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TDA7540N

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

Features

FM-part

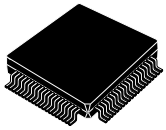
- RF AGC generation by RF and IF detection
- I/Q mixer for 1st FM IF 10.7MHz with image rejection
- Mixer for 2nd IF 450kHz
- Internal 450KHz bandpass filter with bandwidth control by ISS
- Fully integrated FM-demodulator with spike cancellation

AM-part

- Wide and narrow AGC generation
- Mixer for 1st IF 10.7MHz, AM upconversion
- Mixer for 2nd IF 450kHz, AM downconversion
- Integrated AM-demodulator
- AM IF- and audio noise blanking

Stereodecoder

- 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
- Internal noise blanker with several threshold controls



LQFP80

Additional features

- VCO for world tuning range
- 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
- All functions I^2C-Bus controlled

Description

The TDA7540N is a high performance tuner circuit for AM/FM car radio. It contains mixer, IF amplifier, demodulator for AM and FM, stereodecoder, 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	Temp range, °C	Package	Packing
TDA7540N	-40 to 85°C	LQFP80 (14x14x1.4mm)	Tube
TDA7540NTR	-40 to 85°C	LQFP80 (14x14x1.4mm)	Tape and reel

Contents

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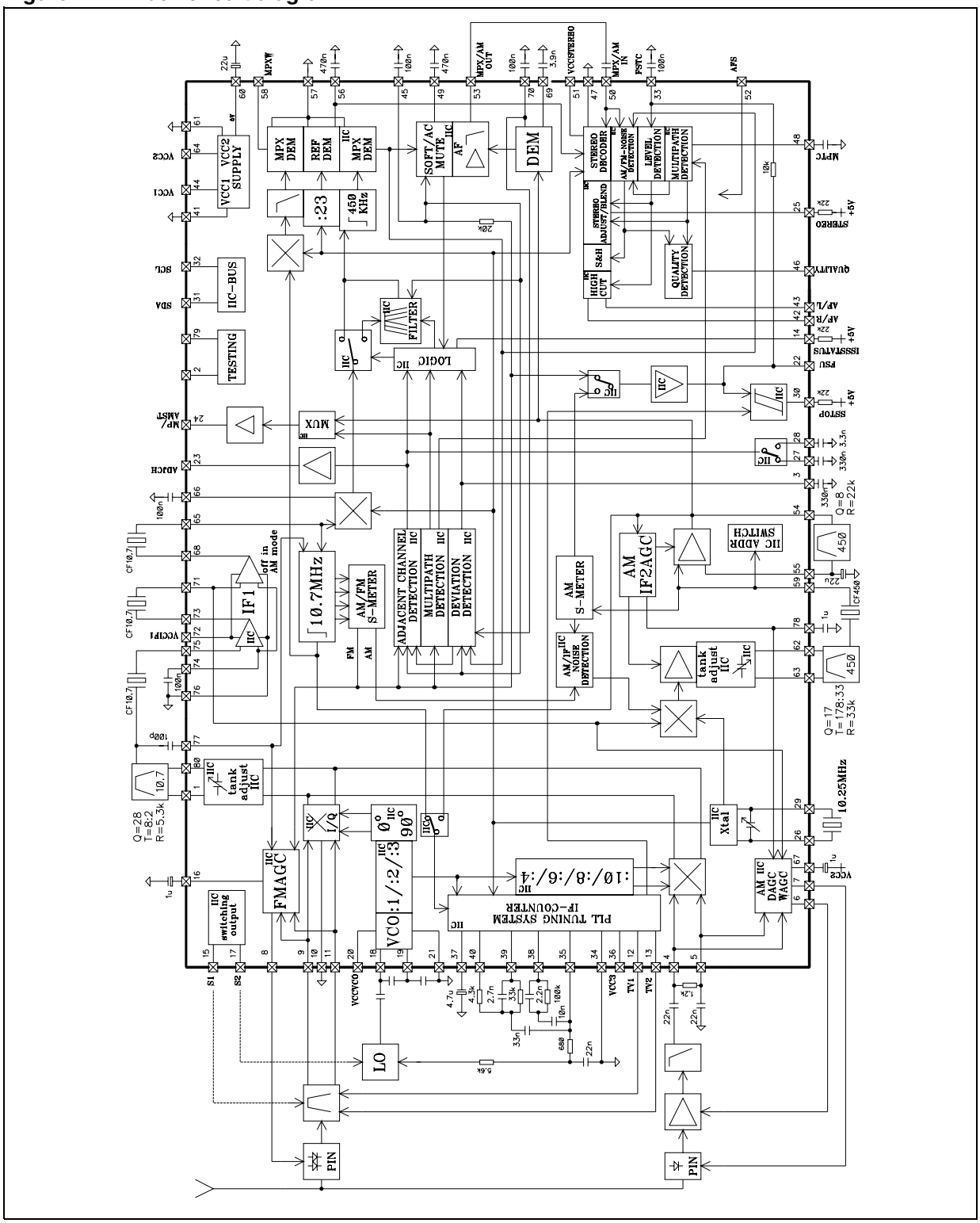
1 Block diagram

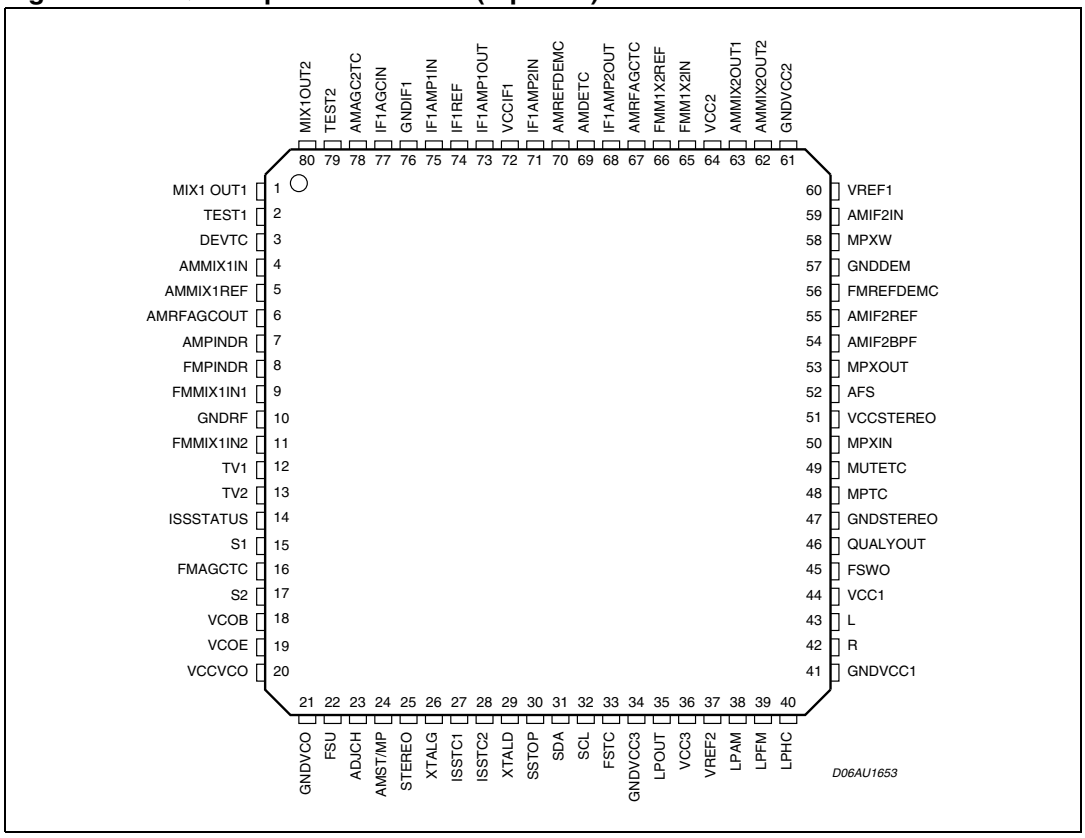
Figure 1. Block circuit diagram



2 Pins description and connection diagrams

2.1 LQFP80 pins connection diagram

Figure 2. LQFP80 pins connection (top view)



2.2 Pin description

Table 2. Pin description

Pin #	Pin name	Function
1	MIX1OUT1	Mixer tank 10.7MHz
2	TEST1	Testing I/O pin
3	DEVTC	Deviation detector time constant
4	AMMIX1IN	AM mixer1 input
5	AMMIX1REF	AM mixer1 reference
6	AMRFAGCOUT	Output AM RF AGC
7	AMPINDR	AM pin diode driver output
8	FMPINDR	FM pin diode driver output
9	FMMIX1IN1	FM mixer1 input1

Table 2. Pin description (continued)

Pin #	Pin name	Function
10	GNDRF	RF ground
11	FMMIX1IN2	FM mixer1 input2
12	TV1	Tuning voltage preselection1
13	TV2	Tuning voltage preselection2
14	ISSSTATUS	ISS filter status output
15	S1	Free programmable switching output
16	FMAGCTC	FM AGC time constant
17	S2	Free programmable switching output
18	VCOB	VCO input base
19	VCOE	VCO output emitter
20	VCCVCO	VCO supply
21	GNDVCO	VCO ground
22	FSU	Unweighted fieldstrength output
23	ADJCH	Ident. adjacent channel output
24	AMST/MP	AM stereo output / ident. multipath output
25	STEREO	Stereo information indication output
26	XTALG	Xtal oscillator to MOS gate
27	ISSTC1	Time constant1 ISS filter switch
28	ISSTC2	Time constant2 ISS filter switch
29	XTALD	Xtal oscillator to MOS drain
30	SSTOP	Search stop output
31	SDA	I^2C-Bus data
32	SCL	I^2C-Bus clock
33	FSTC	S-meter filtering capacitor
34	GNDVCC3	VCC3 ground
35	LPOUT	Op amp output to PLL loop filters
36	VCC3	Supply tuning voltage
37	VREF2	Voltage reference for PLL op amp
38	LPAM	Op amp input to PLL loop filters AM
39	LPFM	Op amp input to PLL loop filters FM
40	LPHC	High current PLL loop filter input
41	GNDVCC1	Digital ground
42	R	Stereodecoder output right
43	L	Stereodecoder output left
44	VCC1	Digital supply
45	FSWO	Weighted fieldstrength output with programmable DC offset
46	Qualyout	Stereodecoder quality output

Table 2. Pin description (continued)

Pin #	Pin name	Function
47	GNDSTEREO	Strereodecoder ground
48	MPTC	Multipath time constant
49	MUTETC	Weak signal mute time constant
50	MPXIN	Stereodecoder Input
51	VCCSTEREO	Stereodecoder supply
52	AFS	Alternative frequency search drive
53	MPX/AFAM	MPX output / AM AF output
54	AMIF2BPF	AM IF2 bandpass filter
55	AMIF2REF	Reference voltage AM IF2 amplifier
56	FMREFDEMC	FM demodulator reference
57	GNDDEM	Ground FM demodulator
58	MPXW	MPX Output without ISS filtering
59	AMIF2IN	Input AM IF2
60	VREF1	Reference 5V
61	GNDVCC2	Analog ground
62	AMMIX2OUT2	AM Tank 450kHz
63	AMMIX2OUT1	AM Tank 450kHz
64	VCC2	Analog supply
65	FMMIX2IN	FM IF1 mixer2 input
66	FMMIX2REF	FM IF1 mixer2 reference
67	AMRFAGCTC	AM RF AGC time constant
68	IF1AMP2OUT	IF1 amplifier2 output
69	AMDETC	AM detector capacitor
70	AMREFDEMC	AM demodulator reference
71	IF1AMP2IN	IF1 amplifier2 input
72	VCCIF1	IF1 supply
73	IF1AMP1OUT	IF1 amplifier1 output
74	IF1REF	IF1 amplifier reference
75	IF1AMP1IN	IF1 amplifier1 input
76	GNDIF1	IF1 ground
77	IF1AGCIN	IF1 AGC input
78	AMAGC2TC	AM AGC2 time constant
79	TEST2	Testing I/O pin
80	MIX1OUT2	Mixer tank 10.7MHz

3 Electrical specifications

3.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Units
V_S	Supply voltage	9.5	V
T_{amb}	Ambient temperature	-40 to 85	°C
T_{stg}	Storage temperature	-55 to 150	°C

3.2 Thermal data

Table 4. Thermal data

Symbol	Parameter		Value	Unit
$R_{th(j\text{-}amb)}$	Thermal resistance junction to ambient	Max.	55	°C/W

3.3 Electrical characteristics

3.3.1 Globals

Table 5. Globals electrical characteristics

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} =8.5V, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Supply						
V_{CC1}	Digital supply voltage		7.7	8.5	9	V
V_{CC2}	Analog supply voltage		7.7	8.5	9	V
V_{CC3}	Analog tuning voltage		7.7	8.5	9	V
V_{CCVCO}	VCO supply voltage		7.7	8.5	9	V
V_{CCMIX1}	MIX1 supply voltage		7.7	8.5	9	V
V_{CCMIX2}	MIX2 supply voltage		7.7	8.5	9	V
V_{CCIF1}	IF1 supply voltage		7.7	8.5	9	V
V_{CCST}	Stereo supply voltage		7.7	8.5	9	V
I_{CC1}	Supply current	FM ON		10	12	mA
I_{CC1}	Supply current	AM ON		10	12	mA
I_{CC2}	Supply current	FM ON / VCO:3		65	78	mA
I_{CC2}	Supply current	AM ON		75	90	mA

Table 5. Globals electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} =8.5V, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I_{CC3}	Supply current			2	3	mA
I_{CCVCO}	Supply current			8	10	mA
I_{CCMIX1}	Supply current	FM ON		8	10	mA
I_{CCMIX1}	Supply current	AM ON		7	8.5	mA
I_{CCMIX2}	Supply current	AM ON		7	8.5	mA
I_{CCIF1}	Supply current			5	6.5	mA
I_{CCST}	Supply current			12	13.5	mA
Reference voltages						
V_{REF1}	Internal reference voltage	I_{REF1} = 0mA	4.8	5	5.2	V
V_{REF2}	Internal reference voltage	I_{REF2} = 0mA	2.4	2.5	2.6	V
I^2C-Bus interface						
f_{SCL}	Clock frequency				400	kHz
V_{IL}	Input low voltage				1	V
V_{IH}	Input high voltage		3		5	V
I_{IN}	Input current		-5		5	µA
V_O	Output acknowledge voltage	I_O = 1.6mA			0.4	V

3.3.2 FM section

Table 6. FM section electrical characteristics

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, dev= 40kHz, f_{MOD} = 1kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Wide band RF AGC						
V_{9-11}	Lower threshold start	V_{16} = 2.5V	83	85	87	dBµV
V_{9-11}	Upper threshold start	V_{16} = 2.5V	94	96	98	dBµV
Narrow band IF & keying AGC						
V_{77}	Lower threshold start	KAGC = off, V_{9-11} = 0mV_{RMS}	84	86	88	dBµV
V_{77}	Upper threshold start	KAGC = off, V_{9-11} = 0mV_{RMS}	96	98	100	dBµV
V_{77}	Lower threshold start with KAGC	KAGC = max, V_{9-11} = 0mV_{RMS}, Δf_{IF}=300KHz	96	98	100	dBµV

Table 6. FM section electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, dev= 40kHz, f_{MOD} = 1kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{22}	Startpoint KAGC	KAGC = max, $V_{9\text{-}11}$ = 0mV_{RMS}, Δf_{IF}=300KHz f_{IF1} generates FS level at V_{22}		2.2		V
Δ	Control range KAGC	ΔV_{22}= +0.8V		16		dB
R_{IN}	Input resistance		10	13	16	kΩ
C_{IN}	Input capacitance			2.5		pF
AGC time constant output						
V_{16}	Max. AGC output voltage	$V_{9\text{-}11}$ = 0mV_{RMS}			V_{REF1} +V_{BE}	V
V_{16}	Min. AGC output voltage	$V_{9\text{-}11}$ = 50mV_{RMS}			0.5	V
I_{16}	Min. AGC charge current	$V_{9\text{-}11}$ = 0mV_{RMS},V_{16} = 2.5V	-16.5	-12.5	-8.5	µA
I_{16}	Max. AGC discharge current	$V_{9\text{-}11}$ = 50mV_{RMS},V_{16} = 2.5V	0.8	1.25	1.68	mA
AGC pin diode driver output						
I_8	AGC OUT, current min.	$V_{9\text{-}11}$ = 0mV_{RMS}, V_8 = 2.5V		12		µA
I_8	AGC OUT, current max.	$V_{9\text{-}11}$ = 50 mV_{RMS}, V_8 = 2.5V	-22	-17	-12	mA
I/Q Mixer1 (10.7MHz)						
R_{IN}	Input resistance	differential		10		kΩ
C_{IN}	Input capacitance	differential		4		pF
R_{OUT}	Output resistance	differential	100			kΩ
$V_{9,11}$	Input DC bias		2.2	2.5	2.8	V
g_m	Conversion transconductance			17		ms
F	Noise figure	400Ω generator resistance		3		dB
CP_{1dB}	1dB compression point	referred to diff. mixer input		100		dBµV
IIP3	3rd order intermodulation			122		dBµV
IQP	I/Q phase adjust	PH	-7		+8	°
IRR	Image rejection ratio	ratio wanted/image	30	40		dB
IRR	Image rejection ratio	with phase adjust	40	46		dB
IF1 Amplifier1 +2 (10.7MHz)						
G2	Gain		5	6	7	dB
$G1_{min}$	Min. gain	IFG1	7.5	9	10.5	dB
$G1_{max}$	Max. gain	IFG1	16	18	20	dB

Table 6. FM section electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, dev= 40kHz, f_{MOD} = 1kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
R_{IN}	Input resistance		260	330	400	W
R_{OUT}	Output resistance		260	330	400	W
CP_{1dB}	1dB compression point	referred to 330Ω input		105		dBµV
IIP3	3rd order Intermodulation	ref. to 330Ω input, 9dB gain		126		dBµV
Mixer2 (450kHz)						
R_{IN}	Input impedance		260	330	400	Ω
V_{65}	Max. input voltage			119		dBµV
V_{65}	Limiting sensitivity	S/N = 20dB		28		dBµV
G	Mixer gain			18		dB
Limiter 1 (450kHz)						
$G_{Limiter}$	Gain			80		dB
Demodulator, audio output						
THD		Dev.= 75kHz, V_{65}= 10mV_{RMS}			0.1	%
V_{MPX}	MPX output signal	Dev.= 75kHz	400	500	600	mV_{RMS}
R_{OUT}	Output impedance			50		Ω
$\|\Delta V\|_{min}$	DC offset fine adjust	DEM, MENA=1		8.5		mV
$\|\Delta V\|_{max}$	DC offset fine adjust	DEM, MENA=1		264		mV
S/N		Dev.= 40kHz,V_{65} = 10mV_{RMS}		76		dB
V_{MPXW}	MPXW output signal	Dev.= 75kHz	280	350	420	mV_{RMS}
Quality detection						
S-meter, unweighted fieldstrength						
V_{65}	Min. input voltage MIX2			30		dBµV
V_{22}	Fieldstrength output	V_{65} = 20dBµV		0.1		V
V_{22}	Fieldstrength output	V_{65} = 80dBµV, SMSL = 0	2.2	2.6	3.0	V
ΔV_{22}	Voltage per decade	SMSL = 0	0.8	1	1.2	V
ΔV_{22}	Voltage per decade	SMSL = 1	1.2	1.5	1.8	V
ΔV_{22}	S-meter offset	SL, SMSL=1	-15		15	dB
R_{OUT}	Output impedance		280	400	520	Ω
T_K	Coefficient temperature			0		ppm/K

Table 6. FM section electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, dev= 40kHz, f_{MOD} = 1kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Adjacent channel gain						
G_{min}	Gain minimum	ACG=0		32		dB
G_{max}	Gain maximum	ACG=1		38		dB
Adjacent channel filter						
f_{HP}	-3dB frequency highpass	ACF=0		100		kHz
f_{BP}	Centre frequency	ACF=1		100		kHz
f_{-20dB}	Attenuation 20dB			70		kHz
Adjacent channel output						
V_{23}	Output voltage low			0.1		V
V_{23}	Output voltage high			4.9		V
R_{OUT}	Output resistance		3.5	4.5	5.5	kΩ
Multipath channel gain						
G_{min}	Gain minimum	MPG=0		12		dB
G_{max}	Gain maximum	MPG=1		23		dB
Multipath bandpass filter						
f_{BP19}	Centre frequency	MPF=0		19		kHz
f_{BP31}	Centre frequency	MPF=1		31		kHz
Q	Quality factor		5	8	10	
Multipath output						
V_{24}	Output voltage low			0.1		V
V_{24}	Output voltage high			4.9		V
R_{OUT}	Output resistance			3		kΩ
ISS (intelligent Selectivity System)						
Filter 450kHz						
f_{centre}	Centre frequency	f_{REF_intern} = 450kHz		450		kHz
BW 3dB	Bandwidth, -3dB	ISS80 = 1	70	80	90	kHz
BW 20dB	Bandwidth, -20dB	ISS80 = 1	132	150	168	kHz
BW 3dB	Bandwidth, -3dB	ISS80 = 0	106	120	135	kHz
BW 20dB	Bandwidth, -20dB	ISS80 = 0	220	250	280	kHz
BW 3dB	Bandwidth weather band	ISS30 = 1	20	30	40	kHz
BW 20dB	-20dB weather band	ISS30 = 1	56	80	104	kHz

Table 6. FM section electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, dev= 40kHz, f_{MOD} = 1kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Adjacent channel ISS filter threshold						
V_{NTH}	Internal low threshold	ACNTH		0		V
V_{NTH}	Internal high threshold	ACNTH	0.24	0.3	0.36	V
V_{WTH}	Internal low threshold	ACWTH	0.2	0.25	0.3	V
V_{WTH}	Internal high threshold	ACWTH	0.76	0.95	1.14	V
Multipath threshold						
V_{THMP}	Internal low threshold	MPTH	0.40	0.50	0.60	V
V_{THMP}	Internal high threshold	MPTH	1.0	1.25	1.5	V
ISS filter time constant						
I_{27},I_{28}	Charge current low mid	TISS, ISSCTL = 1	-96	-74	-54	µA
I_{27},I_{28}	Charge current high mid	TISS, ISSCTL = 1		-60		µA
I_{27},I_{28}	Charge current low narrow	TISS, ISSCTL = 1	-165	-124	-87	µA
I_{27},I_{28}	Charge current high narrow	TISS, ISSCTL = 1		-110		µA
I_{27},I_{28}	Discharge current low	TISS, ISSCTL = 0	-0.4	1	2.0	µA
I_{27},I_{28}	Discharge current high	TISS, ISSCTL = 0	10	15	20	µA
V_{27},V_{28}	Low voltage	ISSCTL = 0		0.1	0.2	V
V_{27},V_{28}	High voltage	ISSCTL = 1	4.6	4.9		V
ISS filter switch threshold						
V_{27},V_{28}	Threshold ISS on	ISSCTL = 0		3		V
V_{27},V_{28}	Threshold ISS off	ISSCTL = 0		1		V
V_{27},V_{28}	Threshold ISS narrow on	ISSCTL = 0		4		V
V_{27},V_{28}	Threshold ISS narrow off	ISSCTL = 0		2		V
I_3	Charge current low	TDEV	-20	-32	-40	µA
I_3	Charge current high	TDEV	-30	-39	-48	µA
I_3	Discharge current low	TDEV	0.5	1	1.5	µA
I_3	Discharge current high	TDEV	5.5	8	10.5	µA
DEV_{WTH}	Internal low threshold	DWTH		30		kHz
DEV_{WTH}	Internal high threshold	DWTH		75		kHz
$RATIO_{min}$	Referred to threshold	DTH		1		
$RATIO_{max}$	Referred to threshold	DTH		1.5		

Table 6. FM section electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, dev= 40kHz, f_{MOD} = 1kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Softmute						
V_{ANT}	Upper startpoint	SMTH, SMD, SLOPE = 0		10		dBµV
V_{ANT}	lower startpoint	SMTH, SMD, SLOPE = 0		3		dBµV
a_{SMmin}	Min. softmute depth	SMD, SLOPE = 0, $SMTH_{Upper}$		18		dB
a_{SMmax}	Max. softmute depth	SMD, SLOPE = 0, $SMTH_{Upper}$		36		dB
$a_{SMTHISS}$	Mute depth threshold for ISS filter on	SMCTH	0.2	1	2	dB
V_{ACTH}	Internal AC mute threshold	ACM	60		340	mV
a_{SMAC}	AC mute depth	ACMD	4		10	dB
I_{49}	Charge current		-65	-47.5	-30	µA
I_{49}	Discharge current		1.5	2.5	4.0	µA
S/N MPX						
(S+N)/N		V_{ANT} = 60dBµV, dev.= 40kHz,LP=15KHz deemphasis t = 50µs	66	69		dB

3.3.3 AM section

Table 7. AM section electrical characteristics

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, m= 30%, f_{MOD} = 400kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Global						
V_{ANT_us}	Usable sensitivity	(S+N)/N = 26 dB	25	19		dBµV
ΔV_{ANT}	IF2 AGC Range	Ref.: V_{INRF} = 60dBµV,	50	52		dB
(S+N)/N	Signal to Noise Ratio	Ref.: V_{INRF} = 60dBµV	50	55		dB
a_{IF}	IF rejection	Ref: V_{INRF} = 60dBµV, IF = 10.7MHz	70	80		dB
f_{AF}	Frequency response	Ref.: V_{INRF} = 60dBµV, ΔV_{AF} = -3 dB		3.6		kHz
THD	Total Harmonic Distortion	V_{INRF} = 60dBµV, m = 0.8 m = 0.3 V_{INRF} = 120dBµV, m = 0.8 m = 0.3		0.5 0.3 1.0 0.3		%
V_{53}	AF output level	V_{INRF} = 60dBµV	160	180	200	mV_{RMS}

Table 7. AM section electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, m= 30%, f_{MOD} = 400kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{24}	IF output level	V_{INRF} = 60dBµV, m=off		190		mV_{RMS}
V_4	Min. RF AGC threshold Max. RF AGC threshold	WAGC		97 109		dBµV dBµV
V_{71}	Min. IF AGC threshold Max. IF AGC threshold	WAGC		96.5 109		dBµV dBµV
V_{71}	Min. DAGC threshold Max. DAGC threshold	DAGC		74 96		dBµV dBµV
$I I_{78max} I$	AGC2 charge current	seek	80	100	120	µA
CCR	Charge current ratio	seek/seek off		30		
AGC voltage driver output						
V_6	Max. AGC output voltage		3.5			V
V_6	Min. AGC output voltage				0.5	V
$I I_6 I$	AGC current			100		µA
AGC pin diode driver output						
I_7	AGC driver current		-2.6	-2	-1.4	mA
AM Mixer1 (10.7MHz)						
R_{IN}	Input resistance	differential	100			kΩ
C_{IN}	Input capacitance	differential		4		pF
R_{OUT}	Output impedance	differential	100			kΩ
CP_{1dB}	1dB compression point	referred to diff. mixer input		112		dBµV
IIP3	3rd order intermodulation			132		dBµV
F	Noise figure			8		dB
A	Gain			26		dB
C_{min}	Min. capacitance step	IF1T		0.55		pF
C_{max}	Max. capacitance	IF1T		8.25		pF
C_{1-80}		IF1T		2		pF
AM Mixer2 (450kHz)						
R_{71}	Input resistance		260	330	400	W
C_{71}	Input capacitance			2.5		pF
CP_{1dB}	1dB compression point	referred to diff. mixer input		120		dBµV
IIP3	3rd order intermodulation			132		dBµV
F	Noise figure			12		dB

Table 7. AM section electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, m= 30%, f_{MOD} = 400kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
A	Max. gain	Mixer2 tank output		34		dB
ΔA	Gain control range			20		dB
C_{min}	Min. cap step	IF2T		1.6		pF
C_{max}	Max. cap	IF2T		24		pF
C_{62-63}		IF2T		2		pF
IF noise blanking						
t_{bl}	Min. blanking time			8		µs
t_{bl}	Max. blanking time			17		µs
V_{th}	Min internal threshold		10	12.5	15	mV
V_{th}	Max. internal threshold		150	187.5	225	mV
V_{thstep}	Threshold step		10	12.5	15	mV
V_{desth}	Min. desensitivity threshold		2.9	3.2	3.5	V
V_{desth}	Max. desensitivity threshold		3.6	4	4.4	V

3.3.4 Stereodecoder

Table 8. Stereodecoder electrical characteristics

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, V_{MPX} = 500mV_{rms} mono, f = 1kHz, deemphasis = 50µs, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Stereodecoder						
V_{in}	MPX input level	STD Gain = 2.5 dB		0.5	0.93	V_{rms}
R_{in}	Input resistance		70	100	130	kΩ
G_{min}	Min. Stereodecoder gain		-0.5	0	0.5	dB
G_{max}	Max. Stereodecoder gain		3.15	3.75	4.35	dB
G_{step}	Stereodecoder gain step resolution		1	1.25	1.5	dB
SVRR	Supply voltage ripple rejection	V_{ripple} = 100mV, f = 1kHz	54	60		dB
a	Max. channel separation	V_{MPX} = 500mV_{rms} stereo only L/R		50		dB
THD	Total harmonic distortion			0.02	0.3	%
(S+N)/N	Signal plus Noise to Noise ratio	A-weighted, 19kHz notch		85		dB

Table 8. Stereodecoder electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, V_{MPX} = 500mV_{rms} mono, f = 1kHz, deemphasis = 50µs, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{puafs}	Pull up voltage for AFS pin		3.1	3.3	3.5	V
R_{puafs}	Pull up resistor for AFS pin			25		kΩ
V_{TH1}	1. threshold for AFS PIN		2.2	2.4	2.6	V
V_{TH2}	2. threshold for AFS PIN		0.6	0.8	1.0	V
Mono/stereo-switch						
V_{PTHST1}	Pilot threshold voltage	for Mono->Stereo, PTH = 1	6	10	15	mV_{rms}
V_{PTHST0}	Pilot threshold voltage	for Mono->Stereo, PTH = 0	10	14	19	mV_{rms}
V_{PTHMO1}	Pilot threshold voltage	for Stereo->Mono, PTH = 1	4	8	12	mV_{rms}
V_{PTHMO0}	Pilot threshold voltage	for Stereo->Mono, PTH = 0	7	12	16	mV_{rms}
19kHz PLL						
f_{lock}	PLL lock range	Pilot magnitude 20 mV_{rms} = 4%	18.9		19.1	kHz
DP	Pilot deviation	Pilot frequency 19kHz	4		30	%
Deemphasis- and highcut						
t_{HC50}	Deemphasis time constant	DEEMP = 0, DESFT = 1 V_{LEVEL} >> V_{HCH}		50		µs
t_{HC75}	Deemphasis time constant	DEEMP = 1, DESFT = 1 V_{LEVEL} >> V_{HCH}		75		µs
t_{HC25}	Deemphasis time constant	DEEMP = 0, DESFT = 0 V_{LEVEL} >> V_{HCH}		25		µs
t_{HC37}	Deemphasis time constant	DEEMP = 1, DESFT = 0 V_{LEVEL} >> V_{HCH}		37.5		µs
t_{HC50}	Highcut time constant	DEEMP = 0, DESFT = 1 V_{LEVEL} << V_{HCL}		150		µs
t_{HC75}	Highcut time constant	DEEMP= 1, DESFT = 1 V_{LEVEL} << V_{HCL}		225		µs
F_{AMCMin}	Min. AM corner frequency	DEEMP = 0, DESFT = 1 AMCF		1.06		kHz
F_{AMCMin}	Max. AM corner frequency	DEEMP = 0, DESFT = 1 AMCF		3.18		kHz
Stereoblend- and highcut-control						
L_{Gmin}	Min. level gain	LG	-0.5	0	0.5	dB
L_{Gmax}	Max. level gain	LG	4.0	4.7	5.2	dB
L_{Gstep}	Level gain step resolution	LG	0.4	0.67	0.9	dB

Table 8. Stereodecoder electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, V_{MPX} = 500mV_{rms} mono, f = 1kHz, deemphasis = 50µs, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$VSBL_{min}$	Min. voltage for mono	SBC		29	33	%V_{REF1}
$VSBL_{max}$	Max. voltage for mono	SBC	54	58		%V_{REF1}
$VSBL_{step}$	Step resolution	SBC		4.2		%V_{REF1}
$VHCH_{min}$	Min. voltage for no highcut	VHCH		42	46	%V_{REF1}
$VHCH_{max}$	Max. Voltage for no highcut	VHCH	61	66		%V_{REF1}
$VHCH_{step}$	Step resolution	VHCH		8		%V_{REF1}
$VHCL_{min}$	Min. voltage for full high cut	VHCL, MAXHC = 11		11	15	%VHCH
$VHCL_{max}$	Max. voltage for full high cut	VHCL, MAXHC = 11	31	33		%VHCH
$VHCL_{step}$	Step resolution	VHCL, MAXHC = 11		7.3		%VHCH
Carrier and harmonic suppression at the output						
a19	Pilot signal f=19kHz	V_{pilot} = 50mV_{rms}		50		dB
a38	Subcarrier f=38kHz			75		dB
a57	Subcarrier f=57kHz			62		dB
a76	Subcarrier f=76kHz			90		dB
Intermodulation(1)						
a2	f_{mod}=10kHz, f_{spur}=1kHz			65		dB
a3	f_{mod}=13kHz, f_{spur}=1kHz			75		dB
Traffic radio(2)						
a57	Signal f=57kHz			70		dB
SCA - Subsidiary communications authorization(3)						
a67	Signal f=67kHz			75		dB
ACI - adjacent channel interference(4)						
a114	Signal f=114kHz			95		dB
a190	Signal f=190kHz			84		dB
FM noise blanker						
V_{TRMIN}	Min. trigger threshold (5)	V_{PEAK}=0.8V, NBLTH		147		mV_{OP}
V_{TRMAX}	Max. trigger threshold (5)	V_{PEAK}=0.8V, NBLTH		280		mV_{OP}
V_{TRSTEP}	Trigger threshold step0)			19		mV_{OP}
$V_{TRNOISE}$	Min. noise controlled trigger threshold(5)	V_{PEAK}=1.5V, NBCTH		450		mV_{OP}
$V_{TRNOISE}$	Max. noise controlled trigger threshold(5)	V_{PEAK}=1.5V, NBCTH		1200		mV_{OP}

Table 8. Stereodecoder electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, V_{MPX} = 500mV_{rms} mono, f = 1kHz, deemphasis = 50µs, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{PEAK}	Peak voltage	NBRR = 00, V_{MPX}=0mV	0.5	0.8	1.0	V
V_{PEAK}	Peak voltage	V_{MPX}=50mV, f=150kHz	1.6	1.9	2.1	V
V_{PEAK}	Peak voltage	V_{MPX}=200mV, f=150kHz	2.2	2.5	2.7	V
$V_{PEAKDEV}$	Min. deviation dependent peak voltage	V_{MPX}=500mV, NBDTH = 11	0.5	0.8 (off)	1.0	V_{OP}
$V_{PEAKDEV}$	Max. deviation dependent peak voltage	V_{MPX}=500mV, NBDTH= 00	1.7	2.0	2.2	V_{OP}
V_{PEAKFS}	Min. fieldstrength controlled peak voltage	V_{MPX}=0mV, V_{LEVEL}<< V_{SBL} (fully mono), NBFS = 11	0.5	0.8 (off)	1.0	V
V_{PEAKFS}	Max. fieldstrength controlled peak voltage	V_{MPX}=0mV, V_{LEVEL}<< V_{SBL} (fully mono), NBFS = 00	1.7	2.0	2.2	V
T_S	Min. blanking time	Signal HOLDN in testmode, NBT		22		µs
T_S	Max. blanking time	Signal HOLDN in testmode, NBT		38		µs
SR_{PEAK}	Noise rectifier charge	Signal PEAK in testmode, NBPC=0		10		mV/µs
SR_{PEAK}	Noise rectifier charge	Signal PEAK in testmode, NBPC=1		20		mV/µs
$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=00, NBSMP=0, MPPC=0		0.3		V/ms
$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=01, NBSMP=0, MPPC=0		0.8		V/ms
$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=10, NBSMP=0, MPPC=0		1.3		V/ms
$V_{RECTADJ}$	Noise rectifier discharge adjustment	Signal PEAK in testmode, NBRR=11, NBSMP=0, MPPC=0		2.0		V/ms
V_{ADJMP}	Noise rectifier adjustment by multipath	Signal PEAK in testmode, V_{MPTC}=1V, NBSMP=0, MPPC=1, NBRR=01		2.5		V/ms
V_{ADJMP}	Noise rectifier adjustment by strong multipath influence	Signal PEAK in testmode, V_{MPTC}=1V,, NBSMP=1, MPPC=0, NBRR=01		3.3		V/ms
V_{ADJMP}	Noise rectifier adjustment by multipath and strong multipath influence	Signal PEAK in testmode, V_{MPTC}=1V,, NBSMP=1, MPPC=1A, NBRR=01		4.5		V/ms

Table 8. Stereodecoder electrical characteristics (continued)

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, V_{MPX} = 500mV_{rms} mono, f = 1kHz, deemphasis = 50µs, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$G_{AMdelay}$	AM delay filter attenuation	f = 2.2kHz		2.0		dB
Multipath detector						
f_{CMP}	Center frequency of multipath-bandpass	stereo decoder locked on pilot tone		19		kHz
G_{BPMP}	Min. band pass gain	MPBPG	4	6	8	dB
G_{BPMP}	Max. band pass gain	MPBPG	10	12	14	dB
G_{RECTMP}	Min. rectifier gain	MPRG	-1	0	1	dB
G_{RECTMP}	Max. rectifier gain	MPRG	4.5	7.6	9.5	dB
I_{CHMP}	Rectifier charge current	MPCC = 0	0.5	0.8	1.2	µA
I_{CHMP}	Rectifier charge current	MPCC = 1	0.2	0.4	0.6	µA
I_{DISMP}	Rectifier discharge current		0.3	0.6	0.8	mA
Quality detector						
a	Min. MP influence factor	QDC	0.5	0.6	0.7	
a	Max. MP influence factor	QDC	0.9	1.05	1.2	
A	Min. noise influence factor	QNG		6		dB
A	Max. noise influence factor	QNG		15		dB

1. Intermodulation Suppression

   a2 = *V_O(signal,@1KHz) / V_O(spurious, @1KHz) ; fs = (2x10KHz) - 19KHz*

   a3 = V_O(signal,@1KHz) / V_O(spurious, @1KHz) ; fs = (3x13KHz) - 38KHz

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

2. Traffic Radio (V.F.) Suppression

   a57(V,W,F) = V_O(signal,@1KHz) / V_O(spurious, @1KHz+/-23KHz)

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

3. SCA (Subsidiary Communications Authorization)

   a67 = V_O(signal,@1KHz) / V_O(spurious, @9KHz) ; fs = (2x38KHz) - 67KHz

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

4. ACI (Adjacent Channel Interference)

   a114 = V_O(signal,@1KHz) / V_O(spurious, @4KHz) ; fs = 110KHz - (3x38KHz)

   a190 = V_O(signal,@1KHz) / V_O(spurious, @4KHz) ; fs = 186KHz - (5x38KHz)

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

5. All thresholds are measured inTestmode at the quality output. The thresholds are calculated by V_{NBTH} - V_{PEAK}

   V_{PEAK} is adjusted by applying a 150kHz sinewave at MPXIN.

Figure 3. Trigger threshold vs. V_{PEAK}

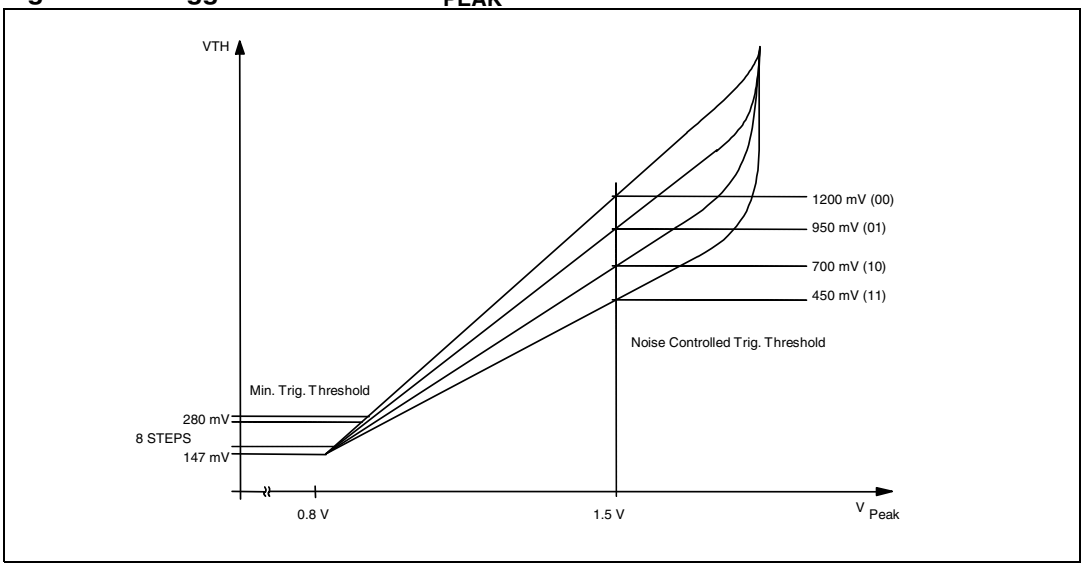


Figure 4. Deviation controlled trigger adjustment

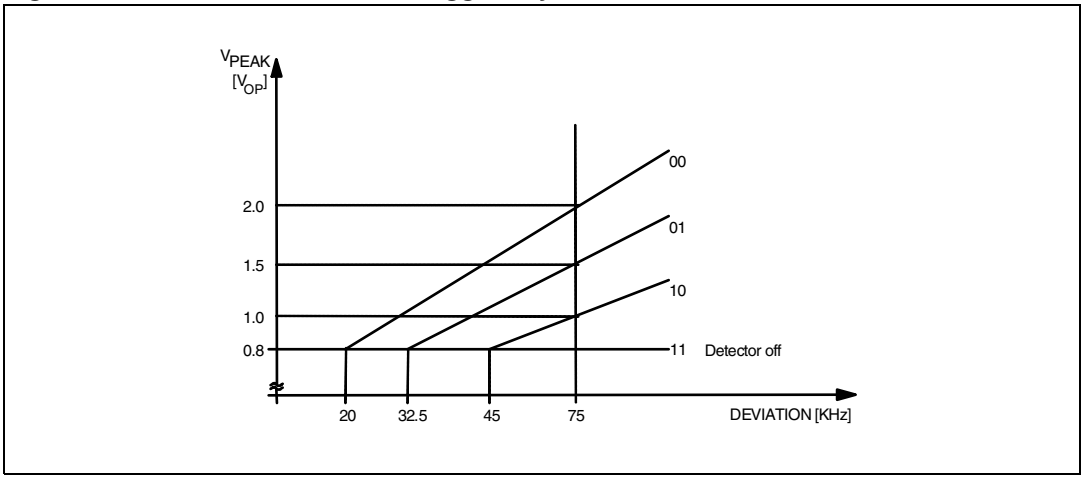
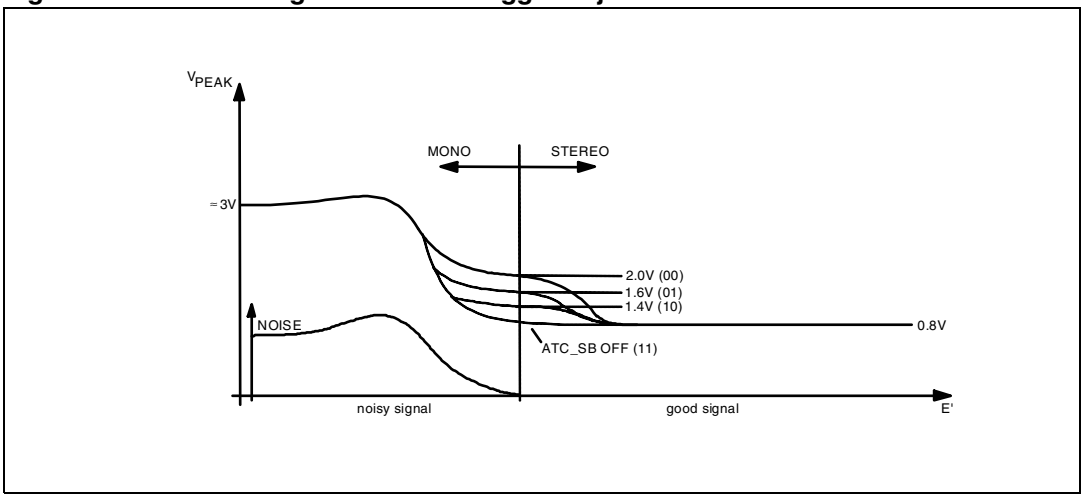


Figure 5. Field strength controlled trigger adjustment



3.3.5 PLL Section

Table 9. PLL electrical characteristics

(T_{amb} = 25°C, V_{CC1} = V_{CC2} = V_{CC3} = V_{CCST}= V_{CCVCO} = V_{CCMIX1} = V_{CCMIX2} = V_{CCIF1} = 8.5V, f_{RF} = 98MHz, dev. = 40kHz, f_{MOD} = 1kHz, f_{Xtal} = 10.25MHz, in application circuit, unless otherwise specified).

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
Output of tuning voltages (TV1,TV2)						
V_{OUT}	Output voltage	TVO	0.5		V_{CC3}-0.5	V
R_{OUT}	Output impedance	TVMODE=0	32	40	48	kΩ
R_{OUT}	Output impedance	TVMODE=1	16	20	24	kΩ
Xtal reference oscillator						
f_{LO}	Reference frequency	C_{Load} = 15pF		10.25		MHz
C_{Step}	Min. cap step	XTAL		0.75		pF
C_{max}	Max. cap	XTAL		23.25		pF
Δf/f	Deviation versus VCC2	ΔV_{CC2} = 1V		1.5		ppm/V
Δf/f	Deviation versus temp	-40°C < T < +85°C		0.2		ppm/K
Loop filter input/output						
$-I_{IN}$	Input leakage current	V_{IN} = GND, PD_{OUT} = Tristate	-0.1		0.1	µA
I_{IN}	Input leakage current	V_{IN} = VREF1 PD_{OUT} = Tristate	-0.1		0.1	µA
V_{OL}	Output voltage Low	I_{OUT} = -0.2mA		0.05	0.5	V
V_{OH}	Output voltage High	I_{OUT} = 0.2mA	V_{CC3}-0.5	V_{CC3}-0.05		V
I_{OUT}	Output current, sink	V_{OUT} = 1V to V_{CC3}-1V			10	mA
I_{OUT}	Output current, source	V_{OUT} = 1V to V_{CC3}-1V	-10			mA
Voltage controlled oscillator (VCO)						
f_{VCOmin}	Minimum VCO frequency		50			MHz
f_{VCOmax}	Maximum VCO frequency				260	MHz
C/N	Carrier to Noise	f_{VCO}= 200MHz, Δf=1KHz, B=1Hz, closed loop		80		dBc
SSTOP, INLOCK, ISSSTATUS outputs (open collector)						
V	Output voltage low	I = -200µA		0.2	0.5	V
V	Output voltage high				5	V
-I	Output leakage current	V = 5V	-0.1		0.1	µA
I	Output current, sink	V = 0.5V-5V			1	mA
Switching outputs S1, S2 (open collector SMODE=1)						
V	Output voltage low	I = -5mA		0.2	0.5	V