TELEFUNKEN electronic
Creative Technologies

U 4058 B · U 4058 B-FP

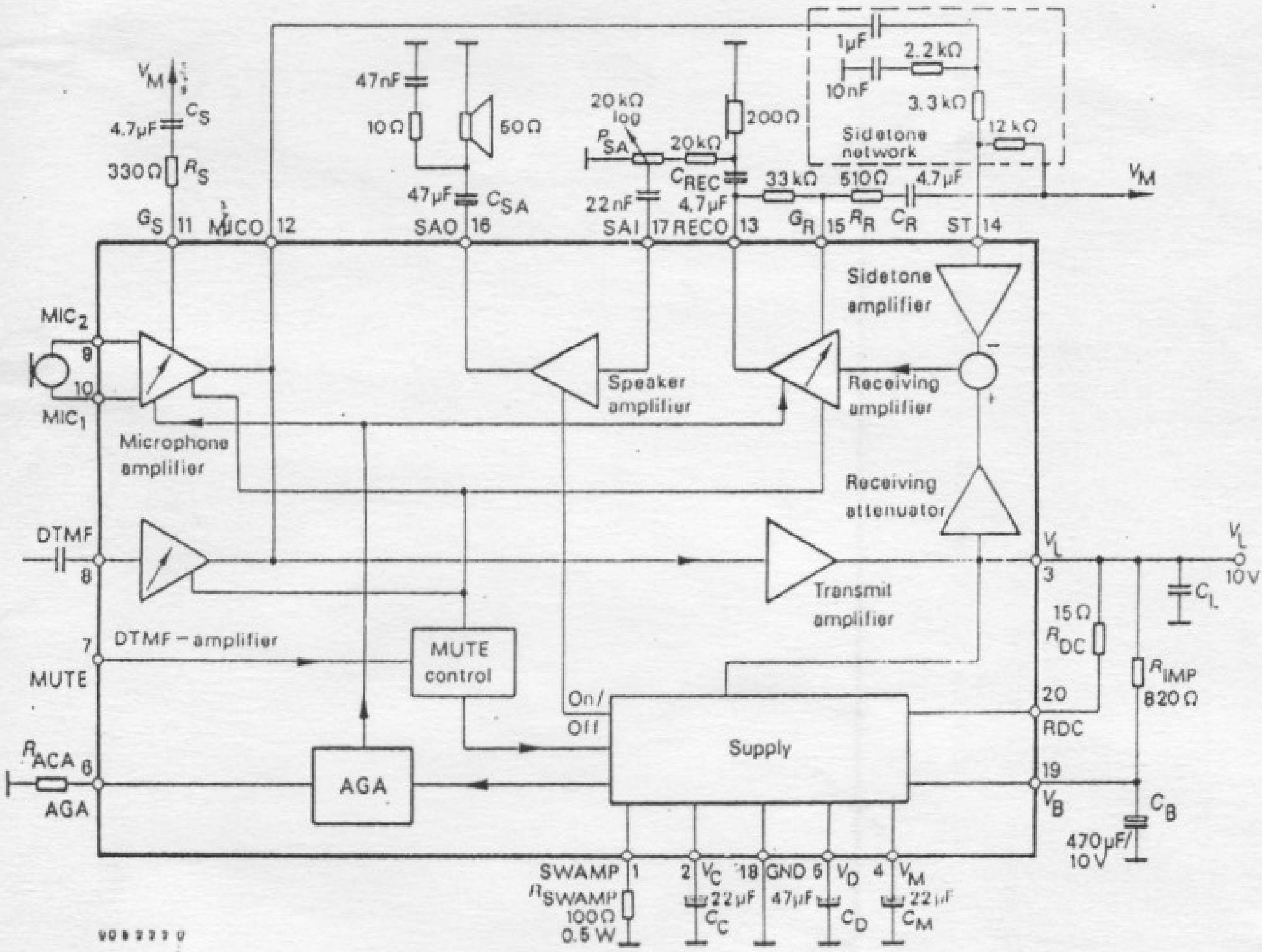
Speech circuit with line powered loudspeaker amplifier

Technology: Bipolar

Features:

- Integrated amplifier for loud hearing operation
- Supply voltages for all functional blocks of a subscriber set including a regulated source for dialers (3.5 V/0.8 mA)
- Sending and receiving amplification adjustable
- Automatic line loss compensation
- Symmetrical input of microphone amplifier
- Sidetone suppression adjustable independent of sending and receiving amplification
- DTMF – and MUTE-input
- Built in ear protection
- U 4058 B – Low level MUTE
- U 4058 B1 – High level MUTE

Case: SO 20 or DIP 20



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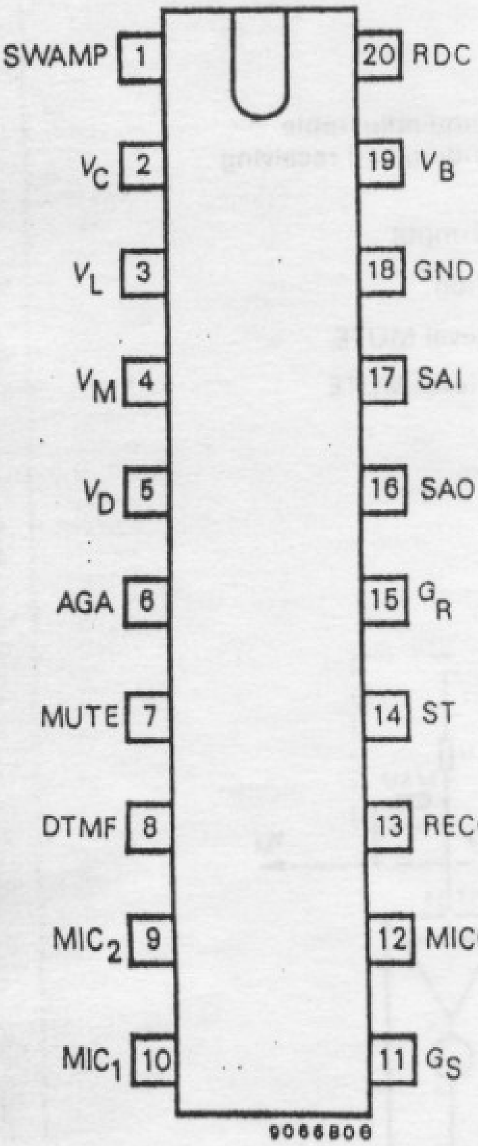

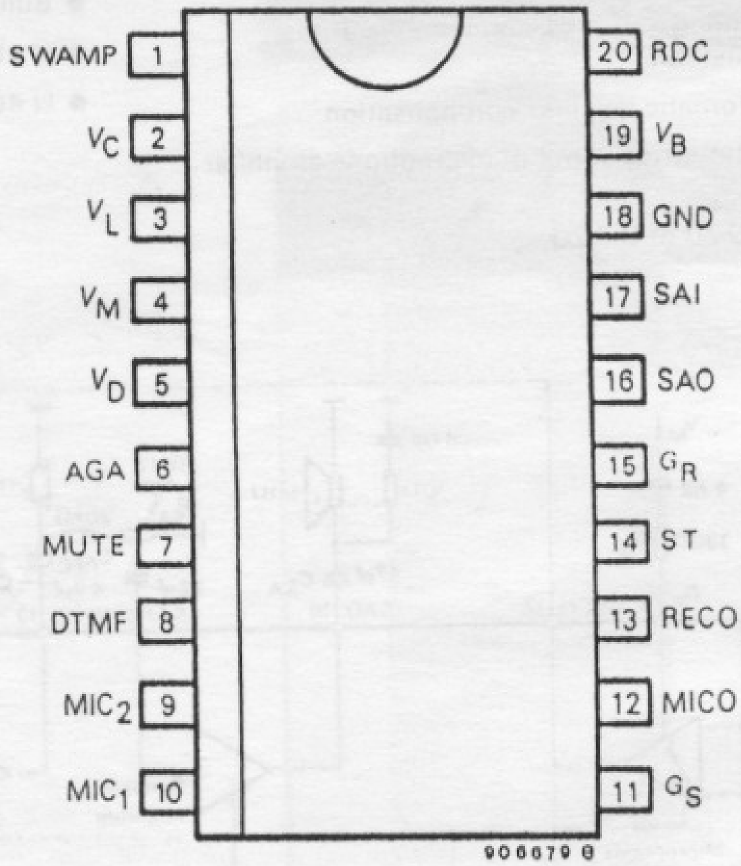

Description

The electronic speech circuit, U 4058 B, is a linear integrated circuit applicable in telephone sets. It replaces the hybrid transformer, sidetone equivalent and ear protection rectifiers. The circuit is line powered and contains all components necessary for amplification of signals and adaption to the line. An integrated loudspeaker amplifier allows loud hearing operation.

Pin description

Pin 1	SWAMP	A resistor connected from this pin to ground converts the excess line current into heat, in order to prevent the IC from thermal destruction at high line currents.
Pin 2	V_C	The internal equivalent inductance of the circuit is proportional to the value of the capacitor at this pin.
Pin 3	V_L	Line voltage
Pin 4	V_M	Reference node for microphone- and earphone amplifier.
Pin 5	V_D	Regulated supply voltage for peripheral circuits (dialers, microprocessors ...). (3.5 V; 0.8 mA)
Pin 6	AGA	Automatic gain adjustment. A resistor connected from this pin to ground reduces line length equalization.
Pin 7	MUTE	MUTE input TTL compatible input to switch circuit into DTMF-condition. Polarity is factory programmable.
Pin 8	DTMF	Input for DTMF signals (AC-coupled). In Mute condition a small portion of the signal at this pin is monitored to the receiver output.
Pin 9	MIC_2	One end of differential input stage of microphone amplifier.
Pin 10	MIC_1	Other end of differential input stage of microphone amplifier.
Pin 11	G_S	A resistor from this pin to V_M (AC coupled) sets the amplification of microphone- and DTMF signals.
Pin 12	MICO	Connection terminal for the sidetone network.
Pin 13	RECO	Single ended output of receiving amplifier
Pin 14	ST	Input of sidetone amplifier.
Pin 15	G_R	A resistor connected from this pin to V_M (AC coupled) sets the receiving amplification.
Pin 16	SAO	Output of loudspeaker amplifier.
Pin 17	SAI	Input of loudspeaker amplifier.
Pin 18	GND	Reference point for DC- and AC- output signals.
Pin 19	V_B	Supply voltage for loudspeaker amplifier and high power peripherals; output current capability and output voltage increase with line current.
Pin 20	RDC	A small resistor connected from this pin to V_L sets the slope of the DC characteristic and has also effect on the line length equalization characteristics and the line current at which the loudspeaker amplifier is switched on.

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Absolute maximum ratings

Line current	I_L	100	mA
DC line voltage	V_L	15	V
Power dissipation, T_{amb} = 60 °C	P_{tot}	590	mW
Junction temperature	T_j	125	°C
Ambient temperature range	T_{amb}	−25 ... + 75	°C
Storage temperature range	T_{stg}	−55 ... +150	°C

Maximum thermal resistance

Junction ambient	R_{thJA}	110	K/W

Electrical characteristics

f = 1 kHz, 0 dBm = 775 mV_{rms}, I_B = 1.5 mA,
I_D = 0.8 mA, I_M = 0.3 mA, pin 6 grounded;
T_{amb} = 25 °C, unless otherwise specified, V_{SAI} = 0 mV

		Min.	Typ.	Max.	
DC characteristics					
DC voltage drop across IC, Fig. 2					
I_L = 19 mA	V_L	3.6	4.2	4.5	V
I_L = 22 mA	V_L	4.7	5.3	5.6	V
I_L = 33 mA	V_L	7.1	7.6	8.0	V
I_L = 60 mA	V_L	8.7	9.2	9.6	V
I_L = 75 mA, Diode 1N 4148 in parallel with R_{DC}	V_L		9.4		V
Transmission amplifier, Fig. 3					
Transmitting amplification range					
I_L = 24 mA	G_S	40	48	56	dB
I_L = 24 mA, R_s = 470 Ω	G_S	44	45	46	dB
Frequency response					
f = 300 ... 3400 Hz, I_L ≧ 19 mA	ΔG_S		±0.5	±1	dB
Gain change with current I_L = 19 ... 60 mA	ΔG_S			1	dB
Temperature deviation T_{amb} = −10 ... +60 °C, I_L ≧ 19 ... 60 mA	ΔG_S			±0.5	dB
CMRR of microphone amplifier	CMRR	60	80		dB
Input resistance of MIC-amplifier	R_i	40			kΩ
Distortion at line I_L ≧ 19 mA, V_L = 510 mV_{rms}	d			2	%
Max. output voltage I_L ≧ 21 mA, d ≦ 5 %	V_{Lmax}	+0			dBm
Noise at line psoph. weighted I_L ≧ 19 mA	n_o			−73	dBmp
Line loss compensation I_L = 60 mA reducible with R_{AGA}	ΔG_{SI}	−7	−8	−9	dB
Mute suppression I_L = 19 mA, R_S = 470 Ω	G_{Mute}	50			dB

		Min.	Typ.	Max.	
Receiving amplifier, Fig. 3					
Receiving amplification range					
$I_L \geqq 19$ mA	G_R	−9	4	+5	dB
$I_L = 24$ mA, $R_R = 360\ \Omega$	G_R	2	3	4	dB
Frequency response					
$I_L \geqq 19$ mA	ΔG_{RF}		±0.5	±1	dB
Gain change with current					
$I_L = 19 \dots 60$ mA	Δ_{GR}			±0.5	dB
Temperature deviation					
$T_{amb} = -10 \dots +60$ °C, $I_L = 19 \dots 60$ mA	Δ_{GR}			±0.5	dB
Distortion at earphone					
$V_{ear} = 1.5\ V_{pp}$, $R_{ear} = 200\ \Omega$, $I_L = 24$ mA	d			2	%
Ear protection					
$I_L \geqq 19$ mA, $V_{GEN} = 2.5\ V_{rms}$	V			1	V_{rms}
Receiving noise psoph. weighted					
$R_{ear} = 200\ \Omega$, $I_L = 19$ mA, $R_R = 360\ \Omega$	n_i		−72	−69	dBmp
Output resistance	R_o			10	Ω
Line loss compensation					
$I_L = 60$ mA reducible with R_{AGA}	ΔG_{RI}	−7	−8	−9	dB
Amplification of DTMF signal from DTMF IN to RECO					
$I_L \geqq 19$ mA, $R_R = 360\ \Omega$, Mute active	G_{RM}	−5.5	−2.0	+1.5	dB
Loudspeaker amplifier, Fig. 5					
Minimum line current for operation (DC)	I_{Lmin}	17	18.5	19.6	mA
Amplification					
$I_L \geqq 20$ mA	G_{LA}	28	30	32	dB
Output power					
$R_L = 50\ \Omega$, $d \leqq 5$ %, $V_g = 300\ mV_{rms}$					
$I_L = 20$ mA	P_{LA}	3	7		mW
$I_L = 33$ mA	P_{LA}	30			mW
$I_L \geqq 60$ mA	P_{LA}	40			mW
Output noise (input grounded)					
$I_L \geqq 20$ mA	n_o			100	µV
Temperature deviation					
$T_{amb} = -10 \dots +60$ °C, $I_L = 20 \dots 60$ mA	ΔG_{LA}			±0.5	dB
DTMF – Amplifier, Fig. 4					
$I_B = 3.5$ mA, $I_D = 0$ mA, $I_M = 300$ µA					
DTMF amplification					
$I_L \geqq 19$ mA, Mute active	G_D	20	28	36	dB
$I_L \geqq 19 \dots 60$ mA, Mute active, $R_S = 470\ \Omega$	G_D	23	24.5	26	dB
Input resistance	R_i	16	20	24	kΩ
Temperature deviation					
$T_{amb} = -10 \dots 60$ °C, $I_L \geqq 19 \dots 60$ mA	ΔG_D			±0.5	dB
Distortion					
$I_L = 24$ mA, $V_L =$ [illegible] m	d			2	%

Supply voltages, Fig. 2		Min.	Typ.	Max.	
Speaker amplifier overdriven. $V_{SAI} = 100\ mV_{rms}$					
Output voltage $I_L = 19 \ldots 60$ mA	V_B	1.9		10	V
Regulated voltage $I_L \geq 20$ mA, $I_D = 0.8$ mA, $V_L = 0$ dBm $T_{amb} = -10 \ldots +60$ °C	V_D	3.0	3.5	3.8	V
Supply for an electret microphone $I_L \geq 20$ mA, $I_M = 0.3$ mA, $V_L = 0$ dBm $T_{amb} = -10 \ldots +60$ °C	V_M	1.7	2.0	2.3	V

$\overline{MUTE}$ or MUTE – Input (Bond-Option)		Min.	Typ.	Max.	
$\overline{MUTE}$-input current $I_L \geq 19$ mA, Mute active, $V_{mute} = 0$ V	I_7		−10	−20	µA
$\overline{MUTE}$-input voltage					
$I_L \geq 19$ mA, Mute inactive	V_7	1.5			V
$I_L \geq 19$ mA, Mute active	V_7			0.7	V
MUTE input current $I_L \geq 19$ mA, Mute active, $V_{mute} = 3.5$ V	I_7			100	µA
MUTE input voltage					
$I_L \geq 19$ mA, Mute inactive	V_7			0.7	V
$I_L \geq 19$ mA, Mute active	V_7	1.5			V

Remarks:

We guarantee component functions down to 19 mA but in most cases operation down to 7 mA is possible, though in certain cases heavily distorted signals at line and receiver output below 18 mA current. The value of the resistor from pin 14 (ST) to pin 4 (V_M) should not exceed 15 kΩ.

In order to avoid a feedback loop in the reception path, it is recommended to use an attenuator between RECO (Pin 13) and SAI (Pin 17). The attenuation needed is directly correlated to the receiving gain G_R.

It is recommended that load at regulated voltage V_D should be switched on after start up phase, only then proper functioning of the IC is guaranteed.

Operation for excessive levels at low line current should be avoided by an external anticlipping circuit.

Applications

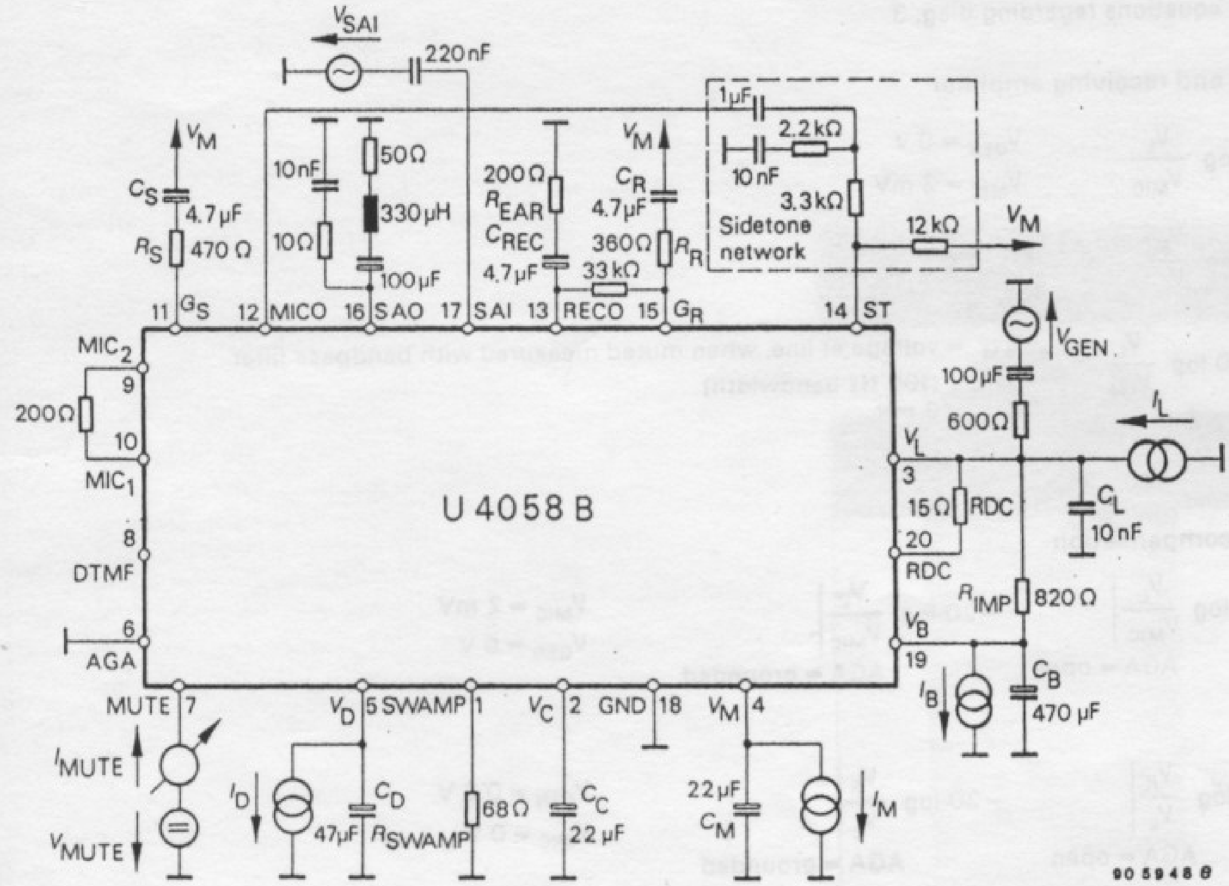


Fig. 2: Power supply

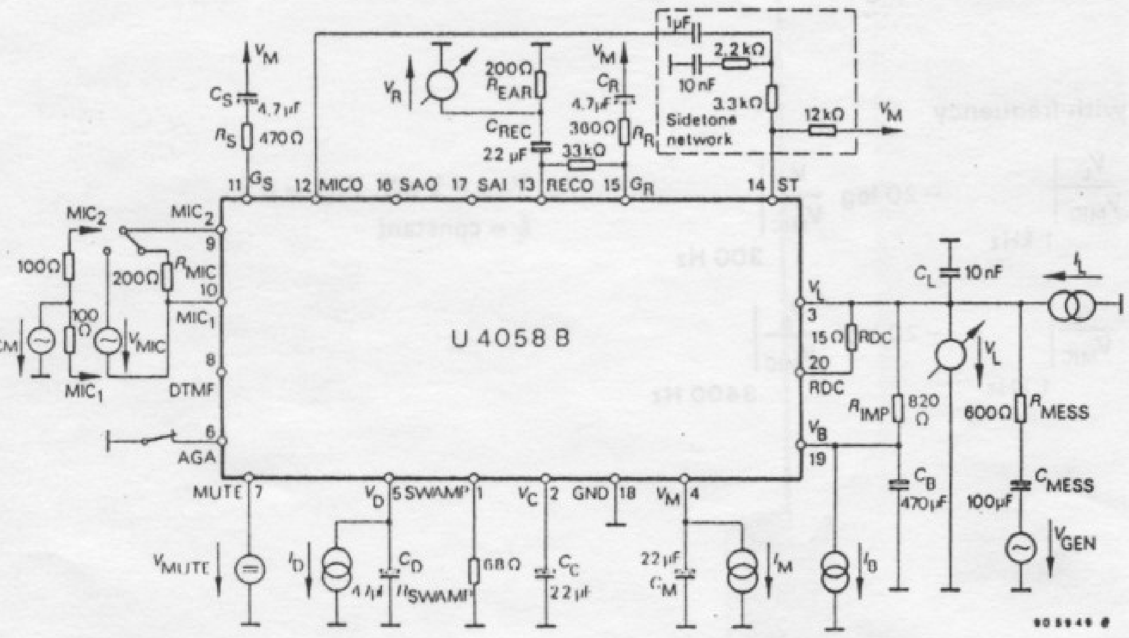


Fig. 3: Transmit and receivin[g a]mplifier and sidetone reduction

Important equations regarding diag. 3

Transmit and receiving amplifier

$G_S = 20 \log \frac{V_L}{V_{MIC}}$ $V_{GEN} = 0$ V, $V_{MIC} = 2$ mV

$G_R = 20 \log \frac{V_R}{V_L}$ $V_{GEN} = 0.6$ V, $V_{MIC} = 0$ V

$G_{Mute} = 20 \log \frac{V_L}{V_{LM}}$ V_{LM} = voltage at line, when muted measured with bandpass filter (100 Hz bandwidth), $V_{MIC} = 3$ mV

Line loss compensation

$\Delta G_S = 20 \log \frac{V_L}{V_{MIC}}\Big|_{AGA = open} - 20 \log \frac{V_L}{V_{MIC}}\Big|_{AGA = grounded}$ $V_{MIC} = 2$ mV, $V_{GEN} = 0$ V

$\Delta G_R = 20 \log \frac{V_R}{V_L}\Big|_{AGA = open} - 20 \log \frac{V_R}{V_L}\Big|_{AGA = grounded}$ $V_{GEN} = 0.6$ V, $V_{MIC} = 0$ V

$CMRR = 20 \log \frac{V_{LS}}{V_{LCM}} + 40$ dB

V_{LS} = Voltage at line in transmit direction when $V_{MIC} = 2$ mV

V_{LCM} = Voltage at line in transmit direction when $V_{CM} = 200$ mV

Gain change with frequency

$\Delta G_S = 20 \log \frac{V_L}{V_{MIC}}\Big|_{1\,kHz} - 20 \log \frac{V_L}{V_{MIC}}\Big|_{300\,Hz}$ $V_{MIC} = 2$ mV, $V_{GEN} = 0$ V, I_L = constant

$\Delta G_S = 20 \log \frac{V_L}{V_{MIC}}\Big|_{1\,kHz} - 20 \log \frac{V_R}{V_{MIC}}\Big|_{3400\,Hz}$

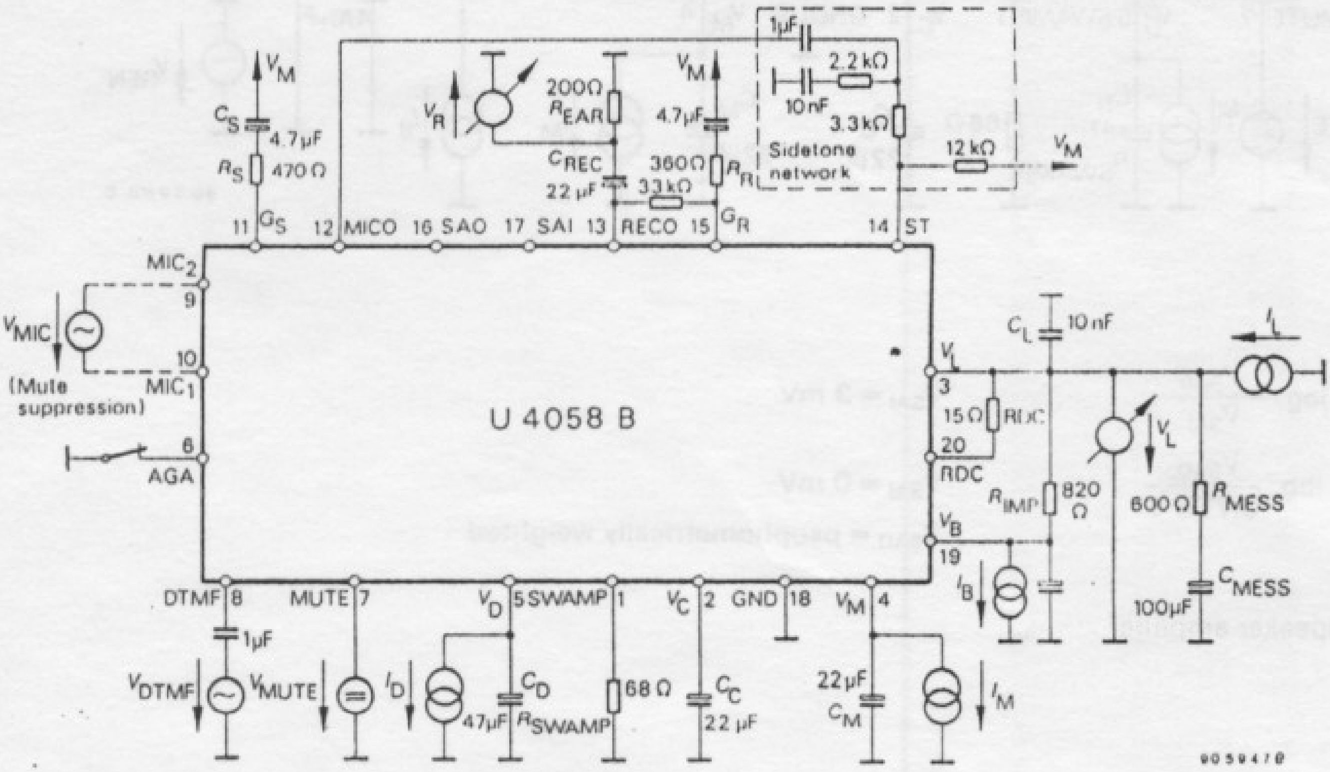
Gain change with current

$$\Delta G_S = 20 \log \left.\frac{V_L}{V_{MIC}}\right|_{60\,mA} - 20 \log \left.\frac{V_L}{V_{MIC}}\right|_{19\,mA}$$ $V_{MIC} = 2$ mV, $V_{GEN} = 0$ V

$$\Delta G_R = 20 \log \left.\frac{V_R}{V_L}\right|_{60\,mA} - 20 \log \left.\frac{V_R}{V_L}\right|_{19\,mA}$$ $V_{GEN} = 0.6$ V, $V_{MIC} = 0$ V

$$n_o = 20 \log \frac{V_L}{0.775\ V}$$ $V_{GEN} = V_{MIC} = 0$ V; V_L is psophometrically weigthed

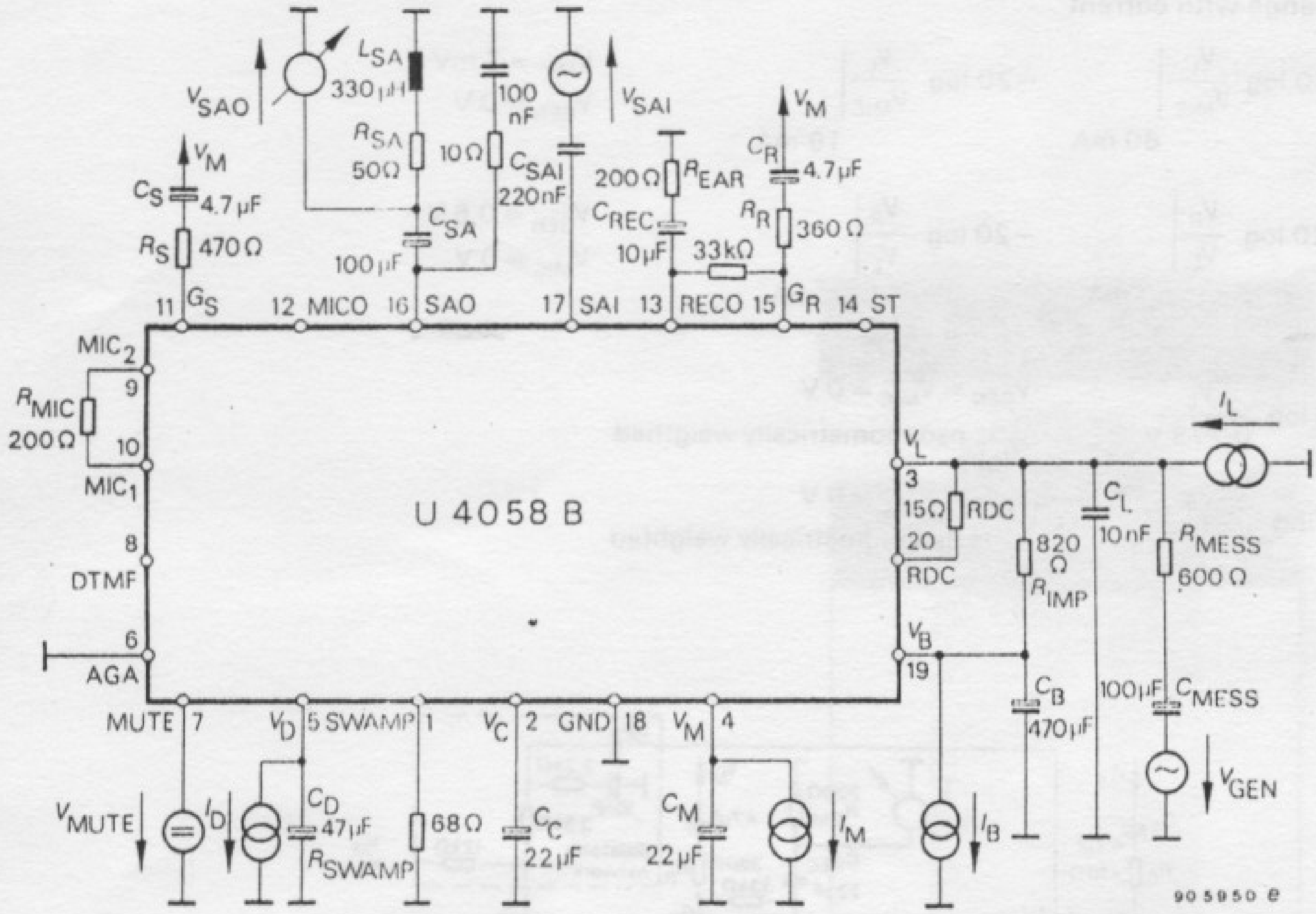
$$n_i = 20 \log \frac{V_R}{0.775\ V}$$ $V_{GEN} = V_{MIC} = 0$ V; V_R is psophometrically weighted



$$G_D = 20 \log \frac{V_L}{V_{DTMF}}$$ $V_{DTMF} = 40$ mV

$$G_{RM} = 20 \log \frac{V_R}{V_{DTMF}}$$ $V_{DTMF} = 40$ mV

Fig. 4



$G_{LA} = 20 \log \dfrac{V_{SAO}}{V_{SAI}}$ $\qquad V_{SAI} = 3$ mV

$n_o = 20 \log \dfrac{V_{SAO}}{0.775\ V}$ $\qquad V_{SAI} = 0$ mV

V_{SAO} = psophometrically weighted

Fig. 5: Speaker amplifier

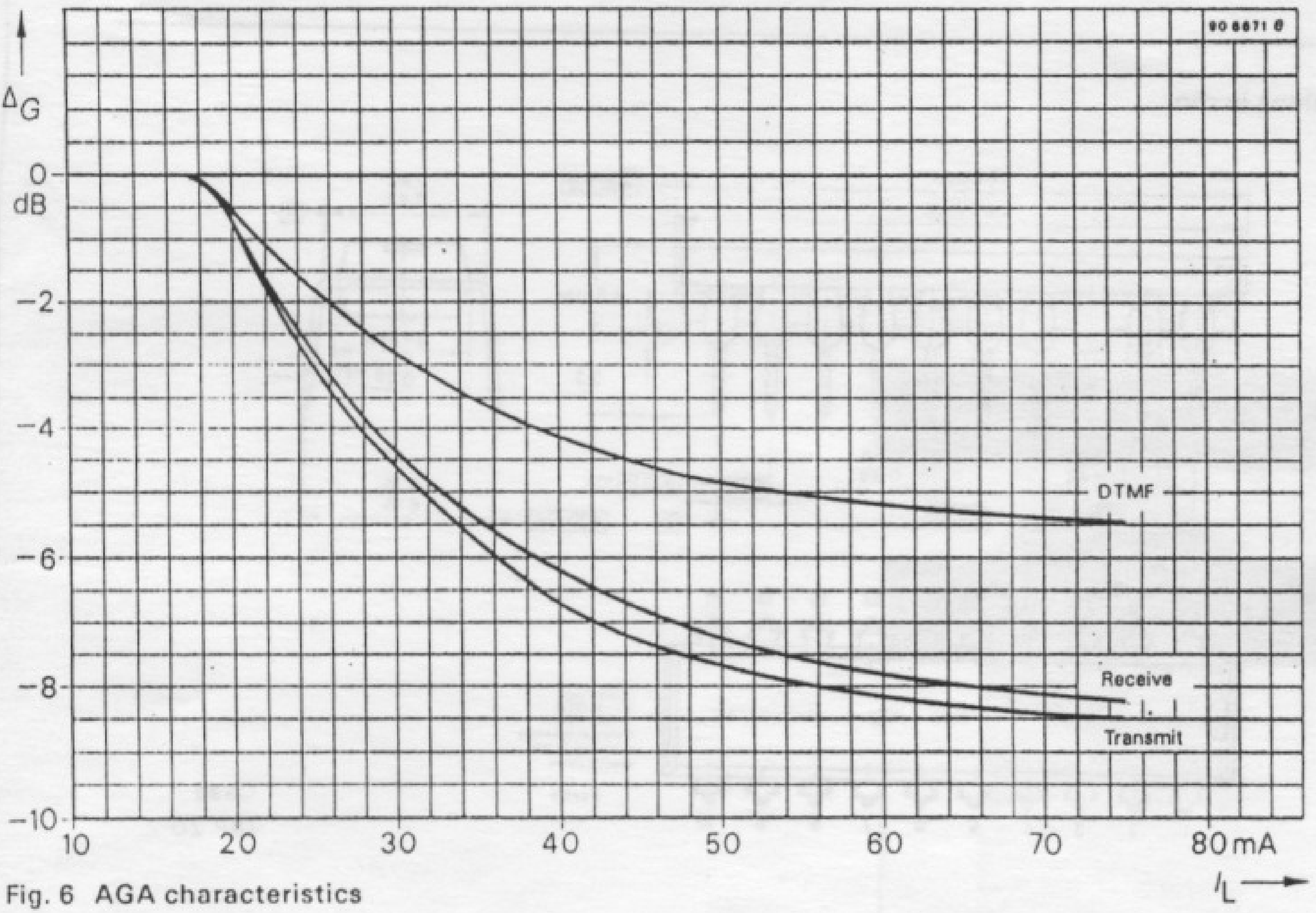


Fig. 6 AGA characteristics

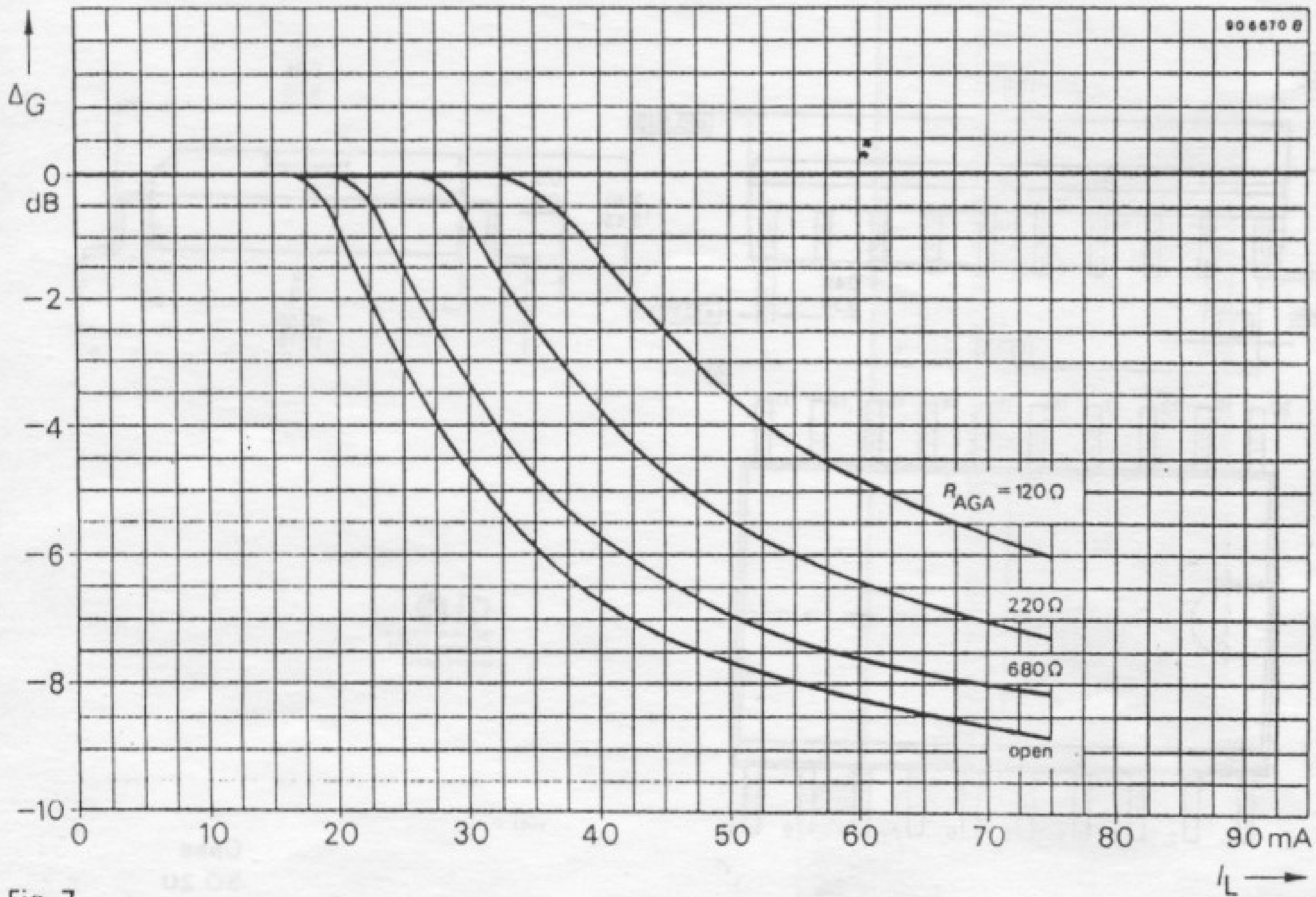


Fig. 7

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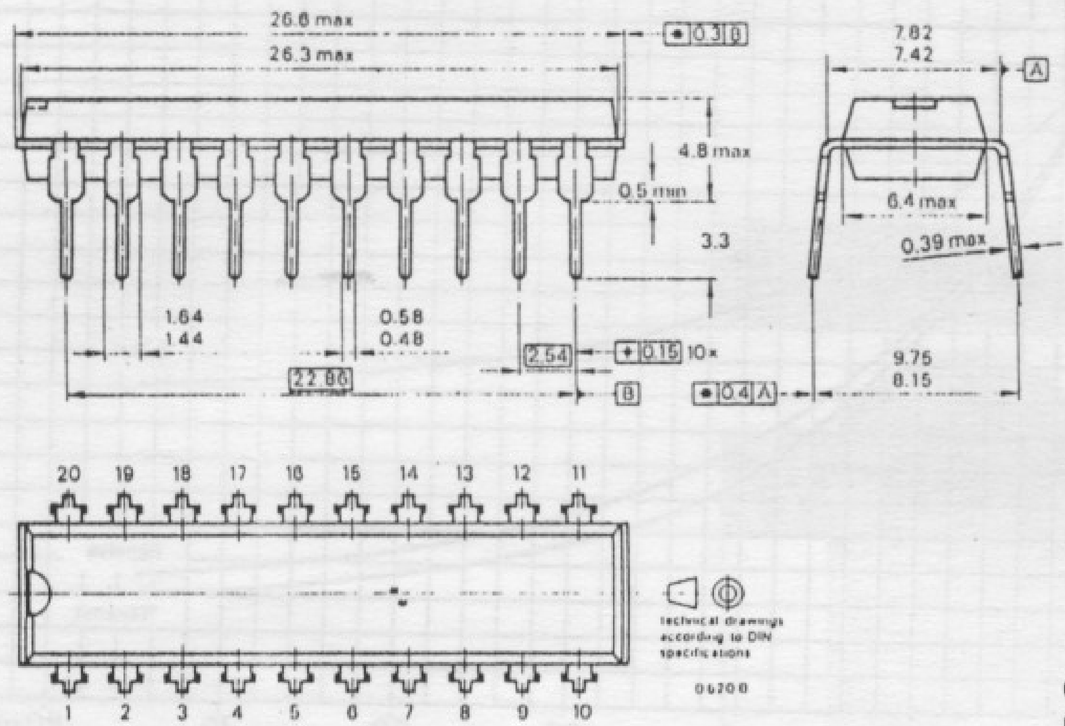
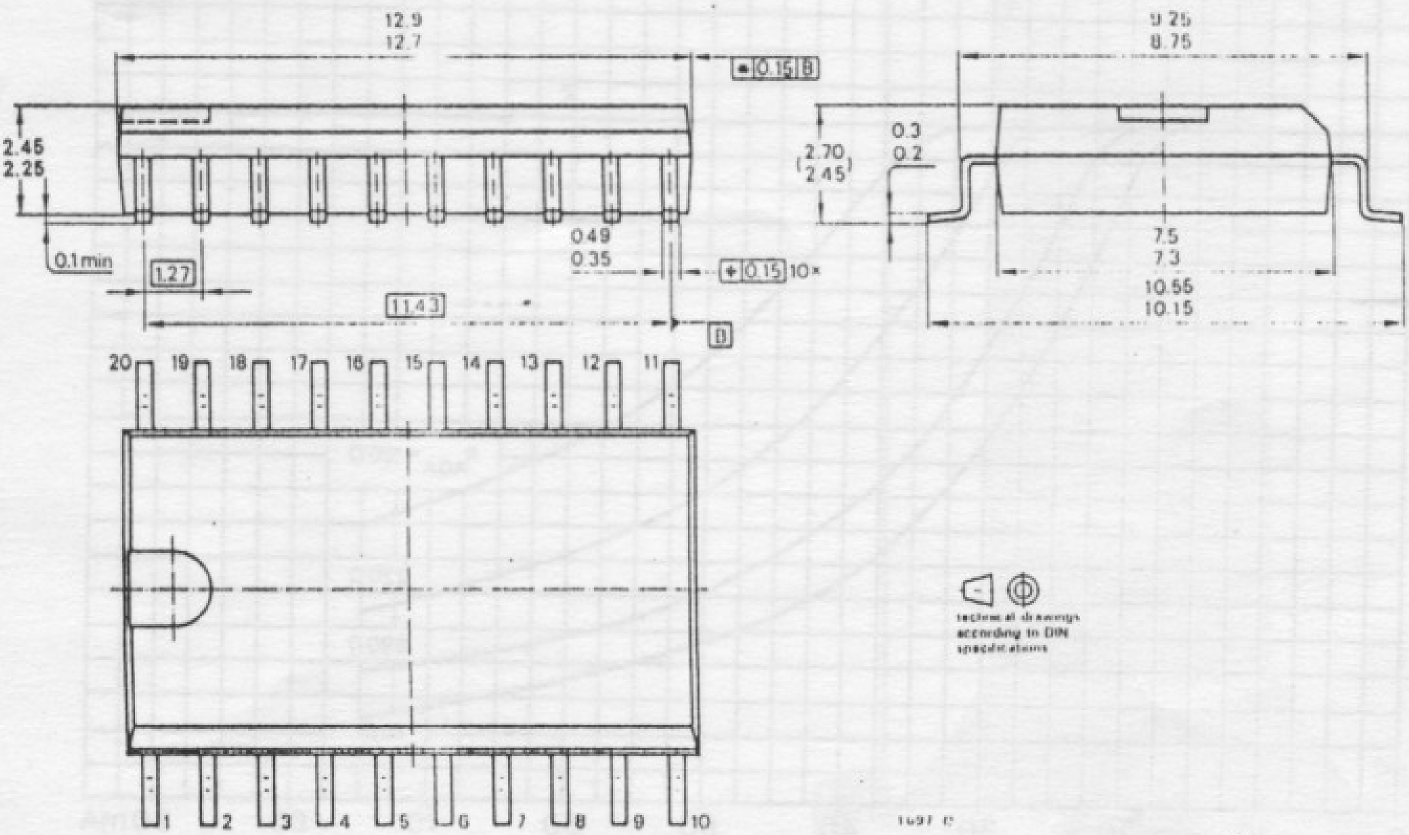
Dimensions in mm



Case
DIP 20



Case
SO 20