TELEFUNKEN ELECTRONIC

U 4260 B

DIGITAL CONTROLLED STEREO AUDIO PROCESSOR T-74-05-01

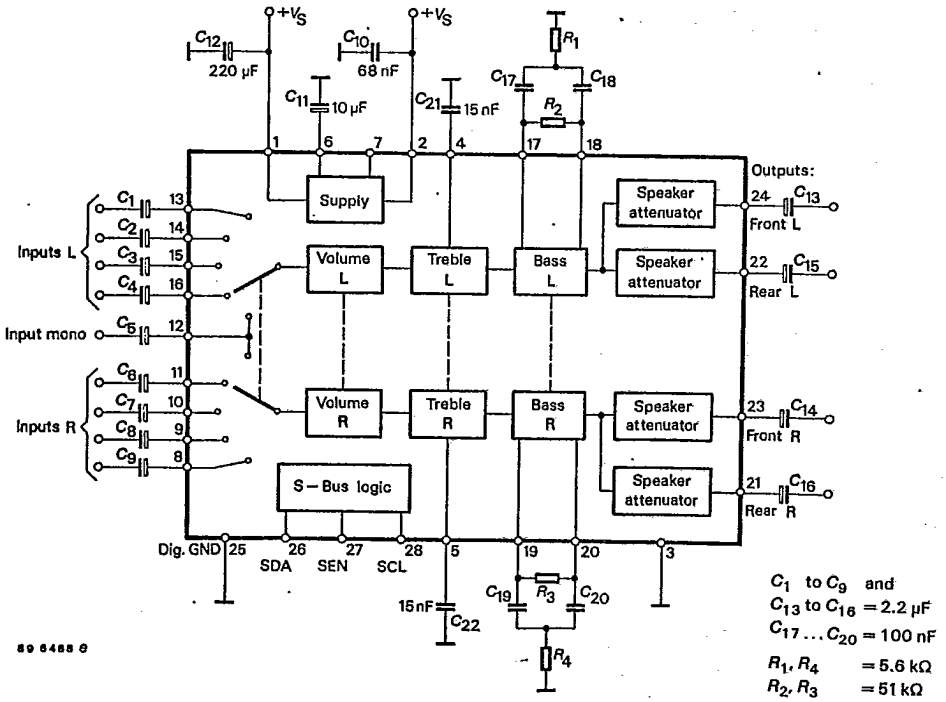
Technology: Bipolar

Features:

- Single supply operation
- Four stereo input source selection
- Mono input
- Treble, bass, volume and balance control
- Four independent output controls
- Programmable via serial bus
- Low noise figure
- Very low noise and distortion
- Noise free switching

Case:

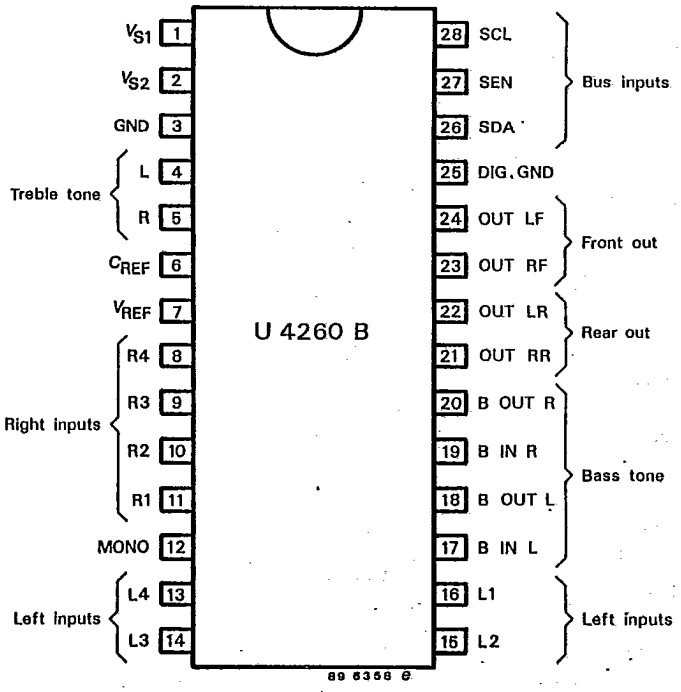
DIP 28



C_1 to C_9 and
C_{13} to C_{16} = 2.2 µF
$C_{17} \ldots C_{20}$ = 100 nF
R_1, R_4 = 5.6 kΩ
R_2, R_3 = 51 kΩ

Block diagram

T1.2/2167.0690 E



Connection diagram

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Circuit description

The integrated circuit U 4260 B is a volume, tone (bass and treble) and fader (front/rear) processor for high quality audio applications in car radio and Hi-Fi systems. Control is accomplished by serial bus microprocessor interface.

The AC signal setting is obtained by resistor networks and analog switches combined with operational amplifiers.
The results are: low noise, low distortion and high dynamic range.

Absolute maximum ratings

Reference point pin 3, 25, $T_{amb} = 25$ °C, unless otherwise specified

Supply voltage	Pin 1	V_S	18	V
Power dissipation		P_{tot}	2	W
Ambient temperature range		T_{amb}	−40...+ 85	°C
Storage temperature range		T_{stg}	−55...+150	°C
Junction temperature		T_j	150	°C

Maximum thermal resistance

Junction ambient		R_{thJA}	65	K/W

Electrical characteristics

Reference point pin 3, $T_{amb} = 25$ °C, $R_L = 10$ kΩ, $R_g = 600$ Ω, $f = 1$ kHz, $V_{S(1)} = 12$ V or $V_{S(2)} = 8.5$ V, unless otherwise specified

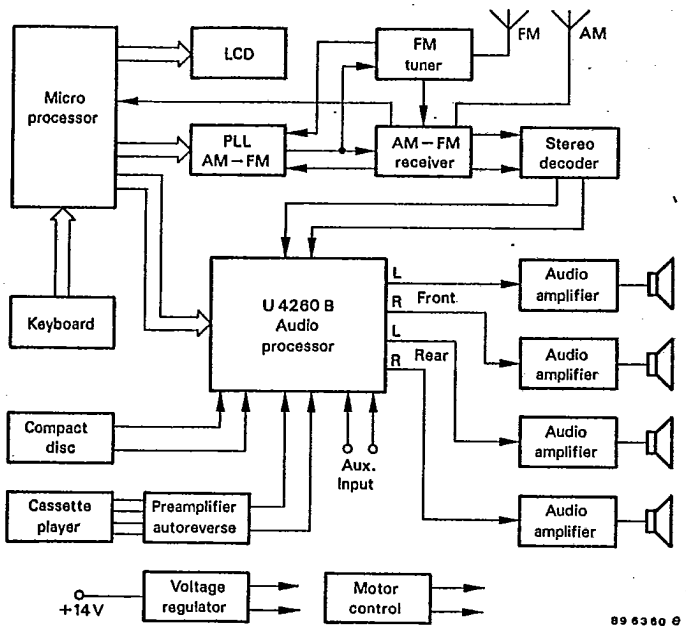
			Min.	Typ.	Max.	
Supply						
Supply voltages [1]	Pin 1	$V_{S(1)}$	10	12	16	V
	Pin 2	$V_{S(2)}$	6	8.5	10	V
Supply current	Pin 1, 2	I_S	20	30	40	mA
Reference voltage	Pin 7	V_{Ref}	3.5	4.3	5	V
Supply voltage rejection ratio $f = 300$ Hz...10 kHz	Pin 1	SVR	80	100		dB
	Pin 2	SVR	46	60		dB
Inputs	Pin 8...16					
Input resistance		R_I	30	45		kΩ
Input signal, max. $d = 0.3\%$, $G_V = 0$ dB		V_I	1.5	2.2		V
Channel separation						
$f = 1$ kHz		Ch sep.	90	100		dB
$f = 10$ kHz		Ch sep.	70	80		dB
DC voltage level		V_I	3.5	4.3	5	V
Volume controls	Pin 8...16					
Control range				78		dB
Max. gain		G		10		dB
Max. attenuation			64	68		dB
Step resolution $G_V = -50...+10$ dB				2	3	dB
Attenuation set error $G_v = -50...+10$ dB					2	dB
Tracking error					2	dB

			Min.	Typ.	Max.	
Output attenuators	Pin 21...24					
Control range			35	38	41	dB
Step resolution				2	3	dB
Attenuator set error					2	dB
Tracking error					2	dB
Bass and treble control [2]	Pin 4, 5, 17...20					
Control range				±15		dB
Step resolution				2.5	3.5	dB
Audio output	Pin 21...24					
Output voltage $d = 0.3\%$		V_O	1.5	2.2		V
Output load resistance		R_L	2			kΩ
Output load capacitance		C_L		1		nF
Output resistance				70	150	Ω
DC voltage level		V_O	3.5	3.8	4.5	V
Output noise voltage						
$G_v = 0$ dB, B = 22 Hz...22 kHz		V_{no}		6		µV
$G_v = 0$ dB, A weighted		V_{no}		4		µV
Signal to noise ratio $G = 0$ dB, B = 22 Hz...22 kHz, $V_o = 1$ V		$\frac{(S+N)}{N}$		105		dB
Distortion $f = 1$ kHz, $V_o = 1$ V, $G_v = 0$		d		0.01	0.1	%
Frequency response (−1 dB)	High	f	20			kHz
	Low	f			30	Hz
Channel separation						
$f = 1$ kHz		Ch sep.	90	100		dB
$f = 10$ kHz		Ch sep.	70	80		dB
Bus inputs						
SDA	Pin 26					
SEN	Pin 27					
SCL	Pin 28					
DIG. GND	Pin 25					
Input low voltage		V_i			0.8	V
Input high voltage		V_i	2			V
Output voltage (SDA acknowledge) $I = 1.6$ mA		V_o			0.4	V

[1] The circuit can be supplied either at V_{s1} or at V_{s2} without the use of the internal voltage regulator. The circuit also operates at a supply voltage V_{s1} lower than 10 V. In this case the ripple rejection of V_{s2} is valid, because the voltage regulator saturates to about 0.8 V.

[2] Bass and treble response see attached diagram. The center frequency and quality of the resonance behaviour can be choosen by the external circuitry. A standard first order bass response can be realized by a standard feedback network.

APPLICATION INFORMATION

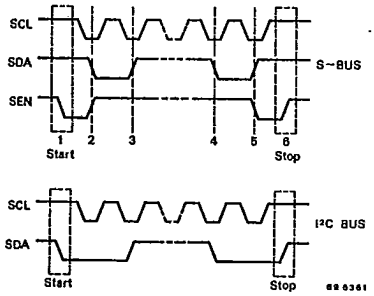


SERIAL BUS INTERFACE

S-BUS Interface and I²CBUS compatibility

Data transmission from microprocessor to the U 4260 B and viceversa takes place through the 3-wire S-BUS interface, consisting of the three lines SDA, SCL, SEN. If SDA and SEN inputs are short-cicuited together, then the U 4260 B appears as a standard I²CBUS slave.

In this case the µP can be programmed to generate the two different transmission systems: the S-BUS using the three lines of the serial bus, and the I²CBUS using the SCL and SDA lines only.



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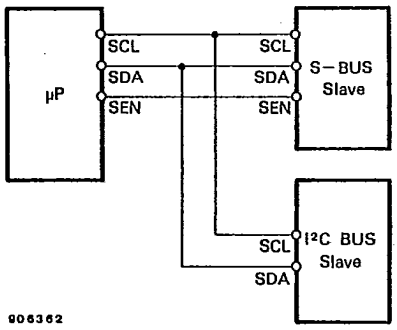
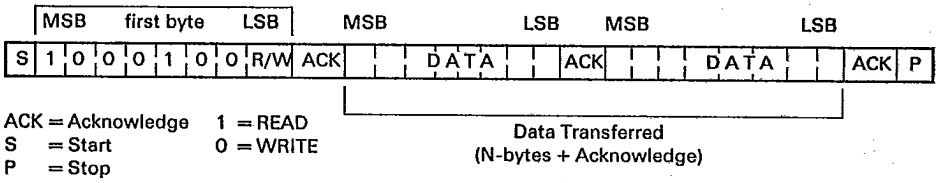
Interface Protocol

The interface protocol comprises:

- A start condition (S)
- A chip address byte, containing the U 4260 B address and the direction of the transmission on the BUS (this information is given in the 8th bit of the Byte: "0" means "write", that is from the master to the slave, while "1" means "read"). The U 4260 B must always acknowledge at the end of each transmitted byte.
- A sequence of data (N-bytes + acknowledge)
- A stop condition (P)



U 4620 B Adress



SOFTWARE SPECIFICATION

Chip address (U 4260 B address)

1 0 0 0 1 0 0 0
MSB LSB

DATA BYTES

MSB							LSB	Function
0	0	B2	B1	B0	A2	A1	A0	Volume control
1	1	0	B1	B0	A2	A1	A0	Speaker ATT LR
1	1	1	B1	B0	A2	A1	A0	Speaker ATT RR
1	0	0	B1	B0	A2	A1	A0	Speaker ATT LF
1	0	1	B1	B0	A2	A1	A0	Speaker ATT RF
0	1	0	X	X	S2	S1	S0	Audio switch
0	1	1	0	C3	C2	C1	C0	Bass control
0	1	1	1	C3	C2	C1	C0	Treble control

X = don't care
Ax = 2 dB steps
Bx = 10 dB steps
Cx = 2.5 dB steps

Status after power-on reset

Volume	−68 dB
Speaker	−38 dB
Audio switch	Mono
Bass	+2.5 dB
Treble	+2.5 dB

DATA BYTES (detailed description)
Volume

MSB							LSB	Function
0	0	B2	B1	B0	A2	A1	A0	Volume 2 dB steps
					0	0	0	0
					0	0	1	−2
					0	1	0	−4
					0	1	1	−6
					1	0	0	−8
					1	0	1	Not allowed
					1	1	0	Not allowed
					1	1	1	Not allowed
0	0	B2	B1	B0	A2	A1	A0	Volume 10 dB steps
		0	0	0				+10
		0	0	1				0
		0	1	0				−10
		0	1	1				−20
		1	0	0				−30
		1	0	1				−40
		1	1	0				−50
		1	1	1				−60

For example if you want setting the volume at −32 dB the 8 bit string is: 00100001

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SPEAKER ATTENUATORS

MSB							LSB	Function
1	0	0	B1	B0	A2	A1	A0	Speaker LF
1	0	1	B1	B0	A2	A1	A0	Speaker RF
1	1	0	B1	B0	A2	A1	A0	Speaker LR
1	1	1	B1	B0	A2	A1	A0	Speaker RR
					0	0	0	0
					0	0	1	−2
					0	1	0	−4
					0	1	1	−6
					1	0	0	−8
					1	0	1	Not allowed
					1	1	0	Not allowed
					1	1	1	Not allowed
		0	0					0
		0	1					−10
		1	0					−20
		1	1					−30

For example attenuation of 24 dB on speaker RF is given by:

1 0 1 1 0 0 1 0

Audio input switches

MSB							LSB	Function
0	1	0	X	X	S2	S1	S0	Audio Switch
			X	X	0	0	0	Stereo 1
			X	X	0	0	1	Stereo 2
			X	X	0	1	0	Stereo 3
			X	X	0	1	1	Stereo 4
			X	X	1	0	0	Mono
			X	X	1	0	1	Not allowed
			X	X	1	1	0	Not allowed
			X	X	1	1	1	Not allowed

X = don't care

For example to set the stereo 2 channel the 8 bit string may be:

0 1 0 0 0 0 0 1

Bass and treble—Control range of ±15 dB (boost and cut) steps of 2.5 dB

MSB							LSB	Function
0	1	1	0	C3	C2	C1	C0	Bass
0	1	1	1	C3	C2	C1	C0	Treble
				0	0	0	0	−15
				0	0	0	1	−15
				0	0	1	0	−12.5
				0	0	1	1	−10
				0	1	0	0	−7.5
				0	1	0	1	−5
				0	1	1	0	−2.5
				0	1	1	1	−0
				1	1	1	1	+0
				1	1	1	0	+2.5
				1	1	0	1	+5
				1	1	0	0	+7.5
				1	0	1	1	+10
				1	0	1	0	+12.5
				1	0	0	1	+15
				1	0	0	0	+15

C3 = Sign

For example Bass at −12.5 dB is obtained by the following 8 bit string:

0 1 1 0 0 0 1 0

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Dimensions in mm

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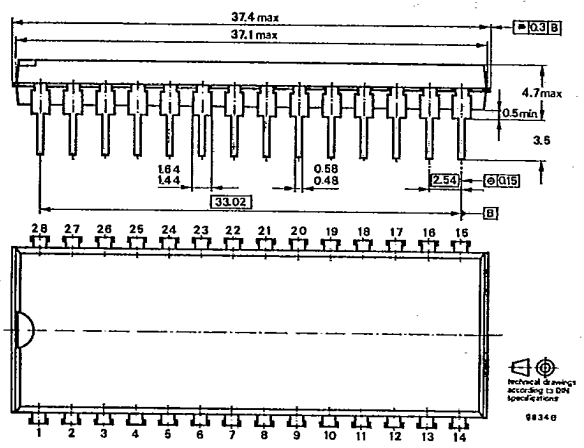

Case
DIP 28