



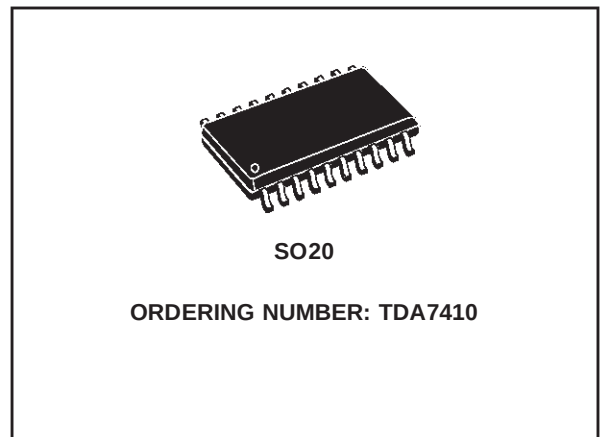
SIGNAL PROCESSOR FOR CAR RADIO APPLICATIONS

- DEVICE INCLUDES AUDIO PROCESSOR, STEREO DECODER AND NOISEBLANKER
- NO EXTERNAL COMPONENTS REQUIRED
- FULLY PROGRAMMABLE VIA I²C BUS
- LOW DISTORTION
- LOW NOISE
- SO20 PACKAGE

DESCRIPTION

TDA7410 is a signal processor specifically designed for car radio applications. The device includes a complete audioprocessor and a stereo decoder with noiseblanker, stereoblend and all signal processing functions for car radio system.

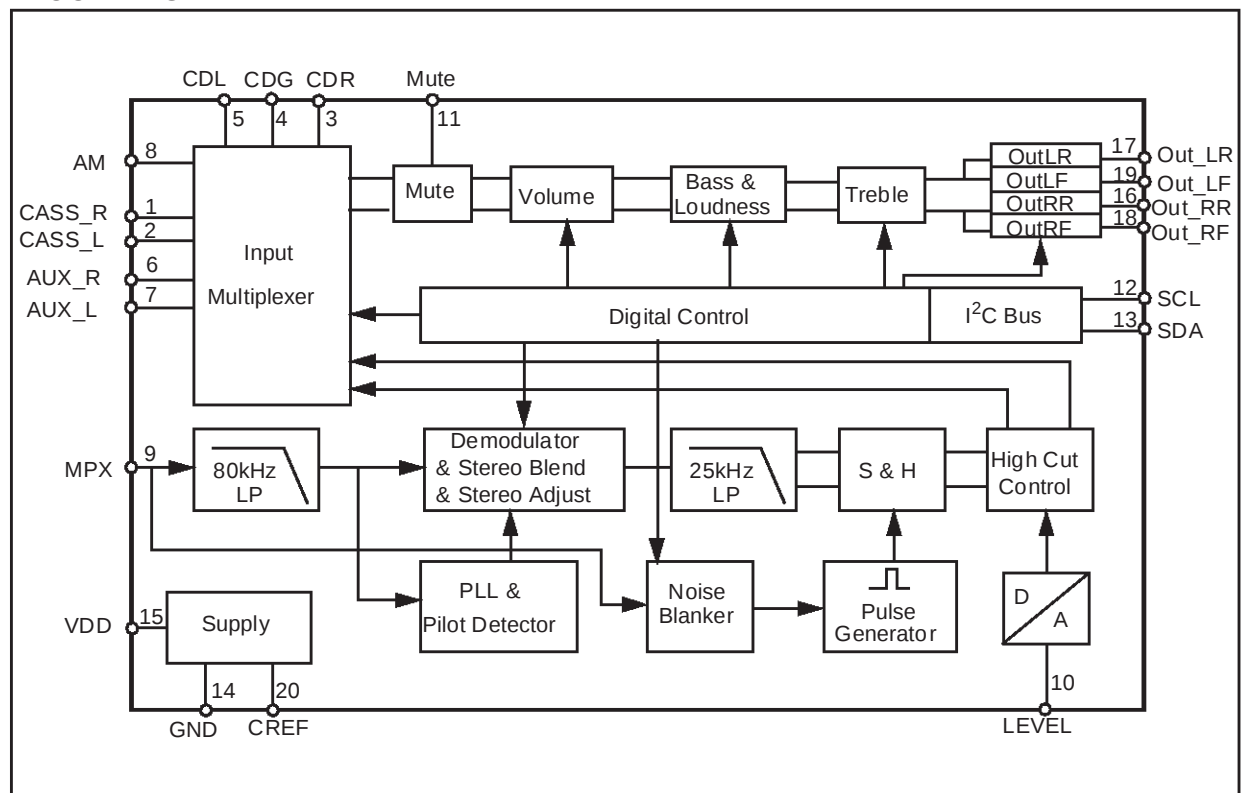
Switched-capacitors design technique allows the users to enjoy these features without external components or adjustments. This means higher quality and



reliability as well as overall cost saving.

The device is fully programmable by I²C bus interface allowing customization of key device parameters, especially filter characteristics.

BLOCK DIAGRAM



PIN DESCRIPTION

N°	Pin	Function	Type
1	CASS_R	Cassette Input Right	I
2	CASS_L	Cassette Input Left	I
3	CDR	CD Right Channel Input	I
4	CDG	Ground reference CD	I
5	CDL	CD Left Channel Input	I
6	AUX_R	Aux Input Right	I
7	AUX_L	Aux Input Left Channel	I
8	AM	AM input	I
9	MPX	FM Input (MPX)	I
10	LEVEL	Level Input Stereodecoder	I
11	MUTE	Mute	I
12	SCL	I2C Clock Line	I/O
13	SDA	I2C Data Line	I/O
14	GND	Supply Ground	S
15	VDD	Supply Voltage	S
16	OUT_RR	Right Rear Speaker Output	O
17	OUT_LR	Left Rear Speaker Output	O
18	OUT_RF	Right Front Speaker Output	O
19	OUT_LF	Left Front Speaker Output	O
20	CREF	Reference Capacitor Pin	S

Note:

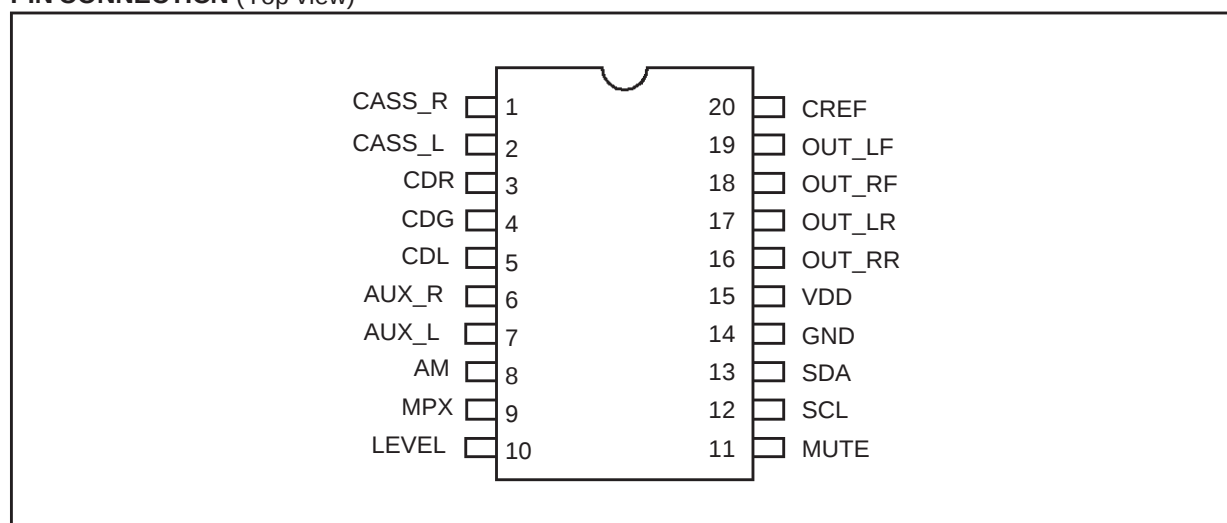
Pin Type:
I = input
O = Output
I/O = Input/Output
S = Supply

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{DD}	Operating Supply Voltage	10.5	V
T _{amb}	Operating Ambient Temperature Range	-40 to 80	°C
T _{stg}	Operating Storage Temperature Range	-55 to 150	°C

SUPPLY

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
V _{DD}	Supply Voltage		7.5	8.5	10	V
I _{DD}	Supply Current	V _{DD} = 8.5V	15	20	25	mA

PIN CONNECTION (Top view)**AUDIO PROCESSOR PART****Input Multiplexer**

- Fully differential CD and cassette stereo input
- AM mono and Aux

Volume Control

- 1dB attenuator
- Max. gain 32dB
- Max. attenuation 79dB

Bass Control

- 2nd order frequency response
- Fixed center frequency 100Hz
- DC gain programmable
- 7x 2dB steps

Treble control

- 2nd order frequency response
- Fixed center frequency 10kHz
- 7x2dB steps

Speaker control

- 4 independent speaker controls (1dB steps control range 50dB)

Mute functions

- Direct mute
- Mute by I^2C

ELECTRICAL CHARACTERISTICS

$V_{DD} = 8.5V$, $T_{amb} = 25\text{ }^{\circ}C$, $R_L = 10k\Omega$, all gains = 0dB, $f = 1kHz$, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
INPUT SELECTOR						
R_{in}	Input Resistance	All inputs	70	100	130	$k\Omega$
V_{CL}	Clipping level		1.2	1.4		V_{RMS}
DIFFERENTIAL CD STEREO INPUT						
R_{in}	Input Resistance		70	100	130	$k\Omega$
CMRR	Common Mode Rejection Ratio	$V_{CM}=1 V_{RMS}@ 1kHz$	40	50		dB

ELECTRICAL CHARACTERISTICS (continued)

$V_{DD} = 8.5V$, $T_{amb} = 25\text{ }^{\circ}C$, $R_L = 10k\Omega$, all gains = 0dB, $f = 1kHz$, unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
VOLUME CONTROL						
G _{MAX}	Max Gain			32		dB
A _{MAX}	Max Attenuation		-83	-79	-75	dB
A _{STEP}	Step Resolution		0.5	1	1.5	dB
BASS CONTROL						
C _{RANGE}	Control Range		±13	±14	±15	dB
A _{STEP}	Step Resolution		1	2	3	dB
f _c	Center Frequency		90	100	110	Hz
Q _{BASS}	Quality Factor		1.3	1.5	1.7	
DC _{GAIN}	Bass-DC-Gain	DC = off	-1	0	1	dB
		DC = on	3.5	4.4	5.5	dB
TREBLE CONTROL						
C _{RANGE}	Control Range		±13	±14	±15	dB
A _{STEP}	Step Resolution		1	2	3	dB
f _c	Center frequency		8	10	12	kHz
SPEAKER CONTROL						
C _{RANGE}	Control Range		-53	-50	-47	dB
A _{STEP}	Step Resolution		0.5	1	2	dB
AUDIO OUTPUTS						
V _{CLIP}	Clipping Level	d = 0.3%	1.8	2.2		V _{RMS}
R _L	Output Load Resistance		2			kΩ
C _L	Output Load Capacitor				10	nF
R _{OUT}	Output impedance			30	100	Ω
G _{OUT}	Output Gain		3	4	5	dB
V _{DC}	DC Voltage Level		4	4.2	4.4	V
GENERAL						
e _{NO}	Output Noise	BW=20Hz to 20 kHz all gain = 0dB		15	25	μV
S/N	Signal to Noise Ratio	all gain = 0dB flat; V ₀ =2V _{RMS}		100		dB
d	Distortion	V _{IN} =1V _{RMS} ; all stages 0dB		0.1	0.3	%
Sc	Channel Separation Left/Right		80	90		dB

STEREODECODER PART

- No External components necessary
- PLL with adjustment fully integrated VCO
- Automatic pilot dependent MONO/STEREO switching
- Very high suppression of intermodulation and interference
- Highcut and Stereoblend characteristics programmable in a wide range
- Internal noiseblanker with threshold controls
- I²C bus control of all necessary functions

ELECTRICAL CHARACTERISTICS

V_{DD} = 8.5V, Deemphasis time const = 50μs, V_{MPX} = 500mV, In Gain = 6dB, 75kHz deviation, f = 1kHz, T_{amb} = 25°C, unless otherwise specified

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
V _{IN}	MPX Input Level	Input Gain = 3.5dB		0.5	1.25	V _{RMS}
R _{in}	Input Resistance		70	100	130	kΩ
Gain	Minimum Input Gain		1.5	3.5	4.5	dB
G _{max}	Maximum Input Gain		8.5	11	12.5	dB
G _{STEP}	Step Resolution		1.75	2.5	3.25	dB
α	Max Channel Separation		25	40		dB
MONO/STEREO SWITCH						
V _{PTHST}	Pilot Threshold Voltage		10	15	25	mV
V _{PTHMO}	Pilot Threshold Voltage		7	12	17	mV
PLL						
Δf/f	Capture Range			0.5		%
DEEMPHASS and HIGHCUT						
τ _{HC50}	Deemphasis Time Constant	Stereodecoder-Byte D5=0 V _{LEVEL} >> V _{HCH}	25	50	75	μs
τ _{HC75}	Deemphasis Time Constant	Stereodecoder-Byte D5=1 V _{LEVEL} >> V _{HCH}	50	75	100	μs
τ _{HC50}	Highcut Time Constant	Stereodecoder-Byte D5=0 V _{LEVEL} >> V _{HCH}	100	150	200	μs
τ _{HC75}	Highcut Time Constant	Stereodecoder-Byte D5=1 V _{LEVEL} >> V _{HCH}	150	225	300	μs
STEREOBLEND and HIGHCUT CONTROL						
REF5V	Internal Reference Voltage		4.8	5	5.2	V
L _{Gmin}	Min. LEVEL Gain		-1	0	+1	dB
L _{Gmax}	Max. LEVEL Gain		8	10	12	dB

ELECTRICAL CHARACTERISTICS (continued)

$V_{DD} = 8.5V$, Deemphasis time const = $50\mu s$, $V_{MPX} = 500mV$, In Gain = 6dB, 75kHz deviation, $f = 1kHz$, $T_{amb} = 25^{\circ}C$, unless otherwise specified

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
L_{Gstep}	LEVEL Gain Step Resolution		0.3	0.67	1	dB
$VSBLmin$	Min. Voltage for Mono		29	33	37	%REF5V
$VSBLmax$	Max. Voltage for Mono		54	58	62	%REF5V
$VSBLstep$	Step Resolution		5	8.4	12	%REF5V
Groll	Roll off Compensation			2.5		dB
$VHCHmin$	Min. voltage for no highcut		36	42	46	%REF5V
$VHCHmax$	Max. voltage for no highcut		62	66	70	%REF5V
$VHCHstep$	Step Resolution		5	8.4	12	%REF5V
$VHCLmin$	Min. voltage for full highcut		13	17	21	%VHCH
$VHCLmax$	Max. voltage for full highcut		29	33	37	%VHCH
CARRIER and HARMONIC SUPPRESSION AT THE OUTPUT						
α_{19}	Pilot Signal	$f = 19kHz$		40		dB
α_{39}	Subcarrier	$f = 38kHz$		40		dB
α_{57}	Subcarrier	$f = 57kHz$		55		dB
α_{76}	Subcarrier	$f = 76kHz$		65		dB
ACI - ADJACENT CHANNEL INTERFERENCE (note 1)						
α_{114}	Signal	$f = 114kHz$		80		dB
α_{190}	Signal	$f = 190kHz$		70		dB

Note: 1. ACI (Adjacent Channel Interference) measured with 90% mono signal; 9% pilot signal; 1% spurious signal.

NOISE BLANKER PART

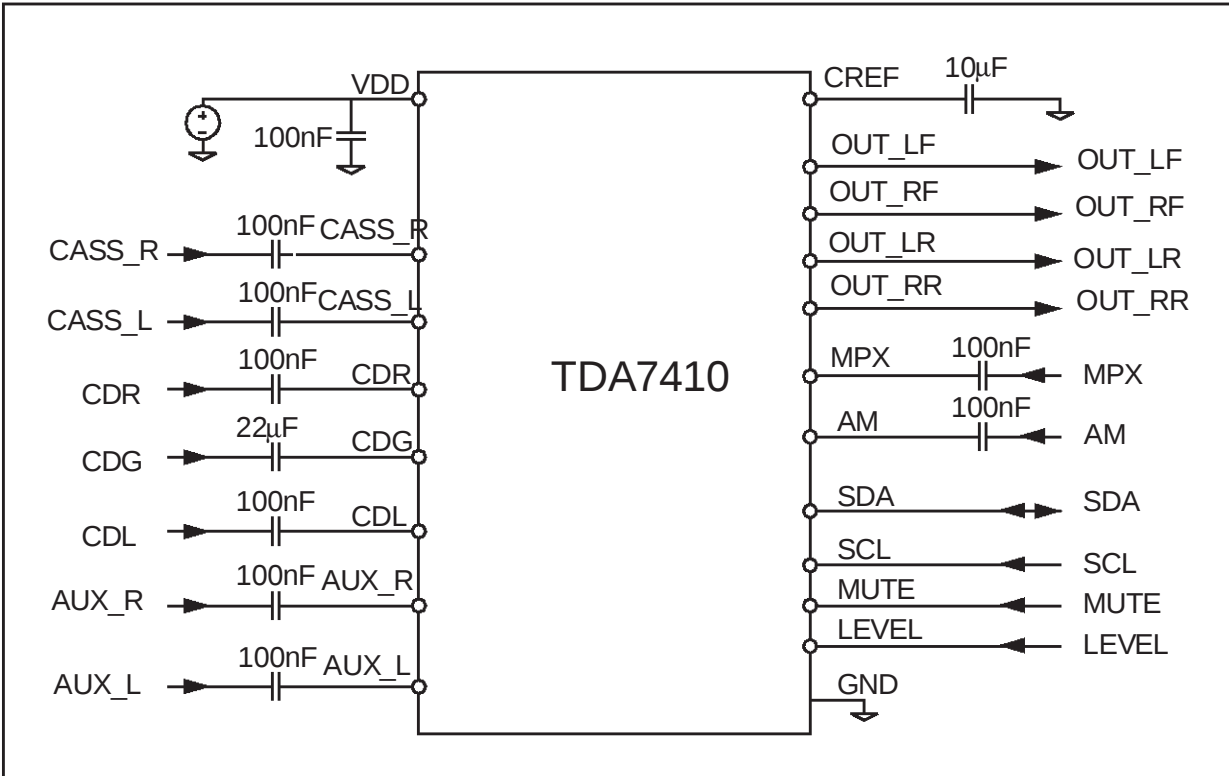
- Internal highpass filter
- Programmable trigger threshold
- Additional circuit for trigger adjustment (deviation, field-strength)
- Very low offset current during hold time
- Selectable pulse suppression times

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
V _{TH}	Trigger Threshold	means. with V _{PEAK} =0.9V	NBT=111		30		mV _{OP}
			NBT=110		35		mV _{OP}
			NBT=101		40		mV _{OP}
			NBT=100		45		mV _{OP}
			NBT=011		50		mV _{OP}
			NBT=010		55		mV _{OP}
			NBT=001		60		mV _{OP}
			NBT=000		65		mV _{OP}
V _{TRNOISE}	Noise Controlled Trigger Threshold	means. with V _{PEAK} =1.5V	NCT=00		260		mV _{OP}
			NCT=01		220		mV _{OP}
			NCT=10		180		mV _{OP}
			NCT=11		140		mV _{OP}
V _{RECT}	Rectifier Voltage	V _{MPX} = 0mV		0.5	0.9	1.3	V
		V _{MPX} = 50mV; f = 150kHz		1.5	1.7	2.1	V
		V _{MPX} = 100mV; f = 150kHz		2.2	2.5	2.9	V
V _{RECT DEV}	deviation dependent rectifier voltage	means. with V _{MPX} =800mV (75kHz dev.)	OVD=11	0.5	0.9(off)	1.3	V _{OP}
			OVD=10	0.9	1.2	1.5	V _{OP}
			OVD=01	1.7	2.0	2.3	V _{OP}
			OVD=00	2.5	2.8	3.1	V _{OP}
V _{RECT FS}	Fieldstrength Controlled Rectifier Voltage	means. with V _{MPX} =0mV V _{LEVEL} <<V _{SBL} (fully mono)	FSC=11	0.5	0.9(off)	1.3	V
			FSC=10	1	1.3	1.6	V
			FSC=01	1.5	1.8	2.1	V
			FSC=00	2	2.3	2.6	V

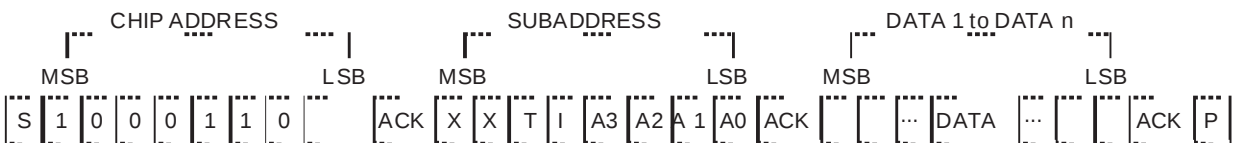
Notes: 1. NBT represents the Noiseblanker-Byte D2–D0 for the noise blanker trigger threshold
 2. NAT represents the Noiseblanker-Byte D4–D3 for the noise controlled trigger adjustment
 3. OVD represents the Noiseblanker-Byte D7–D6 for the over deviation detector
 4. FSC represents the Fieldstrength-Byte D1–D0 for the fieldstrength control

Figure 1. Application Example



I²C BUS INTERFACE DESCRIPTION

- Interface Protocol
- The interface protocol comprises:
 - a start condition (S)
 - a chip address byte (the LSB bit determines read/write transmission)
 - a subaddress byte
 - a sequence of data (N-byte + acknowledge)
 - a stop condition (P)



S = Start
 ACK = Acknowledge
 T = Testing
 I = Autoincrement
 P = Stop
 MAX Clock Speed 500kbts/s

The transferred data is automatically updated after each ACK.
 Transmission can be repeated without new chip address.

Auto increment

If bit I in the subaddress byte is set to "1", the autoincrement of the subaddress is enabled.

TRANSMITTED DATA (send mode)



ST = Stereo

SUBADDRESS (receive mode)

MSB				LSB				Function
X	X	T	I	A3	A2	A1	A0	
				0	0	0	0	Source Selector / Bass
				0	0	0	1	Volume Control
				0	0	1	0	Speaker Attenuator LF
				0	0	1	1	Speaker Attenuator LR
				0	1	0	0	Speaker Attenuator RF
				0	1	0	1	Speaker Attenuator RR
				0	1	1	0	Treble / Level Gain
				0	1	1	1	Stereodecoder Adjustment
				1	0	0	0	Noiseblanker Adjustment
				1	0	0	1	Fieldstrength Control
				1	0	1	0	Test

DATA BYTE SPECIFICATION

Source Selector / Bass

MSB				LSB				FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Source Selector / Bass
					0	0	0	Source Selector
					0	0	1	CD
					0	1	0	Cassette
					0	1	0	Aux
					0	1	1	AM
					1	0	0	Stereo Decoder
					1	0	1	Mute
					1	1	0	Not Used
					1	1	1	Not Used
	0	0	0	0				Bass
	0	0	0	1				-14dB
	:	:	:	:				-12dB
	0	1	1	0				:
	0	1	1	1				-2dB
	1	1	1	1				0dB
	1	1	1	0				0dB
	:	:	:	:				+2dB
	1	0	0	1				:
	1	0	0	0				+12dB
								+14dB
0								DC-Gain = 0dB
1								DC-Gain = ± 4.4 dB

Volume Control

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Volume Control
	0	0	0	0	0	0	0	Gain / Attenuation
	0	0	0	0	0	0	1	+32dB
	:	:	:	:	:	:	:	+31dB
	0	0	0	1	1	0	0	:
	0	0	0	1	1	0	1	+20dB
	0	0	0	1	1	1	0	+19dB
	:	:	:	:	:	:	:	+18dB
	0	0	1	1	1	1	1	:
	0	1	0	0	0	0	0	+1dB
	0	1	0	0	0	0	1	0dB
	:	:	:	:	:	:	:	-1dB
	1	1	0	1	1	1	0	:
	1	1	0	1	1	1	1	-78dB
								-79dB
x								Not used

Note: It is not recommended to use a gain more 20dB for system performance reason. In general, the max. gain should be limited by software to the maximum value, which is needed for the system.

Speaker Attenuation

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Speaker Attenuation LF (LR,RF,RR)
		0	0	0	0	0	0	Attenuation
		0	0	0	0	0	1	0dB
		:	:	:	:	:	:	-1dB
		0	1	0	1	1	1	:
		0	1	1	0	0	0	-23dB
		0	1	1	0	0	1	-24.5dB
		0	1	1	0	1	0	-26dB
		0	1	1	0	1	1	-28dB
		0	1	1	1	0	0	-30dB
		0	1	1	1	0	1	-32dB
		0	1	1	1	0	1	-35dB
		0	1	1	1	1	0	-40dB
		0	1	1	1	1	1	-50dB
		1						Speaker Mute
x	x							Not used

Treble / Level Gain

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Treble / Level Gain
				0	0	0	0	Treble -14dB
				0	0	0	1	-12dB
				:	:	:	:	:
				0	1	1	0	-2dB
				0	1	1	1	0dB
				1	1	1	1	0dB
				1	1	1	0	+2dB
				:	:	:	:	:
				1	0	0	1	+12dB
				1	0	0	0	+14dB
0	0	0	0					LEVEL Gain 0dB
0	0	0	1					0.66dB
0	0	1	0					1.33dB
:	:	:	:					:
1	1	1	1					10dB

Stereodecoder Adjustment

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Stereodecoder Adjustment
							0	STD Unmuted
							1	STD Muted
					0	0		In-Gain 11dB
					0	1		In-Gain 8.5dB
					1	0		In-Gain 6dB
					1	1		In-Gain 3.5dB
				0				Forced MONO
				1				MONO/STEREO switch automatically
			0					Pilot Threshold HIGH
			1					Pilot Threshold LOW
		0						Deemphasis Threshold 50μs
		1						Deemphasis Threshold 75μs
0	0							Blank Time Adj 38μs
0	1							25.5μs
1	0							32μs
1	1							22μs

Noiseblanker Adjustment

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Noiseblanker
					0 0 0 0 1 1 1 1	0 0 1 1 0 0 1 1	0 1 0 1 0 1 0 1	Low Threshold 65mV Low Threshold 60mV Low Threshold 55mV Low Threshold 50mV Low Threshold 45mV Low Threshold 40mV Low Threshold 35mV Low Threshold 30mV
			0 0 1 1	0 1 0 1				Noise Controlled Threshold 260mV Noise Controlled Threshold 220mV Noise Controlled Threshold 180mV Noise Controlled Threshold 140mV
		0 1						Noise Blanker OFF Noise Blanker ON
0 0 1 1	0 1 0 1							Over deviation Adjust 2.8V Over deviation Adjust 2.0V Over deviation Adjust 1.2V Over deviation Adjust OFF

Fieldstrength Control

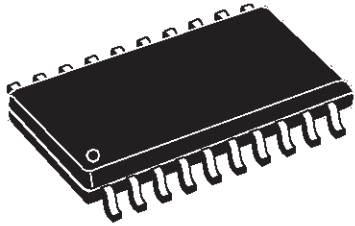
MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Fieldstrength Control
						0 0 1 1	0 1 0 1	NoiseBlanker Field strength Adj 2.3V NoiseBlanker Field strength Adj 1.8V NoiseBlanker Field strength Adj 1.3V NoiseBlanker Field strength Adj OFF
				0 0 1 1	0 1 0 1			VSBL at 33% REF 5V VSBL at 42% REF 5V VSBL at 50% REF 5V VSBL at 58% REF 5V
		0 0 1 1	0 1 0 1					VHCH at 42% REF 5V VHCH at 50% REF 5V VHCH at 58% REF 5V VHCH at 66% REF 5V
	1 0							VHCL at 17% VHCH VHCL at 33% VHCH
0 1								High cut OFF High cut ON

Test

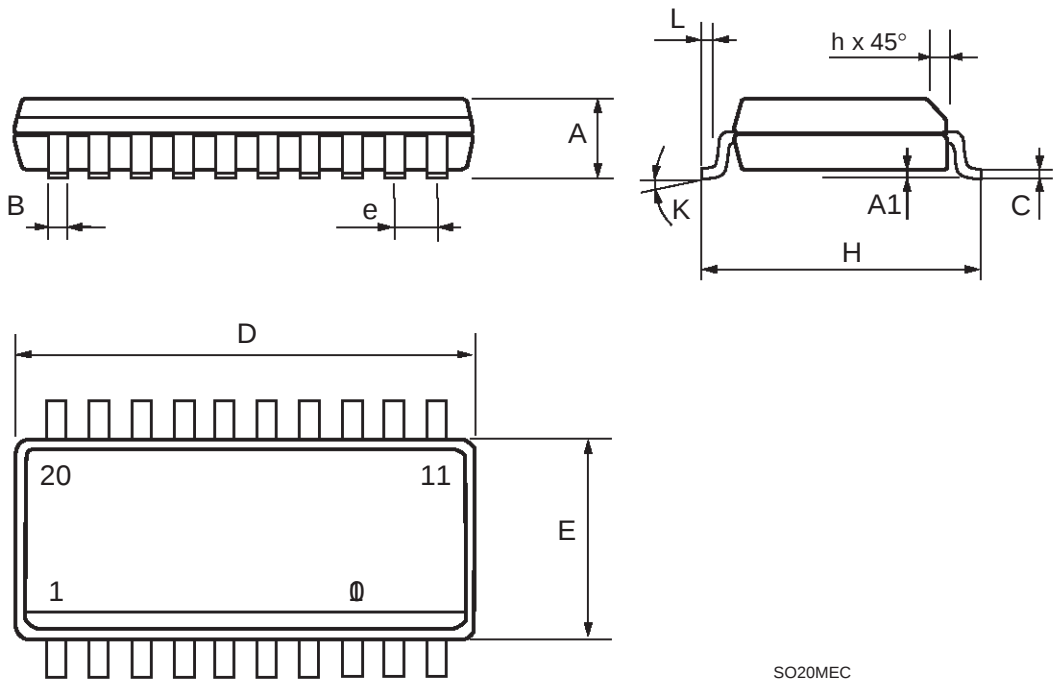
MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	Test
							0 1	Stereodecoder Test Signal OFF Test signal enabled
						0 1		External Clock Internal Clock
		0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 1	0 0 0 0 1 1 1 1 0 0 0 1 0 1 1 1 1	0 0 1 1 0 1 1 1 0 0 1 1 0 0 1 1 1	0 1 0 1 0 1 1 1 0 0 1 0 1 0 1 0 1			Test Signal VHCCH Level internal Pilot magnitude VCO control voltage Pilot Threshold HOLDN NB threshold F228 VHCCL VSBL TBD TBD PEAK TBD REF5V TBD
	0 1							VCO OFF ON
0 1								Audio Processor Test Mode Enabled OFF

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.3	0.004		0.012
B	0.33		0.51	0.013		0.020
C	0.23		0.32	0.009		0.013
D	12.6		13	0.496		0.512
E	7.4		7.6	0.291		0.299
e		1.27			0.050	
H	10		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
K	0° (min.)8° (max.)					

**OUTLINE AND
MECHANICAL DATA**



SO20



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