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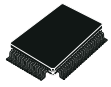
TDA7514

SINGLE-CHIP FM/AM TUNER WITH STEREO DECODER AND AUDIO PROCESSOR

1 FEATURES

- AM/FM WORLD TUNER FOR CAR-RADIO
- INTEGRATED IMAGE REJECTION FM MIXER
- INTEGRATED TUNING PLL
- VARIABLE-BANDWITH FM IF FILTER (ISS)
- FULLY INTEGRATED FM STEREO DECODER
- FULLY INTEGRATED FM/AM NOISE BLANKER
- HIGHLY INTEGRATED AUDIO PROCESSOR

Figure 1. Package



TQFP80

Table 1. Order Codes

Part Number	Package
E-TDA7514	TQFP80
E-TDA7514TR	TQFP80 in Tape & Reel

E- prefix indicates lead free package

2 DESCRIPTION

The TDA7514 is a device for car-radio applications that combines full RF front-end functions with advanced audio-processing capabilities.

As far as FM and AM functions are concerned, the TDA7514 features front-end processing, including the digital tuning PLL. IF processing with demodulation and variable-bandwidth IF filtering (ISS), stop station and quality detection functions, FM stereo decoding by means of a fully integrated adjustment-free dedicated PLL and, finally, AM and FM noise blanking (AM noise blanking comprises one IF NB as well as an audio NB).

The FM stereo decoder and the noise blanking functions are realised entirely without external components. The FM front-end circuit features an image-rejection mixer that allows the simplification of the external preselection filter, and a very low noise level that allows getting rid of the external preamplifier with no loss in sensitivity. A 6 bit on-board ADC makes a digitised version of the Smeter available to the µP via I^2Cbus.

The audio processor section comprises input selectors for one stereo single-ended source, one stereo quasi-differential source and a mono differential source. Volume, loudness, tone (bass and treble), balance and fading controls are available with completely pop-free operation to drive four output channels. An additional input independently mixable on each of the four outputs is provided for chime. A soft mute function and an RDS mute function are included to handle source change as well as RDS AF search without abrupt changes in the audio level.

Most of the parameters in the front-end section are I^2Cbus-driven and therefore under the control of the car-radio maker. The I^2Cbus allows furthermore the user to realise the full electric alignment of all the external coils.

Figure 2. Block Diagram

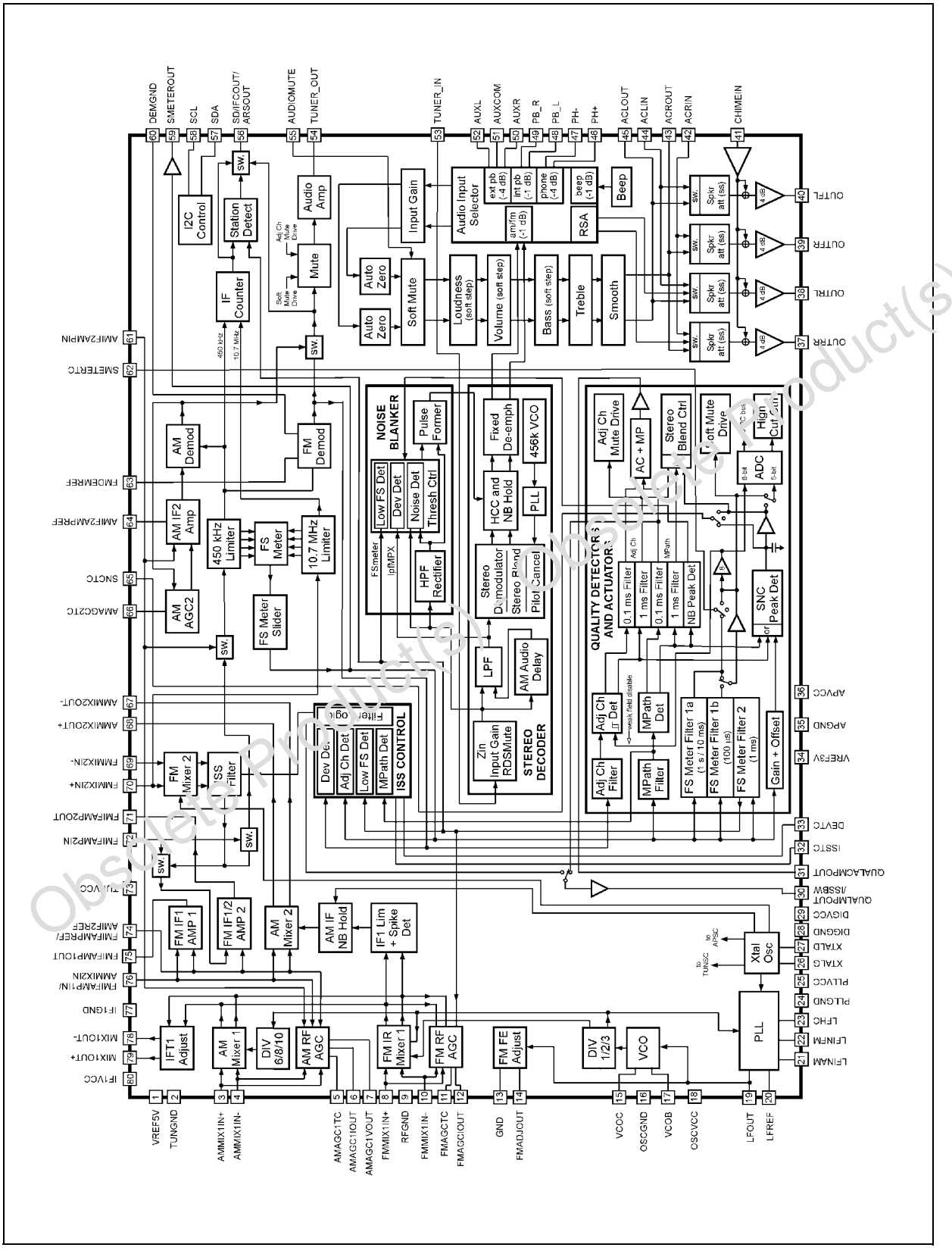


Table 2. Pin Description

N°	Pin	Function
1	VREF5V	5V reference
2	TUNGND	tuner general ground
3	AMMIX1IN+	am mix1 input
4	AMMIX1IN-	am mix1 input
5	AMAGC1TC	am agc1 filter capacitor
6	AMAGC1IOUT	am agc1 current output
7	AMAGC1VOUT	am agc1 voltage output
8	FMMIX1IN+	fm mix1 input
9	RFGND	rf ground
10	FMMIX1IN-	fm mix1 input
11	FMAGCTC	fm agc detector time constant
12	FMAGCIOUT	fm agc current output
13	GND	ground
14	FMADJOUT	fm antenna filter adjustment
15	VCOC	am/fm vco collector
16	OSCGND	vco ground
17	VCOB	am/fm vco base
18	OSCVCC	vco supply (8V)
19	LFOUT	PLL loop filter output
20	LFREF	PLL loop filter reference
21	LFINAM	PLL AM loop filter input
22	LFINFM	PLL FM loop filter input
23	LFHC	PLL loop filter high-current input
24	PLLGND	PLL back-end ground
25	PLLVCC	PLL back-end supply
26	XTALG	ref osc gate
27	XTALD	ref osc drain
28	DIGGND	digital ground
29	DIGVCC	digital dirty supply (8V)
30	QUALMPOUT/ISSBW	multipath det output / ISS BW indicator
31	QUALACMPOUT	multipath det / adjacent channel det output
32	ISSTC	ISS time constant
33	DEVTC	deviation detector time constant
34	VREF3V	3V reference
35	APGND	audio processor/stereo decoderground
36	APVCC	audio processor/stereo decoder supply (8V)
37	OUTRR	audio out
38	OUTRL	audio out
39	OUTFR	audio out
40	OUTFL	audio out

Table 2. Pin Description

N°	Pin	Function
41	CHIMEIN	chime input
42	ACRIN	ac coupling right input
43	ACROUT	ac coupling right output
44	ACLIN	ac coupling left input
45	ACLOUT	ac coupling left output
46	PH+	phone in +
47	PH-	phone in -
48	PB_L	tape in left
49	PB_R	tape in right
50	AUXR	audio aux in right
51	AUXCOM	audio aux in common
52	AUXL	audio aux in left
53	TUNERIN	am audio/fm mpx input
54	TUNEROUT	am audio/fm mpx output
55	AUDIOMUTE	audio processor mute control
56	SD / IFCOUT / ARSOUT	am/fm station detector output / IF counter output / ARS MPX output
57	SDA	I^2C bus data
58	SCL	I^2C bus clock
59	SMETEROUT	filtered / unfiltered Smeter output
60	DEMGND	fm demodulator ground
61	AMIF2AMPIN	am if2 amp input
62	SMETERTC	am/fm smeter filtering capacitor
63	FMDEMREF	fm demodulator reference capacitor
64	AMIF2AMPFB	am if2 amp feedback capacitor
65	SNCTC	SNC detector time constant
66	AMAGC2TC	am agc2 filter capacitor
67	AMMIX2OUT-	am mix2 output
68	AMMIX2OUT+	am mix2 output
69	FMMIX2IN-	fm mix2 input
70	FMMIX2IN+	fm mix2 input
71	FMIFAMP2OUT	fm if1 amp2 output
72	FMIFAMP2IN	fm if1 amp2 input
73	TUNVCC	tuner general supply (8V)
74	FMIFAMPREF/AMIF2REF	fm if1 amps reference capacitor/am if2 reference voltage
75	FMIFAMP1OUT	fm if1 amp1 output
76	FMIFAMP1IN/AMMIX2IN	fm if1 amp1 input/am mix2 in
77	IF1GND	if1 ground
78	MIX1OUT-	am/fm mix1 output
79	MIX1OUT+	am/fm mix1 output
80	IF1VCC	if1 supply (8V)

3 ELECTRICAL CHARACTERISTCS

3.1 FM

(Vcc = 8.5V; T_{amb}= 25°C; Vant,in= 60dBμ_{load}; fc=98.1MHz; fdev = 40kHz; fmod=1KHz; IF1amp1=25dB; IF1amp2=15dB; Filter @TUNEROUT:IEC_TUNER+Deemphasis=50µs, unless otherwise specified)

Table 3.

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
General (measured at audioprocessor output with de-emphasis and high cut active, ISS set to 80 KHz BW)						
US	Usable sensitivity	S/N=40dB		0		dBµV_{load}
SNR	Signal to Noise ratio			65		dB
LS	Limiting Sensitivity	-3dB_point, SoftMute Off		-2.5		dBµV_{load}
THD	Total Harmonic Distortion	fdev = 40kHz		0.26		%
		fdev = 75kHz		0.36		%
Vout	Output Level	@TUNEROUT		243		mV_{rms}
ISN	Interstation Noise	Delta Vout@RF OFF, Soft Mute OFF		-8.5		dB
IFCS	IF Counter Sensitivity			0		dBµV_{load}
Icctun	DC Supply Current@TUNVCC			80		mA
Iccmix1	DC Supply Current@IFT1			5		mA
Iccif1	DC Supply Current@IF1VCC			10		mA
Iccosc	DC Supply Current@OSCVCC			10		mA
Iccpll	DC Supply Current@PLLVCC			3		mA
Iccdig	DC Supply Current@DIGVCC			7		mA
IQ Mixer 1						
RIN	Input Resistance	Differential		6		kΩ
VIN	Input DC Bias	@pin 8, pin 10		2.3		V
Gm	Transconductance			17		mS
IIP3	Input IP3			108		dBµV
IQG	IQ Gain Adjustment		-1		+1	%
IQP	IQ Phase Adjustment		-7		+8	°C
IRR	Image Rejection Ratio	without adjustment	30			dB
		adjusted		42		dB
Gvmix1	Gain	from input (single-ended) to IFT1 out differential		22		dB
IFT1 Adjustment						
Cift1min	IFT1 Adjustment Capacitor Minimum	Between MIX1OUT+ and MIX1OUT-		2.3		pF

Table 3. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Cift1max	IFT1 Adjustment Capacitor Maximum	Between MIX1OUT+ and MIX1OUT-		20.1		pF
Cift1step	IFT1 Adjustment Capacitor Step	Between MIX1OUT+ and MIX1OUT-		1.3		pF
RFT Adjustment						
Vrftadjmin	RFT Adjustment Minimum	@T6<0:7>=[00000000] TVIN=3V		0.4		V
Vrftadjmax	RFT Adjustment Maximum	@ T6<0:7>=[11111111] TVIN=3V		5.9		V
Vrftadjstep	RFT Adjustment Step	TVIN=3V, VRFTadjstep=TVIN/128		23		mV
VRFT0		@ T6<0:7>=[11000001] TVIN=3V		3		V
Voutmax	Output voltage maximum	VCC-0.4		8.1		V
Voutmin	Output voltage minimum			0.4		V
Wide Band RF AGC (input: FMMIXER1in+ and FMMIXER1IN-)						
WAGCspL	Lower Threshold Start (Set 1) (“min” not used)	Level at FMMIXER1IN+ @V12=100mV IFT1 primary is shorted and is connected to GND with 56nF		66.8		dBµV
WAGCspH	Higher Threshold Start (Set max)	Level at FMMIX1IN+ @V12=100mV IFT1 primary is shorted and is connected to GND with 56nF		83.5		dBµV
Wide Band Keying AGC (Controlled by FiltSMeter1ms)						
WAGCK	AGC Start (Set 1) shift	Shifted level of AGC Starting point at FMMIX1IN+ when VSMeter changes from Vkey to Vkey-450mV		-12		dB
Vkey	Vsmeter at Keyed AGC start	when V12 changes to 90mV from 100mV (Set 1)		1.71		V
Narrow Band IF AGC (input: FMMIXEROUT+ and FMMIXER1OUT-)						
NAGCspL	Lower Threshold Start (Set 1) (“min” not used)	Level of IF1 at FMMIX1OUT+ @V12=100mV		90.2		dBµV
NAGCspH	Higher Threshold Start (Set max)	Level of IF1 at FMMIX1OUT+ @V12=100mV WAGC set to max		109		dBµV
RF AGC Pin Diode Driver Out						
Ioutmin	Minimum	AGCOFF			0.1	µA
Ioutmax	Maximum	AGCON; total @330Ω @2.2KΩ		10.1 8.8 1.35		mA mA mA

Table 3. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
FMIF1AMP1 and FMIF1AMP2						
Gv1min	AMP1 Minimum Gain	Source and load impedance: 330ohm.		19		dB
Gv1max	AMP1 Maximum Gain	Source and load impedance: 330ohm.		25		dB
IIP3a1	AMP1 input-referred IP3			TBD		dBµV
Rin1	Input Impedance of AMP1			330		Ω
Rout1	Output Impedance of AMP1			330		Ω
Gv2min	AMP2 Minimum Gain	Source and load impedance: 330ohm.		7		dB
Gv2max	AMP2 Maximum Gain	Source and load impedance: 330ohm.		15		dB
IIP3a2	AMP2 input-referred IP3			TBD		dBµV
Rin2	Input Impedance of AMP2			330		Ω
Rout2	Output Impedance of AMP2			330		Ω
FMMIXER2 (output not accessible)						
Gvmix2	Gain (Single-ended output)	Source impedance: 330ohm.		12.3		dB
Rinmix2	Input Impedance			330		Ω
FMLIMITER (450KHz) (output not accessible)						
Gvlim	Gain (To Demod_IN from FMMIXER2out+)			TBD		dB
FM Filtered Smeter (Mod:off , Slider 0)						
VFSM1	Filtered Smeter1	@FMMIX2IN=50dBµV		1.44		V
VFSM2	Filtered Smeter2	@FMMIX2IN=70dBµV		2.47		V
VFSM3	Filtered Smeter3	@FMMIX2IN=90dBµV		3.96		V
FSMR1	Filtered Smeter resistor	T16<5>= 0		200		kΩ
FSMR2	Filtered Smeter resistor	T16<5>= 1		21		MΩ
CLVFSM	Clamped voltage			5		V
TCsm1	Time constant1	T16<5>= 0		10		ms
TCsm2	Time constant2	T16<5>= 1		0.9		s
FM Smeter Slider						
SLSTEP	Slider step			38		mV
SLMAX	Maximum Slider	@VFSM=2.6V		1.16		V
SLMIN	Minimum Slider	@VFSM=2.6V		-1.18		V
ISS (Intelligent Selectivity System) Filter						
Fcenter	Center Frequency			450		kHz

Table 3. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Fc120BW3	Fcenter=120KHz, @-3dB,BW	@ISS 120KHz		120		kHz
Fc120BW20	Fcenter=120KHz, @-20dB,BW	@ISS 120KHz		250		kHz
Fc80BW3	Fcenter=80KHz, @-3dB,BW	@ISS 80KHz		80		kHz
Fc80BW20	Fcenter=80KHz, @-20dB,BW	@ISS 80KHz		150		kHz
Fc20BW3	Fcenter=20KHz, @-3dB,BW	@ISS 20KHz		25		kHz
Fc20BW20	Fcenter=20KHz, @-20dB,BW	@ISS 20KHz		75		kHz
ΔFmin	Fcenter Fine adjust minimum			-20		kHz
ISS Filter Time Constant						
Ichal1	Charge current low	@Weak adjacent		60		μA
Ichah1	Charge current high	@Weak adjacent		74		μA
Ichal2	Charge current low	@Strong adjacent		110		μA
Ichah2	Charge current high	@Strong adjacent		124		μA
Idischal	Discharge current low			1		μA
Idischahl	Discharge current high			15		μA
VISSTCL	ISSTC Low			0.1		V
VISSTCH	ISSTC High			4.9		V
ISS Filter Switch Threshold						
V120on	Threshold for ISS120on			3		V
V120off	Threshold for ISS120off			1		V
V80on	Threshold for ISS80on			4		V
V80off	Threshold for ISS80off			2		V
Adjacent Channel detector for ISS (input: Smeter unfiltered)						
FcenterAC1	Filter1 cutoff , T22<1:0>=00	HP(106KHz)+HP(100KHz)		130		kHz
FcenterAC2	Filter2 center, T22<1:0>=01	BP(100KHz)+HP(144KHz)		100		kHz
FcenterAC3	Filter3 center, T22<1:0>=10	BP(204KHz)+BP(100KHz)		177		kHz
FcenterAC4	Filter4 center, T22<1:0>=11	BP(100KHz)+BP(144KHz)		101		kHz
Gacmin	Gain minimum			23		dB
Gacmax	Gain maximum			29		dB
Vacl	Output voltage low			3.0		V
Vach	Output voltage high			4.9		V
Vthacl	Threshold for weak adjacent low			3.25		V
Vthach	Threshold for weak adjacent high			3.95		V

Table 3. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Vthacstep	Threshold for weak adjacent step			100		mV
ΔACl	Differential Vthreshold between weak and strong adjacent low			0		mV
ΔACh	Differential Vthreshold between weak and strong adjacent high			300		mV
ΔACstep	Differential Vthreshold between weak and strong step			100		mV
ACdesen1	Desens Th1	Vsmeter at starting desens		0.25		V
ACdesen2	Desens Th2	Vsmeter at starting desens		0.83		V
ACdesen3	Desens Th3	Vsmeter at starting desens		1.42		V
ACdesen4	Desens Th4	Vsmeter at starting desens		2.0		V
Slop1	ΔAC/ΔVsmeter1	T22<6:5>=00		-2.7		
Slop2	ΔAC/ΔVsmeter2	T22<6:5>=01		-3.3		
Slop3	ΔAC/ΔVsmeter3	T22<6:5>=10		-5		
Slop4	ΔAC/ΔVsmeter4	T22<6:5>=11		-10		
Multipath Channel detector for ISS (input: Smeter unfiltered+Buffer						
FcenterMP	BPF center			19		kHz
Qmp	Quality factor of BPF			8.5		
FiltGv1	Gain1 of BPF	T25<1:0>=00		-7		dB
FiltGv2	Gain2 of BPF	T25<1:0>=01		4		dB
FiltGv3	Gain3 of BPF	T25<1:0>=10		7		dB
FiltGv4	Gain4 of BPF	T25<1:0>=11		10		dB
Grect1	Rectifier Gain1	T25<3:2>=00		6		dB
Grect2	Rectifier Gain2	T25<3:2>=01		12		dB
Grect3	Rectifier Gain3	T25<3:2>=10		18		dB
Grect4	Rectifier Gain4	T25<3:2>=11		22		dB
Vmpl	Output voltage low			3.0		V
Vmph	Output voltage high			4.9		V
Vthmp1	Threshold level1			3.49		V
Vthmp2	Threshold level2			3.74		V
Vthmp3	Threshold level3			4.06		V
Vthmp4	Threshold level4			4.31		V
Deviation detector for ISS (input: Demodulator output)						
FcDev	Cutoff Frequency of MPX LPF (2^{nd} order)			10		kHz

Table 3. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Gvlpf	Gain of LPF			14		dB
Idischarl	discharge current low at DEVTC			6		µA
Idischarh	discharge current high at DEVTC			20		µA
Idischarstep	discharge current step at DEVTC			2		µA
Vth1	Low threshold1			15		kHz_{dev}
Vth2	Low threshold2			20		kHz_{dev}
Vth3	Low threshold3			28		kHz_{dev}
Vth4	Low threshold4			44		kHz_{dev}
Rdev1	Ratio of Vthreshold between strong and high deviation	Vthhighdev/Vthdev		1		
Rdev2	Ratio of Vthreshold between strong and high deviation	Vthhighdev/Vthdev		1.3		
Rdev3	Ratio of Vthreshold between strong and high deviation	Vthhighdev/Vthdev		1.4		
Rdev4	Ratio of Vthreshold between strong and high deviation	Vthhighdev/Vthdev		1.5		
DEVdesens1	Offset1 for Vsoftmute for desens	referred to soft mute threshold		50		mV
DEVdesens2	Offset2 for Vsoftmute for desens	referred to soft mute threshold		150		mV
Field Strength ISS (FSISS)						
ΔVthisissl	Low offset for Vthsm of softmute by Smeter(1ms)	referred to soft mute threshold		-467		mV
ΔVthisissh	High offset for Vthsm of softmute by Smeter(1ms)	referred to soft mute threshold		+467		mV
ΔVthisisstep	Step offset for Vthsm of Softmute by Smeter(1ms)			67		mV
SoftMute by Smeter						
Vthsm1	Threshold level1	T14<1:0>=00		0.3		V
Vthsm2	Threshold level2	T14<1:0>=01		0.4		V
Vthsm3	Threshold level3	T14<1:0>=10		1.6		V
Vthsm4	Threshold level4	T14<1:0>=11		1.8		V
Attsmmax	Maximum attenuation			21.5		dB
Attsmmin	Minimum attenuation			4.5		dB
Attsmstep	Step attenuation			2.5		dB

Table 3. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
SoftMute by Adjacent Channel Detector						
Vthsmac1	Threshold level1	T14<2>=0		2.75		V
Vthsmac2	Threshold level2	T14<2>=1		3.25		V
Attsmac1	Attenuation1	T14<7:6>=00		0		dB
Attsmac2	Attenuation2	T14<7:6>=01		6		dB
Attsmac3	Attenuation3	T14<7:6>=10		9		dB
Attsmac4	Attenuation4	T14<7:6>=11		12		dB
Station Detector by Smeter						
VSDl	Low output level	@SDpin		0		V
VSDh	High output level	@SDpin		5		V
Vthsdmin	Threshold level minimum	T20<3:0>=0000		0.4		V
Vthsdmax	Threshold level maximum	T20<3:0>=1111		3.4		V
Vthsdstep	Threshold level step			0.2		V
Adjacent Channel Detector for Quality outputs, SNC and HCC						
F1ac1	Cutoff or center frequency of filter1	T8<4>=0		83		kHz
F1ac2	Cutoff or center frequency of filter1	T8<4>=1		104		kHz
F2ac1	Cutoff or center frequency of filter2	T8<5>=0		119		kHz
F2ac2	Cutoff or center frequency of filter2	T8<5>=1		139		kHz
GcF2ac1	Gain of filter2	T18<7>=0		8.7		dB
GcF2ac2	Gain of filter2	T18<7>=1		14.7		dB
ΔVrect1	Offset1 of rectifier for SNC&HCC	T18<5:4>=00		0.4		V
ΔVrect2	Offset2 of rectifier for SNC&HCC	T18<5:4>=01		0.8		V
ΔVrect3	Offset3 of rectifier for SNC&HCC	T18<5:4>=10		1.2		V
ΔVrect4	Offset4 of rectifier for SNC&HCC	T18<5:4>=11		1.6		V
Multipath Detector for Quality output, SNC and HCC (Filter shared with ISS multipath detector)						
Gvrectl	Rectifier Gain minimum	T15<7:5>=000		5		dB
Gvrecth	Rectifier Gain maximum	T15<7:5>=111		13.4		dB
Gvrectstep	Rectifier Gain step			1.2		dB

Table 3. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Smeter Control for SNC and HCC						
Gvsml	Gain minimum	T15<3:0>=000		0		dB
Gvsmh	Gain maximum	T15<3:0>=111		2.25		dB
Gvsmstep	Gain step			0.15		dB
Quality_ACMPout (High output corresponds to good quality)						
Gqacmp1mp	Gain output level1 for multipath	T25<5:4>=01		-4		dB
Gqacmp2mp	Gain output level2 for multipath	T25<5:4>=10		0		dB
Gqacmp3mp	Gain output level3 for multipath	T25<5:4>=11		+4		dB
Gqacmp4mp	Gain output level4 for multipath	T25<5:4>=00		-60		dB
Gqacmp1ac	Gain output level1 for adjacent channel	T25<7:6>=01		-4		dB
Gqacmp2ac	Gain output level2 for adjacent channel	T25<7:6>=10		0		dB
Gqacmp3ac	Gain output level3 for adjacent channel	T25<7:6>=11		+4		dB
Gqacmp4ac	Gain output level4 for adjacent channel	T25<7:6>=00		-60		dB
Vqacmpmax	Maximum output level			5.0		V
Vqacmpmin	Minimum output level			0		V
Quality_MPout (Low output corresponds to good quality)						
Vqacmax	Maximum output level			5		V
Vqacmin	Minimum output level			0.9		V
Roll off compensation for TUNEROUT						
ΔVc120	Delta voltage between ISS120 ON and ISS OFF	@53KHz		1		dB
ΔVc80	Delta voltage between ISS80 ON and ISS OFF	@53KHz		1		dB
Weather Band Audio Gain Boost						
Gvwbbst	Boosted gain			23.5		dB

3.2 AM

(Vcc = 8.5V; Tamb = 25°C; Vsg = 74dBµV_{emf}; fc = 999KHz; Modulation level = 30%, fmod = 400Hz; 80O+20pF/65pF dummy antenna; Filter@TUNEROUT: IEC_TUNER + Deemphasis = 50us, unless otherwise specified).

Table 4.

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
General (input level @SG emf)						
US	Usable sensitivity	SNR=20dB		26		dBµV_{emf}
SNR	Signal to Noise Ratio			50		dB
MS	Maximum Sensitivity	@∆Vout=-10dB, SoftMute:off		20		dBµV_{emf}
THD1	Total Harmonic Distortion1	mod=30%, VSG=74 dBµV_{emf}		0.1		%
THD2	Total Harmonic Distortion2	mod=80%, VSG=74 dBµV_{emf}		0.2		%
THD3	Total Harmonic Distortion3	mod=30%, VSG=120dBµV_{emf}		0.2		%
THD4	Total Harmonic Distortion4	mod=80%, VSG=120dBµV_{emf}		0.5		%
THDLF	THD @ Low frequency	mod=30%, fmod=100Hz		0.2		%
Vout	Level of TUNEROUT	TUNEROUT		370		mV_{rms}
ISN	Interstation noise level	Vout @RF:off & SoftMute:off		-35		dB
IFCS	IF Counter Sensitivity			10		dBµV_{emf}
Icctun	DC Supply Current@TUNVCC			85		mA
Iccmix1	DC Supply Current@IFT1			5		mA
Iccif1	DC Supply Current@IF1VCC			10		mA
Iccmix2	DC Supply Current@IFT2			2		mA
Iccosc	DC Supply Current@OSCVCC			8		mA
Iccpll	DC Supply Current@PLLVCC			5		mA
Iccdig	DC Supply Current@DIGVCC			10		mA
MIXER1						
Gv	Conversion gain	From AMMIXER1IN+ to IFT1; secondary loaded with 330Ω		3.5		dB
Rin	Input resistance (differential)			1		KΩ
IIP3mix1	Input-referred IP3			130		dBµV
AGC1 Wide Band AGC (input: AMMIXER1in+ and AMMIXER1IN-; FEAGC in open-loop configuration)						
WAGCspl	Starting point minimum	Level at AMMIX1IN+ @IAGCOUT = 1µA, RF=999KHz, Set=0		94.4		dBµV
WAGCsph	Starting point maximum	Level at AMMIX1IN+ @IAGCOUT = 1µA, RF=999KHz, Set=31		115.5		dBµV

Table 4. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
AGC1 Narrow Band AGC (input: AMMIXER2in; FEAGC in open-loop configuration)						
NAGCspl	Starting point minimum	Level at AMMIX2IN @IAGCOUT = 1µA IF1=10.7MHz, Set=0		96.3		dBµV
NAGCsph	Starting point maximum	Level at AMMIX2IN @IAGCOUT = 1µA IF1=10.7MHz, Set=31		117.0		dBµV
AGC1 Ultra Narrow Band AGC (input: AMIF2IN+; FEAGC in open-loop configuration)						
UNAGCspl	Starting point minimum	Level at AMIF2IN @IAGCOUT =1uA IF2=450KHz, Set=0		69.6		dBµV
UNAGCsph	Starting point maximum	Level at AMIF2IN @IAGCOUT =1uA IF2=450KHz, Set=15		76.9		dBµV
AGC1 Output						
Ioutl	Pindiode drive current minimum	AGCOFF			1	µA
Iouth	Pindiode drive current maximum	AGCON	0.4			mA
Voutl	Rfamp control voltage minimum	AGCON			0.5	V
Vouth	Rfamp control voltage maximum	AGCOFF		3.5		V
Ragcvout	Output resistance at VOUT			17		kΩ
AGC1 Time Constant						
Ragc1tc1	Time constant FAST mode	Output resistance AMAGC1TCpin		9		kΩ
Ragc1tc2	Time constant Normal mode	Output resistance AMAGC1TCpin		100		kΩ
AMMIXER2						
Gmix2max	Conversion Gain	From AMMIXER2in to IFT2 secondary loaded with 2kΩ		8		dB
IIP3mix2	Input-referred IP3			140		dBµV
Rmix2in	Input resistance			2.4		kΩ
AMIF2amplifier						
Gif2ampmin	min. gain , no AGC2	T29<7:4>=0010		68		dB
Gif2ampmax	max. gain , no AGC2	T29<7:4>=1111		82		dB
Δ Gif2amp	AGC2 range			-40		dB
Rif2ampin	Input resistance			2		kΩ
SoftMute by Smeter						
Vthsm1	Threshold level1	T14<1:0>=00		0.3		V

Table 4. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Vthsm2	Threshold level2	T14<1:0>=01		0.4		V
Vthsm3	Threshold level3	T14<1:0>=10		1.6		V
Vthsm4	Threshold level4	T14<1:0>=11		1.8		V
Attsmmax	Maximum attenuation			21.5		dB
Attsmmin	Minimum attenuation			4.5		dB
Attsmstep	Step attenuation			2.5		dB
AM Filtered Smeter						
VFSM1	Filtered Smeter1	@AMIF2AMPIN=50dBµV		0.8		V
VFSM2	Filtered Smeter2	@AMIF2AMPIN=70dBµV		2.2		V
VFSM3	Filtered Smeter3	@AMIF2AMPIN=90dBµV		4.4		V
FSMR1	Filtered Smeter resistor	T16<5>=0		200		kΩ
FSMR2	Filtered Smeter resistor	T16<5>=1		21		MΩ
CLVFSM	Clamped voltage			5		V
TCsm1	Time constant1	T16<5>=0		10		ms
TCsm2	Time constant2	T16<5>=1		0.9		s
AM Smeter Slider						
SLSTEP	Slider step			40		mV
SLMAX	Maximum Slider	@VFSM=2.6V		1.23		V
SLMIN	Minimum Slider	@VFSM=2.6V		-1.25		V
AM Station Detector by Smeter						
VSDl	Low output level	@SD pin		0		V
VSDh	High output level	@SD pin		5		V
Vthsdmin	Threshold level minimum	T29<3:0>=0000		0.3		V
Vthsdmax	Threshold level maximum	T29<3:0>=1111		2.55		V
Vthsdstep	Threshold level step			0.15		V
AM AGC 2 Time Constant						
Ragc2tc1	Time constant FAST mode	Output resistance AMAGC1TCpin		4.8		kΩ
Ragc2tc2	Time constant Normal mode	Output resistance AMAGC1TCpin		150		kΩ
AMIFNB						
Wgateifnb	Width of gate			12		µsec
Voffset0	Rectifier offset0	T31<3:0>=0000		0		mV
Voffset1	Rectifier offset1	T31<3:0>=0001		46		mV
Voffset2	Rectifier offset2	T31<3:0>=0010		100		mV
Voffset3	Rectifier offset3	T31<3:0>=0011		146		mV

Table 4. (continued)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Voffset4	Rectifier offset4	T31<3:0>=0100		212		mV
Voffset5	Rectifier offset5	T31<3:0>=0101		257		mV
Voffset6	Rectifier offset6	T31<3:0>=0110		312		mV
Voffset7	Rectifier offset7	T31<3:0>=0111		362		mV
Voffset8	Rectifier offset8	T31<3:0>=1000		439		mV
Voffset9	Rectifier offset9	T31<3:0>=1001		485		mV
Voffset10	Rectifier offset10	T31<3:0>=1010		541		mV
Voffset11	Rectifier offset11	T31<3:0>=1011		587		mV
Voffset12	Rectifier offset8	T31<3:0>=1100		653		mV
Voffset13	Rectifier offset9	T31<3:0>=1101		700		mV
Voffset14	Rectifier offset10	T31<3:0>=1110		755		mV
Voffset15	Rectifier offset11	T31<3:0>=1111		800		mV
Vdesens1	Desens threshold1	T31<5:4>=00		4.4		V
Vdesens2	Desens threshold2	T31<5:4>=01		2.65		V
Vdesens3	Desens threshold3	T31<5:4>=10		1.8		V
Vdesens4	Desens threshold4	T31<5:4>=11		1.4		V

3.3 VCO, PLL AND XTAL OSCILLATOR

Table 5.

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
VCO						
Fvcomin	Minimum VCO frequency	VCC=8.5V		155		MHz
Fvcomax	Maximum VCO frequency	VCC=8.5V		280		MHz
Vosc	Level of oscillation	@200MHz, (RF=89.3MHz) VCOB , Impedance of active probe is 0.7pF//1MΩ		105		dBμV
Loop Filter Output Voltage						
Vlpoutmin	Minimum LPOUT			0.05		V
Vlpoutmax	Maximum LPOUT	VCC-0.05		8.45		V
Xtal Oscillator						
Vxtal	Oscillation level	@XtalD , with 3pF between XtalD and XtalG, Set to 11.25pF		123.5		dBμV
FXTALmax	Adjustment range maximum			+1.95		kHz
FXTALmin	Adjustment range minimum			-1.60		kHz
FXTALstep	Adjustment range step			124		Hz

3.4 STEREODECODER

Standard Conditions, unless otherwise indicated:

FM: Input at #TUNER_IN = 1 kHz at 450 mVrms, Input Gain setting = 0.5 dB, Deemphasis = 75 μs, Roll Off Compensation set to give maximum stereo separation (note that this varies with VSBL setting)

AM: Input at #TUNER_IN = 1 kHz at 1 Vrms, Input Gain setting = 0.5 dB

Table 6.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{IN}	MPX Input Level	Input Gain = 3.5dB		0.5	1.25	V_{RMS}
Rin	Input Resistance (TUNERIN)	FM	70	100	130	kΩ
		AM		30		kΩ
Gain	Minimum Input Gain			0.5		dB
Gmax	Maximum Input Gain			5.75		dB
G_{STEP}	Step Resolution			1.75		dB
a	Max Channel Separation		30	50		dB
SVRR	Supply Voltage Ripple Rejection	Vripple=100mV, f=1kHz	35	55		dB
THD	Total Harmonic Distortion	fin=1kHz, mono		0.02	0.3	%
S+N / N	Signal plus Noise to Noise Ratio	A-weighted, S=2Vrms	80	91		dB
MONO/STEREO SWITCH (With InGain=5.75dB)						
V_{PTHST1}	Pilot Threshold Voltage	for Stereo, PTH=1	10	15	25	mV
V_{PTHST0}	Pilot Threshold Voltage	for Stereo, PTH=0	15	25	35	mV
V_{PTHMO1}	Pilot Threshold Voltage	for Mono, PTH=1	7	12	17	mV
V_{PTHMO0}	Pilot Threshold Voltage	for Mono, PTH=0	10	19	25	mV
PLL						
Δf/f	Capture Range		0.5			%
DEEMPHASIS & HIGHCUT						
$\tau_{DeempFM}$	Deemphasis Time Constants FM; $V_{LEVEL} >> VHCH$	Deemphasis=50μs, FM	25	50	75	μs
		Deemphasis=75μs, FM	50	75	100	μs
$\tau_{DeempAM}$	Deemphasis Time Constants AM; $V_{LEVEL} >> VHCH$	Deemphasis=50μs, AM		22.3		kHz
		Deemphasis=75μs, AM		14.9		kHz
REF5V	Internal Reference Voltage		4.7	5	5.3	V
Carrier and Harmonic suppresion at output						
α19	Pilot Signal	f=19kHz, Deemphasis=75μs	40	50		dB
α38	Subcarrier	f=38kHz, Deemphasis=75μs		75		dB
α57	Subcarrier	f=57kHz, Deemphasis=75μs		62		dB
α76	Subcarrier	f=76kHz, Deemphasis=75μs		90		dB
Intermodulation						
α2	fmod=10kHz, fspur=1kHz			65		dB
α3	fmod=13kHz, fspur=1kHz			75		dB
		Traffic Radio				
α57	Signal	f = 57kHz		70		dB
SCA – Subsidiary Communication Authorization						
α67	Signal	f = 67kHz		75		dB
ACI – Adjacent Channel Interference						
α114	Signal	f = 114kHz		95		dB
α190	Signal	f = 190kHz		84		dB

3.4.1 NOTES TO THE CHARACTERISTICS

3.4.1.1 Intermodulation Suppression

$$\alpha 2 = \frac{V_O(signal)(at1kHz)}{V_O(spurious)(at1kHz)}; \quad f_s = (2 \cdot 10kHz) - 19kHz$$

$$\alpha 3 = \frac{V_O(signal)(at1kHz)}{V_O(spurious)(at1kHz)}; \quad f_s = (3.13 \cdot kHz) - 38kHz$$

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

3.4.1.2 Traffic Radio (V.F.) Suppression

$$\alpha 57(VWF) = \frac{V_O(signal)(at1kHz)}{V_O(spurious)(at1kHz \pm 23kHz)}""$$

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

3.4.1.3 SCA (Subsidiary Communications Authorization)

$$\alpha 67 = \frac{V_O(signal)(at1kHz)}{V_O(spurious)(at1kHz)}; \quad f_s = (2.38kHz) - 67kHz$$

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

3.4.1.4 ACI (Adjacent Channel Interference)

$$\alpha 114 = \frac{V_O(signal)(at1kHz)}{V_O(spurious)(at1kHz)}; \quad f_s = 110kHz - (3.38kHz)$$

$$\alpha 190 = \frac{V_O(signal)(at1kHz)}{V_O(spurious)(at1kHz)}; \quad f_s = 186kHz - (5.38kHz)$$

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

3.5 Noise Blanker

Table 7.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{TR}	BLTHL=PEAK+VBE+V_{PROG}					
	Trigger Threshold 1) meas.with VPEAK=0.9V, InGain=5.75dB	111		30		mV_{OP}
		110		35		mV_{OP}
		101		40		mV_{OP}
		100		45		mV_{OP}
		011		50		mV_{OP}
		010		55		mV_{OP}
		001		60		mV_{OP}
		000		65		mV_{OP}
$V_{TRNOISE}$	BLTHH=PEAK+VBE+m*(PEAK-1.5V)+m*0.56V					
	noise controlled Trigger Threshold meas.with VPEAK=1.5V, InGain=5.75dB	00		260		mV_{OP}
		01		220		mV_{OP}
		10		180		mV_{OP}
		11		140		mV_{OP}
V_{RECT}	Rectifier Voltage with InGain=5.75dB	VMPX=0mV	0.5	0.9	1.3	V
		VMPX=50mV, f=150kHz	1.5	1.7	2.1	V
		VMPX=200mV, f=150kHz	2	2.5	2.9	V
VRECTDEV	Deviation dependent Rectifier Voltage with VMPX=500mVrms & InGain=5.75dB	11		0.9(off)		V_{OP}
		10		1.1		V_{OP}
		01		1.8		V_{OP}
		00		2.6		V_{OP}
V_{RECT}FS	Fieldstrength controlled Rectifier Voltage meas.with VMPX=0mV, VLEVEL<< VSBL (fully mono)	11		0.9(off)		V
		10		1.1		V
		01		1.5		V
		00		2.8		V
TS_{FM}	Suppression Pulse Duration FM Signal HOLDN in Testmode	00		38		µs
		01		25.5		µs
		10		32		µs
		11		22		µs
$V_{RECTADJ}$	Noise rectifier discharge (2) adjustment Signal PEAK in Testmode	00		inf.		W
		01		56		MΩ
		10		33		MΩ
		11		18		MΩ
SR_{PEAK}	Noise rectifier (2) charge Signal PEAK in Testmode	0		10		mV/µs
		1		20		mV/µs

Table 7. (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V_{ADJMP}	Noise rectifier adjustment through Multipath (2) Signal PEAK in Testmode	00		0.3		V/ms
		01		0.5		V/ms
		10		0.7		V/ms
		11		0.9		V/ms
AM Noise Blanker						
T_D	AM delay time			128		µs
f_c	Corner frequency of AM delay filter			4		kHz
AM config	AM configuration	Old mode (signal dependant threshold)	Noise dependent threshold			
		New mode (fixed threshold), STDInGain must be 0.5dB		140		%
fc_{HP}	AM Noise Detector High Pass Frequency	0		10		kHz
		1		20		kHz
	AM Noise Detector High Pass Filter Order	0		1st order		
		1		2nd order		
TSAM	Suppression Pulse Duration AM Signal HOLDN in Testmode	00		1.2		ms
		01		800		µs
		10		1.0		ms
		11		640		µs

Notes:
1. All thresholds are measured using a pulse with T_R = 2 µs, T_{HIGH}= 2 µs and T_F = 10 µs. The repetition rate must not increase the PEAK voltage.
2. By design/characterization functionally guaranteed through dedicated test mode structure

Table 8. Quality Actuators

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Stereo Blend						
Vsb_{ST}	Vsb control voltage for full stereo			5		V
V_{SBL}	VSBL = 2V + ("d" factor) * 3V	see below				
d	VSB Control Voltage for Full Mono d factor	000		29		%
		001		33		%
		010		38		%
		011		42		%
		100		46		%
		101		50		%
		110		54		%
		111		58		%

Table 8. Quality Actuators (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
	Blend Adjustment	The filtered Smeter input to the SNC detector has variable gain and offset. See SNC Detector specs.				
High Cut Control						
VHCH	VHCH = a * b * 4V (level = Smeter * 1.0)	see below				
a	VHCH Shift “a” factor	0001		97		%
		0010		73		%
		0100		50		%
		1000		32		%
b	VHCH “b” factor	00		67		%
		01		75		%
		10		83		%
		11		92		%
VHCL	VHC Control Voltage for FULL Highcut Rolloff	for HCC control from level (where level = Smeter * **1.0**): VHCL = a * b * c * 4V (or VHCL = c * VHCH)				
		for HCC control from SNC: VHCL = 2V + a * b * c * 3V				
c	VHCL “c” factor	00		16.70		%
		01		22.20		%
		10		27.80		%
		11		33.30		%
fc range	HCC Filter cutoff frequency range	00		20kHz ~ 4kHz		
		01		10kHz ~ 2kHz		
		10		4kHz ~ 800Hz		
		11		4kHz ~ 800Hz		
HCC step	Number of settings (per range)			32		

Table 8. Quality Actuators (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$ATT_{MAX/MIN}$	The maximum high cut attenuation can be selected via I^2C [addr 8C, subaddr 23d, bits D2 to D1]. NOTES: - The maximum high cut frequency setting can make the maximum attenuation lower than this. But then you effectively have a fixed rolloff filter, because the max high cut frequency will keep the hcc filter frequency from moving any higher, and the max high cut attenuation will keep the hcc filter frequency from moving any lower. - Also, there is an alternative way of setting the maximum high cut attenuation, but only if a maximum high cut frequency does not need to be selected. The FAST3 can be set to limit the minimum high cut frequency [addr 8C, subaddr 25d, bit D6], then any of the 32 high cut frequencies can be selected to limit the max attenuation.					
	Max/Min high Cut Attenuation(at 10kHz)@ HCC range 20kHz~4kHz	00		-1.8		dB
		01		-4.4		dB
		10		-6.2		dB
		11		-7.0		dB
	Max/Min high Cut Attenuation(at 10kHz)@ HCC range 10kHz~2kHz	00		-5.6		dB
		01		-9.3		dB
		10		-11.3		dB
		11		-12.4		dB
	Fixed Rolloff	There are two ways to set the HCC filter to a fixed filter (there will be no dynamic movement of the filter). Both of these will set the filter to the corner frequency selected in the Max/Min High Cut Frequency [addr 8C, subaddr 25d, bits D4 to D0]. 1) Set the FAST3 to Fixed High Cut ON [addr 8C, subaddr 25d, bit D7]. 2) Turn High Cut OFF [addr 8C, subadress 23, bit D0] and Fix Maximum High Cut Frequency [addr 8C, subaddr 25d, bit D6]				

3.6 AUDIO PROCESSOR

(V_S = 8.5V; T_{amb}= 25°C; R_L= 10kΩ ; all gains = 0dB; f = 1kHz; unless otherwise specified)

Table 9.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
INPUT SELECTOR						
R_{in}	Input Resistance	All single ended inputs	70	100	130	kΩ
V_{CL}	Clipping level			2		V_{RMS}
S_{IN}	Input Separation		80	100		dB
$G_{IN\ MIN}$	Min. Input Gain		-1	0	+1	dB
$GI_{N\ MAX}$	Max. Input Gain		13	15	17	dB
G_{STEP}	Step Resolution		0.5	1	1.5	dB
V_{DC}	DC Steps	Adjacent Gain Steps	-5	1	5	mV
		$G_{MIN\ to\ GMAX}$	-10	6	10	mV
V_{offset}	Remaining offset with AutoZero			0.5		mV
QUASI DIFFERENTIAL STEREO INPUT						
R_{in}	Input Resistance	all inputs to ground	70	100	130	kΩ
G_{QD}	Gain			-4		dB
Symbol	**Parameter**	**Test Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
CMRR	Common Mode Rejection Ratio	V_{CM}=1 V_{RMS}@ 1kHz	46	70		dB
		V_{CM}=1 V_{RMS}@ 10kHz	46	60		dB
e_{NO}	Output Noise @ Speaker Outputs	20Hz-20kHz,flat; all stages 0dB		20		µV
SINGLE-ENDED STEREO INPUT						
R_{in}	Input Resistance		70	100	130	kΩ
G_{QD}	Gain			0		dB
e_{NO}	Output Noise @ Speaker Outputs	20Hz-20kHz,flat; all stages 0dB		TBD		µV
DIFFERENTIAL MONO INPUT						
R_{in}	Input Resistance	Differential	40	56	72	kΩ
G_{MD}	Gain			-4		dB
CMRR	Common Mode Rejection Ratio	V_{CM}=1 V_{RMS}@ 1kHz	40	70		dB
		V_{CM}=1 V_{RMS}@ 10kHz	40	60		dB
e_{NO}	Output Noise @ Speaker Outputs	20Hz-20kHz,flat; all stages 0dB		TBD		µV
BEEP CONTROL						
V_{RMS}	Beep Level	all flat		TBD		mV
f_{Beep}	Beep Frequency	f_{Beep1}		500		Hz
		f_{Beep2}		1		kHz
		f_{Beep1}		2		kHz
		f_{Beep2}		3		kHz

Table 9. (continued)

LOUDNESS CONTROL						
Symbol	**Parameter**	**Test Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
A_{MAX}	Max Attenuation		-21	-19	-17	dB
A_{STEP}	Step Resolution		0.5	1	1.5	dB
$f_{PeakLPF}$	LPF Peak Frequency	f_{P1}		32.5		Hz
		f_{P2}		40		Hz
		f_{P3}		150		Hz
$f_{PeakLPF}$	HPF Peak Frequency	f_{P1}		4		kHz
		f_{P2}		6		kHz
		f_{P3}		8		kHz
		f_{P4}		10		kHz
VOLUME CONTROL						
G_{MAX}	Max Gain		14	15	16	dB
A_{MAX}	Max Attenuation		-83	-79	-75	dB
A_{STEP}	Step Resolution		0.5	1	1.5	dB
E_A	Attenuation Set Error	G = -20 to +15dB			2	dB
		G = -79 to -20dB			4	dB
E_T	Tracking Error				2	dB
V_{DC}	DC Steps	Adjacent Attenuation Steps		0.1	3	mV
		From 0dB to G_{MIN}		0.5	5	mV
SOFT MUTE						
A_{MUTE}	Mute Attenuation		80			dB
T_D	Delay Time	T1		0.48		ms
		T2		0.96		ms
		T3		20.2		ms
		T4		40.4		ms
$V_{TH\ Low}$	Low Threshold for SM Pin				1	V
$V_{TH\ High}$	High Threshold for SM Pin		2.5			V
BASS CONTROL						
C_{RANGE}	Control Range		±14	±15	±16	dB
A_{STEP}	Step Resolution		0.5	1	1.5	dB
fc	Center Frequency	f_{C1}	54	60	66	Hz
		f_{C2}	72	80	88	Hz
		f_{C3}	90	100	110	Hz
		f_{C4}	117	130	143	Hz
Q_{BASS}	Quality Factor	Q_1	0.9	1	1.1	
		Q_2	1.1	1.25	1.4	
		Q_3	1.3	1.5	1.7	

Table 9. (continued)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
		Q_4	1.8	2	2.2	
DC_{GAIN}	Bass-DC-Gain	DC = off	-1	0	+1	dB
		DC = on (shelving filter) @ gain = ±15 dB		±10		dB
TREBLE CONTROL						
C_{RANGE}	Clipping Level		±14	±15	±16	dB
A_{STEP}	Step Resolution		0.5	1	1.5	dB
fc	Center Frequency	f_{C1}	8	10	12	kHz
		f_{C2}	10	12.5	15	kHz
		f_{C3}	12	15	18	kHz
		f_{C4}	14	17.5	21	kHz
SPEAKER ATTENUATORS						
Rin	Input Impedance		35	50	65	kΩ
G_{MAX}	Max Gain		14	15	16	dB
A_{MAX}	Max Attenuation		-83	-79	-75	dB
A_{STEP}	Step Resolution		0.5	1	1.5	dB
A_{MUTE}	Mute Attenuation		80	90		dB
E_E	Attenuation Set Error				2	dB
V_{DC}	DC Steps	Adjacent Attenuation Steps		0.1	5	mV
CHIME INPUT						
G	Gain to speaker outputs			-19		dB
AUDIO OUTPUTS						
V_{CL}	Clipping level	d = 0.3%	1.8	2		V_{RMS}
R_{OUT}	Output impedance			30	100	W
R_L	Output Load Resistance		2			kΩ
C_L	Output Load Capacitor				10	nF
A_V	AC gain			4		dB
V_{DC}	DC Voltage Level		3.8	4.0	4.2	V
GENERAL						
e_{NO}	Output Noise	BW=20Hz to 20 kHz all gain = 0dB		20		μV
S/N	Signal to Noise Ratio	all gain = 0dB flat; Vo=2V_{RMS}		100		dB
d	Distortion	V_{IN}=1V_{RMS}; all stages 0dB		0.005	0.1	%
Sc	Channel Separation Left/Right		80	100		dB