TDA7420

MULTIFUNCTION AUDIO PROCESSOR

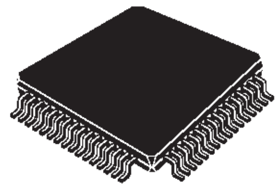
CASSETTE PREAMPLIFIER:
- FORWARD/REVERSE INPUTS GROUND COMPATIBLE
- INTERNAL SWITCHES FOR EQUALIZATION
- INTERNAL ADJUSTMENT FOR TRAKING
- INTERNAL ADJUSTMENT FOR OUTPUT

AMS:
- INPUT GAIN CONTROL
- ADJUSTABLE GAIN VERSUS FREQUENCY

AUDIOPROCESSOR:
- INPUTS: 1 FULLY DIFFERENTIAL, 1 DIFFERENTIAL, 1 STEREO AND 1 MONO
- INPUT GAIN FROM 0 TO 15dB (1dB STEP)
- VOLUME CONTROL FROM +16 TO -63dB (1dB STEP)
- BASS AND TREBLE CONTROL FROM -18 TO 18dB (1dB STEP)
- DIRECT MUTE, SOFT MUTE AND RADIO MUTE
- FOUR INDEPENDENT OUTPUT STAGES:
  - ATTENUATION CONTROL FROM 0 TO -79dB (1dB STEP)
  - BEEP CONTROL (ON/OFF, FRONT/REAR)

STEREO DECODER:
- ROLL-OFF ADJUSTMENT
- SELECTABLE DEEMPHASIS
- 19KHz CANCELLATION
- HIGH CUT CONTROL
- STEREO BLEND

NOISE BLANKER
- AUTOMATIC THRESHOLD CONTROL AND PROGRAMMABLE TRIGGER THRESHOLD
- INTEGRATED HIGH PASS FILTER
- PACKAGE: TQFP64 (14x14)



TQFP 64 (14x14)

ORDERING NUMBER: TDA7420

DESCRIPTION

The TDA7420 I^2C bus controlled multifunction audio processor contains all signal processing blocks of a high performance car radio, including audioprocessor, stereodecoder, noise blanker, different mute functions, cassette preamplifier and AMS function.

The use of BICMOS technology allows the implementation of several filter functions with switched capacitor techniques like fully integrated, adjustment free PLL Loop filter, pilot detector with integrator.

This minimizes the number of external components.

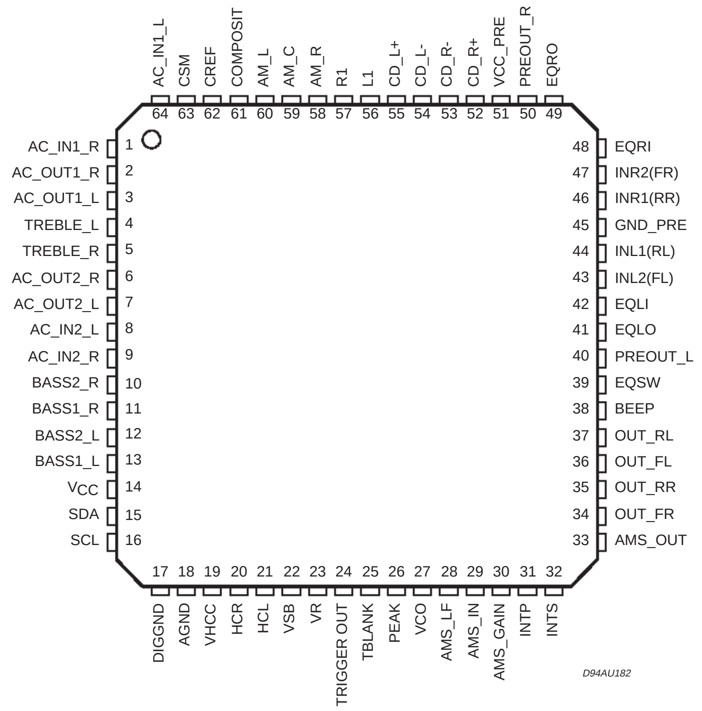
Due to a highly linear signal processing, using CMOS-switching techniques instead of standard bipolar multipliers, very low distortion and very low noise are obtained also in the stereodecoder part.

Very low DC stepping is obtained by use of the BICMOS technology.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_S	Operating Supply Voltage	10	V
T_{amb}	Operating Temperature Range	-40 to 85	°C
T_{stg}	Storage Temperature Range	-55 to 150	°C

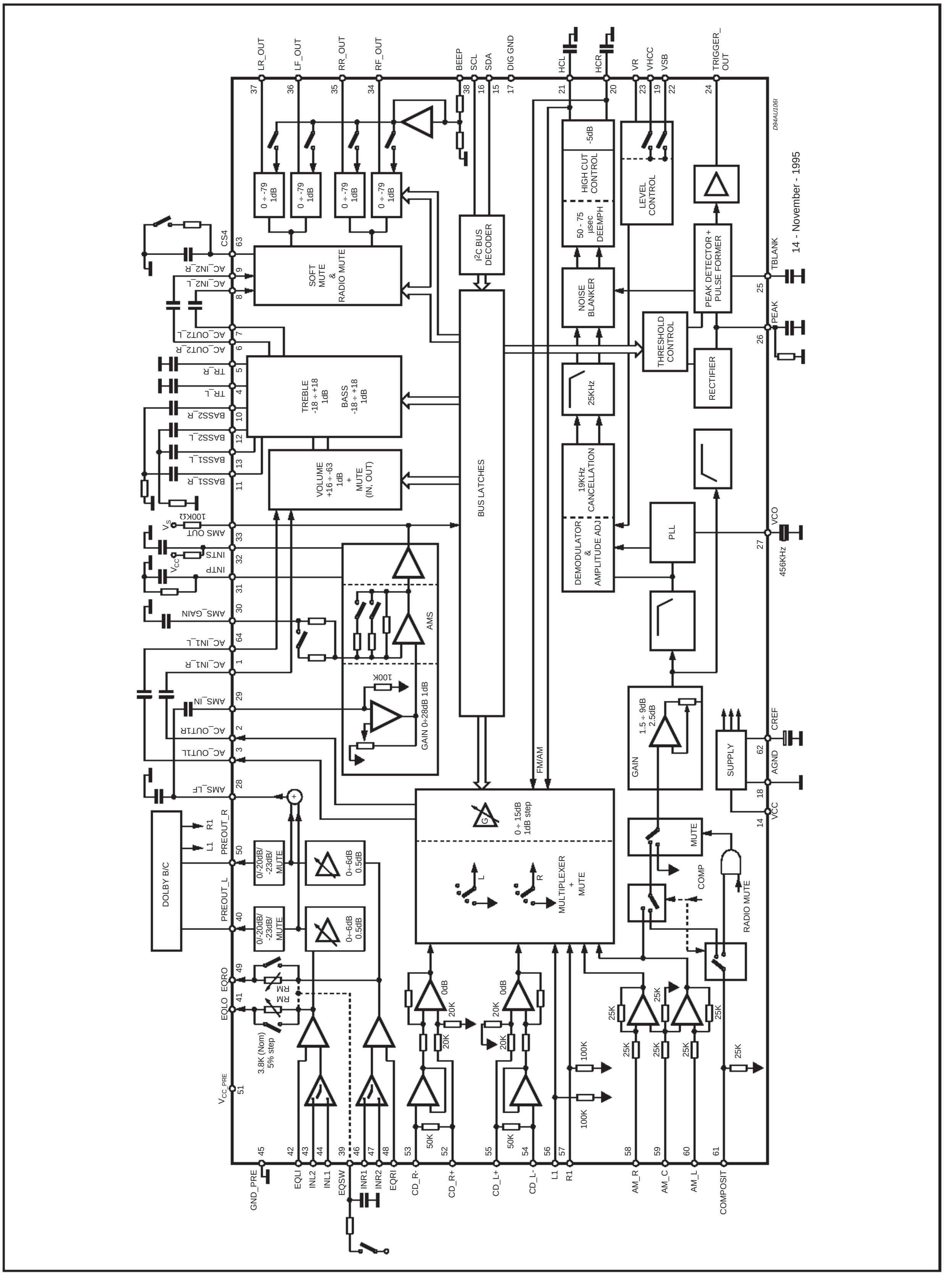
PIN CONNECTION



THERMAL DATA

Symbol	Parameter	Value	Unit
$R_{th\ j\text{-}pins}$	Thermal Resistance Junction-pins	max 85	°C/W

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS (V_S = 8.5V; T_{amb} = 25°C; R_L = 10KΩ; all gains = 0dB; f = 1KHz; unless otherwise specified, refer to the Test Circuit.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
INPUT SECTION Differential Input Pins 52, 53, 54, 55						
R_I	Input Resistance		37	50	63	KΩ
V_{CL}	Clipping Level	THD = 0.3%	2.0	2.5		Vrms
CMRR	Common Mode Rejection Ratio		45	55		dB
G_{DIFF}	Differential Gain		-1	0	1	dB
Stereo Input Pins 56, 57						
R_I	Input Resistance		75	100	125	KΩ
V_{CL}	Clipping Level		2.0	2.5		Vrms
Quasi Differential Input Pins 58, 59,60						
R_I	Input Resistance		18	25	32	KΩ
V_{CL}	Clipping Level		2.0	2.5		Vrms
Composite Input Pin 61						
R_I	Input Resistance		18	25	32	KΩ
V_{CL}	Clipping Level		2.0	2.5		Vrms
MULTIPLEXER						
R_O	Output Resistance (pin 2,3)		100	200	300	Ω
G_{IMIN}	Minimum Gain		-1	0	1	dB
G_{IMAX}	Maximum Gain		14	15	16	dB
G_{STEP}	Step Resolution		0.5	1	1.5	dB
V_{DC}	Dc Steps	Adjacent Gain Step	-5	1	5	mV
		G_{MIN} to G_{MAX}		2		mV
VOLUME CONTROL						
R_I	Input Resistance (1, 64)		24	33	42	KΩ
C_{MAX}	Max Gain		15	16	17	dB
A_{MAX}	Max Attenuation			63		dB
A_{STEPC}	Step Resolution Coarse Attenuation	A_V = 16 to -40dB	0.5	1.0	1.5	dB
E_A	Attenuation Set Error	G =16 to -40dB	-1.5	0	1.5	dB
E_T	Tracking Error				2	dB
V_{DC}	DC Steps	Adjacent Attenuation Steps	-3	0.1	3	mV
		from 0dB to A_{MAX}		0.5	5	mV
SOFT MUTE						
A_{MUTE}	Mute Attenuation		40	50		dB
t_D	Delay Time	C_{EXT} = 22nF; 0 to -20dB; I = I_{MAX}		1.0		ms
		I = I_{MIN}		23		ms
BASS CONTROL						
C_{RANGE}	Control Range		±15	±18	±20	dB
A_{STEP}	Step Resolution		0.5	1	1.5	dB
R_B	Internal Feedback Resistance		48	65	82	KΩ

ELECTRICAL CHARACTERISTICS (continued.)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
TREBLE CONTROL						
C_{RANGE}	Control Range		±17	±18	±19	dB
A_{STEP}	Step Resolution		0.5	1	1.5	dB
R_T	Internal Feedback Resistance		37	50	63	KΩ
SPEAKER ATTENUATORS						
C_{RANGE}	Control Range			79		dB
A_{STEP}	Step Resolution	A_V = 0 to -40dB	0.5	1	1.5	dB
A_{MUTE}	Output Mute Attenuation		80	100		dB
E_A	Attenuation Set Error	A_V = 0 to -40dB			1.50	dB
V_{DC}	DC Step	Adjacent Attenuation Steps		0.1	3	mV
AUDIO OUTPUTS						
V_{CLIP}	Clipping Level	d = 0.3%	2.0	2.5		V_{RMS}
R_L	Output Load Resistance		2			KΩ
R_{OUT}	Output Impedance		100	200	300	Ω
V_{DC}	DC Voltage Level		3.35	3.6	3.85	V
GENERAL						
E_{NO}	Output Noise	BW = 20Hz to 20KHz, flat Output Muted All gains = 0dB		 4.0 5.0	 15	 µV µV
S/N	Signal to Noise Ratio	All gains 0dB; V_O = 1V_{RMS} ;		106		dB
d	Distortion	V_I = 1V_{RMS} ;		0.01	0.08	%
S_C	Channel Separation Left/Right		80	95		dB
E_T	Total Tracking Error	A_V = 0 to -20dB;		0	1	dB
		A_V = -20 to -40dB;		0	2	dB
BUS INPUT						
V_{IL}	Input Low Voltage				1	V
V_{IH}	Input High Voltage		3			V
I_{IN}	Input Current	V_{IN} = 0.4V	-5		5	µA
V_O	Output Voltage SDA Acknowledge	I_O = 1.6mA		0.1	0.4	V
SUPPLY						
V_{IL}	Supply Voltage		6.5	8.5	10.0	V
I_S	Supply Current	Stereo Decoder = ON	25	33	41	mA
		Stereo Decoder = OFF	20	28	35	mA
SVR	Ripple Rejection C_{ref} = 22µF	Audioprocessor		80		dB
		Stereo Decoder + Audioprocessor		60		dB

PREAMPLIFIER (V_S = 8.5V; T_{amb} = 25°C; R_{IN} = 600Ω; unless otherwise specified (see test circuit)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
R_I	Input Resistance		100			KΩ
$V_{out\ DC}$	Output Voltage DC (pin 40, 50)		3.2	3.5	3.9	V
R_O	Output Resistance (pins 40, 50)		100	200	300	Ω
I_I	Input Bias Current				10	µA
G_{VO}	Open Loop Gain	f = 400Hz		110		dB
G_V	Closed Loop Gain	NAB short	31	32.5	34	dB
R_N	Resistance Normal Position		50	250	500	Ω
R_{MLR}	Resistance Metal Position (left ,right)		2.85	3.8	4.75	KΩ
R_{MR}	Step Resolution (versus R_M)			5		%
R_{Mmax}	Maximum Value for R_M		3.42	4.56	5.7	KΩ
R_{Mmin}	Minimum Value for RM		2.28	3.04	3.8	KΩ
	Dolby Level Control	Control Range	5.5	6.0	6.5	dB
		Step Resolution	0.25	0.5	0.75	dB
S_R	Slew Rate	NAB Short		1		V/µs
e_N	Total Input Noise	R_{IN} = 600Ω; unweighted		0.8		µV
		R_{IN} = 600Ω; CCIR warn		0.5		µV
		R_{IN} = 0; unweighted		0.45		µV
	Output Attenuation Control	D1, D0 = 00	-0.75	0	0.75	dB
		D1, D0 = 01		-20		dB
		D1, D0 = 10		-23		dB
		D1, D0 = 11		-80		dB
THD	Total Harmonic Distortion	V_O = 1V; f = 1KHz metal		0.02		%
		V_O = 1V; f = 1KHz normal		0.02	0.1	%
		V_O = 1V; f = 10KHz metal		0.05		%
		V_O = 1V; f = 10KHz normal		0.04		%
		V_O = 2V; f = 1KHz				%
SVR_1	Ripple Rejection			75		dB
C_S	Channel Separation (L to R)		45	60		dB
C_{CT}	Channel Cross talk (F to R)		60	80		dB
S/N	Signal to Noise	V_O = 388mV; metal; CCIR arm		65		dB
AUDIO MUSIC SENSOR						
$IAMS_{OUT}$	AMS Output Current				5	mA
$VAMS_{OUT}$	AMS Output Low Level	IAM_{OUT} = 2mA		500	800	mV
R_{i-29}	Input Resistance AMS Gain	(pin 23)	75	100	125	KΩ
V_{TH1}	Interprogram Threshold Voltage		1.2	1.45	1.7	V
V_{TH2}	Interspace Threshold Voltage		4.8	5.2	5.6	V
AMS_{th}	AMS Threshold Level		2.0	2.8	3.6	V
V_{INTP}	INTP Output Voltage	I_{OUT} = 2mA		0.2	0.8	mV
V_{INTS}	INTS Output Voltage	I_{OUT} = 2mA		0.2	0.8	mV
	INTP Charge Current		50	70	150	µA
	INTS Charge Current		50	70	150	µA
S_G	Gain Sensitivity	min Gain V_{30} vs V_{29}		11		dB
		max Gain V_{30} vs V_{29}		42		dB
R_{i-30}	AMS Gain Resistance	D6, D5 = 00	13	17.5	22	KΩ
		D6, D5 = 01	16.5	22	27.5	KΩ
		D6, D5 = 11	75	100	125	KΩ

STEREO DECODER PART

ELECTRICAL CHARACTERISTICS (V_S = 8.5V; de-emphasis time: T = 50µs; nominal MPX input voltage on pin 61 (composite): V_{MPX} = 0.5V_{RMS} (75KHz deviation); modulation frequency = 1KHz; G_I = 1.5dB; T_{amb} = 27°C; unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
SVRR	Supply Voltage Ripple Rejection	V_{RIPPLE} = 100mV; f = 1KHz	50	65		dB
V_O	DC Output Voltage (HCL, HCR)		3.95	4.25	4.55	V
α	Channel Separation	V_{SB} - V_R = 100mV_{DC}		50		dB
THD	Total Harmonic Distortion			0.02	0.3	%
$\frac{S+N}{N}$	Signal Plus Noise to Noise Ratio	f = 20Hz to 16KHz; S = 2V_{RMS}		91		dB
MONO/ STEREO SWITCH						
V_{INTH}	Pilot Threshold Voltage	for stereo "ON" P_{th} = 1 P_{th} = 0	12 19	16 26	22 34	mV_{RMS} mV_{RMS}
V_{INTH}	Pilot Threshold Voltage	for stereo "OFF" P_{th} = 1 P_{th} = 0	8 16	14 22	20 28	mV_{RMS} mV_{RMS}
STEREO BLEND						
V_{SB-VR}	Control Voltage for Channel Separation	α = 6dB; (note 5)	-300	-250	-200	mV
		α = 26dB;		-80		mV
HIGH CUT CONTROL						
τ_{deemp}	De-Emphasis Time Constant	C_L, C_R = 1nF; STDDS = 0 V_{HCC} - V_R = 100mV	43	50	57	µs
		C_L, C_R = 1nF; STDDS = 1 V_{HCC} - V_R = 100mV	64	75	86	µs
R_{HCC}	High Cut Control Resistance	V_{HCC} - V_R = 100mV; STDDS = 0	43	50	57	KΩ
		V_{HCC} - V_R = -0.5V (note 5)	115	150	185	KΩ
VCO						
f_{OSC}	Oscillator Frequency			456		KHz
Δf/f	Capture and Hold Range		0.5	1		%
CARRIER AND HARMONIC SUPPRESSION AT THE OUTPUT						
α19	Pilot Signal f = 19KHz		40	55		dB
α38	Subcarrier f = 38KHz			75		dB
α57	Subcarrier f = 57KHz			62		dB
α76	Subcarrier f = 76KHz			90		dB
INTERMODULATION (note 1)						
α2	f_{mod} = 10KHz; f_{spur} = 1KHz			65		dB
α3	f_{mod} = 13KHz; f_{spur} = 1KHz			75		dB
TRAFFIC RADIO (note 2)						
α57	Signal f = 57KHz			70		dB
SCA - SUBSIDIARY COMMUNICATIONS AUTHORIZATION (note 3)						
α67	Signal f = 67KHz			75		dB
ACI - ADJACENT CHANNEL INTERFERENCE (note4)						
α114	Signal f = 114KHz			95		dB
α190	Signal f = 190KHz			84		dB

NOTES TO THE CHARACTERISTICS

1 INTERMODULATION SUPPRESSION

$$\alpha 2 = \frac{V_O \text{ (signal) (at1KHz)}}{V_O \text{ (spurious) (at1KHZ)}} \text{; } f_S = (2 \times 10KHz) - 19KHz$$

$$\alpha 3 = \frac{V_O \text{ (signal) (at1KHz)}}{V_O \text{ (spurious) (at1KHZ)}} \text{; } f_S = (3 \times 13KHz) - 38KHz$$

measured with : 91% mono signal; 9% pilot signal; fm=10KHz or 13KHz.

2. TRAFFIC RADIO (V.F.) suppression

$$\alpha 57 \text{ (V.W.F.)} = \frac{V_{O(signal)} \text{ (at1KHz)}}{V_O \text{ (spurious) (at1KHZ } \pm 23Hz)}$$

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

3. SCA (SUBSIDIARY COMMUNICATIONS AUTHORIZATION)

$$\alpha 67 = \frac{V_{O(signal)} \text{ (at1KHz)}}{V_O \text{ (spurious) (at9KHZ)}} \text{; } f_S = (2 \times 38KHz) - 67KHz$$

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

4. ACI (ADJACENT CHANNEL INTERFERENCE)

$$\alpha 114 = \frac{V_{O(signal)} \text{ (at1KHz)}}{V_O \text{ (spurious) (at4KHZ)}} \text{; } f_S = 110KHz - (3 \times 38KHz)$$

$$\alpha 190 = \frac{V_{O(signal)} \text{ (at1KHz)}}{V_O \text{ (spurious) (at4KHZ)}} \text{; } f_S = 186KHz - (5 \times 38KHz) -$$

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

5: Control range for High Cut Control and Stereo Blend is V_R - 400mV $\leq V_{SB}, V_{HCC} \leq V_R$

Figure : High Cut Control

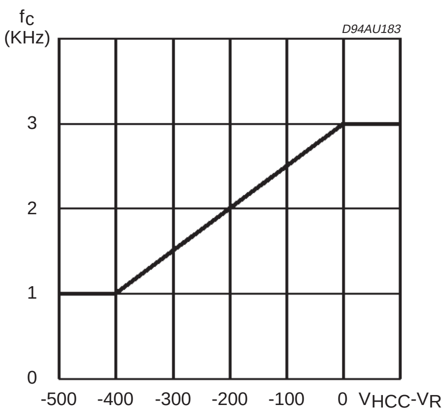
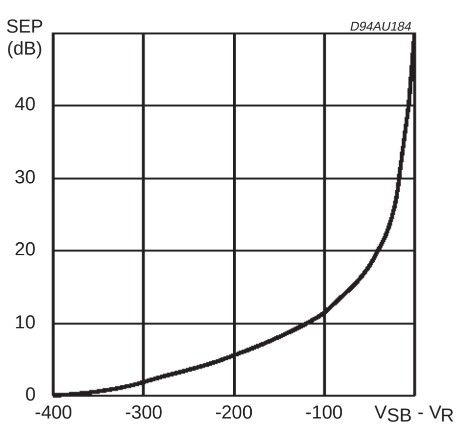


Figure : Stereo Blend



NOISE BLANKER PART

FEATURES:

- INTERNAL 2nd ORDER 140KHz HIGH-PASS FILTER
- NOISE RECTIFIER OUTPUT FOR SIGNAL QUALITY DETECTION
- PROGRAMMABLE TRIGGER THRESHOLD
- TRIGGER THRESHOLD DEPENDENT ON HIGH FREQUENCY NOISE WITH PROGRAMMABLE GAIN
- ADDITIONAL CIRCUITS FOR DEVIATION AND FIELD STRENGTH -DEPENDENT TRIGGER ADJUSTMENT
- BLANKING TIME PROGRAMMABLE BY EXTERNAL CAPACITOR
- VERY LOW OFFSET CURRENT DURING HOLD TIME DUE TO OPAMPS WITH MOS INPUTS

ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Condition		Min.	Typ.	Max.	Unit
V_{TRMIN}	Trigger Threshold (*) 1) minimum	Measured with NBT = 000 V_{PEAK} = 1.2V	D2 on byte 2 = 1 D2 on byte 2 = 0	100	150 30	200	mVp
V_{TRMIN}	Trigger Threshold 1) maximum	Measured with NBT = 111 V_{PEAK} = 1.2V	D2 on byte 2 = 1 D2 on byte 2 = 0	130	185 65	250	mVp
V_{TRSTEP}	Trigger Threshold Step Size				5		mVp
$V_{TRNOISE}$	Noise Adjusted Trigger Threshold 2)	Measured with V_{PEAK} = 1.4V D2 on byte 2 = 0	NAT = 00 NAT = 01 NAT = 10 NAT = 11		140 180 240 280		mVp mVp mVp mVp
V_{PEAK}	Rectifier Voltage D2 on byte 2 = 1	V_{MPX} = 0mV			0.9		V
		V_{MPX} = 50mV f = 200KHz			1.5		V
		V_{MPX} = 100mV f = 200KHz			2.0		V
$V_{RECTDEV}$	Deviation Dependent Rectifier Voltage 3)	Measured with V_{MPX} = 500mV (75KHz dev.)	OVD = 00(off) OVD = 01 OVD = 10 OVD = 11		0.9 1.2 2.0 2.8		V V V V
V_{RECTFS}	Field Strength Controlled Rectifier Voltage 4)	Measured with V_{MPX} = 0mV V_{SB}-V_R = -500mV (fully mono.)	FSC = 00(off) FSC = 01 FSC = 10 FSC = 11		0.9 1.3 1.9 2.4		V V V V
T_S	Suppression Pulse Duration	CBLANK = 330pF			40		µs
I_{OS}	Input Offset Current During Suppression Time				10		pA

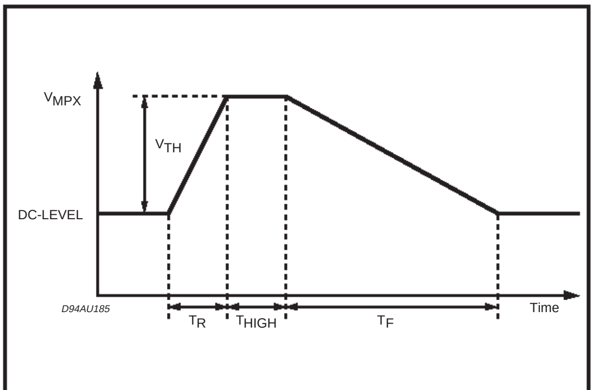
(*) All thresholds are measured by using a pulse with T_R = 2µs, T_{HIGH} = 2µs and T_F = 10µs.
The repetition rate must not increase the PEAK voltage.

1) NTB represents bits D0 - D2 of NB byte 1

2) NAT represents bits D3 - D4 of NB byte 1

3) OVD represents bits D5 - D6 of NB byte 1

4) FSC represents bits D0 - D1 of NB byte 2



DESCRIPTION

DESCRIPTION OF THE NOISEBLANKER

In the normal automotive environment the MPX signal is disturbed by ignition spikes, motors and high frequency switches etc.

The aim of the noiseblanker part is to cancel the influence of the spikes produced by these components.
Therefore the output of the stereodecoder is switched off for a time of 40µs (average spike duration).

In a first stage the spikes must be detected but to avoid a wrong triggering on high frequency noise a complex trigger control is implemented.

Behind the triggerstage a pulse former generates the 40µs "blanking" pulse.

In the following section all of these circuits are described in their function and their programming, too (see fig.1).

1.1 Normal Trigger Path (RECT-PEAK, ACT, PEAK-COMP, BLANK-COMP, BIAS-MONO)

The Incoming MPX signal is highpass-filtered, amplified and rectified (block RECT-PEAK).

The second order highpass-filter has a corner-frequency of 140KHz.

The gain of the rectifier can be controlled by the bit D2 of the noiseblanker byte2.

If programming bit D2 to zero the gain is only half of the nominal value.

All trigger thresholds must be roughly doubled in this case. The rectified signal, RECT, is used to generate by peak-rectification a signal called PEAK, which is available at the PEAK pin.

Also noise with a frequency >100KHz increases the PEAK voltage. The value of the PEAK voltage influences the trigger threshold voltage Vth (block ATC).

Both signals, RECT and PEAK+Vth are fed to a comparator (block PEAK-COMP) which outputs a sawtooth-sharped waveform at the TBLANK pin, it is triggered.

A second comparator (block BLANK-COMP) forms the internal blanking duration of 40µs.

The noiseblanker is supplied by his own biasing circuit (block BIAS-MONO).

1.2 Automatic Threshold Control (ATC)

There are two independent possibilities for programming the trigger threshold:

a)the minimum threshold in 8 steps (bits D0-D2, NB-byte 1)

b)the maximum threshold in 4 steps (bits D3-D4, NB-byte 1) (see fig.2)

The low threshold is used in combination with a good MPX signal without any noise.
The sensitivity in this operation is high, depending only on the programmed "Low Trigger Threshold", bits D0-D2 of the noiseblanker byte 1.

It is independent of the PEAK voltage.

The MPX signal is noisy (low fieldstrength) the PEAK signal increases due to the higher noise, which is also rectified (see part 1.1).

With increasing of the PEAK voltage the trigger threshold voltage increases, too. This particular gain is programmable in 4 steps (see fig.2).

1.3 Automatic Threshold Control by the Stereoblend voltage (ATC-SB)

Besides the noise controlled threshold adjustment there is an additional possibility for influencing the trigger.

It is controlled by the difference between Vsb and Vr, similar to the Stereoblend.

The reason for implementing such a second control will be explained in the following:

The point where the MPX signal starts to become noisy is fixed by the RF part.

Therefore also the starting point of the normal noise controlled trigger adjustment is fixed (fig.3).

But in some cases the behaviour of the noiseblanker can be improved by increasing the threshold even in a region of higher fieldstrength, for the MPX signal often shows distortion in this range.

Because of the overlap of this range and the range of the stereo/mono transition it can be controlled by Vsb and Vr.

This threshold increase is programmable in 3 steps or switched off (see fig.3).

1.4 Over Deviation Detector (MPX-RECT)

Sometimes when listening to stations with a higher deviation than 75KHz the noiseblanker triggers on the high frequency modulation.

To avoid this blanking, which causes noise in the output signal, the noiseblanker offers a deviation-dependent threshold adjustment.

By rectifying the MPX signal a further signal representing the actual deviation is obtained.

It is used to increase the PEAK voltage.

Offset and gain of this circuit are programmable in 3 steps (the first step turns off the detector, see fig.4).

Figure 1: Block Diagram of the Noise Blanker

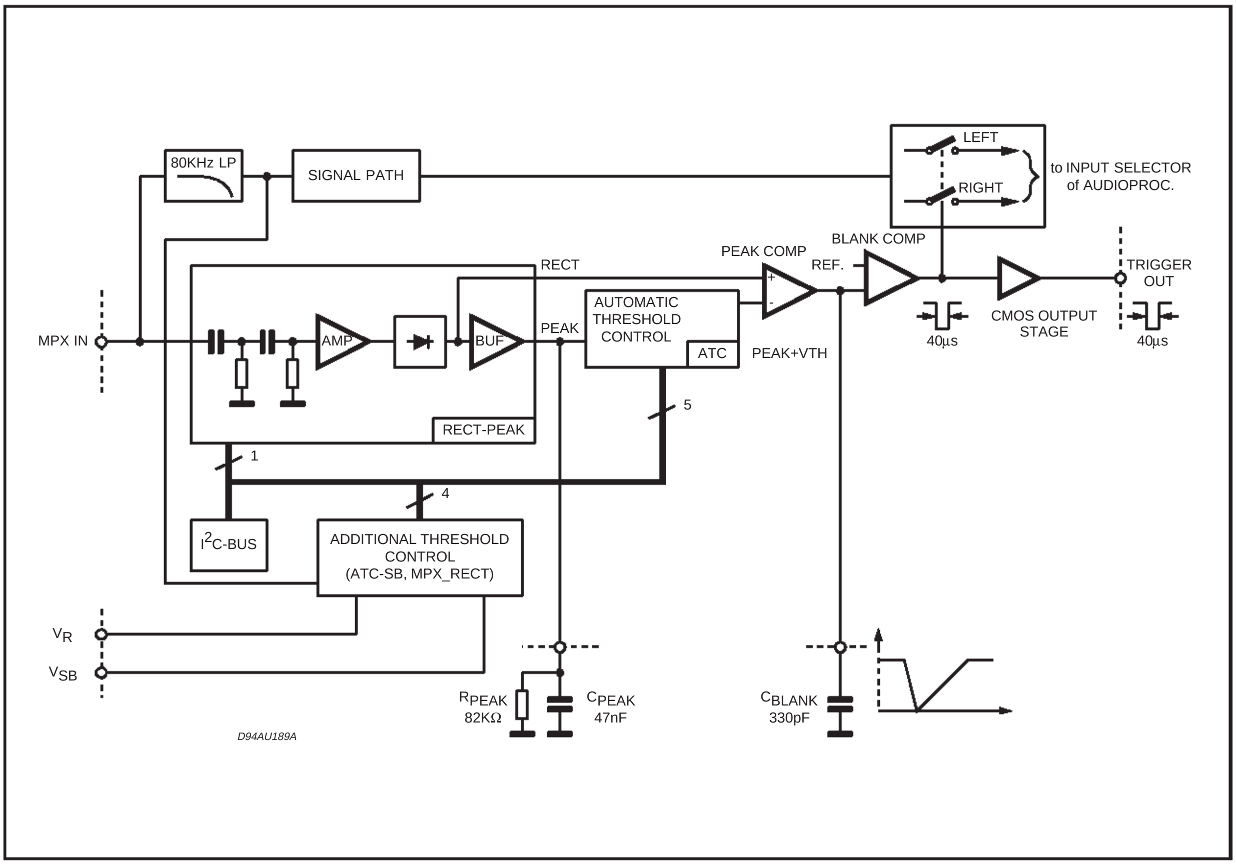


Figure 2: Trigger Threshold vs. V_{peak}

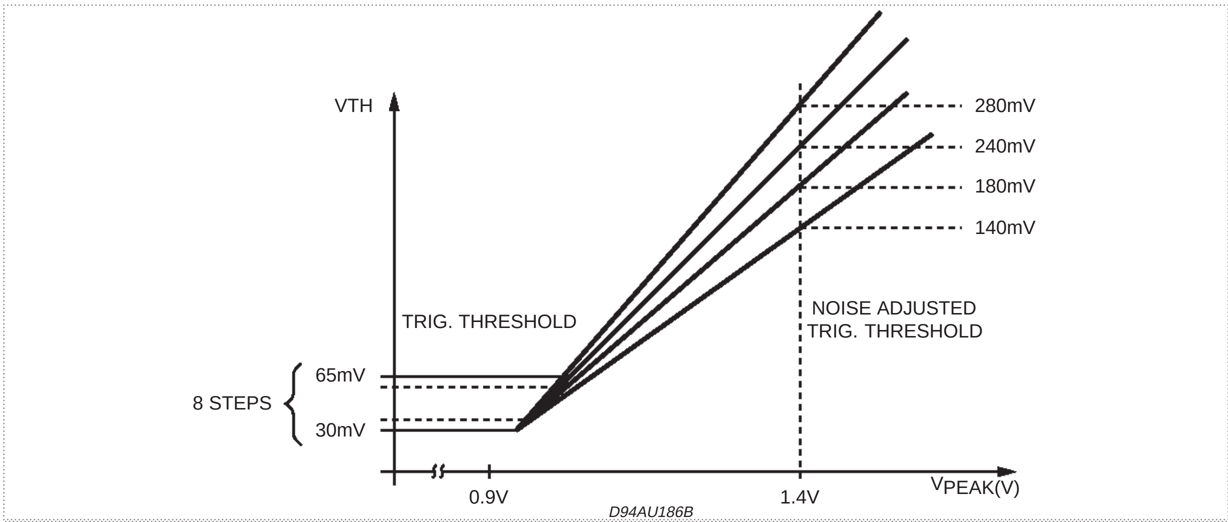


Figure 3: Behaviour of the Field Strength Controlled Threshold Adjustment

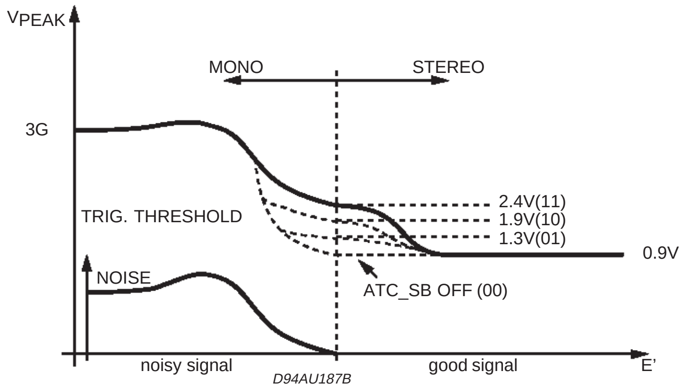
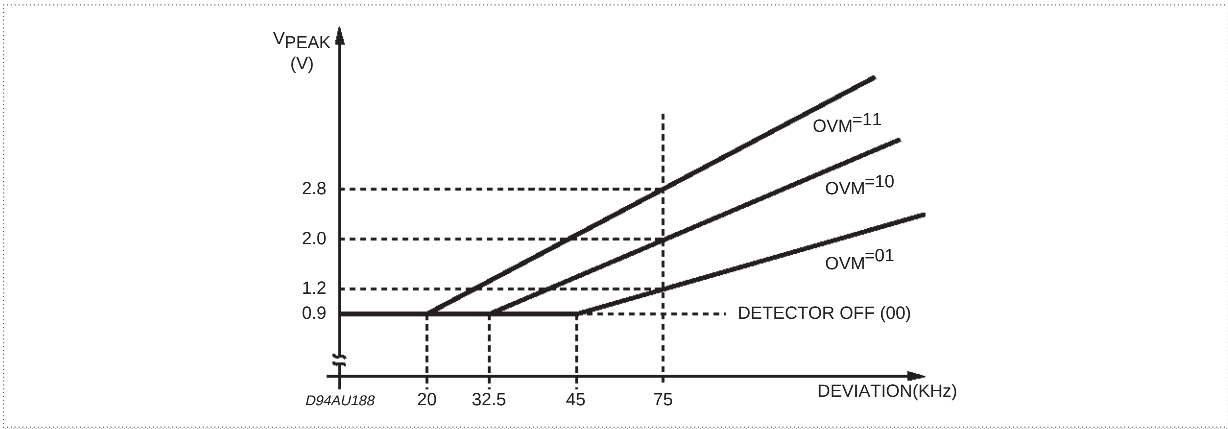


Figure 4: Behaviour of the Deviation Dependent Threshold Adjust (Over Deviation Detector)



I^{2}C BUS INTERFACE

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-bytes + acknowledge)
- A stop condition (P)

CHIP ADDRESS (MSB … LSB) — SUB ADDRESS (MSB … LSB) — DATA 1...DATA n (MSB … LSB)

S	1	0	0	0	1	0	0	R/W	ACK	X	X	T	I	A_3	A_2	A_1	A_0	ACK				DATA				ACK	P

ACK = Acknowledge

S = Start

P = Stop

I = Autoincrement

MAX CLOCK SPEED 500kbits/s

Autoincrement

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

TRANSMITTED DATA (SEND MODE)

MSB							LSB	
X	X	X	X	X	ST	SM	AMS	HIGH = Active

AMS = True Blank Detected
SM = Soft mute activated
ST = Stereo (HIGH = active)

SUBADDRESS (RECEIVE MODE)

MSB							LSB	FUNCTION
X	**X**	**X**	**I**	**D_3**	**D_2**	**D_1**	**D_0**	
				0	0	0	0	Mux
				0	0	0	1	Volume
				0	0	1	0	Treble
				0	0	1	1	Bass
				0	1	0	0	Speaker Attenuator LF
				0	1	0	1	Speaker Attenuator RF
				0	1	1	0	Speaker Attenuator LR
				0	1	1	1	Speaker Attenuator RR
				1	0	0	0	Mute & Beep
				1	0	0	1	Stereodecoder
				1	0	1	0	Noise Blanker 1
				1	0	1	1	Noise Blanker 2
				1	1	0	0	AMS
				1	1	0	1	Dolby Level Control
				1	1	1	0	Metal Resistance Control
				1	1	1	1	Preamplifier Attenuation

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

INPUT SELECTOR

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
								Input Gain
				0	0	0	0	0dB
				0	0	0	1	1dB
				0	0	1	0	2dB
				0	0	1	1	3dB
				0	1	0	0	4dB
				0	1	0	1	5dB
				0	1	1	0	6dB
				0	1	1	1	7dB
				1	0	0	0	8dB
				1	0	0	1	9dB
				1	0	1	0	10dB
				1	0	1	1	11dB
				1	1	0	0	12dB
				1	1	0	1	13dB
				1	1	1	0	14dB
				1	1	1	1	15dB
	0	0	0					Full diff CD
	0	0	1					Stereo
	0	1	0					Stereo Decoder
	0	1	1					AM quasi diff input
	1	0	0					Quasi diff CD
	1	0	1					Not allowed
	1	1	0					Not allowed
	1	1	1					AM Mono (AM R input)

VOLUME

MSB							LSB	FUNCTION
D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	
								-1 dB STEPS
					0	0	0	-0dB
					0	0	1	-1dB
					0	1	0	-2dB
					0	1	1	-3dB
					1	0	0	-4dB
					1	0	1	-5dB
					1	1	0	-6dB
					1	1	1	-7dB
								-8 dB STEPS
	0	0	0	0				16dB
	0	0	0	1				8dB
		0	1	0				0dB
		0	1	1				-8dB
		1	0	0				-16dB
		1	0	1				-24dB
		1	1	0				-32dB
		1	1	1				-40dB
	1	0	0	0				-48dB
	1	0	0	1				-56dB
1								Mute

TREBLE

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
		1	1	0	0	1	0	-18dB
		1	1	0	0	0	1	-17dB
		1	1	0	0	0	0	-16dB
		1	0	1	1	1	1	-15dB
		1	0	1	1	1	0	-14dB
		1	0	1	1	0	1	-13dB
		1	0	1	1	0	0	-12dB
		1	0	1	0	1	1	-11dB
		1	0	1	0	1	0	-10dB
		1	0	1	0	0	1	-9dB
		1	0	1	0	0	0	-8dB
		1	0	0	1	1	1	-7dB
		1	0	0	1	1	0	-6dB
		1	0	0	1	0	1	-5dB
		1	0	0	1	0	0	-4dB
		1	0	0	0	1	1	-3dB
		1	0	0	0	1	0	-2dB
		1	0	0	0	0	1	-1dB
		1	0	0	0	0	0	0dB
		0	0	0	0	0	0	0dB
		0	0	0	0	0	1	1dB
		0	0	0	0	1	0	2dB
		0	0	0	0	1	1	3dB
		0	0	0	1	0	0	4dB
		0	0	0	1	0	1	5dB
		0	0	0	1	1	0	6dB
		0	0	0	1	1	1	7dB
		0	0	1	0	0	0	8dB
		0	0	1	0	0	1	9dB
		0	0	1	0	1	0	10dB
		0	0	1	0	1	1	11dB
		0	0	1	1	0	0	12dB
		0	0	1	1	0	1	13dB
		0	0	1	1	1	0	14dB
		0	0	1	1	1	1	15dB
		0	1	0	0	0	0	16dB
		0	1	0	0	0	1	17dB
		0	1	0	0	1	0	18dB

BASS

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
		1	1	0	0	1	0	-18dB
		1	1	0	0	0	1	-17dB
		1	1	0	0	0	0	-16dB
		1	0	1	1	1	1	-15dB
		1	0	1	1	1	0	-14dB
		1	0	1	1	0	1	-13dB
		1	0	1	1	0	0	-12dB
		1	0	1	0	1	1	-11dB
		1	0	1	0	1	0	-10dB
		1	0	1	0	0	1	-9dB
		1	0	1	0	0	0	-8dB
		1	0	0	1	1	1	-7dB
		1	0	0	1	1	0	-6dB
		1	0	0	1	0	1	-5dB
		1	0	0	1	0	0	-4dB
		1	0	0	0	1	1	-3dB
		1	0	0	0	1	0	-2dB
		1	0	0	0	0	1	-1dB
		1	0	0	0	0	0	0dB
		0	0	0	0	0	0	0dB
		0	0	0	0	0	1	1dB
		0	0	0	0	1	0	2dB
		0	0	0	0	1	1	3dB
		0	0	0	1	0	0	4dB
		0	0	0	1	0	1	5dB
		0	0	0	1	1	0	6dB
		0	0	0	1	1	1	7dB
		0	0	1	0	0	0	8dB
		0	0	1	0	0	1	9dB
		0	0	1	0	1	0	10dB
		0	0	1	0	1	1	11dB
		0	0	1	1	0	0	12dB
		0	0	1	1	0	1	13dB
		0	0	1	1	1	0	14dB
		0	0	1	1	1	1	15dB
		0	1	0	0	0	0	16dB
		0	1	0	0	0	1	17dB
		0	1	0	0	1	0	18dB
	1							Non DC extended bass
	0							DC extended bass

SPEAKERS ATTENUATORS

MSB							LSB	LF, LR, RF, RR
D7	D6	D5	D4	D3	D2	D1	D0	
								-1dB STEPS
					0	0	0	0dB
					0	0	1	-1dB
					0	1	0	-2dB
					0	1	1	-3dB
					1	0	0	-4B
					1	0	1	-5dB
					1	1	0	-6dB
					1	1	1	-7dB
								8dB STEPS
	0	0	0	0				0dB
	0	0	0	1				-8dB
	0	0	1	0				-16dB
	0	0	1	1				-24dB
	0	1	0	0				-32dB
	0	1	0	1				-40dB
	0	1	1	0				-48dB
	0	1	1	1				-56dB
	1	0	0	0				-64dB
	1	0	0	1				-72dB
	1	1	0					Mute
	1	0	1					
	1	1	1					

MUTE & BEEP

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
							1	Soft Mute - FAST SLOPE
							0	Soft Mute - Slow Slope
						1		Soft Mute OFF
						0		Soft Mute ON
					0	0		Direct Input Mute ON
					1	0		Direct Input Mute OFF
				0		0		Radio Mute ON
				1		0		Radio Mute OFF
			1					Composit Input Enabled
			0					Composit Mute Enabled
		1						Beep ON - Front
	1							Beep ON - Rear
1								VCO OFF
0								VCO ON

STEREO DECODER

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
								Input Gain
						0	0	1.5dB Input Gain
						0	1	4.0dB Input Gain
						1	0	6.5dB Input Gain
						1	1	9dB Input Gain
								Roll Off Adjustement
			0	0	1			20.2%
			0	1	0			21.9%
			0	1	1			23.7%
			1	0	0			25.5%
			1	0	1			27.3%
			1	1	0			29.2%
			1	1	1			31%
		0						Deemph. Time Constant 75µs
		1						Deemph. Time Constant 50µs
	1							Forced Mono
	0							Stereo Enabled
0								Pilot Threshold High
1								Pilot Threshold Low

NOISE BLANKER 1

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
								Noise Blanker Threshold Vpeak = 0.9V
					0	0	0	V_{th} = 30mV
					0	0	1	V_{th} = 35mV
					0	1	0	V_{th} = 40mV
					0	1	1	V_{th} = 45mV
					1	0	0	V_{th} = 50mV
					1	0	1	V_{th} = 55mV
					1	1	0	V_{th} = 60mV
					1	1	1	V_{th} = 65mV
								Noise Blanker Noise Adjusted Threshold Vpeak = 1.4V
			0	0				V_{th} = 140mV
			0	1				V_{th} = 180mV
			1	0				V_{th} = 240mV
			1	1				V_{th} = 280mV
								Gain of Overdeviation Detector Vpeak with MPX of 75KHz Deviation
	0	0						Detector Off
	0	1						Vpeak = 1.2Vop
	1	0						Vpeak = 2.0Vop
	1	1						Vpeak = 2.8Vop

NOISE BLANKER 2

MSB							LSB	FUNCTION
D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	
Field Strenght Controlled Rectifier Voltage (control by Vsb-Vr) Vpeak at Vsb-Vr = -500mV (fully Mono)								
						0	0	Control Off
						0	1	Vpeak = 1.3V
						1	0	Vpeak = 1.9V
						1	1	Vpeak = 2.4V
								Noise Blanker Gain
					1			Low
					0			High

AMS

MSB							LSB	FUNCTION
D7	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**	
								Att. Sensitivity Tuning
						0	0	0dB
						0	1	-1dB
						1	0	-2dB
						1	1	-3dB
								Gain Sensitivity Tuning
			0	0	0			0dB
			0	0	1			10dB
			0	1	0			14dB
			0	1	1			18dB
			1	0	0			22dB
			1	0	1			26dB
			1	1	0			30dB
			1	1	1			34dB
								AC Sensitivity Tuning
	0	0						22dB f = 1.1KHz SW1 = SW2 = SW3
	0	1						34dB f = 1.1KHz
	1	0						not allowed
	1	1						21dB f = 160Hz
0								AMS ON
1								AMS OFF

DOLBY LEVEL CONTROL

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
								Right Channel
				0	0	0	0	0dB
				0	0	0	1	-0.5dB
				0	0	1	0	-1.0dB
				0	0	1	1	-1.5dB
				0	1	0	0	-2.0dB
				0	1	0	1	-2.5dB
				0	1	1	0	-3.0dB
				0	1	1	1	-3.5dB
				1	0	0	0	-4.0dB
				1	0	0	1	-4.5dB
				1	0	1	0	-5.0dB
				1	0	1	1	-5.5dB
				1	1	X	X	-6.0dB
								Left Channel
0	0	0	0					-0dB
0	0	0	1					-0.5dB
0	0	1	0					-1.0dB
0	0	1	1					-1.5dB
0	1	0	0					-2.0dB
0	1	0	1					-2.5dB
0	1	1	0					-3.0dB
0	1	1	1					-3.5dB
1	0	0	0					-4.0dB
1	0	0	1					-4.5dB
1	0	1	0					-5.0dB
1	0	1	1					-5.5dB
1	1	X	X					-6.0dB

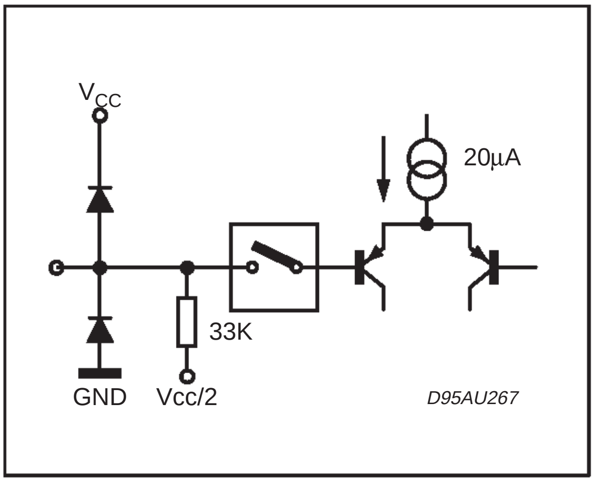
METAL RESISTANCE CONTROL

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
								Right Channel
				1	0	0	0	R metal +20%
				0	0	0	0	R metal +15%
				0	0	0	1	R metal +10%
				0	0	1	0	R metal +5%
				0	0	1	1	R metal =3.8KΩ Typical
				0	1	0	0	R metal - 5%
				0	1	0	1	R metal - 10%
				0	1	1	0	R metal - 15%
				0	1	1	1	R metal - 20%
								Left Channel
1	0	0	0					R metal +20%
0	0	0	0					R metal +15%
0	0	0	1					R metal +10%
0	0	1	0					R metal +5%
0	0	1	1					R metal =3.8KΩ Typical
0	1	0	0					R metal - 5%
0	1	0	1					R metal - 10%
0	1	1	0					R metal - 15%
0	1	1	1					R metal - 20%

PREAMPLIFIER

MSB							LSB	FUNCTION
D7	D6	D5	D4	D3	D2	D1	D0	
								Attenuation control
						0	0	0dB
						0	1	-20dB
						1	0	-23dB
						1	1	Mute
					0			Reverse Mode On
					1			Forward Mode On

PINS: 1, 64



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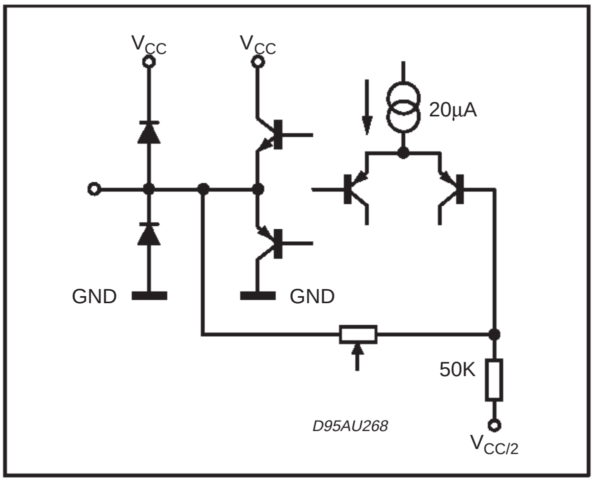

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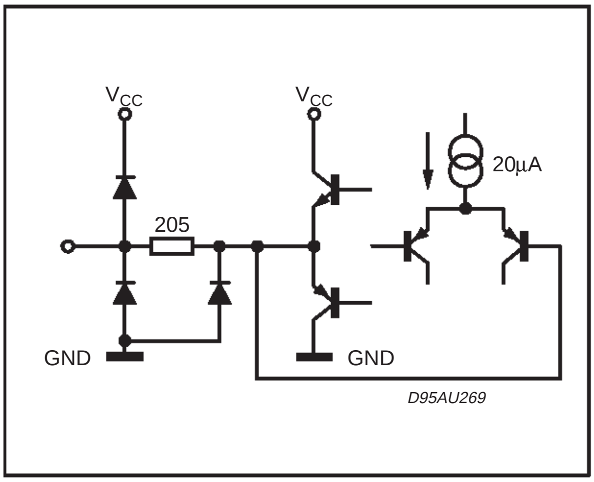

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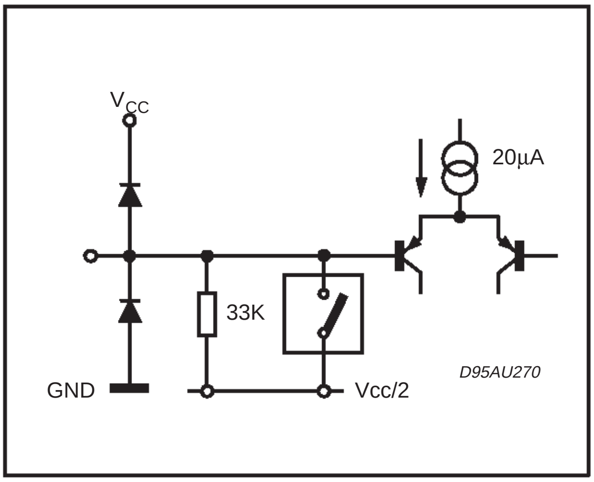

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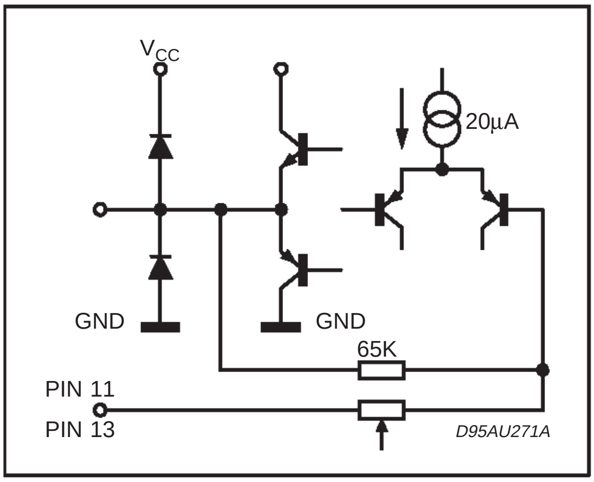

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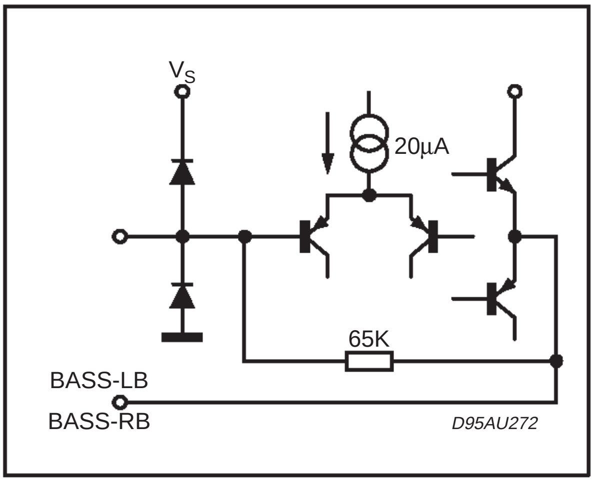

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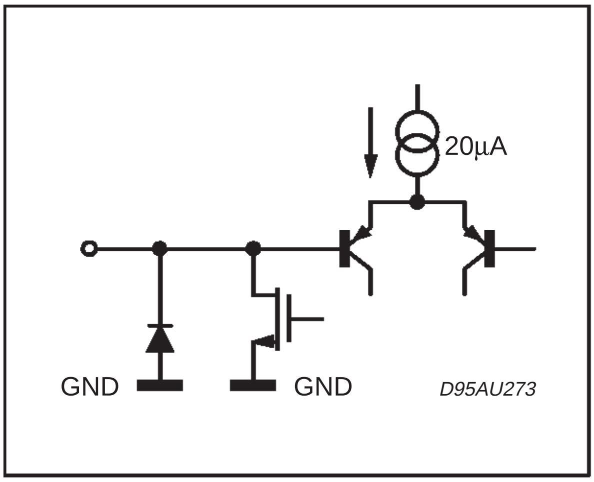

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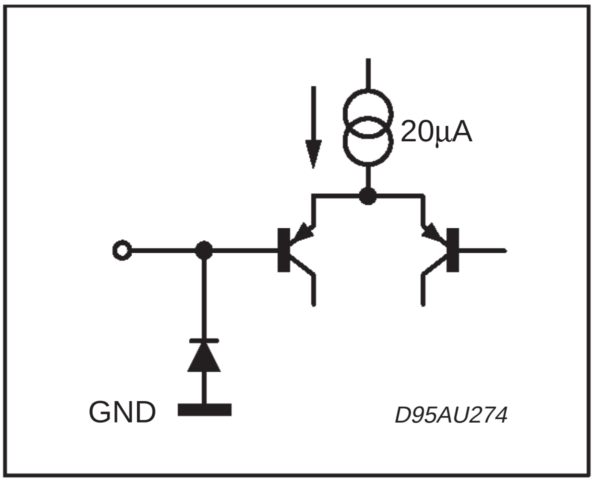

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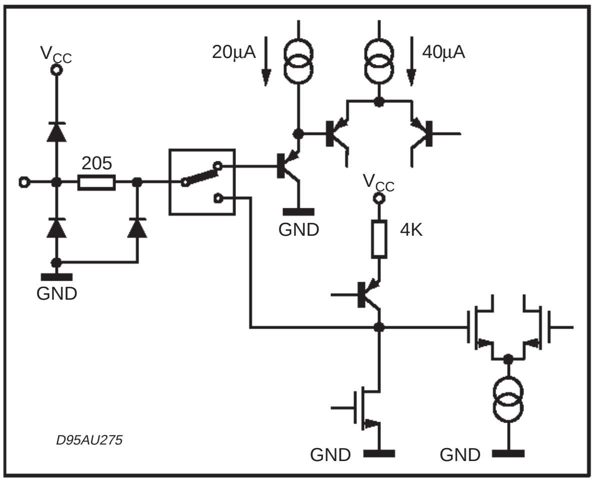

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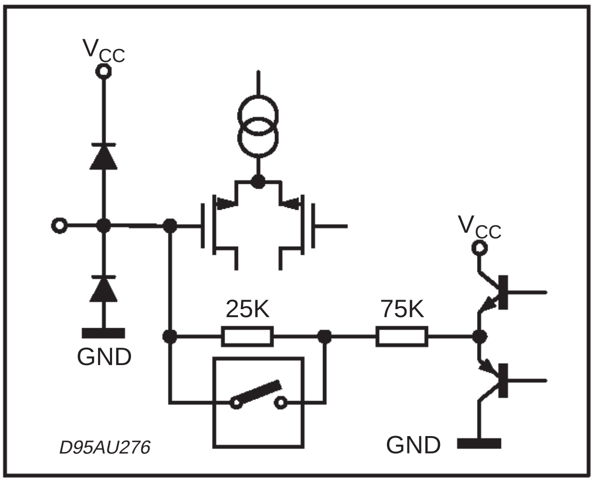

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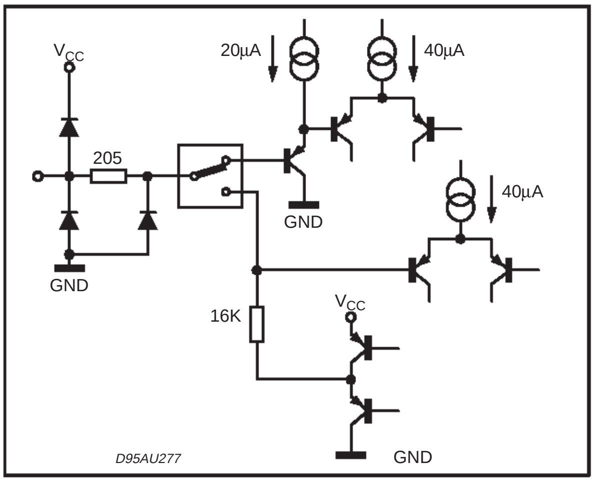

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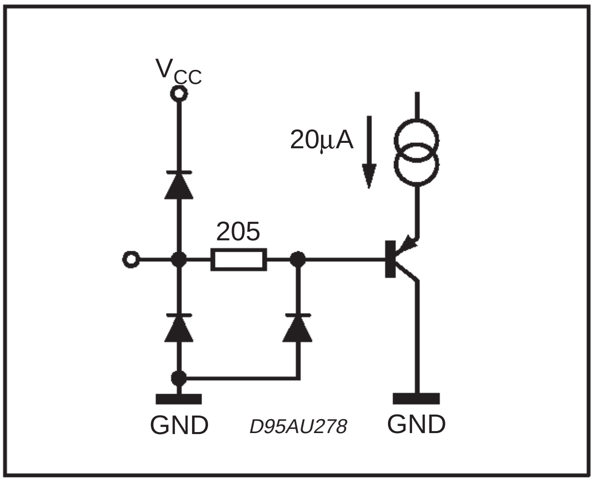

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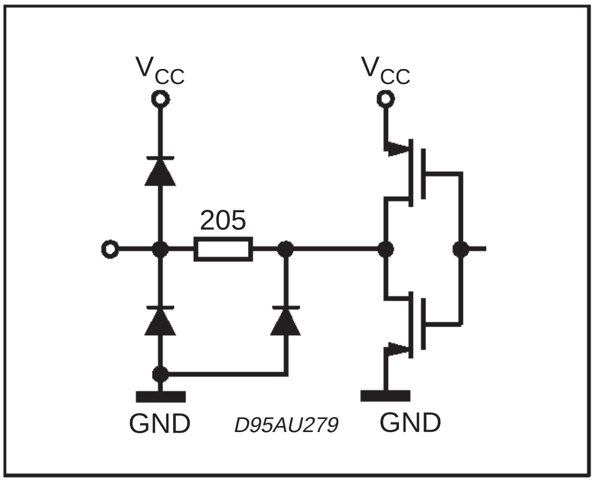

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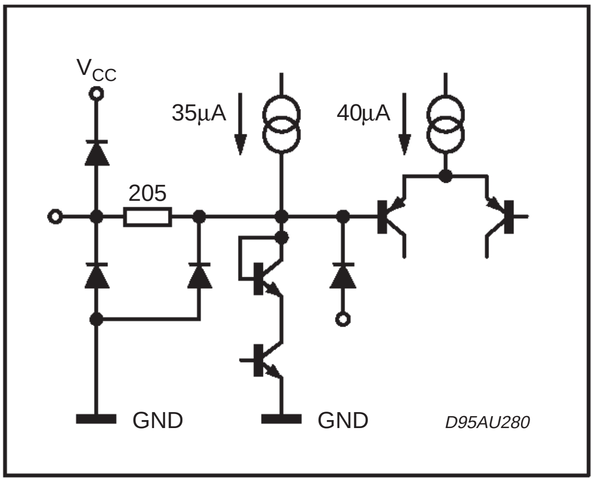

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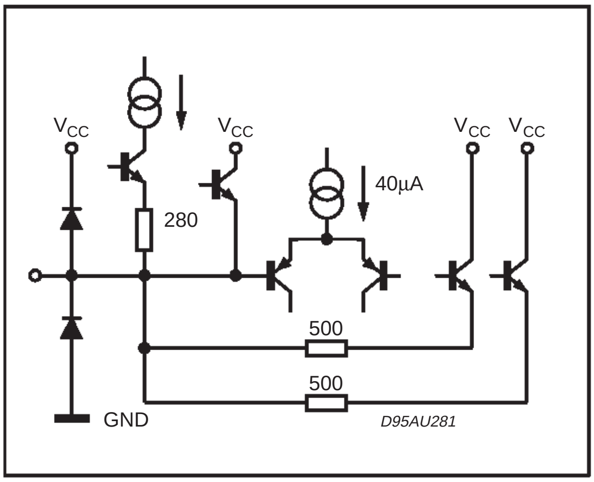

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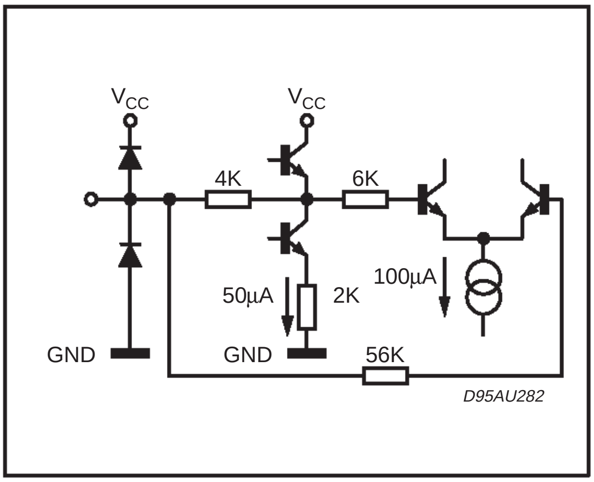

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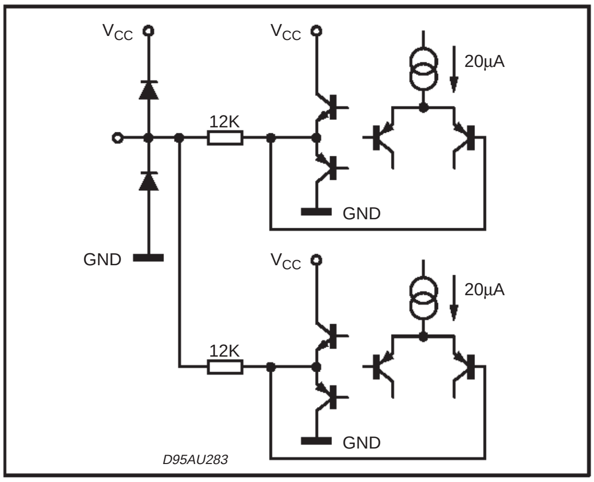

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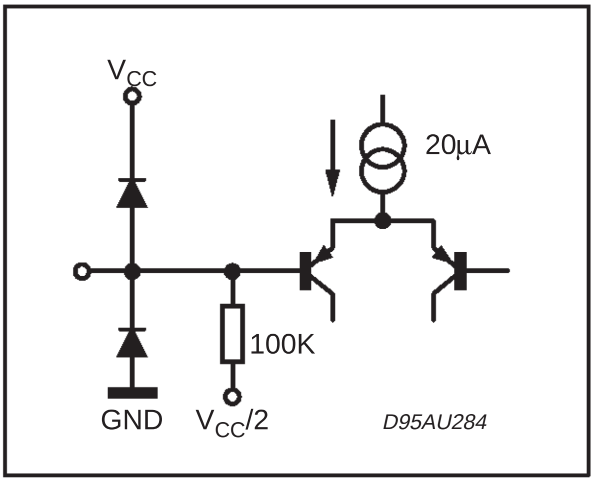
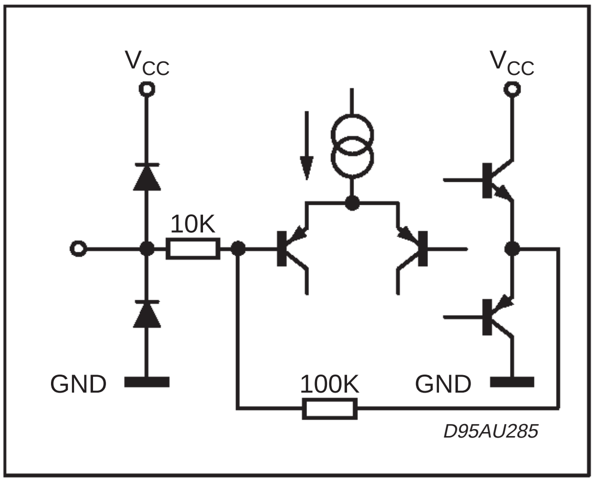


PIN: 30



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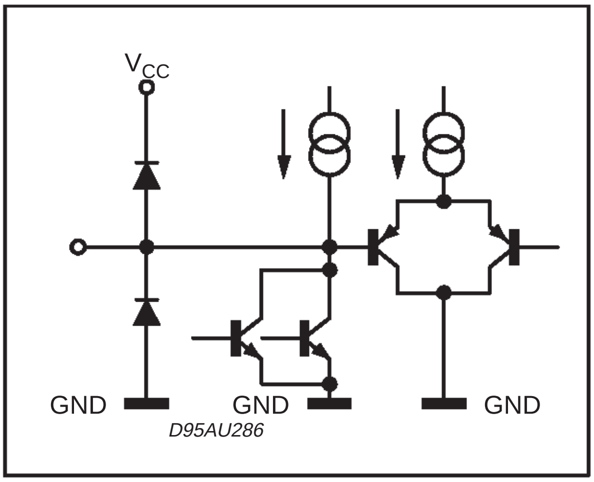

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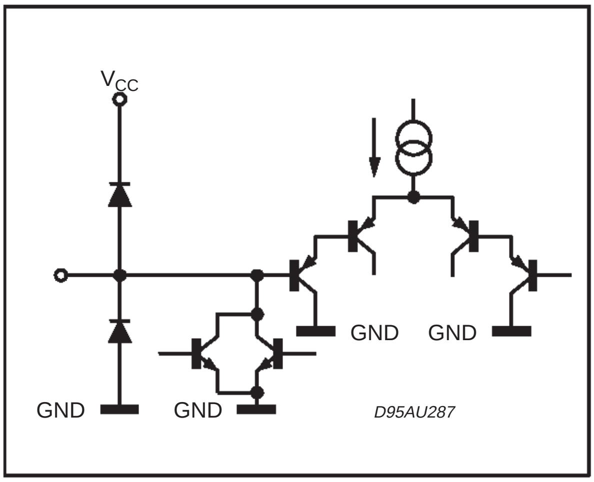

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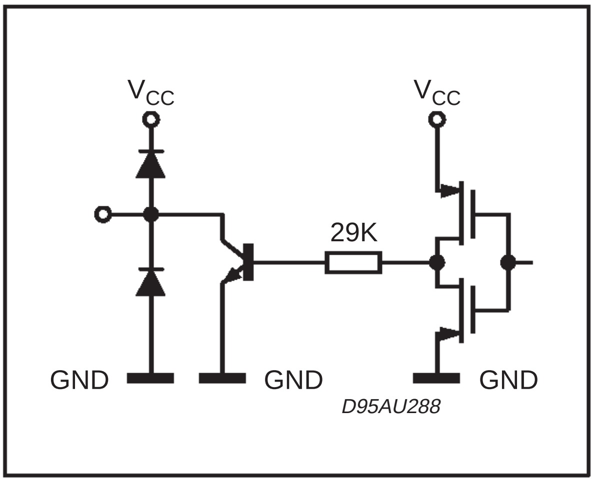

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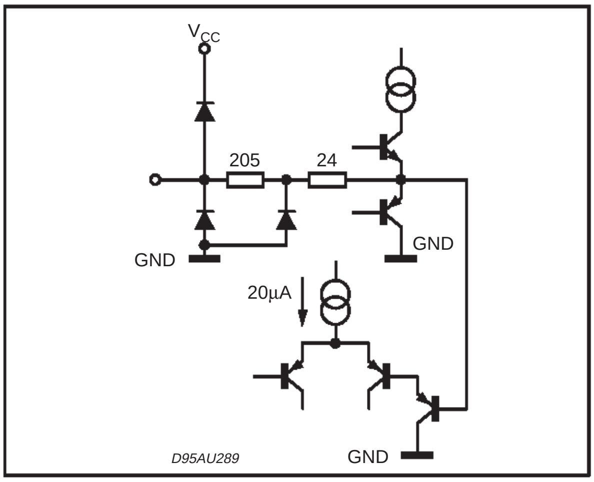

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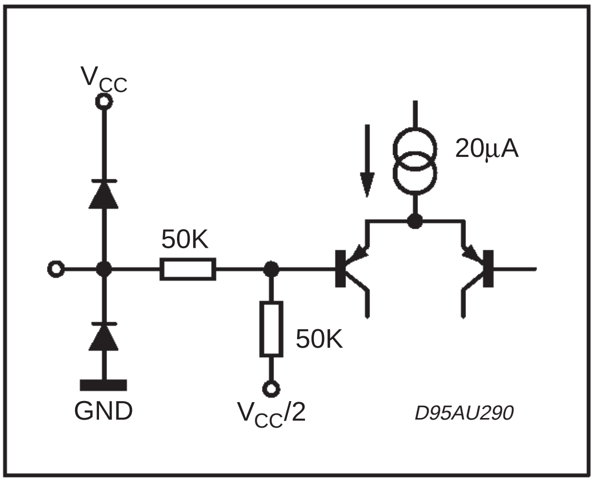

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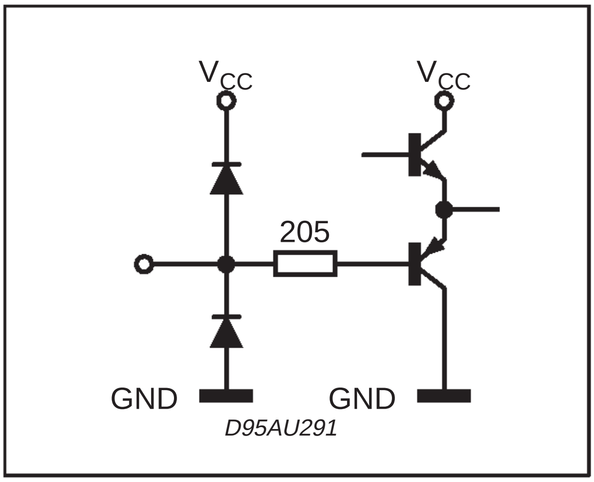

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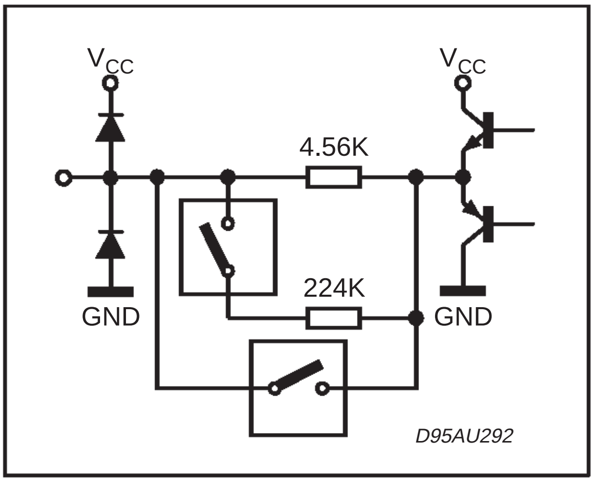

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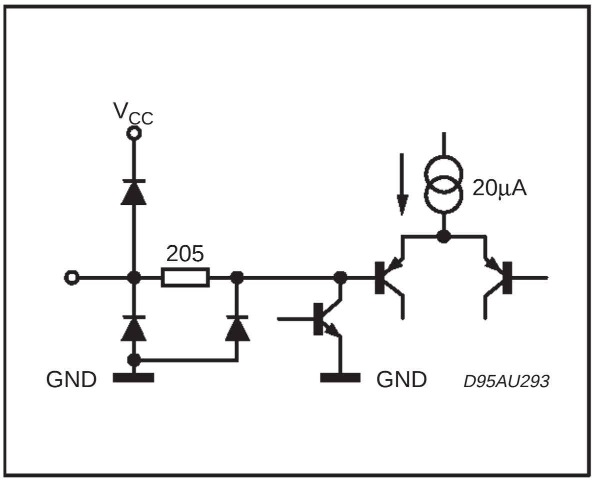

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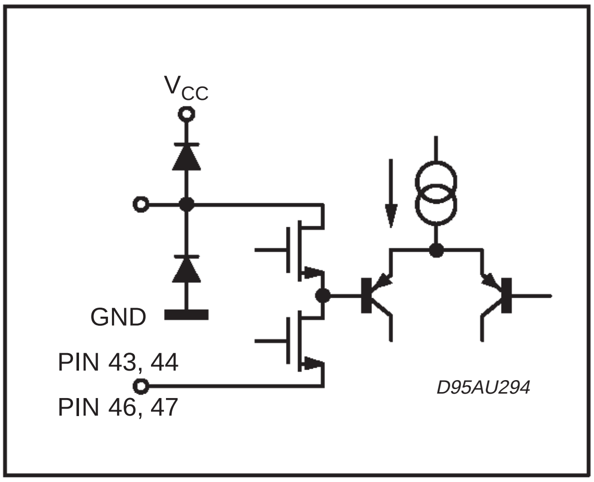

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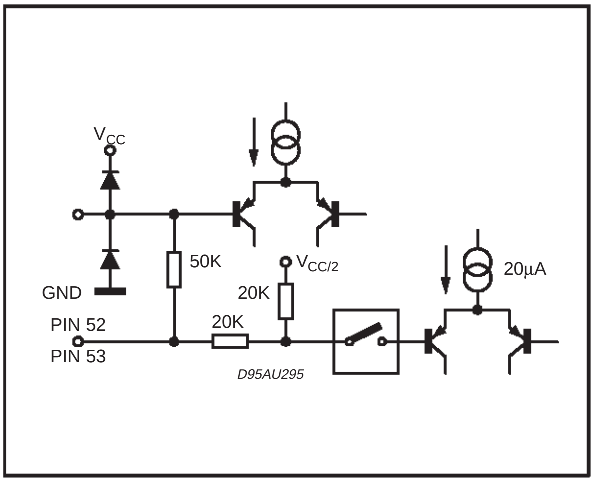

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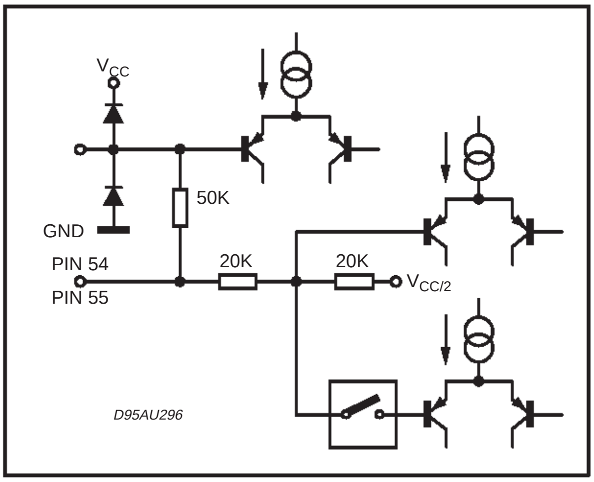

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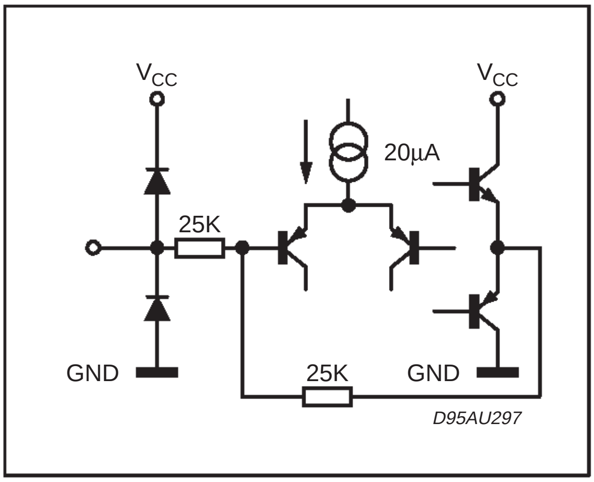

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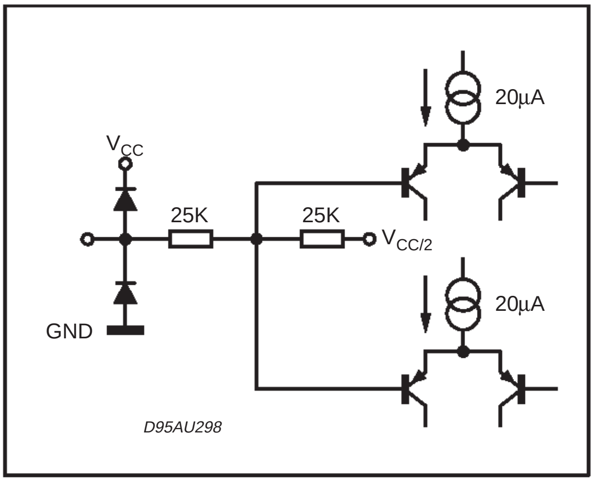

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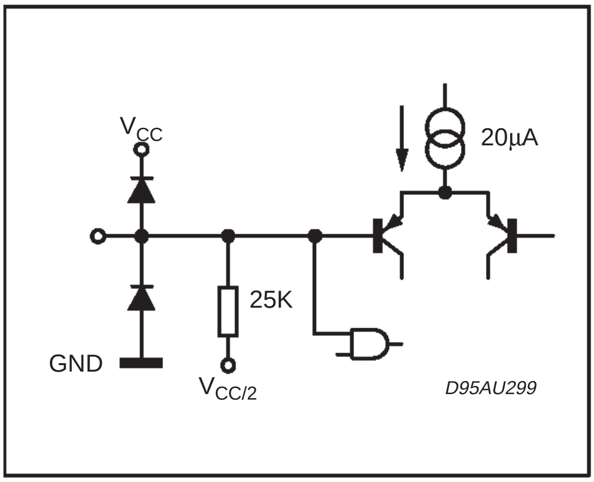

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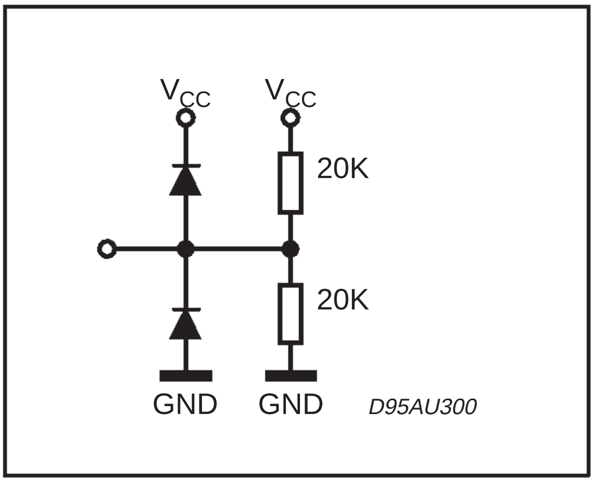

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