TELEFUNKEN electronic
Creative Technologies

U 454 B

TELEFUNKEN ELECTRONIC

Electronic speech circuit having a line fed loudspeaker amplifier and an optional automatic equalization of sending, receiving and sidetone reference equivalent.

T-75-07-15

Technology: Bipolar

Features:

- All functional blocks of a telephone appartus can be subscriberline fed by an internal stabilized voltage of about 3.5 V DC
- The microphone hybrid transformer is replaced by an electronic circuit
- Built–in loudspeaker amplifier giving 40 mW output power into a 25 Ω speaker
- High performance by the use of dynamic transducers as microphones and earphones. Nonlinear distortion ≦1%
- High range of line feeding current
- Input resistance independent of line current and sidetone suppression circuit
- Built–in ear protection by earphone voltage limiter
- Optional automatic equalization of sending, receiving and sidetone reference equivalent up to 5 km subscriberline length
- A common transducer (loudspeaker) can be used for loudspeaking and tone ringing (U 450 B) without mechanical switches necessary
- Sending and receiving amplification adjustable
- Minimal line current 8 mA without loudspeaking for proper performance
- High life expectancy due to reduced power consumption of the chip

Case: DIP 18

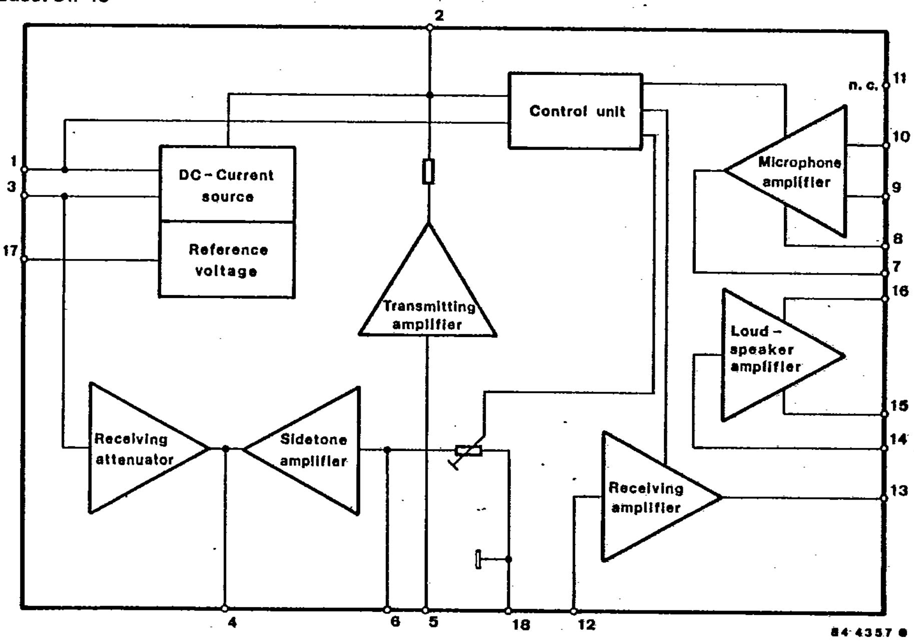

Fig. 1 Block diagram and Pin connections

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Circuit description

The electronic speech circuit U 454 B is a linear integrated circuit applicable in telephone and other line fed terminal equipment. It replaces the common speech circuit with carbon microphone, hybrid transformer, sidetone equivalent and ear protection rectifiers.

Two cheap electrodynamic transducers are used as microphone and earphone. The U 454 B contains all components necessary for amplification of signals and adaption to the line.

The circuit is line fed. An integrated amplifier having 40 mW output power allows loudspeaking.

Sending, receiving and sidetone suppression is optionally equalized from DC part of line current in such a way that the influence of a subscriber line loss or mismatch up to 5 km line length is continuously compensated. A stabilized voltage of about 3.5 V which is generated for the loudspeaker amplifier, is usable for further circuits in the set. There is no interaction between the 3.5 V and line voltage peaks or valleys below 3.5 V.

Pin connections and their function description shown in Fig. 2

Pin	Symb.	Function
1	DC	Input of DC-part of line current. Voltage drop between Pin 1 and 2 > about 80 mV reduces sending and receiving amplification and sidetone suppression voltage. The threshold for amplification control with resistance $R_5 = 3.16\ \Omega$, a line current $I_L > 29$ mA reduces the amplification due to Fig. 10. If the $R_5 = 0$, the amplification can be kept at a high constant value. The differntial resistance is: $13\ \Omega + R_5$
2	+V	Positive line connection
3	AF	Connection of DC stabilization capacitor C_1, which determines the inductive part of Z_L
4	HT	Output of receiver AC voltage reduced by sidetone suppression voltage.
5	SV	Sending amplifier input (AC current driven), with circuitry for radio noise suppression. R_6 for transmission control: $G_S = \frac{V_2}{V_{9,10}} = 60\ \frac{27\ Z_L}{R_6} \times \frac{Z_L}{Z_L + Z_{Send}} = 45$ dB $R_6 = 3.3$ kΩ, $Z_L = Z_{line} = 780\ \Omega$
6	N	Input from sidetone suppression filter. C_9 coupling capacitor for the antisidetone circuit with R_7 and R_8 in conjunction with C_{10} for high frequencies.
7	VM	Output of microphone amplifier
8	MF	Connection of the decoupling capacitor C_8 of microphone amplifier, serves also as an input to small unbalanced input signals. A series resistor will reduce the microphone input amplification
9 10	M_1 M_2	Balanced microphone amplifier input
11	nc	not connected
12	HE	Earphone amplifier input with coupling capacitor C_7
13	HA	Earphone amplifier output with coupling capacitors for earphone C_5, and for speaker amplifier C_6.
14	ELH	Summing point input of loudspeaker amplifier C_3 coupling capacitor for loudspeaker. C_4, C_{13}, R_9, compensation for external output stage and roll off of the speaker amplifier.
15	BN	Base driver output for external NPN loudspeaker driver-transistor.
16	BP	Base driver output for external PNP loudspeaker driver-transistor.
17	3.5 V	Output of internally stabilized DC voltage of about 3.5 V for loudspeaker and other electronic.
18	⊥	Negative line connection and reference point for measurements. C_{12} acts as the capacitive part of Z_L and suppression of RF reception.

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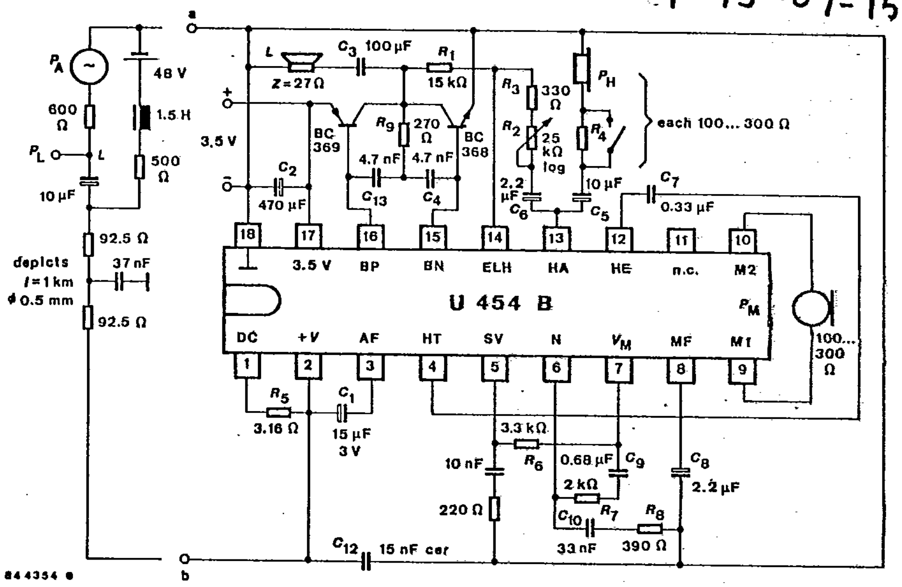

Fig. 2 Typical application circuit

Absolute maximum ratings

Reference point Pin 18, unless otherwise specified

Line current	I_L	100	mA
DC line voltage $t_p = 3$ ms	V_L	20	V
Junction temperature	T_j	150	°C
Ambient temperature range	T_{amb}	−28...+80	°C
Storage temperature range	T_{stg}	−55...+150	°C

Thermal resistance

		Min.	Typ.	Max.	
Junction ambient	R_{thJA}			85	K/W

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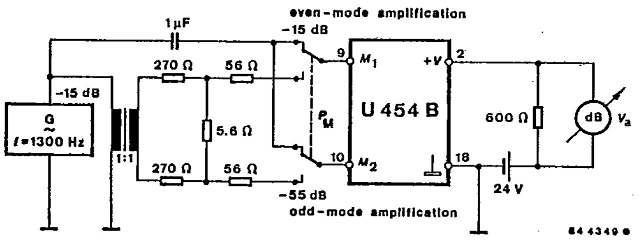
Electrical characteristics	Pin	Symbol	Min.	Typ.	Max.	Unit
Reference point Pin 18, cable equivalent = l = 1 km, ∅ 0.5 mm, R' = 184 Ω, C' = 37 nF, f = 1300 Hz, I_L = 58 mA, 0 dB_m = 775 m V_{eff}, T_{amb} = 25 °C, unless otherwise specified						
Power dissipation						
I_L = 100 mA		P_{tot}		300		mW
DC input voltage Fig. 8	Pin 2					
I_L = 28 mA ≙ l = 5 km		V_I	6.0	6.85	7.2	V
I_L = 38 mA ≙ l = 3 km		V_I		6.95		V
I_L = 58 mA ≙ l = 1 km		V_I	6.3	7.2	7.6	V
I_L = 78 mA ≙ l = 0 km		V_I		7.4		V
I_L = 108 mA		V_I		7.7		V
Input impedance		z_i	600		900	Ω
Common mode rejection ratio of the microphone amplifier (CMRR) Fig. 3		CMRR	60	80		dB
Transmission amplifier	Pin 2					
Amplification $P_2 - P_M$ Fig. 4						
l = 1 km		G_S	43.7		47.4	dB
f = 300...3400 Hz		ΔG_S		±0.5	±1	dB
Compensated with ferrite magnet transducer to ± 0.75 dB, T_{amb} = −28...+60 °C		ΔG_S		±1.5		dB
Distortion at line end						
P_M = −65 dBm		d		0.3	1	%
P_M = −50 dBm		d		1		%
Noise at line P_{RS} Fig. 6		n_o		−84	−75	dBmp
Input resistance						
Micro-amplifier	Pin 9 – 10	R_i	10		24	kΩ
Control current generator	Pin 5	R_i		50		Ω
Sidetone amplifier						
l = 1 km		R_i		2.4		kΩ
l = 5 km		R_i		6		kΩ
Output voltage						
Transmission direction						
l = 1 km	Pin 2	v_o			+2	dBm

			Min.	Typ.	Max.	
Receiving amplifier Fig. 5	Pin 13					
Receiver amplification $P_H - P_L$						
$l = 1$ km		G_R	13.5	11.5	−9.5	dB
$f = 300 \ldots 3400$ Hz		ΔG_R		±0.5	±1	dB
Compensated with ferrite magnet transducer to ±0.75 dB,						
$T_{amb} = -28 \ldots +60$ °C		ΔG_R		±1.5		dB
Distortion at earphone						
$V_{HA} = 800\ mV_{pp}$		d		0.2	1	%
Ear protection						
$V_{HA} \leq 1.6\ V_{pp}$		d			5	%
Receiving weighted noise at earphone P_{RE} Fig. 6		n_i			−90	dBmp
Output resistance	Pin 13	R_O			10	Ω
Speaker amplifier Fig. 2						
$P_{LH} - P_H$, $R_2 = 0$		G	31	33	35	dB
P_{LHmax}		G		± 3		dBm
Distortion at loudspeaker						
$V_{LH} = 3\ V_{pp}$		d			5	%
Sidetone suppression Fig. 4, 11						
$(P_H - P_2) - (P_H - P_2)$ Receiver						
$f = 400$ Hz, $R_5 = 3.16\ \Omega$		G	15	30		dB
Amplification control						
Receiving amplifier P_H Fig. 5						
$R_5 = 0$, without gain control Fig. 10						
$l = 5$ km, $I_L = 28$ mA		G		−6.65		dB
$l = 3$ km, $I_L = 38$ mA		G		−4.5		dB
$l = 1$ km, $I_L = 58$ mA		G		1.5		dB
$l = 0$, $I_L = 78$ mA		G		0		dB
$l = 0 \ldots$ km						
$R_5 = 3.16\ \Omega$, with gain control		ΔG_R		±0.5	±1	dB
Transmission amplifier P_L Fig. 4						
$R_5 = 0$, without gain control Fig. 10						
$l = 5$ km, $I_L = 28$ mA		G		5.9		dB
$l = 3$ km, $I_L = 38$ mA		G		3.25		dB
$l = 1$ km, $I_L = 58$ mA		G		1.1		dB
$l = 0$, $I_L = 78$ mA		G		0		dB
$l = 0 \ldots$ km						
$R_5 = 3.16\ \Omega$, with gain control		ΔG_S		±0.5	±1	dB

		Min.	Typ.	Max.	
Sidetone suppression P_L Fig. 4, 11					
$f = 400$ Hz, $R_5 = 3.16\ \Omega$					
$l = 5$ km, $I_L = 28$ mA	G_i		2.3		dB
$l = 3$ km, $I_L = 38$ mA	G_i		1.4		dB
$l = 1$ km, $I_L = 58$ mA	G_i		0		dB
$l = 0$, $I_L = 78$ mA	G_i		−1.25		dB
Delay time					
Line current increase					
$I_L \geq 22$ mA	t_{dON}		3		ms
Ready for amplification Fig. 7					
$V_{Ref} = 3.5$ V, $C_2 = 470\ \mu$F	t_{dON}		100	150	ms



$$\text{CMRR} = \frac{\text{odd-mode amplification}}{\text{even-mode amplification}}$$

Fig. 3 Measurement of common mode rejection ratio (CMRR). External components are as shown in Fig. 2. Microphone is disconnected.

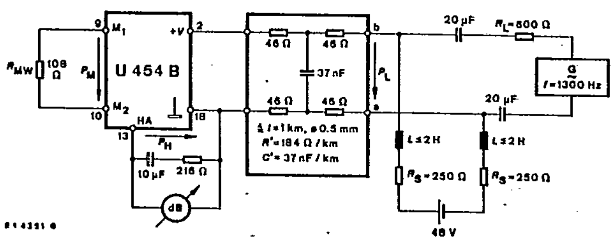


Fig. 4 Sending; sidetone suppression

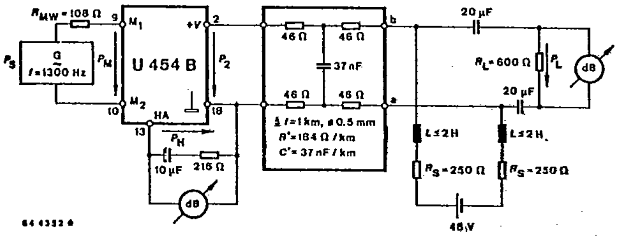


Fig. 5 Receiving

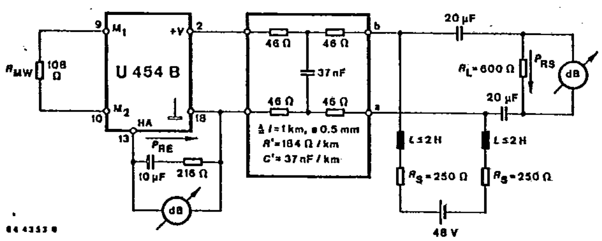


Fig. 6 Weighted noise measurement

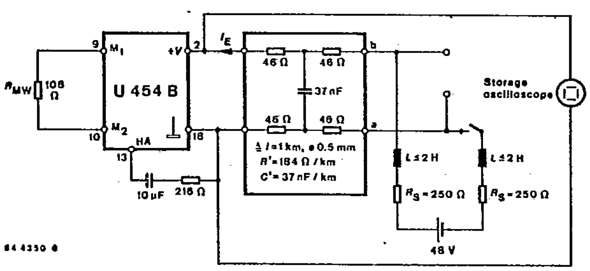


Fig. 7 Time delay operation

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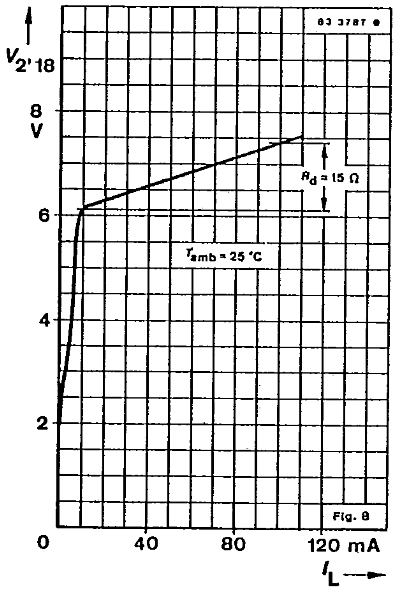
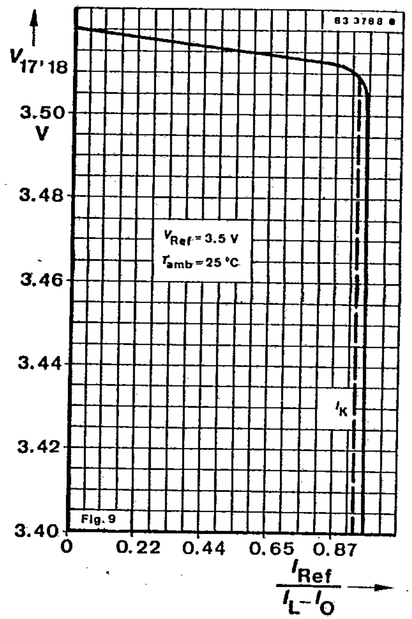
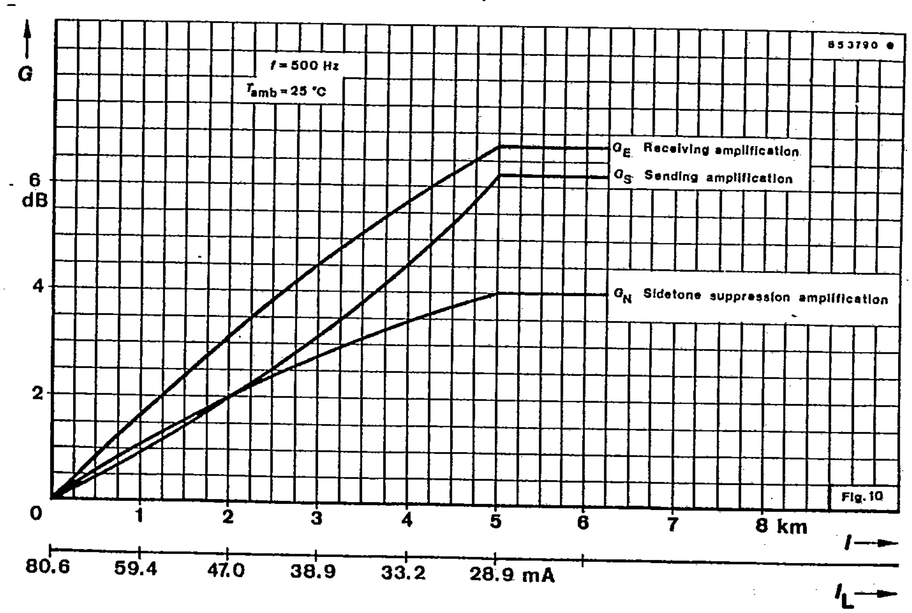
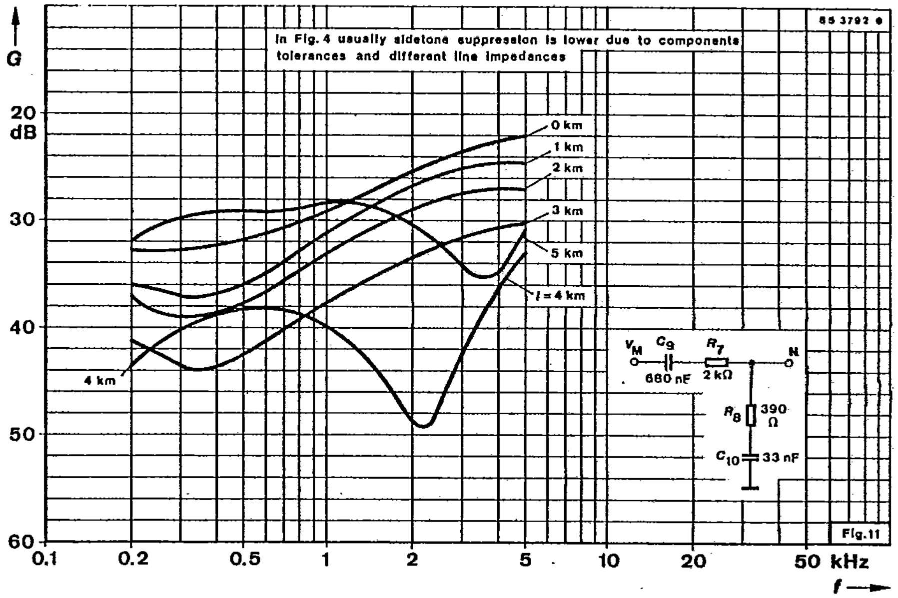








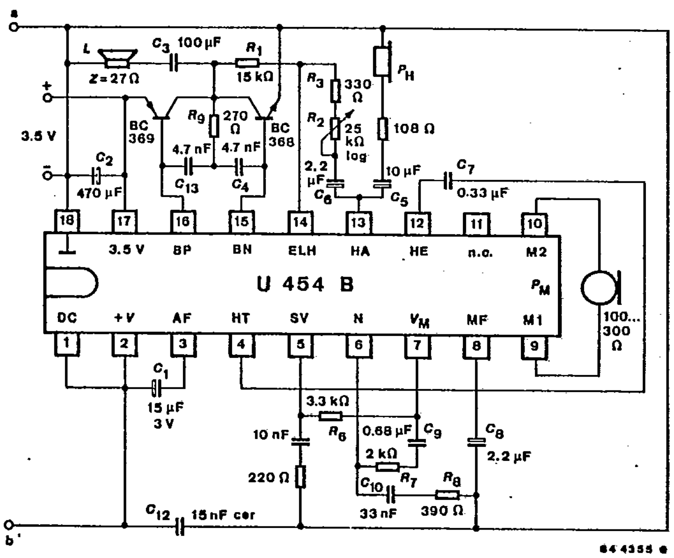


Fig. 12 Wiring of U 454 B with loudspeaker, without line length equalization

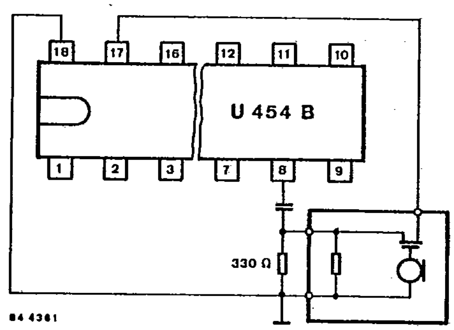


Fig. 13 Connection of an electret – microphone

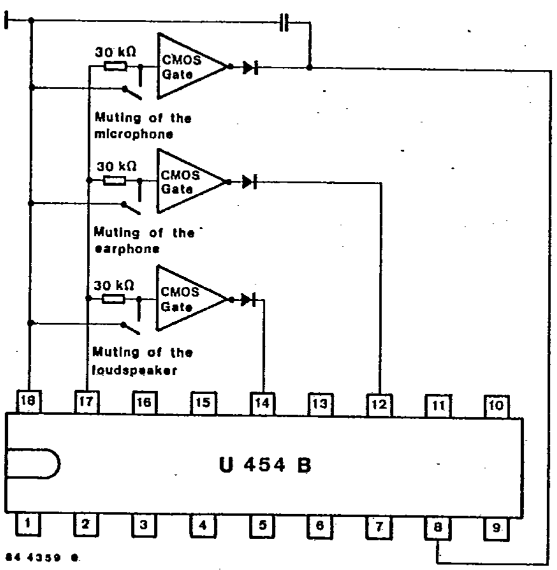
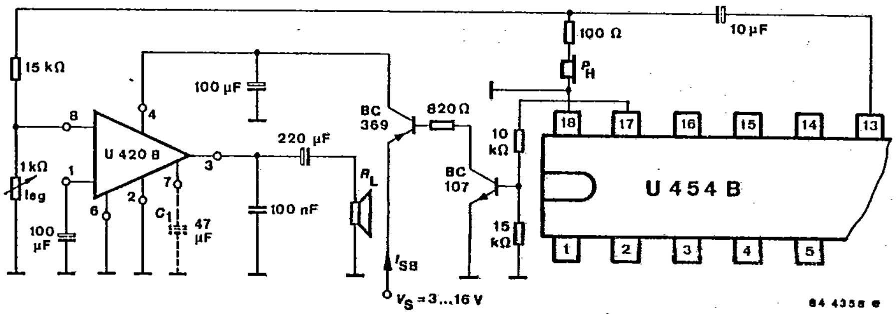
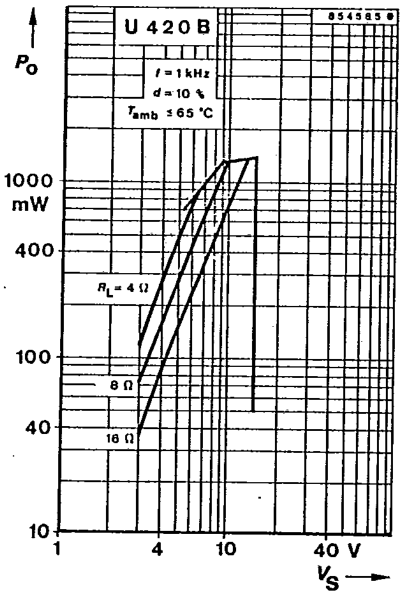


Fig. 14 Muting possibilities with U 454 B





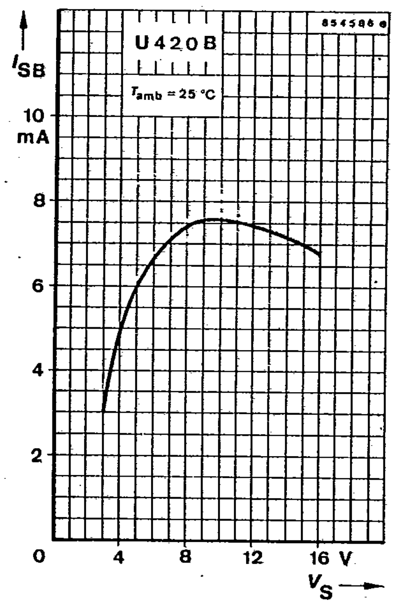


Fig. 15 Speaker amplifier in conjunction with circuit from Fig. 13, with automatic start, up to 1 W

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Dimensions in mm

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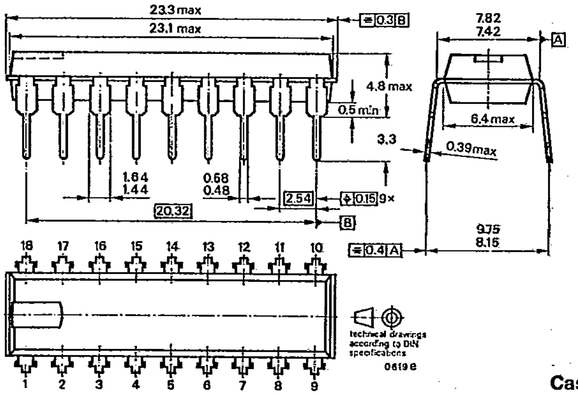

Case
DIP 18