold		-	104	-	dBµV
17.6	V_{61}	Min. IF AGC threshold	IFAGC	-	78	-	dBµV
17.7	V_{61}	Max. IF AGC threshold		-	102	-	dBµV
17.8	V_{56}	Min. DAGC threshold	DAGC	-	86	-	dBµV
17.9	V_{56}	Max. DAGC threshold		-	98	-	dBµV
18. AGC voltage driver output							
18.1	V_4	Max. AGC output voltage	-	3.3	3.5	-	V
18.2	V_4	Min. AGC output voltage	-	-	-	0.5	V
18.3	$\lvert I_4 \rvert$	AGC current	V_4 = 0 V, V_{54} = 3.5 V, LNA"00"	-	340	-	µA
19. AGC PIN diode driver output							
19.1	I_7	AGC driver current	-	-	-	-15	mA
20. AM Mixer1 (10.7 MHz)							
20.1	R_{IN}	Input resistance	differential	45	-	-	kΩ
20.2	C_{IN}	Input capacitance	differential	-	2.5	-	pF
20.3	R_{OUT}	Output impedance	-	530	660	790	Ω
20.4	CP_{1dB}	1dB compression point	referred to diff. mixer input	-	112	-	dBµV
20.5	$V_{3,6}$	Input DC bias	-	0.3	0.4	0.55	V
20.6	IIP3	3rd order intermodulation	-	-	132	-	dBµV
20.7	INOISE	Equivalent input noise	-	-	5.5	-	nV/√Hz
20.8	G	Gain	With 330 Ω filter	3	5.5	7	dB
21. AM mixer2							
21.1	R_{IN}	Input resistance	-	240	300	360	Ω
21.2	C_{IN}	Input capacitance	-	-	2.5	-	pF
21.3	$V_{55.56}$	DC input voltage	-	3.8	4	4.2	V
21.4	R_{OUT}	Output resistance	-	100	-	-	kΩ

Table 7. AM section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
21.5	C_{OUT}	Output capacitance	-	-	2.5	-	pF
21.6	$V_{52,53}$	DC output voltage	-	3.7	4.0	4.3	V
21.7	g_m	Conversion transconductance	MIX2OUT	-	440	-	µA/V
21.8	G_{max}	Max. gain	L = 560 µH, Q = 28; C = 180 pF, referred to MIX2OUT	-	26	-	dB
21.9	ΔG	Gain control range	-	-	20	-	dB
21.10	C_{step}	Min. cap. Step	IF2A	-	2.2	-	pF
21.11	C_{max}	Max. cap.	IF2A	-	33	-	pF
21.12	INOISE	Equivalent input noise voltage, including buffer mixer2	A_{max}, R_{gen}= 330 Ω, R_L = 2 kΩ, noise of R_{gen} not included	-	11	-	nV/√Hz
21.13	CP_{1dB}	1dB compression point	A_{max}, referred to 330 Ω input	-	114	-	dBµV
21.14	IIP3	3rd order Intermodulation	A_{max}, referred to 330 Ω input	-	132	-	dBµV
22. Buffer AM mixer2							
22.1	R_{OUT}	Output resistance	-	1.6	2	2.4	kΩ
22.2	C_{OUT}	Output capacitance	-	-	2.5	-	pF
22.3	V_{50}	DC output voltage	-	3.7	4.0	4.3	V
22.4	G	gain	R_L = 2 kΩ	-8	-6	-4	dB
23. AM IF2 amplifier							
23.1	R_{IN}	Input resistance	-	1.6	2	2.4	kΩ
23.2	C_{IN}	Input capacitance	-	-	2.5	-	pF
23.3	$V_{44,47}$	DC input voltage	-	4.1	4.3	4.5	V
23.4	G_{max}	Max. gain	-	49	52	55	dB
23.5	ΔG	Gain control range	-	36	38	40	dB
23.6	INOISE	Equivalent input noise voltage	G_{max}, R_{gen} = 2 kΩ, noise of R_{gen} not included	-	9.5	-	nV/√Hz
23.7	CP_{1dB}	1 dB compression point	G_{max}, referred to 2 kΩ input	-	74	-	dBµV
23.8	IIP3	3rd order Intermodulation	G_{max}, referred to 2 kΩ input	-	100	-	dBµV
23.9	V_{23}	IF2 output voltage	V_{56} = 90 dBV, m = off	140	190	240	mV_{RMS}
24. AMAGC2							
24.1	$V_{AGC(start)}$	AGC start voltage (PIN47)	Input carrier voltage	-	62	-	dBµV
24.2	ΔAGC	AGC2 range	Between start of AGC2 and the intervention point of prestage AGC	50	55	-	dB
24.3	g_{AGC}	Control slope	Seek mode	-	50	-	µA/V

Table 7. AM section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
24.4	g_{AGC}	Control slope	normal mode	-	5	-	µA/V
24.5	$\|I_{57}\|$	Max. AGC charge current	Seek mode	-	125	-	µA
24.6	$\|I_{57}\|$	Max. AGC charge current	normal mode	-	5	-	µA
24.7	V_{57}	Max. AGC output voltage	V_{47} = 100 dBµ	4.6	4.8	-	V
24.8	V_{57}	Min. AGC output voltage	V_{47} = 20 dBµ	-	0.2	0.5	V
25. AM audio output							
25.1	V_{43}	Audio output voltage	V_{56} = 90 dBµ, m = 30 %, f_{mod} = 1KHz	170	200	230	mV_{RMS}
25.2	THD	Total harmonic distortion	V_{56} = 90 dBµ, m = 30 %, f_{mod} = 1 kHz	-	0.3	0.5	%
25.3			V_{56} = 90 dBµ, m = 80%, f_{mod} = 1 kHz	-	0.5	0.9	
25.4	R_{OUT}	Output impedance	-	20	25	30	Ω
26. IF noise blanking							
26.1	t_{bl}	Min. blanking time	-	-	8	-	µs
26.2	t_{bl}	Max. blanking time	-	-	17	-	µs
26.3	V_{th}	Min internal threshold	-	-	50	-	mV
26.4	V_{th}	Max. internal threshold	-	-	187.5	-	mV
26.5	V_{thstep}	Threshold step	-	-	12.5	-	mV

1. Can be reached in application circuit, not measured.

3.3.4 Stereo decoder section

T_{amb} = 25 °C, $V_{CC1} = V_{CC2} = V_{CCMIX1} = V_{CCVCO} = V_{CCIF}$ = 8.5 V, f_{Xtal} = 10.25 MHz, V_{MPX} = 500 mV_{rms} mono, f = 1 kHz, de-emphasis τ = 50 µs, in application circuit, unless otherwise specified.

Table 8. Stereo decoder section

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
27. Stereo decoder							
27.1	V_{in}	MPX input level	-	-	0.5	0.93	V_{rms}
27.2			WBON = 1	-	0.05	0.06	
27.3	R_{in}	Input resistance	-	80	100	120	kΩ
27.4	G_{STD}	Stereo decoder gain	-	2	2.5	3	dB
27.5	G_{STDWB}	Stereo decoder gain	Weather band mode	23	26	27	dB
27.6	SVRR	Supply voltage ripple rejection	V_{ripple} = 100 mV, f = 1 kHz	-	60	-	dB

Table 8. Stereo decoder section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
27.7	A	channel separation	V_{MPX} = 500 mV_{rms} stereo, only L/R, ROC adjusted	35	40	-	dB
27.8	THD	Total harmonic distortion	-	-	0.02	0.3	%
27.9	(S+N)/N	Signal plus noise to noise ratio	A-weighted, 19 kHz notch	-	85	-	dB
28. Mono/stereo switch							
28.1	V_{PTHST1}	Pilot threshold voltage	for Stereo, PTH = 1	5	8	12	mV_{rms}
28.2	V_{PTHST0}	Pilot threshold voltage	for Stereo, PTH = 0	7	11	16	mV_{rms}
28.3	V_{PTHMO1}	Pilot threshold voltage	for Mono, PTH = 1	3.5	6	10	mV_{rms}
28.4	V_{PTHMO0}	Pilot threshold voltage	for Mono, PTH = 0	6	9	14	mV_{rms}
29. 19kHz PLL							
29.1	f_{lock}	Capture range	Pilot magnitude 20 mV_{rms} = 4 %	18.9	-	19.1	kHz
29.2	DP	Pilot deviation range	f_{pilot} = 19 kHz	4	-	30	%
30. De-emphasis and high cut							
30.1	t_{HC50}	De-emphasis time constant	DEEMP=0, High Cut OFF	45	50	55	µs
30.2	t_{HC75}	De-emphasis time constant	DEEMP = 1, High Cut OFF	67	75	83	µs
30.3	t_{HC50}	High cut time constant	DEEMP = 0, High Cut ON, V_{28}=0.1V	135	150	165	µs
30.4	t_{HC75}	High cut time constant	DEEMP= 1, High Cut ON, V_{28} = 0.1 V	200	225	250	µs
30.5	A_{Ammin}	Min. Attenuation in AM	Voutmax/Vout@ f = 3.5 kHz, DEEMP = 0, AMCF “111”	-	3.6	-	dB
30.6	A_{Ammax}	Max. Attenuation in AM	Voutmax/Vout@ f = 3.5 kHz, DEEMP= 0, AMCF “000”	-	8	-	dB
31. Stereo blend and high cut control							
31.1	LG_{min}	Min. level gain	LG	-0.3	0	0.3	dB
31.2	LG_{max}	Max. level gain	LG	7.75	8.25	8.75	dB
31.3	LG_{step}	Level gain step Resolution	-	0.25	0.55	0.85	dB
31.4	$VSBL_{min}$	Min. voltage for mono	SBC	24	29	34	$\%V_{REF1}$
31.5	$VSBL_{max}$	Max. voltage for mono	SBC	53	58	63	$\%V_{REF1}$
31.6	$VSBL_{step}$	Step resolution	SBC	3.5	4.2	5	$\%V_{REF1}$
31.7	$VHCH_{min}$	Min. voltage for no high cut	HCHT	37	42	47	$\%V_{REF1}$
31.8	$VHCH_{max}$	Max.voltage for no high cut	HCHT	61	66	71	$\%V_{REF1}$

Table 8. Stereo decoder section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
31.9	$VHCH_{step}$	Step resolution	HCHT	7	8	9	$\%V_{REF1}$
31.10	$VHCL_{min}$	Min. voltage for full high cut	HCLT	6	11	16	%VHCH
31.11	$VHCL_{max}$	Max. voltage for full high cut	HCLT	28	33	38	%VHCH
31.12	$VHCL_{step}$	Step resolution	HCLT	6.5	7.3	8.1	%VHCH
32. Carrier and harmonic suppression at the output							
32.1	a19	Pilot signal f = 19 kHz	-	45	50	-	dB
32.2	a38	Subcarrier f = 38 kHz	-	-	75	-	dB
32.3	a57	Subcarrier f = 57 kHz	-	-	62	-	dB
32.4	a76	Subcarrier f = 76 kHz	-	-	90	-	dB
33. Intermodulation (1)							
33.1	a2	f_{mod} = 10 kHz, f_{spur} =1 kHz	-	-	65	-	dB
33.2	a3	f_{mod} = 13 kHz, f_{spur} =1 kHz	-	-	75	-	dB
34. Traffic radio (2)							
34.1	a57	Signal f = 57 kHz	-	65	70	-	dB
35. SCA (3)							
35.1	a67	Signal f = 67 kHz	-	-	75	-	dB
36. ACI – adjacent channel interference (4)							
36.1	a114	Signal f = 114 kHz	-	-	95	-	dB
36.2	a190	Signal f = 190 kHz	-	-	84	-	dB
37. FM noise blanker							
37.1	V_{TRMIN}	Min. trigger threshold (5)	V_{PEAK}=0.8 V, NBLT “111”	-	147	-	mV_{OP}
37.2	V_{TRMAX}	Max. trigger threshold (5)	V_{PEAK}=0.8 V, NBLT “000”	-	280	-	mV_{OP}
37.3	$V_{TRNOISE}$	Min. noise controlled trigger threshold	V_{PEAK} = 1.5 V, NBCT “11”	-	450	-	mV_{OP}
37.4	$V_{TRNOISE}$	Max. noise controlled trigger threshold	V_{PEAK} = 1.5 V, NBCT “00”	-	1200	-	mV_{OP}
37.5	V_{PEAK}	Peak voltage	NBRR “00”, V_{MPX} = 0 mV	-	0.8	-	V
37.6	V_{PEAK}	Peak voltage	NBRR “00”, V_{MPX} = 50 mV, f = 150 kHz	-	1.9	-	V
37.7	V_{PEAK}	Peak voltage	NBRR “00”, V_{MPX} = 200 mV, f = 150 kHz	-	3.5	-	V
37.8	$V_{PEAKDEV}$	Min. deviation dependent peak voltage	V_{MPX} = 500 mV, NBDC = 11 (“OFF”)	-	0.8	-	V
37.9	$V_{PEAKDEV}$	Max. deviation dependent peak voltage	V_{MPX} = 500 mV, NBDC= 00	-	2.0	-	V

Table 8. Stereo decoder section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
37.10	V_{PEAKFS}	Min. fieldstrength controlled peak voltage	V_{MPX}=0mV, V_{LEVEL}<< V_{SBL} (fully mono), NBFC = 11 (“OFF”)	-	0.8	-	V
37.11	V_{PEAKFS}	Max. fieldstrength controlled peak voltage	V_{MPX}=0mV, V_{LEVEL}<< V_{SBL} (fully mono), NBFC = 00	-	2.0	-	V
37.12	T_S	Min. blanking time	Signal HOLDN in testmode, NBT = 00	-	38	-	µs
37.13	T_S	Max. blanking time	Signal HOLDN in testmode, NBT = 11	-	22	-	µs
37.14	SR_{PEAK}	Noise rectifier charge	Signal PEAK in testmode, NBPC =0	-	5	-	mV/µs
37.15	SR_{PEAK}	Noise rectifier charge	Signal PEAK in testmode, NBPC=1	-	12	-	mV/µs
37.16	$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=00	-	0.3	-	V/ms
37.17	$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=01	-	1.8	-	V/ms
37.18	$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=10	-	2.8	-	V/ms
37.19	$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=11	-	4	-	V/ms
37.20	V_{ADJMP}	Noise rectifier adjustment by multipath	Signal PEAK in testmode, V_{MPTC}=1V, NBSMP=0, NBMP=1, NBRR=01	-	3	-	V/ms
37.21	V_{ADJMP}	Noise rectifier adjustment by strong multipath influence	Signal PEAK in testmode, V_{MPTC} = 1V, NBSMP = 1, NBMP = 0, NBRR = 01	-	4	-	V/ms
37.22	V_{ADJMP}	Noise rectifier adjustment by multipath and strong multipath influence	Signal PEAK in testmode, V_{MPTC}=1 V, MBSMP=1, NBMP=1, NBRR=01	-	5.2	-	V/ms
38. Multipath detector							
38.1	G_{MP}	Min. multipath gain	MPG = 00	5	6	7	dB
38.2	G_{MP}	Max. multipath gain	MPG = 11	11	12	13	dB
38.3	G_{RECTMP}	Min. rectifier gain	MPRG = 01	-1	0	1	dB
38.4	G_{RECTMP}	Max. rectifier gain	MPRG = 11	5	7.6	9	dB
38.5	I_{CHMP}	Rectifier charge current	MPCC = 0	0.5	0.8	1.1	µA
38.6	I_{CHMP}	Rectifier charge current	MPCC = 1	0.2	0.4	0.7	µA
38.7	I_{DISMP}	Rectifier discharge current		0.5	1	-	mA
39. Quality detector							
39.1	a	Min. quality detector coefficient	QDC	0.5	0.6	0.7	-

Table 8. Stereo decoder section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
39.2	a	Max. quality detector coefficient	QDC	0.9	1.05	1.2	-
39.3	b	Min. quality noise gain	QNG	5	6	7	dB
39.4	b	Max. quality noise gain	QNG	13	15	17	dB

1. Intermodulation suppression

$$a2 = \frac{V_o(signal, @1\ kHz)}{V_o(spurious, @1\ kHz)}; fs = ((2 \times 10\ kHz) - 19\ kHz)$$

$$a3 = \frac{V_o(signal, @1\ kHz)}{V_o(spurious, @1\ kHz)}; fs = ((3 \times 13\ kHz) - 38\ kHz)$$

measured with: 91 % stereo signal; 9 % pilot signal; fm = 10 kHz or 13 kHz.

2. Traffic radio (V.F.) suppression

$$a57(V,W,F) = \frac{V_o(signal, @1\ kHz)}{V_o(spurious, @1\ kHz) \pm 23\ kHz}$$

measured with: 91% stereo signal; 9% pilot signal; fm=1 kHz; 5% sub carrier (f=57 kHz, fm=23 Hz AM, m=60 %)

3. SCA (subsidiary communications authorization)

$$a67 = \frac{V_o(signal, @1\ kHz)}{V_o(spurious, @9\ kHz)}; fs = ((2 \times 38\ kHz) - 67\ kHz)$$

measured with: 81 % mono signal; 9 % pilot signal; fm=1 kHz; 10 % SCA - sub carrier (f_S = 67 kHz, unmodulated)

4. ACI (adjacent channel interference)

$$a114 = \frac{V_o(signal, @1\ kHz)}{V_o(spurious, @4\ kHz)}; fs = (110\ kHz - (2 \times 38\ kHz))$$

$$a190 = \frac{V_o(signal, @1\ kHz)}{V_o(spurious, @4\ kHz)}; fs = (186\ kHz - (5 \times 38\ kHz))$$

measured with: 90 % mono signal; 9 % pilot signal; fm=1 kHz; 1% spurious signal (f_S = 110 kHz or 186 kHz, unmodulated)

5. All thresholds are measured in test mode at the quality output. The thresholds are calculated by V_{NBTH} - V_{PEAK}. V_{PEAK} can be adjusted by applying a 150 kHz sinewave at MPXIN.

3.3.5 PLL section

T_{amb} = 25 °C, $V_{CC1} = V_{CC2} = V_{CCMIX1} = V_{CCVCO} = V_{CCIF}$ = 8.5 V, f_{Xtal} = 10.25 MHz, V_{MPX} = 500 mV_{rms} mono, f = 1 kHz, de-emphasis τ = 50 µs, in application circuit, unless otherwise specified.

Table 9. PLL section

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
40. Voltage controlled oscillator (VCO)							
40.1	f_{VCOmin}	Min. VCO frequency	-	160	-	-	MHz
40.2	f_{VCOmax}	Max. VCO frequency	-	-	-	260	MHz
40.3	C/N	Carrier-to-noise-ratio	f_{VCO}= 200 MHz, Δf=1 kHz, B = 1 Hz, Q_{loaded}=60	-	80	-	dBc/$\sqrt{}$Hz
41. Crystal oscillator							
41.1	f_{xtal}	Crystal frequency	-	-	10.25	-	MHz
41.2	C/N	Carrier-to-noise-ratio	f_{xtal} =10.25 MHz, Δf=10 kHz	110	-	-	dBc/$\sqrt{}$Hz
41.3	V_{29}	Oscillator output voltage	-	-	400	-	mV_{rms}
41.4	C_{29-32}	Input capacitance	-	-	2.5	-	pF
41.5	C_{step}	Min. cap. Step	XTAL	-	0.75	-	pF
41.6	C_{max}	Max. cap.	XTAL	-	23.25	-	pF
41.7	Δf/f	Deviation versus V_{CC}	Δ V_{CC}=1 V	-	1.5	-	ppm/V
41.8	Δf/f	Deviation versus T	-40 °C<T<+85 °C	-	0.2	-	ppm/K
42. Charge pump current							
42.1	$-I_{20}$	Source current	V_{20} = 2.5 V	-	50	-	µA
42.2	I_{20}	Sink current		-	50	-	µA
42.3	$-I_{20}$	Source current	ICP, V_{20} = 2.5 V	-	550	-	µA
42.4	I_{20}	Sink current		-	500	-	µA
42.5	$-I_{20}$	Source current	ICP, V_{20} = 2.5 V	-	1	-	mA
42.6	I_{20}	Sink current		-	1	-	mA
42.7	$-I_{20}$	Source current		-	1.9	-	mA
42.8	I_{20}	Sink current		-	1.9	-	mA
43. Loop filter input/output							
43.1	$-I_{IN}$	Input leakage current	V_{IN} = GND: PD_{OUT} = Tristate	-0.1	-	0.1	µA
43.2	I_{IN}	Input leakage current	V_{IN} = VREF1 PD_{OUT} = Tristate	-0.1	-	0.1	µA
43.3	V_{OL}	Output voltage Low	I_{OUT} = -0.2 mA	-	0.05	0.5	V
43.4	V_{OH}	Output voltage High	I_{OUT} = 0.2 mA	V_{CCVCO}-0.5	V_{CCVCO}-0.05	-	V
43.5	I_{OUT}	Output current, sink	V_{OUT} = 1 V to V_{CCVCO}-1 V	-	-	10	mA
43.6	I_{OUT}	Output current, source	V_{OUT} = 1 V to V_{CCVCO}-1 V	-10	-	-	mA

Table 9. PLL section (continued)

Item	Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
44. Output of tuning voltage (TV)							
44.1	V_{OUT}	Output voltage	-	0.5	-	V_{VCO}-0.5	V
44.2	$\|V_{step}\|$	Min. voltage step	TVO	-	25	-	mV
44.3	$\|V_{max}\|$	Max. voltage offset	TVO	-	3175	-	mV
44.4	ΔV	Additional offset voltage	TVM=1, TVO+	-	3.175	-	V
44.5	R_{OUT}	Output impedance	TVM=0	-	40	-	kΩ
44.6	R_{OUT}	Output impedance	TVM=1	-	20	-	kΩ
45. SSTOP output (open collector)							
45.1	V_{24}	Output voltage low	I_{24} = -200 µA	-	0.2	0.5	V
45.2	V_{24}	Output voltage high	-	-	-	5	V
45.3	$-I_{24}$	Output leakage current	V_{24} = 5 V	-0.1	-	0.1	µA
45.4	I_{24}	Output current, sink	V_{24} = 0.5 V to 5 V		-	1	mA
45.5	V_{37SSTH}	Internal unfiltered field strength threshold for SSTOP=HIGH	SSTH, FMON=1	2.6	-	4.1	V
45.6	V_{27SSTH}	Internal unfiltered field strength threshold for SSTOP=HIGH	SSTH, FMON=0 SL = “011”	1.2	-	4.8	V
46. Switch output							
46.1	V_{OL}	Output Voltage low	SWM”1”,SW”0”, I_{24} = -5 µA	-	0.35	0.5	V
46.2	V_{OH}	Output Voltage high	SWM”1”,SW”1”	-	V_{CC}-1	-	V
46.3	$-I_{22}$	Output leakage current	V_{22}=5 V	-0.5	-	0.5	µA
46.4	I_{22}	Output Current, sink	-	-	-	7	mA
46.5	V_{OL}	Output Voltage low	SWM”0”,SW”0”, I_{22}=0 µA	-	0.1	0.3	V
46.6	V_{OH}	Output Voltage high	SWM”0”,SW”1”, I_{22}=1 mA	-	V_{CC}-1	-	V
46.7	I_{22}	Output Current, sink	V_{22}=5 V	-7	-	-	mA